

Fishery Data Series No. 94-24

Surveys of the Chinook and Coho Salmon Sport Fisheries in the Alagnak River, Alaska, 1993

by

Dan O. Dunaway

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¹ This investigation was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-9, Job No. S-2-2.

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ABSTRACT

From 2 July through 24 August 1993, the chinook (*Oncorhynchus tshawytscha*) and coho salmon (*Oncorhynchus kisutch*) recreational fisheries on the Alagnak River, Alaska, were surveyed using a self-weighted study design. Anglers were interviewed for catch and harvest information, and catch and harvest characteristics related to gear use, and use of guide services. Age, length, weight, and species data were collected from fish harvested by anglers. A total of 2,204 interviews (1,270 from completed angler trips) were conducted during the study. Of the 936 completed-trip interviews conducted during the 2 July through 3 August chinook salmon fishery, 63% (SE = 2) of the anglers caught and 41% (SE = 2) harvested one or more chinook salmon. Seventy-six percent (SE = 1) of the total chinook salmon harvested were the first fish harvested by anglers. Seventy-three percent (SE = 1) of anglers used spin gear only. These anglers accounted for the majority of the catch and harvest of chinook salmon (89%, SE = 1; and 91%, SE = 1, respectively). During the 25 July through 24 August coho salmon fishery, 524 completed-trip interviews were conducted; 54% of anglers (SE = 2) caught and 31% (SE = 2) harvested one or more coho salmon. Twenty-nine percent (SE = 3) of anglers harvested one or two coho salmon. Fifty-nine percent (SE = 3) of all coho salmon harvested were the first fish among anglers' harvests. In the coho salmon fishery, spin gear was used in 47% (SE = 1) of the catch and 58% (SE = 3) of the harvest. Most anglers were guided in both fisheries. Age, weight and length data were collected from 319 chinook salmon and 164 coho salmon. Estimated mean length of harvested chinook salmon was 865 millimeters (SE = 8), mean weight was 12.2 kilograms (SE = 0.3); 51% (SE = 3) were age-1.4, and 65% (SE = 3) were males. Estimated mean length of coho salmon harvested in the fishery was 585 millimeters (SE = 3), mean weight was 3.6 kilograms (SE = 0.1); 75% (SE = 5) were age-2.1, and 74% (SE = 4) were males.

KEY WORDS: Chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, chum salmon, *Oncorhynchus keta*, sockeye salmon, *Oncorhynchus nerka*, rainbow trout, *Oncorhynchus mykiss*, sport harvest, sport catch, creel survey, fishery survey, angler success, bag limit, guided anglers, unguided anglers, gear type, terminal tackle, Alagnak River, Branch River, Bristol Bay.

INTRODUCTION

The Alagnak River, known locally as the Branch River, is located in the Kvichak River drainage approximately 60 km (40 miles) north of the community of King Salmon, Alaska (Figure 1). The Alagnak River enjoys Wild and Scenic River status and hosts significant recreational fisheries for chinook salmon *Oncorhynchus tshawytscha*, chum salmon *O. keta*, and coho salmon *O. kisutch* as well as rainbow trout *O. mykiss*, Dolly Varden *Salvelinus malma*, Arctic char *S. alpinus*, Arctic grayling *Thymallus arcticus*, and northern pike *Esox lucius*. The Alagnak River's proximity to the community of King Salmon makes it the most economical alternative to fishing the more crowded Naknek River. Anglers typically access the river by boat or float-equipped aircraft from King Salmon.

The primary species of interest to sport anglers include chinook salmon and coho salmon in the lower river, and rainbow trout in the middle and upper sections. The Alagnak River chinook salmon sport fishery occurs in the lower 12 miles of the river and peaks in mid to late July, roughly 2 weeks later than other chinook salmon fisheries in the area. Alagnak River chinook salmon are typically larger than those found in nearby systems, and are particularly attractive to recreational anglers.

Previous surveys have found that the majority of angling effort on the Alagnak River is comprised of guided anglers from three river-based lodges and several fly-in operators. Angling effort estimates for the Alagnak River were first made in 1981. Since 1981, the annual estimates of recreational fishing effort have been erratic but show an overall trend of growth. Prior to 1992 the fishery reached its highest level in 1986 at 7,628 angler-days, and the lowest estimate occurred in 1988 at 1,182 angler-days (Table 1; Mills 1982-1993). Angler use on the Alagnak River since 1990 has been increasing and in 1992 reached an all time record of 12,323 angler-days (Mills 1993). Effort during the 5 years 1988 through 1992 averaged 5,774 angler-days (Minard *In press*).

Harvest of chinook salmon in the Alagnak River sport fishery has generally increased (Table 1). The average harvest from 1988 to 1992 was 1,000 fish. The 1981-1992 high was 1,969 fish harvested in 1987 (Minard *In press*). The potential impacts to chinook salmon stocks by the expanding sport fishery in the Alagnak River had been a source of concern to resource managers, local residents, and members of the sport fishing industry. Further, the department instituted a 3-year rotating schedule to survey the important chinook salmon sport fisheries in the Bristol Bay area. The Alagnak River was last surveyed in 1989 (Dunaway 1990).

Onsite creel surveys have never been conducted during the Alagnak River coho salmon sport fishery and information has been limited to the Statewide Harvest Survey estimates. Mills (1989-1993) estimated the recent 5-year annual sport harvest of Alagnak River coho salmon to be 422 fish (Table 1). The largest annual harvest from 1981 to 1992 was about 1,700 in 1986 (Mills 1987). The Alagnak River coho salmon run usually begins in late July. In 1988, Brookover (1989) reported catches of Alagnak River coho salmon on 29 July, and in 1989 Dunaway (1990) reported the first landings of coho salmon on 28 July. Both creel surveys focused on the chinook salmon fishery and terminated on 5 August, before significant numbers of coho salmon were available.

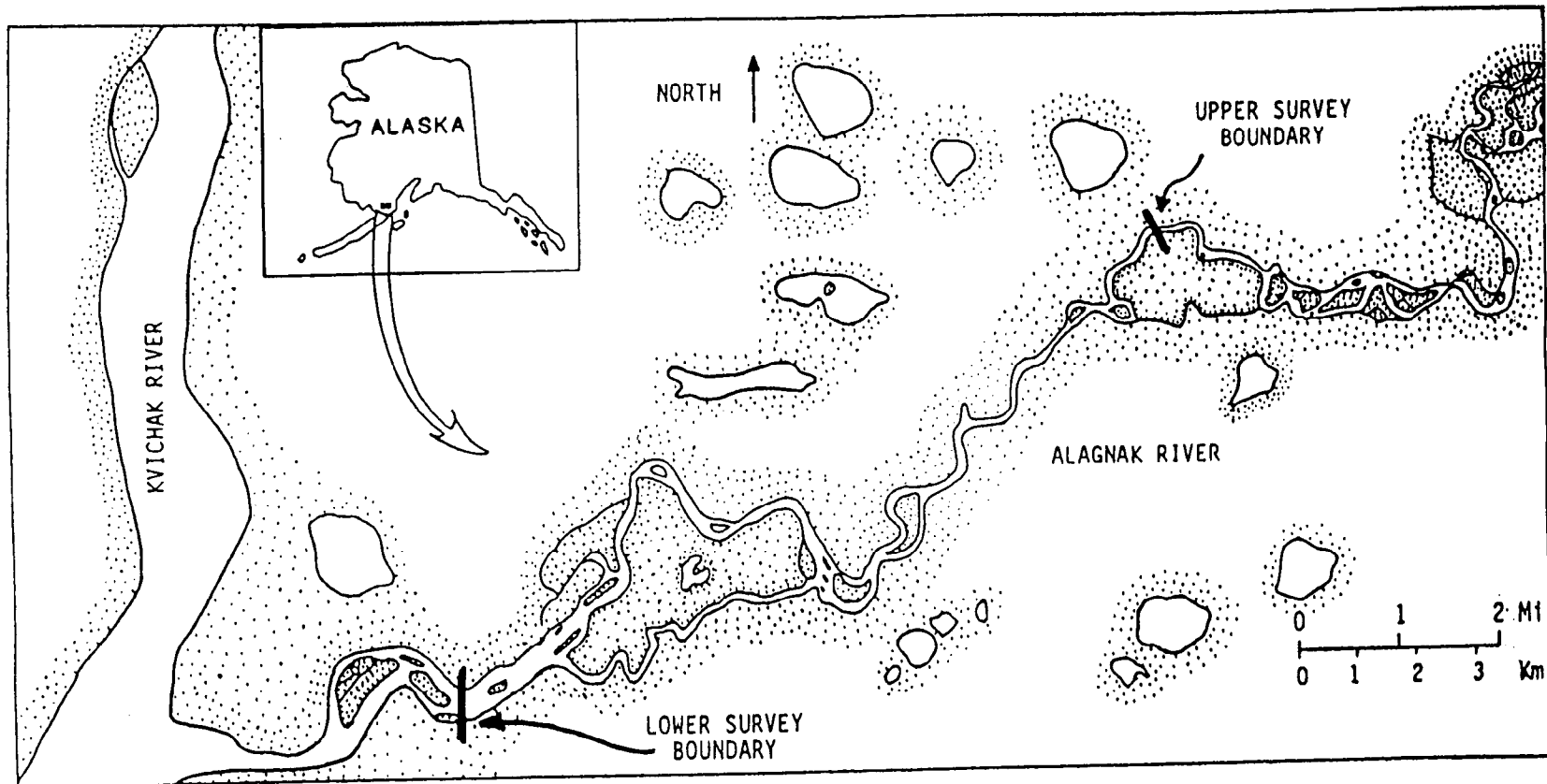


Figure 1. The Alagnak River study site, 1993.

Table 1. Sport fishing effort and harvest of chinook and coho salmon in the Alagnak River fishery, 1981-1992.^a

Year	Effort (Angler-Days)	Chinook Salmon Harvest	Coho Salmon Harvest
1981	1,947	97	400
1982	2,252	220	422
1983	2,348	252	147
1984	5,119	661	599
1985	2,473	757	11
1986	7,628	680	1,699
1987	4,786	1,969	46
1988	1,182	1,243	588
1989	2,717	1,333	403
1990	6,571	474	194
1991	6,079	790	602
1992	<u>12,323</u>	<u>1,160</u>	<u>324</u>
1988-1992 Average	5,774	1,000	422

^a Mills (1982-1993).

The Alagnak River recreational coho salmon fishery was surveyed in 1993 to address the department's general lack of information about the fishery and to respond to the recent growth in angler effort and coho salmon catch estimated for the river. In addition, lodge operators as well as individual anglers have increasingly expressed concerns for the Alagnak River coho salmon sport fishery.

The objectives of the 1993 Alagnak River creel survey were:

1. to estimate the distribution of catch and harvest of chinook and coho salmon by angler-day such that the estimated percentages are within 5 percentage points of the true values 90% of the time;
2. to estimate the percentage of angler-trips by terminal tackle type (flies or lures) and angler type (guided or unguided) such that the estimated percentages are within 10 percentage points of the true values 90% of the time;
3. to estimate the age and sex compositions of chinook and coho salmon harvested by the sport fisheries such that each estimated percentage by age class is within 7.5 percentage points of the true percentage 90% of the time;
4. to estimate the mean length-at-age of chinook and coho salmon harvested in the sport fishery;
5. to assess daily success of anglers during the peaks of the 1993 chinook and coho salmon fisheries; and
6. to determine the distribution of catch and harvest during the peaks of the 1993 chinook and coho salmon fisheries.

In 1987, the bag and possession limit for chinook salmon in the Alagnak River was five per day and in possession; only two were permitted to exceed 28 inches in length (ADF&G 1987). Since 1988, anglers have been limited to three fish per day, two of which may be greater than 28 inches in length (ADF&G 1988-1993).

For many years the bag limit for coho salmon on the Alagnak River has been five fish per day with no size limit (ADF&G 1988-1993).

METHODS

Fishery Survey

Study Design and Data Collection:

The creel survey was conducted along the lower Alagnak River from 5 km above its confluence with the Kvichak River and extending upstream 19 km (12 mi) (Figure 1). This selected portion of river receives most of the angling effort during the chinook and coho salmon fisheries.

The survey commenced on 2 July and continued until 24 August 1993. A self-weighted survey on a systematic sampling schedule formed the basis of the lower Alagnak River survey. Two survey technicians worked 5-day weeks from Friday through Tuesday, 7 hours per day, interviewing sport anglers and sampling harvested chinook and coho salmon. The sampling days were selected to include the common high use days of Friday through Sunday. Up to three passes were made through the fishery during each 7-hour period of each sampling day. Previous survey data indicated that peak angler counts occurred from mid-morning through early evening (Brookover 1989, Dunaway 1990). For the 1993 creel survey, each sampling day ran from 1000 hours to 1700 hours.

Completed-trip angler interviews (anglers who had suspended fishing for the day) and incompleting-trip interviews were collected by the creel technicians. Anglers encountered in the fishery were questioned concerning their catch and harvest, whether they were guided or unguided, terminal tackle used, and general demographic information. Every effort was made to interview anglers who had completed fishing for the day (completed-trip interviews). All interview data were recorded on the Sport Fish Division Angler Interview Mark-Sense Form Version 1.1 as described in the mark-sense instruction manual (Heineman 1991).

To augment the number of completed-trip interviews, all incompleting-trip anglers encountered were asked to provide their completed-trip information on a voluntary angler report card. Anglers were asked to record the numbers of chinook and coho salmon and rainbow trout they released and kept for the entire day (Figure 2). The cards were numbered in a manner allowing the onsite interview data to be matched with data on the returned card. The technicians collected the cards from the anglers, their guides, local lodges, and from collection boxes placed at strategic locations along the study site.

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. To achieve this goal the crew was instructed to, as nearly as possible, interview 100% of the anglers observed in the study area in order to ensure that a consistent and high proportion of all angler-trips were sampled within each day, within each week, and within the season.

Using the procedures outlined in Thompson (1987), 403 interviews were to be collected to achieve Objectives 1 and 2. As mentioned above, the study design was of the self-weighting type, and parameter estimates were calculated by treating all the interview data as a simple random sample of the angler-trips for each fishery. The two types of parameters estimated are both multinomial proportions expressed in percentages (e.g., proportion of angler-trips that resulted in a harvest of 0 fish, 1 or more fish, etc.), therefore the procedures in Thompson (1987) were appropriate for calculating the number of interviews needed.

**ALASKA DEPT. FISH & GAME
ALAGNAK RIVER**

PLEASE WRITE THE NUMBER OF FISH YOU KEPT AND RELEASED
DURING THIS DAY OF FISHING (MIDNIGHT TO MIDNIGHT).

WRITE 0 IF YOU DID NOT CATCH OR KEEP A FISH.

	Kept	Released	office use
King Salmon	_____	_____	Date _____
Coho Salmon	_____	_____	Page # or Litho _____
Rainbow Trout	_____	_____	Line # _____
			Initials _____
OTHER SPECIES, COMMENTS			

Figure 2. The voluntary angler report card.

Data Analysis:

Upon completion of the field project, the data from the returned report cards were typed into a separate electronic data file using the program DATAENTER.PRG. The program arranged the information in standard Angler Interview Mark-Sense format and permitted the data to be used to test assumptions, compare between incompleted and completed-trip interviews, to determine whether data from the two sources could be validly combined for parameter estimation.

Angler Success. Angler catch success and harvest success for the fishery were estimated in the following manner. The "catch success" was defined as the fraction p_k of angler-days in which "k" or more fish were caught, then "k" can be expressed as $k = 1$ to k_{\max} . If $k_{\max} = 5$, then one set of data was analyzed 5 times to obtain all possible fractions p_k in a set. The catch success for $k = 0$ is defined to be the proportion of angler-days that resulted in the catch of no fish. Similar estimates were calculated for the harvest success. Estimates for catch and harvest success for each species were limited to data collected during each fishery's "season": from 2 July until 3 August for chinook salmon; from 25 July through 24 August for coho salmon. The criterion used to define the span of the seasons was determined after the end of the survey, and depended upon the relative numbers of caught and harvested fish observed by species.

The value of k_{\max} for harvest was set to one fish more than the bag and possession limits for each species during the survey. The value of k_{\max} for catch was set after the season according to the largest number of fish reported caught by species.

Catch and harvest success were estimated as if the interview information was collected as a simple random sample of the fishery (given the self-weighted design). As such, the proportion of angler-days for each catch and/or harvest success category (e.g., zero fish, 1 or more fish, 2 or more fish, etc.) was calculated by the usual equation for proportions:

$$\begin{aligned} \hat{p}_k &= \text{estimated proportion of angler-days with the corresponding} \\ &\quad \text{catch or harvest success (k = 0, 1 or more fish, 2 or more} \\ &\quad \text{fish, etc.);} \\ &= \frac{m_k}{m}; \end{aligned} \tag{1}$$

where: m_k equals the number of completed-trip anglers who caught zero fish for $k = 0$, one or more fish for $k = 1$, two or more fish for $k = 2$, etc., for the catch success estimates (with harvest statistics substituted for the harvest success estimates); and m equals the total number of completed-trip anglers sampled.

The variance of the estimate of p_k was obtained by the standard equation for the variance of a binomial proportion (Cochran 1977, equation 3.8, page 52, omitting the finite population correction factor since the total number of angler-days was not estimated or known):

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

Standard errors were obtained by taking the square root of the variance estimates. Percentages for both the point estimates (\hat{p}_k) and the standard errors are simply the proportional values multiplied by 100.

Harvest Analysis. The "season" definitions used for angler success were also used for the harvest analyses. The percentage and variance of angler trips harvesting zero, one, two, etc. fish were calculated from completed-trip interviews in the same manner as the estimates of angler success (equations 1 and 2) except the categories for "k" were 0, 1, 2, etc. fish instead of one or more fish, two or more fish, etc. In addition, the total number of fish harvested among completed-trip interviews was calculated by multiplying the number of anglers by the daily harvest (1, 2, 3, etc. fish) reported. The last harvest category in this series is expressed by 4+ (for chinook salmon) or 5+ (for coho salmon) to include the few cases of over limit harvests reported; and the reported harvests were added together to obtain the total harvest in the four (or 5) or more fish category.

For another view of the harvests, the proportion of the total harvest constituted by the first fish, second fish, etc. kept among all anglers' harvests was calculated from the completed-trip interviews. For example, the total number of first fish among all anglers' harvests equals the number of anglers harvesting one or more fish; and the total number of second fish among all anglers' harvests was the number of anglers harvesting two or more fish; and so on. The total reported harvests exceeding the fourth chinook salmon or fifth coho salmon were summed in the same manner as described in the preceding paragraph. Equations 1 and 2 were used to calculate the proportions and variances for each category.

Angler-Trips by Terminal Tackle Type and Angler Type. Estimates of the percentages of the angler-trips by terminal tackle type (lures versus flies) or by angler type (guided versus unguided) were obtained in a similar manner as described above for catch and harvest success. The primary differences in the calculations were: (1) the different gear categories (spin only, fly only, both spin and fly gear used during the day) or angler categories (guided or unguided) determine the "k" criteria noted in equation 1, above; and (2) all interviews (both completed-trip and incompleted-trip) were used in the calculations.

Assumptions:

The general assumptions necessary for unbiased point and variance estimates of the catch and harvest success, harvest analysis, and angler-trip percentages, obtained by the procedures outlined above are:

1. the number of angler interviews conducted onsite by the procedures outlined above represent a consistent proportion of all angler-trips throughout the progress of each fishery (necessary for all estimates);

2. the angler report card response rate of interviewed incompletd-trip anglers does not vary substantially throughout the survey (necessary for unbiased catch and harvest success and harvest analysis estimates);
3. the angler report card response rate does not vary among angler groups, that is all anglers regardless of success (numbers of fish caught or harvested) return cards at the same mean rate (necessary for unbiased catch and harvest success and harvest analysis estimates);
4. anglers accurately report the number of fish by species released (necessary for unbiased catch success estimates); and
5. anglers who return report cards accurately report their harvest of fish by species (necessary for unbiased harvest success and harvest analysis estimates).

There are no direct ways to evaluate or test the first, fourth, or fifth assumptions. Regarding the first assumption, taking every step necessary to ensure a consistent systematic sampling of the fishery should have resulted in a consistent proportion of angler-trips being interviewed. The technicians were instructed to continually evaluate their performance regarding the assumed ability to interview all anglers fishing during the daily 7-hour sampling periods. Regarding assumptions 4 and 5: 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). Anglers interviewed onsite had their creels inspected by the survey technicians, and as such there is no need to assume that the numbers of fish harvested by species from onsite interviews would be incorrect.

The validity of assumption 2 was evaluated after the season by estimating the response rate during each week or groups of weeks of the survey. Serious departures from a consistent return rate will result in biased estimates, and as such, every attempt was made to maintain consistent return rates.

The validity of assumption 3 was tested postseason by comparing the catch and harvest distribution statistics of completed-trip anglers interviewed onsite with the statistics of anglers who return report cards. These comparisons were made with groups of days within the season. If both types of completed-trip interviews had similar proportions of anglers with zero harvested fish, 1 fish harvested, 2 fish harvested, etc., then assumption 3 was to be deemed valid.

Size, Sex, and Age Composition Sampling

Study Design and Data Collection:

During the angler survey, all observed harvested chinook and coho salmon were sampled for age, weight, length, and sex composition analysis. Since the angler survey was of the self-weighted type and nearly every interviewed angler's creel was censused, the survey of harvested fish was also of the self-weighted type. As such, estimates of age by sex composition, and mean weight and length-at-age were calculated as if the statistics were obtained by

a simple random sample. The creel clerks were encouraged to collect data from other species of harvested fish when time and opportunity permitted.

The number of fish samples required to achieve Objectives 3 and 4 were 176 chinook salmon and 145 coho salmon. The goal sample sizes were based on expected harvests of approximately 1,500 chinook salmon and 500 coho salmon and were calculated by following the procedures outlined in Thompson (1987) for estimating multinomial proportions (i.e., proportions of fish in different age, weight, or length categories by sex).

Each fish sampled was measured to the nearest millimeter for mid-eye to fork-of-tail length, weighed to the nearest 10 grams, and the sex identified from external characteristics. An additional sample of three or four scales was removed from the left side of the body, at a point on a diagonal line from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin, two rows above the lateral line (Welanders 1940; Scarnecchia 1979). The scale samples were then placed on labeled and numbered adhesive coated cards. The completed scale cards were then pressed onto acetate cards in a heated hydraulic press and the resulting scale impressions displayed on a microfiche projector for age determination¹. Age determination from the collected scales followed the procedure used by Lux (1971) for Pacific salmon and Clutter and Whitesel (1956) for sockeye salmon.

All biological data were recorded on the Sport Fish Division Standard Age Weight Length Form Version 1.1 as described in the mark-sense instruction manual (Heineman 1991).

Data Analysis:

Estimates of mean (and associated standard error) length and weight by age group of chinook and coho salmon sampled from the sport harvest were calculated using the procedures outlined by Sokal and Rohlf (1981, Boxes 4.2 and 7.1, pages 56 and 139). As noted above, the estimates were calculated as if the survey was a simple random sample of all fish harvested.

Age compositions (by sex and by both sexes combined) were estimated individually for each fishery. Each percentage and its variance were 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 interviews (the m terms in equations 1 and 2). One assumption is necessary for unbiased estimates of mean length-at-age and age by sex compositions by the procedures outlined above:

the number of harvested fish by species sampled represented a consistent proportion of all fish harvested throughout the progress of each fishery or the true values of the parameters estimated did

¹ 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.

not vary during the progression of the fishery (e.g., mean length-at-age was the same regardless of the portion of the fishery season).

If the true values of the parameters to be estimated did not vary as the fishing season progressed, then estimates should be unbiased. In addition, every attempt was made to consistently sample every contacted angler's creel, and as such, a consistent proportion of the harvest was sampled.

RESULTS

During the 1993 Alagnak River creel survey, 2,204 interviews were conducted from 2 July through 24 August. While the creel technicians could not interview every angler who fished in the study area, they were extremely diligent and likely sampled at least 75%-80% of all anglers using the river during each of the scheduled sampling days. On several occasions the creel technicians traveled to other portions of the river to verify that little effort was occurring outside the survey boundaries. While there is no direct test, the expected high and consistent rate of interviews and comprehensive coverage of the fishing area appear to satisfy the first assumption of the survey.

Only 229 (10%) of the original interviews were from anglers who had completed their fishing trip for the day (Table 2). Of the 1,972 voluntary report cards issued, a substantial 53% (1,041) were retrieved.

Where analyses used both incompleting-trip and completed-trip interviews, 1,510 interviews were available from the chinook salmon season and 1,064 were available from the coho salmon season. The overlapping season dates caused some interviews to be included in the analyses for both seasons.

Preliminary Data Analysis

Before computing estimates of angler success and for the harvest analysis, comparisons were made between onsite completed-trip interviews and card completed-trip interviews using χ^2 statistics. Valid comparisons of the chinook salmon fishery could only be made for 4 weeks during the survey period (Appendix A). Few significant differences were detected between interviews in the chinook salmon fishery. For the coho salmon fishery, only the last 4 weeks of the survey could be compared by combining data: weeks 32 and 33 were combined and weeks 34 and 35 were combined for the tests (Appendix A). Significant statistical differences were found between the two types of interviews in most tests conducted for the coho salmon fishery.

To further examine for differences between interview types, graphic comparisons were made of the point estimates and associated 95% confidence intervals for the estimates of catch and harvest success for each of the interview types for each of the fisheries. Estimates of catch and harvest success of 0 to 2 salmon (of both species) reported in both types of interviews were reasonably similar. Success tended to be more divergent as catch or harvest levels increased above one or two fish; more so with catch than with harvest.

Table 2. Summary of completed-trip interviews and number of fish caught and kept by date and interview type on the lower Alagnak River, 2 July to 24 August 1993.

Date	Week	Interview		Chinook Salmon		Coho Salmon	
		Type	Number	Caught ^a	Kept	Caught ^a	Kept
930702	27	Card	12	95	18	0	0
930703	28	Card	19	58	9	0	0
930704	28	Card	28	166	18	0	0
930704	28	Onsite	2	5	0	0	0
930705	28	Card	35	117	22	1	0
930706	28	Card	23	150	22	0	0
930706	28	Onsite	7	19	7	0	0
930709	28	Card	37	73	12	0	0
930709	28	Onsite	12	22	3	0	0
930710	29	Card	48	161	22	0	0
930710	29	Onsite	7	11	4	0	0
930711	29	Card	52	146	34	0	0
930711	29	Onsite	11	7	3	0	0
930712	29	Card	44	159	23	15 ^b	5 ^b
930712	29	Onsite	18	53	20	0	0
930713	29	Card	25	94	20	0	0
930713	29	Onsite	9	21	9	0	0
930716	29	Card	63	182	30	2	0
930716	29	Onsite	6	9	3	0	0
930717	30	Card	44	156	39	15 ^b	7 ^b
930718	30	Card	37	136	29	7	3
930718	30	Onsite	21	33	13	0	0
930719	30	Card	53	64	18	0	0
930719	30	Onsite	25	24	11	0	0
930720	30	Card	32	69	16	2	1
930720	30	Onsite	15	12	6	0	0
930723	30	Card	27	55	14	0	0
930724	31	Card	34	80	25	0	0
930725	31	Card	30	59	13	5	0
930725	31	Onsite	16	9	8	0	0
930726	31	Card	18	14	3	4	0
930726	31	Onsite	11	6	3	0	0
930727	31	Card	20	41	12	5	1
930730	31	Card	13	1	0	2	2
930730	31	Onsite	6	6	5	0	0
930731	32	Card	15	8	0	5	2
930731	32	Onsite	3	1	1	0	0
930801	32	Card	23	0	0	4	1
930801	32	Onsite	9	4	4	0	0
930802	32	Card	11	2	0	3	1
930803	32	Card	12	4	0	6	1
930803	32	Onsite	3	0	0	0	0
930806	32	Card	9	0	0	9	6

-continued-

Table 2. (Page 2 of 2).

Date	Week	Interview		Chinook Salmon		Coho Salmon	
		Type	Number	Caught ^a	Kept	Caught ^a	Kept
930807	33	Card	30	0	0	83	31
930808	33	Card	25	0	0	67	28
930809	33	Card	4	0	0	1	1
930810	33	Card	11	0	0	17	8
930813	33	Card	11	0	0	127	11
930813	33	Onsite	4	0	0	34	8
930814	34	Card	19	0	0	86	13
930814	34	Onsite	8	0	0	60	16
930815	34	Card	31	13	2	141	19
930815	34	Onsite	5	0	0	5	5
930816	34	Card	25	0	0	62	15
930816	34	Onsite	7	0	0	15	13
930817	34	Card	11	0	0	58	5
930820	34	Card	24	0	0	176	24
930820	34	Onsite	4	0	0	16	8
930821	35	Card	23	1	1	106	12
930822	35	Card	28	1	1	95	17
930822	35	Onsite	20	0	0	26	9
930823	35	Card	18	0	0	69	12
930824	35	Card	17	0	0	70	8
Onsite Interview Total			229	242	100	156	59
Card Interview Total			<u>1,041</u>	<u>2,105</u>	<u>403</u>	<u>1,243</u>	<u>234</u>
Overall Total			1,270	2,347	503	1,399	293
<u>Chinook Salmon Season^c</u>							
Onsite Interview			181	242	100		
Card Interview			<u>755</u>	<u>2,090</u>	<u>399</u>		
Season Total			936	2,332	499		
<u>Coho Salmon Season^d</u>							
Onsite Interview Total			96			156	59
Card Interview Total			<u>428</u>			<u>1,201</u>	<u>218</u>
Season Total			524			1,357	277

^a Catch = fish kept + fish released.

^b These were very unlikely to be all coho salmon and were excluded from coho fishery analysis.

^c 2 July-3 August 1993.

^d 25 July-24 August 1993.

Next, careful consideration was given to the nature of the onsite completed-trip interviews and how they should be treated with regard to the card completed-trip interviews. Though a small proportion of the whole data set, most anglers completing trips onsite used guides who parked their planes in front of the survey camp, and flew in and out on the same day. Their representation in the survey is probably proportional to their participation in the fishery considering the very high proportion of contact the survey technicians had with all anglers on the river. The fly-in anglers were an important part of the fishery and a bias would be incurred by excluding their interviews. Most of the card completed-trip interviews were from anglers from one of the three lodges located along the Alagnak River. Given the general similarity between harvests recorded for onsite and card interviews, and the character of each interview group, the data were combined to produce the following estimates of catch and harvest success for both chinook and coho salmon.

Chinook Salmon Fishery Survey

The period or "season" selected for analysis of the recreational chinook salmon fishery was 2 July through 3 August, during which the majority of anglers reported catches and harvests of that species. During the chinook salmon season, 936 completed-trip interviews were conducted: 755 card completed-trips and 181 onsite interviews (Table 2). The peak day for interviewing anglers during the chinook salmon fishery was 19 July, when 117 anglers were interviewed.

Catch and Harvest:

Anglers caught at least one chinook salmon in 63% (SE = 2) of fishing trips, and 41% (SE = 2) of the trips resulted in a harvest of one or more fish (Table 3 and Figure 3). Very few anglers reported harvesting the full bag limit of three chinook salmon.

Thirty percent (SE = 2) of anglers harvested one chinook salmon (Table 4 and Figure 4). The first chinook salmon harvested among all anglers accounted for 76% (SE = 1) of the total harvest of 499 chinook salmon (Table 4 and Figure 4).

Number of Trips, Catch, and Harvest by Gear and Angler Types:

During the chinook salmon season, 73% (SE = 1) of anglers used spin gear, 7% (SE = 1) used both spin and fly gear, and 21% (SE = 1) used fly tackle exclusively (Table 5). During the chinook salmon season, 704 spin gear trips, 75 spin and fly trips, and 157 fly gear trips were recorded for completed-trip interviews (Table 6). The bulk of the catch and harvest was taken by anglers using spin gear but the rates of retention (number of fish harvested as a percentage of the number caught) differed little between gear types (Table 6).

Most anglers (83%, SE < 1) were guided during the chinook salmon fishery (Table 5). Guided anglers accounted for 92% (SE = 1) of the catch and 87% (SE = 1) of the harvest (Table 6). Guided anglers kept or harvested slightly over 20% of the fish they caught while unguided anglers retained 36% (Table 6).

Table 3. Distribution of catch and harvest during the chinook salmon sport fishery on the lower Alagnak River, 2 July to 3 August 1993.^a

Number of Fish	Catch (released + kept)					Harvest (kept) ^b				
	Percent of Trips	SE	95% Confidence Interval			Percent of Trips	SE	95% Confidence Interval		
			Lower	-	Upper			Lower	-	Upper
0	37	2	34	-	40	59	2	56	-	62
1+	63	2	60	-	66	41	2	38	-	44
2+	46	2	43	-	49	10	1	8	-	12
3+	35	2	32	-	38	1	<1	0	-	1
4+	27	2	24	-	30	<1	<1	0	-	1
5+	22	1	19	-	24					
6+	17	1	14	-	19					
7+	12	1	10	-	14					
8+	9	1	7	-	11					
9+	6	1	5	-	8					
10+	4	1	3	-	5					
11+	3	1	2	-	4					

^a Total Trips = 936; Total Catch = 2,332; Total Harvest = 499.

^b One angler reported keeping 9 fish in 1 day. This may have been a non-English speaking angler who mismarked the angler report card.

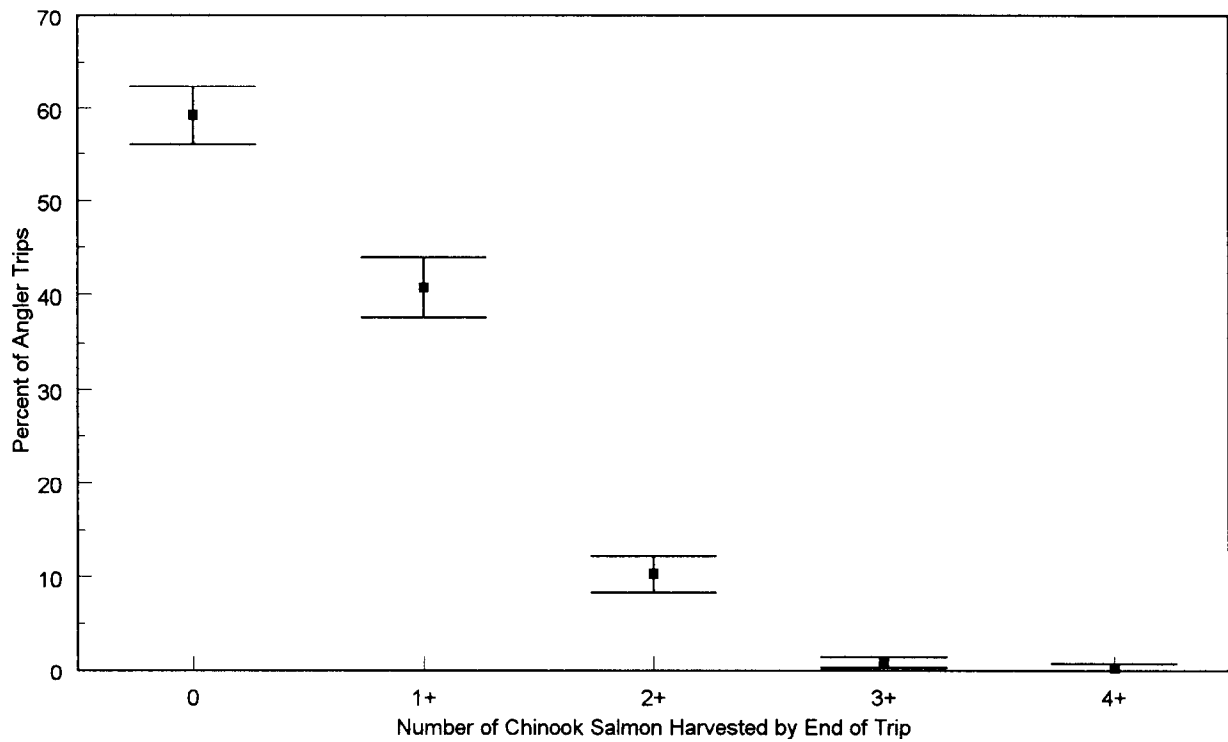
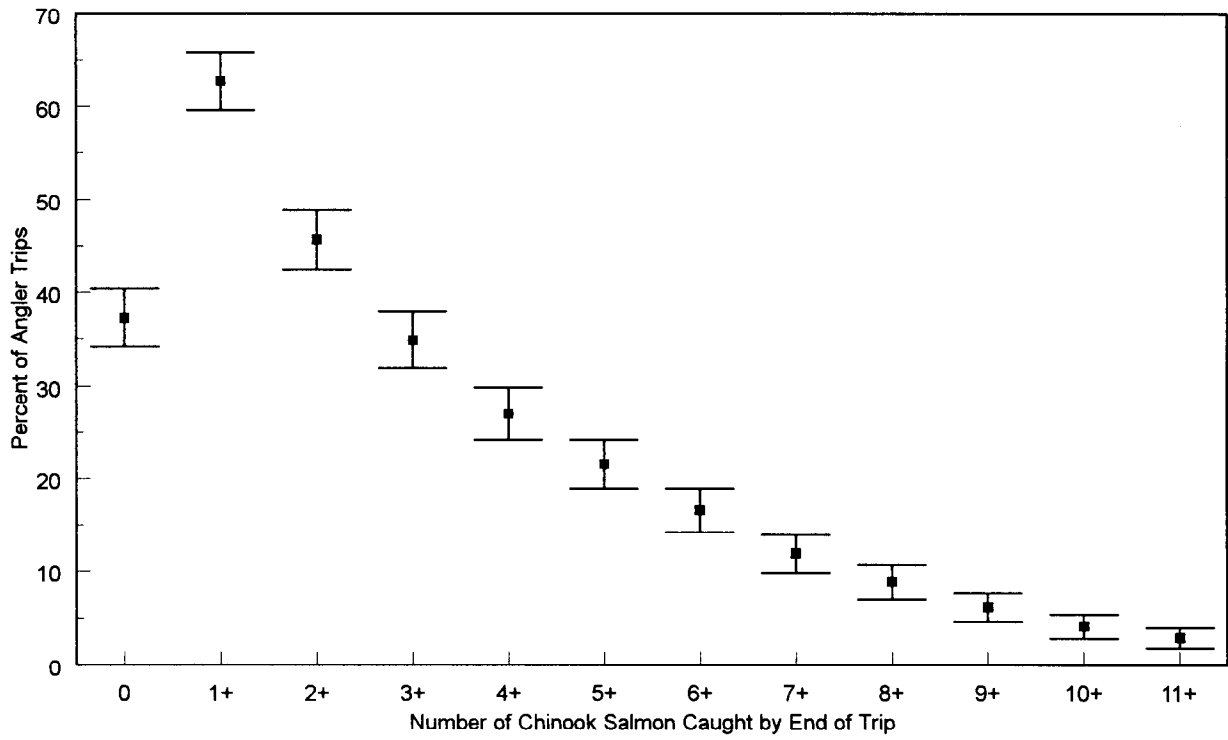


Figure 3. Distribution of catch and harvest in the lower Alagnak River chinook salmon sport fishery, 2 July to 3 August 1993.

Table 4. Number and percent of angler trips by number of fish kept, and harvest by sequence of fish harvested, in the chinook salmon sport fishery on the lower Alagnak River, 2 July to 3 August 1993. (Complete trips only.)

Fish Kept	Angler Trips	Percent of Trips	SE	95% Confidence Interval		Total Harvest	Sequence of Fish Harvested	Contribution to Total Harvest		
				Lower	Upper			Fish	Percent	SE
0	555	59	2	56	- 62					
1	285	30	2	28	- 33	285	1st	381	76	1
2	88	9	1	8	- 11	176	2nd	96	19	1
3	5	1	<1	0	- 1	15	3rd	8	2	<1
4+	<u>3</u>	<1	<1	0	- 1	<u>23</u>	4th+	<u>14</u>	3	1
TOTAL 936						499		499		

^a One angler reported keeping 9 fish in 1 day. This may have been a non-English speaking angler who mismarked the angler report card.

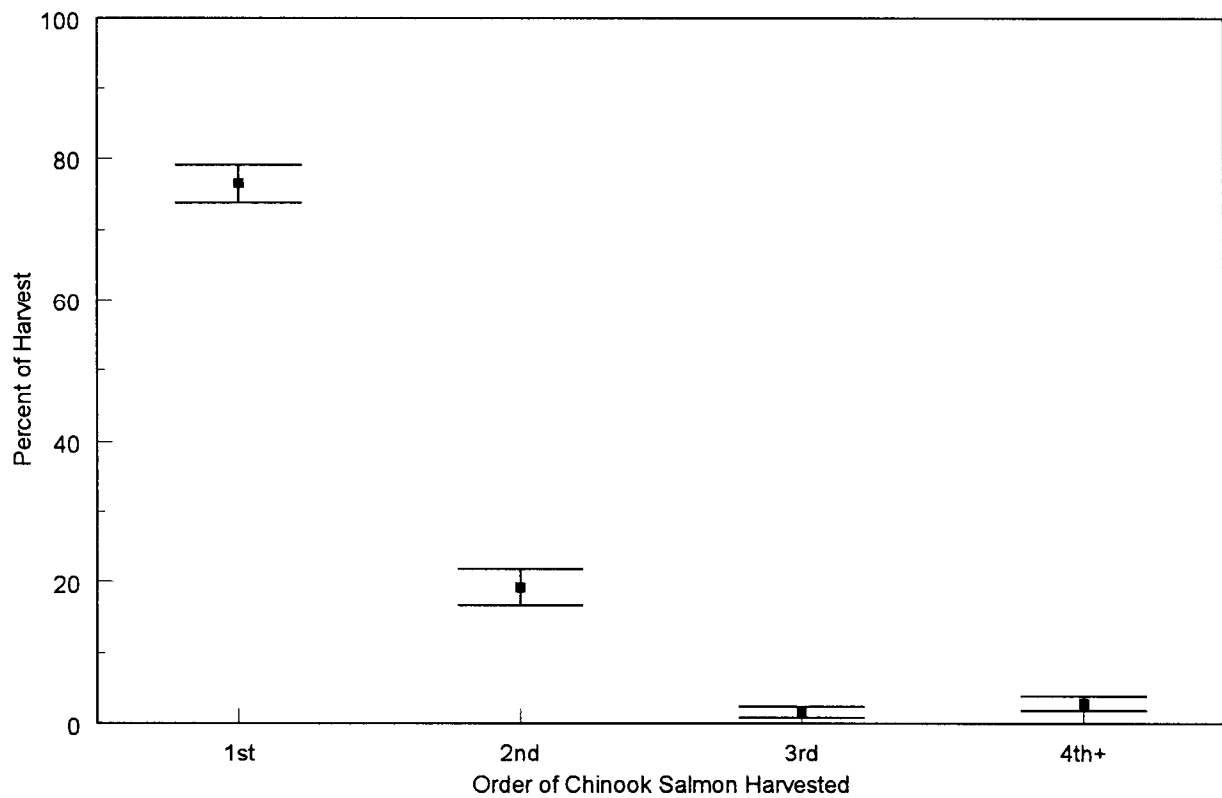
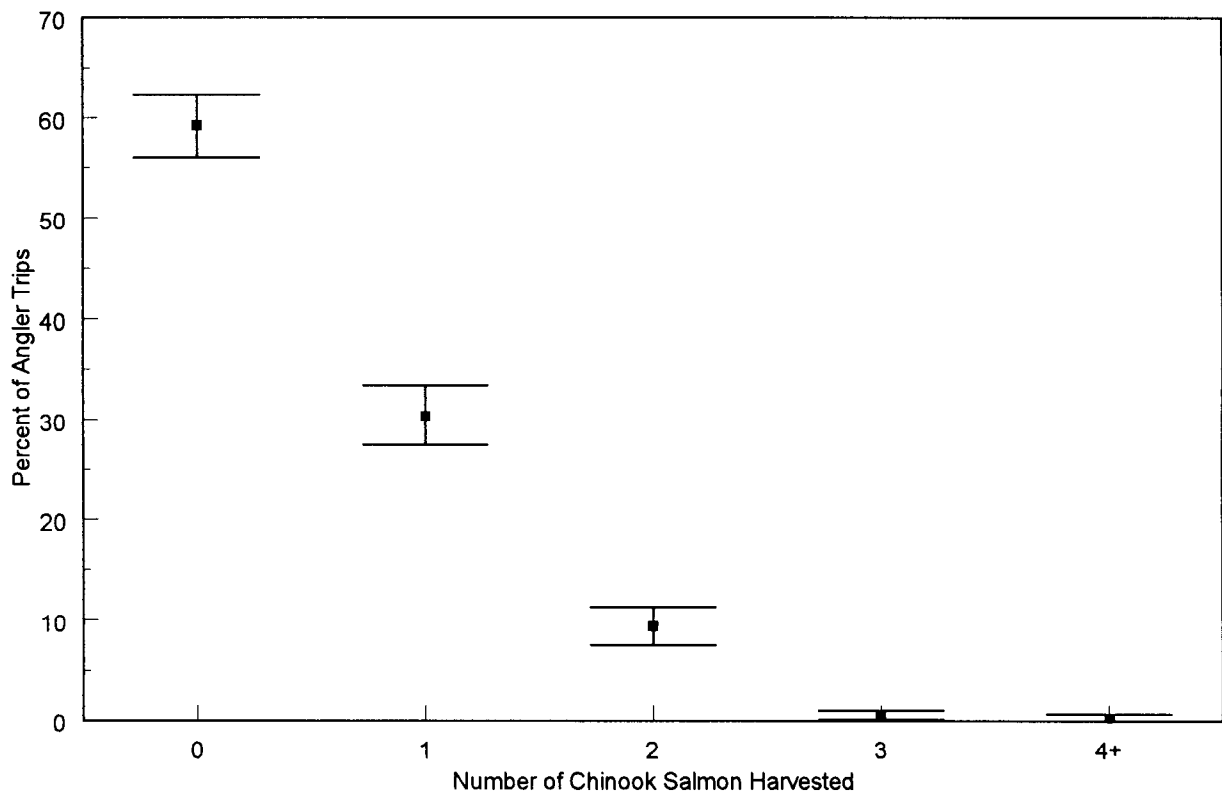


Figure 4. Percent of angler trips by number of chinook salmon harvested in the lower Alagnak River sport fishery, 2 July to 3 August 1993.

Table 5. Number and percent of angler-trips by gear type, and by guided and unguided anglers, during the chinook salmon sport fishery on the lower Alagnak River, 2 July to 3 August 1993. (All interviews.)

Characteristic	Angler-trips	Percent	SE
Spin	1,094	73	1
Spin & Fly	105	7	1
Fly	<u>311</u>	21	1
Total	1,510		
Guided	1,258	83	<1
Unguided	<u>252</u>	17	<1
Total	1,510		

Table 6. Catch and harvest of chinook salmon by gear type and angler type for all completed-trip interviews^a on the lower Alagnak River, 2 July to 3 August 1993.

	Angler Trips	Catch			Harvest			Percent Retained ^b
		Number of Fish	Per- cent	SE	Number of Fish	Per- cent	SE	
<u>Gear Type</u>								
Spin	704	2,079	89	1	457	92	1	22
Spin and Fly	75	153	7	1	22	4	1	14
Fly	<u>157</u>	<u>100</u>	4	1	<u>20</u>	4	1	<u>20</u>
Total	936	2,332			499			21
<u>Angler type</u>								
Guided	783	2,152	92	1	434	87	1	20
Unguided	<u>153</u>	<u>180</u>	8	1	<u>65</u>	13	1	<u>36</u>
Total	936	2,332			499			21

^a All onsite completed-trip interviews + all card completed-trip interviews.

^b Percent retained = number of fish harvested or kept/number of fish caught * 100.

Chinook Salmon Size, Sex, and Age Composition:

The sport harvest of Alagnak River chinook salmon was composed of 35% (SE = 3) females and 65% (SE = 3) males. Most chinook salmon were age-1.4 (51%, SE = 3), while 31% (SE = 3) were age-1.3 (Table 7). Harvested chinook salmon (sexes combined) averaged 865 mm (SE = 8) or 34 inches in length and 12.2 kg (SE = 0.3) or nearly 27 pounds in weight (Table 7). The biggest chinook salmon sampled was 1,091 mm (43 inches) in length and weighed 22.9 kg (50.4 pounds).

Coho Salmon Fishery Survey

Most sport catch and harvest of coho salmon occurred during the "season" of 25 July through 24 August (Table 2). Some reports of catches and harvests of coho salmon prior to 25 July were probably a result of incorrect species identification, particularly in early July, and were excluded from analysis. A total of 524 completed-trip interviews was used: 428 card completed-trip interviews and 96 onsite interviews (Table 2). The peak day for interviewing anglers during the coho salmon season was 15 August when 71 interviews were conducted.

Catch and Harvest:

Anglers were less successful during the coho salmon fishery than during the chinook salmon fishery. Only 54% (SE = 2) of angler trips resulted in a catch of one or more coho salmon, and only 31% (SE = 2) of the trips resulted in a harvest of one or more fish (Table 8 and Figure 5).

The percent of anglers harvesting one and two coho salmon was about equal at 14% (SE = 2) and 15% (SE = 2), respectively (Table 9 and Figure 6). The first coho salmon among all anglers' daily harvests accounted for 59% (SE = 3) of the 277 coho salmon harvested during the season (Table 9 and Figure 6).

Number of Trips, Catch, and Harvest by Gear and Angler Types:

During the coho salmon season, the use of fly gear was most popular (45%, SE = 2), followed by spin gear (43%, SE = 2), and a combination of spin and fly gear (12%, SE = 1) (Table 10). Anglers using spin gear during the coho salmon season accounted for 47% (SE = 1) of the catch and 58% (SE = 3) of the harvest, with a retention rate of 25% (Table 11). Contributions to the catch and harvest by anglers using both spin and fly gear were nearly equal (24% and 25%, respectively). The retention rate by anglers using spin and fly gear was very close to that of spin gear users (Table 11). Anglers using fly gear exclusively accounted for 29% (SE = 1) of the entire coho salmon recreational catch, and produced 17% (SE = 2) of the total coho salmon harvest (Table 11).

During the coho salmon fishery, most anglers were guided (95%, SE = 1) (Table 10). Guided anglers produced 90% (SE = 1) of the catch and 88% (SE = 2) of the harvest, with a retention rate of 20% (Table 11). While unguided anglers accounted for only a small portion of the total catch and harvest, the 23% rate of retention was very similar to that of the guided anglers.

Table 7. Estimated mean lengths (mm) and weights (kg), by sex and age group, of chinook salmon harvested during the sport fishery on the lower Alagnak River, 2 July to 3 August 1993.

	Age Group						TOTAL	
	1.1	1.2	1.3	1.4	1.5	2.2		2.3
<u>FEMALES</u>								
Percent	0	2	10	22	1	0	0	35
SE		1	2	3	1			3
Sample Size (Known Age)	0	6	29	63	2	0	0	100
Mean Length		724	889	929	840			894
SE		72	11	7	2			9
Sample Size	0	6	29	63	2	0	0	115
Mean Weight		7.2	12.2	14.0	9.6			12.7
SE		2.0	0.5	0.4	0.4			0.3
Sample Size	0	6	29	63	2	0	0	115
<u>MALES</u>								
Percent	1	14	20	28	1	<1	<1	65
SE	1	2	3	3	1	<1	<1	3
Sample Size (Known Age)	2	39	58	81	3	1	1	185
Mean Length	410	622	881	938	835	595	710	849
SE	10	15	14	10	112			11
Sample Size	2	38	58	81	3	1	1	204
Mean Weight	14.0	5.2	12.4	14.9	11.5	3.5	6.6	12.0
SE	1.2	0.6	0.6	0.4	3.8			0.4
Sample Size	2	39	57	81	3	1	1	204
<u>ALL SAMPLES</u>								
Percent	1	16	31	51	2	<1	<1	100
SE	1	2	3	3	1	<1	<1	
Sample Size (Known Age)	2	45	87	144	5	1	1	285
Mean Length	410	636	884	934	837	595	710	865
SE	10	16	10	7	61			8
Sample Size	2	44	87	144	5	1	1	319
Mean Weight	14.0	5.5	12.3	14.5	10.7	3.5	6.6	12.2
SE	0.1	0.6	0.4	0.3	2.1			0.3
Sample Size	2	45	86	144	5	1	1	319

Table 8. Distribution of catch and harvest during the coho salmon sport fishery on the lower Alagnak River, 25 July to 24 August 1993.^a

Number of Fish	Catch (released + kept)					Harvest (kept) ^b				
	Percent of Trips	SE	95% Confidence Interval			Percent of Trips	SE	95% Confidence Interval		
			Lower	-	Upper			Lower	-	Upper
0	47	2	42	-	51	69	2	65	-	73
1+	54	2	49	-	58	31	2	27	-	35
2+	43	2	39	-	47	18	2	14	-	21
3+	30	2	26	-	34	2	1	1	-	4
4+	24	2	20	-	27	2	1	1	-	3
5+	20	2	17	-	23	<1	<1	0	-	1
6+	16	2	12	-	19					
7+	14	2	11	-	17					
8+	13	2	10	-	16					
9+	11	1	8	-	13					
10+	8	1	6	-	10					
11+	6	1	4	-	8					
12+	5	1	3	-	7					
13+	4	1	2	-	6					
14+	3	1	2	-	5					
15+	3	1	1	-	4					

^a Total Interviews = 524; Total Catch = 1,357; Total harvest = 277.

^b Bag limit reduced to 2 fish per day beginning 8 August.

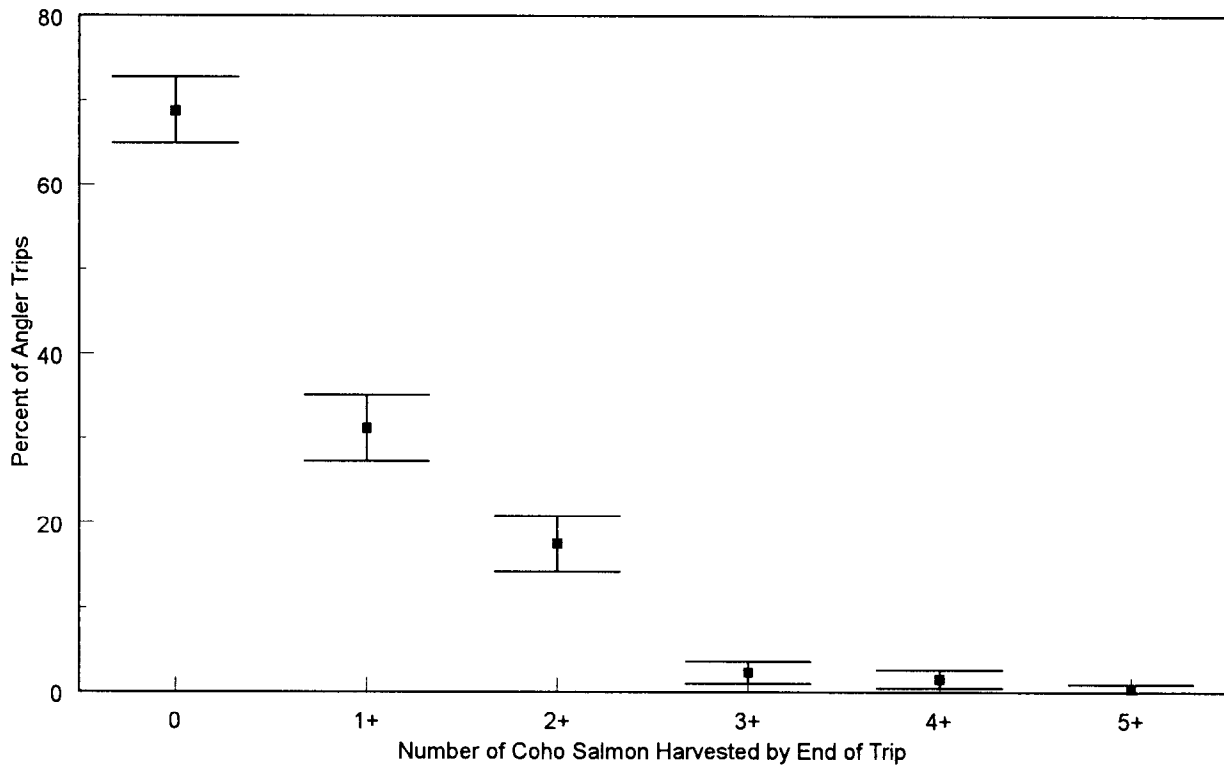
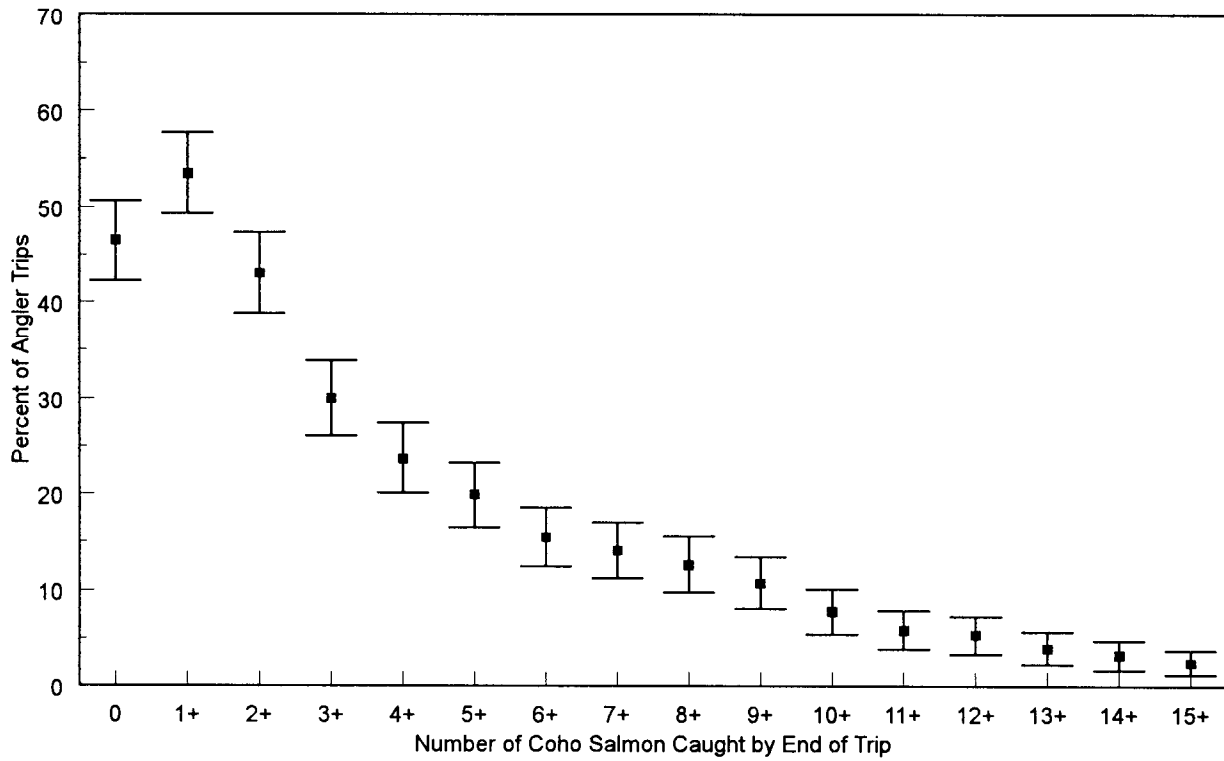


Figure 5. Distribution of catch and harvest in the lower Alagnak River coho salmon sport fishery, 25 July to 24 August 1993.

Table 9. Number and percent of angler trips by number of fish kept, and harvest by sequence of fish harvested, in the coho salmon sport fishery on the lower Alagnak River, 25 July to 24 August 1993. (Completed trips only.)^a

Fish Kept	Angler Trips	Percent of Trips	SE	95% Confidence Interval		Total Harvest	Sequence of Fish Harvested	Contribution to Total Harvest			
				Lower	Upper			Fish	Percent	SE	
0	361	69	2	65	-	73					
1	71	14	2	11	-	17	71	1st	163	59	3
2	80	15	2	12	-	18	160	2nd	92	33	3
3	4	1	<1	0	-	2	12	3rd	12	4	1
4	6	1	1	0	-	2	24	4th	8	3	1
5+	<u>2</u>	<1	<1				<u>10</u>	5th+	<u>2</u>	1	1
Total	524					277			277		

^a Bag limit reduced to 2 fish per day beginning 8 August.

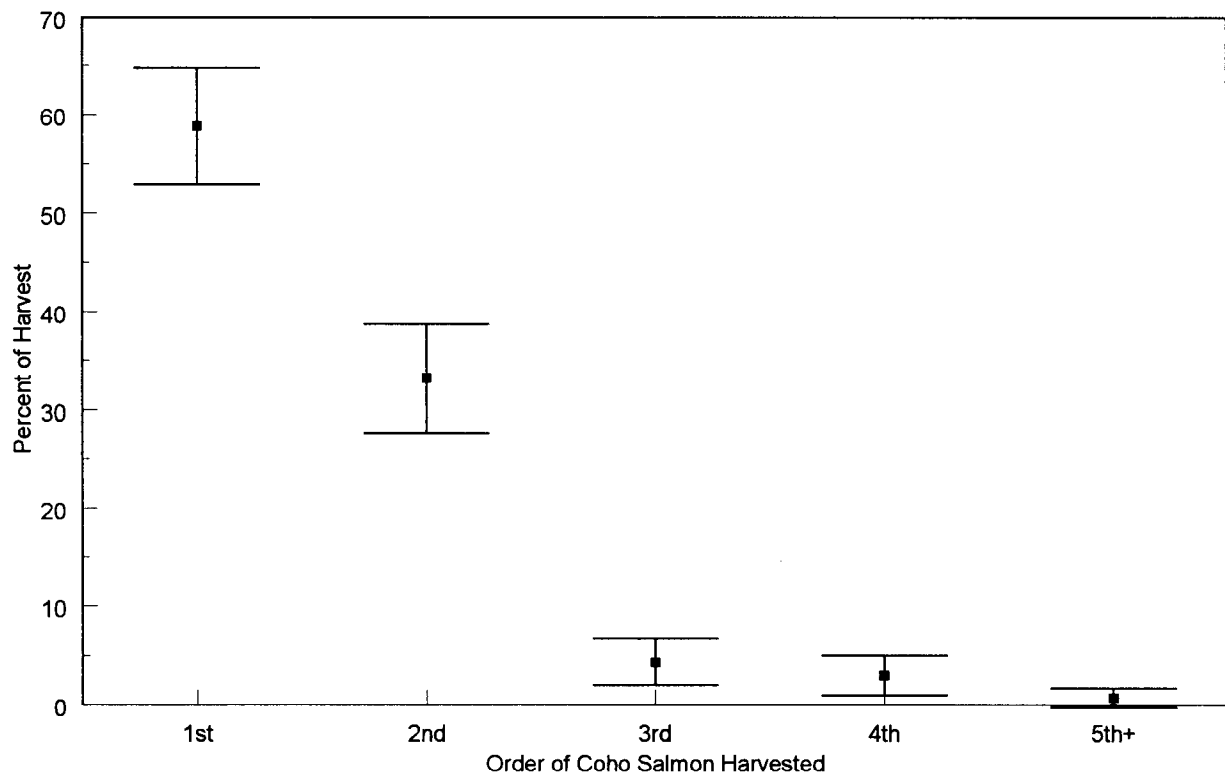
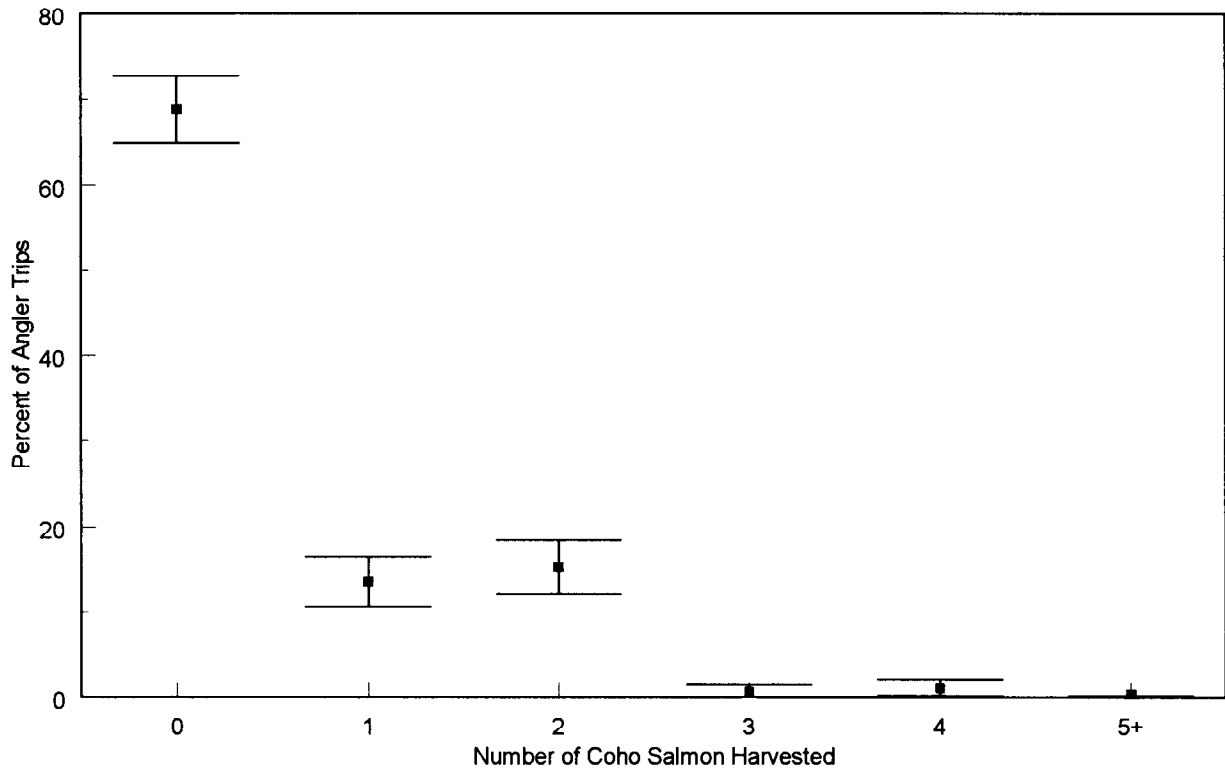


Figure 6. Percent of angler trips by number of coho salmon harvested in the lower Alagnak River sport fishery, 25 July to 24 August 1993.

Table 10. Number and percent of angler-trips by gear type, and by guided and unguided anglers, during the coho salmon sport fishery on the lower Alagnak River, 25 July to 24 August 1993. (All interviews.)

Characteristic	Angler-trips	Percent	SE
Spin	459	43	2
Spin & Fly	127	12	1
Fly	<u>478</u>	45	2
Total	1,064		
Guided	1,006	95	1
Unguided	<u>58</u>	6	1
Total	1,064		

Table 11. Catch and harvest^a of coho salmon by gear and angler type for all completed-trip interviews^b on the lower Alagnak River, 25 July to 24 August 1993.

	Angler Trips	Catch			Harvest			Percent Retained ^c
		Number of Fish	Percent	SE	Number of Fish	Percent	SE	
<u>Gear Type</u>								
Spin	273	641	47	1	161	58	3	25
Spin & Fly	84	324	24	1	69	25	3	21
Fly	<u>167</u>	<u>392</u>	29	1	<u>47</u>	17	2	<u>12</u>
Total	524	1,357			277			20
<u>Angler Type</u>								
Guided	491	1,214	90	1	244	88	2	20
Unguided	<u>33</u>	<u>143</u>	11	1	<u>33</u>	12	2	<u>23</u>
Total	524	1,357			277			20

^a Bag limit reduced to 2 fish per day beginning 8 August.

^b All onsite completed-trip interviews + all card completed-trip interviews.

^c Percent retained = number of fish harvested or kept/number of fish caught * 100.

Coho Salmon Size, Sex, and Age Composition:

Twenty-six percent (SE = 4) of the coho salmon harvested during the season were females and 74% (SE = 4) were males (Table 12). Most harvested coho salmon were age-2.1 (75%, SE = 4), and age-1.1 (19%, SE = 3). Harvested coho salmon averaged 585 mm (SE = 3) or 23 inches in length, and weighed an average 3.6 kg (SE <0.1) or nearly 8 pounds. The biggest coho salmon sampled was 672 mm (26.5 inches) in length and weighed 5.8 kg (12.8 pounds).

Other species sampled during the survey are documented in Appendix B. Computer programs and data files used for this report are in Appendix C.

DISCUSSION

The 1993 recreational chinook salmon fishery on the Alagnak River was quite good. The aerial escapement index conducted by Commercial Fisheries Management and Development Division was 10,170 spawning chinook salmon—the best escapement on record (Minard *In press*). In addition to their abundance, chinook salmon returned consistently throughout the season, providing a steady supply of new fish entering the river and the sport fishery.

Previous fishery surveys were designed to estimate effort, catch, and harvest of Alagnak River chinook salmon, but these surveys did not produce much data comparable to the 1993 data. One comparable statistic is the retention rate for the chinook salmon fishery. The 1988 and 1989 retention rates of about 50% were typical of most of the area's fisheries (Dunaway 1990). In 1993, the overall retention rate was about 23%, which might indicate a change in anglers' habits since 1989. During the 1993 season, a squabble developed between some lodge operators over the interpretation of the state's artificial lure regulation and over an apparent agreement to voluntarily restrict their harvest to two males. Whether this "gentlemen's agreement" or the squabbles influenced actual harvest rates or the catch and harvest reported to ADF&G is unclear. Being dependent upon anglers' memories over long and often eventful days, catches may be less accurately reported than harvests where anglers can easily count the fish they have retained.

An extremely poor early run of coho salmon, and subsequent reduction of the bag limit from five to two fish per day on 8 August (Emergency Order 2-SS-5-30-93) disrupted the normal process of the fishery and influenced the harvest data presented in the coho salmon section of this report. Test results comparing the coho salmon catch and harvest success before and after the bag limit reduction were confusing at best; the poor run early in the season provided very erratic angling success for several weeks and there was a total absence of onsite completed-trip interviews for the days 6 through 10 August (Table 2). The data presented came from the whole "season" since the emergency order occurred too early in the run for distributions of catch and harvest to be meaningful.

The 1993 survey data are expected to provide a good basis for evaluating future fishery performance, the suitability of available management tools, and the potential effects of various management actions. For instance, to significantly reduce the recreational chinook salmon harvest, a bag limit reduction to one fish per day would be required (Table 4), and about 41% of all anglers

Table 12. Estimated mean lengths (mm) and weights (kg), by sex and age group, of coho salmon harvested during the sport fishery on the lower Alagnak River, 30 July to 24 August 1993.

	Age Group				TOTAL
	1.1	1.2	2.1	3.1	
<u>FEMALES</u>					
Percent	5	0	19	2	26
SE	2	0	3	1	4
Sample Size (Known Age)	7	0	26	2	35
Mean Length	580		575	575	577
SE	17		8	26	7
Sample Size	7	0	26	2	37
Mean Weight	3.5		3.3	3.2	3.3
SE	0.3		0.1	0.2	0.1
Sample Size	7	0	26	2	37
<u>MALES</u>					
Percent	14	1	56	4	74
SE	3	1	4	2	4
Sample Size (Known Age)	19	1	75	5	100
Mean Length	568	663	592	577	587
SE	9		4	26	3
Sample Size	19	1	75	5	127
Mean Weight	3.3	5.1	3.7	3.7	3.7
SE	<0.1		<0.1	0.1	<0.1
Sample Size	19	1	75	5	127
<u>ALL SAMPLES</u>					
Percent	19	1	75	5	100
SE	3	1	4	2	-
Sample Size (Known Age)	26	1	101	7	135
Mean Length	571	663	587	576	585
SE	8	-	4	19	3
Sample Size	26	1	101	7	164
Mean Weight	3.3	5.1	3.6	3.6	3.6
SE	<0.1	-	<0.1	<0.1	<0.1
Sample Size	26	1	101	7	164

harvesting chinook salmon would be affected by such a reduction (Table 3). In addition, anglers using spin gear only would probably be affected more than anglers using fly gear only, because anglers using spin gear have a higher retention rate of chinook salmon (Table 6).

Other than a suggestion to clarify the definition of an unbaited, artificial lure, this report finds no need and makes no recommendations for regulatory actions on the Alagnak River sport fishery at this time.

ACKNOWLEDGEMENTS

We are especially grateful to the lodge operators, their guides, and their clients for accommodating and supporting this survey. We wish to acknowledge technicians David Wightman and Brandon Cherry for their diligent and hard work collecting all the data. Mr. Wightman's end-of-the-season notes for the project were particularly helpful in the completion of this report. We thank Sandra Sonnichsen and Keith Webster for their help with the data programs and preliminary analysis; Allen Bingham for his statistical and editorial review and guidance; Kathy Kush for her rapid and accurate card data entry; and Mike and Dalia Andrew for the cabin they allowed us to use.

LITERATURE CITED

- ADF&G (Alaska Department of Fish and Game). 1987. 1987 Alaska sport fishing regulations summary. Alaska Department of Fish and Game, Juneau.
- _____. 1988. 1988 Alaska sport fishing regulations summary. Alaska Department of Fish and Game, Juneau.
- _____. 1989. 1989 Alaska sport fishing regulations summary. Alaska Department of Fish and Game, Juneau.
- _____. 1990. 1990 Alaska sport fishing regulations summary. Alaska Department of Fish and Game, Juneau.
- _____. 1991. 1991 Alaska sport fishing regulations summary. Alaska Department of Fish and Game, Juneau.
- _____. 1992. 1992 Alaska sport fishing regulations summary. Alaska Department of Fish and Game, Juneau.
- _____. 1993. 1993 Alaska sport fishing regulations summary. Alaska Department of Fish and Game, Juneau.
- Bernard, D. R., A. E. Bingham, and M. Alexandersdottir. *In prep.* The mechanics of conducting onsite creel surveys in Alaska. Alaska Department of Fish and Game, Special Publication, Anchorage.
- Brookover, T. E. 1989. Creel and escapement statistics for the Alagnak River, during 1988. Alaska Department of Fish and Game, Fishery Data Series No. 89, Juneau.

LITERATURE CITED (Continued)

- Clutter, R. I. and L. E. Whitesel. 1956. Collection and interpretation of sockeye salmon scales. Bulletin IX of the International Pacific Salmon Fisheries Commission, New Westminster, British Columbia, Canada.
- Cochran, W. G. 1977. Sampling techniques, third edition. John Wiley and Sons, New York.
- Dunaway, D. O. 1990. Creel and escapement statistics for the Alagnak River, Alaska during 1989. Alaska Department of Fish and Game, Fishery Data Series No. 90-9, Anchorage.
- Heineman, G. H. 1991. Instructions for using sport fish creel survey and biological mark-sense forms, 1991. Alaska Department of Fish and Game, Division of Sport Fish, Research and Technical Services Section, Anchorage.
- Lux, F. E. 1971. Age determination of fishes (revised). National Marine Fisheries Service. Fishery Leaflet 637. Seattle, Washington.
- Mills, M. J. 1982. Alaska statewide sport fish harvest studies (1981). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1981-1982, Project F-9-14, 23 (SW-1-A), Juneau.
- _____. 1983. Alaska statewide sport fish harvest studies (1982). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1982-1983, Project F-9-15, 24 (SW-1-A), Juneau.
- _____. 1984. Alaska statewide sport fish harvest studies (1983). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1983-1984, Project F-9-16, 25 (SW-1-A), Juneau.
- _____. 1985. Alaska statewide sport fish harvest studies (1984). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1984-1985, Project F-9-17, 26 (SW-1-A), Juneau.
- _____. 1986. Alaska statewide sport fish harvest studies (1985). Alaska Department of Fish and Game. Federal Aid in Fish Restoration, Annual Performance Report, 1985-1986, Project F-10-1, 27 (RT-2), Juneau.
- _____. 1987. Alaska statewide sport fisheries harvest report 1986. Alaska Department of Fish and Game, Fishery Data Series No. 2, Juneau.
- _____. 1988. Alaska statewide sport fisheries harvest report 1987. Alaska Department of Fish and Game, Fishery Data Series No. 52, Juneau.
- _____. 1989. Alaska statewide sport fisheries harvest report 1988. Alaska Department of Fish and Game, Fishery Data Series No. 122, Juneau.
- _____. 1990. Harvest and participation in Alaska sport fisheries during 1989. Alaska Department of Fish and Game, Fishery Data Series No. 90-44, Anchorage.

LITERATURE CITED (Continued)

- _____. 1991. Harvest and participation in Alaska sport fisheries during 1990. Alaska Department of Fish and Game, Fishery Data Series No. 91-58, Anchorage.
- _____. 1992. Harvest and participation in Alaska sport fisheries during 1991. Alaska Department of Fish and Game. Fishery Data Series No. 92-40, Anchorage.
- _____. 1993. Harvest, catch, and participation in Alaska sport fisheries during 1992. Alaska Department of Fish and Game, Fishery Data Series No. 93-42, Anchorage.
- Minard, R. E. *In press*. Area management report for the recreational fisheries of the Southwest Alaska management area, 1993. Alaska Department of Fish and Game, Fishery Management report, Anchorage.
- Scarnecchia, D. L. 1979. Variation of scale characteristics of coho salmon with sampling location on the body. *Progressive Fish Culturist* 41(3):132-135.
- Sokal, R. R. and F. J. Rohlf. 1981. *Biometry*, second edition. W. H. Freeman and Company, New York.
- Thompson, S. K. 1987. Sample size for estimating multinomial proportions. *The American Statistician* 41:42-46.
- Welanders, A. D. 1940. A study of the development of the scale of the chinook salmon (*Oncorhynchus tshawytscha*). Master's thesis, University of Washington, Seattle.

APPENDIX A
COMPARISONS OF INTERVIEW DATA

Appendix A. Comparisons of interview data.

Harvests and catches made by completed-trip anglers interviewed onsite were compared to catches and harvests reported from card completed-trip interviews. Comparisons were made within each week, however for many weeks there were not enough onsite interviews for valid comparisons to be made. Harvest and catch were divided into three categories of interviews reporting: 0 fish kept (or caught), 1 fish kept (or caught), and > 1 fish kept (or caught)(Test 1).

For chinook salmon kept there was no significant difference between onsite and card completed interviews for any of the 4 weeks that could be tested (Appendix A1). There was a significant difference in the number of chinook salmon caught from onsite and card completed interviews for weeks 30 and 31 (weeks 27 and 28 could not be tested)(Appendix A1). Anglers interviewed onsite reported catching more chinook salmon than those who returned cards.

Harvest and catch were also divided into just two interview categories: 0 fish kept (or caught) and > 0 fish kept (or caught)(Test 2). For weeks that could be tested, there were no significant differences between onsite and card completed interviews for the chinook salmon harvest or catch (Appendix A1).

Preliminary analysis of all coho salmon interview data was conducted in the same manner as for the chinook salmon fishery. Using three harvest or catch categories (Test 1), the card versus onsite interview catch and harvest could only be compared for weeks 32 and 33 combined and weeks 34 and 35 combined. Both periods (weeks 32/33 and 34/35) were significantly different for coho salmon kept, while the catch between interview types for weeks 34/35 were not significantly different (Appendix A2).

The coho salmon harvest and catch interviews were also divided into just two categories (Test 2). Weeks 34 and 35 were still significantly different for the coho salmon kept, but for the coho salmon caught, no difference could be detected (Appendix A2). For the combined weeks 32 and 33, the coho salmon kept were not significantly different while the catch remained significantly different.

Appendix A1. Comparisons of the number of chinook salmon kept or caught from card completed-trip interviews versus onsite completed-trip interviews on the lower Alagnak River, 2 July through 24 August 1993.

Test 1:

Categories: 0 fish kept (or caught), 1 fish kept (or caught), >1 fish kept (or caught); df = 2.

Week	Completed-Trip Interviews		Chinook Salmon		Fish Kept		Fish Caught ^a	
	Cards	Onsite	Kept	Caught ^a	χ^2	P	χ^2	P
27	12	0	18	95				
28	142	21	93	610	0.427	0.81		
29	232	51	168	843	4.992	0.08	3.215	0.20
30	193	61	146	549	3.115	0.21	17.492	0.00
31	115	33	69	216	2.547	0.28	6.258	0.04
32	70	15	5	19				
33	81	4	0	0				
34	110	24	2	13				
35	86	20	2	2				
Total	1,041	229	503	2,347				

Test 2:

Categories: 0 fish kept (or caught), >0 fish kept (or caught); df = 1.

Week	Completed-Trip Interviews		Chinook Salmon		Fish Kept		Fish Caught ^a	
	Cards	Onsite	Kept	Caught ^a	χ^2	P	χ^2	P
27	12	0	18	95				
28	142	21	93	610	0.361	0.55		
29	232	51	168	843	2.345	0.13	0.008	0.93
30	193	61	146	549	0.449	0.50	0.038	0.85
31	115	33	69	216	0.646	0.42	1.072	0.30
32	70	15	5	19				
33	81	4	0	0				
34	110	24	2	13				
35	86	20	2	2				
Total	1,041	229	503	2,347				

^a Caught = fish kept + fish released.

Appendix A2. Comparisons of the number of coho salmon harvested or caught from card completed-trip interviews versus onsite completed-trip interviews on the lower Alagnak River, 2 July through 24 August 1993.

Test 1:

Categories: 0 fish kept (or caught), 1 fish kept (or caught), >1 fish kept (or caught); df = 2.

Week	Completed-Trip Interviews		Coho Kept	Salmon Caught ^a	Fish Kept		Fish Caught ^a	
	Cards	Onsite			χ^2	P	χ^2	P
27	12	0	0	0				
28	142	21	0	1				
29	232	51	5	17				
30	193	61	11	24				
31	115	33	3	16				
32/33	151	19	98	356	5.033	<0.10	5.910	<0.10
34/35	<u>196</u>	<u>44</u>	<u>176</u>	<u>985</u>	15.260	0.00	0.339	>0.10
Total	1,041	229	293	1,399				

Test 2:

Categories: 0 fish kept (or caught), >0 fish kept (or caught); df = 1.

Week	Completed-Trip Interviews		Coho Kept	Salmon Caught ^a	Fish Kept		Fish Caught ^a	
	Cards	Onsite			χ^2	P	χ^2	P
27	12	0	0	0				
28	142	21	0	1				
29	232	51	5	17				
30	193	61	11	24				
31	115	33	3	16				
32/33	151	19	98	356	1.248	0.26	5.073	<0.10
34/35	<u>196</u>	<u>44</u>	<u>176</u>	<u>985</u>	8.658	0.00	0.338	>0.10
Total	1,041	229	293	1,399				

^a C = caught: fish kept + fish released.

APPENDIX B

SIZE, SEX, AND AGE DATA COLLECTED FROM OTHER SPECIES

Appendix B. Size, sex, and age data collected from other species.

During the survey, the technicians also collected samples from other species of fish anglers had caught or harvested. Appendices B1 through B3 summarize the data collected from chum and sockeye salmon, and rainbow trout. Most rainbow trout data were collected from live fish that were subsequently released unharmed.

Appendix B1. Mean lengths (mm) and weights (kg) of chum salmon, by sex and age group, from samples collected from the sport harvest on the lower Alagnak River during the period 6 July to 9 August 1993.

	Age Group				TOTAL
	UNKNOWN	0.3	0.4	0.5	
FEMALES					
Percent		3.8		7.7	11.5
SE		3.85		5.33	6.39
Sample Size (Known Age)		1		2	3
Mean Length		565		570	569
SE				2.50	2.33
Sample Size		1		2	3
Mean Weight		3.0		2.9	2.9
SE				0.00	0.03
Sample Size		1		2	3
MALES					
Percent		30.8	46.2	11.5	88.5
SE		9.23	9.97	6.39	6.39
Sample Size (Known Age)		8	12	3	23
Mean Length	625	583	615	597	603
SE		9.40	7.66	8.02	5.81
Sample Size	1	8	12	3	24
Mean Weight	4.0	3.2	3.9	3.4	3.6
SE		0.24	0.18	0.22	0.14
Sample Size	1	8	12	3	24
ALL SAMPLES					
Percent		34.6	46.2	19.2	100.0
SE		9.51	9.97	7.88	
Sample Size (Known Age)		9	12	5	26
Mean Length	625	581	615	586	599
SE		8.53	7.66	7.88	5.57
Sample Size	1	9	12	5	27
Mean Weight	4.0	3.2	3.9	3.2	3.5
SE		0.22	0.18	0.18	0.13
Sample Size	1	9	12	5	27

Appendix B2. Mean lengths (mm) and weights (kg) of sockeye salmon, by sex and age group, from samples collected from the sport harvest on the lower Alagnak River during the period 3 July to 13 July 1993.

	Age Group			TOTAL
	1.2	1.3	2.2	
FEMALES				
Percent	11.1	11.1		22.2
SE	7.62	7.62		10.08
Sample Size (Known Age)	2	2		4
Mean Length	509	553		531
SE	41.00	1.50		21.11
Sample Size	2	2		4
Mean Weight	2.4	3.2		2.8
SE	0.35	0.10		0.26
Sample Size	2	2		4
MALES				
Percent	22.2	50.0	5.6	77.8
SE	10.08	12.13	5.56	10.08
Sample Size (Known Age)	4	9	1	14
Mean Length	519	584	571	564
SE	21.60	7.43		10.83
Sample Size	4	9	1	14
Mean Weight	2.9	4.0	3.3	3.6
SE	0.22	0.21		0.02
Sample Size	4	9	1	14
ALL SAMPLES				
Percent	33.3	61.1	5.6	100.0
SE	11.43	11.82	5.56	
Sample Size (Known Age)	6	11	1	18
Mean Length	515	578	571	557
SE	17.40	7.06		9.92
Sample Size	6	11	1	18
Mean Weight	2.8	3.9	3.3	3.5
SE	0.19	0.20		0.18
Sample Size	6	11	1	18

Appendix B3. Mean lengths (mm) and weights (g) of rainbow trout, by age group, from samples collected from the sport fishery on the lower Alagnak River during the period 23 July to 4 August 1993.

	Age Group							TOTAL
	3	4	5	6	7	8	9	
ALL SAMPLES								
Percent	5.3	5.3	15.8	31.6	15.8	10.5	15.8	100.0
SE	5.26	5.26	8.59	10.96	8.59	7.23	8.59	
Sample Size (Known Age)	1	1	3	6	3	2	3	19
Mean Length	212	232	337	324	390	406	449	354
SE			29.17	15.27	10.65	24.00	15.72	16.51
Sample Size	1	1	3	6	3	2	3	19
Mean Weight	200	100	433	375	633	775	1100	558
SE			120.19	65.51	66.67	125.00	100.00	74.76
Sample Size	1	1	3	6	3	2	3	19

APPENDIX C

DATA FILES AND COMPUTER PROGRAMS USED TO PRODUCE THIS REPORT

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

Data Files

Interview data:

S008AIA3.DTA Onsite angler interviews 7/2/93 to 7/11/93.
S008AIB3.DTA Onsite angler interviews 7/11/93 to 7/27/93.
S008AIC3.DTA Onsite angler interviews 7/30/93 to 8/10/93.
S008AID3.DTA Onsite angler interviews 8/13/93 to 8/24/93.

Voluntary report card data.

S008AIX3.DTA Merged card and onsite interview data.
S008AIZ3.DTA Merged card and onsite interview data converted to one row per interview, showing catch and harvest of chinook and coho salmon, and rainbow trout. This data file used for the analysis and results presented.

Biological data:

S0080BA3.DTA Rainbow trout sport catch.
S008ABA3.DTA Chinook salmon sport harvest.
S008ABBA3.DTA Sockeye salmon sport harvest.
S008ABC3.DTA Chum salmon sport harvest.
S008ABD3.DTA Coho salmon sport harvest.

Analysis Programs

CC91 A series of programs which sorts raw data from a file and produces frequency reports and finds 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.

CARDENTR.PRG Program to enter data from voluntary report cards.

DOINT90 A set of Dbase (tm) programs that reformats standard angler interview data files into a single row of data for each angler.

MERGE.PRG A set of Dbase (tm) programs used to merge the original onsite interview data files with the products of CARDENTR.PRG.
