FISH PASSAGE CENTER

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MEMORANDUM

TO: Steve Richards, WDFW

FROM: Michele DeHart

DATE: July 27, 2018

RE: Estimates of travel time, passage timing, and juvenile survival for Ringold Springs Hatchery subyearling fall Chinook juveniles, 2016-2018.

In response to your request, the Fish Passage Center has updated our 2016 analysis of fish travel time, passage timing, and juvenile survival for Ringold Spring Hatchery subyearling fall Chinook. This update includes data for migration years 2016, 2017, and 2018 and now included travel times, passage timing, and survivals to John Day Dam.

In general, Ringold Springs Hatchery releases subyearling fall Chinook from two rearing ponds: a small pond (5-acres in 2016 and 2.5 acres in 2017 and 2018) and a larger, 9-acre, pond. Releases from these ponds are volitional, typically occur in mid- to late June, and are generally separated by approximately one week. The one exception to this was in 2018 when the release from the 2.5-acre pond occurred in late May due to an outbreak in cold water disease. Details of the different releases and PIT-tag numbers for each release, over the last three migration years, are provided in Table 1.

Table 1. Details of releases of subyearling fall Chinook from Ringold Springs Hatchery in migration years 2016-2018.

Migration Year	Pond	PIT-Tag Release Date	Number of PIT-tags Released
2016	5-Acre	23-June	913
	9-Acre	29-June	2,144
2017	2.5-Acre	20-June	1,156
	9-Acre	13-June	2,081
2018	2.5-Acre	25-May	1,926
	9-Acre	20-June	2,249

Travel Time and Passage Timing

The hatchery outfall at Ringold Springs Hatchery is equipped with a PIT-tag detection system (RSH), allowing for PIT-detections of fish as they are entering the mainstem Columbia River. Detections at RSH allows for more accurate estimates of fish travel times, as it is an indicator of when each detected fish exits the hatchery facility and begins its out-migration through the Columbia River. We estimated minimum, median, and maximum fish travel times from detection at RSH to McNary Dam (RSH-MCN) and from detection at RSH to John Day Dam (RSH-JDA) for each of the two release groups, as well as for the combined release, over the last three migration years (2016-2018) (Table 2). Also provided, are estimates of the 95% confidence limits around the estimated median travel times.

Table 2. Ringold Springs Hatchery subyearling fall Chinook Travel Times from detection at the hatchery outfall (RSH) to McNary Dam and from detection at the hatchery outfall (RSH) to John Day Dam for migration years 2016, 2017, and 2018.

Reach	Migration Year	Release Group	Number Detected	Travel Time (Days)			95% Confidence Limits	
				Min	Med	Max	Lower	Upper
RSH-MCN	2016	5-Acre	59	2.1	4.7	11.3	4.1	5.5
		9-Acre	100	1.4	3.6	15.2	3.3	4.4
		Combined	159	1.4	4.2	15.2	3.7	4.6
	2017	2.5-Acre	129	2.2	6.0	21.8	5.5	6.3
		9-Acre	251	2.0	5.3	23.4	4.9	5.5
		Combined	380	2.0	5.5	23.4	5.3	5.8
	2018*	2.5-Acre	108	3.2	13.7	46.5	8.6	22.2
		9-Acre	141	2.4	10.5	28.2	9.3	11.9
		Combined	249	2.4	10.8	46.5	9.6	12.9
RSH-JDA	2016	5-Acre	35	4.7	8.5	82.4	7.4	9.5
		9-Acre	48	4.2	6.0	92.8	5.5	6.5
		Combined	83	4.2	6.6	92.8	6.3	7.4
	2017	2.5-Acre	53	4.5	8.3	14.1	7.5	9.1
		9-Acre	144	4.7	9.0	91.9	8.4	9.4
		Combined	197	4.5	8.8	91.9	8.3	9.1
	2018*	2.5-Acre	69	7.0	20.5	50.7	14.5	24.8
		9-Acre	103	5.0	13.5	33.7	11.8	17.0
		Combined	172	5.0	16.1	50.7	13.1	19.5

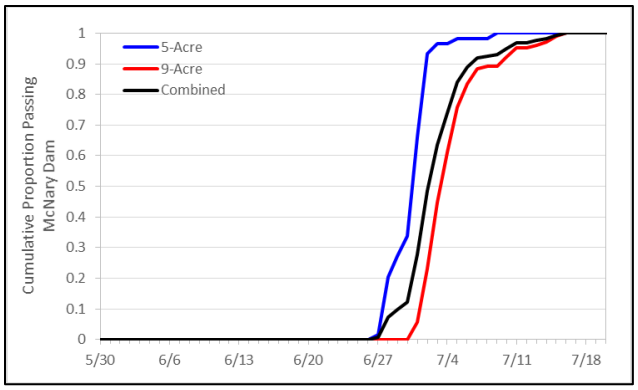
* Travel times for 2018 should be considered preliminary, as these are based on detections through ~July 23, 2018. Future detections may cause this estimate to change.

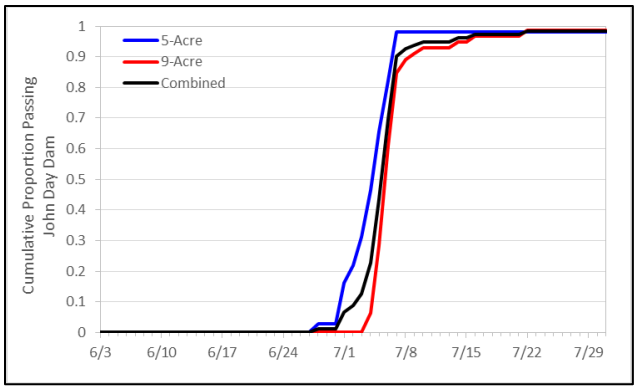
In addition, we estimated the 10%, 50%, and 90% passage dates of Ringold Springs Hatchery subyearling fall Chinook juveniles at McNary Dam and at John Day Dam, for each of the two releases, as well as for the combined release (Table 3). Figure 1 is provided as an illustration of the arrival timing at McNary and John Day dams for each of the two release groups, along with the arrival timing of the combined release in 2016, 2017, and 2018.

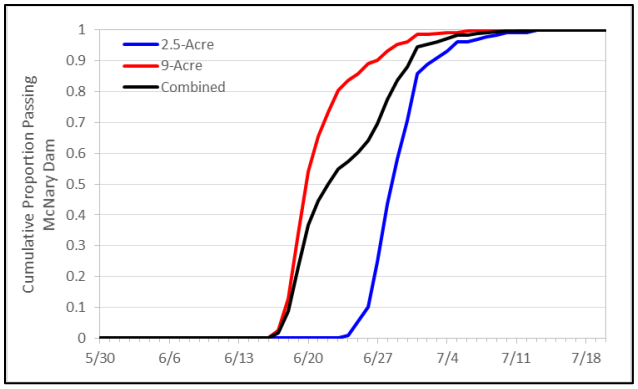
Table 3. Estimated 10%, 50%, and 90% passage dates of Ringold Springs Hatchery subyearling fall Chinook at McNary and John Day dams in migration years 2016, 2017, and 2018.

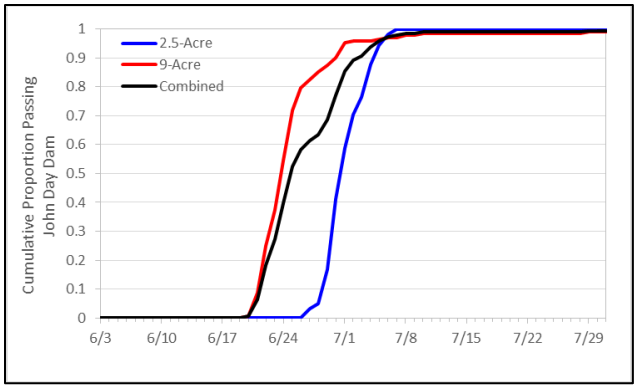
Timing to Project	Migration Year	Release Group	PIT-tag Release Date	10% Passage Date	50% Passage Date	90% Passage Date
MCN	2016	5-Acre	6/23	6/28	7/1	7/2
		9-Acre	6/29	7/2	7/4	7/10
		Combined	6/23 & 6/29	6/30	7/3	7/7
	2017	2.5-Acre	6/20	6/26	6/29	7/3
		9-Acre	6/13	6/18	6/20	6/27
		Combined	6/13 & 6/20	6/19	6/22	7/1
	2018	2.5-Acre	5/25	6/1	6/9	6/28
		9-Acre	6/20	6/23	6/28	7/10
		Combined	5/25 & 6/20	6/3	6/25	7/8
JDA	2016	5-Acre	6/23	7/1	7/5	7/7
		9-Acre	6/29	7/5	7/6	7/9
		Combined	6/23 & 6/29	7/3	7/6	7/7
	2017	2.5-Acre	6/20	6/29	7/1	7/5
		9-Acre	6/13	6/22	6/24	6/30
		Combined	6/13 & 6/20	6/22	6/25	7/3
	2018	2.5-Acre	5/25	6/6	6/16	7/6
		9-Acre	6/20	6/25	7/1	7/15
		Combined	5/25 & 6/20	6/9	6/28	7/14

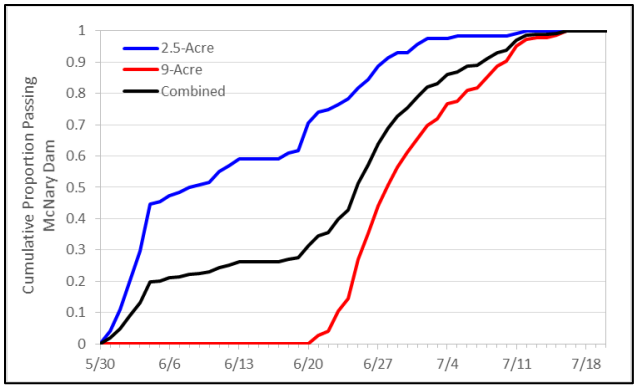
* Passage timing for 2018 should be considered preliminary, as these are based on detections through ~July 23, 2018. Future detections may cause these estimates to change.


Cumulative Proportion Passing
McNary Dam
5-Acre
9-Acre
Combined
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
5/30
6/6
6/13
6/20
6/27
7/4
7/11
7/18


Cumulative Proportion Passing
John Day Dam
5-Acre
9-Acre
Combined
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
6/3
6/10
6/17
6/24
7/1
7/8
7/15
7/22
7/29


Cumulative Proportion Passing
McNary Dam
2.5-Acre
9-Acre
Combined
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
5/30
6/6
6/13
6/20
6/27
7/4
7/11
7/18


Cumulative Proportion Passing
John Day Dam
2.5-Acre
9-Acre
Combined
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
6/3
6/10
6/17
6/24
7/1
7/8
7/15
7/22
7/29


Cumulative Proportion Passing
McNary Dam
2.5-Acre
9-Acre
Combined
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
5/30
6/6
6/13
6/20
6/27
7/4
7/11
7/18

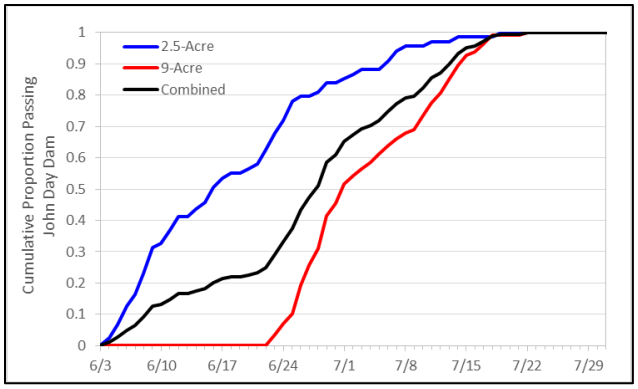

Cumulative Proportion Passing
John Day Dam
2.5-Acre
9-Acre
Combined
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
6/3
6/10
6/17
6/24
7/1
7/8
7/15
7/22
7/29

Figure 1. Cumulative passage timing of Ringold Springs Hatchery subyearling fall Chinook at McNary (Left) and John Day (Right) dams; migration years 2016 (Top), 2017 (Middle), and 2018 (Bottom).

Juvenile Survival

We also estimated juvenile survival for each of the two release groups (5-acre or 2.5-acre vs. 9-acre), along with survival for the combined release. To estimate juvenile survival, we developed a 4-digit and 5-digit capture history for each PIT-tagged fish. The 4-digit capture history was used to estimate survival to McNary and included the following: 1) release, 2) detection at the hatchery outfall (RSH), 3) detection at McNary Dam, and 4) detection at John Day Dam, Bonneville, and/or the estuary trawl. The 5-digit capture history was used to estimate survival to John Day Dam and included: 1) release, 2) detection at RSH, 3) detection at McNary Dam, 4) detection at John Day Dam, and 5) detection at Bonneville Dam and/or the estuary trawl. Using these capture histories, single mark-release mark-recapture survival estimates were generated using the Cormack-Jolly-Seber (CJS) methodology, as described by Burnham et al. (1987) with program MARK (software available free from Colorado State University) (White and Burnham 1999).

By including detections at RSH, we were able to obtain estimates of pond survival (Pond-to-RSH) (i.e., survival from the time tagged fish are placed into the pond to the time fish actively begin to out-migrate). Furthermore, we were able to estimate survival from the hatchery outfall (RSH) to McNary Dam and, with the 5-digit capture histories, survival from McNary to John Day Dam. Individual reach survivals (Pond-to-Outfall, Outfall-to-MCN, and MCN-to-JDA) were then combined to estimate survival from release into the pond to MCN (herein referred to as Pond-to-MCN survival) and survival from release into the pond to JDA (herein referred to as Pond-to-JDA survival). Variance estimates for the product of the individual reach survivals were generated using the delta method (Burnham et al. 1987). Using this methodology, estimates of individual reach survivals (e.g., Pond-to-Outfall or Outfall-to-MCN) can exceed 100%. However, individual reach estimates are often negatively correlated with adjacent reaches. Therefore, when estimating overall reach survivals (e.g., Pond-to-MCN or Pond-to-JDA), we allow individual reach survival estimates to exceed 100%. An overall reach survival (e.g., Pond-to-MCN or Pond-to-JDA) estimate was considered unreliable when its point estimate exceeded 100% or its coefficient of variation exceeded 25%. Table 3 provides estimates of individual reach survivals (Pond-to-RSH, RSH-to-MCN, and MCN-to-JDA) and survivals for the combined reaches (Pond-to-MCN and Pond-to-JDA).

There were several instances where the individual reach survivals and/or the estimates of survival for combined reaches were deemed unreliable. These instances included: 1) the MCN-to-JDA and Pond-to-JDA estimates for the 5-acre release in 2016, 2) the RSH-to-MCN, Pond-to-MCN, and Pond-to-JDA estimates for the 9-acre release in 2016, and 3) the RSH-to-MCN, MCN-to-JDA, Pond-to-MCN, and Pond-to-JDA estimates for the 9-acre release in 2018 (Table 3). Although unreliable, these estimates were included in Table 3 for illustrative purposes.

In addition, there were several instances where the confidence intervals for "reliable" survival estimates were quite wide. For example, the estimates of Pond-to-MCN for the 5-Acre and combined releases in 2016 and Pond-to-JDA for the 2.5-Acre release in 2017 all had relatively wide confidence intervals (Table 3). Finally, detection probabilities at MCN and JDA were relatively low for all the groups we analyzed (Table 4). In fact, there were two instances when detection probabilities at McNary Dam were below 0.10; the 9-Acre release in 2016 (0.05) and the 9-Acre release in 2018 (0.07) (Table 4). In addition, there were two instances when detection probabilities at John Day Dam were below 0.10; the 5-Acre release in 2016 (0.09) and the 9-Acre release in 2018 (0.07) (Table 4).

Table 3. Estimated Pond-to-RSH, RSH-to-MCN, MCN-to-JDA, Pond-to-MCN, and Pond-to-JDA survivals for Ringold Springs Hatchery subyearling fall Chinook juveniles released in migration years 2016 through 2018.

MY	Release Group	Tags Released	Pond-to-RSH (95% CI)	RSH-to-MCN (95% CI)	MCN-to-JDA (95% CI)	Pond-to-MCN (95% CI)	Pond-to-JDA (95% CI)
2016	5-Acre	913	0.91 (0.90-0.93)	0.49 (0.19-0.78)	0.95 (-0.40-2.29)[A]	0.44 (0.18-0.71)	0.42 (-0.58-1.42)[A]
	9-Acre	2,144	0.89 (0.86-0.93)	1.18 (0.07-2.29)[A]	0.18 (-0.04-0.41)	1.06 (-0.15-2.27)[A]	0.19 (-0.06-0.45)[A]
	Comb.	3,057	0.90 (0.88-0.92)	0.70 (0.34-1.07)	0.40 (0.06-0.74)	0.63 (0.29-0.97)	0.25 (0.04-0.46)
2017	2.5-Acre	1,156	0.98 (0.96-0.99)	0.67 (0.45-0.89)	0.69 (0.26-1.12)	0.65 (0.44-0.87)	0.45 (0.19-0.71)
	9-Acre	2,081	0.93 (0.91-0.94)	0.78 (0.59-0.96)	0.65 (0.37-0.92)	0.72 (0.55-0.89)	0.47 (0.28-0.65)
	Comb.	3,237	0.94 (0.93-0.96)	0.74 (0.60-0.88)	0.67 (0.44-0.90)	0.70 (0.56-0.83)	0.47 (0.31-0.62)
2018[B]	2.5-Acre	1,926	0.90 (0.88-0.91)	0.53 (0.31-0.77)	0.41 (0.17-0.66)	0.48 (0.27-0.69)	0.20 (-0.02-0.42)
	9-Acre	2,249	0.90 (0.88-0.91)	1.01 (0.55-1.49)[A]	0.69 (0.17-1.22)[A]	0.91 (0.49-1.33)[A]	0.63 (0.09-1.17)[A]
	Comb.	4,175	0.90 (0.89-0.91)	0.76 (0.52-1.00)	0.52 (0.28-0.77)	0.68 (0.47-0.90)	0.36 (0.18-0.53)

[A] Estimates of survival were deemed unreliable but are still being reported for illustrative purposes.

[B] Estimates of survival for 2018 should be considered preliminary, as these are based on juvenile detections through ~July 23, 2018. Future detections may cause these estimates to change.

Table 4. Estimates of detection probabilities at McNary and John Day dams for Ringold Springs Hatchery subyearling fall Chinook juveniles released in migration years 2016, 2017, and 2018.

Migration Year	Release Group	MCN Detection Probability	JDA Detection Probability
2016	5-Acre	0.15	0.09
	9-Acre	0.05	0.13
	Combined	0.08	0.11
2017	2.5-Acre	0.17	0.11
	9-Acre	0.17	0.15
	Combined	0.17	0.14
2018	2.5-Acre	0.12	0.18
	9-Acre	0.07	0.07
	Combined	0.09	0.12

Literature Cited:

Burnham, K. P., D.R. Anderson, G.C. White, C. Brownie, and K.H. Pollock. 1987. Design and analysis methods for fish survival experiments based on release–recapture. American Fisheries Society Monograph, 5(5).

White, G.C. and K.P. Burnham. 1999. Program MARK: survival estimation from populations of marked animals. Bird Study, 46(S1): S120-S139.