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Production and Spawning Distribution of Chilkat River Chinook Salmon in 2005

by

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and

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December 2006

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

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Measures (fisheries)

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

Mathematics, statistics

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

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ABSTRACT

The purpose of this study was to estimate the sport harvest, escapement, spawning distribution, and production of Chinook salmon *Oncorhynchus tshawytscha* returning to the Chilkat River during 2005. 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 age-stratified mark-recapture experiment to estimate spawning abundance of Chinook salmon returning to the Chilkat River in 2005. The spawning distribution was estimated by radio-tagging a subsample of the fish marked in the lower river with radio transmitters and tracking them upriver. Smolt abundance and marine harvest of 1998 brood year Chilkat River Chinook were estimated through recoveries of fish marked with coded wire tags as smolt in 2000.

An estimated 12,641 angler-h (SE = 1,239) of effort (12,287 salmon-h, SE = 1,216) were expended in the 2005 spring Haines marine sport fishery for a harvest of 252 (SE = 31) Chinook salmon (≥ 28 inches), of which 165 (SE = 26) were wild, mature fish. We estimated that 5,572 (SE = 1,017) Chinook salmon immigrated into the Chilkat River during 2005. Of those, 2,206 (SE = 852) were age-1.1 and -1.2; 1,857 (SE = 433) were age-1.3; and, 1,509 (SE = 347) were age-1.4 and older. A total of 129 fish captured in the lower Chilkat River were radio-tagged. All but two of the radio-tagged fish resumed upriver migration after tagging. We estimated that 89.0% (SE = 2.8%) of the Chinook salmon that entered the lower Chilkat River reached probable spawning areas, 6.0% (SE = 2.1%) were harvested in fisheries, and 5.0% (SE = 1.9%) either regurgitated their radio tags or did not reach probable spawning areas for other reasons. We estimated that 52.2% (SE = 4.7%) of the fish spawned in the Kelsall River drainage, 33.1% (SE = 4.4%) in the Tahini River, and 14.6% (SE = 3.3%) in the Klehini River drainage.

We estimated that 123,680 (SE = 30,554) smolt emigrated from the Chilkat River in 2000 (1998 brood year). An estimated 1,040 (SE = 731) Chilkat River Chinook salmon from this brood year were harvested in marine fisheries between 2001 and 2005. In addition, 34,771 fry captured in the fall of 2005, and 5,075 smolt in the spring of 2006 were coded wire tagged. They averaged 70 mm (SD = 6.8) fork length in the fall and 73 mm (SD = 6.1) in the spring. Future recoveries of these fish will allow us to estimate fall rearing abundance and marine harvest for the 2004 brood year.

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

INTRODUCTION

The Chilkat River drainage produces the third or fourth largest run of Chinook salmon *Oncorhynchus tshawytscha* in Southeast Alaska (McPherson et al. 2003). This large glacial system has its headwaters in British Columbia, Canada, flows through rugged, dissected, mountainous terrain, and terminates in Chilkat Inlet near Haines, Alaska (Figure 1). The mainstem and major tributaries comprise approximately 350 km of river channel in a watershed covering about 2,600 km² (Bugliosi 1988) of which 867.6 km^2 are considered accessible to anadromous fish (Ericksen and McPherson 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, 1990, 1991b; Ericksen 1994-2005). The fishery in Haines contributes significantly to the local economy, supports a salmon derby, and is popular both with local and non-local anglers (Bethers 1986; Jones & Stokes 1991).

Beginning in 1981, the Alaska Department of Fish and Game (ADF&G), Division of Sport Fish began a program to provide index counts to monitor escapement trends of Chinook salmon abundance in the Chilkat River (Kissner 1982) using aerial survey counts in Stonehouse and Big

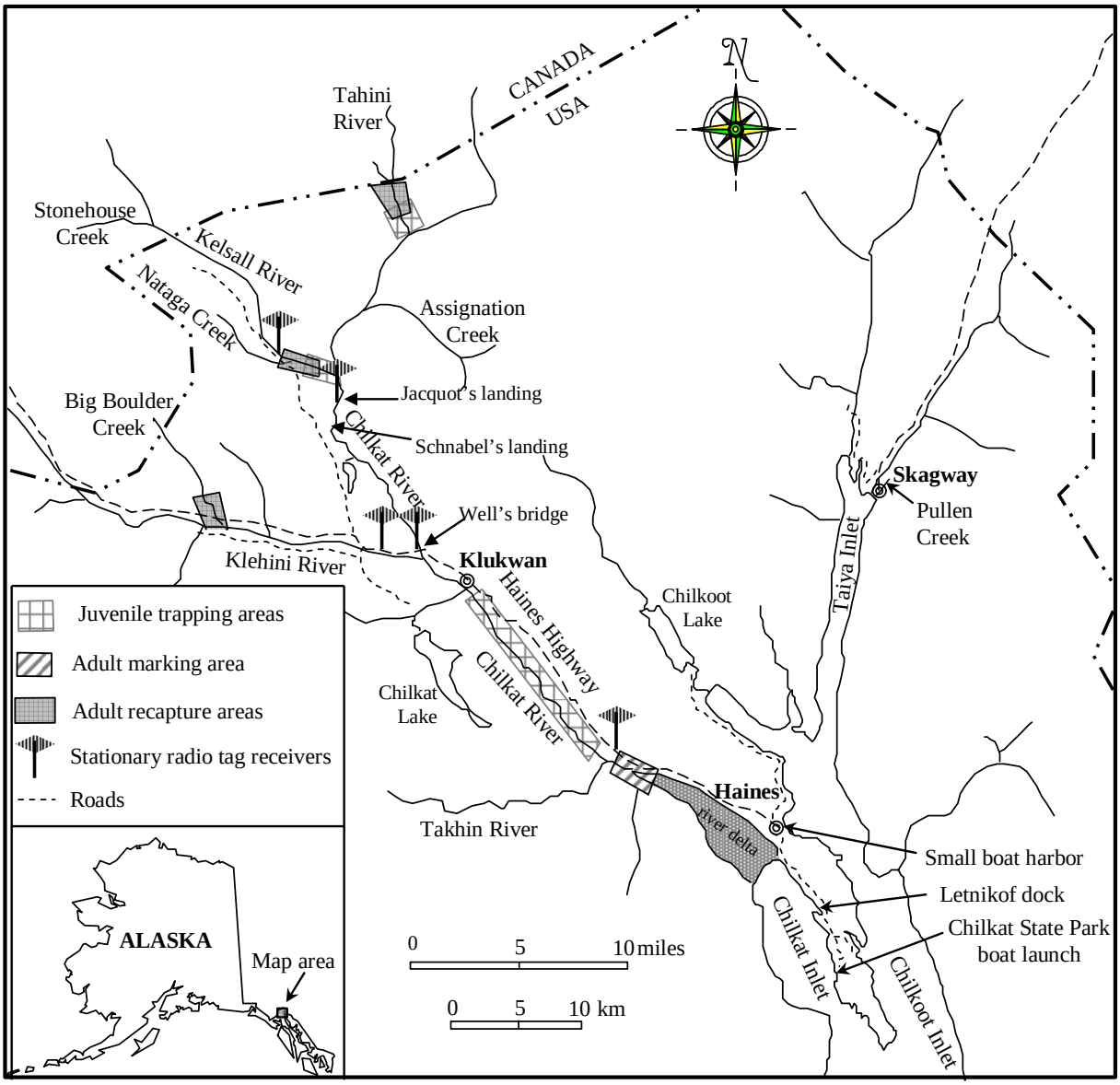

Figure 1.–Location of sampling sites and release sites of coded wire tagged Chinook salmon near Haines and Skagway in Southeast Alaska, 2005.

Boulder creeks (Figure 1). These areas were selected because they were the only clearwater spawning areas that could provide standardized, consistent survey counts. The indices were used in a regionwide program to monitor Chinook salmon escapements in Southeast Alaska (Pahlke 1992).

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

Because of these concerns, the Division of Sport Fish conducted a coded wire tagging (CWT) program on wild juvenile Chinook salmon in 1989 and 1990 to identify migratory patterns and to estimate contributions to sport and commercial

fisheries (Pahlke et al. 1990; Pahlke 1991). The Division of Sport Fish also conducted radiotelemetry and mark-recapture experiments in 1991 and 1992 to estimate spawning distribution and abundance of large (age-1.3 and older) Chinook salmon in the river. Results of this research 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). The Division of Sport Fish has continued to conduct mark-recapture experiments and escapements have ranged between 2,035 (SE = 334) in 2000 and 8,100 (SE = 1,193) in 1997 (Johnson et al. 1992, 1993; Johnson 1994; Ericksen 1995-2005).

In 2000, we began to tag Chinook salmon smolt each spring to estimate the smolt emigration and marine harvest of this stock. During the first year, we tagged very few smolt (1,996 in 2000; Ericksen 2002b). To increase the numbers Chinook salmon outmigrating from the Chilkat River with CWTs, we also started tagging juvenile Chinook salmon (fry) beginning in fall of 2000 (Ericksen 2002a).

ADF&G adopted a biological escapement goal (BEG) of 1,750 to 3,500 Chinook salmon 737 mm (29 inches) total length and greater 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).

Regulations in effect during 2005 prevented 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 or greater in length per day and in possession. Nonresident anglers were allowed to keep 1 Chinook salmon 28 inches or greater in length per day and in possession with an annual limit of 5 Chinook salmon. In addition, effective June 6, the daily bag and possession limit was 3 Chinook salmon any size with no annual limit for all anglers fishing in Taiya Inlet. This regulation was implemented by emergency order to allow anglers to harvest hatchery fish returning to the Skagway area. Commercial fishing regulations were structured to reduce incidental harvests of mature Chinook salmon in the Lynn Canal gillnet fishery.

The purpose of this study was to estimate the sport harvest, escapement, spawning distribution, and production of Chinook salmon returning to the Chilkat River during 2005. We also tagged juvenile Chinook salmon to estimate production and future marine harvest of this stock. This report describes the methods and results of the study during 2005, and smolt production and harvest of 1998 brood year Chilkat River Chinook Salmon. The long-term goal of this study is to refine maximum harvest guidelines for this stock in accordance with sustained yield management.

Research objectives were to estimate:

1. The inriver abundance of Chinook salmon in the Chilkat River in 2005;
2. The age, sex, and length compositions of the escapement of large Chinook salmon in the Chilkat River in 2005;
3. The spawning distribution of large and medium (age-1.2 and older) Chinook salmon in the Chilkat River drainage;
4. The harvest of wild mature Chinook salmon in the Haines spring marine boat sport fishery from May 9 to June 26, 2005;
5. The mean length of juvenile Chinook salmon rearing in the Chilkat River drainage during fall 2005;
6. The number of Chinook salmon smolt that emigrated from the Chilkat River in 2000 (1998 brood year); and,
7. The marine harvest of Chilkat River Chinook salmon from the 1998 brood year.

METHODS

ESCAPEMENT

An age-stratified mark-recapture experiment was used to estimate the number of Chinook salmon immigrating to the Chilkat River in 2005. Stratifying the estimate by age was done to develop a series of escapement and brood year returns needed to assess escapement goals for this stock.

Lower River Marking

Gillnets 21.3 m long and 3.0 m deep (70 ft × 10 ft) were drifted in the lower Chilkat River June 9 through July 22, 2005. The gillnets consisted of two 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. We attempted to complete 43 drifts between 0600 and 1400 hours each day. Fishing was conducted from an 18-ft boat in six adjoining 0.5-km sections, which were marked along a 3-km section of river (Figure 2). This area was about 100 m wide and 2 to 3 m deep. The 43 drifts took about 6 h to complete when fish were not captured.

Fishing continued uninterrupted from area to area when fish were not captured. If a (0.5-km) drift was prematurely terminated because a fish was caught, or if the net became entangled or drifted into shallow water, the terminated drift was subsequently completed before a new drift was started. If 43 drifts could not be completed during the day, additional drifts were added to the next day's total to make up the balance.

Two 3-basket aluminum fish wheels were operated by the ADF&G Division of Commercial Fisheries to tag sockeye *O. nerka*, coho *O. kisutch*, and chum salmon *O. keta* from June 6 to October 11; 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 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.

Captured Chinook salmon were placed in a water-filled tagging box (see Figure 3 in Johnson 1994), inspected for missing adipose fins, and measured to the nearest 5 mm MEF. Fish were initially classified as 'large,' 'medium,' or 'small,'

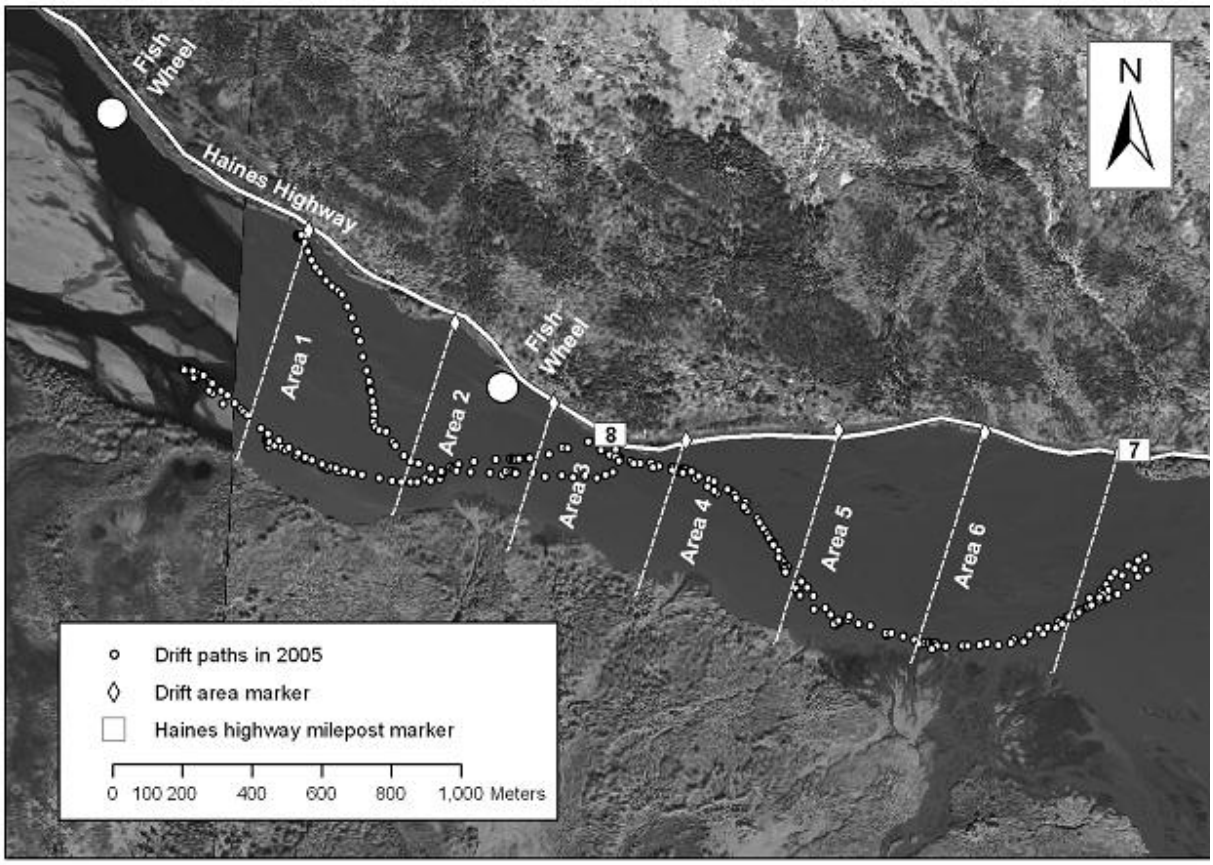

Figure 2.–Drift gillnet areas and fish wheel locations in the lower Chilkat River, 2005.

depending on their length: fish ≥660 mm MEF were designated as large, fish ≥440 and <660 mm MEF as medium, and fish <440 mm MEF as small. Heads were removed from all fish <700 mm MEF with missing adipose fins, marked with an individually numbered strap, and sent to the ADF&G Mark, Tag and Age Laboratory in Juneau for analysis. The heads of all adipose-clipped fish 700 mm or greater (MEF) were tested with a hand-held wand CWT detector for the presence of a CWT. If no CWT was detected, the fish was sacrificed and the head was processed as above. All healthy medium and large Chinook salmon not sacrificed for CWTs were sampled for scales, visually 'sexed,' marked with a uniquely numbered spaghetti tag threaded over a solid plastic core and sewn through the bones near the base of the dorsal fin, and given a ¼-inch hole punch in the upper edge of the left operculum as a secondary mark.

Technicians operating the gillnet also marked fish by clipping (removing) the left axillary appendage. This helped to identify where the fish was marked (whether in the fish wheel or gillnet) in the event of tag loss. A sub-sample of the fish was also given a radio transmitter as described in the radiotelemetry section (below). Small fish (<440 mm MEF) were sampled and marked as above except they were given a uniquely numbered T-bar anchor tag instead of a spaghetti tag. Age of each fish sampled for scales was determined postseason by counting the scale annuli (Olsen 1992). Each fish was then reclassified as large, medium, or small using ocean age, rather than length, as criteria; fish with three or more ocean years of residence were classified as large, those with two ocean years as medium, and those with one ocean year were classified as small. Any fish whose scales could not be aged was classified by length as described above.

Spawning Ground Recovery

Escapements in the Kelsall and Tahini Rivers (Figure 1) were sampled for marks by two 2-person crews. Spawning grounds in the Kelsall River (including Nataga Creek) and in the Tahini River were sampled from August 3 to September 2. Chinook salmon were also sampled in Big Boulder Creek from August 4 through August 24, Little Boulder Creek from August 24 to 29, and in 37 Mile Creek from August 18 to 23. Chinook salmon were captured using gillnets, dip nets, snagging gear, and even bare hands. Duplicate sampling was prevented by punching a hole in the lower edge of the left operculum of all captured fish.

Abundance

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).

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

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

The possibility of selective sampling was also investigated because assumption (a) could be violated if the sampling rate varied by size or sex

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

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

$$\hat{N}_a = \frac{(n_{a1}+1)(n_{a2}+1)}{(m_{a2}+1)} - 1 \qquad (1)$$

$$var[\hat{N}_a] = \frac{(n_{a1}+1)(n_{a2}+1)(n_{a1}-m_{a2})(n_{a2}-m_{a2})}{(m_{a2}+1)^2(m_{a2}+2)} \qquad (2)$$

where n_{a1} is the number of Chinook salmon marked by age class in the lower river, n_{a2} is the number examined by age class on the spawning grounds, and m_{a2} is the subset of n_{a2} that had been marked in the lower river.

Age and Sex Composition of the Escapement

Age and sex composition estimates can be biased due to sampling methods. The fish wheels are usually selective for smaller fish (Ericksen 1995) and for males (Ericksen 1995-2005), and the gillnets are selective for larger fish. Carcass surveys are known to be sex-selective in some situations (Pahlke et al. 1996, McPherson et al. 1997, Zhou 2002, Miyakoshi et al. 2003). In addition, significant variation in age and/or sex compositions between spawning areas can bias composition estimates for the entire drainage when sampling is not proportional to abundance. The potential for bias was reduced in this experiment by stratifying the abundance estimate by age class, and by other actions explained below.

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

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

Age and sex selectivity was investigated by contingency table analysis. The number of large Chinook captured by age or sex in the lower river was compared with the number sampled on the spawning grounds. Because sex compositions differed significantly, spawning ground samples alone were used to estimate sex composition, as sex determination is more difficult early in the season while marking fish in the lower river (Ericksen 1995-2005).

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

$$\hat{p}_{a,s} = \frac{n_{a,s}}{n_a} \qquad (3)$$

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

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

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

$$\hat{N}_{a,s} = \hat{N}_a \hat{p}_{a,s} \qquad (5)$$

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

Radiotelemetry

Model 1845 internal radio transmitters manufactured by Advanced Telemetry Systems (ATS) were placed in Chinook salmon that were handled and marked identically to the other spaghetti-tagged Chinook salmon in the mark-recapture experiment. Due to concerns about small stomachs not being able to withstand radio transmitter insertion, Chinook salmon less than 440 mm MEF were not selected for radio-tagging. The radio transmitters were scheduled to be deployed in statistical weeks 25 through 31 in proportion to historical fish wheel and drift gillnet catches of Chinook salmon greater than 440 mm MEF.

Movement of the radio-tagged Chinook salmon was tracked using stationary receivers, aerial surveys, boat surveys, and ground surveys. The fates of individual fish were tallied to estimate the proportion of the sample that continued to migrate upstream and the distribution of spawning fish.

The radio transmitters used were pulse-coded (Eiler 1995) in the 150 MHz frequency range. Internal radio transmitters were used to avoid the physical drag caused by external tags. A 12 mm-diameter plastic tube was used to gently push the radio transmitter body through the esophagus until it was seated in the stomach. Proper placement of each tag was verified before release by looking into the fish's mouth to see that the radio transmitter antenna protruded from the center of the esophagus into the oral cavity. Anesthesia was not used during the tagging procedure and Chinook salmon were released immediately after tagging.

Each transmitter emitted a unique signal and was equipped with a motion sensor and activity monitor (Eiler 1995). The motion sensor generated additional signal pulses distinct from the basic signal pattern each time the transmitter moved. The signal pattern changed from an active to inactive mode if the motion sensor was not triggered for over 24 hours; the signal reverted to the active pattern if the motion sensor was triggered again. The minimum battery life specification for the transmitters was 177 days.

Tracking stations at five locations recorded movements of the radio-tagged salmon. Each station consisted of an ATS R4500C integrated receiver and data logger, two directional Yagi antennae (one aimed upstream and one aimed downstream), and a solar panel and battery power system. The stations were placed to afford the antennae unobstructed downstream and upstream views. Radio-tagged fish within reception range of the stations were identified and recorded. The ability of each remote tracking station to detect and record the passage of radio-tagged fish was verified by placing radio transmitters in the water in the possible migration routes past the tracking stations. The information collected at the stations included the date and time that each radio transmitter was identified, the antenna (upstream, downstream, or both combined), the signal strength, and the activity pattern (active or inactive) of the transmitter. The location of each transmitter relative to the station (upriver or downriver from the site) was deduced by comparing upstream and downstream antenna signal strengths. A constant signal from a reference transmitter near each tracking station was received and recorded to verify that the station components were functioning properly and to identify when the equipment stopped functioning in the case of failure. Tracking station data files were downloaded weekly using a notebook computer.

The first tracking station encountered by tagged fish was located at MP 9, adjacent to the upstream fish wheel (Figure 1). This station served as a gateway for radio-tagged Chinook salmon entering and possibly leaving the study area, and was operated from June 10 until September 6. To discriminate between fish holding near the tagging site after being tagged and fish that had resumed upriver movement, upstream passage at the MP 9 tracking station was defined as the time when the upstream antenna signal strength became 20 decibels (dB) greater than the downstream antenna signal strength and the upstream signal subsequently remained stronger than the downstream signal. Radio transmitter testing showed that fish were approximately 800m upstream of the MP 9 tracking station when the 20dB difference was achieved.

Four tracking stations monitored movement at upriver locations (Figure 1). One station covered the Chilkat River at Wells Bridge from June 17 to

September 7. A second tracking station covered the Chilkat River at Jacquot's Landing from June 9 to August 30. A third tracking station covered the Kelsall River at the confluence of Nataga Creek from June 9 to September 12. A fourth tracking station monitored the Klehini River from June 10 to September 7. Upstream passage at these four tracking stations was defined as the time when the upstream antenna signal strength became and remained stronger than the downstream antenna signal strength.

We flew aerial radio tracking surveys of the Chilkat River drainage on July 11 and 25, and August 1, 8, 22, and 29. Due to bad weather, the August 22 aerial survey did not cover the Kelsall River drainage upstream of Nataga Creek. Surveys were conducted from slow flying fixed-wing aircraft equipped with two directional antennae aimed to the left and right of the flight path. Dividing the list of transmitter frequencies between two R4500C receivers reduced scan cycle time and increased the precision of location estimates to at least ± 1 km. Locations of transmitters were summarized to the nearest river km, (RKM) as counted moving upstream from the mouth of the river in which the transmitter was located.

Radio tracking surveys by boat, on foot, and by road began in the lower Chilkat River on June 21 and finished in the headwater spawning areas on September 1.

We used data from tracking stations, aerial surveys, and ground surveys to assign each radio-tagged fish one of five possible fates based on criteria in Table 1.

The number of radio tags R, distributed by time stratum i and fate/location j, were adjusted to compensate for unequal effort and unequal tagging fractions over time[1]

$$R'_{ij} = \frac{R_{ij}}{\hat{\phi}_i} \tag{7}$$

where $\hat{\phi}_i$ is the proportion of sampled fish that were radio-tagged, adjusted for unequal fish wheel effort over time[2]

$$\hat{\phi}_i = \frac{x_{FWi} + x_{GNi}}{X_{FWi}\dfrac{H_{FWi}}{h_{FWi}} + X_{GNi}} \tag{8}$$

and where X_{GN} and x_{GN} are the number of Chinook salmon caught and radio-tagged during gillnet sampling, X_{FW} and x_{FW} are the number of Chinook salmon caught and radio-tagged in fish wheels, and H_{FWi} and h_{FWi} are the total possible and actual number of hours of fish wheel operation (fishing effort). All quantities are specific to time stratum i.

The proportion of fish that met fate j was estimated as:

$$\hat{q}_j = \frac{\sum_{i}^{\text{weeks}} R'_{ij}}{\sum_{j}^{\text{fates}} \sum_{i}^{\text{weeks}} R'_{ij}} \tag{9}$$

with approximate variance:

$$\text{var}\left(\hat{q}_j\right) \cong \frac{\hat{q}_j\left(1-\hat{q}_j\right)}{\sum_{i}^{\text{weeks}}\left(x_{FWi} + x_{GNi}\right) - 1} \tag{10}$$

The proportion of the spawning population in each spawning area was estimated similarly, except that we restricted equation (9) to those fish that were assigned a spawning fate.

TERMINAL HARVEST

2005 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.

[1] We assumed that the intrinsic efficiency (probability of capture, standardized for effort) of fish wheel and gillnet sampling did not change over time.

[2] All drift gillnet days were complete (43 drifts completed), so no adjustment to the drift gillnet catch was necessary.

Table 1.–Criteria used to assign fates to radio-tagged Chinook salmon.

Fate	Criteria
Probable spawning in a tributary	A fish whose radio transmitter was tracked into a tributary and remained in or was tracked downstream from that location. When a transmitter was tracked to more than one tributary, the last tributary was assumed to be the spawning location.
Pre-spawning mortality or tag regurgitation	A fish whose radio transmitter never advanced more than two km upstream after tagging, or was recovered in the mainstem Chilkat River with gonads in unspawned condition, or was tracked to a mainstem Chilkat River location and not subsequently tracked to a more downstream Chilkat River location.
Fishing mortality	A fish reported as harvested in a fishery or whose transmitter was tracked to a frequently used fishing or fish processing site.
Probable spawning in the mainstem	A fish whose radio transmitter was tracked upstream, was observed in a mode other than the mortality mode for more than 24 hours near its highest observed location, then was observed in a downstream location, and was not recovered with gonads in unspawned condition.
Lost	A fish whose radio transmitter was rarely located and was never located in a tributary.

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 28, 29, 30, June 4 and 5) 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 2220 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 indicate that with the exception of 2000, anglers landing their catch at the Letnikof Dock account for 51–93% of the harvest of Chinook salmon. Sampling at each location had days as primary sampling units and boat-parties as secondary units.

Sampling at Letnikof Dock occurred from May 9 to June 26, 2005, and contained morning/evening stratification and weekend/weekday stratification of evening strata during the peak of the season. Morning sampling strata lasted from 0800 hours until 2 h before midday, and evening sampling strata lasted from 2 h before midday until civil twilight. Thus, evening strata were 4 h longer in duration than morning strata. This stratification scheme was designed to increase the precision of estimates by maximizing sampling during hours when most anglers exit the fishery. Random selections determined primary units to sample in each stratum. Two morning and three evening strata were sampled each week, except as noted below.

During the peak of the fishery (May 9–June 12) the evening strata at Letnikof Dock were further divided into weekday and weekend stratification. During this time, two morning, two weekday evening, and two weekend/holiday evening periods were sampled each week. In total, 17 unique strata were sampled at Letnikof Dock in 2005.

Sampling at the Small Boat Harbor was initiated on May 9 and continued through June 26. Sampling at the Chilkat State Park boat launch was initiated on May 16, and ended on June 26. There was no type of day stratification at the low-use sites. Each biweekly period was divided into 14 morning and 14 evening periods of equal length at the Small Boat Harbor, except during the Haines King Salmon Derby, when the biweek was divided into one 5-day (derby) with no time-of-day stratification and one 9-day (non-derby). Because of the short sampling schedule at Chilkat State Park boat launch, there was one 5-day (derby) stratum with no time-of-day stratification and one 12-day period stratum. Random

selections determined primary units to sample in each morning and evening stratum. To accommodate the impossibility of sampling three sites simultaneously with only two technicians, 14 changes (period moves) were made to the randomized sampling schedule at low-use sites. Thirteen (13) unique strata were sampled at the low-use harbors during 2005.

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

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

$$\hat{H}_h = D_h \overline{H}_h \tag{11}$$

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

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

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

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

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 charterboat anglers were estimated by considering only data collected from chartered anglers in equations (11) through (14).

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

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

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

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

$$\begin{aligned}\operatorname{var}(\hat{p}_a) \cong \hat{H}^{-2}\sum_h \hat{H}_h^2 \operatorname{var}\left(\hat{p}_{a,h}\right) \\ + \hat{H}^{-2}\sum_h \operatorname{var}\left(\hat{H}_h\right)\left(\hat{p}_{a,h} - \hat{p}_a\right)^2\end{aligned} \quad (16)$$

where $p_{a,h}$ is the proportion age *a* fish sampled in stratum *h*, and 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 2005 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 2005 Haines marine boat sport fishery was estimated:

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

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 in Bernard and Clark (1996, their Table 2) for wild or hatchery stocks harvested in the recreational fishery. The total contribution of one or more cohorts to one or more fisheries is the sum of harvests and variances from the individual cohorts and strata.

JUVENILE TAGGING

Juvenile Chinook salmon (brood year 2004) were captured in primary rearing areas of the Chilkat River drainage during the fall of 2005 (fry) and in the mainstem of the Chilkat River during the spring of 2006 (smolt) and marked with an adipose finclip 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. Adult fish will be sampled from the escapement between 2007 and 2011 to estimate the marked fraction. A hand-held 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 us to estimate the fall rearing abundance in 2005 and smolt emigration in 2006. In addition, random recoveries of CWTs in sampled marine fisheries will allow us to estimate total marine harvest of this stock.

Chinook salmon fry were captured in G-40 minnow traps at three locations in the Chilkat River drainage during fall 2005. Trapping began in upriver locations and moved downstream as the season progressed. The Tahini River was trapped from mid to late September, the Kelsall River was trapped during the first two weeks of October, and the lower Chilkat River near MP 19 (the Council Grounds) during the last week of October. In spring 2006, the lower Chilkat River (below MP 21) was trapped beginning in mid April.

A crew consisting of four people fished approximately 75 traps per day. Traps were baited with disinfected salmon roe and checked at least once per day. Crew members immediately released non-target species at the trapping site. Remaining fish were transported to holding boxes for processing at a central tagging location.

Following the methods in Koerner (1977), all healthy Chinook ≥50 mm FL were injected with a CWT and externally marked by excision of the adipose fin. Prior to marking, fish were first tranquilized in a solution of Tricaine

methanesulfonate (MS 222) buffered with sodium bicarbonate. Every 100th fish tagged with a CWT was additionally measured to the nearest mm FL.

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

In an effort to gather information on the potential relationship between water temperature and smolt production, a battery operated HOBO®[1] temperature data logger was installed in the Kelsall River in 2002 (Ericksen 2004). However, the data logger was lost during a flood in the fall of 2005. Therefore the project was discontinued.

1998 BROOD YEAR SMOLT ABUNDANCE AND ADULT HARVEST

A total of 1,996 wild 1998 brood year Chinook salmon smolt were captured, and released into the Chilkat River with valid coded wire tags between April 16 and June 6, 2000 (Ericksen 2002b). Adult Chinook salmon were sampled from the Chilkat River (Table 19), and from marine commercial and recreational fishery harvests between 2001 and 2005.

A two-event mark-recapture experiment was used to estimate the abundance of 1998 brood year Chinook salmon smolt ($\hat{N}_s$) emigrating from Chilkat River in 2000. The number of smolt marked during spring 2000 defined the first sampling event. Sampling returning brood year 1998 adults in the Chilkat River escapement for missing adipose fins between 2001 and 2005 defined the second sampling event.

Smolt abundance (number emigrating) of Chinook salmon smolt was estimated by substituting the following in equations 1 and 2: $\hat{N}_s$ for $\hat{N}_a$; n_c, the number of smolt marked in the spring of 2000, for n_{a1}; $n_{e,}$ the number of 1998 brood year Chinook salmon sampled for missing adipose fins in the Chilkat River escapement, for n_{a2}; and m_e, the subset of n_e that had been marked with an adipose fin clip as smolt in 2000, for m_{a2}.

Harvest of brood year 1998 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 1998 brood year fish carrying a CWT.

The Division of Commercial Fisheries port sampling program annually sampled landings from commercial drift gillnet, set gillnet, purse seine, and troll fisheries throughout Southeast Alaska and Yakutat. 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, and the resulting information compiled.

The annual Division of Commercial Fisheries port sampling manual (ADF&G *unpublished*) provides a detailed explanation of commercial catch sampling procedures and logistics.

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 fishing period and quadrant. Statistics from drift gillnet fisheries were stratified by week and district. Statistics from the recreational fishery were stratified by fortnight. Hubartt et al. (1997) describe methods

[1] Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

of sampling recreational fisheries in Southeast Alaska.

Data from the port sampling program were used to estimate the commercial harvest of Chinook salmon bound for the Chilkat River $\hat{r}_i$ and its variance (by stratum) using the procedures in Bernard and Clark (1996). Estimates of harvest were summed across strata and across fisheries to obtain an estimate of the total $\hat{T}$:

$$\hat{T} = \sum_i \hat{r}_i \tag{18}$$

$$\mathrm{v}[\hat{T}] = \sum_i \mathrm{v}[\hat{r}_i] \tag{19}$$

Variance was estimated as the sum of variances across strata because sampling was independent across strata and fisheries.

Return (harvest plus escapement) of Chinook salmon returning to the Chilkat River from the 1998 brood year was estimated as:

$$\hat{N}_R = \hat{T} + \hat{N}_e \tag{20}$$

$$\mathrm{var}\left[\hat{N}_R\right] = \mathrm{var}\left[\hat{T}\right] + \mathrm{var}\left[\hat{N}_e\right] \tag{21}$$

where $\hat{N}_e$ is the total escapement of age-1.2 and older 1998 brood year fish estimated between 2002 and 2005.

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

$$\hat{E} = \frac{\hat{T}}{\hat{N}_R} \tag{22}$$

$$\mathrm{var}[\hat{E}] \approx \frac{\mathrm{var}[\hat{T}]\hat{N}_e^2}{\hat{N}_R^4} + \frac{\mathrm{var}[\hat{N}_e]\hat{T}^2}{\hat{N}_R^4} \tag{23}$$

where the variance is an approximation from the delta method (Seber 1982).

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

$$\hat{S} = \frac{\hat{N}_R}{\hat{N}_s} \tag{24}$$

$$\mathrm{var}[\hat{S}] \approx \hat{S}^2\left[\frac{\mathrm{var}[\hat{N}_R]}{\hat{N}_R^2} + \frac{\mathrm{var}[\hat{N}_s]}{\hat{N}_s^2}\right] \tag{25}$$

RESULTS

ESCAPEMENT

We captured 192 large, 27 medium, and 40 small Chinook salmon in the lower Chilkat River with drift gillnets and fish wheels between June 9 and July 30, 2005 (Table 2, Figure 3). Of those captured, 187 large, 26 medium, and 35 small Chinook salmon were given a uniquely numbered external tag and an upper left operculum punch. Two large Chinook salmon captured in the fish wheels escaped prior to being marked. Two large Chinook salmon were lethargic and released without marking. Three large (with negative wand results), one medium, and five small fish were missing adipose fins and were sacrificed to recover coded wire tags. Capture rates of large Chinook salmon peaked on July 10. The mean date of migratory timing (weighted mean, Mundy 1984) in the lower river was July 4 (Figure 4).

Fish captured in gillnets were predominantly age-1.4 (50.4%) and classified as female (55.5%, Table 3). Those captured in the fish wheels were classified mostly as males (59.3%) and most commonly age-1.1 (35.5%) or age-1.3 (34.4%, Table 3). Most (98) of the fish in the drift gillnet were captured in the large mesh (8-in) panel. However, most (5) medium fish in the drift gillnet were caught in the small mesh (6.75-in) panel.

We examined 496 large, 147 medium, and 30 small Chinook salmon on the spawning grounds for marks; 26 large, 3 medium, and 1 small fish possessed marks from the tagging event (Table 4). Three marked fish were recovered missing their spaghetti tags: one large Chinook salmon was partially eaten by a bear; another was a partial carcass; and the last was recovered alive with the primary spaghetti tag missing. These fish were identified as having been marked earlier in the tagging event by the presence of the operculum punch. Recapture rates of large fish marked in June were nearly identical to those marked in July (χ^2 = 0.0034, df = 1, P = 0.954).

Table 2.–Numbers of Chinook salmon caught in the lower Chilkat River by time period, gear type and size[a], June 6–July 30, 2005**.**

	Drift gillnet				Fish wheels						Combined							
	Captured		Radio-tagged		Captured			Radio-tagged			Captured				Radio-tagged			
Time period	L	M	L	M	L	M	S	L	M	S	L	M	S	Total	L	M	S	Total
6/06–6/11	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0
6/12–6/18	2	0	2	0	3	2	0	2	2	0	5	2	0	7	4	2	0	6
6/19–6/25	8	0	8	0	7	0	6	4	0	0	15	0	6	21	12	0	0	12
6/26–7/02	48	2	29	1	12	4	9	7	2	1	60	6	9	75	36	3	1	40
7/03–7/09	43	1	21	0	13	1	15	7	0	0	56	2	15	73	28	0	0	28
7/10–7/16	30	3	15	2	14	9	7	8	3	0	44	12	7	63	23	5	0	28
7/17–7/23	6	3	5	2	4	1	2	4	1	0	10	4	2	16	9	3	0	12
7/24–7/30	0	0	0	0	2	1	0	2	1	0	2	1	0	3	2	1	0	3
	137	9	80	5	55	18	40	34	9	1	192	27	40	259	114	14	1	129

[a] L = age-1.3 and older fish, M = age-1.2 fish, S = age-1.1 fish.

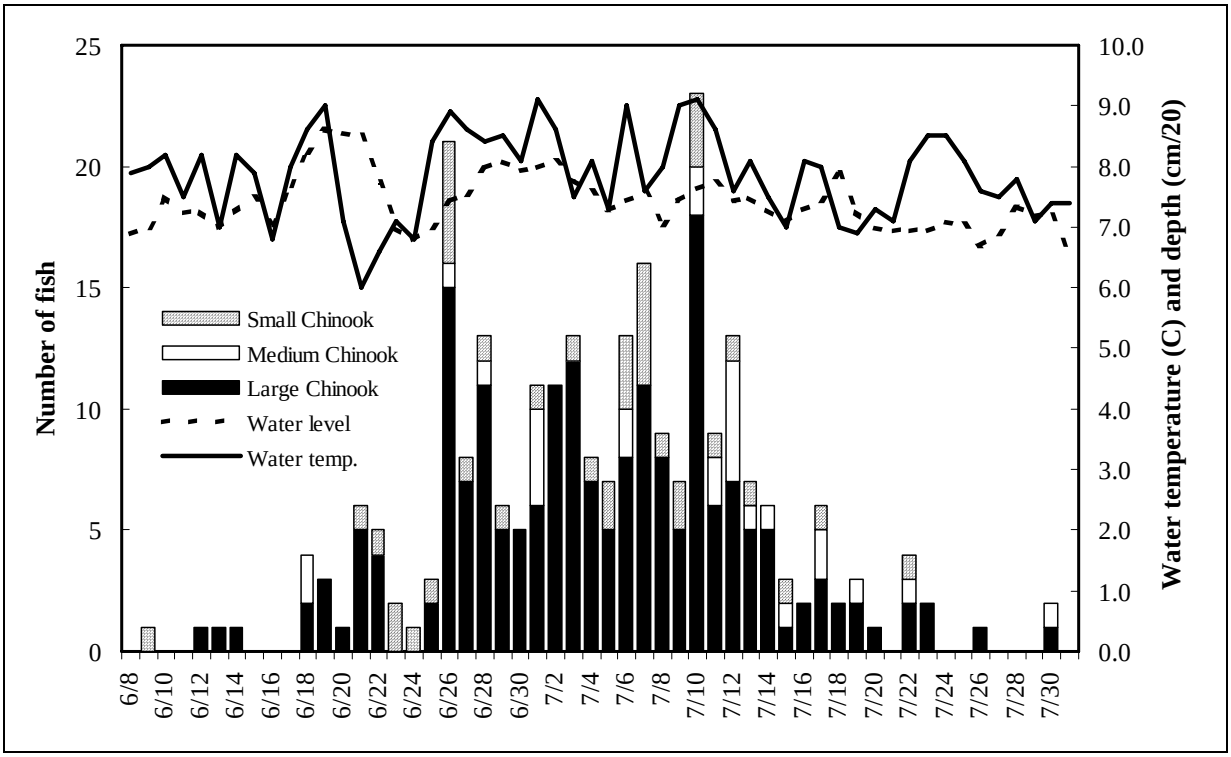

Figure 3.–Daily water depth (cm/20), temperature (°C), and catches of small (age-1.1), medium (age-1.2), and large (≥ age-1.3) Chinook salmon in drift gillnets and fish wheels operating in the lower Chilkat River, June 8–July 31, 2005.

Similar fractions of large (χ^2 = 0.322, df = 2, P = 0.851) and small/medium (χ^2 = 1.846, df = 2, P = 0.397) Chinook salmon sampled at each spawning tributary were marked. Thus, Petersen models were used to estimate abundance for each size group.

The empirical cumulative distribution function (CDF) of lengths of large Chinook salmon marked in the lower Chilkat River was not significantly different from the CDF of marked Chinook salmon recaptured on the spawning grounds (K-S test, dmax = 0.166, P = 0.576, Figure 5, top). The CDF of lengths of large fish sampled in the lower river was also not significantly different from the CDF of those examined for marks on the spawning grounds

Table 3.–Age composition and mean length-at-age (MEF) of Chinook salmon sampled during tagging operations on the Chilkat River by gear type, 2005.

		Brood year and age class						
		2002	2001	2000	1999	1998		
		1.1	1.2	1.3	1.4	1.5	Total aged	Total sampled[a]
DRIFT GILLNET								
Males	Sample size	0	7	27	17	0	51	65
	Percent		13.7	52.9	33.3			44.5
	SD		4.8	7.0	6.6			4.5
	Mean length		601	776	889			
	SD		18.5	17.0	15.5			
Females	Sample size	0	0	26	45	1	72	81
	Percent			36.1	62.5	1.4		55.5
	SD			5.7	5.7	1.4		4.5
	Mean length			798	881	985		
	SD			9.1	7.7			
All fish	Sample size	0	7	53	62	1	123	146
	Percent		5.7	43.1	50.4	0.8		
	SD		2.1	4.5	4.5	0.8		
	Mean length		601	787	884	985		
	SD		18.5	9.8	7.0			
FISH WHEELS								
Males	Sample size	33	10	9	2	0	54	67
	Percent	61.1	18.5	16.7	3.7			59.3
	SD	6.6	5.3	5.1	2.6			5.1
	Mean length	352	595	720	843			
	SD	5.2	24.4	24.6	12.5			
Females	Sample size	0	4	23	12	0	39	46
	Percent		10.3	59.0	30.8			40.7
	SD		4.9	7.9	7.4			5.1
	Mean length		603	767	852			
	SD		15.9	11.4	25.3			
All fish	Sample size	33	14	32	14	0	93	113
	Percent	35.5	15.1	34.4	15.1			
	SD	5.0	3.7	4.9	3.7			
	Mean length	352	597	754	850			
	SD	5.2	17.7	11.2	21.6			

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

(K-S test, dmax = 0.087, P = 0.245, Figure 5, bottom). Therefore, we could not detect size selective sampling during either event. However as done in recent years, the estimate of large fish was stratified by two age classes to facilitate an unbiased estimate for each age class. Thus, an estimated 5,572 (SE = 1,017) Chinook salmon of all ages immigrated into the Chilkat River in 2005 (Table 5). Of those, 2,206 (SE = 852) were age-1.1 and -1.2; 1,857 (SE = 433) were age-1.3; and 1,509 (SE = 347) were age-1.4 and older. The stratified estimate of 5,572 (SE = 1,017) was not significantly different from the pooled estimate of 5,413 (SE = 875). These estimates are germane to time of tagging in the lower river as an unknown number of tags are removed due to predation and unreported subsistence fishery harvest in the time between tagging and recovery events.

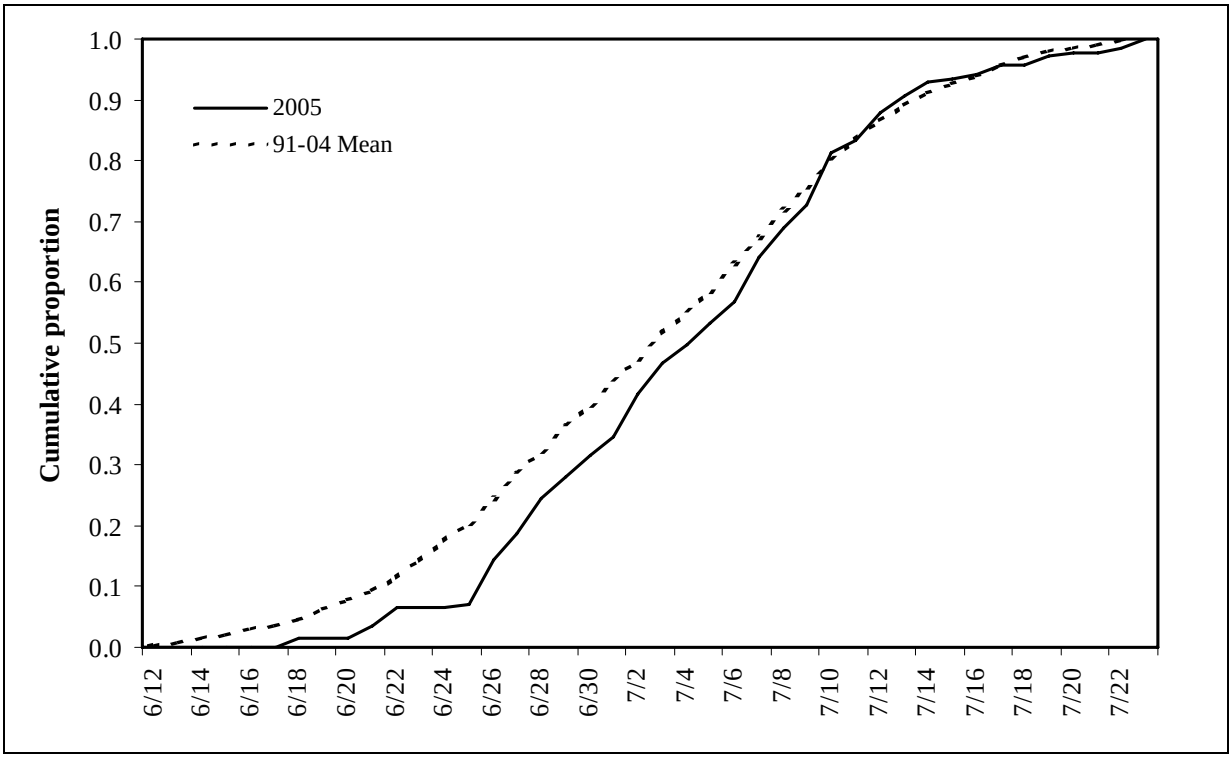

Figure 4.–Cumulative proportion of large (≥ age-1.3) Chinook salmon captured with drift gillnets in the lower Chilkat River in 2005 compared to the mean cumulative proportion, 1991–2004**.**

Table 4.–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[a] in 2005.

		Inspected									Marked							
		Large				Medium			Small		Large				Medium		Small	
	Dates	M	F	U	Total	M	F	Total	M	Total	M	F	U	Total	M	Total	M	Total
Kelsall River	8/03–9/02	91	106	13	210	44	1	45	13	13	4	8	0	12	1	1	1	1
Tahini River	8/03–9/02	88	103	7	198	68	0	68	11	11	3	5	1	9	2	2	0	0
Big Boulder Cr.	8/04–8/24	32	40	1	73	32	1	33	5	5	3	1	0	4	0	0	0	0
Little Boulder Cr.	8/24–8/29	1	3	0	4	1	0	1	1	1	0	0	0	0	0	0	0	0
37 Mile Cr.	8/18–8/23	4	7	0	11	0	0	0	0	0	0	1	0	1	0	0	0	0
Total		216	259	21	496	145	2	147	30	30	10	15	1	26	3	3	1	1

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

Age and Sex Composition of the Escapement

We sampled 649 Chinook salmon on the spawning grounds for age and sex. Of those sampled, 565 were successfully aged (Table 6). The proportion of large fish that were age-1.4 and older sampled from the lower river was not significantly different from those sampled on the spawning grounds ($\chi^2 = 1.029$, df = 1, P = 0.311). Therefore, all samples were pooled to estimate the age composition of the escapement.

Sex composition of large Chinook salmon was significantly different between the marking and recovery events ($\chi^2 = 5.258$, df = 1, P = 0.022). In addition, sex determination was less accurate during the marking event. Five (5) of the 28 recaptures were sexed incorrectly during the marking event, as judged by sex determination on the spawning ground (where sexual dimorphism is more evident). Three were sexed as males when tagged, and as females on the spawning grounds during 2005. Therefore, only

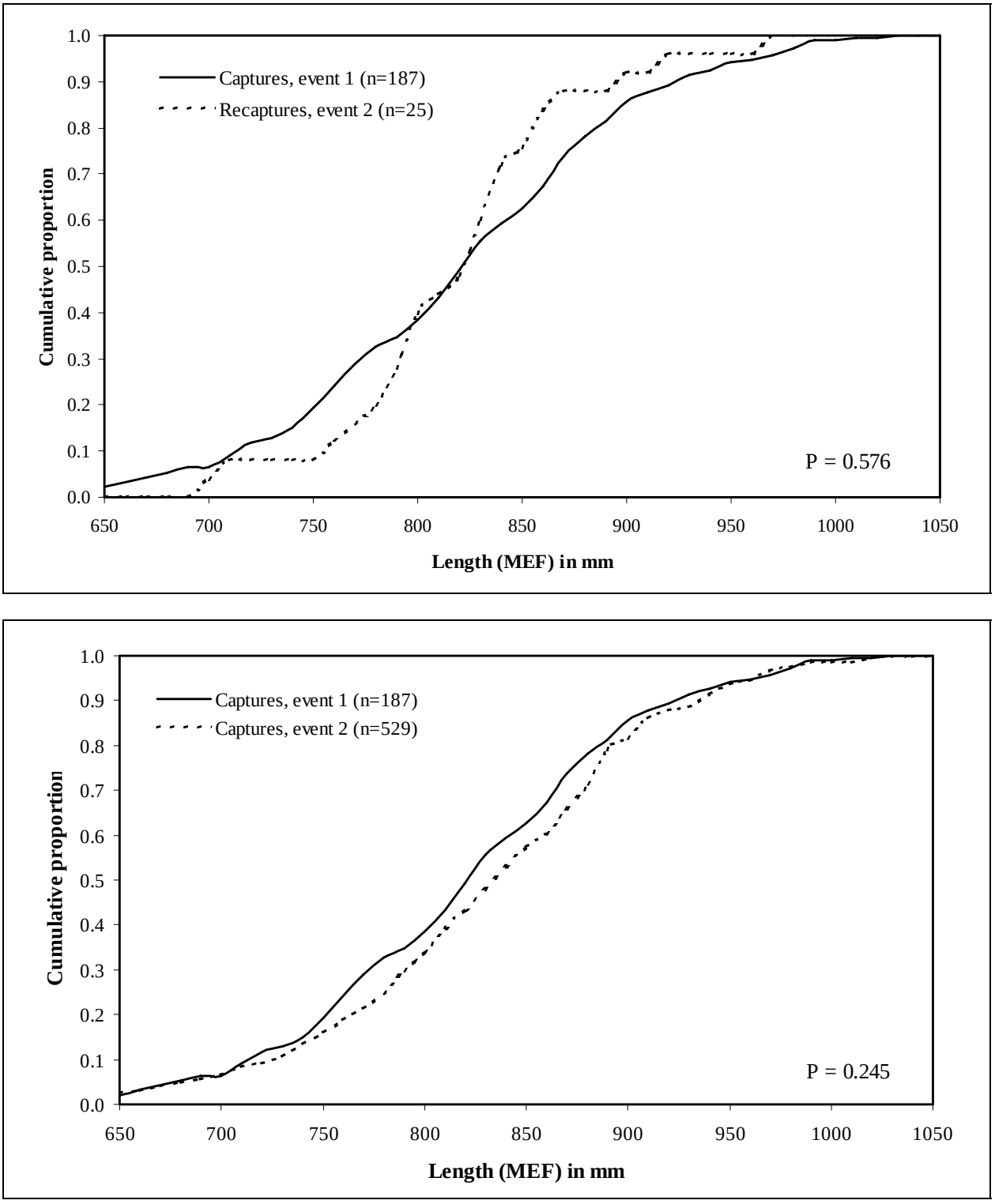

Figure 5.–Empirical cumulative distribution function (CDF) of MEF lengths of large (≥age-1.3) Chinook salmon marked in the lower Chilkat River versus lengths of marked fish recaptured on the spawning grounds (top) and versus lengths of large fish examined for marks on the spawning grounds (bottom), 2005**.**

Table 5.–Abundance estimates and sampling statistics of Chilkat River Chinook salmon by age stratum in 2005.

Stratum	Marked n_1	Examined n_2	Recaptures m_2	Abundance $\hat{N}_a$	Abundance $SE(\hat{N}_a)$
age-1.1+1.2	61	177	4	2,206	852
age-1.3	101	254	13	1,857	433
age-1.4+1.5	86	242	13	1,509	347
Total	248	673	30	5,572	1,017

the spawning ground samples were used to estimate sex composition (by age) in the escapement.

The predominant age class (33%) in the estimated escapement of Chinook salmon in 2005 was age-1.3 (2000 brood year, Table 7). The remainder of the escapement was composed of 11% age-1.1, 29% age-1.2, 27% age-1.4, and less than 1% age-1.5 fish. Most (68%) of the fish were males (Table 7).

Radiotelemetry

Chilkat River fish wheels operated for 2,305 hours out of a possible 2,352 hours from June 5 to July 30, 2005 (Table 8). Of the 73 Chinook salmon 440 mm MEF or greater caught in the fish wheels, 44 were given internal radio transmitters. In the 44 days the drift gillnets were operated, 43 drifts were completed every day and 145 Chinook salmon, all greater than 440 mm MEF, were caught and 85 were given internal radio transmitters.

Below average early season Chinook salmon catches and later than average run timing caused the weekly proportion of fish radio-tagged to vary from 49% to 100% of medium and large fish caught (Table 8). Fish were selected randomly for radio-tagging each day by instructing the tagging crews to select all, every second, or every third fish 440 mm MEF or greater for radio-tagging until the crew's daily supply of radio tags was exhausted.

The 129 radio-tagged fish ranged in size from 565 to 990 mm MEF and had a mean length of 807 mm (SD=99 mm). The 90 medium and large fish that were not radio-tagged ranged in size from 440 to 1,030 mm MEF and had a mean length of 779 mm (SD=120 mm). The length frequency distribution of radio-tagged fish was not significantly different from the medium and large fish that were not radio-tagged (K-S test, D = 0.149, P = 0.156). However, the age composition of radio-tagged fish was significantly different from the other medium and large Chinook salmon sampled in the lower river (χ^2 = 6.81, df = 2, P = 0.033, Table 9). The number of age-1.2 and -1.3 medium and large fish radio-tagged was similar to the number not radio-tagged, but in all weeks more age-1.4 medium and large fish were radio-tagged than were not radio-tagged.

Two radio-tagged fish never passed upstream of the MP 9 tracking station after tagging (Appendix A1). For the 127 radio-tagged fish that did move upriver after tagging, the time taken to resume upstream movement past the MP 9 tracking station averaged 3.3 d and ranged from 0.1 to 23.3 d. The time taken to resume upstream movement had no significant correlation with either success in reaching a spawning area (ANOVA, df = 1, F = 0.332, P = 0.566) or with which of four spawning areas (Kelsall RKM>10, Kelsall RKM 1-10, Tahini, or Klehini) a fish was destined for (ANOVA, df = 3, F = 1.032, P = 0.381).

Fourteen radio-tagged fish did not reach a probable spawning location (Table 10, Appendix A2). Seven were probably harvested in inriver fisheries: three were reported as harvested in the subsistence gillnet fishery (Figure 6), three others were assumed to have been taken in the subsistence gillnet fishery because the transmitters were tracked to heavily used set net or fish cleaning sites, and one fish was assumed to have been illegally taken in the sport fishery because its transmitter was recovered near a popular rod and reel fishing area. Seven fish were probably not taken in fisheries but either died or regurgitated their tags before reaching a spawning location. Because they made little or no upstream progress after tagging, fish numbers 48, 119, and 124 were probable cases of tag regurgitation or mortality due to handling effects. The carcasses of fish numbers 16 and 69 were recovered with full gonads, so they were probably not mainstem spawners. Fish number 36 was tracked to the lower Chilkat River's narrow west (river left) channel (Figure 6), which was an unlikely spawning location. Data from the Jacquot's Landing tracking station indicate that fish number 96 may have reached the mouth of the Kelsall

Table 6.–Age composition and mean length-at-age (MEF) of Chinook salmon sampled during recovery surveys on the Chilkat River drainage by spawning tributary in 2005.

		Brood year and age class						
		2002	2001	2000	1999	1998	Total	Total
		1.1	1.2	1.3	1.4	1.5	aged	sampled [a]
TAHINI RIVER								
Males	Sample size	8	56	55	22	1	142	164
	Percent	5.7	39.7	39.0	15.6	0.7		61.4
	SD	1.9	4.1	4.1	3.1	0.7		3.0
	Mean length	401	578	761	896	945		
	SD	35.5	52.7	76.5	70.1			
Females	Sample size	0	0	36	51	0	87	103
	Percent			41.4	58.6			38.6
	SD			5.3	5.3			3.0
	Mean length			800	863			
	SD			56	45			
All fish	Sample size	8	56	91	73	1	229	267
	Percent	3.5	24.6	39.9	32.0	0.4		
	SD	1.2	2.9	3.2	3.1	0.4		
	Mean length	401	578	776	873	945		
	SD	36	53	71	56			
KLEHINI RIVER TRIBUTARIES								
Males	Sample size	3	27	30	4	0	64	76
	Percent	4.7	42.2	46.9	6.3			59.8
	SD	2.6	6.2	6.2	3.0			4.3
	Mean length	337	568	725	905			
	SD	33	76	99	58			
Females	Sample size	0	1	27	19	0	47	51
	Percent		2.1	57.4	40.4			40.2
	SD		2.1	7.2	7.2			4.3
	Mean length		675	777	846			
	SD			44	46			
All fish	Sample size	3	28	57	23	0	111	127
	Percent	2.7	25.2	51.4	20.7			
	SD	1.5	4.1	4.7	3.8			
	Mean length	337	572	750	856			
	SD	33	77.6	81	52			
KELSALL RIVER/NATAGA CREEK								
Males	Sample size	12	41	39	41	0	133	148
	Percent	9.0	30.8	29.3	30.8			58.0
	SD	2.5	4.0	3.9	4.0			3.1
	Mean length	379	606	785	904			
	SD	26	65	71	84			
Females	Sample size	0	1	29	60	0	90	107
	Percent		1.1	32.2	66.7			42.0
	SD		1.1	4.9	5.0			3.1
	Mean length		720	777	854			
	SD			49	46			
All fish	Sample size	12	42	69	102	0	225	255
	Percent	5.3	18.7	30.7	45.3			
	SD	1.5	2.6	3.1	3.3			
	Mean length	379	609	782	875			
	SD	26.5	66.4	62.4	68.7			

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

Table 7.–Estimated abundance of Chinook salmon escapement in the Chilkat River by age and sex in 2005.

	Brood year and age class					
	2002	2001	2000	1999	1998	
	1.1	1.2	1.3	1.4	1.5	Total
Male	609	1,572	1,066	509	11	3,767
SE	244	611	256	127	8	717
Female		25	791	989		1,805
SE		19	194	233		304
All fish	609	1,597	1,857	1,498	11	5,572
SE	244	620	433	345	8	1,017

Table 8.–Number of Chinook salmon captured and radio-tagged by gear type in the Chilkat River and the adjusted proportion radio-tagged, 2005.

		Fish wheels					Drift gillnet		Combined		
Dates	Stat week	Number caught	Hours fished	Possible fishing hours	Adjusted catch	Number radio-tagged	Number caught	Number radio-tagged	Total adjusted catch	Total radio-tagged	Adjusted prop tagged ϕ
06/05–06/11	24	0	241	258	0.0	0	0	0	0.0	0	
06/12–06/18	25	5	324	336	5.2	4	2	2	7.2	6	0.84
06/19–06/25	26	7	336	336	7.0	4	8	8	15.0	12	0.80
06/26–07/02	27	16	302	336	17.8	10	50	30	67.8	40	0.59
07/03–07/09	28	14	336	336	14.0	7	43	21	57.0	28	0.49
07/10–07/16	29	23	336	336	23.0	11	33	17	56.0	28	0.50
07/17–07/23	30	5	336	336	5.0	5	9	7	14.0	12	0.86
07/24–07/30	31	3	336	336	3.0	3	0	0	3.0	3	1.00
Total		73	2,305	2,352	75	44	145	85	220.0	129	0.59

Table 9.–Age composition of medium and large (≥ 440 mm MEF length) Chinook salmon caught in the lower Chilkat River by radio-tagging status, 2005.

	Age-					
	1.2	1.3	1.4	1.5	Total aged	Total sampled[a]
			Radio-Tagged			
Number	13	49	57	0	119	129
Percent	11%	41%	48%	0%		
			Not Radio-Tagged			
Number	12	49	25	1	87	90
Percent	14%	56%	29%	1%		

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

River, but its rapid return downstream and mortality signal two days later left little time to spawn there. Mainstem spawning in the Jacquot's Landing area was a possible fate for fish 96, but predation at the Kelsall River mouth was more likely.

A total of 115 radio-tagged Chinook salmon were tracked to probable spawning locations in the Chilkat River drainage (Table 10). After adjusting for non-proportional tagging (Table 8), we estimated that 89% (SE = 2.8%) of the fish that entered the Chilkat River reached spawning areas,

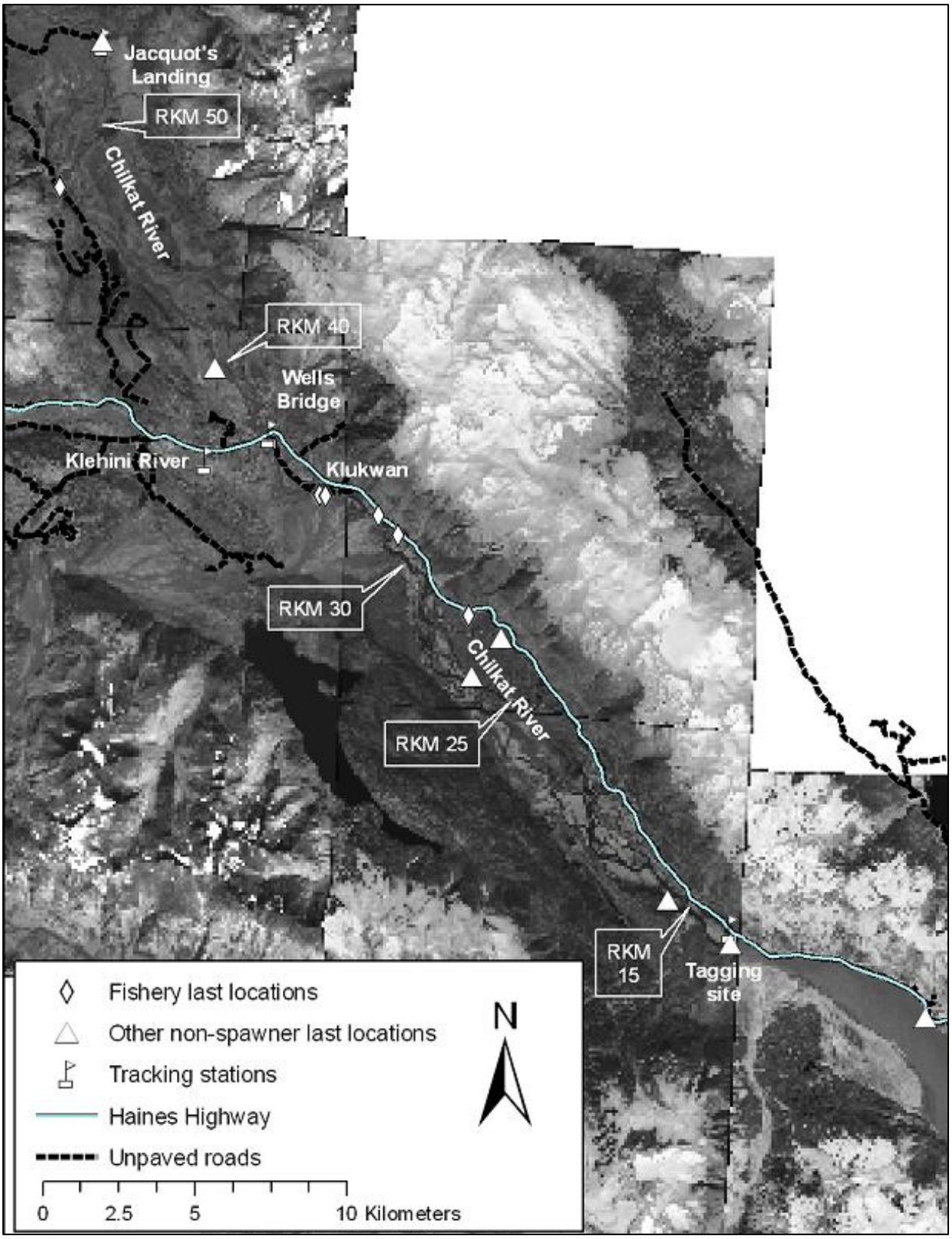

Figure 6.–Furthest upstream locations recorded for radio-tagged Chinook salmon that did not reach spawning areas, Chilkat River, 2005.

6% (SE = 2.1%) were taken by inriver fisheries, and 5% (SE = 2.1%) either regurgitated their tags or did not reach probable spawning areas for other reasons (Table 10). An estimated 52% (SE = 4.7%) spawned in the Kelsall River drainage, 33% (SE 4.4%) in the Tahini River, and 15% (SE 3.3%) in the Klehini River drainage (Table 11). Within the Kelsall River drainage, 10% spawned upstream of the U.S.-Canada border including Stonehouse Creek, 40% in the upper canyon area (Kelsall RKM 11-17), 29% between the upper canyon and the Kelsall River bridge (Kelsall RKM 4-10), and 21% spawned downstream of the Kelsall River bridge (Kelsall RKM 1-3) (Figures 7 and 8). Within the Tahini River, 37% spawned upstream of the escapement sampling area (Tahini RKM 5.5 and greater) and 63% spawned in the escapement sampling area between RKM 4 and 5.5 (Figure 9). In the Klehini River drainage, 72% spawned in Big Boulder Creek, 7% in 37-Mile Creek, 7% in Little Boulder Creek, and 14% in unknown areas of the Klehini River drainage (Figure 10). Fish number 70 was observed near the confluence of Little Boulder Creek from August 15 through 29, but was last observed alive September 1 in 33-Mile Creek, 200 m upstream of Little Boulder Creek. Two fish that spawned in unknown Klehini areas (fish numbers 10 and 129) were tracked to Klehini RKM 7, where post-spawning salmon carcasses have been found in past studies (Rebecca Wilson, Alaska Department of Fish and Game, Haines, personal communication), so it was likely they had washed down from tributary spawning areas. Fish number 25 was tracked to a location near MP 26, so it was probably bound for a Klehini River drainage spawning location.

The date of initial capture was not significantly different for radio-tagged fish that spawned in the upper Kelsall (RKM >10) versus the lower Kelsall (K-S test, D = 0.242, P = 0.326, Figure 11). The date of initial capture of all Kelsall spawners was not significantly different than that of Tahini spawners (K-S test, D = 0.208, P = 0.205). The date of initial capture of Klehini River spawners was not significantly different than that of upper Chilkat River (Kelsall and Tahini) spawners (K-S test, D = 0.318, P = 0.210). Timing differences became more pronounced as upper Chilkat River spawning stocks migrated upstream past the Wells Bridge and Jacquot's Landing tracking stations (Figures 12 and 13). Radio-tagged spawners headed for the upper Kelsall River drainage (Kelsall RKM>10 and Stonehouse Creek) and the Tahini River had similar upstream passage timing at the Jacquot's Landing tracking station (K-S test, D = 0.147, P = 0.867). The upstream passage timing of lower Kelsall River spawners at Jacquot's Landing was different than both upper Kelsall spawners (K-S test, D = 0.423 P = 0.008) and Tahini River spawners (K-S test, D = 0.413, P = 0.006).

Radio-tagged Chinook salmon strongly preferred to migrate up the Chilkat River between the tagging site and the Tsirku River confluence using small sloughs on the eastern side of the flood plain, adjacent to the Haines Highway (Figure 14). Of the 60 fish located between Chilkat RKM 20 (MP 13) and RKM 28 (MP 19) during weekly

Table 10.–Fates of radio-tagged Chinook salmon, by number and by estimated percentages, Chilkat River, 2005. Standard errors of percentages are in parentheses.

	Number of radio-tagged Chinook salmon			
Statistical week	Fishing mortality	Tag regurgitation or pre-spawning mortality	Spawned	Total
25	0	0	6	6
26	0	1	11	12
27	3	2	35	40
28	2	1	25	28
29	2	1	25	28
30	0	2	10	12
31	0	0	3	3
Total number	7	7	115	129
Adjusted percent of radio-tagged Chinook salmon	6.0% (2.1%)	5.0% (1.9%)	89.0% (2.8%)	100.0%

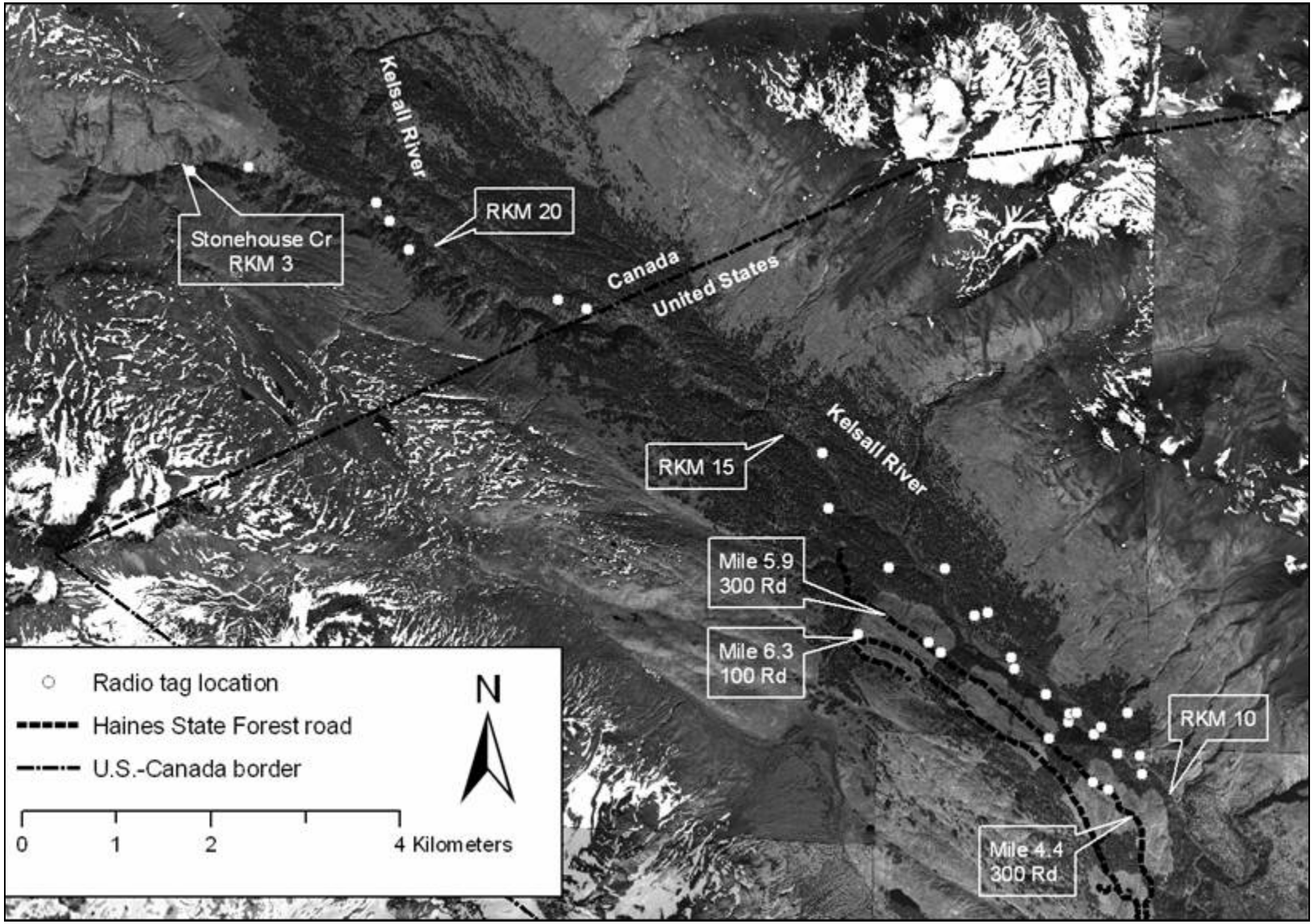

Figure 7.–Furthest upstream locations recorded for radio-tagged Chinook salmon that spawned in the upper Kelsall River drainage, 2005.

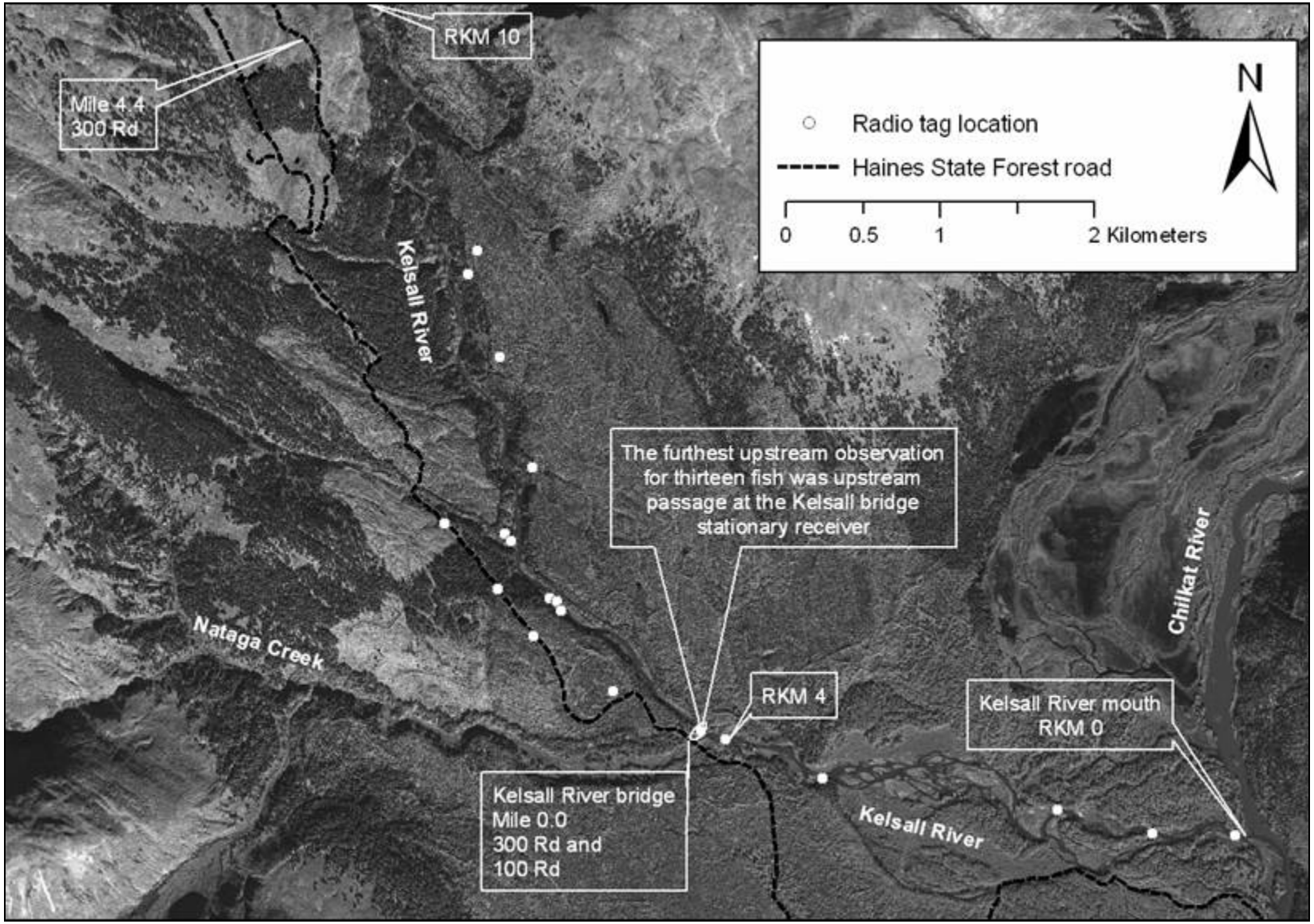

Figure 8.–Furthest upstream locations of radio-tagged Chinook salmon that spawned in the lower Kelsall River drainage, 2005.

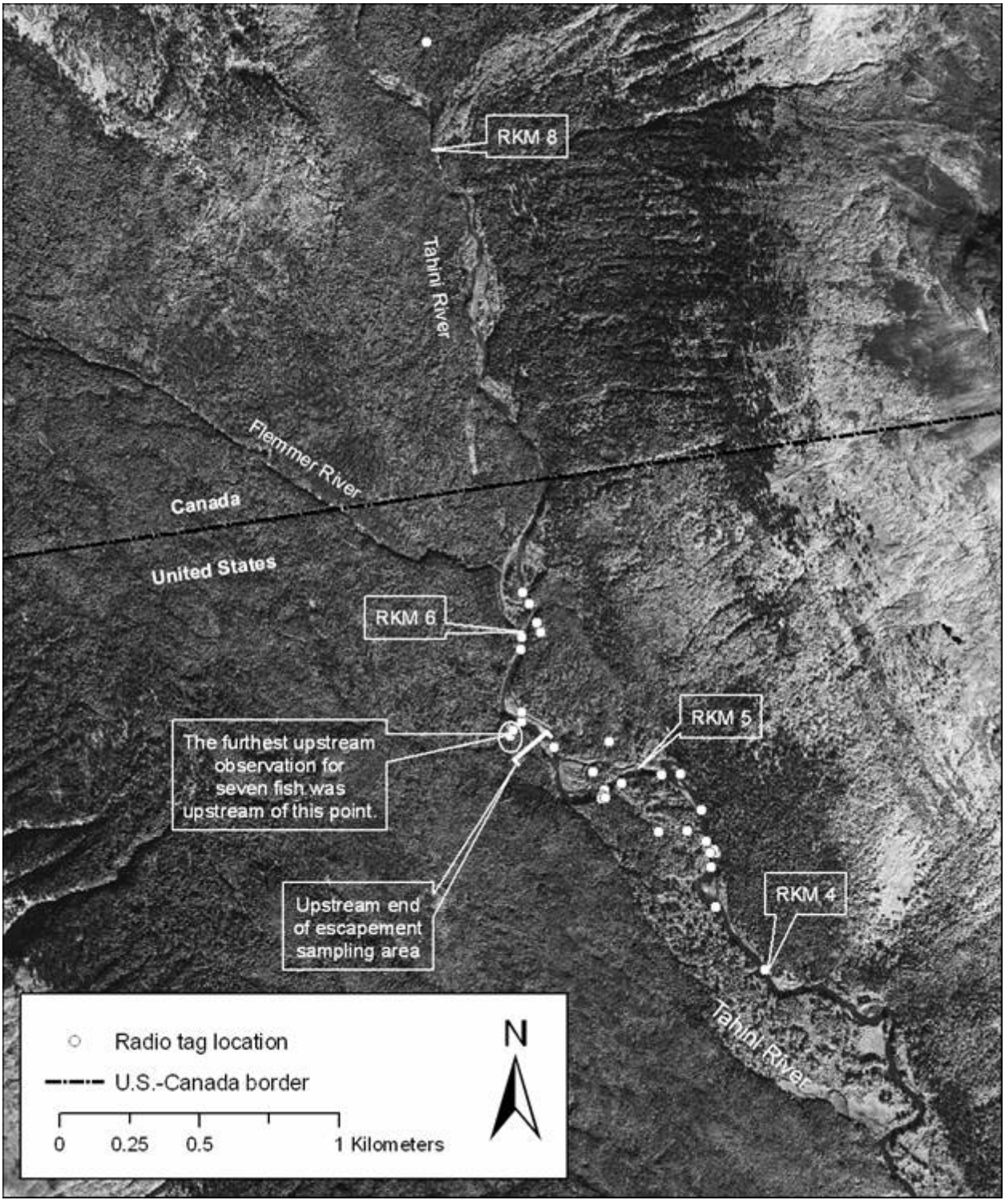

Figure 9.–Furthest upstream locations of radio-tagged Chinook salmon that spawned in the Tahini River, 2005.

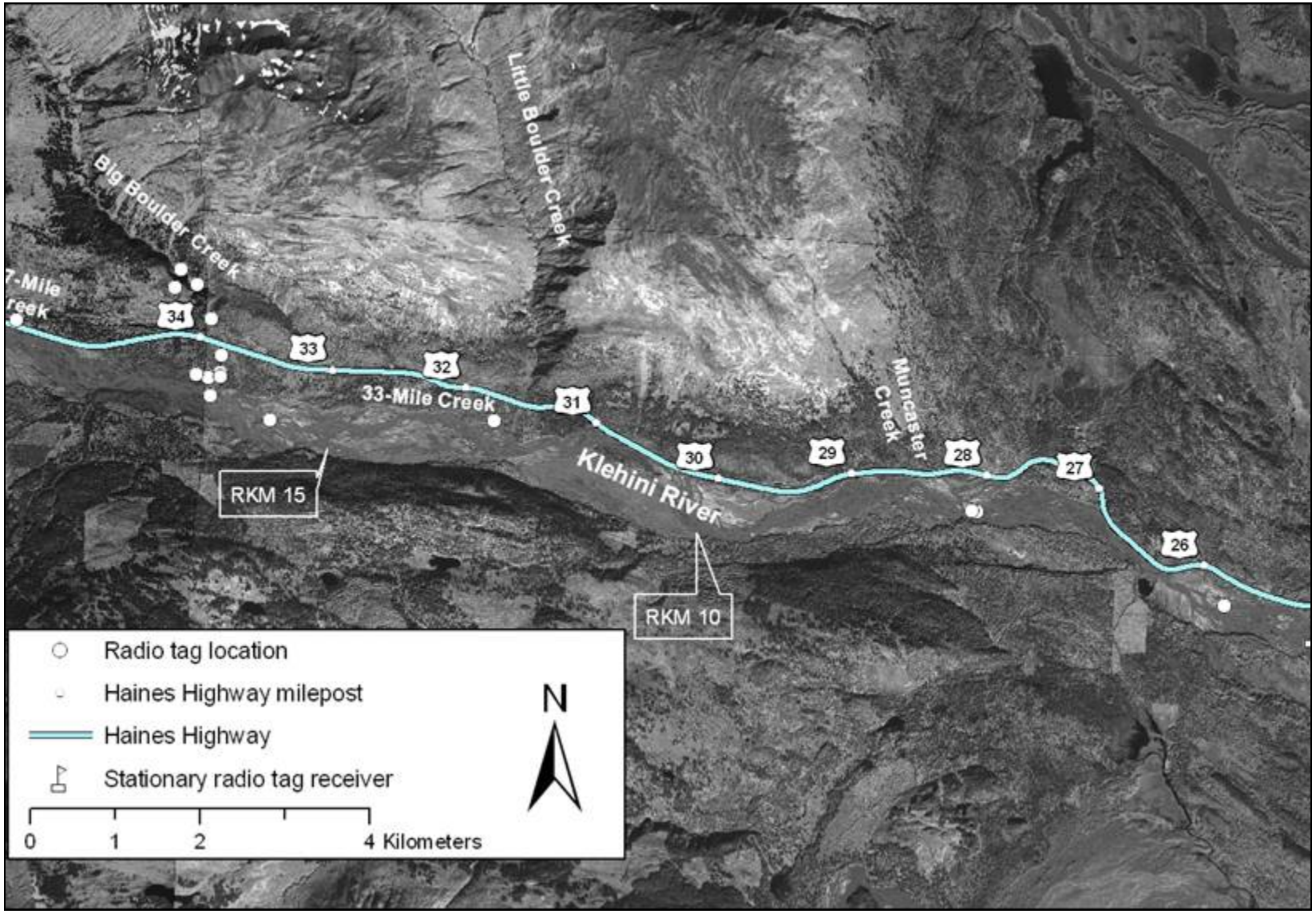

Figure 10.–Furthest upstream locations of radio-tagged Chinook salmon that spawned in the Klehini River drainage, 2005.

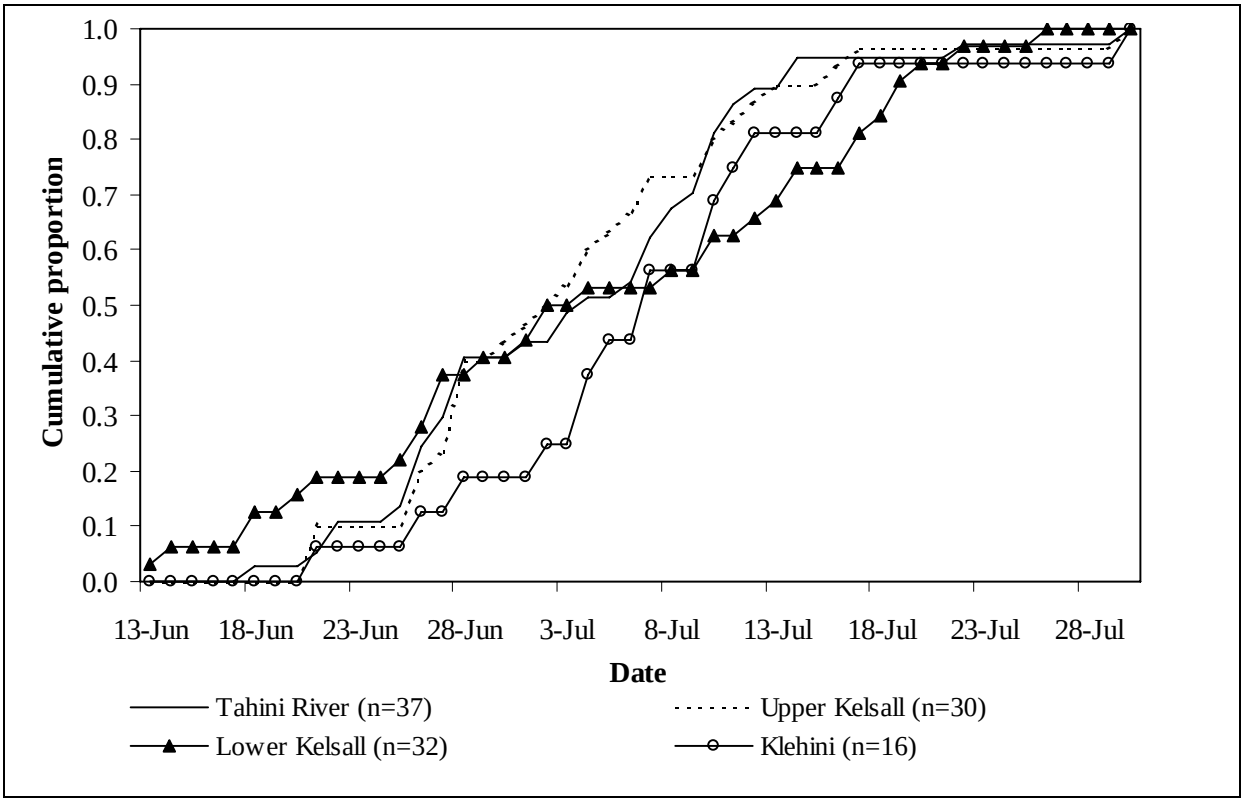

Figure 11.–Capture dates of radio-tagged Chinook salmon in drift gillnets and fish wheels in the lower Chilkat River by spawning destination, 2005.

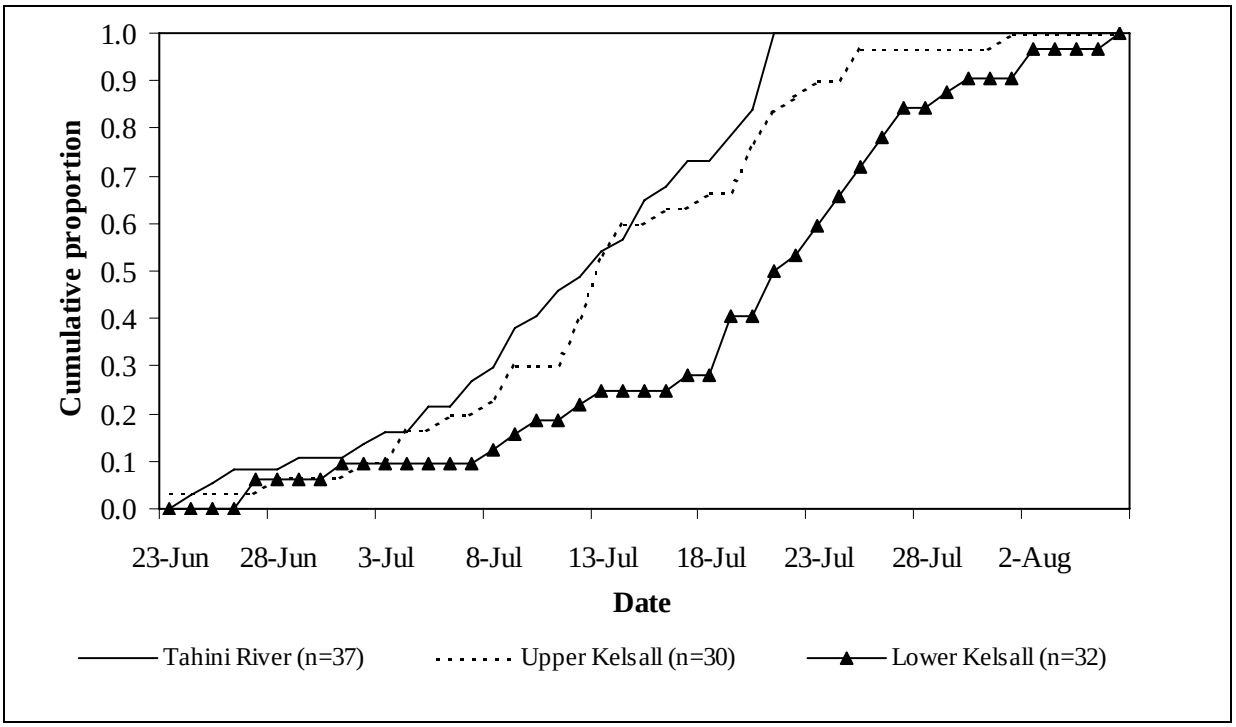

Figure 12.–First upstream passage dates of radio-tagged Chinook salmon at Wells bridge tracking station, by spawning destination, Chilkat River, 2005.

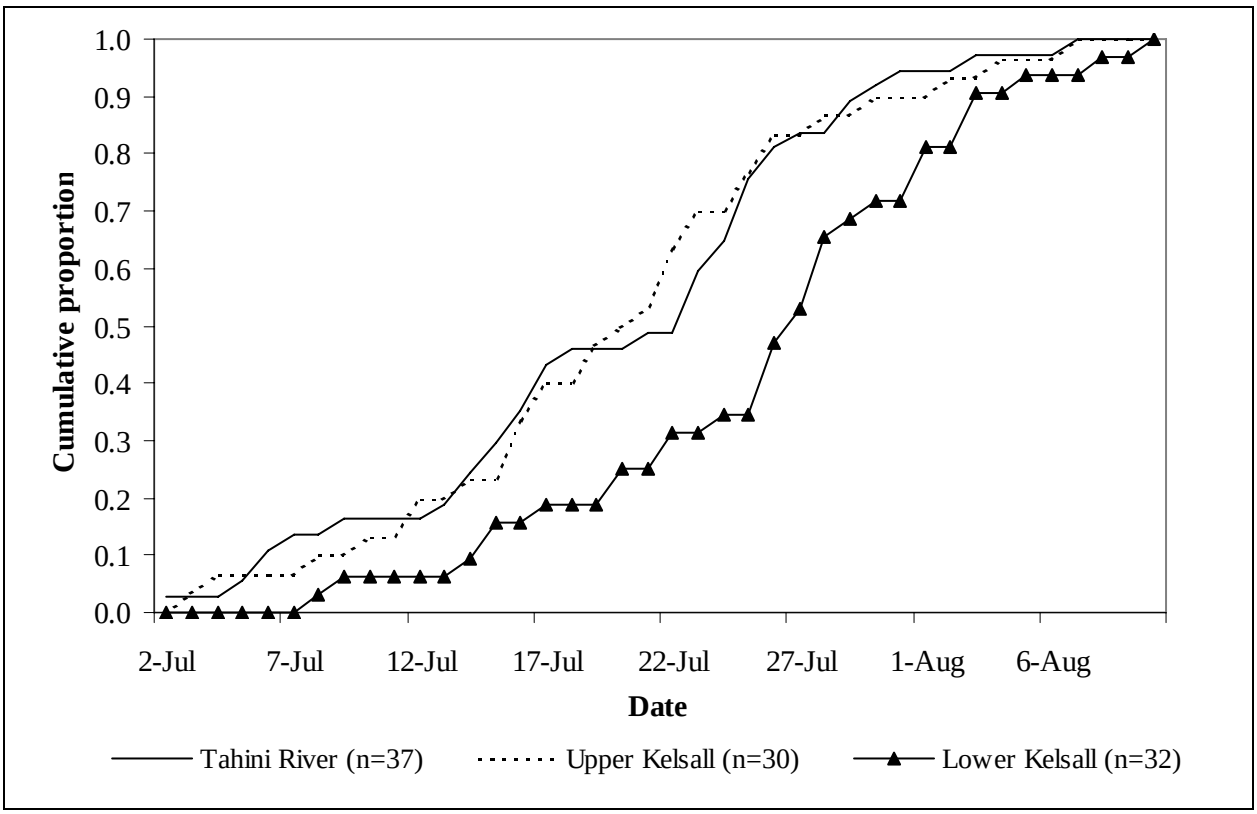

Figure 13.–First upstream passage dates of radio-tagged Chinook salmon at Jacquot's Landing tracking station, by spawning destination, Chilkat River, 2005.

boat surveys from June 23 to July 29, 95% were in the easternmost channel.

Between the Wells Bridge and the Kelsall River mouth, radio-tagged Chinook salmon preferred to migrate up the western channels of the Chilkat River (Figure 15). Of the 56 radio-tagged fish located between Chilkat RKM 40 and RKM 51 during weekly boat surveys from June 27 to August 4, most (84%) were in the western channels. In the section of the Chilkat River between Schnabel's Landing and Jacquot's Landing, the west channel splits into multiple channels. Only the largest and most eastward channel was passable by boat, so the more westward channels were not surveyed on the ground. Because only two radio-tagged Chinook salmon were located in the largest channel during multiple ground surveys, we inferred that most fish used the narrower westward channels.

Weekly radio tracking boat surveys indicated that all spawners heading to the Kelsall River had entered the Kelsall River by August 11. The last Tahini River spawners located in the Chilkat River were near Assignation Creek on August 9. By August 16, all Tahini River spawners had entered the Tahini River. Data from the Klehini tracking station at Klehini RKM 3 showed that Klehini River drainage spawners passed upstream from July 5 to August 19 (Appendix A1).

Upstream migration rates varied by mainstem Chilkat segment and distance to spawning destinations (Appendix A3). Migration rates ranged from 0.9 km/d (a Klehini River drainage spawner that traveled 25 km between the MP 9 and Klehini River tracking stations) to 16.3 km/d (a Tahini River spawner that traveled 24 km between the MP 9 and Wells Bridge tracking stations). In the lower Chilkat River section, Tahini River and upper Kelsall River spawners had the highest mean rates (4.2 and 3.1 km/d) and Klehini River drainage spawners were the slowest (1.7 km/d; Table 12). In the middle Chilkat River segment from Wells Bridge to Jacquot's Landing, mean migration rates were less variable and ranged from 1.7 to 2.4 km/d.

Table 11.–Spawning areas reached by radio-tagged Chinook salmon, by number and estimated percentages, Chilkat River, 2005.

Number of radio-tagged Chinook salmon														
	Kelsall River drainage					Tahini River			Klehini River drainage					
Statistical week tagged	RKM 18+ and Stonehouse	RKM 11-17	RKM 5-10	RKM 1-4	Drainage subtotal	RKM 6+	RKM 1-5	Drainage subtotal	37-Mile Creek	Big Boulder	Little Boulder	Other Klehini	Drainage subtotal	Spawned total
25	0	1	2	0		1	2		0	0	0	0		6
26	1	3	0	2		1	3		0	0	0	1		11
27	3	8	6	4		3	8		0	2	0	1		35
28	1	4	2	1		5	7		1	3	1	0		25
29	1	6	5	2		3	3		0	5	0	0		25
30	0	1	2	5		0	1		0	1	0	0		10
31	0	1	1	0		0	0		0	0	0	1		3
Total	6	24	18	14	62	13	24	37	1	11	1	3	16	115
Adjusted percent	5.3%	20.8%	15.3%	10.8%	52.2%	12.1%	21.0%	33.1%	1.0%	10.6%	1.0%	2.0%	14.6%	100 %
SE (percent)	(2.1%)	(3.8%)	(3.4%)	(2.9%)	(4.7%)	(3.1%)	(3.8%)	(4.4%)	(1.0%)	(2.9%)	(1.0%)	(1.3%)	(3.3%)	

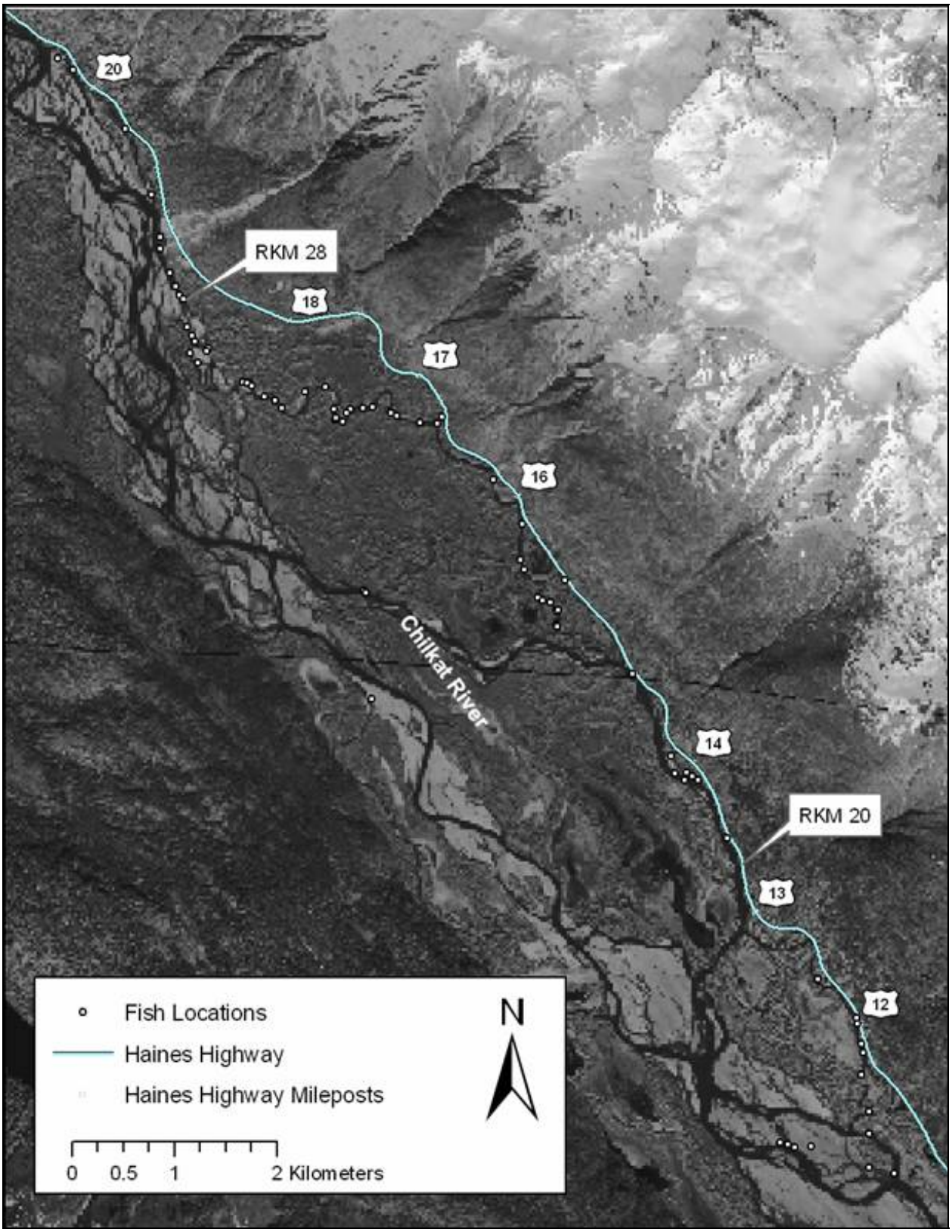

Figure 14.–Locations of radio-tagged Chinook salmon during weekly surveys of the lower Chilkat River, 2005.

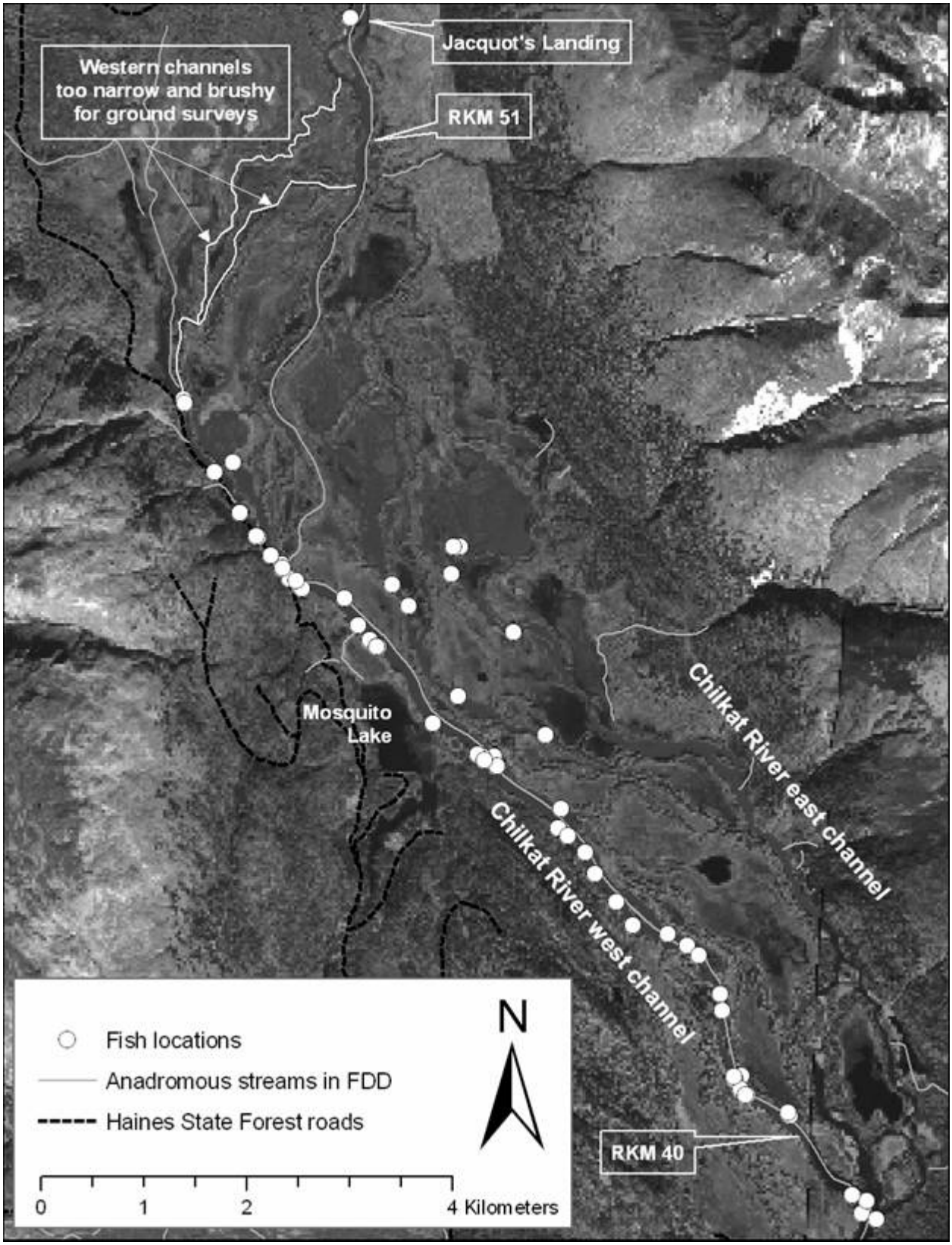

Figure 15.–Locations of radio-tagged Chinook salmon during weekly surveys of the middle Chilkat River, 2005.

Several radio-tagged Chinook salmon made substantial progress up one Chilkat River tributary, returned to the Chilkat River then moved upstream and presumably spawned in a second tributary. Fish number 64 was located by aerial survey at Takhin RKM 16 on July 25 but subsequently spawned in Big Boulder Creek. Fish numbers 49, 115, and 54 each spent three days or more upstream of the Klehini River tracking station and were subsequently tracked to the Kelsall River (Appendix A1). Fish numbers 1, 83, and 95 each passed upstream at the Kelsall Bridge tracking station before returning downstream and being tracked to the Tahini River.

Many fish that spawned above our sampling sites drifted downstream after spawning. About 61% of radio-tagged Kelsall River drainage spawners were available for sampling below the bridge after spawning (Appendix A1). Twelve of the 13 transmitters recorded upstream of the Tahini River sampling area (Figure 9), were later located in the sampling area.

TERMINAL HARVEST

2005 Haines Marine Sport Fishery Harvest

An estimated total 12,641 (SE = 1,239) angler-h of effort were expended in the Haines marine boat fishery between May 9 and June 26, 2005 to catch 260 (SE = 31) and harvest 252 (SE = 31) large Chinook salmon (Table 13). This estimate is based on a sample of 474 boat-parties who fished 3,995 angler-h (3,902 salmon-h), and harvested 138 large (≥ 28 inches TL) Chinook salmon (Table 13). An estimated 165 (SE = 26) of the Chinook salmon harvested in this fishery were wild mature fish assumed to be returning to the Chilkat River. About 97% (12,287 salmon-h, SE = 1,216) of angler effort targeted Chinook salmon, and the remainder was directed toward other species, primarily Pacific halibut. Anglers caught an estimated 958 (SE = 264) small (< 28 inches TL) Chinook salmon, of which 113 (SE = 50) were kept. Eighty-six percent (86%) of the estimated salmon effort occurred between May 23 and June 19 (Table 13). 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. Charterboat anglers accounted for about 13% of the salmon effort (1,651 salmon-h, SE = 405), and 23% of the harvest (57, SE = 16) of large Chinook salmon 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 55% of the estimated salmon effort (6,752 salmon-h, SE = 687) and 59% of the estimated harvest (148, SE = 23) of large Chinook salmon (Appendix B1). Anglers returning to the Chilkat State Park boat launch accounted for an estimated 937 (SE = 322) salmon-h of effort and harvested 5 (SE = 4) large Chinook salmon (Appendix B2). Those returning to the Small Boat Harbor expended 4,598 (SE = 950) salmon-h and harvested 99 (SE = 21) large Chinook salmon (Appendix B3).

Age and Length of Harvest

Creel technicians sampled a total of 151 Chinook salmon for age, sex, and length in the angler harvest; 124 were assigned an age. The age composition of fish landed at the Small Boat Harbor was significantly different from that of fish landed at the Chilkat Inlet harbors ($\chi^2 = 27.8$, df = 2, $P < 0.001$). The difference in age composition at the Small Boat Harbor is likely the result of anglers targeting hatchery produced Chinook salmon returning to the Skagway area. Thus, these samples were analyzed separately.

A total of 106 Chinook salmon were sampled for age and length at the Chilkat Inlet harbors (Letnikof Dock and Chilkat State Park boat launch), and 87 of these were assigned an age (Table 14). Most (54.3%, SE = 4.9%) of the fish harvested were male. The predominant age class was age-1.3 (51.3%, SE = 6.0%).

Creel technicians sampled 45 Chinook salmon for age and length at the Small Boat Harbor and 37 of these were assigned an age. Most (51.1%, SE = 7.5%) of the fish harvested were female. The predominant age class was age-1.2 (42.3%, SE = 10.9%). Twenty-six (26) Chinook salmon from the Chilkat Inlet subsistence fishery were also sampled for age and length between June 18 and July 10, 2005. Subsistence fishers reported harvesting 77 Chinook salmon in this fishery in 2005. These fish were most commonly age-1.2 (38.1%, SE = 10.9%, Appendix B4).

Table 12.–Mean time spent (d) and migration rates (km/d) between tracking stations by radio-tagged Chinook salmon, by spawning destination, Chilkat River, 2005.

Tracking station		Mean days between stations (SE)					Mean km/day			
From	To	Upper Kelsall (n=30)	Lower Kelsall (n=32)	Tahini (n=37)	Klehini (n=15)	Distance (km)	Upper Kelsall	Lower Kelsall	Tahini	Klehini
MP 9	Wells Bridge	7.8 (0.8)	10.8 (1.0)	5.8 (0.6)		24	3.1	2.2	4.2	
MP 9	Klehini River				14.9 (1.5)	25				1.7
Wells Bridge	Jacquot's Landing	6.3 (0.6)	5.9 (0.8)	8.3 (0.7)		14	2.2	2.4	1.7	
MP 9	Jacquot's Landing	14.1 (1.1)	16.7 (1.1)	14.1 (1.0)		38	2.7	2.3	2.7	

Table 13.–Biweekly sampling statistics and estimated effort, catch, and harvest of Chinook salmon in the Haines marine boat sport fishery, May 9–June 26, 2005.

		May 23–June 05				
	May 09–May 22	Non-derby	Derby	June 06–June 19	June 20–June 26	Total
Boats counted	104	92	115	141	22	474
Angler-hs. sampled	585	522	1,515	1,230	143	3,995
Salmon-hs. sampled	541	517	1,506	1,199	139	3,902
Chinook sampled	10	13	76	29	10	138
Sampled for ad-clips	10	13	89	29	10	151
Ad-clips	0	0	6	7	2	15
Angler-hours						
Estimate	1,227	1,844	4,507	4,318	745	12,641
SE	137	137	1,013	677	117	1,239
Salmon-hours						
Estimate	1,022	1,830	4,462	4,257	716	12,287
SE	164	141	981	670	140	1,216
Large Chinook catch						
Estimate	18	41	117	66	18	260
SE	9	16	18	11	13	31
Large Chinook harvest						
Estimate	18	41	117	58	18	252
SE	9	16	18	12	13	31
Wild mature Chinook harvest (excluding hatchery and immature fish)						
Estimate	13	31	83	34	4	165
SE	6	11	20	10	3	26
Small Chinook catch						
Estimate	7	172	393	351	35	958
SE	0	67	242	76	32	264
Small Chinook harvest						
Estimate	0	8	0	84	21	113
SE	0	5	0	46	19	50

Contribution of Coded Wire Tagged Stocks to the 2005 Haines Marine Sport Fishery

Chinook salmon incubated and reared at the Douglas Island Pink and Chum, Inc. (DIPAC) Macaulay hatchery facility were recovered in the 2005 Haines marine creel survey (Table 15). In addition, wild Chilkat River Chinook salmon (1999 and 2000 broods) with CWTs were recovered in this fishery. Fish landed at the Small Boat Harbor were more likely to be from hatchery releases in Taiya Inlet, so these samples were analyzed separately. Six (6) of the 105 large and none of the small (illegal) Chinook salmon

Table 14.–Estimated age composition and mean length-at-age (snout to fork of tail in mm) of harvested Chinook salmon in the Haines marine boat sport fishery by harbor location, May 9–June 26, 2005.

		Brood year and age class							
		2002	2001	2001	2000	1999	1998		
		1.1	0.3	1.2	1.3	1.4	1.5	Total aged	Total sampled[a]
CHILKAT INLET HARBORS									
Males	Sample size	0	0	8	24	12	0	44	57
	Mean length			714	837	1,000			54.3%
	SE			15	16	24			4.9%
Females	Sample size	0	0	1	20	20	1	41	48
	Mean length			690	827	960	1,145		45.7%
	SE				17	15			4.9%
Combined	Sample size	0	0	9	45	32	1	87	106
	Percent			12.5	51.3	35.4	0.9		
	SE			4.4	6.0	5.5	0.9		
	Mean length			711	831	975	1,145		
	SE			13	11	13			
SMALL BOAT HARBOR									
Males	Sample size	4	1	4	10	0	0	19	22
	Mean length	451	900	671	839				48.9%
	SE	22		31	27				7.5%
Females	Sample size	1	0	8	8	1	0	18	23
	Mean length	380		659	757	860			51.1%
	SE			19	17				7.5%
Combined	Sample size	5	1	12	18	1	0	37	45
	Percent	23.4	1.1	42.3	30.9	2.2			
	SE	9.9	1.1	10.9	9.6	2.5			
	Mean length	437	900	663	803	860			
	SE	23		15	19				

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

sampled at the Chilkat Inlet harbors (Letnikof Dock and Chilkat State Park boat launch) were missing their adipose fins. Fourteen (14; SE = 14) of the estimated 153 large Chinook salmon landed at the Chilkat Inlet harbors were of hatchery origin (Table 15). Five (5) of the 31 large and the 4 of the 14 small Chinook salmon sampled at the Small Boat Harbor (harvested in the Taiya Inlet terminal hatchery area) were missing their adipose fins. Seventy-five (75; SE = 42) of estimated 99 large Chinook salmon harvested and 80 (SE = 56) of the estimated 110 small fish landed at the Small Boat Harbor were of hatchery origin.

JUVENILE TAGGING

The trapping crews captured 34,846 Chinook salmon fry during fall 2005 (Table 16). Catch rates were lowest in the Tahini River and highest in the mainstem of the Chilkat River. Of those captured, 34,771 were released with a valid CWT and adipose finclip (Table 17). In addition, we released 5,075 smolt during spring 2006 with valid CWTs and an adipose finclip (Table 17).

A total of 372 Chinook salmon fry were sampled for length during fall 2005 (Table 18). The mean length of fry was 70 mm FL (SD = 6.8 mm FL). In addition, 262 smolt were sampled for length and weight during the spring of 2006 (Table 18). Smolt averaged 73 mm FL (SD = 6.1 mm FL) and 3.8 g (SD = 1.1 g).

1998 BROOD YEAR SMOLT ABUNDANCE

ADF&G personnel sampled 928 adult 1998 brood year Chinook salmon from Chilkat River escapements between 2001 and 2005, of which 14 were missing adipose fins (Table 19). We could not detect a significant difference between the marked fraction of those sampled in the lower river and those sampled on the spawning grounds

Table 15.–Contribution estimate (r) of coded wire tagged Chinook salmon to the Haines marine boat sport fishery, May 9–June 26, 2005. 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	Release site	Tag code	Brood year	Harvest $\hat{H}$	Harvest SE[H]	Sample n	Adclip a	Head a'	Detect t	Decode t'	Tags m	Contribution $\hat{r}$	Contribution SE$[\hat{r}]$
CHILKAT INLET RECOVERIES													
Large Fish													
ADFG	Chilkat River wild	04-01-66, 67 04-02-97, 99	1999	153	24	105	6	6	6	6	2	3	1
ADFG	Chilkat River wild	04-05-40	2000	153	24	105	6	6	6	6	3	4	2
DIPAC	Fish Cr.	04-05-60	2000	153	24	105	6	6	6	6	1	14	14
Subtotal												21	14
SMALL BOAT HARBOR RECOVERIES													
Large Fish													
ADFG	Chilkat River wild	04-01-66, 67	2000	99	21	31	5	5	5	5	1	3	3
DIPAC	Gastineau Channel	04-01-59	2000	99	21	31	5	5	5	5	3	69	41
DIPAC	Pullen Creek	04-01-57	2001	99	21	31	5	5	5	5	1	6	6
Subtotal												78	42
Small Fish													
DIPAC	Pullen Creek	04-03-94	2001	110	50	14	4	4	3	3	1	15	15
DIPAC	Pullen Creek	04-03-94	2002	110	50	14	4	4	3	3	2	65	50
Subtotal												80	56
Grand total large												99	44
Grand total small												80	56

(χ^2 = 1.785, df = 1, P = 0.181). Therefore, we pooled the samples to estimate that 123,680 (SE =30,554) 1998 brood year smolt emigrated from the Chilkat River in 2000 (n_c = 1,996, n_e = 928, m_e =14).

1998 BROOD YEAR ADULT HARVEST

Heads from 12 of the 14 brood year 1998 Chinook salmon with missing adipose fins in the Chilkat River escapement were collected and sent to the ADF&G Mark, Tag, and Age laboratory in Juneau for decoding. Ten (10) of the 12 had valid tags (Table 19). The tagged fraction θ_h germane to estimating harvest contributions was 0.0126 (SE = 0.0037). This estimate is based on the 14 fish with missing adipose fins, multiplied by the tag loss fraction (10/12) in the 928 Chinook salmon inspected for marks in the escapement.

Thirteen (13) Chinook salmon with Chilkat River coded wire tags from the 1998 brood year were recovered between 2001 and 2005 (Table 20). Three of these were random recoveries from marine sport and commercial fisheries. Based on the limited number of recoveries, we estimated that 1,040 (SE = 731) 1998 brood year Chilkat River Chinook salmon were harvested in sampled marine commercial and sport fisheries between 2001 and 2005 (Table 21).

Table 16.–Results of juvenile Chinook salmon trapping in the Chilkat River drainage in fall 2005 and spring 2006.

Year	Trapping area	Dates	Days fished	Trap sets	No. caught	CPUE[a]
2005	Tahini River	09/16–09/23	6	582	6,587	11.3
2005	Kelsall River	10/01–10/13	11	837	17,893	21.4
2005	Chilkat River	10/21–10/27	6	286	10,366	36.2
Fall 2005 subtotal			23	1,705	34,846	20.4
2006	Chilkat River	04/08–05/29	51	5,005	5,089	1.0

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

Table 17.–Number of 2004 brood year Chinook salmon coded wire tagged in the Chilkat River drainage by area and year.

Tag year	Tag code	Sequence	Location	Last date	Stage	Tagged	24h morts	Marked	Shed tags	Valid CWTs
2005	041219	138–11,389	Tahini River	09/23/05	Fingerling	6,587	57	6,530	0	6,530
2005	041219	11,522–44,720	Kelsall River	10/13/05	Fingerling	17,893	13	17,880	0	17,880
2005	041219	44,933–57,532	Chilkat River	10/26/05	Fingerling	7,376	5	7,371	0	7,371
2005	041215	NA	Chilkat River	10/28/05	Fingerling	2,990	0	2,990	0	2,990
Fall subtotal						34,846	75	34,771	0	34,771
2006	041302	NA	Chilkat River	05/29/06	Smolt	5,089	9	5,080	5	5,075
2004 brood year total						39,935	84	39,851	5	39,846

Table 18.–Mean length and smolt weight of 2004 brood year 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
2005	Tahini River	09/19–09/24	69	58–85	72	5.1
2005	Kelsall River	10/01–10/13	191	54–95	71	7.1
2005	Chilkat River	10/21–10/27	112	55–82	67	6.1
Fall subtotal			372	54–95	70	6.8
2006	Chilkat River	04/10–05/30	262	56–93	73	6.1
			Weight (g)	1.8–7.7	3.8	1.1

1998 BROOD YEAR MARINE EXPLOITATION AND SURVIVAL

Based upon a total brood year return of 4,636 (SE = 879) age-1.2 and older fish, we estimate the marine survival rate at 3.7% (Table 22, SE = 1.2%). The marine exploitation rate of this stock was estimated at 22.4% (Table 22, SE = 12.5%).

DATA FILES

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

DISCUSSION

Several assumptions, as noted above, underlie the estimate of abundance. Considerable efforts were made to catch and mark fish in proportion to their abundance (assumption a) by sampling uniformly across the escapement. Also, sampling effort for tag recovery on the Kelsall and Tahini rivers (where 85% of spawning occurred this year and >90% occurred in 1991 and 1992; Johnson et al. 1992, 1993) was fairly constant across the time when spawning fish die and are available for sampling. The radiotelemetry results confirm previous research on the Chilkat River (Johnson et al. 1992, 1993) that suggested that river entry timing is similar for Tahini and Kelsall River stocks. Tagging ratios of large Chinook salmon found on the Tahini (0.045) and Kelsall-Nataga (0.057) rivers in 2005 were very similar. Although carcass surveys can be sex-selective in some situations (Pahlke et al. 1996; McPherson et al. 1997; Zhou 2002; Miyakoshi et al. 2003), this could not be detected using a battery of tests. The assumption of no recruitment during the experiment is reasonable because tagging effort was relatively constant and continued until only about one fish per day was being caught. The assumption that marking does not affect catchability of fish was directly tested through the telemetry study. Three fish (2.3%) apparently failed to make significant upstream progress after being radio-tagged. These fish either died or regurgitated their tags. If we assume that all three died from handling mortality, this would bias our abundance estimate high by about 2.4%. Because all fish had secondary marks that were not lost, assumption (d) was satisfied. Personnel sampling the spawning tributaries carefully examined each fish for marks; therefore failure of assumption (e) was unlikely.

Table 19.–Number of 1998 brood year Chinook salmon sampled in the Chilkat River drainage for missing adipose fins and CWTs, by year, and gear type or spawning drainage, 2001–2005.

Year	Gear/drainage	Sampled for ad clips	Fish with ad clips	Marked fraction	Heads collected	Valid CWTs	CWT loss
		LOWER RIVER RECOVERIES					
2001	Fish wheels	69	3	0.04	3	3	0.00
2002	Gillnet	7	0	0.00			
2002	Fish wheels	32	0	0.00			
2003	Gillnet	61	1	0.02	1	1	0.00
2003	Fish wheels	53	2	0.04	2	2	0.00
2004	Gillnet	50	0	0.00			
2004	Fish wheels	36	1	0.03	1	0	1.00
2005	Gillnet	1	0	0.00			
Lower river total		309	7	0.02	7	6	0.14
		SPAWNING GROUND RECOVERIES					
2001	Kelsall River	7	0	0.00			
2001	Tahini River	9	0	0.00			
2001	Klehini River	1	0	0.00			
2002	Kelsall River	16	0	0.00			
2002	Tahini River	23	0	0.00			
2002	Klehini River	16	0	0.00			
2003	Kelsall River	145	1	0.01	0		
2003	Tahini River	123	4	0.03	3	2	0.33
2003	Klehini River	39	0	0.00			
2004	Kelsall River	107	1	0.01	1	1	0.00
2004	Tahini River	110	1	0.01	1	1	0.00
2004	Klehini River	22	0	0.00			
2005	Tahini River	1	0	0.00			
Spawning ground total		619	7	0.01	5	4	0.20
Grand Total		928	14	0.02	12	10	0.17

Table 20.–Number of recoveries of 1998 brood year Chilkat River coded wire tagged Chinook salmon, by year, fishing district, and gear type, 2001–2005.

Year	District	Troll	Sport	Chilkat escapement	Total
2001	115			3	3
2001 subtotal				3	3
2003	111		1		1
	115			5	5
2003 subtotal			1	5	6
2004	113	1			1
	115		1	2	3
2004 subtotal		1	1	2	4
Grand total		1	2	10	13

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

The 2005 immigration of 3,366 (SE = 555) large Chinook salmon was below the 1991–2004 average and was comprised mainly of age-1.3 fish from the 2000 brood year (Table 23).

The immigration timing of Chinook salmon through the lower Chilkat River was delayed relative to past years. By June 25, less than 10% of the fish had been captured compared to the average of over 20% in past years (Figure 4). However, the mean date of migratory timing (Mundy 1984) was July 4, which was nearly identical to the mean date of July 3 for 1991–2004.

The difference between age compositions of the radio-tagged fish compared to fish not radio-tagged was not thought to result from systematic bias in selection (Table 9). Except for four instances, fish were always selected for radio-tagging following a random pattern: every x^{th} of y

Table 21.–Estimated contributions of 1998 brood year Chilkat River Chinook salmon to marine fishery harvests by year and fishery, 2001–2005.

		Harvest		Sample	Adclip	Head	Detect	Decode	Tags	Contribution	
Fishery	District	$\hat{H}$	Var$[\hat{H}]$	n	a	a'	t	t'	m	$\hat{r}$	SE$[\hat{r}]$
2003 Recoveries age-1.3											
Juneau marine sport	111,112,115	12,456	1,199,025	1,488	126	122	101	101	1	688	687
2004 Recoveries age-1.4											
NW troll period 2		32,586	0	1,488	126	122	101	101	1	191	190
Chilkat Inlet sport	115	302	1,003	159	15	14	13	13	1	161	161
2004 subtotal										352	249
Combined contribution $[\hat{T}]$										1,040	731

fish 440 mm MEF or greater until the daily radio supply was exhausted, except for wounded fish and fish whose heads were taken for CWTs. The percentage of fish selected for radio-tagging from the fish wheels (60%) was nearly equal to the percentage from the drift gillnets (58%), so gear type should not have significantly biased the age composition. The effect of the radio-tagged sample having an older age composition may have been to overestimate the Kelsall River component of the spawning distribution. In the Kelsall River escapement samples, like in the radio-tagged sample, the largest age class was age-1.4, whereas in other tributaries sampled, age-1.3 fish predominated (Table 6).

The radiotelemetry study assumed that the radio-tagging process did not adversely affect the fish's ability to continue upstream migration. Radio-tagged Chinook salmon in the Yukon River that experienced capture and handling methods similar to this study succeeded in reaching distant (> 1,000 km) spawning areas and had migration rates as high as their untagged cohorts (Eiler et al. 2006). The rate at which radio-tagged fish in this study regurgitated tags or did not reach probable spawning areas (5%, Table 10) was lower than rates in other Chinook salmon radiotelemetry studies that used similar methods (Johnson et al. 1992, 1993; Savereide 2005; Stuby 2005, 2006).

Table 22.–Estimated stock assessment parameters for 1998 brood year Chilkat River Chinook salmon.

Parameter	Estimate	SE
2000 smolt emigration	123,680	30,554
Marine harvest	1,040	731
Escapement (age-1.2 and older)	3,596	488
Return (age-1.2 and older)	4,636	879
Marine exploitation rate	22.4%	12.5%
Marine survival	3.7%	1.2%

The criteria used in this study for assigning a mainstem Chilkat River spawning fate were more conservative than in past radiotelemetry studies. Fish numbers 16 and 69 met the mainstem spawner criteria used in Johnson et al. (1992; 1993): they were tracked upstream in the Chilkat River, observed in non-mortality mode, and then observed downstream (Appendix A2). However, full gonads in the recovered carcasses indicated that these two fish died before spawning. Fish number 96 also met the mainstem spawning criteria used in past studies, but its rapid return less than three hours after passing the Jacquot's Landing tracking station and cessation of motion less than one day after downstream passage indicated that it had little opportunity to spawn in the mainstem Chilkat River.

Fish number 25 met the tributary spawning fate criteria because it was observed in the Klehini River. However, it remained upstream and close to the Klehini tracking station from its detection on July 12 through July 16, when the Klehini River station began receiving a mort signal. Because it never traveled very far beyond the Klehini River tracking station and its transmitter ceased moving three days later, it was unlikely that this fish had adequate opportunity to spawn. Future Chilkat River radiotelemetry studies could be improved with more frequent ground surveys of the Klehini River drainage to document spawning use of tributaries other than Big Boulder Creek and possibly the mainstem.

Table 23.–Estimated annual age compositions and brood year escapements of medium and large (≥ age-1.2) Chinook salmon immigrating into the Chilkat River, 1991–2005.

Return year		Age class 1.2	1.3	1.4	1.5	Total
1991[a]	Abundance	817	3,211	2,563	123	6,714
	SE	139	558	445	18	727
1992[b]	Abundance	560	1,689	3,595	0	5,844
	SE	100	304	649	0	723
1993[c]	Abundance	551	2,217	2,005	120	4,894
	SE	104	424	384	22	582
1994[d]	Abundance	184	2,565	4,148	82	6,979
	SE	28	405	657	10	773
1995[e]	Abundance	1,384	530	3,074	186	5,174
	SE	295	111	660	37	733
1996[f]	Abundance	398	4,140	737	43	5,318
	SE	60	639	112	5	652
1997[g]	Abundance	160	1,943	6,157	0	8,260
	SE	48	354	930		997
1998[h]	Abundance	226	1,016	2,440	219	3,901
	SE	54	169	381	48	423
1999[i]	Abundance	427	534	1,656	80	2,698
	SE	94	109	302	27	336
2000[j]	Abundance	629	1,350	653	32	2,664
	SE	122	227	118	14	283
2001[k]	Abundance	755	2,529	1,988	-	5,272
	SE	209	376	617	-	752
2002[l]	Abundance	373	2,353	1,667	30	4,423
	SE	123	312	294	19	446
2003[m]	Abundance	1,267	1,833	3,783	41	6,924
	SE	293	362	582	29	746
2004[n]	Abundance	1,361	1,999	1,379	44	4,783
	SE	492	333	303	17	667
2005	Abundance	1,597	1,857	1,498	11	4,963
	SE	620	433	345	8	831
Avg.	Percent	13.6	37.8	47.4	1.2	
	Abundance	713	1,984	2,490	67	5,254

Brood year	Brood Year Escapements Age class 1.2	1.3	1.4	1.5	Total	SE
1986		3,211	3,595	120	6,926	856
1987	817	1,689	2,005	82	4,593	509
1988	560	2,217	4,148	186	7,111	790
1989	551	2,565	3,074	43	6,234	782
1990	184	530	737	0	1,451	1,393
1991	1,384	4,140	6,157	219	11,899	1,168
1992	398	1,943	2,440	80	4,861	524
1993	160	1,016	1,656	32	2,865	350
1994	226	534	653	0	1,414	169
1995	427	1,350	1,988	30	3,795	664
1996	629	2,529	1,667	41	4,865	493
1997	755	2,353	3,783	44	6,935	693
1998	373	1,833	1,379	11	3,596	488
1999	1,267	1,999	1,498		4,765	566
2000	1,361	1,857			3,218	655
2001	1,597				1,597	620
Avg.	713	1,984	2,484	68	4,537	

[a] Data taken from Johnson et al. (1992).
[b] Data taken from Johnson et al. (1993).
[c] Data taken from Johnson (1994).
[d] Data taken from Ericksen (1995).
[e] Data taken from Ericksen (1996).
[f] Data taken from Ericksen (1997).
[g] Data taken from Ericksen (1998).
[h] Data taken from Ericksen (1999).
[i] Data taken from Ericksen (2000).
[j] Data taken from Ericksen (2001).
[k] Data taken from Ericksen (2002a).
[l] Data taken from Ericksen (2003).
[m] Data taken from Ericksen (2004).
[n] Data taken from Ericksen (2005).

The restricted migration route through smaller channels that Chinook salmon used in the lower Chilkat River in 2005 (Figure 14) could provide efficient lower river capture sites for future mark-recapture studies.

The longer distance to spawning grounds could explain the earlier run timing of Tahini River and upper Kelsall Rivers spawners as compared to lower Kelsall River and Klehini River spawners (Appendix A3, Figures 11, 12, and 13). Distance to spawning grounds could also explain different migration rates in the lower Chilkat River. Tahini River and upper Kelsall River spawners had faster migration rates in the lower Chilkat River compared to lower Kelsall River and Klehini River spawners (Table 12, Appendix A3). Eiler et al. (2006) observed that Yukon River Chinook salmon headed to closer spawning grounds swam slower than spawners headed to further destinations. However, the speed to distance relationship was apparent neither in the middle Chilkat River segment nor in the overall migration rates between the tagging site and Jacquot's Landing.

Since 1991, Chinook salmon escapement sampling effort in the Kelsall River drainage has been focused in the area from the Kelsall River Bridge downstream. The 2005 radiotelemetry results indicated that 79% of the distribution of Kelsall River spawners was in areas above the bridge (Table 11, Figures 7 and 8). Only 61% of Kelsall River drainage spawners were probably available below the bridge after spawning, so it would be desirable to sample spawners upstream of RKM 10 (Figure 8). Steep terrain makes accessing spawning concentrations in the Kelsall

around RKM 11-14 very difficult. In one day of sampling at Kelsall RKM 11-12 on August 31, ten carcasses were sampled. To better sample the entire Kelsall River spawning population, it may be productive in the future to access the Kelsall RKM 11-14 area in the second half of August when water levels are low or declining.

The radiotelemetry data indicated that there were significant spawning areas in Tahini RKM 6-8, upstream of the normal escapement sampling area (Figure 9). These upper areas are very difficult to access by foot, especially beyond the Flemmer River confluence. In most years, most of the Chinook salmon that migrate through the sampling area are accessible to rod and reel sampling gear because Tahini River waters are shallower and less turbid than in the Kelsall River. In addition, over 90% of the radio-tagged fish that spawned above the sampling site drifted downstream into the sampling site after spawning. The July 25 location of fish number 64 at RKM 16 in the Takhin River indicates the possibility of a minor Chinook salmon spawning area in that river. However, this fish later returned down the Takhin River and spawned in Big Boulder Creek. No other radio-tagged salmon were located in the Takhin River.

Sport fishing harvest patterns observed during 2005 were similar to recent years. During 2005, 59% of the estimated harvest of Chinook salmon was landed at the Letnikof Dock. In contrast, 63% of the average total harvest over the past five years was landed at this harbor. Although sport fishing effort remained relatively high in 2005, the estimated harvest of large Chinook salmon was below the average over the previous five years (Figure 16, Table 24).

Trapping Chinook salmon fry in the fall increased the number of CWT-marked fish released for a

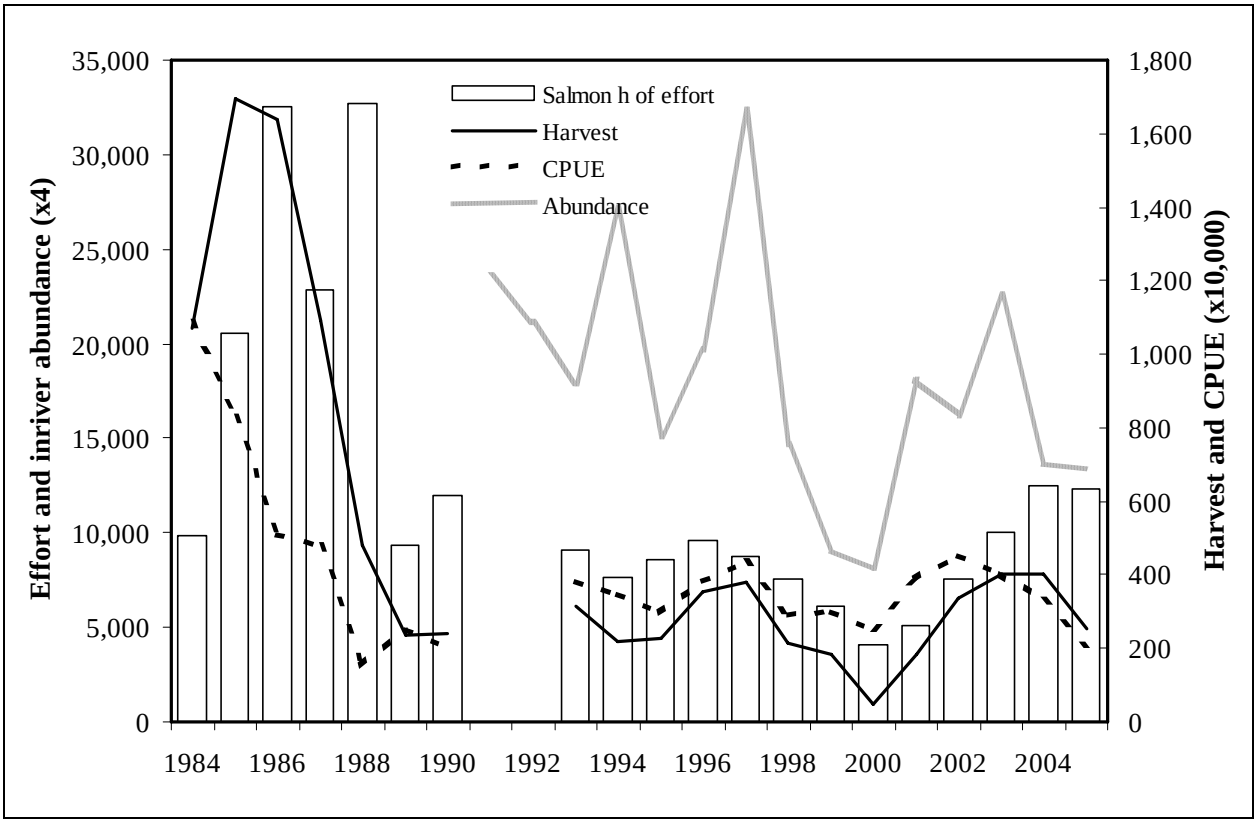

Figure 16.–Estimated angler effort, harvest, and CPUE of large Chinook salmon in the Haines spring marine boat sport fishery, 1984–2005, and estimated inriver abundance of large Chinook salmon in the Chilkat River, 1991–2005. Data taken from Tables 23 and 24 (fishery closed in 1991 and 1992).

Table 24.–Estimated angler effort, and large (≥ 28 in.) Chinook salmon catch and harvest in the Haines marine boat sport fishery for similar sample periods, 1984–2005[a].

		Effort				Large (28") Chinook salmon				
Year	Survey dates	Angler-hours	SE	Salmon-hours	SE	Catch	SE	Harvest	SE	CPUE[b]
1984	5/06-6/30	10,253	[c]	9,855	[c]	1,072	[c]	1,072	[c]	0.109
1985	4/15-7/15	21,598	[c]	20,582	[c]	1,705	[c]	1,696	[c]	0.083
1986	4/14-7/13	33,857	[c]	32,533	[c]	1,659	[c]	1,638	[c]	0.051
1987	4/20-7/12	26,621	2,557	22,848	2,191	1,094	189	1,094	189	0.048
1988	4/11-7/10	36,222	3,553	32,723	3,476	505	103	481	101	0.015
1989	4/24-6/25	10,526	999	9,363	922	237	42	235	42	0.025
1990	4/23-6/21	[d]	[d]	11,972	1,169	248	60	241	57	0.021
1993	4/26-7/18	11,919	1,559	9,069	1,479	349	63	314	55	0.038
1994	5/09-7/03	9,726	723	7,682	597	269	41	220	32	0.035
1995	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
1997	5/12-6/29	9,432	861	8,758	697	381	46	381	46	0.044
1998	5/11-6/28	8,200	811	7,546	747	222	60	215	56	0.029
1999	5/10-6/27	6,206	736	6,097	734	184	24	184	24	0.030
2000	5/08-6/25	4,428	607	4,043	532	103	34	49	12	0.025
2001	5/07-6/24	5,299	815	5,107	804	199	26	185	26	0.039
2002	5/06-6/30	7,770	636	7,566	634	343	40	337	40	0.045
2003	5/05-6/29	10,651	596	10,055	578	405	40	404	40	0.040
2004	5/10-6/27	12,761	763	12,518	744	413	46	403	44	0.033
2005	5/09-6/26	12,641	1,239	12,287	1,216	260	31	252	31	0.021
1984–86 average		21,903		20,990		1,479		1,469		0.081
1987–90 average		24,456		19,227		521		513		0.027
1995–04 average		8,429		7,989		287		274		0.035
2000–04 average		8,182		7,858		293		276		0.037

[a] Data prior to 2005 taken from Table 14 in Ericksen (2005).

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

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

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

given brood year relative to tagging smolt in the spring. The benefits of tagging in the fall are somewhat offset by overwinter mortality of the fry. The cost effectiveness of fall trapping will be better assessed once adequate adult samples are sampled to estimate overwinter survival.

Because of the low number of smolt tagged in 2000, our estimates of smolt abundance and adult harvest for the 1998 brood year were imprecise but reasonable. The estimated marine exploitation rate (Table 22, 22.4%, SE = 12.5%) was close to, but somewhat higher than, historical estimates (range 8-19%, Ericksen and McPherson 2004). The marine survival estimate (Table 22, 3.7%, SE = 1.2%) is very similar to the 3.8% estimated for the 1998 brood year return of Chinook salmon to the Taku River (Ed Jones, Alaska Department of Fish and Game, Douglas, personal communication), which is the closest Chinook stock available for comparisons.

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REFERENCES CITED

ADF&G (Alaska Department of Fish and Game). Unpublished. Coded wire tag sampling program detailed sampling instructions, commercial fisheries sampling, Located at Alaska Department of Fish and Game, Division of Commercial Fisheries, 802 3rd Street, Douglas, Alaska.

Bernard, D. R., and J. E. Clark. 1996. Estimating salmon harvest based on return of coded-wire tags. Canadian Journal of Fisheries and Aquatic Sciences 53:2323-2332.

Bethers, M. 1986. Annual sport fish management report for northern Southeast Alaska. Unpublished report. Alaska Department of Fish and Game, Sport Fish Division, Juneau.

Bingham, A. E., P. N. Suchanek, S. Sonnichsen, and R. D. Mecum. 1988. Harvest estimates for selected sport fisheries in southeast Alaska in 1987. Alaska Department of Fish and Game, Fishery Data Series No. 72, Juneau. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds-072.pdf

Bugliosi, E. F. 1988. Hydrologic reconnaissance of the Chilkat River Basin, Southeast Alaska. U. S. Geological Survey Water Resources Investigation Report 88-4021, Anchorage, Alaska.

Cochran, W. G. 1977. Sampling techniques, third edition. John Wiley & Sons, New York.

Eiler, J. H. 1995. A remote satellite-linked tracking system for studying Pacific salmon with radiotelemetry. Transactions of the American Fisheries Society 124:184-193.

Eiler, J. H., T. R. Spencer, J. J. Pella, and M. M. Masuda. 2006. Stock composition, run timing, and movement patterns of Chinook salmon returning to the Yukon River basin in 2003. U. S. Department of Commerce, NOAA Technical Memo. NMFS-AFSC-163.

Ericksen, R. P. 1994. Effort, catch, and harvest of Chinook salmon in the spring marine boat sport fishery near Haines, Alaska, 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-30, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds94-30.pdf

Ericksen, R. P. 1995. Sport fishing effort, catch, and harvest and inriver abundance of Chilkat River Chinook salmon near Haines, Alaska, in 1994. Alaska Department of Fish and Game, Fishery Data Series No. 95-42, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds95-42.pdf

Ericksen, R. P. 1996. Sport fishing effort, catch, and harvest, fishery contributions, and inriver abundance of Chilkat River Chinook salmon, in 1995. Alaska Department of Fish and Game, Fishery Data Series No. 96-48, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds96-48.pdf

Ericksen, R. P. 1997. Sport fishing effort, catch, and harvest and inriver abundance of Chilkat River Chinook salmon near Haines, Alaska, in 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-27, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds97-27.pdf

Ericksen, R. P. 1998. Sport fishing effort, catch, and harvest and inriver abundance of Chilkat River Chinook salmon near Haines, Alaska, in 1997. Alaska Department of Fish and Game, Fishery Data Series No. 98-31, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds98-31.pdf

REFERENCES CITED (Continued)

Ericksen, R. P. 1999. Sport fishing effort, catch, and harvest, fishery contributions, and inriver abundance of Chilkat River Chinook salmon near Haines, Alaska, in 1998. Alaska Department of Fish and Game, Fishery Data Series No. 99-19, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds99-19.pdf

Ericksen, R. P. 2000. Sport fishing effort, catch, and harvest, and inriver abundance of Chilkat River Chinook salmon near Haines, Alaska in 1999. Alaska Department of Fish and Game, Fishery Data Series No. 00-28, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds00-28.pdf

Ericksen, R. P. 2001. Sport fishing effort, catch, and harvest, and inriver abundance of Chilkat River Chinook salmon near Haines, Alaska in 2000. Alaska Department of Fish and Game, Fishery Data Series No. 01-12, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds01-12.pdf

Ericksen, R. P. 2002a. Escapement, terminal harvest, and fall fry tagging of Chilkat River Chinook salmon in 2001. Alaska Department of Fish and Game, Fishery Data Series No. 02-23, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds02-23.pdf

Ericksen, R. P. 2002b. Smolt production and harvest of coho salmon from the Chilkat River, 2000-2001. Alaska Department of Fish and Game, Fishery Data Series 02-18, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds02-18.pdf

Ericksen, R. P. 2003. Escapement, terminal harvest, and fall fry tagging of Chilkat River Chinook salmon in 2002. Alaska Department of Fish and Game, Fishery Data Series No. 03-26, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds03-26.pdf

Ericksen, R. P. 2004. Escapement, terminal harvest, and fall fry tagging of Chilkat River Chinook salmon in 2003. Alaska Department of Fish and Game, Fishery Data Series No. 04-20, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds04-20.pdf

Ericksen, R. P. 2005. Escapement, terminal harvest, and juvenile tagging of Chilkat River Chinook salmon in 2004. Alaska Department of Fish and Game, Fishery Data Series No. 05-68, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds05-68.pdf

Ericksen, R. P., and S. A. McPherson. 2004. Optimal production of Chinook salmon from the Chilkat River. Alaska Department of Fish and Game, Fishery Manuscript No. 04-01, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fm04-01.pdf

Hubartt, D. J., A. E. Bingham, and P. M. Suchanek. 1997. Harvest estimates for selected marine sport fisheries in Southeast Alaska during 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-16, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds97-16.pdf

Johnson, R. E. 1994. Chilkat River Chinook salmon studies, 1993. Alaska Department of Fish and Game, Fishery Data Series No. 94-46, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds94-46.pdf

Johnson, R. E., R. P. Marshall, and S. T. Elliott. 1992. Chilkat River Chinook salmon studies, 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-49, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds92-49.pdf

Johnson, R. E., R. P. Marshall, and S. T. Elliott. 1993. Chilkat River Chinook salmon studies, 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-50, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds93-50.pdf

Jones & Stokes. 1991. Southeast Alaska sport fishing economic study. Final Research Report. December 1991. (JSA 88-028.) Sacramento, California. Prepared for Alaska Department of Fish and Game, Sport Fish Division, Research and Technical Services, Anchorage.

Kissner, P. D. 1982. Status of important native Chinook salmon stocks in Southeastern Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1981-1982, Project F-9-14, 23 (AFS 41-10), Juneau.

REFERENCES CITED (Continued)

Koerner, J. F. 1977. The use of coded wire tag injector under remote field conditions. Alaska Department of fish and Game, Division of Commercial Fisheries, Informational Leaflet No. 172, Juneau.

McPherson, S., D. Bernard, J. H. Clark, K. Pahlke, E. Jones, J. Der Hovanisian, J. Weller, and R. Ericksen. 2003. Stock status and escapement goals for Chinook salmon stocks in Southeast Alaska. Alaska Department of Fish and Game, Special Publication No. 03-01, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/sp03-01.pdf

McPherson, S. A., D. R. Bernard, M. S. Kelley, P. A. Milligan, and P. Timpany. 1997. Spawning Abundance of Chinook salmon in the Taku River in 1996. Alaska Department of Fish and Game, Fishery Data Series No. 97-14, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds97-14.pdf

Mecum, R. D., and P. M. Suchanek. 1986. Harvest estimates of selected Southeast Alaska sport fisheries. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1985-1986, Project F-10-1, 27 (S-1-1), Juneau. http://www.sf.adfg.state.ak.us/FedAidPDFs/f-10-1(27)S-1-1.pdf

Mecum, R. D., and P. M. Suchanek. 1987. Harvest estimates for selected sport fisheries in southeast Alaska in 1986. Alaska Department of Fish and Game, Fishery Data Series No. 21, Juneau. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds-021.pdf

Miyakoshi, Y., T. Takami, K. Takeuchi, H. Omori, M. Nagata, and J. R. Irvine. 2003. Sampling of masu salmon on the spawning grounds: is carcass sampling effective as a mark-recovery method? Fisheries Management and Ecology. 10:273-275.

Mood, A. M., F. A. Graybill, and D. C. Boes. 1974. Introduction to the theory of statistics, *3rd ed.* McGraw-Hill Book Co., New York.

Mundy, P. R. 1984. Migratory timing of salmon in Alaska with an annotated bibliography on migratory behavior of relevance to fisheries research. Alaska Department of Fish and Game, Informational Leaflet No. 234, Juneau.

Neimark, L. M. 1985. Harvest estimate of selected fisheries throughout Southeast Alaska. Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1984-1985, Project F-9-17, 26 (AFS-41-12[B]), Juneau. http://www.sf.adfg.state.ak.us/FedAidPDFs/f-9-17(26)AFS-41-12(B).pdf

Olsen, M. A. 1992. Abundance, age, sex, and size of Chinook salmon catches and escapements in Southeast Alaska in 1987. Alaska Department of Fish and Game, Technical Data Report 92-07, Juneau.

Pahlke, K. A. 1991. Escapements of Chinook salmon in Southeast Alaska and transboundary rivers in 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-36, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds91-36.pdf

Pahlke, K. A. 1992. Escapements of Chinook salmon in Southeast Alaska and transboundary rivers in 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-32, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds92-32.pdf

Pahlke, K. A., S. A. McPherson, and R. P. Marshall. 1996. Chinook salmon Research on the Unuk River, 1994. Alaska Department of Fish and Game, Fishery Data Series No. 96-14, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds96-14.pdf

Pahlke, K. A., R. D. Mecum, and R. P. Marshall. 1990. Migratory patterns and fishery contributions of Chilkat River Chinook salmon. Alaska Department of Fish and Game, Fishery Data Series No. 90-50, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds90-50.pdf

Savereide, J. W. 2005. Inriver abundance, spawning distribution, and run timing of Copper River Chinook salmon, 2002-2004. Alaska Department of Fish and Game, Fishery Data Series No. 05-50, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds05-50.pdf

Seber, G. A. F. 1982. On the estimation of animal abundance and related parameters, second edition. Griffin and Company, Ltd. London.

REFERENCES CITED (Continued)

Stuby, L. 2005. Inriver abundance of Chinook salmon in the Kuskokwim River, 2002-2004. Alaska Department of Fish and Game, Fishery Data Series No. 05-39, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/Fds05-39.pdf

Stuby, L. 2006. Inriver abundance of Chinook salmon in the Kuskokwim River, 2005. Alaska Department of Fish and Game, Fishery Data Series No. 06-45, Anchorage. http://www.sf.adfg.state.ak.us/FedAidpdfs/fds06-45.pdf

Suchanek, P. M., and A. E. Bingham. 1989. Harvest estimates for selected sport fisheries in southeast Alaska in 1988. Alaska Department of Fish and Game, Fishery Data Series No. 114, Juneau. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds-114.pdf

Suchanek, P. M., and A. E. Bingham. 1990. Harvest estimates for selected enhanced roadside sport fisheries near Juneau, Alaska during 1989. Alaska Department of Fish and Game, Fishery Data Series No. 90-38, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds90-38.pdf

Suchanek, P. M., and A. E. Bingham. 1991a. Harvest estimates for selected marine boat sport fisheries in Southeast Alaska during 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-48, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds91-48.pdf

Suchanek, P. M., and A. E. Bingham. 1991b. Harvest estimates for selected roadside sport fisheries near Juneau, Alaska During 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-29, Anchorage. http://www.sf.adfg.state.ak.us/FedAidPDFs/fds91-29.pdf

Zhou, S. 2002. Size-dependent recovery of Chinook salmon in carcass surveys. Transactions of the American Fisheries Society 131:1194-1202.

APPENDIX A

Appendix A1.–Tagging dates of 129 radio-tagged Chinook salmon and first upstream passage dates at tracking stations by fate and location, Chilkat River, 2005. Shading indicates fish subsequently passed downstream at tracking station.

	Spawning area or furthest upstream location					Date time of upstream passage at tracking stations (River and RKM)				
Fate	River	RKM or trib.	Fish Number	Tagging gear	Date time tagged	Haines Hwy MP 9 (Chilkat 14)	Klehini River (Klehini 3)	Wells Bridge (Chilkat 38)	Jacquot's Landing (Chilkat 52)	Kelsall Bridge (Kelsall 4)
Fishery	Chilkat	34	38	FW1	28-Jun 09:10	9-Jul 00:32				
Fishery	Chilkat	34	55	DGN	2-Jul 08:15	11-Jul 02:56				
Fishery	Chilkat	34	59	DGN	3-Jul 08:14	3-Jul 16:45				
Fishery	Chilkat	34	73	FW 2	6-Jul 10:00	9-Jul 00:45				
Fishery	Chilkat	34	101	DGN	12-Jul 07:14	15-Jul 06:36				
Fishery	Chilkat	33	104	DGN	12-Jul 13:30	15-Jul 08:13				
Fishery	Chilkat	49	53	FW2	1-Jul 10:15	1-Jul 16:16		9-Jul 14:39		
Non-spawner	Chilkat	8	48	DGN	30-Jun 07:00					
Non-spawner	Chilkat	13	119	FW1	18-Jul 09:30					
Non-spawner	Chilkat	13	124	DGN	22-Jul 07:15	31-Jul 06:01				
Non-spawner	Chilkat	23	16	DGN	22-Jun 13:20	26-Jun 03:21				
Non-spawner	Chilkat	28	36	DGN	28-Jun 07:30	29-Jun 01:17				
Non-spawner	Chilkat	33	69	DGN	5-Jul 12:15	8-Jul 08:41		14-Jul 21:36		
Non-spawner	Chilkat	52	96	DGN	10-Jul 13:20	14-Jul 00:25		20-Jul 09:24	4-Aug 15:25	
Spawned	Kelsall	1-4	8	DGN	21-Jun 08:50	26-Jun 18:48		1-Jul 17:20	9-Jul 00:21	
Spawned	Kelsall	1-4	12	FW1	21-Jun 15:15	25-Jun 19:33		19-Jul 01:13	20-Jul 13:32	23-Jul 17:53
Spawned	Kelsall	1-4	20	DGN	26-Jun 07:10	12-Jul 17:30		21-Jul 14:45	24-Jul 15:40	29-Jul 18:54
Spawned	Kelsall	1-4	27	DGN	26-Jun 12:00	26-Jun 20:23		17-Jul 08:14	26-Jul 15:50	14-Aug 10:26
Spawned	Kelsall	1-4	44	DGN	28-Jun 13:00	28-Jun 20:24		8-Jul 14:58	15-Jul 20:15	17-Jul 01:02
Spawned	Kelsall	1-4	49	DGN	30-Jun 09:45	6-Jul 08:07	23-Jul 05:05	27-Jul 17:08	28-Jul 16:39	5-Aug 15:55
Spawned	Kelsall	1-4	71	DGN	6-Jul 08:40	9-Jul 20:43		12-Jul 07:52	15-Jul 22:02	17-Jul 01:55
Spawned	Kelsall	1-4	107	DGN	13-Jul 12:00	13-Jul 17:11		23-Jul 20:44	28-Jul 18:55	2-Aug 13:06
Spawned	Kelsall	1-4	109	DGN	14-Jul 08:40	15-Jul 11:39		23-Jul 19:36	30-Jul 12:24	7-Aug 18:04
Spawned	Kelsall	1-4	115	DGN	17-Jul 07:20	17-Jul 15:01	26-Jul 15:11	2-Aug 20:37	3-Aug 12:28	

-continued-

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Fate	Spawning area or furthest upstream location: River	Spawning area or furthest upstream location: RKM or trib.	Fish Number	Tagging gear	Date time tagged	Date time of upstream passage at tracking stations (station river and RKM): Haines Hwy MP 9 (Chilkat 14)	Klehini River (Klehini 3)	Wells Bridge (Chilkat 38)	Jacquot's Landing (Chilkat 52)	Kelsall Bridge (Kelsall 4)
Spawned	Kelsall	1-4	117	DGN	17-Jul 12:20	18-Jul 01:45		25-Jul 14:34	3-Aug 10:23	6-Aug 20:02
Spawned	Kelsall	1-4	120	FW2	18-Jul 10:05	18-Jul 18:07		6-Aug 21:54	8-Aug 15:31	15-Aug 23:20
Spawned	Kelsall	1-4	121	DGN	19-Jul 08:48	20-Jul 02:18		29-Jul 12:25	1-Aug 08:14	6-Aug 12:46
Spawned	Kelsall	1-4	123	DGN	20-Jul 07:00	21-Jul 04:11		27-Jul 21:24	5-Aug 05:24	
Spawned	Kelsall	5-10	2	FW2	14-Jun 09:20	14-Jun 19:10		27-Jun 12:39	8-Jul 10:50	10-Jul 15:41
Spawned	Kelsall	5-10	3	DGN	18-Jun 09:15	19-Jun 11:15		27-Jun 05:52	17-Jul 23:54	18-Jul 18:41
Spawned	Kelsall	5-10	22	FW2	26-Jun 09:20	27-Jun 19:38		10-Jul 18:15	14-Jul 18:33	21-Jul 12:22
Spawned	Kelsall	5-10	34	DGN	27-Jun 12:50	27-Jun 23:16		9-Jul 14:50	20-Jul 10:41	31-Jul 17:44
Spawned	Kelsall	5-10	47	DGN	29-Jun 11:10	9-Jul 01:33		13-Jul 21:54	26-Jul 17:54	15-Aug 12:04
Spawned	Kelsall	5-10	50	DGN	1-Jul 07:00	1-Jul 12:11		22-Jul 16:05	28-Jul 01:31	2-Aug 08:42
Spawned	Kelsall	5-10	54	DGN	2-Jul 06:50	10-Jul 00:36	22-Jul 01:45	26-Jul 08:11	27-Jul 03:20	28-Jul 18:56
Spawned	Kelsall	5-10	58	DGN	2-Jul 13:50	3-Jul 06:03		19-Jul 10:32	22-Jul 14:53	3-Aug 14:55
Spawned	Kelsall	5-10	66	DGN	4-Jul 10:15	14-Jul 16:41		19-Jul 21:54	22-Jul 15:23	24-Jul 23:00
Spawned	Kelsall	5-10	81	FW1	8-Jul 09:00	8-Jul 15:12		19-Jul 16:50	26-Jul 12:44	27-Jul 16:31
Spawned	Kelsall	5-10	89	DGN	10-Jul 08:10	18-Jul 14:01		21-Jul 15:20	27-Jul 00:26	28-Jul 14:25
Spawned	Kelsall	5-10	91	DGN	10-Jul 09:30	11-Jul 12:54		24-Jul 21:02	28-Jul 10:42	6-Aug 15:14
Spawned	Kelsall	5-10	103	DGN	12-Jul 12:50	13-Jul 05:59		21-Jul 06:20	1-Aug 09:57	4-Aug 10:41
Spawned	Kelsall	5-10	106	DGN	13-Jul 08:00	24-Jul 02:10		26-Jul 17:17	1-Aug 09:02	6-Aug 17:09
Spawned	Kelsall	5-10	108	FW1	14-Jul 08:30	14-Jul 17:41		24-Jul 14:20	26-Jul 18:31	28-Jul 13:34
Spawned	Kelsall	5-10	122	FW1	19-Jul 09:00	21-Jul 10:35		30-Jul 13:25	3-Aug 16:01	11-Aug 15:51
Spawned	Kelsall	5-10	125	DGN	22-Jul 10:00	22-Jul 16:56		25-Jul 12:51	29-Jul 15:12	30-Jul 17:00
Spawned	Kelsall	5-10	127	FW1	26-Jul 09:40	26-Jul 17:27		2-Aug 11:43	10-Aug 17:20	11-Aug 20:40
Spawned	Kelsall	11-17	5	DGN	18-Jun 10:26	19-Jun 03:25		23-Jun 22:50	3-Jul 22:30	5-Jul 06:53
Spawned	Kelsall	11-17	9	FW2	21-Jun 09:15	22-Jun 03:05		28-Jun 00:06	4-Jul 15:11	5-Jul 13:32
Spawned	Kelsall	11-17	13	DGN	22-Jun 08:55	24-Jun 14:41		12-Jul 13:36	22-Jul 06:21	25-Jul 06:32
Spawned	Kelsall	11-17	18	DGN	25-Jun 12:30	27-Jun 15:34		13-Jul 10:44	21-Jul 22:51	25-Jul 06:04

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Fate	Spawning area or furthest upstream location: River	RKM or trib.	Fish Number	Tagging gear	Date time tagged	Date time of upstream passage at tracking stations (station river and RKM): Haines Hwy MP 9 (Chilkat 14)	Klehini River (Klehini 3)	Wells Bridge (Chilkat 38)	Jacquot's Landing (Chilkat 52)	Kelsall Bridge (Kelsall 4)
Spawned	Kelsall	11-17	19	DGN	26-Jun 06:55	27-Jun 00:49		4-Jul 11:36	10-Jul 04:21	14-Jul 19:51
Spawned	Kelsall	11-17	23	DGN	26-Jun 09:55	26-Jun 21:34		2-Jul 01:46	8-Jul 12:49	9-Jul 08:28
Spawned	Kelsall	11-17	24	FW2	26-Jun 10:10	11-Jul 04:26		13-Jul 06:11	14-Jul 17:01	16-Jul 05:53
Spawned	Kelsall	11-17	35	DGN	27-Jun 14:55	28-Jun 00:21		14-Jul 23:08	17-Jul 07:01	25-Jul 19:40
Spawned	Kelsall	11-17	37	DGN	28-Jun 08:00	6-Jul 07:07		9-Jul 09:47	12-Jul 05:05	17-Jul 07:10
Spawned	Kelsall	11-17	40	DGN	28-Jun 09:30	9-Jul 09:45		12-Jul 06:39	16-Jul 16:52	22-Jul 16:01
Spawned	Kelsall	11-17	41	FW2	28-Jun 09:45	7-Jul 06:09		13-Jul 01:04	19-Jul 23:34	23-Jul 07:14
Spawned	Kelsall	11-17	45	DGN	28-Jun 13:50	29-Jun 01:43		6-Jul 14:10	20-Jul 14:33	22-Jul 07:45
Spawned	Kelsall	11-17	62	DGN	3-Jul 09:50	4-Jul 03:04		8-Jul 15:49	17-Jul 07:51	18-Jul 09:49
Spawned	Kelsall	11-17	74	DGN	6-Jul 10:10	6-Jul 21:03		20-Jul 16:50	26-Jul 12:16	27-Jul 16:03
Spawned	Kelsall	11-17	75	DGN	7-Jul 07:00	16-Jul 05:14		20-Jul 07:05	22-Jul 21:38	23-Jul 18:12
Spawned	Kelsall	11-17	84	DGN	8-Jul 14:00	9-Jul 10:22		16-Jul 17:23	22-Jul 22:21	25-Jul 22:01
Spawned	Kelsall	11-17	87	DGN	10-Jul 07:05	11-Jul 06:25		20-Jul 15:03	23-Jul 20:13	25-Jul 14:12
Spawned	Kelsall	11-17	90	FW1	10-Jul 09:20	10-Jul 11:37		23-Jul 16:41	28-Jul 14:11	31-Jul 19:33
Spawned	Kelsall	11-17	94	DGN	10-Jul 10:50	11-Jul 13:48		18-Jul 15:28	26-Jul 12:08	27-Jul 09:43
Spawned	Kelsall	11-17	105	FW1	12-Jul 15:15	16-Jul 07:32		22-Jul 06:30	25-Jul 12:54	28-Jul 17:36
Spawned	Kelsall	11-17	110	FW1	14-Jul 08:40	16-Jul 05:16		25-Jul 22:36	30-Jul 01:52	2-Aug 09:01
Spawned	Kelsall	11-17	111	DGN	14-Jul 10:25	15-Jul 03:03		21-Jul 18:46	7-Aug 07:08	9-Aug 00:33
Spawned	Kelsall	11-17	126	FW1	22-Jul 11:00	22-Jul 13:22		25-Jul 22:44	2-Aug 15:46	4-Aug 20:36
Spawned	Kelsall	11-17	128	FW1	30-Jul 09:00	30-Jul 10:58		1-Aug 14:57	4-Aug 00:31	6-Aug 16:38
Spawned	Kelsall	18+	77	DGN	7-Jul 09:45	8-Jul 23:02		21-Jul 22:47	25-Jul 17:51	27-Jul 17:02
Spawned	Kelsall	Stonehouse Cr	15	DGN	22-Jun 10:40	23-Jun 08:57		4-Jul 16:30	12-Jul 13:42	13-Jul 18:41
Spawned	Kelsall	Stonehouse Cr	21	DGN	26-Jun 07:35	30-Jun 00:53		12-Jul 23:22	19-Jul 09:42	20-Jul 13:02
Spawned	Kelsall	Stonehouse Cr	30	FW2	27-Jun 10:00	6-Jul 00:50		13-Jul 02:09	23-Jul 11:21	25-Jul 09:44
Spawned	Kelsall	Stonehouse Cr	51	FW1	1-Jul 09:15	4-Jul 16:33		9-Jul 23:05	16-Jul 10:04	17-Jul 10:52
Spawned	Kelsall	Stonehouse Cr	99	FW2	11-Jul 10:15	11-Jul 22:13		14-Jul 13:30	16-Jul 15:02	18-Jul 17:22

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Fate	Spawning area or furthest upstream location: River	RKM or trib.	Fish Number	Tagging gear	Date time tagged	Date time of upstream passage at tracking stations (station river and RKM): Haines Hwy MP 9 (Chilkat 14)	Klehini River (Klehini 3)	Wells Bridge (Chilkat 38)	Jacquot's Landing (Chilkat 52)	Kelsall Bridge (Kelsall 4)
Spawned	Klehini	37-Mile Cr	79	DGN	7-Jul-06 13:17	12-Jul-06 1:52	24-Jul-06 22:46	16-Jul-06 19:10		
Spawned	Klehini	Big Boulder	39	DGN	28-Jun-06 9:30	3-Jul-06 21:43	22-Jul-06 16:11			
Spawned	Klehini	Big Boulder	56	DGN	2-Jul-06 8:35	5-Jul-06 6:25	14-Jul-06 23:44	9-Jul-06 18:06		
Spawned	Klehini	Big Boulder	64	DGN	4-Jul-06 7:20	7-Jul-06 2:06	30-Jul-06 16:08			
Spawned	Klehini	Big Boulder	67	FW 2	4-Jul-06 14:00	5-Jul-06 5:27	21-Jul-06 22:47			
Spawned	Klehini	Big Boulder	76	DGN	7-Jul-06 8:00	8-Jul-06 11:44	21-Jul-06 23:02			
Spawned	Klehini	Big Boulder	88	DGN	10-Jul-06 7:25	17-Jul-06 13:32	21-Jul-06 9:41			
Spawned	Klehini	Big Boulder	92	FW2	10-Jul-06 10:20	10-Jul-06 17:10	27-Jul-06 1:26			
Spawned	Klehini	Big Boulder	97	DGN	11-Jul-06 8:35	11-Jul-06 15:32	23-Jul-06 21:15			
Spawned	Klehini	Big Boulder	102	DGN	12-Jul-06 8:20	16-Jul-06 2:18	24-Jul-06 15:51			
Spawned	Klehini	Big Boulder	113	DGN	16-Jul-06 8:30	19-Jul-06 7:52	5-Aug-06 13:56	22-Jul-06 16:35		
Spawned	Klehini	Big Boulder	116	FW1	17-Jul-06 8:55	17-Jul-06 13:42	25-Jul-06 19:59			
Spawned	Klehini	Little Boulder	70	DGN	5-Jul-06 13:50	5-Jul-06 16:36	2-Aug-06 17:33	15-Jul-06 12:28		
Spawned	Klehini	Other Klehini	10	DGN	21-Jun-06 9:25	22-Jun-06 12:51	5-Jul-06 19:02			
Spawned	Klehini	Other Klehini	25	FW2	26-Jun-06 10:15	27-Jun-06 20:24	12-Jul-06 21:42			
Spawned	Klehini	Other Klehini	129	FW2	30-Jul-06 10:30	30-Jul-06 20:28	19-Aug-06 22:19			
Spawned	Tahini	1-5	1	FW1	13-Jun 09:15	20-Jun 06:51		24-Jun 18:07	5-Jul 19:57	8-Jul 03:12
Spawned	Tahini	1-5	6	FW1	18-Jun 15:30	11-Jul 22:37		15-Jul 01:07	17-Jul 13:33	
Spawned	Tahini	1-5	7	FW1	20-Jun 15:00	1-Jul 03:41		11-Jul 12:42	13-Jul 05:33	
Spawned	Tahini	1-5	11	DGN	21-Jun 10:40	22-Jun 05:15		25-Jun 20:45	2-Jul 11:56	
Spawned	Tahini	1-5	17	FW1	25-Jun 09:00	26-Jun 00:31		2-Jul 09:10	6-Jul 01:57	
Spawned	Tahini	1-5	28	DGN	26-Jun 12:45	26-Jun 17:06		29-Jun 11:14	6-Jul 12:01	
Spawned	Tahini	1-5	31	DGN	27-Jun 10:20	28-Jun 21:45		10-Jul 01:02	14-Jul 21:02	
Spawned	Tahini	1-5	32	DGN	27-Jun 10:55	5-Jul 19:23		7-Jul 20:31	14-Jul 16:11	
Spawned	Tahini	1-5	33	DGN	27-Jun 11:25	29-Jun 05:57		15-Jul 14:27	3-Aug 11:25	
Spawned	Tahini	1-5	42	DGN	28-Jun 11:30	12-Jul 02:58		15-Jul 15:06	23-Jul 15:27	
Spawned	Tahini	1-5	43	DGN	28-Jun 12:00	2-Jul 09:32		5-Jul 18:12	15-Jul 02:43	

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Fate	Spawning area or furthest upstream location		Fish number	Tagging gear	Date time tagged	Date time of upstream passage at tracking stations (station river and RKM)				
	River	RKM or trib.				Haines Hwy MP 9 (Chilkat 14)	Klehini River (Klehini 3)	Wells Bridge (Chilkat 38)	Jacquot's Landing (Chilkat 52)	Kelsall Bridge (Kelsall 4)
Spawned	Tahini	1-5	46	FW2	28-Jun 15:45	5-Jul 21:16		8-Jul 18:03	15-Jul 13:32	
Spawned	Tahini	1-5	52	DGN	1-Jul 10:00	12-Jul 00:04		13-Jul 22:16	18-Jul 11:22	
Spawned	Tahini	1-5	60	FW1	3-Jul 08:30	12-Jul 00:04		20-Jul 05:23	26-Jul 20:11	
Spawned	Tahini	1-5	61	FW1	3-Jul 08:45	3-Jul 12:31		9-Jul 17:50	17-Jul 09:22	
Spawned	Tahini	1-5	68	DGN	5-Jul 08:40	5-Jul 23:52		9-Jul 15:10	23-Jul 21:11	
Spawned	Tahini	1-5	72	FW1	6-Jul 09:15	6-Jul 15:59		13-Jul 14:42	23-Jul 14:21	
Spawned	Tahini	1-5	80	DGN	8-Jul 07:15	8-Jul 22:42		11-Jul 22:26	29-Jul 01:43	
Spawned	Tahini	1-5	83	DGN	8-Jul 12:40	11-Jul 03:38		19-Jul 17:13	30-Jul 14:10	31-Jul 15:44
Spawned	Tahini	1-5	85	DGN	9-Jul 07:10	10-Jul 19:01		21-Jul 11:16	31-Jul 15:24	
Spawned	Tahini	1-5	95	FW2	10-Jul 10:55	12-Jul 14:07		17-Jul 08:15	24-Jul 16:42	31-Jul 14:14
Spawned	Tahini	1-5	112	FW1	15-Jul 09:45	16-Jul 17:02		21-Jul 21:05	29-Jul 21:19	
Spawned	Tahini	1-5	114	FW1	16-Jul 09:00	16-Jul 12:00		21-Jul 11:57	25-Jul 06:31	
Spawned	Tahini	1-5	118	DGN	17-Jul 14:30	18-Jul 02:41		21-Jul 17:32	25-Jul 17:11	
Spawned	Tahini	6+	4	FW2	18-Jun 09:35	18-Jun 16:28		5-Jul 17:54	17-Jul 15:43	
Spawned	Tahini	6+	14	DGN	22-Jun 10:40	22-Jun 16:01		26-Jun 07:02	7-Jul 11:30	
Spawned	Tahini	6+	26	FW2	26-Jun 10:20	29-Jun 07:30		3-Jul 13:50	9-Jul 16:30	
Spawned	Tahini	6+	29	DGN	26-Jun 12:45	1-Jul 02:44		7-Jul 15:12	16-Jul 04:10	
Spawned	Tahini	6+	57	DGN	2-Jul 12:40	8-Jul 21:33		12-Jul 10:54	21-Jul 17:39	
Spawned	Tahini	6+	63	DGN	3-Jul 14:26	10-Jul 03:51		14-Jul 07:53	25-Jul 15:24	
Spawned	Tahini	6+	65	FW1	4-Jul 08:40	18-Jul 05:46		21-Jul 00:54	7-Aug 04:58	
Spawned	Tahini	6+	78	DGN	7-Jul 11:30	7-Jul 20:35		9-Jul 07:49	16-Jul 13:43	
Spawned	Tahini	6+	82	DGN	8-Jul 09:30	8-Jul 20:22		16-Jul 17:22	25-Jul 16:11	
Spawned	Tahini	6+	86	DGN	9-Jul 08:35	15-Jul 00:42		19-Jul 00:27	24-Jul 18:33	
Spawned	Tahini	6+	93	FW2	10-Jul 10:40	10-Jul 17:15		17-Jul 18:21	23-Jul 11:34	
Spawned	Tahini	6+	98	FW2	11-Jul 09:45	11-Jul 17:20		21-Jul 23:28	27-Jul 14:00	
Spawned	Tahini	6+	100	DGN	11-Jul 11:30	17-Jul 06:37		20-Jul 19:49	26-Jul 20:07	

Appendix A2.–Locations after tagging of radio-tagged Chinook salmon that did not reach spawning areas by fate, Chilkat River, 2005.

Fish Number	Date	River	Km	Furthest upstream	Location comment	Observation method/comment
Presumed harvested in sport fishery						
53	01-Jul-05	Chilkat	14		Upstream	9-Mile station
53	07-Jul-05	Chilkat	27		Left channel	Boat
53	09-Jul-05	Chilkat	38		Upstream	Wells Bridge station
53	11-Jul-05	Chilkat	46		Right channel	Aerial
53	12-Jul-05	Chilkat	50	X	Right channel	Boat
53	16-Jul-05	Chilkat	<52		Mort signal received from downstream	Jacquot's Landing station
53	19-Jul-05	Chilkat	48		Right channel. Tag recovered in bushes near road.	Boat
Presumed harvested in subsistence fishery						
59	03-Jul-05	Chilkat	14		Upstream	9-Mile station
59	07-Jul-05	Chilkat	26		Left channel	Boat
59	11-Jul-05	Chilkat	33			Aerial
59	15-Jul-05	Chilkat	35	X	Near Klukwan	Boat
59	21-Jul-05	Chilkat	35		Near Klukwan	Boat
59	25-Jul-05	Chilkat	35		Near Klukwan	Aerial
59	29-Jul-05	Chilkat	35		Tag in 4 ft water.	Boat. Jiggled tag but couldn't recover.
59	01-Aug-05	Chilkat	35		Near Klukwan	Aerial
59	04-Aug-05	Chilkat	35		Near Klukwan	Boat
59	08-Aug-05	Chilkat	35		Near Klukwan	Aerial
59	22-Aug-05	Chilkat	31			Aerial
59	29-Aug-05	Chilkat	32			Aerial
101	15-Jul-05	Chilkat	14		Upstream	9-Mile station
101	21-Jul-05	Chilkat	26		Left channel	Boat
101	25-Jul-05	Chilkat	33			Aerial
101	29-Jul-05	Chilkat	34	X	Tag moving	Boat
101	01-Aug-05	Chilkat	34			Aerial
101	04-Aug-05	Chilkat	34		Near Klukwan	Boat
101	08-Aug-05	Chilkat	34			Aerial
101	22-Aug-05	Chilkat	34		Mort signal	Aerial
101	29-Aug-05	Chilkat	34			Aerial

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Fish Number	Date	River	Km	Furthest upstream	Location comment	Observation method/comment
104	15-Jul-05	Chilkat	14		Upstream	9-Mile station
104	21-Jul-05	Chilkat	32	X	MP 21 set net site	Boat
104	25-Jul-05	Chilkat	32		Mort signal	Aerial
104	01-Aug-05	Chilkat	32		Mort signal	Aerial
104	04-Aug-05	Chilkat	32			Boat
104	08-Aug-05	Chilkat	32		Mort signal	Aerial
104	22-Aug-05	Chilkat	32		Mort signal	Aerial
104	29-Aug-05	Chilkat	32		Mort signal	Aerial
104	25-Jul-05	Chilkat	32		Mort signal	Aerial
Reported harvested in subsistence fishery						
38	09-Jul-05	Chilkat	14		Upstream	9-Mile station
38	11-Jul-05	Chilkat	29			Aerial
38	15-Jul-05	Chilkat	31	X	Left channel	Boat
38	18-Jul-05	Chilkat	14		Tag probably in vehicle	9-Mile station
38	01-Aug-05	--	--		ADF&G office	Tag returned
55	11-Jul-05	Chilkat	14		Upstream	9-Mile station
55	15-Jul-05	Chilkat	34	X		Boat
55	18-Jul-05	Chilkat	14		Tag probably in vehicle	9-Mile station
55	25-Jul-05	Chilkat	34			Aerial
55	01-Aug-05	--	--		ADF&G office	Tag returned
73	09-Jul-05	Chilkat	14		Upstream	9-Mile station
73	11-Jul-05	Chilkat	28	X		Aerial
73	14-Jul-05	Chilkat	27		Left channel	Boat
73	01-Aug-05	--	--		ADF&G office	Tag returned
Did not reach spawning area due to tag regurgitation, handling effects, or predation						
16	26-Jun-05	Chilkat	14		Upstream	9-Mile station
16	28-Jun-05	Chilkat	17		Right channel	Boat
16	01-Jul-05	Chilkat	18		Right channel	Boat
16	07-Jul-05	Chilkat	23		Left channel	Boat
16	11-Jul-05	Chilkat	24			Aerial
16	14-Jul-05	Chilkat	26	X	Left channel	Boat
16	21-Jul-05	Chilkat	23		Left channel, mort	Boat. Recovered tag in fish. Unspawned, stomach intact.

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Fish Number	Date	River	Km	Furthest upstream	Location comment	Observation method/comment
36	29-Jun-05	Chilkat	14		Upstream	9-Mile station
36	01-Jul-05	Chilkat	18		Left channel	Boat
36	07-Jul-05	Chilkat	18		Left channel	Boat
36	11-Jul-05	Chilkat	18			Aerial
36	14-Jul-05	Chilkat	18		Left channel	Boat
36	25-Jul-05	Chilkat	27	X		Aerial
36	29-Jul-05	Chilkat	27		Left channel	Boat
36	01-Aug-05	Chilkat	27		Mort signal	Aerial
36	08-Aug-05	Chilkat	27			Aerial
36	22-Aug-05	Chilkat	26		Left channel. Mort	Aerial
36	29-Aug-05	Chilkat	27		Left channel	Aerial
48	01-Jul-05	Chilkat	8	X		Boat
48	08-Jul-05	Chilkat	5			Foot
48	11-Jul-05	Chilkat	1			Aerial
48	20-Jul-05	Chilkat	0			Road
48	25-Jul-05	Chilkat	1		Mort signal	Aerial
48	01-Aug-05	Chilkat	0		Mort signal	Aerial
69	08-Jul-05	Chilkat	14		Upstream	9-Mile station
69	11-Jul-05	Chilkat	20			Aerial
69	14-Jul-05	Chilkat	38		Upstream	Wells Bridge station
69	15-Jul-05	Chilkat	43	X	Right channel	Boat
69	20-Jul-05	Chilkat	38		Downstream	Wells Bridge station
69	20-Jul-05	Chilkat	38		Upstream	Wells Bridge station
69	24-Jul-05	Chilkat	38		Downstream	Wells Bridge station
69	25-Jul-05	Chilkat	33			Aerial
69	29-Jul-05	Chilkat	31		Set net site MP 21	Boat. Recovered mort. Reddish full gonads, 1-in tear in stomach.

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Fish Number	Date	River	Km	Furthest upstream	Location comment	Observation method/comment
96	11-Jul-05	Chilkat	12			Aerial
96	14-Jul-05	Chilkat	14		Upstream	9-Mile station
96	20-Jul-05	Chilkat	38		Upstream	Wells Bridge station
96	25-Jul-05	Chilkat	47			Aerial
96	28-Jul-05	Chilkat	48		Right channel	Boat
96	01-Aug-05	Chilkat	48		Right channel	Aerial
96	04-Aug-05	Chilkat	52			Boat
96	04-Aug-05	Chilkat	52	X	Upstream for 2.5 hours, stayed in reception range.	Jacquot's Landing station
96	04-Aug-05	Chilkat	52		Downstream	Jacquot's Landing station
96	06-Aug-05	Chilkat	<52		Mort signal received from downstream	Jacquot's Landing station
96	08-Aug-05	Chilkat	51		Mort signal	Aerial
96	22-Aug-05	Chilkat	50			Aerial
96	24-Aug-05	Chilkat	51		Right channel, Mort signal	Foot
96	29-Aug-05	Chilkat	50		Mort signal	Aerial
119	20-Jul-05	Chilkat	<14		Mort signal received from downstream	9-Mile station
119	25-Jul-05	Chilkat	13	X		Aerial
119	01-Aug-05	Chilkat	13			Aerial
119	08-Aug-05	Chilkat	13			Aerial
119	22-Aug-05	Chilkat	13			Aerial
119	29-Aug-05	Chilkat	13			Aerial
124	25-Jul-05	Chilkat	7			Aerial
124	31-Jul-05	Chilkat	14		Upstream	9-Mile station
124	01-Aug-05	Chilkat	15	X		Aerial
124	03-Aug-05	Chilkat	14		Downstream	9-Mile station
124	05-Aug-05	Chilkat	<14		Mort signal received from downstream	9-Mile station
124	08-Aug-05	Chilkat	12			Aerial
124	15-Aug-05	Chilkat	8		Location not precise	Road
124	22-Aug-05	Chilkat	13			Aerial
124	23-Aug-05	Chilkat	13		Mort signal	Boat. Tag recovered on gravel shore.

Appendix A3.–River distances (km) upstream from the Chilkat River mouth and tributary confluences.

Location	Km from Chilkat River mouth	Km from tributary confluence (RKM)	Tracking station latitude and longitude (WGS84 map datum)	
Chilkat River mouth	0			
9-Mile tracking station	14		59.274012	-135.65640
Takhin River	15			
Klukwan village	34			
Klehini River	36			
Klehini River tracking station	39	3	59.40686	-135.96735
Little Boulder Creek	49	13		
Big Boulder Creek	53	17		
37-Mile Creek	58	22		
Wells Bridge tracking station	38		59.41548	-135.93114
Jacquot's Landing tracking station	52		59.52906	-136.03536
Kelsall River	53			
Kelsall Bridge tracking station	57	4	59.53957	-136.10231
Upper Kelsall River	63	10		
Stonehouse Creek	74	21		
Tahini River	64			

APPENDIX B

Appendix B1.–Weekly sampling statistics and estimated effort, catch, and harvest of Chinook salmon at the Letnikof Dock, May 9–June 26, 2005.

	May 09–May 15	May 16–May 22	May 23–June 05		June 06–June 12	June 13–June 19	June 20–June 26	Total
			Non-derby	Derby				
Boats counted	19	72	67	89	65	36	12	360
Angler-hs. sampled	109	413	373	1,227	551	306	59	3,038
Salmon-hs. sampled	87	412	370	1,227	536	292	59	2,983
Chinook sampled	0	10	7	57	15	2	1	92
Sampled for ad-clips	0	10	7	70	15	2	1	105
Ad-clips	0	0	0	4	2	0	0	6
Angler-hours								
Estimate	168	625	1,141	3,066	946	764	157	6,867
Variance	3,966	5,477	8,851	368,514	32,662	61,869	2,852	484,191
Salmon-hours								
Estimate	113	622	1,132	3,066	931	732	156	6,752
Variance	418	5,048	9,737	368,514	32,662	52,112	2,833	471,324
Large Chinook catch								
Estimate	0	18	18	78	26	5	4	149
Variance	0	79	73	308	69	3	9	541
Large Chinook harvest								
Estimate	0	18	18	78	25	5	4	148
Variance	0	79	73	308	69	3	9	541
Wild mature Chinook harvest (excluding hatchery and immature fish)								
Estimate	0	13	12	74	22	5	4	130
Variance	0	35	26	379	50	3	9	502
Small Chinook catch								
Estimate	2	5	73	93	15	0	0	188
Variance	0	0	593	139	13	0	0	745
Small Chinook harvest								
Estimate	0	0	3	0	0	0	0	3
Variance	0	0	7	0	0	0	0	7

Appendix B2.–Biweekly sampling statistics and estimated effort, catch, and harvest of Chinook salmon at the Chilkat State Park boat launch, May 16–June 26, 2005.

		May 23–June 05				
	May 16–May 22	Non-derby	Derby	June 06-June 19	June 20–June 26	Total
Boats counted	0	7	4	7	0	18
Angler-hs. sampled	0	42	18	95	0	155
Salmon-hs. sampled	0	41	18	95	0	154
Chinook sampled	0	1	0	0	0	1
Sampled for ad-clips	0	1	0	0	0	1
Ad-clips	0	0	0	0	0	0
Angler-hours						
Estimate	0	187	90	662	0	939
Variance	0	8,052	320	95,141	0	103,513
Salmon-hours						
Estimate	0	185	90	662	0	937
Variance	0	8,261	320	95,141	0	103,722
Large Chinook catch						
Estimate	0	5	0	0	0	5
Variance	0	16	0	0	0	16
Large Chinook harvest						
Estimate	0	5	0	0	0	5
Variance	0	16	0	0	0	16
Wild mature Chinook harvest (excluding hatchery and immature fish)						
Estimate	0	5	0	0	0	5
Variance	0	16	0	0	0	16
Small Chinook catch						
Estimate	0	0	0	0	0	0
Variance	0	0	0	0	0	0
Small Chinook harvest						
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 Chinook salmon at the Small Boat Harbor, May 9–June 26, 2005.

		May 23–June 05				
	May 09–May 22	Non-derby	Derby	June 06–June 19	June 20–June 26	Total
Boats counted	13	18	22	33	10	96
Angler-hs. sampled	63	107	270	278	84	802
Salmon-hs. sampled	42	106	261	276	80	765
Chinook sampled	0	5	19	12	9	45
Sampled for ad-clips	0	5	19	12	9	45
Ad-clips	0	0	2	5	2	9
Angler-hours						
Estimate	434	516	1,351	1,946	588	4,835
Variance	9,345	1,907	657,031	268,968	10,752	948,003
Salmon-hours						
Estimate	287	513	1,306	1,932	560	4,598
Variance	21,441	1,922	593,401	269,472	16,800	903,036
Large Chinook catch						
Estimate	0	18	39	35	14	106
Variance	0	158	20	42	168	388
Large Chinook harvest						
Estimate	0	18	39	28	14	99
Variance	0	158	20	84	168	430
Wild mature Chinook harvest (excluding hatchery and immature fish)						
Estimate	0	14	9	7	0	30
Variance	0	79	20	42	0	141
Small Chinook catch						
Estimate	0	99	300	336	35	770
Variance	0	3,938	58,320	5,712	1,050	69,020
Small Chinook harvest						
Estimate	0	5	0	84	21	110
Variance	0	16	0	2,100	378	2,494

Appendix B4.–Estimated age composition and mean length-at-age (snout to fork of tail in mm) of Chinook salmon incidentally harvested in the Chilkat Inlet subsistence gillnet fishery, June 18–July 10, 2005.

		Brood year and age class				
		2001	2000	1999		
		1.2	1.3	1.4	Total aged	Total sampled[a]
Males	Sample size	7	4	3	14	17
	Percent	50.0	28.6	21.4		70.8
	SE	13.9	12.5	11.4		9.5
	Mean length	657	850	1,035		
	SE	30.2	35.0	88.4		
Females	Sample size	0	2	3	5	7
	Percent		40.0	60.0		29.2
	SE		24.5	24.5		9.5
	Mean length		813	980		
	SE		109.6	25.5		
Combined[b]	Sample size	8	7	6	21	26
	Percent	38.1	33.3	28.6		
	SE	10.9	10.5	10.1		
	Mean length	660	1,008	864		
	SE	30.0	35.8	94.3		

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

[b] Includes fish not sampled for sex information.

APPENDIX C

Appendix C1.–Computer data files used in the analysis of this report.

FILE NAME	DESCRIPTION
05FallChinookCWT.XLS	Excel workbook containing raw trapping and sampling data from fall Chinook CWT project in 2005.
05FallChinookCWT.PRN	Space delimited text file with raw trapping data from fall Chinook CWT project in 2005.
05FallChinookCWT.TXT	Text file describing heading and column layout for 05FallChinookCWT.PRN
BY04ChinookLength.PRN	Space delimited text file with length data from all 2004 brood year juvenile Chinook sampled in 2005 and 2006.
BY04ChinookLength.TXT	Text file describing heading and column layout for BY04ChinookLength.PRN
F2008100M012005.DTA	Mark-sense ASCII file containing angler interview data from the Haines marine sport fishery in 2005.
F2008201AG012005.DTA	Mark-sense ASCII file containing Chinook age & length data from the Haines marine sport fishery in 2005.
F2008202AG012005.DTA	Mark-sense ASCII file containing Chinook age & length data from the Chilkat Inlet subsistence fishery in 2005.
HAINE5.PRG	Dbase program to generate SAS data file from mark-sense file.
05HAINESCT.PRN	Count file (text) used in HAMC04.SAS to expand for missing interview data.
HAMC05.SAS	SAS program to estimate effort and harvest in the Haines marine sport fishery using 05HAINESCT.PRN and output from HAINE5.PRG.
05SPAWN.XLS	Excel workbook containing raw data from Chinook sampled on the Chilkat River spawning tributaries during 2005.
05SPAWN.PRN	Space delimited text file with raw data from Chinook sampled on the Chilkat River spawning tributaries during 2005.
05SPAWN.TXT	Text file describing heading and column layout for 05SPAWN.PRN
05TAGS.XLS	Excel workbook containing raw data from Chinook captured in the lower Chilkat River during 2005.
05TAGS.PRN	Space delimited text file with raw data from Chinook captured in the lower Chilkat River during 2005.
05TAGS.TXT	Text file describing heading and column layout for 05TAGS.PRN
RadiosDeployed05.xls	Excel workbook containing deployment data from Chinook salmon radio-tagged in the lower Chilkat River during 2005.
RadiosDeployed05.prn	Space delimited text file with deployment data from Chinook salmon radio-tagged in the lower Chilkat River during 2005.
RadiosDeployed05.txt	Text file describing heading and column layout for RadiosDeployed05.prn
RadiosLocated05.xls	Excel workbook containing post-deployment location data by river km from radio-tagged Chinook salmon during 2005.
RadiosLocated05.prn	Space delimited text file with post-deployment location data by river km from radio-tagged Chinook salmon during 2005.
RadiosLocated05.txt	Text file describing heading and column layout for RadiosLocated05.prn
RadiosWGS84LatLon05.xls	Excel workbook containing lat./long. data from mobile surveys of radio-tagged Chinook salmon during 2005.
RadiosWGS84LatLon05.prn	Space delimited text file with lat./long. data from mobile surveys of radio-tagged Chinook salmon during 2005.
RadiosWGS84LatLon05.txt	Text file describing heading and column layout for RadiosWGS84LatLon05.txt