



Gitanyow *Fisheries*
Authority



2021 Kitwanga River Salmon Smolt Assessment



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Pacific Salmon Foundation
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Abstract

In 2021, the Gitanyow Fisheries Authority (GFA) operated the Kitwanga River Smolt Enumeration Facility (KsF) for the 14th consecutive year since initiating the program in 2008. The purpose of the program is to enumerate sockeye and coho salmon smolts, and other resident trout and char species migrating out of Gitanyow Lake and the upper Kitwanga Watershed. In 2021, the facility was operated from April 13th to July 14th.

The sockeye smolt emigration was estimated at 3,431 fish in 2021, which is the lowest count through the KsF since it began in 2008, albeit coming from a low brood year of 125 adults and 63 females in 2019. Though scale analysis was not complete in time for this report, in previous years 1-year-old fish have averaged ~99% of the smolt population emigrating through the KsF. Average smolt length and weights were 114.1mm and 14.9g respectively, which were higher than the long term average of 107.3mm and 12.1g. Production estimates for Gitanyow Lake sockeye in 2021 was 54¹ smolts per female spawner (most originating from the 2019 broodyear). The majority (90%) of the sockeye smolts migrated through the weir between April 24th – May 8th, 2021 with a peak count of 1,339 on May the 2nd. This was in line with previous years when peak runs generally occur in the 1st or 2nd week of May.

Coho smolt captures in 2021 totaled 5,960 fish by the time the KsF was decommissioned for the year on July 14th. An additional 641 coho smolts were captured in a rotary screw trap, which was installed just upstream from Gitanyow village, and was operational until May 31. GFA staff successfully sampled, fin clipped, and coded wire tagged (CWT) 90 % of the coho captured in 2021. Scales from 862 coho smolts were submitted to DFO for age analysis. The 2021 coho smolt age results were not available for inclusion in this report.

Overall, GFA is confident that the entire sockeye and upper Kitwanga coho smolt run were captured through the KsF in 2021.

Cutthroat trout, bull trout/Dolly Varden (BT/DV) and rainbow trout were also enumerated and sampled for lengths through the KsF in 2021. DNA samples and PIT tagging were also taken from and conducted on BT/DV in 2021 to help determine species and to track movement, but the results were not available in time for this report. Numbers of BT/DV was lower in comparison to previous year's totals.

¹ With assumption that most smolts came from 2019 brood year (scale analysis was not available in time for this report).

Acknowledgements

The GFA would like to thank Fisheries and Oceans, Canada (Prince Rupert – Stock Assessment division / Aboriginal Fisheries Program) and the Pacific Salmon Foundation for jointly funding the operation of the KsF in 2021. GFA would also like to acknowledge the leadership and support of the Gitanyow Hereditary Chiefs Office and the hard work of the GFA staff whose dedication made the operations a success. GFA staff that worked on the project in 2021 included: Melissa Shirey (Biologist), Earl McLean, Brenton Williams, Johnny Martin, Morgan Douse, Katrina Morgan and Les McLean. GFA lead staff included: Mark Cleveland and Jordan Beblow.

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1. INTRODUCTION AND BACKGROUND

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 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).

Over fishing in mixed stock fisheries in the ocean are thought to be the leading cause of the stocks collapse. Past fishery re-constructions for the last 50 years show an average exploitation on Kitwanga sockeye of over 50% and reaching as high as 70% in some years (Cox-Rogers, DFO, Pers. comm., 2010 in Kingston 2016). Other factors likely contributed to the decline. They include the degradation of spawning and rearing habitat in and around Gitanyow Lake due to poor forest harvesting activities (Cleveland 2006).

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, first through a temporary weir then through a permanent structure, the Kitwanga River Salmon Enumeration Facility (KSEF) which was constructed in 2003. 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 facilities, GFA has conducted spawning assessments, habitat rehabilitation works, egg-to-fry survival studies and small

pilot hatchery programs to try and augment sockeye survival (Cleveland 2007 & 2009, Kingston 2008 & 2009, McCarthy and Cleveland 2012, and Beblow 2016/2017). In addition, an overall reduction in the exploitation rate (ER) on adult Kitwanga sockeye has been implemented since 2009 in most years, where average ER's have been reduced to about 20%. Overall, the exploitation rate on Kitwanga sockeye had remained relatively low over the last four years (average of 16%) but was much higher in 2021 at 48%, primarily through catches from the Alaskan Marine Fisheries (43%).

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 because it helps gauge the effectiveness of sockeye-rebuilding programs currently being carried out in the Kitwanga Watershed.

Starting in 2009, GFA initiated a coho smolt enumeration and coded wire tagging (CWT) program at the KsF. CWT coho are tracked and reported in Alaskan and Canadian fisheries and then at the KSEF when they return to spawn in the Kitwanga River. Tag recovery information helps fisheries managers determine fishery specific exploitation of yearly Kitwanga coho cohorts and helps determine smolt to adult survival for any given year. The program is used as a middle Skeena coho indicator stock on an annual basis to help manage fisheries in northwestern BC.

In this report, the results and findings for the KsF program in 2021 will be discussed.

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 from the coast, 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 Gitanyow Fisheries Authority for salmon research until 2036.

The KsF is located on the Kitwanga River approximately 600m downstream from the outlet of Gitanyow Lake (UTM's 9U 557014E; 6131839N - Figure 1).

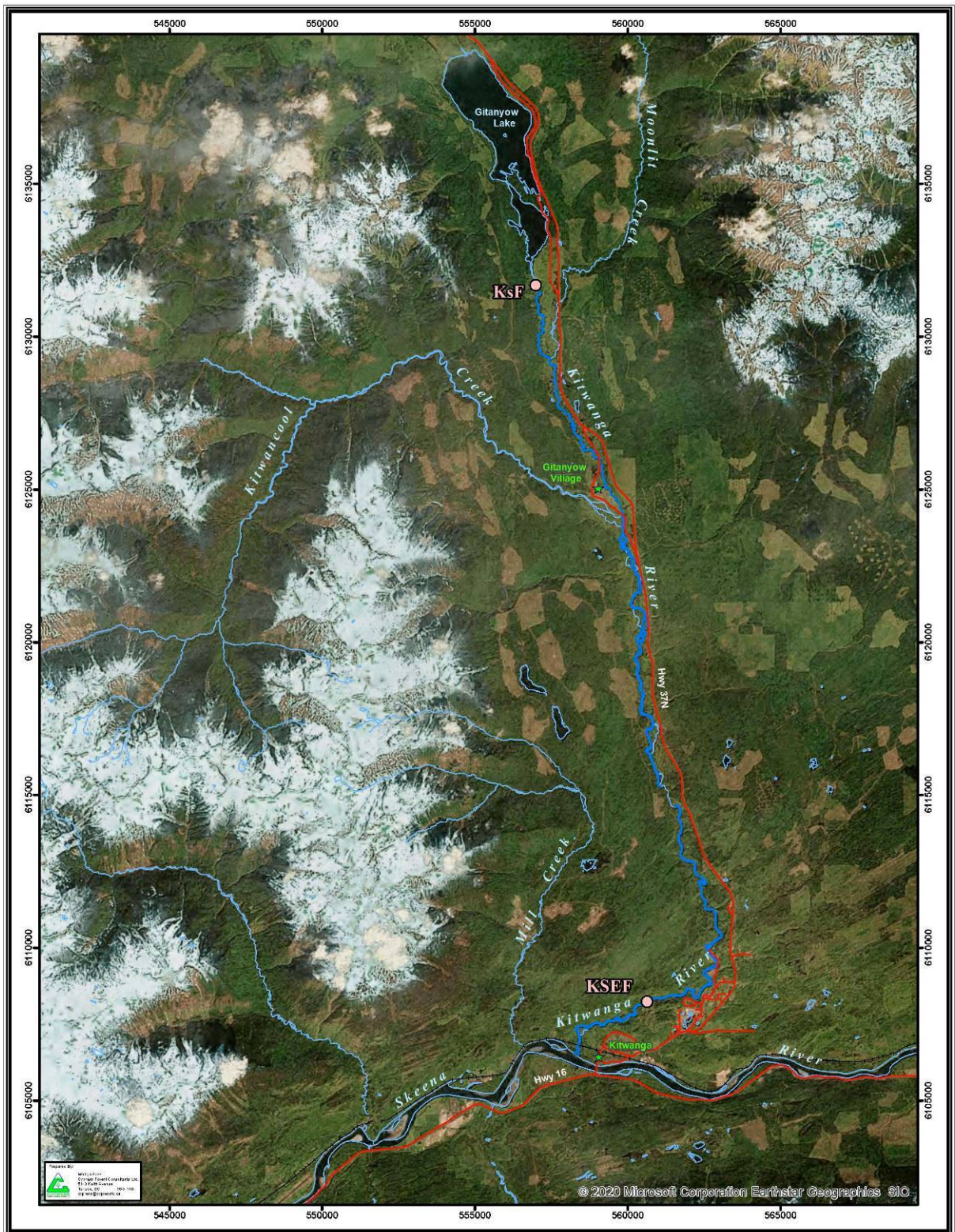


Figure 1: Skeena River and the lower Kitwanga Watershed including the KSEF, KsF and Gitanyow Lake

3. METHODS

The KsF consists of an aluminum fence weir that passively diverts downstream moving fish into trap boxes where they can be easily enumerated, sampled and released on an annual basis (Figure 2).

In 2021, the KsF was set-up between April 6th and 13th. Installation consists of setting up the aluminum weir components, which are pinned to a pre-existing concrete apron. The apron was placed in the riverbed during the construction of the KsF in 2008 (Kingston, 2008). The KsF weir components consist of perforated panels, trap boxes, transoms, and wooden stop logs, all of which can be installed and removed by hand by GFA staff (Figures 2 and 3). 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. Four to five rows of 6 inch by 4 inch by 6 foot stop-logs are placed on the downstream side of each transom to create the desired damming effect. Traps boxes are installed at the spill locations and easily capture downstream moving fish that key in on the flowing water. The weir design is at a 45° angle to the rivers flow, which naturally and passively moves fish to the left bank of the river where the trap boxes are located.

The trap boxes were designed with dewatering screens that funnel smolts through “V” channels into small holding boxes (see Figures 2-3 for photos of fence design). The channels prevent fish from swimming back upstream once they spill over the upstream end of the KsF because the velocity is too great in the dewatering area. From the holding boxes fish have no choice but to continue to move downstream through a 6” rigid plastic hose leading too large covered 8 foot by 4 foot by 4 foot holding boxes, where they remain until they are sampled by GFA staff.



Figure 2:
Photos series
showing
installation of
KsF, including
transoms
(upper left),
and panels
(upper right)



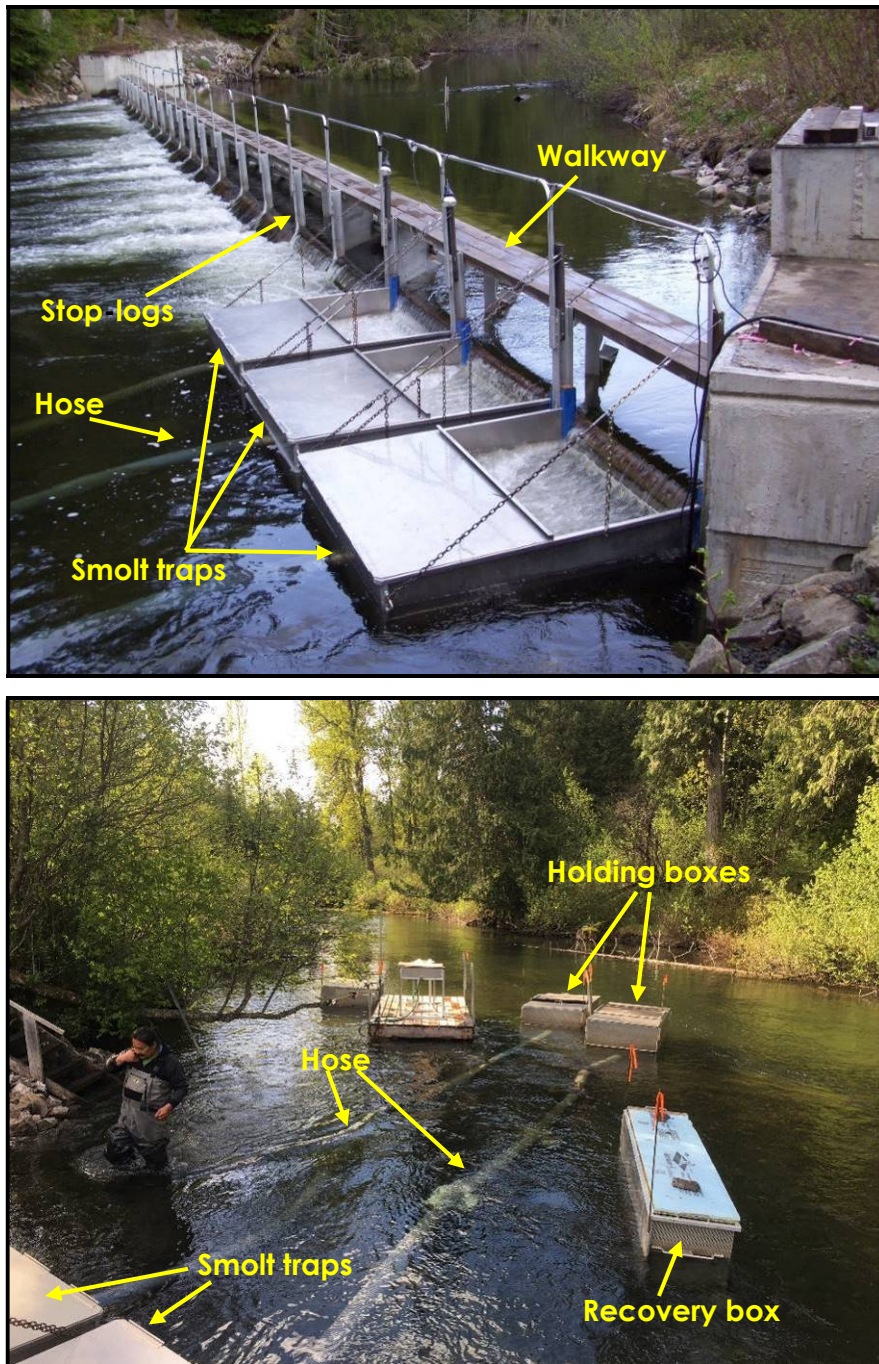


Figure 3: Photos showing smolt traps, 6" hose, stop-logs and walkway (top photo) and downstream view showing smolt traps attached to holding boxes via 6" hose along with recovery box (bottom photo)

3.1 Sockeye Sampling

Crews of two or three GFA technicians check holding boxes daily first thing in the morning and conduct fish sampling and smolt enumeration work. The KsF site is visited again just before dark daily, to remove any debris from the KsF and to ensure the traps are fishing at the proper water level. Trap adjustments are made when needed so the optimum amount of water flows through each trap area (see section 3.3). This ensures that fish are captured in a passive, harmless manner. All fish caught at the KsF are identified and manually counted daily. Sub samples of all sockeye smolts caught daily are measured to determine their lengths and weights (Figure 4). Fork lengths were taken to the nearest 1 millimeter and weights to the nearest 0.1 grams. Scales are also collected from sub samples for aging purposes. Following all sampling and tagging operations, sockeye smolts are placed back into large holding boxes in the Kitwanga River and released at nightfall.



Figure 4: Photo series showing typical downstream route of sockeye and coho smolts through the KsF, including sampling

3.2 Coho Coded Wire Tag (CWT) Program

Since 2009, but excluding 2012, GFA has implemented a coho smolt CWT program in conjunction with the operation of the KsF. In 2020, the coho CWT program did take place and nearly all of the coho captured were implanted with tags. In addition to tagging, coho smolt lengths and weights were collected and scales for aging purposes. Fork lengths were taken to the nearest 1 millimeter and weights to the nearest 0.1 grams.

In order to implant CWT's, fish were anaesthetized using a bath of river water and clove oil. Once anaesthetized, a 1.1 mm long by 0.25 mm diameter CWT was implanted into the nose of each coho with a Handheld Multi-shot Tag Injector (Figure 6). Tagged coho were then released down a PVC pipe with flowing water that spilled into a recovery bucket. The PVC pipe was positioned on top of a coded wire tag detector (V-Detector – Figure 6) to detect whether the tags had been properly implanted into the fish. All coho found to have not retained their tag were re-tagged. Following all sampling and tagging operations, coho smolts were placed back into large holding boxes in the Kitwanga River and released at nightfall. However, as an added quality control measure approximately 10% of each day's CWT group was held for 24-hrs and passed through the V-Detector for a second time to determine tag loss and mortality.

In 2021, GFA installed a rotary screw trap in the Kitwanga River just upstream from Gitanyow village as an additional method to reach the goal of applying 10,000 tags (Figure 5). The screw trap ran from May 19 to May 31, and was shut down prematurely due to high water. The trap was checked twice daily by GFA technicians and sampling and tagging was conducted using the same methods mentioned above.



Figure 5: Photos showing: screw trap installation, operation and a sampled coho

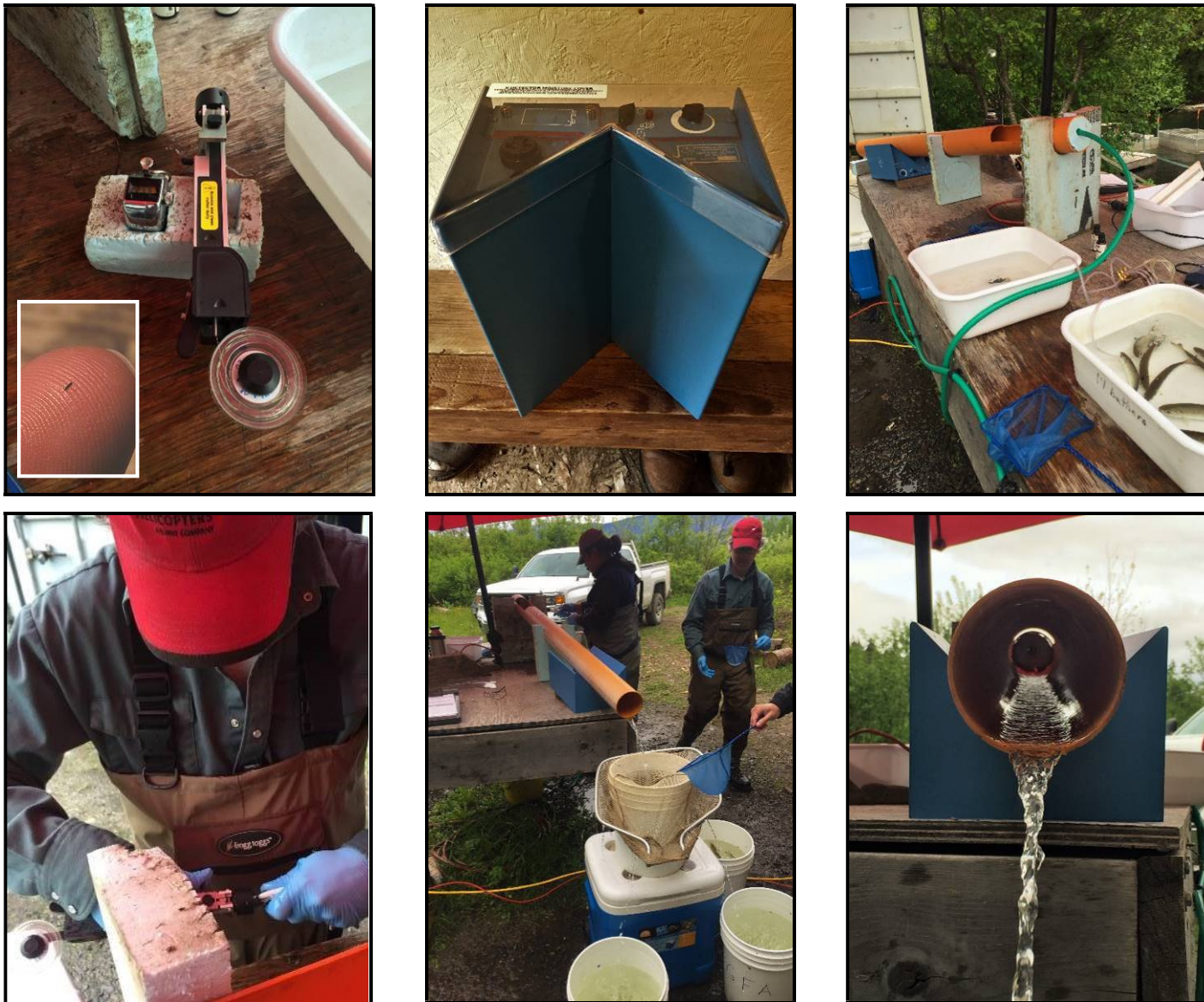


Figure 6: Photo series of handheld multi-shot tag injector (top left), coded wire tag detector (top middle) and sampling station set-up

3.3 Fence Maintenance

In order to prevent build-up and from this, water spilling over the panels below the catwalk, GFA technicians routinely cleaned panels with a coarse bristle push broom (Figure 7).



Figure 7: Photo showing GFA technician cleaning debris off panels

When too little water was spilling over the v-troughs, GFA technicians would lower the weir level by removing stop-logs, or adding stop-logs if too much water was spilling over (Figure 8). Adjustments could also be made to the angle of the v-troughs.



Figure 8: Photo series showing v-trough and stop-logs (left), high flow situation (middle) which needed adjustment and photo on right showing adjusted v-trough

4. RESULTS

Seven species of salmonids were enumerated through the KsF between April 13th and July 14th, 2021: sockeye salmon, coho salmon, cutthroat trout (*Oncorhynchus clarkii*), rainbow/steelhead trout (*O. mykiss*)², bull trout char (*Salvelinus confluentus*), Dolly Varden (*Salvelinus malma*), and mountain whitefish (*Prosopium williamsoni*; Table 1). Sockeye smolts were classified as one or two-year-old fish based on body size in the field and later confirmed through aging. 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 field³. Other species counted include sculpin (*Cottidae* sp., 3,087 fish), northern pikeminnow (*Ptychocheilus oregonensis*, 29 fish), and redbreast shiner (*Richardsonius balteatus*, 2 fish).

Table 1: Number of fish by salmonid species counted through the KSF from April 13 to July 14, 2021

1-YR Old SX	2-YR Old SX	Total Sx Smolts	Total Coho Smolts	CT	Adult BT/DV (> 300mm)	Juv. BT/DV (< 300mm)	RB	ST	MW
3,427	4	3,431	5,960	457	25	56	167	0	373

SX – sockeye salmon, CT – cutthroat trout, BT – bull trout, DV – Dolly Varden, RB – rainbow trout, ST – steelhead, MW – mountain whitefish.

In the following sections, run timing, age and size distribution/statistics for sockeye and coho smolts, will be presented. Sockeye smolt production and details of the coho coded-wire tagging (CWT) program, will also be presented.

4.1 Sockeye Salmon

4.1.1 Sockeye Run Timing

In 2021, 3,431 sockeye smolts were counted through the KsF. Sockeye smolt run timing was in line with the previous five years run timing, with numbers showing up on April 23 and the last on June 11 (Table 2). The peak run of 1,339 sockeye

² For rainbow trout and steelhead - in general fork lengths > 400mm were classified as steelhead

³ DNA samples were taken from DV/BT in 2020 to determine species

smolts occurred on May 2nd when 39% of the entire run migrated past the KsF on the day. This was in line with 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 17 and is comparable to previous year's results. Approximately 90% of the sockeye smolts migrated through the weir during a 15-day period from April 24th – May 8th, which is also comparable to previous years. Based on the results presented above, GFA is confident that the KsF was operational during the entire sockeye smolt run (Table 2).

Table 2: 2021 sockeye run timing compared to 2001 to 2020

Year	Run Start	Run End	Run Peak	Run Midpoint
2001	April 29	May 27	May 6	May 13
2002	April 27	June 1	May 12	May 11
2003	April 23	June 2	May 2	May 13
2004	April 19	May 20	April 30	May 5
2005	April 17	May 19	May 2	May 3
2006	April 22	May 25	May 4	May 9
2007	May 1	May 30	May 10	May 15
2008	April 30	May 28	May 11	May 14
2009	May 1	June 7	May 18	May 19
2010	April 21	June 11	May 3	May 17
2011	April 25	June 23	May 14	May 25
2012	April 26	June 7	May 9	May 17
2013	April 24	June 17	May 7	May 22
2014	April 12	June 17	May 2	May 20
2015	April 4	June 7	May 2	May 5
2016	April 9	June 14	April 24	May 5
2017	April 21	June 12	May 4	May 10
2018	April 28	May 15	May 4	May 6
2019	April 17	June 21	May 2	May 8
2020	April 29	May 21	May 6	May 10
2021	April 23	June 11	May 2	May 17

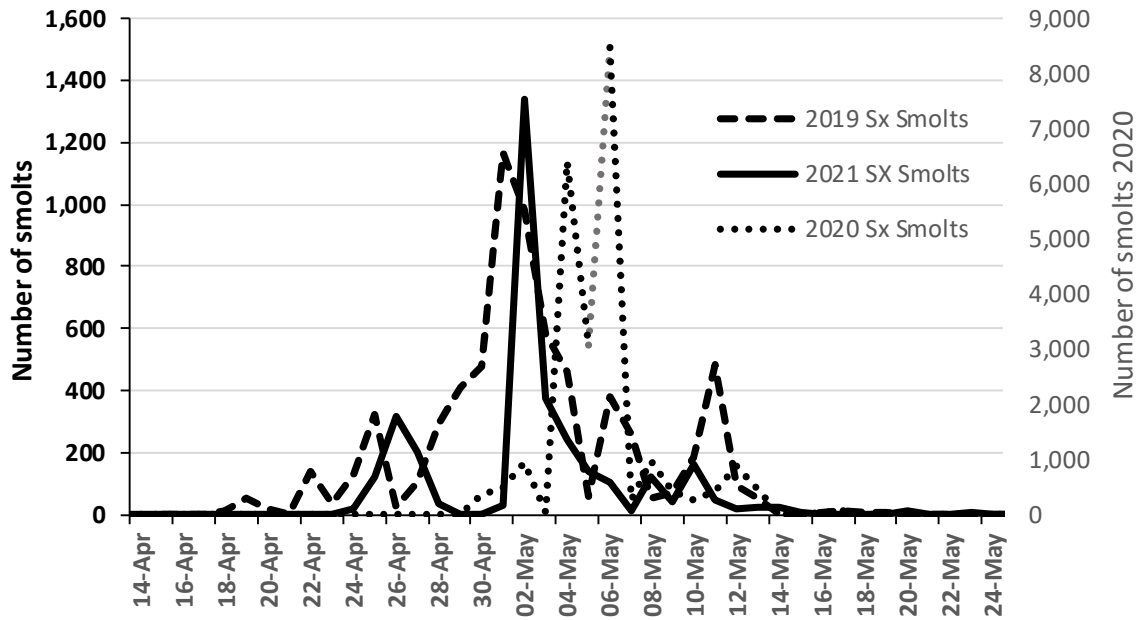


Figure 9: Daily run timing for sockeye smolt emigrating through the KsF in 2021 (n=3,431) compared with 2020 and 2019

4.1.2 Sockeye Age and Size Structure

Scales from 719 sockeye smolts were submitted to the BC Aging Lab and their analysis was not completed in time for this report. In previous years, 1-year olds have comprised ~99 of the run. The smolts had a mean length of 114.1 mm and weight of 14.9 g, which is right in range with the long-term average (2008-2020 - Tables 3 and 4)⁴. Fork length distribution for 1-year-old smolts, grouped into 5mm intervals, was unimodal with the majority of fish falling into the 106 -110, 111-115, 116-120 and 121-125mm length classes (Figure 10).

Table 3: Length and weight statistics for 1-year-old sockeye sampled in 2021 (n=715)

Statistic	Length (mm)	Weight (g)
Mean	114.1	14.9
Standard Deviation	9	3
Sample Variance	80	12
Minimum	77	6

⁴ Note length and weight statistics are estimates for one year olds based on size cut-off from previous years (719 samples were sent for aging, but 715 were used for the length and weight statistics).

Statistic	Length (mm)	Weight (g)
Maximum	134	25
Count	715	715

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)	Min. / Max. Fork Length (mm)	Mean Weight (g)	Min. / Max. 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
2015	505	112.0	94 / 126	13.5	7.2 / 19.0
2016	637	114.0	87 / 135	15.0	6.0 / 26.0
2017	500	115.8	93 / 129	15.2	8.0 / 22.0
2018	990	104.0	80 / 121	11.0	5.4 / 16.9
2019	925	105.4	77 / 122	11.7	5.6 / 18.0
2020	649	107.4	83 / 131	12.4	6.0 / 20.4
2021	715	114.2	77 / 134	14.9	6.0 / 25.0
Average 2008 – 2021		107.3	64 / 151	12.1	2.3 / 32.7

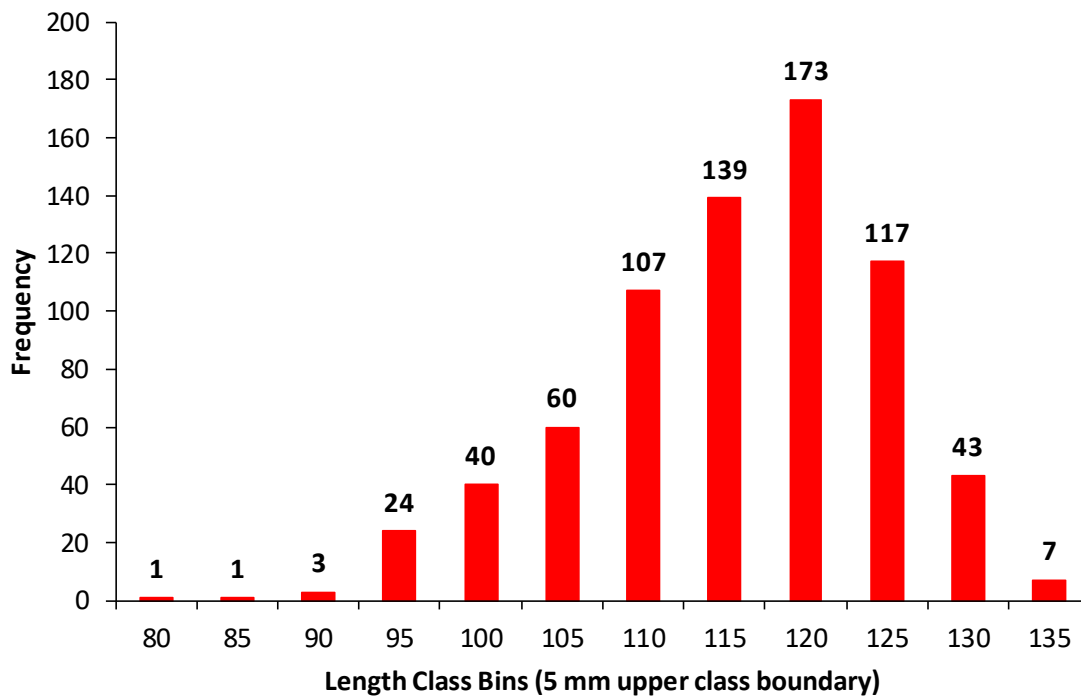


Figure 10: Length distribution (5mm class intervals) for 1-year-old sockeye sampled in 2021 at the KsF (n=715)

4.1.3 Sockeye Smolt Population Estimates and Smolt Production

A total of 3,431 sockeye smolts were counted through the KsF in 2021. The facility remained fish tight throughout the entire sockeye smolt emigration period. The 2021 counts should be considered complete and accurate for the season (Table 5).

The 2021 KsF smolt run was 96% below the 2008 to 2020 running average of 84,684 smolts/year. However, this average is skewed by the record 2012 count of 400,907 smolts. The running average since 2008 now stands at 78,846 smolts/year (Table 6). KsF counts prior to 2008 can be found at <http://www.gitanyowfisheries.com/kitwanga-smolt-fence-enumeration>.

In 2021, an estimated average of 54 smolts were produced per female spawner (Table 6). This estimate was generated by dividing the total number of 1-yr old smolts produced in 2021 by the number of adult females that escaped to the river and presumed to have successfully spawned in 2019.

Table 5: Kitwanga River sockeye smolt population estimate from 2008 – 2021

Year	Total Smolts Captured	2-Yr. Old Smolts	Hatchery Smolt Population Estimate	Wild Smolt Population Estimate
2008	229,026	NA	2,753	226,273
2009	36,554	311	1,273	35,281
2010	113,068	24	--	113,068
2011	83,854	137	--	83,854
2012	400,907	91	--	400,907
2013	84,294	65	--	84,294
2014	46,955	42	--	46,955
2015	12,165	92	--	12,165
2016	33,423	33	--	33,423
2017	11,915	16	--	11,915
2018	22,083	174	--	22,083
2019	6,920	4	--	6,920
2020	23,753	46	--	23,753
2021	3,431	4	-	3,431

Table 6: Sockeye smolt production in 2021 compared to results from the KsF from 2008 to 2020

Female Spawner Brood Year	Female Spawner	Smolt Year	Smolt Estimate	Smolts per Female
2006	2,643	2008	226,273	86
2007	125	2009	34,970	280
2008	684	2010	113,044	165
2009	1,615	2011	83,717	52
2010	9,778	2012	400,907	41
2011	1,230	2013	84,294	69
2012	2,574	2014	46,955	18
2013	277	2015	12,165	44
2014	7,123	2016	33,423	5
2015	2,272	2017	11,914	5
2016	451	2018	22,083	48
2017	134	2019	6,920	52
2018	286	2020	23,753	83
2019	63	2021	3,431	54
Average	2,090		78,846	72

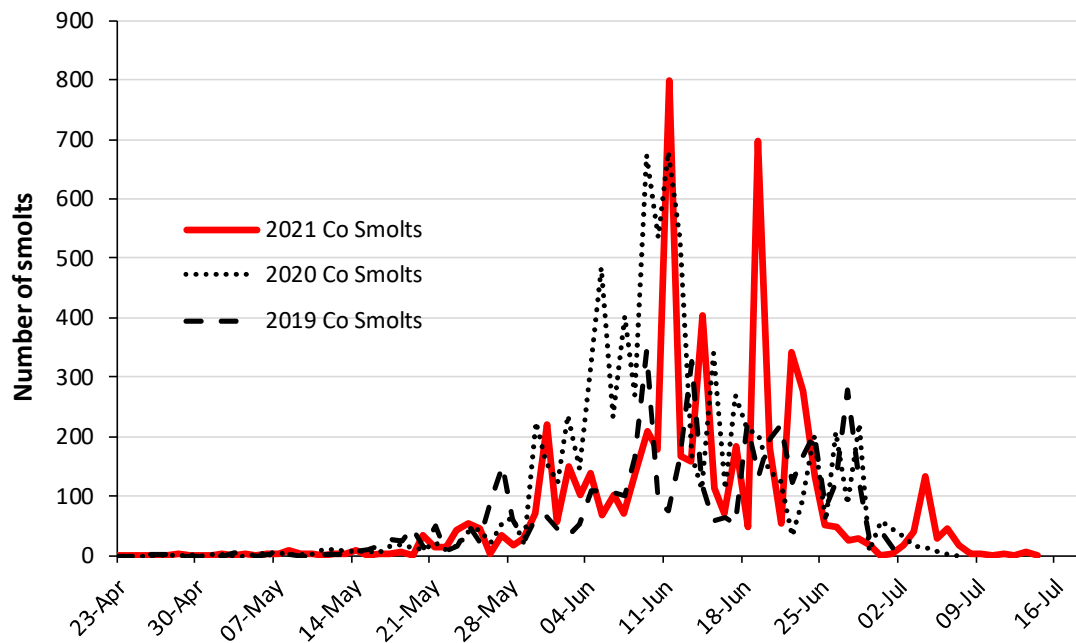
4.1.4 Coho Run Timing

In 2021, 5,960 coho smolts were counted migrating downstream through the KsF. The first coho smolt was counted on April 23 and the last on July 13, two days before operations were shut down for the year (Table 7; Figure 11). The KsF was decommissioned when daily coho smolt emigration numbers were low (in single digits). A very small number of the run was potentially missed, but GFA predicts that it would have been relatively small based on the taper off for numbers counted from July 8 until operations ceased on July 15 (n=15) (Table 7). Daily counts of 100+ fish began on May 31 and continued with a few days' exception until June 24. Unlike sockeye smolts, coho smolts have a long protracted downstream emigration from Gitanyow Lake and the Upper Kitwanga River, absent of any large numbered run peaks.

An additional 641 coho smolts were captured in the rotary screw trap, which was operational until May 31.

Table 7: 2021 coho run timing highlights compared to 2009 to 2020

Year	Run Start	Run End	Run Peak	Run Midpoint
2009	April 19	July 13	June 26	June 1
2010	April 17	June 25	May 31	May 22
2011	April 26	June 28	June 2	May 28
2012	April 25	June 8	May 28	May 18
2013	April 10	NA	June 3 and 12	NA
2014	April 25	NA	June 17 and 20	NA
2015	April 8	NA	June 2 and 6	NA
2016	April 8	NA	May 22/23 and June 1/2	NA
2017	April 13	NA	June 7	NA
2018	May 1	July 18	June 14	June 9
2019	April 25	NA	June 9	NA
2020	April 27	July 6	June 9 - 12	June 7
2021	April 23	July 13	June 11 and June 19	June 12

**Figure 11: Daily run timing for coho smolt emigrating through the KsF in 2021 (n=5,960)**

4.1.5 Coho Age and Size Structure

The 2020 age results for the 2020 final KsF report were not available at time of printing therefore they will be reported in this 2021 KsF report. Scales from 250 coho smolts from 2020 were submitted to DFO for age analysis and of these, 213 scales were deemed readable (3.1% of the total run of 8,194 fish; Table 8). Coho smolts in 2020 were aged mostly as 2-year old fish (55.9%; originating from the 2017 adult run of 1,559 fish), followed by 1-year old coho (42.7%; originating from the 2018 adult run of 551 fish) and a small percentage were aged as 3-year old coho (1.4%) originating from the 2016 adult run of 2,522 fish. Based on previous years, 1-year-old smolts are most abundant, followed by 2-year-old smolts, then incidental by 3-year-old smolts.

Table 8: 2020 coho smolt age results

European	Gilbert-Rich	Brood Yr.	Frequency	Percent
30	44	2016	3	1.4%
20	33	2017	119	55.9%
10	22	2018	91	42.7%
Total			213	100%

Scales from 862 coho smolts were submitted to DFO for age analysis in 2021⁵. The 2021 coho smolt age results were not available for inclusion in this report, but will be included in the 2022 KsF report.

The 2021 mean length (135.4mm) and weight (26.4 g) for the 860 coho sampled was comparable to that found in previous years at the KsF (Tables 9 and 10). Fork length distribution for coho, grouped into 5 mm intervals, was unimodal with the majority of fish falling into size classes from 125 to 145 mm (Figure 12). The histogram also shows that there were a number of large coho (n=39) enumerated through the fence in size classes from 160 to 285 mm.

⁵ Two large coho, 322 and 312mm in length were not included in the histogram.

Table 9: Length and weight statistics for coho smolts sample in 2021 (n=860)

Statistic	Length (mm)	Weight (g)
Mean	135.4	26.4
Standard Deviation	18	9
Sample Variance	311	81
Minimum	101	8.5
Maximum	285	136
Count	860	850

Table 10: Coho smolts mean fork lengths and weights from 2009 to 2021

Year	Sample Size (N)	Mean Fork Length (mm)	Min. / Max. Fork Length (mm)	Mean Weight (g)	Min. / Max. 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
2015	621	133.7	98 / 240	26.0	11.1 / 149.1
2016	800	133.0	95 / 192	26.0	9.0 / 69.0
2017	625	132.6	100 / 265	25.8	10.1 / 175.6
2018	450	137.3	108 / 196	27.8	13 / 74.3
2019	250	139.0	100 / 300	32.2	10.6 / 265.2
2020	250	136.1	105 / 260	29.2	13.0 / 192.0
2021	860	135.5	101/285	26.4	8.5 / 136
Average 2009 - 2020		134.3	85 / 300	26.7	6.1 / 265.2

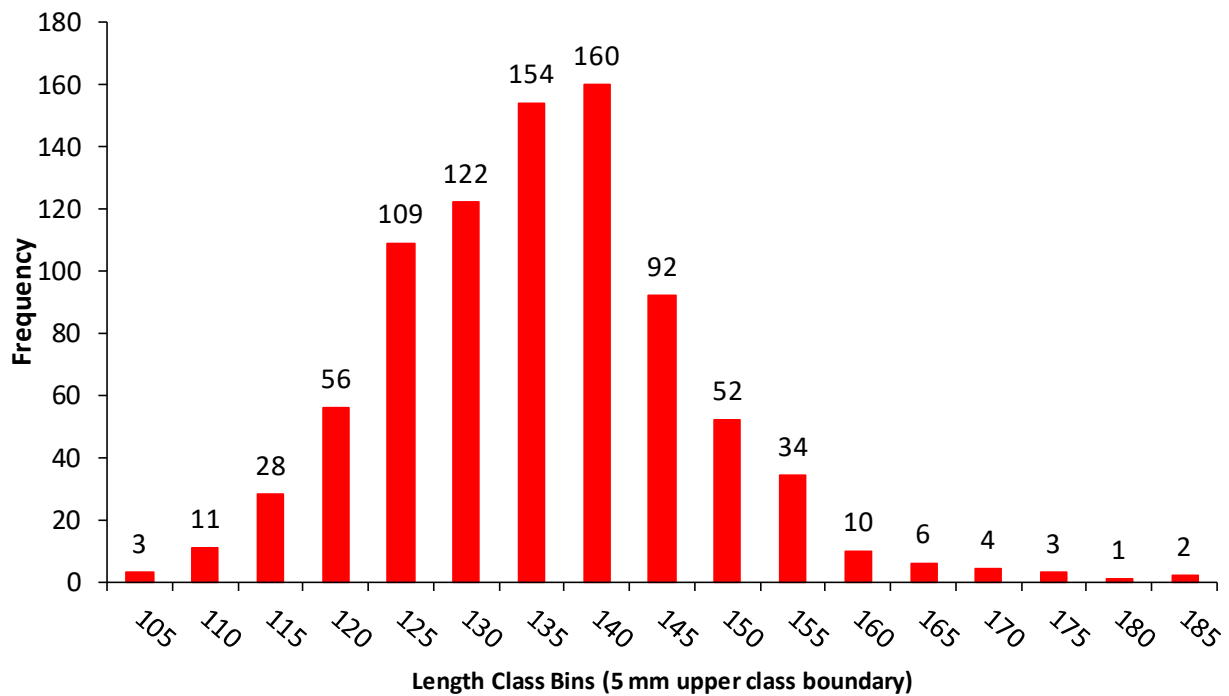


Figure 12: Length distribution (5mm class intervals) for coho sampled in 2021 at the KsF (N=860). Note there were 13 smolts not included on this histogram from 190 to 285mm class intervals

4.1.6 Coho Wire Tag Program

A total of 5,382 coho were coded wire tagged in 2021. However, accounting for tag loss and mortality GFA estimated that the total coho smolt CWT release for 2021 was likely in the order of 5,059 (Table 11). A tag release form was sent to DFO that provides the brood year that the 2021 smolts were from (i.e. majority will be 2018 and 2019), as well as the total number counted through the fence (n=5,960), tag loss and total tagged and released (Table 11). Tagged adult coho are tracked and reported ideally in whole but realistically in part by Alaskan and Canadian fisheries and then at the KSEF on their return to spawn in the Kitwanga River (Figure 13). Tag recovery information helps fisheries managers determine coho fisheries specific exploitation of yearly cohorts and smolt to adult survival rates which represent a portion of Skeena coho stocks with similar life history traits. The program is used as a Skeena coho indicator stock on an annual basis to help better manage fisheries in northwestern BC.

Table 11: Coho CWT estimates for tag mortality, tag loss, and total CWT's released in 2021

CWT Tag Group	# Coho Tagged	Tag Loss + Mortality %	Sample Size	# Coho Released
A18-D33/65 D47/81 D54/76 D16/85	5,382	323	1,615	5,059

**Figure 13: Photos of CWT being extracted from salmon head (left) and CWT read under microscope (right) - <http://www.rmpec.org/recovery-gallery.html#>**

4.2 Other Salmonids

Cutthroat trout (CT), bull trout/Dolly Varden (BT/DV), and rainbow trout (RB) were all documented to have moved downstream through the KsF during the 2020 operations. Table 12 shows the total numbers of CT, BT/DV, RB and mountain whitefish (MW) that were counted through the KsF in 2021 as well totals counted from 2009 to 2020.

Table 12: Total numbers of CT, BT/DV, RB and MW counted from 2009 to 2021

Year	CT	BT/DV	RB	MW
2009	781	481	192	616
2010	987	614	216	143
2011	661	215	88	129
2012	400	277	55	12
2013	547	368	105	165
2014	604	556	113	164
2015	492	545	97	133
2016	530	564	133	251

Year	CT	BT/DV	RB	MW
2017	563	615	92	255
2018	620	299 ⁶	71	189
2019	317	124 ⁷	46	22
2020	540	119 ⁸	77	599
2021	457	81	167	373

4.3 Ice off Gitanyow Lake

From studies conducted on Kitwanga sockeye smolt emigration it has been determined that the peak of Kitwanga sockeye smolts emigrating from Gitanyow Lake has occurred 4 to 15 days after the ice comes off the lake. In 2021, the ice came off the lake on April 24. Table 13 shows the dates that ice was off the lake in past years.

Table 13: Date ice off Gitanyow Lake and sockeye smolt run peak

Year	Date ice off Gitanyow Lake	Peak of smolt migration	Time between ice off lake and peak timing
2006	April 26	May 4	8 days
2007	May 6	May 10	4 days
2008	May 4	May 11	7 days
2009	May 9	May 18	9 days
2010	April 21	May 3	10 days
2011	May 2	May 14	12 days
2012	May 4	May 9	5 days
2018	April 30	May 4	4 days
2019	April 17	May 2	15 days
2020	May 1	May 6	5 days
2021	April 24	May 2	8 days

5. DISCUSSION AND RECOMMENDATIONS

Since 2008, GFA has enumerated salmon smolts emigration from Gitanyow Lake and the Upper Kitwanga Watershed through the operation of the KsF. A focal point of the KsF project is the annual monitoring of Kitwanga sockeye smolt production because of the depressed state of the stock. Kitwanga sockeye are a unique conservation unit as defined under Canada's *Wild Salmon Policy*. It is

⁶ DNA testing of 129 samples, 61% BT, 36% DV and 3% hybrids (Taylor 2019).

⁷ DNA testing of 124 samples, 80% were BT, 13% DV, and 7% hybrid (Taylor 2020).

⁸ DNA results were not ready in time for this report.

currently considered one of the most important stocks of concern in the Skeena and a management unit of special concern (DFO 2020). Annual sockeye smolt enumeration is very important because it provides key information needed to manage the stock and allow fishery experts to gauge the effectiveness of rebuilding programs currently being implemented. The Kitwanga coho CWT program is also important because it is one of only a few coho indicators left in northern BC and the information collected helps to better understand harvest distribution of BC north coast coho salmon and manage fisheries in both Canada and in Alaska.

Sockeye run timing spread, and peak run date, were all similar to previous years. The sockeye smolt emigration was estimated at 3,431 fish in 2021, which is the lowest count through the KsF since it began in 2008, albeit coming from a low brood year of 125 adults and 63 females in 2019. Though scale analysis was not complete in time for this report, in previous years 1-year-old fish have averaged ~99% of the smolt population emigrating through the KsF. Average smolt length and weights were 114.1mm and 14.9g respectively, which were higher than the long term average of 107.3mm and 12.1g. Production estimates for Gitanyow Lake sockeye in 2021 was 54 smolts per female spawner (most originating from the 2019 broodyear). The majority (90%) of the sockeye smolts migrated through the weir between April 24th – May 8th, 2021 with a peak count of 1,339 on May the 2nd. This was in line with previous years when peak runs generally occur in the 1st or 2nd week of May.

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 2022.

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