

**Fishery Data Series No. 94-31**

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**Harvest Estimates for Picnic Cove and Gastineau  
Hatchery Roadside Sport Fisheries in Juneau, Alaska,  
During 1993**

by

**Dean E. Beers**

and

**Robert P. Marshall**

October 1994

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Alaska Department of Fish and Game

Division of Sport Fish



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IN JUNEAU, ALASKA, DURING 1993<sup>1</sup>

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Division of Sport Fish  
Anchorage, Alaska

October 1994

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## ABSTRACT

Angler effort and harvest of chinook salmon *Oncorhynchus tshawytscha* was estimated for the Picnic Cove roadside sport fishery from 12 April through 23 May 1993. Effort and harvest of chinook salmon, coho salmon *Oncorhynchus kisutch*, chum salmon *Oncorhynchus keta*, and pink salmon *Oncorhynchus gorbuscha* was also estimated at Gastineau Hatchery from 5 July to 17 October. Hatchery contributions of chinook and coho salmon by coded wire tag lot were also estimated at each site.

A total of 417 (SE =57) large chinook salmon at least 28 inches (71 cm) in total length was harvested at Picnic Cove. At the Gastineau Hatchery 118 (SE = 34) chinook salmon, 7,057 (SE = 520) coho salmon, 1,515 (SE = 310) chum salmon, and 713 pink salmon (SE = 95) were harvested.

KEY WORDS: Creel survey, roadside, angler effort and harvest, sport fishery, hatchery, coded wire tag, chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, chum salmon, *Oncorhynchus keta*, pink salmon, *Oncorhynchus gorbuscha*, Juneau, Southeast Alaska.

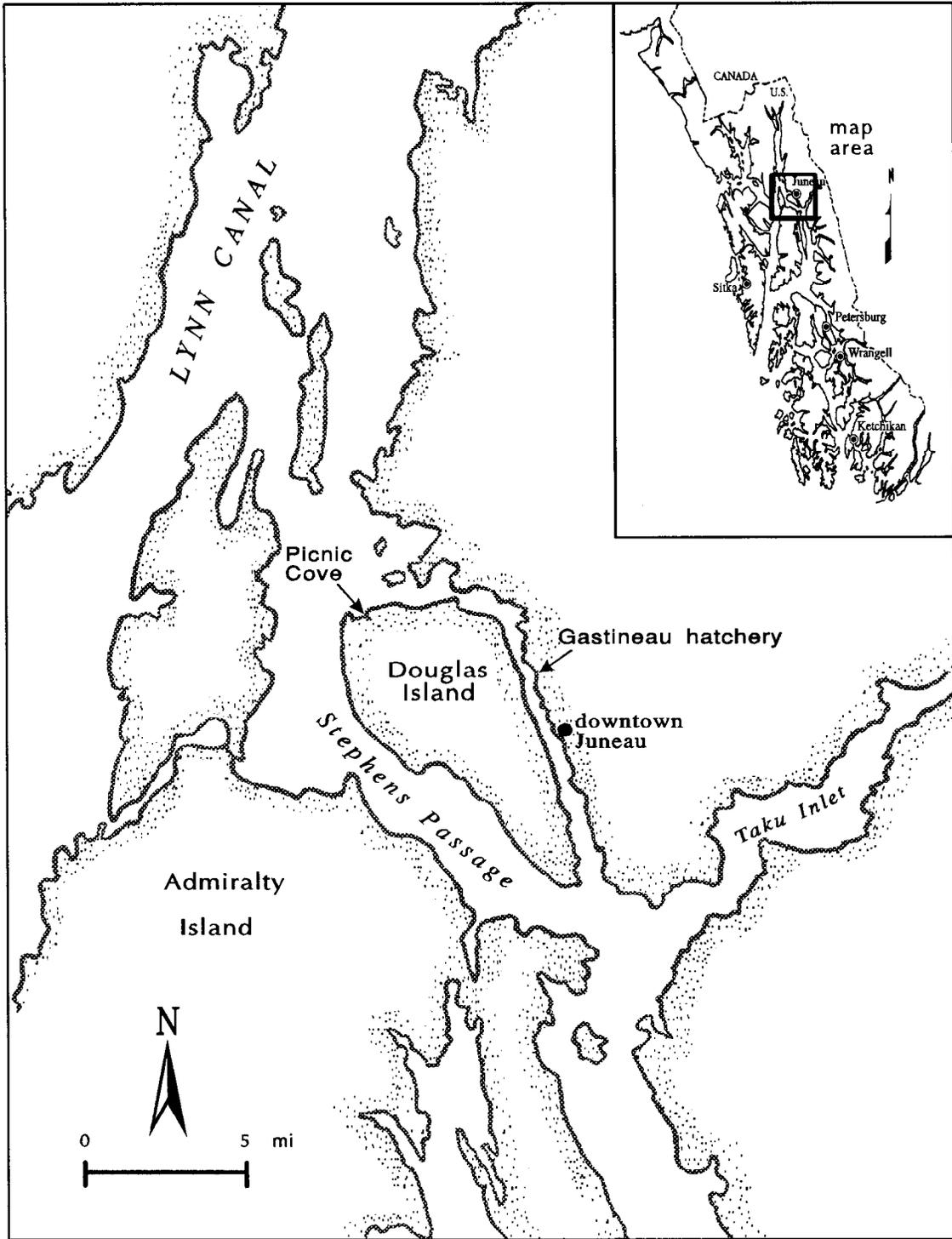


Figure 1. Location of Picnic Cove and Gastineau Hatchery roadside sport fisheries, northern Southeast Alaska.

## INTRODUCTION

Roadside sport fisheries in marine waters around Juneau offer unique fishing opportunities, both for Alaska residents and for tourists. In 1992, an estimated 32,183 angler-days of shoreline saltwater fishing effort were spent along the Juneau roadside (Mills 1993). This represents 52% of the total marine shoreline effort (62,453 angler-days) in Southeast Alaska and 24% of the total marine effort (134,179 angler-days) in the entire Juneau area during 1992. Demand for roadside fishing opportunities in the Juneau area is very high because about 39% of the population of Southeast Alaska resides in the Juneau Borough (according to the 1990 U.S. census) and the area is also visited by several hundred thousand tourists annually.

Although harvests on the Juneau road system are estimated by postal surveys (Mills 1993), onsite creel surveys can provide detailed information about specific roadside fisheries. The purpose of this report is to present detailed information collected in 1993 for two major marine roadside fisheries near Juneau: the Picnic Cove spring chinook salmon *Oncorhynchus tshawytscha* fishery and the Gastineau Hatchery coho *Oncorhynchus kisutch*, chum *Oncorhynchus keta*, pink *Oncorhynchus gorbuscha*, and chinook salmon fishery.

In 1989, a regulatory change reducing the size of the area around Taku Inlet closed to fishing enabled a spring beach fishery for chinook salmon to develop at Picnic Cove (False Outer Point) on the north end of Douglas Island (Figure 1). It is the most heavily used roadside fishery near Juneau in the spring (April-May), and the unique topography of the site enables anglers to make good catches of chinook salmon from the beach. In 1992, an estimated 235 chinook salmon were harvested at Picnic Cove from 27 April through 7 June (Hubartt et al., 1993). The Picnic Cove fishery is now the largest shoreline sport fishery for wild chinook salmon in Southeast Alaska. Because of rapid growth in use of the site, the Alaska Department of Fish and Game (ADF&G) repeated the survey in 1993.

The Gastineau Hatchery, a private non-profit corporation owned and operated by Douglas Island Pink and Chum, Inc. (DIPAC), is located about 3 miles from downtown Juneau (Figure 1). The sport fishery that has developed at the hatchery is primarily a pink and chum salmon fishery in July and August, and a coho salmon fishery in September and October. Small numbers of chinook salmon are also caught in July and August.

In 1991 the hatchery, in cooperation with the Sport Fish Partnership Program, installed a floating dock to increase access to fishing for roadside anglers. Increases in salmon enhancement at Gastineau Hatchery and the nearby Sheep Creek hatchery have been extensive in recent years (Table 1), particularly for chinook and coho salmon, the two species of salmon most preferred by anglers in Southeast Alaska (Jones & Stokes 1991). In 1993, hatchery personnel asked the Department to help them conduct a creel survey to estimate fishing effort and harvest of chinook, coho, pink, and chum salmon at the hatchery. As a result, ADF&G provided technical planning and analysis for the project, and Gastineau Hatchery provided staff to conduct the survey.

Sport harvests of chinook salmon in Southeast Alaska are limited by a management plan which permits an increase in harvest based on the contributions of Alaskan hatchery stocks. Also, a rebuilding program for wild stocks of chinook salmon has been ongoing since 1981. Therefore harvests and hatchery contributions of important chinook salmon fisheries are of primary interest to managers.

## OBJECTIVES

Objectives of the two 1993 roadside creel surveys were:

1. Estimate the harvest (and Alaska hatchery contribution, if any) of chinook salmon at Picnic Cove from 12 April through 23 May, such that the total harvest estimate is within  $\pm 30\%$  of the true value 95% of the time.
2. Estimate harvests of pink, chum, coho and chinook salmon from the floating dock and beach adjacent to Gastineau Hatchery from 5 July through 17 October, such that estimates are within  $\pm 33\%$  of the true values 95% of the time.

## METHODS

### Picnic Cove

The Picnic Cove fishery occurs on a small rocky point about a quarter mile by trail from a public parking lot. Approximately 50 meters of prime fishing area is available, although anglers use several hundred meters of shoreline when crowded conditions occur. All anglers were interviewed as they exited the site along the access trail.

A stratified two-stage direct expansion survey (Cochran 1977) of anglers exiting Picnic Cove was used to estimate angler effort and harvest of chinook salmon between 12 April and 23 May. Strata were defined by unique combinations of weekly (7-day) periods and time of day (morning versus evening), yielding 12 strata. The design has (evening or morning) "days" as primary sampling units and anglers within days as secondary sampling units.

Morning strata lasted from 0700 to 1100 hours (4 hours) and evening strata lasted from 1100 hours to civil twilight (spanning 9 hours 52 minutes, to 11 hours 27 minutes over the course of the survey). The 1100 hour cut-point was selected after reviewing the numbers of anglers exiting the fishery by hour during 13 sampled days in 1992; approximately 40% fewer anglers exited the fishery each hour before 12 noon on these sampled days.

Days were selected randomly for sampling evening strata, and days for sampling morning strata were then randomly selected from the remaining days. This compromise enabled one technician to conduct the survey. Since morning sampling periods are short (4 hours) and relatively "low-use" ( $\approx 12\%$  of anglers in 1992), any bias due to the non-random selection of morning samples should be small. Two days were selected to sample from each stratum (morning and evening) during the first two weeks of the survey. During the final four weeks of the survey, three days were sampled in evening strata and two days were sampled in morning strata.

In conducting the survey, we assumed an insignificant number of anglers exited the area outside of survey hours and an insignificant proportion of anglers avoided the technician or mistakenly or dishonestly reported their effort and/or catch. At the end of each evening period sampled, any anglers still fishing were interviewed so that the first assumption about the survey could be evaluated.

Table 1. Summary of hatchery-reared salmon smolt released at Sheep Creek and Gastineau Hatchery from 1989-1994. Fish were reared at Gastineau Hatchery or Sheep Creek, except as noted.

Year	Release sites	Pink	Chum	Chinook	Coho
1989	Sheep Creek	0	26,697,200	120,000 <sup>a</sup>	44,940 <sup>a</sup>
	Gastineau Hatchery	15,032,297	9,227,285	11,000 <sup>a</sup>	36,866
1990	Sheep Creek	17,962,133	3,073,538	127,155 <sup>a</sup>	533,233
	Gastineau Hatchery	9,669,565	11,586,928	101,462 <sup>a</sup>	546,255
1991	Sheep Creek	16,258,086	37,874,036	100,543 <sup>a</sup>	505,287
	Gastineau Hatchery	14,846,296	11,326,584	43,595	507,819
1992	Sheep Creek	31,636,411	26,585,790	0	582,739
	Gastineau Hatchery	15,420,079	11,959,067	191,765	392,508
1993	Sheep Creek	32,660,175	27,002,939	0	562,150
	Gastineau Hatchery	15,768,972	11,891,265	207,536	477,999
1994	Sheep Creek	0	14,688,180	0	563,571
	Gastineau Hatchery	8,663,298	5,869,938	241,366	380,282

<sup>a</sup> Reared at Snettisham Hatchery.

The harvest in each stratum was estimated by

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

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

$$\hat{H}_{hi} = M_{hi} \cdot \frac{\sum_{j=1}^{m_{hi}} h_{hij}}{m_{hi}} \quad (3)$$

where  $h_{hij}$  is the harvest by angler  $j$  in sampling day  $i$  stratum  $h$ ,  $m_{hi}$  is the number of anglers interviewed in day  $i$ ,  $M_{hi}$  is the number of anglers completing trips in day  $i$ ,  $d_h$  is the number of days sampled in stratum  $h$ , and  $D_h$  is the number of days in stratum  $h$ . The variance of the harvest by stratum was estimated by

$$V[\hat{H}_h] = D_h^2 (1-f_{1h}) \frac{\sum_{i=1}^{d_h} (\hat{H}_{hi} - \bar{H}_h)^2}{d_h(d_h-1)} + D_h \sum_{i=1}^{d_h} M_{hi}^2 (1-f_{2hi}) \frac{\sum_{j=1}^{m_{hi}} (h_{hij} - \bar{h}_{hi})^2}{d_h m_{hi} (m_{hi} - 1)} \quad (4)$$

where  $f_{1h}$  = the sampling fraction for days,  $f_{2h}$  = sampling fraction for anglers. Harvest and effort are estimated similarly, substituting  $C$  and  $E$  for  $H$  in (1) through (4). Total harvests for the season are the sums across strata (e.g.,  $\sum \hat{H}_h$  and  $\sum V[H_h]$ ).

### Gastineau Hatchery

The survey site consists of a beach and a 25 meter floating dock and access ramp. The dock and ramp are located about 50 meter from the end of the fish pass at Gastineau Hatchery. Adjacent to the dock on the side opposite the hatchery building is a beach, which extends approximately 200 meters to a barge landing. The area is discrete in shape and size and easily viewed from the hatchery.

A stratified, two-stage roving creel survey based on expansion of sample ratios was used to estimate fishing effort and harvest from 5 July to 17 October 1993. Days were primary sampling units and anglers within days secondary sampling units. Locations (the dock versus the beach), 15 weekly (7 day) seasonal strata, and weekday versus weekend-holiday stratifications were maintained. Weekdays were defined as Monday through Friday, while the weekend-holiday stratum was designated Saturday and Sunday with Labor Day (6 September) being the only holiday. There were thus 60 discrete strata.

The sampling day was defined as beginning at 0600 and ending at 2200 hours, or at late civil twilight as computed for the mid-day of the sample week. During each sampling day, anglers were counted six times. The first "count" in each sampling day occurred, according to a random selection, at the mid-point of the first, second, or third interval of the first one-sixth of the sampling day.

Subsequent "counts" were conducted at intervals of one-sixth the length of the sampling day<sup>1</sup>. The counts were considered instantaneous and reflected fishing effort at the time of the count. Effort was estimated by multiplying the average angler count for the day for each site by the hours available for sampling each day. The harvest per unit effort (HPUE) for each fish species was estimated from anglers exiting the site(s). The estimated harvest was obtained from the product of the effort and HPUE estimates.

When not counting anglers, the technician interviewed anglers completing their trip without regard to angler success (angler harvest). As many completed-trip interviews as possible were obtained during each day selected for sampling. Since survey technicians also had other duties, interviews were not conducted at all times of each day; however, sampling of anglers exiting the survey area was expected (and reported) to occur roughly in proportion to the number exiting the site at most times of the day.

The harvest in each stratum was estimated by

$$\hat{H}_h = D_h \bar{H}_h \quad (5)$$

$$\bar{H}_h = \frac{\sum_{i=1}^{d_h} \hat{H}_{hi}}{d_h} \quad (6)$$

where  $\hat{H}_{hi}$  is the estimated harvest in day  $i$  stratum  $h$ ,  $d_h$  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 was estimated by

$$V[\hat{H}_h] = (1 - f_{1h}) D_h^2 \frac{\sum_{i=1}^{d_h} (\hat{H}_{hi} - \bar{H}_h)^2}{d_h (d_h - 1)} + f_{1h}^{-1} \sum_{i=1}^{d_h} \hat{V}[\hat{H}_{hi}] \quad (7)$$

where  $f_{1h} = d_h / D_h$ .

The harvest for each sampling period was estimated by

$$\hat{H}_{hi} = \hat{E}_{hi} \overline{HPUE}_{hi}^* \quad (8)$$

where  $\overline{HPUE}_{hi}^*$  is the "jackknife" estimate of mean HPUE during stratum  $h$  day  $i$ , and  $\hat{E}_{hi}$  is the fishing effort in angler hours during the same time.

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<sup>1</sup> Prior to August 21, the counting schedule was slightly different in that counts began at 0600 or 0700 hours each day (according to a random selection). The change was made to reduce bias in estimating mean count for each day.

Angler effort in each period was estimated by

$$\hat{E}_{hi} = H_h \bar{x}_{hi} \quad (9)$$

where  $H_h$  is the number of hours in a sampling day and  $\bar{x}_{hi}$  is the average number of anglers counted in day  $i$  stratum  $h$ . If  $\bar{x}_{hi} = 0$  and anglers are interviewed, then  $\hat{H}_{hi}$  in (8) was set equal to the observed harvest. In contrast, if  $\bar{x}_{hi} > 0$  and no anglers were interviewed, then  $\overline{HPUE}_{hi}^*$  in (8) was set equal to the mean  $\overline{HPUE}_{hi}^*$  for the stratum.

The variance of  $E_{hi}$  was estimated by

$$V[\hat{E}_{hi}] = H_h^2 \frac{\sum_{j=2}^{r_{hi}} (x_{hij} - x_{hi(j-1)})^2}{2 r_{hi} (r_{hi} - 1)} \quad (10)$$

where  $r_{hi}$  is the number of times anglers were counted in day  $i$ .

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

$$V[\hat{H}_{hi}] = V[\hat{E}_{hi}] \overline{HPUE}_{hi}^{*2} + V[\overline{HPUE}_{hi}^*] \hat{E}_{hi}^2 - V[\hat{E}_{hi}] V[\overline{HPUE}_{hi}^*] \quad (11)$$

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

Harvest and effort (and their variances) for the entire season were the sums of the estimates for each strata.

### Hatchery Contribution Estimates

At both sites technicians inspected each harvested chinook and coho salmon for a missing adipose fin indicating the probable presence of an internal coded wire tag (CWT). The number of fish checked for missing adipose fins was recorded, and heads were collected from adipose clipped fish and sent to the Alaska Department of Fish and Game coded wire tag laboratory for tag removal and decoding.

Heads were classified as "random" (randomly sampled during regularly scheduled creel sampling periods) or "select" (voluntarily provided by unsampled anglers). Only random recoveries were used to estimate CWT contributions by release group. Harvest, tag recovery and sampling data were pooled into biweekly periods to provide better sample sizes for determining hatchery contributions. These bi-weekly periods match those in the coded wire tag database maintained for sport recoveries in Southeast Alaska. Hatchery contributions, associated variances, and standard errors were estimated using procedures outlined by Johnson et al. (1993).

## RESULTS

### Picnic Cove

A total of 708 interviews, 147 large chinook salmon (>28 inches), and 2,874 angler-hours of fishing effort were observed in the survey (Appendix A1).

Anglers expended an estimated 7,880 angler hours (SE = 457) to catch and harvest 417 (SE = 57) chinook salmon at least 28 inches in length between 12 April and 23 May 1993 (Table 2). Relative precision (RP) for the harvest estimate (for 95% confidence intervals) was  $\pm 27\%$ . Anglers also caught and released an estimated 67 (SE = 21) sub-legal chinook salmon under 28 inches in length. Harvest and effort was limited during the first week of the survey, but remained high throughout the rest of the survey. Although the survey underestimates the total harvest at the site because fishing continues outside of the survey period, casual observations showed effort dropped off rapidly the first week of June. The peak of the fishery occurred between 26 April and 16 May when 67% (278 fish) of the total estimated harvest occurred.

A total of 154 large chinook salmon was examined for missing adipose fins, and two fish were found to be so marked (both were from the Snettisham hatchery). Contribution from a 1989 Sheep Creek release (tag code 4-31-62) was estimated to be 7 (SE = 7), while the contribution from a Speel Arm release in 1990 (tag code 4-34-14) was estimated to be 22 (SE = 22). The contribution of hatchery releases to the Picnic Cove fishery totaled 29 fish (7% of the total).

Of the chinook salmon examined for sex and age, 63% (76) were age 1.4, and another 32% (38) were age 1.3 (Table 3). The sex ratio was about equal; 51 fish were determined to be females, 50 were males, and 18 were of unknown sex.

Appendix A2 contains sample variances for effort and harvest at Picnic Cove, which are useful for planning future surveys.

### Gastineau Hatchery

An estimated 7,057 (SE = 520, RP = 14%) coho, 1,515 (SE = 310, RP = 40%) chum, 713 (SE = 95, RP = 26%) pink and 118 (SE = 34, RP = 57%) chinook salmon were harvested at Gastineau Hatchery (Table 4). Effort for all species totaled 15,825 (SE = 584) angler-hours. The highest levels of effort were expended during the coho salmon fishery which peaked in the final weeks of September. Additionally, 159 (SE = 45, RP = 56%) Dolly Varden and 40 (SE = 22, RP = 105%) cutthroat trout were harvested at the site. Sampling information, including angler counts and numbers of completed interviews, are presented in Appendix A3.

Hatchery contributions by tag lot were calculated for coho salmon (Table 5). From the 1,409 coho salmon examined for missing adipose fins, 89 coded wire tags were recovered. The total estimated hatchery contribution for coho salmon is 4,319 (SE = 498) fish, of which an estimated 33% (1,438, SE = 272) were jacks (salmon spending only a few months in salt water) returns. This estimate from coded wire tag recoveries is significantly less than the total harvest of 7,057. The large difference between the creel and coded wire tag harvest estimates was unexpected, since we would have assumed nearly all fish were of Gastineau Hatchery origin.

Table 2. Summary of estimated effort and harvest of large chinook salmon and total catch of small chinook salmon in the Picnic Cove marine roadside fishery during 1993.

Weekly period	Effort (angler-hrs)	Variance	Large chinook harvest <sup>a</sup> (>28 in.)	Variance	Small chinook catch <sup>b</sup> (<28 in.)	Variance
4/12-4/18	658	71,159	18	44	0	-
4/19-4/25	1,114	7,412	49	88	0	-
4/26-5/02	1,552	67,273	89	787	18	121
5/03-5/09	1,011	10,039	98	924	5	12
5/10-5/16	2,052	39,387	91	401	9	3
5/17-5/23	1,493	13,140	72	971	35	324
<b>Total</b>	<b>7,880</b>	<b>208,410</b>	<b>417</b>	<b>3,215</b>	<b>67</b>	<b>460</b>

<sup>a</sup> All large chinook salmon caught were harvested.

<sup>b</sup> All small chinook salmon caught were released because they were of sub-legal size.

Table 3. Summary of the age and sex composition of chinook salmon harvested in the Picnic Cove marine roadside fishery in 1993.

Age	Male	Female	Sex unknown	Total	Percent
1.3	17	14	7	38	32
1.4	30	35	11	76	63
1.5	1	1	0	2	2
2.3	1	0	0	1	1
2.4	1	1	0	2	2
<b>Total</b>	<b>50</b>	<b>51</b>	<b>18</b>	<b>119</b>	<b>100</b>

Table 4. Summary of estimated angler effort and harvest of chinook, coho, chum, and pink salmon at the Gastineau Hatchery roadside fishery in 1993.

Weekly period	Angler-hours	Var <sup>a</sup>	Coho harvest	Var <sup>a</sup>	Chinook harvest	Var <sup>a</sup>	Chum harvest	Var <sup>a</sup>	Pink harvest	Var <sup>a</sup>
7/05-7/11	875	5,286	0	-	16	127	32	503	103	1,098
7/12-7/18	983	6,845	0	-	51	698	6	26	32	198
7/19-7/25	992	8,337	0	-	0	-	188	2,915	125	1,197
7/26-8/01	1,341	98,660	0	-	3	5	251	6,526	104	1,103
8/02-8/08	1,283	14,858	0	-	24	222	632	73,913	162	2,488
8/09-8/15	761	11,845	4	9	13	72	124	3,446	92	2,008
8/16-8/22	790	23,161	37	245	8	41	196	7,581	71	674
8/23-8/29	885	6,006	185	1,824	3	13	82	1,409	24	297
8/30-9/05	928	8,469	257	5,280	0	-	0	-	0	-
9/06-9/12	1,103	12,039	829	14,179	0	-	0	-	0	-
9/13-9/19	1,666	11,950	2,074	49,303	0	-	0	-	0	-
9/20-9/26	1,341	68,564	1,617	82,945	0	-	0	-	0	-
9/27-10/03	1,309	46,503	1,127	91,619	0	-	0	-	0	-
10/04-10/10	958	12,519	316	10,014	0	-	0	-	0	-
10/11-10/17	610	5,436	611	14,867	0	-	4	13	0	-
<b>Total</b>	<b>15,825</b>	<b>340,478</b>	<b>7,057</b>	<b>270,285</b>	<b>118</b>	<b>1,178</b>	<b>1,515</b>	<b>96,332</b>	<b>713</b>	<b>9,063</b>

<sup>a</sup> Variance of effort or harvest estimate.

Table 5. Estimates of hatchery produced coho salmon contributions by tag lot to the Gastineau Hatchery roadside sport fishery in 1993. All fish were reared at Gastineau Hatchery.

Release site	Brood year	Release year	Number released	Tag code	Tag recoveries	Hatchery contribution	Standard error
<u>Gastineau Hatchery</u>							
Large coho	90	92	198,304	4-38-34	17	1,019	256
	90	92	<u>194,204</u>	4-38-35	<u>7</u>	<u>451</u>	171
		Subtotal	392,508		24	1,470	
Jack coho	91	93	195,425	4-40-39	3	155	92
	91	93	<u>282,547</u>	4-40-40	<u>0</u>	<u>0</u>	-
		Subtotal	477,972		3	155	
<u>Sheep Creek</u>							
Large coho	90	92	16,934	4-38-31	10	48	16
	90	92	193,122	4-38-32	9	500	171
	90	92	193,069	4-38-33	6	345	143
	90	92	<u>179,614</u>	4-38-44	<u>10</u>	<u>518</u>	171
		Subtotal	582,739		35	1,411	
Jack coho	91	93	173,274	4-40-41	14	614	169
	91	93	194,705	4-40-42	7	344	132
	91	93	<u>194,171</u>	4-40-43	<u>6</u>	<u>325</u>	140
		Subtotal	562,150		27	1,283	
<b>Total</b>			2,015,369		89	4,319	498

Coded wire tags were also recovered from three chinook salmon. Estimated contribution from two coded wire tags (tag code 4-34-10) released at Sheep Creek in 1990 was 24 (SE = 18) chinook salmon. Estimated contribution for a coded wire tag (tag code 4-31-61) released at Sheep Creek was 6 (SE = 5) fish.

Computer files containing raw data, SAS program code and associated data sets for the analysis are listed in Appendix A4.

## DISCUSSION

### Picnic Cove

The Picnic Cove fishery appears to have grown steadily since 1989 when regulations permitted the fishery to develop. Harvests in 1993 were much higher than in 1990 when an estimated that 50 chinook salmon were harvested between 7 May and 7 October. In 1992, an estimated 214 chinook salmon were harvested from 26 April to 23 May, while 350 fish were harvested during the same period in 1993.

Few anglers continued to fish outside survey hours (0700 hours to civil twilight), and only one chinook salmon was observed after an evening shift. However, a moderately high harvest (72 fish) occurred the final week of the survey (17 May -23 May), indicating that the fishery was still active when the survey concluded. Thus, the total harvest estimates are somewhat negatively biased, with respect to true total annual harvests.

The timing of the fishery, lack of coded wire tag recoveries, and age data suggest that this fishery targets nearby wild Taku River stocks which are milling prior to their journey upstream.

### Gastineau Hatchery

Harvests of chinook, coho, and chum salmon were all higher than harvests in 1990 survey (Suchanek and Bingham 1991), whereas pink salmon harvests were well below the 1990 estimate; 1993 returns of pink and chum salmon to the hatchery were considered extremely poor (R. Focht, Gastineau Hatchery manager, Juneau, personal communication). Because some anglers fished outside the sampled fishing day, our estimates of total harvest may contain a small negative bias.

The harvest contribution estimated from coded wire tag data for coho salmon in 1993 (4,319 fish, SE = 498) was unexpectedly lower than our direct expansion survey estimate of total harvest (7,057 fish, SE = 520). It is possible that substantial numbers of wild fish from local stocks mix with hatchery fish at the site; however, we tentatively consider this an unlikely reason for the difference between the two estimates. Other factors which may contribute to the discrepancy are: (1) errors in estimating the tagging fraction at the hatchery, (2) improper sampling and data recording techniques, or (3) a higher mortality rate among tagged fish.

## CONCLUSIONS AND RECOMMENDATIONS

Both roadside fisheries play an important role in providing marine fishing opportunities for urban anglers and tourists who do not have the time or economic resources to participate in more remote roadside or marine boat fisheries.

### Picnic Cove

The Picnic Cove spring chinook salmon fishery is a popular high-use marine roadside fishery which has expanded greatly since 1989. Because the most productive fishing area for anglers appears limited, this fishery is likely near its maximum capacity and harvests are not expected to expand greatly in the near future. Also, the cost of conducting a roadside creel survey for Picnic Cove is relatively high, and yearly data is not essential for inseason management.

### Gastineau Hatchery

Major changes in harvest patterns of chinook and coho salmon have occurred in recent years for Juneau roadside fisheries. In addition to coho salmon returns to Gastineau Hatchery, enhanced chinook salmon fisheries at Auke Bay and Fish Creek have become very popular. Effort (angler-hours) has roughly tripled at Gastineau Hatchery since 1990, when the last comprehensive roadside creel survey was conducted in Juneau. At that time Sheep Creek was the highest use roadside fishery (6,504 angler-hours), with Gastineau Hatchery next at 5,207 angler-hours. Based on available survey data, however, increased returns of coho salmon to the Gastineau Hatchery has made the hatchery site the highest use roadside sport fishery since 1991.

### ACKNOWLEDGMENTS

We wish to thank the Juneau roadside creel survey staff of Linda Wendeborn and Sue Millard for their invaluable data collection efforts at Picnic Cove and suggestions to improve the survey. Hatchery manager Rick Focht supervised the entire Gastineau Hatchery data collection effort; he was assisted by hatchery personnel Dave Gregovich, Aleria Jensen, Fritz Hunter, and John Carswell. The ADF&G staff of the Commercial Fisheries Management and Development (CFMD) Division CWT lab are gratefully acknowledged for their work on dissecting salmon heads, coded wire tag decoding, and data reduction efforts. We thank Donna Buchholz of the Research and Technical Services Unit (RTS) of the Division of Sport Fish for her diligence in mark sense form processing and data archiving. Also, Steve Elliott and Paul Suchanek provided editorial comment, and Alma Seward prepared and edited the final manuscript.

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APPENDIX A

Appendix A1. Summary of sampling data by date and time period for large chinook salmon at Picnic Cove, 1993.

SAMPLE DATE	SAMPLING PERIOD	ANGLERS INTERVIEWED	TOTAL EFFORT(hrs)	HARVEST MEAN	HARVEST VARIANCE	HARVEST TOTAL
12APR93	0700-1100	0	0	0.00	0.00	0
13APR93	1100-2052	15	38	0.06	0.06	1
17APR93	0700-1100	10	26	0.10	0.10	1
18APR93	1100-2052	34	125	0.08	0.08	3
19APR93	1100-2111	31	128	0.03	0.03	1
20APR93	0700-1100	7	14	0.57	0.95	4
23APR93	0700-1100	6	21	0.83	0.56	5
24APR93	1100-2110	47	156	0.08	0.07	4
26APR93	1100-2129	50	225	0.12	0.10	6
27APR93	0700-1100	5	16	0.40	0.30	2
28APR93	1100-2129	31	124	0.06	0.06	2
29APR93	1100-2129	35	164	0.51	0.43	18
02MAY93	0700-1100	22	86	0.27	0.39	6
03MAY93	1100-2148	34	111	0.38	0.48	13
04MAY93	1100-2148	27	60	0.03	0.03	1
05MAY93	0700-1100	15	44	0.13	0.12	2
06MAY93	1100-2148	33	114	0.30	0.34	10
07MAY93	0700-1100	17	56	0.58	0.50	10
10MAY93	1100-2207	40	175	0.25	0.34	10
11MAY93	1100-2207	49	217	0.04	0.03	2
14MAY93	0700-1100	15	54	0.20	0.31	3
15MAY93	0700-1100	18	73	0.38	0.36	7
16MAY93	1100-2207	49	298	0.24	0.23	12
17MAY93	0700-1100	22	87	0.09	0.08	2
18MAY93	1100-2227	30	168	0.23	0.18	7
19MAY93	0700-1100	19	85	0.63	0.46	12
20MAY93	1100-2227	26	121	0.07	0.07	2
21MAY93	1100-2227	<u>21</u>	<u>94</u>	0.04	0.04	<u>1</u>
Total		708	2,880			147

Appendix A2. Sample variances for effort and harvest between days and anglers at Picnic Cove in 1993.

SAMPLE PERIOD		EFFORT VARIANCE BETWEEN DAYS <sup>a</sup>	AVERAGE EFFORT VARIANCE BETWEEN ANGLERS <sup>b</sup>	HARVEST VARIANCE BETWEEN DAYS <sup>a</sup>	AVERAGE HARVEST VARIANCE BETWEEN ANGLERS <sup>b</sup>
<u>Morning</u>					
0700-1100	4/12-4/18	325.1	1.5	0.5	0.1
0700-1100	4/19-4/25	24.5	2.0	0.5	0.8
0700-1100	4/26-5/02	2450.0	1.6	8.0	0.3
0700-1100	5/03-5/09	78.1	1.4	32.0	0.3
0700-1100	5/10-5/16	180.5	1.6	8.0	0.3
0700-1100	5/17-5/23	1.1	2.2	50.0	0.3
<u>Evening</u>					
1100-2052	4/12-4/18	3741.1	3.4	2.0	0.1
1100-2110	4/19-4/25	639.0	4.9	8.0	0.1
1100-2129	4/26-5/02	2668.8	4.4	69.3	0.2
1100-2148	5/03-5/09	963.1	2.0	39.0	0.3
1100-2207	5/10-5/16	3834.3	5.6	28.0	0.2
1100-2227	5/17-5/23	1405.7	5.6	10.3	0.1

<sup>a</sup> Sum of the squared deviations over (d-1), EQ(4).

<sup>b</sup> Sum of the squared deviations over m(m-1), EQ(4).

Appendix A3. Summary of sampling data by date and site at Gastineau Hatchery, 1993.

Week	Stratum <sup>a</sup>	Date	Site	Angler counts			Interview sampling information					
				Number	Mean	SD	Number	Effort	Chinook harv	Coho harv	Pink harv	Chum harv
7/05-/711	WD	08JUL93	DOCK	6	5.50	4.04	14	26.00	0	0	1	0
7/05-/711	WD	08JUL93	BEACH	6	2.33	3.39	2	1.00	0	0	0	0
7/05-/711	WD	09JUL93	DOCK	6	4.67	3.72	9	20.50	0	0	3	0
7/05-/711	WD	09JUL93	BEACH	6	2.17	2.79	3	6.50	0	0	2	2
7/05-/711	WE/H	10JUL93	DOCK	6	6.50	4.23	23	35.00	0	0	6	1
7/05-/711	WE/H	10JUL93	BEACH	6	1.33	1.75	1	1.00	0	0	0	0
7/05-/711	WE/H	11JUL93	DOCK	6	7.83	4.31	51	80.00	0	0	8	1
7/05-/711	WE/H	11JUL93	BEACH	6	2.33	2.34	4	4.50	2	0	1	0
7/12-/718	WD	12JUL93	DOCK	6	6.33	4.68	52	88.75	0	0	2	2
7/12-/718	WD	12JUL93	BEACH	6	1.83	1.17	5	5.75	0	0	0	0
7/12-/718	WD	13JUL93	DOCK	6	7.67	4.46	33	81.25	1	0	5	0
7/12-/718	WD	13JUL93	BEACH	6	1.67	3.20	0	0	0	0	0	0
7/12-/718	WE/H	17JUL93	DOCK	6	7.83	3.43	37	55.25	0	0	2	0
7/12-/718	WE/H	17JUL93	BEACH	6	1.17	1.17	2	6.00	0	0	0	0
7/12-/718	WE/H	18JUL93	DOCK	6	5.50	4.42	50	73.00	0	0	2	0
7/12-/718	WE/H	18JUL93	BEACH	6	3.17	3.31	2	1.50	1	0	0	0
7/19-/725	WD	21JUL93	DOCK	6	4.50	3.73	10	11.75	0	0	1	1
7/19-/725	WD	21JUL93	BEACH	6	2.50	2.35	3	7.00	0	0	1	1
7/19-/725	WD	22JUL93	DOCK	5	3.20	2.95	8	16.50	0	0	2	1
7/19-/725	WD	22JUL93	BEACH	5	3.00	2.00	4	8.00	0	0	2	3
7/19-/725	WE/H	24JUL93	DOCK	6	6.50	4.37	30	52.75	0	0	2	3
7/19-/725	WE/H	24JUL93	BEACH	6	7.67	5.35	12	22.25	0	0	2	11
7/19-/725	WE/H	25JUL93	DOCK	6	8.67	7.94	49	75.50	0	0	9	8
7/19-/725	WE/H	25JUL93	BEACH	6	6.17	6.52	21	38.50	0	0	12	13
7/26-8/01	WD	26JUL93	DOCK	6	4.50	3.73	22	58.00	0	0	6	11
7/26-8/01	WD	26JUL93	BEACH	6	3.67	3.50	14	36.50	0	0	2	21
7/26-8/01	WD	29JUL93	DOCK	6	11.67	19.60	22	43.50	0	0	4	4
7/26-8/01	WD	29JUL93	BEACH	6	3.50	5.36	3	4.00	0	0	0	0
7/26-8/01	WE/H	31JUL93	DOCK	6	6.83	5.67	42	71.00	1	0	3	12
7/26-8/01	WE/H	31JUL93	BEACH	6	5.83	4.79	5	10.50	0	0	1	5
7/26-8/01	WE/H	01AUG93	DOCK	6	6.00	4.47	30	44.00	0	0	3	7
7/26-8/01	WE/H	01AUG93	BEACH	6	6.83	7.19	31	65.00	1	0	9	8
8/02-8/08	WD	03AUG93	DOCK	5	4.80	3.42	20	44.50	1	0	7	4
8/02-8/08	WD	03AUG93	BEACH	5	7.40	6.07	19	54.75	3	0	7	20
8/02-8/08	WD	04AUG93	DOCK	5	5.40	5.68	22	38.25	0	0	7	10
8/02-8/08	WD	04AUG93	BEACH	5	6.20	7.29	6	9.50	0	0	0	17
8/02-8/08	WE/H	07AUG93	DOCK	5	6.20	3.56	48	97.25	0	0	7	11
8/02-8/08	WE/H	07AUG93	BEACH	5	5.00	3.81	16	28.00	0	0	5	5
8/02-8/08	WE/H	08AUG93	DOCK	6	5.33	4.72	30	53.00	2	0	0	5
8/02-8/08	WE/H	08AUG93	BEACH	6	4.17	4.26	9	13.50	0	0	6	4
8/09-8/15	WD	12AUG93	DOCK	6	1.83	3.13	10	8.75	0	0	0	1
8/09-8/15	WD	12AUG93	BEACH	6	2.33	2.58	8	14.00	0	0	0	0
8/09-8/15	WD	13AUG93	DOCK	6	3.33	2.25	22	28.75	0	0	4	1
8/09-8/15	WD	13AUG93	BEACH	6	4.33	3.61	20	52.50	3	0	15	21
8/09-8/15	WE/H	14AUG93	DOCK	6	4.33	5.35	36	49.50	1	1	2	3
8/09-8/15	WE/H	14AUG93	BEACH	6	3.67	3.27	23	43.75	2	2	16	18
8/09-8/15	WE/H	15AUG93	DOCK	5	5.80	5.81	49	60.75	0	0	0	1
8/09-8/15	WE/H	15AUG93	BEACH	5	5.40	3.13	16	36.00	0	0	1	6
8/16-8/22	WD	18AUG93	DOCK	5	5.60	4.72	20	35.00	1	0	3	1
8/16-8/22	WD	18AUG93	BEACH	5	5.00	3.00	12	25.00	0	1	2	6
8/16-8/22	WD	20AUG93	DOCK	5	1.20	1.79	10	10.00	0	0	0	0
8/16-8/22	WD	20AUG93	BEACH	5	3.80	3.35	10	17.50	0	2	4	16
8/16-8/22	WE/H	21AUG93	DOCK	6	1.50	1.87	21	27.50	0	0	0	2
8/16-8/22	WE/H	21AUG93	BEACH	6	3.83	4.54	10	17.25	0	3	0	5
8/16-8/22	WE/H	22AUG93	DOCK	6	4.17	3.06	42	41.00	0	0	0	0
8/16-8/22	WE/H	22AUG93	BEACH	6	3.17	1.94	31	45.75	1	3	4	2
8/23-8/29	WD	25AUG93	DOCK	5	5.20	1.30	10	18.00	0	3	0	0
8/23-8/29	WD	25AUG93	BEACH	5	2.80	2.59	15	28.50	1	19	5	12
8/23-8/29	WD	27AUG93	DOCK	6	4.00	1.26	20	31.50	0	4	1	0
8/23-8/29	WD	27AUG93	BEACH	6	3.83	2.99	11	23.50	0	5	0	3
8/23-8/29	WE/H	28AUG93	DOCK	6	7.50	4.51	49	64.75	0	2	0	0

-continued-

Week	Stratum <sup>a</sup>	Date	Site	Angler counts			Interview sampling information					
				Number	Mean	SD	Number	Effort	Chinook	Coho	Pink	Chum
									harv	harv	harv	harv
8/23-8/29	WE/H	28AUG93	BEACH	6	2.17	2.04	8	8.75	0	3	0	6
8/23-8/29	WE/H	29AUG93	DOCK	6	5.83	4.96	45	59.00	0	5	0	0
8/23-8/29	WE/H	29AUG93	BEACH	6	4.33	4.93	28	56.75	0	10	1	1
8/30-9/05	WD	02SEP93	DOCK	6	1.83	2.14	4	12.00	0	2	0	0
8/30-9/05	WD	02SEP93	BEACH	6	7.83	7.83	9	24.50	0	12	0	0
8/30-9/05	WD	03SEP93	DOCK	6	1.83	2.14	12	18.75	0	2	0	0
8/30-9/05	WD	03SEP93	BEACH	6	8.00	6.16	15	31.50	0	8	0	0
8/30-9/05	WE/H	04SEP93	DOCK	6	3.67	2.88	38	48.75	0	5	0	0
8/30-9/05	WE/H	04SEP93	BEACH	6	2.17	1.72	12	11.00	0	1	0	0
8/30-9/05	WE/H	05SEP93	DOCK	5	5.20	5.81	16	26.50	0	2	0	0
8/30-9/05	WE/H	05SEP93	BEACH	5	3.80	3.70	24	63.75	0	3	0	0
9/06-9/12	WD	07SEP93	DOCK	6	1.83	1.94	13	20.50	0	12	0	0
9/06-9/12	WD	07SEP93	BEACH	6	4.17	1.94	25	57.00	0	30	0	0
9/06-9/12	WD	10SEP93	DOCK	6	2.83	2.23	17	31.25	0	38	0	0
9/06-9/12	WD	10SEP93	BEACH	6	7.83	4.22	14	37.00	0	20	0	0
9/06-9/12	WE/H	06SEP93	DOCK	6	7.00	6.72	29	44.50	0	8	0	0
9/06-9/12	WE/H	06SEP93	BEACH	6	7.83	5.85	11	13.50	0	1	0	0
9/06-9/12	WE/H	11SEP93	DOCK	6	8.67	7.97	29	64.50	0	37	0	0
9/06-9/12	WE/H	11SEP93	BEACH	6	6.67	4.80	12	20.25	0	5	0	0
9/06-9/12	WE/H	12SEP93	DOCK	6	6.83	3.49	30	48.75	0	91	0	0
9/06-9/12	WE/H	12SEP93	BEACH	6	7.33	3.01	10	16.75	0	36	0	0
9/13-9/19	WD	14SEP93	DOCK	6	9.00	4.65	26	54.50	0	82	0	0
9/13-9/19	WD	14SEP93	BEACH	6	9.83	3.76	11	18.50	0	16	0	0
9/13-9/19	WD	15SEP93	DOCK	6	9.17	9.24	20	43.25	0	69	0	0
9/13-9/19	WD	15SEP93	BEACH	6	9.67	5.54	17	32.00	0	41	0	0
9/13-9/19	WE/H	18SEP93	DOCK	6	7.67	5.05	46	56.00	0	76	0	0
9/13-9/19	WE/H	18SEP93	BEACH	6	5.00	4.82	22	30.75	0	20	0	0
9/13-9/19	WE/H	19SEP93	DOCK	5	5.60	2.61	32	44.75	0	43	0	0
9/13-9/19	WE/H	19SEP93	BEACH	5	7.40	6.54	8	13.75	0	13	0	0
9/20-9/26	WD	21SEP93	DOCK	6	6.00	4.34	12	18.50	0	12	0	0
9/20-9/26	WD	21SEP93	BEACH	6	3.50	2.07	10	13.25	0	23	0	0
9/20-9/26	WD	24SEP93	DOCK	6	6.50	3.27	17	27.50	0	45	0	0
9/20-9/26	WD	24SEP93	BEACH	6	13.00	5.06	23	38.25	0	37	0	0
9/20-9/26	WE/H	25SEP93	DOCK	6	0.50	1.22	6	9.75	0	5	0	0
9/20-9/26	WE/H	25SEP93	BEACH	6	6.00	3.16	19	31.00	0	62	0	0
9/20-9/26	WE/H	26SEP93	DOCK	6	5.67	2.58	23	38.25	0	33	0	0
9/20-9/26	WE/H	26SEP93	BEACH	6	14.67	8.52	32	63.25	0	84	0	0
9/27-10/03	WD	27SEP93	DOCK	6	5.67	2.25	23	35.50	0	11	0	0
9/27-10/03	WD	27SEP93	BEACH	6	11.33	6.65	17	31.50	0	40	0	0
9/27-10/03	WD	28SEP93	DOCK	5	2.00	1.41	3	4.00	0	1	0	0
9/27-10/03	WD	28SEP93	BEACH	5	4.60	1.52	9	25.50	0	23	0	0
9/27-10/03	WE/H	02OCT93	DOCK	5	5.80	4.32	29	51.75	0	21	0	0
9/27-10/03	WE/H	02OCT93	BEACH	5	15.00	4.47	6	14.25	0	20	0	0
9/27-10/03	WE/H	03OCT93	DOCK	6	12.17	12.58	26	52.50	0	23	0	0
9/27-10/03	WE/H	03OCT93	BEACH	6	9.50	3.94	11	35.00	0	38	0	0
10/04-10/10	WD	06OCT93	DOCK	6	9.17	4.67	13	34.00	0	18	0	0
10/04-10/10	WD	06OCT93	BEACH	6	4.17	2.14	6	13.00	0	4	0	0
10/04-10/10	WD	08OCT93	DOCK	6	5.67	2.73	29	44.50	0	11	0	0
10/04-10/10	WD	08OCT93	BEACH	6	2.17	1.47	1	2.00	0	1	0	0
10/04-10/10	WE/H	09OCT93	DOCK	6	8.67	4.84	35	68.25	0	15	0	0
10/04-10/10	WE/H	09OCT93	BEACH	6	4.83	3.49	2	1.00	0	0	0	0
10/04-10/10	WE/H	10OCT93	DOCK	6	8.67	5.20	40	81.50	0	17	0	0
10/04-10/10	WE/H	10OCT93	BEACH	6	2.83	2.64	0	0	0	0	0	0
10/11-10/17	WD	11OCT93	DOCK	6	7.67	6.62	32	56.50	0	61	0	0
10/11-10/17	WD	11OCT93	BEACH	6	1.83	1.47	1	1.00	0	2	0	0
10/11-10/17	WD	12OCT93	DOCK	6	6.17	4.26	31	51.50	0	35	0	1
10/11-10/17	WD	12OCT93	BEACH	6	3.33	2.42	4	11.00	0	16	0	0
10/11-10/17	WE/H	16OCT93	DOCK	5	1.20	1.64	6	6.50	0	4	0	0
10/11-10/17	WE/H	16OCT93	BEACH	5	1.40	0.89	4	5.50	0	4	0	0
10/11-10/17	WE/H	17OCT93	DOCK	6	1.17	1.60	8	11.00	0	8	0	0
10/11-10/17	WE/H	17OCT93	BEACH	6	0.83	0.75	8	7.75	0	1	0	0

<sup>a</sup> WD = weekdays (Monday-Fridays, except 6 September); WE/H = weekend/holidays (Saturdays, Sundays, 6 September).

Appendix A4. Major computer files used for data analysis of Picnic Cove and Gastineau Hatchery roadside fisheries in 1993.

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Picnic Cove

C93JRS	DTA	Raw Data in Mark-Sense Format
JRS93MSA	SSD	Summary subset DTA file: interview data
JRS93HC1	SSD	As above: sample dates and durations
PICNIC	SAS	SAS program to estimate effort, harvests, and variance

Gastineau Hatchery

DIPAC931	DTA	Raw data ASCII format (5 July through 21 August and 12 October through 17 October)
DIPAC932	DTA	Raw data ASCII format (8 August through 11 October)
DIPAC931	SAS	SAS program to make SAS data set from first raw data file
DIPAC932	SAS	SAS program to make SAS data set from second raw data file
DIPAC93	SSD	Summary subset DTA file: interview data
BOWDEN3A	SAS	SAS program to estimate effort, harvests, and variance

Hatchery contribution estimate

DIP93BAS	DTA	Individual listings of tag recoveries
DIP93CON	DTA	Summary of tag recovery contributions
CWT4	EXE	Estimates contribution by tag code

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