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FISH PASSAGE AT THE PROTOTYPE SURFACE BYPASS AND COLLECTOR AT LOWER GRANITE DAM IN SPRING 196-1998

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Introduction

We collected fixed-location hydroacoustic data in spring 1996-1998 as part of a comprehensive evaluation of the prototype surface bypass and collector (SBC) at Lower Granite Dam on the Snake River. The goal of this evaluation was to provide information for the Lower Snake River Juvenile Salmon Migration Feasibility Study, which is due in 1999. In 1998, two major structures were added to the SBC originally installed in 1996 at Lower Granite Dam, a Simulated Wells Intake (SWI) and a Behavioral Guidance Structure (BGS). The general objectives of the fish passage work at the SBC in 1996-1998 were to (1) Measure performance of the SBC and associated structures, and (2) Determine fish passage budgets for the SBC.

SBC Performance

SBC efficiently was higher in 1998 than 1996-1997 (Table 1). This may be attributed to the addition of the SWI on the bottom of the SWI. The SWI decreased the downward component of velocity in the forebay of the SBC, presumably reducing fish entrainment into the turbines below and increasing fish availability to the SBC.

Efficiency for a two-unit SBC ($R_{4\text{-}5}$) was 62% for the preferred configuration ("Ice Harbor" with horizontal surface entrances). This is the "stand-alone" performance for the SBC. The SBC in conjunction with the extended-length intake screens, the "hybrid" approach, had an efficiency of 91%.

Table 1. SBC efficiency relative to the entire project ($R_{1\text{-}6}$), Turbines 4-6 ($R_{4\text{-}6}$), and Turbines 4 and 5 ($R_{4\text{-}5}$). Confidence intervals are at 95% level.

Efficiency	1996	1997	1998
R_{all}	n/a	0.136 ± 0.003	0.268 ± 0.002
$R_{1\text{-}6}$	0.349 ± 0.003	0.293 ± 0.006	0.381 ± 0.003
$R_{4\text{-}6}$	0.427 ± 0.003	0.379 ± 0.010	0.510 ± 0.004
$R_{4\text{-}5}$	0.505 ± 0.004	0.462 ± 0.012	0.595 ± 0.005
N	0.61 to 0.69	0.65 to 0.75	0.56 to 0.59

Entrance efficiency (N) was lower in 1998 than 1996-1997 (Table 1). Lower overall efficiency was not due to the presence of the BGS as entrance efficiencies were similar whether the BGS was in or out. Reduced entrance efficiency occurred at the BGS and South entrances to the SBC, not the Middle and North entrances. Apparently entrance conditions, possibly related to relatively low velocities, were unsatisfactory at the south end of the BGS.

BGS Performance

The BGS diverted 77.8% ± 18.0% of the fish intended for Turbines 1-3 to the north. Mean daily passage rates and proportions were generally lower at Turbines 1-3 and higher at Turbines 4-6, the SBC, and the spillway with the BGS in rather than out. The BGS apparently influenced fish migration through much of the forebay. While the BGS successfully diverted fish, some diverted fish did not enter the SBC, as demonstrated by higher SBC efficiency (R4-6) with the BGS in than out. These data indicated that entrance conditions at the SBC might have been less than optimal. On the other hand, with the BGS
in, enhanced passage at the spillway improved FPE such that there was a significant ($P = 0.026$) difference in FPE between BGS in and out conditions.

Fish Budgets

The fish budgets for 1996-1998 show that the 1998 prototype surface bypass structures increased the percentage of fish available to the SBC, i.e., within 3m of the entrances. This is because in 1998 more fish were above the bottom of the SBC (because of the SWI) and fewer fish were entrained than in previous years. This caused SBC efficiencies to increase in 1998. But, although the percentage of fish available to the SBC increased in 1998, the decrease in entrance efficiency meant that the percentage of fish near the SBC that ended up going through the turbines increased.

Recommendations

1. Improve entrance conditions by closing the BGS and South entrances and concentrating SBC discharge in the Middle and North entrances. Open these entrances from the surface to a depth where mean entrance velocities are about 3-4 fps.
2. Increase the percentage of SBC discharge out of total SBC and turbine discharge by running the turbines below the SBC at low load. Keep SBC discharge at its maximum 4,000 cfs.
3. Test the BGS with Turbines 1-3 at full load (~60 kcfs). In general, the BGS concept seems valid, although the first-year test in 1998 is not sufficient for long-term decision-making because Turbine 2 was off-line the entire study.
4. Test the prototype under low flow conditions. The prototype surface bypass structures have been tested under high flow conditions in 1996 (123% of normal) and 1997 (154% of normal) and average flow conditions in 1998 (101% of normal). Low flow periods are a most critical time for fish passage, and a time when a surface bypass might be expected to be most useful.