Fishery Data Series No. 97-12

Creel and Escapement Estimates for Chinook Salmon on the Gulkana River, 1996

by

Todd R. LaFlamme

May 1997

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

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
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

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

Spell out acre and ton.

Time and temperature

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

Spell out year, month, and week.

Physics and chemistry

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

General

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

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

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ABSTRACT

A two-stage, access-point creel survey was conducted to provide an inseason estimate of catch and harvest of, and effort for, chinook salmon *Oncorhynchus tshawytscha* from the Gulkana River prior to a 1996 Alaska Board of Fisheries regulatory meeting. Three locations, the Richardson Highway bridge, Sailor's Pit, and Sourdough were surveyed from 2 June-19 July 1996. An estimated 35,080 (SE = 1,350) hours of fishing effort were expended to catch an estimated 4,920 (SE = 237) chinook salmon of which an estimated 2,441 (SE = 152) were harvested. Estimates were poststratified by location for gear type (baited vs. unbaited), angler type (guided vs. unguided), and trip type (boat vs. shore). Baited gear types accounted for the majority of the catch and harvest of chinook salmon. Guided anglers had higher catch and harvest rates than unguided anglers. Most angler effort came from shore within the lower reaches of the river and nearly all came from a boat within the upper reaches.

From 11 June-31 July 1996, 11,684 adult chinook salmon passed upstream through a weir at river km 51 of the Gulkana River. Adjusting the count of chinook salmon for harvests above and below the weir produced estimates of 13,840 chinook salmon in the inriver return and 11,399 chinook salmon in the spawning escapement. On 20 July about 20% of the escapement counted through that date was observed during an aerial survey. From 15 June-31 July, 3,765 chinook salmon fry were captured at the weir in stationary inclined-plane traps. From 12-28 August, 9,030 juvenile chinook salmon were captured in baited minnow traps.

Key words: Gulkana River, chinook salmon, *Oncorhynchus tshawytscha*, catch, harvest, effort, gear, weir, return, spawning escapement, aerial survey, juvenile, fry.

INTRODUCTION

Chinook salmon *Oncorhynchus tshawytscha* support commercial, personal use, subsistence, and sport fisheries within the Copper River Basin. Commercial harvests occur in the Copper River Delta, personal use harvests occur in the mainstem of the Copper River in the vicinity of Chitina, and subsistence harvests occur in the mainstem of the Copper River from the mouth of the Slana River down to the vicinity of Chitina. Sport harvests occur in primary and secondary tributaries to the Copper River upstream from Chitina. Of these tributaries, the Gulkana River has the highest estimated catch, harvest, and effort expended by sport anglers in the Copper Basin.

The Gulkana River flows approximately 126 river km from the headwaters above Summit Lake to the confluence at the Copper River. It is the only clearwater, nonglacial river in the Copper Basin. It is federally classified as a wild river from Paxson Lake down to the Alaska Department of Fish and Game (ADF&G)/Bureau of Land Management (BLM) boat launch at Sourdough. Below Sourdough the river is characterized by meandering curves with steep embankments on the perimeter of the river basin. Riverbed substrate consists of cobblestone, sand, and silt. The main channel is 1.5-3.0 m deep from May through September.

Anglers fish the Gulkana River for chinook salmon from shore near the Richardson Highway bridge and near a Bureau of Land Management (BLM) trailhead at Sailor's Pit. Anglers also fish from boats (power and drift boats, canoes, rafts, and kayaks), drifting downstream from Paxson Lake to the confluence with the Copper River. Most boaters exit the river at three specific locations: Richardson Highway bridge, Sailor's Pit, and the ADF&G/BLM boat access at Sourdough (Figure 1). Boat anglers fish by drifting through, back trolling in, or anchoring in fish-holding holes. They may also land and fish from shore.

Harvest in this fishery is regulated through bag limits, season closures, and through restrictions on fishing gear. Only unbaited artificial lures may be used in all flowing waters of the Gulkana River upstream from an ADF&G marker approximately 7.5 miles upstream of the confluence of

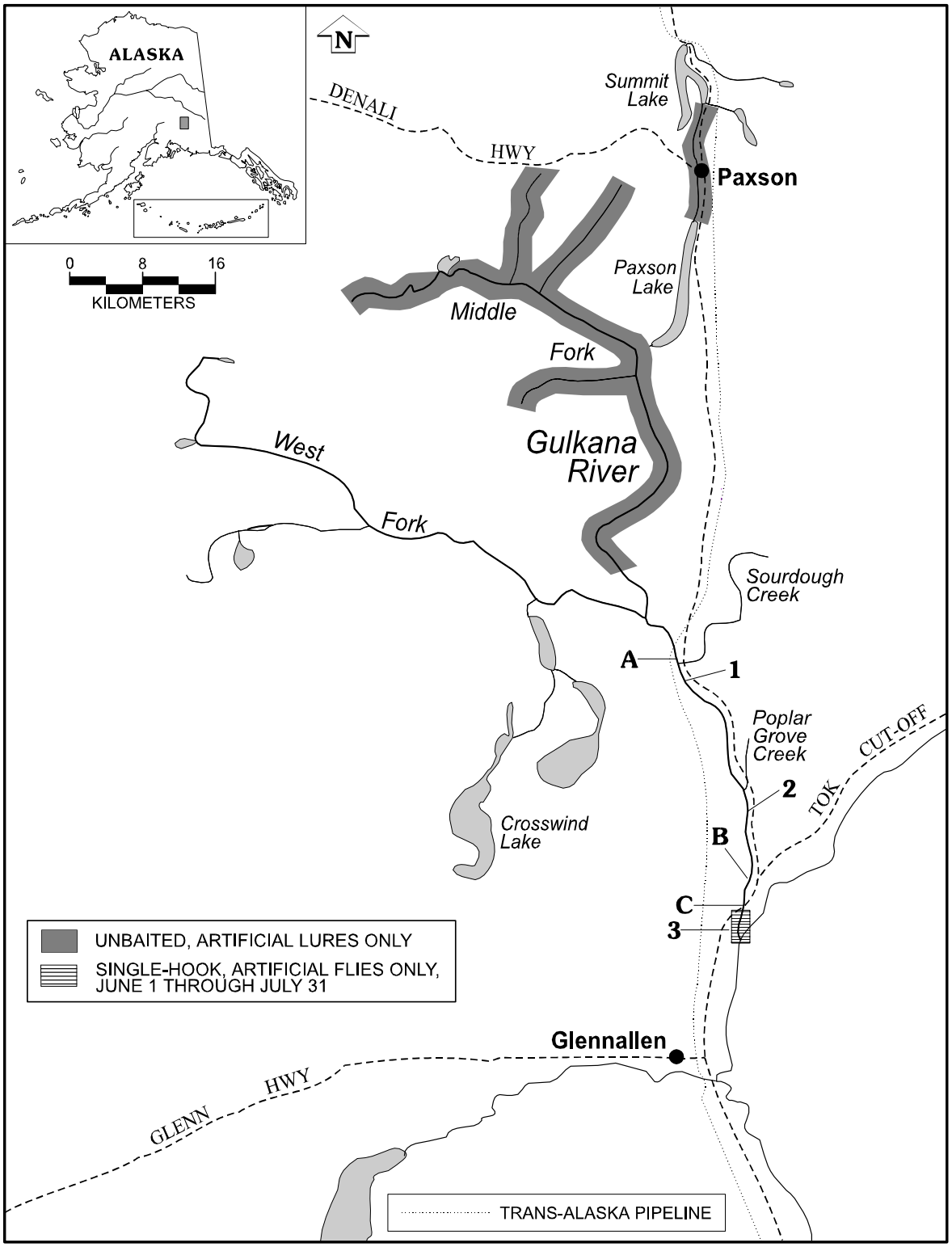

Figure 1.-Gulkana River drainage with locations of creel survey stations (A=Sourdough, B=Sailor's Pit, C=Richardson Highway Bridge), and sites evaluated for weir operations (1-3; 1=final weir location).

the West Fork. Only single-hook, artificial flies may be used from 1 June through 31 July from the Richardson Highway bridge downstream to an ADF&G marker near the confluence with the Copper River. The fishing season on the Gulkana River is from 1 January through 19 July with a daily bag limit of one chinook salmon ≥ 20 inches in total length and a seasonal bag limit of five fish ≥ 20 inches in the Upper Copper/Upper Susitna River management area.

The fishery for chinook salmon on the Gulkana River was surveyed in 1996 to provide timely information for regulatory meetings of the Alaska Board of Fisheries later that year. Annual catch and harvest, estimated annually with the ADF&G Statewide Harvest Survey (SWHS), averaged 6,133 and 2,563 chinook salmon, respectively, from 1990-1992 (Mills 1991-1993), and increased to an average catch of 9,975 chinook salmon and harvest of 4,370 for 1993-1995 (Mills 1994; Howe et al. 1995, 1996). Although precise, information from the SWHS is not available until 1 to 2 years after the annual completion of the fishery.

A weir was also installed in 1996 across the Gulkana River near Sourdough to count returning chinook salmon. Initial site selection for the installation of a floating weir began in 1994 with a potential site being identified near Sourdough (Nicole Szarzi, Alaska Department of Fish and Game, Glennallen, personal communication). In 1995, three areas were identified and evaluated by ADF&G personnel: (1) Sourdough area, (2) Poplar Grove Creek, and (3) near the confluence of the Copper River (Figure 1). A site at river km 51, approximately 2 river km below the ADF&G/BLM boat launch at Sourdough, was selected as the weir site and an anchorage rail was fabricated and installed in 1995. At this site, river width is approximately 75 m, depth ranges from 0.3 m to 1.3 m, and the riverbed substrate comprises small-to-medium sized cobblestone and medium-to-large boulders embedded in sand.

The objectives of the 1996 field season were to:

1. Estimate catch, harvest, and fishing effort in the recreational fishery for chinook salmon on the Gulkana River upstream of a point 2 km above the river's confluence with the Copper River;
2. Estimate harvest, by age and sex, of chinook salmon caught above the weir in that same fishery;
3. Count the passage of adult chinook salmon past river km 51; and
4. Estimate passage of these fish by age and sex group.

Sampling to determine if large numbers of juvenile chinook salmon could be captured with commonly used methods, such as inclined-plane and baited minnow traps, at the weir site and throughout the Gulkana River was also attempted during the 1996 field season.

METHODS

STUDY DESIGN

Creel Survey

Harvest, catch, and fishing effort were estimated with a stratified, two-stage access-point creel survey conducted from 2 June through 19 July 1996. Access location, time of day, and week defined 63 (=3x3x7) strata with days as the first-stage sampling units and anglers as second-stage

units. Weeks were defined as follows: (1) 2-8 June, (2) 9-15 June, (3) 16-22 June, (4) 23-29 June, (5) 30 June-6 July, (6) 7-13 July, and (7) 14-19 July.

Sampling occurred at three locations: Richardson Highway bridge, Sailor's Pit, and at Sourdough (Figure 1). With little *a priori* information on numbers of exiting anglers at each location (based on the SWHS, 30% of the harvest has on average occurred above the weir location at Sourdough and 70% below), sampling effort was allocated equally across the three locations. Discussion with anglers prior to the 1996 field season indicated that most anglers exit the fishery at Sourdough and at the Richardson Highway bridge between 0900 and 1500 hours each day, and the angling day begins at 0500 and ends at 2300 hours. Therefore, the angling day at these two locations was stratified into "morning" periods (0500-0900 hours), "afternoon" periods (0900-1500 hours), and "evening" periods (1500-2300 hours). The angling day was 18-h long with the assumption that no anglers fished between 2300-0500 hours. Because approximately 10% of anglers exit the fishery at these two locations in the morning, 30% in the evening, and 70% in the afternoon (our guess based on talks with anglers), 2 morning periods, all 7 afternoon periods, and 3 evening periods were sampled each week.

Without *a priori* knowledge of anglers exiting at Sailor's Pit, the fishing day (again 18-h long) was stratified into three 6-h periods consecutively running from 0500 hours. Four morning periods, four afternoon periods, and four evening periods were sampled each week. All periods sampled at all three locations were randomly selected without replacement from possible sampling periods at each location (21 sampled periods per location per week split into 3 strata of 7 periods each).

Six technicians (two stationed at each location) implemented the sampling schedule. Estimates were poststratified at all three locations according to whether an angler caught his or her fish with bait or not, according to whether they had fished from shore or from a boat, and according to whether they had been guided or not. Additionally, estimated harvest of anglers exiting at Sourdough was poststratified according to whether the fish had been caught below or above the weir.

Sampling to estimate age and sex composition of chinook salmon harvested above the weir followed a stratified, systematic design. All harvested fish caught above the weir by anglers exiting at Sourdough on three afternoons, Tuesday, Wednesday, and Thursday of each week, were sampled. We believed that sampling on these days would allow adequate samples to be obtained without sacrificing interview time.

Weir

A resistance-board floating weir was installed in the Gulkana River at river km 51 to count passing adult chinook salmon. The weir was installed and 24-h counting began on 11 June. At that time two technicians maintained and operated the weir during a 12-h shift through 31 July. One 4 ft x 8 ft x 4 ft live box with a V-shaped entrance was placed towards the middle of the upstream side of the weir. Individual panels were constructed of 1 in inside diameter schedule 40 polyvinyl chloride (PVC) conduit and measured 20 ft long and 37 in wide. Picket spacing of the weir and live box was 1.5 in and allowed for the corralling of the smallest of chinook salmon through the weir. An adjustable resistance-board was attached to each panel and provided current deflection and floatation. A total of 72 panels were secured to a cable strung along the top of the anchorage rail.

Two stationary inclined-plane traps were anchored at each end on the downstream side of the weir and fished 24 h each day. Technicians manned a counting platform attached to the upstream live box. Both gates to the box were opened to allow for continuous passage of fish. Individual fish were identified and counted by species as they passed through the live box. The downstream inclined-plane traps were checked at 0800, 1200, 1600, and 2000 hours each day. Juvenile fish were identified, counted, and released.

A systematic sample of every tenth adult chinook salmon was anticipated to be measured, its sex noted, and a scale sample taken, but due to the high ratio of sockeye-to-chinook salmon, no biological data were collected.

DATA COLLECTION

Creel Survey

During a sampled period, each technician counted and attempted to interview all persons exiting the fishery. The following questions were asked of each person interviewed:

1. Were you trying to catch chinook salmon during this specific trip to the river?
2. Have you caught and kept any chinook salmon during this specific trip to the river?
3. How many chinook salmon have you kept during this specific trip to the river? (Ask to see the harvested chinook salmon).
4. Did you catch and actively release any chinook salmon?
5. Did you fish from a boat or from shore?
6. Did you use baited, unbaited, or both types of fishing gear during this specific trip to the river?
7. Did you catch the chinook salmon that you kept with baited or unbaited fishing gear?
8. What type of unbaited fishing gear did you catch the chinook salmon with?
9. How many did you catch and release with baited fishing gear?
10. How many did you catch and release with unbaited fishing gear?
11. How many hours did you spend fishing during this specific trip to the river?
12. Did you use the services of a guide for fishing during this specific trip to the river?

Additional questions for anglers interviewed at Sourdough were:

1. Did you catch and keep any chinook salmon from below the fish counting weir?
2. Did you catch and keep any chinook salmon from above the fish counting weir? If yes then,
3. Would you mind if I measured it for you and took a scale for determining its age?

Because nonfishing recreationists could not be distinguished from exiting anglers without being interviewed at each survey site, "No harvests" from nonfishing recreationists were included in calculations of averages for a period, and these averages were expanded by all exiting persons.

The creel surveyor sampled only chinook salmon harvested from above the weir and exiting at Sourdough on Tuesday, Wednesday, and Thursday afternoons. Each sampled fish was measured from mid-eye to fork-of-tail to the nearest 5 mm. Sex was determined by external physical

characteristics. Three scales were taken from the left side of each fish approximately two rows above the lateral line and on a diagonal row downward from the posterior insertion of the dorsal fin (Clutter and Whitesel 1956) and placed on gum cards. Gum cards were pressed with cellulose acetate (Clutter and Whitesel 1956) and age determined using surface reading procedures (Chilton and Beamish 1982) implemented by a single scale reader. All scales were independently read three times with a microfiche reader with a 40x magnification. The modal age was the determined age.

Weir

The following daily counts were recorded at the weir site and reported each day:

1. Number of chinook salmon passed through the upstream live box,
2. Number of chinook salmon passed upstream over the weir during boat passage,
3. Number of chinook salmon passed through the downstream incline plane traps,
4. Number of other species passed through the upstream live box,
5. Number of other species passed upstream over the weir during boat passage,
6. Number of other species passed through the downstream incline plane traps, and
7. Number of juvenile (fry/smolt) fish by species passed through the downstream inclined-plane traps.

DATA ANALYSIS

Creel Survey

Estimated harvest for each sampled period ($\hat{N}_{hi}$) was calculated as:

$$\hat{N}_{hi} = M_{hi}\hat{\bar{N}}_{hi} \qquad \hat{\bar{N}}_{hi} = \frac{\sum_{j=1}^{m_{hi}} N_{hij}}{m_{hi}}, \tag{1}$$

where M_{hi} is the number of anglers (persons) counted exiting during sampled period i, m_{hi} is the number of exiting anglers (persons) interviewed in that sampled period, and N_{hij} is the number of chinook salmon harvested by angler j. Estimated harvest in each stratum ($\hat{N}_h$) was calculated as:

$$\hat{N}_h = D_h\hat{\bar{N}}_h \qquad \hat{\bar{N}}_h = \frac{\sum_{i=1}^{d_h} \hat{N}_{hi}}{d_h}, \tag{2}$$

where d_h is the number of sampled periods in stratum h and D_h is the number of sampling periods in that stratum that could have been sampled. Equations for estimated variance for $\hat{N}_h$ were modified from Thompson (1992, pp. 134-136):

$$v(\hat{N}_h) = (1 - f_{1h})D_h^2 \frac{S_{1h}^2}{d_h} + f_{1h}^{-1} \sum_{i=1}^{d_h} \left[M_{hi}^2 (1 - f_{2hi}) \frac{s_{2hi}^2}{m_{hi}} \right] \tag{3}$$

$$s_{2hi}^2 = \frac{\sum_{j=1}^{m_{hi}} (N_{hij} - \hat{\bar{N}}_{hi})^2}{m_{hi} - 1} \qquad S_{1h}^2 = \frac{\sum_{i=1}^{d_h} (\hat{N}_{hi} - \hat{\bar{N}}_h)^2}{d_h - 1},$$

where $f_{1h} = d_h / D_h$ and $f_{2hi} = m_{hi} / M_{hi}$. Seasonal estimates for estimated harvest $\hat{N}$ and its estimated variance $v(\hat{N})$ were the sums of these statistics across all strata:

$$\hat{N} = \sum_h \hat{N}_h \qquad v(\hat{N}) = \sum_h v(\hat{N}_h). \tag{4}$$

With a few substitutions, the same equations listed above were used to estimate poststratified harvest and its estimated variance. Substitutions were:

$$M_{hi} \leftarrow \hat{M}_{h'i} = M_{hi} \frac{m_{h'i}}{m_h} \qquad m_{hi} \leftarrow m_{h'i} \qquad N_{hij} \leftarrow N_{h'ij}, \tag{5}$$

where $m_{h'i}$ is the number of interviewed anglers in poststratum h'. Estimates of catch and fishing effort (in hours of fishing) and their estimated variances were calculated with the equations above by substituting catch or fishing effort (hours fished) for harvest in the formulations.

RESULTS

CREEL SURVEY

An estimated 35,080 (SE = 1,350) hours of fishing effort was expended to catch an estimated 4,920 (SE = 237) chinook salmon of which an estimated 2,441 (SE = 152) were harvested (Table 1).

Table 1.-Estimates of effort (angler-hours) and catch and harvest of chinook salmon in the recreational fishery on the Gulkana River, 1996.

Location	Interviews	Catch	SE	Harvest	SE	Effort	SE
RHB[a]	1,619	2,652	194	1,538	146	16,271	1,009
SP[b]	718	409	48	277	24	5,745	354
S-BW[c]	419	814	61	341	28	2,918	353
S-AW[d]	1,095	1,045	142	285	38	10,146	682
TOTAL	3,851	4,920	237	2,441	152	35,080	1,350

[a] Richardson Highway bridge.

[b] Sailor's Pit

[c] Sourdough-below weir.

[d] Sourdough-above weir.

Anglers exiting at the Richardson Highway Bridge and Sailor's Pit fished mostly from shore, whereas those fishing at Sourdough (above and below the weir) fished mostly from boats (Table 2). Overall, boat anglers and shore anglers caught about the same number of chinook salmon,

but shore anglers harvested more chinook salmon and expended more effort than boat anglers (Table 2, Figure 2). CPUE for boat and shore anglers was similar, as was HPUE (Table 3).

Table 2.-Poststratified estimates of catch, harvest, and effort for chinook salmon from the Gulkana River, 1996.

	Boat	Shore	Guided	Unguided	Baited	Unbaited
			Richardson Highway Bridge			
Catch	771	1,862	1,367	1,267	2,068	519
SE	118	182	152	108	175	91
Harvest	367	1,161	655	874	1,155	368
SE	63	129	79	103	118	71
Effort	2,284	13,871	4,956	11,121	10,431	4,876
SE	431	853	506	814	682	542
			Sailor's Pit			
Catch	186	223	80	326	360	44
SE	36	27	15	44	45	12
Harvest	115	163	71	203	239	33
SE	15	16	12	18	22	9
Effort	1,578	4,124	1,033	4,691	3,554	1,870
SE	194	293	208	283	260	243
			Sourdough-Below Weir			
Catch	758	55	453	341	708	26
SE	65	38	51	44	61	6
Harvest	334	6	182	156	273	16
SE	30	3	21	16	21	8
Effort	2,833	74	1,274	1,614	2,089	291
SE	355	33	161	271	197	75
			Sourdough-Above Weir			
Catch	749	292	228	817	624	154
SE	95	100	56	122	85	31
Harvest	25	25	98	186	181	45
SE	37	7	25	23	29	8
Effort	9,355	666	999	9,048	4,467	3,679
SE	566	281	215	611	315	527
			Total River			
Catch	2,464	2,432	2,127	2,751	3,760	744
SE	166	223	170	179	202	72
Harvest	841	1,355	1,006	1,419	1,848	462
SE	78	130	86	106	124	51
Effort	16,049	18,735	8,263	26,474	20,541	10,716
SE	875	954	585	1,166	804	618

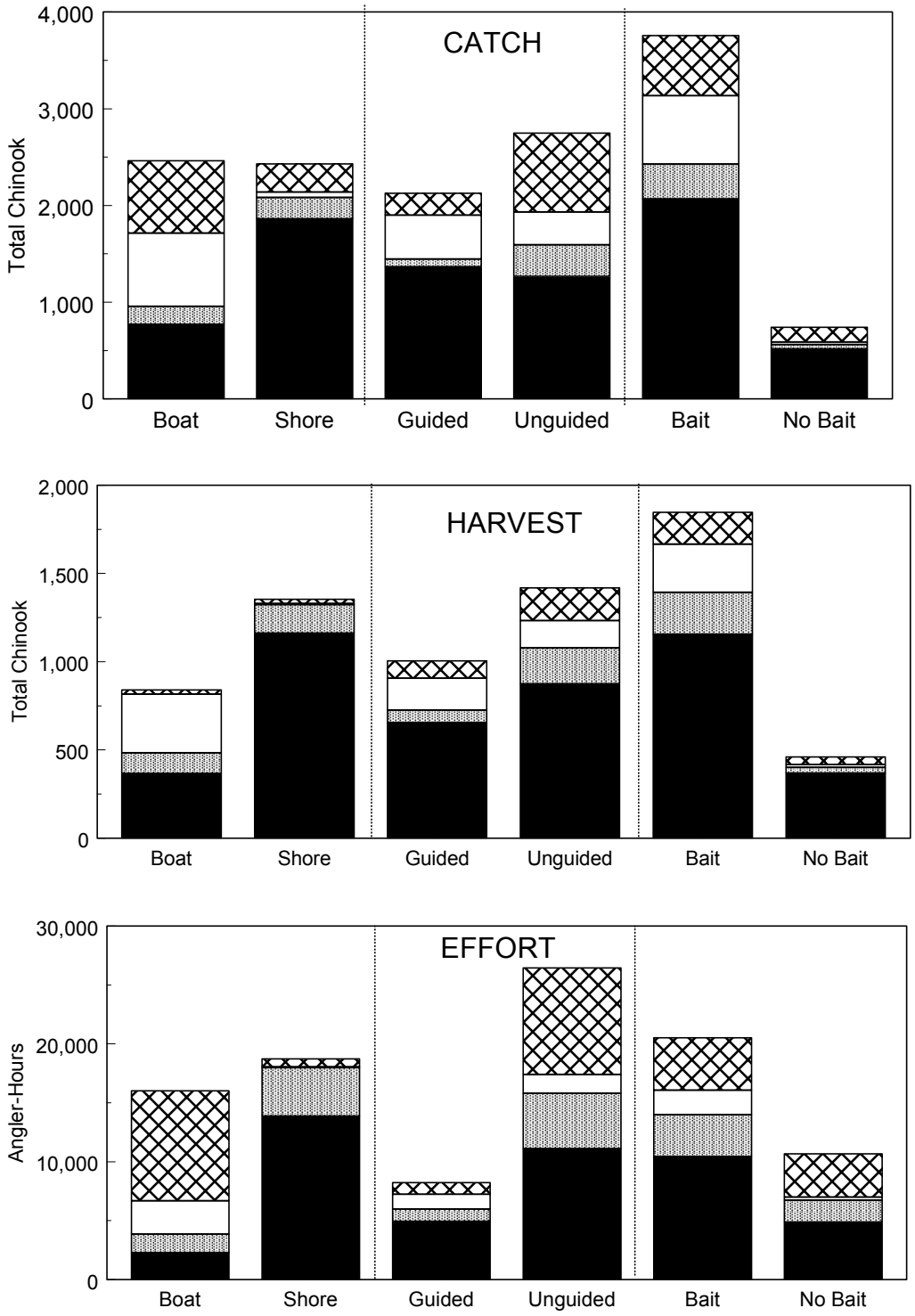

Figure 2.-Poststratified estimates of catch, harvest, and effort for chinook salmon from the Gulkana River, 1996. Estimates are from the Richardson Highway Bridge (black), Sailor's Pit (shaded), Sourdough-Below Weir (white), and Sourdough-Above Weir (hatched).

Table 3.-Catch per unit effort (CPUE) and harvest per unit effort (HPUE) by location, trip type, angler type, and gear type for the chinook salmon fishery on the Gulkana River, 1996. Unit effort is angler-hours.

	CPUE	HPUE
Location		
Richardson Hwy Bridge	0.16	0.09
Sailor's Pit	0.07	0.05
Sourdough-Below Weir	0.28	0.12
Sourdough-Above Weir	0.10	0.03
Trip Type		
Boat	0.15	0.05
Shore	0.13	0.07
Angler Type		
Guided	0.26	0.12
Unguided	0.10	0.05
Gear Type		
Baited	0.18	0.09
Unbaited	0.07	0.04

However, anglers fishing at Sourdough above the weir were more successful than anglers at other locations, guided anglers were more likely than unguided anglers to catch or harvest chinook salmon, and anglers using baited gear were more successful than anglers using unbaited gear (Table 3). For unguided anglers, most catch, harvest, and effort was made from shore, whereas guided anglers fished, and caught, and harvested the majority of their chinook salmon from boats (Table 4 and Figure 3). For both guided and unguided anglers, most caught or harvested chinook salmon were taken with baited gear (Table 5).

At all locations, most fishing effort, catch, and harvest occurred from 9 June to 6 July (Table 6). The highest estimates of catch and harvest occurred between 1500 and 2300 hours at the Richardson Highway bridge and above the weir at Sourdough, between 1100 and 1700 hours at Sailor's Pit, and between 0900 and 1500 hours below the weir at Sourdough (Appendices A1-A3). The highest estimates of fishing effort occurred between 1500 and 2300 hours at the Richardson Highway bridge and above the weir, between 1700 and 2300 hours at Sailor's Pit, and between 0900 and 1500 hours below the weir.

Only 14 chinook salmon harvested from above the weir were sampled at the Sourdough boat launch (Table 7). No harvested chinook salmon were available for sampling during weeks 2-8 June, 9-15 June, 7-13 July, and 14-19 July. Lengths ranged from 750 mm to 1,040 mm.

Table 4.-Poststratified estimates of catch, harvest, and effort for guided and unguided anglers for chinook salmon from the Gulkana River, 1996.

	Unguided Anglers				Guided Anglers			
	Boat		Shore		Boat		Shore	
Exit Location	Estimate	SE	Estimate	SE	Estimate	SE	Estimate	SE
				CATCH				
Richardson Hwy Bridge	98	26	1,161	95	673	116	686	119
Sailor's Pit	109	36	218	25	78	15	2	1
Sourdough Below Weir	286	28	55	38	451	50	0	0
Sourdough Above Weir	525	49	290	71	223	60	3	2
Total River	1,018	69	1,723	137	1,425	141	691	119
				HARVEST				
Richardson Hwy Bridge	62	20	806	82	304	51	348	54
Sailor's Pit	46	11	157	15	69	13	2	1
Sourdough Below Weir	149	14	7	3	181	20	0	0
Sourdough Above Weir	164	16	22	7	93	24	3	2
Total River	421	30	992	84	648	61	343	54
				EFFORT				
Richardson Hwy Bridge	645	129	10,406	676	1,625	294	3,313	359
Sailor's Pit	571	111	4,076	246	1,007	213	27	16
Sourdough Below Weir	1,539	205	74	33	1,270	152	0	0
Sourdough Above Weir	8,379	91	595	167	917	192	71	54
Total River	11,133	554	15,151	745	4,819	422	3,411	363

Eight males and six females were sampled. Age classes were 1.3 and 1.4. Sample sizes were too small to provide useful estimates of age or sex composition of harvest.

WEIR

From 11 June through 31 July, 11,684 chinook salmon passed upstream through the weir (Table 8). Additionally, 183,461 sockeye salmon *O. nerka*, 26 rainbow trout *O. mykiss*, 36 round whitefish *Prosopium cylindraceum*, 143 Arctic grayling *Thymallus arcticus*, 74 longnose sucker *Catostomus catostomus*, 3 burbot *Lota lota*, and 5 Pacific lamprey *Lampetra tridentata* passed upstream through the weir. A total of 46 adult rainbow/steelhead trout were passed downstream over the weir. Seventy-six percent (35) of these rainbow/steelhead trout were passed over the weir prior to 18 July. Juvenile chinook salmon captured in the downstream live boxes totaled 3,765 from 19 June through 4 July.

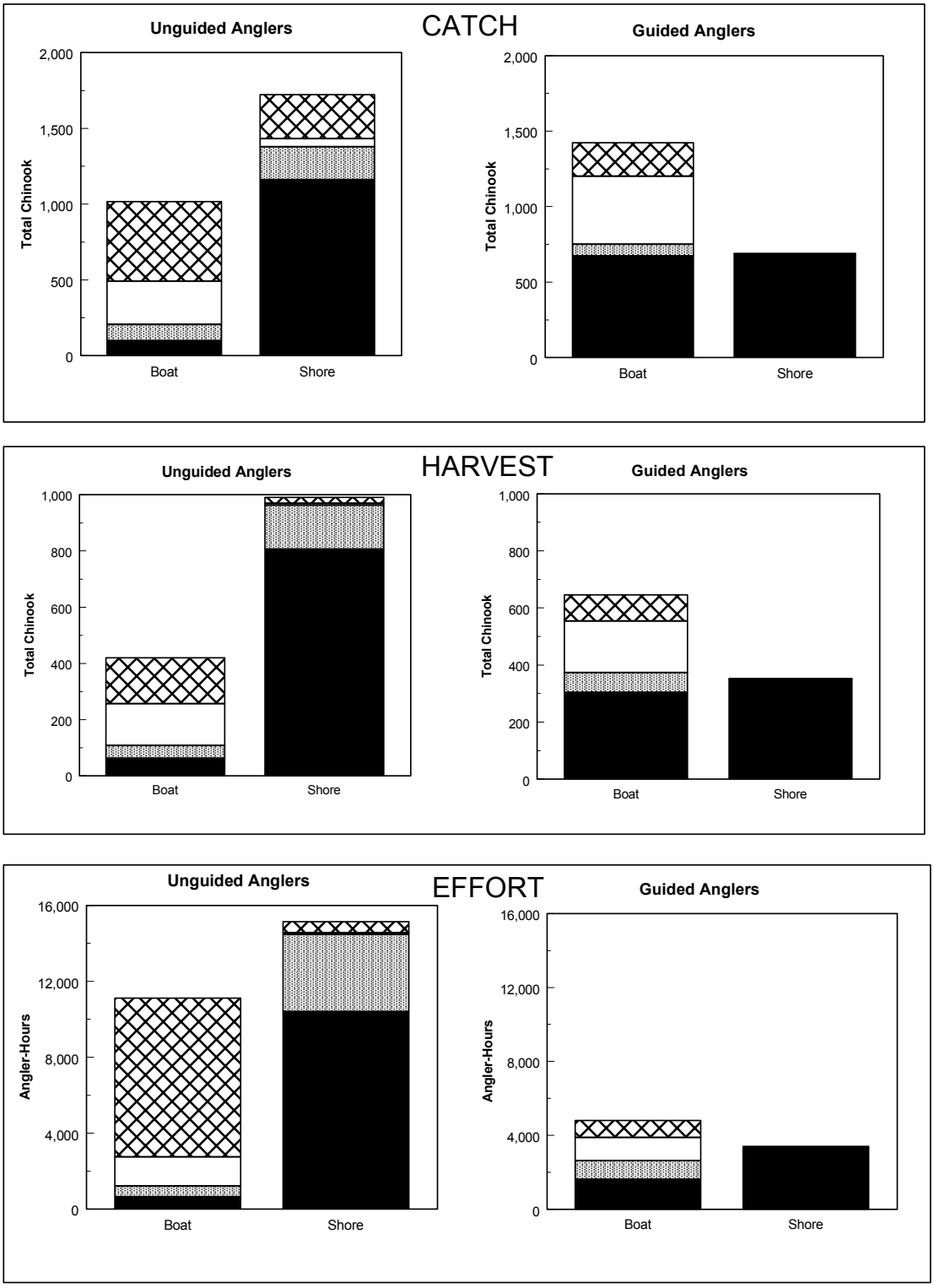

Figure 3.-Poststratified estimates of catch, harvest, and effort for guided and unguided anglers from the Gulkana River, 1996. Estimates are from the Richardson Highway Bridge (black), Sailor's Pit (shaded), Sourdough-Below Weir (white), and Sourdough-Above Weir (hatched).

Table 5.-Poststratified estimates of catch, harvest, and effort for baited and unbaited gear types for chinook salmon from the Gulkana River, 1996.

	Unguided Anglers								Guided Anglers							
	Boat				Shore				Boat				Shore			
	Baited		Unbaited		Baited		Unbaited		Baited		Unbaited		Baited		Unbaited	
	Est.[a]	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE	Est.	SE
CATCH																
R H B[b]	79	25	19	8	702	68	425	64	631	113	34	26	638	118	28	7
S P[c]	101	36	8	4	176	23	37	8	78	15	0	0	2	1	0	0
S - B W[d]	196	24	21	2	50	38	5	4	441	49	0	0	0	0	0	0
S - A W[e]	326	20	104	14	128	51	46	26	162	55	5	4	3	2	0	0
Total River	702	53	152	17	1,056	110	513	70	1,312	136	39	27	643	118	28	7
HARVEST																
R H B	54	19	8	2	478	60	325	56	286	49	17	13	330	54	11	4
S P	38	11	8	4	126	14	26	6	69	13	0	0	2	1	0	0
S - B W	92	6	13	2	4	2	3	2	173	19	0	0	0	0	0	0
S - A W	92	11	38	8	15	6	2	2	68	22	5	4	3	2	0	0
Total River	275	26	67	9	623	62	356	56	596	58	22	14	335	54	11	4
EFFORT																
R H B	448	113	163	57	5,476	423	4,221	478	1,360	281	225	88	3,068	356	89	22
S P	392	99	166	49	2,083	145	1,686	186	1,007	213	0	0	24	16	3	2
S - B W	800	88	257	51	41	21	33	25	1,223	149	0	0	0	0	0	0
S - A W	3,457	281	3,301	304	109	34	302	138	730	178	37	28	71	54	0	0
Total River	5,096	348	3,887	340	7,709	450	6,242	538	4,320	405	262	88	3,163	357	92	22

[a] Estimate

[b] Richardson Highway bridge.

[c] Sailor's Pit.

[d] Sourdough - Below weir.

[e] Sourdough - Above weir.

Table 6.-Weekly estimates of catch, harvest, and effort for each specific location and for all sites combined, Gulkana River, 1996.

Week	Catch	SE	Harvest	SE	Effort	SE
			RICHARDSON HIGHWAY BRIDGE			
2-8 June	133	73	82	45	1,090	567
9-15 June	946	65	504	80	4,278	149
16-22 June	813	86	470	69	4,015	617
23-29 June	337	122	183	56	2,734	74
30 June-6 July	212	23	146	32	1,722	137
7-13 July	184	73	136	62	1,876	490
14-19 July	26	11	15	4	556	169
Total	2,651	194	1,536	146	16,271	1,009
			SAILOR'S PIT			
2-8 June	16	8	16	59	414	122
9-15 June	174	36	99	201	1,491	182
16-22 June	128	26	98	204	1,760	201
23-29 June	52	11	43	73	1,046	149
30 June-6 July	23	12	7	20	446	83
7-13 July	8	4	8	17	425	81
14-19 July	9	4	6	9	163	33
Total	410	48	277	17	5,745	354
			SOURDOUGH-BELOW WEIR			
2-8 June	0	0	0	0	0	0
9-15 June	0	0	0	0	0	0
16-22 June	130	23	69	7	500	108
23-29 June	327	49	107	26	1,018	331
30 June-6 July	225	25	111	6	938	37
7-13 July	82	13	37	4	320	40
14-19 July	50	0	17	0	142	0
Total	814	61	341	28	2,918	353
			SOURDOUGH-ABOVE WEIR			
2-8 June	5	4	2	2	233	110
9-15 June	70	32	28	9	938	286
16-22 June	197	61	100	26	2,848	213
23-29 June	477	110	53	12	2,348	109
30 June-6 July	181	58	67	23	2,462	542
7-13 July	97	9	29	4	1,011	96
14-19 July	18	4	6	4	306	105
Total	1,045	142	285	38	10,146	682
			TOTAL RIVER			
2-8 June	154	74	100	46	1,737	591
9-15 June	1,190	81	631	81	6,707	371
16-22 June	1,268	99	737	73	9,123	706
23-29 June	1,193	149	386	59	7,146	460
30 June-6 July	641	79	331	41	5,568	575
7-13 July	371	75	210	63	3,632	505
14-19 July	103	12	44	7	1,167	202
Total	4,920	224	2,439	152	35,080	1,350

Table 7.-Lengths, sex, and ages of chinook salmon harvested from above the weir and sampled at Sourdough boat launch, Gulkana River, 1996.

Length (millimeters)	Sex	Age
	9-15 June	
860	M	[a]
750	F	1.3
860	M	[a]
810	F	1.3
820	F	1.3
	16-22 June	
900	F	1.3
840	F	1.3
850	M	1.3
910	M	1.3
900	M	1.3
	23-29 June	
880	M	1.3
840	F	1.3
1,040	M	1.4
1,035	M	1.4

[a] Age could not be determined due to scale regeneration.

Most chinook salmon passed through the weir between 2100 and 0700 hours daily (Figure 4). Peak daily passage of 1,429 chinook salmon occurred on 2 July (Figure 5). Peak daily passage of 8,232 sockeye salmon occurred on 21 June (Figure 6). First, second, and third quartile passage of chinook salmon occurred on 20 June, 30 June, and 7 July, respectively (Figure 7). First, second, and third quartile passage of sockeye salmon occurred on 23 June, 9 July, and 20 July, respectively (Figure 7).

Based on the final weir count and harvests of chinook salmon below and above the weir, estimated inriver return was 13,840 chinook salmon, and estimated spawning escapement was 11,399 chinook salmon. The 1996 sport harvest exploited about 20% of this estimated return.

DISCUSSION

The access-point creel survey implemented in 1996 was the first of this type for the Gulkana River and the first inseason estimate of catch and harvest of, and effort for, chinook salmon since a roving creel survey was conducted in 1989 (Potterville and Webster 1990). Results from this

Table 8.-Daily and cumulative passage of adult fish passing upstream at river km 50 between 11 June and 31 July, Gulkana River, 1996.

	Chinook Salmon		Sockeye Salmon		Rainbow Trout		Arctic Grayling	
Date	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.
11-Jun	2	2	1,449	1,449		0		0
12-Jun	21	23	3,433	4,882		0		0
13-Jun	141	164	3,812	8,694	3	3		0
14-Jun	40	204	2,441	11,135		3	1	1
15-Jun	116	320	3,195	14,330		3		1
16-Jun	203	523	1,399	15,729		3	1	2
17-Jun	849	1,372	3,665	19,394		3		2
18-Jun	815	2,187	3,760	23,154		3	16	18
19-Jun	489	2,676	3,776	26,930		3	21	39
20-Jun	203	2,879	1,749	28,679	1	4	21	60
21-Jun	463	3,342	8,232	36,911		4	11	71
22-Jun	346	3,688	3,324	40,235		4	2	73
23-Jun	636	4,324	7,998	48,233		4		73
24-Jun	802	5,126	2,453	50,686		4	4	77
25-Jun	195	5,321	3,560	54,246		4	2	79
26-Jun	75	5,396	754	55,000	1	5	2	81
27-Jun	71	5,467	4,850	59,850		5	5	86
28-Jun	59	5,526	997	60,847		5	5	91
29-Jun	48	5,574	1,176	62,023		5	3	94
30-Jun	376	5,950	4,169	66,192		5		94
1-Jul	114	6,064	2,325	68,517		5	1	95
2-Jul	1,429	7,493	3,942	72,459		5		95
3-Jul	521	8,014	4,416	76,875	2	7	3	98
4-Jul	92	8,106	1,804	78,679		7		98
5-Jul	146	8,252	1,198	79,877	1	8		98
6-Jul	50	8,302	2,451	82,328		8	2	100
7-Jul	597	8,899	4,644	86,972	1	9	4	104
8-Jul	246	9,145	2,961	89,933	2	11	6	110
9-Jul	140	9,285	3,136	93,069		11	1	111
10-Jul	82	9,367	4,040	97,109	3	14	1	112
11-Jul	87	9,454	3,735	100,844		14	1	113
12-Jul	131	9,585	2,773	103,617		14		113
13-Jul	71	9,656	2,113	105,730		14		113
14-Jul	55	9,711	3,352	109,082		14		113
15-Jul	83	9,794	4,555	113,637		14	1	114
16-Jul	203	9,997	5,651	119,288	3	17	1	115
17-Jul	315	10,312	5,530	124,818		17	3	118
18-Jul	334	10,646	4,594	129,412	1	18	4	122
19-Jul	205	10,851	4,142	133,554		18	1	123
20-Jul	196	11,047	5,790	139,344	1	19	3	126
21-Jul	57	11,104	1,949	141,293	1	20	4	130
22-Jul	15	11,119	1,509	142,802		20	3	133
23-Jul	66	11,185	5,364	148,166		20	2	135
24-Jul	54	11,239	4,254	152,420	1	21	2	137
25-Jul	54	11,293	4,618	157,038	2	23	2	139
26-Jul	25	11,318	4,293	161,331		23	2	141
27-Jul	37	11,355	2,910	164,241	2	25		141
28-Jul	20	11,375	5,325	169,566		25		141
29-Jul	57	11,432	6,203	175,769		25		141
30-Jul	92	11,524	2,866	178,635		25	1	142
31-Jul	160	11,684	4,826	183,461	1	26	1	143

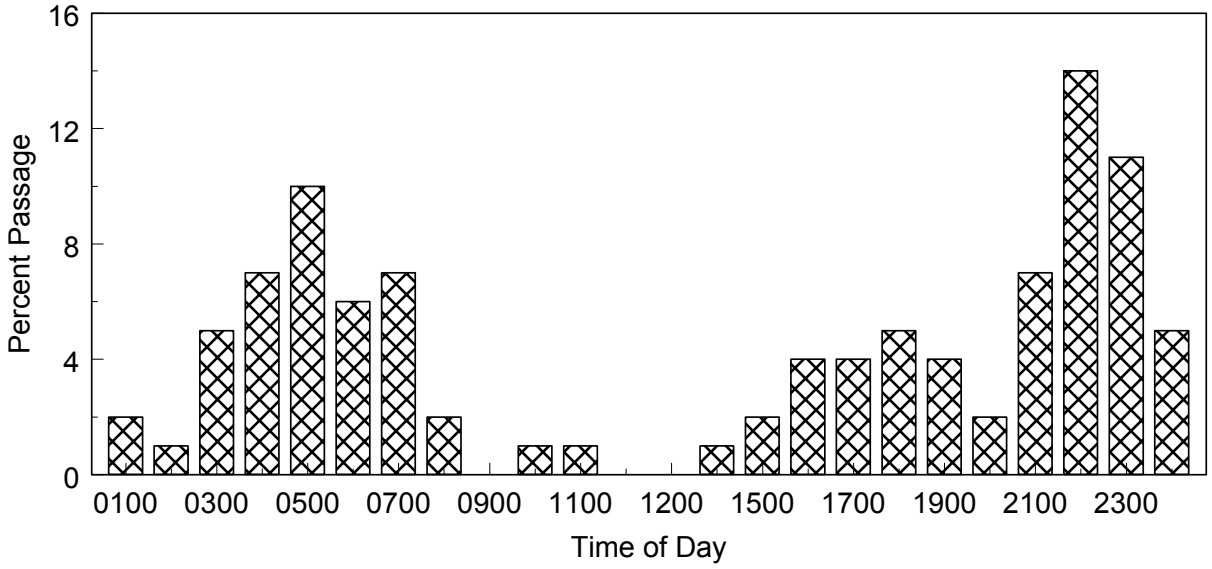

Figure 4.-Hourly percent of total upstream passage of chinook salmon past river km 51, Gulkana River, 1996.

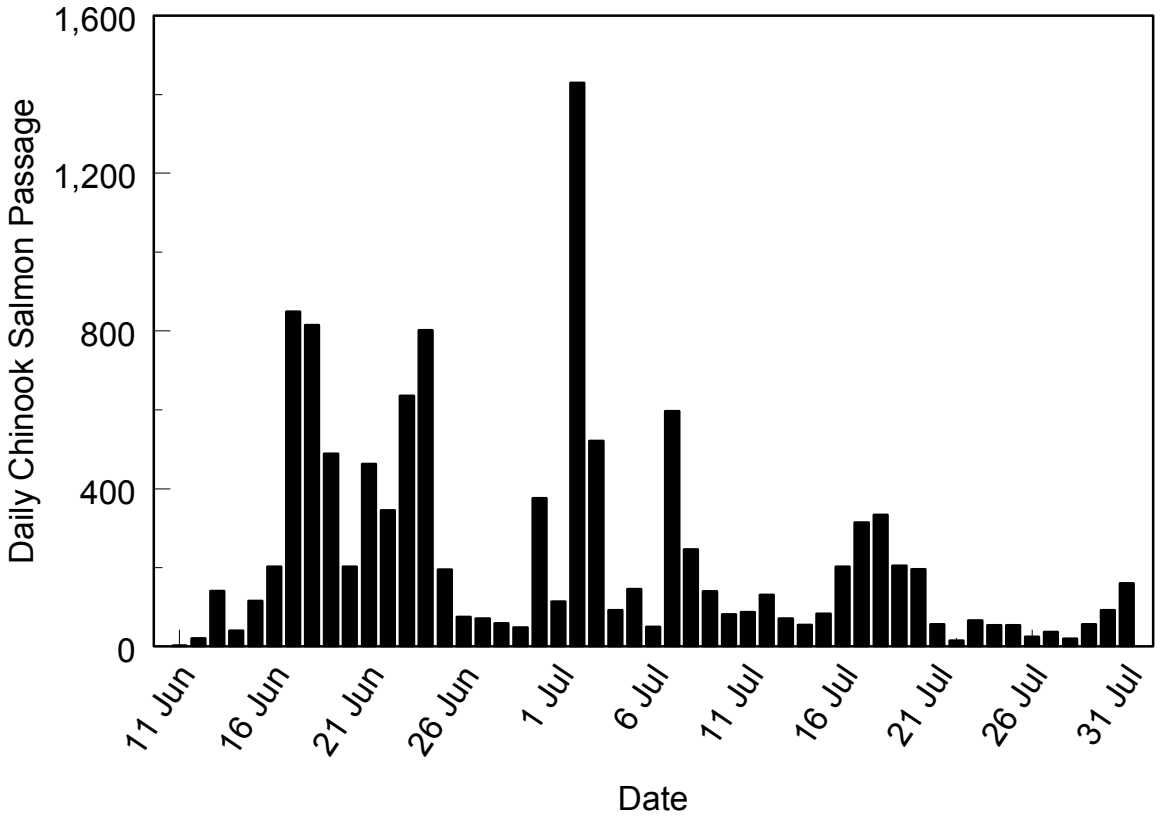

Figure 5.-Daily passage of chinook salmon upstream through the weir at river km 51, Gulkana River, 1996.

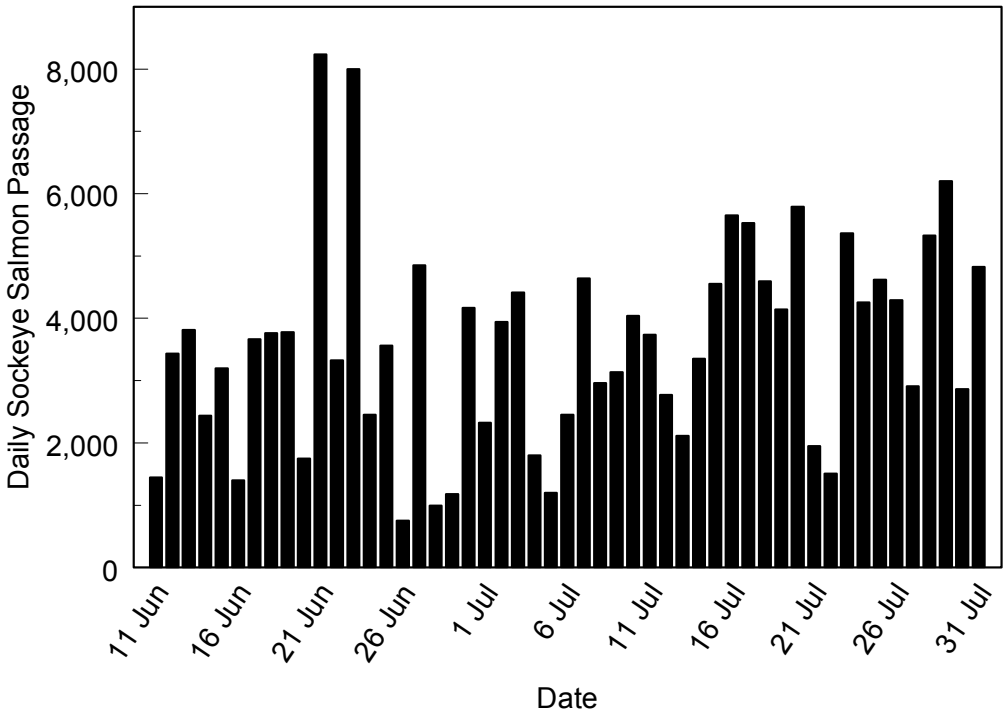

Figure 6.-Daily passage of sockeye salmon passed upstream through the weir at river km 51, Gulkana River, 1996.

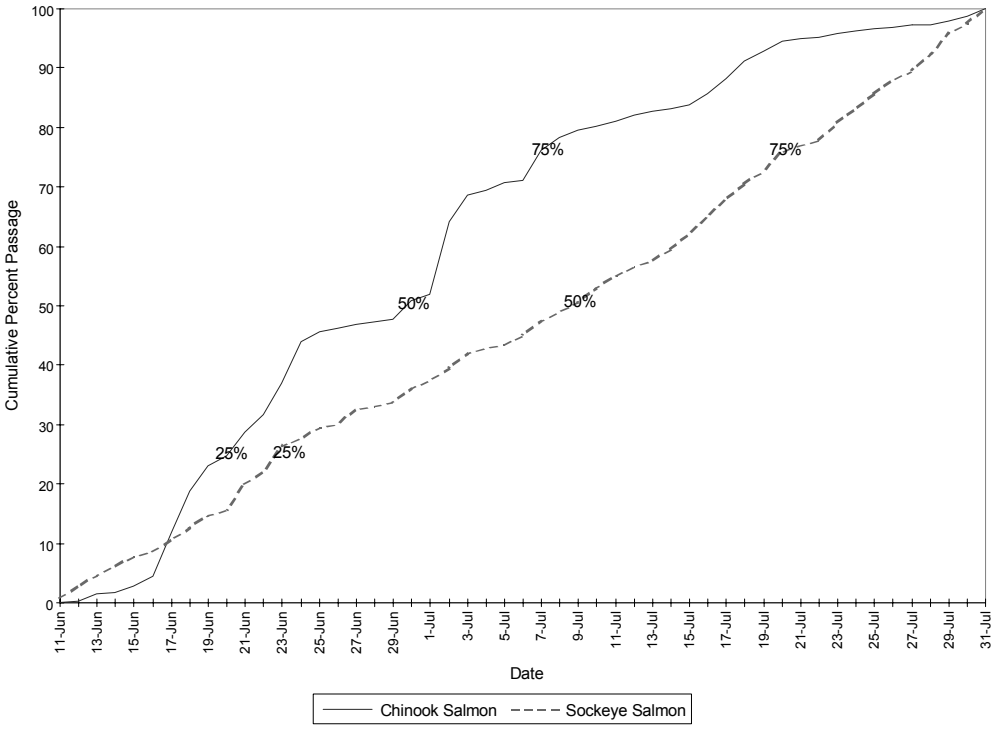

Figure 7.-Cumulative passage of chinook and sockeye salmon passed upstream through the weir at river km 51, Gulkana River, 1996.

year's creel survey were 36% and 45% below the average harvest and catch estimated from the SWHS for 1991-1995, respectively (Table 9).

We consider the creel survey estimates for 1996 to be low due to the nature of the access-point survey design. Two conditions must hold if estimates from this type of creel survey are to be unbiased: (1) interviewed anglers are a representative sample of exiting anglers, and (2) no anglers exit the fishery at times or places not subject to sampling. During the 1996 survey, we anticipated interviewing most, if not all, anglers exiting the fishery at sampled access sites during sampled periods. If this was so, sampling would be representative because scheduling of the sampling of first-stage units would be random. We believe that the first condition was met during this year's survey on the Gulkana River because only 89 (2%) anglers exiting the fishery were not available for interviews.

When designing the survey, we identified three specific locations that historically have had the highest use by both boat and shore anglers. Anecdotal information indicated that almost all anglers exited the fishery at these locations and within the defined fishing day. The first site, the Richardson Highway bridge, provides access to both boat and shore anglers. We feel that adequate coverage was provided at this location throughout the season and that the estimates of catch and harvest of chinook salmon are accurate. Anglers did access and exit the fishery from below the bridge, however we feel that the number of these anglers was minimal in relation to the entire fishery.

The second location, Sailor's Pit, provides shore access for anglers, is an access point for nonmotorized boaters to travel downstream, and is also a take-out point for nonmotorized boaters traveling downstream from upriver access points. All boaters who pass through this location do take out at the Richardson Highway bridge and would be available for interviews there. However, multiple areas of shore access do exist at this location and many anglers were not available for interviews and were not counted. We feel that estimates of catch and harvest at this location are biased low.

Table 9.-Estimates of catch and harvest of chinook salmon from the Gulkana River, 1991-1996. Estimates for 1991-1995 are from the ADF&G mailout Statewide Harvest Survey. Estimates for 1996 are from the inseason creel survey.

Year	Catch	Harvest
1991	6,579	2,991
1992	8,037	3,071
1993	15,558	5,892
1994	6,518	3,702
1995	7,848	3,556
1996	4,920	2,441
Mean (1991-1995)	8,908	3,842

The Sourdough location is almost solely a boat access and take-out point for both motorized and nonmotorized boaters using the upper reaches of the Gulkana River. We feel that the estimates of catch and harvest of chinook salmon from above the weir are accurate. However, we do not feel that estimates from below the weir are accurate. This season a portion of the sport fishery was displaced to below the weir. Fish tended to hold behind the weir for an estimated 1 to 2 days. Old foot trails became new shore access points that are not normally used by anglers. These anglers were not available for interviews at Sourdough. Also, some commercially and noncommercially guided boat anglers had private land access to the river below Sourdough. These anglers were also not available for interviews.

Low water levels may also have influenced the estimation of catch and harvest of chinook salmon in 1996. More fishing holes may have become available due to the low water. Two or three additional shore access sites were observed being used along the Richardson Highway between Poplar Grove and Sourdough that are not normally used during the chinook salmon fishing season. With the same level of resources that were available in 1996, a roving creel survey design may have provided a more accurate estimate of catch, harvest, and effort for this fishery. Results from the 1996 SWHS may provide further direction if another creel survey is to be conducted on the Gulkana River.

The recreational fishery for chinook salmon on the Gulkana River is considered to be at maximum harvest potential at this time. Harvest of chinook salmon has remained relatively stable from 1991-1995, however, fishing effort continues to increase. The passage of 11,684 chinook salmon through the weir was a higher than anticipated return.

A peak aerial survey flown on the Gulkana River in 1996 showed that approximately 20% (2,297) of the cumulative chinook salmon that had passed through the weir were observed on that day. The average index count of chinook salmon in the Gulkana River from 1990-1995 is 1,145 (Szarzi 1996). Based on the premise that survey conditions were at the very least near optimal this year, the average index count for the previous 5 years probably accounts for less than 20% of the actual escapement of chinook salmon to the Gulkana River, considering the less than near optimal survey conditions under which the surveys were flown.

No biological data were collected at the weir. Sockeye-sized chinook salmon (age 1.2) could not be separated from sockeye salmon until they had passed completely through the live box and into the upstream open water. This was due to the high daily passage ratio of sockeye-to-chinook salmon. All age classes of chinook salmon that passed through the weir were included in the total count. The aeration of the water that developed as the high velocity water passed through the upstream pickets found in the live box was also a sampling hindrance. Modifications to the live box will have to be made to accommodate biological sampling in the future. A larger holding pen with a v-shaped exit configured with deflecting fins may be one alternative.

The site below Sourdough was determined to be the best for installation, operation, and maintenance of such a weir. The water velocity is lower than that found at the site evaluated near the confluence at the Copper River and proved to be much more accessible over the length of the data collection period than the site evaluated at Poplar Grove would have been. However, atypical hydrological conditions were observed within the Gulkana River drainage in 1996. Low levels of winter precipitation preceded low levels of spring and summer precipitation which allowed for uninterrupted data collection at the weir due to the lower levels of water. We

anticipate that data collection will be interrupted during years when there is normal or higher than normal levels of annual precipitation.

Data collection from juvenile chinook salmon passing downstream through the weir was possible early in the season when water level and velocity were the highest for the season. After 30 June very few juveniles were captured with the stationary inclined-plane traps. The juvenile salmon were able to avoid these traps during periods of lower water level and velocity after 30 June. Minnow traps baited with cured salmon roe were used for capturing juvenile chinook salmon between 12-28 August in 1996. A total of 9,030 juveniles were captured in the Gulkana River. Mean length of sampled chinook was 78 mm, 77 mm, and 84 mm for each of the 3 weeks of the trapping period. We consider baited minnow traps to be the most effective method for capturing an adequate number of individuals for implementing a coded wire tag mark-recapture study beginning in 1997.

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Terry Bradley provided assistance and guidance during weir site selection and weir design, fabrication, installation and operation. Ron Burr, Joe LeFaive, and Jim Witt assisted with weir fabrication. Jerry Strait and Nicole Szarzi assisted with site selection. Lonnie Baker, Ron Burr, Joe LeFaive, Austin Mahalkey, Matt Miller, Mark Stadtmiller, and Duncan Tipton installed, operated, maintained, and removed the weir and were responsible for all data collection. Pam Herrera and John Olivas assisted with data collection at the weir.

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APPENDIX A. ESTIMATES OF CATCH, HARVEST, AND EFFORT LISTED BY TIME OF DAY AT EACH SPECIFIC LOCATION AND FOR ALL SITES COMBINED, GULKANA RIVER, 1996

Appendix A1.-Estimates of catch listed by time of day at each specific location and for all sites combined, Gulkana River, 1996.

Week	Early-Day[a] Estimate	SE	Mid-Day[b] Estimate	SE	Late-Day[c] Estimate	SE
RICHARDSON HIGHWAY BRIDGE						
2 - 8 June	0	0	37	3	96	73
9 - 15 June	0	0	332	14	614	63
16 - 22 June	35	30	365	17	414	78
23 - 29 June	18	3	111	5	208	122
30 June - 6 July	67	21	94	5	51	10
7 - 13 July	79	67	45	9	60	28
14 - 19 July	0	0	14	4	12	10
Total	199	76	998	25	1,455	177
SAILOR'S PIT						
2 - 8 June	0	0	11	7	6	3
9 - 15 June	24	6	49	10	101	34
16 - 22 June	17	3	94	25	17	6
23 - 29 June	3	3	11	5	37	9
30 June - 6 July	1	1	6	4	15	11
7 - 13 July	4	2	5	3	0	0
14 - 19 July	0	0	9	4	0	0
Total	49	8	185	29	176	37
SOURDOUGH-BELOW WEIR						
2 - 8 June	0	0	0	0	0	0
9 - 15 June	0	0	0	0	0	0
16 - 22 June	0	0	100	0	30	23
23 - 29 June	0	0	20	0	122	49
30 June - 6 July	0	0	102	1	123	25
7 - 13 July	0	0	59	0	23	13
14 - 19 July	0	0	50	0	0	0
Total	0	0	516	1	298	61
SOURDOUGH-ABOVE WEIR						
2 - 8 June	0	0	0	0	5	4
9 - 15 June	0	0	28	2	42	32
16 - 22 June	0	0	59	0	138	61
23 - 29 June	0	0	191	0	286	110
30 June - 6 July	0	0	38	0	143	58
7 - 13 July	0	0	62	0	35	9
14 - 19 July	0	0	12	0	6	4
Total	0	0	390	2	655	142
TOTAL RIVER						
2 - 8 June	0	0	48	8	107	73
9 - 15 June	24	6	409	17	757	78
16 - 22 June	52	30	618	30	599	102
23 - 29 June	21	4	518	7	653	171
30 June - 6 July	68	21	240	7	332	65
7 - 13 July	83	67	171	9	118	32
14 - 19 July	0	0	85	6	18	11
Total	248	77	2,089	39	2,584	238

[a] Early-Day = 0500-0900 hours for Richardson Hwy Bridge, Sourdough-Below Weir, and Sourdough-Above Weir; 0500-1100 hours for Sailor's Pit.

[b] Mid-Day = 0900-1500 hours for Richardson Hwy Bridge, Sourdough-Below Weir, and Sourdough-Above Weir; 1100-1700 hours for Sailor's Pit.

[c] Late-Day = 1500-2300 hours for Richardson Hwy Bridge, Sourdough-Below Weir, and Sourdough-Above Weir; 1700-2300 hours for Sailor's Pit.

Appendix A2.-Estimates of harvest listed by time of day at each specific location and for all sites combined, Gulkana River, 1996.

Week	Early-Day[a] Estimate	SE	Mid-Day[b] Estimate	SE	Late-Day[c] Estimate	SE
RICHARDSON HIGHWAY BRIDGE						
2 - 8 June	0	0	23	2	59	45
9 - 15 June	0	0	196	7	308	79
16 - 22 June	14	12	169	6	287	68
23 - 29 June	14	0	75	3	95	56
30 June - 6 July	56	30	54	4	37	10
7 - 13 July	70	59	27	6	39	18
14 - 19 July	0	0	12	3	3	2
Total	154	67	556	12	828	128
SAILOR'S PIT						
2 - 8 June	0	0	11	7	6	3
9 - 15 June	11	5	36	6	52	12
16 - 22 June	17	3	64	13	17	6
23 - 29 June	3	3	9	4	30	7
30 June - 6 July	1	1	6	4	0	0
7 - 13 July	4	2	5	3	0	0
14 - 19 July	0	0	6	3	0	0
Total	36	7	137	17	105	15
SOURDOUGH-BELOW WEIR						
2 - 8 June	0	0	0	0	0	0
9 - 15 June	0	0	0	0	0	0
16 - 22 June	0	0	60	0	9	7
23 - 29 June	0	0	64	0	43	26
30 June - 6 July	0	0	57	1	55	6
7 - 13 July	0	0	28	0	9	4
14 - 19 July	0	0	17	0	0	0
Total	0	0	226	1	116	28
SOURDOUGH-ABOVE WEIR						
2 - 8 June	0	0	0	0	2	2
9 - 15 June	0	0	16	1	12	9
16 - 22 June	0	0	35	0	65	26
23 - 29 June	0	0	22	0	31	12
30 June - 6 July	0	0	8	0	59	23
7 - 13 July	0	0	18	0	11	4
14 - 19 July	0	0	0	0	6	4
Total	0	0	99	1	186	38
TOTAL RIVER						
2 - 8 June	0	0	34	7	67	45
9 - 15 June	11	5	248	9	372	81
16 - 22 June	31	12	328	14	378	73
23 - 29 June	17	3	170	5	199	63
30 June - 6 July	57	30	125	6	151	26
7 - 13 July	74	59	78	7	59	19
14 - 19 July	0	0	35	4	9	5
Total	190	68	1,018	21	1,235	135

[a] Early-Day = 0500-0900 hours for Richardson Hwy Bridge, Sourdough-Below Weir, and Sourdough-Above Weir; 0500-1100 hours for Sailor's Pit.

[b] Mid-Day = 0900-1500 hours for Richardson Hwy Bridge, Sourdough-Below Weir, and Sourdough-Above Weir; 1100-1700 hours for Sailor's Pit.

[c] Late-Day = 1500-2300 hours for Richardson Hwy Bridge, Sourdough-Below Weir, and Sourdough-Above Weir; 1700-2300 hours for Sailor's Pit.

Appendix A3.-Estimates of effort (angler-hours) listed by time of day at each specific location and for all sites combined, Gulkana River, 1996.

Week	Early-Day[a] Estimate	Early-Day[a] SE	Mid-Day[b] Estimate	Mid-Day[b] SE	Late-Day[c] Estimate	Late-Day[c] SE
RICHARDSON HIGHWAY BRIDGE						
2 - 8 June	14	0	320	6	757	567
9 - 15 June	0	0	1,385	24	2,894	147
16 - 22 June	175	30	1,478	34	2,362	615
23 - 29 June	86	19	1,034	17	1,613	70
30 June - 6 July	158	18	563	12	1,001	135
7 - 13 July	184	156	523	20	1,169	464
14 - 19 July	15	12	358	79	182	149
Total	632	162	5,661	94	9,978	991
SAILOR'S PIT						
2 - 8 June	5	3	240	95	169	76
9 - 15 June	92	29	372	79	1,026	161
16 - 22 June	149	20	879	193	732	53
23 - 29 June	93	60	262	46	691	129
30 June - 6 July	95	31	163	65	188	41
7 - 13 July	87	20	186	55	153	56
14 - 19 July	27	7	126	32	11	4
Total	548	79	2,228	251	2,970	236
SOURDOUGH -BELOW WEIR						
2 - 8 June	0	0	0	0	0	0
9 - 15 June	0	0	0	0	0	0
16 - 22 June	0	0	357	4	143	108
23 - 29 June	0	0	497	11	521	331
30 June - 6 July	0	0	448	12	490	34
7 - 13 July	0	0	246	8	74	40
14 - 19 July	0	0	142	0	0	0
Total	0	0	1,690	19	1,228	352
SOURDOUGH-ABOVE WEIR						
2 - 8 June	0	0	83	2	151	110
9 - 15 June	0	0	482	4	455	286
16 - 22 June	154	130	1,027	11	1,667	169
23 - 29 June	0	0	1,152	18	1,196	108
30 June - 6 July	21	18	663	23	1,778	541
7 - 13 July	0	0	810	19	201	95
14 - 19 July	0	0	42	0	264	105
Total	175	131	4,259	37	5,712	668
TOTAL RIVER						
2 - 8 June	19	3	643	96	1,077	583
9 - 15 June	92	29	2,239	83	4,375	330
16 - 22 June	478	135	3,741	196	4,904	649
23 - 29 June	179	63	2,945	54	4,021	378
30 June - 6 July	274	40	1,837	71	3,457	560
7 - 13 July	271	157	1,765	62	1,597	478
14 - 19 July	42	14	668	85	457	182
Total	1,355	223	13,838	271	19,888	1,268

[a] Early-Day = 0500-0900 hours for Richardson Hwy Bridge, Sourdough-Below Weir, and Sourdough-Above Weir; 0500-1100 hours for Sailor's Pit.

[b] Mid-Day = 0900-1500 hours for Richardson Hwy Bridge, Sourdough-Below Weir, and Sourdough-Above Weir; 1100-1700 hours for Sailor's Pit.

[c] Late-Day = 1500-2300 hours for Richardson Hwy Bridge, Sourdough-Below Weir, and Sourdough-Above Weir; 1700-2300 hours for Sailor's Pit.