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To: David Clugston, USACE Portland District
 From: Matt Keefer and Chris Peery
 RE: Summary of steelhead fallback during November at The Dalles Dam
 Date: 16 January 2007

This summary was prompted by recent interest in the potential survival benefits of wintertime surface spill for adult steelhead that fall back at dams. Specifically, we looked at November fallback patterns at The Dalles Dam for radio-tagged steelhead and then estimated fates and survival for this group of fish. Fallback routes for all fish were unknown, but were presumed to be via the navigation lock, through turbines, or via ice/trash sluiceways.

With this dataset (presumably the best available for addressing winter time fallback) there is no way to estimate survival benefits of providing surface spill in November as this operational scenario was never tested in the study years. However, this summary should provide useful background information on the scope of the behavior, including identifying potential numbers of steelhead that fall back at The Dalles Dam in November.

Of all the steelhead recorded passing The Dalles Dam over the six study years, an estimated 1.42% fell back in November (Table 1). Annual estimates ranged from 0.52-2.25. Adding multiple November fallbacks into the mix generated fallback rate estimates ranging from 0.52-2.92 and 1.66 overall.

Table 1. Annual and total November fallback percentages and rates at The Dalles Dam, based on the numbers of radio-tagged steelhead recorded passing the dam in each migration year. Estimation methods followed those in Boggs et al. 2004, except that only November fallbacks were included.

	Unique fish past	Unique fish with Nov. fallback	Nov. fallback percentage	Total Nov. fallback events	Nov. fallback rate
Year	The Dalles				
1996	577	3	0.52	3	0.52
1997	674	9	1.34	10	1.48
2000	871	8	0.92	8	0.92
2001	964	17	1.76	18	1.87
2002	1,040	18	1.73	24	2.31
2003	445	10	2.25	13	2.92
Total	4,571	65	1.42	76	1.66

In general, the steelhead that fell back at the dam in November were much more likely to have first passed the dam relatively later in the run (Table 2). Incorporating multiple events, fallback

back rate estimates were less than 2% in each biweekly block from June through September then jumped to 2.73% for fish passing in early October, and 9.43% for those passing in late October. Samples were relatively small in November, but fallback rate estimates were high for these fish (43.01% for those that passed in early November and 57.78% for late November). These patterns suggest that November fallback probably has a relatively large effect on fish from the B-group (i.e., Clearwater and Snake River fish), although fish returning to the Deschutes and John Day rivers were well represented, perhaps because of the proximity of The Dalles Dam to these tributary confluences. Fish with multiple November fallback events may have inflated estimates for November somewhat using this method. However, multiple fallbacks and reascensions may be typical for this time of year when fish begin overwintering behaviors (see Keefer et al. *in review* for a steelhead overwintering overview).

Table 2. November fallback rates at The Dalles Dam based on when radio-tagged steelhead first passed The Dalles Dam. Results were combined across years, and both multiple passages and multiple fallbacks for individual fish were included because some fish passed in more than one month (note slight difference from Table 1).

Date of dam passage	Total number of passages	Total Nov. fallbacks	Nov. fallback rate	Annual range
June 1-15	33	0	0.00	-
June 16-30	133	2	1.50	0.0-3.1
July 1-15	231	1	0.43	0.0-2.2
July 16-31	312	5	1.60	0.0-3.8
Aug 1-15	242	2	0.83	0.0-1.6
Aug 16-31	429	2	0.47	0.0-1.7
Sep 1-15	977	4	0.41	0.0-2.9
Sep 16-30	1,176	11	0.94	0.5-1.8
Oct 1-15	841	23	2.73	0.7-6.3
Oct 16-31	350	33	9.43	0.0-13.6
Nov 1-15	93	40	43.01	34.6-56.3
Nov 16-30	45	26	57.78	50.0-100.0

When we multiplied the rates in Table 2 by the counts for each biweekly period, estimates of the total numbers of steelhead that potentially fell back at The Dalles Dam in November were 295 (1996), 1,530 (1997), 449 (2000), 5,160 (2001), 4,436 (2002), and 7,005 (2003). The wide range is attributable in large part to differences in run size among years, though extrapolations from small sample sizes also had some effect. It should also be noted that these estimates do not include the November data, because counts were not recorded in November from 1996-2002. The 2003 estimate increased to 9,568 fish (37%) when November data was included (but see caution about November estimates above).

Overall, about 54% of the steelhead that fell back in November were last recorded in tributaries, 11% were reported harvested in main stem reservoirs and 35% were unaccounted for in reservoirs or downstream from Bonneville Dam (Table 3). When compared to the overall steelhead runs (see Keefer et al. 2005), the 11% harvest rate is low (18% were reported harvested on average from 1996-2002) and the 35% unaccounted for rate is quite high (16% on average). This is consistent with previous results showing that fallback in general has a negative effect on

adult steelhead escapement. It is not clear whether the relatively high apparent escapement cost associated with November fallback at The Dalles Dam is related to fish condition, the late timing of these fallbacks, fallback routes at this time of year, or a combination of these and/or other factors. We did observe that fish with multiple November fallbacks at the dam were more likely to be in the unaccounted for category.

Table 3. Estimated fates of 65 radio-tagged steelhead that fell back at The Dalles Dam in November, by the month fish first passed the dam. All years combined.

Fate	Month fish first passed dam						Total	%
	Jun	Jul	Aug	Sep	Oct	Nov		
Hood R.	1				1		2	3.1
Little White Salmon R.					1		1	1.5
Deschutes R.		1	1	2	5	1	10	15.4
John Day R.		1	1	1	1	2	6	9.2
Snake R. above Granite				1	2	1	4	6.2
Clearwater R.		1		3	5	1	10	15.4
Grande Ronde R.		2					2	3.1
Total in tributaries							35	53.8
Bonneville pool (harvest)			1				1	1.5
The Dalles pool (harvest)					2		2	3.1
John Day pool (harvest)	1			1		2	4	6.2
Total main stem harvest							7	10.8
Downstream from Bonneville (unacct)			1	2	3	1	7	10.8
Bonneville pool (unacct)				3	6		9	13.8
The Dalles pool (unacct)						1	1	1.5
John Day pool (unacct)					3	1	4	6.2
McNary pool (unacct)				1			1	1.5
Little Goose pool (unacct)				1			1	1.5
Total unaccounted for							23	35.4

Citations:

Boggs, C. T., M. L. Keefer, C. A. Peery, T. C. Bjornn, and L. C. Stuehrenberg. 2004. Fallback, reascension and adjusted fishway escapement estimates for adult chinook salmon and steelhead at Columbia and Snake River dams. *Transactions of the American Fisheries Society* 133:932-949.

Keefer, M.L., C.A. Peery, W.R. Daigle, M.A. Jepson, S.R. Lee, C.T. Boggs, K.R. Tolotti, and B.J. Burke. 2005. Escapement, harvest, and unknown loss of radio-tagged adult salmonids in the Columbia River - Snake River hydrosystem. *Canadian Journal of Fisheries and Aquatic Sciences* 62:930-949.

Keefer, M. L., C. T. Boggs, C. A. Peery, and C. C. Caudill. *In review*. Distribution, behavior, and survival of overwintering adult steelhead: variability among Columbia River populations.