Fishery Data Series No. 10-86

Production, Escapement, and Juvenile Tagging of Chilkat River Chinook Salmon in 2007

by

Richard S. Chapell

December 2010

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

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Mathematics, statistics

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

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by

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ABSTRACT

The purpose of this study was to estimate the sport harvest, escapement, and production of Chinook salmon Oncorhynchus tshawytscha returning to the Chilkat River during 2007. Angler effort and spring harvest of wild mature Chinook salmon in the Haines marine boat sport fishery were estimated using an onsite creel survey. We used an unstratified mark–recapture experiment to estimate spawning abundance of Chinook salmon returning to the Chilkat River in 2007. Juvenile abundance and marine harvest of 2000 brood year Chilkat River Chinook were estimated through recoveries of fish marked with coded wire tags as fry in fall 2001 and as smolts in spring 2002.

An estimated 7,411 angler-h (SE = 725) of effort (7,223 salmon-h, SE = 690) were expended in the 2007 spring Haines marine sport fishery for a harvest of 285 (SE = 43) large Chinook salmon (≥ 28 inches), of which 177 (SE = 33) were wild, mature fish.

We captured 200 Chinook salmon with drift gillnets and fish wheels; 187 of these were marked and released in the lower Chilkat River between June 12 and August 5, 2007. Technicians examined 456 Chinook salmon in spawning tributaries of the Chilkat River, and 25 of these had marks. An estimated 3,303 (SE = 573) Chinook salmon immigrated into the Chilkat River during 2007. Using the lower river captures to estimate age composition, an estimated 1,256 (SE = 246) were small (age-1.1), 602 (SE = 138) were medium (age-1.2), and 1,445 (SE = 227) were large (age-1.3 and older) fish.

We estimated that 510,700 (SE = 74,290) fry were rearing in the Chilkat River in fall 2001 (2000 brood year). Overwinter survival from fall 2001 to spring 2002 was estimated as 21.1% (SE = 4.8%), and an estimated 105,300 (SE = 17,170) smolts emigrated in 2002. An estimated 1,003 (SE = 212) Chilkat River Chinook salmon from this brood year were harvested in marine fisheries between 2003 and 2007. In addition, 28,649 fry in the fall of 2007 and 2,499 smolts in the spring of 2008 were released with coded wire tags. They averaged 64 mm (SD = 6) fork length in the fall and 88 mm (SD = 11) in the spring. Future recoveries of these fish will allow us to estimate juvenile abundance and marine harvest for the 2006 brood year.

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

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 2004). 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 that targets mature Chinook salmon returning to 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 1989-1991;Ericksen 1994-2005; Ericksen and Marshall 1991). The fishery in Haines contributes significantly to the local economy, supports a salmon derby, and is popular with both Haines residents and anglers from other areas (Bethers 1986; Jones & Stokes 1991).

Beginning in 1981, the Alaska Department of Fish and Game (ADF&G) Division of Sport Fish (SFD) 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 creeks were selected as index areas because they were the only clearwater spawning areas that could provide standardized, consistent survey counts. These index areas were used in a regionwide program to monitor Chinook salmon escapements in Southeast Alaska (Pahlke 1991).

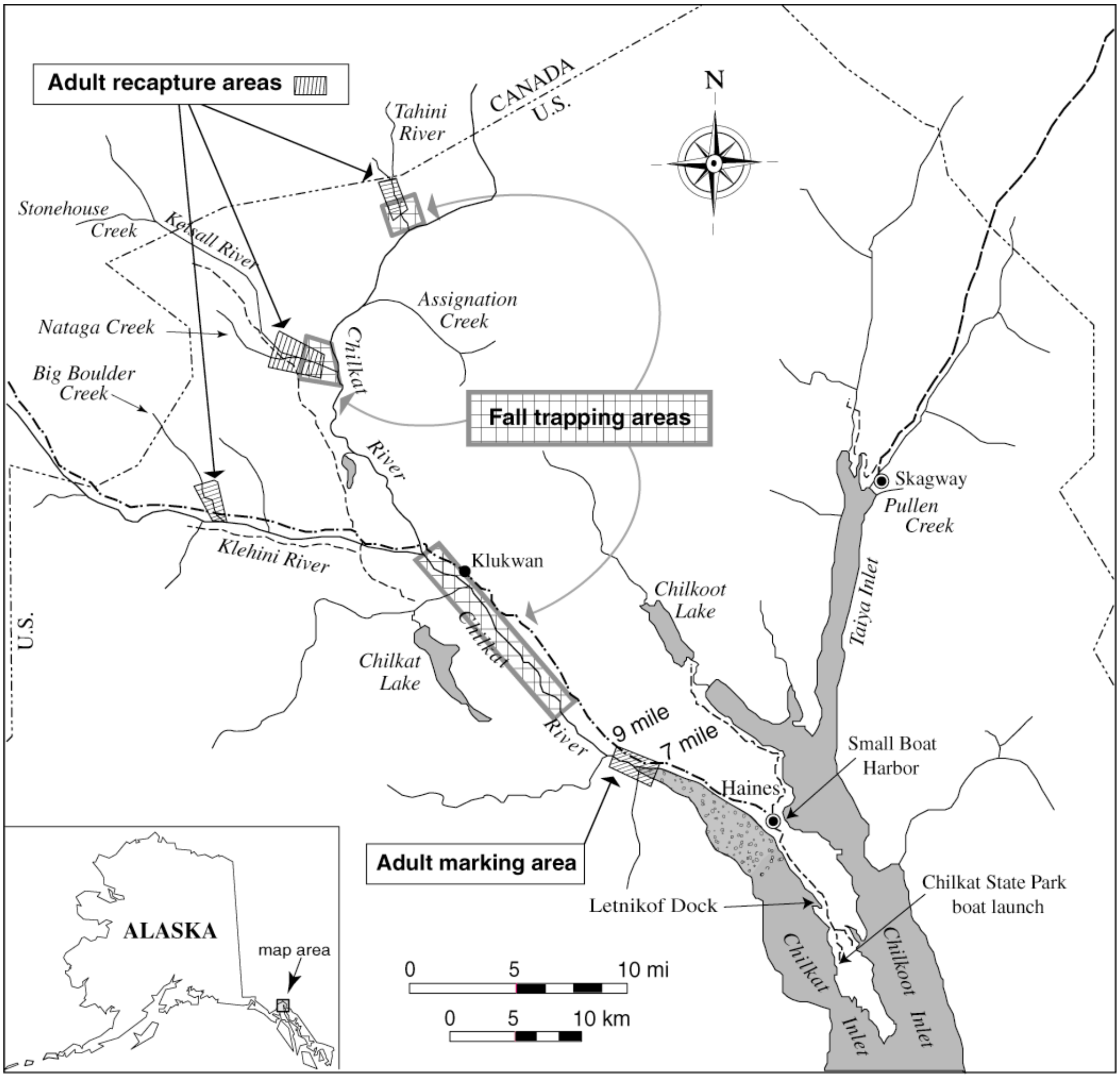


Figure 1.–Location of adult and juvenile Chinook salmon capture, sampling and release sites near Haines and Skagway in Southeast Alaska, 2007.

Concern about the Chilkat River Chinook salmon population 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 sport Chinook salmon fishery near Haines was closed entirely in 1991 and 1992. The Haines King Salmon Derby did not occur from 1988 through 1994.

Because of these concerns, the SFD 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 et al. 1990; Pahlke 1991). SFD also conducted radiotelemetry and mark-recapture experiments in 1991, 1992, and 2005 to estimate spawning distribution and abundance of large (age-1.3 and older) Chinook salmon in the river. Results of this research indicated 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, Ericksen and Chapell 2006, Chapell 2009). SFD has continued to conduct mark-recapture experiments and escapements since 1991 (Johnson et al. 1992, 1993; Johnson 1994; Ericksen 1995–2005, Ericksen and Chapell 2006, Chapell 2009).

In 2000, SFD began to mark Chinook salmon smolts with coded wire tags (CWTs) each spring to estimate the smolt emigration and marine harvest of this stock. During the first year, SFD tagged 1,996 smolts, which was fewer than expected (Ericksen 2002b). To increase the number of Chinook salmon outmigrating from the Chilkat River with CWTs, SFD began tagging juvenile Chinook salmon (fry) beginning in the fall of 2000 (Ericksen 2002a).

ADF&G adopted a biological escapement goal (BEG) of 1,750 to 3,500 large (age-1.3 and older fish, i.e., fish ≥660 mm MEF) Chinook salmon in January 2003 (Ericksen 2004). 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; Ericksen and McPherson 2004).

Saltwater fishing regulations in effect during 2007 prohibited sport fishing for Chinook salmon near the mouth of the Chilkat River (Figure 1). Regionwide regulations allowed resident anglers to keep 3 Chinook salmon 28 inches TL or greater per day and in possession. Regulations for nonresident anglers were a bag and possession limit of 2 Chinook salmon 28 inches TL or greater through May 31, and a bag and possession limit of 1 Chinook salmon 28 inches TL or greater in from June 1 onward. Nonresidents were allowed to keep a total of 4 Chinook salmon 28 inches TL or greater for the whole year. An additional regulation implemented by emergency order in effect June 4-July 31 allowed resident and nonresident anglers fishing in Taiya Inlet to keep 3 Chinook salmon of any size per day and in possession. This regulation was implemented 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.

The purpose of the studies described in this report was to estimate the sport harvest, escapement, and production of Chinook salmon returning to the Chilkat River during 2007. SFD also tagged juvenile Chilkat River Chinook salmon in 2007 to estimate production and future marine harvest of this stock. This report describes the methods and results of the studies and juvenile tagging during 2007, and smolt production and harvest of brood year (BY) 2000 Chilkat River Chinook salmon. The long-term goal of these studies is to refine maximum harvest guidelines for this stock in accordance with sustained yield management.

OBJECTIVES

Research objectives for this project were to estimate:

1. the inriver run of Chinook salmon into the Chilkat River in 2007;
2. the age, sex, and length compositions of the escapement of large Chinook salmon in the Chilkat River in 2007;
3. the harvest of wild mature Chinook salmon in the Haines spring marine boat sport fishery from May 7 to June 24, 2007;
4. the mean length of juvenile Chinook salmon rearing in the Chilkat River drainage during fall 2007;
5. the number of Chinook salmon smolt that emigrated from the Chilkat River in 2002 (BY 2000); and
6. the marine harvest of Chilkat River Chinook salmon from the BY 2000.

METHODS

INRIVER RUN ESTIMATE

An unstratified mark-recapture experiment was used to estimate the number of Chinook salmon that immigrated to the Chilkat River in 2007. Age composition of the 2007 immigration was estimated to develop a series of escapement and brood year returns needed to assess escapement goals for this stock.

Marking Event

Gillnets 21.3 m long and 3.0 m deep (70 ft × 10 ft) were drifted in the lower Chilkat River June 12 through July 27, 2007. The gillnets consisted of 2 equal-length panels: one of 17.1-cm (6.75 inch) and the other of 20.3-cm (8.0 inch) stretch measured nylon mesh. Forty-three (43) drifts were completed between 0600 and 1400 hours each day. Fishing was conducted from an 18-ft boat in 6 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 resumed and completed before a new drift was started. Two 3-basket aluminum fish wheels were operated by the ADF&G Commercial Fisheries Division to tag sockeye *O. nerka*, coho *O. kisutch*, and chum salmon *O. keta* from June 8 to October 9; incidentally captured Chinook salmon were also marked. One fish wheel operated adjacent to milepost (MP) 9 and the other about 300 m downstream (Figure 2). The fish 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. The amount of time each fish wheel was stopped for maintenance was recorded each day.

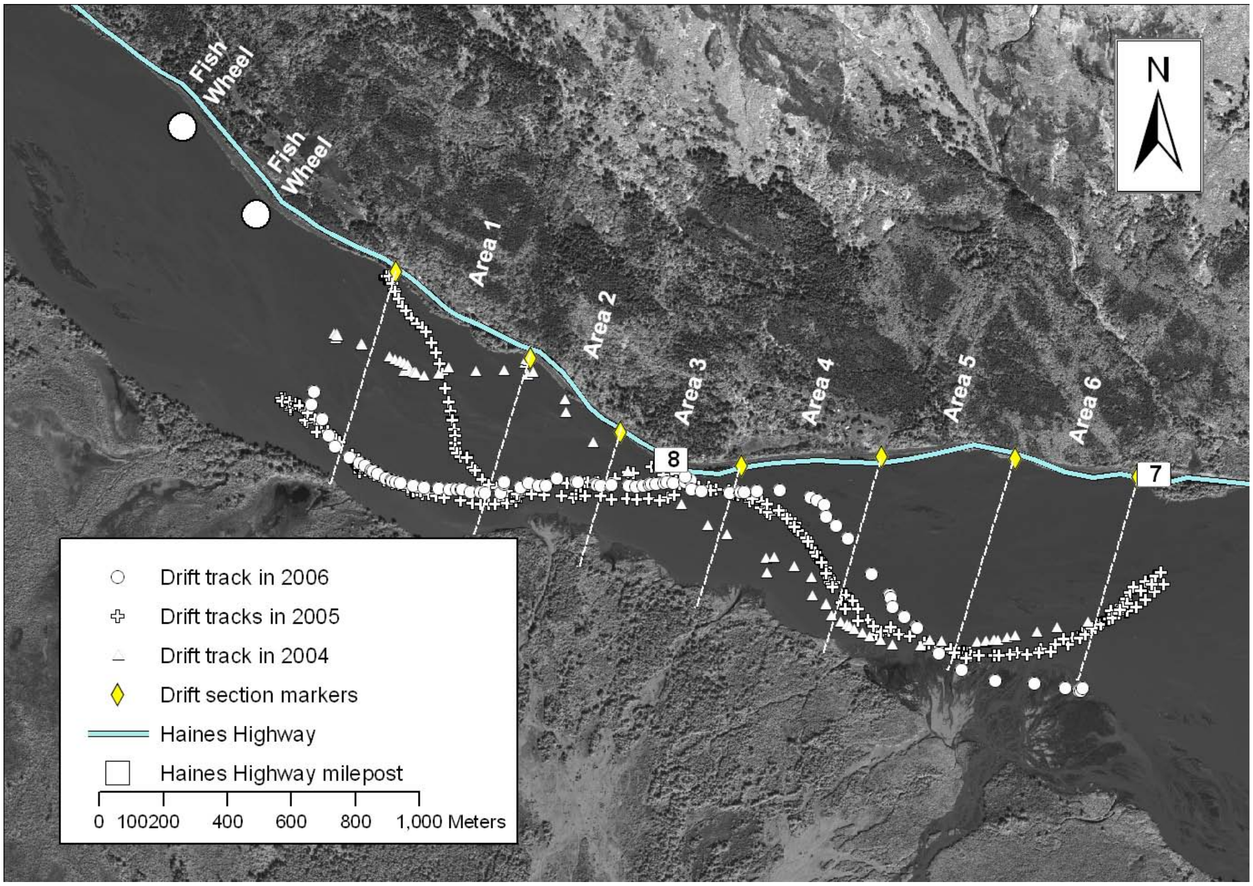


Figure 2.–Section marker locations and gillnet drift paths in the lower Chilkat River, 2004-2006. Area markers remained the same and similar paths were followed in 2007.

Captured Chinook salmon were placed in a water-filled tagging box (see Figure 3 in Johnson [1994]), measured to the nearest 5 mm MEF, sampled for scales, and visually 'sexed'. Fish ≥660 mm MEF were designated as large, fish ≥440 and <660 mm MEF as medium, and fish <440 mm MEF as small. All fish were inspected for missing adipose fins.

All fish with missing adipose fins were scanned with a handheld wand CWT detector in the head area for a CWT, and in the area at the base of the dorsal fin for a second CWT. Heads were removed from all medium and small fish with missing adipose fins. Heads were removed from large fish with missing adipose fins only if no head CWT was detected, to verify tag loss. Collected heads were marked with individually numbered straps and sent to the ADF&G Mark, Tag and Age Laboratory in Juneau for CWT recovery and decoding.

All healthy medium and large Chinook salmon (≥440 mm MEF) not sacrificed for CWT recovery were 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. Healthy small fish (<440 mm MEF) not sacrificed for CWT recovery were marked with a uniquely numbered T-bar anchor tag instead of a spaghetti tag. Unhealthy fish (e.g. lethargic or bleeding from the gills) were released untagged.

All tagged fish were given a ¼-inch hole punch in the upper edge of the left operculum (ULOP) as a secondary mark. Fish captured and tagged in the gillnet gear were also marked by removing the left axillary appendage. This tertiary mark identified the capture gear (fish wheel or gillnet) in the event of primary tag loss.

The scale sampling procedure was to remove 5 scales 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 used to determine age postseason by counting the scale annuli (Olsen 1992). When scale ageing results were available, each fish was reclassified as large, medium, or small using ocean age, rather than length, as criteria; fish with 3 or more ocean years of residence were classified as large, those with 2 ocean years as medium, and those with 1 ocean year were classified as small. Any fish whose scales could not be aged was classified by length as described above.

Recapture Event

Chinook salmon on the Kelsall and Tahini Rivers spawning grounds (Figure 1) were sampled for marks by two 2-person crews. Kelsall River (including Nataga Creek) sampling occurred 7 days/wk August 3-September 1, and Tahini River sampling occurred Monday through Friday August 4-August 31. Chinook salmon were also sampled about every 5 days in Big Boulder Creek August 3-September 1, and in Little Boulder Creek on August 22. Fish were captured using gillnets, dip nets, snagging gear, or by hand. All captured fish were inspected for missing adipose fins, for sex, measured to the nearest 5 mm MEF, and were sampled for scales as described in marking event methods. Duplicate sampling was prevented by punching a hole in the lower edge of the left operculum (LLOP) of all captured fish.

Mark-Recapture Assumptions

The validity of the mark-recapture experiment rests on several assumptions:

(a) every fish has an equal probability of being marked during event 1, or every fish has an equal probability of being captured in event 2, or marked fish mix completely with unmarked fish;

(b) recruitment and "death" (emigration) do not occur between sampling events;

(c) 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) duplicate sampling does not occur (Seber 1982).

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 size-selective sampling was investigated because assumption (a) could be violated if the sampling rate varied by size of the fish. The null hypothesis that fish of different sizes were captured with equal probability during the first and second sampling events was tested using Kolmogorov-Smirnov (K-S) two-sample tests (Conover 1980) to compare size distributions in 3 ways:

(a) fish marked in event 1 versus those recaptured in event 2 (M vs. R),

(b) all fish captured in event 2 versus marked fish recaptured in event 2 (C vs. R),

(c) and fish marked in event 1 versus all fish captured in event 2 (M vs. C).

K-S test results were evaluated using the protocol in Appendix A, which indicated a Case II, where event 1 (combined fish wheel and drift gillnet captures) was not size selective but event 2 (spawning ground captures) was selective. The inriver run was therefore calculated using an unstratified 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 in the lower river, n_2 is the number examined on the spawning grounds, and m_2 is the subset of n_2 that had been marked in the lower river.

The remaining assumptions are considered in the "Discussion."

Age and Sex Composition of the Inriver Run

Age and sex composition estimates can be biased due to sampling methods. Fish wheels are usually selective for smaller fish and males, while the gillnet mesh sizes used in this project are selective for larger fish (Ericksen 1995–2005; Ericksen and Chapell 2006; Chapell 2009). 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 compositions between spawning areas can bias composition estimates for the entire drainage when sampling is not proportional to abundance. Sex determination is more difficult early in the season while marking fish in the lower river (Ericksen 1995–2005).

Age compositions were tabulated separately for fish caught in the lower river by gillnet and fish wheels (event 1), and in each escapement sampling tributary (event 2). Standard sample summary statistics (Cochran 1977) were used to calculate age and sex composition, mean length-at-age, and their variances by event 1 gear type and by event 2 tributary.

Because the K-S tests of size distributions indicated that capture probability was not biased by fish size in event 1, pooled event 1 data were used to estimate the age proportions of the escapement by:

$$\hat{p}_a = \frac{n_a}{n} \qquad (3)$$

$$var[\hat{p}_a] = \frac{\hat{p}_a\ (1-\hat{p}_a)}{n-1} \qquad (4)$$

where p_a is the proportion of age class a fish, n_a is the number of age class a fish in the sample, and n is the number of fish in the sample. The abundance of age a fish in the escapement was estimated by:

$$\hat{N}_a = \hat{N}\ \hat{p}_a \qquad (5)$$

$$var[\hat{N}_a] = var[\hat{p}_a]\hat{N}^2 + var[\hat{N}]\hat{p}_a^{\,2} - var[\hat{p}_a]var[\hat{N}] \qquad (6)$$

The abundance estimate of large fish (age-1.3 and older) was calculated in the same way using equations 3 through 6 with the proportion $\hat{p}_a$ being that of age-1.3 and older fish.

Contingency table analysis (χ^2 test) was used to detect sex-selective sampling in the first and second sampling events, using the null hypothesis that the probability that a sampled fish is male or female is independent of sample in 3 comparisons, similar to comparisons of length distributions:

a) fish marked in event 1 versus those recaptured in event 2 (M vs. R),

b) all fish captured in event 2 versus marked fish recaptured in event 2 (C vs. R),

c) and fish marked in event 1 versus all fish captured in event 2 (M vs. C).

Evaluation of the sex chi^2-test results using protocols in Appendix A indicated that further evaluation was required. Therefore, only pooled event 2 samples were used to estimate proportions by sex within each age class by:

$$\hat{p}_s = \frac{n_s}{n} \tag{7}$$

$$var[\hat{p}_s] = \frac{\hat{p}_s\ (1-\hat{p}_s)}{n-1} \tag{8}$$

where p_s is the proportion of fish of sex s, n_s is the number of fish in the sample of sex s, and n is the number of sex s fish in the sample.

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

$$\hat{N}_s = \hat{N}\ \hat{p}_s \tag{9}$$

$$var[\hat{N}_{a,s}] = var[\hat{p}_s]\hat{N}_a^{\ 2} + var[\hat{N}_a]\hat{p}_s^{\ 2} - var[\hat{p}_s]var[\hat{N}_a] \tag{10}$$

TERMINAL HARVEST

2007 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 King Salmon Derby (May 26–28, June 2 and 3) 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 2214 to 2352 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 indicated 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 May 7-June 24, 2007, 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 3 evening strata were sampled each week, except as noted below. During the peak of the fishery (May 7–June 10) the evening strata at Letnikof Dock were further divided into weekday and weekend stratification. During this time, 2 morning, 2 weekday evening, and 2 weekend/holiday evening periods were sampled each week. In total, 17 unique strata were sampled at Letnikof Dock in 2007.

Sampling at the Small Boat Harbor was initiated on May 7 and continued through June 24. Sampling at the Chilkat State Park boat launch was initiated on May 14, and ended on June 24. There was no type of day stratification at the low-use sites. At the low-use harbors, each biweekly period was divided into 14 morning and 14 evening periods of equal length, except during the Haines King Salmon Derby, when the biweek was divided into one 9-day (non-derby) period and one 5-day (derby) with no time-of-day stratification. Because of the very low use levels at Chilkat State Park boat launch, the initial 7-day stratum and final 7-day stratum had no time-of-day stratification. Random selections determined primary units to sample within each morning and evening stratum. To accommodate the impossibility of sampling the three sites simultaneously with only 2 technicians, 11 changes (period moves) were made to the randomly selected sample periods at low-use sites. Sixteen (16) unique strata were sampled at the low-use harbors during 2007.

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 targeting salmon, hours fished targeting species other than salmon, type of trip (charter or non-charter), target species (Chinook salmon, Pacific halibut *Hippoglossus stenolepis*), and number of fish caught/kept by species. Boat-party interviews also included sampling all harvests of Chinook salmon for maturity and missing adipose fins. Maturity was determined (Appendix A in Ericksen 1994) 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 1 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):

$$\hat{H}_h = D_h \overline{H}_h \qquad (11)$$

$$\overline{H}_h = \frac{\sum_{i=1}^{d_h} \hat{H}_{hi}}{d_h} \qquad (12)$$

$$\hat{H}_{hi} = M_{hi} \frac{\sum_{j=1}^{m_{hi}} h_{hij}}{m_{hi}} \qquad (13)$$

where h_{hij} is the harvest on boat j in sampling days (periods) i in 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:

$$var\left[\hat{H}_h\right] = (1 - f_{1h}) D_h^{\,2} \frac{\sum_{i=1}^{d_h} (\hat{H}_{hi} - \overline{H}_h)^2}{d_h(d_h \text{ -1})} + D_h \sum_{i=1}^{d_h} M_{hi}^{\,2} (1 - f_{2hi}) \frac{\sum_{j=1}^{m_{hi}} (h_{hij} \text{-} \overline{h}_{hi})^2}{d_h m_{hi} (m_{hi} \text{ -1})} \qquad (14)$$

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 (11) through (14). Total harvests for the season are the sums across strata ΣH_h and $\Sigma var[H_h]$. Similarly, effort and harvest by charter boat anglers were estimated by considering only data collected from chartered anglers in equations (11) through (14). Angler effort targeting salmon using trolling gear was calculated in salmon-h, and effort targeting all fish species and all rod & reel gear, including salmon trolling, was calculated in angler-h.

Chinook salmon sampled in the angler harvest were measured to the nearest 5 mm FL and sampled for age by collecting scale samples as described above in the marking event methods. Information recorded for each Chinook salmon sampled included sex, length, maturity, scale sample number, and presence or absence of adipose fins.

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

$$\hat{p}_a = \frac{\sum_h \hat{H}_h \, \hat{p}_{a,h}}{\sum_h \hat{H}_h} \qquad (15)$$

where the estimated harvests supply appropriate 'weights' for the different stratum sizes. Variance was approximated as:

$$\mathrm{var}(\hat{p}_a) \cong \hat{H}^{-2} \sum_h \hat{H}_h^2 \, \mathrm{var}\left(\hat{p}_{a,h}\right) + \hat{H}^{-2} \sum_h \mathrm{var}\left(\hat{H}_h\right)\left(\hat{p}_{a,h} - \hat{p}_a\right)^2 \qquad (16)$$

where the approximation is 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 to the 2007 Haines Marine Sport Fishery

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 2007 Haines marine boat sport fishery was estimated:

$$\hat{r}_{ij} = \hat{H}_i \left(\frac{m_{ij}}{\lambda_i n_i} \right) \hat{\theta}_j^{-1} \qquad (17)$$

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 λ_i adjusts for imperfect tracking and decoding of 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 (Table 2 in Bernard and Clark [1996]) for wild or hatchery stocks harvested in the recreational fishery. The total contribution of 1 or more cohorts to 1 or more fisheries is the sum of harvests and variances from the individual cohorts and strata.

JUVENILE TAGGING

Juvenile Chinook salmon (BY 2006) were captured in primary rearing areas of the Chilkat River drainage during the fall of 2007 (fry) and in the mainstem of the Chilkat River during the spring of 2008 (smolt) and marked with an adipose fin clip and a CWT. In addition, smolt tagged in the spring were given a second CWT inserted in the back just posterior of the dorsal fin to distinguish spring-tagged from fall-tagged fish. Adult fish will be sampled from the escapement between 2009 and 2013 to estimate the marked fraction. A handheld CWT wand detector will be used to identify adults in the escapement that were tagged as smolt without sacrificing the fish, This information will allow estimation of the fall rearing abundance in 2007 and smolt emigration in 2008. In addition, random recoveries of CWTs in sampled marine fisheries will allow estimation of 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 2007. Trapping began in upriver locations and moved downstream as the season progressed. The Tahini River was trapped September 11-20, the Chilkat River near the mouth of the Chilkat River September 28-30, the Kelsall River from October 4-16, and the lower Chilkat River near MP 19 October 21-30. In spring 2007, the lower Chilkat River (below MP 21) was trapped from April 9 to May 24.

A crew consisting of 4 people fished approximately 100 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 juveniles ≥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. In fall 2007, every 100th fish tagged with a CWT was additionally measured to the nearest mm FL. In spring 2008, every 20th fish was measured to the nearest mm FL and weighed to the nearest 0.1 g.

All marked fish were held overnight to check for 24-h 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 Laboratory in Juneau at the completion of the field season.

BROOD YEAR 2000 JUVENILE ABUNDANCE

Between September 19 and October 26, 2001, 23,154 Chinook salmon fry from BY 2000 were captured, marked with adipose fin clips and CWTs, and released into the Tahini, Kelsall, and Chilkat Rivers (Ericksen 2002a). Between April and June 2002, an additional 4,709 smolts (also BY-2000) were marked and released into the Chilkat River (Ericksen 2002a).

Between 2003 and 2007, the Division of Commercial Fisheries sampled landings from commercial drift gillnet, set gillnet, purse seine, and troll fisheries throughout Southeast Alaska and Yakutat for fin clips and CWTs. During summer and early fall, samplers were stationed at processors in Ketchikan, Craig, Wrangell, Petersburg, Sitka, Pelican, Port Alexander, Elfin Cove, Excursion Inlet, and Juneau. The sample goal was to inspect at least 20% of the total catch of Chinook salmon for missing adipose fins. Heads from fish missing their adipose fin were sent to the ADF&G Mark, Tag, and Age Laboratory in Juneau on a weekly basis where CWTs were removed and decoded. The annual Division of Commercial Fisheries port sampling manual (ADF&G *Unpublished*) provides a detailed explanation of commercial catch sampling procedures and logistics.

The number of BY 2000 Chilkat River Chinook salmon CWTs recovered 2003–2007 in all commercial, sport, and subsistence fisheries and the number recovered from Chilkat River escapement sampling events was tallied by release period, whether fall 2001 or spring 2002.

A statistical model was fit to the BY 2000 data to obtain estimates of the number of BY-2000 fry rearing in the Chilkat River in fall 2001 ($\mathbf{N_{FRY}}$), the overwinter survival to spring 2002 (ϕ_1), and the number of smolts outmigrating in 2002 ($N_{\mathbf{SMOLT}}$).

The number of valid CWTs from fall and spring marking events recovered from Chinook salmon sampled in the Chilkat River from 2003 to 2007 was modeled as having a multinomial distribution with parameters π_1, π_2, π_3, π_4, and C, where:

$\pi_1 = q_{FALL}\ \rho$,

$\pi_2 = q_{SPRING}\ \rho$,

$\pi_3 = (q_{FALL} + q_{SPRING})\ (1\text{-}\rho)$,

$\pi_4 = 1 - \pi_2 - \pi_3$, and

C = number of Chinook salmon captured in the Chilkat River and inspected for adipose clips in 2003–2007,

$q_{FALL} = M_{FRY} / N_{FRY}$

$q_{SPRING} = M_{SMOLT} / N_{SMOLT}$

ρ = the proportion of adipose-clipped fish for which the head was collected and a CWT was successfully decoded,

M_{FRY} = number of CWTs applied to Chinook salmon fry marked during fall 2001,

M_{SMOLT} = number of CWTs applied to Chinook salmon smolts marked during spring 2002,

N_{FRY} = abundance of Chinook salmon fry during the fall 2001 marking event,

N_{SMOLT} = abundance of Chinook salmon smolts during spring 2002 marking event, equal to the product of N_{FRY} and:

ϕ_1 = the survival probability from fall 2001 to spring 2002.

The relative proportion of fall and spring CWTs recovered elsewhere (fisheries outside of the Chilkat River) also contains information about the survival probability ϕ_1. Therefore the number of valid CWTs from the fall 2001 marking event recovered from Chinook salmon sampled elsewhere from 2003 to 2007 was modeled as having a binomial distribution with parameters,

$\pi_{FALL} = q_{FALL} / (q_{FALL} + q_{SPRING})$, and

m = number of Chilkat fall and spring CWTs recovered in fisheries outside of the Chilkat River from 2003 to 2007.

Bayesian statistical methods, which are well-suited for analyzing unconventional data[1], were used to estimate the parameters of the model. Bayesian methods use probability distributions to express uncertainty about model parameters. The user supplies the "prior" probability distribution, which expresses knowledge about the parameters outside the frame of the experiment itself. The output of a Bayesian analysis is the "posterior" distribution, which describes the new, updated knowledge about the parameters after consideration of the experimental data. Percentiles of the posterior distribution can be used to construct one-sided probability statements or two-sided intervals about the parameters. Point estimates are de-emphasized in Bayesian statistics; however the mean, median, or mode of the posterior can be used to describe the central tendency of a parameter. The standard deviation of the posterior distribution can be used as an analogue of the standard error of a point estimate in classical statistics.

Bayesian analyses require that prior probability distributions be specified for all unknowns in the model. A normal prior distribution with very large variance was specified for N_{FRY}, essentially equivalent to a uniform distribution. A beta (0.1, 0.1) prior was used for ϕ_1 and ρ. All priors were non-informative, chosen to have a negligible effect on the posterior.

Markov-Chain Monte Carlo simulation, implemented with the Bayesian software WinBUGS (Gilks et al. 1994), was used to draw samples from the joint posterior probability distribution of all unknowns in the model. Three Markov chains were initiated, a 4,000-sample burn-in period discarded, and 100,000+ updates generated to estimate the marginal posterior means, standard deviations, and percentiles. The diagnostic tools of WinBUGS were used to assess mixing and convergence. Interval estimates were obtained from percentiles of the posterior distribution. WinBUGS model code, data, initial values, and results are in Appendix E1.

BROOD YEAR 2000 ADULT HARVEST

Harvest of BY 2000 Chilkat River Chinook salmon was estimated from fish sampled for CWTs in marine commercial and recreational fisheries harvests, and in the Chilkat River escapement to determine the fraction θ_h of BY 2000 fish carrying a CWT.

Because several fisheries exploited Chinook salmon over several months and years, harvest was estimated over several strata, each a combination of time, area, and type of fishery. Statistics from the commercial troll fishery were stratified by troll fishing period and quadrant. Statistics from drift gillnet fisheries were stratified by statistical week and district. Statistics from the Haines area marine subsistence gillnet fishery were stratified by year. In recreational fisheries where creel survey programs estimate harvest, statistics were stratified by fortnight (biweek). In recreational fisheries with no biweekly harvest estimates from creel surveys, annual Statewide Harvest Survey data were used and statistics were stratified by year. Hubartt et al. (1997) describe methods of sampling recreational fisheries in Southeast Alaska.

Data from the port sampling and creel survey programs were used to estimate the commercial and recreational harvest of Chinook salmon bound for the Chilkat River following equation 17[2]. The variance of the individual harvest contribution estimates $\{r_i\}$ (by stratum) followed Table 2 in Bernard and Clark ([1996]; situations 3 and 4) for a wild stock harvested in commercial and recreational fisheries.

Estimates of harvest were summed across strata and across fisheries to obtain an estimate of the total harvest, $\hat{T}$:

[1] The juvenile abundance data would be difficult to analyze correctly using standard statistical methods.

[2] Except that, in the case of commercial fisheries, the harvest N is known, not estimated.

$$\hat{T} = \sum_i \hat{r}_i \quad (18)$$

$$\text{v}[\hat{T}] = \sum_i \text{v}[\hat{r}_i] \quad (19)$$

Variance was estimated as the sum of variances across strata (no covariance terms required) because sampling was independent across strata and fisheries.

Return (harvest plus escapement) of Chinook salmon returning to the Chilkat River from the BY 2000 was estimated as:

$$\hat{R} = \hat{T} + \hat{S} \quad (20)$$

$$var[\hat{R}] = var[\hat{T}] + var[\hat{S}] \quad (21)$$

where $\hat{S}$ is the total escapement of age-1.2 and older BY 2000 fish estimated between 2004 and 2007.

The fraction of the return harvested (the exploitation rate) was calculated as:

$$\hat{\mu} = \frac{\hat{T}}{\hat{R}} = \frac{\hat{T}}{\hat{S} + \hat{T}} \quad (22)$$

$$var[\hat{\mu}] \approx \frac{var[\hat{T}]\hat{S}^2}{\hat{R}^4} + \frac{var[\hat{S}]\hat{T}^2}{\hat{R}^4} \quad (23)$$

where the approximate variance was derived by the delta method (Seber 1982).

The estimated marine survival rate (smolt to adult) and the delta-method approximation of its variance were calculated as:

$$\hat{\phi}_2 = \frac{\hat{R}}{\hat{N}_{SMOLT}} \quad (24)$$

$$var[\hat{\phi}_2] \approx \hat{\phi}_2^2 \left[\frac{var[\hat{R}]}{\hat{R}^2} + \frac{var[\hat{N}_{SMOLT}]}{\hat{N}_{SMOLT}^2} \right] \quad (25)$$

RESULTS

INRIVER RUN ESTIMATE

ADF&G captured 87 large, 36 medium, and 77 small Chinook salmon in the lower Chilkat River with drift gillnets and fish wheels between June 12 and August 5, 2007 (Table 1, Figure 3). Of those captured, 87 large, 34 medium, and 66 small fish were given a uniquely numbered external tag and an ULOP. Two medium and 11 small fish were missing adipose fins and were sacrificed to recover CWTs. Capture rates of large Chinook salmon peaked on July 9 (Figure 3), which was also the mean date of capture for large fish (Figure 4). The mean date of migratory timing for all sizes of fish in the lower river was July 11 (Figure 3; Mundy 1984).

The number of Chinook salmon examined during the recapture event included 270 large, 161 medium, and 25 small fish, of which 17 large, 6 medium, and 2 small had been tagged during the marking event (Table 2). One large fish marked with an ULOP was recovered missing its spaghetti tag; this fish was also marked with a LAA clip.

Table 1.–Number of Chinook salmon caught in the lower Chilkat River by time period, gear type and size, June 12–August 5, 2007.

	Drift gillnet			Fish wheels			Combined			
Time period	Large	Medium	Small	Large	Medium	Small	Large	Medium	Small	Total
6/12 - 6/16	1	0	0	0	0	2	1	0	2	3
6/17 - 6/21	1	1	0	0	0	0	1	1	0	2
6/22 - 6/26	5	1	0	0	0	2	5	1	2	8
6/27 - 7/01	3	2	0	2	3	1	5	5	1	11
7/02 - 7/06	8	1	0	6	2	5	14	3	5	22
7/07 - 7/11	7	5	0	3	7	16	10	12	16	38
7/12 - 7/16	8	2	0	5	4	11	13	6	11	30
7/17 - 7/21	4	0	0	2	7	33	6	7	33	46
7/22 - 7/26	0	1	0	0	0	4	0	1	4	5
7/27 - 7/31	28	0	0	4	0	2	32	0	2	34
8/01 - 8/05	0	0	0	0	0	1	0	0	1	1
	65	13	0	22	23	77	87	36	77	200

Note: L = age-1.3 and older fish, M = age-1.2 fish, S = age-1.1 fish.

Table 2.–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 2007.

		Inspected[a]									Marked						
		Large				Medium			Small		Large			Medium		Small	
	Dates	M	F	U	Total	M	F	Total	M	Total	M	F	Total	M	Total	M	Total
Kelsall River	8/03-9/01	56	59	4	119	30	0	30	5	5	5	5	10	0	0	0	0
Big Boulder	8/03-9/01	19	25	1	45	34	0	34	8	8	1	0	1	0	0	2	2
Little Boulder	8/22	0	2	0	2	1	0	1	0	0	0	0	0	0	0	0	0
Tahini River	8/04-8/31	65	37	2	104	95	1	96	12	12	3	3	6	6	6	0	0
Total		140	123	7	270	160	1	161	25	25	9	8	17	6	6	2	2

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

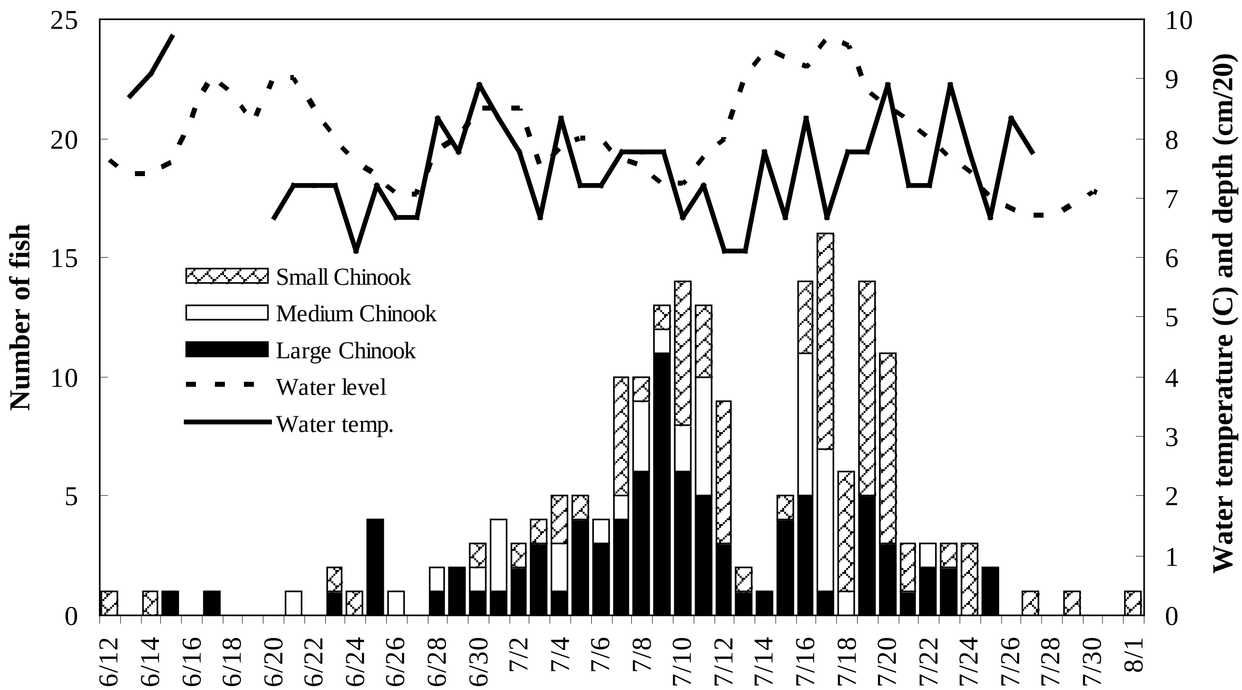


Figure 3.–Daily water depth (cm/20), temperature (°C), and catches of small (age-1.1), medium (age-1.2), and large (≥ age-1.3) Chinook salmon in drift gillnets and fish wheels operating in the lower Chilkat River, June 12–August 5, 2007.

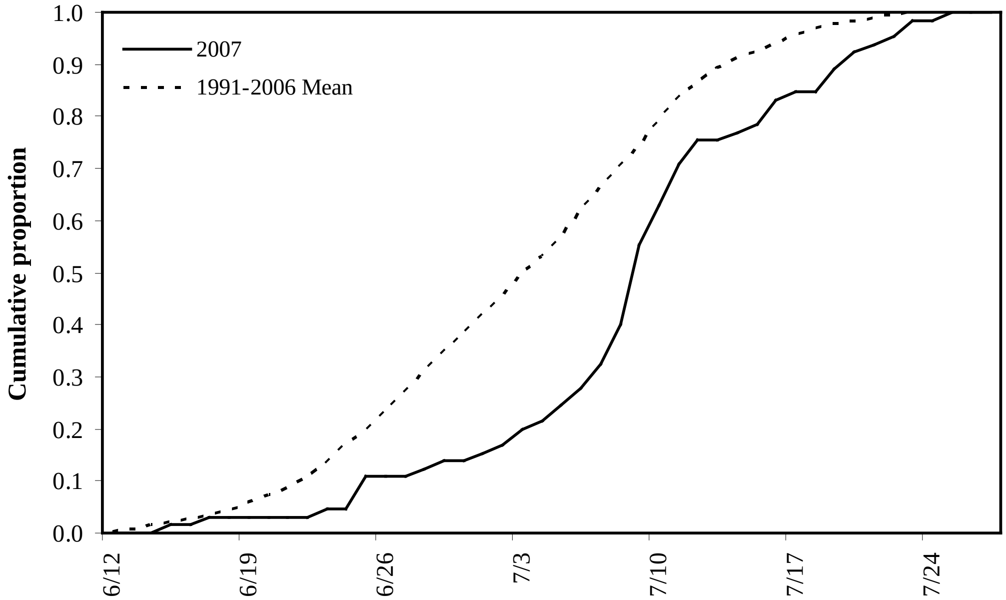


Figure 4.–Cumulative proportion of large (≥age-1.3) Chinook salmon captured with drift gillnets in the lower Chilkat River June 12-July 27, 2007 compared to the mean cumulative proportion, 1991–2006.

Recapture rates of marked fish were not significantly different for fish marked in the first half of event 1 (13%, June 12-July 11) versus the second half (12%, July 12-August 5) (χ^2 = 0.140, df = 1, P = 0.708), so the Petersen-type model used to estimate the inriver run was not stratified by time. The marked fractions of Chinook salmon sampled at the three spawning tributaries (Kelsall 6.5%, Tahini 5.7%, Klehini tributaries 3.3%) were not different (χ^2 = 1.119, df = 2, P = 0.572), so the abundance estimate was not stratified by area.

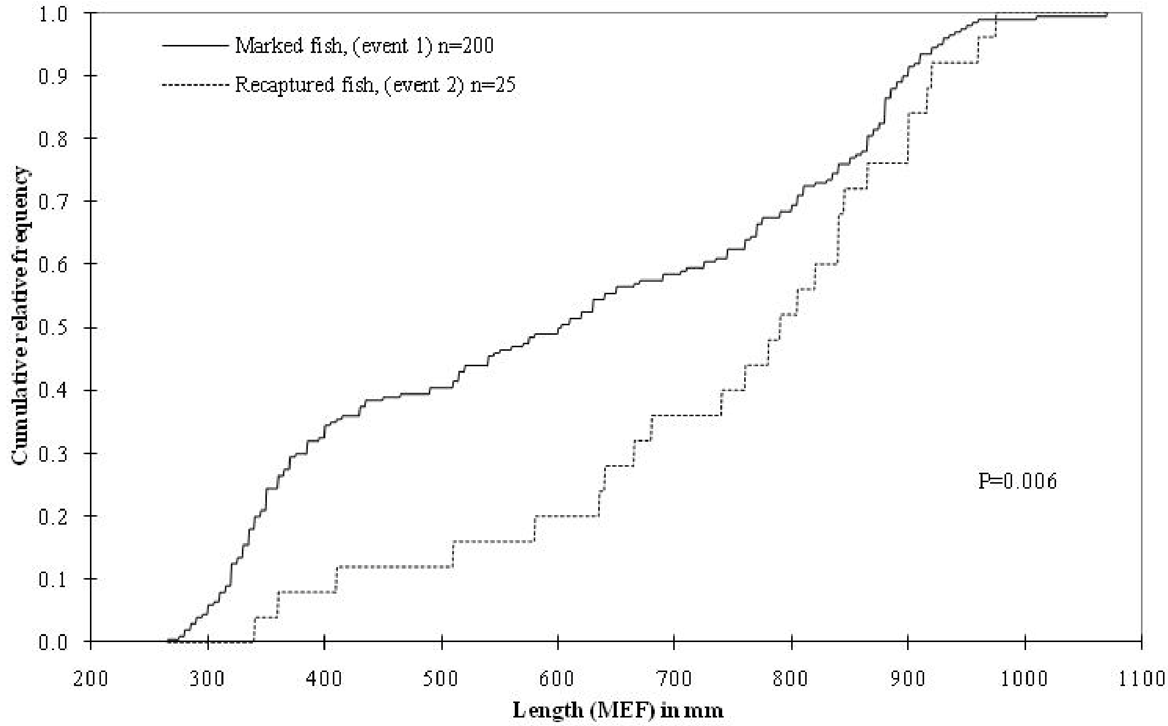
Size selectivity was evaluated by comparing length distributions using the protocol in Appendix A. The length distribution of Chinook salmon marked in the lower Chilkat River (combined fish wheel and drift gillnet captures) was significantly different from that of marked Chinook salmon recaptured on the spawning grounds (K-S test, D = 0.345, P = 0.006, Figure 5, top). The length distribution of all fish captured in event 2 was not significantly different from that of the marked fish recaptured in event 2 (K-S test, D = 0.168, P = 0.490, Figure 5, bottom). These results indicated size-selective sampling during the second event but not the first (Case II in Appendix A), so the abundance estimate was not stratified by size.

Similar tests conducted for sex selectivity concluded that sex composition did not differ (α = 0.1) between marked and recaptured fish, or between captured and recaptured fish, but the sample size of recaptured fish was small (< 30 fish), so further evaluation was required (Appendix A, Table 3). The sex compositions of marked and captured fish were different, but this difference could be attributed to the power of large sample sizes. Sex identification during event 1 has historically been unreliable for this project (Table 4). Therefore, the abundance estimate was not stratified by sex.

Table 3.–Contingency table tests for evaluation of sex selectivity in mark-recapture events 1 and 2.

	Number of fish		
	Male	Female	
Marked	66	120	
Captured	124	325	
Recaptured	8	17	
Comparison	χ^2	df	P
Marked vs. recaptured	0.118	1	0.732
Captured vs. recaptured	0.226	1	0.634
Marked vs. captured	3.882	1	0.049

An estimated 3,303 (SE = 573) Chinook salmon of all ages immigrated into the Chilkat River in 2007 (Table 5). These estimates are germane to the time of marking at lower river capture sites because an unknown number of Chinook salmon are removed due to predation and subsistence fishery harvest between marking and recovery events.



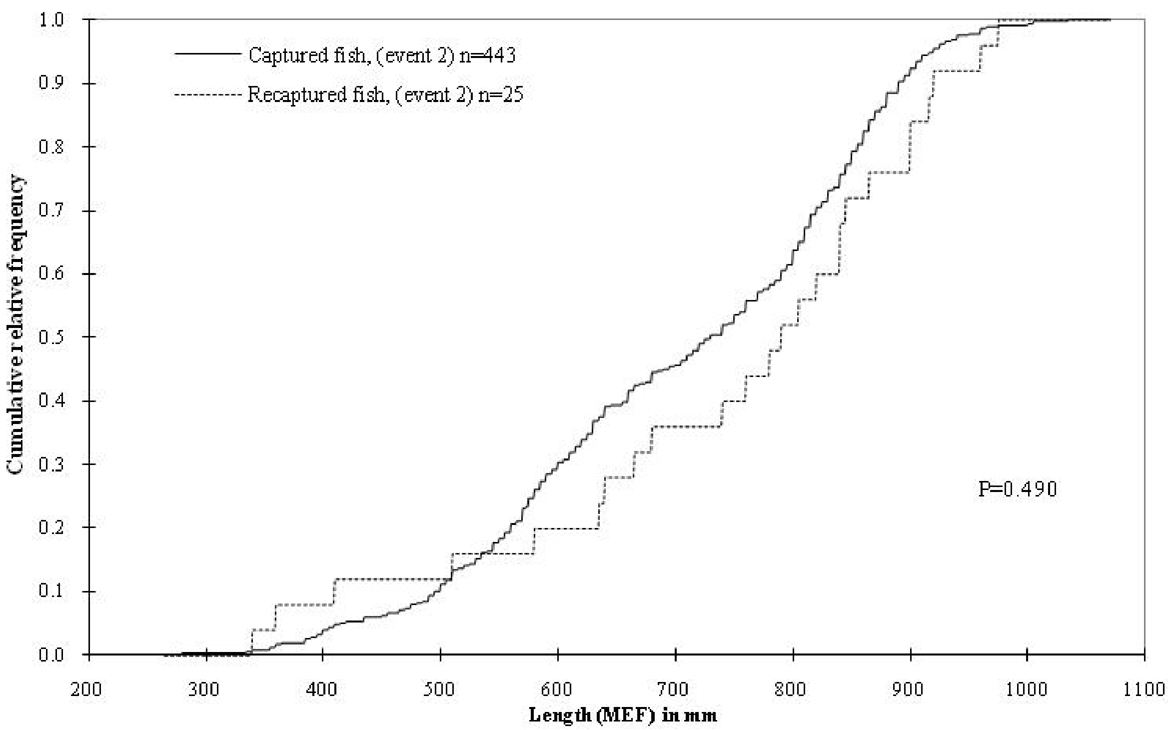


Figure 5.–Empirical cumulative distribution function (ECDF) of MEF lengths of all marked Chinook salmon recaptured on the spawning grounds versus all fish marked in the lower Chilkat River (top) and versus all fish captured on the spawning grounds (bottom), 2007.

Table 4.–Sex determination error rates in Chilkat River Chinook salmon mark–recapture studies, 1991–2007.

Year	Number of recaptures examined	Number incorrectly sexed	Error rate	Data source
1991	24	3	0.13	Ericksen 1995
1992	24	4	0.17	Ericksen 1995
1993	21	2	0.10	Ericksen 1995
1994	32	3	0.09	Ericksen 1995
1995	17	4	0.24	Ericksen 1996
1996	31	5	0.16	Ericksen 1997
1997	29	5	0.17	Ericksen 1998
1998	28	2	0.07	Ericksen 1999
1999	32	7	0.22	Ericksen 2000
2000	37	5	0.14	Ericksen 2001
2001	46	11	0.24	Ericksen 2002a
2002	54	4	0.07	Ericksen 2003
2003	59	9	0.15	Ericksen 2004
2004	43	1	0.02	Ericksen 2005
2005	28	5	0.18	Ericksen and Chapell 2006
2006	32	1	0.03	Chapell 2009
2007	25	3	0.12	
Total	562	74	0.13	

Table 5.–Unstratified inriver run estimate and sampling statistics of Chilkat River Chinook salmon, 2007.

Marked	Examined	Recaptures	Abundance	
n_1	n_2	m_2	$\hat{N}_a$	SE [$\hat{N}_a$]
187	456	25	3,303	573

Age and Sex Composition of the Inriver Run

Fish captured in gillnets were predominantly age-1.4 (50.0%) or age-1.3 (33.8%) and classified as female (62.8%, Table 6). Those captured in the fish wheels were classified mostly as males (86.1%) and were most commonly age-1.1 (61.9%) or age-1.3 (19.5%). More than half (51 out of 78) of the fish in the drift gillnets were captured in the large mesh (8-in) panel. The overall age composition of fish captured in the combined lower Chilkat River gear types was 38.0% age-1.1, 18.2% age-1.2, 17.7% age-1.3, and 26.0% age-1.4 (Table 6).

Following the Case II protocol in Appendix A, the event-1 age proportions (Table 6) were used to estimate the inriver run age composition as 1,256 (SE = 246) age-1.1, 602 age-1.2 (SE = 138), 585 (SE = 136) age-1.3, and 860 (SE = 182) age-1.4 (Table 7). The estimated inriver abundance of large fish (age-1.3 and older) was 1,445 (SE = 227).

ADF&G sampled 451 Chinook salmon on the spawning grounds for age and sex. Of those sampled, 430 were successfully aged (Table 8). Age compositions were significantly different between the Tahini, Kelsall, and Klehini river spawning ground samples (χ^2 test, $\alpha = 0.1$; Table 8). Age-1.2 was the most abundant age class in Tahini and Klehini River, while age-1.4 was the most abundant age class in the Kelsall River samples.

Male fish predominated at all three sampling locations. Should sex composition estimates of the escapement be required for historical comparisons, they can be derived from the sex ratios within each age class using the information in Table 8.

Table 6.–Age composition and mean length-at-age (mm MEF) of Chinook salmon sampled during tagging operations on the Chilkat River, by gear type, 2007.

		Brood year and age class					
		2004	2003	2002	2001	Total	Total
		1.1	1.2	1.3	1.4	aged	sampled[a]
DRIFT GILLNET							
Males	Sample size	0	11	13	5	29	29
	Percent		37.9%	44.8%	17.2%		37.2%
	SE(%)		9.0%	9.2%	7.0%		5.5%
	Mean length		630	766	887		
	SD			77.2	86.5		
Females	Sample size	0	1	12	32	45	49
	Percent		2.2%	26.7%	71.1%		62.8%
	SE(%)		2.1%	6.3%	6.5%		5.5%
	Mean length		603	776	880		
	SD			36.7	36.8		
All fish	Sample size	0	12	25	37	74	78
	Percent		16.2%	33.8%	50.0%		
	SE(%)		4.2%	5.4%	5.7%		
	Mean length		628	771	881		
	SD			47.9	44.7		
FISH WHEELS							
Males	Sample size	73	20	5	3	101	105
	Percent	72.3%	19.8%	5.0%	3.0%		86.1%
	SE(%)	4.4%	3.9%	2.1%	1.7%		3.1%
	Mean length	346	543	751	892		
	SD	42.1	56.6	108.3	122.7		
Females	Sample size	0	3	4	10	17	17
	Percent		17.6%	23.5%	58.8%		13.9%
	SE(%)		9.2%	10.3%	11.9%		3.1%
	Mean length	0	513	815	903		
	SD		25.2	46.5	64.5		
All fish	Sample size	73	23	9	13	118	122
	Percent	61.9%	19.5%	7.6%	11.0%		
	SE(%)	4.4%	3.6%	2.4%	2.8%		
	Mean length	346	539	779	900		
	SD	42.1	54.2	88.4	75.2		
COMBINED LOWER RIVER GEAR							
Males	Sample size	73	31	18	8	130	134
	Percent	56.2%	23.8%	13.8%	6.2%		67.0%
	SE(%)	4.3%	3.7%	3.0%	2.1%		3.3%
	Mean length	346	574	762	889		
	SD	42.1	63.7	83.8	92.6		
Females	Sample size	0	4	16	42	62	66
	Percent	0.0%	6.5%	25.8%	67.7%		33.0%
	SE(%)	0.0%	3.0%	5.4%	5.8%		3.3%
	Mean length	0	536	786	885		
	SD		49.3	41.6	45.1		
All fish	Sample size	73	35	34	50	192	200
	Percent	38.0%	18.2%	17.7%	26.0%		
	SE(%)	3.4%	2.7%	2.7%	3.1%		
	Mean length	346	570	773	886		
	SD	42.1	62.9	67.4	54.1		

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

Table 7.–Estimated inriver run of Chinook salmon in the Chilkat River, by age and sex, 2007.

	Brood year and age class				
	2004	2003	2002	2001	
	1.1	1.2	1.3	1.4	Total
Male	1,256	598	381	317	2,553
SE	246	138	91	77	270
Female	0	4	204	543	751
SE	-	4	53	121	124
All fish	1,256	602	585	860	3,303
SE	246	138	136	182	573

Table 8.–Age composition and mean length-at-age (mm MEF) of Chinook salmon sampled during recovery surveys in the Chilkat River drainage by spawning tributary, 2007.

		Brood year and age class					
		2004	2003	2002	2001	Total	Total
		1.1	1.2	1.3	1.4	aged	sampled[a]
		Tahini River					
Males	Sample size	11	91	42	16	160	173
	Percent	6.9%	56.9%	26.3%	10.0%		82.0%
	SE(%)	2.0%	3.9%	3.5%	2.4%		2.7%
	Mean length	383	573	782	869		
	SD	41	65	90	85		
Females	Sample size	0	1	21	14	36	38
	Percent	0.0%	2.8%	58.3%	38.9%		18.0%
	SE(%)		2.8%	8.3%	8.2%		2.7%
	Mean length		490	797	873		
	SD			51	35		
All fish	Sample size	11	92	63	30	196	211
	Percent	5.6%	46.9%	32.1%	15.3%		
	SE(%)	1.6%	3.6%	3.3%	2.6%		
	Mean length	383	573	787	871		
	SD	41	66	79	65		
		Klehini River					
Males	Sample size	8	35	16	3	62	62
	Percent	12.9%	56.5%	25.8%	4.8%		69.7%
	SE(%)	4.3%	6.3%	5.6%	2.7%		4.9%
	Mean length	378	596	758	820		
	SD	34	56	65	69		
Females	Sample size	0	0	7	20	27	27
	Percent	0.0%	0.0%	25.9%	74.1%		30.3%
	SE(%)			8.6%	8.6%		4.9%
	Mean length			772	842		
	SD			39	57		
All fish	Sample size	8	35	23	23	89	89
	Percent	9.0%	39.3%	25.8%	25.8%		
	SE(%)	3.0%	5.2%	4.7%	4.7%		
	Mean length	378	596	762	839		
	SD	34	56	58	57		

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		Brood year and age class					
		2004	2003	2002	2001	Total	Total
		1.1	1.2	1.3	1.4	aged	sampled[a]
				Kelsall River			
Males	Sample size	5	30	30	23	88	91
	Percent	5.7%	34.1%	34.1%	26.1%		60.3%
	SE(%)	2.5%	5.1%	5.1%	4.7%		4.0%
	Mean length	399	564	753	905		
	SD	35	65	69	62		
Females	Sample size	0	0	19	38	57	60
	Percent	0.0%	0.0%	33.3%	66.7%		39.7%
	SE(%)			6.3%	6.3%		4.0%
	Mean length			795	864		
	SD			37	45		
All fish	Sample size	5	30	49	61	145	151
	Percent	3.4%	20.7%	33.8%	42.1%		
	SE(%)	1.5%	3.4%	3.9%	4.1%		
	Mean length	399	564	769	879		
	SD	35	65	62	55		
				Combined spawning grounds			
Males	Sample size	24	156	88	42	310	326
	Percent	7.7%	50.3%	28.4%	13.5%		72.3%
	SE(%)	1.5%	2.8%	2.6%	1.9%		2.1%
	Mean length	385	576	768	885		
	SD	37	64	80	74		
Females	Sample size	0	1	47	72	120	125
	Percent	0.0%	0.8%	39.2%	60.0%		27.7%
	SE(%)		0.8%	4.5%	4.5%		2.1%
	Mean length		490	792	859		
	SD			44	48		
All fish	Sample size	24	157	135	114	430	451
	Percent	5.6%	36.5%	31.4%	26.5%		
	SE(%)	1.1%	2.3%	2.2%	2.1%		
	Mean length	385	576	776	869		
	SD	37	64	70	60		
			Combined spawning grounds sex proportion by age				
Males	Percent	100.0%	99.4%	65.2%	36.8%	72.1%	72.3
	SE(%)		0.6%	4.1%	4.5%	2.2%	2.1
Females	Percent	0.0%	0.6%	34.8%	63.2%	27.9%	27.7
	SE(%)		0.6%	4.1%	4.5%	2.2%	2.1

[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.).

TERMINAL HARVEST

2007 Haines Marine Sport Fishery Harvest

An estimated total 7,411 (SE = 725) angler-hours of effort were expended in the Haines marine boat fishery between May 7 and June 24, 2007, to catch and harvest 285 (SE = 43) large Chinook salmon (Table 9). This estimate is based on a sample of 291 boat-parties who fished 3,107 angler-h (3,075 salmon-h). An estimated 177 (SE = 33) of the Chinook salmon harvested in this fishery were wild mature fish assumed to be returning to the Chilkat River. About 98% (7,223 salmon-h, SE = 690) of angler effort targeted Chinook salmon, and the remainder was directed toward other species, primarily Pacific halibut. Anglers caught an estimated 325 (SE = 74) small (<28 inches TL) Chinook salmon, of which 13 (SE = 4) were kept. Ninety percent (90%) of the estimated salmon effort occurred between May 21 and June 17 (Table 9). Angling pressure for Chinook salmon was relatively light during the first and last week, so coverage of the fishery for mature Chinook salmon was essentially complete. Charter boat effort was encountered only at the Small Boat Harbor in 2007. Charter boat anglers accounted for about 3% of the salmon effort (238 salmon-h, SE = 130), none of the large Chinook salmon harvest, and 85% of the small Chinook salmon harvest (11, SE = 3) in this fishery.

Estimates by site are presented in Appendices B1 through B3. Anglers returning to Letnikof Dock (the high-use site) were responsible for 67% of the estimated salmon effort (4,954 salmon-h, SE = 568) and 84% of the estimated harvest (238, SE = 38) of large Chinook salmon (Appendix B1). Anglers returning to the Chilkat State Park boat launch accounted for an estimated 415 (SE = 259) salmon-h of effort and harvested 15 (SE = 13) large Chinook salmon (Appendix B2). Those returning to the Small Boat Harbor expended 1,875 (SE = 292) salmon-h and harvested 33 (SE = 14) large Chinook salmon (Appendix B3).

Age and Length of Harvest

Creel technicians sampled a total of 126 Chinook salmon for age, sex, and length in the angler harvest; 101 fish were assigned an age (Table 10). 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 = 9.28, df = 2, P < 0.01). The difference in age composition is likely the result of Small Boat Harbor anglers targeting hatchery-produced Chinook salmon in the Taiya Inlet terminal harvest area, where regulations in effect June 4-July 31 allowed retention of Chinook salmon less than 28 inches TL. Because of this difference, the Chilkat Inlet and Small Boat Harbor samples were analyzed separately.

A total of 118 Chinook salmon were sampled for age and length at the Chilkat Inlet harbors (Letnikof Dock and Chilkat State Park boat launch), and 94 of these were assigned an age (Table 10). The samples were evenly split by sex (50.9% female, SE = 4.7%). The predominant age class was age-1.3 (54.5%, SE = 5.6%). There were 3 age-0.3 fish sampled in Chilkat Inlet in 2007. Age-0.x Chinook salmon are rarely sampled in upper Lynn Canal and the Chilkat River.

Creel technicians sampled 8 Chinook salmon for age and length at the Small Boat Harbor and 7 of these were assigned an age (Table 10). Two additional fish <28-inches TL were harvested on June 21 but were not sampled. Most (75.0%, SE = 16.4%) of the fish sampled were male, and the predominant age class was age-1.2 (45.5%, SE = 20.3%).

Eleven (11) Chinook salmon from the Chilkat Inlet subsistence gillnet fishery were sampled for age and length between June 16 and July 8, 2007. Subsistence fishers reported harvesting 90 Chinook salmon in this fishery in 2007. The predominant age class was age-1.2 fish (36.4%, SE = 15.2%, Appendix C1).

Contribution of Coded Wire Tagged Stocks to the 2007 Haines Marine Sport Fishery

Seven (7) of the 125 Chinook salmon sampled at the Chilkat Inlet harbors (Letnikof Dock and Chilkat State Park boat launch) were missing their adipose fins, and CWTs were recovered from 6 of the 7 heads sent to the ADF&G Mark, Tag, and Age Laboratory (Table 11). Of the estimated 149 (SE = 70) fish that contributed to the Chilkat Inlet marine sport harvest, hatchery stocks contributed 22 (SE = 21) fish, and 127 (SE = 58) fish were wild Chilkat River Chinook salmon. One (1) of the 8 fish examined at the Small Boat Harbor had a clipped adipose fin, which resulted in a calculated expansion of 71 wild BY 2003 Chilkat River salmon harvested at the Small Boat Harbor.

Table 9.–Biweekly sampling statistics and estimated effort, catch, and harvest of large (≥ 28 inches TL) and small (< 28 inches TL) Chinook salmon in the Haines marine sport fishery, May 7–June 24, 2007.

	May 7– May 20	May 21–June 3 Non-Derby	May 21–June 3 Derby	June 4– June 17	June 18– June 24	Total
Boats counted	40	54	70	116	11	291
Angler-hr. sampled	216	499	1,195	1,112	85	3,107
Salmon-hr. sampled	188	499	1,195	1,111	82	3,075
Chinook sampled	3	19	57	46	1	126
Sampled for adipose clips	3	19	57	46	1	126
Adipose clips	0	1	2	4	1	8
Angler-hours						
Estimate	619	1,366	2,788	2,334	304	7,411
SE	274	429	422	276	111	725
Salmon-hours						
Estimate	443	1,366	2,788	2,333	293	7,223
SE	156	429	422	276	119	690
Large Chinook catch						
Estimate	17	65	80	123	0	285
SE	13	36	14	14	0	43
Large Chinook kept						
Estimate	17	65	80	123	0	285
SE	13	36	14	14	0	43
Wild mature large Chinook kept (excluding hatchery and immature fish)						
Estimate	7	48	50	73	0	177
SE	6	30	6	10	0	33
Small Chinook catch						
Estimate	0	73	100	138	14	325
SE	0	46	40	42	0	74
Small Chinook kept						
Estimate	0	0	3	0	11	13
SE	0	0	2	0	3	4

Table 10.–Estimated age composition and mean length-at-age (mm MEF) of harvested Chinook salmon in the Haines marine sport fishery by harbor location, May 7–June 24, 2007.

		Brood year and age class							
		2004 1.1	2003 1.2	2003 0.3	2002 1.3	2001 1.4	2000 1.5	Total aged	Total sampled[a]
CHILKAT INLET HARBORS									
Males	Sample size	0	3	2	27	15	0	47	57
	Mean length		635	753	761	915			49.1%
	SD(length)		6	18	13	16			4.7%
Females	Sample size	0	2	1	24	18	0	45	59
	Mean length		700	840	765	881			50.9%
	SD(length)		0		15	13			4.7%
Unknown		0	1	0	0	1	0	2	2
			605			840			

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		Brood year and age class							
		2004	2003	2003	2002	2001	2000	Total	Total
		1.1	1.2	0.3	1.3	1.4	1.5	aged	sampled[a]
Combined	Sample size	0	6	3	51	34	0	94	118
	Harvest-weighted percent		5.7%	2.0%	54.5%	37.7%			
	SE(%)		2.5%	1.2%	5.6%	5.5%			
	Mean length		652	782	763	894			
	SD(length)		31	37	8	9			
SMALL BOAT HARBOR									
Males	Sample size	0	3	0	0	2	0	5	6
	Mean length		640			928			75.0%
	SD(length)		10			8			16.4%
Females	Sample size	0	1	0	1	0	0	2	2
	Mean length		685		850				25.0%
	SD(length)								16.4%
Combined	Sample size	0	4	0	1	2	0	7	8
	Harvest-weighted percent		45.5%		15.9%	18.2%			
	SE(%)		20.3%		14.9%	15.8%			
	Mean length		655		850	928			
	SD(length)		16			11			

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

Table 11.–Contribution estimate (r) of coded wire tagged Chinook salmon to the Haines marine sport fishery, May 7–June 24, 2007, and statistics used for computing estimates. Contribution estimates for wild Chilkat River fish are preliminary as marked fractions will not be estimated until returns from all brood years are complete.

Agency[a]	Release site	Tag code	Brood year	Harvest N	Harvest SE[N]	Sample *n*	Adipose clip *a*	Head *a'*	Detect *t*	Decode *t'*	Tags *m*	Contribution *r*	Contribution SE
CHILKAT INLET RECOVERIES													
Fish of all sizes													
DIPAC	Gastineau 111-40	04-09-38	2001	256	41	125	7	7	7	6	1	22	21
ADFG	Chilkat River wild	04-05-53	2001								1	33	33
ADFG	Chilkat River wild	04-07-71, 04-09-64	2002								4	94	48
Chilkat Inlet subtotal											6	149	70
SMALL BOAT HARBOR RECOVERIES													
Fish of all sizes													
ADFG	Chilkat River wild	04-10-28	2003	44	15	8	1	1	1	1	1	71	72
Haines marine creel survey total											7	220	100

[a] DIPAC = Douglas Island Pink and Chum, Inc.

JUVENILE TAGGING

ADF&G trapping crews captured and marked 28,666 Chinook salmon fry during fall 2007 (Tables 12, 13). Catch rates were lowest in the Tahini River and highest in the mainstem of the Chilkat River. During tag retention testing, 17 mortalities were discarded, and 28,649 fish were released with valid CWTs. In addition, we released 2,499 smolt with valid CWTs and an adipose fin clip during spring 2008.

A total of 574 Chinook salmon fry were sampled for length during fall 2007 (Table 14). The mean length of fry was 64 mm FL (SD = 6 mm FL). In addition, 393 smolt were sampled for length and weight during the spring 2008. Smolt averaged 88 mm FL (SD = 11 mm FL) and 7.1 g (SD = 2.9 g).

BROOD YEAR 2000 JUVENILE ABUNDANCE

As stated previously, 23,154 Chinook salmon fry were released with valid CWTs in fall 2001, and 4,506 smolts were released in spring 2002 (Ericksen 2002ab). Both groups originated from the BY 2000. ADF&G personnel sampled 859 adult BY 2000 Chinook salmon from Chilkat River escapements between 2003 and 2007, of which 88 were missing adipose fins (Table 15). There was not a significant difference between the marked fraction of fish sampled in the lower river and on the spawning grounds (χ^2 = 1.991, df = 1, P = 0.158) so the inriver marked fraction $\theta_{INRIVER}$ for BY-2000 was estimated at 0.1024 (SE = 0.0104) using combined lower and upper river data.

From the 88 fish with adipose fin clips, 54 heads were collected, and 51 CWTs were successfully recovered and decoded by the ADF&G Mark, Tag, and Age Laboratory (Table 15, Appendix D1). Of the 51 decoded CWTs, 27 were tagged in fall 2001 and 24 were tagged in spring 2002 (Table 16). Among the 33 valid Chilkat CWTs collected in marine sampling, 19 were tagged in fall 2001 and 14 in spring 2002 (Table 16). By fitting a statistical capture/recapture model that considered the above data simultaneously (Appendix E), an estimated[3] 510,700 (SE = 74,290) BY 2000 fry were rearing in the Chilkat River in fall 2001, 21.1% (SE = 4.8% survived the winter, and 105,300 (SE = 17,170) BY 2000 smolts emigrated from the Chilkat River in spring 2002.

[3] Point estimates reported in this paragraph are means of the Bayesian posterior distribution and standard errors are posterior standard deviations.

BROOD YEAR 2000 ADULT HARVEST

The estimated tagged fraction θ_{MARINE} germane to estimating harvest contributions was 0.0968 (SE = 0.0101). This estimate was calculated from the 88 fish with missing adipose fins out of 859 fish inspected in the Chilkat River, multiplied by the CWT loss fraction, 51 CWTs decoded out of 54 heads sent to the ADF&G Mark, Tag, and Age Laboratory (Table 15).

Thirty-three (33) Chinook salmon with Chilkat River CWTs from BY 2000 were recovered through random sampling in marine commercial, sport, and subsistence fisheries between 2003 and 2007 (Table 16, Appendices D1, D2). An estimated 1,003 (SE = 212) BY 2000 Chilkat River Chinook salmon were harvested in sampled marine fisheries between 2003 and 2007 (Table 17). The largest harvest-at-age of BY 2000 fish was 493 (SE = 172) age-1.2 fish in 2004, followed by 383 (SE = 105) age-1.3 fish, in 2003. The commercial fishery sector had the largest share (41%) of the total harvest of BY 2000 Chilkat Chinook salmon, followed by the recreational (35%) and the subsistence (24%) fishery sectors (Table 18). The two largest individual fisheries were the NW quadrant troll and the Skagway-based recreational fishery in Taiya Inlet, which together accounted for 52% of the total harvest (Figures 1, 6).

BROOD YEAR 2000 MARINE EXPLOITATION AND SURVIVAL

Based upon a total inriver return of 4,173 (SE = 681) age-1.2 and older fish and a total marine harvest of 990 (SE = 211) age-1.2 and older fish, the total BY 2000 age-1.2 and older return was 5,163 (SE = 713) fish (Table 19). The estimated smolt-to-adult marine survival rate was 4.9% (SE = 4.5%). The marine exploitation rate of this stock was estimated at 19.2% (SE = 4.2%).

Table 12.–Results of juvenile Chinook salmon trapping in the Chilkat River drainage in fall 2007 and spring 2008.

Year	Trapping area	Dates	Days fished	Trap sets	No. caught	CPUE[a]
2007	Tahini River	9/11 - 9/20	8	482	3,387	7.0
2007	Upper Chilkat River	9/28 – 9/30	2	156	1,889	12.1
2007	Kelsall River	10/4 – 10/16	12	1,016	12,203	12.0
2007	Chilkat River	10/21 – 10/30	8	729	11,187	15.3
	Fall 2007 subtotal		30	2,383	28,666	12.0
2008	Lower Chilkat River	4/10 – 5/27	49	2,927	2,505	0.9

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

Table 13.–Number of brood year 2006 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 released
2007	04-15-57	187-5937	Tahini River	9/20	Fingerling	3,387	0	3,387	0	3,387
2007	04-15-57	6200-9338	Upper Chilkat R	9/30	Fingerling	1,889	3	1,886	0	1,886
2007	04-15-57	9509-31526	Kelsall River	10/16	Fingerling	12,203	7	12,196	0	12,196
2007	04-15-57	31799-52584	Lower Chilkat R	10/30	Fingerling	11,187	7	11,180	0	11,180
Fall subtotal						28,666	17	28,649	0	28,649
2008	04-12-92	Batch code	Chilkat River	5/24	Smolt	2,505	6	2,499	0	2,499

Table 14.–Mean length and smolt weight of brood year 2006 Chinook salmon in the Chilkat River drainage by trapping location and year.

			Length (snout to fork of tail in mm)			
Sample year	Trapping location	Sample dates	n	Range	Mean	SD
2007	Tahini River	9/11 - 9/20	68	54-81	67	6
2007	Upper Chilkat River	9/28 – 9/30	38	52-83	63	7
2007	Kelsall River	10/4 – 10/16	245	54-89	66	6
2007	Lower Chilkat River	10/21 – 10/30	223	50-81	62	5
Fall 2007 subtotal			574	50-89	64	6
2008	Lower Chilkat River	4/9 – 5/24	393	70-137	88	11
			weight (g)	3.6-24.8	7.1	2.9

Table 15.–Number of brood year 2000 Chinook salmon sampled in the Chilkat River drainage for missing adipose fins and coded wire tags, by year, and gear type or spawning drainage, 2003-2007.

Year	Gear/ drainage	Sampled for adipose clips	Fish with adipose clips	Marked fraction	Heads collected	Valid CWTs	CWT loss
		Lower river recoveries					
2003	Gillnet	1	1	1.00	1	1	0.00
2003	Fish wheels	83	7	0.08	7	7	0.00
2004	Gillnet	11	0	0.00	0		
2004	Fish wheels	37	2	0.05	2	2	0.00
2005	Gillnet	69	8	0.12	1	0	1.00
2005	Fish wheels	37	2	0.05	1	1	0.00
2006	Gillnet	19	2	0.11	0		
2006	Fish wheels	25	1	0.04	0		
2007	Gillnet	0	0				
2007	Fish wheels	0	0				
Lower river total		282	23	0.08	12	11	0.09
		Spawning ground recoveries					
2003	Kelsall River	17	0	0.00			
2003	Tahini River	18	0	0.00			
2003	Klehini River	10	2	0.20	2	2	0.00
2004	Kelsall River	37	4	0.11	3	3	0.00
2004	Tahini River	26	1	0.04	1	1	0.00
2004	Klehini River	31	5	0.16	5	5	0.00
2005	Kelsall River	75	8	0.11	8	8[a]	0.00
2005	Tahini River	103	15	0.15	7	6	0.17
2005	Klehini River	61	7	0.11	4	4	0.00
2006	Kelsall River	83	6	0.07	4	4	0.00
2006	Tahini River	74	8	0.11	4	4	0.00
2006	Klehini River	42	9	0.21	4	3	0.33
2007	Kelsall River	0	0				
2007	Tahini River	0	0				
2007	Klehini River	0	0				
Spawning ground total		577	65	0.11	42	40	0.05
Grand total		859	88	0.10	54	51	0.06

[a] Includes 1 code 040552 coded wire tag recovered in a Chinook salmon. This tag code was used in coho smolt in spring 2002. This coded wire tag is assumed to have been mistakenly injected in a BY 2000 Chinook smolt in spring 2002.

Table 16.–Number of random recoveries of brood year (BY) 2000 Chilkat River Chinook salmon coded wire tagged in fall 2001 and spring 2002, by year, fishing district, and gear type, 2003–2007.

	District	Purse		Drift		Troll		Sport		Haines subsistence		Chilkat River escapement		Fall	Spring	Grand
Year	or quad	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring	sub-total	sub-total	total
2003	115	0	0	0	0	0	0	0	0	1	0	8	2	9	2	11
2004	112	1		0										1	0	1
2004	114						2							0	2	2
2004	115	2						2	1	2	2	4	7	10	10	20
2004	NW					1								1	0	1
2004 subtotal		3	0	0	0	1	2	2	1	2	2	4	7	12	12	24
2005	111				1									0	1	1
2005	113					1								1	0	1
2005	114					3	1							3	1	4
2005	115			1	2			3	1	1		12	7	17	10	27
2005	NW						1							0	1	1
2005 subtotal		0	0	1	3	4	2	3	1	1	0	12	7	21	13	34
2006	113								1					0	1	1
2006	115				1				0	1	1	3	8	4	10	14
2006 subtotal		0	0	0	1	0	0	0	1	1	1	3	8	4	11	15
2007		No BY 2000 coded wire tags recovered in 2007.														0
Grand total		1	0	3	4	5	4	5	3	5	3	27	24	46	38	84

Table 17.–Estimated contributions of 2000 brood year Chilkat River Chinook salmon to marine fishery harvests by year and fishery, 2003–2007. Subsistence and commercial fishery harvest estimates are from ALEXANDER, the Integrated Fisheries Database for Southeast Alaska, maintained by ADF&G/Division of Commercial Fisheries, Region 1, Douglas. Commercial fishery sampling data is from the ADF&G Mark, Tag and Age Laboratory online database at http://tagtoweb.adfg.state.ak.us

	Fishery harvest										Contribution	
Fishery	Time SW, BW, TP, or yr.	District or quadrant	$\hat{H}$	SE[$\hat{H}$]	n	a	a'	t	t'	m	$\hat{r}$	SE $[\hat{r}]$
2003 recoveries age-1.1												
Haines subsistence	2003	115-32	46		37	3	3	3	3	1	13	12
2003 subtotal										1	13	12
2004 recoveries age-1.2												
Drift gillnet	SW 26	115	158		106	11	9	8	8	1	19	18
Drift gillnet	SW 29	115	149		91	10	10	9	9	1	17	16
Purse seine	SW 26	112	56 [a]		56	8	8	7	7	1	10	10
Troll	TP 2	NW	32,586		13,759	766	757	650	650	2	50	34
Troll	TP 4	NW	38,607		11,438	852	837	612	609	1	36	35
Skagway sport [b]	2004	115	984	199	127	33	31	31	31	3	256	154
Haines subsistence	2004	115-32	146		57	9	9	9	9	4	106	53
2004 subtotal										13	493	172
2005 recoveries age-1.3												
Drift gillnet	SW 27	111	475		175	10	10	9	8	1	32	31
Drift gillnet	SW 27	115	229		92	21	21	21	21	2	51	36
Drift gillnet	SW 30	115	17		18	4	4	4	4	1	10	9
Troll	TP 1	NW	28,349		5,803	615	608	345	345	1	51	51
Troll	TP 2	NW	26,495		11,787	670	667	573	573	4	93	46
Troll	TP 3	NW	96,688		29,301	1,562	1,506	1,267	1,264	1	35	35
Haines marine sport [c]	SW 20-27	115-32	153	24	105	6	6	6	6	3	45	26
Haines marine sport [c]	SW 20-27	115-34	99	31	31	5	5	5	5	1	33	33
Chilkat Inlet subsistence	2005	115-32	78		25	5	5	5	5	1	32	32
2005 subtotal										15	383	105
2006 recoveries age-1.4												
Drift gillnet	SW 30	115	8		8	1	1	1	1	1	10 [d]	10
Sitka marine sport [e]	BW 12	Sitka	4,105	545	2,254	50	49	45	45	1	19	19
Chilkat Inlet subsistence	2006	115-32	86		21	3	3	3	3	2	85	59
2006 subtotal										4	114	63
2007 recoveries age-1.5												
No BY 2000 Chilkat Chinook salmon CWTs were recovered in 2007.												
Combined contribution $[\hat{T}]$										33	1,003	212

[a] Assumed number Chinook salmon sampled equals total Chinook salmon harvested in this pink salmon-directed seine fishery.

[b] Data from Jennings et al. (2007).

[c] Data from Ericksen and Chapell 2006.

[d] Expanded harvest estimate is greater than reported catch.

[e] Data from personal communication with Mike Jaenicke, project leader of Northern Southeast Alaska Creel Survey, ADF&G Division of Sport Fish, Region 1, Douglas.

Table 18.–Total marine harvest and estimated brood year 2000 Chilkat River Chinook salmon contribution, by fishery and area, 2003-2007.

Fishery	Area	Total fishery harvest	Chilkat harvest	SE	Chilkat percent of fishery	Percent of Chilkat total
Commercial fishery						
Drift gillnet	District 115	561	107	46	19.1%	10.7%
Drift gillnet	District 111	475	32	31	6.6%	3.1%
Troll	NW Quadrant	222,725	265	91	0.1%	26.4%
Purse seine	District 112	56	10	10	18.5%	1.0%
	Subtotal	223,817	414	54	0.2%	41.3%
Recreational fishery						
	Sitka marine	4,105	19	19	0.5%	1.9%
	Skagway marine	984	256	154	26.0%	25.5%
	Haines marine	252	78	42	31.0%	7.8%
	Subtotal	5,341	353	93	6.6%	35.2%
Subsistence fishery						
	Chilkat Inlet	356	236	86	66.2%	23.5%
	Subtotal	356	236	86	66.2%	23.5%
Grand total		229,514	1,003	212	0.4%	100.0%

Table 19.–Estimated stock assessment parameters for brood year 2000 Chilkat River Chinook salmon.

Parameter	Estimate	SE
2001 fall fry abundance	510,700	74,290 [a]
2001-2002 overwinter survival	0.211	0.048 [a]
2002 smolt emigration	105,300	17,170 [a]
Marine harvest (age-1.2 and older)	990	211
Inriver return (age-1.2 and older)	4,173	681
Return (age-1.2 and older)	5,163	713
Marine exploitation rate	0.192	0.042
Smolt to age-1.2 and older survival	0.049	0.045

[a] Standard deviation of the posterior distribution, which is a measure of spread analogous to standard error.

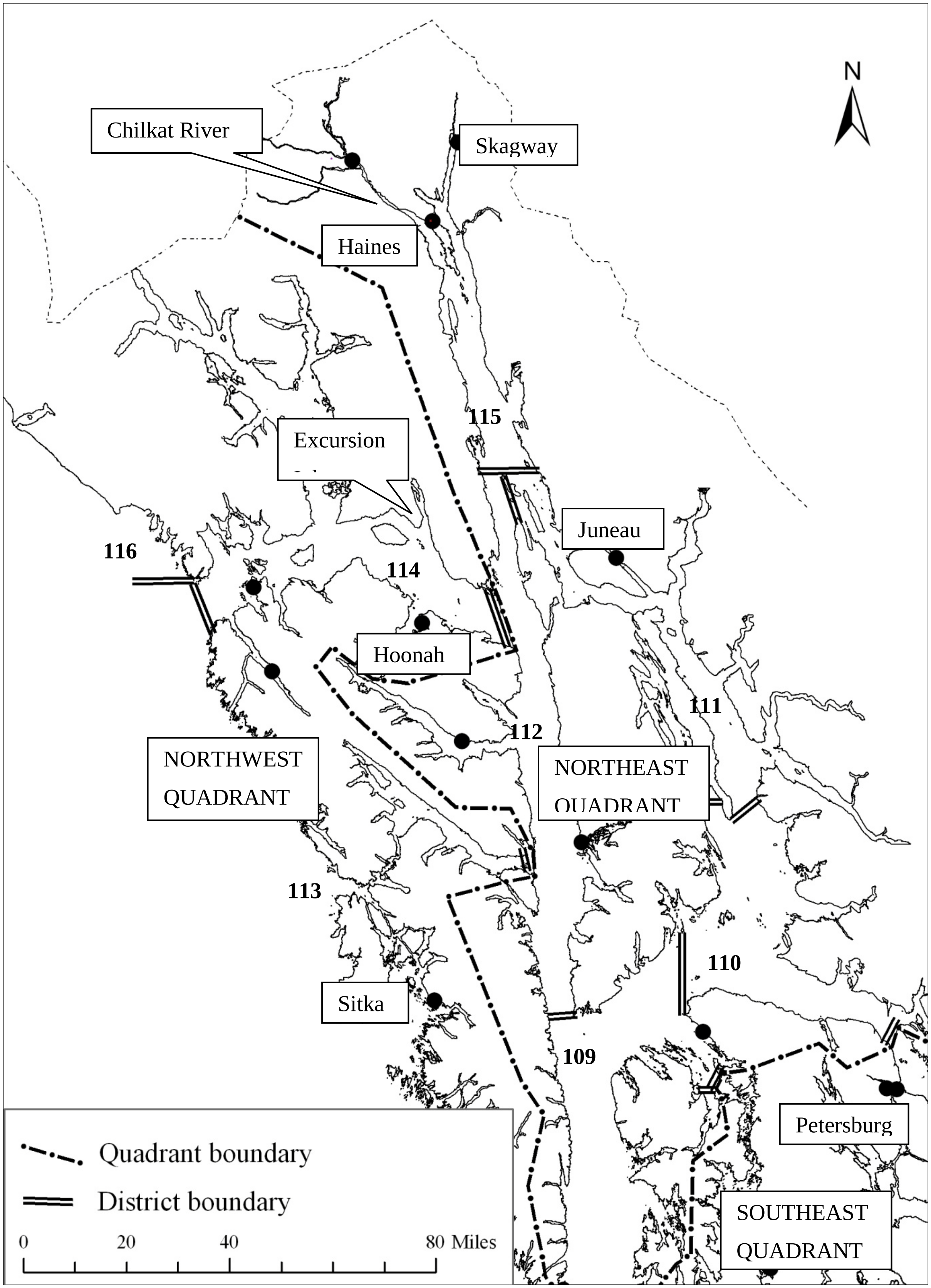

Figure 6.–Quadrants, districts, and sampling ports in northern Southeast Alaska.

DATA FILES

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

DISCUSSION

Several assumptions, as noted above, underlie the mark-recapture estimate of inriver 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 85% of spawning occurred in 2005 and >90% occurred in 1991 and 1992; Ericksen and Chapell 2006; Johnson et al. 1992, 1993) was fairly constant across the time when fish were accessible to sampling as spawners or post-spawners. Carcass retrievals, which can be sex selective in some situations (Pahlke et al. 1996; McPherson et al. 1997; Zhou 2002; Miyakoshi et al. 2003),comprised only 15% of the spawning ground samples. Using a variety of capture methods (35% snagging, 38% gillnet, 18% hands, 9% dip net) on the spawning grounds reduced the potential bias that may be inherent in any one method. The assumption (b) of no recruitment during the experiment is reasonable because tagging effort was relatively constant and continued until only about 1 fish per day was being caught. The assumption (c) that marking does not affect catchability of fish was tested in the 2005 radiotelemetry study where 2.3% or less of tagged fish failed to make significant upstream progress after tagging (Ericksen and Chapell 2006). The assumption (d) that marks were not lost was satisfied because all fish were given an ULOP as a secondary mark. Fish whose upper left operculum could not be examined were not included in the experiment. Personnel sampling the spawning tributaries carefully examined each fish for marks while inspecting them for adipose fin clips, measuring length, and collecting scale samples, so failure of assumption (e) was unlikely.

The 2007 inriver run of 1,445 (SE = 227) large Chinook salmon was the lowest estimate since mark-recapture studies were initiated in 1991 (Table 20, Figure 7). This abundance failed to meet the low end of the inriver run goal range of 1,850 to 3,600 large Chinook salmon specified in the Lynn Canal and Chilkat River King Salmon Fishery Management Plan (5 AAC 33.384).

The Haines marine sport fishery large Chinook salmon CPUE in 2007 (0.039) was above the long-term average of 0.034 in 1993-2006, so performance in this May-June fishery provided no early indication that the inriver run goal would not be met (Table 21). The number of large Chinook salmon caught in the lower Chilkat River drift gillnets was the lowest of all years of the mark-recapture study (1991-2007), so the marking event did provide an inseason indication of inriver abundance before spawning ground surveys in August. However, this inseason indicator was not available to fishery managers until early July.

The mean date of capture (July 9, Figure 4) of large Chinook salmon at the lower Chilkat River marking site was later than the July 3 average date for all previous years of this project (1991-2006).

Sport fishing harvest patterns observed during 2007 were similar to recent years. In 2007, 84% of the estimated marine harvest of large (≥ 28 in TL) Chinook salmon was landed at the Letnikof Dock. In comparison, 71% of the average total harvest in 2001–2006 was landed at this harbor. Estimates of sport fishing effort and harvest of large Chinook salmon were below the 1993-2006 average, but CPUE was slightly above the average CPUE (Figure 7, Table 21). The Haines marine creel survey estimated the Chilkat River wild component of the total large Chinook salmon harvest was 62%, which was lower than the 2001-2006 average of 69%.

Each fall in 2000-2007, an average of 30,021 Chinook salmon fry have been marked with CWTs (brood years 1999–2006). Using the average overwinter survival rates for brood years 1999 (0.364) and 2000 (0.211), the fall marking effort has contributed an average of 8,631 marked smolts, more than double the average number of smolts (4,171) marked each spring in 2001-2008. This fall CWT marking effort has increased the precision of estimates of fry and smolt abundance, adult harvest, smolt-to-adult survival, and the marine harvest of the Chilkat River stock. The increased number of marked fish has allowed the harvest of the 1999 and later brood year Chilkat River Chinook salmon to be documented in many more fisheries than for previous brood years. In addition, the range of overwinter survival estimates has increased. The fall tagging effort should be continued because high-resolution stock assessment of wild Chilkat River Chinook salmon has become a high priority with the advent of annual releases of 500,000 hatchery-reared Chinook salmon smolts in northern Lynn Canal (ADF&G 2010).

The BY 2000 estimated marine exploitation rate (Table 19, 19.2%, SE = 4.1%) was within the range of estimates from CWT studies on Chilkat River Chinook salmon brood years 1988-1989, 1991, 1998-2000 (7.4%-24.8%, Appendix F). The exploitation rate for the most recent 3 brood years (22.1%, BY 1998-2000) indicates that the exploitation rates are higher than those used by Ericksen and McPherson 2004) to set the biological escapement goal (range 8-19%) for Chilkat River Chinook salmon.

The harvest of age-1.1 and -1.2 Chilkat River Chinook salmon by recreational anglers in Taiya Inlet was proportionately high for brood years 1999 (4.0% of total return, Chapell 2009) and 2000 (5.0% of total return, Tables 18, 20). These fish were harvested under liberal size and bag limits (3 Chinook salmon per day of any size, exempt from nonresident annual limit) that were implemented in Taiya Inlet to exploit the return of hatchery-raised Chinook salmon to Pullen Creek (Figure 1). Because the Chilkat River Chinook salmon escapement goal was not met in 2007, the harvest of Chinook salmon <28 inches TL was not allowed in the 2008 and later seasons. The harvest of Chilkat River Chinook salmon in the Skagway recreational fishery should be monitored through Skagway marine sport creel sampling and CWT recovery.

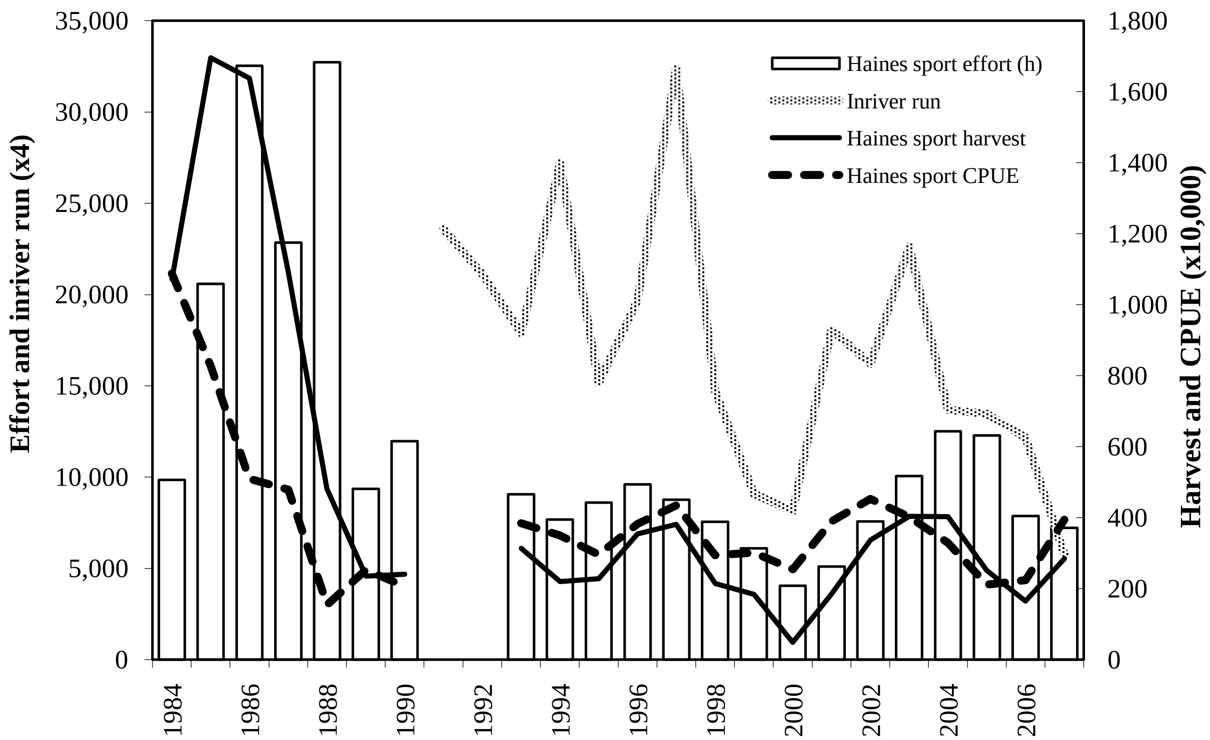

Figure 7.–Estimated angler effort, harvest, and CPUE of large≥(28 inches TL) Chinook salmon in the Haines spring marine boat sport fishery, 1984–2007, and estimated inriver run of large (age-1.3 and older) Chinook salmon in the Chilkat River, 1991–2007. The Chilkat Inlet fishery was closed in 1991 and 1992. Data taken from Tables 20 and 21.

Table 20.–Estimated annual inriver run by age of medium (age-1.2) and large (≥ age-1.3) immigrating Chilkat River Chinook salmon, annual large escapement estimates, 1991–2007, and estimated marine harvest and total return by age class of fish from coded wire tagged brood years 1988, 1989, 1991, 1998-2000.

Calendar year		1.2	(SE)	1.3	(SE)	1.4	(SE)	1.5	(SE)	Inriver run total	(SE)	Large (≥ age-1.3) inriver subsistence harvest[a]	Large (≥ age-1.3) escapement
1991[b]	Inriver run	817	(139)	3,211	(558)	2,563	(445)	123	(18)	6,714	(727)	14	5,833
	Marine harvest												
	Total return												
1992[c]	Inriver run	560	(100)	1,689	(304)	3,595	(649)	0	(0)	5,844	(723)	7	5,277
	Marine harvest[d]	459	(166)										
	Total return	1,019	(194)										
1993[e]	Inriver run	551	(104)	2,217	(424)	2,005	(384)	120	(22)	4,894	(582)	8	4,334
	Marine harvest[f]	134	(50)	572	(208)								
	Total return	685	(115)	2,789	(472)								
1994[g]	Inriver run	184	(28)	2,565	(405)	4,148	(657)	82	(10)	6,979	(773)	2	6,793
	Marine harvest			415	(123)	605	(302)						
	Total return			2,980	(423)	4,753	(723)						
1995[h]	Inriver run	1,384	(295)	530	(111)	3,074	(660)	186	(37)	5,174	(733)	12	3,778
	Marine harvest[i]	286	(129)			134	(74)	2	(1)				
	Total return	1,670	(322)			3,208	(664)	188	(37)				
1996[j]	Inriver run	398	(60)	4,140	(639)	737	(112)	43	(5)	5,318	(652)	10	4,910
	Marine Harvest			459	(129)			0	0				
	Total Return			4,599	(652)			43	(5)				
1997[k]	Inriver run	160	(48)	1,943	(354)	6,157	(930)	0	0	8,260	(997)	5	8,095
	Marine harvest					260	(104)						
	Total return					6,417	(936)						

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Table 20.–Page 2 of 3.

Calendar year		1.2	(SE)	1.3	(SE)	1.4	(SE)	1.5	(SE)	Inriver run total	(SE)	Large (≥ age-1.3) inriver subsistence harvest[a]	Large (≥ age-1.3) escapement
1998[l]	Inriver run	226	(54)	1,016	(169)	2,440	(381)	219	(48)	3,901	(423)	18	3,657
	Marine harvest							1	0				
	Total return							220	(48)				
1999[m]	Inriver run	427	(94)	534	(109)	1,656	(302)	80	(27)	2,698	(336)	12	2,258
	Marine harvest												
	Total return												
2000[n]	Inriver run	629	(122)	1,350	(227)	653	(118)	32	(14)	2,664	(283)	6	2,029
	Marine harvest												
	Total return												
2001[o]	Inriver run	755	(209)	2,529	(376)	1,988	(617)	0		5,272	(752)	3	4,514
	Marine harvest												
	Total return												
2002[p]	Inriver run	373	(123)	2,353	(312)	1,667	(294)	30	(19)	4,423	(446)	16	4,034
	Marine harvest[q]	0											
	Total return	373	(123)										
2003[r]	Inriver run	1,267	(293)	1,833	(362)	3,783	(582)	41	(29)	6,924	(746)	26	5,631
	Marine harvest[s]	505	(373)	688	(687)								
	Total return	1,772	(474)	2,521	(777)								
2004[t]	Inriver run	1,361	(492)	1,999	(333)	1,379	(303)	44	(17)	4,783	(667)	16	3,406
	Marine harvest[u]	493	(164)	795	(190)	352	(249)						
	Total Return	1,854	(519)	2,794	(383)	1,731	(392)						
2005[v]	Inriver run	1,597	(620)	1,857	(433)	1,498	(345)	11	(8)	4,963	(831)	5	3,361
	Marine harvest			383	(105)	244	(75)	0					
	Total return			2,240	(446)	1,742	(353)	11	(8)				

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Table 20.–Page 3 of 3.

Calendar year		1.2	(SE)	1.3	(SE)	1.4	(SE)	1.5	(SE)	Inriver run total	(SE)	Large (≥ age-1.3) inriver subsistence harvest[a]	Large (≥ age-1.3) escapement
2006[w]	Inriver run	260	(81)	2,084	(333)	955	(185)	0		3,299	(488)	36	3,003
	Marine harvest[x]					114	(63)	28	(334)				
	Total return					1,069	(195)	28	(334)				
2007[x]	Inriver run	602	(138)	585	(136)	860	(182)	0		2,047	(266)	7	1,438
	Marine harvest							0					
	Total return							0					

[a] Annual Chilkat River subsistence harvest from ADF&G, Division of Commercial Fisheries ALEXANDER database multiplied by annual estimated large (≥ age-1.3) proportion of subsistence gillnet harvest, Appendix C2.

[b] Inriver abundance data from Johnson et al. (1992).

[c] Inriver abundance data from Johnson et al. (1993).

[d] Brood year 1988 marine harvest data from Ericksen (1995).

[e] Inriver abundance data from Johnson (1994).

[f] Brood year 1989 marine harvest data from Ericksen (1995).

[g] Inriver abundance data from Ericksen (1995).

[h] Inriver abundance data from Ericksen (1996).

[i] Brood year 1991 marine harvest data from Ericksen (1999).

[j] Inriver abundance data from Ericksen (1997).

[k] Inriver abundance data from Ericksen (1998).

[l] Inriver abundance data from Ericksen (1999).

[m] Inriver abundance data from Ericksen (2000).

[n] Inriver abundance data from Ericksen (2001).

[o] Inriver abundance data from Ericksen (2002b).

[p] Inriver abundance data from Ericksen (2003).

[q] Brood year 1998 marine harvest data from Ericksen (2006).

[r] Inriver abundance data from Ericksen (2004).

[s] Brood year 1999 marine harvest data from Chapell (2009).

[t] Inriver abundance data from Ericksen (2005).

[u] Brood year 2000 marine harvest data from Table 17.

[v] Inriver abundance data from Ericksen and Chapell (2006).

[w] Inriver abundance data from Chapell (2009).

[x] Inriver abundance data from Table 8.

Table 21.–Estimated angler effort, and large (≥ 28 inches TL) Chinook salmon catch and harvest in the Haines marine sport fishery for similar sample periods, 1984–2007.

		Effort				Large (≥28") fish				
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
1991		Chinook salmon sport fishery was closed.								
1992		Chinook salmon sport fishery was closed.								
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[t]	5/05-6/29	10,651	596	10,055	578	405	40	404	40	0.040
2004[u]	5/10-6/27	12,761	763	12,518	744	413	46	403	44	0.033
2005[v]	5/09-6/26	12,641	1,239	12,287	1,216	260	31	252	31	0.021
2006	5/08-6/25	8,172	610	7,869	558	176	15	165	13	0.022
2007	5/07-6/24	7,411	725	7,223	690	285	43	285	43	0.039
1984–86 average		23,082		21,455		1,383		1,375		0.073
1987-90 average		23,374		18,019		330		319		0.020
1993–06 average		9,053		8,343		280		264		0.034

[a] Catch of large Chinook salmon per salmon h of effort.
[b] From Neimark (1985).
[c] Estimates of variance were not provided until 1987.
[d] From Mecum and Suchanek (1986).
[e] From Mecum and Suchanek (1987).
[f] From Bingham et al. (1988).
[g] From Suchanek and Bingham (1989).
[h] From Suchanek and Bingham (1990).
[i] From Suchanek and Bingham (1991), no estimate of the total angler effort and harvest was provided.
[j] From Ericksen (1994).
[k] From Ericksen (1995).
[l] From Ericksen (1996).
[m] From Ericksen (1997).
[n] From Ericksen (1998).
[o] From Ericksen (1999).
[p] From Ericksen (2000).
[q] From Ericksen (2001).
[r] From Ericksen (2002b).
[s] From Ericksen (2003).
[t] From Ericksen (2004).
[u] From Ericksen (2005).
[v] From Ericksen and Chapell (2006).
[w] From Chapell (2009).

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APPENDIX A

Appendix A1.–Detection of size or sex selective sampling during a 2-sample mark–recapture experiment and recommended procedures for estimating population size and population composition.

Size selective sampling: The Kolmogorov-Smirnov two sample test (Conover 1980) is used to detect size-selective sampling during the first or second sampling events. The second sampling event is evaluated by comparing the length frequency distribution of all fish marked during the first event (M) with that of marked fish recaptured during the second event (R), using the null test hypothesis of no difference. The first sampling event is evaluated by comparing the length frequency distribution of all fish inspected for marks during the second event (C) with that of R. A third test, comparing M and C, is conducted and used to evaluate the results of the first two tests when sample sizes are small. Guidelines for small sample sizes are <30 for R and <100 for M or C.

Sex selective sampling: Contingency table analysis (Chi^2-test) is used to detect sex-selective sampling during the first or second sampling events. The counts of observed males to females are compared between M&R, C&R, and M&C as described above, using the null hypothesis that the probability that a sampled fish is male or female is independent of sample. When the proportions by gender are estimated for a sample (usually C), rather an observed for all fish in the sample, contingency table analysis is not appropriate and the proportions of females (or males) are compared between samples using a two sample test (e.g. Student's t-test).

M versus. R	**C versus. R**	**M versus. C**
Case I:		
Fail to reject H_o	Fail to reject H_o	Fail to reject H_o

There is no size/sex selectivity detected during either sampling event.

Case II:

Reject H_o	Fail to reject H_o	Reject H_o

There is no size/sex selectivity detected during the first event but there is during the second event sampling.

Case III:

Fail to reject H_o	Reject H_o	Reject H_o

There is no size/sex selectivity detected during the second event but there is during the first event sampling.

Case IV:

Reject H_o	Reject H_o	Reject H_o

There is size/sex selectivity detected during both the first and second sampling events.

Evaluation Required:

Fail to reject H_o	Fail to reject H_o	Reject H_o

Sample sizes and powers of tests must be considered:

A. If sample sizes for M versus R and C versus R tests are not small and sample sizes for M versus C test are very large, the M versus C test is likely detecting small differences which have little potential to result in bias during estimation. *Case I* is appropriate.

B. If a) sample sizes for M versus R are small, b) the M versus R p-value is not large (~0.20 or less), and c) the C versus R sample sizes are not small and/or the C versus R p-value is fairly large (~0.30 or more), the rejection of the null in the M versus C test was likely the result of size/sex selectivity during the second event which the M versus R test was not powerful enough to detect. *Case I* may be considered but *Case II* is the recommended, conservative interpretation.

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C. If a) sample sizes for C versus R are small, b) the C versus R p-value is not large (~0.20 or less), and c) the M versus R sample sizes are not small and/or the M versus R p-value is fairly large (~0.30 or more), the rejection of the null in the M versus C test was likely the result of size/sex selectivity during the first event which the C versus R test was not powerful enough to detect. *Case I* may be considered but *Case III* is the recommended, conservative interpretation.

D. If a) sample sizes for C versus R and M versus R are both small, and b) both the C versus R and M versus R p-values are not large (~0.20 or less), the rejection of the null in the M versus C test may be the result of size/sex selectivity during both events which the C versus R and M versus R tests were not powerful enough to detect. *Cases I, II, or III* may be considered but *Case IV* is the recommended, conservative interpretation.

Case I. Abundance is calculated using a Petersen-type model from the entire data set without stratification. Composition parameters may be estimated after pooling length, sex, and age data from both sampling events.

Case II. Abundance is calculated using a Petersen-type model from the entire data set without stratification. Composition parameters may be estimated using length, sex, and age data from the first sampling event without stratification. If composition is estimated from second event data or after pooling both sampling events, data must first be stratified to eliminate variability in capture probability (detected by the M versus R test) within strata. Composition parameters are estimated within strata, and abundance for each stratum needs to be estimated using a Petersen-type formula. Overall composition parameters are estimated by combining stratum estimates weighted by estimated stratum abundance according to the formulae below.

Case III. Abundance is calculated using a Petersen-type model from the entire data set without stratification. Composition parameters may be estimated using length, sex, and age data from the second sampling event without stratification. If composition is estimated from first event data or after pooling both sampling events, data must first be stratified to eliminate variability in capture probability (detected by the C versus R test) within strata. Composition parameters are estimated within strata, and abundance for each stratum needs to be estimated using a Petersen-type type formula. Overall composition parameters are estimated by combining stratum estimates weighted by estimated stratum abundance according to the formulae below.

Case IV. Data must be stratified to eliminate variability in capture probability within strata for at least one or both sampling events. Abundance is calculated using a Petersen-type model for each stratum, and estimates are summed across strata to estimate overall abundance. Composition parameters may be estimated within the strata as determined above, but only using data from sampling events where stratification has eliminated variability in capture probabilities within strata. If data from both sampling events are to be used, further stratification may be necessary to meet the condition of capture homogeneity within strata for both events. Overall composition parameters are estimated by combining stratum estimates weighted by estimated stratum abundance.

If stratification by sex or length is necessary, overall composition is estimated by combining within-stratum composition estimates as follows:

$$\hat{p}_k = \sum_{i=1}^{j} \frac{\hat{N}_i}{\hat{N}_\Sigma} \hat{p}_{ik} \text{, and} \tag{1}$$

$$\hat{V}[\hat{p}_k] \approx \frac{1}{\hat{N}_\Sigma^2} \left(\sum_{i=1}^{j} \hat{N}_i^2 \hat{V}[\hat{p}_{ik}] + (\hat{p}_{ik} - \hat{p}_k)^2 \hat{V}[\hat{N}_i] \right) \tag{2}$$

where: j = the number of sex/size strata;

$\hat{p}_{ik}$ = the estimated proportion of fish that were age or size k among fish in stratum i;

$\hat{N}_i$ = the estimated abundance in stratum i;

$\hat{N}_\Sigma$ = sum of the $\hat{N}_i$ across strata.

APPENDIX B

Appendix B1.–Biweekly sampling statistics and estimated effort, catch, and harvest of large (≥ 28 inches TL) and small (< 28 inches TL) Chinook salmon at the Letnikof boat launch, May 7–June 24, 2007.

		May 21–June 3				
	May 7–May 20	Non-Derby	Derby	June 4–June 17	June 18–June 24	Total
Boats counted	31	39	56	102	6	234
Angler-hr. sampled	155	416	851	1,004	33	2,459
Salmon-hr. sampled	151	416	851	1,003	30	2,451
Chinook sampled	1	18	51	45	0	115
Sampled for adipose clips	1	18	51	45	0	115
Adipose clips	0	1	2	4	0	7
Angler-hours						
Estimate	239	994	1,964	1,620	137	4,954
Variance	4,467	182,209	92,141	34,881	9,605	323,303
Salmon-hours						
Estimate	231	994	1,964	1,619	126	4,934
Variance	3,725	182,209	92,141	34,879	11,416	324,370
Large Chinook catch						
Estimate	3	56	62	117	0	238
Variance	4	1,310	12	156	0	1,482
Large Chinook kept						
Estimate	3	56	62	117	0	238
Variance	4	1,310	12	156	0	1,482
Wild mature Chinook kept (excluding hatchery and immature fish)						
Estimate	0	44	43	66	0	153
Variance	0	889	19	65	0	973
Small Chinook catch						
Estimate	0	69	40	97	0	206
Variance	0	2,084	155	641	0	2,880
Small Chinook kept						
Estimate	0	0	3	0	0	3
Variance	0	0	4	0	0	4

Appendix B2.–Biweekly sampling statistics and estimated effort, catch, and harvest of large (≥ 28 inches TL) and small (< 28 inches TL) Chinook salmon at Chilkat State Park boat launch, May 14–June 24, 2007.

		May 21–June 3				
	May 14–May 20	Non-Derby	Derby	June 4–June 17	June 18–June 24	Total
Boats counted	0	1	3	1	1	6
Angler-hr. sampled	0	6	234	8	8	256
Salmon-hr. sampled	0	6	234	8	8	256
Chinook sampled	0	0	3	0	0	3
Sampled for adipose clips	0	0	3	0	0	3
Adipose clips	0	0	0	0	0	0
Angler-hours						
Estimate	0	27	276	56	56	415
Variance	0	567	61,051	2,688	2,688	66,994
Salmon-hours						
Estimate	0	27	276	56	56	415
Variance	0	567	61,051	2,688	2,688	66,994
Large Chinook catch						
Estimate	0	0	15	0	0	15
Variance	0	0	180	0	0	180
Large Chinook kept						
Estimate	0	0	15	0	0	15
Variance	0	0	180	0	0	180
Wild mature Chinook kept (excluding hatchery and immature fish)						
Estimate	0	0	5	0	0	5
Variance	0	0	20	0	0	20
Small Chinook catch						
Estimate	0	0	30	0	0	30
Variance	0	0	720	0	0	720
Small Chinook kept						
Estimate	0	0	0	0	0	0
Variance	0	0	0	0	0	0

Appendix B3.–Biweekly sampling statistics and estimated effort, catch, and harvest of large (≥ 28 inches TL) and small (< 28 inches TL) Chinook salmon at the Small Boat Harbor, May 7–June 24, 2007.

		May 21–June 3				
	May 14–May 20	Non-Derby	Derby	June 04–June 17	June 18–June 24	Total
Boats counted	9	14	11	13	4	51
Angler-hr. sampled	61	77	110	100	44	392
Salmon-hr. sampled	37	77	110	100	44	368
Chinook sampled	2	1	3	1	1	8
Sampled for adipose clips	2	1	3	1	1	8
Adipose clips	0	0	0	0	1	1
Angler-hours						
Estimate	382	344	548	658	111	2,043
Variance	70,361	886	25,205	38,472	27	134,951
Salmon-hours						
Estimate	214	344	548	658	111	1,875
Variance	20,717	886	25,205	38,472	27	85,307
Large Chinook catch						
Estimate	14	9	3	7	0	33
Variance	168	0	0	42	0	210
Large Chinook kept						
Estimate	14	9	3	7	0	33
Variance	168	0	0	42	0	210
Wild mature Chinook kept (excluding hatchery and immature fish)						
Estimate	7	5	2	7	0	21
Variance	42	16	0	42	0	100
Small Chinook catch						
Estimate	0	5	30	42	14	91
Variance	0	16	720	1,092	0	1,828
Small Chinook kept						
Estimate	0	0	0	0	11	11
Variance	0	0	0	0	9	9

APPENDIX C

Appendix C1.–Estimated age composition and mean length-at-age (mm MEF) of Chinook salmon incidentally harvested in the Chilkat Inlet subsistence gillnet fishery, June 16–July 8, 2007.

		Brood year and age class					
		2004	2003	2002	2001	Total	Total
		1.1	1.2	1.3	1.4	aged	sampled
Males	Sample size	1	3	2	0	6	6
	Percent	16.7	50.0	33.3			54.5
	SE	16.7	22.4	21.1			15.7
	Mean length	445	630	808			
	SE		30	32			
Females	Sample size	0	1	1	3	5	5
	Percent		20.0	20.0	60.0		45.5
	SE		20.0	20.0	24.5		15.7
	Mean length		555	740	860		
	SE				79		
Combined	Sample size	1	4	3	3	11	11
	Percent	9.1	36.4	27.3	27.3		
	SE	9.1	15.2	14.1	14.1		
	Mean length	445	605	785	860		
	SE	30	32	79			

Appendix C2.–Estimated age composition of Chinook salmon incidentally harvested in the Chilkat Inlet subsistence gillnet fishery, 2000-2007.

	Number	Percent by age class					
Year	aged	1.1	1.2	1.3	1.4	1.5	Large (≥ age-1.3) total
2000[a]	15	0.0	60.0	26.7	13.3	0.0	40.0
2001[b]	20	0.0	35.0	55.0	10.0	0.0	65.0
2002[c]	23	0.0	21.7	52.2	26.1	0.0	78.3
2003[d]	33	3.1	48.5	27.3	21.2	0.0	48.5
2004[e]	38	5.2	31.6	47.4	15.8	0.0	63.2
2005[f]	21	0.0	38.1	33.3	28.6	0.0	62.4
2006[g]	21	0.0	9.5	66.7	23.8	0.0	90.5
2007[h]	11	9.1	36.4	27.3	27.3	0.0	54.6
Average							62.8

[a] Data from Ericksen 2001.
[b] Data from Ericksen 2002.
[c] Data from Ericksen 2003.
[d] Data from Ericksen 2004.
[e] Data from Ericksen 2005.
[f] Data from Ericksen and Chapell 2006.
[g] Data from Chapell 2009
[h] Data from Appendix C1.

APPENDIX D

Appendix D1.–Brood year 2000 Chilkat Chinook salmon coded wire tags recovered from random sampling efforts, 2003-2007.

Year	Head	Tag Code	Gear	Port	Recovery date	Stat. week	Quad-rant	Dist.	Sub-dist.	Length
2003	231976	40297	Subsist	Haines	6/28/2003	26	NE	115	32	470
2003	231979	40296	Escape	Chilkat River	6/20/2003	25	NE	115	32	340
2003	231984	40540	Escape	Chilkat River	6/26/2003	26	NE	115	32	430
2003	231985	40299	Escape	Chilkat River	6/26/2003	26	NE	115	32	380
2003	231987	40299	Escape	Chilkat River	6/27/2003	26	NE	115	32	365
2003	232000	40299	Escape	Chilkat River	6/30/2003	27	NE	115	32	405
2003	231989	40297	Escape	Chilkat River	7/01/2003	27	NE	115	32	420
2003	55915	40299	Escape	Chilkat River	7/10/2003	28	NE	115	32	390
2003	55918	40299	Escape	Chilkat River	7/19/2003	29	NE	115	32	290
2003	55995	40299	Escape	Chilkat River	8/08/2003	32	NE	115	32	375
2003	222737	40540	Escape	Chilkat River	8/19/2003	34	NE	115	32	440
2004	255771	40297	Purse	Petersburg	6/21/2004	26	NE	112	22	533
2004	273097	40540	Troll	Hoonah	6/07/2004	24	NW	114	25	710
2004	273099	40540	Troll	Hoonah	6/08/2004	24	NW	114	25	710
2004	274286	40296	Troll	Hoonah	8/16/2004	34	NW			650
2004	254142	40296	Drift	Haines	6/22/2004	26	NE	115	10	
2004	538159	40299	Drift	Excursion Inlet	7/12/2004	29	NE	115		673
2004	254156	40299	Sport	Skagway	8/10/2004	33	NE	115	34	700
2004	254158	40540	Sport	Skagway	8/11/2004	33	NE	115	34	695
2004	254162	40297	Sport	Skagway	8/30/2004	36	NE	115	34	760
2004	254131	40540	Subsist	Haines	6/19/2004	25	NE	115	32	515
2004	256750	40299	Subsist	Haines	6/19/2004	25	NE	115	32	660
2004	254104	40299	Subsist	Haines	6/26/2004	26	NE	115	32	850
2004	254110	40552	Subsist	Haines	6/26/2004	26	NE	115	32	670
2004	254001	40299	Escape	Chilkat River	7/04/2004	28	NE	115	32	565
2004	264007	40540	Escape	Chilkat River	7/09/2004	28	NE	115	32	555
2004	254221	40540	Escape	Chilkat River	8/04/2004	32	NE	115	32	615
2004	254222	40540	Escape	Chilkat River	8/04/2004	32	NE	115	32	475
2004	221442	40540	Escape	Chilkat River	8/11/2004	33	NE	115	32	440
2004	221444	40540	Escape	Chilkat River	8/11/2004	33	NE	115	32	570
2004	254116	40540	Escape	Chilkat River	8/14/2004	33	NE	115	32	570
2004	254223	40299	Escape	Chilkat River	8/16/2004	34	NE	115	32	545
2004	254121	40297	Escape	Chilkat River	8/18/2004	34	NE	115	32	590
2004	254205	40540	Escape	Chilkat River	8/18/2004	34	NE	115	32	615
2004	221445	40299	Escape	Chilkat River	8/23/2004	35	NE	115	32	670
2005	262023	40299	Troll	Sitka	3/16/2005	12	NW	113	41	790
2005	295005	40297	Troll	Hoonah	5/17/2005	21	NW	114	27	730
2005	295013	40297	Troll	Hoonah	5/22/2005	22	NW	114	27	832
2005	295019	40540	Troll	Hoonah	5/25/2005	22	NW	114	50	801
2005	295038	40299	Troll	Hoonah	6/06/2005	24	NW	114	25	800
2005	295111	40540	Troll	Hoonah	7/05/2005	28	NW			698
2005	14732	40540	Drift	Excursion Inlet	6/29/2005	27	NE	115		699
2005	14734	40297	Drift	Excursion Inlet	6/29/2005	27	NE	115		910

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Appendix D1.–Page 2 of 2.

Year	Head	Tag Code	Gear	Port	Recovery date	Stat. week	Quad-rant	Dist.	Sub-dist.	Length
2005	539626	40540	Drift	Juneau	6/29/2005	27	NE	111		849
2005	252786	40540	Drift	Juneau	7/20/2005	30	NE	115		818
2005	221428	40297	Sport	Haines	5/28/2005	22	NE	115	32	905
2005	221433	40297	Sport	Haines	6/05/2005	24	NE	115	34	730
2005	221438	40299	Sport	Haines	6/12/2005	25	NE	115	32	810
2005	221439	40540	Sport	Haines	6/12/2005	25	NE	115	32	860
2005	254164	40299	Subsist	Haines	6/19/2005	26	NE	115	32	910
2005	254326	40297	Escape	Chilkat River	7/07/2005	28	NE	115	32	830
2005	264013	40552	Escape	Chilkat River	8/09/2005	33	NE	115	32	840
2005	221461	40299	Escape	Chilkat River	8/11/2005	33	NE	115	32	640
2005	254165	40297	Escape	Chilkat River	8/12/2005	33	NE	115	32	600
2005	254168	40296	Escape	Chilkat River	8/13/2005	33	NE	115	32	905
2005	264048	40540	Escape	Chilkat River	8/17/2005	34	NE	115	32	810
2005	264019	40540	Escape	Chilkat River	8/17/2005	34	NE	115	32	780
2005	264073	40299	Escape	Chilkat River	8/19/2005	34	NE	115	32	880
2005	264023	40540	Escape	Chilkat River	8/20/2005	34	NE	115	32	820
2005	264025	40297	Escape	Chilkat River	8/22/2005	35	NE	115	32	790
2005	264026	40540	Escape	Chilkat River	8/23/2005	35	NE	115	32	795
2005	264027	40297	Escape	Chilkat River	8/23/2005	35	NE	115	32	620
2005	264050	40299	Escape	Chilkat River	8/24/2005	35	NE	115	32	820
2005	264051	40299	Escape	Chilkat River	8/24/2005	35	NE	115	32	740
2005	264052	40299	Escape	Chilkat River	8/24/2005	35	NE	115	32	670
2005	264078	40540	Escape	Chilkat River	8/26/2005	35	NE	115	32	870
2005	264080	40540	Escape	Chilkat River	8/26/2005	35	NE	115	32	780
2005	264075	40299	Escape	Chilkat River	8/29/2005	36	NE	115	32	795
2005	264076	40299	Escape	Chilkat River	8/29/2005	36	NE	115	32	760
2006	266503	40540	Drift	Juneau	7/24/2006	30	NE	115		860
2006	318007	40540	Sport	Sitka	6/06/2006	23	NW	113	41	850
2006	221471	40297	Subsist	Haines	6/17/2006	24	NE	115	32	910
2006	254177	40540	Subsist	Haines	6/25/2006	26	NE	115	32	740
2006	254179	40540	Escape	Chilkat River	8/09/2006	32	NE	115	32	840
2006	254180	40540	Escape	Chilkat River	8/09/2006	32	NE	115	32	760
2006	254183	40297	Escape	Chilkat River	8/10/2006	32	NE	115	32	810
2006	221479	40299	Escape	Chilkat River	8/11/2006	32	NE	115	32	840
2006	254357	40540	Escape	Chilkat River	8/17/2006	33	NE	115	32	885
2006	254358	40540	Escape	Chilkat River	8/21/2006	34	NE	115	32	830
2006	254186	40540	Escape	Chilkat River	8/21/2006	34	NE	115	32	860
2006	254234	40299	Escape	Chilkat River	8/25/2006	34	NE	115	32	895
2006	254235	40540	Escape	Chilkat River	8/25/2006	34	NE	115	32	875
2006	254242	40540	Escape	Chilkat River	8/28/2006	35	NE	115	32	770
2006	254245	40540	Escape	Chilkat River	8/30/2006	35	NE	115	32	855

Appendix D2.–Brood year 2000 Chilkat Chinook salmon coded wire tags recovered from select (non-random) sampling events, 2003-2007.

Year	Head	Tag Code	Gear	Port	Recovery date	Stat. week	Quad-rant	Dist.	Sub-dist.	Length
2005	254227	40540	Escape	Chilkat River	8/17/2005	34	NE	115	32	
2005	221430	40299	Sport	Haines	5/28/2005	22	NE	115	32	
2005	264040	40540	Subsist	Haines	6/25/2005	26	NE	115	32	760
2005	252401	40297	Subsist	Haines	6/28/2005	27	NE	115	32	
2006	254229	40540	Sport	Haines	6/03/2006	22	NE	115	32	860
2006	320406	40540	Sport	Juneau	5/21/2006	21	NE	111	31	965
2006	254356	40297	Escape	Chilkat River	8/16/2006	33	NE	115	32	830

APPENDIX E

Appendix E1.–WinBUGS code and results of Bayesian statistical analysis of brood year 2000 Chilkat River juvenile Chinook salmon abundance.

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data from other recoveries included, non-valid tags considered
prior distributions for root nodes underlined
fixed constants are **in bold**
deterministic relationships in black (these link the priors and the likelihoods, or calculate auxiliary quantities)
likelihood (sampling distribution of data) *in italics*

BY 2000 constants

adclips <- 88	**# ad clips found**
heads <- 54	**# heads collected (this is actually not relevant here)**
valid.tags <- 51	**# tags decoded**

model {

N.fry ~ dnorm(0,1.0E-12)	# abundance of fry in fall
phi.1 ~ dbeta(0.1,0.1)	# proportion of fry surviving until spring
rho ~ dbeta(0.1,0.1)	# proportion of adipose-clipped fish for which head collected and tag decoded
M.fry <- 27,839	**# fry marked**
M.smolt <- 4,714	**# smolt marked**
C <- 859	**# fish inspected inriver for ad clips**
m<-33	**# number of Chilkat CWT recoveries elsewhere, fall and spring**
N.smolt <- N.fry * phi.1	# abundance of smolt the following spring
q.fall <- M.fry / N.fry	# fraction marked in fall
q.spring <- M.smolt / N.smolt	# fraction marked in spring
pi[1] <- q.fall * rho	# fraction of returning fish from which could expect a valid fall tag
pi[2] <- q.spring * rho	# fraction of returning fish from which could expect a valid spring tag
pi[3] <- (q.fall + q.spring) * (1 - rho)	# fraction of returning fish with adclip, but no valid tag
pi[4] <- 1 - pi[1] - pi[2] - pi[3]	# fraction with no adclip
R.tags[1:4] ~ dmulti(pi[],C)	*# vector of returns by type is multinomially distributed*
pi.fall <- q.fall / (q.fall + q.spring)	# fraction of fall tags among all Chilkat tags
m.fall ~ dbin(pi.fall,m)	*# number of fall tags among Chilkat tags is binomially distributed*
}	

DATA

list(R.tags=c(27,24,37,771),m.fall=19)	# Data list terms: 27 = fall tags in Chilkat escapement; 34 = spring tags # in Chilkat escapement; 37 = adclipped fish in Chilkat escapement # whose tags weren't decoded (head not taken or tag lost); 771 = fish # with intact adipose fins in Chilkat escapement; 19 = number of fall # tags recovered in marine random sampling.

INITS
list(N.fry =509000, phi.1=0.2, rho=0.6)

RESULTS

Node	mean	sd	MC error	2.5%	10.0%	median	90.0%	97.5%	start	sample
N.fry	510,700	74,290	373.50	386,200	4.22E+5	503,700	608,900	6.76E+5	4001	96,000
N.smolt	105,300	17,170	33.34	77,030	84,980	103,400	127,900	1.44E+5	4001	96,000
phi.1	0.21080	0.04779	1.938E-4	0.1331	0.1546	0.20550	0.27370	0.31900	4001	96,000
pi[1]	0.03224	0.00544	2.338E-5	0.02251	0.02549	0.03192	0.03938	0.04377	4001	96,000
pi[2]	0.02662	0.00487	8.777E-6	0.01800	0.02061	0.02630	0.03302	0.03705	4001	96,000
pi[3]	0.04272	0.00688	1.677E-5	0.03027	0.03417	0.04237	0.05174	0.05715	4001	96,000
pi[4]	0.89840	0.01029	3.394E-5	0.87740	0.88510	0.89870	0.91140	0.91770	4001	96,000
rho	0.57950	0.05228	8.427E-5	0.47560	0.51190	0.57990	0.64640	0.67980	4001	96,000

APPENDIX F

Appendix F1.–Summary of Chilkat Chinook salmon stock assessment parameters from CWT studies, brood years 1988-2000.

	Brood year							
	1988[a]	1989[a]	1991[b]	1998[c]	1999[d]	2000	BY 1988-2000 average	BY 1999-2000 average
Fall fry abundance					386,400	510,700		448,550
SE					38,020	74,290		
Overwinter survival					36.4%	21.1%		28.8%
SE					6.5%	4.8%		
Smolt emigration				123,680	139,500	105,300	122,827	122,400
SE				30,554	21,920	17,170		
Marked fraction (inriver)	0.037	0.110	0.048	0.015	0.113	0.102	0.071	0.097
Harvest (≥ age-1.1)								
Commercial	910	283	681	191	589	414	511	470
SE	235	74	176	190	216	54		
Sport	719	373	374	849	972	353	607	543
SE	327	132	124	706	438	93		
Subsistence	9	27	58		252	236	116	227
SE	1	2	2		123	86		
Total harvest (≥ age-1.2)	1,638	683	1,006	1,040	1,572	990	1,155	1,281
SE	401	152	210	731	541	205		
Inriver return (≥ age-1.2)	7,111	6,233	11,900	3,596	4,764	4,173	6,296	4,469
SE	789	781	1,167	488	562	681		
Total return (≥ age-1.2)	8,749	6,916	12,906	4,636	6,336	5,163	7,451	5,750
SE	885	796	1,186	879	780	711		
Exploitation	18.7%	9.9%	7.8%	22.4%	24.8%	19.2%	17.1%	22.0%
SE				12.5%	6.7%	4.2%		
Smolt-adult survival				3.7%	4.5%	4.9%	4.4%	4.7%
SE				1.2%	0.8%	0.7%		

[a] Data from Ericksen (1996).
[b] Data from Ericksen (1999).
[c] Data from Ericksen and Chapell (2006).
[d] Data from Chapell (2009).

APPENDIX G

Appendix G1.–Computer data files used in the analysis of this report.

FILE NAME	DESCRIPTION
07FallChinookCWT.xls	Excel workbook containing trapping, length sampling, and sequential tag number data from BY 2006 Chinook salmon CWT project in fall 2007.
08SpringChinookCWT.xls	Excel workbook containing trapping, length and weight sampling data from BY 2006 Chinook salmon CWT project in spring 2008.
2007 Haines creel interview.dta	ASCII file containing edited angler interview data from the Haines marine sport fishery in 2007.
Haines Marine Creel 2007 v3a.sas	SAS program to estimate effort and harvest in the 2007 Haines marine sport fishery using 2007 Haines creel interview.dta.
07KingsTagged.xls	Excel workbook containing raw data from Chinook salmon captured in the lower Chilkat River during 2007.
07KingSpawningSamples.xls	Excel workbook containing raw data from Chinook salmon sampled on the Chilkat River spawning tributaries during 2007.
07KingHainesSportSubsAWL.xls	Excel workbook containing raw data from Chinook salmon sampled in Haines marine sport and subsistence fisheries.