

Alouette Project Water Use Plan

Alouette Sockeye Adult Enumeration

Implementation Year 5

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Alouette Adult Sockeye Enumeration – 2012

Study Period: 2012

Alouette River Management Society

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Alouette Adult Sockeye Enumeration – 2012



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Executive Summary

Through BC Hydro's Water Use Plan for the Alouette Watershed, a spring surface release from the Alouette Dam has allowed for kokanee/sockeye smolts to migrate to the ocean for the last six years. The first surface releases occurred in 2005 and in 2007 the first adult sockeye returned to the Alouette Watershed. The 2012 Alouette sockeye salmon run saw 45 adults returning between July 9 and September 1, 2012. All 45 sockeye were caught at the Allco Fish Hatchery and none were caught at the trap at the base of the dam. Forty-three sockeye were released in the Alouette Reservoir (Lake). Fork length measurements were taken for 42 sockeye and scale samples were collected for 42 sockeye and tissue samples from 44 of the 45 returning sockeye. The measurements indicated an average fork length of 57.8cm.

Of the 44 scale samples, only 29 were useable for aging and 45% of those were four year old sockeye with two years in a marine environment. The genetic sampling identified 42 out of 44 tissue samples of returning adults were Alouette stock. Two tissue samples were unable to be analyzed due to the sample being in either poor condition or having been contaminated (pers.comm, Godbout, 2013). Based on microsatellite DNA, 2 out of 3 "sockeye" that returned to Coquitlam in 2012 were actually Alouette sea-run kokanee. Between the return years of 2005-2008, the smolt to adult (return to the hatchery weir) survival of the Alouette sockeye has ranged from a low of 0.084% in the 2007 smolt year to a high of 1.34% in the 2008 smolt year. For the first time, an adult sockeye from the 2006 brood year returned to the weir that had spent 4 years in freshwater and 2 years in the marine environment (6.4 age). A 6.3 aged adult from the 2005 brood year had returned in 2011.

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Introduction

During the 2006 review of the Alouette Water Use Plan (WUP), the consultative Alouette Monitoring Committee identified the restoration of an anadromous sockeye salmon run as a key issue in the Alouette River system. Construction of the dam in the 1920s impounded the reservoir and extirpated the sockeye run soon after. As a means of re-establishing the stock, a spring surface release from the dam was integrated into the WUP. The release of $3\text{m}^3\text{s}^{-1}$ from April to June has indeed facilitated kokanee/sockeye out-migration from the reservoir. Since 2005, smolts have successfully migrated through the spillway gate during the spring release and to the ocean via the Alouette River (Table 1, Mathews et al. 2013).

Table 1. Estimated number of smolts leaving the Alouette Reservoir during the spring surface release, 2005-2012.

Year of Smolt Migration	Estimated Number of Smolts
2005	7,900
2006	5,064
2007	62,915
2008	8,257
2009	4,287
2010	15,434
2011	35,542
2012	728

The viability and authenticity of kokanee smolt “re-anadromization” is dependent on the stocks ability to adapt to salt water conditions, to adopt behavioural strategies to compete and avoid predation in an ocean environment, and to recognize and return to their native lake/stream system to spawn. Through the Alouette Adult Sockeye Enumeration monitoring program, sockeye returning to the Alouette River are collected, counted, aged, genetically tested and released into Alouette Lake. The first run of Alouette sockeye salmon since extirpation were trapped in 2007 and genetically proven to be Alouette stock.

Objectives

The main purpose of the seven year Alouette Adult Sockeye Enumeration monitoring program is to establish whether out-migrating Alouette Lake kokanee/sockeye smolts are capable of adapting to an anadromous existence. Adaptation is considered successful when sockeye return from the ocean environment to spawn in Alouette Lake. Additionally, the monitoring program seeks to establish the timing and genetic structure of the returning sockeye run and to assess whether ocean survival rates of returning re-anadromized kokanee are comparable to that of sockeye stocks found elsewhere. During the first three years of the program (2008-2010), the Allco Hatchery fish fence was operated from April to December to determine the timing and volume of the run. Based on the results of these efforts, the following four years (2011-2014) will involve a shorter fence operation, commencing mid-June through to the fall. Tissue samples

are also collected in order to ensure that returning adults are Alouette stock and not strays from other nearby coastal systems.

Study Area

The South Alouette Watershed (144 km²), comprised of the South Alouette River and Alouette Reservoir, is located within the communities of Maple Ridge and Pitt Meadows (Figure 1). The site of the Alouette Adult Sockeye Enumeration program is approximately 8 km downstream from the Alouette Reservoir at the Allco Fish Hatchery operated by BC Corrections Fraser Regional Correctional Centre. The hatchery is well positioned to intercept all migrating adult sockeye on their way back to the reservoir.

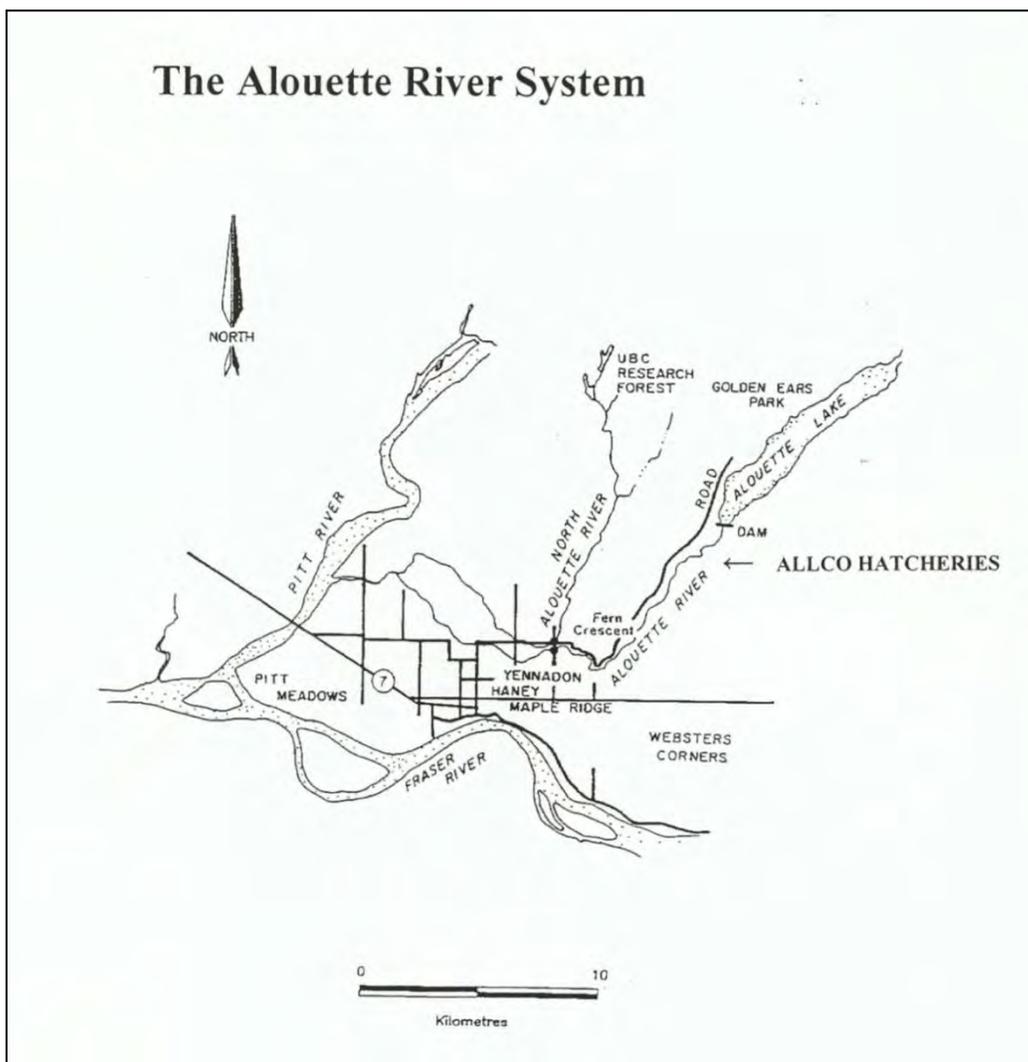


Figure 1. Map of the Alouette Watershed

Methods

The monitor necessitates longer operation of the Allco Fish Hatchery brood stock collection fence and trap in order to characterize the run timing for the Alouette sockeye stock

(Management questions #2;Figure 2). From the first year of monitoring in 2008, the adult sockeye run appeared to be a summer run, arriving in the Alouette Watershed in July and August (Balcke, 2009). Taking this into consideration, as well as the maintenance requirements, and downstream steelhead kelt passage, the Alouette Monitoring Committee decided that in both the 2009 and 2010 the fence would be in operation between April and December, rather than year round (Cruickshank, 2010). In 2011, the fence operation was shortened and the monitor began on June 15, 2011 . Returning sockeye sampling dates commenced on July 9 and completed on September 1, 2012.



Figure 2. The Allco Fish Hatchery fence and trap, July 2008

The fish fence was designed to direct sockeye and other salmon into the trap, which was monitored daily by BC Corrections staff and crew. In case of a failure at the Allco fish fence, BC Hydro installed a trap at the low level outlet of the Alouette Dam to catch returning sockeye. Once trapped, the sockeye were dip-netted out of the trap and transported by BC Corrections to Alouette Lake, where they were released. The sockeye were transported to the reservoir in specifically designed tanks fitted for both the Allco Hatchery truck and sockeye transport trailer (Figure 3). At the lake, a slide was connected to the tanks and the sockeye were released (Figure 4).



Figure 3. Sockeye transport tanks, August 2009

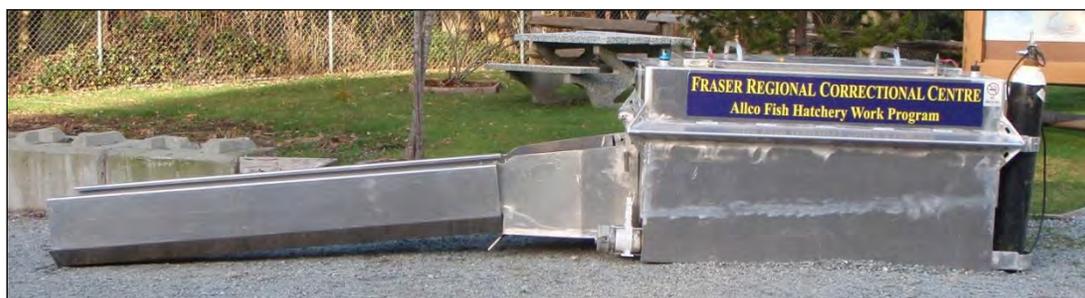


Figure 4. Sockeye transport tank with release slide connected, January 2010

For each returning sockeye, the date of capture and release was recorded. Additionally, fork length measurements and pictures were taken for all returning sockeye. Scale and tissue samples were collected daily from 44 sockeye (Figure 5). The tissue samples were sent to the Pacific Biological Station laboratories in Nanaimo, B.C. for genetic analysis and the scale samples were sent to the Pacific Salmon Commission. In 2012, 18 returning sockeye were also tagged by LGL Limited with motion sensitive MAP tags, which were used to track the sockeye migration in the Alouette Reservoir (Figure 6 and 7). The Allco Hatchery fish trap, the transport trailer and tanks, and the LGL Limited tagging projects were funded by Coastal Fish and Wildlife Compensation Program (formerly Bridge Coastal Restoration Program)), which is outside of the Alouette Water Use Plan monitoring programs.



Figure 5. Returning sockeye is measured and sampled, August 2010



Figure 6 Returning sockeye is tagged with motion sensitive MAP tags, August 14, 2009



Figure 7 Placement of a radio tag in dead sockeye to ensure proper placement of tag.

Results

Adult Sockeye Returns

A total of 45 sockeye returned to the Alouette Watershed during the 2012 run (Table 2). All 45 were caught at the Allco trap while none were caught at the BC Hydro dam trap. Forty-three sockeye were released live into the Alouette Reservoir. The ninth sockeye was found dead as a result of eagle kill and the last sockeye caught was found dead in the trap for unknown reasons.

Table 2. Number of returned adults sockeye to the Alouette Watershed, 2007-2012

Year of Adult Return	Number of Returned Adults	Number of Adults Released Alive into Alouette Reservoir
2007	28	5
2008	54	53
2009	45	43
2010	115	103
2011	11	8
2012	45	43

In 2012, the first sockeye was in the trap on July 9 and the last one on September 1 (Figure 8). The peak of the return was August 12, with ten sockeye caught on this day.

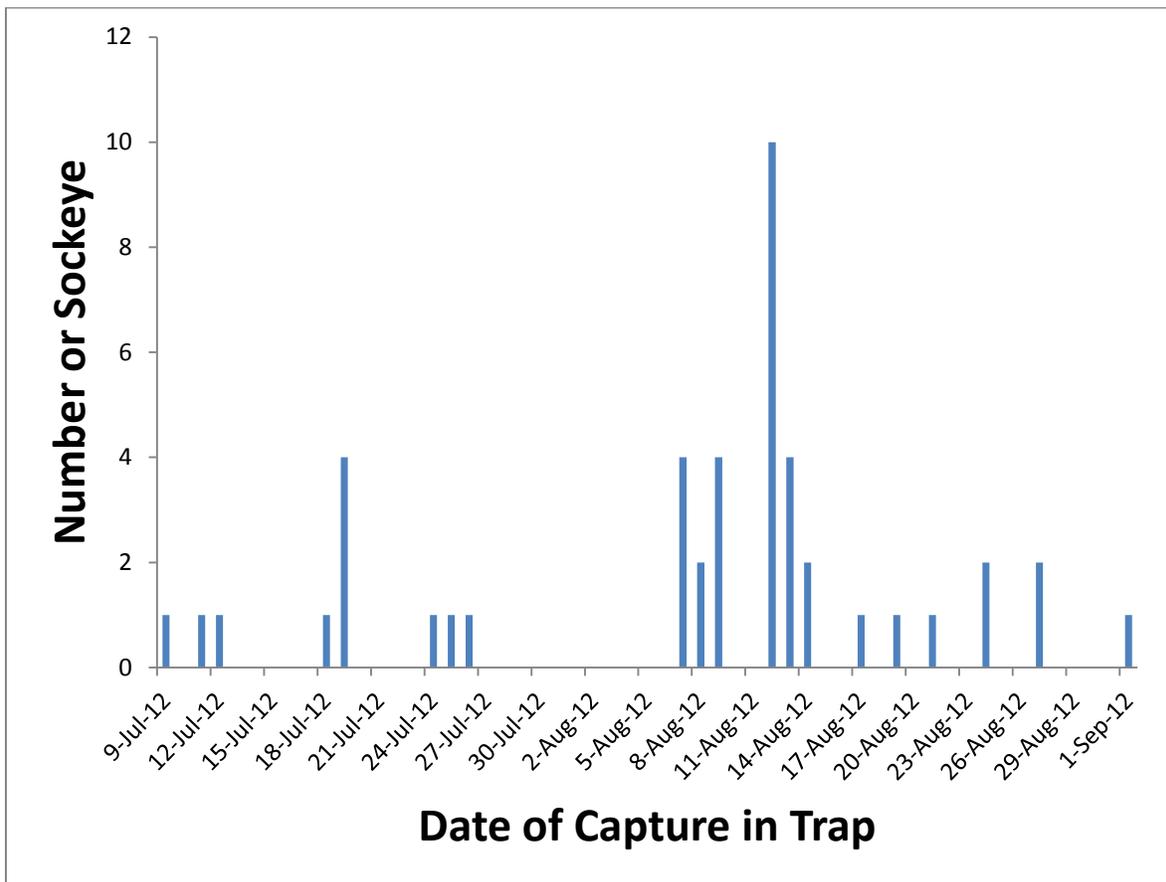


Figure 8 Number of sockeye returned to the Alouette Watershed in 2012, by date

Fork Length

Fork length measurements were collected for all returning sockeye. Of the 45 returns, only 42 allowed for viable measurements, as the ninth sockeye was dead due to eagle kill before measurements were taken and the last sockeye caught was found dead in the trap and not measured. Sockeye number 37 was not measured, reason unknown. The fork length ranged from 52 - 64 cm, with an average fork length of 57.8cm (Figure 9; Appendix A).

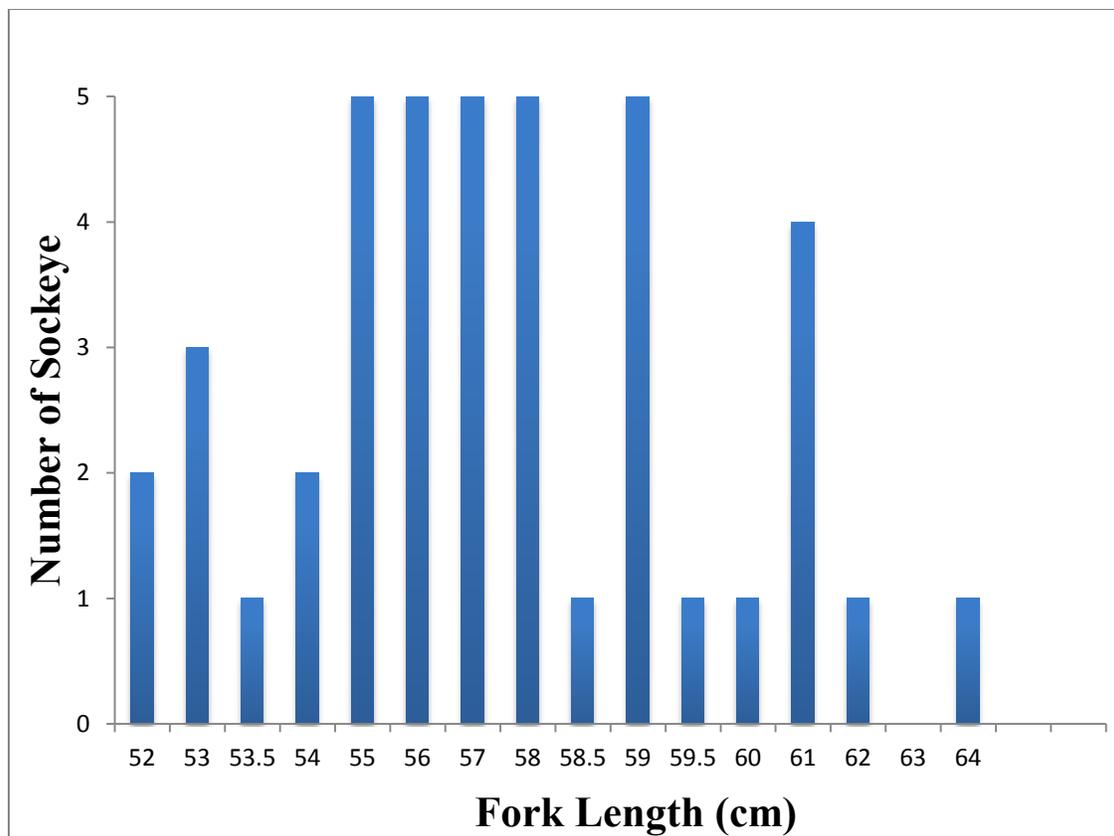


Figure 9 Fork length measurement of sockeye returning to the Alouette Watershed, 2012

Age Structure

Scale samples were analyzed from 44 sockeye to determine the 2012 run age structure. Of the 44 samples, 29 samples were readable (Latham, unpublished data, 2013). There were 20 four year old sockeye with two years spent in a marine environment. There were 8 five year old sockeye with two years in a marine environment. There was 1 six year old sockeye with 2 years in the marine. Lastly, there were 15 sockeye that were not aged due to various reasons. Of the total of 15 unreadable scales, 9 could not be read due to sampler error, 2 samples were missing scales, and 4 samples were damaged scales. Three samples which were analyzed as fish aged at 4 years old with 2 years in a marine environment (Gilbert Rich scale) were resorbed scales (pers.comm. Reichardt.M, May 2013).

Genetic Sampling

Mixture analysis using the program CBAYES, a Bayesian approach (Neaves et al. 2005) was used to assign stock proportions from the 2011 returning adults in the Alouette River to the 85 population coastwide Kokanee-Sockeye genetic baseline collections. Results from this analysis indicate that all 10 returning adults in the Alouette River in 2011 were from the Alouette Reservoir (Godbout, unpublished data, 2012). Genetic testing was completed for 44 of the year

2012 returning adult sockeye. The results indicated 42 adults were Alouette stock and 2 adults could not be analyzed (Godbout, personal communication, 2013).

Table 3. Alouette sockeye brood survivals, 2005-2008 (Bob Bocking, Pers. Comm)

Year of Smolt Migration	Survival (smolts:TRS)¹
2005	0.532%
2006	0.750%
2007	0.084%
2008	1.344%

¹Smolt-to-Spawner survival was calculated from age specific estimates of the number of smolts migrating from the Alouette Reservoir and the number of adults returned to the reservoir (Bob Bocking pers. comm.)

Discussion

Adult Sockeye Returns

The 2012 Alouette Sockeye run continues to demonstrate timing comparable to a summer run, arriving at the Allco Fish Hatchery trapping location in July and August (Figure 10). The peak of the Alouette sockeye run for 2008-2012 is over last week of July to the first week of August.

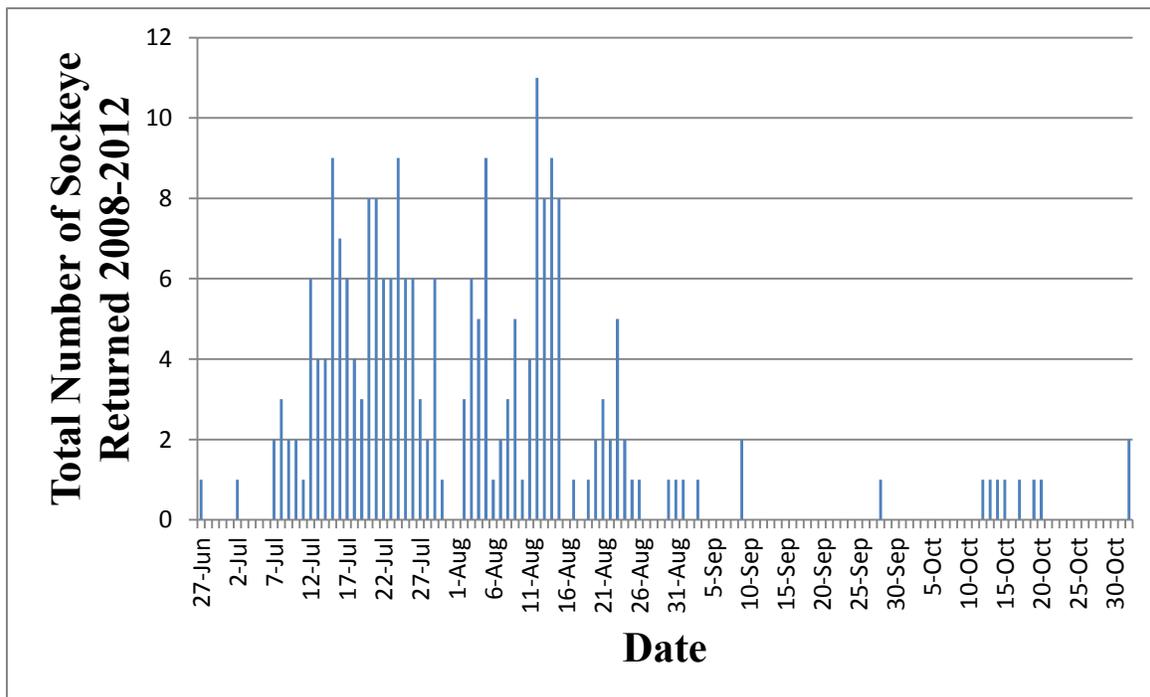


Figure 10 Total number of sockeye returned to the Alouette Watershed in 2008-2012, by date

Fork Length

Measurements were collected for 42 of the 2012 returning sockeye. This represented a sample size which showed an increase from the previous year. The average fork length measured in 2012 was 57.8cm which was slightly lower than the average of 2008-2010 (Table 4; Figure 11).

Table 4. Average sockeye fork length, 2008-2012

Year of Adult Return	Number of Adults Measured	Average Fork Length (cm)
2008	54	59.3
2009	15	59.1
2010	115	58.1
2011	10	60.4
2012	42	57.8

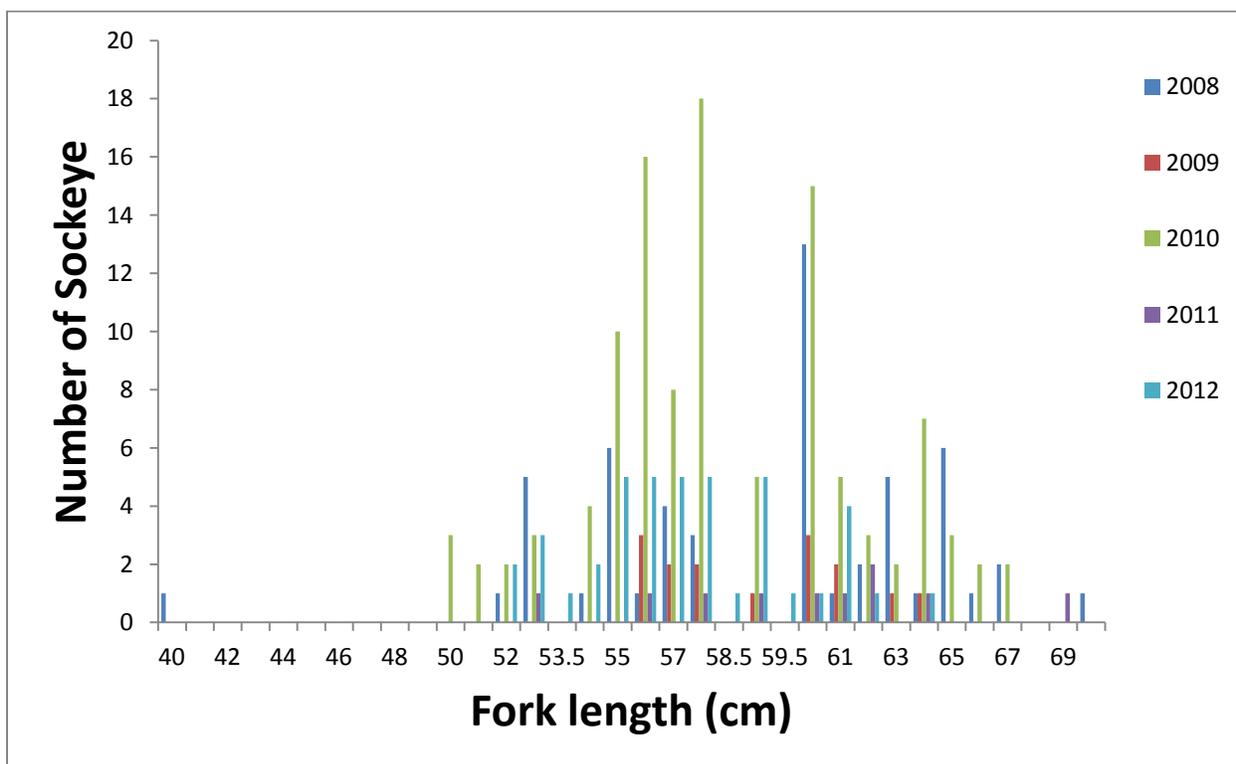


Figure 11 Fork length of sockeye returning in 2008 - 2012

Age Structure

The age class analysis completed by the Pacific Salmon Commission in 2008 and 2009 showed that the returning sockeye salmon are fairly evenly distributed between 4.2 and 5.3 age classes. The 2010 returning sockeye also show this distribution which may be typical for Alouette sockeye, with 53% and 19% respectively. The 2011 returning sockeye have fish in the 6.3 age class, which has not been seen in other study years (Table 5; Latham, unpublished data, 2011). In 2007, there was large smolt outmigration, which corresponds to the 2009 4.2 and 2010 5.3 age

classes. In 2011, the age class structure was spread from 4.2 to 6.3 age classes. The low returns for 2011 leave considerable uncertainty in these age results (Table 5; Bocking, unpublished data, 2012). The age structure for 2012 shows a distribution from 4.2 to 6.4 age classes. There were 3 aged 4.2 scale samples which were determined to be resorbed. This may indicate that the age of these 3 sockeye is actually 5.2 due to the unreliability of the samples. The overall number of sampled sockeye count for 2008 to 2012 was 167. The majority (78%) of these sampled returning spawners were age 4.2 years and 5.3 years fish (i.e. 51% were 2 years old and 27% were 3 years old when they left the Alouette Reservoir and then spent 2 years in the marine environment). Five other age classes have been identified for the Alouette sockeye, representing 22% of the fish sampled (Table 5).

Table 5. Alouette adult sockeye age structure analysis, 2008-2012

Year (% of sampled)	Age Class (Gilbert Rich Scale)						
	4.2	4.3	5.2	5.3	5.4	6.3	6.4
2008 (53)	19 (36%)	1 (2%)	14 (26%)	19 (36%)			
2009 (11)	7 (63%)			4 (36%)			
2010 (68)	36 (53%)		3 (4%)	13 (19%)	1 (1%)		15 (22%)
2011 (6)	3 (50%)			1 (17%)		2 (33%)	
2012 (29)	20 (69%)			8 (28%)			1(3%)
Total (167)	85 (51%)	1 (0.6%)	17(10%)	45 (27%)	1 (0.6%)	2 (1.2%)	16 (10%)

Genetic Analysis

The genetic sampling from 2008 found that there was a significant variation between Alouette sockeye adults and sockeye from neighbouring systems, such as Coquitlam, Cultus, Harrison, and Weaver. The 2008 sockeye run did not include any stray sockeye from other systems, however the same cannot be definitively stated for the 2009 run as only 15 adult sockeye were sampled (Candy, 2009 as quoted in Balcke, 2009; Candy, 2010; Mathews, 2009). However, the 2010 run included six strays from Weaver stock. These six strays were the last six sockeye to arrive at the Allco Fish Hatchery in mid-to-late October and are presumed to be a part of the fall-run sockeye from Weaver. The rest of the 106 sockeye sampled in 2010 were Alouette stock (Godbout, unpublished data, 2011). The 10 sockeye sampled in 2011 were determined to be Alouette stock (Godbout, unpublished data, 2012). Sockeye sampled in 2012 were determined to be of Alouette stock (Godbout, unpublished data, 2013). As an interesting side note, it was found that based on microsatellite DNA, 2 out of 3 “sockeye” that returned to Coquitlam in 2012 were actually Alouette sea-run kokanee both being female (Godbout, unpublished data 2013).

Recommendations

To ensure the beginning of the sockeye run is captured, the Allco fish fence will operate from the middle of June. 2012 saw more sockeye caught at the Allco fish fence than the previous year and it was the second year the fence was running at the end of spring.

After having three fish die from stress and/or being held overnight in 2010, with Alouette Monitoring Committee approval, the sockeye should continue to be caught then released into the reservoir on the same day and handled as little as possible. This practice was observed in 2012 and will continue in 2013.

Due to the number of unreadable scale samples in 2010, measures will continue to be taken to ensure future scale samples are obtained from the correct location above the lateral line on the fish body, correctly placed in the sample vials, and not taken near scars.

Sockeye sampling will continue as per 2012, with fork length and scale and tissue samples taken for all returning sockeye.

Acknowledgements

This monitor was a part of the Alouette Project Water Use Plan funded by BC Hydro and overseen by the Alouette Monitoring Committee. Committee members include: Alouette River Management Society (ARMS), BC Corrections Allco Fish Hatchery, BC Hydro, Department of Fisheries and Oceans, District of Maple Ridge, Katzie First Nations, LGL Limited and Ministry of the Environment. Appreciation is extended to the following individuals: Geoff Clayton and Gerry Miller with ARMS; Ron MacLean and Mike Ilaender, with BC Corrections Allco Fish Hatchery; Dave Hunter, James Bruce and Brent Wilson with BC Hydro; Maurice Coulter-Boisvert, Matt Foy and Keri Benner with Fisheries and Oceans Canada; Mike Leon, Debbie Miller and George Moody with Katzie First Nations; Bob Bocking and Megan Matthews with LGL Limited; Shannon Harris with Ministry of the Environment; John Candy and Lyse Godbout with the Pacific Biological Station; Steve Latham and Michael Lapointe with the Pacific Salmon Commission.

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Appendix A: Sockeye sampling data, 2012

Fish No.	Location Caught	Date Caught	Date Released	Fork Length (cm)
1	Allco Trap	9-Jul-12	9-Jul-12	61
2	Allco Trap	11-Jul-12	11-Jul-12	61
3	Allco Trap	12-Jul-12	12-Jul-12	55
4	Allco Trap	12-Jul-12	18-Jul-12	56
5	Allco Trap	19-Jul-12	19-Jul-12	55
6	Allco Trap	19-Jul-12	19-Jul-12	62
7	Allco Trap	19-Jul-12	19-Jul-12	60
8	Allco Trap	19-Jul-12	19-Jul-12	58
9	Allco Trap	24-Jul-12	dead	0
10	Allco Trap	25-Jul-12	26-Jul-12	57
11	Allco Trap	26-Jul-12	26-Jul-12	53
12	Allco Trap	7-Aug-12	7-Aug-12	59
13	Allco Trap	7-Aug-12	7-Aug-12	58
14	Allco Trap	7-Aug-12	7-Aug-12	59
15	Allco Trap	7-Aug-12	7-Aug-12	58
16	Allco Trap	8-Aug-12	8-Aug-12	64
17	Allco Trap	8-Aug-12	8-Aug-12	58
18	Allco Trap	9-Aug-12	9-Aug-12	55
19	Allco Trap	9-Aug-12	9-Aug-12	57
20	Allco Trap	9-Aug-12	9-Aug-12	58
21	Allco Trap	9-Aug-12	9-Aug-12	58.5
22	Allco Trap	12-Aug-12	12-Aug-12	59
23	Allco Trap	12-Aug-12	12-Aug-12	52
24	Allco Trap	12-Aug-12	12-Aug-12	53
25	Allco Trap	12-Aug-12	12-Aug-12	52
26	Allco Trap	12-Aug-12	12-Aug-12	61
27	Allco Trap	12-Aug-12	12-Aug-12	56
28	Allco Trap	12-Aug-12	12-Aug-12	59.5
29	Allco Trap	12-Aug-12	12-Aug-12	55
30	Allco Trap	12-Aug-12	12-Aug-12	53.5
31	Allco Trap	12-Aug-12	12-Aug-12	57
32	Allco Trap	13-Aug-12	13-Aug-12	56
33	Allco Trap	13-Aug-12	13-Aug-12	54

34	Allco Trap	13-Aug-12	13-Aug-12	57
35	Allco Trap	13-Aug-12	13-Aug-12	59
36	Allco Trap	14-Aug-12	14-Aug-12	54
37	Allco Trap	14-Aug-12	14-Aug-12	0
38	Allco Trap	17-Aug-12	17-Aug-12	56
39	Allco Trap	19-Aug-12	19-Aug-12	53
40	Allco Trap	21-Aug-12	21-Aug-12	55
41	Allco Trap	24-Aug-12	24-Aug-12	61
42	Allco Trap	24-Aug-12	24-Aug-12	59
43	Allco Trap	27-Aug-12	27-Aug-12	57
44	Allco Trap	27-Aug-12	27-Aug-12	56
45	Allco Trap	1-Sep-12	dead	0