

2003 spring–summer Chinook salmon passage at John Day Dam: spill effects

This summary provides an overview of spring–summer Chinook passage times at John Day Dam with respect to spill patterns in 2003. Several spill ‘treatments’ occurred at John Day Dam in 2003, with various levels of mostly night-time spill and several brief periods of continuous day- and night-time spill (Table 1). The latter treatment occurred only in late June and July.

Unfortunately, treatment switching was common, with typical gaps of 2-4 days. Given relatively long Chinook salmon passage times at the dam ($n = 640$, median = 24 h, mean = 50 h), many fish were exposed to multiple treatments. This made assessment of treatment effects difficult.

Figures 1-5 show day- and night-time spill levels for each month of the migration, with scatterplots of fish passage times based on tailrace entry dates. The general pattern in April showed the longest passage times early in the month, during the no-spill low-flow period. Water temperatures were lowest during this time, and fish passage during April is typically low at all lower river dams. From mid-April through the month of May, passage times were generally low, with limited variability. Spill treatments during this time alternated between ~45% spill at night and ~60% spill at night with near-zero spill during the day. A switch occurred in June. Passage times were much more variable, with longer medians. The principle spill treatment was ~60% at night, though the end of the month had several days of continuous 30% day-30% night spill. July passage times were also quite high and variable, and a variety of spill treatments occurred. Few fish passed the dam in August.

Overall, the longest passage times occurred in June and July, which is somewhat atypical. In most cases, we have seen steadily decreasing passage times as the spring–summer migration progresses and temperatures warm.

Some Conclusions: Spill treatments were not evenly distributed through time, and so comparison of treatments was complicated. Table 2 shows passage times by treatment, across all months, but these numbers should be considered cautiously. Table 3 shows some multivariate statistics by individual month. Even this truncated analysis is confounded somewhat by the location of treatments within month. Nonetheless, one could interpret that the spill treatments do have some effect on fish passage times. Treatments, however, appear to be subordinate to other variables such as migration timing (date) and time of tailrace entry (fish passage time is strongly related to whether or not a night is spent in the tailrace or fishway). Total flow did not seem to be an influential factor. It is also likely that treatment switching had a negative effect on fish behavior, as we have observed that sudden changes in spill appears to confuse adults at other dams. Finally, we have previously observed that fishway temperatures at John Day can be unattractive to adults, and exit rates at the dam are the highest in the system. It is possible that temperatures in summer 2003 further complicated fish behaviors -- summer passage times were higher than we have observed in previous years.

Table 1. Number of days each spill “pattern” occurred at John Day Dam in 2003. Night was defined as 8 pm to 6 am, Day was defined as 7 am to 6 pm, and patterns were defined by mean spill values during these time periods.

Spill	April	May	June	July	August
0% night	12				
40-50% night	5	18	2	7	17
50-60% night	12	13	24	13	8
30% day & night			4	10	
other	1			1	6

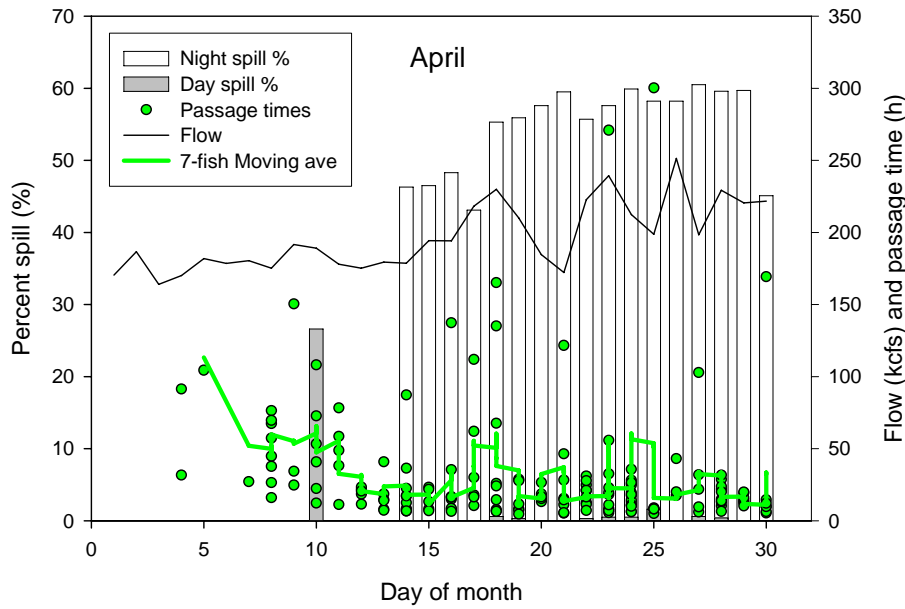


Figure 1. Day and night spill percentages, total flow, and spring–summer Chinook salmon passage times (tailrace to top-of-ladder) at John Day Dam in April, 2003.

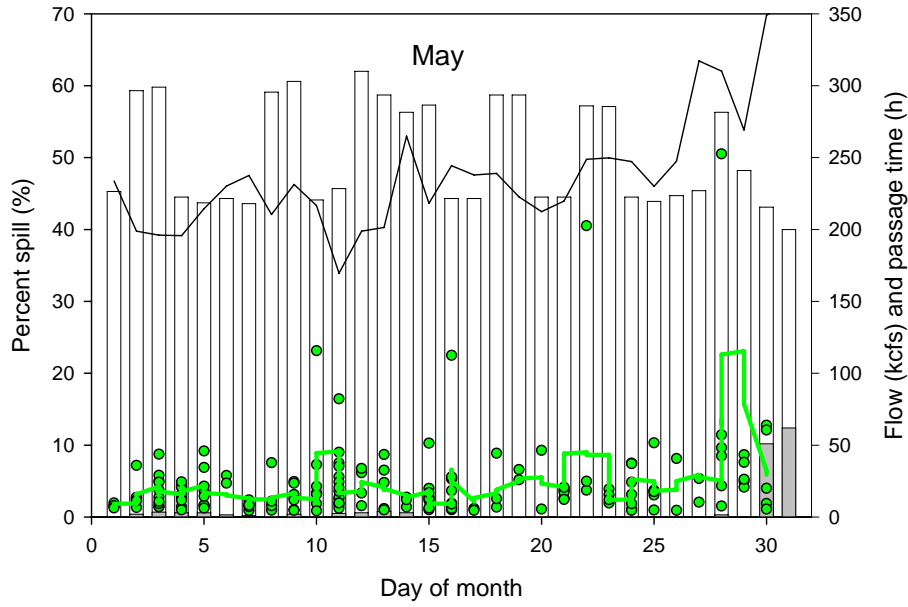


Figure 2. Day and night spill percentages, total flow, and spring–summer Chinook salmon passage times (tailrace to top-of-ladder) at John Day Dam in May, 2003.

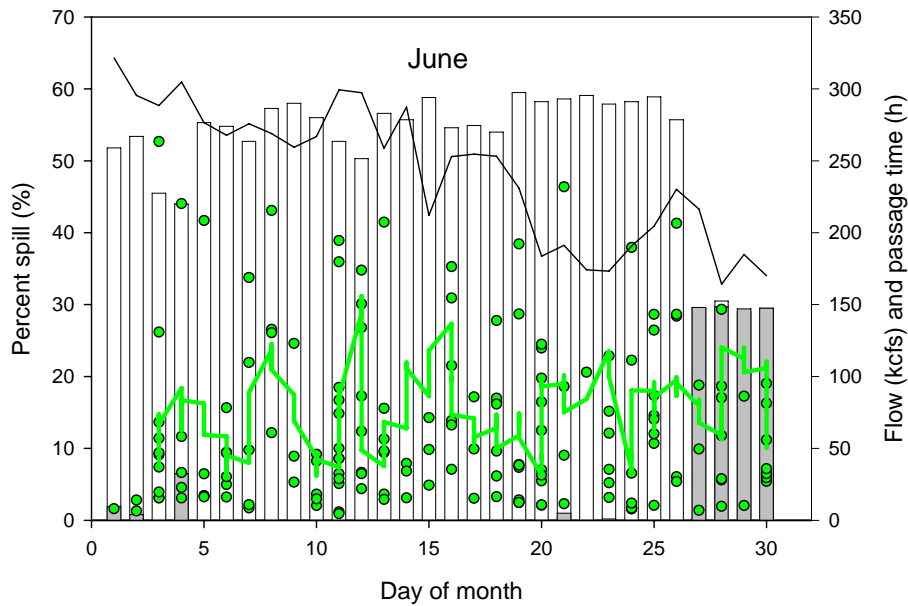


Figure 3. Day and night spill percentages, total flow, and spring–summer Chinook salmon passage times (tailrace to top-of-ladder) at John Day Dam in June, 2003.

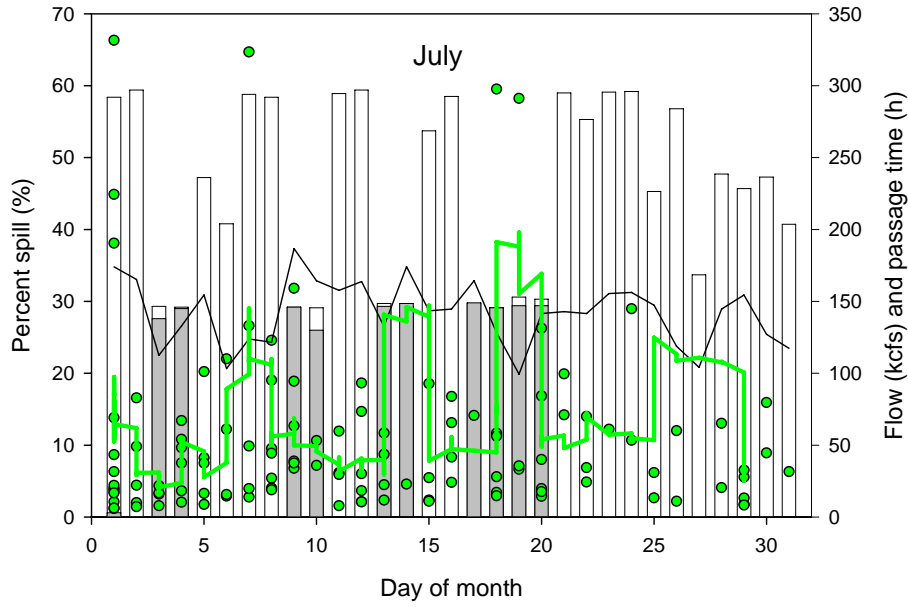


Figure 4. Day and night spill percentages, total flow, and spring–summer Chinook salmon passage times (tailrace to top-of-ladder) at John Day Dam in July, 2003.

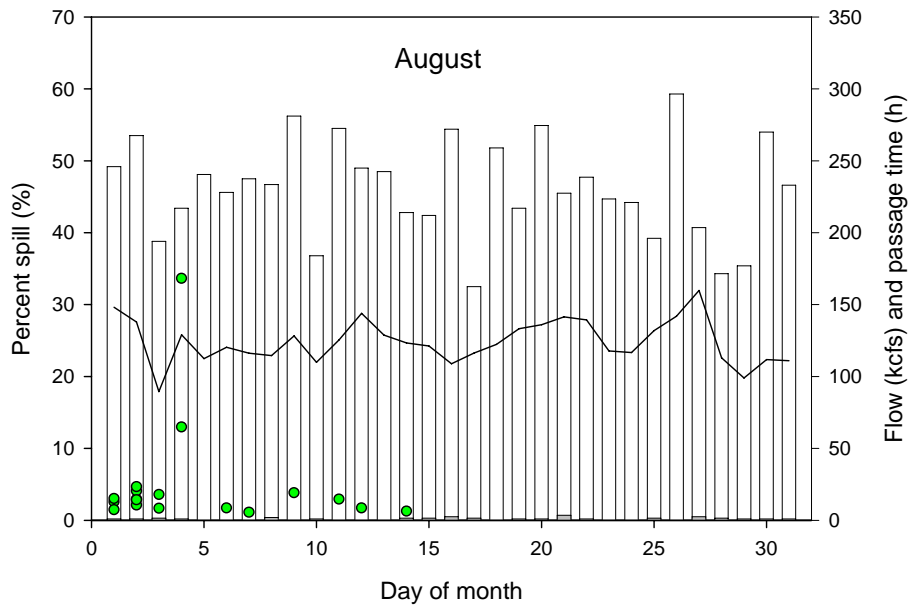


Figure 5. Day and night spill percentages, total flow, and spring–summer Chinook salmon passage times (tailrace to top-of-ladder) at John Day Dam in August, 2003.

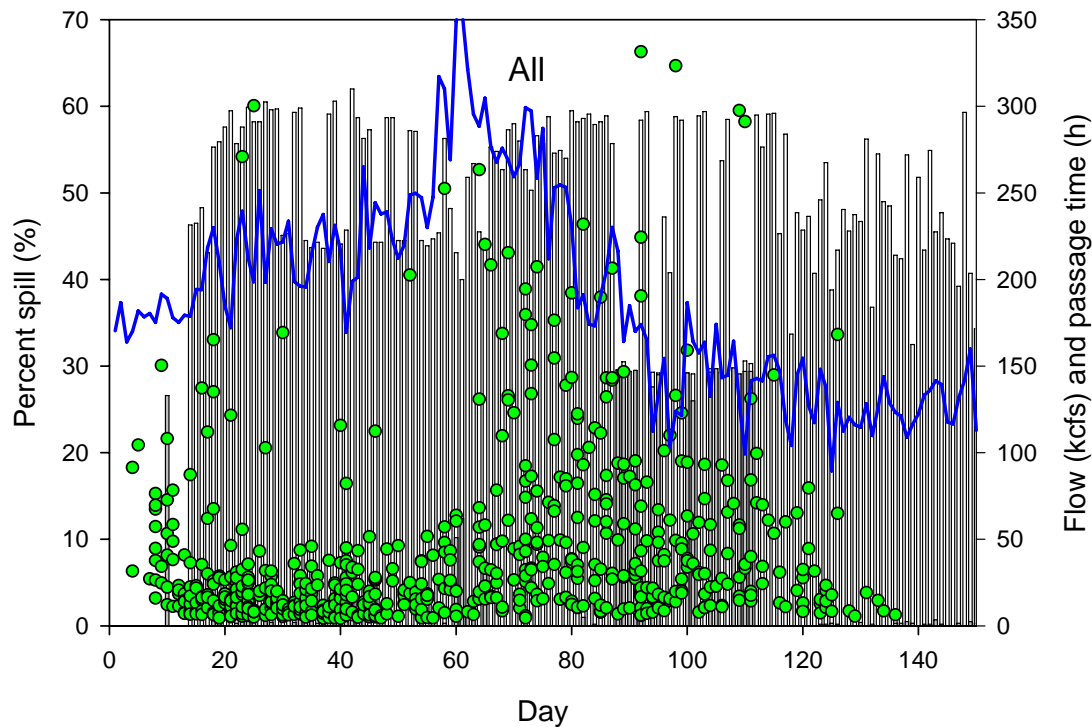


Figure 5. Day and night spill percentages, total flow, and spring–summer Chinook salmon passage times (tailrace to top-of-ladder) at John Day Dam for April–August, 2003.

Table 1. Summary of median and quartile spring–summer Chinook salmon passage times at John Day Dam, 2003, by spill treatment, months, and time of tailrace entry.

Spill ‘treatment’	Month	Time	<i>n</i>	median	25%	75%
All	All	All	640	24.1	12.3	52.3
0 night	All	All	32	32.9	18.4	62.9
40-50% night	All	All	180	17.1	9.0	35.2
50-60% night	All	All	357	24.8	12.8	57.0
30% day and night	All	All	62	38.4	22.4	81.3
All	April	All	169	17.8	10.7	31.0
All	May	All	161	15.8	9.0	26.4
All	June	All	168	47.6	25.7	93.6
All	July	All	123	35.4	17.6	69.1
All	August	All	19	14.6	8.5	20.4
All	All	0-6 h	145	29.6	10.2	58.2
All	All	6-12 h	203	28.0	8.4	57.3
All	All	12-18 h	109	22.4	16.7	43.0
All	All	18-24 h	183	19.4	14.6	45.2

Table 2. Results of multivariate analysis (PROC GLM in SAS) of passage times at John Day Dam. Independent variables were spill treatment, time of tailrace entry (4 6-hour categories), date of tailrace entry, and total flow on entry date. The dependent variable was spring–summer Chinook salmon passage times (\log_e -transformed) from tailrace entry to exit from top of ladder. Median back-transformed times for the spill treatments are included for reference. *P* values show significance levels adjusted for all other model variables.

Month	Variable	<i>n</i>	Median	χ^2	<i>P</i>
April	Spill 'treatment'			2.4	0.0938
	0 night	38	32.9		
	40-50% night	37	14.9		
	50-60% night	94	16.1		
	Time of day			3.5	0.0170
	Date			6.6	0.0170
	Flow			2.3	0.1332
May	Spill 'treatment'			0.4	0.5401
	40-50% night	96	17.0		
	50-60% night	65	14.3		
	Time of day			2.1	0.1076
	Date			6.3	0.0134
	Flow			0.0	0.8798
June	Spill 'treatment'			1.0	0.3842
	40-50% night	15	45.4		
	50-60% night	132	48.1		
	30% day & night	21	49.6		
	Time of day			1.1	0.3461
	Date			3.3	0.0721
	Flow			0.9	0.3406
July	Spill 'treatment'			1.0	0.3857
	40-50% night	22	31.2		
	50-60% night	59	31.6		
	30% day & night	41	37.6		
	Time of day			1.2	0.3290
	Date			0.2	0.6469
	Flow			0.6	0.4421
All	Spill 'treatment'			15.1	<0.0001
	0 night	38	36.0		
	40-50% night	180	17.1		
	50-60% night	357	24.8		
	30% day & night	62	38.4		
	Time of day			4.5	0.0038
	Date			80.3	<0.0001
Flow			17.6	<0.0001	