Gitanyow Fisheries Authority

Kitwanga River Salmon Enumeration Facility – 2009 Annual Report

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ABSTRACT

Since 2003, the Gitanyow Fisheries Authority has operated the Kitwanga River Salmon Enumeration Facility (KSEF), which is a permanent fence structure with removable panels designed to trap and allow identification and enumeration of upstream migrating salmon. From July 10th until October 28th in 2009, GFA enumerated 3,047 sockeye *(Oncorhynchus nerka)*, 824 chinook *(O. tshawytscha)*, 559,865 pink *(O. gorbuscha)*, 829 chum *(O. keta)* and 12,080 coho *(O. kisutch)* salmon. Sockeye, chinook and pink all had later than average arrivals, while the timing of chum and coho were normal. Sockeye (n=397), chinook (n=137) and chum (n=219) were sampled to determine age, sex, ripeness and kype presence. Fork length, post-orbital hypural length (chinook and chum only) and snout length (chinook only) measurements were also collected. DNA was also collected from sockeye salmon. In 2009, sockeye were mostly 4 year old fish from the 2005 brood year (n = 287 or 88.0%). However, some 5 year old fish from the 2004 brood year (n = 37 or 11.3%) and 3 year old fish from the 2006 brood year (n = 1 or 0.3%) also returned to the Kitwanga in 2009. For chinook, the age breakdown was 5 year old fish from the 2004 brood year (n = 53 or 57.0%), 4 year old fish from the 2005 brood year (n = 22 or 23.7%) and 6 year old fish from the 2003 brood year (n = 10 or 10.8%). For chum salmon the age breakdown was 4 year old fish from the 2005 brood year (n = 203 or 95.8%), 5 year old fish from the 2004 brood year (n = 7 or 3.3%) and 3 year old fish from the 2006 brood year (n = 2 or 0.9%). Compared to previous returns pink and coho were much higher; the chinook run was much lower; the chum run slightly lower and the sockeye run substantially higher.

ACKNOWLEDGEMENTS

The Gitanyow Fisheries Authority would like to thank the Skeena Watershed Initiative and Fisheries and Oceans Canada for providing the funds to operate the Kitwanga River Salmon Enumeration Facility in 2009. GFA would also like to acknowledge the hard work and of the Gitanyow Fisheries field staff whose extreme dedication to the project made it a success again this year. To maintain this fence from July to October every year requires workers to be on-call at any hour of the day to clear debris and prevent the fence from breaching. Special thanks to the following GFA staff members who worked on this project in 2009 should go to: Gary Morgan, Earl McLean, Jarvis Williams, Les McLean, Sandy Hnatiak, Brenton Williams, Phillip Johnson, James Morgan, Vern Russell, Scott Williams, Derek Kingston, Mark Cleveland and Gregory Rush.

1. BACKGROUND

The Gitanyow people have inhabited their traditional territory in northwestern British Columbia for thousands of years. The main settlement of Gitanyow is located at the confluence of Xsi Tax (river that flows from the lake), locally known as the Kitwanga River. Gitanyow Village was strategically located where it is because historically the Kitwanga River supplied the Gitanyow with an abundance of salmon, which was the staple of their diets (Rabnett et.al., 2002). The “grease trail” that linked the Nass and Skeena watersheds runs directly adjacent to Gitanyow Village.

The system was particularly rich with sockeye salmon that originated in Gitanyow Lake and even today it is common to hear Gitanyow Elders speak of how the lakeshore used to turn red in the late summer as the sockeye congregated to spawn. However, native fishers observed drastic declines in Kitwanga sockeye abundance in the first half of the 20^{th} Century. In response to this decline, most fishing sites along the Kitwanga River were abandoned by the 1960’s (Rabnett et.al., 2002). The reasons for the stock decline are not completely understood, however it is hypothesized that habitat deterioration in Gitanyow Lake and over-exploitation in the mixed-stock marine commercial fisheries are the main contributors to the stock collapse.

Logging and road building in the Kitwanga River watershed was initiated in the 1960’s and with 475 kilometers of roads throughout the watershed (Marsden, Pers. comm., 2009), it is likely there have been sediment related impacts to the watershed. Field reconnaissance of Gitanyow Lake has revealed that much of the spawning areas in the northern basin of the lake are now grown over with macrophytes, most notably is the Canadian waterweed (*Elodea canadensis*) which is suspected to have resulted from an increase in habitat for macrophytes as sediment levels in the lake increased when the watershed was developed (Cleveland & McCarthy, 2003). Only a fraction of the historical sockeye lakeshore spawning grounds remain useable for sockeye spawning.

Over-exploitation of Kitwanga sockeye is also believed to have significantly contributed to the decimation of the stock. Fishery re-constructions for the last 40 years show average exploitation rates on Kitwanga sockeye of over 50%, reaching highs in excess of 70% in some years (Cox-Rogers, DFO, Pers. comm., 2008). In 2009 there was no B.C. commercial fishery for Skeena River sockeye, of which the Kitwanga sockeye are included. Subsequently, the exploitation rate for Kitwanga sockeye dropped to approximately 15%, and this catch consisted of the Alaskan commercial fishery (~10%), incidental by-catch in the B.C. commercial pink salmon fishery (~2%) and in-river harvest (~3%, including First Nations FSC fish and sport fish) (Cox-Rogers, DFO, Pers. comm., 2009).

For much of the 20th Century, salmon escapement to the Kitwanga River was poorly documented. In most years, salmon spawner surveys were not performed, and if they were conducted, data was only collected once a year, using visual spot checks of the various spawning grounds (DFO 2008*b*). Without a fence structure, Kitwanga sockeye are hard to count accurately because spawning takes place over lakeshore areas where the visibility is often poor.

In the 1990's, under pressure from a Supreme Court of Canada Ruling (R vs. Sparrow), DFO established a program entitled the Aboriginal Fisheries Strategy Program (AFS). This program essentially created a mechanism to allow First Nations people to partake in fisheries management projects and has helped address some of the local fisheries conservation concerns. The Gitanyow have always promoted the long-term sustainability of Kitwanga sockeye, and with the establishment of the AFS program, the Gitanyow became better positioned to address the problem. In 1999, the Gitanyow Fisheries Authority (GFA) initiated the development of a program to determine stock status and to identify the limiting factors to sockeye production in the Kitwanga River.

In the programs infancy, a temporary enumeration facility was established in the upper reaches of the Kitwanga River, directly downstream from Gitanyow Lake. The temporary fence proved effective at enumerating sockeye escapement in the years 2000 (Cleveland & Kingston, 2001), 2001 (Cleveland, 2002) and 2002 (Cleveland, 2003a). Sockeye returns were found to be low (averaging less than 500 fish annually) leading GFA biologists to believe that Kitwanga sockeye were at risk of extinction.

The use of the temporary fish fence in the upper waters of the Kitwanga River proved to be an effective tool to monitor sockeye salmon escapement (Figure 1). However, the temporary enumeration structure could not effectively operate for the entire salmon run because the structure's wood and rebar foundation could not withstand high flows. Because it could not withstand high flows, it was located directly below Gitanyow Lake where water levels were buffered by the lake. This limited the number of fish species that could be counted because the fence was located upstream of where most chinook, pink, chum and some coho salmon spawned, so only the abundance of sockeye could be determined with any accuracy.

In an attempt to enumerate all six species of salmon in the Kitwanga River (including steelhead), plans for the construction of a permanent enumeration facility near the confluence of the Kitwanga and Skeena Rivers were developed. It took three years of intensive planning to secure funding, design an adequate facility, select an appropriate site, acquire land and secure the capital for the project. During the winter and spring of 2003, the Kitwanga River Salmon Enumeration Facility (KSEF) was constructed and became operational for the first time in July of 2003 (Cleveland, 2003).

In 2006 the GFA partnered with DFO and the Skeena Fisheries Commission to develop the Kitwanga Sockeye Rebuilding Program. A key component of this program included the establishment of a means to accurately estimate sockeye escapement to the river, on an annual basis, to gauge the effectiveness of rebuilding efforts (Cleveland et al. 2006).

Again in 2009, the KSEF was rendered operational and sockeye, chinook, pink, chum and coho salmon were successfully sampled and enumerated, marking 2009 as the seventh consecutive year that the project has been successfully undertaken.

2. INTRODUCTION

Prior to 2003, salmon enumeration methods utilized in the Kitwanga River consisted of stream counts (DFO 2008*b*, Kingston, 2003), mark-recapture studies (Cleveland, 2002), aerial surveys (Hamelin et al, 2001, McCarthy et al. 2002) and the use of a temporary fish fence in the upper end of the watershed. These methods were effective in some years at estimating salmon abundance, however the data collected was often limited in scope due to uncontrollable environmental conditions encountered while completing counts. In summary, the above mentioned salmon escapement methods were logistically difficult, highly dependent on favorable environmental conditions and resulted in poorer accuracy than a permanent fence where the majority of spawners must pass to migrate upstream. In addition, a permanent fence allows for fish to be sampled, to be inspected for tags or adipose clips and for staff to better observe overall condition of the fish. As well, other species are observed and enumerated such as bull trout, Dolly Varden, lamprey and whitefish.

Therefore, to obtain reliable escapement numbers a permanent counting fence was installed in the lower Kitwanga River to enumerate salmon, and a resistivity counter was initially installed to enumerate steelhead. The dual design structure is titled the **Kitwanga River Salmon Enumeration Facility (KSEF)**. The KSEF complements other existing salmon escapement estimates within the Skeena Watershed and allows fishery managers to better manage Skeena River salmon stocks and in turn better manage Kitwanga salmon. The KSEF also serves as a valuable public education tool. Hundreds of local residents and tourists from around the world visit the site during its operation, learning about salmon, and getting a general education from GFA staff on salmon biology.

The operation of the KSEF was a success for the seventh consecutive year during the summer and fall of 2009. This report will describe project activities and present the results for the operation of the KSEF in 2009. This project was made possible by financial contributions from the Skeena Watershed Initiative and Fisheries and Oceans Canada.

3. DESCRIPTION OF PROJECT AREA

The Kitwanga River is a fifth order stream that drains into the Skeena River approximately 250 kilometers northeast of Prince Rupert, B.C. It supports 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 salmon (*O. mykiss*). The Kitwanga River is also known to support populations of resident rainbow trout (*O. mykiss*), cutthroat trout (*O. clarki*), Dolly Varden char (*Salvelinus malma*), bull trout (*S. confluentus*), mountain whitefish (*Prosopium williamsoni*), pacific lamprey (*Lampetra tridentata*) and various other species of coarse fish (Cleveland, 2000). It is coded 40-2200 by the B.C. Watershed Classification System. The UTM coordinates at its confluence with the Skeena are 9U 090055840 N, 6106300 E. The drainage encompasses an area of approximately 83,000 hectares and has a total mainstem length of 59 kilometers (Cleveland, 2000). The river can be divided into the upper and lower Kitwanga River. The upper Kitwanga is located directly north of Gitanyow Lake and has a main stem length of approximately 23 km. The lower Kitwanga River flows south for approximately 36 km between Gitanyow Lake and the Skeena River. The lower Kitwanga River has four major tributaries including Tea Creek (40-2200-010), Deuce Creek (40-2200-020), Kitwancool Creek (40-2200-030) and Moonlit Creek (40-2200-040). The upper Kitwanga River has no major tributaries and exhibits a multi-channel meandering morphology, with numerous beaver dams along its lower reaches.

Gitanyow Lake is the only lake found within the Kitwanga Watershed. The lake is considered mesotrophic with a mean depth of approximately 5 meters and a maximum depth of 15m (Shorteed et al., 1998). It is relatively clear and the euphotic zone encompasses the entire water column in most areas of the lake. Gitanyow Lake is considered one of the most productive sockeye nursery lakes in British Columbia, due mainly to its extremely high macrozooplankton biomass, which is composed mostly of Daphnia Sp., the main food source of juvenile sockeye salmon (Shorteed et al., 1998). Through lake and stream reconnaissance surveys completed by the GFA it has been determined that Kitwanga sockeye currently utilize six key shoreline areas in Gitanyow Lake for spawning (Cleveland & McCarthy, 2003). Anecdotal evidence from Gitanyow people indicates sockeye historically had access to a much greater area for spawning within the lake, much of which is currently inundated with macrophytes. Therefore, the remaining, healthy lakeshore spawning areas on Gitanyow Lake play a vital role in the life cycle of Kitwanga sockeye for the purposes of adult spawning and juvenile rearing.

The KSEF is located on the Kitwanga River approximately 4 km upstream from its confluence with the Skeena River (Figure 1.). The facility was built on and is accessed through private property owned by Marcus and Don Halvorson of Cher-Noble Enterprises Ltd. Therefore, to ensure long-term access to the site, the Gitanyow Hereditary Chiefs have secured a Statutory Right of Way to both the access road and the site where the enumeration facility is constructed. The Right of Way was granted on March 26, 2003 for both parcels of land and is legally in effect until 2028 (Cleveland, 2003). The Permanent fence also falls within the Gitwangak Eagle Clan Traditional Territory. Permission was granted to the GFA from the Eagle Clan (Hereditary Chief - Calvin Hyzims) to conduct yearly salmon enumeration on their territory.

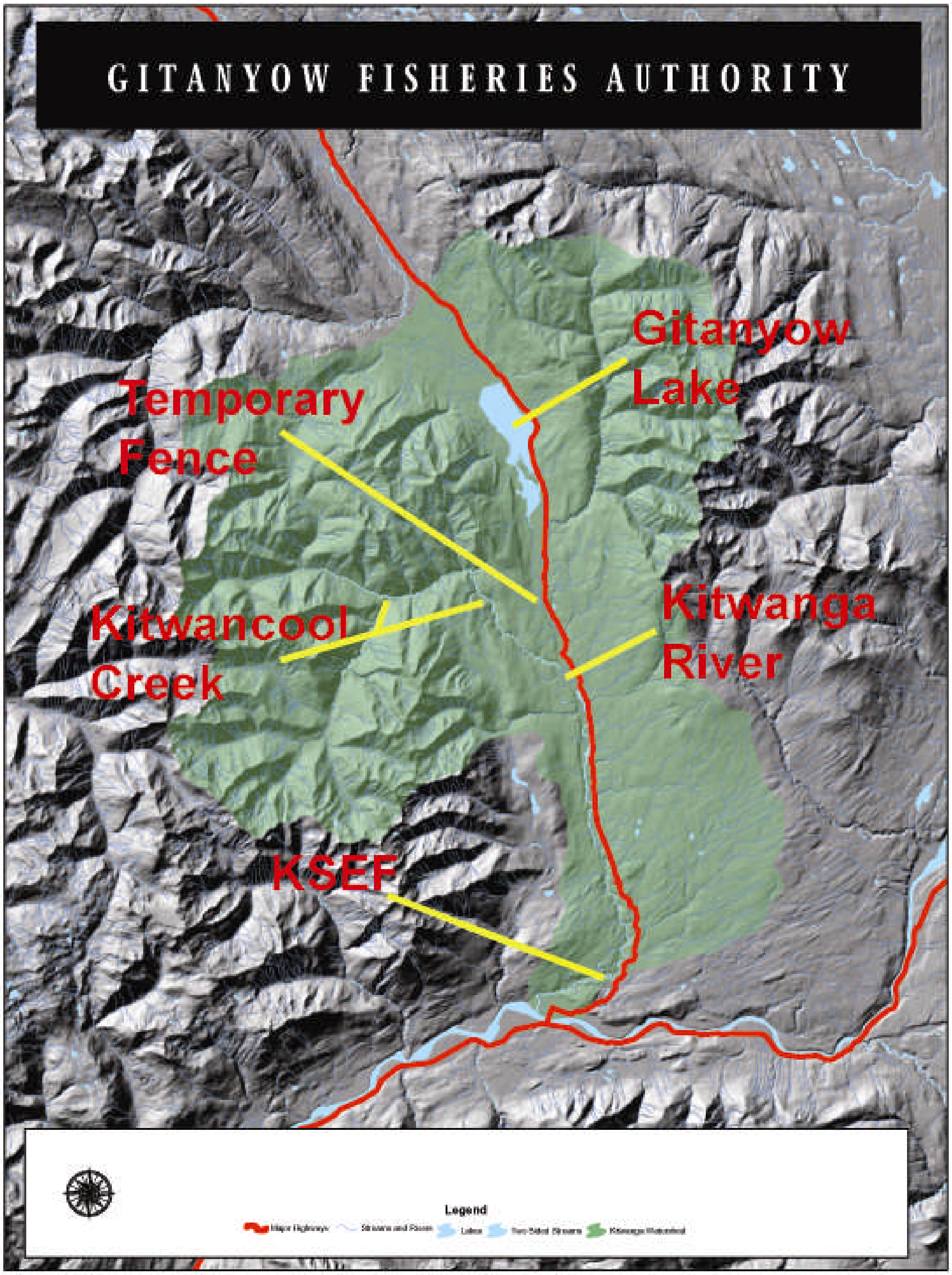

Figure 1: Map of the Kitwanga Watershed making specific reference to the KSEF and the temporary fence location.

4. METHODS

To efficiently and accurately enumerate salmon returning to the Kitwanga River on an annual basis the GFA utilizes a permanent fish fence, which was constructed on the Kitwanga River in the winter and spring of 2003 (Photo 1). The fish fence is formally known as the Kitwanga River Salmon Enumeration Facility (KSEF) and is located near the mouth of the Kitwanga River below most salmon spawning areas (Cleveland, 2004). The KSEF operates in the summer and fall months utilizing a series of aluminum panels that span the river to funnel fish through counting boxes located on each side of the river. In the winter and spring the panels are removed allowing resident trout/char and other fish species such as lamprey or whitefish to move freely past the site.

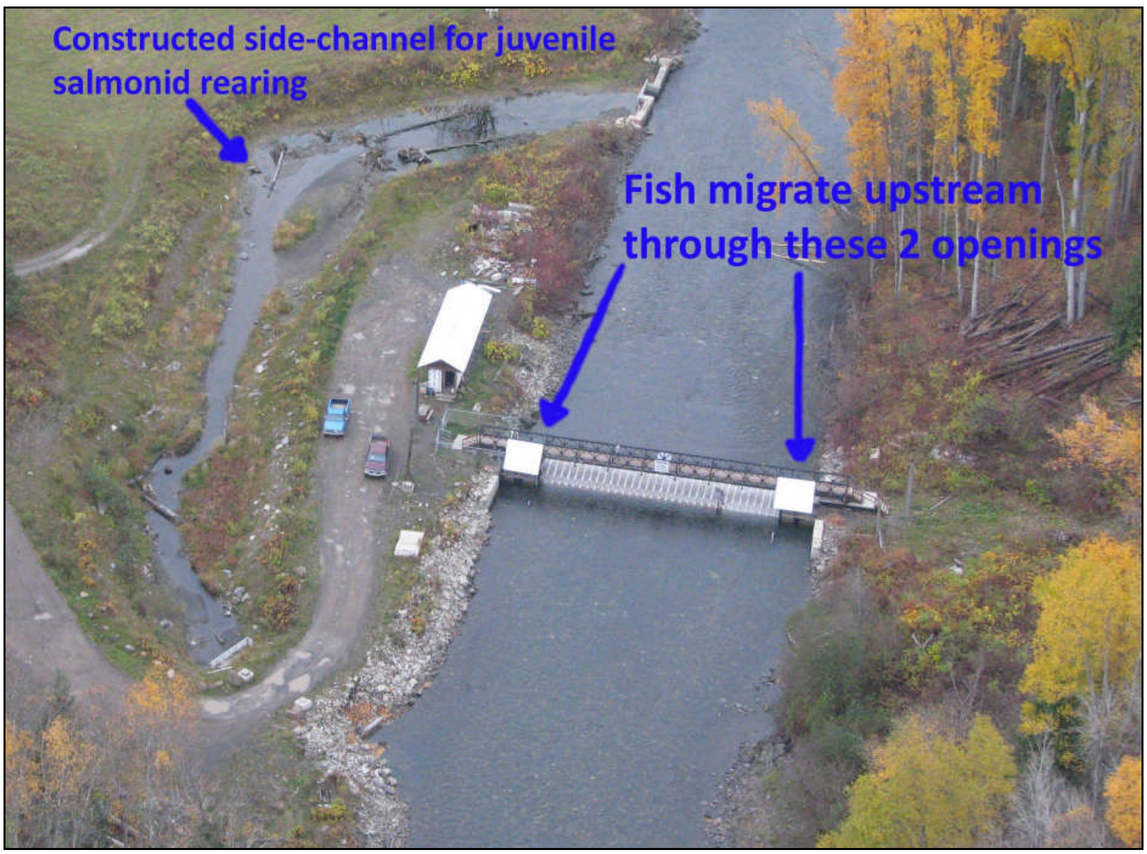

Photo 1: Aerial view of the KSEF, with the river flowing from the bottom to the top of the photo.

The KSEF spans the Kitwanga River perpendicular with the river flow and has a total length of approximately 30m. The base of the facility is constructed of steel, which is embedded into the riverbed, supplying support for the entire structure. Eleven 10,000-pound cement blocks make up the sill from which the aluminum fence is erected seasonally to divert fish through counting boxes. The aluminum panels are pinned to the cement sill, which allows them to hinge up and down as water levels fluctuate. In total, 18 aluminum panels span the river. Originally, the panels were equipped with floats to allow them to self adjust in response to rising and lowering water levels. However, this design only worked under low to medium water levels. Therefore, a secondary method is now utilized where panels are attached to eight 1500 lb winches hung from the overhead walkway. The winches and adjoining ½" cables provide fence staff with the ability to lift and lower fence panels safely and effectively, even during high water periods (Photo 2).

Photo 2: Looking at panels underneath the fence walkway. Cables on the left side of the photo are attached to the walkway by winches, which lower or raise the panels when needed.

The panels weigh approximately 175 lbs each and are transported from shore to their desired location in the river by a guideline and overhead winch. This allows field crews to easily place fence panels in and out of position during installation and removal of the KSEF fence. Once the panels are in the river, GFA staff is required to manually adjust and secure the panels to the sill, which requires that crews enter the river and work underwater. This task is performed fairly easily in most years when water levels at the KSEF site are below 1m in depth.

Once the aluminum panels are secured in the river, trap boxes are installed on each side of the river so that fish can be counted as they migrate past the fence. As the salmon migrate upstream they encounter the aluminum fence panels and swim to the left or right banks of the river. Once they are positioned near the riverbanks they can passively swim through one of two trap boxes where they are identified, sampled if necessary and counted by a fisheries technician stationed above the box. The trap boxes are separated into two sides to allow fish to swim up both sides. A white Teflon background is used on the bottom of the trap boxes to create more contrast and make fish identification easier. A floating view box with a plexiglass bottom is also placed on top of the water column to reduce water glare (Photo 3). The entire trap box is designed to be lowered or raised with a hand winch depending on the water level and clarity.

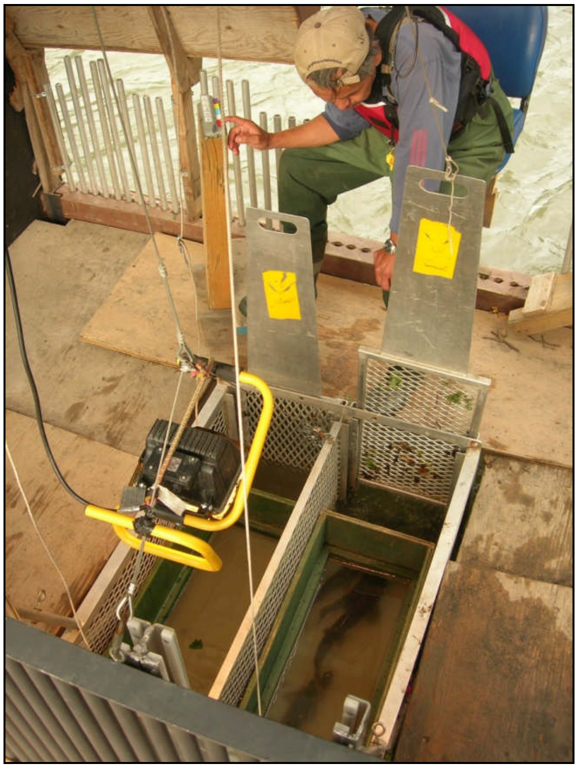

Photo 3: GFA technician identifying and counting salmon at one of the two trapbox locations on the KSEF. Note the green boxes inside the trapboxes, which have plexiglass bottoms. Fish swim overtop a white teflon surface making identification easier.

A portion of the 2009 sockeye, chinook and chum salmon run was sampled to determine sex ratios, size distribution, age and DNA for sockeye (Table 1).

Table 1: Measurements and observations for sockeye, chinook and coho salmon in 2009.

Species	Sex	Fork Length (cm)	Post-Orbital Hypural Length (cm)	Snout Length (mm)	Ripeness	Kype	Scales
Sockeye	Yes	Yes	Yes	No	Yes	Yes	Yes
Chinook	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chum	Yes	Yes	No	No	Yes	Yes	Yes

Sampling consisted of trapping fish in viewing boxes by lowering trap doors from overhead. Once trapped, the fish were dip netted and placed in “V” troughs equipped with a hose and pump that constantly provide fresh river water to the trough. Fish were visually inspected to identify the presence of marks (e.g. adipose fin clip), determine sex and overall condition. Measurements were taken and observations made as listed in table 1. Sockeye scale samples were collected and forwarded to Birkenhead Scale Analysis (Lone Butte, B.C.) and chinook and chum scales were sent to the Pacific Biological Station (Nanaimo, B.C.). Once fish were sampled they were quickly returned to the trap boxes and allowed to swim upstream.

A manual stage gauge was used to measure river levels at the KSEF. Staff record water levels four times daily throughout the entire sampling period. Water stage data used in this report originates from manual recordings collected by KSEF staff between 2004-2009. This information is used to compare river water conditions from year to year and to observe the effects of these parameters on Kitwanga salmon migration.

5. RESULTS AND DISCUSSION

The Kitwanga River Salmon Enumeration Facility was rendered operational for the 2009 season on July 10th, which is a typical starting date for most years of operation. Salmon counting commenced on July 10th and aside from a high water event on September 21-22nd which prevented staff from counting fish, the fence operation continued uninterrupted until October 28th, 2009, for a total of 111 days. High water levels on September 21-22, forced the closure of the counting facility for a period of 36 hours, however no fish passed undetected and counting continued once waters receded to workable levels.

The fence was removed on October 28th in 2009, as fish movement past the fence had stopped and water levels were lower than normal, making removal relatively efficient and safe. Aside from 2004 when the fence was pulled prematurely on September 17th, the average removal date since 2003 was October 21st, making the removal date in 2009 a full week later than average.

Gitanyow Fisheries staff counted fish during daylight hours for a total of 111 days in 2009, and in total 576,645 salmon were enumerated at the facility, which is the highest enumeration record since the inception of the KSEF (Table 2). Fish encountered were identified by species while chinook salmon were further broken down as being either adults or jacks (adult males returning after only one year at sea). A total of 41 chinook jacks were enumerated in 2009 but were not included in the overall escapement reporting because they are not believed to significantly contribute to future chinook returns to the system.

Table 2: 2009 Kitwanga River salmon run timing and total escapement.

Species	Start of Run	Midpoint of Run	End of Run	Run Peaks (% of the total run by day)	Total Escapement
Sockeye	July 14	Sept 4	Oct 26	Aug 14 (6.4%), 18 (5.2%), 29 (4.0%), Sept 6 (4.5%), 12 (7.5%), 19 (12.4%), Oct 23 (2.0%)	3,047
Chinook	July 14	Aug 11	Sept 10	Aug 12 (14.1%) & 14 (16.5%)	824
Pink	Aug 1	Sept 8	Oct 17	Aug 19 (8.2%), 22 (5.1%), 25 (3.0%), 29 (3.3%), Sept 3 (4.2%), 7 (4.2%), 9 (3.7%), 11 (2.8%)	559,865
Chum	Aug 9	Sept 13	Oct 19	Sept 8 (4.5%), 12 (6.3%)	829
Coho	Aug 6	Sept 16	Oct 28	Sept 12 (8.9%), 19 (15.1%), 22 (9.5%), Oct 23 (17.2%)	12,080

Water levels in the Kitwanga River in 2009 averaged 0.70m (min. = 0.49m / max. = 1.30m), which compares quite closely to the 2004-2008 average of 0.74m (min. = 0.43m / max. = 1.40m). Water levels in early July of 2009 were slightly higher than the 2004-2008 average, and then remained close but slightly below the average from the first week of August until the first week of October when they decreased slightly at the time when typically flows increase. A normal flow spike from September 21-22, combined with high levels of pink salmon carcasses on the fence, caused counting to cease for 36 hours while crews maintained the fence. However, the fence remained unbreached and fish were kept downstream until water levels decreased enough to allow GFA technicians back into trap box areas to resume fish enumeration (Figure 2).

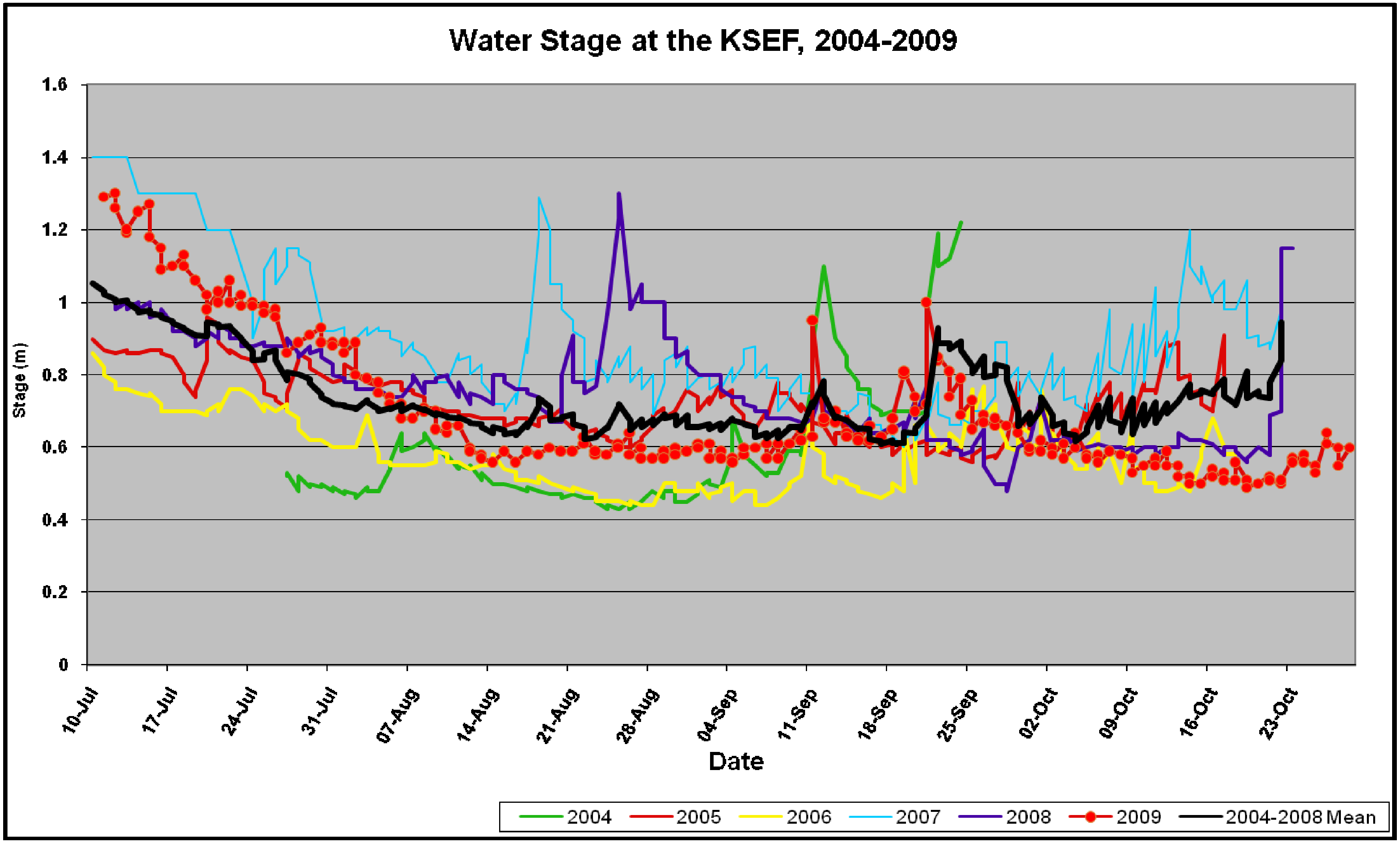

Figure 2: Water levels at the KSEF in 2009 compared to the average water levels from 2004-2008.

5.1 Sockeye Salmon

A total of 3,047 sockeye salmon were counted through the permanent fence in 2009. The 2009 escapement of 3,047 is 183% of the nine-year average of 1,666 since accurate enumeration of Kitwanga sockeye was initiated in 2000 (Figure 3). Previous escapement counts of Kitwanga sockeye were as follows:

- 1,200 in 2008 (Koch and Cleveland, 2009),
- 240 in 2007 (Cleveland, 2008),
- 5,139 in 2006 (Cleveland, 2007),
- 937 in 2005 (Kingston, 2006),
- 1,264 in 2004 (Cleveland, 2005),
- 3,377 in 2003 (Cleveland 2004),
- 971 in 2002 (Kingston and Cleveland 2003),
- 227 in 2001 (Cleveland 2002)
- 260 in 2000 (Cleveland and Kingston 2001).

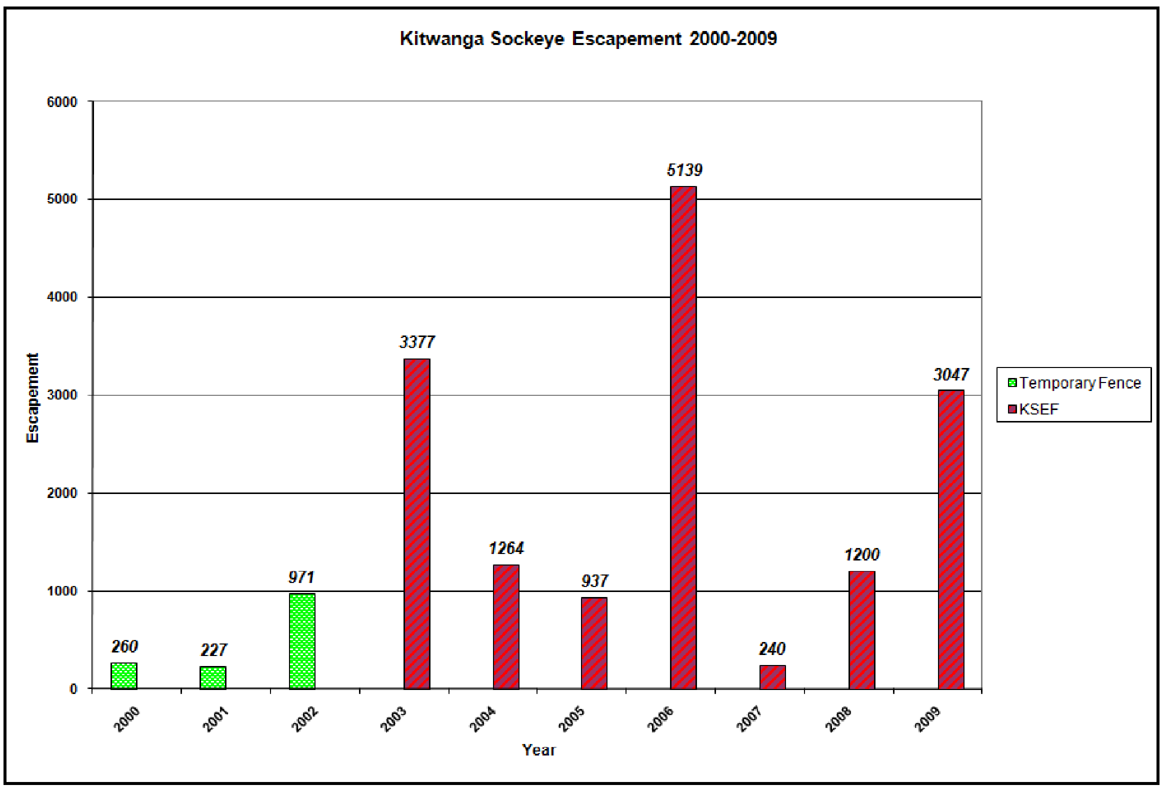

Figure 3: Sockeye escapements in the Kitwanga River from 2000-2002 as enumerated at the temporary fence downstream of Gitanyow Lake, and from 2003-2009 as enumerated at the KSEF.

In 2009, the first sockeye was enumerated at the KSEF on July 14th and the last sockeye migrated through the KSEF on October 26th. The midpoint of the run was approximately September 4th (Table 2). The Kitwanga sockeye run in 2009 was later to arrive than normal, but otherwise timing was fairly typical. The run had 7 significant pulses where relatively large percentages of the total run of fish migrated past the fence, including: August 14 (6.4%), August 18 (5.2%), August 29 (4.0%), September 6 (4.5%), September 12 (7.5%), September 19 (12.4%) and October 23 (2.0%) (Figure 4).

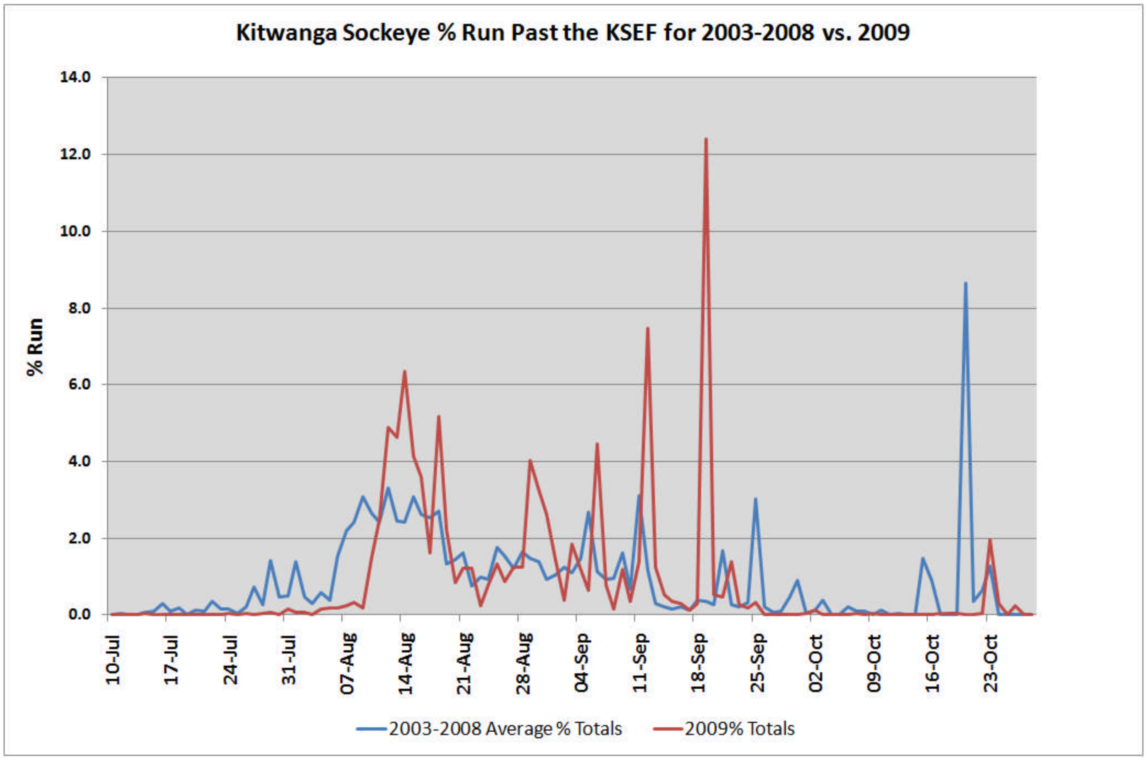

Figure 4: Kitwanga River sockeye salmon run timing expressed as percent daily run for 2009 versus the average from 2003-2008.

Random scale samples were collected from 13.0% (n=397) of the sockeye run in 2009. Of the 397 sockeye that were sampled, 372 were aged successfully, and of these, accurate ages were obtained for 326 sockeye. The remaining 45 fish (12.1%) could not be accurately aged because of scale resorption. These appeared to be European age 1.1, but were likely either 1.2 or 1.3 (Pers. Comm., Carol Lidstone, 2009).

The 326 sockeye which were successfully aged represented 10.7% of the 2009 run. The breakdown of age classes included 4 year old fish from the 2005 brood year (European age 1.2, n = 287 or 88.0%), 5 year old fish from the 2004 brood year (European age 1.3, n = 37 or 11.3% and European age 2.2, n = 1 or 0.3%), and 3 year old fish from the 2006 brood year (European age 1.1, n = 1 or 0.3%) (Lidstone, 2009). Of the 403 total sockeye that were sexed in 2009, 49.6% (n=200) were females and 50.4% (n=203) were males. From 2003-2008, females have been slightly more dominant than males with the female contribution to the return ranging from 52% to 63% (Cleveland 2008, Koch and Cleveland 2009).

Fork length measurements and ages were collected from a total of 323 sockeye in 2009. The fork length of only one 3 year old was measured at 42.0 cm, and the average fork lengths for 4 and 5 year old fish were 56 cm and 60 cm respectively (min. = 43cm / max. = 69 cm) (Table 3). On average male sockeye were larger than female sockeye for the 4 and 5 year old age classes for which we had averages, with low standard error and low relative standard error values (Table 3). As expected, younger fish were on average smaller than older fish.

Table 3: Mean, minimum and maximum fork lengths (cm) and standard error (SE) for 3, 4 and 5 year old sockeye from the Kitwanga River in 2009.

Sex	European age 1.1 (3 year old returning sockeye)					
	# Aged	Mean (cm)	Standard error	Relative standard error %	Min (cm)	Max (cm)
Females	1	42	NA	NA	42	42
Males	0	NA	NA	NA	NA	NA
Total	1	NA	NA	NA	NA	NA
Sex	European age 1.2 (4 year old returning sockeye)					
	# Aged	Mean (cm)	Standard error	Relative standard error %	Min (cm)	Max (cm)
Females	153	54	0.3	0.3	47	63
Males	132	57	0.3	0.5	43	69
Total	285	56	NA	NA	43	69
Sex	European age 1.3 (5 year old returning sockeye)					
	# Aged	Mean (cm)	Standard error	Relative standard error %	Min (cm)	Max (cm)
Females	16	58	0.6	1.0	54	62
Males	21	61	0.7	1.2	53	67
Total	37	60	NA	NA	53	67

5.2 Chinook Salmon

A total of 824 adult and 41 jack chinook salmon migrated past the KSEF in 2009, which was the lowest recorded escapement since the KSEF started operating in 2003 (Figure 5). The 2009 escapement was also lower than numbers recorded by stream walks and helicopter surveys in 2000, 2001, and 2002 during which fish were likely missed as the accuracy of the counts depended on water clarity, weather conditions and observer efficiency (Cleveland 2007). The 2009 chinook escapement was approximately 37% of the average escapement from 2003-2008, which was 2,236 fish. Previous counts of Kitwanga chinook were as follows:

- 1,450 in 2008 (Koch and Cleveland, 2009),
- 3,225 in 2007 (Cleveland, 2008),
- 3,014 in 2006 (Cleveland, 2007),
- 2,408 in 2005 (Kingston, 2006),
- 1,542 in 2004 (Cleveland, 2005),
- 1,776 in 2003 (Cleveland, 2004),
- 1,563 in 2002 (Kingston et. al., 2003),
- 1,307 in 2001 (McCarthy et. al., 2002) and
- 1,121 in 2000 (Hamelin et. al., 2001).

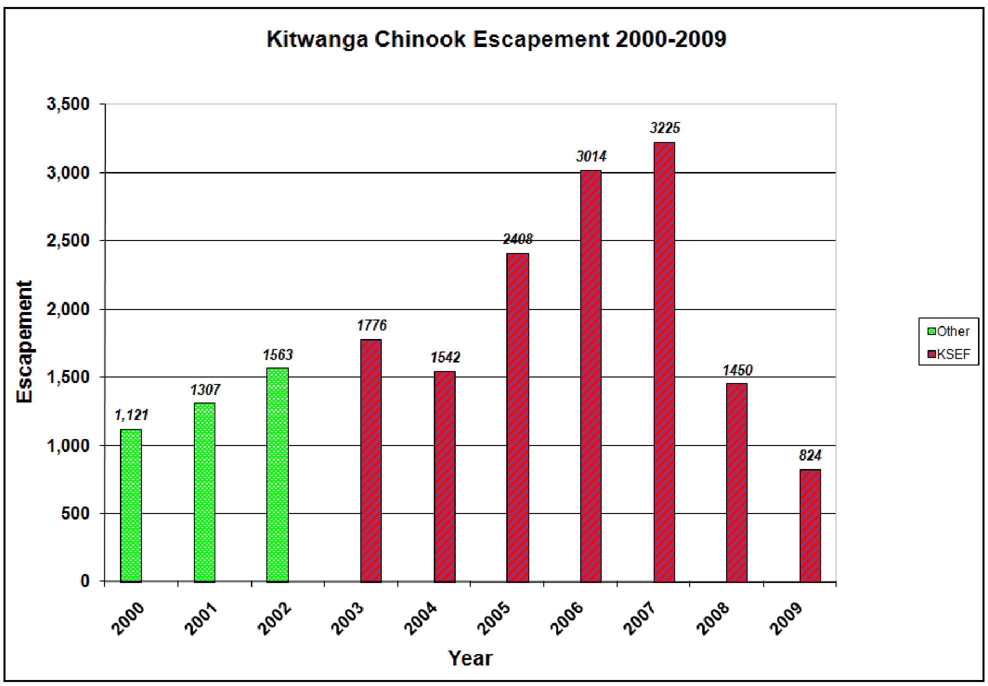

Figure 5: Chinook escapements in the Kitwanga River from 2000-2002 as enumerated by helicopter and ground surveys and from 2003-2009 as enumerated at the KSEF.

In 2009 the first chinook was counted at the KSEF on July 13th and the last one on September 10th. The mid-point of the run was August 15th and there were two distinct peaks: August 12th (14.1% of the total run) and August 14th (16.5% of the total run). In general, the run was later than the average timing from 2003-2008 (Figure 6).

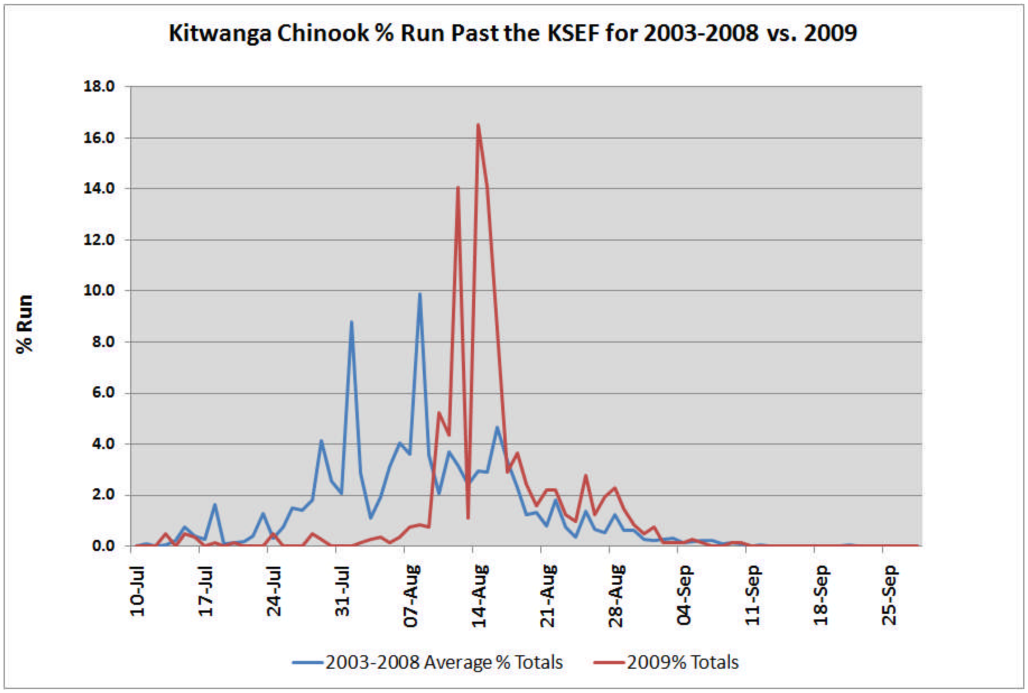

Figure 6: Kitwanga River chinook salmon run timing expressed as percent daily run for 2009 versus the average from 2003-2008.

Scale samples were collected from 137 chinook (16.6%) and from these, accurate ages were determined for 93 chinook (11.2%).

Of the 93 Kitwanga chinook that returned in 2009 that had readable scales, the breakdown of age classes included 5 year old fish from the 2004 brood year (European Age 1.3, n = 53 or 57.0%), 4 year old fish from the 2005 brood year (European Age 1.2, n = 22 or 23.7% and European Age 0.3, n = 5 or 5.4%), 6 year old fish from the 2003 brood year (European Age 1.4, n = 10 or 10.8%) and 3 year old fish from the 2006 brood year (European Age 1.1, n = 3 or 3.2%).

Partial ages were obtained from 40 samples, most of which had recognizable marine ages, however freshwater age could not be determined (n=37). Marine age followed a similar trend as noted above [marine age of 3 years (60%), followed by a marine age of 2 years (15%)]. The remaining samples were equally distributed, with marine ages of 1 year (10%, n=4) and 4 years (7.5%, n=3), while only 1 freshwater annulus was recognizable from the remaining 7.5% (n=3).

Of the 137 total chinook sampled in 2009, 38% (n=52) were females and 62% (n=85) were males.

Fork length measurements and ages were collected from a total of 84 chinook with readable scales in 2009 for 4, 5 and 6 year old fish, which were the dominant age classes with sufficient sample sizes for analysis. The average fork length for each age class was 72.6 cm, 89.6 cm and 93.0 cm for 4, 5 and 6 year old fish respectively (min. = 56cm / max. = 104 cm; Table 4). Within each age class, males were larger fish (Table 4).

Table 4: Mean, minimum and maximum fork length (cm) and standard error (SE) for 4, 5 and 6 year old chinook from the Kitwanga River in 2009.

Sex	European Age 1.2 (4 year old returning chinook)					
	# Aged	Mean (cm)	Standard error	Relative standard error %	Min (cm)	Max (cm)
Females	2	69	13.0	18.8	56	82
Males	20	73	2.3	3.2	56	96
Total	22	73	NA	NA	56	96
Sex	European Age 1.3 (5 year old returning chinook)					
	# Aged	Mean (cm)	Standard error	Relative standard error %	Min (cm)	Max (cm)
Females	22	89	1.2	1.3	76	100
Males	30	90	1.2	1.4	75	104
Total	52	90	NA	NA	75	104
Sex	European Age 1.4 (6 year old returning chinook)					
	# Aged	Mean (cm)	Standard error	Relative standard error %	Min (cm)	Max (cm)
Females	9	92	1.4	1.6	86	99
Males	1	102	NA	NA	102	102
Total	10	93	NA	NA	86	102

5.3 Pink Salmon

A total of 559,865 adult pink salmon migrated past the KSEF in 2009. Kitwanga pink salmon return in larger numbers in odd years compared to even years, therefore the 2009 run was expected to be relatively high. The 2009 return was 66% larger than the previous highest run recorded at the KSEF, since accurate counts were initiated in 2003 (Figure 7). Previous odd year pink salmon escapements to the Kitwanga River were as follows:

- 196,768 in 2007 (Cleveland, 2008),
- 229,226 in 2005 (Kingston, 2006),
- 336,375 in 2003 (Cleveland, 2004).

The first pink salmon was enumerated at the KSEF on August 1st, and the last fish was counted through on October 17th. The mid-point of the run was on August 28th and although there were several peaks, the most distinct peak occurred over a two-day period on August 19th and 20th, when 81,375 (14.6% of the total run) passed through the KSEF. The run started approximately 14 days later than the average from 2003-2008 (Figure 8).

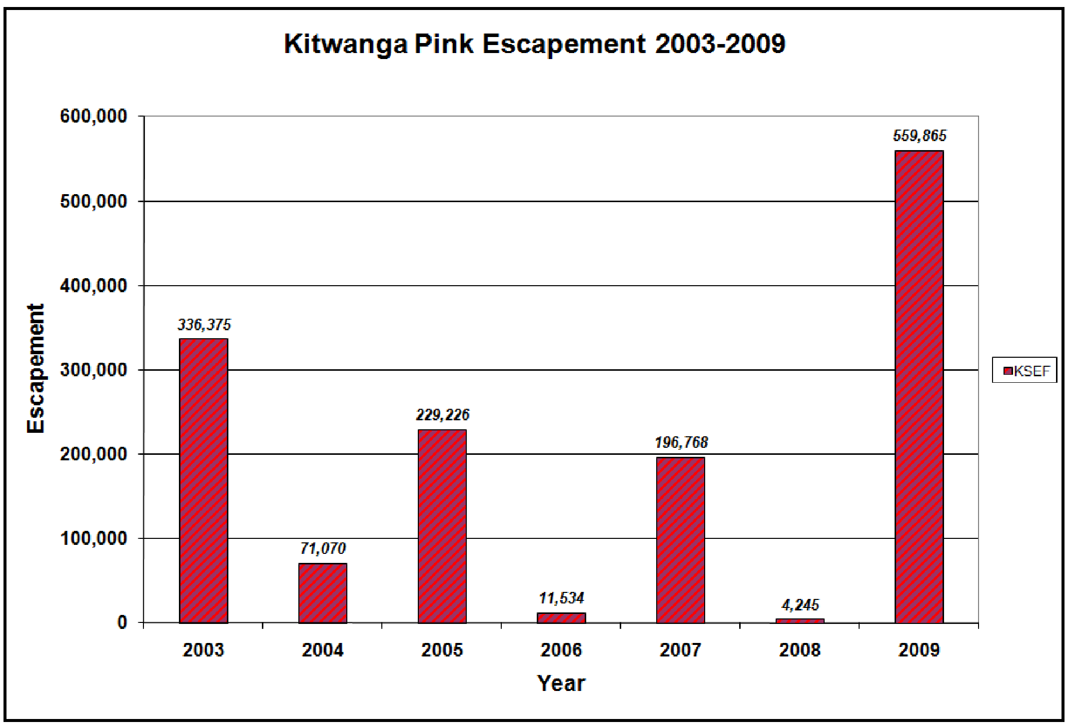

Figure 7: Pink salmon escapements in the Kitwanga River from 2003-2009 as enumerated at the KSEF.

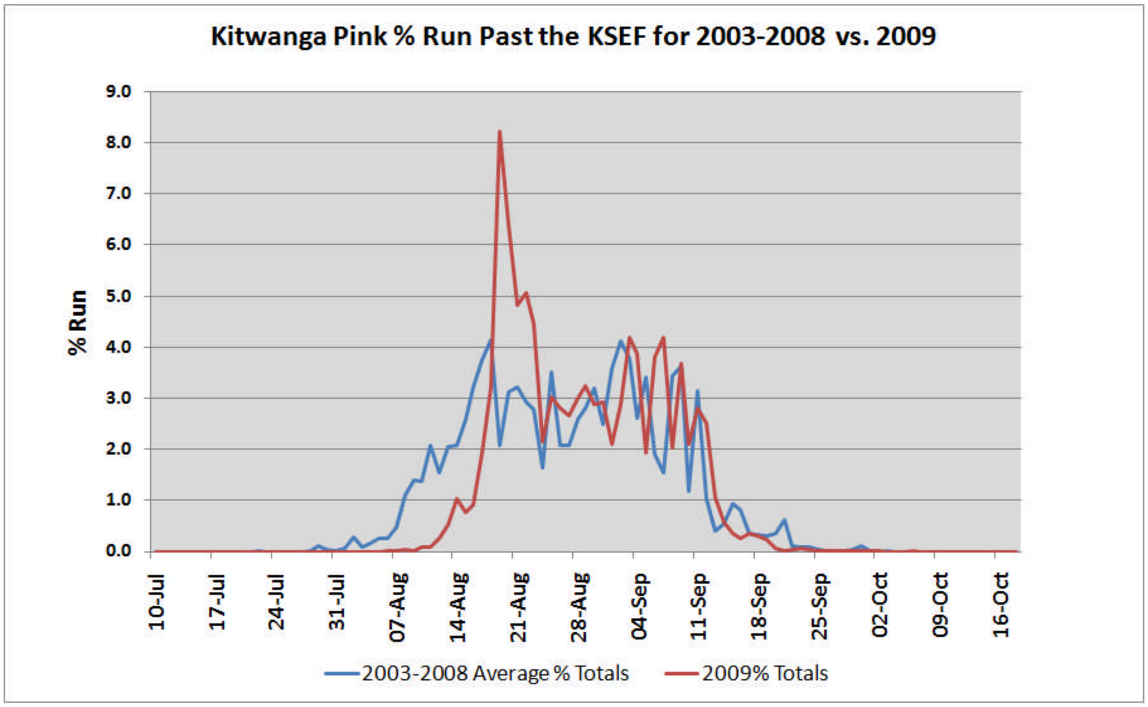

Figure 8: Kitwanga River pink salmon run timing expressed as percent daily run for 2009 versus the average from 2003-2008.

5.4 Chum Salmon

A total of 829 chum salmon migrated past the KSEF in 2009. This escapement is an improvement over the 2008 return (150 fish), and the 2007 return (354 fish), which were the lowest recorded returns since the KSEF was established in 2003 (Koch and Cleveland, 2009). However, the 2009 Kitwanga chum escapement was still only 81% of the average from 2003-2008, which was 1,028 fish. Kitwanga River chum salmon escapements for the previous six years were as follows (Figure 9):

- 150 in 2008 (Koch and Cleveland, 2009),
- 354 in 2007 (Cleveland, 2008),
- 685 in 2006 (Cleveland, 2007),
- 1,862 in 2005 (Kingston, 2006),
- 1,169 in 2004 (Cleveland, 2005),
- 1,775 in 2003 (Cleveland, 2004).

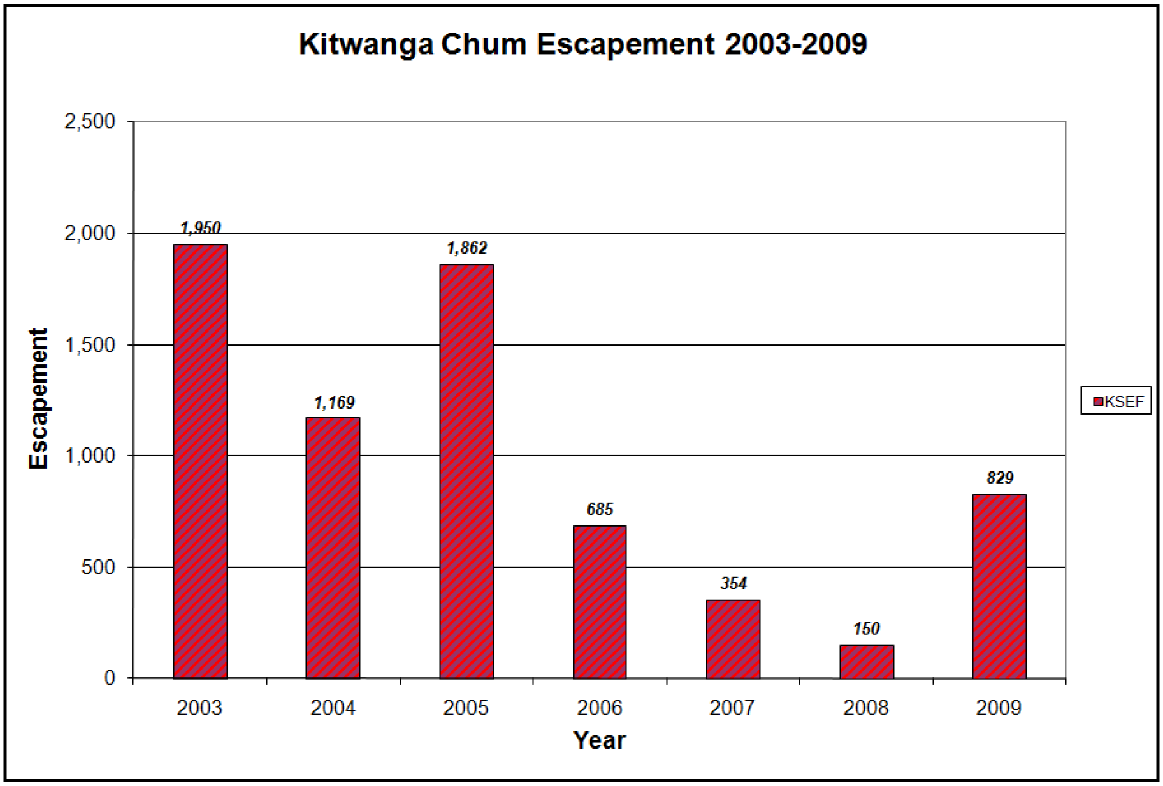

Figure 9: Chum escapements in the Kitwanga River from 2003-2009 as enumerated at the KSEF.

In 2009, the first and last chum salmon were enumerated at the KSEF on August 9th and October 19th respectively. The mid-point of the run was on September 9th and one distinct peak was observed over a six-day period when 270 chum passed through the KSEF from September 7th to 12th (33% of the total run). The start of the Kitwanga chum run in 2008 was 10 days later than the average from 2003-2008 (Figure 10).

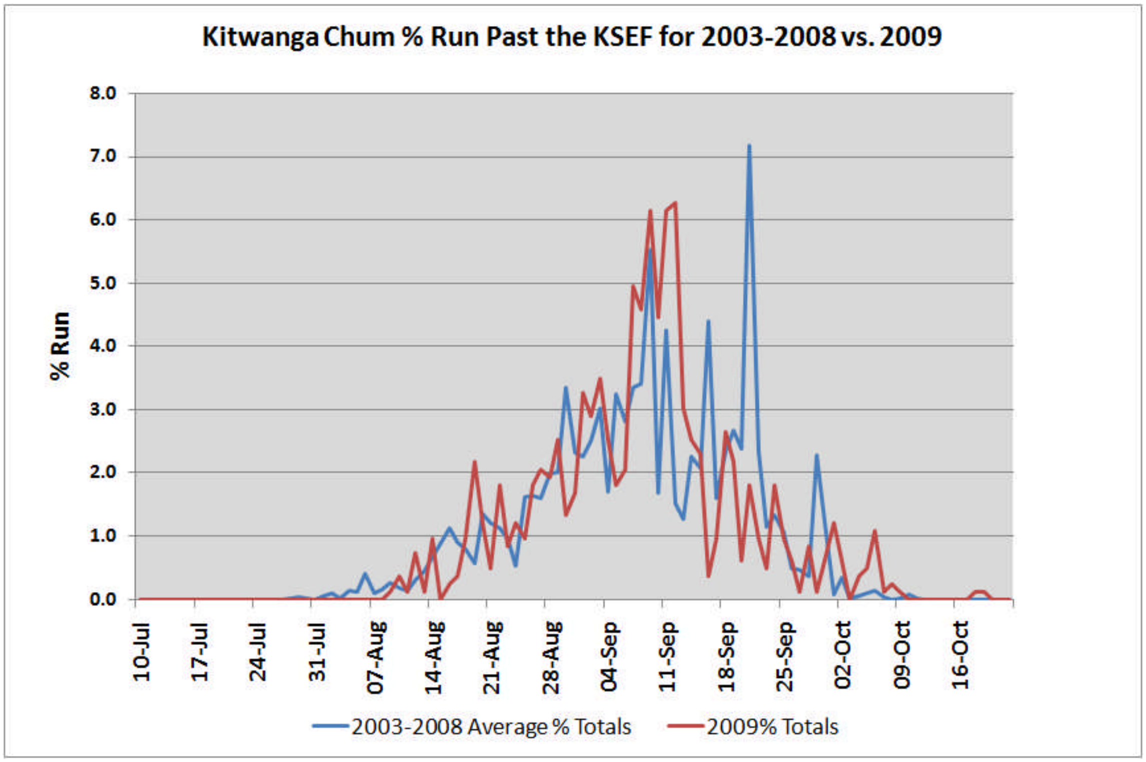

Figure 10: Kitwanga River chum salmon run timing expressed as percentage daily run for 2009 versus the average from 2003-2008.

Scale samples were collected from 218 chum (26.3% of the run) and from these, accurate ages were determined for 212 chum (25.6% of the run). GFA's goal was to collect accurate ages on at least 10% of the run, which was achieved in 2009.

Of the 212 Kitwanga chum that returned in 2009 that had readable scales, 4 year olds (European Age 0.3 from the 2005 brood year) comprised by far the largest percentage of the run at 95.8% (n=203), followed by 5 year olds (European Age 0.4 from the 2004 brood year) at 3.3% (n=7), while 3 year old fish (European Age 0.2 fish from the 2006 brood year) made up 0.9% of the run (n=2).

Of the 218 total chum sampled in 2009, 38% (n=127) were females and 62% (n=91) were males.

Fork length measurements and ages were collected from a total of 206 chum with readable scales in 2009, with the average fork lengths for 3, 4 and 5 year old fish being 69 cm, 74 cm and 74 cm respectively (min. = 55 cm / max. = 91 cm; Table 4). Within each age class, males were larger fish (Table 5).

Table 5: Mean, minimum and maximum fork lengths (cm) for 3, 4 and 5 year old chum sampled in the Kitwanga River in 2009.

Sex	European Age 0.2 (3 year old returning chum)					
	# Aged	Mean (cm)	Standard error	Relative standard error %	Min (cm)	Max (cm)
Females	2	69	1.5	2.2	67	70
Males	0	NA	NA	NA	NA	NA
Total	2	69	NA	NA	67	70
	European Age 0.3 (4 year old returning chum)					
	# Aged	Mean (cm)	Standard error	Relative standard error %	Min (cm)	Max (cm)
Females	112	72	0.5	0.7	59	88
Males	84	76	0.7	1.0	62	90
Total	196	74	NA	NA	59	90
	European Age 0.4 (5 year old returning chum)					
	# Aged	Mean (cm)	Standard error	Relative standard error %	Min (cm)	Max (cm)
Females	5	72	3.0	4.1	63	79
Males	2	79	2.0	2.3	87	91
Total	7	77	NA	NA	63	91

5.5 Coho Salmon

A total of 12,080 coho migrated through the KSEF in 2008. This escapement is 390% of the average since 2001 (3097 fish) and 400% of the average since the KSEF was initiated in 2003 (3007 fish). Previous recorded escapements to the Kitwanga River were as follows (Figure 11):

- 2,882 in 2008 (Koch an Cleveland, 2008),
- 2,780 in 2007 (Cleveland, 2008),
- 2,566 in 2006 (Cleveland, 2007),
- 7,100 in 2005 (Kingston, 2006),
- 690 in 2004 (Cleveland, 2005),
- 2,022 in 2003 (Cleveland 2004),
- 3,515 in 2002 (Kingston, 2003),
- 3,226 in 2001 (Cleveland, 2002).

The coho escapement results from 2001 and 2002 were recorded during stream walks of the entire Kitwanga River, while results from 2003 to 2008 were recorded at the KSEF. It should be noted that coho escapement results from 2003 and 2004 are probably under-estimated given that the fence was submerged for a portion of the coho salmon sampling period in both years.

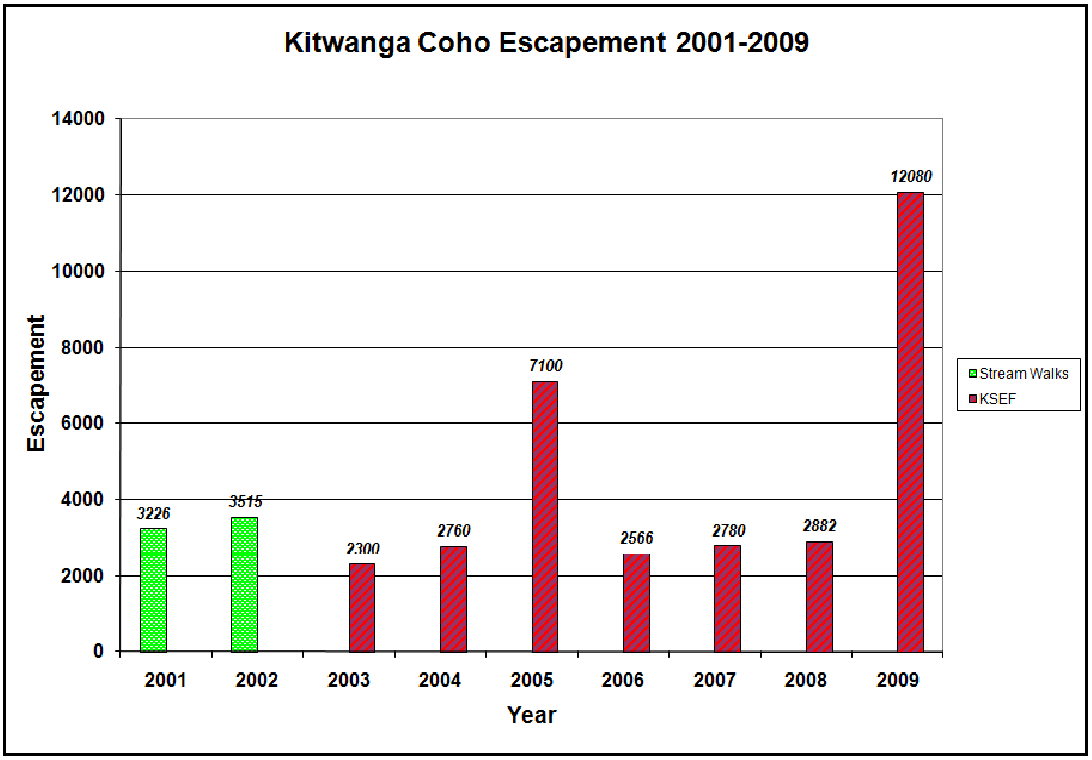

Figure 11: Coho escapements in the Kitwanga River from 2001-2002 as enumerated by conducting stream walks of the anadromous portion of the Kitwanga River and from 2003-2009 as enumerated at the KSEF.

In 2009, the first coho salmon arrived at the KSEF on August 6th and were still passing in low numbers when the KSEF ceased operation on October 28th (Figure 12). The mid-point of the run was September 19th, and there were four very distinct peaks on September 12th (8.8 % of the run), September 19th (15.1% of the run), September 22 (9.4% of the run) and October 23rd (17.2% of the run). In 2009, the timing difference compared to previous years was shown by the lack of coho moving through from September 22nd to October 22nd, followed by the large, late pulse of coho on October 23rd. This lack of fish movement was also observed in 2008 within a similar time frame. Abnormally low water levels during this period both in 2008 and 2009 may have resulted in Kitwanga coho holding in the Skeena River near the mouth until a significant rainfall event occurred.

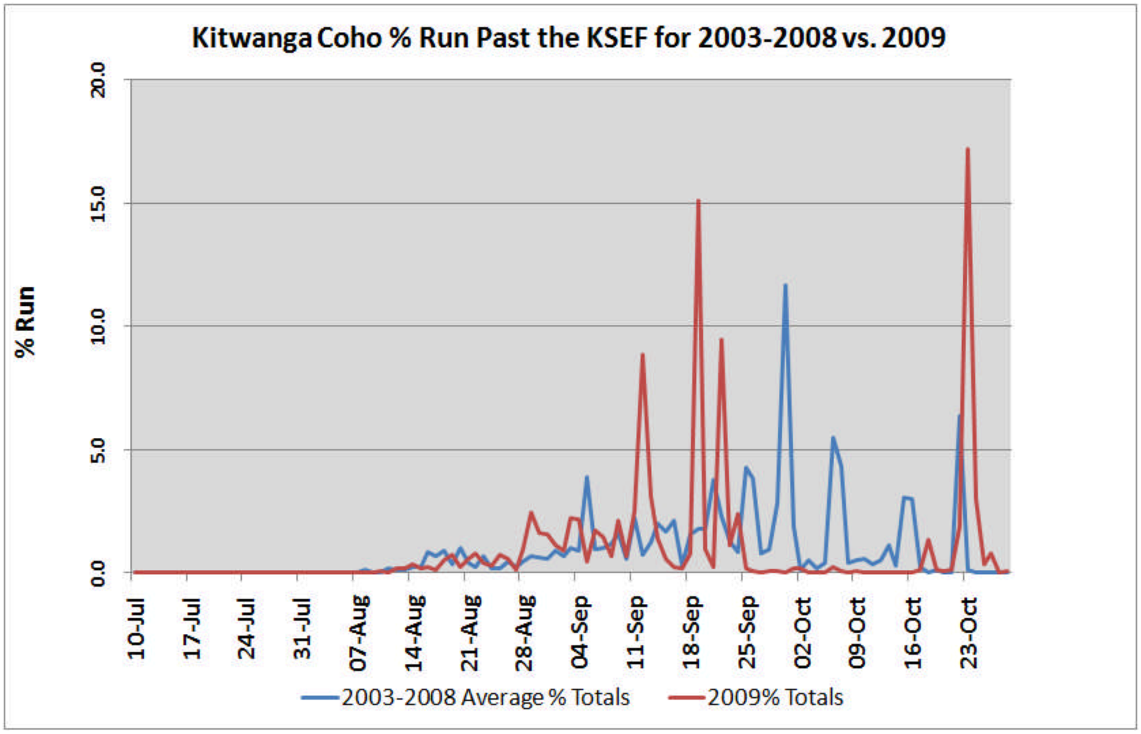

Figure 12: Kitwanga River coho salmon run timing expressed as percentage daily run for 2009 versus the average from 2003-2008.

6. CONCLUSIONS AND RECOMMENDATIONS

The Gitanyow Fisheries Authority successfully operated the KSEF again in 2009, collecting escapement and biological information for sockeye, chinook, pink, chum and coho salmon. This marks the 7th consecutive year of operation for the KSEF, and the 10th consecutive year of overall escapement monitoring of Kitwanga River salmon by GFA.

6.1 Sockeye Salmon

The sockeye escapement to the Kitwanga River of 3,047 in 2009 was considered poor in comparison to historical levels. However, considering an estimated 88% of the 2009 return were from the 2005 brood year, where 937 fish escaped, there was close to a 3:1 ratio for brood replacement, indicating relatively good survivals.

Of the 326 sockeye accurately aged, four-year old fish made up the bulk of the return at 88.0% (n=287), followed by five-year old fish at 11.3% (n=37) and three-year old fish at 0.3% (n=1). From 2002-2006 and in 2008, four-year old sockeye made up a very high proportion of the annual return to the Kitwanga River, however in 2007 this was not the case, with five-year old fish comprising 68%, followed by four-year and three-year fish at 22% and 11% respectively (Cleveland, 2008). The high proportion of four-year old returns in 2009 therefore represents a return to previously observed age ratios.

6.2 Chinook Salmon

The chinook escapement of 824 in the Kitwanga River in 2008 was 37% of the average from 2003-2008, is considered poor, and is the lowest on record since 2001.

Of the 93 chinook accurately aged, five-year old fish made up the bulk of the return at 57.0% (n=53), followed by four-year old fish at 23.7% (n=22) and six-year old fish at 10.8% (n=10). This trend is very similar to results obtained from the 2008 run (Koch and Cleveland, 2009), however a long-term age structure data set is not available for Kitwanga chinook for further comparison at this time. In comparison to sockeye and chum in the Kitwanga, chinook are more difficult to accurately age because chinook exhibit a higher degree of scale resorption (Lidstone, 2009). The value of obtaining age structure information for Kitwanga chinook is high, therefore some recommendations are to 1) maintain the collection of scales from at least 10% of the annual run and 2) develop a system whereby a proportion of the chinook that have had scales taken are collected from spawning grounds (post-spawn) to obtain otolith samples for verify ages obtained from scales. Ages from otoliths can be considered more accurate than from scales (Lidstone, Pers. comm., 2009).

Male chinook made up the largest proportion of the 2009 chinook return to the Kitwanga, comprising 62% of the 137 chinook sampled, while females made up 38%. The continuation of sex identification is important to determine long-term trends in sex ratios for Kitwanga chinook.

Most importantly for Kitwanga chinook is to continue to enumerate the run annually, and if the low returns continue, such as were experienced in 2008 and 2009, to reconsider the current fisheries management regime for that run.

6.3 Pink Salmon

The pink salmon return of 559,865 fish to the Kitwanga River in 2008 was by far the highest on record. Pink salmon in the Kitwanga are odd-year dominant, so a large run was expected.

Pink salmon in the Kitwanga have showed consistent declines in escapement in both the even and odd year classes, since the KSEF was established in 2003, therefore the 2009 return is an encouraging sign that the stock may be starting to recover. However, several more years of escapement data will show if recovery is actually occurring.

6.4 Chum Salmon

Chum salmon returns to the Kitwanga River in 2009 of 829 fish were an improvement over the two previous years which were lowest ever recorded since the KSEF became operational in 2003 (150 fish in 2008 and 354 fish in 2007). However, the 2009 return was still below the average (81%) from 2003-2008.

There are three key recommendations for Kitwanga chum salmon. The first is to continue monitoring chum escapements in the Kitwanga River, which echoes DFO's assessment priorities for 2009 which are to increase monitoring coverage for chum in Areas 3 and 4 (Cox-Rogers, 2008). The second is to obtain more scale samples from Kitwanga chum salmon, in order to obtain a better picture of the age structure of the run. The third is to provide further protection for chum salmon in the marine environment, specifically to address and remedy the late timing issue with pink salmon fisheries (Peacock, 2009).

6.5 Coho Salmon

The coho salmon return of 12,080 coho that migrated through the KSEF in 2009 was approximately 4 times greater than the average since 2001 (3097 fish). As Kitwanga coho are generally three-year old fish (European Age 1.1), the brood year for the 2009 returns was 2006, where 2566 fish returned (4.7:1 replacement), indicating good survival for the progeny of the 2006 brood year.

In general, of all the species that spawn in the Kitwanga, coho appear to have the most stable population since the KSEF became operational in 2003. The exact reason(s) for this is unknown at this time, but is possibly related to marine fishery management, as well as the increased access to spawning and rearing areas provided in the upper Kitwanga River, starting in the fall of 2002. As with the other salmon species that spawn in the Kitwanga River, continued monitoring of coho escapements is the key to gauging the stability of the run.

In summary, salmon escapement results collected through the operation of the KSEF in 2009 are important because they allow for the evaluation of population trends of Kitwanga and Skeena River salmon stocks, provide information on run timing and allow for the collection of biological information such as lengths, sex ratios, condition and age structure. The information currently gained is used in-season and post-season by Federal and First Nations fishery managers to better implement sustainable fisheries. The escapement and age structure information collected on Kitwanga sockeye salmon are especially important because adult escapement data is a direct measure of the health of the stock and the effectiveness of the GFA Kitwanga sockeye rebuilding efforts, and the age structure information helps assess the survival of certain brood years. The *Kitwanga Sockeye Salmon Recovery Plan*, developed by GFA, DFO and the Skeena Fisheries Commission in 2006, listed adult enumeration of sockeye as one of the highest priorities for rebuilding the stock.

The trend in BC since the 1950's has been towards a sharp decline in escapement monitoring for all salmon species, and shows that salmon runs which did not meet escapement targets and were historically small, have been eliminated with higher frequency from DFO's monitoring programs (Price et al., 2008). Kitwanga sockeye, along with other sockeye that rear in lakes in B.C., are identified as a distinct Conservation Unit (CU) under DFO's Wild Salmon Policy (Cox-Rogers, Pers. comm., 2009), and the other Kitwanga salmon species would fall within broader CU's. The foundation for assessing the status of CU's can only be made strong by obtaining consistent information of spawner abundance and distribution (Holt, DFO, 2008). Although there are various ways this could be achieved, the KSEF is now well established, cost efficient and provides absolute escapement numbers. Combined with the Kitwanga smolt fence, this monitoring system is arguably one of the more robust for sockeye in BC.

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