Fishery Data Series No. 04-20

Escapement, Terminal Harvest, and Fall Fry Tagging of Chilkat River Chinook Salmon in 2003

by

Randolph P. Ericksen

October 2004

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

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Measures (fisheries)

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

Mathematics, statistics

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

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ESCAPEMENT, TERMINAL HARVEST, AND FALL FRY TAGGING OF CHILKAT RIVER CHINOOK SALMON IN 2003

by

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October 2004

This investigation was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-18 and F-10-19, Job No. S-1-5 and NOAA Grant No. NA03NMF4380248 (U. S. Chinook Letter of Agreement).

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This document should be cited as:

Ericksen, Randolph P. 2004. Escapement, terminal harvest, and fall fry tagging of Chilkat River Chinook salmon in 2003. Alaska Department of Fish and Game, Fishery Data Series No. 04-20, Anchorage.

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ABSTRACT

The spring harvest of Chinook salmon *Oncorhynchus tshawytscha* in the Haines marine sport fishery and escapement into the Chilkat River are estimated annually to monitor this important sport fishery and the salmon stock that supports it. We used an age-stratified mark-recapture experiment to estimate spawning abundance of Chinook salmon returning to the Chilkat River in 2003. Angler effort and spring harvest of wild mature Chinook salmon in the Haines marine boat fishery were estimated using an onsite creel survey. Harvest of large (≥ 28 inches total length) Chinook salmon and chartered angler effort and harvest were also estimated.

We captured 511 Chinook salmon with drift gillnets and fish wheels; 478 of these were marked and released in the lower Chilkat River between June 10 and August 10, 2003. We examined 1,078 Chinook salmon in spawning tributaries of the Chilkat River, and 64 of these were marked. We estimated that 7,626 (SE = 823) Chinook salmon immigrated into the Chilkat River during 2003. An estimated 702 (SE = 168) were small (age-1.1), 1,267 (SE = 293) were medium (age-1.2), and 5,657 (SE = 690) were large (age-1.3 and older) fish.

An estimated 10,651 angler-h (SE = 592) of effort (10,055 salmon-h, SE = 578) were expended in the spring Haines marine sport fishery for a harvest of 404 (SE = 40) Chinook salmon (≥ 28 inches), of which 285 (SE = 27) were wild, mature fish. Chartered anglers accounted for 5% of the targeted salmon effort and 6% of the harvest of large Chinook salmon.

Wild Chinook salmon fry were trapped in three locations of the Chilkat River drainage during fall 2003. We captured and released a total of 36,640 fry with coded wire tags in 2003. They averaged 69 mm (SE = 0.4) in fork length. Future recoveries of these fish will allow us to estimate fall rearing abundance and marine harvest of these brood years.

Key words: Chinook salmon, *Oncorhynchus tshawytscha,* age-stratified, mark-recapture, escapement, angler effort, creel survey, harvest, angler-h, salmon-h, Haines marine sport fishery, coded wire tags, length-at-age.

INTRODUCTION

The Chilkat River drainage produces the third or fourth largest run of Chinook salmon *Oncorhynchus tshawytscha* in Southeast Alaska (McPherson et al. 2003). This large glacial system has its headwaters in British Columbia, Canada, flows through rugged, dissected, mountainous terrain, and terminates in Chilkat Inlet near Haines, Alaska (Figure 1). The mainstem and major tributaries comprise approximately 350 km of river channel in a watershed covering about 2,600 km² (Bugliosi 1988) of which 867.6 km^2 are considered accessible to anadromous fish (Ericksen and McPherson *In prep.*). Chilkat River Chinook salmon rear primarily in the inside waters of northern Southeast Alaska, and less so in the Gulf of Alaska, Prince William Sound, and Kachemak Bay (Pahlke 1991; Johnson et al. 1993; Ericksen 1996, 1999).

A marine boat sport fishery occurs each spring in Chilkat Inlet (Figure 1) in Southeast Alaska near Haines that targets a run of mature Chinook salmon destined for the Chilkat River. A creel survey has been used to estimate harvest in this fishery since 1984. The harvest in this fishery peaked at over 1,600 Chinook salmon in 1985 and 1986 (Neimark 1985; Mecum and Suchanek 1986, 1987; Bingham et al. 1988; Suchanek and Bingham 1989, 1990, 1991; Ericksen 1994-2003a). The fishery in Haines contributes significantly to the local economy, supports a salmon derby, and is popular both with local and non-local anglers (Bethers 1986, Jones & Stokes 1991).

Beginning in 1981, the Alaska Department of Fish and Game (ADF&G), Division of Sport Fish began a program to provide index counts to monitor escapement trends of Chinook salmon abundance in the Chilkat River (Kissner 1982) using aerial survey counts in Stonehouse and Big Boulder creeks (Figure 1). These areas were selected because they were the only clearwater spawning areas that could provide standardized, consistent survey counts. The

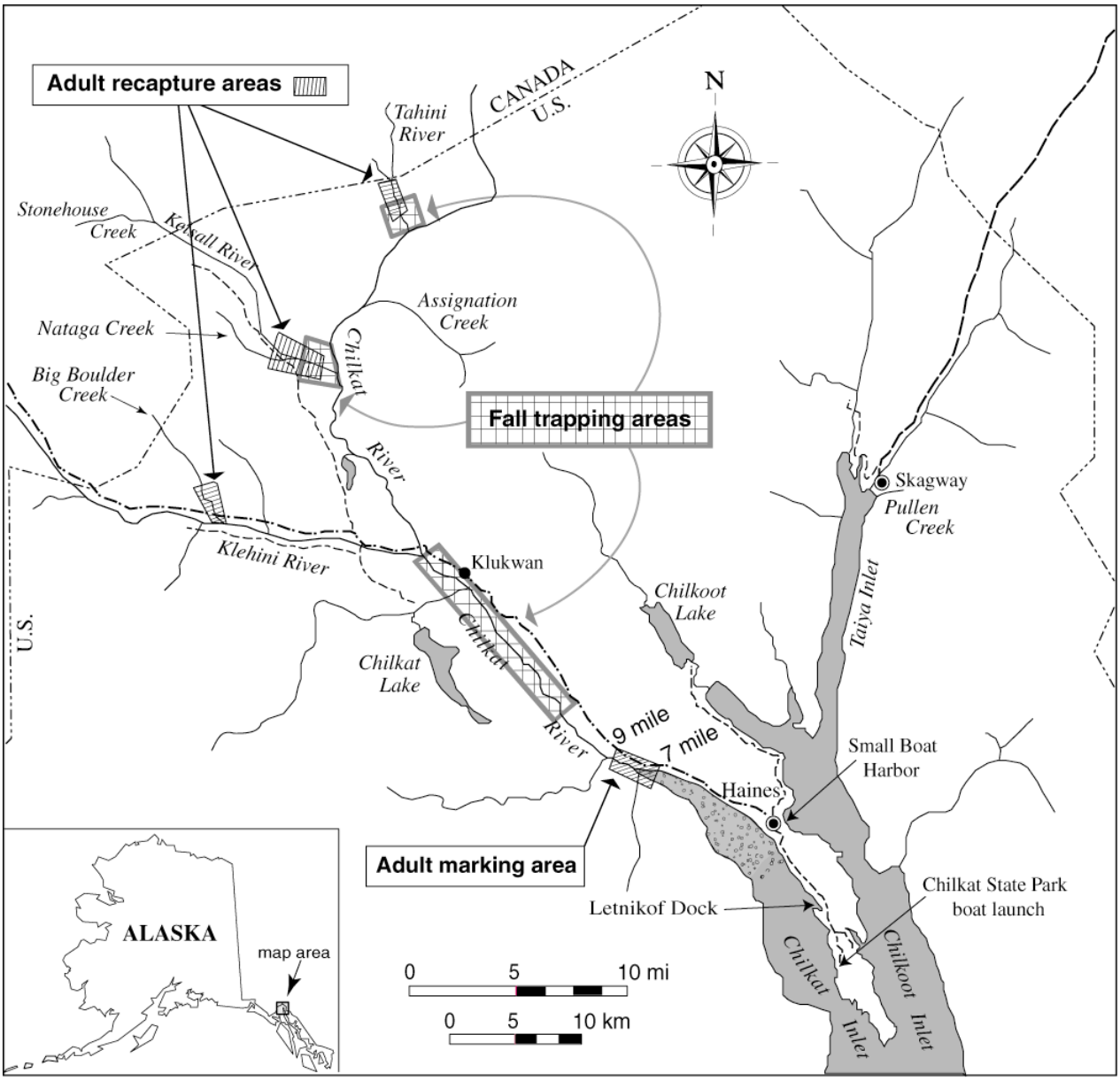


Figure 1.–Location of sampling sites and release sites of coded wire tagged Chinook salmon near Haines and Skagway in Southeast Alaska, 2003.

indices were used in a regionwide program to monitor Chinook salmon escapements in Southeast Alaska (Pahlke 1992).

Concern about Chilkat River Chinook salmon developed when aerial survey counts declined in 1985 and 1986. This decline coincided with increasing marine harvests of Chinook in the commercial troll, commercial drift gillnet, and sport fisheries in the area. In 1987, the Department began to restrict fisheries in upper Lynn Canal, and the spring recreational Chinook fisheries near Haines were closed entirely in 1991 and 1992. The Haines King Salmon Derby was closed between 1988 and 1994.

Because of these concerns, the Division of Sport Fish conducted a coded wire tagging (CWT) program on wild juvenile Chinook salmon in 1989 and 1990 to identify migratory patterns and to estimate contributions to sport and commercial fisheries (Pahlke 1991; Pahlke et al. 1990). The Division of Sport Fish also conducted radiotelemetry and mark-recapture experiments in 1991 and 1992 to estimate spawning distribution and abundance of large (age-1.3 and older) Chinook salmon in the river. Results of this research indicate that most Chinook spawn in two major tributaries of the Chilkat River, the Kelsall and Tahini rivers, and that immature fish are harvested primarily in the inside waters of Southeast Alaska (Johnson et al. 1992, 1993; Ericksen 1996, 1999). Escapements since 1991 have ranged between 2,035 (SE = 334) in 2000 and 8,100 (SE = 1,193) in 1997 (Johnson et al. 1992, 1993; Johnson 1994; Ericksen 1995-2003a).

ADF&G adopted a biological escapement goal (BEG) range of 1,750 to 3,500 Chinook salmon 737 mm (29 inches) total length and greater in January 2003 (Appendix A). This BEG formed the basis of the Lynn Canal and Chilkat River king salmon fishery management plan that was adopted by the Alaska Board of Fisheries in February 2003 (5AAC 33.384). Regulations in effect during 2003 prevented sport fishing for Chinook salmon near the mouth of the Chilkat River (Figure 1). Regionwide regulations allowed resident anglers to keep two king salmon 28 inches or greater in length per day and in possession. Nonresident anglers were allowed to keep one king salmon 28 inches or greater in length per day and in possession with an annual limit of three king salmon. In addition, effective June 10, the daily bag and possession limit was two king salmon any size with no annual limit for all anglers fishing in Taiya Inlet. This regulation was implemented by emergency order to allow anglers to harvest hatchery fish returning to the Skagway area. Commercial fishing regulations were structured to reduce incidental harvests of mature Chinook salmon in the Lynn Canal gillnet fishery.

In 1999, we began to CWT Chinook and coho salmon *O. kisutch* smolt each spring to estimate juvenile abundance, non-terminal harvest and total return (Ericksen 2001a; Ericksen 2002b; Ericksen 2003b, Ericksen and Chapell *In prep*). Although we were successful in capturing sufficient numbers of coho salmon smolt, the number of Chinook salmon smolt tagged was low. To increase the number of coded wire tagged Chinook salmon outmigrating from the Chilkat River, fall juvenile Chinook salmon (fry) were tagged beginning in 2000 (Ericksen 2002a).

The purpose of this study was to estimate the sport harvest, escapement, and production of Chinook salmon returning to the Chilkat River during 2003. We tagged juvenile Chinook salmon to estimate production and marine harvest of this stock in the future. This report describes the methods and results of the study during 2003. The long-term goal of this study is to develop maximum harvest guidelines for this stock in accordance with sustained yield management.

Research objectives in 2003 were to estimate:

1. the immigration of Chinook salmon into the Chilkat River in 2003;
2. the age, sex, and length compositions of the escapement of large Chinook salmon in the Chilkat River in 2003;
3. the harvest of wild mature Chinook salmon in the Haines spring marine boat sport fishery from May 5 to June 29, 2003; and
4. the mean length of juvenile Chinook salmon rearing in the Chilkat River drainage during fall 2003.

METHODS

ESCAPEMENT

An age-stratified mark-recapture experiment was used to estimate the number of Chinook salmon immigrating to the Chilkat River in 2003. Stratifying the estimate by age was done to develop a series of escapement and brood year returns needed to assess escapement goals for this stock. Marks were applied to fish captured in the lower Chilkat River with drift gillnets and fish wheels from June 10 through August 10, between the area adjacent to Haines Highway miles 7 and 9 (Figure 1). Chinook salmon ≥440 mm mid-eye to fork of tail (MEF) were marked with a solid-core spaghetti tag and a hole punch in the upper

left operculum prior to release. Chinook salmon less than 440 mm in length were marked in the same manner but given a t-bar anchor tag instead of a spaghetti tag. Water depth (cm), and temperature (°C) were recorded daily at 0700 and 1330 hours near highway mile 8. Fish were examined for marks on three upriver spawning tributaries of the Chilkat River between August 4 and September 2.

Lower River Marking

Gillnets 21.3 m long and 3.0 m deep (70 ft × 10 ft) were drifted in the lower Chilkat River June 10 through July 24, 2003. The gillnets consisted of two equal-length panels: one of 17.1-cm (6.75 inch stretch measured) and the other of 20.3-cm (8.0 inch stretch measured) nylon mesh. We attempted to complete 43 drifts between 0600 and 1400 hours each day. Fishing was conducted from an 18-ft boat in six adjoining 0.5-km sections, which were marked along a 3-km section of river (Figure 2). This area was about 100 m wide and 2 to 3 m deep. The 43 drifts took about 6 h to complete when fish were not captured. Fishing continued uninterrupted from area to area when fish were not captured. If a (0.5-km) drift was prematurely terminated because a fish was caught, or if the net became entangled or drifted into shallow water, the terminated drift was subsequently completed before a new drift was started. If 43 drifts could not be completed during the day, additional drifts were added to the next day's total to make up the balance.

Two 3-basket aluminum fish wheels were operated from June 6 to October 21 by ADF&G Commercial Fisheries Division (CFD) personnel to estimate escapement of sockeye *O. nerka*, coho *O. kisutch*, and chum salmon *O. keta* to the Chilkat River. One fish wheel operated adjacent to the Haines Highway near mile 9 and the other about 300 m downstream (Figure 2). The wheels were located along the east bank of the river where the main flow was constrained primarily to one side of the floodplain. Fish wheels operated continuously except for maintenance.

Captured Chinook salmon were placed in a water-filled tagging box (see Figure 3 in Johnson 1994), inspected for missing adipose fins, and measured to the nearest 5 mm MEF. Fish were initially classified as 'large,' 'medium,' or 'small,' depending on their length: fish ≥660 mm MEF were designated as large, fish ≥440 and <660 mm MEF as medium, and fish <440 mm MEF as small. Heads were removed from all fish with missing adipose fins, marked with an individually numbered strap, and sent to the ADF&G Mark, Tag and Age Laboratory in Juneau for analysis. All healthy medium and large Chinook salmon possessing an adipose fin were sampled for scales, visually 'sexed,' marked with a uniquely numbered spaghetti tag threaded over a solid plastic core and sewn through the bones near the base of the dorsal fin, and given a ¼-inch hole punch in the upper edge of the left operculum as a secondary mark. Technicians operating the gillnet also marked fish by clipping (removing) the left axillary appendage. This helped to identify where the fish was marked (whether in the fish wheel or gillnet) in the event of tag loss. Small (<440 mm MEF) were sampled and marked as above except they were given a uniquely numbered T-bar anchor tag instead of a spaghetti tag. Age of each fish sampled for scales was determined postseason by counting the scale annuli (Olsen 1992). Each fish was then reclassified as large, medium, or small using ocean age, rather than length, as criteria; fish with three or more ocean years of residence were classified as large, those with two ocean years as medium, and those with one ocean year were classified as small. Any fish whose scales could not be aged was classified by length as described above.

Spawning Ground Recovery

Escapements in the Kelsall and Tahini rivers (Figure 1) were sampled for marks by two teams of two people. Spawning grounds in the Kelsall River (including Nataga Creek) were sampled from August 4 to September 2. Spawning grounds in the Tahini River were

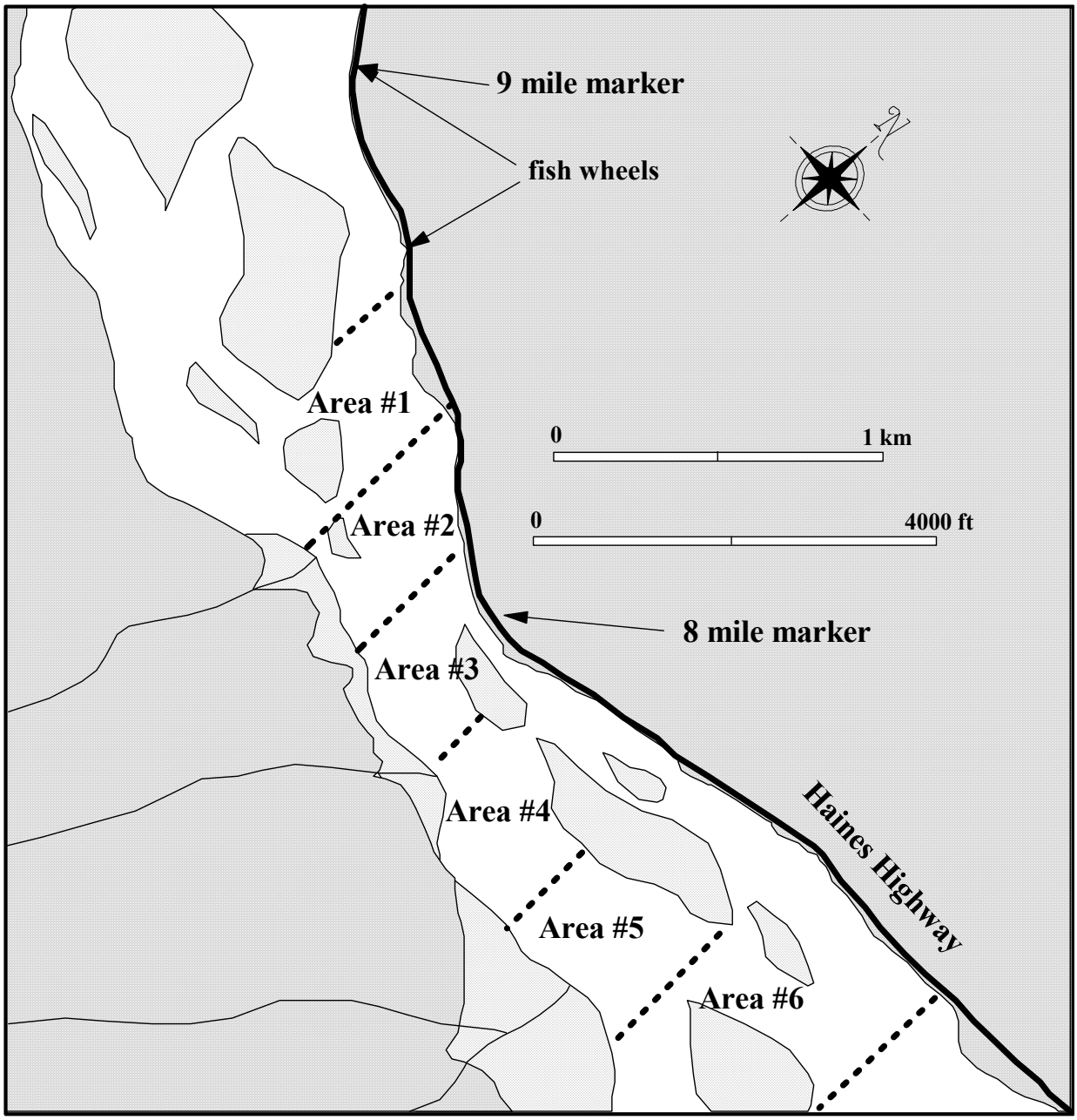


Figure 2.–Active lower Chilkat River channel, drift areas, and sites of fish wheels in 2003.

sampled from August 6 to September 2. Chinook salmon were also sampled in Big Boulder Creek from August 8 through August 25 and in 37 Mile Creek on August 25. Chinook salmon were captured using gillnets, dip nets, snagging gear, and even bare hands. Duplicate sampling was prevented by punching a hole in the lower edge of the left operculum of all captured fish.

The validity of the mark-recapture experiment rests on several assumptions: (a) that every fish has an equal probability of being marked during event 1, or 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) fish do not lose marks between sample events; (e) all recovered marks are reported; and (f) that duplicate sampling does not occur (Seber 1982).

Stratifying the experiment into small- and medium (age-1.1 and -1.2) and large (age-1.3 and older) fish ensures that abundance and age composition estimates for larger fish are obtained by similar, robust methods each year (estimates for smaller fish have not been possible in some years due to meager sample sizes). In addition, key experimental assumptions (sampling is not selective by size, age, or sex) are strained when smaller fish are pooled with larger fish, and meaningful failures can be difficult to detect with marginal sample sizes. Selectivity assumptions for a stratum of smaller fish are, in contrast, robust. These fish are mostly (>95%) male and span a small range of lengths relative to fish age-1.3 and older.

The validity of assumption (a) was tested through a series of hypothesis tests (all at $\alpha = 0.1$). First, a contingency table (chi-square statistic) was used to test the hypothesis that fish sampled at different spawning tributaries were marked at the same rate. Also, a contingency table was used to test the hypothesis that fish marked at different times in the immigration (e.g., early vs. late) were recaptured at the same rate.

The possibility of selective sampling was also investigated because assumption (a) could be violated if the sampling rate varied by size or sex of the fish. The hypothesis that fish of different sizes were captured with equal probability during the second sampling event was tested with a Kolmogorov-Smirnov (K-S) two-sample test comparing the size distribution of marked fish with those recaptured. If significant differences were observed between size compositions, the abundance estimate could be stratified by size, age, and/or by sex to reduce bias. The remaining assumptions are considered in the Discussion.

Abundance (numbers immigrating) of Chinook salmon by age was estimated using the Chapman's modified Petersen estimator for a closed population (Seber 1982):

$$\hat{N} = \frac{(n_1 + 1)(n_2 + 1)}{(m_2 + 1)} - 1 \qquad (1)$$

$$var[\hat{N}] = \frac{(n_1 + 1)(n_2 + 1)(n_1 - m_2)(n_2 - m_2)}{(m_2 + 1)^2 (m_2 + 2)} \qquad (2)$$

where n_1 is the number of Chinook salmon marked by age class in the lower river, n_2 is the number examined by age class on the spawning grounds, and m_2 is the subset of n_2 that had been marked in the lower river.

Age and Sex Composition of the Escapement

Age and sex composition estimates can be biased due to sampling methods. Fish wheels can be selective for smaller fish (Ericksen 1995) and for males (Ericksen 1995-2003a), and gillnets can be selective for larger fish. Carcass surveys are known to be sex-selective in some situations (Pahlke et al. 1996; McPherson et al. 1997; Zhou 2002, Miyakoshi et al. 2003). In addition, significant variation in age and/or sex compositions between spawning areas can bias composition estimates for the entire drainage when sampling is not proportional to abundance. The potential for bias was reduced in this experiment by stratifying the abundance estimate by age class, and by other actions explained below.

Chinook salmon caught in the lower river and encountered on the spawning grounds were sampled for age, length, and sex. Age compositions were tabulated separately for fish caught in the lower river by gillnet and fish wheels, and in each escapement sampling location (tributary). Standard sample summary statistics (Cochran 1977) were used to calculate age composition, mean length-at-age, and variances of the catch in each gear type.

Size selectivity was investigated using two K-S tests: one described above, and the other comparing the lengths of fish marked in the lower river to those sampled on the spawning grounds.

Age and sex selectivity was investigated by contingency table analysis. The number of large Chinook captured by age or sex in the lower

river was compared with the number sampled on the spawning grounds. Because sex compositions differed significantly, spawning ground samples alone were used to estimate sex composition, as sex determination is more difficult early in the season while marking fish in the lower river (Ericksen 1995-2003a).

Sex composition of the escapement was obtained for each age class from pooled escapement samples. Proportions by sex for each age class were estimated by:

$$\hat{p}_{a,s} = \frac{n_{a,s}}{n_a} \tag{3}$$

$$var[\hat{p}_{a,s}] = \frac{\hat{p}_{a,s}\ (1-\hat{p}_{a,s})}{n_a - 1} \tag{4}$$

where $p_{a,s}$ is the proportion of age class a fish of sex s, $n_{a,s}$ is the number of age class a fish in the sample of sex s, and n_a is the number of age a fish in the sample.

The abundance of age a Chinook salmon by sex in the escapement was estimated as:

$$\hat{N}_{a,s} = \hat{N}_a\ \hat{p}_{a,s} \tag{5}$$

$$\begin{aligned} var[\hat{N}_{a,s}] = {} & var[\hat{p}_{a,s}]\hat{N}_a^{\,2} \\ & + var[\hat{N}_a]\hat{p}_{a,s}^{\,2} - var[\hat{p}_{a,s}]var[\hat{N}_a] \end{aligned} \tag{6}$$

where $\hat{N}_a$ is the estimated abundance of age a Chinook salmon.

TERMINAL HARVEST

2003 Haines Marine Sport Fishery Harvest

A stratified two-stage direct expansion creel survey was used to estimate the harvest of Chinook salmon in the Haines marine boat sport fishery. Spatial stratification was by harbor. Temporal stratification included 7-day (weekly) periods at one high-use site and 14-day (biweekly) periods at two low-use sites. A separate temporal stratum existed during the two weekends of the Haines Derby (May 24, 25, 26, 31, and June 1) at both high- and low-use sites. Each fishing day was defined as starting at 0800 hours and ending at civil twilight, which ranged from 2208 to 2351 hours. Midday was defined as the time mid way between 0800 hours and civil twilight.

The three access locations were the Letnikof Dock (the high-use site), the Chilkat State Park boat launch, and the Small Boat harbor (Figure 1). Prior surveys indicate that with the exception of 2000, anglers landing their catch at the Letnikof Dock account for 51–93% of the harvest of Chinook salmon. Sampling at each location had days as primary sampling units and boat-parties as secondary units.

Sampling at Letnikof Dock occurred from May 5 to June 29, 2003, and contained morning/evening stratification and weekend/weekday stratification of evening strata during the peak of the season. Morning sampling strata lasted from 0800 hours until 2 h before midday, and evening sampling strata lasted from 2 h before midday until civil twilight. Thus, evening strata were 4 h longer in duration than morning strata. This stratification scheme was designed to increase the precision of estimates by maximizing sampling during hours when most anglers exit the fishery. Random selections determined primary units to sample in each stratum. Two morning and three evening strata were sampled each week, except as noted below.

During the peak of the fishery (May 5–June 8) the evening strata at Letnikof Dock were further divided into weekday and weekend stratification. During this time, two morning, two weekday evening, and two weekend/holiday evening periods were sampled each week. In total, 19 unique strata were sampled at Letnikof Dock in 2003.

Sampling at the Small Boat Harbor was initiated on May 5 and continued through June 29. Sampling at the Chilkat State Park boat launch was initiated on May 12, and ended on June 29. There was no type of day stratification at the low-use sites. Each biweekly period was divided into 14 morning and 14 evening periods of equal length at the Small Boat Harbor, except during the Haines King Salmon derby, when the biweek was divided into one 5-day (derby) with no time-of-day stratification and one 9-day (non-derby). Because of the short sampling schedule at Chilkat State Park boat launch, one 5-day (derby) with no time-of-day stratification and one 12-day period

were sampled. Random selections determined primary units to sample in each morning and evening stratum. To accommodate the impossibility of sampling three sites simultaneously with only two technicians, 11 changes (period moves) were made to the randomized sampling schedule at low-use sites. Eighteen (18) unique strata were sampled at the low-use harbors during 2003.

During each sample period, all sport fishing boats returning to the harbor were counted. Boat-parties returning to the dock were interviewed to determine: the number of rods fished; hours fished; type of trip (charter or non-charter); target species (Chinook salmon, Pacific halibut *Hippoglossus stenolepis*); and number of fish caught/kept by species. Interviewing boat-parties also included sampling all harvests of Chinook salmon for maturity and missing adipose fins. Maturity was also determined (Ericksen 1994, Appendix A) in order to estimate the harvest of wild mature fish assumed to be returning to the Chilkat River. In rare cases, some parties were not interviewed, or maturity status could not be determined. When one or more boat-parties could not be interviewed, total effort and catch for the stratum was estimated by expanding by the total number of parties returning to the dock during that period. Similarly, when a boat-party had fish of undetermined maturity status, interview information for that boat-party was ignored and expansions (by sample period) were made from harvests by remaining boat-parties and the total number of boat-parties counted.

The harvest in each stratum ($\hat{H}_h$) was estimated (Cochran 1977):

$$\hat{H}_h = D_h \overline{H}_h \tag{7}$$

$$\overline{H}_h = \frac{\sum_{i=1}^{d_h} \hat{H}_{hi}}{d_h} \tag{8}$$

$$\hat{H}_{hi} = M_{hi} \frac{\sum_{j=1}^{m_{hi}} h_{hij}}{m_{hi}} \tag{9}$$

where h_{hij} is the harvest on boat j in sampling days (periods) i stratum h, m_{hi} is the number of boat parties interviewed in day i, M_{hi} is the number of boat-parties counted in day i, d_h is the number of days (morning or evening periods) sampled in stratum h, and D_h is the number of days in stratum h. The variance of the harvest by stratum was estimated:

$$var\left[\hat{H}_h\right] = (1 - f_{1h}) D_h^{\,2} \frac{\sum_{i=1}^{d_h} (\hat{H}_{hi} - \overline{H}_h)^2}{d_h (d_h - 1)} + D_h \sum_{i=1}^{d_h} M_{hi}^{\,2} (1 - f_{2hi}) \frac{\sum_{j=1}^{m_{hi}} (h_{hij} - \overline{h}_{hi})^2}{d_h m_{hi} (m_{hi} - 1)} \tag{10}$$

where f_{1h} is the sampling fraction for periods and f_{2hi} is the sampling fraction for boat-parties. Catch and effort was estimated similarly, substituting C and E for H in equations (7) through (10). Total harvests for the season are the sums across strata ΣH_h and $\Sigma var[H_h]$. Similarly, effort and harvest by charterboat anglers were estimated by considering only data collected from chartered anglers in equations (7) through (10).

Chinook salmon sampled in the angler harvest were measured to the nearest 5 mm FL. Five scales were removed from the left side of each sampled fish (right side if left side scales were missing or regenerated as determined by visual inspection), along a line two scale rows above the lateral line between the posterior insertion of the dorsal fin and anterior insertion of the anal fin. A triacetate impression of the scales (30 s at 3,500 lb/in² at a temperature of 97°C) was later used to determine age (Olsen 1992). Information recorded for each Chinook salmon sampled included sex, length, maturity, and presence or absence of adipose fins.

For each harbor sampling site, age composition (p_a) was estimated for each stratum by substituting p_a, n_a and n, for p_{as} n_{as} and n_a in equations (3) and (4), where p_a is the proportion with estimated age a, n is the number successfully aged, and n_a is the subset of n having estimated age a. Because sampling was not proportional across strata, the estimate for the whole fishery was estimated as:

$$\hat{p}_a = \frac{\sum_h \hat{H}_h \hat{p}_{a,h}}{\sum_h \hat{H}_h} \tag{11}$$

where *h* denotes a (time, harbor, or time-harbor) stratum and the estimated harvests supply appropriate 'weights' for the different stratum sizes. Variance was estimated:

$$var[\hat{p}_a] \approx \sum_h \frac{\left(\hat{p}_{a,h}\left(\sum_i \hat{H}_i\right) - \left(\sum_i \hat{p}_{a,i}\hat{H}_i\right)\right)^2}{\left(\sum_i \hat{H}_i\right)^4} var[\hat{H}_h] + \sum_h \left(\frac{\hat{H}_h}{\sum_i \hat{H}_i}\right)^2 var[\hat{p}_{a,h}] \tag{12}$$

where $p_{a,h}$ is the proportion age *a* fish sampled in stratum *h,* and variance is approximated from a second order Taylor's series expansion around the expected values of the parameter estimates and substituting estimated values for the expected values (Mood et al. 1974 p. 181).

Contribution of Coded Wire Tagged Stocks

Technicians retained heads from Chinook salmon in the marine sport fishery with missing adipose fins, and a plastic strap with a unique number was inserted through the jaw of the head. Heads and CWT recovery data were sent to the ADF&G Mark, Tag and Age Laboratory in Juneau where heads were dissected for the presence of coded wire. Coded wire tags were subsequently decoded and all corresponding information was then entered into the ADF&G Mark, Tag, and Age Laboratory database.

The contribution of all tagged stocks to the 2003 Haines marine boat sport fishery was estimated:

$$\hat{r}_{ij} = \hat{H}_i \left(\frac{m_{ij}}{\lambda_i n_i}\right) \hat{\theta}_j^{-1} \tag{13}$$

where $\hat{H}_i$ is the estimated harvest in stratum *i*, $\hat{\theta}_j$ is the fraction of stock *j* marked with CWTs, n_i is the subset of $\hat{H}_i$ examined for missing adipose fins, m_{ij} is the number of decoded CWTs recovered from stock *j*, and $\lambda_i = (a_i' t_i')/(a_i t_i)$ is the decoding rate for CWTs from recovered salmon. See Bernard and Clark (1996) for further details. Statistics were stratified by bi-week.

Variance of $\hat{r}_{ij}$ was estimated by means of the appropriate large-sample formulations in Bernard and Clark (1996, their Table 2) for wild or hatchery stocks harvested in the recreational fishery. The total contribution of one or more cohorts to one or more fisheries is the sum of harvests and variances from the individual cohorts and strata.

Fall Fry Tagging

Juvenile Chinook salmon (fry) were captured in primary rearing areas of the Chilkat River drainage during fall and marked with an adipose finclip and a CWT in 2003 (brood year 2002). Adult fish will be sampled from the escapement between 2005 and 2009 to estimate the marked fraction for each brood year. This information will allow us to estimate the fall rearing abundance in 2003. In addition, random recoveries of CWTs in sampled marine fisheries will allow us to estimate total marine harvest of this stock.

Chinook salmon fry were captured in G-40 minnow traps at three locations in the Chilkat River drainage during fall 2003. Trapping began in upriver locations and moved downstream as the season progressed. The Tahini River was trapped from mid to late September, the Kelsall River was trapped during the first two weeks of October, and the lower Chilkat River near highway mile 19 (the Council Grounds) during the last week of October.

A crew consisting of four people fished approximately 85 traps per day. Traps were baited with disinfected salmon roe and checked at least once per day. Crew members immediately released non-target species at the trapping site. Remaining fish were transported to holding boxes for processing at a central tagging location.

Following the methods in Koerner (1977), all healthy Chinook ≥50 mm FL were injected with a CWT and externally marked by excision of the adipose fin. Prior to marking, fish were first tranquilized in a solution of Tricaine methanesulfonate (MS 222) buffered with sodium bicarbonate. Every 110th fish tagged with a CWT was additionally measured to the nearest mm FL.

All marked fish were held overnight to check for 24-hour tag retention and handling-induced mortality. The following morning 100 fish in the previous day's catch were randomly selected and checked for the retention of CWTs and mortality. If tag retention was 98/100 or greater, mortalities were counted and all live fish from that batch were released. If tag retention was less than 98/100, the entire batch was checked for tag retention and those that tested negative were retagged. The number of fish tagged, number of tagging-related mortalities, and number of fish that had shed their tags were compiled and submitted to the ADF&G Mark, Tag, and Age Lab in Juneau at the completion of the field season.

In addition, any Chinook salmon smolt incidentally caught during the Chilkat River coho salmon spring CWT project were CWT'd to boost tagging numbers. The methods and tagging results from spring are reported in Ericksen and Chapell (*In prep*).

In an effort to gather information on the potential relationship between water temperature and smolt production, a battery operated HOBO® temperature data logger was installed in the Kelsall River on August 7, 2002. The data logger continuously recorded water temperature every two hours throughout the year (Appendix B). The data logger was replaced and the data downloaded each spring. Information from this long term study will be used to determine if there is a correlation between smolt production and water temperatures.

RESULTS

ESCAPEMENT

We captured 342 large, 85 medium, and 84 small Chinook salmon in the lower Chilkat River with drift gillnets and fish wheels between June 10 and August 10, 2003 (Table 1, Figure 3). Of those captured, 332 large, 71 medium, and 75 small Chinook salmon were given a uniquely numbered external tag and an upper left operculum punch. Five large and two medium Chinook salmon captured in the fish wheels escaped prior to being marked. Two large, one medium, and one small Chinook salmon were lethargic and released without marking. Three large, 11 medium, and 8 small fish were missing adipose fins and were sacrificed to recover coded wire tags. Capture rates of large Chinook salmon peaked on July 2. The mean date of migratory timing (weighted mean, Mundy 1984) in the lower river was July 3 (Figure 4).

Fish captured in gillnets were predominantly age-1.4 (61.7%) and classified as female (62.7%, Table 2). Those captured in the fish wheels were classified mostly as males (72.9%) and most commonly age-1.1 (31.6%) (Table 2). Most (171) of the fish in the drift gillnet were captured in the large mesh (8-in) panel. However, most (14) medium fish in the drift gillnet were caught in the small mesh (6.75-in) panel. Large fish caught in the fishwheels were significantly smaller than those caught in the drift gillnet (K-S test, $d_{max} = 0.171$, $P = 0.021$).

We examined 878 large, 154 medium, and 46 small Chinook salmon on the spawning grounds for marks: 50 large, 10 medium, and 4 small Chinook salmon possessed marks from the tagging event (Table 3). Two (2) large Chinook salmon (both marked at the gillnet) were recovered missing the primary spaghetti tag but were identified as having been marked earlier in the tagging event by the presence of the operculum punch. Large fish sampled from the

Table 1.–Numbers of Chinook salmon caught in the lower Chilkat River by time period, gear type and size, June 10–August 13, 2003.

Time	Drift gillnet			Fish wheels			Combined			
period	Large	Medium	Small	Large	Medium	Small	Large	Medium	Small	**Total**
6/10-6/14	5	0	0	0	0	0	5	0	0	5
6/15-6/19	9	0	0	4	2	2	13	2	2	17
6/20-6/24	13	4	0	12	5	11	25	9	11	45
6/25-6/29	34	4	0	21	10	19	55	14	19	88
6/30-7/04	53	5	1	50	12	25	103	17	26	146
7/05-7/09	31	1	0	20	17	11	51	18	11	80
7/10-7/14	38	6	0	9	3	7	47	9	7	63
7/15-7/19	14	3	0	14	8	6	28	11	6	45
7/20-7/24	12	3	0	2	1	1	14	4	1	19
7/25-7/29				0	0	1	0	0	1	1
7/30-8/03				0	0	0	0	0	0	0
8/04-8/08				0	0	0	0	0	0	0
8/09-8/13				1	1	0	1	1	0	2
	209	26	1	133	59	83	342	85	84	511

Table 2.–Age composition and mean length-at-age (MEF) of Chinook salmon sampled during tagging operations on the Chilkat River by gear type, 2003.

		Brood year and age class						
		2000 1.1	1999 1.2	1998 1.3	1997 1.4	1996 1.5	**Total fish with valid age**	**Total sampled**[a]
		DRIFT GILLNET						
Males	Sample size	1	21	25	47	0	94	114
	Percent	1.1	22.3	26.6	50.0			59.1
	SD	1.1	4.3	4.6	5.2			3.5
	Mean length	390	607	782	940			
	SD		12.4	14.1	11.5			
Females	Sample size	0	1	25	72	1	99	121
	Percent		1.0	25.3	72.7			62.7
	SD		1.0	4.4	4.5			3.5
	Mean length		610	810	902			
	SD			7.9	5.6			
All fish	Sample size	1	22	50	119	1	193	235
	Percent	0.5	11.4	25.9	61.7			
	SD	0.5	2.3	3.2	3.5			
	Mean length	390	607	796	917			
	SD		11.9	8.2	5.9			
		FISH WHEELS						
Males	Sample size	78	38	25	24	0	165	180
	Percent	47.3	23.0	15.2	14.5			72.9
	SD	3.9	3.3	2.8	2.7			2.8
	Mean length	381	561	761	929			
	SD	5.1	8.4	17.1	15.0			
Females	Sample size	0	14	24	43	1	82	89
	Percent		17.1	29.3	52.4			36.0
	SD		4.2	5.0	5.5			3.1
	Mean length		591	792	881			
	SD		14.8	8.2	9.1			
All fish	Sample size	78	52	49	67	1	247	269
	Percent	31.6	21.1	19.8	27.1			
	SD	3.0	2.6	2.5	2.8			
	Mean length	381	569	776	898			
	SD	5.1	7.4	9.8	8.4			

[a] Includes fish that were not assigned an age.

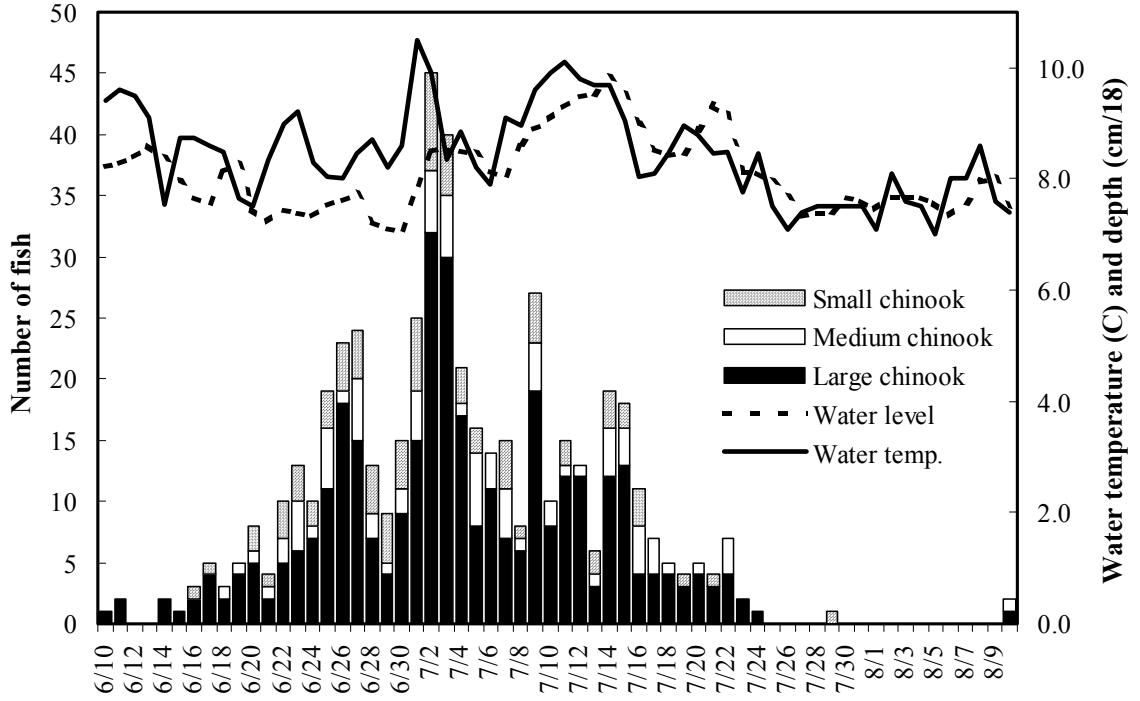


Figure 3.–Daily water depth (cm/18), temperature (°C), and catches of small (age-1.1), medium (age-1.2), and large (≥ age-1.3) Chinook salmon in drift gillnets and fish wheels operating in the lower Chilkat River, June 10–August 10, 2003.

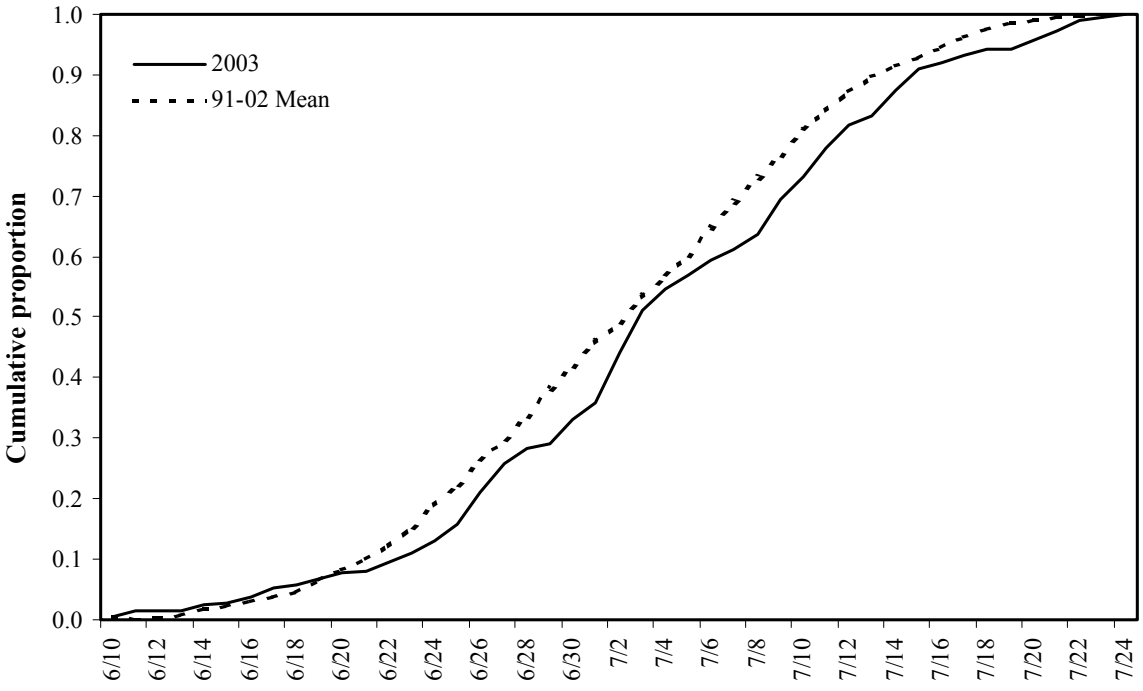


Figure 4.–Cumulative proportion of large **(≥ age-1.3)** Chinook salmon captured with drift gillnets in the lower Chilkat River in 2003 compared to the mean cumulative proportion, 1991–2002.

Table 3.–Number of Chinook salmon inspected for marks and number of marked fish recaptured during tag recovery surveys in the Chilkat River drainage by location, size and sex in 2003.

		Inspected[a]										Marked[a]								
		Large				Medium				Small		Large				Medium			Small	
	Dates	M	F	U	Total	M	F	U	Total	M	Total	M	F	U	Total	F	M	Total	M	Total
Kelsall	8/04-9/02	134	127	3	264	76	1	0	77	17	17	3	10	1	14	1	2	2	2	2
Tahini	8/06-9/02	175	318	25	518	56	1	2	59	19	19	13	20	0	33	0	5	5	0	0
Big Boulder	8/08-8/25	43	45	1	89	17	0	0	17	10	10	1	2	0	3	0	2	2	2	2
37 Mile Creek	8/25	1	6	0	7	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Total		353	496	29	878	150	2	2	154	46	46	17	32	1	50	1	9	10	4	4

[a] M = male, F = female, U = not sexed.

Kelsall River were significantly smaller than those sampled from the Tahini River (K-S test, d_{max} = 0.262, P < 0.001). Recapture rates of large fish marked in June were not significantly different from those marked in July (χ^2 = 1.139, df = 1, P = 0.286).

Similar fractions of large (χ^2 = 1.697, df = 2, P = 0.428) and small/medium (χ^2 = 2.733, df = 2, P = 0.255) Chinook salmon sampled at each spawning tributary were marked. Thus, Petersen models were used to estimate abundance for each size group. The empirical cumulative distribution function (CDF) of lengths of large Chinook salmon marked in the lower Chilkat River was not significantly different from the CDF of marked Chinook salmon recaptured on the spawning grounds (K-S test, d_{max} = 0.079, P = 0.953, Figure 5, top). The CDF of lengths of large fish sampled in the lower river was significantly different from the CDF of those examined for marks on the spawning grounds (K-S test, d_{max} = 0.108, P = 0.007, Figure 5, bottom). These results suggest that the first sampling event was size-selective but the second was not. However, because of significant differences in size distributions between fish caught in gillnet and fish wheels, and also between the two major spawning tributaries (as noted above), the estimate of large fish was stratified by two age classes. This was done to facilitate an unbiased estimate for each age class. Thus, an estimated 7,626 (SE = 823) Chinook salmon of all ages immigrated into the Chilkat River in 2003 (Table 4). Of those, 1,969 (SE = 449) were age-1.1 and -1.2; 1,833 (SE = 362) were age-1.3; and, 3,824 (SE = 588) were age-1.4 and older. The stratified estimate of 7,626 (SE = 823) was not significantly different from the pooled estimate of 7,950 (SE = 882). These estimates are germane to the time of tagging in the lower river since an unknown

Table 4.–Abundance estimates and sampling statistics of Chilkat River Chinook salmon by age stratum in 2003.

	Marked	Examined	Recaptures	Abundance	
Stratum	n_1	n_2	m_2	$\hat{N}_a$	$SE(\hat{N}_a)$
age-1.1+-1.2	146	200	14	1,969	449
age-1.3	110	313	18	1,833	362
age-1.4+-1.5	222	565	32	3,824	588
Combined	478	1,078	64	7,626	823

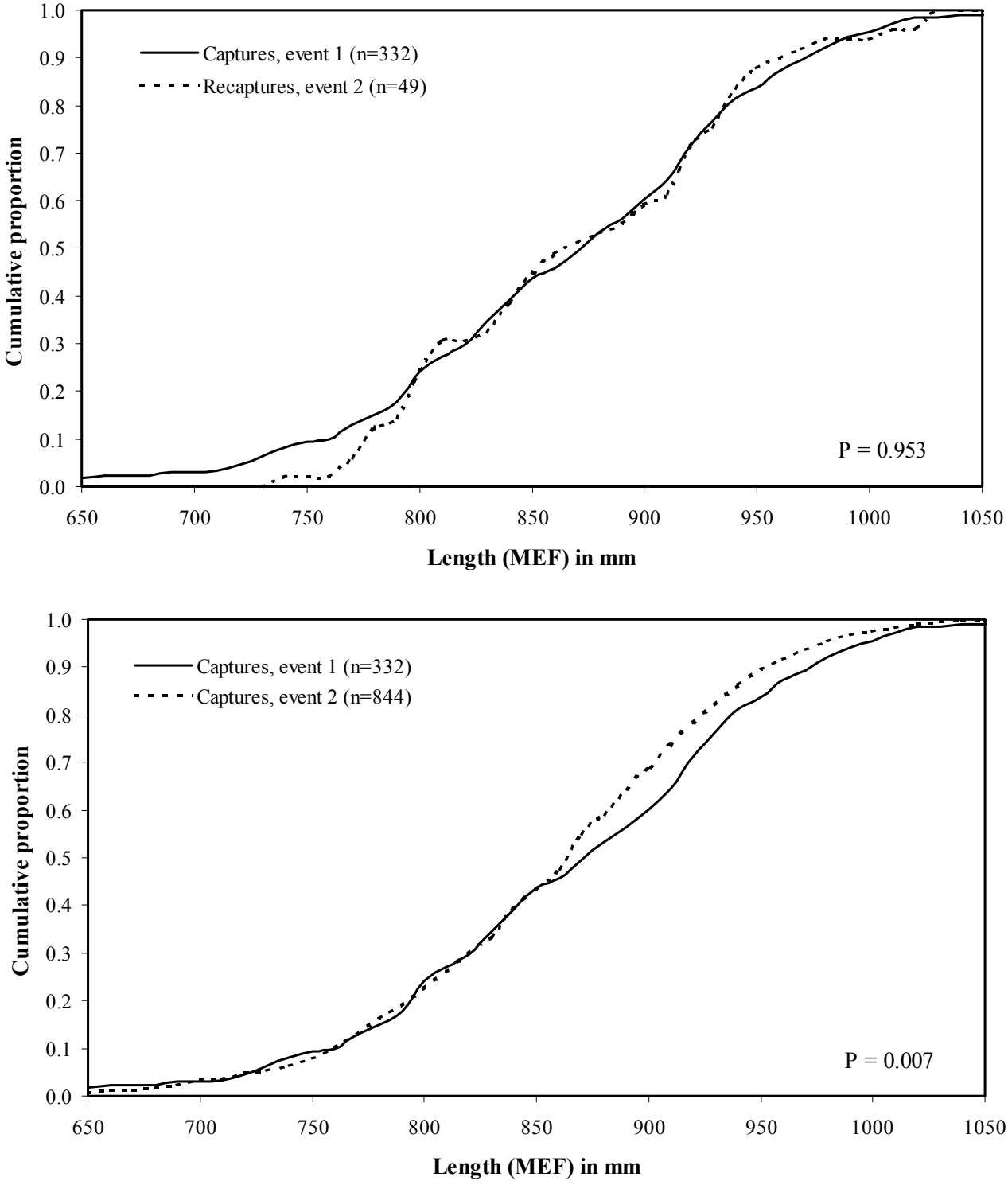


Figure 5.–Empirical cumulative distribution function (CDF) of MEF lengths of large (≥age-1.3) Chinook salmon marked in the lower Chilkat River versus lengths of marked fish recaptured on the spawning grounds (top) and versus lengths of large fish examined for marks on the spawning.

number of tags are removed due to predation and unreported subsistence fishery harvest in the time between tagging and recovery events.

Age and Sex Composition of the Escapement

We sampled 1,047 Chinook salmon on the spawning grounds for age and sex. Of those sampled, 935 were successfully aged (Table 5). The proportion of large fish that were age-1.4 and older in the estimated escapement was not significantly different from the proportion sampled from the lower river (χ^2 = 0545, df = 1, P = 0.460), but significantly different from the spawning grounds (χ^2 = 6.745, df = 1, P = 0.009). Therefore, only the lower river samples were used to estimate the age composition of age-1.4 and older fish. In contrast, the proportion of age-1.1 and -1.2 fish in the estimated escapement was significantly different from both the lower river (χ^2 = 17.200, df = 1, P < 0.001) and spawning ground samples (χ^2 = 18.489, df = 1, P < .001) but not the combined samples (χ^2 = 1.430, df = 1, P = 0.232). Consequently, the lower river and spawning ground samples were pooled to estimate the age composition of age-1.1 and age-1.2 fish.

Sex was estimated with uncertainty early in the season as suggested by 9 of the 59 recaptures that were sexed incorrectly during the marking event, as judged by sex determination on the spawning ground (where sexual dimorphism is more evident). Seven of the nine were sexed as female when tagged, and as males on the spawning grounds during 2003. Therefore, only the spawning ground samples were used to estimate sex composition (by age) in the escapement.

The majority (50%) of the estimated escapement of Chinook salmon in 2003 was age-1.4 fish (1997 brood year, Table 6). The remainder of the escapement was composed of 9% age-1.1, 16% age-1.2, 24% age-1.3, and 1% age-1.5 fish. Most (56%) of the fish were males (Table 6).

TERMINAL HARVEST

2003 Haines Marine Sport Fishery Harvest

An estimated total 10,651 (SE = 648) angler-h of effort were expended in the Haines marine boat fishery between May 5 and June 29, 2003 to catch 405 (SE = 40) and harvest 404 (SE = 40) large Chinook salmon (Table 7). This estimate is based on a sample of 421 boat-parties who fished 3,853 angler-h (3,705 salmon-h), and harvested 191 large (≥28 inches TL) Chinook salmon (Table 7). An estimated 285 (SE = 27) of the Chinook salmon harvested in this fishery were wild mature fish assumed to be returning to the Chilkat River. About 94% (10,055 salmon-h, SE = 578) of angler effort targeted Chinook salmon, and the remainder was directed toward other species, primarily Pacific halibut. Anglers caught an estimated 986 (SE = 217) small (<28 inches TL) Chinook salmon, of which 120 (SE = 65) were kept. Eighty-five percent (85%) of the estimated salmon effort and 93% of the estimated harvest of Chinook salmon occurred between May 19 and June 15 (Table 7).

Angling pressure for Chinook salmon was relatively light during the first and last week, so our coverage of the fishery for mature Chinook salmon was essentially complete.

Estimates by site are presented in Appendices B1 through B3. Charterboat anglers accounted for about 5% of the salmon effort (461 salmon-h, SE = 192), and 6% of the harvest (26, SE = 14) of large Chinook salmon in this fishery.

Anglers returning to Letnikof Dock (the high-use site) were responsible for 76% of the estimated salmon effort (7,648 salmon-h, SE = 508) and 75% of the estimated harvest (301, SE = 32) of large Chinook salmon (Appendix C1). Anglers returning to the Chilkat State Park boat launch accounted for an estimated 598 (SE = 127) salmon-h of effort and harvested 7 (SE = 6) large Chinook salmon (Appendix C2). Those returning to the Small Boat Harbor expended 1,809 (SE = 246) salmon-h and harvested 96 (SE = 23) large Chinook salmon (Appendix C3).

Age and Length of Harvest

We sampled a total of 186 Chinook salmon for age, sex, and length in the angler harvest; 176 were assigned an age. The age composition of fish landed at the Small Boat Harbor was significantly different from that of fish landed at the Chilkat Inlet harbors (χ^2 = 36.855, df = 1, P < 0.001). Thus, these samples were analyzed separately.

Table 5.–Age composition and mean length-at-age (MEF) of Chinook salmon sampled during recovery surveys on the Chilkat River drainage by spawning tributary in 2003.

		Brood year and age class					
		2000 1.1	1999 1.2	1998 1.3	1997 1.4	**Total fish with valid age**	**Total sampled[a]**
TAHINI RIVER							
Males	Sample size	16	49	49	104	218	250
	Percent	7.3	22.5	22.5	47.7		43.9
	SD	1.8	2.8	2.8	3.4		2.1
	Mean length	397	602	794	939		
	SD	11.4	8.4	10.8	6.3		
Females	Sample size	0	1	61	218	280	319
	Percent		0.4	21.8	77.9		56.1
	SD		0.4	2.5	2.5		2.1
	Mean length		570	801	888		
	SD			6.9	2.8		
All fish	Sample size	16	50	110	323	499	569
	Percent	3.2	10.0	22.0	64.7		
	SD	0.8	1.3	1.9	2.1		
	Mean length	397	601	798	905		
	SD	11.4	8.3	6.1	3.1		
KLEHINI TRIBUTARIES							
Males	Sample size	9	16	24	18	67	72
	Percent	13.4	23.9	35.8	26.9		58.5
	SD	4.2	5.2	5.9	5.4		4.4
	Mean length	409	581	759	896		
	SD	14.6	10.9	10.9	18.5		
Females	Sample size	0	0	13	35	48	51
	Percent		0.0	27.1	72.9		41.5
	SD		0.0	6.4	6.4		4.4
	Mean length		0	773	869		
	SD			12.8	7.0		
All fish	Sample size	9	16	37	53	115	123
	Percent	7.8	13.9	32.2	46.1		
	SD	2.5	3.2	4.4	4.6		
	Mean length	409	581	764	878		
	SD	14.6	10.9	8.3	7.9		
KELSALL RIVER/NATAGA CREEK							
Males	Sample size	15	74	78	46	213	227
	Percent	7.0	34.7	36.6	21.6		63.9
	SD	1.8	3.3	3.3	2.8		2.5
	Mean length	405	570	792	917		
	SD	12.1	6.4	8.3	10.4		
Females	Sample size	0	1	54	52	107	128
	Percent		0.9	50.5	48.6		36.1
	SD		0.9	4.8	4.8		2.5
	Mean length		620	807	866		
	SD			6.0	6.2		
All fish	Sample size	15	75	133	98	321	355
	Percent	4.7	23.4	41.4	30.5		
	SD	1.2	2.4	2.7	2.6		
	Mean length	405	570	798	890		
	SD	12.1	6.4	5.5	6.4		

[a] Includes fish that were not assigned a valid age. Not all fish examined for marks were sampled for scales (e.g., carcass decayed, part of body missing, etc.)

Table 6.–Estimated abundance of Chinook salmon in the Chilkat River escapement by age and sex in 2003.

	Brood year and age class					
	2000	1999	1998	1997	1996	
	1.1	1.2	1.3	1.4	1.5	**Total**
Male	702	1,249	992	1,344		4,287
SE	168	289	203	223		450
Female		18	841	2,439	41	3,339
SE		13	175	384	29	423
All fish	702	1,267	1,833	3,783	41	7,626
SE	168	293	362	582	29	823

Table 7.–Biweekly sampling statistics and estimated effort, catch, and harvest of Chinook salmon in the Haines marine boat sport fishery, May 5–June 29, 2003.

		May 19 - June 01				
	May 05–	**Non-**		**June 02–**	**June 16–**	
	May 18	**derby**	**Derby**	**June 15**	**June 29**	**Total**
Boats counted	67	87	99	122	46	421
Angler-h sampled	417	777	1,297	1,062	300	3,853
Salmon-h sampled	412	737	1,297	1,048	211	3,705
Chinook sampled	9	31	83	58	10	191
Sampled for ad-clips	9	31	82	57	10	189
Ad-clips	0	3	4	4	2	13
Angler-hours						
Estimate	779	2,445	3,618	2,681	1,128	10,651
Variance	16,519	174,798	86,521	69,573	71,948	419,359
Salmon-hours						
Estimate	767	2,272	3,618	2,648	750	10,055
Variance	16,163	135,036	86,521	70,215	26,284	334,219
Wild mature Chinook kept (excluding hatchery and immature fish)						
Estimate	4	68	98	110	5	285
Variance	0	136	144	460	12	752
Large Chinook catch						
Estimate	15	96	152	130	12	405
Variance	42	375	368	783	54	1,622
Large Chinook kept						
Estimate	15	96	152	129	12	404
Variance	42	375	368	783	54	1,622
Small Chinook catch						
Estimate	7	96	155	650	78	986
Variance	9	1,446	3,155	40,255	2,266	47,131
Small Chinook kept						
Estimate	0	0	0	71	49	120
Variance				2,184	2,058	4,242

We sampled 146 Chinook salmon for age and length at the Chilkat Inlet harbors (Letnikof Dock and Chilkat State Park boat launch), and 124 of these were assigned an age (Table 8). Most (61.6%, SE = 4.0%) of the fish harvested were female. The predominant age class was age-1.4 (48.5%, SE = 4.6%).

We sampled 40 Chinook salmon for age and length at the Small Boat Harbor and 34 of these were assigned an age. Most (52.5%, SE = 8.0%) of the fish harvested were female. The predominant age class was age-1.2 (61.4%, SE = 12.4%).

Thirty-seven (37) chinook salmon from the Chilkat Inlet subsistence fishery were also sampled for age and length between June 14 and July 13, 2003. Subsistence fishers reported harvesting 46 Chinook salmon in this fishery in 2003. These fish were predominately age-1.2 (Appendix C4).

Contribution of Coded Wire Tagged Stocks

Chinook salmon incubated and reared at the Douglas Island Pink and Chum, Inc. (DIPAC) Macaulay hatchery facility that were released into Pullen Creek (1998 and 1999 broods), Fish Creek (1998 brood), and Auke Bay (1997 brood) were recovered in the 2003 Haines marine creel survey (Table 9). In addition, wild Chilkat River Chinook salmon

Table 8.–Estimated age composition and mean length-at-age (snout to fork of tail in mm) of harvested Chinook salmon in the Haines marine boat sport fishery by harbor location, May 5–June 29, 2003**.**

		Brood year and age class						
		2000	2000	1999	1998	1997	**Total fish**	**Total**
		0.2	1.1	1.2	1.3	1.4	**with valid age**	**sampled**[a]
CHILKAT INLET HARBORS								
Males	Sample size	0	0	5	21	21	47	56
	Mean length			741	872	1,064		45.2%
	SE			40.8	20.7	17.4		4.5%
Females	Sample size	0	0	4	25	27	56	68
	Mean length			736	829	1,001		54.8%
	SE			24.7	15.0	10.1		4.5%
Combined	Sample size	0	0	10	55	59	124	146
	Percent			8.0	43.5	48.5		
	SE			2.5	4.6	4.6		
	Mean length			740	841	1,025		
	SE			20.0	11.6	9.8		
SMALL BOAT HARBOR								
Males	Sample size	0	1	10	5	1	17	19
	Mean length	0	565	632	841	790		47.5%
	SE			20.6	28.6			8.0%
Females	Sample size	1	0	6	8	2	17	21
	Mean length	600	0	618	830	928		52.5%
	SE			18.2	20.9	10.6		8.0%
Combined	Sample size	1	1	16	13	3	34	40
	Percent	5.5	1.7	61.4	26.2	5.2		
	SE	5.7	2.2	12.4	10.4	3.8		
	Mean length	600	565	627	834	882		
	SE			13.9	15.6	56.4		

[a] Includes fish that were not assigned a valid age. Not all fish were sampled for sex data.

(1997 and 1999 broods) with CWTs were recovered in this fishery. Fish landed at the Small Boat Harbor were more likely to be from hatchery releases in Taiya Inlet, so these samples were analyzed separately. Six (6) of the 148 large and the one small (illegal) Chinook salmon sampled at the Chilkat Inlet harbors (Letnikof Dock and Chilkat State Park boat launch) were missing their adipose fins. Eighty-seven (87; SE = 48) of the estimated 148 large Chinook salmon harvested landed at the Chilkat Inlet harbors were of hatchery origin (Table 9). Two (2) of the 23 large and the 4 of the 17 small (harvested in the Taiya Inlet terminal hatchery area) Chinook salmon sampled at the Small Boat Harbor were missing their adipose fins. Eighteen (18; SE = 14) of estimated 96 large Chinook salmon harvested and 23 (SE = 16) of the 119 small landed at the Small Boat Harbor were of hatchery origin.

Fall Fry Tagging

We captured 36,668 Chinook salmon fry during fall 2003 (Table 10). Catch rates were lowest in the Tahini River and highest in the Chilkat River. Of those captured, 36,640 in 2003 were released with a valid CWT and adipose finclip (Table 11). In addition, we released 5,707 smolt during spring 2004 with valid CWTs and an adipose finclip (Table 11).

We sampled 332 Chinook salmon fry for length during fall 2003 (Table 12). The mean length of fry was 69 mm (SE = 0.4 mm). In addition, 300 smolt were sampled for length during the spring of 2004 (Table 12). Smolt averaged 70 mm fork length (SE = 0.4 mm).

DATA FILES

Data collected during this study (Appendix D) have been archived in ADF&G offices in Haines, Douglas, and Anchorage.

DISCUSSION

Several assumptions, as noted above, underlie the estimate of abundance. Considerable efforts were made to catch and mark fish in proportion to their abundance (assumption a) by sampling uniformly across the escapement. Also, sampling effort for tag recovery on the Kelsall and Tahini rivers (where >90% of spawning occurred in 1991 and 1992; (Johnson et al. 1992, 1993) was fairly constant across the time when spawning fish die and are available for sampling. Previous research on the Chilkat River (Johnson et al. 1992, 1993) suggests that immigration timing is similar for Tahini and Kelsall River stocks. Tagging ratios of large Chinook salmon found on the Tahini (0.064) and Kelsall-Nataga (0.053) rivers in 2003 were very similar. Although carcass surveys can be sex-selective in some situations (Miyakoshi et al. 2003, Pahlke et al. 1996, McPherson et al. 1997, Zhou 2002), this could not be detected using a battery of tests. The assumption of no recruitment during the experiment is reasonable, because tagging effort was relatively constant and continued until only about one fish per day was being caught. The assumption that marking does not affect catchability of fish could not be tested directly. However, recovery rates were not significantly different between large fish marked in the gillnet and those marked in the fish wheels, (χ^2 = 0.095, df = 1, P = 0.758). This suggests fish marked at the fish wheels and gillnets had similar fates. Because all fish had secondary marks that were not lost, assumption (d) was satisfied. Personnel sampling the spawning tributaries carefully examined each fish for marks; therefore failure of assumption (e) is unlikely.

The hypothesis that fish sampled on the different spawning grounds were marked at the same rate was not rejected. This is consistent with the results of a meta-analysis of past data (Ericksen 2001b).

The significant differences in age composition between spawning tributaries probably result from flooding that occurred in the Chilkat River drainage during fall 1998. This flooding caused some major channel shifts in the Kelsall River, and likely led to high mortality of eggs (1998 brood year) and juveniles (1997 brood year) rearing in the Kelsall drainage at the time. The number of Chinook salmon spawning in the Kelsall River drainage in 2002 (Ericksen 2003a) and 2003 was noticeably lower than in past years.

Table 9.–Contribution estimate (*r*) of coded-wire-tagged Chinook salmon to the Haines marine boat sport fishery, May 5-June 29, 2003, along with statistics used for computing estimates.

Agency	Release site	Tag code	Brood year	Harvest		Sample	Ad-clip	Head	Detected	Decoded	Tags	Contribution	
				N	SE[*N*]	***n***	***a***	***a′***	***t***	***t′***	***M***	***r***	SE
CHILKAT INLET RECOVERIES													
Large Fish													
ADFG	Chilkat River wild	04-01-25	1997	309	33	148	6	6	5	5	1	3	2
DIPAC	Auke Bay	50-04-55	1997	309	33	148	6	6	5	5	1	24	23
DIPAC	Fish Creek	04-01-62	1998	309	33	148	6	6	5	5	1	20	20
DIPAC	Pullen Creek	04-01-61	1998	309	33	148	6	6	5	5	1	8	8
NSRAA	Hidden Falls	04-46-63	1998	309	33	148	6	6	5	5	1	35	35
Subtotal												**90**	**48**
Small Fish													
ADFG	Chilkat River wild	04-44-38	1999	1	1	1	1	1	1	1	1	1	1
Subtotal												**1**	**1**
SMALL BOAT HARBOR RECOVERIES													
Large Fish													
DIPAC	Pullen Creek	04-02-46	1998	96	23	23	2	2	2	2	1	14	13
DIPAC	Pullen Creek	04-03-93	1999	96	23	23	2	2	2	2	1	4	4
Subtotal												**18**	**14**
Small Fish													
ADFG	Chilkat River wild	04-03-64	1999	119	65	17	4	4	4	4	1	7	7
DIPAC	Pullen Creek	04-03-93	1999	119	65	17	4	4	4	4	3	23	16
Subtotal												**30**	**20**
Grand total large												**108**	**50**
Grand total small												**31**	**20**

Note: *Contribution estimates for wild Chilkat River fish are preliminary as marked fractions will not be estimated until returns from all brood years are complete.*

Table 10.–Results of Chinook salmon fall fry trapping in the Chilkat River drainage in 2003.

Trapping area	Dates	Days fished	Trap sets	Fry caught	CPUE[a]
Tahini River	09/18-09/25	8	705	4,939	7.0
Kelsall River	10/03-10/16	14	1,150	17,039	14.8
Chilkat River	10/24-10/30	7	683	14,662	21.5
Total		29	2,538	36,640	14.4

[a] Catch per unit of effort expressed as the number of fry caught per trap set.

Table 11.–Number of 2002 brood year Chinook salmon coded wire tagged in the Chilkat River drainage by area and tag year.

Tag year	Tag code	Sequence	Location	Last date	Stage	Tagged	24h morts	Marked	Shed tags	Valid CWTs
2003	040771	239-8,820	Tahini River	09/25/03	Fingerling	4,940	1	4,939	0	4,939
2003	040771	9,070-39,863	Kelsall River	10/16/03	Fingerling	17,044	5	17,039	0	17,039
2003	040771	40,074-57,936	Chilkat River	10/29/03	Fingerling	10,683	15	10,668	0	10,668
2003	040812	NA	Chilkat River	10/31/03	Fingerling	4,001	7	3,994	0	3,994
		Fall subtotal				36,668	28	36,640	0	36,640
2004	040964	NA	Chilkat River	05/28/04	Smolt	5,711	4	5,707	0	5,707
2002 brood year total						42,379	32	42,347	0	42,347

Table 12.–Mean length of 2002 brood year Chinook salmon in the Chilkat River drainage by trapping location, and year.

Sample year	Trapping location	Sample dates	Length (snout to fork of tail in mm)			
			n	Range	Mean	SE
2003	Tahini River	09/20-09/26	54	64-91	76	0.8
2003	Kelsall River	10/03-10/16	179	57-89	69	0.4
2003	Chilkat River	10/24-10/27	99	53-84	66	0.6
	Fall subtotal		332	53-91	69	0.4
2004	Chilkat River	04/10-05/28	300	54-89	70	0.4

The 2003 immigration of large Chinook salmon 5,657 (SE = 690) was above the 1991–2002 average (Table 13) and was comprised mainly of age-1.4 fish from the 1997 brood year (Table 13).

The immigration timing of Chinook salmon through the lower Chilkat River was nearly identical to the average observed in past years. The mean date of migratory timing (Mundy 1984) was July 3, the same as the mean date for 1991–2002 (Figure 4).

Sport fishing harvest patterns observed during 2003 were similar to historical patterns. During 2003, 75% of the estimated harvest of Chinook salmon was landed at the Letnikof Dock. The proportion of harvest from this harbor averaged 85% in 1988 and 1989 (Suchanek and Bingham 1991). In contrast, 60% on average of the total harvest over the past five years was landed at this harbor. The 2003 estimated harvest of large Chinook salmon was greater than the average since 1993 but much lower than observed during the mid 1980s (Figure 6, Table 14). Also, sport fishing effort increased from recent years but remained lower than past years.

Trapping Chinook salmon fry in the fall increased the number of CWT'd fish released for a given brood year relative to tagging smolt in the spring. The benefits of tagging in the fall are somewhat offset by overwinter mortality of the fry. The cost effectiveness of fall trapping will be better assessed once adequate adult fish are sampled to estimate overwinter survival.

Table 13.–Estimated annual age compositions and brood year returns of large **(≥ age-1.3)** Chinook salmon immigrating into the Chilkat River, 1991–2003.

Return year		Age class 1.3	1.4	1.5	Total
1991[a]	Abundance	3,211	2,563	123	5,897
	SE	558	445	18	1,005
1992[b]	Abundance	1,689	3,595	-	5,284
	SE	309	662	-	949
1993[c]	Abundance	2,217	2,180	75	4,472
	SE	432	425	10	851
1994[d]	Abundance	2,565	4,148	82	6,795
	SE	415	656	11	1,057
1995[e]	Abundance	530	3,074	186	3,790
	SE	111	660	37	805
1996[f]	Abundance	4,140	737	43	4,920
	SE	641	112	4	751
1997[g]	Abundance	1,943	6,157	-	8,100
	SE	354	930	-	1,193
1998[h]	Abundance	1,016	2,440	219	3,675
	SE	169	381	48	565
1999[i]	Abundance	534	1,656	80	2,271
	SE	109	302	27	408
2000[j]	Abundance	1,350	653	32	2,035
	SE	227	118	14	334
2001[k]	Abundance	2,529	1,988	-	4,517
	SE	376	617	-	722
2002[l]	Abundance	2,353	1,667	31	4,051
	SE	312	294	19	429
2003	Abundance	1,833	3,783	41	5,657
	SE	362	582	29	690
Average	Percent	42.2	56.4	1.5	
	Abundance	1,993	2,665	70	4,728

BROOD YEAR RETURNS					
Brood year	Age class 1.3	1.4	1.5	Total	SE
1986	3,211	3,595	75	6,881	866
1987	1,689	2,180	82	3,951	526
1988	2,217	4,148	186	6,551	787
1989	2,565	3,074	43	5,683	780
1990	530	737	-	1,267	158
1991	4,140	6,157	219	10,516	1,131
1992	1,943	2,440	80	4,463	521
1993	1,016	1,656	32	2,705	347
1994	534	653	-	1,188	160
1995	1,350	1,988	31	3,369	658
1996	2,529	1,667	41	4,236	477
1997	2,353	3,783		6,136	661
1998	1,833			1,833	362
Ave.	1,993	2,673	72	4,738	

[a] Data taken from Johnson et al. (1992).
[b] Data taken from Johnson et al.(1993).
[c] Data taken from Johnson (1994).
[d] Data taken from Ericksen (1995).
[e] Data taken from Ericksen (1996).
[f] Data taken from Ericksen (1997).
[g] Data taken from Ericksen (1998).
[h] Data taken from Ericksen (1999).
[i] Data taken from Ericksen (2000).
[j] Data taken from Ericksen (2001b).
[k] Data taken from Ericksen (2002a).
[l] Data taken from Ericksen (2003a).

Table 14.–Estimated angler effort, and large (≥ 28 in.) Chinook salmon catch and harvest in the Haines marine boat sport fishery for similar sample periods, 1984–2003.

		Effort				Large (≥ 28") Chinook salmon				
Year	**Survey dates**	Angler-h	SE	Salmon-h	SE	Catch	SE	Harvest	SE	**CPUE**[a]
1984[b]	5/06-6/30	10,253	[c]	9,855	[c]	1,072	[c]	1,072	[c]	0.109
1985[d]	4/15-7/15	21,598	[c]	20,582	[c]	1,705	[c]	1,696	[c]	0.083
1986[e]	4/14-7/13	33,857	[c]	32,533	[c]	1,659	[c]	1,638	[c]	0.051
1987[f]	4/20-7/12	26,621	2,557	22,848	2,191	1,094	189	1,094	189	0.048
1988[g]	4/11-7/10	36,222	3,553	32,723	3,476	505	103	481	101	0.015
1989[h]	4/24-6/25	10,526	999	9,363	922	237	42	235	42	0.025
1990[i]	4/23-6/21	[i]	[i]	11,972	1,169	248	60	241	57	0.021
1993[j]	4/26-7/18	11,919	1,559	9,069	1,479	349	63	314	55	0.038
1994[k]	5/09-7/03	9,726	723	7,682	597	269	41	220	32	0.035
1995[l]	5/08-7/02	9,457	501	8,606	483	255	42	228	41	0.030
1996[m]	5/06-6/30	10,082	880	9,596	866	367	43	354	41	0.038
1997[n]	5/12-6/29	9,432	861	8,758	697	381	46	381	46	0.044
1998[o]	5/11-6/28	8,200	811	7,546	747	222	60	215	56	0.029
1999[p]	5/10-6/27	6,206	736	6,097	734	184	24	184	24	0.030
2000[q]	5/08-6/25	4,428	607	4,043	532	103	34	49	12	0.025
2001[r]	5/07-6/24	5,299	815	5,107	804	199	26	185	26	0.039
2002[s]	5/06-6/30	7,770	636	7,566	634	343	40	337	40	0.045
2003	5/05-6/29	10,651	596	10,055	578	405	40	404	40	0.040
1984–86 average		21,903		20,990		1,479		1,469		0.081
1987-90 average		24,456		19,227		521		513		0.027
1993–03 average		8,470		7,648		280		261		0.036

[a] Catch of large Chinook salmon per salmon h of effort.

[b] Neimark (1985).

[c] Estimates of variance were not provided until 1987.

[d] Mecum and Suchanek (1986).

[e] Mecum and Suchanek (1987).

[f] Bingham et al.(1988).

[g] Suchanek and Bingham (1989).

[h] Suchanek and Bingham (1990).

[i] Suchanek and Bingham (1991); no estimate of total angler effort and harvest was provided.

[j] Ericksen (1994).

[k] Ericksen (1995).

[l] Ericksen (1996).

[m] Ericksen (1997).

[n] Ericksen (1998).

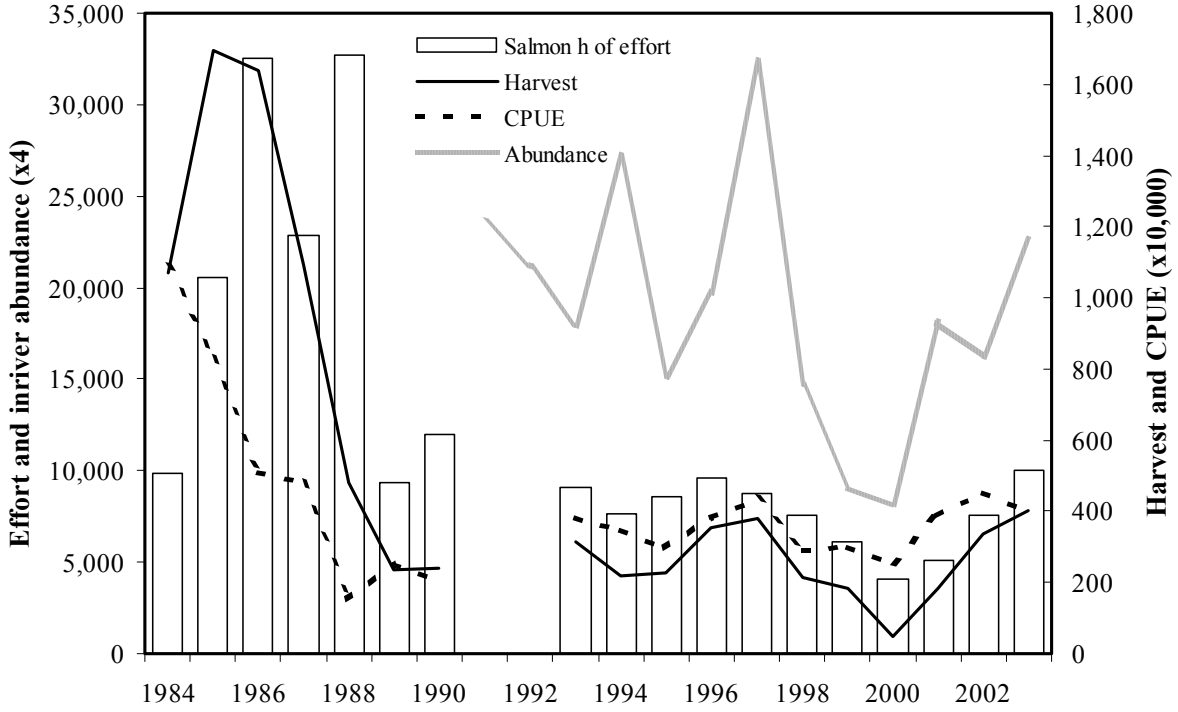
[o] Ericksen (1999).

[p] Ericksen (2000).

[q] Ericksen (2001b).

[r] Ericksen (2002a).

[s] Ericksen (2003a).



Note: Data taken from Tables 13 and 14 (fishery closed in 1991 and 1992).

Figure 6.–Estimated angler effort for, and harvest and catch of large Chinook salmon per salmon h of effort **(CPUE)** in the Haines spring marine boat sport fishery, 1984–2003, and estimated inriver abundance of large Chinook salmon in the Chilkat River, 1991–2003.

ACKNOWLEDGMENTS

Richard Chapell supervised the field operations for the project and provided necessary logistical support. I would like to thank the creel survey staff of Jane Pascoe and Sonja Nelson for their invaluable data collection efforts. John Norton and Lane Taylor captured and tagged Chinook salmon at the fish wheels. Jarbo Crete, Mark Brouwer, Dana VanBurgh III, Renee Hebert, Ted Lambert, Larry Derby, Doug Vollman, Sonja Nelson, and Jessica Edwards worked in the field to capture, mark, and sample fish to complete this project. Kurt Kondzela, Division of Sport Fish, Douglas, provided and downloaded temperature data loggers used at the Kelsall River. The Chilkat Indian Village and family of Victor Hotch allowed us to use their land for juvenile tagging operations. Sue Millard, Division of Sport Fish, Douglas, processed and aged scales from sampled Chinook salmon. Employees at the ADF&G Tag Lab in Juneau dissected heads from adipose finclipped Chinook to remove and read coded wire tags. Margie Nussbaum of the Research and Technical Services (RTS) Unit, Division of Sport Fish, opscanned mark sense forms. Bob Marshall with RTS in Douglas provided biometric support in the study design, and analysis. Scott McPherson and Ed Jones provided critical review of this report. Joanne MacClellan performed final layout of this report for publication.

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APPENDIX A

Appendix A1.–Memo updating the Chilkat River Chinook salmon biological escapement goal.

MEMORANDUM

State of Alaska
DEPARTMENT OF FISH AND GAME

TO: Doug Mecum and Kelly Hepler
Directors
Divisions of Commercial and Sport Fisheries
Juneau

THRU:

DATE: January 27, 2003

FILE NO.: Chilkat King BEG 2003.doc

TELEPHONE NO: 465-4250 (McGregor)
465-4270 (Holmes)

FAX NO: 465-2034

FROM: Rocky Holmes and Andy McGregor
S.E. Regional Supervisors
Divisions of Commercial and Sport Fisheries
Douglas Office

SUBJECT: Updated Chinook Escapement Goal-Chilkat River

This memorandum is written to provide a vehicle to formally change the existing chinook salmon escapement goal for the Chilkat River stock. The existing biological escapement goal calls for an annual escapement goal of 2,000 large spawners (total escapement) into the Chilkat River, which was established in 1981 and not based on production data from this stock. We propose changing this to a biological escapement goal range of 1,750 to 3,500 large spawners, with a point estimate of 2,200 large spawners (total escapement), as measured in the annual mark-recapture project for this stock.

The change is recommended to: 1) conform to the new salmon escapement goal policy; 2) utilize the spawner-recruit data for this stock since 1991, 3) reflect uncertainty in our estimation of the MSY escapement level; 3) recognition that returns will be high over a range of escapement levels and 4) the need for some flexibility in management. The change may affect user allocations. This goal should be used in developing the proposed management plan before the Alaska Board of Fisheries in January and February of 2003. This change to an escapement goal range will strengthen our own management and will also change and strengthen the stock assessment done for this stock as a part of the coastwide chinook stock rebuilding program with the Pacific Salmon Commission (PSC) and their Chinook Technical Committee (CTC) in the future.

The change is tabulated below:

Goal Type	Current ADF&G Goal	Recommended Goal
Total Escapement	2,000	1,750 to 3,500 Large Spawners; point estimate 2,200

The Chilkat River chinook salmon stock is assessed annually with a mark-recapture project. Large spawners are chinook salmon greater than about 29 inches total length and this is the ADF&G standard for the desired spawning stock because large spawners contain almost all females and because, in other systems, smaller chinook salmon cannot by counted accurately during helicopter and foot surveys. The recommended goal for the Chilkat River stock is based upon a stock-

-continued-

Memo to Doug Mecum and Kelly Hepler
Updated Chinook Escapement Goal-Chilkat River

January 27, 2003

recruitment analysis recently reviewed by the members of an inter-divisional review committee appointed by Rocky Holmes and Andy McGregor, consisting of David Bernard, John H. Clark, Robert Clark, Randy Ericksen and Randy Bachman. The analysis and the recommended range has been approved for publication; this report will be finalized and published in March, 2003.

This biological escapement goal is our best scientific estimate of escapements required to provide for maximum sustained yield, the range reflects the uncertainity associated with the limited data and they largely conform to the 0.8 to 1.6 recommendation made by Eggers in his 1993 paper, entitled *Robust harvest policies for Pacific salmon fishieries* paper.

By signing below, you will offically change the ADF&G biological escapement goal for the Chilkat River chinook stock from the single point goal assigned without biological analysis in 1981 to a range established based on relatively high-quality spawner-recruit information specific to this stock, and utilizing spawner-recruit parameters for 10 other chinook salmon stocks in the region. The range is established according to the methods of Eggers around a biologically determined point goal.

Doug Mecum, Director, Commercial Fisheries Division — Date 1/28/03

Kelly Helpler, Director, Sport Fisheries Division — Date 1/29/03

CC Scott McPherson, Randy Ericksen, Randy Bachman, David Bernard, John H. Clark, Robert Clark, Rob Bentz, Scott Kelley, Tom Brookover, David Gaudet

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APPENDIX B

Appendix B1.–Daily minimum, mean, and maximum water temperatures recorded from the Kelsall River, August 7, 2002-May 3, 2004.

	Temperature °C				Temperature °C				Temperature °C		
Date	Min.	Mean	Max.	Date	Min.	Mean	Max.	Date	Min.	Mean	Max.
8/7/2002	9.0	9.4	9.8	9/22/2002	5.0	5.8	6.6	11/7/2002	2.0	3.3	4.2
8/8/2002	8.6	9.4	10.2	9/23/2002	6.2	6.8	7.4	11/8/2002	2.0	2.5	2.9
8/9/2002	9.0	9.6	10.2	9/24/2002	7.0	7.3	7.4	11/9/2002	1.6	2.6	2.9
8/10/2002	8.6	9.7	10.6	9/25/2002	7.0	7.2	7.4	11/10/2002	0.7	1.2	1.6
8/11/2002	8.6	9.5	10.2	9/26/2002	7.0	7.5	7.8	11/11/2002	1.2	1.3	1.6
8/12/2002	8.6	9.4	10.2	9/27/2002	7.4	7.6	7.8	11/12/2002	1.2	1.4	1.6
8/13/2002	8.6	9.7	10.6	9/28/2002	5.8	6.3	7.0	11/13/2002	1.2	1.6	2.0
8/14/2002	9.0	10.1	11.4	9/29/2002	5.0	5.5	5.8	11/14/2002	2.0	2.5	2.9
8/15/2002	7.8	9.4	11.0	9/30/2002	4.6	5.1	5.4	11/15/2002	2.9	2.9	2.9
8/16/2002	7.4	9.3	11.0	10/1/2002	5.4	5.6	5.8	11/16/2002	1.6	1.9	2.9
8/17/2002	8.2	8.9	9.8	10/2/2002	4.2	4.8	5.4	11/17/2002	1.2	1.3	1.6
8/18/2002	8.6	9.1	9.4	10/3/2002	5.0	5.3	5.8	11/18/2002	1.6	1.9	2.5
8/19/2002	8.6	9.2	9.8	10/4/2002	4.6	5.2	5.4	11/19/2002	1.6	1.8	2.0
8/20/2002	8.6	9.1	9.4	10/5/2002	3.7	3.8	4.2	11/20/2002	2.0	2.0	2.0
8/21/2002	8.6	9.1	9.8	10/6/2002	3.7	4.3	5.4	11/21/2002	1.2	1.7	2.0
8/22/2002	8.2	8.8	9.4	10/7/2002	5.4	6.0	6.6	11/22/2002	1.2	1.4	1.6
8/23/2002	8.6	8.8	9.0	10/8/2002	5.0	5.8	6.2	11/23/2002	0.3	0.8	1.2
8/24/2002	7.4	8.4	9.0	10/9/2002	2.0	3.5	4.6	11/24/2002	0.3	0.8	1.6
8/25/2002	7.8	8.7	9.4	10/10/2002	1.2	1.4	1.6	11/25/2002	1.6	1.8	2.0
8/26/2002	8.2	9.1	9.8	10/11/2002	1.2	2.2	3.3	11/26/2002	2.0	2.2	2.5
8/27/2002	8.6	9.1	9.4	10/12/2002	3.3	3.9	4.6	11/27/2002	2.0	2.6	2.9
8/28/2002	8.2	9.0	9.4	10/13/2002	4.2	4.2	4.6	11/28/2002	2.9	2.9	3.3
8/29/2002	8.6	9.0	9.4	10/14/2002	4.2	4.7	5.0	11/29/2002	2.9	3.0	3.3
8/30/2002	8.2	8.8	9.4	10/15/2002	5.0	5.0	5.0	11/30/2002	3.3	3.7	3.7
8/31/2002	8.2	8.9	9.4	10/16/2002	5.4	5.8	6.2	12/1/2002	1.6	2.6	3.3
9/1/2002	8.6	8.9	9.4	10/17/2002	5.4	5.9	6.2	12/2/2002	0.7	0.9	1.2
9/2/2002	7.8	9.0	9.8	10/18/2002	6.2	6.2	6.2	12/3/2002	0.3	0.7	0.7
9/3/2002	7.8	8.9	9.4	10/19/2002	5.8	6.2	6.2	12/4/2002	-0.2	0.3	0.7
9/4/2002	7.0	8.4	9.8	10/20/2002	5.4	6.2	6.6	12/5/2002	-0.2	-0.2	-0.2
9/5/2002	8.2	9.1	9.8	10/21/2002	4.6	5.0	5.4	12/6/2002	-0.2	-0.2	-0.2
9/6/2002	7.8	8.4	9.0	10/22/2002	5.0	5.4	5.8	12/7/2002	0.3	0.7	1.2
9/7/2002	7.8	8.1	8.6	10/23/2002	4.2	4.8	5.8	12/8/2002	1.2	1.5	1.6
9/8/2002	7.8	8.3	8.6	10/24/2002	3.7	4.4	5.0	12/9/2002	1.6	1.9	2.0
9/9/2002	7.4	8.0	8.6	10/25/2002	4.6	5.0	5.4	12/10/2002	2.0	2.1	2.5
9/10/2002	7.0	7.6	7.8	10/26/2002	5.0	5.1	5.4	12/11/2002	1.6	1.9	2.0
9/11/2002	7.4	7.8	7.8	10/27/2002	4.6	4.9	5.0	12/12/2002	1.2	1.3	1.6
9/12/2002	7.0	7.6	7.8	10/28/2002	2.9	3.2	4.6	12/13/2002	1.2	1.6	1.6
9/13/2002	6.6	7.2	7.8	10/29/2002	2.5	2.7	2.9	12/14/2002	-0.2	0.1	0.7
9/14/2002	7.0	7.1	7.4	10/30/2002	1.6	2.0	2.5	12/15/2002	-0.2	0.1	0.3
9/15/2002	6.6	7.1	7.4	10/31/2002	1.6	1.8	2.0	12/16/2002	-0.2	0.1	0.3
9/16/2002	7.0	7.4	7.8	11/1/2002	2.0	2.4	2.9	12/17/2002	0.3	0.5	0.7
9/17/2002	7.4	7.5	7.8	11/2/2002	2.0	2.4	2.9	12/18/2002	0.7	1.0	1.2
9/18/2002	6.2	6.8	7.4	11/3/2002	2.9	2.9	2.9	12/19/2002	-0.2	0.3	1.2
9/19/2002	5.8	6.4	7.0	11/4/2002	2.5	2.9	2.9	12/20/2002	-0.2	0.1	0.3
9/20/2002	6.6	7.0	7.4	11/5/2002	2.9	3.1	3.3	12/21/2002	-0.2	0.2	0.3
9/21/2002	6.2	6.7	7.0	11/6/2002	2.9	3.4	4.2	12/22/2002	-0.2	0.0	0.3

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Appendix B1.–Page 2 of 5.

Date	Temperature °C Min.	Mean	Max.	Date	Temperature °C Min.	Mean	Max.	Date	Temperature °C Min.	Mean	Max.
12/23/2002	-0.2	0.3	0.7	2/7/2003	0.3	0.5	0.7	3/25/2003	-0.2	0.1	0.7
12/24/2002	-0.2	0.9	1.6	2/8/2003	0.3	0.7	1.2	3/26/2003	-0.2	0.0	0.7
12/25/2002	-0.2	-0.2	-0.2	2/9/2003	0.7	1.0	1.2	3/27/2003	-0.2	0.2	0.7
12/26/2002	-0.2	-0.1	0.3	2/10/2003	0.7	1.0	1.2	3/28/2003	0.3	0.3	0.7
12/27/2002	-0.2	-0.1	0.3	2/11/2003	0.7	1.0	1.2	3/29/2003	0.3	0.3	0.3
12/28/2002	-0.2	-0.2	-0.2	2/12/2003	1.2	1.3	1.6	3/30/2003	0.3	0.4	0.7
12/29/2002	-0.2	-0.2	-0.2	2/13/2003	-0.2	0.7	1.2	3/31/2003	-0.2	0.3	0.7
12/30/2002	-0.2	-0.2	-0.2	2/14/2003	-0.2	-0.2	-0.2	4/1/2003	-0.2	0.0	0.3
12/31/2002	-0.2	-0.2	-0.2	2/15/2003	-0.2	-0.2	-0.2	4/2/2003	-0.2	0.0	0.3
1/1/2003	-0.2	-0.1	0.3	2/16/2003	-0.2	-0.1	0.3	4/3/2003	-0.2	0.0	0.3
1/2/2003	-0.2	0.2	0.3	2/17/2003	-0.2	-0.2	-0.2	4/4/2003	-0.2	0.0	0.3
1/3/2003	-0.2	0.1	0.3	2/18/2003	-0.2	-0.2	-0.2	4/5/2003	-0.2	0.0	0.3
1/4/2003	-0.2	0.1	0.3	2/19/2003	-0.2	0.0	0.3	4/6/2003	-0.2	0.2	0.7
1/5/2003	-0.2	0.1	0.3	2/20/2003	-0.2	-0.2	-0.2	4/7/2003	0.3	0.7	1.2
1/6/2003	-0.2	0.1	0.3	2/21/2003	-0.2	-0.2	-0.2	4/8/2003	0.3	1.1	2.5
1/7/2003	0.3	0.3	0.3	2/22/2003	-0.2	-0.2	-0.2	4/9/2003	0.3	1.1	2.0
1/8/2003	-0.2	0.1	0.3	2/23/2003	-0.2	-0.2	-0.2	4/10/2003	0.3	1.4	3.3
1/9/2003	-0.2	0.1	0.3	2/24/2003	-0.2	-0.2	-0.2	4/11/2003	0.3	1.4	3.3
1/10/2003	-0.2	0.3	0.3	2/25/2003	-0.2	-0.2	-0.2	4/12/2003	0.3	1.5	3.3
1/11/2003	-0.2	-0.1	0.3	2/26/2003	-0.2	-0.2	-0.2	4/13/2003	0.3	1.6	3.7
1/12/2003	-0.2	-0.2	-0.2	2/27/2003	-0.2	0.0	0.3	4/14/2003	0.7	2.0	3.3
1/13/2003	-0.2	-0.2	-0.2	2/28/2003	-0.2	0.3	0.7	4/15/2003	1.2	2.2	3.3
1/14/2003	-0.2	-0.2	-0.2	3/1/2003	0.3	0.7	1.2	4/16/2003	1.2	2.0	2.9
1/15/2003	-0.2	-0.2	-0.2	3/2/2003	0.3	0.6	1.2	4/17/2003	1.6	2.7	4.6
1/16/2003	-0.2	0.1	0.3	3/3/2003	0.7	1.0	1.2	4/18/2003	1.2	2.4	3.3
1/17/2003	0.3	0.3	0.7	3/4/2003	0.3	0.9	1.6	4/19/2003	1.6	2.8	4.2
1/18/2003	0.7	1.1	1.2	3/5/2003	-0.2	0.1	0.3	4/20/2003	1.6	2.9	4.6
1/19/2003	1.2	1.2	1.2	3/6/2003	-0.2	-0.2	-0.2	4/21/2003	1.2	2.5	4.2
1/20/2003	1.2	1.2	1.2	3/7/2003	-0.2	-0.2	-0.2	4/22/2003	2.0	3.0	5.0
1/21/2003	-0.2	0.2	1.2	3/8/2003	-0.2	-0.2	-0.2	4/23/2003	1.6	2.8	5.4
1/22/2003	-0.2	0.1	0.3	3/9/2003	-0.2	-0.2	-0.2	4/24/2003	0.7	2.4	5.0
1/23/2003	-0.2	0.0	0.3	3/10/2003	-0.2	-0.2	-0.2	4/25/2003	0.7	2.2	4.6
1/24/2003	-0.2	-0.2	-0.2	3/11/2003	-0.2	-0.2	-0.2	4/26/2003	1.2	2.4	4.6
1/25/2003	-0.2	-0.2	-0.2	3/12/2003	-0.2	-0.2	-0.2	4/27/2003	1.2	2.8	5.0
1/26/2003	-0.2	-0.2	-0.2	3/13/2003	-0.2	-0.2	-0.2	4/28/2003	1.6	3.0	5.0
1/27/2003	-0.2	-0.2	-0.2	3/14/2003	-0.2	-0.2	-0.2	4/29/2003	1.2	3.0	5.0
1/28/2003	-0.2	-0.2	-0.2	3/15/2003	-0.2	-0.2	-0.2	4/30/2003	1.6	3.2	5.4
1/29/2003	-0.2	-0.2	-0.2	3/16/2003	-0.2	-0.1	0.3	5/1/2003	1.6	2.7	4.2
1/30/2003	-0.2	0.2	0.3	3/17/2003	-0.2	-0.2	-0.2	5/2/2003	1.2	2.7	4.2
1/31/2003	-0.2	0.0	0.3	3/18/2003	-0.2	0.0	0.3	5/3/2003	1.6	2.7	4.2
2/1/2003	-0.2	-0.1	0.3	3/19/2003	-0.2	0.0	0.3	5/4/2003	1.6	3.0	4.6
2/2/2003	-0.2	0.3	0.3	3/20/2003	-0.2	0.1	0.3	5/5/2003	2.5	3.8	5.4
2/3/2003	0.3	0.4	0.7	3/21/2003	0.3	0.3	0.3	5/6/2003	2.9	3.9	5.0
2/4/2003	0.3	0.5	0.7	3/22/2003	0.3	0.3	0.3	5/7/2003	2.5	4.1	5.8
2/5/2003	0.7	1.0	1.2	3/23/2003	0.3	0.3	0.3	5/8/2003	2.9	4.5	6.2
2/6/2003	1.2	1.2	1.2	3/24/2003	0.3	0.3	0.3	5/9/2003	2.5	4.4	6.2

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Appendix B1.–Page 3 of 5.

Date	Temperature °C			Date	Temperature °C			Date	Temperature °C		
	Min.	Mean	Max.		Min.	Mean	Max.		Min.	Mean	Max.
5/10/2003	2.9	4.3	5.4	6/25/2003	7.0	7.4	7.8	8/10/2003	8.6	10.5	12.2
5/11/2003	3.3	3.9	4.6	6/26/2003	6.6	7.6	8.6	8/11/2003	9.0	10.9	12.2
5/12/2003	2.9	3.9	5.0	6/27/2003	6.6	7.7	9.0	8/12/2003	9.8	10.2	11.4
5/13/2003	2.9	3.9	4.6	6/28/2003	7.0	8.2	9.4	8/13/2003	9.0	10.2	11.4
5/14/2003	2.9	3.9	5.0	6/29/2003	7.0	7.8	8.6	8/14/2003	9.4	9.9	11.0
5/15/2003	3.3	4.1	5.4	6/30/2003	7.0	9.0	11.0	8/15/2003	9.4	10.0	10.6
5/16/2003	3.3	4.3	5.4	7/1/2003	7.8	9.9	12.2	8/16/2003	9.0	9.5	9.8
5/17/2003	3.7	4.8	5.8	7/2/2003	7.8	8.7	10.2	8/17/2003	8.6	9.4	10.2
5/18/2003	3.3	5.0	6.6	7/3/2003	7.0	7.7	8.2	8/18/2003	7.8	9.4	10.6
5/19/2003	3.3	5.1	6.6	7/4/2003	7.4	8.5	9.8	8/19/2003	8.6	9.5	10.2
5/20/2003	2.9	4.9	6.6	7/5/2003	7.8	8.3	9.0	8/20/2003	8.2	8.7	9.8
5/21/2003	3.3	5.3	7.0	7/6/2003	7.8	9.2	11.0	8/21/2003	7.8	8.6	9.0
5/22/2003	4.2	5.3	6.2	7/7/2003	8.2	9.9	11.4	8/22/2003	7.0	8.3	9.8
5/23/2003	4.2	5.0	5.8	7/8/2003	8.6	9.8	11.4	8/23/2003	8.6	9.5	10.2
5/24/2003	3.7	4.1	4.6	7/9/2003	8.2	10.4	12.9	8/24/2003	8.6	9.3	9.8
5/25/2003	3.3	4.2	5.4	7/10/2003	9.0	11.2	13.7	8/25/2003	8.6	9.5	10.2
5/26/2003	3.7	4.7	5.8	7/11/2003	9.0	11.2	13.3	8/26/2003	7.8	8.9	9.4
5/27/2003	2.9	4.6	6.2	7/12/2003	9.0	11.1	12.9	8/27/2003	9.0	9.4	9.8
5/28/2003	3.3	4.7	6.2	7/13/2003	10.6	11.9	13.3	8/28/2003	8.6	9.6	10.6
5/29/2003	4.6	5.6	6.6	7/14/2003	10.2	11.1	11.8	8/29/2003	8.6	9.7	10.6
5/30/2003	4.2	5.8	7.4	7/15/2003	9.4	9.9	11.4	8/30/2003	9.0	9.2	10.2
5/31/2003	4.2	5.3	6.2	7/16/2003	9.0	9.8	10.6	8/31/2003	7.8	8.5	9.0
6/1/2003	4.2	5.2	6.2	7/17/2003	9.0	10.0	11.0	9/1/2003	7.8	8.3	8.6
6/2/2003	4.6	5.7	6.6	7/18/2003	8.6	10.8	12.9	9/2/2003	7.4	8.0	8.2
6/3/2003	4.6	5.9	7.4	7/19/2003	9.8	11.7	13.3	9/3/2003	7.8	8.2	9.0
6/4/2003	4.2	6.2	8.2	7/20/2003	10.6	11.6	12.6	9/4/2003	7.8	8.6	9.4
6/5/2003	5.4	6.1	6.6	7/21/2003	9.4	10.0	11.0	9/5/2003	6.6	7.9	9.4
6/6/2003	5.4	6.4	7.8	7/22/2003	8.6	9.2	9.4	9/6/2003	8.2	9.1	9.8
6/7/2003	4.6	6.5	8.6	7/23/2003	8.6	10.3	12.2	9/7/2003	8.6	9.2	9.8
6/8/2003	4.2	6.5	9.0	7/24/2003	9.8	11.0	12.2	9/8/2003	8.2	8.7	9.4
6/9/2003	4.6	6.9	9.4	7/25/2003	9.4	10.4	11.4	9/9/2003	7.8	8.4	8.6
6/10/2003	5.4	7.6	9.8	7/26/2003	9.4	9.9	10.6	9/10/2003	7.4	8.0	8.6
6/11/2003	5.8	7.9	10.2	7/27/2003	9.0	9.9	10.6	9/11/2003	7.8	8.4	9.0
6/12/2003	5.8	7.9	9.8	7/28/2003	8.6	9.6	10.2	9/12/2003	7.8	8.4	9.0
6/13/2003	6.6	7.1	7.8	7/29/2003	9.0	9.8	11.0	9/13/2003	7.0	7.9	8.6
6/14/2003	5.4	7.0	9.0	7/30/2003	9.0	10.0	11.0	9/14/2003	5.4	5.7	6.6
6/15/2003	5.8	7.4	9.0	7/31/2003	9.0	9.8	10.6	9/15/2003	3.7	4.5	5.0
6/16/2003	6.2	7.7	9.0	8/1/2003	9.0	10.2	11.4	9/16/2003	3.7	4.0	4.6
6/17/2003	6.6	7.8	8.6	8/2/2003	9.4	10.0	10.6	9/17/2003	2.9	3.5	4.2
6/18/2003	6.6	7.1	7.8	8/3/2003	9.0	9.9	11.0	9/18/2003	3.7	4.2	4.6
6/19/2003	5.8	6.4	7.0	8/4/2003	9.0	9.4	9.8	9/19/2003	2.5	3.1	4.2
6/20/2003	6.2	7.3	8.2	8/5/2003	7.8	9.6	11.4	9/20/2003	4.6	5.0	5.8
6/21/2003	6.6	7.9	9.0	8/6/2003	8.6	10.4	12.2	9/21/2003	5.4	5.6	5.8
6/22/2003	7.0	8.2	9.4	8/7/2003	9.4	11.3	12.9	9/22/2003	4.2	4.9	5.4
6/23/2003	7.4	8.3	9.0	8/8/2003	10.2	11.3	12.6	9/23/2003	4.6	5.1	5.4
6/24/2003	7.0	7.7	8.2	8/9/2003	8.6	10.3	11.8	9/24/2003	2.9	3.7	5.0

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	Temperature °C				Temperature °C				Temperature °C		
Date	Min.	Mean	Max.	Date	Min.	Mean	Max.	Date	Min.	Mean	Max.
9/25/2003	4.6	5.4	6.2	11/10/2003	-0.2	-0.1	0.3	12/26/2003	-0.6	-0.6	-0.6
9/26/2003	5.8	6.3	6.6	11/11/2003	-0.6	-0.3	-0.2	12/27/2003	-0.6	-0.6	-0.6
9/27/2003	6.2	6.4	6.6	11/12/2003	-0.2	0.5	1.2	12/28/2003	-0.6	-0.6	-0.6
9/28/2003	6.2	6.7	7.4	11/13/2003	0.7	1.0	1.2	12/29/2003	-0.6	-0.5	-0.2
9/29/2003	6.6	7.2	7.8	11/14/2003	0.3	0.7	1.2	12/30/2003	-0.6	-0.6	-0.6
9/30/2003	6.6	7.4	7.8	11/15/2003	0.3	0.4	0.7	12/31/2003	-0.6	-0.6	-0.6
10/1/2003	6.6	7.2	7.8	11/16/2003	-0.6	-0.2	1.2	1/1/2004	-0.6	-0.3	-0.2
10/2/2003	6.2	6.7	7.0	11/17/2003	-0.6	-0.5	-0.2	1/2/2004	-0.6	-0.2	0.3
10/3/2003	5.8	6.7	7.8	11/18/2003	-0.6	-0.3	-0.2	1/3/2004	-0.6	-0.6	-0.6
10/4/2003	7.4	7.6	7.8	11/19/2003	-0.6	-0.3	-0.2	1/4/2004	-0.6	-0.6	-0.6
10/5/2003	7.0	7.4	7.8	11/20/2003	-0.6	-0.3	-0.2	1/5/2004	-0.6	-0.6	-0.6
10/6/2003	6.6	6.9	7.0	11/21/2003	-0.6	-0.5	-0.2	1/6/2004	-0.6	-0.6	-0.6
10/7/2003	6.6	7.0	7.0	11/22/2003	-0.6	-0.6	-0.6	1/7/2004	-0.6	-0.6	-0.2
10/8/2003	5.8	6.3	6.6	11/23/2003	-0.6	-0.6	-0.2	1/8/2004	-0.6	-0.6	-0.6
10/9/2003	5.4	5.8	6.2	11/24/2003	-0.6	-0.6	-0.6	1/9/2004	-0.6	-0.6	-0.6
10/10/2003	5.0	5.5	6.2	11/25/2003	-0.6	-0.6	-0.6	1/10/2004	-0.6	-0.2	-0.2
10/11/2003	4.2	4.6	5.0	11/26/2003	-0.6	-0.6	-0.6	1/11/2004	-0.2	-0.2	-0.2
10/12/2003	2.9	3.1	3.7	11/27/2003	-0.6	-0.5	-0.2	1/12/2004	-0.2	-0.2	-0.2
10/13/2003	2.9	3.3	4.2	11/28/2003	-0.2	-0.2	-0.2	1/13/2004	-0.2	0.0	0.3
10/14/2003	2.9	3.4	3.7	11/29/2003	-0.6	-0.5	-0.2	1/14/2004	-0.6	-0.3	-0.2
10/15/2003	2.0	2.7	3.3	11/30/2003	-0.6	-0.6	-0.6	1/15/2004	-0.6	-0.3	-0.2
10/16/2003		Out of water		12/1/2003	-0.6	-0.2	0.3	1/16/2004	-0.6	-0.3	-0.2
10/17/2003		Out of water		12/2/2003	-0.2	0.4	1.2	1/17/2004	-0.6	-0.3	-0.2
10/18/2003		Out of water		12/3/2003	-0.6	-0.4	-0.2	1/18/2004	-0.6	-0.5	-0.2
10/19/2003		Out of water		12/4/2003	-0.6	-0.4	-0.2	1/19/2004	-0.6	-0.6	-0.6
10/20/2003		Out of water		12/5/2003	-0.2	-0.2	-0.2	1/20/2004	-0.6	-0.6	-0.2
10/21/2003		Out of water		12/6/2003	-0.6	-0.5	-0.2	1/21/2004	-0.2	-0.2	-0.2
10/22/2003	2.9	3.5	3.7	12/7/2003	-0.6	-0.5	-0.2	1/22/2004	-0.2	-0.2	-0.2
10/23/2003	3.7	3.8	4.2	12/8/2003	-0.2	-0.2	-0.2	1/23/2004	-0.6	-0.2	-0.2
10/24/2003	3.3	3.7	4.2	12/9/2003	-0.6	-0.3	-0.2	1/24/2004	-0.6	-0.5	-0.2
10/25/2003	2.9	3.7	4.6	12/10/2003	-0.6	-0.4	-0.2	1/25/2004	-0.6	-0.3	-0.2
10/26/2003	4.6	4.7	5.0	12/11/2003	-0.2	-0.2	-0.2	1/26/2004	-0.6	-0.3	0.3
10/27/2003	3.3	4.0	4.6	12/12/2003	-0.2	-0.2	-0.2	1/27/2004	-0.6	-0.2	-0.2
10/28/2003	1.6	2.4	2.9	12/13/2003	-0.2	-0.2	-0.2	1/28/2004	-0.6	-0.3	-0.2
10/29/2003	-0.6	0.5	1.6	12/14/2003	-0.2	-0.2	-0.2	1/29/2004	-0.6	-0.5	-0.2
10/30/2003	-0.6	-0.4	-0.2	12/15/2003	-0.2	-0.2	-0.2	1/30/2004	-0.6	-0.6	-0.6
10/31/2003	-0.6	-0.2	0.3	12/16/2003	-0.2	-0.2	-0.2	1/31/2004	-0.6	-0.6	-0.6
11/1/2003	-0.2	0.8	1.2	12/17/2003	-0.2	-0.2	-0.2	2/1/2004	-0.6	-0.6	-0.6
11/2/2003	0.3	0.9	1.6	12/18/2003	-0.6	-0.2	-0.2	2/2/2004	-0.6	-0.6	-0.6
11/3/2003	0.3	0.5	0.7	12/19/2003	-0.2	-0.2	-0.2	2/3/2004	-0.6	-0.6	-0.6
11/4/2003	-0.6	-0.2	-0.2	12/20/2003	-0.2	-0.2	-0.2	2/4/2004	-0.6	-0.6	-0.6
11/5/2003	-0.6	-0.4	-0.2	12/21/2003	-0.2	-0.2	-0.2	2/5/2004	-0.6	-0.5	-0.2
11/6/2003	-0.6	-0.6	-0.6	12/22/2003	-0.2	-0.2	-0.2	2/6/2004	-0.2	0.1	0.7
11/7/2003	-0.6	-0.2	0.3	12/23/2003	-0.2	-0.2	-0.2	2/7/2004	-0.2	-0.2	-0.2
11/8/2003	-0.2	0.2	0.7	12/24/2003	-0.2	0.1	0.3	2/8/2004	-0.2	0.1	0.3
11/9/2003	0.3	0.7	1.2	12/25/2003	-0.6	-0.1	0.3	2/9/2004	-0.2	0.0	0.3

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Date	Temperature °C Min.	Mean	Max.	Date	Temperature °C Min.	Mean	Max.
2/10/2004	-0.2	-0.2	-0.2	3/27/2004	0.3	1.3	2.0
2/11/2004	-0.2	-0.2	-0.2	3/28/2004	-0.6	0.0	1.2
2/12/2004	-0.2	-0.2	-0.2	3/29/2004	-0.2	0.9	1.6
2/13/2004	-0.2	-0.2	-0.2	3/30/2004	0.3	0.9	1.6
2/14/2004	-0.2	-0.2	-0.2	3/31/2004	-0.2	0.8	1.6
2/15/2004	-0.6	-0.4	-0.2	4/1/2004	0.3	1.3	2.5
2/16/2004	-0.6	-0.2	-0.2	4/2/2004	0.3	0.7	1.2
2/17/2004	-0.2	-0.2	-0.2	4/3/2004	0.7	1.0	1.2
2/18/2004	-0.2	-0.2	-0.2	4/4/2004	0.7	1.6	2.9
2/19/2004	-0.2	-0.2	-0.2	4/5/2004	0.7	1.7	2.9
2/20/2004	-0.2	-0.2	-0.2	4/6/2004	0.7	1.9	2.9
2/21/2004	-0.2	-0.2	-0.2	4/7/2004	1.2	1.8	2.9
2/22/2004	-0.2	-0.1	0.3	4/8/2004	1.2	2.0	3.7
2/23/2004	-0.2	-0.1	0.3	4/9/2004	0.7	1.6	2.5
2/24/2004	-0.2	0.0	0.3	4/10/2004	1.2	2.0	3.3
2/25/2004	-0.6	-0.3	-0.2	4/11/2004	0.3	1.5	3.3
2/26/2004	-0.6	-0.5	-0.2	4/12/2004	0.7	1.6	2.5
2/27/2004	-0.6	-0.3	-0.2	4/13/2004	1.2	2.4	3.7
2/28/2004	-0.6	-0.5	-0.2	4/14/2004	1.6	2.2	3.7
2/29/2004	-0.6	-0.4	-0.2	4/15/2004	0.3	1.7	3.3
3/1/2004	-0.6	-0.4	-0.2	4/16/2004	0.3	1.6	3.3
3/2/2004	-0.6	-0.4	-0.2	4/17/2004	1.2	2.1	3.3
3/3/2004	-0.6	-0.2	-0.2	4/18/2004	1.6	2.2	3.3
3/4/2004	-0.2	-0.1	0.3	4/19/2004	1.2	2.1	3.7
3/5/2004	-0.6	-0.1	0.3	4/20/2004	0.7	2.0	3.7
3/6/2004	-0.2	0.0	0.7	4/21/2004	0.7	2.0	3.7
3/7/2004	-0.2	0.1	0.3	4/22/2004	1.2	1.7	2.0
3/8/2004	-0.6	-0.3	0.3	4/23/2004	1.2	2.4	3.7
3/9/2004	-0.2	-0.1	0.3	4/24/2004	1.6	2.4	3.3
3/10/2004	-0.6	-0.3	-0.2	4/25/2004	1.6	2.1	2.9
3/11/2004	-0.2	0.2	0.7	4/26/2004	1.2	2.0	3.3
3/12/2004	-0.2	0.4	1.2	4/27/2004	1.2	2.2	3.7
3/13/2004	-0.2	0.2	1.2	4/28/2004	1.2	2.6	4.2
3/14/2004	-0.6	-0.3	-0.2	4/29/2004	1.2	2.5	4.6
3/15/2004	-0.2	0.5	1.2	4/30/2004	1.2	2.2	4.2
3/16/2004	0.3	0.8	1.6	5/1/2004	1.2	1.8	2.9
3/17/2004	-0.6	0.0	0.7	5/2/2004	1.6	2.1	2.9
3/18/2004	-0.6	-0.4	-0.2	5/3/2004	1.6	1.8	2.9
3/19/2004	-0.6	-0.5	-0.2				
3/20/2004	-0.6	-0.2	-0.2				
3/21/2004	-0.6	-0.3	-0.2				
3/22/2004	-0.6	-0.3	-0.2				
3/23/2004	-0.6	-0.3	0.3				
3/24/2004	-0.6	-0.2	0.3				
3/25/2004	-0.2	0.3	1.2				
3/26/2004	-0.2	0.7	1.6				

APPENDIX C

Appendix C1.–Weekly sampling statistics and estimated effort, catch, and harvest of Chinook salmon at the Letnikof Dock, May 5-June 29, 2003.

	May 05– May 11	May 12– May 18	May 19 - June 01 Non-derby	May 19 - June 01 Derby	June 02– June 08	June 09– June 15	June 16– June 22	June 23– June 29	Total
Boats counted	10	51	78	84	69	38	27	2	359
Angler-h sampled	55	343	700	1145	638	283	173	41	3,378
Salmon-h sampled	50	343	697	1,145	638	269	160	0	3,302
Chinook sampled	0	8	29	67	30	14	2	0	150
Sampled for ad-clips	0	8	29	66	29	14	2	0	148
Ad-clips	0	0	3	3	1	0	0	0	7
Angler-hours									
Estimate	196	450	2,101	2,862	981	716	433	96	7,835
Variance	540	8,713	124,835	85,871	6,705	19,219	9,377	5,230	260,490
Salmon-hours									
Estimate	184	450	2,092	2,862	981	683	396	0	7,648
Variance	184	8,713	125,712	85,871	6,705	19,861	10,691	0	257,737
Wild mature Chinook kept (excluding hatchery and immature fish)									
Estimate	0	4	63	71	52	37	5	0	232
Variance	0	0	120	64	275	59	12	0	530
Large Chinook catch									
Estimate	0	8	87	100	62	40	5	0	302
Variance	0	0	312	188	444	87	12	0	1,043
Large Chinook kept									
Estimate	0	8	87	100	61	40	5	0	301
Variance	0	0	312	188	444	87	12	0	1,043
Small Chinook catch									
Estimate	0	7	96	115	187	113	29	0	547
Variance	0	9	1,446	1,875	2,214	493	208	0	6,245
Small Chinook kept									
Estimate	0	0	0	0	1	0	0	0	1
Variance	0	0	0	0	0	0	0	0	0

Appendix C2.– Biweekly sampling statistics and estimated effort, catch, and harvest of Chinook salmon at the Chilkat State Park boat launch, May 12-June 29, 2003.

		May 19 - June 01				
	May 12–May 18	Non-derby	Derby	June 02–June 15	June 16–June 29	Total
Boats counted	0	2	4	6	1	13
Angler-h sampled	0	5	8	74	6	93
Salmon-h sampled	0	0	8	74	6	88
Chinook sampled	0	0	0	1	0	1
Sampled for ad-clips	0	0	0	1	0	1
Ad-clips	0	0	0	0	0	0
Angler-h						
Estimate	0	20	38	518	42	618
Variance	0	319	245	14,280	1,512	16,356
Salmon-h						
Estimate	0	0	38	518	42	598
Variance	0	0	245	14,280	1,512	16,037
Wild mature Chinook kept (excluding hatchery and immature fish)						
Estimate	0	0	0	7	0	7
Variance	0	0	0	42	0	42
Large Chinook catch						
Estimate	0	0	0	7	0	7
Variance	0	0	0	42	0	42
Large Chinook kept						
Estimate	0	0	0	7	0	7
Variance	0	0	0	42	0	42
Small Chinook catch						
Estimate	0	0	0	119	0	119
Variance	0	0	0	12,138	0	12,138
Small Chinook kept						
Estimate	0	0	0	0	0	0
Variance	0	0	0	0	0	0

Appendix C3.–Biweekly sampling statistics and estimated effort, catch, and harvest of Chinook salmon at the Small Boat Harbor, May 5-June 29, 2003.

		May 19 - June 01				
	May 05–May 18	Non-derby	Derby	June 02–June 15	June 16–June 29	Total
Boats counted	6	7	11	9	16	49
Angler-h sampled	19	72	144	67	80	382
Salmon-h sampled	19	40	144	67	45	315
Chinook sampled	1	2	16	13	8	40
Sampled for ad-clips	1	2	16	13	8	40
Ad-clips	0	0	1	3	2	6
Angler-h						
Estimate	133	324	718	466	557	2,198
Variance	7,266	49,644	405	29,369	55,829	142,513
Salmon-h						
Estimate	133	180	718	466	312	1,809
Variance	7,266	9,324	405	29,369	14,081	60,445
Wild mature Chinook kept (excluding hatchery and immature fish)						
Estimate	0	5	27	14	0	46
Variance	0	16	80	84	0	180
Large Chinook catch						
Estimate	7	9	52	21	7	96
Variance	42	63	180	210	42	537
Large Chinook kept						
Estimate	7	9	52	21	7	96
Variance	42	63	180	210	42	537
Small Chinook catch						
Estimate	0	0	40	231	49	320
Variance	0	0	1280	25,410	2,058	28,748
Small Chinook kept						
Estimate	0	0	0	70	49	119
Variance	0	0	0	2,184	2,058	4,242

Appendix C4.–Estimated age composition and mean length-at-age (snout to fork of tail in mm) of harvested Chinook salmon in the Chilkat Inlet subsistence gillnet fishery, June 14-July 13, 2003.

		Brood year and age class					
		2000	1999	1998	1997	**Total fish with valid age**	**Total sampled**[a]
		1.1	1.2	1.3	1.4		
Males	Sample size	1	9	4	3	17	19
	Percent	5.9	52.9	23.5	17.6		59.4
	SE	5.9	12.5	10.6	9.5		8.8
	Mean length	470	683	909	973		
	SE		23.9	64.0	26.8		
Females	Sample size	0	4	4	4	12	13
	Percent		33.3	33.3	33.3		40.6
	SE		14.2	14.2	14.2		8.8
	Mean length		625	899	939		
	SE		45.8	22.2	16.1		
Combined[b]	Sample size	1	16	9	7	33	37
	Percent	3.0	48.5	27.3	21.2		
	SE	3.0	8.8	7.9	7.2		
	Mean length	470	663	909	954		
	SE		18.3	26.0	14.2		

[a] Includes fish that were not assigned an age.
[b] Includes fish not sampled for sex information.

APPENDIX D

Appendix D1.–Computer data files used in the analysis of this report.

FILE NAME	DESCRIPTION
03FallChinookCWT.XLS	Excel workbook containing raw trapping and sampling data from fall Chinook cwt project in 2003.
03FallChinookCWT.PRN	Space delimited text file with raw trapping data from fall Chinook cwt project in 2003.
03FallChinookCWT.TXT	Text file describing heading and column layout for 03FallChinookCWT.PRN
02_04KelsallTemp.PRN	Space delimited text file with bi-hourly water temperature data recorded at the Kelsall River from August 2002 to May 2004.
02_04KelsallTemp.TXT	Text file describing heading and column layout for 02_04KelsallTemp.PRN
BY02ChinookLength.PRN	Space delimited text file with length data from all 2002 brood year juvenile Chinook sampled in 2003 and 2004.
BY02ChinookLength.TXT	Text file describing heading and column layout for BY02ChinookLength.PRN
F2008100M012003.DTA	Mark-sense ASCII file containing angler interview data from the Haines marine sport fishery in 2003.
F2008200A012003.DTA	Mark-sense ASCII file containing Chinook age & length data from the Haines marine sport fishery in 2003.
F2008202A012003.DTA	Mark-sense ASCII file containing Chinook age & length data from the Chilkat Inlet subsistence fishery in 2003.
HAINE3.PRG	Dbase program to generate SAS data file from mark-sense file.
03HAINESCT.PRN	Count file (text) used in HAMC03.SAS to expand for missing interview data.
HAMC03.SAS	SAS program to estimate effort and harvest in the Haines marine sport fishery using 03HAINESCT.PRN and output from HAINE3.PRG.
03STRATPOPEST.XLS	Excel workbook used to estimate 2003 abundance of Chilkat River Chinook.
03SPAWN.XLS	Excel workbook containing raw data from Chinook sampled on the Chilkat River spawning tributaries during 2003.
03SPAWN.PRN	Space delimited text file with raw data from Chinook sampled on the Chilkat River spawning tributaries during 2003.
03SPAWN.TXT	Text file describing heading and column layout for 03SPAWN.PRN
03TAGS.XLS	Excel workbook containing raw data from Chinook captured in the lower Chilkat River during 2003.
03TAGS.PRN	Space delimited text file with raw data from Chinook captured in the lower Chilkat River during 2003.
03TAGS.TXT	Text file describing heading and column layout for 03TAGS.PRN
03AGESEX.XLS	Excel workbook used to estimate the number of large Chinook salmon in the 2003 Chilkat River escapement by age and sex.