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MEMORANDUM

TO: Andrea Pearl, Colville Tribes Fish & Wildlife

FROM: Michele DeHart

DATE: January 25, 2013

RE: Juvenile survival estimates and SARs of Upper Columbia River stocks

In response to your request, the FPC staff reviewed historic PIT-tagging efforts for summer Chinook from the Okanogan River in order to determine whether estimation of juvenile survivals and/or Smolt-to-Adult Survivals (SARs) is possible. In addition, the FPC staff has reviewed various FPC Annual Reports, Annual Hatchery Reports, and the most recent Comparative Survival Study (CSS) Annual Report and compiled juvenile survival and SAR data for other Upper Columbia River Chinook and steelhead stocks. Fish Passage Center Annual Reports are available on-line at http://www.fpc.org/documents/FPC_Annual_Reports.html. Furthermore, CSS Annual Reports are available on-line at <http://www.fpc.org/documents/CSS.html>. Below are the results from our review of PIT-tagging efforts on the Okanogan River, as well as results from our review of past FPC and CSS reports. We hope you find this information useful in answering your questions about Okanogan River summer Chinook.

Juvenile Survival Estimates of Okanogan River summer Chinook:

In our review of historic PIT-tagging efforts of Okanogan River stocks, we found that sufficient PIT-tagging efforts of summer Chinook have only occurred in the past two migration years (2011 and 2012). Per your request, we estimated juvenile survival from the release site to John Day Dam reach, for each of these two migration years (Table 1). Estimation of juvenile survival from release to Bonneville Dam requires a juvenile PIT-tag detection site below Bonneville Dam. While such a site exists for spring migrants, the out-migration timing of these

groups was too late for detections below Bonneville Dam. Furthermore, estimation of SARs for these two migration years is not yet possible, as adult returns are not expected for another few years.

Table 1. Juvenile survival estimates (Rel-MCN, MCN-JDA, and Rel-JDA) of wild summer Chinook tagged and released above Wells Dam, near the mouth of the Okanogan River. 95% confidence limits are in parentheses.

Migr. Year	Release Site(s)	Coord. ID	Release Date(s)	Rel. to MCN Survival	MCN to JDA Survival	Rel to JDA Survival
2011	OKANR,COLR8	CSM	6/22-7/10	0.30 (0.26-0.35)	0.63 (0.41-0.80)	0.19 (0.11-0.27)
2012	COLR8	CSM	6/27-7/14	0.39 (0.33-0.46)	0.70 (0.44-0.87)	0.27 (0.28-0.38)

Juvenile Survival Estimates and SARs of other Upper Columbia Stocks from FPC Annual Reports:

The Smolt Monitoring Program (SMP) supports PIT-tagging efforts at many Upper Columbia River hatcheries and Rock Island Dam (RIS) for the purpose of providing estimates of survival for these groups. Specifically, hatchery Chinook are PIT-tagged and released from Leavenworth NFH (yearling spring Chinook), Wells Hatchery (yearling and subyearling summer Chinook), and Priest Rapids Hatchery (subyearling fall Chinook). In addition, Chinook, steelhead, and sockeye juveniles are collected, PIT-tagged, and released from RIS.

Over the years, the FPC Annual Report has provided reach survival estimates for each of these groups. Most of the data presented below are from the 2011 FPC Annual Report. In recent years, the CSS has provided estimates of SARs for some of these Upper Columbia groups in their annual reports. These SAR estimates are from McNary Dam as smolts to adults at Bonneville Dam (MCN-to-BOA). These MCN-to-BOA SARs should be considered with caution, as they overestimate the actual SAR of Upper Columbia stocks. The MCN-to-BOA SARs for Upper Columbia stocks do not account for the significant juvenile mortality that occurs during their out-migration through the hydrosystem above McNary Dam. For example, a review of the juvenile survival estimates from Rock Island to McNary dams (Tables 6 through 9) indicates that mortality can be substantial in this river reach alone.

Estimates of juvenile survival and SARs (where applicable) from the hatchery releases are provided below (Tables 2 through 5). Juvenile survival estimates are annual estimates from release to McNary Dam (MCN) and were taken from the Smolt Monitoring Section of various FPC Annual Reports. Estimates of MCN-to-BOA SARs do not include jacks and were taken from Chapter 4 of the 2012 CSS Annual Report.

Table 2. Juvenile survival estimates and MCN-to-BOA SARs (without jacks) of Leavenworth NFH yearling spring Chinook tagged and released for the SMP. 95% (survivals) and 90% (SARs) confidence limits are in parentheses.

Migration Year	Release Date(s)	Survival (Rel. to MCN)	Overall SAR (MCN-to-BOA)
1998	20-Apr	0.55 (0.49-0.60)	N/A
1999	19-Apr	0.59 (0.55-0.62)	N/A
2000	18-Apr	0.59 (0.52-0.67)	1.83 (1.45-2.21)
2001	17-Apr	0.50 (0.48-0.52)	0.24 (0.13-0.37)
2002	22-Apr, 24-Apr	0.56 (0.55-0.57)	0.36 (0.34-0.39)
2003	21-Apr	0.66 (0.65-0.67)	0.43 (0.40-0.45)
2004	19-Apr	0.48 (0.47-0.49)	0.34 (0.31-0.37)
2005	15-Apr	0.53 (0.50-0.55)	0.09 (0.04-0.15)
2006	17-Apr	0.56 (0.53-0.58)	0.89 (0.72-1.09)
2007	18-Apr	0.59 (0.57-0.61)	0.46 (0.34-0.59)
2008	28-Apr	0.57 (0.53-0.61)	1.91 (1.65-2.18)
2009	28-Apr	0.48 (0.44-0.52)	0.57 (0.43-0.72)
2010	23-Apr, 26-Apr	0.66 (0.60-0.72)	0.75 (0.61-0.90) ^A
2011	19-Apr, 20-Apr	0.43 (0.38-0.47)	N/A
2012 ^B	17-Apr, 18-Apr	0.59 (0.55-0.63)	N/A

^A Incomplete adult return with 2-salts through September 10, 2012.

^B 2012 survival estimate is preliminary and taken from 2012 Leavenworth NFH Hatchery Report (posted to FPC website on December, 2012). Final estimate of survival will be available in 2012 FPC Annual Report (due out in draft form in June 2013).

Table 3. Survival estimates of Wells Hatchery subyearling Chinook tagged and released for the SMP (May Releases).

Migration Year	Release Date	Survival (Rel to MCN)	95% Confidence Limits	
			Lower	Upper
2004	12-May	0.251	0.205	0.296
2005	18-May	0.341	0.243	0.456
2006	12-May	0.376	0.285	0.478
2007	17-May	0.260	0.189	0.347
2008	13-May	0.371	0.298	0.444
2009	15-May	0.284	0.204	0.364
2010	17-May	0.317	0.241	0.393
2011	19-May	0.527	0.380	0.670
2012 ^A	15-May	0.247	0.178	0.332

^A 2012 survival estimate is preliminary and taken from 2012 Wells Hatchery Report (posted to FPC website on December 28, 2012). Final estimate of survival will be available in 2012 FPC Annual Report (due out in draft form in June 2013).

Table 4. Survival estimates of Wells Hatchery subyearling Chinook tagged and released for the SMP (June Releases). These data were compiled from FPC Annual Reports (Smolt Monitoring Section). There have been no June releases from Wells Hatchery since 2008.

Migration Year	Release Date	Survival (Rel to MCN)	95% Confidence Limits	
			Lower	Upper
1997	24-June	0.254	0.170	0.338
1998	10-June	0.291	0.241	0.340
1999	19-June	0.373	0.281	0.465
2000	19-June	0.210	0.168	0.253
2001	20-June	0.211	0.166	0.257
2002	17-June	0.449	0.395	0.503
2003	17-June	0.456	0.406	0.506
2004	15-June	0.160	0.106	0.215
2005	13-June	N/A	N/A	N/A
2006	14-June	0.352	0.199	0.534
2007	15-June	0.281	0.155	0.454
2008	16-June	0.294	0.190	0.398

Table 5. Survival estimates of Priest Rapids Hatchery subyearling fall Chinook tagged and released for the SMP. These data were compiled from FPC Annual Reports (Smolt Monitoring Section).

Migration Year	Release Dates	Survival (Rel-MCN)	95% Confidence Limits	
			Lower	Upper
1997	June 16-24	0.568	0.458	0.679
1998	June 13-25	0.840	0.639	0.940
1999	June 14-23	0.757	0.679	0.836
2000	June 15-27	0.666	0.577	0.755
2001	June 11-19	0.746	0.670	0.794
2002	June 11-19	0.697	0.627	0.767
2003	June 12-20	0.633	0.590	0.677
2004	June 14-22	0.775	0.689	0.861
2005	June 09-17	0.655	0.573	0.729
2006	June 12-20	0.671	0.577	0.765
2007	June 13-21	0.686	0.564	0.808
2008	June 12-20	0.646	0.485	0.807
2009	June 11-19	0.626	0.510	0.742
2010	June 9-17	0.647	0.514	0.780
2011	June 15-23	0.820	0.452	0.962
2012 ^A	June 12-20	0.500	0.358	0.642

^A 2012 survival estimate is preliminary and taken from 2012 Priest Rapids Hatchery Report (posted to FPC website on December 28, 2012). Final estimate of survival will be available in 2012 FPC Annual Report (due out in draft form in June 2012).

To put out-migration conditions into context, Figure 1 provides the total flow volume (Apr. 15-Aug. 31) for the Upper Columbia River (as measured at Priest Rapids Dam), along with the average spill proportions at each of Rocky Reach, Rock Island, Wanapum, and Priest Rapids dams, for each migration year.

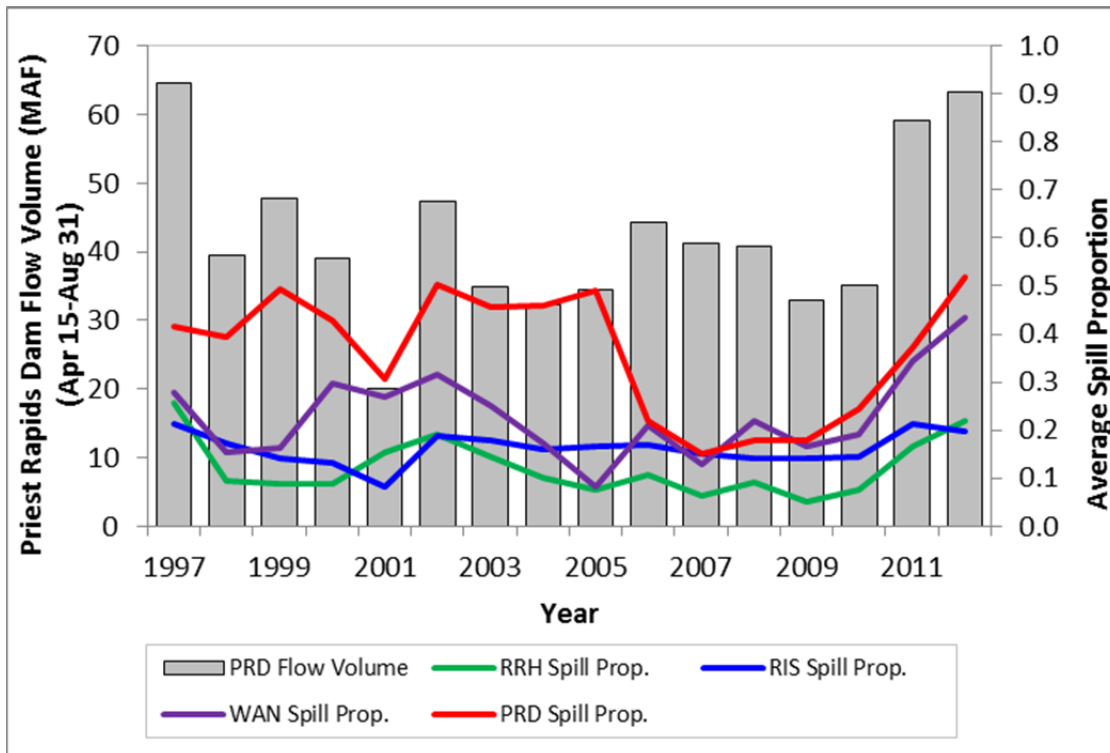


Figure 1. Total flow volume in the Upper Columbia River (at Priest Rapids Dam) and average spill proportion at Rocky Reach, Rock Island, Wanapum, and Priest Rapids dams. Spring period is April 15-August 31.

The FPC Annual Report also provides survival estimates from juvenile salmonids that are PIT-tagged and released from Rock Island Dam (RIS). These survival estimates are for the RIS to MCN reach (Tables 6 through 9). These PIT-tagged juveniles are grouped into up to five two-week blocks for estimation of survival and environmental variables encountered by these juveniles during their out-migration. Environmental variables used in these analyses include: median fish travel time (FTT), water transit time (WTT), average spill percent, and average temperature (°C). Among the groups that the FPC Annual Report provides estimates of RIS-MCN survival for are: 1) hatchery and wild yearling Chinook (Table 6), 2) hatchery and wild steelhead (Table 7), 3) hatchery and wild subyearling Chinook (Table 8), and 4) hatchery and wild sockeye (Table 9). Analyses of these RIS PIT-tagged groups for migration year 2012 have not been done yet. However, they will be available in the 2012 FPC Annual Report, which will be available in draft form in June 2013.

Table 6. Estimates of survival and fish travel time for hatchery and wild yearling Chinook salmon in the reach from Rock Island Dam to McNary Dam and the environmental covariates used the in the analysis. These data were taken from the 2011 FPC Annual Report (Appendix H, Table H-8).

Migration Year	Release Dates	Median FTT (days)	Survival (RIS-MCN)	Survival Variance	WTT (days)	Avg. Spill Percent	Avg. Temp. (°C)
1998	4/21-5/4	12.3	0.589	0.0034	5.6	41.5	9.2
1998	5/5-5/18	10.0	0.872	0.0202	5.1	43.2	11.3
1998	5/19-6/01	12.3	0.795	0.0621	5.0	45.4	13.1
1999	4/21-5/04	13.4	0.738	0.0016	5.6	47.4	9.4
1999	5/05-5/18	9.1	0.748	0.0042	5.5	46.8	10.8
1999	5/19-6/01	8.6	0.794	0.0185	5.3	48.0	12.4
2000	4/21-5/4	14.6	0.783	0.0123	5.4	46.5	12.1
2000	5/5-5/18	12.2	0.790	0.0101	5.8	44.0	13.9
2001	4/21-5/04	30.3	0.527	0.0008	10.5	36.1	11.8
2001	5/05-5/18	17.9	0.677	0.0028	11.7	36.3	12.8
2001	5/19-6/01	16.7	0.588	0.0049	10.1	36.1	14.3
2002	4/21-5/4	15.8	0.637	0.0019	6.5	38.8	10.2
2002	5/5-5/18	10.2	0.678	0.0015	6.3	39.5	11.0
2002	5/19-6/01	9.0	0.603	0.0063	5.3	48.2	12.3
2004	5/05-5/18	8.4	0.515	0.0056	6.8	38.5	11.6
2004	5/19-6/01	10.4	0.543	0.0575	6.5	36.8	13.1
2005	4/21-5/4	11.4	0.540	0.0132	7.3	40.2	10.4
2005	5/5-5/18	9.8	0.633	0.0176	6.4	37.0	11.6
2005	5/19-6/01	10.2	0.507	0.0287	7.1	36.7	13.3
2006	4/21-5/04	10.4	0.595	0.0118	5.2	34.2	9.4
2006	5/19-6/01	10.6	0.364	0.0311	4.6	39.3	12.6
2007	4/21-5/4	8.7	0.649	0.0288	5.6	27.2	9.5
2007	5/5-5/18	9.1	0.599	0.0063	5.6	23.1	11.3
2007	5/19-6/01	8.9	0.749	0.0219	5.8	23.3	13.0
2008	4/21-5/04	14.0	0.549	0.0171	6.6	19.9	8.8
2008	5/05-5/18	8.5	0.720	0.0620	5.2	27.0	10.6
2008	5/19-6/01	6.2	0.456	0.0324	4.4	41.2	11.8
2009	4/21-5/4	20.4	0.669	0.0356	6.2	25.6	8.8
2009	5/5-5/18	11.6	0.593	0.0240	6.1	26.3	10.7
2010	4/21-5/04	11.2	0.496	0.0151	8.0	26.8	9.7
2011	4/21-5/04	11.2	0.489	0.0093	5.8	22.0	8.8

Table 7. Estimates of survival and fish travel time for hatchery and wild steelhead in the reach from Rock Island Dam to McNary Dam and the environmental covariates used the in the analysis. These data were taken from the 2011 FPC Annual Report (Appendix H, Table H-9).

Migration Year	Release Dates	Median FTT (days)	Survival (RIS-MCN)	Survival Variance	WTT (days)	Avg. Spill Percent	Avg. Temp. (°C)
1998	4/21-5/4	8.4	0.586	0.0033	5.7	40.5	9.3
1998	5/5-5/18	5.9	0.650	0.0081	5.1	42.3	11.2
1998	5/19-6/1	7.7	0.481	0.0067	4.7	46.7	12.8
1999	4/21-5/04	6.2	0.677	0.0034	5.3	47.9	9.2
1999	5/05-5/18	6.3	0.611	0.0017	5.6	46.4	10.6
1999	5/19-6/01	7.4	0.657	0.0069	5.1	48.6	12.4
2000	4/21-5/4	6.0	0.913	0.0347	5.0	45.8	11.1
2000	5/5-5/18	5.8	0.657	0.0096	5.5	45.1	12.9
2000	5/19-6/01	7.7	0.405	0.0155	6.6	42.9	13.3
2001	4/21-5/4	19.0	0.247	0.0010	11.3	33.9	11.2
2001	5/5-5/18	17.5	0.231	0.0011	11.8	36.2	13.0
2001	5/19-6/01	17.5	0.186	0.0017	10.2	36.1	14.4
2002	4/21-5/4	6.7	0.764	0.0146	6.4	39.9	10.0
2002	5/5-5/18	7.7	0.676	0.0042	6.3	39.1	10.9
2002	5/19-6/01	7.2	0.576	0.0055	5.1	48.6	12.4
2004	4/21-5/4	8.7	0.475	0.0808	7.5	40.0	10.5
2004	5/5-5/18	7.9	0.506	0.0105	6.8	38.5	11.7
2004	5/19-6/01	8.1	0.492	0.0231	6.5	36.9	13.1
2005	4/21-5/04	8.1	0.622	0.0095	7.5	39.9	10.3
2005	5/05-5/18	8.5	0.674	0.0085	6.3	37.0	11.6
2006	4/21-5/04	7.2	0.730	0.0182	5.0	34.0	9.3
2006	5/05-5/18	6.9	0.665	0.0060	5.1	26.9	11.4
2006	5/19-6/01	5.4	0.547	0.0025	4.3	37.8	12.3
2007	4/21-5/04	5.4	0.659	0.0313	5.6	27.2	9.1
2007	5/05-5/18	5.8	0.950	0.0445	5.4	23.1	11.2
2007	5/19-6/01	7.6	0.506	0.0104	5.7	23.6	13.1
2008	4/21-5/04	9.2	0.811	0.0885	7.1	19.4	8.5
2008	5/05-5/18	8.1	0.588	0.0040	5.1	26.5	10.7
2008	5/19-6/01	6.9	0.574	0.0027	4.1	42.2	11.9
2009	4/21-5/4	9.2	0.503	0.0072	6.7	24.1	7.9
2009	5/05-5/18	8.1	0.497	0.0017	6.2	25.5	10.5
2009	5/19-6/01	6.9	0.528	0.0109	5.1	29.3	12.6
2010	4/21-5/4	8.6	0.604	0.0085	8.0	26.8	10.8
2010	5/05-5/18	8.3	0.499	0.0055	6.8	24.8	12.4
2011	4/21-5/4	7.4	0.568	0.0113	5.9	23.3	9.7
2011	5/05-5/18	5.5	0.739	0.0105	4.3	45.3	11.3
2011	5/19-6/01	4.2	0.632	0.0131	3.2	61.4	11.8

Table 8. Estimates of survival and fish travel time for hatchery and wild subyearling Chinook in the reach from Rock Island Dam to McNary Dam and the environmental covariates used the in the analysis. These data were taken from the 2011 FPC Annual Report (Appendix H, Table H-10).

Migration Year	Release Dates	Median FTT (days)	Survival (RIS-MCN)	Survival Variance	WTT (days)	Avg. Spill Percent	Avg. Temp. (°C)
2000	6/20-7/3	21.8	0.560	0.00745	7.7	12.4	17.1
2000	7/4-7/17	20.9	0.783	0.01696	8.1	29.0	18.4
2000	7/18-7/31	18.7	0.616	0.00604	8.1	29.2	19.4
2000	8/1-8/14	11.1	0.630	0.00720	8.7	27.1	19.5
2001	6/20-7/3	32.7	0.285	0.00528	14.6	18.4	18.0
2001	7/4-7/17	25.6	0.400	0.00104	15.6	18.4	19.1
2001	7/18-7/31	23.7	0.252	0.00098	15.0	10.1	19.5
2001	8/1-8/14	18.8	0.258	0.00197	13.2	1.2	19.4
2001	8/15-8/31	16.1	0.129	0.00213	14.4	2.0	19.1
2002	6/20-7/3	12.2	0.777	0.01298	4.9	44.9	15.7
2002	7/4-7/17	11.7	0.797	0.00480	6.0	36.5	17.5
2002	7/18-7/31	16.3	0.758	0.00299	7.9	28.9	18.8
2002	8/1-8/14	11.6	0.621	0.00413	8.7	25.0	19.2
2003	6/20-7/3	11.7	0.618	0.01143	8.4	25.8	17.0
2003	7/4-7/17	12.0	0.464	0.00254	9.0	29.0	18.9
2003	7/18-7/31	8.4	0.276	0.00455	9.7	28.6	20.1
2003	8/1-8/14	9.5	0.293	0.00783	10.2	21.7	20.6
2004	6/20-7/3	13.0	0.441	0.03558	8.1	27.9	17.8
2004	7/4-7/17	12.8	0.222	0.00170	9.8	27.9	18.8
2004	7/18-7/31	11.1	0.188	0.00453	10.6	28.0	20.0
2005	7/4-7/17	10.9	0.354	0.02450	7.2	45.7	18.3
2006	6/20-7/3	13.2	0.560	0.02813	6.5	30.7	17.4
2006	7/4-7/17	11.6	0.338	0.00519	7.2	24.8	18.8
2006	8/1-8/14	21.0	0.203	0.01606	9.9	16.2	20.1
2007	6/20-7/3	23.5	0.308	0.01622	7.3	26.0	17.6
2007	7/4-7/17	17.7	0.473	0.01169	7.4	25.3	18.7
2007	7/18-7/31	11.9	0.444	0.00793	7.9	25.1	19.3
2008	6/20-7/3	10.1	0.285	0.00343	5.0	37.3	15.6
2008	7/4-7/17	13.1	0.671	0.05265	7.6	28.9	17.6
2009	7/18-7/31	34.7	0.219	0.00299	11.5	33.4	19.9
2010	7/4-7/17	19.7	0.544	0.05876	8.6	29.2	20.8
2010	7/18-7/31	17.7	0.891	0.09442	9.9	31.6	21.4
2010	8/1-8/14	20.8	0.508	0.04084	11.4	33.2	20.4
2011	6/20-7/3	16.3	0.663	0.17727	4.0	55.1	16.6
2011	7/4-7/17	13.3	0.554	0.07052	4.8	50.7	17.7
2011	7/18-7/31	24.6	0.609	0.08696	6.4	33.0	20.0
2011	8/1-8/14	33.8	0.338	0.03640	9.1	13.0	20.0
2011	8/15-8/31	46.7	0.234	0.05157	10.9	1.8	

Table 9. Estimates of survival and fish travel time for hatchery and wild sockeye in the reach from Rock Island Dam to McNary Dam and the environmental covariates used in the analysis. These data were taken from the 2011 FPC Annual Report (Appendix H, Table H-11).

Migration Year	Release Dates	Median FTT (days)	Survival (RIS-JDA)	Survival Variance	WTT (days)	Avg. Spill Percent
1998	4/15-5/26	10.6	0.680	0.0024	5.6	43.4
1999	4/15-5/26	6.7	0.562	0.0008	5.5	44.2
2000	4/15-5/26	10.4	0.554	0.0246	5.5	43.5
2001	4/15-5/26	8.4	0.607	0.0123	11.8	27.7
2002	4/15-5/26	7.1	0.540	0.0021	6.0	42.2
2004	4/15-5/26	8.3	0.750	0.0254	7.1	38.0
2005	4/15-5/26	8.1	0.690	0.0167	7.1	37.3
2006	4/15-5/26	6.2	0.758	0.0035	4.9	34.6
2007	4/15-5/26	7.0	0.584	0.0021	5.6	25.4
2008	4/15-5/26	5.9	0.609	0.0079	5.9	27.2
2009	4/15-5/26	7.4	0.826	0.0062	6.1	23.6
2010	4/15-5/26	12.3	0.782	0.0042	7.2	25.0
2011	4/15-5/26	7.3	0.719	0.0076	4.5	41.5

Estimates of SARs of Upper Columbia Chinook and Steelhead from CSS Analyses:

In recent years, the Comparative Survival Study (CSS) has provided analyses of PIT-tagged hatchery and/or wild Upper Columbia Chinook and steelhead. Wild Chinook and steelhead smolts are trapped and PIT-tagged with screw traps in tributaries throughout the Upper Columbia Basin. These smolt traps are typically in operation for several months, during which time fish are collected, PIT-tagged, and released. Hatchery Chinook and steelhead analyzed by the CSS are generally aggregate groups released into various tributaries of the Upper Columbia River. The long period of tagging for wild stocks, along with the lack of juvenile PIT-tag detection sites between many of the release sites and MCN, makes estimating survival from release to MCN problematic. However, the CSS has provided estimates of SARs for many of these hatchery and wild Upper Columbia PIT-tag groups. Below, we have compiled these SAR estimates for the various hatchery and wild groups that have been analyzed by the CSS so far (Tables 10 through 13). These SAR estimates are from Chapter 4 of the 2012 CSS Annual Report, which is available at (<http://www.fpc.org/documents/CSS.html>).

Table 10. Overall MCN-to-BOA SARs for PIT-tagged hatchery and/or wild Chinook and steelhead from the Wenatchee, Entiat, and/or Methow river basins. 90% confidence intervals are in parentheses. SARs for Chinook are without jacks.

Migration Year	Wenatchee River wild spring Chinook	Wenatchee River hatchery steelhead^A	Entiat & Methow River wild spring Chinook	Wenatchee, Entiat, & Methow wild steelhead
2003	N/A	2.35 (2.12-2.58)	N/A	N/A
2004	N/A	1.46 (1.22-1.69)	N/A	N/A
2005	N/A	0.90 (0.77-1.03)	N/A	N/A
2006	N/A	2.29 (1.90-2.70)	0.43 (0.11-0.81) ^C	1.91 (0.90-3.08) ^C
2007	0.76 (0.54-1.02)	2.05 (1.61-2.56)	0.75 (0.26-1.27)	4.46 (3.16-5.81)
2008	2.75 (2.40-3.14)	5.78 (5.11-6.52)	2.94 (2.51-3.38)	6.68 (5.66-7.84)
2009	1.98 (1.57-2.44)	2.66 (2.23-3.12)	2.22 (1.58-2.87)	4.38 (3.44-5.32)
2010 ^B	1.20 (0.94-1.47)	N/A	1.31 (0.96-1.65)	N/A

^A Wenatchee River hatchery steelhead were reared at Wenatchee, Turtle Rock, and/or Chelan hatcheries.

^B Migration year 2010 returns incomplete with returns of 2-salts through Sept. 10, 2012

^C Migration year 2006 is Entiat River only

Table 11. Overall Rocky Reach to Bonneville SARs for PIT-tagged wild Chinook and steelhead from the Entiat, and Methow river basins. 90% confidence intervals are in parentheses. SARs for Chinook are without jacks.

Migration Year	Entiat & Methow River wild Chinook^A	Entiat, & Methow River wild steelhead
2008 ^B	1.55 (1.17-1.94)	4.77 (3.31-6.47)
2009 ^C		2.30 (1.57-3.17)
2010 ^D	0.80 (0.59-1.00)	N/A

^A The Entiat/Methow wild Chinook aggregate is the same group as used for the MCN-to-BOA SARs (Table 9). SARs are calculated as the number of adults at BOA divided by the estimated number of smolts at Rocky Reach Dam.

^B SAR estimate uses recaptures at Rocky Reach Dam

^C Too few recaptures of Chinook to estimate SARs. SAR estimates for steelhead uses recaptures at Rocky Reach Dam

^D SAR estimate used new juvenile detector and recaptures at Rocky Reach Dam. Migration year 2010 returns incomplete with returns of 2-salts through Sept. 10, 2012

Table 12. Overall **RIS-to-BOA SARs** for hatchery and wild yearling Chinook, steelhead, and subyearling Chinook PIT-tagged at Rock Island Dam. 90% confidence intervals are in parentheses. SARs for Chinook are without jacks.

Migration Year	Hatchery and wild yearling Chinook	Hatchery and wild subyearling Chinook	Hatchery and wild steelhead
2000	0.90 (0.67-1.19)	1.94 (1.60-2.33)	1.42 (1.12-1.77)
2001	0.00 (0.00-0.16)	0.00 (0.00-0.07)	0.07 (0.02-0.19)
2002	0.05 (0.01-0.16)	1.00 (0.78-1.27)	1.88 (1.54-2.27)
2003 ^A		0.28 (0.16-0.45)	
2004	0.11 (0.01-0.52)	0.03 (0.00-0.15)	0.30 (0.15-0.55)
2005	0.00 (0.00-0.41)	0.54 (0.35-0.79)	0.77 (0.52-1.10)
2006	0.18 (0.03-0.56)	0.57 (0.39-0.80)	0.88 (0.63-1.20)
2007	0.00 (0.00-0.35)	0.31 (0.17-0.51)	0.90 (0.66-1.21)
2008	0.47 (0.16-1.08)	1.03 (0.77-1.35)	3.21 (2.84-3.60)
2009	0.73 (0.29-1.52)	0.37 (0.17-0.69)	1.09 (0.87-1.36)
2010 ^B	0.38 (0.10-0.97)	0.11 (0.04-0.25)	N/A

^A No data for 2003 due to bypass inoperable during spring outmigration

^B Incomplete returns with 2-salts through September 10, 2012

Table 13. Overall **MCN-to-BOA SARs** for PIT-tagged hatchery and/or wild Chinook and steelhead from the Yakima River Basin. 90% confidence intervals are in parentheses. SARs for Chinook are without jacks.

Migration Year	Cle Elum Hatchery spring Chinook	Yakima River Wild spring Chinook	Yakima River wild steelhead
2000	3.81 (3.47-4.14)	6.90 (6.10-7.73)	N/A
2001	0.28 (0.19-0.37)	1.54 (0.73-2.52)	N/A
2002	1.37 (1.19-1.55)	2.25 (1.73-2.80)	8.12 (5.13-11.33)
2003	0.59 (0.49-0.71)	2.47 (1.97-3.06)	7.85 (5.02-11.08)
2004	1.54 (1.30-1.78)	3.70 (2.83-4.57)	2.86 (1.39-4.76)
2005	0.66 (0.49-0.84)	1.35 (0.56-2.31)	4.94 (2.56-7.52)
2006	1.25 (1.07-1.44)	1.59 (0.72-2.57)	4.03 (2.32-6.03)
2007	1.01 (0.87-1.16)	1.93 (0.87-3.30)	7.30 (3.12-12.67)
2008	3.12 (2.81-3.42)	6.87 (4.88-8.90)	9.79 (5.77-14.24)
2009	1.78 (1.60-1.96)	4.96 (3.82-6.14)	5.33 (3.25-8.18)
2010 ^A	1.49 (1.30-1.68)	N/A	N/A

^A Incomplete returns with 2-salts through September 10, 2012