



FISH PASSAGE CENTER

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MEMORANDUM

TO: Brian Leth, IDFG

FROM: Brandon R. Chockley

DATE: January 4, 2017

RE: 2016 Clearwater Hatchery Report

The Fish Passage Center has been marking Chinook and steelhead from the Clearwater Hatchery facility over the last several years as part of the Comparative Survival Study (CSS). The CSS is a multi-year program that estimates survival rates over different life stages for spring and summer Chinook and steelhead produced in major hatcheries. We would like to share with you an update of some of the information we developed under the CSS for the Chinook and steelhead used from the Clearwater Hatchery facility in 2016 and past years.

With the marking efforts over the past several years, data on the timing and migration speed from release to Lower Granite Dam are also available. In addition, as part of the CSS study, juvenile survival estimates are developed for the hydrosystem between Lower Granite and Bonneville Dams, as well as survival to adulthood of different passage histories.

Tables 1 and 2 provide estimates of minimum, median, and maximum travel times for each year's release of spring and summer Chinook (Table 1) and steelhead (Table 2) to Lower Granite Dam. Also provided are estimates of the 95% confidence limits around the estimated median travel times. The annual data presented in Tables 1 (Chinook) and 2 (steelhead) are for all release sites combined. For comparison purposes, travel times for each of the different release sites are provided in Appendix A at the end of this memo (Table A.1 for Chinook, Table A.2 for steelhead).

Table 1. Travel times (release to LGR) of Clearwater Hatchery yearling spring and summer Chinook (all release sites combined).

Migration Year	Species Released	Release Date(s)	Travel Time (Days)			95% Confidence Limits	
			Min	Med	Max	Lower	Upper
2006	SpCH	3/22-4/3	8.5	40.6	83.1	40.5	40.8
2007	SpCH	3/6-3/31	8.3	33.2	80.8	33.0	33.5
2008	SpCH	3/19-4/3	6.4	45.7	108.1	45.5	46.2
2009	SpCH	3/23-4/6	4.2	31.4	84.4	30.8	31.7
2010	SpCH	3/2-3/29	7.7	33.2	96.0	32.7	33.4
2011	Sp/Su CH	3/23-4/5	1.8	32.5	115.6	32.5	32.6
2012	Sp/Su CH	3/21-4/4	3.8	28.4	144.2	28.4	28.6
2013	Sp/Su CH	3/18-4/3	10.0	41.1	102.8	40.7	41.4
2014	Sp/Su CH	3/20-3/31	1.3	31.0	226.2	30.6	31.3
2015	Sp/Su CH	3/9-3/24	6.1	25.8	202.3	25.3	26.5
2016	Sp/Su CH	3/14-4/14	2.4	25.5	70.3	25.4	25.6

Table 2. Travel times (release to LGR) of Clearwater Hatchery steelhead (all release sites combined).

Migration Year	Release Date(s)	Travel Time (Days)			95% Confidence Limits	
		Min	Med	Max	Lower	Upper
2008	4/7-4/21	3.8	29.0	88.1	28.5	29.5
2009	4/13-4/28	3.4	10.2	81.0	10.0	10.4
2010	4/12-4/20	2.6	14.0	73.8	13.5	14.4
2011	4/12-4/18	1.4	20.8	87.8	20.4	21.4
2012	4/10-4/12	4.4	18.1	68.5	17.5	18.4
2013	4/8-4/12	0.7	11.7	74.5	11.0	12.5
2014	4/14-4/17	2.5	8.7	71.5	8.5	9.0
2015	4/6-4/9	3.4	11.5	67.8	10.9	12.5
2016	3/28-4/7	3.3	14.5	68.5	14.0	15.0

In addition, we are providing you with the estimated 10%, 50%, and 90% passage dates of yearling spring and summer Chinook (Table 3) and steelhead (Table 4) at Lower Granite Dam. As with the travel time tables, Tables 3 and 4 provide these estimates for all release sites combined. Estimates of passage dates by release site can be found in Appendix A (Table A.3 for Chinook and Table A.4 for Steelhead). Finally, Figures 1 and 2 are provided as illustrations of the cumulative 2016 arrival timing compared to the previous year and the current 10-year average (2006–2015) for yearling Chinook (Figure 1) and 8-year average (2008–2015) for steelhead (Figure 2).

Table 3. Estimated 10%, 50%, and 90% passage dates of PIT-tagged Clearwater Hatchery yearling spring and summer Chinook at Lower Granite Dam (all release sites combined).

Migration Year	Species Released	Release Date(s)	10% Passage Date	50% Passage Date	90% Passage Date
2006	SpCH	3/22-4/3	4/26	5/6	5/14
2007	SpCH	3/6-3/31	4/16	4/30	5/13
2008	SpCH	3/19-4/3	4/22	5/9	5/29
2009	SpCH	3/23-4/6	4/17	5/3	5/19
2010	SpCH	3/2-3/29	4/22	4/27	5/10
2011	Sp/Su CH	3/23-4/5	4/9	4/29	5/12
2012	Sp/Su CH	3/21-4/4	4/6	4/24	5/8
2013	Sp/Su CH	3/18-4/3	4/10	4/30	5/13
2014	Sp/Su CH	3/20-3/31	4/15	4/26	5/6
2015	Sp/Su CH	3/9-3/24	3/30	4/17	4/25
2016	Sp/Su CH	3/14-4/14	4/5	4/16	5/3

Table 4. Estimated 10%, 50%, and 90% passage dates of PIT-tagged Clearwater Hatchery steelhead at Lower Granite Dam (all release sites combined).

Migration Year	Release Date(s)	10% Passage Date	50% Passage Date	90% Passage Date
2008	4/7-4/21	29-Apr	12-May	23-May
2009	4/13-4/28	22-Apr	25-Apr	16-May
2010	4/12-4/20	25-Apr	1-May	21-May
2011	4/12-4/18	20-Apr	7-May	22-May
2012	4/10-4/12	17-Apr	28-Apr	8-May
2013	4/8-4/12	15-Apr	21-Apr	14-May
2014	4/14-4/17	21-Apr	25-Apr	16-May
2015	4/6-4/9	13-Apr	19-Apr	11-May
2016	3/28-4/7	8-Apr	15-Apr	30-Apr

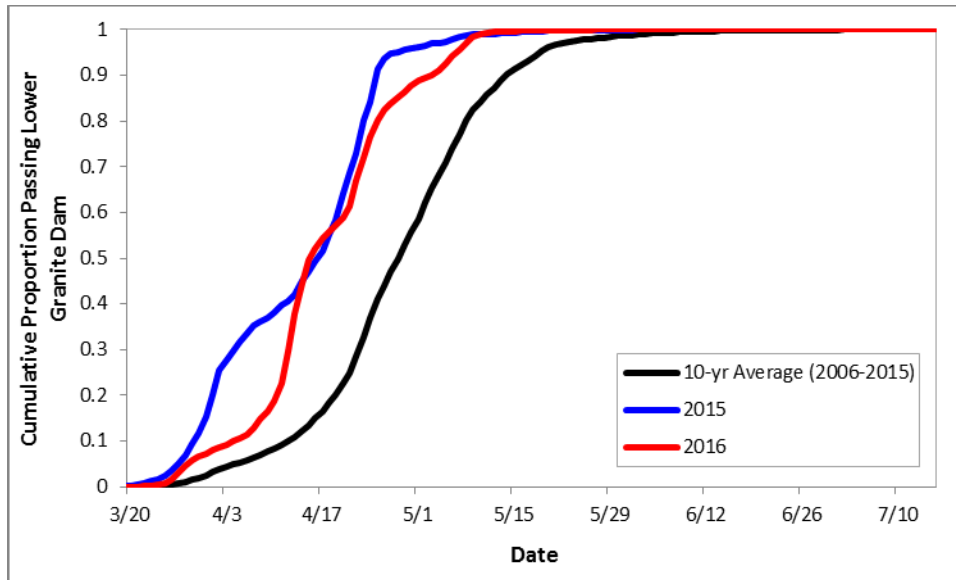


Figure 1. Cumulative passage timing of Clearwater Hatchery yearling spring and summer Chinook (all release sites combined) to Lower Granite Dam in 2016, 2015, and the current 10-year average (2006–2015).

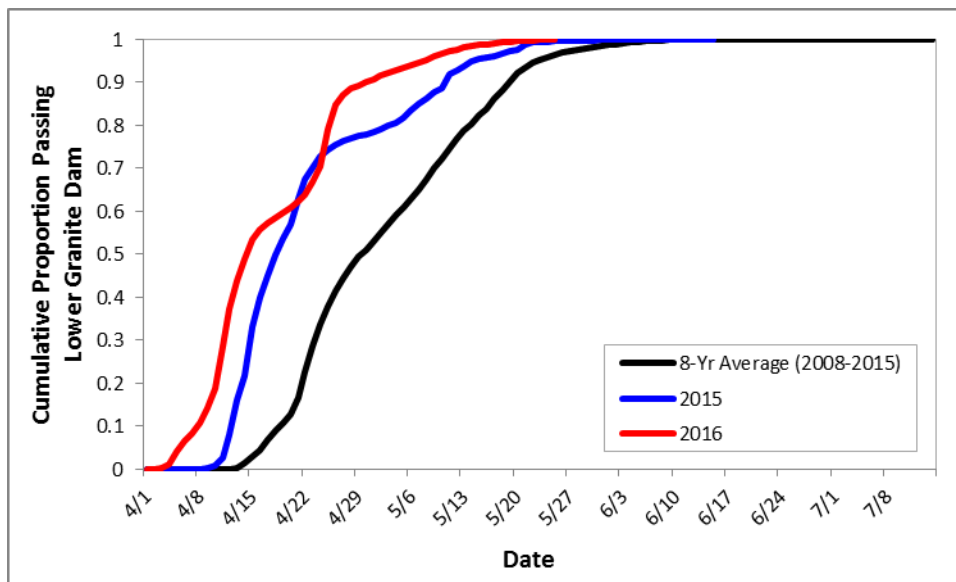


Figure 2. Cumulative passage timing of Clearwater Hatchery steelhead (all release sites combined) to Lower Granite Dam in 2016, 2015, and the current 8-year average (2008–2015).

Figures 3 and 4 are provided below to illustrate the out-migration conditions that these spring migrants may have experienced in the Snake and Middle Columbia rivers. Figure 3 provides the total spring flow volume (April 3–June 20) for the Snake River (as measured at Ice Harbor), along with the average spring spill proportions at each of Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams, for each migration year. Figure 4 provides the total

spring flow volume (April 10–June 30) for the Middle Columbia (as measured at Bonneville), along with the average spring spill proportions at each of McNary, John Day, The Dalles, and Bonneville dams, for each migration year.

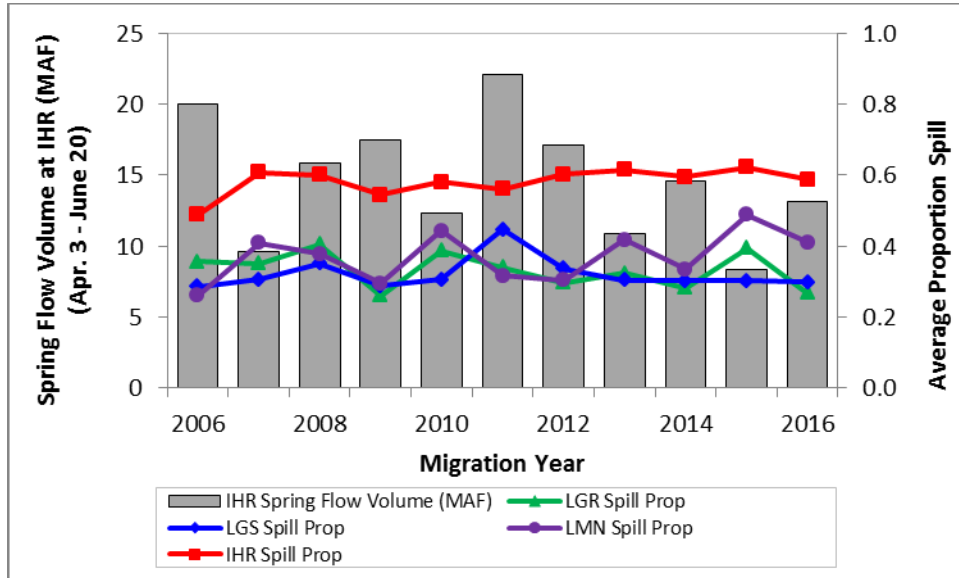


Figure 3. Total spring flow volume in the Snake River (at Ice Harbor Dam) and average spill proportion at Lower Granite, Little Goose, Lower Monumental, and Ice Harbor dams. Spring period in the Snake River is April 3–June 20.

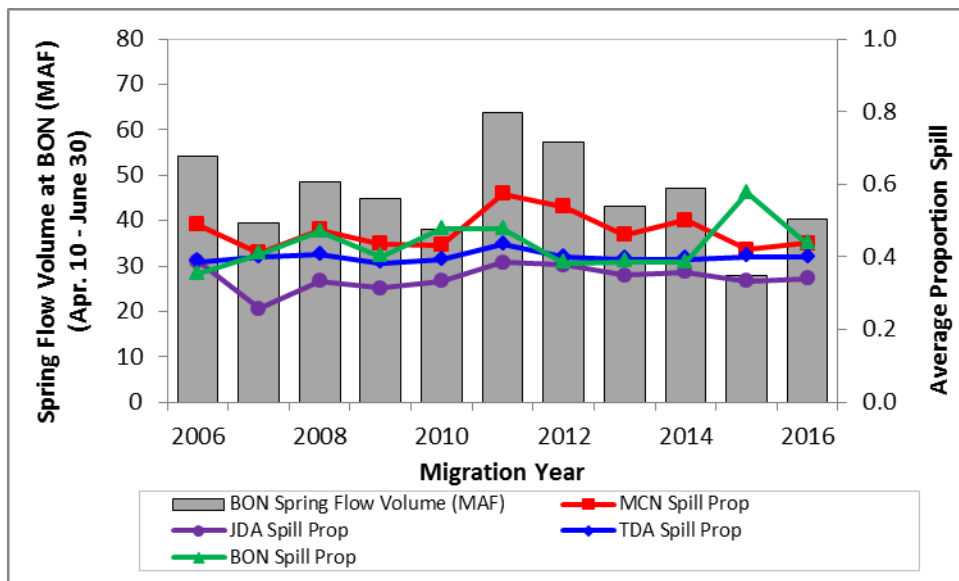


Figure 4. Total spring flow volume in the Middle Columbia River (at Bonneville Dam) and average spill proportion at McNary, John Day, The Dalles, and Bonneville dams. Spring period in the Lower Columbia River is April 10–June 30.

Finally, Tables 5 and 6 contain estimates calculated for Clearwater Hatchery Chinook by the CSS. The estimates provided include: (1) juvenile survival in the hydrosystem between Lower Granite and Bonneville Dams (Table 5), (2) the proportion of the juvenile population destined for transportation (Table 5), and (3) the smolt-to-adult survival (SAR) for several passage categories (Table 6). Those passage categories are SAR(T), SAR(C₀), and Overall SAR, where SAR(T) represents smolts transported from Lower Granite, Little Goose, or Lower Monumental Dam, SAR(C₀) represents smolts migrating in-river (undetected at Snake River transportation collector sites), and Overall SAR is the estimated SAR for the overall hatchery release. All SAR estimates are for the LGR-to-GRA reach and jacks are excluded. The data presented in Tables 5 and 6 were taken from various chapters and appendices of the 2016 CSS Annual Report, which can be downloaded from the FPC webpage www.fpc.org/documents/CSS.html. Figure 5 is a time series of the Overall SAR over the years of available data for Clearwater Hatchery spring and summer Chinook.

Table 5 Clearwater Hatchery spring and summer Chinook juvenile survivals and estimated proportion transported (with 90% confidence intervals) from CSS.

Release Date(s)	Migration Year^A	Species	Juvenile Survival (LGR-BON)	Proportion Transported
3/22-4/3	2006	SpCH	0.64 (0.54-0.75)	0.63 (0.61-0.64)
3/6-3/31	2007	SpCH	0.78 (0.74-0.83)	0.12 (0.12-0.13)
3/19-4/6	2008	SpCH	0.58 (0.48-0.72)	0.44 (0.43-0.45)
3/23-4/8	2009	SpCH	0.63 (0.56-0.73)	0.25 (0.24-0.25)
3/2-3/29	2010	SpCH	0.66 (0.60-0.71)	0.14 (0.14-0.15)
3/21-4/4	2011	SpCH	0.49 (0.41-0.63)	0.25 (0.25-0.26)
3/21-4/5	2012	SpCH	0.65 (0.62-0.70)	0.16 (0.15-0.16)
3/18-3/27	2013	SpCH	0.67 (0.60-0.75)	0.16 (0.15-0.16)
3/20-3/28	2014	SpCH	0.77 (0.61-1.10)	0.27 (0.26-0.27)
3/9-3/16	2015	SpCH	0.65 (0.56-0.78)	0.02 (0.02-0.03)
3/26	2011	SuCH	0.62 (0.53-0.73)	0.38 (0.37-0.39)
3/26	2012	SuCH	0.63 (0.57-0.69)	0.15 (0.15-0.16)
3/20	2013	SuCH	0.63 (0.48-0.89)	0.23 (0.22-0.24)
3/31	2014	SuCH	0.59 (0.46-0.82)	0.29 (0.28-0.30)
3/24	2015	SuCH	0.63 (0.52-0.76)	0.02 (0.01-0.02)

^A All migration years reflect use of new methodology developed for random pre-assignment of “monitor mode” and “return-to-river mode” operations. See 2016 CSS Annual Report for details.

Table 6. Clearwater Hatchery spring and summer Chinook TIR, SAR by study category (T vs. C₀), and Overall SARs (with 90% confidence intervals). SAR estimates are for LGR-to-GRA reach and are without jacks.

Release Date(s)	Migration Year ^A	Species	TIR	SAR(T)		SAR(C ₀)		Overall SAR
					%	%	%	
3/22-4/3	2006	SpCH	1.11 (0.85-1.50)	0.63 (0.53-0.74)	0.57 (0.43-0.70)	0.57 (0.49-0.65)		
3/6-3/31	2007	SpCH	1.47 (0.86-1.24)	0.41 (0.24-0.58)	0.28 (0.22-0.33)	0.30 (0.25-0.35)		
3/19-4/6	2008	SpCH	0.91 (0.71-1.18)	0.93 (0.76-1.11)	1.03 (0.85-1.22)	0.97 (0.85-1.10)		
3/23-4/8	2009	SpCH	1.35 (1.04-1.76)	0.89 (0.71-1.08)	0.66 (0.56-0.76)	0.71 (0.63-0.80)		
3/2-3/29	2010	SpCH	1.33 (0.94-1.78)	0.60 (0.42-0.76)	0.45 (0.39-0.50)	0.48 (0.42-0.54)		
3/21-4/4	2011	SpCH	0.63 (0.24-1.22)	0.09 (0.04-0.15)	0.14 (0.09-0.19)	0.15 (0.12-0.18)		
3/21-4/5	2012	SpCH	1.22 (0.86-1.66)	0.67 (0.48-0.85)	0.55 (0.46-0.64)	0.51 (0.44-0.57)		
3/18-3/27	2013	SpCH	1.11 (0.80-1.44)	0.82 (0.61-1.03)	0.73 (0.66-0.82)	0.73 (0.65-0.81)		
3/20-3/28	2014 ^B	SpCH	1.19 (0.83-1.70)	0.44 (0.32-0.58)	0.37 (0.29-0.45)	0.35 (0.30-0.42)		
3/26	2011	SuCH	0.33 (0.07-0.80)	0.08 (0.00-0.17)	0.26 (0.14-0.38)	0.18 (0.12-0.26)		
3/26	2012	SuCH	0.83 (0.17-2.08)	0.19 (0.06-0.39)	0.23 (0.12-0.35)	0.30 (0.22-0.40)		
3/20	2013	SuCH	0.62 (0.23-1.15)	0.27 (0.09-0.45)	0.43 (0.31-0.55)	0.32 (0.22-0.41)		
3/31	2014 ^B	SuCH	1.05 (0.58-1.73)	0.37 (0.23-0.54)	0.35 (0.25-0.46)	0.30 (0.22-0.38)		

^A All migration years reflect use of new methodology developed for random pre-assignment of “monitor mode” and “return-to-river mode” operations. See 2016 CSS Annual Report for details.

^B Adult returns for migration year 2014 are incomplete with Age 2-salt adult returns through 9/16/2016.

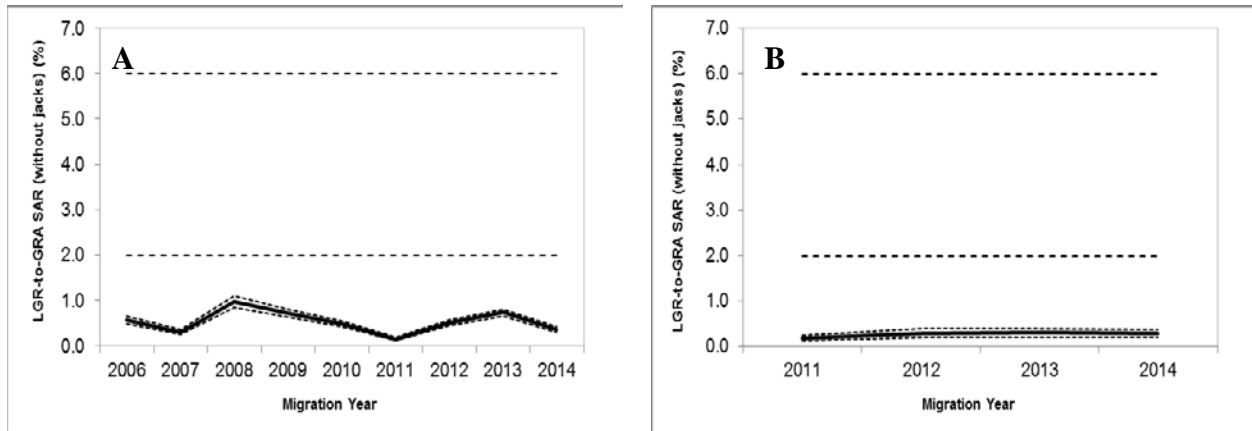


Figure 5. Overall SAR_{LGR-to-GRA} (without jacks) for Clearwater Hatchery spring (A) and summer (B) Chinook (with 90% confidence intervals). The NPCC 2-6% SAR objectives for listed wild populations are shown for reference. Migration year 2014 is incomplete with Age 2-salt adult returns through 9/16/2016.

More representative tagging for Snake River steelhead hatcheries began in coordination among CSS, LSRCP, and IPC in migration year 2008. This increased sample size of PIT tags allowed for finer-scale analyses than in previous years. Since this time, CSS has been grouping and analyzing hatchery steelhead by run (A-run or B-run) and release drainage (e.g., Salmon River, Clearwater River, etc.). Therefore, estimates of SARs are not available for individual hatcheries. However, steelhead reared at Clearwater Hatchery are part of the Clearwater-B group, which also includes hatchery steelhead from Dworshak NFH. Estimates of juvenile survival in the hydrosystem, proportion transported, and various SARs for Clearwater-B hatchery steelhead are provided in Tables 7 and 8 (2008–2013). All SAR estimates are for the LGR-to-GRA reach. The data presented in Tables 7 and 8 were taken from various chapters and

appendices of the 2016 CSS Annual Report, which can be downloaded from the FPC webpage www.fpc.org/documents/CSS.html. A time series of the Overall SAR for the Clearwater-B hatchery steelhead group is also provided in Figure 6.

Table 7. Hatchery Clearwater-B steelhead juvenile survivals and estimated proportion transported (with 90% confidence intervals) from CSS. The Clearwater-B hatchery steelhead group is comprised of hatchery steelhead reared at Clearwater Hatchery and Dworshak NFH.

Migration Year^A	Juvenile Survival (LGR-BON)	Proportion Transported
2008	0.47 (0.44-0.51)	0.30 (0.30-0.31)
2009	0.61 (0.55-0.68)	0.22 (0.21-0.22)
2010	0.52 (0.49-0.56)	0.31 (0.30-0.32)
2011	0.48 (0.46-0.50)	0.26 (0.25-0.26)
2012	0.69 (0.64-0.76)	0.14 (0.14-0.15)
2013 ^B	0.54 (0.47-0.64)	0.15 (0.14-0.15)
2014 ^B	0.67 (0.57-0.60)	0.25 (0.24-0.25)
2015	0.55 (0.50-0.60)	0.08 (0.07-0.08)

^A All migration years reflect use of new methodology developed for random pre-assignment of “monitor mode” and “return-to-river mode” operations. See 2016 CSS Annual Report for details.

Table 8. Hatchery Clearwater-B steelhead TIR, SAR by study category (T vs. C₀), and Overall SARs (with 90% confidence intervals) from CSS. The Clearwater-B hatchery steelhead group is comprised of hatchery steelhead reared at Clearwater Hatchery and Dworshak NFH.

Migration Year^A	TIR	SAR(T) %	SAR(C₀) %	Overall SAR %
2008	1.55 (1.28-1.85)	1.96 (1.68-2.23)	1.26 (1.10-1.43)	1.46 (1.33-1.58)
2009	0.74 (0.57-0.97)	0.99 (0.79-1.20)	1.34 (1.12-1.57)	1.04 (0.93-1.14)
2010	0.76 (0.61-0.92)	0.90 (0.73-1.06)	1.18 (1.07-1.31)	1.05 (0.96-1.15)
2011	1.14 (0.78-1.69)	0.47 (0.36-0.60)	0.41 (0.31-0.53)	0.41 (0.35-0.46)
2012	1.05 (0.73-1.46)	1.21 (0.87-1.57)	1.15 (0.94-1.37)	1.12 (1.01-1.24)
2013 ^B	0.82 (0.53-1.19)	0.48 (0.32-0.68)	0.59 (0.51-0.68)	0.57 (0.50-0.65)

^A All migration years reflect use of new methodology developed for random pre-assignment of “monitor mode” and “return-to-river mode” operations. See 2016 CSS Annual Report for details.

^B Incomplete adult returns until 3-salt returns (if any) occur after Sept. 16, 2016, at GRA.

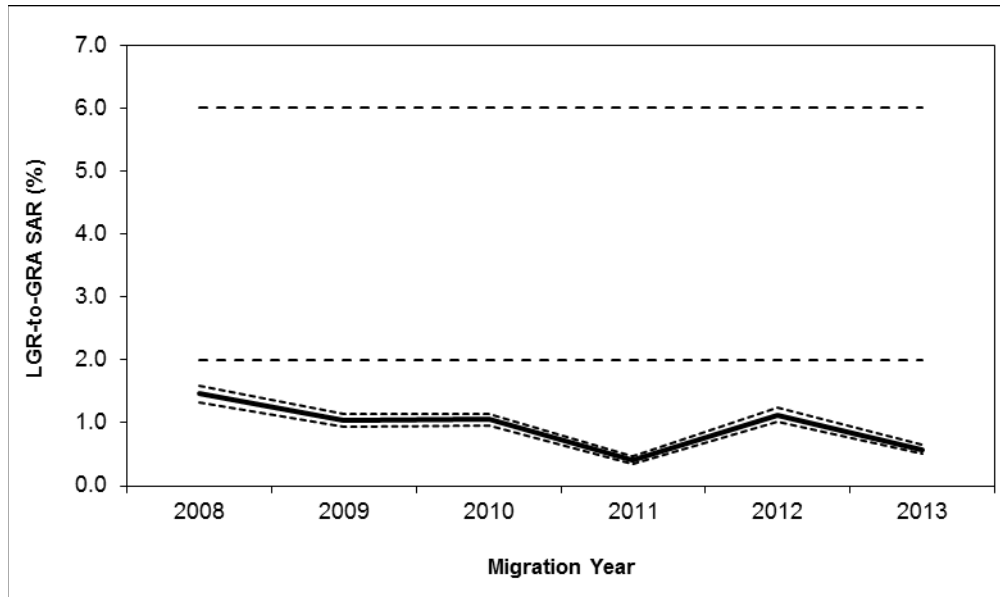


Figure 6. Overall SAR_{LGR-to-GRA} for hatchery Clearwater-B steelhead (with 90% confidence intervals). The NPCC 2-6% SAR objectives for listed wild populations are shown for reference. Migration year 2013 may be incomplete, as Age 3-salt adults returning after through 9/16/2016 are not included.

We hope that the information we have provided regarding the use and application of information from the marked groups over the last several years is of some use to you. If you would like any additional information regarding these releases please feel free to contact us.

- c: Lance Hebdon, IDFG
- Tim Copeland, IDFG
- Bill Tweit, WDFW
- Stuart Rosenberger, IPC
- Jay Hesse, Nez Perce
- Tom Rien, ODFW
- Steve Haeseker, USFWS
- Kyle Hanson, USFWS
- Erick Merrill, NPCC
- Tony Grover, NPCC
- Leslie Bach, NPCC
- FPAC

Appendix A

Table A.1. Travel times (release to LGR) of Clearwater Hatchery yearling sp/su Chinook, by release site.

Migration Year	Species Released	Release Site	Release Date(s)	Travel Time (Days)			95% Confidence Limits	
				Min	Med	Max	Lower	Upper
2006	SpCH	CROOKP	4/3	22.6	36.3	73.4	33.8	41.0
	SpCH	CROOKR	3/27	11.6	41.4	83.1	41.2	41.5
	SpCH	POWP	3/22	14.5	42.9	78.9	42.6	43.4
	SpCH	REDP	3/30	8.5	37.5	82.2	37.3	37.8
2007	SpCH	CROOKP	3/29	21.1	42.3	74.9	35.4	44.3
	SpCH	CROOKR	3/28	10.1	35.3	80.8	34.7	35.5
	SpCH	POWP	3/23	8.3	31.1	60.6	30.7	31.8
	SpCH	REDP	3/6, 3/31	10.6	33.0	80.2	32.7	33.4
2008	SpCH	CROOKP	3/26	39.4	68.2	99.2	63.2	72.6
	SpCH	CROTRP	3/24	26.2	49.7	107.9	49.0	50.9
	SpCH	POWP	3/19-3/20	16.0	47.4	102.6	47.1	47.6
	SpCH	REDP	3/26	29.6	52.5	108.1	50.7	53.1
	SpCH	SELWY1	4/2-4/3	6.4	30.8	84.5	30.0	31.5
2009	SpCH	CLEARC	3/30	4.2	27.0	66.7	26.7	27.4
	SpCH	CROOKR	4/6	5.0	36.6	78.8	36.1	37.1
	SpCH	POWP	3/23, 4/1	9.3	40.4	84.4	38.6	41.4
	SpCH	REDP	4/8	4.9	37.7	80.3	37.5	38.4
	SpCH	SELWY1	4/2	4.4	24.3	69.8	23.8	24.6
2010	SpCH	CLEARC	3/25	7.7	29.0	75.6	28.7	29.2
	SpCH	POWP	3/2	46.7	59.2	96.0	58.4	59.3
	SpCH	REDR + REDP*	3/29	15.1	36.0	85.2	35.4	36.3
	SpCH	SELWY1	3/24	8.1	30.7	79.0	30.7	30.7
2011	SpCH	CLEARC	3/24-3/25	3.2	30.0	115.6	29.5	30.6
	SuCH	CROOKR	3/28	4.9	36.4	106.7	35.9	36.6
	SpCH	POWP	4/5	1.8	28.5	84.4	28.3	28.7
	SpCH	REDP	3/28	7.2	43.4	93.4	42.6	43.6
	SpCH	SELWY1	3/23	4.0	33.6	60.4	33.3	33.9
2012	SpCH	CLEARC	3/22	3.8	28.2	57.4	27.4	28.4
	SuCH	CROOKR	3/26	4.2	28.3	144.2	28.0	28.4
	SpCH	POWP	3/27	5.3	28.9	87.0	28.5	29.3
	SpCH	REDP	3/28, 4/3-4/4	5.5	29.3	71.5	28.4	29.8
	SpCH	SELWY1	3/21	4.1	28.5	62.4	28.1	29.1
2013	SpCH	CLEARC	3/19	16.0	40.6	59.0	39.7	41.0
	SuCH	CROOKR	3/20	13.3	43.5	102.8	43.0	43.6
	SpCH	POWP	3/20-3/21	10.0	41.3	83.7	40.6	41.6
	SpCH	REDP	3/27-4/3	11.7	41.4	81.0	40.5	41.5
	SpCH	SELWY1	3/18-3/19	10.8	31.4	78.9	29.4	32.6
2014	SpCH	KOOS	3/28	1.3	27.5	69.5	27.4	27.7
	SpCH	MEADOC	3/20	6.3	34.6	81.5	34.4	35.1
	SuCH	POWP	3/31	5.3	25.9	83.1	25.6	26.4
	SpCH	REDP	3/25	3.9	41.5	226.2	41.4	41.5
2015	SpCH	CLEARC	3/12	13.6	22.2	57.5	21.4	23.2
	SuCH	POWP	3/24	6.1	28.1	5.7	27.6	28.4
	SpCH	REDP	3/16	9.5	36.5	83.7	35.5	37.5
	SpCH	SELWY1	3/9	9.1	23.5	202.3	23.4	23.6
2016	SpCH	CLEARC	3/21-3/23	2.4	22.6	45.5	22.5	22.9
	SuCH	POWP	3/17-3/18	6.3	26.9	70.3	26.6	27.1
	SpCH	REDP	4/11-4/14	2.5	17.8	52.8	17.3	18.5
	SpCH	SELWY1	3/14-3/15	6.2	30.4	59.6	30.3	30.6

* 9 PIT-tagged fish from REDP were combined with the REDR release for estimation of timing data.

Table A.2. Travel times (release to LGR) of Clearwater Hatchery steelhead, by release site.

Migration Year	Release Site	Release Date(s)	Travel Time (Days)			95% Confidence Limits	
			Min	Med	Max	Lower	Upper
2008	CLWRSF	4/7-4/15	3.8	18.8	48.8	18.1	19.3
	CROOKR	4/7-4/9	15.1	38.3	88.1	37.2	38.7
	LOLOC	4/21	7.8	19.5	42.0	18.5	21.4
	MEAD2C	4/18	10.8	21.8	48.5	20.7	22.9
	MILL2C	4/18	15.1	26.8	53.4	24.3	28.4
	REDR	4/10-4/11	18.2	33.3	83.8	32.5	34.3
2009	CLWRSF	4/14-4/16	3.7	9.4	68.2	9.2	9.5
	CROOKR	4/17	4.5	24.4	52.1	23.4	25.3
	LOLOC	4/28	3.4	9.1	41.3	8.6	9.5
	REDP	4/13	7.6	17.3	81.0	14.5	20.9
	REDR	4/13	8.3	23.7	70.8	13.8	25.9
2010	CLWRSF	4/15-4/19	3.4	11.8	55.5	11.5	12.5
	CROOKR	4/14	10.7	30.2	55.2	27.4	34.7
	KOOS	4/20	2.6	7.5	51.9	6.8	8.3
	REDP	4/12	9.5	24.5	73.8	22.7	25.9
2011	CLWRSF	4/12-4/18	1.4	20.8	87.8	20.4	21.4
2012	MEAD2C	4/10-4/11	4.4	16.6	68.5	16.3	17.2
	NEWSOC	4/12	5.5	31.7	59.9	30.5	32.7
2013	CLWRSF	4/9	3.4	6.5	38.4	6.1	6.8
	MEAD2C	4/8-4/12	0.7	12.7	74.5	11.3	13.6
	NEWSOC	4/10	6.4	31.5	56.1	30.6	32.4
2014	CLWRSF	4/14	3.4	7.4	63.2	6.8	7.8
	MEAD2C	4/16	2.5	8.8	71.5	8.5	9.3
	NEWSOC	4/17	4.6	16.5	52.4	12.4	19.2
2015	CLWRSF	4/6	3.4	7.3	44.8	6.8	7.8
	MEAD2C	4/8	3.4	12.3	67.8	11.2	12.7
	NEWSOC	4/9	6.7	14.9	60.5	12.9	18.7
2016	CLWRSF	4/6-4/7	3.3	5.7	51.7	5.6	5.9
	MEAD2C	3/28	5.4	18.5	68.5	18.3	19.4
	NEWSOC	4/4-4/5	4.3	14.5	58.4	13.1	16.5

Table A.3. Estimated 10%, 50%, and 90% passage dates of PIT-tagged Clearwater Hatchery yearling spring and summer Chinook at Lower Granite Dam, by release site.

Migration Year	Species Released	Release Site	Release Date(s)	10% Passage Date	50% Passage Date	90% Passage Date
2006	SpCH	CROOKP	4/3	5/1	5/10	5/20
	SpCH	CROOKR	3/27	4/25	5/7	5/18
	SpCH	POWP	3/22	4/25	5/4	5/10
	SpCH	REDP	3/30	4/27	5/6	5/15
2007	SpCH	CROOKP	3/29	4/26	5/10	5/17
	SpCH	CROOKR	3/28	4/17	5/1	5/14
	SpCH	POWP	3/23	4/14	4/22	5/3
	SpCH	REDP	3/6, 3/31	4/21	5/3	5/15
2008	SpCH	CROOKP	3/26	5/12	6/2	6/18
	SpCH	CROTRP	3/24	5/3	5/17	6/6
	SpCH	POWP	3/19-3/20	4/21	5/7	5/18
	SpCH	REDP	3/26	5/7	5/19	6/8
	SpCH	SELWY1	4/2-4/3	4/19	5/3	5/11
2009	SpCH	CLEARC	3/30	4/12	4/26	5/8
	SpCH	CROOKR	4/6	4/22	5/13	5/20
	SpCH	POWP	3/23, 4/1	4/18	5/8	5/18
	SpCH	REDP	4/8	4/27	5/16	5/21
	SpCH	SELWY1	4/2	4/14	4/26	5/8
2010	SpCH	CLEARC	3/25	4/22	4/23	4/28
	SpCH	POWP	3/2	4/24	4/30	5/8
	SpCH	REDR + REDP*	3/29	4/27	5/4	5/20
	SpCH	SELWY1	3/24	4/22	4/24	4/20
2011	SpCH	CLEARC	3/24-3/25	4/3	4/23	5/4
	SuCH	CROOKR	3/28	4/17	5/3	5/15
	SpCH	POWP	4/5	4/15	5/3	5/11
	SpCH	REDP	3/28	4/23	5/11	5/26
	SpCH	SELWY1	3/23	4/4	4/25	5/5
2012	SpCH	CLEARC	3/22	3/29	4/21	4/30
	SuCH	CROOKR	3/26	4/13	4/24	5/7
	SpCH	POWP	3/27	4/15	4/25	5/9
	SpCH	REDP	3/28, 4/3-4/4	4/19	4/30	5/17
	SpCH	SELWY1	3/21	3/29	4/20	4/28
2013	SpCH	CLEARC	3/19	4/9	4/28	5/4
	SuCH	CROOKR	3/20	4/15	5/2	5/15
	SpCH	POWP	3/20-3/21	4/12	4/30	5/13
	SpCH	REDP	3/27-4/3	4/23	5/6	5/15
	SpCH	SELWY1	3/18-3/19	4/5	4/19	5/3
2014	SpCH	KOOS	3/28	4/13	4/24	5/5
	SpCH	MEADOC	3/20	4/8	4/24	5/4
	SuCH	POWP	3/31	4/16	4/26	5/7
	SpCH	REDP	3/25	4/24	5/5	5/19
2015	SpCH	CLEARC	3/12	3/30	4/11	4/24
	SuCH	POWP	3/24	4/6	4/21	4/26
	SpCH	REDP	3/16	4/1	4/23	5/7
	SpCH	SELWY1	3/9	3/26	4/4	4/22

*Only 9 PIT-tagged fish from the REDP release were detected at LGR. These 9 fish were combined with the REDR release.

Table A.3 (cont'd). Estimated 10%, 50%, and 90% passage dates of PIT-tagged Clearwater Hatchery yearling spring and summer Chinook at Lower Granite Dam, by release site.

Migration Year	Species Released	Release Site	Release Date(s)	10% Passage Date	50% Passage Date	90% Passage Date
2016	SpCH	CLEARC	3/21-3/23	4/9	4/14	4/24
	SuCH	POWP	3/17-3/18	3/31	4/13	4/24
	SpCH	REDP	4/11-4/14	4/23	4/30	5/9
	SpCH	SELWY1	3/14-3/15	3/30	4/14	4/25

*Only 9 PIT-tagged fish from the REDP release were detected at LGR. These 9 fish were combined with the REDR release for estimation of timing data.

Table A.4. Estimated 10%, 50%, and 90% passage dates of PIT-tagged Clearwater Hatchery steelhead at Lower Granite Dam, by release site.

Migration Year	Release Site	Release Date(s)	10% Passage Date	50% Passage Date	90% Passage Date
2008	CLWRSF	4/7-4/15	22-Apr	3-May	15-May
	CROOKR	4/7-4/9	7-May	18-May	29-May
	LOLOC	4/21	3-May	14-May	21-May
	MEAD2C	4/18	4-May	11-May	20-May
	MILL2C	4/18	8-May	17-May	21-May
	REDR	4/10-4/11	6-May	17-May	26-May
2009	CLWRSF	4/14-4/16	22-Apr	24-Apr	11-May
	CROOKR	4/17	6-May	12-May	22-May
	LOLOC	4/28	3-May	7-May	21-May
	REDP	4/13	23-Apr	2-May	22-May
	REDR	4/13	23-Apr	7-May	31-May
2010	CLWRSF	4/15-4/19	25-Apr	30-Apr	18-May
	CROOKR	4/14	30-Apr	13-May	2-Jun
	KOOS	4/20	24-Apr	28-Apr	11-May
	REDP	4/12	24-Apr	6-May	24-May
2011	CLWRSF	4/12-4/18	20-Apr	7-May	22-May
2012	MEAD2C	4/10-4/11	17-Apr	27-Apr	13-May
	NEWSOC	4/12	25-Apr	12-May	23-May
2013	CLWRSF	4/9	14-Apr	16-Apr	3-May
	MEAD2C	4/8-4/12	16-Apr	21-Apr	14-May
	NEWSOC	4/10	20-Apr	11-May	17-May
2014	CLWRSF	4/14	19-Apr	21-Apr	5-May
	MEAD2C	4/16	22-Apr	25-Apr	17-May
	NEWSOC	4/17	23-Apr	3-May	22-May
2015	CLWRSF	4/6	11-Apr	13-Apr	3-May
	MEAD2C	4/8	14-Apr	19-Apr	11-May
	NEWSOC	4/9	18-Apr	24-Apr	14-May
2016	CLWRSF	4/6-4/7	11-Apr	12-Apr	25-Apr
	MEAD2C	3/28	6-Apr	16-Apr	28-Apr
	NEWSOC	4/4-4/5	11-Apr	20-Apr	10-May