FishL™ Recognition 2019 Bonneville AFF In-Season Chinook and Coho Report

FishL™ Recognition Imaging at the
USACE Bonneville AFF Bonneville Dam
Columbia River WA/OR

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Figure 1. FishL™ Recognition image of hatchery origin Chinook obtained at Bonneville AFF in 2019.

A Whooshh FishL™ Recognition system (scanner) was deployed at the terminal end of the right-side bypass flume of the Bonneville Adult Fish Facility (AFF) in the spring of 2019 and was operational 24 hours, 7 days a week (24/7) between April and November. The system logs each fish sliding through, generates a timestamp and takes eighteen images of each fish. Forklength, circumference, fish orientation and the speed of the fish passing through the system are all calculated and recorded. In the rare instances, less than 0.9%, when multiple fish passed through the system at the same time, images were still taken, however, these records are not included in the size analysis as the calculated measurements are of low confidence. Although operational 24/7, fish passed through the FishL™ Recognition system only when the AFF was watered up for routine manual sampling operations. AFF staff manually 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 had the opportunity to slide through the Whooshh FishL™ Recognition system before returning to the calm channel connected to the WA-side Bonneville fish ladder. This AFF pre-selection process may have introduced some bias into the population sample collected by the FishL™ Recognition system.

Between April 25th, 2019 and Oct 18th, 2019, the FishL™ Recognition system was operational for 4220 continuous hours. During that period, the AFF conducted manual sampling operations for approximately

333.5 hours. As a result, active fish scanning by the FishL™ Recognition system was limited to approximately 8% of the available operational hours (See Table 1). Thus, the data presented in this report represent a small fraction of the fish migrating up the WA-side Bonneville fish ladder and just a portion of the fish that passed through the AFF when it was watered up and operational.

Table 1. FishL™ Recognition Active Imaging Opportunity Across 26 Weeks

# 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%
16	32	0	0%	0	0
17	33	1	14%	3	2%
18	34	4	57%	11.5	7%
19	35	4	57%	16.5	10%
20	36	3	43%	11.5	7%
21	37	4	57%	17	10%
22	38	5	71%	18	11%
23	39	5	71%	15	9%
24	40	4	57%	9.5	6%
25	41	4	57%	13	8%
26	42	3	43%	8.5	5%
total		103		333.5	
average		3.96	57%	333.5	8%

Chinook

Chinook were present and imaged by the scanner during the entire 26-week sampling period. Of the 12260 fish scans obtained during that period, 5405 were identified as Chinook. At Bonneville Dam the Chinook run populations are divided between Spring, Summer, and Fall. The run cohort for a specific dam location is defined by date. At Bonneville dam the Spring Chinook cohort runs through May 31st. The Summer Chinook arrive between June 1 and July 31, and the Fall Chinook run begins August 1. Forklength data was collected on 97% (5255) of the Chinook imaged (Table 2).

Table 2. Chinook Forklength data

2019 FishL Rec Chinook	Spring Chinook	Summer Chinook	Fall Chinook
# of Forklength measurements	1712	812	2731
% of FL set of Chinook	33%	15%	52%
Mean Forklength	708.8 mm	725.8 mm	676.9 mm
Median Forklength	714.0 mm	753.3 mm	704.8 mm

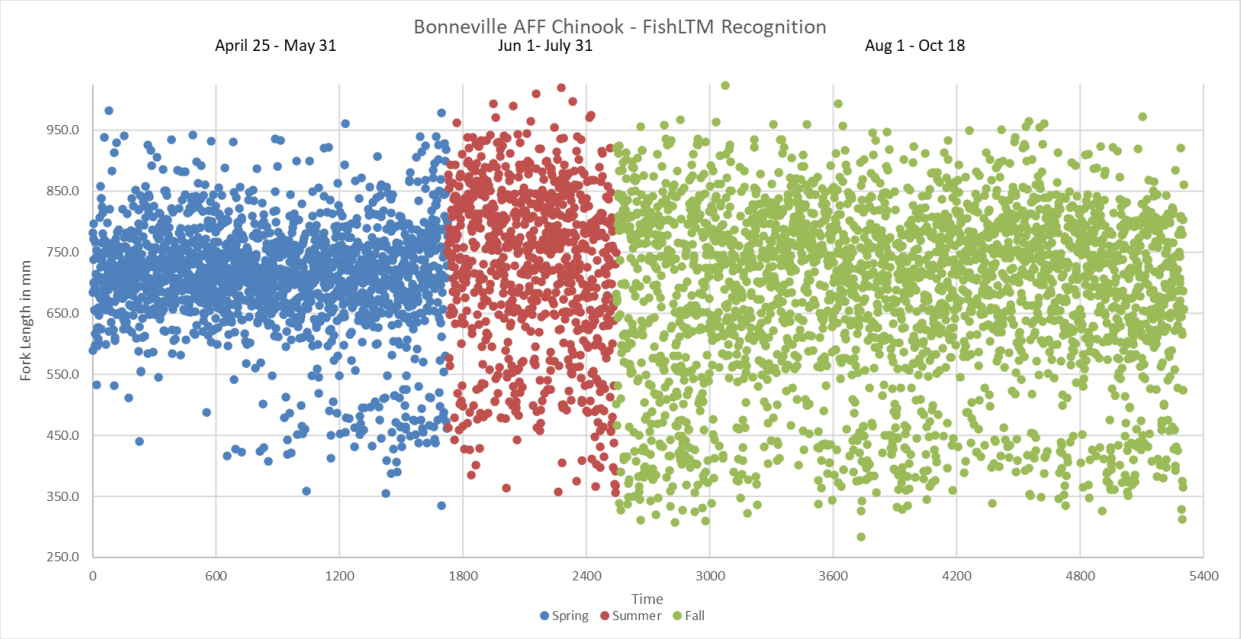
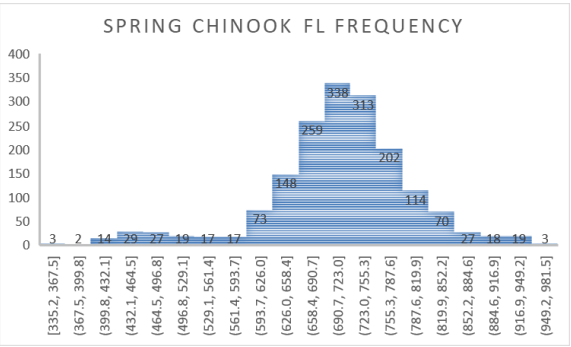
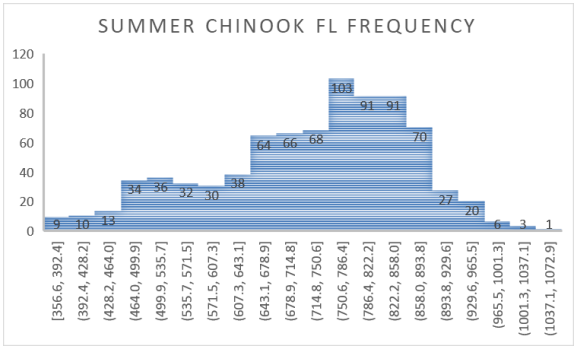


Figure 2. Forklength distribution of FishL™ Recognition imaged Chinook at Bonneville AFF 2019. Spring Chinook in blue, Summer Chinook in red, and Fall Chinook in green.

Figure 2 shows the forklength distribution of Chinook imaged during the operational period. Figure 3 displays the forklength frequency distribution in histogram form, by run. Spring Chinook had the narrowest size distribution, particularly early in the run. Summer Chinook were the largest on average and Fall Chinook had the broadest size distribution.





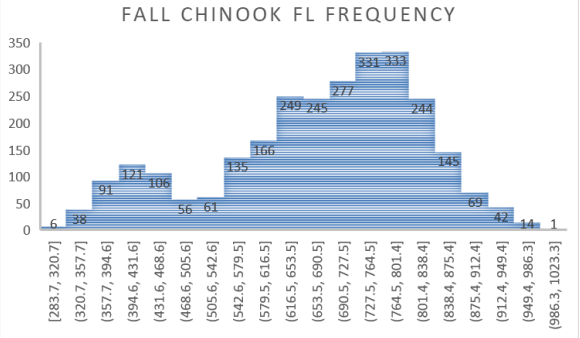


Figure 3. Forklength Histograms of Spring (top left), Summer (top right) and Fall (bottom left) Chinook. Histograms with 20 bins of forklength measurements in millimeters on the X axis and number of fish per bin on the Y axis.

One benefit of the FishL™ Recognition System is the creation of a permanent scan file for each fish, containing a set of 18 images taken at different perspectives and times. The scan files can be revisited and mined for additional analysis to aid in fisheries management. Here, each Chinook scan was evaluated for the presence or absence of an adipose fin which indicates wild or hatchery origin stock. Of the 5405 Chinook scanned, roughly half were of wild origin and half were of hatchery origin. Figure 4 and Table 3 show the proportions of wild and hatchery Chinook by run. Spring and Summer runs were predominately of hatchery origin whereas the Fall run was predominately wild origin Chinook.

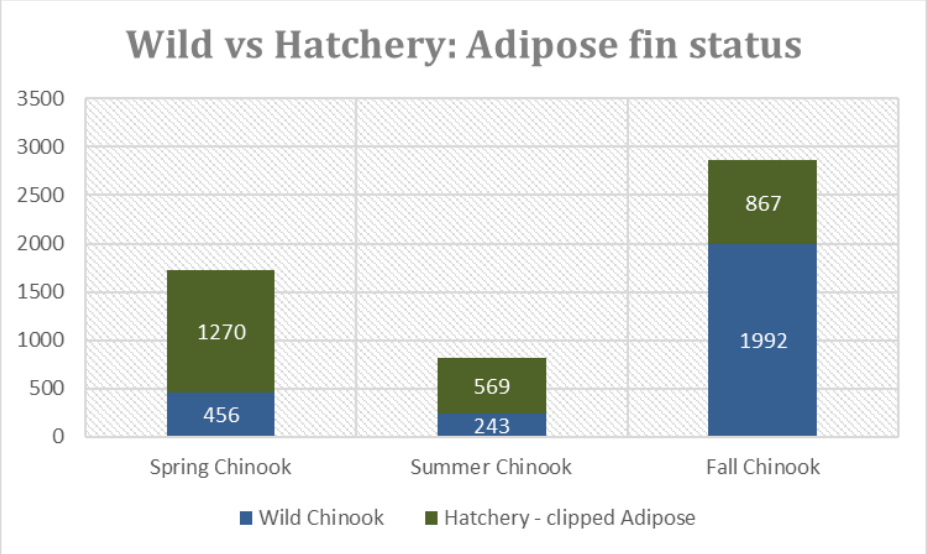


Figure 4. Adipose fin status: Wild origin Chinook with adipose fin intact and hatchery origin Chinook with clipped adipose, by run.

Table 3. Wild vs Hatchery Chinook: Adipose fin status

2019 FishL Rec Chinook	Spring Chinook	Summer Chinook	Fall Chinook
Number of Chinook	1726	812	2859
Wild Chinook	456	243	1992
Hatchery - clipped Adipose	1270	569	867
% Wild	26%	30%	70%

The high quality of the images allows considerable additional information to be collected about the condition of the fish without direct handling of the fish. Because the scans are a permanent record, any fish scan image set can be revisited to explore in more detail and/or validate the first-pass impression. Such examination can produce evidence of fish having been previously hooked by fisherman, caught in nets (Figure 5) or attacked by pinnipeds (Figure 6). Observed injuries from fishing included hooks still in place, wounds or scars in the lip areas, descaling patterns, characteristic fin tears, and thin, straight redundant wounds or scars of net spacing. Markings indicative of pinniped strikes and bites were also observed, including scratches, bites, and puncture wounds. Seal and sea lion predation in the Bonneville dam tailrace are a known problem. Surveillance efforts to observe and record pinniped consumption, fish mortalities, are in place at Bonneville. However, the scope of pinniped damage is not only limited to consumption, but includes injuries inflicted on fish that ultimately escape consumption. This is not a routinely monitored metric. Mining the FishL™ Recognition dataset for injuries provides an opportunity to better understand the range of injuries and frequency of pinniped-associated injury events.

Figure 5. Chinook with hook still in lips (green circles Top left, Bottom right) and common net descale patterns (Top right, Bottom left).

Figure 6. Chinook with pinniped injuries; parallel curved scrapes from teeth or claws, puncture wounds and bites.

Coho

Coho were identified in scanned images during a two-month period from August 20th through October 18th, 2019. Of the 12260 fish scans obtained during the deployment, 958 were identified as Coho. Defining characteristics of the Coho classification include black lips with white lip-liner, small spots on body with generally no visible tail spots, or if observed, a few spots only on the top tail lobe. Forklength data was calculated and collected on 98% (942) of the Coho imaged (Table 4). The majority of Bonneville Coho were of wild origin, having intact adipose fins. The size distribution was quite narrow, centered around 58 cm. Late run Coho tended to be slightly larger than the early run fish (Figure 7). Figure 8 shows the fork length distribution in histogram form and the proportions of wild versus hatchery origin Coho.

Table 4. Coho Forklength data and Wild vs Hatchery origin status

2019 FishL Recognition Coho	Coho
# of Coho Scans	958
# FL measurements of Coho	942
Mean Forklength	573.4 mm
Median Forklength	580.1 mm
Wild origin Coho: Adipose intact	729
Hatchery origin Coho: no Ad	229
% Wild origin Coho	76%

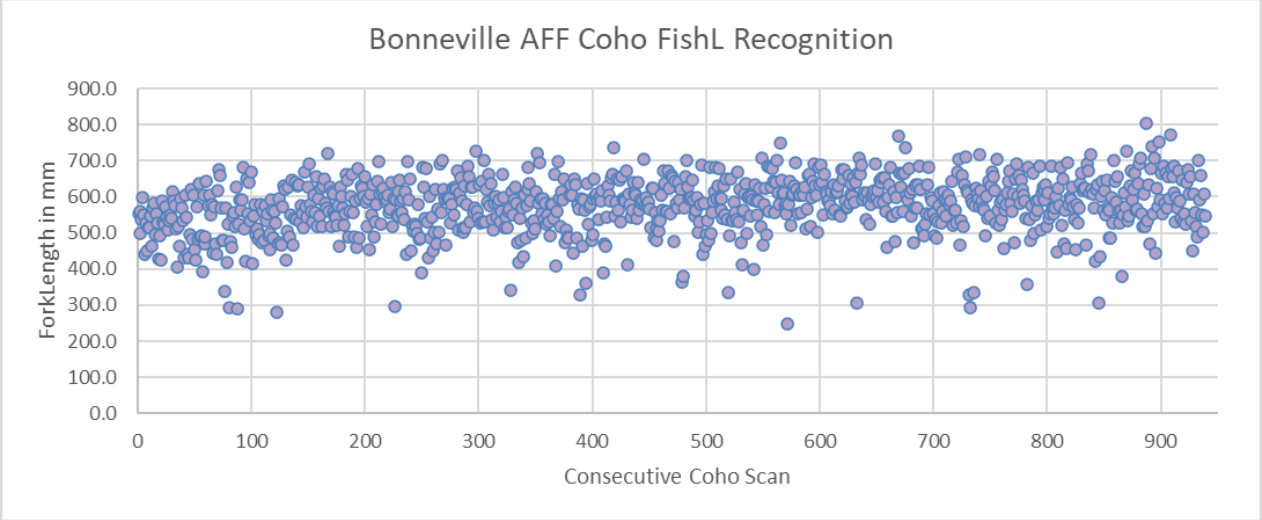
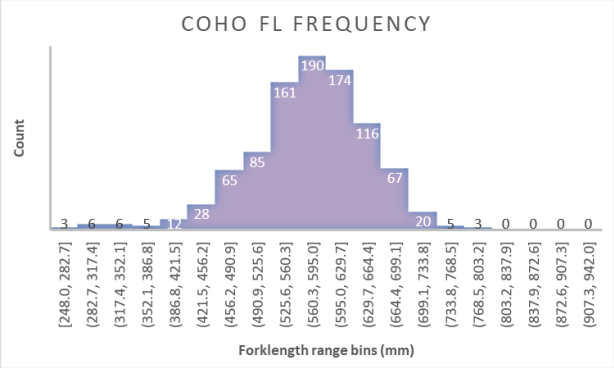


Figure 7. Forklength distribution of FishL™ Recognition imaged Coho at Bonneville AFF 2019.

Figure 9 is a FishL™ Recognition image of a Coho at Bonneville dam. The classic characterizing identification features are clearly visible.



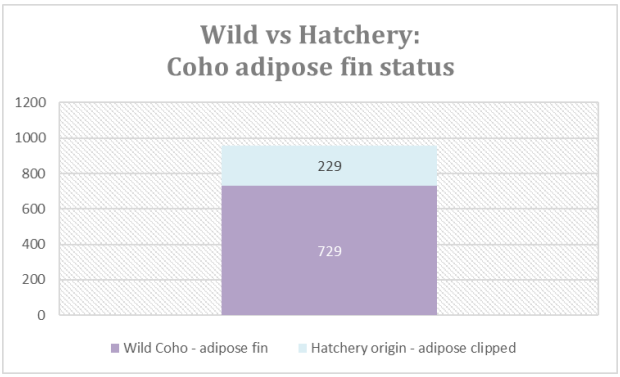


Figure 8. Left: Histogram of Coho forklength with 20 bins of forklength measurements in millimeters on the X axis and number of fish per bin on the Y axis. Right: Adipose fin status: Wild origin Coho with adipose fin intact and hatchery origin Coho with clipped adipose.

Figure 9. Wild origin Coho FishL™ Recognition image obtained at Bonneville AFF 2019.

Conclusions: The FishL^{TM} Recognition system was deployed and operated effectively between April 25th and October 18th, 2019. Although the system was operational 24/7, fish could only access the system via the right-side sampling bypass flume when AFF staff had the AFF watered up, which amounted to about 8% of the operational hours. A total of 5405 Chinook were imaged during the entire deployment period, April to October. A total of 958 Coho were imaged between August 20th and October 18th. The Chinook Spring, Summer, and Fall subpopulations were characterized with respect to forklength and origin, wild or hatchery. 33% of the Chinook scanned were Spring Chinook, 15% were Summer Chinook and the remaining 52% were Fall Chinook. The Fall Chinook were predominantly of wild origin whereas the Spring and Summer Chinook were predominately of hatchery origin. The Coho population appeared to be quite uniform in terms of size, with a mean and median forklength of 57.3 and 58 cm respectively. Coho were predominately of wild origin with just 24% observed with clipped adipose fins. Image analysis of these large cohorts revealed a number of injuries which were associated with fishhooks, prior net capture and pinniped attack. Seal and sea lions are often observed in the Bonneville dam tailrace. Pinniped injury was evident across a portion of all the salmonid species scanned, however it was most significantly noted in the Chinook population. A searchable study database has been created to centralize the collected data and noted findings to date. Further analysis of the scanned images would be required to document all injuries, distinguishing those likely associated with pinniped encounters and those associated with human capture techniques.