

Fishery Data Series No. 92-25

**Angler Effort and Harvest of Chinook Salmon
by the Recreational Fisheries in the Lower
Kenai River, 1991**

by

S. L. Hammarstrom

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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 24 May through 4 August 1991. The recreational fishery in this section of the Kenai River is primarily targeting on chinook salmon *Oncorhynchus tshawytscha*. The estimated angler-effort and harvest during the early (May and June) chinook salmon run were 47,599 angler-hours and 891 chinook salmon, respectively. The estimated angler-effort and harvest during the late (July) chinook salmon run were 229,999 angler-hours and 6,849 chinook salmon, respectively. Inseason restrictions to the recreational fisheries were issued for conservation reasons during both runs. Unguided anglers exerted 61.1% of the total effort and took 37.1% of the chinook salmon harvest while guided anglers exerted 38.9% of the effort and harvested 62.9% of the chinook salmon.

Age and sex composition of the recreational harvest and the inriver return, as estimated by sonar, is 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 260,000 angler-days over the years 1983 to 1989 (Mills 1984-1990). This represents approximately 13% 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 the 1990 and 1991 early-run chinook salmon fishery, angler effort has generally been increasing (Figure 2). 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. Historical growth of the fishery is presented graphically in Figures 2 and 3.

The chinook salmon return to the Kenai River has two distinct 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 setnet fishery along the eastern shore of Cook Inlet (McBride et al. 1985). User-group conflicts have required the Department of Fish and Game to manage the salmon resources of the Kenai River with increasing 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.

Previous information pertaining to the chinook salmon fisheries in the Kenai River has been presented by Hammarstrom (1975-1981, 1988-1991), Hammarstrom and Larson (1982-1984, 1986), Hammarstrom et al. (1985), and Conrad and

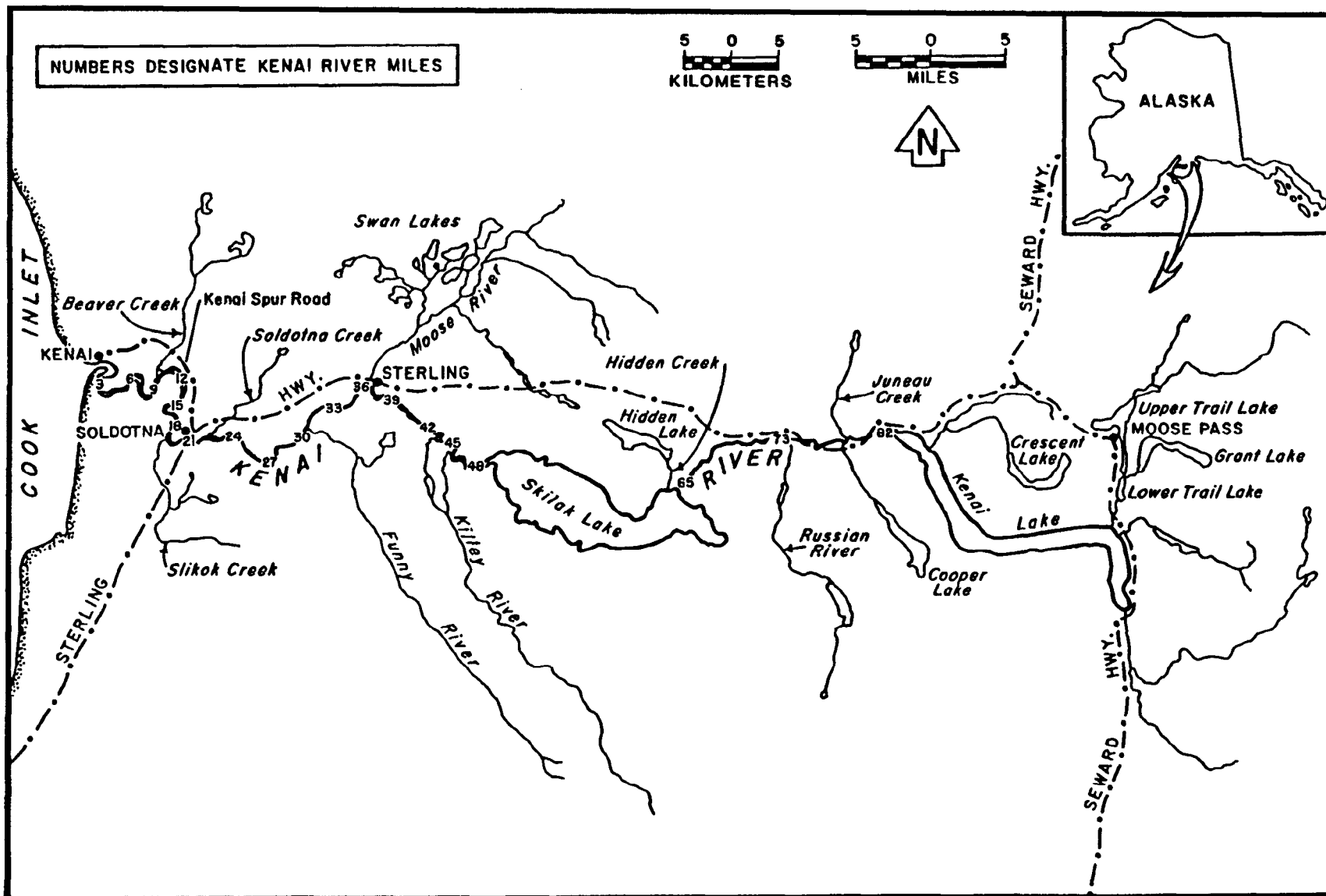


Figure 1. Map of the Kenai River drainage.

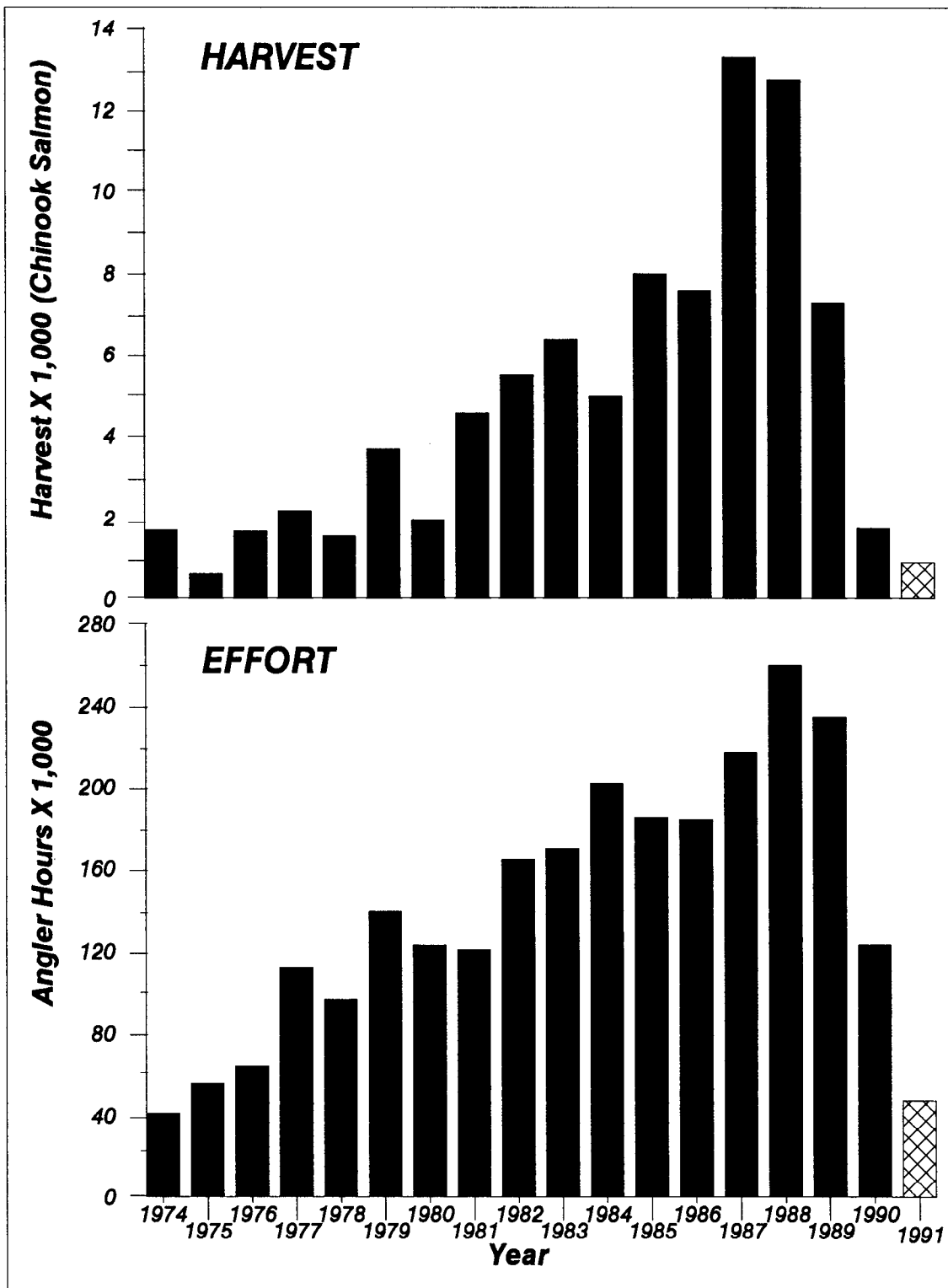


Figure 2. Historical harvest and effort in the recreational fishery for early-run chinook salmon, Kenai River, 1974-1991.

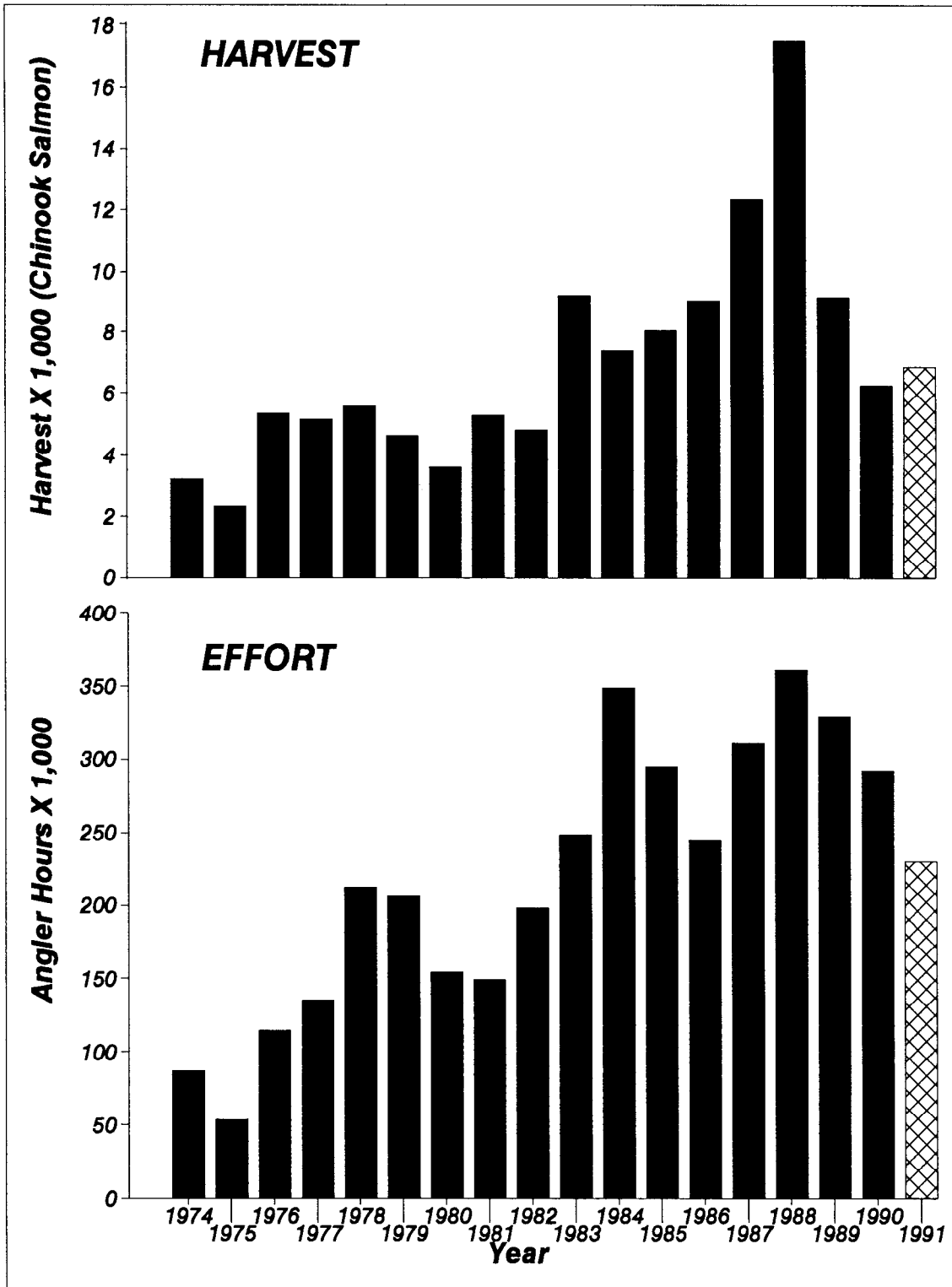


Figure 3. Historical harvest and effort in the recreational fishery for late-run chinook salmon, Kenai River, 1974-1991.

Hammarstrom (1987). In addition, angler-effort and harvest by species for the recreational fishery has been estimated by Mills (1979-1991) 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 of the creel surveys of the recreational fishery for chinook salmon conducted in 1991.

Fishing Regulations

The regulations for the chinook salmon fishery in the Kenai River are the most restrictive of any open waters in Alaska. Only the section of the river between the outlet of Skilak Lake and Cook Inlet (Figure 1) 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 1991, 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 for the remainder of that day. Additionally, the early-run fishery was further restricted in that the use of bait was prohibited until the Department was able to project an escapement of at least 9,000 fish or 1 July, whichever occurred first.

There were 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 was prohibited. In 1991, 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.

The daily bag and possession limits for sockeye and coho salmon were an aggregate of three fish that were 41 cm in length or greater, and there was no annual limit. However, if an escapement of 700,000 sockeye salmon was realized, the daily bag and possession limit for sockeye and coho salmon increased to six, not more than three of which may have been coho salmon. The daily bag and possession limit for pink salmon was six fish that were 41 cm in length or greater, and there was no annual limit. The daily bag and possession limits for rainbow trout were two fish, only one of which may have been over 51 cm (20 in) in length, and there was an annual limit of two fish over 51 cm. The daily bag and possession limits for Dolly Varden were five fish.

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, defined as the mainstem waters downstream of Skilak Lake (Figure 1). During the 1991 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. 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 1991.

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 early-run chinook salmon began 24 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. 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 19 strata; 9 during the early run and 10 during the late run. There were 7 temporal units, 3 during the early run and 4 during the late run, adjusted to correspond to changes in management strategies that altered the fishery. On 6 June, the river was closed to the retention of chinook salmon (hook-and-release fishing only). The river was reopened to retention on 28 June downstream from Slikok Creek and closed to chinook salmon fishing upstream of Slikok Creek (which reopened 16 July).

However, bait was not allowed until 1 July when the late-run fishery began. The use of bait was prohibited on 18 July; this restriction was removed on 26 July. The chinook salmon season was extended on 1 August downstream from Eagle Rock (rm 12.5 or rkm 20) and closed 4 August. 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.

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 four 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 non-powered 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 radio tags was also recorded as part of the project to estimate mortality of chinook salmon attributable to hook-and-release fishing.

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 ended a fishing trip.

Age/Sex Composition

Harvest:

Sampling goals for estimation of age composition of the harvest were 460 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). 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.

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 fish tagged was sufficient. However, in 1992, 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, measured, sex determined from external characteristics, and three scales taken from the preferred area. Fish less than 750 mm were sacrificed in a one-time-only study to positively determine the sex. Scale samples were prepared similarly to those of the recreational harvest samples.

Data Analyses

Angler-effort, harvest and catch rates by species, harvest and catch by species, and associated variances were estimated using the same procedures for guided and non-guided 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.

There were 19 strata in the chinook salmon fishery in the downstream section of the Kenai River, 9 in the early run and 10 in the late run. The early-run strata were: (1) unit 1 (5/24-6/05)-unguided anglers weekdays, (2) unit 1-unguided anglers weekends/holidays, (3) unit 1 (5/24-5/31)-guided anglers, (4) unit 1 (6/01-6/05)-guided anglers, (5) unit 2 (6/06-6/27)-unguided anglers weekdays, (6) unit 2-unguided anglers weekends/holidays, (7) unit 2-guided anglers, (8) unit 3 (6/28-6/30)-unguided anglers, (9) unit 3-guided anglers. The strata to the late run of the downstream section were: (1) unit 4 (7/1-7/17)-unguided anglers weekdays, (2) unit 4-unguided anglers weekends/holidays, (3) unit 4-guided anglers, (4) unit 5 (7/18-7/25)-unguided anglers weekdays, (5) unit 5-unguided anglers weekends/holidays, (6) unit 5-guided anglers, (7) unit 6 (7/26-7/31)-unguided anglers, (8) unit 6-guided anglers, (9) unit 7 (8/01-8/04)-unguided anglers, and (10) unit 7-guided anglers.

Effort:

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

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

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:

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

n_{tj} = the number of angler counts 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:

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 to make the estimates for the chinook salmon fishery in the downstream section.

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):

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

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:

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

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 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 \hat{HPUE}_t was approximated by the variance for the quotient of the mean of two random variables (Jessen 1978), which is:

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

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 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:

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:

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

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.

Assumptions. The major assumptions necessary for these analyses were:

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 π_{θ_v} equal the estimated proportion of age group h in component t, the variance of π_{θ_v} was estimated as (Scheaffer et al. 1979:

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

where:

$n_{Tv}-1$ = the number of legible scales read from chinook salmon sampled during component t.

RESULTS

Effort

As a result of inseason restrictions, the fishery occurred only in the downstream section of the lower Kenai River. Low water levels and lack of

observed recreational activities effectively delayed the commencement of the creel survey until 24 May, approximately 1 week beyond the planned commencement. Because of mechanical and other logistical problems or illness, angler counts were conducted on only 60 of the 64 days possible; 31 of 34 during the early run and 29 of 30 during the late run.

Between one and five angler counts were conducted on each sample day. During the early run, angler counts ranged from 0 to 215 for unguided anglers and from 0 to 259 for guided anglers (Appendix A1). The largest count of unguided anglers occurred on 30 June and of guided anglers on 28 June. During the late run, angler counts ranged from 0 to 680 for unguided anglers and from 0 to 548 for guided anglers (Appendix A2). The largest count of unguided anglers occurred on 28 July and of guided anglers on 23 July.

Mean angler counts for each period by component of the early run appear in Table 1. After retention of chinook salmon was prohibited (6 June), mean angler counts for each period declined except for three; Period E, unguided weekday, Periods C and D, unguided weekends. Mean angler counts increased in all periods for both guided and unguided anglers once retention was permitted (28 June). Corresponding data from the late run appear in Table 2. Of note is the relative lack of participation during the August extension; mean angler counts were the lowest for all late-run periods during this extension.

The estimated effort in the downstream section during the early run was 47,599 (SE = 2,258) angler-hours (Table 3). As happened during 1990, effort declined upon implementation of mandatory catch and release fishing. During the early run, 51% of the total effort was by unguided anglers. The estimated effort during the late run was 229,999 (SE = 6,459) angler-hours (Table 4). The majority of this effort (64%) was by unguided anglers.

Harvest Rates and Catch Rates

A total of 3,201 interviews with completed-trip anglers were collected, 676 interviews during the early run and 2,525 interviews during the late run (Tables 5 and 6). There were 5 days during the early run (16 May-22 May) when no completed-trip anglers reported during the scheduled interview periods/locations.

Daily catch rates of early-run chinook salmon by unguided anglers ranged from 0.000 to 0.338 fish per hour and from 0.000 to 0.500 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 20 June and on 2 June for guided anglers. Daily catch rates of late-run chinook salmon by unguided anglers ranged from 0.000 to 0.128 fish per hour and from 0.004 to 0.117 fish per hour for guided anglers (Appendices B3 and B4). Peak daily catch rates of late chinook salmon by both unguided and guided anglers occurred on 16 July. Estimates of overall harvest and catch rates of chinook salmon for each of the components were higher for guided anglers than for unguided anglers in all components (Tables 5 and 6).

Harvest and Catch

The harvest and catch of chinook salmon by boat anglers were estimated for each run component. Estimated effort and catch rates for each early-run

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, 1991.

Component	Period ^a				
	A	B	C	D	E
Period 1 (24 May - 5 June)					
Unguided anglers, weekdays:					
Number of counts	2	4	4	3	2
Mean count	36.0	43.3	28.8	39.7	11.5
Standard error	21.0	7.7	5.7	5.0	17.6
Unguided anglers, weekends:					
Number of counts	4	4	3	4	4
Mean count	8.0	48.8	38.3	46.5	30.5
Standard error	4.7	12.4	10.1	7.4	7.3
Guided anglers, all days (May):					
Number of counts	3	4	5	4	4
Mean count	25.3	44.3	27.0	22.3	1.0
Standard error	13.5	8.4	4.7	7.1	0.7
Guided anglers, all days (June):					
Number of counts	4	3			
Mean count	120.8	67.3			
Standard error	23.4	18.8			
Period 2 (6 June - 27 June)					
Unguided anglers, weekdays:					
Number of counts	7	7	7	7	5
Mean count	11.1	24.0	20.3	21.1	18.2
Standard error	3.7	4.4	3.2	3.5	4.2
Unguided anglers, weekends:					
Number of counts	4	5	5	2	3
Mean count	12.0	36.6	50.2	51.0	22.7
Standard error	3.5	7.7	15.5	24.0	5.9
Guided anglers, all days:					
Number of counts	15	16			
Mean count	52.6	29.3			
Standard error	5.4	5.1			

-continued-

Table 1. (Page 2 of 2).

Component	Period ^a				
	A	B	C	D	E
Period 3 (28 June - 30 June)					
Unguided anglers, all days:					
Number of counts	2	3	3	3	1
Mean count	43.0	178.7	114.7	130.7	113.0
Standard error	13.0	25.7	28.1	25.8	
Guided anglers, all days:					
Number of counts	3	3			
Mean count	206.3	104.3			
Standard error	44.9	3.5			

^a 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 angler:
 May: Same as unguided angler
 June and July:
 Period A = 0600-1159 hours
 Period B = 1200-1759 hours

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, 1991.

Component	A	B	Period ^a C	D	E
Period 4 (1 July - 17 July)					
Unguided anglers, weekdays:					
Number of counts	4	6	8	5	4
Mean count	162.0	232.5	173.5	203.4	215.0
Standard error	24.7	50.6	30.3	42.2	54.1
Unguided anglers, weekends:					
Number of counts	4	3	3	4	4
Mean count	149.3	343.0	321.0	334.0	281.3
Standard error	55.2	68.9	43.3	53.4	57.6
Guided anglers, all days:					
Number of counts	12	12			
Mean count	337.3	212.9			
Standard error	22.4	26.9			
Period 5 (18 July - 25 July)					
Unguided anglers, weekdays:					
Number of counts	2	3	2	2	2
Mean count	234.5	241.3	212.5	273.5	266.5
Standard error	26.5	12	4.5	17.5	27.5
Unguided anglers, weekends:					
Number of counts	2	2	2	2	2
Mean count	321.0	430.0	566.5	359.5	290.5
Standard error	94.0	64.0	71.5	17.5	40.5
Guided anglers, all days:					
Number of counts	6	6			
Mean count	391.7	263.8			
Standard error	43.3	14.6			

-continued-

Table 2. (Page 2 of 2).

Component	Period ^a				
	A	B	C	D	E
Period 6 (26 July - 31 July)					
Unguided anglers, all days:					
Number of counts	5	4	4	5	4
Mean count	420.2	367.5	361.8	336.8	305.0
Standard error	66.4	92.3	85.2	73.8	34.0
Guided anglers, all days:					
Number of counts	4	4			
Mean count	418.8	187.8			
Standard error	13.1	35.5			
Period 7 (1 Aug - 4 Aug)					
Unguided anglers, all days:					
Number of counts	3	3	3	3	2
Mean count	87.7	90.3	110.0	61.3	83.0
Standard error	2.4	40.8	27.8	17.1	18.0
Guided anglers, all days:					
Number of counts	3	3	3	3	2
Mean count	93.7	81.7	85.0	36.0	12.0
Standard error	13.6	9.2	27.3	13.1	4.0

^a 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 angler:
 July: Period A = 0600-1159 hours
 Period B = 1200-1759 hours
 Aug: Same as unguided angler

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, 1991.

Component	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
EARLY RUN				
Period 1 (24 May - 5 June)				
Unguided weekdays:	4,457	997	2,503 - 6,411	43.8%
Unguided weekends:	3,442	393	2,672 - 4,212	22.4%
Guided anglers (May):	3,835	577	2,704 - 4,966	29.5%
Guided anglers (June):	4,514	719	3,105 - 5,923	31.2%
Period 2 (6 June - 27 June)				
Unguided weekdays:	4,927	446	4,053 - 5,801	17.7%
Unguided weekends:	4,139	729	2,710 - 5,568	34.5%
Guided anglers:	9,338	842	7,688 - 10,988	17.7%
Period 3 (28 June - 30 June)				
Unguided:	7,355	1,002	5,391 - 9,319	26.7%
Guided anglers:	5,592	811	4,002 - 7,182	28.4%
Sub-totals:				
Unguided:	24,320	1,698	20,992 - 27,648	13.7%
Guided:	23,279	1,489	20,361 - 26,197	12.5%
Early Run Total	47,599	2,258	43,173 - 52,025	9.3%

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, 1991.

Component	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
LATE RUN				
Period 4 (1 July - 17 July)				
Unguided weekdays:	35,510	3,375	28,895 - 42,125	18.6%
Unguided weekends:	28,570	2,516	23,639 - 33,501	17.3%
Guided anglers:	39,618	2,520	34,679 - 44,557	12.5%
Period 5 (18 July - 25 July)				
Unguided weekdays:	24,527	1,016	22,536 - 26,518	8.1%
Unguided weekends:	15,740	1,131	13,523 - 17,957	14.1%
Guided anglers:	23,598	1,645	20,374 - 26,822	13.7%
Period 6 (26 July - 31 July)				
Unguided:	36,009	3,273	29,594 - 42,424	17.8%
Guided anglers:	14,556	908	12,776 - 16,336	12.2%
Period 7 (1 Aug - 4 Aug)				
Unguided:	6,937	885	5,202 - 8,672	25.0%
Guided anglers:	4,934	555	3,846 - 6,022	22.0%
Sub-totals:				
Unguided:	147,293	5,615	136,288 - 158,298	7.5%
Guided:	82,706	3,192	76,450 - 88,962	7.6%
Late Run Total	229,999	6,459	217,340 - 242,658	5.5%

Table 5. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) for chinook salmon by boat anglers during each component of the fishery for early-run chinook salmon in the downstream section of the Kenai River, Alaska, 1991.

Component	Time Period ^a	n ^b	N ^c	Number of Interviews ^d	HPUE	Standard Error	CPUE	Standard Error
Unguided weekdays	1	8	8	91	0.0266	0.01389	0.0479	0.01655
Unguided weekends	1	5	5	85	0.0151	0.00922	0.0181	0.00942
Guided all days(May)	1	5	9	48	0.0442	0.01348	0.0763	0.01893
Guided all days (June)	1	4	4	89	0.0491	0.02438	0.0614	0.02450
Unguided weekdays	2	7	13	54	0.0000	0.00000	0.1624	0.04134
Unguided weekends	2	5	6	51	0.0000	0.00000	0.0560	0.03769
Guided all days	2	13	19	83	0.0000	0.00000	0.1559	0.02525
Unguided all days	3	3	3	93	0.0172	0.00696	0.0230	0.00810
Guided all days	3	3	3	82	0.0360	0.01032	0.0382	0.01068
Sub-totals:								
Unguided		28	35	374	0.0123	0.00383	0.0607	0.01270
Guided		25	35	302	0.0255	0.00635	0.0962	0.01477
Early Run Total		28	35	676	0.0187	0.00367	0.0781	0.00969

^a Period

- 1 (23 May-5 June)
- 2 (6 June-27 June)
- 3 (28 June-30 June)

^b Number of days on which interviews were collected.

^c Number of days possible for interviewing.

^d Completed-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, Alaska, 1991.

Component	Time Period ^a	n ^b	N ^c	Number of Interviews ^d	HPUE	Standard Error	CPUE	Standard Error
Unguided weekdays	4	8	9	263	0.0221	0.00466	0.0304	0.00644
Unguided weekends	4	5	5	268	0.0099	0.00272	0.0115	0.00313
Guided all days	4	12	12	356	0.0344	0.00434	0.0445	0.00519
Unguided weekdays	5	5	5	174	0.0134	0.00425	0.0158	0.00471
Unguided weekends	5	2	2	156	0.0188	0.00520	0.0203	0.00543
Guided all days	5	6	6	340	0.0513	0.00479	0.0607	0.00542
Unguided all days	6	5	5	443	0.0332	0.00425	0.0373	0.00444
Guided all days	6	4	4	237	0.0759	0.00656	0.0869	0.00703
Unguided all days	7	4	4	229	0.0140	0.00276	0.0140	0.00276
Guided all days	7	4	4	59	0.0374	0.01264	0.0475	0.01486
Sub-totals:								
Unguided		29	30	1,533	0.0203	0.00221	0.0241	0.00264
Guided		26	26	992	0.0467	0.00377	0.0548	0.00428
Late Run Total		25	26	2,525	0.0298	0.00197	0.0352	0.00230

^a Period:

- 4 (1 July-17 July)
- 5 (18 July-25 July)
- 6 (26 July-31 July)
- 7 (1 Aug-4 Aug)

^b Number of days on which interviews were collected.

^c Number of days possible for interviewing.

^d Completed-trip interviews only.

component from Tables 3 and 5, respectively, were used to estimate harvest and catch during the early run and are presented in Table 7. Estimates for the late run were made for each component from the values presented in Tables 4 and 6; harvest and catch estimates for the late run appear in Table 8.

A total of 891 (SE = 169) fish were harvested during the early run and 6,849 (SE = 410) fish during the late run (Tables 7 and 8). Guided anglers harvested more fish than did unguided anglers during both runs. Because of the prohibition on retention of chinook salmon during the early run, 76% of the catch was released. Only 15% of the catch was released during the late run.

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* 1989 data) and the results of the 1991 season are presented by Burwen and Skvorc (*In prep* 1991 data). Daily counts of chinook salmon sized targets appear in Tables 9 and 10.

Biological Data

Recreational Fishery:

The most abundant age group in the early-run harvest of chinook salmon was age 1.4 which composed 80.9% of the sample. The only other two age classes represented in the sample were 1.3 and 1.5; 8.5% and 10.7%, respectively (Table 11). Age 1.4 was again the most abundant age in the late-run harvest sample, contributing 76.2% to the sample. The next largest contributor was age 1.3 (11.7%), followed by 1.5 (6.3%), 1.2 (4.9%), and 2.3 (0.9%). The mean lengths at age for each age/sex were generally greater for late-run fish than for early-run fish, except early-run males age 1.5 were slightly larger than late-run males of the same age. Age/sex composition of the recreational harvest is summarized in Tables 11 and 12.

Inriver Return:

The most abundant age for each run in the samples collected with gill nets was 1.4, representing 65.2% of the early run and 69.6% of the late run. Age 1.3 was the second largest contributor, 22.4% of the early run and 15.8% of the late run, respectively. Although no representatives of age 1.2 were observed in the early-run harvest sample, 7.3% of the sample of early-run fish taken in the gill nets was age 1.2. This age class represented 7.5% of the late-run sample. Age 1.5 fish composed 5.2% of the early-run sample and 6.5% of the late-run sample. As with the harvest, length at age/sex was generally larger for late-run fish than early-run fish. Age/sex composition of the inriver return is summarized in Tables 13 and 14.

DISCUSSION

In 1990 and again in 1991, an emergency order restricting the fishery to hook-and-release fishing only severely impacts the effort in this fishery. Success, as measured by number of fish caught in a given period of time,

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, Alaska, 1991.

Component	Harvest ^a	SE	Relative Precision ^b	Catch ^c	SE	Relative Precision ^d
Period 1 (23 May - 5 June)						
Unguided weekdays	119	66	108.7%	213	86	79.1%
Unguided weekends	52	32	120.6%	62	33	104.3%
Guided all day (May)	170	57	65.7%	293	84	56.2%
Guided all day (June)	222	114	100.6%	277	118	83.5%
Period 2 (6 June - 27 June)						
Unguided weekdays	0	0		800	215	52.7%
Unguided weekends	0	0		232	159	134.3%
Guided all days	0	0		1,456	269	36.2%
Period 3 (28 June - 30 June)						
Unguided all days	127	54	83.3%	169	63	73.1%
Guided all days	201	64	62.4%	214	67	61.4%
Sub-total:						
Unguided	298	91	59.9%	1,476	290	38.5%
Guided	593	143	47.1%	2,240	313	27.4%
Early Run Total	891	169	37.2%	3,716	426	22.5%

^a Harvest includes only fish kept.

^b Relative precision for 95% confidence interval.

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

^d $\alpha = 0.05$.

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, Alaska, 1991.

Component	Harvest ^a	SE	Relative Precision ^b	Catch ^c	SE	Relative Precision ^d
Period 4 (1 July-17 July)						
Unguided weekdays	785	181	45.2%	1,080	250	45.4%
Unguided weekends	283	81	56.1%	329	94	56.0%
Guided all days	1,363	192	27.6%	1,763	234	26.0%
Period 5 (18 July-25 July)						
Unguided weekdays	329	105	62.6%	388	117	59.1%
Unguided weekends	296	84	55.6%	320	88	53.9%
Guided all days	1,211	141	22.8%	1,432	162	22.2%
Period 6 (26 July-31 July)						
Unguided all days	1,195	187	30.7%	1,343	201	29.3%
Guided all days	1,105	118	20.9%	1,105	118	20.9%
Period 7 (1 Aug-4 Aug)						
Unguided all days	97	23	46.5%	97	23	46.5%
Guided all days	185	65	68.9%	234	30	25.1%
Sub-total:						
Unguided	2,985	305	20.0%	3,557	366	20.1%
Guided	3,864	274	13.9%	4,534	310	13.4%
Late Run Total	6,849	410	11.7%	8,091	479	11.6%

^a Harvest includes only fish kept.

^b Relative precision for 95% confidence interval.

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

^d $\alpha = 0.05$.

Table 9. Daily counts of chinook salmon sized targets during the early run as determined by dual-beam sonar, Kenai River, Alaska, 1991.

Date	Daily Count	Cumulative Count
16 May	30	30
17 May	12	42
18 May	65	107
19 May	55	162
20 May	68	230
21 May	51	281
22 May	111	392
23 May	66	458
24 May	66	524
25 May	57	581
26 May	81	662
27 May	81	743
28 May	78	821
29 May	51	872
30 May	51	923
31 May	69	992
1 Jun	150	1,142
2 Jun	240	1,382
3 Jun	362	1,744
4 Jun	177	1,921
5 Jun	316	2,237
6 Jun	290	2,527
7 Jun	215	2,742
8 Jun	244	2,986
9 Jun	447	3,433
10 Jun	281	3,714
11 Jun	335	4,049
12 Jun	388	4,437
13 Jun	360	4,797
14 Jun	272	5,069
15 Jun	432	5,501
16 Jun	610	6,111
17 Jun	335	6,446
18 Jun	494	6,940
19 Jun	440	7,380
20 Jun	317	7,697
21 Jun	454	8,151
22 Jun	438	8,589
23 Jun	398	8,987
24 Jun	250	9,237
25 Jun	225	9,462
26 Jun	271	9,733
27 Jun	340	10,073
28 Jun	330	10,403
29 Jun	258	10,661
30 Jun	270	10,931

Table 10. Daily counts of chinook salmon sized targets during the late run as determined by dual-beam sonar, Kenai River, Alaska, 1991.

Date	Daily Count	Cumulative Count
1 Jul	267	267
2 Jul	300	567
3 Jul	333	900
4 Jul	519	1,419
5 Jul	316	1,735
6 Jul	240	1,975
7 Jul	186	2,161
8 Jul	139	2,300
9 Jul	393	2,693
10 Jul	481	3,174
11 Jul	403	3,577
12 Jul	330	3,907
13 Jul	308	4,215
14 Jul	572	4,787
15 Jul	542	5,329
16 Jul	1,029	6,358
17 Jul	2,052	8,410
18 Jul	3,114	11,524
19 Jul	1,999	13,523
20 Jul	1,422	14,945
21 Jul	1,030	15,975
22 Jul	1,050	17,025
23 Jul	2,632	19,657
24 Jul	2,204	21,861
25 Jul	1,306	23,167
26 Jul	1,216	24,383
27 Jul	1,195	25,578
28 Jul	1,901	27,479
29 Jul	1,146	28,625
30 Jul	791	29,416
31 Jul	974	30,390
1 Aug	897	31,287
2 Aug	867	32,154
3 Aug	392	32,546
4 Aug	331	32,877
5 Aug	174	33,051
6 Aug	343	33,394
7 Aug	618	34,012
8 Aug	600	34,612

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, Alaska, 1991.

Sex		Age Group				Total
		1.2	1.3	1.4	1.5	
Male	Percent		2.1	27.7	4.3	34.0
Female	Percent		6.4	53.2	6.4	66.0
Combined	Percent		8.5	80.9	10.7	
	SE		4.1	5.8	4.6	
Male	Mean Length (mm) ^a		720	986	1,080	
	SE			23	20	
	Sample size		1	13	2	16
Female	Mean Length (mm) ^a		737	938	1,055	
	SE		26	14	13	
	Sample size		3	25	3	31

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

Table 12. 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, Alaska, 1991.

Sex		Age Group				Total
		1.2	1.3	1.4	1.5	
Male	Percent	7.3	12.9	22.0	2.2	44.4
Female	Percent		9.5	43.1	3.0	55.6
Combined	Percent	7.3	22.4	65.1	5.2	
	SE	1.7	2.7	3.1	1.5	
Male	Mean Length (mm) ^a	640	770	930	1,113	
	SE	8	8	18	19	
	Sample size	17	30	51	5	103
Female	Mean Length (mm) ^a		802	913	1,021	
	SE		10	11	27	
	Sample size		22	100	7	129

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

Table 13. 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, Alaska, 1991.

Sex		Age Group					Total
		1.2	1.3	1.4	1.5	Other	
Male	Percent	3.6	6.8	31.8	3.6	0.9	46.7
Female	Percent	1.3	4.9	44.4	2.7	0.0	53.3
Combined	Percent	4.9	11.7	76.2	6.3	0.9	100.0
	SE	1.5	2.2	2.9	1.6	0.6	
Male	Mean Length (mm) ^a	630	795	1,005	1,076	960	
	SE	27	17	9	31	40	
	Sample size	8	15	71	8	2	104
Female	Mean Length (mm) ^a	637	829	974	1,063		
	SE	28	21	7	37		
	Sample size	3	11	99	6		119

^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, Alaska, 1991.

Sex		Age Group					Total
		1.2	1.3	1.4	1.5	Other	
Male	Percent	7.5	12.1	27.0	2.8	0.6	50.0
Female	Percent	0.0	3.7	42.5	3.7	0.0	50.0
Combined	Percent	7.5	15.8	69.6	6.5	0.6	100.0
	SE	1.5	2.0	2.6	1.4	0.4	
Male	Mean Length (mm) ^a	659	791	999	1,078	873	
	SE	9	9	12	17	13	
	Sample size	24	39	87	9	2	161
Female	Mean Length (mm) ^a		828	970	1,022		
	SE		16	5	21		
	Sample size		12	137	12		161

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

although relatively high, apparently does not satiate the majority of anglers' appetites. Effort declined after the announcement of the emergency order, in spite of the increased numbers of fish entering the system and the numbers of fish caught in proportion to the number of angler-hours expended. Figure 4 graphically presents this data. With no prohibition on retention during the late run, there was not the marked decline in effort, even though the use of bait was not allowed from 18 July through 25 July (Figure 5).

The utility to which these data are put is an accounting of harvest, effort, and catch by run component. While historically negligible, there is a small fishery that occurs in the upstream section (Naptowne Rapids to the outlet of Skilak Lake) which makes total estimates of these fishery statistics by run component biased low. Additionally, the midstream section (Soldotna Bridge to Naptowne Rapids) has also provided a relatively small harvest, the majority of which has come from the early run. It had been planned to conduct a creel survey of the river between the Soldotna Bridge and Skilak Lake during the early run only (Memorial Day through 15 July). However, when the river was restricted to hook-and-release fishing only, effort dropped dramatically with virtually no effort upstream of the Soldotna Bridge. Further, when chinook salmon fishing was prohibited upstream of Slikok Creek through 15 July to protect the remainder of those early-run fish, any harvest of early-run fish in this area was eliminated and thus no survey was conducted upstream of the Soldotna Bridge.

RECOMMENDATIONS

I recommend no significant changes in the creel survey program for the 1992 field season. 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. Further, I would like to go through a season with enough of a fishery upstream of the Soldotna Bridge to adequately evaluate the design changes that have been made for that section of the river.

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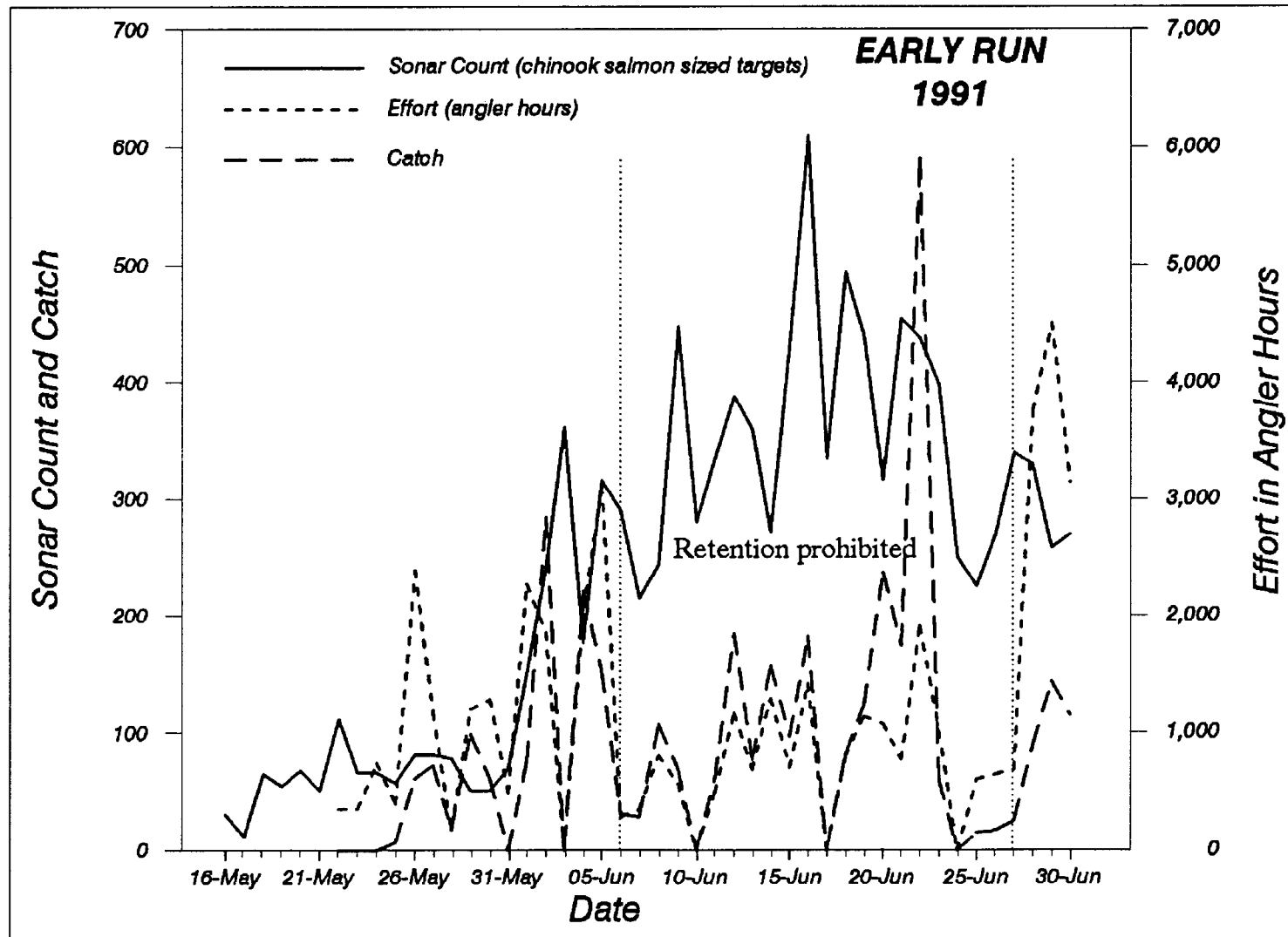


Figure 4. Daily sonar counts of chinook, recreational catch of chinook salmon and angler effort during the early run, Kenai River, Alaska, 1991.

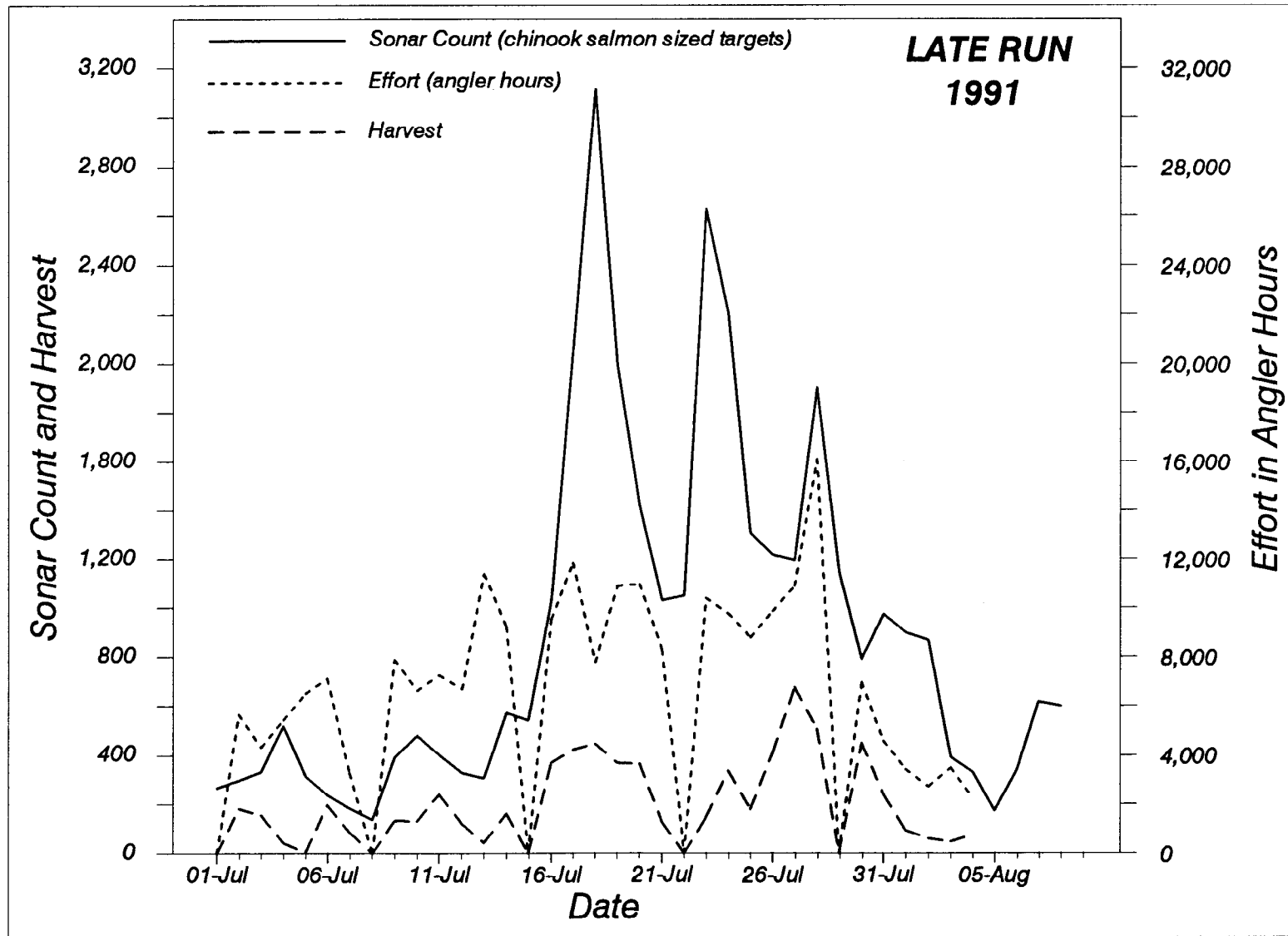


Figure 5. Daily sonar counts of chinook, recreational catch of chinook salmon and angler effort during the late run, Kenai River, Alaska, 1991.

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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, 1991.

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, Alaska, 1991.

Date	Wd/ We ^a	Unguided Anglers Period					Guided Anglers Period				
		A	B	C	D	E	A	B	C	D	E
5/24	Wd			30					12		
5/25	We										
5/26	We	0	41	43	56	21	0	37	30	32	0
5/27	We	14	18	19	29	15	30	24	35	35	3
5/28	Wd				19	4				4	0
5/29	Wd		11	17				60	37		
5/30	Wd	15	26	10			46	56	21		
5/31	Wd				20	19				18	1
6/01	We	18	61		61	43	78	99			
6/02	We	0	75	53	40	43	83	34			
6/03	Wd			CLOSED					CLOSED		
6/04	Wd		53				166				
6/05	Wd	57	83	58	80		156	69			
6/06	Wd ^b	6		2	6		29	9			
6/07	Wd ^b	8				29		0			
6/08	We ^b	10	25	48			34	15			
6/09	We ^b	3	22	32	27	14	18	18			
6/10	Wd			CLOSED					CLOSED		
6/11	Wd ^b										
6/12	Wd ^b	31	20	27	22	18	72	33			
6/13	Wd ^b	2		21			40	36			
6/14	Wd ^b		24	22			76	72			
6/15	We ^b										
6/16	We ^b		40	49			72	46			
6/17	Wd			CLOSED					CLOSED		
6/18	Wd ^b				19	25		39			
6/19	Wd ^b	7	36		15	5	83	65			
6/20	Wd ^b		43	19	35		56	31			
6/21	Wd ^b		15	25			44	36			
6/22	We ^b	18	31	107	75	34	79	13			
6/23	We ^b	17	65	15		20	53	35			
6/24	Wd			CLOSED					CLOSED		
6/25	Wd ^b	7			26	14	60	8			
6/26	Wd ^b	17	20	26	25		46	13			
6/27	Wd ^b		10				27				
6/28	Wd		129	64	119		259	103			
6/29	We	56	192	161	180	113	243	111			
6/30	We	30	215	119	93		117	99			

^a Wd = Weekday, We = Weekend.

^b Closed to the retention of chinook salmon; hook-and-release fishing only.

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, Alaska, 1991.

Date	Wd/ We ^a	Unguided Anglers Period					Guided Anglers Period				
		A	B	C	D	E	A	B	C	D	E
7/01	Wd	Closed					Closed				
7/02	Wd		178	136	159		240	185			
7/03	Wd	125	157	79	66	141	297	91			
7/04	We	58			241	206	254	123			
7/05	Wd		215	182			270	243			
7/06	We	82	243	330	243	182	280	116			
7/07	We						Closed				
7/08	Wd	Closed					Closed				
7/09	Wd		210	110			429	357			
7/10	Wd			136	225		323	201			
7/11	Wd	136				250	366	233			
7/12	Wd	234	155	181	256	117	300	155			
7/13	We	303	311	242	439	301	377	184			
7/14	We	154	475	391	413	436	Closed				
7/15	Wd	Closed					Closed				
7/16	Wd	153		205	311	352	455	276			
7/17	Wd		480	359			457	391			
7/18	Wd ^b		245	217			224	316			
7/19	Wd ^b	261			291	304	420	261			
7/20	We ^b	227	366	495	377	331	384	280			
7/21	We ^b	415	494	638	342	250	Closed				
7/22	Wd ^b	Closed					Closed				
7/23	Wd ^b				256	229	548	211			
7/24	Wd ^b	208	260				424	274			
7/25	Wd ^b		219	208			350	241			
7/26	Wd	368	275	316	494	272	415	183			
7/27	We	336	338	496	590	404	401	286			
7/28	We	680	635	495	371	292	Closed				
7/29	Wd	Closed					Closed				
7/30	Wd	399			173	252	457	164			
7/31	Wd	318	222	140	156		402	118			
8/01	Wd ^c	90					139				
8/02	Wd ^c	89	76		50	65	112	95		62	8
8/03	We ^c	91	167	165	95	101	102	64	51	25	16
8/04	We ^c	83	28	75	39		67	86	65	21	

^a Wd = Weekday, We = Weekend.

^b Closed to the use of bait, artificial lures only.

^c Season extended 4 days by emergency order.

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, 1991

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, Alaska, 1991 (completed-trip interviews only).

Date	Wd/ We ^a	Effort (hours)			Harvest			Catch		
		SS	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
5/23	Wd	6	4.3	0.42	0.00	0.000	0.000	0.00	0.000	0.000
5/24	Wd	4	5.5	1.44	0.00	0.000	0.000	0.00	0.000	0.000
5/25	We	7	4.6	0.28	0.14	0.143	0.031	0.14	0.143	0.031
5/26	We	11	5.3	0.94	0.09	0.091	0.017	0.09	0.091	0.017
5/27	We	10	5.4	0.08	0.00	0.000	0.000	0.00	0.000	0.000
5/28	Wd	4	2.5	0.87	0.25	0.250	0.100	0.25	0.250	0.100
5/29	Wd	3	4.5	0.00	0.33	0.333	0.074	0.33	0.333	0.074
5/30	Wd	13	3.7	0.40	0.00	0.000	0.000	0.23	0.122	0.063
5/31	Wd	5	4.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
6/01	We	33	2.7	0.23	0.06	0.042	0.022	0.09	0.051	0.034
6/02	We	24	4.1	0.31	0.04	0.042	0.010	0.04	0.042	0.010
6/04	Wd	9	4.4	0.39	0.33	0.167	0.075	0.67	0.289	0.150
6/05	Wd	47	4.2	0.27	0.11	0.045	0.026	0.15	0.052	0.036
6/08	We	12	6.0	0.00	0.00	0.000	0.000	0.33	0.142	0.056
6/12	Wd	17	4.5	0.43	0.00	0.000	0.000	0.71	0.187	0.158
6/14	Wd	6	2.5	0.22	0.00	0.000	0.000	0.00	0.000	0.000
6/08	We	18	3.5	0.24	0.00	0.000	0.000	0.17	0.090	0.048
6/15	We	11	4.0	0.53	0.00	0.000	0.000	0.00	0.000	0.000
6/19	Wd	12	4.2	0.50	0.00	0.000	0.000	0.83	0.423	0.200
6/20	Wd	9	4.3	0.57	0.00	0.000	0.000	1.44	0.626	0.338
6/21	Wd	3	3.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
6/22	We	4	4.0	0.00	0.00	0.000	0.000	1.25	0.750	0.313
6/23	We	6	6.3	0.42	0.00	0.000	0.000	0.17	0.167	0.026
6/26	Wd	2	3.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
6/27	Wd	5	4.2	0.49	0.00	0.000	0.000	0.00	0.000	0.000
6/28	Wd	28	2.7	0.17	0.07	0.050	0.026	0.07	0.050	0.026
6/29	We	41	4.1	0.26	0.07	0.041	0.018	0.10	0.047	0.024
6/30	We	24	4.3	0.31	0.04	0.042	0.010	0.08	0.058	0.019

^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, Alaska, 1991 (completed-trip interviews only).

Date	Wd/ We ^a	Effort (hours)			Harvest			Catch		
		SS	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
5/25	We	2	3.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
5/26	We	20	5.1	0.19	0.10	0.069	0.020	0.25	0.099	0.049
5/27	We	12	5.0	0.21	0.25	0.131	0.050	0.50	0.261	0.099
5/28	Wd	10	5.6	0.07	0.60	0.163	0.107	0.80	0.200	0.143
5/31	Wd	4	6.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
6/01	We	39	5.8	0.34	0.21	0.066	0.035	0.21	0.066	0.035
6/02	We	2	1.0	0.00	0.50	0.500	0.500	0.50	0.500	0.500
6/04	Wd	11	5.7	0.08	0.36	0.152	0.064	0.55	0.157	0.096
6/05	Wd	37	5.3	0.19	0.30	0.076	0.056	0.41	0.082	0.076
6/08	We	16	3.3	0.50	0.00	0.000	0.000	1.00	0.183	0.308
6/12	Wd	6	6.7	1.69	0.00	0.000	0.000	1.17	0.167	0.175
6/13	Wd	8	6.8	0.09	0.00	0.000	0.000	1.00	0.267	0.148
6/15	We	2	2.0	0.00	0.00	0.000	0.000	0.50	0.500	0.250
6/16	We	6	4.0	0.89	0.00	0.000	0.000	1.17	0.654	0.292
6/18	Wd	7	5.0	0.00	0.00	0.000	0.000	0.57	0.297	0.114
6/19	Wd	11	5.6	0.27	0.00	0.000	0.000	0.55	0.282	0.097
6/20	Wd	3	6.0	0.00	0.00	0.000	0.000	0.33	0.333	0.056
6/21	Wd	3	3.5	0.00	0.00	0.000	0.000	1.67	0.882	0.476
6/23	We	9	5.2	0.22	0.00	0.000	0.000	0.56	0.176	0.108
6/24	Wd	2	10.0	0.00	0.00	0.000	0.000	0.50	0.500	0.050
6/26	Wd	3	5.0	0.00	0.00	0.000	0.000	0.33	0.333	0.067
6/27	Wd	7	5.1	0.40	0.00	0.000	0.000	0.43	0.202	0.083
6/28	Wd	45	5.8	0.06	0.13	0.051	0.023	0.13	0.051	0.023
6/29	We	21	5.0	0.32	0.19	0.088	0.038	0.24	0.095	0.047
6/30	We	16	4.9	0.50	0.38	0.125	0.076	0.38	0.125	0.076

^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, Alaska, 1991 (completed-trip interviews only).

Date	Wd/ We ^a	Effort (hours)			Harvest			Catch		
		SS	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
7/02	Wd	31	4.3	0.47	0.10	0.054	0.023	0.16	0.067	0.067
7/03	Wd	29	3.6	0.19	0.03	0.034	0.010	0.03	0.034	0.034
7/04	We	31	4.3	0.22	0.00	0.000	0.000	0.03	0.032	0.032
7/06	We	71	5.2	0.30	0.01	0.014	0.003	0.03	0.020	0.020
7/07	We	31	3.6	0.28	0.10	0.054	0.027	0.10	0.054	0.054
7/09	Wd	35	4.7	0.53	0.20	0.069	0.043	0.20	0.069	0.069
7/10	Wd	17	4.6	0.52	0.06	0.059	0.013	0.06	0.059	0.059
7/11	Wd	32	3.6	0.17	0.03	0.031	0.009	0.03	0.031	0.031
7/12	Wd	54	3.9	0.18	0.04	0.026	0.009	0.04	0.026	0.026
7/13	We	29	5.0	0.39	0.00	0.000	0.000	0.00	0.000	0.000
7/14	We	106	4.3	0.19	0.08	0.026	0.018	0.08	0.026	0.026
7/16	Wd	28	5.7	0.33	0.11	0.060	0.019	0.36	0.128	0.128
7/17	Wd	37	3.3	0.40	0.16	0.061	0.049	0.16	0.061	0.061
7/18	Wd	28	3.7	0.45	0.14	0.067	0.039	0.14	0.067	0.067
7/19	Wd	46	5.6	0.34	0.02	0.022	0.004	0.02	0.022	0.022
7/20	We	68	3.8	0.24	0.09	0.035	0.023	0.10	0.037	0.037
7/21	We	88	4.9	0.26	0.08	0.029	0.016	0.08	0.029	0.029
7/23	Wd	24	5.7	0.71	0.04	0.042	0.007	0.04	0.042	0.042
7/24	Wd	41	4.1	0.42	0.12	0.052	0.030	0.17	0.069	0.069
7/25	Wd	35	4.4	0.18	0.00	0.000	0.000	0.00	0.000	0.000
7/26	Wd	55	4.5	0.29	0.15	0.048	0.032	0.15	0.048	0.048
7/27	We	74	3.5	0.18	0.18	0.045	0.050	0.18	0.045	0.045
7/28	We	165	4.3	0.12	0.14	0.027	0.032	0.18	0.035	0.035
7/30	Wd	100	5.4	0.28	0.16	0.037	0.030	0.17	0.040	0.040
7/31	Wd	49	4.7	0.24	0.12	0.047	0.026	0.12	0.047	0.047
8/01	Wd	20	3.8	0.25	0.00	0.000	0.000	0.00	0.000	0.000
8/02	Wd	45	4.3	0.18	0.04	0.031	0.010	0.04	0.031	0.031
8/03	We	53	5.0	0.44	0.02	0.019	0.004	0.02	0.019	0.019
8/04	We	111	4.2	0.20	0.10	0.028	0.023	0.10	0.028	0.028

^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, Alaska, 1991 (completed-trip interviews only).

Date	Wd/ We ^a	Effort (hours)			Harvest			Catch		
		SS	Mean	SE	Mean	SE	HPUE	Mean	SE	CPUE
7/02	Wd	13	5.2	0.30	0.23	0.122	0.044	0.31	0.133	0.059
7/03	Wd	14	4.9	0.42	0.29	0.125	0.058	0.29	0.125	0.058
7/04	We	22	4.8	0.23	0.09	0.063	0.019	0.09	0.063	0.019
7/05	Wd	8	4.3	0.37	0.00	0.000	0.000	0.13	0.125	0.029
7/06	We	35	5.2	0.46	0.40	0.084	0.077	0.40	0.084	0.077
7/09	Wd	46	5.8	0.04	0.00	0.000	0.000	0.02	0.022	0.004
7/10	Wd	39	5.5	0.36	0.15	0.059	0.028	0.23	0.078	0.042
7/11	Wd	43	5.2	0.22	0.30	0.071	0.058	0.35	0.074	0.067
7/12	Wd	58	5.4	0.17	0.17	0.050	0.032	0.21	0.054	0.038
7/13	We	29	5.4	0.13	0.07	0.048	0.013	0.07	0.048	0.013
7/16	Wd	31	4.7	0.28	0.29	0.083	0.062	0.55	0.112	0.117
7/17	Wd	18	5.9	0.56	0.11	0.076	0.019	0.17	0.090	0.028
7/18	Wd	34	5.3	0.07	0.44	0.086	0.084	0.44	0.086	0.084
7/19	Wd	53	5.4	0.11	0.45	0.069	0.083	0.47	0.069	0.087
7/20	We	82	5.6	0.19	0.29	0.051	0.052	0.35	0.072	0.063
7/23	Wd	64	6.7	0.39	0.16	0.046	0.023	0.17	0.048	0.025
7/24	Wd	56	5.3	0.20	0.21	0.055	0.041	0.36	0.069	0.068
7/25	Wd	51	5.4	0.31	0.27	0.063	0.051	0.33	0.072	0.062
7/26	Wd	53	6.4	0.28	0.38	0.067	0.059	0.55	0.083	0.086
7/27	We	82	5.0	0.16	0.41	0.055	0.083	0.48	0.058	0.095
7/30	Wd	58	5.1	0.22	0.48	0.066	0.095	0.48	0.066	0.095
7/31	Wd	44	5.3	0.13	0.34	0.072	0.065	0.34	0.072	0.065
8/01	Wd	13	6.0	0.64	0.38	0.140	0.064	0.54	0.183	0.090
8/02	Wd	7	4.7	0.10	0.14	0.143	0.030	0.29	0.184	0.061
8/03	We	7	4.6	0.30	0.14	0.143	0.031	0.14	0.143	0.031
8/04	We	32	4.7	0.19	0.13	0.059	0.026	0.13	0.059	0.026

^a Wd = Weekday, We = Weekend.

