Gitanyow Fisheries Authority

Kitwanga River Salmon Enumeration Facility (KSEF) – 2017 Annual Report

Submitted to: Gitanyow Hereditary Chiefs,
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Abstract

In 2017, the Gitanyow Fisheries Authority (GFA) operated the Kitwanga River Salmon Enumeration Facility (KSEF) for the 15th consecutive year to count and biologically sample Pacific salmon returning to the Kitwanga River. The fence was operational from July 10th to September 11th, 2017 under normal water conditions. On the morning of September 11th, the KSEF was breached due to extremely high water levels, which forced the closure of the project approximately 6 weeks earlier than anticipated. Within 5 hours of the KSEF going down, GFA staff were able to set-up and modify the KsF (upper smolt fence) and count sockeye and coho until November 2nd, 2017. GFA estimates that 375 sockeye, 586 chinook, 186 jack chinook, 179,071 pink, 338 chum, and 1,559 coho salmon spawned above the KSEF in 2017.

The 2017 estimated sockeye return of 375 fish was well below the highest recorded of 20,804 in 2010, above the lowest return of 240 fish in 2007, and below the running average of 4,580 fish per year (2003-2016).

The 2017 chinook return of 586 fish was 59% below the running average from 2003 to 2016 of 1,438 fish/year and marked the 9th consecutive year of counts below 1,000 fish. The 2017 return is the lowest on record since accurate annual enumeration was initiated in 2003 and down from the more recent average from 2009 to 2016 of 840 fish. The 2017 run compares to a minimum return of 655 fish in 2016 and a maximum return of 3,225 in 2007.

The 2017 Kitwanga pink run of 179,071 fish was below the running odd-year average of 229,417 fish (2003– 2015). This return originated from the 2015 brood year, which had an escapement of 95,101 fish, indicating the 2017 return was about 94% above replacement. The 2017 odd-year pink run compares to a minimum odd-year return of 68,410 fish in 2011 and a maximum return of 559,865 in 2009.

A total of 338 adult chum salmon were estimated to have returned to the Kitwanga River in 2017. The 2017 run compares to a minimum return of 150 fish in 2008 and a maximum return of 1,862 in 2005. This year’s estimate for chum escapement was 54% below the running average of 727 fish recorded from 2003-2016 and seems to be in line with lower stable average seen from 2010 to 2015 (423).

A total of 1,559 adult coho salmon were estimated to have returned to the KSEF in 2017. This coho return is similar to the lowest return recorded in 2005 of 1,527 and well below the highest return of 12,080 coho in 2009. The 2017 coho return was 47% below the running average from 2003 to 2016, which was 4,076 fish/year, and represents the third year in a row of a noted decline.

Acknowledgements

Gitanyow Fisheries Authority (GFA) would like to thank the Gitanyow Hereditary Chiefs Office for their continued leadership and support for the GFA program. In 2017 the project funders were: Pacific Salmon Commission (PSC), Fisheries and Oceans Canada and the Gitanyow Huwilp Sustainability Fund. GFA would also like to acknowledge our field staff that make the project possible year after year. GFA staff are often required to work long hours, sometimes under short notice in adverse weather conditions and for this we are very grateful for their continued commitment to the project. In 2017 GFA technicians included: Les McLean, Earl McLean, Vernon Russell, Phillip Johnson, Brenton Williams, Johnny Martin, Melissa Shirey, Taylor Russell and Sairusi Vipond. GFA leads included: Mark Cleveland, Jordan Beblow and Gregory Rush.

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1. INTRODUCTION AND BACKGROUND

Historically, the Gitanyow fished salmon in the Kitwanga River for section 35 purposes where sockeye was the main 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 1960’s the Elders talked of the noticeable declines in the returns of the Kitwanga sockeye and by the 1970’s most fishing sites along the Kitwanga River were voluntarily abandoned by the Gitanyow due to conservation concerns for the stock (Cleveland 2005, Kingston 2013).

Over fishing in mixed stock fisheries in the ocean are thought to be the leading cause for the declines. Historical exploitation rates on Kitwanga sockeye have been shown through DFO fishery reconstructions to be very high through most of the 1900’s, averaging between 50-70%. Other factors likely contributed to the decline. They include the degradation of spawning and rearing habitats in and around Gitanyow Lake due to poor forest harvesting practices (Cleveland 2006, Kingston 2013).

Historical DFO Salmon Escapement Data (SEDS) records for Kitwanga sockeye prior to the implementation of the KSEF are very limited. In most years, stream escapement counts were not completed and even when they were, the results were likely inaccurate because Kitwanga sockeye are exclusively lakeshore spawners. GFA observations over the last 15 plus years have found that conducting lakeshore counts is very difficult and almost always under estimate the true annual escapements by a large margin.

In 1999, GFA initiated studies on Kitwanga sockeye to conserve, protect and recover the stock. One of the highest priority projects has included the accurate annual assessment of adult and smolt production. Adult sockeye escapement data has been collected continuously since 2000 through the operations of a temporary weir (2000-2003) and then through the operations of the KSEF (2003-2017). Smolt production from Gitanyow Lake has been accurately assessed continuously since 2008, when the Kitwanga River Smolt Facility (KsF) was constructed.

In conjunction with counting fences, GFA has conducted lakeshore spawning assessments, habitat rehabilitation works and a two year small scale pilot hatchery program to try and boost egg to fry survival (Cleveland 2007 & 2009, Kingston 2008 & 2009, McCarthy and Cleveland 2012). In addition, an overall reduction in the exploitation rate (ER) on adult Kitwanga sockeye has been implemented since 2009 in most years, where averages ER have been reduced to about 22%. These compare positively to the more historical exploitation rates which were double and triple these values. All of these works have had a positive effect on Kitwanga sockeye and we have seen some modest rebuilding of the stock in reason years.

The KSEF not only provides fishery management benefits for the Kitwanga sockeye rebuilding program, but it is also used as a middle Skeena salmon index to gauge the annual escapements of Kitwanga chinook, pink, chum and coho salmon. The information collected at the KSEF is relied upon in-season and post-season by DFO and First Nation fisheries managers that use the index to help manage Skeena salmon fisheries.

In 2017, the KSEF was operated with funding contributions from the Pacific Salmon Commission's Northern Fund, Fisheries and Oceans Canada's Stock Assessment and Aboriginal Fisheries Strategy programs and the Gitanyow Hereditary Chiefs Huwilp Sustainability Fund. This report summarizes the sampling results and findings for the KSEF program in 2017. Kitwanga salmon escapement data obtained by GFA in 2000, 2001 and 2002 from the operations of the temporary Kitwanga River weir, through stream walks and aerial flights prior to the construction of the KSEF will not be included in this report for comparison purposes, but those results are available in other annual reports produced by GFA.

2. DESCRIPTION OF THE STUDY AREA

The Kitwanga River (BC Watershed Code 400-364900) is a fifth order stream that drains into the Skeena River about 250 km northeast of Prince Rupert, B.C. It supports all six species of Pacific salmon including pink salmon (*Oncorhynchus gorbuscha*), chum salmon (*O. keta*), chinook salmon (*O. tshawytscha*), coho salmon (*O. kisutch*), sockeye salmon (*O. nerka*), and steelhead trout (*O. mykiss*). The Kitwanga River supports populations of resident rainbow trout (*O. mykiss*), cutthroat trout (*O. clarki*), Dolly Varden char (*Salvelinus malma*), bull trout char (*S. confluentus*), mountain whitefish (*Prosopium williamsoni*) and various other species of coarse fish (BC Fisheries Information Summary System, or FISS).

The drainage encompasses an area of about 83,000 hectares and has a total mainstem length of approximately 59 kilometers (Cleveland 2000). Gitanyow Lake (gazetted name Kitwanga Lake) separates the Upper and the Lower Kitwanga River. The Upper Kitwanga is located directly north of Gitanyow Lake and has a main stem length of about 23 km. The Lower Kitwanga River flows south for about 36 km between Gitanyow Lake and the Skeena River. The Lower Kitwanga River has four major gazetted tributaries: Tea Creek, Deuce Creek, Kitwancool Creek and Moonlit Creek. The Upper Kitwanga River has no major tributaries and exhibits a multi-channel meandering configuration with intensive beaver activity along its lower reaches.

The KSEF is located on the Kitwanga River about 4 km upstream from its confluence with the Skeena River (Figure 1). It is situated on private property and a Statutory Right of Way permit has been granted for the site and the access road to the GFA salmon research facility until 2036. Most of the Kitwanga River is within the Traditional Territory of the Gitanyow, however the KSEF site itself is located on the traditional territory of the Gitksan or Gitwangak Wilp. Gitwangak Wilp members are employed annually on the KSEF project to keep them involved in the project and help foster continued relationships between the nations.

Figure 1: Google Earth image of the Kitwanga Watershed including the KSEF and the KsF.

3. KSEF DESIGN AND OPERATING METHODS

The KSEF counting fence is located on the Kitwanga River about 4 Km upstream from the confluence of the Kitwanga and Skeena Rivers and downstream of most Kitwanga salmon spawning areas (Cleveland, 2004). The KSEF operates during the summer and fall months and uses aluminum panels to funnel fish into one of two counting stations located on the left and right banks of the Kitwanga River (Figure 2; photo series of KSEF design). From late fall through to the following summer, fence panels and counting boxes are removed allowing fish unimpeded movement past the site when it is not in operation. The Kitwanga River at the KSEF site is about 30m wide and the facility spans perpendicular to the rivers flow.

Based on a temporary test panel design that was tested during the regular fence operations in 2013 and 2014, the GFA upgraded the entire fence section to a rotating panel design in 2015. GFA acquired financial assistance from the Pacific Salmon Commission (PSC) to complete the 2015 fence design and fabrication (Kingston, 2015). The rotating panel design provides a much safer platform for the staff working at the facility, allowing them to safely and efficiently remove debris buildup during the fall floods.

The rotating panel design consists of a series of nine aluminum transoms that support the aluminum rotating panels. Annually, nine steel base plates are bolted onto the existing cement crump to secure the aluminum transoms that spanned the entire width of the river. The steel base plates were fastened with Hilti bolts at 2m intervals across the width of the river and parallel to the rivers flow. There are two rotating fence panels in between each transom and there is a total of 21 rotating panels that span the entire river and block fish passage. Each rotating panel is made from 3/4" schedule 40 aluminum bars that are welded to ¼" – 4" X 4" aluminum square tubing at each end. The panel spacing between each aluminum bar is 1" to block adult salmon from swimming upstream through the panels. The rotating panels are 40" wide and 72" tall.

Each aluminum fence panel rotates on 2” steel balls that are permanently secured in the river onto a continuous steel base plate. A lower nylon bushing was fastened to the base of each rotating panel and the bushing was machined to fit a 2” steel ball. At the top of each rotating panel a steel bracket was welded with an upright 1 ½” steel shaft and a nylon bearing that could be fastened to a cross brace between each transom. Each steel bracket had a 1 ¼” Hex head bolt machined into the top of the bracket to aid in turning each panel with a large T-bar to remove leaf litter and woody debris from the fence panels.

An aluminum walkway is installed annually on top of the transoms which allows workers access to each rotating panel from above. By rotating panels regularly, it clears off debris that clogs up the fence during regular operations.

The rotating panels and transoms are designed to be taken out after the adult salmon migration is complete, and the only portion remaining in the river is the concrete slabs thereby allowing other fish to migrate past the survey site unimpeded at all other times of the year (Figure 2; photo series of KSEF design).

Figure 2: Photo series of installation of the KSEF structure.

Once the aluminum rotating panels and walkways are secured into the middle section of the river, the left and right bank counting stations are installed so that all fish movement through the site can be controlled. This allows for easy salmon identification to the species level and biologically sampling to take place as they migrate past the facility. Each trap box has two counting chutes so that counting technicians can direct fish into one of two large holding pens, where they can be examined more closely as necessary, and sampled as instructed in the annual biological sampling protocol. A white Teflon reflective background is used on the bottom of both counting chutes to make the visual identification of fish easier. A floating plexiglass-bottomed viewing box is also used on the water surface to reduce glare and improve fish visibility. Counting chute bottoms are designed to be raised or lowered as necessary to allow adequate water levels in the chutes to make fish identification possible at times when water clarity is not ideal.

In 2017, a portion of the salmon migrating through the KSEF was randomly sampled to acquire a full range of fish sizes and scales were collected for aging purposes. For fish sampling purposes, sampled fish are dipnetted out of the holding boxes, placed in a “V” trough equipped with a hose and electric pump which provided a constant supply of fresh river water during sampling (Figure 3; Photo series showing scale sampling). Samples are taken from all species except pink salmon and GFA staff strive to sample 5-10% of the annual returns in any given year. Fish are also visually inspected to identify the presence of marks (e.g. adipose fin clip), measured for fork length and inspected for sex, ripeness and overall physical condition. Scale samples are collected for aging and the results are presented in this report using the European age method. This method presents ages using a two-number sequence with the first number representing the fresh water occupation period and the second number representing the salt-water occupation period.

GFA fisheries staff are instructed in proper fish handling techniques to reduce the stress on the fish. Crews of two fisheries technicians visually enumerate and count salmon daily as they swim through each counting chute. One GFA technician would work on the right bank counting station and the other on the left during each shift. The hours of operation are during daylight hours only. The KSEF is closed nightly preventing upstream migration between dusk and dawn. A permanently erected stage gauge is used annually to manually measure river levels throughout the operating period. GFA staff record river levels four times daily. The manual stage gauge was established at the KSEF in 2004 and is used to compare water levels and flood events from year to year. Daily water temperatures, rain gauge measurements and air temperature were also recorded throughout the operating period in 2017.

Figure 3: Scale sampling.

4. RESULTS

The operation of the KSEF in 2017 marked the 15th consecutive year that the facility was used to enumerate salmon in the Kitwanga River. The KSEF site was operational for a total of 63 days in 2017, from July 10th to September 11th. Normal operations at the KSEF would see the project continue to the end of October, when most of the returning salmon would have passed the site. However, the project was closed for the season early because the site experienced extreme high water flooding after several days of hard rain, which caused damage to the facility preventing it from continuing operations for the year (Figure 4).

Within 5 hours of the KSEF being shut down in the lower part of the river, GFA staff were able to set-up, modify and render the Kitwanga River Smolt Facility (KsF) fish tight just below Gitanyow Lake to continue to count adult sockeye and coho returns in the upper part of the watershed. In 2017, like in 2016, the KsF was temporarily modified to allow for adult counting and sampling from its current smolt sampling design (Figure 5). The KsF remained operational from September 11th to November 2nd, 2017, adding an additional 62 days to the Kitwanga River adult salmon enumeration program. It should be noted that the operation of the KsF would only provide escapement information for all sockeye and a portion of the coho returns for 2017, because all sockeye spawn above the KsF while only a portion of the coho run spawn above the site. In contrast, the majority of chinook, pink and chum salmon spawn between the KSEF and KsF and in 2017 none of these species of salmon were counted through the KsF site.

Figure 4: Photo on left - taken during normal operating flow and photo on right on September 11th, 2017, during extremely high flow.

Figure 5: KsF on September 11th, 2017 after set-up.

Overall, the average water levels recorded in 2017 at the KSEF for most of the operating period were similar to what has been observed previously (0.60m compared to 0.73m for the period between 2004-2016).

The highest water levels occurred on September 11th, when the fence was shut down, with water levels reaching > 2.0m at the KSEF site over an eight-hour period, which was a significant rise from the previous day's level of 0.69m (Figure 6).

Water levels were within the 2004-2016 averages for July, August and the beginning of September, up to the extreme flooding event, which forced the early closure of the facility (Figure 6).

Water temperatures ranged between 9 ^{0}C to 16 ^{0}C for the sampling period which were within the range previously recorded at the site (2004-2016), and overall considered adequate for salmon survival during the operations of the KSEF and the KsF.

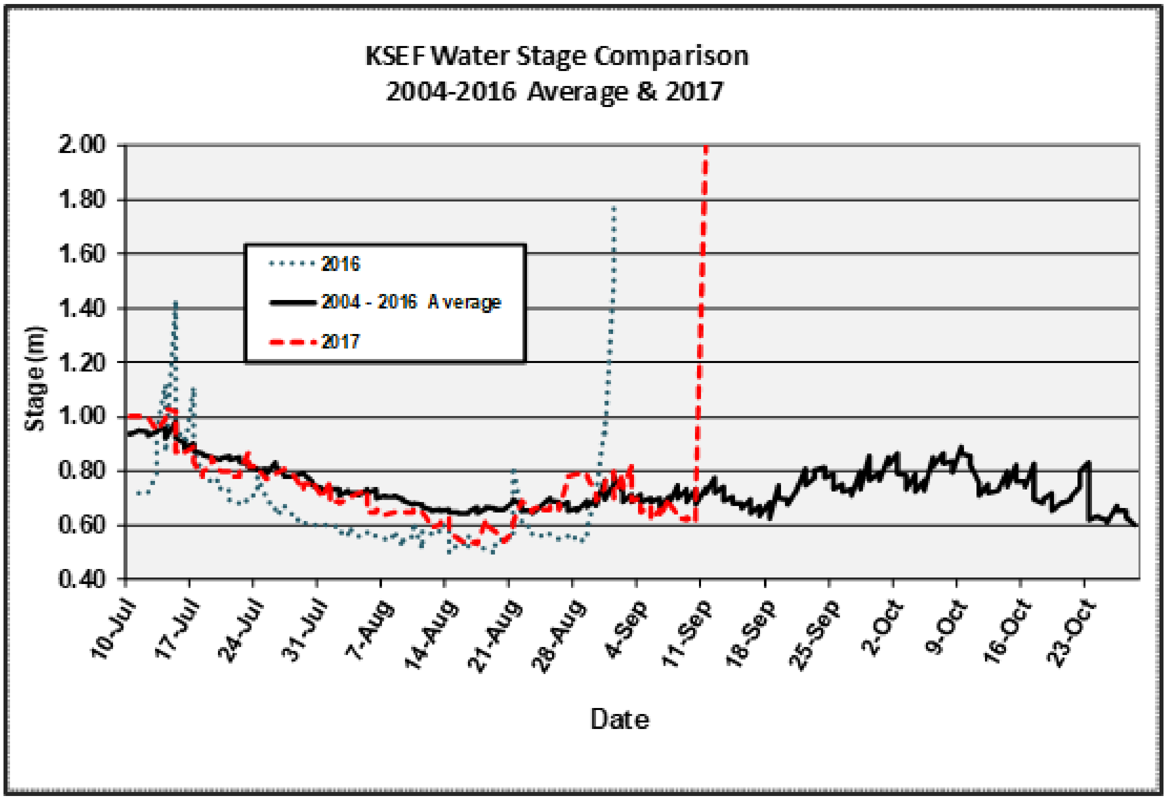

Figure 6: Water Stage at the KSEF, 2004-2016 average and 2017 recordings. Note: in 2017, KSEF was shut down on September 11th.

Total counts, run timing, historical run numbers, size, age and sex ratios, are described for sockeye, chinook, pink, chum and coho salmon in the following sections; 4.1 to 4.5.

4.1 Sockeye

A total of 375 sockeye were estimated to have return through the KSEF and the KsF fences in 2017. At the KSEF, 257 sockeye were counted between July 5 and September 11 and an additional 140 were counted through the KsF between September 12 and November 2, 2017 for a total count of 397 sockeye. It should be noted that some sockeye that migrated through the KSEF earlier in the year when it was operational were likely double counted because of the timing of when they went through the KSEF and the time it would have taken them to reach the KsF. To address this issue, GFA, in consultation with DFO, downgraded the overall estimated return of Kitwanga sockeye slightly in 2017 to 375 by reducing the overall count by 22 fish from the total KSEF and KsF counts (n=397). More specifically, to account for the double counting issue explained above, 22 fish counted through the KSEF in the 4 days (September 7-10) before it was breached were not included in the overall total. Using professional judgment reviewers thought that four days was a reasonable cut off time to use based on how long it may have took sockeye to move between the two sites, but it should be recognized that there is much uncertainty with this travel time scenario because many environmental factors can effect salmon travel rates. That said, the 2017 sockeye escapement should be considered an estimate and used with some caution because it is likely that it does not reflect the exact escapement.

Sockeye returns to the Kitwanga in 2017 were among some of the lowest observed in recent years. Since 2003 Kitwanga sockeye returns have averaged 4,580, with the lowest recorded in of only 240 and the highest of 20,804 in 2010 (Figure 7). This recent downward trend in production should be cause of concern for fisheries managers and more emphasis should be put into finding out why recent production is not performing as expected.

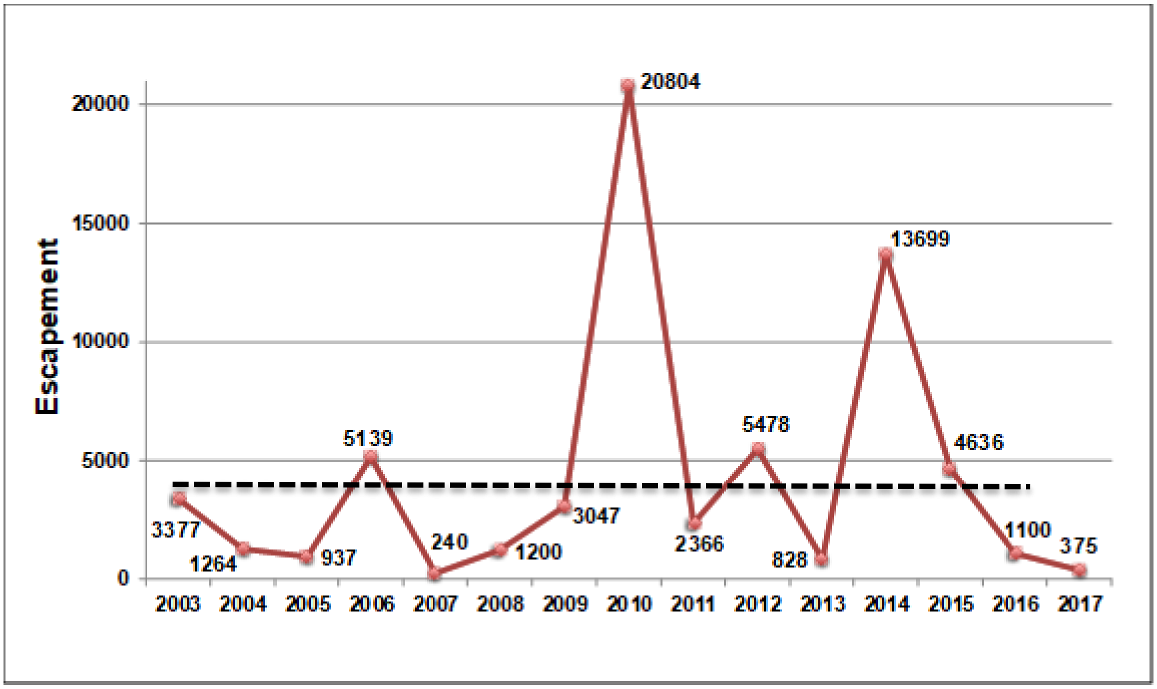

Figure 7: Annual Sockeye escapement into the Kitwanga River through the KSEF from 2003 to 2017 - Dashed line is average from 2003 to 2016.

In 2017, the first sockeye passed through the KSEF on August 5th, which is almost a month later than normal historical timing of first entry (Figure 8). Furthermore, although it is not possible to compare overall run timing from 2017 to historical run timing between 2003-2015[1] because the KSEF was only operational for roughly two-thirds of the season, it would appear that overall the 2017 sockeye run was at least two weeks later than normal. Most of the sockeye run was spread out over a 5-week period from August 7th to September 8th. Significantly higher counts of sockeye were observed at the KSEF on August 7th (n=39), August 18th (n=24) and at the KsF on October 24th (n=34), and when combined accounted for 26% of the total run.

[1] In 2016, the KSEF was also shut down early due to high water

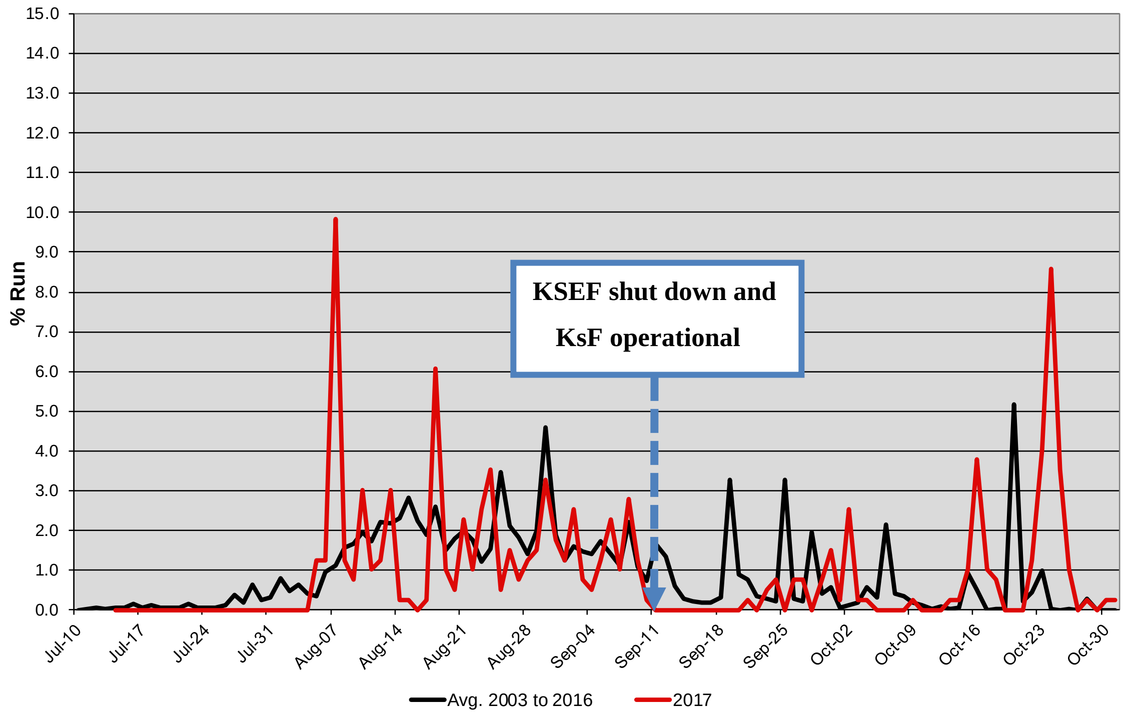

Figure 8: Kitwanga River sockeye salmon average run timing (daily run percent) for 2003-2016 vs. run timing for 2017 at the KSEF.

Preliminary fishery exploitation rates for 2017 reported by DFO in November of 2017 were estimated at 9.3 percent (~5% Alaskan Marine, 0% Canadian Marine and 4.3% Section 35 fisheries) (Cox-Rogers, 2017; Figure 9). Without exploitation (estimated 35 sockeye removed), the estimated total return for 2017 would have been approximately 410 sockeye.

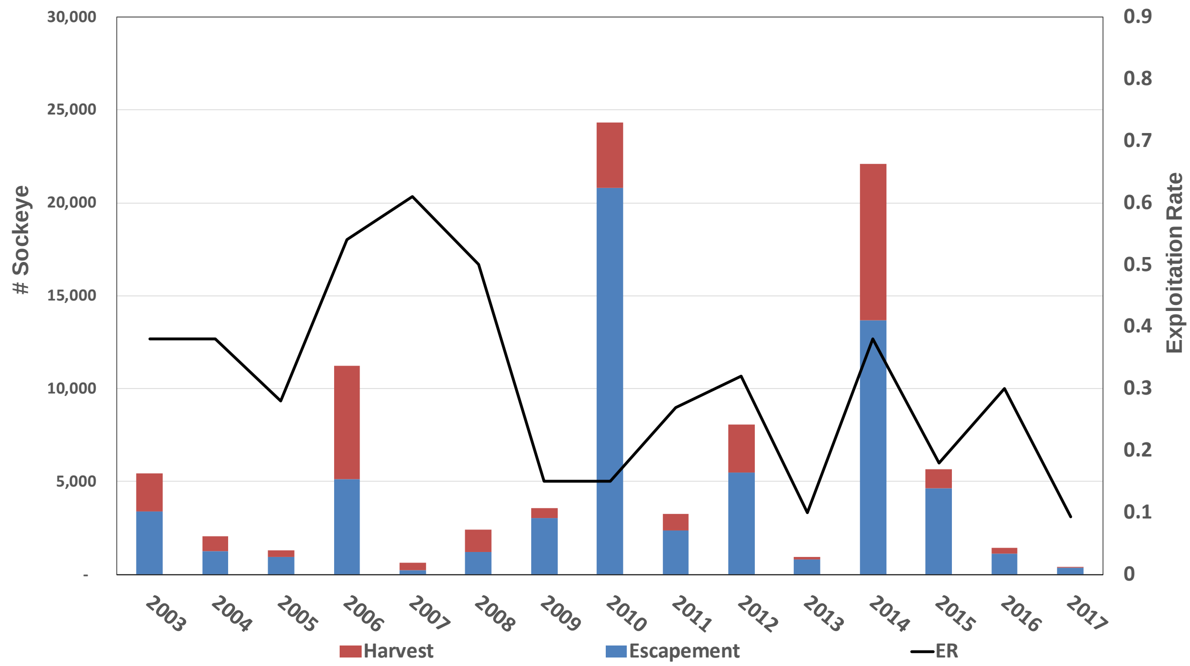

Figure 9: Kitwanga River sockeye salmon escapement and exploitation 2003-2017.

Complete fork length measurements, age and sex data were collected from 45 sockeye (12% of the run) in 2017. Female composition comprised 51.1% (n=23) and males 48.9% (n=22)[2], which is within the normal sex ratio distribution observed previously. Average fork lengths were slightly greater for males and showed a wider range in size than females (Table 1). Size class (5 cm) histogram for combined sexes showed a uni-modal distribution, dominated by fish in the 56 to 60 cm size class (51%) followed by fish in the 51 to 55 cm size class (31%; Figure 10). When male and female average length was compared to previous years, the 2017 results fell within the historical range (Table 2). Average length recorded since 2003 were similar and within a narrow 5 cm size range for females (53 to 57 cm), and males (52 to 59 cm) (Table 2).

[2]Sex was not determined for one sampled sockeye

Table 1: Sockeye salmon fork length (cm) statistics at the KSEF in 2017.

	Female	Male	Combined
Mean	56	58	57
Min	51	49	49
Max	64	64	64
Count	23	22	45

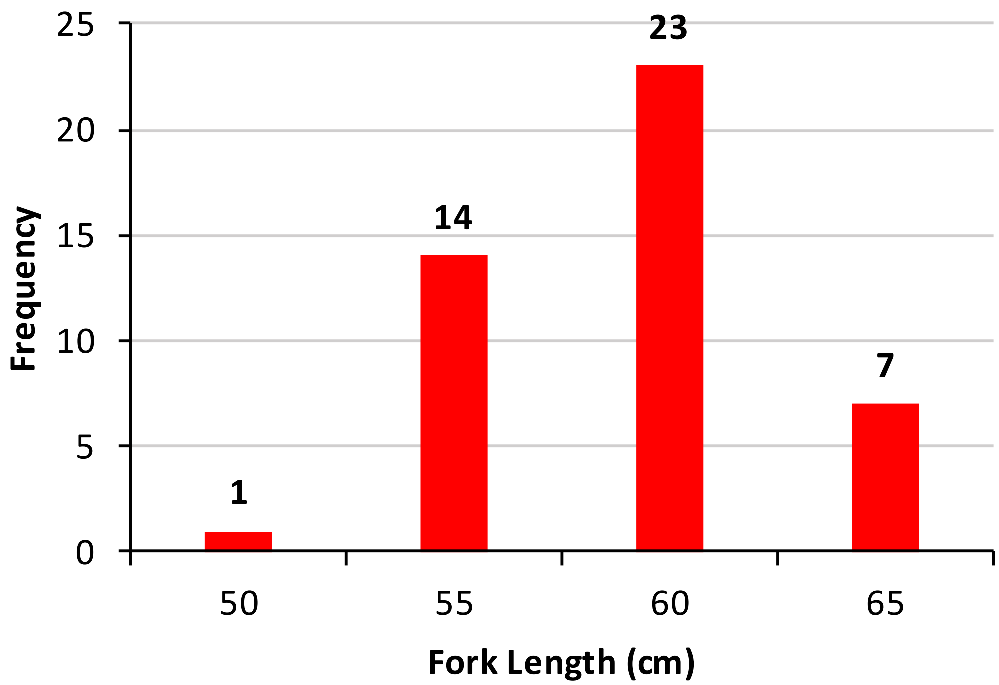

Figure 10: Fork length distribution for sockeye salmon in 2017 (n=45). X axis labels are 5 cm length class upper boundaries.

Table 2: Average length (cm) for sockeye female, male and combined Sexes from 2003 to 2017.

Year	Female	Male	Total
2003	55.3	58.8	56.6
2004	56.4	58.3	57.1
2005	57.2	57.5	57.4
2006	52.6	55.3	53.8
2007	53.5	52.2	53.3
2008	54.9	58.3	56.3
2009	54.3	57.4	55.8
2010	53.9	56.5	55.3
2011	56	59	57.5
2012	55	58	56
2013	54	58	57
2014	52.6	55.9	54.2
2015	53.7	56.3	55
2016	55	57	56
2017	56	58	57

In 2017, scale samples were collected from adult sockeye complete with sex and length data and submitted to Carol Lidstone of Birkenhead Scales Analysis for age determination. A total of 45 samples were confidently readable providing a 12% sample of the total run (23 females and 22 males). Age 4 fish (aged 1.2; or 1 year in fresh water post hatch and 2 years in salt water post-hatch), originating from the 2013 broodyear, were the slightly dominant age class for females (56.5%, n=13), while 5-year old fish (61cm average length) originating from the 2012 broodyear, were slightly dominant for males (54.5%, n=12). Mean size for age 4 fish differed slightly for females and males at 54 and 57 cm respectively. Mean size for age 5 fish differed slightly for females and males at 58 and 59 cm respectively. Therefore, overall 2017 Kitwanga sockeye were 51% 4-year-old (n=191) and 49% 5-year-old fish (n=184). In 2017, only 23% of replacement came from the 2013 broodyear, and only 3% of replacement from the 2012 broodyear. Table 3 shows the ages class distribution from 2004 to 2017.

Table 3: Age class distribution (%) for sockeye salmon from 2004 to 2017.

Species	Age	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Sockeye	3 yr	1%	NA	NA	11%	3%	0%	0%	1%	0%	0%	1%	0%	3%	0%
	4 yr	40%	NA	NA	22%	**95%**	**88%**	**99%**	**65%**	**95%**	**66%**	**96%**	**67%**	**89%**	**51%**
	5 yr	**42%**	NA	NA	**67%**	2%	12%	1%	34%	5%	34%	3%	33%	8%	49%
	6 yr	17%	NA	NA	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
	Total sampled	99	NA	NA	240	65	323	323	238	240	105	360	303	38	45

4.2 Chinook Salmon

When the fence went down on September 11th 2017, a total of 585 Chinook salmon had gone through the KSEF. Based on average run timing through the KSEF from 2003-2016, GFA predicts that approximately 99.9% of the Chinook returns would have migrated past the site, prior to when the KSEF shut down. Based on this, we can extrapolate that the total escapement of adult Chinook salmon in 2017 would have been about 586 large and 186 jack Chinook salmon. The 2017 return is the lowest ever counted through the KSEF, well below the highest return of 3,225 chinook in 2007 and marks the ninth consecutive year of Chinook counts below 1000 fish (Figure 11). The 2017 Chinook return is 59% below the running average from 2003 to 2016 of 1,438 fish per year, and slightly down from the more recent average from 2009 to 2016 of 866. Of note is that the 2017 jack Chinook return was very highest ever recorded at the KSEF since accurate jack Chinook enumerations was initiated at the site in 2007. This return compares to the average return of 45, the previous highest return of 116 and the lowest of 7. Figure 11 shows that Kitwanga Chinook have declined from a higher abundance and have somewhat stabilized at lower levels with further declines in 2016 and 2017, which may be a further cause for concern. Given this, fisheries managers in future years should seriously consider protection measures to prevent further decline of the stock.

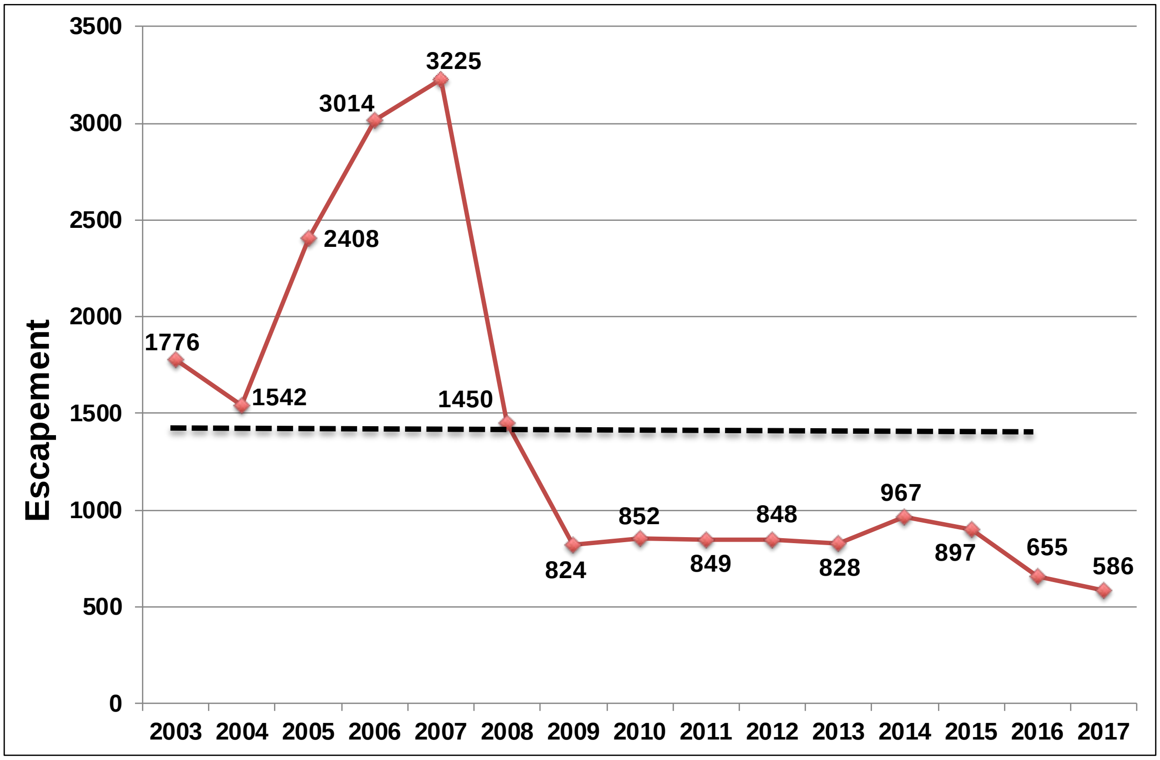

Figure 11: Annual Chinook escapement into the Kitwanga River through the KSEF from 2003 to 2017 - Dashed line is average from 2003 to 2016.

In 2017, the first Chinook salmon was counted at the KSEF on July 15th and the last on September 7th (Figure 12). The 2017 main run timing range was from August 2nd to August 14th (75% of the total run). Relatively high counts were observed over a three-day period from August 5th to 7th(n=332). When combined these three days represented 57% of the total run (Figure 12). The 2017 run timing was very similar to the historical run timing observed through the KSEF from 2003-2016.

Length, age, and sex data was collected from 67 Chinook salmon (12.4% of the total run) in 2017. In addition, 6 jack Chinook were also sampled (average fork length 42cm). Male and female sex ratios were 49 and 51 percent respectively falling within the parameters of what has been seen previously and within a healthy sex ratio breakdown for salmon populations. Fork length histogram (5cm intervals) showed a uni-modal distribution, dominated by fish in 76 to 80cm class (21%), 81 to 85cm class (21%), and 86 to 90cm class (21%; Figure 13). Average fork length of the total sample was 81cm and males and females were 80 and

84cm respectively (Table 4). The 2017 length results fell within the normal range of results observed since 2008 (Table 5).

Age results for 2016 that were not available in 2016 are presented below (Table 6). Of the readable scales from 2016 (63 samples out of a run total of 655 fish, or 9.6% of the 2016 run), the majority of fish (61.9%) were 5-year old's originating from the 2011 broodyear followed by 4-year old's (31.7%) originating from the 2012 broodyear and 6-year old's (6.4%) originating from the 2010 broodyear.

Age results for 2017 are presented below (Table 7). Of the readable scales from 2017 (54 samples out of a run total of 586 fish, or 9.2% of the 2017 run), the majority of fish (57.4%) were 5-year old's originating from the 2012 broodyear followed by 4-year old's (24.1%) originating from the 2013 broodyear and 3-year old's (13.1%) originating from the 2014 broodyear. Six-year old's comprised the final 5.6%, originating from the 2011 broodyear. Table 8 shows age class distribution for Kitwanga chinook salmon from 2008-2017

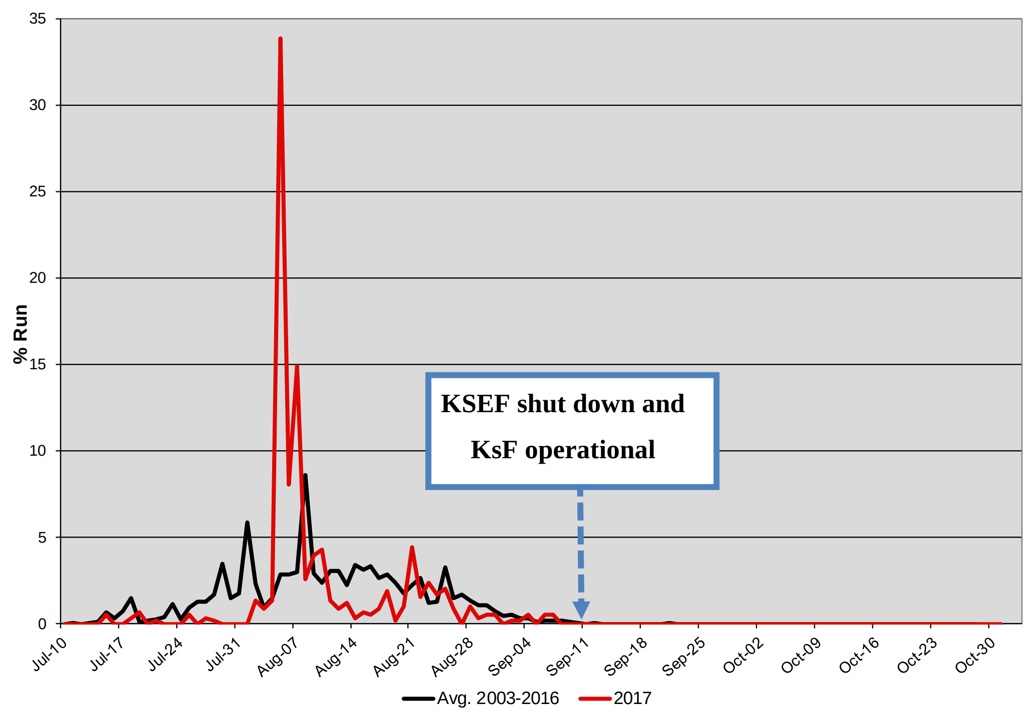

Figure 12: Kitwanga River chinook salmon average run timing (daily run percent) for 2003-2016 vs. run timing for 2017 at the KSEF.

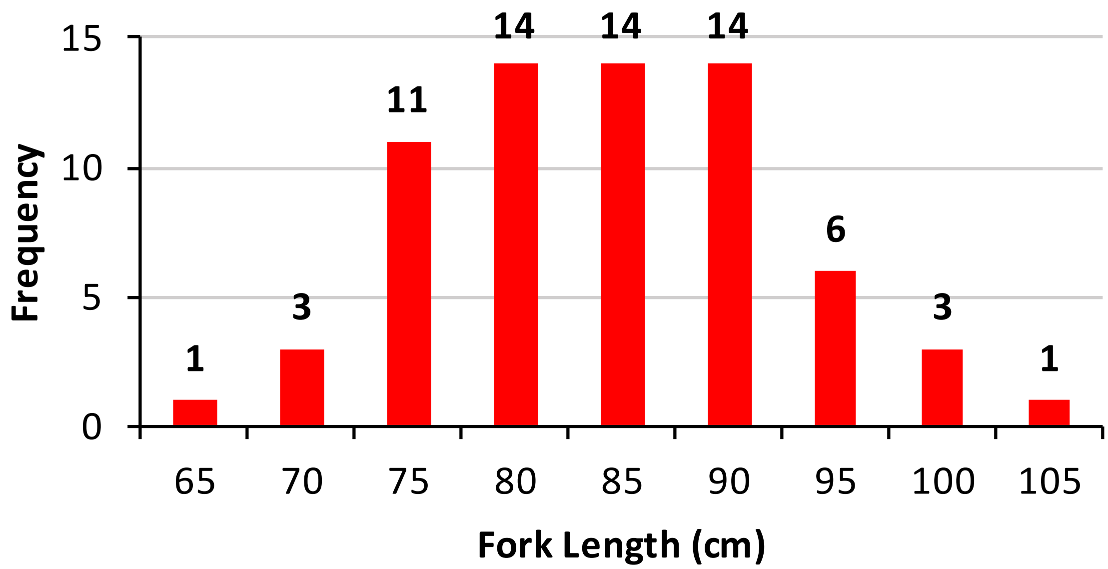

Figure 13: Fork length distribution for Chinook salmon in 2017 (n=67); X axis labels are 5 cm length class upper boundaries.

Table 4: Chinook salmon fork length (cm) statistics at the KSEF in 2017.

	Male	Female	Unknown	Combined
Mean	80	84	78	81
Min	65	74	72	65
Max	101	96	81	101
Count	29	35	3	67

Table 5: Average length (cm) for chinook female, male and combined sexes from 2008 to 2017.

Year	Male	Female	Combined
2008	87.8	92.3	89.2
2009	83.6	88.6	85.6
2010	74.6	87.5	80.7
2011	76.0	86.0	80.1
2012	77.0	84.0	80.0
2013	79.0	84.8	81.3
2014	79.6	84.8	81.3
2015	74.9	86.2	79.9
2016	83.1	84.9	83.9
2017	80.2	84.4	82.3

Table 6: Age distribution for Chinook salmon sampled in 2016 at the KSEF.

Species	European	Gilbert-Rich	Brood Yr.	Frequency	Percent
Chinook	*14*	*62*	2010	4	6.3%
Chinook	13	52	2011	38	60.3%
Chinook	22	53	2011	1	1.6%
Chinook	12	42	2012	20	31.7%
			Total	63	100%

Table 7: Age distribution for Chinook salmon sampled in 2017 at the KSEF.

Species	European	Gilbert-Rich	Brood Yr.	Frequency	Percent
Chinook	*14*	*62*	2011	*3*	5.6%
Chinook	13	52	2012	31	57.4%
Chinook	12	42	2013	13	24.1%
Chinook	11	32	2014	7	13.0%
			Total	54	100%

Table 8: Age class distribution (%) for Chinook salmon from 2008 to 2017.

Species	Age	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Chinook	3 yr	0%	0%	2%	2%	17%	1%	0%	2%	0%	13%
	4 yr	38%	26%	**46%**	28%	32%	30%	**48%**	44%	32%	24%
	5 yr	**53%**	**62%**	25%	**65%**	**48%**	**60%**	38%	**49%**	**62%**	**57%**
	6 yr	9%	12%	27%	5%	3%	9%	14%	5%	6%	6%
	Total sampled	66	84	48	127	90	70	21	101	63	54

4.3 Pink Salmon

When the fence went down on September 11th, a total of 169,043 pink salmon had gone through the KSEF. Based on average run timing through the KSEF from 2003-2016, GFA predicts that approximately 94.4% of the odd-year pink returns would have migrated past the KSEF, prior to when the fence was shut down. Based on this, we can extrapolate that the total escapement of odd year pink salmon in 2017 would have been about 179,071. This return was just down from the running odd-year average of 229,417 fish (2003 – 2015). The 2017 pink return originated from the 2015 brood year, which had an escapement of 95,101 fish, indicating the 2017 return was about 94% above replacement value for the stock (Figure 14). Overall, Figure 14 shows that Kitwanga odd-year pink salmon show typical Skeena pink salmon variability in trend abundance.

The majority of the pinks counted in 2017 migrated through the KSEF during two periods - between August 6th to August 10th and August 18th to 29th (63% of the run; Figure 15). Peak counts occurred on August 7th (n=14,135), August 18th (n=10,887) and August 28h (n=11,252), which when combined represented 20% of the total run. The run timing in 2017 looks to have arrived about one week earlier than previous odd years (2003-2015) with the peak of the run arriving earlier than normal as well (Figure 15).

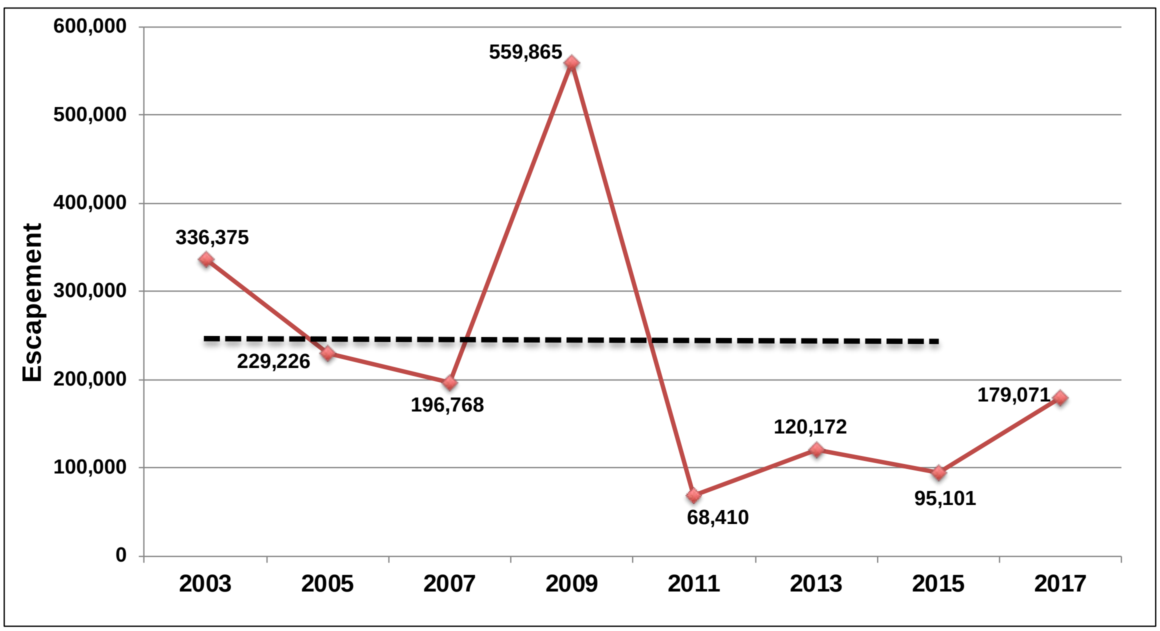

Figure 14: Annual escapement for odd-year pink runs at the KSEF from 2003 to 2017 - Dashed line is average odd year from 2003 to 2015.

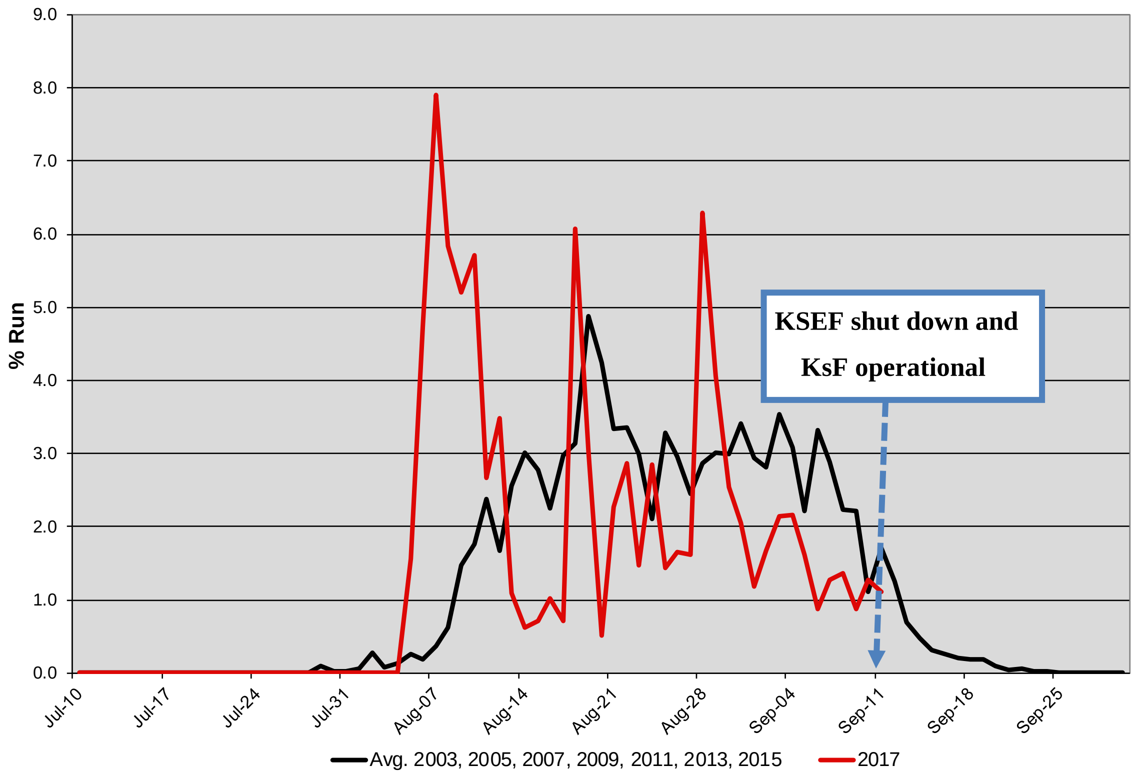

Figure 15: Run timing for pink salmon (daily run %) in 2017 vs. average odd-year run from 2003 to 2015.

4.4 Chum Salmon

When the fence went down on September 11th, a total of 226 chum salmon had gone through the KSEF. Based on average run timing through the KSEF from 2003-2016, GFA predicts that approximately 66.8% of the chum returns would have migrated past the KSEF, prior to the fence being shut down. Based on this, we can extrapolate that the total escapement of adult chum salmon in 2017 would have been about 338. Historical run timing values for Kitwanga chum salmon from year to years do not show much variability, therefore even though only two-thirds of the run was enumerated, GFA believes that reporting the estimated chum escapement for 2017 from extrapolated run timing is fairly accurate. The 2017 run compares to a maximum return of 1,862 fish in 2005 and a minimum of 150 in 2008 (Figure 16). The 2017 chum escapement estimate was 54% below the average escapement of 727 fish recorded from 2003-2016 and seems to be in line with lower stable average seen from 2010 to 2015 (423).

Figure 16 shows that Kitwanga chum salmon have declined from previously higher abundances but have appeared to have stabilized at lower levels.

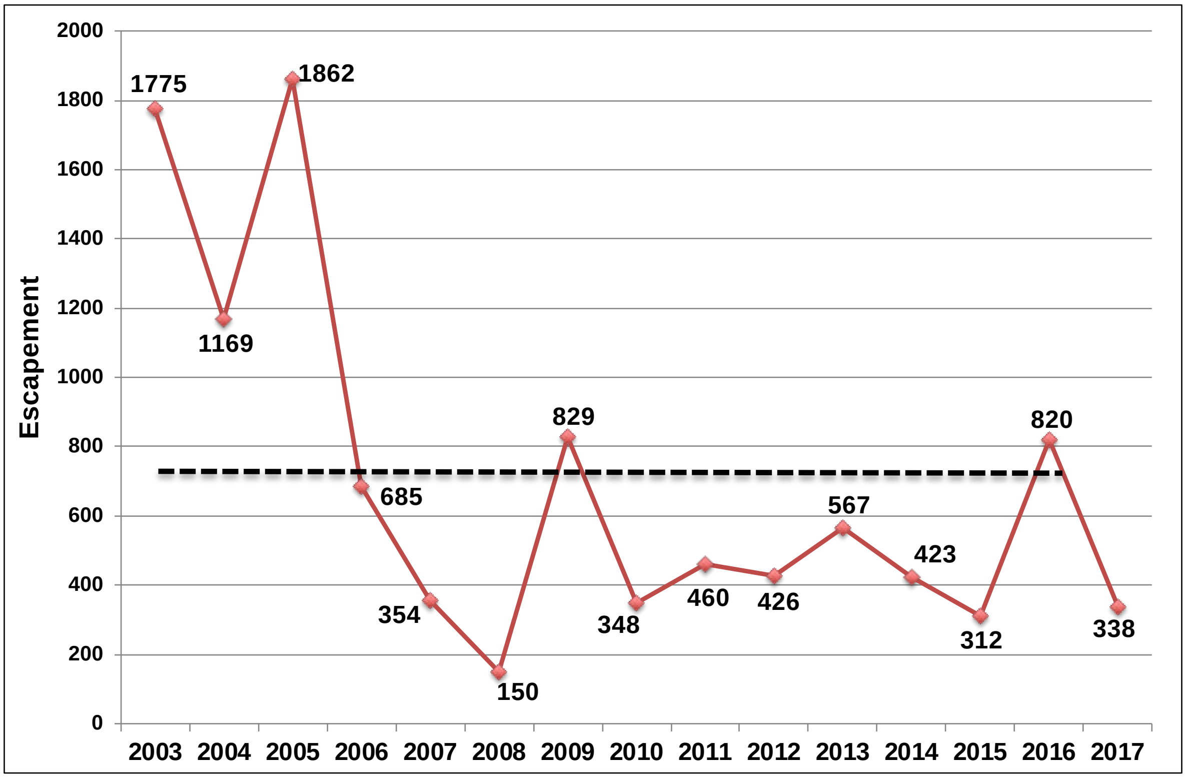

Figure 16: Annual escapement for chum salmon at the KSEF from 2003 to 2017 - Dashed line is average from 2003 to 2016.

In 2017, the first chum salmon was counted at the KSEF on August 5th and the last counted on September 10th, prior to the fence being shut down. In general, chum returns were spread evenly throughout the sampling period with no distinct run pulse observed during the operation of the KSEF (Figure 17). Figure 17 shows that the 2017 chum run timing, was similar to what has been observed in previous years up to when the fence was shut down on September 11th.

Fork length, sex and age data was collected from 55 chum salmon in 2017 (16% of the run). Male and female sex ratios were 37% and 63% respectively, with slightly more females sampled than in previous years, but within the trend of greater numbers of females to males for chum salmon through the KSEF. On average, males were slightly bigger than females (78 and 77cm respectively;

Table 9). The 2017 length results fell within the normal range of results observed since 2008 (Table 10).

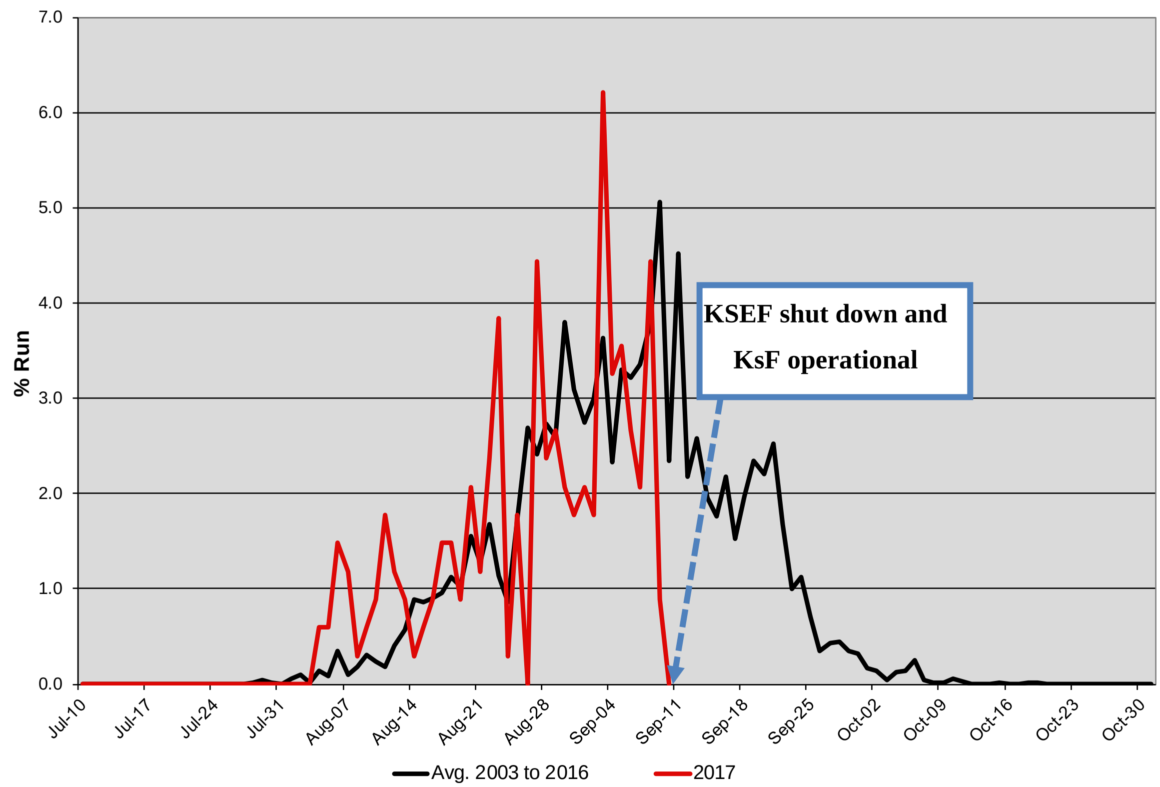

Figure 17: Kitwanga River chum salmon average run timing (daily run %) for 2003-2016 vs. run timing for 2017 at the KSEF. Note that daily run percentages only reflect fish that were actually counted in 2017 therefore their daily values cannot be compared to long-term trends because they do not incorporate the later part of the run which would reduce the 2017 values.

Table 9: Chum salmon fork length (cm) statistics at the KSEF in 2017.

	Male	Female	Unknown	Combined
Mean	78	77	79	78
Min	67	69	70	67
Max	92	86	89	92
Count	19	33	3	55

Table 10: Average length (cm) for chum female, male and combined sexes from 2008 to 2017.

Year	Male	Female	Combined
2008	77.0	70.3	75.0
2009	76.1	72.0	73.7
2010	76.5	73.9	75.1
2011	71.0	70.0	70.7
2012	80.0	77.0	78.0
2013	76.8	74.3	75.4

Year	Male	Female	Combined
2014	72.1	72.0	72.1
2015	75.9	75.3	75.5
2016	80.3	74.4	77.3
2017	77.9	77.0	77.5

Age results that were not available for the 2016 report are presented below (Table 11). Of the readable scales from the 2016 aging sample (17 samples out of a run total of 820 fish, or 2% of the 2016 run), the majority of fish (64.7%) were 4-year old's originating from the 2012 broodyear.

Age results for 2017 are presented below in Table 12. Of the readable scales from the 2017 aging sample (54 samples out of a run total of 338 fish, or 16% of the 2017 run), the majority of fish (50.0%) were 4-year old's originating from the 2013 broodyear, followed by 5-year old's (42.6%) originating from the 2012 broodyear and 3-year old's (7.4%) originating from the 2014 broodyear.

Table 13 shows age class distribution for Kitwanga chum salmon from 2005-2017.

Table 11: Age distribution for chum salmon sampled in 2016 at the KSEF.

Species	European	Gilbert-Rich	Brood Yr.	Frequency	Percent
Chum	04	51	2011	5	29.4%
Chum	03	41	2012	11	64.7%
Chum	02	31	2013	1	5.9%
			Total	17	100%

Table 12: Age distribution for chum salmon sampled in 2017 at the KSEF.

Species	European	Gilbert-Rich	Brood Yr.	Frequency	Percent
Chum	04	51	2012	23	42.8%
Chum	03	41	2013	27	50.0%
Chum	02	31	2014	4	7.4%
			Total	54	100%

Table 13 shows the ages class distribution from 2005 to 2017.

Table 13: Age class distribution (%) for chum salmon from 2005 to 2017.

Species	Age	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Chum	3 yr	4%	NA	NA	**57%**	1%	3%	2%	7%	4%	5%	7%	6%	7%
	4 yr	**88%**	NA	NA	29%	**96%**	**82%**	**95%**	19%	**91%**	**92%**	**74%**	**65%**	**50%**
	5 yr	6%	NA	NA	14%	3%	15%	3%	**73%**	4%	3%	19%	29%	43%
	6 yr	2%	NA	NA	0%	0%	0%	0%	1%	1%	0%	0%	0%	0
	Total sampled	NA	NA	NA	7	205	99	98	80	105	39	74	17	54

4.5 Coho Salmon

When the fence went down on September 11th, 2017, a total of 315 coho salmon had gone through the KSEF. The first coho salmon was counted at the KSEF on August 3rd (n=1) and the last on September 10 (n=1), prior to the fence being shut down. Based on average run timing through the KSEF from 2003-2016, GFA predicts that only about 20% of the coho returns would have migrated past the site when the KSEF was closed on September 11, 2017. Based on this, we can extrapolate that the total escapement of adult coho salmon in 2017 would have been approximately 1,559 coho (KSEF count 315 x 20.2% of run), but there is much uncertainty in this estimate given that only a small percentage of the run was actually enumerated (Figures 18 and 19).

In an attempt to verify the relative accuracy of this 2017 KSEF coho escapement estimate, GFA conducted several stream counts during the coho spawning timing peak and added these numbers to what was counted through the KsF. Counts were conducted on the main coho spawning sites, which are known to GFA to be located between Gitanyow Lake and 1km below the confluence of Moonlit Creek and the Kitwanga River (total distance 6km). Four counts were performed during the historical peak of the Kitwanga coho spawning activities and the highest observed (live / dead) was approximately 278. Note there was a two-week period, where stream counts were not possible (October 23 to November 1) due to high water, and therefore a true peak coho number on the spawning grounds <u>may</u> have occurred without enumeration. This is quite likely, as no dead coho were counted on October 13 (live n=278) and few live coho were counted on November 8 (n=25). Based on experience and professional judgment, GFA estimated that the spawning grounds were lightly to moderately occupied by coho spawners in 2017, which supports the conservative estimate of 1,559 coho extrapolated from the partial KSEF counts. An additional 797 coho migrated through the KsF between September 11 and November 2, 2017 and if we add the estimated spawner counts below the KsF we would estimate a final escapement of 1,075 which is lower than the KSEF extrapolated run timing estimate, but given that a true peak count may have been missed on the spawning grounds, this seems a reasonable match with the extrapolated estimated of 1,559. This total coho spawner estimate is down from the long-term average from 2003 to 2016 (4,076) as seen in Figure 18.

The 2017 return is well below the highest return of 12,080 coho in 2009 and 62% below the running average from 2003 to 2016, which is 4,076 fish/year. As Figure 18 demonstrates, Kitwanga coho returns have been variable for the study period, with a noticeable decline in the last three years.

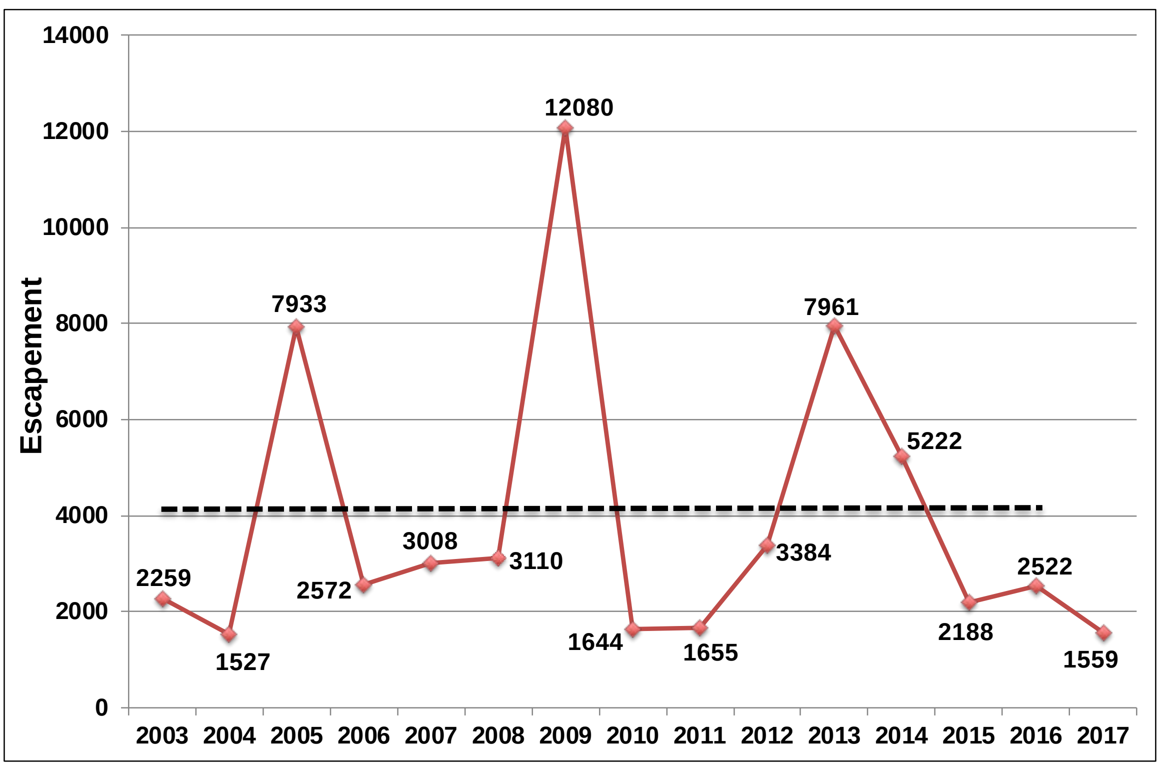

Figure 18: Annual escapement for coho salmon from 2003 to 2017 at the KSEF - Dashed line is average from 2003 to 2016.

Length, age, and sex data was collected from 25 coho salmon in 2017 (1.6% of the total run). Male and female coho sex ratios from the samples were 40% and 60% respectively falling within the parameters of what has been seen previously on the Kitwanga River. Average fork length for males and females were the same at 63cm (Table 14). Fork length histogram (5cm intervals) showed a uni-modal distribution, dominated by fish in the 61 to 65cm size class (56% - Figure 20). The 2017 length results fell within the normal range of results observed since 2010 (Table 15).

Age results that were not available for the 2016 report are presented below in Table 16. Of the 25 readable scales from the 2016 aging samples (1% of the 2016 run of 2,522 fish), the majority of fish were 3-year old returns (88%) followed by 4-year old returns (12%).

Age results for 2017 are presented below in Table 17. Of the 18 readable scales from the 2017 aging samples (1% of the 2017 run of 1,559 fish), the majority of fish were 3-year old returns (83.3%) followed by 4-year old returns (11.1%). Five-year old's comprised the remaining 5.6% of the coho returns.

Table 18 shows age class distribution for Kitwanga coho salmon from 2010-2017.

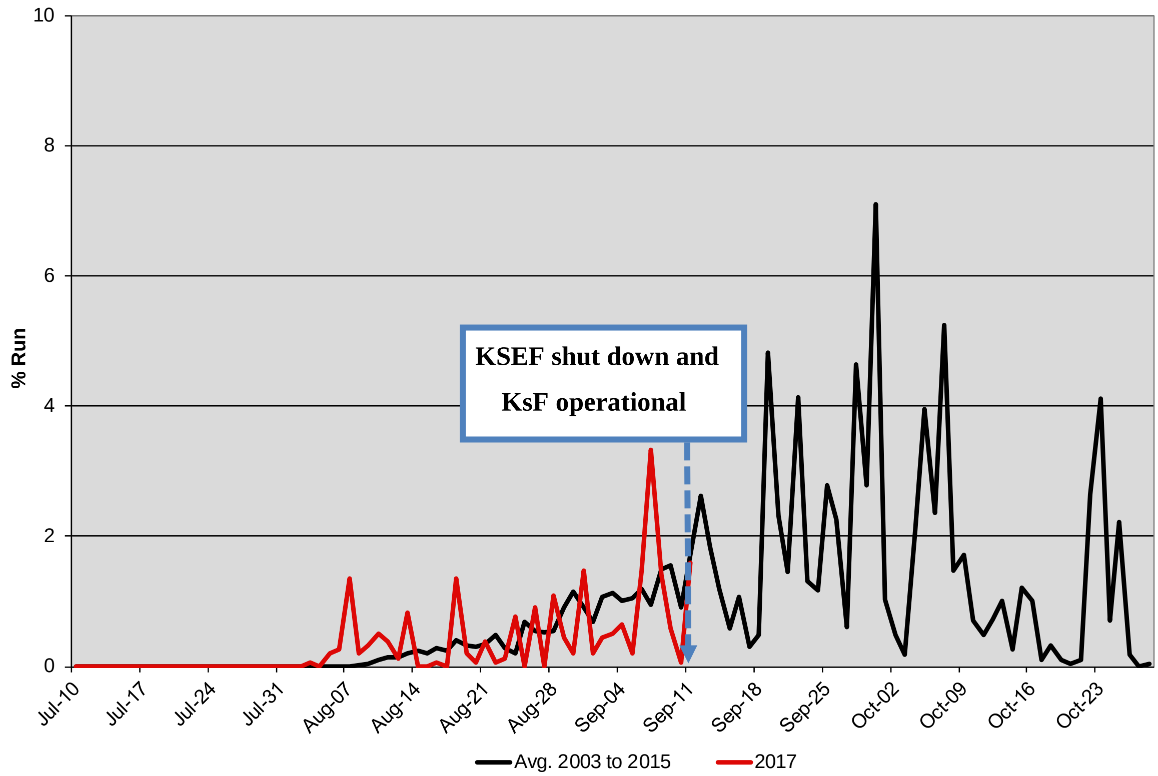

Figure 19: Kitwanga River coho salmon average run timing (daily run %) for 2003-2015[3] vs. run timing for 2017 at the KSEF and through the KsF.

Table 14: Coho salmon fork length (cm) statistics at the KSEF in 2017.

	Male	Female	Combined
Mean	63	63	63
Min	53	59	53
Max	72	70	72
Count	10	15	25

Table 15: Average length (cm) for coho female, male and combined sexes from 2010 to 2017.

Year	Male	Female	Combined
2010	65.3	64.2	64.8
2011	60.8	62.5	61.4
2012	62.3	60.7	61.2
2013	63.7	60.4	62.7
2014	63.6	62.9	63.4
2015	56.8	61.0	58.1
2016	65.1	63.9	64.8
2017	63.2	63.3	63.2

[3] Note KSEF was shut down on September 1st in 2016.

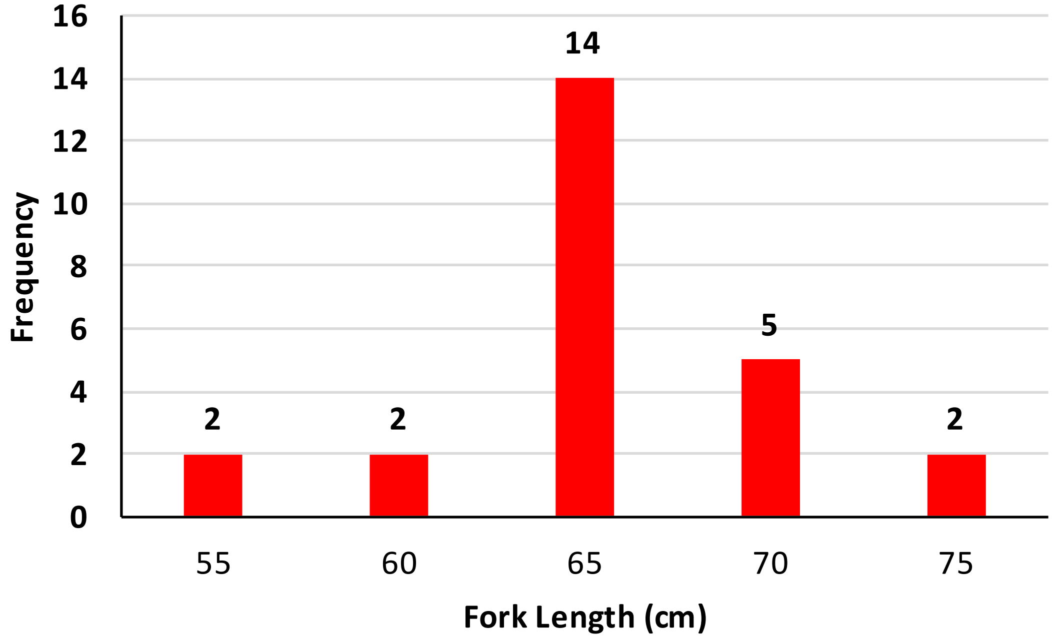

Figure 20: Fork length distribution for coho salmon in 2017 (n=25); X axis labels are 5 cm length class upper boundaries.

Table 16: Age distribution for coho salmon sampled in 2016 at the KSEF.

Species	European	Gilbert-Rich	Brood Yr.	Frequency	Percent
Coho	21	43	2012	3	12.0%
Coho	11	32	2013	22	88.0%
			Total	25	100%

Table 17: Age distribution for coho salmon sampled in 2017 at the KSEF.

Species	European	Gilbert-Rich	Brood Yr.	Frequency	Percent
Coho	31	54	2012	1	5.6%
Coho	21	43	2013	2	11.1%
Coho	11	32	2014	15	83.3%
			Total	18	100%

Table 18: Age class distribution (%) for coho salmon from 2010 to 2017.

Age	2010	2011	2012	2013	2014	2015	2016	2017
3 yr	**72%**	**72%**	**85%**	**82%**	**89%**	**81%**	**88%**	**83**
4 yr	28%	28%	15%	18%	11%	19%	12%	11
5 yr	0%	0%	0%	0%	0%	0%	0%	6
Total sampled	94	154	52	230	55	37	25	18

In the spring of 2016, GFA applied 8,161 CWT's to coho smolts at the Kitwanga Smolt Facility, which is located at the outlet of Gitanyow Lake. Most coho smolts (including CWT implanted fish) generally return to the KSEF 18 months later. The majority of 2016 CWT smolts were expected to return as adults in the fall of 2017. A total of 87 CWT fish out of 886 examined fish were counted through the KSEF and KsF in 2017. Extrapolating to the total run, an estimated 153 tagged fish passed through the fence in 2017 (9.8% recovery). Kitwanga Coho CWT results and information related to where they were caught and their overall ocean survival will be reported on in a separate report and not discussed here.

5. DISCUSSION AND RECOMMENDATIONS

Since the KSEF became operational in 2003, GFA has collected accurate and invaluable stock assessment information on Kitwanga River salmon stocks. The information is used annually to gauge the health of the Kitwanga River and other Skeena River salmon stocks. GFA operated the KSEF to enumerate and collect biological information for sockeye, chinook, chum, pink and coho salmon returning to the Kitwanga River. After lower than normal water levels for much of July and August in 2016, water levels in 2017 returned to near normal conditions for the same months.

On the morning of September 11th, the KSEF was breached due to extremely high water levels, which forced the closure of the project approximately six weeks earlier than anticipated. Within 5 hours of the KSEF going down, GFA staff were able to set-up and modify the KsF (upper smolt fence) and count sockeye and coho until November 2nd, 2017.

The high water on September 11th, 2017 resulted in damage to the facility, compromising the stability of the right bank and footings (lock blocs), and at the outlet of the side channel downstream from the site (Figure 21). The site has been assessed for damage and a repair schedule has been developed and will occur in March of 2018, prior to spring freshet and 2018 operations.

Figure 21: High water on September 11th, 2017 - right bank (left) and damage to outlet of side channel (right).

As a result of the early closure of the KSEF, total escapement numbers for Chinook, pink, chum and coho were scaled upwards accordingly to account for missed fish counts. Salmon counts by species through the KSEF on September 11th, 2017 are presented in Table 19 below. Using the average run timing through the KSEF between 2003-2016 we were able to ESTIMATE the total salmon returns for the year and the results are also presented below. Please keep in mind that these estimates are not true counts but an attempt to approximate overall returns by species for 2017. The values should be used with caution taking into account the assumptions that run timings seen in 2017 are similar to average run timings seen previously by species through the KSEF (2003-2016).

Table 19: Estimated returns in 2017 based on average percent run.

Salmon Species	2017 Returns to Sept.11	Avg. % Run through KSEF to Sept. 11 (2003-2016)	Est. Return for 2017 based on Avg. % run through KSEF to Sept. 11 (2003-2016)
Chinook*	585	99.9%	586
Pink	169,043	94.4%	179,071
Chum	226	66.8%	338

Salmon Species	2017 Returns to Sept.11	Avg. % Run through KSEF to Sept. 11 (2003-2016)	Est. Return for 2017 based on Avg. % run through KSEF to Sept. 11 (2003-2016)
Coho	315	20.2%	1,559

Sockeye escapement in 2017 (n=375) were the lowest since 2007, when the count totaled 240. Overall, exploitation rate was low (9.3%), especially in Alaska and FSC (~5% and 4.3% respectively) and was the lowest reported since the fence became operational in 2013. Low numbers were expected for the entire Skeena River for 2017 (595,000) as was the case in 2013 (~500,000), and further indicated by record low numbers of age 3 jacks (2013 class) in the Tyee test fishery in 2016 (Cox-Rogers, 2017). Poor overall survival to age has been attributed to poor marine survival in the last years at sea for ages 4 and 5 sockeye; part of the potential effects of the ocean 'blob,' a mass of warmer water that has occurred from 2013 through to 2016 in the North Pacific. The warmer waters may be contributing to smaller-size-at-age, reduced body condition factor and later run timing, which did occur this year, where the 2017 sockeye run was at least two weeks later than normal. Body size (fork length) has remained relatively unchanged over the last five years, where the average fork length from 2003 to 2016 is 56mm compared with the 2017 average fork length of 57mm and the sex ratio for 2017 was almost even.

The recent downward trend in production for sockeye should be cause of concern for fisheries managers and more emphasis should be put into finding out why recent production is not performing as expected. This illustrates the importance of continuing the KSEF program to 1: acquire long-term, accurate escapement numbers which can be highly variable from year to year, 2: obtain exploitation rates on the sockeye stock and 3: provide in-season salmon forecasts to DFO Fisheries managers so the information can help implement more sustainable fisheries, 4: continue to develop and update Kitwanga sockeye rebuilding plans. In addition to continuing with the KSEF program, GFA has proposals in to study climate change indicators such as water temperature, and other limnological parameters in Gitanyow Lake in order to assess potential limiting factors to adults and juveniles.

In 2017, GFA initiated a sockeye telemetry study with the primary objectives to confirm and identify any new spawning locations and to see if on-route mortality was observed. The results from this study will be reported separately and no discussed in this report.

The 2017 chinook salmon have declined from a higher abundance and have somewhat stabilized at lower levels with a slight dip over the last two years, which may be cause for concern. Overall, sex ratios in 2017 were in line with previous years as was the average length of sampled Chinook (82.3mm), compared to 2008-2016 average length of 82.4mm. The 2017 run timing was very similar to the historical run timing observed through the KSEF from 2003-2016.

A total of 179,071 adult odd-year pink salmon returned to the KSEF in 2017. This return was just down from the running odd-year average of 229,417 fish (2003 – 2015). Overall, Kitwanga odd-year pink salmon showed typical Skeena pink salmon variability in trend abundance for 2017. The run timing for odd-year pink in 2017 looks to have arrived about one week earlier than previous odd years (2003-2015) with the peak of the run arriving earlier than normal as well.

A total of 338 adult chum salmon are estimated to have returned to the Kitwanga River in 2017 and compares to a minimum return of 150 fish in 2008. Overall, sex ratios in 2017 were in line with previous years for chum salmon as was the average length of sampled chum (77.5mm), compared to 2008-2016 average length of 74.8mm. The 2017 chum run timing, was similar to what has been observed in previous years up to when the fence was shut down on September 11th.

A total of 1,559 adult coho salmon were estimated to have returned to the KSEF in 2017, which is the lowest since 2004 (n=1,527), and part of a noticeable decline in the last three years. Overall, sex ratios in 2017 were in line with previous years as was the average length of sampled coho (63.2mm), compared to 2010-2016 average length of 62.3mm. Based on stream counts conducted over main coho spawning sites in October of 2017, overall run timing was similar to the historical run timing observed through the KSEF.

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