

**Fishery Data Series No. 91-45**

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# **Harvest Estimates for the Chilkoot River Roadside Sport Fishery, Haines, Alaska, 1990**

by

**Randolph P. Ericksen**

and

**Robert P. Marshall**

September 1991

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Alaska Department of Fish and Game

Division of Sport Fish



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## ABSTRACT

Creel surveys conducted on the Chilkoot River east of Haines were used to estimate angler effort, catch, and harvest of sockeye salmon *Oncorhynchus nerka*, coho salmon *Oncorhynchus kisutch*, and Dolly Varden *Salvelinus malma* between June 25 and November 4, 1990. Anglers expended an estimated 25,015 (standard error = 1,257) hours to catch 1,676 (SE = 311) sockeye salmon, 36 (SE = 12) coho salmon, and 6,252 (SE = 1,197) Dolly Varden during the survey period. An estimated 1,497 (SE = 267) sockeye salmon, 27 (SE = 12) coho salmon, and 4,085 (SE = 464) Dolly Varden were harvested.

KEY WORDS: Southeast Alaska, Haines, Chilkoot River, sockeye salmon, *Oncorhynchus nerka*, coho salmon, *Oncorhynchus kisutch*, Dolly Varden, *Salvelinus malma*, creel survey, angler effort, catch, harvest.

## INTRODUCTION

Haines is located at the northern end of Lynn Canal in Southeast Alaska (Figure 1). The community is connected by road to interior Alaska and to Whitehorse in the Yukon Territory, Canada. The Alaska Marine Highway provides transportation between Haines and other communities in Southeast Alaska, Prince Rupert B.C., and Bellingham, Washington. Over 30% of the estimated 1989 freshwater sport fishing effort in Southeast Alaska occurred in the Haines area (Mills 1990), making it the largest freshwater sport fishery in the region. Sport fishing effort in the area has more than doubled since 1982 (Mills 1990). Increased tourism and the proximity of the area to Whitehorse has led to heavy use by nonresident anglers. In addition, commercial fishing harvests of sockeye salmon *Oncorhynchus nerka* and coho salmon *O. kisutch* returning to the Chilkat and Chilkoot systems have increased in recent years.

The Alaska Department of Fish and Game (ADFG) has conducted creel surveys along Lutak Inlet, and the Chilkat and Chilkoot river systems since 1984 (Neimark 1985, Mecum and Suchanek 1986, 1987; Bingham et al. 1988; Suchanek and Bingham 1989; Ericksen and Bingham 1990) to monitor trends in angler use, catch rates, and harvest of coho and sockeye salmon. The surveys along Lutak Inlet and the Chilkat River were discontinued in 1990 due to fiscal constraints. Harvest surveys along the Chilkoot River were canceled in 1991; estimates for this area will, however, appear in the Statewide Harvest Survey.

The Chilkoot River is located 13 km north of Haines at the end of Lutak Road. The river is about 2.4 km long and is paralleled by a road. The sport fishery at Chilkoot Lake and River constituted 68% of the estimated freshwater sport fishing effort in the Haines area in 1989 (Mills 1990). A weir used to count sockeye is installed on the river on about June 1 and remains for counting coho salmon through about November 1. Since estimates of escapement to the Chilkoot River are based on weir counts, estimates of harvests above the weir are used to adjust the projected escapement to the spawning grounds. Weir counts of sockeye and coho salmon are used to guide in-season management of the Lynn Canal commercial gill net fishery.

Coho salmon returning to the Chilkoot River have the highest known rate of harvest (85%) of any stock in Southeast Alaska (Elliott and Sterritt 1990). Most of this harvest occurs in the commercial troll and the Lynn Canal drift gill net fisheries; however, sport harvests of coho salmon in the Chilkoot River have approached one-third of the escapement. Creel survey data has been used to guide in-season management of the sport fishery through emergency closures of that fishery, when necessary. No goal for spawning escapement of coho salmon into the lake has been established; however a minimum escapement of 1,200 to 3,600 fish has been recommended (S. T. Elliott, Alaska Department of Fish and Game, Douglas, personal communication). Relatively large catches of sockeye salmon, Dolly Varden char *Salvelinus malma*, and pink salmon *O. gorbuscha* also occur between June and October.

This report describes the harvest survey conducted along the Chilkoot River in 1990. The objectives of the study are to estimate recreational fishing effort for and harvest of coho and sockeye salmon above and below the weir between June 25 and November 4, 1990. Data were also collected for Dolly Varden and are compiled here for reference by another study (Ericksen and Marshall *In press*).

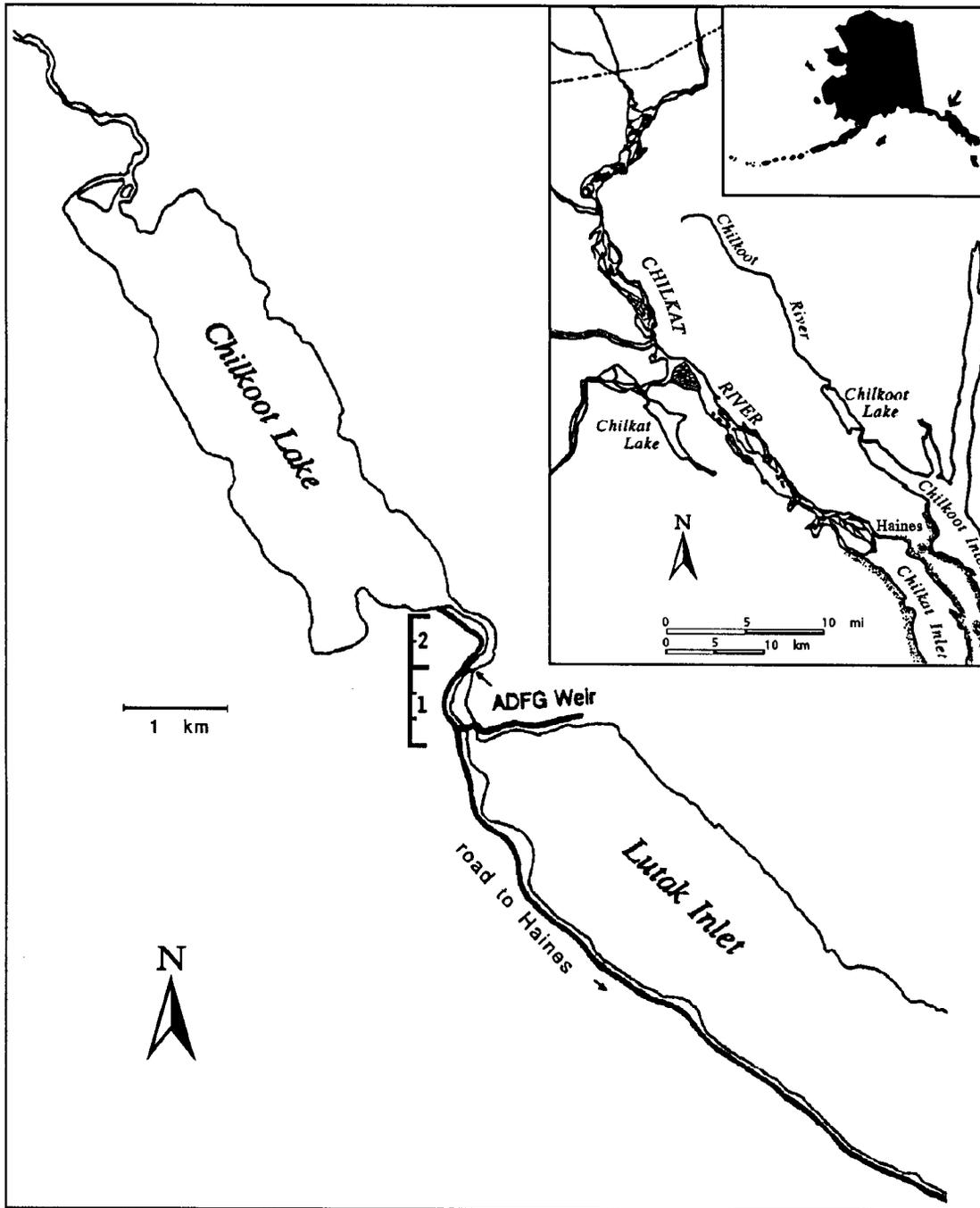


Figure 1. Roadside fishing areas at Chilkoot Lake, near Haines, Alaska. Area 1 extends from the ADFG weir to tidewater; area 2 extends from the weir upstream to Chilkoot Lake.

## METHODS

A stratified, three-stage roving creel survey based on expansion of sample ratios was used to estimate fishing effort, catch, and harvest. Ten biweekly (14-day) seasonal strata and weekday versus weekend-holiday stratifications were maintained. There were thus 20 discrete strata. Days were primary sampling units, periods within days were secondary sampling units, and anglers within periods were tertiary sampling units.

Three weekend-holiday and 4 weekdays per 14-day period were randomly selected for sampling, except between September 24 and October 21 (the peak of coho salmon harvests) when four weekend-holidays were sampled. In each day selected for sampling, 2 of 3, 4, or 5 possible periods were randomly selected to sample, depending on the strata. Fewer periods were defined late in the year because days became shorter. The available sampling periods were equal in length and fixed at between 194 and 243 minutes, depending on the strata, and together equaled the length of time from 0700 hours or sunrise (which ever was later) to average civil twilight on the average day in the strata.

During each sampling period, a technician both counted and interviewed anglers. Angler counts were usually conducted only once in each sample period, at a randomly selected (beginning, middle, or end) time. However, in ten randomly selected sampling periods, anglers were counted 3 times per period (at equally spaced intervals) to estimate the magnitude of variation in angler counts.

When not counting anglers, the technician moved through the fishery to interview anglers completing their trip, or to interview anglers still fishing as the sampling period approached its end. This procedure was used to help reduce bias (if present) which results when catch-per-unit-effort (CPUE) from completed-trip and incomplete-trip interviews are significantly different (see Robson 1960).

The harvest (or catch) in each stratum is estimated by

$$\hat{C}_h = D_h \bar{C}_h \quad (1)$$

$$\bar{C}_h = \frac{\sum_{i=1}^{d_h} \hat{C}_{hi}}{d_h} \quad (2)$$

$$\hat{C}_{hi} = Q_h \bar{C}_{hi} \quad (3)$$

$$\bar{C}_{hi} = \frac{\sum_{j=1}^{q_h} \hat{C}_{hij}}{q_h} \quad (4)$$

where  $\hat{C}_{hij}$  is the estimated harvest in period  $j$  day  $i$  stratum  $h$ ,  $q_h$  is the number of periods sampled in a day,  $Q_h$  is the number of periods in a day,  $d_h$  is the number of days sampled in stratum  $h$ , and  $D_h$  is the total number of days in stratum  $h$ .

The variance of the harvest in each stratum is estimated by

$$V[\hat{C}_h] = (1-f_{1h})D_h^2 \frac{\sum_{i=1}^{d_h} (\hat{C}_{hi} - \bar{C}_h)^2}{d_h(d_h-1)} + D_h Q_h^2 \sum_{i=1}^{d_h} (1-f_{2h}) \frac{\sum_{j=1}^{q_h} (\hat{C}_{hij} - \bar{C}_{hi})^2}{d_h q_h (q_h-1)} + D_h Q_h \frac{\sum_{i=1}^{d_h} \sum_{j=1}^{q_h} \hat{C}_{hij}}{d_h q_h} \quad (5)$$

where  $f_{1h} = d_h/D_h$  and  $f_{2h} = q_h/Q_h$ .

The harvest for each sampling period is estimated by

$$\hat{C}_{hij} = \hat{E}_{hij} \overline{CPUE}_{hij}^* \quad (6)$$

where  $\overline{CPUE}_{hij}^*$  is the "jackknife" estimate of mean CPUE during stratum h day i sampling period j and  $E_{hij}$  is the fishing effort in angler hours during the same time.

Angler effort in each period was estimated by

$$\hat{E}_{hij} = H_h \bar{x}_{hij} \quad (7)$$

where  $H_h$  is the number of hours in a sampling period and  $\bar{x}_{hij}$  is the average number of anglers counted during stratum h day i sampling period j; if only one count was made then  $\bar{x}_{hij}$  in equation (7) is  $x_{hij}$ . If only one angler count is made,  $x_{hij} = 0$ , and anglers are interviewed then  $\hat{C}_{hij}$  in (6) was set equal to the observed catch. In contrast, if  $x_{hij} > 0$  and no anglers are interviewed then  $\overline{CPUE}_{hij}^*$  (or HPUE) in (6) was set equal to the mean  $\overline{CPUE}_{hij}^*$  for the stratum.

When anglers are counted more than once in a period, the variance of  $E_{hij}$  is estimated by

$$V[\hat{E}_{hij}] = H_h^2 \frac{\sum_{j=2}^{r_h} (x_{hij} - x_{hi(j-1)})^2}{2 r_h (r_h - 1)} \quad (8)$$

where  $r_h$  is the number of times anglers were counted. If only one angler count occurs in a period then  $V[\hat{E}_{hij}]$  is undefined; however, after counting anglers 3 times in each of 10 sample periods we concluded that setting  $V[\hat{E}_{hij}] = 0$  significantly underestimates true variability in estimating  $V[\hat{E}_{hij}]$ . Thus, by assuming a linear relationship between  $\sqrt{V[\hat{E}_{hij}]}$  and  $\hat{E}_{hij}$  (Figure 2), we estimate  $V[\hat{E}_{hij}] = (0.3 \cdot \hat{E}_{hij})^2$  in each period, when only one angler count was conducted.

The variance of the harvest  $C_{hij}$  in a period was estimated by

$$V[\hat{C}_{hij}] = V[\hat{E}_{hij}] \overline{CPUE}_{hij}^{*2} + V[\overline{CPUE}_{hij}^*] \hat{E}_{hij}^2 - V[\hat{E}_{hij}] V[\overline{CPUE}_{hij}^*] \quad (9)$$

The  $\overline{CPUE}_{hij}^*$  and its variance are calculated according to procedures in Efron (1982). The inherent correctable bias of  $m_{hij}^{-2}$  (the number of interviews in a sampling period) of our jackknife estimates are removed according to the procedure in Efron (1982, p. 6).

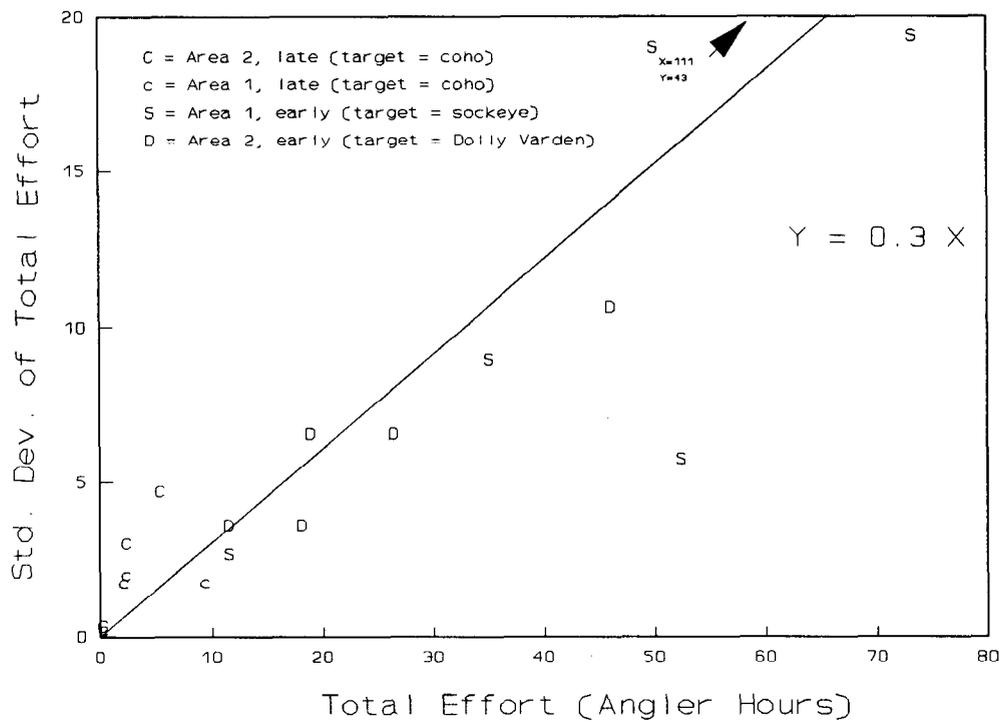


Figure 2. Relationship between total estimated effort and its variance in ten sample periods and two areas of the Chilkooot River in 1991. Area 1 extends from the ADFG weir to tidewater; area 2 extends from weir upstream to Chilkooot Lake.

Total angler effort in each stratum is estimated using equations 1-5 (except that E is substituted for C).

Harvest, catch, and effort for the entire season and for both areas of the Chilkoot River (and their variances) are the sums of the estimates for each strata.

A Student's t-test was used to compare differences between CPUE obtained from complete-trip and incomplete-trip interviews during each 14-day period. The t-test was

$$t = \frac{\overline{CPUE}_I^* - \overline{CPUE}_C^*}{(\overline{V[CPUE}_I^*] + \overline{V[CPUE}_C^*])^{1/2}} \quad \text{vs.} \quad t_{\alpha, df} \quad (10)$$

where subscripts "I" and "C" denote incomplete- and complete-trip interviews, respectively. The degrees of freedom (Steele and Torrie 1980, p. 106) were estimated

$$df = \frac{(\overline{V[CPUE}_I^*] + \overline{V[CPUE}_C^*])^2}{\frac{(\overline{V[CPUE}_I^*])^2}{(n_I - 1)} + \frac{(\overline{V[CPUE}_C^*])^2}{(n_C - 1)}} \quad (11)$$

## RESULTS

Between June 25 and November 4, 1990, 2,138 interviews were conducted and 3,888 angler hours of effort were recorded (Table 1). About two-thirds of the interviews occurred below the ADFG weir. During analysis of survey data, we could in no instance reject the hypotheses that mean CPUE estimated from completed- and incomplete-trip interviews was equal ( $\alpha = 0.05$ ), so both types of data were used to estimate mean CPUE. Mean CPUE for completed-trip angler interviews for sockeye salmon did, however, "look" higher in every biweekly strata, even though we could not detect a statistical difference using the 11 to 46 completed-trip interviews in each 14-day strata (Table 2). The collection of more completed-trip interview data from this fishery in the future may prove useful.

Angling was moderate during the first period (1,978 angler hours), peaked between August 13 and August 26 (6,029 hours) and was practically absent in the 2 weeks beginning October 22 (Tables 3 and 4). Anglers expended an estimated total of 25,015 hours (SE = 1,257) angling on the Chilkoot River between June 25 and November 4, 1990 (Table 4). Approximately two-thirds of the effort (16,942 hours) occurred downstream of the weir. The majority (86%) of the effort occurred between July 2 and September 9 (Table 4), during which time most sockeye salmon (below the weir) and Dolly Varden (above the weir) were harvested (Table 3). Estimates of angler effort, catch, and harvest of sockeye salmon, coho salmon, and Dolly Varden in Chilkoot River, by stratum, are collated in Appendices A1-A4 for use in planning future surveys.

Two unusual events occurred during sampling above the ADFG weir in 1990: (a) 2 Dolly Varden marked during the spring 1990 emigration from Chilkat Lake were sampled; and (b) 7 small hatchery king salmon from a spring 1990 saltwater pen release located about 3 km from the mouth of the Chilkoot River were sampled.

Table 1. Number of interviews, observed angler effort, and observed catch and harvest of sockeye salmon, coho salmon, and Dolly Varden in Chilkoot River, by sampling period and site, June 25 through November 4, 1990.

	June 25 July 1	July 2 July 15	July 16 July 29	July 30 Aug 12	Aug 13 Aug 26	Aug 27 Sept 9	Sept 10 Sept 23	Sept 24 Oct 7	Oct 8 Oct 21	Oct 22 Nov 4	Total
<b>Below ADFG Weir</b>											
<u>Weekends</u>											
Number of interviews	58	48	72	93	178	99	13	65	14	0	640
Angler hours effort	71	104	187	186	354	166	17	100	23	0	1207
Sockeye harvested	0	10	7	19	33	3	0	0	0	0	72
Sockeye caught	0	10	7	20	33	3	0	0	0	0	73
Coho harvested	0	0	0	0	0	0	0	4	1	0	5
Coho caught	0	0	0	0	0	0	0	5	1	0	6
Dolly Varden harvested	3	6	2	0	3	0	0	0	0	0	14
Dolly Varden caught	5	11	3	1	3	4	0	0	0	0	27
<u>Weekdays</u>											
Number of interviews	67	100	101	141	222	131	38	32	12	0	844
Angler hours effort	169	199	222	285	415	298	43	41	22	0	1693
Sockeye harvested	15	19	12	49	61	18	0	0	0	0	174
Sockeye caught	15	19	12	49	61	18	0	0	0	0	174
Coho harvested	0	0	0	0	0	0	0	0	1	0	1
Coho caught	0	0	0	0	0	0	0	0	1	0	1
Dolly Varden harvested	3	16	5	10	9	1	0	0	0	0	44
Dolly Varden caught	4	19	7	30	9	1	0	0	0	0	70
<b>Above ADFG Weir</b>											
<u>Weekends</u>											
Number of interviews	18	45	41	62	24	14	21	40	15	1	281
Angler hours effort	18	66	66	87	32	23	32	54	29	0	408
Sockeye harvested	0	0	0	1	0	0	0	0	0	0	1
Sockeye caught	0	0	0	1	1	0	0	0	0	0	2
Coho harvested	0	0	0	0	0	0	0	0	0	0	0
Coho caught	0	0	0	0	0	0	0	1	1	0	2
Dolly Varden harvested	0	22	29	34	6	26	39	25	38	3	222
Dolly Varden caught	0	26	34	41	21	26	41	25	39	3	256
<u>Weekdays</u>											
Number of interviews	12	65	92	63	67	31	14	26	2	1	373
Angler hours effort	22	76	164	78	128	38	22	46	2	4	580
Sockeye harvested	0	0	0	1	1	0	0	0	0	0	2
Sockeye caught	0	0	0	1	1	0	1	0	0	0	3
Coho harvested	0	0	0	0	0	0	1	3	0	0	4
Coho caught	0	0	0	0	0	0	1	3	0	0	4
Dolly Varden harvested	3	50	59	37	29	42	16	17	0	9	262
Dolly Varden caught	3	63	75	51	33	49	35	17	0	9	335

Table 2. Estimated mean CPUE for complete- and incomplete-trip angler interviews for sockeye salmon on the Chilkoot River below the ADFG weir, 1990.

Time strata	Type of interview	n	$\overline{\text{CPUE}}^*$	df	T-statistic	P-value
June 25 - July 01						
	incomplete	111	0.031	14	-1.56	0.2 < P < 0.1
	complete	14	0.197			
July 02 - July 15						
	incomplete	114	0.099	71	0.36	0.9 < P < 0.5
	complete	34	0.082			
July 16 - July 29						
	incomplete	134	0.042	57	-0.65	0.9 < P < 0.5
	complete	39	0.063			
July 30 - Aug 12						
	incomplete	188	0.132	122	-0.75	0.5 < P < 0.4
	complete	46	0.184			
Aug 13 - Aug 26						
	incomplete	362	0.116	46	-0.91	0.4 < P < 0.2
	complete	38	0.164			
Aug 27 - Sept 09						
	incomplete	175	0.052	11	-0.15	0.9 < P < 0.5
	complete	11	0.062			

Table 3. Estimated angler effort, catch, and harvest of sockeye salmon, coho salmon, and Dolly Varden in Chilkoot River, by sampling period and site, June 25 through November 4, 1990.

	June 25 July 1	July 2 July 15	July 16 July 29	July 30 Aug 12	Aug 13 Aug 26	Aug 27 Sept 9	Sept 10 Sept 23	Sept 24 Oct 7	Oct 8 Oct 21	Oct 22 Nov 4	Total
<b>BELOW ADFG WEIR</b>											
Angler hours effort	1,579	2,561	2,375	2,727	4,920	2,001	331	356	92	0	16,942
Variance	119,327	221,022	111,210	100,006	563,144	105,919	8,540	1,712	825	0	1,231,705
SE <sup>a</sup>	345	470	333	316	750	325	92	41	29	0	1,110
RP <sup>b</sup>	0.43	0.36	0.28	0.23	0.30	0.32	0.55	0.23	0.61		0.13
Sockeye harvested	107	198	109	250	678	94	0	0	0	0	1,436
Variance	3,125	3,908	1,234	4,333	55,433	1,678	0	0	0	0	69,711
SE	56	63	35	66	235	41	0	0	0	0	264
RP	1.02	0.62	0.63	0.52	0.68	0.85					0.36
Sockeye caught	107	198	109	397	699	94	0	0	0	0	1,604
Variance	3,125	3,908	1,234	30,205	54,975	1,678	0	0	0	0	95,125
SE	56	63	35	174	234	41	0	0	0	0	308
RP	1.02	0.62	0.63	0.86	0.66	0.85					0.38
Coho harvested	0	0	0	0	0	0	0	5	6	0	11
Variance	0	0	0	0	0	0	0	16	23	0	39
SE	0	0	0	0	0	0	0	4	5	0	6
RP								1.57	1.57		1.11
Coho caught	0	0	0	0	0	0	0	6	1	5	12
Variance	0	0	0	0	0	0	0	17	1	22	40
SE	0	0	0	0	0	0	0	4	1	5	6
RP								1.35	1.96	1.84	1.03
Dolly Varden harvested	41	139	34	83	69	4	0	0	0	0	370
Variance	418	2,861	305	3,847	715	15	0	0	0	0	8,161
SE	20	53	17	62	27	4	0	0	0	0	90
RP	0.98	0.75	1.01	1.46	0.76	1.90					0.48
Dolly Varden caught	66	190	64	202	69	13	0	0	0	0	604
Variance	1,173	6,345	924	16,134	715	53	0	0	0	0	25,344
SE	34	80	30	127	27	7	0	0	0	0	159
RP	1.02	0.82	0.93	1.23	0.76	1.10					0.52

Table 3. (Page 2 of 2).

	June 25 July 1	July 2 July 15	July 16 July 29	July 30 Aug 12	Aug 13 Aug 26	Aug 27 Sept 9	Sept 10 Sept 23	Sept 24 Oct 7	Oct 8 Oct 21	Oct 22 Nov 4	Total
<b>ABOVE ADFG WEIR</b>											
Angler hours effort	399	1,398	2,233	1,750	1,109	441	206	380	135	22	8,073
Variance	8,358	79,642	94,948	104,403	27,366	9,376	3,117	15,740	4,070	193	347,213
SE	91	282	308	323	165	97	56	125	64	14	589
RP	0.45	0.40	0.27	0.36	0.29	0.43	0.53	0.65	0.93	1.24	0.14
Sockeye harvested	0	0	0	31	30	0	0	0	0	0	61
Variance	0	0	0	781	844	0	0	0	0	0	1,625
SE	0	0	0	28	29	0	0	0	0	0	40
RP				1.77	1.90						1.30
Sockeye caught	0	0	0	31	37	0	4	0	0	0	72
Variance	0	0	0	781	928	0	12	0	0	0	1,721
SE	0	0	0	28	30	0	3	0	0	0	41
RP				1.77	1.61		1.70				1.13
Coho harvested	0	0	0	0	0	0	3	13	0	0	16
Variance	0	0	0	0	0	0	11	60	0	0	71
SE	0	0	0	0	0	0	3	8	0	0	8
RP							2.17	1.17			0.98
Coho caught	0	0	0	0	0	0	3	20	1	0	24
Variance	0	0	0	0	0	0	11	84	2	0	97
SE	0	0	0	0	0	0	3	9	1	0	10
RP							2.17	0.90	2.77		0.82
Dolly Varden harvested	18	702	944	629	330	514	226	165	74	113	3,715
Variance	132	46,984	56,351	39,899	19,322	26,348	8,161	3,624	2,314	4,240	207,375
SE	11	217	237	200	139	162	90	60	48	65	455
RP	1.25	0.61	0.49	0.62	0.83	0.62	0.78	0.72	1.27	1.13	0.24
Dolly Varden caught	18	866	1,177	1,976	408	551	298	165	76	113	5,648
Variance	132	82,096	73,078	1,171,131	26,917	29,732	12,987	3,624	2,403	4,240	1,406,340
SE	11	287	270	1,082	164	172	114	60	49	65	1,186
RP	1.25	0.65	0.45	1.07	0.79	0.61	0.75	0.72	1.26	1.13	0.41

<sup>a</sup> Standard Error.

<sup>b</sup> Relative precision =  $1.96 * SE / Estimate$ .

Table 4. Estimated total angler effort, catch, and harvest of sockeye salmon, coho salmon, and Dolly Varden in Chilkoot River, by sampling period, June 25 through November 4, 1990.

	June 25 July 1	July 2 July 15	July 16 July 29	July 30 Aug 12	Aug 13 Aug 26	Aug 27 Sept 9	Sept 10 Sept 23	Sept 24 Oct 7	Oct 8 Oct 21	Oct 22 Nov 4	Total
Angler hours effort	1,978	3,959	4,608	4,477	6,029	2,442	537	736	227	22	25,015
Variance	127,685	300,664	206,158	204,409	590,510	115,295	11,657	17,452	4,895	193	1,578,918
SE <sup>a</sup>	357	548	454	452	768	340	108	132	70	14	1,257
RP <sup>b</sup>	0.35	0.27	0.19	0.20	0.25	0.27	0.39	0.35	0.60	1.24	0.10
Sockeye harvest	107	198	109	281	708	94	0	0	0	0	1,497
Variance	3,125	3,908	1,234	5,114	56,277	1,678	0	0	0	0	71,336
SE	56	63	35	72	237	41	0	0	0	0	267
RP	1.02	0.62	0.63	0.50	0.66	0.85					0.35
Sockeye catch	107	198	109	428	736	94	4	0	0	0	1,676
Variance	3,125	3,908	1,234	30,986	55,903	1,678	12	0	0	0	96,846
SE	56	63	35	176	236	41	3	0	0	0	311
RP	1.02	0.62	0.63	0.81	0.63	0.85	1.70				0.36
Coho harvest	0	0	0	0	0	0	3	18	6	0	27
Variance	0	0	0	0	0	0	11	76	23	0	110
SE	0	0	0	0	0	0	3	9	5	0	10
RP							2.17	0.95	1.57		0.73
Coho catch	0	0	0	0	0	0	3	26	2	5	36
Variance	0	0	0	0	0	0	11	101	3	22	137
SE	0	0	0	0	0	0	3	10	2	5	12
RP							2.17	0.76	1.70	1.84	0.65
Dolly Varden harvest	59	841	978	712	399	518	226	165	74	113	4,085
Variance	550	49,845	56,656	43,746	20,037	26,363	8,161	3,624	2,314	4,240	215,536
SE	23	223	238	209	142	162	90	60	48	65	464
RP	0.78	0.52	0.48	0.58	0.70	0.61	0.78	0.72	1.27	1.13	0.22
Dolly Varden catch	84	1,056	1,241	2,178	477	564	298	165	76	113	6,252
Variance	1,305	88,441	74,002	1,187,265	27,632	29,785	12,987	3,624	2,403	4,240	1,431,684
SE	36	297	272	1,090	166	173	114	60	49	65	1,197
RP	0.84	0.55	0.43	0.98	0.68	0.60	0.75	0.72	1.26	1.13	0.38

<sup>a</sup> Standard Error.

<sup>b</sup> Relative precision =  $1.96 \cdot SE / \text{Estimate}$ .

### Sockeye Salmon Fishery

Anglers expended an estimated 16,163 hours of effort (SE = 1,105) fishing below the ADFG weir between June 25 and September 9, 1990 (Table 3). During this period 96% of the total estimated harvest of 1,676 sockeye salmon (SE = 311) occurred (Table 4). Seasonal coverage did not include the first weeks of the fishery for sockeye salmon, which also occurs below the weir (Table 3).

### Coho Salmon Fishery

Anglers expended an estimated 1,522 hours (SE = 185) angling on the Chilkoot River between September 10 and November 4, 1990 (Table 4). The coho salmon fishery above the ADFG weir was closed by emergency order on October 5, 1990, due to low counts of coho salmon at the weir. The fishery remained open below the weir for the entire season, however.

Anglers caught an estimated 36 (SE = 12) and harvested an estimated 27 (SE = 10) coho salmon between September 10 and November 4, 1990 along the Chilkoot River (Table 4). Most (59%) of the harvest occurred above the weir (Table 3).

### Dolly Varden Fishery

Anglers caught an estimated 6,252 (SE = 1,197) and harvested an estimated 4,085 (SE = 464) Dolly Varden between June 25 and November 4, 1990 along the Chilkoot River (Table 4). About 90% of the catch and harvest occurred above the weir (Table 3). Catches above the weir were highest between July 16 and August 12, but catches were fairly high through July, August, and September (Table 4).

Two Dolly Varden marked by a caudal fin clip placed on fish emigrating from Chilkat Lake northwest of Haines (Ericksen and Marshall *In press*) were found during random sampling in the Chilkoot River, above the ADFG weir. One of these fish was recovered on August 5 and the other was recovered on August 13. During the period in which these fish were sampled (July 30 through August 26) 106 Dolly Varden above the weir were inspected for marks. Since each of 16,462 emigrant Chilkat Lake Dolly Varden  $\geq 350$  mm FL were marked, and we sampled 4.45% of the Dolly Varden harvest (106 of 2,384) above the weir between July 30 and August 26, we estimate a harvest of 45 marked fish during this period.

### Harvests of Hatchery Chinook Salmon

Approximately 40,000 chinook salmon *O. tshawytscha* smolt of Tahini River brood stock were released during the spring of 1990 about 3 km from the mouth of the Chilkoot River by ADFG, the Haines Sportsmen's Association, and the Northern Southeast Regional Aquaculture Association. The smolt were released in an attempt to increase the number of chinook salmon available to local anglers while taking some of the sport fishing effort off the depressed wild stock of Chilkat River chinook salmon. We sampled 7 small chinook salmon from this release in harvests above the weir in 1990 (4 between July 16 and July 29, 1 between July 30 and August 12, and 2 between August 13 and August 26). Using the methods described, we estimate sport anglers harvested 66 (SE = 40) 0 ocean jacks in the Chilkoot River in 1990.

## DISCUSSION

Angler effort and harvest of sockeye salmon on the Chilkoot River between June 25 and September 9, 1990 was slightly above the 1984-1989 average (Table 5). It is interesting to note that nearly half of this harvest occurred during one bi-weekly period, between August 13 and August 26 (Table 4).

Fishing for coho salmon was extremely poor in 1990, and anglers did not participate at a normal level. The harvest rate for coho salmon (harvest per hour) in 1990 was the lowest on record (Table 6). Angler effort and harvest of coho salmon on the Chilkoot River between September 10 and November 4, 1990 was also a small fraction of the 1984-1989 average (23% and 5% respectively, Table 6). This fishery has been restricted by emergency order in three out of the past four years (1990, 1988, 1987) due to low escapement counts at the weir. Angler effort in 1990 was even significantly below that recorded in 1987, when the coho salmon fishery was closed both above and below the weir.

Data collected from this project and the Chilkoot River weir were used to guide management of the recreational fishery for coho salmon on the Chilkoot River, and to help commercial fishery managers reduce the incidental harvest of coho salmon in the Lynn Canal gill net fishery through area closures when escapements were low. Funding to operate the Chilkoot River weir to count coho salmon in 1991 was not available. Similarly, there are no creel surveys planned for 1991.

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Table 5. Estimated effort, harvest, and harvest per angler-hour of sockeye salmon within the Chilkoot River near Haines, Alaska, 1984-1990.

Year	Survey dates	Effort		Harvest		Harvest per hour
		Hours	SE <sup>a</sup>	Sockeye salmon	SE <sup>a</sup>	
1984	7/06-8/31	21,625 <sup>b</sup>	-- <sup>c</sup>	962 <sup>d</sup>	-- <sup>c</sup>	0.04
1985 <sup>e</sup>	7/15-9/1	19,576	-- <sup>c</sup>	1,206	-- <sup>c</sup>	0.06
1986 <sup>f</sup>	7/14-8/31	21,694	-- <sup>c</sup>	2,873	-- <sup>c</sup>	0.13
1987 <sup>g</sup>	7/13-9/7	20,289	-- <sup>c</sup>	1,007	-- <sup>c</sup>	0.05
1988 <sup>h</sup>	6/20-9/11	18,681	1,172	609	350	0.03
1989 <sup>i</sup>	5/08-9/10	25,235	1,323	914	226	0.04
1984-1989 Mean		21,183	2,102 <sup>j</sup>	1,262	742 <sup>j</sup>	0.06
1990	6/25-9/09	23,493	1,242	1,497	267	0.06

<sup>a</sup> Estimates are square roots of variances summed across sampling areas; this estimate may be biased because sampling at each site is not independent.

<sup>b</sup> (L. M. Neimark, Alaska Department of Fish and Game, Douglas, Alaska, unpublished data).

<sup>c</sup> Estimate of variance not provided.

<sup>d</sup> Neimark (1985).

<sup>e</sup> Mecum and Suchanek (1986).

<sup>f</sup> Mecum and Suchanek (1987).

<sup>g</sup> Bingham et al. (1988).

<sup>h</sup> Suchanek and Bingham (1989).

<sup>i</sup> Ericksen and Bingham (1990).

<sup>j</sup> Estimated as the sample standard deviation of the 1984-1988 annual means.

Table 6. Estimated effort, harvest, and harvest per angler-hour of coho salmon within the Chilkoot River near Haines, Alaska, 1984-1990.

Year	Survey dates	Effort		Harvest		Harvest per hour
		Hours	SE <sup>a</sup>	Coho salmon	SE <sup>a</sup>	
1984	9/01-10/30	9,437 <sup>b</sup>	-- <sup>c</sup>	614 <sup>d</sup>	-- <sup>c</sup>	0.07
1985 <sup>e</sup>	9/02-11/03	6,530	-- <sup>c</sup>	742	-- <sup>c</sup>	0.11
1986 <sup>f</sup>	9/01-10/31	10,790	-- <sup>c</sup>	708	-- <sup>c</sup>	0.07
1987 <sup>g</sup>	9/08-11/01	5,209	-- <sup>c</sup>	378	-- <sup>c</sup>	0.07
1988 <sup>h</sup>	9/12-11/06	3,952	380	395	84	0.10
1989 <sup>i</sup>	9/11-11/05	3,497	343	259	57	0.07
1984-1989 Mean		6,569	2,714 <sup>j</sup>	516	181 <sup>j</sup>	0.08
1990	9/10-11/04	1,522	185	27	10	0.02

<sup>a</sup> Estimates are square roots of variances summed across sampling areas; this estimate may be biased because sampling at each site is not independent.

<sup>b</sup> (L. M. Neimark, Alaska Department of Fish and Game, Douglas, Alaska, unpublished data).

<sup>c</sup> Estimate of variance not provided.

<sup>d</sup> Neimark (1985).

<sup>e</sup> Mecum and Suchanek (1986).

<sup>f</sup> Mecum and Suchanek (1987).

<sup>g</sup> Bingham et al. (1988).

<sup>h</sup> Suchanek and Bingham (1989).

<sup>i</sup> Ericksen and Bingham (1990).

<sup>j</sup> Estimated as the sample standard deviation of the 1984-1989 annual means.

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APPENDIX A



Appendix A1. Estimates of effort, harvest, and catch of coho salmon, sockeye salmon, and Dolly Varden by stratum and sampling period and site, June 18 through November 4, 1990.

		June 18 July 1	July 2 July 15	July 16 July 29	July 30 Aug 12	Aug 13 Aug 26	Aug 27 Sept 9	Sept 10 Sept 23	Sept 24 Oct 7	Oct 8 Oct 21	Oct 21 Nov 4
BELOW ADFG WEIR - WEEKENDS											
	Effort	571	1,097	856	832	1,858	611	109	184	44	0
Coho	Harvest	0	0	0	0	0	0	0	5	1	0
	Catch	0	0	0	0	0	0	0	6	1	0
Sockeye	Harvest	0	65	31	64	214	10	0	0	0	0
	Catch	0	65	31	67	214	10	0	0	0	0
Dolly Varden	Harvest	22	44	9	0	17	0	0	0	0	0
	Catch	37	79	14	5	17	9	0	0	0	0
WEEKDAYS											
	Effort	1,008	1,464	1,519	1,895	3,062	1,390	222	172	48	0
Coho	Harvest	0	0	0	0	0	0	0	0	5	0
	Catch	0	0	0	0	0	0	0	0	5	0
Sockeye	Harvest	107	133	78	186	464	84	0	0	0	0
	Catch	107	133	78	330	485	84	0	0	0	0
Dolly Varden	Harvest	19	95	25	83	52	4	0	0	0	0
	Catch	29	111	50	197	52	4	0	0	0	0
ABOVE ADFG WEIR - WEEKENDS											
	Effort	151	691	655	414	327	113	83	129	62	7
Coho	Harvest	0	0	3	0	0	0	0	0	0	0
	Catch	0	0	3	0	0	0	0	7	1	0
Sockeye	Harvest	0	0	0	3	0	0	0	0	0	0
	Catch	0	0	0	3	7	0	0	0	0	0
Dolly Varden	Harvest	0	186	378	218	28	180	105	86	74	79
	Catch	0	220	425	265	85	180	110	86	76	79
WEEKDAYS											
	Effort	248	707	1,578	1,336	782	328	123	251	73	15
Coho	Harvest	0	0	50	0	0	0	3	13	0	0
	Catch	0	0	50	0	0	0	3	13	0	0
Sockeye	Harvest	0	0	0	28	30	0	0	0	0	0
	Catch	0	0	0	28	30	0	4	0	0	0
Dolly Varden	Harvest	18	516	566	411	302	334	121	79	0	34
	Catch	18	646	752	1,711	323	371	188	79	0	34

Appendix A2. Estimated variances for effort, harvest, and catch of sockeye salmon, by stratum and sampling period and site, June 18 through November 4, 1990.

		June 18 July 1	July 2 July 15	July 16 July 29	July 30 Aug 12	Aug 13 Aug 26	Aug 27 Sept 9	Sept 10 Sept 23	Sept 24 Oct 7	Oct 8 Oct 21	Oct 22 Nov 4
BELOW ADFG WEIR -		WEEKENDS									
Effort	Stage 1	0	56,751	4,355	14,652	103,307	15,184	1,427	0	146	0
	Stage 2	17,104	53,453	11,004	8,865	193,257	1,891	1,916	124	150	0
	Stage 3	3,704	5,740	3,783	4,664	32,763	2,107	226	350	30	0
Harvest	Stage 1	0	661	153	303	4,602	11	0	0	0	0
	Stage 2	0	692	191	88	2,675	9	0	0	0	0
	Stage 3	0	203	43	199	1,129	14	0	0	0	0
Catch	Stage 1	0	661	153	355	4,602	11	0	0	0	0
	Stage 2	0	692	191	71	2,675	9	0	0	0	0
	Stage 3	0	203	43	204	1,129	14	0	0	0	0
		WEEKDAYS									
Effort	Stage 1	26,460	81,677	54,746	28,154	117,658	79,082	2,594	861	418	0
	Stage 2	66,256	16,967	31,759	33,756	86,193	2,602	2,141	253	38	0
	Stage 3	5,804	6,434	5,564	9,916	29,966	5,052	236	124	45	0
Harvest	Stage 1	1,375	1,590	536	2,603	42,003	1,133	0	0	0	0
	Stage 2	1,253	418	138	602	2,673	366	0	0	0	0
	Stage 3	497	344	172	537	2,351	146	0	0	0	0
Catch	Stage 1	1,375	1,590	536	18,942	41,134	1,133	0	0	0	0
	Stage 2	1,253	418	138	7,904	2,974	366	0	0	0	0
	Stage 3	497	344	172	2,729	2,462	146	0	0	0	0
ABOVE ADFG WEIR -		WEEKENDS									
Effort	Stage 1	0	41,808	5,471	332	718	1,033	967	0	1,057	11
	Stage 2	2,117	18,347	8,642	2,949	6,603	1,758	39	52	20	11
	Stage 3	269	2,093	2,388	1,142	932	159	84	241	69	2
Harvest	Stage 1	0	0	0	2	0	0	0	0	0	0
	Stage 2	0	0	0	3	0	0	0	0	0	0
	Stage 3	0	0	0	4	0	0	0	0	0	0
Catch	Stage 1	0	0	0	2	11	0	0	0	0	0
	Stage 2	0	0	0	3	16	0	0	0	0	0
	Stage 3	0	0	0	4	57	0	0	0	0	0
		WEEKDAYS									
Effort	Stage 1	3,792	13,147	66,810	52,520	14,509	2,690	1,790	14,096	2,036	135
	Stage 2	1,880	2,859	6,354	41,006	3,026	3,357	175	872	732	30
	Stage 3	300	1,387	5,284	6,453	1,578	379	62	479	157	5
Harvest	Stage 1	0	0	0	475	524	0	0	0	0	0
	Stage 2	0	0	0	158	175	0	0	0	0	0
	Stage 3	0	0	0	139	145	0	0	0	0	0
Catch	Stage 1	0	0	0	475	524	0	7	0	0	0
	Stage 2	0	0	0	158	175	0	3	0	0	0
	Stage 3	0	0	0	139	145	0	2	0	0	0

Appendix A3. Estimated variances for effort, harvest, and catch of coho salmon, by stratum and sampling period and site, June 18 through November 4, 1990.

		June 18 July 1	July 2 July 15	July 16 July 29	July 30 Aug 12	Aug 13 Aug 26	Aug 27 Sept 9	Sept 10 Sept 23	Sept 24 Oct 7	Oct 8 Oct 21	Oct 22 Nov 4	
BELOW ADFG WEIR		WEEKENDS										
Effort	Stage 1	0	56,751	4,355	14,652	103,307	15,184	1,427	0	146	0	
	Stage 2	17,104	53,453	11,004	8,865	193,257	1,891	1,916	124	150	0	
	Stage 3	3,704	5,740	3,783	4,664	32,763	2,107	226	350	30	0	
Harvest	Stage 1	0	0	0	0	0	0	0	0	1	0	
	Stage 2	0	0	0	0	0	0	0	5	0	0	
	Stage 3	0	0	0	0	0	0	0	11	1	0	
Catch	Stage 1	0	0	0	0	0	0	0	0	1	0	
	Stage 2	0	0	0	0	0	0	0	5	0	0	
	Stage 3	0	0	0	0	0	0	0	12	1	0	
		WEEKDAYS										
Effort	Stage 1	26,460	81,677	54,746	28,154	117,658	79,082	2,594	861	418	0	
	Stage 2	66,256	16,967	31,759	33,756	86,193	2,602	2,141	253	38	0	
	Stage 3	5,804	6,434	5,564	9,916	29,966	5,052	236	124	45	0	
Harvest	Stage 1	0	0	0	0	0	0	0	0	13	0	
	Stage 2	0	0	0	0	0	0	0	0	4	0	
	Stage 3	0	0	0	0	0	0	0	0	5	0	
Catch	Stage 1	0	0	0	0	0	0	0	0	13	0	
	Stage 2	0	0	0	0	0	0	0	0	4	0	
	Stage 3	0	0	0	0	0	0	0	0	5	0	
ABOVE ADFG WEIR		WEEKENDS										
Effort	Stage 1	0	41,808	5,471	332	718	1,033	967	0	1,057	11	
	Stage 2	2,117	18,347	8,642	2,949	6,603	1,758	39	52	20	11	
	Stage 3	269	2,093	2,388	1,142	932	159	84	241	69	2	
Harvest	Stage 1	0	0	2	0	0	0	0	0	0	0	
	Stage 2	0	0	3	0	0	0	0	0	0	0	
	Stage 3	0	0	3	0	0	0	0	0	0	0	
Catch	Stage 1	0	0	2	0	0	0	0	0	1	0	
	Stage 2	0	0	3	0	0	0	0	17	0	0	
	Stage 3	0	0	3	0	0	0	0	7	1	0	
		WEEKDAYS										
Effort	Stage 1	3,792	13,147	66,810	52,520	14,509	2,690	1,790	14,096	2,036	135	
	Stage 2	1,880	2,859	6,354	41,006	3,026	3,357	175	872	732	30	
	Stage 3	300	1,387	5,284	6,453	1,578	379	62	479	157	5	
Harvest	Stage 1	0	0	930	0	0	0	6	36	0	0	
	Stage 2	0	0	177	0	0	0	2	12	0	0	
	Stage 3	0	0	108	0	0	0	3	13	0	0	
Catch	Stage 1	0	0	930	0	0	0	6	36	0	0	
	Stage 2	0	0	177	0	0	0	2	12	0	0	
	Stage 3	0	0	108	0	0	0	3	13	0	0	

Appendix A4. Estimated variances for effort, harvest, and catch of Dolly Varden, by stratum and sampling period and site, June 18 through November 4, 1990.

		June 18 July 1	July 2 July 15	July 16 July 29	July 30 Aug 12	Aug 13 Aug 26	Aug 27 Sept 9	Sept 10 Sept 23	Sept 24 Oct 7	Oct 8 Oct 21	Oct 22 Nov 4
BELOW ADFG WEIR		WEEKENDS									
Effort	Stage 1	0	56,751	4,355	14,652	103,307	15,184	1,427	0	146	0
	Stage 2	17,104	53,453	11,004	8,865	193,257	1,891	1,916	124	150	0
	Stage 3	3,704	5,740	3,783	4,664	32,763	2,107	226	350	30	0
Harvest	Stage 1	0	560	22	0	30	0	0	0	0	0
	Stage 2	291	414	39	0	67	0	0	0	0	0
	Stage 3	80	232	14	0	69	0	0	0	0	0
Catch	Stage 1	0	2,324	48	7	30	29	0	0	0	0
	Stage 2	841	1,098	87	10	67	0	0	0	0	0
	Stage 3	133	670	22	11	69	8	0	0	0	0
		WEEKDAYS									
Effort	Stage 1	26,460	81,677	54,746	28,154	117,658	79,082	2,594	861	418	0
	Stage 2	66,256	16,967	31,759	33,756	86,193	2,602	2,141	253	38	0
	Stage 3	5,804	6,434	5,564	9,916	29,966	5,052	236	124	45	0
Harvest	Stage 1	0	620	119	2,601	267	8	0	0	0	0
	Stage 2	23	693	73	998	115	3	0	0	0	0
	Stage 3	25	342	38	249	169	4	0	0	0	0
Catch	Stage 1	62	799	624	9,680	267	8	0	0	0	0
	Stage 2	94	1,024	44	4,351	115	3	0	0	0	0
	Stage 3	43	431	97	2,076	169	4	0	0	0	0
ABOVE ADFG WEIR		WEEKENDS									
Effort	Stage 1	0	41,808	5,471	332	718	1,033	967	0	1,057	11
	Stage 2	2,117	18,347	8,642	2,949	6,603	1,758	39	52	20	11
	Stage 3	269	2,093	2,388	1,142	932	159	84	241	69	2
Harvest	Stage 1	0	10,807	7,331	4,397	197	4,014	2,745	0	1,833	1,549
	Stage 2	0	1,524	3,393	3,728	296	5,263	1,813	631	117	1,549
	Stage 3	0	925	6,474	1,173	182	1,225	554	573	365	279
Catch	Stage 1	0	16,285	9,105	6,563	1,824	4,014	3,011	0	1,903	1,549
	Stage 2	0	2,005	5,652	7,001	2,736	5,263	2,080	631	131	1,549
	Stage 3	0	1,103	8,498	1,797	3,412	1,225	558	573	369	279
		WEEKDAYS									
Effort	Stage 1	3,792	13,147	66,810	52,520	14,509	2,690	1,790	14,096	2,036	135
	Stage 2	1,880	2,859	6,354	41,006	3,026	3,357	175	872	732	30
	Stage 3	300	1,387	5,284	6,453	1,578	379	62	479	157	5
Harvest	Stage 1	26	26,908	33,871	17,801	9,258	7,815	1,582	1,538	0	683
	Stage 2	46	2,230	1,463	6,871	6,245	3,230	1,076	465	0	152
	Stage 3	60	4,589	3,819	5,929	3,144	4,801	392	417	0	27
Catch	Stage 1	26	48,411	43,382	953,375	8,883	10,002	6,272	1,538	0	683
	Stage 2	46	6,374	903	168,596	6,693	4,286	582	465	0	152
	Stage 3	60	7,917	5,539	33,800	3,369	4,943	485	417	0	27