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CREEL AND ESCAPEMENT STATISTICS FOR THE ALAGNAK RIVER, ALASKA DURING 1989[1]

By

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ABSTRACT

A roving creel survey was conducted on a 19.2 kilometer (11.5 mile) section of the lower Alagnak River from 28 June through 6 August 1989. An estimated 19,723 angler-hours of sport fishing effort were expended on the lower river. This effort resulted in a catch (fish kept plus fish released) of 3,726 chinook salmon *Oncorhynchus tshawytscha*, 0 pink salmon *Oncorhynchus gorbuscha*, 473 chum salmon *Oncorhynchus keta*, 55 coho salmon *Oncorhynchus kisutch*, and 158 rainbow trout *Oncorhynchus mykiss*. Of this catch, an estimated 1,333 chinook salmon, 55 coho salmon, 14 chum salmon, and 14 rainbow trout were harvested (kept). The spawning escapement of chinook salmon into the Alagnak drainage during 1989 was estimated to be 5,400 fish. Age 1.4 chinook salmon was the most abundant age group in the sport harvest (58 percent).

KEY WORDS: chinook salmon, *Oncorhynchus tshawytscha*, pink salmon, *Oncorhynchus gorbuscha*, coho salmon, *Oncorhynchus kisutch*, chum salmon, *Oncorhynchus keta*, rainbow trout, *Oncorhynchus mykiss*, creel survey, sport harvest, sport catch, sport effort, escapement, age composition, Alagnak River, Bristol Bay.

INTRODUCTION

The Alagnak River is located within the Bristol Bay Wild Trout Zone, approximately 64 km (40 mi) north of the town of Naknek (Figures 1 & 2). Besides having an abundance of rainbow trout *Oncorhynchus mykiss*, Arctic grayling *Thymallus arcticus*, and Dolly Varden *Salvelinus malma*, the Alagnak River sustains significant runs of five species of Pacific salmon *Oncorhynchus spp*. Sport fishing effort on the Alagnak River has increased in recent years (Mills 1988).

A major component of the recreational fishery in the Alagnak River is the fishery for chinook salmon *O. tshawytscha* which occurs in the lower 20 km of the river. Sport harvests of chinook salmon have increased steadily from 1981 through 1988 (Brookover 1989; Mills 1989). During 1989, anglers were permitted a daily harvest of three chinook salmon, only two of which could be over 71 cm (28 inches) (ADF&G 1989c). The daily bag and possession limits of other salmon (sockeye *O. nerka*, chum *O. keta*, pink *O. gorbuscha*, and coho *O. kisutch*) during 1989 were five fish in any species combination. Since the Alagnak River is located within the Bristol Bay Wild Trout Zone, terminal tackle is restricted to unbaited, single hook artificial lures from 8 June through 31 October.

Other than the routine escapement reports by the ADF&G, Commercial Fisheries Division (ADF&G 1981-1988, 1989a), data describing the sport fishery on the Alagnak River have been limited to the statewide harvest mail survey (Mills 1988). To improve our knowledge of the sport fishery on the Alagnak River and to evaluate current management practices and regulations governing the fishery, a creel survey of the fishery was initiated during 1988 (Brookover 1989). The creel survey was conducted again in 1989 on the premise that data gathered over two seasons would characterize the fishery more accurately. Specific objectives of the survey were to:

1. estimate the sport fishing effort in the lower Alagnak River from 28 June through 6 August 1989;
2. estimate the number of chinook, coho, pink, and chum salmon, and rainbow trout caught (fish landed) and harvested (fish retained) in the sport fishery on the lower Alagnak River from 28 June through 6 August 1989;
3. estimate the number of chinook salmon in the spawning escapement to the Alagnak River drainage during 1989; and,
4. estimate the size and age compositions of chinook salmon harvested in the Alagnak River sport fishery during 1989.

METHODS

Creel Survey

The survey area started 7.5 km upstream of the confluence of the Alagnak and Kvichak Rivers and extended upstream 19.2 km (Figure 2). Virtually all of the fishing effort for chinook salmon is concentrated in this section of the river. Unlike the 1988 survey which divided the study period into three

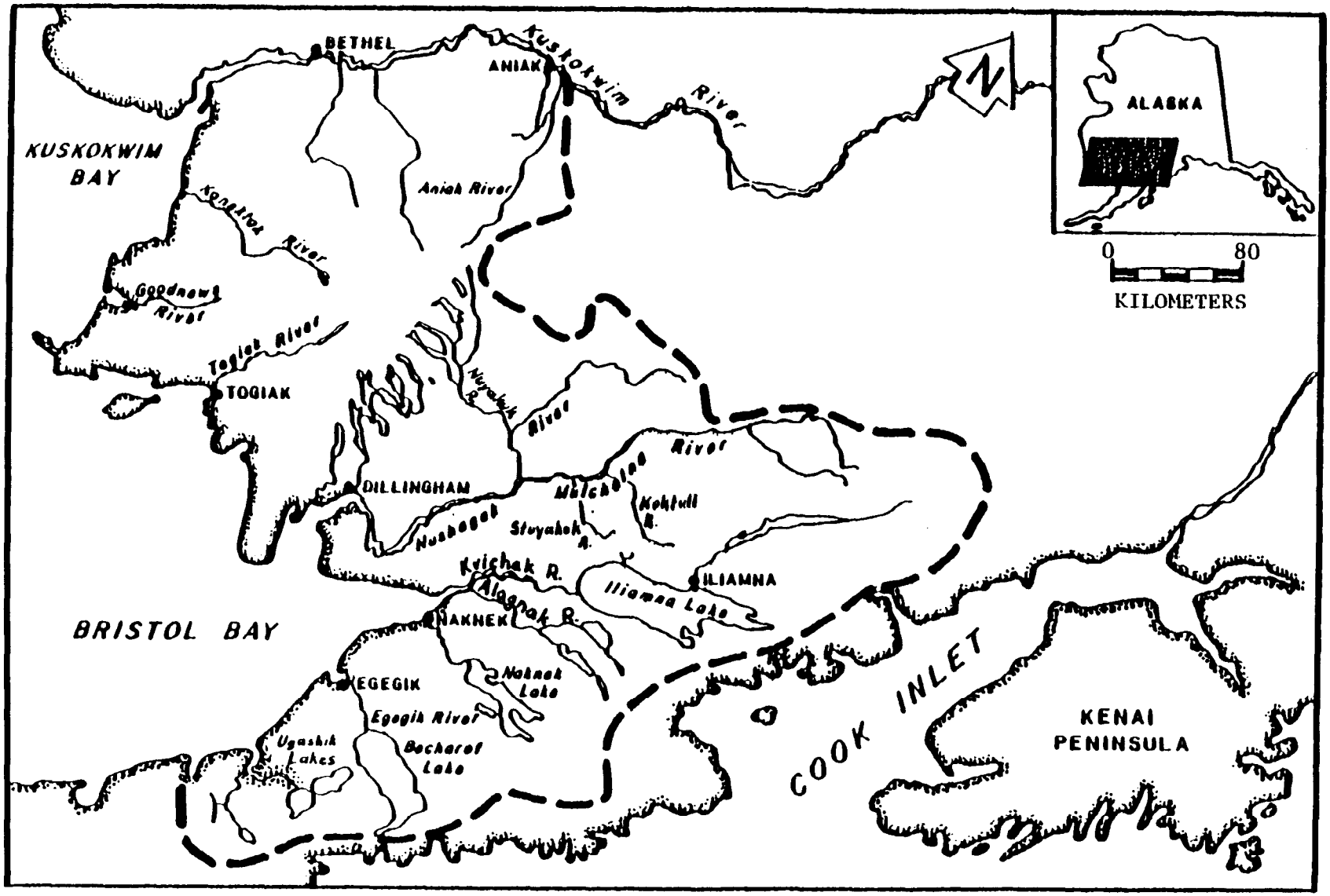

Figure 1. The Wild Trout Management Area of Bristol Bay, Alaska.

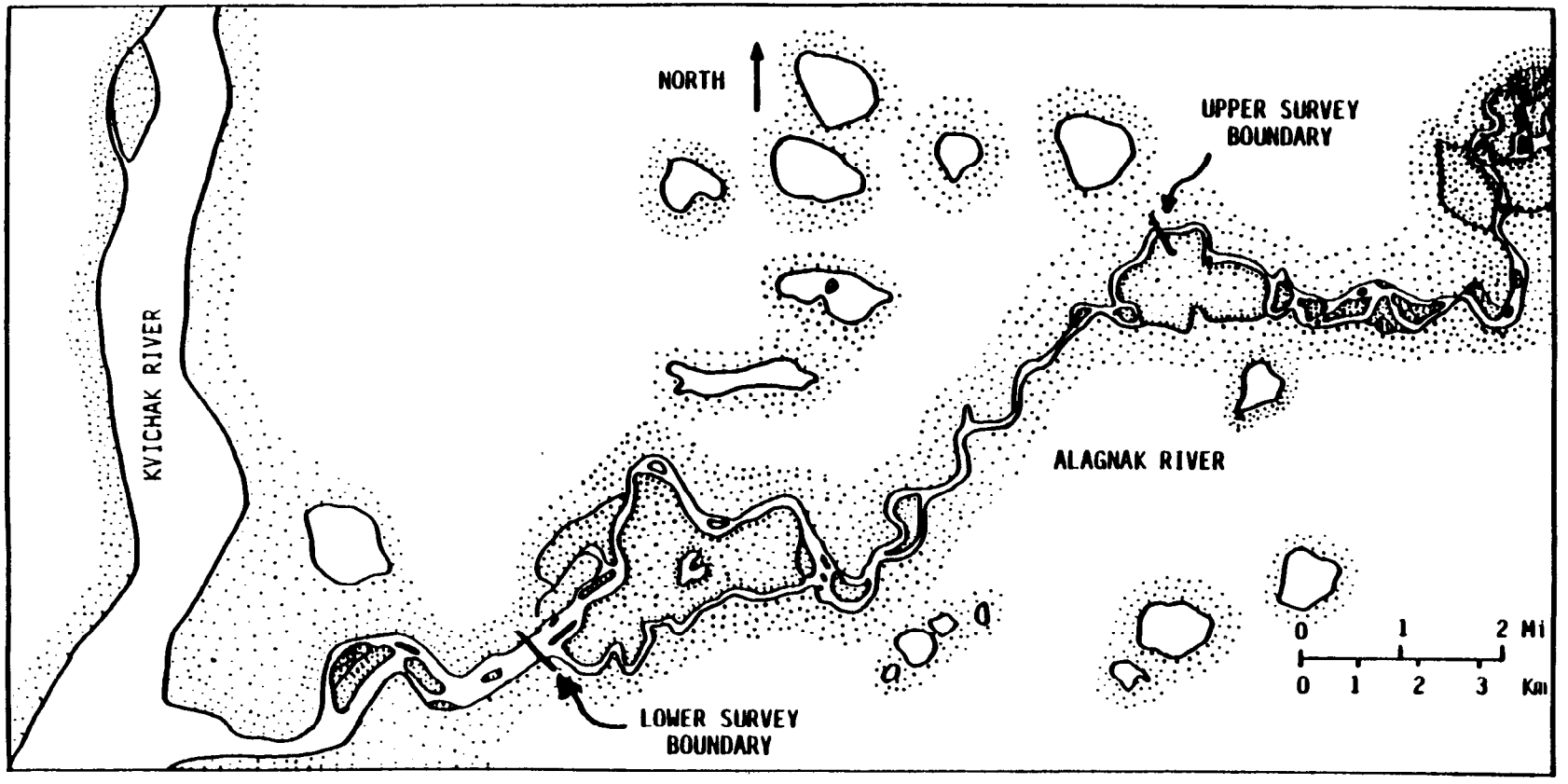

Figure 2. The creel survey study site on the lower Alagnak River, Alaska.

temporal components, the 1989 survey period (28 June to 6 August) was treated as a single temporal component. The fishing day was considered to be 18 hours long and was divided into three time strata: Period A (0600-1159), Period B (1200-1759), and Period C (1800-2359).

A roving creel survey (Neuhold and Lu 1957) using a stratified, multi-stage random sampling design was used to count anglers, conduct angler interviews, and sample the sport harvest. Count and count/interview sessions were scheduled randomly and strata were sampled with relatively equal intensity. Counts of anglers were used to estimate fishing effort in units of angler-hours, while angler interviews provided estimates of catch and harvest rates (fish per angler-hour). Catch and harvest rate estimates were derived from interviews with anglers who had not completed fishing for the day (referred to as incomplete trips). Data from incomplete trips may bias the estimates of catch and harvest rates, but the daily fly-in nature of the fishery made completed trip interviews nearly impossible to obtain.

The sampling level was established at 12 angler count/interview sessions and six additional angler counts per week. Within each designated count/interview session, one angler count was conducted. The remaining time in the session was spent interviewing anglers and obtaining age and size information from the sport harvest. Each count and count/interview session started at the upstream boundary of the survey area. If a count/interview was scheduled, a coin was tossed to determine if an angler count or angler interviews were to be conducted first. For counting anglers, a boat was driven through the survey area at a near constant rate of speed and all anglers actively fishing were counted. The count was completed within 40 to 60 minutes and was considered an instantaneous count (Neuhold and Lu 1957). It was not possible to differentiate between guided and unguided anglers during the count.

All interviews were of individual anglers and were not party interviews. The survey clerk attempted to obtain a random sample of 5% to 10% of the available anglers so that the number of anglers interviewed was kept proportional to effort during the sample unit (Neuhold and Lu 1957; DiConstanzo 1956). For each angler contacted, the following information was recorded: the number of hours fished; the number of fish in the angler's possession, by species; the number of fish released by the angler, by species; and whether the angler was guided or not guided. Additionally, data on gear type (fly or spin), outboard motor size, and angler demographics were obtained and recorded.

Completed-trip angler information was collected from voluntary report forms given to interviewed anglers. The voluntary report form requested the time fishing started and ended, the catch by species, and the number of fish retained, by species. Anglers were asked to mail the postage-paid forms to the Alaska Department of Fish and Game, Dillingham office.

Effort was estimated for the entire season of the fishery using a stratified random sampling approach by period. Effort (E) was estimated as follows:

$$\hat{E}_j = \sum_{i=1}^{p} H_i \bar{x}_i; \quad [1]$$

where:

i = subscript denoting the time of day level of stratification (periods);

p = total number of periods in temporal component j (e.g., p=3 for periods A, B, and C for the first temporal component in the lower river survey);

H_i = the total number of hours of possible fishing time in period i during temporal component j; and

$\bar{x}_i$ = the mean angler count for period i during temporal component j;

k = subscript denoting the count on a day;

$$= \frac{1}{m_i} \sum_{k=1}^{m_i} x_{ik}; \quad [2]$$

where:

m_i = the number of counts of anglers conducted during period i and temporal component j.

The variance of the estimate of E_j was estimated as follows:

$$\hat{V}(\hat{E}_j) = \sum_{i=1}^{p} H_i^2 \, (s_i^2/m_i); \quad [3]$$

where:

$$s_i^2 = [\sum_{k=1}^{m_i} (x_{ik} - \bar{x}_i)^2]/(m_i - 1); \quad [4]$$

and:

x_{ik} = a count of anglers made during day k, period i, and temporal component j.

The total number of angler-hours of effort for the season was estimated by summing the estimates of effort for each of the temporal components. Because

these are independent estimates, the variance for the total number of angler-hours of effort is the sum of the individual variances for each temporal component estimate.

Mean catch per unit effort (catch per angler-hour) was estimated for each temporal component as:

$$\overline{CPUE}_j = \sum_{h=1}^{d_j} \sum_{o=1}^{m_h} c_{jho} \Big/ \sum_{h=1}^{d_j} \sum_{o=1}^{m_h} e_{jho}; \quad [5]$$

where:

d_j = the number of days sampled for angler interviews during temporal component j;

m_h = the number of anglers interviewed during sample h and temporal component j;

c_{jho} = the catch by angler o interviewed during sample h and temporal component j; and

e_{jho} = the effort (number of hours) expended by angler o interviewed during sample h and temporal component j.

The variance of mean $CPUE_j$ was approximated as (Jessen 1978):

$$\hat{V}(\overline{CPUE}_j) = (\bar{C}_j/\bar{E}_j)^2 \left[s_c^2/\bar{C}_j + s_e^2/\bar{E}_j - (2r_j s_c s_e/\bar{C}_j\bar{E}_j)\right]; \quad [6]$$

where:

$$\bar{C}_j = \left(\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} c_{jho}\right) \Big/ \sum_{h=1}^{d_j} m_h; \quad [7]$$

$$\bar{E}_j = \left(\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} e_{jho}\right) \Big/ \sum_{h=1}^{d_j} m_h; \quad [8]$$

$$s_c^2 = (1/d_j)\left[\sum_{h=1}^{d_j} (\bar{c}_{jh}-\bar{C}_j)^2/(d_j-1) + \sum_{h=1}^{d_j} (1/m_h) \sum_{o=1}^{m_h} (c_{jho}-\bar{c}_{jh})^2/(m_h-1)\right]; \quad [9]$$

$$\bar{c}_{jh} = \sum_{o=1}^{m_j} c_{jho} / m_h; \quad [10]$$

$$s_e^2 = (1/d_j)\left[\sum_{h=1}^{d_j} (\bar{e}_{jh}-\bar{E}_j)^2/(d_j-1) + \sum_{h=1}^{d_j} (1/m_h) \sum_{o=1}^{m_h} (e_{jho}-\bar{e}_{jh})^2/(m_h-1)\right] \quad [11]$$

$$\bar{e}_{jh} = \sum_{o=1}^{m_j} e_{jho} / m_h; \qquad [12]$$

$$r_j = \frac{\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} (c_{jho}-\bar{C}_j)(e_{jho}-\bar{E}_j)}{[\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} (c_{jho}-\bar{C}_j)^2][\sum_{h=1}^{d_j} \sum_{o=1}^{m_h} (e_{jho}-\bar{E}_j)^2]}. \qquad [13]$$

The catch of each species during temporal component j was estimated by:

$$\hat{C}_j = \hat{E}_j(\overline{CPUE}_j) \qquad [14]$$

The variance of the estimated catch of each species was estimated using the product of two independent random variables as described by Goodman (1960):

$$\hat{V}(\hat{C}_j) = \hat{E}_j^2\hat{V}(\overline{CPUE}_j) + \overline{CPUE}_j^2\hat{V}(\hat{E}_j) - \hat{V}(\hat{E}_j)\hat{V}(\overline{CPUE}_j) \qquad [15]$$

Harvest rates and total harvest of each species was estimated for each temporal component by substituting appropriate harvests for catches in equations 5-15.

Approximate 95% confidence interval (CI) limits were obtained for angler effort, catch, and harvest estimates as follows, by assuming normality (Cochran 1977):

$$95\%\ CI = \hat{Y} \pm 1.96\ (\hat{V}[\hat{Y}])^{0.5} \qquad [16]$$

where:

$\hat{Y}$ = estimate of the total parameter of interest (e.g., E, C, or H for effort, catch, or harvest). Note that individual stratum estimates (as obtained by equations 1 and 14, above) can be used or totals across strata; and

$\hat{V}[\hat{Y}]$ = estimate of the variance of the total parameter of interest (as obtained by equations 3 and 15, above).

The lower limit of the CI obtained by the above procedure was recorded as zero (0) if the result was a negative number (for the appropriate stratum or total).

The assumptions necessary for these analyses are:

1. incomplete-trip angler CPUE, though likely to be biased, provide a reasonable estimate of completed-trip angler CPUE. (Only three completed trip interviews were available.);

2. interviewed anglers were representative of the total angler population and anglers were interviewed in proportion to their abundance on the day of the interview;

3. no significant fishing effort occurred between 2400 hours and 0600 hours (Guided fishing accounts for the majority of the fishing effort on the Alagnak River and typically occurs between the hours of 0900 to 1800 hours.);

4. catch and effort by individual anglers are normally distributed random variables, for the purpose of establishing confidence intervals limits;

5. catch rate and duration of fishing trip are independent (DiConstanzo 1956); and,

6. catch and harvest rates do not vary between periods within days[1].

Spawning Escapement Surveys

The numbers of spawning chinook salmon of all sizes in the Alagnak River drainage was estimated from aerial counts conducted from fixed wing aircraft. No accounting was made for fish that had already spawned and left the system or fish that had not yet arrived.

Size, Sex, and Age Sampling

All chinook salmon retained by interviewed anglers were measured for mid-eye to fork-of-tail length (to the nearest millimeter), weighed (to the nearest 10 grams), and sexed based on external characteristics. Three scales were removed from the preferred area[2] of each fish and mounted on an adhesive coated card. Cards were thermohydraulically pressed against acetate cards and

[1] While there is the potential for such variability, the great differences between individual anglers would obscure any temporal variations that might exist in the catch or harvest rates. The 1988 study of the Alagnak River sport fishery did not find any indications that catch or harvest rated varied significantly or predictably over the day.

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

the resulting scale impressions were displayed on a microfiche projector for age determination[3].

The proportional age composition of the sport harvest was estimated when sample sizes were sufficient. Letting p_h equal the estimated proportion of age group h, the variance of p_h was estimated using (Scheaffer et al. 1979):

$$V(\hat{p}_h) = \hat{p}_h(1-\hat{p}_h)/(n_T-1) \quad [17]$$

where n_T is the number of scales read. Mean length and weight at age by sex with the associated standard errors were estimated using standard statistical procedures (Sokal and Rohlf 1981, Boxes 4.2 and 7.1, pages 56 and 139).

RESULTS

Creel Statistics

The creel survey of the sport fishery on the lower Alagnak River was conducted from 28 June to 6 August 1989. Daily counts of anglers are presented, by strata, in Appendix A1. Daily harvest and catch rates for all interviewed anglers for chinook, coho, chum, and pink salmon, and rainbow trout are presented in Appendices A2 and A3, respectively.

Total sport effort on the lower section of the Alagnak River was estimated to be 19,723 angler-hours during the survey period (Table 1). The catch rate for chinook salmon (all anglers) was 0.19 fish per hour and the harvest rate averaged 0.07 fish per hour (Table 2). The catch rate for all anglers averaged 0.003 coho per hour and 0.02 chum per hour. The harvest rates in Table 2 indicate all coho caught were kept while only 30% of the chum salmon were retained. The nonexistent pink salmon catch and harvest rates are a result of the species' normally weak runs in odd numbered years in the Bristol Bay area.

Mean chinook salmon catch rates for guided anglers were considerably higher than those for unguided anglers (Table 3). The estimated seasonal catch rate for guided anglers (0.22 fish per hour) was over 250% greater than the estimated seasonal catch rate for unguided anglers (0.087 fish per hour). Harvest rate estimates for guided and unguided anglers for chinook salmon were less divergent, with guided anglers taking an estimated 0.07 fish per hour and the unguided anglers taking less than 0.06 fish per hour.

An estimated 3,726 chinook salmon were caught in the sport fishery during the survey period of which 1,333 (35%) were harvested (Table 4). As mentioned before, very few if any pink salmon were caught or harvested during this low run year. A total of 473 chum salmon were caught of which 14 (3%) were

[3] 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.

Table 1. Estimated effort (angler-hours) by temporal component and strata, for the sport fishery in the lower Alagnak River, 1989.

Temporal Component[a]	Strata[b]	Counts			Effort			
		Number	Mean	SE	Angler Hours	SE	95% CI[c]	Relative Precision[d]
1	A	35	30.8	4.9	7,385	1,175.5	5,081 - 9,689	31.3%
	B	32	40.1	4.6	9,623	1,100.0	7,467 - 11,779	22.4%
	C	35	11.3	2.2	2,715	512.2	1,694 - 3,736	37.6%
Season					19,723	1,692.2	18,031 - 21,415	16.8%

[a] Component 1: 6/28-8/6.

[b] Strata A: 0600-1159, Strata B: 1200-1759, Strata C: 1800-2359.

[c] Confidence interval.

[d] Relative precision =(1.96*SE/point estimate) where x = 0.05.

Table 2. Catch per angler-hour and harvest per angler-hour by species and temporal component for the sport fishery in the lower Alagnak River, 1989.

Species	Sampling Component[a]	Catch Rate		Harvest Rate	
		Fish/Hr	SE	Fish/Hr	SE
Chinook Salmon	1	0.1889	0.1307	0.0676	0.0380
Coho Salmon	1	0.0028	0.0238	0.0028	0.0238
Chum Salmon	1	0.0240	0.0295	0.0073	0.0192
Pink Salmon	1	0.0000	0.0000	0.0000	0.0000
Rainbow Trout	1	0.0080	0.0215	0.0007	0.0014

[a] Component 1: 6/28-8/6.

Table 3. Catch and harvest rates (fish per angler-hour) of chinook salmon by guided and unguided anglers for the sport fishery in the lower Alagnak River, 1989.

Temporal Component[a]	No. Interviews		Catch Rate		Harvest Rate	
	Guided	Unguided	Guided	Unguided	Guided	Unguided
1	590	168	0.2205	0.0866	0.0706	0.0582
Season	590	168	0.2205	0.0866	0.0706	0.0582

[a] Component 1: 6/28-8/6.

Table 4. Estimated catch and harvest by species for the sport fishery in the lower Alagnak River, 1989.

Species	Temporal Component[a]	Catch				Harvest			
		Number	SE	95% CI[b]	Relative Precision[c]	Number	SE	95% CI[b]	Relative Precision[c]
Chinook	1	3,726	2,589	0 - 8,800	136.2%	1,333	756	0 - 2,815	111.2%
Coho	1	55	468	0 - 972	1667.0%	55	468	0 - 972	1667.0%
Chum	1	473	581	0 - 1,611	240.7%	14	741	0 - 1,465	103.7%
Pink	1	0	0	0 - 0		0	0	0 - 0	
Rainbow Trout	1	158	422	0 - 986	523.9%	14	28	0 - 69	393.0%

[a] Component 1 6/28-8/6.

[b] Confidence interval.

[c] Relative precision = (1.96* SE/point estimate) where x = 0.05.

harvested. Rainbow trout catch totaled 158 fish with 9% (14 fish) being harvested. Estimated harvest and catch figures for pink, chum, and coho salmon, and rainbow trout are considered to be minimum estimates due to the limited extent (time and area) of this creel survey. While the creel survey was curtailed at the end of the chinook salmon fishery, additional catches and harvests of rainbow trout and chum, pink, and especially coho salmon, occurred during August and September.

Spawning Escapement

The spawning escapement of chinook salmon into the Alagnak River drainage was estimated to be 5,400 fish (Table 5).

Size, Sex, and Age Compositions

Males comprised 69% of the chinook salmon (n=162) harvested in the sport fishery (Table 6). Age 1.4 (58%) and age 1.3 (25%) fish were the most abundant age group in the harvest (Figure 3). Mean length and weight of harvested chinook salmon was 866 mm (n=162) and 12 kg (n=162). The largest chinook salmon sampled during the survey was 1,068 mm (42 inches) long and weighed 23.3 kg (51 pounds).

DISCUSSION

The estimated sport harvest of 1,333 chinook salmon from the lower Alagnak River in 1989 is slightly greater than the 1,243 fish taken in 1988 (Brookover 1989) and nearly double the 1986 harvest reported in the statewide mail survey (Mills 1987). This, along with the 1987 harvest reported by Mills of 1,969 (Mills 1988), suggests an increasing trend in the annual sport harvest of chinook salmon (Figure 4). Growth of the recreational chinook salmon fishery, although dramatic in recent years, still appears to be within sustainable limits given the relative consistency in spawning escapements (Table 5). Regulation changes adopted by the Alaska Board of Fisheries in 1987, as summarized in the introduction, appear to be satisfactory and no changes in seasons, bag, or possession limits are recommended at this time.

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Table 5. Escapement estimates[a] for returns of chinook salmon in the Alagnak River, 1980-1989.

Year	Escapement Index[b]
1980	5,860
1981	8,540
1982	5,500
1983	3,500
1984	9,135
1985	9,518
1986	7,200
1987	5,363
1988	7,900
Average	6,946[c]
1989	5,400

[a] Estimates are based on unexpanded aerial surveys.

[b] Data for 1980-1988 are reported from Alaska Department of Fish and Game, Commercial Fisheries Division, Annual Management Reports. Data for 1989 taken from Alaska Department of Fish and Game, Division of Commercial Fisheries, in press.

[c] Standard Error = 2017.8

Table 6. Sex, age, lengths (millimeters), and weight (kilograms) compositions of chinook salmon sampled from the sport harvest in the lower Alagnak River, 1989.

	Age Group							
	UNKNOWN	1.1	1.2	1.3	1.4	1.5	2.3	TOTAL
FEMALES								
Percent				5.5	23.3	2.1		30.8
Mean Length	901			895	905	1041		911
SE[a]	27.32			23.19	13.67	15.94		11.18
Sample Size	6			8	34	3		51
Mean Weight	11.60			12.19	12.99	17.80		12.99
SE[b]	112.22			85.74	38.66	57.74		36.23
Sample Size	6			8	34	3		51
Males								
Percent		2.1	6.8	19.9	34.9	4.8	0.7	69.2
Mean Length	900	538	600	759	932	994	702	845
SE[a]	24.12	113.69	27.23	24.93	11.90	29.72		15.13
Sample Size	10	3	10	29	51	7	1	111
Mean Weight	13.20	3.50	3.94	8.13	15.06	15.63	5.50	11.72
SE[b]	116.82	225.91	47.07	81.96	52.06	125.14		52.72
Sample Size	10	3	10	29	51	7	1	111
Both Sexes								
Percent		2.1	6.8	25.3	58.2	6.8	0.7	100.0
Mean Length	900	538	600	788	921	1008	702	866
SE[a]	17.65	113.69	27.23	22.11	9.06	21.96		11.18
Sample Size	16	3	10	37	85	10	1	162
Mean Weight	12.60	3.50	3.94	9.01	14.24	16.28	5.50	12.12
SE[b]	84.21	225.91	47.07	71.95	36.40	92.90		38.09
Sample Size	16	3	10	37	85	10	1	162

[a] Standard error of length.
[b] Standard error of weight.

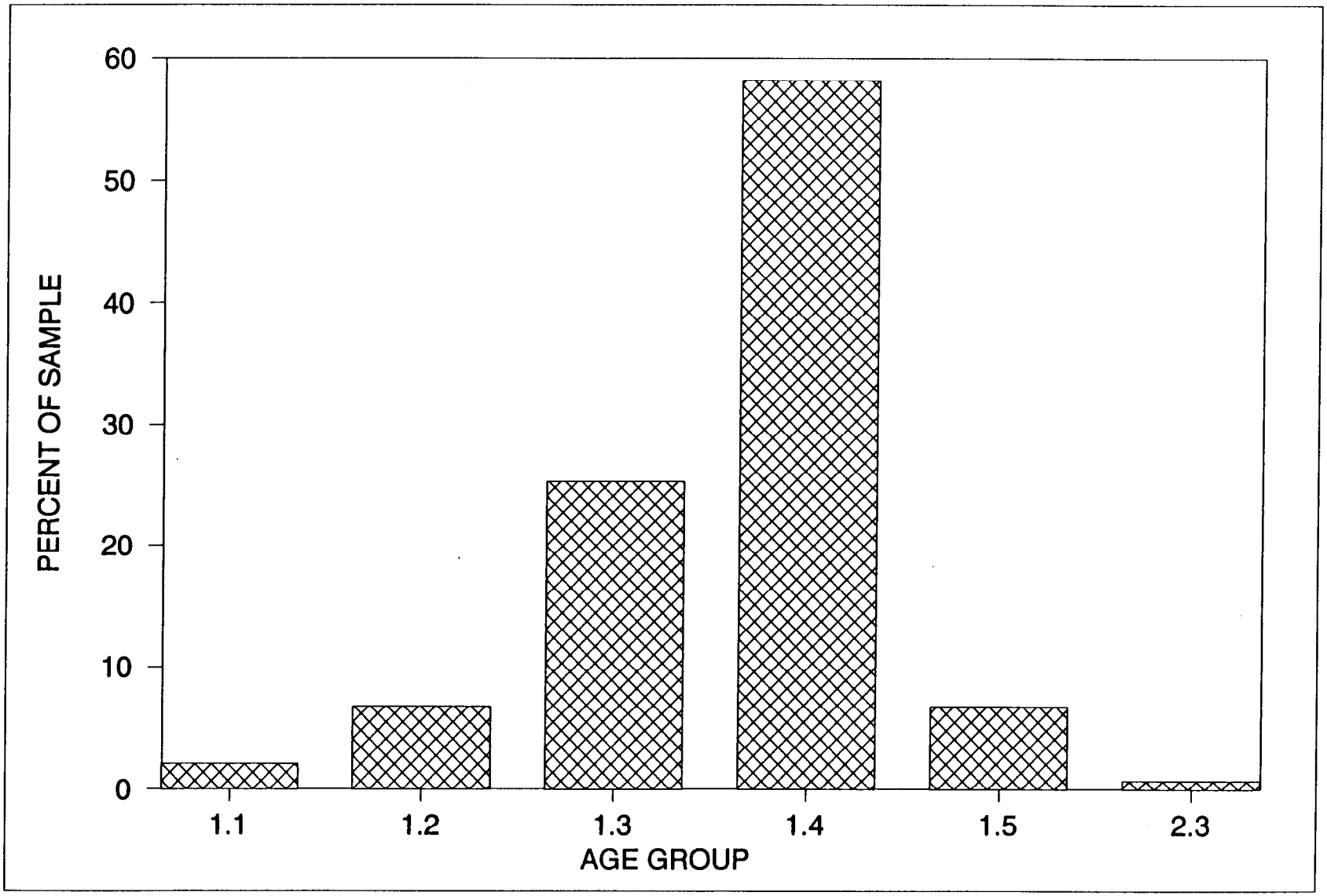

Figure 3. Age composition of chinook salmon harvested in the sport fishery of the Alagnak River during 1989.

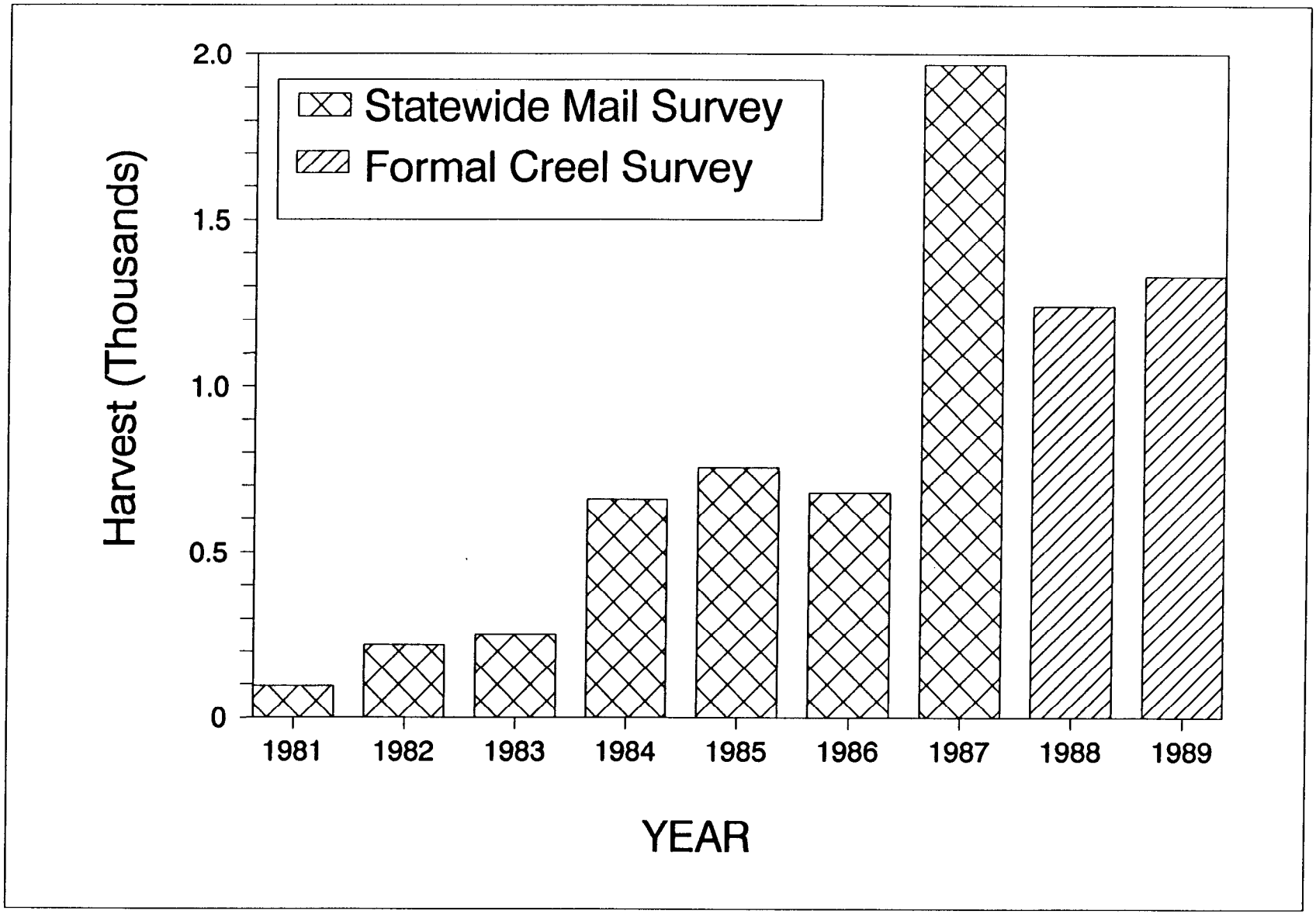

Figure 4. Harvest of chinook salmon in the sport fishery on the Alagnak River during the years 1981-1989.

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APPENDIX A

Appendix A1. Angler counts for the sport fishery on the lower Alagnak River, 1989.

Date	Strata[a] A	B	C	Date	Strata[a] A	B	C
28-Jun	0	2	0	30-Jul	0	28	0
29-Jun	0	0	0	31-Jul	12	40	0
30-Jun	0	16	5	01-Aug	0	2	6
01-Jul	8	22	0	02-Aug	10	29	7
				03-Aug	19	11	0
02-Jul	53		0	04-Aug		7	
03-Jul			2	05-Aug	8	8	6
04-Jul	56	57	2				
05-Jul	10	35	24	06-Aug	0		0
06-Jul		78	36				
07-Jul	76	46	31				
08-Jul	14		14				
09-Jul	85	40					
10 Jul	97		37				
11-Jul	44	82	11				
12-Jul	59	63	43				
13-Jul	99	99	11				
14-Jul		55	18				
15-Jul	47	47	8				
16-Jul		70	27				
17-Jul	26	21	4				
18-Jul	42	68					
19-Jul	65	56	39				
20-Jul	4	68	15				
21-Jul	33	35	16				
22-Jul	33		4				
23-Jul	25	67	13				
24-Jul	7	48					
25-Jul	46		2				
26-Jul	38	24	10				
27-Jul	37	32	5				
28-Jul	4	27					
29-Jul	20		0				

[a] Strata A: 0600-1159, Strata B: 1200-1759, Strata C: 1800-2359.

Appendix A2. Summary of daily angler-effort (angler-hours) and harvest rates (HPUE, fish per angler-hour) for chinook, coho, chum, and pink salmon, and rainbow trout from angler interviews on the lower Alagnak River, 1989.

Date	Sample Size	Effort		Chinook			Coho			Chum			Pink			Rainbow Trout		
		Mean	SE	Mean	SE	HPUE	Mean	SE	HPUE	Mean	SE	HPUE	Mean	SE	HPUE	Mean	SE	HPUE
6/30	7	1.9	0.20	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/01	10	3.4	0.86	0.20	0.133	0.060	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/02	28	1.6	0.12	0.18	0.074	0.113	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/04	55	3.6	0.32	0.22	0.056	0.061	0.00	0.000	0.000	0.02	0.018	0.005	0.00	0.000	0.000	0.00	0.000	0.000
7/05	13	3.6	0.61	0.08	0.077	0.022	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/06	38	5.6	0.32	0.24	0.070	0.042	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/07	23	5.6	0.49	0.52	0.139	0.093	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/08	7	4.7	0.57	0.43	0.202	0.091	0.00	0.000	0.000	0.14	0.143	0.030	0.00	0.000	0.000	0.00	0.000	0.000
7/09	30	1.5	0.21	0.13	0.063	0.086	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/10	12	6.4	0.74	0.50	0.195	0.078	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/11	39	4.5	0.37	0.33	0.099	0.074	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/12	70	3.4	0.23	0.26	0.063	0.076	0.00	0.000	0.000	0.03	0.029	0.008	0.00	0.000	0.000	0.01	0.014	0.004
7/14	41	5.1	0.42	0.39	0.085	0.076	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/15	25	3.7	0.35	0.40	0.115	0.108	0.00	0.000	0.000	0.04	0.040	0.011	0.00	0.000	0.000	0.00	0.000	0.000
7/16	53	5.3	0.38	0.15	0.056	0.028	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/17	4	3.9	2.38	0.50	0.500	0.129	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/18	46	3.0	0.32	0.11	0.056	0.036	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/19	36	3.0	0.30	0.19	0.067	0.065	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.03	0.028	0.009
7/20	8	4.6	1.46	0.38	0.263	0.081	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/21	18	1.3	0.11	0.11	0.076	0.086	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/22	9	4.2	1.03	0.22	0.147	0.053	0.00	0.000	0.000	0.33	0.333	0.079	0.00	0.000	0.000	0.00	0.000	0.000
7/23	27	3.6	0.40	0.30	0.090	0.081	0.00	0.000	0.000	0.11	0.082	0.031	0.00	0.000	0.000	0.00	0.000	0.000
7/24	14	4.2	0.46	0.21	0.114	0.051	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/25	24	2.1	0.19	0.04	0.042	0.020	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/26	21	3.0	0.80	0.10	0.066	0.031	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/27	5	1.8	0.51	0.40	0.245	0.218	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/28	15	2.7	0.41	0.13	0.133	0.049	0.07	0.067	0.024	0.13	0.091	0.049	0.00	0.000	0.000	0.00	0.000	0.000
7/29	2	8.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/30	24	5.9	0.46	0.83	0.167	0.142	0.00	0.000	0.000	0.21	0.120	0.035	0.00	0.000	0.000	0.00	0.000	0.000
7/31	12	4.5	0.46	0.25	0.131	0.055	0.08	0.083	0.018	0.17	0.112	0.037	0.00	0.000	0.000	0.00	0.000	0.000
8/01	2	6.0	0.00	0.00	0.000	0.000	0.50	0.500	0.083	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/02	20	3.5	0.48	0.45	0.153	0.130	0.20	0.092	0.058	0.05	0.050	0.014	0.00	0.000	0.000	0.00	0.000	0.000
8/03	16	2.7	0.17	0.25	0.112	0.094	0.06	0.063	0.024	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/04	4	3.5	0.14	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/05	3	2.7	1.08	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000

Appendix A3. Summary of daily angler-effort (angler-hours) and catch rates (CPUE, fish per angler-hour) for chinook, coho, chum, and pink salmon, and rainbow trout from angler interviews on the lower Alagnak River, 1989.

		Effort		Chinook			Coho			Chum			Pink			Rainbow Trout		
Date	Sample Size	Mean	SE	Mean	SE	CPUE	Mean	SE	CPUE	Mean	SE	CPUE	Mean	SE	CPUE	Mean	SE	CPUE
6/30	7	1.9	0.20	0.57	0.297	0.296	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/01	10	3.4	0.86	0.80	0.291	0.239	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/02	28	1.6	0.12	0.43	0.158	0.270	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/04	55	3.6	0.32	0.65	0.167	0.184	0.00	0.000	0.000	0.02	0.018	0.005	0.00	0.000	0.000	0.09	0.039	0.026
7/05	13	3.6	0.61	0.77	0.545	0.216	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.46	0.462	0.130
7/06	38	5.6	0.32	0.79	0.178	0.141	0.00	0.000	0.000	0.16	0.110	0.028	0.00	0.000	0.000	0.11	0.063	0.019
7/07	23	5.6	0.49	1.52	0.294	0.270	0.00	0.000	0.000	0.48	0.344	0.085	0.00	0.000	0.000	0.00	0.000	0.000
7/08	7	4.7	0.57	3.43	2.245	0.727	0.00	0.000	0.000	0.14	0.143	0.030	0.00	0.000	0.000	0.00	0.000	0.000
7/09	30	1.5	0.21	0.30	0.119	0.194	0.00	0.000	0.000	0.07	0.067	0.043	0.00	0.000	0.000	0.00	0.000	0.000
7/10	12	6.4	0.74	1.00	0.302	0.156	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/11	39	4.5	0.37	0.79	0.239	0.175	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.13	0.066	0.028
7/12	70	3.4	0.23	0.83	0.167	0.246	0.00	0.000	0.000	0.10	0.046	0.030	0.00	0.000	0.000	0.01	0.014	0.004
7/14	41	5.1	0.42	0.66	0.151	0.129	0.00	0.000	0.000	0.02	0.024	0.005	0.00	0.000	0.000	0.00	0.000	0.000
7/15	25	3.7	0.35	0.84	0.236	0.227	0.00	0.000	0.000	0.04	0.040	0.011	0.00	0.000	0.000	0.00	0.000	0.000
7/16	53	5.3	0.38	0.26	0.072	0.050	0.00	0.000	0.000	0.15	0.056	0.028	0.00	0.000	0.000	0.02	0.019	0.004
7/17	4	3.9	2.38	0.50	0.500	0.129	0.00	0.000	0.000	0.25	0.250	0.065	0.00	0.000	0.000	0.00	0.000	0.000
7/18	46	3.0	0.32	0.39	0.141	0.129	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/19	36	3.0	0.30	0.42	0.108	0.139	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.03	0.028	0.009
7/20	8	4.6	1.46	0.63	0.263	0.135	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/21	18	1.3	0.11	0.11	0.076	0.086	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/22	9	4.2	1.03	1.78	0.830	0.421	0.00	0.000	0.000	0.33	0.333	0.079	0.00	0.000	0.000	0.00	0.000	0.000
7/23	27	3.6	0.40	0.67	0.131	0.183	0.00	0.000	0.000	0.33	0.141	0.092	0.00	0.000	0.000	0.00	0.000	0.000
7/24	14	4.2	0.46	0.86	0.206	0.205	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/25	24	2.1	0.19	0.33	0.098	0.159	0.00	0.000	0.000	0.13	0.069	0.060	0.00	0.000	0.000	0.00	0.000	0.000
7/26	21	3.0	0.80	0.19	0.088	0.063	0.00	0.000	0.000	0.10	0.066	0.031	0.00	0.000	0.000	0.00	0.000	0.000
7/27	5	1.8	0.51	0.40	0.245	0.218	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/28	15	2.7	0.41	0.20	0.145	0.073	0.07	0.067	0.024	0.13	0.091	0.049	0.00	0.000	0.000	0.00	0.000	0.000
7/29	2	8.0	0.00	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
7/30	24	5.9	0.46	1.83	0.369	0.312	0.00	0.000	0.000	0.21	0.120	0.035	0.00	0.000	0.000	0.00	0.000	0.000
7/31	12	4.5	0.46	0.42	0.149	0.092	0.08	0.083	0.018	0.17	0.112	0.037	0.00	0.000	0.000	0.00	0.000	0.000
8/01	2	6.0	0.00	2.00	0.000	0.333	0.50	0.500	0.083	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/02	20	3.5	0.48	1.60	0.540	0.463	0.20	0.092	0.058	0.20	0.156	0.058	0.00	0.000	0.000	0.00	0.000	0.000
8/03	16	2.7	0.17	0.88	0.352	0.330	0.06	0.063	0.024	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/04	4	3.5	0.14	1.75	1.031	0.500	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
8/05	3	2.7	1.08	0.00	0.000	0.000	0.33	0.333	0.125	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000