Gitanyow *Fisheries* Authority

2020 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 2020, the Gitanyow Fisheries Authority (GFA) operated the Kitwanga River Smolt Enumeration Facility (KsF) for the 13th 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 2020, the facility was operated from April 14th to July 7th.

The sockeye smolt emigration was estimated at 23,753 fish in 2020, which is the highest count through the KsF since 2014 (n=33,423). Through scale analysis, it was determined that almost all of the smolts were 1-year-old fish (99.8%), which is similar to previous years. Average smolt length and weights were 107.4mm and 12.4g respectively, which were higher than the long term average of 106.8mm and 11.9g. Production estimates for Gitanyow Lake sockeye in 2020 was 83 smolts per female spawner (most originating from the 2018 broodyear). Almost all (99%) of the sockeye smolts migrated through the weir between April 30th – May 13th, 2020 with a peak count of 8,471 on the night of May the 6th. This was in line with previous years when peak runs generally occur in the 1st or 2nd week of May.

Coho smolt captures in 2020 totaled 8,194 fish by the time the KsF was decommissioned for the year on July 7th. GFA staff successfully sampled, fin clipped, and coded wire tagged (CWT) 95 % of the coho captured in 2020. Scales from 296 coho smolts were submitted to DFO for age analysis. The 2020 coho smolt age results were not available for inclusion in this report.

Overall, GFA is confident that the entire sockeye and coho smolt run were captured through the KsF in 2020.

Cutthroat trout, bull trout/Dolly Varden (BT/DV) and rainbow trout were also enumerated and sampled for lengths through the KsF in 2020. DNA samples were also taken from BT/DV in 2020 to help determine species, but the results were not available in time for this report. Abundance by species was lower in comparison to previous year's totals.

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 2020. 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 2020 included: Les McLean, Earl McLean, Phillip Johnson, Brenton Williams, Morgan Douse, and Melissa Shirey. 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%. The average exploitation over the last four years has been 16%. These compare positively to the more historical exploitation rates which were double and triple these values.

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 2020 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).

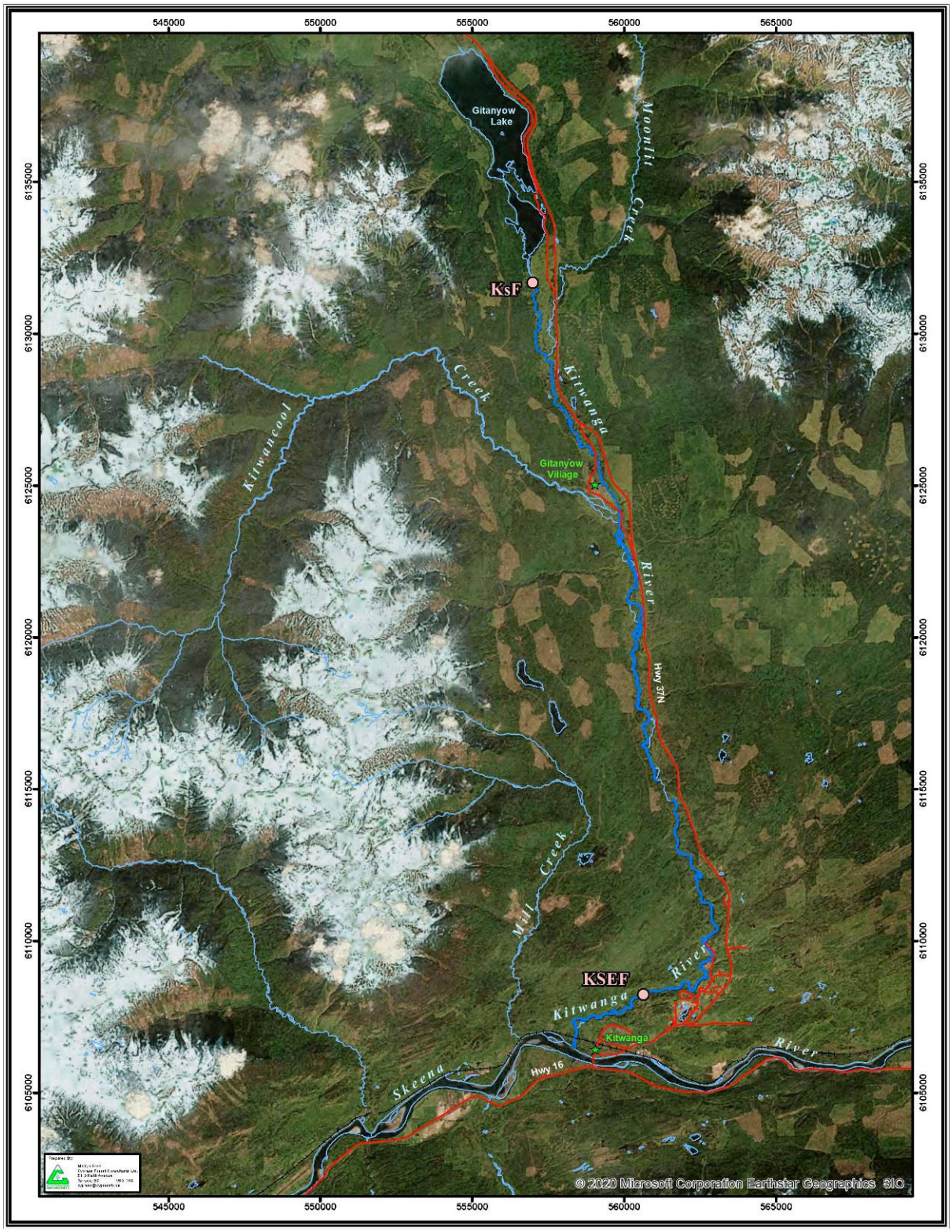

Figure 1: Skeena River and the lower Kitwanga Watershed including the KSEF, KsF and Gitanyow Lake

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 2020, 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)

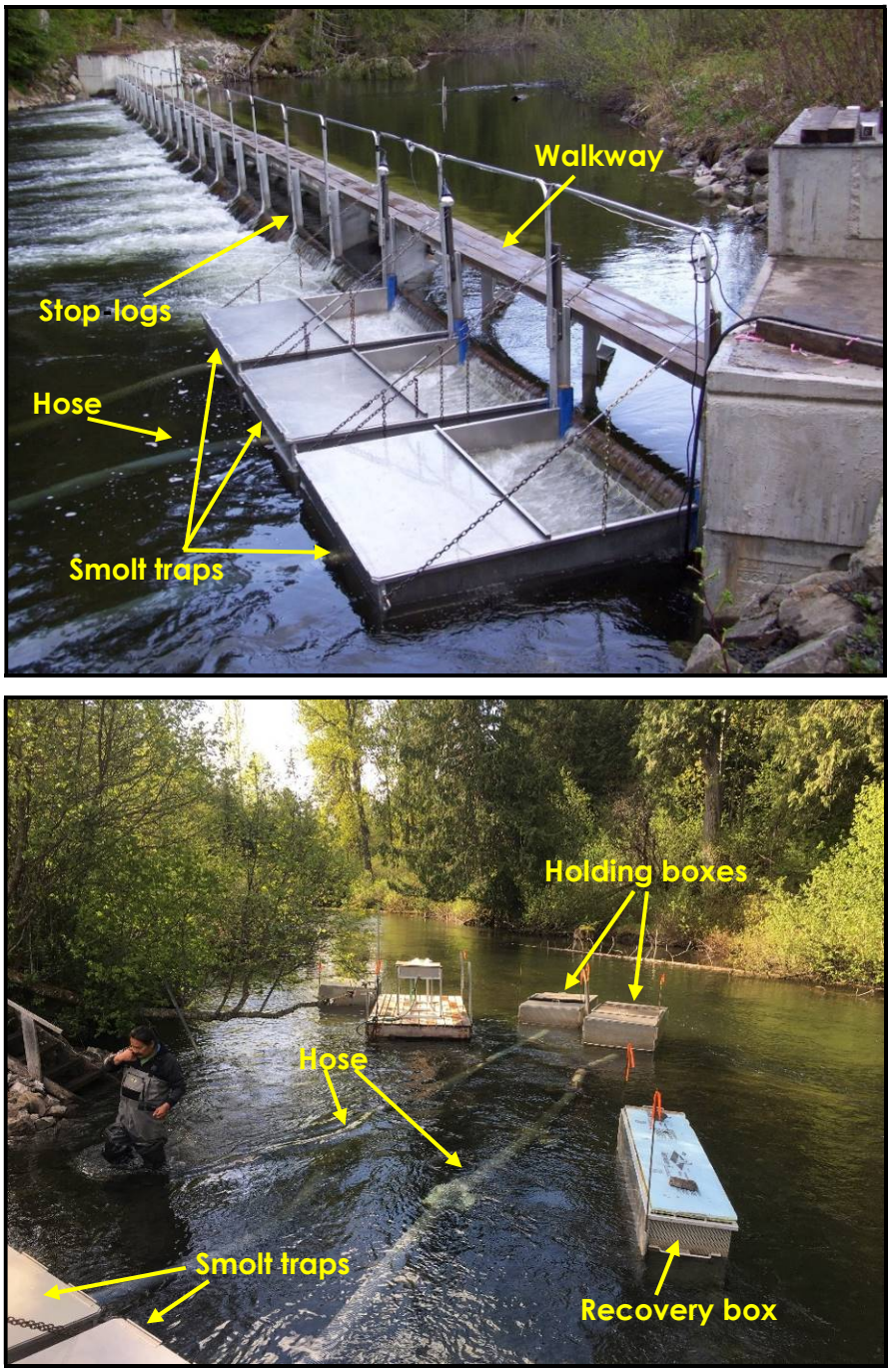

Figure 3: Photos showing smolt traps, 6" hose, stop-logs and walkway (top photo) and downstream view showing smolt traps attached to holding boxes via 6" hose along with recovery box (bottom photo)

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.

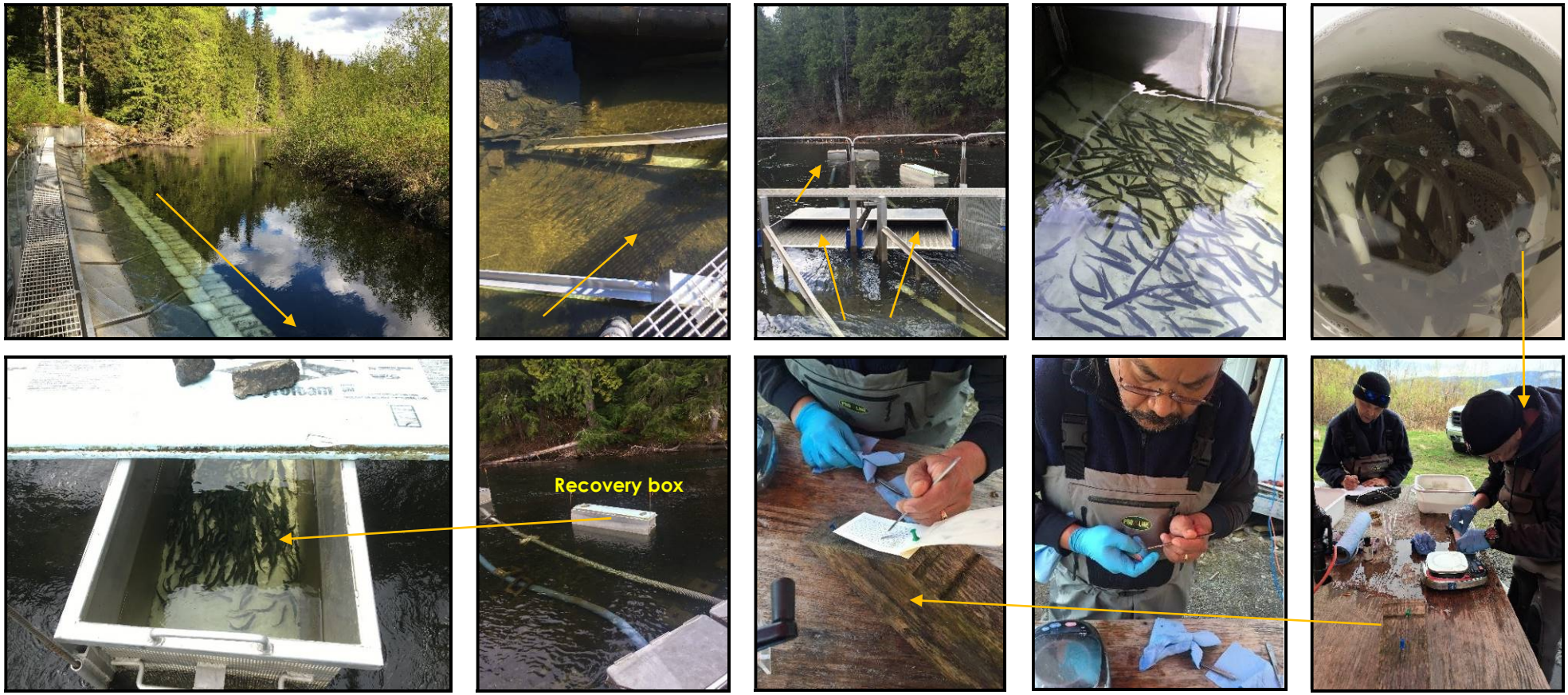

Figure 4: Photo series showing typical downstream route of sockeye and coho smolts through the KsF, including sampling

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 5) 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.

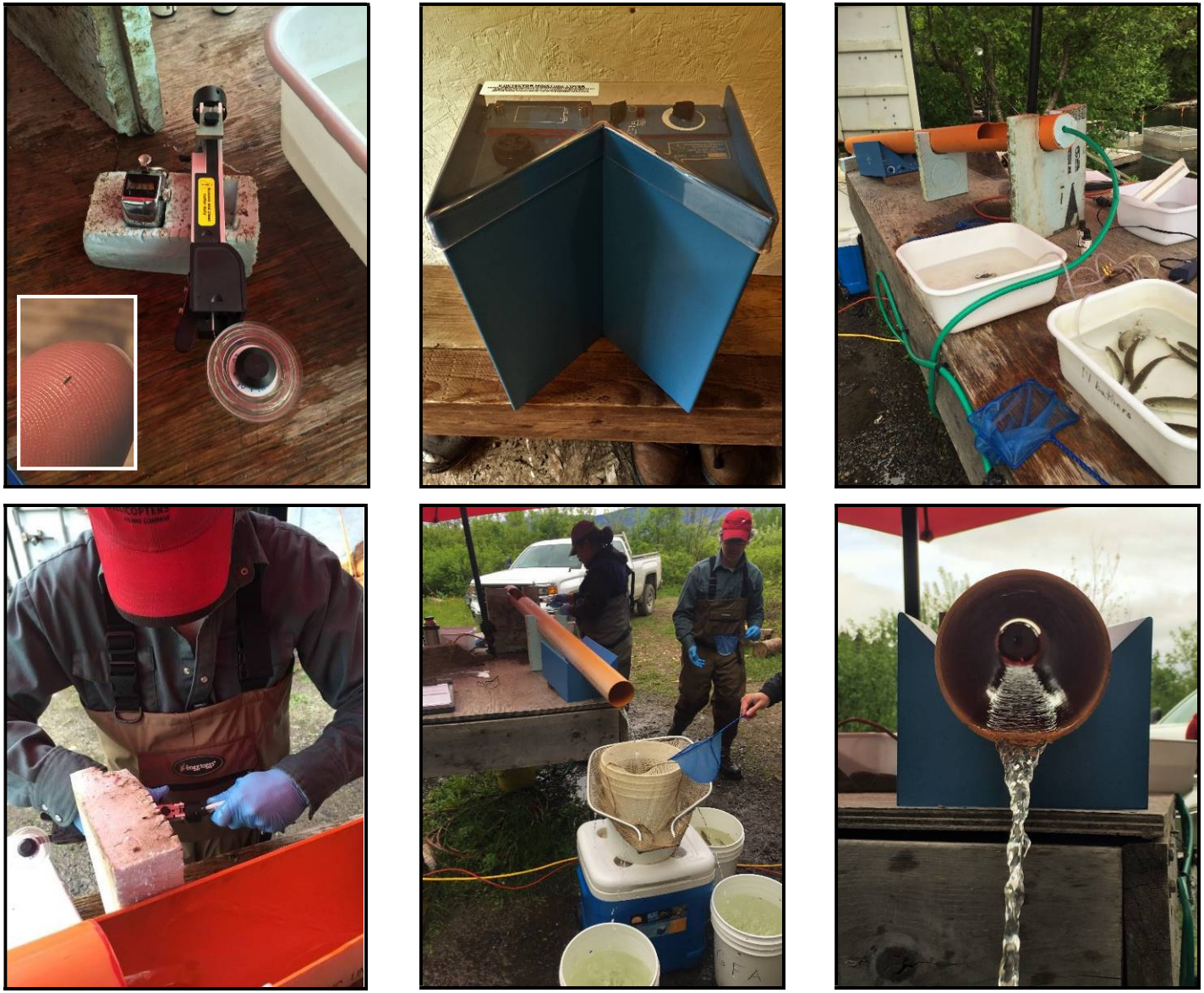

Figure 5: Photo series of handheld multi-shot tag injector (top left), coded wire tag detector (top middle) and sampling station set-up

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 course bristle push broom (Figure 6).

Figure 6: 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 7). Adjustments could also be made to the angle of the v-troughs.

Figure 7: Photo series showing v-trough and stop-logs (left), high flow situation (middle) which needed adjustment and photo on right showing adjusted v-trough

3.4 Decommissioning

The KsF was dismantled by GFA staff over a three-day period, beginning on the afternoon of July 7th, 2020. Once all the pieces were detached and carried out of the river, they were cleaned using hand brushes and a power washer, and stored on site.

4. RESULTS

Seven species of salmonids were enumerated through the KsF between April 14th and July 7th, 2020: sockeye salmon, coho salmon, cutthroat trout (*Oncorhynchus clarkii*), rainbow/steelhead trout (*O. mykiss*)[1], 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 field[2]. Other species counted include sculpin (*Cottidae sp.*, 8,484 fish), northern pikeminnow (*Ptychocheilus oregonensis*, 20 fish), Peamouth chub (*Mylocheilus* caurinus, 2 fish) and redside shiner (*Richardsonius balteatus*, 2 fish).

Table 1: Number of fish by salmonid species counted through the KSF from April 14 to July 7, 2020

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
23,707	46	23,753	8,194	540	89	30	77	2	599

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.

[1] For rainbow trout and steelhead - in general fork lengths > 400mm were classified as steelhead
[2] DNA samples were taken from DV/BT in 2020 to determine species

4.1 Sockeye Salmon

4.1.1 Sockeye Run Timing

In 2020, 23,753 sockeye smolts were counted though the KsF. Sockeye smolt run timing was slightly later than previous five years run timing, with numbers showing up on April 29 (usually around April 24) and the last on June 18 (Table 2). The peak run of 8,471 sockeye smolts occurred on May 6th when 36% 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 8). The midpoint of the run occurred on May 10 and is comparable to previous year's results. Approximately 99% of the sockeye smolts migrated through the weir during a 14-day period from April 30th – May 13th, 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: 2020 sockeye run timing compared to 2001 to 2019

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	June17	May 7	May 22
2014	April 12	June17	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

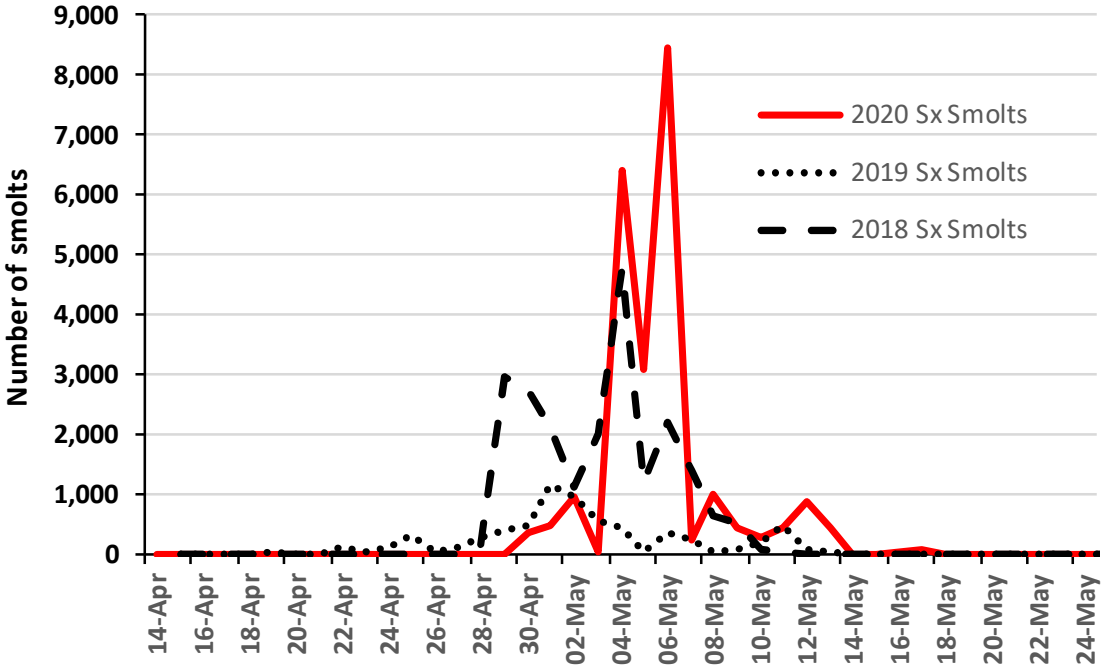

Figure 8: Daily run timing for sockeye smolt emigrating through the KsF in 2020 (n=23,753) compared with 2019 and 2018

4.1.2 Sockeye Age and Size Structure

Scales from 650 sockeye smolts were submitted to Birkenhead Scale Analyses for aging purposes and of these, 644 were deemed readable (2.7% of the total run). From the readable scales it was determined almost all (99.8%) were 1-year-old fish originating from the 2018 broodyear. These smolts had a mean length of 107.4 mm and weight of 12.4 g, which is right in range with the long-term average (2008-2019 - 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 101-105, 106 -110, and 111-115 mm length classes (Figure 9). Only one 2-year-old sockeye smolt was present in 2020 in terms of aging (174mm and 55.3g).

Table 3: Length and weight statistics for 1-year-old sockeye sampled in 2020 (n=643)

Statistic	Length (mm)	Weight (g)
Mean	107.4	12.4
Standard Deviation	8.7	2.9
Sample Variance	76.4	8.2
Minimum	83.0	6.0
Maximum	131.0	20.4

Statistic	Length (mm)	Weight (g)
Count	643	643

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
Average 2008 – 2020		**106.8**	**64 / 151**	**11.9**	**2.3 / 32.7**

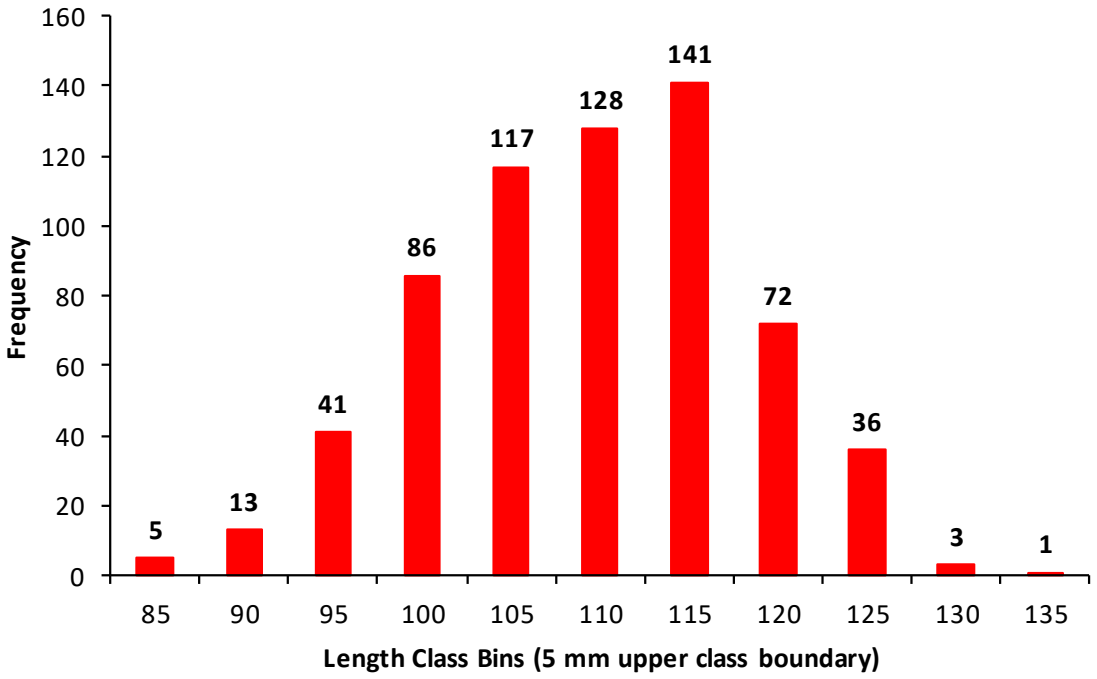

Figure 9: Length distribution (5mm class intervals) for 1-year-old sockeye sampled in 2020 at the KsF (n=643)

4.1.3 Sockeye Smolt Population Estimates and Smolt Production

A total of 23,753 sockeye smolts were counted through the KsF in 2020. The facility remained fish tight throughout the entire sockeye smolt emigration period. The 2020 counts should be considered complete and accurate for the season (Table 5).

One exception is that on some days when steelhead adults are visually seen below the KsF or believed to be in the area, GFA staff open a small "steelhead" door (18" x 18"), which is located in the middle of the facility while they are at the site (usually several hours in the morning). Opening the door allows an opportunity for upstream migrating adult steelhead to pass the facility. However, GFA does not believe that opening the door impacts our sockeye counts in any way. This is based on GFA's >18 years of experience working with Kitwanga sockeye smolt and knowing that they move downstream through the area at dusk and the early hours of the night (likely a predatory avoidance behavior adaptation).

The 2020 KsF smolt run was 74% below the 2008 to 2019 running average of 90,097 smolts/year. However, this average is skewed by the record 2012 count of 400,907 smolts. The running average since 2008 now stands at 84,994 smolts/year (Table 6). KsF counts prior to 2008 can be found at http://www.gitanyowfisheries.com/kitwanga-smolt-fence-enumeration.

In 2020, an estimated average of 83 smolts were produced per female spawner (Table 6). This estimate was generated by dividing the total number of 1-yr old smolts produced in 2020 by the number of adult females that escaped to the river and presumed to have successfully spawned in 2018. It should be noted that in 2018 GFA tracked adult sockeye using radio telemetry between the KSEF and the KsF and it was determined that in-river mortality was very high estimated at 68% for tagged fish and only 268 female adult sockeye reached Gitanyow Lake. Prior to 2017 and 2018, we had not conducted radio telemetry studies, and therefore the total adult escapement through the KSEF was assumed to have reached the lake to spawn. In river tracking was conducted in 2017 and

2018 because in these years' river levels were extremely low and we found that adults struggled to make it to Gitanyow Lake because of high predation and beaver dam blocking issues. **If mortality is not taken into account for the 2018 brood year, the estimated average smolts per female is 31.**

Table 5: Kitwanga River sockeye smolt population estimate from 2008 – 2020

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**

Table 6: Sockeye smolt production in 2020 compared to results from the KsF from 2008 to 2019

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**
Average	**2,246**		**84,994**	**73**

4.1.4 Coho Run Timing

In 2020, 8,194 coho smolts were counted migrating downstream though the KsF. The first coho smolt was counted on April 27 and the last on July 6, a day before operations were shut down for the year (Table 7; Figure 10). The KsF was decommissioned when daily coho smolt emigration numbers were low (in single digits). A small number of the run was likely missed but GFA predicts that it would have been relatively small based on the taper off for numbers counted from June 30 until operations ceased (Table 7). Daily counts of 100+ fish began on May 30 and continued with a few days' exception until June 28. Unlike sockeye smolts, coho smolts have a long protractive downstream emigration from Gitanyow Lake and the Upper Kitwanga River, absent of any large numbered run peaks.

Table 7: 2020 coho run timing highlights compared to 2009 to 2019

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**

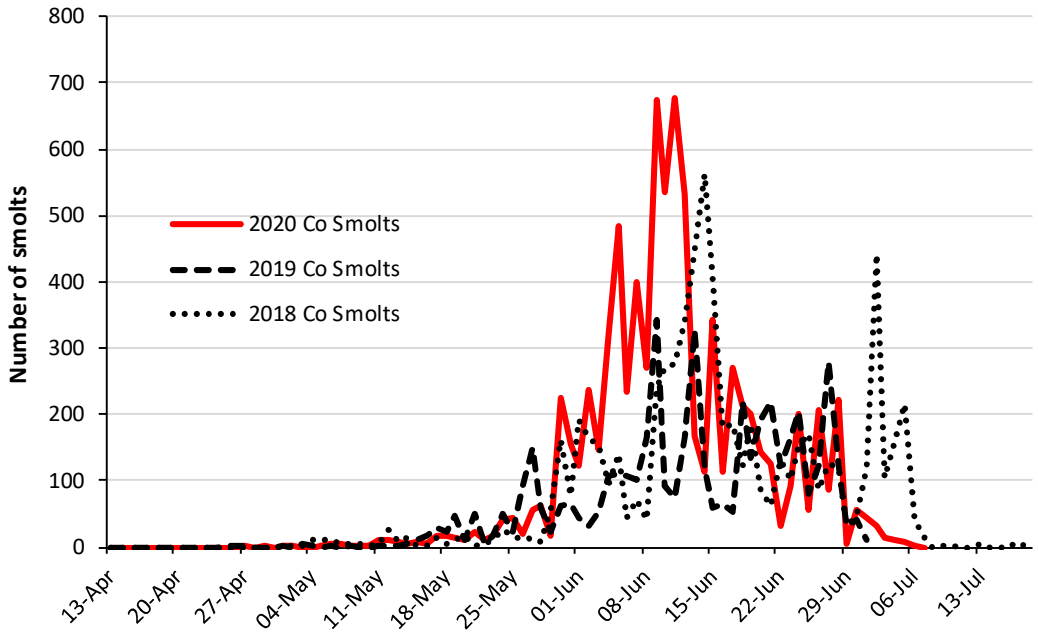

Figure 5: Daily run timing for coho smolt emigrating through the KsF in 2020 (n=8,194)

4.1.5 Coho Age and Size Structure

The 2019 age results for the 2019 final KsF report were not available at time of printing therefore they will be reported in this 2020 KsF report. Scales from 250 coho smolts from 2019 were submitted to DFO for age analysis and of these, 152 scales were deemed readable (3.2% of the total run of 4,725 fish; Table 8). Coho smolts in 2019 were aged mostly as 2-year old fish (52%; originating from the 2016 adult run of 2,522 fish), followed by 1-year old coho (43%; originating from the 2017 adult run of 1,559 fish) and a small percentage were aged as 3-year old coho (~5%) originating from the 2015 adult run of 2,188 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: 2019 coho smolt age results

European	Gilbert-Rich	Brood Yr.	Frequency	Percent
40	55	2014	1	0.7%
30	44	2015	7	4.6%
20	33	2016	79	52.0%
10	22	2017	65	42.8%
		Total	152	100%

Scales from 250 coho smolts were submitted to DFO for age analysis in 2020. The 2020 coho smolt age results were not available for inclusion in this report, but will be included in the 2021 KsF report.

The 2020 mean length (136.1mm) and weight (29.2 g) for the entire 250 coho sample 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 115 to 150 mm (Figure 11). The histogram also shows that there were a number of large coho (n=27) enumerated through the fence in size classes from 160 to 300 mm[3].

Table 9: Length and weight statistics for coho smolts sample in 2020 (n=250)

Statistic	Length (mm)	Weight (g)
Mean	136.1	29.2
Standard Deviation	21	20
Sample Variance	433	392
Minimum	105	13.0
Maximum	260	192
Count	250	250

Table 10: Coho smolts mean fork lengths and weights from 2009 to 2020

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
Average 2009 - 2019		**134.1**	**85 / 300**	**26.4**	**6.1 / 265.2**

[3] A coho 385mm and 194.2g is not included in the histogram and in the mean fork lengths and weights.

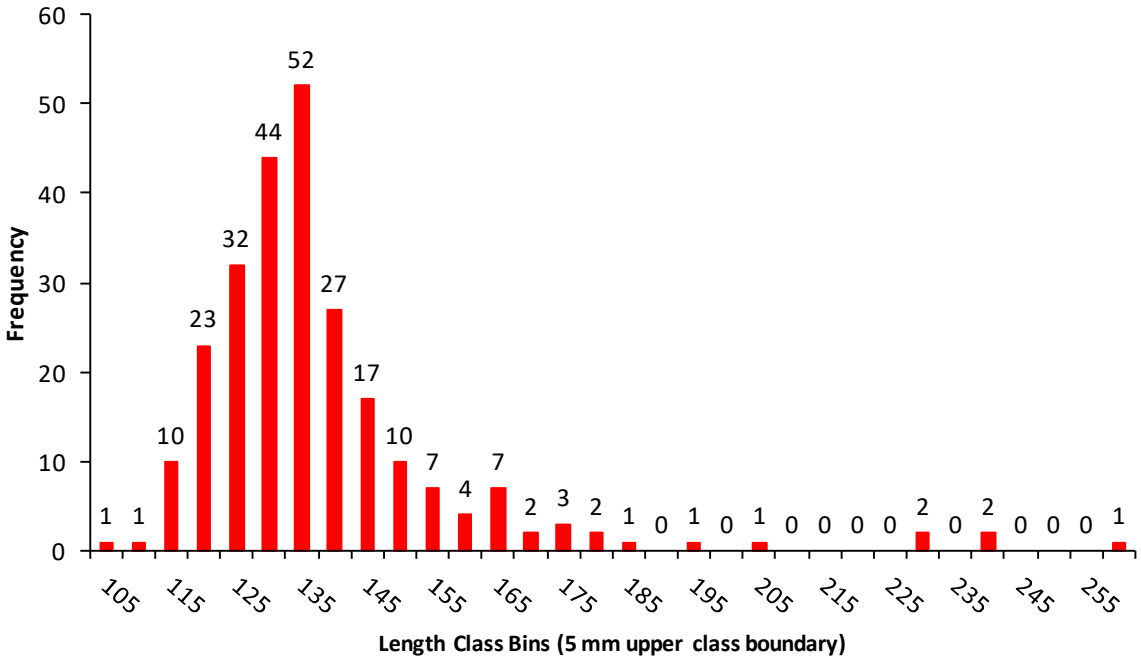

Figure 6: Length distribution (5mm class intervals) for coho sampled in 2020 at the KsF (N=250)

4.1.6 Coho Wire Tag Program

A total of 7,809 coho were coded wire tagged in 2020. However, accounting for tag loss and mortality GFA estimated that the total coho smolt CWT release for 2020 was likely in the order of 7,434 (Table 11). A tag release form was sent to DFO that provides the brood year that the 2020 smolts were from (2018), as well as the total number counted through the fence (n=8,194), tag loss and total tagged and released (Table11). 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 12). 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 2020

CWT Tag Group	# Coho Tagged	Tag Loss + Mortality %	Sample Size	# Coho Released
A18-D21/73	7,809	375	1,799	**7,434**

Figure 7: Figure 8: Photo of CWT being extracted from salmon head (left) and CWT read under microscope (right) - http://www.rmpc.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 2020 as well totals counted from 2009 to 2019.

Table 12: Total numbers of CT, BT/DV, RB and MW counted from 2009 to 2020

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
2017	563	615	92	255
2018	620	299[4]	71	189

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

Year	CT	BT/DV	RB	MW
2019	317	124[5]	46	22
2020	540	119[6]	77	599

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 2020, the ice came off the lake on May 1. 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

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 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

[5] DNA testing of 124 samples, 80% were BT, 13% DV, and 7% hybrid (Taylor 2020).
[6] DNA results were not ready in time for this report.

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 age distribution, run timing spread, and peak run date, were all similar to previous years. The 2020 sockeye smolt population estimate was 23,753, which were comprised of almost all 1-year-old smolts (99.8%). Average smolt length and weights were 107.4mm and 12.4g respectively, which were slightly higher than the long term average of 106.8mm and 11.9g. Production estimates for Gitanyow Lake sockeye in 2020 was 83 smolts per female spawner (most originating from the 2018 broodyear). The peak run of 8,471 sockeye smolts occurred on May 6th when 36% 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. Almost all (99%) of the 2020 sockeye smolts migrated through the weir between April 30th – May 13th, which is slightly earlier than seen previously.

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 2021 where the plan is to try and augment the mark rate to at least 10,000 coho smolts. To do this GFA will include a rotary screw trap sampling program lower down the Kitwanga River to augment KsF mark rates. The purpose of this add on will hopefully improve our estimates of exploitation rate on the stock by increasing the numbers of recoveries seen in the various downstream fisheries. By increasing the number of CWT's we hope to improve estimates of ocean survival as well through the collection of additional coho escapement information in future years at the KSEF.

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Appendix 1: Birkenhead Scale Analyses – 2020 Sockeye Smolts

7. BIRKENHEAD SCALE ANALYSES

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March 6th, 2021

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7.1.1 Re: 2020 Kitwanga River Smolt Sockeye Scale Analysis

Hi Jordan,

Attached is the analysis for the sockeye smolt scales collected from the Kitwanga River from April 30 - May 14, 2020. 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 650 sockeye, mounted on 26 books.

Half of the sample (326) has been fully analyzed to include age, circuli counts, location of freshwater stress and relevant comments. The other half of the sample (324) has been partially analyzed, by scanning the scales quickly to provide age and ensure the typical Kitwanga pattern is exhibited. All of the scales from the partial analysis exhibit the typical Kitwanga pattern. I alternated between full and partial analysis to provide data for the entire sampling period.

Of the 650 fish sampled, only 6 are unreadable, as they are regenerated. Of the 644 readable scales, 643 are age 1 smolts with lengths ranging from 83-131 mm and weights from 6.0-20.4 g. None of the age 1 scales exhibit plus growth. There is one age 2 smolt, with a length of 174 mm, and weight 55.3 grams. The circuli count is as follows: 10 in the first year, with no stress, 23 in the second year with a stress at the 5th circuli, and 1 plus growth, for a total circuli count of 34.

A few samples (n=16) are in poor condition (condition code 2) but fortunately readable enough to age and confirm the typical Kitwanga pattern. Four samples have a wide focus (condition code 3), as the scale is just starting to regenerate, but still exhibit the typical Kitwanga pattern.

Circuli counts are provided for 325 of the age 1 smolts. All of the scales exhibit the typical Kitwanga freshwater stress. As usual, the freshwater stress ranges from moderate to strong.
The circuli counts from the focus to the freshwater stress range from 5 - 16, stress to annulus 4 - 17, for a total circuli count of 14 - 27. Some of the samples exhibit 2 stresses in the first year of growth, usually the first stress is strongest and is the one counted.

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