

# HYDROACOUSTIC EVALUATION OF JUVENILE SALMONID FISH PASSAGE AT BONNEVILLE DAM

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## ABSTRACT

The primary goal of this study was to provide project-wide estimates of fish-passage efficiency (FPE), spill efficiency, and spill effectiveness for run-of-river fish passing the Bonneville Project in 2004. Other fish-passage measures included FPE by powerhouse, fish-guidance efficiency (FGE) by turbine, and horizontal, vertical, and diel distributions of fish passage at both powerhouses and the spillway. These data provide a fourth year of estimates for the entire project and the first year of estimates with the new Powerhouse 2 Corner Collector (B2CC). Sampling with 70 420-kHz hydroacoustic transducers was continuous except for a short break each morning for downloading and archiving data. At least one split-beam transducer was used for each type of transducer deployment to provide deployment-specific data on speeds, trajectories, and target strengths of fish for detectability modeling.

During the Spring Creek hatchery release of sub-yearling Chinook salmon in early March, Project FPE was evaluated for several operational conditions: (1) 5 days of 50,000 cfs spill, (2) 5 days of B2CC operation without spill, and (3) several days of neither spill nor B2CC operation. An analysis of variance and multiple-range test on hourly data indicated that each condition produced significantly different estimates of FPE ( $P < 0.0001$ ). The spill condition produced the highest Project FPE (62%;  $n=96$ ), followed closely by the B2CC operation (54%;  $n=96$ ), and then by no spill + no B2CC (42%;  $n=108$ ). Major metrics calculated from the sum of passage through various routes during each test condition were as follows:

CONDITION	FPE %	Spill Efficiency (%)	Sluice Efficiency % of Project	B1 Sluice Efficiency % of B1	B2CC Efficiency % of B2
50,000 CFS SPILL	60	34	6	24	0
B2CC and No Spill	51	1	29	15	35
NO SPILL OR B2CC	34	1	7	15	0

There were no test conditions for spill in spring but there were a few multi-day tests of low spill during the day and night that deviated from the normal day and night spill pattern. All intakes of modified Unit 17 were sampled to estimate fish guidance efficiency (FGE). The FGE was 49%

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at 17A, 52% at 17B, and 70% at 17C in spring and 32% at 17A, 52% at 17B, and 47% at 17C in summer.

Preliminary estimates of major metrics (%) for spring and summer seasons are tabled below. The 95% confidence limits on all estimates were within  $\pm 3\%$ .

Metric	Spring	Summer
FPE	70	64
Spill Efficiency	43	31
Sluice Efficiency (B1 and B2CC at % of Project)	17	26
B1 Sluice Efficiency (% of Project)	7	7
B2CC Efficiency (% of Project)	10	19
B1 Sluice Efficiency (% of B1)	27	21
B2CC Sluice Efficiency (% of B2)	33	54

The efficiency of the B2CC likely is an underestimate because sampling with an acoustic camera indicates that schools of fish enter the B2CC, and fixed-aspect hydroacoustics cannot always resolve all individual fish for counting. In addition, turbulence sporadically shedding from piers at Unit 11 entrains air, making echograms un-trackable 30-50% of the time. Hanging blocked trash racks in the upper slots of Unit 11 would greatly reduce turbulence. We are working on a regression of DIDSON counts of fish in schools on simultaneous hydroacoustic counts, and this may provide a correction for underestimates by the latter method.