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EFFORT AND CATCH STATISTICS FOR THE SPORT FISHERY FOR CHINOOK SALMON IN THE LOWER NUSHAGAK RIVER, 1987[1]

By

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

A roving creel survey was conducted on the lower Nushagak River from 11 June through 17 July 1987 to estimate sport fishing effort and harvest of chinook salmon *Oncorhynchus tshawytscha*. A total of 416 anglers were interviewed during the 37-day sample period to estimate angling effort in hours and catch and harvest rate in fish per hour. An estimated 9,080 angler-hours were expended on the lower Nushagak River during which an estimated 2,370 chinook salmon were landed. Of these, 1,371 (58 percent) were harvested. Age 1.4 chinook salmon dominated the harvest and escapement (46 and 62 percent, respectively). Mean length of the harvest and escapement was 744 and 793 millimeters, respectively. Mean weight of the harvest was 7.3 kilograms. The 1987 sport harvest intercepted approximately 1 percent of the total run of chinook salmon to the Nushagak/Mulchatna River drainage.

KEY WORDS: chinook salmon, *Oncorhynchus tshawytscha*, sport harvest, sport effort, creel survey, Nushagak River

INTRODUCTION

The Nushagak River is located on the western side of Bristol Bay (Figure 1). It is the largest producer of all species of Pacific salmon *Oncorhynchus* spp., except sockeye salmon *O. nerka*, in Bristol Bay. A sport fishery that targets primarily on chinook salmon *O. tshawytscha* occurs in the lower reach of the river between Black Point and the village of Portage Creek (Figure 2). This stretch of the river is 19.3 km long, about 300 m wide, moderately silty, and influenced by tides. Access to the area is primarily by boat from Dillingham or by float-equipped aircraft. Anglers also use wheel-equipped aircraft to land on gravel bars or at a public airstrip at the village of Portage Creek.

During the period from 1977 through 1987, the chinook salmon run in the Nushagak River averaged nearly 232,000 fish annually (Bucher 1987). Although fish are not exceptionally big in comparison to other Bristol Bay stocks of chinook salmon (the average weight of commercially caught fish is approximately 9.5 kg), large numbers of chinook salmon are available and the fishery is easily accessible to sport anglers. From 1982 through 1985, a voluntary questionnaire was distributed to sport fishing guides operating on the Nushagak River. Results from these questionnaires indicated the guided sport fishery for chinook salmon in the lower Nushagak River was growing (Minard and Morstad 1985, and Brandt and Minard 1985).

The Sport Fish Division of the Alaska Department of Fish and Game (ADF&G) initiated a monitoring program in 1986 to increase the understanding of the growing sport fishery for chinook salmon on the lower Nushagak River and to evaluate current management strategies and policies (Minard 1987). The program included the estimation of fishing effort, catch (fish landed), and harvest (fish retained), and age, sex, and size compositions of the sport harvest and escapement. These data, in conjunction with information from the commercial and subsistence fisheries and spawning escapement (Bucher 1987) provide total return estimates of chinook salmon to the Nushagak River. The objective of this report is to present statistics for the chinook salmon sport fishery and escapement in the Nushagak River during 1987.

METHODS

Creel Survey

Anglers were permitted a daily harvest of five chinook salmon, of which two could be greater than 71 cm (28 in) in 1987 (ADF&G 1987). No further regulatory restrictions were imposed during 1987.

Study Design:

The study was conducted on the mainstem of the Nushagak River between Black Point and the village of Portage Creek (Figure 2). A roving creel survey (Neuhold and Lu 1957) using a stratified, random sampling design was used to

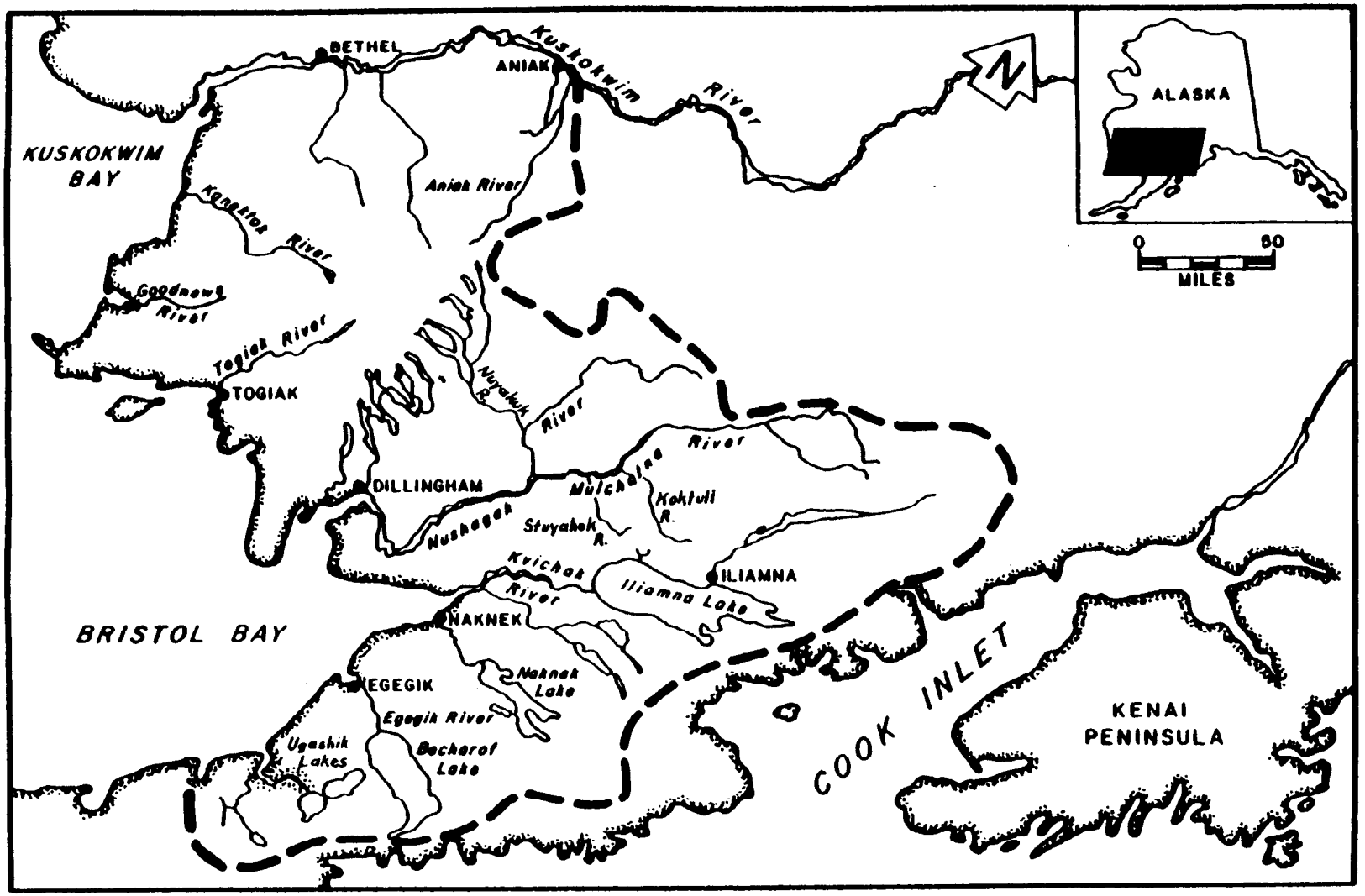

Figure 1. Bristol Bay, southwest Alaska, Sport Fish management area.

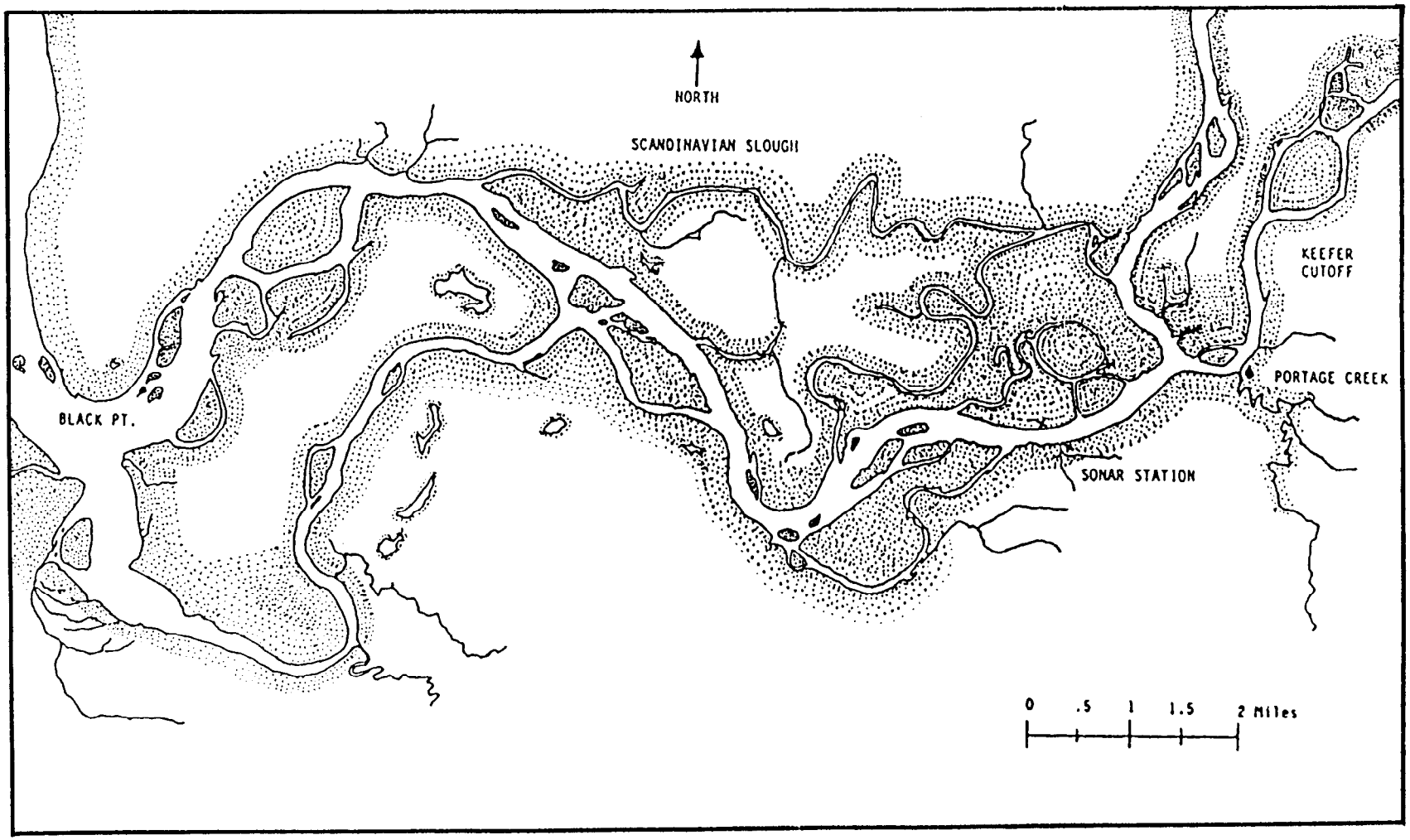

Figure 2. Lower Nushagak River, Bristol Bay, Alaska.

count anglers, conduct angler interviews, and sample the sport harvest. Angler counts were used to estimate fishing effort in units of angler-hours. Angler interviews provided estimates of catch rates (fish per angler-hour).

Guided fishing accounts for the majority of the effort on the Nushagak River with fishing typically occurring between the hours of 1000 and 1800. For the creel survey, the fishing day was considered 14 hours long (0700-2100). Each day was divided into four strata: (A) 0700-0959 hours; (B) 1000-1359 hours; (C) 1400-1759 hours; and (D) 1800-2100 hours.

Chinook salmon first enter the Nushagak River in significant numbers in mid-June and the majority of the run typically migrates through the lower section of river during a 2-week period. Thus, the sport fishery was temporally stratified into peak and non-peak components. The non-peak component (11 June through 23 June and 10 July through 17 July) was subjectively defined as the period when chinook salmon were less abundant. The peak component (24 June through 9 July) occurred when chinook salmon were more abundant in the river. Angler-effort and harvest statistics were estimated separately for peak and non-peak components.

Data Collection:

The sampling level was 9 angler count/interview sessions and 3 angler counts per week during the non-peak components and 12 angler count/interview sessions and 5 angler counts per week during the peak component. During a non-peak week, 3 angler count/interview sessions and 1 angler count trip were made in periods A and D, and 6 angler count/interview sessions and 2 angler counts in periods B and C. During a peak week, 5 angler count/interview sessions and 2 angler counts were made in periods A and D and 7 angler count/interview sessions and 4 angler counts in periods B and C.

Each survey trip started at the upstream boundary of the survey area. A coin was tossed to determine if angler counts or angler interviews were to be conducted first. For an angler count, the technician drove a skiff through the survey area at a near constant speed and counted all anglers actively fishing. The angler count was completed within 40 to 60 minutes of the start and was considered an instantaneous count (Neuhold and Lu 1957). It was not possible to differentiate between guided and non-guided anglers during the angler count.

Two hours were allocated for conducting angler interviews during strata A and D and 3 hours were allocated for angler interviews during strata B and C. All interviews were of individual anglers and were not party interviews. The creel survey technician attempted to contact about 25% of the available anglers so that the number of anglers interviewed was proportional to the angler effort during the sampled time (Neuhold and Lu 1957; DiConstanzo 1956). Anglers were randomly selected throughout the fishing area. For each angler contacted, the creel survey technician recorded the number of hours fished, the number of fish in the angler's possession by species, the number of fish released by species, and whether the angler was guided or not guided.

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. Anglers were asked to mail the postage paid forms to the Dillingham office of the Alaska Department of Fish and Game.

Harvested chinook, chum, and coho salmon encountered during the creel survey were measured for mid-eye to fork-of-tail length to the nearest millimeter, weighed to the nearest 10 grams, and the sex of the fish recorded. Three scales were removed from the preferred area[1] and mounted on an adhesive card.

Data Analyses:

The mean number of anglers per count was calculated for each temporal component as:

$$\bar{X} = (1/H) \sum_{i=1}^{4} H_i \bar{x}_i, \qquad [1]$$

where:

$\bar{X}$ = the mean number of anglers per count during a component,

$\bar{x}_i$ = the mean number of anglers per count for stratum i,

H = the total number of hours in a component, and

H_i = the total number of hours in stratum i.

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

$$V(\bar{X}) = (1/H^2) \sum_{i=1}^{4} H_i^2 [s_i^2/n_i], \qquad [2]$$

where H and H_i are defined as above, and:

n_i = the total number of angler counts in stratum i, and

s_i^2 = the sample variance of $\bar{x}_i$ for stratum i.

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

The total number of angler-hours (E_T) during each temporal component was estimated as:

$$\hat{E}_T = H\bar{X} = \sum_{i=1}^{4} H_i \bar{x}_i. \qquad [3]$$

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

$$V(\hat{E}_T) = H^2 V(\bar{X}). \qquad [4]$$

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

Catch per unit effort (CPUE) for species j during a component (peak or non-peak) was estimated as:

$$CPUE_j = \sum_{k=1}^{m} c_{jk} / \sum_{k=1}^{m} \qquad [5]$$

where:

m = the number of anglers interviewed during the component,

c_{ij} = the catch (either number harvested or total number caught) of species j by angler k, and

f_k = the effort (number of hours) expended by angler k.

The variance of mean effort per angler was estimated using a two-stage sample design with days representing the first-stage sample units and anglers the second-stage sample units (Von Geldern and Tomlinson 1973). On a given sample day, the number of second-stage units available was unknown. The variance of mean effort was estimated as (Sukhatme et al. 1984):

$$V(\bar{f}) = [1-(d/D)]\ s^2_B/d + (\sum_{k=1}^{D} s^2_{Wk}/m)/dD \qquad [6]$$

where:

d = the number of days sampled during the component,

D = the number of days in the component,

s^2_{Wk} = the sample variance of effort for anglers interviewed during day k, and

s^2_B = the between-day variance of mean angler effort.

The between-day variance, s^2_B, was estimated as:

$$s^2_B = [\sum_{k=1}^{D} (\bar{f}_k - \bar{f})^2]/(d-1), \qquad [7]$$

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

The mean and variances for harvest and catch of a species were estimated identically to effort by substituting the corresponding harvest or catch quantities for effort (f).

The variance of the catch and harvest rate of species j ($CPUE_j$) was calculated using the approximation for the variance of the quotient of two random variables (Jessen 1978):

$$\hat{V}(CPUE_j) = (\bar{c}_j/\bar{f})^2 \ (s^2_c/\bar{c}^2_j + s^2_f/\bar{f}^2 - 2rs_{cj}s_f/\overline{cf}) \qquad [8]$$

where:

$\bar{c}_j$ = the mean catch of species j by anglers interviewed during a component,

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

s_c = the two-stage variance estimate for $\bar{c}_j$,

s_f = the two-stage variance estimate for $\bar{f}$, and

r = the correlation between the c_{jk} and f_k.

The catch and harvest of species j was estimated as:

$$\hat{C}_j = \hat{E}_T CPUE_j. \qquad [9]$$

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

$$\hat{V}(\hat{C}_j) = [\hat{E}_T^2 \ V(CPUE_j)] + [CPUE_j^2 \ \hat{V}(E_T)] - [\hat{V}(E_T) \ V(CPUE_j)]. \qquad [10]$$

Total catch and its variance were estimated for the peak and non-peak components and summed to estimate the total season catch. The same procedures were followed in estimating total harvest of each species.

Assumptions necessary for these analyses include:

1. Incomplete-trip angler interviews provided an unbiased estimate of completed-trip angler CPUE.

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 2100 hours and 0700 hours.

4. The catch and effort by individual anglers are normally distributed random variables.

5. Catch rate and duration of fishing trip are independent (DiConstanzo 1956).

The age composition of chinook salmon harvested by the sport fishery was estimated from all legible scales collected during the creel survey. Letting p_h equal the estimated proportion of age group h, the variance of p_h was estimated using the normal approximation to the binomial (Schaeffer et al. 1979):

$$\hat{V}(p_h) = p_h(1-p_h)/n_T-1), \qquad [11]$$

where n_T is the number of chinook salmon scales read.

Mean length at age by sex and its variance were estimated using standard normal procedures. Mean length (millimeters) and weight (kilograms) were calculated by age group for all chinook salmon sampled.

Escapement

The magnitude of the chinook escapement was estimated by sonar at Portage Creek (Morstad and Minard, 1988). Age, sex, and length compositions of spawned-out chinook salmon carcasses sampled from the Koktuli, Stuyahok, and upper Nushagak Rivers were estimated as described above.

RESULTS

Creel Survey

The creel survey on the lower Nushagak River was conducted from 11 June to 17 July 1987. Angler counts by day, and daily time period are presented in Appendix Table 1. Daily catch and harvest rates for chinook, coho, and chum salmon, Dolly Varden, and Northern pike are presented in Appendix Tables 2 and 3.

Effort:

Mean angler counts for periods 1, 2, and 3 were 5.8, 34.9, and 5.9, respectively (Table 1). Total effort was estimated to be 9,085 angler-hours. Most of the fishing effort (7,426 angler-hours or 82%) occurred during period 2. Interviewed anglers who had completed their fishing trip (n = 63) averaged 6.14 hours per trip (standard error = 0.29).

Catch Rate:

Catch rates for chinook salmon varied substantially during the fishery (Appendix Table 3 and Table 2). Peak daily harvest rate of chinook salmon was 0.56 fish per hour and peak catch rate was 0.74 chinook salmon per hour; both occurred on 24 June (Appendix Tables 2 and 3). The only other species with a significant harvest rate was chum salmon *O. keta*.

Catch and Harvest:

An estimated 2,371 chinook salmon were caught. Of these, an estimated 1,371 (58%) were harvested (Table 3). The largest catch (2,117) and harvest (1,201) of chinook salmon occurred during period 2 (24 June through 9 July). Most of the catch and release fishing occurred during the peak component. An estimated 1,321 chum salmon were caught of which 312 (24%) were harvested. Most of the catch and all of the harvest of chum salmon occurred during the peak component. Estimated catch and harvest of coho salmon were 110 and 27, respectively. All were caught during period 2. Catches and harvests of Dolly Varden and Northern pike were negligible.

Size, Sex, and Age Compositions:

Seventy-two percent of the chinook salmon sampled in the sport harvest (n=341) were males (Table 4). Age 1.4 fish were most common (46%), followed by age 1.3 fish (29%) and age 1.2 fish (22%). Mean length and weight of chinook salmon sampled from the sport harvest was 744 mm and 7.3 kg, respectively. Males composed 56% of the sampled chum salmon (n = 18) (Table 5). Age 0.4 were the most abundant age group in the chum salmon harvest sample (72%). Lengths and weights for chum salmon are also presented in Table 5.

Escapement

The escapement of chinook salmon to the Nushagak River estimated by the sonar at Portage Creek was 84,309 fish (Table 6). Chinook salmon carcasses were much more abundant on the upper Nushagak River, indicating a greater escapement than either the Koktuli or Stuyahok River received. Fifty percent of the upper Nushagak chinook salmon sampled (n = 280) were males (Table 7). Age 1.4 fish dominated the sample (62%), followed by age 1.3 fish (27%), and age 1.2 fish (10%). Mean length of the chinook salmon escapement sample was 793 mm; no weights were taken. Samples from the Koktuli and Stuyahok Rivers were small (n=63 and 29, respectively); sex, age, and length compositions are summarized in Tables 8 and 9.

Table 1. Estimated effort (angler-hours) by period for the sport fishery in the lower Nushagak River, 1987.

Sampling Period/ Dates	Number Of Interviews	Number Of Days Possible	Number Of Days Sampled	Anglers Per Count	Estimated Effort			
					Ang-Hrs	SE[1]	95% C. I.[2]	Relative Precision[3]
Period 1 6/11-6/23	69	13	9	5.8	991	184.3	630 - 1,352	36.5%
Period 2 6/24-7/9	291	16	15	34.9	7,426	566.1	6,316 - 8,536	14.9%
Period 3 7/10-7/17	56	8	5	5.9	668	181.5	312 - 1,024	53.3%
Season 6/11-7/17	416	37	29		9,085	622.4	7,860 - 10,300	13.4%

[1] Standard Error.

[2] Confidence interval.

[3] Relative precision of 95% confidence interval.

Table 2. Catch and harvest rate (fish per hour) by species and time period for anglers interviewed during the sport fishery in the lower Nushagak River, 1987.

Species	Period/ Dates	Catch		Harvest	
		Fish/Hr	SE[1]	Fish/Hr	SE[1]
Chinook Salmon	Period 1 6/11-6/23	0.0598	0.0172	0.0598	0.0172
	Period 2 6/24-7/9	0.2851	0.0268	0.1617	0.0196
	Period 3 7/10-7/17	0.2918	0.0517	0.1667	0.0521
Chum Salmon	Period 1 6/11-6/23	0.0066	0.0101	0.0000	0.0000
	Period 2 6/24-7/9	0.1765	0.0323	0.0420	0.0092
	Period 3 7/10-7/17	0.0052	0.0055	0.0000	0.0000
Coho Salmon	Period 1 6/11-6/23	0.0000	0.0000	0.0000	0.0000
	Period 2 6/24-7/9	0.0148	0.0040	0.0037	0.0019
	Period 3 7/10-7/17	0.0000	0.0000	0.0000	0.0000
Dolly Varden	Period 1 6/11-6/23	0.0000	0.0000	0.0000	0.0000
	Period 2 6/24-7/9	0.0012	0.0008	0.0000	0.0000
	Period 3 7/10-7/17	0.0052	0.0084	0.0052	0.0084
Northern Pike	Period 1 6/11-6/23	0.0000	0.0000	0.0000	0.0000
	Period 2 6/24-7/9	0.0012	0.0007	0.0000	0.0000
	Period 3 7/10-7/17	0.0000	0.0000	0.0000	0.0000

[1] Standard Error.

Table 3. Estimated catch and harvest of chinook, chum, and coho salmon, Dolly Varden, and Northern pike for the sport fishery in the lower Nushagak River, 1987.

Species	Period/ Dates	Catch Number	Catch SE[1]	Catch 95% C. I.[2]	Catch Rel. Pre.[3]	Harvest Number	Harvest SE[1]	Harvest 95% C. I.[2]	Harvest Rel. Pre.[3]	Percent Harvested
Chinook Salmon	Period 1 6/11-6/23	59	20	20 - 99	66.4%	59	20	20 - 99	66.4%	100.0%
	Period 2 6/24-7/9	2,117	256	1,616 - 2,618	23.7%	1,201	171	865 - 1,537	27.9%	56.7%
	Period 3 7/10-7/17	195	63	72 - 315	63.3%	111	75	23 - 198	132.4%	56.9%
	Total 6/11-7/17	2,371	264	1,853 - 2,886	21.8%	1,371	178	1,021 - 1,720	25.4%	57.8%
Chum Salmon	Period 1 6/11-6/23	7	10	0 - 26	280.0%	0	0	0 - 0		0.0%
	Period 2 6/24-7/9	1,311	260	802 - 1,819	38.9%	312	72	170 - 454	45.2%	23.8%
	Period 3 7/10-7/17	3	4	0 - 11	238.4%	0	0	0 - 0		0.0%
	Total 6/11-7/17	1,321	260	812 - 1,830	38.6%	312	72	170 - 454	45.2%	23.6%
Coho Salmon	Period 1 6/11-6/23	0	0	0 - 0		0	0	0 - 0		0.0%
	Period 2 6/24-7/9	110	30	50 - 170	53.5%	27	14	0 - 55	101.6%	24.5%
	Period 3 7/10-7/17	0	0	0 - 0		0	0	0 - 0		0.0%
	Total 6/11-7/17	110	30	50 - 170	53.5%	27	14	0 - 55	101.6%	24.5%

-Continued-

Table 3. Estimated catch and harvest of chinook, chum, and coho salmon, Dolly Varden, and Northern pike for the sport fishery in the lower Nushagak River, 1987.

Species	Period/ Dates	Catch Number	Catch SE[1]	Catch 95% C. I.[2]	Catch Rel. Pre.[3]	Harvest Number	Harvest SE[1]	Harvest 95% C. I.[2]	Harvest Rel. Pre.[3]	Percent Harvested
Dolly Varden	Period 1 6/11-6/23	0	0	0 - 0		0	0	0 - 0		0.0%
	Period 2 6/24-7/9	9	6	0 - 21	130.7%	0	0	0 - 0		0.0%
	Period 3 7/10-7/17	3	5	0 - 14	358.9%	3	5	0 - 14	326.7%	0.0%
	Total 6/11-7/17	12	8	0 - 28	130.7%	3	5	0 - 14	326.7%	25.0%
Northern Pike	Period 1 6/11-6/23	0	0	0 - 0		0	0	0 - 0		0.0%
	Period 2 6/24-7/9	9	5	0 - 19	108.9%	0	0	0 - 0		0.0%
	Period 3 7/10-7/17	0	0	0 - 0		0	0	0 - 0		0.0%
	Total 6/11-7/17	9	5	0 - 19	108.9%	0	0	0 - 0		0.0%

[1] Standard Error.

[2] 95% confidence interval.

[3] Relative precision of 95% confidence interval.

Table 4. Sex, age, length (mm), and weight (kg) compositions for chinook salmon sampled from the sport harvest in the lower Nushagak River, 1987.

Sample Period: 6/11 - 7/17

	Age Group					
	1.1	1.2	1.3	1.4	1.5	Total
MALE						
Percent	2.3%	21.7%	24.0%	22.9%	0.9%	71.8%
Av Length	382	546	724	841	944	699
Std Error	8.4	6.0	9.9	11.4	53.3	10.0
Sample Size	8	74	82	78	3	245
Av Weight	0.9	2.7	6.1	10.1	14.2	6.2
Std Error	0.1	0.1	0.2	0.4	3.9	0.3
Sample Size	8	72	77	74	3	234
FEMALE						
Percent			4.7%	22.6%	0.9%	28.2%
Av Length			804	872	861	860
Std Error			16.3	6.8	8.6	6.6
Sample Size			16	77	3	96
Av Weight			8.4	10.5	9.3	10.1
Std Error			0.7	0.3	0.8	0.3
Sample Size			16	72	3	91
BOTH SEXES						
Percent	2.3%	21.7%	28.7%	45.5%	1.8%	100.0%
Av Length	382	546	737	856	902	744
Std Error	8.4	6.0	9.1	6.7	30.4	8.4
Sample Size	8	74	98	155	6	341
Av Weight	0.9	2.7	6.5	10.3	11.7	7.3
Std Error	0.1	0.1	0.2	0.3	2.1	0.2
Sample Size	8	72	93	146	6	325

Table 5. Sex, age, length (mm), and weight (kg) compositions for chum salmon sampled from the sport harvest in the lower Nushagak River, 1987.

Sample Period: 6/11 - 7/17

	Age Group			
	0.3	0.4	0.5	Total
MALE				
Percent	5.6%	50.0%		55.6%
Av Length	603	621		619
Std Error		8.3		7.6
Sample Size	1	9		10
Av Weight	3.5	3.8		3.8
Std Error		0.2		0.2
Sample Size	1	9		10
FEMALE				
Percent	16.7%	22.2%	5.6%	44.4%
Av Length	572	596	550	581
Std Error	7.4	21.1		11.8
Sample Size	3	4	1	8
Av Weight	2.7	3.2	3.0	3.0
Std Error	0.1	0.4		0.2
Sample Size	3	4	1	8
BOTH SEXES				
Percent	22.2%	72.2%	5.6%	100.0%
Av Length	580	613	550	602
Std Error	9.3	8.8		8.0
Sample Size	4	13	1	18
Av Weight	2.9	3.6	3.0	3.4
Std Error	0.2	0.2		0.2
Sample Size	4	13	1	18

Table 6. Harvest and escapement of chinook salmon returns to the Nushagak/Mulchatna River drainage, 1977 - 1987.

Year	Harvest			Escapement	Total Run	Percent Sport
	Commerical	Subsistence	Sport			
1977	85,074	5,200	923	65,000	156,197	1%
1978	118,548	6,600	442	130,000	255,590	0%
1979	157,321	8,900	654	95,000	261,875	0%
1980	64,958	11,800	757	141,000	218,515	0%
1981	193,461	11,500	1,220	150,000	356,181	0%
1982	195,287	12,100	1,824	147,000	356,211	1%
1983	137,123	11,800	2,003	161,730	312,656	1%
1984	61,375	9,800	2,382	80,940	154,497	2%
1985	67,616	7,900	1,852	115,720	193,088	1%
1986	63,859	12,600	1,780[1]	32,774	111,023	4%
Average	114,462	9,820	1,384	111,916	237,587	1%
1987	77,000	13,000	1,371	84,309	175,680	1%

[1] 1986 sport harvest from Minard (1987)

Table 7. Sex, age, and length compositions for chinook salmon sampled during carcass surveys of the upper Nushagak River, 1987.

All Periods Combined	Age Group 1.1	1.2	1.3	1.4	1.5	Total
Males						
Percent	0.4%	9.6%	21.7%	17.5%	0.4%	49.6%
Av Length	454	555	721	851	975	735
Std Error		14.05	10.32	13.24		7.05
Samp Size	1	27	61	49	1	139
Females						
Percent			5.4%	43.9%	1.1%	50.4%
Av Length			814	853	918	850
Std Error			13.73	4.47	17.64	4.18
Samp Size			15	123	3	141
Both Sexes						
Percent	0.4%	9.6%	27.1%	61.4%	1.5%	100.0%
Av Length	454	555	740	852	933	793
Std Error		14.05	8.71	4.95	13.23	4.09
Samp Size	1	27	76	172	4	280

Table 8. Sex, age, and length compositions for chinook salmon sampled during carcass surveys of the Koktuli River, 1987.

All Periods Combined	Age Group 1.2	1.3	1.4	1.5	Total
Males	24	48	333	24	429
Percent	1.6%	3.2%	22.2%	1.6%	28.6%
Av Length	595	765	865	900	840
Std Error		70.00	22.32		19.02
Samp Size	1	2	14	1	18
Females	119	238	666	48	1,071
Percent	7.9%	15.9%	44.4%	3.2%	71.4%
Av Length	597	746	823	840	781
Std Error	60.28	19.38	14.38	40.00	12.11
Samp Size	5	10	28	2	45
Both Sexes	143	286	999	72	1,500
Percent	9.5%	19.1%	66.6%	4.8%	100.0%
Av Length	597	749	837	860	798
Std Error	50.24	19.93	12.14	26.67	10.22
Samp Size	6	12	42	3	63

Table 9. Sex, age, and length compositions for chinook salmon sampled during carcass surveys of the Stuyahok River, 1987.

All Periods Combined	Age Group 1.1	1.2	1.3	1.4	Total
Males	83	124	248	83	538
Percent	6.9%	10.3%	20.7%	6.9%	44.8%
Av Length	468	647	762	970	722
Std Error	42.50	101.70	45.14	70.00	33.82
Samp Size	2	3	6	2	13
Females	0	124	166	372	662
Percent		10.3%	13.8%	31.0%	55.2%
Av Length		538	840	857	793
Std Error		16.41	10.80	12.08	7.93
Samp Size		3	4	9	16
Both Sexes	83	248	414	455	1,200
Percent	6.9%	20.7%	34.5%	37.9%	100.0%
Av Length	468	593	793	878	761
Std Error	42.50	51.51	27.43	16.11	15.78
Samp Size	2	6	10	11	29

DISCUSSION

Based on data from the statewide sport fishing harvest survey (Mills 1979-1987), sport effort and harvest of chinook salmon in the Nushagak and Mulchatna River drainages have increased over the period from 1977 through 1985 (Figure 3). Local residents and resources managers are concerned about potential impacts such increases may have on stocks of chinook salmon in these drainages. Results of monitoring efforts conducted during 1986 (Minard 1987) and 1987 on the lower Nushagak River suggests that both sport effort and chinook salmon harvest in the drainage have stabilized (Figure 3).

It is interesting to note the differences in both effort and harvest estimates as reported in the mail survey to those estimates reported from the creel surveys (Figure 3). The differences in reported efforts can likely be accounted for in that the harvest survey reports effort for all species over the entire drainage and year whereas the creel survey only evaluates efforts for the period of sport fishing for chinook salmon in the lower Nushagak River. The differences in reported harvests can likely be accounted for by a suspect harvest estimate from the 1986 harvest survey given the low escapement in 1986[2]. Such differences do, however, show the need to verify finding of the mail survey when more precise estimates are required.

Based on the estimated sport harvest of 1,371 chinook salmon, sport anglers fishing the lower Nushagak River harvested approximately 1% of the total run of chinook salmon into the Nushagak and Mulchatna River drainages during 1987 (Table 6). This interception rate is comparable to the mean 10-year interception rate for the sport fishery in the drainage (Table 6). Based on this, the impact of the sport fishery on the Nushagak and Mulchatna River drainage stocks of chinook salmon appears minor.

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[2] The staff feels that the majority of the effort for and harvest of chinook salmon occurs in the creel survey area in the lower Nushagak River.

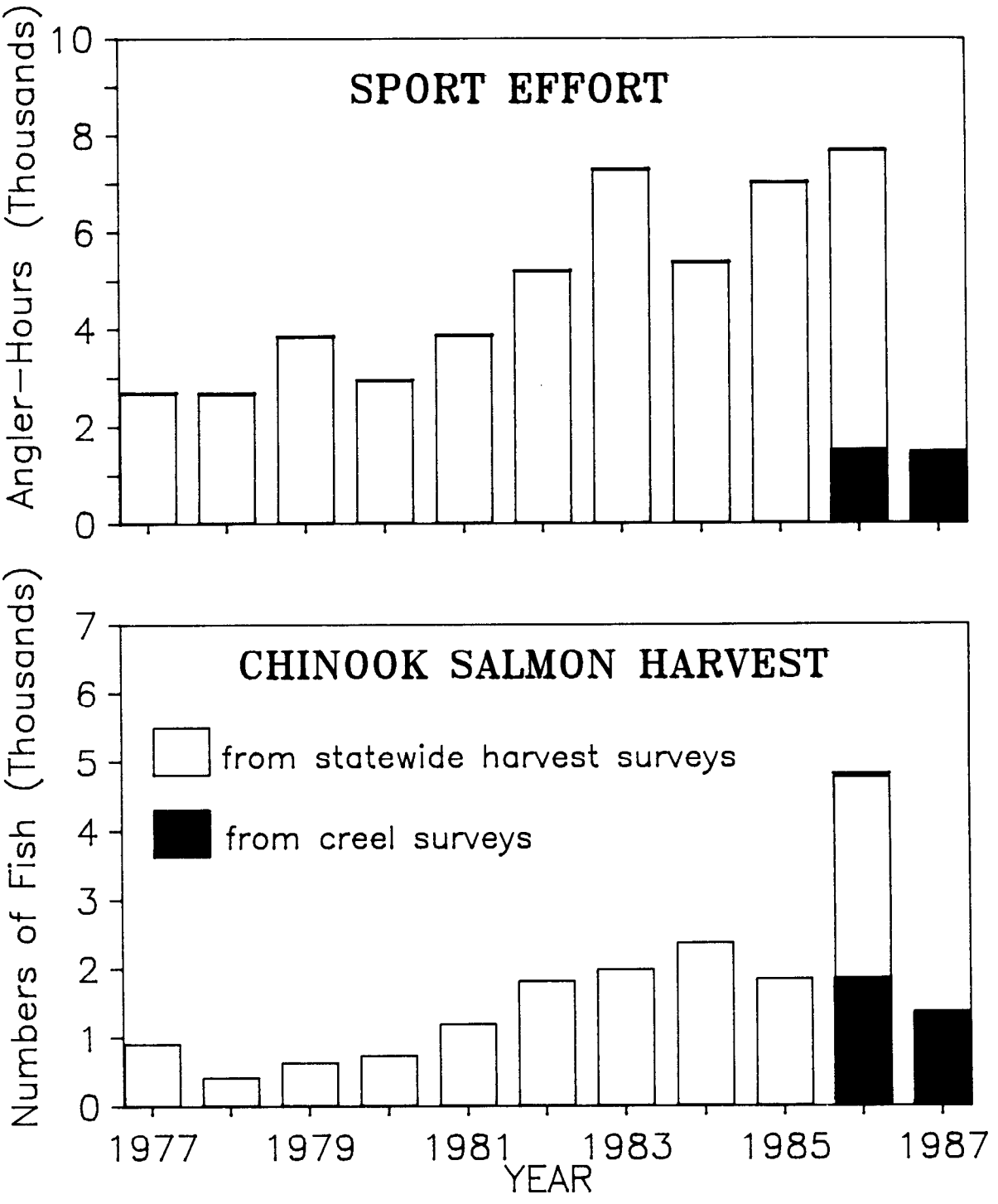

Figure 3. Sport fishing effort and sport harvest of chinook salmon for the Nushagak/Mulchatna River drainage, 1977-1987. Data from the creel survey only include the lower Nushagak River survey area.

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APPENDIX

Appendix Table 1. Angler counts for the sport fishery in the lower Nushagak River, 1987.

Date	Wd/We[2]	Period[1] A	B	C	D
11-Jun	We	0	4	0	
12-Jun	We				
13-Jun	Wd	0	9	0	
14-Jun	Wd		9	3	
15-Jun	Wd				
16-Jun	Wd			3	0
17-Jun	Wd				
18-Jun	We	0	12	11	
19-Jun	We				
20-Jun	Wd	2	13		
21-Jun	Wd	4		6	7
22-Jun	Wd		17	13	
23-Jun	Wd		8	6	
24-Jun	Wd		47	46	9
25-Jun	We	0		45	
26-Jun	We		19	21	9
27-Jun	Wd		60	65	44
28-Jun	Wd	4	85	41	
29-Jun	Wd		13		9
30-Jun	Wd	9		73	
01-Jul	Wd	9	62		21
02-Jul	We		61	31	
03-Jul	We		62	59	41
04-Jul	Wd	12	62		44
05-Jul	Wd	10		57	12
06-Jul	Wd		33	22	
07-Jul	Wd		43	28	
08-Jul	Wd			47	
09-Jul	We	12	30	40	
10-Jul	We		19		11
11-Jul	Wd	0		4	
12-Jul	Wd				
13-Jul	Wd	0	10	12	
14-Jul	Wd				
15-Jul	Wd		10		2

-Continued-

Appendix Table 1. Angler counts for the sport fishery in the lower Nushagak River, 1987.

Date	Wd/We[2]	Period[1] A	B	C	D
16-Jul	We	0		8	
17-Jul	We		0	1	
18-Jul	Wd				
19-Jul	Wd				
20-Jul	Wd				
21-Jul	Wd				
22-Jul	Wd				

[1] Period A = 0700 - 0959; Period B = 1000 - 1359; Period C = 1400 - 1759; Period D = 1800 - 2100.

[2] Wd = Weekday; We = Weekend/Holiday

Appendix Table 2. Summary of daily angler-effort and harvest (HPUE) rates for chinook, coho, and chum salmon, Dolly Varden, and Northern pike from angler interviews in the lower Nushagak River, 1987.

			Effort		Chinook			Coho			Chum			Dolly Varden			Northern Pike		
Date	We/ Wd[1]	Sample Size	Mean	SE[2]	Mean	SE[2]	HPUE	Mean	SE[2]	HPUE	Mean	SE[2]	HPUE	Mean	SE[2]	HPUE	Mean	SE[2]	HPUE
6-11	Wd	4	0.500	0.270	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-12	We	7	1.100	0.190	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-13	We	11	1.300	0.200	0.090	0.091	0.071	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-14	Wd	3	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-18	Wd	5	4.800	0.080	0.200	0.200	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-20	We	9	2.100	0.360	0.220	0.147	0.104	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-21	We	6	3.000	0.210	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-22	Wd	11	2.200	0.630	0.270	0.195	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-23	Wd	13	2.700	0.310	0.150	0.104	0.057	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-24	Wd	15	1.900	0.370	1.070	0.284	0.563	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-25	Wd	13	3.800	0.760	0.310	0.133	0.081	0.000	0.000	0.000	0.380	0.213	0.101	0.000	0.000	0.000	0.000	0.000	0.000
6-26	Wd	29	1.800	0.270	0.340	0.103	0.191	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-27	We	36	2.500	0.300	0.690	0.131	0.273	0.000	0.000	0.000	0.080	0.061	0.033	0.000	0.000	0.000	0.000	0.000	0.000
6-28	We	24	3.400	0.340	0.960	0.195	0.279	0.000	0.000	0.000	0.040	0.042	0.012	0.000	0.000	0.000	0.000	0.000	0.000
6-29	Wd	7	4.200	0.990	0.290	0.286	0.068	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-30	Wd	6	1.200	0.440	0.170	0.167	0.135	0.000	0.000	0.000	0.170	0.167	0.135	0.000	0.000	0.000	0.000	0.000	0.000
7-01	Wd	24	2.600	0.410	0.380	0.157	0.144	0.000	0.000	0.000	0.130	0.069	0.048	0.000	0.000	0.000	0.000	0.000	0.000
7-02	Wd	35	3.300	0.330	0.090	0.048	0.026	0.060	0.057	0.017	0.460	0.171	0.138	0.000	0.000	0.000	0.000	0.000	0.000
7-03	We	23	3.900	0.640	0.220	0.140	0.056	0.000	0.000	0.000	0.090	0.060	0.022	0.000	0.000	0.000	0.000	0.000	0.000
7-04	We	11	1.600	0.230	0.090	0.091	0.058	0.000	0.000	0.000	0.090	0.091	0.058	0.000	0.000	0.000	0.000	0.000	0.000
7-05	We	17	2.800	0.650	0.000	0.000	0.000	0.000	0.000	0.000	0.060	0.059	0.021	0.000	0.000	0.000	0.000	0.000	0.000
7-06	Wd	7	4.100	0.350	0.860	0.404	0.211	0.000	0.000	0.000	0.140	0.143	0.035	0.000	0.000	0.000	0.000	0.000	0.000
7-07	Wd	26	2.300	0.340	0.540	0.194	0.235	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7-09	Wd	18	2.800	0.480	0.670	0.243	0.242	0.060	0.056	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7-10	Wd	16	4.600	0.680	0.190	0.101	0.040	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7-11	We	14	4.400	0.370	1.570	0.309	0.358	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7-13	Wd	7	3.000	0.620	0.430	0.202	0.145	0.000	0.000	0.000	0.000	0.000	0.000	0.140	0.143	0.048	0.000	0.000	0.000
7-15	Wd	11	0.800	0.120	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7-16	Wd	8	3.300	0.350	0.500	0.189	0.150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

[1] Wd = Weekday; We = Weekend/Holiday.

[2] Standard Error.

Appendix Table 3. Summary of daily angler-effort and catch (CPUE) rates for chinook, coho, and chum salmon, Dolly Varden, and Northern pike from angler interviews in the lower Nushagak River, 1987.

			Effort		Chinook			Coho			Chum			Dolly Varden			Northern Pike		
Date	We/ Wd[1]	Sample Size	Mean	SE[2]	Mean	SE[2]	CPUE	Mean	SE[2]	CPUE	Mean	SE[2]	CPUE	Mean	SE[2]	CPUE	Mean	SE[2]	CPUE
6-11	Wd	4	0.500	0.270	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-12	We	7	1.100	0.190	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-13	We	11	1.300	0.200	0.090	0.091	0.071	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-14	Wd	3	2.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-18	Wd	5	4.800	0.080	0.200	0.200	0.042	0.000	0.000	0.000	0.200	0.200	0.042	0.000	0.000	0.000	0.000	0.000	0.000
6-20	We	9	2.100	0.360	0.220	0.147	0.104	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-21	We	6	3.000	0.210	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-22	Wd	11	2.200	0.630	0.270	0.195	0.125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-23	Wd	13	2.700	0.310	0.150	0.104	0.057	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6-24	Wd	15	1.900	0.370	1.400	0.321	0.739	0.000	0.000	0.000	0.070	0.067	0.035	0.000	0.000	0.000	0.000	0.000	0.000
6-25	Wd	13	3.800	0.760	0.920	0.288	0.243	0.000	0.000	0.000	0.920	0.473	0.243	0.000	0.000	0.000	0.000	0.000	0.000
6-26	Wd	29	1.800	0.270	0.450	0.106	0.248	0.000	0.000	0.000	0.000	0.000	0.000	0.030	0.034	0.019	0.000	0.000	0.000
6-27	We	36	2.500	0.300	1.030	0.197	0.404	0.000	0.000	0.000	0.080	0.061	0.033	0.000	0.000	0.000	0.030	0.028	0.011
6-28	We	24	3.400	0.340	1.380	0.350	0.400	0.000	0.000	0.000	0.210	0.104	0.061	0.000	0.000	0.000	0.000	0.000	0.000
6-29	Wd	7	4.200	0.990	0.430	0.297	0.102	0.000	0.000	0.000	0.430	0.297	0.102	0.000	0.000	0.000	0.000	0.000	0.000
6-30	Wd	6	1.200	0.440	0.500	0.224	0.404	0.000	0.000	0.000	1.330	0.803	1.077	0.000	0.000	0.000	0.000	0.000	0.000
7-01	Wd	24	2.600	0.410	0.630	0.232	0.241	0.000	0.000	0.000	1.210	0.614	0.465	0.000	0.000	0.000	0.000	0.000	0.000
7-02	Wd	35	3.300	0.330	0.200	0.107	0.060	0.310	0.141	0.095	1.310	0.474	0.397	0.000	0.000	0.000	0.000	0.000	0.000
7-03	We	23	3.900	0.640	0.700	0.230	0.179	0.000	0.000	0.000	1.170	0.473	0.303	0.000	0.000	0.000	0.000	0.000	0.000
7-04	We	11	1.600	0.230	0.180	0.122	0.116	0.000	0.000	0.000	0.450	0.282	0.290	0.000	0.000	0.000	0.000	0.000	0.000
7-05	We	17	2.800	0.650	0.710	0.329	0.256	0.000	0.000	0.000	0.120	0.081	0.043	0.000	0.000	0.000	0.000	0.000	0.000
7-06	Wd	7	4.100	0.350	0.860	0.404	0.211	0.000	0.000	0.000	0.140	0.143	0.035	0.000	0.000	0.000	0.000	0.000	0.000
7-07	Wd	26	2.300	0.340	0.850	0.307	0.370	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7-09	Wd	18	2.800	0.480	1.610	0.389	0.584	0.060	0.056	0.020	0.060	0.056	0.020	0.000	0.000	0.000	0.000	0.000	0.000
7-10	Wd	16	4.600	0.680	1.500	0.316	0.323	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7-11	We	14	4.400	0.370	1.640	0.289	0.374	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7-13	Wd	7	3.000	0.620	0.710	0.286	0.241	0.000	0.000	0.000	0.000	0.000	0.000	0.140	0.143	0.048	0.000	0.000	0.000
7-15	Wd	11	0.800	0.120	0.000	0.000	0.000	0.000	0.000	0.000	0.090	0.091	0.114	0.000	0.000	0.000	0.000	0.000	0.000
7-16	Wd	8	3.300	0.350	0.500	0.189	0.150	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

[1] Wd = Weekday; We = Weekend/Holiday.

[2] Standard Error.