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Aug 30, 2019

Columbia River Inter-Tribal Fish Commission
700 NE Multnomah St., Suite 1200
Portland, OR 97232

USACE Bonneville AFF Project Coord.
Bonneville Lock & Dam
Cascade Lock, OR 97014

RE: In-Season Sockeye Report

Dear Jon Hess, Jeff Fryer, and Andrew Derugin,

The Whooshh FishL™ Recognition system deployed at the terminal end of the right-side bypass flume at the Bonneville Adult Fish Facility (AFF) has been in place and operational 24/7 since late April. The system logs each fish, generates a timestamp and takes eighteen images of each fish passing through. Fork length, circumference, fish orientation and speed through the system are all calculated and logged. In the rare cases, (<0.9%) in which greater than one fish passes through the system at the same time, images are recorded, however, measurement calculations may be impacted and therefore are not reported. Although operational 24/7, fish pass through the system only when the AFF was watered up for routine sampling operations. The AFF staff selected fish passing down either of the two flumes for redirection down the central chute to the sampling chamber. Only "non-selected" right-side flume bypassed fish slide through the Whooshh FishL™ Recognition system before returning to the calm channel connected to the WA-side Bonneville fish ladder.

Between April 25th, 2019 and Aug 1st, 2019, the FishL™ Recognition system was operational 2520 continuous hours but was only actively collecting fish data when the AFF sampling took place and bypassed fish passed through, which amount to ~210 hours or 8% of the available operational hours.

# of Weeks	Week # of yr	Days Sampled/wk	% of day/wk	Hrs Sampled/ wk	% of hr/wk
1	17	2	29%	2.75	2%
2	18	5	71%	13	8%
3	19	5	71%	15.5	9%
4	20	4	57%	12.75	8%
5	21	5	71%	14.5	9%
6	22	4	57%	10	6%
7	23	5	71%	15.5	9%
8	24	5	71%	17.5	10%
9	25	4	57%	13	8%
10	26	5	71%	19	11%
11	27	4	57%	13.5	8%
12	28	5	71%	17	10%
13	29	5	71%	17	10%
14	30	4	57%	13	8%
15	31	4	57%	16	10%
Total		66	63%	210	8%

Thus, the data presented below represents a small fraction of the fish passing up the WA-side Bonneville fish ladder and of those that did pass through the AFF, this is just a portion of those fish.

The Sockeye presented below were logged between the scan dates of May 31, 2019 and Aug 1, 2019. A total of 1262 Sockeye passed through the system and fork length measurements were calculated and logged on 98.1% of the Sockeye (1244 Sockeye). The mean fork length was 43.5 cm. Plotting the data by fork length vs scan date in a line chart (Figure 1) the data looks generally uniform.

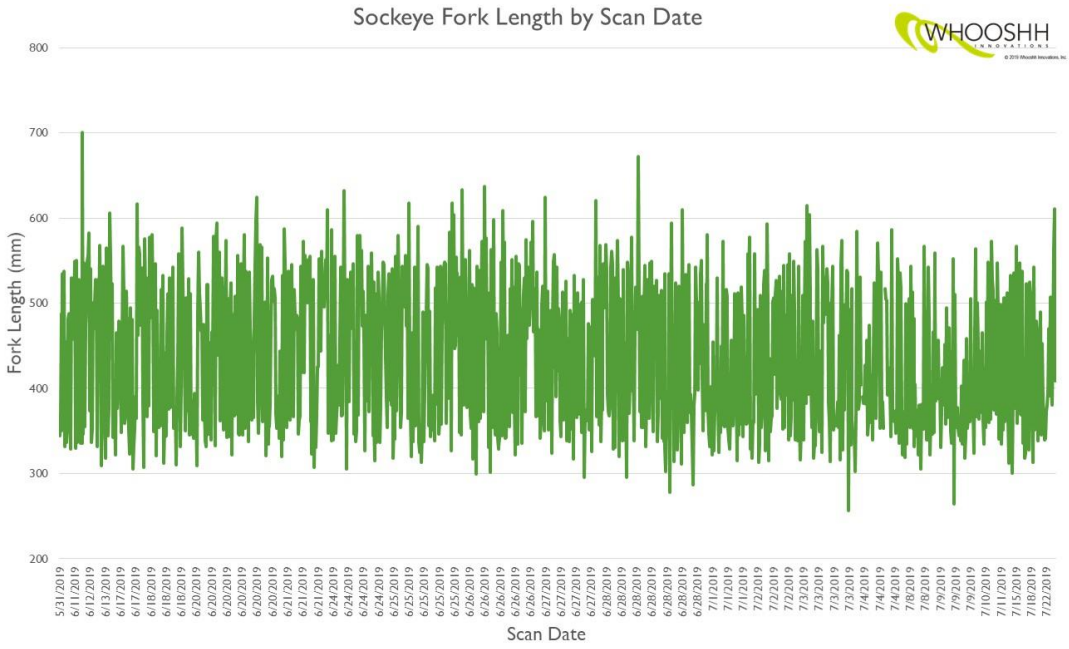

Figure 1. Line graph Sockeye fork length vs scan date

However, replotting the data in a scatter plot of fork length vs scan date, the data appears to separate into two distinct Sockeye populations (Figure 2). This is further supported when a histogram, fork length vs number of occurrences, was plotted (Figure 3). The natural break between the two populations appears

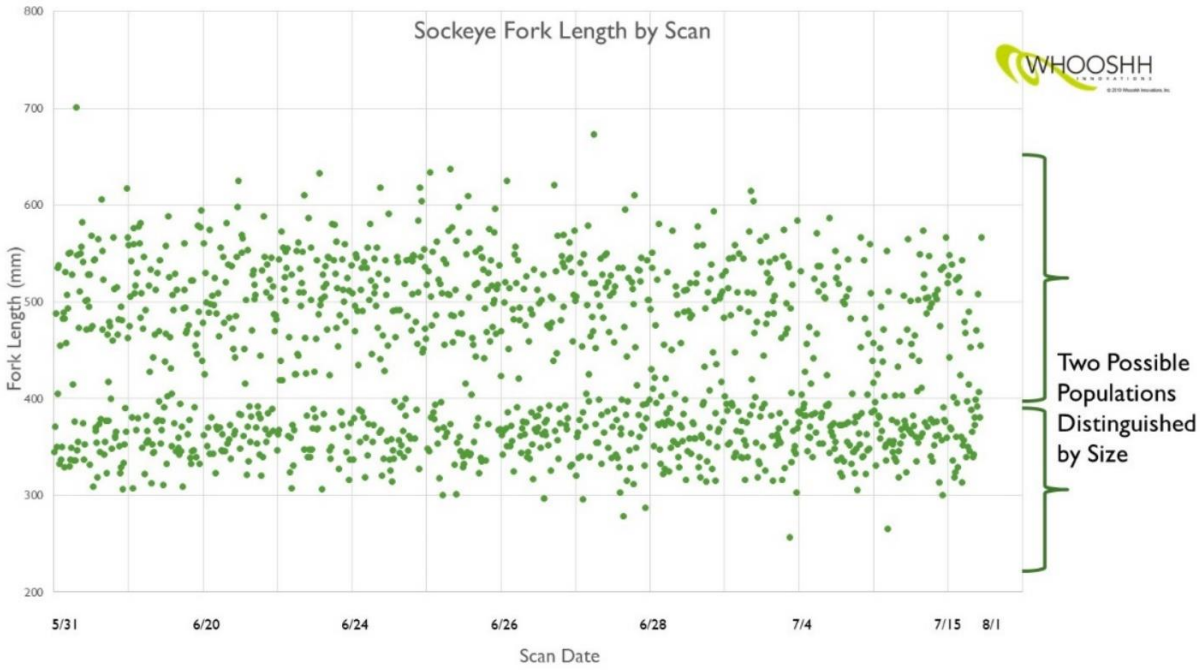

Figure 2. Scatter plot Sockeye fork length vs scan date.

to correspond to ~42 cm. The smaller size population had 632 members which was just slightly more than the larger size population with 612 members. The average fork length of the smaller population was 36 cm and the average fork length of the larger population was 51 cm, both quite distinct from the calculated average fork length of all the Sockeye at 43.5 cm. Although genetic samples and scales were not collected from the FishL™ Recognition system scanned fish, analysis of the CRITFC manually sampled data, which included fork length, genetic sampling and scales for age determination, may provide valuable insight into the makeup of these subpopulations. It is possible that the populations represent genetically distinct subpopulations such as the Wenatchee vs the Okanogan Sockeye subspecies. It is equally feasible to theorize that the two populations represent different age populations such as 3yr vs 4yr old Sockeye. Investigating the population distinctions via a future collaborative study between CRITFC and Whooshh at the Bonneville AFF, may provide definitive insight into these populations and enable future enriched extrapolations of the various Sockeye subpopulations of the Columbia river. It should be noted that such a study and/or a robust comparative study that would validate the fork length measurements of the FishL™ Recognition system relative to the standard deviation of manual measurements, would be a change in scope and time from the current project plan and would require FPOM and USACE approval to keep the system in place for another year rather than removing the system once the AFF is dewatered and dry for the winter.

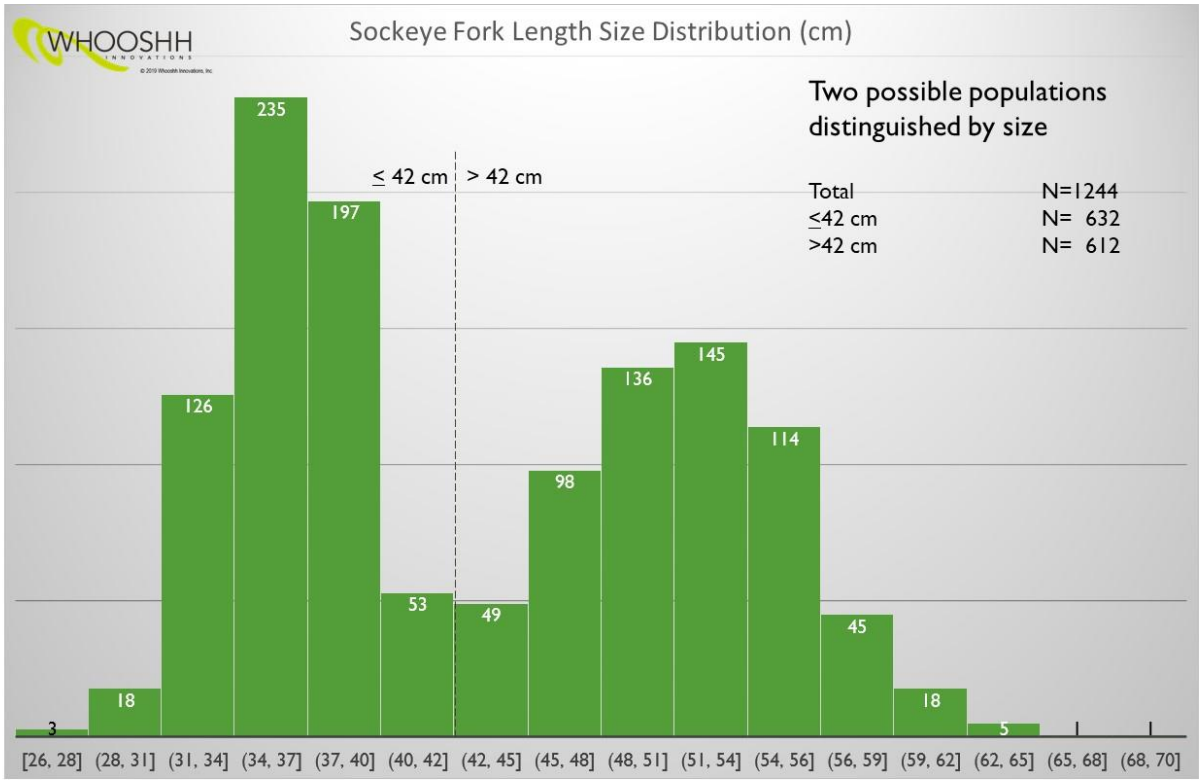

Figure 3. Histogram of FishL™ Recognition System Sockeye data collected 5/31-8/1/2019.

One benefit of the Fish™ Recognition System is the creation of a scan file, a permanent 18 image set, of each fish. The scan files can be revisited and mined for additional analysis. As an example, condition assessment without handling. In a first look, quick analysis of each Sockeye scan, fish condition impressions were noted. Because the scans are a permanent record, any fish scan image set can be revisited to explore more detail and/or validate the first pass impressions. In the first pass Sockeye injury impressions were recorded as follows:

Recorded Major Injury: Open wounds, gashes, pinniped bites, long scratches, >20% descale

Recorded Minor Injury: Scrapes, split fins, small sores, 5-19% descale

No Recorded Injury: Generally normal, <5% descale

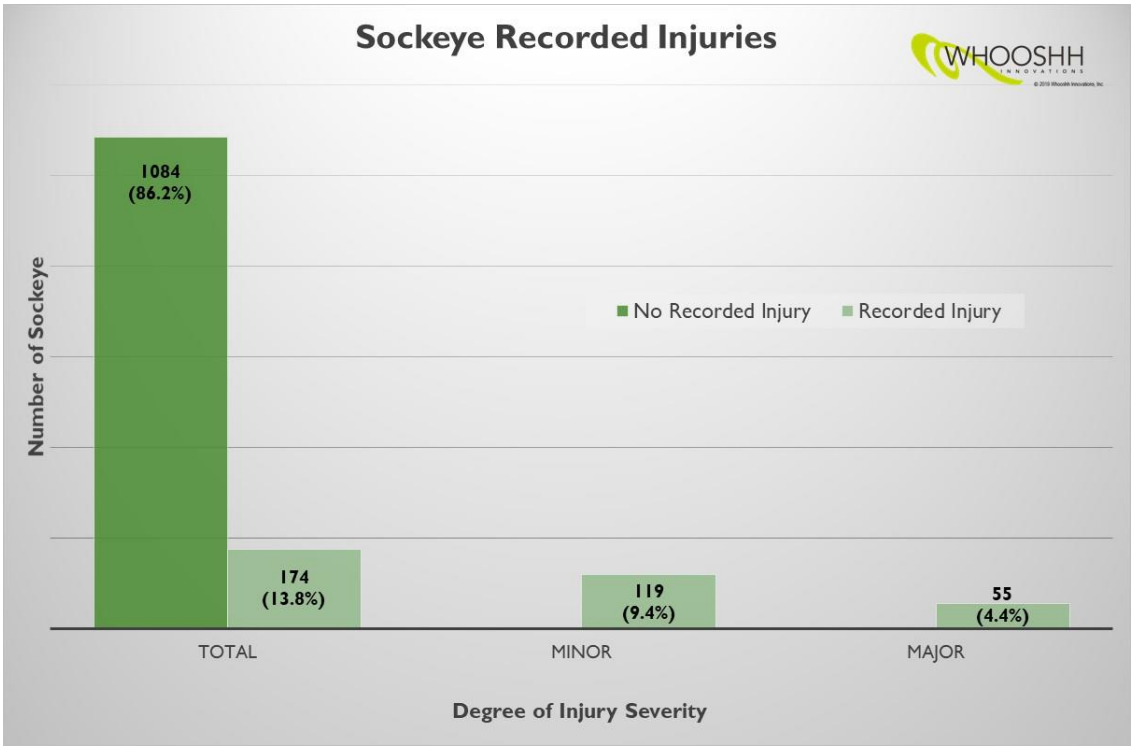

Figure 4. Sockeye images first pass recorded injuries.

CRITFC did sample a number of Sockeye at the AFF during this period, some of which had fork length measurements taken and PIT tag inserted followed by transportation of the Sockeye back downstream of the Bonneville dam fish ladders. A small number returned up through the WA-side Bonneville fish ladder and the AFF right-side flume to be scanned via the FishL^{TM} Recognition system. Although there were minor discrepancies in log timing between the AFF PIT antenna and the image logging of the FishL^{TM} Recognition system, image analysis suggested that the tails of these the Sockeye were clipped or notched and likely the same fish measured by CRITFC. June 24th scanned fish #4133 and July 1st scanned fish #5144 were two such fish. The recorded fork lengths were 32.5 and 35.0 cm CRITFC vs 36.0 and 32.5 cm Whooshh, deviations between the two of 7-11%, which was typical of the deviations in fork lengths seen between the two methods for the other PIT tagged fish identified (N<15). The volume of water that passes down the flumes at the AFF is considerably more than is typical for Whooshh installations. The impact on imaging is that smaller fish or portions of smaller fish tend to be not well resolved as they are more submerged. Thus, full tail views to be searched for CRITFC sampling tail clips or notches on the PIT-tagged Sockeye were not always available.

It is known that handling, even by the best personnel, can impact the health and well-being of the fish[1]. It was noted that most of the PIT-tag identified fish appeared a little "rougher" with localized descale generally 5-19%, notched tail often with additional tail splits and small sores (may include PIT insertion sites). Small sores and minor descale were considered minor injuries and were reasonably common first-pass observations in the population (>9%). Figure 5 is a composite picture of four Sockeye, the top two are believed to be the PIT-tagged fish described above with tail clip or notch and descale localized to potential handling areas near the midline. The bottom two are examples of Sockeye with no recorded injury. Many Sockeye did have a small amount of individual scale loss which we described as "poc" descale. The individual scale loss appears almost like random spots. Poc descale is present on the Sockeye in the bottom right image.

Figure 5. Four Sockeye imaged via the FishL^{TM} Recognition system installed at the AFF. The top two were likely handled and PIT-tagged prior to returning to the river and volitionally entering the right-side AFF flume bypass and passing through the Whooshh scanning system.

Conclusion: The FishL^{TM} Recognition system operated effectively between April and Aug 1, 2019 and continues to image all fish species passing through. Although the system was operational 24/7, fish could only access the bypass at the AFF when staff were actively sampling which was about 8% of the time. Between May 31 and Aug 1, 2019 1262 Sockeye were imaged. The Sockeye were generally without injury. There were two apparent subpopulations that were distinguishable by fork length across the Sockeye run period with 42 cm being the approximate fork length size division point. Those in the fork length group of less than or equal to 42 cm had an average fork length of 36 cm and those in the fork length group greater than 42 cm had an average fork length of 51 cm. The two subpopulations were very similar in numbers although the >42 cm group had a greater size distribution range with the majority falling within a 20 cm span whereas the <42 cm group distribution range was tighter, the majority falling within a14 cm span.

[1] Murauskas, JG, Fryer, JK, Norland, B and Miller, JK. 2014. Trapping Effects and Fisheries Research: A Case Study of Sockeye Salmon in the Wenatchee River, USA. *Fisheries*: 39(9).

At the end of sampling at the AFF this report will be updated with final numbers for Sockeye. Similar data is being analyzed for the Chinook and parceled out between the Spring, Summer and Fall populations. If you have any questions regarding the data presented here, please feel free to contact me.

Best regards,

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