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Abundance and Run Timing of Adult Salmon in Long Lake in the Wrangell-St. Elias National Park/Preserve

Annual Report No. FIS04-501

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ANNUAL REPORT SUMMARY PAGE

Title: Abundance and Run Timing of Adult Salmon in Long Lake in the Wrangell-St. Elias National Park and Preserve

Study Number: FIS04-501

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Management Regions: Cook Inlet/Gulf of Alaska

Information Type: Fish stock status and trends

Issues Addressed: Long Lake sockeye salmon are the largest salmon stock within the Chitina River drainage. The variability of the run demonstrates the need for stock specific monitoring sites in addition to broad scale sonar sites estimating mixed stock returns. Long Lake salmon are susceptible to Federal and State subsistence users as well as commercial harvest. A newly implemented sampling regime will aid in estimating age-sex-length composition of the population.

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Key Words: Copper River, Sockeye, Copper River, Chitina River, Long Lake, Sockeye Escapement, Use Stock/status and Trends

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INTRODUCTION

The Upper Copper River drainage provides spawning habitat for sockeye salmon, *Oncorhynchus nerka*, coho salmon *Oncorhynchus kistuch*, and chinook salmon *Oncorhynchus tshawytscha*. Significant numbers of adult salmon are harvested in commercial drift gillnet operations near the mouth of the Copper River from mid-May to September. Salmon escapement into the Upper Copper River system contributes to federal and state subsistence fishing through September each year. The monitoring and evaluation of these runs is essential to ensure that Wrangell - St. Elias National Park and Preserve (WRST) maintains natural and healthy populations of fish as required by the Alaska National Interest Lands Conservation Act (ANILCA).

Accurate assessment of yearly run strength and migratory timing in tributaries to the Copper River is essential to the development of a management strategy that meets the mandates of ANILCA. The Upper Copper River sockeye salmon populations are of particular importance to both federally qualified and state subsistence users. The primary assessment of inriver abundance for Copper River sockeye salmon occurs at the Miles Lake sonar. However, migratory timing of sockeye salmon into the Copper River is prolonged (May-August); and subsequent assessment of escapement into some drainages is needed to determine spawning distribution.

Thirty years of weir data show annual variations in abundance of Long Lake runs ranging from 4,400 to over 50,000 sockeye. This is the longest running data set of weir counts of salmon in the Copper River drainage. The sockeye salmon stock that spawns within Long Lake is the largest salmon stock within the Chitina River drainage. In 2002 the Long Lake stock composed six percent of the estimated salmon return to the entire Copper River. However, in other years it has composed less than four tenths of a percent of the entire Copper River return (Table 1). This demonstrates the need for stock specific monitoring sites in addition to broad scale sonar sites estimating mixed stock returns.

Background

The Long Lake population has the longest known annual spawning duration (August through April) of any sockeye salmon population in North America. (Ken Roberson, personal communication) Throughout the winter sockeye spawn in the northwest corner of the lake which rarely freezes (Figure 1).

Year	Miles Lake Sonar estimates (fish)	Long Lake Weir Counts (sockeye salmon)	Long Lake % of Sonar Estimates
1974		4,501	
1975		6,786	
1976		24,689	
1977		8,772	
1978	107,011	15,458	14.45
1979	237,173	46,110	19.44
1980	276,538	38,978	14.10
1981	535,263	12,687	2.37
1982	467,306	28,064	6.01
1983	545,724	28,003	5.13
1984	536,806	10,729	2.00
1985	436,313	21,431	4.91
1986	509,275	16,947	3.33
1987	483,478	13,323	2.76
1988	488,398	7,065	1.45
1989	607,797	17,760	2.92
1990	581,895	21,399	3.68
1991	579,435	11,501	1.98
1992	601,952	10,141	1.68
1993	797,902	16,101	2.02
1994	715,181	18,289	2.56
1995	599,265	17,933	2.99
1996	906,867	6,209	0.69
1997	1,148,079	4,433	0.39
1998	866,957	8,531	0.98
1999	848,921	12,922	1.52
2000	587,592	8,665	1.48
2001	833,569	26,939	3.23
2002	819,000	50,000	6.11
2003	695,233	4,604	0.66
2004	669,646	19,215	2.87

Table 1. Long Lake weir counts and sonar estimates, 1974-2004.

Figure 1. Salmon spawning in Long Lake in April, 2004.

The Alaska Department of Fish and Game (ADFG) initially operated the Long Lake weir in 1974 and 1975. Cliff Collins, a local private citizen, voluntarily took over operation of the weir in 1976 when ADFG was no longer able to fund the operation of the weir. He operated the weir continuously from 1976 through 2003. (Table 1) In 2003 when Mr. Collins, at age 93, was no longer able to operate the weir, a cooperative agreement was formed between the Collins' Family Trust, Wrangell-St. Elias National Park/Preserve (WRST) and the Copper River Watershed Project to continue to keep the weir operating. In 2004 the U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Information Service provided funding for the project through 2006. Starting in 2003 the weir operators began sampling sockeye salmon according to a sampling protocol established by ADFG. The physical structure of the weir has changed little since 1974. A small sampling box was constructed on the upstream side of the middle of the weir in 2003.

OBJECTIVES

1) Monitor annual abundance and timing of sockeye and other salmon in Long Lake.
2) To enumerate the number of sockeye salmon entering Long Lake from July 1 to mid-September, thereby continuing a data set initiated in 1974.
3) To measure the entry pattern of sockeye salmon to Long Lake and compare the entry pattern to the historic entry pattern data set to test for change in the interannual run timing.
4) To estimate age-sex-length composition of the Long Lake sockeye salmon population by sampling 10 % of the run or a minimum of 100 fish/week (or as many are as present if <100 present in a given week) and a maximum of 100 fish/day.

5) To correlate run timing and numbers of sockeye entering Long Lake with similar data from the Miles Lake sonar.
6) To test the hypothesis that there is a correlation between run timing and stream temperature.
7) To estimate the contribution of Long Lake sockeye to the Federal subsistence and State personal use fishery in the Chitina Subdistrict of the Copper River.

METHODS

Site Description

Long Lake, located at 480 m asl, at latitude 61 deg 23' 1.68" N and longitude 143 degrees 17' 15.89" W, flows into the Lakina River, a tributary of the Chitina River in the Copper River drainage (Figure 2). Long Lake is located adjacent to the McCarthy Road and is .5 km wide and 8.5 km long. The outlet stream (called Salmon Creek by the Collins family) runs 2.1 kilometers through nearly level terrain to the Lakina River. Willows, alders, mosses and sedges dominate the vegetation. White spruce are the primary evergreens with stands of paper birch and quaking aspen interspersed. The soils are poorly drained. Annual precipitation in the area averages 40.11 cm and the ambient temperature ranges from a high of 13.39° C to a low of -27.06° C. The average annual temperature is -22° C (USDA 1979).

The project uses a rigid picket weir to enumerate the number of salmon migrating into Long Lake and to sample the age, sex and length of a portion of the salmon migrating through the weir. The weir site is on Collins Family Trust land and is located within a few hundred meters of the Collins family residence, at mile 45 on the McCarthy Road (Figure 2).

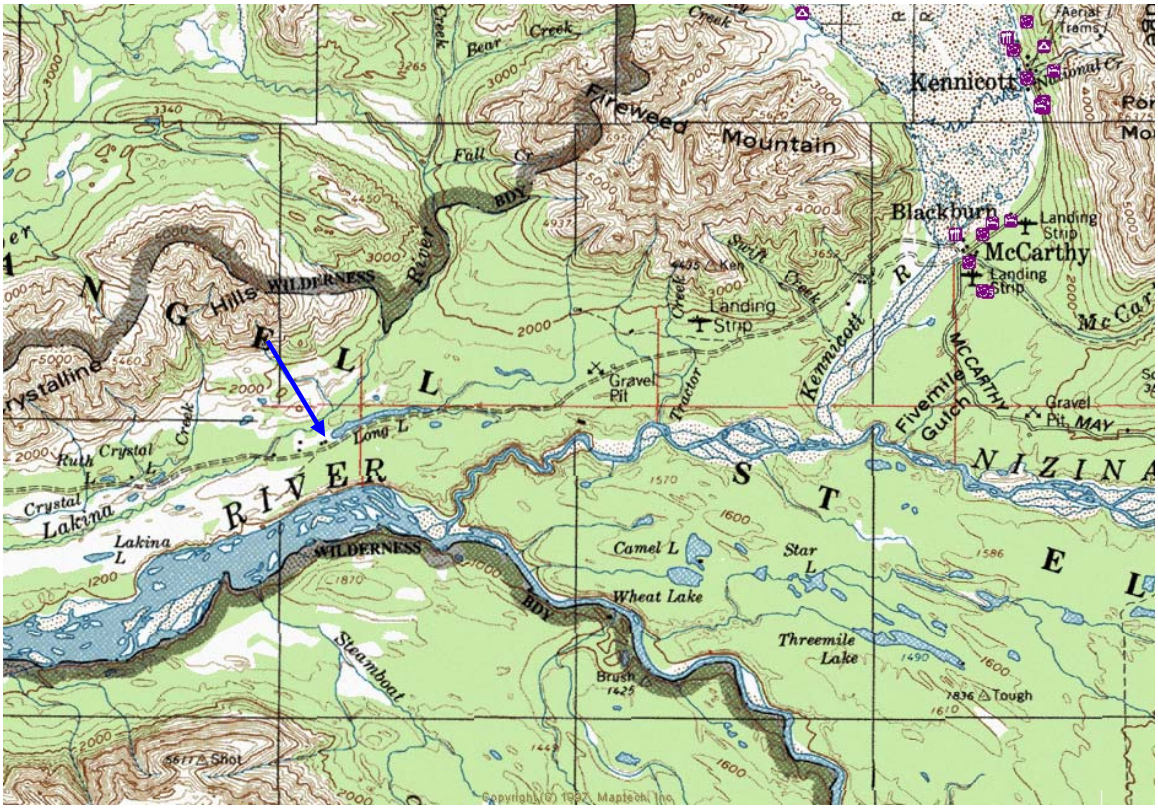

Figure 2. Long Lake weir site.

A rigid picket weir is operated at the outlet of the lake (Figure 3). The weir has a picket spacing of 3.75 cm and to count fish, 1-2 pickets are removed, and the fish are enumerated as they swim through the opening. The weir is monitored daily and is closed when it is not monitored.

The site is extremely conducive to the operation of a rigid picket weir. Flows fluctuate only slightly, water velocity is always low, and the stream is shallow and easily waded. A walkway lays across the stream immediately upstream of the weir where a weir operator can stand and count migrating salmon simply by removing a few pickets from the weir.

Figure 3. Long Lake weir, 2004.

In 2004 a larger sampling box with a funnel-shaped entry trap was erected, approximately 2.1 m x 3.1 m in size, with the west bank of the creek used as one side of the box. A sampling table was constructed at one end and was used to sample fish (Figure 4). A sampling cradle was also used occasionally. On August 13, 2004 an electric fence was put around the weir and the sampling area to reduce the damage (both to the salmon and to the weir) by grizzly bears. In 2004 the weir was installed on July 15 and removed on October 20. Sampling in 2004 was typically performed with a crew of 3.

Figure 4. Sampling box, 2004.

Bears are frequently a problem at the weir and further downstream in the creek. The Collins family has several Karelian bear dogs which are staked out near the weir when fish are being sampled or enumerated. An electric fence was constructed around the weir and sampling box during the 2004 field season to prevent structural damage and to inhibit the bears from eating the salmon captured in the box.

A *HOBO® TEMP* data logger was placed in a submersible case to collect water temperature data throughout the summer. Water levels were determined by reading a staff gauge daily.

Biological Data

Fish migrating through the weir were counted and identified to species. The following 3 window sampling schedule to sample sockeye salmon for age (scale samples), length and sex was set up by the Alaska Department of Fish and Game, Commercial Division in Cordova, Alaska:

1. July15 – August 20 450 fish
2. August 21 – September 5 450 fish
3. September 6 – October 15 450 fish

This sampling strategy was designed to estimate the age, sex and length of the sockeye population by sampling 10 percent of the average total return of sockeye salmon with a maximum of 100 fish per day.

Sockeye salmon were sampled for scales and sexed using external characteristics. Two measurements were taken on each fish, from mid-eye to fork length (MEF) and mid-eye to posterior insertion of anal fin (anal) length. Lengths were recorded to the nearest millimeter. Scales were collected from the preferred area, located on the left side of the fish and two rows above the lateral line on a diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin, according to Alaska Department of Fish and Game sampling protocol. One scale was taken from each sockeye salmon in accordance with this protocol. Scale samples were analyzed by the ADFG Commercial Fisheries Division in Cordova. Ages were adjusted for resorbed margins based on length frequency aggregations.

RESULTS

Weir Operation

Daily staff gauge readings between August 1 and October 10 show a maximum variation of 1.24 feet between September 15 and October 6 (Figure 5).

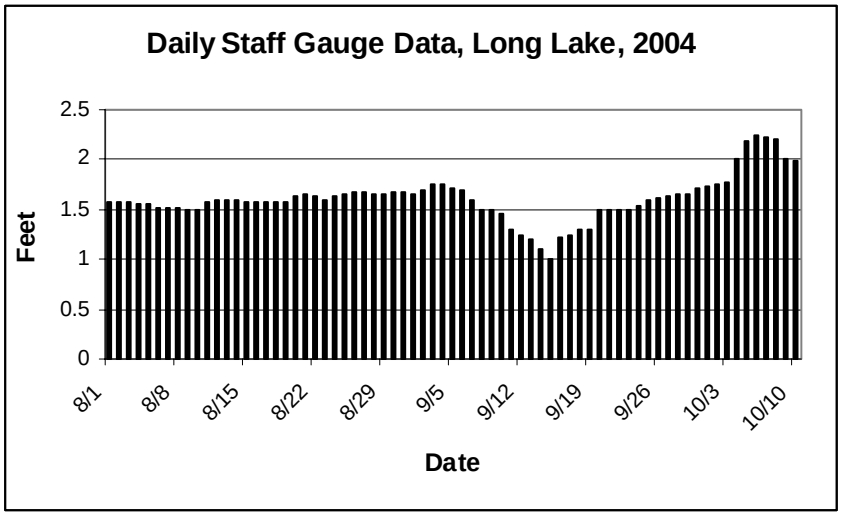

Figure 5. Daily staff gauge readings.

The *HOBO® TEMP* data logger was lost during the summer and no temperature data was collected.

Biological Data

In 2004 19,215 sockeye salmon were enumerated through the Long Lake weir. The first salmon passed through the weir on August 8 when 54 salmon were counted. The largest daily passage of sockeye salmon occurred on September 12 when 4,882 sockeyes migrated through the weir. Daily sockeye counts are displayed in Figure 6 and in Appendix A. A total of 987 measurement, sex, and scale samples were collected, which was 5.1% of the total fish counted. Sex, length and age composition are displayed in Tables 2 and 3. Between September 14 and October 21 281 coho salmon were enumerated.

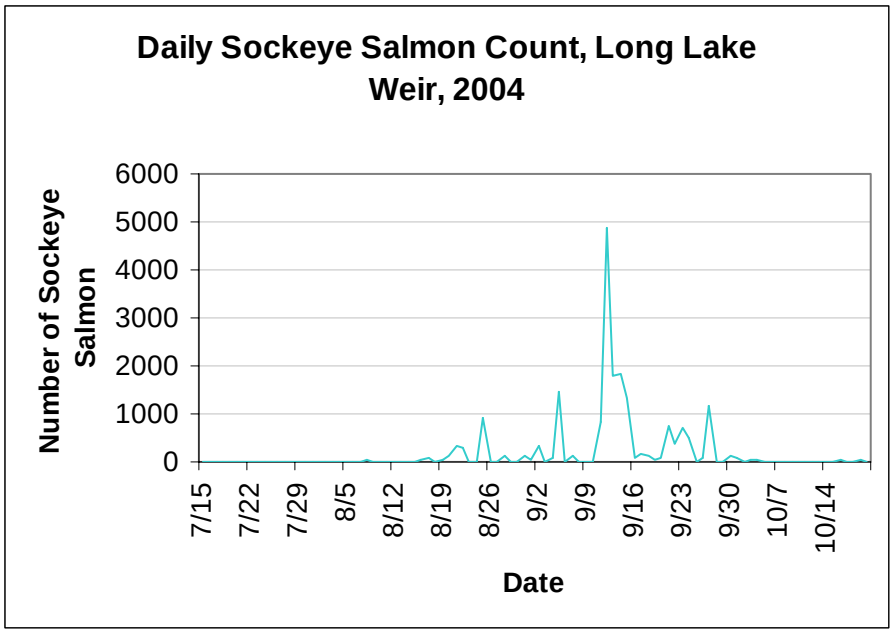

Figure 6. Daily sockeye salmon count, 2004.

The majority of the population that was sampled in 2004 was composed of 1.3 age sockeye salmon (Table 2).

Stratum Dates: July 15-October 21, 2004												
		Age Class									Total Fish Counted	N
Sex		0.2	0.3	1.1	1.2	1.3	1.4	2.1	2.2	2.3		
F	Percent	0.00	0.00	0.00	46.20	46.20	0.00	0.00	6.10	1.40		493
	Number	0	0	0	228	228	0	0	30	7	11,552	
	SE	0.0	0.0	0.0	259.0	259.0	0.0	0.0	124.0	62.0		
M	Percent	0.00	0.00	0.00	38.20	56.60	0.00	0.00	3.40	1.80		327
	Number	0	0	0	125	185	0	0	11	6	7,663	
	SE	0.0	0.0	0.0	206.0	210.0	0.0	0.0	76.0	57.0		
Total	Percent	0.00	0.00	0.00	43.00	50.40	0.00	0.00	5.00	1.60		820
	Number	0	0	0	353	413	0	0	41	13	19,215	
	SE	0.0	0.0	0.0	332.0	336.0	0.0	0.0	146.0	84.0		

Table 2. Numbers by sex and age, entire 2004 field season.

The 1.3 age fish were the largest. The average length of the 1.3 age males was approximately 596 mm; of the 1.3 age females, approximately 572 mm (Table 3).

July 15-October 21, 2004										
		Age Class								
Sex		0.2	0.3	1.1	1.2	1.3	1.4	2.1	2.2	2.3
F	Avg Length (mm)	0.0	0.0	0.0	520.0	572.0	0.0	0.0	510.0	563.0
	SE	0.0	0.0	0.0	1.2	1.2	0.0	0.0	5.8	15.0
	Sample Size	0	0	0	228	228	0	0	30	7
M	Avg Length (mm)	0.0	0.0	0.0	536.0	596.0	0.0	0.0	537.0	585.0
	SE	0.0	0.0	0.0	1.9	1.3	0.0	0.0	5.6	9.6
	Sample Size	0	0	0	125	185	0	0	11	6
	Avg Length (mm)	0.0	0.0	0.0	525.0	583.0	0.0	0.0	518.0	573.0
	SE	0.0	0.0	0.0	1.1	1.1	0.0	0.0	4.8	6.0
Total	Sample Size	0	0	0	353	413	0	0	41.0	13.0

Table 3. Length by sex and age, July 15-October 21, 2004.

Run Timing

The first sockeye was observed migrating through the weir on August 8. The median point in the run occurred on September 12 when the cumulative total of sockeyes reached 9,608 (Figure 7). The last sockeye was counted through the weir on October 19.

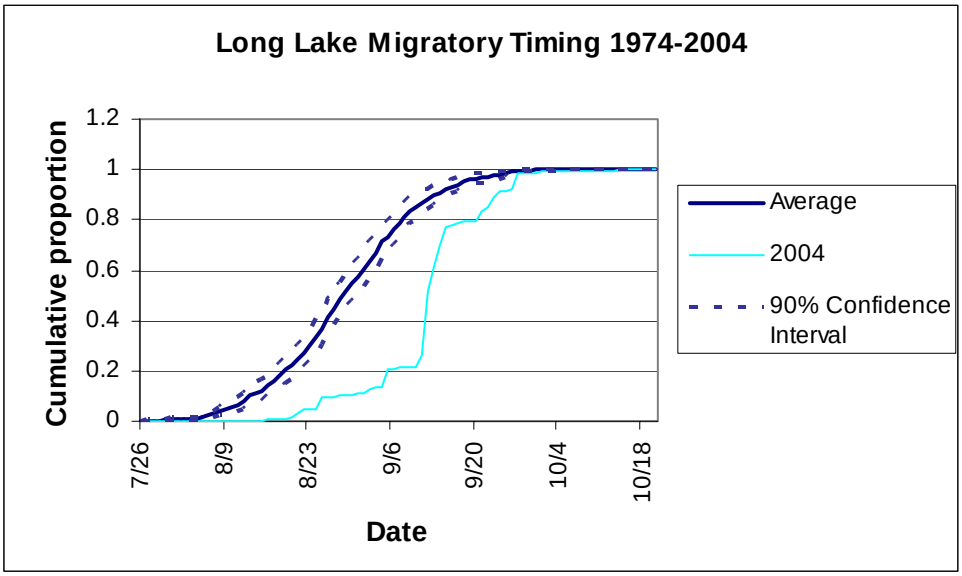

Figure 7. Average migratory run timing, 1974-2003 and 2004 timing.

DISCUSSION

Weir Operation

The basic construction of the weir has changed very little since it was built in 1974 because the rigid picket design works well in this location. The pickets are removed and stored at the end of each field season and then replaced each summer while the weir's framework can remain in place in the creek throughout the winter.

Several changes led to an improved sampling operation at the weir in 2004: the sampling box was enlarged and moved from the center of the weir to the west side, a sampling bench and sampling cradle were installed, and a bear fence was erected to alleviate the destruction and danger caused by grizzly bears.

Biological Data

The adult sockeye salmon population returning to Long Lake in 2004, estimated at 19,215, appears to be close to the 31 year average of 17,292 (Figure 8). The majority of the returning adults in both 2003 and 2004, the only years that scale samples have been taken, were age 1.3 fish (Table 2). The second highest age class group for both years was 1.2 age fish. For both years 1.3 age fish measured the longest (Table 3).

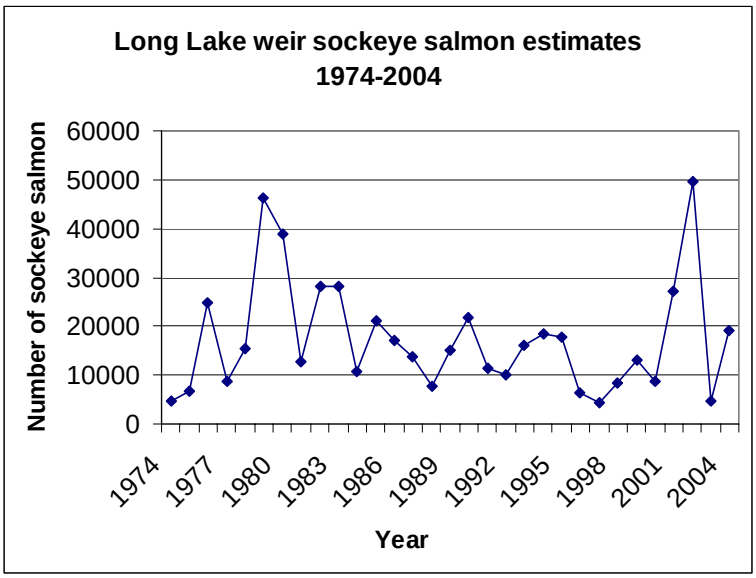

Figure 8. Long Lake weir sockeye estimates, 1974-2004.

The coho salmon run typically occurs later than the sockeye run and there are usually coho salmon still in the stream when the weir is dismantled in mid October. In 2004 281 cohos were counted.

The 2004 escapement of 669,646 at the Miles Lake sonar indicated an average return of sockeye salmon. The average sonar count 1978-2003 is 609,190 salmon. The highest number counted at the sonar was 1,148,079 in 1997; the lowest count, 107,011 was in 1978, the first year the sonar counter was in operation.

Run Timing

Migratory run timing appears to be very constant during the 31 years that the Long Lake weir has operated (Figure 7). The 2004 run appears to have been later than average.

CONCLUSIONS

Weir Operation

The new sampling box worked well in 2004 and will be used again for the 2005 field season. The sampling crew will again be composed of two individuals living in the Collins' household and one living in McCarthy (19 miles down the road).

Biological Data

According to Table 1 sockeye returns to Long Lake appear to be highly variable, from a high of 46,110 in 1979 to a low of 4,443 in 1997. The number of fish counted through the weir in 2004 approximately 11% higher than the 31 year average.

RECOMMENDATIONS

The project continues to operate the Long Lake weir successfully. The age, sex, length sampling provides additional information that was not collected in the past. Therefore, we can provide only the following brief recommendations:

1. Continue monitoring towards defining a natural and healthy escapement for Long Lake.

2. Continue sampling fish for age, length and sex.

ACKNOWLEDGMENTS

The Collins family and the Copper River Watershed Project provided the majority of the labor for operating the weir. Tamara Harper was also instrumental in assuring that age, sex, length sampling was conducted properly. Rick Merizon, ADFG, Commercial Fisheries Division in Cordova, Alaska proposed the sampling regime for the weir, read the scale samples, and provided the information in Tables 2 and 3. The U.S. Fish and Wildlife Service, Office of Subsistence Management, provided $17,780 in funding support through the Fisheries Resource Monitoring Program, under contract number FIS04-501.

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APPENDIX A. Sockeye and coho salmon daily and cumulative counts, 2004.

Long Lake Weir 2004 Counts

Date	Sockeye Daily Count	Sockeye Cumulative	Coho Daily Count	Coho Cumulative
7/13/2004				
7/14/2004				
7/15/2004	0	0	0	0
7/16/2004	0	0	0	0
7/17/2004	0	0	0	0
7/18/2004	0	0	0	0
7/19/2004	0	0	0	0
7/20/2004	0	0	0	0
7/21/2004	0	0	0	0
7/22/2004	0	0	0	0
7/23/2004	0	0	0	0
7/24/2004	0	0	0	0
7/25/2004	0	0	0	0
7/26/2004	0	0	0	0
7/27/2004	0	0	0	0
7/28/2004	0	0	0	0
7/29/2004	0	0	0	0
7/30/2004	0	0	0	0
7/31/2004	0	0	0	0
8/1/2004	0	0	0	0
8/2/2004	0	0	0	0
8/3/2004	0	0	0	0
8/4/2004	0	0	0	0
8/5/2004	0	0	0	0
8/6/2004	0	0	0	0
8/7/2004	0	0	0	0
8/8/2004	54	54	0	0
8/9/2004	13	67	0	0
8/10/2004	0	67	0	0
8/11/2004	2	69	0	0
8/12/2004	0	69	0	0
8/13/2004	0	69	0	0
8/14/2004	4	73	0	0
8/15/2004	0	73	0	0
8/16/2004	54	127	0	0
8/17/2004	63	190	0	0
8/18/2004	0	190	0	0
8/19/2004	22	212	0	0
8/20/2004	139	351	0	0
8/21/2004	325	676	0	0
8/22/2004	312	988	0	0
8/23/2004	0	988	0	0
8/24/2004	0	988	0	0
8/25/2004	911	1899	0	0

8/26/2004	0	1899	0	0
8/27/2004	0	1899	0	0
8/28/2004	128	2027	0	0
8/29/2004	0	2027	0	0
8/30/2004	0	2027	0	0
8/31/2004	109	2136	0	0
9/1/2004	43	2179	0	0
9/2/2004	322	2501	0	0
9/3/2004	19	2520	0	0
9/4/2004	72	2592	0	0
9/5/2004	1452	4044	0	0
9/6/2004	0	4044	0	0
9/7/2004	116	4160	0	0
9/8/2004	0	4160	0	0
9/9/2004	14	4174	0	0
9/10/2004	0	4174	0	0
9/11/2004	828	5002	0	0
9/12/2004	4882	9884	0	0
9/13/2004	1802	11686	0	0
9/14/2004	1817	13503	3	3
9/15/2004	1343	14846	6	9
9/16/2004	84	14930	0	9
9/17/2004	154	15084	2	11
9/18/2004	120	15204	1	12
9/19/2004	22	15226	1	13
9/20/2004	66	15292	2	15
9/21/2004	735	16027	12	27
9/22/2004	386	16413	4	31
9/23/2004	698	17111	24	55
9/24/2004	519	17630	31	86
9/25/2004	0	17630	2	88
9/26/2004	69	17699	6	94
9/27/2004	1168	18867	102	196
9/28/2004	4	18871	4	200
9/29/2004	1	18872	2	202
9/30/2004	128	19000	23	225
10/1/2004	104	19104	34	259
10/2/2004	0	19104	3	262
10/3/2004	23	19127	3	265
10/4/2004	21	19148	3	268
10/5/2004	6	19154	1	269
10/6/2004	0	19154	1	270
10/7/2004	4	19158	0	270
10/8/2004	0	19158	0	270
10/9/2004	6	19164	2	272
10/10/2004	0	19164	1	273
10/11/2004	0	19164	0	273
10/12/2004	0	19164	3	276
10/13/2004	0	19164	3	279
10/14/2004	3	19167	1	280

10/15/2004	0	19167	0	280
10/16/2004	27	19194	0	280
10/17/2004	0	19194	0	280
10/18/2004	0	19194	0	280
10/19/2004	21	19215	1	281
10/20/2004	0	19215	0	
10/21/2004	0	19215	0	281

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