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SPORT EFFORT, HARVEST, AND ESCAPEMENT OF SOCKEYE SALMON IN BUSKIN RIVER, KODIAK, ALASKA, 1988[1]

By

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ABSTRACT

A roving creel survey was conducted on Buskin River 21 May through 24 July 1988. Sport anglers fished an estimated 15,016 angler-hours and harvested 2,723 adult sockeye salmon *Oncorhynchus nerka*. Sockeye salmon catch (including fish released) was estimated to be 3,654. The majority (71 percent) of the sockeye salmon harvested were age 1.3. Age 1.3 sockeye salmon in the harvest averaged 521 millimeters (mid-eye to fork-of-tail length) for females and 558 millimeters for males. Buskin River fish escapement counts, as deter- mined by foot surveys and a weir operated from 23 April through 24 September 1988, totaled 357 emigrant steelhead *Oncorhynchus mykiss*; 21 immigrant steelhead; 12,144 sockeye salmon; 6,182 coho salmon *Oncorhynchus kisutch*; 84 chum salmon *Oncorhynchus keta*; and 233,648 pink salmon *Oncorhynchus gorbuscha*.

KEY WORDS: sockeye salmon, *Oncorhynchus nerka*, coho salmon *Oncorhynchus kisutch*, escapement, harvest, size and age, Buskin River, Kodiak, Alaska.

INTRODUCTION

Buskin River (Figure 1) is centrally located in the urban area of Kodiak Island and receives more effort by anglers than any other water on Kodiak Island. The river contains steelhead/rainbow trout *Oncorhynchus mykiss*; Dolly Varden *Salvelinus malma*; and all species of Pacific salmon *Oncorhynchus spp.* except chinook salmon *Oncorhynchus tshawytscha*. In 1987, it supported approximately 44% (16,390 angler-days) of the sport effort and 40% of the sport harvest (all species) for all Kodiak lakes and streams (Mills 1988). Buskin River salmon also support the largest personal use/subsistence fishery on Kodiak Island and a commercial fishery that targets primarily on pink salmon *Oncorhynchus gorbuscha* and coho salmon *Oncorhynchus kisutch* (Manthey et al. 1984).

The sport fishery is directed at anadromous Dolly Varden during April and May, sockeye salmon *Oncorhynchus nerka* and pink salmon from June through mid-August, and coho salmon from mid-August through mid-October. In 1983, approximately 18.5%, 59.7% and 21.8% of the sport effort (20,136 angler trips) occurred during these time periods, respectively (Murray 1984). Immigrant Dolly Varden are also caught from mid-summer through fall. The primary management concerns are for Dolly Varden, sockeye salmon, pink salmon, and coho salmon because the harvest of these fish by all user groups is thought to be high in relation to the population size.

In 1985, the Alaska Department of Fish and Game initiated a project to estimate the magnitude and composition of salmon, Dolly Varden, and steelhead returns to Buskin River (Murray 1986). The project consists of: (1) counting fish escapements through a weir; (2) estimating sport fish effort and harvest for the spring Dolly Varden and fall coho salmon fisheries; and (3) estimating the age-sex-size composition of Dolly Varden and coho salmon in both the sport harvest and the escapement.

The objective of this report is to present data for Buskin River salmon and steelhead escapements and the sport harvest of sockeye salmon. Information pertaining to the personal use/subsistence and commercial fisheries are reported by Malloy et al. (in press). Results of that portion of the project pertaining to Dolly Varden are reported by Murray (in press).

METHODS

Sport Fishery

Anglers were permitted a daily bag and possession limit of two sockeye salmon 508 mm or more in length and 10 sockeye salmon (daily and in possession) less than 508 mm in length during 1988 (ADF&G 1988). Sport fishing was not permitted within 100 m of the weir by regulation, and this closure was extended an additional 210 m upstream of the weir to encompass a large holding area during the period 15 April to 9 June.

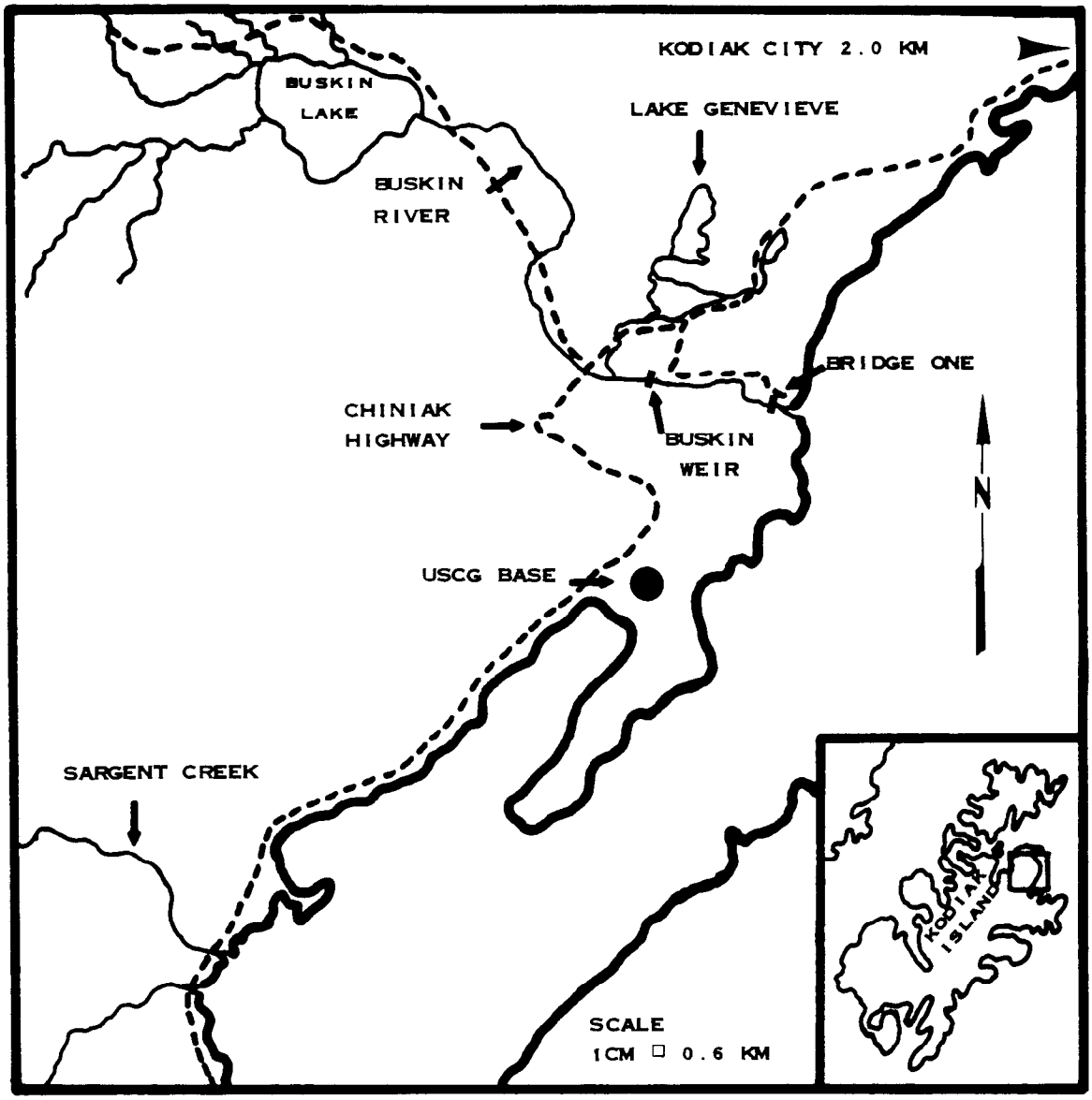

Figure 1. Location of Buskin River, Kodiak Island, Alaska.

Study Area:

Sockeye salmon first enter Buskin River in mid-May and continue through July or early August (Murray 1986). Small numbers of fish enter the river throughout emigration with small bimodal peaks usually occurring in mid-June and mid-July.

The Buskin River sport fishery for sockeye salmon occurs during their immigration. A sport fishery targeting on Dolly Varden occurs prior to the sockeye salmon immigration, and a sport fishery for pink salmon takes place after the sockeye salmon immigration. The sockeye salmon fishery may extend into both the Dolly Varden and pink salmon fisheries by 1 to 2 weeks during some years. Most sport fishing effort for sockeye salmon and pink salmon occurs at the tidal lagoon and lower river below the weir (Figure 1).

Study Design:

A creel survey was conducted on the Buskin River from 21 May through 24 July to estimate sport effort in angler-hours and sport harvest of sockeye salmon.

Angler counts were conducted following a stratified random sampling design. The creel survey was stratified into weekday and weekend/holiday strata. Approximately 50% of the sampling effort was allocated to weekdays and 50% to weekend/holidays. For the creel survey, the fishing day was considered to be 17 hours in duration (0600-2300 hours). The fishing day was stratified into four time periods: A, 0600-0759 hours; B, 0800-1159 hours; C, 1200-1659 hours; and D, 1700-2300 hours.

Angler counts took approximately 20 minutes to complete and were considered instantaneous (Neuhold and Lu 1957). Angler interviews were completed trip interviews collected by monitoring the major access points and interviewing anglers as they departed the fishery.

Assumptions necessary for the creel survey are:

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

2) No significant fishing effort occurs during the hours 2300-0600.

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

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

5) Fishing effort does not influence catch per unit effort.

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

7) No significant differences occur in catch or harvest rates between periods in each day.

Data Collection:

During a selected sample period, a starting time was randomly selected to count the number of anglers. The remaining time in the sample period was spent conducting angler interviews. Angler counts were conducted by walking and/or driving the length of the fishing area as quickly as possible and counting the number of people actively engaged in fishing. Only anglers who had completed fishing were interviewed. The following information was recorded during each interview: number of fish released by species, number of fish retained by species, and total hours fished (to the nearest 1/4 hour). Demographic information about each angler was also recorded.

Data Analyses:

Angler effort was calculated using a stratified random sample design (Schaeffer et al. 1979). Effort was estimated for each of the weekday and weekend/holiday components as:

$$\hat{E} = \sum_{j=1}^{4} H_j \bar{Y}_j \qquad (1)$$

with variance:

$$\hat{V}(\hat{E}) = \sum_{j=1}^{4} H_j^2 (s_j^2/n_j) \qquad (2)$$

where: $\bar{Y}_j$ = the mean number of anglers per count in time period j,

H_j = total number of hours of fishing possible in time period j,

s_j^2 = the sample variance for angler counts in time period j, and

n_j = the number of angler counts conducted in time period j.

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

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

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

where:

$$s_{wi}^2 = [\sum_{K=1}^{m_i}(f_{ik}-\bar{f}_i)^2]/(m_i-1), \quad (4)$$

$$s_B^2 = [\sum_{i=1}^{d}(\bar{f}_i-\bar{F})^2]/(d-1) \quad (5)$$

d = number of days on which sampling was conducted,

D = number of possible days in a component,

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

m_i = number of anglers interviewed on day i,

$\bar{F}$ = mean of mean effort per angler during a component, and

$\bar{f}_i$ = mean effort per angler on day i.

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

Harvest and catch per effort, $\bar{h}/\bar{f}$, was computed for the weekday and weekend holiday component. The variance of harvest and catch per effort is approximated by the variance for a quotient of the means of two random variables (Jessen 1978),

$$V(\bar{h}/\bar{f}) = (\bar{h}/\bar{f})^2[(s_h^2/\bar{h}^2) + (s_f^2/\bar{f}^2) - (2rs_hs_f/\overline{hf})] \quad (6)$$

where: $\bar{h}$ = mean number of sockeye salmon caught or harvests per angler,

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

s_h^2 = two-stage variance of $\bar{h}$,

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

r = Pearson's correlation coefficient for the h_{ik} and f_{ik}.

Total harvest or catch (T) was computed as:

$$\hat{T} = \hat{E}\ (\bar{h}/\bar{f}); \tag{7}$$

and variance (Goodman 1960):

$$V(\hat{T}) = [\hat{E}^2\ V(\bar{h}/\bar{f})] + [(\bar{h}/\bar{f})^2\ V(\hat{E})] - [V(\hat{E})\ V(\bar{h}/\bar{f})]. \tag{8}$$

Fish Counts

The Buskin River weir is located 2 km upstream of the river mouth at an area approximately 40 m wide. Both river banks at the weir site are steep and the river bottom is predominantly small rock substrate. The weir is constructed of 21 mm diameter aluminum pipe spaced 21 mm apart.

Adult fish counted through the weir gates were identified by species and the daily totals recorded. When the coho salmon immigration was nearly completed (24 September) the weir was dismantled and a foot survey was conducted to count fish holding below the weir.

Biological Data

Sockeye salmon from the sport harvest (n=192) and escapement (n=415), and coho salmon (n=461) from the escapement were sampled for age, sex, and size data. Sport-caught fish were sampled when encountered during angler interviews. Salmon in the escapement were originally sampled at the weir, however, initial efforts indicated that sampled fish suffered a high mortality. Thereafter, the salmon escapement was sampled by beach seining spawning fish. Fish were sampled for scales, sex, and length data. Scales were collected from the preferred area[1] and mounted on a gum card. Permanent scale impressions were made on plastic acetate cards which were read on a microfiche projector. Proportional age composition of the harvest was estimated. Letting P_h equal the estimated proportion of age class h, the variance of P_h was estimated as (Schaeffer et al. 1979):

$$V(\hat{p}_h) = \hat{p}_h(1 - \hat{p}_h)/(n_T - 1), \tag{9}$$

where n_T is the number of scales read.

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[1] The preferred area is on the left side of the fish, approximately two rows above the lateral line (Koo 1962)

RESULTS

Sport Fishery

Mean angler counts (Table 1 and Figure 2) progressively increased from the early morning stratum (period A) to the late evening stratum (period D) in the weekday fishery. A similar increase occurred in the weekend fishery, however, mean angler counts peaked in period C and decreased in period D. More of the effort (8,235 angler-hours or 55%) occurred during the weekday fishery than during weekends (6,781 angler-hours). Angler counts by date and daily time period are presented in Appendix Table 1.

Sockeye salmon harvest rates for the weekend and weekday fishery were 0.180 and 0.183 fish per hour, respectively (Table 2). Daily summaries of angler interviews are presented in Appendix Table 2.

An estimated 3,626 sockeye salmon were caught during 15,016 angler-hours of effort. However, only 2,723 sockeye salmon, 75.2% of the total catch, were harvested (Table 3). The weekday fishery and weekend fishery accounted for 55% (n=1,505) and 45% (n=1,218) of the total harvest, respectively.

A comparison of relative precision for the estimates of harvest and effort (Table 3) shows that most of the imprecision occurred in the estimate of harvest for the weekday fishery.

Characteristics of the sport fishery, based on 659 completed-trip angler interviews (Table 4), indicated 87.4% of the anglers were males, 88.8% were adults, 12.9% were military and only 14.1% were tourists. Approximately 60% of the fishermen caught one or more sockeye salmon. Most anglers (98.9%) used a single gear type and flies (74.1%) were the most popular bait.

Fish Counts

Buskin River weir fish counts from 9 May through 24 September 1988 (Appendix Table 3) totaled 12,144 sockeye salmon; 233,648 pink salmon; 84 chum salmon *O. keta*; and 6,182 coho salmon. A total of 357 emigrant and 26 immigrant steelhead were also counted through the weir, but these counts are incomplete as the weir was removed before the fall steelhead immigration was completed. Sockeye salmon weir counts peaked on 17 June, but large numbers entered sporadically through the end of July (Figure 3).

Biological Data

Ages 2.2[2] and 1.3 sockeye salmon comprised 13.6% and 71.4% of the sport fishery sample, respectively (Table 5). Males and females were nearly equally abundant (51.9% females, 48.0% males). Mean lengths of sockeye salmon in the sport harvest ranged from 484 mm for age 2.2 females to 558 mm for age 1.3 males (Table 6). Ages 2.2 and 2.3 sockeye salmon composed most of the

[2] European formula: the first numeral is the number of freshwater annuli. The second numeral refers to the number of marine annuli. Total age is the sum of both numbers plus one.

Table 1. Estimated effort in angler-hours during the Buskin River sport fishery for sockeye salmon, 21 May through 24 July 1988.

Fishery	Counts				Effort (hours)	
	Period[1]	Mean	SE[2]	SS[3]	Total	SE[2]
Weekend	A	5.8	1.0	10	255	45
	B	12.8	2.6	11	1,128	227
	C	24.4	3.1	16	2,688	343
	D	20.5	2.1	15	2,710	284
	TOTAL				6,781	502
Weekday	A	7.6	1.3	12	652	114
	B	7.8	1.3	10	1,342	229
	C	11.1	2.0	19	2,388	418
	D	14.9	2.3	15	3,853	598
	TOTAL				8,235	774
TOTAL FISHERY					15,016	922

[1] Period A: 0600-0759 hrs, Period B: 0800-1159 hrs, Period C: 1200-1659 hrs, Period D: 1700-2300 hrs.
[2] Standard error.
[3] Sample size.

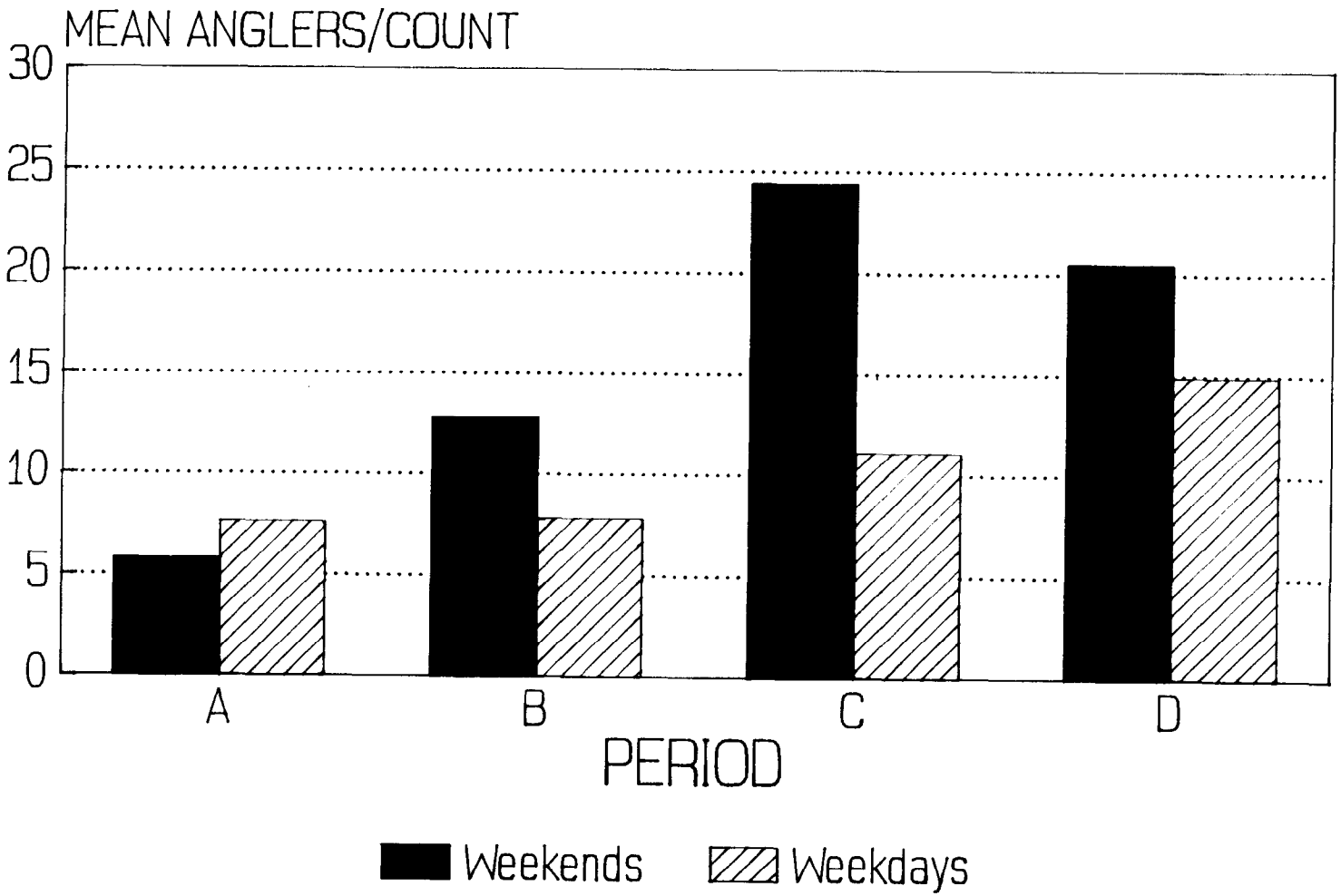

Figure 2. Buskin River anglers per count by fishery and daily period, 1988.

Table 2. Effort and catch summary statistics for anglers interviewed during the Buskin River sport fishery for sockeye salmon, 21 May through 24 July 1988.

Variable	Strata	
	Weekday	Weekend/Holiday
Number of days possible for sampling	43	22
Number of days sampled	24	21
Number of anglers interviewed	285	374
Effort		
Mean (angler-hours)	2.40	2.25
Standard error	0.12	0.08
Harvest (fish kept only)		
Mean (fish per angler)	0.44	0.40
Standard error of mean	0.05	0.04
Correlation coefficient[1]	0.22	0.20
HPUE (fish per angler-hour)	0.18	0.18
Standard error of HPUE	0.02	0.02
Catch (fish kept plus fish released)		
Mean (fish per angler)	0.60	0.52
Standard error of mean	0.12	0.06
Correlation coefficient[1]	0.25	0.16
CPUE (fish per angler-hour)	0.25	0.23
Standard error of HPUE	0.05	0.03

[1] Correlation coefficient between the harvest or catch and angler effort.

Table 3. Estimated effort and harvest during the Buskin River sport fishery for sockeye salmon, 21 May through 24 July 1988.

Variable	Strata		Total
	Weekday	Weekend/Holiday	
Effort			
Number of angler-hours	8,235	6,781	15,016
Standard error	501	774	922
Relative precision[1]	24.0%	20.1%	12.0%
Harvest (fish kept only)			
Number of fish	1,505	1,218	2,748
Standard error	231	154	278
Relative precision[1]	30.3%	24.8%	20.1%
Catch (fish kept plus fish released)			
Number of fish	2,070	1,556	3,626
Standard error	436	213	485
Relative precision[1]	41.2%	26.7%	26.3%
Percent of catch harvested	72.7%	78.3%	75.2%

[1] Relative precision is defined as the ratio of the half-width 95% confidence interval divided by the point estimate expressed as a percentage.

Table 4. Characteristics of Buskin River sport fishery for sockeye salmon, 21 May through 24 July 1988.

Angler Demographics				Fishing Gear	
Females	- 12.6%	Residents	- 81.3%	Multiple gear	- 1.1%
Males	- 87.4%	Tourists	- 14.1%	Single gear	- 98.9%
Adults	- 88.8%	Non-local	- 19.9%		
Youth	- 11.2%	Military	- 12.9%		
Nonresidents	- 18.7%	Unguided	-100.0%		

Angler Success and Harvest Data		Type of Lure[1]	
Successful anglers	- 59.4%	Bait	- 0.6%
Unsuccessful anglers	- 40.6%	Spinners	- 27.8%
		Flies	- 74.1%

[1] Some anglers used more than one type of lure, therefore, total percent of all lure types is greater than 100%.

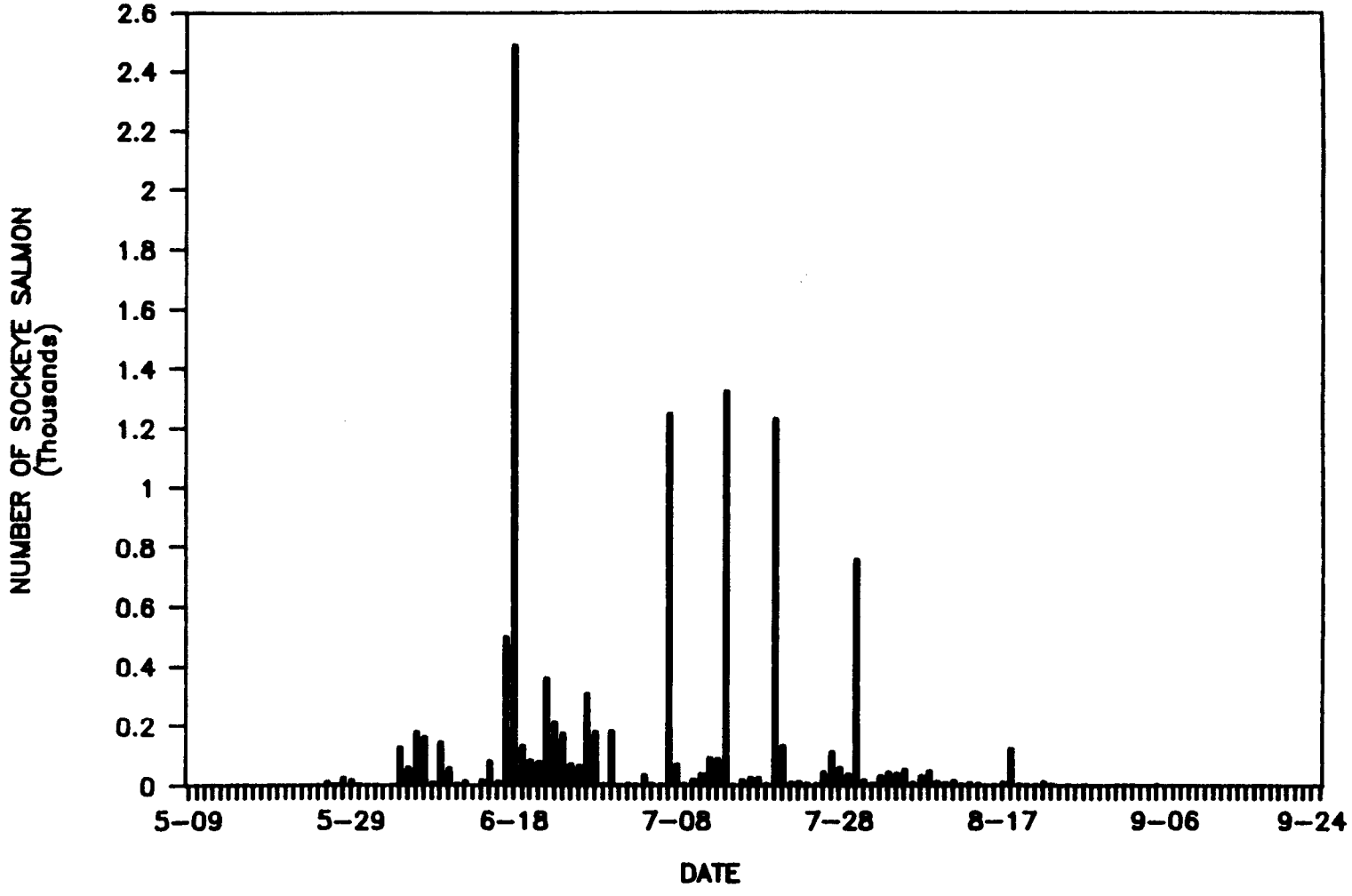

Figure 3. Daily counts of sockeye salmon through the Buskin River weir, 1988.

Table 5. Age composition of sockeye salmon sampled from the Buskin River sport harvest, 1988[1].

Sex	Age Group 2.3	2.2	1.3	1.2	Total[1]
Female					
Sample Size	6	10	59	5	80
Percent	3.9	6.5	38.3	3.2	51.9
Standard Error	8.6	8.1	5.9	8.8	5.1
Male					
Sample Size	8	11	51	4	74
Percent	5.2	7.1	33.1	2.6	48.0
Standard Error	8.3	8.0	6.2	9.1	5.3
Sexes Combined					
Sample Size	14	21	110	9	154
Percent	9.1	13.6	71.4	5.8	99.9
Standard Error	7.6	7.1	2.3	8.1	

[1] Of the 192 fish sampled, 38 (19.8%) had unreadable scales.

Table 6. Mean length (mm) of sockeye salmon in the Buskin River sport harvest, 1988[1].

Sex	Age Group 2.3	2.2	1.3	1.2
Female				
Mean Length	503	484	521	486
Standard Error	12.9	11.5	3.4	4.4
Sample Size	6	10	59	5
Male				
Mean Length	554	501	558	497
Standard Error	6.7	8.1	3.2	24.0
Sample Size	8	11	51	4

[1] Mid-eye to fork-of-tail length.

escapement (17.8% and 58.8%, respectively (Table 7). The sexes were also nearly equally abundant in the escapement. Mean lengths in the escapement ranged from 562 mm for age 1.3 males to 455 mm for age 2.2 females (Table 8).

Ages 1.0, 1.1, 2.0, 2.1 and 3.1 coho salmon comprised 0.2%, 8.3%, 1.0%, 88.8% and 1.7% of the escapement, respectively (Table 9). The mean length of age 2.1 females was 683 mm, and of age 2.1 males was 677 mm (Table 10).

ACKNOWLEDGEMENTS

The assistance of the Kodiak Commercial Fisheries Division staff in operating the weir and collecting field data is gratefully acknowledged.

Table 7. Age composition of sockeye salmon in the Buskin River escapement, 1988.

Sample Size		Ages						Total
		2.3	2.2	1.3	2.1	1.2	0.3	
Females	Sample Size	146	43	36	0	12	1	238
	Percent	35.2	10.4	8.7	0.0	2.9	0.2	57.4
	SE[1]	3.2	4.5	4.5	---	5.0	---	2.1
Males	Sample Size	98	31	26	6	16	0	177
	Percent	23.6	7.5	6.3	1.5	3.9	0.0	42.6
	SE[1]	3.8	4.6	4.7	5.3	4.9	---	2.8
Sexes Combined	Sample Size	244	74	62	6	28	1	415
	Percent	58.8	17.8	14.9	1.5	6.7	0.2	100.0
	SE[1]	2.0	4.1	4.2	5.3	4.7	---	

[1] Standard error expressed as a percentage.

Table 8. Mean length (mm) of sockeye salmon in the Buskin River escapement, 1988.

	Age						
	0.3	1.2	2.1	1.3	2.2	2.3	Total
Females							
Mean Length[1]	542	453	---	514	455	515	501
SE[2]	---	5	---	3	2	2	2
Minimum	542	420	---	482	420	480	420
Maximum	542	472	---	555	474	581	581
Sample Size	1	12	0	36	43	146	238
Males							
Mean Length[1]	---	480	342	562	487	558	532
SE[2]	---	9	12	5	3	2	4
Minimum	---	391	300	519	436	520	300
Maximum	---	515	380	611	515	600	611
Sample Size	0	16	6	26	31	98	177
All Fish							
Mean Length[1]	542	469	342	534	468	532	514
SE[2]	---	6	12	4	3	2	2
Minimum	542	391	300	482	420	480	300
Maximum	542	515	380	611	515	600	611
Sample Size	1	28	6	62	74	244	415

[1] Mid-eye to fork-of-tail length.
[2] Standard error.

Table 9. Age composition of coho salmon in the Buskin River escapement, 1988.

Sex	Age Group 3.1	2.1	2.0	1.1	1.0	Total[1]
Female						
Sample Size	4	205	0	13	0	222
Percent	1.0	49.5	0.0	3.1	0.0	53.6
Standard Error	5.6	2.5	---	4.9	---	2.3
Male						
Sample Size	3	162	5	21	1	192
Percent	0.7	39.1	1.2	5.1	0.2	46.4
Standard Error	6.0	3.0	5.4	4.8	---	2.6
Sexes Combined						
Sample Size	7	367	5	34	1	414
Percent	1.7	88.6	1.2	8.2	0.2	100.0
Standard Error	5.2	0.6	5.4	4.6	---	

[1] Of the 461 fish sampled, 47 (10.2%) had unreadable scales.

Table 10. Mean length (mm) of coho salmon in the Buskin River escapement, 1988[1].

Sex	Age Group				
	3.1	2.1	2.0	1.1	1.0
Female					
Mean Length	676	683	---	658	---
Standard Error	14	2	---	11	---
Sample Size	4	205	0	13	0
Male					
Mean Length	665	681	261	647	160
Standard Error	30	4	66	12	0
Sample Size	3	161	5	21	1

[1] Mid-eye to fork-of-tail length.

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APPENDIX

Sport Harvest and Escapement Data

Appendix Table 1. Angler counts in the Buskin River sockeye salmon sport fishery, 21 May through 24 July 1988.

Date	Week-end (+)	Counts by Period[1] A	B	C	D	Date	Week-end (+)	Counts by Period[1] A	B	C	D
21 May	+	0	0	36		24 June					
22 May	+			22	13	25 June	+	11	23		15
23 May						26 June	+			16	32
24 May					1	27 June				11	18
25 May		4		0	5	28 June					
26 May						29 June					
27 May			0	8	3	30 June		8	12		24
28 May	+	5	15	17		01 July				13	23
29 May	+			12	11	02 July	+	6			
30 May	+	5	12			03 July	+	6	13	29	
31 May						04 July	+			17	31
01 June			4	6		05 July					
02 June						06 July		4		5	14
03 June		9			13	07 July					
04 June	+			14	27	08 July			14	19	
05 June	+		4		17	09 July	+	2	5		25
06 June						10 July	+			18	12
07 June		19	10	25		11 July				8	19
08 June			11		21	12 July					
09 June						13 July		7	7		
10 June				8	27	14 July				15	18
11 June	+		30	27	14	15 July					
12 June	+	10		34		16 July	+	7	9	13	
13 June		12		9		17 July	+			59	11
14 June						18 July					
15 June		6			27	19 July				4	6
16 June			6	5	5	20 July		3	5	13	
17 June						21 July		3		10	
18 June	+			16	16	22 July					
19 June	+		15	38	27	23 July	+		15		22
20 June						24 July	+	6		23	35
21 June				37							
22 June		10	9	5							
23 June		6		10							

[1] Period A: 0600-0759, Period B: 0800-1159, Period C: 1200-1659, Period D: 1700-2300.

Appendix Table 2. Angler effort and harvest data for the Buskin River sockeye salmon sport fishery, 21 May through 24 July 1988.

Date	Wd/ We	No. Int.[1]	Hours		Sockeye Harvest			Pink Harvest			Dolly Varden Harvest		
			Mean	SE[2]	Mean	SE	HPUE[3]	Mean	SE	HPUE	Mean	SE	HPUE
May 21	We	8	1.1	0.27	0.25	0.250	0.227	0.00	0.000	0.000	0.00	0.000	0.000
May 22	We	10	0.9	0.19	0.10	0.100	0.111	0.00	0.000	0.000	0.20	0.200	0.222
May 25	Wd	4	1.3	0.74	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
May 27	Wd	10	1.8	0.22	0.40	0.221	0.228	0.00	0.000	0.000	0.00	0.000	0.000
May 28	We	22	1.7	0.19	0.36	0.155	0.209	0.00	0.000	0.000	0.00	0.000	0.000
May 29	We	13	1.7	0.23	0.46	0.183	0.271	0.00	0.000	0.000	0.00	0.000	0.000
May 30	We	8	2.9	0.34	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
June 1	Wd	9	2.4	0.29	0.22	0.147	0.093	0.00	0.000	0.000	0.00	0.000	0.000
June 3	Wd	8	1.3	0.25	0.25	0.164	0.200	0.00	0.000	0.000	0.00	0.000	0.000
June 4	We	15	3.1	0.46	0.47	0.192	0.148	0.00	0.000	0.000	0.00	0.000	0.000
June 5	We	18	1.5	0.19	0.44	0.202	0.299	0.00	0.000	0.000	0.00	0.000	0.000
June 7	Wd	20	2.3	0.21	0.40	0.134	0.176	0.00	0.000	0.000	0.00	0.000	0.000
June 8	Wd	12	2.7	0.60	0.92	0.260	0.341	0.00	0.000	0.000	0.00	0.000	0.000
June 10	Wd	20	3.0	0.38	0.40	0.152	0.135	0.00	0.000	0.000	0.00	0.000	0.000
June 11	We	39	2.9	0.31	0.28	0.097	0.098	0.00	0.000	0.000	0.00	0.000	0.000
June 12	We	14	2.4	0.35	0.64	0.199	0.269	0.00	0.000	0.000	0.00	0.000	0.000
June 13	Wd	9	2.3	0.63	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
June 15	Wd	15	2.5	0.39	0.53	0.215	0.213	0.00	0.000	0.000	0.00	0.000	0.000
June 16	Wd	10	2.0	0.03	0.30	0.213	0.146	0.00	0.000	0.000	0.00	0.000	0.000
June 18	We	30	1.7	0.15	0.37	0.122	0.221	0.00	0.000	0.000	0.00	0.000	0.000
June 19	We	36	2.3	0.27	0.56	0.141	0.246	0.00	0.000	0.000	0.00	0.000	0.000
June 21	Wd	20	1.7	0.15	0.70	0.206	0.409	0.00	0.000	0.000	0.00	0.000	0.000
June 22	Wd	17	1.5	0.23	0.35	0.170	0.233	0.00	0.000	0.000	0.00	0.000	0.000
June 23	Wd	8	2.6	0.42	0.50	0.267	0.195	0.00	0.000	0.000	0.00	0.000	0.000
June 25	We	16	1.7	0.34	0.63	0.221	0.374	0.00	0.000	0.000	0.00	0.000	0.000
June 26	We	19	2.8	0.24	0.84	0.175	0.304	0.00	0.000	0.000	0.00	0.000	0.000
June 27	Wd	14	3.5	0.61	0.57	0.228	0.165	0.00	0.000	0.000	0.00	0.000	0.000
June 30	Wd	21	3.0	0.62	0.19	0.112	0.064	0.00	0.000	0.000	0.00	0.000	0.000
July 01	Wd	17	2.1	0.30	0.12	0.118	0.057	0.00	0.000	0.000	0.00	0.000	0.000
July 03	We	10	2.2	0.37	0.90	0.233	0.409	0.00	0.000	0.000	0.00	0.000	0.000
July 04	We	9	2.3	0.43	0.33	0.236	0.146	0.00	0.000	0.000	0.00	0.000	0.000
July 06	Wd	10	1.3	0.17	0.50	0.269	0.400	0.00	0.000	0.000	0.00	0.000	0.000
July 08	Wd	13	3.2	0.75	0.69	0.286	0.218	0.00	0.000	0.000	0.00	0.000	0.000
July 09	We	19	2.5	0.54	0.42	0.176	0.170	0.00	0.000	0.000	0.11	0.105	0.043
July 10	We	12	2.0	0.37	0.08	0.083	0.043	0.00	0.000	0.000	0.00	0.000	0.000
July 11	Wd	17	2.2	0.33	0.24	0.161	0.108	0.00	0.000	0.000	0.00	0.000	0.000
July 13	Wd	6	2.2	0.48	1.17	0.401	0.538	0.00	0.000	0.000	0.00	0.000	0.000
July 14	Wd	9	3.8	0.72	0.56	0.294	0.145	0.22	0.147	0.058	0.00	0.000	0.000
July 16	We	16	3.9	0.64	0.88	0.446	0.226	0.31	0.120	0.081	0.13	0.085	0.032
July 17	We	21	2.6	0.31	0.14	0.078	0.055	0.10	0.066	0.037	0.05	0.048	0.018
July 19	Wd	6	3.2	0.87	0.83	0.401	0.260	0.00	0.000	0.000	0.00	0.000	0.000
July 20	Wd	7	3.3	0.54	0.86	0.340	0.258	0.43	0.297	0.129	0.00	0.000	0.000
July 21	Wd	3	2.3	0.33	0.00	0.000	0.000	1.00	0.577	0.429	0.00	0.000	0.000
July 23	We	10	1.7	0.36	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
July 24	We	29	2.2	0.21	0.14	0.096	0.064	0.93	0.302	0.430	0.24	0.209	0.112

[1] Number of anglers interviewed.

[2] Standard error.

[3] Harvest per hour.

[4] Total catch per hour.

Appendix Table 3. Angler effort and catch data for the Buskin River sockeye salmon sport fishery, 21 May through 24 July 1988.

Date	Wd/ We	No. Int.[1]	Hours Mean	Hours SE[2]	Sockeye Catch Mean	Sockeye Catch SE	Sockeye Catch HPUE[3]	Pink Catch Mean	Pink Catch SE	Pink Catch HPUE	Dolly Varden Catch Mean	Dolly Varden Catch SE	Dolly Varden Catch HPUE
May 21	We	8	1.1	0.27	0.25	0.250	0.227	0.00	0.000	0.000	0.00	0.000	0.000
May 22	We	10	0.9	0.19	0.40	0.400	0.444	0.00	0.000	0.000	0.20	0.200	0.222
May 25	Wd	4	1.3	0.74	0.25	0.250	0.188	0.00	0.000	0.000	0.00	0.000	0.000
May 27	Wd	10	1.8	0.22	0.40	0.221	0.228	0.00	0.000	0.000	0.00	0.000	0.000
May 28	We	22	1.7	0.19	0.36	0.155	0.209	0.00	0.000	0.000	0.00	0.000	0.000
May 29	We	13	1.7	0.23	0.46	0.183	0.271	0.00	0.000	0.000	0.00	0.000	0.000
May 30	We	8	2.9	0.34	0.13	0.125	0.044	0.00	0.000	0.000	0.00	0.000	0.000
June 1	Wd	9	2.4	0.29	0.22	0.147	0.093	0.00	0.000	0.000	0.00	0.000	0.000
June 3	Wd	8	1.3	0.25	0.25	0.164	0.200	0.00	0.000	0.000	0.00	0.000	0.000
June 4	We	15	3.1	0.46	0.47	0.192	0.148	0.00	0.000	0.000	0.00	0.000	0.000
June 5	We	18	1.5	0.19	0.50	0.232	0.336	0.00	0.000	0.000	0.00	0.000	0.000
June 7	Wd	20	2.3	0.21	0.40	0.134	0.176	0.00	0.000	0.000	0.00	0.000	0.000
June 8	Wd	12	2.7	0.60	2.50	1.520	0.930	0.00	0.000	0.000	0.00	0.000	0.000
June 10	Wd	20	3.0	0.38	0.40	0.152	0.135	0.00	0.000	0.000	0.00	0.000	0.000
June 11	We	39	2.9	0.31	0.28	0.097	0.098	0.00	0.000	0.000	0.00	0.000	0.000
June 12	We	14	2.4	0.35	0.64	0.199	0.269	0.00	0.000	0.000	0.00	0.000	0.000
June 13	Wd	9	2.3	0.63	0.00	0.000	0.000	0.00	0.000	0.000	0.00	0.000	0.000
June 15	Wd	15	2.5	0.39	0.53	0.215	0.213	0.00	0.000	0.000	0.00	0.000	0.000
June 16	Wd	10	2.0	0.03	0.30	0.213	0.146	0.00	0.000	0.000	0.00	0.000	0.000
June 18	We	30	1.7	0.15	0.37	0.122	0.221	0.00	0.000	0.000	0.00	0.000	0.000
June 19	We	36	2.3	0.27	0.69	0.168	0.307	0.00	0.000	0.000	0.00	0.000	0.000
June 21	Wd	20	1.7	0.15	1.15	0.554	0.672	0.00	0.000	0.000	0.00	0.000	0.000
June 22	Wd	17	1.5	0.23	0.35	0.170	0.233	0.00	0.000	0.000	0.00	0.000	0.000
June 23	Wd	8	2.6	0.42	0.50	0.267	0.195	0.00	0.000	0.000	0.00	0.000	0.000
June 25	We	16	1.7	0.34	0.88	0.397	0.523	0.00	0.000	0.000	0.00	0.000	0.000
June 26	We	19	2.8	0.24	0.89	0.201	0.323	0.00	0.000	0.000	0.00	0.000	0.000
June 27	Wd	14	3.5	0.61	0.57	0.228	0.165	0.00	0.000	0.000	0.00	0.000	0.000
June 30	Wd	21	3.0	0.62	0.19	0.112	0.064	0.00	0.000	0.000	0.00	0.000	0.000
July 01	Wd	17	2.1	0.30	0.12	0.118	0.057	0.00	0.000	0.000	0.00	0.000	0.000
July 03	We	10	2.2	0.37	1.00	0.211	0.455	0.00	0.000	0.000	0.00	0.000	0.000
July 04	We	9	2.3	0.43	0.78	0.278	0.341	0.00	0.000	0.000	0.00	0.000	0.000
July 06	Wd	10	1.3	0.17	0.90	0.526	0.720	0.00	0.000	0.000	0.00	0.000	0.000
July 08	Wd	13	3.2	0.75	0.69	0.286	0.218	0.00	0.000	0.000	0.00	0.000	0.000
July 09	We	19	2.5	0.54	0.89	0.507	0.362	0.00	0.000	0.000	0.11	0.105	0.043
July 10	We	12	2.0	0.37	0.08	0.083	0.043	0.00	0.000	0.000	0.00	0.000	0.000
July 11	Wd	17	2.2	0.33	0.24	0.161	0.108	0.00	0.000	0.000	0.00	0.000	0.000
July 13	Wd	6	2.2	0.48	1.17	0.401	0.538	0.00	0.000	0.000	0.00	0.000	0.000
July 14	Wd	9	3.8	0.72	0.56	0.294	0.145	0.22	0.147	0.058	0.00	0.000	0.000
July 16	We	16	3.9	0.64	1.63	0.638	0.419	0.38	0.125	0.097	0.13	0.085	0.032
July 17	We	21	2.6	0.31	0.19	0.088	0.073	0.14	0.078	0.055	0.05	0.048	0.018
July 19	Wd	6	3.2	0.87	2.00	1.125	0.623	0.00	0.000	0.000	0.50	0.500	0.156
July 20	Wd	7	3.3	0.54	1.86	1.100	0.559	0.43	0.297	0.129	0.00	0.000	0.000
July 21	Wd	3	2.3	0.33	0.00	0.000	0.000	1.00	0.577	0.429	0.00	0.000	0.000
July 23	We	10	1.7	0.36	0.00	0.000	0.000	0.10	0.100	0.059	0.00	0.000	0.000
July 24	We	29	2.2	0.21	0.14	0.096	0.064	1.00	0.337	0.462	0.34	0.311	0.159

[1] Number of anglers interviewed.

[2] Standard error.

[3] Harvest per hour.

[4] Total catch per hour.

Appendix Table 4. Salmon counts through the Buskin River weir, 1988.

Date	Sockeye	Pink	Coho	Date	Sockeye	Pink	Coho	Date	Sockeye	Pink	Coho
5/09	2			6/25	69	0		8/11	6	7,981	1
5/10	0			6/26	314	0		8/12	15	5,825	2
5/11	3			6/27	186	0		8/13	11	4,553	6
5/12	0			6/28	8	0		8/14	2	3,857	3
5/13	0			6/29	187	0		8/15	7	3,074	0
5/14	1			6/30	1	0		8/16	16	4,472	6
5/15	4			7/01	10	0		8/17	130	9,132	34
5/16	0			7/02	4	0		8/18	9	2,271	12
5/17	0			7/03	40	0		8/19	4	977	20
5/18	0			7/04	10	1		8/20	5	2,311	20
5/19	0			7/05	4	0		8/21	17	2,870	85
5/20	0			7/06	1,255	2		8/22	6	491	25
5/21	1			7/07	77	0		8/23	0	776	10
5/22	0			7/08	7	0		8/24	2	713	13
5/23	0			7/09	25	1		8/25	0	1,172	53
5/24	1			7/10	44	4		8/26	5	5,392	352
5/25	17			7/11	99	3		8/27	0	589	460
5/26	7			7/12	96	3		8/28	0	500	500
5/27	31			7/13	1,331	16		8/29	0	700	650
5/28	23			7/14	4	2		8/30	1	600	1,000
5/29	9			7/15	24	19		8/31	1	567	391
5/30	1			7/16	31	16		9/01	1	464	139
5/31	1			7/17	31	29		9/02	0	0	326
6/01	0			7/18	10	3		9/03	0	0	115
6/02	1			7/19	1,237	68		9/04	1	0	67
6/03	134			7/20	140	47		9/05	0	0	66
6/04	65			7/21	15	100		9/06	0	79	67
6/05	185			7/22	17	247		9/07	0	569	122
6/06	169			7/23	11	233		9/08	0	0	20
6/07	14			7/24	10	315		9/09	0	0	51
6/08	150			7/25	50	644		9/10	0	0	133
6/09	61			7/26	120	785		9/11	0	0	229
6/10	10			7/27	65	955		9/12	0	0	174
6/11	19			7/28	43	1,189		9/13	0	0	145
6/12	0			7/29	764	3,459		9/14	0	0	82
6/13	22			7/30	23	3,344		9/15	0	0	40
6/14	88			7/31	11	5,956		9/16	0	0	21
6/15	18			8/01	37	6,190		9/17	0	0	28
6/16	503			8/02	49	11,061		9/18	0	0	14
6/17	2,493			8/03	46	11,938	2	9/19	0	0	155
6/18	138			8/04	58	15,513	0	9/20	0	0	41
6/19	89			8/05	14	10,183	1	9/21	0	0	39
6/20	84			8/06	38	10,741	0	9/22	0	0	23
6/21	364			8/07	54	20,936	1	9/23	0	0	80
6/22	216			8/08	19	9,330	2	9/24	0	0	354
6/23	180			8/09	14	16,595	1				
6/24	77	1		8/10	22	13,714	1	Total[1]	12,144	203,648[2]	6,182[3]

[1] A total of 84 chum salmon, 357 kelt steelhead and 26 immigrant steelhead moved through the weir during July-September, May-July and August-September, respectively.

[2] Approximately 30,000 pink salmon spawned below the weir, therefore, the actual escapement was 233,648 fish.

[3] Approximately 600 coho salmon were below the weir when it was removed, the estimated sport harvest above the weir was 600 fish; therefore, total coho salmon escapement was 6,182 fish.