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FISHERIES STATISTICS FOR SELECTED SPORT FISHERIES ON THE LOWER KENAI PENINSULA, ALASKA, 1987 WITH EMPHASIS ON CHINOOK SALMON *Oncorhynchus tshawytscha*[1]

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ABSTRACT

Creel surveys were conducted to estimate chinook salmon *Oncorhynchus tshawytscha* harvest and angler effort. Both a direct and indirect creel survey method of completed trip anglers were combined to determine a chinook salmon harvest of 716 on the Anchor River, 1,149 on the Ninilchik River, and 790 on Deep Creek.

The recreational harvest of chinook salmon from these three streams was sampled for age composition. Age class 1.3 (brood year 1982) comprised approximately 46 percent and age class 1.4 comprised approximately 44 percent of the recreational harvest of chinook salmon from these three streams. Additional length data for chinook salmon is also presented.

Escapement surveys for chinook salmon were conducted utilizing both ground and aerial techniques on three lower Kenai Peninsula streams. The minimum chinook salmon escapement in 1987 was 4,350 in the Anchor River, 600 in the Ninilchik River, and 1,670 in Deep Creek.

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

INTRODUCTION

Freshwater fishing for chinook salmon *Oncorhynchus tshawytscha* is limited to only four streams on the southern Kenai Peninsula: Anchor River, Deep Creek, Ninilchik River, and Kasilof River (Figure 1). The Kasilof River fishery is supported almost entirely by stocked fish and has only recently become a popular fishery[1]. Historically, significant freshwater recreational fisheries for chinook salmon occurred only on Anchor River, Deep Creek, and Ninilchik River. These are terminal fisheries that harvest single stocks of wild fish.

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 three 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. During 1987, the Deep Creek fishery was extended for a fifth weekend.

Despite the restrictive management scenario under which these fisheries are conducted, Hammarstrom et al. (1987) identified a need to obtain timely quantitative information for these fisheries due to the extremely concentrated levels of effort being exerted on these wild stocks of chinook salmon. Two methods of obtaining these data were identified: (1) a roving creel survey; and (2) voluntary angler interview cards. These data are used to: (1) formulate in-season 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 objectives of this report are (1) to provide baseline data for these fisheries and the lower Kenai Peninsula chinook salmon stocks; and (2) to evaluate the results from the roving creel survey and angler interview cards.

Prior information pertaining to the lower peninsula chinook salmon sport fisheries is presented by Dunn (1961), Logan (1962-1964), 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, 1987).

METHODS

For these fisheries in aggregate, anglers were permitted a daily harvest of one (freshwater) or two (saltwater) chinook salmon greater than 40.6 mm (16 in.) in length and a yearly limit of five chinook salmon greater than 40.6 mm. Freshwater fishing ends by regulation on 31 July (ADFG 1987).

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

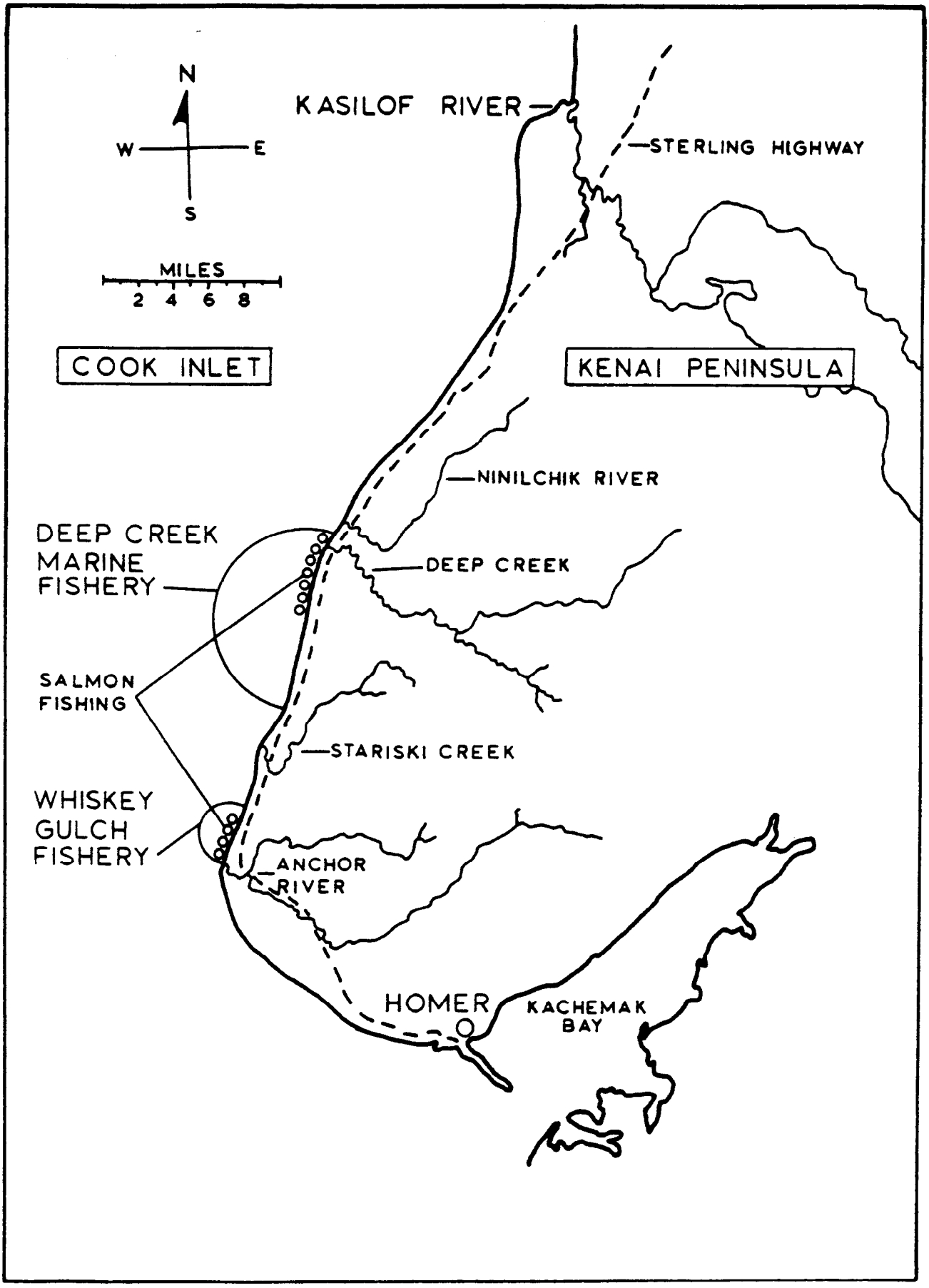

Figure 1. Schematic diagram of the lower Kenai Peninsula.

Fishery Monitoring

The Anchor River, Deep Creek, and Ninilchik River fishing areas are limited to the lower 3 km for each 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 per unit effort (HPUE) was estimated from both direct interviews and voluntary angler interview cards. Direct interviews are the more common methodology used in other Alaskan sport fisheries and has usually been shown to provide unbiased estimates of harvest rates and harvest (Mills 1987). However, direct interviews are expensive to conduct. Although it is not known with certainty which estimate, if either, is correct; we initially hypothesized that the estimate of HPUE derived from the interview cards could be biased high. This would result from a tendency of successful anglers to complete and return the cards.

Roving Creel Survey:

Study Design. Commencing 23 May on each stream and terminating 8 June (Ninilchik River), 15 June (Anchor River), and 22 June (Deep Creek); a creel survey was conducted on the lower 3 km of each stream on each Saturday, Sunday, and Monday.

Angler counts were conducted following a stratified random sample design based on a 20-hour fishing day. Each sample day was stratified into five 4-hour periods: (A) from 0400-0759 hours, (B) from 0800-1159 hours, (C) from 1200-1559 hours, (D) from 1600-1959 hours, and (E) from 2000-2359 hours. Angler counts were conducted in four of the five periods each day and each period was sampled at least twice during each 3-day weekend. A starting time was randomly selected in the first count period of a sample day, subsequent count hours were spaced 4 hours apart throughout the day. This was done to minimize the covariance between counts in adjacent periods.

Angler counts were made by a roving creel survey clerk and took approximately 45 minutes to complete. Those counts were considered instantaneous counts (Neuhold and Lu 1957). Angler interviews were completed trip interviews collected by monitoring the major access points and interviewing anglers as they departed.

Creel survey personnel allocated their interview time between the intertidal area and upstream area according to the most recent angler count. For example, if 1/3 of the anglers counted were in the intertidal area and 2/3 of the anglers counted were upstream of the intertidal area, then, 1 hour was spent in campgrounds and parking areas near the intertidal area and 2 hours in campgrounds and parking areas upstream of the intertidal area.

The major assumptions necessary for the creel survey are:

1. Angler counts made during the same day and on consecutive days are independent;

2. No significant fishing effort occurs during the hours 2400-0400;

3. Interviewed anglers are representative of the total angler population;

4. The number of anglers interviewed during a day is proportional to the effort on that day;

5. Fishing effort does not influence catch per unit effort; and

6. Angler efforts and catches are normally distributed random variables.

Data Collection. During a selected sample period, a random starting time was selected to count the number of anglers along each stream and the remaining time was spent conducting angler interviews. Effort counts were conducted by walking the length of the fishing area as quickly as possible and counting the number of anglers actively engaged in fishing. Angler counts were recorded separately between the intertidal area and upstream of the intertidal area on each stream. Anglers who had completed fishing were interviewed. Information collected from angler interviews consisted of total catch by species, number retained and number released, and total hours fished (to the nearest half hour).

Data Analysis. Angler effort was calculated using a stratified random sample design (Schaeffer et al. 1979). Effort in angler-hours was estimated separately for each weekend and for each fishery as:

$$(1) \qquad \hat{E} = \sum_{j=1}^{5} H_j Y_j$$

with variance

$$(2) \qquad \hat{V}(E) = \sum_{j=1}^{5} H^2_j \quad (s^2_j/n_j)$$

where, Y_j = the mean number of anglers per count in stratum j,

H_j = total number of hours fishing possible in stratum j,

s^2_j = the sample variance for angler counts in stratum j, and

n_j = the number of angler counts conducted in stratum j.

The mean effort and mean harvest per angler was calculated for each location and time frame using a two-stage random sample design with days as the primary sample units and anglers as the secondary sample units (Von Geldern and Tomlinson 1973). Arithmetic means were calculated from all completed trip anglers interviewed at a location and time frame.

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

$$(3) \qquad V(\bar{f}) = [1-(d/D)]s_B^2/d + [\sum_{i=1}^{d} (s_{wi}^2/m_i)]/dD$$

where

$$s_{wi}^2 = [\sum_{i=1}^{m_i}(f_{ik}-\bar{f}_i)^2]/(m_i-1) ,$$

$$s_B^2 = [\sum_{i=1}^{d} (\bar{f}_i-\bar{F})^2]/(d-1) ,$$

d = number of days on which sampling was conducted,

D = number of possible days at a location in a time frame,

f_{ik} = effort by angler k interviewed on day i,

m_i = number of anglers interviewed on day i, and

$\bar{F}$ = mean effort per angler at a location during a time frame.

The variance of mean catch per angler was estimated by substituting individual catches for efforts in the above formulae.

Catch per effort, $\bar{c}/\bar{f}$, was computed for each location and time frame. The variance of catch per effort is approximated by the variance for a quotient of two random variables (Jessen 1978),

$$(4) \qquad \hat{V}(\bar{c}/\bar{f}) = (\bar{c}/\bar{f})^2[(s_c^2/\bar{c}^2) + (s_f^2/\bar{f}^2) - (2rs_cs_f/\bar{c}\bar{f})]$$

where,

$\bar{c}$ = mean number of chinook salmon caught per angler,

$\bar{f}$ = as defined previously,

s_c^2 = two-stage variance of $\bar{c}$,

s_f^2 = two-stage variance of $\bar{f}$, and

r = Person's correlation coefficient for the c_{ik} and f_{ik}.

Total harvest (T) for each location-time frame was computed as

(5) $\hat{T} = \hat{E}\ (\bar{c}/\bar{f})$;

and variance, (Goodman 1960):

(6) $V(\hat{T}) = [\hat{E}^2\ \hat{V}\ (\bar{c}/\bar{f})] + [(\bar{c}/\bar{f})^2\ V(\hat{E})] - [V(\hat{E})\ \hat{V}(\bar{c}/\bar{f})]$.

Voluntary Angler Interview Cards:

After completion of the angler count, described in the roving creel survey, creel personnel again walked the length of the stream back to the starting point of the count prior to conducting completed angler interviews. During this period, voluntary angler interview cards were distributed to all uncompleted anglers encountered. As many cards as possible were distributed on each stream at the rate of one card per angler per weekend. The interview cards were printed on 3.5 inch by 5.5 inch postcards. The postcards were prestamped and self addressed. Anglers could return the cards either at a postal drop or at convenient receptacle boxes located at each fishery. Information requested on the survey card was identical to the information collected by the creel survey.

Angler harvest rates (chinook salmon harvested per hour) were estimated from both completed trip interview data collected during the creel surveys and from angler questionnaire cards returned. The harvest rates from each set of data were compared in each fishery using the Wilcoxon signed rank test (Conover 1980) with the matched pairs being the daily harvest rate estimated by each method.

Biological Sampling

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[1] which were placed on a gummed card. Impressions were made into acetate and read with a microfiche reader.

The proportional age composition of the chinook salmon harvest was estimated for each stream. Letting P_h equal the estimated proportion of age group h for any stream, the variance of P_h was estimated using the normal approximation to the binomial (Schaeffer et al. 1979):

(7) $$V(_{Ph}) = {}_{Ph}(1-{}_{Ph})/(n_t-1),$$

Where n_t = the number of legible scales read from chinook salmon sampled from each stream.

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

Table 1. Mean angler counts by period during the chinook salmon fishery on three southern Kenai Peninsula streams.

Stratum	Period A[1]	B[2]	C[3]	D[4]	E[5]
Anchor River					
Number of counts	11	8	8	12	8
Mean count	58.4	63.6	76.5	71.1	72.6
Standard error	11.8	11.3	17.4	8.7	14.1
Ninilchik River					
Number of counts	8	6	6	9	6
Mean count	103.4	129.0	143.3	111.2	95.5
Standard error	15.5	21.2	34.0	20.3	24.3
Deep Creek					
Number of counts	13	10	11	15	10
Mean count	25.5	38.7	38.4	33.7	39.5
Standard error	6.4	10.2	6.9	7.3	13.5

1 Period A = 0400-0759 hrs.
2 Period B = 0800-1159 hrs.
3 Period C = 1200-1569 hrs.
4 Period D = 1600-1959 hrs.
5 Period E = 2000-2359 hrs.

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

Escapement

Escapement surveys were conducted on 28 July after fish had begun to spawn and water levels were near seasonal lows. Escapement estimates were generated from both ground and aerial surveys. Ground counts were conducted over a limited, predetermined area (hereafter referred to as an index area) and were compared to counts conducted from a helicopter over the same area for each stream on the same day. The remainder of the stream was then surveyed from the air, again on the same day, and the aerial counts were adjusted based on ground counts. Both live and dead fish were recorded.

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 (fish which have not yet entered the survey area or fish which have died and have exited the survey area) to either survey. Therefore, this method provides an estimate of escapement which has a negative bias of unknown magnitude.

Expanded estimates of chinook salmon escapement, N, were calculated from ground and aerial counts as follows:

$$(8) \qquad N_{(i)} = g_{(i)} + [(g_{(i)}/a_{(i)})(r_{(i)})]$$

where: i = stratum (live or dead),

g = number of fish observed from the ground,

a = number of fish observed from the air,

r = number of fish observed from the air in other than the index area.

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

RESULTS AND DISCUSSION

Spring run-off resulted in high and turbid water in Anchor River and Deep Creek from 23 May through 1 June. Relatively few fish were caught in Deep Creek until the fourth weekend (Table 1) and the fishery was extended for a fifth weekend.

Effort

Ranges of angler counts for each stream include: Anchor River, from 6 to 146; Ninilchik River, from 25 to 231; and Deep Creek, from 0 to 102 (Appendix Table A1). Mean angler counts on Ninilchik River were greater than the combined mean angler counts on Anchor River and Deep Creek in all periods except period E (Table 1). Mean angler counts by daily period did not significantly vary for any of the fisheries and, therefore, all angler counts for each weekend fishery were pooled to estimate effort.

Total estimated effort (Table 2) for each stream was: (1) Anchor River, 16,300 angler-hours, (2) Ninilchik River, 20,750 angler-hours, and (3) Deep Creek, 10,280 angler-hours. Effort peaked the first weekend on Ninilchik River, the third weekend on Anchor River, and the fourth weekend on Deep Creek.

Harvest Rates

Harvest per unit effort (HPUE) was estimated from both direct interviews and voluntary angler interview cards (Table 3). Sample sizes for the voluntary cards were consistently higher than for the direct interviews. Estimates of HPUE were not significantly different for either the Anchor River ($q = 0.549$) or Deep Creek ($q = 0.109$) fisheries. However, HPUE as measured from the voluntary cards on the Ninilchik River was consistently lower than the estimates from the direct interviews. This is the opposite of our original hypothesis (i.e., that HPUE estimates from the voluntary cards could be biased high) and may speak to potential biases in the estimates from the direct interviews (Conrad and Hammarstrom 1987).

Since the HPUE data were not significantly different for two of the three fisheries, we elected to pool the direct interview and voluntary interview card data for each fishery to estimate the 1987 fishery parameters (Appendix Tables B1-B3 and Table 4). Peak harvest rates occurred on: the second weekend (1 June) for the Ninilchik River fishery; the third weekend (7 June) for the Deep Creek fishery; and the fourth weekend (15 June) for the Anchor River fishery (Table 5).

Harvest and Escapement

Escapement surveys were conducted under excellent conditions in 1987. All stream flows were low and clear with the exception of Ninilchik River where the water maintained its characteristic dark brown coloration. Most fish were in spawning coloration and actively engaged in spawning activities on riffles. An average of 83% of the live fish observed during the ground survey were seen from the air (range 55%-96%) while only 52% (range 29%-125%) of the carcasses observed on the ground were observed from the air (Appendix Table C1). The minimum escapement estimate for the Anchor River was the largest recorded escapement.

Harvest and escapement estimates plus exploitation rates for each stream are as follows:

Table 2. Estimated number of angler-hours of fishing effort during each component of the chinook salmon fishery on three southern Kenai Peninsula streams.

Stratum	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
ANCHOR RIVER				
5/23 - 5/25	2,300	462	1,394 - 3,206	39.4%
5/30 - 6/01	3,785	360	3,079 - 4,491	18.7%
6/06 - 6/08	5,810	402	5,021 - 6,599	13.6%
6/13 - 6/15	4,405	284	3,849 - 4,961	12.6%
TOTAL	16,300	765	14,800 - 17,800	9.2%
NINILCHIK RIVER				
5/23 - 5/25	8,280	696	6,916 - 9,644	16.5%
5/30 - 6/01	6,895	318	6,272 - 7,518	9.0%
6/06 - 6/08	5,575	435	4,723 - 6,427	15.3%
TOTAL	20,750	880	19,025 - 22,475	8.3%
DEEP CREEK				
5/23 - 5/25	650	260	141 - 1,159	78.3%
5/30 - 6/01	900	91	722 - 1,078	19.8%
6/06 - 6/08	1,675	195	1,293 - 2,057	22.8%
6/13 - 6/15	4,255	421	3,429 - 5,081	19.4%
6/20 - 6/22	2,800	260	2,291 - 3,309	18.2%
TOTAL	10,280	599	9,106 - 11,454	11.4%

Table 3. Comparison of two methods of determining harvest per unit effort (HPUE) during the chinook salmon fishery on three southern Kenai Peninsula streams.

Fishery	Date	Direct Interviews		Voluntary Interview Cards		
		Sample Size	HPUE	Sample Size	HPUE	Sign Difference
Anchor River	23-May	16	0.000	53	0.000	N/A
	24-May	17	0.000	40	0.010	+
	25-May	12	0.065	32	0.060	-
	30-May	21	0.041	59	0.051	+
	31-May	31	0.019	51	0.050	+
	01-Jun	5	0.031	18	0.033	+
	06-Jun	27	0.079	93	0.064	-
	07-Jun	11	0.078	88	0.049	-
	08-Jun	14	0.078	50	0.029	-
	13-Jun	4	0.077	60	0.046	-
	14-Jun	10	0.105	59	0.019	-
	15-Jun	8	0.167	39	0.066	-
Ninilchik River	23-May	11	0.222	54	0.040	-
	24-May	15	0.099	55	0.030	-
	25-May	14	0.046	31	0.042	-
	30-May	10	0.316	54	0.053	-
	31-May	12	0.079	44	0.043	-
	01-Jun			20	0.081	N/A
	06-Jun	6	0.444	49	0.056	-
	07-Jun			37	0.048	N/A
	08-Jun			26	0.038	N/A
Deep Creek	23-May	2	0.000	7	0.000	N/A
	24-May			6	0.000	N/A
	25-May	4	0.000			N/A
	30-May	4	0.000	6	0.033	+
	31-May	3	0.200	4	0.000	-
	01-Jun			4	0.000	N/A
	06-Jun			9	0.036	N/A
	07-Jun	21	0.153	14	0.086	-
	08-Jun	11	0.101	16	0.063	-
	13-Jun	13	0.321	40	0.081	-
	14-Jun	17	0.018	31	0.062	+
	15-Jun	9	0.161	21	0.084	-
	20-Jun	13	0.133	30	0.097	-
	21-Jun	16	0.162	30	0.051	-
	22-Jun	4	0.353	17	0.019	-

Table 4. Effort and harvest summary statistics for anglers interviewed during the Anchor River, Ninilchik River, and Deep Creek chinook salmon fishery, 1987.

					Effort (hours)		Harvest				
Fishery	Date	N[1]	D[2]	d[3]	Mean	SE[4]	Mean	SE	r[4]	HPUE[6]	SE
Anchor River	5/23 - 5/25	170	3	3	4.13	0.279	0.065	0.022	0.117	0.016	0.005
	5/30 - 6/01	185	3	3	5.05	0.362	0.216	0.036	-0.002	0.043	0.008
	6/06 - 6/08	283	3	3	5.11	0.253	0.276	0.026	0.093	0.054	0.006
	6/13 - 6/15	180	3	3	5.05	0.251	0.233	0.036	0.051	0.046	0.007
Ninilchik River	5/23 - 5/25	180	3	3	5.01	0.230	0.233	0.032	-0.147	0.047	0.007
	5/30 - 6/01	141	3	3	5.38	0.338	0.348	0.046	-0.005	0.065	0.009
	6/06 - 6/08	118	3	3	6.38	0.389	0.364	0.047	-0.020	0.057	0.007
Deep Creek	5/23 - 5/25	20	3	3	4.42	0.624	0.000	0.000	0.000	0.000	0.000
	5/30 - 6/01	22	3	3	4.61	0.718	0.136	0.070	-0.122	0.030	0.016
	6/06 - 6/08	72	3	3	4.31	0.371	0.389	0.067	-0.076	0.090	0.018
	6/13 - 6/15	131	3	3	4.95	0.313	0.450	0.044	-0.065	0.091	0.011
	6/20 - 6/22	110	3	3	3.96	0.533	0.318	0.048	-0.133	0.080	0.017

1 Sample size. Includes both direct interviews and voluntary interview cards.

2 Number of days possible for sampling.

3 Number of days sampled.

4 Standard error.

5 Correlation coefficient between angler effort and harvest.

6 Number of chinook salmon harvested per hour fished.

Table 5. Estimated effort and harvest during the chinook salmon fishery on Anchor River, Ninilchik River, and Deep Creek, 1987.

Fishery	Date	Effort Total	Rel. Pre.[1]	HPUE[2]	Rel. Pre.	Harvest Total	SE[3]	Rel. Pre.
Anchor River	5/23 - 5/25	2,300	39.4%	0.016	66.5%	36	14.0	76.3%
	5/30 - 6/01	3,785	18.7%	0.043	35.9%	162	33.3	40.3%
	6/06 - 6/08	5,810	13.6%	0.054	20.4%	314	39.1	24.4%
	6/13 - 6/15	4,405	12.6%	0.046	31.0%	204	34.7	33.4%
	Total	16,300	9.2%			716	63.6	17.4%
Ninilchik River	5/23 - 5/25	8,280	16.5%	0.047	29.6%	386	66.5	33.7%
	5/30 - 6/01	6,895	9.0%	0.065	28.7%	445	68.3	30.1%
	6/06 - 6/08	5,575	15.3%	0.057	28.4%	318	52.3	32.2%
	Total	20,750	8.3%			1,149	108.7	18.5%
Deep Creek	5/23 - 5/25	650	78.3%	0.000	-	0	0	-
	5/30 - 6/01	900	19.8%	0.030	108.4%	27	14.9	108.2%
	6/06 - 6/08	1,675	22.8%	0.090	38.9%	151	34.6	44.9%
	6/13 - 6/15	4,255	19.4%	0.091	23.4%	387	59.8	30.3%
	6/20 - 6/22	2,800	18.2%	0.080	42.0%	225	52.3	45.6%
	Total	10,280	11.4%			790	87.9	21.8%

1 Relative precision for 95% confidence interval.

2 Harvest per angler-hour.

3 Standard error.

Location	Escapement	Harvest	Exploitation Rate
Anchor River	4,350	716	14.1%
Deep Creek	1,670	790	32.1%
Ninilchik River	600	1,149	65.7%

Biological Data

Contributions of age 1.3 and 1.4 chinook salmon were similar on Ninilchik River (48.3 % and 47.3%, respectively) and Deep Creek (40.8% and 42.9%, respectively) fisheries; whereas the Anchor River was predominantly age 1.3 (51.2%) followed by age 1.4 (40.5%) fish (Appendix Table D1 and Table 6). Length by sex data are presented in Table 7.

CONCLUSIONS AND RECOMMENDATIONS

The restrictive regulations for these fisheries greatly minimizes the possibility of exceeding sustainable yield for these stocks. Since we assume that escapement estimates are minimal values, maximum rates of exploitation for each stock are: 14.1% for Anchor River; 32.1% for Deep Creek; and 65.7% for Ninilchik River.

Although a relatively precise and timely estimate of harvest and effort was obtained through the creel survey, the cost of this information was high and the data was not essential to management of the fishery. Quantitative estimates of harvest and effort are available in the succeeding year following the fishery (Mills 1987) and are sufficient for following trends in the fishery. On-site data collection should emphasize subjective estimates of fishing success (poor to excellent) and fishing effort (low to high); quantitative estimates of age, sex, and size composition; and aerial counts of escapement.

We anticipate that there will be a need for quantitative estimates of harvest and effort in future years. The Ninilchik River has been identified as a prime candidate for supplemental stocking of chinook salmon. Evaluation of these returns to the sport fishery will require temporal estimates of harvest and effort. We recommend that the voluntary interview cards be used due to the lower cost and larger number of samples available from this method.

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Table 6. Estimated age composition and numbers by age group from chinook salmon harvested on Anchor River, Ninilchik River, and Deep Creek, 1987.

	Brood Year and Age Group						
	1980	1981		1982	1983	1984	
	1.5	1.4	2.3	1.3	1.2	1.1	Total
Anchor River							
Number	0	290	0	366	51	9	716
Percent	0.0	40.5	0.0	51.2	7.1	1.2	100.0
Ninilchik River							
Number	13	542	0	556	25	13	1,149
Percent	1.1	47.3	0.0	48.3	2.2	1.1	100.0
Deep Creek							
Number	0	338	8	323	89	32	790
Percent	0.0	42.8	1.0	40.9	11.2	4.1	100.0

Table 7. Mean length (mm) by age group of chinook salmon sampled from the Anchor River sport fishery, 1987.

Component		Age Group 1.1	1.2	1.3	1.4	1.5	2.3
Anchor River							
Male	Mean Length	320	582	813	900		
	Standard Error		33.1	42.4	39.7		
	Sample Size	1	6	18	20	0	0
Female	Mean Length			817	899		
	Standard Error			42.8	46.2		
	Sample Size	0	0	25	14	0	0
Ninilchik River							
Male	Mean Length	540	630	791	897	940	
	Standard Error		28.3	54.6	40.5		
	Sample Size	1	2	23	16	1	0
Female	Mean Length			798	867		
	Standard Error			58.4	34.1		
	Sample Size	0	0	21	27	0	0
Deep Creek							
Male	Mean Length	360	543	769	903		
	Standard Error	26.5	60.7	119.5	46.4		
	Sample Size	3	11	19	7	0	0
Female	Mean Length	800		806	862		
	Standard Error			43.8	45		
	Sample Size	1	0	21	35	0	1

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APPENDIX

Appendix Table A1. Angler counts in the chinook salmon fisheries at Anchor River, Ninilchik River, and Deep Creek, 1987.

Fishery	Date	Wd We[2]	Counts by Period[1] A	B	C	D	E
ANCHOR RIVER	523	We	26	41	120	78	
	524	We		34	64	20	32
	525	We	6		15	16	8
	530	We	38	36		89	49
	531	We	69	73		116	100
	601	Wd	34		35	55	
	606	We	137	106	146	100	
	607	We	77		115	77	121
	608	Wd	42	96		64	81
	613	We	114	94		100	113
	614	We	63		94	65	77
	615	Wd	36	29	23	73	
NINILCHIK RIVER	523	We	119	189	215	186	
	524	We		120	213	195	133
	525	We	82		83	64	39
	530	We	168	184		173	194
	531	We	126	91		123	81
	601	Wd	58		25	41	
	606	We	148	134	198	104	
	607	We	83		108	66	87
	608	Wd	43	56		49	39
DEEP CREEK	523	We	1	7	57	21	
	524	We		7	11	19	4
	525	We	0		3	0	0
	530	We	25	22		40	25
	531	We	10	14		6	10
	601	Wd	6		2	5	
	606	We	18	13	35	31	
	607	We	26		50	33	17
	608	Wd	21	34		20	37
	613	We	52	98		88	136
	614	We	75		55	102	88
	615	Wd	31	56	44	26	
	620	We	58	58	67	41	
	621	We		78	50	39	50
	622	Wd	8		48	35	28

1 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.
2 Weekday (Wd) or weekend/holiday (We).

Appendix Table B1. Daily summary statistics for fishing effort and chinook salmon harvest for anglers interviewed at Anchor River, 1987.

Date	Wd/ We[1]	Effort (hrs) SS[2]	Mean	SE[3]	Chinook Salmon Harvest Mean	SE[3]	CPUE[4]
523	We	69	4.9	0.53	0.00	0.000	0.000
524	We	57	3.8	0.54	0.04	0.025	0.009
525	We	44	3.3	0.36	0.20	0.062	0.061
530	We	80	5.4	0.40	0.26	0.050	0.049
531	We	82	4.2	0.34	0.17	0.042	0.040
601	Wd	23	6.7	0.95	0.22	0.088	0.032
606	We	120	5.4	0.29	0.36	0.046	0.067
607	We	99	4.5	0.32	0.23	0.043	0.051
608	Wd	64	5.5	0.62	0.19	0.049	0.034
613	We	64	5.3	0.40	0.25	0.055	0.047
614	We	69	4.8	0.44	0.12	0.039	0.024
615	Wd	47	5.1	0.46	0.38	0.084	0.076

1 Weekday (Wd) or Weekend/Holiday (We).
2 Sample size, number of anglers interviews.
3 Standard error.
4 Harvers Per Unit Effort (HPUE).

Appendix Table B2. Daily summary statistics for fishing effort and chinook salmon harvest for anglers interviewed at Ninilchik River, 1987.

Date	Wd/ We[1]	Effort (hrs) SS[2]	Effort (hrs) Mean	Effort (hrs) SE[3]	Chinook Salmon Harvest Mean	Chinook Salmon Harvest SE[3]	Chinook Salmon Harvest HPUE[4]
523	We	65	5.8	0.43	0.31	0.062	0.053
524	We	70	5.2	0.34	0.21	0.049	0.042
525	We	45	3.6	0.42	0.16	0.055	0.043
530	We	64	6.0	0.47	0.44	0.063	0.073
531	We	56	4.8	0.44	0.23	0.057	0.048
601	Wd	21	5.0	0.78	0.38	0.109	0.076
606	We	55	7.0	0.60	0.49	0.068	0.070
607	We	37	5.7	0.60	0.27	0.074	0.048
608	Wd	26	6.0	0.80	0.23	0.101	0.038

1 Weekday (Wd) or Weekend/Holiday (We).
2 Sample size, number of anglers interviewed.
3 Standard Error.
4 Harvvest Per Unit Effort (HPUE).

Appendix Table B3. Daily summary statistics for fishing effort and chinook salmon harvest for anglers interviewed at Deep Creek, 1987.

Date	Wd/ We[1]	Effort (hrs) SS[2]	Effort (hrs) Mean	Effort (hrs) SE[3]	Chinook Salmon Harvest Mean	Chinook Salmon Harvest SE[3]	Chinook Salmon Harvest HPUE[4]
523	We	9	3.7	1.18	0.00	0.000	0.000
524	We	7	7.4	1.45	0.00	0.000	0.000
525	We	4	0.8	0.14	0.00	0.000	0.000
530	We	10	4.8	1.14	0.10	0.100	0.021
531	We	7	5.1	0.83	0.29	0.184	0.056
601	Wd	5	3.5	1.63	0.00	0.000	0.000
606	We	10	6.5	0.90	0.30	0.153	0.047
607	We	35	4.1	0.42	0.49	0.095	0.120
608	Wd	27	3.8	0.51	0.30	0.090	0.077
613	We	53	5.7	0.77	0.64	0.072	0.114
614	We	48	4.2	0.33	0.21	0.059	0.050
615	Wd	30	5.0	0.43	0.50	0.093	0.100
620	We	43	3.6	0.32	0.37	0.082	0.104
621	We	46	3.6	0.29	0.30	0.069	0.084
622	Wd	21	5.5	1.54	0.24	0.095	0.043

1 Weekday (Wd) or Weekend/Holiday (We).
2 Sample size.
3 Standard error.
4 Harvest Per Unit Effort (HPUE).

Appendix Table C1. Escapement counts of chinook salmon on Anchor River, Deep Creek, and Ninilchik River, 28 July 1987.

Stream	Survey Type	Index Area[1]		Remainder of Stream	
		Live	Dead	Live	Dead
Anchor River					
	Ground	285	68		
	Helicopter	199	20	1,954	351
Deep Creek					
	Ground	98	4		
	Helicopter	54	5	807	102
Ninilchik River					
	Ground	162	77		
	Helicopter	156	53	224	90

1 Anchor River: Old Sterling Highway bridge upstream to New Sterling Highway Bridge (approximately 5 miles).
Deep Creek: Sterling Highway bridge upstream approximately 4 miles to spot marked each year with survey tape.
Ninilchik River: Sterling Highway bridge upstream apprxoimately 2.5 miles to unnamed bridge.

Appendix Table D1. Estimated age and sex composition of the chinook salmon harvest from three southern Kenai Peninsula streams, 1987.

Component	Age Group						
	1.1	1.2	1.3	1.4	1.5	2.3	Total
Anchor River (n = 84)							
Males							
Percent	1.2	7.1	21.4	16.7	0.0	0.0	46.4
Number	9	51	153	120	0	0	333
Females							
Percent	0.0	0.0	29.8	23.8	0.0	0.0	53.6
Number	0	0	213	170	0	0	383
Sexes Combined							
Percent	1.2	7.1	51.2	40.5	0.0	0.0	100.0
Number	9	51	366	290	0	0	716
Standard Error	9	21	54	48	0.0	0.0	
Deep Creek (n = 98)							
Males							
Percent	3.1	11.2	19.4	7.1	0.0	0.0	40.8
Number	24	89	153	56	0	0	322
Females							
Percent	1.0	0.0	21.4	35.8	0.0	1.0	59.2
Number	8	0	170	282	0	8	468
Sexes Combined							
Percent	4.1	11.2	40.8	42.9	0.0	1.0	100.0
Number	32	89	323	338	0	8	790
Standard Error	16	27	52	54	0	8	
Ninilchik River (n = 91)							
Males							
Percent	1.1	2.2	25.3	17.6	1.1	0.0	47.3
Number	13	25	291	201	13	0	543
Females							
Percent	0.0	0.0	23.0	29.7	0.0	0.0	52.7
Number	0	0	265	341	0	0	606
Sexes Combined							
Percent	1.1	2.2	48.3	47.3	1.1	0.0	100.0
Number	13	25	556	543	0	0	1,150
Standard Error	13	18	82	81	13	0.0	