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Continued Studies to Evaluate the Juvenile Bypass Systems at Bonneville Dam-1989

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by
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COASTAL ZONE AND ESTUARINE STUDIES

CONTINUED STUDIES TO EVALUATE THE JUVENILE BYPASS SYSTEMS AT BONNEVILLE DAM - 1989

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INTRODUCTION

Research at Bonneville Dam Second Powerhouse (Bonneville II) began in 1983 with the evaluation of the fingerling collection and bypass system. In these studies, fish guiding efficiency (FGE) was between 20 and 25% for yearling chinook salmon, far less than the 70% or greater at Bonneville Dam First Powerhouse (Bonneville I) and much below the 70% guidance standard considered by the Columbia Basin Fish and Wildlife Authority as the minimum level needed for adequate fish passage. Research in 1985 indicated that streamlined trashracks and lowered submersible traveling screens (STSs) could increase FGE to >40% for yearling chinook salmon. Research in 1986 and 1987 resulted in some FGE estimates >70% when using turbine intake extensions (TIEs) combined with earlier modifications. Tests in 1988 with submerged bar screens (SBSs) resulted in increased FGE; however, descaling of juvenile salmonids during testing was unacceptable. Also in 1988, mercury vapor lights attached to the intake ceiling and STS frame increased FGE, but results were inconsistent.

Initial studies of FGE with prototype STSs at Bonneville I were conducted during the early and late portions of the 1981 juvenile salmonid spring outmigration. Guidance estimates >70% were observed for all species tested (Krcma et al. 1982). Based on these results and information obtained at similar projects, a full complement of STSs was installed at the powerhouse in 1984. Subsequent research on summer migrating subyearling chinook salmon at John Day Dam (Krcma et al. 1986; Brege et al. 1987) and McNary Dam (Brege et al. 1988) indicated guidance ranged from 25 to 45%, varying both during the season and from year to year. Because of these poor results, FGE was measured for the first time during the 1988 summer outmigration at Bonneville I to determine baseline guidance levels prior to installation of a floating guidewall for the new Bonneville Dam navigation lock. Fish guidance was

<12% (Gessel et al. 1989), which was much lower than the 70% average for subyearling chinook salmon measured during May 1981 (Krcma et al. 1982).

During the 1989 juvenile salmonid outmigration, the National Marine Fisheries Service (NMFS) conducted studies at both Bonneville Dam powerhouses with the following objectives:

1) Continue FGE and vertical distribution testing at Bonneville II to evaluate the following modifications or additions for improving FGE and STS effectiveness in conjunction with TIEs (Fig. 1):
   a. Raised operating gate
   b. Bar screens
   c. Perforated plate with bar screens to reduce descaling
   d. Illuminated guiding device
2) Continue FGE and vertical distribution testing at Bonneville I to more accurately assess FGE and STS effectiveness over the spring and summer juvenile salmonid outmigration prior to construction of the navigation lock guidewall.

OBJECTIVE 1 - EVALUATION OF MODIFICATIONS TO IMPROVE FISH GUIDANCE EFFICIENCY AT BONNEVILLE II

Approach

Fish guidance and vertical distribution studies were conducted with existing fyke nets and net frames. Procedures and methodologies were similar to those used at Bonneville II in 1985, 1986, 1987, and 1988 (Gessel et al. 1986, 1987, 1988, 1989). A dipbasket collected guided fish from the gatewell and a net frame attached to the guiding device (traveling screen or bar screen) supported nets to collect unguided fish.

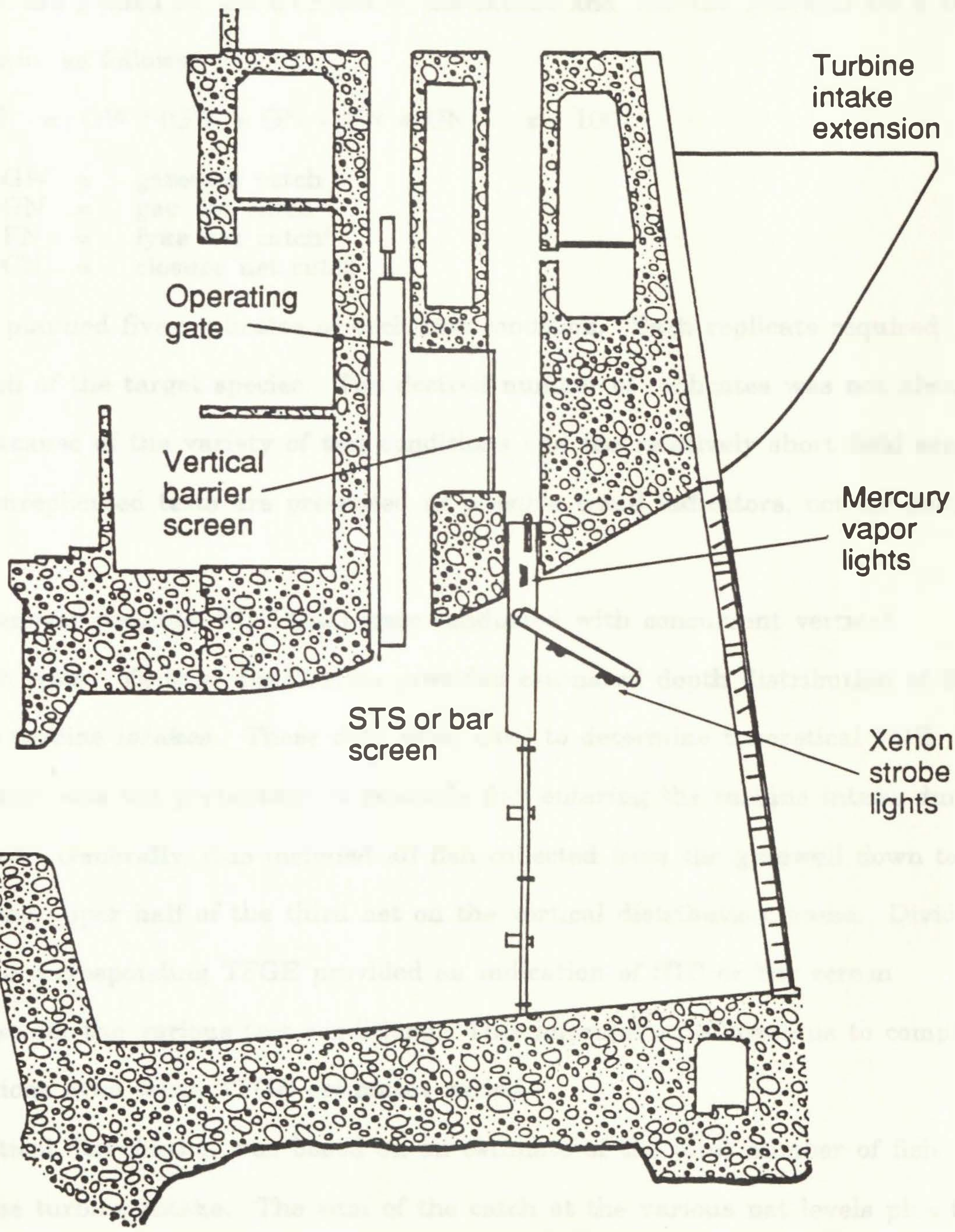

Figure 1.--Cross-sectional view of a turbine intake with turbine intake extension, operating gate, and lights tested at Bonneville Dam Second Powerhouse, 1989.

Fish guidance efficiency is the percentage of fish (by species) entering the turbine intake that are guided by the STS out of the intake and into the gatewell for a specific test condition, as follows:

$$FGE = GW / (GW + GN + FN + CN) \times 100$$

GW = gatewell catch
GN = gap net catch
FN = fyke net catch[1]
CN = closure net catch

We planned five replicates of each test condition. Each replicate required 250-300 fish of the target species. The desired number of replicates was not always attained because of the variety of test conditions and the relatively short field season. Data for unreplicated tests are presented as possible trend indicators, not for statistical analysis.

Whenever possible, FGE tests were conducted with concurrent vertical distribution tests. Vertical distribution provided estimated depth distribution of fish within the turbine intakes. These data were used to determine theoretical FGE (TFGE) which was the percentage of guidable fish entering the turbine intake during an FGE test. Generally, this included all fish collected from the gatewell down to and including the upper half of the third net on the vertical distribution frame. Dividing FGE by the corresponding TFGE provided an indication of STS or bar screen effectiveness for the various test conditions. This information allowed us to compare test conditions even when TFGE estimates varied.

Vertical distribution was based on an estimate of the total number of fish entering the turbine intake. The sum of the catch at the various net levels plus the gatewell catch gave an estimate of the total number of fish during each test. To minimize the number of fish captured in the nets, only the center portion of each net level collected fish, and the number of fish captured was expanded by a factor of 3.

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[1]Net catches with only a middle net were expanded by a factor of 3.

The percentage of fish at each net level was determined by dividing the computed figure for each net level by the estimated total intake catch.

Fish guidance and concurrent vertical distribution testing occurred during the spring (22 April to 4 June) and summer (8 to 28 July) smolt migrations targeting on yearling and subyearling chinook salmon, respectively. Data for other species were collected as available. Subyearling chinook salmon were also captured during late May-June. Guidance for these fish is generally higher than that for late summer migrants and can approach FGEs of yearling chinook salmon (Krcma et al. 1982; Gessel et al. 1988, 1989). However, the major portion of the wild subyearling smolt migration passes Bonneville Dam during the late summer. Subyearling chinook salmon passing during the spring are almost entirely from Spring Creek Hatchery just 20 km upstream from the dam. For these reasons and to remain consistent with past Bonneville Dam reports, we will continue to separate and designate yearling chinook and coho salmon as the early phase fish and subyearling chinook salmon as the late phase fish. All tests began at approximately 2000 h and generally lasted from 1 to 2 hours, depending upon fish numbers. Tests during the spring were conducted with a unit discharge of 16,500 to 17,500 cfs. Late summer tests were conducted at 14,000-15,000 cfs due to lower tailwater levels and higher unit heads. Four units (11, 12, 13, and 18) were operated during all tests. The FGE tests were conducted in Slots 12A and 12B (the majority in 12B, which was equipped with a TIE) while vertical distribution was measured in Slot 13A (also equipped with a TIE). Individual test conditions are specified in Table 1. Lights used to modify fish behavior to increase FGEs or decrease descaling were either 250-watt mercury vapor (12,000-13,000 lumens/light) mounted on the frame of the guiding device and positioned near the gatewell entrance or xenon

Table 1.--Submersible traveling screen and bar screen fish guidance efficiency tests conducted at Bonneville Dam Second Powerhouse during the 1989 field season. All testing occurred with four turbine units operating (11, 12, 13, and 17 or 18).

Test series no.	Date of tests	Test unit	Load kcfs	Guiding device	Light condition	Operating gate
1	25,27,29 April 1,3,6,8 May	12B	17.5	Bar Screen with perforated plate and 26-in solid section	No lights	Standard
2	26,28,30 April 2,4,5,7 May	12B	17.5	Bar screen with perforated plate and 26-in solid section	No lights	Raised 25 ft
3	9,10 May	12B	17.5	Bar screen with 2/3 perf. plate	No lights	Standard
4	11,12,13,14 May	12B	17.5	Bar screen with 4/5 perf. plate	No lights	Standard
5	15,16,17 May	12B	17.5	Bar screen with 4/5 perf. plate	No lights	Standard
	15,16,17 May	12A	17.5	Traveling screen	No lights	Standard
6	26,28,30 May 1,3 June	12B	17.5	Bar screen with 4/5 perf. plate	No lights	Standard
	26,28,30 May 1,3 June	12A	17.5	Traveling screen	No lights	Standard
7	27,29,31 May 2,4 June	12B	17.5	Traveling screen	No lights	Standard
	27,29,31 May 2,4 June	12A	17.5	Bar Screen with 4/5 perf. plate	No lights	Standard
8	8,12,14,18 20,24 July	12B	14-15	Bar screen with 4/5 perf. plate	Four lights mounted on frame in gateslot	Standard
	8,12,14,18 20,24 July	12A	14-15	Traveling screen	Four lights mounted on frame in gateslot	Standard
9	13,17,19,21 25,26 July	12B	14-15	Bar screen with 4/5 perf. plate	No lights	Standard
	13,17,19,21 25,26 July	12A	14-15	Traveling screen	No lights	Standard
10	27,28 July	12B	14-15	Bar screen with 4/5 perf. plate	No lights	Standard
	27,28	12A	14-15	Bar screen no perforated plate	Flashing lights on trashrack (3)	Standard

strobes mounted behind the guiding device (producing 15 joules with a flash rate of one every 2 seconds and a duration of 2 milliseconds).

Fish condition (descaling) was monitored by examining fish captured in the gatewell. Descaling was determined by dividing the fish into five equal areas per side; if any two areas on a side were estimated to be 50% or more descaled, the fish was classified as descaled.

Results and Discussion

Tests at Bonneville II were conducted from 23 April to 4 June with yearling chinook salmon as the target species and from 8 to 28 July with subyearling chinook salmon as the target species. Table 1 and Appendix Tables 1 and 2 provide detailed recapture information for all species.

Yearling Chinook Salmon

Test Series 1 and 2 were alternated in a cross-over test design to determine whether the raised operating gate would increase guidance at Bonneville II. Similar tests conducted at this powerhouse were inconclusive (Gessel et al. 1985, 1986). In 1989, guidance was 43.6% with the raised gate and 41.0% with the standard gate (Table 2) (data were weighted by number of fish captured). The paired t-test ($t = 0.88$, $P > 0.05$) indicated no significant difference between the two tests.

Portions of the perforated plate were removed from the bar screen to determine the optimum porosity of the bar screen to minimize descaling (Test Series 3 and 4). Also, solid plate (26 in) was attached to the downstream end of the bar screen. The STS, bar screen, and bar screen with perforated plate had estimated porosities of 25, 48, and 33%, respectively. Removing a portion of the perforated plate increased the overall porosity somewhat. The use of perforated plate and a solid section on the back of the bar screen reduced descaling rates to approximately the same as the STS (Table 3).

Table 2.--Results of the fish guidance efficiency (FGE) tests conducted at Bonneville Dam Second Powerhouse during the 1989 field season.

Test[a] series	Number of reps.	Chinook salmon	Guidance device	Lights	FGE	Guidance device effectiveness	
						Mean	S.E.
1	7	Yearling	BS[b]	OFF	41.0	57.7	5.6
2	7	Yearling	BS[b]	OFF	43.6	61.1	5.1
3	2	Yearling	BS[c]	OFF	63.5	73.9	1.8
4	4	Yearling	BS[d]	OFF	56.4	76.7	4.5
5	3	Yearling	BS[d]	OFF	65.3	87.0	8.6
	3	Yearling	STS[e]	OFF	78.4	[f]	
6	5	Yearling	BS[d]	OFF	[g]		
	5	Yearling	STS	OFF	[g]		
7	5	Yearling	STS	OFF	[g]		
	5	Yearling	BS[d]	OFF	[g]		
8	6	Subyearling	BS[d]	ON	25.3	58.4	4.4
	6	Subyearling	STS	ON	23.4	54.1	6.4
9	6	Subyearling	BS[d]	OFF	25.1	59.7	6.8
	6	Subyearling	STS	OFF	21.7	52.2	4.2
10	2	Subyearling	BS[d]	OFF	23.4	57.2	8.5
	2	Subyearling	BS[h]	ON	27.8	[f]	

[a] Test series numbers correspond to Table 1, this report.
[b] Bar screen with perforated plate and 26-in solid section.
[c] Bar screen with 2/3 perforated plate and solid section (exact porosity unknown).
[d] Bar screen with 4/5 perforated plate and solid section (exact porosity unknown).
[e] Submersible traveling screen.
[f] Test conducted without the turbine intake extension (TIE), no comparable vertical distribution.
[g] No FGE calculated because small numbers of fish (<100 per replicate) for most replicates.
[h] No perforated plate behind bar screen.

Table 3.--Descaling results for yearling chinook salmon compiled during fish guidance efficiency tests conducted at Bonneville Dam Second Powerhouse during the 1989 field season.

Dates	Gateslot 12B (%)	Gateslot 12A (%)	Gateslot 13A[a] (%)
22 April-6 May	5.5[b]	12.7[c]	4.0
7-8 May	9.5[b]	9.5[d]	8.4
9-10 May	17.0[e]	13.1[d]	13.4
11-17 May	9.5[f]	10.4[d]	5.9

[a] Vertical distribution gateslot, no guiding device.
[b] Bar screen with perforated plate and 26-in solid section.
[c] Bar screen only, no perforated plate.
[d] STS
[e] Bar screen with 2/3 perforated plate and solid section.
[f] Bar screen with 4/5 perforated plate and solid section.

Test Series 5 compared the best bar screen and perforated plate configuration with the STS. A cross-over design was not used at this time because of insufficient test days. Weighted FGE results were 78.4% (STS in 12A) and 65.3% (bar screen in 12B). These results were similar to 1987 tests that compared the STS in 12A and 12B (FGE of 72.1 and 60.0%, respectively) (Gessel et al. 1988).

A cross-over test was conducted under the above conditions in late May early June (Test Series 6 and 7), but yearling chinook salmon numbers were too low for statistical evaluation.

As in past years with TIEs in the alternate configuration, FGEs in Unit 12 were higher in the slot without the TIE. Additionally, the number of fish entering the slot without the TIE was 2-3 times higher than in the adjacent slot with a TIE. Thus the overall FGE for the unit was weighted toward the higher FGE obtained from the non-TIE slots.

Subyearling Chinook Salmon

We conducted six test replicates to determine if there was a difference in guidance between the STS or a bar screen with perforated plate and solid plate (Table 2, Series 8 and 9). We also tested these conditions with addition of mercury vapor lights. Average guidance (weighted for fish numbers) for the bar screen was 25.3 and 25.1% (with and without lights) and for the STS was 23.4 and 21.7% (with and without lights). Effectiveness of the bar screen (tested in 12B) with and without the lights was 58.4 and 59.7%, respectively. Guidance was not increased when flashing lights (xenon strobe) were placed behind the bar screen without perforated plate (Test Series 10); however, descaling rose from 9 to 23%. We believe the lights attracted migrants to the bar screen, and without perforated plate, the screen increased descaling.

OBJECTIVE 2 - FISH GUIDANCE EFFICIENCY AND VERTICAL DISTRIBUTION TESTS AT BONNEVILLE I

Approach

Vertical distribution and FGE procedures used at Bonneville I were identical to those used at Bonneville II. Dipbaskets collected fish from the gatewell, and net frames collected fish from the turbine intake. Testing occurred during the spring outmigration, targeting yearling chinook salmon and during the summer outmigration, targeting subyearling chinook salmon. Data for other species were collected as available. All testing occurred in Unit 3B, with approximately one vertical distribution test for every three FGE tests. Concurrent FGE and vertical distribution tests were not conducted to minimize the number of fish sacrificed in the nets.

A standard elevation STS was used for all FGE tests; therefore, TFGE was estimated to be all fish from the gatewell down to and including fish in the second net level of the vertical distribution frame.

Standard unit operation prevailed with all available units operating at full load. Unit flows ranged from 14,000 to 14,500 cfs in the spring and from 10,200 to 12,700 cfs in the summer.

Results and Discussion

Tests at Bonneville I were conducted from 8 to 14 May with yearling chinook salmon as the target species and from 27 to 30 May and 12 to 24 July with subyearling chinook salmon as the target species. Appendix Tables 3 and 4 provide detailed recapture information for all species.

Yearling Chinook Salmon

Six replicate tests were conducted, and the total number of yearling chinook salmon recaptured per test ranged from 141 to 236. Guidance for the six replicates ranged from 34.7 to 49.6%, with a weighted mean of 41.7% (S.E. = 2.2). The corresponding TFGE was 69.6% (S.E. = 3.2), and screen effectiveness was 60.8% (Fig 2). This was the first time since 1981 that FGE and vertical distribution were measured for yearling chinook salmon at Bonneville I. Between 11 and 13 May in 1981, the weighted average FGE was 83.6% (in Unit 4 with a screen angle of 53°), and the concurrent TFGE (in Gatewells 5A and 5B) was 85.0%, with an overall screen effectiveness of 98.0% (Krcma et al. 1982). Therefore, the lower FGE in 1989 was due to a lower vertical distribution of fish as they entered the turbine intake (Fig. 3) and a decrease in screen effectiveness of 37% compared with 1981.

The lowered vertical distribution in 1989 could have resulted from a number of factors. As a result of dredging for the new navigation lock, the upstream tip of Bradford Island was removed and seven rock groins were placed in the upstream approach to the navigation lock. These two actions straightened the flow approaching the north side of the powerhouse, removed some of the larger eddies, and distributed the flow across the entire powerhouse. Possibly increased squawfish populations in the forebay caused fish to move deeper to avoid predation.

The descaling rate on yearling chinook salmon ranged from 2.9 to 10.3% and averaged 6.6%.

Subyearling Chinook Salmon

During the first subyearling chinook salmon FGE and vertical distribution tests (27 to 30 May), only 76 to 111 fish were recovered per test. This was fewer fish than preferred. The results, however, indicated the range of FGEs and TFGEs for late spring migrating subyearling chinook salmon. The FGEs for the four replicates ranged from 31.0 to 50.0% with a weighted mean of 36.8% (S.E. = 4.3) compared with 40.7% FGE in 1988 during the same period (Gessel et al. 1989). The TFGE for the one vertical distribution test was 63.6%.

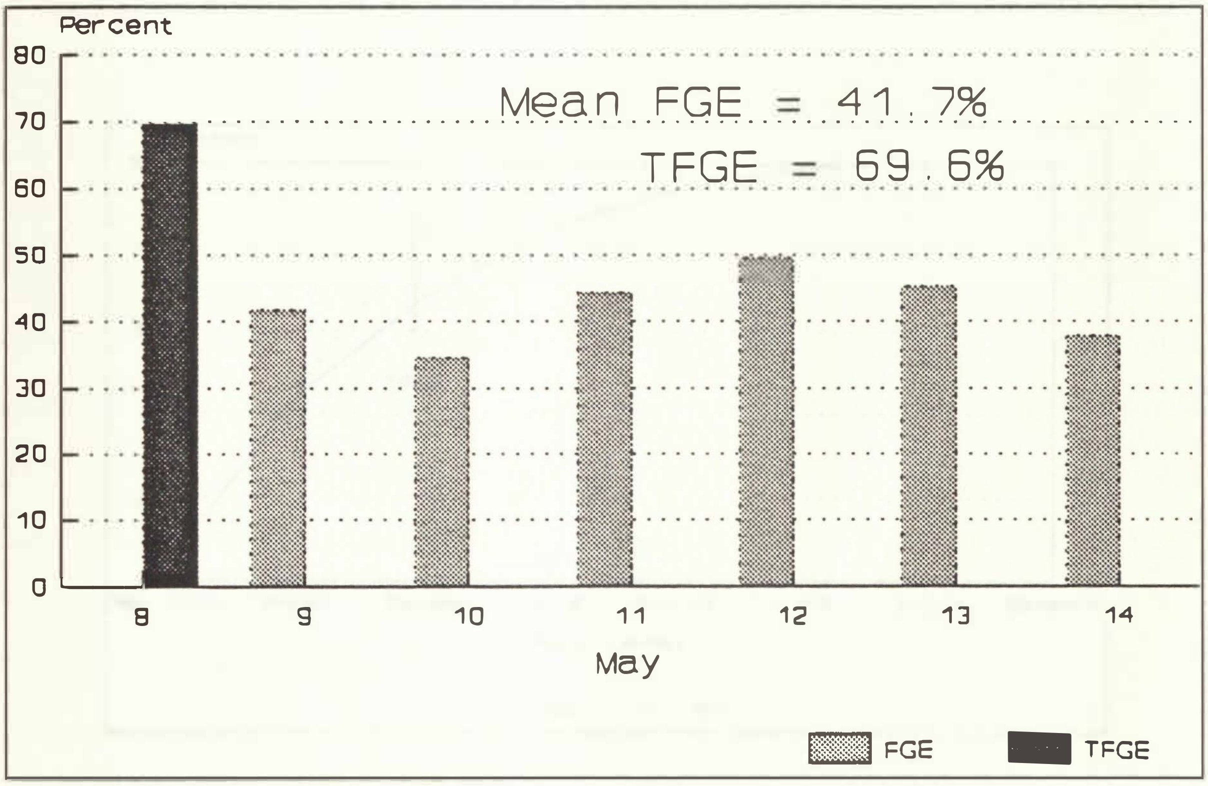

Figure 2.--Fish guidance efficiency (FGE) and theoretical fish guidance efficiency (TFGE) for yearling chinook salmon at Bonneville First Powerhouse, 1989.

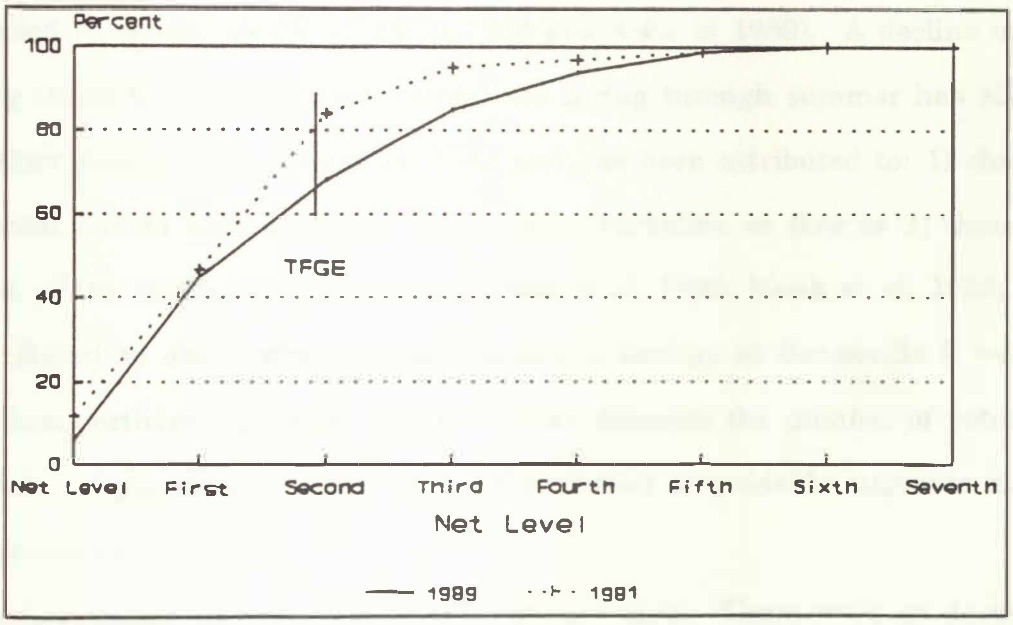

Figure 3.--Cumulative weighted average vertical distribution of chinook salmon at Bonneville Dam First Powerhouse, 1981 and 1989.

During the summer testing (12 and 24 July), the total number of fish ranged from 305 to 613. The weighted average for the corresponding FGEs and TFGEs were 4.4 (S.E. = 1.0) and 11.5% (S.E. = 4.5), respectively (Fig. 4).

The 1989 subyearling chinook salmon tests confirmed that the low FGEs found in 1988 were not an anomaly (Gessel et al. 1989). During both years, FGEs for spring migrating subyearling chinook salmon were about 40% and by the latter part of July had decreased substantially (to 11.4% in 1988 and 4.4% in 1989). A decline in subyearling chinook salmon guidance from late spring through summer has also been noted at other dams on the Columbia River and has been attributed to: 1) changing environmental factors such as water temperature, turbidity, or flow or 2) changing composition of the migrating population (Krcma et al. 1985; Monk et al. 1986; Brege et al. 1988). Based on observations in the immediate forebay at Bonneville I, we also speculate that northern squawfish predation may decrease the number of potentially guidable fish. Migrants may sound to avoid predators or guidable migrants may be eaten by predators.

Descaling varied between spring and summer tests. There were no descaled subyearling chinook salmon collected from the gatewell during the spring testing. However, from 12 to 24 July the descaling rate ranged from 0 to 10.5% with a weighted average of 5.1%. Possibly the summer migrants were more highly smolted than the spring released hatchery fish.

Coho Salmon and Steelhead

Although not the target species, during the first two series of tests (9 May to 14 May and 27 to 30 May), coho salmon and steelhead were also caught. The total number of coho salmon per test ranged from 44 to 205. The weighted average FGE and TFGE for coho salmon for these tests was 63.0 and 80.5%, respectively. During the same period, the FGE and TFGE for steelhead averaged 55.8 and 72.7%,

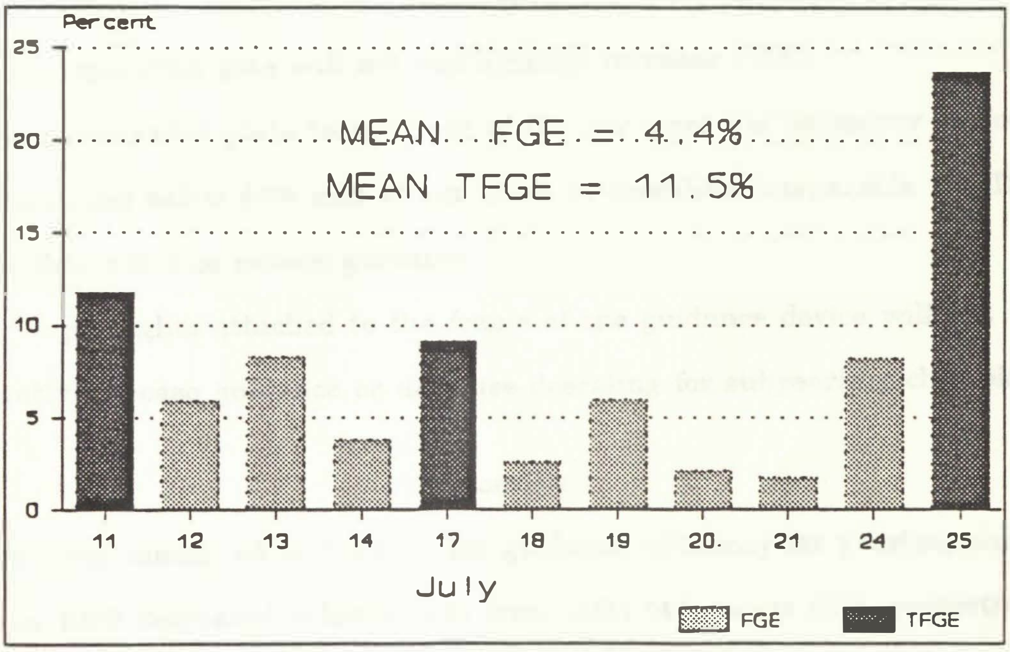

Figure 4.--Fish guidance efficiency (FGE) and theoretical fish guidance efficiency (TFGE) for subyearling chinook salmon at Bonneville First Powerhouse, 1989.

respectively, with the recovery of fish ranging from 55 to 118 total per test. These results compared with 1981 FGE estimates of 81.3 and 77.6% for coho salmon and steelhead, respectively.

CONCLUSIONS

Bonneville II

1) Raising the operating gate will not significantly increase FGE.
2) Addition of perforated plate to the back of the bar screen is necessary to decrease screen porosities below 40% and attain levels of descaling comparable to STSs; however, this will also reduce guidance.
3) Mercury vapor lights attached to the frame of the guidance device will not significantly increase guidance or decrease descaling for subyearling chinook salmon.

Bonneville I

1) Based on tests conducted in Unit 3, fish guidance efficiency for yearling chinook salmon in 1989 decreased substantially from 1981 (41 versus 81%, respectively).
2) The 4.4% guidance during summer 1989 for subyearling chinook salmon was not an anomaly. As in 1988, summer subyearling chinook salmon guided poorly and fish moved deeper as the migration progressed.

RECOMMENDATIONS

Bonneville II

1) To provide a configuration that will result in the highest FGEs attainable at this time; install 1) TIEs in an alternate configuration across the face of the powerhouse, 2) lowered STSs, and 3) streamlined trashracks

Bonneville I

1) Additional studies are required to determine if all units at the powerhouse exhibit the low guidance levels found in Unit 3.
2) Test a raised operating gate to determine possible benefits for increasing FGEs at the powerhouse.
3) Build a hydraulic sectional model to conduct systematic evaluations of potential options for improving FGEs.

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APPENDIX

Data Tables

Appendix Table 1.--Numbers of fish collected in the individual replicates of FGE tests at Bonneville Dam Second Powerhouse, 1989 (tests conducted in July and August captured only subyearling chinook salmon).

Date (Test Unit) and (series number)[a]

Location	22 April (12B) (1)					23 April (12B) (1)					25 April (12B) (1)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	1	89	4	58	--	1	269	17	87	--	1	108	15	74	0
Gap Net	--	--	--	--	--	--	6	--	2	--	--	--	1	--	--
Closure	--	44	3	5	--	2	130	2	19	--	--	46	4	12	--
First	3	6	1	5	--	2	45	2	12	--	2	18	2	7	--
Second	1	96	3	4	--	--	230	7	15	--	5	89	1	10	--
Third	5	59	--	7	--	3	170	6	11	--	5	58	3	9	--
Fourth	3	18	--	--	--	9	84	--	3	--	3	45	--	9	--
Fifth	--	3	--	--	--	--	15	--	--	--	--	6	--	--	--
Totals	**13**	**315**	**11**	**79**	**0**	**17**	**949**	**34**	**149**	**0**	**16**	**370**	**26**	**121**	**0**

Location	26 April (12B) (2)					27 April (12B) (1)					28 April (12B) (2)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	--	74	9	30	--	--	94	16	40	--	1	41	7	28	--
Gap Net	--	1	--	--	--	1	--	--	1	--	--	1	--	--	--
Closure	1	31	2	7	--	1	45	1	18	--	1	7	2	2	--
First	2	8	--	1	--	1	26	2	3	--	1	3	1	1	--
Second	3	49	3	7	--	3	82	2	12	--	3	20	2	7	--
Third	--	36	1	6	--	5	41	3	3	--	2	27	2	5	1
Fourth	9	21	--	3	--	3	36	--	3	--	3	21	--	6	--
Fifth	--	--	--	--	--	--	12	--	--	--	9	--	--	--	--
Totals	**15**	**220**	**15**	**54**	**0**	**14**	**336**	**24**	**80**	**0**	**20**	**120**	**14**	**49**	**1**

Location	29 April (12B) (1)					30 April (12B) (2)					1 May (12B) (1)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	--	38	12	21	--	--	73	30	22	1	--	101	22	32	--
Gap Net	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--
Closure	1	18	3	3	--	2	30	5	7	--	2	23	2	5	--
First	2	3	1	3	--	--	13	4	2	--	1	12	--	2	--
Second	1	32	6	5	--	4	33	4	4	--	3	43	4	12	--
Third	2	20	1	2	--	1	27	6	4	--	6	23	1	7	--
Fourth	6	9	--	--	--	--	39	--	--	--	--	30	--	3	--
Fifth	--	3	--	--	--	12	6	--	3	--	--	--	--	--	--
Totals	**12**	**123**	**23**	**34**	**0**	**20**	**221**	**49**	**42**	**1**	**12**	**232**	**29**	**61**	**0**

Location	2 May (12B) (2)					3 May (12B) (1)					4 May (12B) (2)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	--	72	22	44	1	--	149	33	32	1	--	66	9	25	1
Gap Net	2	2	--	--	--	--	--	2	--	--	--	1	--	--	--
Closure	5	24	3	8	--	1	31	3	9	--	5	13	--	6	--
First	3	10	1	3	--	5	21	1	--	--	3	11	2	3	--
Second	7	43	2	7	1	6	52	5	4	1	4	7	1	4	--
Third	4	31	3	10	--	6	18	4	2	--	2	9	1	1	--
Fourth	6	15	--	12	--	--	18	3	3	--	3	6	--	9	3
Fifth	9	6	--	--	--	3	--	3	--	--	9	3	--	--	--
Totals	**36**	**203**	**31**	**84**	**2**	**21**	**289**	**54**	**50**	**2**	**26**	**116**	**13**	**48**	**4**

Appendix Table 1.--Continued.

Date (Test Unit) and (series number)[a]

Location	5 May (12B) (2)					6 May (12B) (1)					7 May (12B) (2)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	--	101	17	55	10	1	102	33	69	15	1	157	30	120	24
Gap Net	2	--	--	--	--	--	--	--	1	--	1	2	1	2	1
Closure	1	22	11	8	2	1	43	7	10	8	--	37	7	19	7
First	1	8	4	3	2	1	18	1	5	--	--	11	6	3	2
Second	4	38	6	8	4	2	38	7	13	7	4	28	6	9	9
Third	6	15	1	3	--	4	22	3	4	6	2	22	5	9	3
Fourth	6	--	--	3	--	9	3	--	6	--	--	15	--	--	6
Fifth	9	3	3	--	--	3	3	--	--	6	--	--	--	--	--
Totals	**29**	**187**	**42**	**80**	**18**	**21**	**229**	**51**	**108**	**42**	**8**	**272**	**55**	**162**	**52**

Location	8 May (12B) (1)					9 May (12B) (3)					10 May (12B) (3)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	--	158	60	150	41	--	160	111	256	53	1	158	95	187	22
Gap Net	2	2	--	1	2	--	1	1	2	--	1	1	1	2	--
Closure	2	30	16	25	15	1	29	14	21	20	2	32	14	16	8
First	2	11	10	5	5	1	14	10	12	11	1	6	3	9	4
Second	4	30	9	16	16	4	22	19	12	20	2	31	12	11	10
Third	3	12	7	9	9	1	11	9	7	14	5	15	3	10	8
Fourth	--	6	6	6	--	6	12	3	3	15	3	9	--	9	6
Fifth	3	3	--	6	--	--	--	--	--	--	--	--	--	3	--
Totals	**16**	**252**	**108**	**218**	**88**	**13**	**249**	**167**	**313**	**133**	**15**	**252**	**128**	**247**	**58**

Location	11 May (12B) (4)					12 May (12B) (4)					13 May (12B) (4)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	3	101	41	107	9	2	67	33	72	10	4	95	44	111	26
Gap Net	1	1	--	--	1	1	--	--	1	--	--	1	2	3	2
Closure	4	20	10	19	1	3	8	5	13	4	1	19	9	14	8
First	1	5	1	4	--	2	8	6	6	3	--	5	1	8	7
Second	3	17	4	9	1	2	15	9	7	7	7	24	9	17	7
Third	14	12	4	5	1	7	7	4	7	5	6	11	1	7	9
Fourth	--	9	--	--	6	6	15	3	--	--	12	3	--	--	9
Fifth	--	6	--	--	--	3	--	--	--	--	12	3	--	--	3
Totals	**26**	**171**	**60**	**144**	**19**	**26**	**120**	**60**	**106**	**29**	**42**	**161**	**66**	**160**	**71**

Location	14 May (12B) (4)					15 May (12B) (5)					15 May (12A) (5)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	4	33	14	17	13	8	182	91	178	110	33	633	209	635	193
Gap Net	3	--	--	--	--	2	3	1	1	1	3	15	1	21	8
Closure	6	7	2	4	8	11	39	18	21	31	4	68	18	35	47
First	5	3	--	1	2	1	6	6	11	16	--	12	11	14	17
Second	11	14	--	6	7	6	28	14	11	29	6	50	21	34	43
Third	7	10	1	2	6	5	17	9	6	12	6	21	9	14	22
Fourth	9	3	--	--	3	6	6	3	12	--	3	3	3	6	9
Fifth	12	3	--	--	--	--	3	3	--	6	--	--	3	3	--
Totals	**57**	**73**	**17**	**30**	**39**	**39**	**284**	**145**	**240**	**205**	**55**	**802**	**275**	**762**	**339**

Appendix Table 1.--Continued.

Date (Test Unit) and (series number)[a]

Location	16 May (12B) (5)					16 May (12A) (5)					17 May (12B) (5)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	5	70	129	186	67	15	214	280	849	106	4	125	98	242	190
Gap Net	--	--	1	2	3	4	1	2	53	9	2	--	1	3	3
Closure	5	8	16	29	19	--	12	29	61	38	4	31	24	35	79
First	2	3	11	7	8	2	5	10	32	5	1	6	12	10	27
Second	3	7	22	10	25	5	12	21	40	32	9	20	23	29	66
Third	1	4	6	2	3	1	2	14	5	7	6	10	9	7	41
Fourth	3	--	6	--	--	--	--	9	6	9	15	9	6	6	15
Fifth	--	--	--	--	--	--	--	--	--	--	6	--	--	--	3
Totals	**19**	**92**	**191**	**236**	**125**	**27**	**246**	**365**	**1046**	**206**	**47**	**201**	**173**	**332**	**424**

Location	17 May (12A) (5)					26 May (12B) (6)					26 May (12A) (6)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	11	306	169	721	372	19	41	50	57	130	65	85	73	124	107
Gap Net	2	4	4	23	21	3	11	10	7	27	5	3	6	12	7
Closure	1	34	29	47	101	7	4	7	10	29	12	19	25	19	54
First	1	11	10	27	52	2	3	11	--	21	2	12	16	8	45
Second	11	39	29	32	96	4	15	29	8	63	9	17	32	14	72
Third	8	25	16	12	45	5	5	16	6	26	11	12	25	19	61
Fourth	--	3	6	3	27	3	--	--	--	9	--	15	12	6	21
Fifth	3	--	3	3	3	--	--	--	--	--	--	--	--	--	12
Totals	**37**	**422**	**266**	**868**	**717**	**43**	**79**	**123**	**88**	**305**	**104**	**163**	**189**	**202**	**379**

Location	27 May (12B) (7)					27 May (12A) (7)					28 May (12B) (6)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	34	97	26	55	91	67	171	55	153	145	41	75	42	59	66
Gap Net	1	4	--	4	4	2	1	--	6	8	6	--	3	2	1
Closure	16	30	10	17	67	14	69	27	23	116	20	23	15	25	89
First	4	15	3	12	18	6	21	12	7	37	5	9	10	5	20
Second	3	21	14	12	72	18	63	29	16	87	5	15	21	11	53
Third	3	14	9	1	58	7	23	16	8	55	5	7	9	13	42
Fourth	--	--	--	3	21	3	--	3	6	33	3	--	9	6	24
Fifth	3	3	--	--	3	--	--	--	3	9	--	--	--	3	--
Totals	**64**	**184**	**62**	**104**	**334**	**117**	**348**	**142**	**222**	**490**	**85**	**129**	**109**	**124**	**295**

Location	28 May (12A) (6)					29 May (12B) (7)					29 May (12A) (7)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	89	109	69	112	66	23	38	24	55	108	39	79	57	158	238
Gap Net	6	2	1	8	3	1	--	1	1	5	3	1	--	9	9
Closure	14	25	17	26	39	4	8	9	8	74	10	13	15	20	87
First	7	14	10	12	23	4	7	5	4	30	3	6	3	9	56
Second	13	38	31	28	74	13	31	13	14	99	14	29	12	15	128
Third	13	14	26	24	58	3	12	7	8	51	3	8	5	15	72
Fourth	6	15	21	21	36	--	3	3	6	12	3	9	--	9	27
Fifth	3	--	--	6	3	--	6	--	--	3	--	--	--	--	9
Totals	**151**	**217**	**175**	**237**	**302**	**48**	**105**	**62**	**96**	**382**	**75**	**145**	**92**	**235**	**626**

Appendix Table 1.--Continued.

Date (Test Unit) and (series number)[a]

Location	30 May (12B) (6)					30 May (12A) (6)					31 May (12B) (7)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	16	36	22	35	52	58	57	53	83	87	22	25	10	23	57
Gap Net	3	--	--	1	2	2	4	--	9	8	4	--	1	3	4
Closure	8	13	12	13	26	22	20	17	21	29	11	7	10	3	23
First	7	4	1	3	18	4	4	4	5	12	3	4	2	4	11
Second	13	11	3	6	39	21	12	23	14	46	13	15	9	10	38
Third	8	6	7	9	20	14	10	19	14	34	14	12	7	5	30
Fourth	6	--	3	3	12	--	3	--	6	24	3	3	3	6	27
Fifth	--	--	--	--	--	--	3	--	--	3	--	3	3	--	--
Totals	**61**	**70**	**48**	**70**	**169**	**121**	**113**	**116**	**152**	**243**	**70**	**69**	**45**	**54**	**190**

Location	31 May (12A) (7)					1 June (12B) (6)					1 June (12A) (6)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	76	43	38	110	107	48	25	15	34	94	72	33	23	74	83
Gap Net	8	2	--	1	2	12	1	1	3	4	6	--	--	7	9
Closure	12	14	12	11	34	19	11	8	12	44	18	18	9	16	53
First	6	8	8	6	17	6	1	3	3	22	10	4	2	6	38
Second	17	15	10	6	38	14	8	8	10	51	30	19	9	16	75
Third	23	14	9	9	51	11	1	2	1	23	12	7	9	10	37
Fourth	15	--	6	15	24	3	--	3	--	21	--	3	3	12	30
Fifth	3	--	--	6	--	--	--	--	--	--	6	--	--	--	6
Totals	**160**	**96**	**63**	**164**	**273**	**113**	**47**	**40**	**63**	**259**	**154**	**84**	**55**	**141**	**331**

Location	2 June (12B) (7)					2 June (12A) (7)					3 June (12B) (6)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	56	26	11	26	39	113	49	47	94	64	94	30	12	67	27
Gap Net	5	--	--	3	--	6	2	2	4	1	5	--	--	--	1
Closure	28	10	4	4	23	26	18	12	14	45	32	7	6	4	21
First	4	4	4	3	11	7	3	3	5	22	8	4	5	1	7
Second	20	8	11	7	38	19	15	14	15	40	23	8	5	7	22
Third	10	8	6	4	23	21	7	8	6	19	14	3	--	3	14
Fourth	3	--	--	--	3	12	--	9	6	21	3	3	3	--	6
Fifth	--	--	3	--	--	--	6	--	3	--	6	--	--	--	--
Totals	**126**	**56**	**39**	**47**	**137**	**204**	**100**	**95**	**147**	**212**	**185**	**55**	**31**	**82**	**98**

Location	3 June (12A) (6)					4 June (12B) (7)					4 June (12A) (7)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	88	25	14	51	30	62	11	6	16	12	225	24	22	65	35
Gap Net	11	1	--	2	3	4	--	--	--	1	14	--	--	2	1
Closure	28	10	4	16	24	10	2	--	2	6	26	4	4	6	14
First	9	--	1	3	12	4	--	--	1	2	11	1	3	1	8
Second	25	12	4	7	29	18	5	4	2	8	29	4	4	1	10
Third	7	4	--	2	9	12	--	3	4	6	15	1	1	1	3
Fourth	6	9	--	--	9	3	--	--	3	--	15	3	6	3	9
Fifth	--	--	--	--	6	--	--	--	--	3	9	6	--	--	--
Totals	**174**	**61**	**23**	**81**	**122**	**113**	**18**	**13**	**28**	**38**	**344**	**43**	**40**	**79**	**80**

Appendix Table 1.--Continued.

Date (Test Unit) and (series number)[a]

	8 July (12B) (8)					8 July (12A) (8)					12 July (12B) (8)				
Location	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	119					157					45				
Gap Net	12					24					2				
Closure	49					58					23				
First	21					33					10				
Second	67					92					41				
Third	63					76					18				
Fourth	36					24					24				
Fifth	9					21					6				
Total	**376**					**485**					**169**				

	12 July (12A) (8)					13 July (12B) (9)					13 July (12A) (9)				
Location	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	53					91					64				
Gap Net	11					--					6				
Closure	29					35					27				
First	13					14					19				
Second	26					57					81				
Third	28					53					34				
Fourth	9					21					36				
Fifth	--					6					6				
Total	**169**					**277**					**273**				

	14 July (12B) (8)					14 July (12A) (8)					17 July (12B) (9)				
Location	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	80					76					155				
Gap Net	3					16					4				
Closure	34					23					57				
First	14					20					23				
Second	52					64					160				
Third	39					49					166				
Fourth	33					27					87				
Fifth	3					6					21				
Totals	**258**					**281**					**673**				

	17 July (12A) (9)					18 July (12B) (8)					18 July (12A) (8)				
Location	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	122					51					52				
Gap Net	4					4					3				
Closure	64					41					52				
First	32					17					26				
Second	161					78					88				
Third	127					63					88				
Fourth	99					114					117				
Fifth	24					15					63				
Totals	**633**					**383**					**489**				

Appendix Table 1.--Continued.

Date (Test Unit) and (series number)[a]

	19 July (12B) (9)					19 July (12A) (9)					20 July (12B) (8)				
Location	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	36					57					32				
Gap Net	2					1					3				
Closure	29					40					21				
First	23					21					10				
Second	88					101					40				
Third	104					110					19				
Fourth	84					90					15				
Fifth	18					27					6				
Totals	**384**					**447**					**146**				

	20 July (12A) (8)					21 July (12B) (9)					21 July (12A) (9)				
Location	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	25					94					121				
Gap Net	3					5					4				
Closure	24					59					58				
First	15					23					23				
Second	46					77					96				
Third	20					58					64				
Fourth	12					24					33				
Fifth	3					--					3				
Totals	**148**					**340**					**402**				

	24 July (12B) (8)					24 July (12A) (8)					25 July (12B) (9)				
Location	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	69					61					129				
Gap Net	1					6					2				
Closure	54					55					68				
First	14					17					23				
Second	43					55					88				
Third	34					28					50				
Fourth	12					15					18				
Fifth	6					--					6				
Totals	**233**					**237**					**384**				

	25 July (12A) (9)					26 July (12B) (9)					26 July (12A) (9)				
Location	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	74					65					51				
Gap Net	3					2					1				
Closure	58					34					27				
First	23					15					16				
Second	76					50					56				
Third	20					27					23				
Fourth	30					15					24				
Fifth	15					3					3				
Totals	**299**					**211**					**201**				

Appendix Table 1.--Continued.

Date (Test Unit) and (series number)[a]

Location	27 July (12B) (10) SC	YC	ST	CO	SO	27 July (12A) (10) SC	YC	ST	CO	SO	28 July (12B) (10) SC	YC	ST	CO	SO
Gatewell	72					89					61				
Gap Net	2					25					2				
Closure	35					46					53				
First	10					30					14				
Second	60					49					75				
Third	36					40					68				
Fourth	24					15					45				
Fifth	3					9					9				
Totals	**242**					**303**					**327**				

Location	28 July (12A) (10) SC	YC	ST	CO	SO
Gatewell	67				
Gap Net	13				
Closure	18				
First	15				
Second	40				
Third	54				
Fourth	42				
Fifth	9				
Totals	**258**				

Appendix Table 2.--Vertical distribution data for yearling and subyearling chinook and coho salmon, collected at Bonneville Dam Second Powerhouse, 1989.

YEARLING CHINOOK SALMON

Test Unit	13A	13A	13A	13A	13A	13A	13A	13A	13A	13A
Test Date	22 April	23 April	25 April	26 April	27 April	28 April	29 April	30 April	1 May	2 May
Gatewell	95	259	89	82	179	121	64	66	91	123
First Net	138	282	138	132	138	84	96	84	90	144
Second Net	126	231	96	72	99	114	42	63	144	114
Third Net	93	150	72	24	75	102	36	36	60	69
Fourth Net	87	108	81	39	39	48	30	39	75	51
Fifth Net	42	138	81	27	33	48	36	54	48	51
Sixth Net	63	78	48	18	30	27	18	15	42	39
Seventh Net	24	39	15	6	12	9	--	9	12	24
Totals	668	1285	620	400	605	553	322	366	562	615

Test Unit	13A	13A	13A	13A	13A	13A	13A	13A	13A	13A
Test Date	3 May	4 May	5 May	6 May	7 May	8 May	9 May	10 May	11 May	12 May
Gatewell	273	74	141	140	127	100	75	132	58	53
First Net	183	60	219	198	84	153	168	165	54	54
Second Net	156	51	45	123	87	72	78	63	36	27
Third Net	96	36	54	54	54	18	30	36	15	15
Fourth Net	75	30	33	39	33	42	18	24	--	15
Fifth Net	48	15	33	36	30	15	15	12	6	21
Sixth Net	36	9	18	12	21	9	9	3	6	6
Seventh Net	6	3	9	3	3	9	3	--	--	6
Totals	873	278	552	605	439	418	396	435	175	197

Appendix Table 2.--Continued.

YEARLING CHINOOK SALMON

Test Unit	13A	13A	13A	13A	13A	13A	13A	13A	13A
Test Date	13 May	14 May	15 May	16 May	17 May	1 June	2 June	3 June	4 June
Gatewell	31	31	191	31	59	15	11	8	10
First Net	42	48	213	24	66	9	12	15	6
Second Net	30	24	75	33	21	15	6	12	9
Third Net	12	18	30	6	15	9	9	6	3
Fourth Net	24	24	15	3	24	9	3	12	3
Fifth Net	9	18	6	18	18	9	6	3	--
Sixth Net	15	18	9	3	12	9	--	--	--
Seventh Net	--	3	3	--	12	3	3	3	3
Totals	163	184	542	118	227	78	50	59	34

SUBYEARLING CHINOOK SALMON

Test Unit	13A	13A	13A	13A	13A	13A	13A	13A	13A	13A
Test Date	8 July	12 July	13 July	14 July	17 July	18 July	19 July	20 July	21 July	24 July
Gatewell	69	47	47	40	104	28	35	19	35	53
First Net	48	39	33	57	90	33	45	9	33	48
Second Net	42	33	27	51	33	27	54	27	66	48
Third Net	57	30	18	24	96	12	45	36	45	51
Fourth Net	75	51	36	45	123	57	84	15	69	60
Fifth Net	69	30	48	42	168	90	78	27	45	33
Sixth Net	87	24	33	27	171	96	84	21	27	39
Seventh Net	18	15	18	12	45	36	30	3	24	21
Totals	465	269	260	298	830	379	455	157	344	353

Appendix Table 2.--Continued.

SUBYEARLING CHINOOK SALMON

Test Unit	13A	13A	13A	13A
Test Date	25 July	26 July	27 July	28 July
Gatewell	54	37	28	37
First Net	90	54	24	42
Second Net	111	9	66	66
Third Net	60	48	42	51
Fourth Net	78	42	33	63
Fifth Net	78	36	48	90
Sixth Net	21	36	51	27
Seventh Net	12	9	15	69
Totals	504	271	307	445

Appendix Table 3.--Numbers of fish collected in the individual replicates of FGE tests at Bonneville Dam First Powerhouse, 1989 (tests conducted in July and August captured only subyearling chinook salmon).

Date (Test Unit)

Location	9 May (3B) SC	YC	ST	CO	SO
Gatewell	8	99	38	149	6
Gap Net	1	7	0	8	1
Closure	7	34	5	18	2
First	3	27	9	6	3
Second	15	57	3	21	--
Third	12	12	--	3	6
Fourth	12	--	--	--	--
Total	**5 58**	**236**	**55**	**205**	**18**

Location	10 May (3B) SC	YC	ST	CO	SO
Gatewell	5	84	70	69	9
Gap Net	7	6	1	3	--
Closure	5	23	8	4	--
First	12	18	6	6	--
Second	12	60	15	27	6
Third	24	36	18	15	--
Fourth	24	15	--	3	--
Total	**89**	**242**	**118**	**127**	**15**

Location	11 May (3B) SC	YC	ST	CO	SO
Gatewell	19	87	53	78	7
Gap Net	2	2	--	2	0
Closure	2	26	3	6	3
First	6	15	6	--	3
Second	14	42	13	10	5
Third	32	15	8	4	2
Fourth	18	9	--	3	--
Total	**93**	**196**	**83**	**103**	**13**

Location	12 May (3B) SC	YC	ST	CO	SO
Gatewell	27	70	33	64	8
Gap Net	3	5	--	5	1
Closure	10	17	5	3	7
First	0	3	3	--	--
Second	19	26	15	3	4
Third	8	20	4	3	7
Fourth	24	--	3	6	0
Total	**91**	**141**	**63**	**84**	**27**

Location	13 May (3B) SC	YC	ST	CO	SO
Gatewell	25	68	60	58	6
Gap Net	8	8	2	4	1
Closure	5	19	9	7	3
First	--	15	12	--	3
Second	19	31	16	11	7
Third	24	9	5	2	4
Fourth	24	--	3	--	3
Total	**105**	**150**	**107**	**81**	**27**

Location	14 May (3B SC	YC	ST	CO	SO
Gatewell	35	58	64	26	15
Gap Net	3	7	--	1	2
Closure	7	18	2	5	5
First	12	15	--	3	--
Second	29	34	11	4	11
Third	17	18	5	2	1
Fourth	18	3	--	3	--
Total	**121**	**153**	**82**	**44**	**35**

Location	27 May (3B) SC	YC	ST	CO	SO
Gatewell	27	38	50	65	78
Gap Net	4	2	1	13	8
Closure	19	18	11	13	64
First	12	21	12	6	33
Second	20	18	24	14	106
Third	5	8	13	8	54
Fourth	--	9	3	3	9
Totals	**87**	**114**	**114**	**122**	**352**

Location	28 May (3B) SC	YC	ST	CO	SO
Gatewell	29	7	31	36	26
Gap Net	2	1	4	6	2
Closure	12	7	9	17	26
First	9	6	3	12	21
Second	11	12	18	13	31
Third	10	2	11	8	24
Fourth	6	0	9	3	12
Totals	**79**	**35**	**85**	**95**	**142**

Location	29 May (3B) SC	YC	ST	CO	SO
Gatewell	36	5	27	73	26
Gap Net	5	2	0	15	2
Closure	19	8	9	10	19
First	12	--	3	21	2
Second	9	5	10	2	20
Third	27	3	6	13	19
Fourth	3	--	1	--	1
Totals	**111**	**23**	**56**	**134**	**89**

Location	30 May (3B) SC	YC	ST	CO	SO
Gatewell	38	12	31	50	29
Gap Net	4	--	2	3	8
Closure	12	6	6	11	10
First	3	3	9	15	9
Second	9	4	11	16	36
Third	10	1	5	3	13
Fourth	--	--	--	--	6
Totals	**76**	**26**	**64**	**98**	**111**

Appendix Table 3.--Continued.

Date (Test Unit)

Location	12 July (3B) SC	YC	ST	CO	SO	13 July (3B) SC	YC	ST	CO	SO	14 July (3B) SC	YC	ST	CO	SO
Gatewell	18					25					19				
Gap Net	1					1					5				
Closure	24					25					53				
First	12					24					9				
Second	52					89					168				
Third	99					82					142				
Fourth	99					57					108				
Totals	305					303					504				

Location	18 July (3B) SC	YC	ST	CO	SO	19 July (3B) SC	YC	ST	CO	SO	20 July (3B) SC	YC	ST	CO	SO
Gatewell	16					30					9				
Gap Net	3					2					1				
Closure	12					12					22				
First	12					9					33				
Second	177					126					156				
Third	291					213					129				
Fourth	102					105					81				
Totals	613					497					431				

Location	21 July (3B) SC	YC	ST	CO	SO	24 July (3B) SC	YC	ST	CO	SO
Gatewell	8					29				
Gap Net	3					1				
Closure	18					29				
First	6					18				
Second	129					102				
Third	171					105				
Fourth	120					69				
Totals	455					353				

SC = Subyearling chinook salmon
YC = Yearling chinook salmon
ST = Steelhead
CO = Coho salmon
SO = Sockeye salmon

Appendix Table 4.--Vertical distribution data for yearling and subyearling chinook and coho salmon collected at Bonneville Dam First Powerhouse, 1989.

	YR. CHINOOK		SUB. CHINOOK					COHO	
Test Unit	3B	3B	3B	3B	3B	3B	3B	3B	3B
Test Date	8 May	26 May	8 May	26 May	11 July	17 July	25 July	8 May	26 May
Gatewell	15	11	10	13	15	30	15	22	36
First Net	75	84	48	75	18	63	24	48	84
Second Net	54	42	39	48	33	42	27	15	72
Third Net	27	42	21	27	51	123	30	18	27
Fourth Netet	18	18	3	27	102	345	75	9	12
Fifth Net	15	6	--	15	140	444	60	--	6
Sixth Net	3	--	3	9	159	333	33	--	--
Seventh Net	--	--	--	--	42	96	15	--	--
Totals	207	203	124	214	560	1476	279	112	237

	SOCKEYE		STEELHEAD	
Test Unit	3B	3B	3B	3B
Test Date	8 May	26 May	8 May	26 May
Gatewell	3	5	19	45
First Net	9	72	27	114
Second Net	6	39	3	72
Third Net	6	39	3	30
Fourth Net	3	39	6	33
Fifth Net	--	27	6	21
Sixth Net	3	9	--	3
Seventh Net	0	--	3	--
Totals	30	311	67	318