Fishery Data Series Number 09-53

Klutina River Chinook Salmon Creel Survey, 2006

by

Corey J. Schwanke

October 2009

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

Symbols and Abbreviations

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Weights and measures (metric)

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

Weights and measures (English)

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

Time and temperature

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

Physics and chemistry

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

General

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

Measures (fisheries)

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

Mathematics, statistics

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

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KLUTINA RIVER CHINOOK SALMON CREEL SURVEY, 2006

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ABSTRACT

A stratified three-stage access-point survey was used to estimate effort, catch, and harvest for the Chinook salmon *Oncorhynchus tshawytscha* fishery in the Klutina River during 2006. Sampling was stratified by river access points (three elements), month of the fishery, (two elements) and day-of-week (two elements). In addition, estimates were post-stratified by fishing location (lower, middle, and upper river), as guided or not, whether bait was used or not, and how the fishery was accessed (power boat, raft, or foot). Total estimated effort for Chinook salmon from 10 June through 31 July was 11,260 h (95% CI = 8,407-14,114), total catch of Chinook salmon was estimated as 1,777 (95% CI = 1,345-2,209), and total harvest of Chinook salmon was estimated as 993 (95% CI = 791-1,195). The majority of the catch and harvest of Chinook salmon was by guided clients. In June, 93% of the estimated catch and 90% of the estimated harvest was by guided anglers. In July, 85% of the estimated catch and 79% of the estimated harvest was from guided anglers. The estimated harvest of Chinook salmon in June was comprised of anglers using bait entirely. The estimated harvest of Chinook salmon in July was composed of anglers using bait 96% of the time. Power boats accounted for 73% of the estimated harvest in June and 70% in July. This study, along with others, was also used to evaluate catch and harvest estimates from the Alaska Statewide Harvest Survey (SWHS). The annual SWHS estimated a total harvest of 1,136 Chinook salmon in 2006, which was similar to our estimate of 993 and within our estimated 95% CI of 791-1,195. The catch estimate from the SWHS of 2,890 was much higher than our estimate of 1,777 and outside our estimated 95% CI of 1,345-2,209.

Key words: creel survey, Klutina River, Chinook salmon

INTRODUCTION

The Klutina River is the second largest Chinook salmon *Oncorhynchus tshawytscha* fishery in the Upper Copper Upper Susitna Management Area (UCUSMA; Figure 1), second only to the Gulkana River (Somerville 2008). The recent estimated 5-year (2002–2006) average catch of Chinook salmon from the Klutina River was 4,148 and the average harvest was 1,480 (Jennings et al. 2006a-b, 2007, 2009, *in prep*). Estimated annual angling effort averaged 10,256 angler days during the same 5-year period, although not all effort was directed towards Chinook salmon. According to the statewide harvest survey (SWHS), effort, catch, and harvest have decreased since the mid-to-late 1990s (Figure 2). The present sport fishing season for Chinook salmon on the Klutina River is from 1 January through 31 July. The upper river, which includes the entire mainstem river upstream of mile 19.2 of the Klutina Lake Road, closes to Chinook salmon fishing on 20 July. Klutina Lake and all of the tributaries of the Klutina River are closed to Chinook salmon fishing year-round. Bait and treble hooks are permitted year-round in the Klutina River. The daily possession limit on the Klutina River is one Chinook salmon ≥20 in (total length), and the annual limit for waters within the UCUSMA is four fish in the same length category.

Telemetry studies have been conducted by Alaska Department of Fish and Game (ADF&G) on Chinook salmon in the Copper River from 1999 through 2004. Results showed that the Klutina River supports a significant proportion of the total Copper River escapement. For the years 1999 through 2004, approximately 11%–27% of the total Chinook salmon escapement in the Copper River spawned in the Klutina River (Savereide 2005). Two creel surveys were conducted on the Klutina River in 1988 and 1989 that included the Chinook salmon fishing season. The 1988 creel survey estimated that 1,048 (SE = 305) Chinook salmon were caught and 450 (SE = 88) were harvested (Roth and Delaney 1989). The SWHS estimated 483 Chinook salmon were harvested the same year. In 1989, the creel survey estimate for catch was 1,587 (SE = 681) and for harvest was 1,033 (SE = 302) Chinook salmon (Potterville and Webster 1990), whereas estimated harvest from the SWHS was 652 Chinook salmon (Mills 1990). Catch was not estimated via the SWHS until 1990. Creel survey results revealed that boat anglers caught 88% of the total catch in 1988 and 90% in 1989. The vast majority of boat anglers were guided.

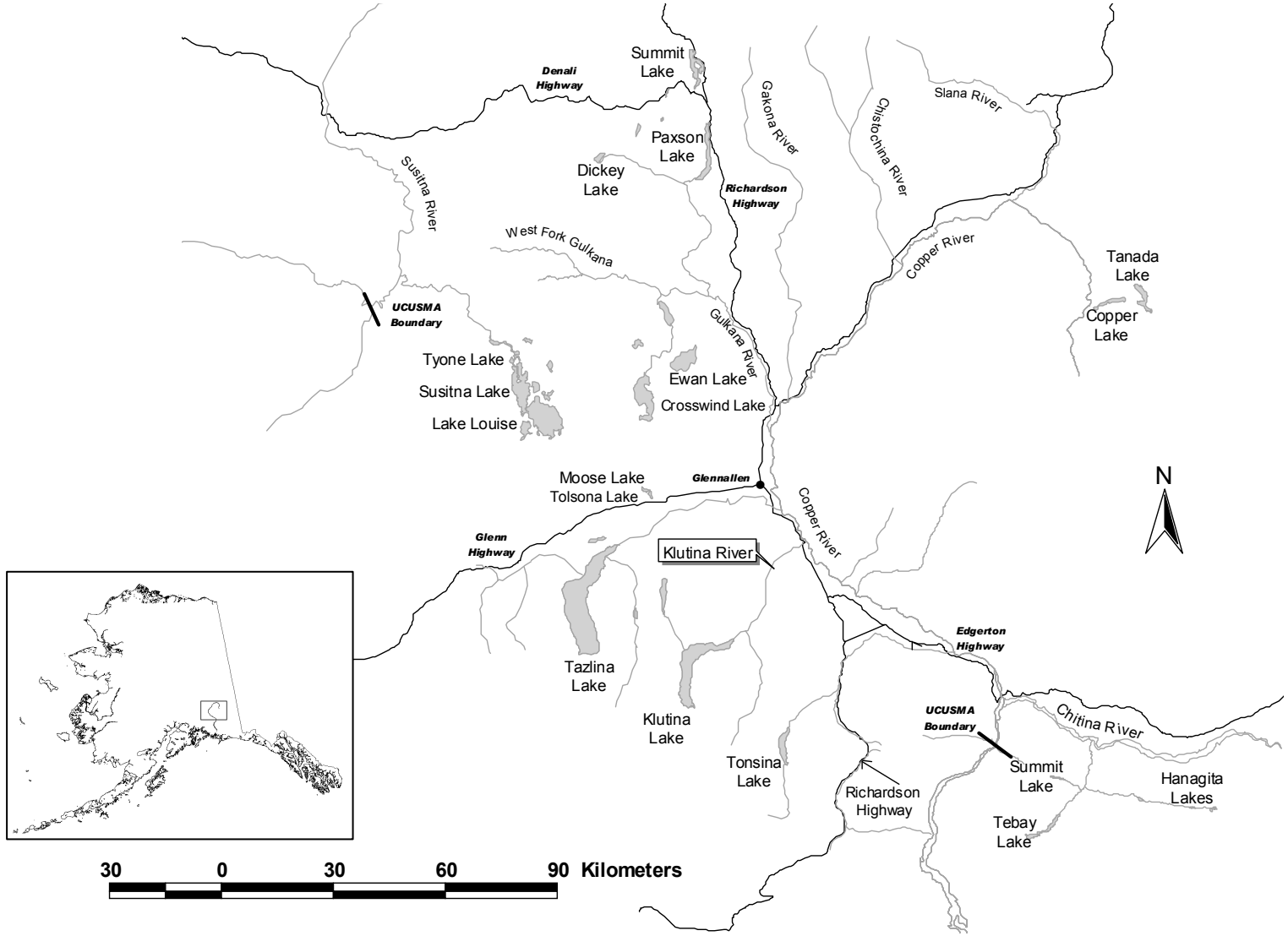

Figure 1.–Location of the Klutina River in the Upper Copper/Upper Susitna Management Area.

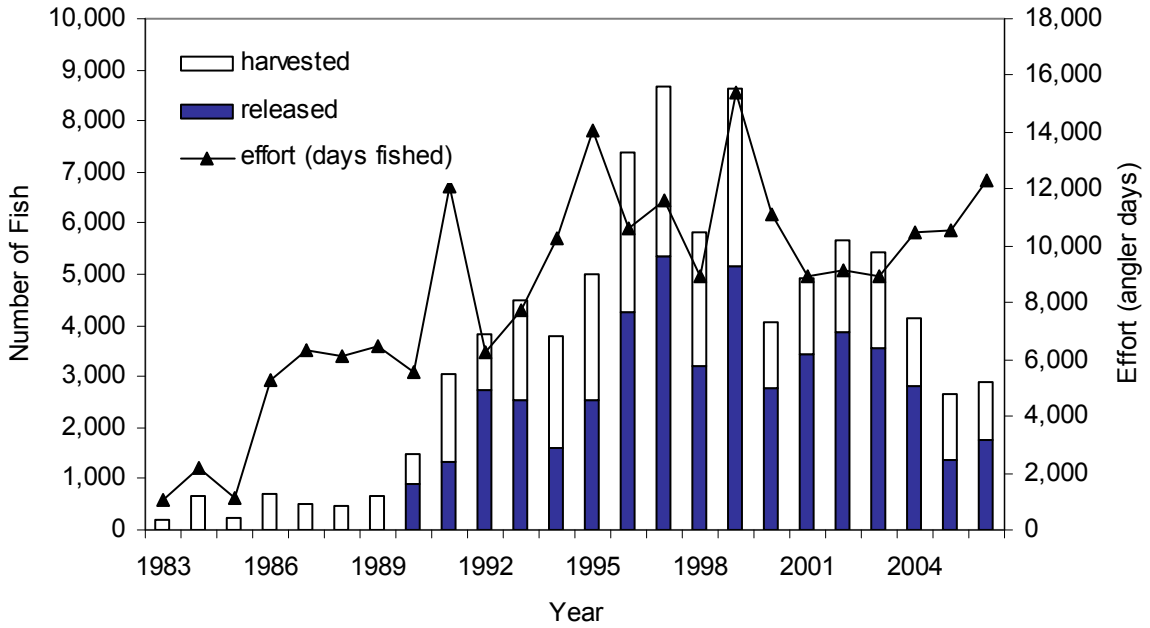

Figure 2.–Number of Chinook salmon harvested and released (the sum is catch) from the Klutina River, 1983–2006. Data is from Howe et al. (1995, 1996, 2001a-d), Jennings et al. (2006 a, b, 2007, 2009, *in prep a*), Mills (1985–1994), Walker et al. (2003).

To better understand and effectively manage the Chinook salmon fishery, a more rigorous creel survey that coincided with the Chinook salmon fishery was done in 2006. Because Chinook salmon do not enter the Klutina River in significant numbers prior to 10 June, effort, catch and harvest were estimated for the time period 10 June through 31 July. The creel survey was designed to estimate catch and harvest of Chinook salmon before and after July 1, as well as by the location fished, whether guided or unguided, whether bait was used, and how anglers accessed the fishery (by powerboat, raft, or foot).

OBJECTIVES

The research objective of this study was to:

1. estimate total effort, catch, and harvest of Chinook salmon from the Klutina River during 10 June through 31 July, such that the estimates were within ± 35% of their true values 95% of the time.

In addition project tasks were to:

1. estimate effort, harvest, and catch for specific strata: 1) before and after 1 July; 2) guided and non-guided anglers; 3) how fishery was accessed (powerboat, raft, or foot); 4) whether bait was used or not; and, 5) by fishing location, all of which will be obtained by post-stratifying;
2. record the guide log book and license numbers, the name of the business responsible for the log book, and whether the reported harvest was verified on the interview forms of all guided anglers to evaluate the freshwater guide logbook process (as described in the operational plan titled, Alaska Department of Fish and Game Statewide Freshwater Sport Fishing Reporting Program); and,
3. collect Dolly Varden Salvelinus malma heads from harvested fish for future microscopic otolith analysis.

METHODS

STUDY AREA

The headwaters of the Klutina River originate in the Chugach Mountain Range. The river starts at the base of Klutina Glacier and flows into Klutina Lake about 27 km from the glacier. Along with numerous smaller creeks, Klutina Lake (6,380 ha) has three major tributary streams: the Hallet River, St. Anne Creek, and the Mahlo River (Figure 3). The Klutina River flows northeast from the outlet of Klutina Lake for approximately 43 km to the Copper River. Manker Creek is the only major tributary of the mainstem Klutina River below the lake. The Klutina River is a fast flowing river with Class III rapids that drops an average of 5.8m/km from an elevation of 540 m at the lake to 290 m at the confluence with the Copper River. The river is considered navigable, but typically only by raft or with relatively large jet driven boats with experienced drivers.

The Klutina River has several access points. Two roads cross the Klutina River within 2.5 river km of the Copper River confluence: the Richardson Highway (upper bridge) and the Old Richardson Highway (lower bridge; Figure 4). The bridges are <1 km apart and most of the shorebased angling takes place near these bridges and down to the confluence with the Copper River. A primitive boat launch exists at the upper bridge and most of the boat angling occurs above this point. Additional access points are located upstream of the Richardson Highway via the Klutina Lake Road (Brenwick-Craig Road) that parallels the river from a point approximately 4 km upstream of the confluence with the Copper River to Klutina Lake. Several access points exist along the road that are used by shorebased anglers and rafters. A rudimentary boat launch exists near the lake outlet (approximately 3 km below the outlet). Ahtna Inc. owns much of the land around the Klutina Lake Road, but fisherman can pay a fee to access the river through these private lands.

SURVEY DESIGN

A stratified three-stage access-point survey (Bernard et al. 1998) was used to estimate the effort, catch, and harvest during the Klutina River Chinook salmon fishery. The sampling design had three levels of stratification: access points (three elements), seasonal (two elements), and day of week (DOW; two elements). In addition, estimates were post-stratified by fishing location (three elements: lower, middle, and upper river), by whether anglers were guided or not (2 elements), whether bait was used or not (two elements), and how the fishery was accessed (three elements: power boat, raft, or foot).

Sampling effort was distributed evenly across each fishing day because there was no prior knowledge of how anglers, particularly guided anglers, would exit the fishery with respect to time of day (TOD). In regards to fishing location, the river was divided into three sections. The lower section was everything below the lower bridge (~3 km); the middle section was the 1-km long section of river between the two bridges (Figure 4). The rest of the river from the upper bridge to Klutina Lake was designated as the upper section. Although this section was substantially larger than the other two sections, a decision was made to not divide the upper section into additional segments because of the difficulty in determining exact locations where people fished. Rafters and boaters often fish multiple spots within this reach and a sampling design that divided the upper section runs the risk of collecting confounding information during interviews due to lapses in the anglers' recollection of the day.

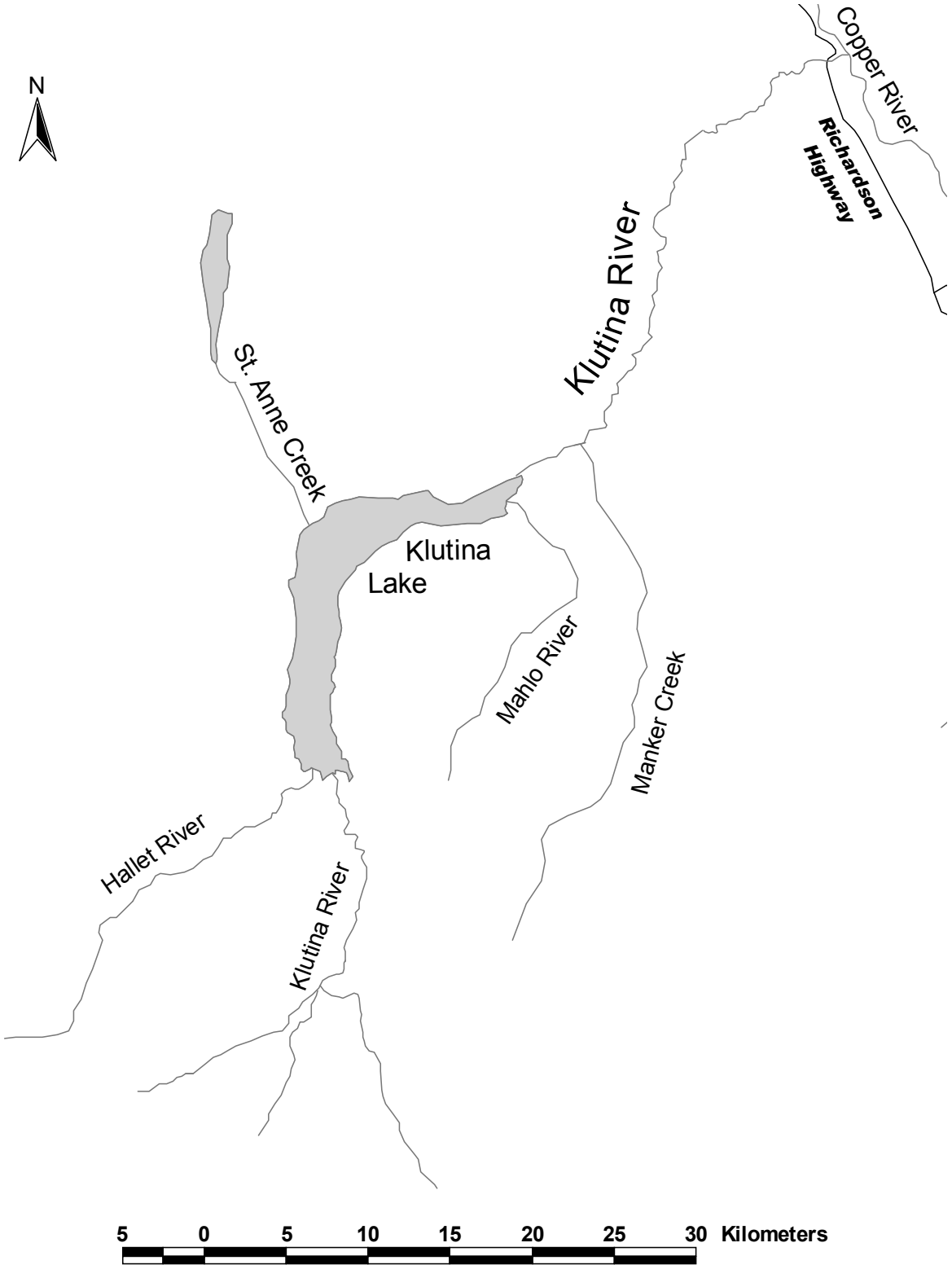

Figure 3.–Map of the Klutina River drainage.

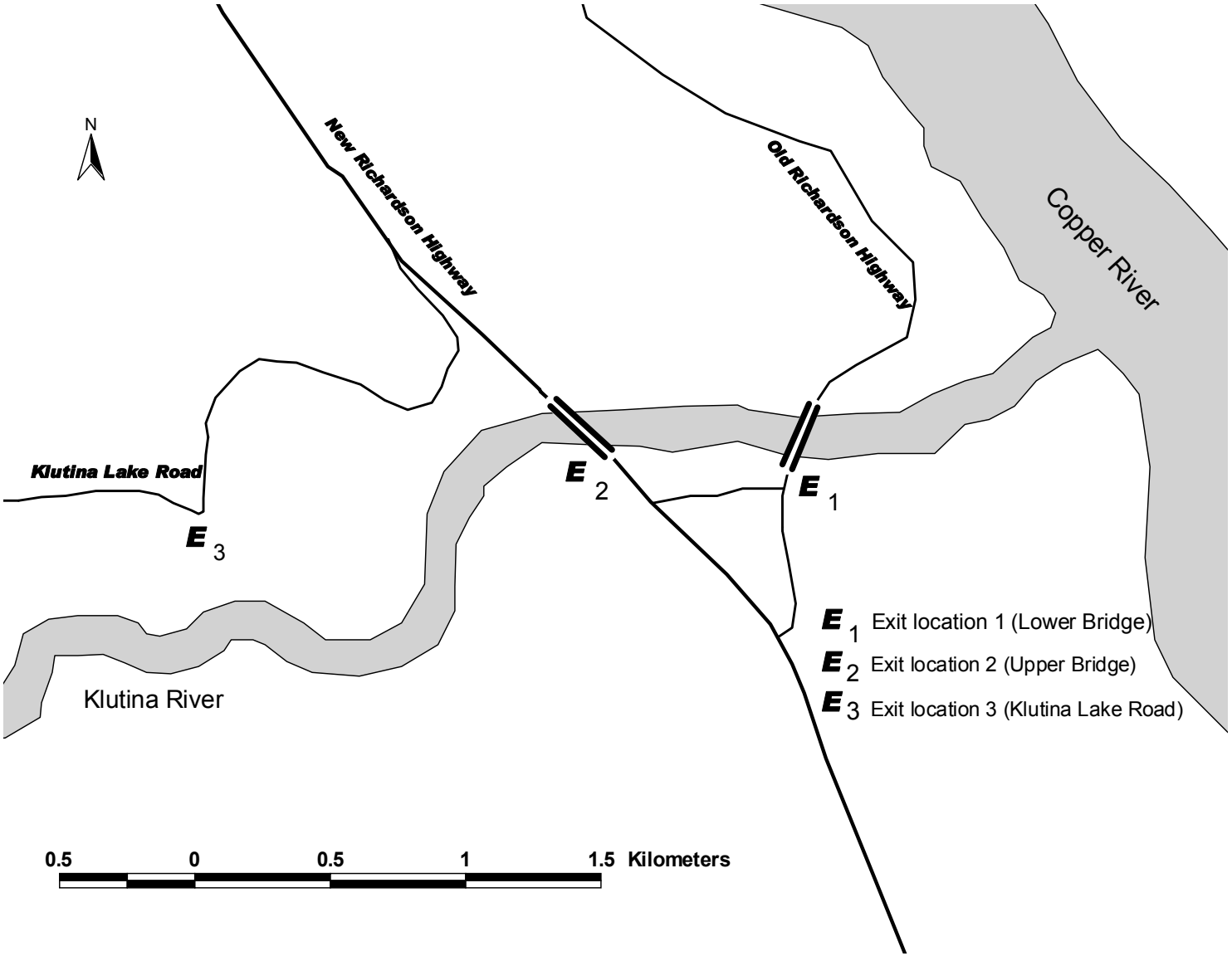

Figure 4.–Map of creel survey area with exit locations.

First-stage units in the survey design were days, second stage units were sampling periods and third stage units were angler-trips. A fishing day was a 21-hour period starting at 0500 hours and lasting until 0200 hours the following day. A fishing day was comprised of three 7-hour sampling periods. The 0200 to 0500 time period was not covered because it was thought that an insignificant number of anglers would be exiting the fishery during this time.

The survey was stratified temporally (early and late season) because available data and general knowledge of the fishery indicate that effort, catch, and harvest increase substantially during July. Therefore, the first stratum encompassed 10 June through 30 June, and the second stratum encompassed the month of July. A similar amount of sampling effort (periods sampled per week) was dedicated to each of these strata to provide technicians time to learn about the fishery and gain the experience necessary to sample the busy second seasonal stratum. Available information about the fishery also indicated that the exit locations had different levels of angler use warranting stratification and different levels of sampling effort among the fishing location strata. With the exception of some shorebased anglers fishing between the bridges, almost all exiting anglers were observed and interviewed by monitoring three access points: 1) near the lower bridge; 2) near the upper bridge; and, 3) at the start of the Klutina Lake Road (Figure 4). It was assumed that anglers harvesting 90% of the total harvest (45% upper bridge and 45% lower bridge) would exit at the bridge locations and anglers harvesting the remaining 10% would exit via the Klutina Lake Road. The sampling effort was allocated among these strata using these proportions as guidelines. Finally, the DOW elements were weekdays and weekend/holidays because less effort, catch, and harvest were expected to occur on weekdays.

The sampling schedule was developed by systematically selecting days within each stratum. Strata were defined by exit location, month, and DOW (Tables 1 and 2). For weekdays in June, one out of every three days or a one-in-three sample was taken at both bridge locations and a one-in-four sample was taken at the Klutina Lake Road location. The sampling was the same for weekdays in July except that a one-in-six sample was taken at the Klutina Lake Road. A one-in-two sample of days was taken at both bridge locations and a one-in-three sample was taken at the Klutina Lake for weekends/holidays in June and July. The selection process for all systematic samples in June and July began with randomly choosing starting dates for the one-in-two systematic samples at the lower bridge during weekends and the one-in-three systematic samples at the lower bridge during weekdays. Next, the initial day of the one-in-two samples during weekends/holidays at the upper bridge was offset from those selected for the lower bridge. After this, the first day of the one-in-three samples during weekdays at the upper bridge was randomly chosen from the two days remaining after selecting for the lower bridge. The initial day of the systematic samples at the Klutina Lake Road during weekdays and weekends/holidays in June was randomly selected. In July, the initial sampling day at the Klutina Lake Road was not permitted to fall on the same day that the lower bridge was sampled, but was otherwise randomly selected. This approach to selecting the initial day sampled was taken to accommodate staffing restrictions because it was not possible to staff both bridges on the same day. Finally, two of the three sampling periods were randomly selected within the days chosen for sampling.

Table 1.–Sampling schedule for the first temporal stratum (10–30 June) for the Klutina River Chinook salmon creel survey, 2006.

		Lower Bridge			Upper Bridge			Klutina Lake Road		
Day of Week	Date	0500–1200 hours	1200–0900 hours	1900–0200 hours	0500–1200 hours	1200–0900 hours	1900–0200 hours	0500–1200 hours	1200–0900 hours	1900–0200 hours
Weekends	6/10	X	X							
	6/11				X	X		X		X
	6/17		X	X						
	6/18				X	X				
	6/24	X		X				X		X
	6/25				X		X			
Weekdays	6/12	X	X							
	6/13									
	6/14					X	X	X	X	
	6/15		X	X						
	6/16									
	6/19				X		X			
	6/20		X	X					X	X
	6/21									
	6/22				X		X			
	6/23	X	X							
	6/26								X	X
	6/27					X	X			
	6/28		X	X						
	6/29									
	6/30				X	X		X		X

Table 2.–Sampling schedule for the second temporal stratum (1–31 July) for the Klutina River Chinook salmon creel survey, 2006.

		Lower Bridge			Upper Bridge			Klutina Lake Road		
Day of Week	Date	0500–1200 hours	1200–0900 hours	1900–0200 hours	0500–1200 hours	1200–0900 hours	1900–0200 hours	0500–1200 hours	1200-0900 hours	1900–0200 hours
Weekend/Holidays	7/1		X	X						
	7/2				X	X		X		X
	7/3	X		X						
	7/4				X		X			
	7/8	X	X						X	X
	7/9				X		X			
	7/15	X		X						
	7/16				X	X			X	X
	7/22		X	X						
	7/23					X	X			
	7/29	X	X					X		X
	7/30					X	X			
Weekdays/Non-Holidays	7/5							X		X
	7/6				X	X				
	7/7	X		X						
	7/10									
	7/11				X	X				
	7/12		X	X						
	7/13							X		X
	7/14					X	X			
	7/17	X	X							
	7/18									
	7/19				X		X			
	7/20		X	X						
	7/21								X	X
	7/24				X	X				
	7/25	X		X						
	7/26									
	7/27				X	X				
	7/28		X	X						
	7/31								X	X

SAMPLING DESIGN

The beginning of the creel survey coincided with Chinook salmon run timing (10 June) and ceased on 31 July, the last day of the Chinook salmon season. Six fishery technicians were used and permanent staff from the Glennallen office filled in during scheduling conflicts. Anglers used five exit locations throughout the fishery; however, these exit locations were effectively and efficiently monitored by technicians stationed at three access locations: the lower bridge, the upper bridge, and the Klutina Lake Road (Figure 4).

The lower bridge had three technicians stationed at all times chosen for sampling. Two campgrounds, day parking areas, and three guide operation's access/exit areas existed near the bridge. The two campgrounds were located on the upstream side of the bridge, and each had a guide operation based in the immediate vicinity of the bridge. Another guide used an access point located about 0.25 km below the lower bridge. A trail existed to this guide's access/exit location and could be monitored from the bridge. Many non-guided shore anglers accessed and fished both upstream and downstream of the lower bridge. These anglers typically parked their vehicles at a pullout located on the north side of the road.

Two technicians were stationed at the upper bridge during all shifts. The upper bridge had a campground located on its southeast side (downstream). A single guide operation used a private lot located about 150 m below the bridge that technicians could monitor from their station. A connecting foot trail along the north side of the river leads from the bridge to this location providing easy access to exiting guided anglers. A public boat launch located at the upper bridge also provided access for guiding operations, non-guided boaters, and rafters exiting the river. Some shore anglers used the upper bridge area as their access/exit point. Parking existed for shore anglers at the boat launch and at pullouts on the west side of the bridge.

Shorebased anglers that fished and camped at one of the three campgrounds between the bridges (may include people that also participated in a guided boat trip) were difficult to count and interview upon completion of their trip using standard creel survey methods. If a person staying at the campground walked across a bridge to access the other side of the river during a sampled period, they were interviewed by one of the technicians when they returned to the campground. Otherwise, technicians were not able to readily discern when these anglers exited the fishery because anglers who fish in front of the campground typically exit the fishery on campground access roads not monitored by technicians. In addition, counting and interviewing these anglers as they exited via campground access roads could not be effectively done from the bridges or with available staff. Available data and experience with this fishery indicated that the vast majority of these anglers were targeting sockeye salmon *O. nerka* because of the lack of holding water for Chinook salmon in this reach. Therefore, the contribution of these anglers to the Chinook salmon fishery was expected to be insignificant.

Data collected from shorebased anglers that fished between the bridges and exited the fishery at one of the bridge access locations during a sampled period were used to estimate Chinook salmon catch and harvest in the middle section of the river. These estimates provided some evidence relative to the importance of the middle-section fishery to the overall Chinook salmon fishery. However, these estimates were biased low because they could not be reliably expanded to account for all angler-trips between the bridges (primarily due to campground anglers). Therefore, to evaluate the contribution of these shore anglers to the Chinook salmon catch and harvest, technicians counted and interviewed people angling at, and staying at the campgrounds

once a day (every other day for each bridge site). A roving-survey was considered (similar to what was done in 1989 for the shorebased anglers) but was considered impractical given resource limitations and the expected lack of participation from this component of the fishery.

One technician was used at the Klutina Lake Road because fishing effort at this location was considerably less than the two bridge locations. In addition, the Klutina Lake Road was easy to monitor because all anglers exit the fishery using this road. The contact point for people traveling down this road was where the road starts behind Princess Lodge. All vehicles exiting the road were stopped to determine if anyone fished the river. If people did, anglers were counted and interviewed.

DATA COLLECTION

Exiting Anglers

Technicians enumerated all anglers exiting the fishery at the three locations. All reasonable attempts were made to interview all exiting anglers. Failing to interview some anglers when busy was acceptable as long as an accurate count of the total number of returning anglers was maintained. When it was not possible to interview all anglers, technicians ensured that the anglers, or groups of anglers, they "chose" to interview was random in the sense that the decision was independent of whether harvest was evident or whether the anglers appeared to want to be interviewed or not. When a group (or individual) was observed and could not be interviewed, the number of anglers in that group or with that individual could not be determined with 100% certainty. For these situations, staff made an educated guess at how many people appeared to have fished and wrote down distinguishing characteristics of the group/individual supporting their idea.

The time the angler exited the fishery defined the end of the angler-trip; however, the beginning of the angler-trip needed to be clarified through the interview. The beginning of the angler-trip was defined as the time when the angler last entered the fishery. For example, if the angler fished in the morning, left the fishery in the early afternoon during a time period not sampled (say to get lunch from their car in the parking area), returned to the fishery, and later exited during a sampled period, then the technician would want information pertaining to the period from lunch to the time of the interview. Therefore, an angler-trip was considered complete even if the anglers were just walking to their vehicle to take a quick lunch break regardless if the anglers planned on fishing later in the day or evening. If an angler did return to angling, these activities would constitute a new trip.

The questions asked from each exiting angler were:

1) Have you been fishing?
2) Where did you fish (location)?
3) Are you a resident of Alaska?
4) Did you access the river with a raft, power boat, or by foot?
5) Did you fish with a registered guide?

   If yes, did you pay for their service?
6) How many hours did you fish for king salmon (if 0, we proceeded to number 14)?
7) How many of these hours fished were with bait (if 0, we proceeded to number 10)?

8) How many king salmon did you catch/land and keep with bait?

9) How many king salmon did you catch/land and release with bait?

10) How many of these hours fished were without bait (questions 9-11 were only asked if the angler did not exclusively use bait)?

11) How many king salmon did you catch/land and keep without bait?

12) How many king salmon did you catch/land and release without bait?

13) Can I see the king salmon (if applicable and it was not in plain view)?

14) Did you fish for red salmon?

If the angler was a paying client for a guide service the following information was recorded for the Freshwater Logbook evaluation:

1) the guide's 5 digit logbook number;

2) the guide's 4 digit guide license number; and,

3) the business name responsible for the logbook.

Campground Anglers

A technician would count the number of anglers fishing in front of the campground(s) from their respective bridges. Immediately after the count, a technician would interview the anglers actively fishing at the campground and those that appeared to have fished earlier that day or the previous day (within the campground). All anglers approached were asked if they were staying at the campground. When the answer was no, the interview was terminated, whereas an answer of yes precipitated the following questions:

1) Are you targeting (or did you target) king salmon today?

2) Have you caught any king salmon today (if so, the # harvested and # released was asked)?

3) Are you finished fishing for the day (only was asked if they are not fishing)?

4) Did you fish for king salmon yesterday?

5) Did you catch any king salmon yesterday (if so, we asked the # harvested and # released)?

6) Did you fish for sockeye salmon?

These counts and interviews took place once a day. Technicians would determine during which period the counts and interviews needed to be performed. Interviewing campground anglers was secondary in importance to counting and interviewing the other exiting anglers. Campground interviews were skipped or interrupted if the primary objective of accurately enumerating and interviewing exiting anglers risked being compromised.

Information from the exiting and campground angler interviews were recorded on appropriate forms provided to the technicians. This data was later transferred, summarized, and entered into Microsoft Excel spreadsheets for analysis and archival (Appendix A1).

Dolly Varden Otolith Collection

Dolly Varden otoliths were to be taken from any angler who was willing to give the head of any harvested fish to a creel technician. Dolly Varden fishing is popular in the upper river near the lake outlet. No Dolly Varden were reported harvested during the survey; however, not many anglers were asked if they had harvested any Dolly Varden.

DATA ANALYSIS

Equations used to estimate harvest, catch, and effort are those for a 3-stage direct expansion (access point, completed-trip interview) survey, as detailed in Bernard et al. (1998).

The harvest of Chinook salmon calculated separately in each stratum ($\hat{H}_h$) was estimated as (Bernard et al. 1998; equation 2.2):

$$\hat{H}_h = D_h \overline{H}_h \tag{1}$$

$$\overline{\hat{H}}_h = \frac{\sum_{i=1}^{d_h} \hat{H}_{hi}}{d_h} \tag{2}$$

$$\hat{H}_{hi} = Q_h \overline{\hat{H}}_{hi} \tag{3}$$

$$\overline{\hat{H}}_{hi} = \frac{\sum_{j=1}^{q_{hi}} \hat{H}_{hij}}{q_{hi}} \tag{4}$$

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

where:

h_{hijk} = harvest by angler k, during sampling period j, on day i, in stratum h;

m_{hij} = number of anglers interviewed during period j on day i;

M_{hij} = number of anglers counted during sampled period j;

q_{hi} = number of periods sampled during day i;

Q_h = number of sampling periods during day i;

d_h = number of days sampled in stratum h; and,

D_h = number of days in stratum h.

It was anticipated that all anglers exiting were counted and interviewed and therefore $m_{hij} = M_{hij}$.

The variance of the harvest by stratum was estimated as (Bernard et al. 1998; equation 2.6):

$$\hat{\text{var}}\left[\hat{H}_h\right] = (1-f_{1h})D_h{}^2 \frac{\sum_{i=2}^{d_h}(\hat{H}_{hi}-\hat{H}_{h(i-1)})^2}{2d_h(d_h-1)} + f_{1h}^{-1}Q_h^2 \sum_{i=1}^{d_h}\left[(1-f_{2hi})\frac{\sum_{j=2}^{q_{hi}}(\hat{H}_{hij}-\bar{\hat{H}}_{hi})^2}{q_{hi}-1}\right] +$$

$$f_{1h}^{-1}\sum_{i=1}^{d_h}\left[f_{2hi}^{-1}\sum_{j=1}^{q_{hi}}\left[M_{hij}^2(1-f_{3hij})\frac{\sum_{k=1}^{m_{hij}}(h_{hijk}-\bar{h}_{hij})^2}{m_{hij}(m_{hij}-1)}\right]\right] \quad (6)$$

where:

f_{1h} = sampling fraction for days;

f_{2hi} = sampling fraction for periods; and,

f_{3hij} = sampling fraction for angler trips.

Catch and effort was estimated similarly, substituting *C* and *E* for *H* in Eq. (1) through Eq. (6). Total harvests for the season were the sums across strata $\sum \hat{H}_h$ and $\sum \hat{\text{var}}\left[\hat{H}_h\right]$.

If the status of all anglers exiting during a sampled period was established by interview or assigned while being counted, then equation 5 was modified by indexing the post-stratified group *h′*.

$$\hat{H}_{h'ij} = \frac{M_{h'ij}}{m_{h'ij}} \sum_{k=1}^{m_{h'ij}} h_{h'ijk} \quad (7)$$

If the status of all anglers exiting during a sampled period was not established, then

$$\hat{H}_{h'ij} = \frac{\hat{M}_{h'ij}}{m_{h'ij}} \sum_{k=1}^{m_{h'ij}} h_{h'ijk} \quad (8)$$

$$\hat{M}_{h'ij} = M_{hij}\frac{m_{h'ij}}{m_{hij}} \quad (9)$$

where $m_{h'ij}$ was the subset of m_{hij} that represented post-stratified group *h′*. Again, it was anticipated that all anglers exiting during a sampled period would be interviewed; however, in the rare event where angler post-stratification status was not completely determined, status was estimated (prorated) using the information from other interviews (as described above). Of note, in most situations the post-stratified groups: guided, non-guided, and mode of access to the fishery was determined when counting but this was not so for the post-stratified groups: location fished or resident vs. non-resident.

RESULTS

A total of 1,047 anglers were interviewed during the month of June, 150 of which targeted Chinook salmon. In July, 1,612 total anglers were interviewed and 567 of them pursued Chinook salmon. Effort directed towards Chinook salmon was estimated as 2,205 (95% CI = 973 – 3,437) hours in June and 9,056 (95% CI = 6,835 – 11,276) hours in July (Table 3).

Combining these two months, the total seasonal effort placed on Chinook salmon was 11,260 (95% CI = 8,407 – 14,114) hours.

Total catch of Chinook salmon for the month of June was estimated as 167 (95% CI = 57 – 246), while the total catch of Chinook salmon for July was estimated as 1,610 (95% CI = 1,192 – 2,029; Table 4). Total catch for the season was estimated as 1,777 (95% CI = 1,345 – 2,209).

Chinook salmon harvest was estimated as 126 (95% CI = 56 – 196) during June and 867 (95% CI = 678 – 1,056) during July (Table 5). The total seasonal harvest estimate was 993 (95% CI = 791 – 1,195) Chinook salmon.

Table 3.–Estimated effort (h) for Chinook salmon by temporal strata on the Klutina River, 2006.

Time Period	Effort	SE	95% CI	RP[a]
June				
Weekend:	509	126	261 – 758	0.49
Weekday:	1,695	614	489 – 2,902	0.71
June Total:	2,205	627	973 – 3,437	0.56
July				
Weekend:	4,187	564	3,079 – 5,295	0.26
Weekday:	4,869	980	2,942 – 6,795	0.40
July Total:	9,056	1,130	6,835 – 11,276	0.24
Season Total:	11,260	1,452	8,407 – 14,114	0.25

[a] RP = relative precision

Table 4.–Estimated catch of Chinook salmon by temporal strata on the Klutina River, 2006

Time Period	Catch	SE	95% CI	RP[a]
June				
Weekend:	18	11	6 – 40	1.23
Weekday:	149	54	42 – 255	0.72
June Total:	167	56	57 – 276	0.65
July				
Weekend:	822	140	548 – 1,097	0.33
Weekday:	788	161	472 – 1,104	0.40
July Total:	1,610	213	1,192 – 2,029	0.26
Season Total:	1,777	220	1,345 – 2,209	0.24

[a] RP = relative precision

Table 5.–Estimated harvest of Chinook salmon by temporal strata on the Klutina River, 2006.

Time Period	Harvest	SE	95% CI	RP[a]
June				
Weekend:	18	11	6 – 40	1.23
Weekday:	108	34	41 – 175	0.62
June Total:	126	36	56 – 196	0.56
July				
Weekend:	417	56	308 – 527	0.26
Weekday:	450	79	295 – 604	0.34
July Total:	867	96	678 – 1,056	0.22
Season Total:	993	103	791 – 1,195	0.20

[a] RP = relative precision

Guided anglers were estimated to account for 155 (SE = 53.1) fish caught and 114 (SE = 33.4) fish harvested in June (Table 6). This was approximately 93% of the estimated catch and 90% of the estimated harvest.

For July, guided anglers caught an estimated 1,377 (SE = 196.8) Chinook salmon and harvested 689 (SE = 80.9) (Table 7). These estimates correspond to 85% of the catch and 79% of the harvest.

The majority of the Chinook salmon harvest occurred in the upper section of the Klutina River. In June, 100% of the estimated harvest (126 fish) occurred in the upper section, while in July, 96% of the estimated harvest (839 out of 867 fish; Tables 8 and 9) occurred in the upper section.

Table 6.–Estimated effort, catch and harvest of Chinook salmon by angler strata for June, Klutina River, 2006.

Estimate	Weekend		Weekday		Total	
	Estimate	SE	Estimate	SE	Estimate	SE
Guided Harvest	15	11.0	99	31.6	114	33.4
Guided Catch	15	11.0	140	51.9	155	53.1
Harvest with Bait	18	11.3	108	34.0	126	35.8
Boat Access Effort (h)	135	54.5	938	390.0	1,073	553.7
Boat Access Harvest	15	11.0	76	29.8	91	31.8
Raft Access Effort (h)	84	55.4	459	162.0	543	171.2
Raft Access Harvest	0	0	27	9.7	27	9.7
Foot Access Effort (h)	290	89.6	298	118.4	588	148.5
Foot Access Harvest	3	2.2	5	4.3	8	4.8

Table 7.–Estimated effort, catch and harvest of Chinook salmon by angler strata for July, Klutina River, 2006

Estimate	Weekend		Weekday		Total	
	Estimate	SE	Estimate	SE	Estimate	SE
Guided Harvest	326	48.8	364	64.5	689	80.9
Guided Catch	670	120.3	707	155.8	1,377	196.8
Harvest with Bait	400	57.3	436	71.0	836	91.2
Boat Access Effort (h)	1,972	425.5	2,590	475.6	4,562	638.2
Boat Access Harvest	297	51.8	310	27.9	607	58.9
Raft Access Effort (h)	905	223.3	1,032	452.9	1937	504.9
Raft Access Harvest	65	17.3	81	27.9	146	37.1
Foot Access Effort (h)	1,309	254.7	923	286.9	2,233	383.6
Foot Access Harvest	55	11.1	59	23.6	114	26.1

Table 8.–Estimated harvest of Chinook salmon by location for June, Klutina River, 2006.

Section	Harvest	SE
Lower	0	0
Middle	0	0
Upper	126	35.8
Total	126	35.8

Table 9.–Estimated harvest of Chinook salmon by location for July, Klutina River, 2006.

Section	Harvest	SE
Lower	19	8.6
Middle	9	4.5
Upper	839	95.8
Total	867	96.3

Bait was the most productive method used to catch and harvest Chinook salmon. All of the estimated Chinook salmon harvested in June (126 fish; Tables 5 and 6) and 96% (836 out of 867 fish; Tables 5 and 7) of the estimated harvest in July were done so by using bait.

The majority of the catch and harvest occurred from anglers who accessed the river with a power boat. Combing both temporal strata, an estimated 993 Chinook salmon were harvested with 698 (70%) being harvested by anglers who accessed their fishing location by power boat, 173 (17%) by raft, and 122 (12%) by foot (Tables 6 and 7).

Few Chinook salmon were reported as caught or harvested by campground anglers. A total of 677 of these anglers were interviewed and they reported catching five Chinook salmon, four of which were harvested. One of these fish was caught the day before interviews took place. Other than these five fish, there was no additional information attained that would lead us to believe that catch and harvest was significant between the bridges.

The information collected from guided anglers (e.g., logbook numbers, harvest information) was forwarded on to ADF&G, Research and Technical Services in the fall of 2006.

DISCUSSION

Considerable thought and effort went into designing this creel survey and we felt a roving survey was not cost-effective considering the additional personnel needs. The advantages of an access point survey outweighed the primary disadvantage that allowed anglers to exit the fishery without detection via private access. The area of private access was very small and only accessed the lower section where holding water for Chinook salmon was negligible and harvest was assumed to be insignificant. The results of this study supported this assumption and an access-point survey is therefore recommended in future creel surveys. In regards to the precision criteria stated in Objective 1, sufficient sampling effort was used in this survey and the precision criteria was exceeded (Tables 3, 4, and 5).

Due to ambiguity in the angler's response, the estimates of effort (h) should be examined with caution when comparing the upper section to the lower and middle sections. Many anglers in the lower and middle sections said they were fishing for "whatever bites" when asked if they were fishing for Chinook salmon, and therefore had to be treated as fishing for Chinook salmon. Based on our observations these anglers appeared to not be directly fishing for Chinook salmon as efficiently when compared to anglers in the upper section. For example, no one who caught a Chinook salmon in the upper section ever said they were fishing for "whatever bites". Therefore, a unit of effort was likely inflated (magnitude unknown) for the lower and middle sections when compared to the upper section.

The road to Klutina Lake was closed by the State of Alaska, Department of Transportation (DOT) during this creel survey due to several land slides. However, the road was not impassable and people could still travel to the lake by driving around the slide areas. Many people continued using the road to recreate and access fishing areas because there was no enforcement of the closure. For example, several guide outfits still used the road to drop off rafts well above the road closure. The road closure very likely did not change how these guided anglers and many local anglers fished, but surely deterred some potential anglers from fishing the upper river. The degree to which this road closure affected angling is unknown.

Campground based anglers probably did not catch Chinook salmon in any significant numbers. Only five Chinook salmon were detected during all the interviews that took place in the campground. In addition, anecdotal information throughout the season showed little indication that many Chinook salmon were caught in front of the campgrounds. This was expected due to the lack of holding water in this area of the river.

The annual SWHS estimated a total harvest of 1,136 Chinook salmon in 2006, which was similar to our estimate of 993 and within our estimated 95% CI of 791 – 1,195. The catch estimate from the SWHS of 2,890 was much higher than our estimate of 1,777 and outside our estimated 95% CI of 1,345 – 2,209.

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APPENDIX A
SUMMARY OF DATA FILE ARCHIVES

Appendix A1.–Summary of data archive for the Klutina River Chinook salmon creel survey, 2006.

Data File[a]	Software
KlutinaCreelSurvey2006.xls	Microsoft Excel

[a] Data files are archived at and are available from the Alaska Department of Fish and Game, Sport Fish Division, Research and Technical Services, 333 Raspberry Road, Anchorage, Alaska 99518-1599