Evaluation of Submerged Orifice Gate Usage by Adult Chinook Salmon and Steelhead at John Day Dam During 2003

Eric Johnson and Chris Peery
University of Idaho
Moscow, ID 83844-1141
cpeery@uidaho.edu, 208 885-7223

Enclosed is information regarding the performance of submerged orifice gates at John Day Dam in 2003. Submerged orifice gates located along the downstream face of the powerhouse were open at John Day Dam during the 2003 migration season. Submerged orifice gates located along the face of the powerhouse (10 gates) and main entrances (3 gates) located at either end the powerhouse and adjacent to the spillway were equipped with a series of underwater antennas to monitor fish movement into and out of the collection channel (Figure 1). Dates and times of receiver outages at submerged orifice gates and main entrances are reported in Figure 2.

We evaluated the total number of known fishway approaches, entrances, and exits for adult Chinook salmon and steelhead at John Day Dam. Unknown approaches, entrances, and exits resulting from a missed antenna or receiver outages were excluded from the summary as were entrances and exits following a fallback event to account for bias that could result from non-naive fish.

Approaches, entrances and exits at John Day Dam were observed for 755 radio-tagged adult Chinook salmon and 415 radio-tagged adult steelhead during 2003. The location where fish approached the dam was distributed between main entrances and floating orifice gates (Figure 3). Of the 93,095 approaches at John Day Dam, 24.3% occurred at main entrances. Although Chinook salmon and steelhead frequently approached floating orifice gates the number of entries was disproportionately lower compared to main entrances (Table 1). The number of approaches per entry (total approaches / total entries) ranged between 3.4 and 6.9 for the main entrances and between 20.4 and 68.8 for floating orifice gates (Table 1). This indicates that fish were attracted to the vicinity of the powerhouse, but that they either were not attracted to enter orifice gates or had difficulty locating orifice gate openings even though they were in close enough proximity to be detected on the underwater telemetry antennas.

We observed adult salmon and steelhead made greatest use of the main entrances to reach the fishway collection channel (Figure 3); ie, south shore entrance (LJD1 telemetry antenna) and north powerhouse entrance (BJD1). The north shore entrance (AJD1) also showed high usage (Figure 3). There was also relatively high use of orifice gates closest to the main entrances. Of the 8,738 entries made by adult Chinook salmon and steelhead, 74.4% occurred at main entrances (Table 1). Of the 7,056 exits, 83.4% occurred at main entrances. Approximately half of the total entries (52.1%) and exits (49.1%) were observed at south-shore entrance. The lowest number of entries at a main entrance occurred at north-powerhouse entrance (8.0% of total entries) which performed similar to southern most (8.1% of total entries) and northern most (6.4% of total entries) floating

orifice gates. We observed a disproportionate number of exits relative to entries at the north-powerhouse main entrance (over twice as many exits to entries) and orifice gate LJD5 (over three times more entries to exits). Trends among the location of entrances, exits and approaches where similar between Chinook salmon and steelhead (Figure 4).

There was no experimental design implemented to address the effects of orifice gate closures on dam passage. Studies conducted at other dams in previous years constitutes the basis for our recommendations. Radio-tagged adult spring and summer Chinook salmon were monitored to assess passage times at Priest Rapids Dam in 1996 during two treatments: half the powerhouse orifice gates open and all orifice gates closed. Travel times from first record in the tailrace to first approach at the dam, to first entry into the fishway, first entry to the junction pool, and to pass the dam were not significantly different with respect to orifice gate closure (Bjornn et al. 1997). Repeating the study at Priest Rapids and Wanapum dams during 1997, we found that times for Chinook and sockeye salmon to enter the dams could be longer (.5 to 5.0 hr) when orifice gates were closed but total times to the projects did not seem significantly affected (Peery et al. 1998). Additional evaluations were conducted at Bonneville, The Dalles, Lower Monumental, and Little Goose dams to determine the effects of closing orifice or sluice gates on passage rates and routes. A randomized block design was implemented at Bonneville Dam in 2000 and 2001. Although passage times were longer during the closed treatment, there was little significant difference between treatments (Daigle et al. draft report). At The Dalles, Lower Monumental, and Little Goose Dam dams, orifice gates were closed in 2000 and 2001 and passage times were compared to those of 1997 and 1998 when gates were open. Chinook salmon and steelhead took less time to approach and enter dams in 2000 and 2001 when orifice gates were closed (Daigle et al. draft report). Times for first entering the dam to exiting the top of the fishway were similar all years for both species (Daigle et al. draft report). The pattern of use of orifice gates at John Day Dam in 2003 was similar to that observed at McNary Dam in previous years, with high numbers of approaches but relatively few entries at these openings. We did see use of the orifice gates adjacent to the main powerhouse fishway entrances, indicating that fish attracted to the vicinity of the main entrances are able to locate those orifice gates better than floating orifice gates not adjacent to larger openings and, presumably, their attractive flow. Based on these results we suggest that closure of floating orifice gates should not negatively affect adult salmon or steelhead passage at John Day Dam, although maintaining the northern and southern most floating orifice gates (those adjacent to NPE and SSE) may provide some benefit to fish passage.

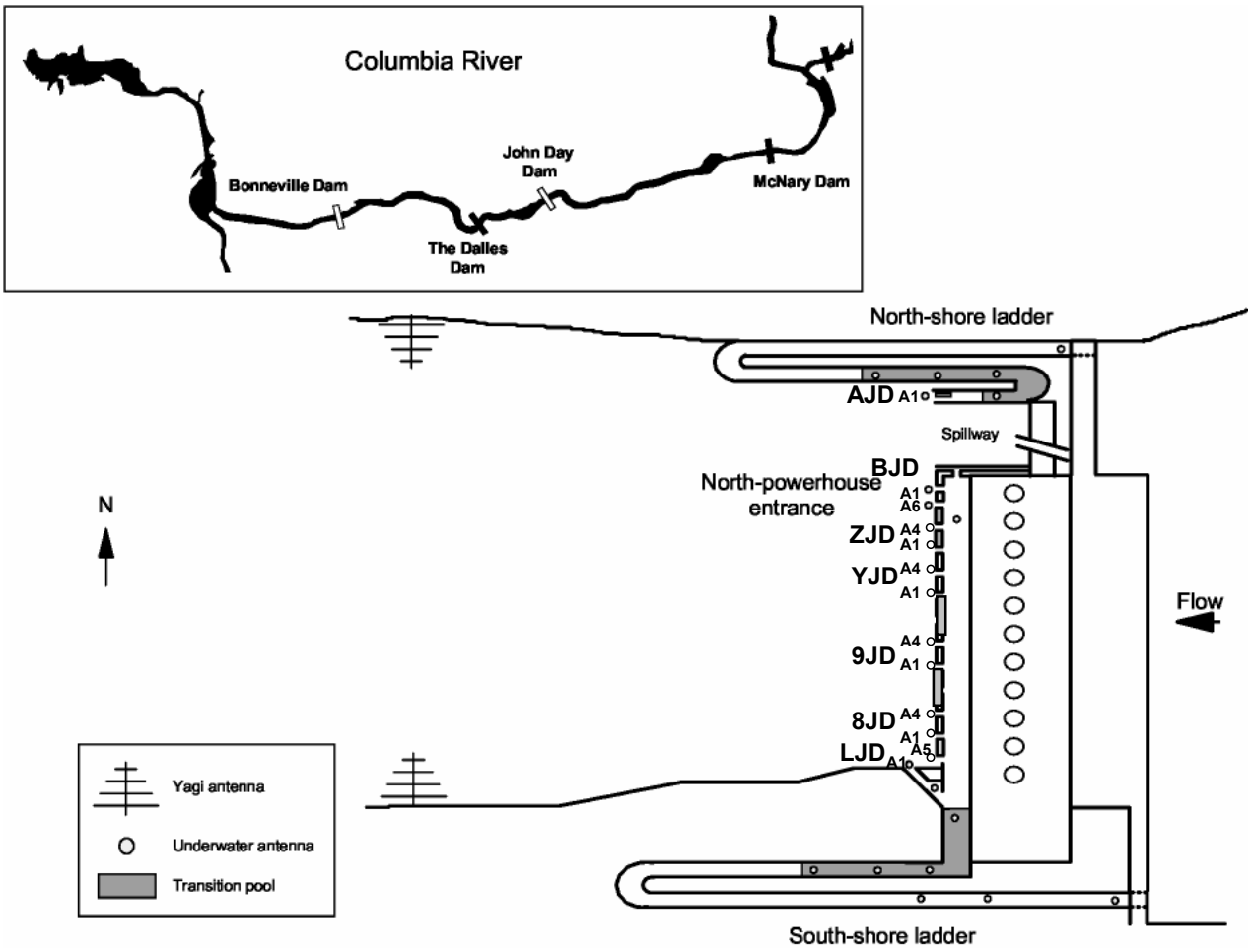

Figure 1. Placement of aerial and underwater antennas for radio receivers at John Day Dam during 2003.

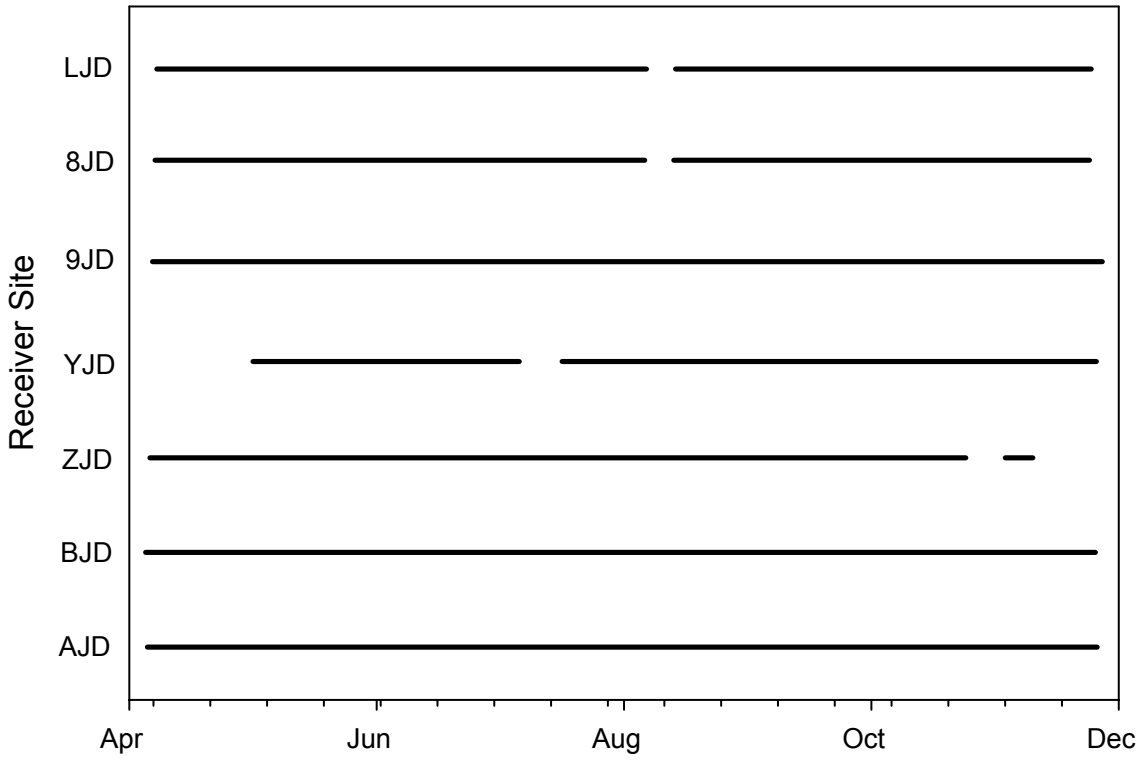

Figure 2. Time of operation of fixed-site radio receivers at John Day Dam, 2003. Breaks in time lines represent periods of time when receivers were not operational.

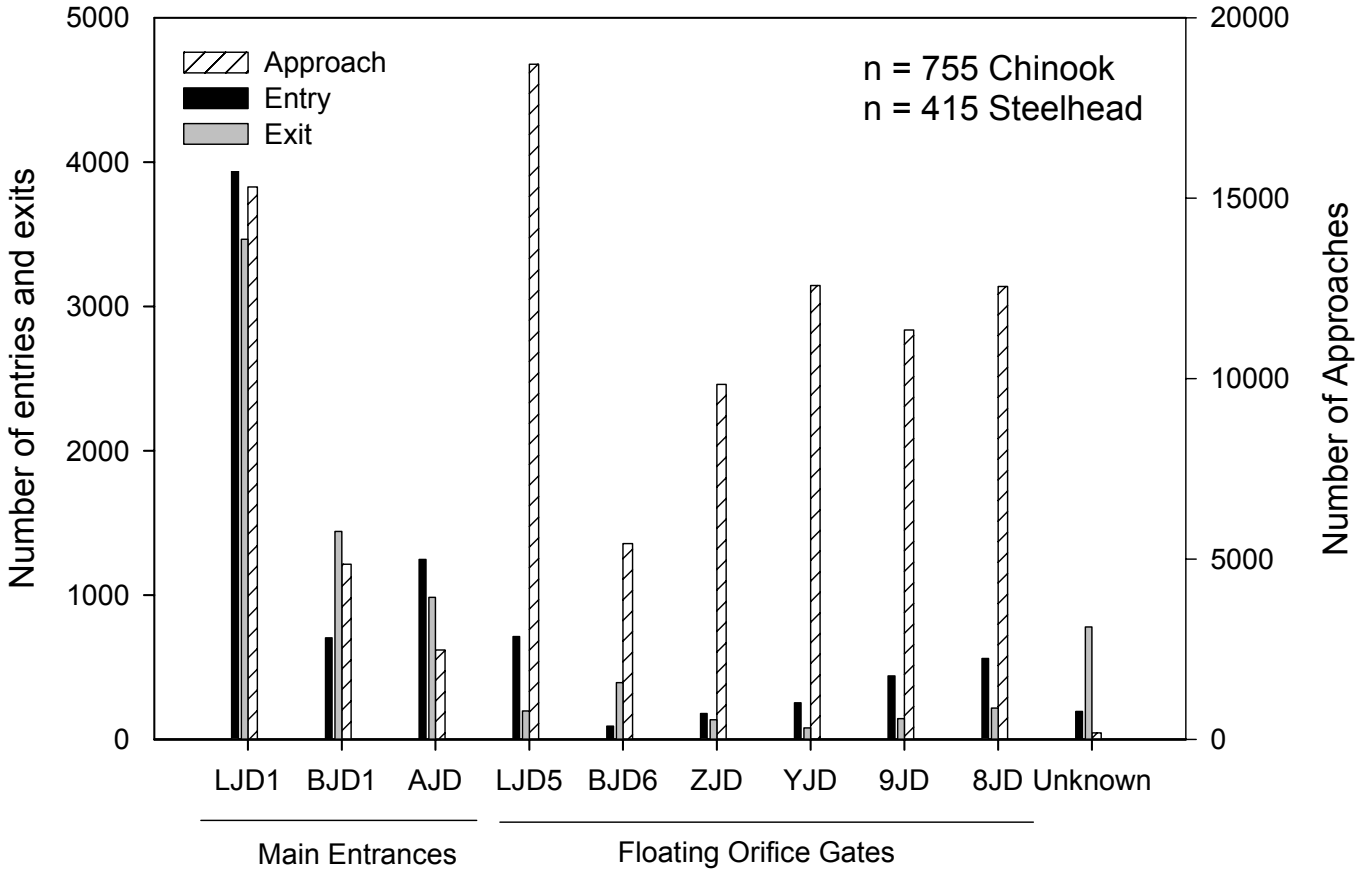

Figure 3. Distribution of total entries, exits, and approaches for radio-tagged Chinook salmon and steelhead at John Day Dam during 2003 (all floating orifice gates open).

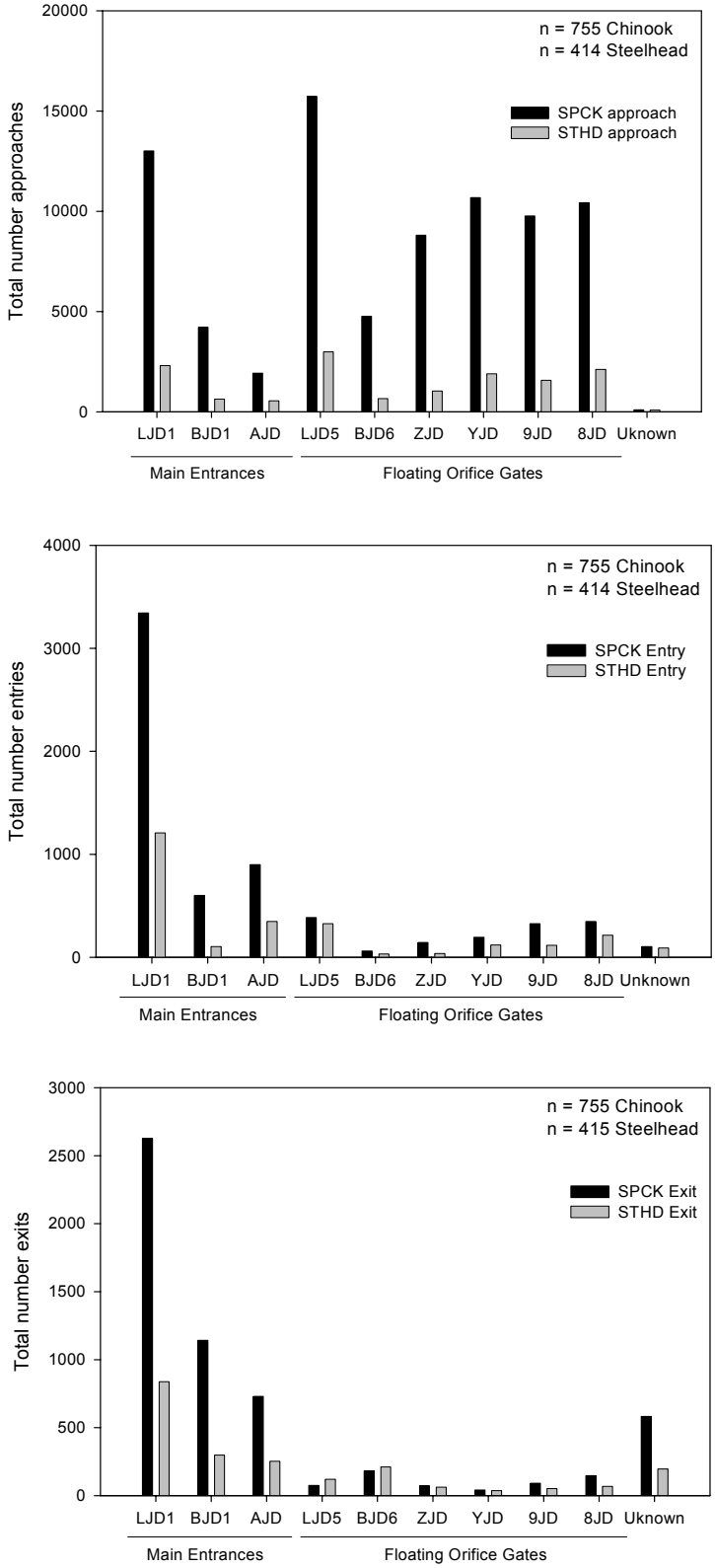

Figure 4. Distribution of total approaches (top), entries (middle), and exits (bottom) for radio tagged Chinook salmon (black) and steelhead (gray) at John Day Dam in 2003.

Table 1. Number of entrances, exits, and approaches at each fishway entrance by Chinook salmon and steelhead at John Day Dam in 2003 (numbers in parenthesis represent the percentage of the total).

Receiver Site	*Antenna #*	*Total Entries*	*Total Exits*	*Total Approach*	*Net Entries*	*Approaches per Entry*
LJD[a]	1	4551 (52.1%)	3465 (49.1%)	15312 (16.4%)	1086	3.4
BJD[a]	1	703 (8.0%)	1441 (20.4%)	4854 (5.2%)	-738	6.9
AJD[a]	1	1246 (14.3%)	984 (13.9%)	2476 (2.7%)	262	2.0
LJD[b]	5	712 (8.1%)	197 (2.8%)	18711 (20.1%)	515	26.3
BJD[b]	6	92 (1.1%)	394 (5.7%)	5425 (5.8%)	302	59.0
ZJD[b]	1	85 (1.0%)	71 (1.0%)	5846 (6.3%)	14	68.8
ZJD[b]	4	95 (1.1%)	65 (0.9%)	3997 (4.3%)	30	42.1
YJD[b]	1	137 (1.6%)	46 (0.7%)	6748 (7.2%)	91	49.3
YJD[b]	4	116 (1.3%)	33 (0.5%)	5830 (6.3%)	83	50.3
9JD[b]	1	227 (2.6%)	97 (1.4%)	6818 (7.3%)	130	30.0
9JD[b]	4	213 (2.4%)	47 (0.7%)	4528 (4.9%)	166	21.3
8JD[b]	1	264 (3.0%)	162 (2.3%)	5391 (5.8%)	102	20.4
8JD[b]	4	297 (3.4%)	54 (0.8%)	7159 (7.7%)	243	24.1
Total		**8738**	**7056**	**93095**	**2286**	

[a] main entrances (shaded)
[b] floating orifice gates

References

Bjornn, T.C., M.A. Jepson, C.A. Peery, and K.R. Tolotti. 1997. Evaluation of adult chinook salmon passage at Priest Rapids Dam with orifice gates open and closed – 1996. Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, Technical Report 97-1.

Daigle, W.R., T.C. Bjornn, C.A. Peery, K.R. Tolotti, R.R. Ringe, M. A. Jepson, and M. Moser. Draft report. Evaluation of adult chinook salmon and steelhead passage at Columbia and Snake River dams with orifice or sluice gates open and closed. Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow. Report for project MPE-P-95-1.

Peery, C. A., T. C. Bjornn, and K.R. Tolotti. 1998. Evaluation of adult Chinook salmon and sockeye salmon passage at Priest Rapids and Wanapum dams – 1997. Idaho Cooperative Fish and Wildlife Research Unit, University of Idaho, Moscow, Technical Report 98-5.