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Estimation of the Sockeye Salmon Escapement into McLees Lake, Unalaska Island, Alaska, 2003

Kenneth S. Gates
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Key Words: McLees Lake, sockeye salmon, *Oncorhynchus nerka*, weir, salmon escapement, Unalaska Island

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Abstract.—From May 31 to July 28, 2003, a flexible picket weir was used to collect abundance, run timing, and biological data from sockeye salmon returning to McLees Lake on Unalaska Island. A total of 101,793 sockeye *Oncorhynchus nerka*, and 19 pink *O. gorbuscha* salmon were counted through the weir. Peak weekly passage occurred between June 21 and June 27 when 29,774 (29%) sockeye salmon entered McLees Lake. The sockeye salmon return to McLees Lake during 2003 was the largest recorded to date, approximately 4% greater than that observed in 2002 (*N*=97,780) and more than twice that observed during 2001 (*N*=45,866).

Nine age groups were identified from 752 sockeye salmon sampled from the weir escapement between May 31 and July 27. This escapement was composed primarily of age 1.3 (79%) fish. Females composed an estimated 46.3% of the sampled sockeye salmon escapement.

Introduction

McLees Lake empties into Reese Bay on the north side of Unalaska Island approximately 12 miles NW of the city of Unalaska (Figure 1). This watershed provides important spawning and rearing habitat for sockeye salmon. Adult sockeye salmon returning to McLees Lake are harvested in Reese Bay by subsistence users from Unalaska. The Reese Bay subsistence fishery currently provides 85-95% of the annual sockeye harvest for this community (Shaul and Dinnocenzo 2002a) and the number of households participating in this fishery has increased in recent years (Appendix 1). Until recently, management of the fishery was limited to using aerial surveys and harvest information to assess escapement.

The escapement of sockeye salmon to McLees Lake has been monitored using aerial survey counts since 1974 (Arnie Shaul, Alaska Department of Fish and Game, personal communication). Aerial surveys have generally been limited to one survey each year and have ranged from 300 - 34,000 fish (Appendix 2). Aerial counts potentially serve as an index of abundance, but can be negatively influenced by several factors including time of survey, poor weather, lack of availability of suitable aircraft and variation among observers. No aerial surveys were conducted during some years because of one or more of these factors.

Subsistence harvests of sockeye salmon returning to McLees Lake have been monitored since 1985 (Shaul and Dinnocenzo 2002b). The estimated annual harvest in the Reese Bay subsistence fishery has ranged from 436 to 4,694 sockeye salmon (Appendix 1). During this time period the number of permits issued for this fishery has ranged from 12 to 121. Annual fluctuations in harvest have generally corresponded to the number of permits issued for the fishery. Since 1995, the average annual harvest has nearly doubled and the number of permits issued has nearly

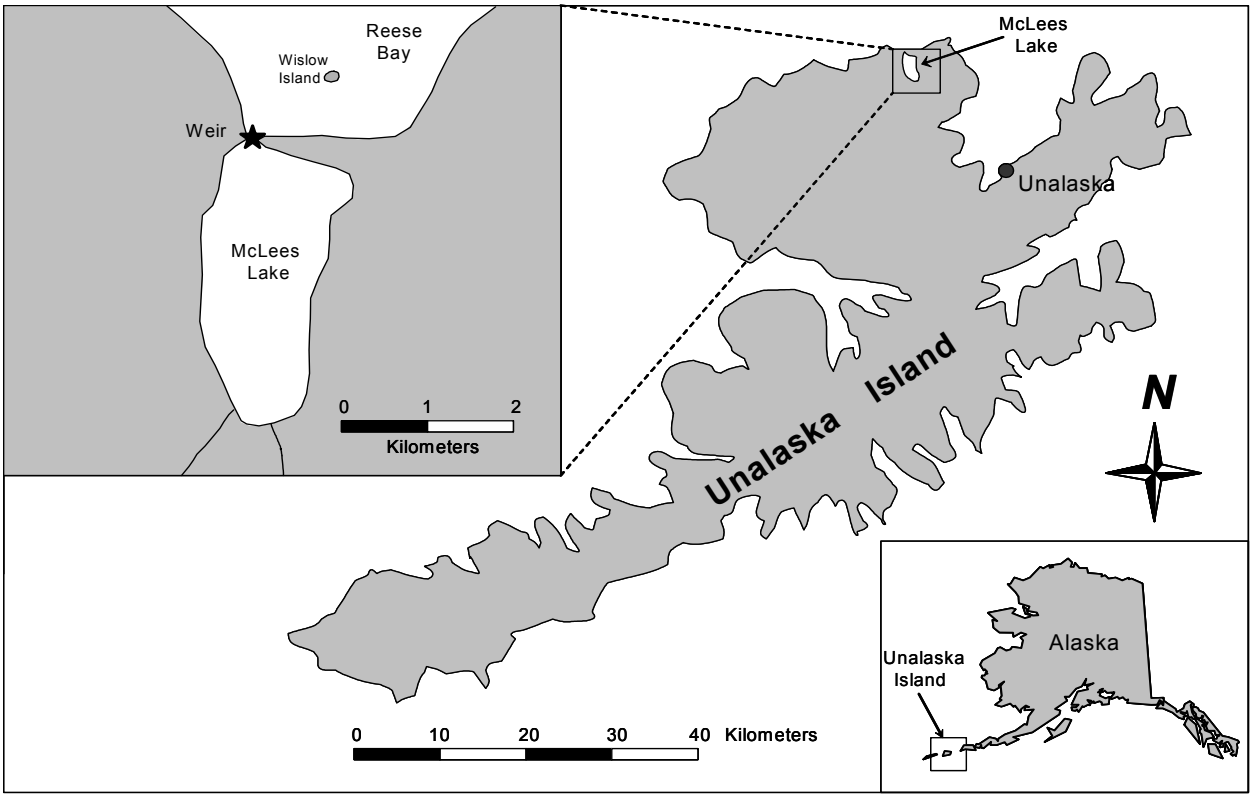

FIGURE 1.—Map of Unalaska Island showing the location of McLees Lake and the weir site.

tripled from that observed from 1985-1994. These numbers suggest that sockeye salmon returning to McLees Lake have become increasingly important to the local subsistence fishery. Local residents and the Alaska Department of Fish and Game (Department) have expressed concerns that the lack of an escapement estimate for sockeye salmon into McLees Lake may jeopardize the health of the run, as well as future opportunities for subsistence fishing. These concerns prompted the Kodiak/Aleutian Federal Regional Subsistence Advisory Council to identify an escapement monitoring project on McLees Lake as a high priority. To address these concerns, the Kenai Fish and Wildlife Field Office (Kenai FWFO) and the Qawalangin Tribe of Unalaska entered into a partnership agreement to monitor the sockeye salmon return to McLees Lake from 2001 to 2003. Specific objectives of the project were to: (1) enumerate the daily passage of sockeye salmon through a flexible picket weir; (2) describe the run-timing of sockeye salmon through the weir; (3) estimate the weekly sex and age composition of the sockeye salmon return; and, (4) estimate the mean length of sockeye salmon by sex and age. This report summarizes findings during 2003, and makes comparisons of escapements observed during all three years of weir operations.

Methods

Weir Design and Operation

A flexible picket weir spanning 21 m was installed at the outlet of McLees Lake and operated from May 31 to July 28, 2003. The weir was patterned after a design used on the Alaska Peninsula (Nick Hetrick, U.S. Fish and Wildlife Service, personal communication). Weir pickets

are electrical metal conduit with a 1.3 cm inside diameter. Picket spacing ranged from 3.5 cm for panels in shallow water near each stream bank to 2.2 cm on panels near the middle of the McLees Lake outlet channel. All pickets are 1.5 m long and strung together with 3-mm aircraft cable to make panels 3 m long (Appendix 3). A spanning cable (6-mm aircraft) was strung bank to bank and pulled tight about 0.3 m above the surface of the water. The weir panels were leaned against the cable which was supported with a single tripod in mid-channel and fence posts approximately every 3 meters (Appendix 4). A trap and holding area was constructed into the upstream side of the weir to facilitate sampling fish and passing adult salmon through the weir. The weir and sampling trap were inspected daily and maintained as needed to ensure integrity.

A staff gauge was installed 4 m downstream of the weir to measure daily water levels. Water temperatures were monitored in the outlet channel with a StowAway® TidbiT® temperature logger.

Escapement Counts

Fish were passed and counted intermittently between 0700 and 2400 hours each day. The duration of each counting session varied depending on the intensity of fish passage through the weir. Daily escapement counts were relayed to Kenai FWFO via satellite phone. Kenai FWFO provided daily escapement information to the Department in Cold Bay (via E-mail) to support in-season management of the Reese Bay subsistence fishery.

Biological Sampling

Data on fish age, sex, and length (ASL) were collected using a temporally stratified sampling design (Cochran 1977), with statistical weeks defining strata. A sample of fish was collected weekly for ASL information. Sampling typically occurred during two or three days during each statistical week in an effort to obtain a weekly sub-sample of 100 sockeye salmon.

Fish sampling consisted of measuring length, determining sex, collecting scales, and then releasing the fish upstream of the weir. Length was measured from mid-eye to fork-of-caudal-fin to the nearest 5 mm. Sex was determined by observing external characteristics. Scales were removed from the preferred area for age determination (Koo 1962; Mosher 1968). One scale was collected from each sockeye salmon.

Sample data for salmon were recorded on all-weather field forms and transferred to ASL mark-sense forms provided by the Department. Salmon scales were cleaned and properly affixed to gummed scale cards. Mark-sense forms and scale cards were completed according to Department procedures for the Alaska Peninsula/Aleutian Islands Area (Murphy 2000). At the end of the season, mark-sense forms and scale cards were forwarded to the Department in Kodiak to determine age from the scales and enter age data onto the ASL forms. The Department scanned the completed forms and provided a synopsis of the ASL data to Kenai FWFO.

Data Analysis

Age and sex composition were estimated using a stratified sampling design (Cochran 1977). Age and sex specific escapements in a stratum, $\hat{A}_{hij}$, and their variances, $V[\hat{A}_{hij}]$, were estimated as:

$$\hat{A}_{hij} = N_h \hat{p}_{hij} \tag{1}$$

and

$$\hat{V}\left[\hat{A}_{hij}\right] = N_h^2\left(1 - \frac{n_h}{N_h}\right)\left(\frac{\hat{p}_{hij}\left(1 - \hat{p}_{hij}\right)}{n_h - 1}\right) \tag{2}$$

where

N_h = total escapement of a given species during stratum h;
$\hat{p}_{hij}$ = estimated proportion of age i and sex j fish, of a given species, in the sample in stratum h; and
n_h = total number of fish, of a given species, in the sample for stratum h.

Abundance estimates and their variances for each stratum were summed to obtain age- and sex-specific escapements for the season as follows:

$$\hat{A}_{ij} = \sum \hat{A}_{hij} \tag{3}$$

and

$$\hat{V}\left[\hat{A}_{ij}\right] = \sum \hat{V}\left(\hat{A}_{hij}\right). \tag{4}$$

Results

Weir Operation

The weir was functional throughout the operational period. No holes were reported, water levels did not exceed the height of the weir, and no salmon were observed escaping through the pickets. The sampling trap was installed mid-channel and worked well throughout the sampling period and at all stage heights (Appendix 5). Water temperatures during weir operations ranged from 9.1 to 13.6 EC and averaged 11.3 EC (Appendix 5).

Biological Data

Two species of Pacific salmon, including 101,793 sockeye and 19 pink salmon, were counted upstream through the weir (Appendix 6). Sockeye salmon passed through the weir from May 31 to July 28. Peak weekly passage occurred from June 21 to June 27, 2003 when 29,774 (29%)

sockeye salmon entered McLees Lake (Figure 2; Appendix 6). During this period, counts of sockeye salmon exceeded 4,000 fish per day on four days. The largest daily count was 5,839 fish on June 25. Pink salmon were first observed on July 3 (*N*=1). Daily counts of pink salmon remained small, continued throughout the remainder of the project, and never exceeded a daily count of five fish (Appendix 6).

Nine age groups were identified from 752 of 885 sockeye salmon sampled from the weir escapement (Appendix 7). Scales were not legible from 133 sockeye salmon sampled. Age 1.3 sockeye salmon were most abundant, accounting for 79% of the escapement. Females made up an estimated 46.3% of the sockeye escapement. Lengths of sampled fish ranged from 360 to 645 mm (Appendix 8). Most of the sample was comprised of age 1.3 sockeye salmon which averaged 568 mm in length. The mean lengths of male sockeye salmon were greater than same-age females for all age groups where both sexes were represented.

Discussion

The McLees Lake weir was operated over a 3-year period from 2001 through 2003. The weir was installed by June 1 and operated into the last week of July during each year of the project except for 2001, when installation was delayed until June 15 (Figure 2).

The sockeye salmon return to McLees Lake ranged from 45,866 fish in 2001 (Palmer 2002) to 101,793 fish in 2003 (Figure 3). Numbers of fish passing the weir during 2002 (*N*=97,780) were similar to those observed during 2003 (Palmer 2003). The smaller escapement observed during 2001 was partially due to the later weir installation date. To allow comparisons of escapements among years, daily estimates of fish passage from June 1 to June 14, 2001 were estimated by calculating the average daily proportion of the run for each day missed using 2002 and 2003 escapement numbers. The total estimated escapement was calculated by dividing the total observed escapement by one minus the sum of the average daily proportions for days missed. Daily estimates were then calculated by distributing the difference between the total estimated escapement and total observed escapement according to the average daily proportion for each missed day (Figure 2; Appendix 9). Using this back-calculation, an estimated 7,303 sockeye salmon entered McLees Lake prior to weir installation during 2001. This adjustment increases the total escapement to 53,169 sockeye salmon during 2001, which is slightly more than half the number of fish observed during 2002 and 2003.

Sockeye salmon escapements to McLees Lake over the last three years have been much larger than expected based on previous aerial survey counts. Aerial surveys conducted by the Department on the McLees Lake watershed between 1974 and 2000 ranged from 300 to 11,000 fish (Appendix 2). Aerial surveys conducted during mid-August in 2001 and 2002 resulted in counts of 34,000 and 33,000 sockeye salmon, respectively (Arnie Shaul, Alaska Department of Fish and Game, personal communication). The 2003 aerial survey was delayed until September 1 because of inclement weather, but resulted in a count of 14,500 live sockeye salmon and 5,000 carcasses. This survey was conducted about two weeks later than the peak spawning period for McLees Lake sockeye and cannot be considered an accurate index of run strength during 2003. Nonetheless, the aerial index counts for 2001 and 2002 were several times larger than any aerial

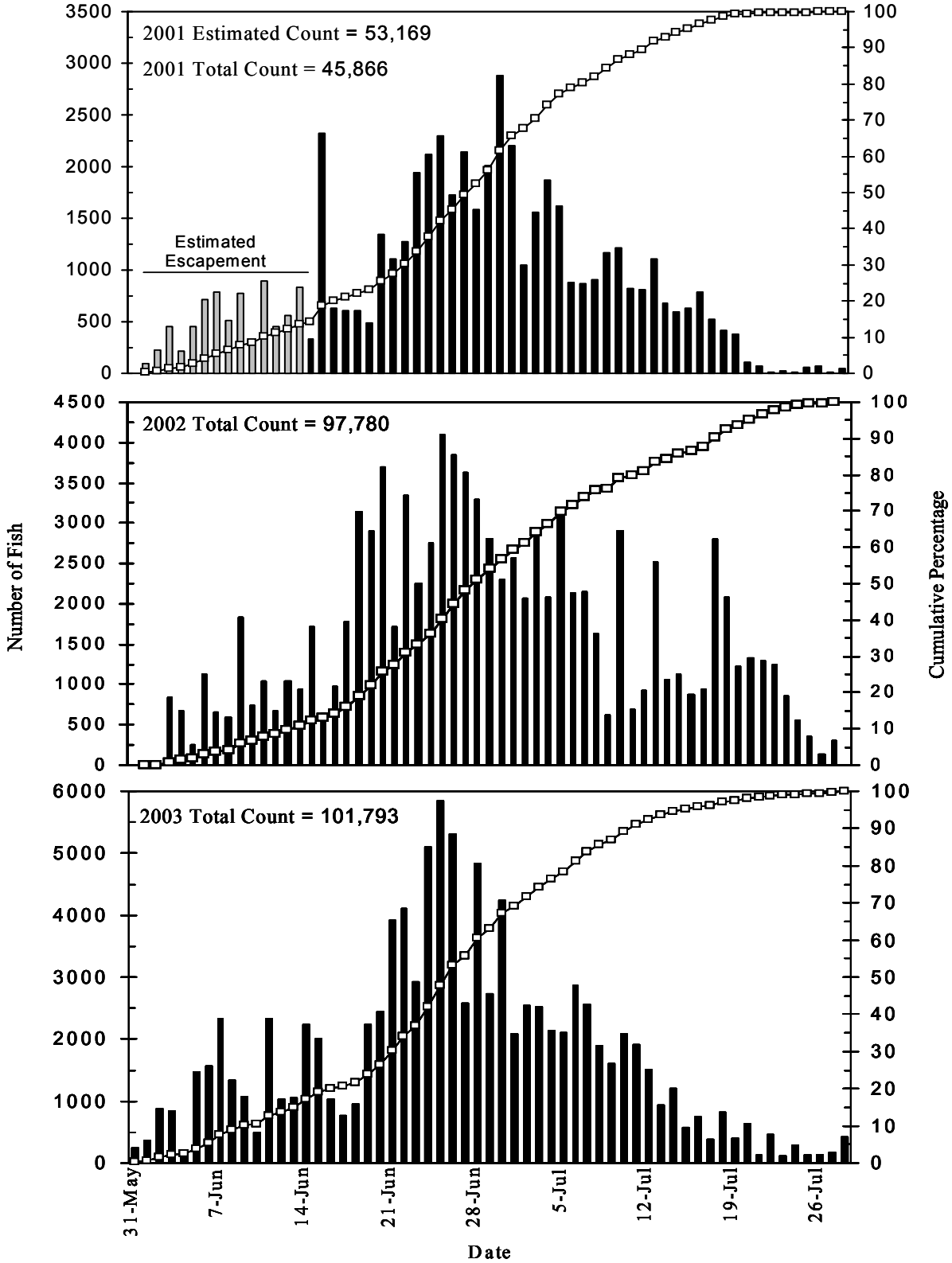

FIGURE 2.—Adult sockeye salmon counts through McLees Lake weir 2001, 2002, and 2003. Escapement for 2001 includes daily estimates between June 1 and June 14.

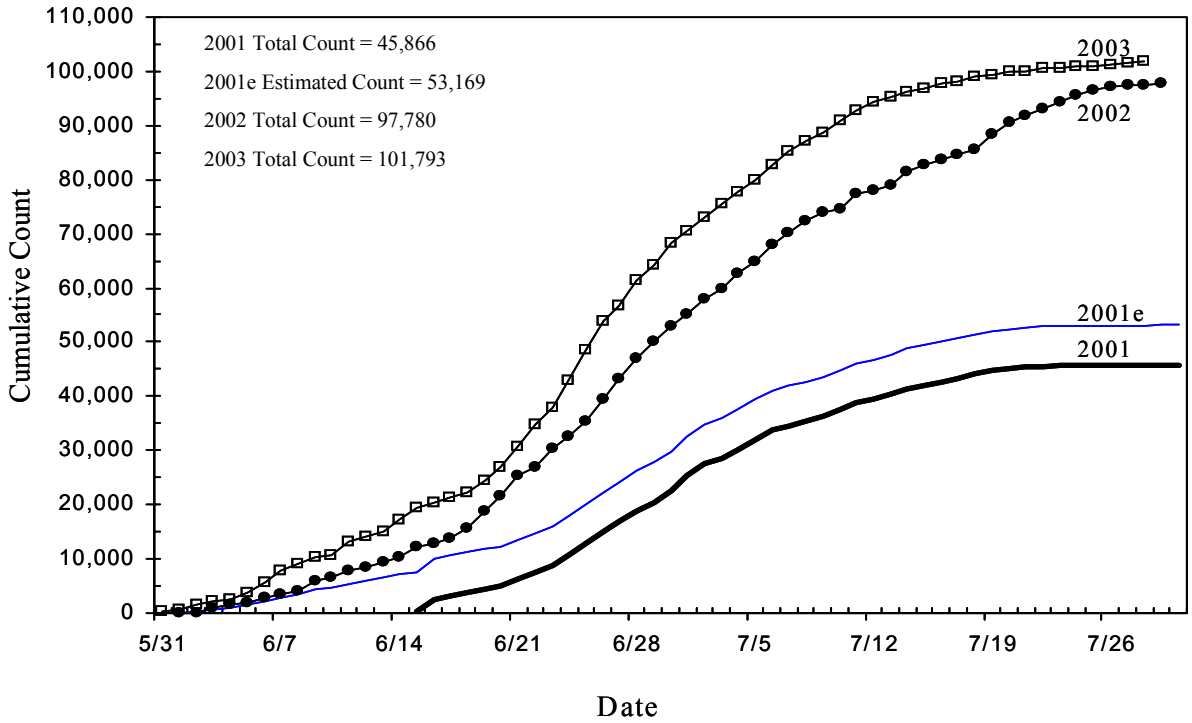

FIGURE 3.—Adult sockeye salmon cumulative counts through McLees Lake weir 2001, 2002, and 2003, where 2001e includes escapement estimates between June 1 and June 14.

count prior to 2001 suggesting that sockeye salmon escapements into McLees Lake over the last three years were much larger than any return since 1974.

The age composition of McLees Lake sockeye salmon differed among sampling years (Figure 4; Appendix 10). The escapement during 2003 was comprised of nine age classes; age 1.3 fish (79%) being the dominant age group followed by age 2.3 and 1.2 fish (10% and 8%). Age compositions during 2001 and 2002 were comprised of seven and six age classes, respectively; primarily age 1.3 fish (95%) in 2001 and age 1.2 and 1.3 fish (60% and 32%) in 2002 (Palmer 2002 and 2003). Annual variability is commonly observed in sockeye salmon populations and can be influenced by lake productivity, competition for food, predation, and ocean conditions (Burgner 1991). The estimated proportion of females in the McLees Lake escapement was similar among years ranging from 41.9% in 2001 to 46.3% in 2003.

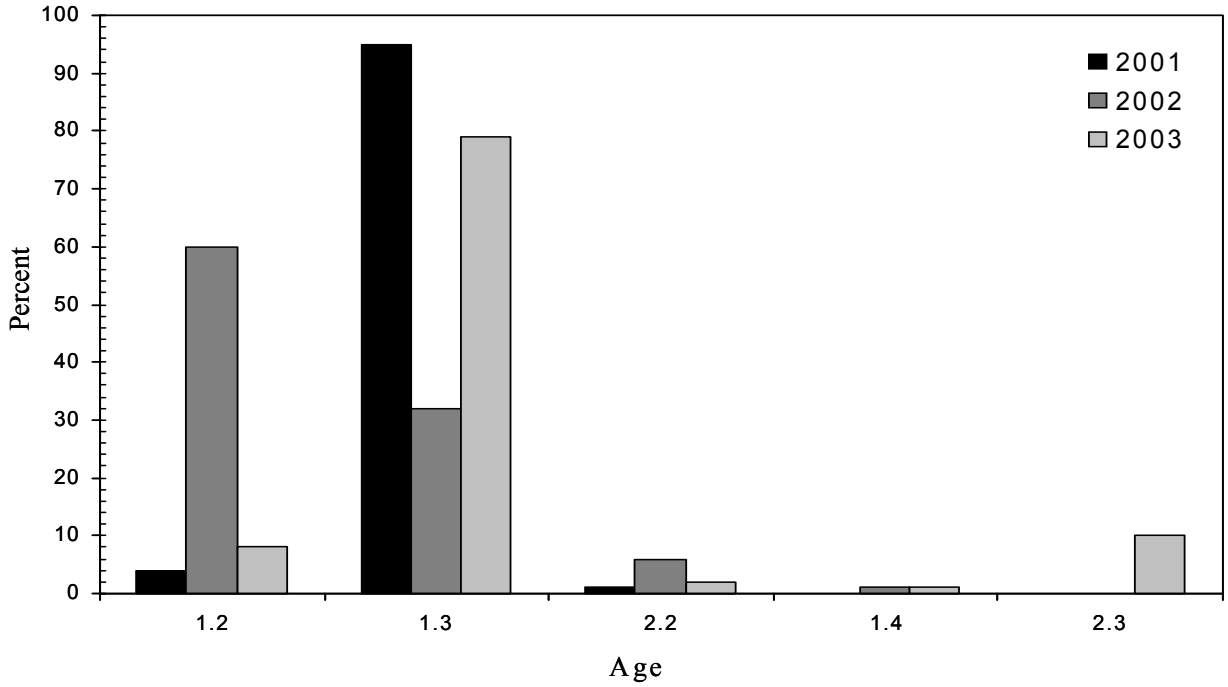

FIGURE 4.—Age compositions of sockeye salmon sampled at McLees Lake weir 2001, 2002, and 2003. Age classes composing less than 1% of the weir escapement were not included.

In conclusion, sockeye salmon escapements to McLees Lake over the last three years have been very strong. Based on aerial survey and weir counts, sockeye salmon returns observed from 2001 to 2003 could be the largest escapements returning to McLees Lake in the past 30 years. Although we have observed three years with large escapements, the trend in aerial index counts suggests that much smaller escapements were prevalent at McLees Lake from 1974-2000. Continued monitoring with a weir would be useful in defining any cyclical trend in abundance that could not be detected over a 3-year period.

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We also appreciate the assistance of the Alaska Department of Fish and Game. Forrest Bowers, local area management biologist with the Department, provided a skiff and personnel to transport groceries and supplies from Dutch Harbor to the weir site during June and July. The Department also provided bunkhouse space for the crew in Dutch Harbor at the beginning and end of field operations. Thanks are also extended to Matt Foster and Patti Nelson with the Department in Kodiak for scale sample analysis.

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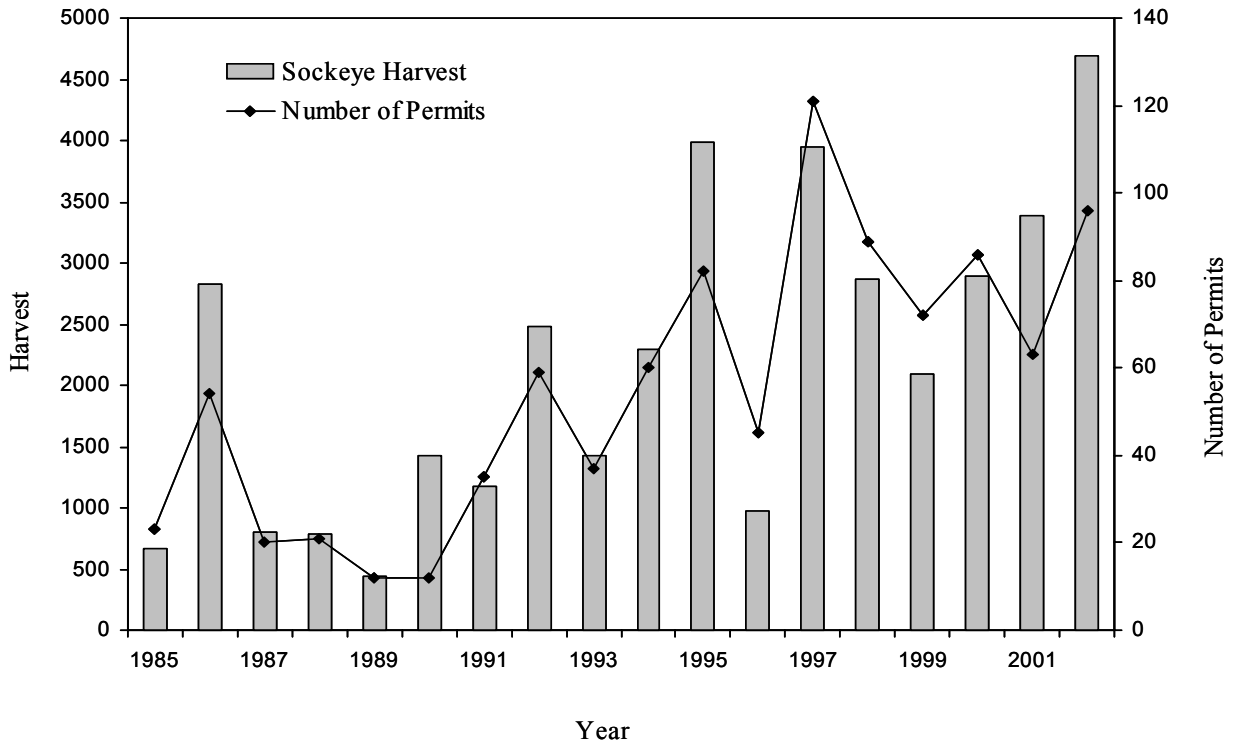
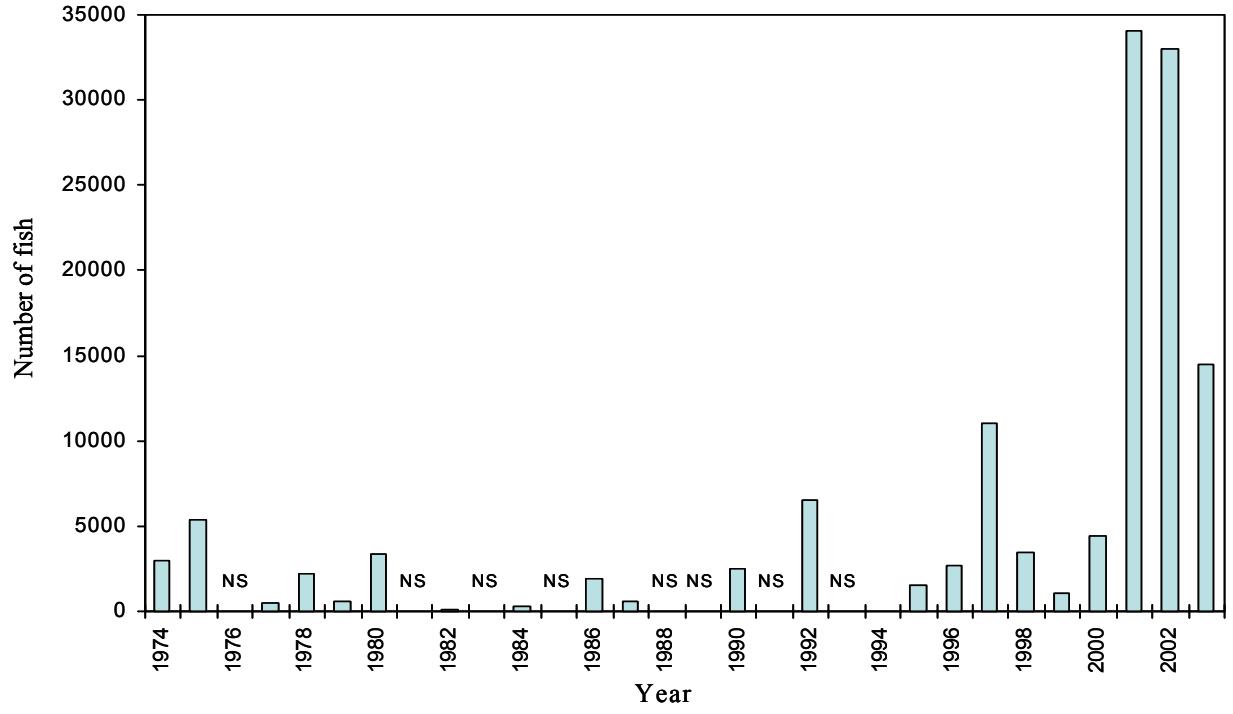
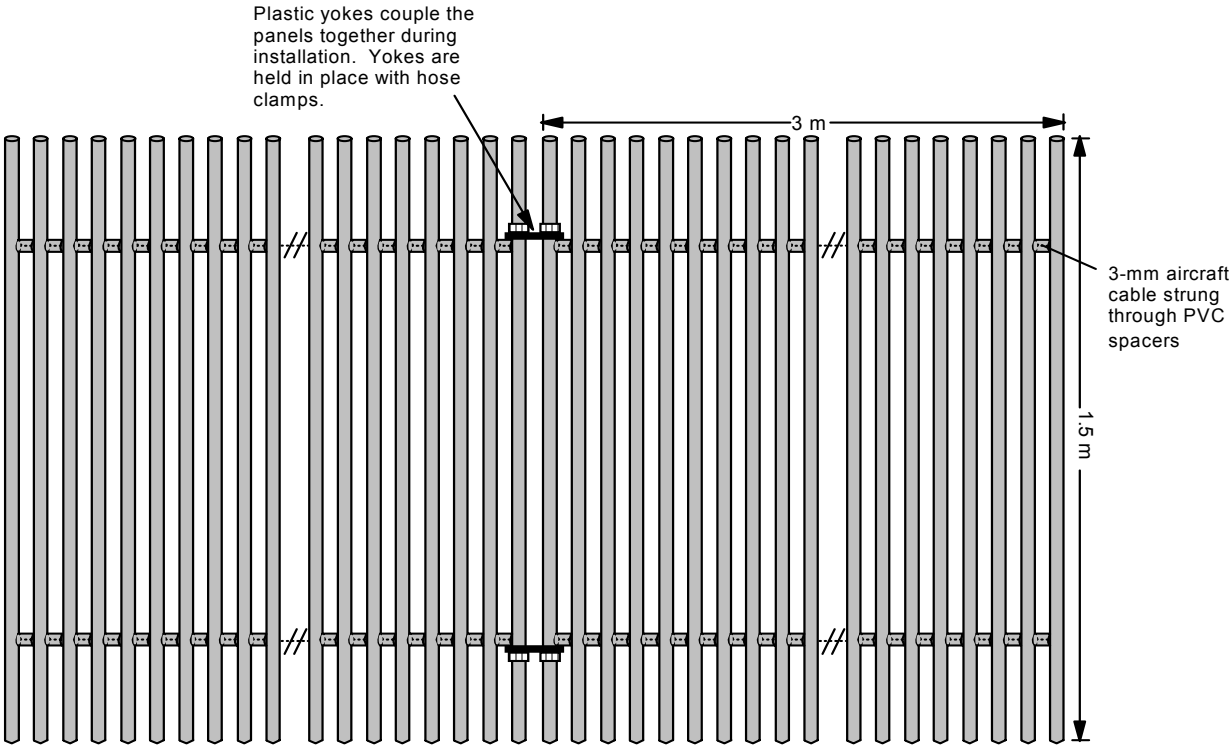


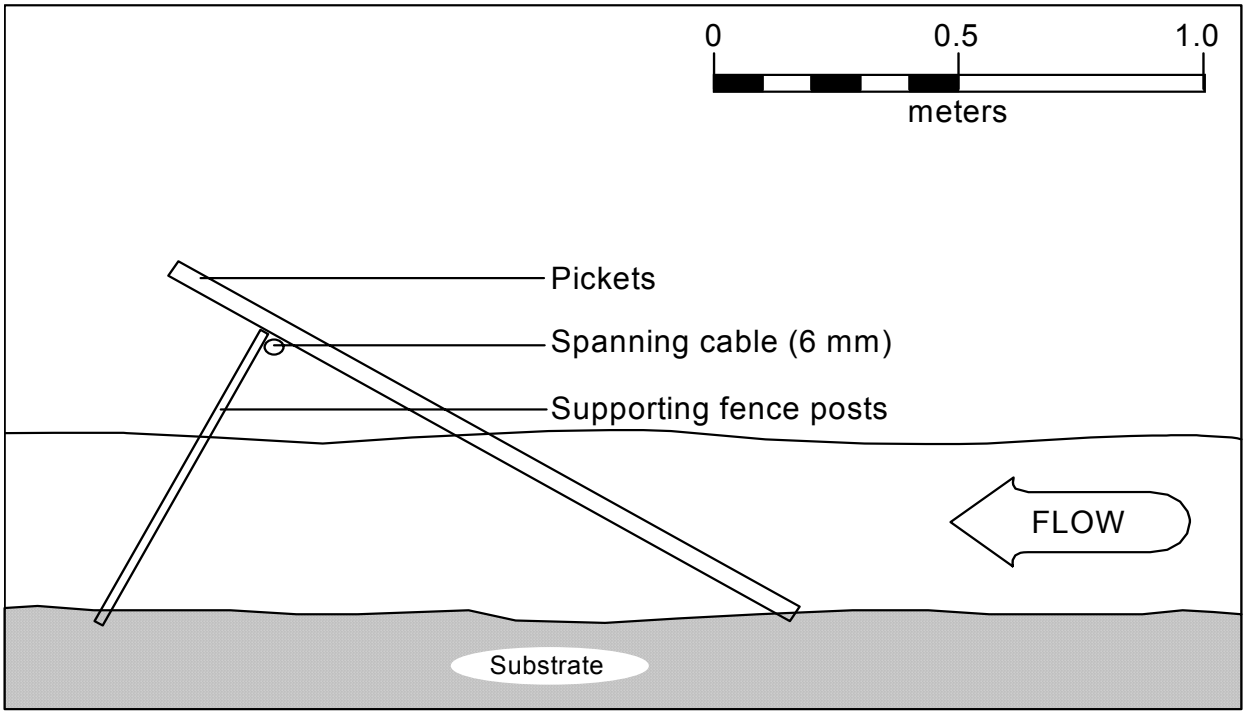
APPENDIX 1.—Estimated harvest of sockeye salmon and number of permits issued for the Reese Bay subsistence fishery 1985-2002 (Shaul and Dinnocenzo 2002a).



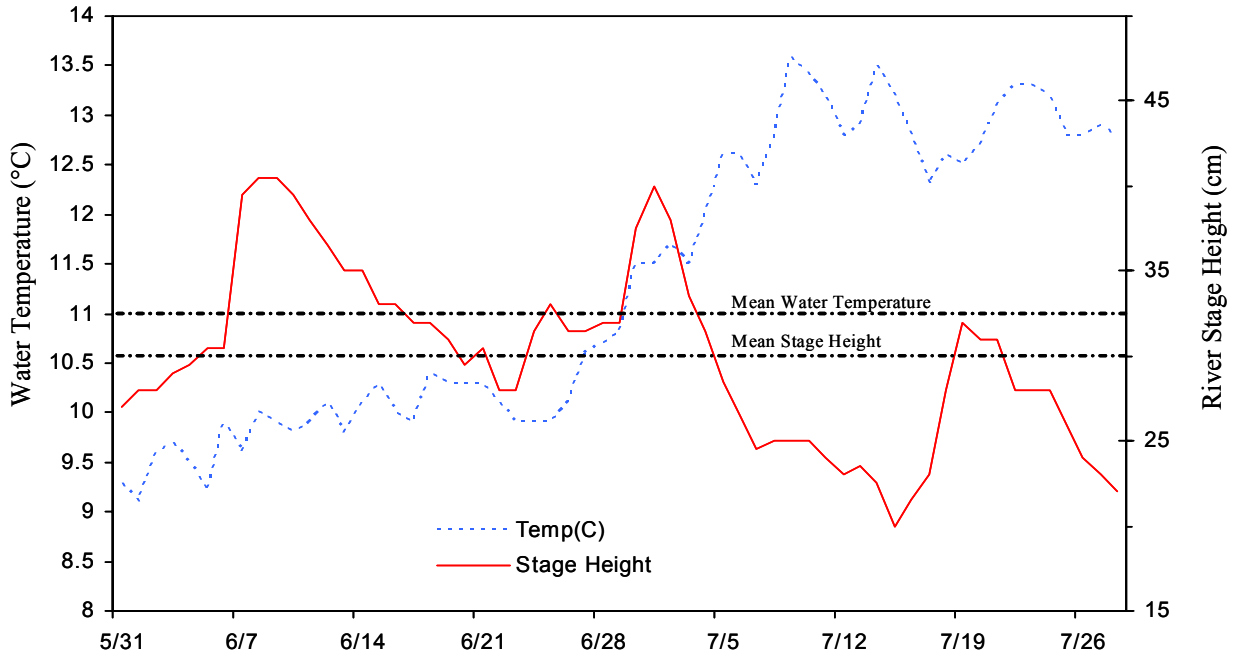
APPENDIX 2.—Aerial index escapement counts of sockeye salmon for the McLees Lake watershed, 1974-2003. NS denotes years when no survey was conducted.



APPENDIX 3.—Weir panels with pickets constructed from electrical metal conduit with a 1.3 cm inside diameter and strung together with 3-mm aircraft cable.



APPENDIX 4.—Lateral view of an installed weir panel. Spanning cable is anchored to both banks and pulled tight so it does not sag into the water. Fence posts and one tripod support the cable so the weight of the weir does not cause the panels to submerge.



APPENDIX 5.—Water temperature and river stage height at the McLees Lake weir, Unalaska Island, 2003.

APPENDIX 6.—Daily counts, cumulative counts, and cumulative proportion of sockeye and pink salmon escapements through McLees Lake weir, 2003. Boxed areas encompass the second quartile, median, and third quartile of the sockeye salmon escapement.

	Sockeye Salmon			Pink Salmon		
	Daily	Cumulative		Daily	Cumulative	
Date	Count	Count	Proportion	Count	Count	Proportion
5/31	254	254	0.002	0	0	0.000
6/1	365	619	0.006	0	0	0.000
6/2	879	1498	0.015	0	0	0.000
6/3	837	2335	0.023	0	0	0.000
6/4	116	2451	0.024	0	0	0.000
6/5	1465	3916	0.038	0	0	0.000
6/6	1574	5490	0.054	0	0	0.000
6/7	2338	7828	0.077	0	0	0.000
6/8	1338	9166	0.090	0	0	0.000
6/9	1070	10236	0.101	0	0	0.000
6/10	491	10727	0.105	0	0	0.000
6/11	2328	13055	0.128	0	0	0.000
6/12	1040	14095	0.138	0	0	0.000
6/13	1053	15148	0.149	0	0	0.000
6/14	2229	17377	0.171	0	0	0.000
6/15	2007	19384	0.190	0	0	0.000
6/16	1025	20409	0.200	0	0	0.000
6/17	770	21179	0.208	0	0	0.000
6/18	963	22142	0.218	0	0	0.000
6/19	2237	24379	0.239	0	0	0.000
6/20	2452	26831	0.264	0	0	0.000
6/21	3920	30751	0.302	0	0	0.000
6/22	4105	34856	0.342	0	0	0.000
6/23	2931	37787	0.371	0	0	0.000
6/24	5100	42887	0.421	0	0	0.000
6/25	5839	48726	0.479	0	0	0.000
6/26	5303	54029	0.531	0	0	0.000
6/27	2576	56605	0.556	0	0	0.000
6/28	4830	61435	0.604	0	0	0.000
6/29	2727	64162	0.630	0	0	0.000
6/30	4251	68413	0.672	0	0	0.000
7/1	2074	70487	0.692	0	0	0.000
7/2	2549	73036	0.717	0	0	0.000
7/3	2531	75567	0.742	1	1	0.053
7/4	2140	77707	0.763	0	1	0.053
7/5	2097	79804	0.784	0	1	0.053
7/6	2864	82668	0.812	0	1	0.053
7/7	2555	85223	0.837	0	1	0.053
7/8	1887	87110	0.856	0	1	0.053
7/9	1602	88712	0.871	0	1	0.053
7/10	2078	90790	0.892	0	1	0.053
7/11	1902	92692	0.911	1	2	0.105
7/12	1516	94208	0.925	0	2	0.105
7/13	944	95152	0.935	0	2	0.105
7/14	1196	96348	0.947	0	2	0.105
7/15	578	96926	0.952	0	2	0.105
7/16	752	97678	0.960	0	2	0.105
7/17	390	98068	0.963	0	2	0.105
7/18	830	98898	0.972	0	2	0.105
7/19	407	99305	0.976	0	2	0.105
7/20	627	99932	0.982	3	5	0.263
7/21	132	100064	0.983	1	6	0.316
7/22	464	100528	0.988	5	11	0.579
7/23	124	100652	0.989	1	12	0.632
7/24	281	100933	0.992	1	13	0.684
7/25	135	101068	0.993	0	13	0.684
7/26	133	101201	0.994	0	13	0.684
7/27	181	101382	0.996	3	16	0.842
7/28	411	101793	1.000	3	19	1.000

APPENDIX 7.—Estimated age and sex composition of weekly sockeye salmon escapements through the McLees Lake weir during 2003.

		Brood Year and Age Group									
		2000	1999	1998		1997			1996		
		1.1	1.2	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Total
Stratum 1:	5/31-06/06										
Sampling Dates:	05/31,06/02,06/04,06/05& 06/06										
Female:	Number in Sample:	0	2	33	0	0	3	0	0	0	38
	Estimated % of Escapement:	0.0	2.4	39.3	0.0	0.0	3.6	0.0	0.0	0.0	45.2
	Estimated Escapement:	0	131	2,157	0	0	196	0	0	0	2,484
	Standard Error:	0.0	91.2	292.0	0.0	0.0	111.0	0.0	0.0	0.0	
Male:	Number in Sample:	0	2	40	0	0	4	0	0	0	46
	Estimated % of Escapement:	0.0	2.4	47.6	0.0	0.0	4.8	0.0	0.0	0.0	54.8
	Estimated Escapement:	0	131	2,614	0	0	261	0	0	0	3,006
	Standard Error:	0.0	91.2	298.6	0.0	0.0	127.3	0.0	0.0	0.0	
Total:	Number in Sample:	0	4	73	0	0	7	0	0	0	84
	Estimated % of Escapement:	0.0	4.8	86.9	0.0	0.0	8.3	0.0	0.0	0.0	100.0
	Estimated Escapement:	0	261	4,771	0	0	458	0	0	0	5,490
	Standard Error:	0.0	127.3	201.7	0.0	0.0	165.3	0.0	0.0	0.0	
Stratum 2:	06/07-06/13										
Sampling Dates:	06/9 & 06/11										
Female:	Number in Sample:	0	2	36	0	0	2	0	0	0	40
	Estimated % of Escapement:	0.0	2.3	41.4	0.0	0.0	2.3	0.0	0.0	0.0	46.0
	Estimated Escapement:	0	222	3,996	0	0	222	0	0	0	4,440
	Standard Error:	0.0	155.4	510.6	0.0	0.0	155.4	0.0	0.0	0.0	
Male:	Number in Sample:	0	2	38	0	0	7	0	0	0	47
	Estimated % of Escapement:	0.0	2.3	43.7	0.0	0.0	8.0	0.0	0.0	0.0	54.0
	Estimated Escapement:	0	222	4,218	0	0	777	0	0	0	5,218
	Standard Error:	0.0	155.4	514.2	0.0	0.0	282.0	0.0	0.0	0.0	
Total:	Number in Sample:	0	4	74	0	0	9	0	0	0	87
	Estimated % of Escapement:	0.0	4.6	85.1	0.0	0.0	10.3	0.0	0.0	0.0	100.0
	Estimated Escapement:	0	444	8,215	0	0	999	0	0	0	9,658
	Standard Error:	0.0	217.1	369.6	0.0	0.0	315.7	0.0	0.0	0.0	
Stratum 3:	06/14-06/20										
Sampling Dates:	06/17, 06/18 & 06/20										
Female:	Number in Sample:	0	2	36	0	0	4	0	0	0	42
	Estimated % of Escapement:	0.0	2.2	38.7	0.0	0.0	4.3	0.0	0.0	0.0	45.2
	Estimated Escapement:	0	251	4,522	0	0	502	0	0	0	5,276
	Standard Error:	0.0	176.0	590.9	0.0	0.0	246.1	0.0	0.0	0.0	
Male:	Number in Sample:	0	1	44	1	0	5	0	0	0	51
	Estimated % of Escapement:	0.0	1.1	47.3	1.1	0.0	5.4	0.0	0.0	0.0	54.8
	Estimated Escapement:	0	126	5,527	126	0	628	0	0	0	6,407
	Standard Error:	0.0	125.1	605.7	125.1	0.0	273.6	0.0	0.0	0.0	
Total:	Number in Sample:	0	3	80	1	0	9	0	0	0	93
	Estimated % of Escapement:	0.0	3.2	86.0	1.1	0.0	9.7	0.0	0.0	0.0	100.0
	Estimated Escapement:	0	377	10,050	126	0	1,131	0	0	0	11,683
	Standard Error:	0.0	214.4	420.7	125.1	0.0	358.7	0.0	0.0	0.0	

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		Brood Year and Age Group									
		2000	1999	1998		1997			1996		
		1.1	1.2	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Total
Stratum 4:	06/21-06-27										
Sampling Dates:	06/24, 06/25 & 06/27										
Female:	Number in Sample:	0	4	35	0	0	9	0	1	0	49
	Estimated % of Escapement:	0.0	3.7	32.4	0.0	0.0	8.3	0.0	0.9	0.0	45.4
	Estimated Escapement:	0	1,103	9,649	0	0	2,481	0	276	0	13,509
	Standard Error:	0.0	542.6	1,344.7	0.0	0.0	794.1	0.0	275.2	0.0	
Male:	Number in Sample:	0	3	53	1	1	1	0	0	0	59
	Estimated % of Escapement:	0.0	2.8	49.1	0.9	0.9	0.9	0.0	0.0	0.0	54.6
	Estimated Escapement:	0	827	14,611	276	276	276	0	0	0	16,265
	Standard Error:	0.0	472.2	1,436.3	275.2	275.2	275.2	0.0	0.0	0.0	
Total:	Number in Sample:	0	7	88	1	1	10	0	1	0	108
	Estimated % of Escapement:	0.0	6.5	81.5	0.9	0.9	9.3	0.0	0.9	0.0	100.0
	Estimated Escapement:	0	1,930	24,260	276	276	2,757	0	276	0	29,774
	Standard Error:	0.0	707.4	1,116.1	275.2	275.2	832.8	0.0	275.2	0.0	
Stratum 5:	06/28-07/04										
Sampling Dates:	07/01, 07/02 & 07/03										
Female:	Number in Sample:	0	3	31	2	0	6	0	0	0	42
	Estimated % of Escapement:	0.0	3.2	33.3	2.2	0.0	6.5	0.0	0.0	0.0	45.2
	Estimated Escapement:	0	681	7,034	454	0	1,361	0	0	0	9,530
	Standard Error:	0.0	387.9	1,034.8	318.4	0.0	539.3	0.0	0.0	0.0	
Male:	Number in Sample:	0	4	40	1	0	5	0	0	1	51
	Estimated % of Escapement:	0.0	4.3	43.0	1.1	0.0	5.4	0.0	0.0	1.1	54.8
	Estimated Escapement:	0	908	9,076	227	0	1,135	0	0	227	11,572
	Standard Error:	0.0	445.4	1,086.8	226.4	0.0	495.1	0.0	0.0	226.4	
Total:	Number in Sample:	0	7	71	3	0	11	0	0	1	93
	Estimated % of Escapement:	0.0	7.5	76.3	3.2	0.0	11.8	0.0	0.0	1.1	100.0
	Estimated Escapement:	0	1,588	16,110	681	0	2,496	0	0	227	21,102
	Standard Error:	0.0	579.1	932.9	387.9	0.0	708.9	0.0	0.0	226.4	
Stratum 6:	07/05-07/11										
Sampling Dates:	07/05, 07/09 & 07/11										
Female:	Number in Sample:	2	5	29	2	0	4	0	0	0	42
	Estimated % of Escapement:	2.4	6.0	34.9	2.4	0.0	4.8	0.0	0.0	0.0	50.6
	Estimated Escapement:	361	903	5,236	361	0	722	0	0	0	7,583
	Standard Error:	253.1	392.6	786.8	253.1	0.0	353.4	0.0	0.0	0.0	
Male:	Number in Sample:	0	4	30	1	1	5	0	0	0	41
	Estimated % of Escapement:	0.0	4.8	36.1	1.2	1.2	6.0	0.0	0.0	0.0	49.4
	Estimated Escapement:	0	722	5,416	181	181	903	0	0	0	7,402
	Standard Error:	0.0	353.4	792.8	180.0	180.0	392.6	0.0	0.0	0.0	
Total:	Number in Sample:	2	9	59	3	1	9	0	0	0	83
	Estimated % of Escapement:	2.4	10.8	71.1	3.6	1.2	10.8	0.0	0.0	0.0	100.0
	Estimated Escapement:	361	1,625	10,652	542	181	1,625	0	0	0	14,985
	Standard Error:	253.1	513.1	748.2	308.0	180.0	513.1	0.0	0.0	0.0	

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		Brood Year and Age Group									
		2000	1999	1998		1997			1996		
		1.1	1.2	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Total
Stratum 7:	07/12-07/18										
Sampling Dates:	07/13, 07/14, 07/17, 07/18										
Female:	Number in Sample:	0	5	30	2	0	4	0	0	0	41
	Estimated % of Escapement:	0.0	5.7	34.1	2.3	0.0	4.5	0.0	0.0	0.0	46.6
	Estimated Escapement:	0	353	2,116	141	0	282	0	0	0	2,891
	Standard Error:	0.0	152.9	313.1	98.5	0.0	137.6	0.0	0.0	0.0	
Male:	Number in Sample:	0	12	31	1	1	1	1	0	0	47
	Estimated % of Escapement:	0.0	13.6	35.2	1.1	1.1	1.1	1.1	0.0	0.0	53.4
	Estimated Escapement:	0	846	2,186	71	71	71	71	0	0	3,315
	Standard Error:	0.0	226.7	315.6	70.0	70.0	70.0	70.0	0.0	0.0	
Total:	Number in Sample:	0	17	61	3	1	5	1	0	0	88
	Estimated % of Escapement:	0.0	19.3	69.3	3.4	1.1	5.7	1.1	0.0	0.0	100.0
	Estimated Escapement:	0	1,199	4,302	212	71	353	71	0	0	6,206
	Standard Error:	0.0	260.8	304.7	119.9	70.0	152.9	70.0	0.0	0.0	
Stratum 8:	07/19-07/25										
Sampling Dates:	07/20, 07/21 & 07/24										
Female:	Number in Sample:	0	13	18	4	0	2	0	0	1	38
	Estimated % of Escapement:	0.0	15.9	22.0	4.9	0.0	2.4	0.0	0.0	1.2	46.3
	Estimated Escapement:	0	344	476	106	0	53	0	0	26	1,006
	Standard Error:	0.0	86.4	97.9	50.9	0.0	36.5	0.0	0.0	26.0	
Male:	Number in Sample:	3	6	26	1	0	7	0	0	1	44
	Estimated % of Escapement:	3.7	7.3	31.7	1.2	0.0	8.5	0.0	0.0	1.2	53.7
	Estimated Escapement:	79	159	688	26	0	185	0	0	26	1,164
	Standard Error:	44.4	61.6	110.1	26.0	0.0	66.1	0.0	0.0	26.0	
Total:	Number in Sample:	3	19	44	5	0	9	0	0	2	82
	Estimated % of Escapement:	3.7	23.2	53.7	6.1	0.0	11.0	0.0	0.0	2.4	100.0
	Estimated Escapement:	79	503	1,164	132	0	238	0	0	53	2,170
	Standard Error:	44.4	99.8	117.9	56.6	0.0	73.9	0.0	0.0	36.5	
Stratum 9:	07/26-07/28										
Sampling Dates:	07/27										
Female:	Number in Sample:	0	6	9	0	1	1	0	0	0	17
	Estimated % of Escapement:	0.0	17.6	26.5	0.0	2.9	2.9	0.0	0.0	0.0	50.0
	Estimated Escapement:	0	128	192	0	21	21	0	0	0	363
	Standard Error:	0.0	47.0	54.4	0.0	20.8	20.8	0.0	0.0	0.0	
Male:	Number in Sample:	0	7	9	1	0	0	0	0	0	17
	Estimated % of Escapement:	0.0	20.6	26.5	2.9	0.0	0.0	0.0	0.0	0.0	50.0
	Estimated Escapement:	0	149	192	21	0	0	0	0	0	363
	Standard Error:	0.0	49.8	54.4	20.8	0.0	0.0	0.0	0.0	0.0	
Total:	Number in Sample:	0	13	18	1	1	1	0	0	0	34
	Estimated % of Escapement:	0.0	38.2	52.9	2.9	2.9	2.9	0.0	0.0	0.0	100.0
	Estimated Escapement:	0	277	384	21	21	21	0	0	0	725
	Standard Error:	0.0	59.9	61.5	20.8	20.8	20.8	0.0	0.0	0.0	

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		Brood Year and Age Group									
		2000	1999	1998		1997			1996		
		1.1	1.2	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Total
Strata 1 - 9:	5/31-7/28										
Female:	Number in Sample:	2	42	257	10	1	35	0	1	1	349
	% Females in Age Group:	0.8	8.7	75.1	2.3	0.0	12.4	0.0	0.6	0.1	100.0
	Estimated % of Escapement:	0.4	4.0	34.8	1.0	0.0	5.7	0.0	0.3	0.0	46.3
	Estimated Escapement:	361	4,115	35,378	1,062	21	5,842	0	276	26	47,081
	Standard Error:	253.1	834.0	2,074.6	421.6	20.8	1,078.9	0.0	275.2	26.0	
Male:	Number in Sample:	3	41	311	7	3	35	1	0	2	403
	% Males in Age Group:	0.1	7.5	81.4	1.7	1.0	7.7	0.1	0.0	0.5	100.0
	Estimated % of Escapement:	0.1	4.0	43.7	0.9	0.5	4.2	0.1	0.0	0.2	53.7
	Estimated Escapement:	79	4,090	44,530	927	527	4,235	71	0	253	54,712
	Standard Error:	44.4	807.5	2,169.8	425.5	336.2	809.3	70.0	0.0	227.9	
Total:	Number in Sample:	5	83	568	17	4	70	1	1	3	752
	Estimated % of Escapement:	0.4	8.1	78.5	2.0	0.5	9.9	0.1	0.3	0.3	100.0
	Estimated Escapement:	440	8,204	79,908	1,989	548	10,077	71	276	280	101,793
	Standard Error:	256.9	1,135.7	1,772.1	595.6	336.9	1,320.7	70.0	275.2	229.3	

APPENDIX 8.—Length (mm) at age for sockeye salmon at McLees Lake weir, 2003.

	Age									
	1.1	1.2	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Total
Females										
Mean Length	368	499	556	501	560	556	-	590	545	545
SE	8	3	1	6	-	3	-	-	-	2
Range	360-375	455-545	495-595	470-540	-	510-590	-	-	-	360-600
Sample Size	2	42	257	10	1	33	-	1	1	413[a]
Male										
Mean Length	388	525	578	549	587	577	490	-	570	570
SE	9	3	1	9	27	4	-	-	-	2
Range	370-400	495-585	515-645	515-575	555-640	505-630	-	-	-	370-645
Sample Size	3	41	311	7	3	38	1	-	1	471[a]
All Fish										
Mean Length	380	512	568	521	580	567	490	590	548	558
SE	8	3	1	8	20	3	-	-	12	1
Range	360-400	455-585	495-645	470-575	555-640	505-630	-	-	530-570	360-645
Sample Size	5	83	568	17	4	71	1	1	3	884[a]

[a] Includes fish that did not have an age association.

APPENDIX 9.— Daily counts, cumulative counts, and cumulative proportion of sockeye salmon passing McLees Lake weir 2001 through 2003. Shaded areas are daily estimates for days missed between June 1 and June 14, 2001. Estimated escapement is represented by 2001e and boxed areas encompass the second quartile, median, and third quartile of the sockeye salmon escapement.

	Daily Counts				Daily Cumulative				Daily Cumulative Proportion			
Date	2001	2001e	2002	2003	2001	2001e	2002	2003	2001	2001e	2002	2003
5/31				254				254				0.002
6/1		95	0	365		95	0	619		0.002	0.000	0.006
6/2		230	0	879		325	0	1498		0.006	0.000	0.015
6/3		447	840	837		772	840	2335		0.015	0.009	0.023
6/4		215	678	116		987	1518	2451		0.019	0.016	0.024
6/5		452	257	1465		1439	1775	3916		0.027	0.018	0.038
6/6		718	1130	1574		2157	2905	5490		0.041	0.030	0.054
6/7		791	662	2338		2948	3567	7828		0.055	0.036	0.077
6/8		508	582	1338		3456	4149	9166		0.065	0.042	0.090
6/9		778	1835	1070		4234	5984	10236		0.080	0.061	0.101
6/10		331	747	491		4565	6731	10727		0.086	0.069	0.105
6/11		890	1037	2328		5455	7768	13055		0.103	0.079	0.128
6/12		454	670	1040		5909	8438	14095		0.111	0.086	0.138
6/13		557	1037	1053		6466	9475	15148		0.122	0.097	0.149
6/14		837	939	2229		7303	10414	17377		0.137	0.107	0.171
6/15	331	331	1713	2007	331	7634	12127	19384	0.007	0.144	0.124	0.190
6/16	2321	2321	635	1025	2652	9955	12762	20409	0.058	0.187	0.131	0.200
6/17	626	626	976	770	3278	10581	13738	21179	0.071	0.199	0.140	0.208
6/18	603	603	1776	963	3881	11184	15514	22142	0.085	0.210	0.159	0.218
6/19	613	613	3143	2237	4494	11797	18657	24379	0.098	0.222	0.191	0.239
6/20	488	488	2907	2452	4982	12285	21564	26831	0.109	0.231	0.221	0.264
6/21	1347	1347	3701	3920	6329	13632	25265	30751	0.138	0.256	0.258	0.302
6/22	1106	1106	1712	4105	7435	14738	26977	34856	0.162	0.277	0.276	0.342
6/23	1270	1270	3346	2931	8705	16008	30323	37787	0.190	0.301	0.310	0.371
6/24	1938	1938	2254	5100	10643	17946	32577	42887	0.232	0.338	0.333	0.421
6/25	2118	2118	2748	5839	12761	20064	35325	48726	0.278	0.377	0.361	0.479
6/26	2301	2301	4093	5303	15062	22365	39418	54029	0.328	0.421	0.403	0.531
6/27	1729	1729	3852	2576	16791	24094	43270	56605	0.366	0.453	0.443	0.556
6/28	2138	2138	3620	4830	18929	26232	46890	61435	0.413	0.493	0.480	0.604
6/29	1585	1585	3298	2727	20514	27817	50188	64162	0.447	0.523	0.513	0.630
6/30	2008	2008	2802	4251	22522	29825	52990	68413	0.491	0.561	0.542	0.672
7/1	2876	2876	2308	2074	25398	32701	55298	70487	0.554	0.615	0.566	0.692
7/2	2200	2200	2565	2549	27598	34901	57863	73036	0.602	0.656	0.592	0.717
7/3	1046	1046	2058	2531	28644	35947	59921	75567	0.625	0.676	0.613	0.742
7/4	1558	1558	2882	2140	30202	37505	62803	77707	0.658	0.705	0.642	0.763
7/5	1872	1872	2080	2097	32074	39377	64883	79804	0.699	0.741	0.664	0.784
7/6	1623	1623	3158	2864	33697	41000	68041	82668	0.735	0.771	0.696	0.812
7/7	876	876	2126	2555	34573	41876	70167	85223	0.754	0.788	0.718	0.837
7/8	871	871	2141	1887	35444	42747	72308	87110	0.773	0.804	0.739	0.856
7/9	902	902	1633	1602	36346	43649	73941	88712	0.792	0.821	0.756	0.871
7/10	1164	1164	620	2078	37510	44813	74561	90790	0.818	0.843	0.763	0.892
7/11	1213	1213	2906	1902	38723	46026	77467	92692	0.844	0.866	0.792	0.911
7/12	816	816	693	1516	39539	46842	78160	94208	0.862	0.881	0.799	0.925
7/13	805	805	927	944	40344	47647	79087	95152	0.880	0.896	0.809	0.935
7/14	1110	1110	2520	1196	41454	48757	81607	96348	0.904	0.917	0.835	0.947
7/15	675	675	1060	578	42129	49432	82667	96926	0.919	0.930	0.845	0.952
7/16	595	595	1133	752	42724	50027	83800	97678	0.931	0.941	0.857	0.960
7/17	627	627	872	390	43351	50654	84672	98068	0.945	0.953	0.866	0.963
7/18	784	784	936	830	44135	51438	85608	98898	0.962	0.967	0.876	0.972
7/19	528	528	2810	407	44663	51966	88418	99305	0.974	0.977	0.904	0.976
7/20	420	420	2074	627	45083	52386	90492	99932	0.983	0.985	0.925	0.982
7/21	378	378	1226	132	45461	52764	91718	100064	0.991	0.992	0.938	0.983
7/22	106	106	1328	464	45567	52870	93046	100528	0.993	0.994	0.952	0.988
7/23	67	67	1295	124	45634	52937	94341	100652	0.995	0.996	0.965	0.989
7/24	6	6	1246	281	45640	52943	95587	100933	0.995	0.996	0.978	0.992
7/25	24	24	860	135	45664	52967	96447	101068	0.996	0.996	0.986	0.993
7/26	16	16	556	133	45680	52983	97003	101201	0.996	0.997	0.992	0.994
7/27	64	64	346	181	45744	53047	97349	101382	0.997	0.998	0.996	0.996
7/28	67	67	126	411	45811	53114	97475	101793	0.999	0.999	0.997	1.000
7/29	13	13	305		45824	53127	97780		0.999	0.999	1.000	
7/30	42	42			45866	53169			1.000	1.000		

Estimates were derived by calculating the average daily proportion of the run for each day missed using 2002 and 2003 daily escapement numbers. Total estimated escapement was calculated by dividing the total observed escapement by one minus the sum of the calculated proportions for each missed day. Daily estimates were then derived by multiplying the average daily proportion by the 2001 estimated total (e.g. Estimate for 6/1 = ((2002 Daily(0)/2002 total(97780)) + (2003 Daily (365)/2003 total (101793))/2) * 53169 = 95, where 53169 is the estimated total).

APPENDIX 10.—Age composition of sockeye salmon sampled at McLees Lake weir, 2001 through 2003.

	Age											
	0.3	1.1	1.2	0.4	1.3	2.2	1.4	2.3	3.2	2.4	3.3	Total
2001												
% Female	0.1	–	1.7	0.1	39.3	0.1	0.0	0.4	–	–	–	41.9
% Male	0.0	–	2.1	0.0	55.2	0.3	0.3	0.2	–	–	–	58.1
% Total	0.1	–	3.8	0.1	94.5	0.4	0.3	0.6	–	–	–	100.0
2002												
% Female	–	–	25.9	–	14.8	2.2	0.0	0.2	0.0	–	–	43.2
% Male	–	–	34.2	–	16.9	4.0	1.1	0.2	0.4	–	–	56.8
% Total	–	–	60.1	–	31.7	6.2	1.1	0.4	0.4	–	–	100.0
2003												
% Female	–	0.4	4.0	–	34.8	1.0	0.0	5.7	0.0	0.3	0.0	46.3
% Male	–	0.1	4.0	–	43.7	0.9	0.5	4.2	0.1	0.0	0.2	53.7
% Total	–	0.4	8.1	–	78.5	2.0	0.5	9.9	0.1	0.3	0.3	100.0