Fishery Data Series No. 95-22

Surveys of the Chinook and Coho Salmon Sport Fisheries in the Kanektok River, Alaska 1994

by

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and

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Alaska Department of Fish and Game

Division of Sport Fish

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
ounce	oz
pound	lb
quart	qt
yard	yd

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
id est (that is)	i.e.,
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

alternate hypothesis	H_A
base of natural logarithm	e
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	F, t, χ^2, etc.
confidence interval	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	*FL*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
mideye-to-fork	MEF
minute (angular)	'
multiplied by	x
not significant	NS
null hypothesis	H_O
percent	*%*
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
standard length	SL
total length	TL
variance	Var

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ABSTRACT

During the summer of 1994, surveys were conducted on the chinook salmon *Oncorhynchus tshawytscha* and coho salmon *Oncorhynchus kisutch* sport fisheries that occur along the lower 16 km of the Kanektok River of southwestern Alaska. The chinook salmon fishery survey was conducted 19 June through 19 July. The coho salmon fishery survey began 5 August and ended on 23 August.

During the chinook salmon fishery 787 anglers were interviewed, 75% (SE = 2%) of the angler-trips caught one or more chinook salmon, and 39% (SE = 2%) of the trips resulted in harvest of one or more chinook salmon. Thirty-six percent, 2%, and 1% of the angler-trips resulted in daily harvest of 1, 2, and 3 chinook salmon, respectively. The daily bag limit was reduced to one chinook salmon per day on 23 June, probably affecting the distribution of harvest. Sixty-eight percent (SE = 2%) of the lower Kanektok River angler-trips were unguided, 76% (SE = 2%) were not residents of Alaska, and tackle used was roughly one-third exclusively spin gear, one-third spin and bait combined, and one-third exclusively fly fishing gear.

During the coho salmon fishery 585 anglers were interviewed, 97% (SE = 1%) of the angler-trips caught one or more coho salmon, and 34% (SE = 2%) of the trips resulted in harvest of one or more coho salmon. Six percent, 6%, 4%, 4%, and 15% of the angler-trips resulted in daily harvests of 1, 2, 3, 4, and 5 coho salmon, respectively. Unguided anglers made 48% (SE = 2%) of the trips and non-Alaskan residents made 90% (SE = 1) of the trips. The majority of angler-trips used spin gear (28%, SE = 2%) or fly fishing gear (59%, SE = 2%).

Results of the 1994 survey were compared to those from similar surveys conducted in 1991. The distribution of catch and harvest was similar between 1991 and 1994 except that more angler-trips harvested four or more coho salmon in 1994. The percentages of guided and unguided trips varied between surveys but in no clear direction. Both the 1991 and 1994 surveys found that a majority (76%-90%) of angler-trips were made by non-Alaskan residents.

Key words: Chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, sport fishing, sport harvest, sport catch, creel survey, fishery survey, angler success, bag limit, guided anglers, unguided anglers, gear type, terminal tackle, Kanektok River, Kuskokwim Bay, Togiak National Wildlife Refuge.

INTRODUCTION

The Kanektok River, located 70 miles south of the community of Bethel in the Togiak National Wildlife Refuge, is well known for its diverse sport fisheries (Figure 1). Besides supporting an abundance of rainbow trout *Oncorhynchus mykiss*, Arctic grayling *Thymallus arcticus*, and Dolly Varden *Salvelinus malma*, the Kanektok River also sustains major runs of all five species of North American Pacific salmon *Oncorhynchus*. Anglers have been fishing this river in significant numbers since 1983 when estimates of sport effort on the Kanektok River first appeared in the Statewide Harvest Survey (Mills 1984). The Kanektok River salmon runs have also provided subsistence and commercial harvests for residents of the community of Quinhagak and the Kuskokwim Bay area. Tables 1 and 2 summarize harvests by the various groups as well as indices of escapement and total run estimates for chinook and coho salmon in the Kanektok River.

The lower 16 km of the Kanektok River have become a popular destination for anglers seeking chinook *O. tshawytscha* and coho *O. kisutch* salmon. The fishery experienced rapid growth in the 1980s with effort estimates for the whole river increasing from 1,517 angler-days in 1983 to 12,697 angler-days in 1988 (Mills 1984-1989). Since 1989 effort has ranged between 3,000 and 5,000 angler-days (Mills 1990-1994). Recreational angling effort for Kanektok River chinook salmon may approach 2,000 angler-days annually while the coho salmon fishery may support 1,000 annual angler-days of effort.

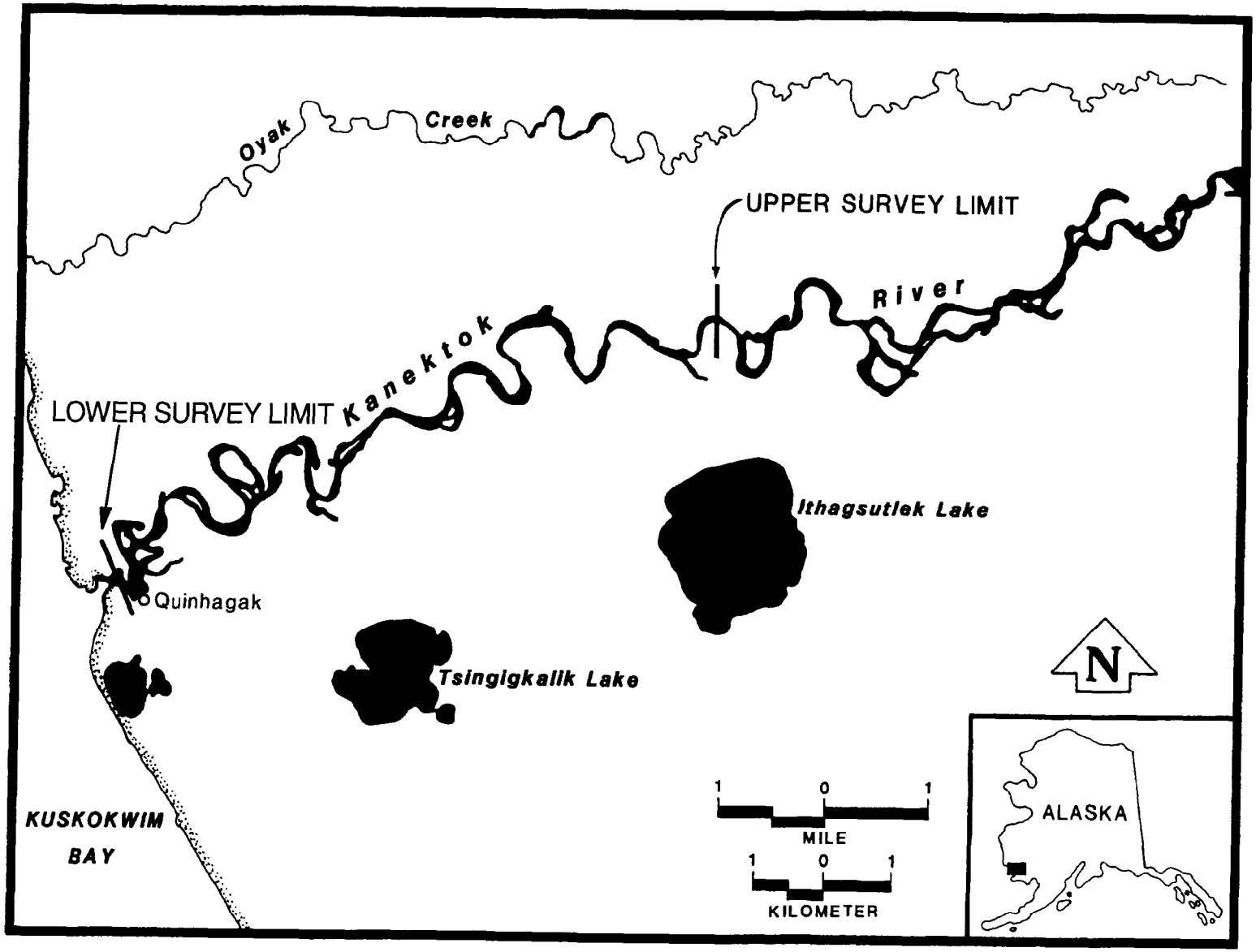

Figure 1.-Location of the 1994 chinook and coho salmon fishery surveys on the lower Kanektok River.

Table 1.-Chinook salmon commercial, subsistence, and sport harvest plus escapement for the Kanektok River, 1960 to 1994.

Year	Harvest				Escapement[c]	Total[d]
	Commercial[a]	Subsistence[a]	Sport[b]	Total	Index	Run
1960	0			0	6,047	6,047
1961	4,328			4,328		4,328
1962	5,526			5,526	935	6,461
1963	6,555			6,555		6,555
1964	4,081			4,081		4,081
1965	2,976			2,976		2,976
1966	278			278	3,718	3,996
1967	0	1,349		1,349		1,349
1968	8,879	2,756		11,635	4,170	15,805
1969	16,802			16,802		16,802
1970	18,269			18,269	4,112	22,381
1971	4,185			4,185		4,185
1972	15,880			15,880		15,880
1973	14,993			14,993	814	15,807
1974	8,704			8,704		8,704
1975	3,928			3,928		3,928
1976	14,110			14,110		14,110
1977	19,090	2,012		21,102	5,787	26,889
1978	12,335	2,328		14,663	19,180	33,843
1979	11,144	1,420		12,564		12,564
1980	10,387	1,940		12,327	6,172	18,499
1981	24,524	2,562		27,086	15,900	42,986
1982	22,106	2,402		24,508	8,142	32,650
1983	46,385	2,542	1,511	50,438	8,890	59,328
1984	33,652	3,109	922	37,683	12,182	49,865
1985	30,401	2,341	667	33,409	13,465	46,874
1986	22,835	2,682	844	26,361	3,643	30,004
1987	26,022	2,663	375	29,060	4,223	33,283
1988	13,872	2,508	1,910	18,290	11,140	29,430
1989	20,820	3,048	884	24,752	7,914	32,666
1990	27,644	5,050	503	33,197	2,563	35,760
1991	9,480	3,536	316	13,332	2,100	15,432
1992	17,197	2,545	656	20,398	3,856	24,254
1993	15,784	2,726	1,006	19,516	4,670	24,186
All Years Average	14,505	2,606	872	17,984	6,801	24,785
Percent	81%	14%	5%			
1989 to 1993 5 Year Avg	18,185	3,381	673	22,239	4,221	26,460
Percent	82%	15%	3%			
1994	8,564	3,000	600	12,164	7,386	19,550
Percent	70%	25%	5%			

[a] Commercial and subsistence harvest from Francisco et al. (1995). Commercial catches from 1990-1994 are preliminary. Subsistence harvest estimate for 1994 is preliminary.

[b] Sport harvest estimates from Mills (1979-1994). Sport harvest estimate for 1994 is preliminary.

[c] Unexpanded raw counts made from fixed-wing aircraft (July 20 to August 5).

[d] Considered a minimum number since escapement estimates are unexpanded.

Table 2.-Coho salmon commercial, subsistence, and sport harvest plus escapement for the Kanektok River, 1983 to 1994.

	Harvest				Escapement	Total
Year	Commercial[a]	Subsistence[a]	Sport[b]	Total	Index	Run
1983	32,442		367	32,809		
1984	135,342		1,895	137,237	46,830	184,067
1985	29,992		622	30,614		
1986	57,544		1,680	59,224		
1987	50,070		2,300	52,370	20,056	72,426
1988	68,591	2,933	1,837	73,361		
1989	44,607	3,346	1,096	49,049	1,755	50,804
1990	26,926	3,510	644	31,080		
1991	42,571	2,901	358	45,830	4,330	50,160
1992	86,404	2,172	275	88,851		
1993	55,817	1,381	734	57,932		
All Years						
Average	57,301	2,707	1,073	61,081	18,243	79,324
Percent	94%	4%	2%			
1989 to 1993						
5 Year Avg	51,265	2,662	621	54,548	3,043	57,591
Percent	94%	5%	1%			
1994 [a]	83,912	3,000	1,000	87,912	No Estimate	
Percent	95%	3%	1%			

[a] Commercial and subsistence harvest from Francisco et al. (1995). Commercial catches from 1990-1994 are preliminary. Subsistence harvest estimate for 1994 is preliminary.

[b] Sport harvest estimates from Mills (1979-1994). Sport harvest estimate for 1994 is preliminary.

Estimated sport harvests of chinook salmon have ranged from 316 in 1991 (Mills 1992) to 1,910 in 1988 (Mills 1989). Estimated sport harvests of coho salmon have ranged from 275 fish in 1992 (Mills 1993) to 2,300 in 1987 (Mills 1988).

The growth of the Kanektok River sport fisheries caused the Alaska Board of Fisheries to reduce bag limits in 1985 from 15 salmon per day of all species to five chinook salmon and 10 salmon of other species per day (ADF&G 1985). The bag limit on chinook salmon was further reduced to three per day, only two of which could exceed 71 mm (28 in) in length in 1988 (ADF&G 1988). The rapid growth of the sport fishery and concerns of the residents of Quinhagak lead the department to conduct onsite creel surveys on the Kanektok River in 1985, 1986 and 1987 (Alt 1986, Minard 1987, Minard and Brookover 1988). Beginning in 1991, the Kanektok River chinook and coho salmon sport fisheries have been included in the department's program of routinely monitoring important salmon fisheries in the Bristol Bay management area on a 3-year rotation.

Recent Kanektok River sport fisheries have not been as controversial as they were in the 1980s, and they are growing in popularity. Local residents are again voicing concerns over renewed yet extremely gradual increases in sport angler activities on the river. However, recent estimates of angling effort remain far below peak use levels recorded in 1986 through 1988 (Mills 1987-1994). At the same time, angling opportunities may increase through the issuance of additional commercial use permits by the Togiak National Wildlife Refuge or through creation of local businesses catering to sport anglers.

Estimates of commercial and subsistence harvests of Pacific salmon for the Kanektok River from 1960-1993 were reported by Francisco (1995). Sport fishery statistics have been reported by Snellgrove (*Unpublished*), Alt (1986), Minard (1987), Minard and Brookover (1988), and Dunaway and Bingham (1992).

Objectives for the 1994 surveys of the recreational chinook and coho salmon fisheries in the lower Kanektok River were to:

1. Estimate the distribution of catch and harvest success among chinook and coho salmon anglers by angler-day.
2. Estimate the contributions to the total harvest by each fish in anglers' daily bags during the chinook and coho salmon sport fisheries.[1]
3. Estimate the percentage of angler-trips by terminal tackle type (flies, bait, or lures) and angler type (residency, guided or unguided, chartered or unchartered, and outfitted or not outfitted) in the chinook and coho salmon sport fisheries.
4. Estimate the age and sex composition of chinook and coho salmon harvested by the sport fisheries.
5. Estimate the mean length-at-age and weight-at-age of chinook and coho salmon harvested by the sport fishery.

METHODS

STUDY LOCATION AND DATES

The survey of the lower Kanektok River chinook salmon sport fishery was conducted along the lower Kanektok River from the village of Quinhagak to a point approximately 16 km upstream during the period from 19 June to 19 July 1994. A coho salmon fishery survey was conducted on the same

[1] The contributions to the total harvest of each fish in anglers' daily bags is defined as the percentage of total harvest due to each successive fish in the anglers' daily bag. For example the proportion of total harvest due to the first fish in all anglers' daily bag is one such percentage.

16 km section of the river from 5 August to 23 August 1994.

Study Design and Data Collection

Angler Interviews

Bernard et al. (*In prep*) reported that fishery attributes such as composition of the harvest and distribution of catch and harvest can be estimated without stratification, stratum weights, stages, or sample weights if the sampling is self-weighting. Self-weighting, in this case, implies that sampling is conducted such that an equal fraction of the anglers are interviewed on a given sample day and an equal fraction will be interviewed throughout the fishing season.

Self-weighted roving surveys conducted on a systematic sampling schedule formed the basis of the surveys. During the study period at each site, survey technicians worked 5-day weeks (Friday-Tuesday), spending 7 hours per day interviewing sport anglers and sampling harvested chinook and coho salmon. One survey technician conducted the 1994 lower Kanektok River surveys. On each sampling day the survey technician made up to three passes through the fishery in order to contact every angler fishing in the survey site during the 7-hour sampling period.

The schedule for collecting interviews and samples was selected to correspond to the peaks of the sport fisheries for chinook or coho salmon as determined by angler counts recorded at each site during previous surveys (Minard and Brookover 1988; Dunaway and Bingham 1992) In addition, the technician was allowed to select a different 7-hour sample period, if necessary, based on onsite observations of the fishery. However, when selecting or altering the 7-hour portion of the day to sample and the daily sampling schedule, the technician was instructed to be aware that the most important criteria for these surveys was to assure that a consistent proportion of all angler-trips were sampled within each day, within each week, and within the season. The daily survey period was initially established from 1000 hours to 1700 hours; after 28 June, the period 1200 hours to 1900 hours was found to be a more effective schedule for obtaining completed-trip interviews.

Anglers encountered in the fishery were asked the number and species of fish they had kept and released during that day. At the same time, the anglers were asked if they were guided or unguided; whether they chartered an air taxi to get to the fishing area; whether they had rented any equipment for their trip; and what type of terminal tackle they used. Guided anglers were defined as having all the benefits of a full service guide: food and lodging, air and boat field transportation, with all fishing equipment provided. Outfitted anglers were defined as unguided anglers who rented some or all major equipment to conduct the trip such as camping, boating, or fishing equipment. Chartered, unguided anglers were defined as those who chartered the services of an air taxi (versus using scheduled airline flights) or boats, or both, for transport to their fishing site. Anglers were also requested to provide some general demographic information.

Both completed-trip angler interviews (anglers who have suspended fishing for the day) and incompleted-trip interviews were conducted by the technician as she passed through the fishery. To augment the number of completed-trip interviews, all incompleted-trip anglers encountered were asked to provide their completed-trip information on a voluntary angler report card (Figure 2). Card collection boxes were placed at popular

ALASKA DEPT. FISH & GAME

PLEASE WRITE THE NUMBER OF FISH YOU KEPT AND RELEASED TODAY (00:00 AM TO 23:59 PM).

Time you began fishing _____ Time you quit _____

	Kept	Released	office use
			Date _____
King Salmon	_____	_____	
			Page #_____
Coho Salmon	_____	_____	
			Line #_____
Rainbow Trout	_____	_____	Initials_____

OTHER SPECIES, COMMENTS

Figure 2.-The voluntary angler report card.

locations throughout the fishery and in each guide camp.

Biological Sampling of Harvested Fish

Sport-harvested chinook and coho salmon encountered during the angler interview portion of the survey were measured to the nearest millimeter for mid-eye to fork-of-tail length, and sex was identified from external characteristics. Chinook salmon were weighed to the nearest 0.5 kilogram and coho salmon were weighed to the nearest 10 grams.

For each salmon sampled, three or four scales were collected and placed on labeled and numbered adhesive coated cards (scale cards). The scales were removed from the left side of the fish from a point along a diagonal line from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin, and two rows of scales above the lateral line (Welander 1940, Scarnecchia 1979). When the scales could not be obtained from the preferred area, three scales were taken from as close to the preferred area as possible. However, scales were only taken from the area bounded dorsally by the fourth row of scales above the lateral line, ventrally by the lateral line, and between lines drawn vertically from the posterior insertion of the dorsal fin and the anterior insertion of the anal

fin. When no scales were available in the preferred area on the left side of the fish, scales were collected from the preferred area on the right side of the fish.

The completed scale cards were pressed against acetate cards in a heated hydraulic press and the resulting scale impressions displayed on a microfiche projector for age determination. Age determination from the collected scales followed Lux (1971). For salmon, the numeral preceding the decimal is the number of freshwater annuli, whereas the numeral following the decimal is the number of marine annuli (European method). Total age from brood year is the sum of the two numerals plus one.

Data Analysis

Combining Data from Interviews and Cards

Analysis of angler success required data from completed fishing trips. Completed-trip data were available from two sources: (1) anglers who had completed their fishing prior to being interviewed onsite; and (2) anglers who were issued voluntary report cards and returned them. We conducted a series of tests in order to determine if and how data from the two sources could be validly pooled to estimate angler success parameters (Appendix A1). These tests found that angler success differed between onsite completed-trip interviews and returned cards, and that the proportion of cards returned varied over the course of the season. Therefore, to estimate angler success and harvest analysis parameters, data from returned cards were weighted to reflect the number of cards issued (rather than the number of cards returned), before being combined with onsite interview data. Since card return rate (and therefore the appropriate weighting factor) changed with time, this procedure was carried out by week (Appendix A1).

Angler Success

In order to characterize the success of anglers seeking chinook and coho salmon, we estimated the proportion of anglers catching 0 fish, 1 or more fish, 2 or more fish, etc. We also estimated the proportion of anglers harvesting 0 fish, 1 or more fish, 2 or more fish, etc. Procedures detailed in Appendix A1 were used with data from completed-trips only to estimate these proportions and their standard errors.

Some anglers did not return voluntary report cards, and in general these anglers had caught and kept more fish at time of interview than anglers who were issued cards and returned them. Therefore angler success estimates may be biased slightly low (Appendix A1).

Harvest Analysis

In order to assess the possible effects of a changing bag limit on the fishery, it was useful to estimate the proportion of the total harvest contributed by the first fish in anglers' daily bag, the second fish in anglers' daily bags, etc. Procedures from Appendix A1 were used with data from completed-trips only to estimate these proportions and their standard errors.

Angler Characteristics

Information on angler characteristics (guided vs. chartered vs. outfitted, use of lures vs. flies) was obtained from anglers in-person during onsite interviews. Therefore data from all interviews could be used regardless of whether anglers had completed their fishing trip. Given the self-weighted nature of the survey design, proportions of angler-trips[2] in the above categories were estimated as if the interview information was collected as a simple random sample of the fishery. That is,

[2] Since each interview represented information collected from one angler during one trip to the surveyed fishery, the proportions estimated by equation (1) are for angler-trips, not anglers.

the estimated proportion of angler-trips with characteristic k was calculated as

$$\hat{p}_k = \frac{m_k}{m}, \quad (1)$$

where m_k equals the number of angler-trips having characteristic k, and m equals the total number of angler-trips.

The variance of the estimate of p_k followed Cochran (1977:52):

$$\hat{Var}(\hat{p}_k) = \frac{\hat{p}_k(1-\hat{p}_k)}{m-1}. \quad (2)$$

Standard errors were obtained by taking the square root of the variance estimates.

Age by Sex Composition of the Harvest

Age composition (overall and by sex) were estimated for each fishery. Each proportion and its variance was calculated according to equations 1 and 2, above. In applying equations 1 and 2, the individual age by sex categories defined the "k" categories, and the numbers of fish sampled were used in lieu of the number of angler-trips.

Mean Length-at-Age and Weight-at-Age

Estimates of mean (and associated standard error) length and weight of chinook and coho salmon sampled from the sport harvest were calculated, by age group, following standard procedures.

Assumptions

The degree to which the above parameter estimates were unbiased depends on the following untested assumptions.

1. The number of angler interviews conducted onsite represent a consistent proportion of all angler-trips throughout the progress of each fishery.
2. The number of harvested fish by species sampled represent a consistent proportion of all fish harvested throughout the progress of each fishery or the true values of the parameters to be estimated do not vary during the progression of the fishery (e.g., mean length-at-age is constant throughout the season).
3. Anglers accurately report the number of fish released by species.
4. Anglers who return report cards accurately report their harvest of fish by species.

Regarding assumptions 1 and 2, systematic sampling of the fishery should have resulted in a consistent proportion of angler-trips interviewed. The technicians onsite were instructed to periodically evaluate their ability to interview all anglers fishing during the daily 7-hour sampling periods. Technicians attempted to take measurements on every contacted angler's creel in order to sample a consistent proportion of the harvest. Regarding assumptions 3 and 4, anglers were expected to have a good recollection of the number of fish caught and harvested by species (at least for the two species of concern). Note that anglers interviewed onsite had their creel inspected by the survey technicians, and as such there is no need to assume that the numbers of fish harvested by species for onsite interviews would be incorrect.

RESULTS

CHINOOK SALMON FISHERY

Angler Success

During the chinook salmon fishery survey on the lower Kanektok River, 787 angler interviews were conducted. Only 318 anglers (40%) were interviewed after they had completed their fishing for the day (onsite completed-trip interviews) while the remaining 469 anglers were issued voluntary angling report cards. Of the cards issued, 348 or 74% were properly completed and returned (card completed-trip interviews) to provide a total of 666 completed-trip interviews for the analysis of angler success (Table 3).

Table 3.-Summary of completed-trip angler interviews, by type, collected from the lower Kanektok River chinook salmon sport fishery, 19 June through 19 July 1994.

		Interview		Hours	Chinook Salmon			
Date	Week	Number	Type[a]	Fished	Catch/Hour	Catch[b]	Kept	Released
6/19/94	25	13	Card	116.08	0.8	91	38	69
6/20/94	25	6	Card	70.5	0.7	48	6	42
6/20/94	25	9	Onsite	78.5	1.1	85	3	82
6/21/94	25	12	Card	71.5	1.3	93	13	80
6/24/94	25	26	Card	143.28	1.2	176	15	161
6/24/94	25	2	Onsite	8	0.3	2	0	2
6/25/94	26	33	Card	275.16	1.4	392	24	368
6/25/94	26	16	Onsite	113.5	1.0	116	14	102
6/26/94	26	32	Card	245.91	1.3	312	16	296
6/26/94	26	13	Onsite	116	1.7	194	5	189
6/27/94	26	20	Card	160.5	0.8	126	11	115
6/27/94	26	11	Onsite	35	1.6	55	8	47
6/28/94	26	20	Card	169	0.7	123	17	106
6/28/94	26	9	Onsite	62	0.7	45	5	40
7/1/94	26	17	Card	181.5	0.8	141	10	131
7/1/94	26	13	Onsite	79	0.7	58	12	46
7/2/94	27	22	Card	214.5	0.9	189	15	174
7/2/94	27	13	Onsite	61.5	0.4	26	2	24
7/3/94	27	13	Card	96.25	0.4	36	2	34
7/3/94	27	24	Onsite	111.75	0.8	91	17	74
7/4/94	27	29	Card	199.67	0.5	93	16	77
7/4/94	27	6	Onsite	37	0.3	10	2	8
7/5/94	27	5	Card	46.25	0.9	41	4	37
7/5/94	27	18	Onsite	129.25	0.4	46	6	40
7/8/94	27	19	Card	117.82	0.5	54	6	48
7/8/94	27	15	Onsite	95	0.1	11	0	11
7/9/94	28	15	Card	139.5	0.4	57	1	56
7/9/94	28	11	Onsite	49.5	0.6	28	5	23
7/10/94	28	34	Card	290	0.3	74	6	68
7/10/94	28	18	Onsite	91.08	0.3	29	0	29
7/11/94	28	8	Card	83.5	0.4	35	0	35
7/11/94	28	11	Onsite	85.5	0.4	37	1	36
7/12/94	28	9	Card	75	0.7	53	0	53
7/12/94	28	10	Onsite	73.58	0.2	18	2	16
7/15/94	28	6	Card	67.75	0.3	17	0	17
7/15/94	28	53	Onsite	359.14	0.2	73	7	66
7/16/94	29	7	Card	58.5	0.1	3	0	3
7/16/94	29	17	Onsite	79.5	0.5	41	1	40
7/17/94	29	2	Card	8	0.0	0	0	0
7/17/94	29	16	Onsite	131.34	0.2	20	2	18
7/18/94	29	19	Onsite	130.5	0.1	19	0	19
7/19/94	29	14	Onsite	130.25	0.1	11	0	11
Total		348	Card	2,830.17	0.8	2,154	200	1,970
Total		318	Onsite	2,056.89	0.5	1,015	92	923
Overall	Total	666	ALL	4,887.06	0.6	3,169	292	2,893

[a] Type: Onsite interviews were collected from anglers who had completed their daily fishing before being interviewed. Card interviews are the result of incompleted-trip interviews later completed with data from returned voluntary angler report cards.

[b] Catch = fish kept + fish released.

Chinook salmon fishing was good during the study period with 75% (SE = 1.5%) of the angler-trips resulting in a catch of at least one fish (Table 4, Figure 3). Thirty-nine percent (SE = 1.7%) of the angler-trips had catches of five or more chinook salmon and 15% (SE = 1.4%) of the trips produced 10 or more fish in a day of fishing (Table 4, Figure 3). Though catch success was good, almost 61% (SE = 1.7%) of the interview pool kept no fish. An estimated 39% (SE = 1.7%) of the angler-trips harvested one or more chinook salmon (Table 4, Figure 3). Most of the few angler-trips during which more than one chinook was harvested (3%, SE = 0.7%) occurred before the bag limit was reduced on 23 June.

Harvest Analysis

Thirty-six percent, 2%, and 1% of angler-trips resulted in harvest of 1, 2, and 3 chinook salmon per day, respectively (Table 5). The first fish harvested during each angler-trip accounted for nearly 90% (SE = 1.9%) of the total harvest, the second fish harvested contributed only 8% (SE = 1.3%), and only 3% (SE = 0.9%) of the total sport harvest was a result of the third fish taken (Table 5, Figure 4).

Percentages of Angler-trips by Angler Type and Gear Type

Of the 787 interviews conducted in the lower Kanektok River chinook salmon study, 32% (SE = 1.7%) of the anglers were guided, 76% (SE = 1.5%) were not Alaska residents and 16% (SE = 1.3%) were residents of some other country (Table 6). The 68% (SE = 1.7%) of unguided angler-trips included 16% (SE = 1.3%) of trips which were unguided and outfitted, and 19% (SE = 1.4%) of trips which were unguided and chartered (Table 6). See Methods for definitions of guided, outfitted, and chartered angler-trips.

The majority of lower Kanektok River anglers used spinning gear (30%, SE = 1.6%) or a combination of spinning gear with bait (30%, SE = 1.6%) (Table 6). A substantial 35% (SE = 1.7%) of the anglers used fly fishing gear exclusively.

Age, Length At Age, and Sex Composition of the Sport Harvest

While collecting angler interviews, the survey technicians also obtained samples from 128 chinook salmon harvested in the lower Kanektok River sport fishery (Table 7). The sport fishery harvested mainly age-1.3 (36%, SE = 4.3%) and age-1.4 (56%, SE = 4.4%) fish (Table 7). Males composed 58% (SE = 4.4%) of the harvest. The overall average length was 825 mm (32.5 in) (SE = 8 mm), and the mean weight was 10 kg (22 lb) (SE = 0.3 kg). The heaviest fish encountered in the sport harvest was a male that was 760 mm (30 in) in length and weighed 17.5 kg (38.5 lb).

Coho Salmon Fishery

Angler Success

During the 5-23 August survey of the coho salmon fishery on the lower Kanektok River, 585 angler interviews were conducted. Roughly 47%, or 273 anglers were interviewed after they had completed their fishing for the day (onsite completed-trip interviews) while the remaining 312 anglers were issued voluntary angling report cards (Table 8). Of the cards issued, 161 or 52% were properly completed and returned (card completed-trip interviews) to provide a total of 434 completed-trip interviews for the analysis of angler success (Table 8). Many coho salmon anglers also caught rainbow trout (Table 8).

Sport fishing for coho salmon was excellent during the study period with 97% (SE = 0.8%) of the angler-trips resulting in a catch of one or more fish (Table 9, Figure 5). Eighty-three percent (SE = 1.6%) of the angler-trips produced catches of five or more coho salmon and 61% (SE = 2.3%) of the trips produced 10 or more fish during a day of fishing (Table 9, Figure 5).

Table 4.-Distribution of angler catch and harvest success during the chinook salmon sport fishery on the lower Kanektok River, 19 June through 19 July 1994.

CATCH

Number of fish	Cards Returned	Weighted Cards	Onsite Interviews	Pooled Interviews	Estimated Percent Angler-Trips	Standard Error (%)	90% Confidence Interval Lower		Upper
0	68	88.1	109	197.1	25.0	1.5	22.5	-	27.6
1 +	280	380.9	209	589.9	75.0	1.5	72.4	-	77.5
2 +	247	334.2	152	486.2	61.8	1.7	58.9	-	64.6
3 +	226	304.9	121	425.9	54.1	1.8	51.2	-	57.0
4 +	192	258.6	96	354.6	45.1	1.8	42.1	-	48.0
5 +	171	230.2	77	307.2	39.0	1.7	36.2	-	41.9
6 +	153	205.3	62	267.3	34.0	1.7	31.2	-	36.8
7 +	133	178.9	46	224.9	28.6	1.6	25.9	-	31.3
8 +	109	146.3	33	179.3	22.8	1.6	20.2	-	25.3
9 +	94	126.7	28	154.7	19.7	1.5	17.2	-	22.1
10 +	73	98.8	23	121.8	15.5	1.4	13.2	-	17.8
11 +	66	89.2	19	108.2	13.7	1.3	11.6	-	15.9
12 +	58	77.9	17	94.9	12.1	1.3	10.0	-	14.1
13 +	51	68.5	15	83.5	10.6	1.2	8.6	-	12.6
14 +	44	59.1	12	71.1	9.0	1.1	7.2	-	10.9
15 +	40	53.8	12	65.8	8.4	1.1	6.6	-	10.2
16 +	35	46.7	11	57.7	7.3	1.0	5.6	-	9.0
17 +	27	36.2	8	44.2	5.6	0.9	4.1	-	7.1
18 +	23	31.2	7	38.2	4.8	0.9	3.4	-	6.3
19 +	22	29.8	7	36.8	4.7	0.8	3.3	-	6.1
20 +	22	29.8	7	36.8	4.7	0.8	3.3	-	6.1
21 +	19	25.6	7	32.6	4.1	0.8	2.8	-	5.4
22 +	12	16.4	6	22.4	2.8	0.7	1.8	-	3.9
23 +	9	12.2	6	18.2	2.3	0.6	1.3	-	3.3
24 +	9	12.2	4	16.2	2.1	0.6	1.1	-	3.0
25 +	7	9.0	3	12.0	1.5	0.5	0.7	-	2.3
26 +	5	6.4	2	8.4	1.1	0.4	0.4	-	1.7
27 +	5	6.4	2	8.4	1.1	0.4	0.4	-	1.7
28 +	5	6.4	2	8.4	1.1	0.4	0.4	-	1.7
29 +	4	5.1	2	7.1	0.9	0.4	0.3	-	1.5
30 +	3	3.8	2	5.8	0.7	0.3	0.2	-	1.3
Totals	348	469	318	787					

HARVEST

Number of Fish	Cards	Weighted Cards	Interviews	Pooled	Estimated Percent Angler-Trips	Standard Error	90% Confidence Interval Lower		Upper
0	189	248.6	228	476.6	60.6	1.7	57.7	-	63.4
1 +	159	220.4	90	310.4	39.4	1.7	36.6	-	42.3
2 +	18	24.5	2	26.5	3.4	0.7	2.3	-	4.5
3 +	7	9.5	0	9.5	1.2	0.4	0.5	-	1.9
Totals	348	469.0	318	787.0					

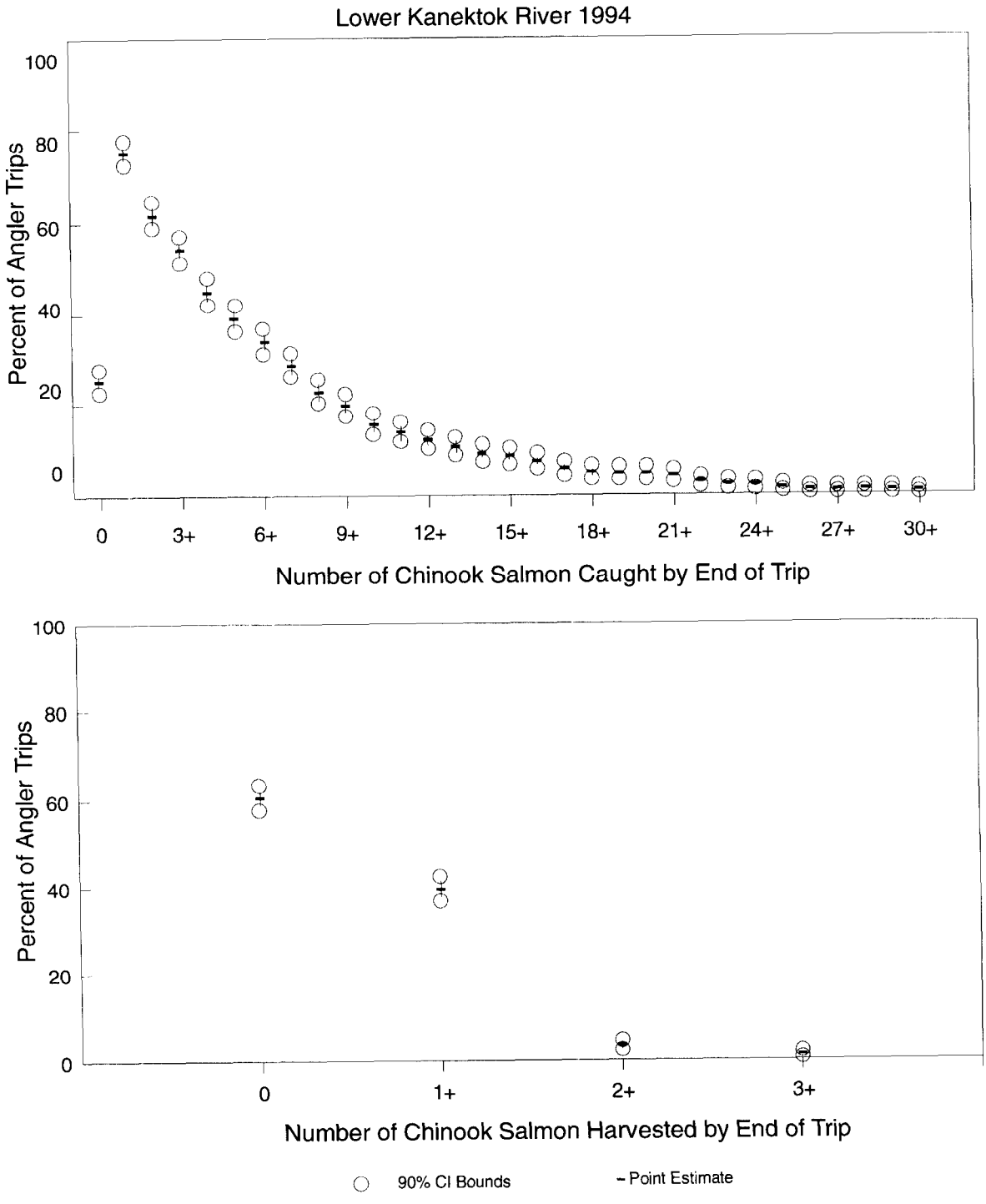

Figure 3.-Distribution of catch and harvest success in the lower Kanektok River chinook salmon sport fishery, 19 June through 19 July 1994.

Table 5.-Percent of angler-trips by number of fish kept and percent of harvest by sequence of fish harvested in the chinook salmon sport fishery on the lower Kanektok River, 19 June through 19 July 1994.

Fish Kept	Angler Trips (Pooled)	Percent of Trips	90% Confidence Interval			Sequence of Fish Harvested	Contribution to Total Harvest		
			SE (%)	Lower	Upper		Fish	Percent	SE (%)
0	476.6	60.6	1.7	57.8	- 63.4				
1	283.9	36.1	1.7	33.3	- 38.9	1st	311	89.9	1.9
2	17.0	2.2	0.6	1.2	- 3.2	2nd	26	7.5	1.3
3+	9.5	1.2	0.4	0.5	- 1.9	3rd +	9	2.6	0.9
Total	787						346		

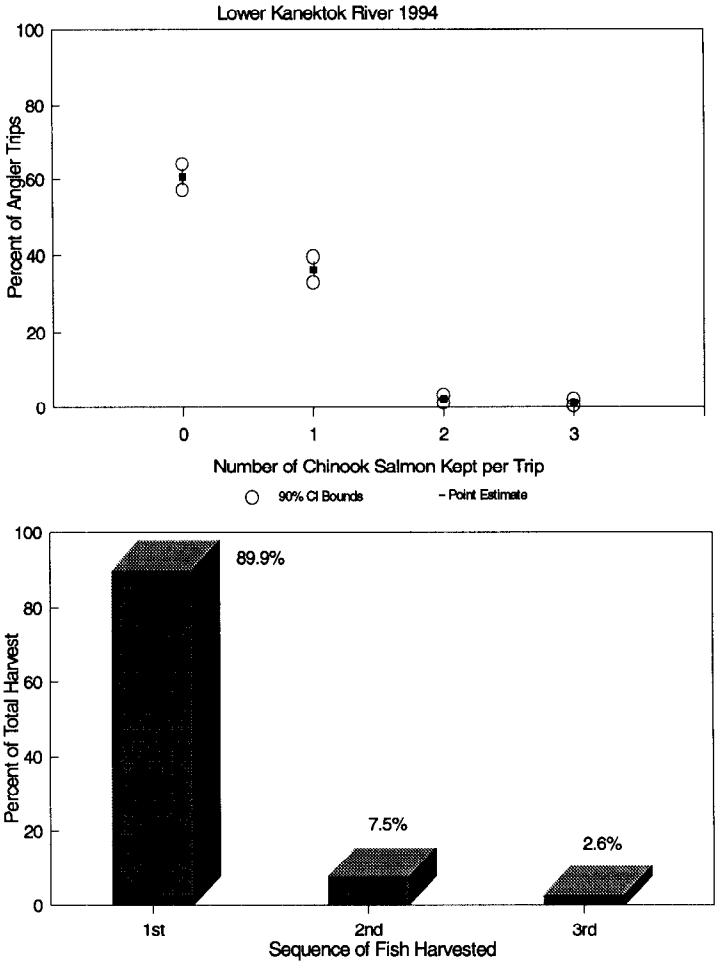

Figure 4.-Percent of angler trips by number of fish kept and percent of total harvest represented by the first, second or third fish taken among all anglers in the lower Kanektok River chinook salmon fishery, 19 June through 19 July 1994.

Table 6.-Number and percent of angler-trips by gear type and angler type during the chinook salmon sport fishery on the lower Kanektok River, 19 June through 19 July 1994.

Characteristic	Angler-trips	Percent	SE (%)
ANGLER TYPE			
Guided (assumes all services provided)	249	32	1.7
Unguided (all)	538	68	1.7
Unguided, Outfitted	126	16	1.3
Unguided, Chartered (boat or air taxi)	146	19	1.4
Alaskan Residents	186	24	1.5
Local Alaska Residents	13	2	0.5
Nonlocal Alaska Residents	173	22	1.5
Non-Alaskan Residents	601	76	1.5
U. S. Resident	476	60	1.7
Non-U. S. Residents	125	16	1.3
TACKLE TYPE			
Spin	236	30	1.6
Spin and Bait	236	30	1.6
Spin and Fly	32	4	0.7
Spin, Fly, and Bait	3	<1	0.2
Bait	3	<1	0.2
Fly	277	35	1.7
Total Angler Trips	787		

Table 7.-Mean lengths (mm) and weights (kg) of chinook salmon, by sex and age group, from samples collected from the sport harvest on the lower Kanektok River, 19 June to 11 July 1994.

	Age Group					
	UNKNOWN	1.2	1.3	1.4	1.5	TOTAL
FEMALES						
Percent			5.5	34.4	2.3	42.2
SE			2.0	4.2	1.3	4.4
Sample Size			7	44	3	54
Mean Length	647		814	879	884	871
SE			13.4	7.5	33.9	7.1
Sample Size	1		7	44	3	55
Mean Weight						
SE			0.4	0.3	0.9	0.3
Sample Size	1		5	40	3	49
MALES						
Percent		3.9	30.4	21.1	2.3	57.8
SE		1.7	4.1	3.6	1.3	4.4
Sample Size		5	39	27	3	74
Mean Length	690	571	763	871	954	793
SE	41.0	15.9	10.5	11.7	7.2	11.9
Sample Size	3	5	39	27	3	77
Mean Weight						
SE	0.9	0.2	0.4	0.5	0.3	0.4
Sample Size	3	4	32	23	3	65
ALL SAMPLES						
Percent		3.9	35.9	55.5	4.7	100.0
SE		1.7	4.3	4.4	1.9	
Sample Size		5	46	71	6	128
Mean Length	729	571	771	876	919	825
SE	48.7	15.9	9.5	6.4	21.9	8.2
Sample Size	4	5	46	71	6	132
Mean Weight						
SE	1.3	0.2	0.3	0.3	0.7	0.3
Sample Size	4	4	37	63	6	114

Table 8.-Summary of completed-trip angler interviews, by type, collected from the lower Kanektok River coho salmon sport fishery, 5 August through 23 August 1994.

		Interview		Hours	Coho Salmon				Rainbow Trout			
Date	Week	Number	Type[a]	Fished	Catch/Hour	Catch[b]	Kept	Released	Catch/Hour	Catch[b]	Kept	Released
8/5/94	31	1	Card	6.3	0.6	4	0	4	0.0	0	0	0
8/5/94	31	16	Onsite	101.0	1.2	121	5	116	0.0	0	0	0
8/6/94	32	16	Card	134.7	1.4	185	56	129	0.1	7	0	7
8/6/94	32	19	Onsite	99.8	0.8	77	2	75	0.0	1	0	1
8/7/94	32	10	Card	91.0	1.3	117	10	107	0.0	2	0	2
8/7/94	32	38	Onsite	237.8	2.3	552	2	550	0.0	5	0	5
8/8/94	32	8	Card	61.3	3.3	202	19	183	0.0	3	0	3
8/8/94	32	32	Onsite	237.8	3.2	760	0	760	0.0	8	0	8
8/9/94	32	48	Onsite	270.5	2.2	594	14	580	0.1	20	0	20
8/12/94	32	23	Onsite	147.8	2.5	369	64	305	0.0	1	0	1
8/13/94	33	13	Card	82.9	1.2	99	34	65	0.0	0	0	0
8/13/94	33	33	Onsite	186.3	1.5	271	10	261	0.1	18	0	18
8/14/94	33	31	Card	280.3	1.3	354	59	295	0.0	13	0	13
8/14/94	33	11	Onsite	40.3	1.1	46	0	46	0.0	1	0	1
8/15/94	33	9	Card	67.2	1.0	66	30	36	0.0	0	0	0
8/15/94	33	6	Onsite	16.3	2.2	35	0	35	0.0	0	0	0
8/16/94	33	22	Card	155.4	2.8	434	22	412	0.0	2	0	2
8/16/94	33	11	Onsite	84.3	2.3	192	0	192	0.2	19	0	19
8/19/94	33	8	Card	35.3	6.6	234	12	222	0.0	0	0	0
8/19/94	33	7	Onsite	42.8	3.5	149	2	147	0.4	18	0	18
8/20/94	34	11	Card	86.2	1.9	164	30	134	0.0	0	0	0
8/20/94	34	4	Onsite	23.0	1.7	38	12	26	0.0	0	0	0
8/21/94	34	19	Card	136.8	2.9	396	24	372	0.0	5	0	5
8/21/94	34	8	Onsite	29.1	2.3	66	7	59	0.0	0	0	0
8/22/94	34	11	Card	66.9	3.7	249	11	238	0.0	0	0	0
8/22/94	34	12	Onsite	31.6	4.1	128	8	120	0.0	0	0	0
8/23/94	34	2	Card	16.5	6.4	105	0	105	0.0	0	0	0
8/23/94	34	5	Onsite	22.5	1.1	25	0	25	0.0	0	0	0
Total		161	Card	1,220.6	2.1	2,609	307	2,302	0.0	32	0	32
Total		273	Onsite	1,570.5	2.2	3,423	126	3,297	0.1	91	0	91
Overall Total		434	ALL	2,791.1	2.2	6,032	433	5,599	0.0	123	0	123

[a] Type: Onsite interviews were collected from anglers who had completed their daily fishing before being interviewed. Card interviews are the result of incomplete interviews later completed with data from returned voluntary angler report cards.

[b] Catch = fish kept + fish released.

Table 9.-Distribution of angler catch and harvest success during the coho salmon sport fishery on the lower Kanektok River, 5 August through 23 August 1994.

CATCH

Number of Fish	Cards Returned	Weighted Cards	Onsite Interviews	Pooled Interviews	Estimated Percent Angler-Trips	Standard Error (%)	90% Confidence Interval Lower		Upper
0	4	6.5	12	18.5	3.2	0.8	1.8	-	4.5
1 +	157	305.5	261	566.5	96.8	0.8	95.5	-	98.2
2 +	156	303.7	241	544.7	93.1	1.1	91.3	-	94.9
3 +	150	293.3	229	522.3	89.3	1.4	87.0	-	91.5
4 +	149	292.0	214	506.0	86.5	1.5	84.1	-	88.9
5 +	145	282.7	204	486.7	83.2	1.6	80.5	-	85.9
6 +	132	257.7	178	435.7	74.5	2.0	71.1	-	77.8
7 +	124	246.2	165	411.2	70.3	2.1	66.8	-	73.8
8 +	121	241.4	163	404.4	69.1	2.2	65.6	-	72.7
9 +	107	218.8	150	368.8	63.0	2.3	59.3	-	66.7
10 +	102	208.4	147	355.4	60.8	2.3	56.9	-	64.6
11 +	93	192.6	130	322.6	55.1	2.4	51.2	-	59.1
12 +	88	184.3	125	309.3	52.9	2.4	49.0	-	56.8
13 +	81	171.0	99	270.0	46.2	2.4	42.3	-	50.1
14 +	74	156.7	97	253.7	43.4	2.4	39.4	-	47.3
15 +	71	149.3	89	238.3	40.7	2.4	36.7	-	44.7
16 +	63	134.1	76	210.1	35.9	2.4	32.0	-	39.9
17 +	58	121.6	71	192.6	32.9	2.4	28.9	-	36.9
18 +	50	103.3	67	170.3	29.1	2.4	25.2	-	33.1
19 +	50	103.3	60	163.3	27.9	2.4	24.0	-	31.8
20 +	48	98.7	58	156.7	26.8	2.4	22.9	-	30.7
21 +	43	88.3	50	138.3	23.6	2.3	19.9	-	27.4
22 +	39	80.3	47	127.3	21.8	2.2	18.1	-	25.4
23 +	39	80.3	39	119.3	20.4	2.2	16.8	-	24.0
24 +	36	74.5	35	109.5	18.7	2.1	15.2	-	22.2
25 +	36	74.5	33	107.5	18.4	2.1	14.9	-	21.8
26 +	27	56.5	27	83.5	14.3	1.9	11.1	-	17.4
27 +	26	53.7	25	78.7	13.4	1.9	10.4	-	16.5
28 +	25	50.9	24	74.9	12.8	1.8	9.8	-	15.8
29 +	24	49.1	23	72.1	12.3	1.8	9.3	-	15.3
30 +	22	46.1	23	69.1	11.8	1.8	8.9	-	14.7
Totals	161	312	273	585					

HARVEST

Number of Fish	Cards Returned	Weighted Cards	Onsite Interviews	Pooled Interviews	Estimated Percent Angler-Trips	Standard Error (%)	90% Confidence Interval Lower		Upper
0	82	165.6	222	387.6	66.3	2.4	62.3	-	70.2
1 +	79	146.4	51	197.4	33.7	2.4	29.8	-	37.7
2 +	68	124.0	37	161.0	27.5	2.3	23.7	-	31.3
3 +	56	104.9	21	125.9	21.5	2.2	17.9	-	25.1
4 +	50	93.9	11	104.9	17.9	2.1	14.5	-	21.3
5 +	41	78.5	6	84.5	14.5	2.0	11.2	-	17.7
Totals	161	312	273	585					

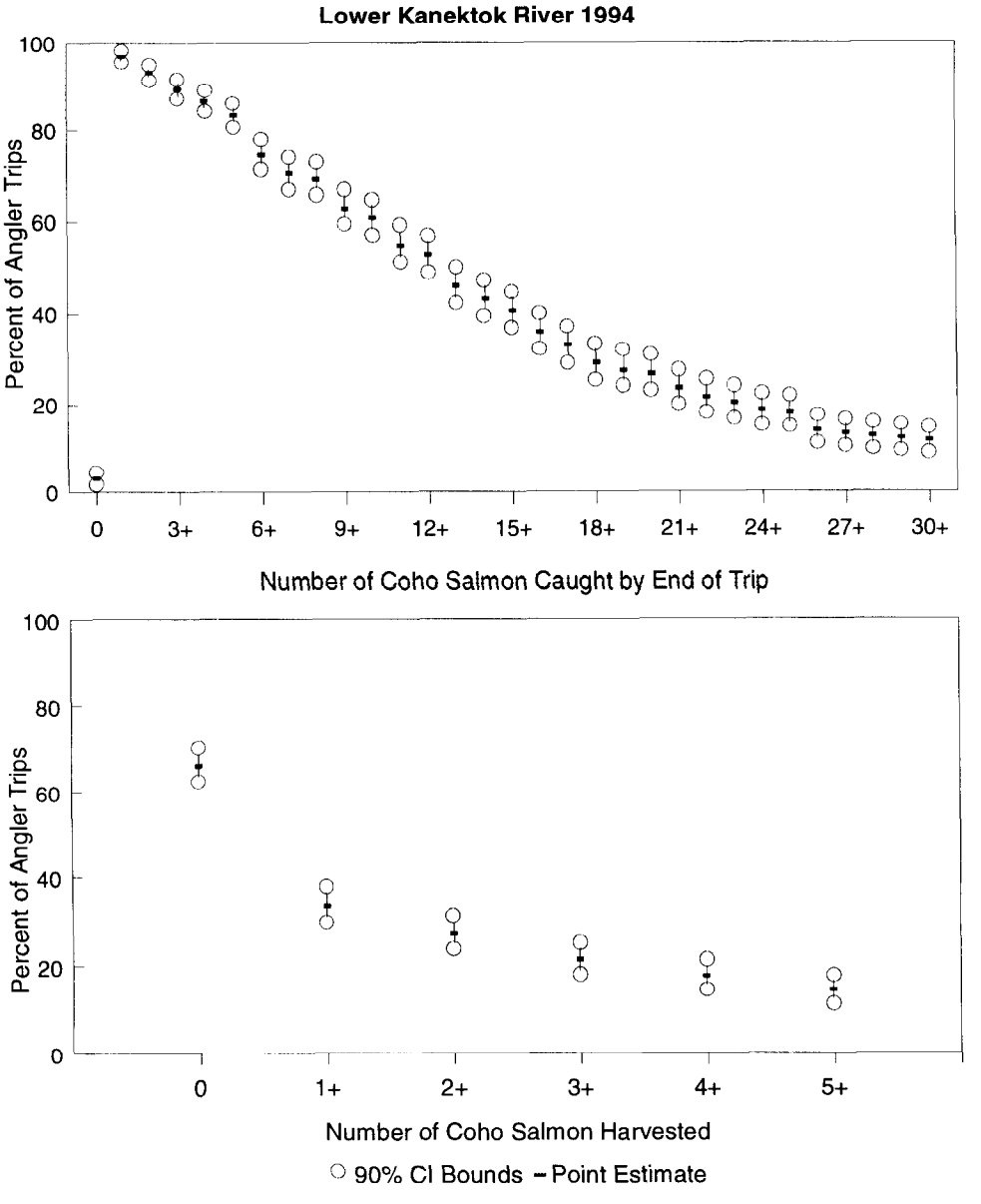

Figure 5.-Distribution of catch and harvest success in the Mulchatna River coho salmon sport fishery 5 August through 23 August 1994.

Although anglers enjoyed very good catches of coho salmon, they chose to harvest the fish at a level similar to the chinook salmon fishery. We estimated that slightly over 66% (SE = 2.4%) of the angler-trips resulted in no harvest of coho salmon and the remaining 34% (SE = 2.4%) harvested one or more (Table 9, Figure 5). The full daily bag limit of five coho salmon was taken in an estimated 14.5% (SE = 2.0%) of the angler-trips (Table 9, Figure 5).

Harvest Analysis

Six percent, 6%, 4%, 4%, and 15% of the angler-trips resulted in daily harvests of 1, 2, 3, 4, and 5 coho salmon, respectively (Table 10). The first and second fish harvested accounted for 29% (SE = 1.4%) and 23% (SE = 0.8%), respectively, of all coho

Table 10.-Percent of angler-trips by number of fish kept and percent of harvest by sequence of fish harvested in the coho salmon sport fishery on the lower Kanektok River, 5 August through 23 August 1994.

Fish Kept	Angler Trips (Pooled)	Percent of Trips	90% Confidence Interval			Sequence of Fish Harvested	Contribution to Total Harvest		
			SE (%)	Lower	Upper		Fish	Percent	SE (%)
0	387.6	66.3	2.4	62.4	- 70.2				
1	36.4	6.2	1.3	4.1	- 8.3	1st	198	28.7	1.4
2	35.0	6.0	1.1	4.2	- 7.8	2nd	161	23.4	0.8
3	21.1	3.6	0.9	2.1	- 5.1	3rd	126	18.3	0.7
4	20.3	3.5	1.0	1.9	- 5.1	4th	105	15.2	0.8
5+	84.5	14.5	2.0	11.2	- 17.8	5th+	100	14.5	1.6
Total	585						689		

salmon harvested (Table 10, Figure 6). The third, fourth, and fifth fish accounted for 18% (SE = 0.7), 15% (SE = 0.8%), and 15% (SE = 1.6%) of the total harvest, respectively.

Percentages of Angler-trips by Angler Type and Gear Type

From the 585 interviews conducted in the lower Kanektok River coho salmon survey, an estimated 52% (SE = 2.1%) of the angler-trips were guided, 90% (SE = 1.2%) were made by non-Alaskan residents and 5% (SE = 0.9%) were made by residents of other countries (Table 11). Among the 48% (SE = 2.1%) unguided angler-trips, 22% (SE = 1.7%) were outfitted and 20% (SE = 1.7%) chartered an air taxi or boat (Table 11). In 59% (SE = 2.0%) of the angler-trips, fly fishing gear was used exclusively, and spinning tackle was used exclusively in 28% (SE = 1.9%) of the trips (Table 11). Very small percentages of the remaining angler-trips used bait, or various combinations of fishing tackle.

Age, Length At Age, and Sex Composition of the Sport Harvest

Samples collected from 192 coho salmon harvested in the lower Kanektok River sport fishery were mainly age 2.1 (84%, SE = 2.8%) (Table 12) Age-1.1 fish comprised another 13% (SE = 2.6%) of the harvest. Almost 70% (SE = 3.5%) of the sport-harvested fish were males (Table 12). The overall average length was 608 mm (24 in) (SE = 3 mm), and the mean weight was 3.9 kg (8.6 lb) (SE = 0.1 kg). The biggest coho salmon sampled was a male 681 mm (24 in) in length that weighed 6.2 kg (13.6 lb).

Computer programs and data files used for this report are in Appendix B1.

DISCUSSION

The 1994 total return to the Kanektok River of 19,550 chinook salmon and the commercial harvest of 8,564 chinook salmon were both below average (Table 1) (Minard and Dunaway 1995). The 23 June bag limit reduction, from three to one chinook salmon per day in the sport fishery as well as major restrictions on the commercial fishery appear to have been effective. The 1994 escapement index of 7,386 chinook salmon was not only well above the 5,800 fish escapement goal but also was the highest index recorded since 1989 (Minard and Dunaway 1995).

In spite of the below-average return and June fishery restrictions, the 1994 recreational chinook salmon fishery on the lower

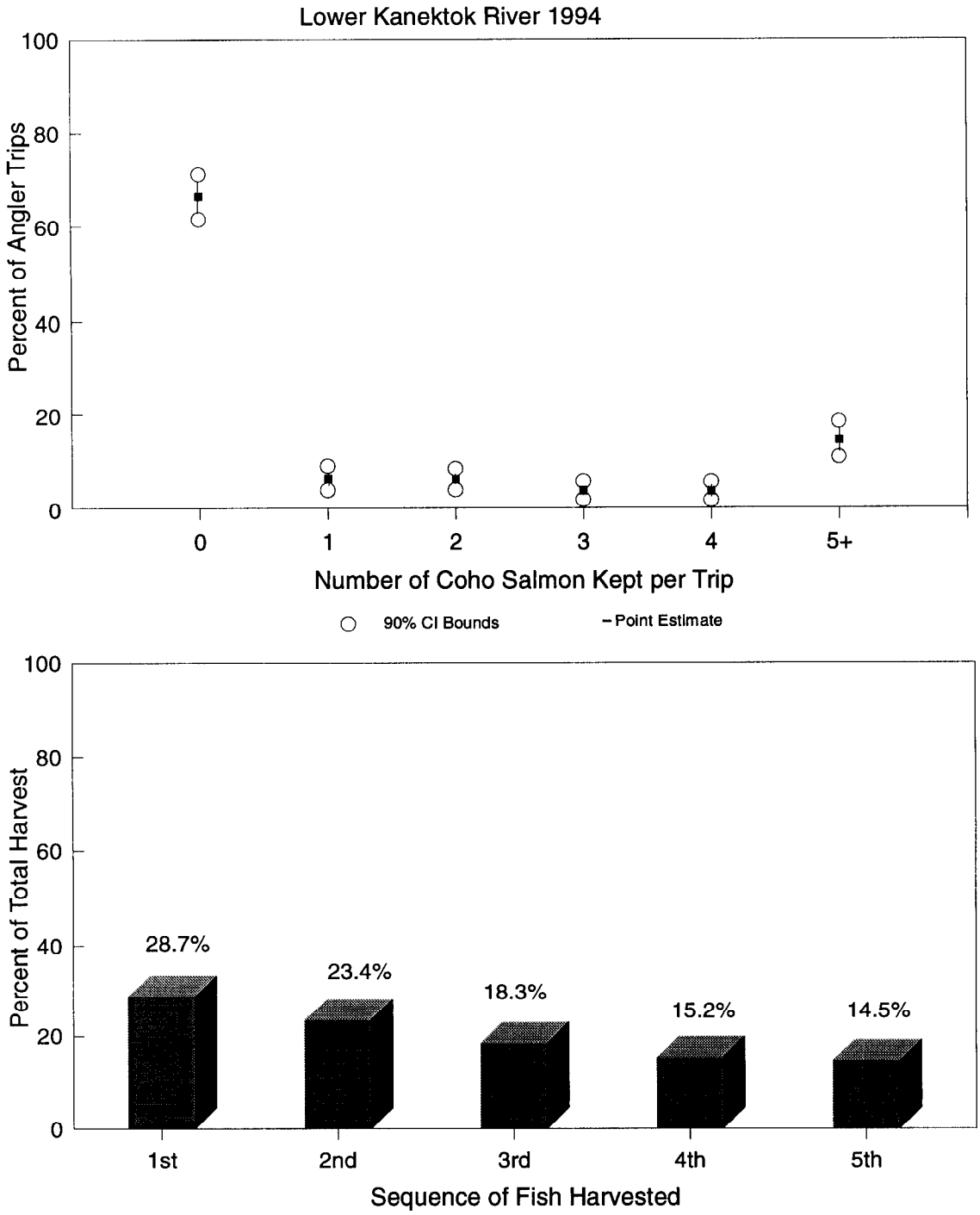

Figure 6.-Percent of angler trips by number of fish kept and percent of total harvest represented by the first, second or third fish taken among all anglers in the Mulchatna River coho salmon fishery, 5 August through 23 August 1994.

Table 11.-Number and percent of angler-trips by gear type and angler type during the coho salmon sport fishery on the lower Kanektok River, 5 August through 23 August 1994.

Characteristic	Angler Trips	Percent	SE (%)
ANGLER TYPE			
Guided (assumes all services provided)	303	52	2.1
Unguided (all)	282	48	2.1
Unguided, Outfitted	128	22	1.7
Unguided, Chartered (boat or air taxi)	115	20	1.7
Alaskan Residents	61	10	1.2
Local Alaska Residents	12	2	0.6
Nonlocal Alaska Residents	49	8	1.1
Non-Alaskan Residents	524	90	1.2
U. S. Resident	493	85	1.5
Non-U. S. Residents	31	5	0.9
TACKLE TYPE			
Spin	165	28	1.9
Spin and Bait	10	2	0.6
Spin and Fly	44	8	1.1
Spin , Fly, and Bait	3	<1	0.3
Bait	11	2	0.6
Fly and Bait	6	1	0.4
Fly	347	59	2.0
Total Angler-trips	585		

Table 12.-Mean lengths (mm) and weights (g) of coho salmon, by sex and age group, from samples collected from the sport harvest on the lower Kanektok River, 5 August to 23 August 1994.

	Age Group				
	UNKNOWN	1.1	2.1	2.2	TOTAL
FEMALES					
Percent		4.7	25.1	0.6	30.4
SE		1.6	3.3	0.6	3.5
Sample Size		8	43	1	52
Mean Length	591	609	602	515	600
SE	12.6	10.1	3.6		3.6
Sample Size	7	8	43	1	59
Mean Weight	3,629	3,731	3,619	2,000	3,608
SE	175.2	259.5	76.4		73.2
Sample Size	7	8	43	1	59
MALES					
Percent		8.2	59.1	2.3	69.6
SE		2.10	3.77	1.16	3.53
Sample Size		14	101	4	119
Mean Length	609	618	612	609	612
SE	6.0	9.7	3.8	9.6	3.1
Sample Size	14	14	101	4	133
Mean Weight	3,946	4,257	4,060	3,762	4,059
SE	136.8	193.1	80.4	314.5	66.5
Sample Size	14	14	101	4	133
ALL SAMPLES					
Percent		12.9	84.2	2.9	100.0
SE		2.57	2.80	1.29	
Sample Size		22	144	5	171
Mean Length	603	614	609	590	608
SE	6	7	3	20	3
Sample Size	21	22	144	5	192
Mean Weight	3.8	4.1	3.9	3.4	3.9
SE	0.11	0.16	0.06	0.43	0.05
Sample Size	21	22	144	5	192

Kanektok River was fairly good and very similar to the 1991 fishery. The distributions of catch observed in the 1991 and 1994 studies were similar (Table 13). The large percentage (61%, SE = 2%) of angler-trips that harvested no chinook salmon during 1994 may be a direct result of the bag limit reduction. The 1994 percentages of guided and unguided anglers were the inverse of the 1991 fishery while the percentages of Alaskan and non-Alaskan residents were virtually identical. Tackle choice among anglers appears to have changed. In 1991 there was a predominance of spinning gear (77%, SE = 5.3%) or bait (18%, SE = 4.5%) while in 1994 more than one-third of the angler-trips (35%, SE = 1.7%) employed fly fishing gear (Table 13).

The Kanektok River coho salmon run was unexpectedly strong in 1994. Unfortunately poor weather made it impossible to conduct surveys of the spawning grounds and the total return could not be estimated. The preliminary commercial harvest estimate of the 83,912 coho salmon was well above the 1989 through 1993 average of 51,265 fish (Table 2). Similarly, the 1994 Kanektok River coho salmon sport fishery was very good with some anglers reporting catches in excess of 30 fish per day (Table 9).

Several changes were observed between the 1994 and 1991 coho fishery surveys. Anglers caught and kept more coho salmon per trip in 1994 than in 1991 (Table 14). The proportion of guided angler-trips increased. Alaskan and non-Alaskan residents enjoyed the Kanektok River coho fishery in similar proportions during both surveys. As with the chinook salmon fishery, the most notable difference in terminal tackle was the increased use of fly tackle in 1994 (59%, SE = 2%) compared to 1991 (14%, SE = 4%) (Table 14).

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We are especially grateful for the assistance provided by biologist Cindy Anderson, seasonal technician Rob Stewart and other staff from the CFMD office in Bethel. Creel technicians Cynde Ferris and Brandon Cherry worked very hard conducting interviews and collecting data for this report. We appreciate Gail Heineman's help with computer programs to digest survey data; and we thank Donna Buchholz for entering the angler report card data into the computer. Thanks to Allen Bingham for his assistance with the statistical design and review of this project. Finally, we'd like to thank the people of Quinhagak and the fishing guides for their assistance and support during the survey.

Table 13.-Comparison of angler success distributions, angler characteristics, and gear selection observed during surveys of the recreational chinook salmon fishery in the lower Kanektok River.

Survey Year	1991[a]		1994	
Survey Dates	6/21 to 7/7		6/19 to 7/19	
Total Interviews	198		787	
Completed-trip Interviews (all types)	85		666	
Catch Rate (fish/hour)	0.5		0.6	
Estimated Harvest	289	SE=44		
Catch Distribution[b]	Percent of Angler-Trips	SE(%)	Percent of Angler-Trips	SE(%)
Number of fish				
0	17	5	25	2
1+	83	8	75	2
2+	50	3	62	2
3+	39	5	54	2
4+	32	9	45	2
5+	27	4	39	2
Harvest Distribution				
0	39	6	61[c]	2
1+	61	9	39	2
2+	21	5	3	<1
3+	4.	2	1	<1
ANGLER TYPES				
Guided	62.4	6.0	32	1.7
Unguided (all)	36.6	6.0	68	1.7
Alaskan Residents	24		24	1.5
Non-Alaskan Residents	76		76	1.5
TACKLE TYPE				
Spin	76.8	5.3	30	1.6
Spin and Bait			30	1.6
Spin and Fly			4	0.7
Spin, Fly, and Bait			<1	0.2
Bait	17.8	4.5	<1	0.2
Fly	4.4	3.5	35	1.7
No Record	0.9	0.6		

[a] Dunaway and Bingham 1992.

[b] For the purposes of this comparison, the percent of angler-trips and SE are shown only for the catch and harvest distribution of the first five or more fish or zero fish.

[c] The 1994 bag limit was reduced from 3 chinook, only 2 over 28 inches in length, per day to 1 chinook of any length per day by emergency order on 23 June.

Table 14.-Comparison of angler success distributions, angler characteristics, and gear selection observed during surveys of the recreational coho salmon fishery in the lower Kanektok River.

Survey Year	1991[a]		1994	
Survey Dates	8/7 to 8/27		8/5 to 8/23	
Total Interviews	260		585	
Completed-trip Interviews (all types)	166		434	
Catch Rate (fish/hour)	1.7		2.2	
Estimated Harvest	2,871	SE=383		
Catch Distribution[b]	Percent of Angler-Trips	SE(%)	Percent of Angler-Trips	SE(%)
Number of fish				
0	4.2	2.1	3	<1
1+	95.8	7.4	97	<1
2+	85.2	6.3	93	1
3+	71.3	4.5	89	1
4+	64.7	4.2	87	2
5+	60.2	4.2	83	2
Harvest Distribution				
0	61	7	66	2
1+	39	5	34	2
2+	27	5	28	2
3+	20	4	22	2
4+	8	3	18	2
5+	7	2	15	2
ANGLER TYPES				
Guided	37	7	52	2
Unguided (all)	62	7	48	2
Alaskan Residents	13		10	1
Non-Alaskan Residents	87		90	1
TACKLE TYPE				
Spin	49	8	28	2
Spin and Bait			2	<1
Spin and Fly	30	7	8	1
Spin, Fly, and Bait			<1	<1
Bait			3	1
Fly	14	4	59	2
No Record	8	3		

[a] Dunaway and Bingham 1992.

[b] For the purposes of this comparison, the percent of angler-trips and SE are shown only for the catch and harvest.

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APPENDIX A. EVALUATION OF INTERVIEW DATA

Appendix A1.-Procedures used to compare and combine data from completed onsite interviews and returned voluntary report cards.

Completed-trip data were available from two sources: (1) anglers who had completed their fishing prior to being interviewed onsite, and (2) anglers who had not completed their fishing prior to being interviewed but were issued voluntary report cards and returned them. This appendix compares the two data sets and describes how data from the two sources were pooled to estimate angler success parameters.

Chi-square tests of independence were used to determine whether the number of fish caught/harvested was independent of type of interview (ONSITE: fishing completed prior to time of interview versus CARD: fishing not completed at time of interview and angler filled out and returned a card). For chinook salmon, angler catch differed by interview type (χ^2=62.9, df=10, P<0.001, Appendix A2), as did angler harvest (χ^2=27.4, df=2, P<0.001, Appendix A3). Catch (χ^2=23.3, df=11, P=0.016, Appendix A2) and harvest (χ^2=69.3, df=5, P<0.001, Appendix A3) of coho salmon also differed by interview type.

In general, CARD anglers reported greater success than ONSITE anglers, however the difference varied over time. For instance, catch of chinook salmon differed by type of interview for week 27, but not weeks 26 or 28; and coho harvest differed by interview type for weeks 32 and 33 but not week 34 (Appendix A4).

Effort (hours fished per day) differed between types of anglers (ONSITE vs. CARD), during both the chinook season (t=20.5, approx. df=482.6, P<0.0001) and the coho season (t=20.1, approx. df=215.4, P=0.0001). In both cases CARD anglers fished substantially longer than ONSITE anglers (Appendix A5).

Because CARD anglers differed from ONSITE anglers, and the differences varied over time, data from the two sources could not be pooled *as is* to estimate overall completed-trip angler success in the fishery. Survey data were self-weighted (by design) over time, however they were not self-weighted with respect to type of angler interview (ONSITE vs. CARD), because not all cards were returned. That is, the interview data were more or less a census of all anglers finishing early (probably few escaped being interviewed), while the card data represent only a sample of all the anglers encountered by the creel technicians who had not completed fishing for the day.

Therefore, when pooling data to estimate completed-trip angler success, data from CARD anglers were weighted by the number of cards issued (representing the number of anglers still fishing when interviewed) rather than by the number of returned cards (only a sample of the former). This reweighting process was carried out by week, since the card return rate (and therefore the weighting factor for the card data) varied over time (Appendix A6).

Because some anglers did not return their cards, estimates of completed-trip angler success such as those described below would be biased if their success differed from that of anglers who did return their cards. Although the completed-trip success of anglers not returning cards was unobserved, the success (catch and harvest) *at time of interview* was known for all anglers. In order to assess the above-noted potential for bias, we compared success at time of interview between anglers who returned cards versus those who did not. During the chinook salmon fishery, catch at time of interview did not differ (χ^2=11.95, df=10, P=0.288, Appendix A7)

although harvest did (χ^2=8.9, df=2, P=0.012, Appendix A8). During the coho salmon fishery, catch at time of interview differed (χ^2=23.6, df=11, P=0.015, Appendix A7) but harvest did not (χ^2=8.62, df=5, P=0.125, Appendix A8). Mean catch and harvest of chinook at time of interview, and catch of coho at time of interview, were greater for anglers who never returned their cards than those who did, although the differences were not great (Appendix A9). These results indicate that the following angler success estimates *may* be biased low. The potential for bias is greater during the coho season, when 151 of 585 interviews (26%) resulted in non-returned cards, than during the chinook season, when only 121 cards (15%) were not returned out of a total of 787 interviews.

Angler Success

We estimated the proportions of anglers achieving certain levels of catch and harvest as follows. Let m be the number of anglers interviewed all season. Of the m_i anglers interviewed during week i, let

m_{1i} = the number of anglers who had already completed fishing,

m_{2i} = the number of anglers who had not completed fishing and were issued a card, and eventually completed and returned it, and caught j or more fish, and

m_{3i} = the number of anglers who had not completed fishing and were issued a card, but either did not complete it correctly or did not return it.

Also, let

m_{1ij} = the number of anglers who had already completed fishing during week i and caught j or more fish, eventually completed and returned it, and caught j or more fish,

m_{2ij} = the number of anglers who had not completed fishing and were issued a card, and eventually completed and returned it, and caught j or more fish, and

m_{3ij} = the number of anglers who had not completed fishing during week i, were issued a card, either did not complete it correctly or did not return it, and caught j or more fish.

Note that we had no information on the completed-trip success of the third category of anglers, i.e., the m_{3ij} are unknown. The proportion of anglers catching j or more fish during the entire season (all weeks) was estimated as

$$\hat{p}_j = \sum_i \left[w_{1i} \frac{m_{1ij}}{m_{1i}} + w_{2i} \frac{m_{2ij}}{m_{2i}} \right] \qquad \text{(A1.1)}$$

where w_{1i} and w_{2i} are the weights applied to the data from onsite completed-trip interviews and returned cards, respectively. The weights, which summed to one over the season, were calculated as

$$w_{1i} = \frac{m_{1i}}{m}, \text{ and} \qquad \text{(A1.2)}$$

$$w_{2i} = \frac{m_{2i} + m_{3i}}{m}. \tag{A1.3}$$

Note that the data from the returned cards were weighted to reflect the number of cards issued rather than the number of cards returned. The proportion of anglers harvesting j or more fish was estimated in the same manner. The proportion of anglers catching or harvesting exactly j fish was also estimated as above, after redefining the m_{1ij} and m_{2jj} appropriately.

The variances of these estimated proportions were estimated as follows:

$$\hat{Var}(\hat{p}_j) = \sum_i \left[w_{1i}^2 \frac{\frac{m_{1ij}}{m_{1i}}\left(1 - \frac{m_{1ij}}{m_{1i}}\right)}{m_{1i} - 1} + w_{2i}^2 \frac{\frac{m_{2ij}}{m_{2i}}\left(1 - \frac{m_{2ij}}{m_{2i}}\right)}{m_{2i} - 1} \right]. \tag{A1.4}$$

Harvest Analysis

The proportion of fish occupying the k^{th} position in the creel was estimated as

$$\hat{p}_k = \frac{\hat{p}_j \cdot m}{\sum_{j=1}^{jmax} \left(\hat{p}_j \cdot m\right)} \tag{A1.5}$$

where j equals k, $\hat{p}_j$ is the proportion of anglers harvesting j or more fish, m is the total number of anglers interviewed, and jmax is the maximum number of fish harvested by any one angler. The denominator of (A1.5) is the estimated total number of fish harvested by all anglers contacted during the survey.

The variance of $\hat{p}_k$ was estimated using the resampling techniques of Efron (1982). Each survey produced data $\{h_{1i}\}$ and $\{h_{2i}\}$, in which each h_{1i} is the harvest of an angler who had already finished fishing at the time of being interviewed during week i, and each h_{2i} is the harvest of an angler who was issued a card during week i and returned it. There were m_{1i} and m_{2i} of such data points (angler-trips), respectively, for each week i. In addition, there were m_{3i} angler-trips in which the completed-trip harvest was unknown because the angler did not return his card. The total number of angler-trips for each week was $m_i = m_{1i} + m_{2i} + m_{3i}$. One thousand bootstrap samples were drawn by resampling these original m_i angler-trips with replacement. For each bootstrap sample, for each week i , m_{1i} angler-trips were randomly chosen with replacement from the m_{1i} angler-trips for which the data came from onsite interviews, and $m_{2i} + m_{3i}$ angler-trips were randomly chosen with replacement from the $m_{2i} + m_{3i}$ angler-trips which came from issued cards. Therefore the number of angler-trips m'_{3i} for which the harvest was unknown varied with each bootstrap sample, and usually differed from the corresponding number m_{3i} in the original data. The numbers m'_{1ij} of angler-trips from onsite interviews in which j fish were harvested were tallied from each bootstrap sample, as were the numbers m'_{2ij} of angler-trips from returned cards in which j fish were harvested. The proportions p'_j of anglers harvesting exactly j fish and

the proportions p'_k of fish occupying the k^{th} position in the creel were calculated for each bootstrap sample using (A1.1) and (A1.5) above, after substituting m'_{3i} for m_{3i}, m'_{1ij} for m_{1ij}, and m'_{2ij} for m_{2ij}. Finally, the variance of $\hat{p}_k$ was estimated by calculating the sample variance of the 1,000 bootstrap values of p'_k.

Appendix A2.-Number of chinook and coho salmon caught as recorded from card completed-trip interviews versus onsite completed-trip interviews on the Kanektok River, 1994.

Chinook Salmon

	Number of Fish Caught											
	0	1	2	3	4	5	6	7	8	9	≥10	Total
Card	68	33	21	34	21	18	20	24	15	21	73	348
Onsite	109	57	31	25	19	15	16	13	5	5	23	318
Total	177	90	52	59	40	33	36	37	20	26	96	666

χ^2=62.9, df=10, P<0.001

Coho Salmon

	Number of Fish Caught											
	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	≥21	Total
Card	4	7	5	21	17	14	12	10	13	8	7	43	161
Onsite	12	32	25	39	15	20	31	10	18	11	10	50	273
Total	16	39	30	60	32	34	43	20	31	19	17	93	434

χ^2=23.3, df=11, P=0.016

Appendix A3.-Number of chinook and coho salmon kept as recorded from card completed-trip interviews versus onsite completed-trip interviews on the Kanektok River, 1994.

Chinook Salmon

	Number of Fish Kept			
	0	1	≥2	Total
Card	189	141	18	348
Onsite	228	88	2	318
Total	417	229	20	666

χ^2=27.4, df=2, P<0.001

Coho Salmon

	Number of Fish Kept						
	0	1	2	3	4	≥5	Total
Card	82	11	12	6	9	41	161
Onsite	222	14	16	10	5	6	273
Total	304	25	28	16	14	47	434

χ^2=69.3, df=5, P<0.001

Appendix A4.-Weekly comparisons of the number of chinook and coho salmon kept or caught from card completed-trip interviews versus onsite completed-trip interviews on the Kanektok River, 1994.

Chinook Salmon Fishery, weeks 26-28 only

Kept categories: 0 or ≥1 fish kept; df = 1

Catch categories: 0, 1-4, 5-9, or ≥10 fish caught; df = 3

	Completed-trip Interviews		Fish Kept		Fish Caught	
Week	Card	Onsite	χ^2	P	χ^2	P
26	122	62	1.62	0.203	2.90	0.408
27	88	76	2.97	0.085	13.51	0.004
28	72	103	0.90	0.342	5.28	0.152

Coho Salmon Fishery, weeks 32-34 only

Kept categories: 0, 1-4, or ≥5 fish kept; df = 2

Catch categories: 0-9, 10-19, or ≥20 fish caught; df = 2

	Completed-trip Interviews		Fish Kept		Fish Caught	
Week	Card	Onsite	χ^2	P	χ^2	P
32	34	160	40.6	0.001	3.36	0.187
33	83	68	30.9	0.001	6.59	0.037
34	43	29	3.71	0.156	14.34	0.001

Appendix A5.-Effort (hours fished) of completed-trip anglers returning cards versus completed-trip anglers interviewed onsite on the lower Kanektok River, 1994.

	Number of Anglers	Hours Fished	
		Mean	Standard Deviation
Chinook Salmon Fishery			
Completed-trip anglers returning cards	309	14.0	5.7
Completed-trip anglers interviewed onsite	318	6.5	3.2
	t=20.46, df=482.6, P<0.0001[a]		
Coho Salmon Fishery			
Completed-trip anglers returning cards	137	13.8	4.1
Completed-trip anglers interviewed onsite	273	5.8	3.1
	t=20.10, df=215.4, P<0.0001[a]		

[a] Variances not assumed to be equal.

Appendix A6.-Return rate of angler interview cards during the chinook salmon sport fisheries on the Kanektok River in 1994.

	Week					
	25	26	27	28	29	Total
Chinook Salmon Fishery						
Cards returned	57	122	88	72	9	348
Cards not returned	21	34	55	11	0	121
Total	78	156	143	83	9	469
Proportion returned	0.73	0.78	0.62	0.87	1.00	0.74
	χ^2=19.8, df=3, P<0.001 (weeks 25-28 only)					

	Week				
	31	32	33	34	Total
Coho Salmon Fishery					
Cards returned	1	34	83	43	161
Cards not returned	2	9	62	78	151
Total	3	43	145	121	312
Proportion returned	0.33	0.79	0.57	0.36	0.52
	χ^2=27.34, df=2, P<0.001 (weeks 32-34 only)				

Appendix A7.-Number of chinook and coho salmon caught at time of interview as reported by anglers who were issued voluntary report cards and returned them versus anglers who were issued cards and did not return them, Kanektok River, 1994.

Chinook Salmon

	Number of Fish Caught at Time of Interview											
	0	1	2	3	4	5	6	7	8	9	≥10	Total
Card returned	120	50	30	21	28	18	14	12	8	5	42	348
Card not returned	27	19	10	6	7	10	7	5	6	2	22	121
Total	147	69	40	27	35	28	21	17	14	7	64	469

χ^2=11.95, df=10, P=0.288

Coho Salmon

	Number of Fish Caught at Time of Interview											
	0	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	19-20	≥21	Total
Card returned	22	22	23	19	15	14	5	10	8	0	4	19	161
Card not returned	5	19	12	25	21	13	9	5	10	4	4	24	151
Total	27	41	35	44	36	27	14	15	18	4	8	43	312

χ^2=23.55, df=11, P=0.015

Appendix A8.-Number of chinook and coho salmon kept at time of interview as reported by anglers who were issued voluntary report cards and returned them versus anglers who were issued cards and did not return them, Kanektok River, 1994.

Chinook Salmon

	Number of Fish Kept at Time of Interview			
	0	1	≥2	Total
Card returned	267	73	8	348
Card not returned	76	41	4	121
Total	343	114	12	469

χ^2=8.89, df=2, P=0.012

Coho Salmon

	Number of Fish Kept at Time of Interview						
	0	1	2	3	4	≥5	Total
Card returned	101	16	16	17	5	6	161
Card not returned	80	24	18	10	12	7	151
Total	181	40	34	27	17	13	312

χ^2=8.62, df=5, P=0.125

Appendix A9.-Number of chinook and coho salmon kept and caught at time of interview by anglers who were issued voluntary report cards and returned them versus anglers who were issued cards and did not return them, Kanektok River, 1994.

	Number of Anglers	Fish Kept		Fish Caught	
		Mean	Standard Deviation	Mean	Standard Deviation
Chinook Salmon Fishery					
Card returned	348	0.26	0.51	3.51	4.78
Card not returned	121	0.40	0.56	4.88	5.51
		t=2.59, df=467, P=0.010		t=2.43, df=186.6, P=0.016[a]	
Coho Salmon Fishery					
Card returned	161	0.93	1.43	8.63	8.70
Card not returned	151	1.15	1.54	11.96	12.93
		t=1.31, df=310, P=0.193		t=2.65, df=260.4, P=0.008[a]	

[a] Variances not assumed to be equal.

APPENDIX B. LIST OF DATA FILES AND PROGRAMS USED

Appendix B1.-Data files and computer programs used to produce this report.

Data Files

Interview data:

V0030IA4.DTA	Kanektok River chinook salmon onsite interviews 6/19/94 to 7/1/94.
V0030IB4.DTA	Kanektok River chinook salmon onsite interviews 7/2/94 to 7/19/94.
V003AIK4.CRD	Kanektok River chinook card interviews.
V003AIK4.MRG	Kanektok River chinook onsite and card interviews merged. These data were used for angler success analysis.
V0030IC4.DTA	Kanektok River coho salmon angler interviews 8/5/94 to 8/23/94.
V0030IC4.CRD	Kanektok River coho card interviews.
V0030IC4.MRG	Kanektok River coho onsite and card interviews merged. These data were used for angler success analysis.

Biological data:

V0030BA4.DTA	Kanektok River sport harvested chinook salmon, 6/19/94 to 7/11/94.
V0030BB4.DTA	Kanektok River sport harvested coho salmon, 8/5/94 to 8/23/94.

Analysis Programs

CC91	A series of programs which sort raw data from files and produce frequency reports and assists in locating some data errors.
BBXPEXE	A series of programs that uses biological data files to produce tables of mean lengths, and weights by sex and age group.
DATAENTER.PRG	The program arranges the information in standard Angler Interview Mark-Sense format and permits the data to be used to test assumptions, compare between and within uncompleted and completed-trip interviews, to determine whether data from the two sources could be validly combined for parameter estimation.
CARDENTR.PRG	Program to enter data from voluntary report cards.
DOINT90	A set of Dbase® programs that reformat standard angler interview data files into a single row of data for each interview.
MERGE.PRG	A set of Dbase® programs used to merge the original onsite interview data files with the products of CARDENTR.PRG