

# Lakelse Sockeye Adult Monitoring

Fry Outplant Project  
Williams Creek Sockeye Return 2016

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\*Title page photo by Storm Carol



## Executive Summary

For the third consecutive year, Hidden River Environmental Management (HREM) was contracted by the Department of Fisheries and Oceans Canada (DFO) to determine the ratio of wild to enhanced (hatchery) sockeye salmon adults returning to Williams Creek during the 2016 spawning run, and to undertake a brood stock population assessment for 2016. The population estimate was calculated by marking fish at the mouth of the creek during seining, and subsequently gillnetting farther upstream during the peak spawning period. Of the total 2016 Williams Creek sockeye escapement, enhanced/hatchery (no adipose fin) fish made up 4.15% of fish seined and 3.34% of fish gillnetted. A total population estimate of approximately 11,137 sockeye adults was determined for the 2016 spawning run.



Figure 2: Aerial shot of participants helping bring in the seine net near the mouth of Williams Creek. Photo credit: Storm Caroll.

## Introduction

### **Background**

Over the last decade, DFO and the local community have recognized Lakelse sockeye salmon as a stock of concern (DFO 2005 and Gottesfeld *et al.* 2002). In 2005, the *Recovering Lakelse Lake Sockeye Salmon—Lakelse Lake Sockeye Recovery Plan* was developed by DFO and partners in order to provide direction for research, enhancement, habitat restoration, and stock assessment related to Lakelse sockeye. Following the creation of the Recovery Plan, funding was provided via the Pacific Salmon Commission for projects related to Lakelse sockeye rehabilitation, restoration, and enumeration—in particular the Lakelse Sockeye Fry Outplant Project.

As a part of the Recovery Plan, the Lakelse Sockeye Fry Outplant Project was implemented to enhance low sockeye escapement numbers. Each year, from 2006 to 2014 (excluding 2009, owing to lack of funding), brood stock was taken from sockeye in Williams Creek and transported to the Snootli Creek Hatchery in Bella Coola for fertilization, incubation, rearing, and adipose fin clipping. After reaching between 0.7g and 0.9g, fry were released back into both Williams Creek and a newly created backchannel to Williams Creek (Drewes and Kujat 2014). In order to monitor the success of the Outplant Project, a sockeye seining program has been carried out annually since 2014 to show the ratio of enhanced versus wild returns, thereby determining the success of the brood releases, returning in three, four, and five year old age classes. Population estimates have also been taken through a mark-recapture program on Williams Creek since 2014.

### **Study Area**

Williams Creek is one of three main tributaries of Lakelse Lake (the others being Schulbuckhand and Hatchery Creeks), which drains via the Lakelse River into the Skeena River towards the Pacific Ocean. Upon returning from the ocean, sockeye spend one to two months holding in Lakelse Lake before making their way up the various tributaries to spawn (Coburn and Bilton 1967, DFO 2005). Because of its abundant beds of medium course gravels found within much of the creek, Williams Creek has been identified as one of the best spawning tributaries feeding into Lakelse Lake. The importance of Williams Creek for sockeye spawning is supported historically by the largest escapement numbers of all tributaries feeding into the Lakelse system (Coburn and Bilton 1967, Cox-Rogers *et al.* 2004, Gottesfeld *et al.* 2002, and Kokelj 2003).





Figure 3: Location of the Williams Creek tributary and alluvial fan draining into Lakelse Lake. Credit: GoogleEarth 2016.

## Methods

### ***Mark-Recapture***

To determine a population estimate for the Williams Creek Sockeye escapement, the Lincoln-Peterson (Figure 4) mark-recapture method was applied. In a mark-recapture study design, a percentage of the population is captured and marked, then released and resampled to determine what percentage of the population carries the given markings (Krebs 1989). Using a hand-held hole-punch, individual sockeye were punched in the right operculum during seining (Figure 5 and 6), and were marked with a left opercular punch during later gillnetting. Initial marking (right punch) of sockeye took place on August 3, 8, 12, 16, 24, 29, and September 2 from 8:30AM to 11:30AM, and recapture upstream using a gillnet (and marked with a left punch) occurred on August 18, August 26, September 1, and September 6 from 8:00am to 11:00am. The intent of collecting a recapture sample upstream was to identify the number of sockeye that had been marked at the mouth of Williams Creek who had proceeded upstream to spawn during the given period, and thus provide data with which to estimate the total population.

$$N = \frac{Kn}{k} \quad \text{where,}$$

N = number of Sockeye in the population  
K = Number of new Sockeye seined  
n = Total Number of Sockeye gillnetted  
k = Number of recaptures gillnetted

Figure 4: Lincoln-Peterson formula used for Williams Creek sockeye population estimate.



Figure 5: New right opercular punch in female.



Figure 6: Recaptured male with pre-existing right opercular punch.



Figure 7: James Powell, DFO, holds female as student Monika Behnke performs a right opercular punch.



### Seining

Prior to seining, a stop net was placed and secured along the width of Williams Creek (100 meters upstream of the mouth) in order to prevent fish from escaping capture by swimming downstream. The stop net also prevented any new arrivals or released fish from entering the marking area once the seine net was pursed. Following placement of the stop net, a 50 meter-long seine net with three inch mesh size was taken 300 meters upstream from the mouth of the creek above a deep pool, where the majority of sockeye were known to hold. The seine net was fed across the creek from the west to east using a jet boat, and was then gradually pulled south down Williams Creek towards the stop net. Upon reaching the stop net, the far east corner of the seine net was brought in adjacent to the stop net, entrapping fish in the purse along a sandy beach on the west side of the creek's outlet (Figure 8). Participants, wearing wool gloves, removed entrapped fish from the seine net, and designated crew members marked a right opercular punch in each sockeye. Marked fish were then released. During handling, participants indicated to the data collector whether the sockeye was a jack, male/female, hatchery/wild (presence or lack of adipose fin), and/or recapture (presence or absence of existing opercular punch). As fish were processed and the quantity of individuals within the seine net decreased, float lines were brought in to decrease the size of the pursed area. Once all fish were marked and released, the seine net and stop nets were taken out of the water and stored.

On both August 8<sup>th</sup> and 12<sup>th</sup>, the lead line of the seine net was lifted up to release a portion of the fish, owing to the high number of individuals initially captured. The intent of releasing fish during these high catch days was to reduce residence time in the seine net, minimizing stress to the fish.



Figure 8: Location of stop and seine nets on Williams Creek.





Figure 9: Stop net and seine net in place near the mouth of Williams Creek.

### ***Gillnetting***

Gillnetting was undertaken both upstream and downstream of the Highway 37 Williams Creek bridge, making up two sets: Gillnet A and Gillnet B (Figure 10). To commence Gillnet A, the net was fed 300 meters downstream of the Williams Creek bridge from north to south across the width of the creek and a human line of 'spookers' were positioned downstream. As the gillnet made its way down, participants splashed the surface water to deter fish from eluding capture and encourage fish to swim upstream and enter the gillnet. After drifting 100 meters downstream, the gillnet was secured to the north shore where handling took place. Ripe females were removed from the net first in order to limit spawning stress. Gillnetted fish were marked with left opercular punch. Handlers indicated to the data collector whether the sockeye was a jack, male/female, hatchery/wild (presence or lack of adipose fin), and if it was a recapture (presence or absence of opercular punch on left and/or right). Once processed, fish were released outside of the net line. Gillnet B followed the same procedures as Gillnet A, excepting that it took place 200 meters upstream of the bridge crossing (Figure 10).





Figure 10: Location of gillnetting sites A (downstream of Hwy 37) and B (upstream of Hwy 37).



Figure 11: Participants releasing sockeye from Gillnet A, while data recorder transcribes results.

## Results

### Seining

Table 1: Sockeye Seining Results August 3, 8, 12, 16, 24, 29, and September 2.

Date	Wild Males	Wild Females	Hatchery Males	Hatchery Females	Jacks	Recap Wild Males	Recap Wild Females	Recap Hatchery Males	Recap Hatchery Females	Daily Totals
03-Aug-16	917	745	45	35	2	0	0	0	0	1744
08-Aug-16	150	203	8	7	1	60	38	7	6	480
12-Aug-16	146	232	15	6	0	31	41	2	3	476
16-Aug-16	191	318	4	15	0	62	83	1	4	678
24-Aug-16	197	278	7	11	0	31	73	0	2	599
29-Aug-16	99	104	1	2	3	66	56	1	0	332
02-Sep-16	105	109	0	2	3	67	63	0	1	350
Grand Totals:	1805	1989	80	78	9	317	354	11	16	4659

As shown in Table 1, females were more abundant than males for all sets after August 3<sup>rd</sup>. Overall, wild females made up approximately 10.2% more of the escapement than wild males, whereas hatchery males made up 2.6% more of the escapement than hatchery females. In total, 4,659 sockeye were handled during the seven total seining events. The highest daily total was 1,744 on August 3<sup>rd</sup> (Figure 12); however it is important to note that on August 8<sup>th</sup> and 12<sup>th</sup> the lead line of the net was lifted to release a portion of the fish owing to the large number captured. As part of the initial capture was released on August 8<sup>th</sup> and 12<sup>th</sup>, a peak residence time in the seining area cannot be accurately determined; however, based on observations of the sheer quantity of fish caught, the highest number of sockeye entering the mouth of Williams Creek was expected to occur from August 3<sup>rd</sup> to the 12<sup>th</sup>.

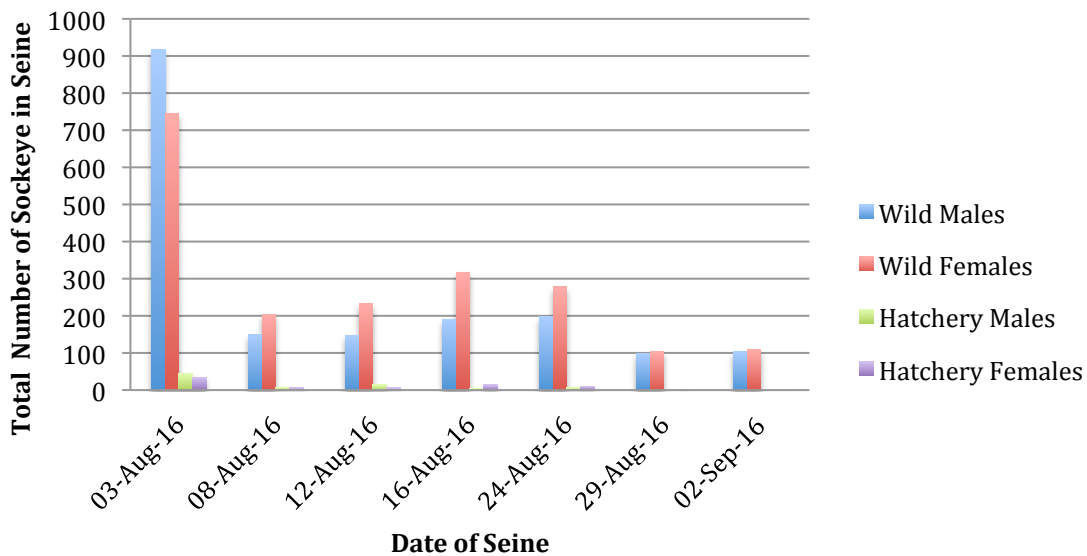


Figure 12: Number of wild males/females and hatchery males/females handled during seining (portion of fish released on August 8<sup>th</sup> and 12<sup>th</sup>).



Table 2: Seining Sample Population Totals August 3, 8, 12, 16, 24, 29, and September 2.

Date	Daily Sample Totals	Daily Recap Total	Total (-Recaps)
03-Aug-16	1744	0	1744
08-Aug-16	480	111	369
12-Aug-16	476	77	399
16-Aug-16	678	150	528
24-Aug-16	599	106	493
29-Aug-16	332	123	209
02-Sep-16	350	131	219
Grand Totals:	4659	698	3961

Daily sample totals during seining ranged from 332 to 1744 individuals (including recaptures), sharply decreasing after August 24<sup>th</sup> (Table 2). In total, 698 sockeye that had previously been marked on the right operculum were recaptured during seining, with a high of 150 recaptures on August 16<sup>th</sup> and a low of 77 on August 12<sup>th</sup> (Table 2). Excluding recaptures, 3,961 individual sockeye were marked over the seven seining sets (Table 2).

Table 3: Hatchery vs. Wild Seining Totals, 2016.

	Male	Female	Jack	Total
Hatchery	80	78	0	158
Wild	1805	1989	9	3803
Grand Totals*:	1885	2067	9	3961

\*does not include recaptures

Following all seven seining sets, the total sample population included 1885 males, 2067 females, and nine jacks (Table 3). Excluding recaptures, hatchery sockeye made up approximately 4.15% of the total number captured during seining.

## Gillnetting

Table 4: Sockeye Gillnetting Data August 18, August 26, September 1, and September 6.

Date	Gillnet Site	W* Male	W Female	H* Male	H Female	Right-Recap* Male	Left-Recap Male	Right-Recap Left-Recap Male	Right-Recap Female	Left-Recap Female	Right-Recap Left-Recap Female	Right-Recap H Male	Left-Recap H Male	Right-Recap Left-Recap H Male	Right-Recap H Female	Left-Recap H Female	Right-Recap Left-Recap H Female	Daily Total
18-Aug-16	A	30	14	2	0	7	0	0	4	0	0	0	0	0	0	0	0	57
18-Aug-16	B	12	10	2	0	10	0	0	2	0	0	2	0	0	0	0	0	38
26-Aug-16	A	46	19	2	3	29	5	0	18	2	0	1	0	0	0	0	0	125
26-Aug-16	B	17	17	0	0	13	2	1	8	0	1	0	0	0	0	0	0	59
01-Sep-16	A	25	21	0	1	15	7	0	11	3	4	0	0	0	0	0	0	87
01-Sep-16	B	20	9	1	0	9	1	0	8	1	2	0	0	1	0	0	0	52
06-Sep-16	A	19	11	1	1	11	0	1	5	1	3	0	0	0	0	0	0	53
06-Sep-16	B	17	8	0	0	10	4	0	7	0	0	0	0	0	0	0	0	46
Grand Totals:		186	109	8	5	104	19	2	63	7	10	3	0	1	0	0	0	517

\* W = Wild, H = Hatchery, Recap = Recapture; Right- or Left- Recap indicating individual was previously marked during seining and/or gillnetting, respectively.

As shown in Table 4, wild males had a higher capture rate than wild females on all occasions, with the exception of August 26<sup>th</sup> at Gillnet Site B, where the catch was even between the two sexes. Over all gillnetting sets, wild males made up 70.6% more of the gillnetting catch than wild females, and right-recapture males made up 65% more of the sample than right-recapture females. Only eight hatchery males and five hatchery females were processed during gillnetting, with a recapture of three and zero respectively. Hatchery stock made up 3.34% of the total sockeye escapement sampled during gillnetting. In total, 517 sockeye were handled during gillnetting (Table 4), including both right and left recaptures. The highest daily total was 185 on August 26<sup>th</sup> (Figure 13), with 125 sockeye at Gillnet Site A and 59 sockeye at Gillnet Site B.

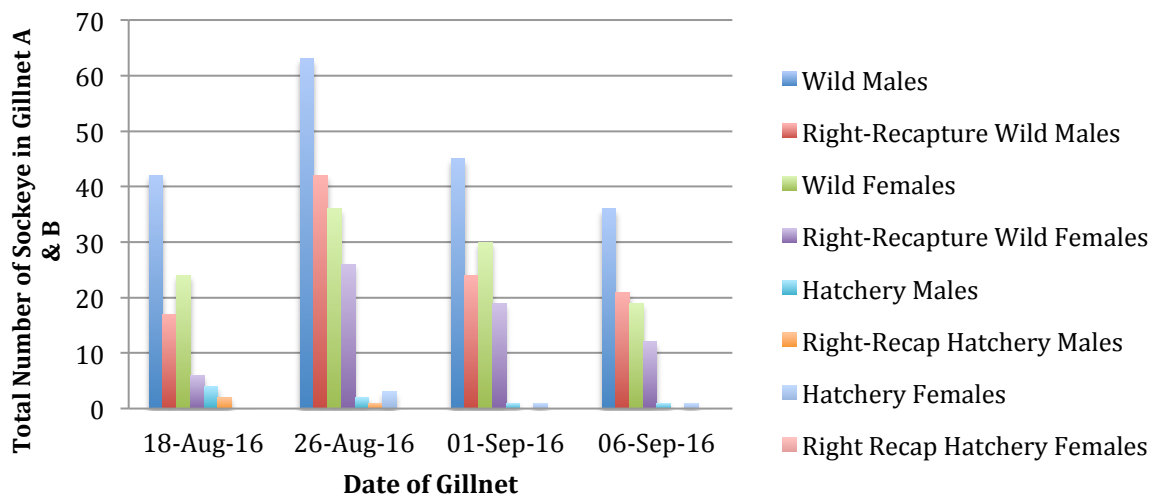


Figure 13: Number of wild males/females, right recapture males/females, hatchery males/females, and right recapture hatchery males/females for both gillnetting sites on August 18<sup>th</sup>, August 26<sup>th</sup>, September 1<sup>st</sup>, and September 16<sup>th</sup>.

Table 5: Gillnetting Sample Population Totals August 18, August 26, September 1, and September 6.

Date	Daily Sample Total	Daily Left Recap Total	Total (-Recaps)
18-Aug-16	95	0	95
26-Aug-16	184	11	173
01-Sep-16	139	19	120
06-Sep-16	99	9	90
Grand Total:	517	39	478

Daily sample totals during gillnetting, including recaptures, ranged from 95 to 185 individuals (Table 5). Of the 517 sockeye handling occurrences, 39 were left opercular punch recaptures (i.e. they had been captured more than once during gillnetting); therefore, in total, 478 sockeye individuals were captured during all gillnetting sets.

Table 6: Gillnetting Sample Population Totals August 18, August 26, September 1, and September 6.

	Male	Female	Jack	Total
Hatchery	11	5	0	16
Wild	290	172	0	462
Grand Total:	301	177	0	478

Following all four gillnetting sets, the total sample population size included 301 males, 177 females, and zero jacks (Table 6). Excluding recaptures, hatchery sockeye made up 3.34% of total escapement captured during gillnetting.

### Population Estimate

Using data collected during seining and gillnetting, a population estimate was calculated using the Lincoln-Peterson equation:

$$N = \frac{Kn}{k}$$

where,

N = number of Sockeye in the population  
K = Number of new Sockeye seined  
n = Total Number of Sockeye gillnetted  
k = Number of recaptures gillnetted



$K = ((UM \text{ Males} + UM \text{ Females} + H \text{ Males} + H \text{ Females} + \text{Jacks})) - (\text{Recap Male} + \text{Recap Female} + \text{Recap H Male} + \text{Recap H Female} + \text{Recap Jack})$

$n = UM \text{ Male} + UM \text{ Female} + H \text{ Male} + H \text{ Female} + \text{Right Recap Male} + \text{Right Recap Female} + \text{Right Recap H Male} + \text{Right Recap H Female} + \text{Jacks}$

$k = \text{Right Recap Male} + \text{Right Recap Female} + \text{Right Recap H Male} + \text{Right Recap H Female}$

$$N = \frac{(3961)(439)}{170}$$
$$N = 11,137$$

The population estimate of 11,137 was determined based on the 3,961 new sockeye seined, 439 gillnetted, and 170 gillnetted recaptures from seining. Calculations excluded right recaptures recorded during seining and left recaptures during gillnetting in order to eliminate duplicating counts for individuals, as indicated by Krebs *et al.* 1989.

## Discussion

The 2016 Lakelse sockeye adult monitoring in Williams Creek was an overall success. Improvements were made this year to the program by marking the right/left operculum with only one punch mark instead of repeating punches for every subsequent catch of the same fish, as this method did not provide data useful in calculating an estimate of total escapement. As a result, handling time/stress of the individual recaptured fish decreased, and overall residence time in the nets was reduced for all individuals.

The assessment provided useful information on the estimated population of sockeye returning to Williams Creek, as well as the percentage of hatchery stock that comprised the escapement. In total, 4,439 individual sockeye were handled and marked during the program. Based on the observed hatchery (no adipose) vs. wild ratio, it was determined that hatchery fish represented 4.15% of the fish captured during seining and 3.34% of fish processed during gillnetting.

Table 7: Williams Creek sockeye stock assessment data from 2014, 2015, & 2016.

Year of Assessment	Population Estimate	% Hatchery in Seine	% Hatchery in Gillnet
2014	6,862	3.30%	4.77%
2015	11,598	7.20%	6.26%
2016	11,137	4.15%	3.34%

As shown in Table 7, the percent of hatchery stock comprising total catch during seining and gillnetting decreased since 2015. The variance in percentages of hatchery stock in seining versus gillnetting show the natural variance related to sampling and therefore may not represent a true difference in percentage of hatchery stock handled. Future monitoring of returning stock will provide insight into population fluctuations and percentage of hatchery stock returning to Williams Creek up to the final brood production year of the 2014 Fry Outplant Project.

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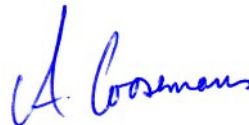


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