

Alouette Project Water Use Plan

Alouette Sockeye Adult Enumeration

Implementation Year 4

Reference: ALUMON-4

Alouette Adult Sockeye Enumeration - 2011

Study Period: 2011

Alouette River Management Society

March 2012

Alouette Adult Sockeye Enumeration – 2011



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Executive Summary

Under BC Hydro's Water Use Plan for the Alouette Watershed, a spring surface release over the Alouette Dam has allowed for kokanee/sockeye smolts to migrate to the ocean for the last five years. The first surface releases occurred in 2005 and in 2007 the first adult sockeye returned to the Alouette Watershed. The 2011 Alouette sockeye salmon run saw 11 adults returning between July 16 and August 19, 2011. Four sockeye were caught at the Allco Fish Hatchery and seven caught at the trap at the base of the dam. Eight sockeye were released in the Alouette Reservoir (Lake). Fork length measurements and scale samples were collected for ten sockeye and tissue samples from seven of the 11 returning sockeye. The measurements indicated an average fork length of 60.4 cm.

Of the 7 sockeye samples, only 6 were useable for aging and 50% of those were four year old sockeye with two years in a marine environment. The genetic sampling identified all out-migrating smolts and 10 returning spawners were Alouette stock. Between the smolt migration years of 2005-2008, the smolt-to-spawner survival of the Alouette sockeye has ranged from a low of 0.084% for the 2005 smolt year to a high of 1.356% for the 2008 smolt year.

Table of Contents

Executive Summary	1
Introduction.....	3
<i>Objectives</i>	3
<i>Study Area</i>	4
Methods.....	4
Results.....	8
<i>Adult Sockeye Returns</i>	8
<i>Fork Length</i>	8
<i>Age Structure</i>	9
<i>Genetic Sampling</i>	9
<i>Survival</i>	9
Discussion.....	10
<i>Adult Sockeye Returns</i>	10
<i>Fork Length</i>	10
<i>Age Structure</i>	11
<i>Genetic Analysis</i>	12
<i>Survival</i>	12
Recommendations.....	12
Acknowledgements.....	13
References.....	13
Appendix A: Sockeye sampling data, 2011	15

List of Figures

Figure 1. Map of the Alouette Watershed.....	4
Figure 2. The Allco Fish Hatchery fence and trap, July 2008	5
Figure 3. Sockeye transport tanks, August 2009	5
Figure 4. Sockeye transport tank with release slide connected, January 2010.....	6
Figure 5. Returning sockeye is measured and sampled, August 2010.....	6
Figure 6. Returning sockeye is tagged with motion sensitive MAP tags, August 14, 2009.....	7
Figure 7. Number of sockeye returned to the Alouette Watershed in 2011, by date.....	8
Figure 8. Fork length measurement of sockeye returning to the Alouette Watershed, 2011	9
Figure 9. Total number of sockeye returned to the Alouette Watershed in 2008-2011, by date..	10
Figure 10. Fork length of sockeye returning in 2008 - 2010	11

List of Tables

Table 1. Estimated number of smolts leaving the Alouette Reservoir during the spring surface release, 2005-2011.	3
Table 2. Number of returned adult sockeye to the Alouette Watershed, 2007-2011.....	8
Table 3. Alouette sockeye brood survivals, 2005-2008.....	10
Table 4. Average sockeye fork length, 2008-2011	11
Table 5. Alouette adult sockeye age structure analysis, 2008-2011	12

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. The 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 will facilitate 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 and Bocking, 2012).

Table 1. Estimated number of smolts leaving the Alouette Reservoir during the spring surface release, 2005-2011.

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

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. 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. 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 spawners 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 appropriately positioned to intercept all migrating adult sockeye on their way back to the reservoir.

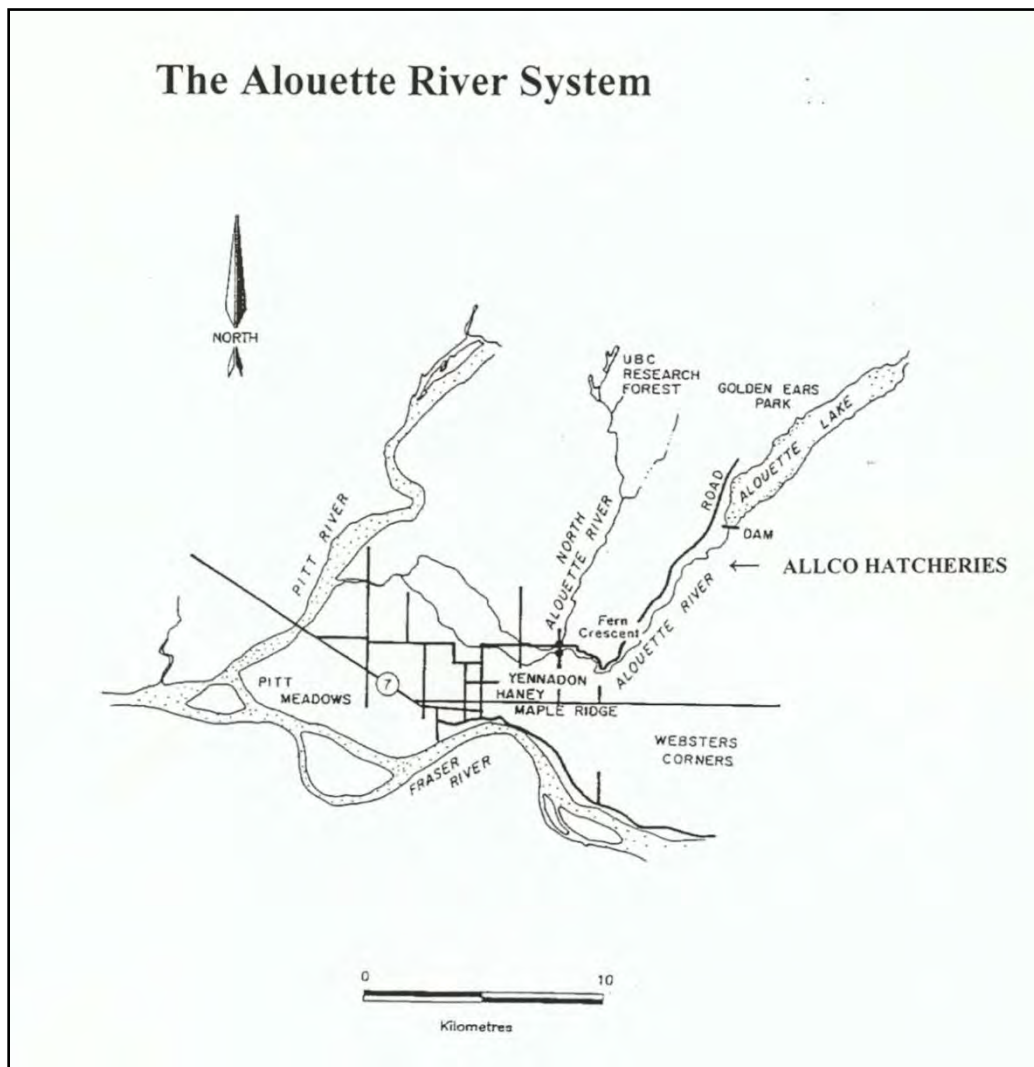


Figure 1. Map of the Alouette Watershed

Methods

The monitor necessitates longer operation of the Allco Fish Hatchery brood stock collection fence and trap (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 extended trapping years the fence will 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.



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 the first ten 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 2011, four 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). The Allco Hatchery fish trap, the transport trailer and tanks, and the LGL Limited tagging projects were funded by Bridge Coastal Restoration Program (now Coastal Fish and Wildlife Compensation 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 11 sockeye returned to the Alouette Watershed during the 2011 run (Table 2). Four were caught at the Allco trap while seven were caught at the BC Hydro dam trap. Eight sockeye were released live into the Alouette Reservoir. The first sockeye went missing overnight and the other two died as a result of stress.

Table 2. Number of returned adult sockeye to the Alouette Watershed, 2007-2011

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

In 2011, the first sockeye was in the trap on July 16 and the last one on August 19 (Figure 8). The peak of the return was August 9 and 11, with three sockeye caught on both days.

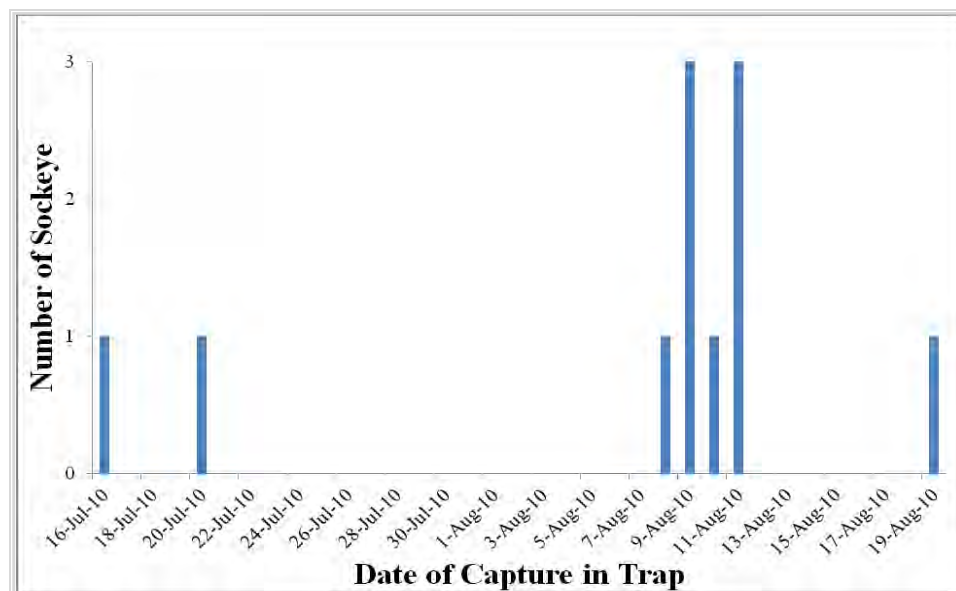


Figure 7. Number of sockeye returned to the Alouette Watershed in 2011, by date

Fork Length

Fork length measurements were collected for all returning sockeye. Of the 11 returns, only 10 allowed for viable measurements, as the first sockeye disappeared before measurements were taken. The length ranged from 53 - 69 cm, with an average fork length of 60.4 cm (Figure 9; Appendix A).

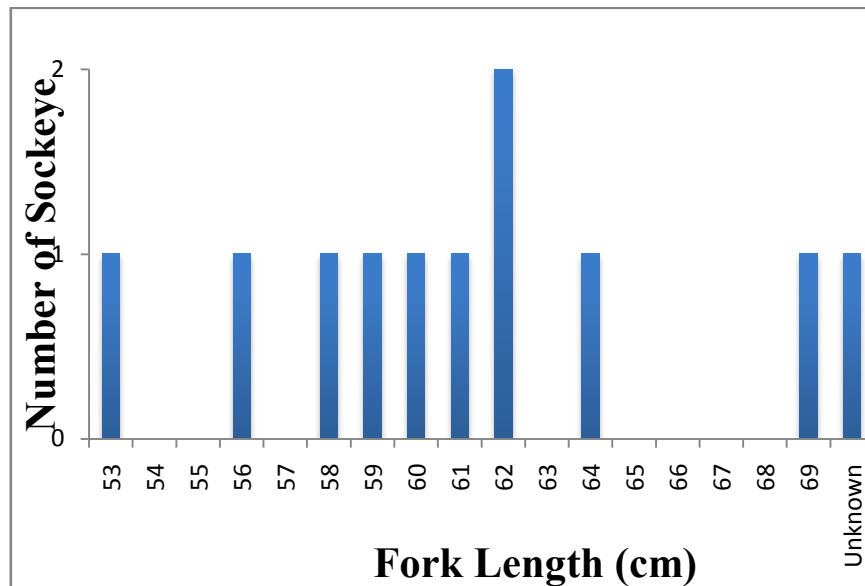


Figure 8. Fork length measurement of sockeye returning to the Alouette Watershed, 2011

Age Structure

Scale samples were analyzed from 7 sockeye to determine the 2011 run age structure. Of the 7 samples, 6 samples were readable (Godbout, unpublished data, 2012). There were 2 six year old sockeye with three years spent in the marine environment. There were 3 four year old sockeye with two years in the marine environment. Lastly, there was 1 five year old sockeye with three years spent in the marine environment. Of the 7 DNA sockeye samples gathered, 1 sample was missing scales.

Genetic Sampling

Mixture analysis using the program CBAYES, a Bayesian approach 1 (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)

Survival

The smolt-to-spawner survival of Alouette sockeye is determined by dividing the number of out-migrating smolts by the total number of adults returning to spawn (TRS) for a given year of smolt migration. Return data by smolt year are sufficiently complete to allow the determination of the survival for 2005-2008 smolt years (Table 3, Bocking, unpublished data, 2012). With the return of sockeye in future years, smolt-to-spawner survival can be determined for 2009 and beyond.

Table 3. Alouette sockeye brood survivals, 2005-2008

Year of Smolt Migration	Survival (smolts:TRS)
2005	0.532%
2006	0.750%
2007	0.084%
2008	1.356%

Discussion

Adult Sockeye Returns

The 2011 Alouette Sockeye run continues to demonstrate timing comparable to a summer run, arriving in the Alouette Watershed in July and August (Figure 8). The peak of the Alouette sockeye run for 2008-2011 is over last week of July to the first week of August.

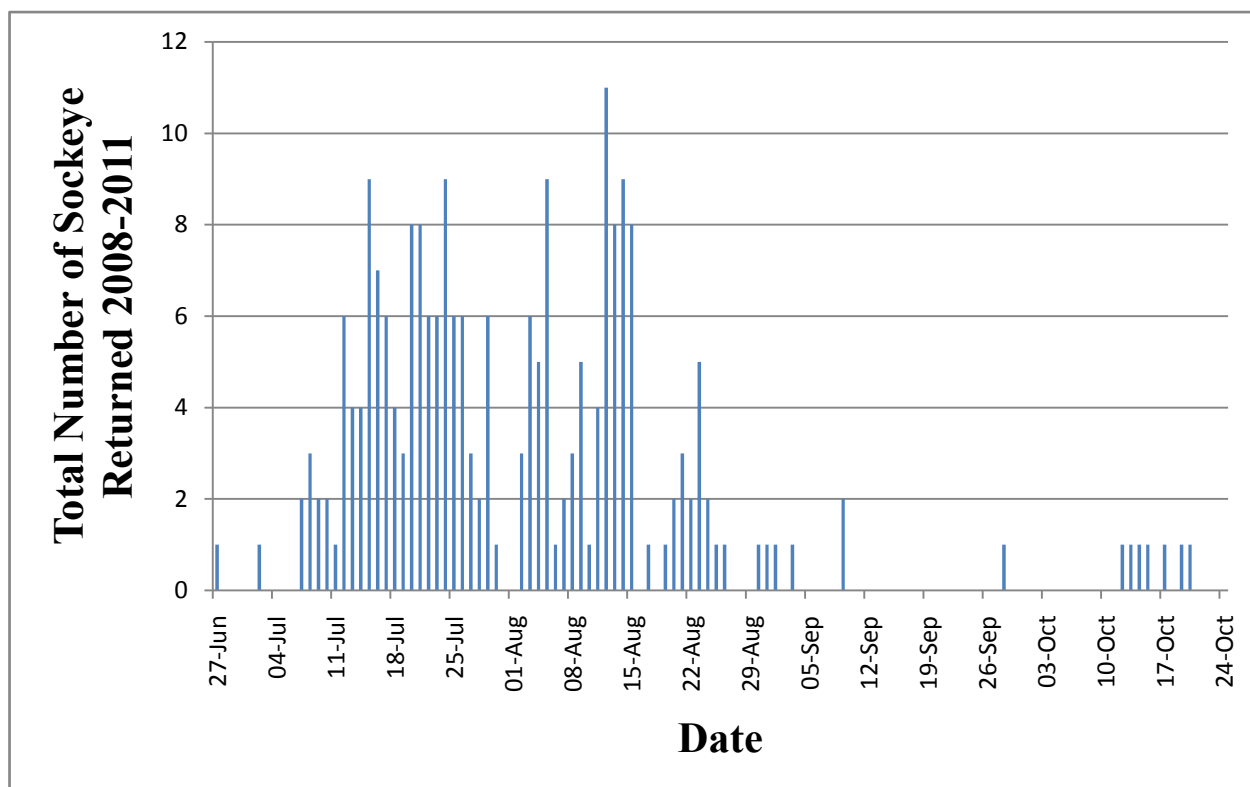


Figure 9. Total number of sockeye returned to the Alouette Watershed in 2008-2011, by date

Fork Length

Measurements were collected for 10 of the 2011 returning sockeye. This represented a sample size that was the lowest of the monitoring years. The fork lengths measured in 2011 were slightly higher than that of 2008-2010 with an average of 60.4 cm (Table 4; Figure 11).

Table 4. Average sockeye fork length, 2008-2011

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

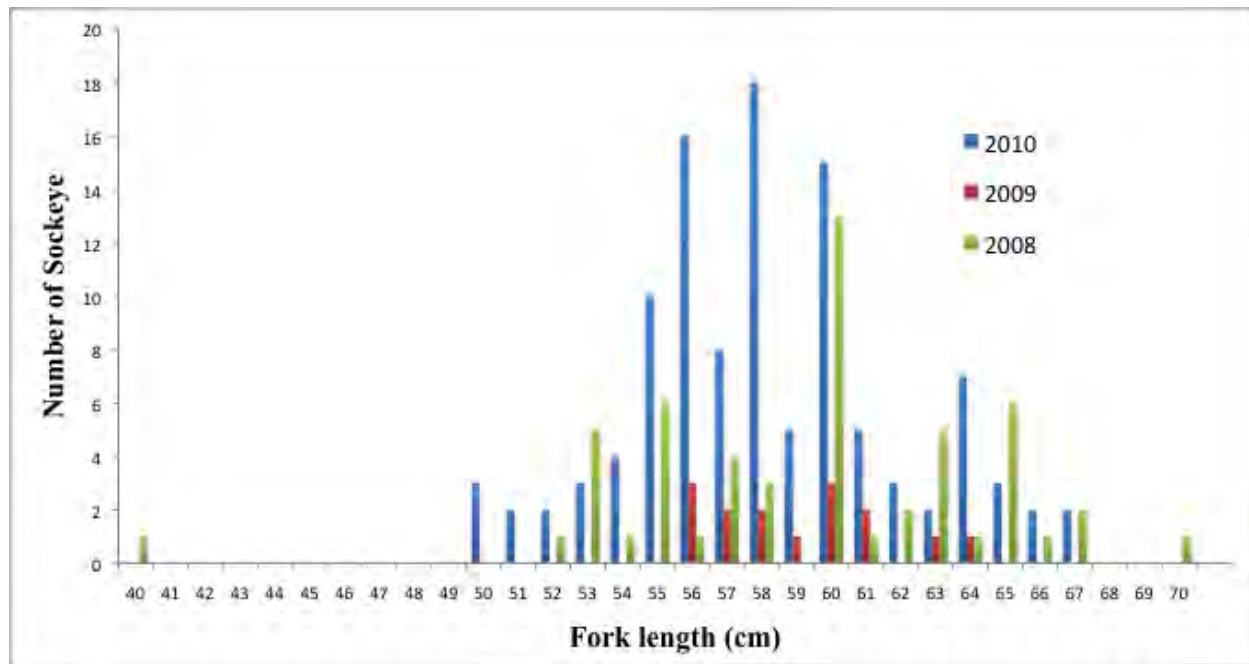


Figure 10. Fork length of sockeye returning in 2008 - 2010

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 4₂ and 5₃ 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 6₃ age class, which has not been seen in previous years (Table 5; Latham, unpublished data, 2011). In 2007, there was large smolt outmigration, which corresponds to the 2009 4₂ and 2010 5₃ age classes. In 2011, the age class structure was spread from 4₂ to 6₃ age classes. The low returns for 2011, leave considerable uncertainty in these age results (Table 5; Bocking, unpublished data, 2012).

Table 5. Alouette adult sockeye age structure analysis, 2008-2011

Year (% of sampled)	Age Class (Gilbert-Rich)						
	4 ₂	4 ₃	5 ₂	5 ₃	5 ₄	6 ₃	6 ₄
2008 (53)	19 (36%)	1 (2%)	14 (26%)	19 (36%)	0		0
2009 (11)	7 (63%)	0	0	4 (36%)	0		0
2010 (68)	36 (53%)	0	3 (4%)	13 (19%)	1 (1%)		15 (22%)
2011 (6)	3 (50%)			1 (17%)		2 (33%)	

Genetic Analysis

The genetic sampling from 2008 found that there was a significant variation between Alouette sockeye spawners 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 10 sockeye sampled in 2011 were determined to be Alouette stock (Godbout, unpublished data, 2012).

Survival

With a smolt-to-spawner survival of 1.356% for the 2008 smolt year, the Alouette sockeye run in 2010 was comparable to the large summer-run sockeye in the Fraser River. The low return of sockeye to the Alouette in 2011 suggests that survivals of age 4₂ and 5₃ fish from the 2009 smolt year (the lowest outmigration in 6 years of monitoring) are low; but this cannot be confirmed until the abundance of 5₂ age returning sockeye (also from the 2009 smolt year) in 2012 is known.

Recommendations

To ensure the beginning of the sockeye run is captured, the Allco fish fence will begin operation in the beginning of June. 2011 saw more sockeye caught at the dam than previous years and it was the first year the fence was running at the end of spring.

After having three fish die from stress and/or being held overnight, with Alouette Monitoring Committee approval, the sockeye should be caught then released into the reservoir on the same day.

Due to the number of unreadable scale samples in 2010, measures were 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 2011, 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, 2011

Fish No.	Location Caught	Date Caught	Date Released	Fork Length (cm)
1	Allco Fence	20-Jul-11	20-Jul-11	60
2	Allco Fence	16-Jul-11	Missing	Unknown
3	Dam Trap	08-Aug-11	08-Aug-11	56
4	Dam Trap	09-Aug-11	09-Aug-11	59
5	Dam Trap	09-Aug-11	09-Aug-11	64
6	Allco Fence	09-Aug-11	11-Aug-11	61
7	Dam Trap	10-Aug-11	Died	58
8	Dam Trap	11-Aug-11	11-Aug-11	69
9	Dam Trap	11-Aug-11	11-Aug-11	53
10	Dam Trap	11-Aug-11	11-Aug-11	62
11	Allco Fence	19-Aug-11	Died	62