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Abundance and Run Timing of Adult Salmon in Long Lake in the
Wrangell-St. Elias National Park and Preserve: 2007-2009

Final Report No. 07-505

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ABSTRACT

Long Lake flows into the Lakina River, a tributary of the Chitina River in the Copper River drainage. It provides important spawning habitat for sockeye salmon, which contribute to intensive down-river commercial and subsistence fisheries. The monitoring and evaluation of this run 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). The Long Lake weir is one of several projects providing accurate assessment of yearly run strength and migratory timing in tributaries to the Copper River and the only ongoing one in the Chitina River drainage.

This report presents a summary of data collected by Wrangell-St. Elias National Park and Preserve at the Long Lake weir over a three year period, 2007-2009 and data collected previously by the Alaska Department of Fish and Game (ADFG) (1974-1975), by local land owner Cliff Collins (1976-2002) and by the National Park Service (2003-2006). The weir operated on daily basis from mid July until late fall. Data collected at the weir includes the enumeration of sockeye salmon migrating through the weir, daily staff gauge and water temperature measurements, and, sex and length measurements and scale and otolith samples for ageing the sockeye salmon

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INTRODUCTION

The upper Copper River drainage provides spawning habitat for sockeye *Oncorhynchus nerka*, coho *O. kisutch*, and Chinook *O. tshawytscha* salmon. 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 site. However, migratory timing of sockeye salmon into the Copper River is prolonged (May-September) and subsequent assessment of escapement into some tributaries is needed to determine spawning distribution. The sonar equipment at the Miles Lake site is typically shut down around August 1st each year, after the majority of the sockeye salmon have migrated through. A portion of the Long Lake sockeye salmon run enters the Copper River after the sonar has been pulled from the Miles Lake site.

Long Lake has the longest running data set of salmon weir counts in the Copper River drainage, with 36 years of observations, and the sockeye salmon stock that spawns within Long Lake is the largest salmon stock within the Chitina River drainage. The Long Lake population also has the longest known annual spawning duration (August through April) of any sockeye salmon population in North America. (Roberson, K, retired ADF&G Commercial Fisheries Division fisheries biologist, personal communication, November 2002). Throughout the winter, sockeye salmon spawn in the northwest corner of the lake since this portion of the lake rarely freezes (Figure 1).

The Alaska Department of Fish and Game (ADF&G) initially operated the Long Lake weir in 1974 and 1975. Cliff Collins, a local private citizen who owned the land where the weir is located, voluntarily took over operation of the weir in 1976 when ADF&G was no longer able to fund its operation (Figure 2). He operated the weir continuously from 1976 through 2003. 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 and the Copper River Watershed Project to keep the weir operating. Since 2004, funding has been provided under the Subsistence Fisheries Resource Monitoring Program¹. Starting in 2003, the weir operators began sampling sockeye salmon for age, sex, and length composition according to a sampling protocol established by ADF&G. 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. In 2004 a larger sampling box was constructed against

¹ Administered by U.S. Fish and Wildlife Service, Office of Subsistence Management.



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



Figure 2. Cliff Collins at the weir at age 93 with Karelian bear dog in 2003.

the west bank of the creek on the upstream side of the weir. This larger box has been used since 2004.

The escapement has varied from a low of 631 sockeye salmon in 2008 to a high of 49,747 sockeye salmon in 2001 (Table 1). The annual mean number of fish counted at the weir for its 36 year period of operation was 15,724. The date of the migration of the first fish through the weir has ranged between July 26 in 1984 to September 2 in 2009; with an average date of around August 5. During the period 1978-1980, inriver returns to the Copper River were very low, and Long Lake escapements comprised 14-19% of the total. Since 1981, escapements into Long Lake have comprised no more than 6% of the total inriver return. There does not appear to be a relationship between the magnitude of inriver return and escapement into Long Lake during this 27-year period, which demonstrates the need for maintaining stock specific monitoring sites in addition to the main river sonar site that estimates the total mixed stock return.

This report presents a summary of assessment results for sockeye salmon escapements into Long Lake during the period 2007-2009. During these years, escapement assessments were conducted by the National Park Service (NPS) through a weir, and were funded by the Office of Subsistence Management (OSM). This report serves as the final deliverable for funded work 2007 through 2009. Additionally, conclusions and recommendations for management and further assessment work are presented from synthesis of the entire data set.

Table 1. Long Lake weir and Miles Lake sonar sockeye salmon counts, 1974-2009. Miles Lake sonar counts obtained from Lewis et al. (2008) and ADF&G (2010). Data for Miles Lake not available (N/A) 1974-1977.

Year	Number of Sockeye Salmon		Long Lake as % of Sonar Estimates
	Miles Lake Sonar	Long Lake Weir	
1974	N/A	4,684	-
1975	N/A	6,768	-
1976	N/A	24,689	-
1977	N/A	8,624	-
1978	107,011	15,458	14.5
1979	237,173	46,110	19.4
1980	276,538	39,038	14.1
1981	535,263	12,659	2.4
1982	467,306	28,047	6.0
1983	545,724	28,133	5.2
1984	536,806	10,637	2.0
1985	436,313	21,131	4.8
1986	509,275	16,997	3.3
1987	483,478	13,633	2.8
1988	488,398	7,543	1.5
1989	607,797	14,981	2.5
1990	581,895	21,664	3.7
1991	579,435	11,511	2.0
1992	601,952	10,091	1.7
1993	797,902	16,101	2.0
1994	715,181	18,289	2.6
1995	599,265	17,923	3.0
1996	906,867	6,309	0.7
1997	1,148,079	4,443	0.4
1998	866,957	8,441	1.0
1999	848,921	12,922	1.5
2000	587,592	8,645	1.5
2001	833,569	26,999	3.2
2002	819,000	49,747	6.1
2003	695,233	4,604	0.7
2004	669,646	19,215	2.9
2005	854,268	7,770	0.9
2006	959,731	9,239	1.0
2007	926,438	7,846	0.9
2008	614,999	631	0.1
2009	709,330	4,555	0.6

OBJECTIVES

- 1) To enumerate the number of sockeye salmon entering Long Lake from July 1 to mid-September, thereby continuing a data set initiated in 1974.
- 2) 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.
- 3) To estimate age-sex-length composition of the Long Lake sockeye salmon population.
- 4) To compare the numbers of sockeye salmon entering Long Lake with similar data from the Miles Lake sonar.

METHODS

Site Description

Long Lake is 480 m above sea level, at latitude 61 deg 23' 1.68" N and longitude 143 degrees 17' 15.89" W (Figure 3). Long Lake is located adjacent to the McCarthy Road and is 0.5 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, a tributary of the Chitina River that flows into the Copper River. Willows, alders, mosses and sedges dominate the vegetation. Forested areas consist mainly of white spruce interspersed with stands of paper birch and quaking aspen. The soils are poorly drained. Average annual precipitation is 40.11 cm, and average annual temperature is 22° C with extremes of 13.39° C and -27.06° C (USDA 1979).

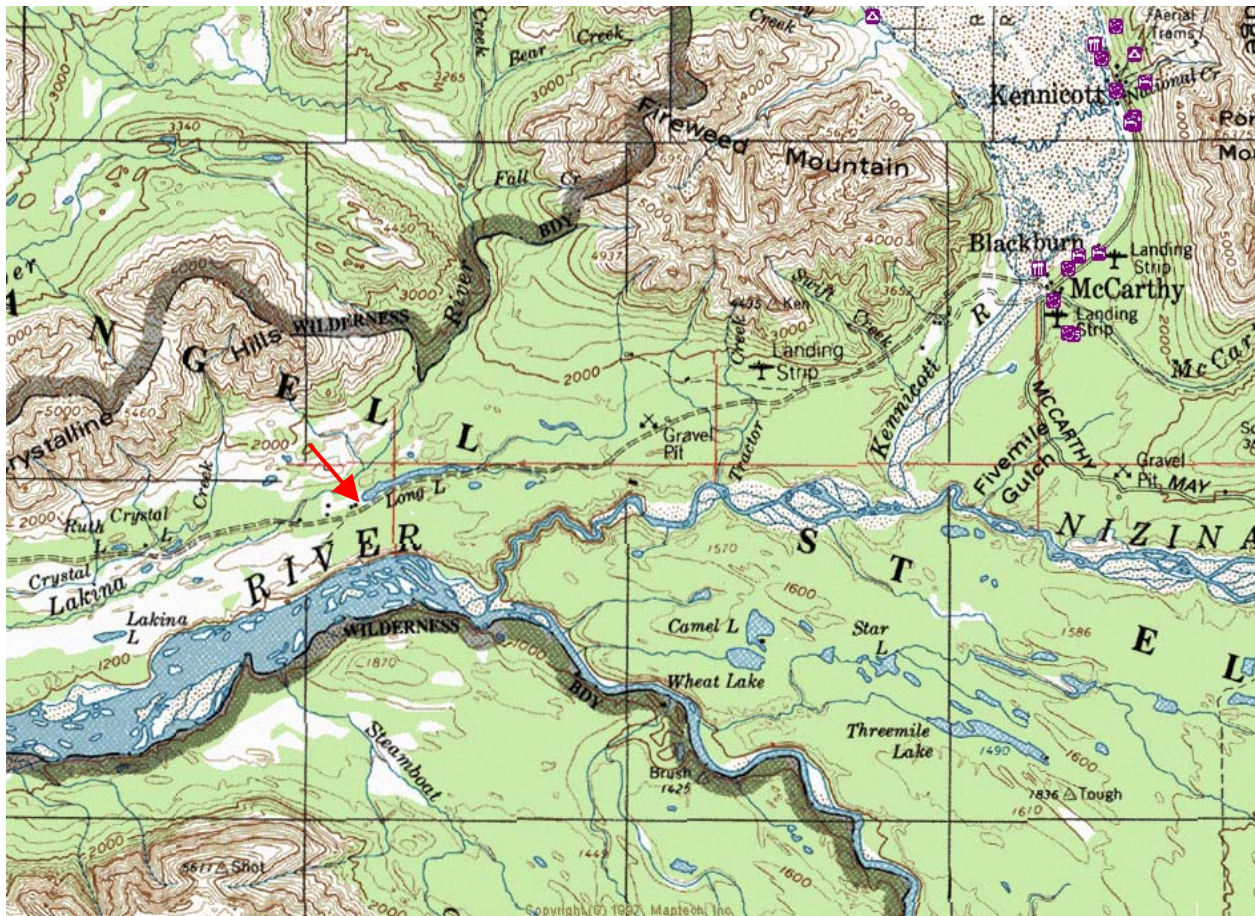


Figure 3. Long Lake weir site.

Weir Operation

The project uses a rigid picket weir to enumerate the number of salmon migrating into Long Lake and to estimate the age, sex and length composition of the run by sampling sockeye 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 3). The weir is installed and operated at the outlet of the lake, and pickets are spaced 3.75 cm apart (Figure 4).

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 is placed across the stream immediately upstream of the weir where a weir operator stands and counts migrating salmon simply by removing one or two pickets from the weir. Counting is done daily, and all pickets are kept in place so that fish cannot pass through when it is not being monitored.



Figure 4. Long Lake weir and sampling box under construction, 2008.

There is a large sampling box approximately 2.1 m x 3.1 m in size, with a funnel-shaped entry trap on the northwestern bank of the creek. The bank of the creek is used as one side of the box, and there is a table at the upstream end that is used to sample salmon (Figure 5). Fish are allowed to enter the sampling box by removing one or two pickets on the west side of the weir. When the box has 20-50 sockeye salmon in it, the pickets are replaced, trapping the salmon within the box. In 2009 the weir and sampling box were installed on July 16. Work at the weir ended on October 23, when the weir pickets were removed for the winter. Sampling was typically performed with a crew of two to three people.

Bears are frequently a problem at the weir and further downstream in the creek. The Collins family has several Karelian bear dogs (Figure 2) that are staked out near the weir when fish are being sampled or enumerated. An electric fence was installed around the weir and sampling box for the entire 2009 field season to prevent bears from damaging the weir and eating salmon captured in the box.

In 2009 both water temperature and water level were monitored throughout the summer, from August 1 to October 23. A *HOBOTM* data logger placed in a submersible case was used to collect water temperature data throughout the season, and a staff gauge installed on the weir was used to measure water level (by observation) each day (Figure 6).



Figure 5. Sampling box, Long Lake weir, 2009.



Figure 6. Staff gauge, electric bear fence, water surface thermometer at Long Lake weir, 2006.

Biological Data

Fish migrating through the weir were counted and identified to species. This was done by removing 1 or 2 pickets in the weir and visually counting the salmon as they passed through. Sockeye salmon were sampled according to the same procedures used by the ADF&G, Division of Commercial Fisheries in Cordova, Alaska. This required sampling 10 percent of the average total return of sockeye salmon to estimate the age, sex and length of the population. To do this, at least 10% of the fish were sampled each week.

Each sockeye salmon that was sampled was measured to the nearest millimeter from mid-eye to fork length (MEF). One scale was 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 ADF&G sampling protocols (Figure 7). Scales were later analyzed by ADF&G Commercial Fisheries Division staff based in Cordova. Ages were adjusted for resorbed scale margins using an age-length relationship developed for Copper River sockeye salmon. Age, sex, and length sampling at the weir occurred from August 26 through October 10, 2009. Additionally, age, sex, and length data were collected from 49 sockeye salmon carcasses sampled from the lake and shore between October 2 and 23, 2009 (Figure 8). Otoliths were removed from these carcasses for future analysis by ADF&G (Figure 9).



Figure 7. Scale collection at the Long Lake weir, 2007.

To determine whether the 1978-2009 time series of sockeye salmon escapements into Long Lake showed linear trends over years, the coefficient of determination (R^2) was calculated to determine the amount of variation explained by the regression, and an F test was used to test the null hypothesis that the slope of the fitted line was equal to zero. Similar statistical analyses were



Figure 8. Otolith sampling, Long Lake, 2008



Figure 9. Otolith sampling, Long Lake, 2009.

applied to 1978-2009 inriver runs at the Miles Lake sonar site. To determine whether sockeye salmon escapements into Long Lake could be predicted from total inriver runs estimated at Miles Lake, linear regression analysis was done using the Miles Lake estimate as the independent variable (x). An alpha level of 0.05 was used for all statistical tests.

RESULTS

Weir Operation

In 2009, daily staff gauge readings between August 1 and October 23 varied between 1.44 feet and 1.99 feet, showing a maximum variation of 0.55 feet (Figure 10). In the early part of the summer the water level was slightly higher than normal compared to the previous four years (Figure 11).

In 2009 daily water temperature data ranged from a high of 64° F on August 4 to a low of 38° F on October 20 (Figure 12).

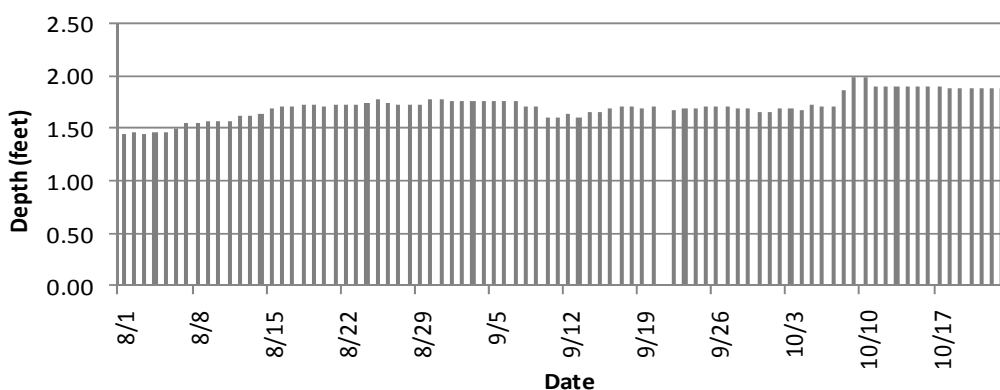


Figure 10. Daily staff gauge readings of water depth, Long Lake weir, 2009.

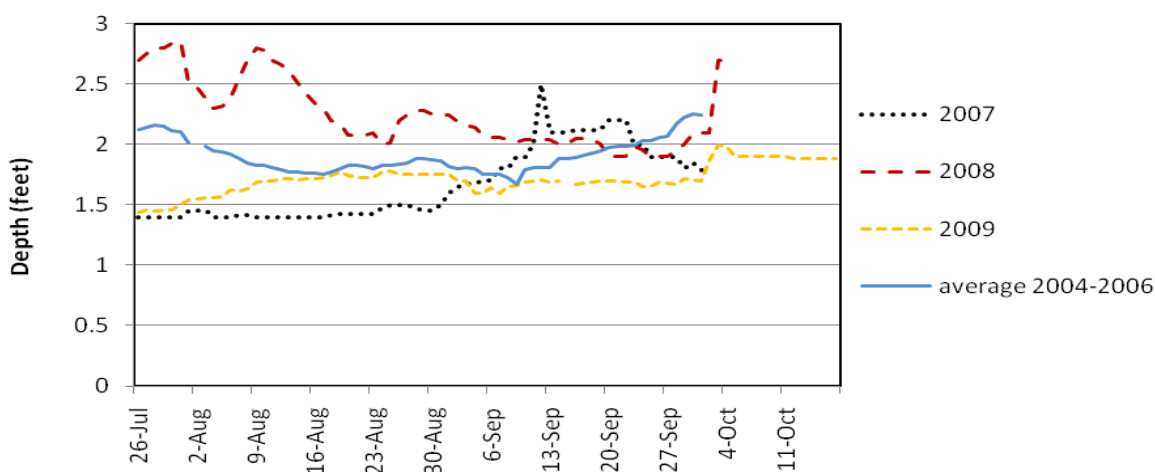


Figure 11. Staff gauge average 2004-2006 and staff gauge for 2007-2009.

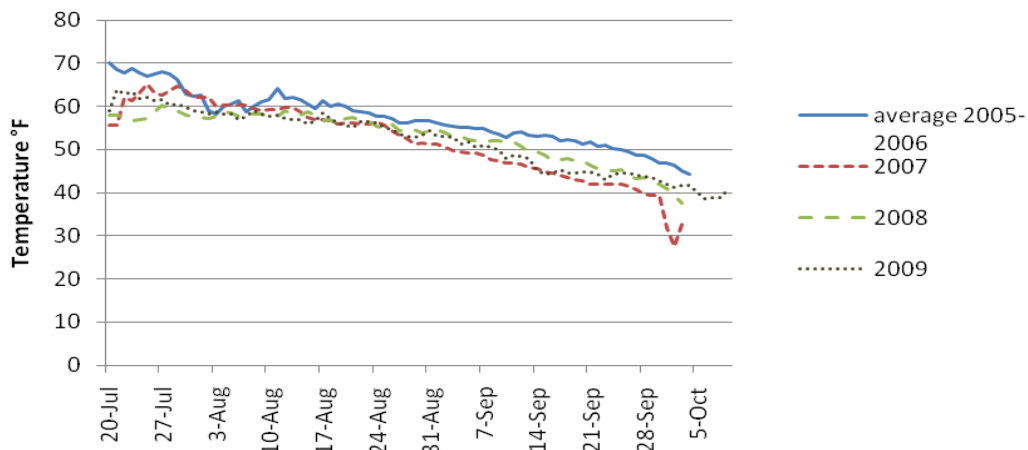


Figure 12. Daily water temperatures 2007-2009 and average daily water temperature 2005-2006.

Biological Data

In 2009, 4,555 sockeye salmon were enumerated through the Long Lake weir (Figure 13 and Appendix A). The first sockeye salmon passed through the weir on August 6 when 115 were counted; this was also the day when the greatest number of salmon were counted through the weir. The median run day occurred on August 20 when 329 sockeye salmon had been counted through the weir. A total of 174 sockeye salmon were sampled for sex, length, and age. Between September 17 and October 9, a total of 184 coho salmon were also enumerated.

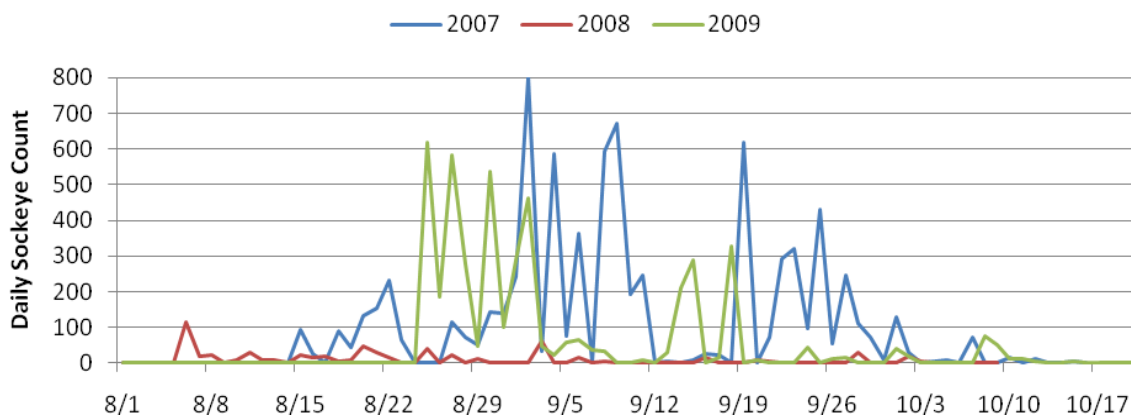


Figure 13. Daily sockeye salmon count, Long Lake weir, 2007-2009.

Sockeye returns to Long Lake during the 36 year period of weir operations have been highly variable, ranging from a high of 50,000 in 2002 to a low of 631 in 2008 (Table 1, Figure 13). The 36 year average migration through the weir is 15,724 sockeye salmon: the 2007 count of 7,846 was 50% of the average, the 2008 count of 631 was 4% and the 2009 count of 4,555 was 29%. In 2007 the total inriver run estimated by the Miles Lake sonar project was 926,438 salmon and the Long Lake sockeye count represented about 0.9% of it; in 2008 the total inriver run was 614,999 and the Long Lake sockeye percentage was 0.1; and in 2009 the total

escapement was 709,330 and Long Lake contributed 06% of that total (Table 1). During 1978-2009, Long Lake escapements counts represented an average of 3.8% of the total inriver run, but ranged from 0.4% to 19.4% of the total inriver run.

Long Lake escapements showed no significant abundance trend (ANOVA F-test, $P = 0.1223$) for the 36 year time period 1974-2009 (Figure 13), while Miles Lake estimates show a significant trend (ANOVA F-test, $P < 0.001$) of increasing abundance for the 32 year time period 1978-2009. There was a significant linear relationship (ANOVA F-test, $P = 0.0284$) between the Miles Lake sonar estimate and the Long Lake sockeye escapements during the 32 year period 1978-2009 (Figure 14). In general, Long Lake escapements tended to decrease with increasing total inriver runs.

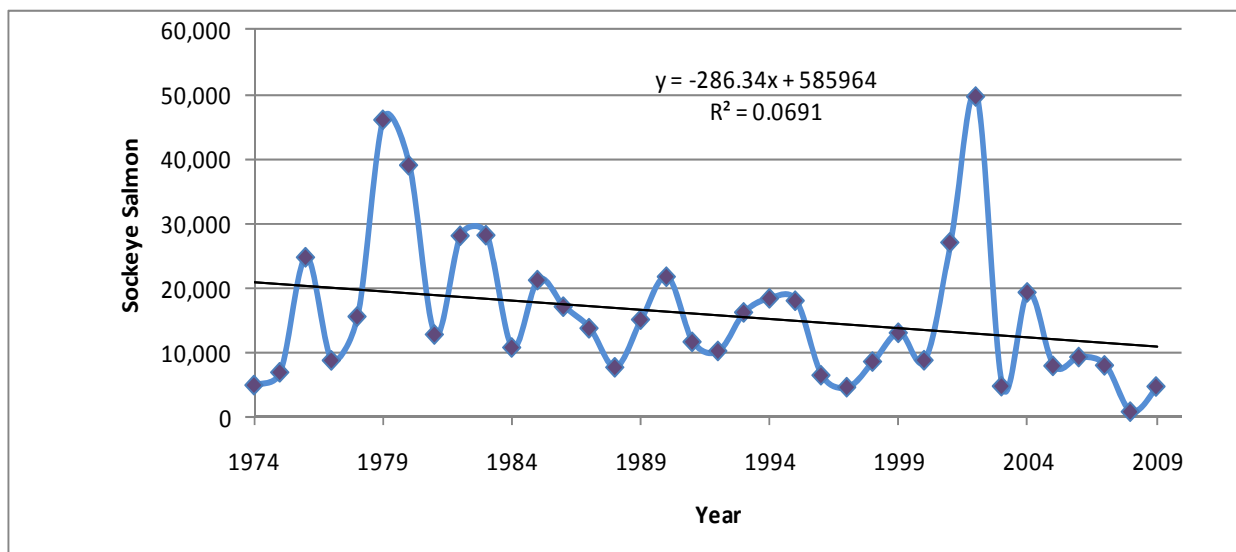


Figure 14. Long Lake weir sockeye estimates, 1974-2009.

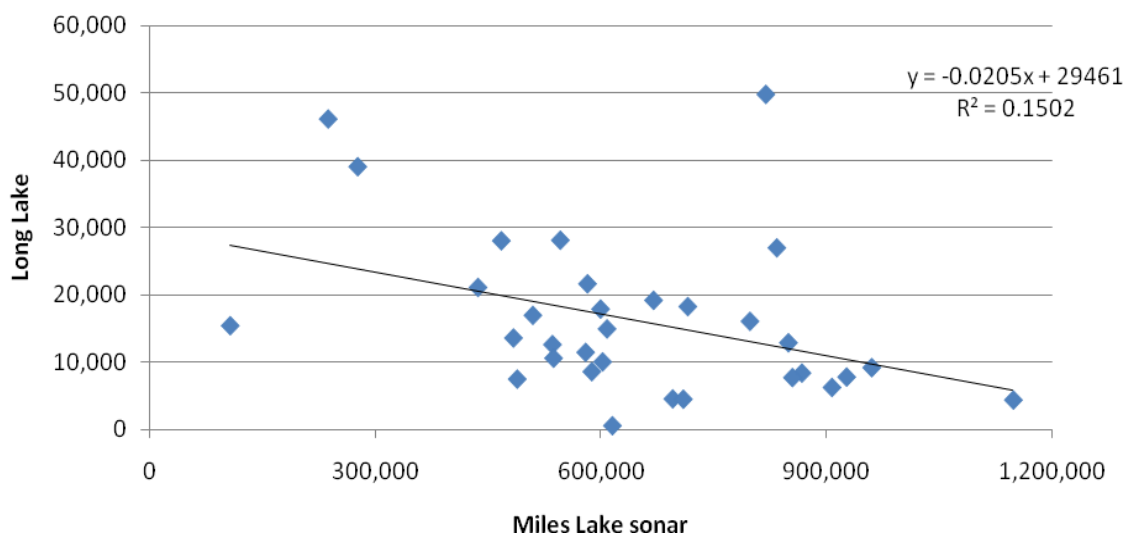


Figure 15. Relationship between Long Lake sockeye salmon and Miles Lake sonar counts, 1978-2009.

In 2009, age-1.3 sockeye salmon comprised 62.2% of sockeye salmon sampled, while females comprised 52.0% (Table 2). Average MEF length of all sockeye salmon sampled was 565 mm, while the average of age-1.3 males was 586 mm and the average of age-1.3 females was 563 mm (Table 3).

From 2007 to 2009, the percent of females in samples has been stable, ranging from 49-52% (Table 4). In 2009, age-1.3 sockeye salmon comprised 62% of those sampled, which was less than that in previous years (2007, 78%; 2008, 72%). The average MFE length of age 1.3 males, which ranged from 576-588 mm, was greater than that of age-1.3 females, which ranges from 556-563 mm, in each of the three years.

Table 2. Numbers by sex and age class of sockeye salmon sampled at the Long Lake weir, August 26 - October 10, 2009.

Sex		Age Class						Total Counted	Number sampled (% of total sample)
		1.1	1.2	2.1	1.3	2.2	2.3		
F	Percent	0.0	9.4	0.0	30.6	4.6	7.4	2,369	204 (52.0%)
	Number	0	428	0	1,394	210	337		
M	Percent	0.5	5.4	0.3	31.6	1.3	8.9	2,186	188 (48.0%)
	Number	23	246	14	1,439	59	405		
Total	Percent	0.5	14.8	0.3	62.2	5.9	16.3	4,555	392
	Number	23	674	14	2,833	269	742		
	SE	18	90	13	123	60	94		

Table 3. Average Length (mid-eye to tail fork), standard error (SE), and sample size by sex and age of sockeye salmon sampled at the Long Lake weir, August 26 - October 10, 2009.

Sex		Age Class					
		1.1	1.2	2.1	1.3	2.2	2.3
F	Average Length (mm)		491		563	492	557
	SE		4.5		3.1	3.3	7.1
	Sample Size		37		120	18	29
M	Average Length (mm)	363.0	515	370	586	513	571
	SE	27.5	2.4		4.4	6.0	7.1
	Sample Size	2.0	21	1	124	5	35
Total	Average Length (mm)	363.0	499	370	575	496	565
	SE	27.5	3.3		2.8	3.4	5.1
	Sample Size	2	58	1	244	23	64

Table 4. Comparison of sex, age and length data of sockeye salmon sampled at Long Lake weir, 2007-2009.

	2007	2008	2009
% of females	51	49	52
% of age-1.3	78	72	62
average MEF length age-1.3 male (mm)	576	588	586
average MEF length age-1.3 female (mm)	556	557	563

Run Timing

The median date of the 2009 run (August 31) occurred much earlier than that observed for four (2004-2007) of the previous five years, even though the date on which the first sockeye salmon passed through the weir (August 23) was several days later than that for any of the five previous years (Table 5, Figure 15). The last sockeye salmon were counted through the weir on October 15.

Table 5. Run timing information for the sockeye salmon migration through the Long Lake weir, 2004-2009.

Year	First Sockeye Salmon	Median Date	Cumulative Count on Median Date
2004	August 8	September 12	9,608
2005	August 11	September 12	3,885
2006	August 7	September 4	4,620
2007	August 15	September 8	4,868
2008	August 6	August 20	329
2009	August 23	August 31	2,352

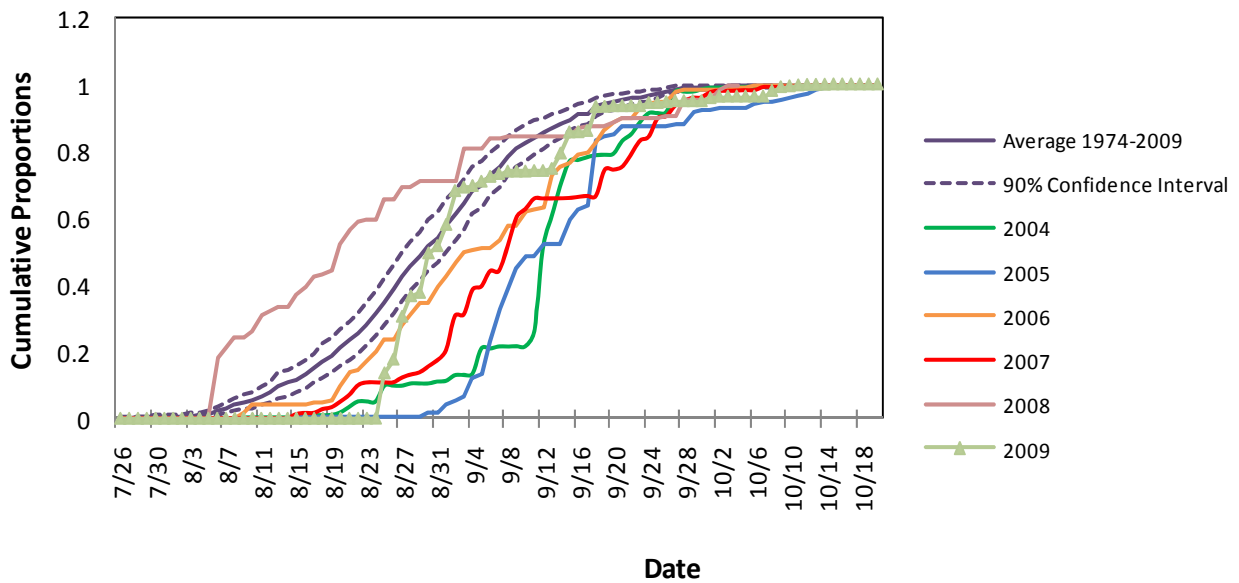


Figure 16. Average migratory run timing for 1974-2009 sockeye salmon runs, and migratory timing 2004-2009, Long Lake weir.

DISCUSSION

Weir Operation

There were no major changes in weir operations in 2009. 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 from the weir and stored at the end of each field season and then replaced each summer, while the weir's framework is left in place in the creek throughout the winter (Fig. 16). Erecting the electric fence earlier in the season to deter bears seems to have provided a safer work place at the weir site. Being able to staff the sampling crew with people living near the weir site (the 2009 sampling crew consisted of two individuals living in the Collins' household and one other local resident) has made it possible to operate this project efficiently and cost effectively.

The 2004 sampling box design has continued to work well. This sampling box replaced a smaller one that was built in 2003 (shown in Figure 2), which was the first year sampling was done at the weir and the first year that WRST was involved in the project. The redesigned box is larger than the 2003 box, and was built adjacent to the northwestern bank of Salmon Creek.



Figure 17. Long Lake weir, April 2006.

Biological Data

Otolith collecting was started in 2007 to supplement the age data collected from scale samples. Scales taken from the sockeye salmon that return to Long Lake are usually difficult to read because they are worn at the edges and have started to be resorbed. Because of this, the ages in these reports are based on length frequency data derived from mixed stock samples collected in the lower Copper River. Otoliths provide a more accurate way to age these salmon, but it is more problematic to collect otoliths. This is because otoliths are collected from carcasses of spawned-out sockeye salmon sampled from spawning areas in the lake and upstream of the weir site. Such sampling depends upon availability of carcasses to the sampling crew. This is a late run and spawning occurs over an extended time period: it has been documented as late as April in some areas of the lake. The crew is generally not available for sampling after the end of October and weather conditions make sampling difficult during the winter months.

Sockeye salmon returns to Long Lake have been highly variable, ranging from 631 in 2008 to 50,000 in 2002 (Table 1). While the total run of sockeye salmon to the Copper River, estimated at the Miles Lake sonar site, has shown an increasing trend in abundance since 1978, the escapement into Long Lake has generally shown a decreasing, although not statistically

significant ($P > 0.05$), trend since 1974. This negative relationship between Miles Lake and Long Lake counts is statistically significant ($P < 0.05$), although we do not know whether this is just a spurious relationship or due to factors associated with the total abundance of sockeye salmon returning to the Copper River drainage. For example, Long Lake sockeye salmon smolt survival may decrease as they compete with increasing numbers of smolt from other Copper River spawning populations, or Long Lake sockeye salmon adults may be harvested at a greater rate than other Copper River run components with changes in fishing patterns due to increasing total runs. However, our findings do indicate that not all spawning components of the total Copper River run experience similar trends over time, and that a large total return does not ensure, and may actually be detrimental to, achieving spawning escapements into all portions of this large drainage. Additionally, even though a statistically significant ($P < 0.05$) relationship was found between Mile Lake estimates and Long Lake escapements, this relationship does not have much predictive power, since Mile Lake estimates only explain about 14% of the observed variability of Long Lake escapements. Therefore, we feel it is important to continue to monitor spawning components of the total run in addition to the total inriver return since it is vitally important to conserve all segments of the population to ensure the continued health and sustainability of this important fishery resource,

CONCLUSIONS

Weir Operation

There were no major changes at the weir in 2009. The sampling box design continued to work well and erecting the electric fence earlier insured a safer work place for the entire sampling season. The sampling crew which was composed of two individuals living in the Collins' household and one other local resident also functioned well. In 2010 we plan on using a solar powered underwater camera and video recording system. This will allow us to reduce the number of crew members to one hired by the Collins Family Trust and one hired by WRST. Both are local residents.

Biological Data

According to Table 1 sockeye returns to Long Lake appear to be highly variable, from a high of 50,000 in 2002 to a low of 631 in 2008. The number of fish counted through the weir in 2009 is approximately 29 percent of the 37 year average of 15,724 sockeye. As in past years, the fish migrating into Long Lake are predominantly age class 1.3.

RECOMMENDATIONS

The Office of Subsistence Management (OSM), a division of USFWS has funded the Long Lake weir for four more years, 2010-2013, which will allow us to:

1. Continue monitoring the sockeye salmon escapement into Long Lake so that an appropriate natural and healthy escapement range can be determined.
2. Continue sampling sockeye salmon for age, length, and sex information to monitor the health of the spawning population.
3. Continue collecting otolith as a means to determine accurate age information for the sockeye salmon spawning population and extend the collection timing into the winter months.

As part of this work, we plan to install an underwater camera and video system, which will operate on solar electricity with generator backup, to improve our research and data collection at the weir in the following ways:

- It will allow the fish to swim through the weir structure according to their natural migratory timing and reduce the likelihood of bear problems.
- It will increase the accuracy of the salmon count migrating through the weir.
- It will reduce the number of man-hours needed to operate the weir and make it more cost efficient.

ACKNOWLEDGMENTS

In 2009 the Collins family and the Prince William Sound Science Center provided labor for operating the weir. Stefanie Tschappat assumed the majority of the responsibility for operating the weir and she and Lucas Stumpf were instrumental in assuring that age, sex, and length and otolith collection were conducted properly. Steve Moffit and crew at the ADF&G, Commercial Fisheries Division in Cordova, Alaska proposed the sampling regime for the weir, read scale samples, and provide age, sex, and length summaries. The U.S. Fish and Wildlife Service, Office of Subsistence Management, provided \$20,121 in funding support for 2009 through the Fisheries Resource Monitoring Program, under contract number FIS07-505. Stephen Fried, FWS, OSM, provided statistical advice.

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Appendix A. Daily and cumulative sockeye and coho salmon counts, and number of sockeye salmon sampled for age, sex, and length information, Long Lake weir, 2007.

Date	Daily Count	Sockeye Cumulative	Sampled	Daily Count	Coho Cumulative
13-Jul					
14-Jul					
15-Jul					
16-Jul					
17-Jul					
18-Jul					
19-Jul	0	0			
20-Jul	0	0			
21-Jul	0	0			
22-Jul	0	0			
23-Jul	0	0			
24-Jul	0	0			
25-Jul	0	0			
26-Jul	0	0			
27-Jul	0	0			
28-Jul	0	0			
29-Jul	0	0			
30-Jul	0	0			
31-Jul	0	0			
1-Aug	0	0			
2-Aug	0	0			
3-Aug	0	0			
4-Aug	0	0			
5-Aug	0	0			
6-Aug	0	0			
7-Aug	0	0			
8-Aug	0	0			
9-Aug	0	0			
10-Aug	0	0			
11-Aug	0	0			
12-Aug	0	0			
13-Aug	0	0			
14-Aug	0	0			
15-Aug	94	94	0		
16-Aug	26	120	0		
17-Aug	2	122	0		
18-Aug	91	213	40		

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Appendix A. Continued.

Date	Sockeye			Coho	
	Daily Count	Cumulative	Sampled	Daily Count	Cumulative
19-Aug	43	256	0		
20-Aug	133	389	39		
21-Aug	155	544	63		
22-Aug	231	775	0		
23-Aug	67	842	65		
24-Aug	0	842	0		
25-Aug	0	842	0		
26-Aug	0	842	0		
27-Aug	114	956	0		
28-Aug	72	1028	0		
29-Aug	52	1080	38		
30-Aug	143	1223	35		
31-Aug	141	1364	73		
1-Sep	243	1607	0		
2-Sep	802	2409	76		
3-Sep	34	2443	0		
4-Sep	588	3031	22		
5-Sep	77	3108	71		
6-Sep	364	3472	100		
7-Sep	2	3474	0		
8-Sep	594	4068	100		
9-Sep	673	4741	0		
10-Sep	193	4934	100		
11-Sep	247	5181	0		
12-Sep	0	5181	0		
13-Sep	6	5187	0		
14-Sep	0	5187	0		
15-Sep	7	5194	0		
16-Sep	26	5220	25		
17-Sep	23	5243	0		
18-Sep	0	5243	0		
19-Sep	618	5861	0		
20-Sep	3	5864	0		
21-Sep	71	5935	35	2	2
22-Sep	291	6226	100	11	13
23-Sep	321	6547	0	15	28
24-Sep	96	6643	0	24	52
25-Sep	431	7074	0	21	73

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Appendix A. Continued.

Date	Sockeye			Coho	
	Daily Count	Cumulative	Sampled	Daily Count	Cumulative
26-Sep	56	7130	0	5	78
27-Sep	246	7376	0	24	102
28-Sep	111	7487	0	21	123
29-Sep	72	7559	0	10	133
30-Sep	8	7567	0	2	135
1-Oct	129	7696	0	17	152
2-Oct	28	7724	0	8	160
3-Oct	0	7724	0	2	162
4-Oct	6	7730	0	2	164
5-Oct	10	7740	0	3	167
6-Oct	0	7740	0	1	168
7-Oct	74	7814	0	4	172
8-Oct	0	7814	0	0	172
9-Oct	0	7814	0	0	172
10-Oct	15	7829	0	2	174
11-Oct	2	7831	0	0	174
12-Oct	11	7842	0	1	175
13-Oct	0	7842	0	0	175
14-Oct	0	7842	0	0	175
15-Oct	4	7846	0	0	175
16-Oct	0	7846	0	0	175

Appendix B. Daily and cumulative sockeye and coho salmon counts, and number of sockeye salmon sampled for age, sex, and length information, Long Lake weir, 2008.

Date	Sockeye Salmon			Coho Salmon	
	Daily Count	Cumulative Count	Number Sampled	Daily Count	Cumulative Count
26-Jul	0	0	0	0	0
27-Jul	0	0	0	0	0
28-Jul	0	0	0	0	0
29-Jul	0	0	0	0	0
30-Jul	0	0	0	0	0
31-Jul	0	0	0	0	0
1-Aug	0	0	0	0	0
2-Aug	0	0	0	0	0
3-Aug	0	0	0	0	0
4-Aug	0	0	0	0	0
5-Aug	0	0	0	0	0
6-Aug	115	115	0	0	0
7-Aug	18	133	0	0	0
8-Aug	22	155	0	0	0
9-Aug	0	155	0	0	0
10-Aug	9	164	0	0	0
11-Aug	30	194	0	0	0
12-Aug	10	204	0	0	0
13-Aug	8	212	0	0	0
14-Aug	0	212	0	0	0
15-Aug	21	233	0	0	0
16-Aug	15	248	0	0	0
17-Aug	20	268	0	0	0
18-Aug	5	273	0	0	0
19-Aug	7	280	5	0	0
20-Aug	49	329	40	0	0
21-Aug	28	357	0	0	0
22-Aug	17	374	17	0	0
23-Aug	1	375	0	0	0
24-Aug	0	375	0	0	0
25-Aug	39	414	0	0	0
26-Aug	0	414	0	0	0
27-Aug	23	437	18	0	0
28-Aug	0	437	0	0	0
29-Aug	13	450	13	0	0
30-Aug	0	450	0	0	0
31-Aug	0	450	0	0	0

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Appendix B. Continued.

Date	Sockeye Salmon			Coho Salmon	
	Daily Count	Cumulative Count	Number Sampled	Daily Count	Cumulative Count
1-Sep	0	450	0	0	0
2-Sep	0	450	0	0	0
3-Sep	61	511	28	0	0
4-Sep	0	511	0	0	0
5-Sep	0	511	0	0	0
6-Sep	17	528	14	0	0
7-Sep	0	528	0	0	0
8-Sep	6	534	4	0	0
9-Sep	0	534	0	0	0
10-Sep	1	535	0	0	0
11-Sep	0	535	0	0	0
12-Sep	0	535	0	0	0
13-Sep	0	535	0	0	0
14-Sep	0	535	0	0	0
15-Sep	0	535	0	0	0
16-Sep	15	550	0	3	3
17-Sep	1	551	0	1	4
18-Sep	1	552	0	0	4
19-Sep	0	552	0	0	4
20-Sep	10	562	0	0	4
21-Sep	5	567	0	4	8
22-Sep	0	567	0	0	8
23-Sep	0	567	0	0	8
24-Sep	0	567	0	1	9
25-Sep	2	569	2	16	25
26-Sep	2	571	2	26	51
27-Sep	0	571	0	0	51
28-Sep	30	601	0	81	132
29-Sep	0	601	0	0	132
30-Sep	2	603	0	2	134
1-Oct	0	603	0	0	134
2-Oct	19	622	19	18	152
3-Oct	6	628	6	16	168
4-Oct	0	628	6	6	174
5-Oct	3	631	0	2	176
6-Oct	0	631	0	2	178
7-Oct	0	631	0	0	178
8-Oct	0	631	0	3	181
9-Oct	0	631	0	3	184

Appendix C. Daily and cumulative sockeye and coho salmon counts, and number of sockeye salmon sampled for age, sex, and length information, Long Lake weir, 2009.

Date	Daily Count	Sockeye		Coho	
		Cumulative	Sampled	Daily Count	Cumulative
7/16	0				
7/17	0				
7/18	0				
7/19	0				
7/20	0				
7/21	0				
7/22	0				
7/23	0				
7/24	0				
7/25	0				
7/26	0				
7/27	0				
7/28	0				
7/29	0				
7/30	0				
7/31	0				
8/1	0				
8/2	0				
8/3	0				
8/4	0				
8/5	0				
8/6	0				
8/7	0				
8/8	0				
8/9	0				
8/10	0				
8/11	0				
8/12	0				
8/13	0				
8/14	0				
8/15	0				
8/16	0				
8/17	0				
8/18	0				

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Appendix C. Continued.

Date	Daily Count	Sockeye		Coho	
		Cumulative	Sampled	Daily Count	Cumulative
8/20	0				
8/21	0				
8/22	0				
8/23	2	2			
8/24	0	2			
8/25	617	619			
8/26	187	806	20		
8/27	584	1390	62		
8/28	279	1669	54		
8/29	47	1716	0		
8/30	537	2253	0		
8/31	99	2352	25		
9/1	289	2641	43		
9/2	461	3102	80		
9/3	47	3149	0		
9/4	22	3171	0		
9/5	58	3229	0		
9/6	67	3296	0		
9/7	38	3334	0		
9/8	33	3367	0		
9/9	0	3367	0		
9/10	0	3367	0		
9/11	8	3375	8		
9/12	0	3375	0		
9/13	28	3403	12		
9/14	209	3612	60		
9/15	289	3901	31		
9/16	2	3903	0		
9/17	17	3920	0		
9/18	328	4248	0		
9/19	1	4249	0		
9/20	9	4258	0		
9/21	0	4258	0		
9/22	0	4258	0		
9/23	0	4258	0		
9/24	43	4301	30		
9/25	0	4301	0		

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Appendix C. Continued.

Date	Daily Count	Sockeye		Coho	
		Cumulative	Sampled	Daily Count	Cumulative
9/26	11	4312	0		
9/27	14	4326	0		
9/28	0	4326	0		
9/29	0	4326	0		
9/30	0	4326	0		
10/1	41	4367	14	11	11
10/2	19	4386	17	1	12
10/3	3	4389	0	0	12
10/4	0	4389	0	0	12
10/5	0	4389	0	0	12
10/6	0	4389	0	0	12
10/7	0	4389	0	0	12
10/8	77	4466	16	9	21
10/9	51	4517	14	12	33
10/10	12	4529	12	4	37
10/11	13	4542	0	0	37
10/12	6	4548	0	3	40
10/13	1	4549	0	0	40
10/14	2	4551	0	3	43
10/15	4	4555	4	0	43
10/16	0	4555	0	0	43
10/17	0	4555	0	0	43
10/18	0	4555	0	0	43
10/19	0	4555	0	0	43
10/20	0	4555	0	0	43
10/21	0	4555	0	0	43
10/22	0	4555	0	0	43
10/23	0	4555	0	0	43

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