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Kanektok River Salmon Monitoring and Assessment, 2013

Final Report for Project OSM 10-300
USFWS Office of Subsistence Management
Fisheries Resource Monitoring Program

by

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

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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ABSTRACT

The Kanektok River is the primary salmon spawning drainage in the Quinhagak area and supports subsistence, commercial, and sport fisheries. The Alaska Department of Fish and Game, in cooperation with U.S. Fish and Wildlife Service and the Native Village of Kwinhagak, has operated a resistance board weir on the Kanektok River since 2001. The project estimates escapement and provides a platform to collect samples used in estimating age, sex, and length for Chinook *Oncorhynchus tshawytscha*, sockeye *O. nerka*, chum *O. keta*, and coho *O. kisutch* salmon. Additionally, the project monitors the annual Dolly Varden char *Salvelinus malma* run. In 2013, the weir was operational from June 25 through August 15. Total escapement observed through the weir during the 2013 season was 3,569 Chinook, 128,761 sockeye, and 43,040 chum salmon, and 41,730 Dolly Varden char. The Chinook salmon escapement was the second lowest on record, although sockeye and chum salmon had near average escapements. The Chinook salmon escapement comprised 63% males and was dominated by age-1.4 fish (38%). The sockeye salmon escapement comprised 44% males and was dominated by age-1.2 fish (71%). The chum salmon escapement comprised 55% males and was dominated by age-0.4 fish (70%).

Key words: Pacific salmon *Oncorhynchus* spp., Chinook *O. tshawytscha*, chum *O. keta*, coho *O. kisutch*, sockeye *O. nerka*, Dolly Varden char *Salvelinus malma*, rainbow trout *O. mykiss*, whitefish *Coregonus* spp, resistance board weir, District W-4, Kuskokwim, Kanektok River.

INTRODUCTION

The Kanektok River drainage flows into Kuskokwim Bay near the village of Quinhagak and provides an important annual fishery for subsistence and commercial harvest of Pacific salmon *Oncorhynchus* spp. The Kanektok River weir project was established in 2001 in an effort to estimate the escapement of Chinook (*O. tshawytscha*), sockeye (*O. nerka*), and chum salmon (*O. keta*), and Dolly Varden char (*Salvelinus malma)* and develop a long-term reliable data set that could be used for management of the fishery. Escapement estimates combined with commercial catch statistics are used to assess daily run strength and provide abundance information that is critical to the management of the commercial salmon fishery in District W-4.

SALMON FISHERIES

Subsistence Fisheries

Subsistence fishing for salmon occurs in the Kanektok River, nearby streams, and Kuskokwim Bay. Salmon caught for subsistence use make important contributions to annual harvests of residents from Quinhagak and nearby communities. The Alaska Department of Fish and Game (ADF&G) has quantified subsistence salmon harvests in the Quinhagak area since 1968, and methods have been consistent since 1988. From 2003 to 2012 annual subsistence harvests averaged 3,506 Chinook, 1,861 sockeye, 1,566 chum, and 1,570 coho salmon (*O. kisutch*) (Shelden et al. 2014). There is no estimate of total subsistence harvest of Dolly Varden char from the Kanektok River. However, in the 2012 subsistence harvest survey, 77 of 162 households in Quinhagak reported a collective harvest of 3,346 char from the Kanektok drainage. It is difficult to track non-salmon subsistence harvest among years because the methods have not been consistent, but the importance of char, primarily Dolly Varden char, to the subsistence diet in southwest Alaska is well known (Mark Lisac, USFWS Fisheries Biologist, personal communication). Wolfe et al. (1984) estimated that char accounted for a significant portion of the total subsistence-harvested fish in the village of Quinhagak.

Commercial Fishery

Commercial salmon fishing has occurred in the Quinhagak area since before statehood. In 1960, commercial fishing District W-4 was established offshore of Quinhagak in Kuskokwim Bay

(Figure 1). Since the inception of District W-4 in 1988, its northern boundary has been shifted between Weelung Creek and Oyak Creek in response to overcrowding issues and concern over the interception of fish bound for the Kuskokwim River. In 2004, the Alaska Board of Fisheries (BOF) extended the northern boundary 3 miles north up the coast from the southern edge of Oyak Creek to the northernmost edge of the mouth of Weelung Creek. The southern boundary is located at the southernmost edge of the mouth of the Arolik River. The boundary area extends 3 miles from the coast into Kuskokwim Bay. The District W-4 commercial fishery targets Chinook, sockeye, and coho salmon. Chum and pink (*O. gorbuscha*) salmon are harvested incidentally, with pink salmon being the least commercially valuable species.

Since 1960, commercial salmon harvests in District W-4 ranged from 3,918 to 273,573 salmon, with a historical average of 130,896 salmon. Sockeye salmon are generally the most abundant portion of harvest totals. Total harvests have increased since the low years of 2001 and 2002 when market demands and processing capacity were low. The most recent 10-year average harvest (2003–2012) was 196,817 salmon (Travis Elison Commercial Fisheries Biologist, ADF&G, Anchorage, personal communication). Additional information on the W-4 commercial fishery can be obtained in the *2011 Kuskokwim Area Management report* (Brazil et al. 2013).

Sport Fisheries

In addition to commercial and subsistence harvest, the Kanektok River also supports a popular sport fishery. Sport anglers target Pacific salmon, rainbow trout (*O. mykiss*), Dolly Varden char, and Arctic grayling (*Thymallus arcticus*) from mid-June through early September each year. Currently, 3 seasonal sport fishing guide camp operations are located on the Kanektok River, along with numerous guided and non-guided anglers that float the Kanektok River from its headwaters to the village of Quinhagak. Annual fishing effort on the Kanektok River averages over 5,781 angler-days per year. The most recent available 5-year average harvest (2008–2012) was 502 Chinook, 1,442 coho, 342 sockeye, and 152 chum salmon, and 431 Dolly Varden char (Chythlook 2014).

ESCAPEMENT MONITORING

In the State of Alaska, ADF&G is responsible for managing salmon fisheries in a manner consistent with *Sustainable Salmon Fisheries Policy* (5 AAC 07.367). This task requires the ability to reliably measure annual escapement to key spawning systems through long-term monitoring projects and to track temporal and spatial patterns in abundance that influence management decisions.

The Kanektok River is the primary salmon spawning drainage within District W-4. Establishing a viable method for monitoring and assessing salmon escapement in the Kanektok River has been problematic (Estensen and Diesigner 2004). The first attempted monitoring project was a counting tower established in 1960 on the lower river near the village of Quinhagak (ADF&G 1960). This tower project was plagued by logistical problems, poor water visibility, and difficulties with species apportionment. In 1961, the tower was relocated to the outlet of Kagati/Pegati Lake (Figure 2) and operated through 1962 (ADF&G 1962). Although successful in providing sockeye salmon escapement information, operation of the tower at this site was discontinued after 1962. Enumeration using hydroacoustic sonar was attempted from 1982 through 1987; however, the use of sonar was deemed unfeasible because of technical obstacles, site limitations, and budget constraints (Huttunen 1988). In 1996, a cooperative effort between the Native Village of Kwinhagak (NVK), United States Fish and Wildlife Service (USFWS), and

ADF&G reinitiated a counting tower located 25 km upriver from the mouth of the Kanektok River. The counting tower again proved to have limited utility (Fox 1997) despite improvements to the project in 1998 (Menard and Caole 1999). In 1999, resources were redirected toward developing a resistance board weir (Burkey et al. 2001). The weir was operational briefly in 2000, but high water levels, technical limitations, and personnel problems precluded the project from meeting its objectives (Linderman 2000). During operation in 2000, the site was determined unsuitable for a weir because of extensive bank erosion.

In 2001, the weir was relocated approximately 33 km upriver from the original site (Estensen and Diesigner 2003). This relocation required a "special use permit" from the USFWS to operate within a congressionally designated Wilderness Area (Togiak National Wildlife Refuge). The weir was successfully installed and operated in 2001; however, installation was delayed until August 10 because of high water. In 2002, an attempt was made to install the weir just after ice-out in early May, but high water still delayed complete installation until late June. In 2003, crews arrived on site even earlier and successfully installed the weir during the last week of April, before snowmelt and spring precipitation raised water levels beyond a workable point. Installation and optimal operational start time of the weir was determined to be dependent upon early installation in late April, just after ice-out. When feasible, an early installation strategy had been employed annually for 2003 through 2011. The weir project operated into coho salmon season during 2001 through 2005. Weir removal can be hindered, in most years, by increasing river depth during early fall. The majority of weir components are removed from the water for the off season. Deep water portions of the rail are left in throughout the winter to ease installation the following year. High water in the fall of 2005 prevented removal of the weir, so components were burdened and buried by debris and gravel and subjected to frozen river conditions. Damages from overwintering totaled the weir and prevented operation in 2006. The weir was rebuilt during the 2006 season and was ready for installation and operation in 2007. To avoid future high water removal complications and possible overwinter component destruction, ADF&G decided to end monitoring operations in August, after the majority of the sockeye salmon run has passed. For this reason, the weir no longer operates through coho salmon season. Since 1996, the project has continued as a cooperative venture between ADF&G, USFWS Togiak National Wildlife Refuge (TNWR), USFWS Office of Subsistence Management (OSM), and NVK. The project has provided escapement data representing fish spawning above the weir location. Salmon spawn throughout the Kanektok River drainage and the weir does not account for fish that spawn below the site. Formal escapement goals have not been developed for any species at this weir (Estensen et al. 2009).

Dolly Varden char, although not managed for commercial interest, are an important subsistence resource, and the annual returns of Dolly Varden char into the Kanektok River have been enumerated since 2001 (Taylor and Elison 2012). Dolly Varden char runs are known to be aggregates of mixed stocks, maturities, and a great range of sizes (DeCicco 1992; Whalen 1992; Lisac and Nelle 2000; Crane et al. 2003, 2004, 2014; Lisac 2006). Comparing Dolly Varden char total run estimates at the weir can be misleading for long-term monitoring efforts. From 2002 to 2007, Dolly Varden char run monitoring at the Kanektok River weir also included radiotelemetry, genetic tissue collection, seining, and sampling, to determine length, sex, and maturity of the sample (Lisac 2004, 2006, 2007, 2008, 2011). This effort, although discontinued, was used to determine the proportion of mature spawning fish in the annual runs of Dolly Varden char and may assist with interpreting long-term trends in future years.

AGE, SEX, AND LENGTH COMPOSITION ESTIMATES

Salmon age, sex, and length (ASL) information has been collected from the weir project since 2001 and from District W-4 commercial harvest since 1969 (Molyneaux et al. 2010). Historical summaries of existing ASL information for salmon returning to the Kanektok River can be found in Molyneaux et al. (2010). Dolly Varden char sex, length, and maturity information was collected at the weir site from 2002 to 2007 (Lisac 2008) but is no longer being collected.

OBJECTIVES

1. Enumerate the daily passage of Chinook, sockeye, and chum salmon through the Kanektok River weir.
2. Estimate the run timing of Chinook, sockeye, and chum salmon at the Kanektok River weir.
3. Estimate the age, sex, and length composition of the Chinook, sockeye, and chum salmon escapements proportionally such that 95% simultaneous confidence intervals for the age composition have a maximum width of ±10% (α = 0.05 and d = 0.10).
4. Enumerate Dolly Varden char daily passage and determine run timing through the Kanektok River weir.
5. Record atmospheric and hydrologic conditions at the weir site.

METHODS

SITE DESCRIPTION

The Kanektok River is located in the Togiak National Wildlife Refuge in southwestern Alaska (Figure 2). The Kanektok River watershed drains approximately 2,261 km^2 of surface area and empties into Kuskokwim Bay near the village of Quinhagak (Walsh 2006). The upper portion of the river consists primarily of a single channel flowing through mountainous terrain. The lower portion of the river flows through a broad alluvial plain and is highly braided with many side channels. The surrounding riparian vegetation is composed primarily of cottonwood, willow, and alder, and uplands are dominated by tundra. Chinook, sockeye, chum, coho, and pink salmon, along with several other anadromous and resident species including Dolly Varden char and rainbow trout, spawn in the Kanektok River drainage.

The Kanektok River weir is located approximately 68 km upstream from the mouth at N 59° 46.057, W 161° 03.616. The channel width is approximately 76 m. The water depth during weir operations ranges from approximately 0.3 to 1.8 m. The bottom substrate is primarily cobblestone, gravel, and sand.

RESISTANCE BOARD WEIR

The design, construction, and installation of the Kanektok River resistance board weir largely followed those described in Stewart (2002, 2003) and Tobin (1994). Additional details concerning the resistance board weir components used on the Kanektok River are described in Estensen and Diesinger (2004) and Pawluk and Jones (2007).

Two fish passage chutes were installed on the weir, 1 approximately 30 m from the south bank and the other approximately 8 m from the north bank. Gates were attached on both chutes to regulate fish passage. Live traps installed directly upstream of both passage chutes were used to collect fish for ASL sampling. Picket spacing (4.3 cm between pickets) allowed smaller fish, such as pink salmon and other non-salmon species, to pass through the weir between pickets. Downstream migrating fish passing over or through the weir were not enumerated.

Boats passed at a designated boat gate as described in Estensen and Diesigner (2004). Boats with jet-drive engines could pass over the boat gate panels independent of the crew by reducing speed. Rafts could pass downstream by submerging the boat passage panels and drifting over the weir. Boats with propeller-drive engines were uncommon and required being towed upstream across the weir with the assistance of crew members.

ESCAPEMENT MONITORING AND ESTIMATES

To determine salmon escapement past the weir, fish passage counts were made daily during the operational period of the project. Passage counts occurred regularly throughout the day, typically for 1–2-hour periods, beginning in the morning and continuing as late as light permitted. During counting periods, fish passage chute gates were opened to allow fish through the weir. Crew members identified and enumerated all fish by species as they passed upriver through the chutes. Any fish observed both in the live trap and returning downstream through the fish passage chutes were excluded from the upstream tally.

Passage missed during inoperable periods or breach events was estimated using the hierarchical Bayesian estimation technique (Adkison and Zu 2001). In this, a log-normal distribution run timing model was fitted to log plus 1 transformed daily passage weir counts (ln(daily weir count +1)).

Let y_{it} be the log plus 1 transformed weir count of i^{th} year (1998–2012) and t^{th} day, so y_{it} = ln(daily weir count +1); and assume that y_{it} is a random variable from a normal distribution of mean θ_{it} and standard deviation of all years, σ. Then:

$$y_{it} \sim N(\theta_{it}, \sigma^2) \quad \text{and} \quad \theta_{it} = a_i \exp((\ln(t/\mu_i))^2 / b_i) \; ,$$

where θ_{it} is modeled to have a log-normal run timing and the following statements are true:

$a_i > 0$ is the maximum daily passage of the i^{th} year;

$t \geq 1$ is the passage date starting June 1 ($t = 1$ is June 1);

$\mu_i > 0$ is the mean passage date starting June 1 of the i^{th} year; and

$b_i > 0$ is the days represented by the run period of the i^{th} year.

At the upper hierarchical level, annual maximum daily passage (a_i), mean passage date (μ_i), and spread (b_i) were assumed to be normally distributed as,

$$a_i \sim N(a_0, \sigma_a^2); \qquad \mu_i \sim N(\mu_0, \sigma_\mu^2); \qquad b_i \sim N(b_0, \sigma_b^2).$$

Prior distribution of the above parameters was assumed to be non-informative as,

$a_0 \sim N(5{,}1000)$ $(a_0 > 0)$; $\mu_0 \sim N(0.5{,}100)$ $(\mu_0 > 0)$; $b_0 \sim N(50{,}10)$ $(b_0 > 0)$;

$\sigma_a \sim$ uniform(0.1, 10,000) ; $\sigma_b \sim$ uniform(0.1, 10,000) ;

$\sigma_\mu \sim$ uniform(0.1, 10,000) ; $\sigma \sim$ uniform(0.1, 10,000) .

Markov-chain Monte Carlo methods (WinBUGS v1.4[1]; Spiegelhalter et al. 1999) were used to generate the joint posterior probability distribution of all unknowns in the model. Simulation was done for 10,000 iterations, with the first 5,000 burn-in period discarded, and samples were taken every 2 iterations. This resulted in 2,500 samples, and the median sample value was used to represent the point estimate of daily missed passage. Bayesian credible intervals (95%) were obtained from the percentiles (2.5 and 97.5) of the marginal posterior distribution (but not reported here). Estimates of missed passage are based on historical observed passage data collected at the weir from 2001 through the current season. Historical observed passage data adequate to estimate passage range from June 26 through August 15.

AGE, SEX, AND LENGTH SAMPLING AND ESTIMATES

Sample sizes were calculated using Bromaghin (1993) and adjusted for a non-readable scale rate of 20%, such that sample sizes would produce simultaneous 95% confidence interval estimates of age composition ±10% for each age category ($\alpha = 0.05$ and $d = 0.10$). The sample size for Chinook salmon was adjusted for a finite population. Sample sizes of sockeye and chum salmon were increased by a factor of 3 to allow for postseason stratification. The minimum sample size objective for each species was 230 Chinook, 630 sockeye, and 600 chum salmon.

Daily sample objectives were based on a proportional sampling design generated from the average run timing for each species. Based on historical average passage data and sample size objectives, seasonal sample proportions were 0.03 for Chinook, 0.004 for sockeye, and 0.012 for chum salmon. Daily sample proportions were derived from historical run timing and average percent passage over 7 days. Therefore, the daily salmon sample size was the derived average percent of the previous day's passage. When daily sample objectives were not met, attempts were made to collect additional samples during the next opportunity. Ultimately, it was up to the crew leader to determine the appropriate sample sizes and schedule based on fish passage patterns and minimum sample size objectives as outlined above.

The weir crew conducted both passive and active sample capture as needed to achieve the desired Chinook, sockeye, and chum salmon sample goals. Passive capture involves blocking upstream passage and leaving the downstream trap gate open, allowing fish to enter and build up in the live trap. Active sampling involved open live trap gates and enumerating all fish passing upstream. Gates are closed when the target species was observed entering the trap. Crew members used a dip net to capture fish and placed them on a partially submerged measurement cradle. Length was measured to the nearest millimeter from mideye to tail fork (METF). Sex was determined by visually examining external morphology such as the development of the kype, roundness of the belly, and the presence or absence of an ovipositor. Scales were removed from the preferred area of the fish (INPFC 1963). A minimum of 3 scales were removed from each Chinook salmon, and 1 scale was removed from each chum and sockeye salmon. Scales were mounted on numbered and labeled gum cards. After sampling, fish were released upstream of the weir. Gum cards and data forms were completed and returned to the Bethel ADF&G office for processing.

ADF&G staff in Bethel and Anchorage processed ASL data and generated data summaries as described by Molyneaux et al. (2010). Samples were divided into 3 strata, based on cumulative percent passage. Each stratum was then weighted by the number of fish passing in that stratum to

[1] Product names are included for completeness but do not constitute endorsement.

estimate the overall age and sex composition. Age and sex confidence interval bounds were estimated to determine whether the desired precision was met for the season estimate. If the desired precision level was met, then the season summary was the weighted average age and sex composition estimate of the escapement. If the desired precision level was not met, then only the sample age and sex composition was presented.

Ages were reported in the tables using European notation. European notation is composed of 2 numerals separated by a decimal, where the first numeral indicates the number of winters spent 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 1 to account for the single winter of egg incubation in the gravel. Original ASL; gum cards, acetates, and mark-sense forms were archived at the ADF&G office in Anchorage. Computer files were archived by ADF&G in the Anchorage and Bethel offices.

Atmospheric and Hydrological Monitoring

Atmospheric and hydrologic conditions were recorded daily at 1000 hours and 1700 hours. Cloud cover was estimated by percent covered and elevation; wind speed was estimated in miles per hour and direction was noted; precipitation was measured in inches per 24 hours; daily air and water temperature were recorded in degrees Celsius. The river gage height was recorded daily and coincided with a benchmark established in 2001, consisting of a three-quarter inch diameter steel rebar driven into the river bed adjacent to the camp. The benchmark was reestablished in 2011 and now consists of an aluminum rod placed near the original bench mark. A marked height on the benchmark represents a river stage of 100 cm. The river gage was a steel rule installed near shore in the river, and the 100 cm mark was set level with the benchmark to measure relative water level between years.

RESULTS

Weir Operations

The Kanektok River weir does not have a target operational date; however, optimal start time is late June. The weir is removed in mid-August, due to the possibility of heavy rainfall that could raise water levels. In 2013, the weir was operated from June 26 through August 15.

Structural integrity of the weir was maintained for the period of operation. No periods of missed passage occurred. The Kanektok River 2013 escapement totals are observed passage only.

Salmon Escapement

The observed Chinook salmon escapement was 3,569 fish. Based on the operational period, the median passage date was July 21 and the central 50% of the run occurred between July 15 and July 25 (Table 1).

The observed sockeye salmon escapement was 128,761 fish. Based on the operational period, the median passage date was July 11 and the central 50% of the run occurred between July 7 and July 17 (Table 1).

The observed chum salmon escapement was 43,040 fish. Based on the operational period, the median passage date was July 18 and the central 50% of the run occurred between July12 and July 23 (Table 1).

Observed passage of coho salmon during operational period was 3,116 fish. The first coho salmon were observed on July 18. Passage upstream continued after weir operations ceased on August 15. The total escapement of coho salmon is unknown. Only the portion of passage that occurred during the operational period was monitored (Table 1).

Pink salmon, Dolly Varden char, whitefish, rainbow trout, and grayling were also counted through the weir. Run timing is not determined for these species. Totals of 529 pink salmon, 41,730 Dolly Varden char, 65 whitefish, 83 rainbow trout, and 9 grayling were observed passing upstream during project operations. The median passage date for Dolly Varden char occurred on July 24, and the date of peak passage was July 23 (6,094 fish). Dolly Varden char passage through the weir continued through the last day of operation (Table 2).

AGE, SEX, AND LENGTH COMPOSITION ESTIMATES

Escapement

Sample goals were met for Chinook, sockeye, and chum salmon. Scale samples are not collected from coho salmon. ASL composition objectives were met for each species collected and samples were adequate to estimate composition.

ASL samples were collected from 234 Chinook salmon at the weir in 2013. Age was determined for 153 (65.3%) of the Chinook salmon sampled. Age cannot be determined for absorbed or regenerated scales. This readability issue was common among Kuskokwim-area projects. Scales collected at the Kanektok weir resulted in better readability than most projects. Sample results were sufficient for stratification, and a weighted average age composition of escapement was determined. Confidence intervals for age composition of annual escapement were no wider than ±7.6%. Applied to escapement, age-1.4 was the most abundant age class for Chinook salmon (37.8%), followed by age-1.2 (35.2%) and age-1.3 fish (25.7%). Sex composition of sampled fish was 63.2% male. Mean male length of sampled fish was 506 mm for age-1.2, 677 mm for age-1.3, and 858 mm for age-1.4 fish. Mean female length of sampled fish was 523 mm for age-1.2, 770 mm for age-1.3, and 857 mm for age-1.4 fish. Overall, male lengths ranged from 413 to 956 mm, and female lengths ranged from 506 to 935 mm (Table 3).

ASL samples were collected from 798 sockeye salmon at the weir in 2013. Age was determined for 601 (75.3%) of the sockeye salmon sampled. Overall, 95% confidence intervals for age composition of annual escapement were no wider than ±3.6%. Applied to escapement, age-1.2 was the most abundant age class for sockeye salmon (71.1%), followed by age-1.3 (24.6%). Sex composition of sampled fish was 44.3% male and 55.7% female. Mean male length of sampled fish was 523 mm for age-1.2 and 574 mm for age-1.3 fish. Mean female length of sampled fish was 490 mm for age-1.2 and 536 mm for age-1.3 fish. Overall, male lengths ranged from 430 to 627 mm, and female lengths ranged from 401 to 600 mm (Table 4).

ASL samples were collected from 707 chum salmon at the weir in 2013. Age was determined for 573 (81%) of the chum salmon sampled. Overall, 95% confidence intervals for age composition of annual escapement were no wider than ±3.7%. Applied to escapement, age-0.4 was the most abundant age class for chum salmon (70.3%), followed by age-0.3 (26%). Sex composition of sampled fish was 54.9% male. Mean male length of sampled fish was 576 mm for age-0.3 and 609 mm for age-0.4 fish. Mean female length of sampled fish was 545 mm for age-0.3 and 563 mm for age-0.4 fish. Overall, male lengths ranged from 505 to 715 mm, and female lengths ranged from 486 to 670 mm (Table 5).

ATMOSPHERIC AND HYDROLOGICAL MONITORING

Atmospheric and hydrological observations were recorded daily from June 23 through August 18. Air temperatures ranged from 4˚ to 31˚ C. Water temperature ranged from 6˚ to 14˚ C. The Kanektok River weir experienced heavy rain events in 2013, but water level stayed within operable range. Approximately 13.74 cm of rain occurred throughout the entire season. The largest single rain event occurred on July 8 when an accumulation of 1.52 cm fell during this 24-hour period. Water levels at the weir site based on the 100 cm set benchmark ranged from approximately 5 to 31 cm for the recorded period (Table 6).

DISCUSSION

WEIR OPERATIONS

Operation of the weir in 2013 was successful and the majority of the Chinook, sockeye, and chum salmon escapement was observed. Total enumeration of coho salmon was not possible because the coho salmon run continued well after the end of operations in 2013. Water levels fluctuated within a manageable range, and the weir held containment with no breach events.

The removal of the weir was successful, with the deepwater rail and cable section left in place. Rail placed in deepwater areas can winter in the substrate with minimal damage and make weir installation easier next season. Removal of all panels and the shallow rail sections prevents component damage from overwintering in the river, as experienced in previous seasons (Jones and Linderman 2006).

ESCAPEMENT MONITORING AND ESTIMATES

The Chinook salmon escapement estimate for 2013 was the second-lowest escapement among the years of data collected at this location (2002–2013; Figure 3; Appendix A). The escapement total improved from the 2012 record low; however, it was less than half of the 10-year historical average (2002–2012). Low Chinook salmon escapement estimates have been reported for several tributaries in the Kuskokwim Area since 2011 (Travis Elison, Commercial Fisheries Biologist, ADF&G, Anchorage; personal communication). The majority of Chinook salmon escapement passed early with 75% passage occurring ahead of the previous 5-year average (2008–2012; Figure 4).

The sockeye salmon escapement estimate for 2013 showed improved gain but remained lower than average among collected historical data (2002–2013; Figure 3; Appendix A). Sockeye salmon run timing was a few days earlier than previous years (Figure 4).

The estimated chum salmon escapement in 2013 was below the average from the last 10 years of operation, although it was a significant improvement from 2012 (Figure 3; Appendix A). Run timing was near average (Figure 4). The weir results do not account for the large number of chum salmon, perhaps in excess of weir escapements, known to spawn downstream of the weir.

The escapement of coho salmon in 2013 represents the portion of the run enumerated during the weir operation period (Appendix A). A low escapement count was expected due to counts ending before peak coho salmon migration in September. Median passage date historically occurs in late August, and the central 50% of the run occurs between late August and early September (Clark and Linderman 2009).

The observed escapement of Dolly Varden char in 2013 was higher than the 2002–2012 average of 17,085 fish and near the peak count of 43,292 fish in 2010 (Lisac 2011). The observed escapement is considered a minimum count because the weir does not consistently prevent smaller fish (<420 mm) from passing between pickets (Lisac 2006). No Dolly Varden char sampling occurred and the proportion of mature fish in the count was not estimated in 2013.

AGE, SEX, AND LENGTH COMPOSITION ESTIMATES

Trapping Chinook salmon for ASL sampling has been problematic. Chinook salmon are generally reluctant to enter the trap when other fish species are present or when the fyke doors on the trap are set to constrict the entrance. In 2011, the sampling goals were changed to a proportional sampling method to better represent the total escapement. The Chinook salmon escapement ASL objective was met in 2013. The samples were divided into 3 strata based on proportions of cumulative escapement. The ASL compositions from the 3 strata are represented in a weighted total.

Sockeye and chum salmon ASL proportional sampling objectives were met in 2013. Generally, salmon sex and age composition changes slightly over the course of the run. Distribution of sample collection across the run can better reflect compositional change. In 2011, sockeye and chum salmon sampling goals were also adjusted to proportions. Adjusting sampling goals to reflect a daily collection based on a set proportion of the cumulative passage has alleviated problems encountered from low abundance during the runs.

Sockeye salmon samples were divided into 3 strata, and a weighted total is presented. Sockeye salmon age-1.2 and age-1.3 dominated escapement age class estimates in 2013. The contribution of age-1.2 fish (71.1%) was stronger than the average observed in previous years (38.9%; Table 4 and Figure 5). The age-1.2 proportion was slightly higher compared to other historical years with high age-1.2 composition dominance.

Chum salmon samples were divided into 3 strata, and a weighted total is presented. Chum salmon age-0.4 was the dominant age class, making up approximately 70% of the weir escapement (Table 5). Historically, the 2 predominant age classes are age-0.3 and age-0.4 fish, with age class majority alternating between years (Figure 5). Compared to historical results in years with dominant age-0.4 fish, 2013 age-0.4 fish showed a higher proportional return than average (57%), and the proportion of age-0.3 fish was near average (30%; Brodersen et al. 2013).

RECOMMENDATIONS

Establishing long-term funding for the project would help provide long-term escapement, run timing, and ASL data required to better understand productivity of the Kanektok River. Long-term data sets could be used to develop inriver escapement goals based on run reconstruction and spawner-recruit brood table analyses.

Early installation for 2009 through 2011 did not prove cost effective and is no longer recommended. Early installation may occur as conditions permit. Monitoring of water level at the weir site should begin in early June each year to assess conditions for installation. The Kanektok River has demonstrated high water level and water flow in May and June, which often leads to substantial delay in installation until July or later depending on the severity and duration of high water conditions. Late-season high water conditions call for removal of the weir in mid to late August to avoid complications. Operating this project until mid-August allows assessment of the majority of the Chinook, sockeye, and chum salmon and Dolly Varden char returns upstream of the weir. Historically, daily escapements of Chinook, sockeye, and chum salmon at this time are less than 1% of cumulative totals.

The weir site is located 68 km upstream, and it is known from observation that a number of fish spawn downstream of the weir. There is not currently a reliable way to determine the proportional number of fish spawning below the weir. Conducting a tagging (telemetry) study or including a sonar or tower project on the lower portion of the river may help to determine spawner distribution above and below the weir location.

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TABLES AND FIGURES

Table 1.–Daily and cumulative Chinook, sockeye, chum, and coho salmon passage at the Kanektok River weir, 2013.

	Chinook			Sockeye			Chum			Coho	
Date	Daily	Cum	% passage	Daily	Cum	% passage	Daily	Cum	% passage	Daily	Cum
6/25	0 [a]	0	0	288 [a]	288	0	22 [a]	22	0	0	0
6/26	0	0	0	1,360	1,648	1	99	121	0	0	0
6/27	3	3	0	2,982	4,630	4	255	376	1	0	0
6/28	11	14	0	2,780	7,410	6	308	684	2	0	0
6/29	2	16	0	1,872	9,282	7	137	821	2	0	0
6/30	22	38	1	3,254	12,536	10	237	1,058	2	0	0
7/01	26	64	2	3,903	16,439	13	296	1,354	3	0	0
7/02	2	66	2	2,542 [b]	18,981	15	322 [b]	1,676	4	0	0
7/03	7	73	2	2,890	21,871	17	254	1,930	4	0	0
7/04	7	80	2	2,588	24,459	19	340	2,270	5	0	0
7/05	49	129	4	3,380	27,839	22	677	2,947	7	0	0
7/06	13	142	4	2,201	30,040	23	1,170	4,117	10	0	0
7/07	28	170	5	3,661	33,701	26	983	5,100	12	0	0
7/08	211	381	11	9,681	43,382	34	2,198	7,298	17	0	0
7/09	78	459	13	8,086	51,468	40	593	7,891	18	0	0
7/10	60	519	15	9,470	60,938	47	1,216	9,107	21	0	0
7/11	35	554	16	5,552	66,490	52	1,376	10,483	24	0	0
7/12	136	690	19	9,031	75,521	59	2,233	12,716	30	0	0
7/13	47	737	21	5,437	80,958	63	1,664	14,380	33	0	0
7/14	102	839	24	5,871 [b]	86,829	67	2,310 [b]	16,690	39	0	0
7/15	111	950	27	4,490	91,319	71	659	17,349	40	0	0
7/16	65	1,015	28	3,898	95,217	74	718	18,067	42	0	0
7/17	67	1,082	30	4,204	99,421	77	1,395	19,462	45	0	0
7/18	184	1,266	35	3,745	103,166	80	1,868	21,330	50	1	1
7/19	157	1,423	40	3,254	106,420	83	1,972	23,302	54	5	6
7/20	289	1,712	48	3,181	109,601	85	2,022	25,324	59	13	19
7/21	154	1,866	52	2,316	111,917	87	2,296	27,620	64	6	25
7/22	207	2,073	58	2,724	114,641	89	2,858	30,478	71	19	44
7/23	323	2,396	67	2,281	116,922	91	2,670	33,148	77	59	103
7/24	185	2,581	72	1,638	118,560	92	1,298	34,446	80	37	140
7/25	161	2,742	77	1,555	120,115	93	945	35,391	82	43	183
7/26	137	2,879	81	1,549	121,664	94	1,678	37,069	86	47	230
7/27	99	2,978	83	1,236	122,900	95	1,375	38,444	89	66	296
7/28	166	3,144	88	1,091	123,991	96	811	39,255	91	47	343
7/29	41	3,185	89	548	124,539	97	482	39,737	92	46	389
7/30	71	3,256	91	714	125,253	97	532	40,269	94	61	450
7/31	65	3,321	93	421	125,674	98	396	40,665	94	73	523
8/01	25	3,346	94	293	125,967	98	400	41,065	95	35	558
8/02	63	3,409	96	407	126,374	98	452	41,517	96	66	624
8/03	51	3,460	97	397	126,771	98	347	41,864	97	89	713
8/04	6	3,466	97	269	127,040	99	230	42,094	98	29	742

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Table 1.–Page 2 of 2.

	Chinook			Sockeye			Chum			Coho	
Date	Daily	Cum	% passage	Daily	Cum	% passage	Daily	Cum	% passage	Daily	Cum
8/05	12	3,478	97	300	127,340	99	194	42,288	98	56	798
8/06	14	3,492	98	247	127,587	99	168	42,456	99	88	886
8/07	23	3,515	98	227	127,814	99	162	42,618	99	137	1,023
8/08	16	3,531	99	223	128,037	99	94	42,712	99	168	1,191
8/09	3	3,534	99	173	128,210	100	92	42,804	99	166	1,357
8/10	6	3,540	99	76	128,286	100	58	42,862	100	123	1,480
8/11	11	3,551	99	123	128,409	100	32	42,894	100	374	1,854
8/12	2	3,553	100	72	128,481	100	34	42,928	100	141	1,995
8/13	12	3,565	100	150	128,631	100	65	42,993	100	493	2,488
8/14	3	3,568	100	72	128,703	100	27	43,020	100	310	2,798
8/15	1	3,569	100	58	128,761	100	20	43,040	100	318	3,116
Total	3,569			128,761			43,040			3,116	

Note: Shaded areas indicate 80% of the run. Outside boxes indicate the estimated central 50% of passage. Bold boxes indicate the date that the estimated cumulative 50% passage occurred.

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

[b] A minor counting error occurred, not significant to daily total.

Table 2.–Daily and cumulative pink salmon, Dolly Varden, whitefish, and rainbow trout passage at the Kanektok River weir, 2013.

	Pink Salmon		Dolly Varden		Whitefish		Rainbow Trout		Grayling	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
6/25	0	0	0	0	0	0	0	0	0	0
6/26	0	0	1	1	0	0	2	2	0	0
6/27	0	0	0	1	0	0	3	5	3	3
6/28	0	0	0	1	0	0	0	5	0	3
6/29	0	0	0	1	0	0	0	5	0	3
6/30	0	0	0	1	0	0	0	5	0	3
7/01	0	0	0	1	0	0	0	5	0	3
7/02	0	0	0	1	0	0	0	5	0	3
7/03	0	0	0	1	0	0	0	5	0	3
7/04	0	0	0	1	0	0	0	5	0	3
7/05	3	3	3	4	0	0	0	5	0	3
7/06	1	4	4	8	0	0	0	5	0	3
7/07	2	6	5	13	0	0	0	5	0	3
7/08	10	16	29	42	0	0	1	6	6	9
7/09	7	23	12	54	1	1	0	6	0	9
7/10	7	30	5	59	0	1	0	6	0	9
7/11	8	38	58	117	0	1	1	7	0	9
7/12	8	46	117	234	0	1	0	7	0	9
7/13	18	64	104	338	0	1	0	7	0	9
7/14	21	85	142	480	0	1	0	7	0	9
7/15	4	89	44	524	1	2	7	14	0	9
7/16	10	99	95	619	0	2	2	16	0	9
7/17	25	124	233	852	1	3	5	21	0	9
7/18	25	149	403	1,255	3	6	13	34	0	9
7/19	23	172	1,320	2,575	0	6	0	34	0	9
7/20	60	232	2,787	5,362	1	7	1	35	0	9
7/21	70	302	2,448	7,810	3	10	3	38	0	9
7/22	52	354	3,808	11,618	0	10	5	43	0	9
7/23	52	406	6,094	17,712	3	13	7	50	0	9
7/24	26	432	2,954	20,666	0	13	0	50	0	9
7/25	15	447	2,581	23,247	4	17	4	54	0	9
7/26	20	467	3,171	26,418	8	25	3	57	0	9
7/27	21	488	3,923	30,341	2	27	2	59	0	9
7/28	6	494	4,591	34,932	0	27	6	65	0	9
7/29	5	499	1,334	36,266	1	28	6	71	0	9
7/30	12	511	1,015	37,281	1	29	5	76	0	9
7/31	2	513	688	37,969	0	29	1	77	0	9
8/01	5	518	282	38,251	1	30	1	78	0	9
8/02	5	523	597	38,848	1	31	2	80	0	9
8/03	0	523	830	39,678	0	31	1	81	0	9
8/04	2	525	133	39,811	0	31	1	82	0	9

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Table 2.–Page 2 of 2.

	Pink Salmon		Dolly Varden		Whitefish		Rainbow Trout		Grayling	
Date	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum	Daily	Cum
8/05	3	528	200	40,011	0	31	0	82	0	9
8/06	1	529	169	40,180	0	31	0	82	0	9
8/07	0	529	284	40,464	0	31	0	82	0	9
8/08	0	529	202	40,666	1	32	0	82	0	9
8/09	0	529	167	40,833	9	41	0	82	0	9
8/10	0	529	94	40,927	2	43	0	82	0	9
8/11	0	529	242	41,169	1	44	0	82	0	9
8/12	0	529	63	41,232	1	45	0	82	0	9
8/13	0	529	287	41,519	20	65	0	82	0	9
8/14	0	529	128	41,647	0	65	0	82	0	9
8/15	0	529	83	41,730	0	65	1	83	0	9
Total	529		41,730		65		83		9	

Table 3.–Chinook salmon age and sex composition and mean length (mm) at the Kanektok River weir, 2013.

		Brood Year (Age)											
Sample Size		2009		2008		2007		2007		2006			
153		1.2		1.3		1.4		2.3		1.5		Total	
		N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
	Male	1,210	33.9	750	21.0	277	7.7	18	0.5	0	0.0	2,255	63.2
Total [a]	Female	46	1.3	168	4.7	1,071	30.0	0	0.0	28	0.8	1,314	36.8
	Total	1,256	35.2	919	25.7	1,348	37.8	18	0.5	28	0.8	3,569	100.0
	95% CI (± %)		7.5		6.8		7.6		1.0		1.5		0.3
	Male Mean Length	506		677		858		674		–			
	SE	7		16		28		–		–			
	Range	413–710		464–874		722–956		–		–			
	n	51		34		12		1		–			
	Female Mean Length	523		770		857		–		707			
	SE	–		30		7		–		–			
	Range	506–549		645–871		699–935		–		–			
	n	2		7		45		–		1			

[a] Based on proportions of cumulative escapement, sample size was sufficient for stratification. A weighted total is presented.

Table 4.–Sockeye salmon age and sex composition and mean length (mm) at the Kanektok River weir, 2013.

		Brood Year (Age)													
		2009		2009		2008		2008		2007		2007			
Sample Size		0.3		1.2		1.3		2.2		1.4		2.3		Total	
601		*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
	Male	245	0.2	41,052	31.9	13,023	10.1	725	0.6	1,491	1.2	491	0.4	57,027	44.3
Total [a]	Female	0	0.0	50,477	39.2	18,675	14.5	725	0.6	1,611	1.3	245	0.2	71,734	55.7
	Total	245	0.2	91,530	71.1	31,698	24.6	1,450	1.1	3,101	2.4	736	0.6	128,761	100.0
	95% CI (± %)		0.4		3.6		3.4		0.9		1.2		0.6		0.1
	Male Mean Length	595		523		574		513		583		596			
	SE	–		2.11		3.38		21.66		13.74		6.50			
	Range	–		430–615		498–627		466–543		536–612		589–602			
	n	1		192		60		3		7		2			
	Female Mean Length			490		536		487		563		543			
	SE	–		1.75		3.25		4.06		4.06		–			
	Range	–		401–583		426–600		468–513		543–582		–			
	n	–		232		92		3		8		1			

[a] Based on proportions of cumulative escapement, sample size was sufficient for stratification. A weighted total is presented.

Table 5.–Chum salmon age and sex composition and mean length (mm) at the Kanektok River weir, 2013.

			Brood Year (Age)							
			2009		2008		2007			
Sample Size			0.3		0.4		0.5		Total	
573			*N*	%	*N*	%	*N*	%	*N*	%
	Total [a]	Male	6,315	14.7	16,551	38.5	750	1.7	23,616	54.9
		Female	4,859	11.3	13,722	31.9	843	2.0	19,424	45.1
		Total	11,175	26.0	30,273	70.3	1,592	3.7	43,040	100.0
		95% CI (± %)		3.6		3.7		1.6		0.1
		Male Mean Length	576		609		613			
		SE	3.30		2.57		5.45			
		Range	506–639		505–715		594–635			
		n	83		220		10			
		Female Mean Length	545		563		577			
		SE	3.79		2.26		9.24			
		Range	488–614		486–670		540–620			
		n	64		185		11			

[a] Based on proportions of cumulative escapement, sample size was sufficient for stratification. A weighted total is presented.

Table 6.–Daily weather and hydrological observations from the Kanektok River weir site, 2013.

Date	Wind (Dir/Speed)	Precip (cm)	Air Temp. °C am	Air Temp. °C pm	Water Temp. °C am	Water Temp. °C pm	Cloud Cover % / altitude	Water level (cm) am	Water level (cm) pm
6/23	W/3	0.00	9	18	7	9	100/4000	21	21
6/24	SE/1	0.00	16	16	8	9	50/10000	22	21
6/25	calm	0.10	11	13	8	8	80/2500	22	18
6/26	W/1	0.03	10	14	10	11	fog	15	15
6/27	N/5	0.00	10	20	–	–	95/3000	16	16
6/28	W/1	0.00	8	–	–	–	80/3000	14	14
6/29	SW/15	0.00	13	12	–	–	20/4000	14	14
6/30	W/15	0.38	9	6	–	–	97/3000	14	14
7/1	SW/15	0.13	5	7	–	–	100/2700	16	15
7/2	SW/15	0.25	5	5	–	–	100/1200	17	18
7/3	SW/15	0.13	6	8	–	7	100/1000	19	19
7/4	W/5	0.43	4	11	6	8	100/2500	21	25
7/5	W/5	1.14	5	9	7	8	60/5000	23	22
7/6	W/5	0.23	7	8	8	8	100/2200	21	23
7/7	SW/2	0.81	7	10	8	10	fog	25	27
7/8	SW/5	1.52	7	6	8	8	100/2800	28	27
7/9	calm	0.38	6	15	7	10	99/2700	26	26
7/10	W/1	0.05	4	21	8	12	fog	26	24
7/11	calm	0.00	8	23	9	12	2/1000	21	21
7/12	SW/5	0.00	14	23	10	12	5/1000	19	19
7/13	W/5	0.00	12	25	10	14	20/8000	18	25
7/14	SW/10	0.05	10	10	9	10	100/2000	14	15
7/15	SW/5	0.05	9	10	9	10	100/3500	15	15
7/16	SW/5	0.51	9	11	9	10	100/3500	15	16
7/17	calm	0.43	9	12	10	11	fog	15	16
7/18	W/5	0.71	10	9	10	11	fog	16	15
7/19	SW/5	0.30	9	10	9	10	90/4500	16	14
7/20	SW/2	0.08	9	13	10	10	fog	14	12
7/21	S/10	0.00	11	19	11	12	95/3000	13	11
7/22	calm	0.00	10	21	10	10	fog	11	11
7/23	calm	0.00	10	–	11	–	fog	10	9
7/24	calm	0.05	12	12	10	10	fog	9	9
7/25	E/10	0.00	12	25	10	10	0	9	7
7/26	calm	0.00	11	31	11	11	0	8	6
7/27	E/12	0.00	14	20	12	11	10\6000	7	6
7/28	calm	0.03	11	15	11	–	fog	5	5
7/29	calm	0.08	12	21	–	–	99/2000	5	8
7/30	calm	0.81	11	23	–	–	50/6000	11	10
7/31	calm	0.00	12	18	–	–	80/1000	8	6
8/1	calm	0.03	14	15	11	–	100/2800	6	6
8/2	SW/4	0.30	13	9	10	–	99/2700	6	6
8/3	calm	0.41	10	11	11	12	fog	5	7

-continued-

Table 6.–Page 2 of 2.

Date	Wind (Dir/Speed)	Precip (cm)	Air Temp. °C am	Air Temp. °C pm	Water Temp. °C am	Water Temp. °C pm	Cloud Cover % / altitude	Water level (cm) am	Water level (cm) pm
8/4	SW/5	0.30	8	14	9	14	100/1800	9	8
8/5	calm	0.08	11	14	9	10	100/2000	7	7
8/6	SW/2	0.00	14	12	10	10	100/2500	7	13
8/7	W/3	0.86	9	10	9	10	100/1500	15	16
8/8	SE/5	0.18	10	13	8	11	100/1200	–	17
8/9	SW/6	0.18	9	9	10	9	95/1400	19	21
8/10	calm	0.43	11	11	8	9	100/1000	20	26
8/11	SW/3	0.53	8	14	9	10	100/2000	31	30
8/12	SW/2	0.05	9	20	9	11	100/1200	30	30
8/13	calm	0.00	22	17	9	11	75/2000	30	28
8/14	calm	0.23	10	12	9	10	100/1200	27	27
8/15	calm	0.76	11	13	9	11	100/1000	29	27
8/16	calm	0.05	11	13	9	9	100/1500	26	–
8/17	calm	0.08	11	14	9	11	98/4000	21	18
8/18	calm	0.58	12	14	9	12	100/1000	17	16
Min		0.00	4		6			5	
Max		1.52	31		14			31	
Average		0.24	12		10			16	

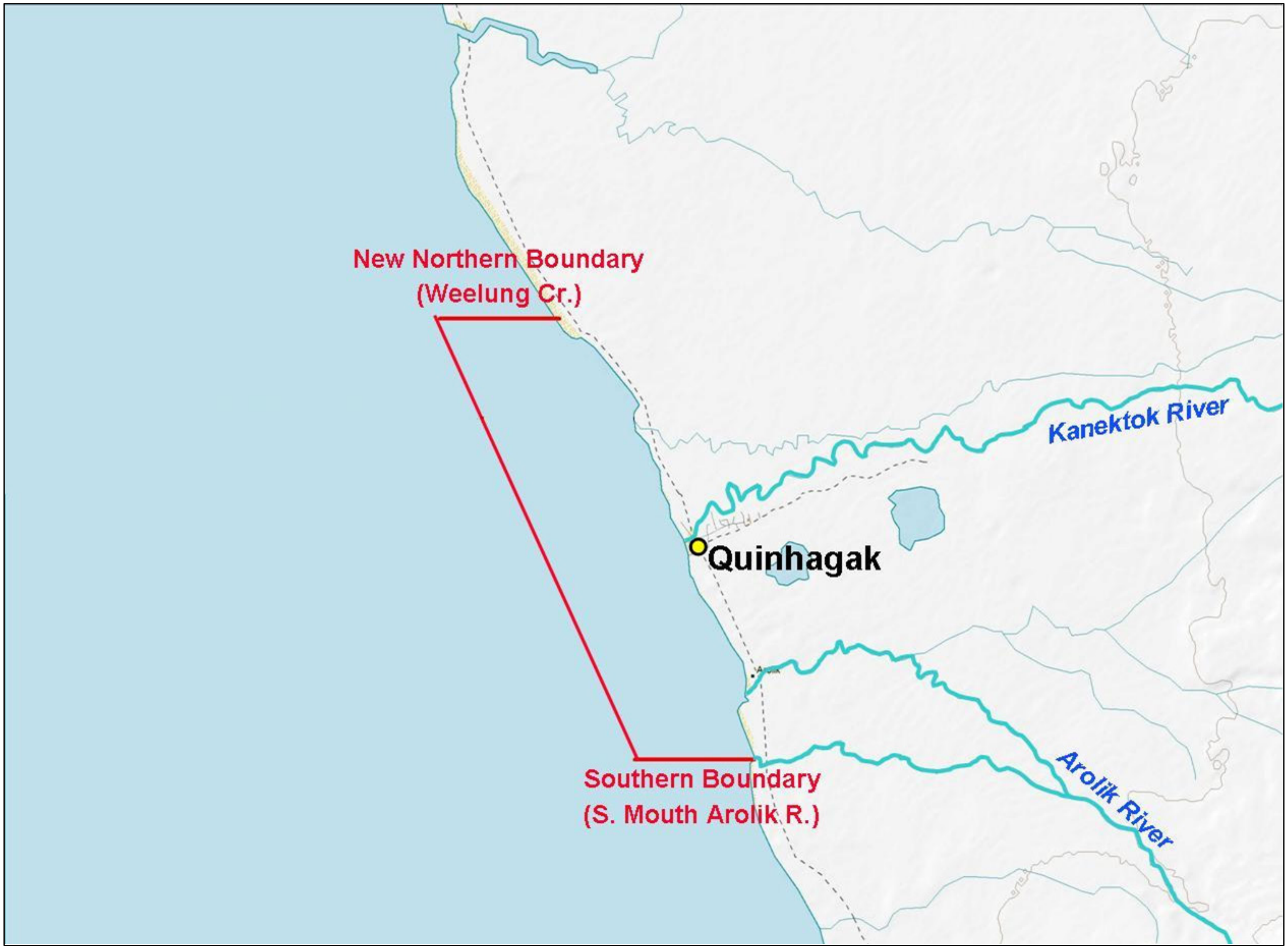

Figure 1.–Commercial fishing District W-4, Kuskokwim Bay, Alaska.

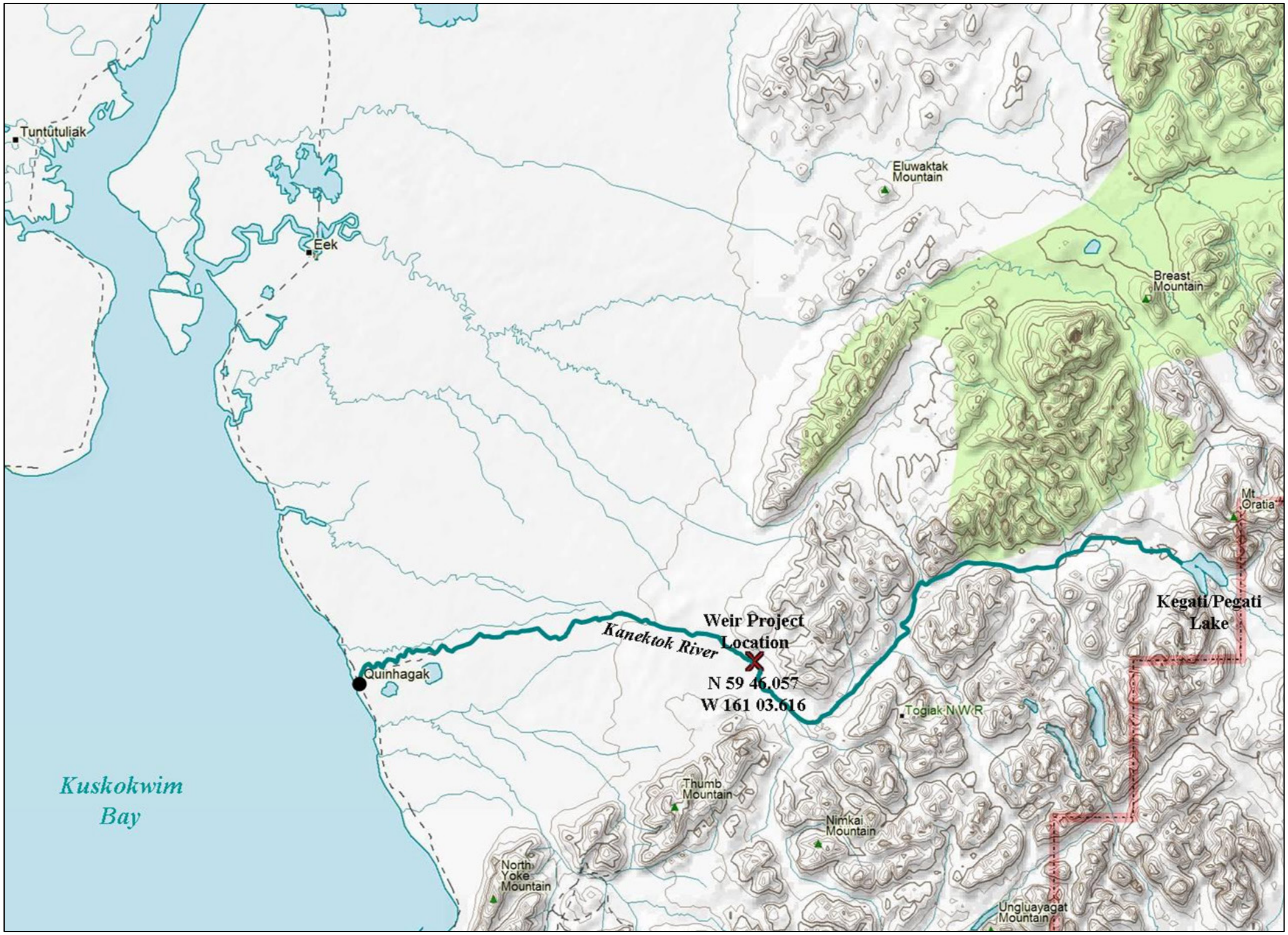

Figure 2.–Kanektok River, Kuskokwim Bay, Alaska.

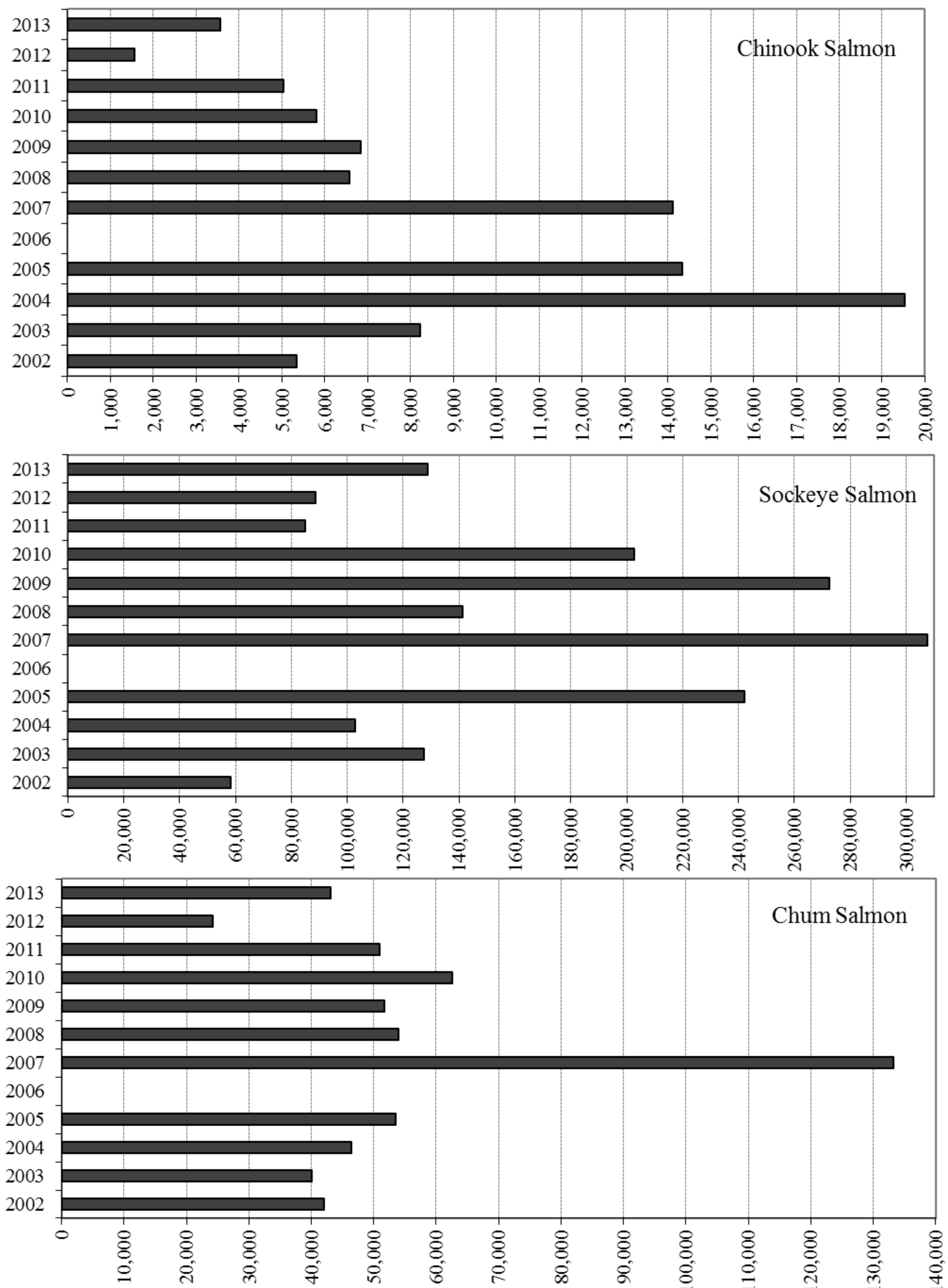

Figure 3.–Historical escapement of Chinook, sockeye, and chum salmon at the Kanektok River weir.

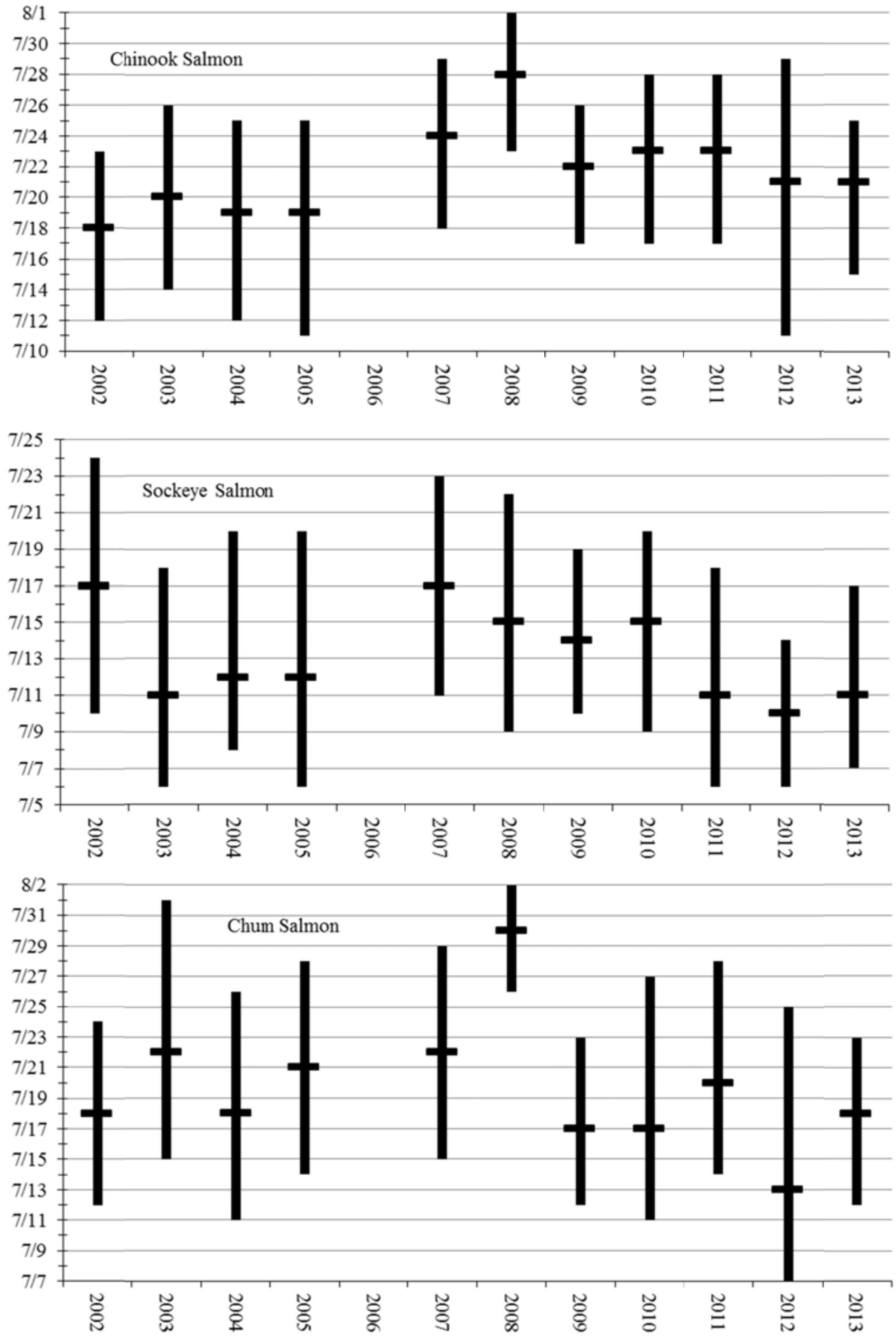

Figure 4.–Annual run timing of Chinook, sockeye, and chum salmon based on cumulative percent passage at the Kanektok River weir, 2002–2013.

Note: Solid lines represent the dates when the central 50% of the run passed, and cross-bars represent the median passage date.

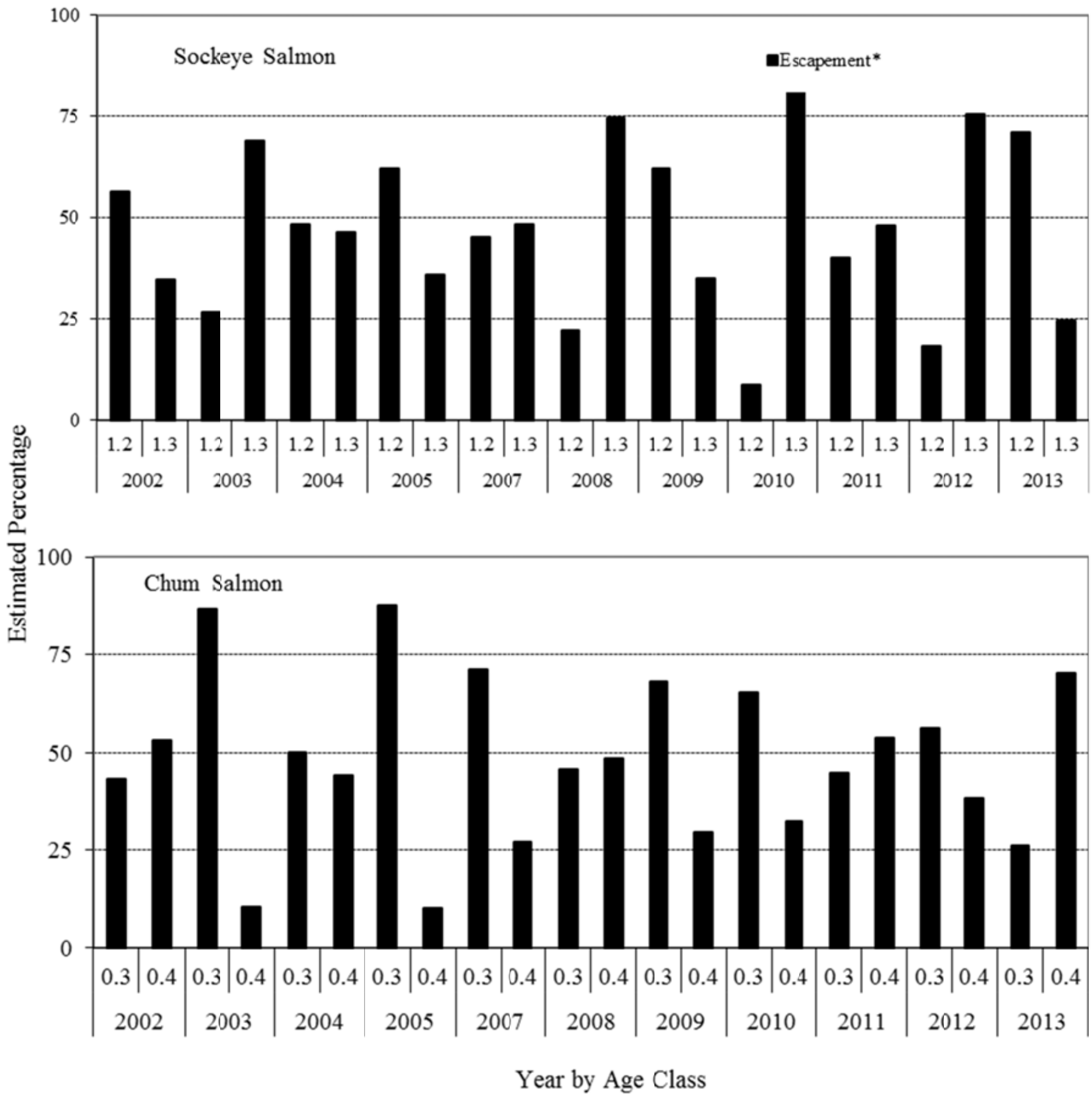

Figure 5.–Percentage of age-1.2 and -1.3 sockeye salmon and age-0.3 and -0.4 chum salmon from Kanektok River weir escapement estimates, 2002–2013.

Note: 2005 escapement ASL data does not represent estimated escapement because it is based on escapement observed and samples collected during weir operations only. 2008 escapement percentages are based on actual samples collected and do not represent total escapement.

APPENDIX A: HISTORICAL KANEKTOK RIVER, ESCAPEMENT PROJECTS, 1996–2013

Appendix A1.–Historical Kanektok River escapement projects, 1996–2013.

Year	Method	Dates of operation	Chinook	Sockeye	Chum	Pink [a]	Coho	Dolly Varden
1996	Counting Tower [b]	July 2–13, 20–25	6,827 [c]	71,637 [c]	70,617 [c]	[c]	[c]	
1997	Counting Tower [b]	June 11–August 21	16,731	96,348	51,180	7,872	23,172 [c]	
1998	Counting Tower [b]	July 23–August 17	[c]	[c]	[c]	[c]	[c]	
1999	Tower/Weir [b]	Not Operational						
2000	Resistance Board Weir [d]	Not Operational						
2001	Resistance Board Weir [e]	August 10–October 3	132 [c]	739 [c]	1,056 [c]	19 [c]	35,650	
2002	Resistance Board Weir	July 1–September 20	5,343	58,326	42,009	87,036	24,840	15,674
2003	Resistance Board Weir	June 24–September 18	8,231	127,471	40,066	2,443	72,448	9,195
2004	Resistance Board Weir	June 29–September 20	19,528	102,867	46,444	98,060	87,828	9,861
2005	Resistance Board Weir	July 8–September 8	14,331	242,208	53,580	3,530	26,343	10,193
2006	Resistance Board Weir	Not Operational						
2007	Resistance Board Weir	June 19–September 11	14,120	307,750	133,215	3,075	30,471	12,774
2008	Resistance Board Weir	July 17–August 21	6,578	141,388	54,024	142,430	24,490	8,140
2009	Resistance Board Weir	July 5–August 11	6,841	272,483	51,652	1,246	2,336 [c]	26,056
2010	Resistance Board Weir	June 28–August 5	5,800	202,634	62,567	114,074	330 [c]	43,292
2011	Resistance Board Weir	June 27–August 15	5,032	84,805	50,908	530	5,779 [c]	30,788
2012	Resistance Board Weir	July 6–August 15	1,568	88,800	24,173	62,141	4,248 [c]	20,547
2013	Resistance Board Weir	26 June–15 August	3,569	128,761	43,040	529	3,116 c	41,730
Average (2002–2012)			8,737	162,873	55,864		28,615	18,652

[a] Picket spacing of the weir panels allows pink salmon to freely pass through the weir unobserved.

[b] Project located approximately 15 river miles from the mouth of the Kanektok River.

[c] No counts or incomplete counts because the project was not operational during a large portion of species migration.

[d] Project located approximately 20 river miles from the mouth of the Kanektok River.

[e] 2001 through 2013, project located approximately 42 river miles from the mouth of the Kanektok River.