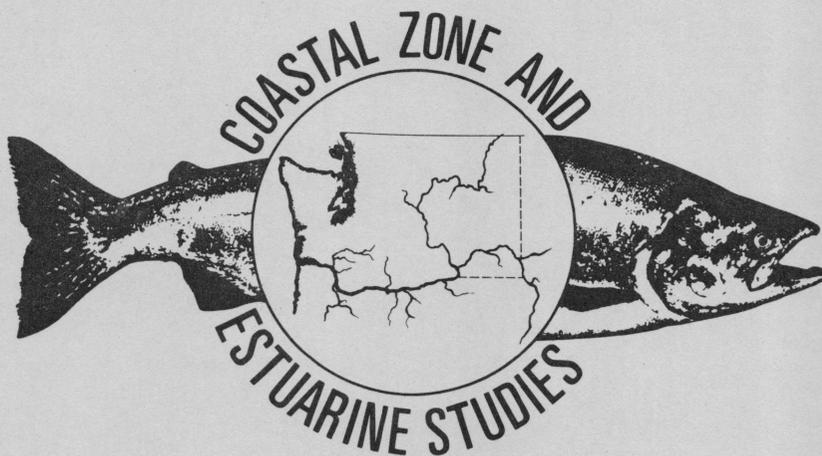


Preliminary Evaluation of the Bonneville Juvenile Bypass System--Second Powerhouse

by
Robert J. McConnell
and
William D. Muir

December 1982

McConnell



PRELIMINARY EVALUATION OF THE BONNEVILLE JUVENILE
BYPASS SYSTEM--SECOND POWERHOUSE

by

Robert J. McConnell
and
William D. Muir

FINAL REPORT

Financed by

U.S. Army Corps of Engineers

Contract DACW57-82-F-0398

and

Coastal Zone and Estuarine Studies Division
Northwest and Alaska Fisheries Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
2725 Montlake Boulevard East
Seattle, Washington 98112

December 1982

CONTENTS

INTRODUCTION. 1

METHODS. 1

RESULTS and CONCLUSIONS. 2

RECOMMENDATIONS. 3

 65 Level Fingerling Bypass Channel. 3

 45 Level Fingerling Observation Room. 8

INTRODUCTION

Included in the design of the second powerhouse at Bonneville Dam is a collection and downstream passage system (DSM) for juvenile salmonid migrants. Major components of the Bonneville second powerhouse DSM system are: (1) submersible traveling screens (STS) to guide fish out of the turbine intakes into gatewells; (2) vertical barrier screens to prevent fingerlings from returning to the turbine intakes; (3) orifices to allow fish egress from gatewells into the bypass gallery; (4) the fingerling bypass downwell, located at the end of the gallery channel, that passes fingerlings to the outfall located on the river bottom in the tailrace of the second powerhouse; (5) a sampler which automatically collects a random 10% sample of juvenile migrants passing through the bypass system; (6) a dry separator connected to a wet separator in the migrant observation room; (7) four raceways to hold fish from the wet separator; and (8) a downwell, located in the fish handling room, which is connected to the bypass outfall on the river bottom.

In early 1982, the U.S. Army Corps of Engineers (CofE) contracted with the National Marine Fisheries Service (NMFS) to oversee the startup and initial function of the DSM. The object was to identify potential problems with the DSM prior to a comprehensive evaluation scheduled for the spring of 1983.

METHODS

Onsite observations throughout the startup and initial operation of the DSM provided the best method of detecting potential problems.

Marked fish (cold brands and fin clips) were released into gatewells and through a portion of the DSM. Percent mortality and descaling were

monitored while the DSM was operating. Descaling was determined by examining five equal areas per side on each fish. If any two adjacent areas were 50% or more descaled, the fish was classified as descaled.

On 23 April, two groups of marked fall chinook salmon from the Bonneville Hatchery were released to determine survival through the gallery downwell-outlet: Group 1--106,216 fish released in the bypass gallery in the second powerhouse and Group 2--101,787 fish released into the tailrace of the first powerhouse. Relative survival was determined by comparing recoveries of the marked fish at the NMFS sampling site at Jones Beach (RKM 75).

To determine the efficiency of the 10% sampling device and its effect on descaling, marked fish which were not descaled were released into Gatewell 18B.

Between 13 May and 12 August, migrant juveniles were dipped from Gatewells 3B, 4A, 4B, and 18B in the first and second powerhouse to ascertain descaling.

RESULTS AND CONCLUSIONS

Construction work on the second powerhouse at Bonneville Dam extended through the 1982 fingerling migration period. In addition, high river flows during the spring and summer of 1982 necessitated the spilling of excess water throughout this period. These two factors influenced the results of the preliminary studies conducted by NMFS personnel. Of the fish released on 23 April, 0.37% of the fish released into tailrace and 0.39% of those released into the DSM gallery downwell were recovered--not a statistically significant difference. Consequently, we concluded that fish that entered the downwell in the DSM gallery and were transported

downstream from the second powerhouse survived as well as those released directly into the tailrace. Apparently there were no obstructions that would impact juvenile survival in that portion of the DSM.

The 10% sampler was exceptionally accurate, of 2,231 marked fish released into Gatewell 18B, 9.9% were recovered by the sampler (Table 1). Approximately 6% of the fish recovered were descaled.

Gatewell dipping of unmarked fish in the first and second powerhouses showed wide variation in descaling between species with averages ranging from 7 to 17% (Table 2). This effort will be expanded in 1983.

During 938 hours of DSM operation, 8,927 fish were obtained from the 10% sampler. Subyearling fall chinook salmon were captured most frequently and had the least descaling (4.4%) whereas sockeye salmon were captured less frequently, however, they sustained the highest rate of descaling (48.9%) (Table 3).

RECOMMENDATIONS

65 Level Fingerling Bypass Channel

- 1) Complete installation of warning system in DSM facilities prior to 1983 season.
- 2) Modify water flow or projection louvers on emergency relief gate.
- 3) Modify flow between stop logs and inclined screen to eliminate turbulence (back eddy).
- 4) Complete automatic water level controls to eliminate fluctuations throughout DSM system.
- 5) Modify 10% sampler to eliminate accumulation of debris on screens (possible solution: a Johnson vertical bar screen).
- 6) Install rubber sheeting in gallery downwell so fish do not impact top of grates or are not stranded on top of concrete sill.
- 7) Modify dry separator so fish passing through 10% sampler are not stranded on dry apron prior to separator.

Table 1.--Bonneville Dam 2nd powerhouse marked fish release test^{a/}, 22-25 June 1982.

Date (1982)	Time of day	Test hours	No. of fish by species				Total no. of fish	Cumulative totals	
			Chinook		Steel- head	Coho		No. fish	Percentage
			Fall "0"	Spring "1"					
22 June	1000	Start							
	1400	4h	28	7	1	1	37	37	1.6
	1800	8h	19	6	-	1	26	63	2.8
	2200	12h	9	8	-	-	17	80	3.6
23 June	0200	16h	11	5	-	1	17	97	4.3
	0600	20h	19	11	-	1	31	128	5.7
	1000	24h	4	2	-	-	6	134	6.0
	1400	28h	12	-	1	-	13	147	6.5
	2200	36h	11	9	-	1	21	168	7.5
24 June	0800	46h	8	7	-	-	15	183	8.2
	1400	52h	14	-	-	1	15	198	9.0
	2200	60h	9	4	-	-	13	211	9.6
25 June	0800	70h	3	-	-	-	3	214	9.7
	1300	75h	4	-	-	1	5	219	9.9
Total			155	59	2	7	219		

^{a/} On 22 June 1982 (0930 h), 2231 marked juvenile salmonids (none descaled) were released into Gatewell 18B. At 1000 h, the orifice from the gatetwell was opened to allow fingerling passage into the bypass channel and subsequently to the bypass outfall or across the 10% sampler. After 48 h of operation, Gatewell 18B was dipped to determine the number of marked fish remaining in the gatewell--23 fish were recaptured. The table relates to the marked fish crossing the 10% sampler--5.9% were descaled.

Table 2.--Results of gatewell dipping at Bonneville Dam to ascertain descaling, 13 May - 12 August 1982.

	<u>"0" Chinook</u>	<u>"1" Chinook</u>	<u>Steelhead</u>	<u>Coho</u>	<u>Sockeye</u>	<u>Total</u>
<u>SECOND POWERHOUSE</u>						
Gatewell 18B - 21, 24, 25 June						
# Captured	41	26	2	1	0	70
% Descaled	4.9	30.8	50.0	0	0	17.1
<u>FIRST POWERHOUSE</u>						
Gatewell 4A - 15, 16 June; 7, 15, 22, 28 July; 2, 3 August						
# Captured	253	19	5	99	7	383
% Descaled	6.7	21.1	20.0	5.1	14.3	7.3
Gatewell 4B - 11, 15, 16 June; 1, 7, 15, 22, 28, 29, 30 July; 2, 3, 4 August						
# Captured ^{a/}	1054	145	18	226	27	1470
% Descaled	10.6	19.7	11.1	4.4	29.6	10.9
Gatewell 3B - 30 July; 3 August (No STS)						
# Captured	15	1	1	1	0	18
% Descaled	--	--	--	--	--	0

^{a/} 217 additional coho salmon and 901 "0" chinook salmon captured but not examined for descaling.

Table 3.--Number of fish captured, percent descaled, and percent mortality of fish recovered from the Bonneville Dam 2nd powerhouse 10% sampler. Included are the cumulative totals.

	Weekly totals								Cumulative totals						
	1982 Date	Hours Fished	"0" Chin.	"1" Chin.	Sthd.	Coho	Sock.	Total	Hours Operated	Chin.	Chin.	Sthd.	Coho	Sock.	Total
Captured	May 10-	3.5	10	4	2	---	2	18	3.5	10	4	2	---	2	18
Descaled	14		10.0	25.0	0	---	50.0	16.7		10.0	25.0	---	---	50.0	16.7
Mortality			16.7	---	---	---	---	11.1		20.0	---	---	---	---	10.0
Captured	May 17-	17	105	60	6	10	7	188	20.5	115	64	8	10	9	206
Descaled	21		7.6	15.0	33.3	---	85.7	13.3		7.8	15.6	25.0	---	77.8	13.6
Mortality			12.5	4.8	---	---	---	8.7		12.9	4.5	---	---	---	8.8
Captured	May 24-	81	201	207	88	343	114	953	101.5	316	271	96	353	123	1159
Descaled	29		3.5	27.5	10.2	8.2	61.4	17.9		5.1	24.7	11.5	7.9	62.6	17.2
Mortality			4.7	5.0	5.4	2.0	23.0	6.6		7.9	4.9	4.9	1.9	21.7	7.0
Captured	May 31	67	324	373	83	291	171	1242	168.5	640	644	179	644	294	2401
Descaled	June 4		1.2	18.2	19.3	6.9	47.4	15.2		3.1	31.0	15.1	7.4	53.7	16.1
Mortality			10.1	5.1	6.7	2.7	25.9	9.9		9.8	5.0	5.8	2.3	24.4	9.1
Captured	June 7-	37	1197	109	10	49	7	1372	205.5	1837	753	189	693	301	3773
Descaled	11		2.8	21.1	30.0	12.2	85.7	5.2		2.9	21.0	15.3	7.8	54.5	12.2
Mortality			5.4	4.4	23.1	2.0	---	5.4		7.9	5.0	6.9	2.3	24.0	7.9
Captured	June 14-	68	376	247	5	33	1	662	273	2213	1000	194	726	302	4435
Descaled	18		3.5	14.2	20.0	21.2	---	8.4		3.0	19.3	16.0	8.4	54.5	11.6
Mortality			2.8	2.0	16.7	2.9	50.0	2.8		7.6	4.2	7.2	2.3	24.1	7.5
Captured	June 21-	74	489	399	13	5	---	906	347	2702	1399	207	731	302	5341
Descaled	25		5.3	17.3	15.4	20.0	---	10.8		3.4	18.7	15.9	8.5	54.5	11.5
Mortality			2.2	1.5	---	---	---	1.8		7.1	3.5	6.8	2.3	24.1	6.8

Table 3.--Continued.

	Weekly totals								Cumulative totals						
	1982 Date	Hours Fished	"0" Chin.	"1" Chin.	Sthd.	Coho	Sock.	Total	Hours Operated	"0" Chin.	"1" Chin.	Sthd.	Coho	Sock.	Total
Captured Descaled Mortality	June 28	74	277	46	3	1	---	327	421	2979	1445	210	732	302	5668
	July 2		6.8	13.0	33.3	---	---	7.9		3.7	18.5	16.1	8.5	54.5	11.3
			.7	---	---	---	---	.6		6.8	3.3	6.7	2.3	24.1	6.6
Captured Descaled Mortality	July 6- 9	70	342	28	---	---	---	370	491	3321	1473	210	732	302	6038
			9.4	21.4	---	---	---	10.3		4.3	18.6	16.1	8.5	54.5	11.2
			1.2	---	100.0	---	---	1.3		6.5	3.3	7.1	2.3	24.1	6.4
Captured Descaled Mortality	July 12- 16	96	486	77	1	5	58	627	587	3807	1550	211	737	360	6665
			6.4	24.7	---	20.0	24.1	10.4		4.6	18.9	16.1	8.5	49.4	11.1
			1.2	1.3	---	---	---	1.1		6.2	3.2	7.0	2.3	20.9	6.1
Captured Descaled Mortality	July 19- 23	92	887	63	1	3	2	956	679	4694	1613	212	740	362	7621
			5.5	14.3	0	---	---	6.1		5.0	18.7	16.0	8.5	49.2	10.6
			.18	---	---	---	---	.17		5.3	3.2	7.0	2.2	20.8	5.4
Captured Descaled Mortality	July 26- 30	82	803	11	---	---	---	814	771	5497	1624	212	740	362	8435
			3.2	---	---	---	---	3.2		4.5	18.6	16.0	8.5	49.2	9.8
			1.3	---	---	---	---	1.3		4.8	3.1	7.0	2.2	20.8	5.0
Captured Descaled Mortality	Aug. 2- 6	93	348	21	---	---	2	371	864	5845	1645	212	740	364	8806
			2.3	4.8	---	---	---	2.4		4.4	18.4	16.0	8.5	48.9	9.5
			1.4	---	---	---	---	1.3		4.7	3.0	7.0	2.2	20.7	4.9
Captured Descaled Mortality	Aug. 9- 12	74.5	103	18	---	---	---	121	938.5	5948	1663	212	740	364	8927
			2.9	0	---	---	---	2.5		4.4	18.2	16.0	8.5	48.9	9.4
			0	0	---	---	---	0		4.6	3.1	7.0	2.2	20.7	4.9

- 8) Modify hopper in dry separator to pass a higher volume of water to observation room.
- 9) Raise alarm system in hopper of dry separator.

45 Level Fingerling Observation Room

- 1) Modify wet separator to facilitate bypassing excess fish.
- 2) Install inverted cone in upwell of wet separator to eliminate insufficient flow in corners of existing upwell.
- 3) Lower top of concrete weir bypass outfall to eliminate turbulence.
- 4) Provide plastic screens for top of raceways and wet separator so fish cannot jump out.
- 5) Complete fish handling system in observation room.
- 6) Modify floor grates so fish cannot pass through "small mesh screening."

These recommendations were discussed with CofE personnel and appropriate action is scheduled prior to the 1983 evaluation period.

