*Gitanyow Fisheries Authority*

# The 2014 Kitwanga River Salmon Smolt Assessment


Submitted to: Gitanyow Hereditary Chiefs
Pacific Salmon Foundation
Fisheries and Oceans Canada (Prince Rupert – Stock Assessment)

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## Abstract

In 2014, the Gitanyow Fisheries Authority (GFA) operated the Kitwanga River Smolt Enumeration Facility (KsF) for the 7th consecutive year since initiated in 2008 to enumerate sockeye and coho salmon smolts, and other resident trout and char species. The KsF was operated from April 12th to June 26th, 2014. The 2014 sockeye smolt population estimate was 46,955 fish and was comprised mostly of 1-Yr old smolts (99%). The peak run of 14,254 sockeye smolts occurred on May 7th when 30% of the entire run migrated past the KsF on that day, which is comparable to previous years when peak runs generally occur in the 1st or 2nd week of May. Approximately 98% of the sockeye smolts migrated through the weir in a 15-day period from April 27th to May 11th, 2014, which is also comparable to previous years. Freshwater production estimates for Gitanyow Lake sockeye in 2014 were estimated at 18 sockeye smolts per female spawner from the 2012 adult run, which was the lowest recorded since 2008. A Vaki Bioscanner was tested for a portion of the sockeye run and proved successful in accurately counting large numbers of sockeye smolts in a short time period. The Vaki Bioscanner will be used in future years to assist fence staff during peak run periods. Coho smolt counts totaled 8,365 fish during the 2014 KsF operation, however coho smolts were still passing through in the 100's of fish per day at fence closure. The coho peak run timing was about 1-2 weeks later than normal. Budget constraints did not allow for the full capture of the coho smolt run. The 2014 aging results for coho were not available in time for this report but will be included in the 2015 Annual Report. A total of 6,966 coho smolts (83% of the run) were implanted with Coded Wire Tags (CWT's) to provide an estimate of adult exploitation rates in subsequent years.



## Acknowledgements

The GFA would like to thank Fisheries and Oceans Canada (Prince Rupert – Stock Assessment division), Pacific Salmon Foundation and the Gitanyow Hereditary Chiefs AFS program for jointly funding the operation of the KsF in 2014. GFA would also like to acknowledge the hard work of the GFA smolt fence staff whose dedication made the operations a success including: Les McLean, Earl McLean, Vern Russell, Phillip Johnson, Brenton Williams, Johnny Martin, Owen Russell, Morgan Douse, Mark Cleveland, Derek Kingston, Gregory Rush and Kevin Koch.

# 1. INTRODUCTION AND BACKGROUND

In this report, emigration (downstream flow) for the 2014 spring smolt run of anadromous sockeye (*Oncorhynchus nerka*) and coho (*O. kisutch*) salmon smolts and resident trout and char species passing through the KsF from Gitanyow Lake will be discussed. The 2014 smolt sampling season represents the 7th consecutive year that this project has been implemented.

Historically, the Gitanyow fished salmon in the Kitwanga River for food, social and ceremonial purposes with sockeye being the main salmon species of choice. In the early 1900's sockeye stocks were thriving and Gitanyow Elders spoke of the lakeshores of Gitanyow Lake turning red every fall as the sockeye congregated to spawn on their respective spawning grounds. However, by the 1920's the Elders talked of the noticeable declines in the returns of the Kitwanga sockeye stock. By the 1960's most fishing sites along the Kitwanga River were abandoned and aboriginal fishing for sockeye had ceased due to low run numbers and concerns for the unique stock (Cleveland 2005, Kingston 2013).

One of the largest contributors to sockeye decline is suspected to be over-exploitation of the stock in commercial ocean fisheries. Past fishery re-constructions for the last 40 years show the average exploitation on Kitwanga sockeye has often been over 50% and reaching as high as 70% in some years (Cox-Rogers, DFO, Pers. comm., 2010). Other factors likely contributed to the declines such as sockeye spawning habitat destruction in the Kitwanga Watershed due to poor forest harvesting practices, which include sedimentation, disruption of water flow patterns, and changes in water quality of Gitanyow Lake tributary streams (Cleveland 2006, Kingston 2013).

Accurate Kitwanga adult salmon escapement data has been ongoing since the construction and continual operation of the Kitwanga River Salmon Enumeration Facility (KSEF) in 2003 near the mouth of the Skeena River and the construction and continual operation of the Kitwanga River Smolt Enumeration Facility (KsF) in 2008. In 1999, GFA initiated a Kitwanga sockeye-rebuilding program to conserve, protect and recover the stock. One of the highest rebuilding priorities for the Kitwanga Sockeye Salmon Recovery Plan (KSRP), which was initiated in 2006, was to continue monitoring the yearly abundance of Kitwanga sockeye salmon smolts emigrating

from Gitanyow Lake (Cleveland et al. 2006, Kingston 2013). Annual KsF reports from 2009 to 2013 can be viewed on http://www.gitanyowfisheries.com/kitwanga-smolt-fence-enumeration .

The KsF plays a critical role in allowing GFA to monitor Kitwanga sockeye smolt production from Gitanyow Lake on a yearly basis. Assessing smolt production is important to the Gitanyow because it helps gauge the effectiveness of sockeye-rebuilding programs currently being carried out in the Kitwanga watershed. Since 1998, the GFA have been working diligently throughout the Kitwanga watershed to restore the sockeye stock to historical levels.

From 2000 to 2007, GFA experimented with different weir and trap designs in an effort to accurately count Kitwanga sockeye smolts on a yearly basis. For the most part, these trap designs were unusable on the Kitwanga River when an unknown number of smolts passed though undetected (Kingston 2013). In 2007 and 2008, the GFA were successful in acquiring funding to construct a permanent smolt fence on the Kitwanga River below Gitanyow Lake. The KsF became operational in April 2008 and since then has annually counted all salmonids emigrating downstream from Gitanyow Lake.

In 2009, GFA initiated a coho coded wire tagging (CWT) program, which are counted at the KSEF or captured and reported ideally in whole but realistically in part by Alaskan and Canadian fisheries. Tag recovery information helps fisheries managers determine coho survival rates and fisheries specific exploitation of yearly cohorts, which represent a portion of Skeena coho stocks with similar life history traits.

In 2008 and 2009 the KsF was used to monitor the production of Kitwanga hatchery sockeye fry out planting programs that took place in Gitanyow Lake in 2007 and 2008 (Cleveland 2007, 2009). At present, all progeny from this program are considered absent.

In 2014, the KsF was operated with funding contributions from Fisheries and Oceans Canada (Stock Assessment - Prince Rupert), Pacific Salmon Foundation and the Gitanyow Hereditary Chief's Aboriginal Fisheries Strategy (AFS) program. This report summarizes the results and findings for the KsF program in 2014.

# 2. METHODS

Counts at the KsF started on April 12th, 2014 and continued until June 26th, 2014. All of the aluminum components were installed then pulled from the river outside this period. The KsF is located on the Kitwanga River approximately 600m downstream from the outlet of Gitanyow Lake (UTM's 9U 557014E; 6131839N - Figure 1). The design of the KsF consists of an aluminum-based weir that passively diverts emigrating smolts and other resident trout species into one of three trap boxes where they can be easily enumerated, sampled and released (Figure 2).

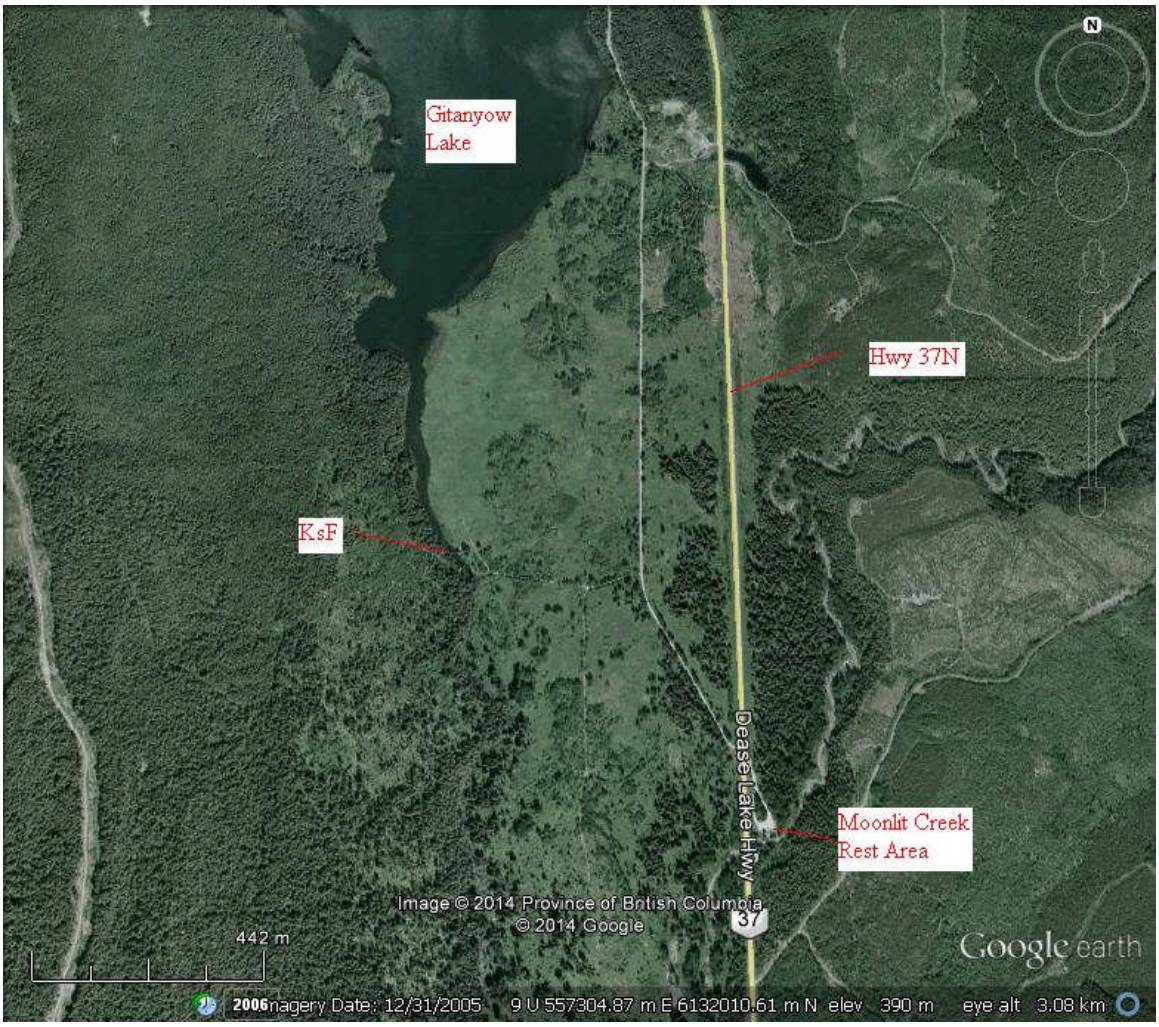


Figure 1: Location of the Kitwanga River Smolt Enumeration Facility (KsF) showing reference to Gitanyow Lake outlet and Highway 37N (Image supplied from www.googleearth.com).

The aluminum weir and smolt trap boxes were attached to preformed concrete aprons that were placed in the riverbed during the construction of the smolt fence completion project (Kingston, 2008). The weir is constructed of prefabricated smolt panels, trap boxes and transoms that can be easily installed and removed by the GFA fisheries technicians. The aluminum weir is designed to mimic the physical features of a beaver dam where water is backed-up, forming a head of water upstream of the weir which spills over in a desired location. Traps boxes are installed at the spill locations and easily capture downstream moving fish that key in on the area. The weir is installed at a 45$^{o}$ angle to the rivers flow, which naturally moves fish to the left bank of the river where the trap boxes are installed.

The trap boxes were designed with dewatering screens that funneled the smolts into a small holding box where they remained trapped (see Figures 2-6 for photos of fence design). Once the fish were committed to entering the dewatering screens, the fish are then transported down the V-shaped grooves where the water velocity was too great for them to swim back upstream. From the small holding boxes that are attached to the dewatering screens, fish continue to move downstream through a 6" rigid plastic hose to a large covered 8' X 4' X 4' holding box where they remain until they are sampled each day. The KsF consisted of three smolt traps that were connected to three large holding boxes. Four to five rows of 6" X 6' stop-logs were placed at the back of each transom to create a damming effect upstream of the fence. The stop-logs created a 6" to 12" head effect upstream of the fence at each of the smolt traps, which allowed them to work effectively to catch fish.

Crews of two or three GFA fisheries technicians would check the trap first thing in the morning and conduct fish sampling and smolt enumeration work. The fence site was visited again just before dark daily to clean debris off the fence and ensure the traps were fishing at the proper water level. Trap adjustments could be made so the optimum amount of water was flowing through each trap area. This ensured the fish were captured in a passive, harmless manner. Sub samples of all sockeye smolts caught daily were measured to determine their lengths and weights. Fork lengths were taken to the nearest 1 mm and weights to the nearest 0.1 grams.

Figure 2: Completed aluminum weir installed in 2013 with new non-skid walkway and safety railings.

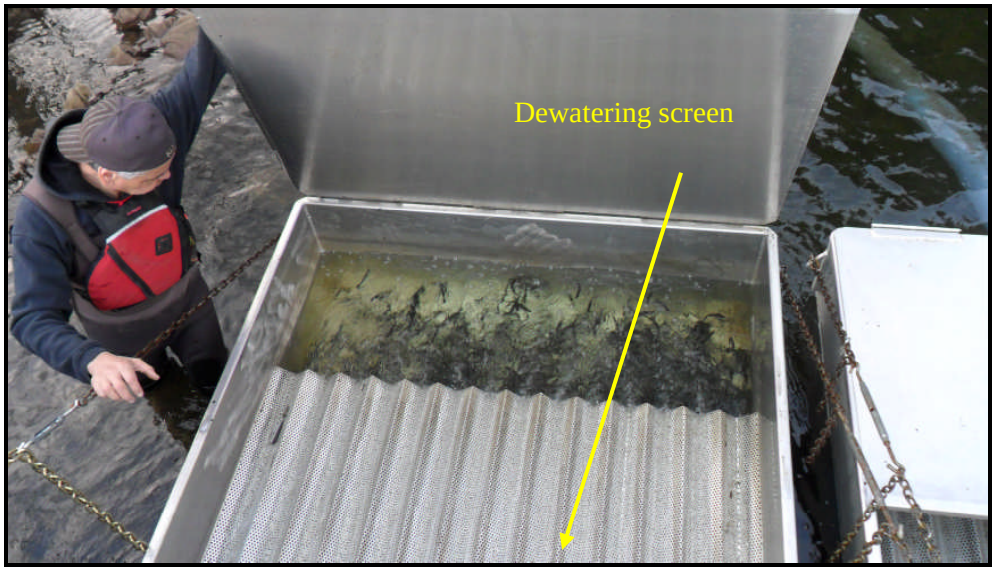


Figure 3: Photo of smolt trap box showing dewatering screen.

Figure 4: Photo of large holding boxes attached to smolt trap boxes with 6” hose.

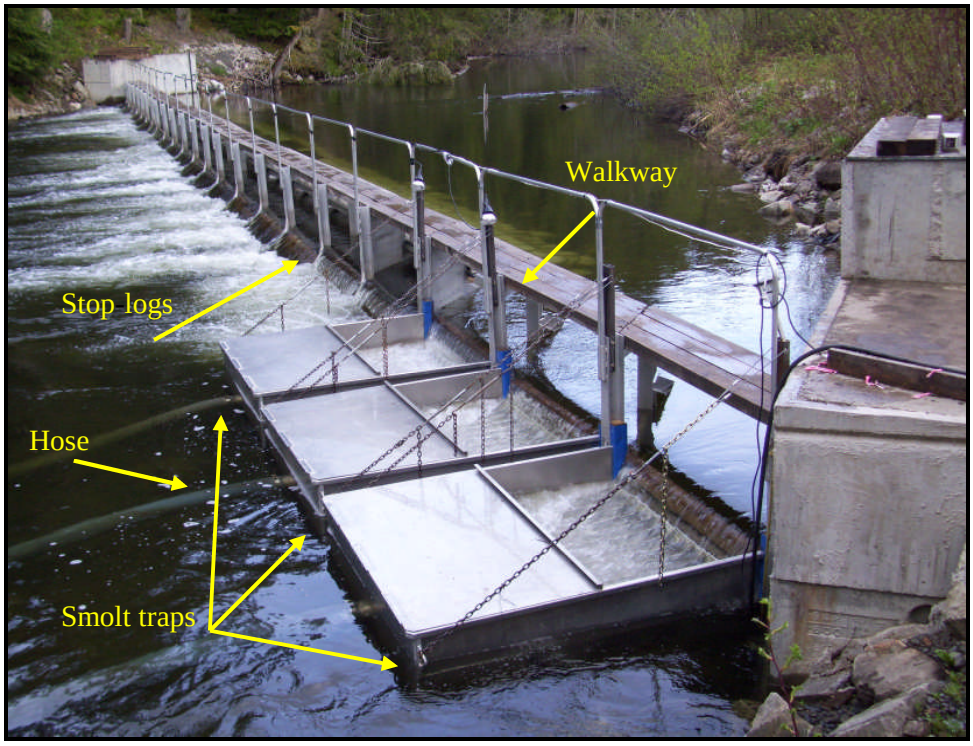


Figure 5: Photo of smolt fence installed showing smolt traps, 6” hose, stop-logs and walkway.

Figure 6: Photo of smolt holding box with captured sockeye smolts.

## *2.1 Coho Coded Wire Tag (CWT) Program*

Since 2009, but excluding 2012, GFA implemented a Kitwanga coho smolt CWT program in conjunction with the operation of the KsF. As in other years nearly all coho captured in 2014 (6,966 out of 8,365 smolts or 83 % of the sample) were implanted with a CWT. In addition to tagging, scales were taken from approximately 3% of the run (400 out of 14,347 fish) for age determination. Fork lengths were taken to the nearest 1 mm and weights to the nearest 0.1 grams.

Coho implanted with a CWT were first anaesthetized using a bath of river water and clove oil. All tagged coho were given an adipose fin clip to make them recognizable by commercial fishers and the KSEF counting crew upon return. Once anaesthetized, the CWT's were implanted into the nose of the coho with a Mark II automated tag injector (see Figure 7 for installation set-up). Tagged coho were then released down a Quality Control Device (QCD) to detect whether the tags had been properly implanted into the fish. All coho found to have not retained their tag were re-tagged. As an added quality control measure approximately 10% of each days tagged group were held for 24-hrs and passed through the QCD for a second time to determine tag loss and

mortality. Following all sampling and tagging operations, coho smolts were placed back into large holding boxes in the Kitwanga River and released at nightfall.

Figure 7: Photo of Coded Wire Tag (CWT) machine, Quality Control Device (QCD) and sampling station set-up.

## *2.2 KsF Facility Modernization in 2014*

In March 2014, the GFA received funding from the Pacific Salmon Commission Northern Fund, which allowed us to purchase an electronic single-channel Vaki Bioscanner unit (Vaki) from PR Aqua Supplies Ltd. in Nanaimo, BC (See Figure 8 for trough design, digital counter, and instream operation). An aluminum stand and fish holding basin were fabricated to hold the Vaki. In April 2014, the Vaki was secured to a wooden floating platform and tested during the regular smolt enumeration program. The Vaki consists of an electronic control unit, V-channel and scanner. The control unit gathers and displays data from the scanner. The control unit also supplies power to the scanner. The V-channel regulates the flow of fish and water, and separates the fish through the scanner, making it possible to count them. The scanner counts the fish as they pass through the V-channel, and relays data to the control unit via the connector lead. The Bioscanner is very gentle as no mechanical parts touch the fish when counted, and the fish are in water at all times (Kingston 2014).

A water source was attached to the Vaki, which supplied a flow rate of 5.0 – 6.5 Liters

per minute and was powered by a gas powered generator. Smolts were placed into the holding basin of Vaki and allowed to swim down the V-channel at their leisure. As the fish come out of the holding basin they are close together, therefore require separation to be counted accurately. The V-form ensures that the fish cannot turn around, and also that they are not crowded together. The curved form accelerates the fish down the channel. If two fish are close together in the beginning the one that is little bit ahead will accelerate faster and this causes a separation of the fish (Kingston 2014).

Once the fish swim down the V-channel they are dropped into a holding bucket with water. When approximately 100 fish have been logged through the control unit a manual count is performed to calibrate the accuracy of the unit. Several accuracy calibrations are completed at the start of each day to make sure the unit is accurately counting smolts. Once several calibrations have been completed the control unit is re-zeroed and the smolts are placed into the holding basin 20-30 at a time until all smolts have been run through the Vaki (Kingston 2014).

Figure 8: Photo series of the Vaki Bioscanner trough design, digital counter, and instream operation.

# 3. RESULTS

Five species of salmonids were enumerated through the KsF between April 12th and June 26th, 2014: sockeye and coho salmon, cutthroat (*Oncorhynchus clarkii*) and rainbow (*O. mykiss*) trout and bull trout char (*Salvelinus confluentus*; Table 1). Sockeye smolts were stratified into 1 and 2 year old fish based on visual observations in the field. Dolly Varden char (*Salvelinus malma*) may be mixed in with the juvenile bull trout samples in Table 1, as these were not differentiated in the field. Other species counted include mountain whitefish (*Prosopium williamsoni*, 164 fish), sculpin (*Cottidae sp*., 2,648 fish), northern pikeminnow (*Ptychocheilus oregonensis*, 14 fish), and redside shiner (*Richardsonius balteatus*, 15 fish).

Table 1: Number of fish by salmonid species (salmon/trout/char) counted through the KSF from April 12th and June 26th, 2014.

| 1-YR Old SX | 2-YR Old SX | Total Sx Smolts | Total Coho Smolts | CT | Adult BT (> 300mm) | Juv. BT (< 300mm) | RBT |
|---|---|---|---|---|---|---|---|
| 46,913 | 42 | 46,955 | 8,365 | 604 | 326 | 230 | 113 |

The following sections will describe run timing, and age and size distribution/statistics for sockeye and coho smolts, and also, sockeye smolt production and details of the coho coded-wire tagging (CWT) program. In addition, results of the Vaki Bioscanner trials will be discussed.

## *3.1 Sockeye Salmon*

### 3.1.1 Sockeye Run Timing

In 2014, 46,955 sockeye smolts were counted migrating downstream though the KsF. The first sockeye smolt was counted on April 23rd and the last on June 17th (Table 2). The peak run of 14,254 sockeye smolts occurred on May 7th when 30% of the entire run migrated past the KsF on that day. This is comparable to previous years when peak runs generally occur in the 1st or 2nd week of May (Figure 9). The midpoint of the run occurred on May 22nd and is also comparable to previous years results. Approximately 98% of the sockeye smolts migrated through the weir in a 15-day period from April 27th to May 11th, 2014, which is also comparable to previous years. Based on the above, the KsF was operational essentially during the entire sockeye smolt run.

Table 2: 2014 sockeye run timing highlights compared to 2001 to 2013 results.

| Year | Run Start | Run End | Run Peak | Run Midpoint |
|---|---|---|---|---|
| 2001 | April 29th | May 27th | May 6th | May 13th |
| 2002 | April 27th | June 1st | May 12th | May 11th |
| 2003 | April 23rd | June 2nd | May 2nd | May 13th |
| 2004 | April 19th | May 20th | April 30th | May 5th |
| 2005 | April 17th | May 19th | May 2nd | May 3rd |
| 2006 | April 22nd | May 25th | May 4th | May 9th |
| 2007 | May 1st | May 30th | May 10th | May 15th |
| 2008 | April 30th | May 28th | May 11th | May 14th |
| 2009 | May 1st | June 7th | May 18th | May 19th |
| 2010 | April 21st | June 11th | May 3rd | May 17th |
| 2011 | April 25th | June 23rd | May 14th | May 25th |
| 2012 | April 26th | June 7th | May 9th | May 17th |
| 2013 | April 24th | June17th | May 7th | May 22nd |
| **2014** | **April 12th** | **June17th** | **May 2nd** | **May 20th** |
| **Average 2001 - 2014** | **April 24th** | **June 2nd** | **May 7th** | **May 15th** |

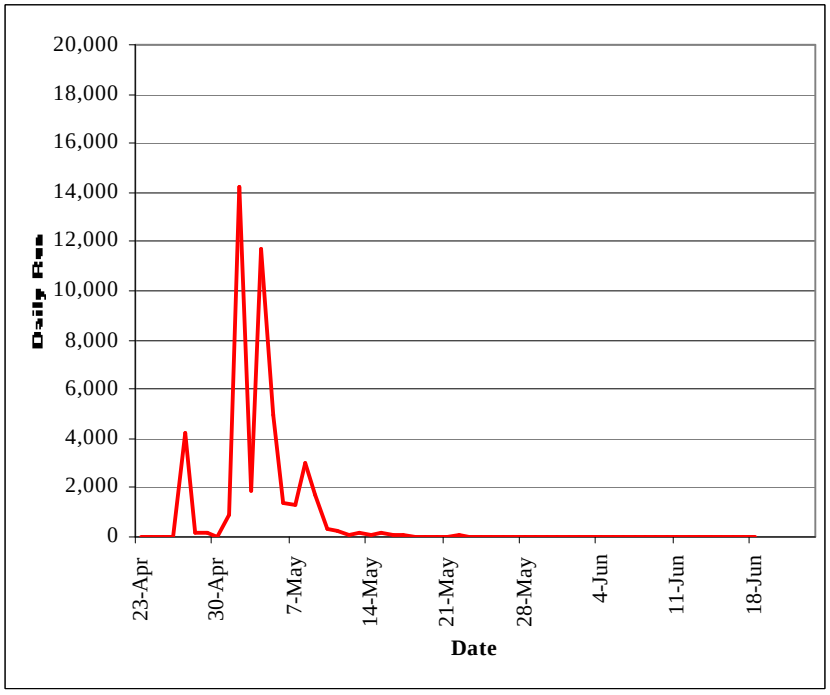


Figure 9: Daily run timing for sockeye smolt emigrating through the KsF in 2014 (n=46,955).

### 3.1.2 Sockeye Age and Size Structure

Scales from 586 sockeye smolts were submitted to Birkenhead Scale Analyses for age analysis and of these, 446 fish were deemed readable (1% of the total run). A total of 444 smolts were identified as 1-year-old fish (99% of the sample) and two smolts were identified as 2-year-old fish. The 2014 mean length of 1-year-old smolts (104.1 mm) and weight (11.0 g) was comparable to that found in previous years at the KsF (Tables 3 and 4). Fork length distribution for 1-year-old smolts, grouped into 5mm intervals, was unimodal with the majority of fish falling into the 105-110 mm length class (Figure 10).

Data from age 1-year-old Gitanyow Lake sockeye smolts shows that average lengths and weights are relatively large when compared to three other high-profile BC sockeye producing lakes (approximately 20 years of data for Babine, Cultus, and Chilko Lakes; in Groot and Margolis 1991). The 2014 results (104mm, 11g) and averages from 2001 to 2013 (104mm, 11g) compares to Babine Lake (79mm, 4.9g), Cultus Lake (82mm, 6.2g), and Chilko Lake (82mm, 6g).

Table 3: Length and weight statistics for 1-year-old sockeye sampled in 2014 (n=445).

| Statistic | Length (mm) | Weight (g) |
|---|---|---|
| Mean | 104.1 | 11.0 |
| Standard Error | 0.33 | 0.11 |
| Median | 105 | 11 |
| Mode | 106 | 12.2 |
| Standard Deviation | 6.97 | 2.24 |
| Sample Variance | 48.62 | 5.03 |
| Kurtosis | 0.07 | 0.08 |
| Skewness | -0.37 | 0.22 |
| Range | 44 | 13.1 |
| Minimum | 80 | 5.7 |
| Maximum | 124 | 18.8 |
| Count | 444 | 444 |
| Confidence Level (95.0%) | 0.65 | 0.21 |

Table 4: Lengths and weight statistics for one-year-old sockeye sampled since 2008 at the KsF.

| Year | Sample Size (N) | Mean Fork Length (mm) | Max. / Min. Fork Length (mm) | Mean Weight (g) | Max. / Min. Weight (g) |
|---|---|---|---|---|---|
| **2008** | 1,224 | 102.8 | 76 / 122 | 9.9 | 4.9 / 28.5 |
| **2009** | 320 | 112.1 | 86 / 132 | 13.4 | 5.7 / 21.3 |
| **2010** | 2,490 | 106.4 | 77 / 128 | 11.5 | 4.1 / 21.5 |
| **2011** | 740 | 106.6 | 85 / 151 | 11.8 | 6.1 / 32.7 |
| **2012** | 1,680 | 96.7 | 64 / 124 | 8.5 | 2.3 / 15.5 |
| **2013** | 684 | 101.3 | 71 / 123 | 10.1 | 3.5 / 17.8 |
| **2014** | 444 | 104.1 | 80 / 124 | 11.0 | 5.7 / 18.8 |
| **Average 2008 - 2014** | | **104.3** | **64 / 151** | **10.9** | **2.3/ 32.7** |

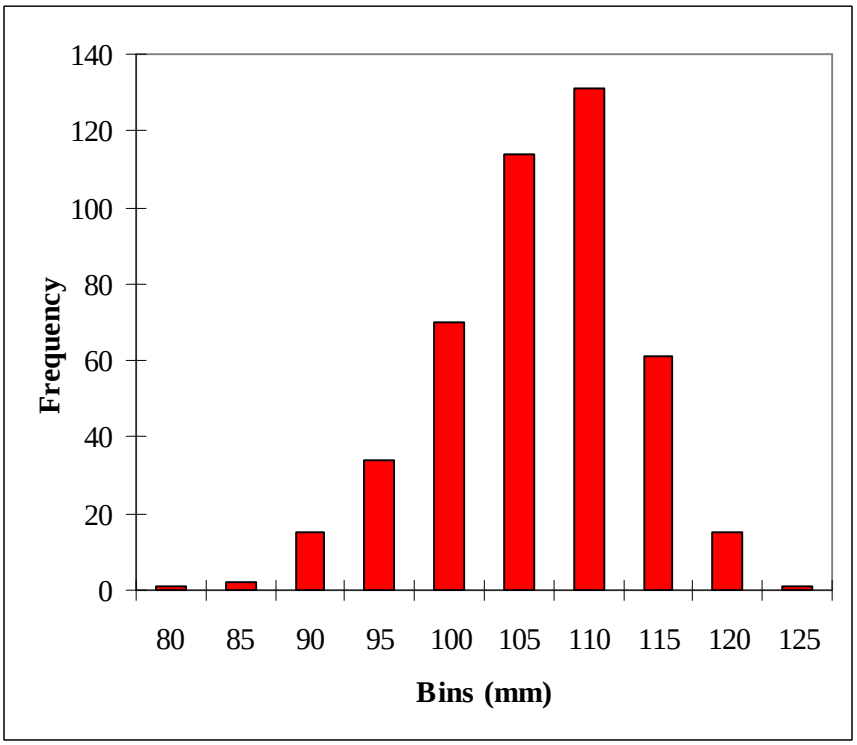


Figure 10: Length distribution (5mm class intervals) for 1-year-old sockeye sampled in 2014 at the KsF (n=444).

### 3.1.3 Sockeye Smolt Population Estimates and Smolt Production

A total of 46,955 sockeye smolts were captured in 2014 and was considered a complete account of the run (Table 5). The 2014 smolt run was the second lowest recorded since 2008, and was

61% below the 2008 to 2013 running average of 120,469 smolts at the KsF, however this average is skewed by the record 2012 count of 400,907 smolts. The running average now stands at 141,151 smolts/year.

In 2014, an estimated average of 18 smolts were produced per female spawner (Table 6). This estimate was generated by dividing the total number of 1-yr old smolts produced in 2014 by the number of adult females that escaped to the river and presumed to have successfully spawned in 2012 (5,476 total spawners x 0.47 female ratio = 2,574 females; McCarthy 2013). The 2014 Kitwanga smolt production was the lowest recorded since 2008. What appears to be an inverse relationship between # of spawners and smolt production could be due to the carrying capacity of either the spawning grounds or their rearing environment in the lake.

Table 5: Kitwanga River sockeye smolt population estimate and trap efficiency from 2001 – 2014.

| Year | # Smolts Marked | # Smolts Recaptured | Trap Efficiency % | Total Smolts Captured | 2-Yr. Old Smolts | Hatchery Smolt Population Estimate | Wild Smolt Population Estimate | 95% C.I. Lower | 95% C.I. Upper |
|---|---|---|---|---|---|---|---|---|---|
| **2001** | 570 | 13 | 2 | 1,921 | | -- | **78,389** | 39,332 | 117,446 |
| **2002** | 1,827 | 294 | 16 | 6,842 | | -- | **42,402** | 38,074 | 46,730 |
| **2003** | 1,702 | 78 | 5 | 4,806 | | -- | **103,623** | 81,628 | 125,619 |
| **2004** | 1,177 | 36 | 3 | 3,773 | | -- | **120,155** | 82,732 | 157,578 |
| **2005** | 4,516 | 372 | 8 | 8,252 | | -- | **99,942** | 90,461 | 109,423 |
| **2006** | 2,166 | 171 | 8 | 8,591 | | -- | **108,248** | 92,925 | 123,571 |
| **2007** | 4,889 | 521 | 11 | 7,436 | | -- | **69,667** | 64,225 | 75,109 |
| **2008** | N/A | N/A | N/A | 229,026 | | 2,753 | **226,273** | 213,486 | 239,060 |
| **2009** | N/A | N/A | N/A | 36,554 | 311 | 1,273 | **35,281** | -- | -- |
| **2010** | N/A | N/A | N/A | 113,068 | 24 | -- | **113,068** | --- | -- |
| **2011** | N/A | N/A | N/A | 83,854 | 137 | -- | **83,854** | -- | -- |
| **2012** | N/A | N/A | N/A | 400,907 | 91 | -- | **400,907** | 389,448 | 412,336 |
| **2013** | N/A | N/A | N/A | 84,294 | 65 | -- | **84,294** | --- | --- |
| **2014** | N/A | N/A | N/A | 46,955 | 42 | -- | **46,955** | --- | --- |

Table 6: Sockeye smolt production in 2014 compared to results from the KsF from 2008 to 2013.

| Year | Smolt Estimate | Female Spawners | Smolts per Female |
|---|---|---|---|
| 2008 | 226,273 | 2,643 | 86 |
| 2009 | 34,970 | 125 | 280 |
| 2010 | 113,044 | 684 | 165 |
| 2011 | 83,717 | 1,615 | 52 |
| 2012 | 400,907 | 9,778 | 41 |
| 2013 | 84,294 | 1,230 | 69 |
| 2014 | 46,955 | 2,574 | 18 |
| **Average** | **141,151** | **2,664** | **102** |

### 3.1.4 Vaki Bioscanner Results

The Vaki Bioscanner was tested in 2014 to determine the viability of using the apparatus to assist the crew in counting sockeye smolts during their peak run period. Initial testing of the Vaki overall yielded approximately 92% - 95% accuracy for counting smolts and 1000 smolts per hour. It was later determined that the scanner unit was malfunctioning. A replacement scanner was sent to the GFA and immediately upon testing the counting accuracy increased to 98-99%. The placement of the water flow was also changed after some testing and smolt counts increased to 3000-4000 smolts per hour (Kingston 2014).

## *3.2 Coho Salmon*

### 3.2.1 Coho Run Timing

In 2014, 8,365 coho smolts were counted migrating downstream though the KsF. The first coho smolt was counted on April 25th and the last on June 26th when operations ceased (Table 7; Figure 11). The KsF ceased operations when coho smolts were still passing through in the 100's of fish, therefore did not capture the entire run. This was due to budget constraints and successfully achieving the primary goals of capturing the entire sockeye smolt run and implanting about 5,000-10,000 coho smolts with a CWT for adult tracking purposes.

Two peak runs of coho smolts were observed on June 17th (791 fish) and June 20th (562 fish), which was about 1-2 weeks later than normal. Daily counts of 100+ fish began on May 25th and continued in approximately the 100-400 fish/day range until closing.

Table 7: 2014 coho run timing highlights compared to 2009 to 2013 results.

| Year | Run Start | Run End | Run Peak | Run Midpoint |
|---|---|---|---|---|
| 2009 | April 19th | July 13th | June 26th | June 1st |
| 2010 | April 17th | June 25th | May 31st | May 22nd |
| 2011 | April 26th | June 28th | June 2nd | May 28th |
| 2012 | April 25th | June 8th | May 28th | May 18th |
| 2013 | April 10th | N/a | June 3rd and 12th | N/a |
| **2014** | **April 25th** | **N/a** | **June 17th and 20th** | **N/a** |
| **Average 2009 – 2014** | **April 19th** | **June 18th** | **June 8th** | **May 25th** |

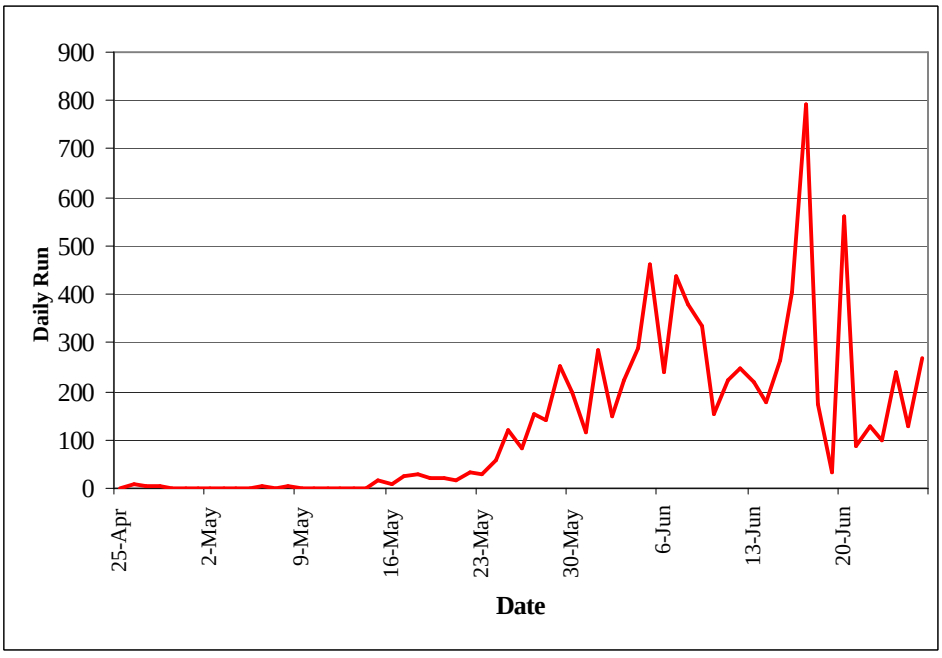


Figure 11: Daily run timing for coho smolt emigrating through the KsF in 2014 (n=8,365).

### 3.2.2 Coho Age and Size Structure

Scales from 544 coho smolts were submitted to DFO for age analysis, however unfortunately results were not available in time for this report but will be included in the 2015 Annual Report. Based on previous year, 1-year-old smolts are most abundant, followed by 2-year-old smolts,

then incidental 3-year-old smolts. The 2014 mean length (132mm) and weight (24.4g) for the entire 544 fish sample was comparable to that found in previous years at the KsF (Tables 8 and 9). Fork length distribution for coho, grouped into 5mm intervals, was unimodal with the majority of fish falling into the 130-135mm length class (Figure 12).

Table 8: Length and weight statistics for coho smolts sample in 2014 (n=544).

| Statistic | Length | Weight |
|---|---|---|
| Mean | 131.7 | 25.1 |
| Standard Error | 0.71 | 0.47 |
| Median | 130 | 23.3 |
| Mode | 133 | 18.9 |
| Standard Deviation | 16.50 | 10.89 |
| Sample Variance | 272.37 | 118.57 |
| Kurtosis | 8.11 | 23.43 |
| Skewness | 1.91 | 3.94 |
| Range | 143 | 108.1 |
| Minimum | 85 | 6.1 |
| Maximum | 228 | 114.2 |
| Count | 544 | 544 |
| Confidence Level (95.0%) | 1.39 | 0.92 |

Table 9: Coho smolts mean fork lengths and weights from 2009 to 2014.

| Year | Sample Size (N) | Mean Fork Length (mm) | Max. / Min. Fork Length (mm) | Mean Weight (g) | Max. / Min. Weight (g) |
|---|---|---|---|---|---|
| **2009** | 95 | 134.8 | 111 / 172 | 26.5 | 13.6 / 55.1 |
| **2010** | 550 | 141.2 | 103 / 272 | 31.1 | 11.8 / 195.4 |
| **2011** | 525 | 130.2 | 104 / 230 | 23.5 | 10.8 / 114.9 |
| **2012** | 400 | 129.8 | 93 / 173 | 22.3 | 8.5 / 51.7 |
| **2013** | 400 | 131.8 | 97 / 215 | 24.4 | 10.2 / 93.2 |
| **2014** | 544 | 131.7 | 85 / 228 | 25.1 | 6.1/ 114.2 |

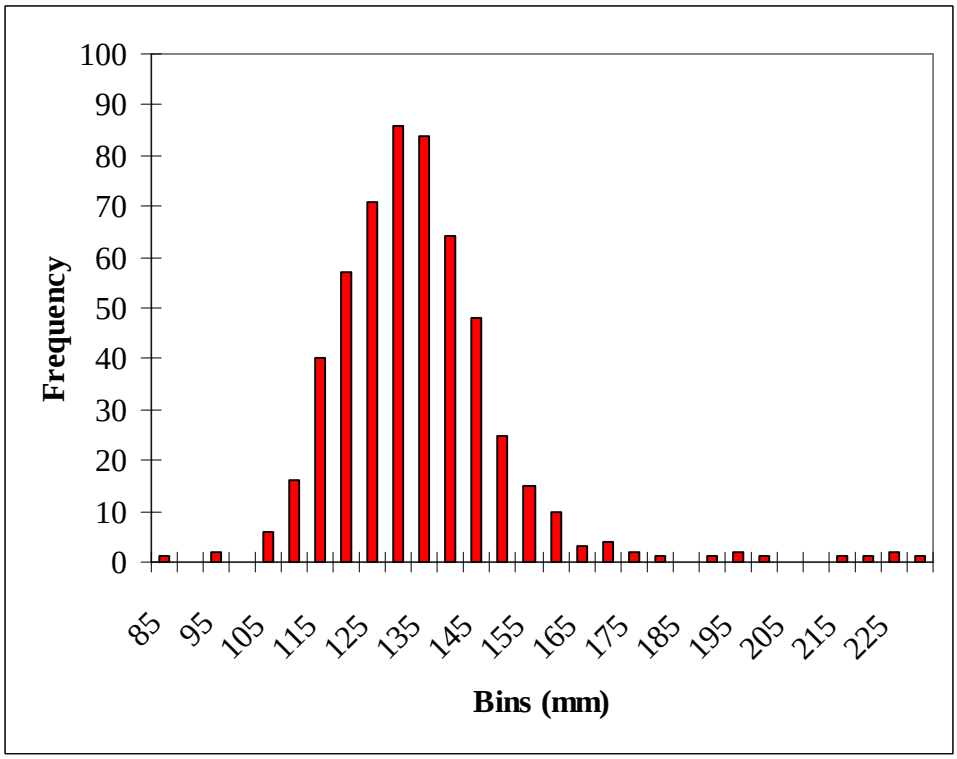


Figure 12: Length distribution (5mm class intervals) for 1 and 2-year-old coho sampled in 2014 at the KsF (N=544).

### 3.2.3 Coho Wire Tag Program

An estimated total of 6,966 coho affixed with a CWT were successfully released downstream in 2014 (out of 8,365 smolts or 83 % of the sample; Table 10). This CWT total takes into account tag loss and mortality based from a subsample of 1,604 coho from two differentiated tag groups.

Table 10: Coho CWT estimates for tag mortality, tag loss, and total CWT's released in 2014 at the KsF.

| CWT Tag Group | Tag Loss # (%) | Mortality # (%) | Tag Loss + Mortality % | Sample Size | # Coho Tagged (Corrected for tag loss and mortality) |
|---|---|---|---|---|---|
| **A08 D03/59** | 26 (3.98%) | 6 (0.92%) | 4.90% | 653 | 2,293 |
| **A18 D60/23** | 11 (1.16%) | 16 (1.68%) | 2.84% | 951 | 4,673 |
| **Total** | | | | 1,604 | 6,966 |

### *3.3 Run Timing of Other Species*

The cutthroat emigration through the KsF (604 fish) was relatively condensed within a 17-day period from April 30th to May 16th (402 fish or 67% of total count). No pattern was observed for bull trout/Dolly Varden char or rainbow trout in which counts were spread out and arrived in single or low double-digit numbers throughout the KsF operation.

## 4. DISCUSSION AND RECOMMENDATIONS

Since 2008, GFA has accurately enumerated sockeye smolts migrating out of Gitanyow Lake at the KsF for the past five years, even during spring flood events. GFA will continue to monitor the migration of sockeye smolts from Gitanyow Lake on a yearly basis as long as funding carries forward. Kitwanga sockeye smolt production is of great interest to fisheries managers and along with the KSEF is the highest assessment priorities currently undertaken by GFA in the Kitwanga Watershed.

Run timing spread, peak run date, and size and age distribution was similar to previous years. The 2014 sockeye smolt population estimate was 46,955, which were comprised almost exclusively of 1-year-old smolts, was similar to previous years. A low smolt run and low freshwater production is of concern to GFA. The 2014 smolt run was the second lowest recorded since 2008, and was 61% below the 2008 to 2013 running average of 120,469 smolts at the KsF. The 2014 Kitwanga sockeye freshwater production estimate from Gitanyow Lake was 18 sockeye smolts were produced per adult female from the 2012 brood year (2,574 females) and was the lowest production rate observed since 2008. Kitwanga 1-year-old smolts continue to be relatively larger in both length and weight compared to the size of 1-year-old smolts from three other high-profile BC sockeye producing lakes (Babine, Cultus, and Chilko Lakes; Groot and Margolis 1991).

The GFA successfully implemented an electronic Vaki Bioscanner into their everyday smolt count operations. This in turn will result in cost savings to the program through reduced labour requirements by speeding up sampling. Higher survivability of smolts is expected because less handling will be required. Overall smolt estimates will improve of smolt abundance at peak-run times as no bulk sampling will be required. The Fish Count Modernization at the KsF was completed on time and within the allowable budget.

Since 2009, but excluding 2012, the GFA have implemented a CWT program on the Kitwanga River to assess survival and harvest rates on coho to track commercial fishing pressure on this stock in both Alaska and BC waters. GFA will resume this worthwhile program in 2015 where the plan is to mark most of the coho smolts in order to obtain sufficient numbers of recoveries from marine fisheries and escapement through the KSEF thereby estimating an exploitation rate.

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# Appendix 1

## Letter from Carol Lidstone of Birkenhead Scale Analyses regarding 2013 sockeye smolt aging results

# Birkenhead Scale Analyses

▲▲▲▲▲

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January 6, 2015

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Re: 2014 Kitwanga River Smolt Sockeye Scale Analysis

Hi Derek,

Attached is the analysis for the sockeye smolt scales collected from the Kitwanga River from April 29 - May 20, 2014. The updated version of the Excel file includes the scale age, condition code, circuli counts, location of freshwater stresses, and relevant comments.

The total sample size is 587 sockeye, mounted on 25 books. Of the 25 books, 12 have been fully analyzed to include age, circuli counts, location of freshwater stress and relevant comments. The other 13 books have been partially analyzed, by scanning the scales quickly to provide age and ensure the typical Kitwanga pattern is exhibited. If any scales from the partial analysis exhibit anything out of the ordinary, the circuli counts and comments are provided. I alternated between full and partial analysis to provide data for the entire sampling period. Please see the inventory sheet on the Excel file which shows which books are fully and partially analyzed.

Unfortunately 110 samples of the 587 fish sampled are unreadable. The scales are missing for 1 sample, 5 samples contain regenerated scales, and 104 samples contain scales that were sampled incorrectly with the grooved side facing down and smooth side facing up, making the impression unreadable.

The majority of readable sockeye are age 1 (n=476), of which two exhibit plus growth (ie. age 1+), and one sample is age 2.

Age One Sockeye (n=476): Lengths range from 80-124 mm, with errors at 9.8, 11.4, 1066 and 1110, which I assume should be 98, 114, 106 and 111, respectively. Weights range from 5.7-18.8 grams, however there is one age 1 at 158 mm/38.2 grams (see below for length/weight not corresponding with scale).

The 109 unreadable samples that have corresponding length and weight data range from 87-119 mm, and 6.4-17.1 grams, respectively.

Circuli counts are provided for 237 of the age 1/1+ smolts. All of the scales exhibit the typical Kitwanga freshwater stress, including the 239 sockeye that were partially analyzed. As usual, the freshwater stress ranges from moderate to strong.

Of the 235 age 1 samples, the circuli counts from the focus to the freshwater stress range from 5-15, stress to annulus 6-13, for a total circuli count of 14-25. Plus growth is exhibited on two samples. One age 1+ shows the typical Kitwanga pattern with a freshwater stress at 11, and 2 circuli in the plus growth zone for a total count of 21. However, sample 72050 #2 exhibits a different pattern than the other age 1/1+ samples. The circuli count from focus to the freshwater stress is 14, stress to freshwater annulus is 13, and a wide plus growth zone of 6, for a total circuli count of 33. The length and weight is 114 mm and 13.1 grams (see below for length/weight not corresponding with scale).

Age Two Sockeye (n=1): There is one age 2 sockeye, with a length of 103 mm and a weight of 9.8 grams (see below for length/weight not corresponding with scale). Each year exhibits 18 circuli with a freshwater stress at 7 in the first year, and at 8 in the second year, with a total circuli count of 36.

Length/Weight Does Not Correspond With Scale Age and/or Circuli Count
The length and weight data does not correspond with the scale age and/or circuli counts for some of the samples in Book 72050.

Sample #1 is 120 mm/18.8 grams. Age 1 with circuli counts of 12+12, for a total of 24
Sample #2 is 114 mm/13.1 grams. Age 1+ with circuli counts of 14+13+6, for a total of 33.
Sample #8 is 158 mm/38.2 grams. Age 1 with circuli counts of 14+7, for a total of 21.
Sample #9 is 103 mm/9.8 grams. Age 2 with circuli counts of 7+11 in the first year, 8+10 in the second year, for a total circuli count of 36.
Sample #10 is 116 mm/15.2 grams. Age 1 with circuli counts of 5+11, for a total of 16.

It appears the scale samples for Book #72050 should be shifted up by one row to correspond with the correct length and weight data. Please note Book #72030 #8 is missing scales. Book 72043 has one scale, but the data is not entered in the spreadsheet. The data for Book #72050 #12 was crossed out on the original sheet (see comments) and the identical length and weight from #12 is entered in #13. Perhaps some of the above has something to do with the length/weight not corresponding with the scale ages and circuli counts in Book #72050?

Finally, please let me know if you have any questions or concerns regarding the results. I will return the scales and results to you via Xpress Post. Once again, thank you very much for the opportunity to complete this work for you.

Sincerely,

Carol Lidstone
Birkenhead Scale Analyses