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Goodnews River Salmon Monitoring and Assessment, 2012

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

by

Davin V. Taylor

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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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By

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ABSTRACT

Goodnews River is the primary salmon spawning drainage in the Goodnews Bay area and supports subsistence, commercial, and sport fisheries near the communities of Goodnews Bay and Platinum in Southwest Alaska. The Alaska Department of Fish and Game, in cooperation with the U.S. Fish and Wildlife Service, operates a resistance board weir to enumerate fish returning to Middle Fork Goodnews River. In 2012, the weir was in operation June 29 through September 3, and a total of 513 Chinook *Oncorhynchus tshawytscha*; 30,472 sockeye *O. nerka*; 10,723 chum *O. keta*; 6,316 pink *O. gorbuscha*; 13,679 coho salmon *O. kisutch*; and 798 Dolly Varden char *Salvelinus malma* were estimated to have passed through the weir. Flood waters resulted in an early end to project operations. A portion of the coho salmon run could not be monitored, but estimates of missed passage for September 4 through September 18 are included in the escapement total. The Chinook and chum salmon escapement at the weir was below their respective escapement goals. Sockeye salmon escapement was within the biological escapement goal range, while coho salmon exceeded their escapement goal. Overall, escapements for Chinook, sockeye, chum, and coho salmon were below average.

Key words: Chinook, *Oncorhynchus tshawytscha*, chum, *O. keta*, coho *O. kisutch*, sockeye *O. nerka* and pink salmon, *O. gorbuscha*, Dolly Varden char *Salvelinus malma*, escapement monitoring, Goodnews River, Kuskokwim Area, Kuskokwim Bay

INTRODUCTION

Salmon returning to Goodnews River support subsistence, commercial, and sport fisheries near the communities of Goodnews Bay and Platinum in Southwest Alaska. The Alaska Department of Fish and Game (ADF&G), in cooperation with the U.S. Fish and Wildlife Service (USFWS) Togiak National Wildlife Refuge (TNWR) and Office of Subsistence Management (OSM) operates a resistance board weir on Middle Fork Goodnews River (Middle Fork). The weir provides a method for enumerating returning adult salmon, by species, and collecting data utilized in an effort to manage the resource sustainably.

ADF&G is responsible for managing the salmon fisheries of Alaska, in a manner consistent with the Sustainable Salmon Fisheries Policy (5 AAC 39.222). A core principle to this policy is management for escapements within ranges that provide a sustainable harvest yield and maintain normal ecosystem functioning. Managing for this policy requires long-term monitoring projects that reliably measure annual escapement to key spawning systems and track temporal and spatial patterns in abundance. Data collected from escapement projects provide a means to set escapement goals and monitor adequacy. Escapement data can be used in managing fisheries harvest, with the goal of managing for a sustainable resource. The Goodnews River weir provides a means for collection of escapement data by monitoring cumulative passage and progress toward achieving escapement goals. Goals have been set for Chinook *Oncorhynchus tshawytscha*, sockeye *O. nerka*, chum *O. keta*, and coho salmon *O. kisutch*.

SALMON FISHERIES

Subsistence Fisheries

Subsistence fishing is allowed throughout the Goodnews River drainage and in Goodnews Bay, and is primarily performed with drift and set gillnets. ADF&G has quantified subsistence salmon harvests in the communities of Goodnews Bay and Platinum since 1977. Harvest estimates are determined from interviews with subsistence fishermen in October and November. Sockeye salmon have been the most utilized subsistence salmon species in the Goodnews Bay area with a 10-year (2001–2010) average harvest of 1,154 fish, followed by Chinook salmon (732 fish), coho salmon (759 fish), and chum salmon (326 fish; Carroll and Hamazaki 2012). There is no estimate of total subsistence harvest of Dolly Varden char *Salvelinus malma* from the Goodnews River, but Carroll and Hamazaki (2012) interviewed 54 of 88 households in Goodnews Bay and Platinum who reported harvesting 1,359 char from the Goodnews 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, 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 Goodnews Bay.

Commercial Fisheries

Commercial salmon fishing occurs in Goodnews Bay within the boundaries of District W-5, the southernmost district in the Kuskokwim Area (Figure 1). Commercial fishing has occurred annually in District W-5 since it was established by the Alaska Board of Fisheries in 1968. Permit holders have unrestricted movement between commercial fishing districts within the Kuskokwim Area and fishermen from distant communities often participate in the District W-5 commercial fishery. The commercial fishery is primarily directed toward harvesting sockeye and coho salmon and is conducted from skiffs using hand-pulled gillnets. Pink salmon *O. gorbuscha* are the least valuable species commercially and have not been targeted in recent years. ADF&G has collected harvest data from fish buyers and processors since the district was created.

Since 1969, combined commercial harvests of salmon species in District W-5 have ranged from 2,879 fish in 1971 to 148,036 fish in 1994. Harvest numbers have been relatively stable since the late 1990s, with the exception of the low harvest in 2002 when market demand and processing capacity were low. The recent 10-year average harvest (2001–2010) was 51,723 salmon. Harvests efforts were high through the early 1990s when over 100 permits were fished annually. Harvest efforts have been relatively low in recent years with the recent 10-year average (2001–2010) of 32 permits fished annually (Brazil et al. 2013).

Sport Fisheries

Sport fishing occurs throughout the Goodnews River drainage. Pacific salmon (primarily Chinook and coho salmon), rainbow trout *O. mykiss*, Dolly Varden char, Arctic char *S. alpinus*, lake trout *S. namaycush*, and Arctic grayling *Thymallus arcticus* are targeted. Many sport fishermen take commercially guided or unguided float trips from lakes in the headwaters to the mouth at Goodnews Bay. There are currently 2 commercially operated lodges with semi-permanent camps in the drainage that offer fishing from powered skiffs. ADF&G has been estimating sport fishery harvests consistently since 1991. From 2007 to 2011 there was an average of 2,929 angler-days annually. The most recent 5-year average annual harvest (2007–2011) was 409 coho, 90 sockeye, 65 Chinook, and 10 chum salmon and 246 Dolly Varden char (Chythlook 2012).

PROJECT HISTORY

ADF&G, Division of Commercial Fisheries, has operated a salmon escapement monitoring project on Middle Fork Goodnews River since 1981 (Appendix A). The project was initiated as a counting tower in 1981 and operated through 1990 (Schultz 1982; Burkey 1990) focusing counts on Chinook, sockeye, and chum salmon. Although successful, the tower was limited by problems with species apportionment and high labor costs (Menard 1999). In 1991, resources were redirected towards a fixed-picket weir to reduce labor costs and improve species identification.

The fixed-picket weir was operated from 1991 through mid-season 1997, approximately 229 m downstream from the former tower site. Fish passage could be controlled, eliminating the need for hourly monitoring and increasing the efficiency of collecting age, sex, and length (ASL) information. Seasonal flood events were problematic if the weir could not be removed in time. The weir would rapidly collect debris, damming the flow until it failed and washed downstream, which occurred several times during the early 1990s.

In the mid-1990s, ADF&G began cooperating with USFWS to build a resistance board (floating) weir that would allow the project's operational period to include the coho salmon run during August and September. In July 1997 the resistance board weir was installed. This weir is designed to shed debris loads by sinking under high water conditions and allows the project to remain operational at higher water levels compared to the fixed-picket weir. The resistance board weir design can be rendered inoperable during extreme high water events; however, the weir can regain operations quickly once the high water subsides.

Extended operation of the weir has also allowed biologists to monitor the migration of Dolly Varden char. Dolly Varden char are anadromous and believed to be aggregates of mature fish returning to spawn and mixed stocks of immature fish that intend to over-winter in the drainage (Lisac 2007). Dolly Varden char contribute to the overall subsistence harvest of the residents in the Goodnews Bay area (Wolfe et al. 1984). However, quantitative information on actual subsistence harvest is not available. The weir has provided run timing and abundance estimates for Dolly Varden char since 1996 and was used as a platform for Dolly Varden char life history studies from 2001 until 2009 (Lisac 2010).

In 2006, TNWR provided an underwater video monitoring system to the project. This system allows the passage chute to be open for more hours per day. The system is controlled by digital video recorder with motion sensing software which condenses the hours of fish passage into a shorter video stream. Video monitoring allows for a reduction in staff hours devoted to visually monitoring daily passage.

ESCAPEMENT MONITORING AND ESCAPEMENT GOALS

The Middle Fork Goodnews River weir serves primarily as a management tool for commercial and subsistence salmon fisheries in the Goodnews Bay area. These data are used to make inseason management decisions based on both sustainable escapement goals (SEG) and biological escapement goals (BEG). The project also serves as a platform for other studies in the drainage, such as collecting samples for genetic stock identification and tagging Dolly Varden char to study run timing and seasonal distribution (Lisac 2010).

An evaluation of AYK Region escapement goals in 2007 resulted in a revision of the Middle Fork Goodnews River weir Chinook and sockeye salmon escapement goals from SEGs to BEGs (Brannian et al. 2006). The BEG for Chinook salmon was set at 1,500 to 2,900 fish and the BEG for sockeye salmon was set at 18,000 to 40,000 fish. The 2013 evaluation of AYK Region escapement goals did not result in changes to escapement goals set for Goodnews River salmon (Conitz et al. 2012).

AGE, SEX, AND LENGTH COMPOSITION ESTIMATES

Salmon ASL information has been collected from the weir project since 1984. Historically, the dominant age classes for Chinook salmon are age-1.2, 1.3 and 1.4 fish. Sockeye salmon escapement is dominated by age-1.3 fish. Chum salmon dominant age class alternates between age-0.3 and 0.4 fish. Age-2.1 fish are dominant for coho salmon. Chinook salmon male to female ratio varies with run timing, with males more dominant for the total run. Sex ratios are approximately 1 to 1 for sockeye, chum and coho salmon. Historical summaries of existing ASL information for salmon returning to the Goodnews River drainage can be found in Brodersen et al. (2013). Dolly Varden char sex, length and maturity information had been collected at the weir site from 2001 to 2009 (Lisac 2010), but is no longer being collected.

OBJECTIVES

Annual project objectives are to:

1. Estimate Chinook, sockeye, chum, coho salmon, and Dolly Varden char escapement at the weir.
2. Estimate the run timing of Chinook, sockeye, chum, Coho salmon, and Dolly Varden char at the weir.
3. Estimate the ASL composition of annual Chinook, sockeye, chum, and coho salmon escapements, such that 95% simultaneous confidence intervals for the age composition have a maximum width of ±10% (α=0.05 and d=0.10).
4. Record atmospheric and hydrologic conditions at the weir site.

METHODS

SITE DESCRIPTION

The Goodnews River watershed drains an area of nearly 2,590 km^2 along the west side of TNWR (Figure 2). It flows a distance of 97 river kilometers (rkm) along its mainstem, from Ahklun Mountains southwest into Goodnews Bay. Two major tributaries, Middle Fork and South Fork Goodnews rivers, join the mainstem a few miles from its mouth and are included within its drainage. In order to differentiate between them, Goodnews River refers to all 3 drainages, and the mainstem Goodnews River upstream of its confluence with Middle Fork will be referred to as North Fork Goodnews River or North Fork. 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 Goodnews River drainage.

Middle Fork Goodnews River parallels North Fork Goodnews River and flows a distance of approximately 72 rkm before joining the mainstem. The weir project is located approximately 16 rkm from the village of Goodnews Bay on the Middle Fork at lat 59°09.595’N, long 161°23.287’W (Figure 2). The channel at the weir location is approximately 61.0 m wide, has a regular profile from 0.3 to 1.2 m deep, which tapers to low cut banks on either side and flows 0.6 to 1.2 $m \cdot s^{-1}$ during average water conditions. The river substrate is primarily cobblestone, gravel, and sand. The channel upstream of the weir is characterized by deep water along a steep cut bank approximately 6.1 m in height on the south bank (as looking downstream) tapering to a gravel bar on the north bank. The project campsite is located on the south bank approximately 46 m upstream and 27 m inland from the weir location.

RESISTANCE BOARD WEIR

Methods for the design, construction, and installation of the resistance board weir followed Tobin (1994) and Stewart (2002, 2003). The picket spacing allows smaller fish, such as pink salmon and other non-salmon species, to pass upstream and downstream through the weir. Further details of resistance board weir components used for the Goodnews River weir are described in Stewart (2004).

Two fish passage chutes were installed on the weir at approximately 15 m and 5 m from the south bank. A 3 m by 4.6 m trap used to collect fish for ASL sampling was installed directly upstream of the passage chute located furthest from the bank. The fish passage chute located nearest to the bank was connected to a passage gate that incorporated an underwater video camera to record fish passage.

Boats pass at a designated boat gate consisting of modified weir panels located near the middle of the weir. Boats with jet-drive engines were common and could pass upstream and downstream over the boat gate easily at reduced 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 assistance from crew members.

ESCAPEMENT MONITORING AND ESTIMATES

The Middle Fork weir operated from June 24 through September 18. Counting periods occurred regularly throughout the day, typically for 1–2 hours duration, beginning in the morning and continuing as late as light permitted. During counting periods the passage gate was opened to allow fish to pass through the weir. Counts were also conducted using underwater video recordings that allowed for continuous monitoring, typically operated from 1000 to 2200 hours. Fish passage captured by the video equipment was reviewed by the crew and included in passage counts recorded as daily video total passage. Any fish observed traveling downstream through the fish passage chutes were excluded from the upstream tally.

Passage missed during inoperable periods or breach events was estimated using Hierarchical Bayesian Estimation technique (Adkison and Su 2001). In this, 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; let 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

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

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

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

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

At 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

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

σ_a ~ uniform(0.1, 10,000); σ_b ~ uniform(0.1, 10,000);

σ_μ ~ uniform(0.1, 10,000); σ ~ uniform(0.1, 10,000).

Markov-chain Monte Carlo methods (WinBUGS v1.4; 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. From those, Bayesian credible intervals (95%) were obtained from the percentiles (2.5 and 97.5) of the marginal posterior distribution. Available historical data limits estimation of missed passage to the dates June 25 through August 18.

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-sex category ($\alpha = 0.05$ and $d = 0.10$). The sample size for Chinook salmon was adjusted for a finite population based on the lower bound of the SEG. Sample sizes of sockeye and chum salmon were increased by a factor of 3 to allow for postseason stratification. The sample size objective for each species was 203 Chinook, 648 sockeye, 606 chum, and 202 coho salmon.

Daily sample objectives were based on a proportional sampling design and a preliminary population estimate based on the lower bound of the escapement goals for each species. Daily sample proportions were 0.14 for Chinook, 0.04 for sockeye, 0.05 for chum, and 0.02 for coho salmon. Therefore, the daily Chinook salmon sample size was 0.14 of the previous day's passage. Due to abundance of sockeye, chum, and coho salmon, samples were collected every few days and the sample size was the sum of the previous day's passage multiplied by the daily proportion. 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 schedule based on fish passage patterns and minimum sample size objectives as outlined above.

Salmon were sampled from a trap attached to the weir. To sample sockeye, chum, and coho salmon the exit gate was closed allowing fish entering the trap to accumulate inside. The trap was typically allowed to fill with fish and sampling was done during scheduled counting periods. Because of the relatively low proportion of Chinook salmon to other species, they were captured in the trap while allowing other species to pass during typical passage counts (active sampling).

For escapement sampling, scales were removed from the preferred area of the fish (INPFC 1963). A minimum of 3 scales were removed from each Chinook and coho salmon and 1 scale was removed from each chum and sockeye salmon. Scales were mounted on numbered and labeled gum cards. 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. Length was measured to the nearest millimeter from mideye to tail fork and the fish released upstream of the weir. After sampling was concluded, gum cards and data forms were completed and returned to the Bethel ADF&G office for processing.

ADF&G staff in Bethel and Anchorage aged scales, processed the ASL data, and generated data summaries as per Brodersen et al. (2013). 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 estimate the overall age and sex composition. Age and sex confidence interval bounds were estimated to determine if the desired precision was met for the season estimate. If the desired precision level was met then season summary was the weighted 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 are 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 are 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 hydrological conditions were recorded at 1000 each day. Cloud cover was judged in percent of total sky covered; wind speed was estimated in miles per hour and direction was noted; precipitation was measured in mm per 24 hours. Daily air and water temperatures were recorded in degrees Celsius. The river level was recorded daily and was referenced to a benchmark established in 1997 representing a river stage of 150 cm. The benchmark was an aluminum I-beam driven into the bank along a steep grade downstream of the field camp. The river gauge is a steel ruler installed near shore in the river and is set level with the top of the benchmark at 150 cm. In 2011, a new benchmark was established because the old benchmark had eroded into the river. The new benchmark is a rebar stake driven into the ground near the camp trail. The new benchmark was calibrated to the old benchmark and represents a water level of 250 cm.

RESULTS

WEIR OPERATIONS

Weir operation began the evening of June 29 and passage was monitored until September 3. A hole in the weir occurred for approximately 14 hours on July 3. The video camera monitoring passage malfunctioned on August 17 for 2.5 hours. High water flowing over submerged panels allowed for unmonitored fish passage from July 15 to July 23. A second high water period submerged panels and caused deep scouring under the substrate rail, rendering the weir inoperable on September 4. Water level remained high and further passage counts were not possible. The crew began weir removal September 15. Passage estimates for inoperable periods and the unmonitored portion of the initial day are included in the total escapement counts. An estimation of missed coho salmon passage was determined for September 4 through September 18.

SALMON ESCAPEMENT

The 2012 Chinook salmon escapement through the Middle Fork weir was 513 fish. The first Chinook salmon was observed on June 29 and the last Chinook salmon was observed on August 30. Passage during inoperable periods was estimated to be 112 fish (21.8% of total passage). Based on the operational period and inclusive of missed passage estimates, the median passage date was July 21 and the central 50% of the run occurred between July 10 and August 4 (Table 1).

Sockeye salmon escapement was 30,472 fish. The first sockeye salmon was observed on June 29 and the last sockeye salmon was observed on September 2. Passage during inoperable periods was estimated to be 3,525 fish (11.6% of total passage). Based on the operational period and inclusive of missed passage estimates, the median passage date was July 6 and the central 50% of the run occurred between July 2 and July 9 (Table 1).

Chum salmon escapement was 10,723 fish. The first chum salmon was observed on June 29 and the last chum salmon was observed on September 1. Passage during inoperable periods was estimated to be 3,921 fish (36.6% of total passage). Based on the operational period and inclusive of missed passage estimates, the median passage date was July 20 and the central 50% of the run occurred between July 14 and July 29 (Table 1).

Coho salmon escapement was 13,679 fish. The first coho salmon was observed on July 28 and the last coho salmon was observed on September 3. Passage during inoperable periods was estimated to be 2,598 fish (19% of total passage). Based on the operational period and inclusive of missed passage estimates, the median passage date was August 27 and the central 50% of the run occurred between August 24 and August 31 (Table 1).

Observed passage of pink salmon was 6,316 fish. The first pink salmon was observed on June 30 and the last pink salmon was observed on September 3. The median passage date was August 13 and the central 50% of the run occurred between August 6 and August 16 (Table 2).

Observed passage of Dolly Varden char was 798 fish. The first Dolly Varden char was observed on June 30 and the last Dolly Varden char was observed on September 1. The median passage date was July 24 and the central 50% of the run occurred between July 10 and July 28. Missed passage estimates of Dolly Varden char are not made for inoperable periods. Observed passage of resident species in 2012 was 104 rainbow trout, 138 whitefish, and 13 Arctic grayling (Table 2).

AGE, SEX, AND LENGTH COMPOSITION ESTIMATES

Sample sizes and distribution of samples were sufficient for estimating sockeye salmon age, sex, and length composition of the escapement. The sample size for Chinook, chum and coho salmon was insufficient for estimating age, sex, and length composition of the escapement.

Age was determined for 45 Chinook salmon in 2012. Sample results were insufficient for stratification and a weighted age composition of escapement could not be determined. Results of processed samples were 4 age-1.2, 30 age-1.3, and 11 age-1.4 fish. Sex composition of sampled fish was 23 male and 22 female. Mean male length of sampled fish was 598 mm for age-1.2, 757 mm for age-1.3, and 732 mm for age-1.4 fish. Mean female length of sampled fish was 603 mm for age-1.2, 785 mm for age-1.3, and 847 mm for age-1.4 fish. Overall, male lengths ranged from 533 to 898 mm and female lengths ranged from 603 to 923 mm (Table 3).

Age was determined for 331 sockeye salmon in 2012. Overall, 95% confidence intervals for age composition of annual escapement were no wider than ±4.7%. Age-1.3 sockeye salmon were the most abundant age class (77.2%), followed by age-2.3 (7.0%), and age-1.2 (6.7%). Females comprised 56.0% of the aged samples. Mean male length was 520 mm for age-1.2, 568 mm for age-1.3, and 556 mm for age-2.3 fish. Mean female length was 485 mm for age-1.2, 528 mm for age-1.3, and 522 mm for age-2.3 fish. Overall, male lengths ranged from 463 to 675 mm and female lengths ranged from 448 to 586 mm (Table 4).

Age was determined for 347 chum salmon in 2012. Sample results were insufficient for stratification and a weighted age composition of escapement could not be determined. Results of processed samples were 2 age-0.2, 267 age-0.3, 73 age-0.4, and 5 age-0.5 fish. Sex composition of sampled fish was 185 male and 162 female. Mean male length was 583 mm for age-0.3 and 583 mm for age-0.4 fish. Mean female length was 541 mm for age-0.3 and 563 mm for age-0.4 fish. Overall, male lengths ranged from 505 to 648 mm and female lengths ranged from 504 to 615 mm (Table 5).

Age was determined for 262 coho salmon in 2012. Sample results were insufficient for stratification and a weighted age composition of escapement could not be determined. Results of processed samples were 34 age-1.1, 217 age-2.1, and 11 age-3.1 fish. Sex composition of sampled fish was 138 male and 124 female. Mean male length of the samples was 540 mm for age-1.1 and 545 mm for age-2.1 fish. Mean female length of the samples was 551 mm for age-1.1 and 555 mm for age-2.1 fish. Overall, male lengths ranged from 412 to 646 mm and female lengths ranged from 411 to 642 mm (Table 6).

ATMOSPHERIC AND HYDROLOGICAL MONITORING

Atmospheric and hydrological observations were recorded daily from June 21 to September 21. Air temperatures ranged from 0˚ to 16˚C. Water temperature ranged from 6˚ to 11˚C. Several rain events resulted in daily accumulations from trace amounts up to 18.54 mm for a 24 hour period. Total rainfall during this period was 354.33 mm. Water levels ranged from 17 to 105 cm (Table 7).

DISCUSSION

WEIR OPERATIONS

The 2012 weir operation was successful in estimating escapement and run timing of Chinook, sockeye, chum, and coho salmon and Dolly Varden char past the weir. The majority of project objectives were achieved with the exception of Chinook, chum and coho salmon ASL sampling objective. Missed passage estimates for inoperable periods accounted for 9 days of Chinook, sockeye, chum, and coho salmon passage and 15 days of coho passage after operation ceased. The project continues to add to the long-term escapement, run timing, and ASL database for salmon returning to Goodnews River and serves as a platform to study other anadromous and resident freshwater species.

ESCAPEMENT MONITORING AND ESTIMATES

The 2012 Chinook salmon escapement at the weir was well below the BEG range of 1,500 to 2,900 fish; and was 17% of the recent 10-year average (2002–2011). The escapement is the lowest among recorded years with similar monitoring methods (Figure 3; Appendix A). Low Chinook salmon escapement estimates were also reported along the Kuskokwim River (T. Elison, Commercial Fishery Biologist, ADF&G, Anchorage, personal communication). The 50% point of the run passed 9 days later than the median passage date for 1998–2011. Chinook salmon have returned between 6 and 10 days later than the median passage date since 2006 (Figure 4).

The 2012 sockeye salmon escapement at the weir was within the BEG range of 18,000 to 40,000 fish; however, it was among the lowest escapements for recorded years with similar monitoring methods. The escapement was slightly greater than half of the recent 10-year average (2002–2011; Figure 3; Appendix A). Run timing was near average and the 50% point of the run passed 2 days earlier than the median passage date (1998–2011; Figure 4).

The 2012 chum salmon escapement at the weir was below the SEG lower bound of 12,000 fish, less than half of the recent 10-year average (2001–2010) and the lowest escapement since 2001 (Figure 3; Appendix A). The run timing was slower than average and the 50% point of the run passed 2 days later than the median passage date (1998–2011; Figure 5).

The 2012 coho salmon escapement was above the SEG lower bound of 12,000 fish. The weir operated until September 3, which is before the end of the coho salmon migration, but considered to be a reasonable time period for an index of total passage. This is considered reasonable because the cumulative passage during the last 6 days of operation were less than 1% of the total observed passage. The run timing was earlier than average (Figure 5).

Passage estimates were included for periods of missed operation, due to flooding. Passage estimates for short term breach events were not determined. Overall passage was low and it was determined that missed passage from short term breaches would not have a significant effect on overall escapement and run timing results.

Dolly Varden char counts generated by the weir project represented an unknown proportion of the overall Dolly Varden char migration within Middle Fork Goodnews River and should be considered an index. The current spacing between weir panel pickets was chosen for optimal weir operations during high water events and for generating escapement counts of Chinook, sockeye, chum, and coho salmon. Therefore, the weir count must be considered to be size selective for larger (>400 mm) Dolly Varden char and probably does not well represent the younger, smaller fish that can pass through the weir unobserved (Lisac 2004). The 2012 Dolly Varden char count was the lowest count recorded, since 1996 and less than half of the historical average (2,666; Figure 6; Appendix A).

AGE, SEX, AND LENGTH COMPOSITION ESTIMATES

Achieving Chinook salmon ASL sampling objectives continues to be problematic. Low daily passage, migration patterns, and behavior at the weir have made sample collection difficult. Chinook salmon tend to migrate in large pulses so that their passage may be slow for a period of days and then suddenly peak. Coordinating ASL sampling to coincide with these pulses is difficult because timing of the pulses cannot be accurately predicted. An active sampling strategy of capturing Chinook salmon individually or in small groups as other species are allowed to pass freely through the trap has improved sample sizes, but the fish trap used at the weir does not present the best platform for active sampling. This strategy can work well, but is time intensive and Chinook salmon are often hesitant to approach the trap in its current fixed location and when there is increased activity around the trap. In an effort to achieve Chinook salmon sample objectives, active sampling will continue to be conducted at the weir.

The sample objective was met for sockeye salmon, and the samples were sufficient to estimate the age composition of the total escapement. The age-1.2 contribution was less than observed in past years. Age-2.3 showed an increase from previous observations (Elison and Taylor 2011, 2012).

Proportional sampling was attempted for chum salmon and sample results were divided among strata. However, sample distribution was not adequate to represent ASL composition for the escapement. A period of operation loss occurred during the mid-part of the run which, prevented adequate ASL collection.

The proportional sample goals were met for coho salmon, and sample results were divided among strata. Sample distribution did not produce adequate representation of the second half of the run. Early weir closure prevented collection of samples after the historical mid-point of the run and data was not available to represent all portions of the run.

RECOMMENDATIONS

Annual operation of the Middle Fork Goodnews River weir should continue indefinitely. As the only ground-based monitoring project in District W-5, the project provides valuable, reliable in-season and postseason information about Chinook, sockeye, chum, and coho salmon that are critical for sustainable salmon management.

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TABLES AND FIGURES

Table 1.–Daily, cumulative and cumulative percent passage of Chinook, sockeye, chum, and coho salmon, Middle Fork Goodnews River weir, 2012.

	Chinook			Sockeye			Chum			Coho		
Date	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	% passage
6/29	6	6	1	2,209	2,209	7	24	24	0	0	0	0
6/30	10	16	3	2,283	4,492	15	109	133	1	0	0	0
7/01	4	20	4	1,439	5,931	19	115	248	2	0	0	0
7/02	4	24	5	1,736	7,667	25	63	311	3	0	0	0
7/03	28[a]	52	10	2,203[a]	9,870	32	137[a]	448	4	0[a]	0	0
7/04	3	55	11	1,440	11,310	37	68	516	5	0	0	0
7/05	15	70	14	2,340	13,650	45	387	903	8	0	0	0
7/06	13	83	16	3,269	16,919	56	326	1,229	11	0	0	0
7/07	11	94	18	3,076	19,995	66	297	1,526	14	0	0	0
7/08	10	104	20	1,609	21,604	71	276	1,802	17	0	0	0
7/09	16	120	23	1,677	23,281	76	281	2,083	19	0	0	0
7/10	7	127	25	2,600	25,881	85	136	2,219	21	0	0	0
7/11	25	152	30	437	26,318	86	123	2,342	22	0	0	0
7/12	10	162	32	669	26,987	89	90	2,432	23	0	0	0
7/13	3	165	32	474	27,461	90	119	2,551	24	0	0	0
7/14	6[b]	171	33	310	27,771	91	80	2,631	25	0	0	0
7/15	14[b]	184	36	361[b]	28,132	92	479[b]	3,109	29	0[d]	0	0
7/16	14[b]	198	39	316[b]	28,448	93	482[b]	3,592	33	0[d]	0	0
7/17	13[b]	211	41	269[b]	28,717	94	486[b]	4,078	38	0[d]	0	0
7/18	13[b]	224	44	228[b]	28,945	95	470[b]	4,547	42	0[d]	0	0
7/19	12[b]	236	46	194[b]	29,139	96	452[b]	4,999	47	0[d]	0	0
7/20	12[b]	247	48	163[b]	29,302	96	425[b]	5,425	51	0[d]	0	0
7/21	11[b]	259	50	146[b]	29,448	97	413[b]	5,838	54	0[d]	0	0
7/22	11[b]	269	53	122[b]	29,570	97	378[b]	6,216	58	0[d]	0	0
7/23	10[c]	280	55	111[c]	29,681	97	348[c]	6,563	61	0[a]	0	0
7/24	11	291	57	47	29,728	98	212	6,775	63	0	0	0
7/25	0	291	57	60	29,788	98	169	6,944	65	0	0	0
7/26	15	306	60	102	29,890	98	594	7,538	70	0	0	0
7/27	0	306	60	7	29,897	98	112	7,650	71	0	0	0
7/28	19	325	63	42	29,939	98	272	7,922	74	3	3	0
7/29	3	328	64	15	29,954	98	156	8,078	75	0	3	0
7/30	11	339	66	18	29,972	98	159	8,237	77	0	3	0
7/31	6	345	67	13	29,985	98	201	8,438	79	9	12	0

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Table 1.–Page 2 of 3.

Date	Chinook			Sockeye			Chum			Coho		
	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	% passage
8/01	14	359	70	17	30,002	98	281	8,719	81	22	34	0
8/02	7	366	71	6	30,008	98	193	8,912	83	24	58	0
8/03	2	368	72	4	30,012	98	62	8,974	84	3	61	0
8/04	5	373	73	12	30,024	99	78	9,052	84	17	78	1
8/05	13	386	75	17	30,041	99	154	9,206	86	7	85	1
8/06	9	395	77	18	30,059	99	144	9,350	87	7	92	1
8/07	10	405	79	11	30,070	99	66	9,416	88	43	135	1
8/08	4	409	80	18	30,088	99	151	9,567	89	39	174	1
8/09	27	436	85	36	30,124	99	279	9,846	92	121	295	2
8/10	1	437	85	17	30,141	99	83	9,929	93	8	303	2
8/11	8	445	87	32	30,173	99	128	10,057	94	55	358	3
8/12	3	448	87	39	30,212	99	117	10,174	95	56	414	3
8/13	12	460	90	27	30,239	99	138	10,312	96	201	615	4
8/14	8	468	91	35	30,274	99	142	10,454	97	250	865	6
8/15	7	475	93	16	30,290	99	63	10,517	98	234	1,099	8
8/16	4	479	93	12	30,302	99	26	10,543	98	169	1,268	9
8/17	0[a]	479	93	6	30,308	99	18	10,561	98	51	1,319	10
8/18	2	481	94	12	30,320	100	24	10,585	99	33	1,352	10
8/19	5	486	95	31	30,351	100	42	10,627	99	456	1,808	13
8/20	4	490	96	34	30,385	100	32	10,659	99	401	2,209	16
8/21	4	494	96	8	30,393	100	23	10,682	100	268	2,477	18
8/22	3	497	97	6	30,399	100	7	10,689	100	260	2,737	20
8/23	3	500	97	10	30,409	100	7	10,696	100	603	3,340	24
8/24	0	500	97	3	30,412	100	5	10,701	100	549	3,889	28
8/25	1	501	98	9	30,421	100	6	10,707	100	954	4,843	35
8/26	2	503	98	5	30,426	100	6	10,713	100	1,798	6,641	49
8/27	6	509	99	13	30,439	100	3	10,716	100	918	7,559	55
8/28	1	510	99	4	30,443	100	4	10,720	100	619	8,178	60
8/29	2	512	100	4	30,447	100	1	10,721	100	439	8,617	63
8/30	1	513	100	3	30,450	100	1	10,722	100	1,502	10,119	74
8/31	0	513	100	16	30,466	100	0	10,722	100	253	10,372	76
9/01	0	513	100	3	30,469	100	1	10,723	100	276	10,648	78
9/02	0	513	100	3	30,472	100	0	10,723	100	355	11,003	80
9/03	0	513	100	0	30,472	100	0	10,723	100	78	11,081	81
9/04	[d]	513	100	[d]	30,472	100	[d]	10,723	100	366[b]	11,447	84

-continued-

Table 1.–Page 3 of 3.

	Chinook			Sockeye			Chum			Coho		
Date	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	% passage
9/05	[d]	513	100	[d]	30,472	100	[d]	10,723	100	326[b]	11,773	86
9/06	[d]	513	100	[d]	30,472	100	[d]	10,723	100	290[b]	12,063	88
9/07	[d]	513	100	[d]	30,472	100	[d]	10,723	100	260[b]	12,323	90
9/08	[d]	513	100	[d]	30,472	100	[d]	10,723	100	228[b]	12,551	92
9/09	[d]	513	100	[d]	30,472	100	[d]	10,723	100	206[b]	12,756	93
9/10	[d]	513	100	[d]	30,472	100	[d]	10,723	100	167[b]	12,924	94
9/11	[d]	513	100	[d]	30,472	100	[d]	10,723	100	155[b]	13,078	96
9/12	[d]	513	100	[d]	30,472	100	[d]	10,723	100	129[b]	13,207	97
9/13	[d]	513	100	[d]	30,472	100	[d]	10,723	100	113[b]	13,320	97
9/14	[d]	513	100	[d]	30,472	100	[d]	10,723	100	97[b]	13,417	98
9/15	[d]	513	100	[d]	30,472	100	[d]	10,723	100	80[b]	13,497	99
9/16	[d]	513	100	[d]	30,472	100	[d]	10,723	100	69[b]	13,566	99
9/17	[d]	513	100	[d]	30,472	100	[d]	10,723	100	61[b]	13,627	100
9/18	[d]	513	100	[d]	30,472	100	[d]	10,723	100	52[b]	13,679	100
Total	513			30,472			10,723			13,679		
Observed	401			26,947			6,802			11,081		
Estimated	112			3,525			3,921			2,598		
% Observed	78.2			88.4			63.4			81.0		

Note: Boxes indicate 80% of the run. Inside boxes indicate the estimated central 50% of passage. Bold indicates the date that the estimated cumulative 50% passage occurred.

[a] Partial count, a breach occurred in the weir; missed passage was not estimated.

[b] Weir was not operational, daily passage was estimated.

[c] Weir was not operational for a portion of the day, missed passage was estimated.

[d] Weir was not operational, daily passage was not estimated.

Table 2.–Daily and cumulative percent passage of pink salmon and Dolly Varden, Middle Fork Goodnews 2012.

	Pink Salmon			Dolly Varden			Whitefish		Rainbow Trout		Arctic Grayling	
Date	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	Daily	Cum.	Daily	Cum.
6/29	0	0	0	0	0	0	0	0	1	1	0	0
6/30	10	10	0	1	1	0	6	6	1	2	1	1
7/01	16	26	0	4	5	1	3	9	0	2	0	1
7/02	9	35	1	5	10	1	2	11	0	2	0	1
7/03	13[a]	48	1	8[a]	18	2	2[a]	13[a]	3[a]	5	1[a]	2
7/04	3	51	1	8	26	3	5	18	2	7	0	2
7/05	26	77	1	24	50	6	7	25	1	8	3	5
7/06	27	104	2	41	91	11	2	27	1	9	2	7
7/07	17	121	2	28	119	15	2	29	0	9	3	10
7/08	51	172	3	7	126	16	2	31	1	10	1	11
7/09	90	262	4	22	148	19	3	34	2	12	0	11
7/10	42	304	5	91	239	30	0	34	0	12	0	11
7/11	21	325	5	17	256	32	0	34	0	12	0	11
7/12	11	336	5	8	264	33	0	34	0	12	0	11
7/13	25	361	6	29	293	37	0	34	2	14	0	11
7/14	39	400	6	29	322	40	0	34	0	14	0	11
7/15	0[a]	400	6	0[a]	322	40	[a]	34	[a]	14	[a]	11
7/16	0[a]	400	6	0[a]	322	40	[a]	34	[a]	14	[a]	11
7/17	0[a]	400	6	0[a]	322	40	[a]	34	[a]	14	[a]	11
7/18	0[a]	400	6	0[a]	322	40	[a]	34	[a]	14	[a]	11
7/19	0[a]	400	6	0[a]	322	40	[a]	34	[a]	14	[a]	11
7/20	0[a]	400	6	0[a]	322	40	[a]	34	[a]	14	[a]	11
7/21	0[a]	400	6	0[a]	322	40	[a]	34	[a]	14	[a]	11
7/22	0[a]	400	6	0[a]	322	40	[a]	34	[a]	14	[a]	11
7/23	8[a]	408	6	7[a]	329	41	1[a]	35	1[a]	15	0[a]	11
7/24	111	519	8	80	409	**51**	0	35	1	16	0	11
7/25	55	574	9	90	499	63	0	35	0	16	0	11
7/26	155	729	12	86	585	73	0	35	0	16	0	11
7/27	29	758	12	5	590	74	0	35	0	16	0	11
7/28	94	852	13	38	628	79	0	35	0	16	0	11
7/29	48	900	14	12	640	80	0	35	0	16	0	11
7/30	31	931	15	16	656	82	0	35	0	16	0	11
7/31	69	1,000	16	14	670	84	0	35	0	16	0	11
8/01	136	1,136	18	10	680	85	0	35	0	16	0	11
8/02	106	1,242	20	7	687	86	0	35	0	16	0	11

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Table 2.–Page 2 of 3.

Date	Pink Salmon Daily	Pink Salmon Cum.	Pink Salmon % passage	Dolly Varden Daily	Dolly Varden Cum.	Dolly Varden % passage	Whitefish Daily	Whitefish Cum.	Rainbow Trout Daily	Rainbow Trout Cum.	Arctic Grayling Daily	Arctic Grayling Cum.
8/03	51	1,293	20	3	690	86	0	35	0	16	0	11
8/04	79	1,372	22	8	698	87	0	35	1	17	0	11
8/05	95	1,467	23	7	705	88	0	35	4	21	0	11
8/06	117	1,584	25	5	710	89	0	35	3	24	0	11
8/07	205	1,789	28	5	715	90	0	35	0	24	0	11
8/08	137	1,926	30	3	718	90	2	37	2	26	0	11
8/09	361	2,287	36	12	730	91	1	38	2	28	0	11
8/10	89	2,376	38	5	735	92	3	41	5	33	0	11
8/11	346	2,722	43	1	736	92	0	41	3	36	0	11
8/12	234	2,956	47	11	747	94	7	48	5	41	0	11
8/13	434	3,390	54	5	752	94	4	52	7	48	1	12
8/14	837	4,227	67	5	757	95	15	67	16	64	0	12
8/15	432	4,659	74	1	758	95	20	87	9	73	0	12
8/16	333	4,992	79	5	763	96	4	91	3	76	0	12
8/17	145	5,137	81	2	765	96	8	99	5	81	0	12
8/18	78	5,215	83	1	766	96	0	99	2	83	0	12
8/19	325	5,540	88	4	770	96	4	103	2	85	0	12
8/20	117	5,657	90	2	772	97	10	113	0	85	0	12
8/21	66	5,723	91	2	774	97	6	119	2	87	0	12
8/22	27	5,750	91	1	775	97	1	120	1	88	0	12
8/23	76	5,826	92	2	777	97	0	120	5	93	0	12
8/24	67	5,893	93	0	777	97	5	125	2	95	0	12
8/25	104	5,997	95	1	778	97	1	126	0	95	1	13
8/26	112	6,109	97	4	782	98	4	130	3	98	0	13
8/27	40	6,149	97	4	786	98	0	130	3	101	0	13
8/28	21	6,170	98	4	790	99	0	130	0	101	0	13
8/29	32	6,202	98	3	793	99	6	136	1	102	0	13
8/30	44	6,246	99	1	794	99	2	138	0	102	0	13
8/31	29	6,275	99	3	797	100	0	138	1	103	0	13
9/01	28	6,303	100	1	798	100	0	138	1	104	0	13
9/02	9	6,312	100	0	798	100	0	138	0	104	0	13
9/03	4	6,316	100	0	798	100	0	138	0	104	0	13
9/04	[b]	6,316	100	[b]	798	100	[b]	138	[b]	104	[b]	13

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Table 2.–Page 3 of 3.

	Pink Salmon			Dolly Varden			Whitefish		Rainbow Trout		Arctic Grayling	
Date	Daily	Cum.	% passage	Daily	Cum.	% passage	Daily	Cum.	Daily	Cum.	Daily	Cum.
9/05	[b]	6,316	100	[b]	798	100	[b]	138	[b]	104	[b]	13
9/06	[b]	6,316	100	[b]	798	100	[b]	138	[b]	104	[b]	13
9/07	[b]	6,316	100	[b]	798	100	[b]	138	[b]	104	[b]	13
9/08	[b]	6,316	100	[b]	798	100	[b]	138	[b]	104	[b]	13
9/09	[b]	6,316	100	[b]	798	100	[b]	138	[b]	104	[b]	13
9/10	[b]	6,316	100	[b]	798	100	[b]	138	[b]	104	[b]	13
9/11	[b]	6,316	100	[b]	798	100	[b]	138	[b]	104	[b]	13
9/12	[b]	6,316	100	[b]	798	100	[b]	138	[b]	104	[b]	13
9/13	[b]	6,316	100	[b]	798	100	[b]	138	[b]	104	[b]	13
9/14	[b]	6,316	100	[b]	798	100	[b]	138	[b]	104	[b]	13
Total	6,316			798			138		112		13	

Note: Boxes indicate 80% of the run. Inside boxes indicate the estimated central 50% of passage. Bold indicates the date that the estimated cumulative 50% passage occurred.

[a] Partial day counts because of a breach in weir, no estimates were made.

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

Table 3.–Age and sex composition and mean length (mm) of Chinook salmon escapement, Middle Fork Goodnews River weir, 2012.

Sample Size		Brood Year / Age Class	2008 1.2 N	%	2007 1.3 N	%	2006 1.4 N	%	Total N	%
45	Total [a]	Male	3	6.7	16	35.6	4	8.9	23	51.1
	all data	Female	1	2.2	14	31.1	7	15.6	22	48.9
	no stratification	Total	4	8.9	30	66.7	11	24.4	45	100.0
		95% C.I.		-		-		-		
		Male Mean	598		757		732			
		SE	39.33		18.29		37.65			
		Range	533-651		643-898		598-867			
		n	3		16		4			
		Female Mean	603		785		847			
		SE	0.00		7.61		17.51			
		Range	603-603		746-862		805-923			
		n	1		14		7			

[a] Samples were insufficient for stratification based on proportions of cumulative escapement. A weighted total is not available.

Table 4.–Age and sex composition and mean length (mm) of sockeye salmon escapement, Middle Fork Goodnews River weir, 2012.

Sample Size		Brood Year / Age Class	2008 0.3 N	%	2008 1.2 N	%	2007 1.3 N	%	2007 2.2 N	%	2006 1.4 N	%	2006 2.3 N	%	2006 3.2 N	%	Total N	%
331		Male	277	0.9	831	2.7	10,794	35.4	536	1.8	210	0.7	769	2.5	0	0.0	13,417	44.0
	Weighted [a]	Female	192	0.6	1,212	4.0	12,727	41.8	826	2.7	594	2.0	1,379	4.5	125	0.4	17,056	56.0
	Total	Total	469	1.5	2,043	6.7	23,521	77.2	1,362	4.5	805	2.6	2,148	7.0	125	0.4	30,473	100.0
		95% C.I.		1.4		2.7		4.7		2.4		1.9		2.7		0.8		0.2
		Male Mean Length	559		520		568		510		586		556		-			
		SE	0.00		13.36		2.13		11.13		0.00		10.17		-			
		Range	535-585		463-574		507-675		476-542		573-595		493-584		0-0			
		n	3		9		117		6		2		9		-			
		Female Mean Length	505		485		528		491		527		522		477			
		SE	0.00		7.62		2.15		13.72		16.28		3.10		0.00			
		Range	499-516		448-572		453-586		457-564		467-565		494-542		477-477			
		n	2		15		138		8		6		15		1			

[a] Samples were sufficient for stratification based on proportions of cumulative escapement. A weighted total is presented.

Table 5.–Age and sex composition and mean length (mm) of chum salmon escapement, Middle Fork Goodnews River weir, 2012.

Sample Size		Brood Year / Age Class	2009 / 0.2 N	%	2008 / 0.3 N	%	2007 / 0.4 N	%	2006 / 0.5 N	%	Total N	%
347	Total [a]	Male	0	0.0	135	38.9	48	13.8	2	0.6	185	53.3
	all data	Female	2	0.6	132	38.0	25	7.2	3	0.9	162	46.7
	no stratification	Total	2	0.6	267	76.9	73	21.0	5	1.4	347	100.0
		95%C.I.		-		-		-		-		
		Male Mean	-		583		583		572			
		SE	-		2.77		4.04		1.00			
		Range	0-0		505-692		514-648		571-573			
		n	-		135		48		2			
		Female Mean	519		541		563		563			
		SE	14.50		2.50		6.21		22.73			
		Range	504-533		442-613		513-615		537-608			
		n	2		132		25		3			

[a] Samples were insufficient for stratification based on proportions of cumulative escapement. A weighted total is not available.

Table 6.–Age and sex composition and mean length (mm) of coho salmon escapement, Middle Fork Goodnews River weir, 2012.

Sample Size		Brood Year / Age Class	2009 / 1.1 N	%	2008 / 2.1 N	%	2007 / 3.1 N	%	Total N	%
262		Male	17	6.5	114	43.5	7	2.7	138	52.7
	Weighted [a]	Female	17	6.5	103	39.3	4	1.5	124	47.3
	Total	Total	34	13.0	217	82.8	11	4.2	262	100.0
		95% C.I.		-		-		-		
		Male Mean	540		545		518			
		SE	9.90		4.37		12.27			
		Range	478-614		412-646		476-556			
		n	17		114		7			
		Female Mean	551		555		571			
		SE	9.47		3.45		1.46			
		Range	464-600		411-642		556-587			
		n	17		103		4			

[a] Samples were insufficient for stratification based on proportions of cumulative escapement. A weighted total is not available.

Table 7.–Daily weather and hydrological, Middle Fork Goodnews River weir site, 2012.

Date	Wind (Dir./Speed)	Precipitation mm/24hr	Air Temp. °C	Water Temp °C	Cloud Cover %/altitude (ft)	Water Level (cm)
6/21	calm	0.00	14	9	0	56
6/22	calm	0.00	16	10	50/2000	52
6/23	E/5	0.00	9	9	100/1000	50
6/24	calm	7.11	8	8	100/2000	48
6/25	calm	3.81	7	7	100/1000	49
6/26	calm	1.27	6	7	100/500	47
6/27	W/5	0.00	9	7	100/1000	45
6/28	calm	0.76	8	7	100/1500	42
6/29	calm	0.00	6	7	100/500	40
6/30	W/5	0.00	9	8	100/1000	37
7/01	W/5	0.00	9	8	100/1000	35
7/02	calm	0.00	8	8	100/1000	34
7/03	calm	10.92	8	7	100/500	35
7/04	calm	5.59	8	8	100/1000	39
7/05	calm	3.05	12	8	20/3000	39
7/06	calm	9.14	10	8	100/1500	36
7/07	W/5	2.79	11	8	80/1000	34
7/08	calm	0.00	16	10	20/3000	32
7/09	calm	trace	10	10	100/1000	32
7/10	-	-	-	-	-	-
7/11	calm	12.70	10	9	100/500	34
7/12	calm	7.37	8	8	100/500	42
7/13	calm	4.57	8	8	100/500	45
7/14	W/5	9.91	9	8	100/500	52
7/15	calm	15.75	10	9	100/500	69
7/16	calm	1.52	11	9	90/3000	72
7/17	calm	0.00	12	8	0	69
7/18	calm	0.00	11	9	50/2000	62
7/19	W/10	0.00	9	9	100/500	56
7/20	calm	0.51	12	9	10/3000	50
7/21	calm	10.67	12	9	100/3000	50
7/22	calm	2.29	12	9	100/500	48
7/23	calm	0.51	9	9	100/300	44
7/24	SE/5	0.00	11	9	100/1000	40
7/25	SW/10	trace	10	9	100/500	37
7/26	calm	3.81	10	9	100/300	37
7/27	calm	0.51	10	9	100/500	34
7/28	calm	0.00	11	9	100/500	30
7/29	calm	1.27	9	9	100/500	31
7/30	calm	20.32	8	8	100/1500	40
7/31	SE/5	0.00	9	8	100/1000	33
8/01	calm	4.06	9	9	100/400	34
8/02	SE/5	5.59	9	8	100/200	42
8/03	S/5	0.00	9	9	100/200	42
8/04	calm	0.51	8	7	100/1500	39
8/05	W/5	0.00	9	9	100/1500	38
8/06	calm	5.08	9	9	100/1500	38
8/07	calm	0.51	9	9	100/200	39

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Table 7.–Page 2 of 2.

Date	Wind (Dir./Speed)	Precipitation mm/24hr	Air Temp. °C	Water Temp °C	Cloud Cover %/altitude (ft)	Water Level (cm)
8/08	calm	0.00	12	9	50/1500	33
8/09	calm	0.00	9	9	fog	32
8/10	calm	0.00	16	10	100/3000	28
8/11	calm	0.00	11	11	100/200	27
8/12	calm	0.00	13	11	0	25
8/13	calm	0.00	12	11	0	23
8/14	calm	0.00	15	11	25/3000	21
8/15	NE/5	0.00	15	11	100/200	20
8/16	S/10	0.00	12	11	100/2000	20
8/17	calm	0.00	11	11	100/1000	18
8/18	S/20	7.62	11	10	100/300	18
8/19	SW/10	3.81	9	9	100/1000	27
8/20	calm	3.81	9	9	25/2000	28
8/21	calm	0.51	9	9	fog	21
8/22	calm	1.78	10	9	100/200	20
8/23	SW/10	1.27	10	10	100/2000	18
8/24	S/10	3.81	9	9	100/300	17
8/25	calm	1.78	9	9	100/200	18
8/26	SW/10	15.24	12	11	100/200	20
8/27	calm	9.40	14	9	25/2000	32
8/28	calm	0.76	9	9	100/200	26
8/29	calm	1.27	13	10	100/500	23
8/30	W/10	9.91	9	9	100/500	37
8/31	W/5	2.54	10	9	75/1000	40
9/01	-	-	-	-	-	-
9/02	SE/15	13.21	10	9	100/2000	39
9/03	W/15	14.99	9	9	100/100	60
9/04	SW/20	14.73	8	9	100/200	70
9/05	S/5	18.54	9	9	100/300	100
9/06	calm	5.33	9	9	100/1500	105
9/07	SW/5	12.95	8	8	100/1500	100
9/08	calm	5.08	6	8	25/2000	98
9/09	calm	0.51	7	8	100/2500	90
9/10	calm	0.00	7	7	100/2500	81
9/11	calm	1.02	8	8	100/1000	72
9/12	calm	7.62	8	8	100/2000	65
9/13	calm	0.51	8	7	100/2000	60
9/14	E/5	3.05	7	7	90/1500	53
9/15	calm	2.79	9	7	100/500	49
9/16	W/15	19.81	8	7	100/1000	54
9/17	calm	11.18	8	7	100/500	60
9/18	calm	5.59	8	7	100/1000	64
9/19	calm	1.52	6	7	100/1000	64
9/20	calm	0.51	4	7	0	59
9/21	calm	0.00	0	6	25/2000	54
Min		0.00	0	6		17
Max		20.32	16	11		105
Average		3.98	10	9		44

Note: Weather conditions are recorded at 10 am each day.

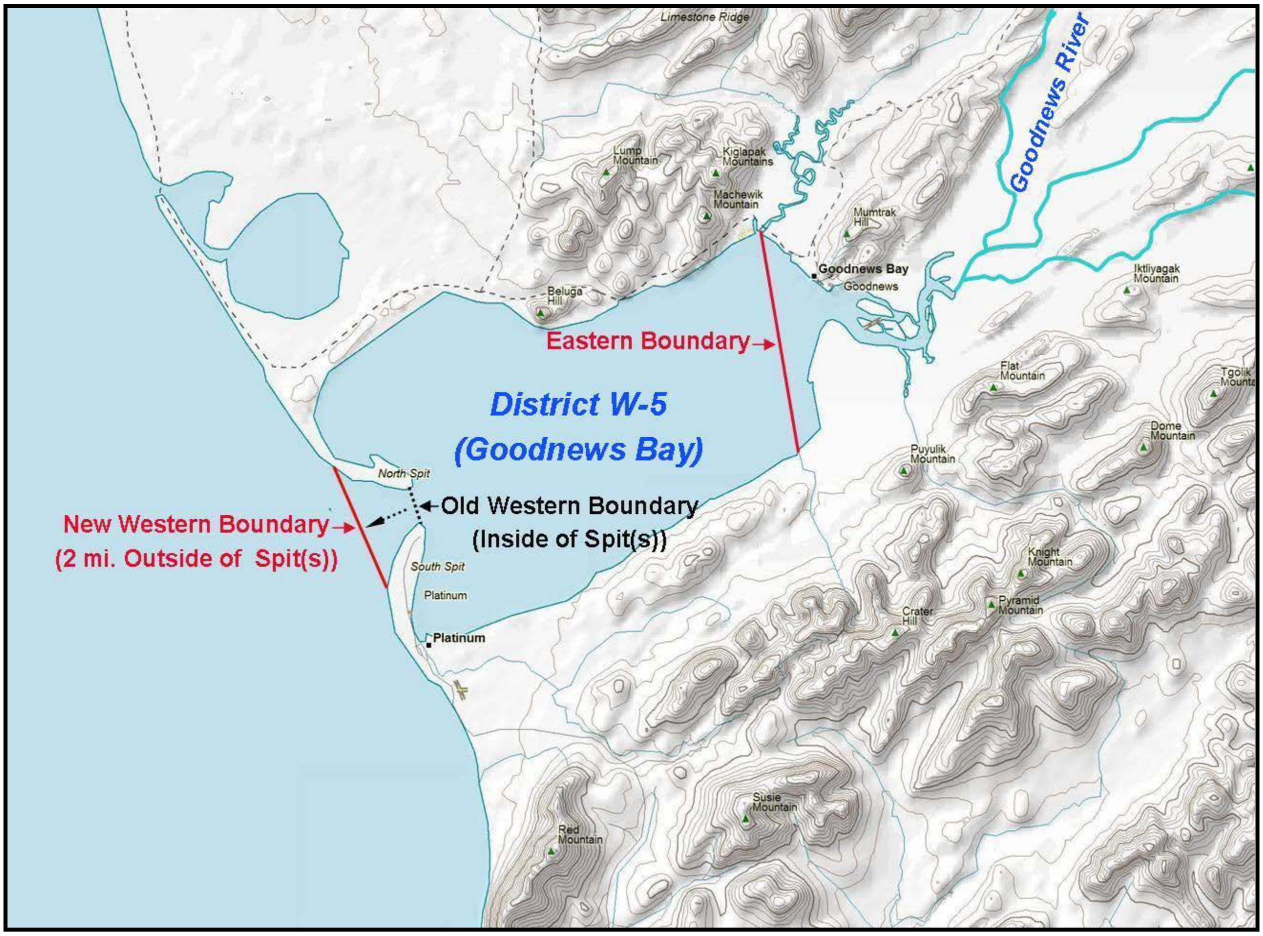


Figure 1.–Commercial fishing District W-5 (Goodnews Bay), Kuskokwim Bay, Alaska.

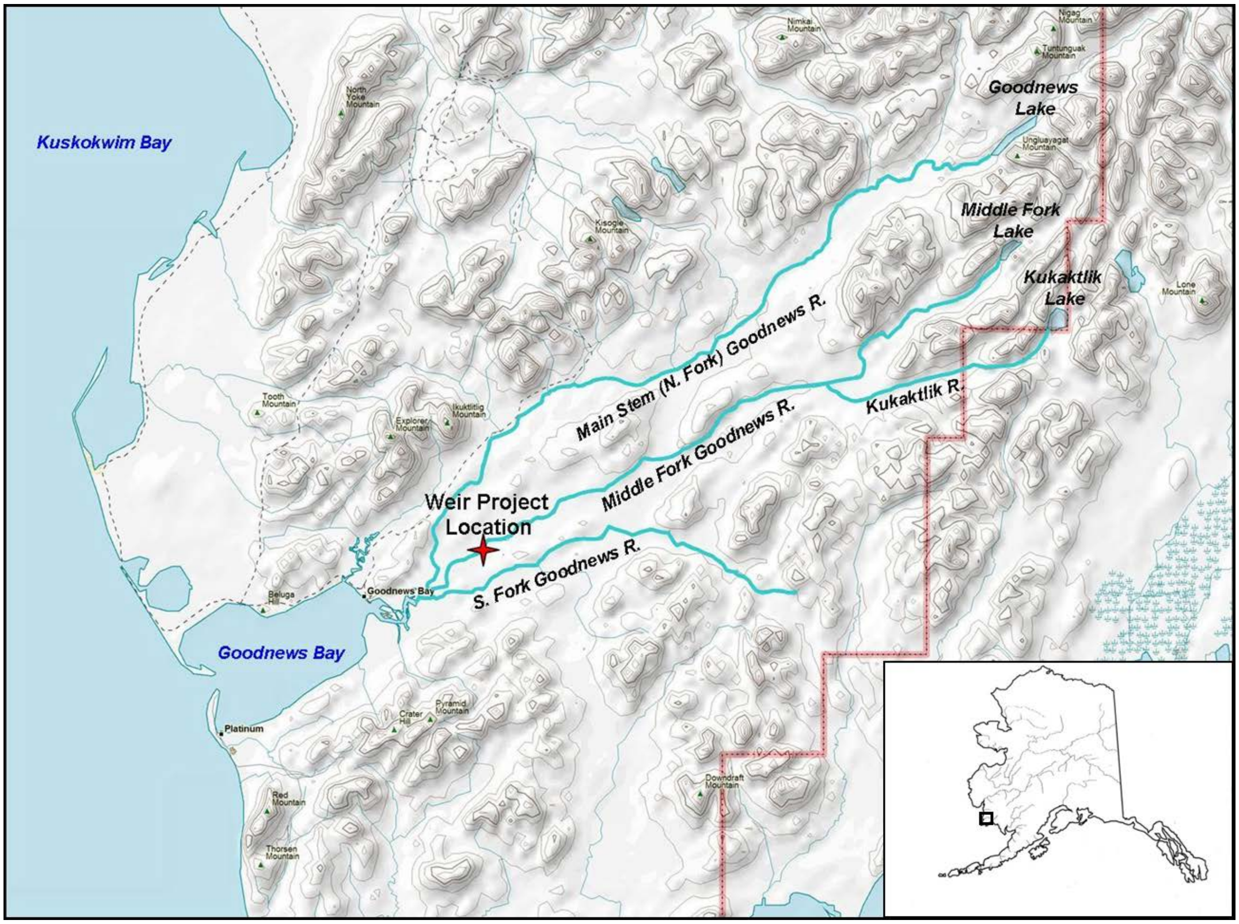


Figure 2.–Goodnews Rover drainage, Kuskokwim Bay, Alaska.

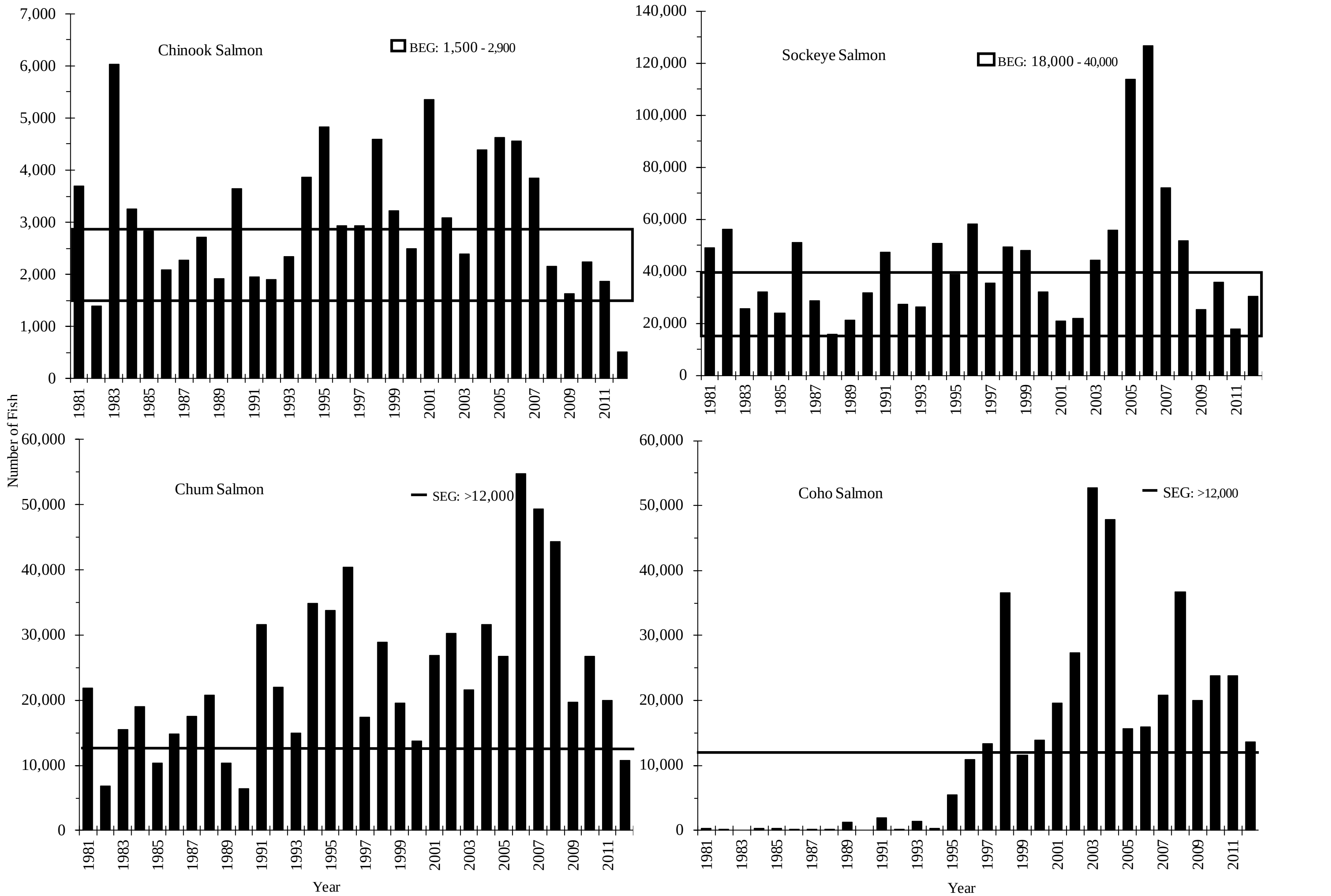
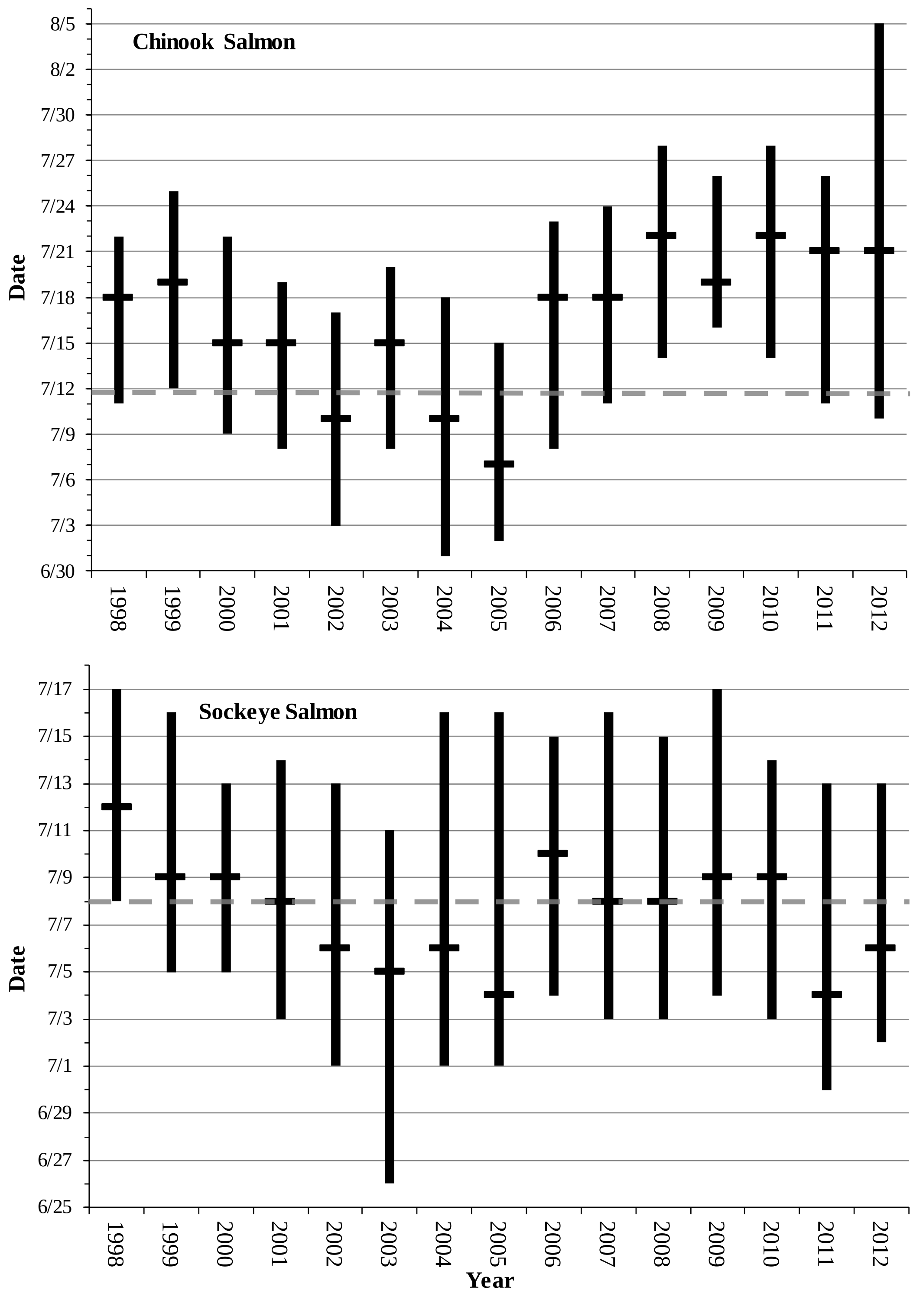
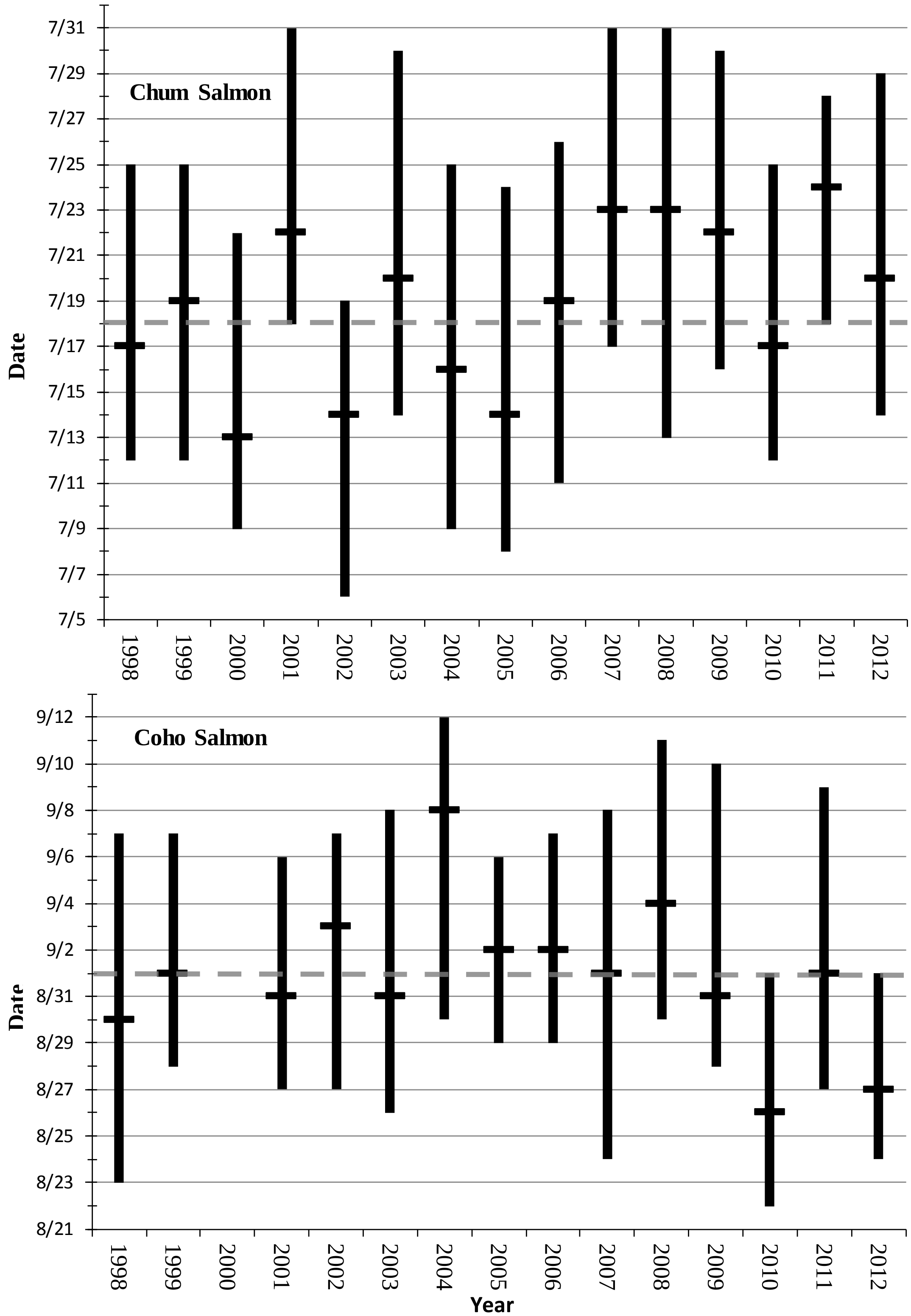


Figure 3.–Historical Chinook, sockeye, chum, and coho salmon escapement estimates, Middle Fork Goodnews River weir, 1981–2012.



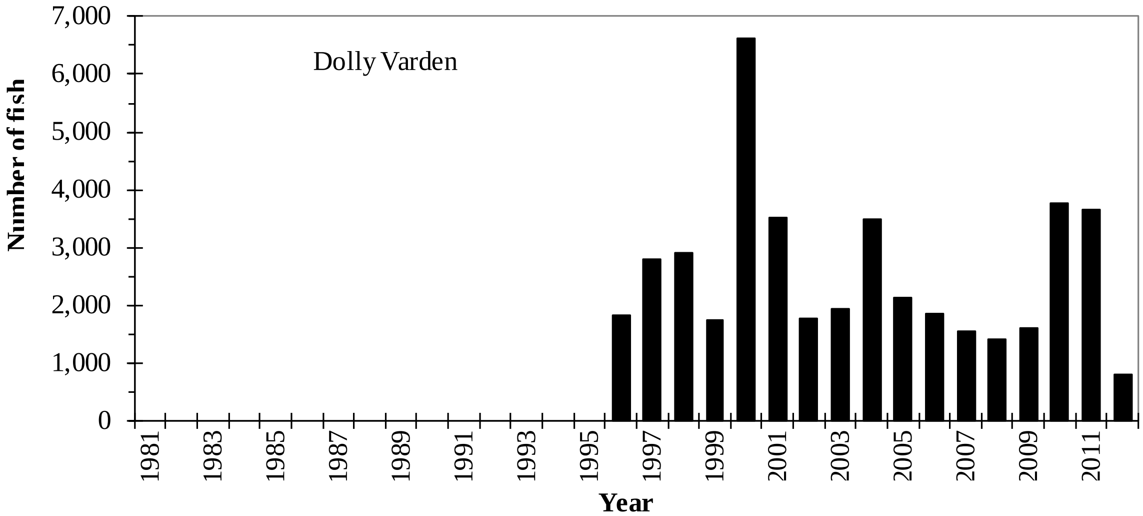
Note: Solid lines represent the dates when the central 50% of the run passed, cross-bars represent the median passage date and dashed line represent historic median (1998–2011).

Figure 4.–Annual run timing of Chinook and sockeye salmon based on cumulative percent passage at the Middle Fork Goodnews River weir, 1998–2012.



Note: Solid lines represent the dates when the central 50% of the run passed, cross-bars represent the median passage date and dashed line marks represent historic median (1998–2011).

Figure 5.–Annual run timing of chum, and coho salmon based on cumulative percent passage at the Middle Fork Goodnews River weir, 1998–2012.



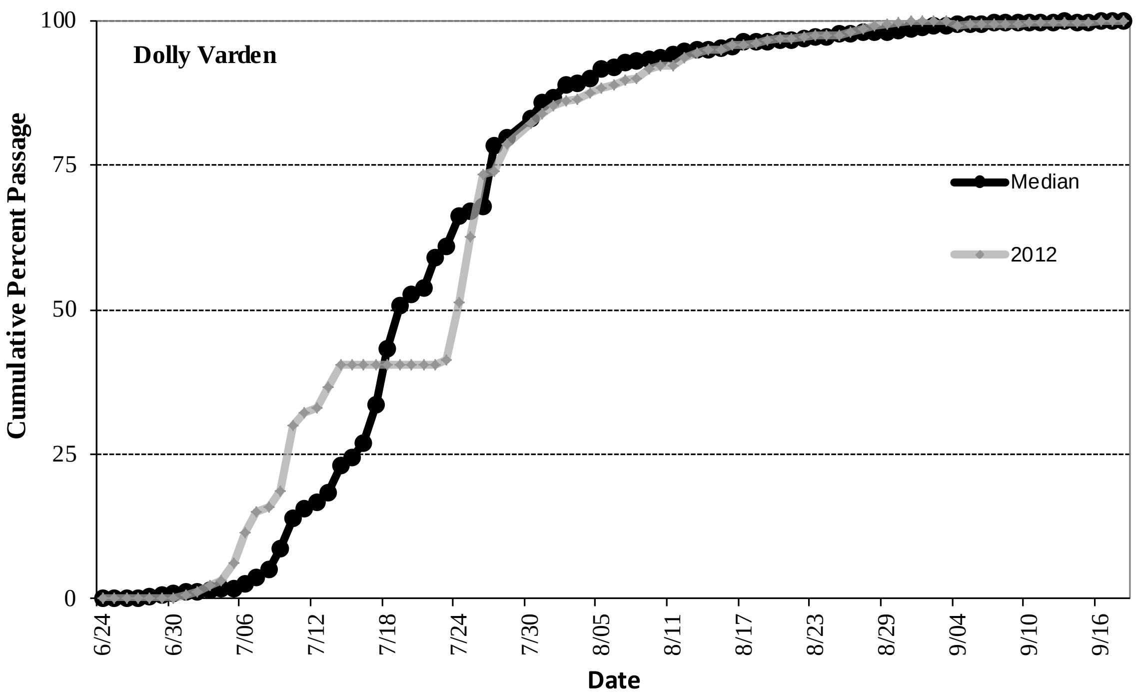


Figure 6.–Historical Dolly Varden escapement estimate, 1981–2012, and cumulative percent passage of Dolly Varden, 2012 and historical median, at Middle Fork Goodnews Rover weir.

APPENDIX A: HISTORICAL ESCAPEMENT 1981–2012

Appendix A1.–Historical escapement, Middle Fork Goodnews River escapement projects 1981–2012.

Year	Method	Dates of Operation	Chinook	Sockeye	Chum	Pink[a]	Coho	Dolly Varden
1981	Counting Tower[b]	6/13 – 8/9	3,688	49,108	21,827	[c]	356[d]	[c]
1982	Counting Tower[b]	6/23– 8/3	1,395	56,255	6,767	[c]	91[d]	[c]
1983	Counting Tower[b]	6/11 – 7/28	6,027	25,816	15,548	[c]	0[d]	[c]
1984	Counting Tower[b]	6/15 – 7/31	3,260	32,053	19,003	[c]	249[d]	[c]
1985	Counting Tower[b]	6/27 – 7/31	2,831	24,131	10,367	[c]	282[d]	[c]
1986	Counting Tower[b]	6/16 – 7/24	2,080	51,069	14,764	[c]	163[d]	[c]
1987	Counting Tower[b]	6/22 – 7/30	2,272	28,871	17,517	[c]	62[d]	[c]
1988	Counting Tower[b]	6/23 – 7/30	2,712	15,799	20,799	[c]	6[d]	[c]
1989	Counting Tower[b]	6/27 – 7/31	1,915	21,186	10,380	[c]	1,212[d]	[c]
1990	Counting Tower[b]	6/20 –7/31	3,636	31,679	6,410	[c]	0[d]	[c]
1991	Fixed Picket Weir[e]	6/29 - 8/23	1,952	47,397	31,644	1,428	1,978[d]	[c]
1992	Fixed Picket Weir[e]	6/21 – 8/4	1,905	27,268	22,023	22,601	150[d]	[c]
1993	Fixed Picket Weir[e]	6/23 – 8/18	2,349	26,452	14,952	318	1,451[d]	[c]
1994	Fixed Picket Weir[e]	6/23 – 8/9	3,856	50,801	34,849	38,705	309[d]	[c]
1995	Fixed Picket Weir[e]	6/19 – 8/28	4,836	39,009	33,699	330	5,415[d]	[c]
1996	Fixed Picket Weir[e]	6/19 – 8/23	2,931	58,290	40,450	20,105	10,869[d]	1,829[d]
1997	Fixed/R. Board Weir	6/12 – 9/17	2,937	35,530	17,369	940	13,413	2,808
1998	R. Board Weir	7/4 – 9/17	4,584[d]	49,513[d]	28,832[d]	10,376	36,596	2,915
1999	R. Board Weir	6/25 – 9/26	3,221	48,205	19,513	914	11,545	1,761
2000	R. Board Weir	7/2 – 8/27	2,500[d]	32,341[d]	13,791[d]	0	13,907	6,616
2001	R. Board Weir	6/26 – 9/30	5,351	21,024	26,820	5,405	19,626	3,535
2002	R. Board Weir	6/25 – 9/18	3,085	22,101	30,300	0	27,364	1,770
2003	R. Board Weir	6/18 – 9/18	2,389	44,387	21,637	1,921	52,810	1,949
2004	R. Board Weir	6/21 – 9/20	4,388	55,926	31,616	21,633	47,917	3,492
2005	R. Board Weir	6/26 – 9/8	4,633	113,809	26,690	5,926	15,683	2,128
2006	R. Board Weir	6/26 – 9/7	4,559	126,772	54,699	18,432	15,969	1,858
2007	R. Board Weir	6/25 – 9/10	3,852	72,282	49,285	4,819	20,767	1,549
2008	R. Board Weir	7/02 – 9/15	2,158	51,763	44,310	9,807	36,663	1,416
2009	R. Board Weir	6/28 – 9/21	1,630	25,465	19,715	714	20,000	1,608
2010	R. Board Weir	6/25 – 9/18	2,244	35,762	26,687	3,444	23,839	3,757
2011	R. Board Weir	6/25 – 9/19	1,861	17,946	19,974	1,394	23,826	3,667
2012	R. Board Weir	6/29 – 9/3	513	30,472	10,723	6,316	13,679	798
10 year average (2002 – 2011)			3,080	56,621	32,491	6,809	28,484	2,319
Historical Average			3,130	43,162	24,266	8,058	12,984	2,666

[a] Picket spacing of the weir panels allows pink salmon to freely pass through the weir unobserved.
[b] Project located approximately 500 yd upriver from current weir location.
[c] Species not enumerated during project operations.
[d] No counts or incomplete counts as the project was not operational during a large portion of species migration.
[e] Fixed picket weir operated in the same location as the current weir.