

Fishery Data Series No. 94-7

**Angler Effort and Harvest of Chinook Salmon by the
Recreational Fisheries in the Lower Kenai River,
1993**

by

S. L. Hammarstrom

July 1994

Alaska Department of Fish and Game

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ABSTRACT

A creel survey was conducted on the Kenai River between the Soldotna Bridge and Cook Inlet from 22 May through 4 August 1993. The recreational fishery in this section of the Kenai River primarily targets chinook salmon *Oncorhynchus tshawytscha*. The estimated angler-effort and harvest during the early (May and June) chinook salmon run were 153,899 angler-hours and 7,727 chinook salmon, respectively. The estimated angler-effort and harvest during the late (July) chinook salmon run were 293,908 angler-hours and 15,279 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 66.7% of the total effort and took 46.1% of the chinook salmon harvest while guided anglers exerted 33.3% of the effort and harvested 53.9% of the chinook salmon.

Age and sex compositions of the recreational harvest and the inriver return as estimated by sonar are also presented.

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 5 years (Mills 1989-1993). This represents approximately 15% of the state's recreational fishing effort. The majority of the angler-effort occurs in the section of the river between the outlet of Skilak Lake and Cook Inlet (Figure 1) during a fishery directed primarily at returning chinook salmon *Oncorhynchus tshawytscha* during May, June, and July. With the exception of 1990, 1991 and 1992, angler effort in the chinook salmon fishery has generally been increasing (Figures 2 and 3). Although coho salmon *O. kisutch*, sockeye salmon *O. nerka*, pink salmon *O. gorbuscha*, Dolly Varden *Salvelinus malma*, and rainbow trout *O. mykiss* are also harvested by anglers in the Kenai River, this report deals only with the early- and late-run chinook salmon fisheries.

Prior to 1970, the recreational fishery in the Kenai River was comprised of shorebased anglers targeting on sockeye salmon in July and coho salmon in August and early September. In 1973, large numbers of anglers began experimenting with a new fishing method that involved bouncing brightly colored terminal gear along the river bottom from a drifting boat. This technique had been used effectively by anglers fishing for chinook salmon on rivers in the Pacific Northwest. It proved to be a very effective method for catching chinook salmon on the Kenai River, and the fishery began to expand rapidly (Figures 2 and 3).

The chinook salmon return to the Kenai River has two distinct temporal components: an early run which typically enters the river from mid-May until late June; and a late run which typically enters the river from late June through early August. Fish from both runs are prized by recreational anglers due to their large size, especially those from the late run which average about 18 kg (40 lbs) and may exceed 36 kg (80 lbs). 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 further 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 precision. During the winter of 1988, the Alaska Board of Fisheries adopted management plans for both the early and late chinook salmon runs. These plans define escapement goals and mechanisms by which the various fisheries are to be regulated to achieve the stated goals. Another component of these plans defines the separation date between the two runs as 1 July. Both management plans were reviewed by the Alaska Board of Fisheries in late 1990. Minor changes were made which were to be implemented for the entire 1991 fisheries, however, legal complications in the process of turning Board action into regulation delayed the implementation until 21 July 1991. The modifications were in place for both the 1992 and 1993 seasons.

Previous information pertaining to the chinook salmon fisheries in the Kenai River has been presented by Hammarstrom (1975-1981, 1988-1993), Hammarstrom

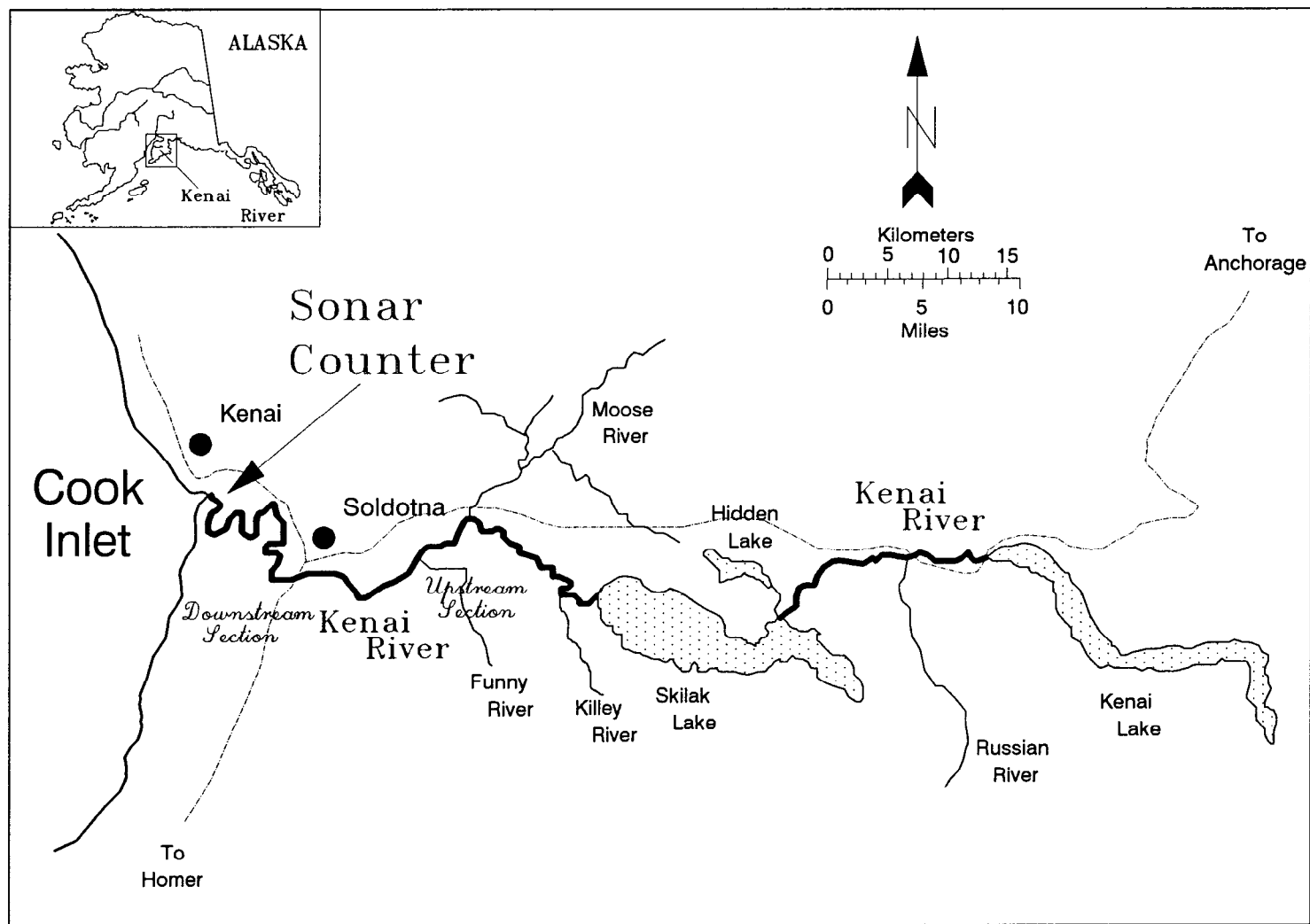


Figure 1. Map of the Kenai River drainage.

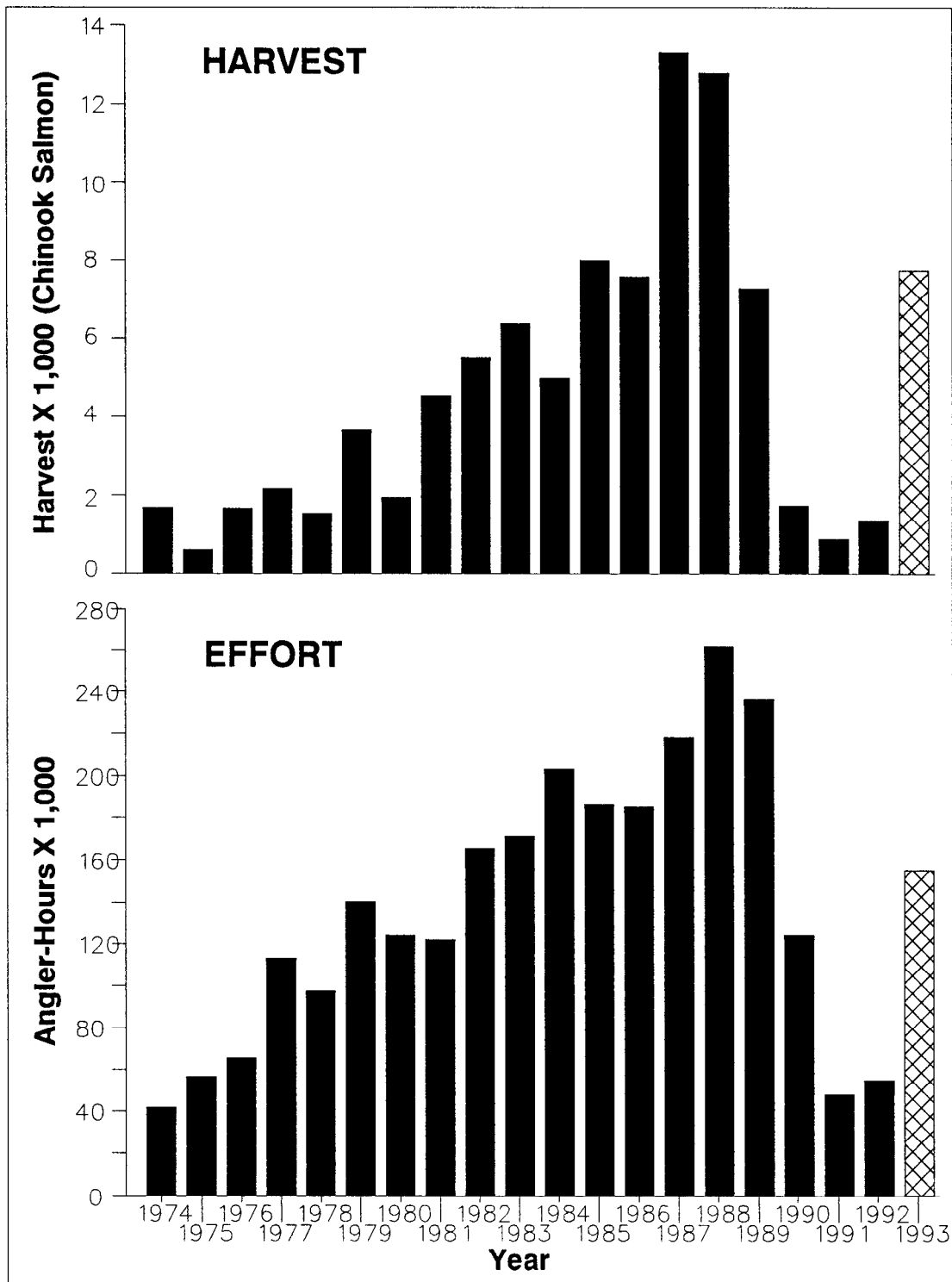


Figure 2. Historical harvest and effort in the recreational fishery for early-run chinook salmon, Kenai River, 1974-1993.

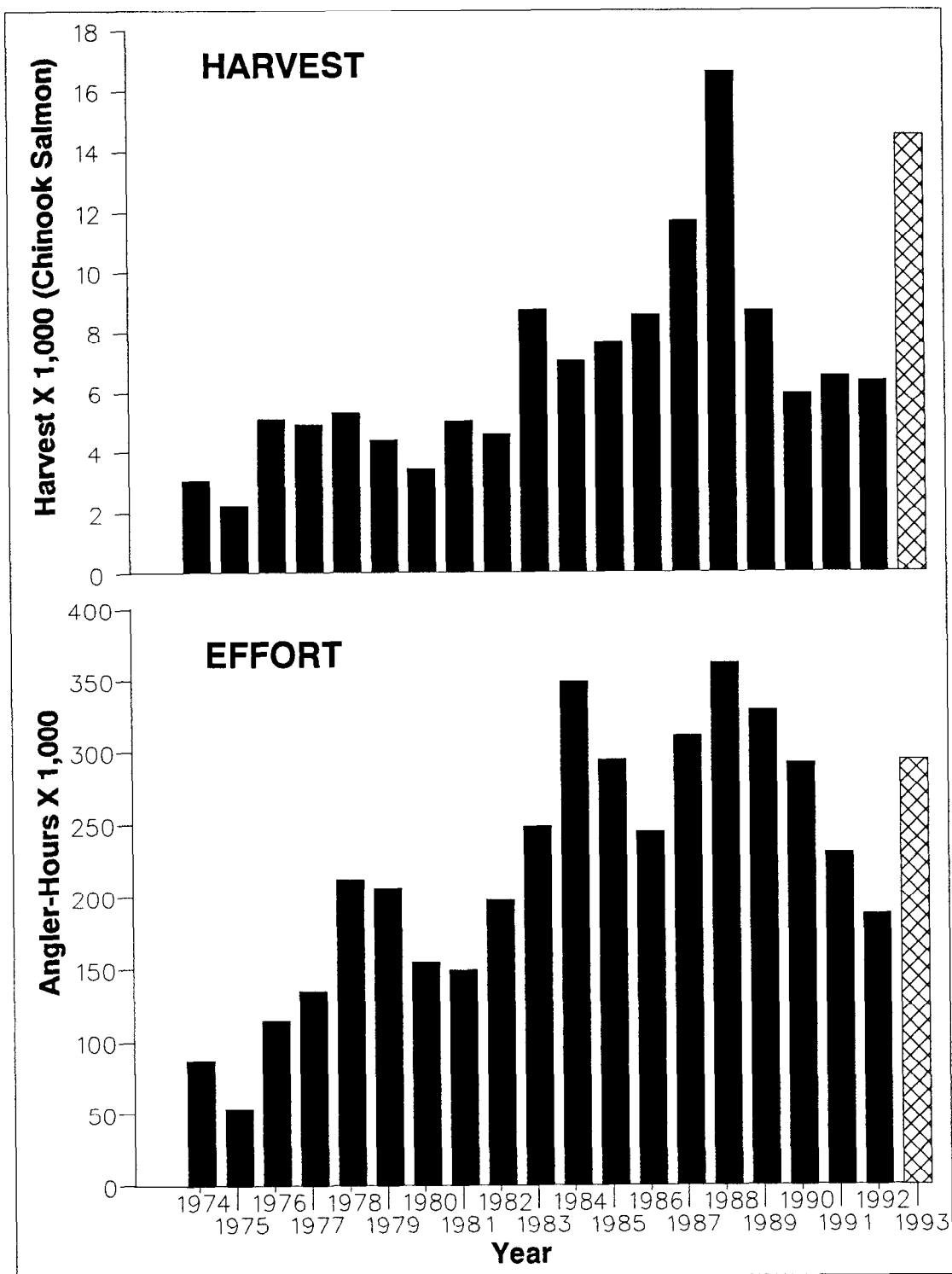


Figure 3. Historical harvest and effort in the recreational fishery for late-run chinook salmon, Kenai River, 1974-1993.

and Larson (1982-1984, 1986), Hammarstrom et al. (1985), and Conrad and Hammarstrom (1987). In addition, angler-effort and harvest by species for the recreational fishery has been estimated by Mills (1979-1993) in the Alaska Statewide Sport Fish Harvest Survey.

The current creel survey program in the Kenai River provides data which are used as a basis 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. The objective of this report is to present detailed information from the creel surveys of the recreational fishery for chinook salmon conducted in 1993.

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. By regulation, the season for chinook salmon is from 1 January through 31 July, but it effectively begins in mid-May when the fish first begin entering the river. 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. In 1993, fishing from boats downstream from the outlet of Skilak Lake was prohibited on Mondays in May, June, and July, except Monday of Memorial Day. Anyone retaining a chinook salmon that was 41 cm in length or greater was prohibited from fishing from a boat in the Kenai River downstream of Skilak Lake for the remainder of that day. Additionally, 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. Anglers who have reached their daily bag limit of coho salmon are prohibited from fishing in the Kenai River for the remainder of that calendar day.

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. In 1993, fishing from a guided boat was allowed only between 0600 and 1800 hours during June and July. There were no days or hours closed to boat fishing for either guided or unguided anglers during the remainder of the year.

In 1993, the river was opened to the use of bait on 26 June, and on 1 August, the period of allowable chinook salmon retention was extended through 4 August in that section of river downstream of "Eagle Rock" (approximately river kilometer 18). 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 units of 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 by the product of effort and harvest (or catch) rate estimates. Fishery parameters were established separately for the early and late runs.

The chinook salmon fishery is limited to the lower Kenai River, which is defined as the mainstem waters downstream of Skilak Lake. During the 1993 early-run and late-run fisheries, angler effort, harvest, and catch were estimated only for the downstream section (Cook Inlet, river mile/kilometer 0, to the Soldotna Bridge, river mile [rm] 21 or river kilometer [rkm] 34) of the lower Kenai River (Figure 4). Although an attempt to survey the fishery upstream of the Soldotna Bridge was made in 1993, insufficient interviews of completed-trip anglers were achieved to make a meaningful estimate of harvest and effort. Few anglers and many access locations make interviews difficult to obtain with limited manpower in this section of the river. Because of emergency orders that restricted the fishery and reduced effort upstream of the Soldotna Bridge (upstream section of the lower Kenai River), that area was not surveyed in 1992.

Both unguided and guided anglers participate in the fishery for chinook salmon in the Kenai River. The times/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 anglers using the services of a guide. Guided clients fish exclusively from boats and are easily recognized because these boats are required to be marked with a prominent identifying decal. Since shore anglers harvest very few chinook salmon, only boat anglers were surveyed.

The creel survey of the fishery for chinook salmon began 22 May and continued through 4 August. The fishing day for unguided anglers was defined as 20 hours long, from 0400 to 2400 hours and was stratified into five 4-hour daily time strata (referred to as periods) for effort estimation. The periods were: A, from 0400 to 0759 hours; B, from 0800 to 1159 hours; C, from 1200 to 1559 hours; D, from 1600 to 1959 hours; and E, from 2000 to 2359 hours. Because of reduced daylight hours in August, the fishing day was considered to be 16 hours long, from 0600 to 2200 hours and was stratified into four 4-hour periods. These periods were: A, from 0600 to 0959 hours; B, from 1000-1359 hours; C, from 1400 to 1739 hours; and D, from 1800 to 2159 hours. In May and August, stratification of the fishing day for anglers using guides 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. No further stratification for guided anglers was used.

The above design resulted in 20 strata: 12 during the early run and eight during the late run. There were seven temporal units, four during the early run and three during the late run.

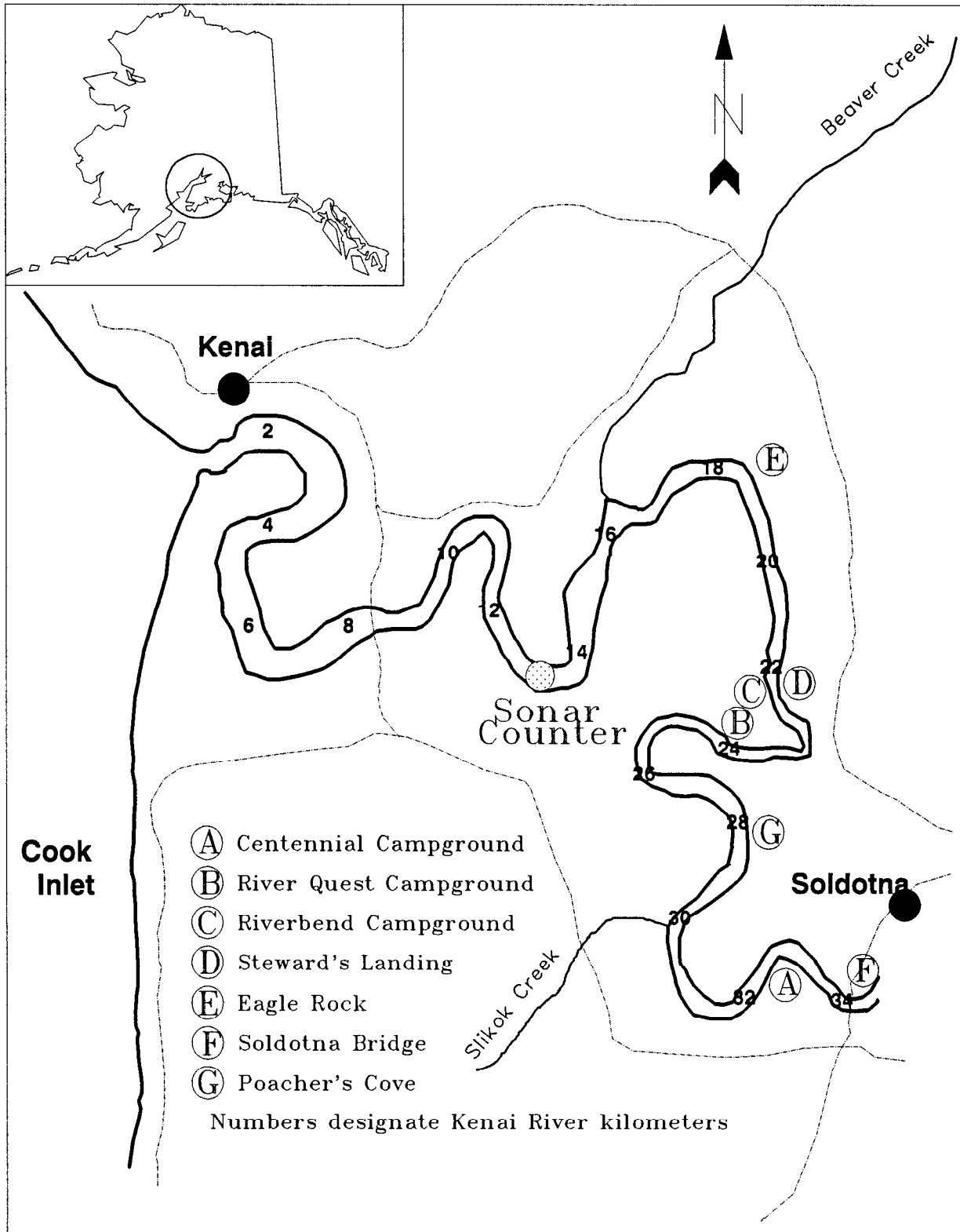


Figure 4. Map of the Kenai River study area.

The early-run strata were:

- (1) unit 1 (5/22-5/31), unguided anglers, weekdays;
- (2) unit 1, unguided anglers, weekends/holidays;
- (3) unit 1, guided anglers;
- (4) unit 2 (6/01-6/14), unguided anglers, weekdays;
- (5) unit 2, unguided anglers, weekends/holidays;
- (6) unit 2, guided anglers;
- (7) unit 3 (6/15-6/25), unguided anglers, weekdays;
- (8) unit 3, unguided anglers, weekends/holidays;
- (9) unit 3, guided anglers;
- (10) unit 4 (6/26-6/30), unguided anglers, weekdays;
- (11) unit 4, unguided anglers, weekends/holidays; and,
- (12) unit 4, guided anglers.

The late-run strata were:

- (13) unit 5 (7/1-7/16), unguided anglers, weekdays;
- (14) unit 5, unguided anglers; weekends/holidays;
- (15) unit 5, guided anglers;
- (16) unit 6 (7/17-7/31), unguided anglers, weekdays;
- (17) unit 6, unguided anglers, weekends/holidays;
- (18) unit 6, guided anglers;
- (19) unit 7 (8/01-8/04), unguided anglers, all days; and,
- (20) unit 7, guided anglers, all days.

Angler Counts:

Sampling levels were designed to estimate catch and harvest within 15% of the true value 95% of the time. Two creel survey clerks, each working 37.5 hours per week, conducted the angler counts in the downstream section.

On every weekend day and holiday, an unguided angler count was made during each of the five periods. One of the 4 whole-hours of each period (A through E) was selected randomly as a time that an unguided angler count was to be initiated. During each 4-day week (weekdays only Tuesday through Friday), 2 days for each period, A through E, were selected randomly to be sampled. 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 in the downstream section of the Kenai River. At the time designated on the schedule, a creel survey clerk was at the randomly selected extremity of the downstream section. The angler count was made while the boat was driven at a constant rate of speed through the survey area to the opposite end of the river section. This trip 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 creel survey clerk recorded the following: (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 to be 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 being conducted. Guides were not included in the counts during the chinook salmon fishery as they are prohibited from fishing while guiding. When the clerks responsible for angler counts were not conducting a count, they conducted completed-trip angler interviews at access locations.

Angler Interviews:

The angler interview schedule in the downstream section was designed for two access survey clerks, each working 37.5 hours per week plus whatever time, of their scheduled 37.5 hours per week, the two angler count clerks could devote to interviews.

The following information was recorded for each angler interview: (1) powered or nonpowered boat; (2) fished midstream section only (yes or no); (3) guided or unguided angler; (4) number of hours spent fishing (to the nearest 0.5 hour); (5) number and species of fish retained; (6) number and species of fish released. Additional information regarding the presence of adipose fin clips was also recorded. 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 seven popular boat landings in the downstream section. Two creel survey clerks conducted the interviews at the boat landings. Each clerk was scheduled to work 7.5-hour days on each weekend/holiday day and on 3 randomly selected weekdays each week. Two randomly selected landings were sampled by a clerk on a sample day. Thus on weekend/holidays, four landings were sampled each day, and on weekdays either two or four landings 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 creel survey clerks conducted interviews for about 3.5 hours at each landing. The two landings frequented by guided

anglers were sampled primarily around noon or early evening hours to correspond with the times guides normally end a fishing trip.

Age/Sex Composition

Harvest:

Sampling goals for estimation of age composition of the harvest were 250 harvested fish from each run. 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 scale cards were made on acetate, and scale images were examined using a microfiche reader. If the adipose fin was missing on any observed fish, every attempt was made to secure the head to be later examined for the presence of a coded wire tag by the department's tag lab.

Inriver Return:

In order to estimate the age and sex composition of the inriver return, chinook salmon were captured in large mesh gill nets in the intertidal area using the techniques described by Hammarstrom and Larson (1984). In the past, as part of a tag/recapture project to estimate the inriver return, four crews (eight people) were required to perform the duties in order to insure the number of tagged fish was sufficient. However, in 1993, the inriver return was estimated with sonar and the tag/recapture project was not operated. As a result only two crews of two individuals each were utilized. No tagged fish were released and the sample size required to estimate the age/sex composition was considerably smaller than what was required for the tag/recapture estimate. Sampling was stratified into two 3-week periods during each run with a sampling goal of 125 fish per sample period.

Fish were placed in a tagging cradle, untangled from the gill net and measured. Sex was determined from external characteristics and three scales 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:

In the downstream section during the chinook salmon fishery, the number of angler-hours of effort during fishery component (stratum) t was estimated as follows (Neuhold and Lu 1957):

$$\hat{E}_t = \sum_{j=1}^s H_{tj} \bar{x}_{tj}, \quad (1)$$

where:

\bar{x}_{tj} = the mean number of anglers per count during period j of component t;

H_{tj} = the total number of hours of possible fishing time during period j of component t; and

s = the number of periods (A, B, C, etc.) in component t.

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

$$V(\hat{E}_t) = \sum_{j=1}^s H_{tj}^2 (s_{tj}^2/n_{tj}), \quad (2)$$

where:

$$s_{tj}^2 = \text{the variance of } \bar{x}_{tj}, \text{ and } = \frac{\sum_{o=1}^{n_{tj}} (x_{tjo} - \bar{x}_{tj})^2}{n_{tj} - 1}, \quad (3)$$

n_{tj} = the number of angler counts during period j of component t, and

x_{tjo} = angler count o during period j of component t.

This method assumes a single-stage design with all possible counts within a stratum representing the population to be sampled. The finite population correction factor is not applied as angler counts are considered instantaneous, and so there are an infinite number of counts that can be taken.

Harvest Rates and Catch Rates:

Mean effort and mean harvest per angler were estimated for each stratum using the angler interview data for the component. Only completed-trip interviews were used.

Mean effort per angler during component t was estimated as:

$$\bar{f}_t = \left(\sum_{i=1}^D \sum_{k=1}^{m_i} f_{ik} \right) / \sum_{i=1}^D m_i; \quad (4)$$

where:

f_{ik} = the effort (in hours) by angler k at the time of the interview on day i;

m_i = the number of anglers interviewed on day i ; and

D = the number of days the fishery was open during component t .

A two-stage sample design with days representing the first-stage sample units and anglers the second-stage sample units was used to estimate the variance of mean effort (Von Geldern and Tomlinson 1973). The number of second-stage units available on a given sample day was unknown. The variance of mean effort was estimated as follows (Sukhatme et al. 1984):

$$V(\bar{f}_t) = [1 - (d/D)] s_B^2/d + (\sum_{i=1}^D s_{Wi}^2/m_i)/dD, \quad (5)$$

where:

d = the number of days interviews were conducted during component t ;

s_{Wi}^2 = the sample variance of mean effort per angler for interviews conducted on day i ; and

s_B^2 = the between-day variance of mean effort per angler.

The between-day variance, s_B^2 , was estimated as follows:

$$s_B^2 = [\sum_{i=1}^D (\bar{f}_{ti} - \bar{f}_t)^2]/(d-1), \quad (6)$$

where:

\bar{f}_{ti} = the mean effort per angler during day i of component t .

Mean harvest (or catch) and its variance were estimated identically to mean effort except the corresponding quantities for harvest (or catch) were substituted for all occurrences of effort (f).

Harvest rate (HPUE) during stratum t was estimated by:

$$\hat{HPUE}_t = \bar{c}_t/\bar{f}_t, \quad (7)$$

where:

\bar{c}_t = the mean harvest per angler during component t , obtained by substituting catch for effort in equation 4.

The variance of $HPUE_t$ was approximated by the variance for the quotient of the mean of two random variables (Jessen 1978), which is:

$$\hat{V}(\bar{c}_t/\bar{f}_t) = (\bar{c}_t/\bar{f}_t)^2 (s_c^2/c_t^2 + s_f^2/f_t^2 - 2rs_c s_f/c_t f_t), \quad (8)$$

where:

s_c^2 = the two-stage estimate of variance for \bar{c}_t ;

s_f^2 = the two-stage estimate of variance for \bar{f}_t ; and

r = the correlation coefficient between the f_{ik} and the c_{ik} in component t .

Catch per unit effort (CPUE) and its variance were estimated by replacing the mean and variance of number of fish harvested per angler with the mean and variance of the number of fish caught per angler in equations 7 and 8.

Harvest and Catch:

The harvest during each component was estimated by:

$$\hat{H}_t = \hat{E}_t \hat{HPUE}_t. \quad (9)$$

The variance of \hat{H}_t was estimated using Goodman's (1960) formula for the variance of the product of two independent random variables, which is:

$$V(\hat{H}_t) = [\hat{E}_t^2 V(\hat{HPUE}_t)] + [\hat{HPUE}_t \hat{V}^2(\hat{E}_t)] - [\hat{V}(\hat{E}_t) \hat{V}(\hat{HPUE}_t)]. \quad (10)$$

Totals (for example, the total for unguided anglers during the early run) for effort and harvest were estimated by summing the appropriate component estimates. Estimates of effort and harvest for the components are considered independent estimates, therefore, the variance of the total was estimated by the sum of the appropriate variances.

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;
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:

Proportional age composition of the chinook salmon harvest and inriver return was estimated for each run. Letting p_{ht} equal the estimated proportion of age

group h in component t, the variance of p_{ht} was estimated as (Scheaffer et al. 1979):

$$V(\hat{p}_{ht}) = \frac{\hat{p}_{ht}(1-\hat{p}_{ht})}{(n_t-1)}, \quad (11)$$

where:

n_t-1 = the number of legible scales read from chinook salmon sampled during component t.

It was assumed that there were no significant differences in the ages and lengths of fish harvested by guided and unguided anglers; therefore, biological data from harvests of both angler types were pooled.

RESULTS

Effort

Administrative problems with hiring new survey clerks and some immediate mechanical difficulties effectively delayed the commencement of the creel survey until 22 May, approximately 7 days beyond the planned commencement. Angler counts were conducted on all of the 66 days possible; 35 during the early run and 31 during the late run.

During the early run, angler counts ranged from 11 to 380 for unguided anglers and from 3 to 272 for guided anglers (Appendix A1). The largest count of unguided anglers occurred on 13 June and of guided anglers on 22 June. During the late run, angler counts ranged from 67 to 839 for unguided anglers and from 10 to 562 for guided anglers (Appendix A2). The largest count of unguided anglers occurred on 11 July and of guided anglers on 21 July. Summaries of angler counts are presented in Tables 1 and 2.

The estimated effort in the downstream section during the early run was 123,273 (SE = 3,234) angler-hours (Table 3). This is an increase of nearly 69,000 angler hours (127%) from the 1992 estimate (Hammarstrom 1993) which can be attributed to the strong early run, no additional restrictions, and a regulation liberalization allowing use of bait during the last few days of June. During the early run, 62% of the total effort was by unguided anglers.

In 1990-1992, relatively weak returns resulted in restrictions to the recreational fishery that effectively reduced the harvest upstream of the Soldotna Bridge to an insignificant level, and this area was not surveyed. In 1993 there was more effort in this area than had been noticed in the past, suggesting a fishery similar to what had taken place during the years 1986-1989, which had been surveyed. The particular design that had been prepared for the 1993 fishery failed to achieve sufficient completed-trip angler interviews to produce meaningful estimates of harvest and effort. However, some level of harvest did occur in the upstream area, and in order to account for that harvest it was decided to expand the harvest and effort estimates derived for the downstream section by the average proportion noted in that area of the river upstream of the Soldotna Bridge during the years 1986-1989;

Table 1. Mean counts of boat anglers by period for each of the components of the creel survey of the fishery for early-run chinook salmon in the downstream section of the Kenai River, 1993.

Component	Period ^a				
	A	B	C	D	E
<u>Period 1 (22 May - 31 May)</u>					
Unguided anglers, weekdays:					
Number of counts	2	3	2	2	2
Mean count	35.5	44.3	24.0	45.0	52.5
Standard error	23.5	13.0	13.0	16.0	20.5
Unguided anglers, weekends:					
Number of counts	5	5	3	3	3
Mean count	52.6	93.8	147.3	109.3	81.7
Standard error	22.8	18.4	28.4	41.3	13.3
Guided anglers, all days (May):					
Number of counts	6	8	5	5	5
Mean count	48.3	76.1	60.6	31.4	15.6
Standard error	17.3	9.7	15.0	6.8	5.7
<u>Period 2 (1 June - 14 June)</u>					
Unguided anglers, weekdays:					
Number of counts	3	5	5	4	4
Mean count	80.3	75.4	75	66.8	103.3
Standard error	15.9	18.9	13.1	10.4	10.6
Unguided anglers, weekends:					
Number of counts	4	4	4	4	4
Mean count	102.5	262.8	185.8	163.0	113.8
Standard error	19.5	40.3	30.4	36.6	33.9
Guided anglers, all days:					
Number of counts	10	11			
Mean count	142.9	73.5			
Standard error	12.7	6.5			
<u>Period 3 (14 June - 25 June)</u>					
Unguided anglers, weekdays:					
Number of counts	4	7	5	5	3
Mean count	116.5	122.6	93.4	80.0	68.0
Standard error	29.9	16.4	3.8	10.8	19.0
Unguided anglers, weekends:					
Number of counts	2	2	2	2	2
Mean count	183.5	224.5	191.0	184.0	136.5
Standard error	20.5	4.5	29.0	69.0	51.5
Guided anglers, all days:					
Number of counts	10	9			
Mean count	185.6	83.7			
Standard error	11.6	7.3			

-continued-

Table 1. (Page 2 of 2).

Component	A	B	Period ^a		
			C	D	E
<u>Period 4 (26 May - 30 June)</u>					
Unguided anglers, weekdays:					
Number of counts	1	2	2	2	1
Mean count	115.0	152.0	111.5	152.0	131.0
Standard error		62.0	17.5	30.0	
Unguided anglers, weekends:					
Number of counts	2	2	2	2	2
Mean count	244.0	332.5	369.0	180.0	112.0
Standard error	95.0	33.5	2.0	11.0	11.0
Guided anglers, all days (May):					
Number of counts	4	4			
Mean count	186.3	92.0			
Standard error	6.2	13.5			

a Unguided anglers, all months:

Period A = 0400-0759
 Period B = 0800-1159
 Period C = 1200-1559
 Period D = 1600-1959
 Period E = 2000-2359

Guided anglers:

May: Same as unguided anglers
 June: Period A = 0600-1159
 Period B = 1200-1759

Table 2. Mean counts of boat anglers by period for each of the components of the creel survey of the fishery for late-run chinook salmon in the downstream section of the Kenai River, 1993.

Component	Period ^a				
	A	B	C	D	E
<u>Period 5 (1 July - 16 July)</u>					
Unguided anglers, weekdays:					
Number of counts	7	4	4	7	5
Mean count	247.9	368.3	274.5	237.3	357.8
Standard error	47.2	44.8	46.2	43.2	61.1
Unguided anglers, weekends:					
Number of counts	4	4	4	4	4
Mean count	302.5	548.0	420.5	313.3	312.3
Standard error	74.7	110.7	146.7	36.7	54.1
Guided anglers, all days:					
Number of counts	10	11			
Mean count	336.9	199.6			
Standard error	29.7	28.6			
<u>Period 6 (17 July - 31 July)</u>					
Unguided anglers, weekdays:					
Number of counts	4	3	3	5	4
Mean count	375.5	507.7	407.3	317.0	284.5
Standard error	20.5	118.8	57.0	35.3	27.2
Unguided anglers, weekends:					
Number of counts	5	5	5	5	4
Mean count	436.8	579.6	449.8	382.2	299.0
Standard error	51.9	46.8	21.6	66.1	102.4
Guided anglers, all days:					
Number of counts	8	8			
Mean count	447.6	281.9			
Standard error	25.8	29.6			
<u>Period 7 (1 August - 4 August)</u>					
Unguided anglers, all days:					
Number of counts	3	3	2	2	
Mean count	169.7	161.3	89.0	107.0	
Standard error	41.3	34.7	21.0	0.0	
Guided anglers, all days:					
Number of counts	3	3	2	2	
Mean count	132.7	138.0	47.5	21.5	
Standard error	8.7	17.4	2.5	11.5	

^a Unguided anglers, all months:

July	August
Period A = 0400-0759	0600-0959
Period B = 0800-1159	1000-1359
Period C = 1200-1559	1400-1759
Period D = 1600-1959	1800-2159
Period E = 2000-2359	

Guided anglers:

July:	Period A = 0600-1159
	Period B = 1200-1759
August:	Same as unguided anglers

Table 3. Estimated number of angler-hours of fishing effort by boat anglers during each of the components of the fishery for early-run chinook salmon in the downstream section of the Kenai River, 1993.

Component	Estimated Effort	Standard Error	95% Confidence Interval		Relative Precision
<u>EARLY RUN</u>					
Downstream Section					
Period 1 (22 May - 31 May)					
Unguided weekdays:	3,221	633	1,980	- 4,462	38.5 %
Unguided weekends:	9,195	1,192	6,859	- 11,531	25.4 %
Guided anglers:	8,355	951	6,491	- 10,219	22.3 %
Period 2 (1 June - 14 June)					
Unguided weekdays:	12,824	1,013	10,839	- 14,809	15.5 %
Unguided weekends:	13,244	1,177	10,937	- 15,551	17.4 %
Guided anglers:	15,584	1,029	13,567	- 17,601	12.9 %
Period 3 (15 June - 25 June)					
Unguided weekdays:	15,375	1,302	12,823	- 17,927	16.6 %
Unguided weekends:	7,356	746	5,894	- 8,818	19.9 %
Guided anglers:	16,156	825	14,539	- 17,773	10.0 %
Period 4 (26 June - 30 June)					
Unguided weekdays:	5,385	733	3,948	- 6,822	26.7 %
Unguided weekends:	9,900	816	8,301	- 11,499	16.2 %
Guided anglers:	6,678	357	5,978	- 7,378	10.5 %
Subtotals					
Unguided:	76,500	2,773	71,065	- 81,935	7.1 %
Guided:	46,773	1,665	43,510	- 50,036	7.0 %
Early Run Total	123,273	3,234	116,934	- 129,612	5.1 %
Expansion					
Unsurveyed area:	30,626				
<u>GRAND TOTAL</u>	<u>153,899</u>				

years when estimates were made and the fishery was conducted in a manner similar to 1993, i.e. there were no additional restrictions to the recreational fishery. Thus the downstream estimate was expanded by 30,626 angler-hours (19.9%) to account for the fishery in the unsurveyed area, resulting in a total early-run estimate of 153,899 angler-hours (Table 3).

The estimated effort during the late run was 293,908 (SE = 8,670) angler-hours (Table 4), an increase of 57% from the 1992 fishery (Hammarstrom 1993). The majority of the 1993 effort (69%) was by unguided anglers.

During interviews with completed-trip early-run anglers in the downstream section, a total of 10,943 angler-hours were reported. This represents 8.9% of the effort. During late-run interviews, anglers reported 22,974 angler-hours; 7.8% of the estimated effort.

Harvest Rates and Catch Rates

A total of 7,128 interviews with completed-trip anglers were collected: 2,532 interviews during the early run and 4,596 interviews during the late run (Tables 5 and 6). Interviews were conducted with both guided and unguided completed-trip anglers on each day possible during both the early and late runs.

Daily catch rates of early-run chinook salmon by unguided anglers ranged from 0.000 to 0.171 fish per hour and from 0.035 to 0.667 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 3 June and on 25 June for guided anglers. Daily catch rates of late-run chinook salmon by unguided anglers ranged from 0.008 to 0.129 fish per hour and from 0.024 to 0.154 fish per hour for guided anglers (Appendices B3 and B4). Peak daily catch rates of late chinook salmon by unguided anglers occurred on 8 July and by guided anglers also occurred on 8 July. Estimates of overall harvest rates are 0.0555 for the early run and 0.0520 for the late run. Overall catch rates are 0.0804 for the early run and 0.0669 for the late run (Tables 5 and 6).

Harvest and Catch

An estimated 6,846 (SE = 382) chinook salmon were harvested during the early run in the downstream section (Table 7), 41% by unguided anglers. This estimate was expanded by 881 fish (11.4%) to account for those fish harvested upstream of the Soldotna Bridge during the early run. The estimated catch of early-run chinook salmon in the downstream section was 9,906 (SE = 523). Approximately 31% of the catch was voluntarily released.

An estimated 15,279 (SE = 620) chinook salmon were harvested during the late run (Table 8). Unguided anglers accounted for 49% of the harvest. The estimated catch of chinook salmon in the downstream section was 19,660 (SE = 787). Approximately 22% of the catch was voluntarily released during the late run.

During interviews with completed-trip early-run anglers in the downstream section, a total 561 fish were reported as harvested. This represents 8.2% of the estimated harvest. During late-run interviews, anglers reported a harvest of 1,261 fish, 8.3% of the estimated harvest.

Table 4. Estimated number of angler-hours of fishing effort by boat anglers during each of the components of the fishery for late-run chinook salmon in the downstream section of the Kenai River, 1993.

Component	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
<u>LATE RUN</u>				
Period 5 (1 July - 16 July)				
Unguided weekdays:	59,427	4,377	50,848 - 68,006	14.4 %
Unguided weekends:	30,344	3,342	23,794 - 36,894	21.6 %
Guided anglers:	38,631	2,968	32,814 - 44,448	15.1 %
Period 6 (17 July - 31 July)				
Unguided weekdays:	60,544	4,499	51,726 - 69,362	14.6 %
Unguided weekends:	42,948	2,844	37,374 - 48,522	13.0 %
Guided anglers:	48,147	2,592	43,067 - 53,227	10.6 %
Period 7 (1 August - 4 August)				
Unguided anglers:	8,432	926	6,617 - 10,247	21.5 %
Guided anglers:	5,435	363	4,724 - 6,146	13.1 %
Subtotals:				
Unguided:	201,695	7,715	186,575 - 216,815	7.5 %
Guided:	92,213	3,957	84,457 - 99,969	8.4 %
Late Run Total	293,908	8,670	276,914 - 310,902	5.8 %

Table 5. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of chinook salmon by boat anglers during each component of the fishery for early-run chinook salmon in the downstream section of the Kenai River, 1993.

Component	Time Period ^a	n ^b	N ^c	Number of Interviews ^d	HPUE	Standard Error	CPUE	Standard Error
Unguided weekdays	1	4	4	117	0.0612	0.01908	0.0878	0.02040
Unguided weekends	1	5	5	294	0.0381	0.00496	0.0676	0.00785
Guided all days	1	9	9	216	0.0915	0.00856	0.1162	0.01027
Unguided weekdays	2	8	8	243	0.0516	0.00740	0.0838	0.01259
Unguided weekends	2	4	4	457	0.0253	0.00357	0.0437	0.00511
Guided all days	2	12	12	201	0.0823	0.00817	0.1098	0.01141
Unguided weekdays	3	8	8	260	0.0207	0.00768	0.0342	0.00909
Unguided weekends	3	2	2	175	0.0151	0.00402	0.0151	0.00402
Guided all days	3	10	10	299	0.0599	0.00542	0.0870	0.00726
Unguided weekdays	4	2	2	63	0.0699	0.02721	0.1204	0.03675
Unguided weekends	4	2	2	119	0.0440	0.00865	0.0676	0.01155
Guided all days	4	4	4	88	0.1568	0.02381	0.1954	0.03088
Subtotals:								
Unguided		35	35	1,728	0.0364	0.00374	0.0590	0.00540
Guided		35	35	804	0.0868	0.00660	0.1153	0.00873
Early Run Total		35	35	2,532	0.0555	0.00343	0.0804	0.00474

^a Period

- 1 (22 May - 31 May)
- 2 (1 June - 14 June)
- 3 (15 June - 25 June)
- 3 (26 June - 30 June)

^b Number of days on which interviews were collected.

^c Number of days possible for interviewing.

^d Complete trip interviews only.

Table 6. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of chinook salmon by boat anglers during each component of the fishery for late-run chinook salmon in the downstream section of the Kenai River, 1993.

Component	Time Period ^a	n ^b	N ^c	Number of Interviews ^d	HPUE	Standard Error	CPUE	Standard Error
Unguided weekdays	5	10	10	763	0.0523	0.00363	0.0768	0.00547
Unguided weekends	5	4	4	618	0.0287	0.00309	0.0401	0.00494
Guided all days	5	12	12	709	0.0981	0.00403	0.1198	0.00446
Unguided weekdays	6	8	8	637	0.0327	0.00343	0.0433	0.00395
Unguided weekends	6	5	5	765	0.0296	0.00290	0.0364	0.00335
Guided all days	6	11	11	825	0.0759	0.00339	0.0919	0.00384
Unguided weekdays	7	4	4	153	0.0217	0.00511	0.0260	0.00616
Guided all days	7	4	4	126	0.0776	0.01046	0.0776	0.01046
Subtotals:								
Unguided		31	31	2,936	0.0368	0.00265	0.0505	0.00358
Guided		27	27	1,660	0.0853	0.00586	0.1028	0.00699
Late Run Total		31	31	4,596	0.0520	0.00261	0.0669	0.00333

^a Period:

- 5 (1 July - 16 July)
- 6 (17 July - 31 July)
- 7 (1 August - 4 August)

^b Number of days on which interviews were collected.

^c Number of days possible for interviewing.

^d Complete trip interviews only.

Table 7. Estimated number of chinook salmon harvested and number caught by boat anglers during each component of the fishery for early-run chinook salmon in the downstream section of the Kenai River, 1993.

Component	Harvest ^a	SE	Relative Precision ^b	Catch ^c	SE	Relative Precision ^b
<u>Period 1</u> (22 May - 31 May)						
Unguided weekdays	196	72	71.6 %	283	85	58.9 %
Unguided weekends	350	64	35.9 %	622	108	33.9 %
Guided all days	764	112	28.8 %	971	140	28.2 %
<u>Period 2</u> (1 June - 14 June)						
Unguided weekdays	662	108	32.0 %	1,075	182	33.2 %
Unguided weekends	335	56	32.6 %	579	85	28.7 %
Guided all days	1,283	153	23.3 %	1,711	210	24.1 %
<u>Period 3</u> (15 June - 25 June)						
Unguided weekdays	318	121	74.4 %	526	146	54.5 %
Unguided weekends	111	32	55.6 %	111	32	55.6 %
Guided all days	968	100	20.3 %	1,406	137	19.1 %
<u>Period 4</u> (26 June - 30 June)						
Unguided weekdays	376	154	80.3 %	648	215	65.0 %
Unguided weekends	436	93	41.6 %	669	127	37.1 %
Guided all days	1,047	168	31.5 %	1,305	217	32.7 %
Subtotal:						
Unguided	2,784	268	18.9 %	4,513	379	16.5 %
Guided	4,062	273	13.2 %	5,393	360	13.1 %
Early Run Total	6,846	382	10.9 %	9,906	523	10.4 %
Expansion						
Unsurveyed area	881					
GRAND TOTAL	7,727					

^a Harvest includes only fish kept.

^b Relative precision for 95% confidence interval.

^c Catch includes fish kept and fish reported as released.

Table 8. Estimated number of chinook salmon harvested and number caught by boat anglers during each component of the fishery for late-run chinook salmon in the downstream section of the Kenai River, 1993.

Component	Harvest ^a	Relative		Catch ^c	Relative	
		SE	Precision ^b		SE	Precision ^b
<u>Period 5</u> (1 July - 16 July)						
Unguided weekdays	3,108	314	19.8 %	4,564	467	20.1 %
Unguided weekends	871	134	30.1 %	1,217	201	32.3 %
Guided all days	3,790	330	17.1 %	4,628	395	16.7 %
<u>Period 6</u> (17 July - 31 July)						
Unguided weekdays	1,980	254	25.1 %	2,622	308	23.0 %
Unguided weekends	1,271	150	23.2 %	1,563	113	14.2 %
Guided all days	3,654	256	13.7 %	4,425	302	13.4 %
<u>Period 7</u> (1 August - 4 August)						
Unguided all days	183	47	50.7 %	219	57	51.0 %
Guided all days	422	63	29.4 %	422	63	29.4 %
Subtotal:						
Unguided	7,413	454	12.0 %	10,185	608	11.7 %
Guided	7,866	422	10.5 %	9,475	501	10.4 %
Late Run Total	15,279	620	8.0 %	19,660	787	7.9 %

^a Harvest includes only fish kept.

^b Relative precision for 95% confidence interval.

^c Catch includes fish kept and fish reported as released.

Inriver Return

The inriver return of chinook salmon was estimated using hydroacoustic equipment (sonar). Information regarding the details of this project are presented by Burwen and Skvorc (*In prep a, b*) and the results of the 1993 season are presented by Burwen (*In prep*). Daily counts of chinook salmon-sized targets for 1993 appear in Tables 9 and 10. The inriver return for the early run was 19,921 and for the late run was 49,674.

Biological Data

Recreational Fishery:

A significant difference in age composition of the recreational harvest during time strata 1 and 2 (22 May-14 June) and time strata 3 and 4 (15 June-30 June) was detected ($\chi^2 = 15.09$, $df = 4$, $\alpha = 0.05$, $0.001 < P < 0.005$). The most abundant age group in the early-run harvest of chinook salmon was age 1.4 which composed 71.0% of strata 1 and 2 and 79.0% of strata 3 and 4. The only other age classes of significance represented in the sample were 1.2, 1.3 and 1.5 (Table 11). Age 1.4 was again the most abundant age in the late-run harvest sample, contributing 85.6% to the sample (Table 12). The next largest contributor was age 1.5 (5.8%) followed by 1.3 (5.7%), and 1.2 (1.9%). The mean lengths-at-age for each age/sex were generally greater for late-run fish than for early-run fish (Tables 11 and 12).

Inriver Return:

There was a significant difference in the age/sex composition between the first 3-week stratum and second 3-week stratum during the early run (16 May-7 June, 8 June-30 June) ($\chi^2 = 10.51$, $df = 4$, $\alpha = 0.05$, $0.025 < P < 0.050$). The most abundant age for the early run in the samples collected with gill nets was 1.4, representing 54.7% of the first 3-week stratum and 70.2% of the second 3-week stratum (Table 13). Age 1.3 was the second largest contributor followed by 1.2 and 1.5. There was a significant difference in the age/sex composition between the first 3-week stratum and second 3-week stratum during the late run also (1 July-23 July, 24 June-15 August) ($\chi^2 = 26.83$, $df = 4$, $\alpha = 0.05$, $0.025 < P < 0.050$). The most abundant age for the late run in the samples collected with gill nets was 1.4, representing 64.8% of the 3-week stratum ending 23 July and 82.8% of the last 3-week stratum (Table 14). Age 1.3 was again the second largest contributor to the late run, followed by 1.2 and 1.5.

DISCUSSION

In 1990, 1991 and again in 1992, emergency orders restricting the bag limit to 0 (hook and release fishing), or fish 132 cm or greater (trophy fishing) severely impacted the effort in this fishery (Figures 2 and 3). Success, as measured by number of fish caught in a given period of time, although relatively high, apparently does not satiate the majority of anglers' appetites. Effort declined after the announcement of the emergency orders, regardless of the increased numbers of fish entering the system and the

Table 9. Daily counts of chinook salmon-sized targets during the early run as determined by dual-beam sonar, Kenai River, 1993.

Date	Daily Count	Cumulative Count
16 May	85	85
17 May	91	176
18 May	66	242
19 May	69	311
20 May	165	476
21 May	117	593
22 May	155	748
23 May	141	889
24 May	150	1,039
25 May	168	1,207
26 May	150	1,357
27 May	322	1,679
28 May	488	2,167
29 May	340	2,507
30 May	266	2,773
31 May	185	2,958
1 Jun	389	3,347
2 Jun	324	3,671
3 Jun	255	3,926
4 Jun	276	4,202
5 Jun	327	4,529
6 Jun	198	4,727
7 Jun	297	5,024
8 Jun	378	5,402
9 Jun	453	5,855
10 Jun	549	6,404
11 Jun	600	7,004
12 Jun	951	7,955
13 Jun	812	8,767
14 Jun	406	9,173
15 Jun	617	9,790
16 Jun	567	10,357
17 Jun	606	10,963
18 Jun	425	11,388
19 Jun	504	11,892
20 Jun	621	12,513
21 Jun	399	12,912
22 Jun	608	13,520
23 Jun	720	14,240
24 Jun	808	15,048
25 Jun	1050	16,098
26 Jun	1156	17,254
27 Jun	797	18,051
28 Jun	732	18,783
29 Jun	657	19,440
30 Jun	481	19,921

Table 10. Daily counts of chinook salmon-sized targets during the late run as determined by dual-beam sonar, Kenai River, 1993.

Date	Daily Count	Cumulative Count
1 Jul	539	539
2 Jul	432	971
3 Jul	325	1,296
4 Jul	397	1,693
5 Jul	429	2,122
6 Jul	884	3,006
7 Jul	1,572	4,578
8 Jul	1,855	6,433
9 Jul	1,876	8,309
10 Jul	820	9,129
11 Jul	1,238	10,367
12 Jul	676	11,043
13 Jul	3,345	14,388
14 Jul	3,177	17,565
15 Jul	2,233	19,798
16 Jul	2,329	22,127
17 Jul	2,037	24,164
18 Jul	1,438	25,602
19 Jul	715	26,317
20 Jul	1,348	27,665
21 Jul	981	28,646
22 Jul	1,166	29,812
23 Jul	1,163	30,975
24 Jul	1,344	32,319
25 Jul	2,245	34,564
26 Jul	1,421	35,985
27 Jul	1,952	37,937
28 Jul	1,915	39,852
29 Jul	1,363	41,215
30 Jul	1,628	42,843
31 Jul	862	43,705
1 Aug	767	44,472
2 Aug	613	45,085
3 Aug	337	45,422
4 Aug	463	45,885
5 Aug	711	46,596
6 Aug	1,079	47,675
7 Aug	656	48,331
8 Aug	669	49,000
9 Aug	422	49,422
10 Aug	252	49,674

Table 11. Age composition and mean length-at-age of chinook salmon sampled from the recreational harvest during the fishery for early-run chinook salmon in the Kenai River, 1993.

Sex		Age Group					Total
		1.2	1.3	1.4	1.5	Other	
<u>Stratum: (22 May - 14 June)</u>							
Male	Percent	1.0	11.4	27.6	2.8	0.3	43.1
Female	Percent	2.1	8.6	43.4	2.4	0.3	56.9
Combined	Percent	3.1	20.0	71.0	5.2	0.7	
	SE	1.0	2.4	2.7	1.3	0.5	
Male	Mean Length (mm) ^a	645	788	970	1,102	930	
	SE	26	8	9	42		
	Sample size	3	33	80	8	1	125
Female	Mean Length (mm) ^a	634	805	929	1,025	930	
	SE	33	13	5	5		
	Sample size	6	25	126	7	1	165
<u>Stratum: (15 June - 30 June)</u>							
Male	Percent	3.5	4.5	38.2	4.0	0.5	50.7
Female	Percent	1.5	3.5	40.8	2.0	1.5	49.3
Combined	Percent	5.0	8.0	79.0	6.0	2.0	
	SE	1.6	1.9	2.9	1.7	1.0	
Male	Mean Length (mm) ^a	647	809	1,015	1,047	425	
	SE	18	16	9	15		
	Sample size	7	9	76	8	1	101
Female	Mean Length (mm) ^a	665	818	971	1,056	728	
	SE	28	14	8	29	50	
	Sample size	3	7	81	4	3	98

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

Table 12. Age composition and mean length-at-age of chinook salmon sampled from the recreational harvest during the fishery for late-run chinook salmon in the Kenai River, 1993.

Sex		Age Group					Total
		1.2	1.3	1.4	1.5	Other	
<u>Stratum: (1 July - 4 August)</u>							
Male	Percent	1.5	3.2	35.6	2.9	0.9	44.0
Female	Percent	0.4	2.5	50.1	2.9	0.1	56.0
Combined	Percent	1.9	5.7	85.6	5.8	1.0	
	SE	1.6	1.9	2.9	1.7	1.0	
Male	Mean Length (mm) ^a	664	821	1,044	1,088	785	
	SE	17	16	5	18	70	
	Sample size	10	22	245	20	6	303
Female	Mean Length (mm) ^a	658	812	1,004	1,061	965	
	SE	30	16	3	10		
	Sample size	3	17	345	20	1	386

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

Table 13. Age composition and mean length-at-age of chinook salmon sampled with large mesh gill nets during the fishery for early-run chinook salmon in the Kenai River, 1993.

Sex		Age Group					Total
		1.2	1.3	1.4	1.5	Other	
<u>Stratum: (16 May - 7 June)</u>							
Male	Percent	4.1	23.6	25.7	2.7	2.0	58.1
Female	Percent	0.0	12.2	29.1	0.7	0.0	41.9
Combined	Percent	4.1	35.8	54.7	3.4	2.0	
	SE	1.6	4.0	4.1	1.5	1.2	
Male	Mean Length (mm) ^a	628	771	959	1,122	783	
	SE	23	7	14	63	12	
	Sample size	6	35	38	4	3	86
Female	Mean Length (mm) ^a		770	900	1,030		
	SE		9	8			
	Sample size		18	43	1		62
<u>Stratum: (8 June - 30 June)</u>							
Male	Percent	3.9	12.6	38.1	1.7	0.6	56.9
Female	Percent	0.0	8.8	32.0	2.2	0.0	43.1
Combined	Percent	3.9	21.5	70.2	3.9	0.6	
	SE	1.4	3.1	3.4	1.4	0.6	
Male	Mean Length (mm) ^a	655	793	1,022	1,113	710	
	SE	18	8	10	35		
	Sample size	7	23	69	3	1	103
Female	Mean Length (mm) ^a		817	970	1,068		
	SE		11	9	30		
	Sample size		16	58	4		78

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

Table 14. Age composition and mean length-at-age of chinook salmon sampled with large mesh gill nets during the fishery for late-run chinook salmon in the Kenai River, 1993.

Sex		Age Group					Total
		1.2	1.3	1.4	1.5	Other	
<u>Stratum: (1 July - 23 July)</u>							
Male	Percent	11.6	15.7	31.0	2.8	0.9	62.0
Female	Percent	0.9	1.9	33.8	1.4	0.0	38.0
Combined	Percent	12.5	17.6	64.8	4.2	0.9	
	SE	2.3	2.6	3.3	1.4	0.7	
Male	Mean Length (mm) ^a	677	768	1,026	1,123	873	
	SE	7	7	8	20	63	
	Sample size	25	34	67	6	2	134
Female	Mean Length (mm) ^a	683	873	993	1,043		
	SE	23	35	6	23		
	Sample size	2	4	73	3		82
<u>Stratum: (24 July - 10 August)</u>							
Male	Percent	0.7	6.7	33.6	4.5		45.5
Female	Percent	0.0	1.5	49.3	3.7		54.5
Combined	Percent	0.7	8.2	82.8	8.2		
	SE	0.7	2.4	3.3	2.4		
Male	Mean Length (mm) ^a	680	817	1,025	1,080		
	SE		14	11	32		
	Sample size	1	9	45	6		61
Female	Mean Length (mm) ^a		880	970	1,055		
	SE		10	7	18		
	Sample size		2	66	5		73

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

numbers of fish caught in proportion to the number of angler-hours expended (Hammarstrom 1993). This was not observed in 1993. Daily effort during both runs did not exhibit any dramatic decrease over time and it is assumed to be the result of no additional restrictions required this past season (Figures 5 and 6).

RECOMMENDATIONS

I recommend no significant changes in the creel survey program for the 1994 field season in the downstream section. As long as the regulations remain unchanged, the management objectives are consistent, and no major changes occur in the characteristics of the recreational fishery, the current design is appropriate. However, the creel survey upstream of the Soldotna Bridge should be redesigned if meaningful estimates of harvest and catch in that area are desired. Without a significant increase in manpower, I do not feel that sufficient completed-trip angler interviews can be collected in that area. Although interviews with incomplete anglers would probably introduce a bias, it would probably not be great enough to alter any decisions concerning the status of the stock.

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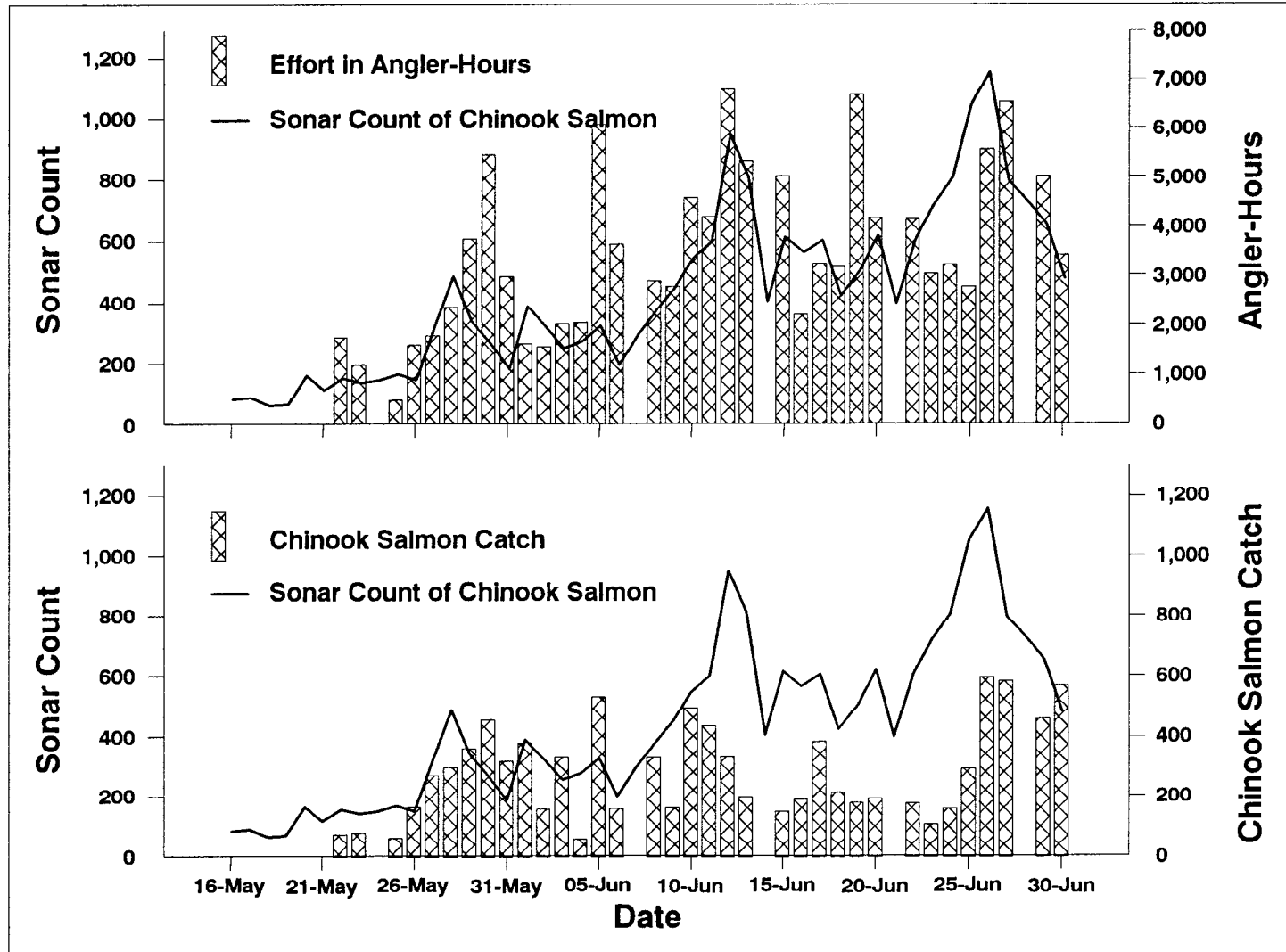


Figure 5. Daily sonar counts of chinook salmon, recreational catch of chinook salmon and angler effort during the early run, Kenai River, 1993.

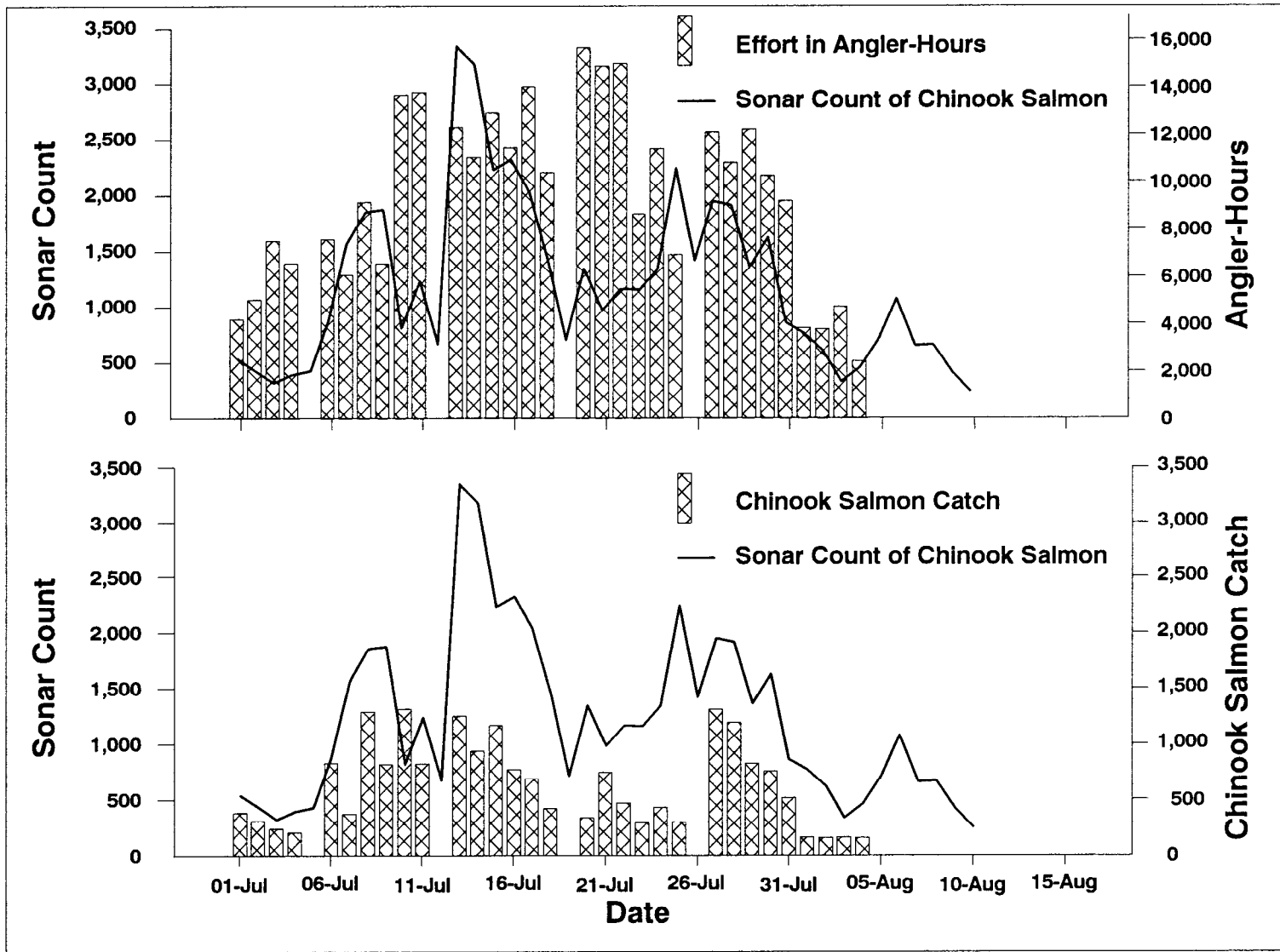


Figure 6. Daily sonar counts of chinook salmon, recreational catch of chinook salmon and angler effort during the late run, Kenai River, 1993.

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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, 1993

Appendix A1. Counts of unguided and guided boat anglers during the fishery for early-run chinook salmon in the downstream section of the Kenai River, 1993.

Date	Wd/ We ^a	Unguided Anglers Period					Guided Anglers Period				
		A	B	C	D	E	A	B	C	D	E
5/22	We	19	40				23	42			
5/23	We	19	70				8	41			
5/24	Wd			CLOSED					CLOSED		
5/25	Wd			11	29	32			33	7	3
5/26	Wd	12	35				53	63			
5/27	Wd		28	37		73		85	21		17
5/28	Wd	59	70		61			78		39	
5/29	We	11	92	123	107	95	12	124	103	38	15
5/30	We	91	142	204	182	95	115	94	68	46	36
5/31	We	123	125	115	39	55	79	82	78	27	7
6/01	Wd		40				79				
6/02	Wd		31	43			93	67			
6/03	Wd			63		74		52			
6/04	Wd	49			75	104		28			
6/05	We	146	196	138	180	116	149	88			
6/06	We	124	240	129	85	29	120	68			
6/07	Wd			CLOSED					CLOSED		
6/08	Wd	91			36	111	182	55			
6/09	Wd	101	79	66	75		143	95			
6/10	Wd		91	82	81		119	86			
6/11	Wd		136	121		124	181	90			
6/12	We	77	235	246	256	195	203	95			
6/13	We	63	380	230	131	115	160	85			
6/14	Wd			CLOSED					CLOSED		
6/15	Wd	186	200				208				
6/16	Wd	123	74		78	50	162	58			
6/17	Wd		97	92	113		147	88			
6/18	Wd		91	81			197	81			
6/19	We	204	229	220	253	188	205	79			
6/20	We	163	220	162	115	85	176	60			
6/21	Wd			CLOSED					CLOSED		
6/22	Wd		151		92		272	86			
6/23	Wd	117	138	99	68	106	161	75			
6/24	Wd	40		103			161	93			
6/25	Wd		107	92	49	48	167	133			
6/26	We ^b	149	299	367	191	101	171	105			
6/27	We ^b	339	366	371	169	123	189	96			
6/28	Wd			CLOSED					CLOSED		
6/29	Wd ^b		214	94	182		184	114			
6/30	Wd ^b	115	90	129	122	131	201	53			

^a Wd = Weekday, We = Weekend

^b The use of bait allowed.

Appendix A2. Counts of unguided and guided boat anglers during the fishery for late-run chinook salmon in the downstream section of the Kenai River, 1993.

Date	Wd/ We ^a	Unguided Anglers Period					Guided Anglers Period				
		A	B	C	D	E	A	B	C	D	E
7/01	Wd	88			102	169	207	101			
7/02	Wd	174		143			234	113			
7/03	We	156	352	175	238	254	225	85			
7/04	We	325	402	271	264	221					
7/05	Wd			CLOSED							
7/06	Wd	220			143	266	387	183			
7/07	Wd				211			117			
7/08	Wd	247	299	278	148	461	277	201			
7/09	Wd	177									
7/10	We	228	599	397	389	465	337	239			
7/11	We	501	839	839	362	309					
7/12	Wd			CLOSED							
7/13	Wd		482	331			388	396			
7/14	Wd		294	346	347		442	284			
7/15	Wd	440			393	492	429	283			
7/16	Wd	389	398		317	401	443	184			
7/17	We	526	490	476	585	555	400	215			
7/18	We	526	683	502	405						
7/19	Wd			CLOSED							
7/20	Wd		745	515	386	299					
7/21	Wd	424					562	450			
7/22	Wd						461				
7/23	Wd			321	367	214		214			
7/24	We	332	503	410	410	343	420	323			
7/25	We	510	704	473	175	67					
7/26	Wd			CLOSED							
7/27	Wd	343		386	359	345	532	322			
7/28	Wd	395	380		198		472	247			
7/29	Wd	340	398				379				
7/30	Wd				275	280		287			
7/31	We	290	518	388	336	231	355	197			
8/01	We ^b	248	219	110	107		118	107	50	10	
8/02	Wd ^b	108	99				132	140			
8/03	Wd ^b	153	166				148	167			
8/04	Wd ^b			68	107				45	33	

^a Wd = Weekday, We = Weekend

^b Fishery extended by emergency order. No restrictions on hours anglers could fish from guided vessels. Fishing day 16 hours (0800-2200 hours).

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, 1993

Appendix B1. Daily sample size (SS), 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 in the downstream section of the Kenai River, 1993 (completed trip interviews only).

Date	Wd/ We ^a	Effort (hours)			Harvest			Catch		
		SS	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
522	We	24	3.3	0.26	0.00	0.000	0.000	0.13	0.069	0.038
523	We	69	4.3	0.24	0.16	0.044	0.037	0.26	0.057	0.060
525	Wd	6	3.7	0.42	0.50	0.224	0.136	0.50	0.224	0.136
526	Wd	17	3.8	0.41	0.18	0.095	0.047	0.24	0.106	0.063
527	Wd	31	4.0	0.31	0.26	0.080	0.065	0.29	0.083	0.073
528	Wd	63	3.2	0.20	0.17	0.048	0.055	0.32	0.067	0.100
529	We	60	3.7	0.24	0.25	0.056	0.067	0.32	0.061	0.085
530	We	75	4.0	0.24	0.12	0.038	0.030	0.27	0.061	0.066
531	We	66	3.8	0.25	0.14	0.043	0.036	0.27	0.067	0.072
601	Wd	10	4.5	0.48	0.20	0.133	0.044	0.40	0.163	0.089
602	Wd	44	3.5	0.13	0.30	0.070	0.084	0.48	0.089	0.135
603	Wd	11	3.2	0.61	0.09	0.091	0.029	0.55	0.282	0.171
604	Wd	17	3.0	0.40	0.00	0.000	0.000	0.00	0.000	0.000
605	We	103	4.1	0.17	0.22	0.041	0.054	0.35	0.053	0.085
606	We	92	4.5	0.21	0.08	0.028	0.017	0.21	0.055	0.046
608	Wd	56	4.1	0.27	0.30	0.062	0.073	0.38	0.070	0.091
609	Wd	46	4.1	0.20	0.04	0.030	0.011	0.15	0.054	0.038
610	Wd	32	3.8	0.24	0.25	0.078	0.066	0.31	0.083	0.083
611	Wd	27	3.9	0.18	0.19	0.076	0.047	0.33	0.107	0.085
612	We	100	4.8	0.28	0.12	0.033	0.025	0.15	0.036	0.031
613	We	162	4.5	0.17	0.06	0.019	0.014	0.12	0.029	0.027
615	Wd	15	3.9	0.23	0.00	0.000	0.000	0.07	0.067	0.017
616	Wd	45	3.2	0.18	0.09	0.043	0.028	0.11	0.047	0.035
617	Wd	27	4.0	0.37	0.11	0.062	0.028	0.22	0.097	0.056
618	Wd	31	4.6	0.18	0.10	0.054	0.021	0.13	0.061	0.028
619	We	96	5.1	0.27	0.10	0.031	0.021	0.10	0.031	0.021
620	We	79	4.8	0.28	0.04	0.022	0.008	0.04	0.022	0.008
622	Wd	60	5.2	0.49	0.10	0.039	0.019	0.18	0.069	0.035
623	Wd	25	4.2	0.24	0.04	0.040	0.009	0.04	0.040	0.009
624	Wd	51	4.1	0.31	0.08	0.038	0.019	0.16	0.051	0.038
625	Wd	6	5.6	3.72	0.33	0.211	0.060	0.33	0.211	0.060
626	We	63	5.5	0.46	0.24	0.054	0.043	0.37	0.076	0.067
627	We	56	4.4	0.26	0.20	0.054	0.045	0.30	0.067	0.069
629	Wd	9	5.9	1.43	0.56	0.176	0.094	0.56	0.176	0.094
630	Wd	54	3.8	0.18	0.24	0.059	0.064	0.48	0.142	0.127

^a Wd = Weekday, We = Weekend.

Appendix B2. Daily sample size (SS), 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 in the downstream section of the Kenai River, 1993 (completed trip interviews only).

Date	Wd/ We ^a	Effort (hours)			Harvest			Catch		
		SS	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
522	We	25	5.2	0.37	0.16	0.075	0.031	0.24	0.087	0.046
523	We	13	4.9	0.29	0.23	0.122	0.047	0.38	0.180	0.078
525	Wd	23	4.3	0.47	0.35	0.102	0.080	0.39	0.104	0.090
526	Wd	20	3.7	0.57	0.40	0.112	0.110	0.45	0.114	0.123
527	Wd	13	2.8	0.32	0.54	0.144	0.189	0.69	0.175	0.243
528	Wd	16	5.2	0.31	0.81	0.101	0.157	0.81	0.101	0.157
529	We	36	5.4	0.35	0.42	0.083	0.078	0.61	0.107	0.114
530	We	40	4.6	0.29	0.43	0.079	0.092	0.55	0.101	0.119
531	We	30	3.5	0.32	0.47	0.093	0.131	0.60	0.113	0.169
601	Wd	6	2.3	0.81	0.83	0.167	0.370	0.83	0.167	0.370
602	Wd	9	5.9	0.63	0.44	0.176	0.075	0.44	0.176	0.075
603	Wd	21	4.8	0.28	0.48	0.112	0.100	0.67	0.105	0.139
604	Wd	18	4.9	0.32	0.33	0.114	0.068	0.72	0.109	0.148
605	We	15	5.9	0.40	0.53	0.133	0.091	0.53	0.133	0.091
606	We	11	5.2	0.42	0.09	0.091	0.018	0.18	0.122	0.035
608	Wd	18	5.5	0.70	0.61	0.118	0.111	0.78	0.101	0.141
609	Wd	19	5.2	0.31	0.42	0.116	0.080	0.42	0.116	0.080
610	Wd	29	5.0	0.30	0.48	0.094	0.097	0.62	0.104	0.125
611	Wd	10	6.2	0.88	0.30	0.153	0.048	0.80	0.490	0.129
612	We	29	4.9	0.41	0.34	0.090	0.071	0.45	0.094	0.092
613	We	16	4.7	0.79	0.25	0.112	0.054	0.31	0.120	0.067
615	Wd	19	4.3	0.22	0.16	0.086	0.037	0.26	0.104	0.061
616	Wd	14	4.8	0.38	0.36	0.133	0.075	0.57	0.173	0.120
617	Wd	28	4.3	0.39	0.64	0.092	0.149	0.89	0.149	0.207
618	Wd	39	5.5	0.23	0.33	0.076	0.060	0.64	0.145	0.116
619	We	46	6.7	0.34	0.28	0.067	0.042	0.30	0.069	0.045
620	We	32	4.4	0.26	0.31	0.083	0.071	0.56	0.127	0.129
622	Wd	33	6.3	0.47	0.30	0.081	0.048	0.33	0.083	0.053
623	Wd	56	5.2	0.23	0.25	0.058	0.048	0.36	0.065	0.069
624	Wd	30	5.1	0.29	0.23	0.079	0.046	0.33	0.088	0.065
625	Wd	2	1.5	0.50	1.00	0.000	0.667	1.00	0.000	0.667
626	We	16	5.4	1.01	0.75	0.112	0.140	1.19	0.209	0.221
627	We	23	4.7	0.32	0.65	0.102	0.139	0.74	0.113	0.157
629	Wd	4	6.0	1.00	0.25	0.250	0.042	0.50	0.289	0.083
630	Wd	45	3.8	0.28	0.73	0.067	0.193	0.84	0.063	0.222

^a Wd = Weekday, We = Weekend.

Appendix B3. Daily sample size (SS), harvest per unit of effort (HPUE), catch per unit of effort (CPUE), and other summary statistics for unguided anglers interviewed during the fishery for late-run chinook salmon in the downstream section of the Kenai River, 1993 (completed trip interviews only).

Date	Wd/ We ^a	Effort (hours)			Harvest			Catch		
		SS	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
701	Wd	42	4.2	0.35	0.24	0.067	0.056	0.29	0.078	0.068
702	Wd	18	4.9	0.55	0.06	0.056	0.011	0.22	0.129	0.045
703	We	155	5.0	0.17	0.04	0.016	0.008	0.06	0.025	0.013
704	We	192	4.9	0.17	0.11	0.023	0.023	0.15	0.026	0.031
706	Wd	84	3.5	0.17	0.35	0.052	0.099	0.42	0.054	0.120
707	Wd	63	4.0	0.17	0.10	0.037	0.024	0.13	0.042	0.032
708	Wd	117	4.8	0.23	0.42	0.046	0.088	0.62	0.072	0.129
709	Wd	105	3.6	0.17	0.22	0.041	0.061	0.38	0.072	0.106
710	We	65	4.4	0.16	0.15	0.045	0.035	0.32	0.082	0.073
711	We	206	5.2	0.17	0.24	0.030	0.047	0.31	0.038	0.059
713	Wd	55	4.6	0.27	0.27	0.061	0.059	0.36	0.075	0.079
714	Wd	88	5.3	0.25	0.16	0.039	0.030	0.28	0.062	0.053
715	Wd	94	4.9	0.19	0.18	0.040	0.037	0.31	0.080	0.063
716	Wd	97	4.7	0.21	0.13	0.035	0.029	0.15	0.037	0.033
717	We	149	4.3	0.15	0.13	0.027	0.030	0.14	0.029	0.033
718	We	248	4.5	0.14	0.14	0.022	0.031	0.18	0.026	0.040
720	Wd	66	8.6	0.50	0.15	0.044	0.018	0.17	0.046	0.019
721	Wd	98	5.2	0.32	0.11	0.032	0.021	0.13	0.034	0.025
722	Wd	29	4.0	0.18	0.07	0.048	0.017	0.10	0.058	0.026
723	Wd	129	5.2	0.29	0.09	0.025	0.017	0.10	0.027	0.020
724	We	152	5.4	0.24	0.12	0.026	0.022	0.13	0.028	0.024
725	We	101	4.6	0.21	0.17	0.037	0.036	0.20	0.040	0.043
727	Wd	122	4.0	0.16	0.25	0.039	0.062	0.34	0.058	0.087
728	Wd	94	4.0	0.23	0.23	0.044	0.058	0.32	0.063	0.080
729	Wd	75	5.1	0.37	0.20	0.046	0.039	0.31	0.057	0.060
730	Wd	24	4.4	0.34	0.17	0.078	0.038	0.17	0.078	0.038
731	We	115	5.3	0.22	0.17	0.035	0.033	0.24	0.047	0.046
801	We	56	4.3	0.20	0.11	0.042	0.025	0.13	0.045	0.029
802	Wd	35	4.3	0.31	0.20	0.069	0.047	0.23	0.083	0.054
803	Wd	28	4.4	0.24	0.00	0.000	0.000	0.04	0.036	0.008
804	Wd	34	5.4	0.30	0.06	0.041	0.011	0.06	0.041	0.011

^a Wd = Weekday, We = Weekend.

Appendix B4. Daily sample size (SS), harvest per unit of effort (HPUE), catch per unit of effort (CPUE), and other summary statistics for guided anglers interviewed during the fishery for late-run chinook salmon in the downstream section of the Kenai River, 1993 (completed trip interviews only).

Date	Wd/ We ^a	Effort (hours)			Harvest			Catch		
		SS	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
701	Wd	38	6.1	0.20	0.68	0.076	0.112	0.68	0.076	0.112
702	Wd	35	5.7	0.16	0.34	0.081	0.060	0.46	0.085	0.080
703	We	57	5.6	0.21	0.25	0.058	0.044	0.46	0.075	0.081
706	Wd	77	5.6	0.19	0.44	0.057	0.079	0.51	0.057	0.090
707	Wd	19	4.8	0.15	0.53	0.118	0.110	0.58	0.116	0.122
708	Wd	56	5.2	0.24	0.79	0.055	0.151	0.80	0.059	0.154
709	Wd	44	5.2	0.21	0.68	0.071	0.131	0.77	0.085	0.148
710	We	36	4.9	0.20	0.64	0.081	0.130	0.72	0.086	0.147
713	Wd	52	5.6	0.17	0.60	0.069	0.107	0.69	0.075	0.124
714	Wd	77	6.2	0.28	0.62	0.056	0.100	0.75	0.072	0.121
715	Wd	100	5.6	0.16	0.55	0.050	0.097	0.75	0.073	0.133
716	Wd	118	5.1	0.16	0.47	0.046	0.094	0.64	0.064	0.127
717	We	93	5.3	0.14	0.40	0.051	0.075	0.46	0.054	0.087
720	Wd	33	6.4	0.40	0.12	0.058	0.019	0.15	0.063	0.024
721	Wd	114	5.7	0.17	0.44	0.047	0.077	0.51	0.053	0.090
722	Wd	32	5.6	0.09	0.16	0.065	0.028	0.22	0.074	0.039
723	Wd	91	5.3	0.15	0.27	0.047	0.052	0.31	0.049	0.058
724	We	70	5.4	0.14	0.27	0.054	0.050	0.30	0.055	0.056
727	Wd	107	5.6	0.18	0.56	0.048	0.100	0.71	0.053	0.126
728	Wd	125	5.2	0.13	0.62	0.043	0.119	0.78	0.062	0.148
729	Wd	59	5.1	0.25	0.27	0.058	0.054	0.37	0.063	0.074
730	Wd	57	5.0	0.18	0.61	0.065	0.124	0.63	0.069	0.127
731	We	44	5.4	0.13	0.23	0.064	0.042	0.39	0.087	0.072
801	We	22	5.6	0.25	0.23	0.091	0.041	0.23	0.091	0.041
802	Wd	22	4.7	0.38	0.32	0.102	0.068	0.32	0.102	0.068
803	Wd	40	4.1	0.28	0.58	0.079	0.140	0.58	0.079	0.140
804	Wd	42	4.8	0.31	0.26	0.069	0.054	0.26	0.069	0.054

^a Wd = Weekday, We = Weekend.

