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Abundance and Run Timing of Adult Salmon in Long Lake in the
Wrangell-St. Elias National Park and Preserve, 2011

2011 Annual Report 10-505

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ABSTRACT

The outlet creek of Long Lake flows into 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 only three projects providing accurate assessment of yearly run strength and migratory timing in tributaries to the Copper River. In 2011 the weir continued to use the underwater camera, DVR recording system, and solar panel array that was initiated in 2010, to enumerate salmon at this weir. The weir and recording system were installed August 1 and removed October 20. A total of 12,885 sockeye salmon migrated through the weir between August 9 and October 14. This was approximately 83% of the 38 year average weir count of 15,519 sockeye salmon, and represented about 1.4% of the total inriver run estimated by the Miles Lake sonar project. Run timing in 2011 started early and ended earlier than what was observed in the last eight years. In 2011 age, sex and length samples were collected from 9% of the escapement. Females comprised about 52% of the total sample. Age-1.2 sockeye salmon comprised 55% of the returning adults sampled; age-1.3 class comprised 39%. Average mid-eye-to-tail fork length of age-1.3 sockeye salmon was 565 mm for males and 545 mm for females.

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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. The ten year average (2000-2009) of the commercial harvest of Copper River sockeye salmon is 1,163,610; of Chinook salmon, 32,032; of coho salmon, 9,356 (Botz et al, 2012). There are also upriver and delta sport fisheries that have a combined ten year average sockeye harvest (2000-2009) of 12,175 and 4,230 Chinook, and an upriver personal use fishery that harvests 93,858 sockeye and 1,943 Chinook (average 2000-2009) (Botz et al, 2012). Salmon escapement into the upper Copper River system contributes to federal and state subsistence fishing from May through September each year: the ten year average harvest (combined state and federal, upriver and marine/delta) of sockeye is 69,475 and of Chinook is 4,042 (Botz et al, 2012). 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 is believed to enter the Copper River after the sonar has been pulled from the Miles Lake site.

Thirty-eight years of weir data show annual variations in abundance of Long Lake runs ranging from 636 to 50,000 sockeye salmon (Table 1). This is the longest running data set of salmon weir counts in the Copper River drainage. The sockeye salmon stock that spawns within Long Lake is the largest known salmon stock within the Chitina River drainage. The magnitude of escapement, and its contribution to the total inriver return of the Copper River, is widely variable (Table 1). The largest measured escapement of 50,000 sockeye salmon into Long Lake occurred in 2002, and comprised 6% of the estimated total inriver return. 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 31-year period, which 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 (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 the west bank of the creek on the upstream side of the weir which has been in use since then. In 2010 an underwater camera and DVR recording system were installed at the weir and a video viewing and monitoring station was set up on the west bank. We continued to use this system in 2011.

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

Table 1. Long Lake weir sockeye salmon escapement data from 1974-2011. Miles Lake sonar sockeye salmon counts from 1978-2011 (Botz et al. 2010; ADF&G 2011) .

Year	Miles Lake Sonar	Long Lake Weir	Long Lake as % of Sonar Estimates
1974		4,684	
1975		6,768	
1976		24,689	
1977		8,624	
1978	107,011	15,458	14.4
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	0.8
2008	614,999	631	0.1
2009	709,330	4,555	0.6
2010	924,010	10,876	1.2
2011	914,285	12,885	1.4



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



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

OBJECTIVES

- 1) To enumerate adult sockeye salmon migrating past a weir from late July until mid-October by using video equipment to count all individuals entering Long Lake.
- 2) To use hierarchical models and model selection criteria (e.g. AIC, DIC) to determine whether there are detectable trends in run timing and to identify relationships between run timing and climate conditions. Trends and relationships to climate variables would be considered to be identifiable if supported by the model selection criteria and if the 95% credible intervals did not include 0 (this objective was not addressed in 2011).
- 3) To estimate the age, sex, length composition of the sockeye salmon escapement from scale and otolith interpretation, such that the estimates are within 5% of the true proportion 90% of the time.

METHODS

Site Description

Long Lake is 480 m above sea level, at latitude 61° 23' 1.68" N and longitude 143° 17' 15.89" W (Figure 3). Long Lake is located adjacent to the McCarthy Road (see map, Appendix A) 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).

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. The weir is installed and operated at the outlet of the lake, Weir pickets are spaced 3.75 cm apart (Figure 3).

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.

We incorporated a major change in the escapement estimation methodology in 2010 by installing an underwater video camera recording system (Figure 5). The system was designed from insight gained through the use of similar technology at the Tanada Creek weir (Sarafin 2010). The underwater camera was installed directly onto a fish passage chute which was connected to the upstream side of the weir (Figure 4). This provides a means of allowing fish passage throughout the day and night, except when the weir gate is closed during the review of recorded video footage or to obtain AWL data from fish captured in the sampling trap. The fish passage chute forces fish passing through the weir to swim within a few inches of the glass surface of the camera housing. Footage is then recorded on a digital video recorder (DVR).

A 12 volt, underwater LED light was installed in the fish passage chute to illuminate the view area. A photocell switch automatically turns the light on and off in response to changes in the level of ambient light. A 12 volt deep cycle battery bank (400 Amp-hours total capacity) provides power to the system. The charge is maintained in the battery bank from a photovoltaic solar panel array (360 Watts total rating) and a MPPT charge controller.

Daily weir checks were performed throughout the season. The underwater video system was not consistently used during the 2011 season. Instead, counts were primarily obtained by periodically opening and closing the weir gate and visually counting fish that pass or fish that are sampled. All observed salmon passage was recorded on a daily count data form.

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 6). 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 2011 the weir, video camera recording system, and sampling box were installed and running by August 1. Work at the weir ended on October 20, when the weir pickets were removed for the winter. Sampling was typically performed with a crew of two people.

In 2011 water level was monitored throughout the summer, from August 1 to October 20. A staff gauge installed on the weir was used to measure water level (by observation) each day (Figure 7). Water temperature was monitored from August 1 through September 14, when the thermometer was lost.

Bears are frequently a problem at the weir and further downstream in the creek. An electric fence was installed around the weir, viewing station and sampling box for the entire 2011 field season to prevent bears from damaging the weir, equipment, and eating salmon from the box.



Figure 3. Long Lake weir with video installed.



Figure 4. Camera box and fish passage chute.



Figure 5. Work station and photovoltaic array.



Figure 6. Sampling box, Long Lake weir, 2011.



Figure 7. 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. Sockeye salmon were sampled with a schedule provided to us 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. Age, sex, and length sampling at the weir occurred from August 12 through September 21 (Figure 8). Age, sex, and length data were also collected from 200 sockeye salmon carcasses sampled from the lake and shore in October. During the winter months, (December – April) otoliths were collected from approximately 200 sockeye salmon carcasses gathered from the open water spawning area of the lake. Sex and length was obtained from these carcasses when possible. The otoliths were sent to ADF&G in Cordova for analysis.

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. 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.

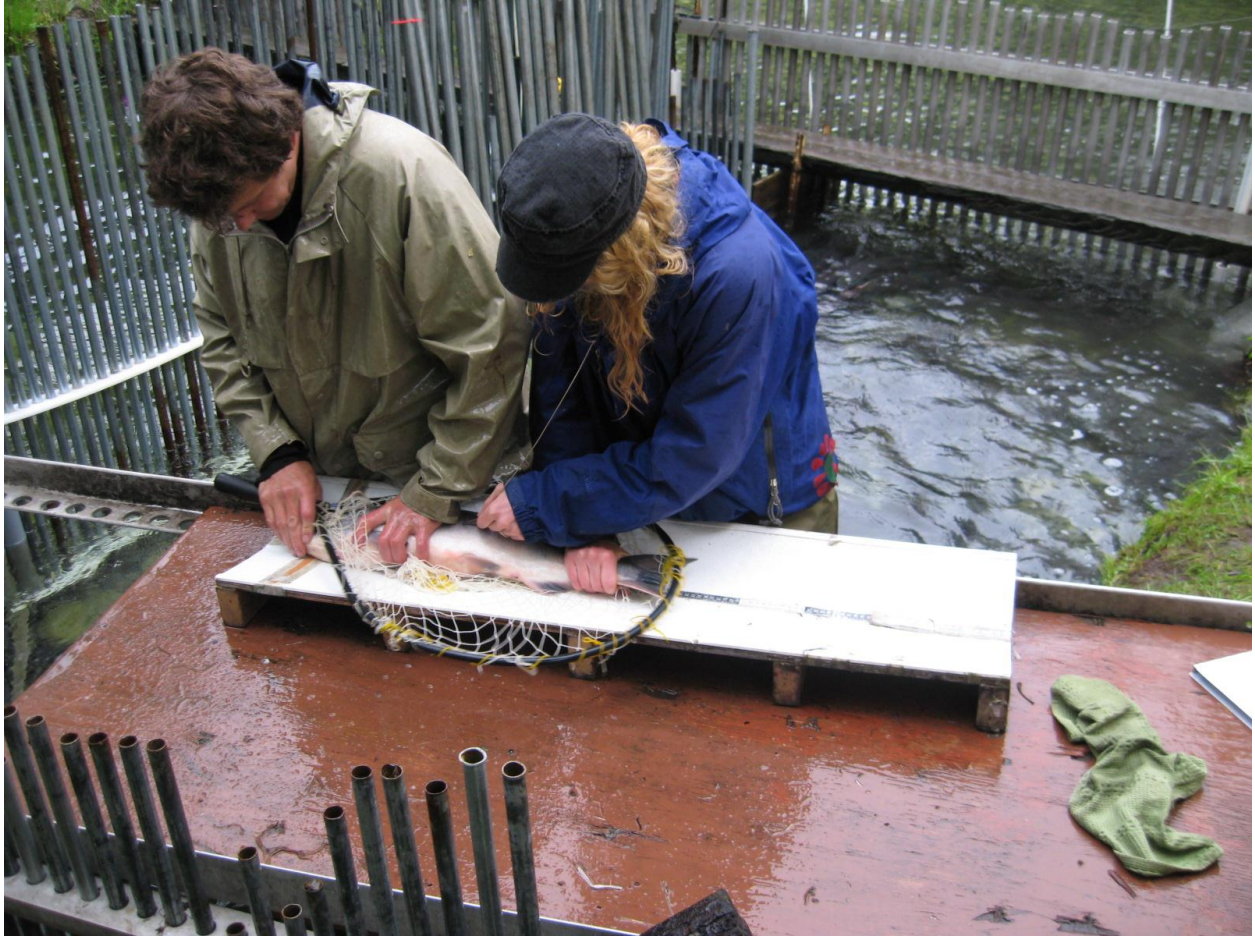


Figure 8. Scale collection at Long Lake weir, 2011.

A simple linear regression line in excel was fitted to data from both Long Lake and Miles Lake sonar to see if escapement at these two locations showed any trends over time in. The coefficient of determination (R^2) was also given. .



Figure 9. Otolith sampling, 2011.

RESULTS

Weir Operation

In 2011, daily staff gauge readings between August 1 and October 20 varied between 1.58 feet and 1.78 feet, showing a maximum variation of 0.20 feet (Figure 10). The water level was average throughout the field season. (Figure 11).

In 2011, between August 9 and September 14 when the thermometer was lost downstream, daily water temperature data ranged from a high of 60° F to a low of 22° F but was not recorded consistently (Figure 12).

Biological Data

In 2011, 12,885 sockeye salmon were enumerated through the Long Lake weir (Table 1, Figure 13, and Appendix A). The first sockeye salmon passed through the weir on August 9. The median run day occurred on August 17 when 6,514 sockeye salmon had been counted through

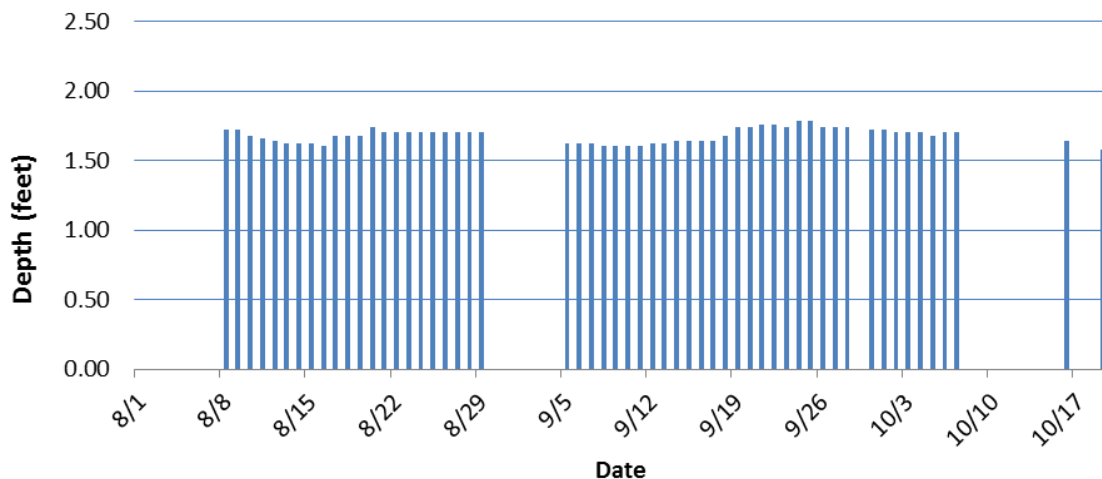


Figure 10. Daily staff gauge readings of water depth, Long Lake weir, 2011.

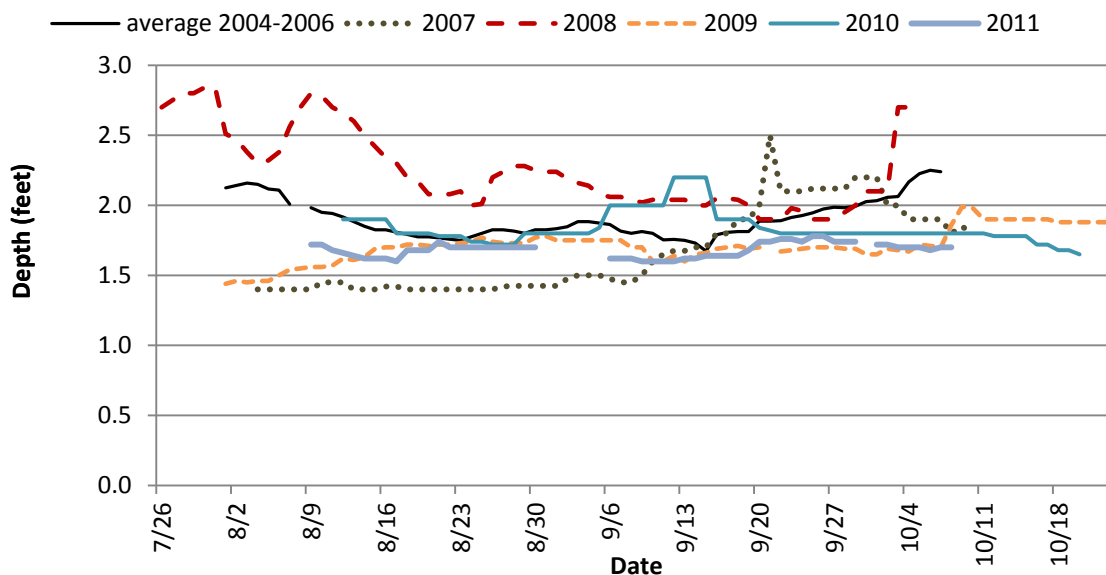


Figure 11. Staff gauge reading average 2004-2006, and staff gauge readings for 2007-2011.

the weir. A total of 1,047 sockeye salmon were sampled for sex, length, and age. No age data was available for 209 samples because the scales were not readable. Between August 14 and October 20, a total of 257 coho salmon were also enumerated.

Sockeye returns to Long Lake during the 38 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 14). The 38 year average migration through the weir is 15,519 sockeye salmon; the 2011 count of

12,885 was 83% of the average. In 2011 the total inriver run estimated by the Miles Lake sonar project was 914,285 salmon and the Long Lake sockeye count represented about 1.4% of it (Table 1). During 1978-2011, Long Lake escapements counts represented an average of 3.5% of the total inriver run, but ranged from 0.4% to 19.4% of the total inriver run.

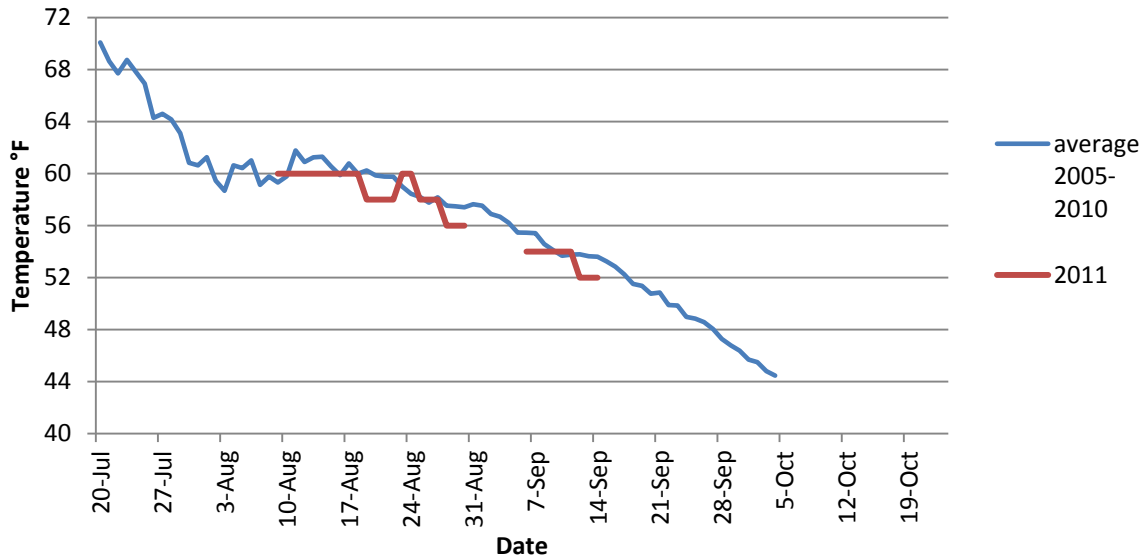


Figure 12. Daily water temperature data at Long Lake weir during 2011 and the average daily temperature data, 2005-2010.

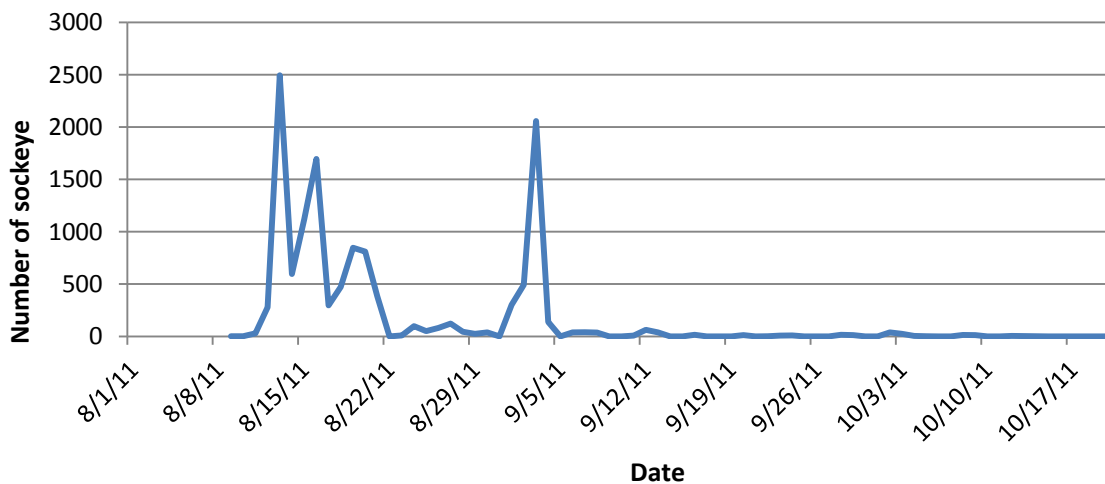


Figure 13. Daily sockeye salmon count, Long Lake weir, 2011.

Long Lake escapements showed a decreasing abundance trend ($R^2=0.1798$) for the 34 year time period 1978-2011 (Figure 14). Conversely, Miles Lake estimates showed an increasing abundance trend ($R^2=0.6012$) (Figure 15).

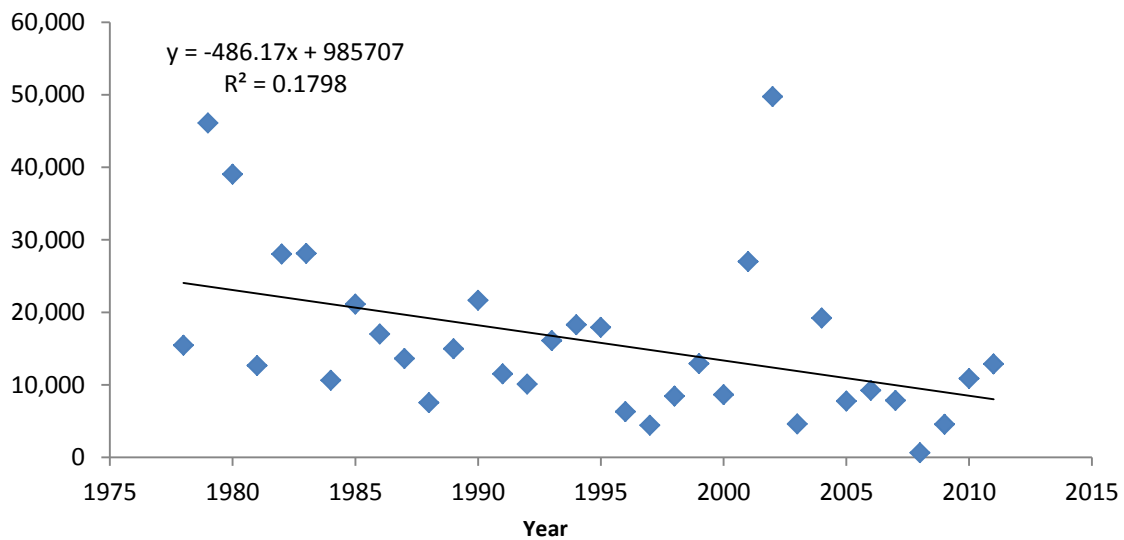


Figure 14. Sockeye salmon escapement estimates and trend line, Long Lake weir, 1978-2011.

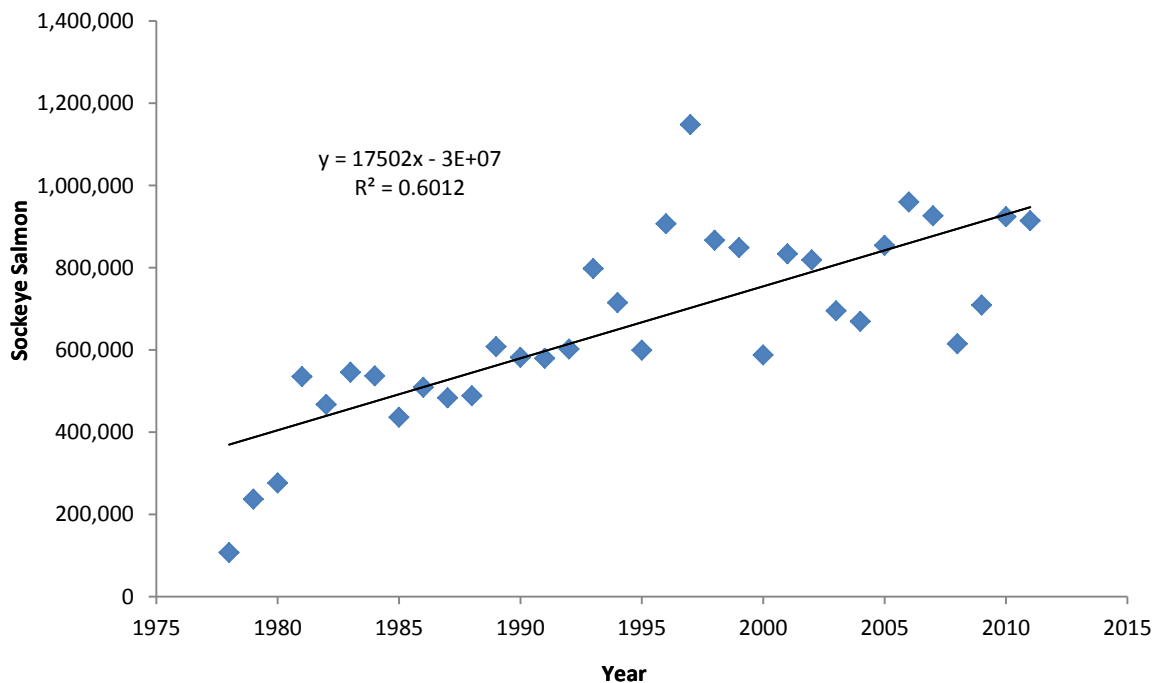


Figure 15. Sockeye salmon escapement estimates and trend line, Miles Lake sonar, 1978-2011.

In 2011 age-1.3 sockeye salmon comprised 61% of sockeye salmon sampled and age-1.2 comprised 33% of the sockeye salmon sampled. Forty-seven percent were males and 53% were females (Table 2). In the past ten years, excepting for 2010 when the majority was age-1.2, the majority of sampled salmon were age-1.3 fish. Average MEF length of all sockeye salmon

sampled was 526 mm, while the average of age-1.3 males was 559 mm and the average of age-1.3 females was 542 mm (Table 3).

Table 2. Numbers by sex and age class of sockeye salmon sampled at the Long Lake weir, August 9, 2011 – April 12, 2012.

Brood Year and Age Class ¹									
Sex		2007		2006		2005		Total Fish Counted	Number of fish sampled
		1.2	1.3	2.2	2.3				
F	Percent	20.0	29.7	0.8	1.9	6,744		448	
	Number	2,574	3,823	105	241				
M	Percent	12.5	31.5	0.8	2.1	6,051		402	
	Number	1,611	4,064	105	291				
Total	Percent	33.1	61.3	1.6	4.0	12,885		856	
	Number	4,260	7,903	211	512				
	SE	207	215	56	86				

¹Ages determined using length frequency and otolith data.

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 9 2011 – April 12, 2012.

Sex		Brood Year and Age Class ¹			
		2007	2006	2005	
		1.2	1.3	2.2	2.3
F	Average Length (mm)	495	542	518	560
	SE	2	1	6	4
	Sample Size	168	252	6	15
M	Average Length (mm)	506	559	518	560
	SE	2	1	7	5
	Sample Size	103	266	5	17
Total	Average Length (mm)	499	551	505	552
	SE	1	1	6	4
	Sample Size	271	518	11	32

Run Timing

Migratory timing started early and ended earlier than every year since 2004. The median date of the 2011 run (August 17) occurred earlier than observed in the previous seven years. The last sockeye salmon was counted through the weir on October 14 (Table 4 and Figure 16).

Table 4. Run timing information for the sockeye salmon migration through the Long lake weir, 2004-2011

Year	First Sockeye Salmon	Median Date	Cumulative Count on Median Date
2004	8-Aug	12-Sep	9,608
2005	11-Aug	12-Sep	3,885
2006	7-Aug	4-Sep	4,620
2007	15-Aug	8-Sep	4,868
2008	6-Aug	20-Aug	329
2009	23-Aug	31-Aug	2,352
2010	11-Aug	29-Aug	6,168
2011	9-Aug	17-Aug	6,514

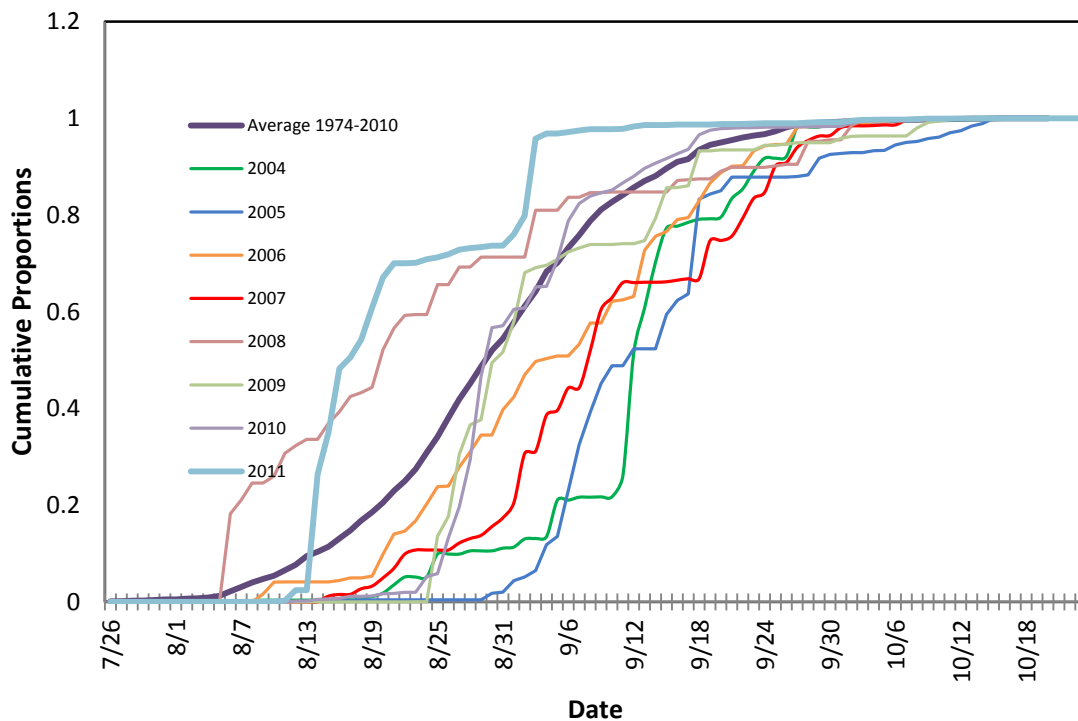


Figure 16. Average sockeye salmon migratory run timing for 1974-2010 and annual migratory run timing for 2004-2011, Long Lake weir.

DISCUSSION

Weir Operation

Escapement monitoring typically relies on video, sonar, or direct visual observation. Video technology provides a means of monitoring without having staff continually on site throughout the field season. Prior to 2010, Long Lake weir operations were based on direct visual observations at the weir made one or more times each day. The gate in the weir was only open to allow fish passage when counting was being done. Despite efforts to make counts and pass fish at various times of the day, salmon would not always pass through the weir while someone was on site and opened the gate. Inevitably, salmon would be observed backed up below the weir and congregated in pools, delayed in their migration due to weir operations. This increases their vulnerability to predation, can cause self-inflicted injuries when salmon repeatedly attempt to pass the weir when the gate is closed, and may also deplete their energy stores. When salmon concentrate behind the weir, the likelihood of human-bear habituation is also increased, particularly as bears begin to associate the weir site with food availability.

An alternative to regulating fish passage by closing and opening a gate within the weir is to keep the gate open at all times. However, this makes it necessary to either, continuously observe and record salmon passage or to extrapolate data to cover periods when visual observations are lacking. Since salmon passage rates vary within and among days, direct visual observations would need to be made several times each day to reduce the magnitude of extrapolation errors. In 2010, we were able to avoid these problems by using an underwater video recording system in conjunction with a passage chute built into the weir to ensure that all fish passing through the weir travel close to the camera lens. This allows us to keep the weir gate open when staff is not present, and allows salmon to pass the site in a less obstructed manner that should allow them to migrate in a more natural pattern with fewer detrimental effects. The underwater camera and video recording were only used sporadically in 2011.

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. Erecting the electric fence earlier in the season to deter bears seems to have provided a safer work place at the weir site. Staffing the sampling crew with people living near the weir site (the 2011 sampling crew consisted of two individuals living on Long Lake) 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.

Biological Data

The other change made in 2011 was to contract a local, year-round resident, from Long Lake to collect otoliths during the winter months from carcasses in the open water on the spawning grounds located on the north shore of the lake. Two hundred and three otoliths were collected from December through April.

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.

Sockeye salmon returns to Long Lake have been highly variable, ranging from 631 in 2008 to 49,747 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 trend since 1974. Long Lake sockeye salmon start coming into the Copper River in early to mid July. The Miles Lake sonar stops operations around the end of July and there are no other ways of estimating these late-run stocks while there are still multiple fisheries using the resource. We feel it is important to continue monitoring spawning components of the total run in addition to the total inriver return. It is important to conserve all segments of the population to ensure genetic diversity and the continued health and sustainability of this important fishery resource.

CONCLUSIONS

Weir Operation

Although not consistently utilized in 2011, the underwater camera and video recording system functioned well and provided an excellent means of enumerating salmon passage through the weir. Likewise, the photovoltaic system demonstrated its capability of providing necessary power for the electronics. There were no other major changes at the weir in 2011. 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 local residents also functioned well. The incorporation of the underwater video system allowed us to reduce the number of crew members and work hours required for the project.

Biological Data

Sockeye salmon returns to Long Lake appear to be highly variable, from a high of 50,000 in 2002 to a low of 631 in 2008 (Table 1). The number of fish counted through the weir in 2011 is approximately 83 percent of the 38 year average of 15,519 sockeye. The majority of fish migrating into Long Lake were predominantly age-1.3.

RECOMMENDATIONS

The Office of Subsistence Management has provided funding for the Long Lake weir for four more years, 2010-2013, and this 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. We now know that it is feasible to collect otoliths from salmon carcasses during the winter months. Since it is difficult to use scale samples from fish that have been in the freshwater systems for a long period for accurate age analysis, we would like to depend more on the collection of otoliths for the aging process.
4. Continue to operate the underwater video recording system to estimate escapement and to utilize this system more methodically in 2012.
5. Remove Objective 2 in future years. This objective is not within the scope of this project.

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LITERATURE CITED

Alaska Department of Fish and Game (ADF&G). 2010. Fish Count Data. Internet: <<http://www.sf.adfg.state.ak.us/FishCounts/index.cfm/FA/main.home>>.

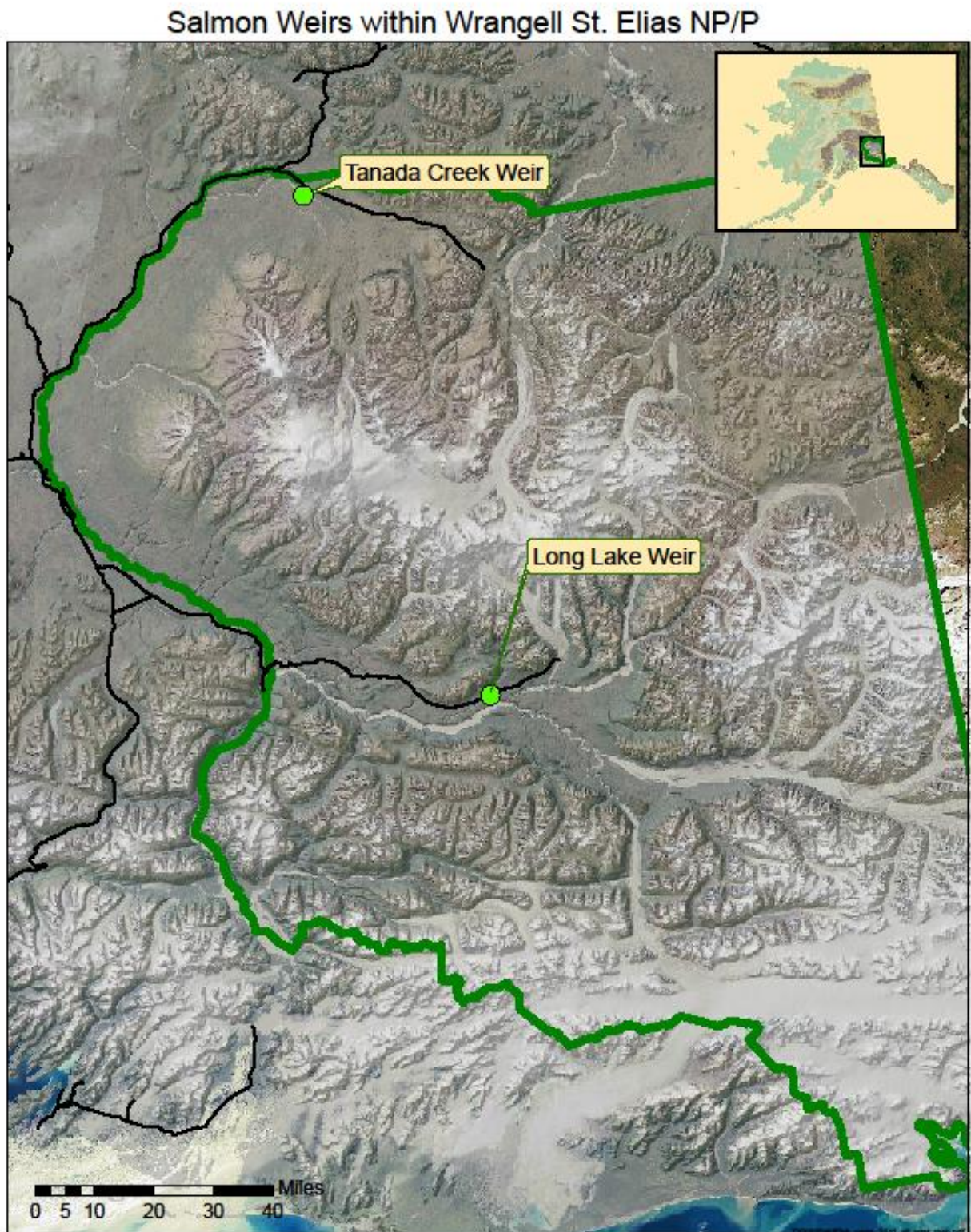
Botz, J., G. Hollowell, T. Sheridan, R. Brenner, and S. Moffitt. 2012. 2010 Prince William Sound area finfish management report. Alaska Department of Fish and Game, Fishery Management Report No. 12-06, Anchorage.

Lewis, B., J. Botz, R. Brenner, G. Hollowell, and S. Moffit. 2008. 2007 Prince William Sound Area finfish management report. Alaska Department of Fish and Game Fishery Management Report No. 08-53.

Sarafin, D.R. 2010. Abundance and Run Timing of Adult Salmon in Tanada Creek in the Wrangell-St. Elias National Park and Preserve, 2007-2009. USFWS Office of Subsistence Management, Fisheries Resource Monitoring Program, Final Report No. OSM07-502-2010, Anchorage, Alaska.

USDA (United States Department of Agriculture, Soil Conservation Service). 1979. Exploratory Soil Survey of Alaska, National Cooperative Soil Survey.

Appendix A. Map of Salmon Weirs in Wrangell-St. Elias National Park and Preserve



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, 2011.

Date	Sockeye Salmon (Number)				Coho Salmon (Number)	
	Daily Count	Cumulative Count	Daily Sample	Cumulative Sample	Daily Count	Cumulative Sample
8/1/11	0	0	0	0	0	0
8/2/11	0	0	0	0	0	0
8/3/11	0	0	0	0	0	0
8/4/11	0	0	0	0	0	0
8/5/11	0	0	0	0	0	0
8/6/11	0	0	0	0	0	0
8/7/11	0	0	0	0	0	0
8/8/11	0	0	0	0	0	0
8/9/11	2	2	0	0	0	0
8/10/11	2	4	0	0	0	0
8/11/11	29	33	29	29	0	0
8/12/11	278	311	89	118	0	0
8/13/11	2495	2806	120	238	0	0
8/14/11	597	3403	40	278	1	1
8/15/11	1119	4522	150	428	0	1
8/16/11	1695	6217	69	497	0	1
8/17/11	297	6514	80	577	2	3
8/18/11	472	6986	80	657	0	3
8/19/11	847	7833	80	737	0	3
8/20/11	810	8643	0	737	0	3
8/21/11	381	9024	0	737	0	3
8/22/11	0	9024	0	737	0	3
8/23/11	10	9034	10	747	0	3
8/24/11	98	9132	27	774	3	6
8/25/11	50	9182	0	774	0	6
8/26/11	81	9263	0	774	3	9
8/27/11	122	9385	20	794	0	9
8/28/11	45	9430	6	800	0	9
8/29/11	25	9455	17	817	1	10
8/30/11	39	9494	0	817	0	10
8/31/11	0	9494	0	817	0	10
9/1/11	302	9796	0	817	0	10
9/2/11	492	10288	0	817	0	10
9/3/11	2057	12345	0	817	34	44
9/4/11	138	12483	0	817	0	44
9/5/11	0	12483	0	817	0	44
9/6/11	38	12521	0	817	0	44
9/7/11	40	12561	0	817	0	44
9/8/11	37	12598	14	831	2	46
9/9/11	0	12598	0	831	0	46
9/10/11	0	12598	0	831	0	46
9/11/11	8	12606	8	839	1	47
9/12/11	63	12669	0	839	3	50
9/13/11	38	12707	0	839	5	55
9/14/11	0	12707	0	839	0	55
9/15/11	0	12707	0	839	0	55
9/16/11	15	12722	0	839	0	55

-continued-

Appendix A. Continued.

Date	Sockeye Salmon (Number)				Coho Salmon (Number)	
	Daily Count	Cumulative Count	Daily Sample	Cumulative Sample	Daily Count	Cumulative Count
9/17/11	0	12722	0	839	0	55
9/18/11	0	12722	0	839	0	55
9/19/11	0	12722	0	839	0	55
9/20/11	12	12734	5	844	2	57
9/21/11	0	12734	0	844	0	57
9/22/11	2	12736	0	844	16	73
9/23/11	8	12744	0	844	0	73
9/24/11	10	12754	0	844	2	75
9/25/11	0	12754	0	844	0	75
9/26/11	0	12754	0	844	0	75
9/27/11	0	12754	0	844	3	78
9/28/11	15	12769	0	844	3	81
9/29/11	13	12782	0	844	2	83
9/30/11	0	12782	0	844	2	85
10/1/11	0	12782	0	844	0	85
10/2/11	39	12821	0	844	8	93
10/3/11	24	12845	0	844	8	101
10/4/11	4	12849	0	844	28	129
10/5/11	1	12850	0	844	4	133
10/6/11	0	12850	0	844	0	133
10/7/11	0	12850	0	844	0	133
10/8/11	14	12864	0	844	6	139
10/9/11	12	12876	0	844	19	158
10/10/11	0	12876	0	844	0	158
10/11/11	0	12876	0	844	0	158
10/12/11	4	12880	0	844	1	159
10/13/11	3	12883	0	844	8	167
10/14/11	2	12885	0	844	15	182
10/15/11	0	12885	0	844	25	207
10/16/11	0	12885	0	844	11	218
10/17/11	0	12885	0	844	20	238
10/18/11	0	12885	0	844	9	247
10/19/11	0	12885	0	844	8	255
10/20/11	0	12885	0	844	2	257

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