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ANGLER-EFFORT AND HARVEST OF CHINOOK SALMON AND COHO SALMON BY THE RECREATIONAL FISHERIES IN THE LOWER KENAI RIVER, 1988[1]

By

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ABSTRACT

A creel survey was conducted on the Kenai River between the outlet of Skilak Lake and Cook Inlet from 17 May through 30 September 1988. The recreational fishery in this section of the Kenai River is directed primarily for two species, chinook salmon *Oncorhynchus tshawytscha* during June and July, and coho salmon *Oncorhynchus kisutch* during August and September. The estimated angler-effort and harvest during the early (May and June) chinook salmon run were 259,901 angler-hours and 12,747 chinook salmon, respectively. The estimated angler-effort and harvest during the late (July) chinook salmon run were 361,759 angler-hours and 17,512 chinook salmon, respectively. Unguided anglers exerted 72.1 percent of the total effort and took 47.5 percent of the chinook salmon harvest while guided anglers exerted 27.9 percent of the effort and harvested 52.5 percent of the chinook salmon.

The estimated angler-effort and harvest during the coho salmon fishery (August and September) were 312,811 angler-hours and 38,175 coho salmon, respectively. Unguided anglers exerted 82.6 percent of the total effort and took 78.4 percent of the coho salmon harvest while guided anglers exerted 17.4 percent of the effort and harvested 21.6 percent of the coho salmon.

Harvest and catch estimates for sockeye salmon *Oncorhynchus nerka*, rainbow trout *Oncorhynchus mykiss*, and Dolly Varden char *Salvelinus malma* are presented, also.

KEY WORDS: Kenai River, chinook salmon, coho salmon, creel survey, effort, harvest.

INTRODUCTION

The largest freshwater recreational fishery in Alaska occurs in the Kenai River which received an average of nearly 270,000 angler-days of effort over the years 1983-1987 (Mills 1984-1988). 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, and a second fishery directed primarily at returning coho salmon *O. kisutch* during August and September. Angler-effort in both fisheries has generally been increasing since creel surveys for these fisheries were begun in 1977 (Figure 2). Sockeye salmon *O. nerka*, pink salmon *O. gorbuscha*, Dolly Varden char *Salvelinus malma*, and rainbow trout *O. mykiss* are also harvested by anglers in the Kenai River.

Prior to 1970, the recreational fishery in the Kenai River was confined to shore-based 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 very effective for chinook salmon on the Kenai River and the fishery began to expand rapidly.

The chinook salmon return to the Kenai River has two distinct components: (1) an early run which typically enters the river from mid-May until late June, and (2) 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 lb) and may exceed 36 kg (80 lb). The world record sport-caught chinook salmon was taken from the Kenai River in 1985; it weighed 44.1 kg (97 lb). The separation date between the early run and late run varies annually and is determined by inspecting graphs of daily sonar counts, daily catch per unit effort (CPUE) for recreational anglers, and daily CPUE for drift gill nets used in a chinook salmon mark-recapture study. There is usually a low point on the two CPUE curves that is used to separate the runs. The two runs are not discrete units, however, as the number of early-run fish entering the Kenai River declines, the number of late-run fish increases. The degree of overlap is not estimated at this time.

The coho salmon return to the Kenai River also has two distinct components: an early run which typically peaks in August, and a late run which typically peaks in September. The late run continues to enter the river into November but fishing effort after September is minimal.

Management of these recreational fisheries in the Kenai River is complicated by the relatively large commercial harvests of returning chinook and coho salmon. Chinook salmon are harvested primarily by the set net fishery along the eastern shore of Cook Inlet (McBride et al. 1985), and coho salmon are harvested primarily by the drift gill net fishery. User-group conflicts have

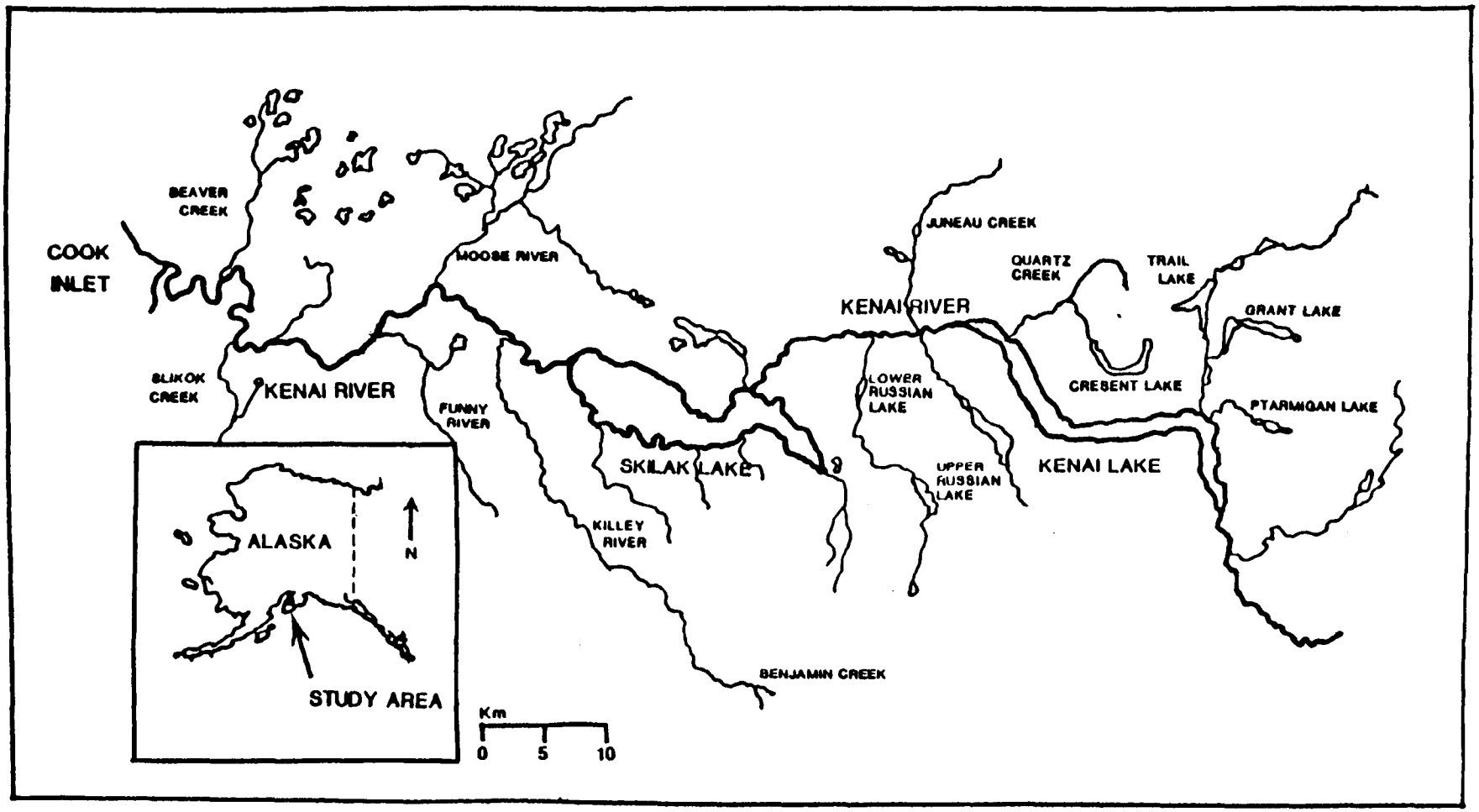

Figure 1. Schematic diagram of the Kenai River drainage.

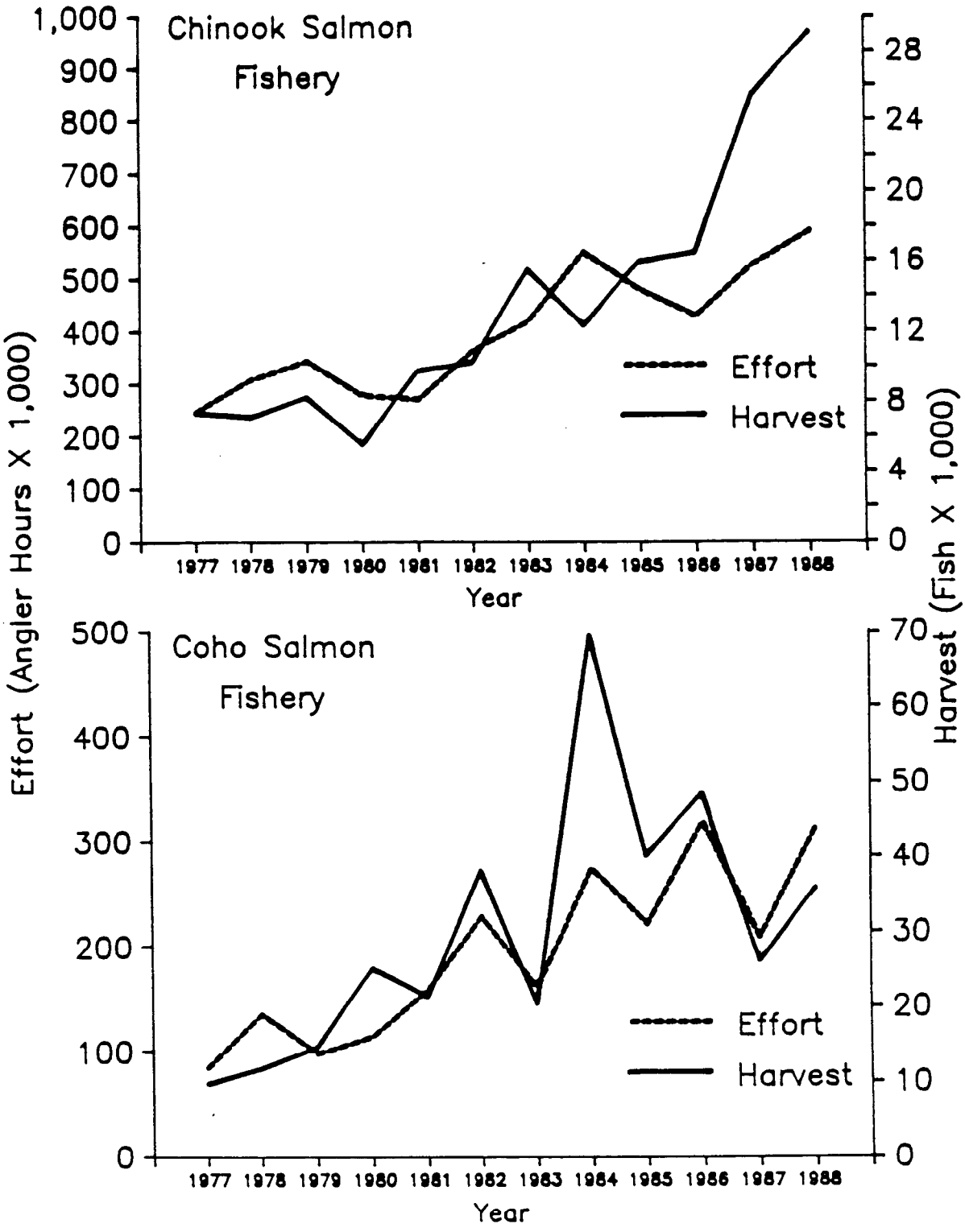

Figure 2. Creel survey estimates of effort and harvest by the recreational fisheries for chinook and coho salmon in the Kenai River, 1977-1988.

necessitated that the Department of Fish and Game conduct increasingly precise management of the salmon resources of the Kenai River. During the winter of 1988, the Alaska Board of Fisheries adopted formal management plans for both the early and late chinook salmon runs. These plans present escapement goals and probable actions taken in the respective fisheries to achieve the stated goals.

The extreme popularity of the fishery resources of the Kenai River has increased the emphasis on habitat protection in the river. In 1984, the Alaska State Legislature created the Kenai River Special Management Area, which placed the water column and State lands adjacent to the Kenai River into the State park system under the direction of the Department of Natural Resources, Division of Parks and Outdoor Recreation.

Previous information pertaining to the chinook and coho salmon fisheries in the Kenai River has been presented by Hammarstrom (1975-1981, 1988), Hammarstrom 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 have been estimated by Mills (1979-1988) in the Alaska Statewide 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, are evaluated to refine long-term management objectives, and are used by the Alaska Board of Fisheries to allocate the salmon resources. The objective of this report is to present detailed information from the creel surveys of the recreational fisheries for chinook salmon and coho salmon conducted in 1988.

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 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 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 1988, 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 is 41 cm in length or greater is prohibited from fishing from a boat in the Kenai River for the remainder of that day.

There are further restrictions for guided anglers. In addition to the closure to fishing from boats on Mondays, fishing from a registered guide vessel on any Sunday in July is prohibited. In 1988, fishing from a guided boat was allowed only between 0600 and 1800 hours during June and between 0700 and 1900 hours during July. There are no days or hours closed to boat fishing for either unguided or guided anglers during the remainder of the year.

The daily bag and possession limits for other salmon species are an aggregate of three fish that are 41 cm in length or greater, and there is no annual limit. The daily bag and possession limits for rainbow trout are two fish, only one of which may be over 51 cm (20 in) in length, and there is an annual limit of two fish over 51 cm. The daily bag and possession limits for Dolly Varden char are five fish.

METHODS

A roving creel survey (Neuhold and Lu 1957) was used to estimate sport fishing effort, in units of angler-hours, by the fisheries for chinook and coho salmon in the Kenai River. Harvest per unit effort (HPUE, number of fish harvested per hour fished) for each species was estimated from angler interviews. Harvest of each species was estimated by the product of the effort and harvest rate estimates. Angler-effort was estimated for three sections of the Kenai River below Skilak Lake (Figure 3): (1) downstream, from Cook Inlet (river mile 0) to the Soldotna Bridge (rm 21); (2) midstream, from the Soldotna bridge to Naptowne Rapids (rm 39.5); and (3) upstream, from Naptowne Rapids to the outlet of Skilak Lake (rm 50). These stratifications were selected because of the distance involved and effort patterns observed over the years. Effort and harvest were estimated separately for the early and late run components of the fisheries for chinook and coho salmon.

Both unguided and guided anglers participate in the fisheries for chinook and coho salmon in the Kenai River. These two groups have very different harvest rates; therefore, effort, HPUE, and harvest were estimated separately for unguided anglers and guided anglers. Guided anglers fish strictly from boats and are easily recognized because guides are required to display a large identifying decal on their boats. Only boat anglers were surveyed during the chinook salmon fishery because shore anglers harvest very few chinook salmon. During the coho salmon fishery, both boat and shore anglers were surveyed.

Creel Survey of the Chinook Salmon Fishery

The creel surveys of the chinook salmon fishery began on 17 May in the downstream section and on 3 June in the upstream section and continued until the end of the chinook salmon season on 31 July. 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). The periods were: A, from 0400 to 0759; B, from 0800 to 1159; C, from 1200 to 1559; D, from 1600 to 1959; and E, from 2000 to 2359. In May, the stratification of the fishing day for guided anglers was the same as that for unguided anglers. Since most guides schedule two trips per day, one in the morning and one in the afternoon, the fishing day of guided anglers in June and July was stratified into only two periods: A, from 0600 to 1159 in June and from 0700 to 1259 in July; and B, from 1200 to 1759 in June and from 1300 to 1859 in July.

In the downstream section, estimates for unguided anglers during each run were stratified into two temporal units; Early run, unit 1 (17 May-5 June),

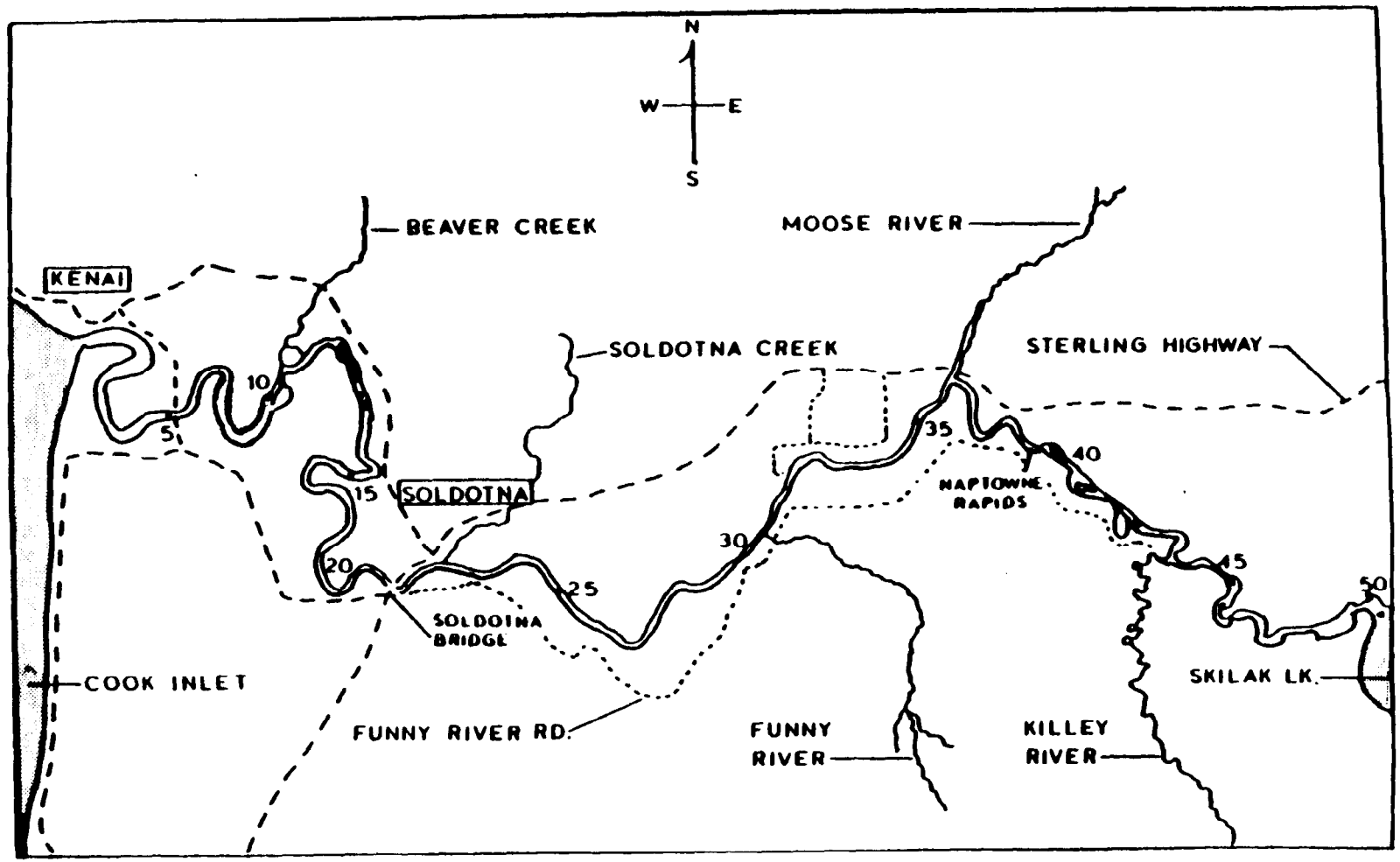

Figure 3. The lower Kenai River between Cook Inlet and the outlet of Skilak Lake.

unit 2 (6 June-26 June), Late run, unit 3 (27 June-10 July) and unit 4 (11 July-31 July). Because of the regulation limiting the guided angler to a 12 hour fishing day in June, the temporal units for the early run for guided anglers were 17 May-31 May and 1 June-26 June. Temporal units during the late run were identical for both guided and unguided anglers. Estimates for unguided anglers were stratified further by weekdays and weekends/holidays. Estimates for guided anglers were not similarly stratified because this does not significantly reduce the variance of the effort estimates (Conrad and Hammarstrom 1987).

Angler Counts:

A modification of a stratified random sample design was used to conduct angler counts. The modification incorporated a sample design into that of a simple stratified random sample. The purpose of the design was to ensure that angler counts were never conducted in two consecutive periods during the same day or in the same period on two consecutive days for the weekday component of the survey of unguided anglers. This modification was designed to minimize the autocorrelation between counts. Some deviation from the schedule did occur because of mechanical breakdown and/or other duties such as public assistance or enforcement activities.

Separate sampling schedules were established for the downstream and upstream sections of the river. Sampling levels were determined by the amount of creel survey clerk time available. The creel survey in the downstream section was designed for two creel survey clerks, each working 37.5 hours per week. The creel survey in the upstream section was designed for one creel survey clerk working 37.5 hours per week.

Counts of anglers were conducted from a boat in the downstream and upstream sections of the Kenai River. At the time designated on the schedule, a creel survey clerk was at a randomly selected end of the section of the river to be surveyed. 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 were considered to be engaged in fishing and were counted if they were 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.

Downstream Section. There were two possible sampling patterns for the counts of unguided anglers during weekdays (Figure 4), one of which was randomly selected each week. Within a period (A, B, C, etc.) to be sampled, a starting time for the angler count was randomly selected from the four whole-hour times (for example, 0400, 0500, 0600, or 0700 for period A) in the period.

DAY	PERIOD A	B	C	D	E
TUE	0400 0500 0600 0700		1200 1300 1400 1500		2000 2100 2200 2300
WED		0800 0900 1000 1100		1600 1700 1800 1900	
THU	0400 0500 0600 0700		1200 1300 1400 1500		2000 2100 2200 2300
FRI		0800 0900 1000 1100		1600 1700 1800 1900	
TUE		0800 0900 1000 1100		1600 1700 1800 1900	
WED	0400 0500 0600 0700		1200 1300 1400 1500		2000 2100 2200 2300
THU		0800 0900 1000 1100		1600 1700 1800 1900	
FRI	0400 0500 0600 0700		1200 1300 1400 1500		2000 2100 2200 2300

Figure 4. The two possible lattice sampling patterns for counts of unguided anglers during weekdays of the Kenai River chinook salmon fishery, 1988.

For unguided anglers during weekend/holidays, an angler count was made during each period of each day. During weekend/holidays, a starting time was randomly selected for the count in period A and counts in all subsequent periods began 4 hours after the starting time of the previous count. This modification was designed to minimize the autocorrelation between angler counts conducted on the same day.

During May, guided and unguided anglers were counted according to the same schedule. During June and July, one count of guided anglers was made during each of the two daily periods defined for guided anglers on each day the fishery was open to guided anglers. The count schedule for guided anglers was established by overlaying the schedule for unguided anglers and randomly selecting a count time for those periods of the guided angler day when a count of unguided anglers was not being conducted.

Upstream Section. Angler counts were scheduled for each weekend/holiday day and on 3 randomly selected weekdays each week in the upstream section. On a sample day, two periods (A, B, C, etc.) were randomly selected without replacement and a starting time for the angler count designated as described for the creel survey of unguided anglers during weekdays in the downstream section.

Midstream Section. Three aerial surveys of the river between Skilak Lake and Cook Inlet were scheduled each week, one on a weekend and two during weekdays. During the flight, a count of each boat actively engaged in fishing was recorded for each section of the river. The boats counts were used to estimate the proportion of fishing effort occurring in the midstream section of the river.

Angler Interviews:

Interviews of anglers for harvest and catch rate information were conducted primarily at seven popular boat landings in the downstream section, two landings in the upstream section, and two landings in the midstream section. Information gathered in 1987 (Conrad and Hammarstrom 1988) showed no significant difference between anglers using the seven campgrounds and other areas, thus only those seven sites were sampled.

Two creel survey clerks conducted the interviews at the boat landings. Each clerk was scheduled to work 5 days each week, on each weekend/holiday day and on 3 randomly selected weekdays. 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) or a late shift (possible start times: 1500, 1530, 1600, or 1630). 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. When the clerks responsible for angler counts were not conducting a count, they contacted completed-trip anglers who were docking at one of the seven locations not being sampled by other clerks.

In the midstream section, completed-trip anglers were interviewed at two locations, one frequented by guides and one used primarily by unguided anglers. In the upstream section, incomplete-trip angler interviews were conducted at one private launch site and one public site.

The following information was recorded for each angler interviewed: (1) completed-trip or incomplete trip angler; (2) guided or unguided angler; (3) number of hours spent fishing; (4) number and species of fish retained; (5) number and species of fish released; and (6) docking location. Additional information regarding the presence of tags was also recorded as part of the recovery effort in the project to estimate the escapement of chinook salmon into the Kenai River (Hammarstrom in preparation).

Chinook salmon observed in anglers' creels during the surveys were randomly selected for biological sampling. Mid-eye to fork-of-tail length was measured to the nearest 1/2 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.

Creel Survey of the Coho Salmon Fishery

The coho salmon creel survey began on 1 August and ended on 30 September in both the downstream and upstream sections of the river. The survey was conducted similarly to the creel survey of the chinook salmon fishery in the upstream section with the following exceptions. The fishing day was reduced to 16 hours in August (from 0600 to 2200) and 12 hours in September (from 0800 to 2000) to account for the decreased number of daylight hours. Daily time strata were adjusted for the coho salmon fishery by eliminating period E in August and shifting the starting time of period A to 0600, and in September eliminating period D and shifting the starting time of period A to 0800. The fishing day was the same for both unguided and guided anglers during the creel survey of the coho salmon fishery. The weekday and weekend/holiday stratification was used for both unguided and guided anglers, also. Shore anglers as well as boat anglers were interviewed during the coho salmon creel survey and both completed-trip and incomplete trip anglers were interviewed.

Angler Counts:

Separate angler count schedules were established for the downstream and upstream sections of the river. Sampling levels were determined by the amount of creel survey clerk time available. Both creel surveys were designed for one creel survey clerk working 37.5 hours per week.

Angler counts were scheduled for each weekend/holiday day and on 3 randomly selected weekdays each week in both the downstream and upstream sections. Two angler counts were scheduled on each sample day. Sample periods and count times were selected as described for the creel survey of the chinook salmon fishery in the upstream section.

Angler counts were conducted following the procedures described for the counts during the chinook salmon fishery. One exception was that guides were included in the count of guided anglers as they are permitted to fish after 31 July. Shore anglers were considered a separate stratum in the downstream section but combined with unguided boat anglers in the upstream section.

Effort in the midstream section of the river was estimated using the same procedure as during the chinook salmon fishery, however, shore anglers were also counted.

Angler Interviews:

During August and September both shore and boat anglers were interviewed by the creel survey clerks. All interviews were done by the survey clerks conducting the angler counts; there were no clerks stationed at boat landings as during the creel survey of the chinook salmon fishery. The same information was recorded for each angler interviewed as during the chinook salmon creel survey, except that both completed and incomplete angler trips were included and the docking location was not recorded.

Biological samples for coho salmon (scales, sex, and length) were collected identically to those for the chinook salmon survey.

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 the downstream and upstream sections of the chinook and coho salmon fisheries. 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 12 components to the chinook salmon fishery in the downstream section of the Kenai River, six in the early run and six in the late run. The early run components were: (1) unit 1--unguided anglers weekdays; (2) unit 1--unguided anglers weekends/holidays; (3) unit 2--unguided anglers weekdays; (4) unit 2--unguided anglers weekends/holidays; (5) guided anglers in May; and (6) guided anglers in June. Effort for guided anglers had to be estimated separately for May and June because of the change in the length of the guided angler day from 20 hours to 12 hours on 1 June. The components to the late run of the downstream section were: (1) unit 3--unguided anglers weekdays; (2) unit 3--unguided anglers weekends/holidays; (3) unit 3--guided anglers; (4) unit 4--unguided anglers weekdays; (5) unit 4--unguided anglers weekends/holidays; and (6) unit 4--guided anglers.

There were seven components to the chinook salmon fishery in the upstream section of the Kenai River, four in the early run and three in the late run. The early run components were: (1) unguided anglers weekdays; (2) unguided anglers weekends/holidays; (3) guided anglers in June; and (4) guided anglers in July. Effort for guided anglers had to be estimated separately for June and July because of the change in the starting time of the guided angler day from 0600 to 0700 on 1 July. The components to the late run of the upstream

section were: (1) unguided anglers weekday; (2) unguided anglers weekends; and (3) guided anglers.

There were 12 fishery components in the downstream section and eight in the upstream section during the coho salmon fishery. The early (August 1-August 31) and late run (September 1-September 30) in each section had the same components: (1) unguided anglers weekdays; (2) unguided anglers weekends/holidays; (3) guided anglers weekdays; (4) guided anglers weekends/holidays; (5) shore anglers weekdays; and (6) shore anglers weekends/holidays. The shore angler component was combined with the unguided component in the upstream section during both runs.

Effort:

The number of angler-hours of effort during fishery component t was estimated as follows (Neuhold and Lu 1957):

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

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):

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

where:

s_{tj}^2 = the variance of $\bar{x}_{tj}$, and

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

The finite population correction factor is not applied as angler counts are considered instantaneous.

Harvest Rates:

Mean effort and mean harvest by species per angler were estimated for each component 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 and midstream section; both completed-trip and incomplete-trip interviews were used to make the estimates for the chinook salmon fishery in the upstream section and the entire coho salmon fishery.

Mean effort per angler during component t was estimated as:

$$\bar{f}_t = \left(\sum_{i=1}^{D} \sum_{k=1}^{m_i} f_{ik}\right) / \sum_{i=1}^{D} m_i, \qquad [3]$$

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):

$$V(\bar{f}_t) = [1 - (d/D)]\ s_B^2/d + \left(\sum_{i=1}^{D} s_{Wi}^2/m_i\right)/dD, \qquad [4]$$

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:

$$s_B^2 = \left[\sum_{i=1}^{D} (\bar{f}_{ti} - \bar{f}_t)^2\right]/(d-1), \qquad [5]$$

where:

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

Mean harvest (or catch) of a species 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) for a species during component t was estimated by:

$$HPUE_t = \bar{c}_t/\bar{f}_t, \qquad [6]$$

where:

$\bar{c}_t$ = the mean harvest of the species per angler during component t.

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

$$\hat{V}(\bar{c}_t/\bar{f}_t) \approx (\bar{c}_t/\bar{f}_t)^2(s_c^2/\bar{c}_t^2 + s_f^2/\bar{f}_t^2 - 2rs_cs_f/\bar{c}_t\bar{f}_t), \qquad [7]$$

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) for a species 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 6 and 7.

Harvest:

The harvest of a species during each component was estimated by:

$$\hat{H}_t = \hat{E}_t HPUE_t. \qquad [8]$$

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:

$$\hat{V}(\hat{H}_t) = [\hat{E}_t^2\, V(HPUE_t)] + [HPUE_t^2\, \hat{V}(\hat{E}_t)] - [\hat{V}(\hat{E}_t)\, V(HPUE_t)]. \qquad [9]$$

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.

Catch of a species and its variance were estimated by replacing HPUE with CPUE in equations 8 and 9.

Assumptions:

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. For the coho salmon creel survey, incomplete trip angler interviews provide an unbiased estimate of completed-trip HPUE and CPUE (DiConstanzo 1956).

4. Anglers are interviewed in proportion to their abundance on day i (DiConstanzo 1956) and interviewed anglers are representative of the total angler population.

5. For the coho salmon creel survey, rates of harvest, or catch, and length of fishing trip are independent (DiConstanzo 1956).

Midstream Section Effort and Harvest:

Fishing effort in the midstream section of the Kenai River during the chinook salmon creel survey was estimated from the counts of boats made during aerial surveys of the river. The proportion of boat fishing effort occurring in the midstream section was calculated separately for the early run and the late run. For each aerial survey, the proportion of effort in the midstream section (p_m) was calculated as the quotient of the number of boats counted in the midstream section and the number of boats counted for all sections. Effort in the midstream section for both guided and unguided anglers (E_m) during either the early run or the late run was estimated as follows:

$$\hat{E}_m = \bar{p}_m \, (\hat{E}_d + \hat{E}_u)/(1-\bar{p}_m), \qquad [10]$$

where $\bar{p}_m$ = the mean of all proportions (p_ms) for a run,

$\hat{E}_d$ = the estimated number of angler-hours of effort in the downstream section for a run, and

$\hat{E}_u$ = the estimated number of angler-hours of effort in the upstream section for a run.

Effort was estimated separately for unguided and guided anglers. The variances of the midstream effort estimates were approximated by the delta method (Seber 1982) using the following formula:

$$\hat{V}(\hat{E}_m) \approx [(\hat{E}_d+\hat{E}_u)/(1-\bar{p})^2]^2 V(\bar{p}) + [\bar{p}/(1-\bar{p})]^2 \hat{V}(\hat{E}_d+\hat{E}_u), \quad [11]$$

where the variance of $\bar{p}$ is the sample variance of the p_ms divided by the number of flights, the variances of $\hat{E}_d$ and $\hat{E}_u$ are estimated as described under Effort, and the covariance between the estimated effort for the downstream and upstream sections and $\bar{p}$ is assumed to be zero.

Harvest and catch rates in the midstream section during the chinook salmon fishery were estimated from completed-trip angler interviews. Total harvest and catch for the midstream section were estimated from the product of the effort and harvest or catch rate.

Harvest and catch rates during the coho salmon fishery in the midstream section were estimated using the total harvest and catch and total effort (angler-hours) for the downstream and upstream sections. This is expressed as:

$$HPUE_m = (\hat{H}_d + \hat{H}_u)/(\hat{E}_d + \hat{E}_u), \quad [12]$$

for the harvest rate and:

$$CPUE_m = (\hat{C}_d + \hat{C}_u)/(\hat{E}_d + \hat{E}_u), \quad [13]$$

for the catch rate, where the subscripts denote the middle (m), downstream (d), or upstream (u) sections of the river. The variances of the rates were approximated by the delta method, also. The following formula was used to estimate the variance of harvest rate (HPUE):

$$\hat{V}(HPUE_m) \approx [1/(\hat{E}_d+\hat{E}_u)]^2 \hat{V}(\hat{H}_d+\hat{H}_u) + [-(\hat{C}_d+\hat{C}_u)/(\hat{E}_d+\hat{E}_u)^2]^2 \hat{V}(\hat{E}_d+\hat{E}_u), \quad [14]$$

where the variances of $(\hat{E}_d+\hat{E}_u)$ and $(\hat{H}_d+\hat{H}_u)$ are calculated as described previously in equations 11 and 14. The covariance between the combined downstream and upstream effort and harvest is omitted from the above equation because it is unknown, although it is assumed positive (as effort increases harvest should increase). The product of the covariance and the derivatives of the numerator and denominator of $HPUE_m$ (or $CPUE_m$) would be subtracted from equation 14 because of the negative derivative for the denominator. Therefore, the formula above is probably a conservative estimate of the variance of $HPUE_m$. The variance of $CPUE_m$ was estimated using the same formula but the combined downstream and upstream catches and their variances were substituted for the harvest counterparts.

The harvest and catch of coho salmon in the midstream section were estimated for unguided and guided anglers following the procedures described for the downstream and upstream sections. The variances of these estimates were also estimated as described previously in equations 11 and 14.

Biological Data:

The proportional age composition of the chinook and coho salmon harvest 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):

$$\hat{V}(p_{ht}) = \hat{p}_{ht}(1-\hat{p}_{ht})/(n_{Tt}-1), \qquad [15]$$

where n_{Tt} is the number of legible scales read from chinook or coho salmon sampled during component t.

Mean length at age by sex and its variance were estimated using standard normal procedures.

RESULTS

The following dates, based on the criteria described previously, were used to define the early and late runs in the chinook salmon fishery. The early run was from 17 June through 26 June and the late run from 27 June through 31 July in the downstream section. In the upstream section, the early run was from 3 June through 15 July and the late run from 16 July through 31 July. During the coho salmon fishery, the early run was designated from 1 August through 31 August and the late run from 1 September through 30 September in both the downstream and upstream sections of the river.

Chinook Salmon Creel Survey

Because of mechanical and other logistical problems during the creel survey in the downstream section of the Kenai River, angler counts were conducted on only 60 of the 67 days possible and interviews were conducted on each of the 67 days. In the upstream section, 42 of the 53 days possible were surveyed.

Effort:

Between one and five angler counts were conducted on each sample day in the downstream section (Appendix Tables A1 and A2). One or two angler counts were conducted on each day surveyed in the upstream section (Appendix Tables A3 and A4).

Downstream Section. Angler counts in the downstream section ranged from 2 to 891 for unguided anglers and from 2 to 544 for guided anglers (Appendix Tables A1 and A2). The largest count of unguided anglers occurred on 17 July and the largest count of guided anglers on 19 July. In general, as the

season progressed, the mean count of unguided and guided anglers increased for each daily period (A, B, etc.) both weekday and weekend/holiday (Table 1).

The estimated effort during the early run was 201,443 angler-hours (Table 2). During the early run, 67% of the total effort was by unguided anglers. Of this effort, 51% occurred during weekdays and 49% during weekends/holidays. The estimated effort during the late run was 323,374 angler-hours (Table 2). The majority of this effort (73%) was by unguided anglers. Of the unguided effort, 58% occurred during weekdays and 42% during weekends/holidays.

Upstream Section. Angler counts in the upstream section ranged from 0 to 305 for unguided anglers and from 0 to 18 for guided anglers (Appendix Tables A3 and A4). The largest count of unguided anglers occurred on 30 July and the largest count of guided anglers on 28 July. For each period of both runs, the mean count of unguided anglers for the weekend/holiday component was larger than the mean count for the weekday component except Period E during the early run (Table 3).

The estimated effort during the early run was 26,490 angler-hours (Table 4). During the early run, 92% of the total effort was by unguided anglers. Of the unguided effort, 58% occurred during weekdays and 42% during weekends/holidays. During the late run, there were not enough counts of unguided anglers conducted in period D of the weekday component and in periods A, C, and D of the weekend/holiday component to estimate effort using the stratified estimate. For these components, effort was estimated using the mean of all counts in the component. The estimation procedures were the same as for the stratified random sample except that there was no summation over periods and the mean and sample variance in equations 1 and 2 refer to the entire component. The estimated effort during the late run was 16,824 angler-hours (Table 4). The majority of this effort (93%) was by unguided anglers.

Midstream Section. The counts of sportfishing boats in each section of the Kenai River between Skilak Lake and Cook Inlet, conducted during aerial surveys, are summarized in Table 5. Nine counts were conducted during the early run and 10 counts during the late run. The mean proportion of the total boat effort in the midstream section was 0.123 for the early run and 0.060 for the late run. Because boats with unguided anglers cannot be distinguished from boats with guided anglers from the air, the estimated proportion of effort in the midstream section during each run was used to estimate both unguided and guided angler effort. Estimated effort for the midstream section during the early run was 22,317 angler-hours for unguided anglers (standard error [SE] = 6,211) and 9,651 angler-hours for guided anglers (SE = 2,671). During the late run, estimated effort for the midstream section was 15,888 angler-hours for unguided anglers (SE = 7,784) and 5,673 angler-hours for guided anglers (SE = 2,781).

Table 1. Mean counts of boat anglers by period for each of the components for the creel survey of the fishery for chinook salmon in the downstream section of the Kenai River, 1988.

Component	Period[1] A	B	C	D	E
EARLY RUN					
Period 1 (17 May - 5 June)					
Unguided anglers weekdays:					
Number of counts	2	3	2	4	4
Mean count	61.0	151.3	110.5	113.0	67.5
Standard error	8.0	60.8	7.5	20.4	34.5
Unguided anglers weekends:					
Number of counts	7	6	6	6	6
Mean count	195.1	362.8	227.3	195.5	175.3
Standard error	24.5	54.2	70.1	58.0	84.4
Guided anglers in May:					
Number of counts	7	7	5	8	7
Mean count	73.4	105.5	77.4	36.8	7.7
Standard error	15.6	11.3	16.9	6.6	2.0
Period 2 (6 June - 26 June)					
Unguided anglers weekdays:					
Number of counts	6	6	6	4	6
Mean count	168.5	216.3	167.7	205.0	166.2
Standard error	31.0	28.1	16.9	62.4	30.7
Unguided anglers weekends:					
Number of counts	6	6	6	6	6
Mean count	277.0	406.7	331.5	248.8	150.2
Standard error	45.6	32.9	50.4	68.2	50.3
Guided anglers in June:					
Number of counts	20	19			
Mean count	229.0	131.8			
Standard error	10.9	9.4			

-Continued-

Table 1. Mean counts of boat anglers by period for each of the components for the creel survey of the fishery for chinook salmon in the downstream section of the Kenai River, 1988 (continued).

Component	Period[1] A	B	C	D	E
LATE RUN					
Period 3 (27 June - 10 July)					
Unguided anglers weekdays:					
Number of counts	4	4	4	3	3
Mean count	277.5	242.5	196.3	197.7	72.3
Standard error	23.1	17.6	48.2	37.4	36.0
Unguided anglers weekends:					
Number of counts	4	4	4	4	4
Mean count	363.5	524.8	523.8	445.0	287.5
Standard error	104.0	73.0	88.7	30.3	103.8
Guided anglers:					
Number of counts	21	23			
Mean count	263.9	182.4			
Standard error	23.2	20.2			
Period 4 (11 July - 31 July)					
Unguided anglers weekdays:					
Number of counts	5	5	5	7	4
Mean count	423.4	543.0	452.4	385.4	365.5
Standard error	52.5	49.8	35.5	33.3	82.5
Unguided anglers weekends:					
Number of counts	6	6	6	6	6
Mean count	484.7	742.5	676.7	514.5	291.0
Standard error	95.4	33.9	42.5	18.2	74.6
Guided anglers:					
Number of counts	13	13			
Mean count	406.9	308.2			
Standard error	28.6	16.1			

[1] 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 angler:
May: same as unguided
June: Period A = 0600 - 1159
Period B = 1200 - 1759
July: Period A = 0700 - 1259
Period B = 1300 - 1859

Table 2. Estimated number of angler-hours of fishing effort by boat anglers during each of the components of the fishery for chinook salmon in the downstream section of the Kenai River, 1988.

Component	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
EARLY RUN				
Period 1 (17 May - 5 June)				
Unguided weekdays	24,160	3,534	17,233 - 31,087	28.7%
Unguided weekends	32,371	3,853	24,819 - 39,923	23.3%
Guided	16,840	1,485	13,929 - 19,751	17.3%
Period 2 (6 June - 26 June)				
Unguided weekdays	44,336	3,979	36,537 - 52,135	17.6%
Unguided weekends	33,940	2,725	28,600 - 39,280	15.7%
Guided	49,796	1,983	45,910 - 53,682	7.8%
Sub-totals:				
Unguided anglers	134,807	7,113	120,866 - 148,748	10.3%
Guided anglers	66,636	2,477	61,780 - 71,492	7.3
Early Run Total	201,443	7,532	186,680 - 216,206	7.3%

-Continued-

Table 2. Estimated number of angler-hours of fishing effort by boat anglers during each of the components of the fishery for chinook salmon in the downstream section of the Kenai River, 1988 (continued).

Component	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
LATE RUN				
Period 3 (27 June - 10 July)				
Unguided weekdays	31,560	2,448	26,763 - 36,357	15.2%
Unguided weekends	34,312	3,023	28,386 - 40,238	17.3%
Guided	23,967	1,145	21,723 - 26,211	9.4%
Period 4 (11 July - 31 July)				
Unguided weekdays	104,147	5,760	92,857 - 115,437	10.8%
Unguided weekends	65,024	3,215	58,722 - 71,326	9.7%
Guided	64,364	2,952	58,578 - 70,150	9.0%
Sub-totals:				
Unguided anglers	235,043	7,658	220,033 - 250,053	6.4%
Guided anglers	88,331	3,166	82,125 - 94,537	7.0%
Late Run Total	323,374	8,287	307,132 - 339,616	5.0%
BOTH RUNS COMBINED				
Unguided anglers	369,850	10,452	349,364 - 390,336	5.5%
Guided anglers	154,967	4,020	147,088 - 162,846	5.1%
GRAND TOTAL	524,817	11,198	502,869 - 546,765	4.2%

Table 3. Mean counts of boat anglers by period for each of the components for the creel survey of the fishery for chinook salmon in the upstream section of the Kenai River, 1988.

Component	Period A	B	C	D	E
EARLY RUN					
Unguided anglers weekdays:					
Number of counts	4	7	9	7	6
Mean count	10.3	23.3	34.1	37.3	25.3
Standard error	1.4	4.2	5.9	7.6	7.1
Unguided anglers weekends:					
Number of counts	4	4	6	5	5
Mean count	24.0	49.8	63.8	59.2	16.6
Standard error	10.9	14.7	11.3	21.2	5.3
Guided anglers:					
Number of counts	16	20			
Mean count	3.8	6.0			
Standard error	1.2	0.9			
LATE RUN					
Unguided anglers weekdays:					
Number of counts	3	4	2	2	1
Mean count	5.0	47.0	66.0	66.5	47.0
Standard error	3.6	4.3	5.0	6.5	
Unguided anglers weekends:					
Number of counts	1	2	1	1	3
Mean count	21.0	128.0	305.0	17.0	93.0
Standard error		65.0			33.3
Guided anglers:					
Number of counts	7	5			
Mean count	8.9	9.0			
Standard error	2.6	2.9			

Table 4. Estimated number of angler-hours of fishing effort by boat anglers during each of the components of the fishery for chinook salmon in the upstream section of the Kenai River, 1988.

Component	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
EARLY RUN				
Unguided weekdays	14,069	1,375	11,374 - 16,764	19.2%
Unguided weekends	10,243	1,469	7,363 - 13,123	28.1%
Guided	2,178	332	1,527 - 2,829	29.9%
Sub-totals:				
Unguided anglers	24,312	2,012	20,368 - 28,256	16.2%
Guided anglers	2,178	332	1,527 - 2,829	29.9%
Early Run Total	26,490	2,040	22,493 - 30,487	15.1%
LATE RUN				
Unguided weekdays	6,867	1,166	4,582 - 9,152	33.3%
Unguided weekends	8,780	2,426	4,030 - 13,530	54.1%
Guided	1,177	241	705 - 1,649	40.1%
Sub-totals:				
Unguided anglers	15,647	2,689	10,376 - 20,918	33.7%
Guided anglers	1,177	241	705 - 1,649	40.1%
Late Run Total	16,824	2,700	11,532 - 22,116	31.5%
BOTH RUNS COMBINED				
Unguided anglers	39,959	3,358	33,377 - 46,541	16.5%
Guided anglers	3,355	410	2,551 - 4,159	24.0%
GRAND TOTAL	43,314	3,383	36,683 - 49,945	15.3%

Table 5. Counts of sport fishing boats by river section conducted during aerial surveys of the fishery for chinook salmon in the Kenai River, 1988.

Date	Downstream Count	Downstream Pro.[1]	Midstream Count	Midstream Pro.[1]	Upstream Count	Upstream Pro.[1]	Total Count
EARLY RUN							
6/03	77	0.811	14	0.147	4	0.042	95
6/05	220	0.909	16	0.066	6	0.025	242
6/10	160	0.825	22	0.113	12	0.062	194
6/12	152	0.734	35	0.169	20	0.097	207
6/14	166	0.814	29	0.142	9	0.044	204
6/17	153	0.729	25	0.119	32	0.152	210
6/18	130	0.765	18	0.106	22	0.129	170
6/24	150	0.794	25	0.132	14	0.074	189
6/26	102	0.611	18	0.101	47	0.281	167
Mean		0.777		0.123		0.101	
Standard Error		0.082		0.030		0.080	
LATE RUN							
6/29	119	0.773	9	0.058	26	0.169	154
7/02	197	0.857	8	0.035	25	0.109	230
7/08	214	0.918	7	0.030	12	0.052	233
7/10	261	0.842	8	0.026	41	0.132	310
7/15	259	0.841	14	0.045	35	0.114	308
7/17	144	0.682	20	0.095	47	0.223	211
7/19	260	0.800	34	0.105	31	0.095	325
7/23	335	0.833	21	0.052	46	0.114	402
7/26	248	0.792	26	0.083	39	0.125	313
7/30	385	0.833	31	0.067	46	0.100	462
Mean		0.817		0.060		0.123	
Standard Error		0.062		0.027		0.046	

[1] Proportion of total count.

Harvest Rates and Catch Rates:

A total of 6,657 interviews with completed-trip anglers were collected during the creel survey in the downstream section of the Kenai River: 3,034 interviews during the early run and 3,623 interviews during the late run. In the upstream section, 3,495 interviews, both incomplete and completed-trip anglers were collected, 2,175 interviews during the early run and 1,320 interviews during the late run. In addition, 111 completed-trip interviews were collected from anglers fishing the midstream section.

Downstream Section. Daily harvest rates of chinook salmon by unguided anglers ranged from 0.000 to 0.188 fish per hour during the early run and from 0.000 to 0.161 fish per hour during the late run (Appendix Tables B1 and B3). Peak daily catch rates of chinook salmon by unguided anglers occurred on 1 June during the early run and on 22 July during the late run (Figure 5). Daily harvest rates of chinook salmon by guided anglers ranged from 0.000 to 0.271 fish per hour during the early run and from 0.030 to 0.212 fish per hour during the late run (Appendix Tables B2 and B4). Peak daily catch rates of chinook salmon by guided anglers occurred on 1 June during the early run and 22 July during the late run (Figure 5). 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 (Table 6).

In the downstream section guided anglers were probably targeting on chinook salmon and therefore the catch rates for other species tended to be lower than for the unguided angler (Table 7). The most drastic difference was for sockeye salmon during the late run, the guided catch rate being only about one third that of the unguided angler.

Upstream Section. Daily harvest rates of chinook salmon by unguided anglers ranged from 0.000 to 0.033 fish per hour during the early run and from 0.000 to 0.004 fish per hour during the late run (Appendix Tables B5 and B6). Peak daily catch rates of chinook salmon by unguided anglers occurred on 22 June during the early run and on 19 July during the late run. Daily harvest rates of chinook salmon by guided anglers ranged from 0.000 to 0.281 fish per hour during the early run (Appendix Table B7). Peak daily catch rates of chinook salmon by guided anglers occurred on 30 June during the early run and on 30 July during the late run. For the early run, 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 (Table 8).

During the early run in the upstream section, guided anglers were probably targeting on chinook salmon as the catch rates tended to be greater for other species by unguided anglers; however, the opposite was true during the late run when guided anglers reported better catch rates for all species (Table 9).

Midstream Section. A total of 70 unguided completed-trip anglers were contacted that had fished the midstream section during the early run. None of these anglers reported harvesting or catching a chinook salmon. The harvest rate for guided anglers during the early run was 0.0443 based on 37

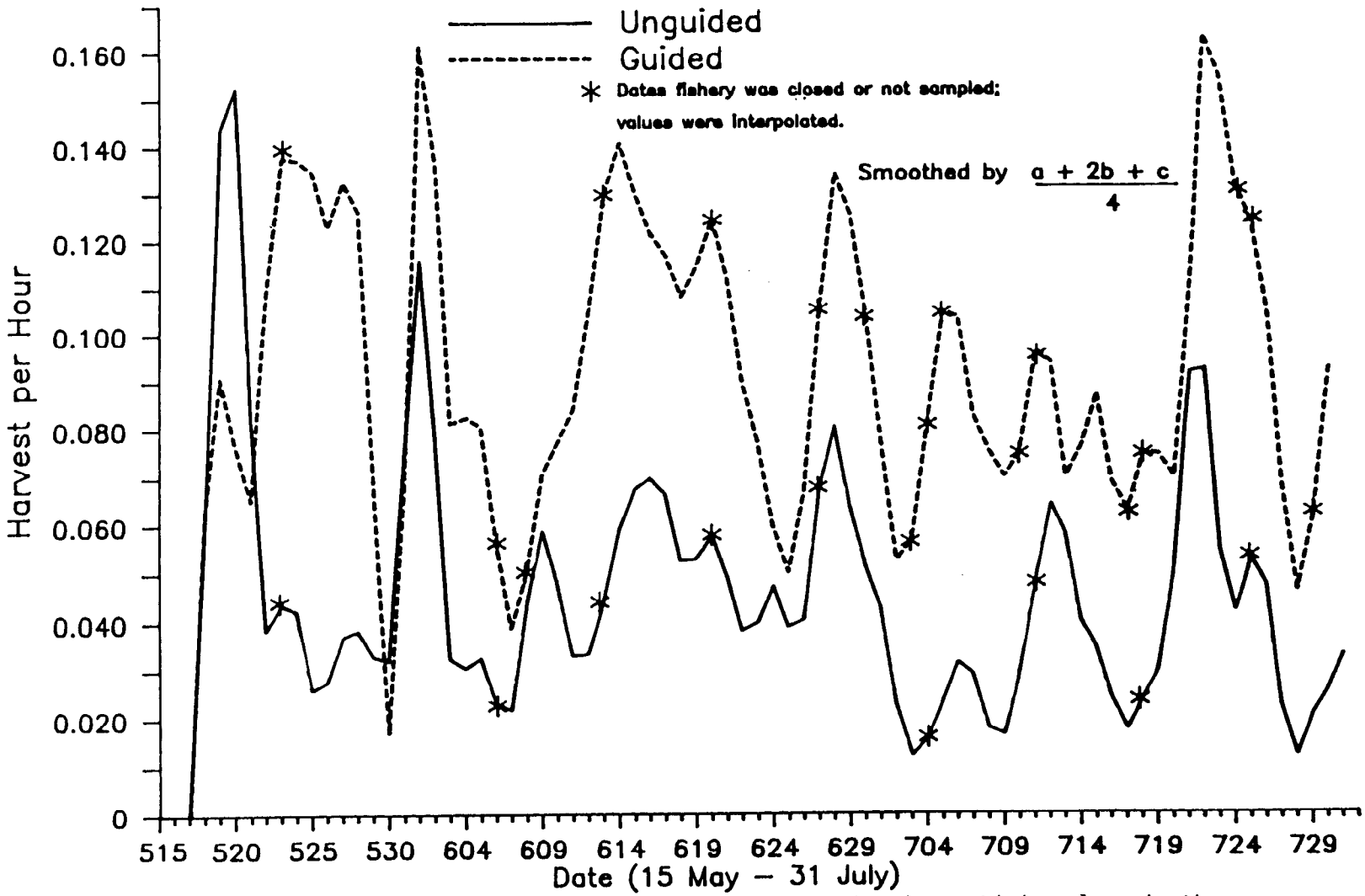

Figure 5. Daily harvest per hour of chinook salmon by guided and unguided anglers in the recreational fishery for chinook salmon in the downstream section of the Kenai River, 1988.

Table 6. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of chinook salmon by boat anglers during each of the components of the fishery for chinook salmon in the downstream section of the Kenai River, 1988.

Component	Days n[1]	Days N[2]	Number of Interviews[3]	Harvest HPUE	Standard Error	Catch CPUE	Standard Error
EARLY RUN							
Unguided weekdays[4]	12	12	239	0.0471	0.00844	0.0698	0.01000
Unguided weekends[4]	7	7	629	0.0323	0.00429	0.0422	0.00514
Unguided weekdays[5]	12	12	514	0.0502	0.00763	0.0758	0.00355
Unguided weekends[5]	6	6	519	0.0351	0.00569	0.0542	0.00807
Guided May	14	14	249	0.1049	0.01391	0.1425	0.01752
Guided June	22	23	884	0.0920	0.00538	0.1328	0.00696
LATE RUN							
Unguided weekdays[6]	8	8	276	0.0413	0.00760	0.0652	0.01319
Unguided weekends[6]	4	4	255	0.0180	0.00380	0.0291	0.00542
Guided[6]	8	10	269	0.1023	0.01480	0.1239	0.01713
Unguided weekdays[7]	12	12	972	0.0436	0.00377	0.0571	0.00485
Unguided weekends[7]	6	6	1,004	0.0243	0.00260	0.0279	0.00277
Guided[7]	14	15	847	0.0923	0.00753	0.1250	0.00847

[1] Number of days on which interviews were collected.
[2] Number of days possible for interviewing.
[3] Completed-trip interviews only.
[4] Period 1 (17 May - 05 June).
[5] Period 2 (06 June - 26 June).
[6] Period 3 (27 June - 10 July).
[7] Period 4 (11 July - 31 July).

Table 7. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of sockeye salmon, coho salmon, pink salmon, rainbow trout, and Dolly Varden char by boat anglers during each of the components of the fishery for chinook salmon in the downstream section of the Kenai River, 1988.

	SOCKEYE SALMON		COHO SALMON		PINK SALMON		RAINBOW TROUT		DOLLY VARDEN	
Component	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE
EARLY RUN										
Unguided weekdays	0.0011	0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0059	0.0096
(Standard Error)	(0.0005)	(0.0008)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0004)	(0.0047)	(0.0051)
Unguided weekends	0.0004	0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0002	0.0052	0.0066
(Standard Error)	(0.0004)	(0.0004)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0006)	(0.0028)	(0.0030)
Guided May	0.0020	0.0020	0.0000	0.0000	0.0000	0.0000	0.0000	0.0010	0.0049	0.0119
(Standard Error)	(0.0012)	(0.0012)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0003)	(0.0031)	(0.0047)
Guided June	0.0020	0.0020	0.0000	0.0000	0.0000	0.0000	0.0010	0.0038	0.0070	0.0145
(Standard Error)	(0.0008)	(0.0008)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0004)	(0.0008)	(0.0017)	(0.0022)
LATE RUN										
Unguided weekdays	0.0153	0.0161	0.0006	0.0006	0.0033	0.0058	0.0002	0.0003	0.0060	0.0084
(Standard Error)	(0.0039)	(0.0038)	(0.0004)	(0.0004)	(0.0013)	(0.0020)	(0.0003)	(0.0004)	(0.0021)	(0.0029)
Unguided weekends	0.0367	0.0464	0.0015	0.0016	0.0021	0.0025	0.0003	0.0003	0.0042	0.0069
(Standard Error)	(0.0057)	(0.0066)	(0.0010)	(0.0010)	(0.0019)	(0.0020)	(0.0007)	(0.0007)	(0.0022)	(0.0028)
Guided	0.0141	0.0194	0.0006	0.0006	0.0012	0.0014	0.0007	0.0008	0.0049	0.0078
(Standard Error)	(0.0095)	(0.0099)	(0.0005)	(0.0005)	(0.0010)	(0.0010)	(0.0009)	(0.0010)	(0.0018)	(0.0023)

Table 8. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of chinook salmon by boat anglers during each of the components of the fishery for chinook salmon in the upstream section of the Kenai River, 1988.

Component	Days n[1]	Days N[2]	Number of Interviews[3]	Harvest HPUE	Standard Error	Catch CPUE	Standard Error
EARLY RUN							
Unguided weekdays	18	25	959	0.0088	0.00196	0.0272	0.00532
Unguided weekends	12	12	978	0.0064	0.00235	0.0123	0.00350
Guided	21	35	238	0.0861	0.01592	0.2056	0.03026
LATE RUN							
Unguided weekdays	6	8	424	0.0012	0.00088	0.0082	0.00682
Unguided weekends	6	6	829	0.0015	0.00090	0.0025	0.00125
Guided	6	8	67	0.0101	0.01908	0.0151	0.02026

[1] Number of days on which interviews were collected.

[2] Number of days possible for interviewing.

[3] Completed-trip and incompleted-trip interviews.

Table 9. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of sockeye salmon, coho salmon, pink salmon, rainbow trout, and Dolly Varden char by boat anglers during each of the components of the fishery for chinook salmon in the upstream section of the Kenai River, 1988.

Component	SOCKEYE SALMON		COHO SALMON		PINK SALMON		RAINBOW TROUT		DOLLY VARDEN	
	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE
EARLY RUN										
Unguided weekdays	0.0396	0.0921	0.0000	0.0000	0.0000	0.0000	0.0189	0.0953	0.0640	0.1156
(Standard Error)	(0.0084)	(0.0187)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0054)	(0.0258)	(0.0090)	(0.0135)
Unguided weekends	0.0183	0.0501	0.0000	0.0000	0.0000	0.0000	0.0050	0.0301	0.0669	0.1224
(Standard Error)	(0.0025)	(0.0051)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0011)	(0.0051)	(0.0079)	(0.0130)
Guided	0.0083	0.0111	0.0000	0.0000	0.0000	0.0000	0.0056	0.0431	0.0403	0.1222
(Standard Error)	(0.0062)	(0.0065)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0028)	(0.0160)	(0.0124)	(0.0352)
LATE RUN										
Unguided weekdays	0.1978	0.4414	0.0035	0.0035	0.0000	0.0000	0.0035	0.0035	0.0188	0.0353
(Standard Error)	(0.0281)	(0.0501)	(0.0021)	(0.0021)	(0.0000)	(0.0000)	(0.0020)	(0.0020)	(0.0042)	(0.0073)
Unguided weekends	0.1922	0.4529	0.0005	0.0005	0.0000	0.0000	0.0010	0.0025	0.0186	0.0368
(Standard Error)	(0.0112)	(0.0283)	(0.0006)	(0.0006)	(0.0000)	(0.0000)	(0.0006)	(0.0013)	(0.0042)	(0.0063)
Guided	0.3266	0.5226	0.0151	0.0151	0.0151	0.0151	0.0050	0.0050	0.0553	0.1005
(Standard Error)	(0.0622)	(0.1390)	(0.0260)	(0.0260)	(0.0258)	(0.0258)	(0.0026)	(0.0026)	(0.0189)	(0.0308)

completed-trip interviews. During the late run only 23 unguided anglers and 4 guided were interviewed, none of which reported catching a chinook salmon. The author felt that insufficient contacts were made and thus the harvest and catch in the midstream section during the late run was estimated by using the average HPUE and CPUE for the combined downstream and upstream totals.

Harvest and Catch:

The harvest and catch of chinook salmon by boat anglers were estimated for each component in the downstream and upstream sections of the Kenai River. Estimated effort and catch rates for each component from Tables 2 and 6, respectively, were used to estimate harvest and catch in the downstream section. For the upstream section, estimated effort and catch rates for each component from Tables 4 and 8, respectively, were used to estimate harvest and catch.

Downstream Section. An estimated 28,384 chinook salmon were harvested by boat anglers in the downstream section: 11,949 fish (42%) during the early run and 16,435 fish (58%) during the late run (Table 10). Unguided anglers harvested 13,643 chinook salmon (48% of the total) and guided anglers harvested 14,741 fish (52% of the total). The total catch of chinook salmon by boat anglers in the downstream section was 39,099 fish: 17,266 fish (44%) during the early run and 21,833 fish (56%) during the late run (Table 10). Unguided anglers released 28% of their chinook salmon catch while guided anglers released 26% of their catch.

Upstream Section. An estimated 411 chinook salmon were harvested by boat anglers in the upstream section: 378 fish (92%) during the early run and 33 fish (8%) during the late run (Table 11). Unguided anglers harvested 211 chinook salmon (51% of the total) and guided anglers harvested 200 fish (49% of the total). The total catch of chinook salmon by boat anglers in the upstream fishery was 1,053 fish: 957 fish (91%) during the early run and 96 fish (9%) during the late run (Table 11). Unguided anglers released 64% of their chinook salmon catch while guided anglers released only 57% of their catch.

Midstream Section. During the early run, an estimated 420 chinook salmon (SE = 179) were harvested and caught in the midstream section. Estimated harvests of chinook salmon for the midstream section during the late run was 1,044 (SE = 511). The estimated catch of chinook salmon during the late run was 1,309 (SE = 338). All of the harvest and catch in the midstream section during the early run was by guided anglers.

Other Species. The estimates of harvest and catch of species other than chinook salmon for the downstream and upstream sections are summarized in Tables 12 and 13. Sockeye salmon were the second most common species caught after chinook salmon in the downstream section; 7,200 sockeye salmon were harvested and 8,773 fish were caught. Sockeye salmon were the most common species caught in the upstream section; 4,192 fish were harvested and 9,270 fish were caught.

Table 10. Estimated number of chinook salmon harvested and number caught by boat anglers during each of the components in the fishery for chinook salmon in the downstream section of the Kenai River, 1988.

Component	Harvest[1]	Standard Error	Rel. Pre.[2]	Catch[3]	Standard Error	Rel. Pre.[2]
EARLY RUN						
Unguided weekdays	3,364	471	27.4%	5,047	483	18.8%
Unguided weekends	2,237	284	24.9%	3,206	387	23.7%
Guided May	1,767	281	31.1%	2,400	362	29.6%
Guided June	4,581	324	13.9%	6,613	435	12.9%
Sub-totals:						
Unguided	5,601	550	19.2%	8,253	620	14.7%
Guided	6,348	429	13.2%	9,013	566	12.3%
Early Run Total	11,949	698	11.4%	17,266	839	9.5%
LATE RUN						
Unguided weekdays	5,844	533	17.9%	8,005	749	18.3%
Unguided weekends	2,198	241	21.5%	2,812	321	22.4%
Guided anglers	8,393	685	16.0%	11,016	820	14.6%
Sub-totals:						
Unguided	8,042	585	14.3%	10,817	815	14.8%
Guided	8,393	685	16.0%	11,016	820	14.6%
Late Run Total	16,435	901	10.7%	21,833	1,156	10.4%
BOTH RUNS COMBINED						
Unguided	13,643	803	11.5%	19,070	1,024	10.5%
Guided	14,741	808	10.7%	20,029	996	9.8%
GRAND TOTAL	28,384	1,140	7.9%	39,099	1,428	7.2%

1 Harvest includes only fish kept.

2 Relative precision for 95% confidence interval.

3 Catch includes fish kept and fish reported as released.

Table 11. Estimated number of chinook salmon harvested and number caught by boat anglers during each of the components in the fishery for chinook salmon in the upstream section of the Kenai River, 1988.

Component	Harvest[1]	Standard Error	Rel. Pre.[2]	Catch[3]	Standard Error	Rel. Pre.[2]
EARLY RUN						
Unguided weekdays	124	30	47.5%	383	83	42.6%
Unguided weekends	66	26	75.9%	126	40	61.8%
Guided	188	45	46.6%	448	94	41.3%
Sub-totals:						
Unguided	190	39	40.7%	509	92	35.5%
Guided	188	45	46.6%	448	94	41.3%
Early Run Total	378	60	30.9%	957	132	27.0%
LATE RUN						
Unguided weekdays	8	6	151.0%	56	47	122.3%
Unguided weekends	13	8	126.4%	22	12	108.5%
Guided anglers	12	22	361.3%	18	24	257.2%
Sub-totals:						
Unguided	21	10	97.1%	78	49	122.3%
Guided	12	22	361.3%	18	24	257.2%
Late Run Total	33	24	145.2%	96	54	110.5%
BOTH RUNS COMBINED						
Unguided	211	40	37.4%	587	104	34.8%
Guided	200	50	49.1%	466	97	40.8%
GRAND TOTAL	411	65	30.9%	1,053	143	26.6%

[1] Harvest includes only fish kept.

[2] Relative precision for 95% confidence interval.

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

Table 12. Estimated number of sockeye salmon, coho salmon, pink salmon, rainbow trout, and Dolly Varden char harvested and caught by boat anglers during the fishery for chinook salmon in the downstream section of the Kenai River, 1988.

	Unguided Anglers				Guided Anglers				Total			
Species	Harvest[1]	St. Err.	Catch[2]	St. Err.	Harv.[1]	St. Err.	Catch[2]	St. Err.	Harv.[1]	St. Err.	Catch[2]	St. Err.
EARLY RUN												
Sockeye salmon	89	25	133	40	134	43	134	43	223	49	267	59
Rainbow trout	0	0	45	28	50	20	206	40	50	20	251	49
Dolly Varden	732	168	1,061	196	432	100	922	140	1,164	195	1,983	241
LATE RUN												
Sockeye salmon	5,728	540	6,794	620	1,249	288	1,712	350	6,977	612	8,506	712
Coho salmon	233	77	246	78	51	35	51	35	284	85	297	85
Pink Salmon	656	183	1,028	244	103	65	122	66	759	194	1,150	252
Rainbow trout	62	40	83	45	64	26	70	37	126	48	153	58
Dolly Varden	1,236	199	1,816	280	437	83	688	108	1,673	215	2,504	300

[1] Harvest includes only fish kept.

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

Table 13. Estimated number of sockeye salmon, coho salmon, pink salmon, rainbow trout, and Dolly Varden char harvested and caught by boat anglers during the fishery for chinook salmon in the upstream section of the Kenai River, 1988.

	Unguided Anglers				Guided Anglers				Total			
Species	Harvest[1]	St. Err.	Catch[2]	St. Err.	Harv.[1]	St. Err.	Catch[2]	St. Err.	Harv.[1]	St. Err.	Catch[2]	St. Err.
EARLY RUN												
Sockeye salmon	744	135	1,809	305	18	14	24	14	762	136	1,833	305
Rainbow trout	317	81	1,649	390	12	6	94	37	329	81	1,743	392
Dolly Varden	1,585	199	2,880	333	88	30	266	86	1,673	201	3,146	344
LATE RUN												
Sockeye salmon	3,046	561	6,822	1,269	384	106	615	204	3,430	571	7,437	1,285
Coho salmon	28	16	28	16	18	30	18	30	46	34	46	34
Pink Salmon	0	0	0	0	18	30	18	30	18	30	18	30
Rainbow Trout	33	15	46	19	6	3	6	3	39	15	52	19
Dolly Varden	292	68	565	123	65	26	118	43	357	72	683	130

[1] Harvest includes only fish kept.

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

Summary:

The estimated total angler-effort during the chinook salmon fishery was 621,660 angler-hours (Table 14). Estimated total harvest and catch of chinook salmon were 30,259 fish and 41,961 fish, respectively (Table 14). Unguided anglers exerted 72.1% of the effort and harvested 47.5% of the chinook salmon while guided anglers exerted 27.9% of the effort and harvested 52.5% of the fish. The majority of the effort (84.4%) and chinook salmon harvest (93.8%) were estimated to occur in the downstream section of the fishery (Figure 6). Just 7.1% of the effort occurred in the upstream section and 8.4% in the midstream section. Only 1.4% of the chinook salmon harvest was from the upstream section and 4.8% from the midstream section.

Biological Data:

The most abundant age groups in the early run harvest were ages 1.3 and 1.4 chinook salmon, which comprised 12.1% and 79.0% of the sample, respectively (Table 15). Ages 1.4 and 1.5 chinook salmon were the most abundant age groups in the late-run harvest, contributing 79.0% and 16.7% to the sample, respectively (Table 15). The mean lengths at age for each sex were generally greater for late-run fish than for early-run fish (Table 16). For both the early and late runs, the mean lengths of 4- and 5-ocean age male chinook salmon sampled from the harvest were larger than the mean lengths of females from the same age group but the converse was true for 2- and 3-ocean age fish.

Discussion:

The major assumptions necessary for the effort and harvest estimates were explained in the Methods section. It is important to determine how well the data conform to these assumptions to evaluate whether the current experimental design and methods of analysis are appropriate. It is beyond the scope of this report to examine every assumption, but two were examined.

The assumption that interviews with unguided and guided anglers were conducted in proportion to the abundance of anglers at the time of the interview was examined previously by Conrad and Hammarstrom (1987) and found to be valid in 1985 and 1986. This assumption was not examined in 1988.

The survey for counting unguided anglers in the downstream section of the river during the chinook salmon fishery was designed to minimize the autocorrelation (Cochran 1977) among counts conducted on the same day. In previous years, angler counts were often conducted within 1 or 2 hours of each other (although they were conducted in different periods). Conrad and Hammarstrom (1987) found significant correlations between same-day counts of unguided anglers conducted from 1 to 7 hours apart for the creel survey of the Kenai River in 1986. In 1988, there were usually at least 8 hours between same-day counts of unguided anglers during the weekday component, in order to minimize the autocorrelation and covariance between counts. There was a minimum of 4 hours between same-day counts of unguided anglers in the

Table 14. Summary of estimated angler effort, chinook salmon harvest, and chinook salmon catch by all boat anglers for each river section of the fishery for chinook salmon in the Kenai River, 1988.

Run	Downstream Section	Upstream Section	Midstream Section	Total	95% Confidence Interval
Early Run					
Effort	201,443	26,490	31,968	259,901	236,790 - 283,012
St. Err.	7,532	2,040	8,840	11,791	
Harvest	11,949	378	420	12,747	11,332 - 14,162
St. Err.	697	60	179	722	
Catch	17,266	957	420	18,643	16,942 - 20,344
St. Err.	839	132	179	868	
Late Run					
Effort	323,374	16,824	21,561	361,759	334,930 - 388,588
St. Err.	8,287	2,700	10,555	13,688	
Harvest	16,435	33	1,044	17,512	15,481 - 19,543
St. Err.	901	24	511	1,036	
Catch	21,833	96	1,309	23,238	20,875 - 25,601
St. Err.	1,156	54	338	1,206	
Total Both Runs					
Effort	524,817	43,314	53,529	621,660	586,249 - 657,070
St. Err.	11,198	3,385	13,768	18,067	
Harvest	28,384	411	1,464	30,259	27,886 - 32,632
St. Err.	1,139	65	405	1,211	
Catch	39,099	1,053	1,809	41,961	38,894 - 45,028
St. Err.	1,429	143	973	1,565	

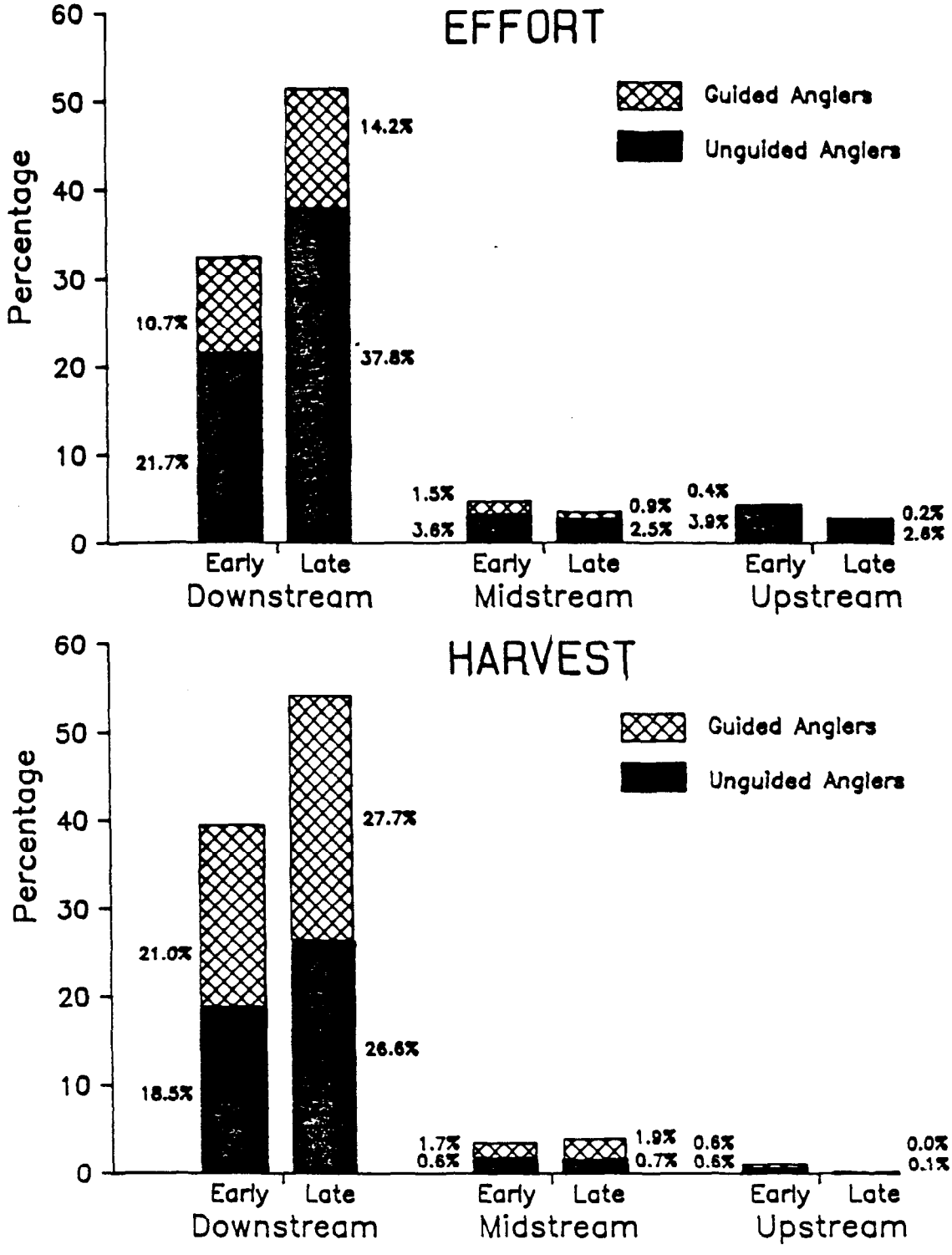

Figure 6. Percent of total angler effort and chinook salmon harvest by guided and unguided anglers for each run and river section of the chinook salmon fishery in the Kenai River, 1988.

Table 15. Age composition of chinook salmon sampled from the harvest during the early and late runs of chinook salmon in the Kenai River, 1988.

RUN	Sex		Age Group 1.1	1.2	1.3	1.4	1.5	Total
EARLY	Male	Percent	0.2	1.6	7.3	26.2	5.5	40.8
(n=560)[1]	Female	Percent	0.0	0.4	4.8	52.8	1.2	59.2
	Combined	Percent	0.2	2.0	12.1	79.0	6.7	
		St. Error	0.2	0.6	1.4	1.7	1.1	
LATE	Male	Percent	0.7	0.2	2.4	35.4	7.5	46.2
(n=413)	Female	Percent	0.0	0.0	1.0	43.6	9.2	53.8
	Combined	Percent	0.7	0.2	3.4	79.0	16.7	
		St. Error	0.4	0.2	0.9	2.0	0.8	

[1] n = sample size.

Table 16. Mean length (mm) by age group of chinook salmon sampled from the harvest during the early and late runs of chinook salmon in the Kenai River, 1988.

RUN / Sex		Age Group 1.1	1.2	1.3	1.4	1.5
EARLY RUN						
Male	Mean Length	370	631	772	1010	1104
	Standard Error		18	8	6	7
	Sample Size	1	9	41	147	31
Female	Mean Length		650	837	963	1073
	Standard Error		60	8	3	34
	Sample Size		2	27	296	6
LATE RUN						
Male	Mean Length	367	570	820	1059	1120
	Standard Error	30		20	6	10
	Sample Size	3	1	10	146	31
Female	Mean Length			862	1016	1048
	Standard Error			48	4	8
	Sample Size			4	180	38

weekend/holiday component. The mean length of an angler-trip in this component was 4.3 hours (SE = 0.124) during the early run and 4.3 hours (SE = 0.062) during the late run. I feel that the autocorrelation between counts made in consecutive periods of the weekend/holiday component was minimal as there should have been a large turnover in anglers during the time between counts in consecutive periods.

Completed-trip angler interviews were conducted at only seven of the numerous possible locations where anglers enter and leave the fishery. A major assumption of the current creel survey design is that anglers using the seven surveyed boat launches are representative of the fishing population (Hammarstrom 1988).

Coho Salmon Fishery

During the coho salmon fishery, 42 of the 61 days possible during the survey period were sampled in the downstream section of the Kenai River. In the upstream section, 40 of the 61 days possible were surveyed.

Effort:

Two angler counts were usually conducted on each sample day in the downstream section; there were 4 days when only one angler count was conducted. Two angler counts were conducted on all but 1 day surveyed in the upstream section.

Downstream Section. Angler counts in the downstream section ranged from 12 to 405 for unguided boat anglers, from 1 to 205 for shore anglers, and from 0 to 135 for guided anglers (Appendix Table C1 and C2). The largest count of unguided boat anglers occurred on 17 September, the largest count of shore anglers occurred on 14 and 20 August, and the largest count of guided anglers on 8 August and 3 September. For each period in both runs, the mean count of unguided boat anglers and shore anglers for the weekend/holiday component was larger than the mean count for the weekday component (Table 17). The same was also true for the mean counts of guided anglers, except for period C of the early run.

The estimated effort during the early run (August) was 156,405 angler-hours (Table 18). During the early run, 80% of the total effort was by unguided anglers (shore anglers are assumed to be unguided). Anglers fishing on weekdays accounted for 63% of the effort while weekend/holiday anglers accounted for 37% of the effort. The estimated effort during the late run (September) was 88,423 angler-hours (Table 18). The majority of this effort (83%) was by unguided anglers. Also, 58% of the effort occurred during weekdays and 42% during weekends/holidays.

Upstream Section. Angler counts in the upstream section ranged from 0 to 143 for unguided anglers and from 0 to 17 for guided anglers (Appendix Table C3). The largest count of unguided anglers occurred on 20 August and the largest count of guided anglers on 2 September. For each period in both runs, the mean count of unguided anglers for the weekend/holiday component was larger

Table 17. Mean counts of anglers by period for each of the components of the fishery for coho salmon in the downstream section of the Kenai River, 1988.

Component	Period A	B	C	D
EARLY RUN				
Unguided boat anglers weekdays:				
Number of counts	8	6	7	4
Mean count	93.1	135.0	125.3	98.5
Standard error	18.7	24.5	25.8	17.6
Unguided boat anglers weekends:				
Number of counts	4	4	5	3
Mean count	239.5	344.3	260.0	221.7
Standard error	63.3	51.8	40.4	85.0
Guided anglers weekdays:				
Number of counts	8	6	7	4
Mean count	74.5	93.0	69.4	12.5
Standard error	10.4	10.6	12.7	2.8
Guided anglers weekends:				
Number of counts	4	4	5	3
Mean count	83.0	98.0	47.6	18.0
Standard error	14.3	8.5	3.7	5.5
Unguided shore anglers weekdays:				
Number of counts	8	6	7	4
Mean count	63.9	83.8	110.3	108.8
Standard error	12.2	17.8	18.8	34.9
Unguided shore anglers weekends:				
Number of counts	4	4	5	3
Mean count	94.5	149.3	149.8	111.3
Standard error	14.5	23.0	27.0	15.9

-Continued-

Table 17. Mean counts of anglers by period for each of the components of the fishery for coho salmon in the downstream section of the Kenai River, 1988 (continued).

Component	Period A	B	C
LATE RUN			
Unguided anglers weekdays:			
Number of counts	8	8	6
Mean count	111.3	82.2	79.2
Standard error	31.3	22.1	13.1
Unguided anglers weekends:			
Number of counts	5	6	6
Mean count	359.4	293.0	161.7
Standard error	40.0	35.3	30.4
Guided anglers weekdays:			
Number of counts	8	8	6
Mean count	50.5	35.6	12.2
Standard error	15.9	8.3	3.5
Guided anglers weekends:			
Number of counts	5	6	6
Mean count	105.8	56.3	17.3
Standard error	18.3	14.9	7.2
Unguided shore anglers weekdays:			
Number of counts	8	8	6
Mean count	44.9	51.5	50.0
Standard error	12.1	13.4	7.8
Unguided shore anglers weekends:			
Number of counts	5	6	6
Mean count	93.2	95.3	67.0
Standard error	24.9	14.3	15.2

Table 18. Estimated number of angler-hours of fishing effort during each of the components of the fishery for coho salmon in the downstream section of the Kenai River, 1988.

Component	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
EARLY RUN				
Unguided weekdays	41,576	4,035	33,667 - 49,485	19.0%
Unguided weekends	34,093	3,991	26,270 - 41,916	22.9%
Guided weekdays	22,947	1,815	19,389 - 26,505	15.5%
Guided weekends	7,891	574	6,766 - 9,016	14.3%
Unguided shore wd[1]	33,741	4,513	25,602 - 41,880	24.1%
Unguided shore we[2]	16,157	1,327	13,555 - 18,759	16.1%
Sub-totals:				
Unguided anglers	75,669	5,676	64,545 - 86,793	14.7%
Guided anglers	30,838	1,904	27,106 - 34,570	12.1%
Shore anglers	49,898	4,360	41,353 - 53,433	17.1%
Early Run Total	156,405	7,406	141,890 - 170,920	9.3%
LATE RUN				
Unguided weekdays	22,904	3,399	16,243 - 29,565	29.1%
Unguided weekends	29,306	2,211	24,973 - 33,639	14.8%
Guided weekdays	8,257	1,534	5,250 - 11,264	36.4%
Guided weekends	6,461	888	4,720 - 8,202	26.9%
Unguided shore wd[1]	12,296	1,653	9,056 - 15,536	26.3%
Unguided shore we[2]	9,199	1,169	6,907 - 11,480	24.9%
Sub-totals:				
Unguided anglers	52,210	4,055	44,263 - 60,157	15.2%
Guided anglers	14,718	1,733	11,244 - 18,192	23.6%
Shore anglers	21,495	2,025	17,526 - 25,464	18.5%
Late Run Total	88,423	4,866	78,885 - 97,961	10.8%
BOTH RUNS COMBINED				
Unguided anglers[3]	199,272	8,471	182,669 - 215,874	8.3%
Guided anglers	45,556	2,601	40,457 - 50,655	11.2%
GRAND TOTAL	244,828	8,861	227,460 - 262,196	7.1%

[1] wd = weekday. [2] we = weekend. [3] includes shore anglers.

than the mean count for the weekday component (Table 19). However, the opposite was true for guided anglers with the weekday component being larger than the weekend/holiday component in all cases except period C during the early run.

The estimated effort during the early run was 19,103 angler-hours (Table 20). During the early run, 91% of the total effort was by unguided anglers; 57% of the effort occurred during weekdays and 43% during weekends/holidays. The estimated effort during the late run was 13,532 angler-hours (Table 20). The majority of this effort (91%) was by unguided anglers, also.

Midstream Section. The counts of anglers in each section of the Kenai River between Skilak Lake and Cook Inlet, conducted during aerial surveys during the fishery for coho salmon, are summarized in Table 21. A total of five flights was made. The mean proportion of effort in the midstream section for both early and late runs was 0.113 (SE = 0.044). Each effort component was expanded accordingly to estimate the midstream component. Estimated effort occurring in the midstream section during the early and late runs was 22,359 angler-hours and 12,989 angler-hours, respectively.

Harvest Rates and Catch Rates:

A total of 3,364 angler interviews (both completed-trip and incomplete trip) were collected during the creel survey in the downstream section of the Kenai River; 1,761 during the early run and 1,603 during the late run. In the upstream section, 2,970 angler interviews were collected; 1,309 during the early run and 1,661 during the late run.

Downstream Section. Daily harvest rates of coho salmon by unguided boat anglers ranged from 0.000 to 0.538 fish per hour during the early run and from 0.000 to 0.245 fish per hour during the late run (Appendix Table D1 and D2). Peak daily catch rates of coho salmon by unguided anglers occurred on 12 August during the early run and on 9 September during the late run (Figure 7). Daily harvest rates of coho salmon by guided anglers ranged from 0.048 to 0.500 fish per hour during the early run and from 0.000 to 0.348 fish per hour during the late run (Appendix Table D3). Peak daily catch rates by guided anglers occurred on 5 August during the early run and on 2 September during the late run (Figure 7). The highest mean harvest rate among all components of the fishery was for shore anglers on the weekends of the early run (Table 22).

Other species in the downstream section are considered incidental during the fishery for coho salmon except for pink salmon. The highest mean harvest rate for pink salmon was 0.404 fish/hour by unguided anglers on weekdays during the early run (Table 23).

Upstream Section. Daily harvest rates of coho salmon by unguided anglers ranged from 0.000 to 0.231 fish per hour during the early run and from 0.013 to 0.215 fish per hour during the late run (Appendix Table D5). Peak daily catch rates of coho salmon by unguided anglers occurred on 19 August during the early run and on 29 September during the late run. Daily harvest rates of coho salmon by guided anglers ranged from 0.000 to 0.424 fish per hour

Table 19. Mean counts of anglers by period for each of the components for the creel survey of the fishery for coho salmon in the upstream section of the Kenai River, 1988.

Component	Period A	B	C	D
EARLY RUN				
Unguided anglers weekdays:				
Number of counts	6	7	9	5
Mean count	6.7	41.3	35.7	19.2
Standard error	2.8	9.2	6.2	5.8
Unguided anglers weekends:				
Number of counts	3	5	4	2
Mean count	32.7	79.4	86.3	51.0
Standard error	8.5	7.9	22.4	44.0
Guided anglers weekdays:				
Number of counts	6	7	9	5
Mean count	3.5	7.3	3.7	0.8
Standard error	2.1	1.9	1.3	0.8
Guided anglers weekends:				
Number of counts	4	4	4	2
Mean count	1.8	2.5	4.0	0.0
Standard error	1.0	1.9	2.4	0.0
LATE RUN				
Unguided anglers weekdays:				
Number of counts	5	7	10	
Mean count	27.2	26.6	20.9	
Standard error	5.8	3.8	3.0	
Unguided anglers weekends:				
Number of counts	3	8	5	
Mean count	40.7	82.0	45.8	
Standard error	10.2	11.5	10.9	
Guided anglers weekdays:				
Number of counts	5	7	10	
Mean count	5.4	3.0	3.0	
Standard error	3.0	1.2	1.1	
Guided anglers weekends:				
Number of counts	3	8	5	11
Mean count	3.0	1.8	1.8	0.4
Standard error	2.1	0.6	1.1	0.2

Table 20. Estimated number of angler-hours of fishing effort during each of the components of the fishery for coho salmon in the upstream section of the Kenai River, 1988.

Component	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
EARLY RUN				
Unguided weekdays	9,458	1,178	7,150 - 11,766	24.4%
Unguided weekends	7,978	1,623	4,797 - 11,159	39.9%
Guided weekdays	1,403	293	829 - 1,977	40.9%
Guided weekends	264	102	64 - 464	75.7%
Sub-totals:				
Unguided anglers	17,436	2,005	13,506 - 21,366	22.5%
Guided anglers	1,667	310	1,059 - 2,275	36.5%
Early Run Total	19,103	2,029	15,126 - 23,080	20.8%
LATE RUN				
Unguided weekdays	6,273	630	5,039 - 7,507	19.7%
Unguided weekends	6,065	677	4,738 - 7,392	21.9%
Guided weekdays	958	285	400 - 1,516	58.3%
Guided weekends	236	87	65 - 407	72.5%
Sub-totals:				
Unguided anglers	12,338	925	10,526 - 14,150	14.7%
Guided anglers	1,194	298	610 - 1,778	48.9%
Late Run Total	13,532	972	11,628 - 15,436	14.1%
BOTH RUNS COMBINED				
Unguided anglers	29,774	2,208	25,446 - 34,101	14.5%
Guided anglers	2,861	430	2,018 - 3,704	29.5%
GRAND TOTAL	32,635	2,250	28,225 - 37,045	13.5%

Table 21. Counts of sport fishing anglers by river section conducted during aerial surveys of the fishery for coho salmon in the Kenai River, 1988.

Date	Downstream Count	Downstream Pro.[1]	Midstream Count	Midstream Pro.[1]	Upstream Count	Upstream Pro.[1]	Total Count
8/16	570	0.832	43	0.063	72	0.105	685
8/24	199	0.793	37	0.147	15	0.060	251
8/28	400	0.747	86	0.160	50	0.093	536
9/15	219	0.760	36	0.125	33	0.115	288
9/24	280	0.657	30	0.070	116	0.273	426
Mean		0.758		0.113		0.129	
Standard Error		0.065		0.044		0.083	

[1] Proportion of total count.

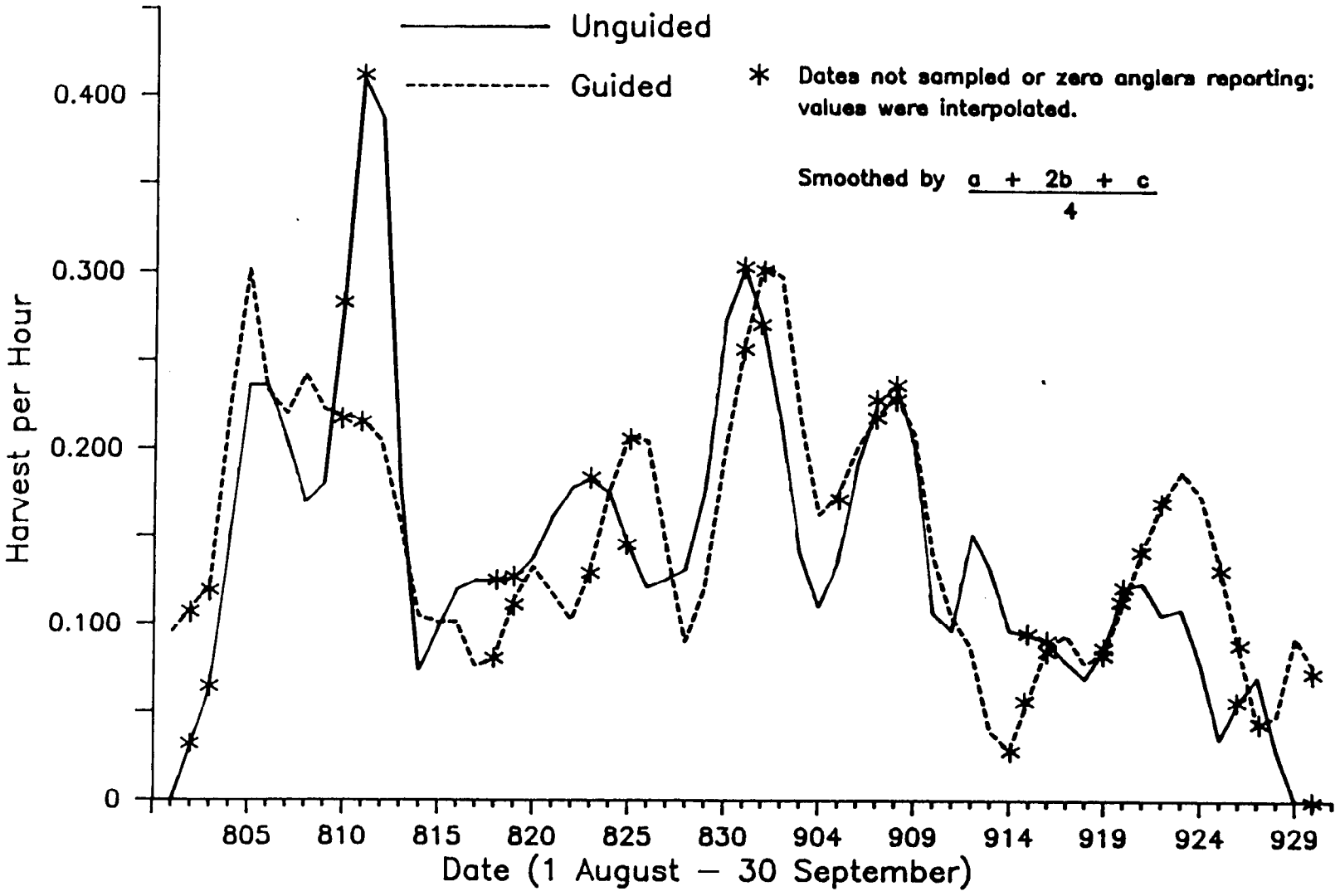

Figure 7. Daily harvest per hour of coho salmon by guided and unguided anglers in the recreational fishery for coho salmon in the downstream section of the Kenai River, 1988.

Table 22. Estimated harvest per unit effort (HPUR) and catch per unit effort (CPUE) of coho salmon by anglers during each of the components of the fishery for coho salmon in the downstream section of the Kenai River, 1988.

Component	Days n[1]	Days N[2]	Number of Interviews[3]	Harvest HPUE	Standard Error	Catch CPUE	Standard Error
EARLY RUN							
Unguided weekdays	14	22	535	0.1539	0.02054	0.1539	0.02054
Unguided weekends	8	8	482	0.1330	0.01204	0.1357	0.01243
Guided weekdays	14	22	407	0.1505	0.02245	0.1505	0.02245
Guided weekends	8	8	202	0.1361	0.01636	0.1361	0.01636
Shore weekdays	7	22	110	0.0958	0.02452	0.0998	0.02490
Shore weekends	4	8	25	0.2293	0.05843	0.2293	0.05843
LATE RUN							
Unguided weekdays	12	19	558	0.1511	0.01907	0.1523	0.01893
Unguided weekends	9	9	632	0.0803	0.00802	0.0808	0.00811
Guided weekdays	8	19	79	0.1812	0.03734	0.1812	0.03734
Guided weekends	7	9	138	0.1201	0.01791	0.1201	0.01791
Shore weekday	8	19	85	0.0764	0.04040	0.0764	0.04040
Shore weekends	7	9	111	0.0445	0.01362	0.0445	0.01322

[1] Number of days on which interviews were collected.
[2] Number of days possible for interviewing.
[3] Both completed-trip and incomplete trip interviews.

Table 23. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of sockeye salmon, pink salmon, rainbow trout, and Dolly Varden char by anglers during each of the components of the fishery for coho salmon in the downstream section of the Kenai River, 1988.

Component	SOCKEYE SALMON		PINK SALMON		RAINBOW TROUT		DOLLY VARDEN	
	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE
EARLY RUN								
Unguided weekdays	0.0007	0.0007	0.0513	0.4038	0.0000	0.0000	0.0007	0.0013
(Standard Error)	(0.0014)	(0.0014)	(0.0014)	(0.0650)	(0.0000)	(0.0000)	(0.0014)	(0.0023)
Unguided weekends	0.0000	0.0000	0.0373	0.2843	0.0000	0.0000	0.0007	0.0007
(Standard Error)	(0.0000)	(0.0000)	(0.0090)	(0.0281)	(0.0000)	(0.0000)	(0.0005)	(0.0005)
Guided weekdays	0.0000	0.0054	0.0515	0.2983	0.0000	0.0000	0.0014	0.0020
(Standard Error)	(0.0000)	(0.0045)	(0.0114)	(0.0462)	(0.0000)	(0.0000)	(0.0018)	(0.0020)
Guided weekends	0.0000	0.0000	0.0399	0.3340	0.0000	0.0000	0.0000	0.0000
(Standard Error)	(0.0000)	(0.0000)	(0.0079)	(0.0370)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Shore anglers wd[1]	0.0000	0.0319	0.1198	0.2754	0.0000	0.0000	0.0000	0.0040
(Standard Error)	(0.0000)	(0.1730)	(0.0362)	(0.0913)	(0.0000)	(0.0000)	(0.0000)	(0.0026
Shore anglers we[2]	0.0000	0.0000	0.0764	0.3312	0.0000	0.0000	0.0000	0.0000
(Standard Error)	(0.0000)	(0.0000)	(0.0363)	(0.0184)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
LATE RUN								
Unguided weekends	0.0000	0.0108	0.0018	0.0331	0.0000	0.0000	0.0006	0.0006
(Standard Error)	(0.0000)	(0.0063)	(0.0028)	(0.0306)	(0.0000)	(0.0000)	(0.0005)	(0.0005)
Unguided weekends	0.0000	0.0000	0.0000	0.0808	0.0000	0.0000	0.0000	0.0000
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0156)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Guided weekdays	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Guided weekends	0.0000	0.0000	0.0000	0.0607	0.0000	0.0000	0.0000	0.0000
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0366)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Shore anglers wd[1]	0.0000	0.0000	0.0449	0.3371	0.0000	0.0000	0.0000	0.0000
(Standard Error)	(0.0000)	(0.0000)	(0.0424)	(0.3010)	(0.0000)	(0.0000)	(0.0000)	(0.0000
Shore anglers we[2]	0.0000	0.0000	0.0000	0.0223	0.0000	0.0000	0.0000	0.0000
(Standard Error)	(0.0000)	(0.0000)	(0.0000)	(0.0684)	(0.0000)	(0.0008)	(0.0000)	(0.0000)

[1] wd - weekdays.
[2] we - weekends.

during the early run and from 0.000 to 0.417 fish per hour during the late run (Appendix Table D6). Peak daily catch rates of coho salmon by guided anglers occurred on 24 August during the early run and on 3 September during the late run. Overall harvest and catch rates of coho salmon by guided anglers were not significantly higher than those for unguided anglers during both runs (Table 24).

In the upstream section, other species were more significant to the recreational harvest of both guided and unguided anglers than in the downstream section, as can be attested to by the comparatively larger harvest and catch rates, especially for sockeye and pink salmon (Table 25).

Midstream Section. Harvest and catch rates for the midstream section were estimated by using the average downstream and upstream rates.

Harvest and Catch:

Harvest and catch of coho salmon by shore and boat anglers were estimated for each component in the downstream and upstream sections of the Kenai River. Estimated effort and catch rates for each component from Tables 18 and 22, respectively, were used to estimate harvest and catch in the downstream section. For the upstream section, estimated effort and catch rates for each component from Tables 20 and 24, respectively, were used to estimate harvest and catch.

Downstream Section. An estimated 31,832 coho salmon were harvested by anglers in the downstream section: 22,398 fish (70%) during the early run and 9,434 fish (30%) during the late run (Table 26). Unguided anglers harvested 25,032 coho salmon (79% of the total) and guided anglers harvested 6,800 fish (21% of the total). The total coho salmon catch by anglers in the downstream section was 32,101 fish: 22,625 fish (70%) during the early run and 9,476 fish (30%) during the late run (Table 26). Unguided anglers released only 1% of their coho salmon catch while guided anglers did not release any of their catch.

Upstream Section. An estimated 2,480 coho salmon were harvested by anglers in the upstream section: 1,463 fish (59%) during the early run and 1,017 fish (41%) during the late run (Table 27). Unguided anglers harvested 2,063 coho salmon (83% of the total) and guided anglers harvested 417 fish (17% of the total). The total coho salmon catch by anglers in the upstream section was 2,912 fish: 1,591 fish (55%) during the early run and 1,321 fish (45%) during the late run (Table 27). Unguided anglers released 17% of their coho salmon catch while guided anglers released only 3% of their catch.

Midstream Section. An estimated 3,747 coho salmon were harvested by anglers in the upstream section: 2,532 fish (68%) during the early run and 1,215 fish (32%) during the late run (Table 28).

Other Species. The estimates of harvest and catch of species other than coho salmon for the downstream and upstream sections are summarized in Tables 29 and 30, respectively. Pink salmon were the most common species caught in

Table 24. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of coho salmon by anglers during each of the components of the fishery for coho salmon in the upstream section of the Kenai River, 1988.

Component	Days n[1]	Days N[2]	Number of Interviews[3]	Harvest HPUE	Standard Error	Catch CPUE	Standard Error
EARLY RUN							
Unguided weekdays	12	22	542	0.0854	0.01860	0.0948	0.02054
Unguided weekends	6	8	644	0.0530	0.00688	0.0579	0.00753
Guided weekdays	10	22	100	0.1463	0.02885	0.1463	0.02885
Guided weekends	4	8	23	0.1040	0.03098	0.1040	0.03898
LATE RUN							
Unguided weekdays	11	19	585	0.0720	0.01112	0.0951	0.01251
Unguided weekends	8	9	966	0.0627	0.00648	0.0868	0.00847
Guided weekdays	9	19	78	0.1557	0.02827	0.1637	0.02872
Guided weekdays	6	9	32	0.1520	0.05257	0.1754	0.04834

[1] Number of days on which interviews were collected.

[2] Number of days possible for interviewing.

[3] Both completed-trip and incomplete trip interviews.

Table 25. Estimated harvest per unit effort (HPUE) and catch per unit effort (CPUE) of sockeye salmon, pink salmon, rainbow trout, and Dolly Varden char by anglers during each of the components of the fishery for coho salmon in the upstream section of the Kenai River, 1988.

Component	SOCKEYE SALMON		PINK SALMON		RAINBOW TROUT		DOLLY VARDEN	
	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE	HPUE	CPUE
EARLY RUN								
Unguided weekdays	0.0528	0.1925	0.0119	0.2074	0.0030	0.0126	0.0565	0.1219
(Standard Error)	(0.0113)	(0.0378)	(0.0039)	(0.0506)	(0.0028)	(0.0083)	(0.0118)	(0.0238)
Unguided weekends	0.0039	0.0708	0.0123	0.1676	0.0019	0.0084	0.0734	0.2216
(Standard Error)	(0.0018)	(0.0164)	(0.0027)	(0.0293)	(0.0008)	(0.0024)	(0.0103)	(0.0279)
Guided weekdays	0.0937	0.2991	0.0181	0.1299	0.0030	0.0393	0.0514	0.0967
(Standard Error)	(0.0332)	(0.0700)	(0.0088)	(0.0642)	(0.0017)	(0.0160)	(0.0161)	(0.0327)
Guided weekends	0.0203	0.2234	0.0000	0.0609	0.0000	0.0000	0.1218	0.2234
(Standard Error)	(0.0119)	(0.0579)	(0.0000)	(0.0637)	(0.0000)	(0.0000)	(0.0599)	(0.1060)
LATE RUN								
Unguided weekdays	0.0000	0.0177	0.0163	0.3743	0.0007	0.0034	0.0109	0.0149
(Standard Error)	(0.0000)	(0.0052)	(0.0044)	(0.0657)	(0.0008)	(0.0020)	(0.0032)	(0.0033)
Unguided weekends	0.0000	0.0429	0.0130	0.4807	0.0005	0.0005	0.0121	0.0260
(Standard Error)	(0.0000)	(0.0095)	(0.0039)	(0.0469)	(0.0004)	(0.0004)	(0.0051)	(0.0084)
Guided weekdays	0.0000	0.0838	0.0040	0.2834	0.0000	0.0080	0.0279	0.0319
(Standard Error)	(0.0000)	(0.0603)	(0.0016)	(0.0713)	(0.0000)	(0.0176)	(0.0128)	(0.0148)
Guided weekends	0.0000	0.2222	0.0000	0.6784	0.0000	0.0000	0.0117	0.0117
(Standard Error)	(0.0000)	(0.0728)	(0.0000)	(0.2390)	(0.0000)	(0.0000)	(0.0091)	(0.0091)

Table 26. Estimated number of coho salmon harvested and number caught by anglers during each of the components in the fishery for coho salmon in the downstream section of the Kenai River, 1988.

Component	Harvest[1]	Standard Error	Rel. Pre.[2]	Catch[3]	Standard Error	Rel. Pre.[2]
EARLY RUN						
Unguided weekdays	6,399	1,053	32.2%	6,399	1,053	32.2%
Unguided weekends	4,534	669	28.9%	4,626	686	29.1%
Guided weekdays	3,454	582	33.0%	3,454	582	33.0%
Guided weekends	1,074	152	27.8%	1,074	152	27.8%
Shore weekdays	3,367	932	54.3%	3,367	932	54.3%
Shore weekends	3,705	989	52.3%	3,705	989	52.3%
Sub-totals:						
Unguided	17,870	1,835	22.4%	18,097	1,851	22.3%
Guided	4,528	601	26.0%	4,528	601	26.0%
Early Run Total	22,398	1,931	16.9%	22,625	1,946	16.9%
LATE RUN						
Unguided weekdays	3,461	671	38.0%	3,488	672	37.8%
Unguided weekends	2,353	294	24.5%	2,368	297	24.6%
Guided weekdays	1,496	411	53.9%	1,496	411	53.9%
Guided weekdays	776	157	39.5%	776	157	39.5%
Shore weekdays	939	508	106.1%	939	508	106.1%
Shore weekends	409	135	64.4%	409	135	64.4%
Sub-totals:						
Unguided	7,162	733	24.7%	7,204	735	24.6%
Guided	2,272	440	38.0%	2,272	440	38.0%
Late Run Total	9,434	1,003	20.8%	9,476	1,005	20.8%
BOTH RUNS COMBINED						
Unguided	25,032	2,045	16.0%	25,301	2,060	16.0%
Guided	6,800	745	21.5%	6,800	745	21.5%
GRAND TOTAL	31,832	2,176	13.4%	32,101	2,190	13.4%

1 Harvest includes only fish kept.
2 Relative precision for 95% confidence interval.
3 Catch includes fish kept and fish reported as released.

Table 27. Estimated number of coho salmon harvested and number caught by anglers during each of the components in the fishery for coho salmon in the upstream section of the Kenai River, 1988.

Component	Harvest[1]	Standard Error	Rel. Pre.[2]	Catch[3]	Standard Error	Rel. Pre.[2]
EARLY RUN						
Unguided weekdays	808	202	48.9%	897	229	48.7%
Unguided weekends	423	101	47.0%	462	111	47.0%
Guided weekdays	205	58	55.8%	205	58	55.8%
Guided weekends	27	13	94.4%	27	13	94 4%
Sub-totals:						
Unguided	1,321	226	35.9%	1,359	249	35.9%
Guided	232	60	50.5%	232	60	50.5%
Early Run Total	1,463	233	31.3%	1,591	256	31.5%
LATE RUN						
Unguided weekdays	452	832	35.9%	597	98	32.3%
Unguided weekends	380	58	29.8%	526	78	29.0%
Guided weekdays	149	51	67.5%	157	54	66.9%
Guided weekends	36	18	95.7%	41	19	89.0%
Sub-totals:						
Unguided	832	101	23.8%	1,123	126	21.9%
Guided	185	54	57.5%	198	57	56.1%
Late Run Total	1,017	115	22.1%	1,321	138	20.4%
BOTH RUNS COMBINED						
Unguided	2,063	247	23.5%	2,482	279	22.0%
Guided	417	81	37.9%	430	82	37.5%
GRAND TOTAL	2,480	260	20.5%	2,912	291	19.6%

1 Harvest includes only fish kept.

2 Relative precision for 95% confidence interval.

3 Catch includes fish kept and fish reported as released.

Table 28. Summary of estimated angler-effort, coho salmon harvest, and coho salmon catch by all anglers for each river section of the fishery for coho salmon in the Kenai River, 1988.

Run	Downstream Section	Upstream Section	Midstream Section	Total	95% Confidence Interval
Early Run					
Effort	156,405	19,103	22,359	197,867	173,228 - 222,505
St. Err.	7,406	2,029	9,953	12,571	
Harvest	22,398	1,463	2,532	26,393	22,252 - 30,534
St. Err.	1,931	233	825	2,113	
Catch	22,625	1,591	2,614	26,830	22,650 - 31,010
St. Err.	1,946	256	834	2,133	
Late Run					
Effort	88,423	13,532	12,989	114,944	100,000 - 129,887
St. Err.	4,866	972	5,788	7,642	
Harvest	9,434	1,017	1,215	11,666	9,463 - 13,869
St. Err.	1,003	115	494	1,124	
Catch	9,476	1,321	1,376	12,173	9,963 - 14,383
St. Err.	1,005	138	493	1,128	
Total Both Runs					
Effort	244,828	32,635	35,348	312,811	283,955 - 341,627
St. Err.	8,862	2,250	11,513	14,702	
Harvest	31,832	2,480	3,747	38,059	33,510 - 42,608
St. Err.	2,176	260	962	2,393	
Catch	32,101	2,912	3,990	39,003	34,275 - 43,731
St. Err.	2,190	291	969	2,412	

Table 29. Estimated number of sockeye salmon, rainbow trout, and Dolly Varden char harvested and caught by anglers during the fishery for coho salmon in the downstream section of the Kenai River, 1988.

Species	Unguided Anglers				Guided Anglers				Shore Anglers			
	Harvest[1]	St. Err.	Catch[2]	St. Err.	Harv.[1]	St. Err.	Catch[2]	St. Err.	Harv.[1]	St. Err.	Catch[2]	St. Err.
EARLY RUN												
Sockeye salmon	29	58	29	58	0	0	124	103	0	0	1,105	5,801
Pink Salmon	3,405	401	26,481	3,475	1,497	284	9,481	1,239	5,276	1,440	14,643	4,428
Dolly Varden	53	61	78	97	32	40	46	45	0	0	135	90
LATE RUN												
Pink Salmon	41	65	3,126	856	0	0	392	240	552	525	4,350	3,760
Dolly Varden	14	11	14	11	0	0	0	0	0	0	0	0

[1] Harvest includes only fish kept.

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

Table 30. Estimated number of sockeye salmon, rainbow trout, and Dolly Varden char harvested and caught by anglers during the fishery for coho salmon in the upstream section of the Kenai River, 1988.

Species	Unguided Anglers				Guided Anglers			
	Harvest[1]	St. Err.	Catch[2]	St. Err.	Harvest[1]	St. Err.	Catch[2]	St. Err.
EARLY RUN								
Sockeye salmon	530	124	2,386	455	136	53	579	133
Pink salmon	211	49	3,299	641	25	13	198	97
Rainbow trout	43	27	186	82	4	3	55	25
Dolly Varden	1,120	193	2,921	498	104	33	195	63
LATE RUN								
Sockeye salmon	0	0	371	73	0	0	132	65
Pink salmon	181	39	5,263	640	4	2	431	131
Rainbow trout	7	5	24	13	0	0	8	16
Dolly Varden	141	38	251	58	30	14	34	16

[1] Harvest includes only fish kept.

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

both the downstream and upstream sections. A total of 67,664 pink salmon were caught during August and September; however, only 11,192 fish (17%) were retained.

Summary:

The estimated total angler-effort in the Kenai River during the coho salmon fishery was 312,811 angler-hours (Table 28). Estimated total harvest and catch of coho salmon during the coho salmon fishery were 38,059 fish and 39,003 fish, respectively (Table 28). An additional 330 coho salmon were harvested during the chinook salmon fishery. Based on information collected from the downstream and upstream sections, unguided anglers exerted 82.6% of the effort and harvested 79.0% of the coho salmon while guided anglers exerted 17.4% of the effort and harvested 21.0% of the fish. The majority of the effort (78.3%) and coho salmon harvest (83.7%) were estimated to occur in the downstream section of the fishery (Figure 8). In contrast to the chinook salmon fishery, where an estimated 28% of the chinook salmon caught by anglers were released, only 2% of the coho salmon caught were released.

Biological Data:

The most abundant age groups in the early run harvest were ages 2.1 and 3.1 coho salmon which composed 73.2% and 18.0% of the sample, respectively (Table 31). Ages 2.1 and 3.1 coho salmon were the most abundant age groups in the late run harvest, also, contributing 67.3% and 20.5% to the sample, respectively (Table 31). The mean lengths at age for each sex were greater in late-run fish than in early-run fish for all age groups (Table 32).

Discussion:

The assumption was made that incomplete-trip interviews provide an unbiased estimate of harvest rate. Conrad and Hammarstrom (1987) concluded that this was not a significant source of error in the 1986 survey. The assumption that interviews were collected in proportion to effort was also examined in 1986 (Conrad and Hammarstrom 1987) and concluded to be met in all but one strata, thus no similar examination was performed in 1988.

SUMMARY

Creel surveys were conducted from 17 May through 30 September in the downstream section and from 3 June through 30 September in the upstream section of the Kenai River. The estimated total effort by recreational anglers in the Kenai River between the outlet of Skilak Lake and Cook Inlet was 934,471 angler-hours (Table 33). This is a minimum estimate of effort, as it does not include the effort by shore anglers during the period 16 May through 31 July. Most fishing effort occurred in the downstream section of the Kenai River. About 75% of the total effort was by unguided anglers and 25% by guided anglers. Effort during the chinook salmon fishery was the largest recorded since creel surveys of these fisheries began in 1974.

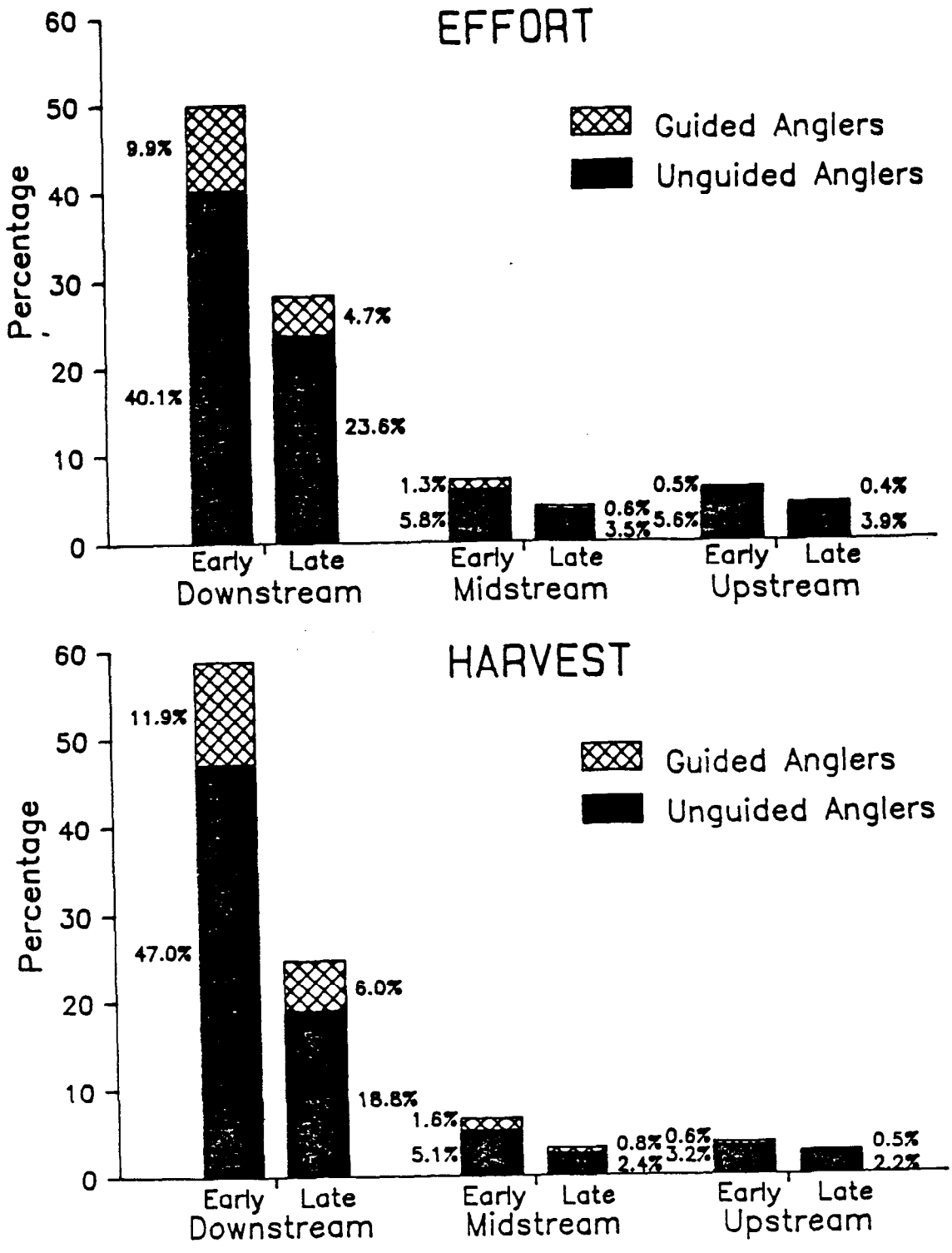

Figure 8. Percent of total angler effort and coho salmon harvest by guided and unguided anglers for each run and river section of the coho salmon fishery in the Kenai River, 1988.

Table 31. Age composition of coho salmon sampled from the harvest during the early and late runs of the fishery for coho salmon in the Kenai River, 1988.

RUN	Sex		Age Group 1.1	2.1	3.1	Total
EARLY	Male	Percent	3.5	43.6	11.5	58.7
(n=433)[1]	Female	Percent	5.1	29.6	6.5	41.3
	Combined	Percent	8.5	73.2	18.0	
		St. Error	0.01	0.02	0.02	
LATE	Male	Percent	6.9	37.3	11.3	55.7
(n=566)	Female	Percent	5.1	30.0	9.2	44.3
	Combined	Percent	12.0	67.3	20.5	
		St. Error	0.01	0.02	0.02	

[1] n = sample size.

Table 32. Mean length (mm) by age group of coho salmon sampled from the harvest during the early and late runs of the fishery for coho salmon in the Kenai River, 1988.

Run / Sex		Age Group 1.1	2.1	3.1
EARLY RUN				
Male	Mean Length	619	633	639
	Standard Error	16	3	5
	Sample Size	15	189	50
Female	Mean Length	596	612	626
	Standard Error	8	4	6
	Sample Size	22	128	28
LATE RUN				
Male	Mean Length	654	658	657
	Standard Error	6	3	6
	Sample Size	39	209	64
Female	Mean Length	636	648	653
	Standard Error	7	3	6
	Sample Size	29	169	51

Table 33. Summary of the number of angler-hours of fishing effort estimated for each of the major components of the recreational fishery in the lower Kenai River, 1988.

Component	Estimated Effort	Standard Error
Chinook Salmon Fishery[1]		
Early Run - Downstream - Unguided anglers	134,807	7,113
- Guided anglers	66,636	2,477
- Upstream - Unguided anglers	24,312	2,012
- Guided anglers	2,178	332
- Midstream - Unguided anglers	22,317	6,211
- Guided anglers	9,651	2,671
Late Run - Downstream - Unguided anglers	235,043	7,658
- Guided anglers	88,331	3,166
- Upstream - Unguided anglers	15,647	2,689
- Guided anglers	1,177	241
- Midstream - Unguided anglers	15,888	7,784
- Guided anglers	5,673	2,781
Sub-totals:		
Unguided anglers	448,014	14,822
Guided anglers	173,646	5,585
Coho Salmon Fishery		
Early Run - Downstream - Unguided anglers[1]	75,669	5,676
- Guided anglers[1]	30,838	1,904
- Shore anglers	49,898	4,360
- Upstream - Unguided anglers[2]	17,436	2,005
- Guided anglers[1]	1,667	310
- Midstream - Unguided anglers[2]	18,218	8,125
- Guided anglers[1]	4,141	1,851
Late Run - Downstream - Unguided anglers[1]	52,210	4,055
- Guided anglers[1]	14,718	1,773
- Shore anglers	21,495	2,025
- Upstream - Unguided anglers[2]	12,338	925
- Guided anglers[1]	1,194	298
- Midstream - Unguided anglers[2]	10,962	4,891
- Guided anglers[1]	2,027	927
Sub-totals:		
Unguided anglers[2]	258,226	12,907
Guided anglers[1]	54,585	3,352
GRAND TOTAL	934,471	20,705

[1] Estimates are for boat anglers only.
[2] Estimates are for both boat and shore anglers.

The harvest of chinook salmon was also the largest recorded since 1974. Pink salmon were the most frequently caught species in the survey area (Table 34), followed by chinook salmon and coho salmon. More coho salmon were harvested than any other species in the survey area (Table 34), followed by chinook salmon and sockeye salmon. The estimated harvest of sockeye salmon is a minimum estimate because shore-based anglers during late July and the fishery in the midstream section during early August harvest large numbers of this species.

RECOMMENDATIONS

Based upon the results of the creel survey conducted in the lower Kenai River in 1988, we recommend the following changes to the sample design and data analyses for 1989.

1. When not conducting angler counts during the chinook salmon fishery, the survey clerks using boats should conduct interviews to gather observations of the harvest for use in the population estimate. The information should only contain data regarding the harvest of tagged and untagged fish.

2. During both the chinook and coho fisheries, the upstream survey clerk should conduct angler interviews in the midstream section. Sampling intensity may be increased by utilizing the two boat operators in the downstream section to conduct angler interviews in the midstream section.

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Table 34. Estimated harvest and catch of major fish species by anglers during the recreational fisheries surveyed in the lower Kenai River, 1988.

Species	Estimated Harvest	Standard Error	Estimated Catch	Standard Error
Chinook salmon	30,259	1,211	41,961	1,565
Coho salmon	38,389	2,395	39,346	2,339
Sockeye salmon	16,096	3,499	37,435	14,040
Pink salmon	13,395	1,737	77,452	7,731
Rainbow trout	821	208	3,525	637
Dolly Varden char	6,932	506	13,160	840

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APPENDIX A

Counts of boat anglers during the creel survey of the fishery for chinook salmon in the Kenai River, 1988.

Appendix Table A1. Counts of unguided and guided boat anglers during the fishery for early run chinook salmon in the downstream section of the Kenai River, 1988.

		Unguided Anglers Period					Guided Anglers Period				
Date	Wd/ We	A	B	C	D	E	A	B	C	D	E
5/17	Wd										
5/18	Wd										
5/19	Wd	53				24	57				7
5/20	Wd		69		79			50		11	
5/21	We	134	222	121	118	148	97	95	93	28	5
5/22	We	249	275	139	89	39	109	112	83	48	15
5/23	Wd					CLOSED					
5/24	Wd		115		57			143		17	
5/25	Wd	69		103		61	91		54		15
5/26	Wd				77	18				69	4
5/27	Wd		115		156			129		33	
5/28	We	176	255	77	140	49	43	95	29	40	2
5/29	We	264	389	497	340	99	115	114	128	48	6
5/30	We	89					2				
5/31	Wd										
6/01	Wd										
6/02	Wd				142	167		96			
6/03	Wd		270	118			168	81			
6/04	We	216	523	388	409	588	281	137			
6/05	We	238	513	142	77	129	241	102			
6/06	Wd					CLOSED					
6/07	Wd										
6/08	Wd		161		134		223				
6/09	Wd	142	194	198		70	230	171			
6/10	Wd	79		232		84	268	119			
6/11	We	152	416	486	555	320	260	171			
6/12	We	399	336	279	87	19	169	33			
6/13	Wd					CLOSED					
6/14	Wd		287		267		268	168			
6/15	Wd	251		141		196	280	80			
6/16	Wd	242				267	247				
6/17	Wd		138		347		173	149			
6/18	We	160	461	347	293	102	289	152			
6/19	We	374	318	145	141	67	236	126			
6/20	Wd					CLOSED					
6/21	Wd		311	120			272	138			
6/22	Wd	208		145		190	265	178			
6/23	Wd		207		72		108	133			
6/24	Wd	89		170		190	193	199			
6/25	We	354	377	444	246	287	223	158			
6/26	We	223	532	288	171	106	186	114			

Appendix Table A2. Counts of unguided and guided boat anglers during the fishery for late run chinook salmon in the downstream section of the Kenai River, 1988.

Date	Wd/ We	Unguided Anglers Period A	B	C	D	E	Guided Anglers Period A	B
6/27	Wd					CLOSED		
6/28	Wd							
6/29	Wd		193		192		217	156
6/30	Wd	229		83		94	245	117
7/01	Wd	294	246	230		121	214	129
7/02	We	379	392	358	411	43	195	76
7/03	We	72	439	389	377	256	CLOSED TO GUIDES	
7/04	We					CLOSED		
7/05	Wd		256		136		275	182
7/06	Wd	253		163		2	264	163
7/07	Wd		275		265		224	154
7/08	Wd	334		309			313	157
7/09	We	558	547	717	496	549	325	189
7/10	We	445	721	631	496	302	CLOSED TO GUIDES	
7/11	Wd					CLOSED		
7/12	Wd		446		494		448	309
7/13	Wd		469		256		425	273
7/14	Wd	470		415		576	428	321
7/15	Wd	463		450		290	199	271
7/16	We	853	667	616	561	476	392	322
7/17	We	549	891	772	465	139	CLOSED TO GUIDES	
7/18	Wd					CLOSED		
7/19	Wd		724		494		544	348
7/20	Wd	570		348		404	485	378
7/21	Wd		508		421		418	381
7/22	Wd	270		489	335		185	288
7/23	We	416	690	792	515	556	436	
7/24	We	466	783	704	495	238	CLOSED TO GUIDES	
7/25	Wd					CLOSED		
7/26	Wd		568		491		483	346
7/27	Wd	344		560		192	429	344
7/28	Wd							
7/29	Wd				370			260
7/30	We	497	727	512	574	111	418	166
7/31	We	127	697	664	477	266	CLOSED TO GUIDES	

Appendix Table A3. Counts of unguided and guided boat anglers during the fishery for early run chinook salmon in the upstream section of the Kenai River, 1988.

		Unguided Anglers Period					Guided Anglers Period	
Date	Wd/We	A	B	C	D	E	A	B
6/03	Wd			10		7		4
6/04	We		12			21	0	
6/05	We			21		5	0	0
6/06	Wd					CLOSED		
6/07	Wd		7				0	
6/08	Wd							
6/09	Wd							
6/10	Wd		10	16			0	4
6/11	We	51				23		
6/12	We			37	17			3
6/13	Wd					CLOSED		
6/14	Wd			24				4
6/15	Wd			47	42		5	3
6/16	Wd							
6/17	Wd					48		
6/18	We	9	67				0	
6/19	We			85		1		8
6/20	Wd					CLOSED		
6/21	Wd							
6/22	Wd		24	35			4	5
6/23	Wd	12	30				4	6
6/24	Wd				75	32		15
6/25	We	32			108		7	9
6/26	We			82		8		7
6/27	Wd					CLOSED		
6/28	Wd		30	12			16	6
6/29	Wd							
6/30	Wd	13				18	3	
7/01	Wd			38	44		11	7
7/02	We				64	30		
7/03	We		78		102		CLOSED TO GUIDES	
7/04	We					CLOSED		
7/05	Wd		38	54			8	0
7/06	Wd				27	7		
7/07	Wd							
7/08	Wd	7			34			4
7/09	We		42	74			3	16
7/10	We	4		84			CLOSED TO GUIDES	
7/11	Wd					CLOSED		
7/12	Wd		24		29		0	4
7/13	Wd	9		19			0	5
7/14	Wd							
7/15	Wd			62		40		10

Appendix Table A4. Counts of unguided and guided boat anglers during the fishery for late run chinook salmon in the upstream section of the Kenai River, 1988.

		Unguided Anglers Period					Guided Anglers Period	
Date	Wd/We	A	B	C	D	E	A	B
7/16	We		63			109	4	
7/17	We				17	29	CLOSED TO GUIDES	
7/18	Wd					CLOSED		
7/19	Wd	3	44				0	
7/20	Wd							
7/21	Wd	12		61			14	17
7/22	Wd		50		73			0
7/23	We						3	8
7/24	We						CLOSED TO GUIDES	
7/25	Wd					CLOSED		
7/26	Wd	0						
7/27	Wd			71			14	
7/28	Wd		57		60		18	7
7/29	Wd		37			47	9	
7/30	We			305		141		13
7/31	We	21	193				CLOSED TO GUIDES	

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, 1988.

Appendix Table B1. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by unguided anglers interviewed during the early run of the fishery for chinook salmon in the downstream section of the Kenai River, 1988 (completed-trip interviews only).

Date	Wd/ We	SS[1]	EFFORT (hrs) Mean	EFFORT (hrs) SE[2]	HARVEST Mean	HARVEST SE[2]	HARVEST HPUE	CATCH Mean	CATCH SE[2]	CATCH CPUE
517	Wd	3	7.0	3.04	0.00	0.000	0.000	0.00	0.000	0.000
518	Wd	13	3.3	0.75	0.08	0.077	0.023	0.15	0.104	0.047
519	Wd	7	3.1	0.32	0.57	0.202	0.186	0.57	0.202	0.186
520	Wd	5	3.3	0.37	0.60	0.245	0.182	0.60	0.245	0.182
521	We	19	2.6	0.42	0.16	0.086	0.062	0.32	0.110	0.124
522	We	52	4.1	0.31	0.10	0.041	0.024	0.12	0.045	0.028
524	Wd	28	4.0	0.73	0.25	0.083	0.063	0.68	0.193	0.170
525	Wd	9	4.3	0.67	0.00	0.000	0.000	0.00	0.000	0.000
526	Wd	57	5.6	0.55	0.23	0.056	0.041	0.33	0.084	0.060
527	Wd	25	4.2	0.50	0.12	0.066	0.029	0.12	0.066	0.029
528	We	63	5.1	0.39	0.25	0.055	0.050	0.30	0.058	0.059
529	We	160	4.7	0.20	0.12	0.026	0.025	0.15	0.032	0.032
530	We	90	3.4	0.14	0.11	0.033	0.032	0.14	0.037	0.042
531	Wd	35	3.7	0.47	0.14	0.060	0.039	0.14	0.060	0.039
601	Wd	21	2.3	0.44	0.43	0.111	0.188	0.48	0.112	0.208
602	Wd	7	2.9	0.14	0.14	0.143	0.050	0.29	0.184	0.100
603	Wd	29	7.9	0.93	0.21	0.077	0.026	0.34	0.124	0.043
604	We	142	5.3	0.27	0.15	0.030	0.028	0.19	0.036	0.036
605	We	103	4.2	0.18	0.17	0.037	0.040	0.23	0.048	0.056
607	Wd	24	7.5	0.91	0.04	0.042	0.006	0.04	0.042	0.006
608	Wd	33	4.1	0.38	0.21	0.072	0.052	0.24	0.076	0.059
609	Wd	8	3.8	0.91	0.25	0.164	0.067	0.38	0.183	0.100
610	Wd	73	3.8	0.34	0.19	0.046	0.050	0.23	0.050	0.061
611	We	96	4.7	0.26	0.11	0.033	0.025	0.21	0.049	0.045
612	We	133	4.7	0.22	0.15	0.031	0.032	0.17	0.035	0.037
614	Wd	84	3.7	0.19	0.20	0.044	0.055	0.39	0.076	0.106
615	Wd	46	4.0	0.44	0.33	0.070	0.082	0.43	0.106	0.109
616	Wd	67	4.0	0.27	0.21	0.050	0.052	0.42	0.088	0.104
617	Wd	14	3.8	0.57	0.36	0.133	0.094	0.36	0.133	0.094
618	We	9	4.3	0.53	0.11	0.111	0.026	0.33	0.167	0.077
619	We	100	3.6	0.21	0.23	0.042	0.064	0.38	0.056	0.106
621	Wd	107	4.2	0.26	0.21	0.040	0.051	0.31	0.052	0.073
622	Wd	17	3.2	0.35	0.12	0.081	0.037	0.12	0.081	0.037
623	Wd	36	2.9	0.19	0.08	0.047	0.028	0.11	0.053	0.038
624	Wd	5	3.0	0.32	0.20	0.200	0.067	0.60	0.400	0.200
625	We	76	4.3	0.37	0.12	0.037	0.028	0.18	0.058	0.043
626	We	105	4.3	0.19	0.14	0.034	0.033	0.23	0.043	0.053

[1] Sample size, number of anglers interviewed.

[2] Standard error.

Appendix Table B2. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by guided anglers interviewed during the early run of the fishery for chinook salmon in the downstream section of the Kenai River, 1988 (completed-trip interviews only).

Date	Wd/ We	EFFORT (hrs) SS[1]	Mean	SE[2]	HARVEST Mean	SE[2]	HPUE	CATCH Mean	SE[2]	CPUE
517	Wd	6	3.8	0.53	0.00	0.000	0.000	0.00	0.000	0.000
518	Wd	5	4.8	1.36	0.40	0.245	0.083	0.40	0.245	0.083
519	Wd	5	4.7	0.49	0.40	0.245	0.085	0.40	0.245	0.085
520	Wd	2	4.5	0.50	0.50	0.500	0.111	0.50	0.500	0.111
521	We	8	5.5	0.19	0.00	0.000	0.000	0.00	0.000	0.000
522	We	39	3.9	0.25	0.59	0.080	0.150	0.74	0.088	0.190
524	Wd	20	4.0	0.43	0.50	0.115	0.125	0.65	0.150	0.163
525	Wd	15	3.7	0.62	0.60	0.131	0.161	0.93	0.228	0.250
526	Wd	19	3.4	0.43	0.32	0.110	0.092	0.47	0.140	0.137
527	Wd	32	3.8	0.33	0.56	0.089	0.147	0.78	0.108	0.204
528	We	33	3.5	0.39	0.52	0.088	0.145	0.64	0.085	0.179
529	We	57	4.6	0.26	0.32	0.062	0.068	0.40	0.070	0.087
530	We	2	3.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
531	Wd	6	3.7	0.76	0.00	0.000	0.000	0.83	0.477	0.227
601	Wd	10	3.0	0.69	0.80	0.133	0.271	1.00	0.211	0.339
602	Wd	23	4.2	0.36	0.43	0.106	0.104	0.74	0.157	0.177
603	Wd	18	5.0	0.46	0.33	0.114	0.067	0.39	0.118	0.078
604	We	41	5.6	0.50	0.49	0.079	0.087	0.80	0.136	0.143
605	We	26	4.3	0.34	0.38	0.097	0.089	0.58	0.159	0.133
607	Wd	29	5.8	0.42	0.14	0.065	0.024	0.21	0.077	0.036
609	Wd	38	4.4	0.40	0.34	0.078	0.077	0.55	0.090	0.124
610	Wd	41	5.0	0.30	0.39	0.077	0.078	0.59	0.110	0.118
611	We	60	5.0	0.28	0.38	0.063	0.076	0.72	0.095	0.142
612	We	45	3.8	0.32	0.40	0.074	0.107	0.40	0.074	0.107
614	Wd	34	3.9	0.39	0.59	0.086	0.153	0.71	0.130	0.183
615	Wd	74	4.1	0.25	0.53	0.058	0.127	0.65	0.068	0.157
616	Wd	67	4.5	0.23	0.51	0.062	0.113	0.75	0.081	0.166
617	Wd	60	4.0	0.27	0.53	0.065	0.133	0.78	0.107	0.195
618	We	58	4.7	0.25	0.41	0.065	0.088	0.71	0.101	0.150
619	We	41	3.8	0.32	0.46	0.079	0.123	0.66	0.096	0.175
621	Wd	26	4.3	0.71	0.54	0.100	0.126	0.69	0.133	0.161
622	Wd	75	4.9	0.19	0.33	0.055	0.068	0.47	0.067	0.095
623	Wd	26	4.4	0.35	0.42	0.099	0.096	0.42	0.099	0.096
624	Wd	29	4.4	0.45	0.21	0.077	0.047	0.48	0.118	0.111
625	We	40	4.7	0.41	0.23	0.067	0.048	0.33	0.075	0.069
626	We	23	4.5	0.35	0.26	0.094	0.057	0.35	0.102	0.077

[1] Sample size, number of anglers interviewed.

[2] Standard error.

Appendix Table B3. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by unguided anglers interviewed during the late run of the fishery for chinook salmon in the downstream section of the Kenai River, 1988 (completed-trip interviews only).

Date	Wd/ We	EFFORT (hrs) SS[1]	Mean	SE[2]	HARVEST Mean	SE[2]	HPUE	CATCH Mean	SE[2]	CPUE
628	Wd	28	3.1	0.23	0.32	0.090	0.102	0.57	0.158	0.182
629	Wd	36	3.8	0.46	0.19	0.067	0.051	0.19	0.067	0.051
630	Wd	15	5.4	0.74	0.27	0.118	0.050	0.73	0.316	0.137
701	Wd	16	3.5	0.40	0.19	0.101	0.054	0.19	0.101	0.054
702	We	44	5.3	0.47	0.07	0.038	0.013	0.07	0.038	0.013
703	We	47	4.4	0.42	0.04	0.030	0.010	0.09	0.041	0.019
705	Wd	32	3.0	0.41	0.06	0.043	0.021	0.06	0.043	0.021
706	Wd	43	3.9	0.26	0.14	0.053	0.036	0.21	0.071	0.054
707	Wd	89	4.3	0.18	0.15	0.038	0.034	0.24	0.053	0.055
708	Wd	17	4.9	0.71	0.06	0.059	0.012	0.12	0.081	0.024
709	We	80	3.8	0.21	0.05	0.025	0.013	0.06	0.027	0.017
710	We	84	5.1	0.30	0.14	0.038	0.028	0.26	0.074	0.052
712	Wd	144	3.3	0.12	0.22	0.035	0.068	0.35	0.044	0.105
713	Wd	34	4.0	0.46	0.29	0.079	0.074	0.50	0.135	0.126
714	Wd	56	4.7	0.40	0.07	0.035	0.015	0.11	0.042	0.023
715	Wd	71	3.7	0.28	0.21	0.049	0.056	0.21	0.049	0.056
716	We	212	5.3	0.20	0.06	0.017	0.012	0.08	0.019	0.015
717	We	263	4.5	0.17	0.08	0.016	0.017	0.08	0.017	0.018
719	Wd	60	3.2	0.18	0.10	0.039	0.031	0.15	0.052	0.047
720	Wd	71	3.9	0.14	0.13	0.040	0.033	0.13	0.040	0.033
721	Wd	63	2.9	0.20	0.32	0.059	0.109	0.38	0.073	0.131
722	Wd	71	3.0	0.18	0.35	0.057	0.116	0.39	0.058	0.130
723	We	87	5.1	0.42	0.15	0.038	0.029	0.15	0.038	0.029
724	We	242	4.6	0.16	0.20	0.026	0.043	0.22	0.029	0.048
726	Wd	108	3.9	0.19	0.24	0.041	0.062	0.32	0.051	0.084
727	Wd	162	4.7	0.19	0.06	0.018	0.012	0.07	0.021	0.016
728	Wd	83	4.4	0.15	0.01	0.012	0.003	0.02	0.017	0.005
729	Wd	49	3.4	0.28	0.10	0.044	0.030	0.10	0.044	0.030
730	We	125	4.4	0.18	0.09	0.025	0.020	0.12	0.031	0.027
731	We	75	4.1	0.26	0.13	0.040	0.033	0.15	0.041	0.036

[1] Sample size, number of anglers interviewed.

[2] Standard error.

Appendix Table B4. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by guided anglers interviewed during the late run of the fishery for chinook salmon in the downstream section of the Kenai River, 1988 (completed-trip interviews only).

Date	Wd/ We	EFFORT (hrs) SS[1]	Mean	SE[2]	HARVEST Mean	SE[2]	HPUE	CATCH Mean	SE[2]	CPUE
628	Wd	71	4.1	0.33	0.63	0.058	0.155	0.83	0.069	0.203
629	Wd	30	4.7	0.47	0.57	0.092	0.121	0.77	0.133	0.163
701	Wd	3	3.8	0.17	0.33	0.333	0.087	0.33	0.333	0.087
702	We	6	5.0	0.00	0.17	0.167	0.033	0.17	0.167	0.033
706	Wd	49	3.7	0.27	0.47	0.072	0.128	0.57	0.071	0.156
707	Wd	11	5.2	0.74	0.27	0.141	0.053	0.36	0.203	0.070
708	Wd	50	4.1	0.29	0.40	0.070	0.097	0.40	0.070	0.097
709	We	49	6.8	0.53	0.37	0.070	0.054	0.39	0.070	0.057
712	Wd	112	4.4	0.24	0.52	0.047	0.118	0.65	0.062	0.149
713	Wd	38	4.9	0.27	0.21	0.067	0.043	0.29	0.075	0.059
714	Wd	102	4.9	0.28	0.37	0.048	0.076	0.54	0.069	0.110
715	Wd	4	4.5	0.50	0.50	0.289	0.111	0.75	0.250	0.167
716	We	40	4.5	0.20	0.23	0.067	0.051	0.25	0.069	0.056
719	Wd	42	5.3	0.37	0.45	0.078	0.086	0.55	0.109	0.104
720	Wd	42	4.6	0.22	0.24	0.067	0.051	0.31	0.080	0.067
721	Wd	29	4.2	0.39	0.38	0.092	0.091	0.97	0.145	0.232
722	Wd	66	3.2	0.23	0.68	0.058	0.212	0.92	0.092	0.288
723	We	112	3.8	0.17	0.52	0.047	0.138	0.63	0.058	0.169
726	Wd	71	4.2	0.26	0.49	0.060	0.116	0.63	0.081	0.149
727	Wd	107	4.6	0.20	0.29	0.044	0.063	0.48	0.058	0.104
728	Wd	50	5.3	0.21	0.16	0.052	0.030	0.16	0.052	0.030
730	We	32	4.4	0.37	0.41	0.088	0.093	0.47	0.100	0.107

[1] Sample size, number of anglers interviewed.

[2] Standard error.

Appendix Table B5. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by unguided anglers interviewed during the early run of the fishery for chinook salmon in the upstream section of the Kenai River, 1988 (all interviews).

Date	Wd/ We	EFFORT (hrs) SS[1]	Mean	SE[2]	HARVEST Mean	SE[2]	HPUE	CATCH Mean	SE[2]	CPUE
603	Wd	18	1.8	0.35	0.00	0.000	0.000	0.00	0.000	0.000
604	We	54	1.8	0.22	0.02	0.019	0.010	0.04	0.026	0.021
605	We	41	1.3	0.15	0.00	0.000	0.000	0.00	0.000	0.000
607	Wd	26	0.9	0.08	0.00	0.000	0.000	0.00	0.000	0.000
610	Wd	42	1.4	0.13	0.05	0.033	0.033	0.07	0.053	0.050
611	We	50	3.7	0.36	0.02	0.020	0.005	0.04	0.028	0.011
612	We	27	2.2	0.19	0.04	0.037	0.017	0.04	0.037	0.017
614	Wd	32	2.8	0.34	0.00	0.000	0.000	0.00	0.000	0.000
615	Wd	51	2.9	0.27	0.00	0.000	0.000	0.00	0.000	0.000
617	Wd	65	3.2	0.37	0.05	0.026	0.014	0.05	0.026	0.014
618	We	84	1.7	0.14	0.00	0.000	0.000	0.00	0.000	0.000
619	We	29	3.6	0.39	0.07	0.048	0.019	0.14	0.082	0.038
622	Wd	44	2.8	0.23	0.02	0.023	0.008	0.20	0.090	0.074
623	Wd	46	2.3	0.24	0.07	0.037	0.028	0.15	0.054	0.065
624	Wd	92	1.7	0.13	0.05	0.024	0.032	0.10	0.035	0.058
625	We	128	2.6	0.18	0.03	0.015	0.012	0.09	0.031	0.033
626	We	79	2.0	0.18	0.00	0.000	0.000	0.01	0.013	0.006
628	Wd	52	2.3	0.21	0.02	0.019	0.008	0.15	0.100	0.067
630	Wd	55	2.2	0.24	0.00	0.000	0.000	0.07	0.044	0.033
701	Wd	105	2.3	0.19	0.03	0.016	0.012	0.05	0.021	0.020
702	We	102	3.5	0.26	0.02	0.014	0.006	0.02	0.014	0.006
703	We	203	2.7	0.11	0.01	0.007	0.004	0.02	0.013	0.009
705	Wd	73	1.8	0.14	0.01	0.014	0.007	0.12	0.070	0.067
706	Wd	37	1.7	0.18	0.00	0.000	0.000	0.00	0.000	0.000
708	Wd	13	1.2	0.12	0.00	0.000	0.000	0.00	0.000	0.000
709	We	96	3.1	0.22	0.01	0.010	0.003	0.01	0.010	0.003
710	We	85	2.2	0.19	0.02	0.017	0.011	0.02	0.017	0.011
712	Wd	88	3.4	0.26	0.00	0.000	0.000	0.02	0.016	0.007
713	Wd	100	2.1	0.19	0.00	0.000	0.000	0.00	0.000	0.000
715	Wd	228	2.4	0.13	0.00	0.000	0.000	0.01	0.006	0.004

[1] Sample size, number of anglers interviewed.

[2] Standard error.

Appendix Table B6. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by unguided anglers interviewed during the late run of the fishery for chinook salmon in the upstream section of the Kenai River, 1988 (all interviews).

Date	Wd/ We	EFFORT (hrs) SS[1]	Mean	SE[2]	HARVEST Mean	SE[2]	HPUE	CATCH Mean	SE[2]	CPUE
716	We	158	3.5	0.18	0.01	0.009	0.004	0.01	0.009	0.004
717	We	109	3.1	0.20	0.00	0.000	0.000	0.02	0.013	0.006
719	Wd	22	1.0	0.10	0.00	0.000	0.000	0.09	0.063	0.087
721	Wd	72	1.9	0.19	0.00	0.000	0.000	0.00	0.000	0.000
722	Wd	118	2.2	0.13	0.00	0.000	0.000	0.00	0.000	0.000
723	We	197	2.0	0.10	0.00	0.000	0.000	0.00	0.000	0.000
724	We	155	1.9	0.10	0.00	0.000	0.000	0.00	0.000	0.000
727	Wd	81	2.0	0.15	0.00	0.000	0.000	0.01	0.012	0.006
728	Wd	95	2.5	0.16	0.01	0.011	0.004	0.02	0.015	0.009
729	Wd	36	1.1	0.13	0.00	0.000	0.000	0.06	0.039	0.051
730	We	103	3.0	0.31	0.01	0.010	0.003	0.01	0.010	0.003
731	We	107	1.3	0.10	0.00	0.000	0.000	0.00	0.000	0.000

[1] Sample size, number of anglers interviewed.

[2] Standard error.

Appendix Table B7. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by guided anglers interviewed during the early and late runs of the fishery for chinook salmon in the upstream section of the Kenai River, 1988 (all interviews).

Date	Wd/ We	EFFORT (hrs) SS[1]	Mean	SE[2]	HARVEST Mean	SE[2]	HPUE	CATCH Mean	SE[2]	CPUE
					Early Run					
603	Wd	4	9.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
610	Wd	8	1.6	0.15	0.25	0.164	0.160	0.25	0.164	0.160
612	We	3	1.3	0.17	0.33	0.333	0.250	0.33	0.333	0.250
615	Wd	9	5.4	0.37	0.00	0.000	0.000	0.11	0.111	0.020
619	We	8	3.4	0.38	0.25	0.164	0.074	0.25	0.164	0.074
622	Wd	7	3.7	0.90	0.43	0.202	0.115	0.43	0.202	0.115
623	Wd	10	2.1	0.28	0.50	0.167	0.233	1.20	0.442	0.558
624	Wd	15	4.3	0.68	0.33	0.126	0.078	1.33	0.454	0.310
625	We	20	1.9	0.28	0.20	0.092	0.105	0.35	0.109	0.184
626	We	8	3.2	0.58	0.75	0.164	0.235	1.00	0.000	0.314
628	Wd	25	2.3	0.30	0.44	0.101	0.188	1.44	0.444	0.615
630	Wd	3	1.0	0.00	0.00	0.000	0.000	0.67	0.333	0.667
701	Wd	19	3.1	0.40	0.32	0.110	0.103	1.16	0.318	0.376
702	We	17	4.5	0.27	0.12	0.081	0.026	0.18	0.095	0.039
703	We	3	2.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
705	Wd	22	1.5	0.23	0.41	0.107	0.281	0.95	0.213	0.656
706	Wd	19	3.0	0.20	0.26	0.104	0.088	0.32	0.110	0.106
709	We	16	4.1	0.75	0.00	0.000	0.000	0.06	0.063	0.015
712	Wd	8	1.5	0.00	0.00	0.000	0.000	0.00	0.000	0.000
713	Wd	16	3.3	0.06	0.00	0.000	0.000	0.00	0.000	0.000
715	Wd	20	2.6	0.68	0.10	0.069	0.038	0.10	0.069	0.038
					Late Run					
721	Wd	16	3.3	0.53	0.00	0.000	0.000	0.00	0.000	0.000
723	We	8	1.6	0.34	0.00	0.000	0.000	0.13	0.125	0.077
727	Wd	9	5.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
728	Wd	22	3.0	0.10	0.05	0.045	0.015	0.05	0.045	0.015
729	Wd	9	1.3	0.17	0.00	0.000	0.000	0.00	0.000	0.000
730	We	3	3.0	0.50	0.33	0.333	0.111	0.33	0.333	0.111

[1] Sample size, number of anglers interviewed.

[2] Standard error.

Appendix Table B8. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch by unguided and guided anglers interviewed during the fishery for chinook salmon in the midstream section of the Kenai River, 1988 (completed-trip interviews only).

Date	Wd/ We	EFFORT (hrs) SS[1]	Mean	SE[2]	HARVEST Mean	SE[2]	HPUE	CATCH Mean	SE[2]	CPUE
					Unguided Anglers					
612	We	14	2.8	0.18	0.00	0.000	0.000	0.00	0.000	0.000
619	We	5	3.3	0.12	0.00	0.000	0.000	0.00	0.000	0.000
624	Wd	2	3.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
626	We	6	4.8	0.11	0.00	0.000	0.000	0.00	0.000	0.000
628	Wd	2	0.5	0.00	0.00	0.000	0.000	0.00	0.000	0.000
702	We	15	2.6	0.30	0.00	0.000	0.000	0.00	0.000	0.000
716	We	6	2.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
724	We	5	1.7	0.12	0.00	0.000	0.000	0.00	0.000	0.000
729	Wd	3	2.5	0.00	0.00	0.000	0.000	0.00	0.000	0.000
730	We	9	3.3	0.33	0.00	0.000	0.000	0.00	0.000	0.000
					Guided Anglers					
612	We	2	3.5	0.00	0.00	0.000	0.000	0.00	0.000	0.000
615	Wd	9	5.8	0.68	0.22	0.147	0.038	0.22	0.147	0.038
624	Wd	10	3.9	0.45	0.30	0.153	0.077	0.30	0.153	0.077
626	We	4	3.6	0.38	0.25	0.250	0.069	0.25	0.250	0.069
628	Wd	2	3.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
708	Wd	10	6.2	0.51	0.20	0.133	0.032	0.20	0.133	0.032
730	We	4	3.5	0.00	0.00	0.000	0.000	0.25	0.250	0.071

[1] Sample size, number of anglers interviewed.

[2] Standard error.

APPENDIX C

Counts of anglers during the creel survey of the fishery for coho salmon in the Kenai River, 1988

Appendix Table C1. Counts of unguided and guided boat anglers during the fishery for coho salmon in August and September in the downstream section of the Kenai River, 1988.

Date	Wd/ We	Unguided Anglers Period A	B	C	D	Guided Anglers Period A	B	C	D
8/01	Wd		21	32			93	37	
8/02	Wd								
8/03	Wd								
8/04	Wd			147	108			23	6
8/05	Wd	80	177			63	90		
8/06	We			295	251			54	12
8/07	We	234	397			86	75		
8/08	Wd		147	229			135	81	
8/09	Wd	178	184			121	93		
8/10	Wd								
8/11	Wd								
8/12	Wd								
8/13	We	411			352	117			29
8/14	We		403	287			102	53	
8/15	Wd	137				87			
8/16	Wd			147	113			110	15
8/17	Wd								
8/18	Wd								
8/19	Wd								
8/20	We		388	375			99	53	
8/21	We	107			62	47			13
8/22	Wd			126	47			78	10
8/23	We								
8/24	Wd	51	159			68	94		
8/25	Wd								
8/26	Wd	140			126	109			19
8/27	We		189	202			116	35	
8/28	We	206		141		82		43	
8/29	Wd	49		43		64		51	
8/30	Wd	29	122			33	53		
8/31	Wd								
9/01	Wd		152				60		
9/02	Wd								
9/03	We	388	379			135	59		
9/04	We		340	189			118	5	
9/05	We	395		183		96		31	
9/06	Wd		127	78			46	12	
9/07	Wd								
9/08	Wd								
9/09	Wd	250	172			112	67		
9/10	We		358	277			53	45	
9/11	We	402		56		128		6	
9/12	Wd	154	78			97	40		
9/13	Wd		73	96			41	23	
9/14	Wd	204		119		99		3	
9/15	Wd								

-Continued-

Appendix Table C1. Counts of unguided and guided boat anglers during the fishery for coho salmon in August and September in the downstream section of the Kenai River, 1988 (continued).

Date	Wd/ We	Unguided Anglers Period A	B	C	D	Guided Anglers Period A	B	C	D
9/16	Wd								
9/17	We	405	287			132	65		
9/18	We		247	147			34	17	
9/19	Wd								
9/20	Wd								
9/21	Wd	82		79		42		6	
9/22	Wd	28	25			0	0		
9/23	Wd	133		81		15		7	
9/24	We	200		118		38		0	
9/25	We		147				9		
9/26	Wd								
9/27	Wd		19				8		
9/28	Wd	25		22		18		0	
9/29	Wd	14	12			17	9		

Appendix Table C2. Counts of shore anglers during the fishery for coho salmon in August and September in the downstream section of the Kenai River, 1988.

Date	Wd/ We	Period A	B	C	D
8/01	Wd		20	49	
8/02	Wd				
8/03	Wd				
8/04	Wd			114	96
8/05	Wd	61	88		
8/06	We			167	111
8/07	We	116	180		
8/08	Wd		131	139	
8/09	Wd	100	133		
8/10	Wd				
8/11	Wd				
8/12	Wd				
8/13	We	121			139
8/14	We		138	205	
8/15	Wd	93			
8/16	Wd			158	211
8/17	Wd	101		154	
8/18	Wd				
8/19	Wd				
8/20	We		190	205	
8/21	We	81			84
8/22	Wd			124	63
8/23	Wd				
8/24	Wd	61	73		
8/25	Wd				
8/26	Wd	65			65
8/27	We		89	84	
8/28	We	60		88	
8/29	Wd	19		34	
8/30	Wd	11	58		
8/31	Wd				
9/01	Wd				
9/02	Wd		80		
9/03	We	81	127		
9/04	We		117	124	
9/05	We	184		90	
9/06	Wd		70	59	
9/07	Wd				
9/08	Wd				
9/09	Wd	96	109		
9/10	We		111	75	
9/11	We	92		29	
9/12	Wd	55	41		
9/13	Wd		77	51	
9/14	Wd	91		77	
9/15	Wd				
9/16	Wd				
9/17	We	77	93		
9/18	We		95	56	
9/19	Wd				
9/20	Wd				
9/21	Wd	40		36	
9/22	Wd	1	4		
9/23	Wd	37		55	
9/24	We	32		28	
9/25	We		29		
9/26	Wd				
9/27	Wd		19		
9/28	Wd	25		22	
9/29	Wd	14	12		

Appendix Table C3. Counts of unguided and guided boat anglers during the fishery for coho salmon in August and September in the upstream section of the Kenai River, 1988.

Date	Wd/ We	Unguided Anglers Period A	B	C	D	Guided Anglers Period A	B	C	D
8/01	Wd								
8/02	Wd								
8/03	Wd		84	68			4	4	
8/04	Wd			50	33			0	0
8/05	Wd	0		23		0		0	
8/06	We	16	60			0	0		
8/07	We								
8/08	Wd								
8/09	Wd								
8/10	Wd	12	14			5	0		
8/11	Wd			12	5			0	0
8/12	Wd	4	53			3	8		
8/13	We		104		95		8		0
8/14	We		81	101			0	9	
8/15	Wd								
8/16	Wd		26	33			14	5	
8/17	Wd	2		22		0		6	
8/18	Wd			52	21			10	0
8/19	Wd	18	33			13	13		
8/20	We		87	143			4	0	
8/21	We	38			7	0			0
8/22	Wd			19	30			8	4
8/23	Wd								
8/24	Wd	4	56			0	7		
8/25	Wd								
8/26	Wd			42				0	
8/27	We		65	47			2	0	
8/28	We	44		54		3		7	
8/29	Wd								
8/30	Wd		23		7		5		0
8/31	Wd								
9/01	Wd								
9/02	Wd	25	28			17	7		
9/03	We	29	119			2	2		
9/04	We		53	59			4	4	
9/05	We		69	39			2	5	
9/06	Wd		13	10			0	0	
9/07	Wd								
9/08	Wd								
9/09	Wd								
9/10	We								
9/11	We		35	13			3	0	
9/12	Wd								
9/13	Wd		21	15			0	0	
9/14	Wd	22		24		2		0	
9/15	Wd		34	29			4	2	

-Continued-

Appendix Table C3. Counts of unguided and guided boat anglers during the fishery for coho salmon in August and September in the upstream section of the Kenai River, 1988 (continued).

		Unguided Anglers				Guided Anglers			
	Wd/	Period				Period			
Date	We	A	B	C	D	A	B	C	D
9/16	Wd								
9/17	We	32	127			0	0		
9/18	We		65	40			0	0	
9/19	Wd								
9/20	Wd		42	17			3	3	
9/21	Wd	15		15		0		0	
9/22	Wd								
9/23	Wd								
9/24	We		103	78			0	0	
9/25	We	61	85			7	3		
9/26	Wd		30	23			0	4	
9/27	Wd	49		42		4		8	
9/28	Wd		18	12			7	4	
9/29	Wd	25		22		4			

APPENDIX D

Daily summary statistics for fishing effort, harvest rate, and catch rate for anglers interviewed during the fishery for coho salmon in the Kenai River, 1988

Appendix Table D1. Daily summary statistics for fishing effort, coho salmon harvest, and coho salmon catch by unguided boat anglers interviewed during the fishery for coho salmon in August in the downstream section of the Kenai River, 1988 (both completed-trip and incomplete-trip interviews).

Date	Wd/ We	EFFORT (hrs) SS[1]	Mean	SE[2]	HARVEST Mean	SE[2]	HPUE	CATCH Mean	SE[2]	CPUE
801	Wd	5	2.1	0.37	0.00	0.000	0.000	0.00	0.000	0.000
804	Wd	18	3.4	0.52	0.33	0.162	0.097	0.33	0.162	0.097
805	Wd	12	2.7	0.43	0.92	0.229	0.338	0.92	0.229	0.338
806	We	29	4.0	0.34	0.69	0.150	0.174	0.69	0.150	0.174
807	We	24	3.1	0.25	0.79	0.190	0.257	0.79	0.190	0.257
808	Wd	23	4.2	0.37	0.57	0.138	0.134	0.57	0.138	0.134
809	Wd	18	3.6	0.32	0.56	0.246	0.154	0.56	0.246	0.154
812	Wd	11	2.4	0.41	1.27	0.333	0.538	1.27	0.333	0.538
813	We	49	3.3	0.40	0.20	0.082	0.061	0.24	0.107	0.073
814	We	44	2.4	0.18	0.16	0.065	0.068	0.16	0.065	0.068
815	Wd	15	2.1	0.23	0.20	0.107	0.097	0.20	0.107	0.097
816	Wd	96	3.2	0.22	0.42	0.066	0.130	0.42	0.066	0.130
817	Wd	63	3.2	0.35	0.40	0.097	0.123	0.40	0.097	0.123
820	We	89	3.3	0.21	0.42	0.067	0.128	0.44	0.075	0.134
821	We	53	3.0	0.31	0.51	0.113	0.168	0.51	0.113	0.168
822	Wd	29	3.1	0.31	0.55	0.161	0.181	0.55	0.161	0.181
824	Wd	87	1.8	0.09	0.33	0.065	0.186	0.33	0.065	0.186
826	Wd	74	3.1	0.24	0.32	0.080	0.103	0.32	0.080	0.103
827	We	112	3.4	0.20	0.46	0.066	0.132	0.46	0.066	0.132
828	We	82	2.2	0.20	0.30	0.073	0.137	0.30	0.073	0.137
829	Wd	35	3.6	0.39	0.43	0.125	0.120	0.43	0.125	0.120
830	Wd	49	1.7	0.12	0.57	0.120	0.335	0.57	0.120	0.335

[1] Sample size, number of anglers interviewed.
[2] Standard error.

Appendix Table D2. Daily summary statistics for fishing effort, coho salmon harvest, and coho salmon catch by unguided boat anglers interviewed during the fishery for coho salmon in September in the downstream section of the Kenai River, 1988 (both completed-trip and incomplete-trip interviews).

Date	Wd/ We	EFFORT (hrs) SS[1]	Mean	SE[2]	HARVEST Mean	SE[2]	HPUE	CATCH Mean	SE[2]	CPUE
902	Wd	25	3.5	0.42	0.84	0.221	0.240	0.84	0.221	0.240
903	We	65	3.3	0.20	0.34	0.101	0.103	0.35	0.108	0.108
904	We	70	3.8	0.29	0.44	0.111	0.115	0.44	0.111	0.115
905	We	42	4.0	0.37	0.43	0.141	0.107	0.43	0.141	0.107
906	Wd	66	3.1	0.22	0.67	0.127	0.218	0.67	0.127	0.218
909	Wd	40	3.4	0.22	0.82	0.171	0.245	0.82	0.171	0.245
910	We	79	3.9	0.37	0.28	0.094	0.071	0.28	0.094	0.071
911	We	78	2.9	0.25	0.12	0.055	0.039	0.12	0.055	0.039
912	Wd	50	3.4	0.30	0.80	0.146	0.237	0.80	0.146	0.237
913	Wd	73	2.4	0.18	0.23	0.074	0.095	0.23	0.074	0.095
914	Wd	77	2.8	0.18	0.27	0.086	0.098	0.27	0.086	0.098
917	We	92	4.0	0.18	0.35	0.079	0.087	0.35	0.079	0.087
918	We	108	2.9	0.21	0.15	0.049	0.051	0.15	0.049	0.051
921	Wd	46	3.1	0.36	0.48	0.135	0.157	0.48	0.135	0.157
922	Wd	58	2.1	0.14	0.12	0.043	0.059	0.16	0.054	0.075
923	Wd	72	3.5	0.27	0.51	0.119	0.147	0.51	0.119	0.147
924	We	96	3.2	0.21	0.27	0.065	0.084	0.27	0.065	0.084
925	We	2	4.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
927	Wd	20	4.0	0.56	0.45	0.170	0.113	0.45	0.170	0.113
928	Wd	17	2.5	0.27	0.00	0.000	0.000	0.00	0.000	0.000
929	Wd	14	3.0	0.53	0.00	0.000	0.000	0.00	0.000	0.000

1 Sample size, number of anglers interviewed.
2 Standard error.

Appendix Table D3. Daily summary statistics for fishing effort, coho salmon harvest, and coho salmon catch by guided boat anglers interviewed during the fishery for coho salmon in August and September in the downstream section of the Kenai River, 1988 (both completed-trip and incomplete-trip interviews).

Date	Wd/ We	EFFORT (hrs) SS[1]	Mean	SE[2]	HARVEST Mean	SE[2]	HPUE	CATCH Mean	SE[2]	CPUE
801	Wd	12	6.1	0.37	0.58	0.260	0.096	0.58	0.260	0.096
804	Wd	17	4.3	0.35	0.59	0.211	0.136	0.59	0.211	0.136
805	Wd	8	3.0	0.00	1.50	0.267	0.500	1.50	0.267	0.500
806	We	7	4.0	0.00	0.29	0.184	0.071	0.29	0.184	0.071
807	We	15	3.7	0.13	1.07	0.330	0.291	1.07	0.330	0.291
808	Wd	29	5.6	0.34	1.28	0.253	0.228	1.28	0.253	0.228
809	Wd	3	3.0	0.00	0.67	0.667	0.222	0.67	0.667	0.222
812	Wd	11	3.8	0.35	0.82	0.226	0.214	0.82	0.226	0.214
813	We	14	1.6	0.10	0.29	0.194	0.174	0.29	0.194	0.174
814	We	21	2.7	0.20	0.19	0.088	0.071	0.19	0.088	0.071
815	Wd	20	1.9	0.21	0.20	0.117	0.103	0.20	0.117	0.103
816	Wd	30	3.4	0.29	0.43	0.141	0.127	0.43	0.141	0.127
817	Wd	71	2.9	0.26	0.14	0.050	0.048	0.14	0.050	0.048
820	We	21	4.5	0.34	0.67	0.174	0.147	0.67	0.174	0.147
821	We	23	1.8	0.18	0.22	0.088	0.123	0.22	0.088	0.123
822	Wd	38	5.8	0.41	0.45	0.140	0.078	0.45	0.140	0.078
824	Wd	54	2.6	0.23	0.48	0.117	0.184	0.48	0.117	0.184
826	Wd	44	4.5	0.16	1.05	0.149	0.232	1.05	0.149	0.232
827	We	66	5.1	0.33	0.74	0.121	0.146	0.74	0.121	0.146
828	We	35	2.7	0.27	0.14	0.073	0.053	0.14	0.073	0.053
829	Wd	31	3.3	0.57	0.35	0.164	0.108	0.35	0.164	0.108
830	Wd	39	2.2	0.12	0.46	0.115	0.214	0.46	0.115	0.214
902	Wd	11	4.2	0.69	1.45	0.434	0.348	1.45	0.434	0.348
903	We	18	6.2	0.35	1.17	0.316	0.189	1.17	0.316	0.189
904	We	14	6.0	1.26	0.86	0.345	0.143	0.86	0.345	0.143
906	Wd	12	1.2	0.07	0.25	0.250	0.207	0.25	0.250	0.207
909	Wd	12	5.1	0.74	1.25	0.411	0.244	1.25	0.411	0.244
910	We	18	4.0	0.31	0.44	0.232	0.111	0.44	0.232	0.111
911	We	30	4.2	0.17	0.37	0.155	0.088	0.37	0.155	0.088
912	Wd	11	4.2	0.33	0.55	0.157	0.130	0.55	0.157	0.130
913	Wd	9	2.7	0.53	0.00	0.000	0.000	0.00	0.000	0.000
917	We	36	6.0	0.44	0.69	0.202	0.117	0.69	0.202	0.117
918	We	15	6.0	0.37	0.33	0.187	0.055	0.33	0.187	0.055
923	Wd	4	2.5	0.87	0.50	0.289	0.200	0.50	0.289	0.200
924	We	7	4.0	0.00	0.71	0.286	0.179	0.71	0.286	0.179
928	Wd	6	3.5	0.22	0.00	0.000	0.000	0.00	0.000	0.000
929	Wd	15	4.5	0.63	0.67	0.270	0.149	0.67	0.270	0.149

1 Sample size, number of anglers interviewed.
2 Standard error.

Appendix Table D4. Daily summary statistics for fishing effort, coho salmon harvest, and coho salmon catch by shore anglers interviewed during the fishery for coho salmon in August and September in the downstream section of the Kenai River, 1988 (both completed-trip and incomplete-trip interviews).

Date	Wd/ We	EFFORT (hrs) SS[1]	Mean	SE[2]	HARVEST Mean	SE[2]	HPUE	CATCH Mean	SE[2]	CPUE
806	We	3	2.0	0.00	0.33	0.333	0.167	0.33	0.333	0.167
807	We	8	2.6	0.31	1.00	0.267	0.381	1.00	0.267	0.381
809	Wd	3	2.2	0.93	0.33	0.333	0.154	0.33	0.333	0.154
810	Wd	18	1.9	0.33	0.06	0.056	0.029	0.06	0.056	0.029
812	Wd	24	2.7	0.26	0.38	0.145	0.137	0.42	0.146	0.153
814	We	7	3.8	0.24	1.00	0.378	0.264	1.00	0.378	0.264
816	Wd	17	1.4	0.13	0.06	0.059	0.041	0.06	0.059	0.041
817	Wd	15	1.7	0.18	0.13	0.091	0.078	0.13	0.091	0.078
818	Wd	28	2.9	0.30	0.29	0.101	0.100	0.29	0.101	0.100
820	We	7	3.6	0.69	0.29	0.184	0.080	0.29	0.184	0.080
826	Wd	5	2.8	0.93	0.40	0.245	0.143	0.40	0.245	0.143
904	We	3	1.7	0.33	0.00	0.000	0.000	0.00	0.000	0.000
905	We	20	2.6	0.55	0.15	0.082	0.057	0.15	0.082	0.057
909	Wd	9	2.3	0.34	0.11	0.111	0.048	0.11	0.111	0.048
910	We	33	2.3	0.22	0.06	0.042	0.026	0.06	0.042	0.026
911	We	15	2.7	0.46	0.00	0.000	0.000	0.00	0.000	0.000
912	Wd	4	2.8	1.01	1.00	0.408	0.364	1.00	0.408	0.364
914	Wd	5	1.4	0.24	0.20	0.200	0.143	0.20	0.200	0.143
917	We	13	4.2	0.96	0.38	0.180	0.091	0.38	0.180	0.091
918	We	11	3.2	0.62	0.09	0.091	0.029	0.09	0.091	0.029
921	Wd	26	2.8	0.24	0.19	0.079	0.068	0.19	0.079	0.068
923	Wd	23	3.1	0.49	0.09	0.060	0.028	0.09	0.060	0.028
924	We	16	3.1	0.25	0.19	0.101	0.061	0.19	0.101	0.061
927	Wd	7	2.5	0.52	0.14	0.143	0.057	0.14	0.143	0.057
928	Wd	4	2.5	0.29	0.50	0.500	0.200	0.50	0.500	0.200
929	Wd	7	1.6	0.43	0.14	0.143	0.087	0.14	0.143	0.087

[1] Sample size, number of anglers interviewed.

[2] Standard error.

Appendix Table D5. Daily summary statistics for fishing effort, coho salmon harvest, and coho salmon catch by unguided boat anglers interviewed during the fishery for coho salmon in August and September in the upstream section of the Kenai River, 1988 (both completed-trip and incomplete-trip interviews).

Date	Wd/ We	EFFORT (hrs) SS[1]	Mean	SE[2]	HARVEST Mean	SE[2]	HPUE	CATCH Mean	SE[2]	CPUE
803	Wd	99	2.1	0.10	0.01	0.010	0.005	0.01	0.010	0.005
804	Wd	67	2.2	0.18	0.01	0.015	0.007	0.01	0.015	0.007
805	Wd	22	1.3	0.15	0.00	0.000	0.000	0.00	0.000	0.000
806	We	38	1.6	0.17	0.03	0.026	0.016	0.03	0.026	0.016
810	Wd	23	1.9	0.25	0.30	0.117	0.157	0.30	0.117	0.157
811	Wd	14	1.9	0.28	0.14	0.097	0.075	0.14	0.097	0.075
812	Wd	42	2.2	0.14	0.40	0.084	0.187	0.40	0.084	0.187
813	We	120	2.1	0.14	0.10	0.032	0.047	0.13	0.046	0.062
814	We	179	2.3	0.12	0.11	0.026	0.046	0.11	0.026	0.049
816	Wd	53	1.7	0.17	0.04	0.038	0.023	0.06	0.042	0.034
817	Wd	28	2.4	0.29	0.46	0.141	0.195	0.46	0.141	0.195
818	Wd	62	3.4	0.25	0.11	0.041	0.033	0.13	0.043	0.037
819	Wd	42	1.4	0.12	0.33	0.094	0.231	0.38	0.113	0.264
820	We	161	2.2	0.12	0.17	0.033	0.076	0.18	0.035	0.082
821	We	43	1.2	0.19	0.05	0.032	0.038	0.05	0.032	0.038
822	Wd	43	2.4	0.27	0.53	0.135	0.221	0.56	0.134	0.231
824	Wd	62	2.6	0.20	0.29	0.070	0.110	0.31	0.071	0.116
827	We	77	1.6	0.18	0.22	0.063	0.138	0.22	0.063	0.138
828	We	94	2.8	0.21	0.14	0.039	0.049	0.14	0.039	0.049
830	Wd	36	2.6	0.26	0.33	0.098	0.130	0.50	0.129	0.196
902	Wd	52	1.9	0.20	0.13	0.055	0.069	0.31	0.097	0.158
903	We	118	1.9	0.09	0.19	0.047	0.097	0.28	0.065	0.146
904	We	112	1.9	0.13	0.13	0.041	0.072	0.19	0.047	0.101
905	We	114	1.8	0.13	0.11	0.037	0.062	0.20	0.068	0.110
906	Wd	30	1.9	0.23	0.17	0.084	0.085	0.30	0.109	0.154
911	We	57	3.0	0.24	0.16	0.065	0.053	0.25	0.076	0.082
913	Wd	40	2.9	0.33	0.13	0.053	0.043	0.23	0.084	0.077
914	Wd	56	2.4	0.18	0.13	0.045	0.052	0.16	0.056	0.067
915	Wd	63	3.0	0.25	0.14	0.055	0.048	0.17	0.058	0.059
917	We	172	2.4	0.11	0.13	0.029	0.056	0.15	0.031	0.061
918	We	83	1.9	0.15	0.10	0.044	0.050	0.10	0.044	0.050
920	Wd	65	3.6	0.25	0.18	0.053	0.051	0.20	0.055	0.056
921	Wd	40	2.0	0.27	0.03	0.025	0.013	0.03	0.025	0.013
924	We	152	2.6	0.12	0.10	0.028	0.038	0.16	0.036	0.061
925	We	147	1.9	0.08	0.14	0.031	0.076	0.19	0.037	0.101
926	Wd	57	2.4	0.22	0.05	0.030	0.022	0.12	0.050	0.051
927	Wd	97	2.4	0.20	0.24	0.048	0.101	0.27	0.050	0.114
928	Wd	36	2.8	0.37	0.39	0.107	0.138	0.47	0.116	0.167
929	Wd	48	1.9	0.18	0.42	0.098	0.215	0.46	0.107	0.237

[1] Sample size, number of anglers interviewed.
[2] Standard error.

Appendix Table D6. Daily summary statistics for fishing effort, coho salmon harvest, and coho salmon catch by guided boat anglers interviewed during the fishery for coho salmon in August and September in the upstream section of the Kenai River, 1988 (both completed-trip and incomplete-trip interviews).

Date	Wd/ We	EFFORT (hrs) SS[1]	Mean	SE[2]	HARVEST Mean	SE[2]	HPUE	CATCH Mean	SE[2]	CPUE
803	Wd	13	2.9	0.30	0.00	0.000	0.000	0.00	0.000	0.000
804	Wd	5	0.5	0.00	0.00	0.000	0.000	0.00	0.000	0.000
810	Wd	5	3.0	0.00	0.40	0.245	0.133	0.40	0.245	0.133
812	Wd	11	2.1	0.34	0.82	0.226	0.383	0.82	0.226	0.383
813	We	5	3.0	0.00	0.40	0.245	0.133	0.40	0.245	0.133
814	We	4	2.0	0.00	0.50	0.289	0.250	0.50	0.289	0.250
816	Wd	17	3.7	0.14	0.47	0.174	0.126	0.47	0.174	0.126
817	Wd	11	4.9	0.51	0.64	0.244	0.130	0.64	0.244	0.130
818	Wd	8	3.5	0.94	0.88	0.295	0.250	0.88	0.295	0.250
819	Wd	13	4.1	0.24	0.85	0.249	0.208	0.85	0.249	0.208
820	We	7	4.4	0.20	0.57	0.202	0.129	0.57	0.202	0.129
822	Wd	12	1.8	0.47	0.17	0.112	0.091	0.17	0.112	0.091
824	Wd	3	5.5	0.00	2.33	0.333	0.424	2.33	0.333	0.424
827	We	2	6.0	0.00	2.00	0.000	0.333	2.00	0.000	0.333
828	We	7	4.6	1.01	0.14	0.143	0.031	0.14	0.143	0.031
830	Wd	5	3.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
902	Wd	24	2.8	0.14	0.42	0.119	0.148	0.50	0.120	0.178
903	We	4	3.0	1.44	1.25	0.750	0.417	1.25	0.750	0.417
904	We	7	1.8	0.61	0.14	0.143	0.080	0.29	0.184	0.160
905	We	7	3.8	0.18	0.29	0.184	0.075	0.29	0.184	0.075
911	We	3	7.0	0.00	0.67	0.333	0.095	1.00	0.000	0.143
914	Wd	2	1.5	0.00	0.50	0.500	0.333	0.50	0.500	0.333
915	Wd	6	5.0	1.02	1.00	0.632	0.200	1.00	0.632	0.200
917	We	7	1.4	0.30	0.29	0.184	0.211	0.29	0.184	0.211
920	Wd	6	2.0	0.45	0.50	0.224	0.250	0.50	0.224	0.250
921	Wd	4	3.0	0.00	0.25	0.250	0.083	0.25	0.250	0.083
925	We	4	1.0	0.00	0.25	0.250	0.250	0.25	0.250	0.250
926	Wd	4	2.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
927	Wd	4	3.5	0.00	0.25	0.250	0.071	0.25	0.250	0.071
928	Wd	15	3.2	0.39	0.67	0.187	0.206	0.67	0.187	0.206
929	Wd	13	4.3	0.56	0.54	0.144	0.126	0.54	0.144	0.126

[1] Sample size, number of anglers interviewed.
[2] Standard error.