

Fishery Data Series No. 94-9

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

by

Mary A. Schwager King

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ABSTRACT

A creel survey was conducted from 1 August through 30 September 1993 on the downstream section of the Kenai River (Soldotna Bridge to Cook Inlet) to estimate recreational angler effort and catch and harvest of coho salmon *Oncorhynchus kisutch*. During this time period, the recreational fishery is primarily directed toward coho salmon. Results from this survey showed recreational anglers exerted an estimated 101,176 angler-hours to harvest an estimated 21,628 coho salmon during the early (August) coho salmon run and an estimated 46,342 angler-hours to harvest an estimated 7,444 coho salmon during the late (September) coho salmon run. The total catch exceeded the harvest for both runs by no more than 1%; most fish caught were retained. More effort (69%) was expended by anglers during the early run than the late run. For both early and late runs, more angler effort occurred on weekdays (72% and 63%, respectively) than weekends and during morning periods (65% and 68%, respectively) compared to afternoon periods. Over both runs, unguided boat anglers contributed 56% of the total effort and harvested 44% of the coho salmon while guided boat anglers contributed 26% of the effort and harvested 43% of the coho salmon. Only 18% of effort and 13% of harvest was attributed to shore anglers. The predominant age class in each run was age 2.1 (94% of the early run and 97% of the late run). Late-run coho salmon tended to have larger mean lengths than early-run coho salmon. More males than females were harvested during both early and late runs (57% in each run).

KEY WORDS: Kenai River, coho salmon, creel survey, effort, harvest, *Oncorhynchus kisutch*.

INTRODUCTION

Background

Coho salmon *Oncorhynchus kisutch* return annually to the Kenai River (Figure 1) in two temporal components, termed early and late runs. The early-run stock typically enters the river from late July through August while the late-run stock typically begins entering the river in early September. There has been no exact determination on the duration of the return of the late-run stock; however, fish have been observed spawning into late March. Early-run fish are believed to spawn predominantly in tributaries of the Kenai River while late-run fish are believed to spawn predominantly in the mainstem (Booth 1990).

The early- and late-run coho salmon stocks of the Kenai River support the largest freshwater sport fisheries for coho salmon in Alaska with over 52,000 taken by sport anglers in 1992 (Mills 1993). Until recent years (1992 and 1993) effort and harvest have generally increased annually since 1976. Presently effort and harvest in just the downstream section of the Kenai River exceeds 100,000 angler-hours and 21,000 coho salmon for the early run and 46,000 angler-hours and 7,000 coho salmon for the late run (Figure 2). The economic value of these fisheries during 1986 was estimated at 3.9 million dollars for the early run and 4.6 million dollars for the late run (Jones and Stokes 1987).

The early-run stock and, to a lesser degree, the late-run stock of coho salmon from the Kenai River contribute significantly to mixed-stock commercial fisheries that occur in the marine waters of Upper Cook Inlet (UCI). In terms of coho salmon harvest, these fisheries are second only to those in Southeast Alaska (Meyer et al. *Unpublished*). From 1977 through 1989, UCI commercial fisheries harvested just over 450,000 coho salmon annually. Major UCI commercial fisheries that are believed to intercept large numbers of Kenai River coho salmon include the drift and set gill net fisheries in the Central District. Kenai River coho salmon stocks also support various subsistence and personal use fisheries in UCI. Harvests in these fisheries have been relatively small, averaging approximately 2,500 fish annually from 1986 through 1990. After the allocation decision by the Alaska Board of Fisheries to liberalize subsistence fisheries, harvest by the subsistence dip net and gill net fisheries in the Central District of UCI increased to 3,918 in 1991 (D. Nelson, Alaska Department of Fish and Game, Soldotna, personal communication) and to 6,230 in 1992 (J. Fox, Alaska Department of Fish and Game, Soldotna, personal communication). With no subsistence fisheries occurring in 1993, the personal use and native educational fisheries harvested only 2,430 coho salmon (J. Fox and D. Nelson, personal communication).

The stock-specific contributions of Kenai River coho salmon to the mixed-stock fisheries and the magnitude of escapements is unknown. Without this information, sustainable exploitation rates cannot be determined. This lack of knowledge about the Kenai River coho salmon stocks and exploiting fisheries suggests a conservative approach to management. However, the growth and efficiency of the fisheries exploiting these stocks, coupled with the lack of quantifiable information, raise fears that these stocks may be in danger of overexploitation.

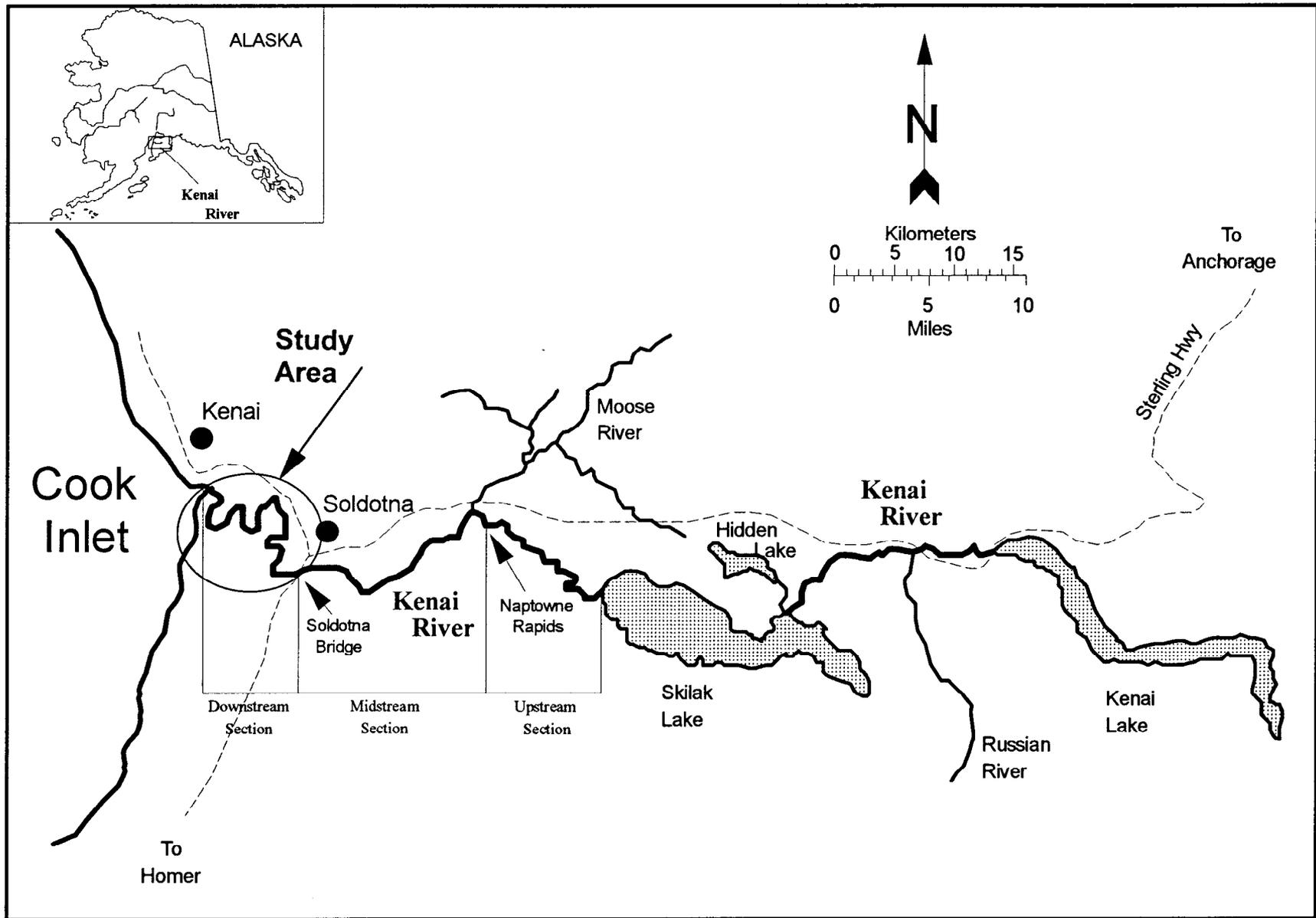


Figure 1. Map of Kenai River drainage.

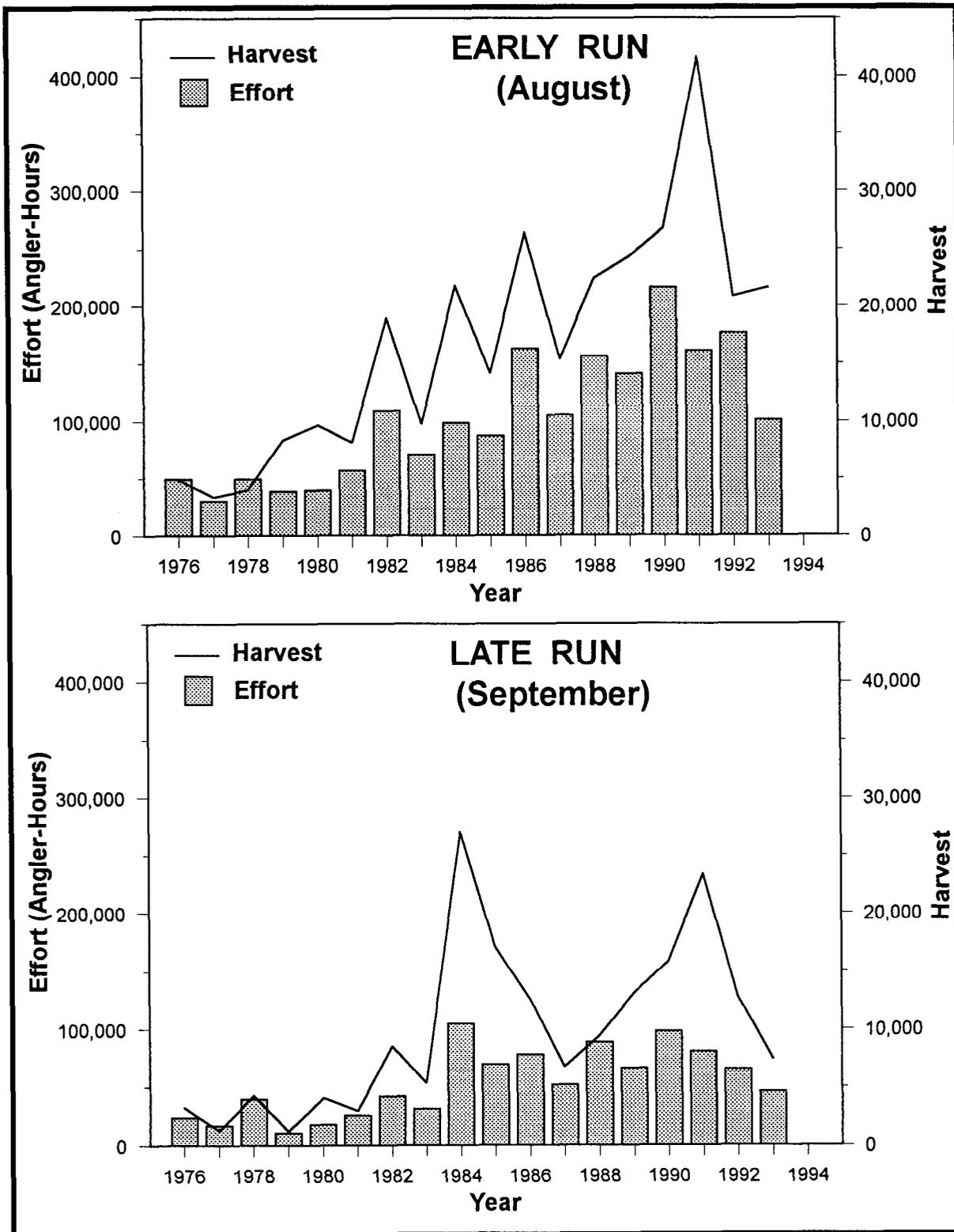


Figure 2. Historical harvest and effort in the recreational fishery for coho salmon in the downstream section of the Kenai River, 1976-1993.

To provide data required to define meaningful management objectives and strategies, a long-term study has been initiated to assess the status and sustained yields of the early and late Kenai River coho salmon stocks (Meyer et al. *Unpublished*). As part of this long-term effort, recreational harvests of early- and late-run coho salmon stocks in the Kenai River are estimated annually. Beginning with the 1993 coho salmon fishery, members of the coho salmon creel survey project inspected sport harvested coho salmon for adipose finclips; when present, heads were removed and stored for later detection and identification of coded wire tags (CWT) implanted during the juvenile stage. These data will be analyzed and reported as part of another research project. In combination with other studies, results of these efforts will provide the data necessary to estimate the productivity of the Kenai River coho salmon resource. This information will be used to define meaningful management objectives and strategies that assure for the sustainable yield of this resource.

Description of the Kenai River Coho Salmon Sport Fishery

The recreational fishery targeting coho salmon in the Kenai River usually begins after the closure of the chinook salmon *O. tshawytscha* sport fishery on 31 July. During most years, anglers have reported few coho salmon being caught during the directed chinook salmon fishery prior to 1 August. Although late-run fish continue to enter the river after 1 October, effort typically declines rapidly due to reduced river navigability, cold weather and shorter daylight periods.

The directed coho salmon fishery in the Kenai River is unlike that which targets chinook salmon. While the sport fishery targeting chinook salmon is highly mobile and fluid, the sport fishery targeting coho salmon is much more stationary. After launching at developed boat launches and campgrounds, boat anglers typically anchor their boats near a favorite "hole." In addition, shore anglers fish for coho salmon along the banks of the Kenai River. In the past, most of the anglers have been unguided, however in recent years guided boat anglers have accounted for an increased portion of the recreational effort (Figure 3) and harvest.

Most anglers fish for coho salmon in the mainstem Kenai River either downstream from the Soldotna Bridge (downstream section) or from Skilak Lake to Naptowne Rapids (upstream section) (Figure 1). In past years, an upstream creel survey was conducted but in 1992 and 1993 this survey was precluded due to budget constraints. Harvest in the upstream section is relatively small (average <15% of the total inriver harvest; Mills 1985-1993). Coho salmon are also harvested in the mainstem between these two river sections, but past surveys have shown the number harvested to be small (typically <15% of the total inriver harvest; Mills 1985-1993).

Previous information pertaining to the coho salmon fishery in the Kenai River is presented in Hammarstrom (1977 and 1978, 1988-1992), Wallis and Hammarstrom (1979-1984), Hammarstrom et al. (1985), Hammarstrom and Larson (1986), Conrad and Hammarstrom (1987) and King (1993). In addition, angler-effort and harvest by species for the recreational fishery in the Kenai River have been estimated by Mills (1979-1993).

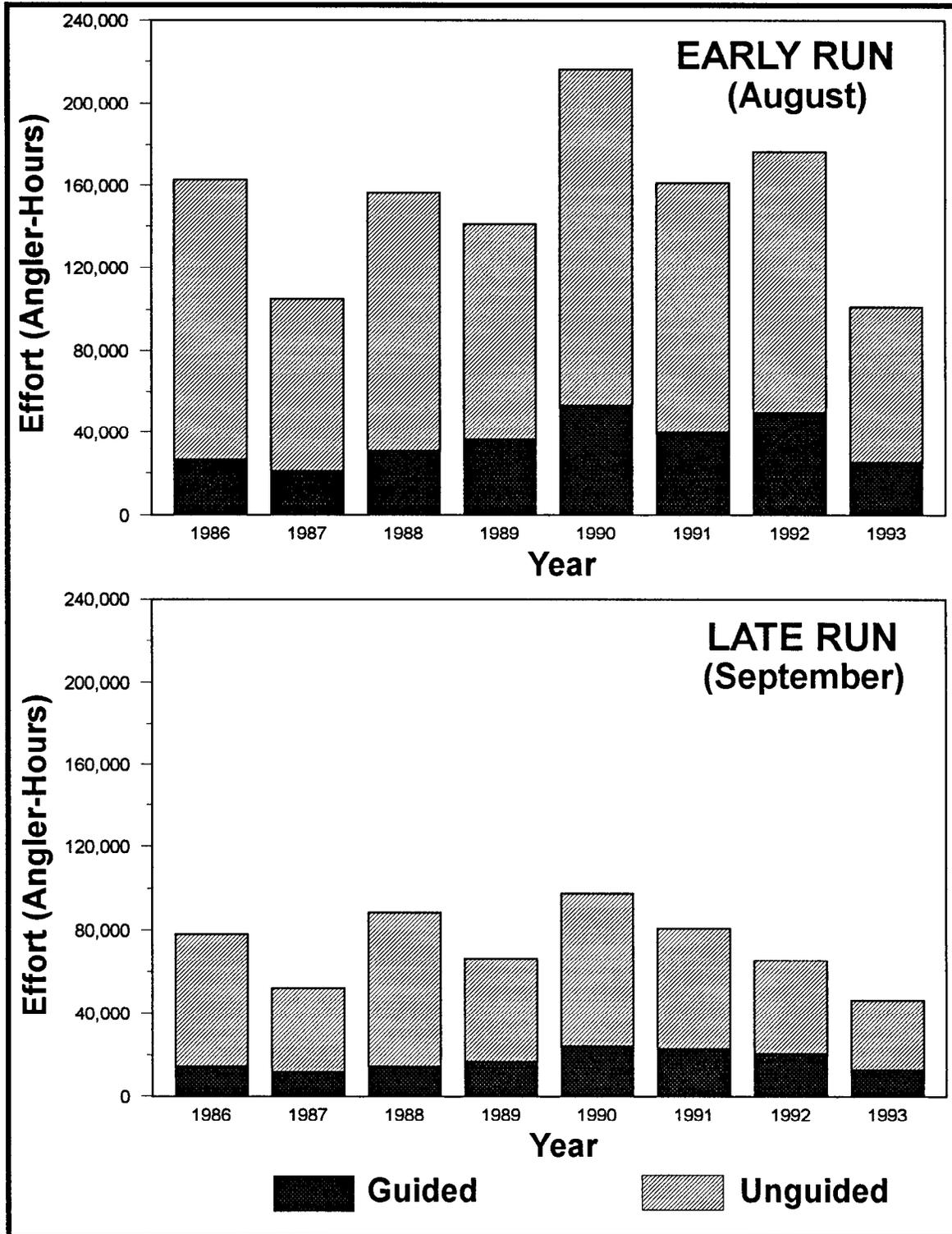


Figure 3. Historical effort of guided and unguided (includes both boat and shore) anglers in the recreational fishery for coho salmon in the downstream section of the Kenai River, 1986-1993.

Regulations Governing the Sport Fishery

For the Kenai River, coho salmon are categorized with "salmon other than chinook salmon" and have aggregate bag and possession limits. During 1993, the aggregate daily bag and possession limits were three salmon 41 cm in length or greater with no annual limit. A new regulation, adopted by the Board of Fisheries for the 1993 season, prohibited anglers from continuing to fish for any species of fish in the Kenai River once their daily bag and possession limit of three coho salmon greater than 41 cm was attained. This regulation targets the illegal practice of fishing for a "boat limit." Unlike the chinook salmon recreational fishery, there was no limitation or restriction on the use of bait other than the prohibition of the use of live bait and no time/day closures or restrictions on the fishery; plus, guides were permitted to fish while guiding clients.

Objectives

The objectives of the 1993 studies were to:

1. estimate total harvest and catch of coho salmon in the mainstem Kenai River downstream from the Soldotna Bridge during the period from 1 August through 30 September 1993;
2. estimate angler effort by the sport fishery in the mainstem Kenai River downstream from the Soldotna Bridge during the period from 1 August through 30 September 1993; and
3. estimate the age, sex, and length compositions of coho salmon harvested during the sport fishery in the mainstem Kenai River downstream from the Soldotna Bridge during the period from 1 August through 30 September 1993.

METHODS

Creel Survey

A roving creel survey (Neuhold and Lu 1957) was used to estimate sport fishing effort in units of angler-hours fished. Angler interviews were used to estimate both harvest per unit of effort (HPUE, in units of numbers of coho salmon harvested per angler-hour fished) and catch per unit of effort (CPUE, in units of numbers of coho salmon caught per angler-hour fished). Harvest and catch were estimated as the product of the estimated effort and HPUE or CPUE, respectively. Harvest refers to fish retained by anglers as part of their creel and catch refers to fish retained plus those reported to be released by anglers.

The survey was based on a two stage sample design. The first stage represented days surveyed which were stratified into two periods: morning (0600-1359 hours, August; 0800-1359 hours, September) and afternoon (1400-2159 hours, August; 1400-1959 hours, September). The second stage represented anglers and counts within a period. The survey was divided into two seasonal strata: early run (August) and late run (September). Sampling was also stratified by day type: weekday and weekend (Saturdays, Sundays, and legal

holidays). Sample days were randomly chosen and once a period was selected the entire period was sampled. Postseason, the data were further stratified into boat and shore anglers and into guided and unguided anglers. Thus, there were a total of 24 strata:

1. August weekday morning unguided boat
2. August weekday afternoon unguided boat
3. August weekend morning unguided boat
4. August weekend afternoon unguided boat
5. August weekday morning guided boat
6. August weekday afternoon guided boat
7. August weekend morning guided boat
8. August weekend afternoon guided boat
9. August weekday morning unguided shore
10. August weekday afternoon unguided shore
11. August weekend morning unguided shore
12. August weekend afternoon unguided shore
13. September weekday morning unguided boat
14. September weekday afternoon unguided boat
15. September weekend morning unguided boat
16. September weekend afternoon unguided boat
17. September weekday morning guided boat
18. September weekday afternoon guided boat
19. September weekend morning guided boat
20. September weekend afternoon guided boat
21. September weekday morning unguided shore
22. September weekday afternoon unguided shore
23. September weekend morning unguided shore
24. September weekend afternoon unguided shore.

Sampling levels were designed to estimate effort to within $\pm 10\%$ and harvest and catch to within $\pm 25\%$ of their true values 95% of the time. During August, 20 days were scheduled for sampling: 14 weekday days (12 mornings and 4 afternoons) and 6 weekend days (3 mornings and 4 afternoons). During September, 20 days were scheduled for sampling: 12 weekday days (9 mornings and 6 afternoons) and 8 weekend days (8 mornings and 3 afternoons). Some deviation from the schedule occurred due to mechanical breakdown and other duties such as public assistance or enforcement activities. Three people conducted the survey: one creel clerk worked from a boat and two creel clerks were stationed at access sites.

Angler counts were conducted during all scheduled sampling periods. Counts were conducted using a boat driven at a constant rate of speed through the length of the survey area, starting at one end of the area. The trip usually took 45 minutes or less to complete and every effort was made to ensure the trip was completed within 1 hour. Angler counts were considered instantaneous and reflected fishing effort at that time. During each count, the survey clerk recorded the total number of unguided boats, guided boats, anglers in unguided boats, anglers in guided boats, and shore anglers. Guided boats were easily recognized by the prominent identifying decal, which is required.

Angler interviews were conducted during all scheduled sampling periods. This enabled angler counts (effort) to be related to angler interviews (HPUE or CPUE estimates). The interviews were conducted by two access clerks and

augmented by the boat creel clerk as time permitted. Four interview locations (two per access clerk) were randomly selected with the interview periods lasting 3.5 hours at each location during August and 3.0 hours at each location during September. The clerks attempted to interview all anglers departing the fishery at each surveyed access site during a sampling period. Only anglers who had finished fishing were interviewed with the following information obtained from each interviewed angler: (1) the river section the angler fished, (2) whether the angler fished from a boat or shore (and if a boat was used whether it was a motorized or nonmotorized boat), (3) whether the angler was guided or unguided, (4) the total number of hours the angler fished, (5) the total number of fish the angler harvested (kept) by species, and (6) the total number of fish the angler released by species.

Total effort, catch, and harvest were estimated by expanding means over all periods sampled in a stratum h. For any period i sampled, three counts were made unless mechanical failure compromised the schedule. The mean count \bar{x}_i for period i was estimated as:

$$\bar{x}_i = \frac{\sum_{j=1}^{r_i} x_{ij}}{r_i} \quad (1)$$

where:

x_{ij} = the number of anglers observed in the jth count of period i
and
 r_i = the number of counts in period i, normally three.

Angler counts were systematically selected within a period and the variance of the mean angler count was estimated as:

$$\text{Var}(\bar{x}_i) = \frac{\sum_{j=2}^{r_i} (x_{ij} - x_{i(j-1)})^2}{2r_i(r_i-1)} \quad (2)$$

Effort for period i in stratum h was estimated as:

$$\hat{E}_{hi} = L_h \bar{x}_i \quad (3)$$

where:

\hat{E}_{hi} = effort for period i in angler-hours during stratum h, and
 L_h = length of period in hours in stratum h, which was 8 hours in August and 6 hours in September.

The within period variance of the effort for period i in stratum h was estimated as:

$$\widehat{\text{Var}}(E_{hi}) = L_h^2 \text{Var}(\bar{x}_i). \quad (4)$$

The mean effort for stratum h was estimated as:

$$\bar{E}_h = \frac{\sum_{i=1}^d \widehat{E}_{hi}}{d} \quad (5)$$

where:

\bar{E}_h = mean effort for stratum h , and

d = number of periods (or days) sampled in stratum h .

Sampling periods (morning or afternoon) were chosen randomly. The variance of mean effort was estimated as:

$$S_{Ehi}^2 = \frac{\sum_{i=1}^d (\widehat{E}_{hi} - \bar{E}_h)^2}{(d-1)}. \quad (6)$$

Total effort for strata h was estimated as:

$$\widehat{E}_h = D \bar{E}_h \quad (7)$$

where:

\widehat{E}_h = total effort for stratum h , and

D = total number of periods in stratum h .

The variance of total effort for the stratum in a two stage design was estimated by (Cochran 1977):

$$\widehat{\text{Var}}(E_h) = (1-f) D^2 \frac{S_{Ehi}^2}{d} + f D^2 \frac{\sum_{i=1}^d \widehat{\text{Var}}(E_{hi})}{d^2} \quad (8)$$

where:

f = finite population correction factor for periods (days) sampled
 = d/D .

Catch and harvest per unit of effort were estimated from angler interviews of each sampled period using jackknife methods to minimize the bias of these ratio estimators (Efron 1982).

A jackknife estimate of CPUE (or HPUE) was made for each angler as:

$$\begin{aligned}
 \text{CPUE}_{hi}^* &= \frac{\sum_{k=1}^{m_{hi}} c_{hik}}{\sum_{k=1}^{m_{hi}} e_{hik}} \quad (9)
 \end{aligned}$$

where:

- * CPUE_{hi}^* = jackknife estimate for angler j,
- c_{hik} = catch for angler k interviewed in period i of stratum h,
- e_{hik} = effort (in hours fished) for angler k interviewed in period i of stratum h, and
- m_{hi} = number of anglers interviewed in period i of stratum h.

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

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

and the bias corrected mean was estimated as:

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

where:

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

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

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

The estimate of HPUE was made as for CPUE, substituting angler harvest for angler catch in equations (9) through (12) above.

Catch for the sample period was then estimated as the product of effort and CPUE:

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

and the variance as (Goodman 1960):

$$\begin{aligned} \text{Var}(\hat{C}_{hi}) = & \text{Var}(\hat{E}_{hi}) (\overline{CPUE_{hi}}^{**})^2 + \text{Var}(\overline{CPUE_{hi}}^{**}) \hat{E}_{hi}^2 - \\ & \overline{CPUE_{hi}}^{**} \hat{E}_{hi} \text{Var}(\hat{E}_{hi}). \end{aligned} \quad (14)$$

Harvest for sample period i was estimated by substituting the appropriate $\overline{HPUE_{hi}}$ statistics into equations (13) and (14).

Total catch and harvest for stratum h was estimated using equations (5) through (8) above for effort, substituting estimated sample period catch (\hat{C}_{hi}) or harvest (\hat{H}_{hi}) for sample period effort (\hat{E}_{hi}).

The estimates of total effort, catch, or harvest and their variances were summed across strata as these estimates were considered independent.

The major assumptions necessary for these analyses are:

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

Age, Sex, and Size Data

Harvested coho salmon observed during angler interviews were systematically selected (the first twenty fish observed by the interview clerks) for biological sampling. For two 15-day intervals per run, a minimum sample size of 150 coho salmon was obtained. This sample size enabled estimates of age composition of the total harvest to be within $\pm 10\%$ of the true value 95% of the time, allowing for 15% scale regeneration (Thompson 1987). For each fish, the mid-eye to fork-of-tail length was measured to the nearest 5 millimeters, the sex was identified, and three scales were removed from the preferred area (Scarnecchia 1979). Scales were placed on adhesive-coated cards which were later heat pressed to make scale impressions on acetate cards. These scale impressions, enlarged with the use of a microfiche reader, were used to determine ages.

Proportional age composition of the coho salmon harvest during each run was estimated. Letting p_{gt} equal the estimated proportion of age group g in component t , the variance of p_{gt} was estimated as (Scheaffer et al. 1979):

$$V(\hat{p}_{gt}) = \frac{\hat{p}_{gt}(1-\hat{p}_{gt})}{(n_{gt}-1)} \quad (15)$$

where n_{gt} equals the number of legible scales read from coho salmon sampled during run t .

A chi-square test was utilized to detect differences in age composition within and between early and late runs. Student's t-test was used to examine differences in mean lengths at age, by sex, within and between runs. All tests were conducted at $\alpha = 0.05$

RESULTS AND DISCUSSION

Creel Statistics

Angler counts and interviews were conducted on 21 of 31 possible days in August and 20 of 30 possible days in September.

Effort:

During the early run, angler counts ranged from 3 to 305 for unguided anglers, from 0 to 208 for guided anglers, and from 7 to 93 for shore anglers (Appendix A1). The largest count occurred for unguided anglers on 8 August, for guided anglers on 11 August, and for shore anglers on 1 and 8 August. During the late run, angler counts ranged from 2 to 260 for unguided anglers, from 0 to 149 for guided anglers, and from 0 to 42 for shore anglers (Appendix A2). The largest count for all angler types occurred on 11 September.

The total estimated effort for the early run (101,176 angler hours, SE = 6,200) was more than twice that of the late run (46,342 angler hours, SE = 2,643) (Table 1).

During both early and late runs, angler effort was greater during the A period (morning) than the B period (afternoon). The A period effort was 65% of the total effort for the early run and 68% of the total effort for the late run (Table 1). All angler types, in both runs, displayed significantly reduced effort from period A to B. For both early and late runs, the weekday effort was greater than the weekend effort at 72% and 68%, respectively. This difference was largely due to reduced effort of guided anglers on weekends. The guided weekday effort was nearly three times greater than the total guided weekend effort throughout both runs. Combining runs, the contribution of effort from period A weekdays was 45% of the total effort. A comparison of effort by angler type showed unguided anglers with the highest percent of the total effort (53% for the early run and 62% for the late run), guided anglers with the next highest (25% for the early run and 27% for the late run), and shore anglers with the lowest (22% for the early run and 11% for the late run) (Table 1).

Table 1. Estimated effort (angler-hours) during each stratum of the sport fishery for coho salmon in the downstream section of the Kenai River, 1993.

Angler Type	WE/WD ^a	Estimated Effort	Standard Error	95% Confidence Interval		Relative Precision	
<u>AUGUST</u>							
Period A (0600-1359)							
Guided	WD	18,338	2,133	14,158	-	22,518	22.8 %
	WE	4,056	1,547	1,025	-	7,087	74.7 %
Unguided	WD	20,978	2,156	16,753	-	25,203	20.1 %
	WE	10,288	2,968	4,470	-	16,106	56.6 %
Shore	WD	8,414	570	7,297	-	9,531	13.3 %
	WE	3,840	732	2,405	-	5,275	37.4 %
Total Period A		65,914	4,611	56,877	-	74,951	13.7 %
Period B (1400-2159)							
Guided	WD	2,185	892	437	-	3,933	80.0 %
	WE	903	371	176	-	1,630	80.5 %
Unguided	WD	16,133	2,945	10,361	-	21,905	35.8 %
	WE	6,345	1,567	3,273	-	9,417	48.4 %
Shore	WD	7,011	2,217	2,666	-	11,356	62.0 %
	WE	2,685	459	1,786	-	3,584	33.5 %
Total Period B		35,262	4,145	27,137	-	43,387	23.0 %
Total August		101,176	6,200	89,024	-	113,328	12.0 %
<u>SEPTEMBER</u>							
Period A (0800-1359)							
Guided	WD	6,129	518	5,114	-	7,144	16.6 %
	WE	4,042	375	3,307	-	4,777	18.2 %
Unguided	WD	11,134	1,306	8,575	-	13,693	23.0 %
	WE	8,162	596	6,994	-	9,330	14.3 %
Shore	WD	1,442	211	1,028	-	1,856	28.7 %
	WE	818	106	610	-	1,026	25.4 %
Total Period A		31,727	1,589	28,613	-	34,841	9.8 %
Period B (1400-1959)							
Guided	WD	1,701	812	110	-	3,292	93.5 %
	WE	732	285	174	-	1,290	76.3 %
Unguided	WD	6,468	1,836	2,870	-	10,066	55.6 %
	WE	2,688	299	2,103	-	3,273	21.8 %
Shore	WD	2,300	490	1,340	-	3,260	41.7 %
	WE	726	151	429	-	1,023	40.9 %
Total Period B		14,615	2,112	10,475	-	18,755	28.3 %
Total September		46,342	2,643	41,161	-	51,523	11.2 %

^a WE = Weekend, WD = Weekday.

Harvest and Catch:

A total of 1,612 completed-trip angler interviews were conducted, 896 during the early run (27% guided, 62% unguided, and 11% shore anglers) and 716 during the late run (25% guided, 69% unguided, and 7% shore anglers) (Appendices B1-B6).

For the early run, the estimated harvest of 21,628 coho salmon (SE = 2,429) was 98.9% of the estimated catch of 21,878 coho salmon (SE = 2,437) and for the late run, the estimated harvest of 7,444 coho salmon (SE = 662) was 99.9% of the estimated catch of 7,454 coho salmon (SE = 662) (Tables 2 and 3). For both fisheries nearly all coho salmon caught were retained, i.e. catch and harvest were approximately equal.

Greater than 75% of the estimated harvest for each fishery occurred during Period A (morning) (Table 2). The harvest rate (HPUE) was also greater during Period A than Period B for all angler types in both fisheries (Figure 4). For the early- and late-run coho salmon fisheries, more than 69% of the total estimated harvest occurred on weekdays (Table 4). The guided and unguided anglers accounted for similar proportions of the harvest: 43% and 41%, respectively, for the early run; and 42% and 52%, respectively, for the late run. Shore anglers took less than 17% of the total harvest in each run. In the early run, the harvest rate for guided anglers (0.3629) was more than twice that of unguided anglers (0.1667) and shore anglers (0.1559). In the late run, guided anglers also had the highest rate of harvest (0.2469), followed by unguided anglers (0.1354) and shore anglers (0.0908). Decreased effort during the late run may be partly attributed to unseasonably high water levels in the Kenai River.

Summary:

Estimates of catch and harvest were within desired levels of precision and accuracy specified by the project design; however, relative precision for estimates of effort for the early (12.0%) and late (11.2%) runs was slightly higher than preferred (10.0%) (Table 1).

Historical estimates of effort and harvest suggest that 1991 may be the beginning of a stabilizing to downward trend in the early- and late-run coho salmon fisheries (Figure 2). Figures 5 and 6 depict a similar trend in daily effort by run for 1991 and 1992; but in 1993, effort estimates were lower at the beginning of each days run and failed to increase to levels historically typified during peak days for each run. The reduced effort at the beginning of the early run in 1993 may be attributed to the 4-day extension (1-4 August) of the chinook salmon season. Comparing effort estimates for 1993 to 1992 and to the historic mean (early run = 159,877, late run = 75,591) there was a decrease during the early run of 43% and 37%, respectively, and during the late run of 29% and 39%, respectively. There was an appreciable effort reduction (20%-49%) from 1992 to 1993 during both runs by all angler types.

The 1993 early-run harvest estimate increased by 17% and the HPUE nearly doubled in comparison to 1992 while the late-run harvest estimate decreased by 45% and the HPUE remained relatively unchanged (Figure 2). The increased harvest in the early run is the result of shore anglers almost doubling their harvest from 1992 (3,421 and 1,749, respectively) while guided and unguided

Table 2. Estimated harvest during each stratum of the sport fishery for coho salmon in the downstream section of the Kenai River, 1993.

Angler Type	WE/WD ^a	Estimated Harvest	Standard Error	95% Confidence Interval		Relative Precision	
<u>AUGUST</u>							
Period A (0600-1359)							
Guided	WD	7,820	1,465	4,948	-	10,692	36.7 %
	WE	901	568	0	-	2,015	123.7 %
Unguided	WD	6,175	1,536	3,164	-	9,186	48.8 %
	WE	727	356	30	-	1,424	95.9 %
Shore	WD	714	301	124	-	1,304	82.7 %
	WE	752	0	752	-	752	0.0 %
Total Period A		17,089	2,246	12,686	-	21,492	25.8 %
Period B (1400-2159)							
Guided	WD	408	187	42	-	774	89.7 %
	WE	118	68	0	-	252	113.4 %
Unguided	WD	1,509	546	438	-	2,580	71.0 %
	WE	549	248	64	-	1,034	88.4 %
Shore	WD	1,791	649	519	-	3,063	71.0 %
	WE	164	180	0	-	516	214.7 %
Total Period B		4,539	923	2,729	-	6,349	39.9 %
Total August		21,628	2,429	16,868	-	26,388	22.0 %
<u>SEPTEMBER</u>							
Period A (0800-1359)							
Guided	WD	1,684	375	949	-	2,419	43.6 %
	WE	981	193	603	-	1,359	38.5 %
Unguided	WD	1,989	338	1,327	-	2,651	33.3 %
	WE	809	120	574	-	1,044	29.1 %
Shore	WD	119	58	6	-	232	94.8 %
	WE	66	38	0	-	141	114.0 %
Total Period A		5,648	558	4,555	-	6,741	19.4 %
Period B (1400-1959)							
Guided	WD	225	110	9	-	441	95.9 %
	WE	222	192	0	-	598	169.6 %
Unguided	WD	840	267	318	-	1,362	62.2 %
	WE	214	74	69	-	359	67.8 %
Shore	WD	295	41	215	-	375	27.2 %
	WE	0	0	0	-	0	
Total Period B		1,796	357	1,097	-	2,495	38.9 %
Total September		7,444	662	6,147	-	8,741	17.4 %

^a WE = Weekend, WD = Weekday.

Table 3. Estimated catch during each stratum of the sport fishery for coho salmon in the downstream section of the Kenai River, 1993.

Angler Type	WE/WD ^a	Estimated Catch	Standard Error	95% Confidence Interval		Relative Precision	
<u>AUGUST</u>							
Period A (0600-1359)							
Guided	WD	7,947	1,468	5,070	-	10,824	36.2 %
	WE	901	568	0	-	2,015	123.7 %
Unguided	WD	6,192	1,537	3,179	-	9,205	48.7 %
	WE	759	379	16	-	1,502	97.8 %
Shore	WD	714	301	124	-	1,304	82.7 %
	WE	752	0	752	-	752	0.0 %
Total Period A		17,265	2,253	12,850	-	21,680	25.6 %
Period B (1400-2159)							
Guided	WD	408	187	42	-	774	89.7 %
	WE	118	68	0	-	252	113.4 %
Unguided	WD	1,559	551	479	-	2,639	69.3 %
	WE	573	262	59	-	1,087	89.6 %
Shore	WD	1,791	649	519	-	3,063	71.0 %
	WE	164	180	0	-	516	214.7 %
Total Period B		4,613	930	2,790	-	6,436	39.5 %
Total August		21,878	2,437	17,101	-	26,655	21.8 %
<u>SEPTEMBER</u>							
Period A (0800-1359)							
Guided	WD	1684	375	949	-	2,419	43.6 %
	WE	981	193	603	-	1,359	38.5 %
Unguided	WD	1999	337	1,339	-	2,659	33.0 %
	WE	809	120	574	-	1,044	29.1 %
Shore	WD	119	58	6	-	232	94.8 %
	WE	66	38	0	-	141	114.0 %
Total Period A		5,658	557	4,566	-	6,750	19.3 %
Period B (1400-1959)							
Guided	WD	225	110	9	-	441	95.9 %
	WE	222	192	0	-	598	169.6 %
Unguided	WD	840	267	318	-	1,362	62.2 %
	WE	214	74	69	-	359	67.8 %
Shore	WD	295	41	215	-	375	27.2 %
	WE	0	0	0	-	0	
Total Period B		1,796	357	1,097	-	2,495	38.9 %
Total September		7,454	662	6,157	-	8,751	17.4 %

^a WE = Weekend, WD = Weekday.

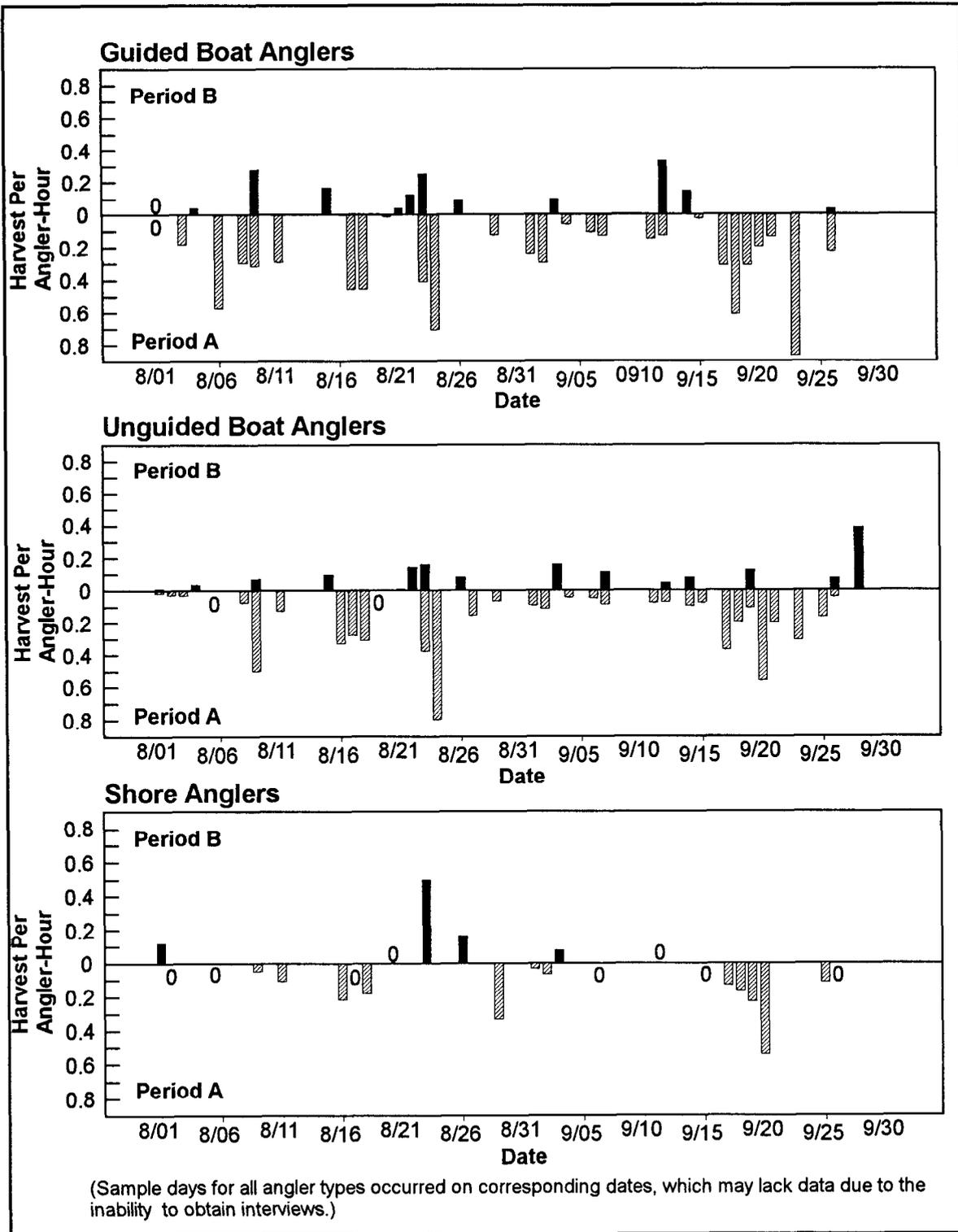


Figure 4. Number of coho salmon harvested per angler-hour by recreational anglers fishing in the downstream section of the Kenai River, 1 August through 30 September 1993.

Table 4. Summary of angler effort and harvest, HPUE, catch, and CPUE of coho salmon during August and September in the downstream section of the Kenai River, 1993.

	WE/WD ^a	Effort Estimate	Harvest		Catch	
			Estimate	HPUE	Estimate	CPUE
<u>August</u>						
Guided	WD	20,523	8,228	0.4009	8,355	0.4071
	WE	4,959	1,019	0.2055	1,019	0.2055
Unguided	WD	37,111	7,684	0.2071	7,751	0.2089
	WE	16,633	1,276	0.0767	1,332	0.0801
Shore	WD	15,425	2,505	0.1624	2,505	0.1624
	WE	6,525	916	0.1404	916	0.1404
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Total WD		73,059	18,417	0.2521	18,611	0.2547
Total WE		28,117	3,211	0.1142	3,267	0.1162
Total Guided		25,482	9,247	0.3629	9,374	0.3679
Total Unguided		53,744	8,960	0.1667	9,083	0.1690
Total Shore		21,950	3,421	0.1559	3,421	0.1559
<hr/>						
TOTAL AUGUST		101,176	21,628	0.2138	21,878	0.2162
<hr/>						
<u>September</u>						
Guided	WD	7,830	1,909	0.2438	1,909	0.2438
	WE	4,774	1,203	0.2520	1,203	0.2520
Unguided	WD	17,602	2,829	0.1607	2,839	0.1613
	WE	10,850	1,023	0.0943	1,023	0.0943
Shore	WD	3,742	414	0.1106	414	0.1106
	WE	1,544	66	0.0427	66	0.0427
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Total WD		29,174	5,152	0.1766	5,162	0.1769
Total WE		17,168	2,292	0.1335	2,292	0.1335
Total Guided		12,604	3,112	0.2469	3,112	0.2469
Total Unguided		28,452	3,852	0.1354	3,862	0.1357
Total Shore		5,286	480	0.0908	480	0.0908
<hr/>						
TOTAL September		46,342	7,444	0.1606	7,454	0.1608
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GRAND TOTAL		147,518	29,072	0.1971	29,332	0.1988

^a WD = weekday, WE = weekend

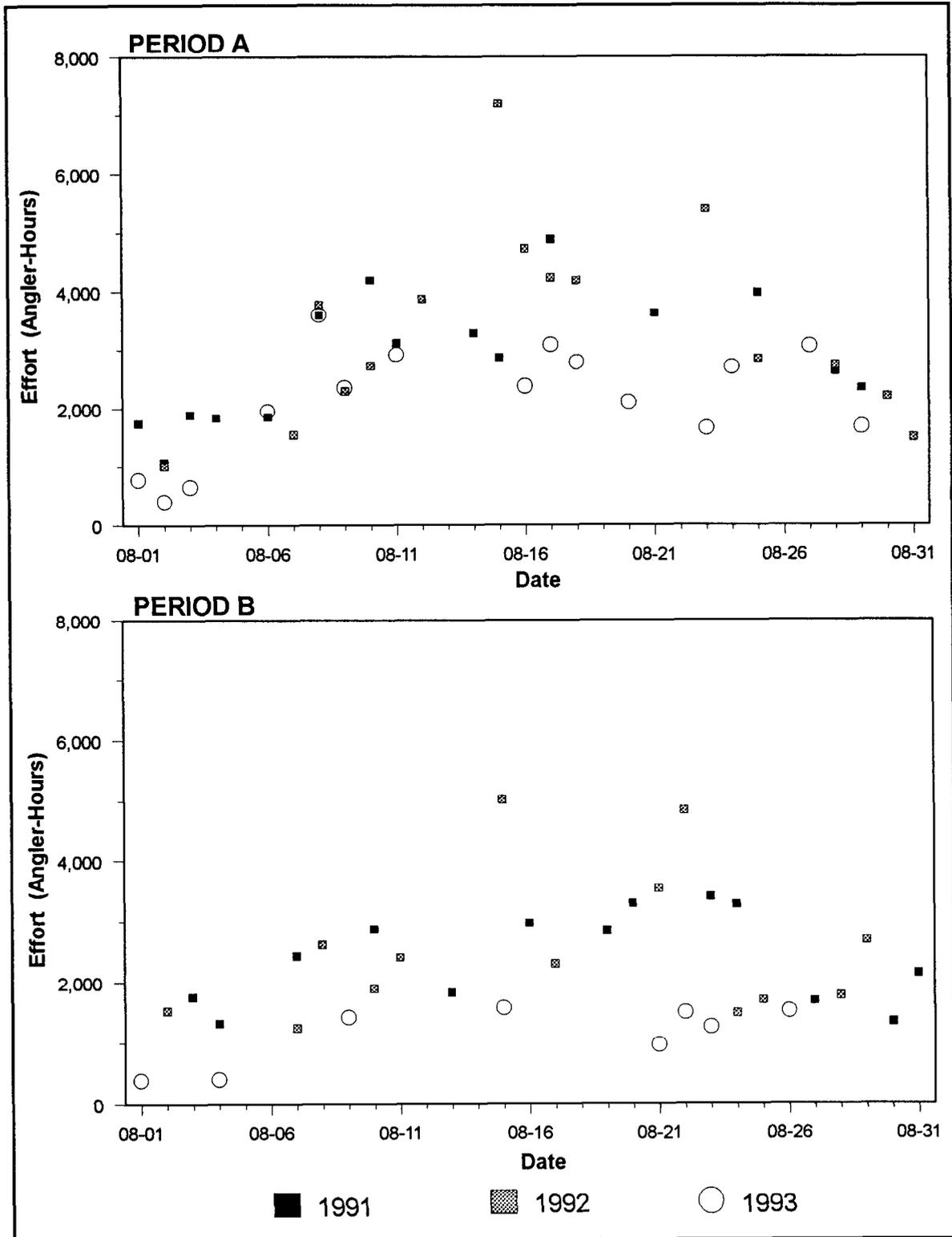


Figure 5. Historical effort by days sampled in the recreational fishery for early-run coho salmon in the downstream section of the Kenai River, 1991-1993.

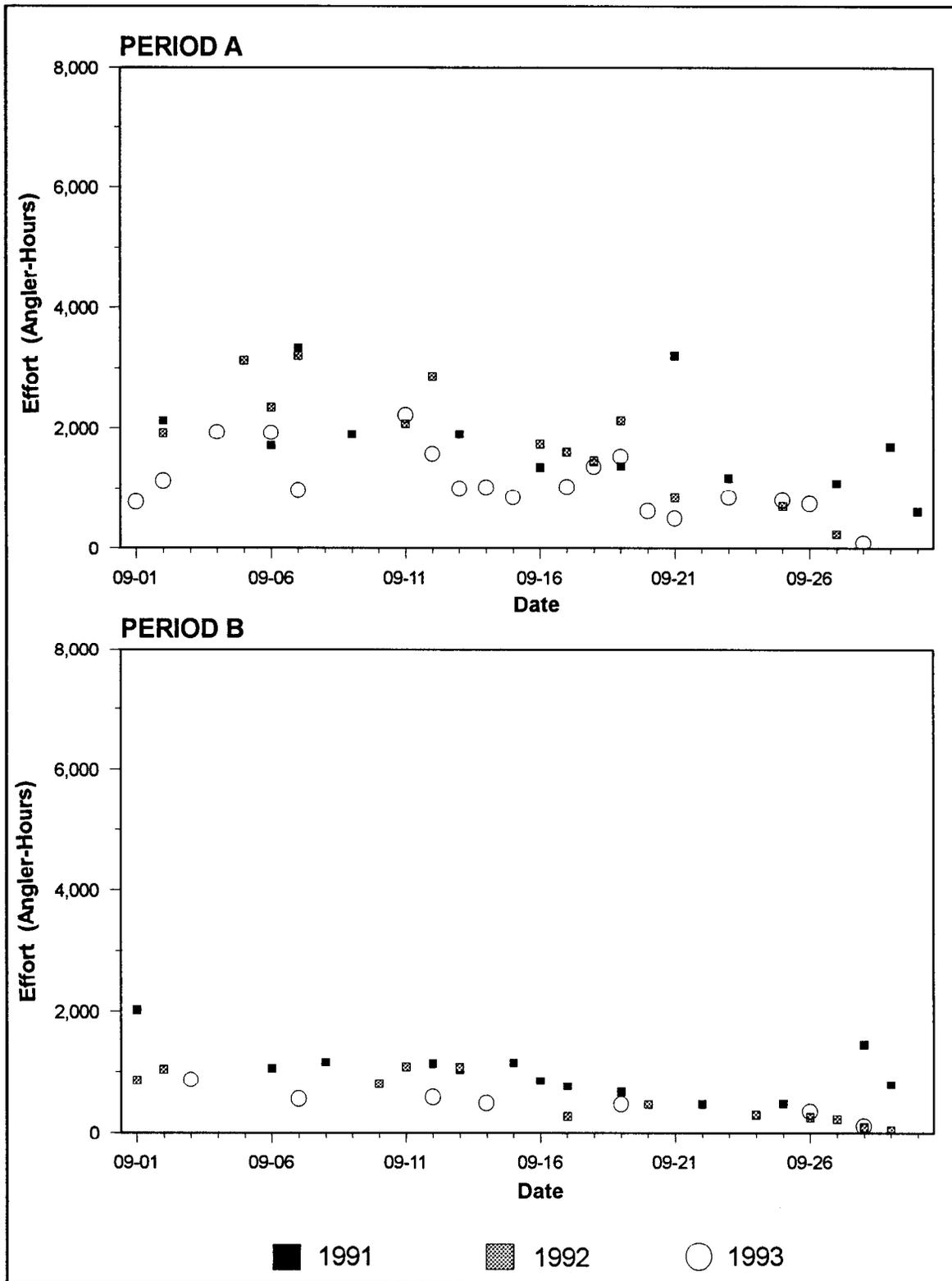


Figure 6. Historical effort by days sampled in the recreational fishery for late-run coho salmon in the downstream section of the Kenai River, 1991-1993.

anglers witnessed a slight decrease in harvest from 1992 (King 1993) (Table 4).

Guided anglers remain the most successful harvesters having an HPUE double that of other angler types for the early run and nearly double that of the others for the late run (Table 4). Interestingly, guided effort was significantly reduced from 1992 during both runs (Figure 3).

HPUE data suggest that early-run coho salmon entered the fishery about 3 August and were gone by about 27 August. Late-run fish then entered the fishery about 1 September, validating the August-September separation of the creel survey.

Biological Data

Age composition data were used to estimate harvests by sex and age class (Table 5). There was no significant difference in age composition between 2-week time strata within each run (early run: $\chi^2 = 3.4$, $df = 2$, $P > 0.1$; late run: $\chi^2 = 1.6$, $df = 2$, $P = 0.1$) nor between runs ($\chi^2 = 4.5$, $df = 2$, $P > 0.1$). The predominant age class in both the early- and late-run harvests was age 2.1 which comprised 94.3% and 96.6% of the samples, respectively, or 95.4% of the combined fishery (Tables 5 and 6). Only two other age classes were significantly represented in the sample: age 1.1 (2.1% of the early run, 0.3% of the late run) and age 3.1 (3.3% of the early run, 2.8% of the late run). More males were harvested than females during both the early and late runs.

Both male ($t = 6.03$, $df = 388$, $P < 0.01$) and female ($t = 3.09$, $df = 288$, $P < 0.01$) age-2.1 coho salmon had greater mean lengths during the late run than during the early run (Table 5). This relationship was observed in other age classes, but sample sizes were insufficient to detect a significant difference. The 2.1 age class was further stratified into 2-week periods within each run to determine if significant differences in mean lengths existed within a run. During the early run, there was no significant difference in mean length between periods for females ($t = 0.25$, $df = 158$, $P > 0.5$) or for males ($t = 0.60$, $df = 205$, $P > 0.5$). For the late run, age-2.1 males sampled during the last 2 weeks of September had greater mean lengths than those sampled during the first 2 weeks of September ($t = 3.29$, $df = 179$, $P < 0.01$). For the same periods in September, age-2.1 females showed no significant difference in mean length ($t = 1.48$, $df = 128$, $P > 0.05$). Since coho salmon grow rapidly during their last several months in salt water (Hartt 1980), the larger mean length during the late run is not surprising.

RECOMMENDATIONS

The 1993 coho salmon creel survey was restructured to emphasize more sampling in the morning periods (80%) which provided a more precise estimate of effort, catch, and harvest. This season at least 62% of the early- and late-run effort occurred on weekday days as opposed to weekend days; in fact, the majority of early-run (65%) and late-run (59%) effort occurred in period A on weekdays. The creel design may need to be restructured again, increasing the proportion of weekday days sampled.

Table 5. Age composition and mean length-at-age of coho salmon sampled from the recreational harvest during the fishery for coho salmon in the downstream section of the Kenai River, 1993.

	Sex	Age Group				Total	
		1.1	2.1	3.1	Other		
AUGUST							
Percent	Male	1.5	53.2	2.3	0.3	57.3	
	Female	0.5	41.1	1.0	0.0	42.6	
	Combined	2.1	94.3	3.3	0.3	100.0	
	SE	0.7	1.2	0.9	0.3		
Mean Length (mm) ^a	Male	583	578	598	660		
	SE	18	4.4	22.1			
	Sample size	6	207	9	1	223	
	Female	515	576	620			
	SE	5	3	12			
	Sample size	2	160	4	0	166	
	SEPTEMBER						
	Percent	Male		56.2	0.6		56.8
Female		0.3	40.4	2.2	0.3	43.2	
Combined		0.3	96.6	2.8	0.3	100.0	
SE		0.3	1.0	0.9	0.3		
Mean Length (mm) ^a	Male		613	663			
	SE		4	28			
	Sample size	0	181	2	0	183	
	Female	610	594	594	360		
	SE		5	22			
	Sample size	1	130	7	1	139	
COMBINED ^b							
Percent	Male	0.8	54.6	1.6	0.1	57.1	
	Female	0.5	40.8	1.5	0.1	42.9	
	Combined	1.3	95.4	3.1	0.2	100.0	
	SE	0.4	0.8	0.7	0.1		

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

^b No significant difference in age compositions existed between runs.

Table 6. Estimated number, by sex and age class, of coho salmon harvested by the recreational fishery in the downstream section of the Kenai River, 1993.

Stratum	Sex	Statistic	Age Group				Total
			1.1	2.1	3.1	Other	
August (n=389)	Male	Sample Size	6	207	9	1	223
		Percent	1.5	53.2	2.3	0.3	57.3
		SE	0.63	2.53	0.76	0.26	2.51
		Harvest	334	11,509	500	56	12,399
		SE Harvest	140	1,403	173	56	
	Female	Sample Size	2	160	4	0	166
		Percent	0.5	41.1	1.0	0.0	42.7
		SE	0.36	2.50	0.51	0.00	2.51
		Harvest	111	8,896	222	0	9,229
		SE Harvest	79	1,134	113	0	
	Combined	Sample Size	8	367	13	1	389
		Percent	2.1	94.3	3.3	0.3	100.0
		SE	0.72	1.17	0.91	0.26	0.00
		Harvest	445	20,405	723	56	21,628
		SE Harvest	163	2,305	212	56	2,429
September (n=322)	Male	Sample Size	0	181	2	0	183
		Percent	0.0	56.2	0.6	0	56.8
		SE	0.00	2.77	0.44	0.00	2.76
		Harvest	0	4,184	46	0	4,231
		SE Harvest	0	425	33	0	
	Female	Sample Size	1	130	7	1	139
		Percent	0.3	40.4	2.2	0	43.2
		SE	0.31	2.74	0.81	0.31	2.76
		Harvest	23	3,005	162	23	3,213
		SE Harvest	23	336	62	23	
	Combined	Sample Size	1	311	9	1	322
		Percent	0.3	96.6	2.8	0	100.0
		SE	0.31	1.01	0.92	0.31	0.00
		Harvest	23	7,190	208	23	7,444
		SE Harvest	23	644	71	23	662

There was a discrepancy during the early run between the proportion of total effort (counts) for shore anglers (22%) and the proportion of angler interviews for shore anglers (11%). This occurred to a lesser degree during the late run (11% and 7%, respectively). In many sample periods, no shore anglers were interviewed, although the angler counts show that many shore anglers were present. When this occurred, the catch and harvest by shore anglers was set to 0. This problem also occasionally happened with guided anglers. This may cause a biased estimate of harvest and catch by shore and guided anglers. Creel personnel should be stationed at areas where they can interview more shore and guided boat anglers.

With increasing concern being voiced regarding fishing effort/harvest in the mid and upstream sections of the Kenai River, it may be prudent to reconsider the need for onsite evaluation of the early- and late-run coho salmon fisheries in these sections. This could also provide opportunity for CWT recovery in these sections of the river, allowing for the determination of a marked-to-unmarked ratio of coho salmon which could be compared to the downstream ratio possibly reinforcing the importance of the Moose River as a rearing habitat for juvenile coho salmon.

As part of a program to determine the coho salmon population size, wild fingerling and smolt were marked with CWTs in 1991-1993 (Carlson 1992, 1993, *In prep*). In order to establish a marked-to-unmarked ratio, an estimated 4,000 adult coho salmon will have to be sampled annually from the recreational harvest (Meyer et al. *Unpublished*). With additional sampling effort, this goal was achieved in 1993. The same sampling effort will be required during the 1994 coho salmon fishery.

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LITERATURE CITED

- Booth, J. 1990. Run timing and spawning distribution of coho salmon (*Oncorhynchus kisutch*) in the Kenai River, Alaska and their relation to harvest strategies. Master's thesis. Montana State University, Bozeman.
- Carlson, J. 1992. Feasibility of capturing and marking juvenile coho salmon for stock assessment in the Kenai River. Alaska Department of Fish and Game, Fishery Data Series No. 92-57. Anchorage.
- _____. 1993. Marking juvenile coho salmon in the Kenai River with coded, microwire tags. Alaska Department of Fish and Game, Fishery Data Series No. 93-52. Anchorage.
- _____. *In prep.* Marking juvenile coho salmon in the Kenai River with coded, microwire tags. Alaska Department of Fish and Game, Fishery Data Series No. 93-52. Anchorage.
- Cochran, W. G. 1977. Sampling techniques. Third edition. John Wiley and Sons, New York.
- Conrad, R. H. and S. L. Hammarstrom. 1987. Harvest of chinook salmon *Oncorhynchus tshawytscha* and coho salmon *O. kisutch* and angler-effort by the lower Kenai River recreational fisheries, 1986. Alaska Department of Fish and Game, Fishery Data Series No. 6. Juneau.
- DiCostanzo, C. J. 1956. Creel census techniques and harvest of fishes in Clear Lake, Iowa. Ph.D. dissertation, Iowa State College, Ames, Iowa.
- Efron, B. 1982. The jackknife, the bootstrap and other resampling plans. Society for Industrial and Applied Mathematics, CBMS-NSF Monograph 38, Philadelphia, Pennsylvania.
- Goodman, L. A. 1960. On the exact variance of products. Journal American Statistical Association 55:708-713.
- Hammarstrom, S. L. 1977. Inventory and cataloging of Kenai Peninsula, Cook Inlet drainages and fish stocks. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1976-1977, Project F-9-9, 18 (G-I-C):29-46. Juneau.
- _____. 1978. Inventory and cataloging of Kenai Peninsula, Cook Inlet and fish stocks. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1977-1978, Project F-9-10, 19 (G-I-C):42-56. Juneau.
- _____. 1988. Angler effort and harvest of chinook salmon *Oncorhynchus tshawytscha* and coho salmon *O. kisutch* by the recreational fisheries in the lower Kenai River, 1987. Alaska Department of Fish and Game. Fishery Data Series No. 50. Juneau.

LITERATURE CITED (Continued)

- _____. 1989. Angler effort and harvest of chinook salmon and coho salmon by the recreational fisheries in the lower Kenai River, 1988. Alaska Department of Fish and Game. Fishery Data Series No. 100. Juneau.
- _____. 1990. Angler effort and harvest of chinook salmon and coho salmon by the recreational fisheries in the lower Kenai River, 1989. Alaska Department of Fish and Game. Fishery Data Series No. 90-22. Anchorage.
- _____. 1991. Angler effort and harvest of chinook salmon and coho salmon by the recreational fisheries in the lower Kenai River, 1990. Alaska Department of Fish and Game. Fishery Data Series No. 91-44. Anchorage.
- _____. 1992. Angler effort and harvest of coho salmon during the recreational fisheries in the lower Kenai River, 1991. Alaska Department of Fish and Game. Fishery Data Series No. 92-36. Anchorage.
- Hammarstrom, S. L. and L. L. Larson. 1986. Cook Inlet chinook and coho salmon studies. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1985-1986, Project F-9-18, 27 (G-32-1,2,4,5):1-56. Juneau.
- Hammarstrom, S. L., L. L. Larson, M. Wenger, and J. Carlon. 1985. Kenai River chinook and coho salmon studies/Kenai River chinook salmon hook and release study. Alaska Department of Fish and Game, Federal Aid in Fish Restoration/Anadromous Fish Study, Annual Performance Report, 1984-1985, Project F-9-17/AFS-50, 26 (G-II-L). Juneau.
- Jones & Stokes Associates, Inc. 1987. Southcentral Alaska sport fishing economic study. Final research report. November 1987. (JSA86-0413.) Sacramento, CA. Prepared for Alaska Department of Fish and Game, Sport Fish Division, Research and Technical Services Section, Anchorage, AK.
- Hartt, A. C. 1980. Juvenile salmonids in the oceanic ecosystem-the critical first summer. Pages 25-27 in W. J. McNeil and D. C. Himsworth, editors. Salmonid ecosystems of the North Pacific. Oregon State University Press, Corvallis.
- King, M. A. S. 1993. Angler effort and harvest of coho salmon during the recreational fisheries in the lower Kenai River, 1992. Alaska Department of Fish and Game. Fishery Data Series No. 93-31. Anchorage.
- Meyer, S. C., D. Vincent-Lang, and D. McBride. *Unpublished*. Goal statement and study plan for the development of a stock assessment program for upper Cook Inlet coho salmon stocks. Located at Alaska Department of Fish and Game, Division of Sport Fish, 333 Raspberry Road, Anchorage.
- Mills, M. 1979. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1978-1979, Project F-9-11, 20 (SW-1). Juneau.

LITERATURE CITED (Continued)

- _____. 1980. Alaska statewide sport fish harvest studies. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1979-1980, Project F-9-12, 21 (SW-1). Juneau.
- _____. 1981a. Alaska statewide sport fish harvest studies (1979). Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22 (SW-I-A). Juneau.
- _____. 1981b. Alaska statewide sport fish harvest studies (1980). Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22 (SW-I-A). Juneau.
- _____. 1982. Alaska statewide sport fish harvest studies (1981). Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1981-1982, Project F-9-14, 23 (SW-1). Juneau.
- _____. 1983. Alaska statewide sport fish harvest studies (1982). Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1982-1983, Project F-9-15, 24 (SW-1). Juneau.
- _____. 1984. Alaska statewide sport fish harvest studies (1983). Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984. Project F-9-16, 25 (SW-1-A). Juneau.
- _____. 1985. Alaska statewide sport fish harvest studies (1984). Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1984-1985, Project F-9-17, 26 (SW-1-A). Juneau.
- _____. 1986. Alaska statewide sport fish harvest studies (1985). Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1985-1986, Project F-10-1, 27 (RT-2). Juneau.
- _____. 1987. Alaska statewide sport fisheries harvest report 1986. Alaska Department of Fish and Game, Fishery Data Series No. 2. Juneau.
- _____. 1988. Alaska statewide sport fisheries harvest report 1987. Alaska Department of Fish and Game, Fishery Data Series No. 52. Juneau.
- _____. 1989. Alaska statewide sport fisheries harvest report 1988. Alaska Department of Fish and Game, Fishery Data Series No. 122. Juneau.
- _____. 1990. Harvest and participation in Alaska sport fisheries during 1989. Alaska Department of Fish and Game, Fishery Data Series No. 90-44. Anchorage.
- _____. 1991. Harvest, catch, and participation in Alaska sport fisheries during 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-58. Anchorage.
- _____. 1992. Harvest, catch, and participation in Alaska sport fisheries during 1991. Alaska Department of Fish and Game, Fishery Data Series No. 92-40. Anchorage.

LITERATURE CITED (Continued)

- _____. 1993. Harvest, catch, and participation in Alaska sport fisheries during 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-42. Anchorage.
- Neuhold, J. M. and K. H. Lu. 1957. Creel census methods. Utah State Department of Fish and Game, Publ. 8, Salt Lake City, Utah.
- Scarnecchia, D. L. 1979. Variation of scale characteristics of coho salmon with location on body. Prog. Fish Cult. 41(3):132-135.
- Scheaffer, R. L., W. Mendenhall, and L. Ott. 1979. Elementary survey sampling. Duxbury Press, North Scituate, Mass.
- Thompson, S. K. 1987. Sample size for estimating multinomial proportions. The American Statistician 41(1):42-46.
- Wallis, J. and S. L. Hammarstrom. 1979. Inventory and cataloging of Kenai Peninsula and Cook Inlet drainages and fish stocks. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1978-1979, Project F-9-11, 20 (G-I-C):49-96. Juneau.
- _____. 1980. Inventory and cataloging of Kenai Peninsula and Cook Inlet drainages and fish stocks. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1979-1980, Project F-9-12, 21 (G-I-C):59-90. Juneau.
- _____. 1981. Inventory and cataloging of Kenai Peninsula and Cook Inlet drainages and fish stocks. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1980-1981, Project F-9-13, 22 (G-I-C):33-61. Juneau.
- _____. 1982. Inventory and cataloging of Kenai Peninsula and Cook Inlet drainages and fish stocks. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1981-1982, Project F-9-14, 23 (G-I-C):45-75. Juneau.
- _____. 1983. Inventory and cataloging of Kenai Peninsula and Cook Inlet drainages and fish stocks. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1982-1983, Project F-9-15, 24 (G-I-C):27-58. Juneau.
- _____. 1984. Kenai Peninsula/Lower Cook Inlet angler use and stock assessment studies. Alaska Department of Fish and Game, Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984, Project F-9-16, 25 (G-I-C):1-35. Juneau.

APPENDIX A

Counts of anglers during the creel survey of the fishery
for coho salmon in the downstream section
of the Kenai River, Alaska, 1993.

Appendix A1. Angler counts by stratum during the recreational fishery for coho salmon in the downstream section of the Kenai River, during August 1993.

DATE	GUIDED ANGLERS						UNGUIDED ANGLERS						SHORE ANGLERS					
	PERIOD A			PERIOD B			PERIOD A			PERIOD B			PERIOD A			PERIOD B		
	Count			Count			Count			Count			Count			Count		
	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3	#1	#2	#3
8/01	25	18	0	5	0	0	24	15	34	7	6	13	12	76	87	67	33	15
8/02	6	6					3	10	10				33	40	45			
8/03	5	0	6				30	13	20				58	61	52			
8/04				0	0	0				51	37	29				16	12	8
8/05																		
8/06	90	137	87				51	114	128				23	44	57			
8/08	110	115	87				305	289	236				59	87	65			
8/09	174	120	177	21	0	87	128	152	130	80	105	143	27	37	36	76	93	12
8/11		208	165					142	132					26	78			
8/15				43	17						133	122				43	35	
8/16	167	175	75				112	144	56				50	44	67			
8/17	194	185	78				212	189	110				84	71	35			
8/18	206	191	69				170	140	102				53	86	26			
8/20	134	133	64				137	148	96				7	28	40			
8/21				21	6	0				114	101	62				22	21	12
8/22					14	5					164	84					70	37
8/23	76	19	46	31	30	4	145	63	92	88	105	137	47	62	71	19	26	31
8/24	113	136	106				148	186	169				38	61	55			
8/26				46	10	7				144	102	120	74	29	38			
8/27	107	120	89				198	257	211				29	71	67			
8/29	78	47	27				198	108	77				35	32	27			

Appendix A2. Angler counts by stratum during the recreational fishery for coho salmon in the downstream section of the Kenai River, during September 1993.

DATE	GUIDED ANGLERS						UNGUIDED ANGLERS						SHORE ANGLERS					
	PERIOD A			PERIOD B			PERIOD A			PERIOD B			PERIOD A			PERIOD B		
	Count #1	Count #2	Count #3	Count #1	Count #2	Count #3	Count #1	Count #2	Count #3	Count #1	Count #2	Count #3	Count #1	Count #2	Count #3	Count #1	Count #2	Count #3
9/01	69	52	54				75	49	37				15	11	23			
9/02	94	81	54				103	103	51				19	37	18			
9/03				41	30	22				81	85	79				30	38	21
9/04	138	126	88				181	224	136				22	28	21			
9/06	85	73	55				254	255	178				14	36	10			
9/07	37	29	22	5	5	5	121	130	101	71	75	55	12	18	11	25	17	17
9/11	149	119	73				260	235	185				42	33	12			
9/12	88	74	57	38	20	15	193	194	116	77	45	42	14	24	22	16	14	21
9/13	80	72	44				114	101	62				8	6	8			
9/14	46	46	45	19	22	10	116	106	113	36	58	55	6	14	12	13	12	14
9/15	57	43	32				96	85	67				14	12	16			
9/17	94	59	60				109	83	82				3	6	12			
9/18	57	64	72				136	151	178				4	7	8			
9/19	108	88	75	32	7	0	189	166	91	64	57	51	12	15	16	7	7	6
9/20	42	47	24				61	64	54				0	6	13			
9/21	46	43	28				49	46	38				0	0	0			
9/23	51	37	33				90	90	74				7	23	18			
9/25	45	50	16				147	93	36				4	7	2			
9/26	43	23	19	8	2	0	123	74	66	50	34	28	4	9	12	16	18	16
9/28	3	7	7	0	0	0	6	8	10	2	10	9	0	0	4	9	13	10



APPENDIX B

Daily summary statistics for fishing effort, harvest rate,
and catch rate for anglers interviewed during the fishery
for coho salmon in the downstream section
of the Kenai River, Alaska, 1993.

Appendix B1. Daily summary statistics for fishing effort, number of anglers interviewed, and coho salmon HPUE, harvest, CPUE and catch by stratum for guided boat anglers interviewed during the fishery for coho salmon in the downstream section of the Kenai River during August 1993.

Date	Period ^a	Estimated		Ang Int ^b	HPUE		Estimated		CPUE		Estimated	
		Effort	Variance		Mean	Variance	Harvest	Variance	Mean	Variance	Catch	Variance
930801	A	115	1,989	15	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930801	B	13	133	5	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930802	A	32	192	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930803	A	29	325	6	0.1838	0.0179	5	21	0.1838	0.0179	5	21
930804	B	0	0	4	0.0417	0.0017	0	0	0.0417	0.0017	0	0
930806	A	837	25,115	16	0.5759	0.0028	482	10,239	0.5759	0.0028	482	10,239
930808	A	832	4,315	4	0.3000	0.0033	250	2,681	0.3000	0.0033	250	2,681
930809	A	1016	55,920	8	0.3160	0.0068	321	12,197	0.3672	0.0099	373	17,157
930809	B	56	2,352	4	0.2804	0.0014	16	186	0.2804	0.0014	16	186
930811	A	1467	14,987	16	0.2906	0.0081	426	18,650	0.2906	0.0081	426	18,650
930815	B	240	10,816	3	0.1667	0.0011	40	352	0.1667	0.0011	40	352
930815	A	1112	53,675	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930817	A	1219	61,493	26	0.4576	0.0002	558	13,139	0.4576	0.0002	558	13,139
930818	A	1243	80,581	20	0.4563	0.0013	567	18,657	0.4563	0.0013	567	18,657
930820	A	883	25,397	44	0.0134	0.0001	12	47	0.0134	0.0001	12	47
930821	B	72	1,392	4	0.0417	0.0017	3	9	0.0417	0.0017	3	9
930822	B	76	1,296	4	0.1250	0.0017	10	28	0.1250	0.0017	10	28
930823	A	376	21,216	13	0.4130	0.0048	155	4,191	0.4130	0.0048	155	4,191
930823	B	173	3,611	4	0.2500	0.0000	43	226	0.2500	0.0000	43	226
930824	A	947	7,621	12	0.7102	0.0030	672	6,491	0.7102	0.0030	672	6,491
930826	B	168	6,960	14	0.0903	0.0003	15	63	0.0903	0.0003	15	63
930827	A	843	6,027	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930829	A	405	7,259	23	0.1255	0.0020	51	429	0.1255	0.0020	51	429

^a Period A = 0600-1359 hours, B = 1400-2159 hours

^b Anglers interviewed

Appendix B2. Daily summary statistics for fishing effort, number of anglers interviewed, and coho salmon HPUE, harvest, CPUE and catch by stratum for unguided boat anglers interviewed during the fishery for coho salmon in the downstream section of the Kenai River during August 1993.

Date	Period ^a	Estimated		Ang Int ^b	HPUE		Estimated		CPUE		Estimated	
		Effort	Variance		Mean	Variance	Harvest	Variance	Mean	Variance	Catch	Variance
930801	A	195	2,357	17	0.0206	0.0004	4	16	0.0206	0.0004	4	16
930801	B	69	267	22	0.0081	0.0001	1	0	0.0081	0.0001	1	0
930802	A	61	261	7	0.0301	0.0009	2	3	0.0301	0.0009	2	3
930803	A	168	1,803	16	0.0343	0.0005	6	16	0.0343	0.0005	6	16
930804	B	312	1,387	13	0.0307	0.0005	10	46	0.0307	0.0005	10	46
930806	A	781	22,213	5	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930808	A	2,213	16,347	49	0.0755	0.0002	167	1,223	0.0803	0.0002	178	1,257
930809	A	1,128	4,272	2	0.5000	0.0000	564	1,068	0.5000	0.0000	564	1,068
930809	B	765	3,381	51	0.0675	0.0003	52	211	0.0675	0.0003	52	211
930811	A	1,077	1,301	34	0.1292	0.0008	139	979	0.1292	0.0008	139	979
930815	B	1,020	1,936	7	0.0932	0.0006	95	623	0.0932	0.0006	95	623
930816	A	832	46,763	4	0.3333	0.0000	277	5,196	0.3333	0.0000	277	5,196
930817	A	1,363	36,107	34	0.2794	0.0017	381	5,843	0.2860	0.0017	390	6,031
930818	A	1,099	12,501	9	0.3140	0.0059	345	8,332	0.3140	0.0059	345	8,332
930820	A	1,016	15,067	10	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930821	B	739	9,013	27	0.0082	0.0001	6	40	0.0082	0.0001	6	40
930822	B	992	102,400	65	0.1436	0.0004	142	2,475	0.1540	0.0004	153	2,813
930823	A	800	40,347	15	0.3785	0.0031	303	7,666	0.3785	0.0031	303	7,666
930823	B	880	7,003	36	0.1582	0.0010	139	941	0.1582	0.0010	139	941
930824	A	1,341	9,243	2	0.8000	0.1600	1,073	292,304	0.8000	0.1600	1,073	292,304
930826	B	976	11,136	42	0.0758	0.0003	74	316	0.0850	0.0003	83	353
930827	A	1,776	29,851	25	0.1569	0.0022	279	7,647	0.1569	0.0022	279	7,647
930829	A	1,021	48,325	60	0.0698	0.0002	71	452	0.0698	0.0002	71	452

^a Period A = 0600-1359 hours, B = 1400-2159 hours

^b Anglers interviewed

Appendix B3. Daily summary statistics for fishing effort, number of anglers interviewed, and coho salmon HPUE, harvest, CPUE and catch by stratum for shore anglers interviewed during the fishery for coho salmon in the downstream section of the Kenai River during August 1993.

Date	Period ^a	Estimated		Ang Int ^b	HPUE		Estimated		CPUE		Estimated	
		Effort	Variance		Mean	Variance	Harvest	Variance	Mean	Variance	Catch	Variance
930801	A	467	22,491	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930801	B	307	7,893	2	0.1190	0.0278	37	2,505	0.1190	0.0278	37	2,505
930802	A	315	395	4	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930803	A	456	480	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930804	B	96	171	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930806	A	331	3,253	7	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930808	A	563	6,763	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930809	A	203	1,733	13	0.0509	0.0014	10	59	0.0509	0.0014	10	59
930809	B	600	8,843	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930811	A	373	14,955	9	0.1104	0.0125	41	1,732	0.1104	0.0125	41	1,732
930815	B	312	1,024	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930816	A	429	3,013	21	0.2205	0.0028	95	650	0.2205	0.0028	95	650
930817	A	507	7,813	7	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930818	A	440	25,008	23	0.1843	0.0039	81	1,515	0.1843	0.0039	81	1,515
930820	A	200	3,120	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930821	B	147	437	9	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930822	B	428	17,424	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930823	A	480	1,632	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930823	B	203	395	1	0.5000	0.0000	101	99	0.5000	0.0000	101	99
930824	A	411	3,013	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930826	B	376	11,232	2	0.1636	0.0400	62	5,507	0.1636	0.0400	62	5,507
930827	A	445	9,493	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930829	A	251	181	1	0.3333	0.0000	84	20	0.3333	0.0000	84	20

^a Period A = 0600-1359 hours, B = 1400-2159 hours

^b Anglers interviewed

Appendix B4. Daily summary statistics for fishing effort, number of anglers interviewed, and coho salmon HPUE, harvest, CPUE and catch by stratum for guided anglers interviewed during the fishery for coho salmon in the downstream section of the Kenai River during September 1993.

Date	Period ^a	Estimated		Ang Int ^b	HPUE		Estimated		CPUE		Estimated	
		Effort	Variance		Mean	Variance	Harvest	Variance	Mean	Variance	Catch	Variance
930901	A	350	879	12	0.2392	0.0017	84	254	0.2392	0.0017	84	254
930902	A	458	2,694	4	0.3000	0.0100	137	2,313	0.3000	0.0100	137	2,313
930903	B	192	780	20	0.0918	0.0005	18	24	0.0918	0.0005	18	24
930904	A	704	4,764	7	0.0631	0.0019	44	933	0.0631	0.0019	44	933
930906	A	426	1,404	3	0.1111	0.0031	47	573	0.1111	0.0031	47	573
930907	A	176	339	9	0.1346	0.0012	24	42	0.1346	0.0012	24	42
930907	B	30	0	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930911	A	682	9,048	20	0.1532	0.0004	104	395	0.1532	0.0004	104	395
930912	A	438	1,455	8	0.1349	0.0044	59	858	0.1349	0.0044	59	858
930912	B	146	1,047	2	0.3333	0.0000	49	116	0.3333	0.0000	49	116
930913	A	392	2,544	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930914	A	274	3	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930914	B	102	459	4	0.1429	0.0102	15	111	0.1429	0.0102	15	111
930915	A	264	951	8	0.0287	0.0008	8	54	0.0287	0.0008	8	54
930917	A	426	3,678	16	0.3145	0.0045	134	1,160	0.3145	0.0045	134	1,160
930918	A	386	339	10	0.6154	0.0105	238	1,696	0.6154	0.0105	238	1,696
930919	A	542	1,707	14	0.3132	0.0037	170	1,250	0.3132	0.0037	170	1,250
930919	B	78	2,022	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930920	A	226	1,662	7	0.1980	0.0072	45	422	0.1980	0.0072	45	422
930921	A	234	702	6	0.1384	0.0031	32	183	0.1384	0.0031	32	183
930923	A	242	636	7	0.8719	0.0027	211	640	0.8719	0.0027	211	640
930925	A	222	3,543	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930926	A	170	1,248	6	0.2266	0.0181	39	566	0.2266	0.0181	39	566
930926	B	20	120	13	0.0307	0.0003	1	0	0.0307	0.0003	1	0
930928	A	34	48	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930928	B	0	0	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0

^a Period A = 0800-1359 hours, B = 1400-1959 hours

^b Anglers interviewed

Appendix B5. Daily summary statistics for fishing effort, number of anglers interviewed, and coho salmon HPUE, harvest, CPUE and catch by stratum for unguided anglers interviewed during the fishery for coho salmon in the downstream section of the Kenai River during September 1993.

Date	Period ^a	Estimated		Ang Int ^b	HPUE		Estimated		CPUE		Estimated	
		Effort	Variance		Mean	Variance	Harvest	Variance	Mean	Variance	Catch	Variance
930901	A	322	2,460	28	0.0964	0.0009	31	112	0.0964	0.0009	31	112
930902	A	514	8,112	29	0.1198	0.0004	62	227	0.1287	0.0006	66	297
930903	B	490	156	18	0.1578	0.0007	77	172	0.1578	0.0007	77	172
930904	A	1,082	28,779	43	0.0458	0.0004	50	540	0.0458	0.0004	50	540
930906	A	1,374	17,790	46	0.0496	0.0002	68	440	0.0496	0.0002	68	440
930907	A	704	2,766	18	0.0880	0.0010	62	538	0.0880	0.0010	62	538
930907	B	402	1,248	12	0.1107	0.0010	44	179	0.1107	0.0010	44	179
930911	A	1,360	9,375	41	0.0791	0.0003	108	592	0.0791	0.0003	108	592
930912	A	1,006	18,255	11	0.0750	0.0011	75	1,184	0.0750	0.0011	75	1,184
930912	B	328	3,099	9	0.0402	0.0008	13	84	0.0402	0.0008	13	84
930913	A	554	5,070	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930914	A	670	447	20	0.0986	0.0009	66	412	0.0986	0.0009	66	412
930914	B	298	1,479	26	0.0747	0.0005	22	51	0.0747	0.0005	22	51
930915	A	496	1,335	12	0.0795	0.0021	39	521	0.0795	0.0021	39	521
930917	A	548	2,031	13	0.3713	0.0060	203	2,071	0.3713	0.0060	203	2,071
930918	A	930	2,862	31	0.1972	0.0018	183	1,649	0.1972	0.0018	183	1,649
930919	A	892	18,462	13	0.1095	0.0006	98	715	0.1095	0.0006	98	715
930919	B	344	255	22	0.1229	0.0013	42	153	0.1229	0.0013	42	153
930920	A	358	327	5	0.5664	0.0005	203	172	0.5664	0.0005	203	172
930921	A	266	219	2	0.2000	0.0000	53	9	0.2000	0.0000	53	9
930923	A	508	768	8	0.3139	0.0022	159	642	0.3139	0.0022	159	642
930925	A	552	18,495	37	0.1674	0.0012	92	859	0.1674	0.0012	92	859
930926	A	526	7,395	9	0.0444	0.0019	23	535	0.0444	0.0019	23	535
930926	B	224	876	36	0.0702	0.0005	16	31	0.0702	0.0005	16	31
930928	A	48	24	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930928	B	42	195	4	0.3792	0.0194	16	58	0.3792	0.0194	16	58

^a Period A = 0800-1359 hours, B = 1400-1959 hours

^b Anglers interviewed

Appendix B6. Daily summary statistics for fishing effort, number of anglers interviewed, and coho salmon HPUE, harvest, CPUE and catch by stratum for shore anglers interviewed during the fishery for coho salmon in the downstream section of the Kenai River during September 1993.

Date	Period ^a	Estimated		Ang Int ^b	HPUE		Estimated		CPUE		Estimated	
		Effort	Variance		Mean	Variance	Harvest	Variance	Mean	Variance	Catch	Variance
930901	A	98	480	6	0.0340	0.0012	3	12	0.0340	0.0012	3	12
930902	A	148	2,055	4	0.0685	0.0055	10	120	0.0685	0.0055	10	120
930903	B	178	1,059	6	0.0790	0.0024	14	80	0.0790	0.0024	14	80
930904	A	142	255	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930906	A	120	3,480	7	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930907	A	82	255	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930907	B	118	192	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930911	A	174	1,566	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930912	A	120	312	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930912	B	102	159	9	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930913	A	44	24	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930914	A	64	204	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930914	B	78	15	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930915	A	84	60	2	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930917	A	42	135	4	0.1329	0.0030	6	7	0.1329	0.0030	6	7
930918	A	38	30	2	0.1667	0.0278	6	40	0.1667	0.0278	6	40
930919	A	86	30	2	0.2333	0.0278	20	206	0.2333	0.0278	20	206
930919	B	40	3	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930920	A	38	255	1	0.5455	0.0000	21	76	0.5455	0.0000	21	76
930921	A	0	0	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930923	A	96	843	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930925	A	26	102	2	0.1190	0.0278	3	17	0.1190	0.0278	3	17
930926	A	50	102	2	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930926	B	100	24	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930928	A	8	48	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0
930928	B	64	75	0	0.0000	0.0000	0	0	0.0000	0.0000	0	0

^a Period A = 0800-1359 hours, B = 1400-1959 hours

^b Anglers interviewed

