Fishery Data Series No. 11-36

George River Salmon Studies, 2010

Annual Report for Study 08-303
USFWS Office of Subsistence Management
Fisheries Resource Monitoring Program

by

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and

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Alaska Department of Fish and Game Divisions of Sport Fish and Commercial Fisheries

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$log_{2,}$ etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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ABSTRACT

The George River is a major tributary of the Kuskokwim River and produces Chinook *Oncorhynchus tshawytscha*, chum *O. keta*, and coho salmon *O. kisutch* which contribute to subsistence and commercial salmon fisheries of the Kuskokwim River. George River weir has operated since 1996 to estimate the return and age, sex, and length compositions of salmon escapements, monitor environmental variables, and facilitate other Kuskokwim Area fisheries projects. In 2010, a resistance board weir was operated from 15 June to 20 September to estimate escapements of 3 species of Pacific salmon. Chinook escapement of 1,500 was below average; chum escapement of 26,154 was near average, and coho salmon escapement of 12,961 was above average. Samples were collected from fish caught in a live trap and used to describe the age and sex structure of the Chinook, chum, and coho salmon escapements. Females comprised 30.6% of the Chinook salmon escapement, 51.6% of the chum salmon escapement, and 51.5% of the coho salmon escapement. The Chinook salmon escapement was composed of 5 age classes, dominated by age-1.2 fish (35.9%). The chum salmon escapement was composed of 4 age classes, dominated by age-0.3 fish (87.7%). The coho salmon escapement was composed of 3 age classes, dominated by age-2.1 fish (89.6%).

The George River weir is one of several components which form an integrated array of escapement monitoring projects in the Kuskokwim Area. This array of projects provides a means to monitor and assess escapement trends that must be considered in harvest management.

Key words Chinook salmon, *Oncorhynchus tshawytscha*, chum salmon, *Oncorhynchus keta*, coho salmon, *Oncorhynchus kisutch*, longnose suckers, *Catostomus catostomus*, George River, Kuskokwim River, upper Kuskokwim, escapement, age-sex-length, ASL, resistance board weir, radiotelemetry, mark–recapture, stock specific run timing

INTRODUCTION

The Kuskokwim River is the second largest river in Alaska, draining an area approximately 130,000 km^2, or 11% of the total area of Alaska (Figure 1). Each year mature salmon *Oncorhynchus* spp. return to the river to spawn, supporting an annual average subsistence and commercial harvest of approximately 650,000 salmon. The subsistence salmon fishery in the Kuskokwim Area is one of the largest and most important in the state and remains a fundamental component of local culture. The commercial salmon fishery, though modest in value compared to other areas of Alaska, has been an important component of the market economy of lower Kuskokwim River communities. Salmon that contribute to these fisheries spawn and rear in nearly every tributary of the Kuskokwim River basin (Brown 1983; Buklis 1999; Coffing 1991; Coffing et al. 2001; Bavilla et al. 2010).

Since 1960, management of Kuskokwim River subsistence, commercial, and sport fisheries has been the responsibility of the Alaska Department of Fish and Game (ADF&G), though other agencies contribute to the decision making process. Management authority for the subsistence fishery was broadened in October 1999 to include the federal government under Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA). The U.S. Fish and Wildlife Service (USFWS) is the federal agency most involved within the Kuskokwim Area and tribal groups such as the Kuskokwim Native Association (KNA) are charged by their constituency to actively promote a healthy and sustainable subsistence salmon fishery. These and other groups have combined their resources to develop projects such as the George River weir to better achieve the common goal of providing for sustainable salmon fisheries in the Kuskokwim River.

In the State of Alaska, the goal of salmon management is to provide for sustainable fisheries by ensuring that adequate numbers of salmon escape to the spawning grounds each year in accordance with the State of Alaska's *Policy for the Management of Sustainable Salmon Fisheries* (5 AAC 39.222). This goal requires an array of long-term monitoring projects that reliably measure annual escapement to key spawning systems as well as track temporal and spatial patterns in abundance that influence management decisions. Over time and with sufficient data, escapement goals can be developed as a means to gauge escapement adequacy, but current spawner–recruit models for escapement goal development require many years of data. For much of ADF&G management history in the Kuskokwim Area, escapement monitoring has been limited to aerial surveys and two ground-based escapement monitoring projects.

With dozens of tributaries known to support spawning populations of salmon, the presence of escapement monitoring projects on two tributaries was not adequate with respect to the entire Kuskokwim River basin. This deficiency was addressed with the establishment of several additional projects in the mid to late 1990s, including the George River weir in 1996 (Molyneaux and Brannian 2006). The data provided by the current array of projects have much greater utility for fishery managers (Holmes and Burkett 1996; Mundy 1998) and have decreased reliance on aerial stream surveys, which are known to be imprecise (Bavilla et al. 2010). In addition, mainriver tagging studies rely on the expanded weir infrastructure to estimate inriver abundance and develop run reconstruction models for Kuskokwim River salmon. Run reconstruction models that result from these studies will be an important tool in answering questions of exploitation, distribution, abundance and travel time for Kuskokwim River salmon and may eventually lead to the development of escapement goals for the entire Kuskokwim River drainage. Such projects have since become deeply integrated components of Kuskokwim River salmon management.

The George River weir also serves as a platform for collecting information on habitat variables including water temperature and stream discharge (stage), which may directly or indirectly influence salmon productivity and timing of migrations (Hauer and Hill 1996; Kruse 1998; Quinn 2005). These variables can be affected by human activities (i.e., mining, timber harvesting, man-made impoundments, etc.; NRC 1996) or broader climatic variability (e.g., El Nino and La Nina events).

BACKGROUND

The George River is a tributary of the middle Kuskokwim River basin that provides spawning and rearing habitat for Chinook (*O. tshawytscha)*, chum (*O. keta)*, and coho salmon (*O. kisutch)* (ADF&G 1998), which contribute to the subsistence, commercial, and sport fisheries of the Kuskokwim River. Smaller numbers of sockeye *O. nerka* and pink salmon *O. gorbuscha* also spawn in the George River. In addition to Pacific salmon, other species found throughout the system include: Arctic grayling *Thymallus arcticus*, various whitefishes *Coregonus* spp., *Stenodus leucichthys*, *Prosopium cylindraceum*, Dolly Varden *Salvelinus malma*, northern pike *Esox lucius*, longnose suckers *Catostomus catostomus*, lampreys *Lampetra* spp., slimy sculpin *Cottus cognatus*, burbot *Lota lota*, blackfish *Dallia pectoralis*, and nine-spine stickleback *Pungitius pungitius*.

Salmon escapement monitoring began at the George River in 1996 through the joint effort of KNA and ADF&G (Linderman et al. 2002). In 1999, the fixed-panel weir design was replaced with a resistance board weir, which improved performance in subsequent years. Since then, the George River weir has been collecting escapement and age, sex, and length (ASL) composition information on Chinook, chum, and coho salmon; habitat and climatic variables; and has served as a platform for other collaborative research efforts (Stewart et al. 2008).

George River originates in the northern Kuskokwim Mountains within the middle Kuskokwim River basin and flows south for approximately 120 km to its confluence with the Kuskokwim

River (Figures 1 and 2). The river drains an area of approximately 3,558 km² of mostly upland spruce-hardwood forest. Major tributaries include the East, South, and North Forks, and Michigan and Beaver Creeks. White spruce and scattered birch or aspen are common on south-facing slopes, and black spruce is characteristic on northern exposures and poorly drained areas. The understory consists of spongy moss and low brush in poorly drained areas, grasses in well-drained areas, and willow and alder in open forest near timberline. At normal flow, the George River is stained due to organic leaching, limiting visibility to less than one meter.

OBJECTIVES

1. Determine daily and total Chinook, chum, and coho salmon escapements to George River from 15 June to 20 September.
2. Estimate the age, sex, and length composition of Chinook, chum, and coho salmon escapements to the George River such that 95% confidence intervals of age composition are no wider than ±10% ($\alpha=0.05$ and $d=0.10$).
3. Monitor habitat variables including daily water temperature, water level, and stream discharge.
4. Serve as a platform to facilitate current and future fisheries research projects by:
    a. Collection of escapement and ASL data for development and maintenance of salmon run reconstruction models and other management tools for the entire Kuskokwim River.
    b. Serving as a monitoring and recovery location for sockeye salmon equipped anchor tags deployed as part of the project: *Kuskokwim River sockeye salmon*;
    c. Operating and maintaining two radiotelemetry fixed receiver stations located between Red Devil and Crooked Creek on the mainstem Kuskokwim River for the study: *Kuskokwim chum tagging effects*;
    d. Hosting local area high school students as part of KNA's High School Internship Program;
    e. Maintaining a stream gage and collecting discharge measurements to establish an instream flow reservation for the George River; and
    f. Installing and monitoring air and stream thermographs at George River weir as part of a broader *Temperature monitoring* project.

METHODS

STUDY SITE

The weir site is located at N61° 55.4' Latitude and W157° 41.9' Longitude, approximately 7 river kilometers (rkm) up the George River from its confluence with the Kuskokwim River and captures nearly all the salmon spawning habitat within the drainage (Figure 2). The weir has operated at this location since the project began in 1996. The river channel at this site is about 110 m wide and has a depth of about 1 m during normal summer flow. The substrate is composed mostly of gravel, with some sand and cobble. Discharge measurements taken at the site over the years have ranged between 16 and 149 $m^3 \cdot s^{-1}$, with velocities reaching between 0.6 and 1.3 $m \cdot s^{-1}$ in the thalweg. Discharge measurements have not been attempted during flood conditions.

WEIR DESIGN

Details of design and materials used to construct the resistance board weir are described in Tobin (1994) with panel modifications described by Stewart (2002). The George River weir was designed with a gap of 3.33 cm (1-5/16 in) between each picket. The weir was installed across the entire 110 m channel following the techniques described by Stewart (2003). The substrate rail and resistance board panels covered the middle 100 m portion of the channel, and fixed weir materials extended the weir 5 m to each bank.

A live trap and skiff gate were installed within the deeper portion of the channel. The live trap was designed as the primary means of upstream fish passage. The trap could be easily configured to pass fish freely upstream, capture individual fish for tag recovery, or trap numerous fish for collection of ASL or genetic samples. The skiff gate allowed boat operators to pass with little or no involvement of the weir crew as the weight of a boat submerged the passage panels and allowed boats to pass over the weir. Boats with jet-drive engines were the most common and could pass up or downstream over the skiff gate after reducing speed to 5 miles per hour or less.

To accommodate downstream migration of longnose suckers and other non-salmon species, downstream passage chutes were installed into the weir mid-season. At locations where downstream migrants were most concentrated, chutes were created by releasing the resistance boards on one or two adjacent weir panels so the distal ends dipped slightly below the stream surface. The chute's shallow profile guides downstream migrants while preventing upstream salmon passage. The chutes were monitored and adjusted to ensure salmon were not passing upstream. Few salmon have been observed passing downstream over these chutes, and their numbers are considered negligible.

ESCAPEMENT MONITORING

A target operational period, spanning most of the salmon runs, was used to provide for consistent comparisons of annual escapements among years. The target operational period for George River weir has been established as 15 June to 20 September, although actual operational dates may vary annually with stream conditions. Daily and total annual escapements consisted of the observed passage during the target operational period. Counts of all other species were reported simply as total observed passage.

Passage counts were conducted periodically during daylight hours. Substantial delays in fish passage occurred only at night or during ASL sampling. Crew members visually identified each fish as it passed upstream and recorded it by species on a multiple tally counter. Counting continued for a minimum of one hour, or until passage waned. This schedule was adjusted as needed to accommodate the migratory behavior and abundance of fish, or operational constraints such as reduced visibility in evening hours late in the season. Crew members recorded the total upstream fish count in a designated notebook and zeroed the tally counter after each counting session. At the end of each day, total daily and cumulative seasonal counts were copied to logbook forms. These counts were reported each morning to ADF&G staff in Bethel via single side band radio or satellite telephone.

The live trap was used as the primary means of upstream fish passage. A clear plastic viewing window was placed on the stream surface to improve visual identification of fish entering the trap.

Upstream salmon passage was estimated for days the weir was inoperable due to high water events. Estimates were not produced if passage was negligible based on historical or inseason data. When the weir was inoperable for two or more days and later became operable, missed daily passage was calculated using the following linear method:

$$\hat{n}_{d_i} = (\alpha + \beta \cdot i)$$

$$\alpha = \frac{n_{d_1-1} + n_{d_1-2}}{2} \tag{1}$$

$$\beta = \frac{\left(n_{d_i+1} + n_{d_i+2}\right) - \left(n_{d_1-1} + n_{d_1-2}\right)}{2(i+1)}$$

where:

n_{d_1-1}, n_{d_1-2} = observed passage for the first and second days before the inoperable period,

n_{d_i+1}, n_{d_i+2} = observed passage the first and second day after the weir was reinstalled.

Carcass Counts

The weir was cleaned several times each day, typically after morning and late evening counts. Dead or spawned out live salmon that washed up on the weir, both referred to hereafter as carcasses, were counted by species, visually sexed, and passed downstream. Daily and cumulative carcass counts were copied to logbook forms. These counts are not considered a census as both skiff gate and downstream passage chutes are installed to facilitate migration of non-salmon species which additionally provide a pathway for dead and dying salmon to pass downstream uncounted.

AGE, SEX, AND LENGTH COMPOSITION

To estimate age, sex, and length composition of Chinook, chum, and coho salmon escapements, live sampling was conducted as fish migrated upstream through the weir. Samples were collected throughout the season to account for temporal dynamics in ASL characteristics. Samples were stratified postseason to develop weighted estimates.

Sample Size and Distribution

A minimum sample size was determined for each species following conventions described by Bromaghin (1993) to achieve simultaneous 95% confidence intervals of age-sex composition no wider than ±10% (α=0.05 and d=0.10), assuming 10 age-sex categories for Chinook salmon (*n*=190), 8 age-sex categories for chum salmon (*n*=180), and 6 age-sex categories for coho salmon (*n*=168). These sample sizes were then increased by about 20% to account for unreadable scales or collection errors. This yielded a minimum collection goal for each sample of 230 Chinook, 220 chum, and 200 coho salmon.

The abundance of chum and coho salmon at George River weir was generally high enough to collect a large sample size in a short period of time. A pulse sampling strategy was employed to ensure adequate temporal distribution of chum and coho salmon samples. A pulse sample is a type of random stratified sampling, where each instantaneous sample characterizes a large portion of the run (i.e., early, middle, and late). Well spaced pulse samples are thought to have greater power for detecting temporal changes in ASL composition than other sampling methods (Geiger and Wilbur 1990). Pulse sampling was conducted approximately every 7–10 days. The goal was to collect a minimum of one pulse sample from each third of the run.

The relatively low abundance of Chinook salmon at George River weir makes pulse sampling impractical. Instead, the sample was collected continuously over the run following a daily collection schedule based on historical run timing information. Daily sample sizes were proportional to average historical escapements by day to ensure a good distribution across the run. The overall sample size (232 Chinook salmon) was selected to exceed the minimum necessary to meet precision and accuracy criteria for this location, and was similar to average historical sampling success.

Sample Collection Procedures

Chinook, chum, and coho salmon were sampled from the fish trap installed in the weir. Salmon were trapped by opening the entrance gate while the exit gate remained closed. Fish were allowed to swim freely into the live trap, and the V-shape positioning of the entrance gate prevented them from easily escaping. The live trap was allowed to fill with fish until a reasonable number was inside. Short handled dip nets were used to capture fish within the holding box. To obtain length data and aid in scale collection, fish were removed from the dip net and placed into a partially submerged trough, or "fish cradle," which allowed continuous water flow over the fishes' gills. Scales were taken from the preferred area of the fish (INPFC 1963) and transferred to numbered gum cards (DuBois and Molyneaux 2000). Sex was determined through visual examination of the external morphology, focusing on the prominence of a kype, roundness of the belly, and the presence or absence of an ovipositor. Mideye fork (MEF) length was measured to the nearest millimeter using a straight-edged meter stick. Sex and length data were recorded on standardized numbered data sheets that correspond with numbers on the gum cards used for scale preservation. After sampling, each fish was released upstream of the weir. The procedure was repeated until the holding box was emptied, to ensure no bias was introduced.

A more active sampling approach was used for Chinook salmon, when relative abundance was notably lower than other salmon species. During "active sampling," Chinook salmon could be individually trapped and sampled while other species were allowed to pass. To prevent bias, all Chinook salmon observed during this process were sampled. Further details on active sampling procedures are described in Linderman et al. (2002). This method was also used for tag recoveries.

After sampling was completed, all ASL data and metadata was copied to Microsoft Excel spreadsheets that correspond to numbered gum cards. Completed Excel spreadsheets were sent to the Bethel ADF&G office for processing. The original ASL gum cards, acetates, and Excel spreadsheets were archived at the ADF&G office in Anchorage. Data were also loaded into the Arctic-Yukon-Kuskokwim (AYK) salmon database management system (Brannian et al. 2006). Further details of sampling procedures can be found in Molyneaux et al. (2008).

Data Processing and Reporting

Samples were aged and processed by ADF&G staff in Bethel and Anchorage following procedures describe by Molyneaux et al. (2008). Samples were partitioned into a minimum of 3 temporal strata, based on overall distribution within the run. The escapement in each stratum was divided into age-sex classes proportionately with strata sample composition. Mean length by age-sex class was determined for each stratum as well. Annual estimates were calculated as strata sums, weighted by the abundance in each stratum. When sample size or distribution was not considered adequate to estimate ASL composition, results were reported but not applied to annual escapements.

Two summary tables were generated for each species. The first table provides the escapement and percentage of each age-sex class by stratum, with season totals weighted by escapement in each stratum. The second table provides a summary of mean length-at-age by sex for each stratum, with season totals weighted by escapement in each stratum. Sample sizes and dates are included for each stratum. Age is reported in the European notation, composed of 2 numerals separated by a decimal. The first numeral represents the number of winters the juvenile spent in freshwater excluding the first winter spent incubating in the gravel, and the second numeral is the number of winters it spent in the ocean (Groot and Margolis 1991). The total age is therefore one year greater than the sum of these 2 numerals.

WEATHER AND STREAM OBSERVATION

Water and air temperatures were manually measured each day at approximately 1000 and 1700 hours. Water temperature was determined by submerging a calibrated thermometer (°C) below the water surface until the temperature reading stabilized. Air temperature was obtained by placing the thermometer in a shaded location until the temperature reading stabilized. Temperature readings were recorded in a designated logbook, along with notations about wind direction, estimated wind speed, cloud cover, and precipitation. Daily precipitation was measured using a rain gauge calibrated in millimeters (Appendix A). These manual techniques are consistent with past years at this project. As in 2005 to 2008, water temperature readings were also obtained using a Hobo® Water Temp Pro V1[1] data logger installed at mid channel near the stream bottom. The data logger was programmed to record temperature every hour during the operational period. Records were retrieved at the end of the season and compared to temperatures measured manually using a thermometer.

Daily operations included recording river depth (stage height) as determined by a standardized staff gauge at approximately 1000 and 1700 hours. The staff gauge consisted of a metal rod driven into the stream channel with a meter stick attached. The height of the water surface, as measured from the meter stick, represented the “stage” of the river in centimeters above an established datum plane. The staff gauge was calibrated to the datum plane by a semi-permanent benchmark (Stewart et. al. 2006; Appendix A).

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[1] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

RELATED FISHERIES PROJECTS

Kuskokwim River Salmon Run Reconstruction

Salmon escapement and ASL information from George and other weir projects are vital annual inputs to models used to estimate total salmon abundance in the Kuskokwim River drainage. From those estimates we determine total exploitation rates, fluctuations in annual productivity, etc.

Kuskokwim River Sockeye Salmon

The George River weir served as a recovery site for a basinwide mark–recapture study entitled *Kuskokwim River Sockeye Salmon Run Reconstruction*, operated cooperatively with KNA and funded by Alaska Sustainable Salmon Fund (project #45920). Upstream passage of all fishes occurred through the weir's live trap, enabling captures of tagged sockeye salmon. A clear plastic viewing window on the stream surface aided species identification and tag presence. Recorded data for 'recovered' fish included the tag number, tag color, fish condition, presence of secondary mark, and recovery date. Tagged fish that passed through the trap without being captured were recorded as "observed" along with the tag color and passage date. Tag loss was assessed at the weir by inspecting for secondary marks during routine ASL sampling.

Kuskokwim Chum Tagging Effects

George River weir served as a recovery site for a second basinwide mark–recapture study entitled *Kuskokwim Chum Tagging Effects*, operated cooperatively with KNA and funded by Alaska Sustainable Salmon Fund (project #44508). Tagged chum salmon were captured at the weir site using the method described above for sockeye salmon. The weir crew was also responsible for maintaining and downloading two radiotelemetry receiver stations; near the communities of Crooked Creek and Red Devil.

Kuskokwim Native Association High School Internship Program

Local area high school students were recruited to participate in the Kuskokwim Native Association's (KNA) High School Internship Program at the George River weir for 3 weeks. Crew members instructed students in fish species identification, weather and stream observations, and ASL sampling. In addition, the crew assisted the KNA Partners Fisheries Educator in conducting daily lessons related to salmon biology and watershed ecology. Career guidance and mentoring from fishery biologists and technicians is an integral part of the program and provides students with role models for future work in fisheries science.

Since 1998, KNA has provided 176 internships to local area high school students at fisheries projects operated cooperatively with ADF&G. A number of students have subsequently been employed by KNA and ADF&G as technicians at these same projects (Hildebrand and Orabutt 2007). KNA high school internships provide a much needed level of community involvement, which the authors believe contributes to continued local support of the research and management utility of the weirs.

Hydrologic Data for the George River

Statewide Aquatic Resources Coordination Unit (SARCU) initiated this project to collect accurate hydrologic data during annual salmon spawning migration in order to assess relationships between fish populations and flow dynamics, and provide baseline hydrologic data.

Data may eventually be used to establish water rights for: 1) protecting fish and wildlife habitat, migration, and propagation; 2) recreation and parks; 3) navigation and transportation; and 4) sanitation and water quality (Estes 1996). The 2010 season marked the fifth year of a 5-year study aimed at addressing temporal flow dynamics.

In 2010, George River weir crew installed an Aquistar stream gage (Instrumentation Northwest, Inc.) approximately 200 meters downstream of the weir (river right) on 15 June. The station was monitored throughout the season and removed on 25 September. Stream discharge was measured manually on 9 July, 8 August, and 22 September, representing 3 different water levels. A Price AA current-meter and top-setting wading rod were used following methods described by the U.S. Geological Survey (Rantz 1982). Information collected for calculating discharge was recorded in the camp logbook. This data was transferred to SARCU along with the stream gage after the season.

Temperature Monitoring

George River weir also served as a monitoring site for the *Temperature Monitoring* project funded by Office of Subsistence Management, Fishery Resource Monitoring Program (FRMP 08-701). From 15 June to 23 September, 2 Hobo® Water Temp Pro V2 data loggers and 2 Hobo® Air Temperature R/H data loggers were deployed. One of each pair of temperature sensors was removed on 23 September and returned to the contractor, while the other 2 remained for continual monitoring.

RESULTS

OPERATIONS

George River weir operated from 2200 hours on 14 June until nightfall on 20 September, spanning the entire target operational period. Weir became inoperable due to high water for 3 days (18–20 August) out of 98 total days in the target operational period. Daily passage estimates were determined for chum, coho, and sockeye salmon for all 3 days during this breach. Estimates of Chinook salmon passage during the breach were not determined, because the inoperable period occurred at the end of passage when daily Chinook salmon counts ranged from 5 to 0 individuals for the previous week. Because this high water event comprised only 3% of the target operational period, and partial day counts were possible for 18 and 19 August, season escapement totals are considered representative of annual runs for each target species.

ESCAPEMENT ABUNDANCE AND RUN TIMING

Chinook Salmon

A total of 1,500 Chinook salmon are estimated to have passed upstream of the weir during the operational period. The first Chinook salmon was seen on 23 June, and a peak count of 217 fish occurred on 5 July. The central 50% of the run occurred from 6 to 18 July, with a median passage date of 11 July (Table 1; Figure 3).

Chum Salmon

A total of 26,154 chum salmon are estimated to have passed upstream of the weir during the operational period, of those 26,086 were observed and 68 were estimated (less than 1% of the total escapement). The first chum salmon passed the weir on 21 June, and a peak count of 1,501 fish occurred on 13 July. The central 50% of the run occurred from 9 to 24 July, with a median passage date of 16 July (Table 1; Figure 3).

Coho Salmon

A total of 12,961 coho salmon are estimated to have passed upstream of the weir during the operational period, of those 25,602 were observed and 552 were estimated (4% of the total escapement). The first coho salmon was observed on 26 July, and a peak count of 987 fish occurred on 1 September. The central 50% of the run occurred from 25 August to 5 September, with a median passage date of 31 August; Table 1; Figure 3). Fish counts were performed until September 20 which was the last day of the target operational period. Though coho salmon passage was still being observed, the run was waning and is not in our objectives of the current target operational period to continue estimating passage beyond this date.

Other Species

A total of 115 sockeye salmon are estimated to have passed upstream of the weir, 112 were observed and 3 were estimated to have escaped during a 3 day inoperable period (Table 1). A total of 869 pink salmon were observed passing upstream of the weir during the operational period. Non-salmon species included 2,452 longnose suckers, 4 whitefish 49 Arctic grayling 1 northern pike and 3 Dolly Varden (Appendix B).

Carcasses

Salmon carcass counts included 192 Chinook, 2148 chum, and 1 coho salmon. Females accounted for 24% and 30% of Chinook and chum salmon carcasses respectively. The first Chinook salmon carcass was found on 11 July, and a peak count of 22 occurred on August 8. The first chum salmon carcass was found on 4 July, and a peak count of 111 occurred on 10 August. The single coho salmon carcass was observed on 20 September (Appendix C).

AGE, SEX, AND LENGTH COMPOSITION

Chinook Salmon

ASL samples were collected from 184 Chinook salmon from 26 June to 27 July. Age was determined for 163 of these samples (89% of the total sample), or 11% of the escapement. ASL samples were well distributed and adequate to estimate age and sex composition of the total Chinook salmon escapement. Escapement was partitioned into 3 temporal strata based on sampling effort over the run, with sample sizes of 58, 59, and 46 fish. Age-1.2 Chinook salmon were the most abundant (35.9%), followed by age-1.4 (29.9%), and age-1.3 (27.8%). Sample size and distribution resulted in 95% confidence intervals that ranged from ±6.4% to ±6.7%. Sex composition included 69.4% male and 30.6% female (Table 2). The lengths of males ranged from 380 to 942 mm and females ranged from 624 to 892 mm (Table 3).

Chum Salmon

ASL samples were collected from 1,112 chum salmon from 28 June to 2 August. Age was determined for 1,067 of these samples (96% of the total sample), or 4% of the escapement. ASL samples were well distributed and adequate to estimate age and sex composition of the total chum salmon escapement. Escapement was partitioned into 5 temporal strata based on sampling effort over the run, with sample sizes of 226, 196, 205, 142, and 298 fish. Age-0.3 chum salmon were the most abundant (87.7%), followed by age-0.4 (7.5%), and age-0.2 (3.9%). Sample size and distribution resulted in 95% confidence intervals that ranged from ±1.2% to ±1.9%. Sex composition included 48.4% male and 51.6% female (Table 4). The lengths of males ranged from 441 to 625 mm and females ranged from 441 to 612 mm (Table 5).

Coho Salmon

ASL samples were collected from 600 coho salmon from 22 August to 12 September. Age was determined for 559 of these samples (93% of the total sample), or 4% of the escapement. ASL samples were adequate to estimate age and sex composition of the total coho salmon escapement. Escapement was partitioned into 3 temporal strata based on sampling effort over the run, with samples sizes of 188, 188, and 183 fish per stratum. Age-2.1 coho salmon were the most abundant (89.6%), followed by age-3.1 (7.7%) and age-1.1 (2.7%). Sample size and distribution resulted in 95% confidence intervals for age sex compositions that ranged from ±1.2% to ±2.5%. Sex composition included 48.5% male and 51.5% female (Table 6). The lengths of males ranged from 412 to 646 mm and females ranged from 426 to 643 mm (Table 7).

WEATHER AND STREAM OBSERVATION

During the operation period, water level ranged from 33 to 120 cm and averaged 55 cm. Stream temperature ranged from 4.5 to 15.0°C and averaged 9.6°C (Appendix A). Stream discharge was measured 3 times, resulting in an average flow of 0.62 $m \cdot sec^{-1}$ at an average depth of 86.8 cm (Figure 4).

RELATED FISHERIES PROJECTS

Kuskokwim River Sockeye Salmon

Results for this study will be published in an ADF&G Fishery Data Series report upon completion.

Kuskokwim Chum Tagging Effects

Results for this study will be published in an ADF&G Fishery Data Series report (Zachary Liller, Fisheries Research Biologist, ADF&G, Anchorage; personal communication).

Kuskokwim Native Association High School Internship Program

A total of 6 students participated in this program at George River weir, including 5 first-year and 1 second-year intern.

Hydrologic Data for the George River Project

Preliminary data for this study are available from the SARCU. Results will be applied to an instream flow reservation once the study has been completed (Jason Mouw, Wildlife Biologist, ADF&G, Anchorage; personal communication).

Temperature Monitoring

Results for temperature monitoring will be reported under USFWS, Office of Subsistence Management, Project No. 08-701.

DISCUSSION

Project Objectives

Daily and season total escapements were successfully determined for all target species at the George River weir in 2010 (Table 1). High precipitation in George River headwaters produced above average water levels at the weir site and a subsequent breech in weir integrity for 3 days (18 to 20 August). Estimates of missed passage were necessary for chum, coho, and sockeye salmon during this period.

ASL composition was estimated successfully for Chinook, chum, and coho salmon. Precision and accuracy objectives for Chinook salmon ASL composition were achieved. Although, optimal sample sizes were not obtained, ASL compositions for the George River are considered representative of the total run. Samples were well distributed throughout the migration, and the 95% confidence interval for season age composition was within ±10% (Table 2). Project objectives were also met for weather and stream observations, and related fisheries projects.

Chinook Salmon

In 2010, Chinook salmon escapement (1,500) was 1,600 fish below the lower bound of the escapement goal range (3,100–7,900), making it the lowest escapement on record for this project (Figure 5). Escapement at George River weir followed a downward pattern from 2004 to 2010, which is consistent with 10 year cycles in abundance documented in nearby Holitna River drainage at Kogrukluk River weir (Williams and Shelden 2010). Based on median passage dates the Chinook salmon run was 4 days later than historical median. Passage of the central 50% of the run was 5 days longer than historical median (Figure 3).

Age-1.2, -1.3, -1.4, and -1.5 Chinook salmon dominated ASL samples in all project years (Figure 6). In some project years, age-1.1 and -2.4 fish also contributed a small number of samples. Abundance estimates of age-1.3 and -1.4 fish were a historic low. Abundance of age-1.2 and -1.5 fish were also below historical average. In 2010, season percent composition of female Chinook salmon (31%) was the third lowest on record (Figure 5).

Years of low abundance like 2010 present an opportunity for studying the resilience to low returns of spawners of distinct tributary stocks within the Kuskokwim River. Perspectives provided by projects like George River weir, also may one day be used to examine differential exploitation of stocks by commercial and subsistence fisheries in the lower river. It is our intent that by continuing to collect annual run data in concert with other data sources, we may be able to design management strategies that will take into account the needs of distinct tributary stocks within the Kuskokwim drainage. Without widely distributed projects like the George River weir, management would be focused on the sum total of fish returning to the Kuskokwim drainage in general and would fail to address the needs of stock distribution throughout.

Chum Salmon

Chum salmon escapement (26,164) was above historical median (Figure 5). Based on median passage dates, chum salmon run timing was within the historical range (Figure 3). Age-0.3 chum salmon dominated ASL samples in 2010 as in most project years, followed by age-0.4, -0.2, and -0.5 fish (Figure 6). Age-0.2 and -0.3 fish were above historical average, whereas the older age classes, -0.4 and -0.5, were below historical average. In 2010, season percent composition of female chum salmon (52%) was above the historical median of 49% (Figure 5).

COHO SALMON

Coho salmon escapement (12,961) was above historical median, and the fourth highest escapement on record (Figure 5). Based on median passage dates, the coho salmon run was 3 days later than the historical median (Figure 3). Age-2.1 coho salmon dominated ASL samples in 2010 as in all project years, followed by age-3.1 and -1.1 fish (Figure 6). In 2010, season percent composition of female coho salmon (52%) was above the historical median of 45% (Figure 5).

OTHER SPECIES

The George River does not show high abundances of sockeye and pink salmon. Accurate enumeration of spawning pink salmon at the weirs is confounded by their small size, which allows some individuals to pass between pickets undetected. Furthermore, it is unclear to what extent either of these species represent a distinct George River spawning population or strays from nearby tributaries.

Longnose suckers are historically the most abundant non-salmon species, and George River is thought to have a distinct breeding population. As many as 15,843 longnose suckers have been observed migrating upstream of the weir. However, enumeration of longnose suckers is incomplete because smaller individuals may be able to pass freely between pickets and upstream migration appears to start before weir operations typically begin.

CARCASS COUNTS

The number of salmon carcasses found on the weir is not a complete census of the number of post-spawning salmon (postspawners) above the weir site (Appendix C). The "sucker chutes" that are installed to facilitate downstream passage of non-salmon species provide a pathway for post-spawners or weak salmon to drift downstream. Daily carcass counts noticeably decrease following chute installation, and no attempt was made to estimate missed carcasses. The weir was removed long before most coho salmon had completed spawning, so the number of coho salmon carcasses counted on the weir largely underestimates the number of post-spawners that drifted past the weir site.

WEATHER AND STREAM OBSERVATION

Water level was below historical average for the first half of the operational period. After 28 June, water level rose to above historical average and peaked at 120 cm on 20 August. Water clarity degraded due to high water in August. Water temperature was near historical average for much of the operational period, with an extended below average period in August corresponding with the high water event (Figure 4).

CONCLUSIONS

- Escapement monitoring occurred from 15 June to 20 September.
- Daily and total annual escapements were successfully determined for Chinook and chum salmon, and for coho salmon except those at the tail end of the run.
- ASL compositions were successfully determined for all objective species (Figures 2–7).
- Project objectives were successfully met for supporting other fisheries related projects as noted above.

ACKNOWLEDGEMENTS

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Bob Vanderpool (1915–2010) of GeorgeTown served the Kuskokwim and Yukon River communities as a bush pilot for 50 years. Bob and his family have also provided invaluable support to the success of George River weir and all fisheries research projects on the Kuskokwim River.

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TABLES AND FIGURES

Table 1.–Daily and cumulative percent passage of Chinook, chum coho, and sockeye salmon at George River weir, 2010.

	Chinook		Chum		Coho		Sockeye	
Date	Daily	%	Daily	%	Daily	%	Daily	%
6/15	0	0	0	0	0	0	0	0
6/16	0	0	0	0	0	0	0	0
6/17	0	0	0	0	0	0	0	0
6/18	0	0	0	0	0	0	0	0
6/19	0	0	0	0	0	0	0	0
6/20	0	0	0	0	0	0	0	0
6/21	0	0	6	0	0	0	0	0
6/22	0	0	1	0	0	0	0	0
6/23	3	0	8	0	0	0	0	0
6/24	2	0	73	0	0	0	0	0
6/25	1	0	37	0	0	0	0	0
6/26	4	1	81	1	0	0	0	0
6/27	0	1	31	1	0	0	0	0
6/28	0	1	37	1	0	0	0	0
6/29	7	1	280	2	0	0	1	1
6/30	8	2	562	4	0	0	0	1
7/1	17	3	576	6	0	0	0	1
7/2	36	5	457	8	0	0	0	1
7/3	1	5	300	9	0	0	0	1
7/4	55	9	424	11	0	0	0	1
7/5	217	23	1,341	16	0	0	0	1
7/6	106	30	623	18	0	0	0	1
7/7	87	36	327	20	0	0	1	2
7/8	49	40	936	23	0	0	0	2
7/9	36	42	1,035	27	0	0	1	3
7/10	78	47	755	30	0	0	0	3
7/11	107	54	748	33	0	0	1	3
7/12	21	56	1,007	37	0	0	1	4
7/13	116	63	1,501	43	0	0	4	8
7/14	28	65	859	46	0	0	4	11
7/15	22	67	640	48	0	0	3	14
7/16	47	70	1,198	53	0	0	8	21
7/17	42	73	1,041	57	0	0	3	23
7/18	28	75	990	61	0	0	5	28
7/19	33	77	790	64	0	0	2	30
7/20	52	80	600	66	0	0	0	30
7/21	58	84	833	69	0	0	2	31
7/22	21	85	591	71	0	0	6	36
7/23	2	86	432	73	0	0	4	40
7/24	31	88	482	75	0	0	3	43
7/25	27	89	811	78	0	0	3	45
7/26	24	91	615	80	1	0	2	47
7/27	9	92	607	83	0	0	2	49
7/28	27	93	498	85	0	0	3	51
7/29	13	94	410	86	6	0	2	53
7/30	5	95	522	88	6	0	2	55
7/31	17	96	440	90	8	0	2	56
8/1	12	97	375	91	11	0	4	60
8/2	4	97	286	92	8	0	3	62
8/3	11	98	282	93	15	0	4	66
8/4	0	98	228	94	10	1	0	66
8/5	1	98	155	95	12	1	5	70
8/6	1	98	217	96	4	1	3	73

-continued-

Table 1.–Page 2 of 2.

Date	Chinook		Chum		Coho		Sockeye	
	Daily	%	Daily	%	Daily	%	Daily	%
8/7	5	98	153	96	18	1	1	74
8/8	1	98	154	97	9	1	2	75
8/9	2	98	91	97	52	1	4	79
8/10	1	98	71	98	36	2	0	79
8/11	5	99	111	98	49	2	2	81
8/12	4	99	76	98	71	2	0	81
8/13	3	99	67	99	139	4	2	82
8/14	5	99	59	99	254	5	2	84
8/15	2	100	35	99	189	7	0	84
8/16	0	100	22	99	106	8	1	85
8/17	2	100	42	99	235	10	0	85
8/18	1 [a]	100	27 [b]	99	177 [b]	11	1 [b]	86
8/19	1 [a]	100	23 [b]	99	184 [b]	12	1 [b]	86
8/20	0 [a]	100	18 [b]	99	191 [b]	14	1 [b]	87
8/21	0	100	13	99	154	15	2	89
8/22	0	100	14	100	241	17	0	89
8/23	0	100	19	100	379	20	0	89
8/24	0	100	17	100	237	22	0	89
8/25	0	100	8	100	455	25	0	89
8/26	0	100	7	100	277	27	2	90
8/27	0	100	4	100	349	30	1	91
8/28	1	100	5	100	489	34	0	91
8/29	0	100	4	100	461	37	1	92
8/30	0	100	2	100	629	42	0	92
8/31	0	100	3	100	964	50	2	94
9/1	0	100	2	100	987	57	1	95
9/2	0	100	4	100	463	61	3	97
9/3	0	100	2	100	475	64	0	97
9/4	0	100	7	100	941	72	1	98
9/5	0	100	5	100	621	76	0	98
9/6	0	100	2	100	406	80	0	98
9/7	1	100	2	100	699	85	0	98
9/8	0	100	2	100	478	89	1	99
9/9	0	100	7	100	330	91	0	99
9/10	0	100	4	100	254	93	0	99
9/11	0	100	4	100	234	95	0	99
9/12	0	100	4	100	136	96	0	99
9/13	0	100	4	100	121	97	0	99
9/14	0	100	3	100	87	98	0	99
9/15	0	100	5	100	80	98	1	100
9/16	0	100	3	100	69	99	0	100
9/17	0	100	1	100	41	99	0	100
9/18	0	100	0	100	27	99	0	100
9/19	0	100	0	100	49	100	0	100
9/20	0	100	0	100	37	100	0	100
Totals	1500	100	26,154	100	12,961	100	115	100

Note: Elongated boxes delineate the central 50% of the run and the bold box delineates the median passage date.

[a] Partial day count, passage was not estimated.

[b] The weir was not operational; daily passage was estimated.

Table 2.–Age and sex composition of Chinook salmon at the George River weir in 2010 based on escapement samples collected with a live trap.

			Age Class															
Sample Dates	Sample		1.1		1.2		1.3		1.4		2.3		1.5		2.4		Total	
(Stratum Dates)	Size	Sex	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%
6/26, 6/29-7/1, 7/4-6	58	M	8	1.7	181	39.7	118	25.9	32	6.9	0	0.0	8	1.7	0	0.0	347	75.9
		F	0	0.0	0	0.0	39	8.6	71	15.5	0	0.0	0	0.0	0	0.0	110	24.1
(6/16-7/6)		Subtotal[a]	8	1.7	181	39.7	0	0.0	103	22.4	0	0.0	8	1.7	0	0.0	457	100.0
7/7-11, 7/13	59	M	8	1.7	285	57.6	100	20.3	50	10.2	0	0.0	0	0.0	0	0.0	443	89.8
(7/7-7/13)		F	0	0.0	0	0.0	17	3.4	33	6.8	0	0.0	0	0.0	0	0.0	50	10.2
		Subtotal[a]	8	1.7	285	57.6	117	23.7	83	17.0	0	0.0	0	0.0	0	0.0	493	100.0
7/14-19, 7/21-22, 7/24-27,	46	M	0	0.0	72	13.0	107	19.6	60	10.9	0	0.0	12	2.2	0	0.0	251	45.7
		F	0	0.0	0	0.0	36	6.5	203	37.0	0	0.0	60	10.9	0	0.0	299	54.3
(7/14-9/7)		Subtotal[a]	0	0.0	72	13.0	143	26.1	263	47.9	0	0.0	72	13.1	0	0.0	550	100.0
Season[b]	163	M	16	1.1	538	35.9	325	21.7	142	9.5	0	0.0	20	1.3	0	0.0	1,041	69.4
		F	0	0	0	0.0	92	6.1	307	20.5	0	0.0	60	4.0	0	0.0	459	30.6
		Total	16	1.1	538	35.9	417	27.8	449	29.9	0	0.0	80	5.3	0	0.0	1,500	100.0
		95% C.I.				(± 6.4)		(± 6.7)		(± 6.7)								

[a] The number of fish in each stratum age and sex category are derived from the sample percentages; discrepancies in sums are attributed to rounding errors.

[b] The number of fish in "Season" summaries are the strata sums; "Season" percentages are derived from the sums of the estimated escapement.

Table 3.–Mean length (mm) of Chinook salmon at the George River weir in 2010 based on escapement samples collected with a live trap.

Sample Dates (Stratum Dates)	Sex		Age Class 1.1	1.2	1.3	1.4	2.3	1.5	2.4
	M	Mean Length	380	528	630	669		892	
6/26, 6/29-7/1, 7/4-6		SE[a]	-	12	23	-		-	
(6/16-7/6)		Range	-	440-667	532-876	608-797		-	
		Sample Size	1	23	15	4	0	1	0
	F	Mean Length			700	872			
		SE[a]			-	17			
		Range			624-819	760-935			
		Sample Size	0	0	5	9	0	0	0
7/07-11, 7/13	M	Mean Length	447	506	638	740			
(7/7-7/13)		SE[a]	-	10	16	-			
		Range	-	367-625	556-733	488-914			
		Sample Size	1	34	12	6	0	0	0
	F	Mean Length			783	784			
		SE[a]			-	-			
		Range			752-814	714-845			
		Sample Size	0	0	2	4	0	0	0

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Table 3.–Page 2 of 2.

Sample Dates (Stratum Dates)	Sex		Age Class 1.1	1.2	1.3	1.4	2.3	1.5	2.4
7/14-19, 7/21-22, 7/24-27, (7/14-9/7)	M	Mean Length		495	632	793		942	
		SE[a]		-	26	-		-	
		Range		380-562	497-711	743-868		-	
		Sample Size	0	6	9	5	0	1	0
	F	Mean Length			816	826		869	
		SE[a]			-	16		-	
		Range			806-823	665-916		826-892	
		Sample Size	0	0	3	17	0	5	0
Season[b]	M	Mean Length	415	509	633	737		919	
		SE[a]	-	11	13	26		-	
		Range	380-447	367-667	497-876	488-914		892-942	
		Sample Size	2	63	36	15	0	2	0
	F	Mean Length			770	826		869	
		SE[a]			16	13		-	
		Range			624-823	665-935		826-892	
		Sample Size	0	0	10	30	0	5	0

Note: The sum of the sample sizes in each stratum equal the total sample size reported for that stratum in Table 2.

[a] Standard error was not calculated for small sample sizes.

[b] "Season" mean lengths are weighted by the escapement passage in each stratum.

Table 4.–Age and sex composition of chum salmon at the George River weir in 2010 based on escapement samples collected with a live trap.

			Age Class											
			0.2		0.3		0.4		0.5		0.6		Total	
Sample Dates (Stratum Dates)	Sample Size	Sex	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%
6/28-6/30, 7/3, 7/5-7	226	M	0	0.0	2,376	46.0	297	5.8	23	0.4	0	0.0	2,696	52.2
(6/15-7/7)		F	23	0.4	1,988	38.5	366	7.1	91	1.8	0	0.0	2,468	47.8
		Subtotal[a]	23	0.4	4,364	84.5	663	12.8	114	2.2	0	0.0	5,164	100.0
7/8, 7/9, 7/10, 7/11	196	M	153	2.6	3,174	53.1	336	5.6	0	0.0	0	0.0	3,662	61.2
(7/08-7/13)		F	61	1.0	2,259	37.8	0	0.0	0	0.0	0	0.0	2,320	38.8
		Subtotal[a]	214	3.6	5,433	90.8	336	5.6	0	0.0	0	0.0	5,982	100.0
7/14, 7/16, 7/18, 7/19	205	M	54	1.0	2,046	37.1	81	1.5	27	0.5	0	0.0	2,207	40.0
(7/14-7/19)		F	296	5.4	2,961	53.7	54	1.0	0	0.0	0	0.0	3,311	60.0
		Subtotal[a]	350	6.3	5,007	90.7	135	2.4	27	0.5	0	0.0	5,518	100.0
7/21, 7/22, 7/23, 7/24	142	M	106	2.8	1,663	44.4	211	5.6	26	0.7	0	0.0	2,007	53.5
(7/20-7/25)		F	79	2.1	1,478	39.4	158	4.2	26	0.7	0	0.0	1,742	46.5
		Subtotal[a]	185	4.9	3,142	83.8	370	9.9	53	1.4	0	0.0	3,749	100.0
7/26-27, 7/31, 8/1-2	298	M	96	1.7	1,849	32.2	116	2.0	0	0.0	19	0.3	2,081	36.2
(7/26-9/20)		F	154	2.7	3,159	55.0	347	6.0	0	0.0	0	0.0	3,660	63.8
		Subtotal[a]	250	4.4	5,009	87.2	462	8.1	0	0.0	19	0.3	5,741	100.0
Season[b]	1,067	M	409	1.6	11,108	42.5	1,041	4.0	76	0.3	19	0.1	12,653	48.4
		F	613	2.3	11,845	45.3	925	3.5	118	0.5	0	0.0	13,501	51.6
		Total	1,022	3.9	22,954	87.7	1,965	7.5	194	0.7	19	0.1	26,154	100.0
		95% C.I.		(± 1.2)		(± 1.9)		(±1.5)						

[a] The number of fish in each stratum age and sex category are derived from the sample percentages; discrepancies in sums are attributed to rounding errors.

[b] The number of fish in "Season" summaries are strata sums; "Season" percentages are derived from the sums of the estimated escapement that occurred in each stratum.

Table 5.–Mean length (mm) of chum salmon at the George River weir in 2010 based on escapement samples collected with a live trap.

Sample Dates (Stratum Dates)	Sex		Age Class 0.2	0.3	0.4	0.5	0.6
6/28-6/30, 7/3, 7/5-7 (6/15-7/7)	M	Mean Length		548	581	592	
		SE		2	8	-	
		Range		490-621	520-613	-	
		Sample Size	0	104	13	1	0
	F	Mean Length	500	524	543	554	
		SE	-	3	11	-	
		Range	-	443-591	454-604	540-570	
		Sample Size	1	87	16	4	0
7/8, 7/9, 7/10, 7/11 (7/08-7/13)	M	Mean Length	515	544	561		
		SE[b]	-	3	7		
		Range	465-572	441-596	519-586		
		Sample Size	5	104	11	0	0
	F	Mean Length	508	525			
		SE[a]	-	3			
		Range	496-519	419-612			
		Sample Size	2	74	0	0	0
7/14, 7/16, 7/18, 7/19 (7/14-7/19)	M	Mean Length	498	550	546	559	
		SE[a]	-	3	-	-	
		Range	488-508	507-612	520-565	-	
		Sample Size	2	76	3	1	0
	F	Mean Length	508	513	555		
		SE[a]	9	2	-		
		Range	473-572	419-578	552-557		
		Sample Size	11	110	2	0	0
7/21, 7/22, 7/23, 7/24 (7/20-7/25)	M	Mean Length	514	544	564	558	
		SE[a]	-	4	15	-	
		Range	492-535	469-625	513-616	-	
		Sample Size	4	63	8	1	0
	F	Mean Length	492	516	519	536	
		SE[a]	-	3	-	-	
		Range	465-510	478-570	490-535	-	
		Sample Size	3	56	6	1	0

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Table 5.–Page 2 of 2.

Sample Dates (Stratum Dates)	Sex		Age Class 0.2	0.3	0.4	0.5	0.6
7/26-27, 7/31, 8/1-2 (7/26-9/20)	M	Mean Length	519	540	544		565
		SE[a]	-	3	-		-
		Range	475-548	469-624	498-593		-
		Sample Size	5	96	6	0	1
	F	Mean Length	506	512	529		
		SE[a]	7	2	6		
		Range	478-526	452-595	502-579		
		Sample Size	8	164	18	0	0
Season[b]	M	Mean Length	512	545	558	571	565
		SE[a]	7	1	6	-	-
		Range	465-572	441-625	498-616	558-592	-
		Sample Size	16	443	41	3	1
	F	Mean Length	503	518	538	546	
		SE[a]	5	1	4	-	
		Range	465-572	419-612	454-604	536-570	
		Sample Size	25	491	42	5	0

Note: The sum of the sample sizes in each stratum equal the total sample size reported for that stratum in Table 4.

[a] Standard error was not calculated for small sample sizes.

[b] "Season" mean lengths are weighted by the escapement passage in each stratum.

Table 6.–Age and sex composition of coho salmon at the George River weir in 2010 based on escapement samples collected with the live trap.

			Age Class							
			1.1		2.1		3.1		Total	
Sample Dates (Stratum Dates)	Sample Size	Sex	Esc.	%	Esc.	%	Esc.	%	Esc.	%
8/22, 8/23, 8/26,	188	M	129	2.7	2,391	49.5	180	3.7	2,699	55.9
8/28, 8/29		F	51	1.1	1,825	37.8	257	5.3	2,134	44.1
(6/15-8/29)		Subtotal[a]	180	3.7	4,216	87.2	437	9.0	4,833	100.0
8/30, 8/31, 9/03-9/05	188	M	0	0.0	2,081	41.0	189	3.7	2,270	44.7
		F	0	0.0	2,567	50.5	243	4.8	2,810	55.3
(8/30-9/5)		Subtotal[a]	0	0.0	4,648	91.5	432	8.5	5,080	100.0
9/09, 9/10, 9/12	183	M	83	2.7	1,183	38.8	50	1.6	1,316	43.2
(9/6-9/20)		F	83	2.7	1,566	51.4	83	2.7	1,732	56.8
		Subtotal[a]	167	5.5	2,748	90.2	133	4.4	3,048	100.0
Season[b]	559	M	212	1.6	5,654	43.6	419	3.2	6,285	48.5
		F	135	1.0	5,958	46.0	584	4.5	6,676	51.5
		Total	347	2.7	11,612	89.6	1,003	7.7	12,961	100.0
		95% C.I.		(± 1.2)		(± 2.5)		(± 2.3)		

[a] The number of fish in each stratum age and sex category are derived from the sample percentages; discrepancies in sums are attributed to rounding errors.

[b] The number of fish in "Season" summaries are the strata sums; "Season" percentages are derived from the sums of the estimated escapement.

Table 7.–Mean length (mm) of coho salmon at the George River weir in 2010 based on escapement samples collected with a live trap.

Sample Dates (Stratum Dates)	Sex		Age Class 1.1	2.1	3.1
8/22, 8/23, 8/26, 8/28, 8/29	M	Mean Length	477	540	542
		SE[a]	-	5	14
(6/15-8/29)		Range	438-533	422-652	470-579
		Sample Size	5	93	7
	F	Mean Length	534	542	569
		SE[a]	-	4	9
		Range	502-566	478-600	523-611
		Sample Size	2	71	10
8/30, 8/31, 9/03-9/05	M	Mean Length		548	549
		SE[a]		5	18
(8/30-9/5)		Range		415-632	506-646
		Sample Size	0	77	7
	F	Mean Length		562	561
		SE[a]		3	11
		Range		426-634	522-602
		Sample Size	0	95	9
9/09, 9/10, 9/12	M	Mean Length	537	527	520
(9/6-9/20)		SE[a]	-	6	-
		Range	476-604	412-642	494-557
		Sample Size	5	71	3
	F	Mean Length	559	542	543
		SE[a]	-	4	-
		Range	521-587	445-643	492-576
		Sample Size	5	94	5
Season[b]	M	Mean Length	500	540	540
		SE[a]	16	3	10
		Range	438-604	412-652	470-646
		Sample Size	10	241	17
	F	Mean Length	544	550	560
		SE[a]	20	2	6
		Range	502-587	426-643	492-611
		Sample Size	7	260	24

Note: The sum of the sample sizes in each stratum equal the total sample size reported for that stratum in Table 6.

[a] Standard error was not calculated for small sample sizes.

[b] "Season" mean lengths are weighted by the escapement passage in each stratum.

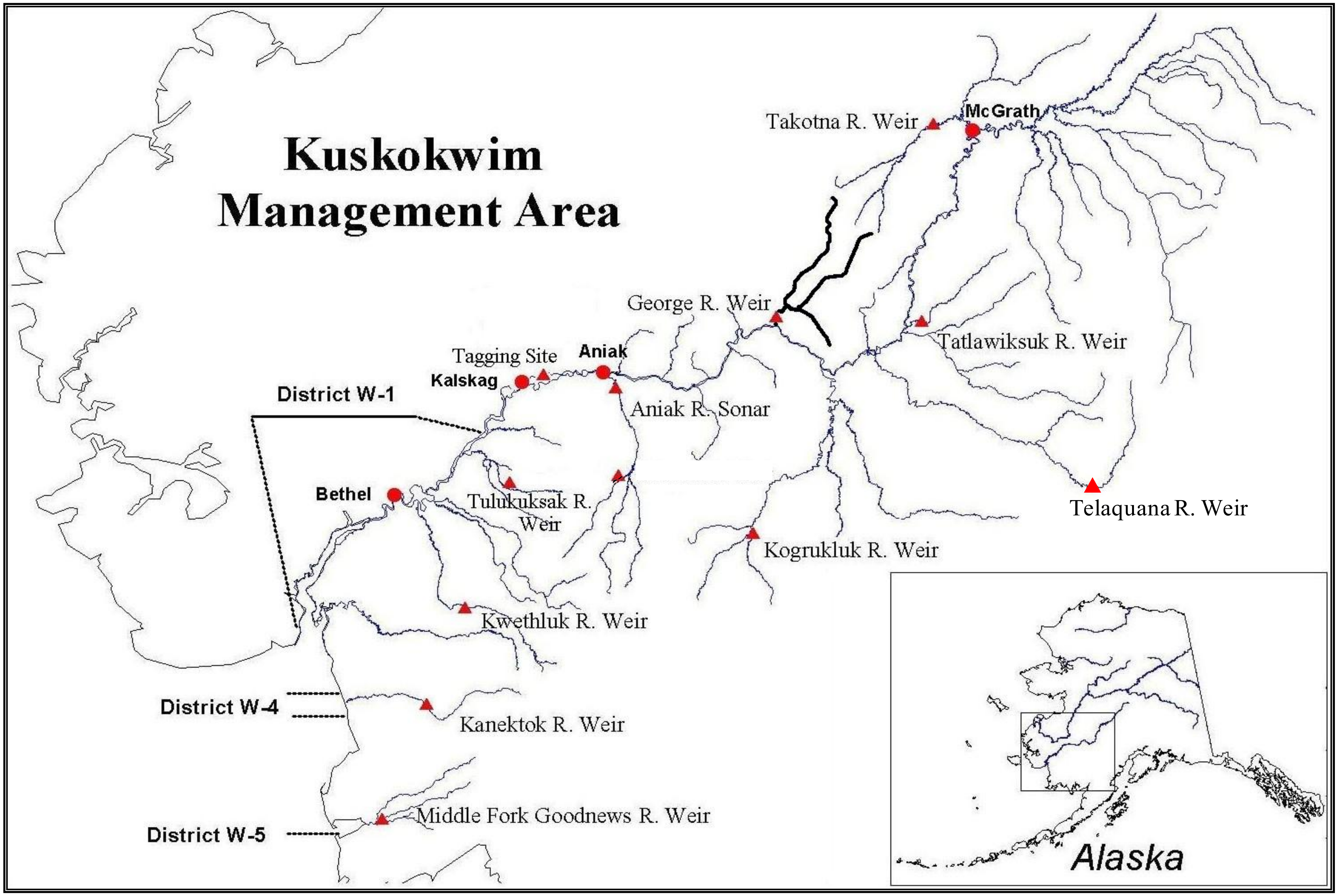


Figure 1.–Map depicting the location of Kuskokwim Area salmon management districts and escapement monitoring on the George River.

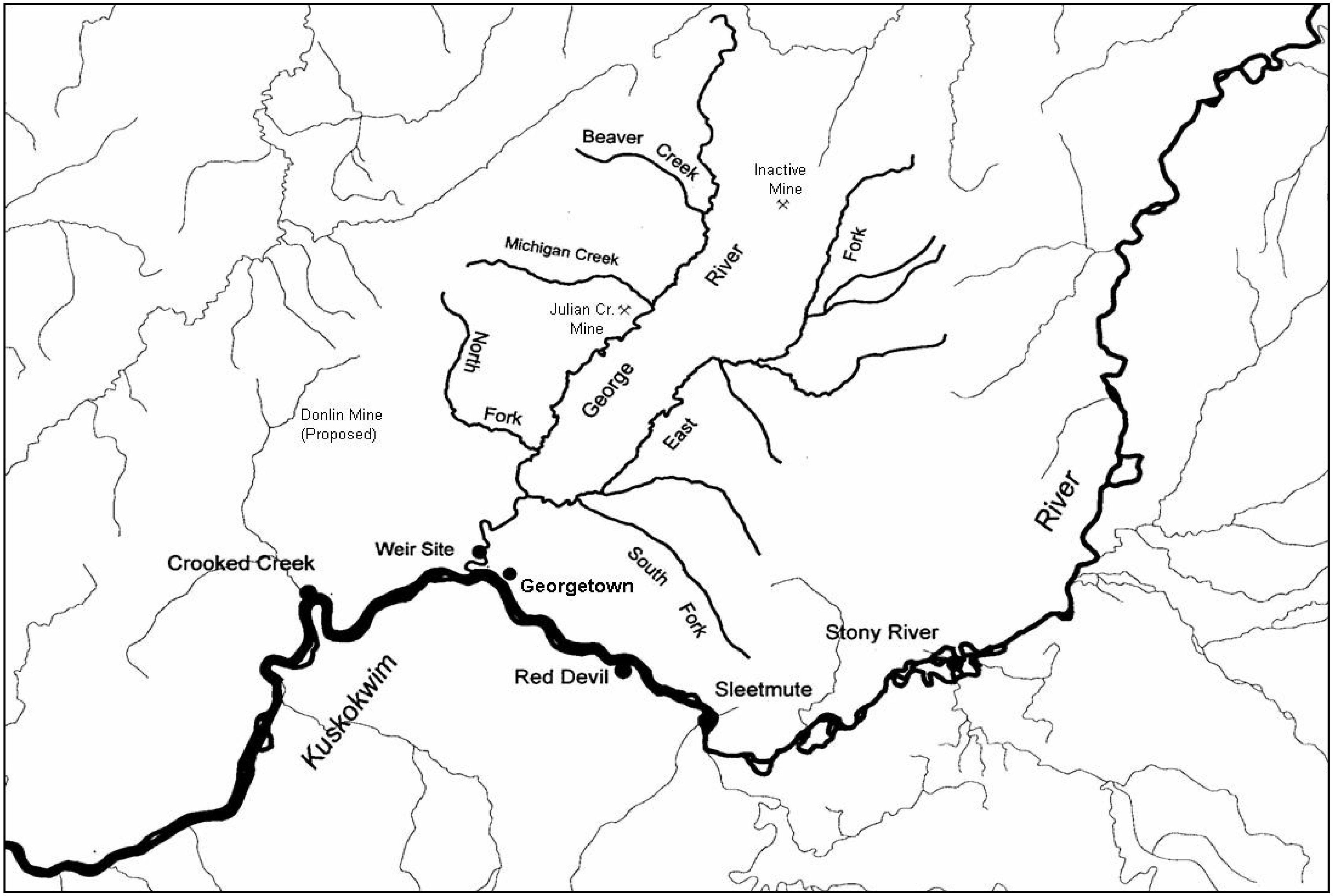


Figure 2.–George River, middle Kuskokwim River basin.

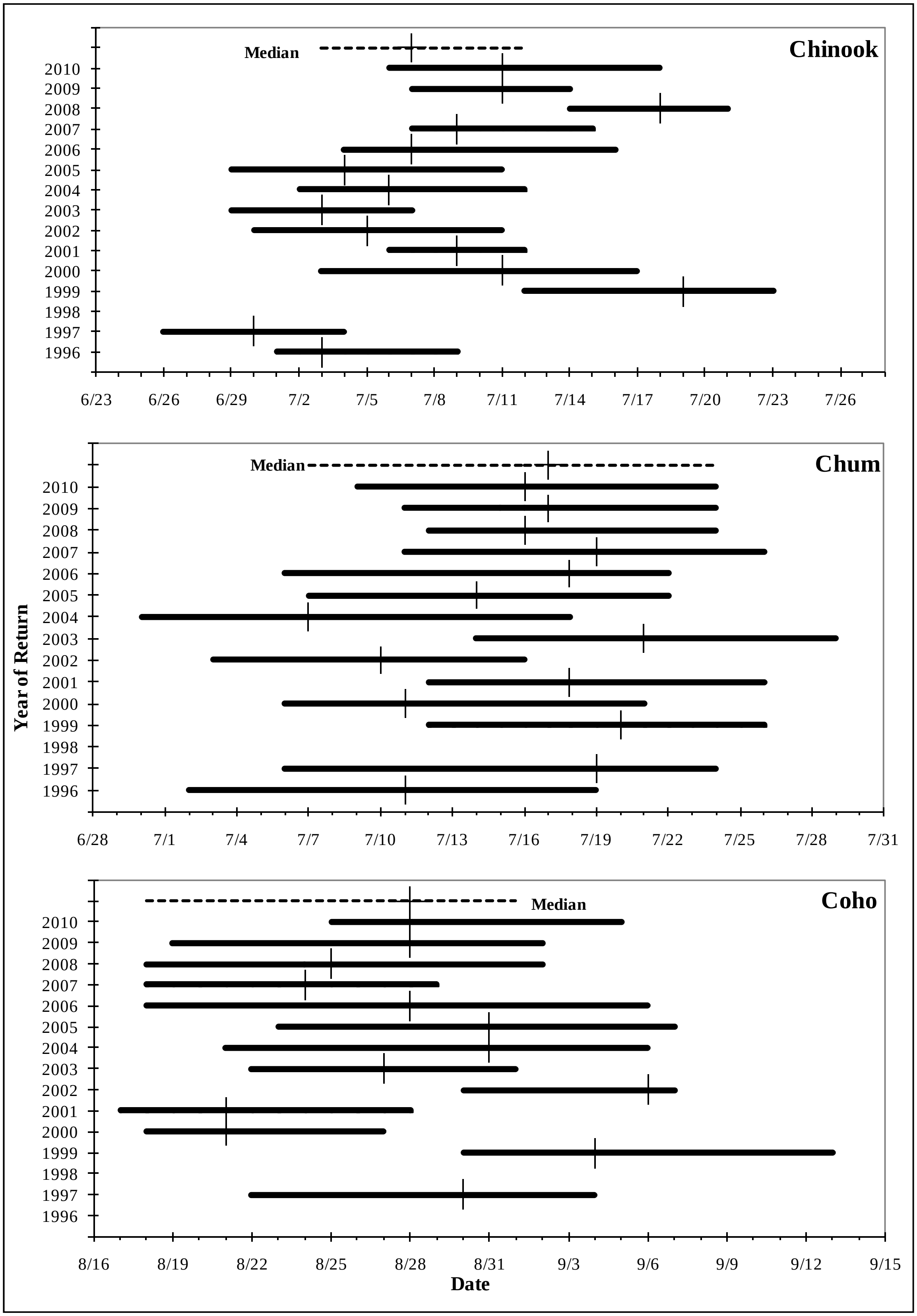


Figure 3.–Run timing of Chinook, chum, and coho salmon based on cumulative percent passage at the George River weir, 1996–2010.

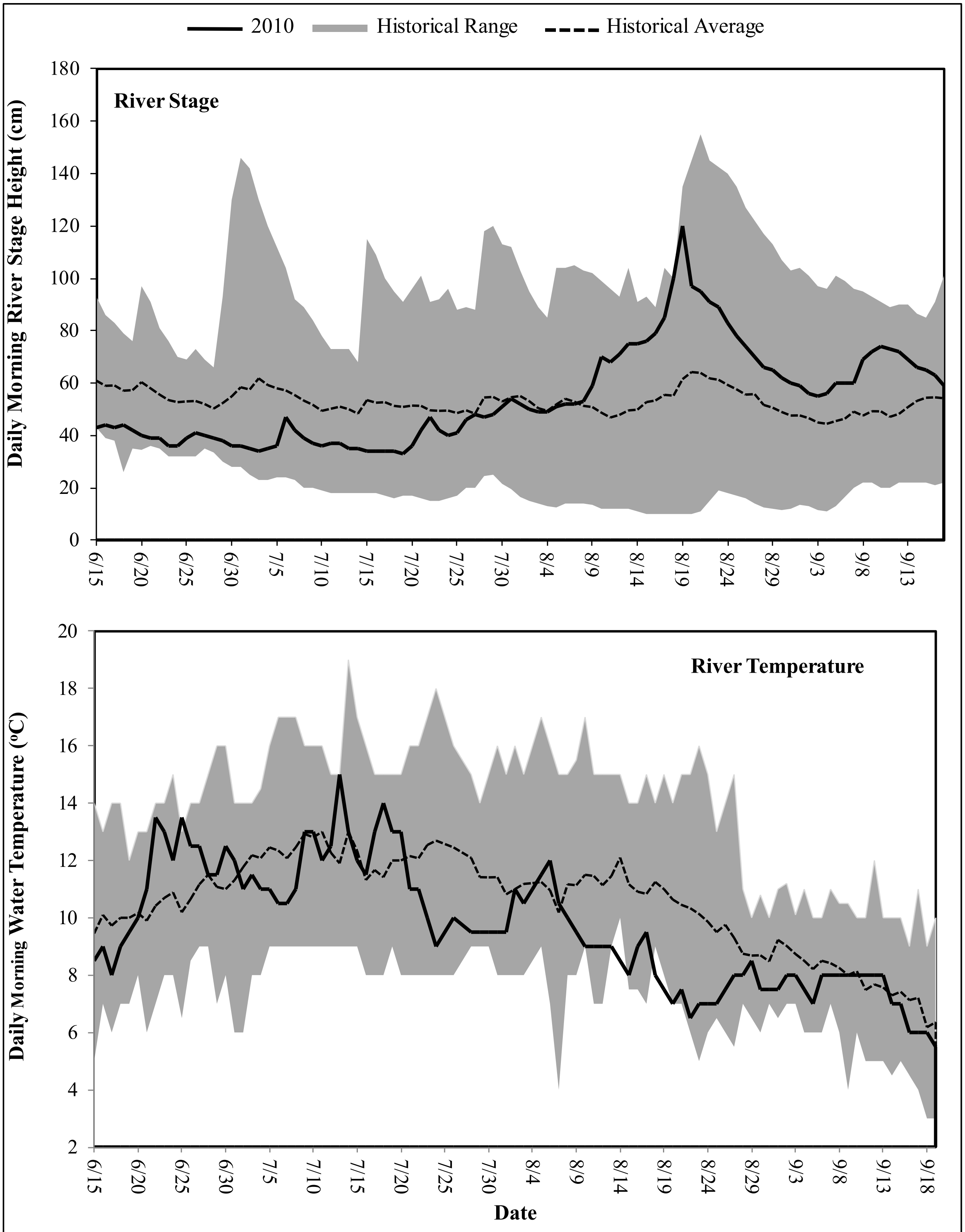
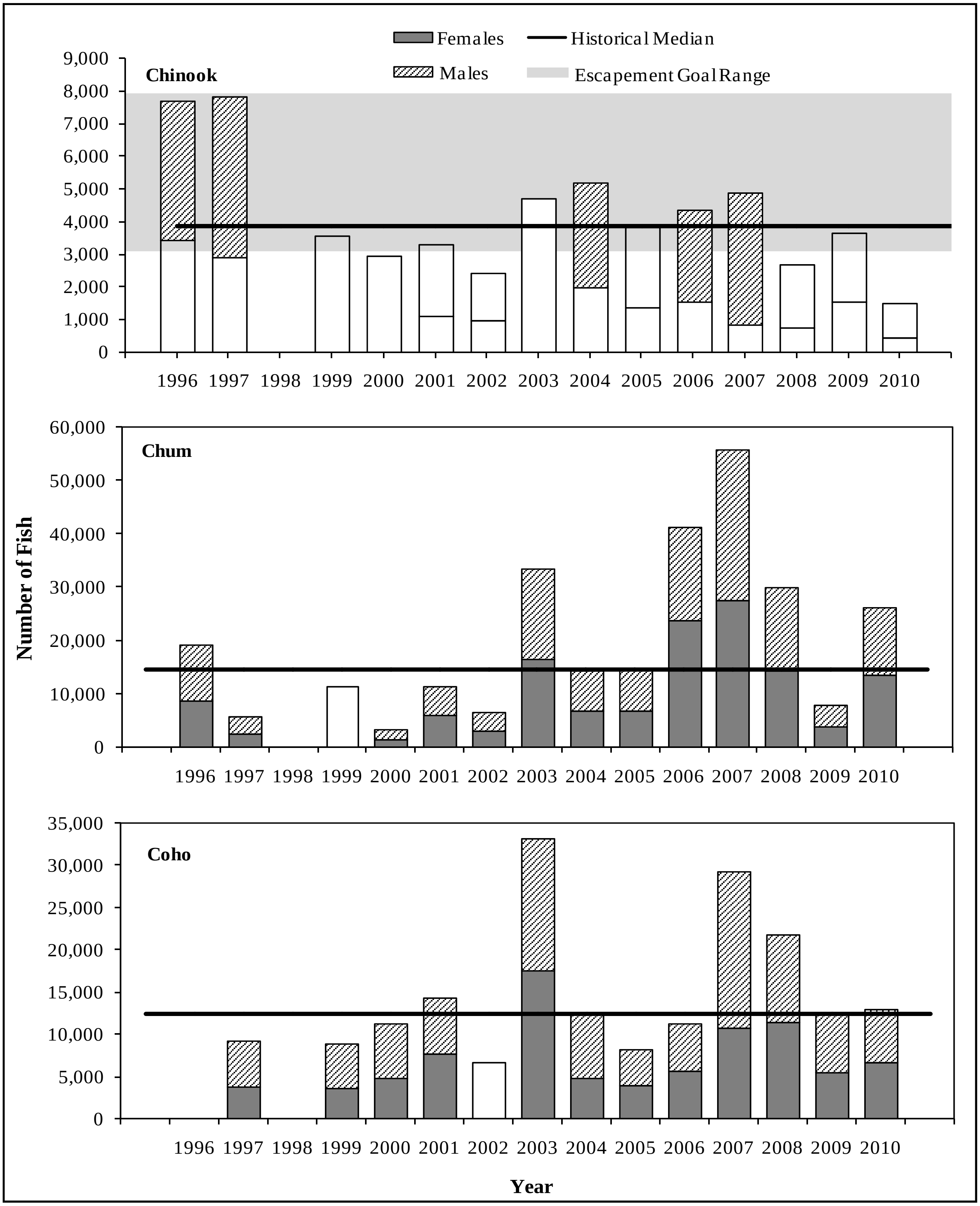


Figure 4.–Comparison of daily morning river stage and temperature measurements in 2010 with historical range and averages at George River weir.



Note: Open bars represent years when estimates of missed passage exceeded 20%, and were not used to calculate historical statistics.

Figure 5.–Historical escapement of salmon at the George River weir, showing historical median and Chinook salmon escapement goal range.

APPENDIX A: WEATHER AND STREAM OBSERVATIONS

Appendix A1.–Daily weather and stream observations at George River weir, 2010.

Date	Time	Sky Conditions[a]	Precipitation (mm)	Temperature (°C) Air	Temperature (°C) Water	River Stage (cm)	Water Clarity[b]
6/14	17:00	4	0.7	12.5	9.5	43	2
6/15	10:00	4	1.8	10	8.5	43	1
	17:00	3	0.0	14	10	43	1
6/16	10:00	4	0.2	9	9	44	1
	17:00	4	0.0	11	9	44	1
6/17	10:00	4	0.8	9.5	8	43	2
	17:00	3	0.0	14	10.5	44	1
6/18	10:00	4	0.0	9.5	9	44	1
	17:00	3	0.0	10.5	9.5	43	1
6/19	10:00	2	0.0	12.5	9.5	42	1
	17:00	3	0.0	15	12.5	40	1
6/20	10:00	3	0.0	11.5	10	40	1
	17:00	3	0.0	18	12	40	1
6/21	10:00	1	0.0	14.5	11	39	1
	17:00	2	0.0	23.5	15	39	1
6/22	10:00	1	0.0	15	13.5	39	1
	17:00	3	0.0	20.5	14	37	1
6/23	10:00	4	0.0	14	13	36	1
	17:00	3	0.0	20	16	36	1
6/24	10:00	4	0.0	13	12	36	1
	17:00	3	1.5	18.5	14.5	36	1
6/25	10:00	2	5.2	15	13.5	39	1
	17:00	4	0.2	17.5	14.5	40	1
6/26	10:00	3	0.2	15.5	12.5	41	2
	17:00	3	0.0	22	15	41	2
6/27	10:00	4	0.0	9.5	12.5	40	1
	17:00	4	0.0	10	12	40	1
6/28	10:00	4	1.0	11	11.5	39	1
	17:00	3	0.0	17	13	39	1
6/29	10:00	4	0.2	12.5	11.5	38	1
	17:00	3	0.0	19	13.5	38	1
6/30	10:00	3	0.0	14.5	12.5	36	1
	17:00	4	0.0	16	13.5	36	1
7/1	10:00	4	0.0	10	12	36	1
	17:00	4	0.0	15	13.5	36	1
7/2	10:00	4	0.2	10.5	11	35	1
	17:00	3	0.0	16.5	13	34	1
7/3	10:00	4	2.0	11	11.5	34	1
	17:00	4	3.6	15	12.5	35	1
7/4	10:00	4	1.4	10.5	11	35	1
	17:00	4	2.0	13.5	12	36	1
7/5	10:00	4	1.6	12	11	36	2
	17:00	4	0.2	14	12.5	44	2
7/6	10:00	4	0.0	10	10.5	47	2
	17:00	4	0.0	13	11.5	46	2
7/7	8:45	2	0.0	10	10.5	42	1
	17:00	4	0.0	18.5	12.5	42	1

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Appendix A1.–Page 2 of 5.

Date	Time	Sky Conditions[a]	Precipitation (mm)	Temperature (°C) Air	Water	River Stage (cm)	Water Clarity[b]
7/8	8:45	1	0.0	12	11	39	1
	17:00	4	0.0	19.5	14	38	1
7/9	10:00	1	0.2	17	13	37	1
	17:00	2	0.0	22	16	38	1
7/10	10:00	4	0.3	12	13	36	1
	17:00	4	0.2	13.5	13	36	1
7/11	10:00	4	0.0	14	12	37	1
	17:00	2	0.0	18	14	37	1
7/12	9:00	4	0.0	10	12.5	37	1
	17:00	1	0.0	18	16	36	1
7/13	10:00	3	0.0	16	15	35	1
	17:00	4	0.0	15.5	15	35	1
7/14	10:00	4	0.0	14.5	13	35	1
	17:00	4	0.0	17	14	34	1
7/15	10:00	4	0.3	10.5	12	34	1
	17:00	3	0.0	17	13.5	34	1
7/16	10:00	3	0.0	10	11.5	34	1
	17:30	3	0.0	22	16	34	1
7/17	9:00	1	0.0	12	13	34	1
	17:00	3	0.0	21.5	17	34	1
7/18	10:00	4	3.9	13	14	34	1
	17:00	4	1.0	15	15	34	1
7/19	10:00	4	2.0	12.5	13	33	1
	17:00	4	8.0	13	13.5	34	1
7/20	10:00	5	3.4	11	13	36	1
	17:00	4	6.2	14	12.5	38	2
7/21	7:30	4	1.8	10	11	42	2
	17:00	4	0.0	15	13	47	3
7/22	7:30	4	0.0	10	11	47	3
	17:00	4	0.0	14.5	12	45	2
7/23	7:30	4	0.4	7.5	10	42	2
	17:00	4	0.2	9.5	10	41	2
7/24	7:30	5	0.7	8.5	9	40	2
	17:00	3	4.4	13	11.5	40	1
7/25	7:45	4	0.2	9.5	10	41	1
	17:00	4	1.2	11	10	43	1
7/26	10:00	3	0.3	11	9.5	46	2
	17:00	3	0.0	16	11.5	47	2
7/27	10:00	4	0.0	8	9.5	48	1
	17:00	4	0.0	15.5	10.5	48	1
7/28	10:00	4	2.8	10	9.5	47	2
	17:00	4	2.6	11.5	10.5	47	2
7/29	10:00	4	1.4	11	9.5	48	2
	17:00	4	0.5	13	11	50	2
7/30	10:00	4	5.0	12	9.5	51	2
	17:00	4	0.4	16.5	10.5	52	2

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Date	Time	Sky Conditions[a]	Precipitation (mm)	Temperature (°C) Air	Temperature (°C) Water	River Stage (cm)	Water Clarity[b]
7/31	10:00	4	1.4	14	11	54	3
	17:00	3	0.0	19	12	54	3
8/1	10:00	3	0.0	14	10.5	52	2
	17:30	3	0.0	20	13	51	2
8/2	10:00	4	0.0	14.5	11	50	2
	17:00	3	0.0	19	13.5	49	2
8/3	10:00	3	0.0	14	11.5	49	2
	17:00	3	0.0	17	13	49	2
8/4	10:00	4	4.0	13	12	49	2
	17:00	3	0.6	17.5	13	49	2
8/5	10:00	3	0.0	14	10.5	51	2
	17:30	4	0.0	18.5	14	52	2
8/6	10:00	4	2.0	10.5	10	52	2
	17:00	4	0.6	12	11	52	2
8/7	10:00	4	0.8	10.5	9.5	52	2
	17:00	4	0.3	12.5	10	53	2
8/8	10:00	4	0.0	11	9	53	2
	17:00	4	4.8	12	10	54	2
8/9	10:00	4	5.6	11.5	9	59	3
	17:00	4	0.7	13	9.5	66	3
8/10	10:00	4	0.3	11	9	70	3
	17:00	4	0.6	13.5	10	71	3
8/11	10:00	4	3.4	10	9	68	3
	17:00	4	0.4	14	10	70	3
8/12	10:00	4	3.0	10	8.5	71	3
	17:00	4	3.6	13	9	74	3
8/13	10:00	4	1.2	10	8	75	3
	17:00	4	0.0	13	9.5	76	3
8/14	10:00	3	3.0	14	9	75	3
	17:00	4	0.0	20	10	78	3
8/15	10:00	4	4.6	12.5	9.5	76	3
	17:00	4	5.8	10.5	9.5	76	3
8/16	10:00	4	0.5	9	8	79	3
	17:00	4	2.6	11	9.5	82	3
8/17	10:00	4	8.4	9.5	7.5	85	3
	17:00	4	0.8	11	8	90	3
8/18	10:00	4	0.8	8	7	100	3
	17:00	3	0.0	11	8	110	3
8/19	10:00	3	0.0	6	7.5	120	3
	17:00	3	0.0	14	7.5	110	3
8/20	10:00	2	0.0	5	6.5	97	3
	17:00	3	0.0	8.5	7	96	2
8/21	10:00	3	0.0	10	7	95	2
	18:00	3	0.0	15	7.5	94	2
8/22	10:00	4	0.0	13.5	7	91	2
	17:00	3	6.5	12	8	90	2
8/23	10:00	2	6.0	12	7	89	2

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Appendix A1.–Page 4 of 5.

Date	Time	Sky Conditions[a]	Precipitation (mm)	Temperature (°C) Air	Temperature (°C) Water	River Stage (cm)	Water Clarity[b]
	17:00	2	0.0	19	10	88	2
8/24	10:00	4	0.0	10	7.5	83	2
	17:00	3	0.0	14	9	82	2
8/25	10:00	5	0.0	6	8	78	1
	17:00	1	0.0	20	10	77	1
8/26	10:00	3	0.0	10	8	74	1
	17:00	4	0.0	16	9	73	1
8/27	10:00	4	1.0	11.5	8.5	70	1
	17:00	4	2.4	13	9.5	68	1
8/28	10:00	4	1.2	10	7.5	66	1
	17:00	4	0.0	12	8	68	1
8/29	10:00	4	0.2	8	7.5	65	1
	17:00	0					
8/30	10:00	3	2.5	10	7.5	62	1
	17:00	3	3.6	12	9.5	62	1
8/31	10:00	4	1.5	10	8	60	1
	17:00	3	0.4	15	9	60	1
9/1	10:00	4	0.0	8.5	8	59	1
	17:00	4	0.0	13	9	58	1
9/2	10:00	4	0.0	6	7.5	56	1
	17:00	4	1.0	10	8.5	56	1
9/3	10:00	4	7.5	8.5	7	55	1
	17:00	4	1.2	12	9	55	1
9/4	10:00	4	1.0	11	8	56	1
	17:00	4	0.6	15	9.5	60	1
9/5	10:00	4	0.3	10	8	60	1
	17:00	4	0.0	14	9	60	1
9/6	10:00	4	0.0	9	8	60	1
	17:00	4	0.5	13	9	60	1
9/7	10:00	3	4.3	12.5	8	60	2
	17:00	4	0.2	14	9	61	2
9/8	10:00	4	0.2	10	8	69	3
	17:00	4	0.5	12	9	70	3
9/9	10:00	4	3.0	8	8	72	3
	17:00	2	0.6	15	10	75	3
9/10	10:00	1	0.0	10	8	74	2
	17:00	1	0.0	20	10	74	2
9/11	10:00	2	0.0	12	8	73	2
	17:00	1	0.0	19	9	73	2
9/12	10:00	5	0.0	4	7	72	2
	17:00	1	0.0	19	10	71	2
9/13	10:00	5	0.0	2.5	7	69	2
	17:00	1	0.0	19	9.5	68	1
9/14	10:00	5	0.0	1.5	6	66	1
	17:00	1	0.0	18	8	66	1
9/15	10:00	5	0.0	3	6	65	1
	17:00	1	0.0	19	8.5	65	1

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Appendix A1.–Page 5 of 5.

Date	Time	Sky Conditions[a]	Precipitation (mm)	Temperature (°C) Air	Temperature (°C) Water	River Stage (cm)	Water Clarity[b]
9/16	10:00	5	0.0	2	6	63	1
	17:00	1	0.0	18	9	62	1
9/17	10:00	1	0	2	5.5	59	1
	17:00	1	0.0	18	8	59	1
9/18	10:00	5	0.0	1	5	57	1
	17:00	1	0.0	17	8	56	1
9/19	10:00	1	0.0	1	4.5	55	1
	17:00	1	0.0	18	9	54	1
9/20	10:00	1	0.0	-1	4	53	1
	17:00	1	0.0	15	7	52	1
9/21	10:00	1	0.0	1	4	50	1

[a] Sky condition codes:
0 = no observation
1 = < 1/10 cloud cover
2 = partly cloudy; < 1/2 cloud cover
3 = mostly cloudy; > 1/2 cloud cover
4 = complete overcast
5 = thick fog

[b] Water clarity codes:
1 = visibility greater than 1 meter
2 = visibility 0.5 to 1 meter
3 = visibility less than 0.5 meter

APPENDIX B: DAILY PASSAGE COUNTS BY SPECIES

Appendix B1.–Daily passage counts by species at George River weir, 2010.

Date	Chinook Salmon	Sockeye Salmon	Chum Salmon	Pink Salmon	Coho Salmon	Longnose Sucker	Whitefish	Other[a]
6/15	0	0	0	0	0	13	0	
6/16	0	0	0	0	0	1	0	
6/17	0	0	0	0	0	2	0	
6/18	0	0	0	0	0	14	0	1 AG
6/19	0	0	0	0	0	5	0	3 AG
6/20	0	0	0	0	0	57	0	10 AG
6/21	0	0	6	0	0	55	0	3 AG, 1 NP
6/22	0	0	1	0	0	39	0	
6/23	3	0	8	0	0	84	0	
6/24	2	0	73	0	0	195	0	
6/25	1	0	37	0	0	226	0	1 AG
6/26	4	0	81	0	0	78	0	
6/27	0	0	31	0	0	23	0	2 AG
6/28	0	0	37	0	0	7	0	
6/29	7	1	280	0	0	52	0	7 AG
6/30	8	0	562	0	0	35	0	
7/1	17	0	576	0	0	53	0	2 AG
7/2	36	0	457	0	0	62	0	2 AG
7/3	1	0	300	1	0	21	0	
7/4	55	0	424	0	0	7	0	1 AG
7/5	217	0	1,341	10	0	26	0	
7/6	106	0	623	3	0	30	0	
7/7	87	1	327	12	0	35	0	1 AG
7/8	49	0	936	25	0	80	0	2 AG
7/9	36	1	1,035	20	0	227	0	
7/10	78	0	755	21	0	185	0	4 AG
7/11	107	1	748	23	0	123	0	1 AG
7/12	21	1	1,007	20	0	92	0	
7/13	116	4	1,501	40	0	105	0	1 AG
7/14	28	4	859	42	0	86	1	1 AG
7/15	22	3	640	21	0	38	2	
7/16	47	8	1,198	34	0	102	0	
7/17	42	3	1,041	32	0	23	0	
7/18	28	5	990	50	0	13	0	
7/19	33	2	790	30	0	37	0	1 DV
7/20	52	0	600	25	0	5	0	
7/21	58	2	833	20	0	41	0	
7/22	21	6	591	21	0	29	0	
7/23	2	4	432	20	0	2	0	
7/24	31	3	482	37	0	3	0	1 AG
7/25	27	3	811	55	0	4	0	
7/26	24	2	615	65	1	0	0	1 DV
7/27	9	2	607	47	0	5	0	
7/28	27	3	498	57	0	3	0	
7/29	13	2	410	26	6	3	0	
7/30	5	2	522	21	6	10	0	
7/31	17	2	440	22	8	26	0	
8/1	12	4	375	13	11	12	0	
8/2	4	3	286	7	8	15	0	3 AG
8/3	11	4	282	12	15	33	0	
8/4	0	0	228	12	10	0	0	
8/5	1	5	155	4	12	3	0	
8/6	1	3	217	1	4	7	0	
8/7	5	1	153	2	18	0	0	
8/8	1	2	154	4	9	0	0	

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Appendix B1.–Page 2 of 2.

Date	Chinook Salmon	Sockeye Salmon	Chum Salmon	Pink Salmon	Coho Salmon	Longnose Sucker	Whitefish	Other[a]
8/9	2	4	91	2	52	1	0	
8/10	1	0	71	1	36	0	0	
8/11	5	2	111	0	49	0	0	
8/12	4	0	76	0	71	0	0	
8/13	3	2	67	0	139	1	0	
8/14	5	2	59	2	254	3	0	
8/15	2	0	35	0	189	1	0	
8/16	0	1	22	2	106	0	0	
8/17	2	0	42	0	235	0	0	
8/18 [b]	0	0	21	0	79	0	0	
8/19 [b]	0	0	6	0	34	0	0	
8/20 [b]	0	0	4	0	28	0	0	
8/21	0	2	13	0	154	0	0	
8/22	0	0	14	1	241	0	0	
8/23	0	0	19	0	379	0	0	
8/24	0	0	17	0	237	0	0	
8/25	0	0	8	0	455	0	0	
8/26	0	2	7	0	277	0	0	
8/27	0	1	4	2	349	0	0	
8/28	1	0	5	0	489	2	0	
8/29	0	1	4	0	461	2	0	
8/30	0	0	2	0	629	1	0	
8/31	0	2	3	0	964	3	0	
9/1	0	1	2	0	987	0	0	1 DV
9/2	0	3	4	0	463	1	0	
9/3	0	0	2	0	475	2	0	
9/4	0	1	7	0	941	0	0	
9/5	0	0	5	0	621	0	0	
9/6	0	0	2	0	406	0	1	
9/7	1	0	2	1	699	0	0	
9/8	0	1	2	0	478	0	0	
9/9	0	0	7	1	330	0	0	1 AG
9/10	0	0	4	0	254	0	0	
9/11	0	0	4	1	234	0	0	
9/12	0	0	4	0	136	0	0	
9/13	0	0	4	0	121	0	0	
9/14	0	0	3	0	87	0	0	
9/15	0	1	5	1	80	2	0	
9/16	0	0	3	0	69	1	0	
9/17	0	0	1	0	41	0	0	
9/18	0	0	0	0	27	0	0	
9/19	0	0	0	0	49	0	0	
9/20	0	0	0	0	37	0	0	
Totals	1,498	113	26,117	869	12,550	2,452	4	

[a] G= Arctic Grayling; P = Northern pike; D = Dolly Varden: count may not correspond to actual day observed.

[b] Incomplete or partial daily count.

APPENDIX C: DAILY CARCASS COUNTS

Appendix C1.–Daily carcass counts at George River weir, 2010.

	Chinook			Sockeye			Chum			Pink			Coho			Longnose	White-	
Date	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Sucker	fish	Other[a]
6/15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1 NP
6/16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
6/17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	
6/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
6/19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1 AG
6/20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6/21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3 AG
6/22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
6/23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	
6/24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1 NP
6/25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	
6/26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6/27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	5	1 NP
6/28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	
6/29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
6/30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7/1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	1 AG
7/2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4 AG
7/3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7/4	0	0	0	0	0	0	1	2	3	0	0	0	0	0	0	8	0	
7/5	0	0	0	0	0	0	1	3	4	0	0	0	0	0	0	8	0	
7/6	0	0	0	0	0	0	3	1	4	0	0	0	0	0	0	5	0	
7/7	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	3	0	
7/8	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	2	0	
7/9	0	0	0	0	0	0	2	2	4	0	0	0	0	0	0	4	1	1 NP
7/10	0	0	0	0	0	0	11	2	13	0	0	0	0	0	0	4	3	
7/11	2	0	2	0	0	0	7	3	10	0	0	0	0	0	0	9	2	
7/12	0	0	0	0	0	0	8	0	8	0	0	0	0	0	0	5	0	1 AG
7/13	0	0	0	0	0	0	17	4	21	0	0	0	0	0	0	17	1	
7/14	0	0	0	0	0	0	10	1	11	0	0	0	0	0	0	8	0	1 NP
7/15	0	0	0	0	0	0	9	1	10	0	0	0	0	0	0	3	0	
7/16	0	0	0	0	0	0	14	4	18	0	0	0	0	0	0	8	2	
7/17	0	0	0	0	0	0	17	9	26	2	0	2	0	0	0	16	0	
7/18	0	0	0	0	0	0	17	1	18	0	0	0	0	0	0	5	0	1 AG

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Appendix C1.–Page 2 of 3.

	Chinook			Sockeye			Chum			Pink			Coho			Longnose	White-	
Date	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Sucker	fish	Other[a]
7/19	0	0	0	0	0	0	19	13	32	3	0	3	0	0	0	11	0	
7/20	0	0	0	0	0	0	31	15	46	3	0	3	0	0	0	27	2	
7/21	0	0	0	0	0	0	28	9	37	3	2	5	0	0	0	18	3	
7/22	0	0	0	0	0	0	21	9	30	4	0	4	0	0	0	11	0	
7/23	0	0	0	0	0	0	21	14	35	8	3	11	0	0	0	4	1	1 AG
7/24	0	0	0	0	0	0	29	10	39	11	4	15	0	0	0	5	0	1 AG,2R
7/25	1	0	1	0	0	0	23	4	27	16	3	19	0	0	0	10	0	
7/26	1	1	2	0	0	0	38	16	54	28	1	29	0	0	0	2	0	2 AG
7/27	0	0	0	0	0	0	45	10	55	35	2	37	0	0	0	4	0	1 NP
7/28	1	0	1	0	0	0	41	13	54	32	1	33	0	0	0	8	0	
7/29	2	0	2	0	0	0	45	12	57	42	1	43	0	0	0	3	0	
7/30	0	0	0	0	0	0	29	14	43	13	8	21	0	0	0	4	0	
7/31	3	0	3	0	0	0	82	21	103	56	5	61	0	0	0	11	0	2 AG
8/1	1	0	1	0	0	0	59	10	69	48	4	52	0	0	0	5	0	
8/2	1	2	3	0	0	0	38	23	61	19	15	34	0	0	0	4	0	
8/3	2	1	3	0	0	0	37	16	53	26	7	33	0	0	0	6	1	
8/4	6	2	8	0	0	0	35	12	47	38	14	52	0	0	0	2	0	
8/5	6	3	9	0	0	0	47	15	62	23	7	30	0	0	0	4	0	
8/6	5	0	5	0	0	0	26	15	41	36	5	41	0	0	0	9	3	
8/7	18	3	21	0	0	0	53	18	71	36	18	54	0	0	0	8	2	
8/8	19	3	22	0	0	0	45	19	64	34	20	54	0	0	0	21	1	
8/9	13	1	14	0	0	0	50	20	70	28	12	40	0	0	0	16	0	
8/10	12	2	14	1	0	1	74	37	111	23	13	36	0	0	0	216	0	1 NP
8/11	9	10	19	0	0	0	63	25	88	19	17	36	0	0	0	191	0	2 AG
8/12	9	3	12	0	0	0	53	29	82	7	21	28	0	0	0	146	0	
8/13	2	5	7	0	0	0	54	23	77	8	5	13	0	0	0	114	0	
8/14	11	3	14	0	0	0	62	44	106	3	9	12	0	0	0	146	0	2 AG
8/15	2	1	3	0	0	0	24	11	35	0	4	4	0	0	0	93	1	
8/16	3	1	4	0	0	0	58	44	102	2	7	9	0	0	0	109	0	1 AG
8/17	11	3	14	0	0	0	57	37	94	3	13	16	0	0	0	158	1	1 AG
8/18 [b]	0	1	1	0	0	0	36	10	46	1	0	1	0	0	0	59	0	
8/19 [b]	2	0	2	0	0	0	10	13	23	0	1	1	0	0	0	25	0	
8/20 [b]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
8/21	0	0	0	0	0	0	8	3	11	0	0	0	0	0	0	54	0	

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Appendix C1.–Page 3 of 3.

Date	Chinook			Sockeye			Chum			Pink			Coho			Longnose	White-	
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Sucker	fish	Other[a]
8/22	0	2	2	0	0	0	4	1	5	0	0	0	0	0	0	0	0	
8/23	0	0	0	1	0	1	20	10	30	0	1	1	0	0	0	7	0	
8/24	0	0	0	0	0	0	0	3	3	0	0	0	0	0	0	4	0	
8/25	0	0	0	0	0	0	5	2	7	0	0	0	0	0	0	3	0	
8/26	0	0	0	0	0	0	4	0	4	0	0	0	0	0	0	2	0	
8/27	0	0	0	0	0	0	2	1	3	0	0	0	0	0	0	3	0	
8/28	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	
8/29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8/30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8/31	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	3	0	
9/1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9/2	1	0	1	1	0	1	2	1	3	0	0	0	0	0	0	0	2	
9/3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9/4	1	0	1	0	0	0	2	0	2	0	1	1	0	0	0	2	6	
9/5	0	0	0	1	0	1	1	0	1	0	0	0	0	0	0	2	1	
9/6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9/7	0	0	0	0	0	0	1	1	2	0	0	0	0	0	0	2	0	
9/8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9/9	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	13	0	
9/10	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	7	0	1 M
9/11	0	0	0	0	0	0	1	2	3	0	0	0	0	0	0	87	0	
9/12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	0	
9/13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	
9/14	0	0	0	0	0	0	0	1	1	0	1	1	0	0	0	4	0	
9/15	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	16	0	
9/16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9/17	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
9/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1 NP
9/19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9/20	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	
Totals	145	47	192	4	0	4	1502	646	2148	610	225	835	0	0	1	1832	39	

[a] B = Burbot; G = Arctic Grayling; P = Northern pike; D = Dolly Varden; M = Mink; R=Mice

[b] Partial daily count