Fishery Data Series No. 97-27

Sport Fishing Effort, Catch, and Harvest and Inriver Abundance of Chilkat River Chinook Salmon near Haines, Alaska, in 1996

by

Randolph P. Ericksen

October 1997

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

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

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

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

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
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
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

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	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
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.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
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
standard length	SL
total length	TL
variance	Var

FISHERY DATA SERIES NO. 97-27

SPORT FISHING EFFORT, CATCH, AND HARVEST AND INRIVER ABUNDANCE OF CHILKAT RIVER CHINOOK SALMON NEAR HAINES, ALASKA, IN 1996

by

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ABSTRACT

A mark-recapture experiment was used to estimate spawning abundance of chinook salmon *Oncorhynchus tshawytscha* of age 1.3 and older returning to the Chilkat River in 1996. A stratified two-stage direct expansion survey was used to estimate angler effort for and harvest of, wild mature chinook salmon assumed to be bound for the Chilkat River in the Haines marine boat fishery during the spring of 1996. Harvest of large (>28 inches in total length) chinook salmon and chartered angler effort and harvest were also estimated.

Two hundred forty-five (245) large (age 1.3 and older) chinook salmon were captured in the lower Chilkat River between June 11 and August 10, 1996 in drift gillnets and two fish wheels; 233 of these fish were tagged with solid-core spaghetti tags (188 in drift gillnets and 45 in the fish wheels). We examined a total of 714 large chinook salmon on spawning tributaries to the Chilkat River, and 33 of these were marked. On the basis of these data, we estimated that 4,920 (SE = 751) large chinook salmon ($n_1 = 233$, $n_2 = 714$, $m_2 = 33$) immigrated into the Chilkat River during 1996.

An estimated 10,082 angler-hours (SE = 880) of effort (9,596 targeted salmon hours, SE = 866) were expended for a harvest of 354 (SE = 41) large chinook salmon, of which 257 (SE = 29) were wild mature fish. Chartered anglers accounted for 16% and 18% of the estimated targeted salmon effort and harvest of large chinook salmon, respectively.

Key words: Mark-recapture, creel survey, angler effort, harvest, marine boat sport fishery, hatchery, escapement, coded wire tag, age composition, length-at-age, chinook salmon, *Oncorhynchus tshawytscha*, Chilkat River, Kelsall River, Tahini River, Big Boulder Creek, Haines, Southeast Alaska.

INTRODUCTION

The Chilkat River is a large glacial system that originates in British Columbia, Canada, flows through rugged dissected mountainous terrain, and terminates in Chilkat Inlet near Haines, Alaska (Figure 1). The mainstem and major tribu-taries comprise approximately 350 km of river channel in a watershed covering about 1,600 km² (Bugliosi 1988).

The third largest population of chinook salmon in Southeast Alaska occurs in the Chilkat River (Pahlke 1993). Previous studies suggest Chilkat River chinook salmon rear in the inside waters of Southeast Alaska (Pahlke 1991, Johnson et al. 1993, Ericksen 1996). Electrophoretic analysis indicates that this population is genetically related more to southern British Columbia and Washington stocks than to other Southeast Alaskan populations (Gharett et al. 1987).

A spring marine boat sport fishery occurs annually in Chilkat Inlet (Figures 1 and 2) in Southeast Alaska near Haines and targets mature chinook salmon *Oncorhynchus tshawytscha* returning to the Chilkat River. A creel survey has been used to monitor harvest in this fishery since 1984. The harvest in this fishery peaked at over 1,600 chinook salmon in 1985 and 1986 (Neimark 1985, Mecum and Suchanek 1986, 1987, Bingham et al. 1988, Suchanek and Bingham 1989, 1990, 1991, Ericksen 1994, 1995, 1996).

The spring marine boat fishery in Haines has been popular both with local and non-local anglers; an estimated 61% of the anglers that fished in 1985 were not from Haines (Bethers 1986). In 1988, an estimated 1.1 million dollars were spent by anglers fishing in Haines and Skagway for chinook salmon (Jones and Stokes 1991). The Haines King Salmon Derby, which began in the mid 1950s, is directed primarily at returning Chilkat River chinook salmon.

Beginning in 1981, the Alaska Department of Fish and Game (ADF&G), Division of Sport Fish began a program to index chinook salmon abundance in the Chilkat River (Pahlke 1992) using aerial survey counts in Stonehouse and Big Boulder creeks (Figure 1). These areas were

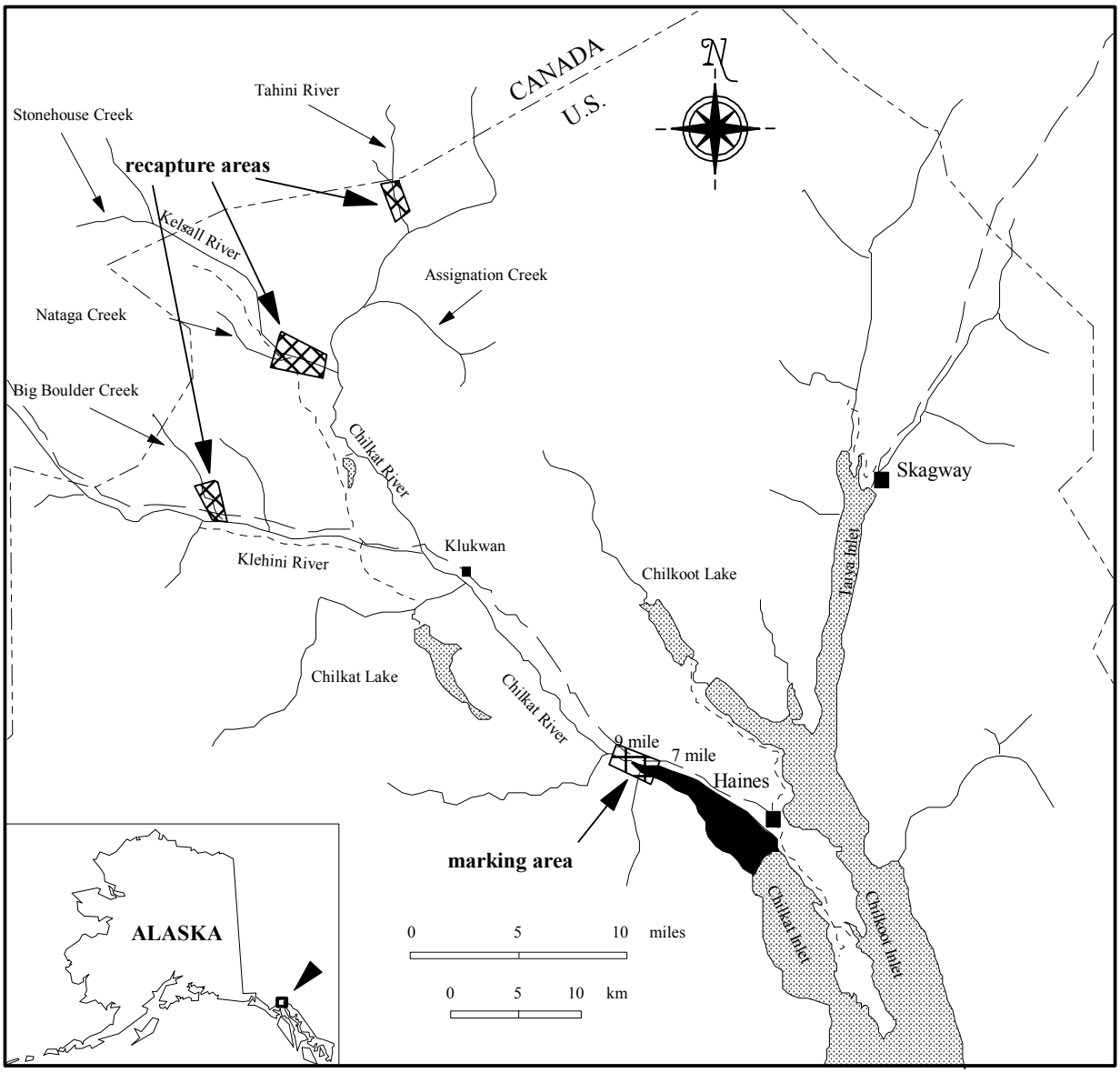

Figure 1.–Location of sampling sites and release sites of coded wire tagged chinook salmon near Haines and Skagway, Southeast Alaska, 1996.

selected because they were the only clearwater spawning areas that could be effectively surveyed. The indices were used in a regionwide program to monitor chinook salmon escapements in Southeast Alaska (Pahlke 1992). In 1983, annual enhancement of the Chilkat River chinook salmon began by collecting gametes in a tributary to the Chilkat River (the Tahini River) for incubation in the Crystal Lake Hatchery.

Concern about Chilkat River chinook salmon developed when the indices of adult abundance declined in 1985 and 1986. This decline coincided with high harvests of chinook in the commercial troll, commercial drift gillnet, and marine sport fisheries in the area. In 1987, the Department began to restrict sport, subsistence and commercial fisheries in upper Lynn Canal, and recreational fisheries were closed entirely in

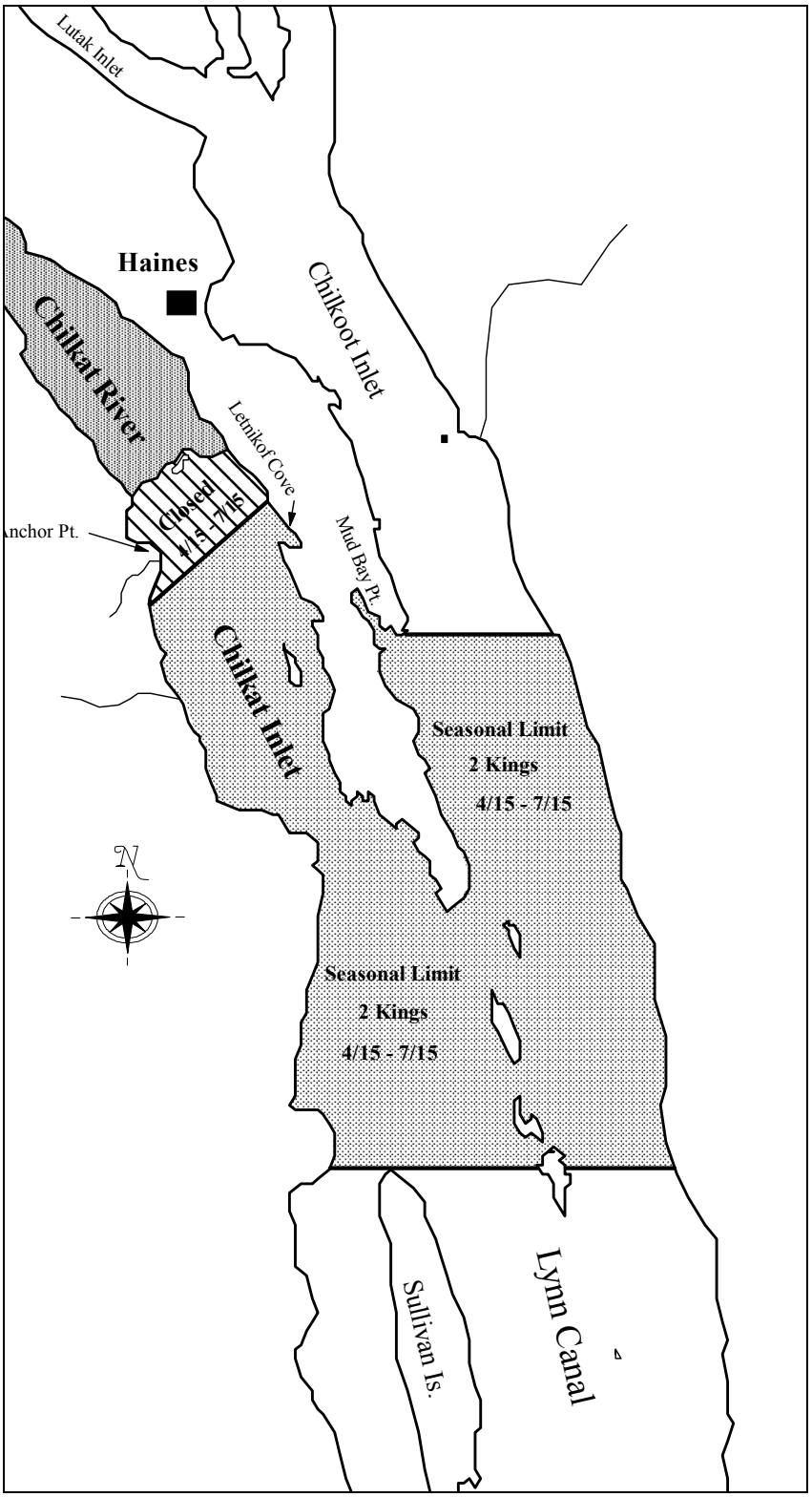

Figure 2.–Location of the 1996 Haines marine chinook salmon sport fishing regulatory area. The seasonal limit was increased by emergency order from 2 to 5 on June 6, 1996.

1991 and 1992. The Haines King Salmon Derby was closed beginning in 1988.

As a result of these concerns, the Division of Sport Fish initiated a program to tag wild juvenile chinook salmon in 1988 with coded wire tags (CWTs) to better determine migratory patterns and contributions to sport and commercial fisheries. The Division also conducted radio telemetry and mark-recapture experiments in 1991 and 1992 to estimate spawning distribution and abundance of large (age 1.3 years and older) chinook salmon in the river. Results of this research indicated that most of the chinook spawn in two major tributaries of the Chilkat River; the Kelsall and Tahini rivers, and immature fish are harvested as they rear in the inside waters of Southeast Alaska (Johnson et al. 1992, 1993, Ericksen 1996).

Mark-recapture experiments were maintained as a means to estimate the escapement of large chinook salmon after 1992. Estimates have ranged between 4,472 (SE = 851) and 6,795 (SE = 1,005) fish (Johnson et al. 1992, 1993; Johnson 1994; Ericksen 1995, 1996). Because abundance has appeared relatively high and stable, a King Salmon Derby was held in Haines during 1995, for the first time in eight years, and continued through 1996.

The current Chilkat River escapement goal of 2,000 chinook salmon was established in the late 1970s and is currently under review. Regulations in effect during 1996 prevented sport fishing for chinook salmon near the mouth of the Chilkat River, and included a seasonal limit of two chinook salmon between April 15 and July 15 (Figure 2). However, because of an anticipated large return of chinook from the 1991 brood, the seasonal limit was increased to five by emergency order on June 6. Commercial fishing regulations are structured to reduce incidental harvests of mature chinook salmon in the Lynn Canal gillnet fishery.

Estimating harvest and escapement is the continuing goal of the Chilkat River chinook salmon research program. Research objectives in 1996 were:

1. to estimate the 1996 immigration of large (≥age 1.3) chinook salmon into the Chilkat River; and
2. to estimate the harvest of wild mature chinook salmon in the Haines spring marine boat sport fishery from May 6 to June 30, 1996.

METHODS

ABUNDANCE

A mark-recapture experiment was used to estimate the number of large chinook salmon returning to the Chilkat River in 1996. Marks were applied to fish captured in the lower Chilkat River with drift gillnets and fish wheels from June 11 through August 10, between the area adjacent to Haines Highway miles 7 and 9 (Figure 1). Large chinook salmon were marked with a solid-core spaghetti tag and a hole punch in the upper left operculum, prior to release. Water depth (cm), and temperature (°C) were recorded daily at 0700 and 1330 hours near highway mile 8. Fish were examined for marks on three spawning tributaries of the Chilkat River between August 6 and September 6. Expected relative precision (95% confidence intervals) for the experiment was about ±30%.

Lower River Marking

Gillnets 21.3 m long and 3.0 m deep (70 ft x 10 ft) with an 18.5-cm (7.25-in.) stretched mesh were drifted from June 11 through July 22, 1996. Each day an attempt was made to complete 43 drifts between 0600 and 1400 hours. Fishing was conducted from an 18-ft boat in three adjoining 0.5-km-long areas, which were marked along the same 1.5-km-long stretch of river used in previous years (Figure 3). This section of the river was about 100 m wide and 2 to 3 m deep. The 43 drifts took about 6 hours to complete when fish were not captured. Fishing continued uninterrupted from area 1 to area 2, and then to area 3 if 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

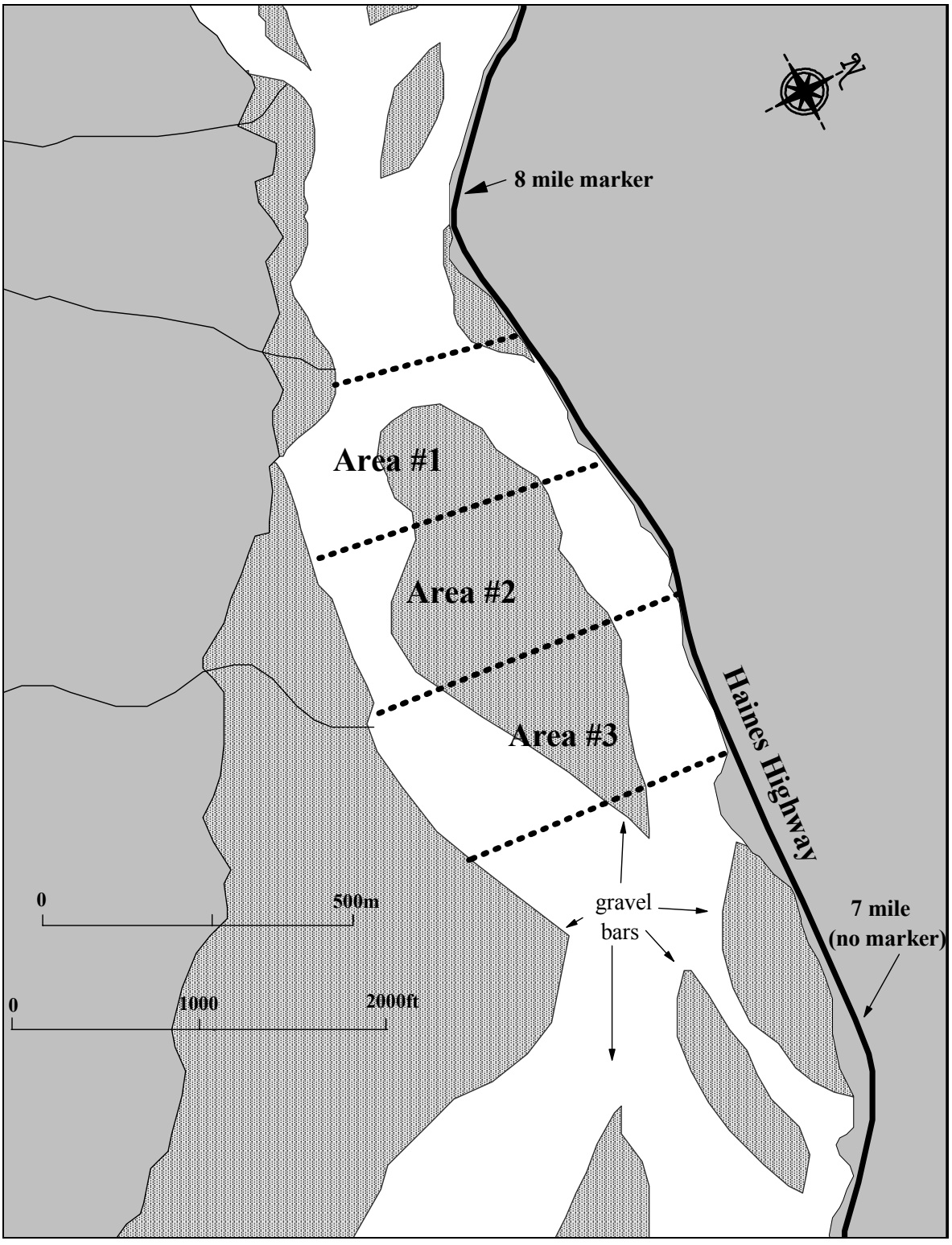

Figure 3.–The lower Chilkat River showing active river channel and drift gillnet locations in 1996.

was subsequently completed before a new drift was started. If 43 drifts could not be completed during the day, additional drifts were added to the next day's total to make up the balance.

Two four-basket fish wheels were installed by ADF&G Commercial Fisheries Management and Development Division (CFMADD) personnel early in the season to monitor the escapement of sockeye salmon *O. nerka* to the Chilkat River. The Division of Sport Fish provided funding for one technician to work on the fish wheels in exchange for CFMADD tagging of captured chinook. One fish wheel operated adjacent to the Haines Highway at approximately mile 9 from June 22 through September 15, and another about 300 m upstream from June 25 through September 15. The wheels were located along the east bank of the river where the main flow was constrained primarily to one side of the floodplain. Fish wheels were operated continuously except for maintenance.

Captured chinook salmon were placed in a water-filled tagging box (see Figure 4 *in* Johnson 1994), inspected for missing adipose fins, and measured to the nearest 5 mm, mid-eye-to-fork length (MEF). Fish were initially classified as "large" or "small," depending on their length: fish ≥660 mm MEF were designated large, and fish <660 mm MEF were designated small. Healthy chinook salmon ≥ 660 mm MEF were scale sampled, visually "sexed," and marked with a uniquely numbered spaghetti tag threaded over a solid plastic core, and a ¼-inch hole was punched into the upper edge of the left operculum as a secondary mark. Age of each fish was deter-mined at the end of the season from scale pattern analysis (Olsen 1992). Each fish was then reclas-sified as large or small, using ocean age, rather than length, as criteria; fish with three or more ocean years of residence were classified as large, and younger fish were classified as small. Any fish whose scales could not be aged was classified small or large by using the 660-mm MEF cutpoint criteria.

Spawning Ground Recovery

Escapements in the Kelsall and Tahini rivers (Figure 1), which comprised about 90% of the large chinook salmon spawning in the Chilkat River in 1991 and 1992 (Johnson et al. 1992, 1993), were sampled for marks by two teams of two people. Spawning grounds in the Kelsall River (including Nataga Creek) were sampled from August 6 to September 5. Spawning grounds in the Tahini River were sampled from August 8 to September 6. Chinook salmon were also sampled in Big Boulder Creek from August 9 through September 3, with assistance from CFMADD staff. Chinook salmon were captured with gill-nets, dip nets, bare hands, and spears. Double sampling was prevented by punching a hole in the lower edge of the left operculum of all captured fish.

The validity of the (assumed closed-population) experiment rests on several assumptions: (a) that every fish has an equal probability of being marked during event 1, or that every fish has an equal probability of being captured in event 2, or that marked fish mix completely with unmarked fish; (b) that recruitment and "death" (emigration) do not both occur between sampling events; (c) that marking does not affect catchability (or mortality) of the fish; (d) fish do not lose marks between sample events; (e) all recovered marks are reported; and (f) that double sampling does not occur (Seber 1982).

The validity of assumption (a) was tested through a series of hypothesis tests. First, a 3×2 contingency table (chi-square statistic) was used to test the hypothesis ($\alpha = 0.05$) that fish sampled at the three spawning tributaries were marked at the same rate. If this hypothesis was accepted, a simple Petersen model was used to estimate abundance; otherwise a Darroch estimator would have been used. Assumption (a) implies that tagging occurs in proportion to abundance during immigration or, if it does not, that no difference in the immigration timing, sex and age composition occurs between stocks bound for different spawning locations. The possibility of selective sampling was also investigated because assumption (a) could be violated if the sampling rate varied by size (or sex) of the fish. The hypothesis that fish of different sizes were captured with equal probability was tested with at Kolmogorov-Smirnov (K-S) 2-sample test. Sex selective sampling was tested using a 2×2 contingency table. If selective sampling was

apparent the abundance estimate could be stratified by age and/or by sex. The remaining assumptions are considered in greater detail under the Discussion section.

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

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

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

where n_1 is the number of large chinook salmon marked in the lower river, n_2 is the number of large chinook salmon examined on the spawning grounds, and m_2 is the number of marked fish recaptured on the spawning grounds.

Age composition, mean length-at-age, and variances of the catch in each gear type were calculated using standard normal statistics.

HARVEST

1996 Haines Spring Marine Boat Sport Fishery

A stratified multi-stage direct expansion creel survey was used to estimate the harvest of chinook salmon in the Haines marine boat sport fishery. Temporal stratification included 7-day (weekly) periods at one high-use site and 14-day (biweekly) periods at two low-use sites. However, a separate temporal strata existed during the two weekends of the Haines Derby (May 25, 26, 27, June 1 and 2) at both high- and low-use sites. Each fishing day was defined as starting at 0800 and ending at civil twilight.

The three access locations were the Letnikof Dock (the high-use site), the Chilkat State Park boat launch, and the Small Boat harbor (Figure 1). Prior surveys indicate that anglers landing their catch at the Letnikof Dock account for 62–93% of the harvest of chinook salmon. Sampling at each location had days as primary sampling units and boat-parties as secondary units.

Sampling at Letnikof Dock occurred from May 6 to June 30, 1996 contained morning/evening stratification and weekend/weekday stratification of the evening strata during the peak of the season. Morning sampling strata lasted from 0800 to two hours before midday, and evening sampling strata lasted from two hours before midday to civil twilight. Thus, evening strata were four hours longer in duration than morning strata. This stratification scheme was designed to maximize sampling during hours when most of the anglers exited the fishery, increasing the precision of the estimates. Random selections determined primary units to sample in each strata. Two morning and three evening strata were sampled each week, except as noted below.

During the peak of the fishery (May 13 through June 9) the evening strata at Letnikof Dock were further divided into weekday and weekend stratification defined by Saturdays and Sundays. During this peak season, two morning, two weekday evening, and two weekend/holiday evening periods were sampled each week. In total, 19 unique strata were sampled at Letnikof Dock in 1996.

Sampling at the Small Boat Harbor and Chilkat State Park boat launch was initiated on May 6 and May 20, respectively, and continued through June 30. There was no type of day stratification at the low-use sites, so each sampling bi-weekly period was divided into 14 morning and 14 evening periods of equal length. Random selections determined primary units to sample in each morning and evening strata. To accommodate the impossibility of sampling three sites simultaneously with only two technicians, 14 changes (period moves) were made to the randomized sampling schedule at low-use sites. Sixteen unique strata were sampled at the low-use harbors during 1996. Sampling densities with two technicians were expected to yield an overall relative precision (95% confidence intervals) of about ±35%.

During each sample period, all sport fishing boats returning to the harbor were counted. Boat-parties returning to the dock were interviewed to determine: the number of rods fished; hours fished; type of trip (charter or noncharter); target species (chinook salmon, Pacific halibut *Hippoglossus stenolepis*); and number of fish kept and/or released by species. Interviewing boat-parties also included sampling all harvests of chinook salmon for maturity and missing adipose fins. Maturity was also determined (Ericksen 1994, Appendix A) in order to estimate the harvest of wild mature fish assumed to be returning to the Chilkat River. Chinook salmon were defined to be wild if: (a) they were not adipose finclipped; (b) they were captured in the Chilkat River drainage and CWT'd prior to release; or (c) if they were the progeny of gametes taken from the Chilkat River drainage and were CWT'd and released as fry back into their natal stream. In rare cases, some parties were not interviewed, or maturity status could not be determined. When one or more boat-parties could not be interviewed, total effort and catch for the stratum was estimated by expanding by the total number of parties returning to the dock during that period. Similarly, when a boat-party had fish with a nondeterminant maturity status, interview information for that boat-party was ignored and expansions (by sample period) were made from harvests by remaining boat-parties and the total number of boat-parties counted.

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

$$\hat{H}_h = D_h \overline{H}_h \tag{3}$$

$$\overline{H}_h = \frac{\sum_{i=1}^{d_h} \hat{H}_{hi}}{d_h} \tag{4}$$

$$\hat{H}_{hi} = M_{hi} \frac{\sum_{j=1}^{m_{hi}} h_{hij}}{m_{hi}} \tag{5}$$

where h_{hij} = harvest on boat j in sampling days (periods) i stratum h,

m_{hi} = number of boat parties interviewed in day i,

M_{hi} = number of boat-parties completed in day i,

d_h = number of days (morning or evening periods) sampled in stratum h,

and

D_h = number of days in stratum h.

The variance of the harvest by stratum is estimated:

$$V\left[\hat{H}_h\right] = (1 - f_{1h}) D_h{}^2 \frac{\sum_{i=1}^{d_h} (\hat{H}_{hi} - \overline{H}_h)^2}{d_h (d_h - 1)} + D_h \sum_{i=1}^{d_h} M_{hi}{}^2 (1 - f_{2hi}) \frac{\sum_{j=1}^{m_{hi}} (h_{hij} - \overline{h}_{hi})^2}{d_h m_{hi} (m_{hi} - 1)} \tag{6}$$

where f_{1h} is the sampling fraction for periods and f_{2hi} is the sampling fraction for boat-parties. Catch and effort is estimated similarly, substituting C and E for H in equation 3 through equation 6. Total harvests for the season are the sums across strata ΣH_h and $\Sigma V[H_h]$.

Chinook salmon sampled in the angler harvest were measured to the nearest 5 mm in fork length. Five scales were removed from the left side of each sampled fish (right side if left side scales were regenerated), 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 for age determination. Scales were aged using procedures in Olsen (1992). Information recorded for each chinook salmon sampled included sex, length, maturity, and the presence or absence of adipose fins. Heads from chinook salmon missing adipose fins were retained by technicians, and a locking 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 CWT Processing Laboratory in Juneau, where any tags present were removed, decoded, and corresponding information was entered into the tag lab data base.

A subset n_i of the catch in each stratum was counted and inspected to find recaptured fish. Of those a_i salmon in this sample without adipose fins, heads were retrieved from a subset, marked, and sent to Juneau for dissection. Of the a_i' heads that arrived in Juneau, all were passed through a magnetometer to detect a CWT. Of the t_i tags detected, t_i' were successfully decoded under a microscope after dissection of which m_{ij} had come from a cohort from a given release site.

Statistics from the recreational fishery were expanded to estimate harvest of hatchery fish for each stratum. From Bernard and Clark (1996), estimated harvest of a cohort was calculated as

$$\hat{r}_{ij} = \hat{H}_i \left(\frac{m_{ij}}{\lambda_i n_i} \right) \theta_j^{-1} \qquad (7)$$

where $\hat{H}_i$ is the estimated harvest for a stratum, θ is the fraction of hatchery fish marked, and $\lambda_i = (a_i' t_i')/(a_i t_i)$. The total harvest of hatchery fish $\hat{T}_i$ in a stratum was estimated as the sum of the estimated cohort harvests $\sum_j \hat{r}_{ij}$ in that stratum, and the variance as

$$\hat{Var}[\hat{T}_i] = \sum \hat{r}_{ij}^2 [G(\hat{H}_i) \qquad (8)$$

where G( ) is the squared coefficient of variation for the specified variable, $\hat{p}_{ij}$ is the estimated fraction of tagged fish from a cohort in the harvest, and $G[\hat{p}_{ij}]$ was calculated from Table 2 in Bernard and Clark (1996):

$$G[\hat{p}_{ij}] = \frac{1 - \lambda_i \hat{\phi}_i \theta}{m_{ij}} \qquad (9)$$

where ϕ_i is the fraction of harvest sampled (n_i / H_i). Finally, the total harvest of hatchery fish was calculated as

$$\hat{T} = \sum_i \hat{r}_i \qquad (10)$$

and its variance:

$$Var[\hat{T}] = \sum_i \hat{Var}[\hat{T}_i] \qquad (11)$$

Age composition and mean length-at-age of chinook salmon in the sport fishery harvest, and associated variances were estimated using standard normal statistics. This calculation for a stratified sampling program is warranted when there is no trend in the age composition or sampling is proportional over time. A chi-square statistic was used to test whether there was a change in the age composition over time.

RESULTS

ABUNDANCE

We captured 245 large (age 1.3 and older) and 24 small chinook salmon in the lower Chilkat River with drift gillnets and fish wheels between June 11 and August 10, 1996 (Table 1, Figure 4). Capture rates of large chinook salmon peaked on July 5. The mean date of migratory timing (when 50% of the immigration has occurred, Mundy 1984) in the lower river was also July 5 (Figure 5). Fish captured in the gillnet were predominantly age 1.3 (80.6%) and were evenly split between males and females (Table 2). Similarly, age 1.3 was dominant (67.2%) in fish wheels, although these fish were classified as mostly males (75.4%, Table 2). Large chinook salmon captured in gillnets and fish wheels were not significantly different in size (K-S test, d_{max} = 0.115, P = 0.728), but a significantly higher proportion in the fish wheels appeared to be males (χ^2 = 4.32, df = 1, P = 0.038). Of the 245 large fish captured, 233 were given an external spaghetti tag. Eight large (≥age 1.3) fish captured in the drift gillnet and three captured in the fish wheels were not marked because they were <660 mm in length. Also, one large fish captured in the drift gillnet was injured and therefore not tagged.

Table 1.–Numbers of chinook salmon caught in the lower Chilkat River by time period, gear type, and size, June 11 through September 15, 1996.

Time period	Drift gillnet		Fish wheels		Total		
	Large	Small	Large	Small	Large	Small	Total
6/11-6/15	0	1	0	0	0	1	1
6/16-6/20	7	0	0	0	7	0	7

6/21-6/25	17	2	1	2	18	4	22
6/26-6/30	22	0	4	3	26	3	29
7/01-7/05	57	0	13	5	70	5	75
7/06-7/10	42	0	11	4	53	4	57
7/11-7/15	23	0	4	2	27	2	29
7/16-7/20	27	2	10	1	37	3	40
7/21-7/25	2	0	1	1	3	1	4
7/26-7/30			2	1	2	1	3
7/31-8/04			1	0	1	0	1
8/05-8/09			0	0	0	0	0
8/10-8/14			1	0	1	0	1
8/15-9/15			0	0	0	0	0
Total	197	5	48	19	245	24	269

Seven hundred fourteen (714) large and 89 small chinook salmon were examined on the spawning grounds for marks (Table 3). Thirty three (33) large and no small marked fish were recovered (Table 3). Three of the 17 marked fish recovered were missing their tags but were identified by the opercular punch. The probability of capturing a marked chinook salmon on the three spawning tributaries was not significantly different (χ^2 = 0.720, df = 2, P = 0.698), thus data from all spawning areas were combined.

The cumulative distribution function (CDF) of lengths of large chinook salmon marked in the lower Chilkat River was not significantly different from the CDF of large tagged chinook salmon recaptured on the spawning grounds (K-S test, d_{max} = 0.093, P = 0.972, Figure 6, top). This result suggests the second sampling event was not

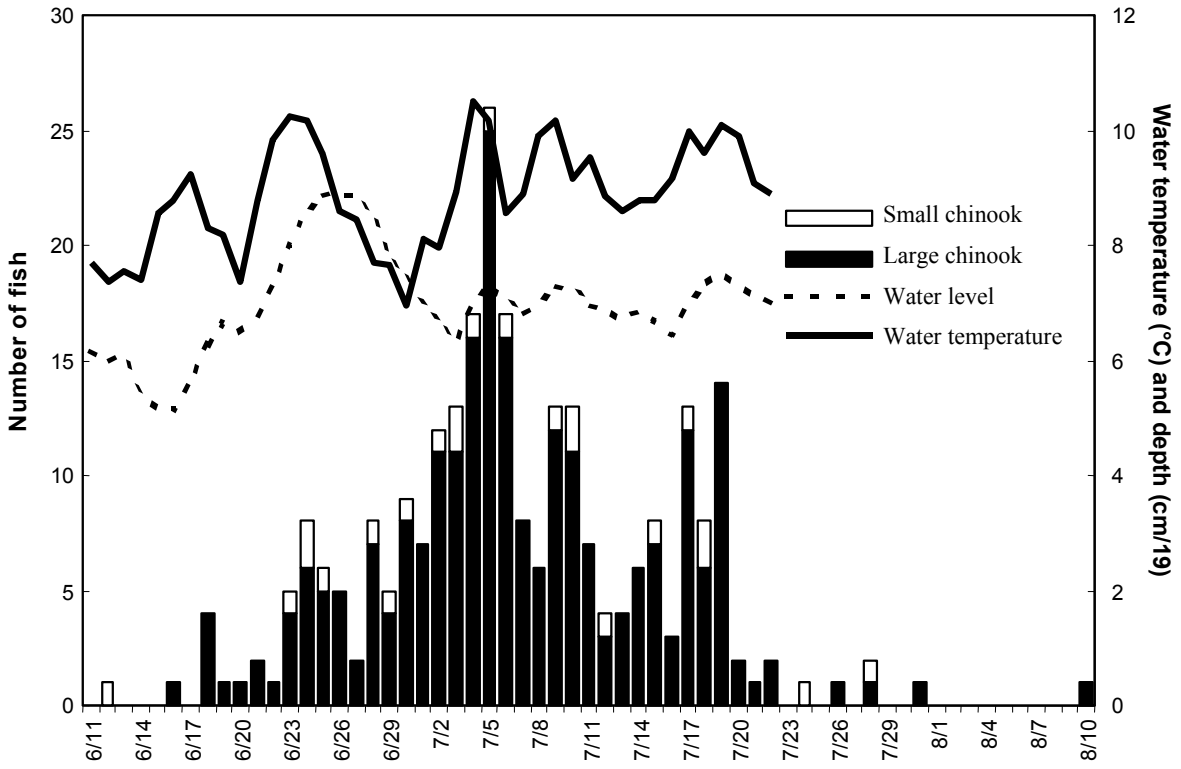

Figure 4.–Daily water depth (cm/19), temperature (°C), and catch of small (<age 1.3) and large (≥age 1.3) chinook salmon catch in drift gillnets and fish wheels operating in the lower Chilkat River, June 11 through August 10, 1996.

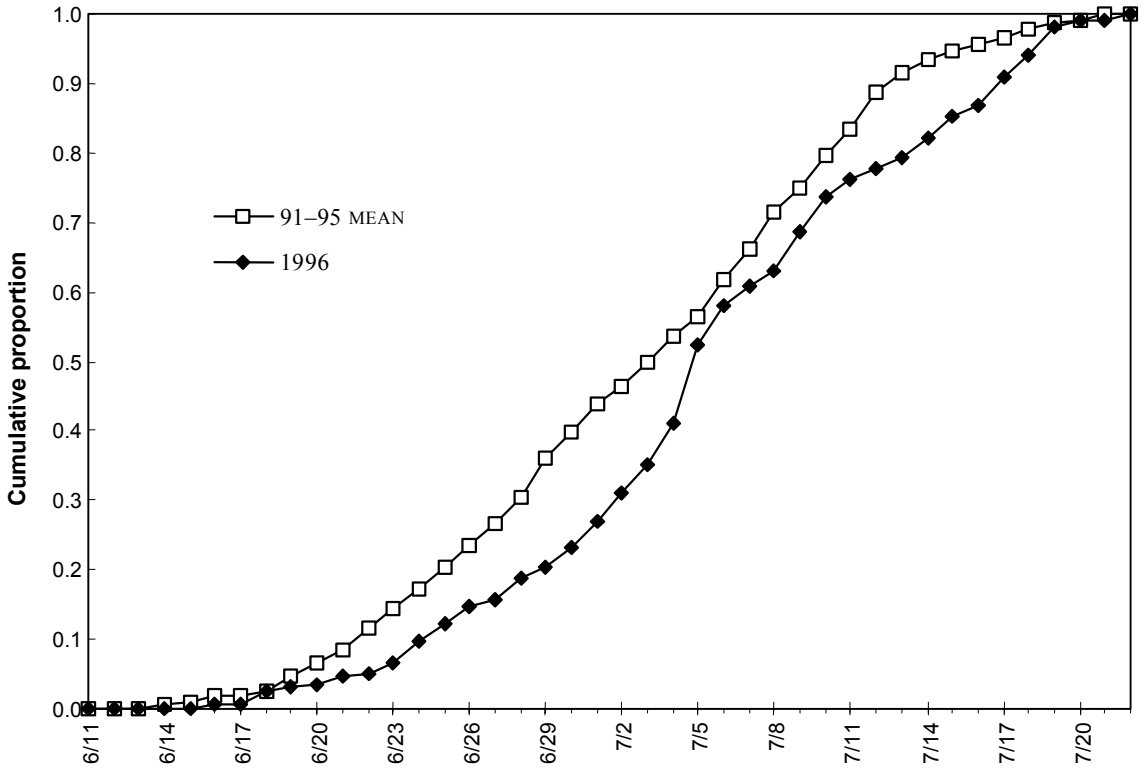

Figure 5.–Cumulative proportion of large (≥age 1.3) chinook salmon captured with drift gillnets in the lower Chilkat River in 1996 compared with the mean cumulative proportion, 1991–1995.

size-selective. Thus, an estimated 4,920 (SE = 751) large chinook salmon immigrated into the Chilkat River in 1996 under the Petersen model (n_1 = 233, n_2 = 714, m_2 = 33). This estimate is germane to the time of tagging in the lower river, since an unquantified removal occurs (due to natural mortality and subsistence fishery harvest) between the two sampling events.

The CDF of lengths of marked fish was not significantly different from the CDF of large chinook salmon examined for marks on the spawning grounds (K-S test, d_{max} = 0.056, P = 0.646, Figure 6, bottom). In addition, sex composition of large chinook salmon sampled was not significantly different between the marking and recovery events (χ^2 = 0.038, df = 1, P = 0.845). In conjunction with prior tests, these results suggest the marking event was not size (or sex) selective and fish from both sampling events could be used to estimate age and length composition of the escapement. However, although sex compositions appear to be similar (Table 4), the age composition of large chinook salmon was significantly different between the three spawning tributaries (χ^2 = 12.4, df = 2, P = 0.002). Thus, only fish sampled in the drift gillnet during the first sampling event were used to estimate age and length composition of the escapement.

HARVEST

1996 Haines Spring Marine Boat Sport Fishery

An estimated total of 10,082 (SE = 880) angler-hours of effort were expended in the Haines marine boat fishery between May 6 and June 30, 1996 to catch 367 (SE = 43) and harvest 354 (SE = 41) large chinook salmon (Table 5). This was based on a sample of 471 boat-parties who

Table 2.–Age composition of chinook salmon sampled during tagging activities on the Chilkat River drainage, by gear type, 1996.

	Brood year and age class						Total aged	Total sampled[a]
	1993	1992	1991	1990	1990	1989		
	1.1	1.2	1.3	1.4	2.3	1.5		
TAGGING: GILLNET, MILE 7.5								
Male								
Sample size	0	5	79	10	0	2	96	104
Percent		5.2	82.3	10.4		2.1		51.5
SD		2.3	3.9	3.1		1.5		3.5
Mean length		647	773	878		1,008		
SD		6.2	9.0	23.1		42.5		
Female								
Sample size	0	0	71	19	0	0	90	98
Percent			78.9	21.1				48.5
SD			4.3	4.3				3.5
Mean length			807	855				
SD			4.7	14.1				
All fish								
Sample size	0	5	150	29	0	2	186	202
Percent		2.7	80.6	15.6		1.1		
SD		1.2	2.9	2.7		0.8		
Mean length		647	789	863		1,008		
SD		6.2	5.4	12.1		42.5		
TAGGING: FISH WHEELS 8 AND 9 MILE								
Male								
Sample size	5	10	29	2	0	0	46	49
Percent	10.9	21.7	63.0	4.3				75.4
SD	4.6	6.1	7.1	3.0				5.3
Mean length	348	547	765	860				
SD	11.6	24.1	17.4	38.1				
Female								
Sample size	0	0	12	3	0	0	15	16
Percent			80.0	20.0				24.6
SD			10.3	10.3				5.3
Mean length			808	910				
SD			11.1	36.1				
All fish								
Sample size	5	10	41	5	0	0	61	65
Percent	8.2	16.4	67.2	8.2				
SD	3.5	4.7	6.0	3.5				
Mean length	348	547	778	890				
SD	11.6	24.1	14.6	24.1				

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

fished 4,490 angler-hours (4,091 salmon-hours), and harvested 189 large (28 inches or greater total length) chinook salmon (Appendix A1 through A3). An estimated 257 (SE = 29) of the chinook salmon harvested in this fishery were wild mature fish assumed to be returning to the Chilkat River. About 95% (9,596 salmon-hours, SE = 866) of angler effort targeted chinook salmon, and the remainder was directed toward other species, primarily Pacific halibut. Anglers caught an estimated 152 (SE = 69) small (sublegal, <28 inches total length) chinook salmon (none were

Table 3.–Number of chinook salmon inspected for marks and number of marked fish recaptured during tag recovery surveys in the Chilkat River drainage, by location, size, and sex, 1996.

		Number inspected							Number marked[a]		
		Large[b]				Small[b]			Large		
Location	Dates	M	F	U[c]	Total	M	F	Total	M	F	Total
Kelsall	8/06-9/05	160	159	0	319	41	0	41	7	6	13
Nataga	8/19-9/01	3	6	0	9	0	0	0	0	0	0
Tahini	8/08-9/06	126	112	19	257	31	1	32	7	7	14
Big Boulder	8/09-9/03	62	67	0	129	16	0	16	3	3	6
Total		351	344	19	714	88	1	89	17	16	33

[a] Also included under number of fish inspected; no small marked fish were recovered on the spawning grounds.

[b] Fish were defined as "large" if they were ≥3 yr ocean residence and ≥660 mm MEF (or ≥660 mm MEF if not aged).

[c] Fish sampled with no sex information.

harvested). Seventy-nine percent of the estimated salmon effort and 87% of the estimated harvest of chinook salmon occurred between May 20 and June 16 (Table 5). Angling pressure for chinook salmon was relatively light during the first and last week, so our coverage of the fishery for mature chinook salmon was essentially complete. Estimates by site are presented in Appendices A1 through A3. Charter boat anglers accounted for about 16% of the salmon effort (1,514 salmon-hours, SE = 271), and 18% of the harvest (65, SE = 20) of chinook salmon in this fishery.

Anglers returning to the Letnikof Dock were responsible for 76% of the estimated salmon effort (7,328 salmon-hours, SE = 732) and 71% of the estimated harvest (276, SE = 34) of large chinook salmon (Appendix A1). Anglers returning to the Chilkat State Park boat launch and the Small Boat Harbor accounted for an estimated 636 (SE = 409) and 1,632 (SE = 218) salmon-hours of effort, respectively, and took respective harvests of 47 (SE = 14) and 31 (SE = 18) large chinook salmon (Appendices A2, A3).

AGE AND LENGTH OF HARVEST

We sampled a total of 187 chinook salmon for age and length in the angler harvest; 157 of these were assigned an age. The age composition of the harvest during May was not significantly different from that during June ($\chi 2$ = 0.466, df = 1, P = 0.495) so samples were pooled over time. The proportion of adipose finclipped chinook salmon was significantly higher at the Small Boat Harbor (in Chilkoot Inlet) ($\chi 2$ = 10.2, df = 1, P = 0.001) from those sampled at the other harbors (in Chilkat Inlet), so these samples were analyzed separately. Fish landed at the Small Boat Harbor are more likely to be from hatchery releases in Taiya Inlet (Figure 1), so this is a sensible result.

We sampled a 182 chinook salmon for age and length at the Chilkat Inlet harbors (Letnikof Dock and Chilkat State Park boat launch), and 150 of these were assigned an age (Table 6). Most (56.0%, SE = 3.7%) of the chinook harvested were male. The predominant age class was age 1.3 (78.7%, SE = 3.4%).

Four of the five fish sampled at the Small Boat Harbor were male. All three of the successfully aged fish were aged 1.3.

CONTRIBUTIONS OF CODED WIRE TAGGED STOCKS TO THE SPORT FISHERY

Hatchery-reared chinook salmon released into the Chilkat River (1991 brood), fish with CWTs from upper Lynn Canal (90-92 broods), and fish released in Fish Creek, near Juneau (1991 brood) were recovered in the 1996 Haines marine creel survey (Table 7). One hundred eighty-one (181)

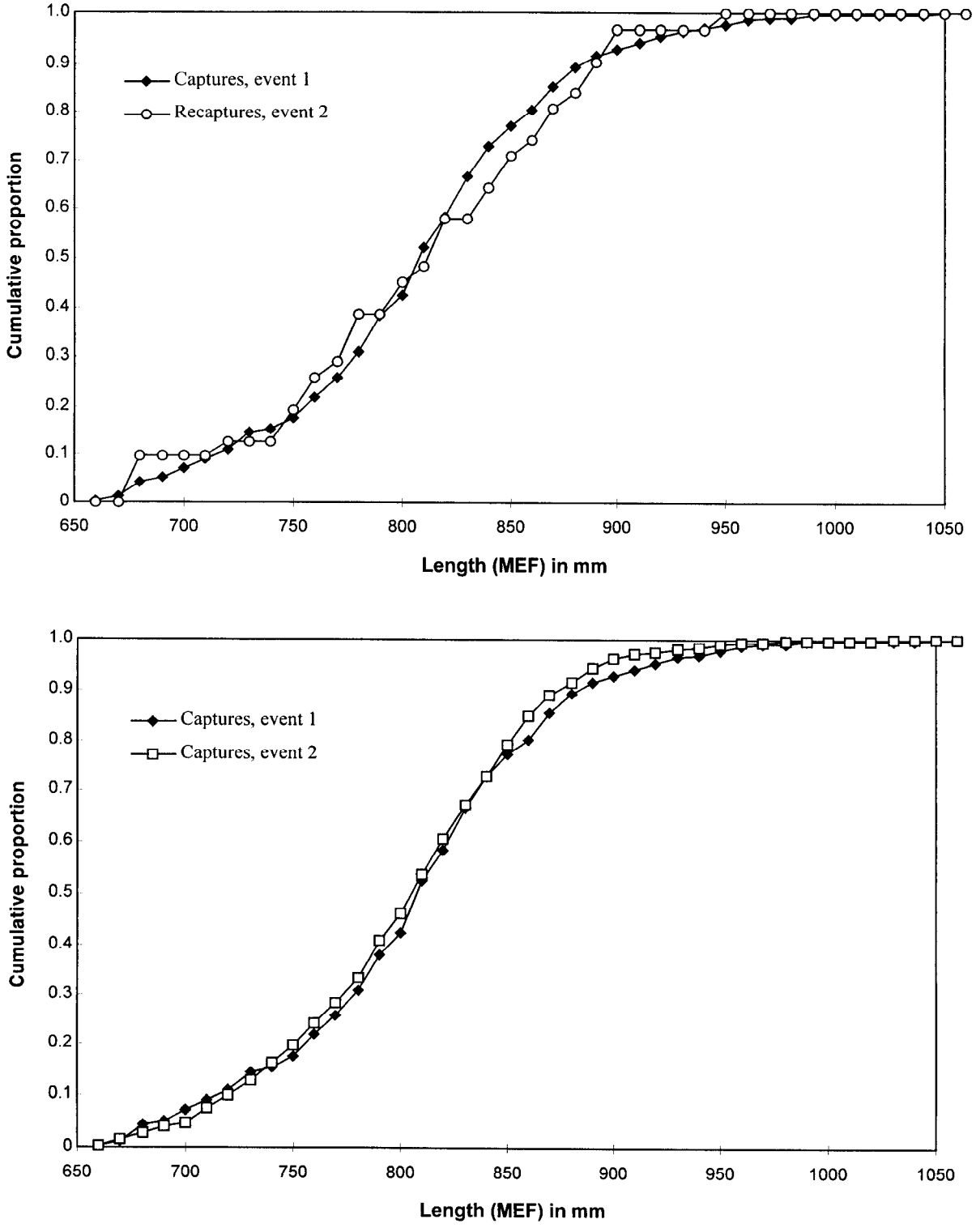

Figure 6.–The cumulative distribution function (CDF) of lengths (MEF) of large (≥age 1.3) chinook salmon marked in the lower Chilkat River versus lengths of marked fish recaptured on the spawning grounds (top) and versus lengths of large fish examined for marks on the spawning grounds (bottom), 1996.

Table 4.–Age composition of chinook salmon sampled during recovery surveys on the Chilkat River drainage, by spawning tributary, 1996.

	Brood year and age class						Total aged	Total sampled[a]
	1993	1992	1991	1990	1990	1989		
	1.1	1.2	1.3	1.4	2.3	1.5		
RECOVERY SURVEY: TAHINI RIVER SPAWNING GROUNDS								
Male								
Sample size	1	15	104	5	1	0	126	135
Percent	0.8	11.9	82.5	4.0	0.8			56.5
SD	0.8	2.9	3.4	1.7	0.8			3.2
Mean length	355	553	771	929	680			
SD		21.9	8.5	30.7				
Female								
Sample size	0	1	83	10	0	0	94	104
Percent		1.1	88.3	10.6				43.5
SD		1.1	3.3	3.2				3.2
Mean length		590	822	858				
SD			4.8	22.2				
All fish								
Sample size	1	16	187	15	1	0	220	239
Percent	0.5	7.3	85.0	6.8	0.5			
SD	0.5	1.8	2.4	1.7	0.5			
Mean length	355	555	793	881	680			
SD		20.6	5.4	19.6				
RECOVERY SURVEY: BIG BOULDER CREEK SPAWNING GROUNDS								
Male								
Sample size	2	7	63	0	0	1	73	78
Percent	2.7	9.6	86.3			1.4		54.9
SD	1.9	3.4	4.0			1.4		4.2
Mean length	320	580	775			885		
SD	50.0	27.2	7.4			10.6		
Female								
Sample size	0	0	50	9	0	1	60	64
Percent			83.3	15.0		1.7		45.1
SD			4.8	4.6		1.7		4.2
Mean length			795	863		900		
SD			4.8	14.3				
All fish								
Sample size	2	7	113	9	0	2	133	142
Percent	1.5	5.3	85.0	6.8		1.5		
SD	1.1	1.9	3.1	2.2		1.1		
Mean length	320	580	784	863		893		
SD	50.0	27.2	5.5	14.3		7.5		
RECOVERY SURVEY: KELSALL RIVER/NATAGA CREEK SPAWNING GROUNDS								
Male								
Sample size	1	26	146	16	0	0	189	204
Percent	0.5	12.7	71.6	7.8				55.3
SD	0.5	2.3	3.2	1.9				2.6
Mean length	350	598	783	877				
SD		13.8	6.3	16.9				

-continued-

Table 4.–Page 2 of 2.

	Brood year and age class						Total aged	Total sampled[a]
	1993	1992	1991	1990	1990	1989		
	1.1	1.2	1.3	1.4	2.3	1.5		
Female								
Sample size	0	0	119	36	0	0	155	165
Percent			72.1	21.8				44.7
SD			3.5	3.2				2.6
Mean length			791	837				
SD			3.7	7.7				
All fish								
Sample size	1	26	265	52	0	0	344	369
Percent	0.3	7.0	71.8	14.1				
SD	0.3	1.3	2.3	1.8				
Mean length	350	598	787	850				
SD		13.8	3.9	7.8				

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

Table 5.–Total estimated effort, catch, and harvest of chinook salmon in the Haines marine boat sport fishery, by bi-week, May 6 through June 30, 1996.

		May 20 to June 02				
	May 06 May 19	Non-derby	Derby	June 03 June 16	June 17 June 30	Total
Angler-hours						
Estimate	771	872	3,038	3,754	1,647	10,082
Variance	22,241	34,599	231,355	473,672	12,208	774,075
Salmon-hours						
Estimate	692	816	3,011	3,696	1,381	9,596
Variance	19,854	32,592	228,137	460,801	9,167	750,551
Large chinook catch						
Estimate	9	9	93	216	40	367
Variance	13	54	99	1,448	231	1,845
Large chinook kept						
Estimate	9	9	83	216	37	354
Variance	13	54	9	1,448	173	1,697
Wild mature chinook kept (excluding hatchery and immature fish)						
Estimate	2	9	62	151	33	257
Variance	0	54	6	658	147	865
Small (< 28") chinook catch						
Estimate	0	21	59	54	18	152
Variance	0	159	369	1,078	82	1,688

Table 6.–Estimated age composition and mean length-at-age of harvested chinook salmon landed at Chilkat Inlet harbors during the Haines Marine boat sport fishery, May 6 through June 30, 1996.

	Brood year and age class					Total aged	Total sampled[a]
	1992	1991	1991	1990	1989		
	1.2	0.4	1.3	1.4	1.5		
Male							
Sample size	1		68	15		84	102
Percent	1.2		81.0	17.9			56.0
SE	1.2		4.3	4.2			3.7
Mean length[b]	720		853	953			
SE			9	24			
Female							
Sample size		1	50	14	1	66	80
Percent		1.5	75.8	21.2	1.5		44.0
SE		1.5	5.3	5.1	1.5		3.7
Mean length		840	834	949	990		
SE			11	15			
All							
Sample size	1	1	118	29	1	150	182
Percent	0.7	0.7	78.7	19.3	0.7		
SE	0.7	0.7	3.4	3.2	0.7		
Mean length	720	840	845	951	990		
SE			7	14			

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

[b] Length measured snout to fork of tail in mm.

chinook salmon (54% of estimated harvest) were sampled at Chilkat Inlet harbors (Letnikof Dock and Chilkat State Park) between May 6 and June 30, and 19 fish were missing fins. Thirty-three (SE = 7) of the estimated 333 chinook salmon harvested in Chilkat Inlet were of hatchery origin, 5 of which (SE = 1) were from fry releases into tributaries (Tahini River and Big Boulder Creek) of the Chilkat River (Table 7).

Five chinook salmon were sampled for missing adipose fins at the Small Boat Harbor, four of which were missing their adipose fins. An estimated 21 hatchery fish (SE = 13) that were released into the upper Lynn Canal (1991 brood) were landed at this harbor between May 6 and June 30 (Table 7), which accounted for 68% of the estimated total of 31 fish from the on-site creel survey.

A list of computer files used in this analysis is found in Appendix A-4.

DISCUSSION

In estimating abundance we assumed: (a) tagging of large chinook salmon was in proportion to their numbers immigrating over time, or that immigration timing of the stocks was similar and sampling for marks on fish spawning in the areas sampled was random; (b) untagged fish did not recruit to the population between sampling events; (c) tagged and untagged fish suffered similar mortality rates between sampling events; (d) fish did not lose marks; and (e) all marked fish were recognized. Considerable efforts were made to catch and mark fish in proportion to their abundance (assumption a) during the immigration by sampling uniformly across the escapement. Sampling effort for tags on the Kelsall and Tahini rivers (where >90% of spawning occurred in 1991 and 1992), was fairly constant across the time when spawning fish die and are available for sampling. Previous research on the Chilkat River (Johnson et al. 1992, 1993) suggest immigration timing is similar for Tahini and Kelsall River

Table 7.–Contribution estimates of coded wire tagged chinook salmon to the Haines marine sport fishery, with statistics used for computing estimates by biweek, 1996.

Hatchery	Release site	Tag code	Brood year	Biweek	Harvest		Sample	Aclp	Heads	Detect	Decode	Tags	Contribution	
					N	Var[N]	n	a	a'	t	t'	m	$\hat{r}$	SE
CHILKAT INLET RECOVERIES														
Hidden Falls	Taiya Inlet	04-36-55	90	May 20-June 6	99	59	79	12	12	11	11	1	1	0
		04-40-57	91	May 6-19	9	13	5	2	2	2	2	2	4	2
		04-40-57,58,59,60	91	May 20-June 6	99	59	79	12	12	11	11	6	8	1
		04-40-59	91	June 3-16	188	1,112	78	4	4	3	3	1	2	2
		04-41-33	92	June 3-16	188	1,112	78	4	4	3	3	1	2	2
		Release site contribution											17	4
Gastineau	Tahini River	04-01-020602	91	June 17-30	37	173	19	1	1	1	1	1	2	1
		Release site contribution											2	1
Snettisham	Fish Creek	04-40-31	91	May 20-June 6	99	59	79	12	12	11	11	2	9	6
		Release site contribution											9	6
Burro Creek	Burro Creek	04-40-47	91	June 3-16	188	1,112	78	4	4	3	3	1	2	2
		Release site contribution											2	2
Gastineau	Big Boulder	04-01-010911	91	May 20-June 6	99	59	79	12	12	11	11	2	3	1
		Release site contribution											3	1
SMALL BOAT HARBOR RECOVERIES														
Hidden Falls	Taiya Inlet	04-40-56,60	91	June 3-16	28	336	4	4	4	3	3	2	14	11
		Release site contribution											14	11
Burro Creek	Burro Creek	04-40-47	91	June 3-16	28	336	4	4	4	3	3	1	7	7
		Release site contribution											7	7

stocks. Also, I failed to reject the hypothesis that tagging ratios on the Tahini (p = 0.054:1) and Kelsall-Nataga (p = 0.040:1) rivers were different. To achieve a random sample during the second sampling event carcass sampling must not be size selective. Carcass surveys are known to be selective for females in some situations (Pahlke et al. 1996). While some selection may have occurred in this study, I could not detect a significant difference from the battery of tests applied. Assumption (b) is reasonable since tagging effort was relatively constant and continued until only about one fish a day was being caught. I could not test assumption (c) directly, however, recovery rates of fish marked in the gillnet were not significantly different from those marked in the fish wheels ($\chi 2$ = 0.943, df = 1, P = 0.332). This suggests that marked fish did not suffer greater mortality than unmarked fish, or if they did, mortality was similar between the two gear types. Two of the marked fish that were recaptured had been partially eaten by bear and were missing tags. However, these fish were still identified as marked fish by the secondary mark (opercular-punch). Thus assumption (d) appears to be robust. Personnel sampling on the spawning tributaries carefully examined each fish for marks, therefore failure of assumption (e) is unlikely.

The 1996 immigration of 4,920 (SE = 751) is close to the mean (5,193) of the abundance estimates since 1991 (Table 8). However, based on age composition in the drift gillnet, 82% (4,011, SE = 622) of the large chinook salmon entering the Chilkat River were age 1.3 (Table 9). On average, age 1.3 fish constitute 44.1% of the abundance in the Chilkat River (Table 9). In contrast, age 1.4 fish which normally account for 53.3% of the abundance were notably absent (775, SE = 158, 15.8%) in the population. Thus, while the 1991 brood year appears to be very strong; the 1990 brood year appears to be very weak (Table 9). The relative abundance of these two brood years during 1996 resulted in an overall abundance of large chinook salmon to the Chilkat River that was only average.

Sex was estimated with significant uncertainty early in the season. Five out of 31 tagged fish that were recaptured on the spawning grounds were sexed incorrectly during the marking event, as judged by sex determination on the spawning ground (where sexual dimorphism is more evident). As in past years (Ericksen 1995), the proportion of females was overestimated during the marking event. Sex composition during the marking event should therefore be viewed with great caution.

Sport fishing effort and harvest patterns observed during 1996 were similar to those observed in recent years. During 1996, 76% of the estimated salmon effort and 81% of the estimated harvest of chinook salmon originated from the Letnikof Dock. The 1996 estimated harvest of large chinook salmon is similar to the harvest during last six years (1988, 1989, 1990, 1993, 1994 and 1995) the fishery was open (Figure 7, Table 10). Sport fishing effort was also similar to that observed in recent years. Catch of large chinook salmon per salmon hour of effort (CPUE) in 1996 was similar to that observed in recent years, but was lower than that observed during the mid-1980s (Table 10) when anglers were allowed to fish to the mouth of the river. The 1996 effort and harvest did not approach the levels that prompted fishery restrictions in 1987 despite the increase in the seasonal limit. Thus, it appears that the seasonal limit regulation does not limit the harvest significantly.

ACKNOWLEDGMENTS

Mike Gaede supervised the field operations for the project and provided the necessary logistical support. I would like to thank the creel survey staff of Elizabeth Wilson, Doris Armijo, and Patricia Kermoian for their invaluable data collection efforts. Jarbo Crete, Elizabeth Wilson, Eric Holle, Sherrie Duncan, Doris Armijo, Annie Beesley, Dave Folletti, and Patrick Kelly worked in the field to capture, mark, and sample fish to complete this project. Sue Millard of the Division of Sport Fish in Douglas processed and aged scales from sampled chinook salmon. Scott McPherson provided input into the study design and analysis. Employees at the ADF&G Tag Lab in Juneau dissected heads from adipose finclipped

Table 8.–Parameters used to estimate abundance of large (≥age 1.3) chinook salmon to the Chilkat River, 1991–1996.

	1991[a]	1992[b]	1993[c]	1994[d]	1995[e]	1996
Drift gillnet	(5/22-7/19)	(6/01-7/23)	(6/15-7/22)	(6/14-7/22)	(6/13-7/21)	(6/11-7/22)
Marked	80	148	159	212	121	188
Fishwheels	(5/05-7/19)			(6/16-7/22)	(6/14-8/9)	(6/22-9/15)
Marked	145	N/A	N/A	84	59	45
SPAWNING GROUND RECOVERIES						
Kelsall/Nataga	(8/06-9/05)	(7/29-9/04)	(8/09-9/05)	(8/04-9/03)	(8/06-9/04)	(8/06-9/05)
Captures	507	571	445	482	240	328
Recoveries	15	18	15	24	11	13
Tahini gillnet	(7/22-8/09)	(7/16-8/17)	(7/22-8/11)			
Captures	155	158	90	N/A	N/A	N/A
Recoveries	9	4	4	N/A	N/A	N/A
Tahini carcass[f]	(8/11-9/03)	(8/14-8/31)	(8/20-9/01)	(8/10-9/03)	(8/07-9/04)	(8/08-9/06)
Captures	39	156	43	250	84	257
Recoveries	2	1	1	5	4	14
Big Boulder	(8/05-9/12)	(7/31-8/15)	(8/04-8/10)	(8/03-8/19)	(8/04-9/05)	(8/09-9/03)
Captures	30	20	36	44	59	129
Recoveries	0	0	1	4	2	6
ALL RECOVERY AREAS						
Captures	733[g]	905	614	776	383	714
Recoveries	27[g]	23	21	33	17	33
Abundance	5,897	5,284	4,472	6,795	3,790	4,920
SE	1,005	949	851	1,057	805	751
Rel. precision[h]	0.33	0.35	0.37	0.30	0.42	0.30

[a] Taken from Johnson et al. (1992).

[b] Taken from Johnson et al. (1993).

[c] Taken from Johnson (1994).

[d] Taken from Ericksen (1995).

[e] Taken from Ericksen (1996).

[f] Sampling was not consistent at this site prior to 1994.

[g] Includes capture data from additional tributaries not listed.

[h] Relative precision = 1.96 Standard Error/estimate.

chinook to remove and read coded wire tags. Special thanks to Sam Bertoni and Anna Sharp at the tag lab, for providing timely CWT data summaries and answering my many requests for information. Donna Buchholz of the Research and Technical Services (RTS) Unit of the Division of Sport Fish processed mark sense forms and provided data control. Bob Marshall with RTS in Douglas provided biometric support in the study design, and analysis. Finally, Bob Marshall and Steve Elliott provided critical review of this report.

Table 9.–Estimated annual age compositions[a] and brood year returns of large (≥age 1.3) chinook salmon immigrating into the Chilkat River.

Return year		Age class 1.3	1.4	1.5	Total
1996	Abundance	4,011	775	134	4,920
	SE	622	158	3	751
1995[b]	Abundance	450	3,077	263	3,790
	SE	93	653	53	805
1994[c]	Abundance	2,405	4,276	114	6,795
	SE	445	708	67	1,057
1993[d]	Abundance	2,218	2,178	76	4,472
	SE	468	461	54	851
1992[d]	Abundance	1,689	3,595	0	5,284
	SE	375	682		949
1991[d]	Abundance	3,211	2,563	123	5,897
	SE	586	484	64	1,005
Average	Percent	44.1	53.3	2.5	
	Abundance	2,331	2,744	118	5,193

BROOD YEAR RETURNS

Brood year	Age class 1.3	1.4	1.5	Total	SE
1984			123		
1985		2,563	0		
1986	3,211	3,595	76	6,882	901
1987	1,689	2,178	114	3,981	598
1988	2,218	4,276	263	6,757	851
1989	2,405	3,077	134	5,616	792
1990	450	775		1,226	183
1991	4,011				
Avg.	2,331	2,744	118	4,892	

[a] Estimated as the age composition large (≥age 1.3) chinook salmon in the drift gillnet multiplied by the estimated abundance.

[b] Taken from Ericksen (1996).

[c] Taken from Ericksen (1995).

[d] Taken from Johnson (1994).

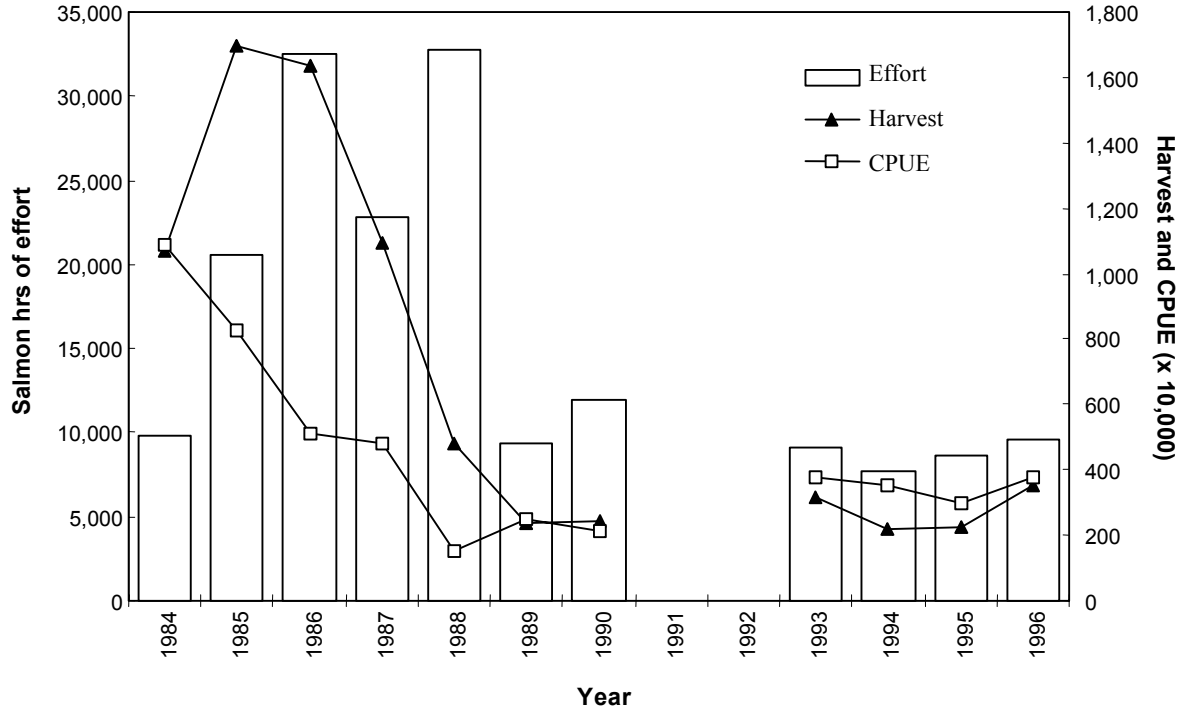

Figure 7.–Estimated angler effort for, and harvest and catch of large chinook salmon per salmon hour of effort (CPUE) in the Haines spring marine boat sport fishery, 1984–1996. Data taken from Table 10 (fishery closed in 1991 and 1992).

Table 10.–Estimated angler effort, and large (≥28 in.) chinook salmon catch and harvest in the Haines marine boat sport fishery for similar sample periods, 1984–1996.

Year	Survey dates	Effort				Large (≥28") chinook salmon				CPUE[a]
		Total angler-hours	SE	Salmon-hours	SE	Catch	SE	Harvest	SE	
1984[b]	5/06-6/30	10,253	c	9,855	c	1,072	c	1,072	c	0.109
1985[d]	4/15-7/15	21,598	c	20,582	c	1,705	c	1,696	c	0.083
1986[e]	4/14-7/13	33,857	c	32,533	c	1,659	c	1,638	c	0.051
1987[f]	4/20-7/12	26,621	2,557	22,848	2,191	1,094	189	1,094	189	0.048
1988[g]	4/11-7/10	36,222	3,553	32,723	3,476	505	103	481	101	0.015
1989[h]	4/24-6/25	10,526	999	9,363	922	237	42	235	42	0.025
1990[i]	4/23-6/21	i	I	11,972	1,169	248	60	241	57	0.021
1993[j]	4/26-7/18	11,919	1,559	9,069	1,479	349	63	314	55	0.038
1994[k]	5/09-7/03	9,726	723	7,682	597	269	41	220	32	0.035
1995[l]	5/08-7/02	9,457	501	8,606	483	255	42	228	41	0.030
1996	5/06-6/30	10,082	880	9,596	866	367	43	354	41	0.038
1984–86 average		21,903		20,990		1,479		1,469		0.070
1989–96 average		10,342		9,390		291		269		0.031

[a] Catch of large chinook salmon per salmon hour 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 total angler effort and harvest was provided.
[j] From Ericksen (1994).
[k] From Ericksen (1995).
[l] From Ericksen (1996).

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APPENDIX A

Appendix A1.–Sampling statistics, estimated effort, catch, and harvest of chinook salmon at the Letnikof Dock by week, May 6 through June 30, 1996.

	May 06 May 12	May 13 May 19	Non-derby May 20 June 02	Derby May 20 June 02	June 03 June 09	June 10 June 16	June 17 June 23	June 24 June 30	Total
Boats counted	1	41	25	90	59	93	79	2	390
Angler-hr. sampled	4	246	170	1,332	537	811	742	6	3,848
Salmon-hr. sampled	4	237	168	1,332	347	778	624	6	3,496
Chinook reported	0	5	3	78	32	40	18	0	176
Sampled for ad-clips	0	5	1	78	32	40	18	0	174
Ad-clips	0	2	0	12	1	3	1	0	19
Angler-hours									
Estimate	7	370	536	2,521	1,070	1,647	1,467	14	7,632
Variance	21	13,419	33,397	217,474	66,905	216,779	7,571	49	555,615
Salmon-hours									
Estimate	7	347	527	2,521	1,070	1,589	1,253	14	7,328
Variance	21	10,570	30,992	217,474	66,905	203,908	5,884	49	535,803
Large chinook catch									
Estimate	0	9	9	90	65	81	35	0	289
Variance	0	13	54	95	375	569	214	0	1,320
Large chinook kept									
Estimate	0	9	9	80	65	81	32	0	276
Variance	0	13	54	5	375	569	156	0	1,172
Wild mature chinook kept									
Estimate	0	2	9	60	49	67	28	0	215
Variance	0	0	54	5	173	443	130	0	805
Small chinook catch									
Estimate	0	0	21	47	5	14	18	0	105
Variance	0	0	159	348	0	28	82	0	617

Appendix A2.–Sampling statistics, estimated effort, catch, and harvest of chinook salmon at the Chilkat State Park boat launch by bi-week, May 20 through June 30, 1996.

	Non-derby	Derby			
	May 20	May 20	June 03	June 17	
	June 02	June 02	June 16	June 30	Total
Boats counted	2	0	6	3	11
Angler-hr. sampled	6	0	79	16	101
Salmon-hr. sampled	4	0	79	13	96
Chinook reported	0	0	6	1	7
Sampled for ad-clips	0	0	6	1	7
Ad-clips	0	0	0	0	0
Angler-hours					
Estimate	27	0	550	89	666
Variance	315	0	164,735	3,223	168,273
Salmon-hours					
Estimate	18	0	550	68	636
Variance	252	0	164,735	2,089	167,076
Large chinook catch					
Estimate	0	0	42	5	47
Variance	0	0	168	17	185
Large chinook kept					
Estimate	0	0	42	5	47
Variance	0	0	168	17	185
Wild mature chinook kept					
Estimate	0	0	35	5	40
Variance	0	0	42	17	59
Small chinook catch					
Estimate	0	0	35	0	35
Variance	0	0	1,050	0	1,050

Appendix A3.–Sampling statistics, estimated effort, catch, and harvest of chinook salmon at the Small Boat Harbor by biweek, May 6 through June 30, 1996.

		Non-derby	Derby			
	May 06	May 20	May 20	June 03	June 17	
	May 19	June 02	June 02	June 16	June 30	Total
Boats counted	20	17	19	8	6	70
Angler-hr. sampled	80	69	310	70	12	541
Salmon-hr. sampled	68	60	294	70	7	499
Chinook reported	0	0	2	4	0	6
Sampled for ad-clips	0	0	1	4	0	5
Ad-clips	0	0	0	4	0	4
Angler-hours						
Estimate	394	309	517	487	77	1,784
Variance	8,801	887	13,881	25,253	1,365	50,187
Salmon-hours						
Estimate	338	271	490	487	46	1,632
Variance	9,263	1,348	10,663	25,253	1,145	47,672
Large chinook catch						
Estimate	0	0	3	28	0	31
Variance	0	0	4	336	0	340
Large chinook kept						
Estimate	0	0	3	28	0	31
Variance	0	0	4	336	0	340
Wild mature chinook kept						
Estimate	0	0	2	0	0	2
Variance	0	0	1	0	0	1
Small chinook catch						
Estimate	0	0	12	0	0	12
Variance	0	0	21	0	0	21

Appendix A4.–Computer data files used in the analysis of this report.

FILE NAME	DESCRIPTION
F0810MA6.DTA	Mark-sense ASCII file containing angler interview data from the Haines marine sport fishery in 1996.
HAINE.PRG	Dbase program to generate SAS data file from mark-sense file.
HAINESCT.PRN	Count file (text) used in HAMC96.SAS to expand for missing interview data.
HAMC96.SAS	SAS program to estimate effort and harvest in the Haines marine sport fishery using HAINESCT.PRN and output from HAINE.PRG.
96AWL.XLS	Excel workbook containing all age-length data from the Haines sport fishery, and tagging and recovery efforts in the Chilkat River drainage during 1996.
96POPEST.XLS	Excel workbook used to estimate 1996 abundance of Chilkat River chinook.
96SPAWN.XLS	Excel workbook containing raw data from chinook sampled on the Chilkat River spawning tributaries during 1996.
96TAGS.XLS	Excel workbook containing raw data from chinook captured in the lower Chilkat River during 1996.