

Fishery Data Series No. 99-4

**Angler Effort and Harvest of Chinook Salmon by the
Recreational Fisheries in the Lower Kenai River, 1997**

by

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May 1999

Alaska Department of Fish and Game

Division of Sport Fish



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Weights and measures (metric)		General		Mathematics, statistics, fisheries	
centimeter	cm	All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.	alternate hypothesis	H_A
deciliter	dL	All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.	base of natural logarithm	e
gram	g	and	&	catch per unit effort	CPUE
hectare	ha	at	@	coefficient of variation	CV
kilogram	kg	Compass directions:		common test statistics	F, t, χ^2 , etc.
kilometer	km	east	E	confidence interval	C.I.
liter	L	north	N	correlation coefficient	R (multiple)
meter	m	south	S	correlation coefficient	r (simple)
metric ton	mt	west	W	covariance	cov
milliliter	ml	Copyright	©	degree (angular or temperature)	°
millimeter	mm	Corporate suffixes:		degrees of freedom	df
Weights and measures (English)		Company	Co.	divided by	÷ or / (in equations)
cubic feet per second	ft ³ /s	Corporation	Corp.	equals	=
foot	ft	Incorporated	Inc.	expected value	E
gallon	gal	Limited	Ltd.	fork length	FL
inch	in	et alii (and other people)	et al.	greater than	>
mile	mi	et cetera (and so forth)	etc.	greater than or equal to	≥
ounce	oz	exempli gratia (for example)	e.g.,	harvest per unit effort	HPUE
pound	lb	id est (that is)	i.e.,	less than	<
quart	qt	latitude or longitude	lat. or long.	less than or equal to	≤
yard	yd	monetary symbols (U.S.)	\$, ¢	logarithm (natural)	ln
Spell out acre and ton.		months (tables and figures): first three letters	Jan,...,Dec	logarithm (base 10)	log
Time and temperature		number (before a number)	# (e.g., #10)	logarithm (specify base)	log ₂ , etc.
day	d	pounds (after a number)	# (e.g., 10#)	mideye-to-fork	MEF
degrees Celsius	°C	registered trademark	®	minute (angular)	'
degrees Fahrenheit	°F	trademark	™	multiplied by	x
hour (spell out for 24-hour clock)	h	United States (adjective)	U.S.	not significant	NS
minute	min	United States of America (noun)	USA	null hypothesis	H_0
second	s	U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)	percent	%
Spell out year, month, and week.				probability	P
Physics and chemistry				probability of a type I error (rejection of the null hypothesis when true)	α
all atomic symbols				probability of a type II error (acceptance of the null hypothesis when false)	β
alternating current	AC			second (angular)	"
ampere	A			standard deviation	SD
calorie	cal			standard error	SE
direct current	DC			standard length	SL
hertz	Hz			total length	TL
horsepower	hp			variance	Var
hydrogen ion activity	pH				
parts per million	ppm				
parts per thousand	ppt, ‰				
volts	V				
watts	W				

FISHERY DATA SERIES NO. 99-4

**ANGLER EFFORT AND HARVEST OF CHINOOK SALMON BY THE
RECREATIONAL FISHERIES IN THE LOWER KENAI RIVER, 1997**

by

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May 1999

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ABSTRACT

A creel survey to estimate angler effort, and catch and harvest of chinook salmon *Oncorhynchus tshawytscha* was conducted on the Kenai River between the Soldotna Bridge and Cook Inlet from 17 May through 3 August 1997. During the early run (May and June), estimated angler-effort was 102,243 (SE = 5,130) angler-hours and harvest was 4,942 (SE = 619) chinook salmon. During the late run (July and August), estimated angler-effort was 263,642 (SE = 10,153) angler-hours and harvest was 10,336 (SE = 710) chinook salmon. During the early run, the recreational fishery was restricted by emergency order on 17 June through 30 June to catch-and-release fishing for all chinook salmon less than 132 cm in total length. This management action was taken due to low numbers of returning chinook salmon, as determined by sonar, and relatively high harvest rates in the sport fishery. During the late run the fishery was extended until 3 August in response to a greater than average return. Unguided anglers accounted for 37% of the fishing effort and took 26% of the harvest during the early run, while guided anglers accounted for 63% of the effort and took 74% of the harvest. During the late run, unguided anglers had 52% of the effort and 43% of the harvest, and guided anglers had 48% of the effort and 57% of the harvest.

The predominant age class in the recreational harvest as well as the inriver return during both runs was age-1.4 chinook salmon, followed by age-1.3 fish.

Key words: Kenai River, chinook salmon, creel survey, effort, harvest, *Oncorhynchus tshawytscha*.

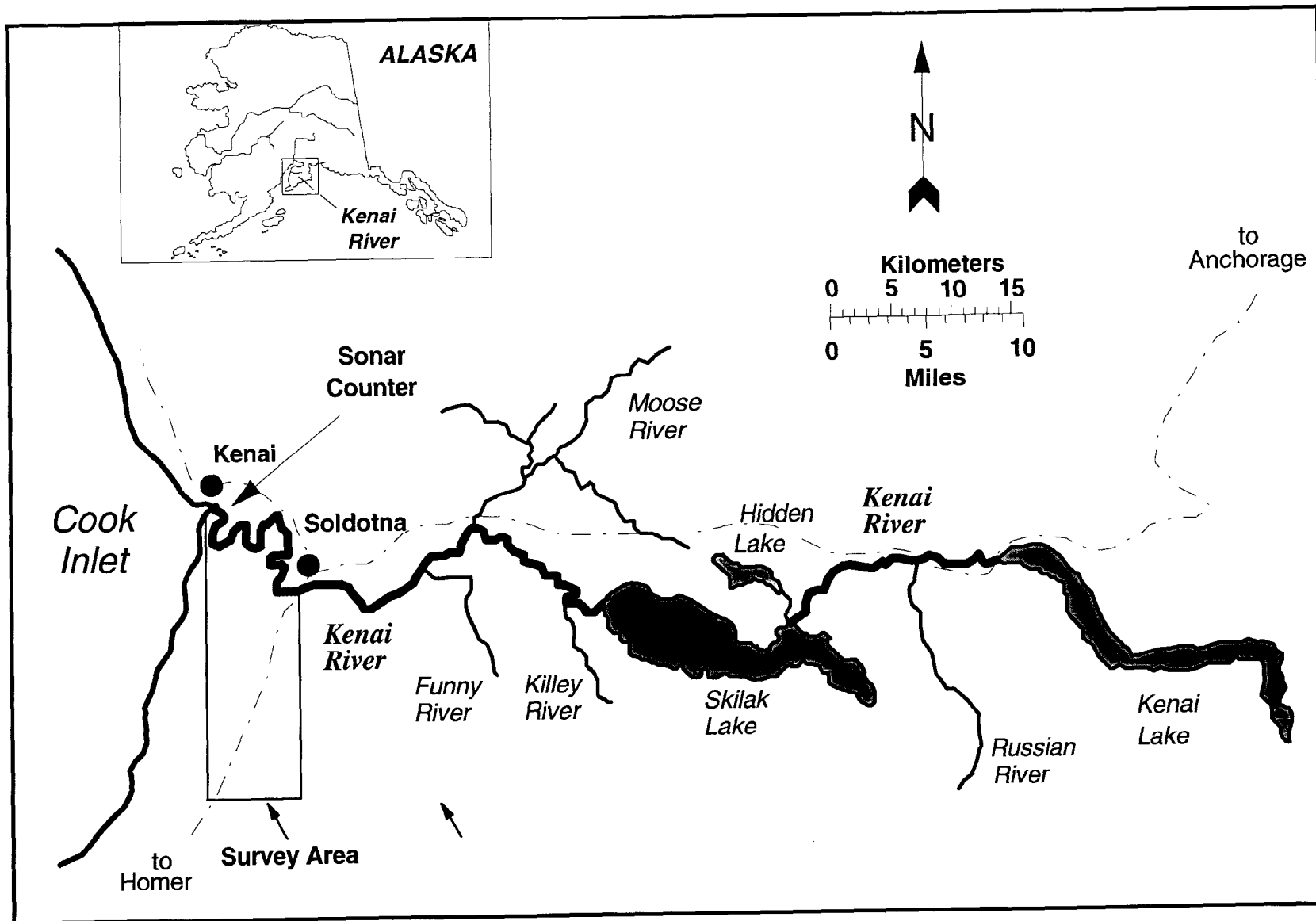
INTRODUCTION

The Kenai River supports the largest freshwater recreational fishery in Alaska with an average annual effort of over 340,000 angler-days during the past 7 years (Mills 1991-1994, Howe et al. 1995-1997). This represents about 13% of the state's total recreational fishing effort. The majority of sport fishing effort on the Kenai River occurs during the chinook salmon *Oncorhynchus tshawytscha* fishery (May through July) between the outlet of Skilak Lake and Cook Inlet (Figure 1). Angler effort in the chinook salmon fisheries increased from 1974 through 1988. Effort and harvest dropped during 1990-1992 because of decreased run size which necessitated restrictions to the fishery. Effort and harvest since 1992 have been similar to historical averages (Figures 2 and 3). Although coho salmon *O. kisutch*, sockeye salmon *O. nerka*, pink salmon *O. gorbuscha*, Dolly Varden *Salvelinus malma*, and rainbow trout *O. mykiss* are also harvested by sport anglers fishing the Kenai River, this report focuses only on the chinook salmon fisheries.

Prior to 1970, the recreational fishery in the Kenai River was composed of shorebased anglers targeting sockeye salmon in July and coho salmon in August and early September. In 1973, anglers began experimenting with new fishing techniques which proved effective for harvesting chinook salmon in the Kenai River; thus, the chinook salmon fishery began to expand rapidly (Figures 2 and 3).

Chinook salmon return to the Kenai River in two distinct temporal components: an early run, typically entering the river in early May until late June; and a late run, typically entering the river from late June through early August. Recreational anglers value fish from both runs due to their large size, especially those from the late run which average about 18 kg (40 lb) and may exceed 36 kg (80 lb). The world record sport-caught chinook salmon, which weighed 44.1 kg (97 lb), was taken from the Kenai River in May 1985.

The early and late chinook salmon returns to the Kenai River are managed by separate management plans adopted by the Board of Fisheries (BOF) in 1988. The Kenai River Early King Salmon Management Plan stipulates that the use of bait is prohibited from 1 January until



2

Figure 1.-Map of the Kenai River drainage.

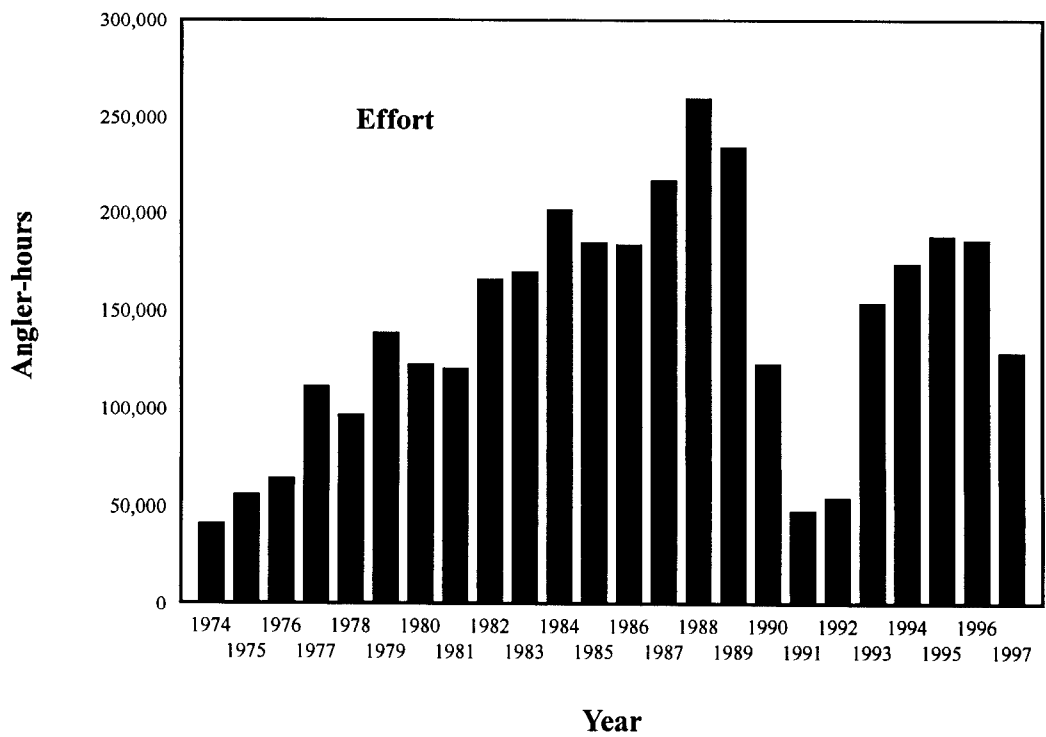
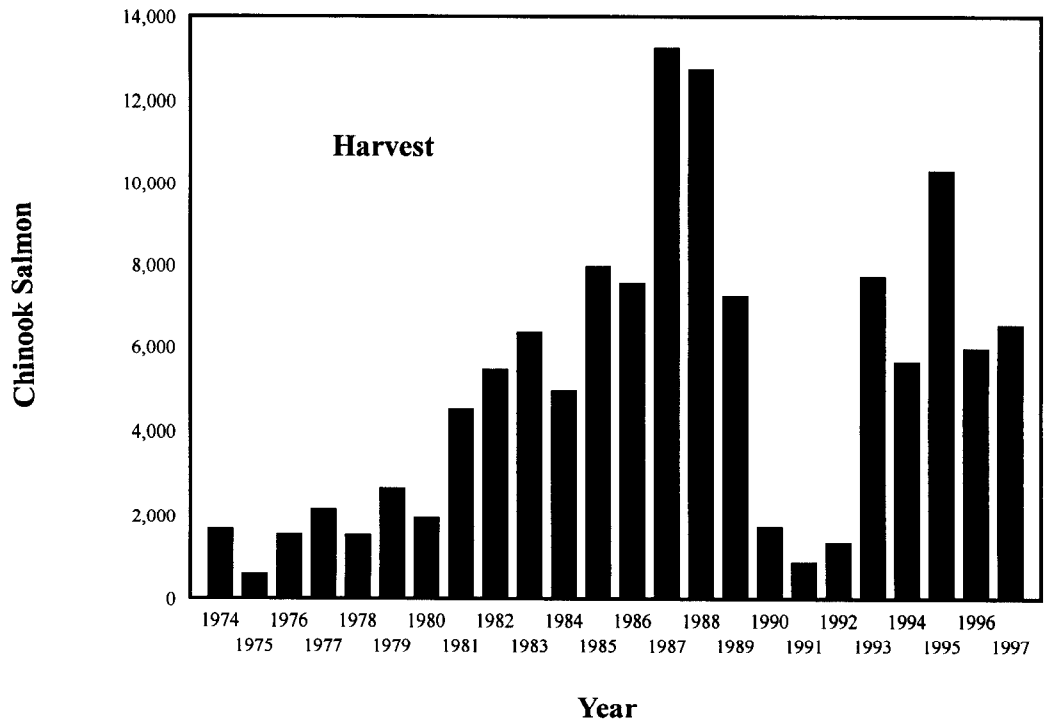


Figure 2.-Historical harvest and effort in the recreational fishery for early-run chinook salmon, Kenai River, 1974-1997.

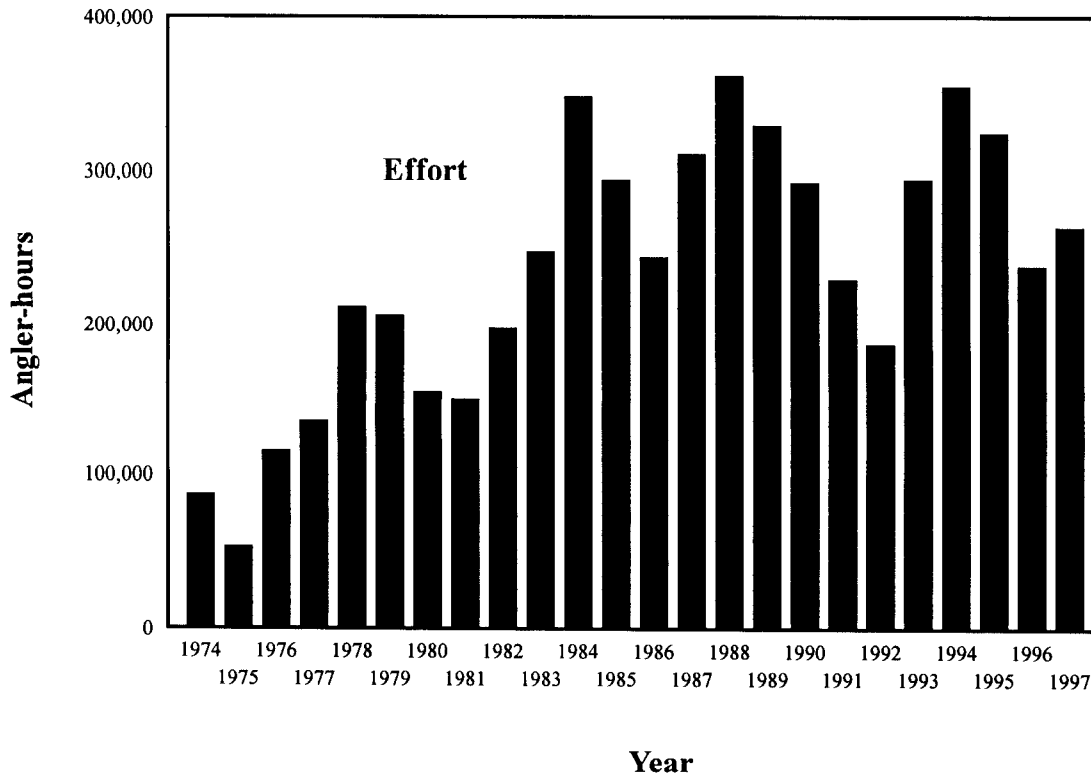
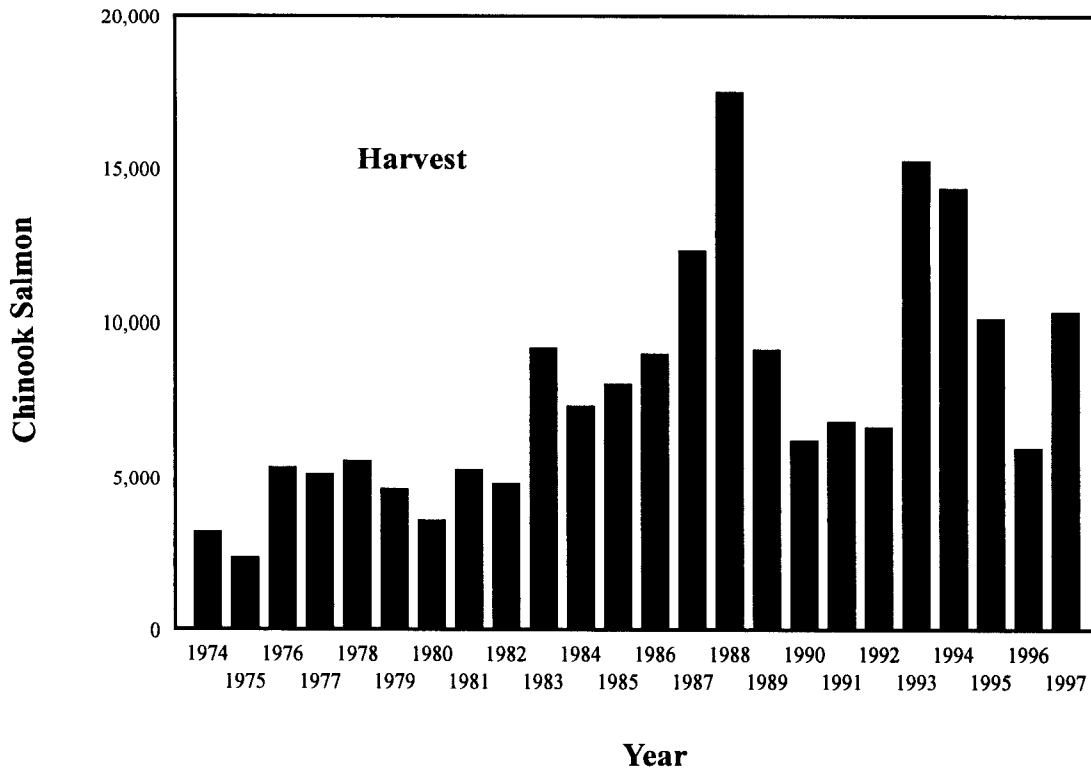


Figure 3.-Historical harvest and effort in the recreational fishery for late-run chinook salmon, Kenai River, 1974-1997.

an estimated optimum spawning escapement level of 9,000 fish is projected. If the projected spawning escapement is between 5,300 and 9,000 fish, the department shall, by emergency order, restrict the fishery through bag limit reduction and/or time/area closure to achieve 9,000 fish in the escapement. If the projected escapement is less than 5,300, chinook salmon fishing is to be prohibited until 1 July downstream of the Funny River and 10 July upstream of the Funny River. A 1990 amendment to the plan, which was implemented in 1992, allowed retention of fish 132 cm (52 in) or larger if hook-and-release (or trophy) fishing was imposed.

Management of the late-run recreational fishery in the Kenai River is complicated by the relatively large commercial harvest of returning chinook salmon. Chinook salmon are commercially harvested primarily by the setnet fishery along the eastern shore of Cook Inlet (McBride et al. 1985). User-group conflicts have required the Department of Fish and Game to manage the salmon resources of the Kenai River with increasing accuracy and precision.

In 1997, a creel survey was conducted to estimate angler effort, and catch and harvest of chinook salmon by the recreational fishery in the Kenai River. Chinook salmon were sampled to estimate the age and sex composition of the harvest and of the inriver return. This program provided data used for inseason management decisions appropriate to the recreational fishery, as well as information used by the Board of Fisheries to refine long-term management objectives and to allocate salmon resources. Previous information on the chinook salmon fisheries in the Kenai River was presented by Hammarstrom (1975-1981, 1988-1994), Hammarstrom and Larson (1982-1984, 1986), Hammarstrom et al. (1985), Conrad and Hammarstrom (1987), and King (1995-1997). In addition, angler-effort and harvest by species for the recreational fishery have been estimated by Mills (1979-1994) and Howe et al. (1995-1997) in the Alaska Statewide Sport Fish Harvest Survey.

FISHING REGULATIONS

Regulations for the chinook salmon fishery in the Kenai River are among the most restrictive of any open waters in Alaska. The river is open to fishing for chinook salmon between the outlet of Skilak Lake and Cook Inlet, with the exception of the confluence areas of the Funny River and Slikok Creek with the Kenai River. These waters are closed to fishing for chinook salmon until 15 July to protect early-run chinook salmon that stage in these locations prior to entering their natal streams. The season for chinook salmon is from 1 January through 31 July, but the fishery effectively begins in mid-May when the fish begin entering the river in harvestable numbers and the river becomes navigable for anglers. For management purposes the early run is defined as all chinook salmon entering the river prior to 1 July, and the late run is defined as fish entering on or after 1 July. The daily bag and possession limits are one chinook salmon per day greater than 41 cm (16 in) in length and a seasonal limit of two chinook salmon greater than 41 cm. Fishing from boats downstream from the outlet of Skilak Lake is prohibited on Mondays in May, June, and July, except Memorial Day Monday. Anyone retaining a chinook salmon that is 41 cm in length or greater is prohibited from fishing from a boat in the Kenai River downstream of Skilak Lake for the remainder of that day. The early-run fishery is further restricted in that the use of bait is prohibited until the department is able to project an escapement of at least 9,000 fish or 1 July, whichever occurs first.

There are further restrictions for guided anglers. In addition to prohibiting fishing from boats on Mondays, fishing from a registered guide vessel on Sundays in July is prohibited as well.

Fishing from a guided boat is allowed only between 0600 and 1800 hours during June and July. Also, during May, June, and July guides are prohibited from actively fishing while conducting clients.

In 1997, the early-run fishery was restricted to catch-and-release fishing for all chinook salmon less than 132 cm (52 inches) by emergency order on 17 June. This management action was required to curtail harvest in response to low numbers of returning chinook salmon to the Kenai River as estimated by sonar. However, the late-run fishery was opened to guided anglers on Sunday, 27 July, and to fishing from boats on two successive Mondays, 21 and 28 July. The fishery was also extended through 3 August to allow retention of chinook salmon downstream of "Eagle Rock" (approximately river kilometer 18.2). These emergency orders were issued in response to the magnitude of the early and late inriver returns, but allowed continued fishing opportunity while insuring that escapement goals were achieved.

METHODS

CREEL SURVEY

A stratified, two-stage roving-access site creel survey (Bernard et al. 1998a and 1998b) was used to estimate sport fishing effort, in angler-hours, and catch and harvest of chinook salmon by the recreational fishery in the Kenai River from Cook Inlet (river mile [rm]/river kilometer [rkm] 0) to the Soldotna Bridge (rm 21 or rkm 34) of the Kenai River (Figure 4). Angler effort was estimated by conducting angler counts. Harvest per unit of effort (HPUE) and catch per unit of effort (CPUE) for chinook salmon were estimated from completed-trip angler interviews. The number of chinook salmon caught or harvested by the fishery was estimated as the product of the effort and harvest or catch rate estimates. Harvest refers to fish legally hooked and retained by anglers as part of their creel. Catch refers to fish legally hooked and retained plus those reported to be released by anglers, but not those that broke off before the fish was brought to the boat.

Regulations and inherent characteristics of the chinook salmon fishery determined stratification of the creel survey. The chinook salmon sonar site was originally located downstream of the sport fishery such that returning chinook salmon were enumerated prior to any harvest by the recreational fishery, but over the years, the fishery expanded downstream of the sonar site. Significant harvest downstream of the sonar site might affect the estimate of the inriver return. Thus, angler counts were stratified geographically by: (1) from the Warren Ames Bridge to the sonar site, and (2) from the sonar site to the Soldotna Bridge.

Both unguided and guided anglers participate in the Kenai River chinook salmon fishery and generally fish from boats (Hammarstrom 1977). By regulation, guides are required to register and place a decal on their boat(s), making these two groups easily identifiable on the river. The times and days when guides may participate in the fishery are restricted, and harvest and catch rates between guided and unguided anglers are significantly different (King 1995-1997); therefore, angler counts and interviews were stratified by angler type.

Geographic location of effort, catch, harvest, and angler type (above or below the sonar site) were determined during completed-trip angler interviews and estimates were poststratified by these two factors. Harvest and catch rates have also differed significantly among biweekly time intervals and between weekdays and weekend/holidays (King 1995-1997). Therefore, the creel

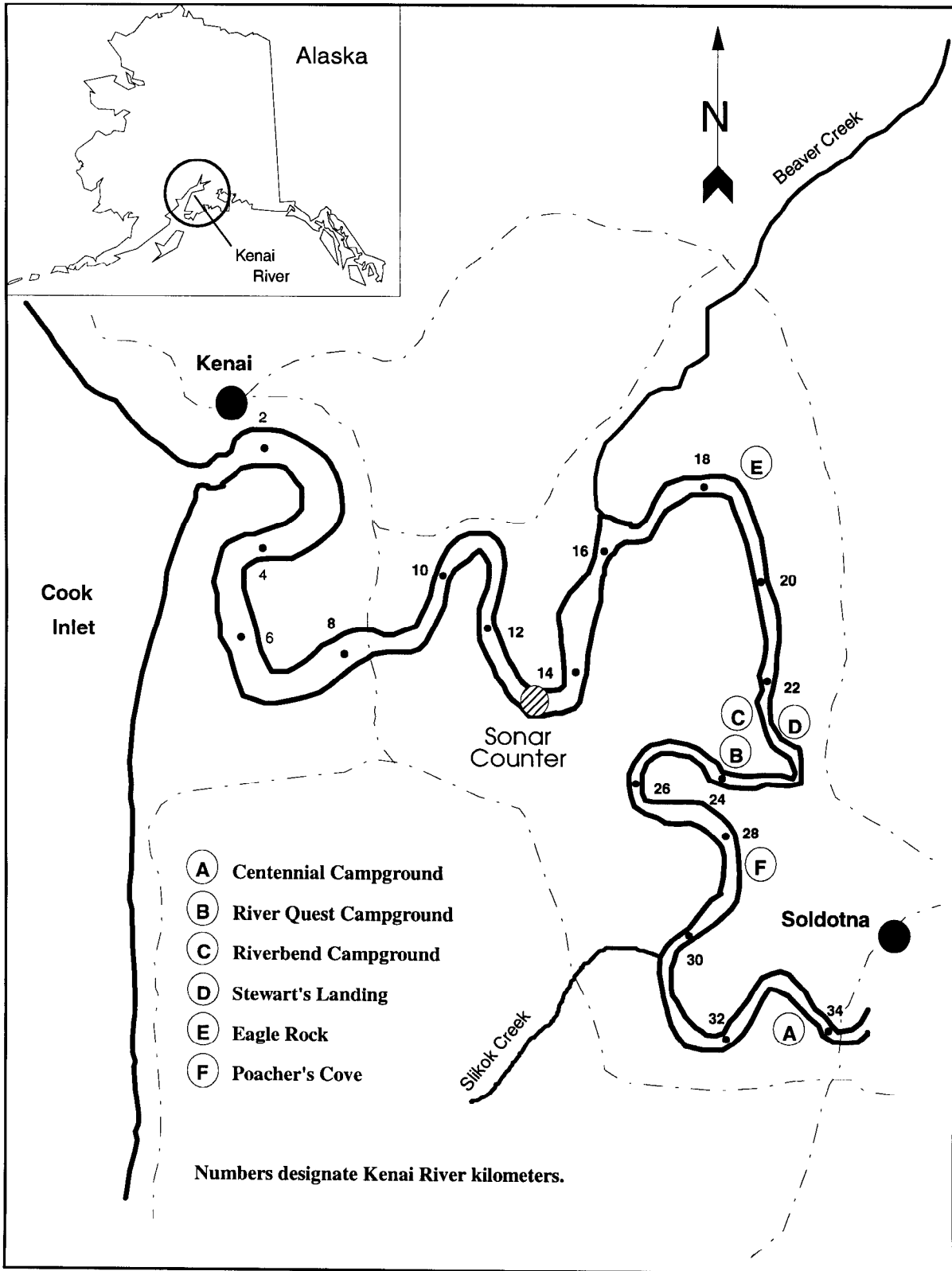


Figure 4.-Map of the Kenai River creel survey study area.

survey in 1997 was further stratified into approximate biweekly time intervals and by day type (weekdays and weekends/holidays).

The creel survey began 17 May and continued through 3 August. The two-stage design consisted of periods, 12 or 20 hours in length (the entire angler-day) as the first stage and angler-trips the second stage. The entire fishing day was sampled to minimize problems with length-of-stay bias (Bernard et al. 1998b). The unguided angler day was 20 hours long, from 0400 to 2400 hours during May, June and July. In May, the guided angler day was also 20 hours long but in June and July the guided angler day is restricted by regulation from 0600 to 1800 hours. The guided angler day is very structured during these two months because guides are limited to a 12-hour fishing day and the basic unit of charter time is generally one-half day.

Based upon these factors, the following strata were used for conducting angler counts and estimating creel statistics:

Geographic	2 strata	(1) from the Warren Ames Bridge to the sonar site, and (2) from the sonar site to the Soldotna Bridge
Temporal	5 strata	Biweekly
Day Type	2 strata	Weekday and Weekend/Holiday
Angler Type	2 strata	Guided and Unguided

This resulted in a total of 40 strata. Within each of the two geographic strata, the following temporal/day type/angler type strata were employed:

Stratum	Run	Temporal	Day Type	Angler Type
1	Early	17-31 May	Weekday	Guided
2				Unguided
3			Weekend	Guided
4				Unguided
5		1-15 June	Weekday	Guided
6				Unguided
7			Weekend	Guided
8				Unguided
9		16-30 June	Weekday	Guided
10				Unguided
11			Weekend	Guided
12				Unguided
13	Late	1-15 July	Weekday	Guided
14				Unguided
15			Weekend	Guided
16				Unguided
17		16-31 July	Weekday	Guided
18				Unguided
19			Weekend	Guided
20				Unguided

All weekend/holiday days and one less than half of all possible weekday days (excluding Mondays when no boats were allowed on the river) were sampled within each temporal stratum. Weekday days to sample were chosen at random from all possible weekday days in each temporal stratum.

Anglers were interviewed at the following six popular campground/boat launch areas (Figure 4):

- A. Centennial Campground
- B. River Quest
- C. Riverbend Campground
- D. Stewart's Landing
- E. Eagle Rock Launch Area
- F. Poacher's Cove.

Angler Counts

Five counts were made during each sample day. Time to begin the first count was chosen at random from a whole hour from 0400 to 0700 hours. All remaining counts in a day were made systematically, resulting in an angler count occurring every 4 hours. In June and July, when guided anglers were restricted to fishing from 0600-1800 hours, at least three counts of guided anglers were made. Some deviation from the schedule did occur because of mechanical breakdown and/or other duties such as public assistance or enforcement activities.

Counts of anglers were conducted from a boat from the Warren Ames Bridge to the Soldotna Bridge on the Kenai River. Two boat technicians, each working 37.5 hours per week, conducted the angler counts. The starting point of each count (upstream or downstream extremity of the survey area) was chosen at random. The technician counted anglers while driving the boat at a constant rate of speed through the survey area to the opposite end. The technician made a complete count for each geographic stratum. The entire count period usually required about 45 minutes to finish and every effort was made to ensure that the trip was completed in less than 1 hour. Angler counts were considered instantaneous and to reflect fishing effort at the time of the count. During the angler count, the boat technicians, with the use of multiple "tally-wackers," counted the following: (1) total number of unguided power boats; (2) total number of unguided drift boats; (3) total number of guided power boats; (4) total number of guided drift boats; (5) total number of unguided anglers in power boats; (6) total number of unguided anglers in drift boats; (7) total number of guided anglers in power boats (excluding the guide); (8) total number of guided anglers in drift boats (excluding the guide); and (9) total number of shore anglers.

Boats and anglers were considered engaged in fishing and were counted if the boat was in operation, regardless of whether or not an angler's line was in the water when the count was conducted. Guides were not included in the counts during the chinook salmon fishery as they are prohibited from fishing while guiding; however, this regulation does not apply during August so guides were counted as anglers during the August extension of the fishery.

Angler Interviews

Two technicians, each working 37.5 hours per week, conducted angler interviews at the designated access sites. The two boat technicians also conducted angler interviews when they were not engaged in angler counts, but only during times when the access technicians were not conducting interviews.

For each angler interviewed, the technician inquired in which geographic stratum the angler had fished. The technician obtained an interview for each stratum fished (possibly two interviews per angler) and recorded the following information for each interview: (1) powered or nonpowered boat; (2) location fished; (3) guided or unguided angler; (4) number of hours spent fishing (to the nearest 0.5 hour); (5) number of fish, by species, retained; (6) number of fish, by species, released. All data were entered into a Hewlett-Packard HP95LS computerized data recorder.

During the interview, technicians inspected harvested fish for an adipose finclip indicating that the fish had been tagged with a coded wire tag. This sampling was done to provide data for other projects, including estimating the proportion of chinook salmon marked with coded wire tags as juveniles in the Kenai River and out-of-system interception of straying of other stocks marked with coded wire tags in Cook Inlet. For harvested fish missing the adipose fin, flesh color (red or white) was recorded and the angler was asked for permission to remove the fish head so that the coded wire tag could be recovered and decoded. Creel technicians also asked anglers if they caught or harvested any fish with a radio transmitter. All harvested fish were observed for transmitter hole-marks and an attempt was made to recover radio transmitters from anglers. If a radio tagged fish was caught or harvested, the technician recorded the date, tag number, and river location caught or harvested on a data form. Technicians gave sampled fish a hole punch in the dorsal or caudal fin to prevent resampling. Because data from coded wire tagged and transmitted chinook salmon are presented in other reports (King and Breakfield *In prep*, Hammarstrom and Hasbrouck *In prep*), this information is not presented in this report.

AGE/SEX COMPOSITION

Harvest

Harvested chinook salmon were sampled for age, sex, and length during angler interviews. Mideye-to-fork of tail length was measured to the nearest one-half centimeter, sex of the fish was identified, and scales removed from the preferred area (Clutter and Whitesel 1956; Welander 1940). Three scales were collected from each fish and placed on an adhesive-coated card. Impressions of the scales were made on acetate, and the resulting images were projected with a microfiche reader to determine age.

Inriver Return

To estimate the age and sex composition of the inriver return, chinook salmon were captured with 7 1/4-inch (18.4 cm) mesh gillnets in the intertidal area (from approximately Beaver Creek downstream to the Warren Ames Bridge), using the techniques described by Hammarstrom and Larson (1984). Two crews of two individuals in v-hull river boats conducted the sampling. Sampling was stratified into two 3-week strata during each run.

Fish were untangled from the gillnet and placed in a tagging cradle (Conrad and Larson 1987) for sampling and later released. Biological data collected included length (mideye-to-fork of tail), sex (using external characteristics) and three scales which were taken from the preferred area. Scale samples were prepared similarly to those of the creel samples. As with the creel samples, each fish was examined for the presence of the adipose fin.

DATA ANALYSES

Total effort, catch, and harvest were estimated by expanding means over all days sampled in a stratum (i.e., location, biweek, day type, and angler type). During each sample day five counts were made and interviews collected.

Angler effort, harvest, and catch rates for chinook salmon, harvest and catch of chinook salmon, and associated variances were estimated using the same procedures for guided and unguided anglers.

Effort

The mean number of anglers counted on day i in stratum h was estimated by:

$$\bar{x}_{hi} = \frac{\sum_{g=1}^{r_{hi}} x_{hig}}{r_{hi}}, \quad (1)$$

where:

x_{hig} = the number of anglers observed in the g th count of day i in stratum h , and

r_{hi} = the number of counts on day i in stratum h .

Angler counts were conducted systematically within each sample day. The variance of the mean angler count was estimated by:

$$\hat{V}(\bar{x}_{hi}) = \frac{\sum_{g=2}^{r_{hi}} (x_{hig} - x_{hi(g-1)})^2}{2r_{hi}(r_{hi} - 1)}. \quad (2)$$

Effort (angler-hours) during day i in stratum h was estimated by:

$$\hat{E}_{hi} = L_{hi} \bar{x}_{hi}, \quad (3)$$

where:

L_{hi} = length of the sample day (= 20 hours for unguided anglers, = 20 hours for guided anglers in May, and = 12 hours for guided anglers in June and July) in each stratum.

The within day variance (effort) was estimated by:

$$\hat{V}(\hat{E}_{hi}) = L_{hi}^2 \hat{V}(\bar{x}_{hi}). \quad (4)$$

The mean effort of stratum h was estimated by:

$$\bar{E}_h = \frac{\sum_{i=1}^{d_h} \hat{E}_{hi}}{d_h}, \quad (5)$$

where:

d_h = number of days sampled in stratum h.

Weekday days were sampled at random in each stratum; however, every weekend/holiday day was sampled. The variance of mean effort among days was estimated by:

$$\hat{V}(\bar{E}_h) = \frac{\sum_{i=2}^{d_h} (\hat{E}_{hi} - \bar{E}_h)^2}{(d_h - 1)}. \quad (6)$$

Total effort of stratum h was estimated by:

$$\hat{E}_h = D_h \bar{E}_h, \quad (7)$$

where:

D_h = total number of days the fishery is open in stratum h.

The variance of total effort of each stratum in a two-stage design, omitting the finite population correction factor for the second stage, was estimated by (Cochran 1977):

$$\hat{V}(\hat{E}_h) = (1-f)D_h^2 \frac{\hat{V}(\bar{E}_h)}{d_h} + fD_h^2 \frac{\sum_{i=1}^{d_h} \hat{V}(\hat{E}_{hi})}{d_h^2}, \quad (8)$$

where:

f = finite population correction factor for days sampled (= d_h/D_h).

Harvest and Catch

Catch and harvest per unit of effort of each day sampled was estimated from angler interviews using the jackknife method to minimize the bias of these ratio estimators (Efron 1982). A jackknife estimate of CPUE (similarly HPUE) was made for each angler by:

$$CPUE_{hij}^* = \frac{\sum_{\substack{a=1 \\ a \neq j}}^{m_{hi}} c_{hia}}{\sum_{\substack{a=1 \\ a \neq j}}^{m_{hi}} e_{hia}}, \quad (9)$$

where:

c_{hia} = catches of all anglers interviewed on day i in stratum h except angler j,

e_{hia} = effort (hours fished) of all anglers interviewed on day i in stratum h except angler j, and

m_{hi} = number of anglers interviewed on day i in stratum h.

The jackknife estimate of mean CPUE of day i was the mean of the angler estimates:

$$\overline{\text{CPUE}}_{hi}^* = \frac{\sum_{j=1}^{m_{hi}} \text{CPUE}_{hij}^*}{m_{hi}}, \quad (10)$$

and the bias corrected mean was:

$$\overline{\text{CPUE}}_{hi}^{**} = m_{hi} \left(\overline{\text{CPUE}}_{hi} - \overline{\text{CPUE}}_{hi}^* \right) + \overline{\text{CPUE}}_{hi}^*, \quad (11)$$

where:

$$\overline{\text{CPUE}}_{hi} = \text{the standard estimate of CPUE, or the sum of all catches over the sum of all hours fished in a day.}$$

The variance of the jackknife estimate of CPUE was estimated by:

$$\hat{V} \left(\overline{\text{CPUE}}_{hi}^{**} \right) = \frac{m_{hi} - 1}{m_{hi}} \sum_{j=1}^{m_{hi}} \left(\text{CPUE}_{hij}^* - \overline{\text{CPUE}}_{hi}^* \right)^2. \quad (12)$$

Catch during each sample day was estimated as the product of effort and CPUE by:

$$\hat{C}_{hi} = \hat{E}_{hi} \overline{\text{CPUE}}_{hi}^{**}, \quad (13)$$

and the variance by (Goodman 1960):

$$\hat{V}(\hat{C}_{hi}) = \hat{V}(\hat{E}_{hi}) \left(\overline{\text{CPUE}}_{hi}^{**} \right)^2 + \hat{V} \left(\overline{\text{CPUE}}_{hi}^{**} \right) \hat{E}_{hi}^2 - \hat{V}(\hat{E}_{hi}) \hat{V} \left(\overline{\text{CPUE}}_{hi}^{**} \right). \quad (14)$$

HPUE was estimated by substituting angler harvest for angler catch in equations (9) through (12). Harvest during sample day i was estimated by substituting the appropriate HPUE_{hi} statistics into equations (13) and (14). Total catch and harvest during stratum h was estimated using equations (5) through (8), substituting estimated catch (\hat{C}_{hi}) and harvest (\hat{H}_{hi}) during sample day i for the estimated effort (\hat{E}_{hi}) during day i.

The estimate of total effort, catch, and harvest, and their respective variances, were summed across the strata within each run as these estimates were considered independent. Covariances that arise because geographic locale and angler type were post-stratified (i.e., estimates of these strata are not statistically independent) are likely too small to affect the precision of the estimates.

Biological Data

Age and sex composition of the chinook salmon harvest and inriver return was estimated for each run. The proportion of chinook salmon in age/sex group b in stratum t was estimated as:

$$\hat{p}_{bt} = \frac{n_{bt}}{n_t}, \quad (15)$$

where:

- n_{bt} = the number of fish of age group b sampled during stratum t , and
- n_t = the number of legible scales read from chinook salmon sampled during stratum t .

The variance of \hat{p}_{bt} was estimated as (Scheaffer et al. 1979):

$$V(\hat{p}_{bt}) = \frac{\hat{p}_{bt}(1 - \hat{p}_{bt})}{(n_t - 1)}. \quad (16)$$

Secchi Disc Measurements

During each sampled day of the recreational fishery, the two boat technicians recorded a water clarity measurement using a Secchi disc at the beginning of their work shift. All measurements were made at approximately river mile 15.6. The average of the two daily measurements was used to reflect the water conditions for that particular day and incorporated into the historical database. These historical data are utilized inseason for comparative purposes when reviewing the catch rates between different years.

RESULTS

CREEL SURVEY

The creel survey commenced on 17 May. Angler counts were conducted on 47 of the 71 possible days: 24 days of the 39 possible sample days during the early run; and 23 days of the possible 32 days during the late run. Because of the regulatory restrictions placed on guided anglers, there were only 29 sampling days possible during the late run for guided anglers. Counts were made only 20 of those 29 days. A total of 4,292 completed-trip angler interviews were collected during both early- and late-run fisheries: 1,679 interviews during the early run; and 2,613 interviews during the late run (Tables 1 and 2).

Relatively few anglers were observed fishing, and on a number of days no anglers were counted downstream of the sonar site (Appendices A1 and A2). Estimates of effort showed that less than 1% of the total effort during the early run, and only 5% of the total effort during the late run occurred downstream of the sonar site. Because so few people fished between the Warren Ames Bridge and the sonar site, completed-trip interviews were collected from anglers who fished this area of the river. Based on the lack of fishing effort and potential biases in estimating harvest and catch rates in this area, count and interview data were combined across spatial strata to provide more accurate estimates of total effort, catch, and harvest.

During the early run, angler counts ranged from 0 to 208 for unguided anglers and from 0 to 403 for guided anglers (Appendix A1). The largest count of unguided anglers occurred on 14 June and for guided anglers on 10 June. During the late run, angler counts ranged from 0 to 562 for unguided anglers and from 0 to 741 for guided anglers (Appendix A2). The largest count of unguided anglers occurred on 15 July, and for guided anglers on 8 July.

Estimated effort during the early run was 102,243 (SE = 5,130) angler-hours (Table 3). The relative precision of the total effort estimate (9.8%) for the early run was within the levels desired

Table 1.-Estimated effort, catch, and harvest of chinook salmon by boat anglers during each stratum of the fishery for early-run chinook salmon in the downstream section of the Kenai River, 1997.

Angler Day Type	n ^a	N ^b	Number of Interviews ^c	Effort		Catch		Harvest	
				Estimate	SE	Estimate	SE	Estimate	SE
<u>17 - 31 May</u>									
Unguided weekdays	3	8	89	5,099	763	386	115	235	102
Unguided weekends	6	6	263	6,568	580	179	40	169	40
Guided weekdays	3	8	112	9,995	1,717	830	170	781	183
Guided weekends	6	6	156	6,956	897	408	112	361	98
<u>1 - 15 June</u>									
Unguided weekdays	3	8	196	10,464	738	738	156	501	103
Unguided weekends	5	5	234	9,633	864	487	78	377	65
Guided weekdays	3	8	136	22,315	4,179	2,291	661	2,024	552
Guided weekends	5	5	139	10,404	1,084	547	99	494	93
<u>16 - 30 June^d</u>									
Unguided weekdays	3	8	30	3,200	511	162	111	0	0
Unguided weekends	4	4	108	2,828	443	39	21	0	0
Guided weekdays	3	8	76	10,933	1,059	565	229	0	0
Guided weekends	4	4	140	3,848	372	150	30	0	0
<u>Subtotals:</u>									
Unguided	24	39	920	37,792	1,633	1,991	241	1,282	164
Guided	24	39	759	64,451	4,863	4,791	736	3,660	597
Early Run Total	24	39	1,679	102,243	5,130	6,782	775	4,942	619

^a Number of days during which interview data were collected.

^b Number of days possible for interviewing.

^c Completed-trip interviews only.

^d Fishery was restricted to catch-and-release fishing by emergency order on 17-30 June for all chinook salmon less than 132 cm in length.

Table 2.-Estimated effort, catch, and harvest of chinook salmon by boat anglers during each stratum of the fishery for late-run chinook salmon in the downstream section of the Kenai River, 1997.

Angler Day Type	n ^a	N ^b	Number of Interviews ^c	Effort		Catch		Harvest	
				Estimate	SE	Estimate	SE	Estimate	SE
<u>1 - 15 July</u>									
Unguided weekdays	4	8	234	34,936	5,631	1,894	417	1,493	360
Unguided weekends	5	5	391	21,484	1,676	1,154	156	865	128
Guided weekdays	4	8	485	44,328	3,284	2,874	324	2,410	296
Guided weekends	3	3	202	11,736	1,306	715	118	673	113
<u>16 - 31 July</u>									
Unguided weekdays	7	12	404	51,444	5,100	1,443	349	1,072	265
Unguided weekends	4	4	239	26,096	2,035	1,241	250	1,042	224
Guided weekdays	7	12	438	55,652	4,914	2,832	420	2,437	362
Guided weekends	3	3	114	10,160	1,128	290	75	257	70
<u>1 - 3 August</u>									
Unguided weekdays	1	1	15	1,110	151	0	0	0	0
Unguided weekends	2	2	18	2,156	336	8	9	8	9
Guided weekdays	1	1	28	2,320	459	29	22	29	22
Guided weekends	2	2	45	2,220	392	56	29	50	28
<u>Subtotals:</u>									
Unguided	23	32	1,301	137,226	8,050	5,740	619	4,480	516
Guided	20	29	1,312	126,416	6,186	6,796	550	5,856	488
Late Run Total			2,613	263,642	10,152	12,536	828	10,336	710

^a Number of days during which interview data were collected.

^b Number of days possible for interviewing.

^c Completed-trip interviews only.

Table 3.-Estimated number of angler-hours of fishing effort by boat anglers during each of the strata of the fishery for early-run chinook salmon in the downstream section of the Kenai River, 1997.

Stratum	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
<u>17 May - 31 May</u>				
Unguided, weekdays:	5,099	763	3,604 - 6,594	29.3 %
Unguided, weekends:	6,568	580	5,431 - 7,705	17.3 %
Guided, weekdays:	9,995	1,717	6,630 - 13,360	33.7 %
Guided, weekends:	6,956	897	5,198 - 8,714	25.3 %
<u>1 June - 16 June</u>				
Unguided, weekdays:	10,464	738	9,018 - 11,910	13.8 %
Unguided, weekends:	9,633	864	7,940 - 11,326	17.6 %
Guided, weekdays:	22,315	4,179	14,124 - 30,506	36.7 %
Guided, weekends:	10,404	1,084	8,279 - 12,529	20.4 %
<u>17 June - 30 June</u>				
Unguided, weekdays:	3,200	511	2,198 - 4,202	31.3 %
Unguided, weekends:	2,828	443	1,960 - 3,696	30.7 %
Guided, weekdays:	10,933	1,059	8,857 - 13,009	19.0 %
Guided, weekends:	3,848	372	3,119 - 4,577	18.9 %
Subtotals				
Unguided:	37,792	1,633	34,591 - 40,993	8.5 %
Guided:	64,451	4,863	54,919 - 73,983	14.8 %
Early Run Total	102,243	5,130	92,188 - 112,298	9.8 %

for this survey. Estimated effort during the late run was 263,642 (SE = 10,153) angler-hours (Table 4). The relative precision (7.5%) of the total effort estimate for the late run was also within the levels desired for the survey.

Completed-trip anglers interviewed during the early run fished a total of 7,445 angler-hours; 7% of the total estimated effort. During the late run, interviewed anglers reported fishing a total of 12,152 angler-hours; 5% of the total estimated effort. Approximately 3% of the total late-run effort occurred during the 3-day extension of the fishery.

Daily catch rates of early-run chinook salmon by unguided anglers ranged from 0.000 (SE = 0.000) to 0.129 (SE = 0.025) fish per hour, and from 0.015 (SE = 0.011) to 0.169 (SE = 0.038) fish per hour for anglers employing guides (Appendices C1 and C2). Peak daily catch rates of early-run chinook salmon by unguided anglers occurred on 1 June, and on 12 June for guided

Table 4.-Estimated number of angler-hours of fishing effort by boat anglers during each of the strata of the fishery for late-run chinook salmon in the downstream section of the Kenai River, 1997.

Stratum	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
<u>1 July - 16 July</u>				
Unguided, weekdays:	34,936	5,631	23,899 - 45,973	31.6 %
Unguided, weekends:	21,484	1,676	18,199 - 24,769	15.3 %
Guided, weekdays:	44,328	3,284	37,891 - 50,765	14.5 %
Guided, weekends:	11,736	1,306	9,176 - 14,296	21.8 %
<u>17 July - 31 July</u>				
Unguided, weekdays:	51,444	5,100	41,448 - 61,440	19.4 %
Unguided, weekends:	26,096	2,035	22,107 - 30,085	15.3 %
Guided, weekdays:	55,652	4,914	46,021 - 65,283	17.3 %
Guided, weekends:	10,160	1,128	7,949 - 12,371	21.8 %
<u>1 August - 3 August</u>				
Unguided, weekdays:	1,110	151	814 - 1,406	26.7 %
Unguided, weekends:	2,156	336	1,497 - 2,815	30.5 %
Guided, weekdays:	2,320	459	1,420 - 3,220	38.8 %
Guided, weekends:	2,220	392	1,452 - 2,988	34.6 %
Unguided:	137,226	8,050	121,448 - 153,004	11.5 %
Guided:	126,416	6,187	114,290 - 138,542	9.6 %
Late Run Total	263,642	10,153	243,743 - 283,541	7.5 %

anglers. Daily catch rates of late-run chinook salmon by unguided anglers ranged from 0.000 (SE = 0.000) to 0.081 (SE = 0.029) fish per hour, and from 0.000 (SE = 0.000) to 0.077 (SE = 0.016) fish per hour for guided anglers (Appendices C3 and C4). Peak daily catch rates of late-run chinook salmon by unguided anglers occurred on 26 July, and by guided anglers on 5 July. During both runs, catch and harvest rates were generally higher for guided anglers than for unguided anglers (Appendices C1-C4).

An estimated 4,942 (SE = 619) chinook salmon were harvested during the early run (Table 1). Unguided anglers harvested 26% of the total. The estimated catch of early-run chinook was 6,782 (SE = 775). The relative precision for total catch and harvest (22.4% and 24.6%, respectively) exceeded the desired levels of precision (15%). Completed-trip anglers interviewed during the early run reported harvesting 299 fish which represented 6.0% of the estimated total

harvest. The catch-and-release emergency order for 17 June through 30 June (regulatory end of the early run) increased the number of chinook salmon released by anglers. Prior to the emergency order, only 16% of the catch was released, but because of the emergency order, 27% of the total early-run catch was released.

An estimated 10,336 (SE = 710) chinook salmon were harvested during the late run (Table 2). Unguided anglers accounted for 43% of the harvest. The estimated catch of chinook salmon was 12,536 (SE = 828). The relative precision for total catch and harvest (12.9% and 13.4%, respectively) was within desired levels of precision (15%). Approximately 17% of the catch was voluntarily released during the late run. Anglers interviewed during the late run reported a harvest of 487 fish, 4.7% of the estimated total harvest.

The majority of the 1997 late-run effort was by unguided anglers (52%). About 3% of the total effort for the late run occurred during the extension period, 1-3 August, with the guided effort (4,540 angler-hours) slightly greater than the unguided angler effort (3,266 angler-hours; Table 4). In general, catch per unit of effort (CPUE) and harvest per unit of effort (HPUE) for guided anglers was greater than for unguided anglers for both runs (Appendices B1-B4).

BIOLOGICAL DATA

Recreational Fishery

Because the sport fishery was limited to catch-and-release fishing on 17 June through 30 June, there was essentially no recorded harvest during the third time stratum. Between the first two temporal strata (17 May-31 May, 1 June-15 June) of the early-run harvest, there was no significant difference ($\chi^2 = 0.677$, $df = 2$, $P = 0.713$) in the age composition among the three major age classes. Therefore, biological data from the temporal strata were combined. The most abundant age group in the early-run harvest was age-1.4 fish which comprised 82% of the total sampled harvest (Table 5). The only other major age class was 1.3-age chinook salmon (11%). Chinook salmon aged 1.2 and 1.5 composed 3% and 4% of the harvest, respectively.

Similarly, during the late run, the age composition of the three major age classes did not differ significantly ($\chi^2 = 0.260$, $df = 2$, $P = 0.878$) between temporal strata (1 July-15 July and 16 July-3 August). Therefore, biological data were combined by strata. The most abundant age group in the late-run harvest of chinook salmon was age-1.4 fish which comprised 72% of the total sampled harvest (Table 6). The only other age class of significance was 1.3-age chinook salmon (24%).

Inriver Return

For the early run, there was no significant difference ($\chi^2 = 3.43$, $df = 2$, $P = 0.18$) in the age composition of the inriver return between the first 3-week stratum and second 3-week stratum (17 May-8 June, 9 June-30 June). Thus, it was not necessary to temporally stratify the netting data to estimate the age structure of the inriver return during the early run (Table 7). The most abundant age class was 1.4-age fish, representing approximately 60% of the sampled fish. Age-1.3 fish was the second largest contributor, with the 1.2 and 1.5 age classes also present. These age classes represented 35%, 4%, and 1%, respectively, of the inriver return during the early run.

During the late run, there was also no significant difference ($\chi^2 = 1.41$, $df = 2$, $P = 0.49$) in the age composition of the major age classes of the inriver return. The most abundant age class was

Table 5.-Age composition and mean length-at-age of chinook salmon sampled from the recreational harvest during the fishery for early-run chinook salmon in the Kenai River, 1997.

Sex	Age Group				Total
	1.2	1.3	1.4	1.5	
<u>Males</u>					
Percent	2.5	6.8	42.2	3.7	55.2
SE	1.2	2.0	3.9	1.5	
<u>Females</u>					
Percent	0.6	3.7	39.8	0.6	44.7
SE		1.5	3.8		
<u>Combined</u>					
Percent	3.1	10.6	82.0	4.3	100.0
SE	1.4	2.4	3.0	1.6	
<u>Males</u>					
Mean Length (mm) ^a	624	844	1,012	1,115	
SE	25	18	9	39	
Sample size	4	11	68	6	89
<u>Females</u>					
Mean Length (mm) ^a	510	841	954	1,090	
SE		17	7		
Sample size	1	6	64	1	72
<u>Combined</u>					
Sample size	5	17	132	7	161

^a Lengths measured mid-eye-to-fork of tail.

1.4-age fish, representing 72% of the inriver return (Table 8). Age-1.3 fish were the second largest contributor to the late run with approximately 22%, followed by ages 1.2 and 1.5 with 4% and 2%, respectively.

Analysis-of-variance was used to test for differences in mean length-at-age by sex, run, and sampling method (recreational harvest or inriver netting). For age-1.3 fish, those sampled from the recreational harvest were significantly ($F = 10.68$; $df = 1, 278$; $P = 0.001$) larger than those

Table 6.-Age composition and mean length-at-age of chinook salmon sampled from the recreational harvest during the fishery for late-run chinook salmon in the Kenai River, 1997.

Sex	Age Group					Total
	1.1	1.2	1.3	1.4	1.5	
<u>Male</u>						
Percent	1.0	2.2	12.0	32.2	1.3	48.7
SE	0.5	0.8	1.8	2.6	0.6	
<u>Female</u>						
Percent		0.3	11.4	39.7		51.4
SE			1.8	2.8		
<u>Combined</u>						
Percent	1.0	2.5	23.3	72.0	1.3	100
SE	0.5	0.9	2.4	2.5	0.6	
<u>Male</u>						
Mean Length (mm) ^a	408	636	867	1,055	1,150	
SE	20	26	13	5	11	
Sample size	3	7	38	102	4	154
<u>Female</u>						
Mean Length (mm) ^a		640	905	1,017		
SE			9	4		
Sample size		1	36	126		163
<u>Combined</u>						
Sample size	3	8	74	228	4	317

^a Lengths measured mid-eye-to-fork of tail.

sampled with gillnets. In addition, late-run fish were significantly larger than early-run fish ($F = 15.26$; $df = 1, 278$; $P < 0.001$) and females were significantly larger than males ($F = 7.74$; $df = 1, 278$; $P = 0.006$). For age-1.4 fish, the mean length for late-run fish was significantly larger than for early-run fish ($F = 147.86$; $df = 1, 787$; $P < 0.001$). Age-1.4 males were also significantly larger than 1.4 females ($F = 133.89$; $df = 1, 787$; $P < 0.001$), and fish sampled from the inriver return were significantly ($F = 9.23$; $df = 1, 787$; $P = 0.003$) larger than those sampled from the harvest.

Table 7.-Age composition and mean length-at-age of chinook salmon sampled with large mesh gillnets during the fishery for early-run chinook salmon in the Kenai River, 1997.

Sex	Age Group				Total
	1.2	1.3	1.4	1.5	
<u>Male</u>					
Percent	4.2	19.0	23.5	0.8	47.5
SE	1.0	2.0	2.2	0.5	
<u>Female</u>					
Percent		15.8	36.4	0.3	52.5
SE		1.9	2.5		
<u>Combined</u>					
Percent	4.2	34.8	59.9	1.1	100
SE	1.2	2.4	2.5	0.5	
<u>Male</u>					
Mean Length (mm) ^a	660	796	1,019	1,113	
SE	9	8	8	28	
Sample size	16	72	89	3	180
<u>Female</u>					
Mean Length (mm) ^a		817	972	1,070	
SE		7	5		
Sample size		60	138	1	199
<u>Combined</u>					
Sample size	16	132	227	4	379

^a Lengths measured mid-eye-to-fork of tail.

DISCUSSION

This was the first year that a stratified, two-stage roving-access creel design (Bernard et al. 1998a and 1998b) was used on the Kenai River. The study design replaced a roving creel survey (Neuhold and Lu 1957) used on the river for more than a decade. The new design was implemented so that effort, catch, and harvest could be estimated for sampled days, statistics that were not possible to estimate with the old design. In designing the survey, it was determined that

Table 8.-Age composition and mean length-at-age of chinook salmon sampled with large mesh gillnets during the fishery for late-run chinook salmon in the Kenai River, 1997.

	Age Group					Total
	1.2	1.3	1.4	1.5	2.2	
<u>Male</u>						
Percent	3.1	13.8	29.1	1.0		47.0
SE	1.0	2.0	2.7	0.6		
<u>Female</u>						
Percent	1.0	8.0	42.9	0.7	0.3	52.9
SE	0.6	1.6	2.9	0.5		
<u>Combined</u>						
Percent	4.2	21.8	72.0	1.7	0.3	100
SE	1.2	2.4	2.6	0.8		
<u>Male</u>						
Mean Length (mm) ^a	684	815	1,079	1,193		
SE	11	14	8	13		
Sample size	9	40	84	3		136
<u>Female</u>						
Mean Length (mm) ^a	670	883	1,019	1,080	700	
SE	15	16	4	40		
Sample size	3	23	124	2	1	153
<u>Combined</u>						
Sample size	12	63	208	5	1	289

^a Lengths measured mid-eye-to-fork of tail.

sampling all weekend/holiday days and one less than half of all weekday days of each biweekly stratum would provide estimates with the desired accuracy and precision. This resulted in sampling only 1 of the 4 weekday days during some weeks, including the first week of June which is historically a critical time in making inseason management decisions. Therefore, although the level of sample effort was sufficient for stock assessment purposes, it did not provide managers sufficient information about the fishery during an important period. Pivotal periods during both runs when historical trends indicate that peak escapements and catches are

likely to occur should receive more sampling effort to guard against the possibility that high harvests may impact spawning escapements.

In 1990-1992, and 1997, emergency orders restricting the early-run fishery to catch-and-release fishing, or to a bag limit of one fish 132 cm or greater (trophy fishing) were implemented to meet escapement goals. These management actions greatly diminished angler participation in the recreational fishery (Figure 2). Relatively high catch rates apparently do not provide sufficient angler satisfaction when fish retention is limited or prohibited. Effort declined dramatically after the implementation of the emergency orders, regardless of the increased numbers of fish entering the system (Appendix D1) and the numbers of fish caught in proportion to the number of angler-hours expended. While effort during the catch-and-release period declined from the previous weeks, fishing effort during the last 2 weeks of the early run remained relatively stable at nearly 50% of the effort during early June (Figure 5).

Effort during the 1997 early run was nearly 28,000 angler hours (21%) less than in 1996 (King 1997). The most likely explanation for this reduction is the catch-and-release emergency order during 17-30 June. Unguided anglers had the greatest decrease in effort (16%) while effort by guided anglers declined only 5%. In 1997, guided anglers contributed 63% of the total effort and unguided anglers 37%, following a trend similar to the 1996 early run when guided anglers contributed 55% of the fishing effort and unguided anglers contributed 45% of the total effort (King 1997).

Angler participation during the 1997 late run of 263,642 angler-hours was nearly 11% greater than the recreational effort expended during the 1996 late run (King 1997). While the total fishing effort experienced only a moderate increase in 1997 versus 1996, the total harvest of chinook salmon (10,336) was nearly 73% greater than the harvest evidenced during the 1996 late run (King 1997). Harvest and effort levels were highest approximately 15 July (Figure 6) and lagged several days after the seasonal high daily sonar passage estimates (Appendix D2).

Improved angler success rates relative to the 1996 season in both the early and late run during 1997 may well have been influenced by improved water levels and water clarity. Water clarity during 1997, as measured by Secchi transparency readings taken daily during the fishery, was generally less clear than the historical average, but was consistently much better than those conditions that occurred in 1996 (Figure 7). Poor water clarity is generally perceived by many anglers to reduce success in this fishery.

The creel survey was stratified to estimate harvest between the Warren Ames Bridge and the sonar site to facilitate better estimates of total inriver return (the sonar estimate plus the harvest between the Warren Ames Bridge and the sonar site (Hammarstrom and Timmons *In prep*). However, the estimated harvest from the Warren Ames Bridge to the sonar site was negligible, with approximately one fish for the early run and 473 fish for the late run. For both runs this harvest was approximately 0.7% of the total inriver return of 14,963 (SE = 236) for the early run and 54,881 (SE = 914) for the late run (Bosch and Burwen *In prep*). This is very similar to the 1996 results when harvests of five fish for the early run and 304 fish for the late run were estimated between the Warren Ames Bridge and the sonar site. Although no estimates of harvest downstream of the sonar site exist prior to 1996, personal observation of this fishery has indicated much greater effort in that area during past years.

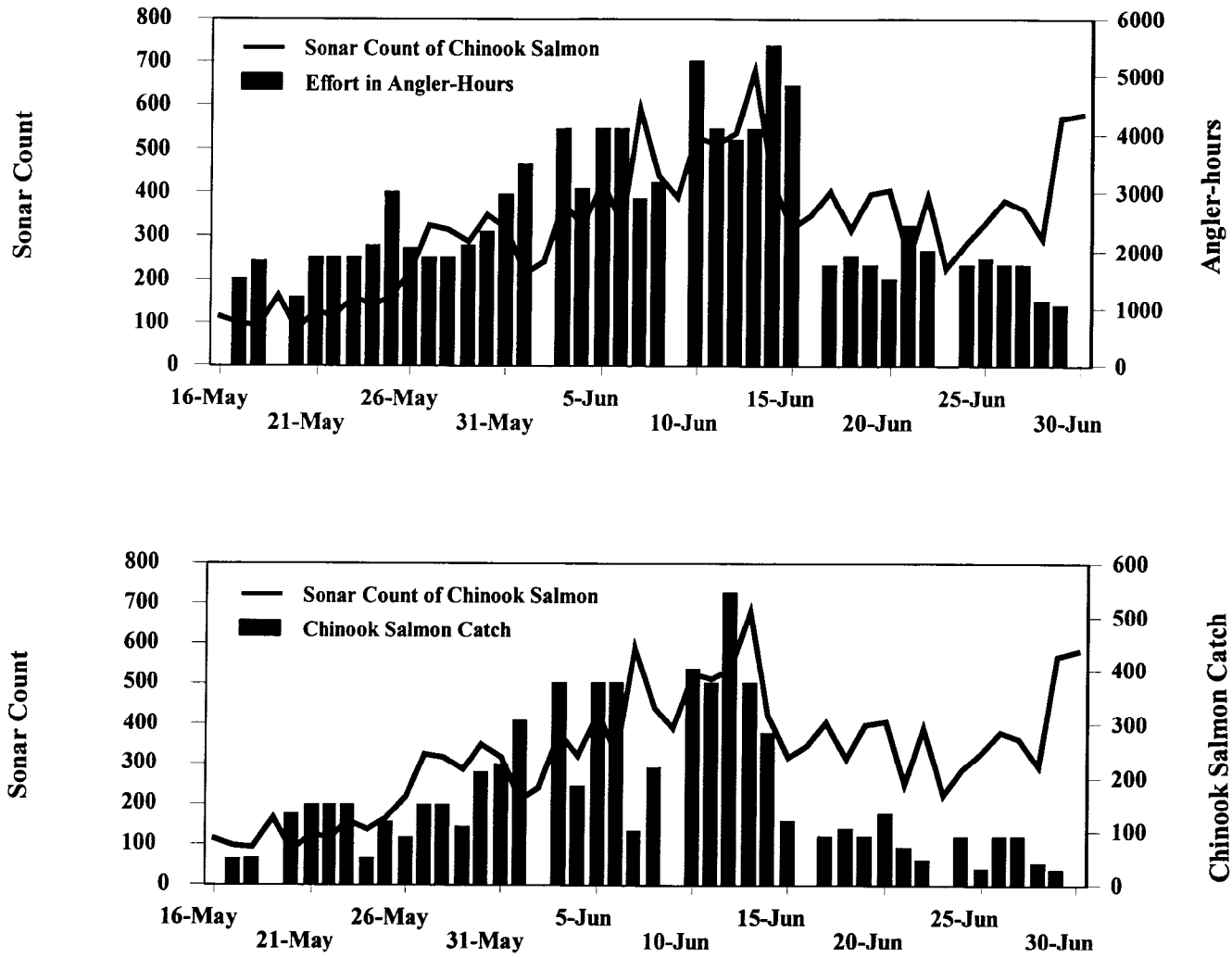


Figure 5.-Daily sonar counts of chinook salmon, recreational catch of chinook salmon (bottom) and angler effort (top) during the early run, Kenai River, 1997.

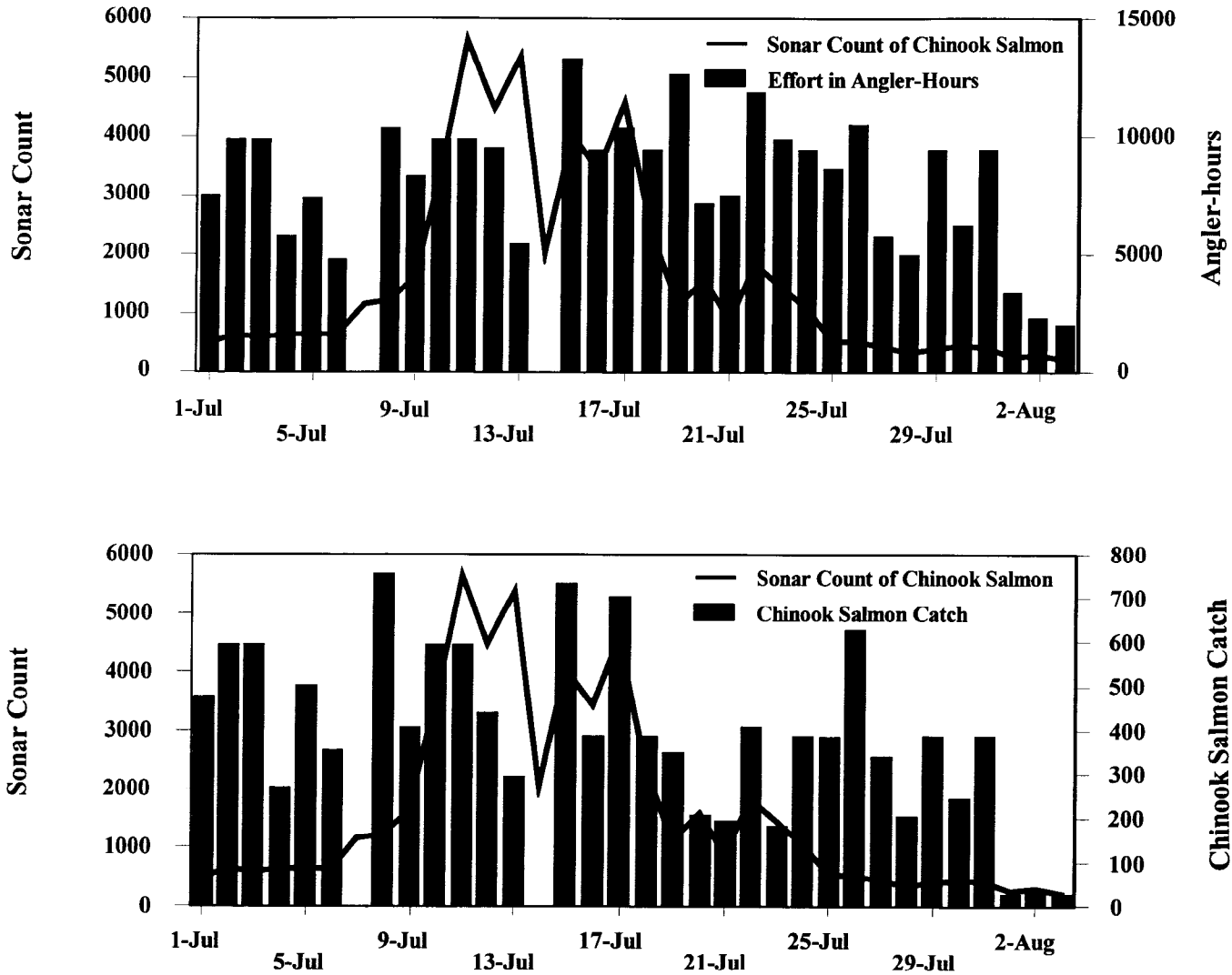


Figure 6.-Daily sonar counts of chinook salmon, recreational catch of chinook salmon (bottom) and angler effort (top) during the late run, Kenai River, 1997.

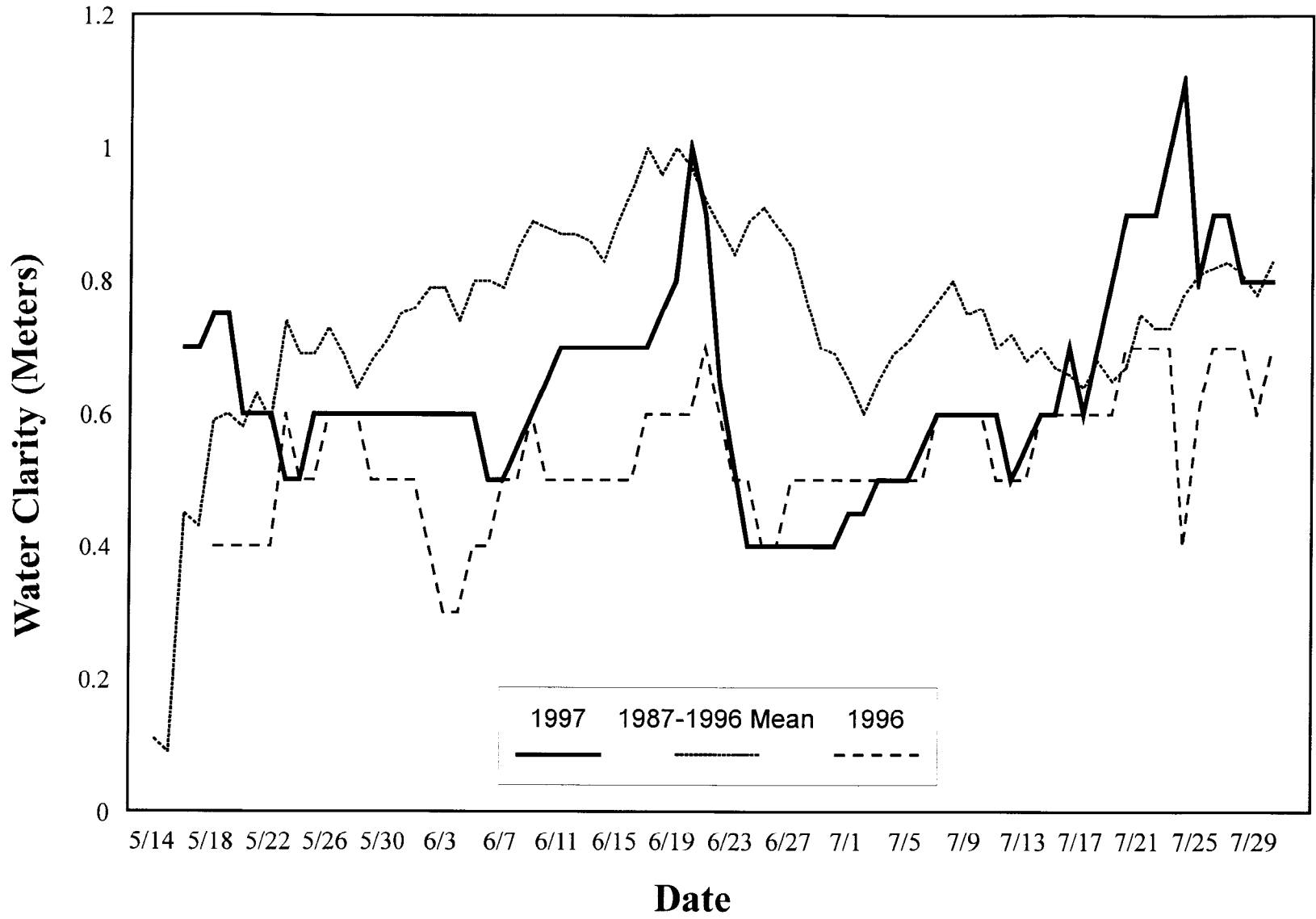


Figure 7.-Historic Kenai River Secchi transparency readings, 1987-1997.

RECOMMENDATIONS

Although the chinook harvest downstream of the sonar site was minimal, the creel survey should continue to estimate harvest in this river section for several years. This would allow a more accurate assessment of total inriver return. However, if harvest downstream of the sonar site continues to be a minor component of the total harvest after several years, it may not be necessary to continue to geographically stratify the creel survey.

The level of sampling of the new creel survey design should be modified to ensure that management objectives are accomplished. Increased sampling of the fishery during pivotal periods when historical data indicate that peak escapements and catches likely occur would improve the department's ability to project final harvests and escapements. Such a measure would further the department's ability to provide for continued opportunity while meeting goals for spawning escapements.

ACKNOWLEDGMENTS

I would like to express my gratitude to those individuals involved with the continued success of the project. Ed Borden and Gary Titus conducted the boat creel survey in the downstream section of the Kenai River and with a "can do" attitude were able to complete the season without missing any sampling days. Stacie Mallette, J. R. Dailey and Kate Dering conducted angler interviews at selected access locations downstream of the Soldotna Bridge, and maintained a cheerful outlook despite the sometimes contentious nature of the angling public. Patti Berkahn prepared scales for aging, read the scales, and entered the data into an electronic file. Steve Hammarstrom provided long-term, historical insight of the fishery as well as valued guidance. I also thank the Research and Technical Service staff, particularly Jim Hasbrouck who provided invaluable technical assistance with developing the survey design as well as the creel sampling schedule.

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**APPENDIX A. COUNTS OF BOAT ANGLERS DURING THE
CREEL SURVEY OF THE FISHERY FOR CHINOOK SALMON
ON THE KENAI RIVER, ALASKA, 1997**

Appendix A1.-Counts of unguided and guided boat anglers, by stratum (A, B, C, D, E), during the fishery for early-run chinook salmon in the downstream section of the Kenai River, 1997.

Date	Day Type ^b	Downstream ^a										Upstream ^a										Combined Strata									
		Unguided Anglers					Guided Anglers					Unguided Anglers					Guided Anglers					Unguided Anglers					Guided Anglers				
		A ^c	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
17-May	We	0	0	0	0	0	0	0	0	0	12	22	53	30	10	18	95	103	35	0	12	22	53	30	10	18	95	103	35	0	
18-May	We	0	0	0	0	0	0	0	0	0	47	73	51	20	15	77	86	37	32	21	47	73	51	20	15	77	86	37	32	21	
19-May	Wd	CLOSED					CLOSED					CLOSED					CLOSED					CLOSED									
20-May	Wd	0	0	0	0	0	0	0	0	0	18	16	17	38	14	59	73	57	9	4	18	16	17	38	14	59	73	57	9	4	
21-May	Wd	Not Sampled																													
22-May	Wd	Not Sampled																													
23-May	Wd	Not Sampled																													
24-May	We	0	0	0	0	0	0	0	0	0	49	52	46	39	33	98	101	85	23	0	49	52	46	39	33	98	101	85	23	0	
25-May	We	0	0	0	0	0	0	0	0	0	71	84	130	118	43	121	115	61	13	0	71	84	130	118	43	121	115	61	13	0	
26-May	We	0	0	0	0	0	0	0	0	0	10	94	98	49	40	0	112	80	27	5	10	94	98	49	40	0	112	80	27	5	
27-May	Wd	Not Sampled																													
28-May	Wd	Not Sampled																													
29-May	Wd	0	0	0	0	0	0	0	0	0	25	49	39	35	41	102	144	71	12	5	25	49	39	35	41	102	144	71	12	5	
30-May	Wd	0	0	0	0	0	0	0	0	0	51	53	34	37	11	133	173	85	10	0	51	53	34	37	11	133	173	85	10	0	
31-May	We	0	0	0	0	0	0	0	0	0	5	77	124	62	85	0	174	135	70	15	5	77	124	62	85	0	174	135	70	15	
1-Jun	We	0	1	0	0	0	0	7	0	0	83	153	125	70	42	146	135	113		83	154	125	70	42	146	142	113	0	0		
2-Jun	Wd	CLOSED					CLOSED					CLOSED					CLOSED					CLOSED									
3-Jun	Wd	Not Sampled																													
4-Jun	Wd	0	0	3	0	0	0	0	3	0	32	86	58	63	92		205	137	98		32	86	61	63	92	0	205	140	98	0	
5-Jun	Wd	Not Sampled																													
6-Jun	Wd	Not Sampled																													
7-Jun	We	0	0	0	0	0	0	0	0	0	9	141	72	67	66		234	74	66		9	141	72	67	66	0	234	74	66	0	
8-Jun	We	0	0	0	0	0	0	0	0	0		112	82	64	55		165	149	92		0	112	82	64	55	0	165	149	92	0	

-continued-

Appendix A1.-Page 2 of 2.

Date	Day Type ^b	Downstream ^a					Upstream ^a					Combined Strata															
		Unguided Anglers			Guided Anglers		Unguided Anglers			Guided Anglers		Unguided Anglers			Guided Anglers												
		A ^c	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E						
9-Jun	Wd	CLOSED					CLOSED					CLOSED															
10-Jun	Wd	0	0	0	0	0	0	0	0	142	69	53	44	37	378	403	193	142	69	53	44	37	378	403	193	0	0
11-Jun	Wd	Not Sampled																									
12-Jun	Wd	0	0	0	0	0	0	3	0	9	61	93	52	90	323	238	111	9	61	93	52	90	0	323	241	111	0
13-Jun	Wd	Not Sampled																									
14-Jun	We	0	7	0	5	0	24	0	0	41	187	208	116	120	360	199	121	41	194	208	121	120	0	384	199	121	0
15-Jun	We	6	3	0	0	0	15	22	0	178	130	80	85	22	285	269	125	184	133	80	85	22	300	291	125	0	0
16-Jun	Wd	CLOSED					CLOSED					CLOSED															
17-Jun	Wd ^d	Not Sampled																									
18-Jun	Wd	0	0	1	1	0	0	0	0	2	52	25	25	17	162	123	72	2	52	26	26	17	0	162	123	72	0
19-Jun	Wd	Not Sampled																									
20-Jun	Wd	0	0	0	0	0	0	0	0	0	29	3	31	28	172	69	47	0	29	3	31	28	0	172	69	47	0
21-Jun	We	0	1	0	0	0	0	2	0	53	63	111	30	15	117	129	94	53	64	111	30	15	117	131	94	0	0
22-Jun	We	0	0	4	0	0	0	0	6	28	97	51	26	0	76	132	82	28	97	55	26	0	76	132	88	0	0
23-Jun	Wd	Not Sampled																									
24-Jun	Wd	Not Sampled																									
25-Jun	Wd	0	0	0	0	0	0	0	0	0	28	26	13	19	177	117	86	0	28	26	13	19	0	177	117	86	0
26-Jun	Wd	Not Sampled																									
27-Jun	Wd	Not Sampled																									
28-Jun	We	0	0	0	0	0	0	0	0	7	36	33	22	13	110	51	16	7	36	33	22	13	0	110	51	16	0
29-Jun	We	0	0	0	0	0	0	0	0	15	46	30	17	9	40	47	60	15	46	30	17	9	40	47	60	0	0
30-Jun	Wd	Not Sampled																									

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- ^a Downstream = downstream of the chinook salmon sonar site to the Warren Ames Bridge; upstream = upstream of the chinook salmon sonar site to the Soldotna Bridge.
- ^b Wd = weekday; We = weekend.
- ^c Angler counts beginning on the whole hour between 0400–0700 hours (A), 0800–1100 hours (B), 1200–1500 hours (C), 1600–1900 hours (D), and 2000–2300 hours (E).
- ^d Fishery was restricted to catch-and-release fishing by emergency order on 17–30 June for all chinook salmon less than 132 cm in length.

Appendix A2.-Counts of unguided and guided boat anglers, by stratum, during the fishery for late-run chinook salmon in the downstream section of the Kenai River, 1997.

Date	Day Type ^b	Downstream ^a										Upstream ^a										Combined Strata									
		Unguided Anglers					Guided Anglers					Unguided Anglers					Guided Anglers					Unguided Anglers					Guided Anglers				
		A ^c	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
1-Jul	Wd	0	0	3	4	10		0	4	0		193	113	80	107	133		621	428	194		193	113	83	111	143	0	621	432	194	0
2-Jul	Wd	Not Sampled																													
3-Jul	Wd	Not Sampled																													
4-Jul	We	0	7	6	0	0		4	9	0		87	155	150	192	115		442	169	121		87	162	156	192	115	0	446	178	121	0
5-Jul	We	12	6	10	7	0		0	0	0		170	197	128	287	72		356	347	266		182	203	138	294	72	0	356	347	266	0
6-Jul	We	0	0	17	7	0	CLOSED					116	235	325	256	251	CLOSED					116	235	342	263	251	CLOSED				
7-Jul	Wd	CLOSED					CLOSED					CLOSED					CLOSED					CLOSED									
8-Jul	Wd	0	29	17	7	0		16	0	16		243	285	199	148	234		725	372	304		243	314	216	155	234	0	741	372	320	0
9-Jul	Wd	1	7	9	19	0		0	6	7		109	174	175	99	234		578	360	307		110	181	184	118	234	0	578	366	314	0
10-Jul	Wd	Not Sampled																													
11-Jul	Wd	Not Sampled																													
12-Jul	We	0	16	10	8	12		15	7	14		126	313	212	189	291		559	411	214		126	329	222	197	303	0	574	418	228	0
13-Jul	We	9	0	7	0	0	CLOSED					324	463	380	126	77	CLOSED					333	463	387	126	77	CLOSED				
14-Jul	Wd	CLOSED																													
15-Jul	Wd	28	69	22	19	3		24	61	6		534	382	340	241	97		588	488	440		562	451	362	260	100	612	549	446	0	0
16-Jul	Wd	Not Sampled																													
17-Jul	Wd	3	14	21	13	10		0	12	5		268	270	260	153	88		503	533	458		271	284	281	166	98	503	545	463	0	0
18-Jul	Wd	Not Sampled																													
19-Jul	We	42	51	3	11	0		6	22	0		478	457	333	289	99		517	557	309		520	508	336	300	99	523	579	309	0	0
20-Jul	We	7	61	74	83	9	CLOSED					279	499	348	217	224	CLOSED					286	560	422	300	233	CLOSED				
21-Jul	Wd ^d	0	8	0	4	0		0	4	0		296	203	201	216	176		307	302	180		296	211	201	220	176	307	306	180	0	0

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Date	Day Type ^b	Downstream ^a										Upstream ^a										Combined Strata									
		Unguided Anglers					Guided Anglers					Unguided Anglers					Guided Anglers					Unguided Anglers					Guided Anglers				
		A ^c	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
22-Jul	Wd	0	57	33	16	0	13	55	110			251	412	133	140	243	614	467	441			251	469	166	156	243	0	627	522	551	0
23-Jul	Wd	0	0	19	43	56	0	8	70			11	414	226	253	390	566	221	208			11	414	245	296	446	0	566	229	278	0
24-Jul	Wd	Not Sampled																													
25-Jul	Wd	0	9	34	52	0	0	26	50			12	300	329	179	224	525	231	196			12	309	363	231	224	0	525	257	246	0
26-Jul	We	8	16	63	112	0	13	62	51			210	400	195	262	241	490	274	239			218	416	258	374	241	0	503	336	290	0
27-Jul	We	27	6	43	30	0	0	0	0			245	503	378	162	59	0	0	0			272	509	421	192	59	0	0	0		
28-Jul	Wd ^d	12	0	15	0	11	22	0	2			169	198	116	119	51	189	233	120			181	198	131	119	62	211	233	122	0	0
29-Jul	Wd	Not Sampled																													
30-Jul	Wd	0	3	7	12	5	9	49	0			50	189	93	162	82	486	196	225			50	192	100	174	87	0	495	245	225	0
31-Jul	Wd	Not Sampled																													
1-Aug	Wd ^e	0	0	0	0		0	0	0	0		59	77	45	41		209	135	98	22		59	77	45	41	0	209	135	98	22	0
2-Aug	We ^e	0	0	0	0	0	0	0	0	0	0	25	110	95	53	39	30	116	78	29	10	25	110	95	53	39	30	116	78	29	10
3-Aug	We ^e	0	0	0	0	0	0	0	0	0	0	36	55	69	36	21	103	102	66	21	0	36	55	69	36	21	103	102	66	21	0

^a Downstream = downstream of the chinook salmon sonar site to the Warren Ames Bridge; upstream = upstream of the chinook salmon sonar site to the Soldotna Bridge.

^b Wd = weekday; We = weekend.

^c Angler counts beginning on the whole hour between 0400–0700 hours (A), 0800–1100 hours (B), 1200–1500 hours (C), 1600–1900 hours (D), and 2000–2300 hours (E).

^d Normal Monday closure opened to fishing by emergency order, 21 July and 28 July.

^e Fishery extended by emergency order, 1-3 August. No restrictions on hours or days during which anglers, including guides, were allowed to fish.

**APPENDIX B. DAILY SUMMARY STATISTICS FOR FISHING
EFFORT, HARVEST RATE, AND CATCH RATE FOR
ANGLERS INTERVIEWED DURING THE FISHERY FOR
CHINOOK SALMON IN THE KENAI RIVER, ALASKA, 1997**

Appendix B1.-Number of completed-trip interviews (n), catch, and harvest for unguided anglers interviewed during the fishery for early-run chinook salmon in the downstream section of the Kenai River, 1997.

Date	Wd/ We ^a	Effort (hours)			Catch		Harvest ^b	
		n	Mean	SE	Mean	SE	Mean	SE
17-May	We	10	4.5	0.82	0.20	0.13	0.20	0.13
18-May	We	11	4.3	0.54	0.09	0.09	0.09	0.09
20-May	Wd	53	4.1	0.37	0.53	0.09	0.43	0.07
24-May	We	58	4.1	0.24	0.07	0.03	0.07	0.03
25-May	We	103	3.5	0.16	0.11	0.03	0.09	0.03
26-May	We	46	4.9	0.34	0.15	0.05	0.15	0.05
29-May	Wd	10	3.4	0.64	0.10	0.10	0.00	0.00
30-May	Wd	26	3.1	0.39	0.31	0.09	0.19	0.08
31-May	We	35	4.5	0.46	0.11	0.05	0.11	0.05
1-Jun	We	73	3.0	0.17	0.36	0.06	0.26	0.05
4-Jun	Wd	57	3.9	0.35	0.18	0.05	0.12	0.04
7-Jun	We	50	4.1	0.36	0.14	0.05	0.12	0.05
8-Jun	We	48	3.5	0.25	0.21	0.07	0.19	0.06
10-Jun	Wd	45	4.4	0.44	0.40	0.10	0.22	0.06
12-Jun	Wd	21	3.7	0.69	0.29	0.10	0.24	0.10
14-Jun	We	89	4.0	0.24	0.13	0.04	0.10	0.03
15-Jun	We	47	4.6	0.59	0.06	0.04	0.04	0.03
18-Jun	Wd	13	5.0	0.52	0.54	0.14	0.00	0.00
20-Jun	Wd	5	2.6	0.24	0.00	0.00	0.00	0.00
21-Jun	We	34	4.9	0.48	0.03	0.03	0.00	0.00
22-Jun	We	47	3.4	0.20	0.02	0.02	0.00	0.00
25-Jun	Wd	12	3.3	0.39	0.08	0.08	0.00	0.00
28-Jun	We	18	2.8	0.24	0.06	0.06	0.00	0.00
29-Jun	We	9	3.2	0.54	0.11	0.11	0.00	0.00

^a Wd = weekday; We = weekend/holiday.

^b Fishery was restricted to catch-and-release fishing by emergency order on 17–30 June for all chinook salmon less than 132 cm in length.

Appendix B2.-Number of completed-trip interviews (n), catch, and harvest for guided anglers interviewed during the fishery for early-run chinook salmon in the downstream section of the Kenai River, 1997.

Date	Wd/ We ^a	Effort (hours)			Catch		Harvest ^b	
		n	Mean	SE	Mean	SE	Mean	SE
17-May	We	12	5.8	0.40	0.17	0.11	0.17	0.11
18-May	We							
20-May	Wd	64	5.2	0.36	0.52	0.06	0.45	0.06
24-May	We	22	4.7	0.32	0.14	0.07	0.14	0.07
25-May	We	40	5.2	0.34	0.28	0.08	0.25	0.07
26-May	We	37	4.7	0.37	0.30	0.08	0.30	0.08
29-May	Wd	28	5.7	0.48	0.39	0.09	0.36	0.09
30-May	Wd	20	4.5	0.44	0.40	0.11	0.40	0.11
31-May	We	45	4.1	0.35	0.51	0.08	0.40	0.07
1-Jun	We	35	4.4	0.31	0.23	0.07	0.20	0.07
4-Jun	Wd	25	6.0	0.72	0.44	0.10	0.44	0.10
7-Jun	We	14	5.9	0.25	0.21	0.11	0.14	0.10
8-Jun	We	37	4.4	0.34	0.35	0.08	0.35	0.08
10-Jun	Wd	41	4.7	0.33	0.34	0.07	0.29	0.07
12-Jun	Wd	35	3.8	0.39	0.66	0.10	0.57	0.08
14-Jun	We	45	4.8	0.31	0.33	0.07	0.31	0.07
15-Jun	We	43	5.7	0.32	0.19	0.06	0.16	0.06
18-Jun	Wd	20	5.3	0.38	0.20	0.09	0.00	0.00
20-Jun	Wd	29	7.1	0.41	0.83	0.14	0.00	0.00
21-Jun	We	43	5.4	0.27	0.26	0.07	0.00	0.00
22-Jun	We	60	5.6	0.11	0.20	0.05	0.00	0.00
25-Jun	Wd	27	4.9	0.34	0.07	0.05	0.00	0.00
28-Jun	We	17	5.1	0.74	0.24	0.11	0.00	0.00
29-Jun	We	20	5.6	0.36	0.10	0.07	0.00	0.00

^a Wd = weekday; We = weekend/holiday.

^b Fishery was restricted to catch-and-release fishing by emergency order on 17–30 June for all chinook salmon less than 132 cm in length.

Appendix B3.-Number of completed-trip interviews (n), catch, and harvest for unguided anglers interviewed during the fishery for late-run chinook salmon in the downstream section of the Kenai River, 1997.

Date	Wd/ We ^a	Effort (hours)			Catch		Harvest	
		n	Mean	SE	Mean	SE	Mean	SE
1-Jul	Wd	53	5.0	0.44	0.21	0.060	0.19	0.050
4-Jul	We	54	4.9	0.45	0.22	0.060	0.17	0.050
5-Jul	We	89	3.7	0.24	0.21	0.040	0.16	0.040
6-Jul	We	126	3.4	0.18	0.25	0.040	0.19	0.040
8-Jul	Wd	53	3.6	0.29	0.28	0.060	0.26	0.060
9-Jul	Wd	32	3.8	0.31	0.19	0.070	0.16	0.070
12-Jul	We	58	4.7	0.40	0.17	0.060	0.14	0.050
13-Jul	We	64	4.4	0.25	0.23	0.050	0.17	0.050
15-Jul	Wd	96	3.7	0.23	0.17	0.050	0.09	0.030
17-Jul	Wd	82	3.7	0.24	0.23	0.050	0.16	0.040
19-Jul	We	59	4.1	0.32	0.12	0.040	0.08	0.040
20-Jul	We	69	4.0	0.26	0.12	0.040	0.12	0.040
21-Jul	Wd	62	4.0	0.24	0.08	0.030	0.05	0.030
22-Jul	Wd	87	4.6	0.21	0.11	0.030	0.08	0.030
23-Jul	Wd	53	4.2	0.28	0.02	0.020	0.00	0.000
25-Jul	Wd	71	3.7	0.23	0.11	0.040	0.10	0.040
26-Jul	We	33	3.6	0.43	0.30	0.080	0.27	0.080
27-Jul	We	78	4.1	0.25	0.24	0.060	0.18	0.040
28-Jul	Wd	22	4.1	0.62	0.14	0.070	0.14	0.070
30-Jul	Wd	27	5.0	0.57	0.15	0.070	0.15	0.070
1-Aug	Wd	15	3.4	0.31	0.00	0.000	0.00	0.000
2-Aug	We	4	8.0	1.73	0.00	0.000	0.00	0.000
3-Aug	We	14	6.8	0.90	0.07	0.070	0.07	0.070

^a Wd = weekday; We = weekend/holiday.

Appendix B4.-Number of completed-trip interviews (n), catch, and harvest for guided anglers interviewed during the fishery for late-run chinook salmon in the downstream section of the Kenai River, 1997.

Date	Wd/ We ^a	Effort (hours)			Catch		Harvest	
		n	Mean	SE	Mean	SE	Mean	SE
1-Jul	Wd	119	4.7	0.17	0.35	0.040	0.34	0.040
4-Jul	We	76	5.4	0.29	0.26	0.050	0.21	0.050
5-Jul	We	69	4.5	0.30	0.35	0.060	0.33	0.060
6-Jul	We ^b							
8-Jul	Wd	140	5.2	0.15	0.36	0.040	0.29	0.040
9-Jul	Wd	124	5.4	0.20	0.27	0.040	0.21	0.040
12-Jul	We	57	5.3	0.33	0.30	0.060	0.30	0.060
13-Jul	We ^b							
15-Jul	Wd	102	5.4	0.20	0.35	0.050	0.28	0.040
17-Jul	Wd	75	5.0	0.26	0.36	0.060	0.29	0.050
19-Jul	We	60	5.7	0.31	0.15	0.050	0.13	0.040
20-Jul	We ^b							
21-Jul	Wd	51	4.6	0.22	0.16	0.050	0.16	0.050
22-Jul	Wd	48	5.4	0.20	0.23	0.060	0.19	0.060
23-Jul	Wd	132	5.5	0.14	0.20	0.040	0.14	0.030
25-Jul	Wd	54	5.1	0.30	0.31	0.060	0.31	0.060
26-Jul	We	54	5.2	0.16	0.17	0.050	0.15	0.050
27-Jul	We	0	0	0	0	0	0	0
28-Jul	Wd	46	5.7	0.30	0.30	0.080	0.22	0.060
30-Jul	Wd	32	5.9	0.45	0.28	0.080	0.28	0.080
1-Aug	Wd	28	5.6	0.26	0.07	0.050	0.07	0.050
2-Aug	We	35	5.1	0.30	0.17	0.060	0.14	0.060
3-Aug	We	10	5.2	0.39	0.10	0.100	0.10	0.100

^a Wd = weekday; We = weekend/holiday.

^b Sunday closed to fishing for guided anglers by regulation.

**APPENDIX C. EFFORT, CATCH AND HARVEST OF
CHINOOK SALMON ESTIMATED DURING THE CREEL
SURVEY OF THE FISHERY FOR CHINOOK SALMON ON THE
KENAI RIVER, ALASKA, 1997**

Appendix C1.-Effort, catch, and harvest of chinook salmon by unguided boat anglers and other summary statistics estimated during each sampled day of the fishery for early-run chinook salmon in the downstream section of the Kenai River, 1997.

Date	Wd/ We ^a	Number Counts	Mean Count	Number of Interviews ^b	Effort (hours)		Catch				Harvest			
					Total	SE	Total	SE	CPUE	SE	Total	SE	HPUE	SE
5/17/97	We	5	25	10	508	141	21	16	0.042	0.032	21	16	0.042	0.032
5/18/97	We	5	41	11	824	146	17	17	0.021	0.021	17	17	0.021	0.021
5/20/97	Wd	5	21	53	412	101	53	17	0.129	0.025	44	13	0.106	0.020
5/24/97	We	5	44	58	876	36	15	7	0.017	0.008	15	7	0.017	0.008
5/25/97	We	5	89	103	1,784	284	55	18	0.031	0.009	45	17	0.025	0.008
5/26/97	We	5	58	46	1,164	309	36	17	0.031	0.012	36	17	0.031	0.012
5/29/97	Wd	5	38	10	756	85	20	23	0.027	0.030	0	0	0.000	0.000
5/30/97	Wd	5	37	26	744	102	71	28	0.096	0.035	44	22	0.060	0.028
5/31/97	We	5	71	35	1,412	343	35	20	0.025	0.013	35	20	0.025	0.013
6/1/97	We	5	95	73	1,896	311	227	57	0.120	0.023	165	46	0.087	0.020
6/4/97	Wd	5	66	57	1,324	214	59	21	0.045	0.014	42	17	0.031	0.012
6/7/97	We	5	71	50	1,420	471	48	23	0.034	0.013	41	21	0.029	0.012
6/8/97	We	4	78	48	1,565	147	92	32	0.059	0.020	83	28	0.053	0.017
6/10/97	Wd	5	69	45	1,380	239	126	37	0.091	0.022	70	23	0.051	0.014
6/12/97	Wd	5	61	21	1,220	262	91	43	0.075	0.032	77	38	0.063	0.029
6/14/97	We	5	137	89	2,736	558	92	31	0.034	0.009	69	26	0.025	0.008
6/15/97	We	5	101	47	2,016	307	28	16	0.014	0.008	18	13	0.009	0.007
6/18/97	Wd ^c	5	25	13	492	180	53	23	0.107	0.029	0	0	0.000	0.000
6/20/97	Wd	5	18	5	364	152	0	0	0.000	0.000	0	0	0.000	0.000
6/21/97	We	5	55	34	1,092	302	7	7	0.006	0.006	0	0	0.000	0.000
6/22/97	We	5	41	47	824	284	5	5	0.006	0.006	0	0	0.000	0.000
6/25/97	Wd	5	17	12	344	100	8	9	0.024	0.026	0	0	0.000	0.000
6/28/97	We	5	22	18	444	103	9	9	0.020	0.020	0	0	0.000	0.000
6/29/97	We	5	23	9	468	120	18	17	0.038	0.035	0	0	0.000	0.000

^a Wd = weekday; We = weekend/holiday.

^b Completed-trip interviews only.

^c Fishery was restricted to catch-and-release fishing by emergency order on 17–30 June for all chinook salmon less than 132 cm in length.

Appendix C2.-Effort, catch, and harvest of chinook salmon by guided boat anglers and other summary statistics estimated during each sampled day of the fishery for early-run chinook salmon in the downstream section of the Kenai River, 1997.

Date	Wd/ We ^a	Number Counts	Mean Count	Number of Interviews ^b	Effort (hours)		Catch				Harvest			
					Total	SE	Total	SE	CPUE	SE	Total	SE	HPUE	SE
5/17/97	We	5	50	12	1,004	344	28	21	0.028	0.020	28	21	0.028	0.020
5/18/97	We	5	51	0 ^d	1,012	162	34	34	0.034	0.034	34	34	0.034	0.034
5/20/97	Wd	5	40	64	808	167	79	21	0.098	0.016	70	19	0.086	0.016
5/24/97	We	5	61	22	1,228	215	36	21	0.029	0.016	36	21	0.029	0.016
5/25/97	We	5	62	40	1,240	233	64	24	0.052	0.017	58	21	0.047	0.015
5/26/97	We	5	45	37	896	411	55	30	0.062	0.020	55	30	0.062	0.020
5/29/97	Wd	5	67	28	1,336	326	91	33	0.068	0.019	83	32	0.062	0.019
5/30/97	Wd	5	80	20	1,604	388	140	59	0.088	0.031	140	59	0.088	0.031
5/31/97	We	5	79	45	1,576	625	191	86	0.121	0.028	149	69	0.095	0.024
6/1/97	We	3	134	35	1,604	101	81	30	0.051	0.019	71	28	0.044	0.017
6/4/97	Wd	3	148	25	1,772	268	126	46	0.071	0.024	126	46	0.071	0.024
6/7/97	We	3	125	14	1,496	555	54	34	0.036	0.020	36	27	0.024	0.017
6/8/97	We	3	135	37	1,624	205	128	41	0.079	0.023	128	41	0.079	0.023
6/10/97	Wd	3	325	41	3,896	733	278	90	0.071	0.019	238	83	0.061	0.018
6/12/97	Wd	3	225	35	2,700	521	455	133	0.169	0.038	396	115	0.147	0.033
6/14/97	We	3	235	45	2,816	695	192	68	0.068	0.018	179	65	0.063	0.018
6/15/97	We	3	239	43	2,864	576	92	37	0.032	0.011	80	34	0.028	0.011
6/18/97	Wd ^c	3	119	20	1,428	222	54	25	0.038	0.017	0	0	0.000	0.000
6/20/97	Wd	3	96	29	1,152	365	135	47	0.117	0.018	0	0	0.000	0.000
6/21/97	We	3	114	43	1,368	137	65	18	0.047	0.012	0	0	0.000	0.000
6/22/97	We	3	99	60	1,184	247	43	14	0.036	0.009	0	0	0.000	0.000
6/25/97	Wd	3	127	27	1,520	234	23	16	0.015	0.011	0	0	0.000	0.000
6/28/97	We	3	59	17	708	238	32	18	0.045	0.021	0	0	0.000	0.000
6/29/97	We	3	49	20	588	51	11	7	0.018	0.013	0	0	0.000	0.000

^a Wd = weekday; We = weekend/holiday.

^b Completed-trip interviews only.

^c Fishery was restricted to catch-and-release fishing by emergency order on 17–30 June for all chinook salmon less than 132 cm in length.

^d Inferential values for effort, harvest and catch based on ratio of guided and unguided CPUE, HPUE for early run.

Appendix C3.-Effort, catch, and harvest of chinook salmon by unguided boat anglers and other summary statistics estimated during each sampled day of the fishery for late-run chinook salmon in the downstream section of the Kenai River, 1997.

Date	Wd/ We ^a	Number Counts	Mean Count	Number of Interviews ^b	Effort (hours)		Catch				Harvest			
					Total	SE	Total	SE	CPUE	SE	Total	SE	HPUE	SE
7/1/97	Wd	5	129	53	2,572	302	106	36	0.041	0.013	97	31	0.038	0.011
7/4/97	We	5	142	54	2,848	359	127	41	0.045	0.013	95	35	0.033	0.012
7/5/97	We	5	178	89	3,556	885	203	65	0.057	0.012	150	52	0.042	0.010
7/6/97	We	5	241	126	4,828	566	355	79	0.074	0.014	266	63	0.055	0.011
7/8/97	Wd	5	232	53	4,648	496	364	103	0.078	0.021	340	100	0.073	0.020
7/9/97	Wd	5	165	32	3,308	478	161	69	0.049	0.020	134	63	0.040	0.018
7/12/97	We	5	235	58	4,708	803	172	65	0.037	0.013	137	54	0.029	0.010
7/13/97	We	5	277	64	5,544	965	297	89	0.054	0.013	217	74	0.039	0.012
7/15/97	Wd	5	347	96	6,940	750	316	98	0.046	0.013	177	63	0.025	0.009
7/17/97	Wd	5	220	82	4,400	425	277	72	0.063	0.015	190	57	0.043	0.012
7/19/97	We	5	353	59	7,052	845	203	81	0.029	0.011	145	69	0.021	0.010
7/20/97	We	5	360	69	7,204	1,065	208	79	0.029	0.010	208	79	0.029	0.010
7/21/97	Wd	5	218	62	4,368	324	87	40	0.020	0.009	52	31	0.012	0.007
7/22/97	Wd	5	257	87	5,140	1,212	127	49	0.025	0.008	89	39	0.017	0.007
7/23/97	Wd	5	282	53	5,648	1,470	25	25	0.004	0.004	0	0	0.000	0.000
7/25/97	Wd	5	228	71	4,556	1,042	137	56	0.030	0.011	119	52	0.026	0.010
7/26/97	We	5	301	33	6,028	976	486	190	0.081	0.029	437	177	0.073	0.027
7/27/97	We	5	291	78	5,812	1,158	343	117	0.059	0.017	252	86	0.043	0.012
7/28/97	Wd	5	138	22	2,764	286	86	57	0.031	0.020	86	57	0.031	0.020
7/30/97	Wd	5	121	27	2,412	646	69	40	0.029	0.015	69	40	0.029	0.015
8/1/97	Wd	4	56	15	1,110	151	0	0	0.000	0.000	0	0	0.000	0.000
8/2/97	We	5	64	4	1,288	307	0	0	0.000	0.000	0	0	0.000	0.000
8/3/97	We	5	43	14	868	137	8	9	0.010	0.011	8	9	0.010	0.011

^a Wd = weekday; We = weekend/holiday.

^b Completed-trip interviews only.

Appendix C4.-Effort, catch, and harvest of chinook salmon by guided boat anglers and other summary statistics estimated during each sampled day of the fishery for late-run chinook salmon in the downstream section of the Kenai River, 1997.

Date	Wd/ We ^a	Number Counts	Mean Count	Number of ^b Interviews	Effort (hours)		Catch				Harvest			
					Total	SE	Total	SE	CPUE	SE	Total	SE	HPUE	SE
7/1/97	Wd	3	414	119	4,972	1,051	374	96	0.075	0.011	356	93	0.072	0.011
7/4/97	We	3	248	76	2,980	949	145	55	0.049	0.010	115	46	0.039	0.010
7/5/97	We	3	323	69	3,876	282	300	65	0.077	0.016	288	64	0.074	0.016
7/6/97	We ^c	0												
7/8/97	Wd	3	478	140	5,732	1,291	394	104	0.069	0.010	315	85	0.055	0.009
7/9/97	Wd	3	419	124	5,032	756	248	60	0.049	0.009	195	49	0.039	0.008
7/12/97	We	3	407	57	4,880	852	270	82	0.055	0.014	270	82	0.055	0.014
7/13/97	We ^c	0												
7/15/97	Wd	3	536	102	6,428	418	421	73	0.066	0.011	339	66	0.053	0.010
7/17/97	Wd	3	504	75	6,044	319	429	86	0.071	0.014	349	79	0.058	0.013
7/19/97	We	3	470	60	5,644	955	147	55	0.026	0.009	130	51	0.023	0.008
7/20/97	We ^c	0												
7/21/97	Wd	3	264	51	3,172	436	107	40	0.034	0.012	107	40	0.034	0.012
7/22/97	Wd	3	567	48	6,800	377	285	86	0.042	0.012	233	79	0.034	0.012
7/23/97	Wd	3	358	132	4,292	1,180	160	53	0.037	0.007	113	40	0.026	0.006
7/25/97	Wd	3	343	54	4,112	929	249	82	0.061	0.015	249	82	0.061	0.015
7/26/97	We	3	376	54	4,516	600	143	51	0.032	0.011	127	48	0.028	0.010
7/27/97	We	3	0	0	0	0	0	0	0.000	0.000	0	0	0.000	0.000
7/28/97	Wd	3	189	46	2,264	392	120	37	0.053	0.014	85	30	0.038	0.012
7/30/97	Wd	3	322	32	3,860	869	179	72	0.046	0.016	179	72	0.046	0.016
8/1/97	Wd	4	116	28	2,320	459	29	22	0.012	0.009	29	22	0.012	0.009
8/2/97	We	5	53	35	1,052	341	35	18	0.033	0.014	29	16	0.028	0.013
8/3/97	We	5	58	10	1,168	194	21	23	0.018	0.019	21	23	0.018	0.019

^a Wd = weekday; We = weekend/holiday.

^b Completed-trip interviews only.

^c Sundays closed to fishing for guided anglers by regulation.

**APPENDIX D. ESTIMATES OF CHINOOK SALMON PASSAGE
IN THE KENAI RIVER DETERMINED BY SONAR DURING
THE EARLY AND LATE RUNS, 1997**

Appendix D1.-Daily estimates of chinook salmon passage during the early run as determined by split-beam sonar, Kenai River, 1997.

Date	Daily Estimate	Cumulative Estimate
16-May	114	114
17-May	99	213
18-May	93	306
19-May	165	471
20-May	84	555
21-May	129	684
22-May	114	798
23-May	162	960
24-May	138	1,098
25-May	165	1,263
26-May	220	1,483
27-May	325	1,808
28-May	317	2,125
29-May	288	2,413
30-May	350	2,763
31-May	318	3,081
1-Jun	213	3,294
2-Jun	241	3,535
3-Jun	376	3,911
4-Jun	324	4,235
5-Jun	427	4,662
6-Jun	327	4,989
7-Jun	591	5,580
8-Jun	441	6,021
9-Jun	391	6,412
10-Jun	527	6,939
11-Jun	512	7,451
12-Jun	537	7,988
13-Jun	681	8,669
14-Jun	424	9,092
15-Jun	318	9,410
16-Jun	348	9,758
17-Jun	405	10,163
18-Jun	315	10,478
19-Jun	399	10,877
20-Jun	408	11,285
21-Jun	252	11,537
22-Jun	390	11,928
23-Jun	225	12,153
24-Jun	285	12,438
25-Jun	332	12,770
26-Jun	381	13,151
27-Jun	363	13,514
28-Jun	297	13,811
29-Jun	570	14,381
30-Jun	582	14,963

Source: Bosch and Burwen *In prep.*

Appendix D2.-Daily estimates of chinook salmon passage during the late run as determined by split-beam sonar, Kenai River, 1997.

Date	Daily Estimate	Cumulative Estimate
1-Jul	486	486
2-Jul	642	1,128
3-Jul	600	1,728
4-Jul	633	2,361
5-Jul	657	3,018
6-Jul	627	3,645
7-Jul	1,158	4,803
8-Jul	1,221	6,025
9-Jul	1,618	7,643
10-Jul	3,486	11,129
11-Jul	5,649	16,778
12-Jul	4,497	21,275
13-Jul	5,373	26,648
14-Jul	2,031	28,679
15-Jul	4,042	32,721
16-Jul	3,420	36,141
17-Jul	4,584	40,725
18-Jul	2,334	43,059
19-Jul	1,146	44,205
20-Jul	1,578	45,783
21-Jul	894	46,677
22-Jul	1,840	48,517
23-Jul	1,441	49,958
24-Jul	1,080	51,038
25-Jul	532	51,570
26-Jul	519	52,089
27-Jul	438	52,527
28-Jul	333	52,860
29-Jul	401	53,260
30-Jul	450	53,710
31-Jul	420	54,130
1-Aug	247	54,377
2-Aug	291	54,668
3-Aug	213	54,881

Source: Bosch and Burwen *In prep.*