# 2015 Taseko River Dual-frequency Identification Sonar (DIDSON) Feasibility Study

**March 2016**

**Project Partners:**

**Tsilhqot'in National Government**

**Upper Fraser Fisheries Conservation Alliance**

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## Introduction

The Tsilhqot'in National Government (TNG) and Upper Fraser Fisheries Conservation Alliance (UFFCA) have been strong advocates for researching and protecting the Taseko River and the salmon species that return to its watershed. A significant portion of the Taseko River is within the "Caretaker Area" defined by the Williams Case and entirely within the Tsilhqot'in Traditional Territory. Previously proposed resource development such as Prosperity and New Prosperity presented a risk to salmon populations in the Taseko watershed; the extent of the risk was unknown due to existing knowledge gaps of salmon populations utilizing the watershed. As a result of these issues, combined with the understanding that the Taseko River is classified as both a data poor conservation unit (floating carcass count only) and a "Red Zone" Sockeye Conservation Unit under DFO's Wild Salmon Policy, TNG and the UFFCA partnered to improve upon the Taseko River salmon information that will better inform First Nations and fisheries management.

The mentioned knowledge gaps for Taseko salmon include: adult return estimates, migration timing, inventory of salmon stock and associated life histories, as well as migratory behaviours.

To initiate the process of filling knowledge gaps, implementation of alternative methods of adult salmon enumeration which could improve upon the adult sockeye carcass counts and historical information about adult Chinook presence were discussed between project partners (TNG and UFFCA) and DFO. The challenges in adult salmon enumeration in the Taseko watershed are significant: The Taseko River and lakes are nearly-opaque glacial-origin systems that preclude standard visual enumeration techniques. The river is volatile, with very limited road access throughout its course. In 2012, the project partners (and DFO) discussed the various challenges presented by the Taseko system, and implementation of a Dual-frequency Identification Sonar (DIDSON) feasibility project was determined to be the most viable solution to address the challenges. In spring 2013, the TNG and UFFCA conducted a field site evaluation of the proposed DIDSON site identified by the UFFCA, TNG and DFO via helicopter in 2012.

In 2013 and 2014, a single Long Range DIDSON unit was deployed on the east side (river right) of the Taseko to test the feasibility, suitability and effectiveness of DIDSON enumeration methodology in the Taseko system; which has few possible locations within the watershed due to the extremely remote and limited access to the river and turbulent nature of the river hydrology. The 2013 and 2014 projects were conducted with the main objective of testing and developing the identified DIDSON site in order to determine the feasibility of operating a DIDSON in that location for the entire sockeye migration period.


**Figure 1. General map of the area**

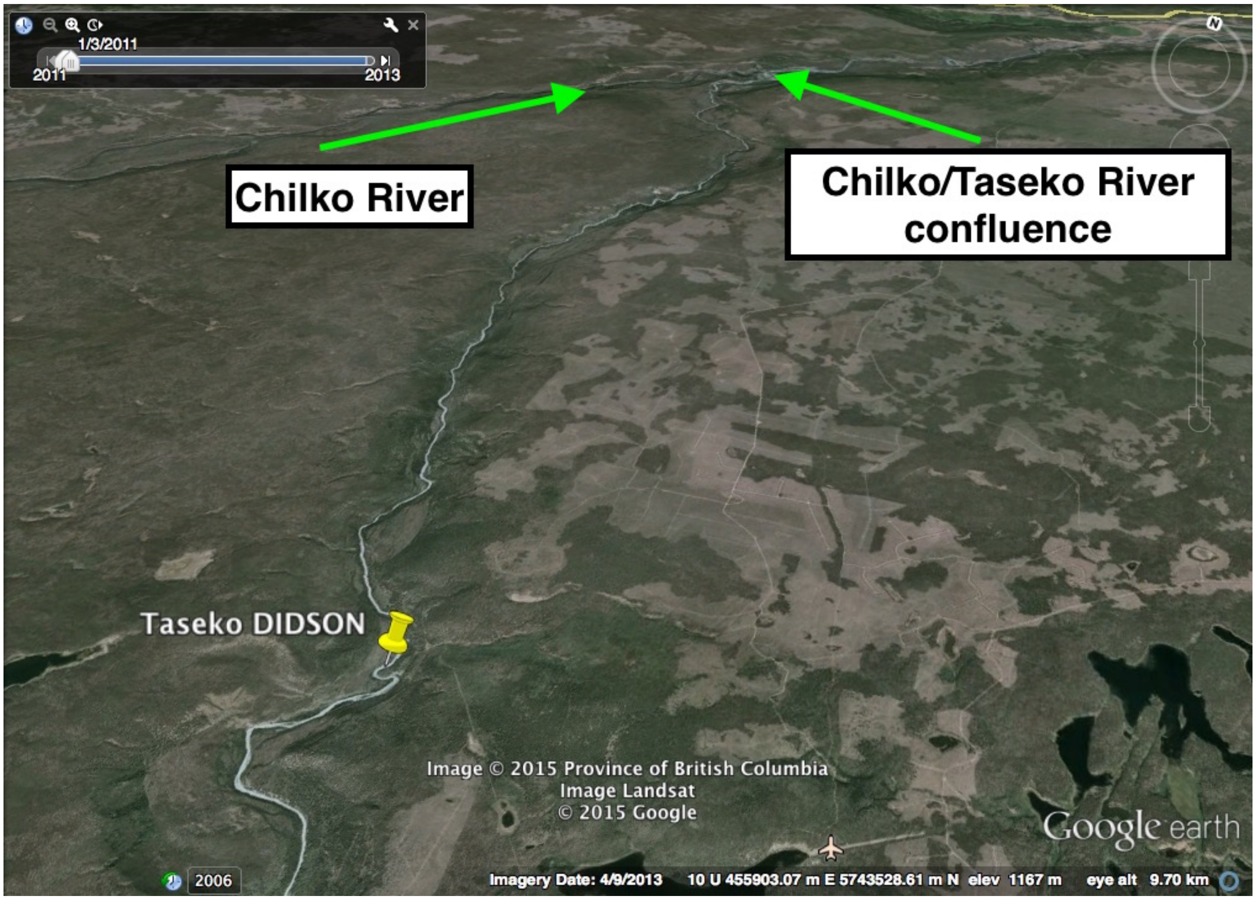


Figure 2. Taseko DIDSON site location

The 2014 Taseko DIDSON project met all five of its objectives, including full system operation for almost two weeks, and the installation of a deflection weir to force migrating salmon through the ensonified DIDSON window. Analysis of the 2014 data and a subsequent allocation of the minimum financial resources necessary allowed for continued research at the Taseko site in 2015.

The methods, results and recommendations from the 2013 and 2014 projects were compiled in separate reports to the TNG and UFFCA, which are available upon request.

## Project Overview and Objectives

The continual progress and knowledge base, established in the 2013 and 2014 Taseko River DIDSON projects, guided the implementation of the 2015 project. The 2015 project focused on attempting to match the methods utilized by the UFFCA, NSTC and DFO (with a limited budget and feasibility/research objectives) with the methods and procedures detailed in the Quesnel River DIDSON projects from 2009 and 2010[1].

The Taseko DIDSON is a relatively small project geared towards developing the utilization of DIDSON technology for the purposes of enhancing salmon enumeration information on the Taseko, and supporting the long term goal of producing higher quality information on peak run timing and relative population abundance of sockeye and Chinook stocks returning to the watershed. It should be noted this project is still in a feasibility and research stage, and cannot be considered a complete and defensible population enumeration for Taseko sockeye or Chinook.

The Taseko DIDSON site has been selected based on several site/project criteria outlined in published DIDSON enumeration literature: accessibility, health & safety, river hydrology, river bank depth/slope, salmon behaviour in the project area, and options for future site improvements (Reference Holmes et al. Refer to Appendix 1).

The overall goal of the 2015 project was to complete a DIDSON project that met the following objectives and established the Taseko DIDSON project as an integral and annual component of Taseko salmon assessment. The 2015 project objectives were as follows:

1. To build capacity and strengthened partnerships with local First Nations through improved communication and employment of Xeni Gwet'in technicians
2. To continue to improve the DIDSON deployment site and the field camp/office
3. To establish a single continuous DIDSON deployment at the site
4. To improve on data collected in 2013 and 2014, and – if possible – test a second DIDSON unit on the opposite bank to assess salmon passage occurring outside the ensonification window of the primary DIDSON
5. To identify peak migration timing for sockeye
6. To determine the feasibility of utilizing DIDSON for identifying Chinook and peak run timing for that species

## Materials and Methods

### Field Site Location

The Taseko DIDSON project is located at the end of a forestry spur road branching west off the 7000 Rd (Chilko–Whitewater Road) at kilometer 37. The road had been deactivated several years prior to the 2013 Taseko DIDSON project, which required significant excavator work and brushing to re-establish vehicle access to the designated field camp site. Due to budget constraints, vehicle access to the field camp was not completed until 2015.

[1] Upper Fraser Fisheries Conservation Alliance (UFFCA). 2010 & 2011.

The field camp is located on a natural bench above the Taseko River, which provided a protected area for all camp/office structures. Shortly after the field camp was established, a semi-permanent outhouse structure was constructed and tarped tree-framed computer office and a kitchen shelter were constructed.

The DIDSON site is located at UTM Zone 10U Easting 454664.00m Northing 5739077.00m.

**Project Timeframe**

Field camp setup and DIDSON installation were completed from July 23, 24 and 27th, 2015. DIDSON operations and data collection were initiated on the afternoon of July 28th, 2015 and ran 24/7 (exceptions are noted in subsequent section) through to September 6th, 2015.

**Project Personnel**

The DIDSON project crew consisted of the UFFCA Habitat Biologist (Shamus Curtis), and two full-time fisheries technicians from Xeni Gwet'in (Trevanian William and Rocky Quilt). Project Management and Technical Direction was provided by the UFFCA Resource Management Biologist (Pete Nicklin). Paul Grinder and Randy Billyboy (Tsilhqot'in National Government) oversaw project logistics, budget management, field technician hiring, site access and field camp site completion, community communications and local knowledge.

## Project Materials

1. Laptop Computers
2. Spot satellite phone
3. Waterproof handheld radios
4. Tents and sleeping materials
5. Tarps for Kitchen and Office
6. Tree poles for frames
7. Construction materials for outhouse
8. Power bars and extension cords
9. Tables and chairs
10. Cooking and food storage equipment
11. 12-foot zodiac boat with outboard and trailer
12. Two Honda Generators (model 2000)
13. Jerry cans and fuel for generators
14. Deflection Weir (standard aluminum dowel/panels, snow fence, ½" rebar, angle iron)
15. Construction tools
16. Sasha DIDSON track Mount (see Figure)
17. DIDSON Ladder Mount (to be used for second DIDSON deployment)
18. Water temperature thermometer

19. High Frequency long range DIDSON unit (for backup and testing of River Left site)
20. High Frequency short range DIDSON unit (main DIDSON unit on River Right)
21. 150’ standard DIDSON data & power cable
22. 2 - 1 TB External Hard Drives
23. Handheld tally counter
24. Secchi Disk

The laptop computer, controlling the acoustic systems was housed in a dedicated “office” workspace constructed of opaque tarps stretched over a wood frame located on the top of bank in the general worksite away from the river shore. Additional laptops were used as a dedicated DIDSON file review station, along with external hard drives for complete backups of all recorded files. Power for the DIDSON and the computers was provided by a small Honda generator, which was operational for the entire project.

**Methods**

DIDSON Unit Installation

Overall, the DIDSON site required little improvement from the prior year during the setup of the deflection weir and DIDSON Sasha mount, as the site and DIDSON viewing window were clear of rocks and debris; a result of efforts to improve the site in May of 2015 during the low water conditions preceding the high elevation melt. The addition of a fish deflection weir in 2014 made for a better and safer work site, as well as improving the DIDSON window by preventing migrating salmon from swimming inside of the DIDSON “blind zone”. Installation of a deflection weir is a standard approach used in other DIDSON projects and was extended to an adjustable distance of approximately 5 to 8 meters into the river, allowing for extension/retraction as the water fluctuated throughout the field operations. The DIDSON unit was installed on the upstream side of the deflection weir, and protected from upstream debris by a hand-constructed partial rock weir 2 meters upstream from the Sasha Mount. The rock weir also decreased the water turbulence around the DIDSON unit, for increased clarity of image viewing (see Appendix 1: Photo 8).

The 2015 project utilized a specifically designed “Sasha Mount” for holding and adjusting the DIDSON unit. The Sasha Mount is tracked and fully adjustable aluminum frame that allows the DIDSON to be moved further into the water or back out of the water as the river fluctuates, rebar anchors the mount to the river bed. Further aiming adjustments can be fine-tuned in all planes of aiming (up-down horizontal, left-right, angled up and down – tilting). This mount is a major improvement in utility and function compared to the traditional ladder mount used in 2013 and 2014 (see figure 3).

Figure 3. Sasha Mount

The high frequency short range DIDSON unit was aimed according to procedures outlined in reference literature:

- DIDSON was placed in the installed Sasha Mount with top approximately 2cm above water level
- DIDSON aiming downward angle of approximately -6 degrees with the DIDSON aimed to view outward end of diversion fence within the lower right portion of the viewing window.
- DIDSON was also angled 15 degrees downstream to prevent feedback from the rock cliffs on the far shore.
- Using these aiming settings, the DIDSON beams ensonified the entire area within the 20m window length.
- The upstream/downstream boundaries of detection were confirmed safely even in the strong currents using a spinning rod and salmon analog (2L pop bottle filled with tinfoil, rocks and water).
- The viewing window was set at 10 meters with a window start at 2 meters for a total viewing window of 12 meters from the DIDSON unit. This window length was chosen based on 2014 data showing vast majority of salmon migration within the 12-meter distance from the DIDSON.
    - On August 27, 2015 at 18:00 the 60 minute files were split into 40 minutes at 10 meter and 20 minutes at 20 meters. This was in response to suggestions from DFO.
- The DIDSON unit was powered by a standard topside box connected to the 150’ DIDSON cable and laptop computer.

## Acoustic Data Collection

A single high frequency short range DIDSON unit was used for data collection, operating at a 10m window with a window start length of 2 meters, and a frame rate 8 frames per second in high frequency mode (1.8 MHz) for the first 30 minutes of every hour from 19:00 July 28th till 11:00 July 29th, 2105; starting at this time the recording was extended to 40 minutes (800mb of data/40 minutes), while maintaining the same recording window and settings. On August 21st, 2015 at 14:00 the file length was further extended to a full 60-minute (1.4GB of data/60-minutes) recording as recommended by DFO.

Following a site visit by DFO on August 25th, 2015, additional changes in the recordings were adopted on August 27th at 18:00. This change split the 60-minute recording into two parts, a 40 minute 10-meter recording and a 20 minute 20-meter recording. The 20-meter window was used to determine if the 10-meter window was missing salmon as the water levels dropped. These split files continued till a generator failure caused the crew to revert to 60 minute, 10 meter files on the 31st of August at 14:00 for the remainder of the project. The field of view for all the recordings was 14º vertical and 29º horizontal.

The DIDSON software was programed to create new files (time and date stamped) for each recording automatically at the start of every hour, with the exception of the split 40/20 files, which generated 2 files for every hour: one at the start of every hour and the second file (XX:41) started at the 40-minute mark of every file and continues till the end of that hour.

All the recordings, programming and post-processing of fish counts were conducted using version 5.25.53 of the DIDSON operating system software (Sound Metrics Corporation 2013). Due to the number and size of files being created the data were recorded directly to an “always on and always connected” 1Tb external hard drive. To ensure data security a system was set in place to back up all the recordings to a second 1Tb external drive each morning.  Thus ensuring that minimal data would be lost if something was to happen to the connected hard drive.

## DIDSON Fish Counting

DIDSON files were recorded every hour of the day for forty days. Subsequently, these files were counted manually; using a hand held counter (tally whacker) the numbers of upstream and downstream fish were recorded on a spreadsheet. All the recordings were slowed to a play back speed of 65 frames per second (fps), and a sample of the files were counted twice.

The spreadsheet was designed to calculate the net upstream count and used the same time expansion formula outlined in the Quesnel 2010 DIDSON paper to extend the counts for an estimated hourly count.

Hour expansion formula: E= (X*60 min)/ (file length)

E= the expanded count
X= the number of salmon counted in the file

Power failures occurred on occasion that resulted in a few consecutive hours of data being missed within the data set. These data gaps were interpolated using data averaged from the previous and subsequent day's migration, as outlined in the Quesnel 2010 DIDSON paper.

The count data and the following expansions generated by this project can only provide information on the estimated passage of salmon on the right bank. A full enumeration cannot be assumed from this data, it is representative of river right bank passage and is intended as an index of salmon abundance.

Due to the nature of the Taseko, heavy glacial rock flower, the use of background subtraction could not be used as it missed some of the fish movement and made the task of counting files more difficult. All the data files were counted using the tools and software packages outlined in the DIDSON operation manual (Version 5.22). The image was corrected for beam pattern and transmission loss.

The river current at this particular site is very fast down the center, it is believed that the sockeye salmon exhibit a migration behaviour that is forced to the near-shore edge of flow (river right at the site). The salmon are constrained by flow and this causes them to swim in a single file band primarily within the first 2m of the DIDSON unit. Chinook (species verified by swim pattern and digital DIDSON measurement) are forced into migrating in the same manner but migration was observed to extend out to 9m. This location made for an extremely shore oriented migration, which in turn made for easier file counts in the 10 and 20-meter recording window.

## Downstream moving fish and the flux model

The hourly count data obtained with the DIDSON system were used in a simple model[2] to estimate the net upstream flux (fish per unit time) of salmon passing through the acoustic site. This model is:

$N = U – D$

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[2] Xie et al, 2002

(Where N = the net upstream flux, U = the upstream actively migrating fish and D = the downstream actively migrating fish).

Because the DIDSON site is located a considerable distance downstream of Taseko system spawning areas and the characteristics of the river at this site, downstream movement of salmon is estimated at zero. This estimation is based on the fact that no downstream migration has been observed during the 2013, 2014 or 2015 projects. Milling in this site is also negligible, due to flow.

### Species Identification

The Taseko River is home to a several resident species, most common are rainbow trout, and Bull trout. The migration behaviour of these species and the size of them, make them easily identified on the Sonar file. Additionally, the resident species of this site displayed a tendency (also experienced during the Quesnel DIDSON project in 2010) to mill within the ensonified area as they migrate upstream. Whereas, sockeye and Chinook typically display directed upstream migration.

Two species of salmon co-migrate, sockeye and Chinook, these two species have both an average distinct size difference and migration swim pattern. These behaviour and biological characteristics were documented in the 2010 Quesnel DIDSON report where it was determined by visual counts that Chinook and sockeye salmon could be appropriately separated in the DIDSON files due to their size, spatial and behavioural differences. The use of spatial migration, swim pattern and the measuring tool software are the only ways of determining a difference between the sockeye and Chinook in this feasibility study as visual assessment is impossible due to the glacial origins of these waters. The size parameters used to ID the salmon on the DIDSON files were: between 35cm to 65cm = sockeye, while Chinook were considered <65cm. These size limits were used in correlation with the interpretation of swim pattern and migration behaviour to make the overall determination on species.

### Sub-Sampling Analysis

The estimate of migration passage, on the right bank, was based on samples taken over 40 days were a recording was made every hour and the recording length varied from 30 to 60 minutes. Procedures outlined in Holmes et al. 2005 for the 20 minute files were also followed here for the longer files in order to estimate variance caused by the temporal expansion for the 30 and 40 minute counts into hourly estimates. The method of successive difference was used to estimate a variance caused by temporal expansion from these counts into hourly estimates[3, 4]. In this method, the variance can be estimated strictly from adjoining pairs of counts using the systematic sample-variance estimator[5] This however can only be used on the files that require expansion up to 60 minutes (60 min file has no expansion), the temporal variance calculation is conducted on only those files that were less than 60 minutes in length.

Data recording gaps were incurred either from cleaning and repositioning the DIDSON, or came as a result of Generator failure/maintenance.

Gaps in recording occurred on the following days:

| | | |
|---|---|---|
| 2015-07-29 | 15:00,16:00 | Swapped out computers |
| 2015-08-05 | 0:00 - 7:00 | Generator failure (oil temp) |
| 2015-08-11 | 10:00 | DIDSON cleaning |
| 2015-08-15 | 13:00 | Repositioning |
| 2015-08-27 | 17:00 | DIDSON cleaning |
| 2015-08-29 | 11:00, 11:41 | Repositioning |
| 2015-08-31 | 13:00 | Fence extension and Repositioning |
| 2015-09-01 | 11:00 till 09-02 10:00 | Generator failure/recording set up problems |

## Results

### Taseko River Conditions

When the weir for the DIDSON project was installed so was a depth gauge and thermometer. As part of the project a depth and temperature reading was taken at the same time every day to gain a better understanding of the in-season changes of the river. The date the weir and depth gauge were installed (24th of July, 2015), the water level was 91.4cm and the water temperature was 13°C. On the last day of the (September 4, 2015) project and the weir was removed, the depth read 15.4 cm and temperature 12°C. See figures 1 and 2 for the detailed temp and depth thought the project.

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[3]Wolter 1985; [4]Eggers et al. 1995

[5] Lijha et al. 2007
[5] Holmes et al. 2005

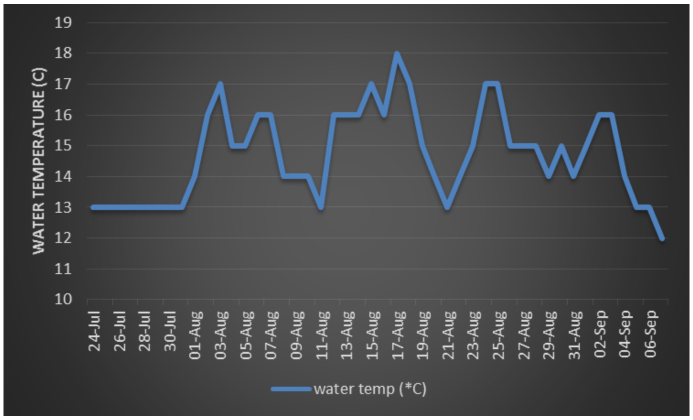


**Figure 4. Taseko Water Temperature**

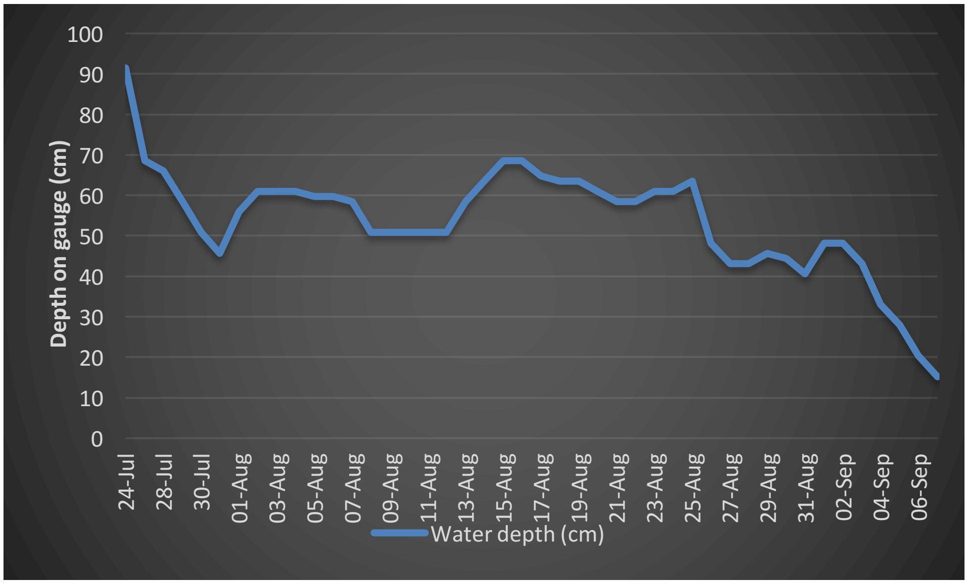


**Figure 5. Water level according to the weir water gauge**

## Estimate of Sockeye Salmon Population

On January 21st 2015 the Department of Fisheries and Oceans' 2015 post-season estimate of escapement for sockeye in the Taseko system was 853 sockeye, with 420 effective female spawners. These estimates are based on floating carcass counts done year to year and are thought to be biased low. As such these numbers should be considered a relative index of abundance rather than escapement estimate

The 2015 Taseko DIDSON project, river right, provided a direct, non-expanded, count from 40 days of DIDSON recordings of 1154 sockeye and 1467 Chinook totaling a count of 2621 salmon that passed the right bank DIDSON site (See figures 6, 7 and 8). The expanded values are 1515 sockeye and 1858 Chinook with a total passage of salmon being 3373 ± 56

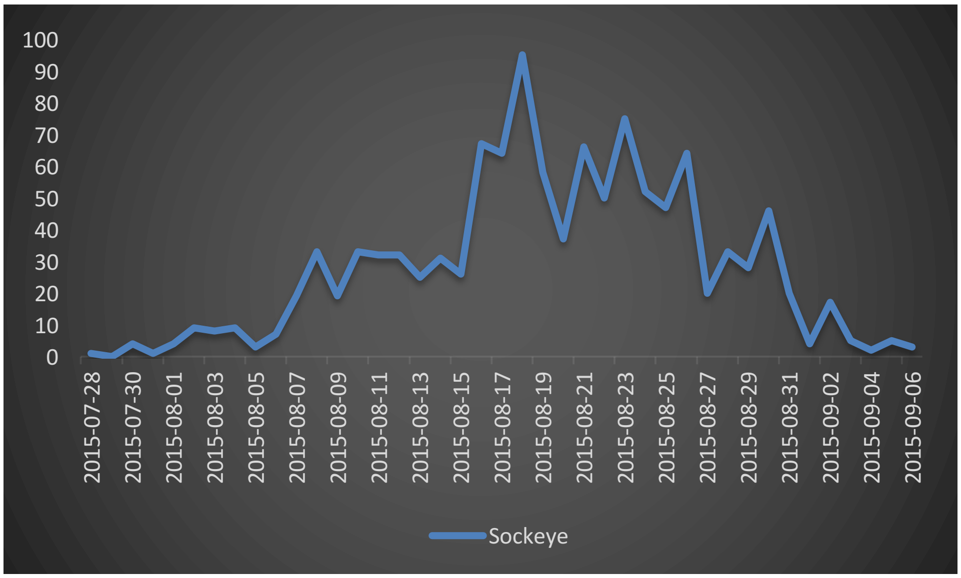


**Figure 6. Non-expanded sockeye upstream right bank migration by day.**

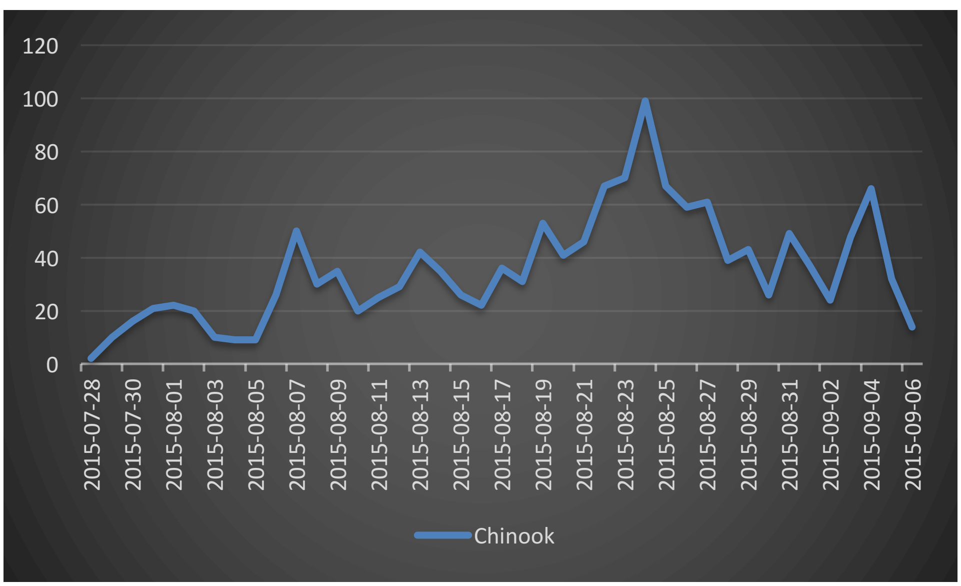


**Figure 7. Non-expanded Chinook upstream right bank migration by day.**

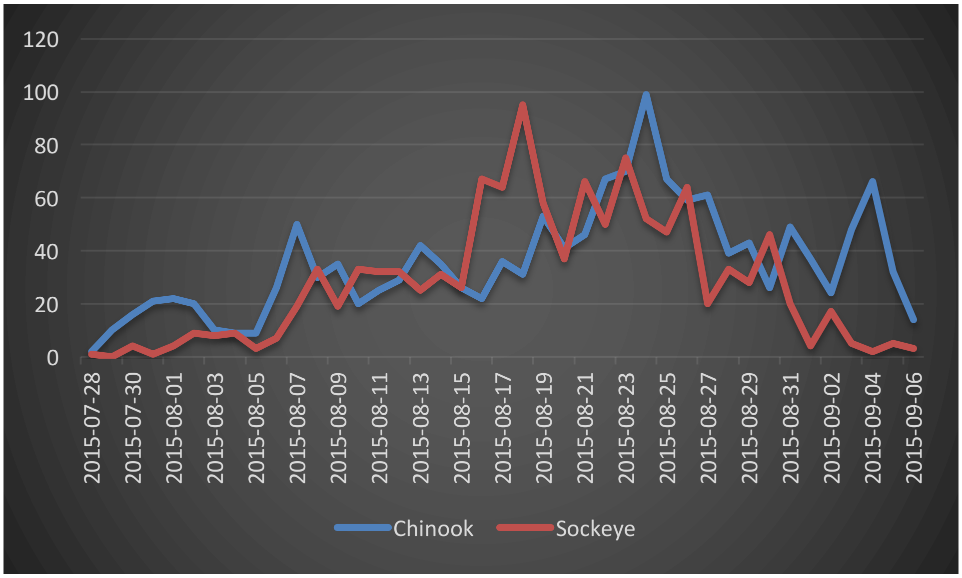


**Figure 8. Daily Non-expanded migration of both sockeye and Chinook.**

With the extended recording window developed for 2015 we were able to successfully cover the bulk of the sockeye migration giving a clear peak migration timing. The time frame does indicate that a peak migration was reached on the 18$^{th}$ with an expanded count of 142 sockeye (see Figure 9). Of note for this project is that on the first day of recording we saw a single sockeye and on the last day of recording we counted three. This indicates a very lengthy migration that could be caused by the migration of two overlapping spawning groups.

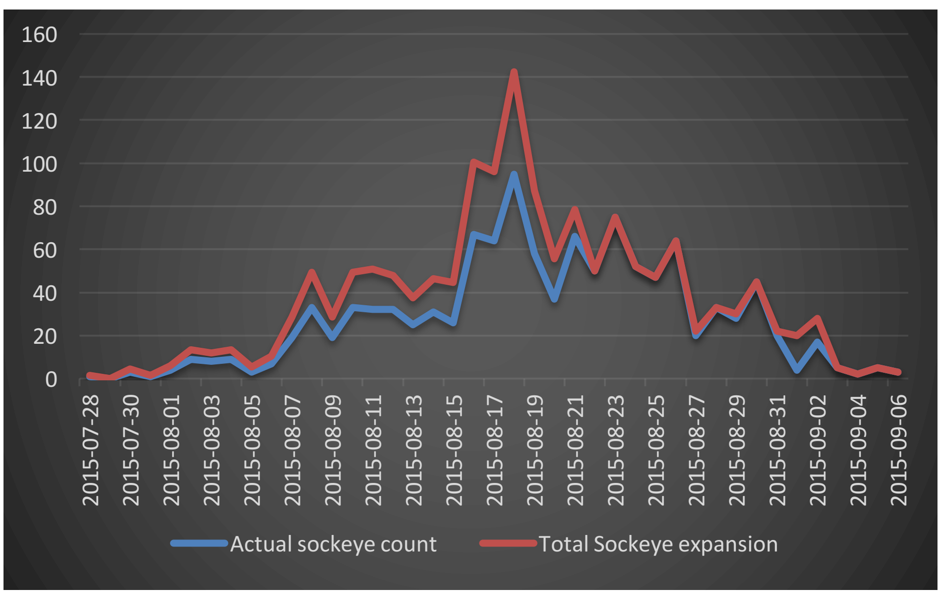


**Figure 9. Expanded and actual count for sockeye migration on the right bank**

The Chinook migration is very interesting and could reveal a need for future projects to cover an even larger time scale as the numbers and lengthy migration seem to indicate multiple migration timings. The peak migration for Chinook is not as clear as the sockeye peak, however the max migration date is the 24th with a true 60 minute, no expansion needed, count of 99 Chinook (see Figure 5). Of note for this right bank observation is the multiple large spikes in migration starting early in the project and continuing well into the end.

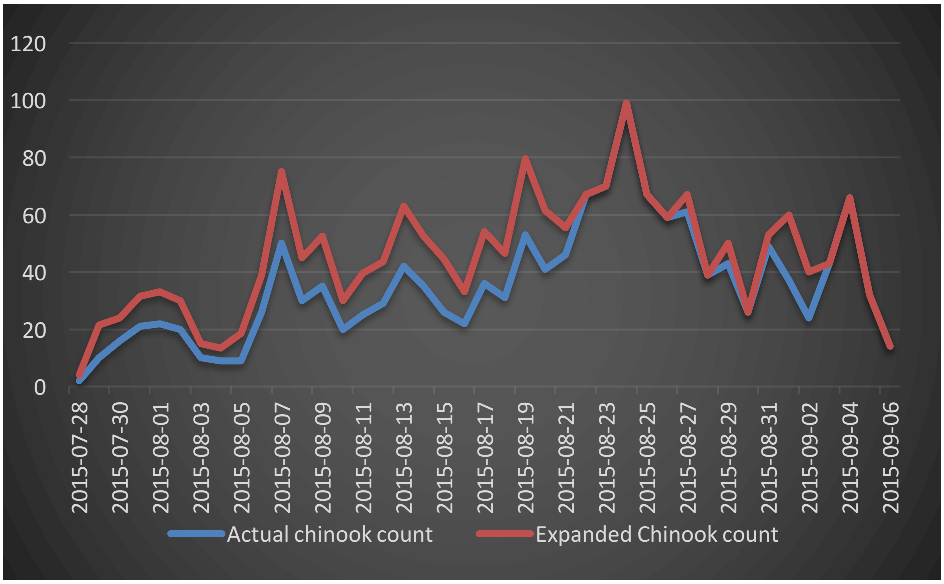


**Figure 10. Expanded and actual count for Chinook migration on the right bank**

As per protocol, the distance that each salmon traveled past the DIDSON at was recorded and used as part of the method for species identification between sockeye and Chinook, the DIDSON software measuring tool and migration behaviour were also used for species identification. This year the Taseko project involved the use of an extendable weir that allowed for it to be expanded further out into the flow than was done in years previous. As a result, the majority of migration looks to be between 2 and 3 meters from the DIDSON for both species. This however is caused by the attempts to keep the DIDSON and the weir at the same distance from each other while adjusting changes in water level. 2015 observed the lowest water levels over the 3 years of operation. Due to the force of the Taseko River both the Chinook and sockeye are heavily shore oriented and without the weir would likely migrate closer to shore. (Figures 11 and 12).

The distance recording also helped in determining the window length as described in methods. A test set of recordings to determine if the salmon could be passing outside the 10-meter window range (12 meters @ window start length), these files recorded 40 minutes at 10 meters and then 20 minutes at the 20-meter window length (22 meters). Within those files only one salmon passed outside the 10-meter window range, a 91 cm long Chinook entering the recording at 14m and exited at 9m.

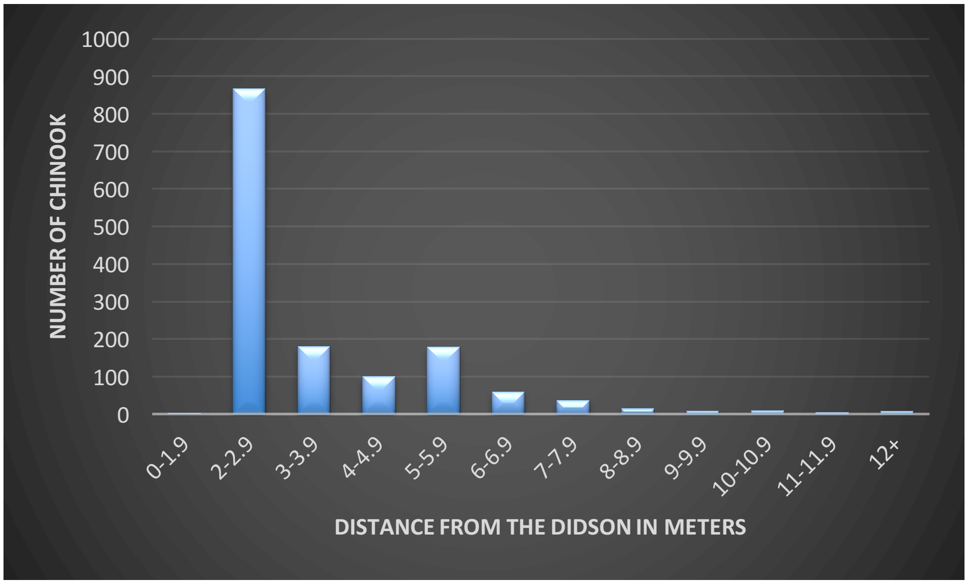


Figure 11. Chinook migration pattern as relates to distance from the DIDSON.

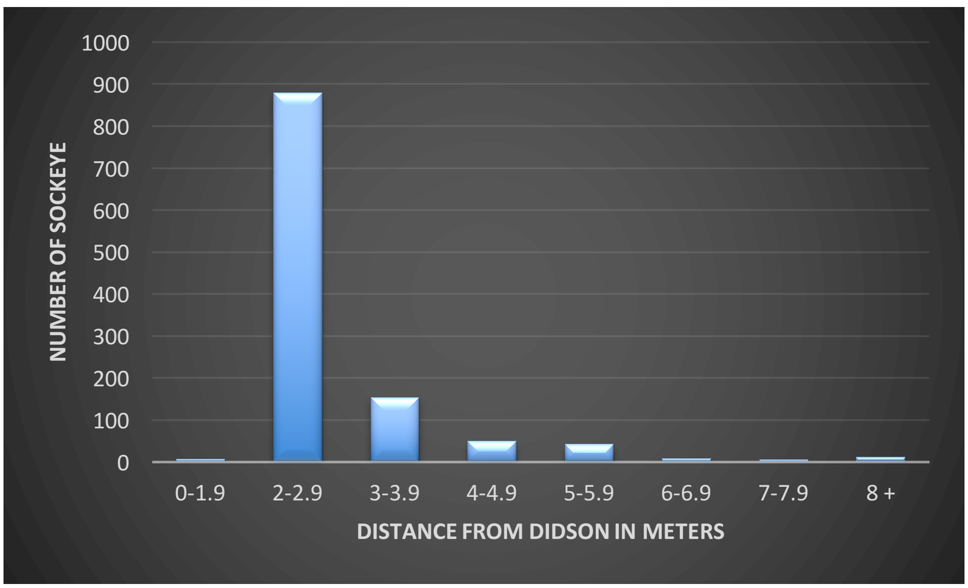


Figure 12. Sockeye migration pattern as it relates to distance from the DIDSON.

## Discussion and Recommendations

For the third year of operation the 2015 TNG Taseko River DIDSON project has met the project objectives established pre-season, including worksite and right bank improvements over the previous two years of studies.

**Objective 1: To build capacity and strengthened partnerships with local First Nations through improved communication and employment of Xeni Gwet'in technicians.**

Objective was met.

The 2015 project began with an invitation for greater involvement of fisheries technicians from and a pre-project information session in Nemiah Valley with the Xeni Gwet'in to present on the 2014 project as well as discuss the upcoming 2015 project.

Through this engagement the project gained two great crew members: Trevarian William and Rocky Quilt, both of whom contributed to the success of this project. Trevarian quickly understood the DIDSON technology and contributed greatly in counting files and troubleshooting through various issues.

Rocky also contributed largely to the project by counting files and in addition made life in the camp comfortable: with 2 large shelters, kitchen and office, and an outhouse. Rocky also patrolled the area around the camp each morning looking for bears, cougars, and wolves and overall safety of the site.

The site was also opened up to tours via communication with Paul Grinder and Randy Billyboy at TNG. Interested community members contacted TNG to arrange a trip to the site.

**Objective 2: Continue improvements to the DIDSON deployment site and field camp/office**

Objective was met.

The Taseko DIDSON site was originally accessed by ATV in 2013 and has since been improved to allow 4-wheel drive vehicle access right to the DIDSON site. This has allowed for full DIDSON deployment as we can bring in heavier loads of ice, coolers, water and gear for improving food storage and comfort as well as lengthening the time between re-fueling/restocking. Having vehicle access right to camp also improved the Operational, Health and Safety Requirements of the site. Other improvements included:

1. Pre-season site visits during low water to clear the sight window for the DIDSON. Any large rocks were removed and the depressions filled in.
2. Improved weir. The weir deployed in 2015 improved on 2014 with the ability to extend further out into the river as required. Providing adequate fish deflection no matter the water level.
3. A log framed kitchen and dining area in addition to a large log framed Office to keep the computers and staff out of the elements and also an outhouse.
4. A cleared, fire safe location for generator and fuel storage.
5. A satellite phone for emergencies, system failures and daily check-ins.
6. Fire pumps and hoses
7. A three-man crew (providing weekends and down time for all involved)

All these improvements provided the project with the ability to operate the DIDSON 24-hours, 7 days per week for 40 straight days.

**Objective 3: To establish a single continuous DIDSON deployment at the site**

Objective met.

The 2015 project was active from 19:00 hrs on July 28$^{th}$ till 09:00 hrs on September 6$^{th}$, 2015, a total of 40 days, 1017 files and 734 hours of recordings with minimal downtime. Both sockeye and Chinook were counted in the very first and last hours of the project lending to the theory that there are multiple spawning populations of both species within the Taseko System.

Note: 2015 saw a marked increase in days recorded (40 compared to 13 days in 2014 and 5 in 2013) contributing to the amount of recorded hours: 734hrs in 2015 in comparison to 89hrs in 2914. Providing the longest and most complete look at the right bank migration patterns for both sockeye and Chinook.

**Objective 4: To improve on data collected in 2013 and 2014, and – if possible – test a second DIDSON unit on the opposite bank to assess salmon passage occurring outside the ensonification window of the primary DIDSON**

Objective was mostly met.

Improvement in the length of the project and the extension of the file length from 20 minute to 60-minute continuous recording provided a noticeable improvement to the data collected. Additionally, having files double counted by different people allowed for a calculation of the average percent error between observers counts of ± 1.02%. The calculated error of the files, were of a temporal variance (any file less than 60 minutes) and was ± 4.33%.

Being able to count a full 60 minutes contributed to a clearer understanding of the right bank migration. The long files were able to address concerns around low passage rates per file, where the 20 minute files in 2014 may, in theory, have left a portion of the migration undetected.

The 2015 Taseko DIDSON project provided a direct, non-expanded, count from 40 days of DIDSON recordings of 1154 sockeye and 1467 Chinook totaling a count of 2621 salmon that migrated by the right bank DIDSON site.

The 2015 expanded values are: 1515 sockeye and 1858 Chinook and a total passage of 3373 ± 56 salmon.

We also established a series of split recordings that covered an entire 60 minutes, separated into 40 minutes at 10 meters and 20 minutes at 20 meters. The purpose was to determine if the 10-meter window was missing salmon passage. Within all the files only one salmon entered outside the 10-meter window range, a 91 cm long Chinook that entered the recording at 14m but exited at 9m. This fish would have been detected on and counted on the 10 meter window.

Unfortunately establishing a left bank DIDSON set up was not achieved in 2015 due to access and safety issues to the far side of the river.

**Objective 5: To identify peak migration timing for sockeye.**

Objective met.

In extending the recording window of 40 days in 2015, the majority of sockeye migration was recorded and a well-defined peak migration timing was established for August 18$^{th}$, 2015. The expanded count on this day was 142 sockeye.

Note: On the first day of recording a single sockeye was observed and on the last day of recording 3 sockeye were counted, indicating a very protracted migration.

As mentioned earlier this could be the result of the migration of two overlapping spawning groups. This is just a possible explanation and warrants further study.

**Objective 6: To determine the feasibility of utilizing DIDSON for identifying Chinook and peak run timing for that species**

Objective met.

Utilizing the measurement tools built into the DIDSON software and studying migration behaviour, tail beat frequency and overall size/shadow, distinguishing Chinook from sockeye is feasible. The limits of this practice is that any of the Chinook jacks or smaller (under 65 cm) 3 or 4 year olds may be misinterpreted as sockeye. Via reading files, the average calculated size of the chinook in 2015 was 78.6cm and the average size of sockeye was 56.6cm.

Right bank Chinook migration was complicated by numerous peaks starting at the beginning of the project and continuing almost till the end. This was unexpected and may indicate the observation of a spring and summer $5_2$, or 2 separate spawning populations.

Though not as straight forward as the sockeye peak the Chinook peak migration is evident in Figure 10 and occurs on August 24$^{th}$ with 99 Chinook. This is a direct 24-hour count value as the files recorded on this day were all 60 minute files with no expansion or interpolation due to no down time. The same is also true for the two days before and two days after this peak.

## Recommendations

The chosen location has again demonstrated its usefulness for documenting the migration of both Chinook and sockeye on the right bank and leaves little question that a DIDSON can be deployed here. To continue to improve the data the following recommendations are made:

1. The current site continues to be utilized and be involved with other comprehensive projects
2. A feasible plan for crossing the river safely be developed.
3. Establish a second DIDSON onto the left bank. Thus ensuring 100% coverage of the migrating salmon stocks. Obtaining a second unit and improving access to the far bank is a priority for 2016. Alternatively, the testing of an ARIS unit on the right bank set with a 40m window would also cover the rivers full width (36m) if the river topography cooperates.
4. That the 10-meter window and 60 minute recordings be maintained as protocol for the right bank.
5. Train 4 people in data entry and DIDSON file counting/trouble shooting to allow for quicker processing of the files and reporting.
6. Develop a trap to authenticate species and length data for comparison with the DIDSON measuring tool and species classification. Additional utility could be for tagging and recovery in stream walk projects.

Additional recommendations are as follows:

- Pre-season site during low water to further prepare the exposed river bed for DIDSON view improvements and develop a safe crossing plan.
- Continued road maintenance/upgrade for ease of use and safety.
- Further improve the site to house a camp for the technicians and provide a safe site for training/staging for possible other projects in the area.

## Summary

The 2015 Taseko DIDSON project objectives were: to further assess the location and feasibility of the DIDSON at this location, provide us with a better understanding of the migration of salmon stocks, and test the limits of the site. The 40 days of operation were a testament to the crew and site, as major improvements, field office, kitchen and road, made it easier to do the work required. The length of this project also provided us with interesting and important data for right bank migration showing peak migration of sockeye, August 18th and Chinook, August 24th with an overall expanded right bank migration of 3373 ± 56. Thereby improving on the limited data available for the Taseko. With this project it was determined that the selected site provides a great workspace, with ever-improving access. Both the river and behaviour of the salmon, on river right, have proven to be very favorable for recording the migrating salmon.

The site shows significant potential as the right bank DIDSON location has provided great information for 2015. The migration has proven to be extremely shore oriented, this was observed during the high flows of 2014 as well as the lower water levels of 2015. The combination of the extendible weir and the Sasha mount made maintaining the window start distance at 2m and down time to a minimum. Once initiated the 60-minute recordings provided a far better representation of migration leaving nothing to chance with the low rate of migration. With the goal of this project to build on the initial 2 years, this was more than accomplished with the support of the Tsilhqot'in National Government and UFFCA and continuation of this project, to progress towards the testing of the left bank to determine fish passage and potentially development of the site as a fully operational dual bank DIDSON location.

## Appendix 1: Project pictures

Picture 1. April 2015 low water site visit to clear and improve the DIDSON site window. Paul and the sticks mark the end of the 2014 weir.

Picture 2. April 2015 low water site visit. The red lined displays the window the right bank DIDSON viewes when it is set up later in July.

Picture 3. River flow and overall view of the area around the DIDSON at very low water in April 2015.

Picture 4. River flow and overall view of the DIDSON site during operation in August 2015

Picture 5. The original Computer hut just didn't cut it this year as the wind layed it to waist.

Picture 6. The new and improved Field Office. Made by Rocky, Trever and Shamus

Picture 7. The camp kitchen and field office, September 2$^{nd}$, note the frost.

Picture 8. July 24th 2015 Weir set up day. Water level was at its highest 36"

Picture 9. August 20th 2015 Overview of the DIDSON and weir

Picture 10. The water level dropped so the weir is being extended and the DIDSON is being rolled further out on its track.

Picture 11. Trever realigning the DIDSON after cleaning

Picture 12. Trever taking down the last of the weir as we pack up, Sept 6th 2015

Picture 13. The DIDSON site after everything has been packed up and moved out, Sept 7th 2015. The stick indicates the end of the 2015 weir.

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