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MEMORANDUM

TO: Rob Lothrop, CRITFC

FROM: Michele DeHart

DATE: April 24, 2012

RE: Review of "Adult Upper Columbia River and Snake River Spring Chinook Salmon and Steelhead Survival through the Federal Columbia River Power System Hydroelectric Projects" Final Phase I Report June 29, 2011

In response to your request the Fish Passage Center staff reviewed the subject report. Our summary conclusions are listed, followed by detailed discussion of each point. Our approach to this review began with a thorough review of the document and replication of the analyses utilizing the same methods described in the report. Our overall conclusions are:

- The Peven analyses are based upon adult salmon and steelhead PIT tagged as juveniles for a myriad of other studies and purposes. The tags have not been applied in proportion to the run-at large and therefore cannot support conclusions relative to the run-at-large.
- Neither the Peven et al. analyses or the FPC analyses supports the conclusion that there is a significant difference in upstream migration success of upper Columbia Chinook and steelhead compared to Snake River salmon and steelhead.
- There is a higher degree of uncertainty in the Upper Columbia survival estimates as compared to the Snake River survival estimates primarily because of smaller tag groups.
- When using the combined in-river and transported smolt groups for hatchery and wild steelhead, Upper Columbia adult survival was significantly lower than for Snake River adults only in the 2004 and 2005 adult return years. In these two years the Upper Columbia River adult tag return group was composed primarily of Ringold Hatchery steelhead marked for the McNary transportation study. This raises serious questions about the applicability of these results to the Upper Columbia run-at-large.

- When using the combined in-river and transported smolt groups for hatchery and wild Chinook, Upper Columbia adult survival was significantly higher than for their Snake River counterparts in the 2010 adult return year.
- We do not agree with the overall conclusions and recommendations in the Peven et al. analyses. Rather than recommending adult telemetry studies, we believe increasing PIT tag mark groups in the Upper Columbia would provide complete life cycle information including adult success rate. This is consistent with the Peven et al. model analyses which indicate that juvenile passage history, origin and year class affect adult upstream success rate.
- Although the model results indicate that origin (hatchery or wild) affect adult migration success rate there was no discussion of the fact that over 95% of production from the Upper Columbia is hatchery origin, compared to a smaller hatchery proportion from the Snake River basin. In addition, there was no discussion of the potential effect of mark select sport fisheries for hatchery fish in the Bonneville to McNary reach.
- Both the Peven et al. analyses and the FPC analyses are based upon detection of adult PIT tagged fish at Bonneville Dam and their subsequent detections at upstream sites. A large component of the Upper Columbia PIT tags originated from a study of transportation of upper Columbia Chinook and steelhead at McNary Dam. Coincidently the greatest differences observed by Peven et al. and FPC for steelhead, were in the years of the McNary transportation study. Although the Peven et al. model analyses included transported smolts it did not include consideration of a McNary transportation interaction variable.
- Transportation at McNary for spring migrants is no longer implemented as a management action; therefore the results for the years of the McNary transportation study, return years 2004-2007 are irrelevant.
- The Peven et al. report is comprised of a model analyses and an analyses of empirical data. We agree with the Peven et al. model analyses that indicate that juvenile smolt transportation negatively effects adult upstream migration success. This is consistent with other analyses. However, when calculating survival estimates Peven et al. states that transported fish were removed and only in-river outmigrants were included (table 2; figures 1 and 2). We do not agree, because this does not reflect actual conditions, for fish passage or fisheries.
- The Peven et al. comparison of upper Columbia and Snake adult migration survival displayed in Table 2 of the analyses, does not reflect actual passage or harvest management because all Snake River transported fish were removed from the survival estimates (table 2; figures 1 and 2). A large portion of the juvenile migrants from the Snake River have been transported and this has varied across years. For example, 99% of Snake River wild Chinook run as a whole were transported in 2001 and 42% was transported in 2008. Peven et al. does not account for this and likely overestimates Snake River survival. Data and analyses clearly indicate that juvenile migration history affects adult survival. The analysis clearly recognizes this in the logistic model but excludes transported fish in the survival estimates. However, the analyses do not discuss or investigate juvenile migration history of Upper Columbia salmon and steelhead compared to the Snake River migrants.
- The adult return is one portion of the life cycle of threatened salmon and steelhead and should not be evaluated without considering its relative importance as compared to all

portions of the entire life cycle. Impacts may occur in any phase of the life-cycle or effects from previous experiences may extend into later life stages including the effects of juvenile passage experience on adult success.

The Peven analyses are based upon adult salmon and steelhead PIT tagged as juveniles for a myriad of studies and purposes. The tags have not been applied in proportion to the run-at large and therefore cannot support conclusions relative to the run-at-large.

The authors do not consider the composition of their mark groups or the original purpose of the PIT tag groups that they use in the subsequent adult analyses. Since the PIT tag groups utilized in the Peven analyses were not marked to represent the run-at-large it is possible that some of the observations in the data may represent specific stock or specific hatchery characteristics or specific study treatments that could affect upstream migration success rate. For example, the FPC analyses found that there was only a difference in upstream migration success for steelhead in 2004 and 2005. In those years the mark group was heavily weighted to marked steelhead from Ringold hatchery that was part of the McNary transportation study. In the comparison of in-river and transported fish, this group, comprised primarily of Ringold hatchery steelhead, had a lower upstream survival. The results and differences observed could reflect higher stray rates of Ringold hatchery steelhead or could reflect the short distance between McNary and Ringold Hatchery, and larger transportation and or passage effects on that specific group.

Neither the Peven et al. analyses or the FPC analyses supports the conclusion that there is a significant difference in upstream migration success of upper Columbia Chinook and steelhead compared to Snake River salmon and steelhead.

Table 2, Page 12, of Peven et al. summarizes survival estimates. This table should be considered with caution. The FPC calculated confidence intervals on the data described in this table which showed that, even in the author's analyses, a significant difference in upstream survival estimates only occurred in 5 of the nine years examined. The conclusion on page 11; "Upper Columbia survival rates are lower every year for both steelhead and Chinook salmon (preliminary estimates for 2010)" is not supportable when confidence intervals are calculated for the point estimates in Peven Table 2.

Peven concludes that Upper Columbia salmon and steelhead have faster upstream migration rates and lower fall back rates when compared to Snake River adults. This apparent contradiction with the overall conclusion that Upper Columbia salmon and steelhead have a lower upstream migration survival rate is not discussed.

The FPC repeated the analyses using the same methods described in the report. The full re-analyses is described in detail in the following discussion. In completing the re-analyses the FPC generated Table 2 of the Peven analyses using the methods described in the report. However, the FPC analysis does not remove Snake River transported fish, but instead compares in-river fish to in river fish and transported fish with transported fish. In generating the same survival summary statistics, the FPC also calculated confidence intervals and p values on each annual estimate and tested for significant differences between Snake and Upper Columbia annual adult survival.

There was no statistically significant difference in adult survival between Snake River and Upper Columbia River adult migrants except for 2004 and 2005 (the years of the McNary transportation study), for steelhead, when transported and in-river fish from both basins were compared.

The Peven analysis was recreated by querying the PTAGIS database for adult returns to BON in the years 2002 – 2010. Fish were included or excluded from the analysis using the same criteria outlined in Peven et al. Included were those fish tagged as juveniles who were of known origin (hatchery or wild), known outmigration status (transported or in-river), and originated in the Snake or Upper Columbia ESU (Chinook) or DPS (Steelhead). For Chinook, spring and summer yearlings were used from the Snake and spring yearlings were used from the Upper Columbia. The sample sizes obtained from PTAGIS given these criteria were higher than those used in Peven et al. This is possibly due to the incomplete returns for 2010 used in Peven et al. However, because the sample sizes used in Peven et al are shown only in total and not by year, the reason for the difference in sample sizes cannot be determined.

Instead of excluding fish transported from the Snake River as done in Peven et al. adult success rate was considered in three ways because review of the Peven analyses indicated that a transportation interaction might be occurring. Because juvenile fish transportation effects adult success rate, the FPC analyses compared; 1) in-river juvenile migrants from the Snake River to in-river juvenile migrants from the Upper Columbia, 2) Upper Columbia fish that were transported at McNary to Snake River fish transported at the Snake River projects and 3) Upper Columbia transported and in-river migrants combined and compared to Snake River transported and in-river migrants combined. In these results, 1-salt returns (jacks) were not included for Chinook but were included for Steelhead. For each comparison of Upper Columbia and Snake River stocks a relatively common method was used to calculate binomial confidence intervals. The binomial 95% confidence intervals were calculated with program R (R Development Core Team 2010) employing the Clopper Pearson method (Clopper Pearson 1934). The Clopper Pearson method is based on the cumulative probabilities of the binomial distribution and satisfies the following two conditions:

$$\sum_{k=x}^{n} \binom{n}{k} P_{LL^k} (1 - P_{LL})^{n-k} = \frac{\alpha}{2}$$

and,

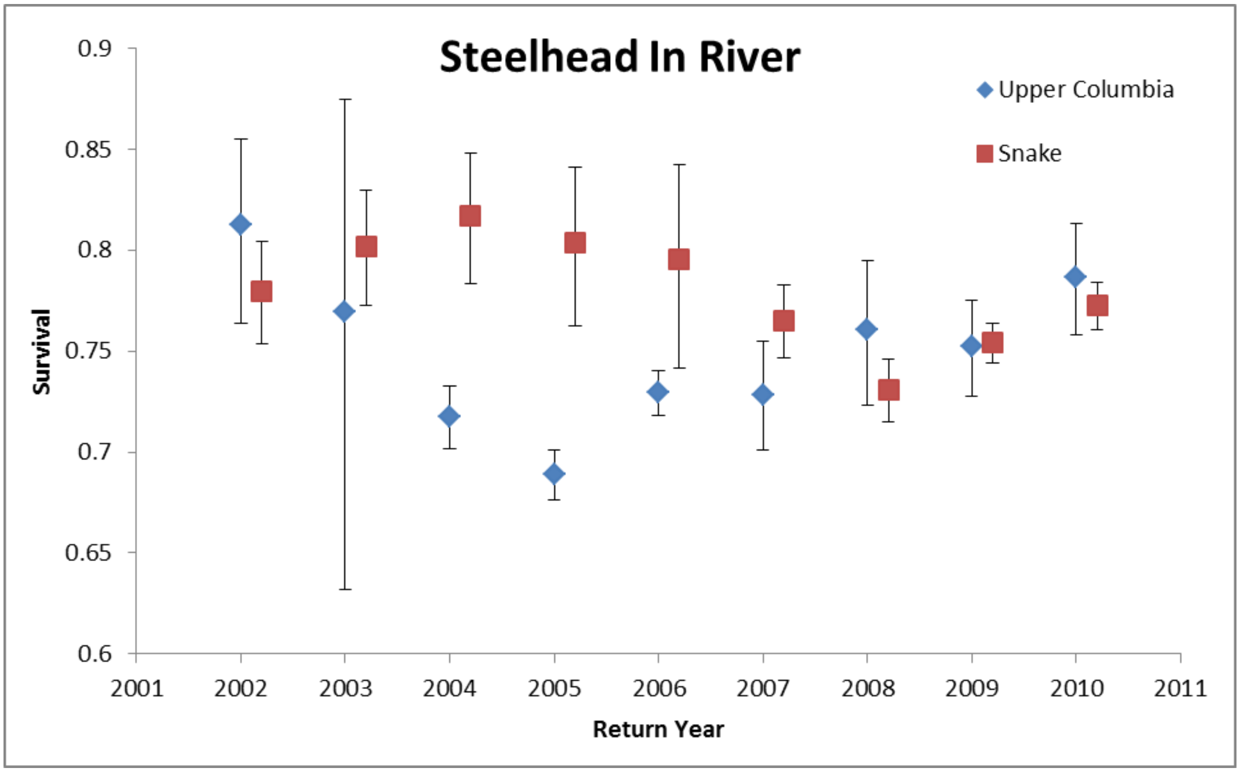
$$\sum_{k=0}^{x} \binom{n}{k} P_{UL^k} (1 - P_{UL})^{n-k} = \frac{\alpha}{2}$$

where

P_{UL} = confidence interval upper bound
P_{LL} = confidence interval lower bound
n = number of adult detects at BON
x = number of adult detects at MCN
α = confidence level

Figure 1, displays the comparison of survival of PIT tag adults from the Snake and Upper Columbia rivers detected at Bonneville Dam and subsequently detected at McNary Dam that migrated in-river as juveniles. All fish from both basins that were transported as juveniles were removed from this comparison. Table 1, displays the point estimates, confidence intervals and p values for each species each year. Upper Columbia in-river migrating steelhead, upstream success rate was significantly lower than Snake River steelhead in 2004, 2005 and 2006, the return years from the McNary transportation study. In these years these steelhead mark groups were primarily composed of Ringold Hatchery steelhead. There was a significant difference in in-river migrating Chinook upstream success rate in 2005 and 2006, the return years of the McNary transportation study. Figure 2 illustrates the comparison of upstream migration success of fish that were transported as juveniles from the Snake River and at McNary Dam. Transportation of juvenile yearling Chinook and steelhead at McNary Dam as a passage mitigation measure ended in 1997. Beginning in 1998 the initiation of transportation was delayed until after the "spring like" conditions ended, when the subyearling migrants were passing the project. This continued until 2001, when transportation was maximized at McNary Dam, except for the period between May 25th and June 15th when transportation only occurred on alternate days. In 2001, for smolts originating in the Upper Columbia River, 35% of yearling Chinook, 30% of steelhead and 59% of sub-yearling Chinook were transported at McNary Dam (FPC Annual Report 2001). In 2002 to 2004 transport studies were conducted at McNary Dam for yearling Chinook and from 2003 to 2005 for steelhead (Marsh et al. 2010). The majority of PIT tags in the Peven analysis for the years 2002-2005 outmigration years originated from the McNary transportation study. The upper Columbia hatchery Chinook the mark groups utilized in the McNary transportation study, over the years were comprised of 5.8%-5.9% Winthrop Hatchery, 10.2% Methow Hatchery, 17.1% - 17.3% Entiat Hatchery and 66.6% - 77.1% Leavenworth Hatchery. The hatchery steelhead mark group composition for the McNary transportation study for outmigration years 2003-2005 50.2% , Wells Hatchery, 10.3% Winthrop Hatchery, 6.8% Chelan Hatchery, 12.8% Eastbank Hatchery and 19.9% Ringold Hatchery (Marsh et al 2010). Although Ringold Hatchery only comprised 19.9% of the juvenile steelhead mark group, the composition of the returning adult steelhead group in this analysis was primarily from Ringold Hatchery, probably because of the comparatively short migration distance of this group to McNary Dam. Juvenile migration history should be considered when analyzing adult return. Since 2006 the operation at McNary Dam has been to return collected fish to the river and to maximize in-river migration routes during the spring passage period.

Figure 3, illustrates the comparison of point estimates and confidence intervals when transported and in-river fish from the Snake River are compared with transported and in-river fish combined from the Upper Columbia. Table 3, displays the point estimates and confidence intervals. This comparison reflects the actual management conditions, in which fish transported as juveniles are migrating through the same river reach and fisheries. Juvenile transportation is an actual management program, for the Snake River and it is included in the Biological Opinion as a mitigation measure targeting for steelhead. For that reason combining in-river and transported juveniles is more representative of actual management. This is particularly important if the author is assessing potential differential impacts of fisheries. In this comparison the Upper Columbia steelhead groups returning in 2004 and 2005 had significantly lower upstream success rates than their Snake River counterparts. However this result cannot be applied to the run at-large steelhead from the Upper Columbia because this mark group was comprised primarily of steelhead from Ringold Hatchery marked for the McNary transportation study. In this comparison Upper Columbia Chinook had a significantly better upstream migration rate then their Snake River counterparts.



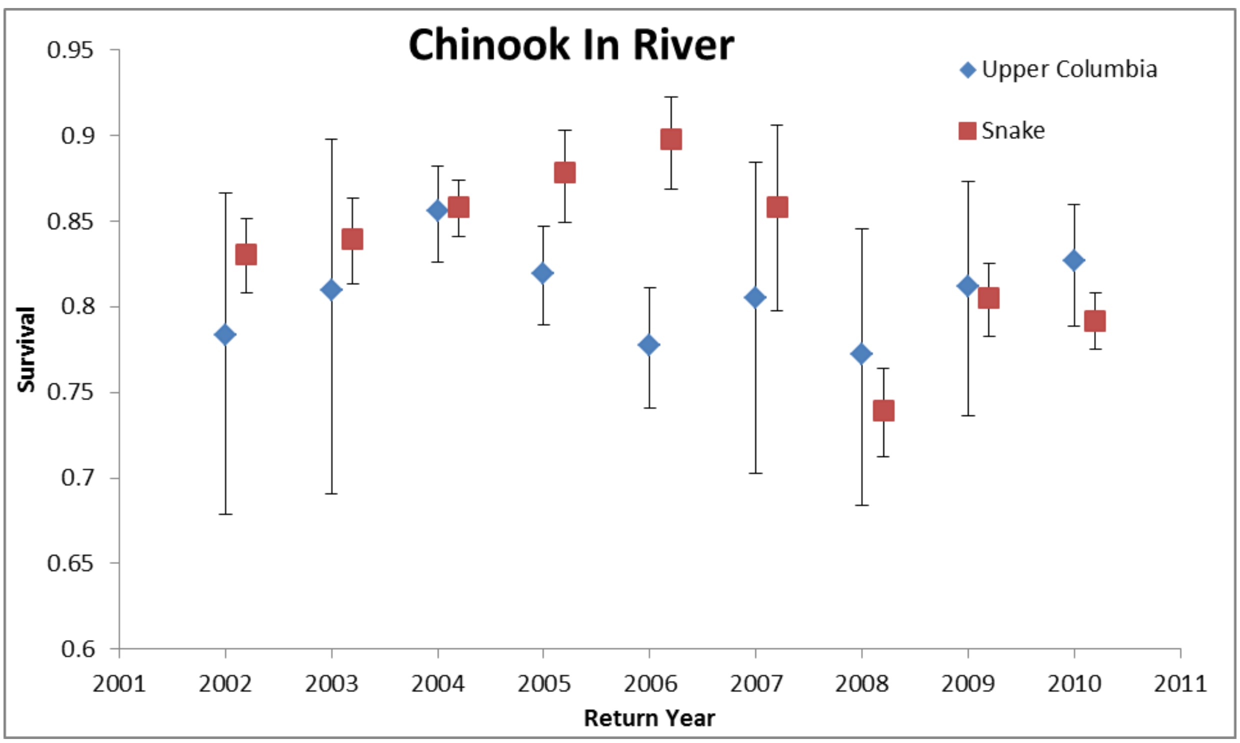
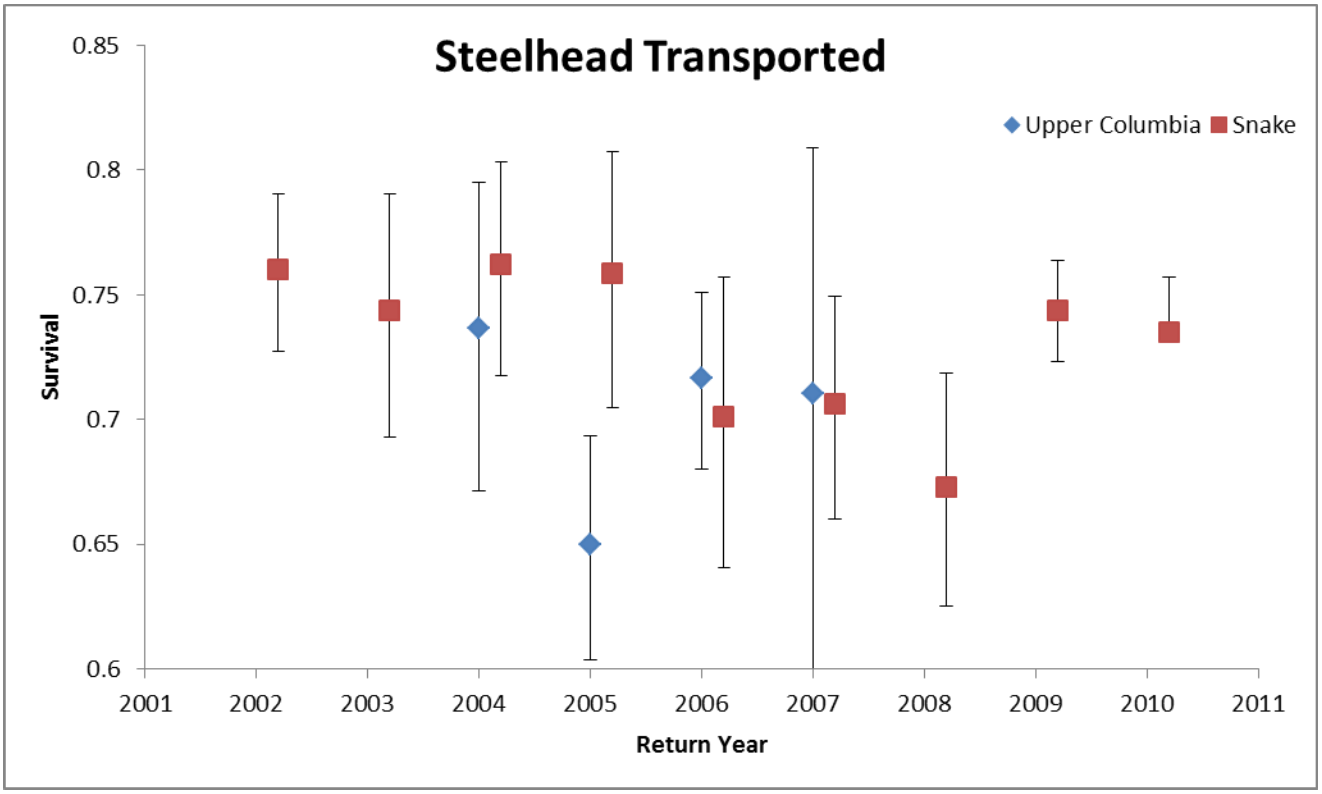


Figure 1: Survival estimates for adult returns Steelhead (top) and yearling Chinook (bottom), excluding all fish which were transported as juveniles. Vertical bars are 95% confidence intervals, and when overlapping indicate non-significant differences in point estimates.

Table 1: Survival estimates for Steelhead (top) and yearling Chinook (bottom), excluding all fish which were transported as juveniles. Snake River stock survival was significantly higher for Steelhead in 2004, 2005, and 2006. Snake River stock survival was significantly higher for Chinook in 2005 and 2006.

Steelhead	Upper Columbia				Snake River				
Year	# BON	Survival	95% CI LL	95% CI UL	# BON	Survival	95% CI LL	95% CI UL	P < 0.05
2002	304	0.813	0.764	0.855	1054	0.780	0.754	0.805	No
2003	52	0.769	0.632	0.875	783	0.802	0.772	0.829	No
2004	3278	0.717	0.701	0.733	580	0.817	0.783	0.848	**Yes**
2005	5667	0.689	0.676	0.701	413	0.804	0.762	0.841	**Yes**
2006	6131	0.729	0.718	0.740	264	0.795	0.742	0.842	**Yes**
2007	1094	0.729	0.701	0.755	2150	0.765	0.747	0.783	No
2008	580	0.760	0.723	0.795	3256	0.731	0.715	0.746	No
2009	1311	0.752	0.728	0.775	7502	0.754	0.744	0.764	No
2010	872	0.787	0.758	0.813	4902	0.772	0.760	0.784	No

Chinook	Upper Columbia				Snake River				
Year	# BON	Survival	95% CI LL	95% CI UL	# BON	Survival	95% CI LL	95% CI UL	P < 0.05
2002	83	0.783	0.679	0.866	1163	0.831	0.808	0.852	No
2003	63	0.810	0.691	0.898	867	0.840	0.814	0.863	No
2004	638	0.856	0.826	0.882	1747	0.858	0.841	0.874	No
2005	715	0.820	0.789	0.847	599	0.878	0.849	0.903	**Yes**
2006	562	0.778	0.741	0.811	528	0.898	0.869	0.922	**Yes**
2007	82	0.805	0.703	0.884	176	0.858	0.797	0.906	No
2008	114	0.772	0.684	0.845	1138	0.739	0.712	0.764	No
2009	138	0.812	0.736	0.873	1398	0.805	0.783	0.825	No
2010	461	0.826	0.789	0.860	2359	0.792	0.775	0.808	No



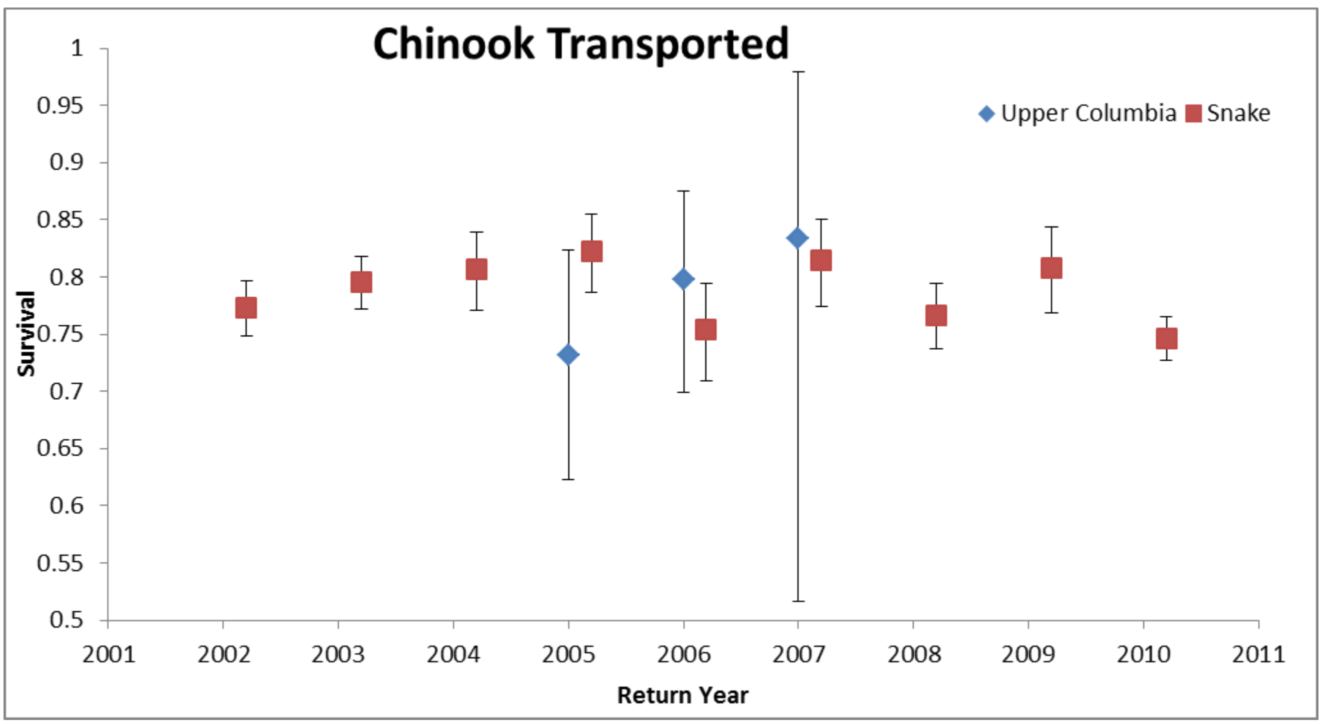


Figure 2: Survival estimates of adult returns for Steelhead (top) and yearling Chinook (bottom), including only fish which were transported as juveniles. Vertical bars are 95% confidence intervals, and when overlapping indicate non-significant differences in point estimates.

Table 2: Survival estimates for Steelhead (top) and yearling Chinook (bottom), including only fish transported as juveniles. Snake River stock survival was significantly higher for Steelhead in 2005.

Steelhead	Upper Columbia				Snake River				
Year	# BON	Survival	95% CI LL	95% CI UL	# BON	Survival	95% CI LL	95% CI UL	P < 0.05
2002					725	0.760	0.727	0.791	No
2003					328	0.744	0.693	0.790	No
2004	209	0.737	0.672	0.795	400	0.763	0.718	0.803	No
2005	451	0.650	0.604	0.694	282	0.759	0.705	0.808	**Yes**
2006	646	0.717	0.680	0.751	251	0.701	0.640	0.757	No
2007	76	0.711	0.595	0.809	419	0.706	0.660	0.750	No
2008					410	0.673	0.625	0.718	No
2009					1831	0.744	0.723	0.764	No
2010					1506	0.735	0.712	0.757	No

Chinook	Upper Columbia				Snake River				
Year	# BON	Survival	95% CI LL	95% CI UL	# BON	Survival	95% CI LL	95% CI UL	P < 0.05
2002					1183	0.773	0.749	0.797	No
2003					1253	0.796	0.772	0.818	No
2004					548	0.807	0.771	0.839	No
2005	82	0.732	0.622	0.824	512	0.822	0.786	0.854	No
2006	89	0.798	0.699	0.876	406	0.754	0.709	0.795	No
2007	12	0.833	0.516	0.979	420	0.814	0.774	0.850	No
2008					849	0.767	0.737	0.795	No
2009					438	0.808	0.768	0.844	No
2010					1998	0.746	0.727	0.765	No

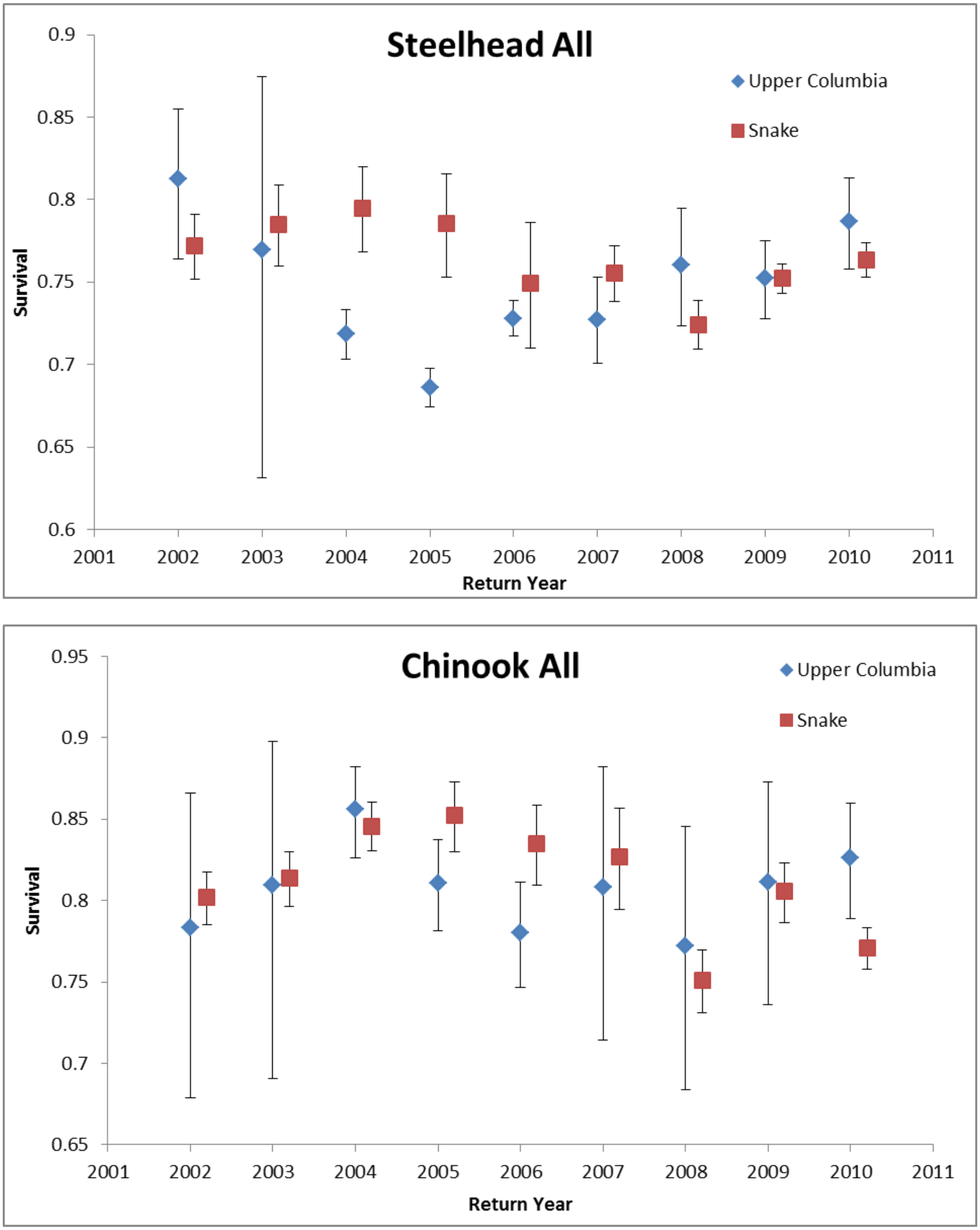


Figure 3: Survival estimates for adult returns of Steelhead (top) and yearling Chinook (bottom), including all in-river and transported juveniles. Vertical bars are 95% confidence intervals, and when overlapping indicate non-significant differences in point estimates.

Table 3: Survival estimates for Steelhead (top) and yearling Chinook (bottom), including all in-river and transported juveniles. Snake River stock survival was significantly higher for Steelhead in 2004 and 2005. *In 2010, Upper Columbia survival estimates were significantly higher than Snake River survival estimates, unlike other significant results.

Steelhead	Upper Columbia				Snake River				
Year	# BON	Survival	95% CI LL	95% CI UL	# BON	Survival	95% CI LL	95% CI UL	P < 0.05
2002	304	0.813	0.764	0.855	1779	0.772	0.752	0.791	No
2003	52	0.769	0.632	0.875	1111	0.785	0.760	0.809	No
2004	3487	0.718	0.703	0.733	980	0.795	0.768	0.820	**Yes**
2005	6118	0.686	0.674	0.697	695	0.786	0.753	0.816	**Yes**
2006	6777	0.728	0.717	0.739	515	0.750	0.710	0.786	No
2007	1170	0.727	0.701	0.753	2569	0.756	0.738	0.772	No
2008	580	0.760	0.723	0.795	3666	0.724	0.709	0.739	No
2009	1311	0.752	0.728	0.775	9333	0.752	0.743	0.761	No
2010	872	0.787	0.758	0.813	6408	0.764	0.753	0.774	No

Chinook	Upper Columbia				Snake River				
Year	# BON	Survival	95% CI LL	95% CI UL	# BON	Survival	95% CI LL	95% CI UL	P < 0.05
2002	83	0.783	0.679	0.866	2346	0.802	0.785	0.818	No
2003	63	0.810	0.691	0.898	2120	0.814	0.796	0.830	No
2004	638	0.856	0.826	0.882	2295	0.846	0.830	0.860	No
2005	797	0.811	0.782	0.837	1111	0.852	0.830	0.873	No
2006	651	0.780	0.747	0.812	934	0.835	0.810	0.858	No
2007	94	0.809	0.714	0.882	596	0.827	0.794	0.857	No
2008	114	0.772	0.684	0.845	1987	0.751	0.731	0.770	No
2009	138	0.812	0.736	0.873	1836	0.806	0.787	0.823	No
2010	461	0.826	0.789	0.860	4357	0.771	0.758	0.783	**Yes***

The Peven et al. comparison of upper Columbia and Snake adult migration does not reflect realistic passage or harvest management because all Snake River transported fish were removed from the analyses. In recent years this equates to about 50% of juvenile migrants and in earlier years the percentage of transported fish is higher.

The Peven et al. analyses reflected in Table 2, excluded fish that were transported as juveniles from the Snake River because their model analyses indicate that downstream migration history, specifically, smolt transportation adversely affects adult migration and survival. This conclusion is consistent with other analyses. However, the smolt transportation program in the Snake River remains as an RPA in the NOAA Biological Opinion for Snake River migrants and is a key element of passage management. Adult migrants from the Snake River which are transported as juveniles are subject to harvest and are not managed separately as returning adults, from in-river migrants. For these reasons it is not reasonable to exclude transported fish from the comparison of success rates. The FPC re-analyses compared Upper Columbia and Snake River adult success rate, included transported fish in each group and then repeated with transported fish in each group excluded from the analyses. The data is displayed in Figures 1 – 3 and Tables 1-3.

Peven et al. and the FPC analyses show the largest difference in upstream migration success for steelhead in 2003-2004. An immediate observation from the Peven data is that the differences noted, occur in years that the McNary transportation study was being implemented. Further, a review of the composition of the mark groups used by Peven is that over half of the Upper Columbia steelhead in the PIT tag mark group, were comprised of the Ringold hatchery steelhead, released 60 miles above McNary Dam. The authors did not discuss potential differential stray rates or specific hatchery group characteristics of the Ringold group which could affect adult success rate. The authors did not consider the possibility or include in the model analyses an interaction variable for transportation at McNary Dam.

Data and analyses clearly indicate that juvenile migration history affects adult survival. The analysis clearly recognizes this, in excluding transported Snake River smolts from Table 2. However, the analyses do not discuss or investigate juvenile migration history of Upper Columbia salmon and steelhead compared to the Snake River migrants.

The authors recognize that juvenile migration history effects adult return survival. A growing body of scientific analyses shows that juvenile migration history has extended effects throughout the life cycle, including reach survival, travel time, first year ocean survival and adult migration success. The authors recognize, as a result of their model analyses, that smolt transportation from the Snake River reduces adult success rate. However, the authors did not address the potential effect of smolt transportation of upper Columbia juvenile migrants at McNary on adult migration success rate as it relates to the transportation study. The range of adult migration years included

The in the Peven analyses, such as 2001, includes years in which upper Columbia juvenile migrants would have experienced transportation at McNary Dam. In addition the years of the Peven analyses include the years of the upper Columbia transportation study at McNary Dam. Over the years of the Peven et al. analyses, juvenile migration conditions through the upper Columbia have changed. Spill for fish passage has been reduced at Priest Rapids and Wanapum dams, changing juvenile migration route of passage at those projects. All of these juvenile passage conditions should be considered in analyses of adult migration success.

References

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