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Stock Assessment Studies of Chilkat River Adult Sockeye and Chum Salmon Stocks in 2002

by

Randall L. Bachman

July 2005

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

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Measures (fisheries)

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

Mathematics, statistics

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

FISHERY DATA REPORT NO. 05-36

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by

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ABSTRACT

Mark–recapture studies of adult Chilkat River chinook *Oncorhynchus tshawytscha,* sockeye *O. nerka,* coho *O. kisutch and* chum *O. keta* salmon stocks were conducted by the Alaska Department of Fish and Game (ADF&G) and the Northern Southeastern Regional Aquaculture Association (NSRAA) in 2002. The objectives of the sockeye and chum salmon study were to provide estimates of escapement and age, sex and length composition of sockeye salmon stocks to Chilkat Lake and the Chilkat River and estimates of escapement and age, sex and length composition of chum salmon to the Chilkat River drainage. Salmon were captured, marked, and released using two fish wheels located on the lower Chilkat River. The total fish wheel catch by species was 4,217 sockeye, 270 chinook, 5,090 coho, 1,030 pink, and 2,895 chum salmon. Of the 4,217 sockeye salmon captured, 4,076 were marked with a primary adipose fin clip and a secondary mark that varied according to timing strata. A total of 6,695 sockeye salmon were examined for marks during recovery efforts in Chilkat Lake, of which 142 had been marked at the fish wheels. A total of 610 sockeye salmon were examined for marks during recovery efforts in mainstem spawning areas, of which 30 had been marked at the fish wheels. Tagging and recovery data were stratified by size to develop estimates of the total inriver abundance of sockeye salmon returning to the Chilkat River drainage. The drainage-wide sockeye salmon inriver abundance estimate at the time of tagging was 170,000 (SE 12,909) fish. Abundance estimates by stock were determined by applying stock composition and fish wheel catch-per-unit effort data to the drainage-wide estimate. Escapements to Chilkat Lake and Chilkat River mainstem spawning areas were estimated to be 130,000 and 40,000 fish, respectively. Of the 2,908 chum salmon captured, 2,599 fish received numbered tags and fin clips corresponding to timing strata. A total of 6,484 chum salmon were examined for marks during recovery events on spawning grounds, of which 81 had been marked at the fish wheels. The drainage wide chum salmon abundance estimate at the time of tagging was 206,000 (SE 21,000) fish.

Key Words: mark–recapture, stratified population estimations, escapement estimation, scale pattern analysis, Chilkat River, Chilkat Lake, salmon, fish wheel, age, length, and sex composition.

INTRODUCTION

Since 1994 mark–recapture studies have been conducted annually to assess the productivity, run timing, exploitation patterns, and abundance of Chilkat Lake and Chilkat River adult sockeye salmon stocks (David Barto, Anne Beesley and Fred Bergander, formerly with the Alaska Department of Fish and Game, Commercial Fisheries Division, Juneau, personal communication; Kelley and Bachman 2000; Bachman and McGregor 2001).

The Chilkat River fish wheel program was experimentally conducted by the Alaska Department of Fish and Game (ADF&G) during 1977, 1978, 1982, and 1983 and again in 1990 to assess chum and coho salmon escapements in the Chilkat River. Beginning in 1991 the fish wheel program was used to assess chinook salmon escapement in the Chilkat River (Ericksen, 2003a). From 1994 through 2002, the Chilkat River fish wheel program was operated to assess the immigration of all species of Pacific salmon (Table 1).

Sockeye salmon escapement studies have been conducted at Chilkat Lake from 1967 to 1995 and from 1999 to 2002 using a steel picket weir (Table 2). Due to delays in migratory timing between the marine commercial fishery and the Chilkat Lake counting weir, the escapement information collected at the weir is not useful for inseason commercial fishery management. In addition, increased public boat traffic and frequent flow reversals at the weir site have resulted in unreliable escapement counts of sockeye salmon into Chilkat Lake. Development of the Chilkat River fish wheel program began in 1994 using mark–recapture techniques to assess Chilkat Lake and Chilkat River mainstem sockeye salmon escapement. Fish wheel catch is also used as in indicator of inriver abundance during the commercial fishing season.

Mark–recapture studies on adult fall chum salmon originating from the Chilkat River drainage utilizing fish wheel technology was first performed in 1990 (Leon Shaul, ADF&G employee, personal communication). The primary focus of the project at that time was to provide the

District 115 (Figure 1) fishery managers with an assessment of chum salmon escapement to the Chilkat River drainage (Figure 2).

Since 1994, ADF&G and the Northern Southeastern Regional Aquaculture Association (NSRAA) have worked cooperatively to assess Chilkat River sockeye salmon stocks using the fish wheels in the lower river as the marking event (first event). From 1994 to 1995 and 1999 to 2002, the Chilkat Lake weir was operated in conjunction with the fish wheel project. Sockeye salmon were captured at the weir and examined for marks applied at the fish wheels (second event). Results of the 1994 and 1995 mark–recapture work revealed that visual counts at Chilkat weir were not producing reliable estimates of the sockeye salmon escapement into Chilkat Lake. As a result, the operation of the weir for determining escapement at Chilkat Lake was discontinued in 1996. From 1996 through 1998, second event sampling of sockeye salmon was conducted by extensive beach seining at holding and spawning areas in Chilkat Lake. Analysis of the 1998 data revealed that recovery efforts targeted early run fish because later returning fish were not available at spawning beaches during seining operations (Kelley and Bachman 2000). Operation of the Chilkat Lake weir was re-established in 1999 to sample returning sockeye salmon for marks applied from the fish wheels and to determine age, sex and length composition of the Chilkat Lake sockeye salmon run.

The majority of the Chilkat River drainage chum salmon are late fall spawners. Spawning locations include the mainstem Chilkat River and side sloughs where upwelling water occurs. Major spawning areas are located within the Alaska Chilkat Bald Eagle Preserve near the village of Klukwan. A smaller run of fall chum salmon occur in the Klehini River drainage with a large portion of the production occurring from the Herman Creek spawning channel incubation facility operated by NSRAA (Figure 2). The Chilkat River drainage has historically supported the largest known population of fall chum salmon in southeast Alaska. The escapement of chum salmon to the Chilkat River drainage was estimated for two years (1990 and 2002). The 1990 population estimate was estimated at a 95% confidence interval range of 200,000 to 350,000 fish. The large amount of uncertainty in this estimate was due to tag loss during this initial mark–recapture experiment (Dangel et al. 1991). In 2002, chum salmon were captured and tagged at the fish wheels (first event) and recaptured with beach seines (second event) on spawning locations in the Chilkat River near the village of Klukwan, and on spawning grounds of the Klehini River including Herman Creek and other spawning areas near the confluence of the Klehini River.

The majority of the commercial sockeye salmon harvest in the Lynn Canal fishery is comprised of a mixture of Chilkat Lake, Chilkat River, Chilkoot Lake, Berners Bay rivers, and other smaller sockeye salmon stocks. Scale pattern analysis (SPA) is used to estimate the contribution of these stocks of sockeye salmon in this fishery each season (Marshall et al. 1982; McPherson et al. 1983,1992; McPherson and Marshall 1986; McPherson 1987, 1989; McPherson et al. 1992). Scale pattern analysis is used in seasonally to identify Chilkat Lake, Chilkoot Lake, and “other” (an amalgamation of Chilkat River mainstem, Berners Bay, and other smaller stocks) sockeye salmon stocks in the Lynn Canal fishery. Scale samples used for SPA standards for Chilkat Lake and mainstem area sockeye salmon stocks are collected by this project.

Sockeye salmon originating in Chilkat Lake and the Chilkat River mainstem contribute significantly to the Lynn Canal (District 115) commercial drift gillnet fishery (Bachman et al. 1999). Chilkat Lake has produced annual commercial sockeye salmon harvests as high as 168,000 in 1986, with mean harvests of 97,000 (SE = 39,800) fish for the years 1976 to 2002. Annual harvests of “other” sockeye stocks, which include Chilkat River mainstem spawning fish, have been as high as 33,000 in 1992 with a mean harvest of 13,800 (SE = 9,790) fish for the years 1976 to 2001. In addition to the commercial harvest, sockeye salmon originating from Chilkat Lake and the Chilkat River are harvested in the Haines area subsistence fishery. Reported harvests in Chilkat Inlet and Chilkat River in that fishery for the period 1990 to 2002 averaged approximately 5,000 (SE = 170) sockeye salmon. During 2002, the Lynn Canal drift gillnet fishery was managed to target Chilkat Lake sockeye salmon while protecting other stocks present in lesser abundance.

Biological spawning escapement goals have been established for two separate stocks of sockeye salmon in Chilkat Lake (McPherson 1990; Geiger et al. 2003). The escapement goal for the early run is 17,500 (range 14,000 to 28,000) fish and the goal for the late run is 47,500 (range 38,000 to 78,000) fish. The biological total escapement goal is the sum of the individual stock goals. There are no formal escapement goals for sockeye salmon that originate in the Chilkat River mainstem. The escapement of sockeye salmon to mainstem areas is currently monitored inseason through fish wheel catch and visual foot surveys and estimated through mark–recapture methods.

Sockeye salmon escapements to Chilkat Lake have averaged approximately 117,000 (SE = 13,201) fish for the period 1976 to 2002 with a range of 24,000 to 263,000 fish (Table 3). Escapement estimates of sockeye salmon to the Chilkat mainstem areas are available since 1994. Chilkat River mainstem sockeye salmon escapement estimates have averaged 32,000 (SE = 5,000) fish from 1994 through 2002 with a high of 54,000 fish in 2000 (Table 4).

District 115 commercial drift gillnet harvests of fall chum have been as high as 621,000 fish in 1985 and in recent years, averaging 73,500 (SE = 11,333, 1992–2002 average) to the District 115 drift gillnet commercial fishery. Due to a decline in abundance of Chilkat drainage fall chum salmon beginning in 1989, management of the fall commercial gillnet fishery has been curtailed to reduce harvest of this stock. Prior to 1990, the majority of the chum salmon harvested in the Lynn Canal drift gillnet fishery were wild fall chum salmon (Figure 3). However, hatchery chum salmon releases in lower Lynn Canal now contribute over 80% of the chum harvest in the district. A mark–recapture program, similar in structure to the existing Chilkat River sockeye salmon mark–recapture program began in 2002 to provide information on the run-timing, age, sex and length (ASL) compositions and total estimated abundance of the fall chum salmon return to the Chilkat River drainage.

Mark–recapture methods were used in 2002 to estimate sockeye and chum salmon escapements to the Chilkat River drainage. Two fish wheels were operated in the lower Chilkat River adjacent to the Haines Highway between mileposts 9 and 9.5 to capture fish for marking strata. Marking data and ratios of marked to unmarked fish collected in the Chilkat River mainstem, Chilkat Lake and Klehini River areas were used to develop escapement estimates for sockeye and chum salmon. Trends in fish wheel catches were used inseason to provide a general idea of inriver abundance of these species. Fishery managers use this information to adjust commercial fishing effort accordingly. Daily fish wheel catches of all fish species were recorded, and age, length, and sex data were collected from chinook, sockeye, coho and chum salmon, prior to release back into the river.

STUDY AREA DESCRIPTION

The Chilkat River drainage is located at the head of Lynn Canal in northern southeast Alaska (Figure 2). The northern and western parts of the basin lie within British Columbia, Canada. The Chilkat River is a large glacial system that originates in Yukon, Canada, and has its terminus near Haines, Alaska. The mainstem and major tributaries (Tsirku, Klehini, Kelsall, and Tahini

Rivers) comprise approximately 350 km of river channel in a watershed covering about 1,600 km^2. The river system originates from many glaciers and flows through rugged mountainous terrain, converging to a turbid, braided river system. This turbidity precludes complete enumeration of salmon escapements in many areas by aerial or foot surveys.

Chilkat Lake is a relatively large, clear water lake with a surface area of 9.8 km^2, mean depth of 32.5 m, a maximum depth of 57 m, and a volume of 0.319 km^3. The outlet of the lake is located approximately 30 km northwest of the city of Haines, Alaska. Chilkat Lake drains into the Chilkat River by way of the Tsirku River. It is located approximately 30 km upstream from the town of Haines near the northern terminus of Lynn Canal (Figure 1). Average precipitation for this area is approximately 165 cm/yr. (Bugliosi 1988). Resident fish include sockeye *(O. nerka)*, coho *(O. kisutch)*, pink (*O. gorbuscha*), and chum (*O. keta*) salmon, Dolly Varden *(Salvelinus malma)*, cutthroat trout (*Salmo clarki)*, threespine stickleback *(Gasterosteus aculeatus),* and sculpin *(Cottus sp.)*, with sockeye salmon being the most abundant (ADF&G 1987).

OBJECTIVES

The purpose of this study was to estimate the sockeye and chum salmon escapement to the Chilkat River drainage during 2002. This report describes the methods and results of this study.

Research objectives in 2002 were to:

1. Estimate the escapement of adult sockeye salmon into Chilkat Lake and to the Chilkat River mainstem in 2002.
2. Estimate the age, sex, and length composition of adult sockeye salmon entering the Chilkat River in 2002.
3. Estimate the escapement of adult chum salmon to the Chilkat River in 2002.
4. Estimate the age, sex, and length composition of adult chum salmon entering the Chilkat River in 2002.
5. Develop a relationship between fish wheel catch, visual aerial survey counts and mark–recapture escapement estimates of Chilkat River adult chum salmon.

METHODS

ABUNDANCE ESTIMATES

Lower River Adult Sampling and Marking (First Event)

Returning adult sockeye and chum salmon were captured in fish wheels operating adjacent to MP 9 Haines highway on the eastern bank of the Chilkat River where the main flow was constrained primarily to one side of the floodplain (Figure 2). Commercial Fisheries Division (CFD) personnel installed two 3-basket configured aluminum fish wheels in early June to estimate escapement of chinook, sockeye, coho and chum salmon to the Chilkat River. One fish wheel was located adjacent to MP 9, and the other approximately 300 m downstream of the first. The Chilkat River channel at this location is conducive for fish wheel operation, however, seasonal fluctuations in water flow velocities required minor changes in fishing location to maintain fish wheel rpm at an optimal rate. The fish wheels were operated continuously from June 5 through October 19, except for infrequent periods of high flow events and routine maintenance. The number of hours each wheel operated was recorded daily. Water depth (cm), and temperature (°C), was recorded each morning near MP 8 Haines highway.

Sockeye salmon

All sockeye salmon were dip netted from the fish wheel live boxes and placed into a tagging/marking trough partially filled with river water. Every sockeye salmon was visually examined for sex, and measured to the nearest mm MEF. A scale sample was systematically collected from the first 40 sockeye salmon per day for age determination. One scale was removed from the left side of the fish, along a line 2 to 4 rows above the lateral line between the posterior insertion of the dorsal fin and anterior insertion of the anal fin. Ages were determined from patterns of circuli according to protocols in Mosher (1968). The scale sample data was used for age and stock of origin determination, and assignment of marked fish to Chilkat Lake and Chilkat River mainstem marking groups. All uninjured sockeye salmon > 360 mm MEF were marked by removing the adipose fin and a secondary fin mark based on timing stratum. All salmon that had serious wounds or that were lethargic in behavior were immediately released and were not marked, tagged, or sampled. Sockeye salmon ≤ 360 mm MEF (jacks) were subsequently not included the mark–recapture analysis because fish in this size range do not have equal probability of capture in recovery events at Chilkat Lake. Each release or timing stratum was established to correspond to two-week blocks of time throughout the season. Sockeye salmon strata marks for the 2002 season are described in Table 5.

Chum salmon

Procedures for sampling chum salmon are similar to what was previously discussed for sockeye salmon. Every healthy chum salmon were visually examined for sex, and measured to the nearest mm MEF. A scale sample was systematically collected from every healthy chum salmon captured in the fish wheels to estimate the age composition of the chum salmon escapement. Every healthy chum salmon captured were marked with a uniquely numbered solid-core spaghetti tag sewn at the posterior end of the dorsal fin through the pterygiophores and had it's adipose fin removed. Chum salmon were also given secondary marks that included fin clips that corresponded to two-week blocks of time throughout the sampling season to allow the abundance estimate to be stratified over time in the event of tag loss. Chum salmon strata marks for the 2002 season are shown in Table 6.

Biological sampling was conducted during application of the marks and tags to sockeye and chum salmon. Date of sample, sample sequence number and ASL measurements were recorded on OPSCAN ASL forms according to ADF&G 1994. The tagging and sampling procedures took from 30 to 50 seconds per fish to complete. The fish were then immediately returned to the river. Fish wheel catches were sampled in the morning (0800–1200 hrs) and late afternoon (1430–1630 hrs) with more frequent sampling during periods of peak fish movement.

We used a set gillnet to capture chum salmon when dropping river levels stopped the fish wheels on October 19. A 7.6-m long and 1.0-m deep (25 ft × 3 ft) gillnet with 13.3-cm (5.25-in) stretched mesh was drifted in the lower Chilkat River from October 21 through October 25, 2002. Fishing effort consisted of a single 4-hour time block that started 8:30 am each morning and continued to 12:30 pm. Fishing was conducted from a river boat along a 0.8-km-long stretch of river adjacent to MP 9 and 9.5 Haines highway. The river channel actively fished was approximately 10–15 m wide and 0.5–2 m deep. Healthy chum salmon captured were sampled and tagged as described above.

Recapture Event

Sockeye salmon

Chilkat Lake sockeye salmon were examined by NSRAA personnel from June 26 through October 17 at the outlet of Chilkat Lake with the use of a metal picket weir. Fish were captured as they swam through the weir into a fish trap. In addition, beach seines were also used to capture adult sockeye salmon milling and holding immediately behind the weir. All sockeye salmon were examined for missing adipose fins and secondary marks. Double sampling was prevented by punching a hole in the lower edge of the left operculum of all fish sampled during recovery efforts. Approximately forty (40) fish each day were measured for length (MEF in mm), sex and scale samples.

ADF&G staff sampled Chilkat River mainstem sockeye salmon in two (2) spawning tributaries. Sampling efforts were concentrated in known large spawning areas in Mosquito Lake and at Mule Meadows (a small tributary just north of the Kelsall River confluence, Figure 2). Chilkat River mainstem sockeye salmon were captured with gillnets, beach seines and bare hands once or twice each week beginning July 30 through September 13. Fish were examined and sampled in the same manner as described for Chilkat Lake. Scheduling of recovery sampling efforts at mainstem areas varied based on the percentage of recaptures in a given area to avoid unnecessary handling of fish on spawning grounds.

Chum salmon

Chum salmon in two (2) spawning areas were sampled for marks by two teams of three people. In addition, chum salmon caught incidental to coho salmon recovery efforts were sampled by SFD personnel, and by NSRAA personnel collecting chum salmon brood stock at Herman Creek and on Chilkat River spawning grounds near the village of Klukwan. The sampling sites were classified into two distinct areas based upon a similar study conducted in 1990 (Figure 2, Dangle et al, unpublished). The Klehini River (including Herman Creek) area was sampled from September 3 to October 26. The lower Chilkat River area was sampled August 26 to October 26. All chum salmon were examined for marks and missing adipose fins, measured for length (MEF in mm), and sexed. Double sampling was prevented by punching a hole in the lower edge of the left operculum of all sampled fish during recovery efforts.

Mark recovery data were organized into strata by statistical week for analysis. Statistical weeks begin at 00:01 a.m. Sunday and end the following Saturday at midnight, with weeks being numbered sequentially beginning with the week encompassing the first Saturday in January (Appendix A1).

Inriver Abundance

Sockeye salmon

A two-event mark–recapture experiment was used to develop separate estimates of the spawning escapement of sockeye salmon (N_{es}) to Chilkat Lake and the Chilkat River mainstem in 2002. The number of adult sockeye salmon marked at the fish wheels defined the first sampling event. Sampling returning adult sockeye salmon on spawning grounds and as sockeye salmon passed through the Chilkat Lake weir defined the second event. Mark–recapture data was compiled into a matrix summarized by marking and recapture timing periods and an estimate of abundance was calculated for sockeye salmon for the entire Chilkat River drainage. The weekly estimates of

Chilkat River mainstem and Chilkat Lake sockeye salmon were then determined by multiplying the weekly abundance estimate by the proportion of mainstem and Chilkat Lake fish as determined by scale pattern analysis (SPA).

Sockeye salmon scale samples collected from the fish wheels were analyzed for stock of origin by CFD personnel at the ADF&G scale lab in Douglas, Alaska. Scales were projected onto a microfiche reader and aged. Each scale was then assigned to one of the two Chilkat River drainage stocks (Chilkat Lake or Chilkat River mainstem) based on scale pattern characteristics. The proportions of each stock in the fish wheel catch were calculated for each week to provide compositions of each stock group based on fish wheel catch.

Sockeye salmon abundance was estimated using the Chapman's modified Peterson estimator for a closed population (Seber 1982):

$$N_{es} = \frac{(n_1+1)(n_2+1)}{(m_2+1)} - 1 \quad (1a)$$

$$var[N_{es}] = \frac{(n_1+1)(n_2+1)(n_1-m_2)(n_2-m_2)}{(m_2+1)^2(m_2+2)} \quad (1b)$$

where n_1 is the number of sockeye salmon marked in the lower Chilkat River fish wheels (first event sampling), n_2 is the number of sockeye salmon captured and examined for marks in the second event sampling, and m_2 is the subset of n_2 which had been marked in the fish wheels or first event sampling. The Peterson model is used to estimate inriver abundance (N_{es}) if certain assumptions are met. They include: (a) every fish has an equal probability of being marked during event 1, that every fish has an equal probability of being captured in event 2, or that marked fish mix completely with unmarked fish; (b) that recruitment and "death" (emigration) do not both occur between sampling events; (c) that marking does not affect catchability (or mortality) of the fish; (d) that fish do not lose marks between sample events; (e) that all recovered marks are reported; and (f) that double sampling does not occur (Seber 1982). If assumptions of the Peterson model are not met, a Darroch model was used to form the estimate by stratifying the estimate by time of marking and/or recapture area.

Marking and recovery data were organized in temporal strata and a drainage-wide sockeye salmon abundance estimate was determined for the time of marking. The estimate was derived for all mark and recovery data combined. Sockeye salmon that were ≤ to 360 mm MEF were not included in this analysis as it is likely that fish in this size category are not equally sampled in recovery events. Estimates of weekly abundance by stock group were determined by multiplying the proportion of the weekly fish wheel sockeye salmon CPUE for each weekly period by the total abundance estimate. Fish wheel CPUE is calculated by the number of fish caught per basket hour.

The weekly stock proportion of the fish wheel catch is multiplied by the weekly value of the drainage wide abundance estimate to determine the weekly passage of sockeye salmon by stock group entering the lower Chilkat River.

Chum salmon

A two-event mark–recapture experiment was used to develop estimates of the spawning escapement of chum salmon (N_{ec}) to the Chilkat River drainage in 2002. The number of adult chum salmon marked at the fish wheels defined the first sampling event. Sampling returning adult chum salmon on spawning grounds defined the second event. Mark–recapture data was compiled into a matrix summarized by marking and recapture timing periods and an estimate of abundance was generated for chum salmon for the entire the Chilkat River drainage. Chum salmon abundance was estimated using the Chapman's modified Peterson estimator for a closed population. Formulae and necessary assumptions are identical to what was described for sockeye salmon.

To test assumption (a), a series of hypothesis tests ($\alpha = 0.10$) were used. Violating assumption (a) could occur if the sampling rate varied by size of the fish. The hypothesis that fish of different sizes were captured with equal probability was tested with a Kolomogorov-Smirnov (K-S) 2-sample test (Bernard and Hansen 1992). This test compared the size distributions of marked fish in the first event with those examined for marks in the second event. If selective sampling was apparent, the abundance estimate could be stratified by size or sex. A contingency table (chi-square statistic) was used to test the hypothesis that fish sampled at differing second event sampling areas were marked at the same rate. Also, a contingency table was used to test the hypothesis that fish marked at different times in the migration were recaptured at the same rate. If either of these hypothesis tests was accepted, a simple Peterson model was appropriate to estimate abundance; if not, a Darroch estimator was used. If the Darroch model is applied based on Chapman and Junge (1956) and Darroch (1961), temporal and/or geographical strata were pooled to find admissible (non-negative) estimates, reduce the number of parameters, and increase precision while finding no evidence of lack of fit (Arnason et al. 1996). Strategies used to pool data include: the similarity of the fractions of fish marked (marking strata) and the similarity of recovery fractions (recovery strata). Pooling of neighboring stratum or stratum with very small sample sizes was also considered to remove redundancy and to develop a basis for pooling. Other assumptions are considered in the Discussion section.

AGE, SEX AND LENGTH COMPOSITIONS

Length, sex and scale data from adult sockeye and chum salmon were collected at the fish wheels, Chilkat Lake weir site, and on spawning grounds of the Chilkat River mainstem following methods stated in ADF&G (1994). Sex and length compositions were tabulated separately for fish captured in the fish wheels and in each second event sampling area. Scale samples were taken from the preferred area of each fish and prepared for analysis as described by Clutter and Whitesel (1956).

Length, sex and scale data from every adult chum salmon were collected at the fish wheels. Additionally, length and sex data were collected from chum salmon examined on spawning grounds located on the Klehini River and the Chilkat River following methods presented previously in the report.

Age classes were designated following the European aging system where freshwater and saltwater years are separated by a period (e.g., 1.3 denotes 1 year freshwater and 3 years saltwater).

Mean length-at-age and their variances were calculated using standard sample summary statistics (Cochran 1977). Size and sex selectivity was investigated by comparing the numbers of sockeye and chum salmon by size and sex captured in the lower river and spawning ground samples with contingency table analysis ($\alpha = 0.10$). Age and/or sex composition of the escapement was obtained from pooled samples when no selectivity was found from separate unbiased samples as appropriate. Proportions in the age or sex compositions and their variances were estimated as:

$$\hat{p}_a = \frac{n_a}{n} \tag{2a}$$

$$var[\hat{p}_a] = \frac{\hat{p}_a(1-\hat{p}_a)}{n-1} \tag{2b}$$

where n is the number of samples (age or sex) and n_a is the subset of n determined to be age or sex a. The abundance of sex s sockeye and chum salmon in the escapement was estimated as:

$$\hat{N}_s = \hat{N}\hat{p}_s \tag{3a}$$

$$\mathrm{var}[\hat{N}_s] = \mathrm{var}[p_s]\hat{N}^2 + \mathrm{var}[\hat{N}]p_s^{\,2} - \mathrm{var}[p_s]\mathrm{var}[\hat{N}] \tag{3b}$$

where $\hat{N}$ is the estimated inriver abundance of sockeye or chum salmon. The abundance of age a sockeye or chum salmon in the escapement $\hat{N}_a$ was estimated by substituting $\hat{N}_s$ and $\hat{p}_s$ for $\hat{N}_a$ and $\hat{p}_a$ in equations 3a and 3b.

Marking and recovery data were organized by temporal strata and a drainage-wide sockeye salmon abundance estimate was determined for the time of marking. The estimate was derived for all mark and recovery data combined. Sockeye salmon that were ≤ to 360 mm MEF were not included in this estimate as it is likely that fish in this size category are not equally sampled in recovery events as larger fish are (Bachman and McGregor 1999).

RESULTS

Lower River Adult Sampling and Marking (First Event)

In 2002, fish wheels were operated on the Chilkat River from June 7 through October 19. Due to very high winds, woody debris entanglements and high water events caused by stormy weather, fish wheels were inoperable on June 16 through June 17. On October 6 through October 8, the lower fish wheel became inoperable because water levels were below that necessary to operate the fish wheels. This wheel was successfully relocated to an area with adequate flow and fished through the end of the sampling season. Fish wheel effort (hours of operation per day), rpm, and physical river parameters are summarized in Appendix B1. In 2002, the daily water level measurements were below the 1994–2001 average through the first half of the season. From August 10 to September 10, water levels were above the 1994–2001 average. From September 11 through October 19, water levels were again below this average (Figure 4).

Inriver Abundance

Sockeye salmon

A total of 4,076 sockeye salmon were marked and released out of 4,217 fish captured in the lower Chilkat River fish wheels (Table 7). Seventy-nine sockeye salmon were ≤ 360 mm (MEF) length and were released with out marks. Twenty-seven fish escaped prior to being marked, 20 were found dead and 15 fish were thought to be injured so were released prior to being sampled.

We examined 7,305 sockeye salmon at the Chilkat Lake weir and on spawning grounds in the Chilkat River drainage for marks and recovered 172 marked fish (Table 8).

The cumulative distribution function (CDF) of lengths of sockeye salmon marked in the lower Chilkat River was significantly different from the CDF of marked sockeye salmon recaptured at Chilkat Lake and Chilkat River mainstem spawning grounds (K-S test, d_{max}.= 0.170, P = 0.014, Figure 5, top). In addition, sockeye salmon marked in the lower Chilkat River were significantly smaller than those sampled on the spawning grounds (K-S test, d_{max} = 0.187, P < 0.001, Figure 5, bottom). These results suggest the second sampling event was size-selective but the status of the first event was unknown. Therefore, the estimate was stratified into two size classes: small fish (≤ 530 mm MEF); and large fish (>530 mm MEF), to reduce bias. The resulting CDFs of lengths of marked fish were not significantly different from CDFs of those recaptured at Chilkat Lake weir or Chilkat River mainstem spawning grounds for small fish (K-S test, d_{max} = 0.237, P = 0.762, Figure 6, top), and large fish (K-S test, d_{max} = 0.148, P = 0.065, Figure 6, bottom). Second event sampling was not uniform over time as recovery rates were greater for large fish marked later in the immigration (Table 9). Large fish marked during three marking periods (6/12–7/13, 7/14-8/10, and 8/11-10/19) were recaptured at significantly different rates (χ^2 = 42.0, df = 2, P < 0.001). In addition, the probability of capturing a large marked sockeye salmon differed significantly among the two recovery areas (χ^2 = 62.0, df = 1, P < 0.001). Therefore, a Darroch estimator was used to estimate abundance.

Partial pooling of the strata was necessary because inadmissible estimates (probabilities of capture and stratum abundance < 0) were obtained when we applied the Darroch model to the original 10 marking strata and 17 recovery strata. The data for small and large sockeye salmon were pooled into three temporal marking strata and two recovery areas (Table 10). An estimated 167,000 (SE = 12,000) sockeye salmon immigrated to the Chilkat River drainage in 2002 (Table 11). Of those, 40,000 (SE = 7,000) were small, and 127,000 (SE = 10,000) were large fish. The estimates are germane to the time of marking in the lower river because subsistence harvests and natural predation between the two sampling events occur.

Scale samples collected from sockeye salmon marked at the fish wheels were assigned to stock of origin through scale pattern analysis and weekly proportions by stock of the fish wheel catch were developed. The total abundance estimate was then multiplied by the weekly stock proportions to generate the weekly passage of sockeye salmon by stock group through the lower Chilkat River. The estimated abundance of Chilkat Lake sockeye salmon is 128,000 fish. The estimated abundance of Chilkat River mainstem fish is 39,000 fish (Table 12).

Chum salmon

Of the total fish wheel catch of 2,898 chum salmon, 2,601 fish where tagged and fin clipped (Table 13). Seventy-five (75) chum salmon escaped prior to being marked and 42 were found dead. An additional 180 fish were intentionally released without marks (primarily September 15 and 28) when large fish wheel catches of both chum and coho salmon resulted in severe overcrowding in the holding boxes. None of the 10 fish marked in the set gillnet were later recaptured so those fish were removed from further analysis.

We examined 6,484 chum salmon on the spawning grounds for marks (Table 14) and recovered 81 marked fish. Of these 80 had tags and were recaptured 3 to 41 days (mean = 21.5 days, SE = 0.9) after being marked in the lower river. One recovered fish was missing its tag, however the secondary fin clip was recognized and noted.

The CDF of lengths of chum salmon marked in the fish wheels was not significantly different from the CDF of marked chum salmon recaptured on the spawning grounds (K-S test, d_{max} = 0.11, P = 0.68, Figure 7, top). In addition, the CDF of lengths of chum salmon marked in the fish wheels was not significantly different from the CDF of all fish recovered during second event sampling (K-S test, d_{max} = 0.03, P = 0.21, Figure 7, bottom). These results suggest there were no size selectivity during either sampling events. Thus, a Peterson model was used to estimate the abundance of chum salmon. We estimate that 206,000 (SE = 22,000) chum salmon immigrated into the Chilkat River in 2002. This estimate is germane to the time of tagging in the lower river because an unquantified removal occurs (from natural mortality and subsistence fishery harvest) between the two sampling events.

An objective of this study is to develop a relationship between fish wheel catch, visual survey counts and mark-recapture escapement estimates of Chilkat River adult chum salmon. The 2002 season is the first of four consecutive seasons of developing abundance estimates for chum salmon. The sum of the 2002 peak aerial survey is 31% of the mark-recapture estimate (206,000, SE = 22,000) and 2% of the total fish wheel catch (4,217, Table 15). In 2002, the mark-recapture estimate (206,000, SE = 22,000) is 3.2 times the peak aerial escapement count and 48.8 times the total fish wheel catch.

Age and Sex and Composition of the Inriver Run

Sockeye salmon

We sampled 1,234 small and 4,095 large sockeye salmon for age (scales), sex and length in the Chilkat River drainage during 2002. A total of 5,145 of these fish were aged, representing 9 age classes (Table 16). Additionally, 1,174 small and 3,988 large sockeye salmon were sampled for length determination during first and second event sampling. The proportion of small fish sampled for age in the fish wheels (0.23) was very close to the proportion of small fish in the abundance estimate (0.24). This analysis with prior tests showing the second sampling event was selective for size, suggest that the first sampling event may not be size selective. Therefore, samples from the first event (Table 16) were used to estimate the age and sex and length composition of the escapement.

The majority of the escapement was age-2.3 and 1.3 fish (61,000, SE = 4,000 and 47,000, SE= 3,000), and similar in sex composition (Table 17).

Chum salmon

In 2002, we sampled 1,378 male and 1,246 female chum salmon for age (scales), sex determination and length. A total of 2,336 fish were successfully aged, representing 4 age classes (Table 18). The average length for the dominant age class (age-0.3) fish was 670 mm MEF (Table 19). Sex ratios from the two second event areas (Chilkat River and Klehini River) were not significantly different (χ^2 = 0.41, df = 1, P = 0.52). However; sex ratio comparisons from samples collected from the fish wheels and on spawning ground recovery trips were significantly different (χ^2 = 27.5, df = 1, P < 0.001). The majority of the chum salmon samples collected on the fish wheels early in the season were predominantly males. Sample taken from the fish wheels late in the season were predominantly females. The peak chum salmon fish wheel catch occurred very late in the sampling season. Therefore, compositions of age, length and sex determination of the escapement were estimated from samples collected from the fish wheels as we believe the fish wheel samples represent the majority of the escapement.

The most abundant age class in the escapement (123,000, SE = 13,000, Table 20) was age-0.3 fish and males (108,000, SE = 12,000).

DISCUSSION

The accuracy of mark–recapture studies in providing estimates of abundance is dependent on the degree to which the underlying assumptions, as noted above, are satisfied.

Fish wheels were operational in early June, when relatively small numbers of sockeye salmon were captured (one fish caught on June 7). Fish wheels operated 24 hours per day except during equipment breakdowns, debris entanglements or high water events, however it is known that river conditions affect the fishing efficiencies of both wheels. Fish wheels were in operation well before the first chum salmon was captured on July 10, and continued through October 19. We did not catch any sockeye salmon the last week of fish wheel operations. However, large numbers of chum salmon were still being caught during the last days of the fish wheel operations. Fewer than 1% of the chum salmon were captured after October 19 in 1990 (when wheels were operated through October 25, Figure 8) and we captured only 10 chum salmon with a set gillnet on October 24 and 25 (Table 13). Thus, we assume that we tagged essentially throughout the entire sockeye and chum salmon emigration.

Adult sockeye salmon have been known to back out of some rivers after being tagged (Ericksen, 2003b). This can violate assumption (a) if fish are caught in fisheries down river from the fish wheels (tagging site) or ultimately spawn in another drainage. Our marking site is located several miles upstream of the intertidal zone thus we assume this phenomenon does not occur in this study.

The results suggest that fish wheels were not size selective for sockeye salmon because length distributions of marked fish in the first event and recaptured fish are dissimilar. Probabilities of capture were not equal for fish of all size classes during second event sampling. Length distributions of marked chum salmon and recaptured fish were similar. Probabilities of capture were equal for fish of all size classes during the second event. The divergent results between both species suggest annual differences in fish wheel catchability, perhaps related to gear placement and changes in stream morphology caused by variations in stream discharge throughout the season. We continued recovery sampling until all Chilkat River mainstem sockeye salmon had completed spawning. We also continued second event sampling at Chilkat Lake weir for Chilkat Lake sockeye salmon until we were certain that the majority of the escapement was through the weir. NSRAA crews sampled 133 sockeye salmon during the last week of weir operations and recovered a marked fish originating from the last stratum sampled from the fish wheels. Historical weir data indicates an average of approximately 99% of the Chilkat Lake sockeye salmon run passes the weir by October 16 (Figure 9). We sampled chum salmon on the spawning grounds through November 9 (last day of sampling), and recovered a marked chum salmon that had been tagged from set net near gear on October 25 (last fish tagged). We assume that any bias due to this failure of assumption (a) was inconsequential.

We believe that non-recognition and non-identification of marks (assumption b) were negligible. All marked sockeye salmon had primary (adipose fin clip) and secondary marks (additional fin clips). Since no physical tags were applied and fish examined during recovery sampling were alive and not in advanced stages of decomposition, marks were not likely to be missed. Sampling crews were trained and aware of all specific marks. Chum salmon were individually number tagged with solid core monofilament spaghetti tags as well as marked with an adipose fin clip and other fin clips based on timing strata.

We assume that mortality of marked fish was negligible (assumption a). Holding studies of sockeye salmon captured with fish wheels in a similar study on the Taku River indicated negligible short-term mortality due to tagging and handling (Kelley et al 1997). Tagging/marking of sockeye salmon at both rivers takes only 30–50 seconds. Standard protocol for mark–recapture projects on both rivers is to not mark or tag salmon that exhibit serious wounds or that are lethargic in behavior. While it is not possible to definitively conclude mortality of marked fish differs from unmarked fish, we have no information suggesting mark-induced mortality is an important factor in this ongoing study.

Kelley et al. (1997) concluded that tagging and handling procedures could effect fish behavior (assumption d). Their study conducted on the Taku River found that effects can be species specific. They found that tagged chinook salmon recaptured in the fish wheels had been delayed for a much longer periods (mean 12.3 days) than either sockeye (mean 3.6 days) or coho (mean 4.3 days) salmon; these results are similar to those seen in 1988 (McGregor and Clark 1989). They assumed that these fish dropped back or held near the vicinity of the capture site before resuming their upstream migration.

The effects of the length of holding time, the time that fish are held in fish wheel live boxes before being tagged or marked, was examined at the Taku River in 1996 (Kelley et al. 1997). No significant differences in elapsed days from fish wheel release to recovery in the inriver commercial fishery were apparent between the long holding time groups and short holding time groups for chinook, sockeye, and coho salmon. There were also no substantial differences in tag recovery rate for a given species for the two holding times, similar to observations of McGregor and Clark (1989) for chinook salmon in 1988.

A removal of an unknown quantity of sockeye salmon between mark and recovery sites occurred in a subsistence gillnet fishery located between the fish wheels and spawning sites. Catches in this fishery are not well documented but are small relative to run size. Sampling of the subsistence fishery for marks is not conducted. We believe it is unlikely that removal rates in this fishery affected population estimates but cannot rule out the possibility that behavioral differences could cause differential susceptibility of marked and unmarked fish to this fishery. It is assumed that removal rates of marked sockeye salmon from the subsistence fishery are similar to removal rates of unmarked fish.

In this study, abundance estimates for the Chilkat Lake and Chilkat River mainstem components of the escapement were developed by applying weekly fish wheel CPUE and stock composition data to the drainage-wide abundance estimate. It is also known that the stock composition of sockeye salmon migrating past the fish wheels changes through time. These factors may induce bias in the total and weekly estimates of abundance for different components of the return. Any such bias could be minimized if we had the ability to generate separate estimates of abundance directly from the mark–recapture experiment. The current scale analysis methodology, however, is not capable of assigning stock of origin without error, a necessary element of such an estimation program.

The Chilkat River mark–recapture program has become an integral part of the department’s stock assessment and management program for salmon in upper Lynn Canal. ADF&G commercial fishery managers use abundance and stock composition data from this program together with fishery performance data from the drift gillnet fishery in Lynn Canal to adjust fishing times, catches, and escapements in order to meet escapement goal requirements (Bachman et al. 1999). Information from this project is used to determine if escapement goals are being attained, to assess the effects of various management decisions on the escapement levels, and to provide data needed to reconstruct the run size of Chilkat River drainage sockeye and chum salmon stocks. Over time and as the information base increases, daily fish wheel catch may be used as a relative inseason index of abundance by comparing weekly catches with historical averages. Age and sex compositions of the escapements are monitored for any changes over the years that would give insight into the status of these stocks and would allow assessment of management strategies pertaining to these stocks. Run reconstruction conducted over a number of years provides a time series of data useful in the development of spawner–recruit relationships for the estimation of maximum sustainable yield, optimum escapement, and forecasting of future returns as well as refining biological escapement goals (BEGs) for these stocks.

RECOMMENDATIONS

1. Continue to operate the weir at the outlet of Chilkat Lake as a mark–recovery platform as an integral part of the Chilkat River drainage sockeye salmon escapement estimation project.
2. Record larger samples of length and sex of marked and unmarked fish during second event sampling.
3. Continue making necessary safety and fish handling modifications to the fish wheels.

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TABLES AND FIGURES

Table 1.–Chilkat fish wheels dates of operation and catches of chinook, sockeye, coho, pink, and chum salmon, 1977, 1978, 1982, 1983, 1990, 1991, and 1994 to 2002.

Year	Dates of Operation	Chinook	Sockeye	Coho	Pink	Chum	Number, type and basket Configuration of fish wheels
1977	8/21–10/21	0	108	729	0	604	N/A
1978	8/14–11/9	0	119	369	14	1,586	N/A
1982	10/5–26	0	10	78	0	254	1 wooden 4-basket wheel
1983	8/9–10/3	0	299	190	67	176	1 wooden 4-basket wheel
1990	8/14–10/25	0	2,984	3,686	1,140	3,025	2 wooden 4-basket wheels
1991	6/10–7/20	382	1,385	0	578	8	2 wooden 4-basket wheels
1994	6/18–9/11	214	3,865	140	532	196	2 wooden 4-basket wheels
1995	6/16–9/16	139	3,231	1,353	609	2,288	2 wooden 4-basket wheels
1996	6/22–9/16	68	3,118	546	494	430	2 wooden 4-basket wheels
1997	6/11–10/9	179	5,016	1,057	1,657	1,315	2 aluminum 3-basket wheels
1998	6/8–10/13	138	5,747	1,071	1,738	1,947	2 aluminum 3-basket wheels
1999	6/7–10/8	320	7,735	1,697	15,740	4,250	2 aluminum 3-basket wheels
2000	6/9–10/7	99	3,709	1,495	1,265	4,045	2 aluminum 3-basket wheels
2001	6/6–10/7	172	4,417	2,550	1,971	4,680	2 aluminum 3-basket wheels
2002	6/7–10/19	270	4,219	5,090	1,030	2,895	2 aluminum 3-basket wheels
Average Catch[a]		166	4,605	1,926[b]	3,001	3,210[b]	

[a] Average catch taken from the 1994–2001 catch years where dates of operation are comparable.

[b] Average calculated from 1990, and 1997–2001.

Table 2.–Chilkat Lake weir dates of operation and visual counts of sockeye, coho, pink, and chum salmon, 1967–1995 and 1999–2002.

Year	Dates of Operation	Sockeye	Coho[a]	Pink[a]	Chum
1967	6/13–9/02	20,111	n/a	n/a	n/a
1968	6/08–9/12	41,246	168	4[a]	n/a
1969	6/04–9/16	44,555	n/a	n/a	n/a
1970	5/29–9/17	41,085	n/a	n/a	n/a
1971	5/31–10/28	49,342	1,063	n/a	n/a
1972	6/03–10/12	51,850	518	n/a	n/a
1973	6/11–10/15	50,527	167	n/a	n/a
1974	5/30–9/28	82,811	161	n/a	n/a
1975	6/04–11/06	41,520	644	n/a	n/a
1976	6/03–10/21	69,723	204	n/a	n/a
1977	6/03–9/27	41,044	n/a	n/a	n/a
1978	6/05–11/05	67,520	390	n/a	n/a
1979	6/09–11/11	80,589	965	n/a	n/a
1980	6/15–10/8	87,847	n/a	n/a	n/a
1981	6/11–10/22	82,597	n/a	n/a	n/a
1982	6/24–10/06	80,208	n/a	n/a	n/a
1983	6/22–11/12	134,022	n/a	n/a	n/a
1984	6/09–10/07	115,269	n/a	n/a	n/a
1985	6/23–10/22	57,724	n/a	n/a	n/a
1986	6/16–11/14	23,947	n/a	n/a	n/a
1987	6/19–11/20	48,593	n/a	n/a	n/a
1988	6/18–11/14	27,575	n/a	n/a	n/a
1989	6/05–10/28	140,475	n/a	n/a	n/a
1990	6/06–11/13	53,780	n/a	n/a	n/a
1991	7/10–10/24	47,436	n/a	n/a	n/a
1992	6/08–10/15	94,278	1,052	2	41
1993	6/13–10/14	210,257	595	0	5
1994	5/20–10/05	80,788	797	0	0
1995	6/08–10/09	59,698	797	0	0
1999[b]	6/30–10/23	129,533	2,785	17	10
2000	6/16–10/18	47,077	872	0	0
2001	6/19–10/13	51,979	978	0	0
2002	6/23–10/18	65,085	4,740	0	1

Source: All counts acquired from Alaska Department of Fish and Game Alexander database.

[a] Weir counts do not reflect total escapement as weir was not operated through entire course of coho salmon return.

[b] Weir was not operated in years 1996–1998 as sockeye salmon sampling was conducted using beach seines on spawning areas in Chilkat Lake.

Table 3.–Historical estimated escapements of Chilkat Lake sockeye salmon by week, 1976 to 2002.

Stat.	Year[a]													
Week	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
23														62
24	1		22	6										689
25		214	476	44	72	3			302					5,802
26	433	305	1,302	698	887		31	368	1,441	7	4	88	59	10,690
27	944	572	8,622	6,930	1,152	5	532	1,248	5,436	98	2	1,777	2,015	7,845
28	2,437	773	2,751	2,081	3,560	141	605	11,144	623	1,317	602	2,197	496	2,295
29	1,140	207	11,816	8,576	4,355	549	461	15,284	3,280	1,141	139	5,601	9	8,126
30	2,055	542	1,310	4,068	4,575	1,071	2,515	8,935	6,011	334	20	2,542	722	15,810
31	2,816	711	1,814	1,413	2,100	1,002	1,743	10,750	929	812	24	1	1,969	3,161
32	310	1,184	40	2,056	2,100	266	3,496	6,865	141	2,029	1	123	1,965	4,340
33	2,740	725	1,078	5,895	2,100	729	509	4,254	2,971	157	3	1,776	200	11
34	9,810	968	1,634	7,288	5,666	1,450	4,073	5,589	1,417	1,555	138	1,875	566	3,207
35	4,283	1,269	1,246	11,212	6,910	767	5,151	1,433	14,899	4,434	736	6,193	280	7,582
36	6,799	18,711	5,670	3,639	10,351	4,967	1,575	5,475	18,015	3,271	1,006	1,618	469	8,379
37	17,483	8,664	6,106	19,464	29,613	18,652	6,091	10,526	18,512	3,372	5,364	27	7,973	15,019
38	9,655	144	7,747	12	10,739	1,113	20,378	21,097	21,106	12,639	6,943	259	2,254	34,155
39	5,584	5,821	9,469	2,353	7,015	6,134	25,516	9,455	17,510	17,688	3,796	18,033	2,747	2,713
40	0	234	6,334	1,413	3,374	32,516	7,467	9,398	2,252	5,258	3,762	6,165	4,551	2,936
41	3,001		91	2,125	778	10,222	78	7,305	424	2,009	831	0	655	3,053
42	238			1,316		4,502		5,081		1,603	576	318	663	4,600
Total	69,729	41,044	67,528	80,589	95,347	84,089	80,221	134,207	115,269	57,724	23,947	48,593	27,593	140,475
Early stock	17,582	9,437	17,924	30,433	10,253	10,617	9,640	47,885	28,193	7,449	2,536	13,345	7,512	54,090
Late stock	52,147	31,607	49,604	50,156	85,094	73,472	70,581	86,322	87,076	50,275	21,411	35,248	20,081	86,385

-continued-

Table 3. Page 2 of 2.

Stat.	Year [a]														76-02
Week	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	Mean	SE
23		1												32	8
24	202	44	10			57		476	395	270	53	105	683	179	48
25	639	305	53	75		2,232		1,857	2,562	1,140	3,861	392	4,695	1,178	342
26	3,615	901	1,016	1,745	1,510	5,323	2,720	3,618	6,382	5,737	14,933	4,580	6,169	2,736	699
27	1,660	1,600	1,653	3,557	3,456	8,471	11,051	11,759	12,307	12,659	13,238	5,014	6,699	4,754	859
28	4,353	1,971	1,762	4,240	8,223	9,674	32,814	5,951	10,495	26,856	10,034	6,595	7,185	5,923	1,486
29	9,566	503	6,529	3,552	5,125	9,387	28,393	5,713	12,343	16,442	9,594	12,139	6,745	6,922	1,248
30	2,380	2,812	5,034	7,615	8,025	18,775	28,308	13,187	9,500	20,819	8,399	19,314	9,037	7,488	1,425
31	1,449	2,234	2,263	5,336	8,184	17,172	26,778	16,044	10,900	14,853	7,176	12,945	11,728	5,945	1,308
32	1,925	3,724	3,579	6,490	9,375	17,973	42,335	22,138	15,897	17,906	8,886	20,775	15,074	7,535	1,896
33	380	1,821	1,197	14,537	34,085	15,054	22,358	11,283	17,350	21,197	9,347	11,512	14,182	7,049	1,704
34	2,948	4,295	5,768	6,643	17,559	25,643	17,767	9,617	16,221	20,962	11,167	10,196	10,325	7,462	1,320
35	7,167	10,732	10,357	23,593	16,367	21,007	21,848	14,521	19,738	20,035	7,145	9,084	10,109	9,538	1,386
36	9,647	5,380	13,172	19,677	19,346	13,394	13,942	18,044	12,723	9,563	9,647	9,641	13,339	9,389	1,153
37	259	2,260	6,014	1,251	18,274	20,377	14,112	27,518	19,149	10,180	5,595	3,139	7,219	11,346	1,588
38	664	3,264	8,779	61,222	4,012		425	42,800	12,857	13,788	6,492	2,813	2,379	12,214	2,831
39	4,465	1,873	22,150	32,323				9,474	18,121	10,382	3,009	2,519	1,354	10,354	1,642
40	3,552	1,091	6,171	297				21,328	10,598	10,685	1,742	924	902	6,176	1,422
41	4,456	1,427	1,891	2,947				3,475	3,163	2,899	1,003		287	2,468	476
42	904	6,651	342	14,630					411					2,988	766
Total	60,231	52,889	97,740	209,730	154,000	185,000	263,000	239,000	211,000	236,000	131,000	132,000	128,000	116,815	13,201
Early stock	25,792	15,916	23,096	47,147	44,000	90,000	172,000	81,000	81,000	117,000	97,000	82,000	68,000	43,881	7,981
Late stock	34,439	36,973	74,644	162,583	110,000	95,000	91,000	158,000	130,000	119,000	34,000	50,000	60,000	72,931	7,469

[a] Escapement estimates based on weir counts in 1976 to 1993 and on mark–recapture estimates from fish wheel programs in 1994 to 2002.

Table 4.–Weekly and yearly escapement of Chilkat River mainstem sockeye salmon from 1994 to 2002.

Stat.	Year									1994–2002	
week	1994	1995	1996	1997	1998	1999	2000	2001	2002	mean	SE
23											
24		27		69	65		53	51	98	61	7.8
25		1,410		270	1,153	39	309	55	1,745	712	235.4
26	137	2,867	585	162	3,820	431	2,222	1,294	4,917	1,826	579.3
27	1,061	3,700	4,428	1,189	2,842	1,565	5,817	2,254	7,001	3,318	699.6
28	3,427	3,529	12,508	1,059	2,893	5,571	8,440	2,261	6,159	5,094	1,189.6
29	1,434	3,116	10,239	1,433	3,312	2,671	13,472	3,145	5,068	4,877	1,393.4
30	2,242	4,283	11,416	3,277	3,335	5,001	7,805	6,645	3,966	5,330	955.1
31	2,720	3,140	6,615	2,845	4,271	2,607	8,025	2,627	4,884	4,193	657.2
32	3,170	1,588	5,207	2,222	1,252	2,891	4,944	2,330	2,136	2,860	461.9
33	8,431	1,229	1,036	613	1,201	1,724	2,318	964	1,200	2,079	810.3
34	1,882	449	661	371	243	1,083	657	209	996	728	176.7
35	886	740	398	430	481	257	139	34	432	422	89.7
36	691		217	140		381	65	29	484	287	80.9
37	105		59	377	90			26		131	46.9
38				180		133				157	11.0
Yearly total[a]	26,000	26,000	53,000	15,000	25,000	24,000	54,000	22,000	39,000	32,000	5,000
Weekly mean	2,182	2,173	4,447	976	1,920	1,873	4,174	1,566	3,007	2,480	390.5

[a] Based on mark–recapture estimates from apportionment of fish wheel captured sockeye salmon by stock through scale pattern analysis (SPA).

Table 5.–Sockeye salmon strata marks assigned to statistical weeks in the 2002 season.

Dates	Statistical weeks[a]	Secondary mark[b]
Start to–June 15	Start–24	Adipose fin clip only
June 16 to June 29	25–26	Clip last 4 rays of dorsal fin
June 30 to July 13	27–28	Left ventral fin clip
July 14 to July 27	29–30	Right ventral fin clip
July 28 to August 10	31–32	Left axillary appendage clip
August 11 to August 24	33–34	Right axillary appendage clip
August 25 to September 7	35–36	Right pectoral fin clip
September 8 to September 21	37–38	Left pectoral clip
September 22 to October 5	39–40	Upper Right Opercule punch
October 6 to October 19	41–End	Lower Right Opercule punch

[a] Statistical weeks are defined in Appendix A.
[b] All sockeye salmon received an adipose fin clip; secondary marks designate the statistical week of capture.

Table 6.–Chum salmon strata marks assigned to statistical weeks in the 2002 season.

Dates	Statistical weeks[a]	Secondary mark[b]
Start to August 10	Start–32	Adipose fin clip only
August 11 to August 24	33–34	Left ventral fin clip
August 25 to September 7	35–36	Right ventral fin clip
September 8 to September 21	37–38	Left axillary fin clip
September 22 to October 5	39–40	Right axillary appendage clip
October 6 to October 19	41–42	Left Pectoral fin clip

[a] Statistical weeks are defined in Appendix A.

[b] All chum salmon received an adipose fin clip; secondary marks designate the statistical week of capture.

Table 7.–Number of sockeye salmon captured in the lower Chilkat River fish wheels, and marked by temporal strata and size class, June 12 through October 19, 2002.

		Number	Number marked[a]			Proportion
Date	Finclip	captured	Small	Large	Total	marked
6/12–6/15	Adipose fin clip only	19	6	13	19	1.00
6/15–6/29	Clip last 4 rays of dorsal fin	433	136	291	427	0.99
6/30–7/13	Left ventral fin clip	679	165	499	664	0.97
7/14–7/27	Right ventral fin clip	640	135	469	604	0.94
7/28–8/10	Left axillary appendage clip	874	230	593	823	0.94
8/11–8/24	Right axillary appendage clip	667	192	438	630	0.94
8/25–9/7	Right pectoral fin clip	597	215	395	610	0.97
9/8–9/21	Left pectoral clip	243	82	155	237	0.96
9/22–10/5	Upper Right Opercule punch	55	10	45	55	1.00
10/6–10/19	Lower Right Opercule punch	10	1	6	7	0.70
	Total	4,217	1,172	2,904	4,076	0.96

[a] Fish were classified by length (MEF): small ≤ 530 mm MEF; large; > 530 mm MEF.

Table 8.–Number of sockeye salmon inspected for marks and number of marked fish recaptured during mark recovery surveys in the Chilkat River by site, size class, and sex, 2002.

		Number inspected [a]					Number marked [a]				
		Small		Large			Small		Large		
Site	Dates	M	F	M	F	Total	M	F	M	F	Total
Chilkat Lake	6/23–6/29	27	11	59	83	180	2	2	1	5	10
	6/30–7/6	25	9	207	142	383	0	2	0	2	5
	7/7–7/13	32	9	158	165	363	3	0	0	7	10
	7/14–7/20	27	11	216	196	451	5	0	7	0	12
	7/21–7/27	36	7	138	178	359	0	0	0	0	0
	7/28–8/3	20	16	198	205	440	0	0	7	7	14
	8/4–8/10	14	11	189	216	431	0	0	5	5	10
	8/11–8/17	23	14	165	138	338	0	2	2	2	7
	8/18–8/24	9	29	140	183	361	0	0	7	8	15
	8/25–8/31	38	20	192	201	451	0	0	7	5	12
	9/1–9/7	27	47	187	189	451	0	0	5	7	12
	9/8–9/14	54	50	198	149	451	5	0	7	0	12
	9/15–9/21	79	56	176	194	505	0	0	5	7	12
	9/22–9/28	41	52	194	165	451	2	0	0	2	5
	9/29–10/5	18	50	189	194	451	0	0	2	0	2
	10/6–10/12	20	45	122	264	451	0	2	0	0	2
	10/13–10/19	2	14	52	110	178	0	0	0	0	0
Subtotal		492	451	2,780	2,972	6,695	17	10	57	60	142
Chilkat River	7/30	6	0	8	10	24	0	0	0	0	0
mainstem	8/4	7	0	6	11	24	1	0	0	1	2
	8/7	9	3	38	55	105	1	0	5	5	11
	8/16	36	1	40	45	122	0	0	1	2	3
	8/23	4	2	23	29	58	0	0	1	1	2
	8/30	11	0	20	17	48	1	0	0	1	2
	9/6	40	5	44	47	136	0	0	5	3	8
	9/13	25	0	33	35	93	1	0	1	0	2
Subtotal		138	11	212	249	610	4	0	13	13	30
Total		630	462	2,992	3,221	7,305	21	10	70	73	172

[a] Fish were classified by length (MEF): small ≤ 530 mm MEF; large; > 530 mm MEF.

Table 9.–Number of marked sockeye salmon released into the lower Chilkat River and recaptured by marking period and recovery site, and number examined for marks at each recovery site by size class, 2002.

Marking stratum	No. marked	Fraction recovered	Chilkat Lake weir	Chilkat River mainstem
SMALL FISH				
6/12–6/15	6	0.000	0	0
6/15–6/29	136	0.029	4	0
6/30–7/13	165	0.030	5	0
7/14–7/27	135	0.037	5	0
7/28–8/10	230	0.013	1	2
8/11–8/24	192	0.021	4	0
8/25–9/7	215	0.009	1	1
9/8–9/21	82	0.073	5	1
9/22–10/5	10	0.100	1	0
10/6–10/19	1	0.000	0	0
Examined for marks			943	149
Fraction marked			0.028	0.027
LARGE FISH				
6/12–6/15	13	0.000	0	0
6/15–6/29	291	0.024	7	0
6/30–7/13	499	0.018	9	0
7/14–7/27	469	0.017	8	0
7/28–8/10	593	0.062	26	11
8/11–8/24	438	0.055	19	5
8/25–9/7	395	0.084	24	9
9/8–9/21	155	0.129	19	1
9/22–10/5	45	0.089	4	0
10/6–10/19	6	0.000	0	0
Examined for marks			5,752	461
Fraction marked			0.020	0.056

Table 10.–Pooled number of sockeye salmon marked by stratum, recovered by marking stratum and recovery area, and examined for marks by recovery area and size class in the Chilkat River drainage, 2002.

Marking stratum	No. marked	Fraction recovered	Chilkat Lake weir	Chilkat River mainstem
		Small fish		
6/12–7/13	307	0.032	10	0
7/14–8/24	557	0.017	7	2
8/25–10/19	308	0.038	10	2
Examined for marks			943	149
Fraction marked			0.029	0.027
		Large fish		
6/12–7/13	803	0.020	16	0
7/14–8/24	1500	0.045	51	16
8/25–10/19	601	0.097	48	10
Examined for marks			5,752	461
Fraction marked			0.020	0.056

Table 11.–Estimated abundance of sockeye salmon in the Chilkat River drainage by size class, 2002.

Size category	Abundance	SE
Small	40,000	7,000
Large	127,000	10,000
Combined	167,000	12,000

Table 12.–Estimated weekly abundance of Chilkat Lake and Chilkat River mainstem sockeye salmon stocks in the Chilkat River drainage, 2002.

Stat	Mid-Week	Weekly	Weekly	Chilkat	Chilkat	Chilkat Lake		Chilkat mainstem	
Week	Date	Proportion	Abundance	Lake	mainstem	Age 1.	Age 2.	Age 0.	Age 1.
24	12–Jun	0.005	779	683	98	0.56	0.31	0.06	0.06
25	19–Jun	0.039	6,440	4,695	1,745	0.52	0.21	0.18	0.10
26	26–Jun	0.066	11,075	6,169	4,917	0.38	0.18	0.36	0.09
27	3–Jul	0.082	13,700	6,699	7,001	0.23	0.26	0.28	0.23
28	10–Jul	0.080	13,331	7,185	6,159	0.24	0.30	0.28	0.18
29	17–Jul	0.071	11,813	6,745	5,068	0.31	0.27	0.24	0.19
30	24–Jul	0.078	13,003	9,037	3,966	0.42	0.27	0.17	0.13
31	31–Jul	0.099	16,612	11,728	4,884	0.28	0.43	0.15	0.15
32	7–Aug	0.103	17,227	15,074	2,136	0.32	0.55	0.04	0.08
33	14–Aug	0.092	15,382	14,182	1,200	0.27	0.65	0.02	0.06
34	21–Aug	0.068	11,321	10,325	996	0.25	0.66	0.01	0.08
35	28–Aug	0.063	10,542	10,109	432	0.13	0.83	0.01	0.04
36	4–Sep	0.083	13,823	13,339	484	0.12	0.84	0.02	0.02
37	11–Sep	0.043	7,219	7,219	0	0.11	0.89	0.00	0.00
38	18–Sep	0.014	2,379	2,379	0	0.21	0.80	0.00	0.00
39	25–Sep	0.008	1,354	1,354	0	0.12	0.88	0.00	0.00
40	2–Oct	0.005	902	902	0	0.30	0.70	0.00	0.00
41	9–Oct	0.002	287	287	0	0.40	0.60	0.00	0.00
Total			167,000	128,000	39,000				

Table 13.–Number of chum salmon captured in the lower Chilkat River, and marked by temporal strata, 2002.

Date	Finclip	Number captured	Number marked	Proportion marked
7/10–8/10	Adipose fin clip only	111	107	0.96
8/11–8/24	Left ventral fin clip	259	248	0.96
8/25–9/7	Right ventral fin clip	448	446	1.00
9/8–9/21	Left axillary appendage clip	702	606	0.86
9/22–10/5	Right axillary appendage clip	475	406	0.85
10/6–10/19	Left pectoral clip	903	776	0.86
10/24–10/25[a]	Upper right opercule hole punch	10	10	1.00
	Total	2,908	2,599	0.90

[a] Adults captured with a set gillnet; all others caught using fish wheels.

Table 14.–Number of chum salmon inspected for marks and number of marked fish recaptured during recovery surveys in the Chilkat River drainage, 2002.

Site	Dates	Number Inspected	Number Marked	Fraction Marked
Chilkat River	9/1–9/7	21	2	0.095
Drainage	9/8–9/14	8	1	0.125
	9/15–9/21	345	11	0.032
	9/22–9/28	389	9	0.023
	9/29–10/5	419	7	0.017
	10/6–10/12	351	11	0.031
	10/13–10/19	346	4	0.012
	10/20–10/26	568	6	0.011
	10/27–11/2	1,712	3	0.002
	11/3–11/9	2,325	27	0.012
Total		6,484	81	0.012

Table 15.–Comparisons of Peak aerial counts, fish wheel catch and abundance estimate for Chilkat River drainage chum salmon, 2002.

Year	Drainage wide Peak aerial count	Total chum Fish wheel Catch	Drainage wide M–R estimate	SE	M–R/PAC[a]	M–R/FWC[b]	Prop. PAC	Prop. FWC
2002	64,000[c]	4,217	206,000	22,000	3.2	48.8	0.31	0.02

[a] Mark–recapture estimate/peak aerial survey counts.
[b] Mark–recapture estimate/fish wheel count.
[c] Peak counting dates were; Chilkat River (November 1), Klehini River (September 25) and Herman Creek (September 17).

Table 16.–Estimated age composition of sockeye salmon sampled in the Chilkat River drainage by size class, 2002.

	Brood year and age class										
	2000	1999	1999	1998	1998	1998	1997	1996	1995	Total	Total
	0.1	0.2	1.1	0.3	2.1	1.2	1.3	2.2	2.3	aged	sampled
Small											
Sample size	9	145	46	13	34	186	77	591	86	1,183	1,234
Pecent	0.8	12.3	3.9	1.1	2.9	15.7	6.5	50.0	7.3		23.2
SE	0.3	1.0	0.6	0.3	0.5	1.1	0.7	1.5	0.8		0.6
Large											
Sample size	0	2	0	277	0	57	1,369	455	1,832	3,962	4,095
Pecent		0.0		6.8		1.4	33.4	11.1	44.7		76.8
SE				0.4		0.2	0.7	0.5	0.8		0.6
Combined											
Sample size	9	147	46	290	34	243	1,446	1,046	1,918	5,145	5,329
Pecent	0.2	2.8	0.9	5.4	0.6	4.6	27.1	19.6	36.0		
SE	0.1	0.2	0.1	0.3	0.1	0.3	0.6	0.6	0.7		

Table 17.–Estimated abundance of sockeye salmon in the Chilkat River drainage by age, sex and size class, 2002.

	Brood year and age class										
	2000	1999	1999	1998	1998	1998	1997	1996	1995	1995	
	0.1	0.2	1.1	0.3	2.1	1.2	1.3	2.2	1.4	2.3	Total
Small fish											
Male	282	4,303	1,456	324	1,100	3,883	1,585	8,219	65	1,715	22,932
SE	11	174	59	13	45	157	64	333	3	70	929.56
Female		388		97		2,136	841	10,904		1,035	15,402
SE		16		4		87	34	442		42	624
All small	282	4,692	1,456	421	1,100	6,018	2,427	19,123	65	2,750	40,060
SE	11	190	59	17	45	244	98	775	3	111	6,777
Large fish											
Male		65		2,394		971	18,411	6,018	194	27,503	55,557
SE		4		147		60	1,129	369	12	1,686	3,405
Female				6,568		841	25,724	8,704	453	30,998	73,288
SE				403		52	1,577	534	28	1,900	4,492
All large		65		8,963		1,812	44,135	14,722	647	58,501	127,123
SE		4		549	0	111	2,705	902	40	3,586	10,248
Combined											
Male	282	4,368	1,456	2,718	1,100	4,854	19,997	14,237	259	29,218	78,489
SE	11	178	59	160	45	217	1,193	702	15	1,755	4,335
Female		388		6,666		2,977	26,565	19,608	453	32,033	88,690
SE		16		407		138	1,611	976	28	1,942	5,117
All fish	280	4,800	1,450	9,400	1,100	8,000	47,000	33,800	700	61,000	167,000
SE	20	300	60	700	40	600	3,000	2,500	50	4,000	12,000

Table 18.–Estimated age composition of chum salmon captured in the Chilkat River fish wheels by sex.

	Brood year and age class					
	1999	1998	1997	1996	Total	Total
	0.2	0.3	0.4	0.5	aged	sampled
			Male			
Sample size	100	789	339	2	1,230	1,378
Proportion	0.07	0.57	0.25	0.00		0.53
SE	0.007	0.013	0.012	0.001		0.013
			Female			
Sample size	57	775	271	3	1,106	1,245
Percent	0.05	0.62	0.22	0.00		0.47
SE	0.006	0.014	0.012	0.001		0.010
			Combined			
Sample size	157	1,564	610	5	2,336	2,623
Percent	0.1	0.6	0.2	0.0		
SE	0.005	0.010	0.008	0.001		

Table 19.–Average length at age for Chilkat River chum salmon sampled from the Chilkat River fish wheels, 2002.

	Brood year and age class					
	1999	1998	1997	1996	Total	Total
	0.2	0.3	0.4	0.5	measured	sampled
			Male			
Sample size	100	789	339	2	1,230	1,378
Average length	624	678	703	693		
SE	3.3	1.2	2.0	7.5		
			Female			
Sample size	57	775	271	3	1,106	1,245
Average length	612	662	683	678		
SE	4.3	1.1	2.1	17.4		
			Combined			
Sample size	157	1,564	610	5	2,336	2,623
Average length	620	670	694	684		
SE	2.7	0.9	1.5	10.4		

Table 20.–Estimated abundance of chum salmon in the Chilkat River by age and sex, 2002.

	Brood year and age class				
	1999	1998	1997	1996	
	0.2	0.3	0.4	0.5	Total
			Male		
Male	7,845	61,898	26,595	157	108,107
SE	1,138	6,892	3,154	112	11,774
			Female		
Female	4,472	60,800	21,260	235	97,672
SE	755	6,776	2,586	137	10,672
			Combined		
All fish	12,317	122,699	47,856	392	205,779
SE	1,627	13,315	5,407	179	22,088

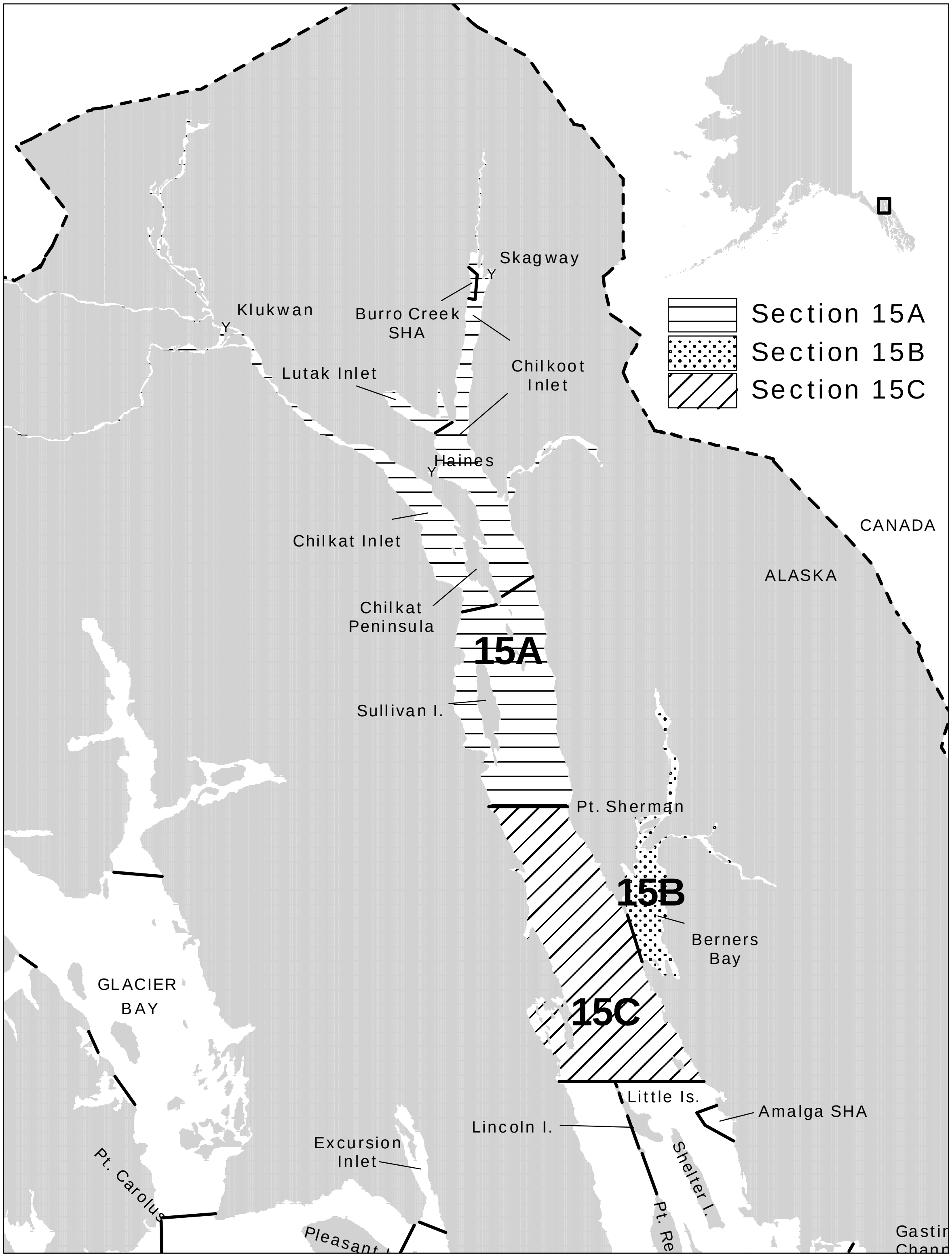


Figure 1.–Sections within District 115 (includes all areas north of the latitude of Little Island).

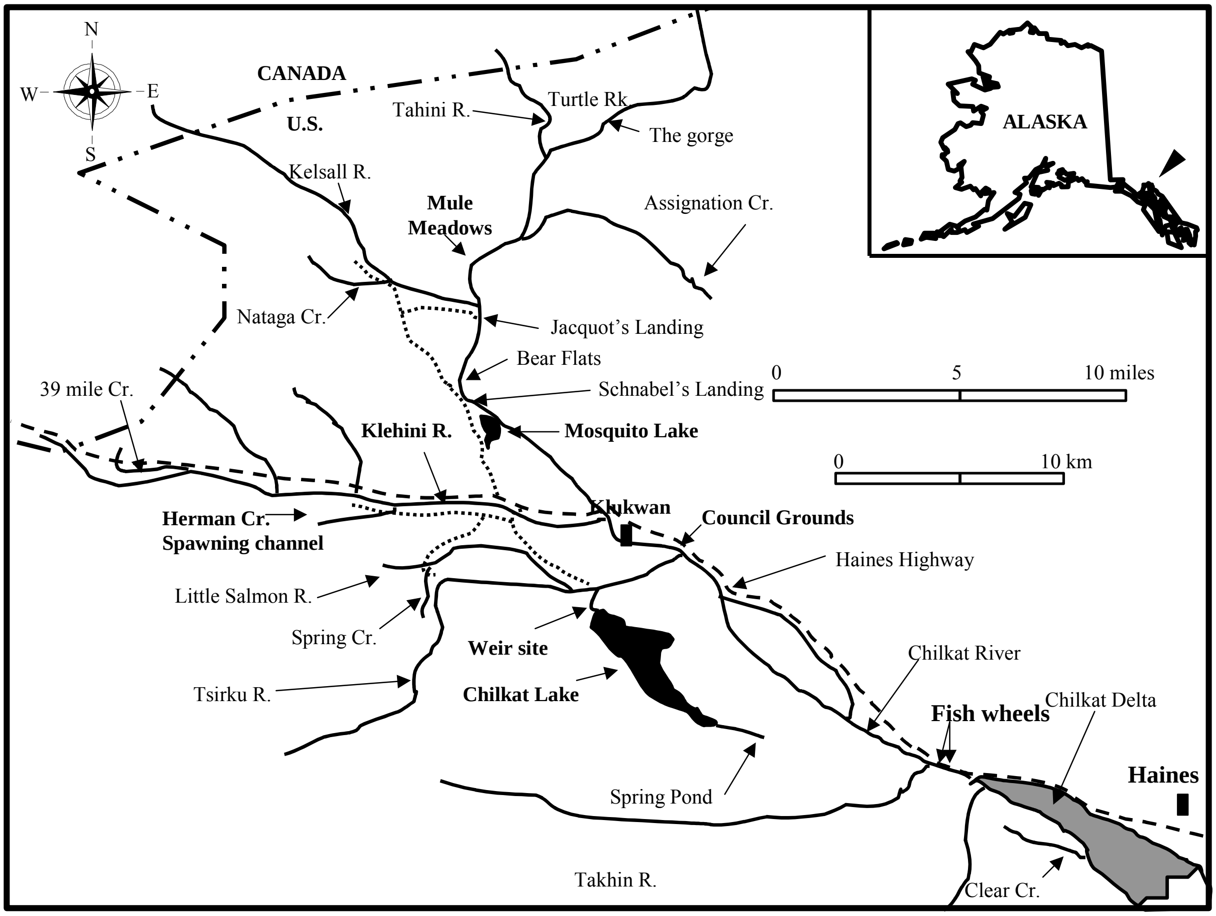


Figure 2.–The Chilkat River drainage, showing location of sampling sites.

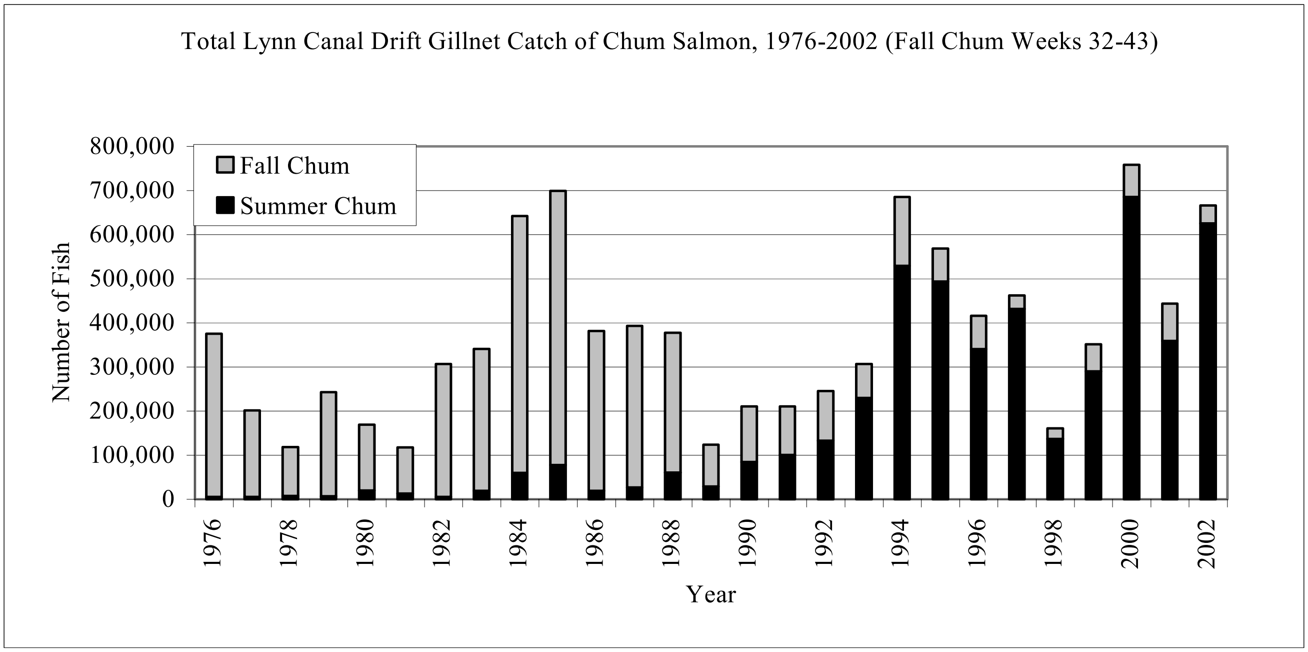


Figure 3.–Summer and fall chum salmon harvests in the Lynn Canal (District 15), drift gillnet fishery, 1976–2002.

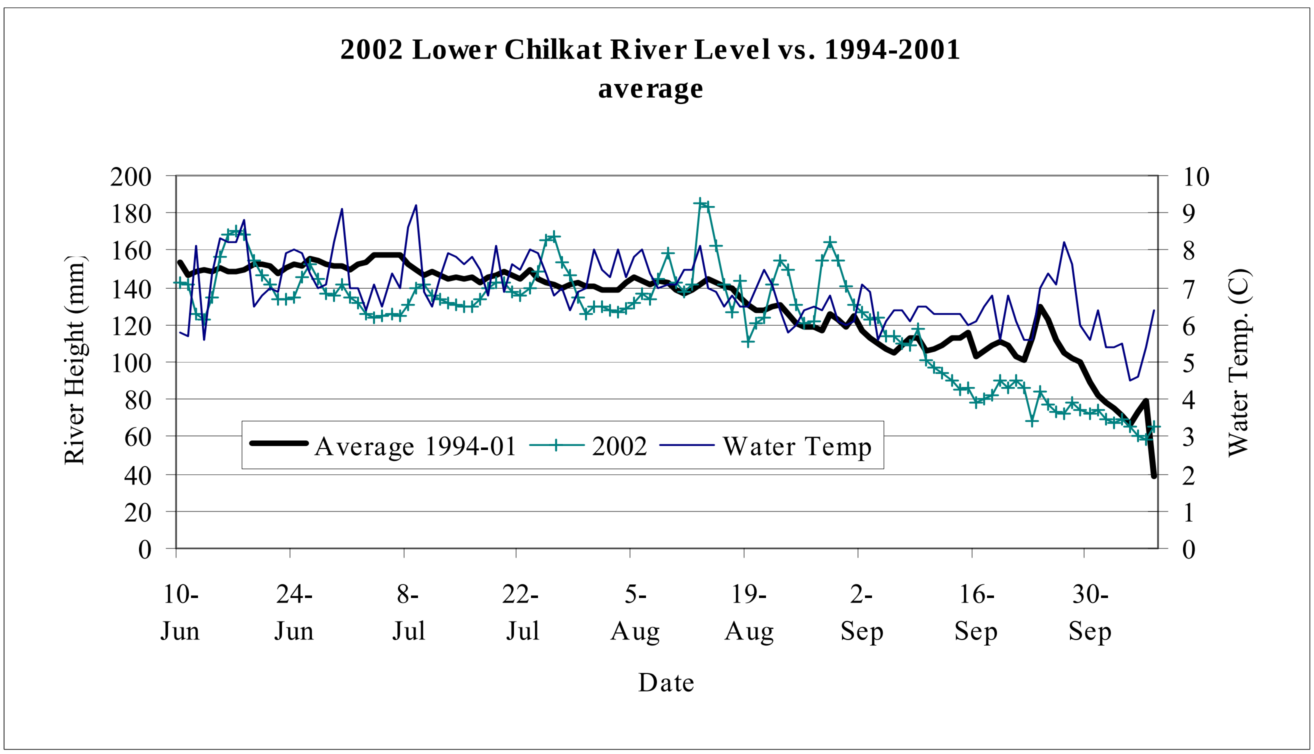


Figure 4.–Water level and temperature measurements of the Chilkat River compared to the 1994–2001 average.

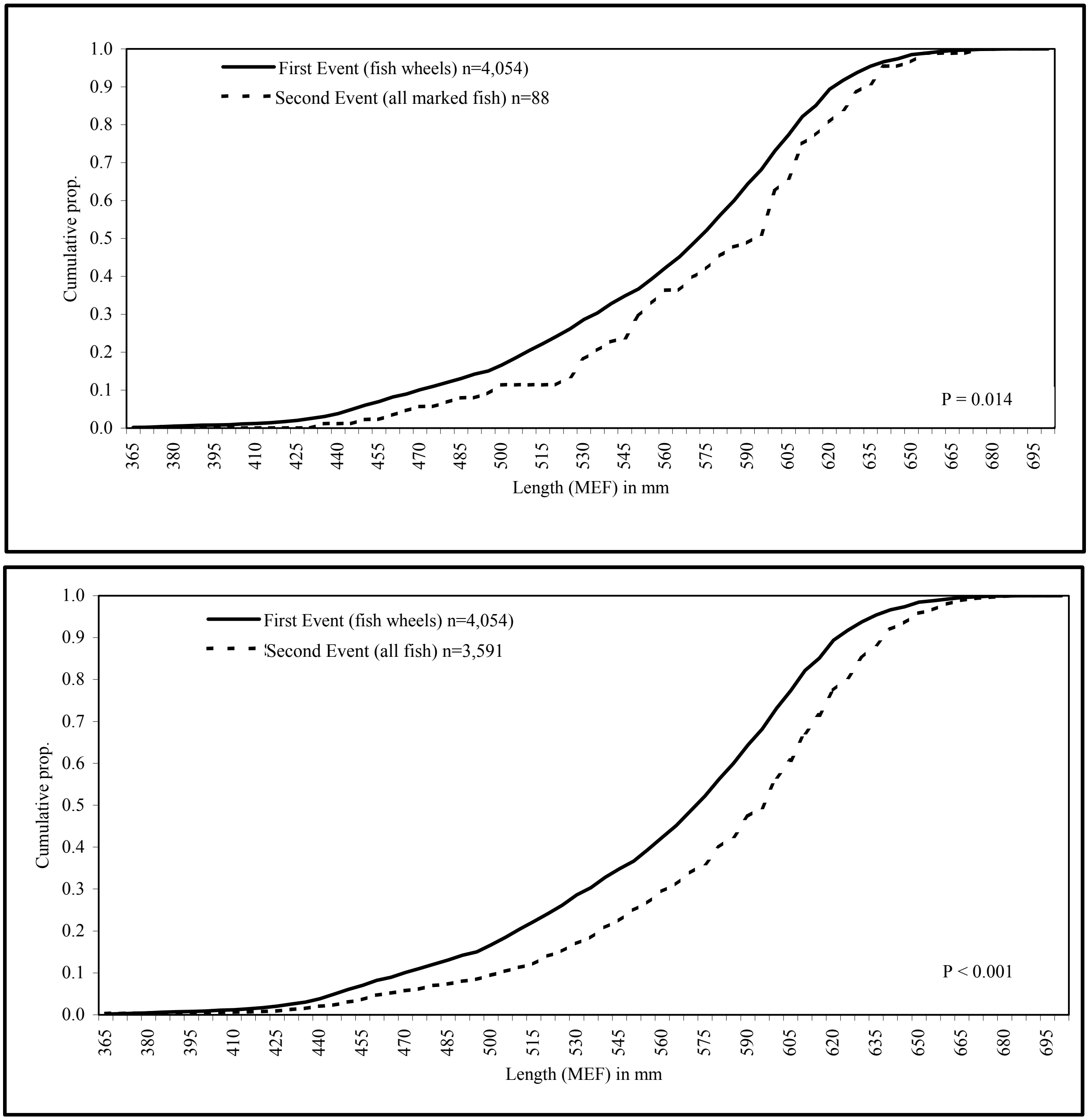
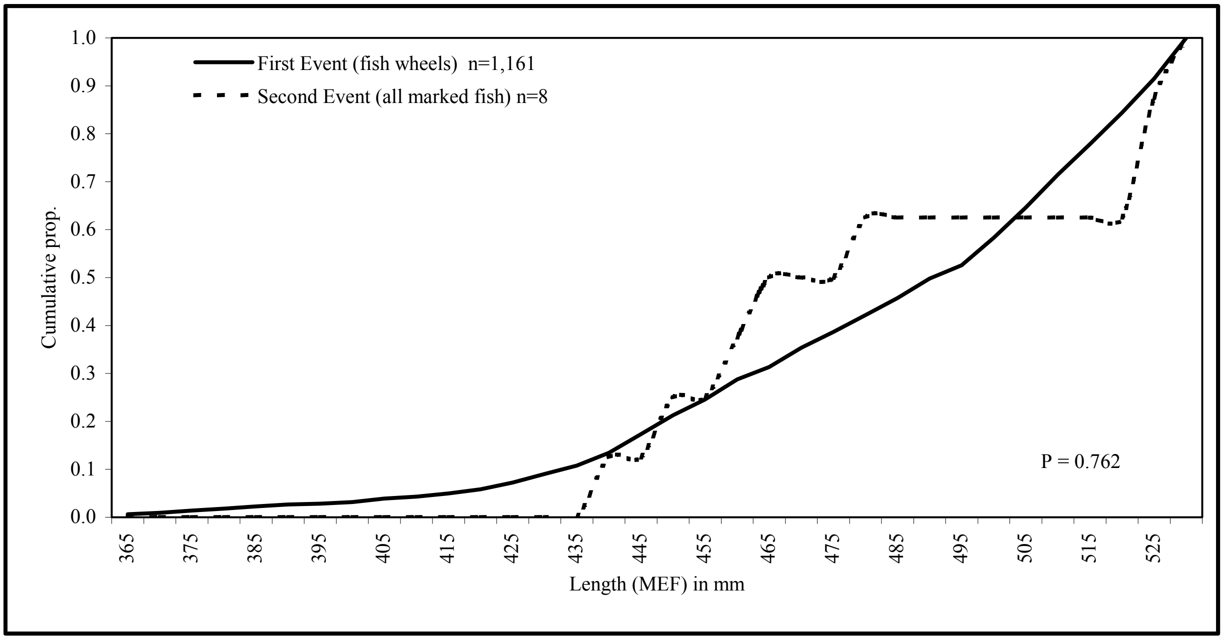


Figure 5.–Cumulative distribution function (CDF) of MEF lengths of sockeye salmon marked in the lower Chilkat River versus lengths of marked fish recaptured on spawning grounds (top) and versus lengths of fish examined for marks during recovery events (bottom), 2002.



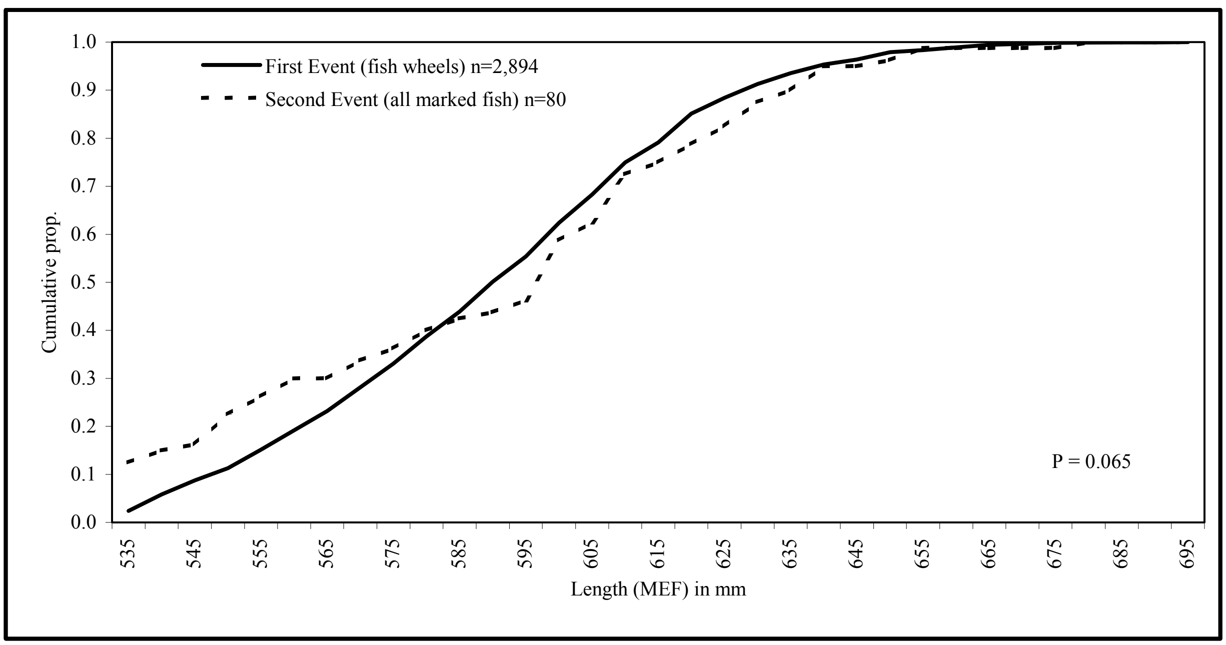
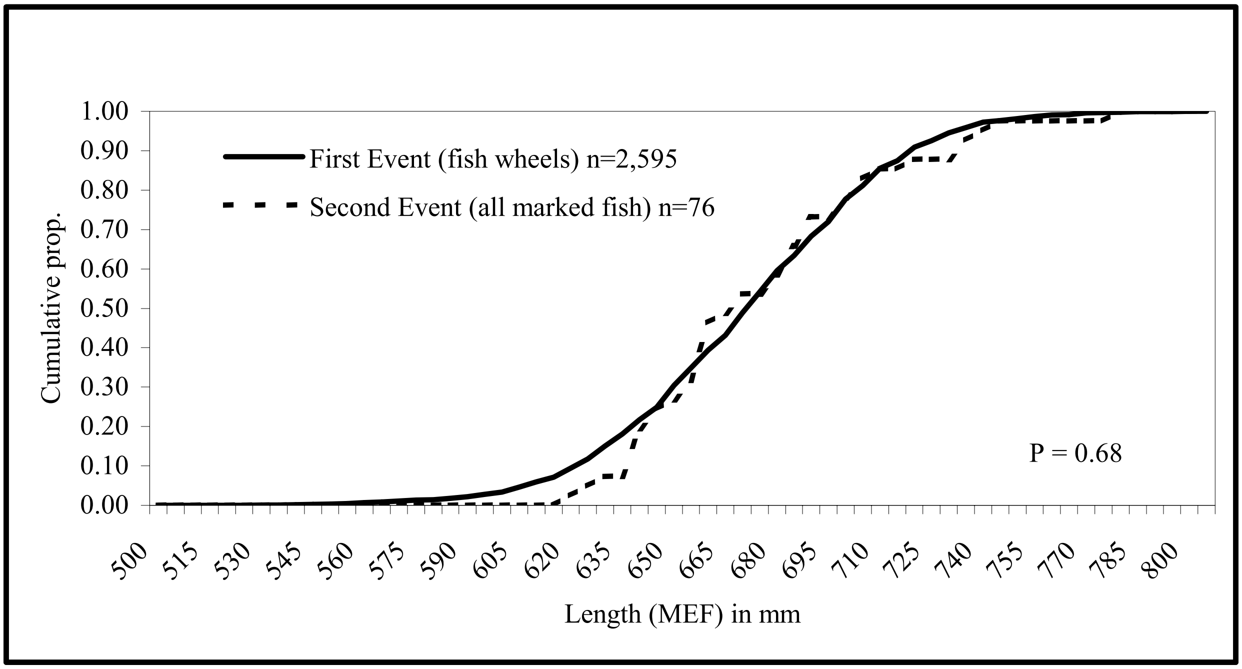


Figure 6.–Cumulative distribution function (CDF) of MEF lengths of small (top) and large (bottom) sockeye salmon marked in the lower Chilkat River versus lengths of marked fish recaptured on the spawning grounds, 2002.



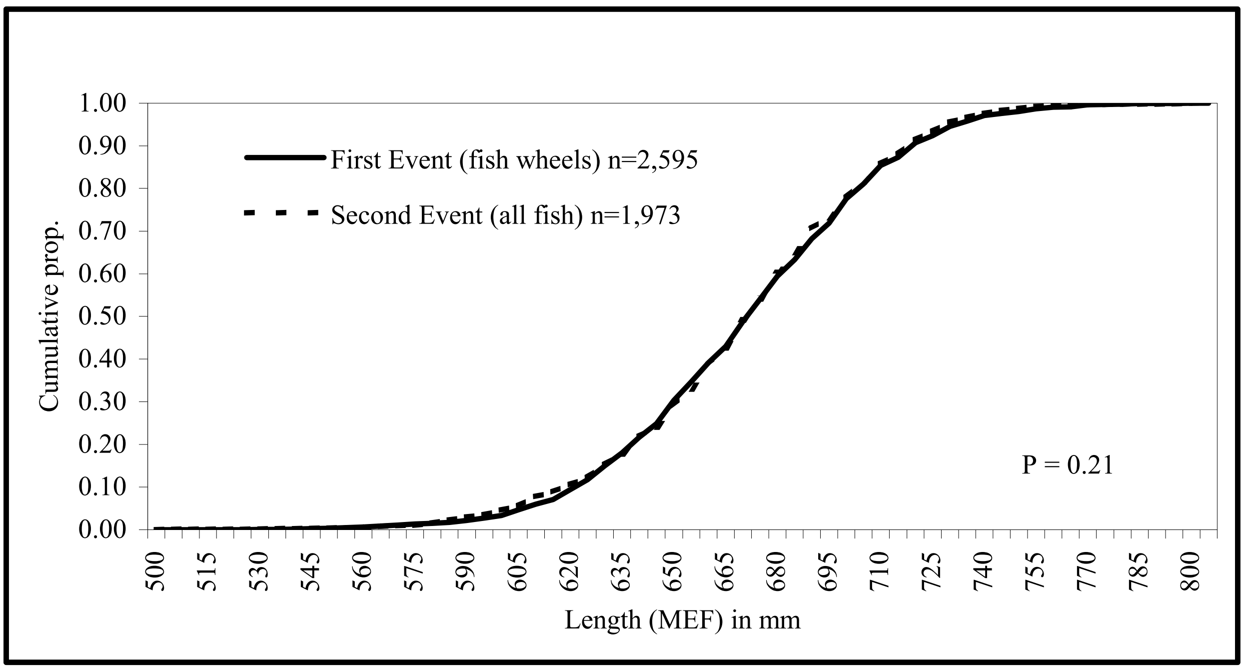


Figure 7.–Cumulative distribution function (CDF) of MEF lengths of chum salmon marked in the lower Chilkat River versus lengths of marked fish recaptured on the spawning grounds (top) and versus lengths of fish examined for marks on the spawning grounds (bottom), 2002.

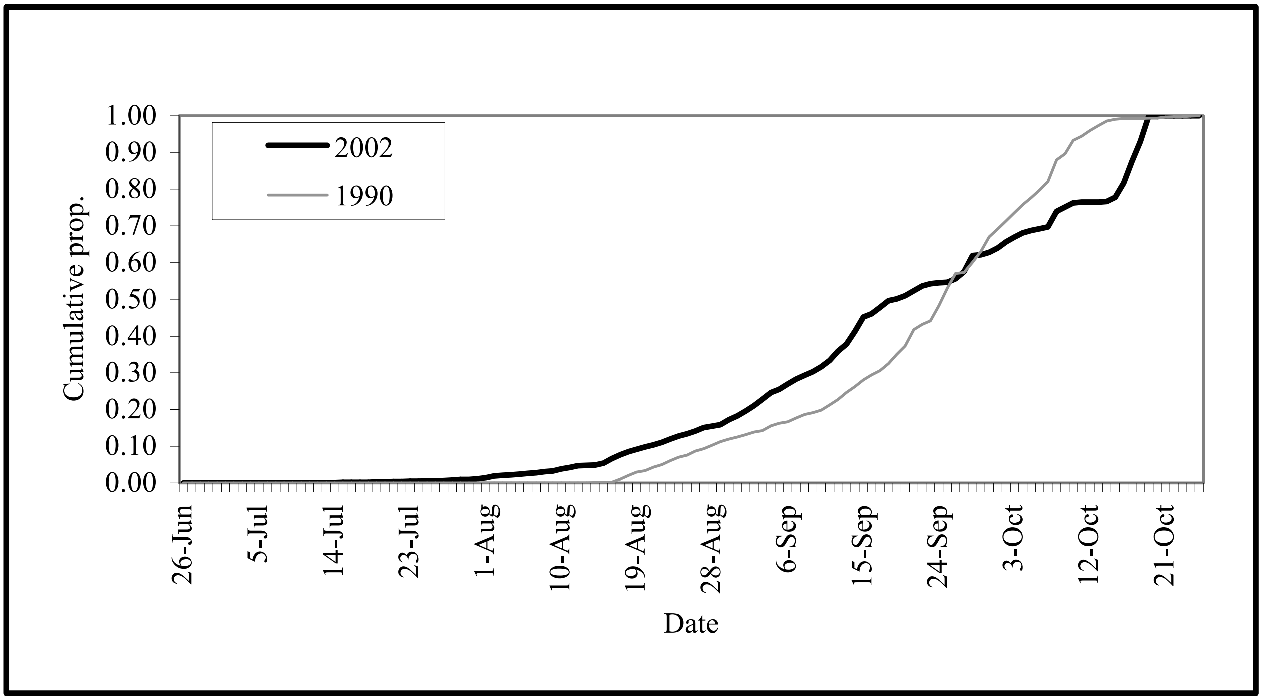


Figure 8.–Cumulative proportion of adult chum salmon captured in the Chilkat River fish wheels during 2002, compared to the cumulative proportion of 1990.

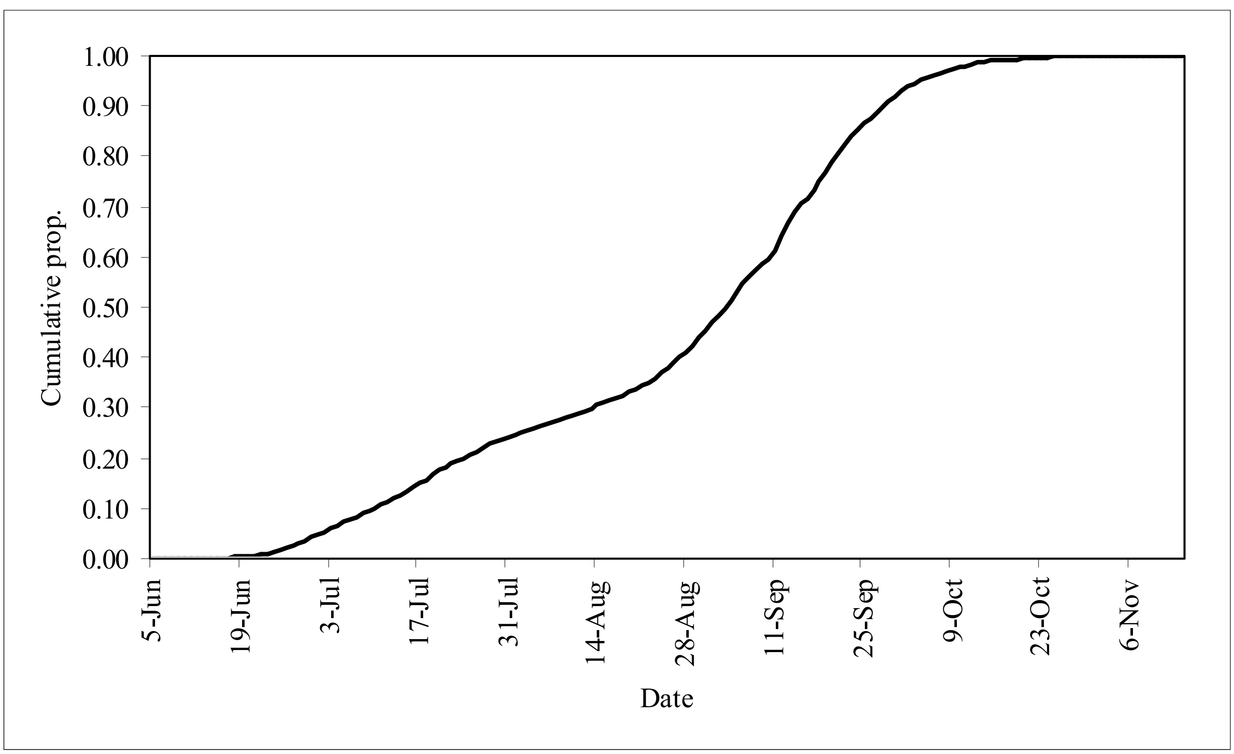


Figure 9.–Average cumulative proportions of Chilkat Lake sockeye salmon weir counts, 1970 to 1995, 1999–2002.

APPENDIX A

Appendix A1.–Calendar dates for statistical weeks in 2002.

Week #	From	Through
1	1–Jan	5–Jan
2	6–Jan	12–Jan
3	13–Jan	19–Jan
4	20–Jan	26–Jan
5	27–Jan	2–Feb
6	3–Feb	9–Feb
7	10–Feb	16–Feb
8	17–Feb	23–Feb
9	24–Feb	2–Mar
10	3–Mar	9–Mar
11	10–Mar	16–Mar
12	17–Mar	23–Mar
13	24–Mar	30–Mar
14	31–Mar	6–Apr
15	7–Apr	13–Apr
16	14–Apr	20–Apr
17	21–Apr	27–Apr
18	28–Apr	4–May
19	5–May	11–May
20	12–May	18–May
21	19–May	25–May
22	26–May	1–Jun
23	2–Jun	8–Jun
24	9–Jun	15–Jun
25	16–Jun	22–Jun
26	23–Jun	29–Jun
27	30–Jun	6–Jul
28	7–Jul	13–Jul
29	14–Jul	20–Jul
30	21–Jul	27–Jul
31	28–Jul	3–Aug
32	4–Aug	10–Aug
33	11–Aug	17–Aug
34	18–Aug	24–Aug
35	25–Aug	31–Aug
36	1–Sep	7–Sep
37	8–Sep	14–Sep
38	15–Sep	21–Sep
39	22–Sep	28–Sep
40	29–Sep	5–Oct
41	6–Oct	12–Oct
42	13–Oct	19–Oct
43	20–Oct	26–Oct
44	27–Oct	2–Nov
45	3–Nov	9–Nov
46	10–Nov	16–Nov
47	17–Nov	23–Nov
48	24–Nov	30–Nov
49	1–Dec	7–Dec
50	8–Dec	14–Dec
51	15–Dec	21–Dec
52	22–Dec	28–Dec
53	29–Dec	31–Dec

APPENDIX B

Appendix B1.–Chilkat River daily water level, temperature, fish wheel rpm, and fish wheel effort data, 2002.

Statistical Week	Date	Water level	Water temp.(C)	Fish wheel I[a] RPM	Fish wheel II RPM	Fish wheel I effort	Fish wheel II effort
23	8–Jun				2.4		18.00
24	9–Jun			3.3	2.4	24.00	24.00
24	10–Jun	143	5.8	3.5	2.6	24.00	22.00
24	11–Jun	142	5.7	3.5	2.6	24.00	24.00
24	12–Jun	126	8.1	3	2.5	24.00	24.00
24	13–Jun	123	5.6	3.2	2.6	24.00	24.00
24	14–Jun	135	7.4	3.2	2.6	24.00	24.00
24	15–Jun	156	8.3	3.8	3.2	19.00	17.50
25	16–Jun	168	8.2	0	0	0.00	0.00
25	17–Jun	170	8.2	0	0	0.00	0.00
25	18–Jun	168	8.8	4	3.3	12.00	12.00
25	19–Jun	154	6.5	3.7	3.1	23.00	24.00
25	20–Jun	147	6.8	3.5	2.9	24.00	24.00
25	21–Jun	142	7	3.3	3	24.00	24.00
25	22–Jun	134	6.9	2.9	2.9	24.00	24.00
26	23–Jun	134	7.9	3.2	2.9	24.00	24.00
26	24–Jun	135	8	3.5	2.9	24.00	24.00
26	25–Jun	146	7.9	4	3.5	24.00	23.00
26	26–Jun	152	7.4	3.9	3.4	24.00	24.00
26	27–Jun	145	7	3.8	3.1	24.00	20.00
26	28–Jun	137	7.1	3.2	3	24.00	24.00
26	29–Jun	136	8.2	3.3	3	23.00	24.00
27	30–Jun	142	9.1	3.4	3.1	24.00	24.00
27	1–Jul	135	7	3.3	2.8	23.00	24.00
27	2–Jul	132	7	3.3	3	24.00	24.00
27	3–Jul	126	6.4	3	2.7	24.00	24.00
27	4–Jul	124	7.1	3.2	3	24.00	24.00
27	5–Jul	125	6.5	3.3	3	24.00	24.00
27	6–Jul	126	7.4	3.2	2.8	24.00	24.00
28	7–Jul	125	7	3.1	2.8	24.00	24.00
28	8–Jul	131	8.6	3.3	2.8	24.00	24.00
28	9–Jul	140	9.2	3.7	2.9	24.00	24.00
28	10–Jul	142	6.9	3.4	3	24.00	20.00
28	11–Jul	136	6.5	3.5	3	24.00	24.00
28	12–Jul	134	7.3	3.2	3	24.00	22.00
28	13–Jul	132	7.9	3.5	3	24.00	24.00
29	14–Jul	131	7.8	3.4	2.9	24.00	24.00
29	15–Jul	130	7.6	3.4	2.9	24.00	24.00
29	16–Jul	130	7.8	3.5	3	24.00	18.00
29	17–Jul	134	7.5	3.5	3.1	24.00	24.00
29	18–Jul	140	6.8	3.6	3.1	24.00	24.00
29	19–Jul	143	8.1	4	3.1	24.00	24.00
29	20–Jul	143	6.9	4	3	24.00	24.00
30	21–Jul	138	7.6	3.4	3	24.00	24.00
30	22–Jul	136	7.5	3.5	3	24.00	24.00
30	23–Jul	140	8	3.7	3.1	24.00	24.00
30	24–Jul	149	7.9	4	3.1	24.00	20.00
30	25–Jul	165	7.4	4	3.1	24.00	22.00
30	26–Jul	167	6.8	3.8	3.2	24.00	11.00

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Statistical Week	Date	Water level	Water temp.(C)	Fish wheel I[a] RPM	Fish wheel II RPM	Fish wheel I effort	Fish wheel II effort
30	27–Jul	153	7	3.8	3.1	24.00	24.00
31	28–Jul	147	6.4	3.5	2.8	24.00	24.00
31	29–Jul	135	6.9	3.3	3	23.00	24.00
31	30–Jul	126	7	3.2	3	24.00	24.00
31	31–Jul	130	8	3.3	3.2	24.00	24.00
31	1–Aug	130	7.5	3.3	3.2	24.00	24.00
31	2–Aug	128	7.3	3.3	3.2	24.00	24.00
31	3–Aug	127	8	3.3	3	24.00	24.00
32	4–Aug	129	7.3	3.3	3	24.00	24.00
32	5–Aug	132	7.8	3.5	3	24.00	24.00
32	6–Aug	137	8	3.6	3.2	24.00	24.00
32	7–Aug	134	7.4	3.6	3.1	24.00	24.00
32	8–Aug	145	7	4	3.5	22.75	23.33
32	9–Aug	158	7.1	3.7	3.4	21.75	22.50
32	10–Aug	143	7.1	3.7	3.1	24.00	24.00
33	11–Aug	138	7.5	3.7	3.2	24.00	24.00
33	12–Aug	142	7.5	3.8	3.1	22.50	23.00
33	13–Aug	185	8.1	4.7	na	22.00	8.00
33	14–Aug	183	7	4.6	3.2	23.00	4.00
33	15–Aug	162	6.9	4.3	3.2	11.50	22.00
33	16–Aug	142	6.5	4	3	23.00	23.00
33	17–Aug	127	6.8	3.2	3.1	23.00	22.00
34	18–Aug	144	6.5	3	3	24.00	24.00
34	19–Aug	111	6.5	2.4	2.6	23.50	23.50
34	20–Aug	121	7	2.4	3	22.50	23.00
34	21–Aug	124	7.5	3	3.1	22.00	22.50
34	22–Aug	142	7.1	3.4	3.2	22.50	20.00
34	23–Aug	154	6.4	4	4.2	23.00	23.00
34	24–Aug	150	5.8	4	4	22.00	24.00
35	25–Aug	131	6	2.8	4.4	22.00	24.00
35	26–Aug	121	6.4	2.5	3.8	23.00	23.00
35	27–Aug	122	6.5	2.9	4	22.25	20.00
35	28–Aug	154	6.4	3.8	0	22.75	0.00
35	29–Aug	164	6.8	4.2	0	23.00	0.00
35	30–Aug	154	6.1	3.9	2.9	22.00	21.50
35	31–Aug	141	6	3.5	2.5	21.50	20.25
36	1–Sep	131	6.1	2.9	2	22.00	18.00
36	2–Sep	127	7.1	3.5	3.2	20.00	21.50
36	3–Sep	123	6.9	2.9	3	21.75	19.00
36	4–Sep	124	5.6	3.1	2.8	21.00	N/A
36	5–Sep	114	6.1	3	2.9	14.00	14.00
36	6–Sep	114	6.4	3	2.9	16.00	16.00
36	7–Sep	110	6.4	3	2.9	17.50	8.50
37	8–Sep	109	6.1	2.9	2.8	21.50	13.00
37	9–Sep	118	6.5	3.1	2.7	22.50	19.50
37	10–Sep	101	6.5	2.4	2.3	22.00	15.25
37	11–Sep	97	6.3	2.8	2.5	14.40	14.25
37	12–Sep	94	6.3	2.9	2.7	14.25	14.00
37	13–Sep	90	6.3	2.8	2.7	14.00	15.75
37	14–Sep	85	6.3	2.8	2.7	15.00	15.00

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Appendix B1. –Page 3 of 3.

Statistical Week	Date	Water level	Water temp.(C)	Fish wheel I[a] RPM	Fish wheel II RPM	Fish wheel I effort	Fish wheel II effort
38	15–Sep	86	6	2.7	2.7	16.00	8.75
38	16–Sep	78	6.1	2.3	1.8	16.25	7.00
38	17–Sep	80	6.5	2.5	2	15.00	15.50
38	18–Sep	82	6.8	2.5	2.1	12.75	13.00
38	19–Sep	90	5.6	2.6	2.7	21.00	22.30
38	20–Sep	86	6.8	2.6	2.7	15.50	15.50
38	21–Sep	90	6.1	2.8	2.7	15.50	15.00
39	22–Sep	86	5.6	2.1	2.1	14.25	14.25
39	23–Sep	68	5.6	2.2	2.3	14.25	14.00
39	24–Sep	84	7	0.25	2.2	24.00	20.80
39	25–Sep	77	7.4	2.4	2.7	3.50	24.00
39	26–Sep	73	7.1	2.5	2.6	21.00	23.00
39	27–Sep	72	8.2	2.5	2.5	15.75	24.00
39	28–Sep	78	7.6	2.5	2.7	16.50	16.50
40	29–Sep	74	6	2.4	2.6	16.50	22.00
40	30–Sep	72	5.6	2	2	22.00	24.00
40	1–Oct	74	6.4	2.1	1.9	23.10	22.75
40	2–Oct	69	5.4	2.2	2.1	21.30	22.10
40	3–Oct	67	5.4	2.1	2	21.25	22.00
40	4–Oct	69	5.5	2	2	24.00	24.00
40	5–Oct	65	4.5	2	2	24.00	22.00
41	6–Oct	60	4.6	1.8	0	24.00	10.50
41	7–Oct	58	5.4	1.5	0	24.00	0.00
41	8–Oct	65	6.4	2	0	18.00	0.00
41	9–Oct	68	5.6	2	2.2	22.50	23.00
41	10–Oct	65	2	1.4	1.8	24.00	24.00
41	11–Oct	56	2	1.3	1.3	23.00	24.00
41	12–Oct	51	4.4	1.3	2	8.00	24.00
41	13–Oct	51	3.6	0	0	0.00	0.00
41	14–Oct	51	3.8	1.2	2.8	24.00	13.00
41	15–Oct	45	4.6	1.1	2.9	24.00	24.00
41	16–Oct	55	6.8	2.2	2.5	22.00	21.50
41	17–Oct	75	6.4	2.2	4.2	16.25	16.40
41	18–Oct	71	5.5	2.5	4	24.00	17.00
41	19–Oct	75	6	2.2	4	9.25	9.00

[a] Fish wheel I is referred to the fish wheel located furthest upstream.

Appendix B2.–Daily catch, daily marked, and CPUE of sockeye salmon captured in the Chilkat River fish wheels, 2002.

Date	Daily sockeye catch	Cum. sockeye catch	Daily sockeye marked	Cum. Sockeye marked	Daily CPUE	Cum. prop. CPUE
8–Jun	1	1	1	1	0.17	0.00
9–Jun	2	3	2	3	0.13	0.00
10–Jun	0	3	0	3	0.00	0.00
11–Jun	6	9	6	9	0.38	0.00
12–Jun	3	12	3	12	0.19	0.00
13–Jun	4	16	4	16	0.25	0.00
14–Jun	3	19	3	19	0.19	0.00
15–Jun	0	19	0	19	0.00	0.00
16–Jun	0	19	0	19	N/A	0.00
17–Jun	0	19	0	19	N/A	0.00
18–Jun	12	31	12	31	1.50	0.01
19–Jun	10	41	10	41	0.64	0.01
20–Jun	39	80	39	80	2.44	0.02
21–Jun	61	141	59	139	3.81	0.03
22–Jun	38	179	37	176	2.38	0.04
23–Jun	32	211	32	208	2.00	0.05
24–Jun	32	243	32	240	2.00	0.05
25–Jun	20	263	20	260	1.28	0.06
26–Jun	18	281	18	278	1.13	0.06
27–Jun	38	319	37	315	2.59	0.07
28–Jun	58	377	57	372	3.63	0.08
29–Jun	75	452	74	446	4.79	0.10
30–Jun	70	522	68	514	4.38	0.12
1–Jul	46	568	45	559	2.94	0.13
2–Jul	41	609	41	600	2.56	0.13
4–Jul	61	715	60	705	3.81	0.16
5–Jul	48	763	47	752	3.00	0.17
6–Jul	28	791	28	780	1.75	0.17
7–Jul	32	823	30	810	2.00	0.18
8–Jul	57	880	52	862	3.56	0.19
9–Jul	35	915	34	896	2.19	0.20
10–Jul	53	968	50	946	3.61	0.21
11–Jul	38	1,006	37	983	2.38	0.22
12–Jul	68	1,074	66	1,049	4.43	0.24
13–Jul	57	1,131	56	1,105	3.56	0.25
14–Jul	46	1,177	45	1,150	2.88	0.26
15–Jul	58	1,235	57	1,207	3.63	0.27
16–Jul	32	1,267	31	1,238	2.29	0.28
17–Jul	49	1,316	46	1,284	3.06	0.29
18–Jul	32	1,348	31	1,315	2.00	0.30
19–Jul	41	1,389	37	1,352	2.56	0.30
20–Jul	45	1,434	41	1,393	2.81	0.31
21–Jul	58	1,492	56	1,449	3.63	0.33
22–Jul	66	1,558	63	1,512	4.13	0.34

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Date	Daily sockeye catch	Cum. sockeye catch	Daily sockeye marked	Cum. Sockeye marked	Daily CPUE	Cum. prop. CPUE
23–Jul	49	1,607	49	1,561	3.06	0.35
24–Jul	37	1,644	32	1,593	2.52	0.36
25–Jul	31	1,675	28	1,621	2.02	0.37
26–Jul	21	1,696	21	1,642	1.80	0.37
27–Jul	75	1,771	68	1,710	4.69	0.39
28–Jul	77	1,848	73	1,783	4.81	0.40
29–Jul	74	1,922	66	1,849	4.72	0.42
30–Jul	62	1,984	57	1,906	3.88	0.43
31–Jul	62	2,046	59	1,965	3.88	0.45
1–Aug	52	2,098	50	2,015	3.25	0.46
2–Aug	47	2,145	43	2,058	2.94	0.47
3–Aug	59	2,204	57	2,115	3.69	0.48
4–Aug	81	2,285	78	2,193	5.06	0.50
5–Aug	86	2,371	80	2,273	5.38	0.52
6–Aug	76	2,447	72	2,345	4.75	0.53
7–Aug	80	2,527	77	2,422	5.00	0.55
8–Aug	37	2,564	35	2,457	2.41	0.56
9–Aug	32	2,596	31	2,488	2.17	0.57
10–Aug	49	2,645	47	2,535	3.06	0.58
11–Aug	67	2,712	67	2,602	4.19	0.59
12–Aug	73	2,785	73	2,675	4.81	0.61
13–Aug	18	2,803	18	2,693	1.80	0.61
14–Aug	12	2,815	12	2,705	1.33	0.62
15–Aug	61	2,876	61	2,766	5.46	0.64
16–Aug	79	2,955	77	2,843	5.15	0.65
17–Aug	74	3,029	67	2,910	4.93	0.67
18–Aug	46	3,075	46	2,956	2.88	0.68
19–Aug	47	3,122	47	3,003	3.02	0.69
20–Aug	45	3,167	43	3,046	2.97	0.70
21–Aug	52	3,219	48	3,094	3.51	0.71
22–Aug	27	3,246	27	3,121	1.91	0.72
23–Aug	33	3,279	33	3,154	2.15	0.73
24–Aug	33	3,312	32	3,186	2.15	0.73
25–Aug	33	3,345	33	3,219	2.15	0.74
26–Aug	39	3,384	38	3,257	2.54	0.75
27–Aug	44	3,428	44	3,301	3.12	0.76
28–Aug	26	3,454	25	3,326	3.43	0.77
29–Aug	21	3,475	21	3,347	2.74	0.78
30–Aug	54	3,529	54	3,401	3.72	0.79
31–Aug	42	3,571	42	3,443	3.02	0.81
1–Sep	69	3,640	69	3,512	5.18	0.82
2–Sep	58	3,698	58	3,570	4.19	0.84
3–Sep	60	3,758	60	3,630	4.42	0.85
4–Sep	50	3,808	49	3,679	3.95	0.87
5–Sep	14	3,822	14	3,693	1.50	0.87
6–Sep	33	3,855	33	3,726	3.09	0.88

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Date	Daily sockeye catch	Cum. sockeye catch	Daily sockeye marked	Cum. Sockeye marked	Daily CPUE	Cum. prop. CPUE
7–Sep	54	3,909	54	3,780	6.23	0.90
8–Sep	33	3,942	33	3,813	2.87	0.91
9–Sep	40	3,982	40	3,853	2.86	0.92
10–Sep	28	4,010	28	3,881	2.26	0.93
11–Sep	29	4,039	29	3,910	3.04	0.94
12–Sep	14	4,053	14	3,924	1.49	0.95
13–Sep	17	4,070	17	3,941	1.71	0.95
14–Sep	15	4,085	15	3,956	1.50	0.96
15–Sep	22	4,107	14	3,970	2.67	0.97
16–Sep	8	4,115	8	3,978	1.03	0.97
17–Sep	8	4,123	8	3,986	0.79	0.97
18–Sep	5	4,128	4	3,990	0.58	0.97
19–Sep	8	4,136	8	3,998	0.55	0.98
20–Sep	9	4,145	9	4,007	0.87	0.98
21–Sep	7	4,152	7	4,014	0.69	0.98
22–Sep	6	4,158	6	4,020	0.63	0.98
23–Sep	14	4,172	9	4,029	1.49	0.99
24–Sep	0	4,172	0	4,029	0.00	0.99
25–Sep	3	4,175	3	4,032	0.33	0.99
26–Sep	6	4,181	6	4,038	0.41	0.99
27–Sep	5	4,186	5	4,043	0.38	0.99
28–Sep	4	4,190	4	4,047	0.36	0.99
29–Sep	2	4,192	2	4,049	0.16	0.99
30–Sep	2	4,194	2	4,051	0.13	0.99
1–Oct	2	4,196	2	4,053	0.13	0.99
2–Oct	3	4,199	3	4,056	0.21	1.00
3–Oct	3	4,202	3	4,059	0.21	1.00
4–Oct	7	4,209	7	4,066	0.44	1.00
5–Oct	2	4,211	2	4,069	0.19	1.00
6–Oct	1	4,212	1	4,070	0.09	1.00
7–Oct	0	4,212	0	4,070	0.00	1.00
8–Oct	1	4,213	1	4,071	0.17	1.00
9–Oct	1	4,214	1	4,073	0.13	1.00
10–Oct	1	4,215	1	4,074	0.06	1.00
11–Oct	1	4,216	1	4,075	0.06	1.00
12–Oct	1	4,217	1	4,076	N/A	N/A

Appendix B3.–Daily catch, daily marked, and CPUE of chum salmon captured in the Chilkat River fish wheels, 2002.

Date	Daily chum catch	Cum. chum catch	Daily chum tagged	Cum. chum tagged	Daily CPUE	Cum. Prop. CPUE
10–Jul	3	3	3	3	0.20	0.00
11–Jul	0	3	0	3	0.00	0.00
12–Jul	0	3	0	3	0.00	0.00
13–Jul	0	3	0	3	0.00	0.00
14–Jul	1	4	1	4	0.06	0.00
15–Jul	1	5	1	5	0.06	0.00
16–Jul	0	5	0	5	0.00	0.00
17–Jul	0	5	0	5	0.00	0.00
18–Jul	0	5	0	5	0.00	0.00
19–Jul	2	7	2	7	0.13	0.00
20–Jul	0	7	0	7	0.00	0.00
21–Jul	3	10	3	10	0.19	0.00
22–Jul	2	12	2	12	0.13	0.00
23–Jul	1	13	1	13	0.06	0.00
24–Jul	1	14	1	14	0.07	0.00
25–Jul	2	16	2	16	0.13	0.00
26–Jul	1	17	1	17	0.09	0.00
27–Jul	2	19	2	19	0.13	0.01
28–Jul	4	23	4	23	0.25	0.01
29–Jul	4	27	3	26	0.19	0.01
30–Jul	2	29	2	28	0.13	0.01
31–Jul	3	32	2	30	0.13	0.01
1–Aug	11	43	10	40	0.63	0.01
2–Aug	13	56	13	53	0.81	0.01
3–Aug	5	61	5	58	0.31	0.02
4–Aug	3	64	3	61	0.19	0.02
5–Aug	6	70	6	67	0.38	0.02
6–Aug	5	75	5	72	0.31	0.02
7–Aug	6	81	6	78	0.38	0.02
8–Aug	9	90	9	87	0.59	0.02
9–Aug	5	95	4	91	0.27	0.03
10–Aug	16	111	16	107	1.00	0.03
11–Aug	10	121	10	117	0.63	0.03
12–Aug	15	136	15	132	0.99	0.04
13–Aug	2	138	2	134	0.20	0.04
14–Aug	4	142	4	138	0.44	0.04
15–Aug	15	157	15	153	1.34	0.05
16–Aug	35	192	35	188	2.28	0.06
17–Aug	31	223	31	219	2.07	0.06
18–Aug	25	248	24	243	1.50	0.07
19–Aug	15	263	15	258	0.96	0.07
20–Aug	20	283	20	278	1.32	0.08
21–Aug	17	300	17	295	1.15	0.09
22–Aug	19	319	19	314	1.34	0.09

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Date	Daily chum catch	Cum. chum catch	Daily chum tagged	Cum. chum tagged	Daily CPUE	Cum. Prop. CPUE
23–Aug	27	346	27	341	1.76	0.10
24–Aug	24	370	24	365	1.57	0.11
25–Aug	17	387	16	381	1.04	0.11
26–Aug	23	410	23	404	1.50	0.12
27–Aug	28	438	28	432	1.99	0.13
28–Aug	11	449	11	443	1.45	0.13
29–Aug	10	459	10	453	1.30	0.14
30–Aug	39	498	39	492	2.69	0.15
31–Aug	29	527	29	521	2.08	0.16
1–Sep	41	568	41	562	3.08	0.17
2–Sep	42	610	42	604	3.04	0.19
3–Sep	48	658	48	652	3.53	0.20
4–Sep	53	711	53	705	4.18	0.22
5–Sep	26	737	26	731	2.79	0.23
6–Sep	43	780	42	773	3.94	0.25
7–Sep	38	818	38	811	4.38	0.27
8–Sep	29	847	26	837	2.26	0.28
9–Sep	29	876	29	866	2.07	0.29
10–Sep	39	915	39	905	3.14	0.30
11–Sep	51	966	51	956	5.34	0.32
12–Sep	70	1,036	70	1,026	7.43	0.36
13–Sep	61	1,097	61	1,087	6.15	0.38
14–Sep	100	1,197	100	1,187	10.00	0.43
15–Sep	113	1,310	31	1,218	3.76	0.44
16–Sep	24	1,334	24	1,242	3.10	0.46
17–Sep	51	1,385	51	1,293	5.02	0.48
18–Sep	53	1,438	45	1,338	5.24	0.50
19–Sep	14	1,452	14	1,352	0.97	0.50
20–Sep	26	1,478	26	1,378	2.52	0.52
21–Sep	39	1,517	39	1,417	3.84	0.53
22–Sep	37	1,554	37	1,454	3.89	0.55
23–Sep	17	1,571	17	1,471	1.81	0.56
24–Sep	8	1,579	8	1,479	0.54	0.56
25–Sep	4	1,583	4	1,483	0.44	0.56
26–Sep	26	1,609	26	1,509	1.77	0.57
27–Sep	58	1,667	58	1,567	4.38	0.59
28–Sep	126	1,793	57	1,624	5.18	0.61
29–Sep	6	1,799	6	1,630	0.47	0.61
30–Sep	21	1,820	21	1,651	1.37	0.62
1–Oct	33	1,853	33	1,684	2.16	0.63
2–Oct	49	1,902	49	1,733	3.39	0.64
3–Oct	35	1,937	35	1,768	2.43	0.65
4–Oct	34	1,971	34	1,802	2.13	0.66
5–Oct	21	1,992	21	1,823	1.31	0.67
6–Oct	12	2,004	12	1,835	1.04	0.67
7–Oct	15	2,019	15	1,850	1.88	0.68

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Date	Daily chum catch	Cum. chum catch	Daily chum tagged	Cum. chum tagged	Daily CPUE	Cum. Prop. CPUE
8–Oct	123	2,142	123	1,973	20.50	0.77
9–Oct	32	2,174	32	2,005	2.11	0.78
10–Oct	35	2,209	35	2,040	2.19	0.79
11–Oct	5	2,214	5	2,045	0.32	0.79
12–Oct	0	2,214	0	2,045	N/A	0.79
13–Oct	0	2,214	0	2,045	N/A	0.79
14–Oct	4	2,218	4	2,049	0.32	0.79
15–Oct	34	2,252	34	2,083	2.13	0.80
16–Oct	112	2,364	112	2,195	7.72	0.83
17–Oct	170	2,534	165	2,360	15.16	0.90
18–Oct	157	2,691	112	2,472	8.20	0.94
19–Oct	204	2,908	129	2,599	14.65	1.00