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Date: June 2, 2010

To: Tom Lorz, CRITFC

From: Michele DeHart

Subject: Data request looking at SARs by passage route at Bonneville Dam for subyearling Chinook.

This memorandum is in response to your request for an evaluation of whether the available PIT-tag data indicates any differences in SARs based on passage route of juvenile fall Chinook at Bonneville Dam (BON). The FPC staff analyzed the available PIT tag data to determine if there was any measurable difference in SARs of fall Chinook occurring based on whether these PIT-tagged smolts were detected passing through either the corner collector (route BCC) or standard juvenile bypass channel (route B2J) at Powerhouse 2 or were undetected and thereby passing through either the spillway or turbines. The results of our analysis are:

- The available data set to address the questions is extremely limited in terms of sample size and time period.
- Since the Bonneville corner collector only became operational in 2006, we have complete returns from the 2006 juvenile migration and only partial returns from the 2007 juvenile migration.
- SAR data implies that passage through the Bonneville Corner Collector results in SARs that are equal to or higher than SARs resulting from passage through the Bonneville second powerhouse bypass system.
- The SARs for juvenile fall Chinook that passed via the Bonneville Dam corner collector were 20-38% higher than for those that passed via the bypass system. However, given the limited data to date, Chi-square tests did not show a statistically significant difference. SAR data implies that passage through the Bonneville Corner Collector could potentially result in higher SARs than passage through the Bonneville Second powerhouse bypass system.
- Detection capability for PIT tags below Bonneville dam is extremely limited. This made it impossible to adequately estimate the 2006 PIT-tag collection probability at Bonneville Dam for Snake River fall Chinook and thereby estimate a SAR for the undetected PIT-

tagged fall Chinook (passing over the spillway or through the turbines) at Bonneville Dam with any precision for the 2006 data.

Data collected after the operation of the corner collector commenced were considered in order to address your question. Table 1 shows the SARs for 2006 and partial return SARs for 2007 (1 and 2-salts) and 2008 (jacks only) by major basin (MCOL, SNK, and SNK-sur as defined above plus the additional basin of LCOL = tributaries of Bonneville Dam pool). Again, few middle Columbia basin PIT-tag fall Chinook (subyearlings) were detected at BON in migration years 2006 and 2007, however numbers have greatly increased for migration years 2007 and 2008, so future returns should likewise be higher. SARs of upper Columbia basin PIT-tagged fall Chinook subyearlings (including Wells Hatchery subyearling summer Chinook stock) as well as Snake River basin PIT-tagged fall Chinook subyearlings (excluding surrogates) have exceeded 1% for the 2006 juvenile migration regardless of whether last detected at B2J or BCC. The SARs were 20-38% higher for those smolts that passed BCC; however, Chi-square tests did not show a statistical significance for this magnitude of difference. Migration year 2007 saw very low SARs for 1- and 2-salt returns for all groups of fish, while migration year 2008 with only jack returns to date is heading for the highest SARs for the Snake River fall Chinook (including surrogates) of any of the prior years 2001 to 2007. The 2008 SAR was very similar between juveniles detected at B2J and BCC for the Snake River fish (based on large numbers of returning jacks), while few returning jacks for lower and upper Columbia River fish resulted in very inconsistent changes between SARs for B2J and BCC detected smolts. The percentage of smolts detected at BCC has increased each year from 2006 to 2008, and has remained near 2008 levels for migration year 2009. More PIT-tagged fall Chinook subyearlings are passing BON at BCC than at B2J in recent years, and SAR data implies that passage at BCC provides as good to potentially higher SARs than passage at B2J.

Table 1. SARs for PIT-tagged fall Chinook by major basin for juvenile migration years 2006 to 2008, with smolt numbers only for 2009.

Migr Year	Basin	B2J			BCC			SAR change B2J to BCC	BCC smolts % of total
		Adults	Smolts	SAR	Adults	Smolts	SAR		
2006	MCOL	1	49	2.04%	0	24	na	na	32.9%
2006	SNK ¹	50	3,419	1.46%	56	3,183	1.76%	20.3%	48.2%
2006	SNK-sur ¹	13	1,600	0.81%	24	2,147	1.12%	37.6%	56.3%
2006	UCOL	5	458	1.09%	5	364	1.37%	25.8%	44.3%
2007	MCOL	0	52	0.00%	0	50	0.00%	na	49.0%
2007	SNK	0	364	0.00%	1	774	0.13%	na	68.0%
2007	UCOL	0	533	0.00%	1	930	0.11%	na	63.6%
2008	LCOL ²	1	1,000	0.10%	1	1,564	0.06%	-36.1%	59.8%
2008	MCOL	0	33	na	0	34	na	na	50.7%
2008	SNK ²	58	2,495	2.32%	153	6,839	2.24%	-3.8%	73.3%
2008	SNK-sur ²	10	999	1.00%	49	4,944	0.99%	-1.0%	82.6%
2008	UCOL	1	406	0.25%	4	1,048	0.38%	55.0%	72.1%
2009	LCOL ³		914			1,413			60.0%
2009	MCOL		11			18			62.1%
2009	SNK ³		1,963			6,528			76.9%
2009	SNK-sur ³		523			2,171			80.3%
2009	UCOL		213			632			74.8%

Note: Smolts detected at B2J after BCC dewatered in early Sept are not included in the B2J counts in table.

¹ 2006 had 66 smolts (65 SNK-sur with 2 adults; 1 SNK with no adults) after 12AM Sep 4 to Dec 15.

² 2008 had 99 smolts (45 SNK-sur with 3 jacks; 53 LCOL & 1 SNK with no jacks) after 3AM Sep 1 to Dec 18.

³ 2009 had 37 smolts (9 SNK-sur; 27 LCOL; 1 SNK) detected at B2J after 4PM Sep 2 to Dec 18.

The question of whether the smolts that passed BON undetected (primarily through spill) had a different SAR than those detected at either B2J or BCC is not possible to address at this time. The methodologies rely on the recapture of fish downstream of Bonneville Dam and the detection probability of marks below Bonneville dam is extremely limited. We attempted to estimate the collection probability at Bonneville Dam using the 2006 PIT-tagged fall Chinook from the Snake River basin since they had a relatively high SAR with nearly complete adult returns (including jacks). In addition to the typical use of the trawl as the last detection site below Bonneville Dam, we looked at the use of PIT-tag detections from the bird colonies on Rice and East Sands islands, as well as considered using the PIT-tag detections of returning adults as the last detection site. However, each of these approaches produced different collection efficiency estimates with high coefficient of variations ranging from 0.203 to 0.287, which indicates that the 95% CI around these collection efficiency estimates ranged between approximately 40 – 56% of the mean estimate. With so much uncertainty in the estimate of PIT-tag collection efficiency at Bonneville Dam, it is not possible to estimate a starting PIT-tag population at Bonneville Dam with any confidence. Therefore, our attempt to estimate the population of undetected PIT-tagged fall Chinook of Snake River origin (total population minus those detected at Bonneville Dam) for use in estimating a SAR for the undetected population was unsuccessful.