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To: Marvin Shuttters and Dave Clugston, USACE
From: George Naughton and Chris Peery University of Idaho

Re: Lower Granite Dam transition pool weir test 2001; Letter Report.

The following is a preliminary summary of our evaluation of a weir modification to improve passage of adult salmon and steelhead through the transition pool at Lower Granite Dam conducted in 2001. The goal of this modification was to decrease passage times and increase the proportion of fish that passed through the transition pool area at Lower Granite Dam.

Methods:

Fishway Modification

In 2000, the first five downstream weirs in the fish ladder at Lower Granite Dam were modified so a minimum head of 0.25 ft could be maintained at each weir. Slotted aluminum panels that were eight inches wide and varied from 15-19 feet long were used to restrict the flow through the overflow portion of the modified weirs. Each panel added to a weir increased the head by about one-tenth of a foot. Head differences were monitored periodically with a water-level meter. In 2000, the weir panels were lowered in place for the entire migration period. While results from monitoring passage of radio-tagged adult salmon and steelhead were encouraging, they were inconclusive because inter-annual variation in river conditions made comparisons difficult. In 2001, a test was conducted in which the weir panels were raised and lowered in paired treatment design. This allowed intra-annual comparison of the weir modification on adult salmon and steelhead passage.

Passage Times and Fish Behavior

Passage times for radio-tagged adult salmon and steelhead at Lower Granite Dam were divided into five segments: (1) from the first tailrace record to first approach at the dam, (2) first approach to first fishway entry, (3) first record in transition pool to last record in transition pool, (4) last record in transition pool to first record at top-of-the-ladder site and (5) first record at the tailrace site to last record at top-of-the-ladder site.

Fish behavior was analyzed from the time a fish first entered the transition pool until it exited the transition pool upstream into the ladder. Transition pool behaviors were divided into three categories: (1) passed straight through the transition pool on the first attempt, (2) exited the transition pool into the collection channel and (3) exited the transition pool into the tailrace.

Experimental Design

We compared paired treatments blocks to determine if passage times were significantly different between transition pool treatments. Treatments were defined as control (two panels down) and test (all 14 panels down) on each of the first two weirs. All 14 weir panels in place produced a bout a 1 ft head differential at the two modified weirs. We queried PTAGIS or downloaded radio-telemetry receivers to determine the number of fish passing through the transition pool. Weir panels were changed at night after at least 10 fish had passed through the transition pool. Treatment periods were from 1 April to 15 October 2001. We used analysis of variance (ANOVA) at $\alpha = 0.05$ level to statistically compare passage times between the two treatment conditions, using median times for fish from each treatment block as the dependent variable. Only paired blocks that contained at least 10 fish with usable passage times each (total 20 fish per treatment) were used in these analyses. Passage times were log transformed to reduce variance heterogeneity and normalize the distributions. Due to receiver outages and low numbers of fish, we eliminated treatment blocks from 1 April to 1 May from the analysis.

Results

Chinook salmon and steelhead passed through the Lower Granite Dam transition pool at a significantly ($P = 0.014$) faster rate when the weir panels were down (Table 1). Overall dam passage time was also significantly faster ($P = 0.034$) when weir panels were down than when weir panels were up (Table 2). Passage times for the other passage segments were not significantly different. The proportion of chinook salmon and steelhead that passed straight through the transition pool was significantly higher, and the proportion exiting to the collection channel and to the tailrace was significantly lower when the weir panels were down (Table 3).

Table 1. Passage times through Lower Granite Dam transition pool. (mean of block medians?)

Treatment	Sample size	Mean (h)	SD	P-value
Up	18	3.2	9.5	0.014
Down	18	1.0	6.0	

Table 2. Times (mean of treatment medians? h) for passage segments at Lower Granite Dam.

Treatment	Passage Segment				
	F1A1 ^a	A1E1 ^b	FPLP ^c	LPFT ^d	F1LT ^e
Up	1.6	4.2	3.2	2.9	15.1
Down	1.7	4.9	1.0	3.2	11.0
P-value	0.455	0.420	0.014	0.519	0.035

^a First tailrace record to first approach at dam.

^b First approach at site to first fishway entry.

^c First record in transition pool to last record in transition pool.

^d Last record in transition pool to first record at top-of-the-ladder site.

^e First record at the tailrace site to last record at top-of-the-ladder site.

Table 3. Proportion of chinook salmon and steelhead passing straight through transition pool or exiting to collection channel or tailrace at Lower Granite Dam.

Treatment	Sample size	Behavior		
		Straight through	Exit to collection channel	Exit to Tailrace
Up	18	0.20	0.42	0.37
Down	18	0.43	0.31	0.26
	P-value	0.000	0.048	0.034

Discussion

Weir modifications appeared effective in reducing the travel time through the transition pool at Lower Granite Dam. Chinook salmon and steelhead passage times were more than two hours faster when weirs were down than when up. Total dam passage times were also faster during treatment periods in the transition pool. Modifications also appeared effective in increasing the number of fish that passed straight through the transition pool while reducing the number of exits to the collection channel and tailrace.

Future work

Telemetry data for spring and summer chinook salmon at Lower Granite Dam has been coded. Analysis of 2002 transition pool data will be initiated when George Naughton returns from the headwaters of the Yangtze River in January 2003, (or when the fall chinook salmon and steelhead have been coded).