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George River Salmon Studies, 2004

by

Robert Stewart,

Douglas B. Molyneaux,

and

David Orabutt

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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)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

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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By
Robert Stewart, Douglas B. Molyneaux,
Alaska Department of Fish and Game, Division of Commercial Fisheries, Anchorage
and
David Orabutt
Kuskokwim Native Association, Aniak

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1599

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Robert Stewart, Douglas B. Molyneaux,
Alaska Department of Fish and Game, Division of Commercial Fisheries,
333 Raspberry Road, Anchorage, AK 99518-1599, USA
and
David Orabutt
Kuskokwim Native Association, P.O. Box 127, Aniak, AK 99557

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ABSTRACT

The George River is a tributary of the Kuskokwim River, and produces Chinook salmon *Oncorhynchus tshawytscha*, chum salmon *O. keta*, and coho salmon *O. kisutch* that contribute to intensive subsistence and commercial salmon fisheries downstream of its confluence. The George River weir is one of several projects operated in the Kuskokwim Area that form an integrated geographic array of escapement monitoring projects. Collectively, and in accordance with the State of Alaska Sustainable Fishery Policy (5 AAC 39.222), this array of projects is a tool to assure appropriate geographic and temporal distribution of spawning salmon, and provide a means to assess trends in escapement that should be monitored and considered in harvest management decisions. Towards this end, George River weir has been operated annually since 1996 to determine daily and total salmon escapements for the target operational period of 15 June through 20 September; to estimate age, sex, and length compositions of Chinook, chum, and coho salmon escapement; to monitor environmental variables that influence salmon productivity; and to provide part of an integrated platform in support of other Kuskokwim Area fisheries projects.

In 2004, a resistance board weir was operated on the George River from 27 June through 24 September. Escapements for the target operational period were estimated as 5,207 Chinook, 14,409 chum, and 12,499 coho salmon. Escapement goals have not been set for the George River.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, chum salmon, *O. keta*, coho salmon, *O. kisutch*, longnose suckers, *Catostomus catostomus*, escapement, age, sex, and length composition, George River, Kuskokwim River, resistance board weir, radiotelemetry, mark–recapture, genetic stock identification, stock specific run timing.

INTRODUCTION

George River is located in the middle Kuskokwim River basin (Figure 1) and provides spawning and rearing habitat for Chinook salmon *Oncorhynchus tshawytscha*, chum salmon *O. keta*, and coho salmon *O. kisutch* which contribute to subsistence, commercial, and sport fisheries of the Kuskokwim River (ADF&G 1998). Small numbers of sockeye salmon *O. nerka* and pink salmon *O. gorbuscha* also migrate into the river. The average annual Kuskokwim River subsistence harvest downstream of George River includes 75,169 Chinook salmon, 57,431 chum salmon, 34,288 sockeye salmon, and 26,867 coho salmon (Ward et al. 2003). The Kuskokwim River supports one of the largest subsistence salmon fisheries in the world, and for many local residents subsistence fishing is a fundamental component of their culture (Coffing 1991, *Unpublished* a, *Unpublished* b; Coffing et al. 2000). Lower Kuskokwim River supports commercial fisheries that average an annual harvest of 14,312 Chinook salmon, 173,353 chum salmon, 39,905 sockeye salmon, and 422,961 coho salmon (Ward et al. 2003). These commercial fisheries are important to the market economy of Lower Kuskokwim River communities (Buklis 1999; Ward et al. 2003). George River salmon production contributes to Kuskokwim River salmon harvests in terms of numbers of fish, and by adding to the diversity of salmon spawning populations supporting these fisheries.

Historically, the northern region of the Kuskokwim Mountains, including the George River drainage, supported a relatively high level of mining activity. Since the early 1900s, several small to moderate size mining camps operated intermittently in the middle and upper George River drainage (Brown 1983). A small tributary of George River named Julian Creek received intermittent mining activity since the early 1900s, and this activity continues at a recreational level today. Mining interest in the northern region of the Kuskokwim Mountains expanded in recent years with proposed large-scale open-pit gold mining operations at Donlin Creek in the Crooked Creek drainage, which borders the George River drainage. Development of Donlin Creek mine heightens interest and need for continued monitoring of George River salmon populations. Impacts of this proposed mine will likely include increased recreational and subsistence activities in the George River area because of a resulting increase in human population associated with development of Donlin Creek mine.

George River is popular for sport fishing, and the river is an access route for recreational and subsistence hunters. Professional guide operations based within and outside of the Kuskokwim Area use George River as an angling and hunting destination for their clients. In 2000, George River received some of the highest Chinook salmon sport fishing angler effort in the Middle Kuskokwim River area (Burr 2002). Escapement monitoring will help ensure continued wise management practices to provide sustainable harvest opportunity for these various user groups.

The George River weir project is operated cooperatively by the Alaska Department of Fish and Game (ADF&G) and the Kuskokwim Native Association (KNA). Oversight of field operations is shared between KNA and ADF&G. Both organizations make use of weir data during inseason salmon management deliberations. Generally, ADF&G takes the lead in data management, data analysis, and reporting; and KNA takes the lead in field operations. George River weir has developed into a useful tool for salmon management, and serves as a vital platform for collecting data used by other Kuskokwim area salmon projects. Part of the mission of this project is to promote local involvement and to develop the capacity of KNA to engage effectively in salmon resource management. The project's crew consisted of two locally hired KNA technicians and one ADF&G technician. The project annually hosts several student interns from surrounding communities for a "hands-on" work experience at the weir.

OBJECTIVES

The objectives of this project were to:

1. Determine daily and total escapements of Chinook, chum, and coho salmon to George River from 15 June through 20 September.
2. Estimate the age, sex, and length (ASL) composition of total Chinook, chum and coho salmon escapements to George River from a minimum of 3 pulse samples, one collected from each third of the run, such that simultaneous 95% confidence intervals of age composition in each pulse (Chinook and chum) or over the entire run (coho) are no wider than 0.20 ($\alpha = 0.05$ and $d = 0.10$).
3. Monitor habitat variables including daily water temperature and daily water level.
4. Recover tag numbers and associated information from chum and coho salmon in support of a tagging study being conducted on the mainstem Kuskokwim River.
5. Serve as a monitoring site for Chinook salmon equipped with radio transmitters deployed as part of a radiotelemetry study being conducted in the mainstem Kuskokwim River.
6. Participate in the collection of salmon tissue samples for genetic analysis and stock identification.
7. Participate in the collection of chum salmon morphology data in support of a study of fall chum salmon in the Kuskokwim River drainage.

BACKGROUND

The Kuskokwim River drains an area of approximately 50,000 mi², 11% of the total area of Alaska (Brown 1983) (Figure 1). Each year mature Pacific salmon return to the river and support intensive subsistence and commercial fisheries. Historically, 179 Kuskokwim Area tributaries were intermittently surveyed for spawning salmon through the use of small fixed-wing aircraft or ground-based assessment techniques (Brannian et al. 2005; Gilk and Molyneaux 2004; Ward et al. 2003). Biologists from ADF&G conducted sporadic aerial surveys to document salmon escapements in George River since 1960 (Appendix A1) (Burkey and Salomone 1999; Schneiderhan *Unpublished*). Aerial surveys were typically flown in late July when Chinook salmon are believed to be at their peak spawning abundance. Aerial surveys provide an index of escapement abundance and their utility for indexing chum and coho salmon escapements is not reliable under conditions found in the Kuskokwim River basin (Ward et al. 2003).

The only long-term ground-based escapement monitoring projects in the Kuskokwim River basin began in the Kogrukluk River in 1976 (Shelden et al. 2004) and in the Aniak River in 1980 (McEwen 2005). These tributaries constitute a modest fraction of the total Kuskokwim River basin, and are incomplete in their representation of the diversity of salmon populations that contribute to harvests. In addition, the pattern of chum salmon ASL composition observed in Kogrukluk River has been shown to be an anomaly (DuBois and Molyneaux 2000), and passage estimates generated by the Aniak River sonar project are not explicitly apportioned to species. Other escapement monitoring projects were developed within the Kuskokwim River basin, but these initiatives were short-lived (Ward et al. 2003). Inception of the George River weir in 1996, coupled with other initiatives begun in the late 1990s and beyond (Chythlook and Evenson 2003; Gilk and Molyneaux 2004; Kerkvliet et al. 2003; Stuby 2003), provides some of the additional escapement monitoring and abundance estimates required for sustainable salmon management (Holmes and Burkett 1996; Mundy 1998).

The goal of salmon management is to provide for sustainable long-term fisheries, and is achieved in part by ensuring adequate numbers of salmon escape the fisheries to spawn each year. Since 1960, ADF&G has been responsible for management of Kuskokwim River subsistence, commercial, and sport fisheries. Management authority for the subsistence fishery was broadened in October 1999 to include the federal government under Title VIII of Alaska National Interest Lands Conservation Act (ANILCA). U.S. Fish and Wildlife Service (USFWS) is the federal agency most involved in the Kuskokwim Area. In addition, Tribal groups such as Kuskokwim Native Association (KNA) are charged by their constituency to actively promote a healthy and sustainable subsistence salmon fishery. These 3 groups combined their resources to develop several new projects, including George River weir, to better achieve their common goal of providing for sustainable long-term salmon fisheries in the Kuskokwim River.

Sustainable salmon fisheries require more than just adequate escapement numbers. Escapement projects, such as George River weir, commonly serve as platforms for collecting other types of information useful for management and research. ASL compositions of salmon populations provide insight into fluctuations in salmon abundance, and they are used for developing spawner-recruit relationships used in formulating escapement goals (DuBois and Molyneaux 2000). Collection of ASL data is typically included in most escapement monitoring projects (Estensen 2002; Roettiger et al. 2004; Shelden et al. 2004; Zabkar et al. 2004). Water temperature, water chemistry and stream discharge (level) are fundamental variables of the stream environment that directly and indirectly influence salmon productivity and timing of salmon migrations (Hauer and Hill 1996; Kruse 1998; Quinn 2005) and these variables can be affected by human activities such as mining, timber harvesting, or man-made impoundments (NRC 1996), or climatic changes (e.g., El Nino and La Nina events). In addition George River weir, along with other Kuskokwim River escapement projects, serves as a vital platform for collecting information used by other projects. The *Kuskokwim River Chinook Salmon Stock Assessment Project* (Stuby 2003) is critically dependent on data collected from George River weir to generate total river abundance estimates. The *Kuskokwim River Salmon Mark–Recapture Project* (Kerkvliet et al. 2003) uses weir-recaptured spaghetti tagged chum, sockeye, and coho salmon to develop and test total river abundance estimates, and these recaptures are critical for determining stock-specific run timing in the mainstem Kuskokwim River. The project was also employed this season to collect morphology data in support of a study on fall chum salmon in the Kuskokwim River drainage (Gilk et al. 2005). The operational plan for George River weir included collecting ASL, habitat, and mark–recapture data that contributed towards long-term information needs. Additionally, George River weir has served as collection site for genetic and juvenile salmon information, and will continue to do so in the future.

METHODS

A resistance board weir was installed at the project site during the 2004 field season, and a complete census of fish migrating upstream was conducted for each day the weir was operational. A live trap was incorporated into the weir to collect ASL, genetic, and morphology data, and to recover tag information from live fish. A "target operational period", spanning most of the salmon runs, was observed to provide for consistent comparisons of escapements among years. The target operational period for George River weir has been established as 15 June through 20 September. Passage estimates for days the weir was inoperable during this period, were conducted for Chinook, chum, and coho salmon, if adequate data existed to support them. Inoperable periods may have resulted from a breach in the weir, a delayed start date, or a premature end date.

STUDY SITE

George River originates in the northern Kuskokwim Mountains within the middle Kuskokwim River basin and flows south for approximately 75 mi to its confluence with the Kuskokwim River at river mile (rm) 277 (river kilometer (rkm) 446; Figure 2). George River drains an area of approximately 1,400 mi² 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.

A weir has been used to enumerate salmon escapements in George River since 1996 (Linderman et al. 2003). The weir site is located at N61° 55.4' Latitude and W157° 41.9' Longitude, approximately 4 rm (7 rkm) up the George River from its confluence with the Kuskokwim River (Figure 1). The site is situated along a section of river that flows straight SSE for about .5 mi. Profile of the 360-ft channel is uniform, and the central 300-ft measures approximately 3 ft in depth during average water levels. The substrate is composed mostly of gravel, with some sand and coble. Discharge measurements taken at the site over the years have ranged between 561 ft^3/s and 4,509 ft^3/s, with velocities reaching 2.0 ft/s and 4.3 ft/s respectively in the thalweg. The original fixed weir design was replaced in 1999 with a resistance-board weir.

Georgetown is the nearest settlement located on the mainstem of the Kuskokwim River approximately .5 mi upstream from the George River confluence. Georgetown is currently the homestead of the Vanderpool family. Historically, the formal community of Georgetown was an early 1900s mining settlement of approximately 200 residents until a fire destroyed most of the town in 1911 (Brown 1983).

WEIR DESIGN AND INSTALLATION

The weir consisted of two principal components: the resistance-board panels, which formed the face of the weir; and the substrate rail, which anchored the panels to the stream bed. The design is described in detail in Tobin (1994) with panel modifications described in Stewart (2002).

Installation of the weir followed the techniques described in Stewart (2003), using drysuits and snorkel gear to improve wading capability and complete underwater tasks. The weir was installed across the entire 360-ft channel. The substrate rail and resistance board panels covered the middle 340-ft portion of the channel, and fixed weir materials extended the weir 10 ft to each bank.

The substrate rail consisted of 10 ft sections of steel angle that were bolted end to end across the channel. Each rail section was attached to the stream bed with 6 rebar stakes, and secured to a duckbill anchor approximately 15 ft upstream. A polyethylene mesh apron extended from the rail 4 ft downstream to prevent scouring from turbulence behind the rail.

Each resistance board panel consisted of a 3 ft wide framework of 20 ft tubular plastic pickets sealed for positive buoyancy. The 1-5/16 in (3.33 cm) diameter pickets were spaced at 2-5/8 in (6.67 cm) intervals, leaving a 1-5/16 in (3.33 cm) gap between each picket. One end of each panel was attached to the substrate rail and the other end floated 20 ft downstream. A plywood resistance-board mounted on the underside of each panel near its distal end was set to an inclined position causing the stream flow beneath to lift the distal end above the stream surface. Linked side by side the panels formed an array of pickets across the channel through which only small resident species and juvenile fish were able to pass. During flood conditions, panels would be forced below the water's surface, allowing debris to pass unobstructed over the weir.

Vertical bulkheads were attached to each end of the weir. These were mated to the banks with fixed weir materials, consisting of ridged metal pickets supported by wooden tripods and metal stringers, to bridge the irregular profile. Sand bags were used to fill any gaps along the banks or beneath the rail.

A live trap and skiff gate were installed within the deeper portion of the channel. The live trap was also 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 samples. It consisted of a welded aluminum frame 5 ft wide, 8 ft long, and 4 ft tall. The frame was place immediately in front of the substrate rail and leveled with sand bags. Gates were installed on the upstream and downstream ends and 5 ft long tubular steel pickets were inserted vertically around the remaining perimeter of the trap. The resulting picket spacing was the same as the weir panels. A 3 ft wide passage was led into the trap by removing a single weir panel, installing a pair of vertical bulkheads along either side of the opening, and mating them to the rear of the trap. A single weir panel was removed from behind the trap and vertical bulkheads were installed along either side of the opening to create a 3 ft wide passage into the trap. A sturdy walkway was placed around the top perimeter of the trap to allow crew to observe passage from either gate.

The skiff gate consisted of 3 specially modified weir panels that allowed boats to travel over them. The resistance boards on the skiff gate panels were left unset so the distal ends of the panels laid flat on the water’s surface. Weight of a passing boat submerged these panels, allowing boats to pass over the weir with little or no involvement by the weir crew. Modifications included scuff plates at the distal end of the panels to protect them from contact with boats, and special attachments at the base of each panel to prevent them from unhooking from the substrate rail by the force of boats traveling upstream.

The live trap was used as the primary means of upstream fish passage so crew members could capture and recover information from fish tagged in the mainstem Kuskokwim River. A Plexiglas viewing window was placed on the stream surface to improve visual identification of fish entering the trap. This allowed passage counts to be conducted from the downstream entrance of the trap, and enabled crew members to capture tagged fish once they entered the trap.

A secondary passage gate could be employed if fish were discouraged from entering the live trap. Using the trap as a counting platform, a connecting picket would be removed between 2 nearby panels. By folding the panels to stand on edge, an opening 6 ft wide would be created. A rigid aluminum weir panel would be lashed to the upstream ends of the panels to serve as an easily removable gate. When removed for counting the gate would be placed on the river bottom, in front of the opening, to act as a flash panel for the identification of passing fish.

Alternatively, a weir panel could be removed from anywhere along the weir, and a crew member could wade next to the opening to conduct a passage count.

WEIR OPERATION

Monitoring Upstream 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 1 hour, or until passage waned. Crew members recorded fish passage 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.

Facilitating Downstream Passage

In late summer several resident species, especially longnose suckers *Catostomus catostomus*, typically migrate downstream past the weir site. To accommodate this migration, downstream passage chutes were incorporated into the weir once resident species were observed congregating just upstream. These chutes were created by simply releasing the resistance boards on one or two adjacent weir panels so the distal ends dipped slightly below the stream surface. Several downstream passage chutes were created along the weir in locations where downstream migrants were most concentrated. The shallow profile of these chutes prevented salmon migrating upstream from finding them. Each chute was monitored and adjusted to ensure salmon were not passing upstream over it, and resident species could pass downstream effectively. Downstream passage was not enumerated, however few salmon have typically been observed passing downstream over these chutes, and these numbers are not considered significant.

Cleaning and Maintenance

The weir was cleaned several times each day, typically at the beginning and end of counting shifts. A technician walked across the weir to partially submerge each panel, thereby allowing the current to wash any debris downstream. A rake was used to push larger debris loads off the weir. Spawned out salmon and carcasses of dead salmon (both hereafter referred to as carcasses) that washed up on the weir, were counted by species and sex, and passed downstream. Daily and cumulative carcass counts were copied to logbook forms. Each time the weir was cleaned, a visual inspection was made of weir panels, substrate rail, fish trap, and fixed weir sections to ensure no breaches would allow fish to pass upstream unobserved. If conditions prevented an adequate visual inspection, technicians used snorkel gear to ensure there were no breaches in the weir.

ESCAPEMENT DETERMINATIONS

The target operational period for the George River weir is 15 June through 20 September, although actual operational periods may vary. In years when the operational period falls short of the target operational period, estimates of daily salmon passage are made for missed days in order to provide consistent comparisons of escapements among years. Daily and total escapements consisted of the observed passage plus any estimated passage for Chinook, chum, and coho salmon during the target operational period. Counts of all other species were reported simply as observed passage. The term "total annual escapement" is used to describe escapements for the target operation period 15 June through 20 September.

Passage Estimates

Upstream salmon passage was estimated for days the weir was inoperable. Estimates were assumed to be zero if passage was considered negligible based on historical data and run timing indicators. Otherwise, estimates for a single day were calculated as the average observed passage 1 or 2 days before and after the inoperable day, minus any observed passage from the inoperable day. Daily estimates for inoperable periods lasting 2 or more days were derived by one of several methods, depending on the situation.

A "linear method" has commonly been used to extrapolate daily estimates from average observed passage 2 days before an inoperable period to average observed passage 2 days after the inoperable period. This method resulted in a linear increase or decrease in daily estimates over the duration of the inoperable period. Daily estimates from this method were calculated using the formula:

$$\hat{n}_{d_i} = \alpha + \beta \cdot i \qquad (1)$$

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

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

for (d_1, 2, …, d_i, …d_I)

where:

$\hat{n}_{d_i}$ = passage estimate for the i^{th} day of the period (d_1, 2, …, d_i, …d_I) when the weir was inoperative;

n_{d_I+1} = observed passage of the first day after the weir was reinstalled;

n_{d_I+2} = observed passage of the second day after the weir was reinstalled;

n_{d_1-1} = observed passage of the day before the weir was washed out;

n_{d_1-2} = observed passage of the second day before the weir was washed out and;

I = the number of inoperative days.

A "proportion method" was used if evidence supporting similar fish passage characteristics existed between estimated and model data sets. A model data set could be from a different year at George River, or from the same year at a neighboring project. In either case, daily passage was based on a model data set's daily passage proportions, and was calculated using the formula:

$$n_{d_i} = \left(\frac{\left(n_{2d_i} \times n_{1t_1} \right)}{n_{2t_1}} \right) - n_{o_i} \tag{2}$$

where:

n_{d_i} = passage estimate for a given day (i) of the inoperable period;

n_{2d_i} = average passage for the i^{th}-1, $i^{th,}$, and i^{th} +1 day in the model data set 2;

n_{1t_1} = known cumulative passage for the operational time period (t_1) from the estimated data set 1;

n_{2t_1} = known cumulative passage for the corresponding time period (t_1) from the model data set 2 and;

n_{o_i} = observed passage (if any) from the given day (i) being estimated.

AGE, SEX, AND LENGTH COMPOSITION OF ESCAPEMENT

The ASL composition of the total Chinook, chum, and coho salmon escapements were estimated by sampling a fraction of the fish passage and applying the ASL composition of those samples to the total escapement as described in DuBois and Molyneaux (2000).

Sample Collection

A pulse sampling design was used for Chinook and chum salmon, in which intensive sampling was conducted for 1 to 3 days followed by a few days without sampling. The goal for each pulse was to collect samples from 210 Chinook salmon and 200 chum salmon. These sample sizes were selected for simultaneous 95% confidence interval estimates of age composition proportions no wider than 0.20 (Bromaghin 1993). The minimum number of pulse samples was one per species from each third of the run.

The coho salmon sample design was modified from previous years to account for stability in ASL compositions over the duration of the coho salmon run. Pulse sample goals were replaced with a total run sample goal of 170 fish in 2003. The total run sample goal was divided between 3 pulse samples, each representing a third of the run.

Salmon were sampled from the fish trap installed in the weir. The general practice was to open the entrance gate and leave the exit gate closed, which allowed fish to accumulate inside the holding pen. The holding pen was typically allowed to fill with fish and sampling was done during scheduled counting periods.

Scales were removed from the preferred area of the fish (INPFC 1963). A minimum of 3 scales were taken from each fish and mounted on numbered and labeled gum cards. Sex was determined by visually examining external morphology, keying on the development of the kype, roundness of the belly and the presence or absence of an ovipositor. Length was measured to the nearest millimeter from mideye to tail fork. After each fish was sampled, it was released into a recovery area upstream of the weir. After sampling was completed, relevant information such as sex, length, date, and location was copied from hardcopy forms to computer mark-sense forms. Further details of sampling procedures can be found in DuBois and Molyneaux (2000) and Linderman et al. (2003). The completed gum cards and data forms were sent to the Bethel and Anchorage ADF&G offices for processing.

Weir crews conducted active sampling on Chinook salmon to increase Chinook salmon sample sizes. Active sampling consisted of capturing and sampling Chinook salmon while actively passing and enumerating fish. Further details of active sampling procedures are described in Linderman et al. (2002).

Estimating Age, Sex, and Length Composition of Escapement

ADF&G staff in Bethel and Anchorage aged scales, processed the ASL data, and generated data summaries (DuBois and Molyneaux 2000). These procedures generated 2 types of summary tables for each species; one described the age and sex composition and the other described length statistics. These summaries account for ASL composition changes over the season by first partitioning the season into temporal strata based on pulse sample dates, applying ASL composition of individual pulse samples to the corresponding temporal strata, and finally summing the strata to generate the estimated ASL composition for the season. This procedure ensured ASL composition of the total escapement was weighted by fish abundance in the escapement rather than fish abundance in the samples. Likewise, estimated mean length composition of total escapement was calculated by weighting sample mean lengths from each stratum by the escapement of chum salmon past the weir during that stratum. Similar procedures were used for coho salmon, however, sample design modifications implemented in 2003 reduced the ability to estimate ASL composition changes over the season in favor of estimating ASL composition for the entire run.

Ages were reported in tables using European notation, with total age reported in parenthesis. European notation is composed of 2 numerals separated by a decimal, where the first numeral indicates the number of winters spent by the juvenile fish in fresh water and the second numeral indicates the number of winters spent in the ocean (Groot and Margolis 1991). Total age is equal to the sum of these 2 numerals, plus one to account for the winter when the egg was incubating in the gravel. For example, a Chinook salmon described as an age-1.4 fish under European notation has a total age of 6 years.

The original ASL gum cards, acetates and mark-sense forms were archived at the ADF&G office in Anchorage. The computer files were archived by ADF&G in the Anchorage and Bethel offices.

HABITAT MONITORING

Daily weather and stream observations were taken in the morning and usually again in the late afternoon to monitor habitat variables. Air and water temperatures were measured using a thermometer calibrated in °C. Stream temperature was determined by submerging the thermometer 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 the logbook, along with notations about cloud cover, wind direction and speed, and precipitation. Wind speed was estimated in miles per hour, and daily precipitation was measured using a rain gauge calibrated in millimeters.

Water level observations represented the stream height in centimeters above an arbitrary datum plane. Water levels were measured using a staff gage secured to a stake driven into the river bottom near the bank just downstream from the weir. The arbitrary datum plane was pegged to semi-permanent benchmarks intended to allow for consistency of measurements among years (Appendix B1). Benchmarks consisted of steel pipe sections driven into the bank. These were driven nearly flush with the gravel to protect them from ice flows during break-up.

CHINOOK SALMON RADIOTELEMETRY

George River weir served as a monitoring site for radiotagged Chinook salmon in 2004 as part of a mark–recapture project in the Kuskokwim River. This study was designed to incorporate escapement data from various projects including George River weir, to estimate run abundance of Chinook salmon in the Kuskokwim River drainage above Kalskag. Methods for this project are presented in Stuby (2005). The primary role of George River weir was to provide Chinook salmon escapement and ASL data for this project. The weir crew made no attempt to capture radiotagged Chinook salmon as these fish were monitored by a radio-tracking station located at the weir site.

CHUM AND COHO SALMON TAG RECOVERY

George River weir served as a tag-recovery site in support of the Kuskokwim River tagging project. This project was designed to estimate coho salmon abundance and identify stock specific run timing of sockeye, chum, and coho salmon past the tagging site in the mainstem Kuskokwim River near Aniak (Figure 1). Tagged fish were captured as they passed through the live trap, and tag numbers were recovered and recorded along with the date, tag color, species, and presence of an adipose clip used as a secondary mark. Any tags not recovered were recorded along with date, color, and species. All salmon sampled for ASL were examined for a second mark to determine tag loss.

GENETIC SAMPLE COLLECTION

Crew members collected fin clips from 100 coho salmon at George River weir for genetic analysis by the USFWS as part of *Genetic Variation Among Coho Salmon Populations from the Kuskokwim River Region and Application to Stock-Specific Harvest Estimation* (Crane et al. *In prep*). Genetic samples were gathered during each of 3 ASL sampling pulses to better approximate the genetic composition of George River coho salmon. The collection of tissue samples was done concurrently with standard ASL techniques. A thumbnail-sized piece of caudal fin was removed, blotted dry, and placed in a vial of isopropyl alcohol. Strict care was taken to prevent contamination. Vials were numbered, and the corresponding sex, location, and sampling date were recorded. The tissue samples were sent to the USFWS genetics laboratory in Anchorage for analysis.

CHUM SALMON MORPHOLOGY

The weir crew collected body measurements and fecundity samples from chum salmon at the George River weir as part of a fall chum study in the Kuskokwim River. George River chum salmon were chosen as representative of summer chum salmon in the Kuskokwim River for comparison to the genetically distinct fall chum salmon. Maximum dorsal to ventral height and maximum depth was measured in millimeters with calipers, for all ASL sampled chum salmon during a minimum of 3 pulse samples distributed over the run. Whole egg skein pairs were collected from 5 individuals in each ASL pulse sample, placed in ethyl alcohol containers, and labeled with identifying information. Detailed methods of the fall chum study are reported in Gilk et al. (2005).

RESULTS

OPERATIONS

High water levels delayed the installation of the weir in 2004. The weir was installed as river levels receded between 17 and 26 June, and operated continuously from 0000 hours on 27 June through 2400 hours on 24 September in 2004, 4 days beyond the target operational period.

FISH PASSAGE AND ESCAPEMENT

Chinook Salmon

A total escapement of 5,207 Chinook salmon was estimated for the operational period in 2004 (Table 1). This estimate consisted of an observed passage of 5,108 fish from 27 June through 20 September, and an estimated passage of 99 fish from 15 June through 26 June. Daily passage was estimated for the 15 June through 26 June inoperable period using the "proportional method". Daily passage of Chinook salmon at the Tatlawiksuk River weir trended with (Figure 3) and was highly correlated to (Figure 4) counts at the George River and was chosen as the model data set. The Tatlawiksuk data set was shifted 2 days back to represent travel time differences and resulted in the highest correlation with George River data.

The first Chinook salmon was observed on 27 June, the first day of operation, and the last Chinook salmon was observed on 7 September. Based on the operational period and inclusive of estimated passage, the median passage date was 6 July and the central 50% of the run occurred between 2 and 12 July.

Chum Salmon

A total escapement of 14,409 chum salmon was estimated for the operational period in 2004 (Table 1). This estimate consisted of an observed passage of 13,056 fish from 27 June through 20 September, and an estimated passage of 1,353 fish from 15 June through 26 June. Daily passage was estimated for the 15 June through 26 June inoperable period using the "proportional method". Daily passage of chum salmon at the George River weir in 2000 trended with (Figure 5) and was correlated to (Figure 6) counts at the George River in 2004 and was chosen as the model data set. The 2000 George River data set was shifted forward 5 days to account for differences in run timing between the 2 years.

The first chum salmon was observed on 27 July, the first day of operation, and the last chum salmon was observed on 24 September, 4 days after the Target operational period. Based on the operational period and inclusive of estimated passage, the median passage date was 7 July and the central 50% of the run occurred between 30 June and 18 July.

Coho Salmon

A total escapement of 12,499 coho salmon was observed for the operational period in 2004 (Table 1). No coho salmon were estimated for the period 15 June through 27 June that the weir was inoperable.

The first coho salmon was observed on 21 July. Coho salmon were still passing upstream in small numbers before the weir was dismantled on 25 September. Based on the operational period and inclusive of estimated passage, the median passage date was 31 August and the central 50% of the run occurred between 21 August and 6 September.

Other Species

Passage through the weir in 2004 also included 177 sockeye salmon, 37 pink salmon, 5,022 longnose sucker, 83 Arctic grayling *Thymallus arcticus*, and 59 whitefish (Appendix C1). No estimates of unobserved passage were made for these species.

Carcass Counts

Carcass counts in 2004 included 157 Chinook salmon, 1,248 chum salmon, and 42 coho salmon during the target operational period (Appendix D1–D3). The percentage of carcasses to escapement was 3.0% for Chinook salmon and 8.7% for chum salmon.

AGE, SEX, AND LENGTH COMPOSITION

Samples were collected from 339 Chinook, 994 chum, and 220 coho salmon to determine ASL composition of escapements in 2004.

Chinook Salmon

Age, sex, and length were determined for 269 Chinook salmon, or 5.2% of the total escapement (Table 2). The run was partitioned into 4 temporal strata based on the distribution of sample dates. Sample sizes ranged from 68 to 80 fish per stratum. As applied to the total annual Chinook escapement, age 1.4 was the most abundant age class (49.6%), followed by age 1.2 (25.9%), and age 1.3 (21.2%). Female Chinook salmon composed 37.7% of the total escapement. Age-1.4 Chinook salmon were the dominant age class in each of the 4 temporal strata this season, increasing from 30.9% in the earliest stratum to 66.7% in the latest. Age-1.2 fish decreased from 42.6% in the earliest stratum to 9.5% in the latest. Age-1.3 fish remained fairly constant at 23.5%, 20.3%, 17.5%, and 21.4% from earliest to latest stratum.

Male Chinook salmon ranged in length from 481 to 694 mm at age 1.2, 555 to 860 mm at age 1.3, and 737 to 960 mm at age 1.4, with mean lengths of 599, 707, and 845 mm respectively. Female Chinook salmon ranged in length from 725 to 872 mm at age 1.3, and 760 to 951 mm at age 1.4, with mean lengths of 780 and 840 mm respectively (Table 3).

Chum Salmon

Age, sex, and length were determined for 923 chum salmon, or 6.4% of the total escapement (Table 4). The run was partitioned into 5 temporal strata based on the distribution of sample dates. Sample sizes ranged from 130 to 205 fish per stratum. As applied to the total chum escapement, age 0.4 was the most abundant age class (52.0%), followed by age 0.3 (38.6%), and age 0.2 (9.2%). Age-0.4 fish was the dominant age class during most of the run, decreasing as a proportion of escapement as the run progressed. The proportion of age-0.2 fish increased late in the run. Female chum salmon composed 47.9% of the total escapement.

Male chum salmon ranged in length from 460 to 590 mm at age 0.2, 428 to 672 mm at age 0.3, and 479 to 689 mm at age 0.4, with mean lengths of 527, 574, and 586 mm respectively. Female chum salmon ranged in length from 442 to 569 mm at age 0.2, 400 to 625 mm at age 0.3, and 466 to 630 mm at age 0.4, with mean lengths of 502, 536, and 545 mm respectively (Table 5).

Coho Salmon

Age, sex, and length were determined for 191 coho salmon, or 1.5% of the total escapement (Table 6). The run was partitioned into 3 temporal strata based on the distribution of sample dates. Sample sizes ranged from 59 to 66 fish per stratum. As applied to the total coho escapement, age 2.1 was the most abundant age class (89.8%), followed by age 3.1 (8.9%), and age 1.1 (1.3%). Female coho salmon composed 36.6% of the total escapement.

Male coho salmon ranged in length from 396 to 660 mm at age 2.1 and 481 to 575 mm at age 3.1, with mean lengths of 534 mm in both age classes. Female coho salmon ranged in length from 447 to 599 mm at age 2.1, and 482 to 585 mm at age 3.1, with mean lengths of 548, and 527 mm respectively (Table 7).

HABITAT VARIABLES

A total of 207 complete observations of weather and stream conditions were recorded between 11 June and 25 September during the 2004 field season (Appendix E1). Stream temperatures ranged from 3.0°C to 20°C, air temperatures ranged from -4°C to 29°C, and stream height measurements ranged from 30 to 83 cm, during the target operational period 15 June through 20 September.

CHINOOK SALMON RADIOTELEMETRY

Results for the Chinook salmon radiotelemetry study are reported in Stuby (2005). Nine radiotagged Chinook salmon were detected at the weir site by a receiving station, and later by aerial telemetry upstream of the weir. Travel time to the weir site averaged 9.7 days, and ranged between 6 and 15 days. One Chinook salmon entered George River and was detected by the receiver station near the weir 6 August, lingered near the weir until 15 August, but did not pass through the weir. This tagged fish was later detected by aerial survey below the weir near the mouth and is considered a George River Chinook salmon.

CHUM AND COHO SALMON TAG RECOVERY

Results for the sockeye, chum, and coho salmon tagging study will be reported in Pawluk et al. (*In prep*). Tag numbers were recorded at George River weir for 58 of 62 tagged chum salmon detected, and 5 of 21 tagged coho salmon detected. No secondary tag marks were found among 994 chum salmon and 220 coho salmon examined without tags. Of the 177 sockeye salmon counted past George River weir in 2004, 14 had tags and 13 tags were recovered. Sockeye salmon were not examined for secondary marks.

GENETIC SAMPLE COLLECTION

Fin clip samples were collected from 100 coho salmon for genetic analysis of population structure and genetic stock identification in Anchorage. Results of this study will be reported in Crane et al. (*In prep*).

CHUM SALMON MORPHOLOGY

A total of 992 sets of morphology measurements were collected during 6 pulse samples, and egg skeins were collected from 5 chum salmon in each of 4 pulse samples. Results of the fall chum salmon study will be published in Gilk et al. (2005).

DISCUSSION

OPERATIONS

Although all project objectives were achieved in 2004, installation of the weir was delayed 12 days by high river levels. Moderate and low river levels resulted in successful operation of the weir during the remainder of the target operational period, 15 June through 20 September.

FISH PASSAGE AND ESCAPEMENT

Chinook Salmon

Chinook salmon escapement in 2004 of 5,207 fish was intermediate to the higher escapements seen in 1996 and 1997 and the lower escapements seen in 2000 and 2002 (Figure 7). Chinook salmon escapements have increased annually over the last 3 years, following a trend seen in most other Kuskokwim River tributaries (Figure 8).

Currently, no escapement goal exists for George River Chinook salmon to serve as a benchmark for assessing adequacy of escapements. In tributaries where escapement goals have been established (ADF&G 2004) trends have improved since 2000, but to varying degrees. Escapement trends have generally remained within sustainable escapement goal (SEG) ranges at upper Kuskokwim River tributaries, but have increased sharply beyond SEG ranges at lower tributaries (Whitmore et al. *In prep*). Overall, Chinook salmon escapements in 2004 were considered above average in the Kuskokwim River drainage. Escapement goals were achieved at Kogrukluk River and at all aerial survey streams, and the Kuskokwim River Chinook salmon escapement index was the highest on record. Since 2001 Chinook salmon escapements to the Kuskokwim River have improved, but increases to George River escapements have been small in comparison with increases at other tributaries in the Kuskokwim River drainage.

Escapements since 2001 must be considered in respect to recent management actions and market conditions. Kuskokwim River Chinook salmon have been classified as stocks of yield concern by the Alaska Board of Fisheries (BOF) since September 2000 (Burkey et al. 2000a), and have been managed more conservatively as a result. A subsistence fishing schedule has been implemented annually since 2001. The schedule observes a 3 day weekly closure to allow large pulses of salmon passage through the river, and has likely contributed to higher escapements (Bergstrom and Whitmore 2004). The recent lack of a commercial market for Kuskokwim River chum salmon has also likely influenced Chinook salmon escapements. Surpluses were identified for a chum salmon directed commercial fishery in 2002 and 2003 and went unharvested as a result.

Chinook salmon are harvested incidentally with chum salmon in the Kuskokwim River, and most previous years experienced some level of commercial fishing during the Chinook salmon run.

In response to adequate run strength indicators for Chinook and chum salmon in 2004, the subsistence schedule was lifted for the season on 20 June, and 4 commercial fishing periods were conducted in the Kuskokwim River between 30 June and 7 July. Only 2,581 Chinook salmon were reported in 2004 commercial salmon harvests compared with a pre-2001 10 year average of 18,081 fish. The impact of the subsistence fishery is likely much greater. An estimated 85,086 Chinook salmon were harvested in 2004 compared to the 10-year average of 81,854 fish (Whitmore et al. *In prep*).

In order to fulfill the project's first objective Chinook salmon passage was estimated for inoperable periods that occurred between 15 June and 20 September. In 2004 data from the Tatlawiksuk River weir represented the most suitable model for estimation of Chinook salmon passage at George River weir during the inoperable period of 15 June and 26 June based on the following considerations:

1. Both projects showed similar passage characteristics during the Chinook salmon migration of 25 June and 31 July.
2. The Tatlawiksuk River weir was the closest neighboring escapement project at a distance of approximately 115 river km or 35 air km, and experienced similar environmental conditions during the estimation period, such as decreasing river flow levels.
3. Both projects are situated similarly in the lower portions of their respective drainages, just a few miles from the mainstem of the Kuskokwim River.

The model's application estimated few Chinook salmon passing the George River weir before 27 June (2%) and preliminary radiotagging data from the *Kuskokwim River Chinook Salmon Stock Assessment Project* supports this. The project tagged adult Chinook salmon with radio transmitters at a site on the Kuskokwim River, 204 river km downstream of the George River weir. All 9 fish detected by receivers arrived at the weir site after 26 June, the last day the weir was inoperable.

Chinook salmon run timing in 2004 was similar to most previous years (Figure 9), with a median passage date of 6 July. Median passage dates at George River weir have typically occurred between 3 and 11 July. Other Kuskokwim River projects reported Chinook salmon run timing earlier or similar to previous years in 2004 (Costello et al. 2005; Roettiger et al. 2005; Shelden et al. 2005; Stewart and Molyneaux 2005; Zabkar et al. 2005).

Chum Salmon

The total escapement of 14,409 chum salmon in 2004 was the third highest of 8 years determined at George River weir (Figure 7). Total chum salmon escapements at George River weir have ranged between 3,492 fish in 2000 and 33,666 fish in 2003. The average of all previous years for which total escapements have been determined is 13,165 fish.

A formal escapement goal does not exist to evaluate the adequacy of chum salmon escapements into the George River. Escapement goals have been established for chum salmon at Aniak River and Kogrukluk River (Whitmore et al. *In prep*). Comparisons among these projects show common years of low escapement in 1999 and 2000 when goals were not achieved, and significantly higher escapements in subsequent years when goals were achieved or nearly achieved (Figure 10). The 2004 Aniak River sonar count was likely out of proportion with previous years' counts. DIDSON[1] (Dual-frequency Identification Sonar) equipment was newly deployed in 2004, and by allowing technicians to better distinguish fish swimming in close groups, it is believed the DIDSON produced a higher count than technologies in previous years (McEwen 2005). The current chum salmon escapement goal was determined using data produced by older sonar technologies.

Escapements since 2001 must be considered in respect to recent management actions and market conditions. Kuskokwim River chum salmon have been classified as stocks of yield concern by the BOF since September 2000 (Burkey et al. 2000b), and have been managed more conservatively as a result. A subsistence fishing schedule has been implemented annually since 2001. The schedule observes a 3 day weekly closure to allow large pulses of salmon passage through the river, and has likely contributed to higher escapements (Bergstrom and Whitmore 2004). The recent lack of a commercial market for Kuskokwim River chum salmon has also likely influenced escapements. Surpluses were identified for a chum salmon directed commercial fishery in 2002 and 2003 and went unharvested as a result. Most previous years experienced some level of commercial fishing for chum salmon. In 2004 the commercial harvest was only 20,429 chum salmon (Martz and Whitmore 2005) and the subsistence harvest was 55,575 chum salmon (T. Krauthoefer, ADF&G, Division of Subsistence, Bethel; personal communication).

In order to fulfill the project's first objective chum salmon passage was estimated for inoperable periods that occurred between 15 June and 20 September. Historic data from the George River weir in 2000 were the most suitable model for estimation of chum salmon passage at George River weir during the inoperable period of 15 June and 26 June, 2004. Tatlawiksuk River weir offered concurrent year data for this period, but unlike Chinook salmon, chum passage characteristics during the bulk of the run were too dissimilar to be useful.

The run timing of chum salmon in 2004 was early relative to other years determined at George River weir (Figure 9), with a median passage date of 7 July. Median passage dates at George River weir had previously ranged between 9 and 21 July. Other Kuskokwim River projects observed median passage dates earlier or similar to previous years for chum salmon in 2004 (Costello et al 2005; McEwen 2005; Roettiger et al. 2005; Shelden et al. 2005; Stewart and Molyneaux 2005; Zabkar et al. 2005).

Coho Salmon

The total escapement of 12,499 coho salmon in 2004 was higher than most other years at George River weir (Figure 7). Total escapements have been determined in 7 of 9 years the project has operated, and have ranged between 6,759 fish in 2002 and 33,280 fish in 2003. Coho salmon escapements are monitored at 5 other weir projects in the Kuskokwim River drainage, and an escapement goal exists at Kogrukluk River weir (Figure 11). Though escapements decreased in abundance from 2003, the escapement goal was achieved and escapements were above most other years at every project in 2004, except Takotna River weir.

The level of coho salmon escapement seen in the George River is influenced by harvest activity in the mainstem Kuskokwim River. Over 85% of coho salmon subsistence harvest, and all

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

commercial harvest occurs downstream of the George River confluence. Coho salmon runs to the Kuskokwim River were generally depressed between 1997 and 2002, as indicated by below average commercial harvests concurrent with low escapements (Ward et al. 2003). The run recovered in 2003 with record high escapements and a commercial harvest of 284,064 fish. The commercial harvest had averaged 150,453 fish in the 6 years previous. The 2003 commercial harvest of coho salmon was limited by processor capacity (Bergstrom and Whitmore 2004). Market interest increased in 2004, as indicated by the 2004 commercial harvest of 433,809 fish, an increase of 35% over 2003 (Whitmore et al. *In prep*).

The run timing of coho salmon in 2004 was intermediate relative to other years determined at George River weir (Figure 9), with a median passage date of 31 August. Median passage dates at George River weir have historically ranged from 21 August to 6 September. Run timing at other Kuskokwim River projects was mixed in comparison with previous years (Costello et al. 2005; Roettiger et al. 2005; Shelden et al. 2005; Stewart and Molyneaux 2005; Zabkar et al. 2005).

Other Species

Other salmon species observed historically at George River weir include small numbers of sockeye and pink salmon. The George River is not a primary spawning tributary for these species; therefore, it is not surprising that few sockeye and pink salmon were observed in 2004 (Appendix C1).

Other species commonly observed at George River weir include longnose suckers, whitefish, and Arctic grayling. Longnose suckers are historically the most abundant non-salmon species counted at George River weir; however, counts are likely incomplete because smaller individuals may be able to pass freely between the pickets, and upstream migration appears to start before weir operations typically begin. The highest recorded passage of this species was 15,840 in 2001. Longnose suckers have been reported as common in the Aniak, Tatlawiksuk, and Takotna Rivers, but they appear to be uncommon or absent from the Kwethluk, Tuluksak, and Kogrukluk Rivers.

Carcass Counts

Though not a project objective, carcass counts may provide a means for measuring nutrient retention and loss in the George River. Approximately 3.0% of the Chinook salmon escapement and 8.7% of chum salmon escapement was later observed as carcasses at the George River weir in 2004 (Appendix D1–D2). The proportion of carcasses to escapement does not account for carcasses washed downstream during inoperable periods and historical proportions are likely higher than reported. Decreasing water levels throughout the 2004 season likely resulted in a lower than historical proportion of carcasses at the weir. The protracted retention of salmon carcasses upstream of the weir in 2004 likely enhanced the absorption of marine derived nutrients, and further contributed to the productivity of the George River (Cederholm et al. 1999; 2000). No speculation is made from coho salmon carcass data as the weir was likely removed before the majority of these fish completed spawning.

Age, Sex, and Length Composition of Escapement

Chinook Salmon

ASL data collected from Chinook salmon in 2004 were adequate to describe the composition for total escapement into the George River in that sampling occurred throughout most of the run and total sample size met or exceeded our minimum single pulse goal. ASL composition has been estimated for the total Chinook escapement in only 5 of 9 years the project has operated.

Premature project termination or late start up was cited in some years, and problems collecting the minimum ASL sample size were cited in other years. Increased abundances and improved sampling techniques have resulted in adequate sample collections in 2002 and 2004. An “active sampling” strategy has become an effective means of capturing adequate numbers of Chinook salmon for ASL collection. This strategy entails passing all species through the live trap and capturing Chinook salmon individually or in small groups entering the trap together. Active sampling creates more crew activity around the weir, and Chinook salmon sometimes move back downstream as a result. This behavior is especially evident in low water conditions, and pulse sample collection must sometimes be abbreviated to prevent an abnormal delay in fish passage.

The ASL composition of Chinook salmon varies throughout the migration at the George River weir. In 2004 the run started with 19.1% female increasing to 48.1% and remaining near that level for the following 2 temporal strata (Table 2). This was expected as male salmon generally migrate earlier than female salmon. Historically (Figure 12) lower percentage female are estimated early in the run and increase over time. In 2004, the proportion of age-1.2 Chinook salmon decreased over time, while the percentage of age-1.4 fish increased. Historically (Figure 13) the largest percentages of age-1.2 Chinook were estimated from samples earlier in the run. In contrast the percentage of age-1.4 Chinook salmon are lowest early in the migration.

Data from several Kuskokwim River projects indicated a higher than usual proportion of age-1.2 Chinook salmon in 2004 escapements (Figure 14) (Molyneaux and Folletti 2005). These returns contrast with the poor escapements of Chinook salmon observed in the parent year 2000. The high return of age-1.2 Chinook salmon indicates the potential for a strong return of age-1.3 fish in 2005. As nearly all age-1.2 Chinook salmon are male this also had the effect of skewing the sex ratio at many escapement projects.

In 2004, George River Chinook salmon exhibited length partitioning by age class for male and female fish (Figure 15). Often times female Chinook salmon are larger at age than males. Mean length in 2004 was similar to that in 2002 for all age classes. Changes in mean length through time are not obvious by sex and age (Figure 16).

Chum Salmon

The ASL data collected from chum salmon in 2004 were adequate for describing the age composition for the total annual escapement into the George River. ASL composition of chum salmon has been estimated in 7 of 9 years the project has operated. The project was terminated early in 1998 and began late in 1999.

The percentage of female chum salmon past the weir was at 47.9% in 2004 which is well within the historical range of 42.8 to 53.8 (Molyneaux and Folletti 2005). Age-0.2 and -0.4 chum salmon were higher in abundance and percentage to escapement in 2004 than all previous years observed (Figure 17) (Molyneaux and Folletti 2005). Record high abundances of age-0.2 fish were observed in all monitored tributaries in 2004 (Molyneaux and Folletti 2005). This coupled with the above average escapement in 2001 indicates the potential for a strong return of age-0.3 chum salmon in 2005.

Length partitioning occurs between sex and age class at George River weir (Figure 15). Mean lengths in 2004 were similar to that in 2001 (Figure 15). This trend was also observed over comparable years in the Kwethluk, Tatlawiksuk, Kogrukluk, and Takotna Rivers (Molyneaux and Folletti 2005).

Trends in ASL composition over the 2004 season followed overall trends for chum salmon observed in previous years at George River weir. Estimates of percent female tend to be less than 50% early in the migration ending at greater than 50% (Figure 12). Age became younger (Figure 18) and mean length shorter (Figure 19) over the run. Mean lengths increased with age, and males tended to be longer than females at George weir (Figure 15).

Coho Salmon

The ASL data collected from coho salmon in 2004 were adequate for describing the age composition for the total annual escapement into the George River. ASL composition for coho salmon has been estimated in 6 of 7 years the project has operated for coho salmon.

Comparisons among years indicate the lowest percent female was observed in 2004 at 36.6%, with previous percentages ranging from 40.9% in 1999 to 53.3% in 2001 (Molyneaux and Folletti 2005). The proportion of age-2.1 coho salmon was average in 2004, at 89.9% of escapement (Table 6). Estimates of age-2.1 fish previously ranged from 65.6% of the escapement in 2001, to 97.6% of the escapement in 2000. Length partitioning does not appear strong between sexes in age-2.1 fish, and mean length of this age class was shorter in 2004 than previously observed at George River weir (Figure 15).

Trends in ASL composition over the 2004 season followed overall trends for coho salmon observed in previous years at George River weir. Seasonal trends indicate the ratio of female fish tends to increase slightly over the run (Figure 12). Age composition remains fairly consistent (Figure 20), and mean length increases only slightly (Figure 21) for age 2.1, over the season.

HABITAT VARIABLES

Migration in salmon is controlled by genetic factors as an adaptation to long-term average environmental conditions (Quinn 2005). Keefer et al. (2004) found a positive correlation between river discharge and run timing of Columbia River Chinook salmon stocks. Columbia River sockeye salmon have started their inriver migration 2 weeks earlier in response to warmer water conditions resulting from dam construction. Knowledge of environmental conditions and a commitment to long-term monitoring may be valuable in understanding migration and survival. The weir crew maintained a relatively complete record of the habitat variables collected during the 2004 season. These measurements can easily be neglected in field camps, and may seem a low priority among project objectives. Incorporating weather and stream observations into the daily morning and afternoon radio schedules with ADF&G staff in Bethel helps insure the data are gathered consistently throughout the season.

Historical data indicate above average water temperatures in 2004 in comparison to previous years lower only to that observed in 1996 (Figures 22–23) for the Chinook and chum salmon migration and 1997 for the coho salmon migration (Figure 24). Stream height data indicates low water levels (discharge) in 2004 relative to previous years during the Chinook and chum salmon runs, and again low during the coho salmon run (Figures 25–27). Any relationship between stream temperature and passage strength or timing is not easily discernable from the available data. The effect of migration timing does change in relation to long term changes in freshwater water temperatures (Quinn 2005). The relation of water level to fish passage is less well understood and varies among sites and species (Quinn 2005).

CHINOOK SALMON RADIOTELEMETRY

The primary objective of the radiotelemetry project was to estimate inriver abundance of Chinook salmon in the Kuskokwim River, upstream of the tagging site near Lower Kalskag. Findings in 2004 are discussed by Stuby (2005). The study was designed to incorporate escapement data from various projects including George River weir, to estimate inriver abundance. George River weir successfully provided these data in 2004.

The radiotelemetry data offered an opportunity to study migration characteristics of George River Chinook salmon in 2004. A total of 9 radiotagged Chinook salmon were detected migrating past the weir in 2004 (Figure 28) (L. Stuby, Sport Fish Biologist, ADF&G, Fairbanks; personal communication). The distance between the tagging site and the weir was 126 rm and transit time averaged 9.7 days. An additional average 1.4 days elapsed between the initial detection by the receiver station at the weir and passage upriver through the weir. This delay is similar to that seen at the Kogrukluk weir (0.8 day average) and is in contrast to the average period of delay measured at the Tatlawiksuk River weir of 4.5 days (L. Stuby, Sport Fish Biologist, ADF&G, Fairbanks; personal communication). No radio tagged fish passed the weir site prior to the weir becoming operational on 27 June, though the first Chinook salmon was tagged near Kalskag on 8 June.

Data from Stuby (2003, 2004, 2005) indicates the run timing of discreet Chinook salmon spawning aggregates past the Lower Kalskag tagging site in 2004 (Figure 29) (L. Stuby, Sport Fish Biologist, ADF&G, Fairbanks; personal communication). The pattern of upper river populations migrating past the tagging site earlier than lower river populations was more distinct in 2004 than in 2003, when timing was more compacted. The run timing pattern in 2004 was more consistent with the pattern indicated in 2002, with the exception being the later timing of Kogrukluk River Chinook salmon.

CHUM AND COHO SALMON TAG RECOVERY

Tag recovery efforts were successful throughout the 2004 season salmon run at George River weir. Operations at George River weir were uninterrupted between 27 June and 24 September, and tag detection was considered complete during this period. All chum salmon passage was successfully conducted through the live trap under average water conditions, enabling crew to recover 58 of 62 tags observed. Occasionally tagged salmon escaped upstream before they could be captured in the live trap, resulting in missed tag recoveries (i.e. recording of the unique tag number). The recovery of coho salmon was more problematic under low water conditions with only 5 of 21 tags recovered. The recovery of tag numbers offered an opportunity to study migration characteristics of George River chum and coho salmon in 2004, compare it across years and among recovery tributaries within a year.

Chum Salmon

The distribution of tags detected relative to passage at the weir indicates that George River chum salmon were not tagged early in their migration. By 15 July at the weir 71% of the chum run had passed but only 6 tagged fish (10% of total observed) had passed (Figure 28) (Pawluk et al. *In prep*). Recovered tag numbers can be used to indicate the distribution of tagged George River chum salmon relative to the total chum salmon catch at the tagging site near Lower Kalskag (Figure 30) (Pawluk et al. *In prep*). The low catches seen during the first half of July at Lower Kalskag may account for the low proportion of tagged chum salmon passing the weir during the period when the majority of the escapement migrated. Assuming low Kalskag catches in early July had a similar effect on estimated timing of other stocks, tag recoveries from other Kuskokwim River escapement projects can be compared and continue to suggest a difference in run timing between spawning populations as they pass the tagging site near Lower Kalskag (Figure 31) (Pawluk et al. *In prep*). These findings are similar to previous years and further suggest that George River chum salmon migrate past this area during the later portion of the mainstem chum salmon run (Figure 31) (Kerkvliet et al. 2003; 2004; Pawluk et al. *In prep*).

Transit time, between tagging and passage at the weir, ranged from 4 to 14 days and averaged 7 days in 2004 (Pawluk et al. *In prep*). This is similar to the 7 day average transit time observed for chum salmon in 2002 and 2003 (Kerkvliet et al. 2003; 2004).

Coho Salmon

Few tagged coho salmon were observed passing the George River weir in 2004 (21) as compared to 2002 (59) and 2003 (413). Even so, the distribution of tags detected relative to passage at the weir indicates that most tags passed during peak passage periods in late August. Furthermore only 5 tag numbers were recorded representing the earliest and latest George River tags (Figure 28) and were released at Kalskag during catches from the last half of total Kuskokwim River passage (Figure 30). Tag recoveries from other Kuskokwim River escapement projects in 2004 suggest a difference in run timing between spawning populations as they pass the tagging site near Lower Kalskag (Figure 32) (Pawluk et al. *In prep*). These findings are similar to previous years and suggest that George River coho salmon migrate past this area during the latter portion of the mainstem Kuskokwim River coho salmon run (Figure 31) (Kerkvliet et al. 2003; 2004; Pawluk et al. *In prep*).

Transit time, between tagging and passage at the weir, ranged from 6 to 15 days and averaged 11 days in 2004. This is faster than the 14 day average transit time observed for coho salmon in 2002 (Kerkvliet et al. 2003) and 19 day average in 2003 (Kerkvliet et al. 2004).

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TABLES AND FIGURES

Table 1.–Daily, daily cumulative, and daily cumulative percent passage for Chinook, chum, and coho salmon at George River weir with the median passage date and central 50% of the run, 2004.

	Chinook Salmon			Chum Salmon			Coho Salmon		
Date	**Daily**	**Cumulative**	**%**	**Daily**	**Cumulative**	**%**	**Daily**	**Cumulative**	**%**
6/15	0 [a]	0	0	6 [a]	6	0	0 [b]	0	0
6/16	1 [a]	1	0	14 [a]	20	0	0 [b]	0	0
6/17	2 [a]	4	0	63 [a]	83	1	0 [b]	0	0
6/18	2 [a]	6	0	78 [a]	161	1	0 [b]	0	0
6/19	4 [a]	10	0	92 [a]	253	2	0 [b]	0	0
6/20	7 [a]	17	0	45 [a]	297	2	0 [b]	0	0
6/21	9 [a]	26	1	138 [a]	435	3	0 [b]	0	0
6/22	8 [a]	34	1	116 [a]	552	4	0 [b]	0	0
6/23	4 [a]	38	1	120 [a]	672	5	0 [b]	0	0
6/24	2 [a]	40	1	20 [a]	692	5	0 [b]	0	0
6/25	7 [a]	47	1	158 [a]	851	6	0 [b]	0	0
6/26	52 [a]	99	2	502 [a]	1,353	9	0 [b]	0	0
6/27	310	409	8	883	2,236	16	0	0	0
6/28	230	639	12	602	2,838	20	0	0	0
6/29	305	944	18	567	3,405	24	0	0	0
6/30	220	1,164	22	360	3,765	26	0	0	0
7/1	100	1,264	24	148	3,913	27	0	0	0
7/2	25	1,289	25	179	4,092	28	0	0	0
7/3	409	1,698	33	543	4,635	32	0	0	0
7/4	161	1,859	36	472	5,107	35	0	0	0
7/5	539	2,398	46	444	5,551	39	0	0	0
7/6	375	2,773	53	685	6,236	43	0	0	0
7/7	152	2,925	56	972	7,208	50	0	0	0
7/8	398	3,323	64	514	7,722	54	0	0	0
7/9	194	3,517	68	311	8,033	56	0	0	0
7/10	69	3,586	69	305	8,338	58	0	0	0
7/11	244	3,830	74	467	8,805	61	0	0	0
7/12	240	4,070	78	272	9,077	63	0	0	0
7/13	108	4,178	80	412	9,489	66	0	0	0
7/14	99	4,277	82	381	9,870	68	0	0	0
7/15	75	4,352	84	298	10,168	71	0	0	0
7/16	89	4,441	85	182	10,350	72	0	0	0
7/17	86	4,527	87	194	10,544	73	0	0	0
7/18	97	4,624	89	311	10,855	75	0	0	0
7/19	114	4,738	91	308	11,163	77	0	0	0
7/20	66	4,804	92	197	11,360	79	0	0	0
7/21	40	4,844	93	268	11,628	81	1	1	0
7/22	22	4,866	93	208	11,836	82	0	1	0
7/23	40	4,906	94	258	12,094	84	0	1	0
7/24	38	4,944	95	251	12,345	86	0	1	0
7/25	29	4,973	96	210	12,555	87	5	6	0
7/26	49	5,022	96	229	12,784	89	3	9	0
7/27	16	5,038	97	133	12,917	90	0	9	0
7/28	20	5,058	97	118	13,035	90	0	9	0
7/29	6	5,064	97	111	13,146	91	4	13	0
7/30	3	5,067	97	110	13,256	92	2	15	0

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Table 1.–Page 2 of 3.

	Chinook Salmon			Chum Salmon			Coho Salmon		
Date	**Daily**	**Cumulative**	**%**	**Daily**	**Cumulative**	**%**	**Daily**	**Cumulative**	**%**
7/31	19	5,086	98	108	13,364	93	10	25	0
8/1	16	5,102	98	97	13,461	93	17	42	0
8/2	14	5,116	98	46	13,507	94	10	52	0
8/3	13	5,129	99	45	13,552	94	6	58	0
8/4	8	5,137	99	46	13,598	94	43	101	1
8/5	5	5,142	99	60	13,658	95	42	143	1
8/6	2	5,144	99	36	13,694	95	38	181	1
8/7	10	5,154	99	55	13,749	95	69	250	2
8/8	7	5,161	99	161	13,910	97	72	322	3
8/9	1	5,162	99	71	13,981	97	69	391	3
8/10	7	5,169	99	56	14,037	97	445	836	7
8/11	4	5,173	99	35	14,072	98	77	913	7
8/12	2	5,175	99	41	14,113	98	82	995	8
8/13	0	5,175	99	15	14,128	98	61	1,056	8
8/14	3	5,178	99	5	14,133	98	57	1,113	9
8/15	2	5,180	99	41	14,174	98	712	1,825	15
8/16	6	5,186	100	16	14,190	98	316	2,141	17
8/17	3	5,189	100	20	14,210	99	207	2,348	19
8/18	4	5,193	100	8	14,218	99	155	2,503	20
8/19	0	5,193	100	5	14,223	99	96	2,599	21
8/20	4	5,197	100	3	14,226	99	299	2,898	23
8/21	1	5,198	100	24	14,250	99	489	3,387	27
8/22	0	5,198	100	10	14,260	99	168	3,555	28
8/23	0	5,198	100	12	14,272	99	201	3,756	30
8/24	2	5,200	100	19	14,291	99	147	3,903	31
8/25	0	5,200	100	12	14,303	99	149	4,052	32
8/26	1	5,201	100	6	14,309	99	88	4,140	33
8/27	1	5,202	100	12	14,321	99	162	4,302	34
8/28	0	5,202	100	7	14,328	99	108	4,410	35
8/29	1	5,203	100	9	14,337	99	413	4,823	39
8/30	1	5,204	100	15	14,352	100	733	5,556	44
8/31	0	5,204	100	8	14,360	100	672	6,228	50
9/1	2	5,206	100	18	14,378	100	1,487	7,715	62
9/2	0	5,206	100	4	14,382	100	479	8,194	66
9/3	0	5,206	100	4	14,386	100	366	8,560	68
9/4	0	5,206	100	2	14,388	100	301	8,861	71
9/5	0	5,206	100	6	14,394	100	413	9,274	74
9/6	0	5,206	100	4	14,398	100	310	9,584	77
9/7	1	5,207	100	5	14,403	100	397	9,981	80
9/8	0	5,207	100	1	14,404	100	139	10,120	81
9/9	0	5,207	100	2	14,406	100	133	10,253	82
9/10	0	5,207	100	0	14,406	100	371	10,624	85
9/11	0	5,207	100	1	14,407	100	414	11,038	88
9/12	0	5,207	100	0	14,407	100	389	11,427	91
9/13	0	5,207	100	0	14,407	100	222	11,649	93
9/14	0	5,207	100	0	14,407	100	267	11,916	95
9/15	0	5,207	100	1	14,408	100	245	12,161	97

-continued-

Table 1.–Page 3 of 3.

	Chinook Salmon			Chum Salmon			Coho Salmon		
Date	Daily	Cumulative	%	Daily	Cumulative	%	Daily	Cumulative	%
9/16	0	5,207	100	0	14,408	100	116	12,277	98
9/17	0	5,207	100	0	14,408	100	94	12,371	99
9/18	0	5,207	100	0	14,408	100	81	12,452	100
9/19	0	5,207	100	1	14,409	100	36	12,488	100
9/20	0	5,207	100	0	14,409	100	11	12,499	100
9/21	0	[c]		0	[c]		23	[c]	
9/22	0	[c]		0	[c]		256	[c]	
9/23	0	[c]		1	[c]		422	[c]	
9/24	0	[c]		1	[c]		48	[c]	

Note: The boxes represent the median passage date and central 50% of the run.

[a] Weir was not operational, daily passage assumed zero.

[b] Weir was not operational, daily passage estimated

[c] Daily passage not included in cumulative escapement; date outside of target operational period.

Table 2.–Age and sex composition of the Chinook salmon escapement at the George River weir, 2004.

Sample and	Sample		Age 1.1		Age 1.2		Age 2.2		Age 1.3		Age 1.4		Age 1.5		Age 2.4		Total	
(Stratum) Dates	Size	Sex	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%	Esc.	%
6/29 - 7/2	68	M	27	1.5	766	41.2	0	0.0	355	19.1	328	17.7	27	1.5	0	0.0	1,504	80.9
(6/15 - 7/4)		F	0	0.0	27	1.4	0	0.0	82	4.4	246	13.2	0	0.0	0	0.0	355	19.1
		Subtotal [a]	27	1.5	793	42.6	0	0.0	437	23.5	574	30.9	27	1.5	0	0.0	1,859	100.0
7/6 - 7, 9 - 10	79	M	0	0.0	420	19.0	0	0.0	364	16.5	336	15.2	28	1.3	0	0.0	1,147	51.9
(7/5 - 12)		F	0	0.0	0	0.0	0	0.0	84	3.8	923	41.8	56	2.5	0	0.0	1,064	48.1
		Subtotal [a]	0	0.0	420	19.0	0	0.0	448	20.3	1,259	57.0	84	3.8	0	0.0	2,211	100.0
7/14 - 17	80	M	0	0.0	84	12.5	8	1.3	109	16.3	125	18.8	9	1.3	0	0.0	334	50.0
(7/13 - 19)		F	0	0.0	8	1.3	0	0.0	8	1.2	309	46.2	8	1.2	0	0.0	334	50.0
		Subtotal [a]	0	0.0	92	13.8	8	1.3	117	17.5	434	65.0	17	2.5	0	0.0	668	100.0
7/21, 23 - 24, 27, 30	42	M	0	0.0	45	9.5	0	0.0	78	16.7	134	28.6	0	0.0	0	0.0	257	54.8
8/1, 11, 15		F	0	0.0	0	0.0	0	0.0	23	4.7	179	38.1	11	2.4	0	0.0	212	45.2
(7/20 - 9/24)		Subtotal [a]	0	0.0	45	9.5	0	0.0	101	21.4	313	66.7	11	2.4	0	0.0	469	100.0
Season[b]	269	M	27	0.5	1,313	25.2	8	0.2	906	17.4	923	17.8	64	1.2	0	0.0	3,242	62.3
		F	0	0.0	36	0.7	0	0.0	197	3.8	1,657	31.8	75	1.5	0	0.0	1,965	37.7
		Total	27	0.5	1,349	25.9	8	0.2	1,103	21.2	2,580	49.6	139	2.7	0	0.0	5,207	100.0

[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.

Table 3.–Mean length (mm) composition of the Chinook salmon escapement at the George River weir, 2004.

Sample and			Age Class						
(Stratum) Dates	**Sex**		**1.1**	**1.2**	**2.2**	**1.3**	**1.4**	**1.5**	**2.4**
6/29 - 7/2	M	Mean Length	490	613		685	845	780	
(6/15 - 7/4)		SE	-	7		18	6	-	
		Range	490 - 490	535 - 685		555 - 780	800 - 870	780 - 780	
		Sample Size	1	28	0	13	12	1	0
	F	Mean Length		570		737	837		
		SE		-		6	14		
		Range		570 - 570		725- 745	785 - 905		
		Sample Size	0	1	0	3	9	0	0
7/6 - 7, 9 - 10	M	Mean Length		571		722	832	835	
(7/5 - 12)		SE		15		9	17	-	
		Range		481 - 685		685 - 775	737 - 925	835 - 835	
		Sample Size	0	15	0	13	12	1	0
	F	Mean Length				799	835	950	
		SE				23	6	43	
		Range				763 - 841	763 - 895	907 - 992	
		Sample Size	0	0	0	3	33	2	0
7/14 - 17	M	Mean Length		617	660	747	871	843	
(7/13 - 19)		SE		18	-	20	12	-	
		Range		540 - 694	660 -660	660 - 860	805 - 960	843 - 843	
		Sample Size	0	10	1	13	15	1	0
	F	Mean Length		640		846	846	884	
		SE		-		-	8	-	
		Range		640 - 640		846 - 846	760 - 951	884 - 884	
		Sample Size	0	1	0	1	37	1	0
7/21, 23 - 24, 27, 30	M	Mean Length		579		688	858		
8/1, 11, 15		SE		15		8	14		
(7/20 - 9/24)		Range		545 - 610		660 - 712	790 - 935		
		Sample Size	0	4	0	7	12	0	0
	F	Mean Length				844	858	865	
		SE				29	13	-	
		Range				815 - 872	770 - 950	865 - 865	
		Sample Size	0	0	0	2	16	1	0
Season[a,b]	M	Mean Length	490	599	660	707	845	812	
		Range	490 - 490	481 - 694	660 -660	555 - 860	737 - 960	780 - 843	
		Sample Size	1	57	1	46	51	3	0
	F	Mean Length		586		780	840	930	
		Range		570 - 640		725 - 872	760 - 951	865 - 992	
		Sample Size	0	2	0	9	95	4	0

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

[b] "Season" mean lengths are simple averages of number of fish sampled.

Table 4.–Age and sex composition of the chum salmon escapement at the George River weir, 2004.

Sample and	Sample		Age 0.2		Age 0.3		Age 0.4		Age 0.5		Total	
(Stratum) Dates	**Size**	**Sex**	**Esc.**	**%**	**Esc.**	**%**	**Esc.**	**%**	**Esc.**	**%**	**Esc.**	**%**
6/28 - 7/2	130	M	0	0.0	471	9.2	2,200	43.1	0	0.0	2,671	52.3
(6/15 - 7/4)		F	0	0.0	1,100	21.6	1,336	26.1	0	0.0	2,436	47.7
		Subtotal [a]	0	0.0	1,571	30.8	3,536	69.2	0	0.0	5,107	100.0
7/6 - 8	189	M	254	6.9	1,115	30.1	822	22.2	20	0.5	2,211	59.8
(7/5 - 11)		F	196	5.3	920	24.9	372	10.1	0	0.0	1,487	40.2
		Subtotal [a]	540	12.2	2,035	55.0	1,194	32.3	20	0.5	3,698	100.0
7/13 - 16	201	M	51	2.5	275	13.4	663	32.3	0	0.0	989	48.3
(7/12 - 18)		F	31	1.5	408	19.9	622	30.4	0	0.0	1,061	51.7
		Subtotal [a]	82	4.0	683	33.3	1,285	62.7	0	0.0	2,050	100.0
7/20 - 24	198	M	156	8.1	273	14.2	555	28.8	0	0.0	984	51.0
(7/19 - 26)		F	185	9.6	409	21.2	341	17.7	10	0.5	945	49.0
		Subtotal [a]	341	17.7	682	35.4	896	46.5	10	0.5	1,929	100.0
7/27 - 8/1, 11 - 12	205	M	174	10.7	190	11.7	286	17.6	0	0.0	651	40.0
(7/27 - 9/24)		F	278	17.1	397	24.4	301	18.5	0	0.0	976	60.0
		Subtotal [a]	452	27.8	587	36.1	587	36.1	0	0.0	1,627	100.0
Season [b]	923	M	636	4.4	2,325	16.1	4,526	31.4	19	0.1	7,506	52.1
		F	689	4.8	3,234	22.5	2,972	20.6	10	0.1	6,905	47.9
		Total	1,325	9.2	5,559	38.6	7,498	52.0	29	0.2	14,411	100.0

[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.

Table 5.–Mean length (mm) composition of the chum salmon escapement at George River weir, 2004.

Sample and (Stratum) Dates	Sex		Age Class 0.2	0.3	0.4	0.5
6/28 - 7/2	M	Mean Length		574	589	
(6/15 - 7/4)		SE		8	4	
		Range		540 - 622	528 - 651	
		Sample Size	0	12	56	0
	F	Mean Length		555	553	
		SE		4	5	
		Range		510 - 600	510 - 612	
		Sample Size	0	28	34	0
7/6 - 8	M	Mean Length	541	585	585	595
(7/5 - 11)		SE	9	4	5	-
		Range	487 - 590	522 - 672	500 - 675	595 - 595
		Sample Size	13	57	42	1
	F	Mean Length	514	536	551	
		SE	12	4	8	
		Range	450 - 565	485 - 625	485 - 620	
		Sample Size	10	47	19	0
7/13 - 16	M	Mean Length	528	564	585	
(7/12 - 18)		SE	8	6	4	
		Range	512 - 557	502 - 632	515 - 675	
		Sample Size	5	27	65	0
	F	Mean Length	511	522	536	
		SE	8	5	4	
		Range	499 - 525	400 - 590	466 - 595	
		Sample Size	3	40	61	0
7/20 - 24	M	Mean Length	520	557	581	
(7/19 - 26)		SE	8	5	5	
		Range	460 - 560	505 - 604	515 - 689	
		Sample Size	16	28	57	0
	F	Mean Length	497	518	530	492
		SE	6	4	6	-
		Range	462 - 550	450 - 580	470 - 587	492 - 492
		Sample Size	19	42	35	1
7/27 - 8/1, 11 - 12	M	Mean Length	513	546	575	
(7/27 - 9/24)		SE	6	9	6	
		Range	465 - 560	428 - 640	479 - 662	
		Sample Size	22	24	36	0
	F	Mean Length	497	520	539	
		SE	5	5	5	
		Range	442 - 569	455 - 610	485 - 630	
		Sample Size	35	50	38	0
Season [a,b]	M	Mean Length	527	574	586	595
		Range	460 - 590	428 - 672	479 - 689	595 - 595
		Sample Size	56	148	256	1
	F	Mean Length	502	536	545	492
		Range	442 - 569	400 - 625	466 - 630	492 - 492
		Sample Size	67	207	187	1

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

[b] "Season" mean lengths are simple averages of number of fish sampled.

Table 6.–Age and sex composition of the coho salmon escapement at George River weir, 2004.

Sample and (Stratum) Dates	Sample Size	Sex	Age 1.1		Age 2.1		Age 3.1		Total	
			Esc.	%	Esc.	%	Esc.	%	Esc.	%
8/11 - 15	66	M	0	0.0	1,851	71.2	158	6.1	2,008	77.3
(7/20 - 8/19)		F	0	0.0	590	22.7	0	0.0	591	22.7
		Subtotal [a]	0	0.0	2,441	93.9	158	6.1	2,599	100.0
8/22 - 25	59	M	87	1.7	2,775	54.2	433	8.5	3,295	64.4
(8/20 - 9/1)		F	0	0.0	1,734	33.9	87	1.7	1,821	35.6
		Subtotal [a]	87	1.7	4,509	88.1	520	10.2	5,116	100.0
9/4 - 5, 7	66	M	0	0.0	2,850	51.5	252	4.6	3,102	56.1
(9/2 - 9/24)		F	84	1.5	2,096	37.9	251	4.5	2,431	43.9
		Subtotal [a]	84	1.5	4,946	89.4	503	9.1	5,533	100.0
Season[b]	191	M	87	0.7	7,476	56.4	843	6.4	8,405	63.4
		F	84	0.6	4,421	33.4	338	2.5	4,843	36.6
		Total	171	1.3	11,897	89.8	1,181	8.9	13,248	100.0

[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.

Table 7.–Mean length (mm) composition of the coho salmon escapement at George River weir, 2004.

Sample and (Stratum) Dates	Sex		Age Class 1.1	2.1	3.1
8/11 - 15	M	Mean Length		526	532
(7/20 - 8/19)		SE		7	12
		Range		420 - 650	500 - 558
		Sample Size	0	47	4
	F	Mean Length		533	
		SE		8	
		Range		476 - 568	
		Sample Size	0	15	0
8/22 - 25	M	Mean Length	532	535	530
(8/20 - 9/1)		SE	-	9	19
		Range	532 - 532	396 - 635	481 - 573
		Sample Size	1	32	5
	F	Mean Length		557	516
		SE		7	-
		Range		462 - 599	516 - 516
		Sample Size	0	20	1
9/4 - 5, 7	M	Mean Length		538	540
(9/2 - 9/24)		SE		8	25
		Range		430 - 660	491 - 575
		Sample Size	0	34	3
	F	Mean Length	529	544	531
		SE	-	6	30
		Range	529 - 529	447 - 579	482 - 585
		Sample Size	1	25	3
Season [a,b]	M	Mean Length	532	534	534
		Range	532 - 532	396 - 660	481 - 575
		Sample Size	1	113	12
	F	Mean Length	529	548	527
		Range	529 - 529	447 - 599	482 - 585
		Sample Size	1	60	4

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

[b] "Season" mean lengths are simple averages of number of fish sampled.

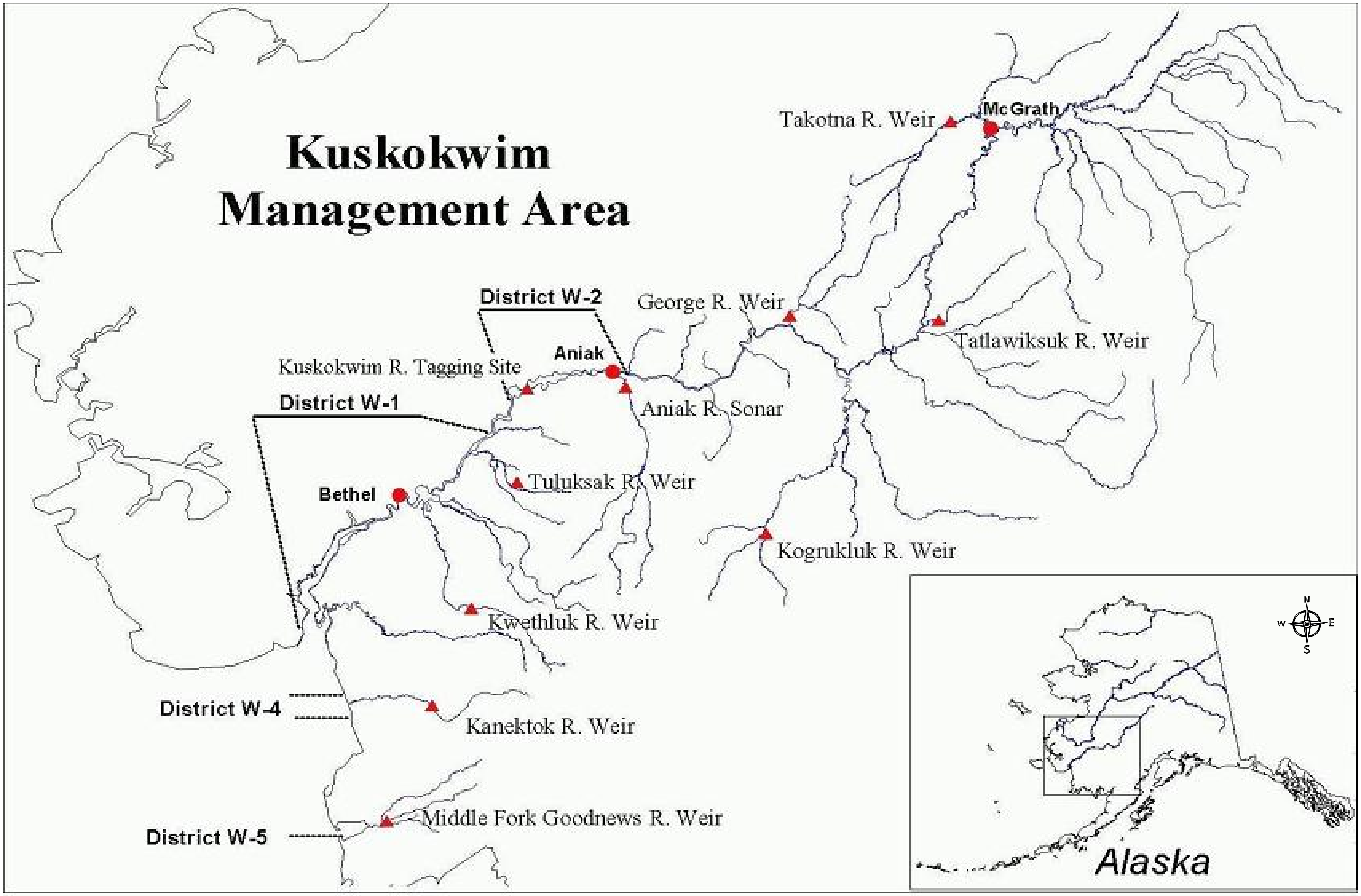


Figure 1.–Kuskokwim Area salmon management districts and escapement monitoring projects.

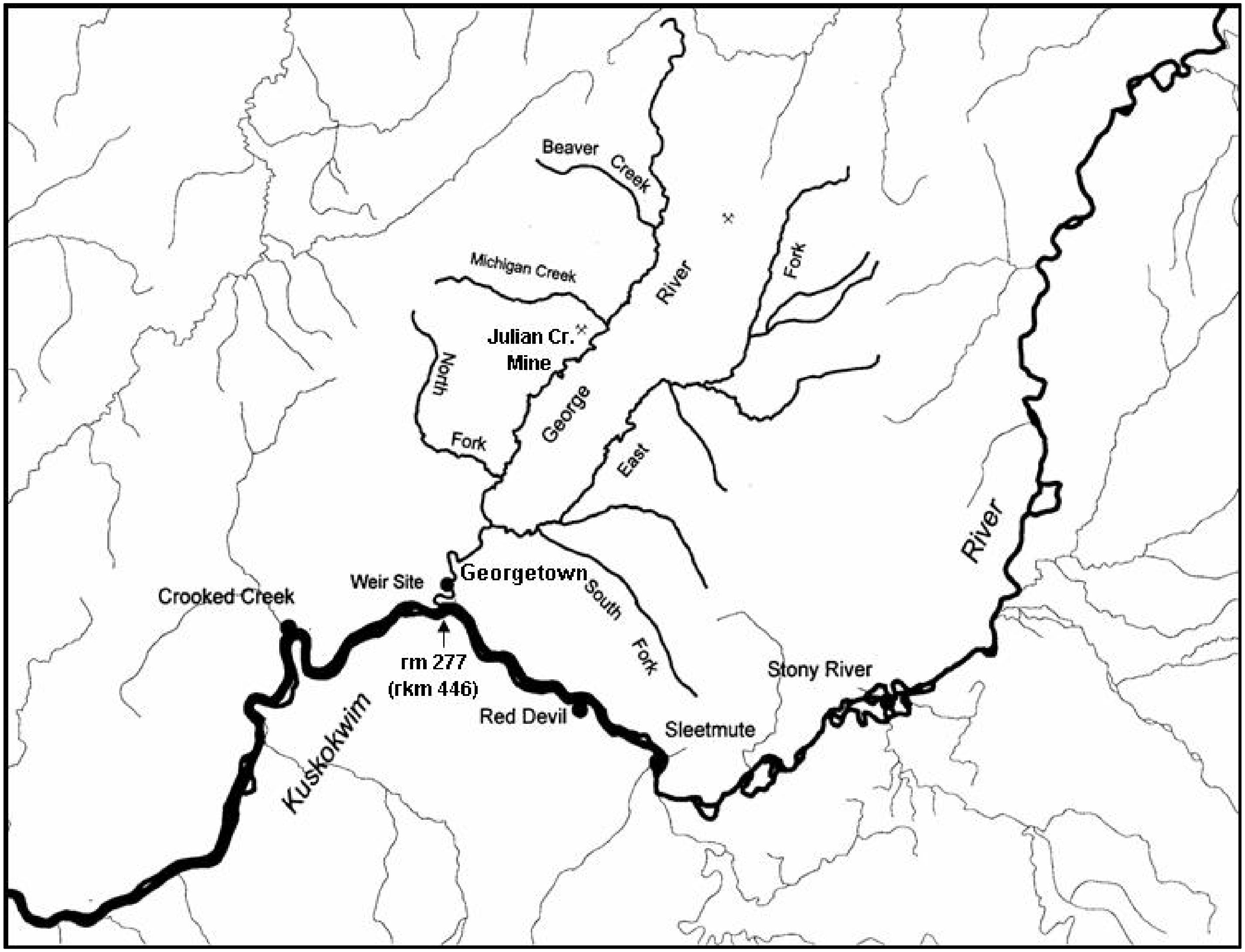


Figure 2.–George River, middle Kuskokwim River basin.

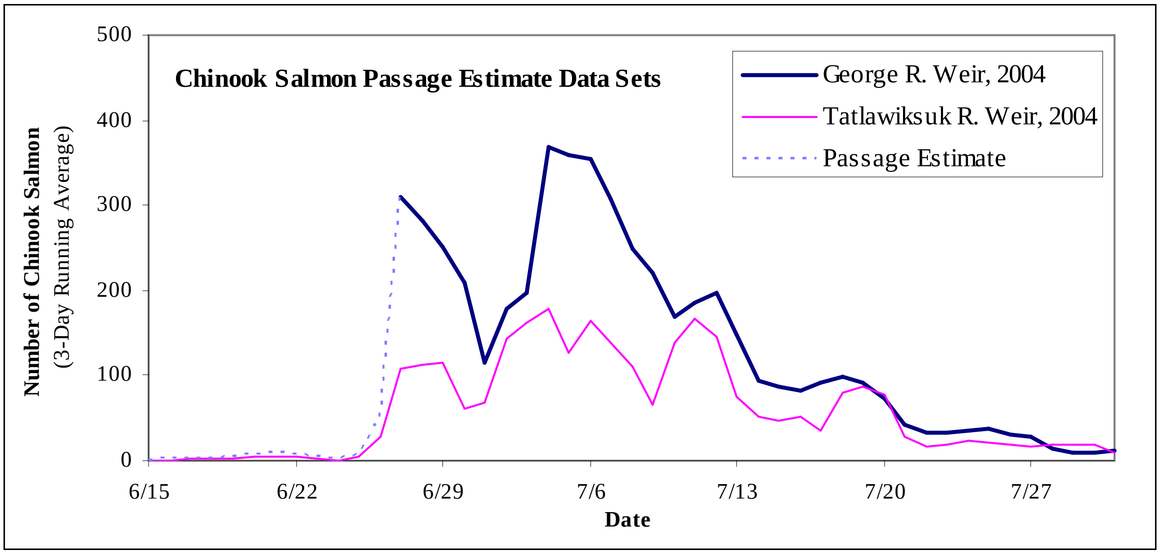


Figure 3.–Chinook salmon passage at the George and Tatlawiksuk River weirs, 2004.

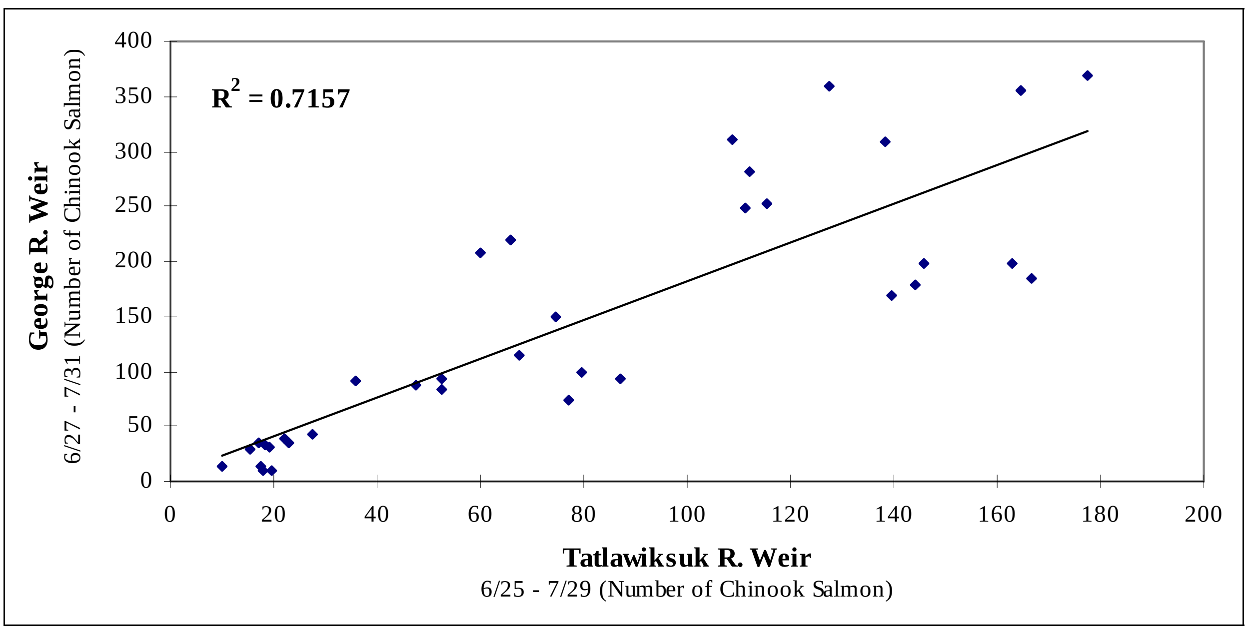


Figure 4.–Correlation of daily Chinook salmon passage between 27 June and 31 July at George River weir, and 25 June and 29 July at Tatlawiksuk River weir, 2004.

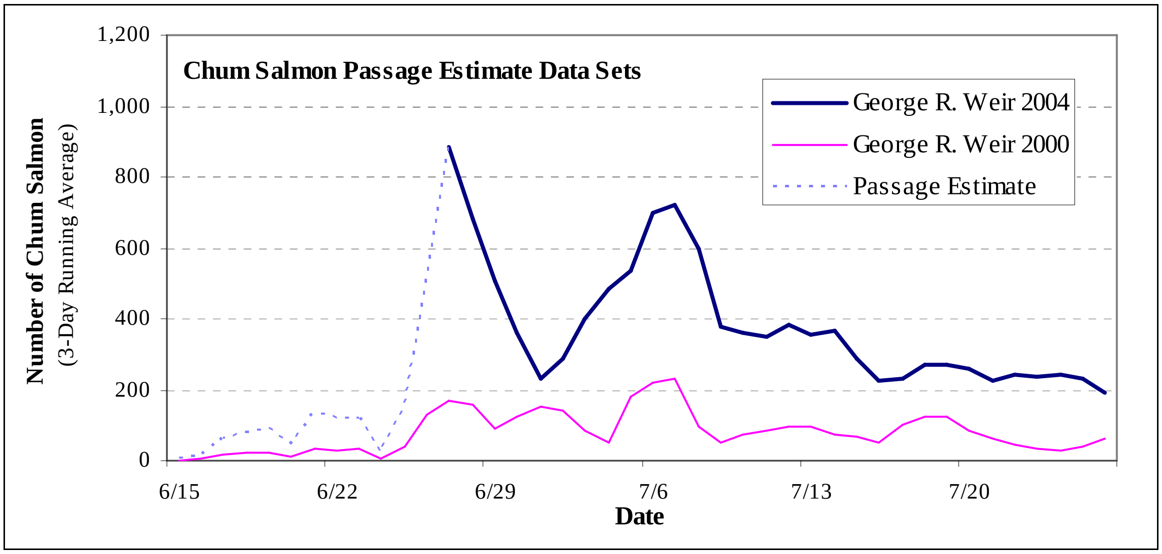


Figure 5.–Chum salmon passage at the George River weir in 2000 and 2004.

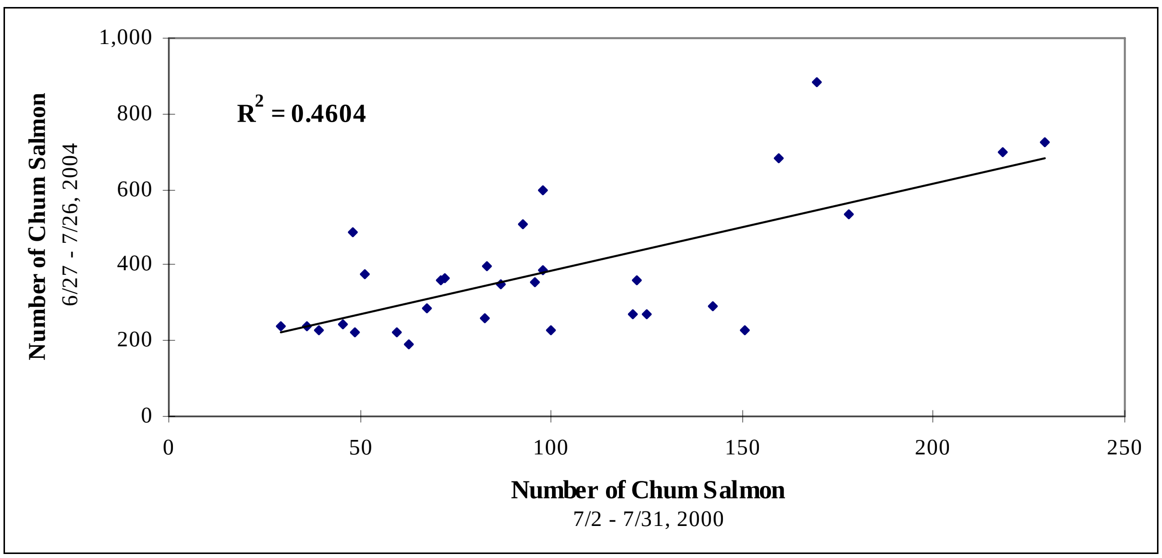
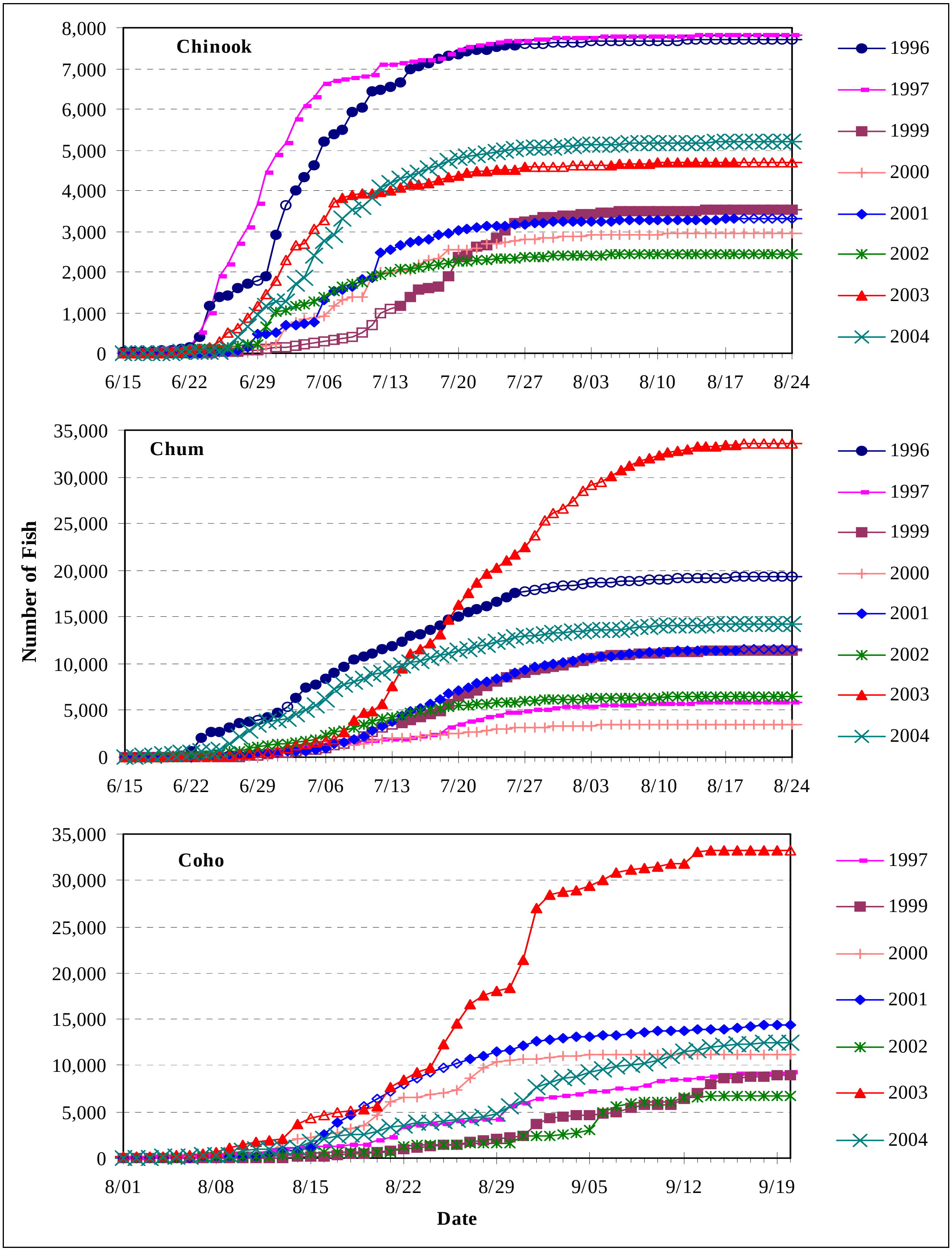


Figure 6.–Correlation of daily chum salmon passage between similar periods in 2000 and 2004 at the George River weir.



Note: Solid symbols represent observed passage, open symbols represent estimated passage.

Figure 7.–Historical intra-annual cumulative passage of Chinook, chum, and coho salmon at the George River weir.

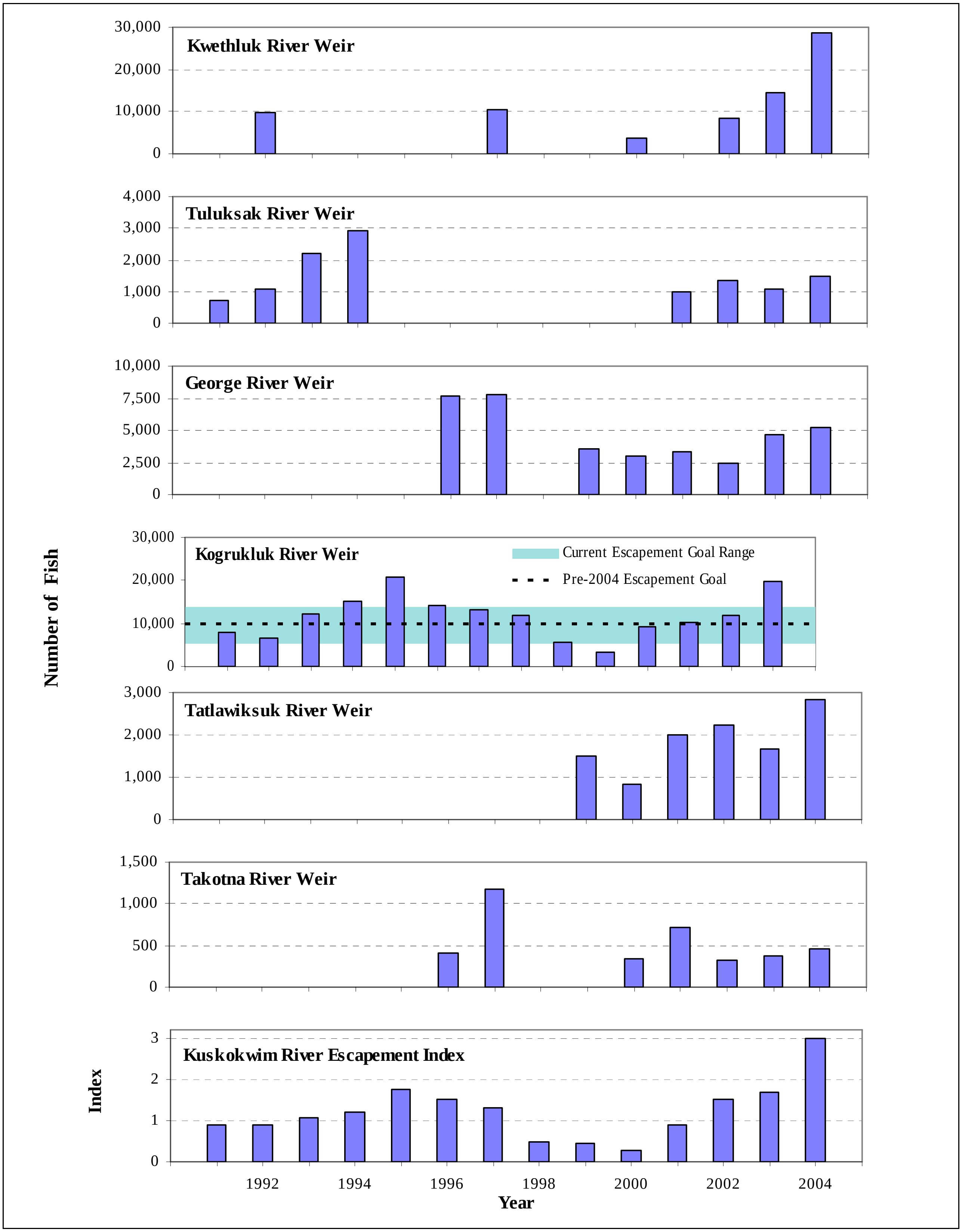
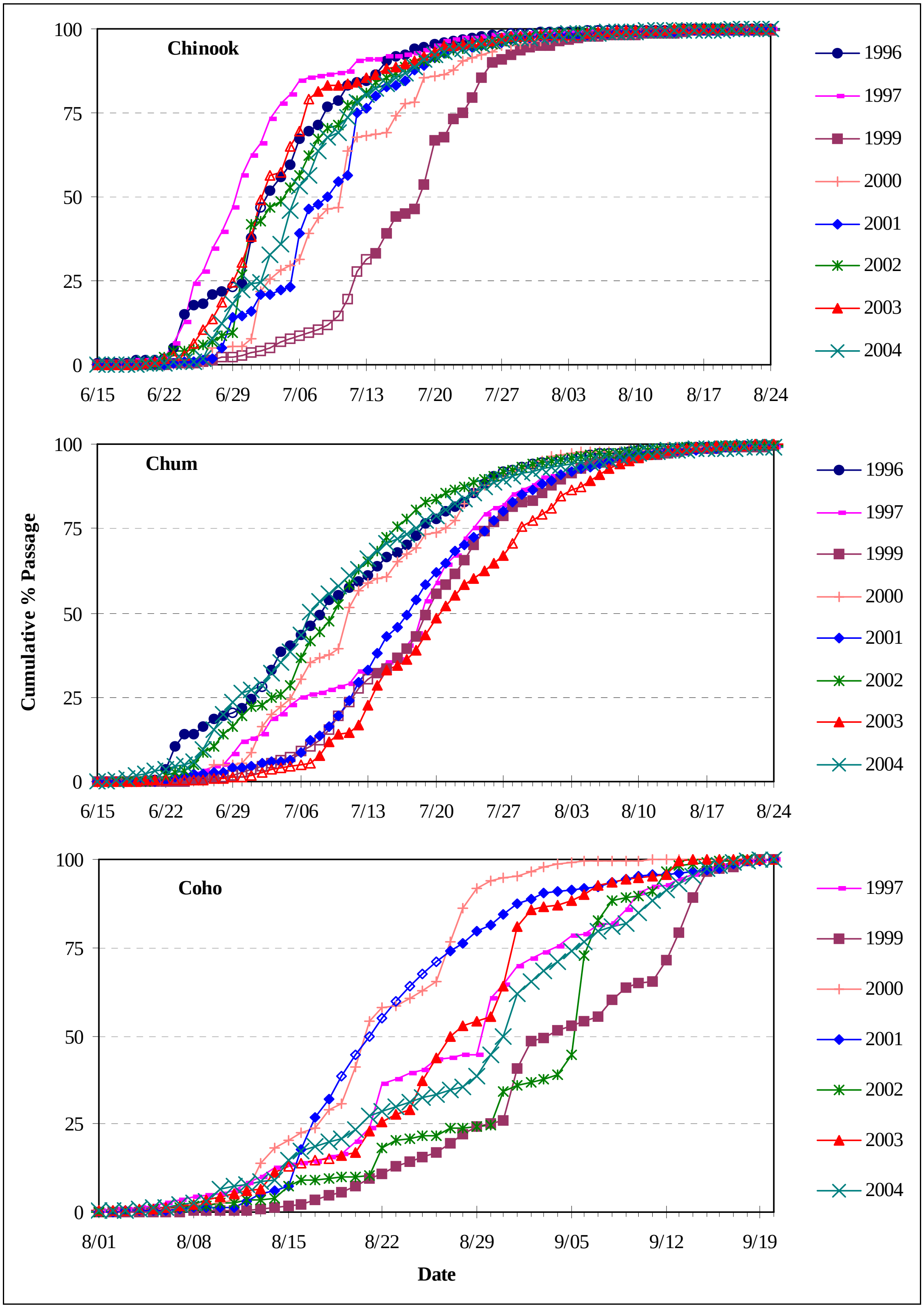


Figure 8.–Historical annual Chinook salmon escapement into 6 Kuskokwim River tributaries, and the Kuskokwim River Chinook salmon escapement indices, 1991–2004.



Note: Solid symbols represent observed passage, open symbols represent estimated passage.

Figure 9.–Historical intra-annual percent passage of Chinook, chum, and coho salmon at the George River weir.

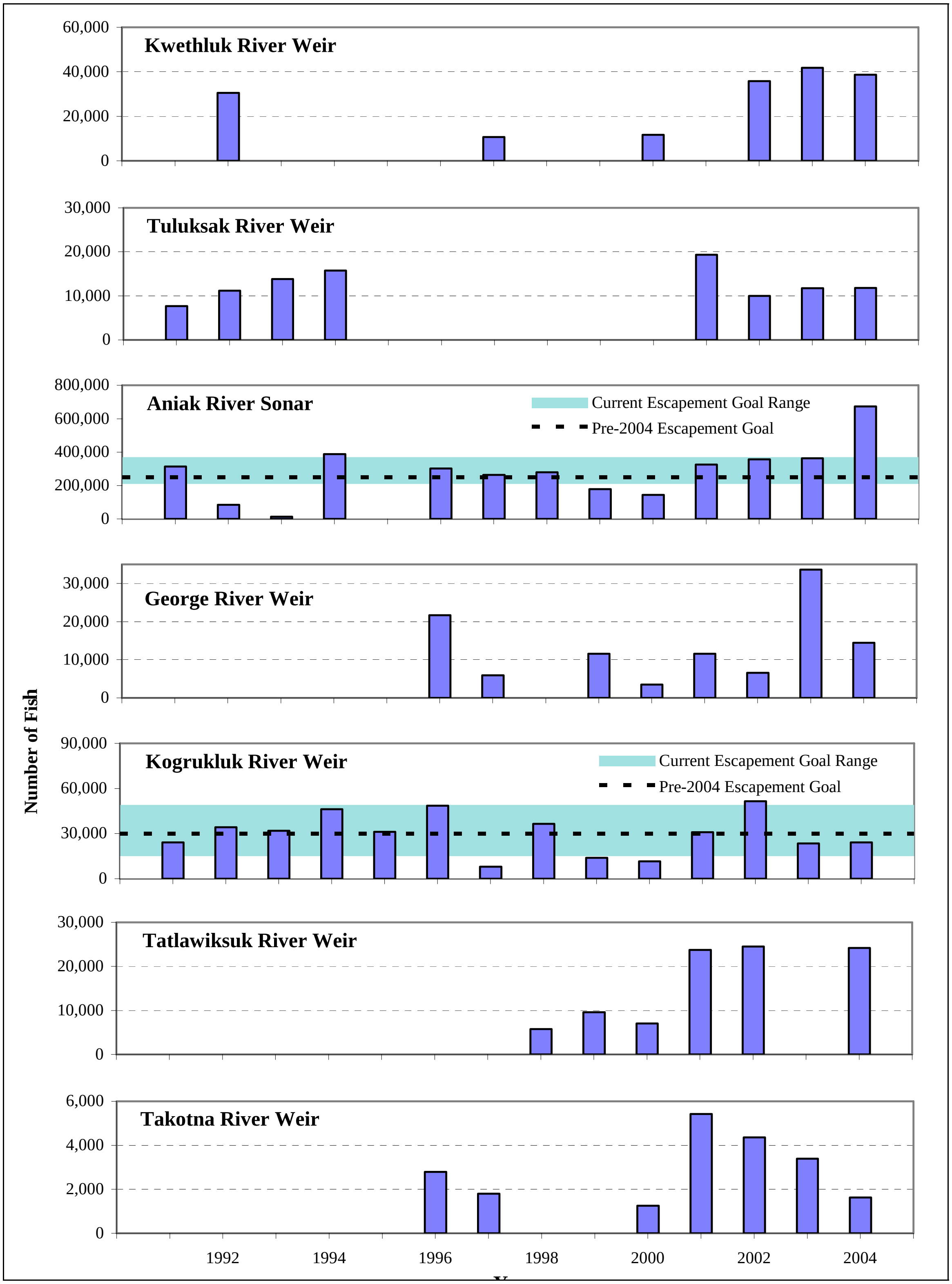


Figure 10.–Historical annual chum salmon escapement into 7 Kuskokwim River tributaries, 1991–2004.

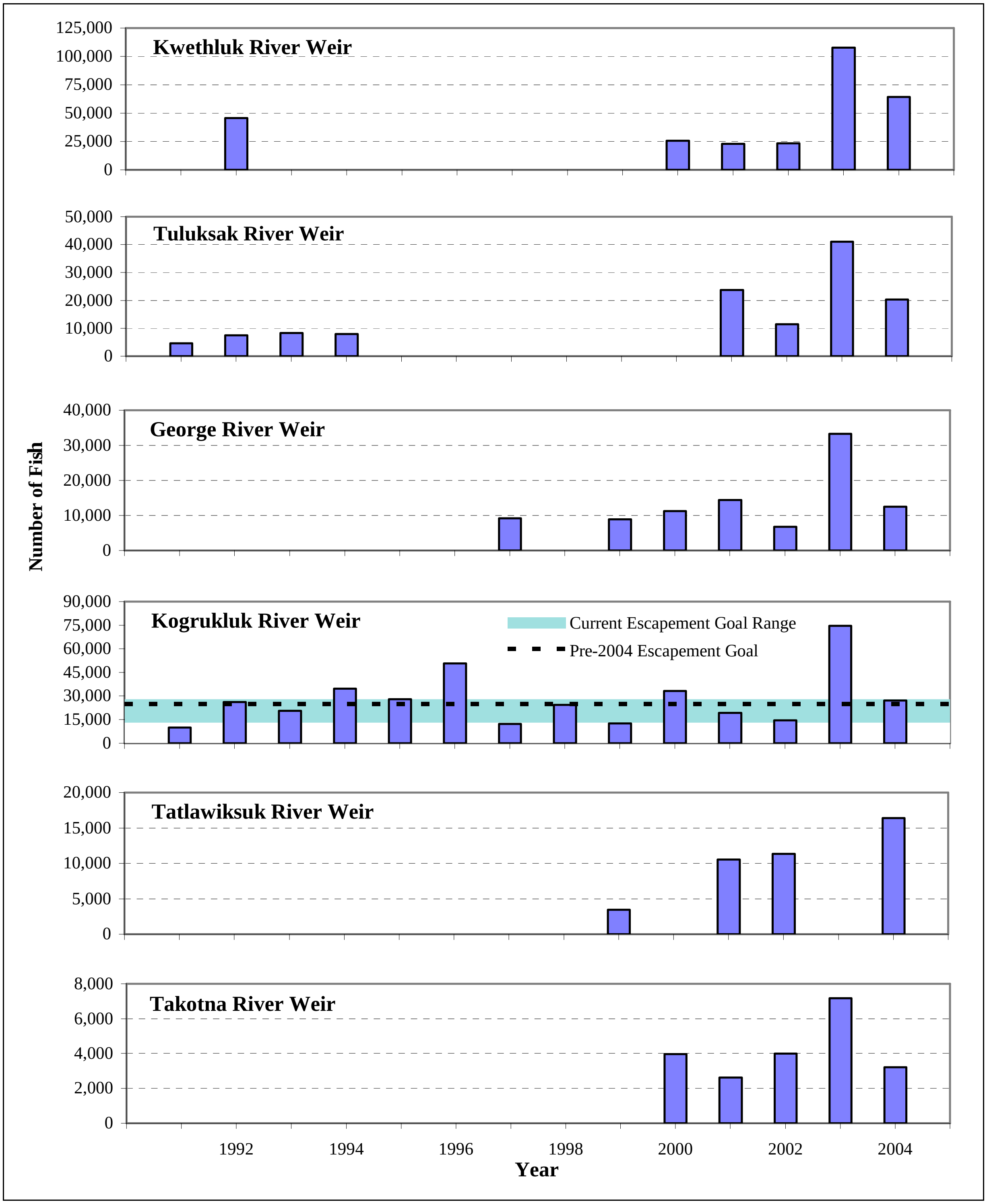


Figure 11.–Historical annual coho salmon escapement into 6 Kuskokwim River tributaries, 1991–2004.

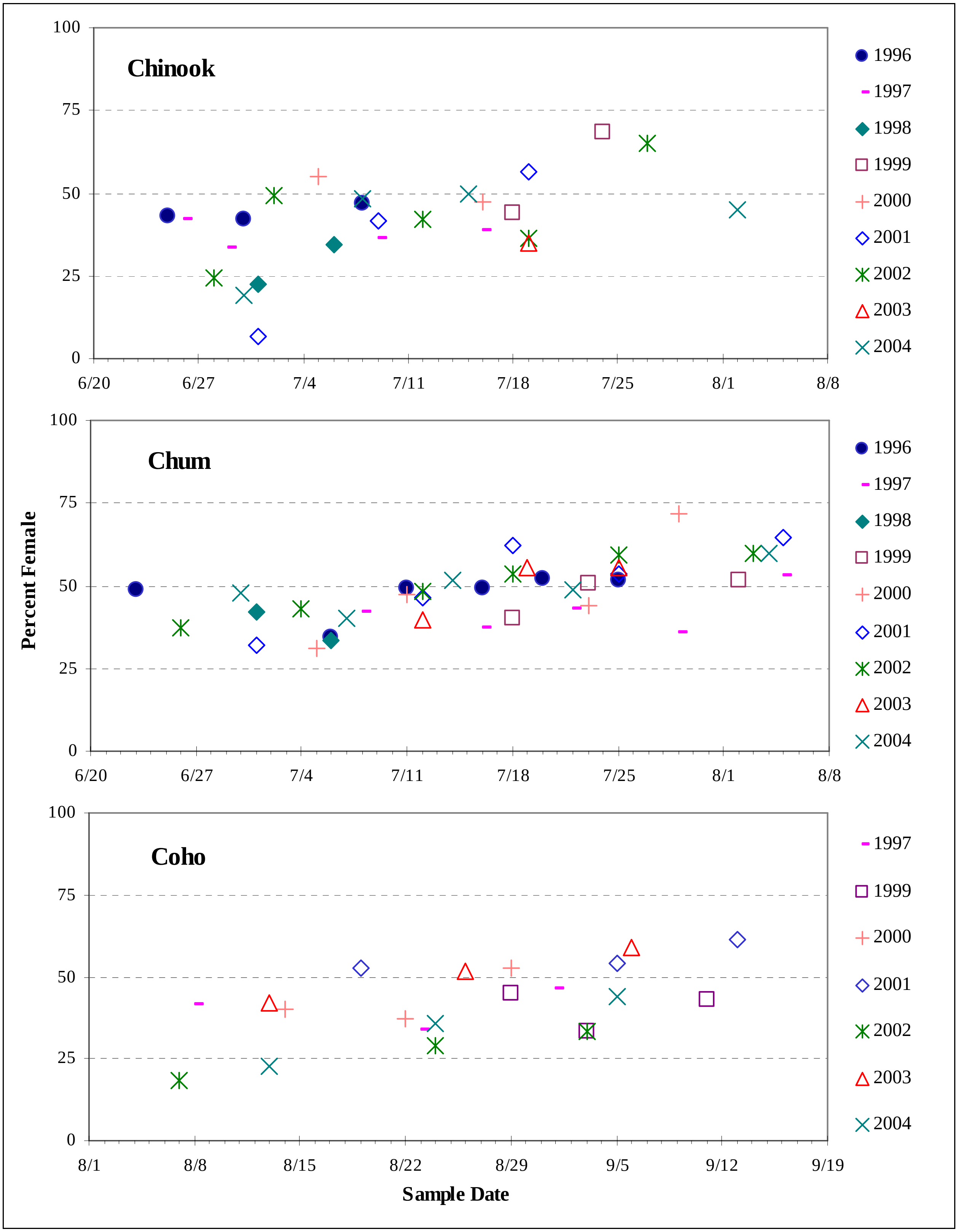


Figure 12.–Historical intra-annual percent female Chinook, chum, and coho salmon at George River weir by sample date.

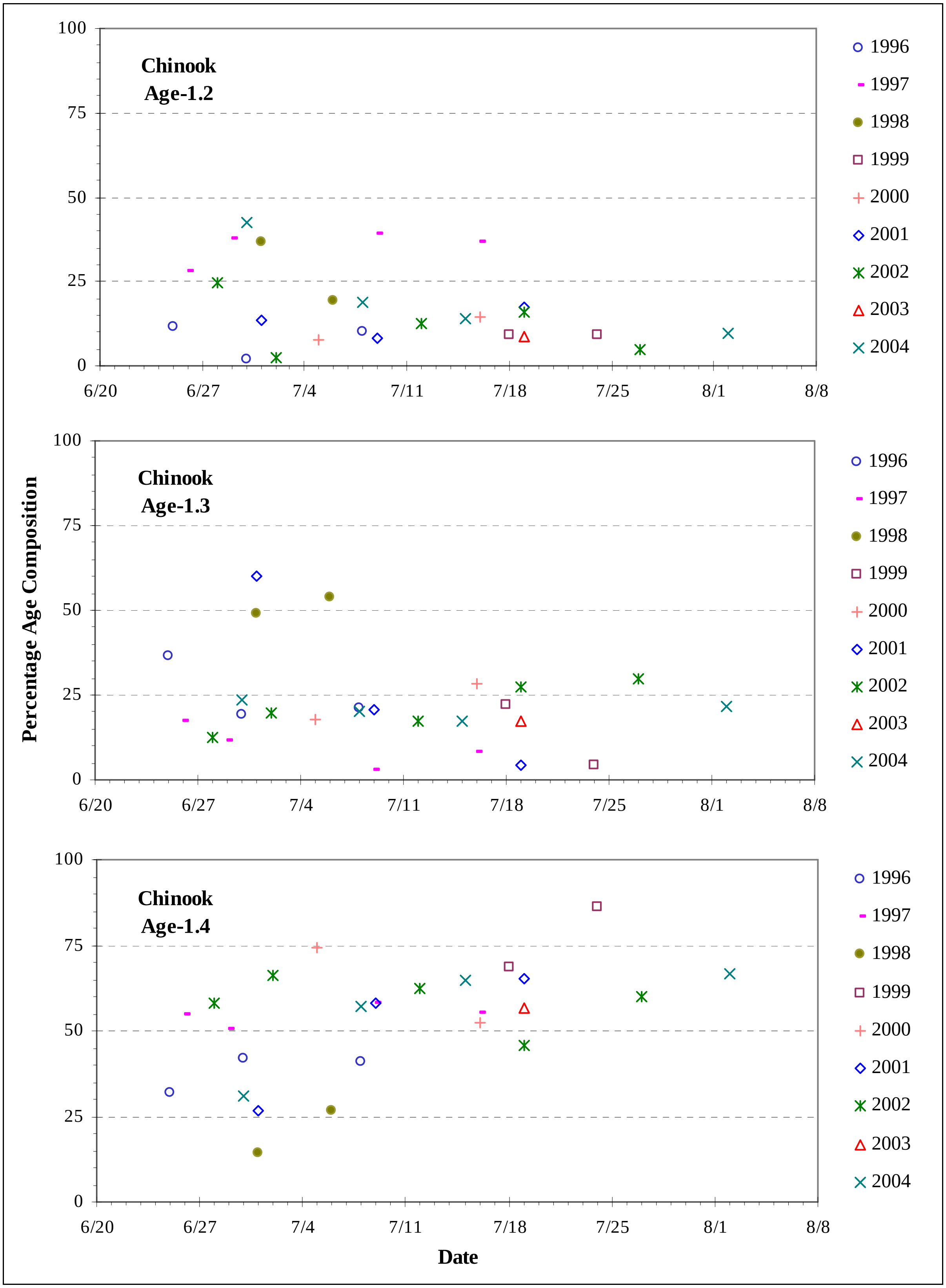


Figure 13.–Historical intra-annual age composition of Chinook salmon at George River weir by sample date.

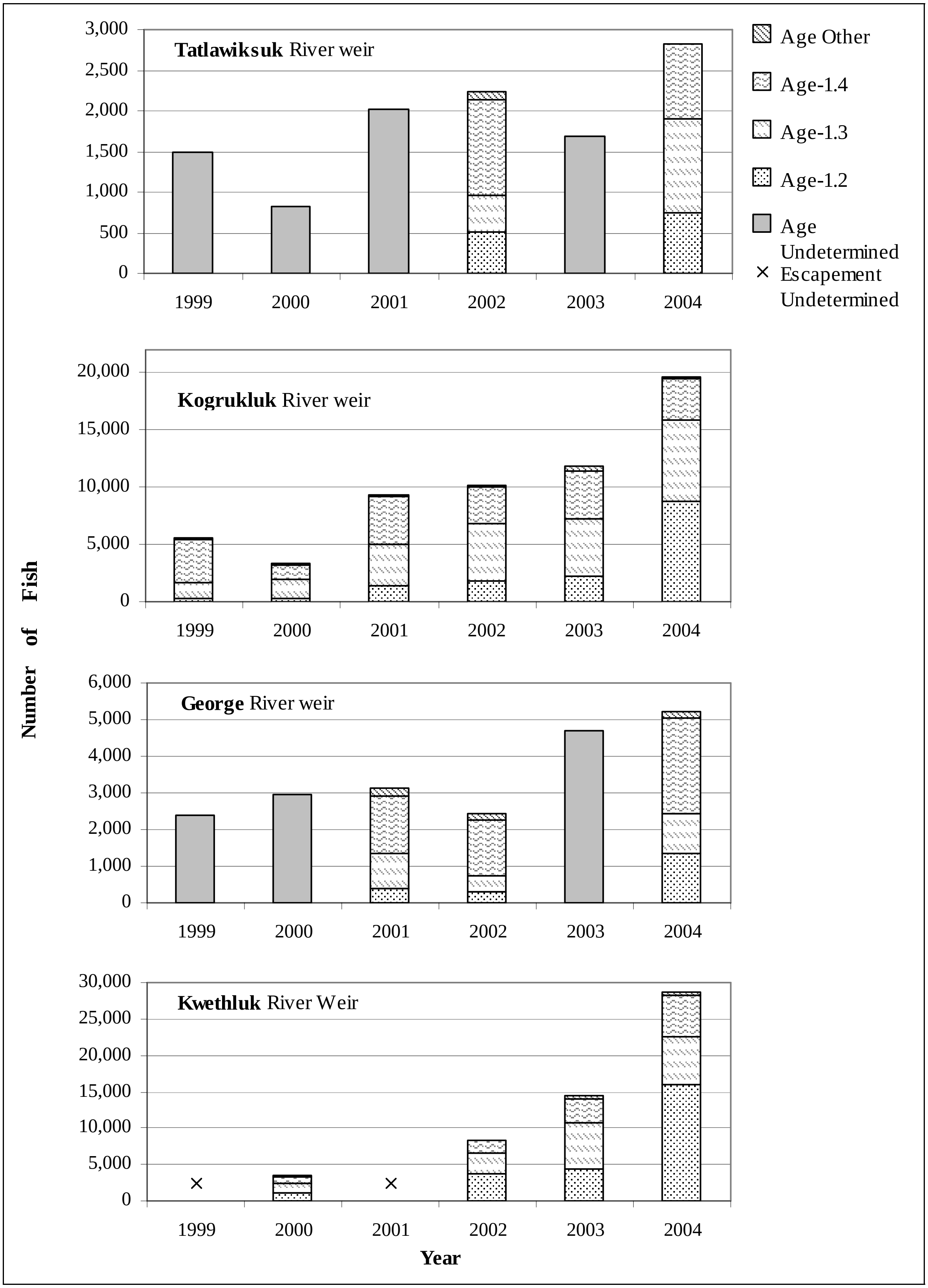


Figure 14.–Age composition relative to escapement of Chinook salmon at 4 Kuskokwim River tributary projects, 1999–2004.

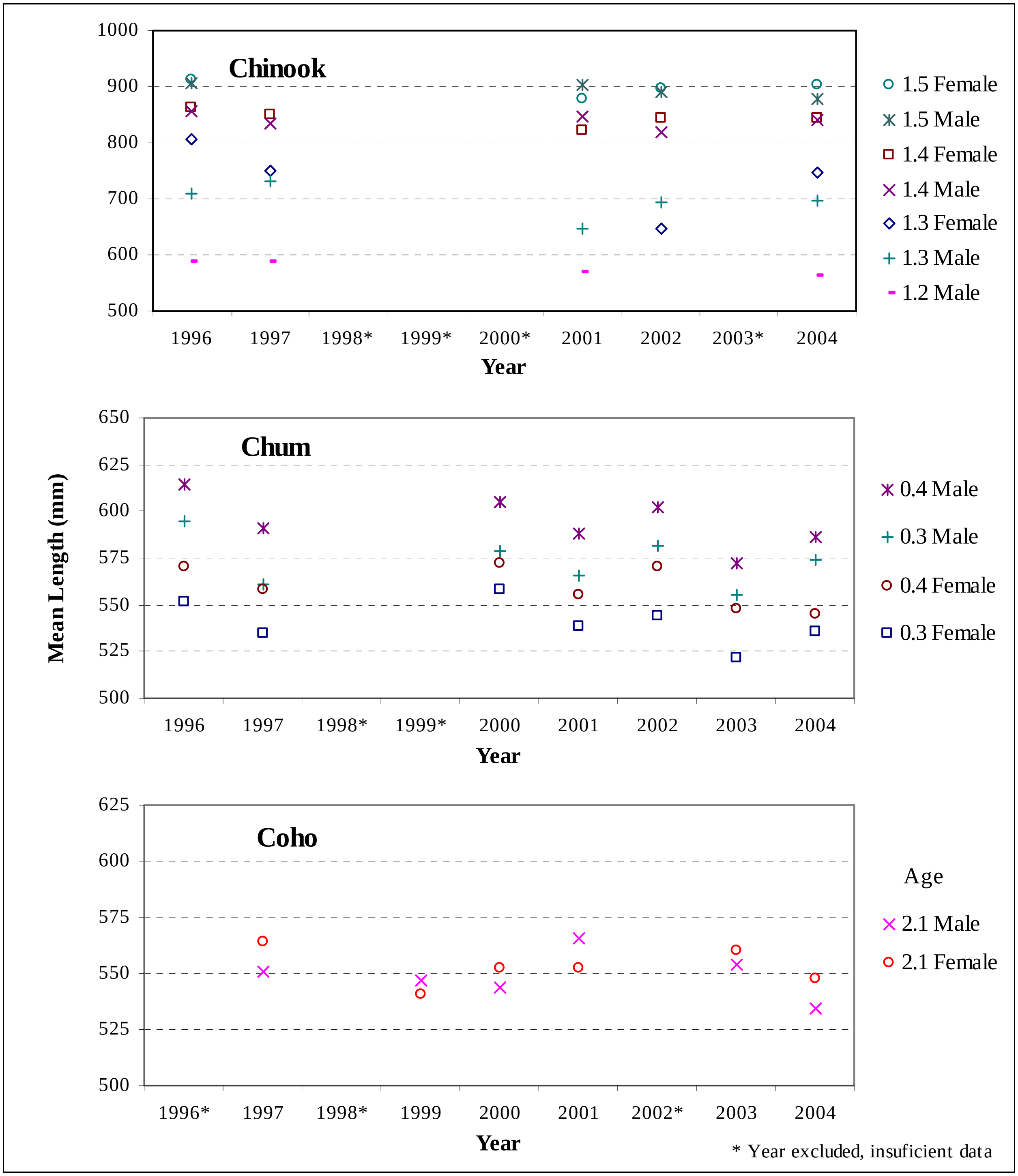


Figure 15.–Historical annual mean length of Chinook, chum, and coho salmon at George River weir.

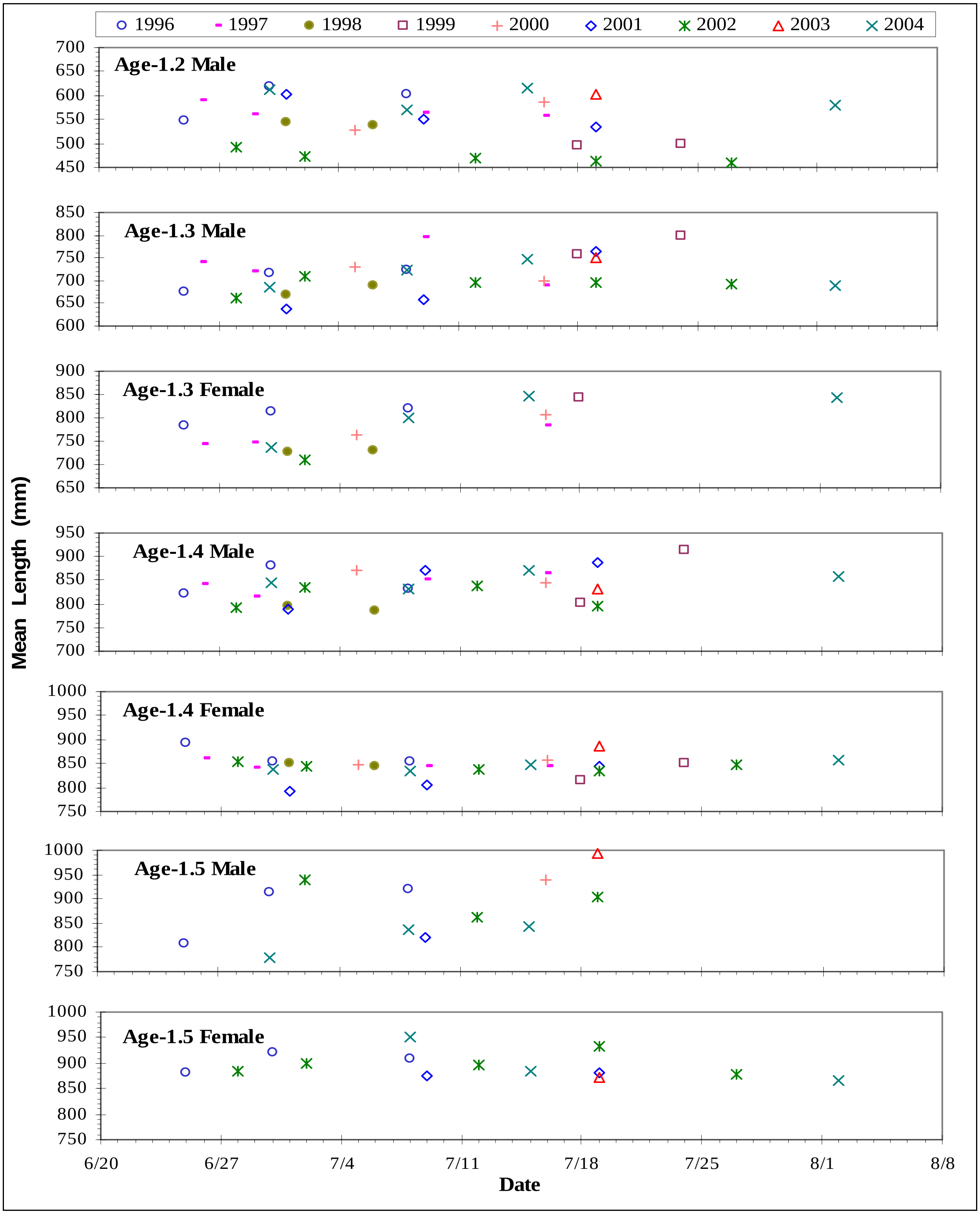


Figure 16.–Historical intra-annual mean length at age for male and female Chinook salmon at George River weir by sample date.

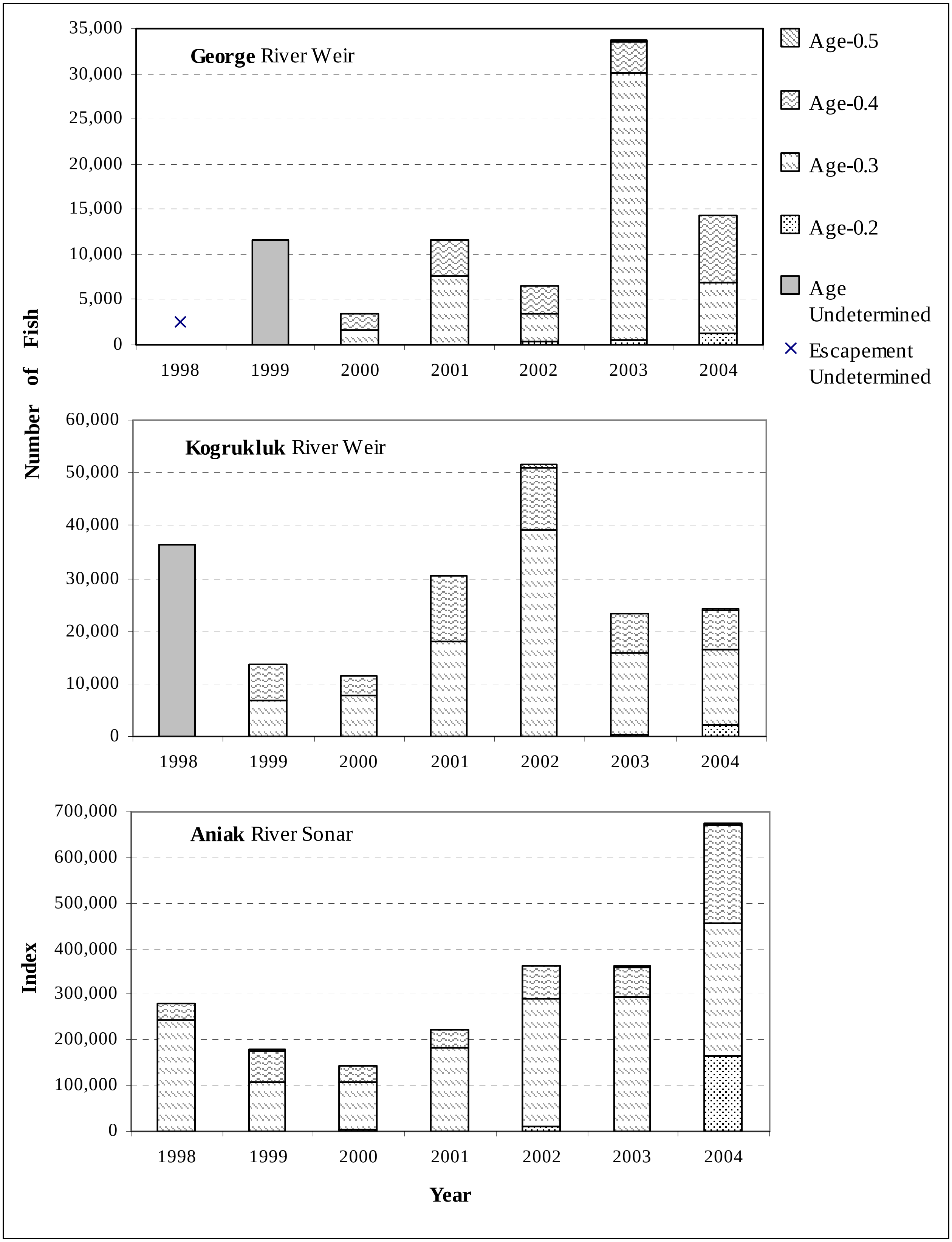


Figure 17.–Age composition relative to escapement of chum salmon at 3 Kuskokwim River tributary projects, 1998–2004.

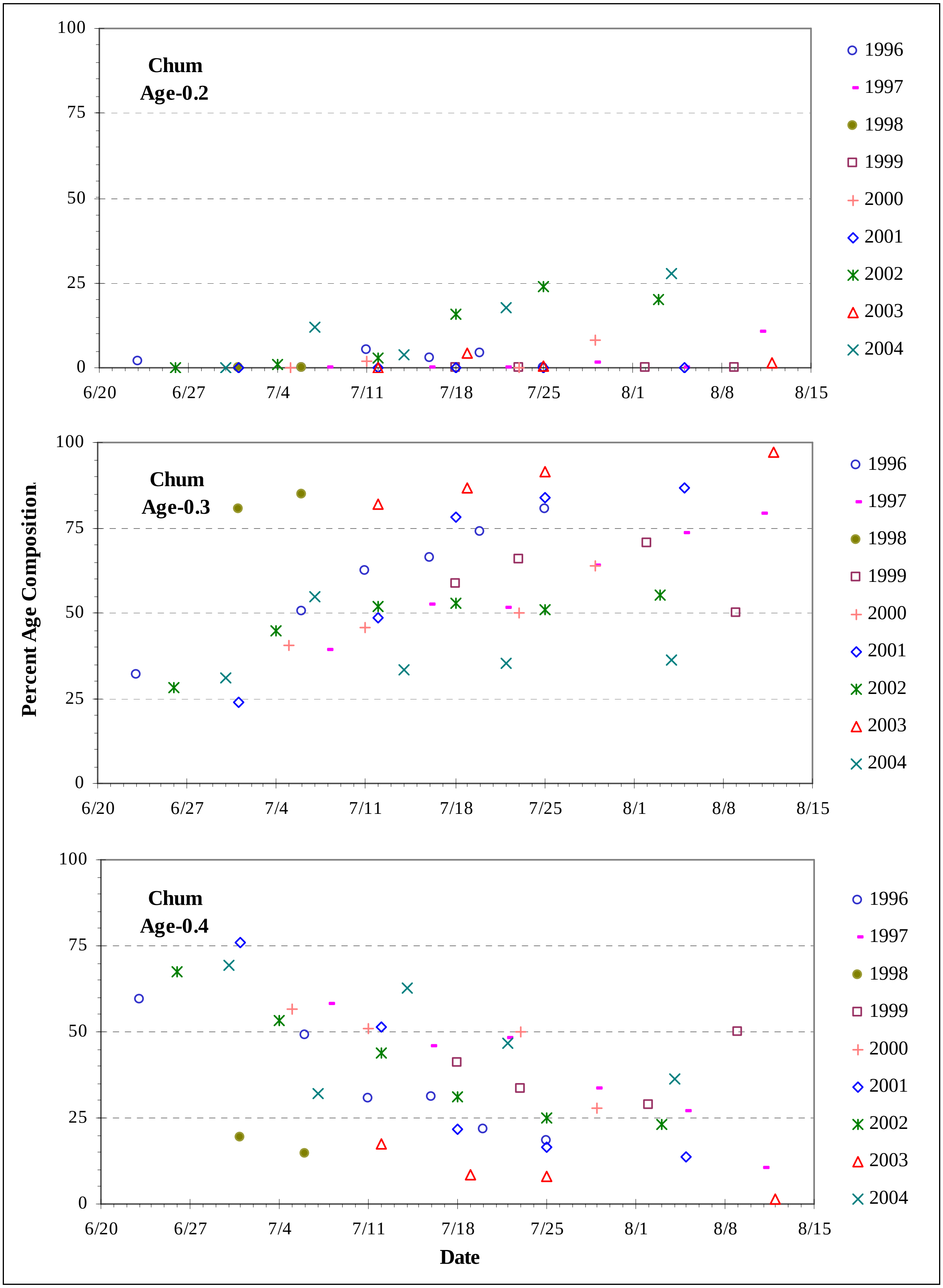


Figure 18.–Historical intra-annual age composition of chum salmon at George River weir by sample date.

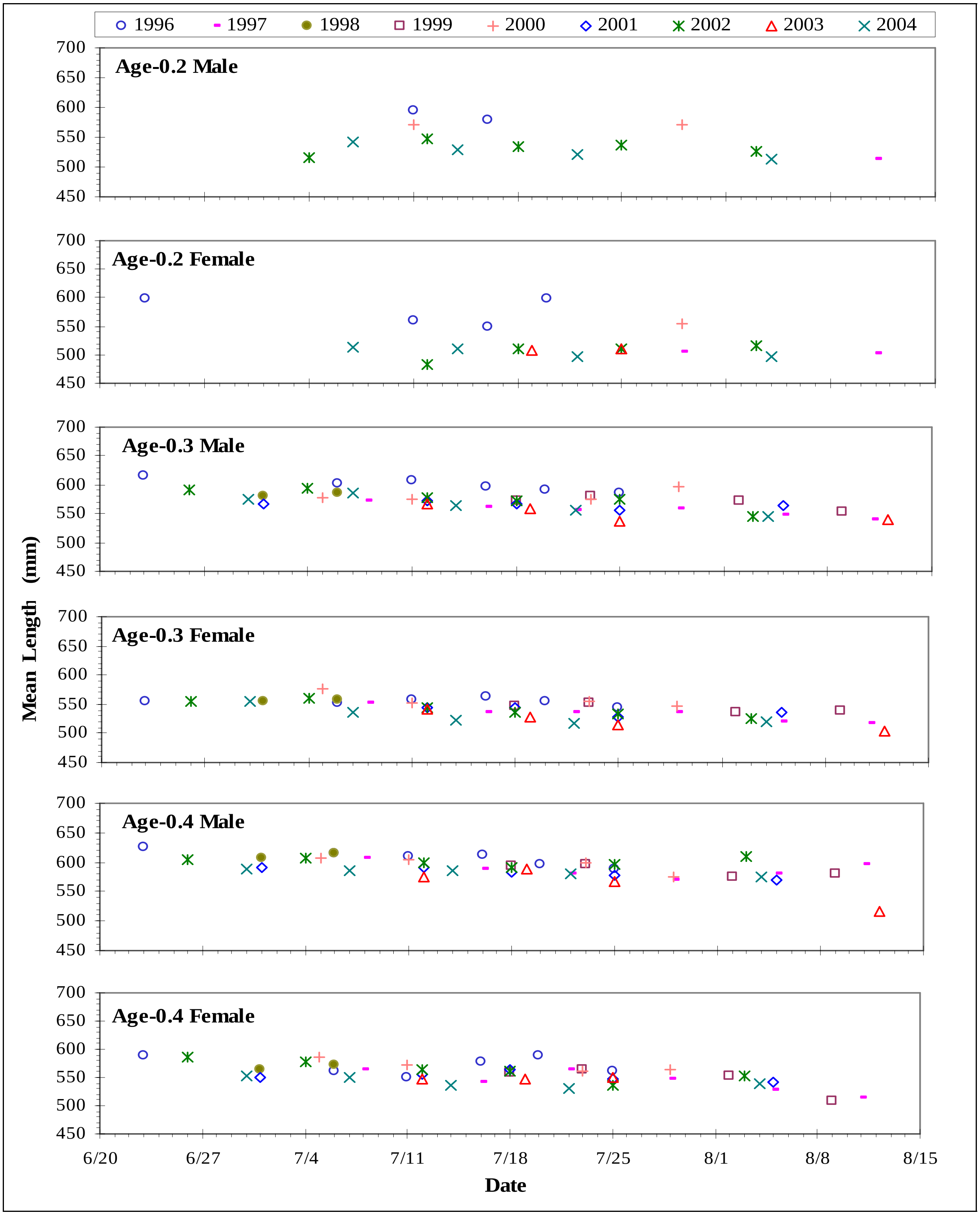


Figure 19.–Historical intra-annual mean length (mm) at age for male and female chum salmon at George River weir by sample date.

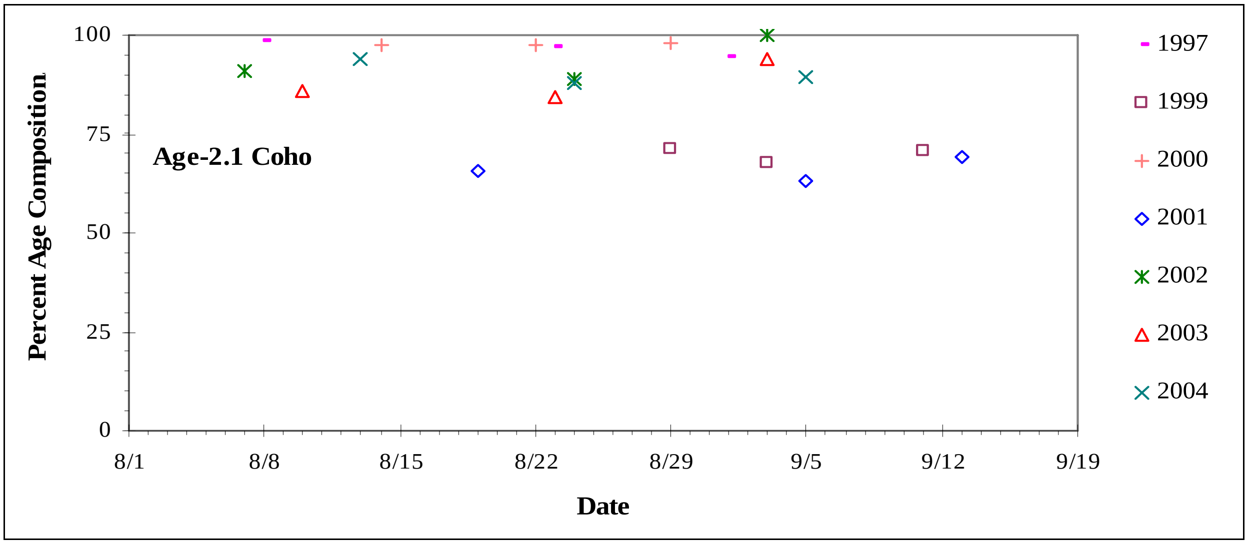


Figure 20.–Historical intra-annual percentage of age-2.1 coho salmon at George River weir by sample date.

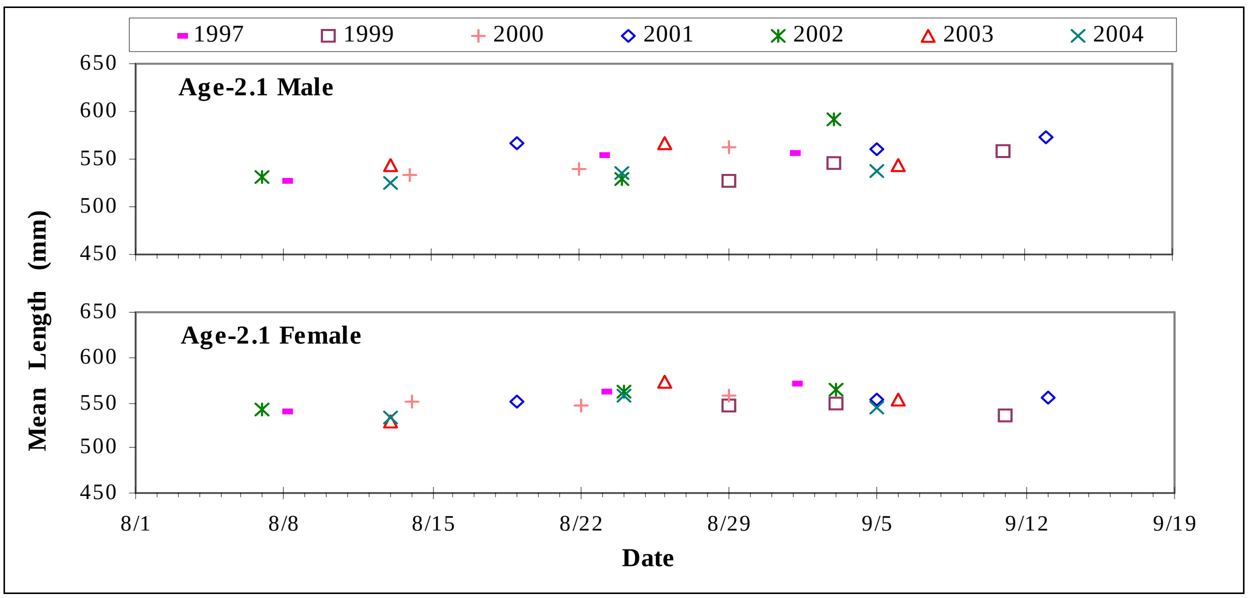
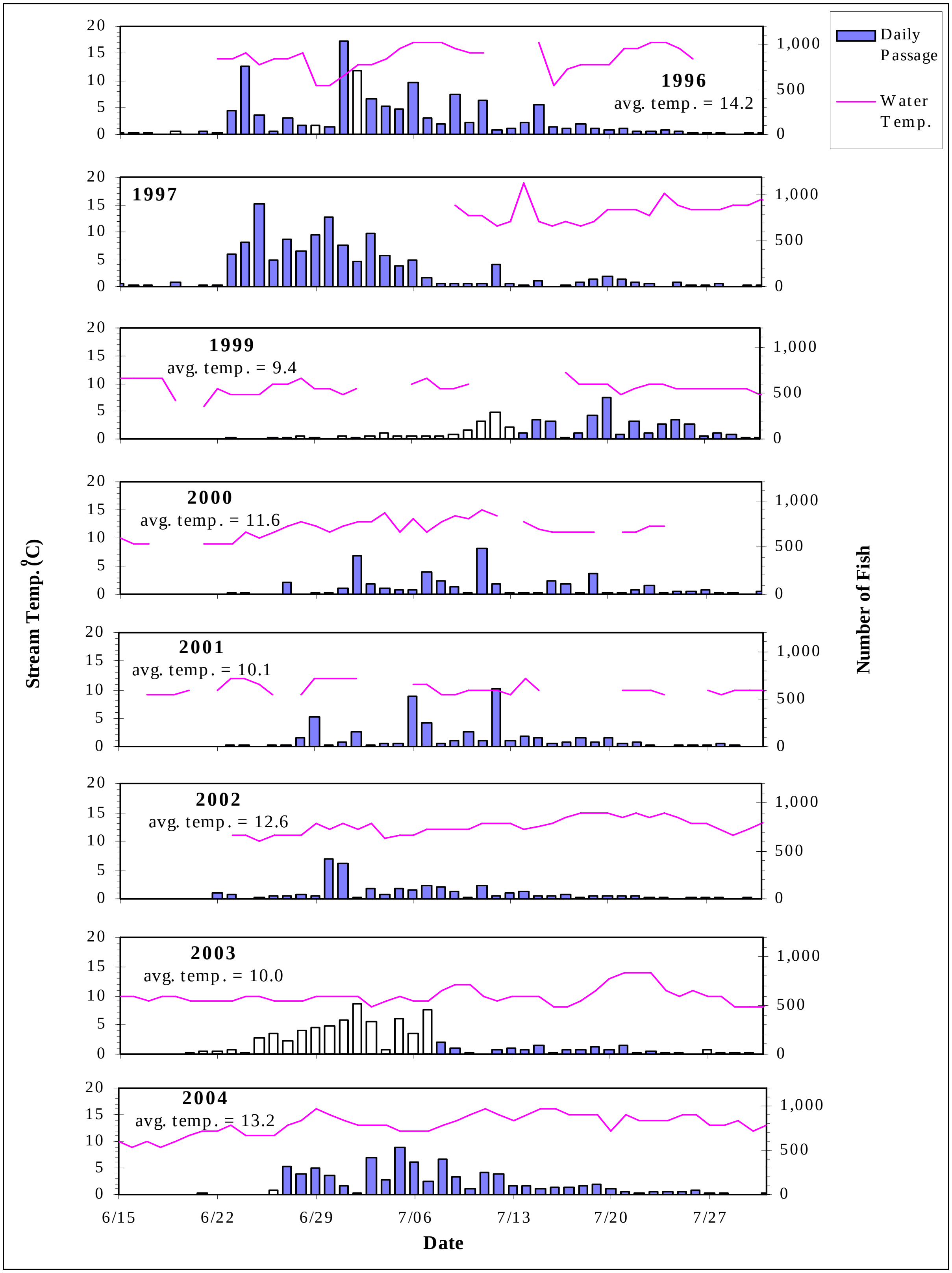
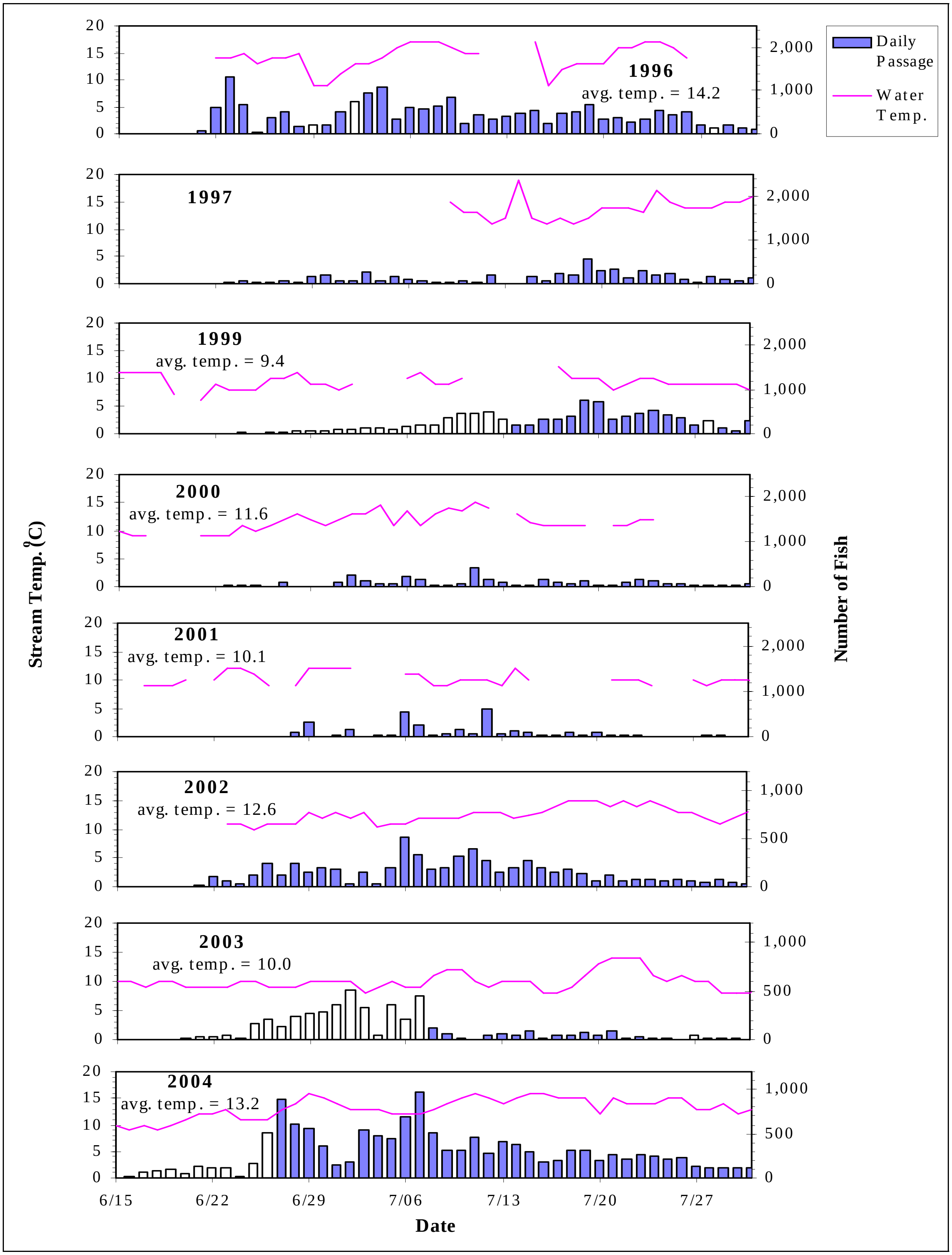


Figure 21.–Historical intra-annual mean length of age-2.1 coho salmon at George River weir by sex and sample date.



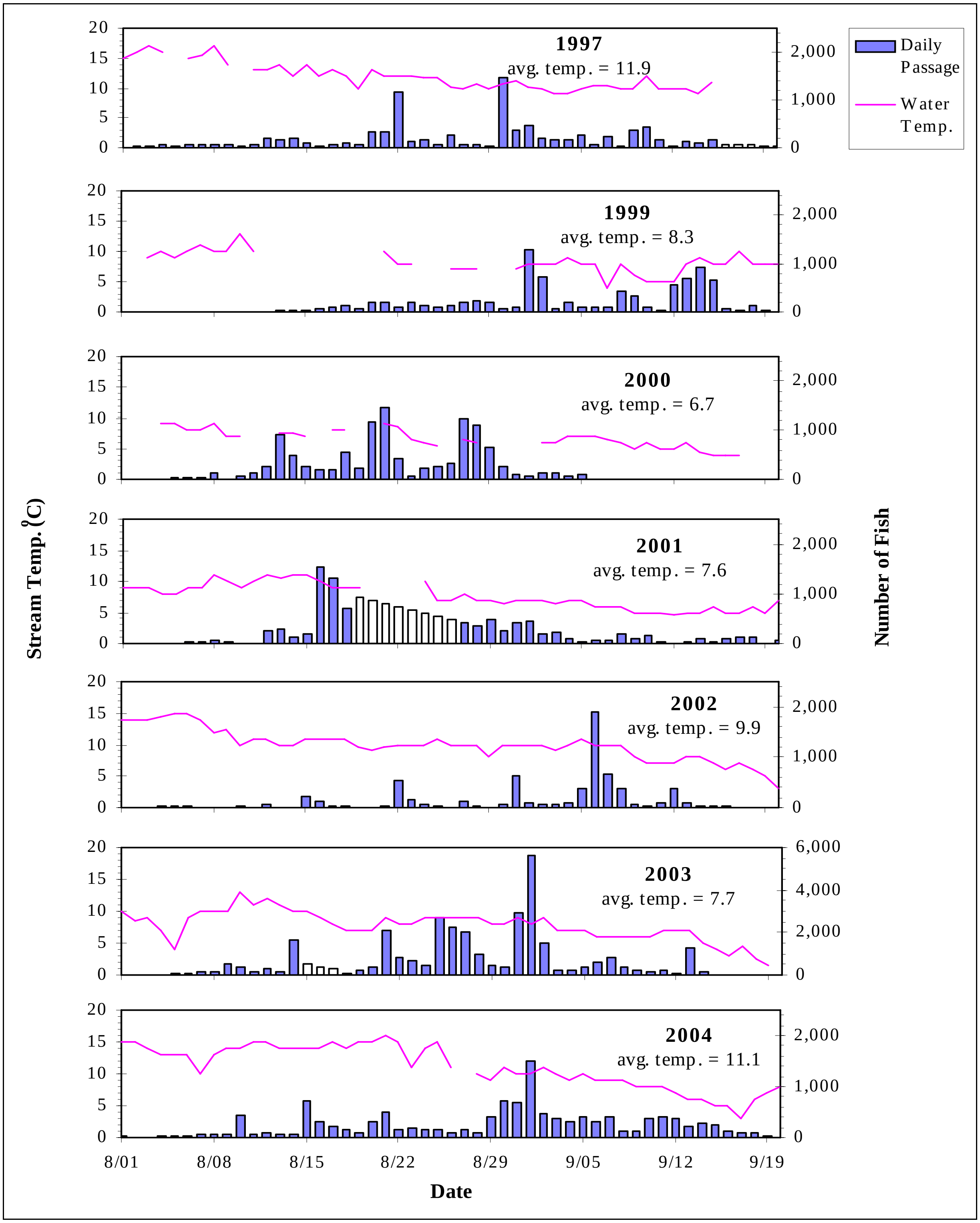
Note: Solid bars represent observed passage, open bars represent estimated passage.

Figure 22.–Historical daily Chinook salmon passage relative to daily morning stream temperature at George River weir.



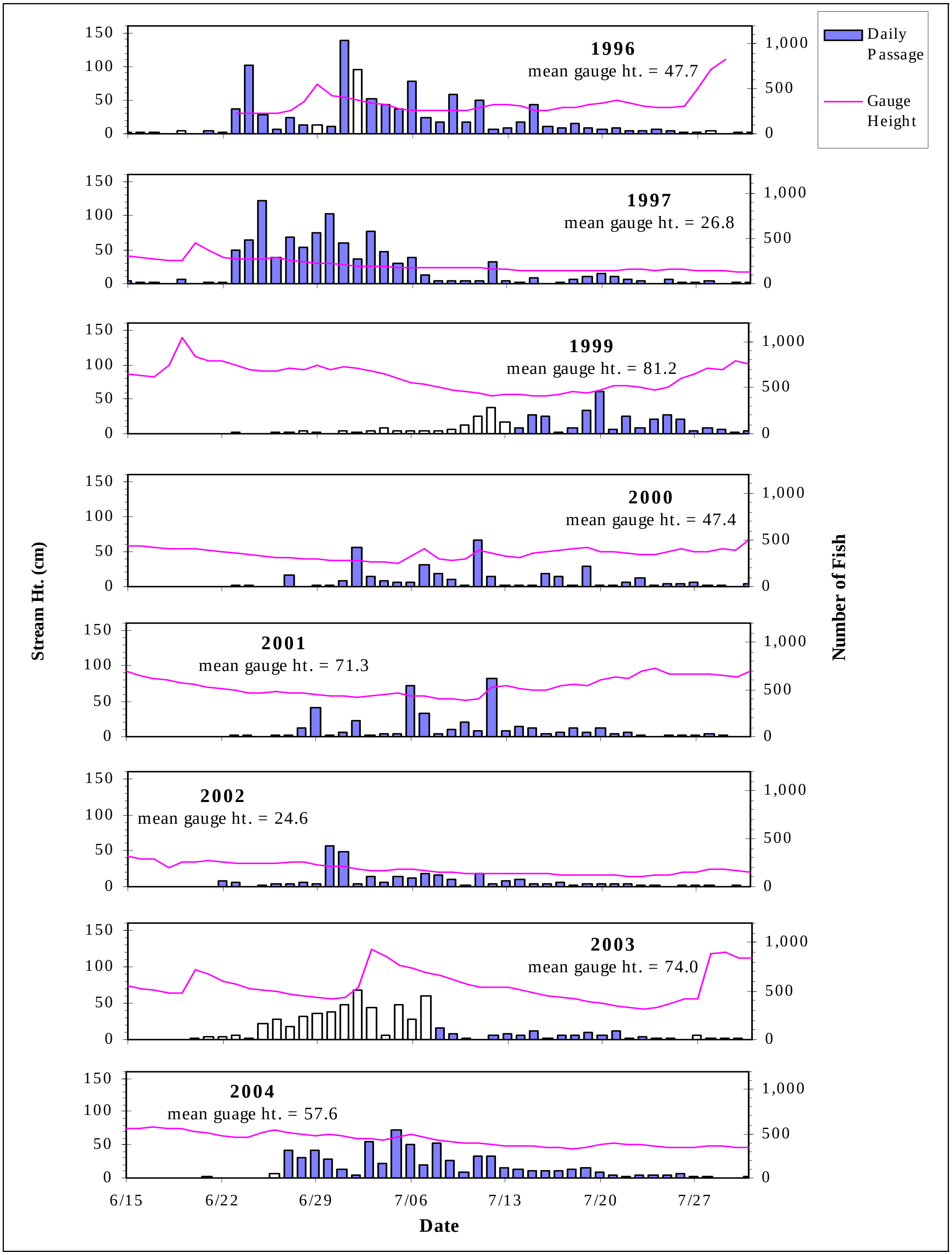
Note: Solid bars represent observed passage, open bars represent estimated passage.

Figure 23.–Historical daily chum salmon passage relative to daily morning stream temperature at George River weir.



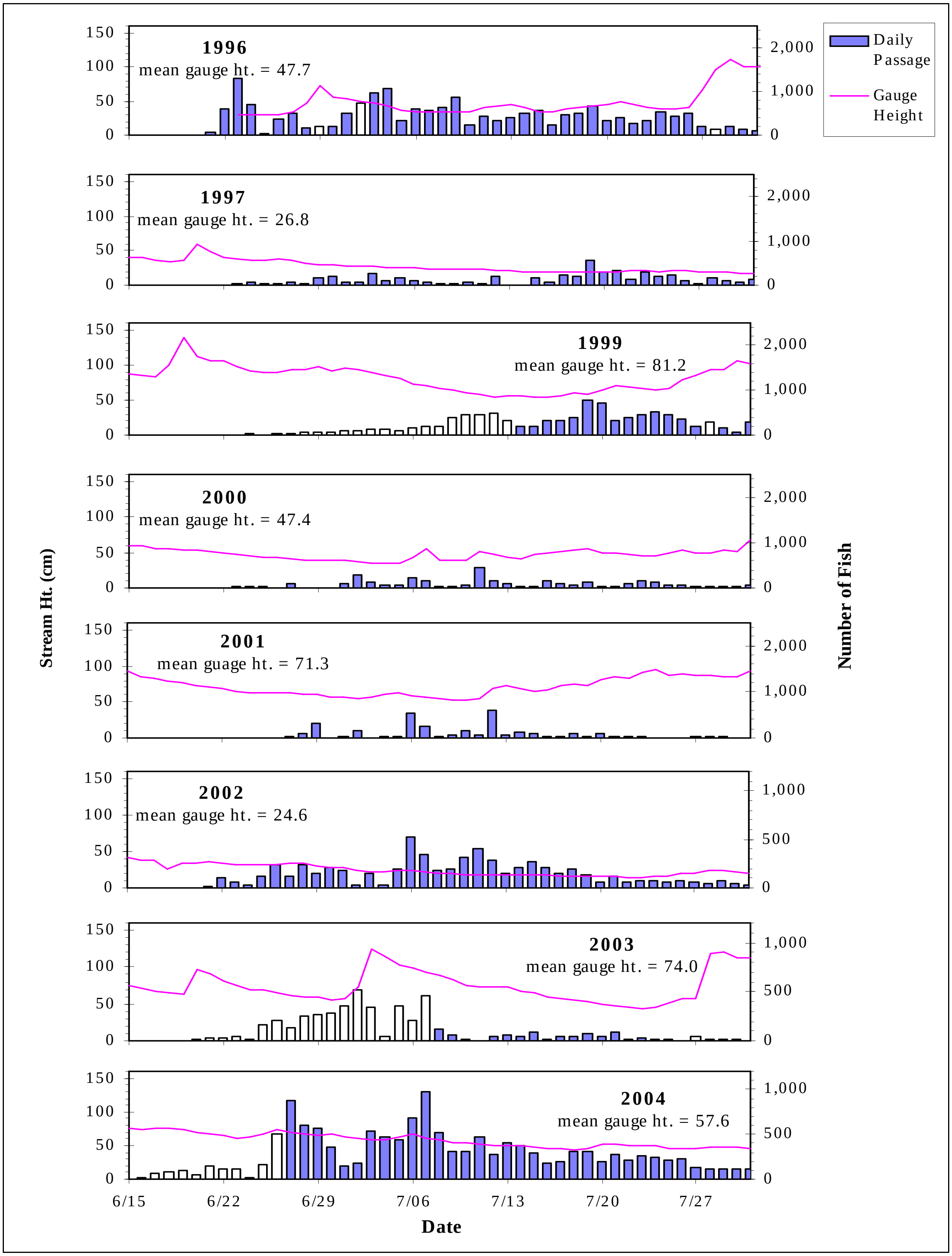
Note: Solid bars represent observed passage, open bars represent estimated passage.

Figure 24.–Historical daily coho salmon passage relative to daily morning stream temperature at George River weir.



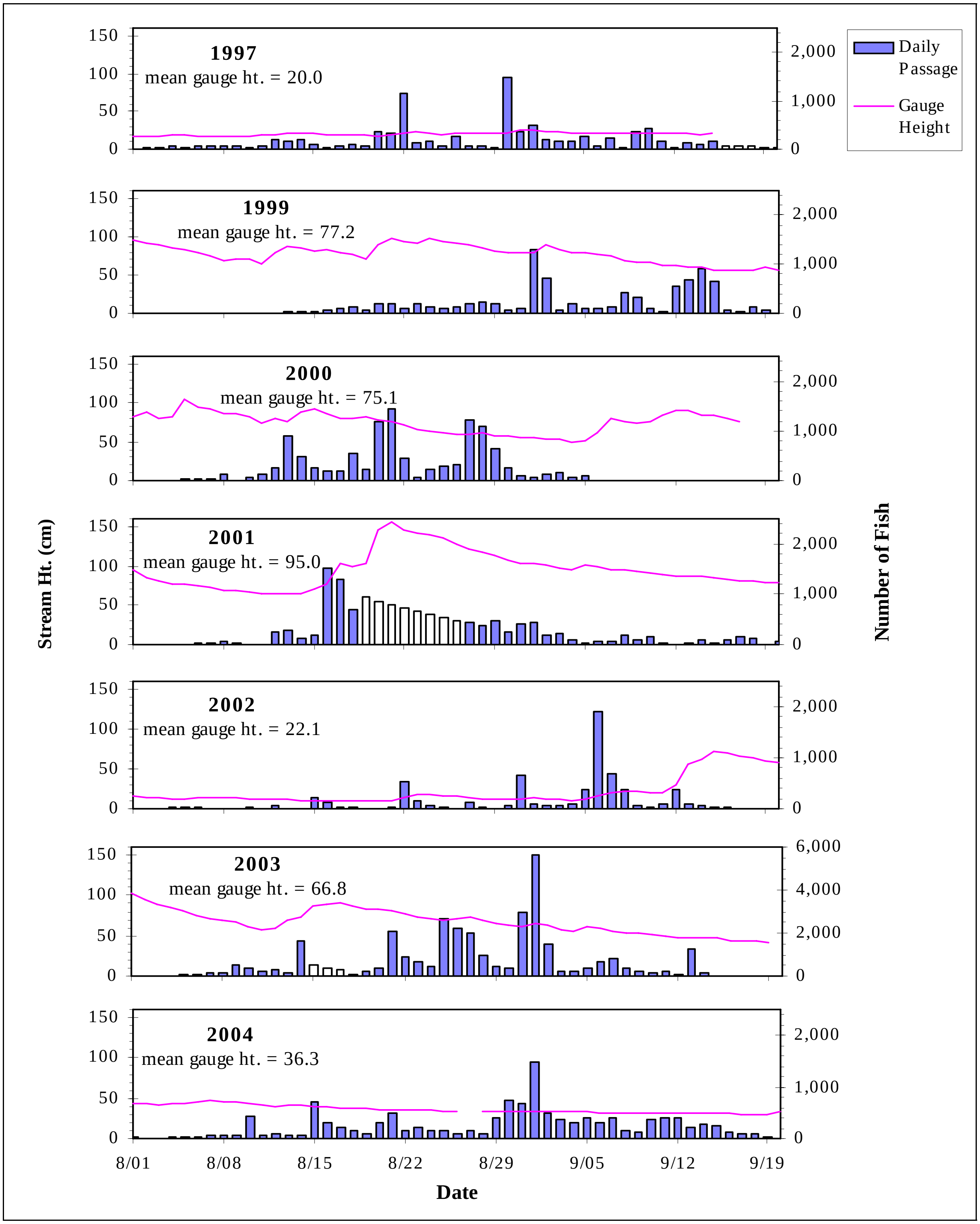
Note: Solid bars represent observed passage, open bars represent estimated passage.

Figure 25.–Historical daily Chinook salmon passage relative to daily morning stream gauge height at George River weir.



Note: Solid bars represent observed passage, open bars represent estimated passage.

Figure 26.–Historical daily chum salmon passage relative to daily morning stream gauge height at George River weir.



Note: Solid bars represent observed passage, open bars represent estimated passage.

Figure 27.–Historical daily coho salmon passage relative to daily morning stream gauge height at George River weir.

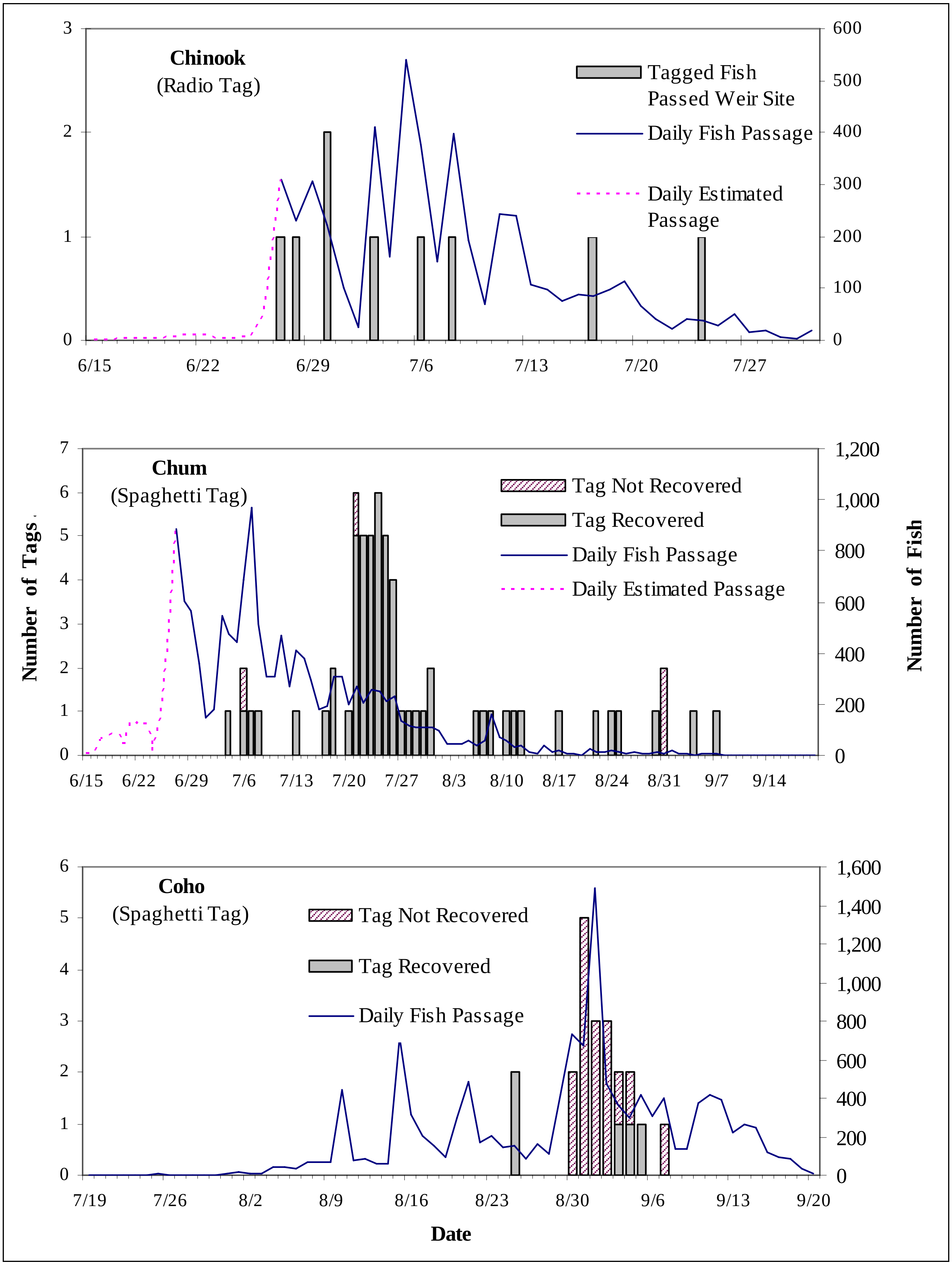
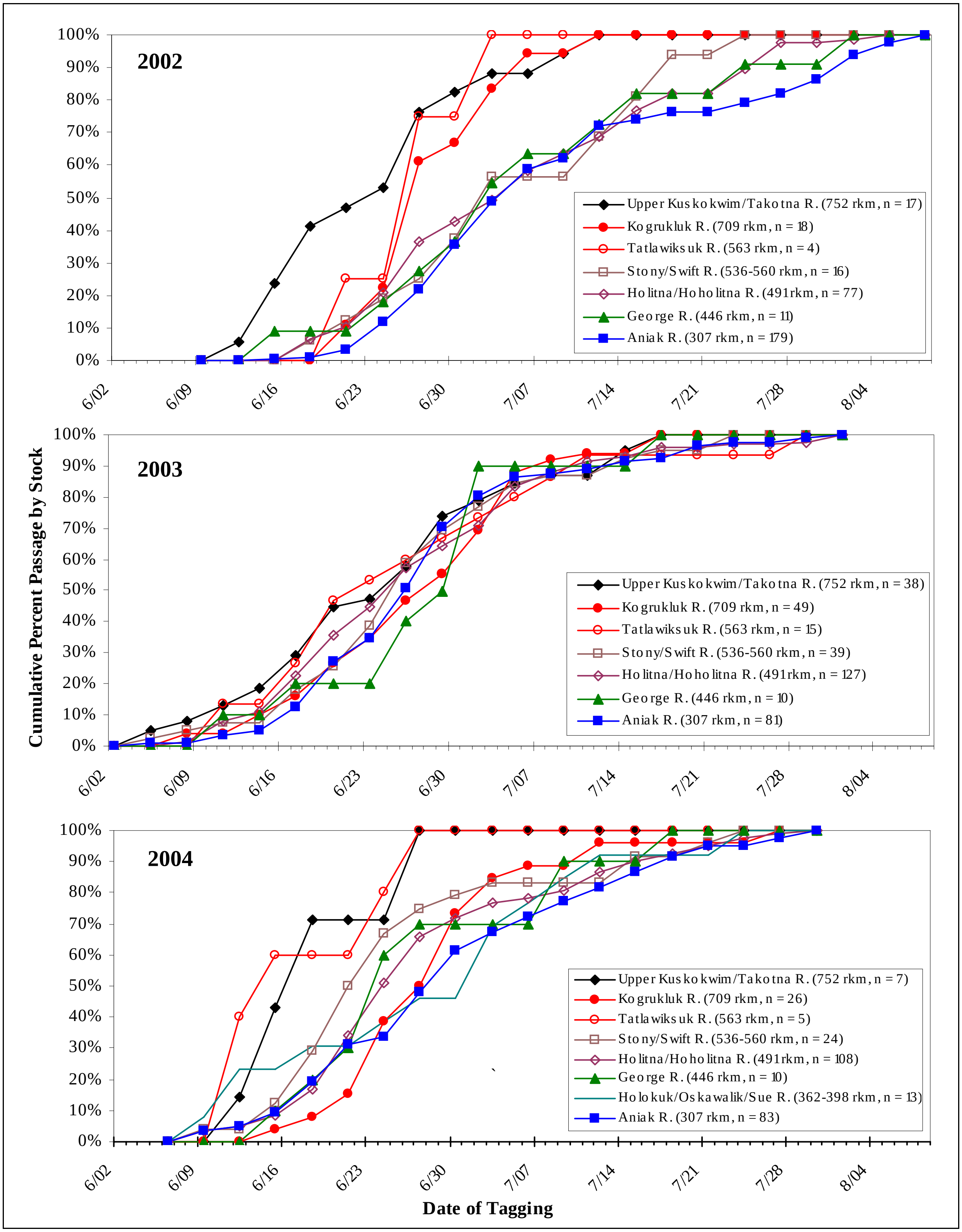


Figure 28.–Daily detections of tagged Chinook, chum, and coho salmon at George River weir compared to daily escapement, 2004.



Source: Stuby 2003, 2004, 2005. *Note*: River kilometer (rkm) from marine waters and sample size in parentheses.

Figure 29.–Historical cumulative percent passage of selected Chinook salmon stocks at the Kalskag-Aniak tagging site based on radio tagging studies.

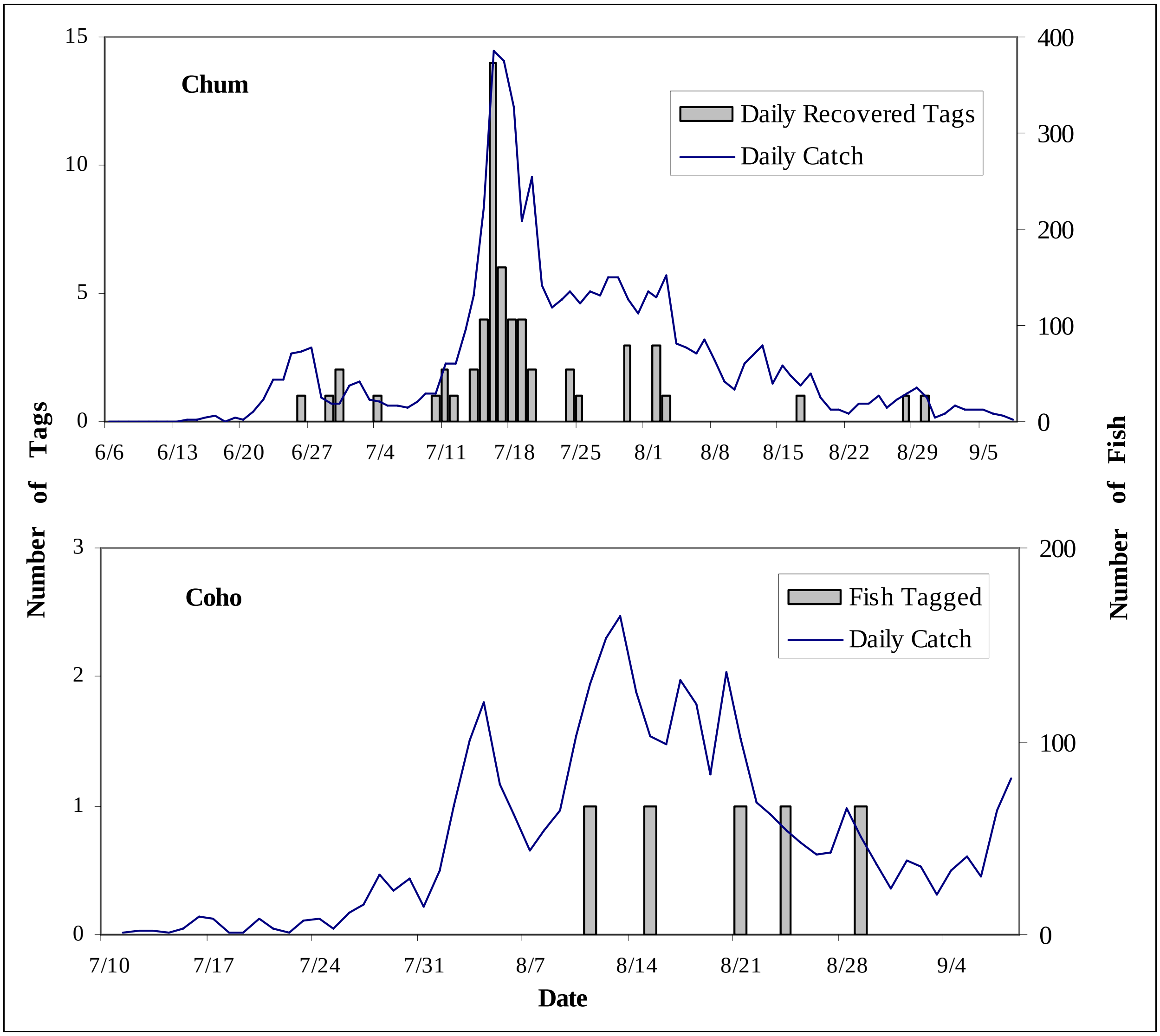
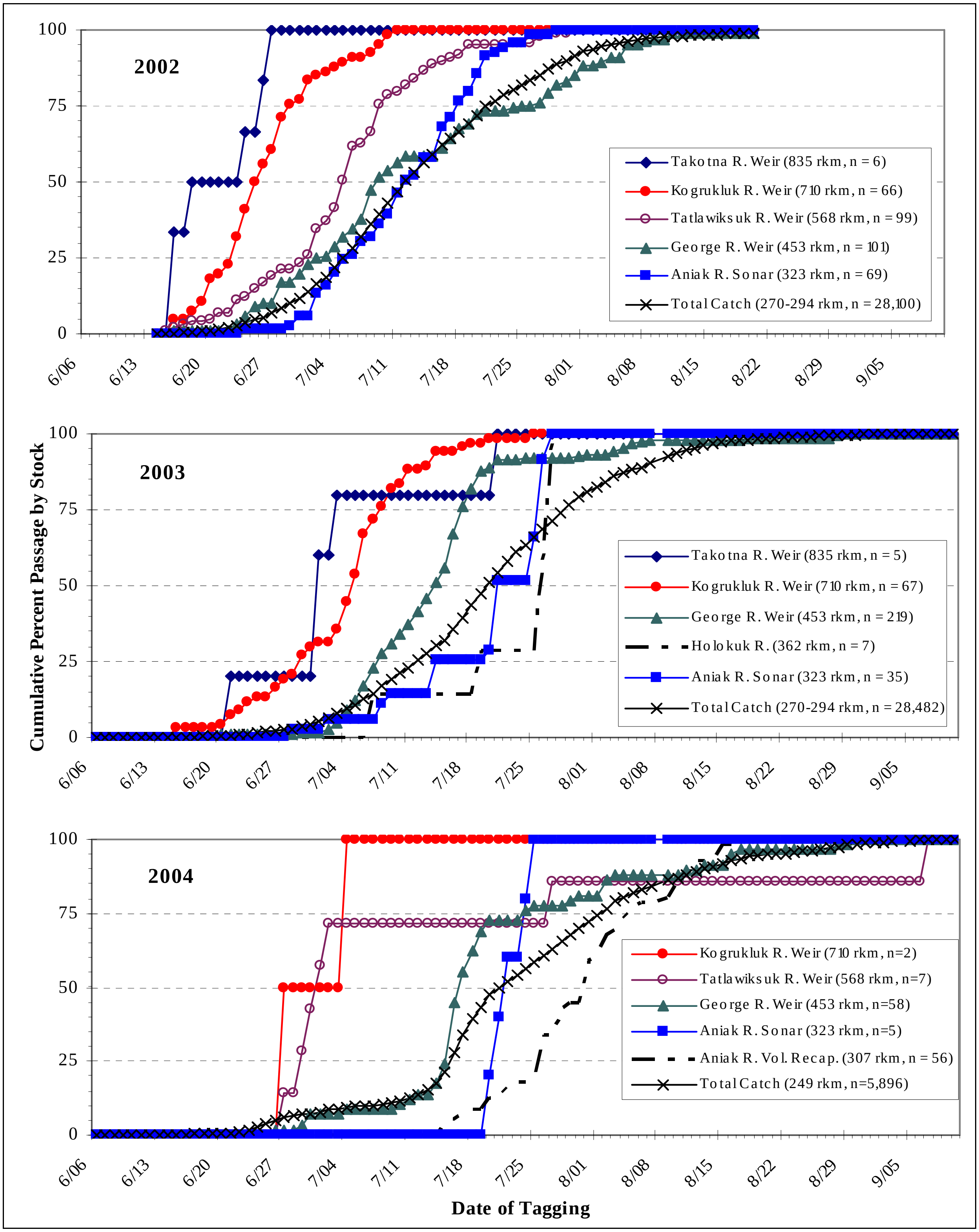
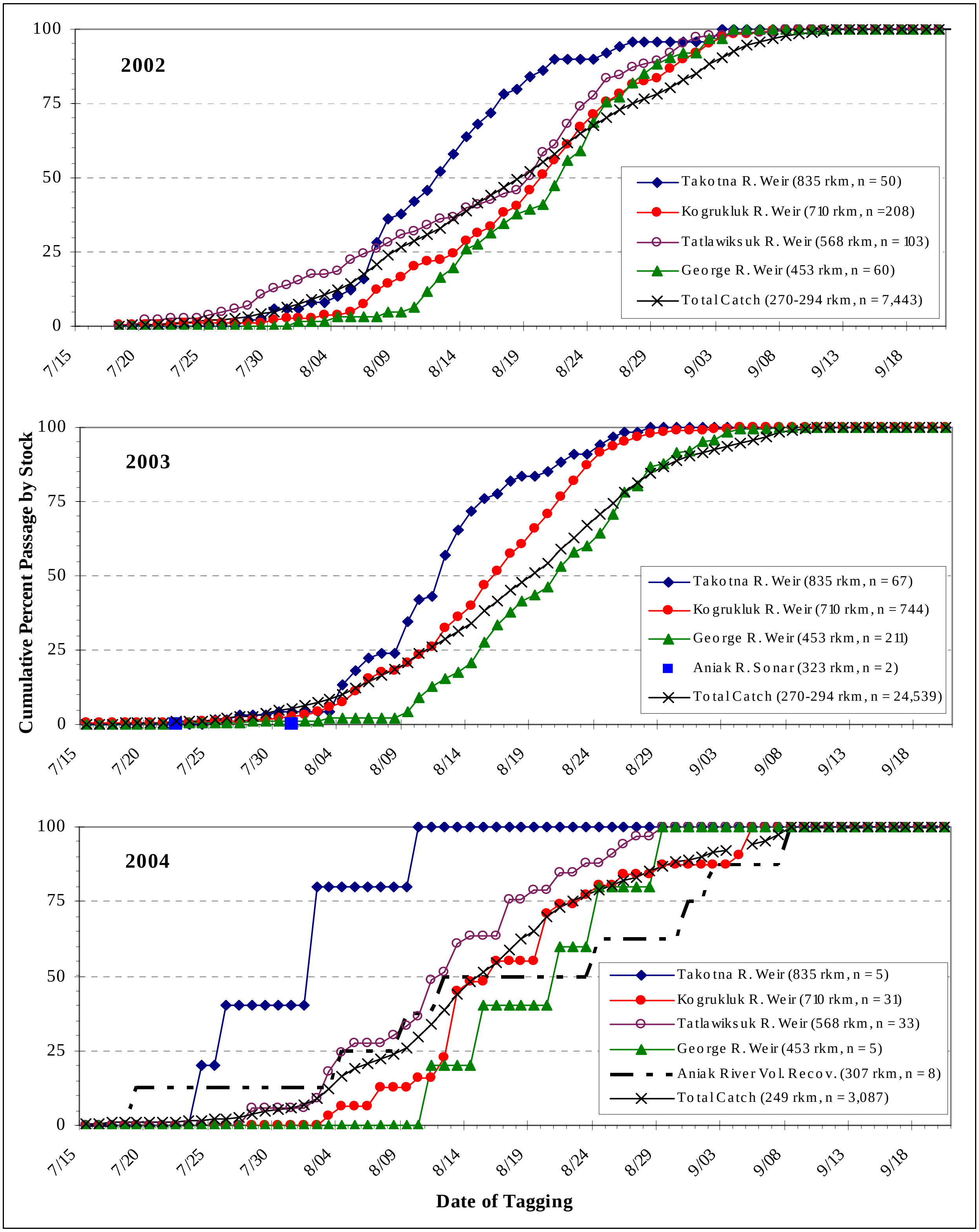


Figure 30.–Occurrence of chum and coho salmon tags recovered at George River weir by date tagged in comparison to the daily catch of the species at the Lower Kalskag tagging site, 2004.



Source: Kerkvliet et al. 2003; 2004; Pawluk et al. *In prep*.
Note: River kilometer (rkm) from marine waters and sample size in parentheses.

Figure 31.–Historical cumulative percent passage of chum salmon stocks at the Kalskag-Aniak tagging site based on tag returns at selected Kuskokwim River tributaries.



Source: Kerkvliet et al. 2003; 2004; Pawluk et al. *In prep.*

Note: River kilometer (rkm) from marine waters and sample size in parentheses.

Figure 32.–Historical percent passage of coho salmon stocks at the Kalskag-Aniak tagging site based on tag returns at selected Kuskokwim River tributaries.

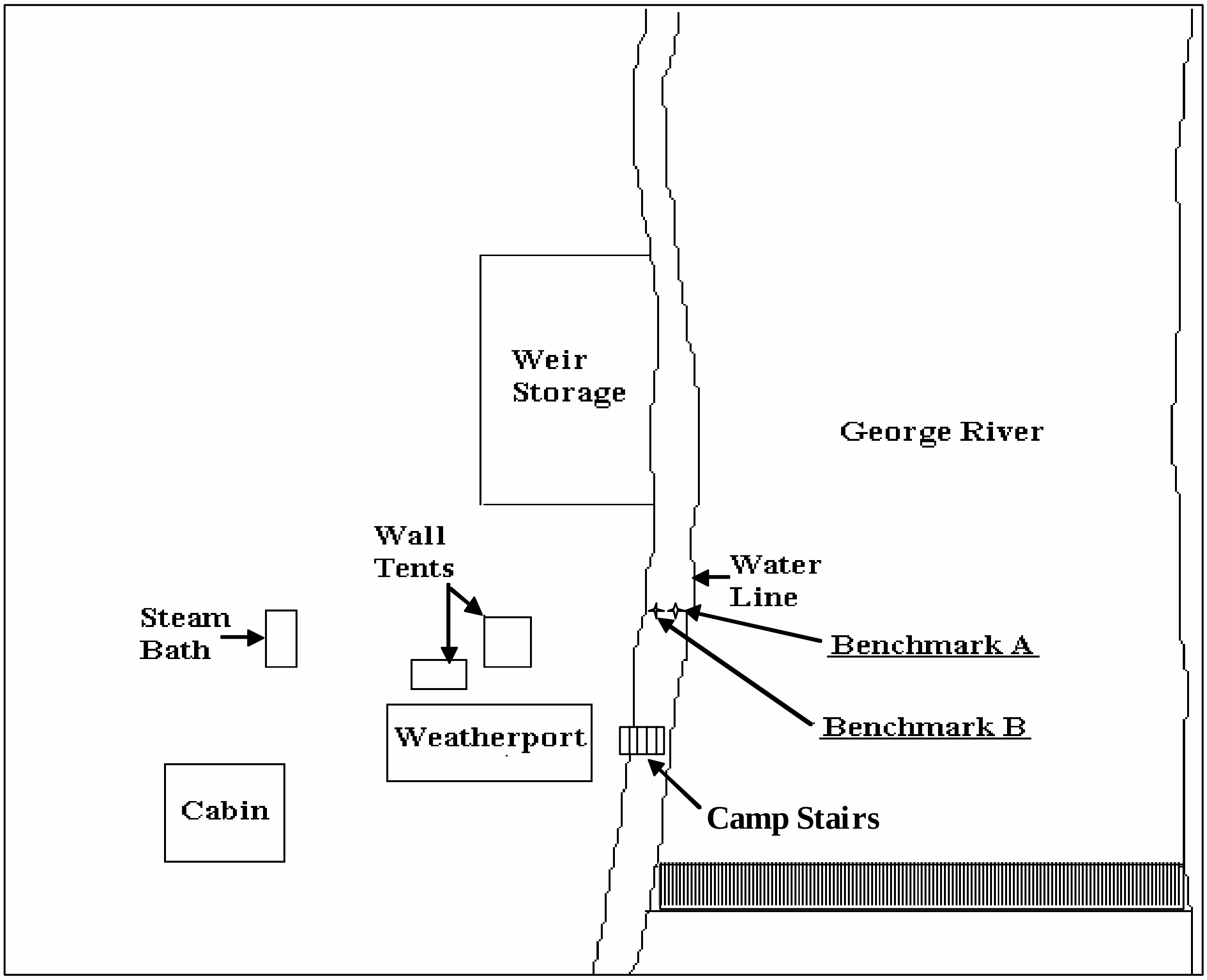
APPENDIX A. AERIAL SURVEYS

Appendix A1.–History of aerial spawning ground surveys of the George River drainage.

Location	Date of Survey	Observer	Survey Conditions	Species: Chinook	Chum	Coho	Comments
Main Stem	Jul 23 2002	John Linderman	Good	469	320	0	surveyed from weir site to 63 mi upstream
	Jul 27&28 2001	John Linderman	Good	1,143	472	0	surveyed from weir site to 63 mi upstream
	Jul 28 1995	Charlie Burkey	Good	1,173	420	0	surveyed mouth to 25 mi upstream
	Jul 30 1993	Charlie Burkey	Fair	75	0	0	surveyed East Fork confluence to 20 mi upstream
	Jul 18 1976	Gary Schaefer	Good	199	1,298	0	surveyed mouth to 40 mi above North Fork confluence
	Oct 1 1976	Gary Schaefer	Good	0	0	0	surveyed mouth to 5 mi above North Fork confluence
	Aug 1 1975	Fritz Kuhlman	Fair	28	717		
	Jul 16 1960	Unknown	Excellent	526	470		
East Fork	Jul 24 2002	John Linderman	Poor	135	40	0	surveyed from mainstem confluence to 28 mi upstream
	Jul 27 2001	John Linderman	Poor	27	0	0	surveyed from mainstem confluence to 37 mi upstream
	Jul 24 1980	Dan Schniederhan	Fair	89	3,479	0	surveyed mouth to headwaters
	Jul 18 1976	Gary Schaefer	Fair	a few	a few		
North Fork	Jul 28 2001	John Linderman	Fair	12	0	0	surveyed from mainstem confluence to 15 mi upstream
	Jul 18 1976	Gary Schaefer	Good	a few	200	0	
	Aug 1 1975	Fritz Kuhlman	Fair	0	123	0	
	Aug 1 1975	Fritz Kuhlman	Good	3	20	0	unnamed tributary
South Fork	Jul 27 2001	John Linderman	Fair	12	0	0	surveyed 15 mi upstream from E. Fork confluence

APPENDIX B. STREAM HEIGHT BENCHMARK

Appendix B1.–Locations and descriptions of stream height benchmarks at George River weir.



Descriptions:

Benchmark A:

Benchmark A was established in 2000 and consists of a 4-ft by 1-in steel pipe driven vertically into the gravel bank, with approximately 4-in of the pipe exposed above the gravel. It is located about 30 m upstream of the camp stairs and approximately 1 m up the bank from the water line at average water levels. Benchmark A represents a river stage measurement of 85 cm from its top.

Benchmark B:

Benchmark B was established in 2000 and consists of a 4-ft by 1-in steel pipe driven vertically into the gravel bank, with approximately 4-in of the pipe exposed above the gravel. It is located about 30 m upstream of the camp stairs and approximately 1.25 m up the bank from the water line at average water levels. Benchmark B represents a river stage measurement of 93 cm from its top.

The descriptions above represent the only semi-permanent benchmarks which exist to date at the George River weir project. Benchmarks used prior to 2000 were established in each year of project operations, but were subsequently washed-out after project operations ended.

APPENDIX C. DAILY PASSAGE

Appendix C1.–Daily passage of sockeye and pink salmon, and non-salmon species observed at George River weir, 2004.

Date	Sockeye Salmon	Pink Salmon	Longnose Sucker	Whitefish	Arctic Grayling	Dolly Varden
6/15	ND	ND	ND	ND	ND	ND
6/16	ND	ND	ND	ND	ND	ND
6/17	ND	ND	ND	ND	ND	ND
6/18	ND	ND	ND	ND	ND	ND
6/19	ND	ND	ND	ND	ND	ND
6/20	ND	ND	ND	ND	ND	ND
6/21	ND	ND	ND	ND	ND	ND
6/22	ND	ND	ND	ND	ND	ND
6/23	ND	ND	ND	ND	ND	ND
6/24	ND	ND	ND	ND	ND	ND
6/25	ND	ND	ND	ND	ND	ND
6/26	ND	ND	ND	ND	ND	ND
6/27	0	0	688	33	8	0
6/28	0	0	1,113	6	21	0
6/29	0	0	1,010	8	7	0
6/30	0	0	65	2	0	0
7/1	0	0	29	0	1	1
7/2	0	1	68	1	0	0
7/3	0	0	101	0	3	0
7/4	0	0	106	2	0	0
7/5	0	0	54	0	2	0
7/6	0	0	170	1	1	0
7/7	0	1	188	2	1	0
7/8	0	2	233	1	0	0
7/9	1	0	187	0	1	0
7/10	0	0	224	0	0	0
7/11	0	3	191	0	0	0
7/12	1	2	72	0	0	0
7/13	0	1	139	0	2	0
7/14	0	0	93	0	0	0
7/15	0	0	35	0	10	0
7/16	0	0	10	0	3	0
7/17	0	0	4	1	0	0
7/18	0	0	33	2	4	0
7/19	2	0	23	0	4	1
7/20	0	1	1	0	2	0
7/21	6	1	8	0	0	0
7/22	1	0	22	0	0	0
7/23	1	0	6	0	1	0
7/24	1	1	5	0	1	0
7/25	1	1	13	0	2	0
7/26	0	2	5	0	0	0
7/27	0	1	1	0	0	0
7/28	1	1	1	0	0	0
7/29	0	0	4	0	0	0
7/30	2	0	0	0	0	0
7/31	4	3	0	0	0	0

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Date	Sockeye Salmon	Pink Salmon	Longnose Sucker	Whitefish	Arctic Grayling	Dolly Varden
8/1	5	1	9	0	0	0
8/2	1	0	1	0	1	0
8/3	0	1	1	0	3	0
8/4	2	0	1	0	0	0
8/5	0	2	2	0	0	0
8/6	1	0	1	0	0	0
8/7	0	0	2	0	0	0
8/8	13	0	3	0	0	0
8/9	4	1	7	0	1	0
8/10	28	0	3	0	0	0
8/11	5	0	0	0	0	0
8/12	8	0	5	0	0	0
8/13	3	0	0	0	0	0
8/14	3	0	0	0	0	0
8/15	13	0	5	0	0	0
8/16	14	0	3	0	0	0
8/17	11	0	8	0	0	0
8/18	9	0	12	0	0	0
8/19	2	0	5	0	0	0
8/20	2	0	7	0	0	0
8/21	1	0	8	0	0	0
8/22	1	0	0	0	1	0
8/23	1	0	10	0	0	0
8/24	3	0	5	0	0	0
8/25	3	0	2	0	2	0
8/26	0	0	1	0	0	0
8/27	3	0	3	0	0	0
8/28	2	0	4	0	0	0
8/29	3	0	1	0	1	0
8/30	2	1	3	0	0	0
8/31	9	2	2	0	0	0
9/1	1	2	1	0	0	0
9/2	1	2	1	0	0	0
9/3	0	0	0	0	0	0
9/4	0	0	0	0	0	0
9/5	0	0	0	0	0	0
9/6	0	0	0	0	0	0
9/7	0	3	0	0	0	0
9/8	0	0	0	0	0	0
9/9	0	0	0	0	0	0
9/10	1	0	0	0	0	0
9/11	0	0	1	0	0	0
9/12	0	0	0	0	0	0
9/13	1	0	0	0	0	0
9/14	0	0	0	0	0	0
9/15	0	0	3	0	0	0
9/16	0	0	0	0	0	0
9/17	0	0	0	0	0	0

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Date	Sockeye Salmon	Pink Salmon	Longnose Sucker	Whitefish	Arctic Grayling	Dolly Varden
9/18	0	0	0	0	0	0
9/19	0	0	0	0	0	0
9/20	0	0	0	0	0	0
9/21	0	0	0	0	0	0
9/22	0	1	0	0	0	0
9/23	0	0	0	0	0	0
9/24	0	0	0	0	0	0
Total	177	37	5,022	59	83	2

Note: ND = No data.

APPENDIX D. SALMON CARCASS COUNTS

Appendix D1.–Historical daily carcass counts of Chinook salmon at George River weir.

Date	1996	1997	1998	1999	2000	2001	2002	2003	2004
6/15	[a]	0	[a]	[a]	[a]	[a]	[a]	[a]	[a]
6/16	[a]	0	[a]	[a]	[a]	[a]	[a]	[a]	[a]
6/17	[a]	0	[a]	[a]	0 [b]	[a]	[a]	[a]	[a]
6/18	[a]	0	[a]	[a]	0	[a]	[a]	[a]	[a]
6/19	[a]	0	[a]	[a]	0	[a]	[a]	[a]	[a]
6/20	[a]	0	[a]	[a]	0	[a]	[a]	[a]	[a]
6/21	0	0	[a]	[a]	0	[a]	0 [b]	[a]	[a]
6/22	0	0	0 [b]	[a]	0	[a]	0	[a]	[a]
6/23	0	0	0	[a]	0	[a]	0	[a]	[a]
6/24	0	0	0	[a]	0	[a]	0	[a]	[a]
6/25	1	0	0	[a]	0	0 [b]	0	[a]	[a]
6/26	0	0	0	[a]	1	0	0	[a]	[a]
6/27	0	0	0	[a]	0	0	0	[a]	0
6/28	0	0	0	[a]	0	0	1	[a]	0
6/29	3	0	0	[a]	0	0	1	[a]	0
6/30	0	4	0	[a]	0	0	0	[a]	0
7/01	0	0	0	[a]	0	0	0	0 [b]	1
7/02	1	0	0	[a]	0	0	0	0 [b]	0
7/03	1	0	0	[a]	0	0	0	[a]	0
7/04	2	0	0	[a]	0	0	0	[a]	0
7/05	2	1	0	[a]	0	0	0	[a]	0
7/06	0	1	0	[a]	0	0	0	[a]	0
7/07	2	0	0 [b]	[a]	0	0	0	[a]	0
7/08	0	0	[a]	[a]	0	0	0	0	0
7/09	6	2	[a]	[a]	0	1	0	0	1
7/10	10	0	[a]	[a]	0	0	0	0	0
7/11	10	1	[a]	[a]	0	0	0	0	1
7/12	8	1	[a]	[a]	0	0	1	0	0
7/13	3	1	[a]	[a]	0	0	3	0	0
7/14	3	2	[a]	0	0	0	1	0	1
7/15	5	1	[a]	1	0	1	3	0	0
7/16	7	3	[a]	0	0	0	3	0	0
7/17	8	1	[a]	1	0	0	1	1	0
7/18	10	0	[a]	0	0	1	1	0	1
7/19	5	1	[a]	1	0	0	2	0	0
7/20	14	2	[a]	1	0	0	2	0	0
7/21	36	0	[a]	0	0	0	2	0	3
7/22	29	0	[a]	2	10	1	1	0	2
7/23	11	2	[a]	0	0	0	3	1	0
7/24	9	0	[a]	3	0	0	0	3	1
7/25	10	0	[a]	1	1	2	1	3	1
7/26	[c]	0	[a]	1	0	0	3	2	2
7/27	[a]	6	[a]	2	1	4	4	2	7
7/28	[a]	1	[a]	4	2	9	4	[a]	5
7/29	[a]	1	[a]	0	0	12	6	[a]	2
7/30	[a]	4	6	16	2	17	6	[a]	7
7/31	[a]	0	0	5	4	11	4	[a]	5
8/01	[a]	0	10	2	[a]	18	6	[a]	13
8/02	[a]	0	13	7	[a]	16	5	[a]	18
8/03	[a]	0	[a]	12	0	15	2	[a]	7
8/04	[a]	0	[a]	12	0	22	3	6 [b]	12
8/05	[a]	0	[a]	21	0 [b]	22	1	3	6

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Date	1996	1997	1998	1999	2000	2001	2002	2003	2004
8/06	[a]	2	[a]	7	5	13	1	6	15
8/07	[a]	1	[a]	23	7	21	2	7	10
8/08	[a]	0	[a]	0	5	12	2	11	9
8/09	[a]	6	[a]	30	0	6	0	13	4
8/10	[a]	4	[a]	35	12	18	0	5	5
8/11	[a]	0	[a]	0	0	4	1	4	2
8/12	[a]	2	[a]	25	7	5	1	0	3
8/13	[a]	1	[a]	25	0	1	0	2	4
8/14	[a]	0	[a]	12	0	5	0	2	0
8/15	[a]	4	[a]	6	10	0	0	[a]	0
8/16	[a]	0	[a]	2	0	0	0	[a]	0
8/17	[a]	2	[a]	0	0	0	0	[a]	1
8/18	[a]	0	[a]	5	0	0	0	0 [b]	4
8/19	[a]	0	[a]	0	0	[a]	0	0	0
8/20	[a]	0	[a]	2	0	[a]	1	0	1
8/21	[a]	0	[a]	4	0	[a]	0	0	0
8/22	[a]	0	[a]	2	0	[a]	0	0	0
8/23	[a]	0	[a]	1	0	[a]	0	0	0
8/24	[a]	0	[a]	1	0	[a]	0	0	1
8/25	[a]	0	[a]	2	0	[a]	0	0	0
8/26	[a]	0	[a]	1	5	[a]	0	0	0
8/27	[a]	0	[a]	0	0	0	0	0	1
8/28	[a]	0	[a]	0	0	0	0	0	1
8/29	[a]	0	[a]	2	0	0	0	0	0
8/30	[a]	0	[a]	0	0	0	0	0	0
8/31	[a]	0	[a]	0	0	0	0	0	0
9/01	[a]	0	[a]	0	0	0	0	0	0
9/02	[a]	0	[a]	2	0	0	0	0	0
9/03	[a]	0	[a]	0	0	1	0	0	0
9/04	[a]	1	[a]	0	0	0	0	0	0
9/05	[a]	0	[a]	0	0	0	0	0	0
9/06	[a]	0	[a]	0	1	0	0	0	0
9/07	[a]	0	[a]	0	0	0	0	0	0
9/08	[a]	0	[a]	0	0	0	0	0	0
9/09	[a]	0	[a]	0	0	0	0	0	0
9/10	[a]	0	[a]	0	0	0	0	0	0
9/11	[a]	0	[a]	0	0	0	0	0	0
9/12	[a]	0	[a]	0	0	0	0	0	0
9/13	[a]	0	[a]	0	0	0	0	0	0
9/14	[a]	0	[a]	1	0	0	0	0	0
9/15	[a]	0	[a]	0	0	0	0	0	0
9/16	[a]	[a]	[a]	0	0	1	0	0	0
9/17	[a]	[a]	[a]	0	[a]	0	0	0	0
9/18	[a]	[a]	[a]	0	[a]	0	0	0	0
9/19	[a]	[a]	[a]	0	[a]	0	0	0	0
9/20	[a]	[a]	[a]	0	[a]	0	0	[a]	0
Total	196	58	29	280	73	239	78	71	157
% of Total Escapement	2.5	0.7	n.a.	7.9	2.5	7.2	3.2	1.5	3.0

[a] Weir was not operational and no count was conducted. n.a. = Not applicable.
[b] Count was likely incomplete as weir was not operational during part of the day.
[c] Weir was operational but a count was not conducted.

Appendix D2.–Historical daily carcass counts of chum salmon at George River weir.

Date	1996	1997	1998	1999	2000	2001	2002	2003	2004
6/15	[a]	0	[a]	[a]	[a]	[a]	[a]	[a]	[a]
6/16	[a]	0	[a]	[a]	[a]	[a]	[a]	[a]	[a]
6/17	[a]	0	[a]	[a]	0 [b]	[a]	[a]	[a]	[a]
6/18	[a]	0	[a]	[a]	0	[a]	[a]	[a]	[a]
6/19	[a]	0	[a]	[a]	0	[a]	[a]	[a]	[a]
6/20	[a]	0	[a]	[a]	0	[a]	[a]	[a]	[a]
6/21	0	0	[a]	[a]	0	[a]	0 [b]	[a]	[a]
6/22	0	0	0 [b]	[a]	0	[a]	0	[a]	[a]
6/23	0	0	0	[a]	0	[a]	1	[a]	[a]
6/24	0	0	0	[a]	0	[a]	0	[a]	[a]
6/25	4	0	0	[a]	0	0 [b]	0	[a]	[a]
6/26	1	0	0	[a]	0	1	2	[a]	[a]
6/27	0	0	0	[a]	0	0	1	[a]	0
6/28	1	0	0	[a]	0	1	3	[a]	1
6/29	5	0	0	[a]	1	0	2	[a]	3
6/30	4	0	2	[a]	0	0	1	[a]	0
7/01	6	0	2	[a]	0	0	3	0 [b]	3
7/02	10	1	3	[a]	0	3	8	0 [b]	1
7/03	8	0	4	[a]	3	0	6	[a]	0
7/04	13	0	2	[a]	0	0	7	[a]	2
7/05	11	0	10	[a]	0	0	5	[a]	4
7/06	23	0	10	[a]	0	10	11	[a]	3
7/07	25	4	0 [b]	[a]	0	1	11	[a]	7
7/08	19	2	[a]	[a]	0	3	9	0	14
7/09	40	4	[a]	[a]	4	2	11	1	16
7/10	53	2	[a]	[a]	7	0	18	3	14
7/11	44	3	[a]	[a]	0	10	17	6	11
7/12	55	4	[a]	[a]	0	11	20	3	22
7/13	33	6	[a]	[a]	0	1	14	2	22
7/14	50	7	[a]	14	7	9	22	7	40
7/15	45	4	[a]	15	0	9	27	19	46
7/16	69	12	[a]	4	0	6	18	2	32
7/17	73	3	[a]	7	0	22	26	12	45
7/18	65	7	[a]	37	0	14	31	11	42
7/19	56	9	[a]	18	0	8	16	11	57
7/20	130	17	[a]	21	0	0	15	24	38
7/21	126	0	[a]	8	9	0	34	16	37
7/22	143	0	[a]	23	0	25	41	50	39
7/23	108	21	[a]	8	0	0	34	40	25
7/24	72	0	[a]	9	0	0	38	43	80
7/25	126	30	[a]	18	10	28	37	52	20
7/26	[c]	0	[a]	21	0	0	48	56	27
7/27	[a]	76	[a]	28	19	5	45	101	45
7/28	[a]	48	[a]	20	23	23	27	[a]	23
7/29	[a]	28	[a]	0	0	17	25	[a]	24
7/30	[a]	65	26	62	14	32	22	[a]	31
7/31	[a]	0	0	30	11	33	29	[a]	30
8/01	[a]	0	24	15	[a]	27	26	[a]	47
8/02	[a]	0	51	26	[a]	35	20	[a]	22
8/03	[a]	0	[a]	21	0	39	17	[a]	32
8/04	[a]	0	[a]	30	0	27	10	89 [b]	51
8/05	[a]	0	[a]	27	0 [b]	33	15	48	15

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Date	1996	1997	1998	1999	2000	2001	2002	2003	2004
8/06	[a]	10	[a]	10	4	31	13	74	26
8/07	[a]	15	[a]	21	7	23	8	60	23
8/08	[a]	0	[a]	0	0	35	5	80	38
8/09	[a]	27	[a]	31	0	34	6	99	30
8/10	[a]	25	[a]	30	4	49	0	114	20
8/11	[a]	14	[a]	0	0	31	5	187	8
8/12	[a]	3	[a]	47	5	39	2	230	21
8/13	[a]	13	[a]	37	0	39	2	211	19
8/14	[a]	0	[a]	27	0	45	5	121	2
8/15	[a]	11	[a]	11	4	58	1	[a]	7
8/16	[a]	0	[a]	6	0	8	3	[a]	4
8/17	[a]	7	[a]	5	0	0	0	[a]	11
8/18	[a]	8	[a]	13	0	0	0	0 [b]	7
8/19	[a]	0	[a]	12	0	[a]	0	96	10
8/20	[a]	5	[a]	19	0	[a]	1	85	9
8/21	[a]	4	[a]	16	0	[a]	1	67	5
8/22	[a]	5	[a]	24	0	[a]	0	50	5
8/23	[a]	0	[a]	7	0	[a]	0	41	3
8/24	[a]	5	[a]	7	0	[a]	0	32	5
8/25	[a]	2	[a]	7	0	[a]	1	22	3
8/26	[a]	4	[a]	10	5	[a]	1	34	3
8/27	[a]	0	[a]	3	0	4	1	14	5
8/28	[a]	5	[a]	3	0	0	0	32	3
8/29	[a]	2	[a]	3	0	1	0	9	4
8/30	[a]	3	[a]	2	0	1	0	1	0
8/31	[a]	3	[a]	0	0	0	0	14	0
9/01	[a]	0	[a]	2	1	0	0	0	0
9/02	[a]	0	[a]	3	0	3	0	11	1
9/03	[a]	0	[a]	0	0	3	0	3	1
9/04	[a]	1	[a]	0	0	2	0	2	0
9/05	[a]	0	[a]	0	0	1	1	6	0
9/06	[a]	0	[a]	0	1	0	1	2	1
9/07	[a]	0	[a]	0	0	1	0	1	1
9/08	[a]	0	[a]	0	1	1	0	1	0
9/09	[a]	0	[a]	2	0	1	0	1	0
9/10	[a]	6	[a]	2	0	0	0	2	0
9/11	[a]	0	[a]	0	0	1	0	0	0
9/12	[a]	0	[a]	0	0	0	0	0	0
9/13	[a]	0	[a]	0	0	0	1	0	1
9/14	[a]	0	[a]	1	0	0	1	1	0
9/15	[a]	0	[a]	0	0	0	0	0	0
9/16	[a]	[a]	[a]	1	0	0	0	0	0
9/17	[a]	[a]	[a]	0	[a]	0	0	0	0
9/18	[a]	[a]	[a]	0	[a]	0	0	1	0
9/19	[a]	[a]	[a]	0	[a]	0	0	1	0
9/20	[a]	[a]	[a]	0	[a]	1	0	[a]	1
Total	1,418	531	134	824	140	847	832	2,301	1,248
% of Total Escapement	7.3	9.0	n.a.	7.1	4.0	7.3	12.7	6.8	8.7

[a] Weir was not operational and no count was conducted. n.a. = Not applicable.
[b] Count was likely incomplete as weir was not operational during part of the day.
[c] Weir was operational but a count was not conducted.

Appendix D3.–Historical daily carcass counts of coho salmon at George River weir.

Date	1996	1997	1998	1999	2000	2001	2002	2003	2004
6/15	[a]	0	[a]	[a]	[a]	[a]	[a]	[a]	[a]
6/16	[a]	0	[a]	[a]	[a]	[a]	[a]	[a]	[a]
6/17	[a]	0	[a]	[a]	0 [b]	[a]	[a]	[a]	[a]
6/18	[a]	0	[a]	[a]	0	[a]	[a]	[a]	[a]
6/19	[a]	0	[a]	[a]	0	[a]	[a]	[a]	[a]
6/20	[a]	0	[a]	[a]	0	[a]	[a]	[a]	[a]
6/21	0	0	[a]	[a]	0	[a]	0 [b]	[a]	[a]
6/22	0	0	0 [b]	[a]	0	[a]	0	[a]	[a]
6/23	0	0	0	[a]	0	[a]	0	[a]	[a]
6/24	0	0	0	[a]	0	[a]	0	[a]	[a]
6/25	0	0	0	[a]	0	0 [b]	0	[a]	[a]
6/26	0	0	0	[a]	0	0	0	[a]	[a]
6/27	0	0	0	[a]	0	0	0	[a]	0
6/28	0	0	0	[a]	0	0	0	[a]	0
6/29	0	0	0	[a]	0	0	0	[a]	0
6/30	0	0	0	[a]	0	0	0	[a]	0
7/01	0	0	0	[a]	0	0	0	0 [b]	0
7/02	0	0	0	[a]	0	0	0	0 [b]	0
7/03	0	0	0	[a]	0	0	0	[a]	0
7/04	0	0	0	[a]	0	0	0	[a]	0
7/05	0	0	0	[a]	0	0	0	[a]	0
7/06	0	0	0	[a]	0	0	0	[a]	0
7/07	0	0	0 [b]	[a]	0	0	0	[a]	0
7/08	0	0	[a]	[a]	0	0	0	0	0
7/09	0	0	[a]	[a]	0	0	0	0	0
7/10	0	0	[a]	[a]	0	0	0	0	0
7/11	0	0	[a]	[a]	0	0	0	0	0
7/12	0	0	[a]	[a]	0	0	0	0	0
7/13	0	0	[a]	[a]	0	0	0	0	0
7/14	0	0	[a]	0	0	0	0	0	0
7/15	0	0	[a]	0	0	0	0	0	0
7/16	0	0	[a]	0	0	0	0	0	0
7/17	0	0	[a]	0	0	0	0	0	0
7/18	0	0	[a]	0	0	0	0	0	0
7/19	0	0	[a]	0	0	0	0	0	0
7/20	0	0	[a]	0	0	0	0	0	0
7/21	0	0	[a]	0	0	0	0	0	0
7/22	0	0	[a]	0	0	0	0	0	0
7/23	0	0	[a]	0	0	0	0	0	0
7/24	0	0	[a]	0	0	0	0	0	0
7/25	0	0	[a]	0	0	0	0	0	0
7/26	[c]	0	[a]	0	0	0	0	0	0
7/27	[a]	1	[a]	0	0	0	0	0	0
7/28	[a]	0	[a]	0	0	0	0	[a]	0
7/29	[a]	0	[a]	0	0	0	0	[a]	0
7/30	[a]	0	0	0	0	0	0	[a]	0
7/31	[a]	0	0	0	0	0	0	[a]	0
8/01	[a]	0	0	0	[a]	0	0	[a]	2
8/02	[a]	0	0	0	[a]	0	0	[a]	3
8/03	[a]	0	[a]	0	0	0	0	[a]	0
8/04	[a]	0	[a]	0	0	0	0	0 [b]	0
8/05	[a]	0	[a]	0	0 [b]	0	0	0	0

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Date	1996	1997	1998	1999	2000	2001	2002	2003	2004
8/06	[a]	0	[a]	0	0	0	0	0	0
8/07	[a]	1	[a]	0	0	0	1	0	1
8/08	[a]	0	[a]	0	0	0	0	0	0
8/09	[a]	0	[a]	0	0	0	0	0	0
8/10	[a]	0	[a]	0	0	0	0	0	1
8/11	[a]	0	[a]	0	0	0	0	0	1
8/12	[a]	6	[a]	0	0	0	0	0	0
8/13	[a]	0	[a]	0	0	0	0	0	0
8/14	[a]	0	[a]	0	0	0	0	0	0
8/15	[a]	0	[a]	0	0	0	0	[a]	0
8/16	[a]	0	[a]	0	0	1	0	[a]	0
8/17	[a]	0	[a]	0	0	0	0	[a]	0
8/18	[a]	0	[a]	0	0	0	0	0 [b]	0
8/19	[a]	0	[a]	0	0	[a]	0	0	0
8/20	[a]	0	[a]	0	0	[a]	1	0	1
8/21	[a]	0	[a]	0	0	[a]	1	0	2
8/22	[a]	0	[a]	0	0	[a]	0	0	0
8/23	[a]	0	[a]	0	0	[a]	0	0	1
8/24	[a]	0	[a]	0	0	[a]	0	0	1
8/25	[a]	0	[a]	0	0	[a]	0	1	4
8/26	[a]	0	[a]	0	0	[a]	0	0	1
8/27	[a]	0	[a]	0	0	0	0	0	2
8/28	[a]	1	[a]	0	0	0	0	0	1
8/29	[a]	0	[a]	0	0	0	0	0	2
8/30	[a]	0	[a]	0	0	0	0	0	0
8/31	[a]	0	[a]	0	0	1	0	1	0
9/01	[a]	0	[a]	0	0	0	1	0	0
9/02	[a]	0	[a]	0	0	0	0	0	1
9/03	[a]	0	[a]	0	0	0	0	0	1
9/04	[a]	0	[a]	0	0	0	1	0	3
9/05	[a]	0	[a]	0	0	0	0	0	0
9/06	[a]	0	[a]	0	0	0	0	0	2
9/07	[a]	0	[a]	0	0	0	3	0	0
9/08	[a]	0	[a]	0	0	0	0	1	0
9/09	[a]	0	[a]	0	0	1	1	1	1
9/10	[a]	3	[a]	0	0	0	1	0	3
9/11	[a]	0	[a]	0	0	0	2	0	1
9/12	[a]	0	[a]	0	0	1	0	1	0
9/13	[a]	0	[a]	0	0	0	0	1	2
9/14	[a]	0	[a]	0	0	0	0	1	0
9/15	[a]	0	[a]	0	0	0	2	0	0
9/16	[a]	[a]	[a]	0	0	0	0	2	0
9/17	[a]	[a]	[a]	0	[a]	0	0	1	0
9/18	[a]	[a]	[a]	1	[a]	1	0	1	0
9/19	[a]	[a]	[a]	1	[a]	0	0	0	1
9/20	[a]	[a]	[a]	0	[a]	0	0	[a]	4
Total	0	12	0	2	0	5	14	11	42

[a] Weir was not operational and no count was conducted.

[b] Count was likely incomplete as weir was not operational during part of the day.

[c] Weir was operational but a count was not conducted.

APPENDIX E. WATER AND WEATHER CONDITIONS

Appendix E1.–Daily water conditions and weather at George River weir, 2004.

Observation		Sky	Wind Direction	Precipitation		Temperature °C		Water
Date	Time	Code[a]	and Velocity (mph)	Code[b]	Amount (mm)	Air	Water	Level (cm)
6/11	17:00	4	NE 5-10	A	9.0	19	10	ND
6/12	10:30	4	S 0-5	A	1.5	14	9	83
6/12	17:00	3	0	n.a.	0.0	23	10	83
6/13	10:30	3	SE 5-10	n.a.	0.0	18	10	81
6/13	17:00	4	SSE 15-20	n.a.	0.0	20	12	81
6/14	07:30	4	0	n.a.	0.0	9	10	78
6/14	17:00	2	SE 5-10	n.a.	0.0	24	11	77
6/15	07:30	3	0	n.a.	3.0	10	10	75
6/15	17:00	4	0	n.a.	0.0	20	11	75
6/16	07:30	4	0	n.a.	0.0	9	9	74
6/16	17:00	4	S 15	n.a.	0.0	13	12	74
6/17	07:30	4	0	n.a.	0.0	9	10	76
6/17	17:00	4	SE 10	A	0.0	14	10	76
6/18	07:30	4	0	A	5.0	10	9	75
6/18	17:00	4	0	n.a.	0.0	19	10	76
6/19	10:30	4	0	n.a.	1.0	16	10	74
6/20	10:30	2	0	n.a.	0.0	20	11	70
6/21	07:30	2	0	n.a.	0.0	11	12	67
6/21	17:00	2	S 10	n.a.	0.0	24	14	66
6/22	07:30	2	0	n.a.	0.0	12	12	64
6/22	17:00	4	S 10	n.a.	0.0	20	15	63
6/23	07:30	4	S 15	n.a.	0.0	14	13	61
6/23	17:00	4	0	n.a.	0.0	14	12	62
6/24	07:30	4	0	B	4.5	10	11	62
6/24	17:00	4	0	B	4.5	13	11	63
6/25	07:30	4	0	A	3.1	11	11	68
6/25	17:00	3	0	n.a.	0.3	17	12	71
6/26	07:30	2	0	n.a.	0.0	16	11	73
6/26	17:00	2	NE 5	n.a.	0.0	23	13	72
6/27	10:30	1	0	n.a.	0.0	19	13	69
6/27	17:00	1	NE 5	n.a.	0.0	26	16	68
6/28	07:30	2	0	n.a.	0.0	13	14	66
6/28	17:00	1	0	n.a.	0.0	26	17	63
6/29	10:30	4	0	F	11.0	19	16	64
6/29	17:00	4	0	n.a.	0.0	24	17	66
6/30	07:30	4	0	n.a.	0.0	17	15	66
6/30	17:00	3	0	n.a.	0.0	25	16	64
7/1	07:30	5	0	n.a.	0.0	14	14	63
7/1	17:00	5	0	n.a.	0.0	20	15	61
7/2	07:30	4	0	n.a.	0.0	13	13	60
7/2	17:00	3	S 10	n.a.	0.0	21	14	61
7/3	10:30	3	0	n.a.	0.0	17	13	59
7/3	17:00	4	0	n.a.	0.0	19	15	59
7/4	10:30	4	0	n.a.	0.0	17	13	58
7/4	17:00	4	NW 10	A	0.0	18	14	57
7/5	07:30	4	0	A	8.5	14	12	62
7/5	17:00	3	NW 5	n.a.	0.0	19	13	65
7/6	07:30	1	0	n.a.	0.0	11	12	66

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Observation		Sky	Wind Direction	Precipitation		Temperature °C		Water
Date	Time	Code[a]	and Velocity (mph)	Code[b]	Amount (mm)	Air	Water	Level (cm)
7/6	17:00	2	SW 10	n.a.	0.0	24	15	65
7/7	07:30	2	0	n.a.	0.0	11	12	61
7/7	17:00	3	N 10	n.a.	0.0	23	16	59
7/8	07:30	4	0	n.a.	0.0	10	13	58
7/8	17:00	3	NE 10	n.a.	0.0	22	17	57
7/9	07:30	1	0	n.a.	0.0	11	14	55
7/9	17:00	1	NE 10	n.a.	0.0	24	18	54
7/10	10:30	1	0	n.a.	0.0	20	15	53
7/10	17:00	1	W 5	n.a.	0.0	28	18	53
7/11	10:30	1	S 5	n.a.	0.0	20	16	52
7/11	17:00	1	S 5	n.a.	0.0	28	18	51
7/12	07:30	1	0	n.a.	0.0	10	15	50
7/12	17:00	1	S 5	n.a.	0.0	29	19	50
7/13	09:00	1	S 5	n.a.	0.0	17	14	49
7/13	17:00	1	S 10	n.a.	0.0	24	19	49
7/14	07:00	1	0	n.a.	0.0	8	15	49
7/14	17:00	2	S 5	n.a.	0.0	27	19	48
7/15	07:15	2	0	n.a.	0.0	9	16	48
7/15	17:00	2	S 10	n.a.	0.0	26	18	47
7/16	07:00	2	0	n.a.	0.0	12	16	46
7/16	17:00	3	SE 10	n.a.	0.0	20	17	45
7/17	10:00	4	0	n.a.	0.0	15	15	45
7/17	17:00	4	SE 10	n.a.	0.0	18	18	45
7/18	10:00	4	0	n.a.	0.0	14	15	44
7/18	17:00	3	SE 10	n.a.	0.0	25	19	45
7/19	07:00	3	0	A	5.0	14	15	46
7/19	17:00	3	0	n.a.	0.0	16	14	49
7/20	07:00	5	0	A	3.7	10	12	51
7/20	17:00	3	NE 10	A	6.0	22	16	52
7/21	07:00	4	0	A	1.5	14	15	52
7/21	17:00	3	SW 10	A	1.6	21	17	51
7/22	07:00	5	0	A	0.5	6	14	50
7/22	17:00	3	NE 10	n.a.	0.0	21	16	50
7/23	07:00	2	0	A	1.4	8	14	50
7/23	17:00	2	0	n.a.	0.0	22	16	50
7/24	10:30	3	0	n.a.	0.0	12	14	49
7/24	17:00	4	0	n.a.	0.0	17	16	49
7/25	07:00	2	SE 10	n.a.	0.0	19	15	46
7/25	17:00	2	SE 10	n.a.	0.0	21	15	45
7/26	07:00	4	S 10	n.a.	0.0	16	15	45
7/26	17:00	4	S 10	A	10.0	18	16	45
7/27	07:00	4	0	A	7.0	12	13	46
7/27	17:00	4	S 5	n.a.	0.0	16	15	47
7/28	07:00	4	0	n.a.	3.8	11	13	48
7/28	17:00	2	S 10	n.a.	0.0	17	15	48
7/29	07:00	4	0	n.a.	0.0	12	14	48
7/29	17:00	4	S 5	n.a.	0.0	17	15	47
7/30	07:00	4	0	n.a.	0.0	13	12	47

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Observation		Sky	Wind Direction	Precipitation		Temperature °C		Water
Date	Time	Code[a]	and Velocity (mph)	Code[b]	Amount (mm)	Air	Water	Level (cm)
7/30	17:00	2	0	A	1.4	20	17	46
7/31	07:00	4	0	A	1.6	10	13	45
7/31	17:00	2	0	n.a.	0.0	21	17	44
8/1	10:30	3	N 5	A	0.5	14	15	44
8/1	17:00	4	SE 10	n.a.	0.0	17	15	43
8/2	07:00	4	0	n.a.	0.0	14	15	43
8/2	17:00	1	S 5-10	n.a.	0.0	20	17	42
8/3	07:00	4	0	n.a.	0.0	13	14	41
8/3	07:00	4	0	A	7.0	17	14	41
8/4	07:00	4	0	A	10.0	14	13	43
8/4	17:00	4	0	n.a.	0.0	18	14	43
8/5	07:00	2	0	n.a.	0.0	15	13	43
8/5	17:00	2	0	n.a.	0.0	22	16	45
8/6	07:00	2	0	n.a.	0.0	9	13	46
8/6	17:00	2	0	n.a.	0.0	27	17	47
8/7	07:30	4	0	n.a.	0.0	9	10	47
8/7	17:00	4	S 5	n.a.	0.0	22	15	46
8/8	10:30	3	0	n.a.	0.0	17	13	45
8/8	17:00	3	S 10	n.a.	0.0	24	16	45
8/9	07:00	3	0	n.a.	0.0	14	14	45
8/9	17:00	4	SE 5	n.a.	0.0	22	16	44
8/10	07:30	4	0	n.a.	0.0	13	14	43
8/10	17:00	3	0	n.a.	0.0	23	17	42
8/11	07:00	2	0	A	0.5	13	15	41
8/11	17:00	4	0	F	1.4	18	17	40
8/12	07:00	4	N 5	A	3.6	15	15	40
8/12	17:00	4	SW 10	n.a.	0.0	20	16	41
8/13	07:00	4	SW 15	A	0.4	14	14	42
8/13	17:00	4	SW 15	A	1.4	16	14	42
8/14	10:30	3	S 5	n.a.	0.0	16	14	41
8/14	17:00	3	S 5-10	n.a.	0.0	17	15	40
8/15	10:30	3	0	n.a.	0.0	12	14	40
8/15	17:00	3	0	n.a.	0.0	24	16	40
8/16	07:30	2	0	n.a.	0.0	12	14	39
8/16	17:00	2	0	n.a.	0.0	26	18	39
8/17	07:00	5	0	n.a.	0.0	11	15	38
8/17	17:00	2	0	n.a.	0.0	25	18	38
8/18	07:00	2	0	n.a.	0.0	10	14	38
8/18	17:00	3	0	n.a.	0.0	28	19	37
8/19	07:00	5	0	n.a.	0.0	11	15	37
8/19	17:00	2	0	n.a.	0.0	26	20	36
8/20	07:00	2	0	n.a.	0.0	12	15	36
8/20	17:00	1	0	n.a.	0.0	24	18	36
8/21	10:30	2	S 5-10	n.a.	0.0	16	16	36
8/21	17:00	1	S 5-10	n.a.	0.0	26	17	35
8/22	10:30	5	0	n.a.	0.0	11	15	35
8/22	17:00	2	0	n.a.	0.0	24	17	35
8/23	07:15	2	0	n.a.	0.0	3	11	35

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Observation		Sky	Wind Direction	Precipitation		Temperature °C		Water
Date	Time	Code[a]	and Velocity (mph)	Code[b]	Amount (mm)	Air	Water	Level (cm)
8/23	17:00	1	S 5-10	n.a.	0.0	24	16	35
8/24	07:15	1	0	n.a.	0.0	2	14	35
8/24	17:00	1	0	n.a.	0.0	25	17	34
8/25	07:15	5	0	n.a.	0.0	5	15	34
8/25	17:00	5	S 5-10	n.a.	0.0	22	16	34
8/26	07:15	5	0	n.a.	0.0	0	11	34
8/26	17:00	5	N 5	n.a.	0.0	12	13	34
8/27	14:30	4	0	n.a.	0.0	14	12	34
8/28	10:30	5	0	n.a.	0.0	9	10	34
8/28	17:00	5	0	n.a.	0.0	16	12	34
8/29	10:30	5	0	n.a.	0.0	3	9	33
8/29	17:00	4	N 5	n.a.	0.0	15	13	33
8/30	07:15	4	0	n.a.	0.0	9	11	33
8/30	17:00	4	0	n.a.	0.0	13	11	33
8/31	07:15	4	0	n.a.	0.0	8	10	33
8/31	17:00	4	SE 5	n.a.	0.0	ND	ND	33
9/1	07:15	4	0	A	2.4	10	10	33
9/1	17:00	4	0	A	0.0	17	12	33
9/2	07:15	4	0	n.a.	1.0	10	11	33
9/2	17:00	2	N 10	n.a.	0.0	16	13	33
9/3	07:30	3	0	n.a.	1.7	5	10	34
9/3	17:00	2	NW 15	n.a.	0.0	12	12	34
9/4	10:30	2	0	n.a.	0.0	4	9	34
9/4	17:00	3	SW 5	n.a.	0.0	14	11	34
9/5	10:30	4	0	n.a.	0.0	9	10	33
9/5	17:00	4	0	A	0.6	13	11	33
9/6	10:30	1	N 5	n.a.	0.5	4	9	33
9/6	17:00	1	N 5	n.a.	0.0	16	12	33
9/7	07:30	3	0	n.a.	0.0	1	9	32
9/7	17:00	1	E 10	n.a.	0.0	17	11	32
9/8	10:30	2	0	n.a.	0.0	7	9	32
9/8	17:00	2	0	n.a.	0.0	18	11	32
9/9	10:30	3	0	n.a.	0.0	5	8	32
9/9	17:00	3	0	n.a.	0.0	15	10	32
9/10	10:30	2	0	n.a.	0.0	9	8	31
9/10	17:00	2	S 5	A	0.5	14	10	31
9/11	10:30	4	0	A	3.0	6	8	32
9/11	17:00	3	0	n.a.	0.0	13	8	32
9/12	10:30	3	0	A	1.5	4	7	32
9/12	17:00	4	NW 5	n.a.	0.0	11	8	32
9/13	10:30	1	0	A	0.5	6	6	32
9/13	17:00	1	0	n.a.	0.0	12	6	32
9/14	10:30	3	0	n.a.	0.0	4	6	32
9/14	17:00	2	0	n.a.	0.0	9	9	32
9/15	10:30	4	0	n.a.	0.0	2	5	31
9/15	17:00	4	0	n.a.	0.0	10	7	31
9/16	10:30	4	0	n.a.	0.0	1	5	31
9/16	17:00	3	N 5	n.a.	0.0	11	6	31

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Observation		Sky	Wind Direction	Precipitation		Temperature °C		Water
Date	Time	Code[a]	and Velocity (mph)	Code[b]	Amount (mm)	Air	Water	Level (cm)
9/17	10:30	4	0	n.a.	0.0	-4	3	30
9/17	17:00	4	N 5	n.a.	0.0	7	6	30
9/18	10:30	4	N 5	n.a.	0.0	1	6	30
9/18	17:00	3	N 5	n.a.	0.0	13	7	30
9/19	10:30	4	0	B	2.3	7	7	30
9/19	17:00	4	0	B	0.0	11	8	31
9/20	10:30	4	0	A	10.2	4	8	34
9/20	17:00	4	NW 5	n.a.	0.0	11	8	34
9/21	10:30	4	0	A	3.0	6	7	36
9/21	17:00	4	W 10	B	0.0	9	8	36
9/22	10:30	4	0	A	11.1	4	6	37
9/22	17:00	4	W 5	A	0.0	10	7	37
9/23	10:30	3	N 5	A	1.0	3	4	38
9/23	17:00	3	NW 10	n.a.	0.0	9	5	38
9/24	10:30	4	0	C	0.0	0	4	40
9/24	17:00	3	0	D	0.0	6	6	39
9/25	10:30	2	0	n.a.	1.0	-3	3	36
9/25	17:00	3	NW 10	n.a.	0.0	7	4	32

Note: ND = no Data, n.a. = Not applicable.

[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] Precipitation Codes:
- A = intermittent rain
- B = continuous rain
- C = snow
- D = snow and rain
- E = hail
- F = thunder