

FISHERIES STATISTICS FOR SELECTED SPORT  
FISHERIES ON THE LOWER KENAI PENINSULA,  
ALASKA, 1986, WITH EMPHASIS ON CHINOOK  
SALMON (*Oncorhynchus tshawytscha*)

By: S. L. Hammarstrom  
L. L. Larson and  
D. T. Balland



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STATE OF ALASKA  
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Don W. Collinsworth, Commissioner  
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P.O. Box 3-2000, Juneau, Alaska 99802

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<sup>1</sup>This investigation was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-2, Job Numbers S-31-1, S-32-4, S-32-5.

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## ABSTRACT

Baseline statistics are presented for selected lower Kenai Peninsula chinook salmon (*Oncorhynchus tshawytscha* Walbaum) fisheries and escapements during 1986. Escapement surveys were conducted utilizing both ground and aerial techniques on three lower Kenai Peninsula streams. The minimum chinook salmon escapement in 1986 was estimated at 2,830 in the Anchor River, 2,550 in Deep Creek, and 790 in Ninilchik River. The recreational harvest of chinook salmon from these three streams was sampled for age composition. Age class 1.3 (brood year 1982) comprised approximately 70 percent of the recreational harvest of chinook salmon from these three streams.

Effort and harvest were estimated for the Deep Creek and Whiskey Gulch marine sport fisheries. For the Deep Creek fishery, an estimated 151,793 angler-hours were expended in pursuit of chinook salmon and/or Pacific halibut (*Hippoglossus stenolepis* Schmidt). Total harvest of chinook salmon and Pacific halibut was estimated at 3,881 and 18,867 fish, respectively. The recreational harvest of chinook salmon was sampled for age composition, age class 1.3 and 1.4 being the most prevalent. For the Whiskey Gulch fishery, a total of 71,964 angler-hours were expended to harvest 1,544 chinook salmon and 13,222 Pacific halibut.

A creel survey was also conducted for the late run Kasilof River chinook salmon fishery. In the shore based fishery near Crooked Creek, an estimated 11,024 angler-hours were expended to harvest 128 chinook salmon. The harvest by boat anglers was estimated at 186 fish. The majority of the boat effort (82 percent) and the harvest (94 percent) were by guided anglers fishing from non-powered boats.

KEY WORDS: Alaska, Kenai Peninsula, Anchor River, Deep Creek, Ninilchik River, Kasilof River, Deep Creek Marine, Whiskey Gulch, chinook salmon, pacific halibut, harvest, effort, creel survey, age, length.

## INTRODUCTION

Recreational fisheries for chinook salmon (*Oncorhynchus tshawytscha* Walbaum) on the lower Kenai Peninsula occur in both fresh and marine waters (Figure 1 and Figure 2). These fisheries represent a mix of both long established, relatively stable fisheries; and new fisheries which are rapidly developing.

Freshwater fishing is limited to only four streams on the southern Kenai Peninsula: Anchor River, Deep Creek, Ninilchik River, and Kasilof River. These are terminal fisheries that harvest single stocks. However, additional harvest of Kasilof River chinook salmon occurs to an unknown degree in the commercial and personal use gill-net fisheries along the eastern shores of Cook Inlet (McBride et al. 1985). Historically, significant freshwater recreational fisheries for chinook salmon occurred only on Anchor River, Deep Creek and

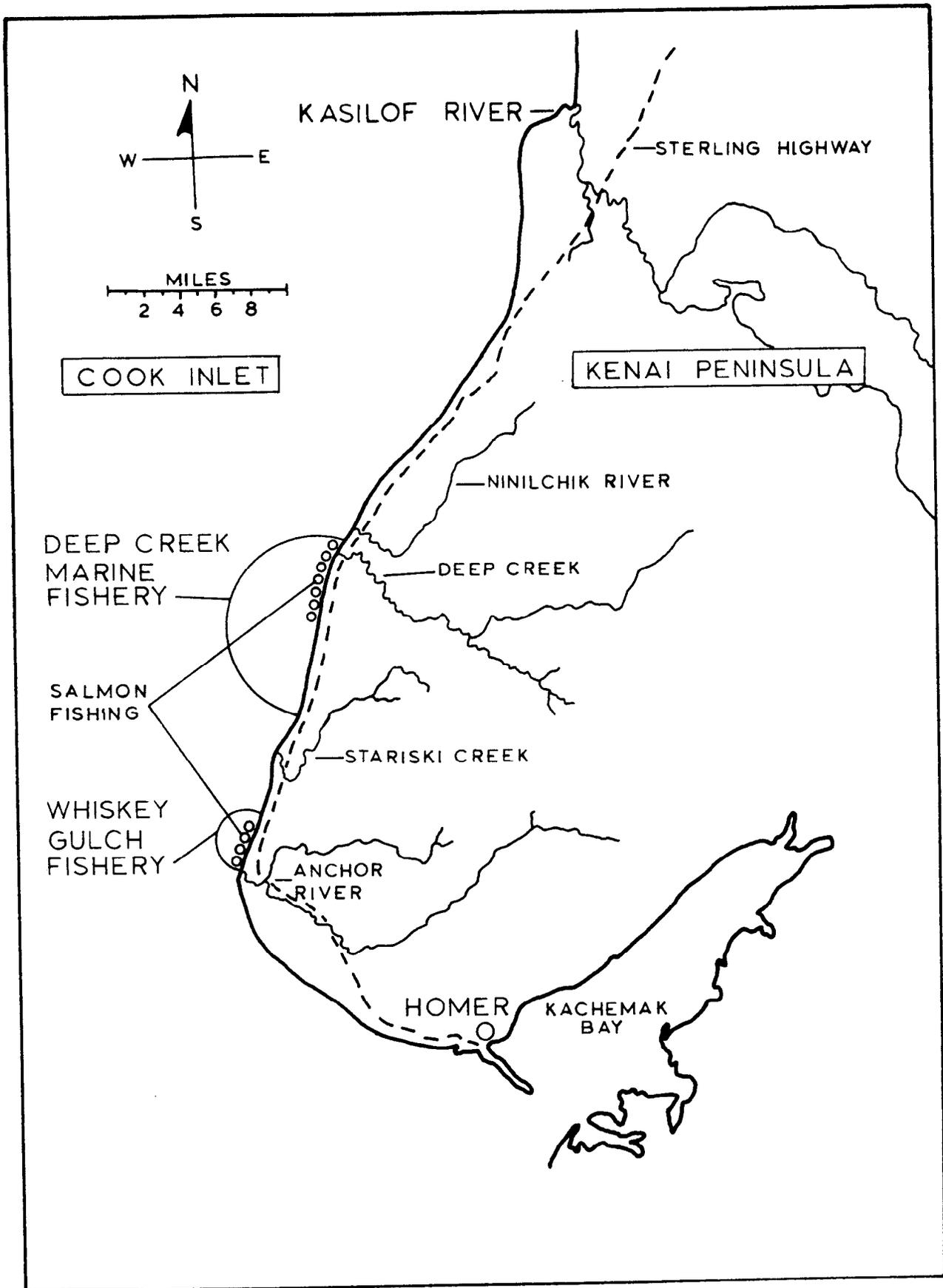


Figure 1. Schematic diagram of the lower Kenai Peninsula.

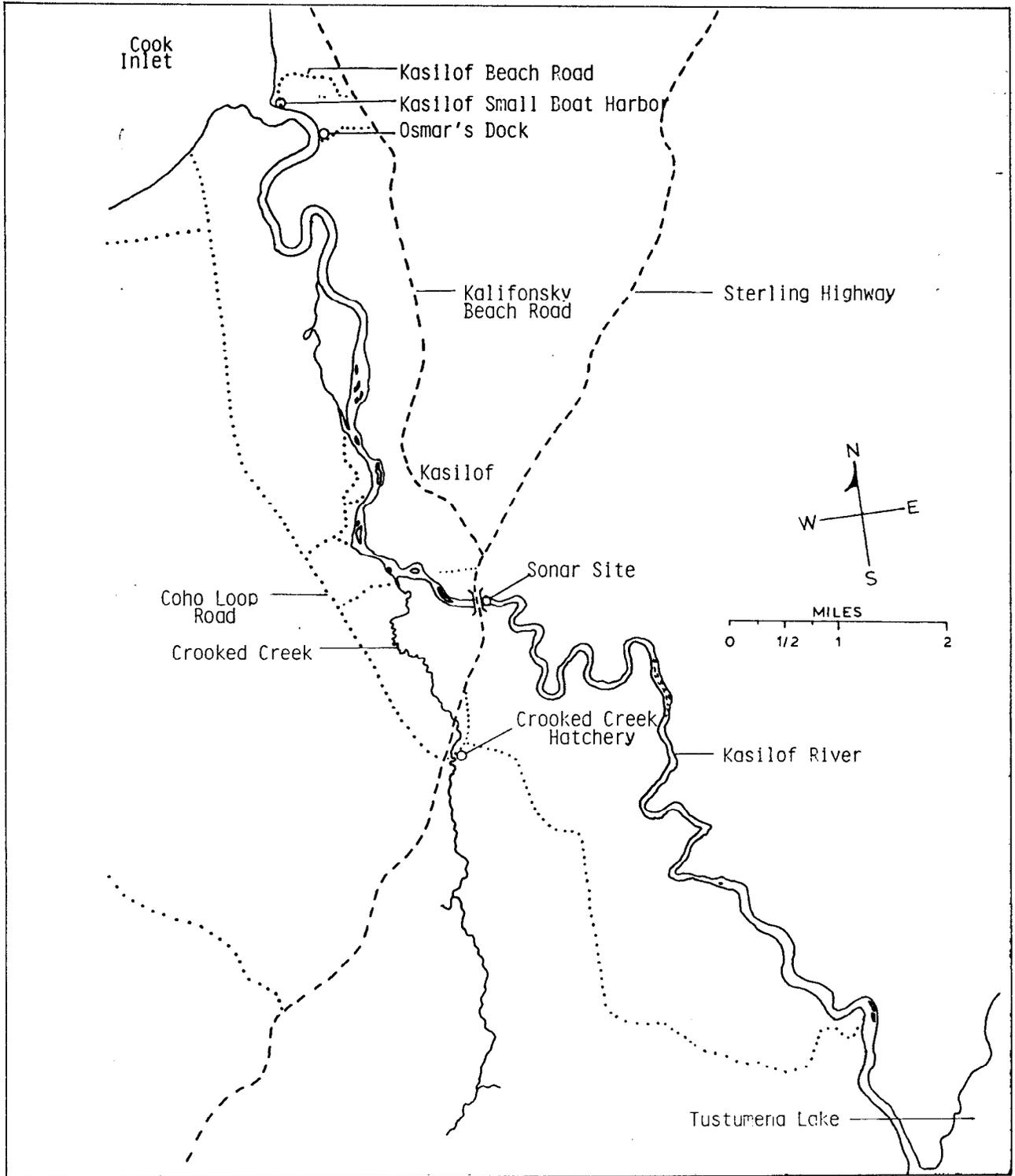


Figure 2. Schematic diagram of the Kasilof River.

Ninilchik River. Only recently has the Kasilof River become a popular fishery as a result of a stocking program<sup>1</sup>.

The freshwater chinook salmon fisheries on Anchor River, Deep Creek, and Ninilchik River are limited by time and area. Since 1978, Anchor River and Deep Creek have been opened to fishing approximately 3 km upstream from salt water during the last weekend of May (Saturday, Sunday and Monday) and the first 3 weekends of June. The Ninilchik River fishery is similar except that it is closed after the second weekend in June. This strategy has resulted in stable fisheries and relatively consistent escapements over two life-cycles.

Chinook salmon return to the Kasilof River in two temporal components termed early and late runs. Enhancement efforts have been directed at the early run which spawns primarily in Crooked Creek. Enhancement efforts have been successful and it appears that the early run is now numerically superior to the late run. Recreational fishing for chinook salmon in the Kasilof River was first allowed in 1978. Initially, the season closed 30 June which prevented any significant harvest of late run fish. In 1985, the season was extended to 31 July to provide for a limited harvest of late run fish. The early run fishery has developed into a shore based fishery located at the confluence of Crooked Creek and the Kasilof River; while the late run fishery has developed into primarily a drift-boat fishery in the lower 5 km of river immediately downstream from the Sterling Highway Bridge. During 1986, only the late run fishery was monitored.

The chinook salmon fishery in the marine waters near Deep Creek began in the early 1970's. Limited boat launching facilities have restricted vessel size, and as a result, recreational harvests of chinook salmon have been more dependent on local weather conditions than on abundance.

The Deep Creek marine fishery harvests mixed stocks of chinook salmon. Chinook salmon migrate through this area from early May through early August. Early run (May and June) fish are believed to originate in Ninilchik River, Deep Creek, Crooked Creek, Kenai River, Kasilof River, and Susitna River. The majority of late run (July and August) fish are presumed to originate in the Kenai River and, to some extent, the Kasilof River. In addition to chinook salmon, Pacific halibut (*Hippoglossus stenolepis* Schmidt) are also highly sought after by recreational anglers.

A new fishery has recently developed in the marine waters near Whiskey Gulch, approximately 15 miles south of Deep Creek. Timing and stock structure are presumed to be similar to those for the Deep Creek fishery.

Prior information pertaining to the lower peninsula chinook salmon sport fisheries is presented by Dunn (1961), Logan (1962, 1964),

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1 An enhanced chinook salmon return has been established at the state hatchery on Crooked Creek, a tributary to the Kasilof River.

Engel and Logan (1965-1966), Engel (1967), Redick (1968), McHenry (1969), Watsjold (1970), Nelson (1971-1972a, 1972b), Hammarstrom (1974-1981), Hammarstrom and Larson (1982-1984, 1986) and Hammarstrom et al. (1985).

The current monitoring program of these chinook salmon recreational fisheries provides data which are used to: (1) formulate inseason management decisions regarding the conduct of the freshwater fisheries; (2) evaluate the dynamics of the Upper Cook Inlet chinook salmon return; and (3) provide timely information to the angling public. The objective of this report is to provide baseline data for these fisheries and the lower Kenai Peninsula chinook salmon stocks.

## METHODS

For all of these fisheries, anglers were permitted a daily harvest of one (freshwater) or two (marine water) chinook salmon greater than 16 in and a yearly limit of five chinook salmon greater than 16 in. Freshwater fishing ends by regulation on 31 July (ADFG 1986).

### Anchor River, Deep Creek, and Ninilchik River

Although fishing area is limited to the lower 3 km for all of these fisheries, access within the open area is virtually unlimited and includes public parking lots, campgrounds, and private property. All fishing is conducted from the shore due to the relatively small size of the streams.

Harvest and effort for these fisheries will be estimated by mail questionnaire (Mills in press). Since these estimates are not available for approximately a year, a limited monitoring program is in place to detect any drastic changes from previous years which could precipitate emergency management action. This program is subjective in nature and is not reported here.

### Age, Sex, and Length Composition of the Harvest:

Biological samples were collected from the recreational harvest to estimate age, sex, and length composition. Survey personnel sampled harvested chinook salmon for length (mid-eye to fork of tail to the nearest mm), sex, and collected three scales from the preferred area<sup>1</sup> which were placed on a gummed card. Scale impressions into acetate, for reading with a microfiche reader, were completed post-season.

The proportional age composition of the chinook salmon harvest was estimated from all legible scales for each stream. Letting  $p_h$  equal the estimated proportion of age group  $h$  for any stream, the variance

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1 The left side of the fish approximately two rows above the lateral line and on the diagonal row downward from the posterior insertion of the dorsal fin (Clutter and Whitesel 1956).

of  $p_h$  was estimated using the normal approximation to the binomial (Schaeffer et al. 1979):

$$V(\hat{p}_h) = \hat{p}_h(1-\hat{p}_h)/(n_t-1),$$

Where,  $n_t$  is the number of legible scales read from chinook salmon sampled from each stream.

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

Escapement:

Spawning occurs throughout each stream from the Sterling Highway bridge to the headwaters. Although some spawning occurs downstream from the bridges, it is assumed to be insignificant.

Escapement surveys are conducted in late July after fish have begun to spawn and water levels are near seasonal lows. Escapement estimates are generated from both ground and aerial surveys. Ground counts for a predetermined area are compared to counts conducted from a helicopter over the same area for each stream on the same day. The remainder of the stream is then surveyed from the air, again on the same day, and the counts expanded. This method attempts to account for fish missed during the aerial survey. Since these surveys are only done once, this method does not account for fish unavailable to either survey (fish which have not yet entered the survey area or fish which have died and have exited the survey area). Therefore, this method provides an estimate of escapement which has a negative bias of unknown magnitude.

Each ground surveyor recorded the number of live chinook salmon and the number of carcasses observed in the predescribed area. The surveyors in the helicopter also made an independent count recording similar information in both the index area and over the remainder of the stream.

Expanded estimates of chinook salmon escapement,  $\hat{N}$ , were calculated from ground and aerial counts as follows:

$$\hat{N}_{(i)} = g_{(i)} + [(g_{(i)}/a_{(i)})(r_{(i)})],$$

where:  $i$  = stratum (live or dead),  
 $g$  = number of fish observed from the ground,  
 $a$  = number of observed from the air,  
 $r$  = number of fish observed from the air in other than the index area.

In most cases ground survey counts are greater than aerial survey counts and the above method is utilized. On occasion however, an aerial count of the area exceeds the ground count. If the latter

case arises, the escapement is estimated by summing only the aerial counts and the ground survey counts are ignored.

### Deep Creek Marine Fishery

#### Study Area:

The Deep Creek Marine chinook salmon fishery occurs from the terminus of Deep Creek with Cook Inlet south to Cape Stariski, approximately 24 km. Boat counts include all recreational boats viewed in this area. Angler interviews are restricted to anglers returning to the Deep Creek Wayside parking area (Figure 1).

#### Study Design:

A stratified random creel survey of the marine waters immediately south of Deep Creek was conducted to determine the harvest of chinook salmon and Pacific halibut and the angler effort from May through 30 July.

Each weekend/holiday and 3 of 5 weekdays were sampled each week. Each fishing day consisted of 20 hours (0400-2359) and each day was divided into five 4-hour periods (A through E). Two periods were sampled randomly without replacement each day. Within each period, 2 hours were selected randomly without replacement and designated as count hours.

Each count took approximately 30 minutes to complete. The remaining time on each shift was spent interviewing completed anglers as they returned to the State Wayside at Deep Creek. Collected information included: number of anglers per boat, fishing time, and harvest by species. In addition, each chinook salmon encountered was examined for finclips. For any adipose finclipped fish found, an attempt was made to retrieve the head for tag decoding. Additionally, length, sex and scale samples were collected from each chinook salmon encountered.

#### Data Collection:

Angler counts were conducted from the bluff overlooking Cook Inlet along the Sterling Highway from two locations. The first, located approximately 2 miles south of the terminus of Deep Creek with Cook Inlet, and the second, located approximately 3 miles further south along the Sterling Highway.

At the selected count hour, the survey clerk insures he/she is at the first counting location. With the use of field glasses provided, all recreational boats were counted from as far south as can be seen (not to exceed Cape Stariski) to as far north as can be seen. Most boats are within 3 miles of shore. During late-June and July, there may be commercial drift vessels operating in the area; these are not included in the count. After completion of the count at the first location, the survey clerk moved expeditiously to the second location. At the second location, again with the use of field glasses, a

second count was made, being careful not to duplicate counting any boats previously counted from the first location. The two counts are combined.

Completed angler interviews were conducted at the Deep Creek Wayside and the following information was gathered: (1) number of anglers in the boat, (2) time the boat started fishing, (3) time the boat quit fishing, (4) total harvest retained by species per boat, and (5) biological data to include sex, length (mid-eye to fork of tail) and scale sample.

#### Data Analysis:

Effort and harvest were estimated for both the early and late runs. Mean boat counts were used to estimate effort in boat-hours. The number of boat-hours of effort and variance were calculated using methods identical to those used to estimate effort in angler-hours for Kasilof River. Effort in boat-hours was then multiplied by the mean number of anglers per boat for each stratum to estimate effort in angler-hours. The variance of effort in angler-hours was calculated using the formula for the product of two independent, random variables (Goodman 1960).

Harvest of a species was estimated as the product of effort in angler-hours and CPUE (catch per hour fished by an angler) estimated from angler interviews collected at Deep Creek Wayside. The variance of CPUE was calculated identically to that described for the Kasilof River creel survey. The variance of the harvest was estimated as the product of two independent, random variables; also, effort in angler-hours and CPUE. Actually, harvest is the product of three variables; effort in boat-hours, mean number of anglers per boat; and CPUE. Goodman (1962) shows that the variance for the product of three independent, random variables can be estimated by applying the formula for two independent, random variables consecutively, as was done here.

#### Whiskey Gulch Marine Fishery

The creel survey was conducted from 17 May to 19 July. The study design and analysis for this creel survey was similar to that for the Deep Creek program. Angler counts were conducted at two locations: Stariski Wayside and Sterling Highway milepost 153.4. Angler interviews were conducted at several locations along the beach with the use of a three-wheeled all terrain vehicle.

#### Kasilof River

The late run chinook salmon fishery on the Kasilof River contains two components: (1) a shore fishery near the confluence of Crooked Creek; and (2) a drift boat fishery which occurs from the Sterling Highway bridge downstream to the public boat launch near salt water (Figure 2). Creel surveys were conducted during the period 30 June to 31 July.

## Study Design:

Drift Boat Fishery. Boats were launched at the state facility immediately upstream from the Sterling Highway bridge and were removed at five identified locations downstream. All boat anglers were enumerated as they departed the boat launch. This was accomplished by Commercial Fisheries Division staff stationed at a sonar counting site located directly across the river from the boat launch. This counting station is operated 24 hours per day. Staff members were able to enumerate and record all effort departing the launch facility.

Completed-trip information was obtained from angler interviews conducted at the downstream boat landing areas. The angler-day was considered to be 20 hours in duration (0400-2359 hours) and was stratified into five 4-hour strata, hereby referred to as periods. They were: period A (0400-0759 hrs), period B (0800-1159 hrs), period C (1200-1559 hrs), period D (1600-1959 hrs), and period E (2000-2359 hrs). Estimates of effort and harvest were stratified by guided and non-guided anglers.

Each weekend/holiday and 3 of 5 weekdays were randomly selected for sampling. Two of five periods were sampled each day.

Shore Fishery. Stratification for the shore fishery is similar to that explained above. However, virtually all anglers in this fishery are non-guided. Estimates of effort and harvest were stratified by weekday and weekend/holiday. Within each selected daily period, 1 hour was randomly selected to conduct an angler count. During the time when not conducting angler counts, completed angler interviews were conducted at the trailhead to the shore based fishery and at three of the five boat landing areas.

## Data Collection:

Angler counts at the confluence were conducted by walking as rapidly as possible from one end of the fishing area to the other. An angler count was completed within 30 to 40 minutes and was considered an instantaneous count (Neuhold and Lu 1957).

All interviews were of individual anglers. During the completed angler interviews, the following information was collected and recorded: (1) harvest by species, (2) hours fished, (3) guided or non-guided angler, and (4) powered or non-powered boat<sup>1</sup>. Each chinook salmon encountered was examined for an adipose finclip<sup>1</sup>.

## Data analysis:

Shore Fishery. The mean number of anglers per count was calculated by:

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1 A portion of the hatchery release was marked with coded wire tags and adipose fin clipped.

$$\bar{X} = (1/N) \sum_{i=1}^4 N_i \bar{x}_i$$

where:  $\bar{X}$  = the mean number of anglers per count for a period,  
 $\bar{x}_i$  = the mean number of anglers per count for stratum i,  
 $N$  = the total number of hours in a period, and  
 $N_i$  = the total number of hours in stratum i.

The variance of the mean number of anglers per count was calculated as follows (Jessen 1978):

$$\hat{V}(\bar{X}) = (1/N^2) \sum_{i=1}^4 N_i^2 [s_i^2/n_i]$$

where:  $N$  and  $N_i$  are defined as above,  
 $n_i$  = the total number of angler counts in stratum i, and  
 $s_i^2$  = the sample variance of  $\bar{x}_i$  for stratum i.

The number of angler-hours ( $E_t$ ) in each period was estimated as:

$$\hat{E}_t = N\bar{X} = \sum_{i=1}^4 N_i \bar{x}_i.$$

The variance for the estimate of total angler-hours was:

$$\hat{V}(E_t) = N^2 \hat{V}(X).$$

The total number of angler-hours for the season was estimated by summing the estimates of total angler-hours across strata. Because these are independent estimates, the total variance is the sum of the individual variances.

Harvest rate for each stratum was estimated by the following:

$$HPUE = \frac{\sum_{j=1}^m c_j}{\sum_{j=1}^m f_j}$$

where:  $m$  = the number of anglers interviewed during the period,  
 $c_j$  = the catch by angler j, and  
 $f_j$  = the effort (number of hours) expended by angler j.

The variance of mean effort per angler was estimated using a two-stage sample design with days representing the first-stage sample units and anglers the second (Von Geldern and Tomlinson 1973). The

variance of mean effort was estimated as follows (Sukhatme et al. 1984):

$$V(\bar{f}) = [1 - (d/D)] s_B^2/d + (\sum_{k=1}^D s_{wk}^2/m)/dD,$$

where: d = the number of days sampled during the period,

D = the number of days in the period,

$s_{wk}^2$  = the sample variance of effort for anglers during day k, and

$s_B^2$  = the between-day variance of angler effort, where:

$$s_B^2 = [\sum_{k=1}^D (\bar{f}_k - \bar{f})^2]/(d-1),$$

where  $\bar{f}_k$  = the mean effort by anglers interviewed during day k.

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

$$V(\text{HPUE}) = (\bar{c}/\bar{f})^2 (s_c^2/\bar{c}^2 + s_f^2/\bar{f}^2 - 2rs_c s_f/\bar{c}\bar{f})$$

where  $\bar{c}$  = the mean catch by interviewed anglers,

$\bar{f}$  = the mean number of hours fished by interviewed anglers,

$s_c^2$  = the two-stage variance estimate for c,

$s_f^2$  = the two-stage variance estimate for f, and

r = the correlation coefficient between c and f.

The harvest of chinook salmon during a stratum was estimated by:

$$H_t = E_t \text{HPUE}_t$$

The variance of  $H_t$  was estimated using Goodman's (1960) formula for the variance of the product of two independent random variables which is:

$$V(H_t) = [E_t^2 V(\text{HPUE}_t)] + [\text{HPUE}_t^2 V(E_t)] - [V(E_t) V(\text{HPUE}_t)].$$

Totals for harvest and effort were estimated by summing the appropriate strata estimates. Estimates for the strata are considered independent estimates, therefore, the variance of the total was estimated by the sum of the appropriate variances.

Boat Fishery. Effort for boat anglers was estimated as follows:

$$E_{bt} = Y_{bt} Z_{bt}$$

where  $Y_{bt}$  = total boat anglers enumerated in stratum t, and

$z_{bt}$  = mean hours reported fished by individual anglers in stratum t.

Since all anglers were enumerated, only the sample variance of  $z_{bt}$  was computed in the variance of  $E_{bt}$ .

Harvest for boat anglers was estimated as follows:

$$H_{bt} = (HPUE_{bt})(E_{bt})$$

where  $HPUE_{bt}$  = harvest rate for anglers in stratum t, and

$E_{bt}$  = effort in stratum t.

Variances were computed as describe above.

## RESULTS AND DISCUSSION

### Anchor River, Deep Creek, and Ninilchik River

Age 1.3 was the predominant chinook salmon age class for all three of the lower peninsula fisheries (Tables 1-6). In each stream the age 1.3 component comprised approximately 70% of the recreational harvest. Length by sex data are also presented in Tables 1-6.

Escapement surveys were conducted under moderate conditions in 1986. All stream flows were relatively low, however, some turbidity was detectable in each stream. Most live fish were in spawning coloration actively engaged in spawning activities on riffles. The wind was calm and the skies partially overcast. An average of 71% of the live fish observed during the ground survey were seen from the air (range 38%-131%) while only 37% (range 34%-42%) of the carcasses observed on the ground were observed from the air (Appendix Table A1). Minimum escapement estimates for each stream are as follows:

Location	Escapement Estimate
Anchor River	2,830
Deep Creek	2,550
Ninilchik River	790

### Deep Creek Marine

Creel survey activities commenced 17 May and were continuous through 30 July. A total of 54 of the possible 75 days were surveyed. Based on run timing of inshore returns, we hypothesize that early run stocks were predominant until 27 June and late run stocks predominated thereafter.

Table 1. Mean length (mm) by age class of chinook salmon sampled from the Anchor River chinook salmon sport fishery, 1986.

Sex		Age Class			
		1.2	1.3	1.4	1.5
Male	Mean Length	-	842	902	-
	Standard Error	-	102.3	116.7	-
	Sample Size	0	6	2	0
Female	Mean Length	-	820	903	-
	Standard Error	-	43.2	50.2	-
	Sample Size	0	11	5	0

Table 2. Age composition of chinook salmon sampled from the Anchor River sport fishery, 1986.

Sex		Age Class				Total	
		1.2	1.3	1.4	1.5		
<hr/>							
(n=24) <sup>1</sup>	Male	Percent	0	25.0	8.3	0	33.3
	Female	Percent	0	45.9	20.8	0	66.7
	Combined	Percent	0	70.9	29.1	0	
		Standard Error	-	9.5	9.5	-	
<hr/>							

<sup>1</sup> n = sample size

Table 3. Mean length (mm) by age class of chinook salmon sampled from the Deep Creek sport fishery, 1986.

Sex		Age Class			
		1.2	1.3	1.4	1.5
Male	Mean Length	617	783	920	-
	Standard Error	25.7	63.8	64.0	-
	Sample Size	3	11	1	0
Female	Mean Length	-	819	885	-
	Standard Error	-	34.1	31.2	-
	Sample Size	0	8	3	0

Table 4. Age composition of chinook salmon sampled from the Deep Creek sport fishery, 1986.

Sex		Age Class				Total
		1.2	1.3	1.4	1.5	
<hr/>						
(n=26) <sup>1</sup>						
Male	Percent	11.5	42.3	3.9	0	57.7
Female	Percent	0	30.8	11.5	0	42.3
Combined	Percent	11.5	73.1	15.4	0	
	Standard Error	6.4	8.9	7.2	-	

<sup>1</sup> n = sample size

Table 5. Mean length (mm) by age class of chinook salmon sampled from the Ninilchik River sport fishery, 1986.

Sex		Age Class			
		1.2	1.3	1.4	1.5
Male	Mean Length	570	773	881	850
	Standard Error	47.1	58.3	64.0	-
	Sample Size	3	18	3	1
Female	Mean Length	-	783	857	865
	Standard Error	-	43.2	50.2	-
	Sample Size	0	24	9	2

Table 6. Age composition of chinook salmon sampled from the Ninilchik River sport fishery, 1986.

Sex		Age Class				Total
		1.2	1.3	1.4	1.5	
(n=60) <sup>1</sup>						
Male	Percent	5.0	30.0	5.0	1.7	41.7
Female	Percent	0	40.0	15.0	3.3	58.3
Combined	Percent	5.0	70.0	20.0	5.0	
	Standard Error	2.8	6.0	5.2	2.8	

<sup>1</sup> n = sample size

#### Effort:

Four boat counts were made on each day surveyed. Boat counts ranged from 0 to 264 during the early run and from 0 to 126 during the late run (Appendix Tables B1 and B2). Mean boat counts for all strata were larger during the early run than during the late run (Table 7). Except for period D (1600-1959) during the early run and B (0800-1159) and D during the late run, weekend/holiday counts were larger than weekday counts for corresponding strata (Table 7). The mean number of anglers per boat was not significantly different ( $\alpha = 0.05$ ) between early and late runs nor between weekend/holiday and weekdays (Appendix Table B3 and Table 8).

Total effort was estimated at 151,793 angler-hours (Table 9). Most of the effort occurred during the early run (75%). During both runs, more effort was expended during weekdays than during weekends.

#### Harvest Rates:

Mean daily harvest rates ranged from 0.000 to 0.131 chinook salmon per hour during the early run and from 0.000 to 0.167 during the late run (Appendix Tables C1 and C2). Harvest rates for Pacific halibut ranged from 0.000 to 0.315 fish per hour during the season. Peak harvest rates for chinook salmon occurred on 5 June and 13 July during the early and late runs, respectively. The peak harvest rate for Pacific halibut was 29 June. Harvest rates were similar between weekends and weekdays (Table 10).

#### Harvest:

A total of 3,881 chinook salmon were estimated to have been harvested in the Deep Creek marine recreational fishery in 1986; 3,251 (84%) from the early run and 630 (16%) from the late run (Table 11). Additionally, an estimated 18,867 Pacific halibut were taken in this fishery.

Temporal changes in age composition were evident between the runs (Table 12). Age 1.3 fish were most abundant during the early run (53%) while age 1.4 fish were most abundant during the late run (60%). These two age classes combined comprised 84% of the early run and 86% of the late run. Mean length by sex for early run fish was smaller than for late run fish (Table 13).

#### Whiskey Gulch Marine

The creel survey was conducted during the period 17 May to 19 July. A total of 37 days were sampled of the possible 64 days. No distinction was made between early and late runs though both runs are believed to migrate through the area.

Table 7. Summary of boat counts by daily strata for the Deep Creek marine sport fishery, 1986.

Stratum	Period				
	A	B	C	D	E
<u>EARLY RUN</u>					
Weekdays					
Number of counts	7	5	7	7	6
Mean count	17.9	58.3	63.4	53.0	6.2
Standard Error	3.9	9.2	7.4	4.2	0.7
Weekends					
Number of counts	6	5	4	5	4
Mean count	26.8	74.0	131.0	44.7	68.3
Standard Error	2.7	13.8	17.3	5.3	14.0
<u>LATE RUN</u>					
Weekdays					
Number of counts	5	4	7	4	8
Mean count	1.1	23.8	23.6	33.0	20.7
Standard Error	0.3	4.4	3.4	10.3	3.0
Weekends					
Number of counts	4	5	4	5	4
Mean count	1.6	16.7	30.8	15.0	38.9
Standard Error	0.5	3.9	6.8	3.2	10.9

Table 8. Summary of anglers interviewed and their respective boats by run in the Deep Creek marine sport fishery, 1986.

Stratum	Early Run	Late Run
Weekdays		
Number of boats	167	209
Number of anglers	447	544
Mean anglers/boat	2.68	2.75
Standard error	0.071	0.078
Weekends		
Number of boats	231	146
Number of anglers	665	405
Mean anglers/boat	2.88	2.77
Standard error	0.069	0.084

Table 9. Effort (angler-hours) by boat anglers in the Deep Creek marine sport fishery, 1986.

Stratum	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
<u>EARLY RUN</u>				
Weekdays	61,847	23,064	16,641 - 107,053	73.1%
Weekends	51,521	20,420	11,499 - 91,543	77.7%
Early Run Total	113,368	30,805	52,991 - 173,745	53.3%
<u>LATE RUN</u>				
Weekdays	25,845	12,140	2,052 - 49,638	92.1%
Weekends	12,580	5,626	1,553 - 23,607	87.7%
Late Run Total	38,425	13,380	12,201 - 64,649	68.2%
<u>TOTAL BOTH RUNS</u>	151,793	33,585	85,966 - 217,760	43.4%

Table 10. Harvest per unit effort (HPUE) for chinook salmon and Pacific halibut by boat anglers in the Deep Creek marine sport fishery, 1986.

Stratum	Days		Number of Interviews	<u>Chinook Salmon</u>		<u>Pacific Halibut</u>	
	n <sup>1</sup>	N <sup>2</sup>		HPUE	Standard Error	HPUE	Standard Error
<u>EARLY RUN</u>							
Weekdays	15	29	447	0.0339	0.00068	0.1193	0.00147
Weekends	12	13	665	0.0224	0.00027	0.1225	0.00070
Sub-total	27	42	1,112				
<u>LATE RUN</u>							
Weekdays	12	22	544	0.0179	0.00027	0.1303	0.00091
Weekends	9	11	405	0.0133	0.00032	0.1439	0.00185
Sub-total	21	33	949				

1 Number of days on which interviews were collected.

2 Number of days possible for interviewing.

Table 11. Estimated number of chinook salmon and Pacific halibut harvested by boat anglers in the Deep Creek marine sport fishery, 1986.

Stratum	Chinook Salmon			Pacific Halibut		
	Harvest	Standard Error	Rel. Pre. <sup>1</sup>	Harvest	Standard Error	Rel. Pre.
<u>EARLY RUN</u>						
Weekdays	2,097	783	73.2%	7,378	2,753	73.1%
Weekends	1,154	458	77.1%	6,311	2,502	77.7%
Early Run Total	3,251	908	54.7%	13,689	3,720	53.3%
<u>LATE RUN</u>						
Weekdays	463	217	92.0%	3,368	1,582	92.1%
Weekends	167	75	87.9	1,810	810	87.7%
Late Run Total	630	230	71.5	5,178	1,777	67.3%
<u>TOTAL BOTH RUNS</u>	3,881	936	47.2	18,867	4,123	42.8%

<sup>1</sup> Relative precision for 95% confidence interval.

Table 12. Age composition of chinook salmon sampled from the Deep Creek marine sport fishery, 1986.

Run	Sex		Age Class				Total
			1.2	1.3	1.4	1.5	
<u>Early Run</u>							
(n=88) <sup>1</sup>	Male	Percent	13.7	14.8	6.8	1.1	36.4
	Female	Percent	0	38.6	23.9	1.1	63.6
	Combined	Percent Standard Error	13.6 3.7	53.4 5.3	30.7 4.9	2.2 0.4	
<u>Late Run</u>							
(n=42)	Male	Percent	4.8	9.5	28.6	2.4	45.3
	Female	Percent	0	16.7	30.9	7.1	54.7
	Combined	Percent Standard Error	4.8 3.3	26.2 6.9	59.5 7.7	9.5 4.6	

<sup>1</sup> n = sample size

Table 13. Mean length (mm) by age class of chinook salmon sampled from the Deep Creek marine sport fishery, 1986.

Run	Sex		Age Class			
			1.2	1.3	1.4	1.5
<u>Early Run</u>						
	Male	Mean Length	632	784	798	1,125
		Standard Error	42	94	132	-
		Sample Size	12	13	6	1
	Female	Mean Length	-	806	919	1,035
		Standard Error	-	67	66	-
		Sample Size	0	34	21	1
<u>Late Run</u>						
	Male	Mean Length	708	894	1099	1,143
		Standard Error	42	90	124	-
		Sample Size	2	4	12	1
	Female	Mean Length	-	899	982	998
		Standard Error	-	21	68	104
		Sample Size	0	7	13	3

Effort:

From one to four boat counts were made on each day surveyed. Boat counts ranged from 0 to 159 (Appendix Table D1) and the largest count occurred 14 June. Mean boat counts for all strata were larger during weekend/holiday than weekdays (Table 14). The mean number of anglers per boat was not significantly different ( $\alpha = 0.05$ ) between weekend/holiday and weekdays (Appendix Table D2 and Table 15).

Total effort was estimated at 71,964 angler-hours. Effort was nearly equally distributed between weekdays (45%) and weekend/holidays (55%) (Table 16).

Harvest rates:

A total of 1,912 anglers were interviewed during the Whiskey Gulch marine creel survey (Table 17). Mean daily harvest rates ranged from 0.000 to 0.164 chinook salmon per hour with the peak occurring on 27 May (Appendix Table D3). Harvest rates for Pacific halibut ranged from 0.000 to 0.429 fish per hour with the peak occurring on 14 June.

Harvest:

Total harvest of chinook salmon was estimated at 1,544 fish (Table 18). Additionally, an estimated 13,222 Pacific halibut were taken in this fishery.

Kasilof River

Creel survey was conducted on the Kasilof River during the period 1 July to 31 July when the chinook salmon season closed. After 20 July, angler effort at the Crooked Creek fishery had declined to a point where continued monitoring was not warranted. A total of 17 of the 31 possible days were sampled in the boat fishery.

Effort:

Since sampling of the shore fishery was discontinued after 20 July, there were insufficient samples to temporally stratify weekend/holidays and a simple random sample design was used. Weekday stratification remained unchanged. For both weekend and weekday strata, mean counts were greatest during evening hours (Appendix Table E1 and Table 19).

Total effort was estimated at 11,024 angler-hours (Table 20). Most of the effort was expended by shore anglers (78%). Most of the boat angler effort (82%) was guided. A total of 495 boat anglers were enumerated (Appendix Table E2); of which most (93%) were drift boat anglers. Guided drift boat anglers accounted for 85% of the drift boat effort and 79% of all boat effort.

Table 14. Summary of boat counts by daily strata in the Whiskey Gulch marine sport fishery, 1986.

Stratum	Period				
	A	B	C	D	E
Weekdays					
Number of counts	4	3	5	6	5
Mean count	5.4	4.8	34.9	13.9	8.0
Standard error	1.6	1.5	5.4	1.8	1.8
Weekends					
Number of counts	7	6	5	8	5
Mean count	17.4	50.5	37.8	34.8	20.2
Standard error	4.9	9.4	3.4	3.8	6.1

Table 15. Summary of anglers interviewed and their respective boats in the Whiskey Gulch marine sport fishery, 1986.

Stratum	Weekdays	Weekends
Number of boats	156	523
Number of anglers	440	1,472
Mean anglers/boat	2.82	2.81
Standard error	0.043	0.094

Table 16. Effort (angler-hours) by boat anglers in the Whiskey Gulch marine sport fishery, 1986.

Stratum	Estimated Effort (Angler-hours)	Standard Error	95% Confidence Interval	Relative Precision
Weekdays	32,250	14,903	3,040 - 61,460	90.6%
Weekends	39,714	16,037	8,282 - 71,146	79.1%
Total	71,964	21,892	29,055 - 114,873	59.6%

Table 17. Harvest per unit effort (HPUE) for chinook salmon and Pacific halibut by boat anglers in the Whiskey Gulch marine sport fishery, 1986.

Stratum	Days		Number of Interviews	<u>Chinook Salmon</u>		<u>Pacific Halibut</u>	
	n <sup>1</sup>	N <sup>2</sup>		HPUE	Standard Error	CPUE	Standard Error
Weekdays	13	44	440	0.0289	0.00074	0.1558	0.00247
Weekends	17	20	1,472	0.0154	0.00016	0.2064	0.00075
Total	30	64	1,912				

<sup>1</sup> Number of days on which interviews were collected.

<sup>2</sup> Number of days possible for interviewing.

Table 18. Harvest of chinook salmon and Pacific halibut by boat anglers in the Whiskey Gulch marine sport fishery, 1986.

Stratum	Chinook Salmon			Pacific Halibut		
	Harvest	Standard Error	Rel. Pre. <sup>1</sup>	Harvest	Standard Error	Rel. Pre. <sup>1</sup>
Weekdays	932	431	90.7%	5,025	2,323	88.9%
Weekends	612	247	79.1%	8,197	3,310	78.3%
Total	1,544	497	63.1%	13,222	3,935	59.2%

<sup>1</sup> Relative precision at  $\alpha = 0.05$ .

Table 19. Summary of angler counts by daily strata in the Kasilof River shore sport fishery, 1986.

Stratum	Period				
	A	B	C	D	E
Weekdays					
Number of counts	2	4	2	3	3
Mean count	1.0	3.8	12.5	58.7	51.0
Standard Error	0.0	2.0	2.5	23.6	30.5
Weekends					
Number of counts	0	2	1	3	2
Mean count		2.5	9.0	24.3	12.5
Standard Error		0.5		2.8	0.5

Table 20. Effort (angler-hours) by shore and boat anglers during each stratum in the Kasilof River late run sport fishery, 1986.

Stratum	Estimated Effort (Angler-hours)	Standard Error	95% Confidence Interval	Relative Precision
<u>Shore Anglers</u>				
Weekdays	1,960	392	1,192 - 2,728	39.2%
Weekends	6,600	2,015	2,651 - 10,549	59.8%
<u>Boat Anglers</u>				
Guided	2,020	74	1,874 - 2,166	7.2%
Non-guided	444	90	268 - 620	39.7%
<u>Total</u>	11,024	2,056	6,995 - 15,053	36.5%

#### Harvest rates:

A total of 250 angler interviews were conducted; 108 shore anglers and 142 boat anglers (Table 21). Mean daily harvest rates for shore anglers ranged from 0.000 to 0.074 (Appendix Table E3). No fish were reported by shore anglers after 6 July. Mean daily harvest rates for guided boat anglers ranged from 0.000 to 0.182 (Appendix Table E4) and from 0.000 to 0.308 (Appendix Table E5) for non-guided boat anglers. Only one fish was reported harvested by non-guided boat anglers.

#### Harvest:

Harvest of chinook salmon by shore anglers was estimated at 128 fish with another 11 fish released (Table 22). Since this catch came in early July and from the Crooked Creek confluence, it is assumed that the majority of these fish were the end of the early run bound for Crooked Creek. Total boat angler harvest was estimated at 186 chinook salmon with another 39 fish released. The majority of these fish are presumed to be of late run origin since they were not taken at the Crooked Creek confluence but rather in the mainstem Kasilof with many being reported upstream from Crooked Creek. Guided anglers were estimated to have taken 94% of the boat angler harvest and 95% of the total catch.

### CONCLUSIONS AND RECOMMENDATIONS

#### Anchor River, Deep Creek, and Ninilchik River

The restrictive regulations implemented on these fisheries greatly minimize the possibility of over exploitation by recreational anglers. However, a need still exists to obtain timely quantitative information. A precise estimate of harvest and effort could be obtained by a roving creel survey. However, unlimited angler access will increase the manpower necessary to conduct angler interviews. One possible alternative would be to distribute angler interview cards to anglers while they are fishing to be returned by mail.

#### Deep Creek and Whiskey Gulch Marine

The Deep Creek and Whiskey Gulch marine fisheries are important sport fisheries, however, a precise estimate of harvest and effort is not critical to the management of either the chinook salmon or Pacific halibut stocks. However, biological sampling should be continued.

#### Kasilof River

Chinook salmon exploited by sport anglers on the Kasilof River consist mainly of the enhanced early run stock propagated by the Crooked Creek Hatchery. The strength of future returns is directly related to the success or failure of this hatchery. An intense creel survey

Table 21. Estimated chinook salmon harvest per unit effort (HPUE) and catch per unit effort (CPUE) in the Kasilof River late run sport fishery, 1986.

Stratum	Days		Number of Interviews	HPUE	Standard Error	CPUE	Standard Error
	n <sup>1</sup>	N <sup>2</sup>					
<u>Shore Anglers</u>							
Weekdays	7	13	64	0.0299	0.00147	0.0359	0.00160
Weekends	4	7	44	0.0105	0.00297	0.0105	0.00295
<u>Boat Anglers</u>							
Guided	17	31	129	0.0865	0.00107	0.1059	0.00126
Non-guided	17	31	13	0.0240	0.08370	0.0240	0.08370
Total	17 <sup>3</sup>	31	250				

- 1 Number of days on which interviews were collected.
- 2 Number of days possible for interviewing.
- 3 Shore angler effort was insignificant after 20 July.

Table 22. Estimated number of chinook salmon harvested and caught (landed) in the Kasilof River late run sport fishery, 1986.

Stratum	Harvest	Standard Error	Rel. Pre. <sup>1</sup>	Catch	Standard Error	Rel. Pre. <sup>1</sup>
<u>Shore Anglers</u>						
Weekdays	59	12	40.0%	70	14	40.3%
Weekends	69	28	80.1%	69	28	40.3%
<u>Boat Anglers</u>						
Guided	175	46	7.6%	214	8	7.6%
Non-guided	11	36	649.3%	11	36	649.3%
Total	314	48	30.0	314	49	26.4%

<sup>1</sup> Relative precision at  $\alpha = 0.05$ .

is not essential to the management of this fishery. However, periodic investigations should continue with the purpose of identifying any significant growth in this fishery.

#### ACKNOWLEDGMENTS

We would like to express our gratitude to those individuals that assisted with data collection, compilation and analysis. Gilbert Marick conducted the creel survey at the Deep Creek Wayside. Andy Couch conducted the creel survey on the Kasilof River. Jay Carlon provided local data processing support. The Research and Technical Service staff, especially Bob Conrad, provided invaluable assistance. Gary Fidler and Gail Heineman assisted with data reduction and micro-computer troubleshooting. Doug McBride for overall guidance and editing of the report.

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## APPENDICES

Appendix Table A1. Escapement counts of chinook salmon, 29 July 1986.

Stream	Survey Type	Index Area <sup>1</sup>		Remainder of Stream	
		Live	Dead	Live	Dead
Anchor River					
	Ground	173	64		
	Helicopter	227	22	1,764	264
Deep Creek					
	Ground	114	72		
	Helicopter	44	8	819	105
Ninilchik River					
	Ground	215	62		
	Helicopter	81	26	125	75

- <sup>1</sup> Anchor River - Old Sterling Highway bridge upstream to New Sterling Highway bridge (approximately 5 mi.).  
 Deep Creek - Sterling Highway bridge upstream approximately 4 miles to spot marked each year with survey tape.  
 Ninilchik River - Sterling Highway bridge upstream approximately 2.5 miles to unnamed bridge.

Appendix Table B1. Recreational boat counts and times during the early run of chinook salmon in the Deep Creek marine sport fishery, 1986.

Date	Wd/ We <sup>1</sup>	Time <sup>2</sup>	Count	Time	Count	Time	Count	Time	Count
517	We	0900	161	1100	91	1700	19	1800	61
518	We	1000	66	1100	264	1700	35	1800	12
519	Wd	0500	0	0600	3	1300	135	1500	110
520	Wd								
521	Wd	1300	141	1500	144	2200	7	2300	8
522	Wd								
523	Wd	1800	78	1900	28	2200	17	2300	12
524	We	0500	46	0700	41	1300	129	1400	245
525	We	1200	126	1300	130	2100	1	2200	1
526	We								
527	Wd	0400	1	0600	44	1600	51	1900	127
528	Wd								
529	Wd	0400	14	0700	142	0900	144	1100	95
530	Wd	0800	59	1000	133	1400	88	1500	43
531	We	1200	232	1500	117	2000	124	2300	56
601	We	1600	44	1900	45	2200	47	2300	52
602	Wd								
603	Wd								
604	Wd								
605	Wd	0400	2	0700	3	1600	49	1800	25
606	Wd	0900	21	1100	38	2000	4	2300	6
607	We	0400	47	0600	36	0900	41	1000	67
608	We	1000	5	1100	20	1600	130	1900	48
609	Wd	0400	5	0700	22	1800	92	1900	71
610	Wd	1300		1500		1700		1900	
611	Wd	0800	25	1000	34	1600	43	1800	99
612	Wd								
613	Wd								
614	We	0500	4	0600	56	2000	147	2300	118
615	We	0600	16	0700	48	1600	27	1800	26
616	Wd	1200	54	1500	24	2100	1	2200	4
617	Wd								
618	Wd	0600	2	0700	3	1700	6	1800	5
619	Wd								
620	Wd	0400	5	0500	5	1400	48	1500	56
621	We	0600	9	0700	11	1200	34	1300	35
622	We	0500	2	0700	5	0800	6	0900	19
623	Wd	1600	24	1800	44	2000	0	2200	9
624	Wd	1200	4	1500	14	2000	3	2100	3
625	Wd								
626	Wd	0900	22	1000	12	1200	10	1300	16
627	Wd								

1 Weekday (Wd) or Weekend/Holiday (We).

2 Period A, 0400-0759 hours; Period B, 0800-1159 hours; Period C, 1200-1559 hours; Period D, 1600-1959 hours; Period E, 2000-2359 hours.

Appendix Table B2. Recreational boat counts and times during the late run of chinook salmon in the Deep Creek marine sport fishery, 1986.

Date	Wd/ We <sup>1</sup>	Time Count <sup>2</sup>		Time Count		Time Count		Time Count	
628	We	1600	36	1800	46	2000	82	2200	112
629	We	0400	2	0500	3	1700	15	1800	12
630	Wd								
701	Wd								
702	Wd	0800	15	1000	28	2100	0	2200	0
703	Wd	0500	0	0600	0	2200	2	2300	5
704	We	0600	2	0700	6	2200	7	2300	8
705	We	0800	16	0900	31	1200	58	1300	70
706	We	1300	35	1400	41	2200	4	2300	2
707	Wd	0400	2	0500	4	1300	23	1400	28
708	Wd								
709	Wd	1300	53	1400	55	2100	18	2200	2
710	Wd								
711	Wd	0800	32	1100	33	1800	45	1900	126
712	We	0400	0	0700	0	1600	0	1800	0
713	We	0900	6	1100	1	1600	0	1900	25
714	Wd	1700	28	1900	65	2200	91	2300	21
715	Wd	0800	21	1000	61	1200	39	1500	4
716	Wd	1400	71	1500	41	2100	53	2200	53
717	Wd								
718	Wd								
719	We	0800	5	1000	12	1700	7	1900	7
720	We	0800	0	0900	0	1300	0	1400	0
721	Wd								
722	Wd	0400	0	0600	0	1200	3	1400	6
723	Wd	1200	0	1300	0	2100	0	2200	0
724	Wd								
725	Wd	0400	0	0600	5	2000	10	2200	4
726	We	0400	0	0500	0	1200	18	1400	24
727	We	0900	51	1000	45	2000	60	2200	36
728	Wd	0400	0	0500	0	2000	35	2100	37
729	Wd	0800	0	1100	0	1600	0	1900	0
730	Wd	1200	3	1400	4	1800	3	1900	3

1 Weekday (Wd) or Weekend/Holiday (We.)

2 Period A, 0400-0759 hours; Period B, 0800-1159 hours; Period C, 1200-1559 hours; Period D, 1600-1959 hours; Period E, 2000-2359 hours.

Appendix Table B3. Number of recreational boats and their respective anglers interviewed from the Deep Creek marine sport fishery, 1986.

Date	Wd/ We <sup>1</sup>	Anglers	Boats	Anglers/ Boat	Date	Wd/ We	Anglers	Boats	Anglers/ Boat
517	We	74	27	2.74	623	Wd	61	22	2.77
518	We	70	24	2.92	624	Wd	10	4	2.50
519	Wd	22	10	2.20	626	Wd	24	9	2.67
521	Wd	6	3	2.00	628	We	120	43	2.79
524	We	33	12	2.75	629	We	10	3	3.33
525	We	59	17	3.47	702	Wd	9	4	2.25
527	Wd	51	9	5.67	703	Wd	6	3	2.00
529	Wd	24	21	1.14	704	We	16	5	3.20
530	Wd	33	13	2.54	705	We	52	20	2.60
531	We	68	24	2.83	706	We	44	14	3.14
601	We	63	22	2.86	707	Wd	21	8	2.63
605	Wd	42	14	3.00	709	Wd	51	25	2.04
606	Wd	14	5	2.80	711	Wd	118	41	2.88
607	We	47	16	2.94	713	We	20	10	2.00
608	We	56	21	2.67	714	Wd	79	26	3.04
609	Wd	34	14	2.43	715	Wd	72	27	2.67
611	Wd	36	15	2.40	716	Wd	91	35	2.60
614	We	117	39	3.00	719	We	23	9	2.56
615	We	20	7	2.86	722	Wd	11	3	3.67
616	Wd	47	16	2.94	725	Wd	38	14	2.43
618	Wd	9	3	3.00	726	We	14	5	2.80
620	Wd	34	10	3.40	727	We	106	37	2.86
621	We	30	12	2.50	728	Wd	40	19	2.11
622	We	6	2	3.00	730	Wd	8	4	2.00

1 Weekday (Wd) or Weekend/Holiday (We).

Appendix Table C1. Daily summary statistics for fishing effort, chinook salmon harvest and Pacific halibut harvest for completed-trip anglers in the Deep Creek marine sport fishery interviewed during the early run of chinook salmon, 1986.

Date	Wd/ We <sup>1</sup>	SS <sup>2</sup>	Effort		Chinook Salmon			Pacific Halibut		
			Mean	SE <sup>3</sup>	Mean	SE <sup>3</sup>	HPUE	Mean	SE <sup>3</sup>	HPUE
517	We	27	7.0	0.61	0.07	0.051	0.011	0.33	0.177	0.048
518	We	24	16.8	1.43	0.21	0.104	0.012	3.17	0.567	0.189
519	Wd	10	7.5	1.33	0.10	0.100	0.013	0.80	0.416	0.107
521	Wd	2	8.0	0.00	0.50	0.500	0.063	1.50	1.500	0.188
524	We	20	13.7	1.40	0.65	0.342	0.047	1.50	0.450	0.109
525	We	17	23.2	4.01	0.29	0.143	0.013	1.59	0.743	0.068
527	Wd	9	20.9	5.00	0.67	0.333	0.032	1.78	0.703	0.085
529	Wd	21	7.4	0.51	0.33	0.211	0.045	0.62	0.341	0.083
530	Wd	13	10.8	1.26	0.69	0.472	0.064	0.46	0.332	0.043
531	We	24	12.5	1.13	0.50	0.190	0.040	1.50	0.413	0.120
601	We	22	16.8	2.83	0.27	0.188	0.016	3.68	0.594	0.220
605	Wd	14	12.6	1.82	1.64	0.541	0.131	1.36	0.530	0.108
606	Wd	5	12.0	1.10	0.00	0.000	0.000	0.00	0.000	0.000
607	We	16	9.3	1.30	0.56	0.341	0.060	0.44	0.302	0.047
608	We	21	8.8	0.75	0.90	0.300	0.103	0.67	0.303	0.076
609	Wd	14	5.9	0.77	0.71	0.322	0.120	0.00	0.000	0.000
611	Wd	15	14.5	2.75	0.13	0.091	0.009	1.07	0.384	0.074
614	We	39	25.1	3.11	0.15	0.086	0.006	2.87	0.398	0.114
615	We	7	10.4	3.21	0.00	0.000	0.000	2.14	1.122	0.205
616	Wd	16	9.8	1.42	0.00	0.000	0.000	2.75	0.722	0.282
618	Wd	3	17.0	6.81	0.00	0.000	0.000	3.00	1.155	0.176
620	Wd	10	15.7	3.74	0.00	0.000	0.000	1.60	0.833	0.102
621	We	12	9.0	1.68	0.00	0.000	0.000	1.25	0.509	0.139
622	We	2	10.0	6.00	0.00	0.000	0.000	0.00	0.000	0.000
623	Wd	22	8.3	0.65	0.00	0.000	0.000	1.86	0.438	0.225
624	Wd	4	10.5	2.50	0.00	0.000	0.000	0.25	0.250	0.024
626	Wd	9	11.4	3.30	0.22	0.147	0.019	2.56	1.303	0.223

- 1 Weekday (Wd) or Weekend/Holiday (We).
- 2 Sample size, number of boats contacted.
- 3 Standard error.

Appendix Table C2. Daily summary statistics for fishing effort, chinook salmon harvest and Pacific halibut harvest for completed-trip anglers in the Deep Creek marine sport fishery interviewed during the late run of chinook salmon, 1986.

Date	Wd/ We <sup>1</sup>	SS <sup>2</sup>	Effort		Chinook Salmon			Pacific Halibut		
			Mean	SE <sup>3</sup>	Mean	SE <sup>3</sup>	HPUE	Mean	SE <sup>3</sup>	HPUE
628	We	43	13.7	1.69	0.12	0.060	0.009	3.12	0.453	0.228
629	We	3	18.0	3.46	0.00	0.000	0.000	5.67	1.453	0.315
702	Wd	4	7.8	2.84	0.00	0.000	0.000	1.00	0.577	0.129
703	Wd	3	9.7	4.63	0.00	0.000	0.000	0.00	0.000	0.000
704	We	5	16.8	2.06	0.00	0.000	0.000	1.20	0.583	0.071
705	We	20	9.3	1.20	0.05	0.050	0.005	0.90	0.429	0.097
706	We	14	16.4	2.99	0.14	0.097	0.009	2.36	0.731	0.143
707	Wd	8	16.9	5.59	0.00	0.000	0.000	0.88	0.743	0.052
709	Wd	25	14.0	1.69	0.20	0.115	0.014	2.12	0.543	0.151
711	Wd	41	7.9	0.69	0.15	0.066	0.019	1.05	0.353	0.133
713	We	10	3.6	0.88	0.60	0.267	0.167	0.00	0.000	0.000
714	Wd	26	11.2	2.51	0.46	0.177	0.041	1.73	0.581	0.155
715	Wd	27	10.9	1.07	0.37	0.132	0.034	1.15	0.423	0.105
716	Wd	35	12.6	1.75	0.14	0.060	0.011	2.20	0.528	0.175
719	We	9	11.8	1.27	0.33	0.167	0.028	1.00	0.527	0.085
722	Wd	3	8.3	1.20	0.00	0.000	0.000	1.00	0.577	0.120
725	Wd	14	11.1	3.26	0.00	0.000	0.000	1.07	0.519	0.096
726	We	5	10.2	1.20	0.00	0.000	0.000	0.40	0.400	0.039
727	We	37	12.6	2.36	0.19	0.076	0.015	1.08	0.343	0.086
728	Wd	19	8.4	1.35	0.16	0.086	0.019	0.89	0.425	0.107
730	Wd	4	14.5	2.87	0.00	0.000	0.000	1.00	1.000	0.069

- 1 Weekday (Wd) or Weekend/Holiday (We).
- 2 Sample size, number of boats contacted.
- 3 Standard error.

Appendix Table C3. Daily summary statistics for fishing effort, chinook salmon harvest and Pacific halibut harvest for anglers interviewed at Whiskey Gulch, 1986.

Date	Wd/ We <sup>1</sup>	Effort			Chinook Salmon Harvest			Pacific Halibut Harvest		
		SS <sup>2</sup>	Mean	SE <sup>3</sup>	Mean	SE <sup>3</sup>	CPUE	Mean	SE <sup>3</sup>	CPUE
517	We	52	2.7	0.19	0.077	0.046	0.028	0.29	0.084	0.106
518	We	15	5.2	0.64	0.000	0.000	0.000	1.13	0.215	0.217
519	Wd	2	7.5	0.00	0.000	0.000	0.000	1.00	1.000	0.133
524	We	33	2.6	0.20	0.000	0.000	0.000	0.76	0.123	0.296
525	We	65	3.0	0.18	0.138	0.048	0.046	0.48	0.096	0.157
527	Wd	9	2.7	0.61	0.444	0.176	0.164	0.56	0.294	0.205
601	We	14	8.2	2.18	0.071	0.071	0.009	2.21	0.604	0.271
604	Wd	15	8.9	1.58	0.667	0.347	0.075	0.27	0.153	0.030
606	Wd	17	9.2	0.81	0.765	0.349	0.083	0.12	0.118	0.013
607	We	21	6.7	0.74	0.571	0.263	0.085	0.90	0.337	0.135
608	We	13	7.8	2.21	0.000	0.000	0.000	0.46	0.268	0.060
612	Wd	28	10.4	1.70	0.071	0.050	0.007	1.43	0.429	0.138
614	We	13	5.4	0.77	0.077	0.077	0.014	2.31	0.603	0.429
615	We	14	9.6	1.76	0.071	0.071	0.007	2.64	0.580	0.276
619	Wd	10	3.4	0.73	0.400	0.306	0.118	1.10	0.458	0.324
622	We	38	7.1	0.67	0.158	0.080	0.022	1.79	0.344	0.254
628	We	60	10.4	1.10	0.050	0.028	0.005	2.53	0.342	0.245
630	Wd	21	9.0	1.15	0.000	0.000	0.000	2.19	0.661	0.244
701	Wd	6	3.7	1.33	0.000	0.000	0.000	0.83	0.401	0.227
703	Wd	16	7.2	1.18	0.063	0.063	0.009	0.50	0.274	0.070
704	We	87	9.5	0.61	0.080	0.034	0.008	1.99	0.244	0.209
705	We	55	10.2	0.88	0.145	0.060	0.014	2.33	0.363	0.228
706	We	28	9.8	1.08	0.179	0.090	0.018	0.89	0.323	0.091
708	Wd	3	6.8	2.17	0.667	0.333	0.098	0.00	0.000	0.000
710	Wd	8	13.6	3.83	0.375	0.263	0.028	2.13	1.156	0.156
712	We	11	7.1	1.31	0.000	0.000	0.000	0.55	0.312	0.077
714	Wd	10	19.7	4.99	0.200	0.200	0.010	5.10	1.090	0.260
718	Wd	11	10.4	2.63	0.000	0.000	0.000	2.73	1.088	0.263
719	We	2	3.5	0.50	0.000	0.000	0.000	0.50	0.500	0.143

- 1 Weekday (Wd) or Weekend/Holiday (We).
- 2 Sample size, number of anglers interviewed.
- 3 Standard error.

Appendix Table D1. Recreational boat counts and times during the chinook salmon return in the Whiskey Gulch marine sport fishery, 1986.

Date	Wd/ We <sup>1</sup>	Time <sup>2</sup>	Count	Time	Count	Time	Count	Time	Count
517	We	0600	1	0700	5	1600	11	1800	13
518	We	2100	1	2300	0				
519	Wd	0600	2	0700	1	2000	0	2300	0
520	Wd	0800	0	0900	3	1400	4	1500	2
524	We	0400	1	0500	2	1300	36	1500	69
525	We	2000	0	2300	4				
527	Wd	1600	21	1800	25				
601	We	0400	0	1000	39	2100	4	2200	4
603	Wd	1200	54	1400	29				
604	Wd	1700	5	1900	4	2000	8	2100	5
606	Wd	1700	16	1900	1				
607	We	0400	6	0700	10	1000	49	1100	72
607	We	1300	67	1400	50				
608	We	0500	12	0700	5	1800	28	1900	11
611	Wd	0400	0	0500	7				
612	Wd	2000	40	2200	6				
614	We	0800	95	1100	159				
615	We	1700	33	1900	36				
618	Wd	0400	1	0500	2				
619	Wd	0800	6	1000	14	1300	39	1400	48
622	We	0600	6	0700	5	0800	11	0900	22
622	We	1600	63	1900	22				
623	Wd	0800	2	1000	4				
628	We	1300	18	1500	45	2000	59	2100	86
701	Wd	2100	7	2300	10				
703	Wd	1600	9	1800	4				
704	We	0800	10	1000	26	1600	119	1800	20
704	We	2100	21	2300	23				
705	We	1700	115	1900	60				
706	We	1300	10	1400	47	1800	11	1900	4
708	Wd	0500	13	0700	17				
710	Wd	1200	52	1300	51				
712	We	1300	19	1500	17				
714	Wd	1700	39	1800	24				
716	Wd	2200	2						
718	Wd	1800	12	1900	7				
719	We	0800	7	1000	13	1700	5		

1 Weekday (Wd) or Weekend/Holiday (We.)

2 Period A, 0400-0759 hours; Period B, 0800-1159 hours; Period C, 1200-1559 hours; Period D, 1600-1959 hours; Period E, 2000-2359 hours.

Appendix Table D2. Number of recreational boats and their respective anglers interviewed from the Whiskey Gulch marine sport fishery, 1986.

Date	Wd/ We <sup>1</sup>	Anglers	Boats	Anglers/ Boat
517	We	131	52	2.52
518	We	42	15	2.80
519	Wd	2	2	1.00
524	We	89	33	2.70
525	We	179	65	2.75
527	Wd	9	9	1.00
601	We	34	14	2.43
604	Wd	46	15	3.07
606	Wd	55	17	3.24
607	We	55	21	2.62
608	We	29	13	2.23
612	Wd	82	28	2.93
614	We	29	13	2.23
615	We	44	14	3.14
619	Wd	18	10	1.80
622	We	100	38	2.63
628	We	179	60	2.98
630	Wd	64	21	3.05
701	Wd	21	6	3.50
703	Wd	42	16	2.63
704	We	275	87	3.16
705	We	171	55	3.11
706	We	76	28	2.71
708	Wd	8	3	2.67
710	Wd	23	8	2.88
712	We	30	11	2.73
713	We	3	2	1.50
714	Wd	36	10	3.60
718	Wd	34	11	3.09
719	We	6	2	3.00

1 Weekday (Wd) or Weekend/Holiday (We).

Appendix Table D3. Daily summary statistics for fishing effort, chinook salmon harvest and Pacific halibut harvest for anglers interviewed at Whiskey Gulch, 1986.

Date	Wd/ We <sup>1</sup>	Effort			Chinook Salmon			Pacific Halibut		
		SS <sup>2</sup>	Mean	SE <sup>3</sup>	Mean	SE <sup>3</sup>	HPUE	Mean	SE <sup>3</sup>	HPUE
517	We	52	2.7	0.19	0.077	0.046	0.028	0.29	0.084	0.106
518	We	15	5.2	0.64	0.000	0.000	0.000	1.13	0.215	0.217
519	Wd	2	7.5	0.00	0.000	0.000	0.000	1.00	1.000	0.133
524	We	33	2.6	0.20	0.000	0.000	0.000	0.76	0.123	0.296
525	We	65	3.0	0.18	0.138	0.048	0.046	0.48	0.096	0.157
527	Wd	9	2.7	0.61	0.444	0.176	0.164	0.56	0.294	0.205
601	We	14	8.2	2.18	0.071	0.071	0.009	2.21	0.604	0.271
604	Wd	15	8.9	1.58	0.667	0.347	0.075	0.27	0.153	0.030
606	Wd	17	9.2	0.81	0.765	0.349	0.083	0.12	0.118	0.013
607	We	21	6.7	0.74	0.571	0.263	0.085	0.90	0.337	0.135
608	We	13	7.8	2.21	0.000	0.000	0.000	0.46	0.268	0.060
612	Wd	28	10.4	1.70	0.071	0.050	0.007	1.43	0.429	0.138
614	We	13	5.4	0.77	0.077	0.077	0.014	2.31	0.603	0.429
615	We	14	9.6	1.76	0.071	0.071	0.007	2.64	0.580	0.276
619	Wd	10	3.4	0.73	0.400	0.306	0.118	1.10	0.458	0.324
622	We	38	7.1	0.67	0.158	0.080	0.022	1.79	0.344	0.254
628	We	60	10.4	1.10	0.050	0.028	0.005	2.53	0.342	0.245
630	Wd	21	9.0	1.15	0.000	0.000	0.000	2.19	0.661	0.244
701	Wd	6	3.7	1.33	0.000	0.000	0.000	0.83	0.401	0.227
703	Wd	16	7.2	1.18	0.063	0.063	0.009	0.50	0.274	0.070
704	We	87	9.5	0.61	0.080	0.034	0.008	1.99	0.244	0.209
705	We	55	10.2	0.88	0.145	0.060	0.014	2.33	0.363	0.228
706	We	28	9.8	1.08	0.179	0.090	0.018	0.89	0.323	0.091
708	Wd	3	6.8	2.17	0.667	0.333	0.098	0.00	0.000	0.000
710	Wd	8	13.6	3.83	0.375	0.263	0.028	2.13	1.156	0.156
712	We	11	7.1	1.31	0.000	0.000	0.000	0.55	0.312	0.077
714	Wd	10	19.7	4.99	0.200	0.200	0.010	5.10	1.090	0.260
718	Wd	11	10.4	2.63	0.000	0.000	0.000	2.73	1.088	0.263
719	We	2	3.5	0.50	0.000	0.000	0.000	0.50	0.500	0.143

- 1 Weekday (Wd) or Weekend/Holiday (We).
- 2 Sample size, number of boats contacted.
- 3 Standard error.

Appendix Table E1. Shore angler counts by date and period  
for the Kasilof River chinook salmon sport  
fishery at Crooked Creek, 1986.

Date	Period <sup>1</sup>				
	A	B	C	D	E
701				92	112
703				71	
706				30	13
707					18
709	1	0			
711	1	1			
712		3		21	
713					22
714					23
717		9	15	13	
718		5	10		
719		2			12
720			9		

1 Period A, 400-0759 hours; Period B, 0800-1159 hours; Period C, 1200-1559 hours; Period D, 1600-1959 hours; Period E, 2000-2359 hours.

Appendix Table E2. Guided and unguided boat and angler counts by powered and non-powered vessel in the Kasilof River sport fishery, 1986.

	<u>Non-powered Boats</u>				<u>Powered Boats</u>			
	<u>Guided</u>		<u>Non-guided</u>		<u>Guided</u>		<u>Non-guided</u>	
	Anglers	Boats	Anglers	Boats	Anglers	Boats	Anglers	Boats
701	7	2	6	2	0	0	4	1
702	6	2	0	0	0	0	0	0
703	0	0	0	0	0	0	0	0
704	3	1	8	3	0	0	2	1
705	10	3	8	3	0	0	0	0
706	32	10	5	2	0	0	0	0
707	27	7	3	1	0	0	0	0
708	0	0	0	0	0	0	0	0
709	3	1	3	1	0	0	0	0
710	9	3	3	1	0	0	0	0
711	21	6	0	0	0	0	1	1
712	15	5	0	0	0	0	2	2
713	50	15	8	3	0	0	6	2
714	36	11	9	4	0	0	0	0
715	9	3	3	1	0	0	0	0
716	7	2	0	0	0	0	0	0
717	6	2	0	0	0	0	1	1
718	12	4	3	1	0	0	2	1
719	21	6	2	1	0	0	0	0
720	25	8	2	1	0	0	2	1
721	28	9	0	0	0	0	0	0
722	0	0	2	2	0	0	0	0
723	4	2	3	1	0	0	4	1
724	0	0	0	0	0	0	0	0
725	15	5	0	0	0	0	0	0
726	5	2	0	0	0	0	0	0
727	8	3	0	0	0	0	7	2
728	16	5	0	0	0	0	0	0
729	0	0	0	0	0	0	0	0
730	3	1	0	0	0	0	0	0
731	12	4	3	1	0	0	3	1

Appendix Table E3. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch for completed shore anglers in the Kasilof River sport fishery, 1986.

Date	Wd/ We <sup>1</sup>	SS <sup>2</sup>	Effort		Chinook Salmon Harvest			Chinook Salmon Catch		
			Mean	SE <sup>3</sup>	Mean	SE <sup>3</sup>	HPUE	Mean	SE <sup>3</sup>	CPUE
701	Wd	15	3.6	0.48	0.27	0.118	0.074	0.27	0.118	0.074
703	Wd	14	3.7	0.23	0.07	0.071	0.019	0.14	0.097	0.038
706	We	6	2.8	0.54	0.17	0.167	0.059	0.17	0.167	0.059
707	Wd	10	2.0	0.44	0.00	0.000	0.000	0.00	0.000	0.000
709	Wd	9	1.5	0.42	0.00	0.000	0.000	0.00	0.000	0.000
711	Wd	4	1.4	0.41	0.00	0.000	0.000	0.00	0.000	0.000
712	We	26	2.1	0.28	0.00	0.000	0.000	0.00	0.000	0.000
717	Wd	2	2.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
718	Wd	10	1.8	0.32	0.00	0.000	0.000	0.00	0.000	0.000
719	We	10	2.2	0.68	0.00	0.000	0.000	0.00	0.000	0.000
720	We	2	1.5	0.50	0.00	0.000	0.000	0.00	0.000	0.000

- 1 Weekday (Wd) or Weekend/Holiday (We).
- 2 Sample size, number of anglers contacted.
- 3 Standard error.

Appendix Table E4. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch for completed, guided, boat anglers in the Kasilof River chinook salmon fishery, 1986.

Date	Wd/ We <sup>1</sup>	SS <sup>2</sup>	Effort		Chinook Salmon Harvest			Chinook Salmon Catch		
			Mean	SE <sup>3</sup>	Mean	SE <sup>3</sup>	HPUE	Mean	SE <sup>3</sup>	CPUE
701	Wd	7	4.9	0.07	0.14	0.143	0.029	0.14	0.143	0.029
707	Wd	6	5.0	0.00	0.83	0.477	0.167	0.83	0.477	0.167
711	Wd	9	4.0	0.51	0.67	0.167	0.166	0.67	0.167	0.166
712	We	4	6.0	0.00	0.25	0.250	0.042	1.00	0.408	0.167
713	We	14	5.5	0.38	1.00	0.182	0.182	1.21	0.214	0.221
714	Wd	14	4.6	0.62	0.57	0.137	0.124	0.79	0.239	0.171
717	Wd	2	6.0	0.00	0.50	0.500	0.083	0.50	0.500	0.083
718	Wd	3	4.3	1.67	0.33	0.333	0.077	0.33	0.333	0.077
719	We	4	6.0	0.20	0.00	0.000	0.000	0.00	0.000	0.000
720	We	5	6.0	0.32	0.40	0.245	0.067	0.60	0.400	0.100
721	Wd	26	5.2	0.40	0.15	0.072	0.029	0.15	0.072	0.029
723	Wd	4	4.5	0.29	0.50	0.289	0.111	0.50	0.287	0.111
726	We	5	5.1	0.10	0.20	0.200	0.039	0.20	0.200	0.039
727	We	4	5.5	0.58	0.25	0.250	0.045	0.25	0.250	0.045
728	Wd	10	4.7	0.58	0.50	0.167	0.106	0.60	0.163	0.128
730	Wd	3	8.5	0.00	0.67	0.333	0.078	0.67	0.333	0.078
731	Wd	9	5.6	0.14	0.44	0.176	0.079	0.67	0.289	0.119

1 Weekday (Wd) or Weekend/Holiday (We).

2 Sample size, number of anglers contacted.

3 Standard error.

Appendix Table E5. Daily summary statistics for fishing effort, chinook salmon harvest, and chinook salmon catch for completed, unguided, boat anglers in the Kasilof River chinook salmon fishery, 1986.

Date	Wd/ We <sup>1</sup>		Effort		Chinook Salmon Harvest			Chinook Salmon Catch		
	SS <sup>2</sup>	Mean	SE <sup>3</sup>	Mean	SE <sup>3</sup>	HPUE	Mean	SE <sup>3</sup>	CPUE	
701	Wd	1	3.0		0.00		0.000	0.00		0.000
709	Wd	3	6.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000
711	Wd	1	3.2		1.00		0.308	1.00		0.308
712	We	1	4.0		0.00		0.000	0.00		0.000
717	Wd	1	0.5		0.00		0.000	0.00		0.000
719	We	2	3.5	2.00	0.00	0.000	0.000	0.00	0.000	0.000
722	Wd	4	6.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000

1 Weekday (Wd) or Weekend/Holiday (We).

2 Sample size, number of anglers contacted.

3 Standard error.