PASSAGE OF DOWNSTREAM MIGRATING SALMONIDS THROUGH AN ORIFICE IN A TURBINE INTAKE GATEWELL AT BONNEVILLE DAM

by

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INTRODUCTION

The presence of large concentrations of juvenile salmonids in turbine intake gatewells indicates that these areas may provide a means by which downstream migrants can be diverted safely around the powerhouse section of a dam. One method that might be employed would be to divert accumulated fish from the gatewell to an adjoining ice and trash sluiceway by means of an orifice connecting the two areas. Once in the sluiceway, the fish would be carried safely to the tailrace below the dam.

Exploratory experiments were conducted at Bonneville Dam during the spring and early summer of 1962 to test the above method of bypassing fingerlings. In cooperation with the U.S. Army Corps of Engineers, an orifice was installed in turbine intake gatewell 5-A, and the number of fish passing through the orifice was determined. This report summarizes the results of the study.

METHODS AND MATERIALS

The orifice, installed between turbine intake gatewell 5-A and the ice and trash sluiceway, was fitted with a tapered metal liner 18 inches high by 36 inches wide at the gatewell side and 6 inches high by 24 inches wide at the sluiceway side. A hinged gate on the gatewell side controlled the movement of water and fish through the orifice.

To determine the number of fingerling migrants diverted from the gatewell to the sluiceway, an orifice net was constructed to capture fish after they had passed through the opening. This net, made of 1/2-inch stretch measure knotless nylon in the form of a fyke, covered the exit of the orifice and was installed on the sluiceway side (fig. 1). The net could be operated from a platform at the upstream side of the sluiceway.

A dip net 19 feet long, 7 feet wide, and 4 feet deep was used to capture fish in the gatewells. The frame of the net was hinged longitudinally for insertion and removal from a 4-foot-wide gatewell opening on the turbine intake deck. The gatewell and orifice net are shown in figure 1.

Before the orifice test series, fish were removed from each of three independent gatewells (A, B, and C) each day for eight days to obtain preliminary information on distribution to the respective wells. This was done during a period that appeared to be at the peak of downstream migration.

During the orifice test schedule, the orifice net was checked twice daily--at 10 p.m. and at 8 a.m. on the following morning--to determine the number of fish passing through the orifice. The adjacent gatewell (5-B) was fished once a day and gatewells A and C were randomly fished on a 1-, 2-, or 3-day schedule to determine the number of fish present in these areas. These tests

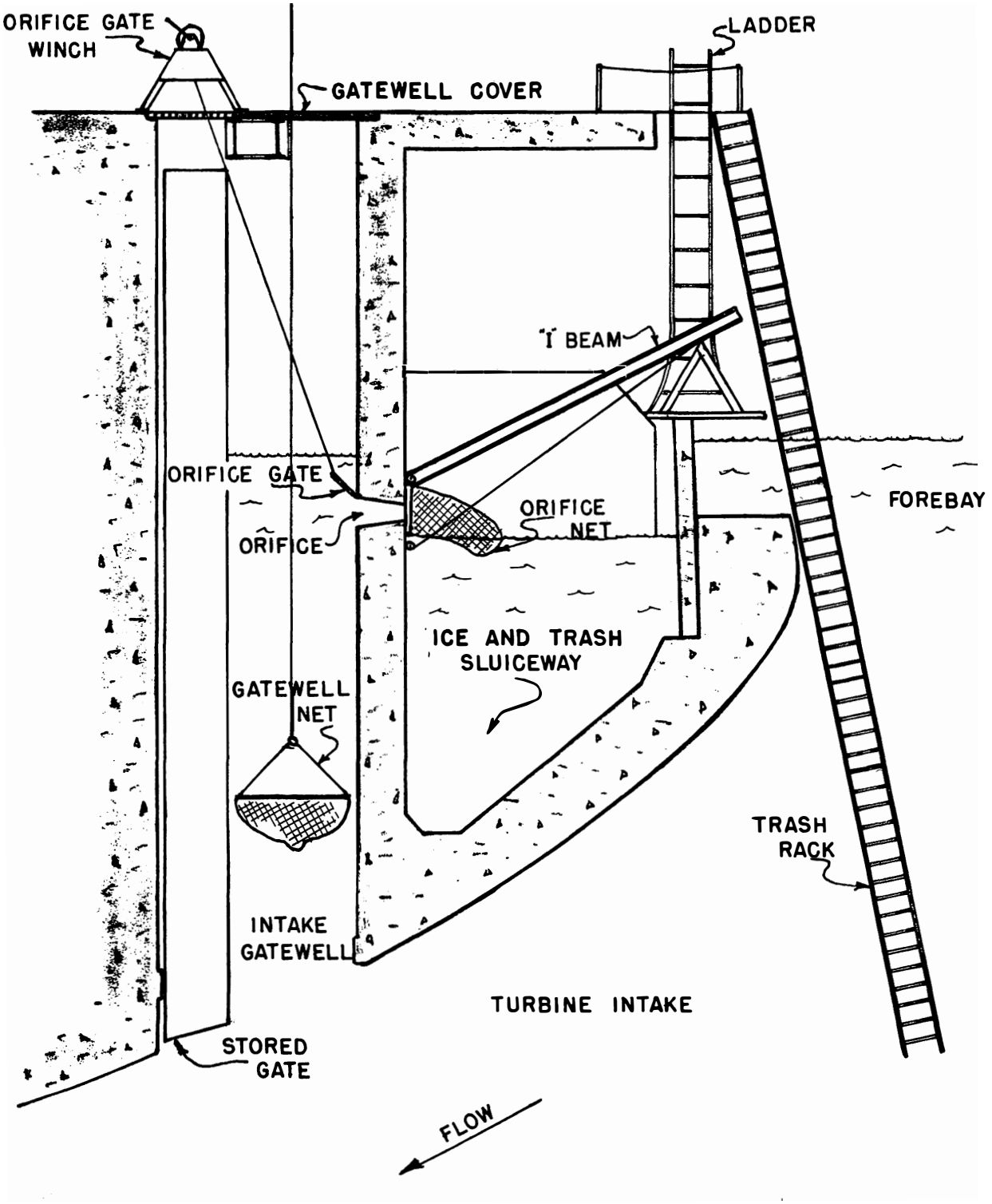

Figure 1.--Orifice and gatewell net (schematic) used to examine fingerling salmonid passage from turbine intake gatewell 5-A to ice and trash sluiceway, Bonneville Dam, 1962.

were made after the peak of the spring migration.

RESULTS

The distribution of salmonids observed in gatewells 5-A, B, and C (table 1) before the orifice experiment show by inspection that well B contained the most fish and well C the least. Statistically, there was no significant difference between the numbers of fish observed in the three wells, but the relative proportion in each well was of value in comparing distributions during the subsequent orifice tests.

Table 2 shows the distribution of fish in the three gatewells and catches in the orifice during tests of the orifice in well 5-A. In these trials, gatewell A contained the least number of fish and well B again held the largest number. If the numbers of fish bypassed through the orifice are added to those taken in gatewell A, however, it may be seen that the relative distribution of the three wells is comparable to that in the pretest series. Although relatively few fish were present during the orifice test series, it would appear that substantial proportions of the fish in well 5-A were bypassed to the ice and trash sluiceway.

Passage through the orifice appeared to vary with species (table 3). Based on the respective combined gatewell and orifice net catches, approximately 91 percent of the steelhead and 64 percent of the chinook passed through the orifice.

Table 1.--Numbers of salmonids removed from intake gatewells of Unit Number 5, Bonneville Dam.

Date		Numbers of fish				Percent of total		
		5-A	5-B	5-C	Total	5-A	5-B	5-C
May	8	443	602	356	1,401	31.6	42.0	25.4
	9	196	198	185	579	33.9	34.2	32.0
	10	84	242	120	446	18.8	54.3	26.9
	11	41	36	31	108	38.0	33.3	28.7
	12	126	176	140	442	28.5	39.8	31.7
	13	298	221	140	659	45.2	33.5	21.3
	14	48	88	70	206	23.3	42.7	34.0
	15	86	45	27	158	54.4	28.5	17.1
Summary:		1,322	1,608	1,069	3,999	33.1	40.2	26.7

Table 2.--Total number of salmonid fingerlings accumulated in three fishing periods of 1-, 2-, & 3-days duration, showing gatewell and orifice fish counts in well 5-A and fish counts in wells B and C.

	Turbine intake gatewell				
	5-A			5-B	5-C
Days in fishing period	No. fish in gatewell[1/]	No. fish through orifice[2/]	Total	No. fish in gatewell[2/]	No. fish in gatewell[1/]
1	14	42	56	54	30
2	21	52	73	71	24
3	16	82	98	114	50
Totals:	51	176	227	239	104

1/ Fish removed at end of fishing period.

2/ Fish removed daily.

Table 3.--Comparison of numbers of chinook and steelhead passing through the gatewell orifice in relation to corresponding numbers in the gatewell.

Species	No. of days in one fishing period	No. of fish in gatewell 5-A	No. of fish through orifice	Total
Chinook	1	8	14	22
	2	19	14	33
	3	14	45	59
		41	73	114
Steelhead	1	6	28	34
	2	2	38	40
	3	2	37	39
		10	103	113