

Fishery Data Series No. 04-19

**Harvest Estimates for the Macaulay (Gastineau)
Hatchery Roadside Sport Fishery in Juneau, Alaska
during 2003**

by

Bruce A. White

October 2004

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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ABSTRACT

Angler effort and sport harvests of Chinook salmon *Oncorhynchus tshawytscha*, coho salmon *O. kisutch*, chum salmon *O. keta*, and pink salmon *O. gorbuscha* were estimated at Macaulay Hatchery from 09 June to 05 October 2003. An estimated 25,628 (SE = 724) angler-hours were expended to harvest a total of 2,389 (SE = 198) large Chinook salmon at least 28 inches in total length, 78 (SE = 36) small Chinook salmon (<28 inches in length), 12,128 (SE = 861) large coho salmon at least 16 inches in length, 346 (SE = 87) small coho salmon (<16 inches in length), 1,942 (SE = 215) chum salmon, and 2,305 (SE = 222) pink salmon. The Chinook and coho salmon harvests were record highs, 389% and 34% above the recent five-year average (1998-2002), respectively. Angler effort (25,628 h) was 14% above the recent five-year average.

Key words: Creel survey, roadside, Juneau, angler effort and harvest, sport fishery, hatchery, Chinook salmon, *Oncorhynchus tshawytscha*, coho salmon, *Oncorhynchus kisutch*, chum salmon, *Oncorhynchus keta*, pink salmon, *Oncorhynchus gorbuscha*, Macaulay Hatchery, Gastineau Hatchery, Southeast Alaska.

INTRODUCTION

Roadside sport fisheries in marine waters around Juneau, Alaska offer unique fishing opportunities for both Alaskan residents and tourists. Demand for these fishing opportunities is heavy, with 30,558 people residing in the Juneau Borough in 2001, according to the latest estimate available from the U.S. Census Bureau. Additionally, the number of visitors coming to Juneau has steadily increased from approximately 87,000 cruise ship passengers in 1982 to 776,991 in 2003. This number does not include passengers who arrived on small cruise ships, crew members, or the estimated 100,000 independent travelers who visited Juneau this year. The projected number of large cruise ship passengers for 2004 is 850,000 (L. Palmer, Juneau Convention and Visitors Bureau, Juneau, Alaska, personal communication).

The Macaulay Hatchery (prior to 2001 named Gastineau Hatchery), and its visitor center located about 3 miles north of downtown Juneau, is a popular destination for both tourists and residents (Figure 1). The hatchery is owned and operated by Douglas Island Pink and Chum, Inc. (DIPAC), a private non-profit corporation. Approximately 114,000 people toured the facility during the 2003 season, which is about 1,000 more than in 2002 (R. Focht, Director of Research and Evaluation, DIPAC, Juneau, personal communication).

In 2001, Wayside Park was constructed just north of the Macaulay Hatchery to better accommodate increased use by anglers. The park includes a van and wheelchair accessible dock for disabled anglers, restrooms, benches, and off-road parking. Federal transportation funds were used to construct the \$2.5 million park. The original floating access dock next to the hatchery was permanently removed in the fall of 2000.

Salmon enhancement efforts at Macaulay and nearby Sheep Creek hatcheries (Figure 1) have been extensive, including releases of Chinook *Oncorhynchus tshawytscha*, coho *O. kisutch*, pink *O. gorbuscha*, and chum *O. keta* salmon (Monage Unpublished). The two species of salmon most preferred by anglers in Southeast Alaska are Chinook and coho salmon (Jones & Stokes 1991). The sport fishery at the Macaulay hatchery targets Chinook, pink, and chum salmon from mid-June through August, and coho salmon from mid-August through late September or early October.

Since 1991, ADF&G staff has assisted the Macaulay Hatchery in developing an onsite creel program to estimate sport harvests at the site. The onsite creel survey at the hatchery provides detailed angler demographic and fishery performance information. Information gathered in this survey is more detailed than the information gathered through the Statewide Harvest Survey (SWHS), which also estimates

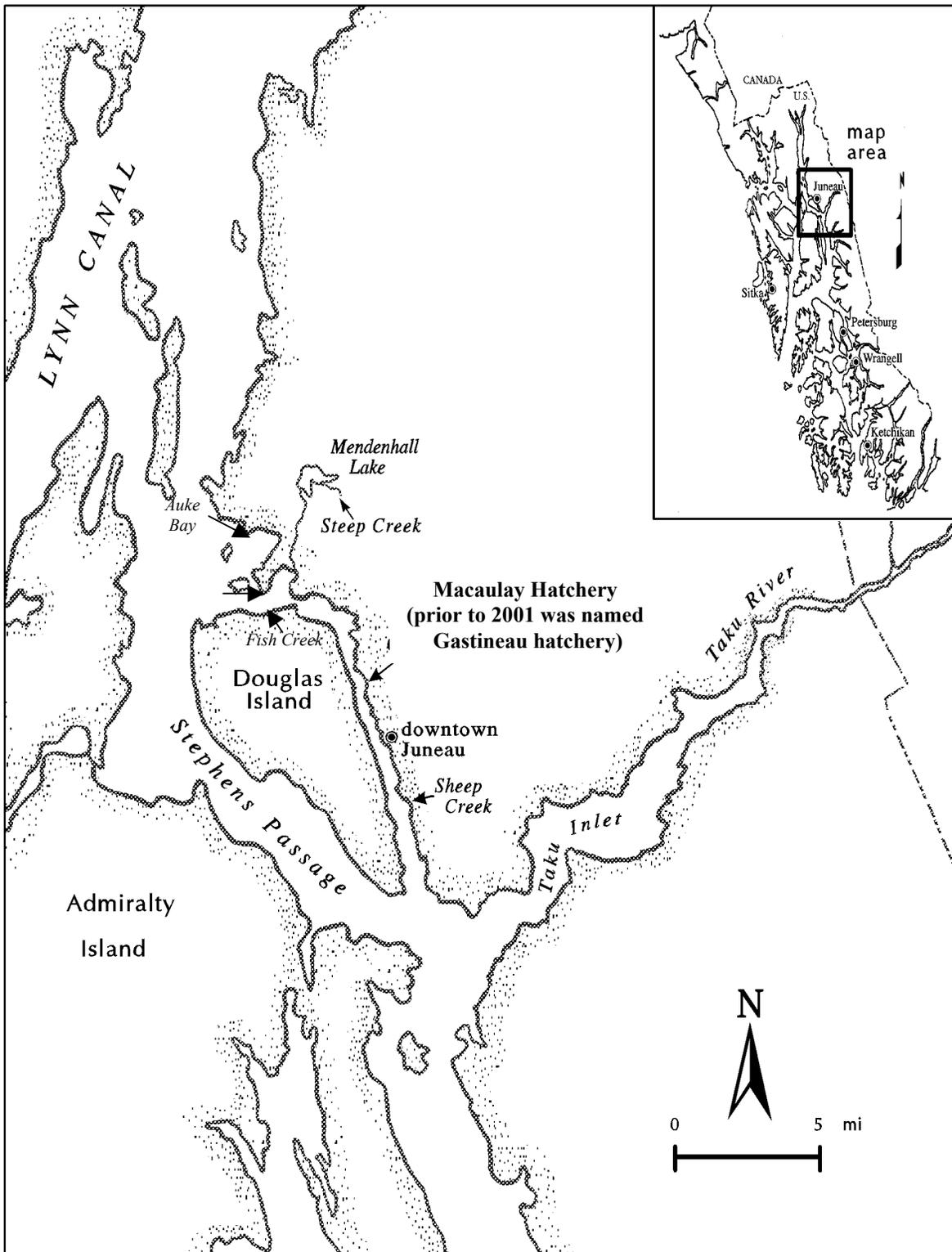


Figure 1.—Location of the Macaulay Hatchery, site of a roadside sport fishery in Juneau, northern Southeast Alaska.

sport harvests for the site “Shoreline-Gastineau Hatchery (DIPAC)” along with region-wide harvests through the use of questionnaires mailed annually to a random sample of sport anglers (Jennings et al. *In prep.*).

In 1994, ADF&G entered into an agreement with DIPAC to rear Chinook salmon for release at the following sites in the Juneau area (Figure 1): Macaulay Hatchery, Fish Creek (north Douglas Island), Auke Bay, and Sheep Creek (Bentz et al. 1996). This program was designed to increase sport fishing opportunities for Chinook salmon in the Juneau marine boat fishery; marine shoreline fisheries at Macaulay Hatchery, Fritz Cove, Auke Bay; and freshwater and marine shoreline fisheries at Fish Creek. Although sport harvests of Chinook salmon in Southeast Alaska are limited by an allocation and management plan, Alaska hatchery Chinook salmon do not count toward the U.S./Canada Pacific Salmon Treaty catch totals. The onsite creel survey at Macaulay Hatchery provides additional information for evaluating the hatchery as a release site and terminal harvest area. In 2003, hatchery and ADF&G staff again cooperated to conduct the survey.

OBJECTIVE

The objective of the 2003 creel survey at the Macaulay Hatchery was to estimate the effort and harvest of Chinook, coho, pink, and chum salmon from 6/09 to 10/05, such that estimates were within the specified true values 95% of the time: $\pm 10\%$ for angler-hours of effort, $\pm 25\%$ for coho, $\pm 40\%$ for Chinook, $\pm 30\%$ for pink, and $\pm 35\%$ for chum salmon harvests.

METHODS

The survey area (Wayside Park) was divided into two zones. This division was necessary due to the long, rectangular shape of the survey area, making it impossible to interview anglers exiting opposite ends of the survey area concurrently. The zone nearest the hatchery (South zone) included the public fishing dock and 300 ft of shoreline, 150 ft in either direction from the dock’s access ramp. The South zone is identical to the area that in previous years was the designated non-snagging

zone. The second zone (North zone) included the remaining 300 ft of beach extending north from the boundary of the South zone to the end of the park. The North zone had previously been defined as the snagging zone. Both zones were clearly marked, discrete in shape and size, and easily surveyed.

The bag and possession limit for Chinook salmon at the hatchery was 4 fish from 8 June to 31 August 2003, with no size limit and Chinook salmon harvested by non-residents in the terminal area during this period did not count toward the three fish annual limit. Chinook salmon were classified as large (≥ 28 inches TL), or small (< 28 inches TL). After 31 August, the Chinook salmon bag limit was 2 fish ≥ 28 inches TL for residents and 1 fish ≥ 28 inches TL for non-residents. The bag limit for pink, chum, and coho salmon ≥ 16 inches TL was 6 per day for each species, and an additional 10 salmon < 16 inches TL could be taken in combination. Coho salmon were classified as either “large” (≥ 16 inches TL) or “small” (< 16 inches TL).

A stratified, two-stage roving creel survey based on expansion of sample ratios was used to estimate fishing effort and harvest. The survey period was from 6/09 to 10/05, 2003. Days were primary sampling units, and anglers within days were secondary sampling units. Two zones, 17 weekly (7-day) strata, and weekday versus weekend-holiday stratification were maintained¹. Therefore, there were 68 discrete temporal/spatial strata.

For the 2003 creel survey design, the number of weekend/holiday days sampled per week remained the same as in previous years (2 days). During weeks with holidays, (making for 3 possible survey days), two sampling days were randomly selected. Two weekdays (Monday through Friday) were also randomly selected for sampling. The sampling day was defined as beginning at early civil twilight or 0600 (whichever was later), and ended at late civil twilight, as computed for the midday of the

¹ Weekdays = Mondays–Fridays. Weekend/holidays = Saturdays, Sundays, Independence Day (observed on 4 July), and Labor Day (1 September).

sample week. Most angling at the hatchery was expected to occur between those hours. During each sampling day, anglers were counted six times within each zone (North and South). The first count was randomly selected from the mid-point of the first, second, or last third of the first one-sixth of each sampling day. Subsequent counts occurred at intervals equal to one-sixth the length of each sampling day.

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 completed-trip interviews. The estimated harvest was obtained from the product of the effort and HPUE estimates.

When not counting anglers, survey personnel interviewed anglers completing their trip without regard to angler success (angler harvest). Interviews were conducted during one-hour periods that alternated between sites (North or South). The site to start interviews in each stratum was selected at random, and alternated each day sampled.

During each interview, anglers were asked to report their effort and harvest at the site being sampled. In addition, technicians recorded the age class (child—under 16 years of age, adult—16 to 60 years, or senior—over the age of 60) and the residency (Alaska resident or non-resident) of the angler. As many completed-trip interviews as possible were obtained during each day selected for sampling.

Since hatchery technicians had other assigned duties, interviews were not conducted at various times during the day; however, sampling of anglers exiting the survey area was thought to occur roughly in proportion to the number exiting the site over time.

Angler effort and harvest by species along with associated variances and standard errors were calculated by the following procedures.

The harvest in each stratum (and within each specific class) was estimated by

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

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

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 (and within each specific class) was estimated by

$$v[\hat{H}_h] = (1 - f_{hi}) D_h^2 \frac{\sum_{i=1}^{d_h} (\hat{H}_{hi} - \bar{H}_h)^2}{d_h (d_h - 1)} + f_{ih}^{-1} \sum_{i=1}^{d_h} \hat{v}[\hat{H}_{hi}] \quad (3)$$

where $f_{ih} = d_h / D_h$.

Harvest for each sampling day was estimated by

$$\hat{H}_{hi} = \hat{E}_{hi} \overline{HPUE}_{hi}^* \quad (4)$$

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.

Angler effort in each day was estimated by

$$\hat{E}_{hi} = T_h \bar{x}_{hi} \quad (5)$$

where T_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 were interviewed, then \hat{H}_{hi} in equation (4) was set equal to the observed harvest. In contrast, if $\bar{x}_{hi} > 0$ and no anglers were interviewed, then \overline{HPUE}_{hi}^* in equation (4) was set equal to the mean \overline{HPUE}_{hi}^* for the stratum.

The variance of \hat{E}_{hi} was estimated by (Wolter 1985)

$$v[\hat{E}_{hi}] = T_h^2 \frac{\sum_{j=2}^{r_{hi}} (x_{hi,j} - x_{hi(j-1)})^2}{2r_{hi}(r_{hi} - 1)} \quad (6)$$

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

The variance of the harvest H_{hi} in a day was estimated by (Goodman 1960).

$$v[\hat{H}_{hi}] = v[\hat{E}_{hi}] \overline{HPUE}_{hi}^{*2} + v[\overline{HPUE}_{hi}^*] \hat{E}_{hi}^2 - v[\hat{E}_{hi}] v[\overline{HPUE}_{hi}^*] \quad (7)$$

The \overline{HPUE}_{hi}^* 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 jackknife estimates was 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 stratum. The standard error (SE) for the estimate (\hat{N}) is the square root of the variance. Relative precision (RP) of the estimates with a 95% confidence interval was calculated using equation (8).

$$RP(\hat{N}) = \left[\frac{(SE * 1.96)}{\hat{N}} \right] * 100 \quad (8)$$

RESULTS

During the 2003 fishing season at Macaulay Hatchery, 2,623 angler interviews and 742 angler counts were conducted. Total estimated fishing effort was 25,628 (SE = 724) angler-hours. The amount of angler effort was fairly consistent throughout the season (Table 2). An estimated 2,389 (SE = 198) large Chinook salmon, 12,128 (SE = 861) large coho salmon, 1,942 (SE = 215) chum salmon, and 2,305 (SE = 222) pink salmon were harvested at Macaulay Hatchery from 6/09

to 10/5. In addition, 78 (SE = 36) small Chinook salmon and 346 (SE = 87) small coho salmon were also harvested.

Large Chinook salmon were harvested from the beginning of the survey through the third week of August. The peak harvest occurred during the week of 7/14 to 7/20, when 397 large Chinook salmon were harvested. The majority of small Chinook salmon were harvested from the third week in June to mid- July.

The majority of the pink and chum salmon were harvested during July and August. A few coho salmon were taken in early August, but most were harvested from mid-August through the end of the survey in early October.

Alaska residents accounted for 89% of the total effort and 94% of the large Chinook, 94% of the large coho, 84% of the chum, and 76% of the pink salmon harvest (Table 2).

Adults accounted for 63% of the effort, and 66% of the large Chinook, 84% of the large coho, 73% of the chum, and 68% of the pink salmon harvested. Children accounted for 26% of the effort, and 21% of the large Chinook, 6% of the large coho, 14% of the chum, and 22% of the pink salmon harvested. Seniors accounted for 11% of the effort, and 14% of the large Chinook, 11% of the large coho, 13% of the chum and 11% of the pink salmon harvested (Table 3).

The relative precision for the estimates of effort, large Chinook, large coho, pink and chum salmon harvests were well within goals stated in the objective. The relative precision goal for small Chinook and small coho salmon harvests were exceeded (Table 1). Detailed sampling information, including angler counts and numbers of completed interviews for overall estimates, are presented in Appendix A1. Appendix A2 lists archived files containing final data sets used for the analysis.

Table 1.—Summary of estimated weekly angler effort and harvest of large (≥ 16 in) and small (< 16 in) coho, large (≥ 28 in) and small (< 28 in) Chinook, chum, and pink salmon at the Macaulay Hatchery roadside fishery in 2003.

Weekly period	Effort		Large (≥ 16 in) coho salmon		Small (< 16 in) coho salmon		Large (≥ 28 in) Chinook salmon		Small (< 28 in) Chinook salmon		Chum salmon		Pink salmon	
	Angler-hours	SE ^a	Harvest ^b	SE ^a	Harvest ^b	SE ^a	Harvest ^b	SE ^a	Harvest ^b	SE ^a	Harvest ^b	SE ^a	Harvest ^b	SE ^a
6/09-6/15	1,232	124	0	0	0	0	81	29	3	3	0	0	0	0
6/16-6/22	1,002	247	0	0	10	7	20	10	0	0	0	0	0	0
6/23-6/29	1,401	199	0	0	0	0	196	80	42	34	123	42	0	0
6/30-7/06	1,654	153	0	0	0	0	380	86	10	8	71	33	102	39
7/07-7/13	2,025	124	7	5	4	3	232	58	17	10	387	72	515	96
7/14-7/20	2,411	307	9	5	0	0	397	92	6	6	334	118	190	43
7/21-7/27	1,964	156	0	0	0	0	388	66	0	0	454	114	124	54
7/28-8/03	1,556	142	0	0	0	0	328	50	0	0	331	77	364	79
8/04-8/10	1,854	121	0	0	22	18	217	68	0	0	171	64	535	111
8/11-8/17	1,085	190	163	48	26	12	93	28	0	0	39	27	244	100
8/18-8/24	1,805	178	438	100	271	83	57	17	0	0	33	23	209	69
8/25-8/31	1,371	207	1,605	258	3	3	0	0	0	0	0	0	22	22
9/01-9/07	1,750	156	2,612	294	11	11	0	0	0	0	0	0	0	0
9/08-9/14	2,087	152	4,491	472	0	0	0	0	0	0	0	0	0	0
9/15-9/21	921	138	961	192	0	0	0	0	0	0	0	0	0	0
9/22-9/28	923	124	1,112	221	0	0	0	0	0	0	0	0	0	0
9/29-10/05	588	150	730	518	0	0	0	0	0	0	0	0	0	0
Total ^b	25,628	724	12,128	861	346	87	2,389	198	78	36	1,942	215	2,305	222
Relative Precision	6%		14%		49%		26%		91%		22%		19%	
Goal Relative Precision	10%		25%		25%		40%		40%		35%		30%	

^a Standard error of effort or harvest estimate.

^b Columns may not exactly sum to the totals due to rounding.

DISCUSSION

A new record harvest for large Chinook and large coho salmon was established during the 2003 sport fishing season at the Macaulay Hatchery roadside fishery. There were an estimated 2,389 large Chinook salmon and 12,128 large coho salmon harvested, which was 391% and 35% above the recent five-year average, respectively. The estimated chum salmon harvest of 1,942 fish was 24% above the recent five-year average, while the estimated 2,305 pink salmon harvest was 15% below the five-year average. Lastly, the estimated 25,628 hours of angler effort at the site was 14% above the five-year average (Table 4). Overall, the Chinook salmon return to the hatchery was the second highest on record. Chinook salmon were being harvested at the beginning of the survey (first week in June), and they continued to be harvested through the third week of August. The greatest one-week harvest occurred during the week of 7/14 to 7/20, when 397 large Chinook salmon were harvested. The overall coho salmon return to Macaulay Hatchery was slightly below average. (R. Focht, DIPAC Director of Research & Evaluation, Juneau, personal communication). The coho salmon harvest occurred from August through October, and peaked during the second week of September. Overall, the chum salmon returns to the hatchery were below average. However, the angler harvest was above average, beginning in late June and continuing through early August. Pink salmon returns to the hatchery were slightly below average. The pink salmon harvest was also below average, but was considerably higher than last year. Pink salmon were harvested from the first week in July until the end of August.

During 2003, angler effort returned to levels seen during the years prior to the construction of Wayside Park. Construction activity at the park was a likely cause for the reduction in effort observed during 2001. Angler effort was up 14% from 2002 (White 2003b). In 2003, Juneau experienced slightly warmer and drier weather when compared to the recent five-year average. Residency information collected

during the survey indicated that the vast majority (89%) of the anglers using this site were residents. Adults harvested the majority of the salmon, followed by children and seniors.

Chinook salmon smolts reared at Macaulay Hatchery are released at three locations, onsite in Gastineau Channel, at Fish Creek on the north end of Douglas Island, and in Auke Bay (Bentz et al. 1996). The latter two sites provide additional Chinook salmon fishing opportunities for marine boat, shoreline, and freshwater anglers.

Harvest estimates and coded wire tag recovery information generated during the Juneau marine boat creel survey from 4/28 to 9/28, indicated that these anglers also benefited from DIPAC enhancement activities. In 2003, Juneau marine boat anglers harvested an estimated 2,538 Chinook salmon that originated from DIPAC hatchery releases (Hubartt and Jaenicke *In prep.*). This was approximately 46% of total Chinook salmon harvested in the 2003 Juneau area marine boat sport fishery. An estimated 644 (SE = 132) of the Chinook salmon taken in the Juneau area marine boat sport fishery originated from releases directly at Macaulay Hatchery (Gastineau Channel). DIPAC also contributed an estimated 2,142 coho salmon to the marine boat sport fishery. This is approximately 11% of the total estimated (18,628, SE = 1,768) coho salmon harvested in the Juneau area by marine boat sport anglers.

Commercial fishers harvested about 1,000 Chinook salmon from the Juneau releases, down from 1,400 last year. Chinook salmon from the Auke Bay release site accounted for 13% of the DIPAC Chinook salmon harvested in the commercial fishery, down from 40% last year. The Fish Creek and Macaulay hatchery release sites contributed 31% and 56% respectively. Finally, a total of 2,200 adult Chinook salmon returned to the hatchery rack, down from 4,400 last year (R. Focht, DIPAC Director of Research & Evaluation, Juneau, personal communication).

Table 2.—Effort and harvest estimates by angler residency of large (≥ 16 in) and small (< 16 in) coho, large (≥ 28 in) and small (< 28 in) Chinook, chum, and pink salmon at the Macaulay Hatchery roadside fishery in 2003.

Angler residency	Angler Effort		Large (≥ 16 in) coho salmon		Small (< 16 in) coho salmon		Large (≥ 28 in) Chinook salmon		Small (< 28 in) Chinook salmon		Chum salmon		Pink salmon	
	Hours	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a
Resident	22,846	678	11,395	823	321	98	2,234	191	60	35	1,621	203	1,756	183
Non-resident	2,773	228	734	145	24	21	155	37	18	11	321	92	549	53
Total ^b	25,619	724	12,129	861	345	87	2,389	198	78	36	1,942	215	2,305	222

^a Standard error of the effort and harvest estimates.

^b Totals for hours and harvests may differ slightly from overall estimates due to rounding error. Totals for standard errors will not equal the overall estimate standard errors because they are not independent estimates across angler types.

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Table 3.—Effort and harvest estimates by angler age class of large (≥ 16 in) and small (< 16 in) coho, large (≥ 28 in) and small (< 28 in) Chinook, chum, and pink salmon at the Macaulay Hatchery roadside fishery in 2003.

Angler Age Class	Angler Effort		Large (≥ 16 in) coho salmon		Small (< 16 in) coho salmon		Large (≥ 28 in) Chinook salmon		Small (< 28 in) Chinook salmon		Chum salmon		Pink salmon	
	Hours	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a
Adult	16,230	613	10,124	735	196	58	1,565	175	25	11	1,421	175	1,562	167
Child	6,681	437	719	134	109	44	490	82	46	34	273	66	500	89
Senior	2,717	256	1,286	227	41	17	334	64	7	5	248	84	243	73
Total ^b	25,628	676	12,129	693	346	105	2,389	131	78	25	1,942	276	2,305	194

^a Standard error of the effort and harvest estimates.

^b Totals for hours and harvests may differ slightly from overall estimates due to rounding error. Totals for standard errors will not equal the overall estimate standard errors because they are not independent estimates across angler types.

Table 4.—Summary of estimated angler effort and harvest of large (≥ 16 in) coho, large (≥ 28 in) Chinook, chum, and pink salmon from onsite creel surveys at the Macaulay Hatchery roadside fishery in 1990 and 1993–2003.

Year (survey period)	Angler-hours	Large (≥ 16 in) coho salmon		Large (≥ 28 in) Chinook salmon		Chum salmon		Pink salmon		
		SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	SE ^a	Harvest	
1990 (05 May–11 Nov) ^b	5,207	477	69	35	0	—	118	45	4,225	961
1993 (05 Jul–17 Oct) ^c	15,825	584	7,057 ^d	520	118 ^d	34	1,515	310	713	95
1994 (04 Jul–09 Oct) ^e	24,192	905	3,509	317	70	17	593	66	9,197	560
1995 (03 Jul–25 Sep) ^f	21,546	555	2,212	303	157	36	2,047	254	3,421	250
1996 (21 Jun–23 Sep) ^g	19,189	555	2,860	285	695	73	2,274	250	1,039	135
1997 (16 Jun–05 Oct) ^h	22,385	654	3,507	436	931	123	1,605	235	2,878	297
1998 (08 Jun–27 Sep) ⁱ	28,273	701	11,722	937	471	63	2,376	280	5,653	414
1999 (07 Jun–03 Oct) ^j	18,828	541	7,275	382	109	23	1,028	173	2,986	303
2000 (12 Jun–06 Oct) ^k	23,536	567	10,303	461	155	29	1,518	190	2,387	235
2001 (13 Jun–07 Oct) ^l	19,045	591	4,222	290	581	82	1,176	178	1,453	201
2002 (11 Jun–06 Oct) ^m	22,531	746	11,521	754	1,121	124	1,706	303	1,079	248
5-year (1997-2001) Mean	22,443		9,009		487		1,561		2,712	
2003 (09 Jun–05 Oct)	25,628	724	12,128	861	2,389	198	1,942	215	2,305	222

^a Standard error (SE) of effort or harvest.

^b Estimates from Suchanek and Bingham (1991).

^c Estimates from Beers and Marshall (1994).

^d Includes both large and small fish.

^e Estimates from Beers (1995).

^f Estimates from Beers (1996).

^g Estimates from Beers (1997).

^h Estimates from Frenette (1998).

ⁱ Estimates from Frenette (1999).

^j Estimates from Jaenicke (2000).

^k Estimates from Jaenicke (2001).

^l Estimates from White (2003a).

^m Estimates from White (2003b).

Beginning with the 1997 brood year, the Andrew Creek stock was released from all three release sites in Juneau. Returns of the Andrew Creek stock have been better than the returns of the King Salmon river stock, which was being developed as a possible new brood stock for the hatchery (R. Focht, DIPAC Director of Research and Evaluation, Juneau, personal communication). Other factors that affected this year's return were the relatively better ocean survival of the 1997 and 1999 brood years and a significant contribution from releases at the Macaulay salmon hatchery.

Terminal area regulations in Gastineau Channel surrounding the hatchery and in nearby Auke Bay and Fritz Cove provided increased Chinook salmon bag limits (4 fish, no size limit) to harvest hatchery returns during the period from 6/11 to

8/31. This opportunity was important as the bag limit outside the terminal area was either 1 or 2 Chinook salmon ≥ 28 inches TL. The liberal regulations, coupled with substantial hatchery returns, provided increased opportunities for a large number of anglers. The exploitation rate of the Chinook salmon returning to the hatchery terminal area was 52%.

Harvest estimates for the onsite survey at Gastineau Hatchery were compared to the "parallel" estimates from the SWHS (i.e., for "Shoreline-Gastineau Hatchery-DIPAC" in 2001, Walker et al. 2003) from 1994 through 2001. Ninety-five percent (95%) confidence intervals for several of the paired estimates did not overlap, suggesting the two surveys yield dissimilar estimates.

A two-tailed test of the hypotheses (H_0) that both survey procedures yield similar estimates was tested during 2001 (White 2003a) using the Wilcoxon Signed Ranks test (Conover 1980) The Wilcoxon test results suggested the two survey methods yield different ($\alpha \leq 0.1$) results for coho, pink, chum, and all salmon. It is not known why estimates for these species at Gastineau Hatchery are higher in our creel survey.

We have no reason to suspect the observed differences are due to biases in the onsite survey estimates, but the possibility of some bias in these estimates cannot be absolutely ruled out.

For a more detailed discussion on why the two surveys sometimes result in different results, see (White 2003a).

CONCLUSIONS AND RECOMMENDATIONS

Macaulay Hatchery plays an important role in providing fishing opportunities to residents and non-residents alike, who may be limited by time or other constraints to participate in remote roadside or marine boat fisheries. The Macaulay Hatchery roadside fishery is unique because it represents a centrally located, easily accessible area that provides concentrated angler effort and harvest near an area where salmon congregate, a hatchery fish ladder. Increased fishing opportunities are also provided by hatchery returns for marine boat anglers on both charter and non-charter vessels. Pressure on the wild stocks of salmon in the Juneau area is likely reduced due to the opportunities provided by the hatchery.

Documentation of class specific harvests at the hatchery's terminal harvest area through onsite creel surveys can be used to supplement harvest and effort information for the Juneau area provided by the SWHS and marine boat surveys.

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APPENDIX A

Appendix A1.–Summary of sampling results by date at Macaulay Hatchery in 2003.

Week	Stratum ^a	Date	Site	ANGLER COUNTS			INTERVIEW SAMPLING INFORMATION							
				No.	Mean	SD	No.	Effort	Large Chinook harvest	Small Chinook harvest	Large coho harvest	Small coho harvest	Pink harvest	Chum harvest
6/09-6/15	WD	9-Jun-03	South	6	8.83	7.19	26	36.75	2	0	0	0	0	0
6/09-6/15	WD	9-Jun-03	North	6	1.67	2.25	7	10.75	0	0	0	0	0	0
6/09-6/15	WD	10-Jun-03	South	5	11.2	3.27	18	38.5	3	0	0	0	0	0
6/09-6/15	WD	10-Jun-03	North	5	1.8	1.64	3	4.5	1	0	0	0	0	0
6/09-6/15	WE/H	14-Jun-03	South	5	5.4	6.39	15	22.5	0	0	0	0	0	0
6/09-6/15	WE/H	14-Jun-03	North	5	0	0	3	1.25	0	0	0	0	0	0
6/09-6/15	WE/H	15-Jun-03	South	5	6.2	3.63	20	34.25	4	1	0	0	0	0
6/09-6/15	WE/H	15-Jun-03	North	5	0.8	1.3	2	0.5	0	0	0	0	0	0
6/16-6/22	WD	16-Jun-03	South	6	9.17	10.32	29	57	1	0	0	0	0	0
6/16-6/22	WD	16-Jun-03	North	6	1.67	1.86	5	13.75	1	0	0	0	0	0
6/16-6/22	WD	19-Jun-03	South	5	3	2	9	17.75	0	0	0	0	0	0
6/16-6/22	WD	19-Jun-03	North	5	0.2	0.45	1	3	0	0	0	0	0	0
6/16-6/22	WE/H	21-Jun-03	South	6	5.33	3.88	22	42.75	2	0	0	2	0	0
6/16-6/22	WE/H	21-Jun-03	North	6	4.17	4.26	16	24.75	1	0	0	2	0	0
6/16-6/22	WE/H	22-Jun-03	South	5	10.4	9.1	35	66.5	0	0	0	0	0	0
6/16-6/22	WE/H	22-Jun-03	North	5	2.6	2.61	5	16	0	0	0	0	0	0
6/23-6/29	WD	25-Jun-03	South	6	3.67	2.73	16	30	0	0	0	0	0	0
6/23-6/29	WD	25-Jun-03	North	6	2.17	2.48	5	7	0	0	0	0	0	0
6/23-6/29	WD	27-Jun-03	South	6	6.67	4.72	21	30.25	9	4	0	0	0	3
6/23-6/29	WD	27-Jun-03	North	6	2.5	2.51	13	17.75	5	0	0	0	0	2
6/23-6/29	WE/H	28-Jun-03	South	5	11.6	13.22	25	58.25	6	0	0	0	0	4
6/23-6/29	WE/H	28-Jun-03	North	5	9.6	11.78	13	21.5	2	0	0	0	0	5
6/23-6/29	WE/H	29-Jun-03	South	5	14.4	8.73	29	75.75	7	1	0	0	0	6
6/23-6/29	WE/H	29-Jun-03	North	5	7.4	4.77	20	42.75	6	0	0	0	0	3
6/30-7/06	WD	30-Jun-03	South	5	7	3.32	23	42.5	17	0	0	0	0	0
6/30-7/06	WD	30-Jun-03	North	5	4.6	5.13	25	39.25	23	1	0	0	0	1
6/30-7/06	WD	2-Jul-03	South	6	5.5	1.87	15	22.25	3	0	0	0	2	3
6/30-7/06	WD	2-Jul-03	North	6	2.5	3.33	11	20.5	7	0	0	0	9	2
6/30-7/06	WE/H	5-Jul-03	South	5	11	6.44	38	102.5	11	0	0	0	7	0
6/30-7/06	WE/H	5-Jul-03	North	5	6.4	6.19	8	15.5	4	0	0	0	1	0
6/30-7/06	WE/H	6-Jul-03	South	5	12.6	8.11	39	96.75	9	2	0	0	0	5
6/30-7/06	WE/H	6-Jul-03	North	5	7.6	6.69	25	38	5	0	0	0	4	4
7/07-7/13	WD	8-Jul-03	South	6	11	4.73	34	79.5	12	0	0	0	27	13
7/07-7/13	WD	8-Jul-03	North	6	6.33	4.03	15	30	7	0	0	0	6	6
7/07-7/13	WD	9-Jul-03	South	6	11.17	5.53	22	41.75	3	0	0	0	11	9
7/07-7/13	WD	9-Jul-03	North	6	5.67	3.67	18	39.95	2	0	0	0	20	9
7/07-7/13	WE/H	12-Jul-03	South	6	15.67	9.09	47	139.75	21	1	2	1	12	32
7/07-7/13	WE/H	12-Jul-03	North	6	5.33	5.5	12	23.75	0	4	0	0	2	6
7/07-7/13	WE/H	13-Jul-03	South	6	9.67	7.97	50	91.75	6	0	2	1	14	5
7/07-7/13	WE/H	13-Jul-03	North	6	2.33	4.08	5	5	0	0	0	0	0	2
7/14-7/20	WD	14-Jul-03	South	6	8.5	6.89	32	61.79	7	1	0	0	7	2
7/14-7/20	WD	14-Jul-03	North	6	8.17	7.22	13	25.5	5	0	0	0	1	7
7/14-7/20	WD	15-Jul-03	South	6	16.17	6.88	28	67.25	13	0	0	0	7	13
7/14-7/20	WD	15-Jul-03	North	6	5.5	4.59	19	38.25	6	0	0	0	2	8
7/14-7/20	WE/H	19-Jul-03	South	6	22.67	13.75	48	131.5	24	0	3	0	9	2
7/14-7/20	WE/H	19-Jul-03	North	6	7.33	6.68	20	43.25	1	0	0	0	1	10
7/14-7/20	WE/H	20-Jul-03	South	5	13	9.41	43	73.25	15	0	0	0	8	6
7/14-7/20	WE/H	20-Jul-03	North	5	3.8	3.7	19	22	1	0	0	0	0	2
7/21-7/27	WD	22-Jul-03	South	6	14.5	7.01	41	95.75	26	0	0	0	9	11
7/21-7/27	WD	22-Jul-03	North	6	3.5	2.95	9	14.75	1	0	0	0	0	4

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INTERVIEW SAMPLING INFORMATION														
Week	Stratum ^a	Date	Site	ANGLER COUNTS			No.	Effort	Large	Small	Large	Small	Pink	Chum
				No.	Mean	SD			Chinook	Chinook	coho	coho		
				No.	Mean	SD	No.	Effort	harvest	harvest	harvest	harvest	harvest	harvest
7/21-7/27	WD	23-Jul-03	South	6	14	5.69	42	84.25	16	0	0	0	0	19
7/21-7/27	WD	23-Jul-03	North	6	4.33	6.38	19	39.25	3	0	0	0	3	13
7/21-7/27	WE/H	26-Jul-03	South	6	6	7.24	30	55.25	20	0	0	0	4	2
7/21-7/27	WE/H	26-Jul-03	North	6	2.5	5.21	6	8	4	0	0	0	0	11
7/21-7/27	WE/H	27-Jul-03	South	5	10.8	5.4	41	89.75	17	0	0	0	19	9
7/21-7/27	WE/H	27-Jul-03	North	5	8.2	10.62	24	38.25	0	0	0	0	2	25
7/28-8/03	WD	29-Jul-03	South	6	10.17	7.73	35	64	20	0	0	0	9	6
7/28-8/03	WD	29-Jul-03	North	6	1.17	2.4	10	9.25	1	0	0	0	0	7
7/28-8/03	WD	31-Jul-03	South	5	12.4	8.26	20	31.75	7	0	0	0	5	4
7/28-8/03	WD	31-Jul-03	North	5	1.8	1.79	11	9.5	0	0	0	0	8	7
7/28-8/03	WE/H	2-Aug-03	South	5	11.6	8.08	29	52	11	0	0	0	13	6
7/28-8/03	WE/H	2-Aug-03	North	5	3.8	5.22	17	23.25	2	0	0	0	7	11
7/28-8/03	WE/H	3-Aug-03	South	5	12.2	8.7	49	113	16	0	0	0	40	12
7/28-8/03	WE/H	3-Aug-03	North	5	4	3.39	11	13	2	0	0	0	7	14
8/04-8/10	WD	5-Aug-03	South	5	11.8	4.55	38	75.25	5	0	0	0	11	10
8/04-8/10	WD	5-Aug-03	North	5	3	3.74	13	20.25	1	0	0	0	18	10
8/04-8/10	WD	8-Aug-03	South	4	12.5	2.65	20	58.5	12	0	0	2	2	0
8/04-8/10	WD	8-Aug-03	North	4	5.25	1.26	23	35.5	6	0	0	0	32	6
8/04-8/10	WE/H	9-Aug-03	South	6	12.17	8.04	39	109.5	16	0	0	0	11	3
8/04-8/10	WE/H	9-Aug-03	North	6	6.83	6.74	19	25	1	0	0	0	21	4
8/04-8/10	WE/H	10-Aug-	South	5	12.6	6.15	32	55.5	4	0	0	1	8	0
8/04-8/10	WE/H	10-Aug-	North	5	3.6	3.51	10	10.7	0	0	0	0	6	0
8/11-8/17	WD	12-Aug-	South	5	9	6.16	22	29	3	0	2	1	12	2
8/11-8/17	WD	12-Aug-	North	5	2.6	2.41	10	18.25	0	0	1	1	3	0
8/11-8/17	WD	14-Aug-	South	4	3.75	1.26	13	20.25	3	0	0	1	6	0
8/11-8/17	WD	14-Aug-	North	4	1	1.15	6	11.5	0	0	0	0	11	0
8/11-8/17	WE/H	16-Aug-	South	6	8.5	5.68	32	60	5	0	11	1	0	0
8/11-8/17	WE/H	16-Aug-	North	6	0.33	0.82	6	4.5	0	0	0	0	0	0
8/11-8/17	WE/H	17-Aug-	South	6	13.83	7.33	25	49.75	4	0	19	0	3	3
8/11-8/17	WE/H	17-Aug-	North	6	6	7.56	11	26.5	2	0	7	0	0	1
8/18-8/24	WD	18-Aug-	South	6	13.17	8.33	31	93.8	3	0	29	11	5	0
8/18-8/24	WD	18-Aug-	North	6	4.33	4.68	16	22	1	0	4	3	15	3
8/18-8/24	WD	19-Aug-	South	5	10	5.34	27	65	4	0	11	24	2	0
8/18-8/24	WD	19-Aug-	North	5	7.2	6.38	14	24.5	1	0	4	4	5	0
8/18-8/24	WE/H	23-Aug-	South	5	11.4	4.39	28	68.25	0	0	9	0	5	4
8/18-8/24	WE/H	23-Aug-	North	5	4.4	2.88	13	35.25	0	0	7	0	0	2
8/18-8/24	WE/H	24-Aug-	South	5	10.2	5.36	28	70.25	1	0	12	6	3	0
8/18-8/24	WE/H	24-Aug-	North	5	6	4.06	13	21	0	0	18	0	0	0
8/25-8/31	WD	27-Aug-	South	5	6	2.12	18	47	0	0	39	0	0	0
8/25-8/31	WD	27-Aug-	North	5	2.2	1.92	5	10	0	0	8	0	0	0
8/25-8/31	WD	29-Aug-	South	6	9.67	3.01	12	47.5	0	0	28	0	3	0
8/25-8/31	WD	29-Aug-	North	6	7.33	8.94	9	23.5	0	0	26	0	0	0
8/25-8/31	WE/H	30-Aug-	South	6	7.17	4.88	20	34	0	0	59	1	0	0
8/25-8/31	WE/H	30-Aug-	North	6	4.83	4.58	29	58.5	0	0	111	0	0	0
8/25-8/31	WE/H	31-Aug-	South	6	6.67	3.56	49	85.75	0	0	152	0	0	0
8/25-8/31	WE/H	31-Aug-	North	6	10.33	6.25	18	24.5	0	0	57	0	0	0
9/01-9/07	WD	2-Sep-03	South	6	6.5	4.09	30	45.75	0	0	115	0	0	0
9/01-9/07	WD	2-Sep-03	North	6	3.33	3.27	12	12.5	0	0	30	0	0	0
9/01-9/07	WD	5-Sep-03	South	6	10.33	5.61	34	53.25	0	0	73	2	0	0
9/01-9/07	WD	5-Sep-03	North	6	3.67	5.24	10	12	0	0	21	0	0	0
9/01-9/07	WE/H	6-Sep-03	South	6	15	6.9	29	80	0	0	64	0	0	0
9/01-9/07	WE/H	6-Sep-03	North	6	12	7.18	19	28.25	0	0	23	0	0	0

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Appendix A1.–Page 3 of 3.

INTERVIEW SAMPLING INFORMATION														
Week	Stratum ^a	Date	Site	ANGLER COUNTS			INTERVIEW SAMPLING INFORMATION							
				No.	Mean	SD	No.	Effort	Large Chinook harvest	Small Chinook harvest	Large coho harvest	Small coho harvest	Pink harvest	Chum harvest
9/01-9/07	WE/H	7-Sep-03	South	6	13.83	7.31	29	44.5	0	0	78	0	0	0
9/01-9/07	WE/H	7-Sep-03	North	6	7.83	6.18	19	25.25	0	0	47	0	0	0
9/08-9/14	WD	9-Sep-03	South	6	12.17	4.49	45	63.25	0	0	191	0	0	0
9/08-9/14	WD	9-Sep-03	North	6	6.83	8.04	22	32.25	0	0	74	0	0	0
9/08-9/14	WD	10-Sep-03	South	5	11.8	3.63	15	37.25	0	0	75	0	0	0
9/08-9/14	WD	10-Sep-03	North	5	10.8	12.72	15	38.25	0	0	75	0	0	0
9/08-9/14	WE/H	13-Sep-03	South	6	12.67	5.92	20	38.75	0	0	71	0	0	0
9/08-9/14	WE/H	13-Sep-03	North	6	5.5	4.51	15	20	0	0	52	0	0	0
9/08-9/14	WE/H	14-Sep-03	South	6	15.33	8.02	35	67.75	0	0	108	0	0	0
9/08-9/14	WE/H	14-Sep-03	North	6	9.5	6.19	12	20.5	0	0	31	0	0	0
9/15-9/21	WD	17-Sep-03	South	5	6.4	3.85	17	47.75	0	0	70	0	0	0
9/15-9/21	WD	17-Sep-03	North	5	5.4	4.34	11	22.25	0	0	18	0	0	0
9/15-9/21	WD	19-Sep-03	South	6	4.17	3.06	25	52.75	0	0	59	0	0	0
9/15-9/21	WD	19-Sep-03	North	6	1.33	1.51	3	2.05	0	0	0	0	0	0
9/15-9/21	WE/H	20-Sep-03	South	6	9.67	5.32	18	27.25	0	0	36	0	0	0
9/15-9/21	WE/H	20-Sep-03	North	6	3	2.83	12	21.75	0	0	13	0	0	0
9/15-9/21	WE/H	21-Sep-03	South	6	7.67	2.73	19	47.75	0	0	37	0	0	0
9/15-9/21	WE/H	21-Sep-03	North	6	3.17	1.72	8	10	0	0	11	0	0	0
9/22-9/28	WD	23-Sep-03	South	3	6	4.36	23	35.25	0	0	57	0	0	0
9/22-9/28	WD	23-Sep-03	North	3	5.33	4.73	7	11.5	0	0	14	0	0	0
9/22-9/28	WD	25-Sep-03	South	5	6.2	1.79	11	30	0	0	35	0	0	0
9/22-9/28	WD	25-Sep-03	North	5	2	2.92	5	9.5	0	0	4	0	0	0
9/22-9/28	WE/H	27-Sep-03	South	5	6	2.35	10	15.5	0	0	22	0	0	0
9/22-9/28	WE/H	27-Sep-03	North	5	1.4	1.34	3	5	0	0	3	0	0	0
9/22-9/28	WE/H	28-Sep-03	South	5	8.8	3.77	15	28	0	0	27	0	0	0
9/22-9/28	WE/H	28-Sep-03	North	5	4.4	3.65	9	12.5	0	0	9	0	0	0
9/29-10/05	WD	30-Sep-03	South	5	9.4	5.03	25	34	0	0	75	0	0	0
9/29-10/05	WD	30-Sep-03	North	5	1.2	0.84	1	0.25	0	0	0	0	0	0
9/29-10/05	WD	3-Oct-03	South	4	3.5	0.58	4	6	0	0	0	0	0	0
9/29-10/05	WD	3-Oct-03	North	4	1.5	1.29	4	6.5	0	0	5	0	0	0
9/29-10/05	WE/H	4-Oct-03	South	6	2.17	1.47	11	14.5	0	0	0	0	0	0
9/29-10/05	WE/H	4-Oct-03	North	6	0.17	0.41	1	1	0	0	0	0	0	0
9/29-10/05	WE/H	5-Oct-03	South	6	3.83	1.33	9	12.25	0	0	9	0	0	0
9/29-10/05	WE/H	5-Oct-03	North	6	1.17	2.04	1	0.75	0	0	0	0	0	0
Totals				742			2623	5121	470	15	2253	64	458	379

^a WD = weekdays (Mondays–Fridays, except 4 July and 2 September); WE/H = weekend/holidays [Saturdays, Sundays, Independence Day (observed on 4 July) and Labor Day (2 September)]

Appendix A2.—Major computer files used for data analysis of 2003 Macaulay Hatchery roadside fishery. Custodian of data files listed below include the author and the Alaska Department of Fish and Game, Division of Research and Technical Services, Anchorage, Alaska. File archive name is “dipac_03.zip.”

File name	File type	File Description
DIPAC03	XLS	Final edited ASCII data set worksheet [sheet1] in an EXCEL spreadsheet.
DIPAC03A	SAS	SAS program to reformat data file in 2003_DIPAC.XLS
DIPAC03	SAS7BDAT	Summary subset SAS data file: count and interview data
BOWEN03A	SAS	SAS program to estimate overall effort, harvests, and associated variances
DIPAC_03_Age_eff	SAS	SAS program to estimate effort, harvest, and associated variances by age class (A, C, S, U)
DIPAC_03_RESID_eff	SAS	SAS program to estimate effort, harvest, and associated variances by residency (R, N, and U)
DIPAC_03_SA	SAS	SAS program to summarize daily estimate of effort and harvest.
DIPAC_2003_analysis	XLS	Summary of 2003 data analysis and comparison with historical data in an EXCEL spreadsheet