Fishery Data Series No. 97-9

Angler Effort and Harvest of Chinook Salmon by the Recreational Fisheries in the Lower Kenai River, 1996

by

Mary A. King

April 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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by

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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 16 May through 4 August 1996. The estimated angler-effort and harvest during the early (May and June) chinook salmon run were 130,180 (SE = 3,914) angler-hours and 4,166 (SE = 290) chinook salmon, respectively. The estimated angler-effort and harvest during the late (July and August) chinook salmon run were 238,495 (SE = 7,285) angler-hours and 5,984 (SE = 404) chinook salmon, respectively. During the early run, the recreational fishery was liberalized, allowing the use of bait, and during the late run the fishery was extended until 4 August in response to a large return. Unguided anglers exerted 51% of the total effort and harvested 31% of the total chinook salmon harvest while guided anglers exerted 49% of the effort and harvested 69% of the total chinook salmon harvest.

In the recreational harvest and inriver return, for both runs, predominant age class was age 1.4, followed by age 1.3. The inriver return was 23,505 (SE = 376) chinook salmon during the early run and 53,934 (SE = 1,053) chinook salmon during the late run.

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 nearly 350,000 angler-days over the last 7 years (Mills 1989-1994; Howe et al. 1995, 1996). This represents approximately 15% of the state's recreational fishing effort. The majority of Kenai River angler-effort occurs during the chinook salmon *Oncorhynchus tshawytscha* fishery (May through July) between the outlet of Skilak Lake and Cook Inlet (Figure 1). With the exception of 1990, 1991 and 1992, angler effort in the chinook salmon fishery has generally been increasing (Figures 2 and 3). Decreased effort in these years was related to decreased run size resulting in restrictions to the fisheries. 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 anglers in the Kenai River, this report focuses on the chinook salmon fisheries.

Prior to 1970, the recreational fishery in the Kenai River was comprised 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 from mid-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 of 1985.

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 set net 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. The early and late chinook salmon returns to the Kenai River are managed by separate management plans

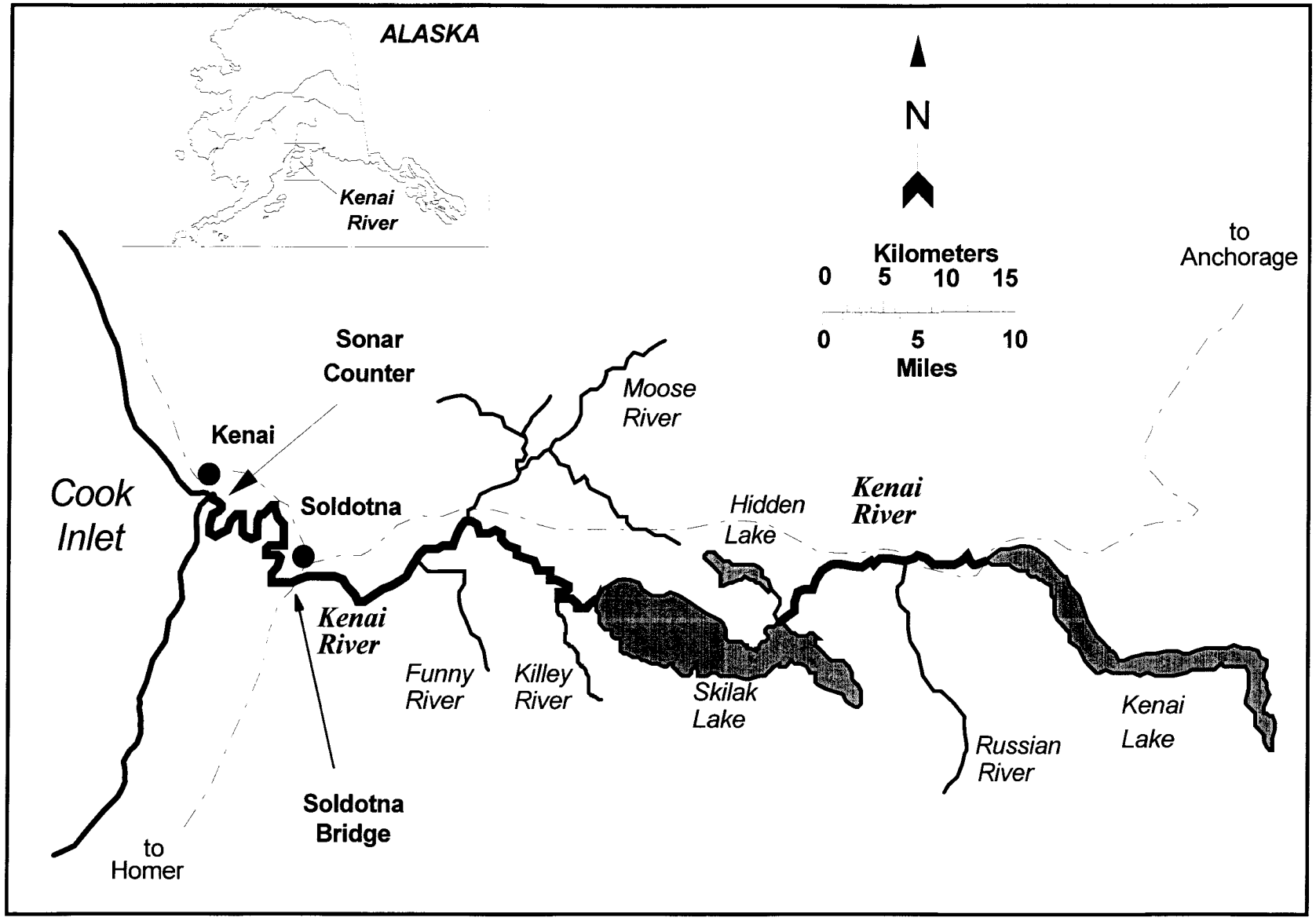

Figure 1.-Map of the Kenai River drainage.

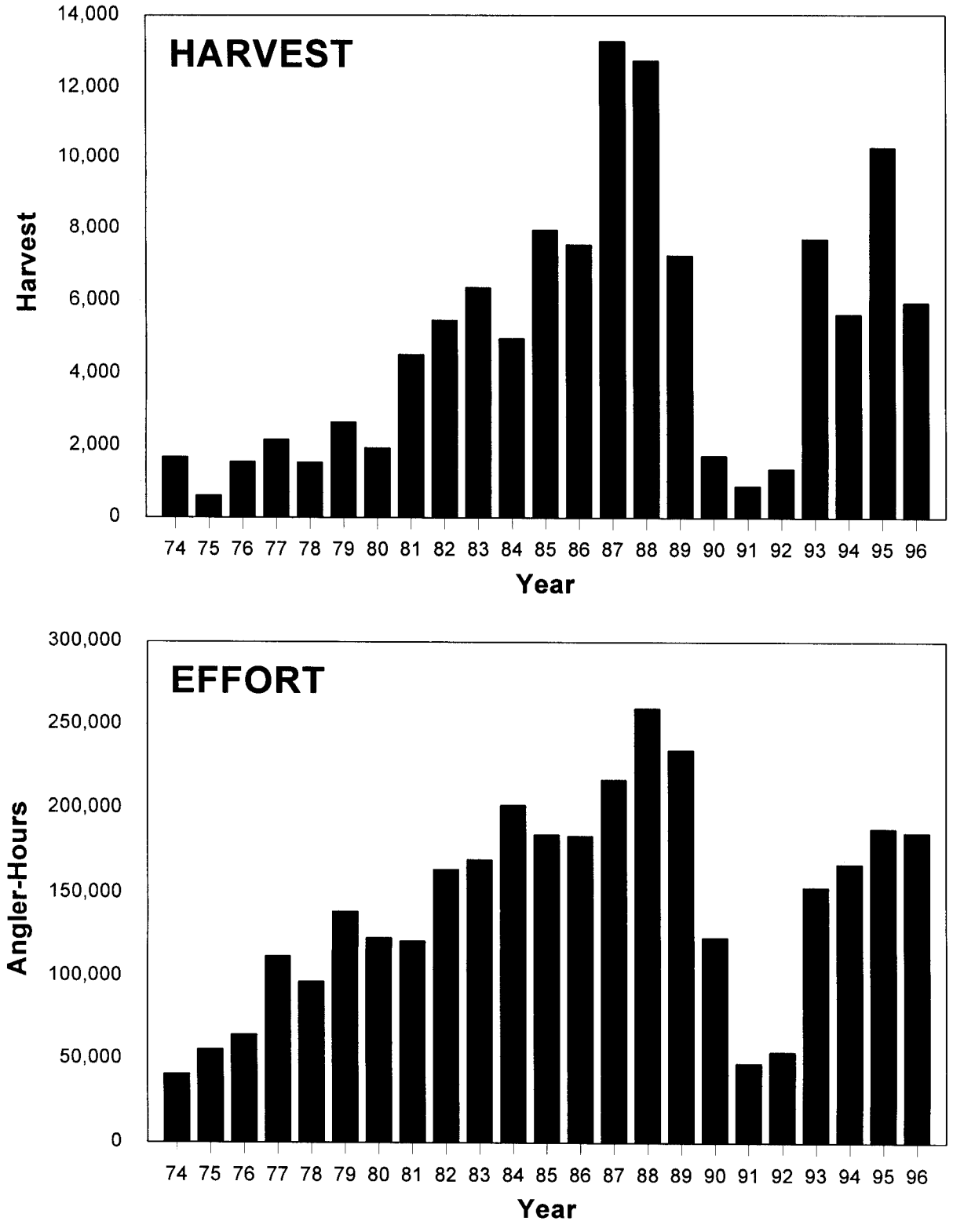

Figure 2.-Historical harvest and effort in the recreational fishery for early-run chinook salmon, Kenai River, 1974-1996.

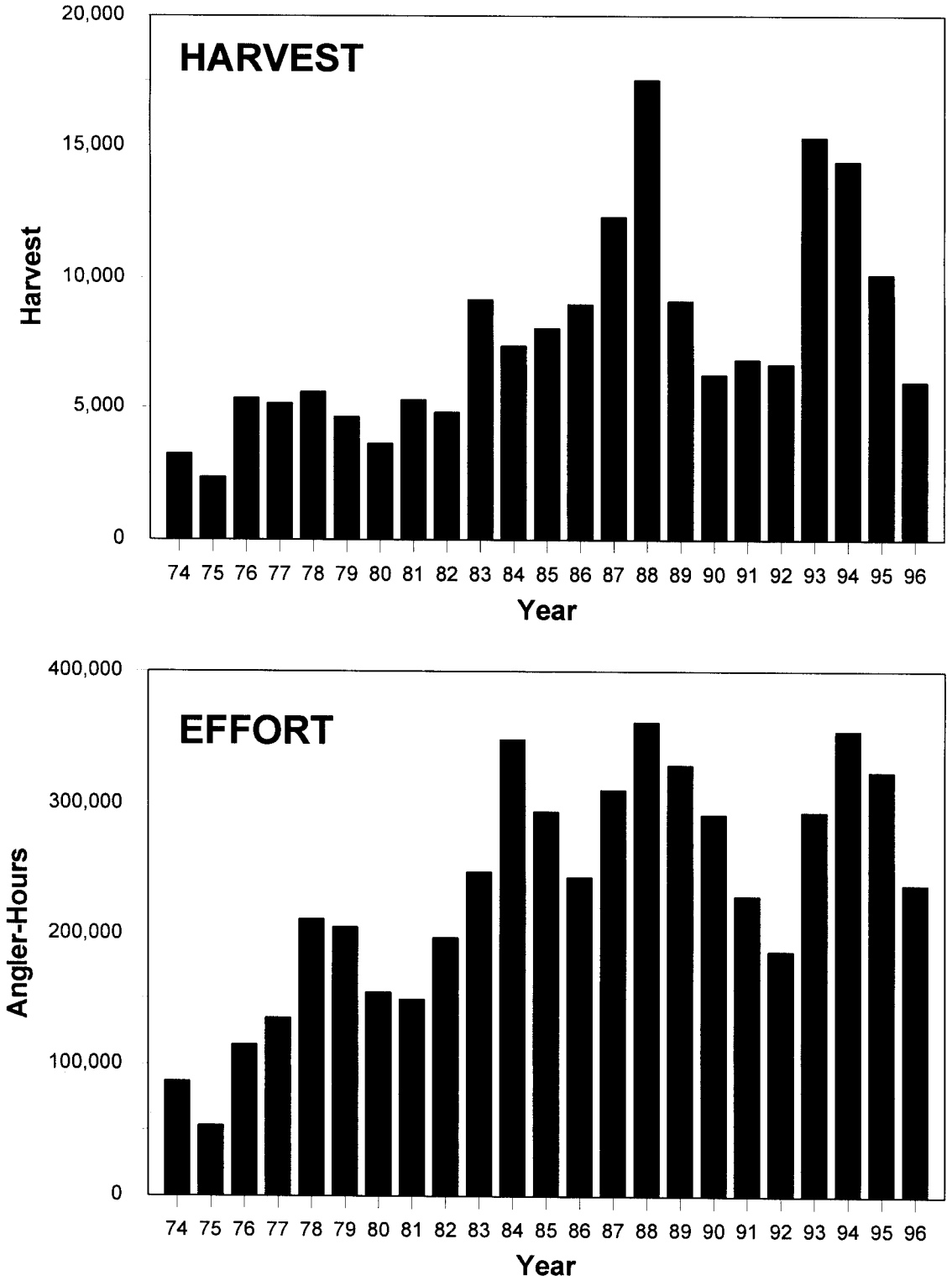

Figure 3.-Historical harvest and effort in the recreational fishery for late-run chinook salmon, Kenai River, 1974-1996.

adopted by the Board of Fisheries (BOF) in 1988, later modified in 1991.

Previous information on the chinook salmon fisheries in the Kenai River has been presented by Hammarstrom (1975-1981, 1988-1994), Hammarstrom and Larson (1982-1984, 1986), Hammarstrom et al. (1985), Conrad and Hammarstrom (1987), and King (1995, 1996). In addition, angler-effort and harvest by species for the recreational fishery have been estimated by Mills (1979-1994) and Howe et al. (1995, 1996) in the Alaska Statewide Sport Fish Harvest Survey.

This creel survey program provides data that are used for inseason management decisions for the recreational fishery, evaluated to refine long-term management objectives, and used by the Alaska Board of Fisheries to allocate salmon resources.

Specific objectives of this project were:

1. To estimate the total harvest and catch of early-run chinook salmon by the sport fishery in the mainstem Kenai River downstream of Skilak Lake during the period 16 May through 15 July and of late-run chinook salmon in the mainstem Kenai River downstream from the Soldotna Bridge between 1 July and 6 August.
2. To estimate angler effort by the sport fishery in the mainstem Kenai River downstream of the Soldotna Bridge for the periods 16 May through 30 June and 1 July through 6 August.
3. To estimate the age, sex, and length composition of chinook salmon harvested by the sport fishery in the mainstem Kenai River downstream of the Soldotna Bridge.
4. To estimate the age, sex, and length composition of the chinook salmon population entering the Kenai River from 16 May through 15 August.

FISHING REGULATIONS

The regulations for the chinook salmon fishery in the Kenai River are among the most restrictive of any open waters in Alaska. Only the section of the river between the outlet of Skilak Lake and Cook Inlet is open to fishing for chinook salmon, with the exception of the restricted waters at the confluences 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 areas prior to entering their natal streams. By regulation, 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 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 those 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 Monday of Memorial Day. 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 the regulation prohibiting fishing from boats on Mondays, fishing from a registered guide vessel on any Sunday in July is prohibited. Fishing from a guided boat is allowed only between 0600 and

1800 hours during June and July. There are no days or hours closed to boat fishing by either guided or unguided anglers during the remainder of the year. Also, during May, June, and July guides are prohibited from fishing while conducting clients.

In 1996, the early-run fishery was opened to the use of bait on 9 June, and fishing from boats was permitted for all anglers on two Mondays, the 17th and 24th of June, with guided anglers being restricted to 0600 to 1800 hours. The late-run fishery was also extended through 4 August to allow chinook salmon retention downstream of "Eagle Rock" (approximately river kilometer 18.2). The above emergency orders were issued in response to the development of the inriver return in an attempt to allow maximum opportunity while insuring that escapement goals were achieved.

METHODS

CREEL SURVEY

A roving creel survey (Neuhold and Lu 1957) was used to estimate sport fishing effort, in angler-hours, by the recreational fishery for chinook salmon in the Kenai River. Harvest per unit of effort (HPUE) and catch per unit of effort (CPUE) for chinook salmon were estimated from angler interviews. Harvest and catch of chinook salmon were estimated as the product of effort and harvest (or catch) rate estimates. Fishery statistics were estimated separately for the early and late runs.

During the 1996 fisheries, angler effort, harvest, and catch were estimated from Cook Inlet (river mile (rm)/kilometer (rkm) 0) to the Soldotna Bridge (rm 21 or rkm 34) of the Kenai River (Figure 4). There was no creel survey of the fishery upstream of the Soldotna Bridge in 1996 due to difficulties in obtaining a desired sample size of completed-trip angler interviews and conducting angler counts.

Both unguided and guided anglers participate in the fishery for chinook salmon in the Kenai River. The times and days when guides may be used on the Kenai River are restricted, and anglers employing commercial guides have very different harvest and catch rates; therefore, effort, HPUE, CPUE, harvest, and catch were estimated separately for guided and unguided anglers. Guided anglers fish exclusively from boats and are easily recognized because these boats are required to display a prominent identifying decal. Since shore anglers harvest very few chinook salmon, only boat anglers were surveyed.

The creel survey began 16 May and continued through 4 August. The fishing day for unguided anglers was defined as 20 hours long, 0400 to 2400 hours, and was stratified into five 4-hour time periods to estimate effort. The periods were: A (0400 to 0759 hours), B (0800 to 1159 hours), C (1200 to 1559 hours), D (1600 to 1959 hours), and E (2000 to 2359 hours). In May and August, stratification of the fishing day for guided anglers was the same as that for unguided anglers. However, by regulation, anglers may fish from a registered guide boat only from 0600 to 1800 hours during June and July, which therefore defined the fishing day (12 hours) for guided anglers. Since most guides schedule two trips per day, morning and afternoon, each fishing day for guided anglers had two temporal strata: Period A (0600 to 1159 hours) and B (1200 to 1759 hours). Unguided anglers were further stratified into weekdays and weekend/holidays. Estimates for guided and unguided anglers were stratified temporally into approximate 2-week intervals. This design resulted in 20 strata:

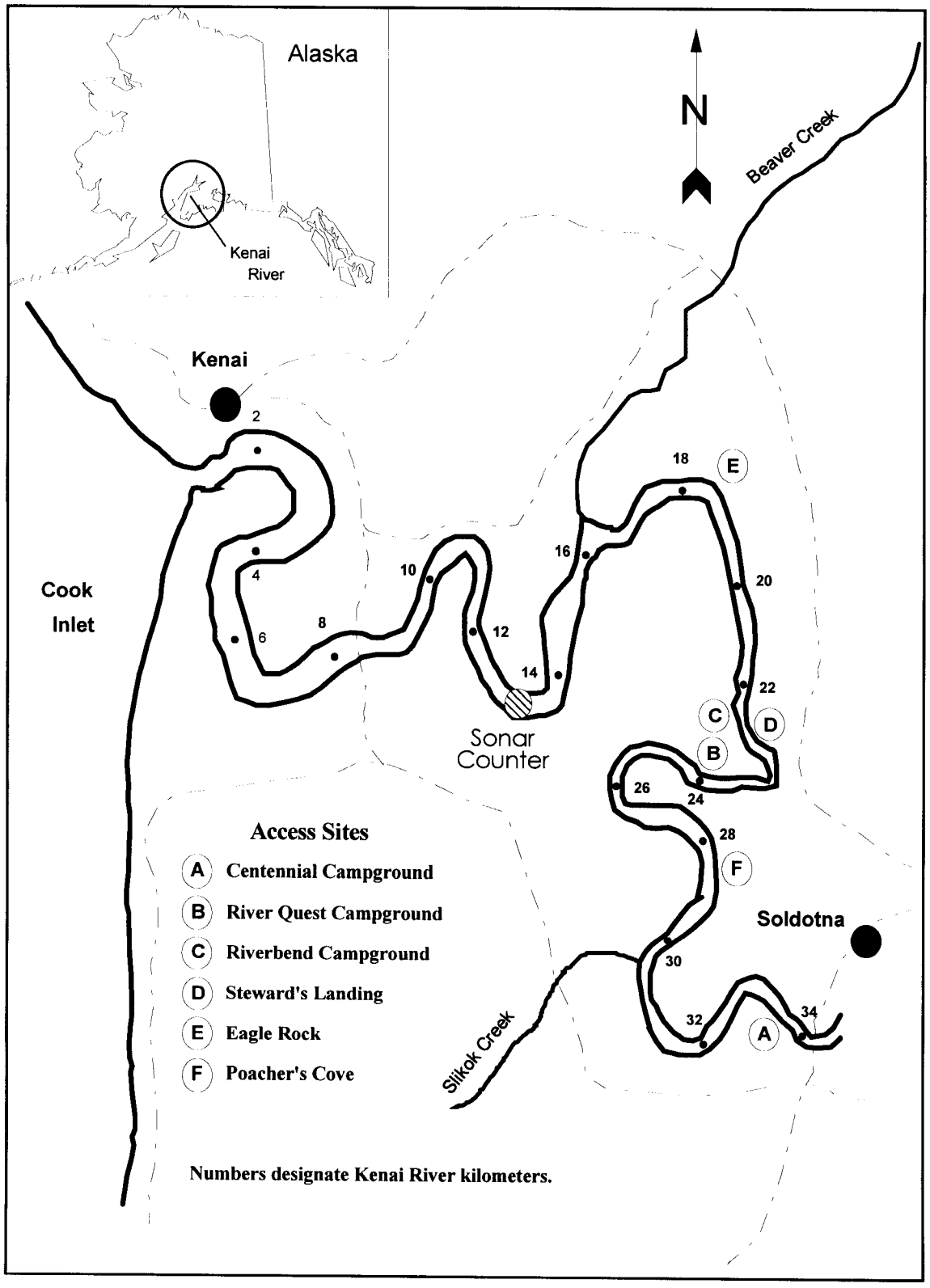

Figure 4.-Map of the Kenai River creel survey study area.

12 during the early run and eight during the late run. There were seven temporal strata, four during the early run and three during the late run.

The early-run strata were:
(1) 5/16-5/31, unguided anglers, weekdays;
(2) 5/16-5/31, unguided anglers, weekends/holidays;
(3) 5/16-5/31, guided anglers;
(4) 6/1-6/8, unguided anglers, weekdays;
(5) 6/1-6/8, unguided anglers, weekends/holidays;
(6) 6/1-6/8, guided anglers;
(7) 6/9-6/16, unguided anglers, weekdays;
(8) 6/9-6/16, unguided anglers, weekends/holidays;
(9) 6/9-6/16, guided anglers;
(10) 6/17-6/30, unguided anglers, weekdays;
(11) 6/17-6/30, unguided anglers, weekends/holidays;
(12) 6/17-6/30, guided anglers;

The late-run strata were:
(13) 7/1-7/15, unguided anglers, weekdays;
(14) 7/1-7/15, unguided anglers; weekends/holidays;
(15) 7/1-7/15, guided anglers;
(16) 7/16-7/31, unguided anglers, weekdays;
(17) 7/16-7/31, unguided anglers, weekends/holidays;
(18) 7/16-7/31, guided anglers;
(19) 8/1-8/4, unguided anglers, all days; and
(20) 8/1-8/4, guided anglers, all days.

In 1996 the study area was geographically stratified into two areas: (1) downstream of the chinook salmon sonar counters to the Warren Ames Bridge, and (2) upstream of the chinook salmon sonar counters to the Soldotna Bridge. The chinook salmon sonar site was originally located downstream of the fishery such that returning chinook salmon were enumerated prior to any harvest by the recreational fishery. Over the years the chinook salmon recreational fishery expanded downstream of the chinook salmon sonar counters. There was concern that the level of harvest which occurred there might significantly affect the estimate of the inriver return determined by the sonar counters. By geographically stratifying the study area, estimates of effort, catch, and harvest were made for each stratum, specifically identifying the level of harvest downstream of the sonar counters. Therefore, each geographic stratum was further stratified by the above 20 strata, for a total of 40 strata.

Angler Counts

Sampling levels were designed to estimate effort within ± 10% of the true value 95% of the time, and catch and harvest within ± 15% of the true value 95% of the time. Two boat technicians, each working 37.5 hours per week, conducted the angler counts downstream of the Soldotna Bridge.

On every weekend day and holiday, an unguided angler count was made during each of the five periods. One of the four whole-hours of each period (A through E) was selected randomly as a time to initiate an unguided angler count. During each 4-day week (weekdays only, Tuesday through Friday), 2 days for each period, A through E, were sampled at random. Within each sampled period, an angler count was initiated at one of the four randomly selected whole-

hours. This sampling design allowed for 10 unguided angler counts on a typical weekend and 10 unguided angler counts during the 4 weekdays the fishery was open.

Since guided and unguided anglers fished under similar regulations during May and August, guided angler counts were conducted as described above. However, during June and July, if a selected unguided angler count occurred during the A period (0600-1159 hours) or B period (1200-1759 hours) corresponding to the guided angler strata, then a guided angler count was also conducted. If no unguided angler counts were scheduled during the A or B period for guided anglers, an additional count for guided anglers only was conducted at a randomly selected whole-hour during the guided period in question. If two or more counts occurred during the guided period, A or B, then one was selected randomly as the guided angler count and the remaining counts were designated as unguided angler counts only. 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 downstream of the Soldotna Bridge to the Warren Ames Bridge on the Kenai River. The starting point of each count (upstream or downstream extremity of the river section) 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 of the river section. The technician actually made a complete count for each geographic stratum. The entire count period usually took about 45 minutes and every effort was made to ensure that the trip was completed in less than 1 hour. Angler counts were considered to be instantaneous and to reflect fishing effort at the time of the count. During the angler count, the boat technician recorded the following for each geographic stratum: (1) total number of unguided boats, (2) total number of guided boats, (3) total number of anglers in unguided boats, (4) total number of anglers in guided boats, and (5) total number of shore anglers. Boats and anglers were considered engaged in fishing and were counted if the boat was in operation, as opposed to tied to the shore, 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 to guides 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 designated access sites. The number of interviews was augmented by the two boat technicians who conducted angler interviews at times when they were not engaged in angler counts.

For each angler interviewed, the technician inquired as to which geographic stratum the angler fished: downstream of the chinook salmon sonar site to the Warren Ames Bridge or upstream of the chinook salmon sonar site to the Soldotna Bridge. The technician obtained an interview for each stratum fished (a possible two interviews per angler) and recorded the following information for each interview: (1) powered or nonpowered boat; (2) location fished (upstream or downstream, in reference to the chinook salmon sonar counters); (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. Although boat type was recorded for each interview, these data are not

presented in this report because they are collected for use by the Board of Fisheries and other agencies and are not germane to the objectives of this report.

Interviews of completed-trip anglers for harvest and catch rate information were conducted primarily at six access sites (Figure 4). Two access technicians conducted the interviews at access sites. Each technician was scheduled to work 7.5-hour days on each weekend/holiday day and on 3 randomly selected weekdays each week. Two access sites were sampled by a technician on a sample day. The access sites sampled each day were chosen at random. Thus on weekend/holidays, four access sites were sampled each day, and on weekdays either two or four access sites were sampled. The starting time for the 7.5-hour interview period was randomly selected from either an early shift (possible start times: 0600, 0630, 0700, or 0730 hours) or a late shift (possible start times: 1500, 1530, 1600, or 1630 hours). The technicians conducted interviews for about 3.5 hours at each access site.

AGE/SEX COMPOSITION

Harvest

Sampling goals for estimation of age composition of the harvest were 140 harvested fish per 2-week stratum (three strata in the early run and two strata in the late run). The sample goal was increased over previous years (120) due to increased occurrence of scale regeneration, reducing the number of legible scale samples. Samples were obtained from anglers' creels during the surveys. Mid-eye to fork-of-tail length was measured to the nearest one-half centimeter, the sex of the fish was identified, and scales were 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 these images, observed with a microfiche reader, were used to age the fish. If the adipose fin was missing on any observed fish, every attempt was made to secure the head for later examination by the department's tag lab for the presence of a coded wire tag. These data are part of a chinook salmon stock assessment program conducted on the Deep Creek Marine recreational fishery.

Inriver Return

The age and sex composition of the inriver return were also estimated because the age and sex composition estimated by sampling the sport fishery is biased toward larger fish which the anglers tend to retain. The inriver return was sampled by live capturing chinook salmon in 7 1/4-inch mesh gill nets 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 each were used. Sampling was stratified into two 3-week strata during each run with a sampling goal of 185 fish per stratum. The sample goal was increased this season due to scale regeneration problems as discussed above.

Fish were untangled from the gillnet and placed in a tagging cradle to be sampled and later released. Biological data collected included length (mid-eye 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

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. In the following sections, harvest refers to fish

retained by anglers and catch refers to fish retained plus those reported as released by anglers.

Effort

The number of angler-hours of effort during fishery stratum h was estimated as (Neuhold and Lu 1957):

$$\hat{E}_h = D_h H_h \sum_{k=1}^{p_h} \bar{x}_{hk}, \quad (1)$$

where:

$\bar{x}_{hk}$ = the mean angler count during period k of stratum h,

$$= \frac{\sum_{i=1}^{d_h} x_{hik}}{d_h},$$

x_{hik} = angler count in stratum h on day i of period k,

d_h = the number of days sampled in stratum h,

H_h = the number of hours in the fishing day during stratum h,

D_h = the total number of days in stratum h, and

p_h = the number of periods (A, B, C, etc.) in stratum h.

The variance of effort was estimated by (Scheaffer et al. 1979):

$$V(\hat{E}_h) = (1 - f_h)(D_h H_h)^2 \sum_{k=1}^{p_h} \frac{s_{hk}^2}{d_h}, \quad (2)$$

where:

$$f_h = \frac{d_h}{D_h}, \text{ and}$$

s_{hk}^2 = the variance of angler counts among days of period k during stratum h.

This method assumes a stratified two-stage design: strata being angler type, weekend or weekday (for unguided anglers), temporal interval and periods; first stage being days and second stage being counts. The finite population correction factor was not applied to the second stage because angler counts are considered instantaneous, and thus there are an infinite number of counts that can be taken.

Harvest Rates and Catch Rates

The catch or harvest per unit of effort (CPUE or HPUE) was estimated from completed-trip angler interviews in a two-stage design with days being the first stage and anglers being the second stage. The catch (or harvest) per angler hour for stratum h was estimated as a ratio of means (Pollock et al. 1994):

$$\hat{CPUE}_h = \frac{\bar{c}_h}{\bar{e}_h} = \frac{\sum_{i=1}^{d_h}\sum_{j=1}^{m_{hi}} c_{hij} \Big/ \sum_{i=1}^{d_h} m_{hi}}{\sum_{i=1}^{d_h}\sum_{j=1}^{m_{hi}} e_{hij} \Big/ \sum_{i=1}^{d_h} m_{hi}}, \quad (3)$$

and the variance was estimated by (Jessen 1978):

$$V(\hat{CPUE}_h) = \left(\frac{\bar{c}_h}{\bar{e}_h}\right)^2 \left[\frac{s_{ch}^2}{\bar{c}_h^2} + \frac{s_{eh}^2}{\bar{e}_h^2} - \frac{2\,\mathrm{cov}(\bar{c}_h, \bar{e}_h)}{\bar{c}_h \bar{e}_h}\right], \quad (4)$$

where:

c_{hij} = catch by angler j on day i of stratum h,

e_{hij} = hours fished by angler j on day i of stratum h, and

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

The covariance of catch and effort in stratum h was estimated by:

$$\mathrm{cov}(\bar{c}_h, \bar{e}_h) = \frac{\sum_{i=1}^{d_h} (\bar{c}_{hi} - \bar{c}_h)(\bar{e}_{hi} - \bar{e}_h)}{d_h - 1}. \quad (5)$$

The variances of angler catch (c) and effort (e) are two-stage variances and, ignoring the finite population correction factor for the second stage (anglers), were estimated by (Cochran 1977, Pollock et al. 1994):

$$s^2_{ch} = (1 - f_h)\frac{s^2_h}{d_h} + \frac{f_h}{d^2_h}\sum_{i=1}^{d_h}\frac{s^2_{hi}}{m_{hi}}, \quad (6)$$

where:

s^2_h = variance among days for catch (harvest) or effort, and

s^2_{hi} = variance among anglers on day i,

$$= \frac{\sum_{j=1}^{m_{hi}} \left(c_{hij} - \bar{c}_{hi}\right)^2}{m_{hi} - 1}.$$

The variance of angler effort (s^2_{eh}) was estimated by substituting hours fished (e) for catch (c) in the above equation.

Harvest and Catch

The total catch (or harvest) during each stratum was estimated by:

$$\hat{C}_h = (\hat{CPUE}_h)(\hat{E}_h). \quad (7)$$

The variance of total catch (or harvest) was estimated as the variance of two independent random variables (Goodman 1960):

$$V(\hat{C}_h) = \left[\hat{E}^2_h V(\hat{CPUE}_h)\right] + \left[\hat{CPUE}^2_h V(\hat{E}_h)\right] - \left[V(\hat{CPUE}_h)V(\hat{E}_h)\right]. \quad (8)$$

Totals of effort, catch and harvest for each temporal/angler type stratum within each geographic stratum (for example, the total for unguided anglers within a geographic stratum) were estimated by summing the appropriate strata estimates. Estimates for each stratum are considered independent; therefore, the variance of the total was estimated by the sum of the appropriate variances of the strata. Totals for the geographic strata combined were estimated by pooling the data within each temporal/angler type stratum.

The major assumptions necessary for these analyses are:

1. Significant fishing effort occurs only between the hours defined for the angler day;
2. Individual effort and harvest (or catch) by anglers are normally distributed random variables; and
3. Anglers are interviewed in constant proportions to their abundance within each stratum (DiCostanzo 1956), and interviewed anglers are representative of the total angler population.

Biological Data

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

$$\hat{p}_{bt} = \frac{n_{bt}}{n_t}, \quad (9)$$

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):

$$V(\hat{p}_{bt}) = \frac{\hat{p}_{bt}(1-\hat{p}_{bt})}{(n_t - 1)}. \quad (10)$$

There were no significant differences in the ages of fish harvested by guided and unguided anglers (χ^2 = 0.53, df = 3, P = 0.91), therefore biological data from harvests of both angler types were pooled.

RESULTS

EFFORT

The creel survey commenced on 16 May. Angler counts were conducted on all of the 74 days possible: 43 during the early run and 31 during the late run.

During the early run, combined angler counts (upstream and downstream with reference to the sonar counters) ranged from 0 to 361 for unguided anglers and from 0 to 448 for guided anglers (Appendix A1). The largest combined count of unguided anglers occurred on 23 June and of guided anglers on 22 June. During the late run, combined angler counts ranged from 0 to 806 for unguided anglers and from 0 to 765 for guided anglers (Appendix A2). The largest combined count of unguided anglers occurred on 21 July and for guided anglers on 20 July. In nearly all cases for both angler types, the count upstream of the sonar site was considerably greater than the downstream count. Mean angler counts tend to be lowest in May and gradually increase throughout June and early July, with the highest mean angler counts occurring during the last 2 weeks of July (Tables 1 and 2).

The estimated effort downstream of the Soldotna Bridge during the early run was 130,180 (SE = 3,914) angler-hours [downstream of sonar = 2,682 (SE = 459); upstream of sonar = 126,926 (SE = 3,927)] (Table 3). The total relative precision (5.9%) was within desired levels, ± 10% of the true values 95% of the time.

The estimated effort downstream of the Soldotna Bridge during the late run was 238,495 (SE = 7,285) angler-hours [downstream of sonar = 18,461 (SE = 1,307); upstream of sonar = 220,766 (SE = 6,870] (Table 4). The total relative precision (6.0%) was also within the desired level. Completed-trip anglers interviewed during the early run reported a total of 10,167 angler-hours, 8% of the total estimated effort. During the late-run, interviewed anglers reported fishing a total of 14,475 angler-hours, 6% of the total estimated effort. Approximately 5% of the total late-run effort occurred during the 4-day extension of the fishery.

HARVEST RATES AND CATCH RATES

A total of 5,145 completed-trip angler interviews were collected: 2,234 (141 downstream and 2,093 upstream) during the early run and 2,911 (178 downstream and 2,733 upstream) during the late run (Tables 5 and 6). Interviews were conducted with guided and/or unguided completed-trip anglers on each day of the fishery during the early and late runs.

Daily catch rates of early-run chinook salmon by unguided anglers ranged from 0.000 to 0.182 fish per hour and from 0.000 to 0.130 fish per hour for anglers employing guides (Appendices B1 and B2). Peak daily catch rates of early-run chinook salmon by unguided anglers occurred on 18 June and on 12 June for guided anglers. Daily catch rates of late-run chinook salmon by unguided anglers ranged from 0.000 to 0.070 fish per hour and from 0.007 to 0.167 fish per hour for guided anglers (Appendices B3 and B4). Peak daily catch rates of late-run chinook salmon by unguided anglers occurred on 16 July and by guided anglers on 4 August.

Table 1.-Mean counts of boat anglers by period for each stratum of the creel survey of the fishery for early-run chinook salmon downstream of the Soldotna Bridge on the Kenai River, 1996.

	Downstream[a]					Upstream[a]					Total				
	Period[b]					Period[b]					Period[b]				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
16 May - 31 May															
Unguided anglers, weekdays:															
Number of counts	5	5	5	6	4	5	5	5	6	4	5	5	5	6	4
Mean count	0	0	0	0	1	15	24	20	20	14	17	24	20	20	15
Standard error	0	0	0	0	1	6	8	9	6	11	5	8	9	6	10
Unguided anglers, weekends:															
Number of counts	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Mean count	0	0	0	1	0	17	47	58	30	33	17	47	58	31	33
Standard error	0	0	0	1	0	9	11	12	4	13	9	11	12	4	13
Guided anglers, all days (May):															
Number of counts	10	10	10	11	9	10	10	10	11	9	10	10	10	11	9
Mean count	0	0	0	0	0	30	63	46	27	6	30	63	46	27	6
Standard error	0	0	0	0	0	9	10	9	6	4	9	10	9	6	4
1 June - 8 June															
Unguided anglers, weekdays:															
Number of counts	3	2	2	2	2	3	2	2	2	2	3	2	2	2	2
Mean count	0	0	1	0	2	39	59	47	46	35	39	59	48	46	37
Standard error	0	0	1	0	2	20	5	6	15	14	20	5	7	15	16
Unguided anglers, weekends:															
Number of counts	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Mean count	0	0	3	2	0	29	83	89	71	55	29	83	92	74	55
Standard error	0	0	2	2	0	15	4	14	6	5	15	4	13	4	5
Guided anglers, all days:															
Number of counts	7	7				7	7				7	7			
Mean count	0	1				152	84				152	94			
Standard error	0	1				17	12				17	12			

-continued-

Table 1.-Page 2 of 2.

	Downstream[a]					Upstream[a]					Total				
	Period[b]					Period[b]					Period[b]				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
9 June - 16 June															
Unguided anglers, weekdays:															
Number of counts	2	3	4	2	2	2	3	4	2	2	2	3	4	2	2
Mean count	0	0	2	0	0	72	92	99	96	73	72	92	101	96	73
Standard error	0	0	2	0	0	51	5	6	7	26	51	5	5	7	26
Unguided anglers, weekends:															
Number of counts	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Mean count	1	2	6	0	0	174	239	179	164	106	175	241	185	164	106
Standard error	1	1	3	0	0	30	16	5	54	22	30	17	4	54	22
Guided anglers, all days:															
Number of counts	7	7				7	7				7	7			
Mean count	0	1				316	152				318	153			
Standard error	0	1				12	13				13	13			
17 June - 30 June															
Unguided anglers, weekdays:															
Number of counts	4	8	8	3	4	4	8	8	3	4	4	8	8	3	4
Mean count	0	4	2	7	2	65	92	94	59	65	65	97	96	65	67
Standard error	0	2	1	4	1	27	9	20	14	26	26	10	20	11	25
Unguided anglers, weekends:															
Number of counts	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Mean count	6	7	8	3	2	111	212	156	107	37	117	219	164	110	37
Standard error	3	2	3	3	1	24	52	19	19	26	27	52	22	18	25
Guided anglers, all days:															
Number of counts	14	14				14	14				14	14			
Mean count	10	6				233	124				243	130			
Standard error	4	2				25	15				24	16			

[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] Unguided anglers, all months:
Period A = 0400-0759 hours
Period B = 0800-1159 hours
Period C = 1200-1559 hours
Period D = 1600-1959 hours
Period E = 2000-2359 hours

Guided anglers:
May: Same as unguided anglers

June: Period A = 0600-1159 hours
Period B = 1200-1759 hours

Table 2.-Mean counts of boat anglers by period for each stratum of the creel survey of the fishery for late-run chinook salmon downstream of the Soldotna Bridge on the Kenai River, 1996.

	Downstream[a]					Upstream[a]					Total				
	Period[b]					Period[b]					Period[b]				
	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
1 -15 July															
Unguided anglers, weekdays:															
Number of counts	2	5	7	3	3	2	5	7	3	3	2	5	7	3	3
Mean count	5	16	5	4	5	183	134	106	148	72	187	150	111	152	77
Standard error	5	5	2	3	3	35	19	17	24	10	39	23	17	26	9
Unguided anglers, weekends:															
Number of counts	5	5	5	5	5	5	4	5	5	5	5	4	5	5	5
Mean count	3	11	18	11	3	129	286	161	164	120	132	249	178	175	123
Standard error	1	6	2	3	3	68	83	41	56	38	69	101	39	53	40
Guided anglers, all days:															
Number of counts	9	10				8	10				8	10			
Mean count	28	14				416	194				447	207			
Standard error	10	4				37	31				41	29			
16 - 31 July															
Unguided anglers, weekdays:															
Number of counts	6	7	10	5	5	6	7	10	5	5	6	7	10	5	5
Mean count	19	34	31	13	10	286	310	253	185	209	305	344	284	197	218
Standard error	8	5	7	8	3	59	31	34	16	32	62	34	33	15	35
Unguided anglers, weekends:															
Number of counts	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Mean count	20	76	51	52	8	389	468	368	332	284	409	543	419	384	295
Standard error	7	4	17	16	2	46	93	13	25	60	53	95	27	37	59
Guided anglers, all days:															
Number of counts	12	12				12	12				12	12			
Mean count	29	27				492	355				522	382			
Standard error	7	8				41	32				43	34			
1 - 4 August															
Unguided anglers, weekdays:															
Number of counts	1	2	2	2	2	1	2	2	2	2	1	2	2	2	2
Mean count	1	24	13	6	3	14	66	69	30	18	18	90	81	35	21
Standard error		6	2	6	3		9	17	19	10		15	18	24	13
Unguided anglers, weekends:															
Number of counts	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Mean count	4	34	53	43	3	43	137	76	40	9	47	171	129	83	12
Standard error	0	13	31	25	3	27	11	45	8	1	27	3	76	33	4
Guided anglers, all days:															
Number of counts	3	4	4	4	4	3	4	4	4	4	3	4	4	4	4
Mean count	0	9	33	22	0	32	136	78	41	8	32	144	110	64	8
Standard error	0	4	6	8	0	9	36	23	12	3	9	35	21	19	3

[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] Unguided anglers, all months:
July: Period A = 0400-0759 hours
Period B = 0800-1159 hours
Period C = 1200-1559 hours
Period D = 1600-1959 hours
Period E = 2000-2359 hours

Guided anglers:
July: Period A = 0600-1159 hours
Period B = 1200-1759 hours

August: Same as unguided anglers

Table 3.-Estimated number of angler-hours of fishing effort by boat anglers during each stratum of the fishery for early-run chinook salmon downstream of the Soldotna Bridge on the Kenai River, 1996.

	Downstream[a]		Upstream[a]		Total[b]			
Strata	Effort	SE	Effort	SE	Effort	SE	95% Confidence Interval	Relative Precision
16 May - 31 May								
Unguided, weekday	50	50	3,721	717	3,875	708	2,488 - 5,262	35.8 %
Unguided, weekend	20	14	3,696	451	3,716	455	2,825 - 4,607	24.0 %
Guided, all days:	0		10,297	1,091	10,207	1,091	8,069 - 12,345	20.9 %
1 June - 8 June								
Unguided, weekday	40	32	3,605	470	3,645	487	2,690 - 4,600	26.2 %
Unguided, weekend	68	34	3,932	267	4,000	252	3,506 - 4,494	12.4 %
Guided, all days:	36	25	9,900	879	10,356	860	8,670 - 12,042	16.3 %
9 June - 16 June								
Unguided, weekday	24	24	6,909	931	6,941	930	5,119 - 8,763	26.3 %
Unguided, weekend	116	44	10,344	805	10,460	813	8,867 - 12,053	15.2 %
Guided, all days:	36	27	19,662	742	19,800	772	18,287 - 21,313	7.6 %
17 June - 30 June								
Unguided, weekday	582	174	14,952	1,770	15,578	1,764	12,121 - 19,035	22.2 %
Unguided, weekend	396	92	9,956	1,090	10,336	1,119	8,142 - 12,530	21.2 %
Guided, all days:	1,314	404	29,952	2,463	31,266	2,429	26,505 - 36,027	15.2 %
Subtotals								
Unguided:	1,296	215	57,115	2,616	58,551	2,626	53,404 - 63,698	8.8 %
Guided:	1,386	406	69,811	2,929	71,629	2,903	65,940 - 77,318	7.9 %
Early Run Total	2,682	459	126,926	3,927	130,180	3,914	122,508 - 137,852	5.9 %

[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] Total estimates are independent, not the sum of the downstream and upstream estimates.

Table 4.-Estimated number of angler-hours of fishing effort by boat anglers during each stratum of the fishery for late-run chinook salmon downstream of the Soldotna Bridge on the Kenai River, 1996.

	Downstream[a]		Upstream[a]		Total[b]			
Strata	Effort	SE	Effort	SE	Effort	SE	95% Confidence Interval	Relative Precision
1 July - 15 July								
Unguided, weekday	964	229	17,980	1,398	18,945	1,551	15,905 - 21,985	16.0 %
Unguided, weekend	920	156	17,197	2,665	17,156	2,891	11,490 - 22,822	33.0 %
Guided, all days:	2,497	650	36,581	2,916	39,266	2,992	33,403 - 45,129	14.9 %
16 July - 31 July								
Unguided, weekday	4,238	574	49,707	3,316	53,945	3,496	47,093 - 60,797	12.7 %
Unguided, weekend	3,296	398	29,456	1,967	32,792	2,098	28,680 - 36,904	12.5 %
Guided, all days:	4,038	749	61,020	3,725	65,058	3,925	57,365 - 72,751	11.8 %
1 August - 4 August								
Unguided, weekday	400	133	1,680	428	2,080	548	1,006 - 3,154	51.6 %
Unguided, weekend	1,092	336	2,428	429	3,520	693	2,162 - 4,878	38.6 %
Guided, all days:	1,016	172	4,717	726	5,733	745	4,272 - 7,194	25.5 %
Subtotals								
Unguided:	10,910	833	118,448	4,928	128,438	5,307	118,036 - 138,840	8.1 %
Guided:	7,551	1,006	102,318	4,786	110,057	4,991	100,274 - 119,840	8.9 %
Late Run Total	18,461	1,307	220,766	6,870	238,495	7,285	224,216 - 252,774	6.0 %

[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] Total estimates are independent, not the sum of the downstream and upstream estimates.

Table 5.-Estimated harvest per unit effort (HPUE) and catch per unit of effort (CPUE) of chinook salmon by boat anglers during each stratum of the fishery for early-run chinook salmon downstream of the Soldotna Bridge on the Kenai River, 1996.

		Downstream[a]						Upstream[a]						Total					
Angler Day Type[b]	N[c]	n[d]	No. of Ints.[e]	HPUE	SE	CPUE	SE	n[d]	No. of Ints.[e]	HPUE	SE	CPUE	SE	n[d]	No. of Ints.[e]	HPUE	SE	CPUE	SE
16 - 31 May																			
Unguided WD	10	3	21	0.013	0.009	0.013	0.007	8	57	0.008	0.004	0.012	0.007	9	78	0.009	0.004	0.012	0.007
Unguided WE	5	2	12	0.000	0.000	0.000	0.000	4	84	0.023	0.007	0.023	0.007	4	96	0.021	0.006	0.021	0.006
Guided all days	15	5	22	0.000	0.000	0.007	0.007	13	195	0.048	0.009	0.051	0.009	13	217	0.043	0.008	0.046	0.008
1 - 8 June																			
Unguided WD	4	3	18	0.011	0.022	0.023	0.022	3	62	0.000	0.000	0.004	0.005	3	80	0.003	0.002	0.008	0.005
Unguided WE	3	3	20	0.000	0.000	0.000	0.000	3	56	0.030	0.012	0.030	0.012	3	76	0.020	0.009	0.020	0.009
Guided all days	7	4	27	0.020	0.012	0.020	0.012	7	161	0.031	0.007	0.033	0.007	7	188	0.029	0.006	0.031	0.006
9 - 16 June																			
Unguided WD	4	1	13	0.023	0.008	0.034	0.009	4	112	0.028	0.007	0.052	0.008	4	125	0.027	0.007	0.049	0.007
Unguided WE	3	0	0	0.000	0.000	0.000	0.000	3	243	0.018	0.004	0.028	0.007	3	243	0.017	0.004	0.027	0.007
Guided all days	7	2	8	0.069	0.035	0.138	0.071	7	339	0.072	0.006	0.104	0.007	7	347	0.072	0.006	0.105	0.007
17 - 30 June																			
Unguided WD	10	0	0	0.000	0.000	0.000	0.000	10	145	0.016	0.005	0.024	0.008	10	145	0.016	0.005	0.024	0.008
Unguided WE	4	0	0	0.000	0.000	0.000	0.000	4	203	0.016	0.004	0.023	0.005	4	203	0.016	0.004	0.023	0.005
Guided all days	14	0	0	0.000	0.000	0.000	0.000	14	436	0.033	0.006	0.039	0.006	14	436	0.033	0.006	0.039	0.006
Subtotals:																			
Unguided	43	12	84	0.002	0.001	0.002	0.001	39	962	0.018	0.002	0.027	0.004	40	1046	0.017	0.002	0.025	0.003
Guided	43	11	57	0.001	0.001	0.002	0.002	41	1131	0.045	0.004	0.057	0.005	41	1188	0.044	0.004	0.056	0.005
Early Run Total	43	12	141	0.001	0.001	0.002	0.001	80	2,093	0.033	0.003	0.044	0.003	41	2,234	0.032	0.003	0.042	0.003

[a] Downstream = downstream of the chinook salmon sonar counters to the Warren Ames Bridge.
Upstream = upstream of the chinook salmon sonar counters to the Soldotna Bridge.

[b] WD = weekday, WE = weekend.

[c] Number of days possible for interviewing.

[d] Number of days of which interviews were collected.

[e] Completed-trip interviews only.

Table 6.-Estimated harvest per unit effort (HPUE) and catch per unit of effort (CPUE) of chinook salmon by boat anglers during each stratum of the fishery for late-run chinook salmon downstream of the Soldotna Bridge on the Kenai River, 1996.

		Downstream[a]						Upstream[a]						Total					
			No. of						No. of						No. of				
Angler Day Type[b]	N[c]	n[d]	Ints.[e]	HPUE	SE	CPUE	SE	n[d]	Ints.[e]	HPUE	SE	CPUE	SE	n[d]	Ints.[e]	HPUE	SE	CPUE	SE
1 - 15 July																			
Unguided WD	7	2	6	0.000	0.000	0.000	0.000	6	201	0.006	0.004	0.006	0.004	6	207	0.006	0.004	0.006	0.004
Unguided WE	5	3	15	0.000	0.000	0.000	0.000	5	320	0.010	0.003	0.017	0.004	5	335	0.010	0.003	0.016	0.004
Guided all days	10	4	15	0.052	0.027	0.052	0.027	10	424	0.030	0.004	0.037	0.005	10	439	0.031	0.004	0.038	0.005
16 - 31 July																			
Unguided WD	10	6	51	0.011	0.009	0.015	0.012	10	526	0.018	0.003	0.022	0.004	10	577	0.018	0.003	0.021	0.003
Unguided WE	4	4	38	0.012	0.010	0.012	0.010	4	407	0.032	0.005	0.034	0.004	4	445	0.026	0.004	0.031	0.004
Guided all days	12	8	41	0.023	0.014	0.038	0.016	12	738	0.040	0.003	0.043	0.003	12	779	0.039	0.003	0.043	0.003
1 - 4 August																			
Unguided WD	2	2	6	0.000	0.000	0.000	0.000	2	30	0.007	0.004	0.007	0.004	2	36	0.006	0.004	0.006	0.004
Unguided WE	2	1	4	0.000	0.000	0.050	0.035	2	29	0.010	0.007	0.010	0.007	2	33	0.008	0.006	0.016	0.013
Guided all days	4	1	2	0.000	0.000	0.000	0.000	4	58	0.021	0.018	0.021	0.018	4	60	0.019	0.017	0.019	0.017
Subtotals:																			
Unguided	30	18	120	0.008	0.005	0.014	0.007	29	1,513	0.018	0.002	0.021	0.197	29	1,633	0.017	0.002	0.021	0.002
Guided	26	13	58	0.029	0.013	0.037	0.014	26	1,220	0.036	0.003	0.040	0.004	26	1,278	0.035	0.003	0.040	0.004
Late Run Total	30	18	178	0.017	0.006	0.024	0.007	29	2,733	0.026	0.002	0.030	0.106	30	2,911	0.026	0.002	0.029	0.002

[a] Downstream = downstream of the chinook salmon sonar counters to the Warren Ames Bridge.
Upstream = upstream of the chinook salmon sonar counters to the Soldotna Bridge.

[b] WD = weekday, WE = weekend.

[c] Number of days possible for interviewing.

[d] Number of days in which interviews were collected.

[e] Completed-trip interviews only.

During both runs guided angler catch and harvest rates were generally twice that of unguided anglers (Tables 5 and 6). Estimates of overall harvest rates were 0.032 for the early run and 0.026 for the late run. Overall catch rates were 0.042 for the early run and 0.029 for the late run (Tables 5 and 6).

HARVEST AND CATCH

An estimated 4,166 (SE = 290) chinook salmon were harvested during the early run (Table 7), with an estimated harvest of 5 (SE = 2) downstream of the sonar counters and 4,197 (SE = 290) upstream of the sonar counters to the Soldotna Bridge. Unguided anglers harvested 24% of the total. The estimated catch of early-run chinook was 5,552 (SE = 320), with an estimated catch of 9 (SE = 4) fish downstream of the sonar counters and 5,555 (SE = 342) upstream of the counters to the Soldotna Bridge. The relative precision for total catch and harvest (11.3% and 13.6%, respectively) was within desired levels of precision (± 15% of the true values 95% of the time). Approximately 25% of the catch was voluntarily released.

An estimated 5,984 (SE = 404) chinook salmon were harvested during the late run (Table 8), with an estimated harvest of 304 (SE = 106) fish downstream of the sonar counters and 5,816 (SE = 379) upstream of the sonar counters to the Soldotna Bridge. Unguided anglers accounted for 36% of the harvest. The estimated catch of chinook salmon was 6,983 (SE = 428), with an estimated catch of 436 (SE = 124) downstream of the sonar counters and 6,592 (SE = 415) upstream of the sonar counters to the Soldotna Bridge. The relative precision for total catch and harvest (12.0% and 13.2%, respectively) was within desired levels of precision (± 15% of the true values 95% of the time). Approximately 14% of the catch was voluntarily released during the late run.

Completed-trip anglers interviewed during the early run reported harvesting 437 fish which represented 10.5% of the estimated total harvest. Anglers interviewed during the late run reported a harvest of 426 fish, 7.1% of the estimated total harvest.

INRIVER RETURN

The inriver return of chinook salmon was estimated using hydroacoustic equipment (sonar). Information regarding the details of this project are presented by Eggers et al. (1995). Daily estimates of chinook salmon counts for 1996 appear in Tables 9 and 10. The estimated inriver return in 1996 (Burwen and Bosch *In prep*) for the early run was 23,505 (SE = 376) and for the late run was 53,934 (SE = 1,053).

BIOLOGICAL DATA

Recreational Fishery

There was a significant difference in the age composition of the recreational harvest among the three temporal strata of the early run (Table 11) when considering the four major age classes (χ^2 = 19.23, df = 6, P = 0.003) but not with the two most predominant age classes (χ^2 = 3.33, df = 2, P = 0.19). Further testing showed no difference in the age composition between the first two strata, 16 May-31 May versus 1 June-16 June (all four age classes: χ^2 = 5.22, df = 3, P = 0.16; two predominant age classes: χ^2 = 2.53, df = 1, P = 0.11). For 1 June-15 June and 16 June-30 June there was a significant difference when comparing all four age classes (χ^2 = 11.33, df = 3, P = 0.01) due to an increase in fish aged 1.2 and 1.5 during the latter half of June; but, there was not a significant difference with the two predominant age classes (χ^2 = 0.21, df = 1, P = 0.65). Therefore, age composition data and estimating harvest by age were not combined by strata. The most abundant age group in the early-run harvest of chinook

Table 7.-Estimated number of chinook salmon harvested and number caught by boat anglers during each stratum of the fishery for early-run chinook salmon downstream of the Soldotna Bridge on the Kenai River, 1996.

	Downstream[a]						Upstream[a]						Total[e]					
Strata	Harvest[b]	SE	RP[c]	Catch[d]	SE	RP[c]	Harvest[b]	SE	RP[c]	Catch[d]	SE	RP[c]	Harvest[b]	SE	RP[c]	Catch[d]	SE	RP[c]
16 May - 31 May																		
Unguided weekdays	1	1	117.6 %	1	1	117.6 %	29	16	109.5 %	44	27	118.5 %	35	18	99.7 %	35	18	99.7 %
Unguided weekends	0	0		0	0		85	29	66.4 %	85	29	66.4 %	76	26	66.0 %	76	26	66.0 %
Guided all days	0	0		0	0		496	104	41.0 %	527	106	39.6 %	435	96	43.2 %	471	57	23.7 %
1 June - 8 June																		
Unguided weekdays	0	1		1	1	176.4 %	0	0		13	19	278.9 %	10	7	133.3 %	31	17	107.5 %
Unguided weekends	0	0		0	0		116	46	77.6 %	116	46	77.6 %	79	35	86.3 %	79	35	86.3 %
Guided all days	1	1	117.6 %	1	1	117.6 %	305	77	49.3 %	328	79	47.0 %	302	69	45.0 %	323	71	43.1 %
9 June - 16 June																		
Unguided weekdays	1	1	98.0 %	1	1	156.8 %	190	54	56.1 %	357	72	39.5 %	187	57	59.7 %	342	68	39.2 %
Unguided weekends	0	0		0	0		182	43	46.6 %	285	75	51.2 %	182	44	46.8 %	287	75	51.2 %
Guided all days	2	2	196.0 %	5	4	160.7 %	1,424	125	17.2 %	2,045	162	15.6 %	1,432	125	17.1 %	2,081	163	15.4 %
17 June - 30 June																		
Unguided weekdays	0	0		0	0		242	75	60.9 %	363	121	65.4 %	251	78	60.7 %	375	92	48.1 %
Unguided weekends	0	0		0	0		155	44	55.4 %	227	57	48.9 %	161	45	55.3 %	236	59	48.7 %
Guided all days	0	0		0	0		973	191	38.4 %	1,165	201	33.7 %	1,016	197	38.0 %	1,216	207	33.3 %
Subtotal:																		
Unguided	2	1	96.5 %	3	1	87.9 %	999	125	24.5 %	1,490	181	23.8 %	981	124	24.8 %	1,461	157	21.1 %
Guided	3	2	136.4 %	6	4	135.4 %	3,198	262	16.0 %	4,065	290	14.0 %	3,185	262	16.1 %	4,091	279	13.4 %
Early Run Total	5	2	90.5 %	9	4	94.9 %	4,197	290	13.5 %	5,555	342	12.1 %	4,166	290	13.6 %	5,552	320	11.3 %

[a] Downstream = downstream of the chinook salmon sonar counters to the Warren Ames Bridge.
Upstream = upstream of the chinook salmon sonar counters to the Soldotna Bridge.

[b] Harvest includes only fish kept.

[c] Relative precision for the 95% confidence level.

[d] Catch includes fish kept and fish reported as released.

[e] Total estimates are independent, not the sum of the downstream and upstream estimates.

Table 8.-Estimated number of chinook salmon harvested and number caught by boat anglers during each stratum of the fishery for late-run chinook salmon downstream of the Soldotna Bridge on the Kenai River, 1996.

	Downstream[a]						Upstream[a]						Total[e]					
Strata	Harvest[b]	SE	RP[c]	Catch[d]	SE	RP[c]	Harvest[b]	SE	RP[c]	Catch[d]	SE	RP[c]	Harvest[b]	SE	RP[c]	Catch[d]	SE	RP[c]
1 July - 15 July																		
Unguided weekdays	0	0		0	0		111	74	129.8 %	111	74	129.8 %	116	77	130.8 %	116	77	130.8 %
Unguided weekends	0	0		0	0		177	53	58.2 %	284	77	53.1 %	172	142	161.8 %	274	77	55.4 %
Guided all days	129	73	110.3 %	129	73	110.3 %	1,094	165	29.6 %	1,361	202	29.1 %	1,198	175	28.7 %	1,476	214	28.4 %
16 July - 31 July																		
Unguided weekdays	46	40	170.9 %	62	51	162.2 %	915	163	34.9 %	1,099	196	35.0 %	955	169	34.6 %	1,154	191	32.4 %
Unguided weekends	38	32	164.5 %	38	32	164.5 %	928	148	31.2 %	993	142	27.9 %	846	130	30.1 %	1,017	144	27.8 %
Guided all days	91	57	123.6 %	152	70	90.1 %	2,459	229	18.2 %	2,612	233	17.5 %	2,544	225	17.3 %	2,765	238	16.9 %
1 August - 4 August																		
Unguided weekdays	0	0		0	0		11	8	137.2 %	11	8	137.2 %	13	9	131.2 %	13	9	131.2 %
Unguided weekends	0	0		55	40	144.0 %	24	17	135.6 %	24	17	135.6 %	29	23	154.1 %	57	46	156.8 %
Guided all days	0	0		0	0		97	85	172.0 %	97	85	172.0 %	111	100	177.1 %	111	100	177.1 %
Subtotal:																		
Unguided	84	51	119.6 %	155	73	91.9 %	2,166	238	21.6 %	2,522	265	20.6 %	2,131	268	24.7 %	2,631	267	19.9 %
Guided	220	93	82.5 %	281	101	70.3 %	3,650	294	15.8 %	4,070	320	15.4 %	3,853	302	15.4 %	4,352	335	15.1 %
Late Run Total	304	106	68.2 %	436	124	55.9 %	5,816	379	12.8 %	6,592	415	12.3 %	5,984	404	13.2 %	6,983	428	12.0 %

[a] Downstream = downstream of the chinook salmon sonar counters to the Warren Ames Bridge.
Upstream = upstream of the chinook salmon sonar counters to the Soldotna Bridge.

[b] Harvest includes only fish kept.

[c] Relative precision for the 95% confidence level.

[d] Catch includes fish kept and fish reported as released.

[e] Total estimates are independent, not the sum of the downstream and upstream estimates.

Table 9.-Daily estimates of chinook salmon during the early run as determined by dual-beam sonar, Kenai River, 1996.

Date	Daily Estimate	Cumulative Estimate
16-May	60	60
17-May	91	151
18-May	63	214
19-May	96	310
20-May	177	487
21-May	165	652
22-May	156	808
23-May	159	967
24-May	159	1,126
25-May	153	1,279
26-May	240	1,519
27-May	204	1,723
28-May	330	2,053
29-May	512	2,565
30-May	348	2,913
31-May	474	3,387
1-Jun	603	3,990
2-Jun	741	4,730
3-Jun	873	5,603
4-Jun	1,051	6,654
5-Jun	943	7,597
6-Jun	741	8,338
7-Jun	773	9,110
8-Jun	918	10,028
9-Jun	1,140	11,168
10-Jun	684	11,852
11-Jun	882	12,734
12-Jun	864	13,598
13-Jun	1,071	14,669
14-Jun	1,111	15,780
15-Jun	1,116	16,896
16-Jun	420	17,316
17-Jun	495	17,811
18-Jun	697	18,508
19-Jun	657	19,165
20-Jun	315	19,480
21-Jun	351	19,831
22-Jun	396	20,227
23-Jun	401	20,628
24-Jun	573	21,201
25-Jun	684	21,885
26-Jun	504	22,389
27-Jun	228	22,617
28-Jun	303	22,920
29-Jun	234	23,154
30-Jun	351	23,505

From: Burwen and Bosch *In prep.*

Table 10.-Daily estimates of chinook salmon during the late run as determined by dual-beam sonar, Kenai River, 1996.

Date	Daily Estimate	Cumulative Estimate
1-Jul	341	341
2-Jul	240	581
3-Jul	303	884
4-Jul	393	1,277
5-Jul	1,067	2,343
6-Jul	879	3,222
7-Jul	780	4,002
8-Jul	867	4,869
9-Jul	768	5,637
10-Jul	1,023	6,660
11-Jul	1,146	7,806
12-Jul	714	8,520
13-Jul	1,128	9,648
14-Jul	4,437	14,085
15-Jul	3,222	17,308
16-Jul	3,494	20,802
17-Jul	2,253	23,054
18-Jul	2,820	25,874
19-Jul	2,236	28,110
20-Jul	2,609	30,719
21-Jul	3,435	34,155
22-Jul	2,250	36,405
23-Jul	3,050	39,455
24-Jul	3,634	43,089
25-Jul	3,240	46,329
26-Jul	2,319	48,648
27-Jul	1,782	50,430
28-Jul	861	51,291
29-Jul	474	51,765
30-Jul	621	52,386
31-Jul	1,548	53,934

From: Burwen and Bosch *In prep.*

Table 11.-Age composition and mean length-at-age, by sex, of chinook salmon sampled from the recreational harvest during the fishery for early-run chinook salmon in the Kenai River, 1996.

Sex		Age Group 1.2	1.3	1.4	1.5	Total
16 May - 31 May						
Male	Percent			42.3	2.2	44.5
	SE			7.5	2.2	
Female	Percent		11.1	44.4		55.5
	SE		4.7	7.5		
Combined	Percent		11.1	86.7	2.2	100.0
	SE		4.7	5.1	2.2	
Male	Mean Length (mm)[a]			1,024	1,040	
	SE			20		
	Sample size			19	1	20
Female	Mean Length (mm)[a]		802	1,012		
	SE		16	17		
	Sample size		5	20		25
1 June - 15 June						
Male	Percent	2.7	11.6	36.3	0.7	51.3
	SE	1.4	2.7	4.0	0.7	51.4
Female	Percent	1.4	9.6	37.7		48.7
	SE	1.0	2.5	4.0		4.2
Combined	Percent	4.1	21.2	74.0	0.7	100.0
	SE	1.7	3.4	3.6	0.7	
Male	Mean Length (mm)[a]	625	780	970	1,230	
	SE	7	13	11		
	Sample size	4	17	53	1	75
Female	Mean Length (mm)[a]	630	782	966		
	Mean Length (mm)[a]	10	7	9		
	Sample size	2	14	55		71
16 June - 30 June						
Male	Percent	10.3	14.4	23.7	3.1	51.5
	SE	3.1	3.6	4.3	1.8	5.1
Female	Percent	2.1	6.2	38.1	2.1	48.5
	SE	1.45	2.5	5.0	1.5	5.1
Combined	Percent	12.4	20.6	61.8	5.2	100.0
	SE	3.4	4.1	5.0	2.3	
Male	Mean Length (mm)[a]	601	741	953	1,081	
	SE	17	19	16	24	
	Sample size	10	14	23	3	50
Female	Mean Length (mm)[a]	640	813	949	1,093	
	SE	60	16	13	23	
	Sample size	2	6	37	2	47

[a] Lengths measured mid-eye to fork of tail.

salmon was age 1.4 which comprised 87% of the harvest from 16-31 May, 74% from 1-15 June, and 62% from 16-30 June. The only other age classes of significance represented in the sample were 1.2, 1.3, and 1.5.

During the late run, there was a significant difference in the age composition of chinook salmon harvested during each of the two temporal strata and the extended fishery (1-4 August), using all four major age classes (χ^2 = 29.38, df = 6, P < 0.001) or the two predominant age classes (χ^2 = 9.32, df = 2, P = 0.01) (Table 12). There was a significant difference between the two July strata: four major age classes (χ^2 = 26.61, df = 3, P < 0.01) or two predominant age classes (χ^2 = 7.28, df = 1, P = 0.01). There was also a significant difference between the last July stratum (16-31 July) and the fishery extension with the four major age classes (χ^2 = 9.76, df = 3, P = 0.02) but not with the two predominant age classes (χ^2 = 2.79, df = 1, P = 0.10). Results for the fishery extension in August are likely biased due to the small sample size. Age composition data and estimating harvest by age were not combined by strata.

During the 1-15 July stratum the 1.3 age class was the most abundant representing 46% of the harvest. From 16 July-4 August the 1.4 age class was the most abundant representing 62% of the harvest (Table 12). The age 1.2 and 1.5 age classes had the next highest representation.

Inriver Return

There was no significant difference in the age composition between the first 3-week stratum and second 3-week stratum during the early run (16 May-7 June, 8 June-30 June): four major age classes (χ^2 = 2.39, df = 3, P = .50) or two predominant age classes (χ^2 = 0.17, df = 1, P = 0.68). The most abundant age for the early run was 1.4, representing 62% of the first 3-week stratum and 61% of the second 3-week stratum (Table 13). Age 1.3 was the second largest contributor, with the 1.5 and 1.2 age classes also present. A significant difference was detected in the age composition between the first 3-week stratum (1 July-23 July) and second 3-week stratum (24 July-7 August) during the late run with the four major age classes (χ^2 = 16.24, df = 3, P = 0.001) but not with the two predominant age classes (χ^2 = 2.28, df = 1, P = 0.13). The most abundant age for the late run in the samples collected with gill nets was 1.4, representing 53% of the 1-23 July stratum and 67% of the 24 July-7 August stratum (Table 14). Age 1.3 was the second largest contributor to the late run, followed by 1.2 and 1.5.

Analysis-of-variance was used to test for differences in mean length-at-age by sex and run sampling method (recreational harvest or inriver netting). For age-1.3 fish, there was no significant difference in mean length based upon sample method (F = 1.76, df = 1, 388; P = 0.185); however, late-run fish were significantly larger than early-run fish (F = 238.32, df = 1, 388; P < 0.001) and females were significantly larger than males (F = 7.94, df = 1, 388; P = 0.005). There was also a significant interaction among run, sex, and sampling method (F = 5.57, df = 1, 388; P =0.019). For age-1.4 fish, the mean length for late-run fish was significantly larger than for early-run fish (F = 149.91; df = 1, 800; P < 0.001). Age-1.4 males were also significantly larger than 1.4 females (F = 61.87; df = 1, 800; P < 0.001). There was significant interaction between run and sex (F = 4.88; df = 1, 800; P =.027). There was no significant difference in length-at-age of age-1.4 fish sampled in the harvest versus nets (F = 2,015; df = 1, 800; P =0.143). No significant differences were detected for age-1.5 fish.

Table 12.-Age composition and mean length-at-age, by sex, of chinook salmon sampled from the recreational harvest during the fishery for late-run chinook salmon in the Kenai River, 1996.

Sex		Age Group 1.2	1.3	1.4	1.5	Other	Total
1 July-15 July							
Male	Percent	10.5	12.3	17.5		1.8	42.1
	SE	4.1	4.4	5.1		1.8	6.6
Female	Percent	7.0	33.3	17.5			57.8
	SE	3.4	6.3	5.1			6.6
Combined	Percent	17.5	45.6	35.1		1.8	100.0
	SE	5.1	6.7	6.4		1.8	
Male	Mean Length (mm)[a]	650	843	1,017	530		
	SE	20	33	27			
	Sample size	6	7	10	1		24
Female	Mean Length (mm)[a]	653	870	984			
	SE	23	19	27			
	Sample size	4	19	10			33
16 July - 4 August							
Male	Percent	2.3	12.4	25.4	0.6		40.7
	SE	1.1	2.5	3.3	0.6		3.8
Female	Percent		21.5	36.1	1.7		59.3
	SE		3.1	3.6	1.0		3.8
Combined	Percent	2.3	33.9	61.5	2.3		100.0
	SE	1.0	3.6	3.7	1.2		
Male	Mean Length (mm)[a]	715	926	1,068	1,090		
	SE	20	13	11			
	Sample size	4	22	45	1		72
Female	Mean Length (mm)[a]		926	1,022	1,060		
	SE		10	6	12		
	Sample size		38	64	3		105

[a] Lengths measured mid-eye to fork of tail.

Table 13.-Age composition and mean length-at-age, by sex, of chinook salmon sampled with large mesh gill nets during the fishery for early-run chinook salmon in the Kenai River, 1996.

Sex		Age Group 1.2	1.3	1.4	1.5	Total
16 May - 7 June						
Male	Percent	3.3	15.0	25.9	1.7	45.9
	SE	1.7	3.3	4.0	1.2	4.6
Female	Percent	1.7	15.8	35.8	0.8	54.1
	SE	1.2	3.4	4.4	0.8	4.6
Combined	Percent	5.0	30.8	61.7	2.5	100.0
	SE	2.0	4.2	4.5	1.4	
Male	Mean Length (mm)[a]	590	780	997	1,078	
	SE	15	16	14	38	
	Sample size	4	18	31	2	55
Female	Mean Length (mm)[a]	638	773	944	1,110	
	SE	23	11	8		
	Sample size	2	19	43	1	65
8 June - 30 June						
Male	Percent	9.0	21.3	27.5	1.9	59.7
	SE	2.0	2.8	3.1	0.9	3.4
Female	Percent	0.5	6.2	33.6		40.3
	SE	0.5	1.7	3.3		3.4
Combined	Percent	9.5	27.5	61.1	1.9	100.0
	SE	2.0	3.1	3.4	0.9	
Male	Mean Length (mm)[a]	629	771	984	1,108	
	SE	10	8	15	10	
	Sample size	19	45	58	4	126
Female	Mean Length (mm)[a]	690	789	928		
	SE		13	8		
	Sample size	1	13	71		85

[a] Lengths measured mid-eye to fork of tail.

Table 14.-Age composition and mean length-at-age, by sex, of chinook salmon sampled with large mesh gill nets during the fishery for late-run chinook salmon in the Kenai River, 1996.

Sex		Age Group 1.2	1.3	1.4	1.5	Other	Total
1 July - 23 July							
Male	Percent	10.5	21.9	26.9	0.6	0.3	60.2
	SE	1.7	2.3	2.5	0.4	0.3	
Female	Percent		13.0	26.2	0.6		39.8
	SE		1.9	2.5	0.4		
Combined	Percent	10.5	34.9	53.1	1.2	0.3	100.0
	SE	0.3	1.7	2.7	2.8	0.6	
Male	Mean Length (mm)[a]	656	847	1,055	1,163	390	
	SE	9	11	9	43		
	Sample size	34	71	87	2	1	195
Female	Mean Length (mm)[a]		899	982	1,058		
	SE		10	7	12.5		
	Sample size		42	85	2		129
24 July - 7 August							
Male	Percent	1.4	17.2	36.6			55.2
	SE	1.0	3.2	4.0			
Female	Percent		14.5	30.3			44.8
	SE		2.9	3.8			
Combined	Percent	1.4	31.7	66.9			100.0
	SE	1.0	3.9	3.9			
Male	Mean Length (mm)[a]	623	909	1,089			
	SE	18	15	8			
	Sample size	2	25	53			80
Female	Mean Length (mm)[a]		939	1,027			
	SE		9	8			
	Sample size		21	44			65

[a] Lengths measured mid-eye to fork of tail.

DISCUSSION

In 1990, 1991 and 1992, emergency orders restricting the bag limit to zero for fish less than 132 cm (hook and release fishing), or to one fish 132 cm or greater (trophy fishing) severely affected the effort in this fishery (Figures 2 and 3). Relatively high catch rates apparently do not provide sufficient angler satisfaction when fish retention is limited or prohibited. Effort declined after the implementation of the emergency orders, regardless of the increased numbers of fish entering the system and the numbers of fish caught in proportion to the number of angler-hours expended (Hammarstrom 1993). In 1993-1996 this situation did not occur. Daily effort during both runs did not exhibit any dramatic decrease over time, and this is assumed to be the result of no additional restrictions required inseason (Figures 5 and 6). During the early run there was a steady increase in effort beginning 9 June when the bait restriction was removed (Figure 5).

For the early run, there was a decrease of over 36,000 angler hours (22%) from 1995 (King 1996). Two events may have contributed to the reduced angler effort. During September 1995, a 100-year flood occurred on the Kenai River. Shifting of the substrate and deposition of new materials during and after the flood resulted in river channel changes. Additionally, waters of the Kenai River were unseasonably low during the spring and much of the summer of 1996. Many anglers were very hesitant about navigating the river under these conditions, resulting in decreased angler participation, particularly during the early run. Unguided anglers had the greatest decrease in effort (35%) while guided anglers showed a small decrease in effort (6%). In 1996 guided anglers contributed 55% of the total effort and unguided anglers 45%, a near reversal of 1995.

For the late run there was a 26% decrease in effort from the 1995 fishery (King 1996). The flood may have been partially responsible for this decreased effort, particularly in early July when water levels were questionably low for many anglers less familiar with navigating the river. Again, unguided anglers had the greatest reduction in effort (36%). Guided anglers had an 11% reduction in effort. The majority of the 1996 effort was by unguided anglers (54%). Only 5% of the total effort for the late run occurred during the extension period, 1-4 August, with the effort evenly split between guided (5,733 angler hours) and unguided (5,600 angler hours) anglers (Table 4).

CPUE and HPUE for guided anglers was greater than that of the unguided anglers for both runs. The HPUE of the guided anglers was twice that of the unguided anglers, which has been the historical trend. The HPUE (all anglers) for the early run was 0.032 (Table 5), slightly lower than the mean historic HPUE (0.040). For the late run, the HPUE (all anglers) was 0.026 (Table 6), also lower than the mean historic HPUE (0.037). Reduced angler success may be partly due to the September 1995 flood, resulting in sediments being continuously flushed from the river, both from the substrate and the banks as the water level rose. Water clarity, as measured by Secchi transparency readings taken daily during the fishery, remained stable at approximately 0.6 meters, well below the normal levels for the time period of the fishery (Figure 7). Poor water clarity is perceived by anglers to reduce success in this fishery.

This year harvest by the recreational fishery was estimated downstream of the sonar site to the Warren Ames Bridge to allow a better estimate of total inriver return (the sonar estimate plus the harvest downstream of the

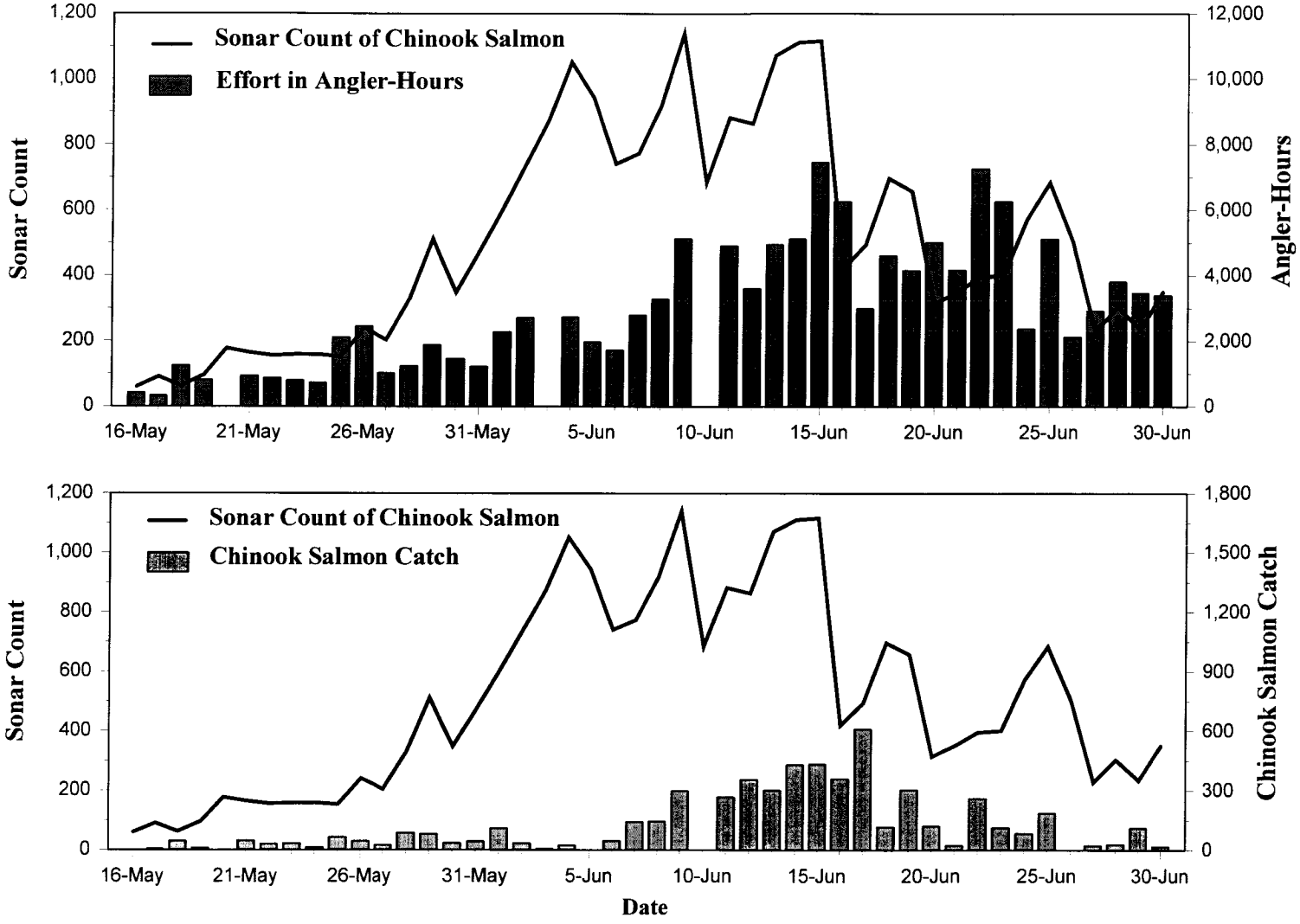

Figure 5.-Daily sonar counts of chinook salmon, recreational catch of chinook salmon (bottom) and angler effort (top) during the early run, Kenai River, 1996.

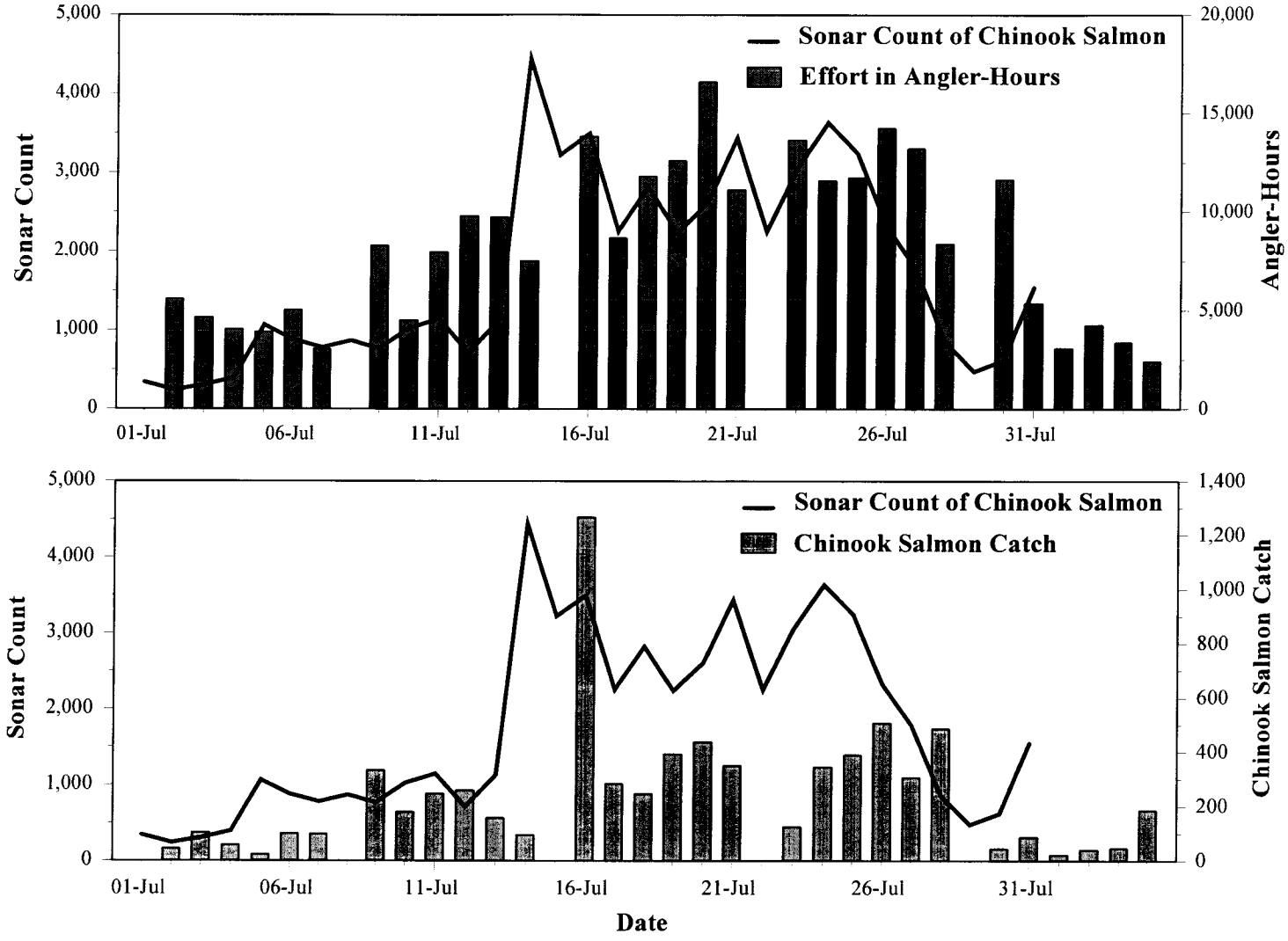

Figure 6.-Daily sonar counts of chinook salmon, recreational catch of chinook salmon (bottom) and angler effort (top) during the late run, Kenai River, 1996.

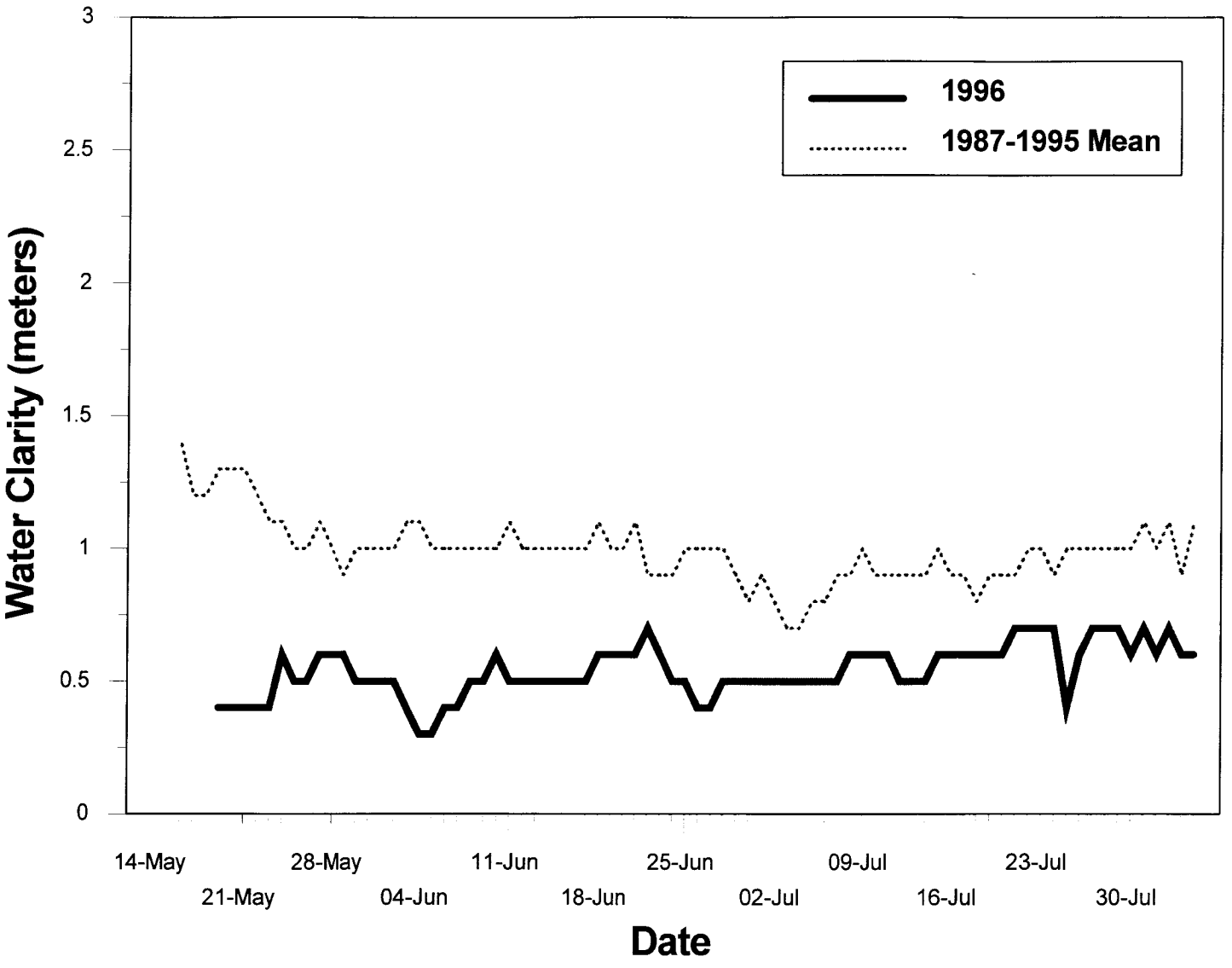

Figure 7.-Historic Kenai River Secchi transparency readings, 1984-1996.

sonar site). The estimated harvest downstream of the sonar site was negligible, five fish for the early run and 304 fish for the late run (Tables 7 and 8). For both runs this was approximately 0.01% of the total inriver return. However, the level of effort downstream of the sonar site was very atypical during both runs, 2% for the early run and 8% for the late run (Tables 3 and 4). Although no previous data have been collected, personal familiarity with this fishery has indicated much greater effort downstream of the sonar site in past years. This did not occur in 1996 due to extremely low water levels prohibiting navigation. The decreased water clarity throughout both runs (Figure 7) also influenced anglers' decisions to select fishing locations upstream of the sonar site.

Using data from the inriver sampling of the age composition, the predominant age class for both runs was age 1.4, 61% for the early run and 57% for the late run (Tables 13 and 14). The next largest age class was age-1.3 fish, 29% of the early run and 34% of the late run (Tables 13 and 14). Historically, age-1.4 fish are the dominant age class followed by age 1.3 fish.

RECOMMENDATIONS

Although harvest downstream of the sonar site was minimal, due to atypical river conditions, 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. If, in fact, the harvest level downstream of the sonar site is minimal, then it may not be necessary to geographically stratify the creel survey.

ACKNOWLEDGMENTS

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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, 1996

Appendix A1.-Counts of unguided and guided boat anglers, by stratum, during the fishery for early-run chinook salmon downstream of the Soldotna Bridge on the Kenai River, 1996.

		Downstream[a]										Upstream[a]										Combined Strata									
		Unguided Anglers Period					Guided Anglers Period					Unguided Anglers Period					Guided Anglers Period					Unguided Anglers Period					Guided Anglers Period				
Date	Day Type[b]	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	A	B	C	D	E
16-May	Wd				0					0					14					8					14					8	
17-May	Wd	0	0	0	0	0	0	0	0	0	0	3	7	10	2	0	0	2	2	2	2	3	7	10	2	0	0	2	2	2	2
18-May	We	0	0	0	3	0	0	0	0	0	0	0	12	35	37	40	9	43	26	40	4	0	12	35	40	40	9	43	26	40	4
19-May	We	0	0	0	0	0	0	0	0	0	0	41	37	29	19	3	30	21	14	3	0	41	37	29	19	3	30	21	14	3	0
20-May	Wd	**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**				
21-May	Wd	0	0				0	0				17	21				33	52				17	21				33	52			
22-May	Wd	0	0			0	0	0			0	6	9			2	19	96			3	6	9			2	19	96			3
23-May	Wd			0	0				0	0				5	16				24	42				5	16				24	42	
24-May	Wd			0	0				0	0				7	18				40	9				7	18				40	9	
25-May	We	0	0	0	0	0	0	0	0	0	0	6	65	53	30	35	11	98	91	34	0	6	65	53	30	35	11	98	91	34	0
26-May	We	0	0	0	0	0	0	0	0	0	0	5	72	81	40	75	11	94	79	50	4	5	72	81	40	75	11	94	79	50	4
27-May	We	0	0	2	0	0	0	0	0	0	0	35	47	90	26	11	90	83	67	15	8	35	47	92	26	11	90	83	67	15	8
28-May	Wd	0	0				0	0				12	38				22	64				12	38				22	64			
29-May	Wd	0	0	0			0	0	0			35	46	28			73	74	61			35	46	28			73	74	61		
30-May	Wd			0	0	0			0	0	0			52	47	45			52	41	0			52	47	45			52	41	0
31-May	Wd				0	5				0	0				25	7				55	36				25	12				55	36
01-Jun	We	0	0	5	7	0	0	0				2	77	64	62	57	137	72				2	77	69	69	57	137	72			
02-Jun	We	0	0	5	0	0	0	4				54	90	91	70	45	113	113				54	90	96	70	45	113	117			
03-Jun	Wd	**CLOSED**					**CLOSED**					**CLOSED**										**CLOSED**					**CLOSED**				
04-Jun	Wd	0		1			0	2				77		53			206	46				77		54			206	48			
05-Jun	Wd	0			0	4	0	0				32			61	48	97	71				32			61	52	97	71			
06-Jun	Wd	0	0		0		0	0				9	54		31		124	50				9	54		31		124	50			
07-Jun	Wd		0	0		0	0	0					63	41		21	195	133					63	41		21	195	133			
08-Jun	We	0	0	0	0	0	0	0				32	83	112	82	62	193	100				32	83	112	82	62	193	100			

-continued-

Appendix A1.-Page 2 of 2.

Date	Day Type[b]	Downstream[a] Unguided Anglers Period A	B	C	D	E	Downstream[a] Guided Anglers Period A	B	C	D	E	Upstream[a] Unguided Anglers Period A	B	C	D	E	Upstream[a] Guided Anglers Period A	B	C	D	E	Combined Strata Unguided Anglers Period A	B	C	D	E	Combined Strata Guided Anglers Period A	B	C	D	E
09-Jun	We[c]	0	0	0	0	0	0	0				169	208	183	77	67	273	141				169	208	183	77	67	273	141			
10-Jun	Wd	**CLOSED**					**CLOSED**					**CLOSED**										**CLOSED**					**CLOSED**				
11-Jun	Wd		0	0			0	0					101	94			309	146					101	94			309	146			
12-Jun	Wd	0	0	0	0	0	0	0				21	83	95	89	99	274	122				21	83	95	89	99	274	122			
13-Jun	Wd		0	0			0	0					83	115			326	168					83	115			326	168			
14-Jun	Wd	0		6	0	0	2	0				123		90	103	47	351	218				123		96	103	47	353	218			
15-Jun	We	3	3	11	0	0	0	0				228	257	169	262	108	341	156				231	260	180	262	108	341	156			
16-Jun	We	0	4	8	0	0	0	4				126	252	184	153	143	337	115				126	256	192	153	143	337	119			
17-Jun	Wd		0	0			0	0					91	82			151	79					91	82			151	79			
18-Jun	Wd	0	0	0			8	0				126	104	231			189	60				126	104	231			197	60			
19-Jun	Wd		0	0	0	0	12	4					90	65	87	88	296	167					90	65	87	88	308	171			
20-Jun	Wd		12	7			2	20					135	95			291	152					147	102			293	172			
21-Jun	Wd	0			12	0	0	12				92			49	126	288	108				92			61	126	288	120			
22-Jun	We	11	11	15	0	0	0	14				166	195	178	160	0	448	250				177	206	193	160	0	448	264			
23-Jun	We	11	4	12	11	0	0	24				134	357	196	97	108	246	131				145	361	208	108	108	246	155			
24-Jun	Wd		7	4		3	0	0					84	65			110	67					91	69		3	110	67			
25-Jun	Wd		0	0			0	4					74	60			364	209					74	60			364	213			
26-Jun	Wd	0	0		8	5	54	0				15	46		40	19	176	74				15	46		48	24	230	74			
27-Jun	Wd	0		5			0	0				27		57			184	91				27		62			184	91			
28-Jun	Wd		12	0			34	4					112	94			140	123					124	94			174	127			
29-Jun	We	0	3	0	0	2	10	0				80	108	112	97	38	211	113				80	111	112	97	40	221	113			
30-Jun	We	0	9	6	0	4	17	0				64	187	138	74	0	165	109				64	196	144	74	4	182	109			

[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/holiday.

[c] The use of bait was permitted by emergency order 9-30 June.

Appendix A2.-Counts of unguided and guided boat anglers, by stratum, during the fishery for late-run chinook salmon downstream of the Soldotna Bridge on the Kenai River, 1996.

		Downstream[a]										Upstream[a]										Combined Strata									
		Unguided Anglers Period					Guided Anglers Period					Unguided Anglers Period					Guided Anglers Period					Unguided Anglers Period					Guided Anglers Period				
Date	Day Type[b]	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	A	B	C	D	E
1-Jul	Wd	**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**				
2-Jul	Wd		9	9	0		20	17					129	75	100		315	159					138	84	100		335	176			
3-Jul	Wd		8	3			4	37					63	38			345	110					71	41			349	147			
4-Jul	We	0	0	23	17	0	0	18				75	109	85	61	48	266	76				75	109	108	78	48	266	94			
5-Jul	Wd			7		0		23						70		88		100						77		88		123			
6-Jul	We	5	3	20	17	0	3	24				61		119	104	151		143				66	3	139	121	151	3	167			
7-Jul	We	6	2	20	16	0	**CLOSED**					120	245	96	67	98	**CLOSED**					126	247	116	83	98	**CLOSED**				
8-Jul	Wd	**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**				
9-Jul	Wd		36	3			85	8					165	151			429	209					201	154			514	217			
10-Jul	Wd		18	0			23	0					166	137			518	183					184	137			541	183			
11-Jul	Wd	0	8	0	4	9	64	0				148	146	132	167	74	419	258				148	154	132	171	83	483	258			
12-Jul	Wd	9		14	9	5	8	8				217		138	176	55	581	382				226		152	185	60	589	390			
13-Jul	We	0	21	9	7	15	46	0				0	283	305	240	251	454	318				0	304	314	247	266	500	318			
14-Jul	We	5	28	16	0	0	**CLOSED**					390	508	198	348	51	**CLOSED**					395	536	214	348	51	**CLOSED**				
15-Jul	Wd	**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**				
16-Jul	Wd	22		44			12	6				317		238			666	452				339		282			678	458			
17-Jul	Wd	3	25	27	0	15	20	15				181	234	219	226	297	357	253				184	259	246	226	312	377	268			
18-Jul	Wd		38	48	5	15	33	97					255	137	196	266	530	391					293	185	201	281	563	488			
19-Jul	Wd		43	55			12	34					374	195			538	391					417	250			550	425			
20-Jul	We	0	70	67	87	9	48	55				264	339	355	338	460	717	317				264	409	422	425	469	765	372			
21-Jul	We	21	83	89	70	3	**CLOSED**					438	723	404	397	248	**CLOSED**					459	806	493	467	251	**CLOSED**				

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		Downstream[a]										Upstream[a]										Combined Strata									
		Unguided Anglers Period					Guided Anglers Period					Unguided Anglers Period					Guided Anglers Period					Unguided Anglers Period					Guided Anglers Period				
Date	Day Type[b]	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	A	B	C	D	E
22-Jul	Wd	**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**				
23-Jul	Wd		51	23			12	30					456	265			434	440					507	288			446	470			
24-Jul	Wd	55		24	42	5	44	14				316		294	154	160	567	347				371		318	196	165	611	361			
25-Jul	Wd		22	63			29	21					305	308		124	411	443					327	371			440	464			
26-Jul	Wd	24		14	16		45	16				289		509	207		523	497				313		523	223		568	513			
27-Jul	We	24	83	35	33	11	88	25				380	319	347	279	229	439	363				404	402	382	312	240	527	388			
28-Jul	We	34	66	12	18	9	**CLOSED**					473	490	367	315	199	**CLOSED**					507	556	379	333	208	**CLOSED**				
29-Jul	Wd	**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**					**CLOSED**				
30-Jul	Wd	10	42	11			0	7				521	307	221			542	96				531	349	232			542	103			
31-Jul	Wd	0	16	0	0	13	10	0				93	239	145	141	196	182	274				93	255	145	141	209	192	274			
1-Aug[c]	Wd		18	14	0	0		0	25	0	0		57	85	11	8		233	145	6	6		75	99	11	8		233	170	6	6
2-Aug	Wd	1	29	11	11	6	0	20	38	29	0	14	75	52	48	28	32	148	60	58	13	15	104	63	59	34	32	168	98	87	13
3-Aug	We	4	21	84	68	5	0	4	48	33	0	70	147	120	47	10	48	71	54	54	0	74	168	204	115	15	48	75	102	87	0
4-Aug	We	4	47	22	18	0	0	10	20	27	0	16	126	31	32	8	17	91	51	47	13	20	173	53	50	8	17	101	71	74	13

[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/holiday.

[c] Fishery was extended by emergency order 1 - 4 August. No restrictions on hours which anglers, including guides, could fish from a guided vessel.

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, 1996

Appendix B1.-Daily sample size (n), effort, harvest per unit of effort (HPUE), catch per unit of effort (CPUE), and other summary statistics for unguided anglers interviewed during the fishery for early-run chinook salmon downstream of the Soldotna Bridge on the Kenai River, 1996 (completed-trip interviews only).

		Downstream[a]									Upstream[b]									Combined Strata[c]								
	Day	Effort			Harvest			Catch			Effort			Harvest			Catch			Effort			Harvest			Catch		
Date	Type[d]	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
16-May	Wd										5	4.2	0.49	0.0	0.00	0.000	0.0	0.00	0.000	5	4.2	0.49	0.0	0.00	0.000	0.0	0.00	0.000
17-May	Wd	3	5.0	0.00	0.0	0.00	0	0.0	0.00	0.000	8	4.5	1.61	0.0	0.00	0.000	0.0	0.00	0.000	11	4.6	1.15	0.0	0.00	0.000	0.0	0.00	0.000
19-May	We										27	4.4	0.36	0.1	0.06	0.025	0.1	0.06	0.025	27	4.4	0.36	0.1	0.06	0.025	0.1	0.06	0.025
21-May	Wd										18	3.8	0.43	0.0	0.00	0.000	0.0	0.00	0.000	18	3.8	0.43	0.0	0.00	0.000	0.0	0.00	0.000
22-May	Wd										5	3.9	0.64	0.0	0.00	0.000	0.2	0.20	0.051	5	3.9	0.64	0.0	0.00	0.000	0.2	0.20	0.051
23-May	Wd	11	2.9	0.07	0.1	0.09	0.032	0.1	0.09	0.032										11	2.9	0.07	0.1	0.09	0.032	0.1	0.09	0.032
24-May	Wd										10	5.1	0.46	0.2	0.13	0.039	0.2	0.13	0.039	10	5.1	0.46	0.2	0.13	0.039	0.2	0.13	0.039
25-May	We	5	2.6	0.24	0.0	0.00	0	0.0	0.00	0.000	4	5.0	1.73	0.0	0.00	0.000	0.0	0.00	0.000	9	3.7	0.83	0.0	0.00	0.000	0.0	0.00	0.000
26-May	We	7	4.3	0.68	0.0	0.00	0	0.0	0.00	0.000	36	4.1	0.48	0.1	0.05	0.027	0.1	0.05	0.027	43	4.1	0.41	0.1	0.05	0.023	0.1	0.05	0.023
27-May	We										17	3.5	0.40	0.1	0.06	0.017	0.1	0.06	0.017	17	3.5	0.40	0.1	0.06	0.017	0.1	0.06	0.017
28-May	Wd										3	6.0	0.00	0.0	0.00	0.000	0.0	0.00	0.000	3	6.0	0.00	0.0	0.00	0.000	0.0	0.00	0.000
30-May	Wd	7	4.4	0.20	0.0	0.00	0	0.0	0.00	0.000	5	3.6	0.40	0.0	0.00	0.000	0.0	0.00	0.000	12	4.1	0.23	0.0	0.00	0.000	0.0	0.00	0.000
31-May	Wd										3	7.5	0.00	0.0	0.00	0.000	0.0	0.00	0.000	3	7.5	0.00	0.0	0.00	0.000	0.0	0.00	0.000
1-Jun	We	13	4.5	0.22	0.0	0.00	0	0.0	0.00	0.000	17	5.2	0.21	0.0	0.00	0.000	0.0	0.00	0.000	30	4.9	0.16	0.0	0.00	0.000	0.0	0.00	0.000
2-Jun	We	4	7.0	0.00	0.0	0.00	0	0.0	0.00	0.000	15	4.6	0.50	0.3	0.12	0.058	0.3	0.12	0.058	19	5.1	0.46	0.2	0.10	0.041	0.2	0.10	0.041
5-Jun	Wd	11	4.3	0.24	0.0	0.00	0	0.1	0.09	0.021	15	5.1	0.18	0.0	0.00	0.000	0.1	0.07	0.013	26	4.8	0.16	0.0	0.00	0.000	0.1	0.05	0.016
6-Jun	Wd	4	3.5	0.29	0.0	0.00	0	0.0	0.00	0.000	10	4.9	0.94	0.0	0.00	0.000	0.0	0.00	0.000	14	4.5	0.69	0.0	0.00	0.000	0.0	0.00	0.000
7-Jun	Wd	3	9.0	0.00	0.3	0.33	0.037	0.3	0.33	0.037	37	3.9	0.20	0.0	0.00	0.000	0.0	0.00	0.000	40	4.3	0.29	0.0	0.03	0.006	0.0	0.03	0.006
8-Jun	We	3	10.0	0.00	0.0	0.00	0	0.0	0.00	0.000	24	3.4	0.33	0.1	0.07	0.037	0.1	0.07	0.037	27	4.1	0.50	0.1	0.06	0.027	0.1	0.06	0.027

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		Downstream[a]									Upstream[b]									Combined Strata[c]								
	Day	Effort			Harvest			Catch			Effort			Harvest			Catch			Effort			Harvest			Catch		
Date	Type[d]	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
9-Jun[e]	We										85	3.9	0.15	0.1	0.03	0.024	0.1	0.03	0.024	86	4.0	0.16	0.1	0.03	0.023	0.1	0.03	0.023
11-Jun	Wd										3	3.0	0.00	0.0	0.00	0.000	0.0	0.00	0.000	3	3.0	0.00	0.0	0.00	0.000	0.0	0.00	0.000
12-Jun	Wd										14	5.0	0.94	0.1	0.10	0.029	0.1	0.10	0.029	14	5.0	0.94	0.1	0.10	0.029	0.1	0.10	0.029
13-Jun	Wd										19	4.6	0.42	0.2	0.09	0.034	0.2	0.09	0.034	19	4.6	0.42	0.2	0.09	0.034	0.2	0.09	0.034
14-Jun	Wd	13	6.8	0.66	0.2	0.10	0.023	0.2	0.12	0.034	76	5.5	0.38	0.1	0.04	0.027	0.3	0.06	0.060	89	5.7	0.34	0.2	0.04	0.026	0.3	0.06	0.056
15-Jun	We										102	5.8	0.26	0.1	0.03	0.013	0.1	0.03	0.017	102	5.8	0.26	0.1	0.03	0.013	0.1	0.03	0.017
16-Jun	We										56	4.7	0.33	0.1	0.04	0.019	0.3	0.09	0.056	56	4.7	0.33	0.1	0.04	0.019	0.3	0.09	0.056
17-Jun	Wd										19	3.3	0.37	0.2	0.09	0.048	0.2	0.09	0.048	19	3.3	0.37	0.2	0.09	0.048	0.2	0.09	0.048
18-Jun	Wd										6	3.7	0.46	0.2	0.17	0.045	0.7	0.33	0.182	6	3.7	0.46	0.2	0.17	0.045	0.7	0.33	0.182
19-Jun	Wd										30	5.3	0.44	0.1	0.05	0.012	0.1	0.05	0.012	30	5.3	0.44	0.1	0.05	0.012	0.1	0.05	0.012
20-Jun	Wd										16	5.8	0.48	0.0	0.00	0.000	0.1	0.09	0.022	17	5.8	0.45	0.0	0.00	0.000	0.1	0.08	0.020
21-Jun	Wd										15	6.8	0.60	0.1	0.07	0.010	0.1	0.07	0.010	15	6.8	0.60	0.1	0.07	0.010	0.1	0.07	0.010
22-Jun	We										54	5.6	0.41	0.0	0.02	0.003	0.1	0.03	0.010	54	5.6	0.41	0.0	0.02	0.003	0.1	0.03	0.010
23-Jun	We										41	4.3	0.20	0.1	0.05	0.023	0.1	0.05	0.028	41	4.3	0.20	0.1	0.05	0.023	0.1	0.05	0.028
24-Jun	Wd										29	5.7	0.29	0.1	0.07	0.024	0.2	0.07	0.030	29	5.7	0.29	0.1	0.07	0.024	0.2	0.07	0.030
25-Jun	Wd										11	4.3	0.37	0.1	0.09	0.021	0.1	0.09	0.021	11	4.3	0.37	0.1	0.09	0.021	0.1	0.09	0.021
26-Jun	Wd										4	2.0	0.00	0.0	0.00	0.000	0.0	0.00	0.000	4	2.0	0.00	0.0	0.00	0.000	0.0	0.00	0.000
27-Jun	Wd										5	4.3	0.12	0.0	0.00	0.000	0.0	0.00	0.000	5	4.3	0.12	0.0	0.00	0.000	0.0	0.00	0.000
28-Jun	Wd										10	6.1	0.77	0.0	0.00	0.000	0.0	0.00	0.000	10	6.1	0.77	0.0	0.00	0.000	0.0	0.00	0.000
29-Jun	We										49	5.0	0.37	0.1	0.04	0.012	0.1	0.06	0.025	49	5.0	0.37	0.1	0.04	0.012	0.1	0.06	0.025
30-Jun	We										59	4.1	0.19	0.1	0.04	0.029	0.1	0.05	0.033	59	4.1	0.19	0.1	0.04	0.029	0.1	0.05	0.033

[a] Downstream of the chinook salmon sonar counters to the Warren Ames Bridge.

[b] Upstream of the chinook salmon sonar counters to the Soldotna Bridge.

[c] Combined strata are independent, not the sum of the downstream and upstream estimates.

[d] Wd = weekday, We = weekend/holiday day.

[e] The use of bait was permitted by emergency order 9 - 30 June.

Appendix B2.-Daily sample size (n), effort, harvest per unit of effort (HPUE), catch per unit of effort (CPUE), and other summary statistics for guided anglers interviewed during the fishery for early-run chinook salmon downstream of the Soldotna Bridge on the Kenai River, 1996 (completed-trip interviews only).

		Downstream[a]									Upstream[b]									Combined Strata[c]								
	Day	Effort			Harvest			Catch			Effort			Harvest			Catch			Effort			Harvest			Catch		
Date	Type[d]	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
17-May	Wd										2	6.0	0.00	0.0	0.00	0.000	0.0	0.00	0.000	2	6.0	0.00	0.0	0.00	0.000	0.0	0.00	0.000
18-May	We										10	5.4	0.12	0.3	0.15	0.056	0.3	0.15	0.056	10	5.4	0.12	0.3	0.15	0.056	0.3	0.15	0.056
19-May	We										4	6.3	1.75	0.3	0.25	0.040	0.3	0.25	0.040	4	6.3	1.75	0.3	0.25	0.040	0.3	0.25	0.040
21-May	Wd										13	5.2	0.72	0.4	0.14	0.074	0.4	0.14	0.074	13	5.2	0.72	0.4	0.14	0.074	0.4	0.14	0.074
22-May	Wd										12	4.5	0.37	0.2	0.11	0.037	0.2	0.11	0.037	12	4.5	0.37	0.2	0.11	0.037	0.2	0.11	0.037
23-May	Wd	5	4.3	0.12	0.0	0.00	0	0.2	0.20	0.047	23	5.6	0.61	0.3	0.09	0.047	0.3	0.09	0.047	28	5.4	0.51	0.2	0.08	0.040	0.3	0.08	0.047
24-May	Wd	4	5.0	0.00	0.0	0.00	0	0.0	0.00	0.000	37	5.6	0.14	0.2	0.06	0.029	0.2	0.08	0.033	41	5.6	0.13	0.2	0.06	0.026	0.2	0.07	0.031
25-May	We	2	3.0	0.00	0.0	0.00	0	0.0	0.00	0.000	15	5.6	0.34	0.2	0.11	0.036	0.2	0.11	0.036	17	5.3	0.37	0.2	0.10	0.034	0.2	0.10	0.034
26-May	We	7	6.7	0.61	0.0	0.00	0	0.0	0.00	0.000	25	5.1	0.47	0.2	0.09	0.047	0.2	0.09	0.047	32	5.4	0.41	0.2	0.07	0.035	0.2	0.07	0.035
27-May	Wd										8	5.5	0.19	0.3	0.16	0.045	0.3	0.16	0.045	8	5.5	0.19	0.3	0.16	0.045	0.3	0.16	0.045
28-May	Wd										4	4.1	1.66	0.5	0.29	0.121	0.5	0.29	0.121	4	4.1	1.66	0.5	0.29	0.121	0.5	0.29	0.121
29-May	Wd										27	4.9	0.35	0.3	0.09	0.053	0.3	0.11	0.068	27	4.9	0.35	0.3	0.09	0.053	0.3	0.11	0.068
30-May	Wd	4	10.0	0.00	0.0	0.00	0	0.0	0.00	0.000	15	4.2	0.22	0.4	0.13	0.095	0.4	0.13	0.095	19	5.4	0.58	0.3	0.11	0.058	0.3	0.11	0.058
1-Jun	We										9	4.2	0.42	0.2	0.15	0.053	0.2	0.15	0.053	9	4.2	0.42	0.2	0.15	0.053	0.2	0.15	0.053
2-Jun	We	8	6.0	0.00	0.3	0.16	0.042	0.3	0.16	0.042	31	5.0	0.27	0.1	0.05	0.013	0.1	0.05	0.019	39	5.2	0.22	0.1	0.05	0.020	0.1	0.05	0.025
4-Jun	Wd										44	5.9	0.12	0.1	0.03	0.008	0.1	0.03	0.008	44	5.9	0.12	0.1	0.03	0.008	0.1	0.03	0.008
5-Jun	Wd	8	5.4	0.18	0.0	0.00	0	0.0	0.00	0.000	11	4.8	0.30	0.0	0.00	0.000	0.0	0.00	0.000	19	5.1	0.19	0.0	0.00	0.000	0.0	0.00	0.000
6-Jun	Wd	5	5.0	0.00	0.2	0.20	0.04	0.2	0.20	0.040	8	6.0	0.00	0.3	0.16	0.042	0.3	0.16	0.042	13	5.6	0.14	0.2	0.12	0.041	0.2	0.12	0.041
7-Jun	Wd	6	5.7	0.21	0.0	0.00	0	0.0	0.00	0.000	15	4.8	0.54	0.4	0.13	0.083	0.4	0.13	0.083	21	5.0	0.39	0.3	0.10	0.057	0.3	0.10	0.057
8-Jun	We										43	5.9	0.35	0.3	0.07	0.052	0.3	0.08	0.056	43	5.9	0.35	0.3	0.07	0.052	0.3	0.08	0.056

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Appendix B2.-Page 2 of 2.

		Downstream[a]									Upstream[b]									Combined Strata[c]								
	Day	Effort			Harvest			Catch			Effort			Harvest			Catch			Effort			Harvest			Catch		
Date	Type[d]	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
9-Jun[e]	We	2	3.5	0.00	0.5	0.50	0.143	1.5	0.50	0.429	55	4.4	0.26	0.4	0.07	0.091	0.5	0.08	0.115	57	4.4	0.25	0.4	0.07	0.092	0.5	0.08	0.124
11-Jun	Wd										33	5.7	0.32	0.3	0.08	0.058	0.5	0.10	0.090	33	5.7	0.32	0.3	0.08	0.058	0.5	0.10	0.090
12-Jun	Wd										46	5.5	0.35	0.4	0.07	0.079	0.7	0.13	0.130	46	5.5	0.35	0.4	0.07	0.079	0.7	0.13	0.130
13-Jun	Wd										50	5.9	0.17	0.4	0.07	0.068	0.5	0.07	0.078	50	5.9	0.17	0.4	0.07	0.068	0.5	0.07	0.078
14-Jun	Wd	6	8.5	1.31	0.5	0.22	0.059	0.8	0.31	0.098	44	5.4	0.24	0.4	0.08	0.080	0.6	0.10	0.114	50	5.8	0.29	0.4	0.07	0.076	0.6	0.09	0.111
15-Jun	We										58	6.0	0.26	0.3	0.06	0.051	0.6	0.07	0.094	58	6.0	0.26	0.3	0.06	0.051	0.6	0.07	0.094
16-Jun	We										53	5.0	0.28	0.4	0.07	0.086	0.6	0.09	0.112	53	5.0	0.28	0.4	0.07	0.086	0.6	0.09	0.112
17-Jun	Wd										7	4.1	0.77	0.4	0.20	0.105	0.4	0.20	0.105	7	4.1	0.77	0.4	0.20	0.105	0.4	0.20	0.105
18-Jun	Wd										31	5.4	0.24	0.3	0.08	0.054	0.4	0.09	0.072	31	5.4	0.24	0.3	0.08	0.054	0.4	0.09	0.072
19-Jun	Wd										36	5.2	0.47	0.4	0.08	0.085	0.5	0.09	0.096	36	5.2	0.47	0.4	0.08	0.085	0.5	0.09	0.096
20-Jun	Wd										61	5.7	0.19	0.2	0.05	0.035	0.2	0.05	0.040	61	5.7	0.19	0.2	0.05	0.035	0.2	0.05	0.040
21-Jun	Wd										2	9.0	0.00	0.0	0.00	0.000	0.0	0.00	0.000	2	9.0	0.00	0.0	0.00	0.000	0.0	0.00	0.000
22-Jun	We										70	5.6	0.21	0.2	0.05	0.031	0.2	0.05	0.041	70	5.6	0.21	0.2	0.05	0.031	0.2	0.05	0.041
23-Jun	We										59	5.8	0.26	0.2	0.05	0.035	0.2	0.05	0.035	59	5.8	0.26	0.2	0.05	0.035	0.2	0.05	0.035
24-Jun	Wd										16	5.7	0.35	0.2	0.10	0.033	0.3	0.12	0.055	16	5.7	0.35	0.2	0.10	0.033	0.3	0.12	0.055
25-Jun	Wd										3	6.0	0.00	0.3	0.33	0.056	0.3	0.33	0.056	3	6.0	0.00	0.3	0.33	0.056	0.3	0.33	0.056
26-Jun	Wd										17	5.8	0.26	0.0	0.00	0.000	0.0	0.00	0.000	17	5.8	0.26	0.0	0.00	0.000	0.0	0.00	0.000
27-Jun	Wd										22	5.7	0.25	0.1	0.06	0.016	0.1	0.06	0.016	22	5.7	0.25	0.1	0.06	0.016	0.1	0.06	0.016
28-Jun	Wd										18	5.9	0.20	0.0	0.00	0.000	0.0	0.00	0.000	18	5.9	0.20	0.0	0.00	0.000	0.0	0.00	0.000
29-Jun	We										54	5.8	0.30	0.2	0.05	0.026	0.2	0.06	0.035	54	5.8	0.30	0.2	0.05	0.026	0.2	0.06	0.035
30-Jun	We										40	6.6	0.38	0.08	0.04	0.011	0.08	0.04	0.011	40	6.6	0.38	0.08	0.04	0.011	0.08	0.04	0.011

[a] Downstream of the chinook salmon sonar counters to the Warren Ames Bridge.

[b] Upstream of the chinook salmon sonar counters to the Soldotna Bridge.

[c] Combined strata are independent, not the sum of the downstream and upstream estimates.

[d] Wd = weekday, We = weekend/holiday day.

[e] The use of bait was permitted by emergency order 9 - 30 June.

Appendix B3.-Daily sample size (n), effort, harvest per unit of effort (HPUE), catch per unit of effort (CPUE), and other summary statistics, by stratum, for unguided anglers interviewed during the fishery for late-run chinook salmon downstream of the Soldotna Bridge on the Kenai River, 1996 (completed-trip interviews only).

		Downstream[a]									Upstream[b]									Combined Strata[c]								
	Day	Effort			Harvest			Catch			Effort			Harvest			Catch			Effort			Harvest			Catch		
Date	Type[d]	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
2-Jul	Wd										17	7.3	0.70	0.0	0.00	0.000	0.0	0.00	0.000	17	7.30	0.70	0.0	0.00	0.000	0.00	0.00	0.000
4-Jul	We	7	3.1	0.40	0.0	0.00	0	0.0	0.00	0.000	39	3.4	0.19	0.0	0.00	0.000	0.0	0.00	0.000	46	3.40	0.17	0.0	0.00	0.000	0.00	0.00	0.000
5-Jul	Wd										40	3.5	0.20	0.0	0.03	0.007	0.0	0.03	0.007	40	3.50	0.20	0.0	0.03	0.007	0.03	0.03	0.007
6-Jul	We	5	3.4	0.24	0.0	0.00	0	0.0	0.00	0.000	37	5.1	0.41	0.0	0.03	0.005	0.1	0.04	0.011	42	4.90	0.37	0.0	0.02	0.005	0.05	0.03	0.010
7-Jul	We										60	4.0	0.30	0.1	0.04	0.025	0.2	0.06	0.038	60	4.00	0.30	0.1	0.04	0.025	0.15	0.06	0.038
9-Jul	Wd										11	5.7	0.51	0.1	0.09	0.016	0.1	0.09	0.016	11	5.70	0.51	0.1	0.09	0.016	0.09	0.09	0.016
10-Jul	Wd										15	4.2	0.25	0.1	0.07	0.016	0.1	0.07	0.016	15	4.20	0.25	0.1	0.07	0.016	0.07	0.07	0.016
11-Jul	Wd	3	5.0	0.00	0.0	0.00	0	0.0	0.00	0.000	59	4.8	0.27	0.0	0.02	0.007	0.0	0.02	0.007	62	4.80	0.25	0.0	0.02	0.007	0.03	0.02	0.007
12-Jul	Wd	3	4.0	0.00	0.0	0.00	0	0.0	0.00	0.000	59	4.9	0.39	0.0	0.02	0.003	0.0	0.02	0.003	62	4.90	0.37	0.0	0.02	0.003	0.02	0.02	0.003
13-Jul	We										59	4.2	0.28	0.1	0.03	0.012	0.1	0.03	0.012	59	4.20	0.28	0.1	0.03	0.012	0.05	0.03	0.012
14-Jul	We	3	2.0	0.00	0.0	0.00	0	0.0	0.00	0.000	125	5.2	0.19	0.0	0.02	0.008	0.1	0.03	0.016	128	5.10	0.19	0.0	0.02	0.008	0.08	0.03	0.015
16-Jul	Wd										26	4.4	0.33	0.2	0.08	0.044	0.3	0.09	0.070	26	4.40	0.33	0.2	0.08	0.044	0.31	0.09	0.070
17-Jul	Wd	6	2.7	0.56	0.3	0.21	0.125	0.3	0.21	0.125	69	3.9	0.18	0.1	0.03	0.022	0.1	0.03	0.022	75	3.80	0.18	0.1	0.04	0.028	0.11	0.04	0.028
18-Jul	Wd	4	2.0	0.00	0.0	0.00	0	0.0	0.00	0.000	63	4.8	0.29	0.1	0.04	0.020	0.1	0.04	0.023	67	4.60	0.28	0.1	0.04	0.019	0.10	0.04	0.023
19-Jul	Wd										47	4.6	0.24	0.1	0.05	0.023	0.2	0.06	0.033	47	4.60	0.24	0.1	0.05	0.023	0.15	0.06	0.033
20-Jul	We	8	3.8	0.82	0.0	0.00	0	0.0	0.00	0.000	75	4.6	0.22	0.1	0.03	0.014	0.1	0.03	0.014	83	4.50	0.21	0.1	0.03	0.013	0.06	0.03	0.013
21-Jul	We	3	5.0	0.00	0.0	0.00	0	0.0	0.00	0.000	163	4.4	0.19	0.1	0.03	0.028	0.2	0.04	0.038	166	4.40	0.19	0.1	0.03	0.028	0.16	0.04	0.037
23-Jul	Wd	17	6.1	0.77	0.0	0.00	0	0.0	0.00	0.000	57	6.4	0.40	0.0	0.02	0.003	0.0	0.02	0.003	74	6.30	0.36	0.0	0.01	0.002	0.01	0.01	0.002
24-Jul	Wd	8	3.9	0.47	0.1	0.13	0.032	0.3	0.16	0.065	80	3.7	0.22	0.1	0.04	0.031	0.2	0.04	0.041	88	3.70	0.20	0.1	0.03	0.031	0.16	0.04	0.043
25-Jul	Wd										34	5.0	0.51	0.1	0.06	0.024	0.1	0.06	0.024	34	5.00	0.51	0.1	0.06	0.024	0.12	0.06	0.024
26-Jul	Wd	9	4.3	0.73	0.0	0.00	0	0.0	0.00	0.000	49	4.4	0.29	0.2	0.05	0.037	0.2	0.05	0.037	58	4.40	0.26	0.1	0.05	0.031	0.14	0.05	0.031
27-Jul	We	23	7.9	0.78	0.1	0.06	0.011	0.1	0.06	0.011	85	5.3	0.29	0.1	0.02	0.009	0.1	0.03	0.011	108	5.80	0.30	0.1	0.02	0.010	0.06	0.02	0.011
28-Jul	We	4	8.0	2.00	0.3	0.25	0.031	0.3	0.25	0.031	84	4.4	0.27	0.3	0.05	0.063	0.3	0.05	0.071	88	4.50	0.28	0.3	0.05	0.060	0.31	0.05	0.068
30-Jul	Wd										39	4.2	0.23	0.0	0.00	0.000	0.0	0.00	0.000	39	4.20	0.23	0.0	0.00	0.000	0.00	0.00	0.000
31-Jul	Wd	7	10.9	0.40	0.0	0.00	0	0.0	0.00	0.000	62	5.3	0.37	0.0	0.02	0.003	0.0	0.02	0.003	69	5.90	0.39	0.0	0.01	0.002	0.01	0.01	0.002

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		Downstream[a]									Upstream[b]									Combined Strata[c]								
	Day	Effort			Harvest			Catch			Effort			Harvest			Catch			Effort			Harvest			Catch		
Date	Type[d]	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
1-Aug	Wd	4	3.00	0.58	0.0	0.00	0	0.0	0.00	0.000	24	4.90	0.46	0.0	0.04	0.008	0.0	0.04	0.008	28	4.60	0.42	0.04	0.04	0.008	0.04	0.04	0.008
2-Aug	Wd	2	3.00	0	0.0	0.00	0	0.0	0.00	0.000	6	4.70	0.21	0.0	0.00	0.000	0.0	0.00	0	8	4.30	0.31	0.00	0.00	0.000	0.00	0.00	0.000
3-Aug	We										21	3.30	0.37	0.1	0.05	0.015	0.1	0.05	0.015	21	3.30	0.37	0.05	0.05	0.015	0.05	0.05	0.015
4-Aug	We	4	5.00	0	0.0	0.00	0	0.3	0.25	0.050	8	4.30	0.44	0.0	0.00	0.000	0.0	0.00	0	12	4.50	0.30	0.00	0.00	0.000	0.08	0.08	0.018

[a] Downstream of the chinook salmon sonar counters to the Warren Ames Bridge.

[b] Upstream of the chinook salmon sonar counters to the Soldotna Bridge.

[c] Combined strata are independent, not the sum of the downstream and upstream estimates.

[d] Wd = weekday, We = weekend/holiday day.

Appendix B4.-Daily sample size (n), effort, harvest per unit of effort (HPUE), catch per unit of effort (CPUE), and other summary statistics, by stratum, for guided anglers interviewed during the fishery for late-run chinook salmon downstream of the Soldotna Bridge on the Kenai River, 1996 (completed-trip interviews only).

		Downstream[a]									Upstream[b]									Combined Strata[c]								
	Day	Effort			Harvest			Catch			Effort			Harvest			Catch			Effort			Harvest			Catch		
Date	Type[d]	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
2-Jul	Wd										22	6.0	0.45	0.1	0.06	0.015	0.1	0.06	0.015	22	6.0	0.45	0.1	0.06	0.015	0.1	0.06	0.015
3-Jul	Wd										35	5.5	0.24	0.2	0.07	0.036	0.2	0.07	0.036	35	5.5	0.24	0.2	0.07	0.036	0.2	0.07	0.036
4-Jul	We										38	5.6	0.19	0.1	0.06	0.024	0.2	0.06	0.028	38	5.6	0.19	0.1	0.06	0.024	0.2	0.06	0.028
5-Jul	Wd	2	6.5	0.00	0.0	0.00	0	0.0	0.00	0.000	46	5.7	0.40	0.0	0.02	0.004	0.0	0.03	0.008	48	5.8	0.38	0.0	0.02	0.004	0.0	0.03	0.007
6-Jul	We	2	4.5	1.50	0.5	0.50	0.111	0.5	0.50	0.111	43	6.1	0.30	0.1	0.05	0.015	0.2	0.06	0.034	45	6.0	0.29	0.1	0.05	0.019	0.2	0.06	0.037
9-Jul	Wd										23	5.5	0.31	0.2	0.08	0.032	0.4	0.14	0.063	23	5.5	0.31	0.2	0.08	0.032	0.4	0.14	0.063
10-Jul	Wd										33	4.7	0.34	0.4	0.09	0.078	0.5	0.10	0.098	33	4.7	0.34	0.4	0.09	0.078	0.5	0.10	0.098
11-Jul	Wd	7	5.0	0.71	0.3	0.18	0.057	0.3	0.18	0.057	42	5.1	0.37	0.2	0.06	0.042	0.3	0.07	0.052	49	5.1	0.33	0.2	0.06	0.044	0.3	0.06	0.053
12-Jul	Wd	4	5.1	0.88	0.3	0.25	0.049	0.3	0.25	0.049	74	5.2	0.22	0.2	0.05	0.041	0.2	0.05	0.044	78	5.2	0.21	0.2	0.05	0.042	0.2	0.05	0.044
13-Jul	We										69	5.5	0.23	0.1	0.04	0.024	0.1	0.04	0.024	69	5.5	0.23	0.1	0.04	0.024	0.1	0.04	0.024
16-Jul	Wd	2	2.0	1.50	1.0	0.00	0.5	1.0	0.00	0.500	30	4.6	0.38	0.5	0.09	0.11	0.6	0.10	0.125	32	4.4	0.38	0.5	0.09	0.121	0.6	0.10	0.135
17-Jul	Wd	4	4.6	0.88	0.3	0.25	0.054	0.3	0.25	0.054	170	5.3	0.18	0.2	0.03	0.045	0.3	0.03	0.048	174	5.2	0.18	0.2	0.03	0.045	0.3	0.03	0.048
18-Jul	Wd	7	5.4	0.45	0.1	0.14	0.027	0.1	0.14	0.027	21	5.8	0.38	0.1	0.08	0.025	0.1	0.08	0.025	28	5.7	0.31	0.1	0.07	0.025	0.1	0.07	0.025
19-Jul	Wd										49	4.8	0.28	0.2	0.06	0.039	0.2	0.06	0.039	49	4.8	0.28	0.2	0.06	0.039	0.2	0.06	0.039
20-Jul	We	4	5.4	0.63	0.3	0.25	0.047	0.3	0.25	0.047	88	4.6	0.19	0.2	0.05	0.052	0.2	0.05	0.052	92	4.6	0.18	0.2	0.05	0.051	0.2	0.05	0.051
23-Jul	Wd	4	11.0	0.00	0.0	0.00	0	0.0	0.00	0.000	50	6.8	0.36	0.2	0.05	0.023	0.2	0.05	0.023	54	7.1	0.36	0.2	0.05	0.021	0.2	0.05	0.021
24-Jul	Wd	6	7.8	1.33	0.2	0.17	0.021	0.8	0.40	0.106	48	5.7	0.13	0.1	0.04	0.015	0.1	0.04	0.015	54	6.0	0.20	0.1	0.04	0.016	0.2	0.06	0.028
25-Jul	Wd										24	4.8	0.43	0.3	0.09	0.052	0.3	0.09	0.052	24	4.8	0.43	0.3	0.09	0.052	0.3	0.09	0.052
26-Jul	Wd	11	7.8	1.13	0.0	0.00	0	0.0	0.00	0.000	59	5.5	0.36	0.3	0.06	0.061	0.4	0.06	0.064	70	5.9	0.36	0.3	0.05	0.048	0.3	0.06	0.051
27-Jul	We	3	2.5	0.00	0.0	0.00	0	0.0	0.00	0.000	85	5.1	0.22	0.2	0.05	0.044	0.2	0.05	0.046	88	5.0	0.22	0.2	0.04	0.043	0.2	0.05	0.045
30-Jul	Wd										29	5.6	0.26	0.1	0.05	0.012	0.1	0.05	0.012	29	5.6	0.26	0.1	0.05	0.012	0.1	0.05	0.012
31-Jul	Wd										80	5.3	0.15	0.1	0.04	0.024	0.2	0.04	0.031	80	5.3	0.15	0.1	0.04	0.024	0.2	0.04	0.031

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		Downstream[a]									Upstream[a]									Combined Strata[c]								
	Day	Effort			Harvest			Catch			Effort			Harvest			Catch			Effort			Harvest			Catch		
Date	Type[d]	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE	n	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
1-Aug	Wd	2	9.0	0.00	0.0	0.00	0	0.0	0.00	0.000	16	6.4	0.50	0.1	0.06	0.01	0.1	0.06	0.010	18	6.7	0.48	0.1	0.06	0.008	0.1	0.06	0.008
2-Aug	Wd										12	5.7	0.22	0.2	0.11	0.029	0.2	0.11	0.029	12	5.7	0.22	0.2	0.11	0.029	0.2	0.11	0.029
3-Aug	We										27	4.3	0.29	0.1	0.05	0.017	0.1	0.05	0.017	27	4.3	0.29	0.1	0.05	0.017	0.1	0.05	0.017
4-Aug	We										3	2.0	0.00	0.3	0.33	0.167	0.3	0.33	0.167	3	2.0	0.00	0.3	0.33	0.167	0.3	0.33	0.167

[a] Downstream of the chinook salmon sonar counters to the Warren Ames Bridge.

[b] Upstream of the chinook salmon sonar counters to the Soldotna Bridge.

[c] Combined strata are independent, not the sum of the downstream and upstream estimates.

[d] Wd = weekday, We = weekend/holiday day.