

Alouette Project Water Use Plan

Alouette Sockeye Adult Enumeration

Implementation Year 6

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Alouette Adult Sockeye Enumeration – 2013

Study Period: 2013

Alouette River Management Society

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Alouette Adult Sockeye Enumeration – 2013



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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 seven years. The first surface releases occurred in 2005 and in 2007 the first adult sockeye returned to the Alouette Watershed. The 2013 Alouette sockeye salmon run saw 10 adults returning between July 7 and September 13, 2013. Of the 10 sockeye caught, 1 was found dead on the river bank downstream of the Allco Fish Hatchery, 3 were caught at the Allco Hatchery trap. At the dam trap, 5 live were caught, of which 1 went missing, and 1 dead was taken. Seven sockeye were released in the Alouette Reservoir (Lake). Fork length measurements for 8 sockeye were taken and 4 scale and tissue samples were collected from the 10 total returning adults. The measurements indicated an average fork length of 46.6cm.

Of the 4 scale samples, only 2 were useable for aging and 100% of those were four year old sockeye with two years in a marine environment. The genetic sampling identified 4 out of 4 tissue samples of returning adults were Alouette stock. Two scale samples for aging were unable to be analyzed due to the sample being either rated as unreadable or regenerated. Regeneration means that a scale was lost through damage and when it grows back it has lost all its previous information (pers.comm, Reichardt, 2014). 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.

The peak of the 2013 Alouette adult sockeye return was on 13 September, when 2 fish arrived at the Allco fish fence. Since 2008, up to and including the 2013 season, 239 adult sockeye salmon have returned to the Allco fish fence.

Current marine survival rates (smolt – adult) being experienced by the Alouette River Sockeye (Table 3) are lower but in the same range as Chilko Lake Sockeye which has seen marine survivals less than 3.5% since the 2007 return year and as low as 0.3% for the 2009 adult return year (2007 smolt year), respectively (Rensel et al. 2010).

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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 testing of a specific surface 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 outmigrated 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, 2005-2013.

| 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 |
| 2013 | 6,264 |

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. In 2007, it was found that returning sockeye salmon trapped at the Allco Fish Fence were 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 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 Reservoir. 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) have had a shorter fence operation timeframe, commencing mid-June through to the fall. Tissue samples are also collected from all sockeye 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 Lake Reservoir, are 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.

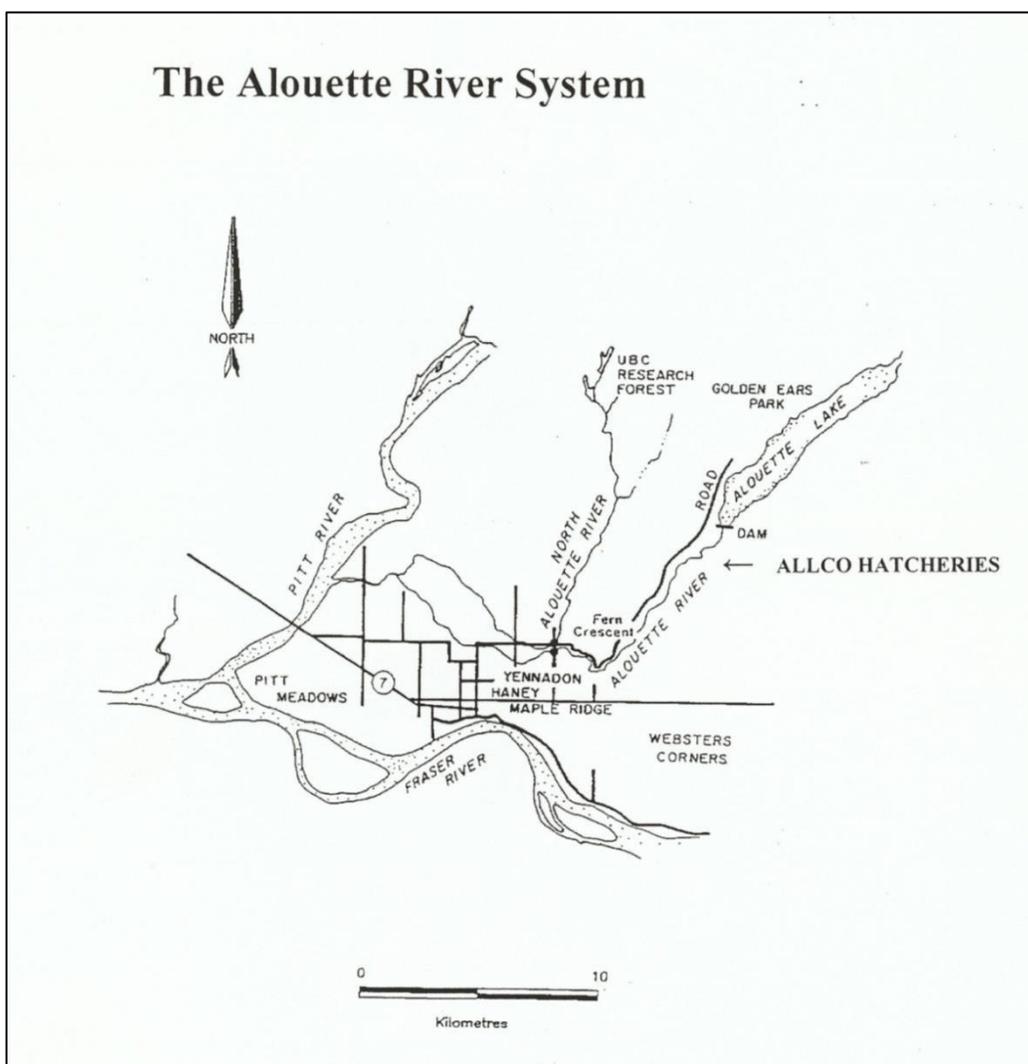


Figure 1. Map of the Alouette Watershed

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 question #2; Figures 2 and 3). 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. In 2013, returning sockeye sampling dates commenced on July 7 when the first adult arrived and completed on September 13, 2013 when the last adult arrived.



Figure 2. Allco Fish Hatchery fence and trap, May 2014



Figure 3 Allco Fish Hatchery fence and bladder, May 2014

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 that were not captured at the Allco fence. Once trapped, the sockeye were dip-netted out of the trap and transported by BC Corrections to Alouette Lake Reservoir, where they were then released. The sockeye were transported to the reservoir in specifically designed tanks fitted for both the Allco Hatchery truck and sockeye transport trailer (Figure 4). At the lake, a slide was connected to the tanks and the sockeye were released (Figure 5).



Figure 4 Sockeye transport tanks, May 2014



Figure 5 Sockeye transport tank with release slide connected, January 2010

For each returning sockeye in 2013, 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 a total of 4 returning adult sockeye (Figure 6 and 7). 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.



Figure 6 Returning sockeye is photographed and dated - July 7, 2013



Figure 7 Returning sockeye is measured for length-August 12, 2013

In 2011 and 2012, returning sockeye were also tagged by LGL Limited with motion sensitive MAP tags, which were used to track the sockeye migration in the Alouette Lake Reservoir (Figure 8). 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 program.



Figure 8 Placement of a radio tag in dead sockeye

Results

Adult Sockeye Returns

A total of 10 sockeye returned to the Alouette Watershed during the 2013 run (Table 2). Of the 10 sockeye caught, 1 was found dead on the river bank downstream of the Allco fish fence, 3 were caught at the Allco Fence Trap box. At the Alouette Dam trap box, 6 sockeye were caught, of which 1 fish was presumably poached or preyed upon as it was not found in the trap the next day, and 1 was dead. Seven sockeye were released in the Alouette Lake Reservoir. At the Allco fish fence, the first sockeye was found dead (reason unknown, possibly a predator), the third fish to arrive chronologically went missing from the dam trap and the tenth sockeye caught was found dead in the dam trap for unknown reasons.

Table 2. Number of returned adults sockeye to the Alouette Watershed, 2007-2013

| 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 |
| 2013 | 10 | 7 |

In 2013, the first sockeye was found beside the Alouette River downstream of the Allco trap on July 7 and the last sockeye was taken at the dam trap on September 13 (Figure 9). The peak of the return was September 13, with two sockeye caught on this day.

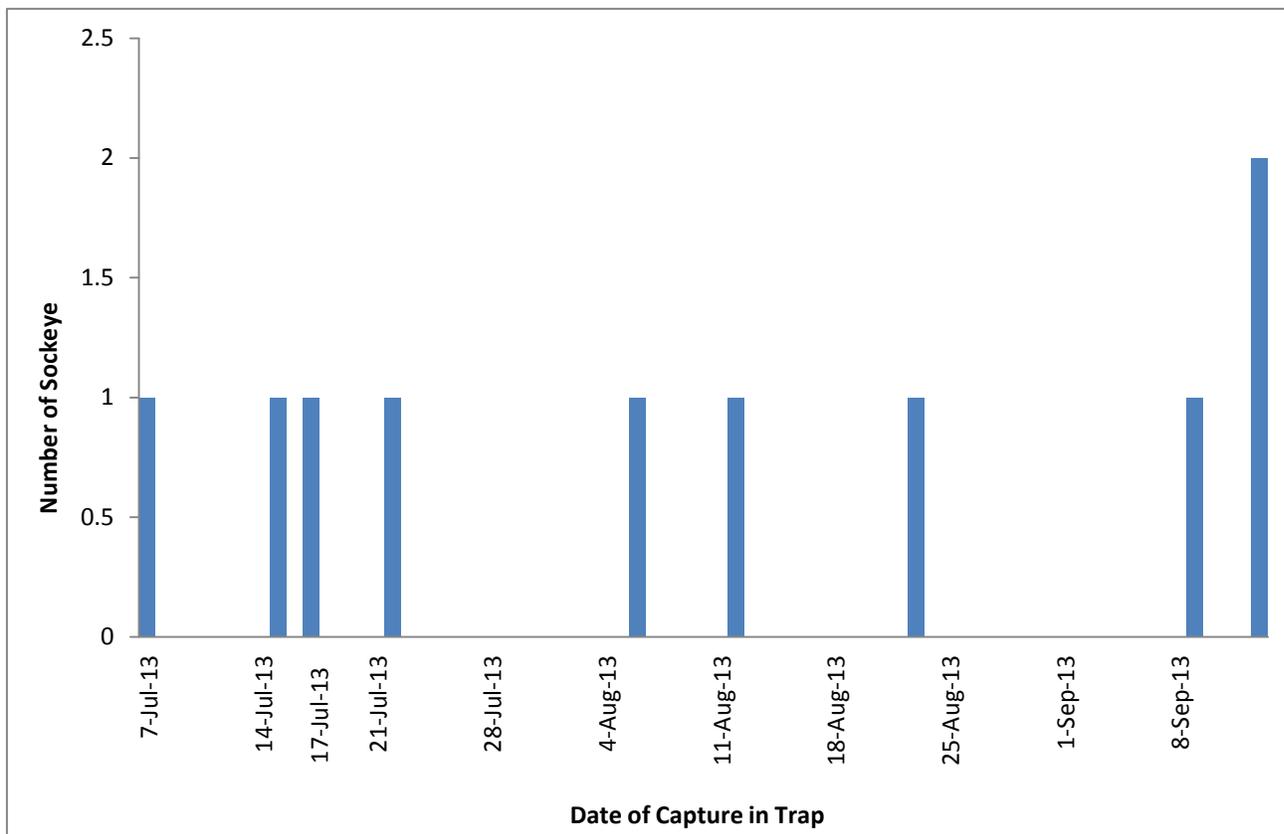


Figure 9. Number of sockeye returned to Alouette Watershed 2013 by date

Fork Length

Fork length measurements were collected for 8 of the 10 returning sockeye. The third sockeye went missing from the dam trap and the tenth sockeye was dead (reason unknown) and no measurements were taken. The fork lengths ranged from 44 - 57 cm, with an average fork length of 46.6cm (Figure 10; Appendix A).

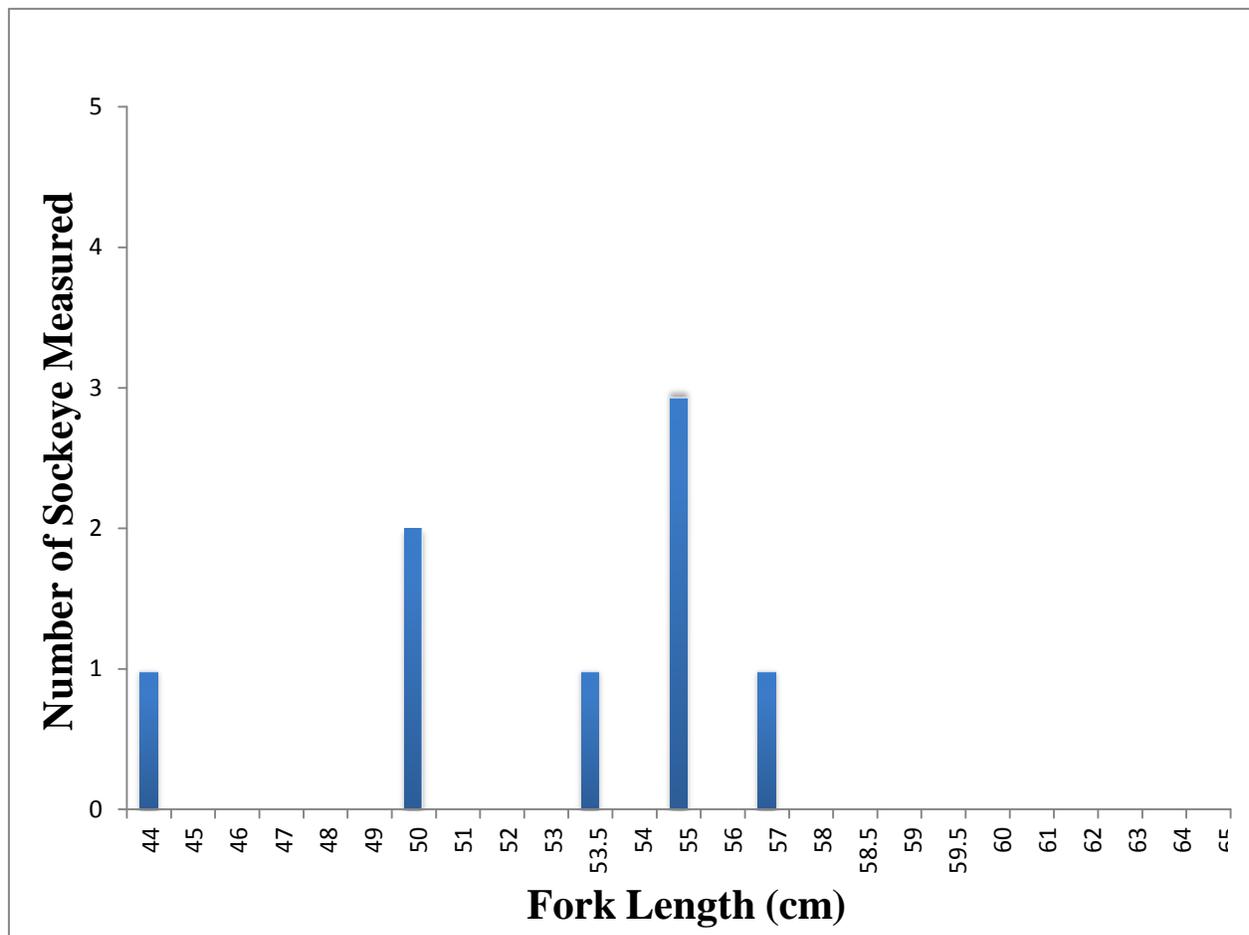


Figure 10. Sockeye fork length measurement for 2013

Age Structure

Scale samples were analyzed from 4 sockeye to determine the 2013 run age structure. Of the 4 samples collected, 2 samples were readable (Sellars, unpublished data, 2014). There were 2 four year old sockeye with two years spent in a marine environment. The remaining two of the four scale samples for aging were unable to be analyzed due to the samples being either rated as unreadable or regenerated. Regeneration means that a scale was lost through damage and when it grows back it has lost all its previous information (pers.comm, Reichardt, 2014).

Genetic Sampling

Mixture analysis using the program CBAYES, a Bayesian approach (Neaves et al. 2005) was used to assign stock proportions from the 2013 returning adults in the Alouette River to the 85 population coastwide Kokanee-Sockeye genetic baseline collections. Results from this analysis indicate that all 4 returning adults in the Alouette River in 2013 were from the Alouette Reservoir (Godbout, unpublished data, 2014). Genetic testing was completed for 4 of the year

2013 returning adult sockeye. The results indicated 4 adults were Alouette stock (Godbout, personal communication, 2014).

Smolt to Spawner Survival

Smolt to spawner survival has ranged from a low of 0.084% to a high of 1.344% since 2005 to 2010 (see Table 3). For the years 2011 to 2014, smolt to spawner survival rates will be reported in the 2014 season report. Smolt-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.¹).

Current marine survival rates (smolt – adult) being experienced by the Alouette River Sockeye (Table 3) are lower but in the same range as the Chilko Lake Sockeye which has seen marine survivals less than 3.5% since the 2007 return year and as low as 0.3% for the 2009 adult return year (2007 smolt year), respectively (Rensel et al. 2010). Survival rates for other Fraser River Sockeye stocks, and in particular the Pitt River early summer run stock grouping are not available from Fisheries and Oceans. However, survival rates for Cultus Lake Sockeye which has undergone a re-building effort have also been poor in recent years (Figure 14; CSAS 2010).

Table 3. Alouette sockeye brood survivals, 2005-2010 (Bob Bocking, Pers. Comm)¹

| Year of Smolt Migration | Survival (smolts:TRS) |
|--------------------------------|------------------------------|
| 2005 | 0.532% |
| 2006 | 0.750% |
| 2007 | 0.084% |
| 2008 | 1.344% |
| 2009 | 0.171% |
| 2010 | 0.282% |
| 2011 | 0.028%* |

* Survival estimate for 2011 is preliminary based on unreported data for 5.2 and older adult returns.

Discussion

Adult Sockeye Returns

The 2013 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 2008-2013 is typically over the last week of July to the second week of August.

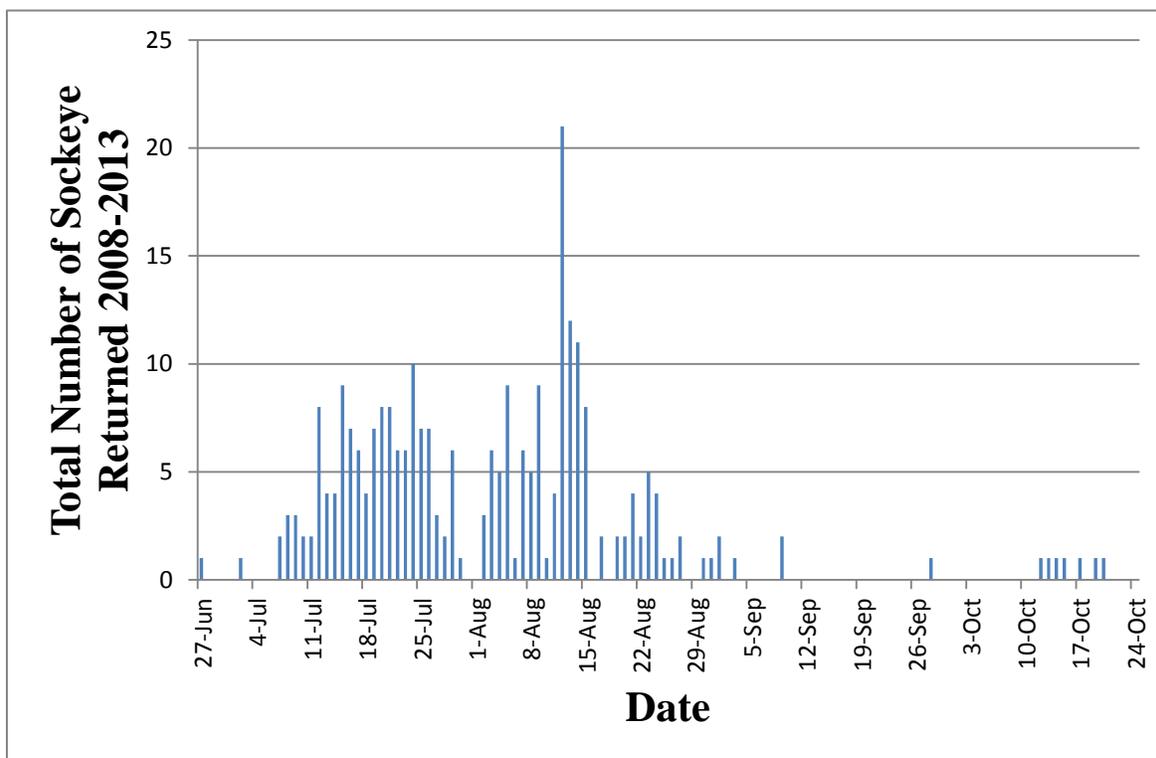


Figure 11. Total number of sockeye returned to Alouette watershed 2008-2013 by date

Fork Length

Measurements were collected for 8 of the 2013 returning sockeye. This represented a sample size which showed a decrease from the previous year. The average fork length measured in 2013 was 46.6cm which was lower than the yearly averages of 2008-2012 (Table 4; Figure 12).

Table 4. Average sockeye fork length, 2008-2013

| 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 |
| 2013 | 8 | 46.6 |

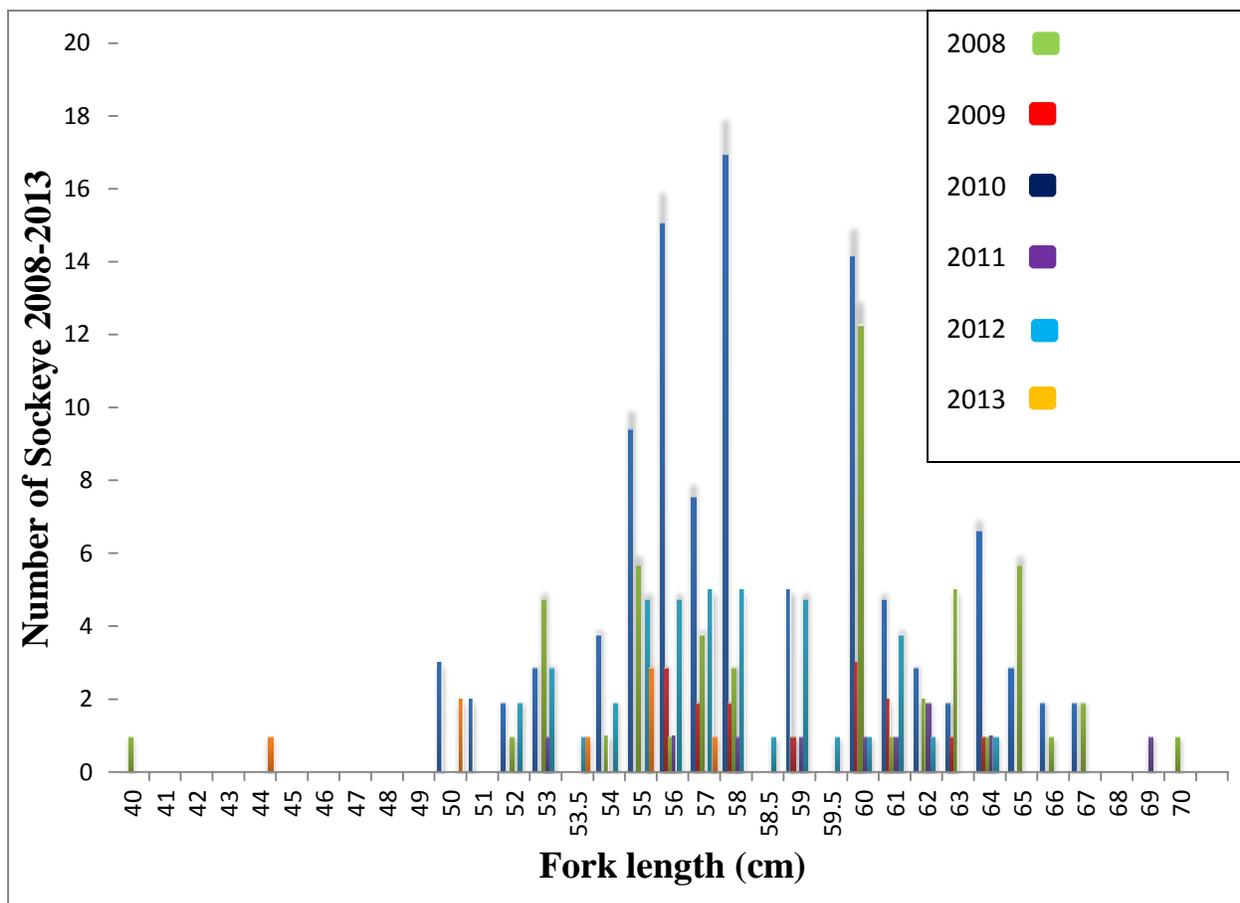


Figure 12 Fork length of returning sockeye 2008-2013

Age Structure

The age class analysis completed by the Pacific Salmon Commission for the 2013 season showed that the returning adult Alouette sockeye were represented by 2 fish in age class 4.2 (Table 5; Sellars, unpublished data.). Due to errors in the 2 other samples, an age class could not be determined (pers.comm, Reichardt 2014).

In earlier years, the age class analysis completed by the Pacific Salmon Commission, for example in 2008 and 2009, showed that the returning sockeye salmon were evenly distributed between 4.2 and 5.3 age classes. The 2010 returning sockeye also showed this distribution which may be typical for Alouette sockeye, with 53% and 19% respectively. The 2011 returning sockeye had fish in the 6.3 age class, which had not been seen in other study years (Table 5; Latham, unpublished data, 2011). In 2007, there was a large smolt outmigration, which corresponded 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 left considerable uncertainty in these age results (Table 5; Bocking, unpublished data, 2012). The age structure for 2012 showed 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 2013 was 171. The majority (77.3%) of these sampled returning spawners were age 4.2 years and 5.3 years fish (i.e. 51% were 2 years old and 26.3% 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 21.4% of the fish sampled (Table 5).

Table 5. Alouette adult sockeye age structure analysis, 2008-2013 (Latham, Bocking, Sellars)

| 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%) |
| 2013 (4) | 2 (50%) | | | | | | |
| Total (171) | 87 (51%) | 1 (0.6%) | 17 (10%) | 45 (26.3%) | 1 (0.6%) | 2 (1.2%) | 16 (9%) |

Genetic Analysis

All adult sockeye sampled in 2013 were determined to be of Alouette stock (Godbout, unpublished data, 2014). In earlier years, 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 should continue to operate from the middle of June each year.
- 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 to work well in 2013 and should continue for 2014.
- 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 in 2014 as per 2013, with fork length and scale and tissue samples taken for all returning sockeye.
- Due to some predator loss of sockeye in 2013, a downstream assessment of returning sockeye could be implemented to boost the numbers counted at the hatchery trap. Otter-proofing the Allco hatchery trap would also be helpful to assist with losses occurred by predators accessing the trap.

Acknowledgements

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Appendix A: Sockeye sampling data, 2013

| Fish No. | Location Caught | Date Caught | Date Released | Fork Length (cm) |
|----------|-----------------|-------------|--|------------------|
| 1 | Allco Trap | 7-Jul-13 | Dead on bank of river downstream of trap | 50 |
| 2 | Dam Trap | 15-Jul-13 | - | 55 |
| 3 | Dam Trap | 17-Jul-13 | went missing from trap | - |
| 4 | Dam Trap | 22-Jul-13 | - | 55 |
| 5 | Allco Trap | 6-Aug-13 | 6-Aug-13 | 57 |
| 6 | Allco Trap | 12-Aug-13 | 12-Aug-13 | 55 |
| 7 | Allco Trap | 23-Aug-13 | 23-Aug-13 | 53.5 |
| 8 | Dam Trap | 9-Sep-13 | 9-Sep-13 | 50 |
| 9 | Dam Trap | 13-Sep-13 | 13-Sep-13 | 44 |
| 10 | Dam Trap | 13-Sep-13 | Dead in freezer | - |

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