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Evaluation of the Juvenile Salmonid Collection and Bypass Systems at Bonneville Dam—1986

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COASTAL ZONE AND ESTUARINE STUDIES

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INTRODUCTION

Since 1983, the National Marine Fisheries Service (NMFS) has been conducting studies to evaluate the juvenile salmonid bypass system at the Bonneville Dam Second Powerhouse. The initial studies indicated that fish guiding efficiency (FGE) for the submersible traveling screens (STS) was very poor (< 30%). Vertical distribution tests, conducted in conjunction with the FGE studies, indicated that the poor guidance was caused by at least two problem areas. First, a large percentage of the fish were entering the turbine intakes at a depth below that intercepted by the STS, and second, avoidance/deflection was also occurring since only about half of the potentially guidable fish (those entering the intake at or above the interception point of the STS) were being guided. Through various modifications/additions to the STS and trashracks, FGE for yearling chinook salmon, Oncorhynchus tshawytscha, has gradually increased from approximately 25% (Krcma et al. 1984) to over 40% for studies conducted during the 1985 field season (Gessel et al. 1986).

Research conducted during the 1985 field season addressed the avoidance/deflection problem as possibly being caused by flow restriction in the throat area of the STS and/or by turbulence near the trashrack. To determine if the throat area was a problem, an STS was modified so that it could be lowered an additional 2 to 4 ft into the turbine intake. Lowering the STS enlarges the throat opening which allows more flow through this area and should subsequently reduce any blockage or restriction that fish may encounter. Avoidance/deflection could also be occurring near the trashrack because turbulent flow conditions are present on the downstream side of the standard

trashracks. Also, when the STS is extended into the guiding position the upstream end of the STS is relatively close (< 10 ft) to the trashrack (distance from the STS to the trashracks at other projects is at least 20 ft). This closeness, coupled with the turbulence near the trashracks, could be contributing factors to the avoidance/deflection problems at this powerhouse. To test this possibility, three specially designed, streamlined trashrack sections were placed in the upper half of Intake 12B. The lowered STS and streamlined trashracks are depicted in Figure 1. Results of these tests indicated that FGEs of over 40% could be attained for yearling chinook salmon through the use of a 27-in lowered STS and the streamlined trashrack sections.

Also in 1985, model studies were conducted to develop additional items that might further improve FGE. One promising item was an intake ceiling extension (Fig. 2). Flow patterns, determined by dye releases, in both a sectional turbine intake model and a full powerhouse model indicated these extensions could have a positive effect on FGE.

During the 1986 smolt migration, the NMFS cooperated with the U.S. Army Corps of Engineers (COE) to test the effectiveness of the ceiling extension and several other methods for improving the fingerling collection and bypass efficiency at the Second Powerhouse. Research was also conducted to continue the evaluation of the fingerling bypass and sampling facility at the First Powerhouse.

The 1986 research had the following objectives:

1. Continue FGE and vertical distribution tests to evaluate the following modifications/additions for improving STS effectiveness:

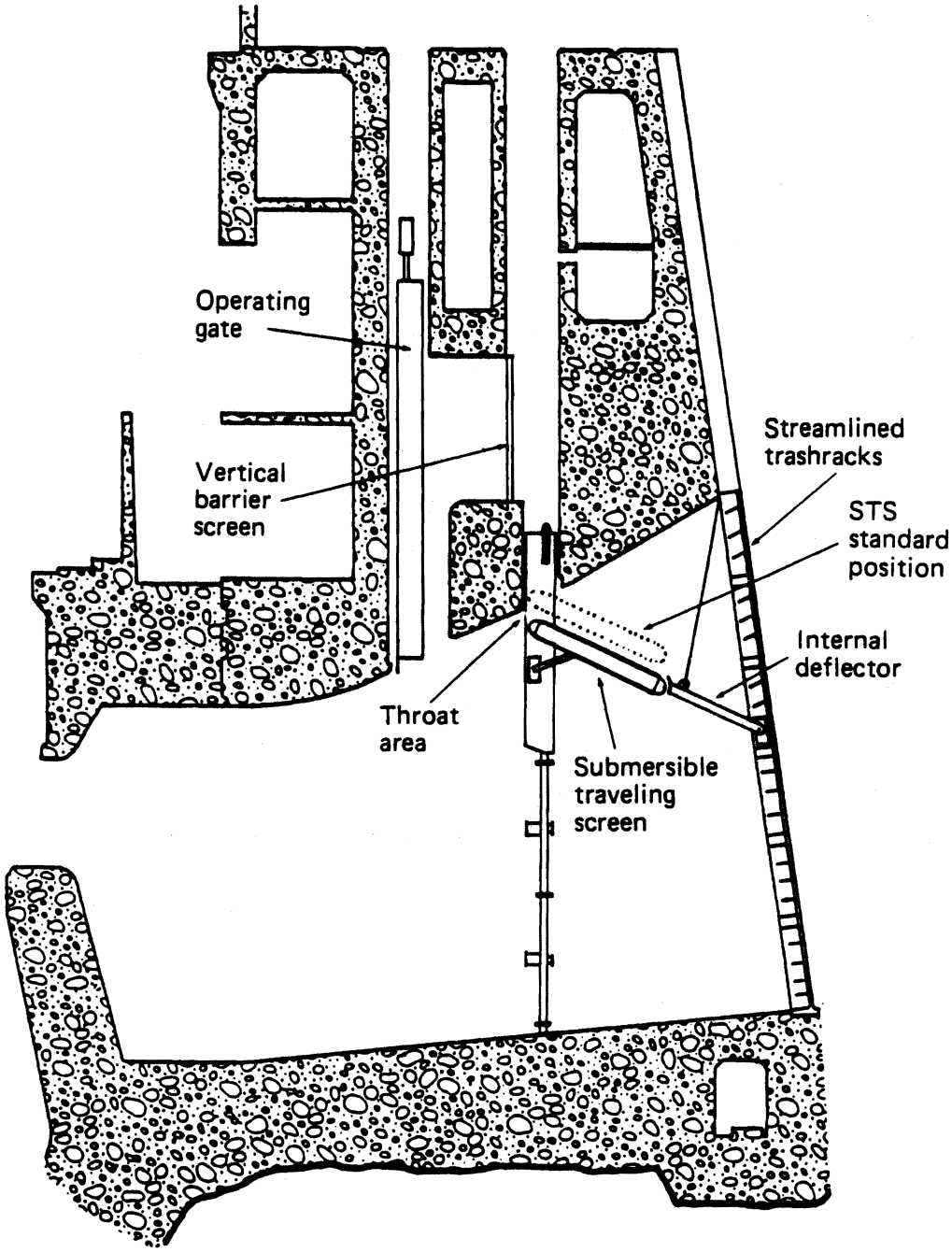

Figure 1.--Cross-sectional drawing of a turbine entrance showing a 55° STS at the 48-in lowered position, the internal deflector, and the placement of the streamlined trashracks, Bonneville Dam Second Powerhouse, 1986.

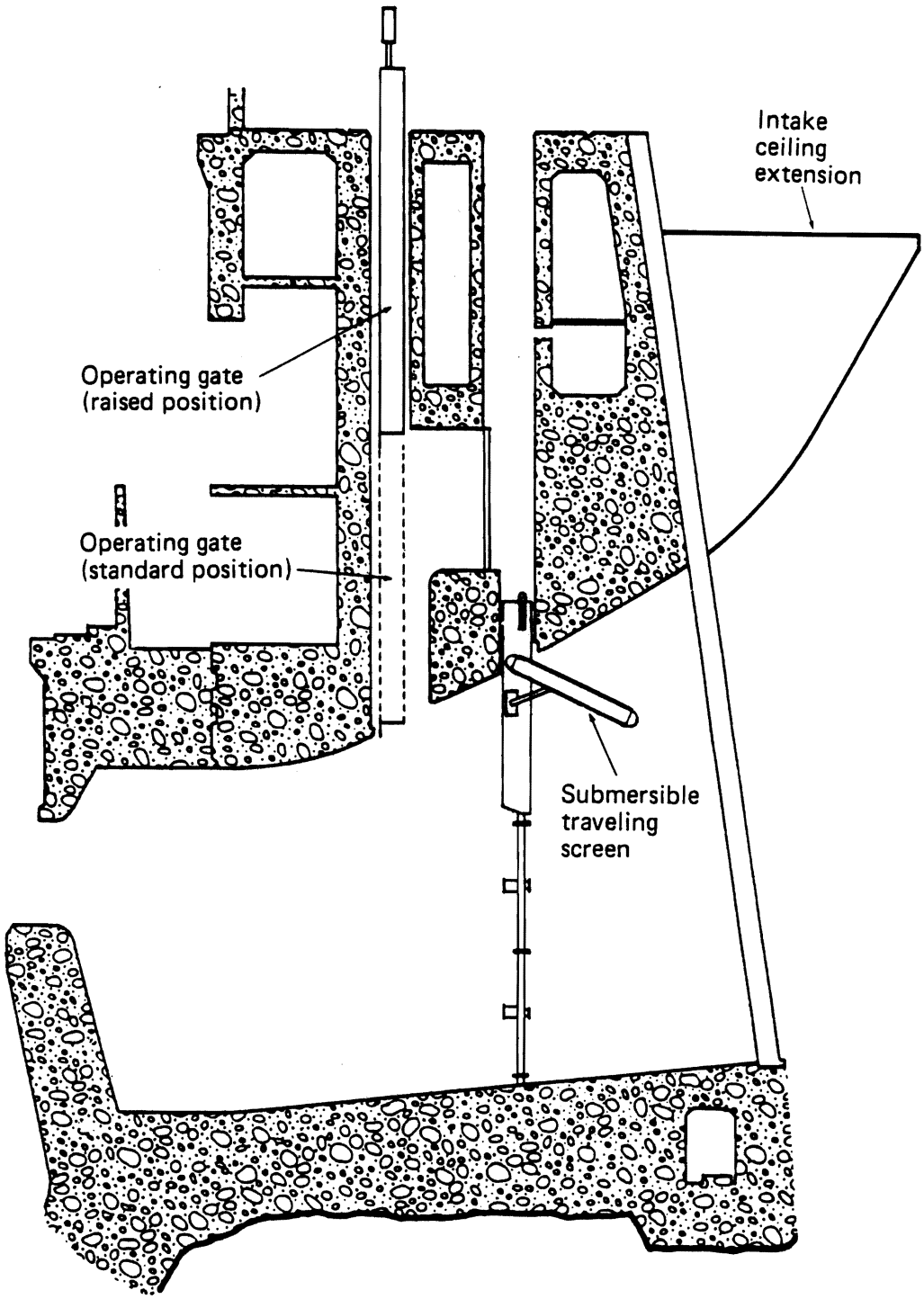

Figure 2.--Cross-sectional view of a turbine intake with intake ceiling extension and standard and raised operating gates, Bonneville Dam Second Powerhouse, 1986.

a. Lowered STS

b. Raised operating gate

c. Streamlined trashrack

d. False gap

e. Internal deflector

f. Bar screen scoop[1/]

g. Illuminated trashracks[2/]

h. Ceiling extensions

2. Continue monitoring the Second Powerhouse downstream migrant system sampling facilities.

3. Continue the evaluation of the First Powerhouse juvenile bypass and sampling facilities.

OBJECTIVE I — EVALUATION OF MODIFICATIONS TO IMPROVE FGE AT THE SECOND POWERHOUSE

In previous studies at the Bonneville Dam Second Powerhouse, and for most studies conducted at other COE projects, FGE tests were conducted in conjunction with vertical distribution tests during selected periods of the juvenile outmigration. Vertical distribution tests provide depth information within the turbine intakes for the migrants. These data can be used to determine theoretical FGE (TFGE). The TFGE is the percentage of fish that are in the portion of the turbine intake intercepted by the STS and therefore should be guided by the STS. At the Second Powerhouse, this included all fish

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1/ Tests utilizing this modification were not required during the field season.

2/ These items were not constructed.

collected from the gatewell down to and including the upper half of the third net on the vertical distribution frame (Fig. 3). Generally, an early season and late season vertical distribution sample for each target species was sufficient to establish this information. Studies at the Second Powerhouse, however, have shown that vertical distribution at this project can change quite suddenly for no obvious reason (i.e., changing water temperatures or different stocks of fish). Therefore, during the 1986 field season, vertical distribution tests at the Second Powerhouse were conducted on a daily basis in conjunction with the STS tests. This method allowed a direct comparison of the two data sets (FGE and TFGE) for individual replicates.

Also, measures of FGE divided by the corresponding TFGE give an indication of STS effectiveness for the various modifications tested. This FGE measurement takes into account the fluctuations in vertical distribution that can occur at this powerhouse.

Methods

FGE tests used the procedures developed in previous years. A net frame attached to the traveling screen supported nets to collect unguided fish (Fig. 4). A standard replicate began by closing the orifice, lowering the STS and net frame into the intake, setting the STS at the required operating angle, dipnetting the gatewell to remove all residual fish, and starting the turbine. The gatewell was then dipnetted periodically until sufficient numbers of fish had entered the unit. Each test was ended by lowering the dipnet and leaving it open, shutting the unit off, closing the dipnet and making a final clean-out dip, raising the STS and net frame, and emptying the

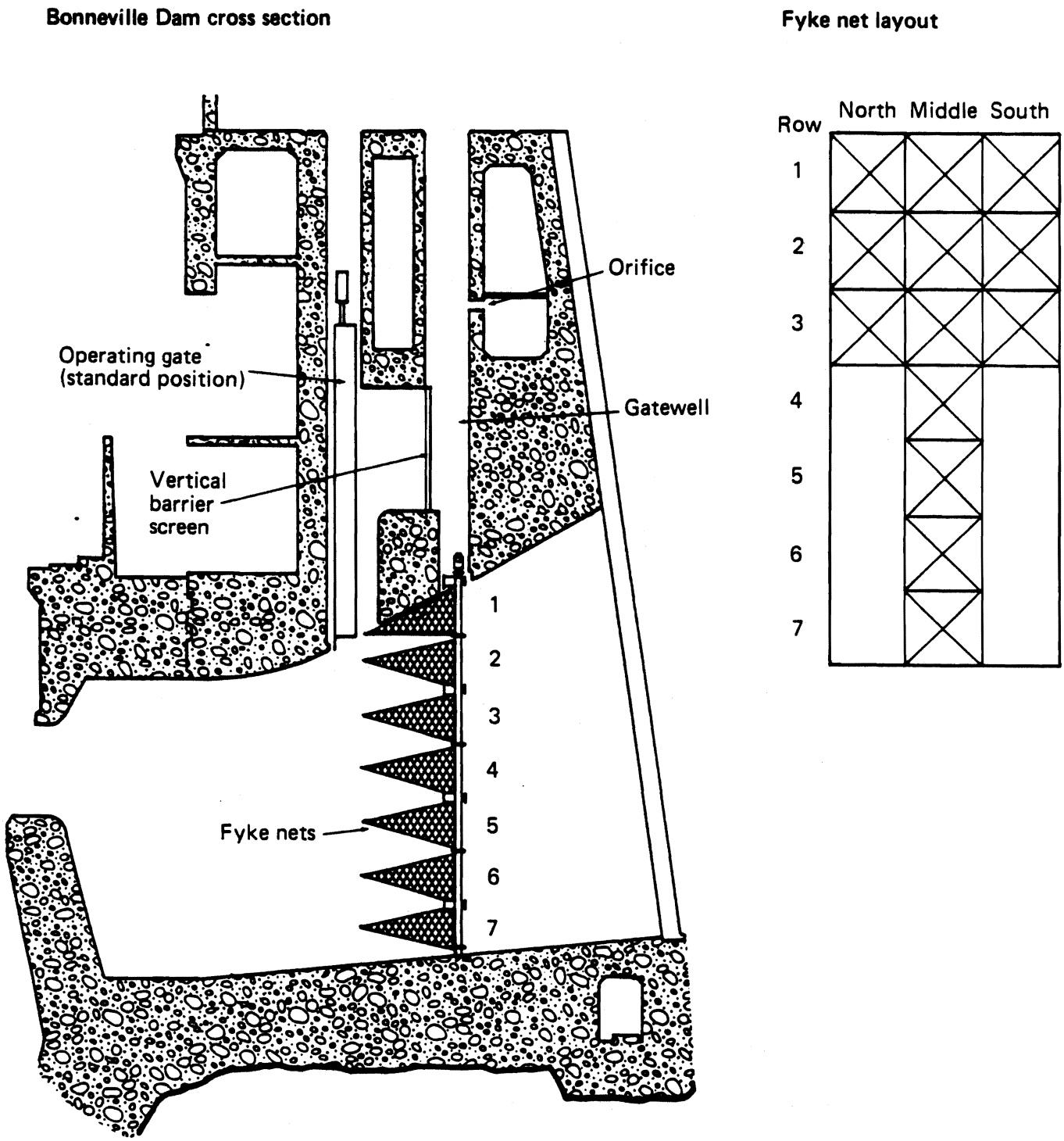

Figure 3.--Cross-section of the turbine intake at Bonneville Dam Second Powerhouse with a vertical distribution frame and fyke nets, including a view showing the net layout - 1986.

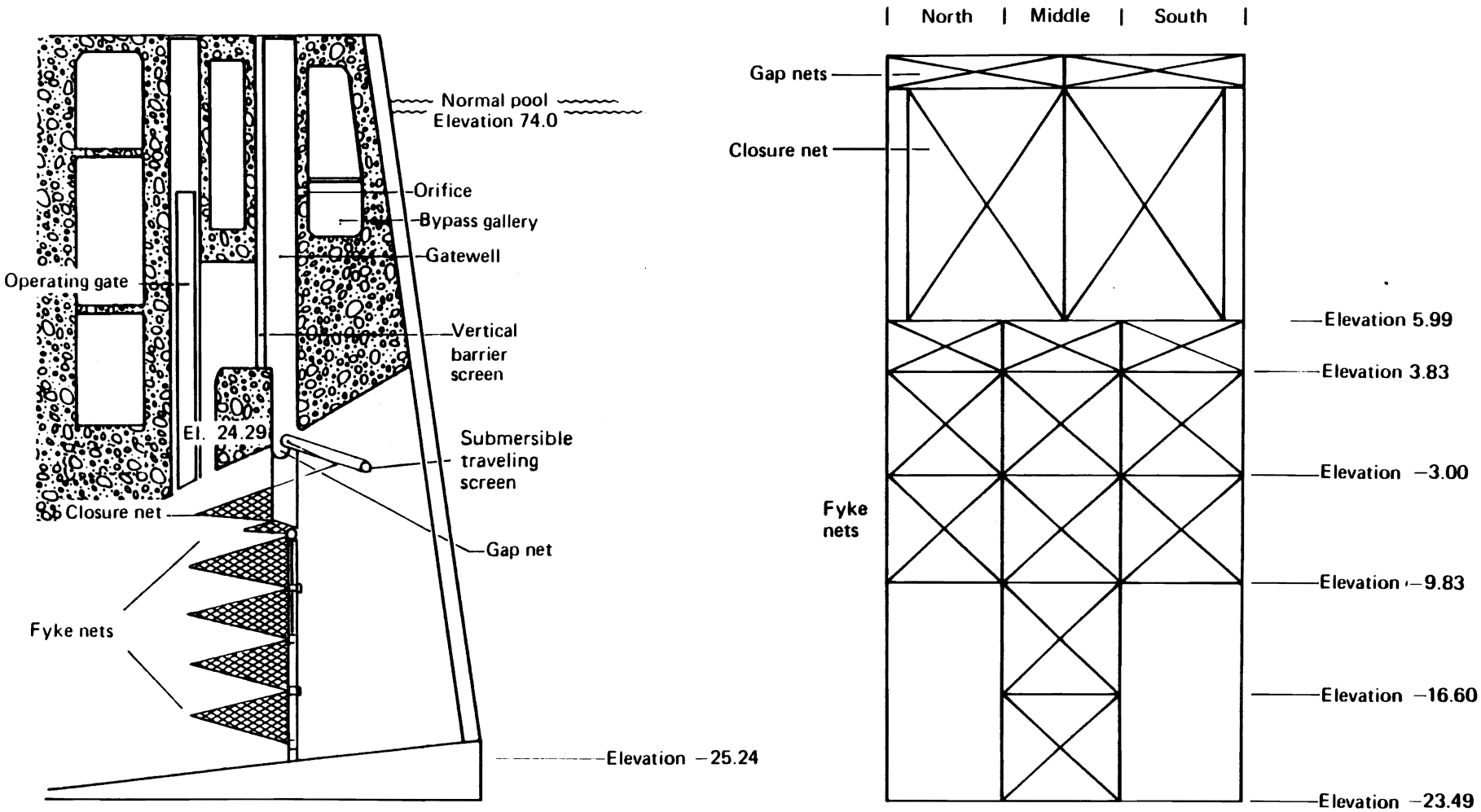

Figure 4.--Cross-section of the turbine intake with a submersible traveling screen and attached nets at Bonneville Dam Second Powerhouse; the net layout is also shown - 1986.

catch from each net into marked containers. Species identification and number could then be determined for all fish.

FGE 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. This is represented by the following formula:

$$FGE = \frac{GW}{GW + GN + FN + CN} \times 100$$

GW = gatewell catch
GN = gap net catch
FN = fyke net catch[3/]
CN = closure net catch

Three to five replicates, each with about 250-300 fish of the target species for each test condition, are usually required for statistical analysis. This replication was not always attained because of the variety of possible test conditions and the relatively short time available for testing. Data for unreplicated tests are presented as possible trend indicators, not for statistical analysis.

Vertical distribution data were obtained by using fyke nets attached to a frame installed in the turbine intake (Fig. 3). All nets were 6.0 x 6.5 ft at the mouth and approximately 15 ft long. The nets tapered to an 8-in diameter metal ring to which a 3-ft-long cod-end bag was attached. A standard replicate was obtained in the same manner as the FGE tests, i.e., closing the orifice, lowering the net frame, dipnetting the gatewell, etc. As in the FGE tests, the turbine was run only during the hours when tests were conducted. At the end of each test individual net catches were identified and enumerated.

3/ Net catch levels with only a middle net are expanded by a factor of 3.

Vertical distribution was based on an estimate of the total number of fish entering the intake. The sum of the catch at the various net levels plus the gatewell catch gave an estimate of the total number of fish entering the intake during the test. The percentage of fish for each net level was determined by dividing the computed figure for each net level by the total intake estimate.

Starting time for all FGE and vertical distribution tests was approximately 30 min after sunset, and the duration of each test was generally from 1 to 2 h, depending upon fish numbers. Tests during the spring, with yearling fish, were generally conducted with a unit discharge of 18,000 cfs. Summer tests, with subyearling chinook salmon, were conducted with a slightly reduced load of 17,000 cfs. The majority of the FGE tests were conducted in Slots 12A and 12B. Vertical distribution tests were conducted in Slot 13A during the yearling migration and in Slot 13B during the subyearling migration.

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 50% or more descaled, the fish was classified as descaled.

Measures of FGE for several test conditions were required prior to the installation of the intake ceiling extensions. This information was needed because once the extensions were installed, all subsequent testing would be with them in place.

The FGE tests were conducted during two phases. An early phase (21 April to 5 June) used yearling chinook salmon as the target species. The late phase (14 July to 1 August) collected data on subyearling chinook salmon. Other

species were observed as available. Specific objectives were set for each phase of the FGE testing. During the early phase, the initial series (Tests 1-4) was to determine: (1) the difference (if any) between the standard and streamlined trashracks when used in conjunction with a 27-in lowered STS and (2) if a raised operating gate improved FGE under either of the trashrack conditions. During these tests, the operating gates for each gatewell were raised on alternating days (1st day - 12A raised, 12B standard; 2nd day - 12A standard, 12B raised; etc.). The second series (Tests 5-7) was to determine if a 48-in lowered STS in conjunction with either a 24- or 12-in false gap device (Fig. 5) would improve FGE when used with an internal deflector (Fig. 1). The third series (Tests 8-12) was the initial testing of the intake ceiling extensions. For these tests, the best (highest FGE) of the previous test conditions in Slots 12A and 12B were used. The fourth series (Tests 13-16) again used the best conditions from the previous tests, but this series was conducted under full powerhouse (Units 11-18) operation. In the fifth, and last, early-phase series (Tests 17-18), there were insufficient numbers of fish for statistical analyses.

All testing during the late phase was conducted with the ceiling extensions in place. In addition to measuring benefits, if any, of the ceiling extensions on subyearlings, three test series were conducted that were designed to answer several questions. First, is a 30-in lowered STS an acceptable alternative to the 27-in lowered STS? Second, with the intake ceiling extensions installed, is there a significant difference in FGE between the streamlined trashracks and the standard trashracks? Third, what (if any) effect does the internal deflector have on subyearling chinook salmon FGE?

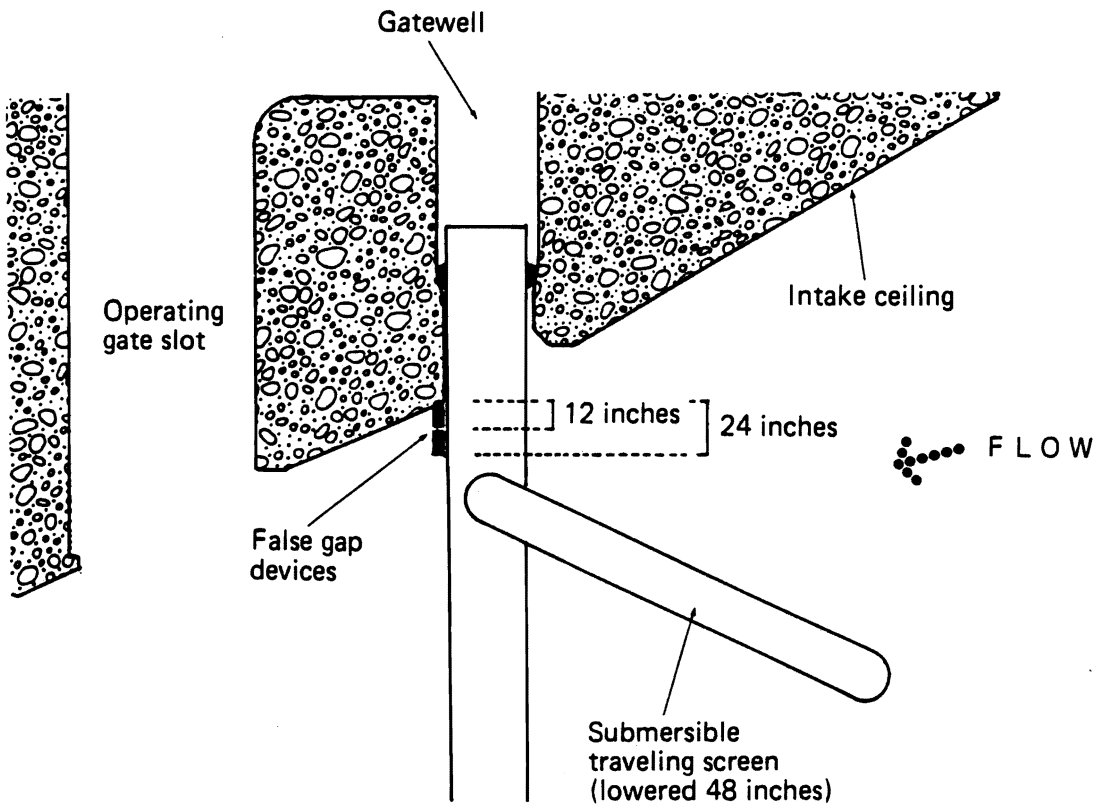

Figure 5.--Cross-sectional drawing of a turbine intake showing the position of a 48-in lowered STS and the 12- and 24-in false gap devices, Bonneville Dam Second Powerhouse, 1986.

Fourth, does raising the operating gate increase FGE when the internal deflector is used?

Results

The dates and number of replicates for each condition tested during the STS studies and also the corresponding FGE, TFGE, STS effectiveness, and descaling percentages are shown in Table 1. Figures 6, 7, and 8 indicate the percentage of fish captured at the different net levels for each test condition. The vertical distribution data obtained for each of the FGE tests are shown in Table 2. Appendix Tables 1 and 2 give individual catch data for FGE and vertical distribution tests. Table 3 is a statistical comparison of FGE using the G-test (Sokal and Rohlf 1981) for several conditions tested during the STS studies.

The initial early-phase test series indicated that streamlined trashracks significantly ($P < 0.01$) increased FGE for yearling chinook salmon from about 35 to 44% with a standard operating gate (Tests 2 vs 3) and from 33 to 48% with a raised operating gate (Tests 1 vs 4). Overall STS effectiveness (percentage of TFGE) was 75 to 80% (Tests 2 and 4) for streamlined trashracks vs about 55 to 59% (Tests 1 and 3) for standard trashracks. Raising the operating gate provided a slight benefit with streamlined trashracks (Test 4 - raised gate, STS effectiveness 80%, FGE 48%; vs Test 2 - standard gate, 75 and 44%) and provided no benefit with the standard trashrack (Test 1 - raised gate, STS effectiveness 55%, FGE 33% vs Test 3 - standard gate, 59 and 35%).

Test results from the second series (Tests 5, 6, and 7) indicate that simply increasing the length of a guiding device may not automatically increase FGE, especially at a project such as the Second Powerhouse where FGE

Table 1.—Traveling screen fish guiding efficiency (FGE) tests on yearling and subyearling chinook salmon conducted at Bonneville Dam Second Powerhouse during the 1986 field season.

Test no.	Date(s) of tests	Test slot	Turbine units	Flow load (Kcfs)	STS low. position (in)	False gap (in)	Internal deflector	Trashrack design	Operating gate position	Intake ceiling extensions	Yearling FGE (%)	Yearling Descaling (%)	Yearling TFGE[a] (%)	Yearling STS Effectiveness[b] (%)
1	21,24,25 April	12A	11,12 13,18	18	27	None	None	Standard	Raised	None	33.2	1.0	60	55
2	21,24,25 28,29 April	12B	11,12 13,18	18	27	None	None	Streamlined	Standard	None	44.3	2.7	59	75
3	23,26,27 28,29 April	12A	11,12 13,18	18	27	None	None	Standard	Standard	None	35.2	4.8	60	59
4	23,26,27 April	12B	11,12 13,18	18	27	None	None	Streamlined	Raised	None	48.1	5.6	60	80
5	6,7,8 May	12A	11,12 13,18	18	48	24	Yes	Streamlined	Standard	None	41.8	21.3	81	52
6	6,7,8,9,10 May	12B	11,12 13,18	18	48	24	None	Streamlined	Standard	None	52.9	10.1	75	71
7	9,10 May	12A	11,12 13,18	18	48	12	Yes	Streamlined	Standard	None	45.5	8.2	81	56
8	19,20,21 May	12A	11,12 13,18	18	48	12	Yes	Streamlined	Standard	Yes	65.5	8.8	79	83
9	19,20,21,23 24 May 2, June	12B	11,12 13,18	18	27	None	None	Streamlined	Standard	Yes	60.5	8.9	75	81
10	23,24 May 2,3 Jun	12A	11,12 13,18	18	48	12	None	Streamlined	Standard	Yes	45.4	15.6	75	61
11	25 May	12A	11,12 13,18	15	48	12	None	Streamlined	Standard	Yes	39.3	22.7	54	73
12	25 May	12B	11,12 13,18	15	27	None	None	Streamlined	Standard	Yes	46.8	7.8	54	87
13	25 May	12A	11-18	18	48	12	None	Streamlined	Standard	Yes	42.0	26.2	76	55
14	26 May	12B	11-18	18	27	None	None	Streamlined	Standard	Yes	48.0	7.8	76	63
15	27,28,29,30 May	12A	11-13 14-18	17 14.5	48	12	None	Streamlined	Standard	Yes	66.8	15.3	89	75
16	27,28,29,30 May	12B	11-13 14-18	17 14.5	27	None	None	Streamlined	Standard	Yes	71.0	14.9	89	80
17	4,5 June	12A	11,12 13,18	18	48	None	Yes	Streamlined	Standard	Yes	61.4	11.1	65	94[c]
18	3,4,5 June	12B	11,12	18	27	None	None	Streamlined	Standard	Yes	70.2	5.9	66	106[c]
19	14-18 July	12C	11,12 13,18	17	30	None	None	Standard	Standard	Yes	19.2		47	41
20	20,22,24 25,28 July	12A	11,12 13,18	17	48	12	Yes	Streamlined	Standard	Yes	23.4		51	46
21	21,23,26 27,29 July	12A	11,12 13,18	17	48	12	None	Streamlined	Standard	Yes	18.2		42	43
22	30,31 July 1 Aug	12A	11,12 13,18	17	48	12	Yes	Streamlined	Raised	Yes	23.9			
23	14-18 20-31 July 1 Aug	12B	11,12 13,18	17	30	None	None	Streamlined	Standard	Yes	22.4		43	52

a/ Percentage of fish in the turbine intake at or above the interception point of the STS, based on vertical distribution data.
b/ % FGE/% TFGE.
c/ Numbers of fish collected insufficient for analysis (< 100 per replicate).

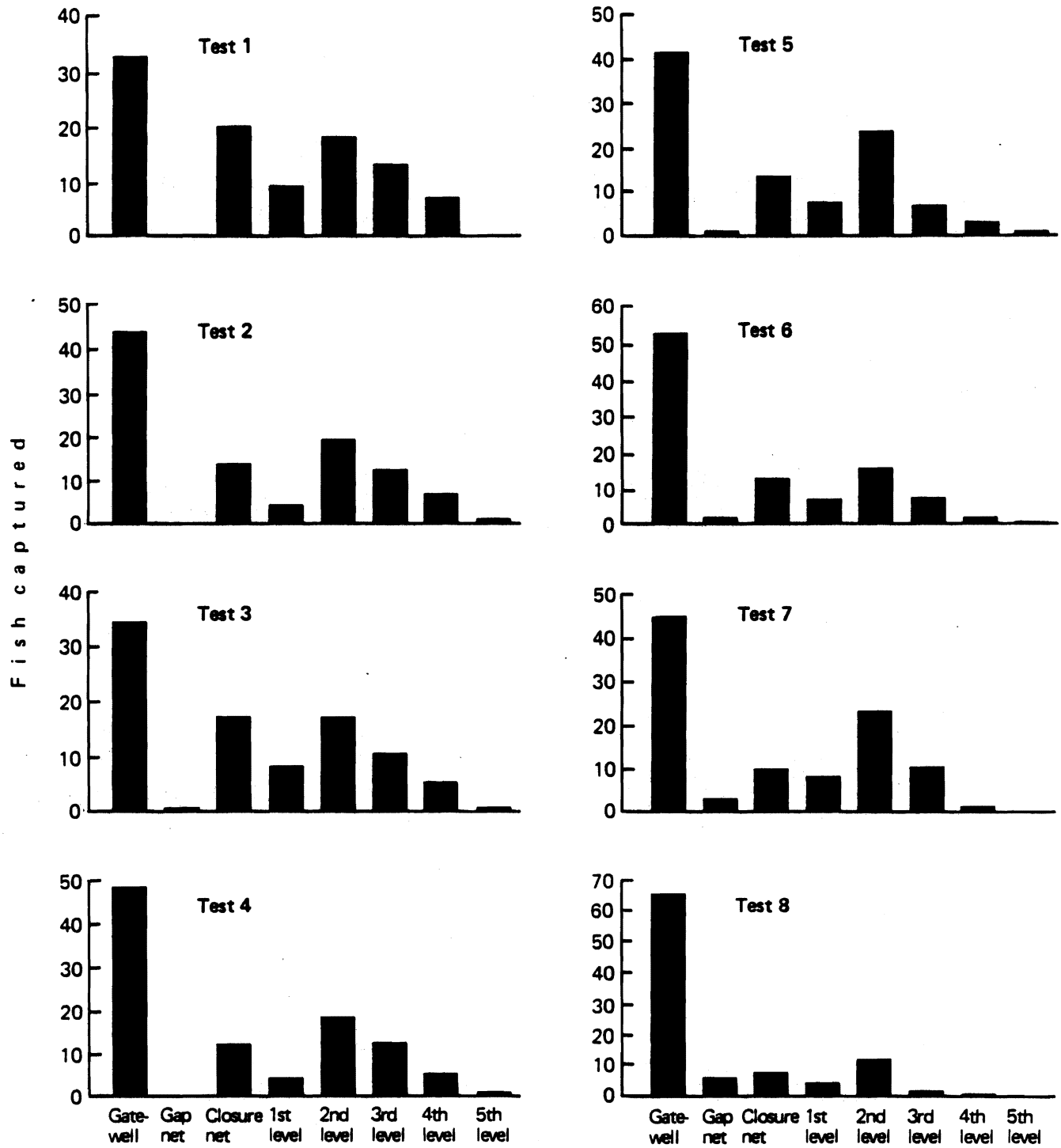

Figure 6.--Results of STS tests for yearling chinook salmon showing FGE and percentage of fish captured at various net levels, Bonneville Dam Second Powerhouse, 1986. Test numbers correspond to tests as listed in Table 1 (refer to this table for complete test details).

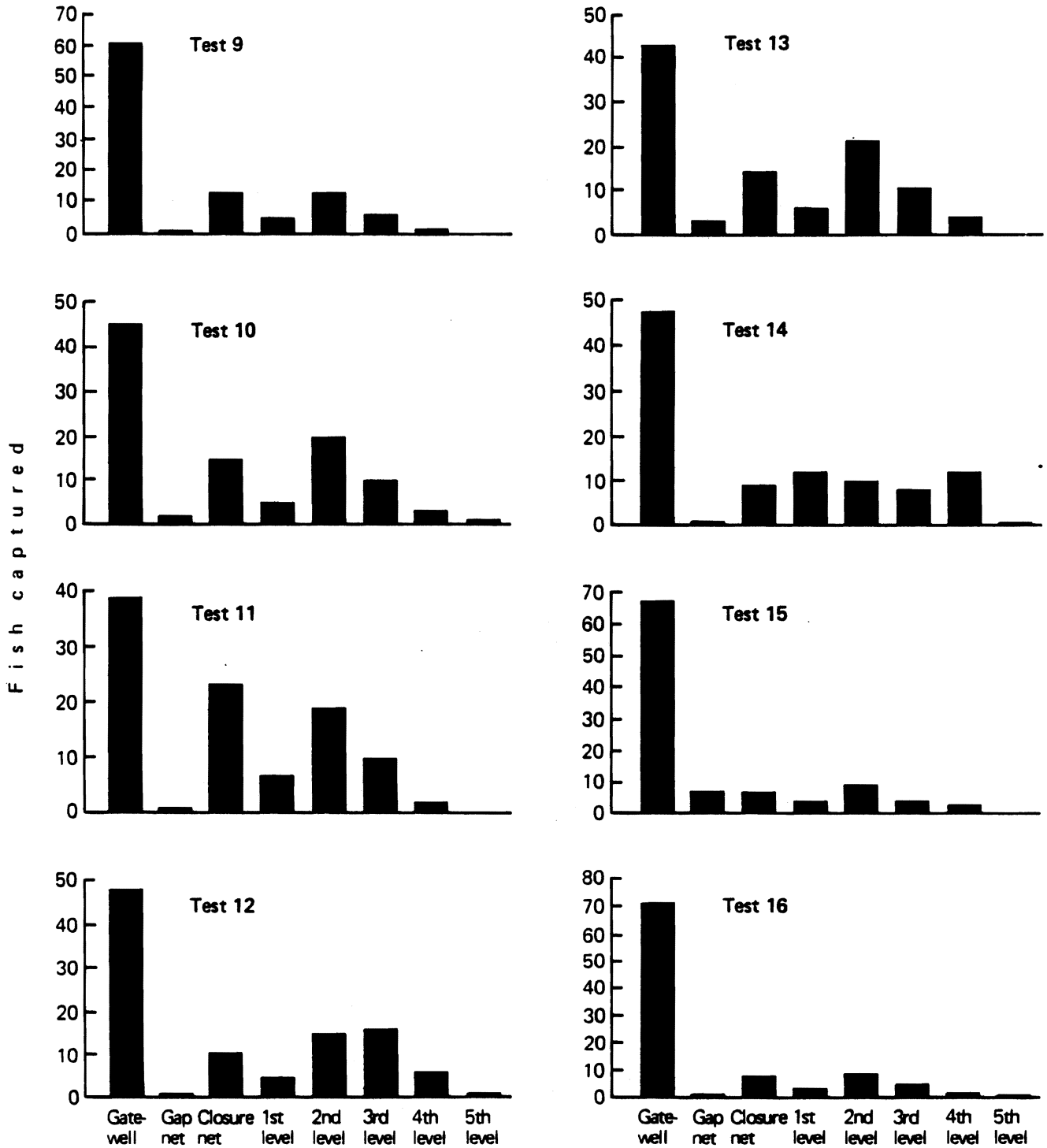

Figure 7.--Results of STS tests for yearling chinook salmon showing FGE and percentage of fish captured at various net levels, Bonneville Dam Second Powerhouse, 1986. Test numbers correspond to tests as listed in Table 1 (refer to this table for complete test details).

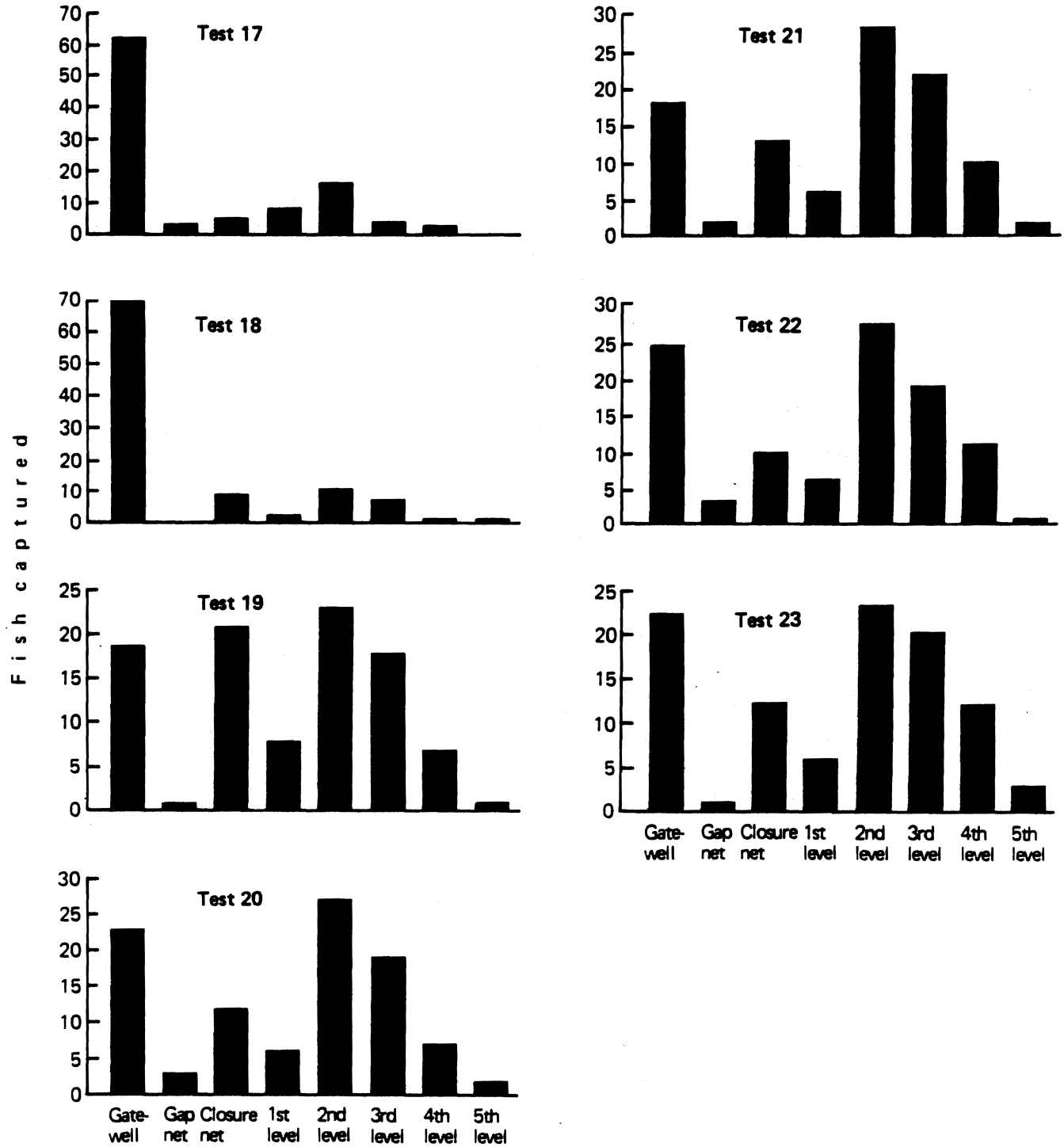

Figure 8.--Results of STS tests for subyearling chinook salmon showing FGE and percentage of fish captured at the various net levels, Bonneville Dam Second Powerhouse, 1986. Test numbers correspond to tests as listed in Table 1 (refer to this table for complete test details).

Table 2. Vertical distribution tests conducted at Bonneville Dam Second Powerhouse during the 1986 field season. Test numbers and test dates are identical to those for Table 1 (FGE data, 1986).

Test no.	1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18	
Test date(s)	21,24 25 April		21,24 25,28 29 April		23,26 27,26 29 April		23,26 27 April		6,7,8 May		6,7,8 9,10 May		9,10 May		19,20 21 May		19,20, 21,23, 24 May 2 June		23,24 May 2,3 June		25 May		25 May		25 May		26 May		27,28, 29 30 May		27,28, 29,30 May		4,5 June		3,4,5, June	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Gatewell	455	17	590	18	504	20	369	20	341	26	639	25	298	23	439	20	729	21	313	23	45	12	45	12	556	23	556	23	409	30	409	30	26	23	49	27
1st net	611	23	752	22	558	22	417	22	367	28	717	28	350	28	681	31	1018	29	358	27	65	17	65	17	714	29	714	29	486	36	486	36	15	13	36	20
2nd net	362	14	464	14	337	13	235	13	210	16	441	17	231	18	379	17	607	18	237	18	79	20	79	20	446	18	446	18	255	19	255	19	12	11	21	11
3 upper	152	6	181	5	122	5	93	5	62	5	133	5	71	6	139	6	234	7	95	7	20	5	20	5	157	6	157	6	57	4	57	4	15	13	15	8
3 lower	166	6	216	6	160	6	110	6	72	6	146	6	74	6	113	5	176	5	66	5	36	9	36	9	163	7	163	7	75	6	75	6	6	5	9	5
4th net	255	10	336	10	285	11	204	11	93	7	192	7	99	8	165	8	237	7	81	6	63	16	63	16	174	7	174	7	54	4	54	4	12	11	21	11
5th net	330	13	423	13	309	12	216	12	84	7	174	7	90	7	144	7	252	7	111	8	36	9	36	9	153	6	153	6	6	.4	6	.4	12	11	15	8
6th net	255	10	315	9	249	10	189	10	57	4	105	4	48	4	84	4	132	4	48	4	27	7	27	7	75	3	75	3	9	1	9	1	12	11	12	7
7th net	54	2	69	2	54	2	39	2	6	.4	15	1	9	1	45	2	72	2	30	2	15	4	15	4	24	1	24	1	6	.4	6	.4	3	3	6	3
Totals	2640		3346		2578		1872		1292		2652		1270		2189		3457		1339		386		386		2462		2462		1357		1357		113		184	

Test no. Test date(s)	19 14-18 July		20 20-23 July		Combined data	
	#	%	#	%	#	%
Gatewell	209	9	317	9	526	9
1st net	292	13	434	12	726	12
2nd net	378	17	499	14	877	15
3 upper	175	8	259	7	434	7
3 lower	220	10	306	9	526	9
4th net	357	16	531	15	888	15
5th net	315	14	612	17	927	16
6th net	243	11	447	13	690	12
7th net	84	4	168	5	252	4
Totals	2273		3573		5846	

a. Estimated depth of interception during FGE tests with just the STS. (TFGE is the accumulative percentage to this line.)

b. Estimated depth of interception during FGE tests with the STS plus internal deflector. (TFGE is the accumulative percentage to this line.)

Table 3.--A G-statistic comparison of the various FGE values of the different STS conditions tested at Bonneville Dam Second Powerhouse during the 1986 field season. (Test numbers correspond to those in Table 1).

Comparison	Number of replicates	FGE $\bar{X}$ (%)	FGE Range (%)	G-statistic
		Yearling chinook salmon		
Test 1 vs	3	33.2	27-43	
Test 3	5	35.2	28-39	2.0072
Test 2 vs	5	44.3	29-57	
Test 4	3	48.1	39-51	5.2293*
Test 2 vs	5	44.3	29-57	
Test 3	5	35.2	28-39	42.2003***
Test 2 vs	5	44.3	29-57	
Test 9	6	60.5	53-67	137.0706***
Test 8 vs	3	65.5	63-69	
Test 9	6	60.5	53-67	9.7183**
Test 8 vs	3	65.5	63-69	
Test 10	4	45.4	42-58	132.1130***
Test 15 vs	4	66.8	61-70	
Test 16	4	71.0	66-79	5.8978*
		Subyearling chinook salmon		
Test 19 vs	5	19.2	16-26	
Test 23	18	22.4	15-30	8.0446**
Test 20 vs	5	23.4	21-26	
Test 21	5	18.2	15-21	23.5623***
Test 20 vs	5	23.4	21-26	
Test 22	3	23.9	20-29	0.1145
Test 20 vs	5	23.4	21-26	
Test 23	18	22.4	15-30	1.2886

* = $P < 0.05$
** = $P < 0.01$
*** = $P < 0.001$

appears to be influenced by several factors. As indicated by results in Test 5 (without) and Test 6 (with an internal deflector), the addition of the deflector actually lowered STS effectiveness from 71 to 52%. In both tests there was a 48-in lowered STS and 24-in false gap device approximating the throat opening of a 27-in lowered STS and standard ceiling. In Test 7, with the false gap device decreased by 12 in, allowing a larger throat opening, the STS effectiveness increased slightly to 56%. Results of these tests reiterate the fact that as more water is intercepted (i.e., through the use of the internal deflector) and directed toward the throat area, an adjustment (i.e., through enlarging the throat opening) must be made or FGE will decrease (Gessel et al. 1986).

The third early-phase series was the first with the intake ceiling extensions. A comparison of Test 2 (without) and Test 9 (with the ceiling extensions) showed that the addition of these extensions significantly ($P < 0.01$) improved FGE from about 44 to 61%. Also, a comparison of Tests 8 and 10 indicated that with the intake ceiling extensions, the internal deflector can be a very effective addition to the 48-in lowered STS (FGE 66% with and FGE 45% without the internal deflector). The STS effectiveness for those tests was 83 and 61%.

The initial test for the fourth series (full powerhouse operation) occurred on 26 May, with turbine discharge set at 18,000 cfs for each unit. FGE for this replicate was very poor (Test 13 - 42%, Test 14 - 48%), and no further testing was done at this discharge. There was additional testing with full powerhouse operation with Units 11-13 at 17,000 cfs and Units 14-18 at 14,500 cfs. FGEs for these tests were the highest recorded during the 1986 field season, 67 and 71% for Tests 15 and 16. Fish migrating at this time

were higher in the water column as indicated by TFGEs of 89%. As a result, overall STS effectiveness was about the same as some of the previous tests, 75 and 80%.

The wide range of TFGE percentages (54 to 89%) for tests with the intake ceiling extensions (Tests 8-16) gave an indication of how flow conditions, as measured by different turbine discharge patterns, can affect FGE.

Results obtained during the late phase of FGE tests indicated primarily that the intake ceiling extensions did not provide any FGE enhancement for subyearling chinook salmon. Maximum FGE measured was only about 23%, about the same as in 1985. The results of the other tests indicated that: (1) a 30-in lowered STS was an acceptable alternative to a 27-in lowered STS (Test 23 had a total of 18 replicates and an average gap net catch of only 0.6% (range 0.2 - 1.2%). Tests with a 27-in lowered STS with subyearlings as the target species during the 1985 field season (Gessel et al. 1986) had similar results); (2) FGE measured with the streamlined trashracks in Slot 12A was 22.2%, slightly higher than the 19.2% measured in Slot 12C with the standard trashrack; (3) the internal deflector appeared to improve FGE when used in conjunction with the 48-in lowered STS (Test 20, FGE of 23.4% vs Test 21, FGE of 18.2%); and (4) the raised operating gate did not increase FGE when used in conjunction with a 48-in lowered STS and internal deflector (Test 20, FGE 23.4% vs Test 22, FGE of 23.9%).

That the ceiling extensions did not seem to have much of an effect on subyearling FGE is not unexpected since these fish migrate at a greater depth than others and therefore the majority are probably below the area thought to be influenced by the extensions. Vertical distribution data generally agree with this statement since TFGE in 1986 was about 45% (about the same as

estimates from previous years). The subyearling data present another problem: the relatively low (compared to yearling chinook salmon) STS effectiveness for these fish. Data for yearling chinook salmon indicated TFGEs of approximately 75% and FGEs of about 60% for an STS effectiveness of about 80% whereas for subyearling chinook salmon under similar flow conditions, the percentages are 43% (TFGE), 22% (FGE) and 52% (STS effectiveness). What the data seem to indicate is that aside from migrating at greater depth, subyearling chinook salmon may present avoidance/deflection problems that have not yet been identified.

A series of vertical distribution tests conducted between 25 July and 1 August suggested a potential for increasing FGE for subyearling chinook salmon. During these tests, a high intensity (1,000 W) incandescent underwater light was positioned in the center of various nets on the vertical distribution frame in an attempt to measure a response from the migrants (Fig. 4). Table 4 gives the results of these tests. Since the tests were conducted at the end of the 1986 field season, with only two replicates of each light condition, the data for the lighted tests are not intended to represent absolute values. The data presented as tests without lights was the mean collection percentages for the gatewell and various nets derived from vertical distribution tests conducted during 14 - 24 July. Confidence intervals at the 95% level for these means were calculated using the formula:

$$P \pm t(1 - \frac{\alpha}{2}, K - 1) \frac{S}{\sqrt{K}}$$

Where: K = number of replicates
S = standard deviation among replicates

Table 4.--Comparison of the percentage of subyearling chinook salmon captured in the gatewell and the various nets of the vertical distribution frame with or without a light positioned in the mouth of some of the fyke nets, Bonneville Dam Second Powerhouse, 1986.

Site[c]	Tests without lights [mean (95% NCI)][d]	Tests with lights[a/b] 25-26 July (mean)	27-28 July (mean)	29-30 July (mean)	31-1 Jul/Aug (mean)
Gatewell	13.2 (11.5 - 14.9)	6.6	8.9	3.8	6.6
Left 1	6.2 (5.3 - 7.1)	2.9	3.2	2.3	6.4
Middle 1	6.1 (5.3 - 6.8)	3.3	10.1	9.5	5.1
Right 1	6.1 (5.6 - 6.6)	3.6	5.3	2.7	1.8
Left 2	6.7 (6.0 - 7.4)	2.3	5.7	2.9	13.5
Middle 2	7.3 (6.2 - 8.3)	8.7	10.4	11.9	7.6
Right 2	8.4 (7.6 - 9.2)	4.9	5.6	5.1	1.8
Left 3	7.1 (6.4 - 7.9)	5.5	4.7	4.3	13.3
Middle 3	7.9 (7.1 - 8.8)	12.9	12.4	18.9	13.6
Right 3	8.9 (7.8 - 10.0)	9.2	6.2	8.5	3.5
Middle 4	7.4 (6.8 - 8.1)	17.9	8.8	13.5	12.5
Middle 5	7.3 (5.9 - 8.8)	14.7	8.3	9.5	8.6
Middle 6	5.4 (4.3 - 6.6)	4.3	6.9	4.6	4.7
Middle 7	2.0 (1.5 - 2.5)	3.1	3.7	2.4	1.2

a/ Boxed-in figures indicate nets with lights.

b/ Two replicates each test.

c/ Refers to capture location, see Figure 4.

d/ From nine replicates, 14-23 July.

For the nine tests without lights, confidence intervals calculated indicated minimal variance about the mean gatewell and net values. The minor differences observed between the left, middle, and right nets of Rows 1 to 3 provide additional verification that fishing only the middle row of nets would provide a reasonable measure of vertical distribution with less sacrifice of fish. (Single rows of nets were utilized in vertical distribution tests at McNary and Lower Monumental Dams in 1986.)

The eight tests with lights indicated that the percentage of fish captured increased dramatically in the lighted net. In addition, the percentage of fish entering the gatewell was much less in tests where fyke nets were lighted. This suggests that the basic concept warrants further consideration.

OBJECTIVE II - CONTINUED MONITORING OF THE SECOND POWERHOUSE JUVENILE SAMPLING FACILITY

The random sampler in the Second Powerhouse provides the means to examine the condition of salmonids passing through the downstream migrant bypass system (DSM) and to monitor smolt migrations passing this powerhouse. The DSM consists of a smolt sampler designed to randomly collect a portion of the juvenile migrants passing through the system, a dry separator for removing adult fish and debris, a wet separator in the migrant observation room for separating juveniles by size, and four raceways to hold fish graded by the wet separator.

During 1986 monitoring of the DSM sampling facility, we did the following: (1) enumerated fish collected by species, recorded marks, and observed descaling, mortality, and incidence of gas bubble disease daily

throughout the smolt migration and (2) evaluated improvements made to correct deficiencies in the DSM and made adjustments and recommendations as needed.

Task 1 - Smolt Indexing

Methods

Fish passing through the Second Powerhouse bypass system were collected by the random sampler and examined to monitor their condition. At least once a day fish were crowded to the downstream end of the raceway and dipnetted into an anesthetic bath (MS 222). The fish were enumerated by species or race and examined for descaling, gas bubble disease, and marks. The fish were classified as descaled using the criteria of 1985 (Gessel et al. 1986). When large numbers of fish were captured, daily subsamples of 100 fish per species or race were examined, and the remainder enumerated by species, checked for marks, and released. During most weeks, the random sampler operated Monday through Friday, 24 h per day. Estimates of total weekly passage (by species) were calculated by multiplying the daily catch by 10 [random sampler efficiency is 10% (Krcma et al. 1984)] and expanding to a 7-d week. It should be cautioned that estimates obtained reflect only passage through the Second Powerhouse DSM and not a viable index of timing of migrations at Bonneville Dam.

Results

Between 3 March and 19 November, the random sampler operated for 3,496 h for an average of about 92 h per week. During this time, a total of 37,569 juvenile salmonids were captured, of which 17,117 were examined for descaling, gas bubbles, and injury (Appendix Table 3). These numbers represent a passage rate for a reduced powerhouse operating level similar to that in 1984 and 1985

when usually only three or four of the existing eight turbines were operating during the nightly peak periods of fish movement. As in 1985, nighttime operation was restricted to the hours of FGE testing (21 April to 5 June and 14 July to 1 August). During the week of 27 May, FGE tests were conducted under full powerhouse operation during the evening hours.

Periods of peak migration and the total estimated Second Powerhouse DSM passage by species were: (1) yearling chinook salmon--23 April, 216,987; (2) subyearling chinook salmon--9 April, 335,475; (3) steelhead, *Salmo gairdneri*--28 May, 31,839; (4) coho salmon, *O. kisutch*--28 May, 130,726; and (5) sockeye salmon, *O. nerka*--28 May, 55,008. Table 5 includes the weekly passage estimates for these fish.

The amount of descaling varied among species (Appendix Table 3). Sockeye had the highest descaling (31.0 %) and subyearling chinook salmon the lowest (1.7 %). Yearling chinook salmon, coho salmon, and steelhead had descaling of 6.3, 1.8, and 7.2 %, respectively. Except for sockeye salmon, these descaling rates were comparable to previous years' outmigration (Table 6). The reason for the higher descaling of sockeye salmon is unknown.

Mortality during 1986 was highest for sockeye salmon (22.7%) followed by subyearling chinook salmon (2.5%). Mortality for other species was low (Table 6). Cause of the high mortality of sockeye salmon, which has been observed every year since 1983, is unknown.

Gas bubbles were observed in 24 juvenile steelhead (197 examined) at the Second Powerhouse and in 18 steelhead (187 examined) and 1 coho salmon (47 examined) at the First Powerhouse between 2 and 5 June. Gas bubbles were observed primarily in the fins. Dissolved gas measurements from Warrendale, Oregon, during this period were as high as 134% and averaged 127% saturation.

Table 5.--Total salmonid passage estimates at Bonneville Dam Second Powerhouse DSM, 1986.

Week	Yearling chinook	Subyearling chinook	Steelhead	Coho	Sockeye	Total
5-Mar	36	19,457	0	179	0	19,672
12-Mar	1,785	9,993	35	4,375	0	16,188
19-Mar	5,425	2,240	70	1,523	18	9,276
26-Mar	2,695	910	70	1,068	53	4,796
2-Apr	2,864	1,933	501	3,741	54	9,093
9-Apr	1,409	77,882	632	1,166	0	81,089
16-Apr	19,863	4,918	1,068	1,365	0	27,214
23-Apr	43,365	24,255	1,085	1,593	18	70,316
30-Apr	35,259	5,888	3,473	3,979	805	49,404
7-May	21,088	20,493	2,328	3,080	2,538	49,527
14-May	19,040	13,808	2,975	3,780	4,183	43,786
21-May	27,335	42,350	6,178	19,600	8,943	104,406
28-May	30,590	23,975	9,310	45,010	18,655	127,540
4-Jun	4,988	7,403	3,553	18,288	17,150	51,382
11-Jun	805	9,100	490	4,743	2,415	17,553
18-Jun	18	4,918	0	613	35	5,584
25-Jun	0	12,075	0	105	0	12,180
2-Jul	0	2,424	0	0	0	2,424
9-Jul	0	1,120	0	0	0	1,120
16-Jul	18	9,555	0	18	18	9,609
23-Jul	0	14,805	35	280	53	15,173
30-Jul	18	7,735	0	315	70	8,138
6-Aug	0	1,120	0	18	0	1,138
13-Aug	0	683	0	0	0	683
20-Aug	0	175	0	0	0	175
27-Aug	0	2,783	0	18	0	2,801
3-Sep	0	2,540	0	47	0	2,587
10-Sep	0	2,013	0	35	0	2,048
17-Sep	0	1,946	0	14	0	1,960
24-Sep	0	1,103	0	0	0	1,103
1-Oct	0	228	0	0	0	228
8-Oct	140	700	0	5,915	0	6,755
15-Oct	0	47	0	932	0	979
22-Oct	0	0	0	210	0	210
29-Oct	70	490	0	4,323	0	4,883
5-Nov	70	525	18	770	0	1,383
12-Nov	53	1,645	0	228	0	1,926
19-Nov	53	2,240	18	3,395	0	5,706
Total	216,987	335,475	31,839	130,726	55,008	770,035

Table 6.--Descaling and mortality percentages by species for juvenile salmonids passing through the Second Powerhouse DSM at Bonneville Dam, 1983-86.

Year	Yearling chinook	Subyearling chinook	Steelhead	Coho	Sockeye
			Descaling (%)		
1983	8.3	1.0	7.2	2.3	16.9
1984	9.6	3.2	5.9	1.9	28.3
1985	4.1	1.1	3.0	1.8	20.7
1986	6.8	1.7	7.2	1.8	31.0
			Mortality (%)		
1983	3.4	1.2	1.9	0.6	18.7
1984	2.4	4.5	0.9	0.7	23.7
1985	4.1	1.1	3.0	1.8	20.7
1986	1.3	2.5	2.1	0.7	22.7

No signs of gas bubble disease were observed for the remainder of the 1986 smolt outmigration.

Brand information collected during the 1986 outmigration was forwarded to the Water Budget Center.

Task 2 - DSM Improvements

The only major improvements to the DSM at the Second Powerhouse made prior to the 1986 outmigration were in the dry separator (El. 65). These included the lowering (by 8 in) and screening of the dry separator hopper end-wall, installing an additional accessory water supply to the hopper, and installing a new dry apron between the random sampler and the dry separator. These improvements stabilized the water level in the dry separator, reduced flooding underneath the hopper, and eliminated periodic draining of the hopper. However, water levels were still too variable in the wet separator (El. 45) to safely grade fish. For this reason, the grading bars were removed from the wet separator, and all salmonids were collected in one raceway during 1986.

By eliminating the periodic draining problem in the dry separator, the amount of fish holdup was increased. Fish holdup is the percentage of fish collected by the random sampler that failed to enter the raceways during a 24-h period. To measure this, the salmonids in the raceway were counted each morning, the dry and wet separators were drained, the pipe connecting the two separators was flushed by sending rags through it, and the resulting fish enumerated. The amount of holdup varied both daily and by species but in general was approximately 50% of the daily total (Table 7). During 1 week, the dry separator was not drained daily to measure the amount of holdup under

Table 7.--The amount of holdup in the Second Powerhouse juvenile salmonid sampling system at Bonneville Dam, 1986.

	Yearling chinook	Subyearling chinook	Steelhead	Coho	Sockeye	Total
			Daily			
n	3,752	3,082	776	2,742	1,800	12,152
Volitional (%)	56.4	34.7	51.2	47.4	65.3	49.8
Holdup (%)	43.6	65.3	48.8	52.6	34.7	50.2
Range	30.2-61.2	34.0-95.6	25.0-73.1	33.1-67.5	19.5-51.6	30.2-62.0
S.D.	8.9	14.4	12.8	12.6	9.2	10.8
			Weekly			
n	1,562	2,420	353	*	511	5,966
Holdup (%)	18.1	26.0	22.4	*	16.8	22.2

* = Not included because of large hatchery release.

this operating mode. Again, the amount of holdup varied by species, but averaged about 22% of the weekly total (Table 6). This amount of holdup in the DSM sampling system makes it difficult to get an accurate, timely sample for indexing smolts without draining the system daily. Draining the system is not a problem unless grading fish with the wet separator is required. Grading fish while draining the system would be impractical with the present wet separator system.

OBJECTIVE III - CONTINUED EVALUATION OF THE FIRST POWERHOUSE JUVENILE SAMPLING FACILITY

Evaluation of the First Powerhouse juvenile sampling facility has been in progress since 1984. Initial tests were conducted to determine the utility and efficiency of the system and sampling gear. Many problems have been encountered and many modifications have been made to resolve them. Studies were conducted in 1986 to complete the evaluation, but various delays in construction coupled with mechanical breakdowns during much of the field season severely limited sampler operation. Except for 19 May to 4 June, the First Powerhouse juvenile sampling facility was unavailable for continuous use until 29 August. After that date there were no further breakdowns, and sampling was consistent until the bypass system was shut down for the year during the first week in December. Comments regarding availability of the facility are noted in Appendix Table 4.

The sample tank and flumes used in 1985 were replaced with a new design to improve function, mechanical reliability, and safety. Sampling was conducted to monitor juvenile outmigrants for incidence of descaling, and tests were undertaken to determine if fish were avoiding the sampling gear,

thereby affecting sampler accuracy. In addition, some work was done to determine catch proportion for the subsampler (center flume).

Task 1 - Improvement of Sampling Gear

Development of satisfactory sampling gear for the First Powerhouse facility (Fig. 9) has been difficult, primarily due to the limited space available for sample tank and flumes. The tank and flumes must fit within a downwell area measuring approximately 12 ft from screen crest to the downstream wall of the downwell and 9 ft across the width of the downwell. Present use of the space from screen crest to downstream wall is: sample flumes, 4 ft; sample tank, 4.5 ft; and clearance to the downstream wall, 3.5 ft. All of the 9-ft width is being used. The most troublesome problem with the lack of space is that to separate fish from flow, virtually all of the water passing the screen crest (normally about 56 cfs) must be dissipated in the length of the flumes. To eliminate the water and provide some adjustment for fluctuation, we installed variable-slope flumes constructed of 50% porosity wedge-wire screen. This design controls the flow across the flumes, but the flumes must be fished on an incline. Later in this report, we discuss the possibility of fish avoiding the inclined flumes and also mention some tests conducted with the flumes on a downslope. Fishing in this manner was done by increasing the emergency-gate opening so that more water was removed via the emergency-relief conduit, resulting in less volume passing over the screen crest.

Additional limitations are encountered through lack of headroom in the facility. Because fish must be passed into a holding tank at deck level, sample tank depth cannot be greater than the distance from the top of the

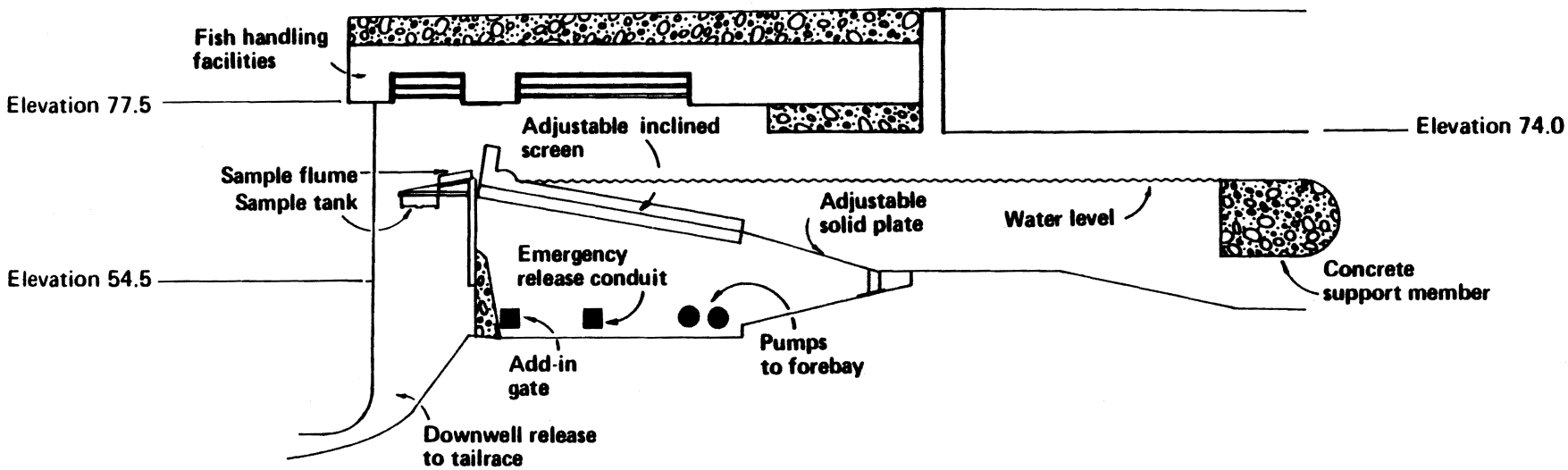

Figure 9.--Cross-section of the juvenile bypass (downstream end) system at Bonneville Dam First Powerhouse, 1986. The inclined screen, emergency-relief conduit, add-in gate, and pumps are designed to operate under automatic control.

holding tank to the ceiling. After space is allowed for the lifting mechanism, only about 2.5 ft remain for tank depth. The new sample tank constructed and installed prior to the 1986 field season was designed to make the best use of available headroom.

A third problem with design of the sampling gear is encountered when equipment must be lifted by hoists fixed to the ceiling. Since the inclined screen assembly moves vertically to follow fluctuations in forebay level, a permanent hoist connection cannot be made between the ceiling and gear mounted on the screen assembly. The original flume design (tested in 1984) addressed this problem by raising and lowering the flume for each sample. This design proved unworkable in use. Placing the flume into the fishing position was a time-consuming, hit or miss procedure, often requiring several attempts. Our solution for 1985 was to hinge the flumes to the inclined screen frame and simply pivot them in or out of the flow. This design provided a quick and positive method of moving flumes into fishing position, but since a ceiling-mounted hoist was used, the potential for equipment damage was introduced. This occurred on several occasions before pneumatic cylinders were installed for raising and lowering the flumes in August 1986. Air for the cylinders is fed through hoses from ceiling-mounted reels which play out and take up hose as the inclined screen assembly moves. This arrangement reduces the potential for equipment damage and improves safety of personnel by eliminating the rigging that was necessary to raise and lower the flumes.

Improvement in sample tank placement is possible by replacing the dual chain hoists currently in use with a hoist system powered from a single motor. Operation with the dual hoist arrangement occasionally results in minor damage by racking the sample tank. Cost of the alternative hoist system is estimated

at $11,000. Implementation awaits decisions regarding future use of the sampling facility.

In working through these difficulties, considerable progress has been made toward developing workable and versatile sampling equipment. As an example, placement of the 1984 sample tank and flumes was time consuming, uncertain, and required three people, each controlling separate hoist switches. In fall 1986, sample tank and flumes were routinely placed by one person in one attempt. Many other modifications have been made and are detailed in Appendix Table 5.

Task 2 - Monitoring of Juvenile Migrants

Methods

Day-shift catches were examined for descaling, mortality, length frequency, and marks. Descaling and length data were taken on 100 fish per species per day whenever possible. In general, mortality and mark recovery information was taken on the total day-shift catch. Classification of descaled fish followed previous guidelines (Objective II, this report). Identification of chinook salmon as yearlings or subyearlings was based primarily on the length frequency distributions, but we also considered other factors such as timing of hatchery releases, mark recoveries, and physical characteristics of the fish.

Exposure to sampling gear and handling of fish can contribute to observed descaling rates. This was of particular concern at the First Powerhouse sampling facility because of occasional turbulence in the sample tank, heavy debris load in the bypass system, and the necessity of dipnetting fish from the holding tank to the anesthetic tank. During initial samping in 1986, we

placed six marked groups of approximately 20 non-descaled yearling chinook salmon in the sample tank at the start of sample periods. Fish prone to descaling (possibly deciduous scales) were selected for these tests. When the sampling was terminated, marked fish were examined to determine the degree of descaling caused by sampling gear and handling.

Also of concern was whether the sampling process was causing sufficient stress to result in gross mortality following release. Groups of descaled and non-descaled yearling chinook salmon were removed from the sample catch and held for 5 d observation of delayed mortality. Similar tests in 1985 showed association between mortality and descaling (Gessel et al. 1986). Although our principal objective in 1986 was to determine delayed mortality for non-descaled fish, descaled groups were also included in the tests to verify this association. Data were pooled for each group and analysed with the G-test (Sokal and Rohlf 1981) for significance.

Results

General catch data by day and shift are compiled in Appendix Table 6. Descaling information summarized by week is shown in Table 8. Results of the monitoring were provided to COE fisheries personnel at Bonneville Dam and to the NMFS Environmental and Technical Services Division.

The degree of descaling caused by sampling gear and handling was minimal. Even with heavy flow over the flumes and turbulent conditions within the sample tank, only 2 of 127 (1.6%) fish examined at the conclusion of these tests were considered descaled. During the field season we reduced turbulence in the sample tank by minimizing inflow and placing blocking plates in front of overflow screens on the downstream end of the sample tank. Descaling

Table 8.--Weekly summary of salmonid descaling data collected at the Bonneville Dam First Powerhouse sampling facility during 1986 (n = sample size, D = descaled).

	Sample size and percent descaled									
	Yearling chinook		Subyearling chinook		Steelhead		Coho		Sockeye	
Week	n	D(%)	n	D(%)	n	D(%)	n	D(%)	n	D(%)
18-24 May	400	9.0	404	1.2	411	6.3	400	2.5	343	35.6
25-31 May	416	14.9	403	6.9	403	4.7	409	4.9	401	54.1
01-07 June	290	19.7	300	8.7	300	13.7	300	2.7	281	71.9
03-09 Aug			678	3.4						
10-16 Aug			525	4.2						
17-23 Aug			72	1.4						
24-30 Aug			91	5.5						
31 Aug - 06 Sep			422	6.4						
07-13 Sep			184	3.3						
14-20 Sep			166	4.8						
21-27 Sep			142	13.4						
28 Sep - 04 Oct			158	4.4			69	0.0		
05-11 Oct			82	3.7			110	0.0		
12-18 Oct	71	0.0	147	3.4			130	0.0		
19-25 Oct	57	3.5	117	2.6			60	0.0		
25 Oct - 01 Nov	43	0.0	164	3.7			315	1.3		
02-08 Nov	28	3.6	311	1.6			138	0.0		
09-15 Nov	59	6.8	557	1.4			166	0.6		
16-22 Nov	30	6.7	397	2.3			387	0.0		
23-29 Nov			26	0.0			43	0.0		

during handling was reduced by limiting the number of fish in each net load and by using dipnets with fine, non-abrasive mesh.

Due to the late startup of the facility, monitoring of the spring outmigration was limited to 19 May to 4 June. Descaling ranges for weekly data during this period were: yearling chinook salmon, 9.0-19.7%; subyearling chinook salmon, 1.2-8.7%; steelhead, 4.7-13.7%; coho salmon, 2.5-4.9%; and sockeye salmon, 35.6-71.9%. Subyearling chinook salmon examined from August through November averaged 3.9% descaled (range 1.1-19.7%). Coho salmon sampled in October and November were from a 30 September release at Little White Salmon National Fish Hatchery (NFH). Negligible descaling was observed for these fish. In past years, similar, low descaling rates were seen for releases from this station, as well as for releases from Spring Creek and Carson NFHs. Yearling chinook salmon sampled in October and November were almost entirely from fall releases into the Warm Springs River (fish were identified by right and left ventral clips). Weekly descaling rates for these fish ranged from 0-6.8%.

Results of delayed mortality tests are given in Table 9. The 5-d mortality of non-descaled yearling chinook salmon was 1.9%, higher than results observed for samples taken at the First Powerhouse sampling facility in 1985, but not indicative of severe problems in the sampling process. Highly significant differences ($P < 0.001$, df=1) were seen between delayed mortality of descaled (18.3%) and non-descaled (1.9%) fish.

At the conclusions of the 5-d holding periods, scale regeneration was beginning on some fish. Similar scale regeneration was also seen after close examination of some yearling chinook salmon at the First Powerhouse sampling facility. These observations are pertinent both to assumptions regarding the

Table 9.--Five-day delayed mortality of descaled and non-descaled yearling chinook salmon collected at the Bonneville Dam First Powerhouse sampling facility, 1986.

	Non-descaled			Descaled		
	Sample size	Live	Dead	Sample size	Live	Dead
21-26 May	80	80	0	80	67	13
27 May - 1 June	50	50	0	37	30	7
28 May - 2 June	100	99	1	82	60	22
2-7 June	32	31	1	29	24	5
3-8 June	55	51	4	50	46	4
Totals	317	311	6	278	227	51
Mortality (%)			1.9*			18.3*

*G-statistic test of independence for mortality of non-descaled vs descaled. $G = 51.269$, $df = 1$, $P < 0.001$.

source of descaling seen at the sampling facility, and to the setting of descaling criteria.

Monitoring at the First Powerhouse sampling facility documents the condition of fish passing through the system, but does not provide an adequate basis for identifying localized problems within the system. High observed descaling rates could result from the following, either singly or in combination: (1) injury in the sampling process, (2) passage conditions at upstream projects, (3) localized problems within the bypass system, and (4) operational problems within the bypass system.

Task 3 - Effect of Avoidance on Sampler Accuracy

During sampling in 1985, juvenile salmon and steelhead were observed avoiding the flumes by escaping upstream. Because the fish disappeared from view, it was not known whether the avoidance was momentary or whether the fish remained upstream and were lost to the sample. It was also observed that the percentage of steelhead in sample catches was low compared to that seen in orifice passage efficiency tests at the time. Based on these observations, we concluded that sample catches of steelhead were likely to be biased. Since steelhead were known to have an aversion to shallow, lighted areas, we ran paired samples with the facility alternately lighted and dark. Steelhead catch totals for lighted and dark conditions were 118 and 543 fish, respectively, a strong indication that samples could be biased due to avoidance.

For 1986, sample flumes were redesigned so that sampling could occur with the flumes on a slight downslope, similar to the random sampler at the Second Powerhouse. Plans were made to test for avoidance with a variety of

conditions of flume slope, lighting, and flow. Objectives of the test were to: (1) determine if fish were avoiding the full complement of flumes for the duration of the sample, (2) determine if there was avoidance specific to the center flume, and (3) identify fishing conditions that would give the most representative sample. Although the late startup in 1986 prevented the completion of all planned tests, limited testing was completed for lighting and flume slope.

Methods

Each test consisted of a series of paired samples with the conditions being tested (flume-slope up vs flume-slope down or light vs dark) alternated from sample to sample. Paired samples were of equal duration (5, 10, or 15 min) and were taken within the same hour to minimize the effects of changing passage. Catch data by species were recorded separately for center and side flumes. The bypass system was operated with a 4.5-ft head differential between forebay and transportation channel throughout the tests.

To determine if fish were avoiding the full complement of flumes for the duration of the sample, we compared total catch by species between conditions. Since the samples were separated in time, catch from sample to sample could vary with passage rate. Accordingly, we examined the data for gross differences such as the 4.6:1.0 catch ratio observed in the 1985 light/dark test with steelhead.

We also compared whether the center flume catch by species varied significantly between conditions. If this was the case, then avoidance specific to the center flume would be indicated. For these comparisons, data

were tested for significance with the G-test of independence (Sokal and Rohlf 1981).

Results

Table 10 lists the results of the avoidance tests. For comparisons of total catch, the catch ratios for all species were near 1:1. Gross differences, such as observed for steelhead in 1985, were not evident. It should be noted that in 1985, the tests of light vs dark were done with 3.5-ft head differential between forebay and DSM channel and, consequently, less velocity at the screen crest.

For comparisons of center and side flume catch, significant differences were observed for yearling chinook and coho salmon (higher percentage of catch in the center flume with facility dark) and for steelhead and coho salmon (higher percentage of catch in the center flume with flumes on a downslope). No significant differences were seen for subyearling chinook or sockeye salmon in any of the comparisons.

It appears that conditions under which the samples are taken can affect catch in the center flume. For much of the season, sampling can be done with all flumes in place, eliminating the possibility of avoidance specific to the center flume. At other times, particularly during seasonal and diel peaks of passage, sample catches taken with all flumes in place can exceed 1,000 fish per min. At these times, when passage rates are changing rapidly, it may be preferable to sample more frequently over a given time period. Fishing only with the center flume would allow this to be done without handling excessive numbers of fish, however, more information is needed to determine conditions under which these sample catches would accurately represent passage.

Table 10.--Results of avoidance tests at the Bonneville Dam First Powerhouse juvenile bypass system sampling facility, 1986. n = number of samples used in comparisons.

		Catch and G-test values									
n	Condition	Yearling		Subyearling		Steelhead		Coho		Sockeye	
Comparisons of total catch, light vs dark at screen crest and flume-slope up vs flume-slope down[a/]											
12	Light	951		681		344		1,508		531	
			1:0.91		1:1.08		1:0.97		1:1.05		1:1.01
12	Dark	1,040		628		355		1,435		524	
15	Slope up	756		603		388		1,929		501	
			1:0.98		1:0.95		1:0.82		1:1.09		1:1.13
15	Slope down	774		633		472		1,765		445	
Comparisons of center and side flume catch, light vs dark and flume-slope up vs flume-slope down[b/]											
11	Light - Center	176		157		42		208		84	
	Sides	673		470		279		1,129		374	
			6.489*		0.076		2.979		8.167**		3.838
11	Dark - Center	244		150		61		260		107	
	Sides	701		433		279		1,054		346	
15	Slope up - Center	195		184		39		337		115	
	Sides	561		419		349		1,592		386	
			0.063		0.547		6.868*		4.585*		1.067
15	Slope down Center	204		181		76		357		115	
	Sides	570		452		396		1,408		330	

a/ Ratios for light:dark and slope up:slope down.

b/ G-test of independence.

* = $P < 0.05$, ** = $P < 0.01$

Task 4 - Determine Subsampler Catch Proportion

Methods

Totals by species were kept separately for center and side flume catches whenever possible throughout the field season. Daily catch data by species were pooled and compared to the theoretical 16.7% subsampler rate using the G-test for goodness of fit (Sokal and Rohlf 1981). The mean percentage for subsampler catch of each species was calculated by averaging percentages for days when sample catch equaled or exceeded 100 fish of that species. Because subsampler catch appeared biased for yearling chinook salmon, steelhead, and coho salmon in spring tests (discussed previously), consideration of results for this time period are limited to subyearling chinook and sockeye salmon. Results for subyearling chinook and coho salmon in fall sampling are given for reference only, since we did not test for avoidance during this time.

Results

Highly significant differences ($P < 0.001$, df=1) were seen in all comparisons of actual to theoretical subsampler catch rate (Table 11). Actual catch rates were higher than the theoretical 16.7%: 30.1 and 25.6% for subyearling chinook salmon in spring and fall samples, respectively; 25.2% for sockeye salmon in spring samples; and 21.0% for coho salmon in fall samples.

Subsampler catch differed among species and was not proportional to the percentage of flow intercepted. If avoidance is ruled out, as in the case of the subyearling and sockeye salmon sampled during the spring, then non-random distribution of fish across the width of the channel is indicated. This does not prevent the use of the subsampler catches for estimating passage; however, calibration would be necessary to determine catch proportion for each species.

Table 11.--Comparison of actual to theoretical (16.7%) subsampler catch rate. Data for yearling chinook, sockeye, and coho salmon at Bonneville Dam First Powerhouse sampling facility, 1986.

Species and sample time	n[a/]	Catch totals			Center flume catch		
		Center flume	Side flume	Total	Mean %	SE	G-value[b/]
Subyearling chinook salmon (spring)	13	2,818	6,570	9,388	30.1	0.91	1015.758***
Subyearling chinook salmon (fall)	31	1,724	5,363	7,087	25.6	1.04	267.076***
Sockeye salmon (spring)	12	688	2,061	2,749	25.2	2.47	122.526***
Coho salmon (fall)	12	723	2,702	3,425	21.0	1.15	44.908***

a/ Days with sample catch of 100 or more fish.

b/ G-test for goodness of fit [comparing center flume catch percentages versus theoretical (16.7%).

*** = $P < 0.001$

For determinations of species composition, it would be simpler and more accurate to fish with all flumes.

Task 5 - Continued Monitoring of Temporal Passage

Consistent sampling was conducted at the First Powerhouse sampling facility from September until the bypass system was shut down for the season during the first week in December. One objective of sampling through the fall was to estimate the number of downstream migrants utilizing the bypass system at this time.

Methods

Sampling was scheduled from 0800 to 1600 h Monday through Friday and additionally from 1600 to 2400 h and 0000 to 0800 h for 2 d each week. Sampling gear was fished for 20 min/h, either continuously or in two 10-min subsamples. Nine hourly samples were missed due to COE maintenance or NMFS repairs to sampling gear. A total of 871 hourly samples were taken on schedule. No sampling was done on 12 October or 27 and 28 November. Because of the possible bias in the center flume catch previously mentioned, samples were taken with all flumes (100% of flow sampled).

Data from 24-h sampling periods were used to calculate the mean value for percent catch from 0800 to 1600, 1600 to 2400, and 0000 to 0800 h (Appendix Table 7). Upper and lower 95% confidence limits for the mean were calculated using the formula described earlier in this report (Objective I).

Passage estimates for days with 24-h sampling were calculated directly by multiplying 24-h catch totals by 3 (since only 20 min/h fished). Passage estimates for days with fish sampling only from 0800 and 1600 h were derived by expanding the 8-h catch by 12.9 for chinook salmon and 10.8 for coho salmon

to reflect the proportion of chinook salmon (0.233) and coho salmon (0.278) passing through the bypass between 0800 and 1600 each day (3 ÷ 0.233 = 12.9 and 3 ÷ 0.278 = 10.8). Weekly passage estimates were derived by expanding the sum of daily estimates to a 7-d week.

Results

Passage through the First Powerhouse bypass system during fall 1986 was estimated to include 65,662 subyearling chinook salmon, 5,732 yearling chinook salmon, and 33,630 coho salmon. Weekly estimates of passage are given in Table 12 and daily estimates of passage in Appendix Table 8. No estimates were made for the few steelhead and sockeye salmon observed during sampling. A generalized indication of diel passage is shown in Figure 10 which gives mean percentages of 95% confidence interval by species passing each 8-h period. Appendix Table 7 provides additional detail including weekly differences in diel passage.

Some conclusions are possible regarding migrants captured during fall sampling. Subyearling chinook salmon caught at this time are consistent in size and physical characteristics with up-river stock fall chinook salmon arriving at Bonneville Dam in July and August. Movement of these fish through the fall has been observed annually at Bonneville Dam and probably represents a natural migration pattern for this stock. In contrast, most of the movement of yearling chinook salmon and coho salmon observed during the fall was a result of hatchery releases at this time. Nearly all yearling chinook salmon observed in samples were from releases into the Warm Springs River. Coho salmon were from a 30 September release of 1.2 million fish at Little White Salmon NFH. Other fall hatchery releases of chinook salmon were made at

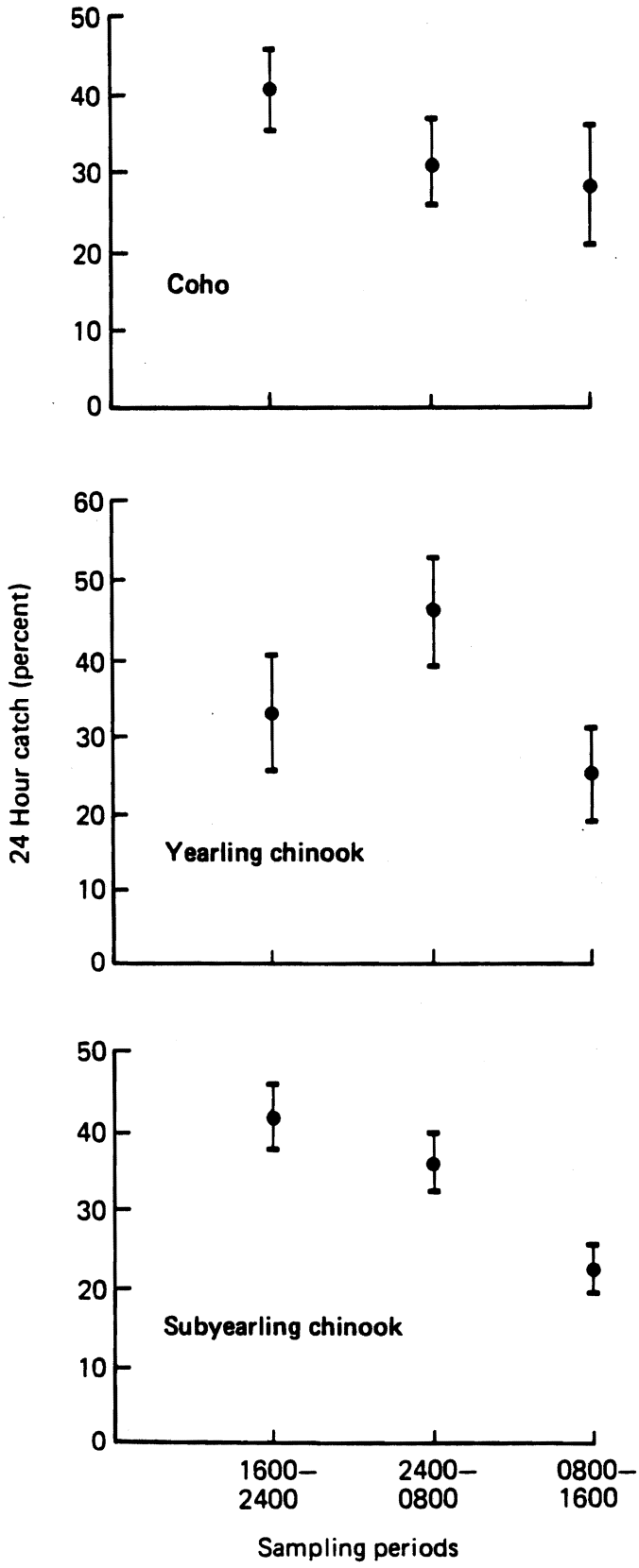

Figure 10.--Percentages of 24-h chinook and coho salmon catches taken in 8-h sample periods at the Bonneville Dam First Powerhouse sampling facility, fall 1986. Bars denote 95% confidence intervals.

Looking Glass Creek (163,000, 66% ad-clipped) and into the Umatilla River (150,000, 100% ad-clipped). Since only eight non-branded, adipose-fin-clipped chinook salmon were observed in samples, we assumed that these fish did not contribute significantly to this fall passage. Fall passage of subyearling chinook salmon at the First Powerhouse followed similar patterns in 1985 and 1986. In both years, estimated passage during the first 2 weeks of September was relatively high -- 23,912 in 1985 and 17,434 in 1986. From mid-September through October, passage rate declined to 3,252 and 2,904 fish/week in 1985 and 1986 whereas estimates increased in November to 10,325 and 4,926 fish/week in 1985 and 1986, respectively.

CONCLUSIONS

1. A Second Powerhouse FGE of nearly 70% was attained for yearling chinook salmon through the use of intake ceiling extensions, 27-in lowered STSs, and streamlined trashracks during full, but uneven, powerhouse operation.

2. A 30-in lowered STS is an acceptable alternative to a 27-in lowered STS.

3. The streamlined trashracks are an improvement (in terms of higher FGE) over the standard trashracks.

4. There was no increase in FGE on subyearling chinook salmon with intake ceiling extensions. The low FGE of 23% was about the same as that measured in 1985 with no ceiling extensions.

5. Descaling in the Second Powerhouse collection system was higher during 1986 than during 1985 for all salmonid species.

6. Mortality rates in the Second Powerhouse collection system were similar to 1985 rates for all species except sockeye salmon, which increased.

7. Gas bubble disease symptoms were observed in salmonids (primarily steelhead) during 1 week in early June when dissolved gas concentrations were high.

8. Modifications to the dry separator (El. 65) reduced flooding and stabilized water levels in the wet and dry separators; however, this increased holdup in the system.

9. Modifications to the sampling gear at the First Powerhouse are satisfactory. Modifications to the trash sweep resulted in increased reliability; however, as in any mechanical system, breakdowns are possible. If repair parts to the trash sweep are readily available then season-long sampling with minimal down-time appears feasible.

10. Descaling of yearling chinook salmon caused by sampling gear or handling was measured under very adverse sampling conditions and found to be less than 2.0% at the First Powerhouse sampling facility.

11. There is a close relationship between descaling and delayed mortality for yearling chinook salmon.

12. Additional tests are required to determine subsampler accuracy and catch proportion at the First Powerhouse sampling facility.

RECOMMENDATIONS

First Powerhouse

1. Continue evaluation of the juvenile collection facilities.

2. Collect temporal data throughout the 1987 field season.

Second Powerhouse

1. Continue the evaluation of the intake ceiling extensions and any other modifications/additions that may improve FGE.

2. Continue vertical distribution tests in conjunction with FGE tests.

3. Install and evaluate an 8-in long, clear section of lighted pipe directly below the dry separator. This may reduce fish holdup in the dry separator hopper.

4. Install screen in the dry separator to reduce the area for fish holdup.

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APPENDIX

Data Tables

Appendix Table 1.--Numbers of fish collected in the individual replicates of STS FGE tests at Bonneville Dam Second Powerhouse, 1986 (tests conducted in July and August captured only subyearling chinook salmon).

	Date and (test number)[a]														
	21 April (1)					24 April (1)					25 April (1)				
Location	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	16	420	2			4	186	5			1	179	13		
Gap Net		1					1					3	1		
Closure Net	25	273	2				115	5				76	6		
1st Level	9	105	1			1	65	3				36	1		
2nd Level	41	226				6	132	6			2	63	5		
3rd Level	22	175	1			5	94	3				34	3		
4th Level[b]	12	60				6	72	3			3	24			
5th Level[b]	9	9				3	12								
Totals	134	1269	6			25	677	25			6	415	29		
			33					30					415		

	21 April (2)					24 April (2)					25 April (2)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	32	644	6			7	129				2	207	13		
Gap Net		1										3			
Closure Net	19	195				1	54					42	5		
1st Level	6	55					21					8			
2nd Level	37	245	1			5	112					47	5		
3rd Level	28	136				2	86				1	26	5		
4th Level[b]	12	75				3	33					27			
5th Level[b]		12					12					6			
Totals	134	1363	7			18	447				3	366	28		
			86										96		

	28 April (2)					29 April (2)					23 April (3)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell		97	37		1		98					379	13		
Gap Net												3			
Closure Net		43	11				24					174	9		
1st Level		18	2				3					94	3		
2nd Level		64	10		2		36				2	171	7		
3rd Level	2	45	2		1		25				2	86	5		
4th Level[b]		12	6		6		6					63			
5th Level[b]		3										3			
Totals	2	282	68		10		192				4	973	37		
			54		10								85		

Appendix Table 1.--Continued.

Date and (test number)[a]

Location	26 April (3) SC	YC	ST	CO	SO	27 April (3) SC	YC	ST	CO	SO	28 April (3) SC	YC	ST	CO	SO
Gatewell		75	7			1	155	18				118	31		1
Gap Net		4					3					3			
Closure Net		32	6				67	5			2	82	24		2
1st Level		23	3		1		36	3				40	6		
2nd Level		53	5			1	64	4		2		73	16		2
3rd Level	1	31	3				43					61	11		5
4th Level[b]	3	15					30					15			3
5th Level[b]		3					12					6			
Totals	4	236	24		1	2	410	30		2	2	398	88		13
			29		0			60		0			35		8

Location	29 April (3) SC	YC	ST	CO	SO	23 April (4) SC	YC	ST	CO	SO	26 April (4) SC	YC	ST	CO	SO
Gatewell		66	22		1	7	416	14				69	5		
Gap Net		2					1								
Closure Net		59	10		1		98					18			
1st Level		13	5		1		34	6				7			1
2nd Level		49	15		2		136	1				39	4		2
3rd Level		27	5				101	1				31			
4th Level[b]		15	12		3		33					15			
5th Level[b]		3					3								
Totals		234	69		8	7	882	22			1	179	9		3
			32		13			64					56		5

Location	27 April (4) SC	YC	ST	CO	SO	6 May (5) SC	YC	ST	CO	SO	7 May (5) SC	YC	ST	CO	SO
Gatewell	1	173	15			6	246	60	6	13	1	152	34	4	21
Gap Net		1										5			2
Closure Net		47	5		2	5	90	12	2	2		54	10		8
1st Level		17					56	6		4		24	4		3
2nd Level	1	68	4		1	5	155	20	5	10	3	75	10		18
3rd Level	2	36	1		2	4	35	7	1	5	3	44	4		5
4th Level[b]	3	21	3				27				3		3		9
5th Level[b]		3					6								
Totals	7	366	28		5	25	615	105	14	34	10	354	65	4	66
			54		0			57	43	38			52	0/32	

Appendix Table 1.--Continued.

Location	8 May (5) SC	YC	ST	CO	SO	6 May (6) SC	YC	ST	CO	SO	7 May (6) SC	YC	ST	CO	SO
Gatewell	4	225	47	14	17	11	279	37	5	34	10	227	25	7	24
Gap Net	1	3			1							10			2
Closure Net		68	4		6	1	58	7		5	1	56	12		8
1st Level	3	38	7		5	1	32	4		2	1	33			3
2nd Level	3	124	11		22	4	67	6		8	1	59	9		13
3rd Level	2	28	5		12	2	32	4		11	5	40	6		13
4th Level[b]	3	24	6		12	3	3	3			3	6			3
5th Level[b]		3										3			
Totals	16	513	80	14	75	22	471	61	5	60	21	434	52	7	66
			59	100	23			61	100	57			48	100	36

Location	8 May (6) SC	YC	ST	CO	SO	9 May (6) SC	YC	ST	CO	SO	10 May (6) SC	YC	ST	CO	SO
Gatewell	8	249	38	6	33	1	219	26	24	3	5	250	56		70
Gap Net	1	15					10	1			2	7			7
Closure Net	2	67	18		17	4	57	4		2	3	54	13		20
1st Level		38	6		4	1	34	1		2		21	5		6
2nd Level	3	88	14		15	3	80	8		7	3	66	17		30
3rd Level	3	36	2		7	2	36	6		4	4	28	7		12
4th Level[b]	3	12			6		15					9	3		12
5th Level[b]		3					3								
Totals	20	508	78	6	82	11	454	46	24	18	17	435	101		157
			49	100	40			57	100	17			55		45

Location	9 May (7) SC	YC	ST	CO	SO	10 May (7) SC	YC	ST	CO	SO	19 May (8) SC	YC	ST	CO	SO
Gatewell		179	37		6	3	174	57	15	42	69	387	87	221	125
Gap Net		1	1		1		20	2		4	25	45	5	20	35
Closure Net	1	40	3		2		36	14		12	12	64	20	16	58
1st Level		27	5		2		37	7		9	6	33	24	4	41
2nd Level	1	93	10		7	2	86	15		20	8	60	49	15	110
3rd Level	4	37	1		4	2	40	7		13	3	10	20	3	38
4th Level[b]		6	3		3	3		3		6	3	6	3	3	24
5th Level[b]															
Totals	6	383	60		25	10	393	105	15	106	126	605	208	282	431
			62		24			54	100	40			42	78	29

Appendix Table 1.--Continued.

Location	20 May (8) SC	YC	ST	CO	SO	21 May (8) SC	YC	ST	CO	SO	19 May (9) SC	YC	ST	CO	SO
Gatewell	55	267	87	125	96	57	322	116	138	69	81	383	85	181	116
Gap Net	7	27	3		20	17	20	5		10	1	10		5	7
Closure Net	7	27	23		45	11	31	25		26	36	82	52	28	90
1st Level	6	25	16		26		18	9		9	2	25	10	11	59
2nd Level	18	61	34		93	9	51	36		36	11	52	51	30	128
3rd Level	14	11	11		39	4	12	19		22	8	14	24	6	60
4th Level[b]	6	3	3		6	6	12	3				3	15		24
5th Level[b]					3					3					
Totals	113	421	177	125	328	104	466	213	138	175	139	569	237	261	484
			49	100	29			54	100	39			36	69	24

Location	20 May (9) SC	YC	ST	CO	SO	21 May (9) SC	YC	ST	CO	SO	23 May (9) SC	YC	ST	CO	SO
Gatewell	75	257	84	80	58	74	264	106	80	52	47	196	59	58	20
Gap Net	4	3			3	3	4				5		1		3
Closure Net	13	59	29		58	9	42	17		32	10	43	12		13
1st Level	4	21	8		34	2	20	12		20	3	21	5		13
2nd Level	18	52	28		101	8	52	26		43	14	57	22		27
3rd Level	9	21	14		43	6	19	15		22	11	40	13		14
4th Level[b]		12			18	3	9	6		9	6	9	3		15
5th Level[b]											3	6	3		3
Totals	123	425	163	80	315	105	410	182	80	178	101	372	118	58	108
			52	100	18			58	100	29			50	100	19

Location	24 May (9) SC	YC	ST	CO	SO	2 June (9) SC	YC	ST	CO	SO	23 May (10) SC	YC	ST	CO	SO
Gatewell	53	304	70	38	88	48	145	54	108	69	46	291	96	77	48
Gap Net	5	3	1		5	1					8	8	4		4
Closure Net	21	72	37		71	14	33	16		29	11	87	19		27
1st Level	7	28	17		45	4	9	4		14	3	28	12		9
2nd Level	17	90	25		99	12	22	19		61	15	140	36		45
3rd Level	14	41	20		79	1	16	17		61	8	96	18		38
4th Level[b]	3	12	6		21	9	9			30	6	27	6		15
5th Level[b]	6									3		9			3
Totals	126	550	176	38	408	89	234	110	108	267	97	686	191	77	189
			40	100	22			49	100	26			50	100	25

Appendix Table 1.--Continued.

Location	24 May (10) SC	YC	ST	CO	SO	2 June (10) SC	YC	ST	CO	SO	3 June (10) SC	YC	ST	CO	SO
Gatewell	51	278	73	49	75	46	139	58	98	69	33	96	33	73	57
Gap Net	8	18	1		20	7	3			18	7		2		13
Closure Net	19	116	31		80	19	25	16		67	7	30	9		51
1st Level	2	47	19		31	4	10	13		31	3	8	7		27
2nd Level	8	125	43		124	32	42	21		114	19	41	17		120
3rd Level	7	44	19		64	6	15	21		62	10	21	6		78
4th Level[b]	6	12			27	6	3	12		42	9	9	3		42
5th Level[b]						3	3			3					6
Totals	91	640	186	49	421	123	240	141	98	406	88	205	77	73	394
			39	100	18			41	100	17			43	100	19

Location	25 May (11) SC	YC	ST	CO	SO	25 May (12) SC	YC	ST	CO	SO	26 May (13) SC	YC	ST	CO	SO
Gatewell	20	116	53		51	46	125	46	22	45	28	342	212	196	162
Gap Net	2	2	2		20	1	2			2		28	10		42
Closure Net	14	68	26		72	11	28	19		40	5	112	91		123
1st Level	3	20	16		33	3	13	16		42	4	52	77		113
2nd Level	13	55	29		130	16	39	18		122	10	168	159		344
3rd Level	5	28	12		104	7	42	27		90	5	83	55		210
4th Level[b]	3	6			15	3	15	9		42		30	18		75
5th Level[b]			3				3	3							
Totals	60	295	141		425	87	267	138	22	383	52	815	622	196	1069
			58		12			33	100	12			34	100	15

Location	26 May (14) SC	YC	ST	CO	SO	27 May (15) SC	YC	ST	CO	SO	28 May (15) SC	YC	ST	CO	SO
Gatewell	35	410	201	206	190	53	192	31	100	29	39	149	38	94	26
Gap Net		5	1		9	10	27	1		9	10	13			2
Closure Net	10	75	40		90	10	26	3		17	5	22	13		9
1st Level	6	103	87		131	6	16	7		6	3	7	4		6
2nd Level	11	88	80		201	8	22	11		26	7	34	13		19
3rd Level	8	68	66		199	9	15	4		13	6	12	7		2
4th Level[b]	6	102	66		189						9	6			6
5th Level[b]		3			12										
Totals	76	854	541	206	1021	96	298	57	100	100	79	243	75	94	70
			37	100	19			54	100	29			51	100	37

Appendix Table 1.--Continued.

Location	29 May (15) SC	YC	ST	CO	SO	30 May (15) SC	YC	ST	CO	SO	27 May (16) SC	YC	ST	CO	SO
Gatewell	62	225	25	136	56	65	310	32	245	104	119	363	55		75
Gap Net	10	28			15	18	22			28	3	4			1
Closure Net	5	8	4		15	22	42	8		44	26	43	10		25
1st Level	5	11	3		15	9	19	2		35	12	24	8		18
2nd Level	9	24	12		36	23	32	8		110	26	50	18		41
3rd Level	3	10	1		22	10	12	5		49	11	22	6		20
4th Level[b]	18	18				6	9	3		9		12			12
5th Level[b]					3						3	3			
Totals	112	324	45	136	162	153	446	58	245	379	200	521	97		192
			56	100	35			55	100	27			57		39

Location	28 May (16) SC	YC	ST	CO	SO	29 May (16) SC	YC	ST	CO	SO	30 May (16) SC	YC	ST	CO	SO
Gatewell	110	287	52	172	49	85	276	27	151	81	63	271	29	202	107
Gap Net	8	3			2						3	2			4
Closure Net	9	32	8		18	28	36	4		51	17	21	4		41
1st Level	9	25	7		12	12	13	4		19	12	11			29
2nd Level	19	44	15		24	15	36	10		55	18	29	12		60
3rd Level	7	30	9		8	6	16	6		25	6	10	1		35
4th Level[b]		12			12	3	12	6		15	6				15
5th Level[b]	9														
Totals	171	433	91	172	125	149	389	57	151	246	125	344	46	202	291
			57	100	39			47	100	33			63	100	37

Location	5 June (17) SC	YC	ST	CO	SO	4 June (17) SC	YC	ST	CO	SO	3 June (18) SC	YC	ST	CO	SO
Gatewell	26	20	25		94	22	42	27	30	72	23	87	30	70	61
Gap Net	7	2	3		25	4	1	2		26					
Closure Net	12	1	11		124	9	4	15		84	7	9	11		49
1st Level	5	4	6		74	5	4	3		55	3	1			29
2nd Level	11	4	14		179	6	12	18		107	3	13	13		74
3rd Level	4	1	5		119	6	3	14		101	4	10	6		80
4th Level[b]			3		24	3	3	6		54		3			51
5th Level[b]															3
Totals	75	32	67		639	55	69	85	30	499	40	123	60	70	347
			37		15			32	100	14			50	100	18

Appendix Table 1.--Continued.

Location	4 June (18) SC	YC	ST	CO	SO	5 June (18) SC	YC	ST	CO	SO	14 July (19) SC	YC	ST	CO	SO
Gatewell	35	52	25	41	80	46	33	17	27	128	52		1		
Gap Net										2	7				
Closure Net	7	4	4		41	13	9	11		93	36				
1st Level	2	1	3		23	10	3	5		66	14				
2nd Level	5	7	11		89	13	4	11		144	46				
3rd Level	7	6	9		66	7		4		118	25				
4th Level[b]	3		3		42			6		54	15				
5th Level[b]		3			3					3	6				
Totals	59	73	55	41	344	89	49	54	27	608	201		1		
			45	100	23			51	100	21			100		

	15 July (19) SC	YC	ST	CO	SO	16 July (19) SC	YC	ST	CO	SO	17 July (19) SC	YC	ST	CO	SO
Gatewell	50					66					62				
Gap Net	6					4					3				
Closure Net	58					66					73				
1st Level	23					20					37				
2nd Level	69					61					87				
3rd Level	50					46					70				
4th Level[b]	15					15					33				
5th Level[b]	3					3									
Totals	274					281					365				

	18 July (19) SC	YC	ST	CO	SO	20 July (20) SC	YC	ST	CO	SO	22 July (20) SC	YC	ST	CO	SO
Gatewell	66					143					85				
Gap Net	2					17					5				
Closure Net	87					70					57				
1st Level	32					43					26				
2nd Level	98					192					109				
3rd Level	93					174					92				
4th Level[b]	33					51					48				
5th Level[b]	6					9									
Totals	417					699					422				

Appendix Table 1.--Continued.

Date and (test number)[a]

Location	24 July (20) SC	YC	ST	CO	SO	25 July (20) SC	YC	ST	CO	SO	28 July (20) SC	YC	ST	CO	SO
Gatewell	329					97					109				
Gap Net	37					13					17				
Closure Net	171					45					50				
1st Level	80					25					33				
2nd Level	342					101					134				
3rd Level	207					76					87				
4th Level[b]	69					24					48				
5th Level[b]	33					9					6				
Totals	1367					390					484				

	21 July (21) SC	YC	ST	CO	SO	23 July (21) SC	YC	ST	CO	SO	26 July (21) SC	YC	ST	CO	SO
Gatewell	118					133					63				
Gap Net	10					17					5				
Closure Net	83					89					63				
1st Level	44					38					22				
2nd Level	201					175					122				
3rd Level	168					128					108				
4th Level[b]	93					33					39				
5th Level[b]	24					15									
Totals	741					628					422				

	27 July (21) SC	YC	ST	CO	SO	29 July (21) SC	YC	ST	CO	SO	30 July (22) SC	YC	ST	CO	SO
Gatewell	104					58					113				
Gap Net	13					7					12				
Closure Net	69					34					50				
1st Level	28					16					33				
2nd Level	129					98					136				
3rd Level	88					73					91				
4th Level[b]	69					30					48				
5th Level[b]	9					6					3				
Totals	509					322					486				

Appendix Table 1.--Continued.

	Date and (test number)[a]														
	31 July (22)					1 August (22)					14 July (23)				
Location	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	55					76					58				
Gap Net	8					7					2				
Closure Net	22					33					42				
1st Level	23					10					13				
2nd Level	68					69					61				
3rd Level	58					44					52				
4th Level[b]	33					27					36				
5th Level[b]	3										6				
Totals	270					266					270				

	15 July (23)					16 July (23)					17 July (23)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	71					91	1				72				
Gap Net	2					3					1				
Closure Net	52					54					42				
1st Level	22					18					25				
2nd Level	74					79					137				
3rd Level	72					65					112				
4th Level[b]	36					48					69				
5th Level[b]	6					6					9				
Totals	335					364	1				467				

	18 July (23)					20 July (23)					21 July (23)				
	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	103					154					161				
Gap Net	3					8					6				
Closure Net	67					99					93				
1st Level	27					60					57				
2nd Level	90					195					200				
3rd Level	101					148					178				
4th Level[b]	54					147					81				
5th Level[b]	36					18					24				
Totals	481					829					800				

Appendix Table 1.--Continued.

Location	22 July (23) SC	YC	ST	CO	SO	23 July (23) SC	YC	ST	CO	SO	24 July (23) SC	YC	ST	CO	SO
Gatewell	105					202					397				
Gap Net	2					1					10				
Closure Net	68					81					179				
1st Level	31					48					95				
2nd Level	134					157					330				
3rd Level	104					128					267				
4th Level[b]	57					54					165				
5th Level[b]	9					15					27				
Totals	510					686					1470				

	25 July (23) SC	YC	ST	CO	SO	26 July (23) SC	YC	ST	CO	SO	27 July (23) SC	YC	ST	CO	SO
Gatewell	107					105					94				
Gap Net	4					4					2				
Closure Net	56					72					78				
1st Level	41					27					31				
2nd Level	111					125					99				
3rd Level	104					99					87				
4th Level[b]	66					45					72				
5th Level[b]	15					15					12				
Totals	504					492					475				

	28 July (23) SC	YC	ST	CO	SO	29 July (23) SC	YC	ST	CO	SO	30 July (23) SC	YC	ST	CO	SO
Gatewell	98					71					124				
Gap Net	4					4					4				
Closure Net	63					39					57				
1st Level	32					18					36				
2nd Level	118					88					148				
3rd Level	111					73					113				
4th Level[b]	99					42					63				
5th Level[b]	18					9					9				
Totals	543					344					554				

Appendix Table 1.--Continued.

	Date and (test number)[a]														
	31 July (23)					1 August (23)									
Location	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO	SC	YC	ST	CO	SO
Gatewell	75					104									
Gap Net	2					1									
Closure Net	34					39									
1st Level	22					18									
2nd Level	68					73									
3rd Level	61					67									
4th Level[b]	45					39									
5th Level[b]	9					6									
Totals	316					347									

[a] Test numbers correspond to those in Table 1, this report.

[b] Only the middle net was fished at these levels.

Appendix Table 2.--Collection data of yearling and subyearling chinook salmon for the individual replicates of vertical distribution tests at Bonneville Dam Second Powerhouse, 1986.

YEARLING CHINOOK SALMON

Test Date	21 April	23 April	24 April	25 April	26 April	27 April	28 April	29 April	6 May	7 May
Gatewell	268	243	73	114	39	87	78	57	109	104
1st Level	410	268	72	129	55	94	84	57	110	113
2nd Level	257	144	55	50	33	58	62	40	65	75
3rd Level	222	125	62	34	34	44	45	34	33	49
4th Level	156	129	60	39	15	60	63	18	33	21
5th Level	210	150	84	36	36	30	54	39	18	36
6th Level	186	126	54	15	33	30	36	24	21	18
7th Level	33	27	9	12	6	6	9	6	3	--
Totals	1742	1212	469	429	251	409	431	275	392	416

Test Date	8 May	9 May	10 May	19 May	20 May	21 May	23 May	24 May	25 May	26 May	27 May
Gatewell	128	161	137	234	96	109	77	140	45	556	61
1st Level	144	199	151	282	162	237	123	193	65	714	186
2nd Level	70	122	109	118	121	140	81	135	79	446	84
3rd Level	52	82	63	95	88	69	61	91	56	320	51
4th Level	39	66	33	39	54	72	15	48	63	174	18
5th Level	30	66	24	45	45	54	15	78	36	153	--
6th Level	18	33	15	39	33	12	6	39	27	75	--
7th Level	3	3	6	21	12	12	--	24	15	24	3
Totals	484	732	538	873	611	705	378	748	386	2462	403

Appendix Table 2.--Continued.

YEARLING CHINOOK SALMON

Test Date	28 May	29 May	30 May	2 June	3 June	4 June	5 June
Gatewell	183	87	78	73	23	15	11
1st Level	192	60	48	21	21	6	9
2nd Level	84	51	36	12	9	3	9
3rd Level	51	18	12	6	3	12	9
4th Level	21	12	3	9	9	3	9
5th Level	--	3	3	15	3	6	6
6th Level	9	--	--	3	--	6	6
7th Level	--	--	3	3	3	--	3
Totals	540	231	183	142	71	51	62

SUBYEARLING CHINOOK SALMON

Test Date	14 July	15 July	16 July	17 July	18 July	20 July	21 July	22 July	23 July
Gatewell	36	42	40	35	56	61	111	55	90
1st Level	45	63	55	58	71	107	115	80	132
2nd Level	54	86	63	75	100	138	139	81	141
3rd Level	52	86	70	90	97	168	168	105	124
4th Level	48	72	60	75	102	153	120	102	156
5th Level	27	54	63	78	93	192	201	102	117
6th Level	21	45	39	42	96	147	120	75	105
7th Level	18	15	9	18	24	51	63	21	33
Totals	301	463	399	471	639	1017	1037	621	898

Appendix Table 3.—Weekly and cumulative totals of fish captured by the random sampler in the Second Powerhouse DSM at Bonneville Dam, 1986.

	Weekly Totals								Cumulative Totals						
	"1" chin.	"0" chin.	Sthd.	Coho	Sock.	Total	1986 date	Hours fished	"1" chin.	"0" chin.	Sthd	Coho	Sock	Total	Hours fished
No. captured	2	1,087	—	10	—	1,099	Mar		2	1,087	—	10	—	1,099	
No. examined	2	200	—	10	—	212	3		2	200	—	10	—	212	
No. descaled	0	0	—	0	—	0		94	0	0	—	0	—	0	94
No. morts.	0	6	—	0	—	6	Mar		0	6	—	0	—	6	
% descaled	0.0	0.0	—	0.0	—	0.0	7		0.0	0.0	—	0.0	—	0.0	
% mortality	0.0	0.6	—	0.0	—	0.5			0.0	0.6	—	0.0	—	0.5	
No. captured	102	571	2	250	—	925	Mar		104	1,658	2	260	—	2,024	
No. examined	102	313	2	250	—	667	10		104	513	2	260	—	879	
No. descaled	1	1	0	0	—	2		96	1	1	0	0	—	2	190
No. morts.	0	15	0	0	—	15	Mar		0	21	0	0	—	21	
% descaled	1.0	0.3	0.0	0.0	—	0.3	14		1.0	0.2	0.0	0.0	—	0.2	
% mortality	0.0	2.6	0.0	0.0	—	1.6			0.0	1.3	0.0	0.0	—	1.0	
No. captured	310	128	4	87	1	530	Mar		414	1,786	6	347	1	2,554	
No. examined	307	128	4	87	1	527	17		411	641	6	347	1	1,406	
No. descaled	4	0	0	1	0	5		96	5	1	0	1	0	7	286
No. morts.	3	0	0	0	0	3	Mar		3	21	0	0	0	24	
% descaled	1.3	0.0	0.0	1.1	0.0	0.9	21		1.2	0.2	0.0	0.3	0.0	0.5	
% mortality	1.0	0.0	0.0	0.0	0.0	0.6			0.7	1.2	0.0	0.0	0.0	0.9	
No. captured	154	52	4	61	3	274	Mar		568	1,838	10	408	4	2,828	
No. examined	152	52	4	61	3	272	24		563	693	10	408	4	1,678	
No. descaled	1	0	0	0	0	1		96	6	1	0	1	0	8	382
No. morts.	2	0	0	0	0	2	Mar		5	21	0	0	0	26	
% descaled	0.7	0.0	0.0	0.0	0.0	0.4	28		1.1	0.1	0.0	0.2	0.0	0.5	
% mortality	1.3	0.0	0.0	0.0	0.0	0.7			0.9	1.1	0.0	0.0	0.0	0.9	
No. captured	160	108	28	209	3	508	Mar		728	1,946	38	617	7	3,336	
No. examined	159	108	28	209	3	507	31		722	801	38	617	7	2,185	
No. descaled	2	0	0	1	0	3		94	8	1	0	2	0	11	476
No. morts.	1	0	0	0	0	1	Apr		6	21	0	0	0	27	
% descaled	1.3	0.0	0.0	0.5	0.0	0.6	4		1.1	0.1	0.0	0.3	0.0	0.5	
% mortality	0.6	0.0	0.0	0.0	0.0	0.2			0.8	1.1	0.0	0.0	0.0	0.8	

Appendix Table 3.—cont.

	Weekly Totals								Cumulative Totals						
	"1" chin.	"0" chin.	Sthd.	Coho	Sock.	Total	1986 date	Hours fished	"1" chin.	"0" chin.	Sthd	Coho	Sock	Total	Hours fished
No. captured	58	3,205	26	48	—	3,337	Apr		786	5,152	64	665	7	6,673	
No. examined	57	386	24	47	—	514	7		779	1,187	62	664	7	2,699	
No. descaled	4	1	0	1	—	6		69	12	2	0	3	0	17	545
No. morts.	1	151	2	1	—	155	Apr		7	172	2	1	0	182	
% descaled	7.0	0.3	0.0	2.1	—	1.2	11		1.5	0.2	0.0	0.5	0.0	0.6	
% mortality	1.7	4.7	7.7	2.1	—	4.6			0.9	3.3	3.1	0.2	0.0	2.7	
No. captured	1,135	281	61	78	—	1,555	Apr		1,921	5,432	125	743	7	8,228	
No. examined	478	279	60	78	—	895	14		1,257	1,466	122	742	7	3,594	
No. descaled	13	1	2	3	—	19		96	25	3	2	6	0	36	641
No. morts.	5	2	1	0	—	8	Apr		12	174	3	1	0	190	
% descaled	2.7	0.4	3.3	3.8	—	2.1	18		2.0	0.2	1.6	0.8	0.0	1.0	
% mortality	0.4	0.7	1.6	0.0	—	0.5			0.6	3.2	2.4	0.1	0.0	2.3	
No. captured	2,478	1,386	62	91	1	4,018	Apr		4,399	6,818	187	834	8	12,246	
No. examined	400	400	58	91	1	950	21		1,657	1,866	180	833	8	4,544	
No. descaled	8	5	1	2	0	16		96	33	8	3	8	0	52	737
No. morts.	32	44	4	0	0	80	Apr		44	218	7	1	0	270	
% descaled	2.0	1.3	1.7	2.2	0.0	1.7	25		2.0	0.4	1.7	1.0	0.0	1.1	
% mortality	1.3	3.2	6.5	0.0	0.0	2.0			1.0	3.2	3.7	0.1	0.0	2.2	
No. captured	1,533	256	151	173	35	2,148	Apr		5,932	7,074	338	1,007	43	14,394	
No. examined	300	250	150	173	32	905	28		1,957	2,116	330	1,006	40	5,449	
No. descaled	12	6	8	3	7	36		73	45	14	11	11	7	88	810
No. morts.	20	6	1	0	3	30	May		64	224	8	1	3	300	
% descaled	4.0	2.4	5.3	1.7	21.9	4.0	2		2.3	0.7	3.3	1.1	17.5	1.6	
% mortality	1.3	2.3	0.7	0.0	8.6	1.4			1.1	3.2	2.4	0.1	7.0	2.1	
No. captured	1,205	1,171	133	176	145	2,830	May		7,137	8,245	471	1,183	188	17,224	
No. examined	633	493	133	172	139	1,570	5		2,590	2,609	463	1,178	179	7,019	
No. descaled	51	6	15	7	24	103		96	96	20	26	18	31	191	906
No. morts.	20	18	0	3	6	47	May		84	242	8	4	9	347	
% descaled	8.1	1.2	11.3	4.1	17.3	6.6	9		3.7	0.8	5.6	1.5	17.3	2.7	
% mortality	1.7	1.5	0.0	1.7	4.1	1.7			1.2	2.9	1.7	0.3	4.8	2.0	

Appendix Table 3.—cont.

	Weekly Totals								Cumulative Totals						
	"1" chin.	"0" chin.	Sthd.	Coho	Sock.	Total	1986 date	Hours fished	"1" chin.	"0" chin.	Sthd	Coho	Sock	Total	Hours fished
No. captured	1,088	789	170	216	239	2,502	May		8,225	9,034	641	1,399	427	19,726	
No. examined	400	270	169	216	226	1,281	12		2,990	2,879	632	1,394	405	8,300	
No. descaled	40	1	16	7	42	106		96	136	21	42	25	73	297	1,002
No. morts.	8	3	1	2	13	27	May		92	245	9	6	22	374	
% descaled	10.0	0.4	9.5	3.2	18.6	8.3	16		4.5	0.7	6.6	1.8	18.0	3.6	
% mortality	0.7	0.4	0.6	0.9	5.4	1.1			1.1	2.7	1.4	0.4	5.2	1.9	
No. captured	1,562	2,420	353	1,120	511	5,966	May		9,787	11,454	994	2,519	938	25,692	
No. examined	500	500	345	373	357	2,075	19		3,490	3,379	977	1,767	762	10,375	
No. descaled	45	6	27	9	94	181		96	181	27	69	34	167	478	1,098
No. morts.	33	67	8	5	125	238	May		125	312	17	11	147	612	
% descaled	9.0	1.2	7.8	2.4	26.3	8.7	23		5.2	0.8	7.1	1.9	21.9	4.6	
% mortality	2.1	2.8	2.3	0.4	24.5	4.0			1.3	2.7	1.7	0.4	15.7	2.4	
No. captured	874	685	266	1,286	533	3,644	May		10,661	12,139	1,260	3,805	1,471	29,336	
No. examined	200	200	200	200	200	1,000	28		3,690	3,579	1,177	1,967	962	11,375	
No. descaled	12	4	14	3	45	78		48	193	31	83	37	212	556	1,146
No. morts.	12	16	7	22	93	150	May		137	328	24	33	240	762	
% descaled	6.0	2.0	7.0	1.5	22.5	7.8	30		5.2	0.9	7.1	1.9	22.0	4.9	
% mortality	1.4	2.3	2.6	1.7	17.4	4.1			1.3	2.7	1.9	0.9	16.3	2.6	
No. captured	285	423	203	1,045	980	2,936	Jun		10,946	12,562	1,463	4,850	2,451	32,272	
No. examined	258	356	197	400	400	1,611	2		3,948	3,935	1,374	2,367	1,362	12,986	
No. descaled	52	16	18	8	186	280		96	245	47	101	45	398	836	1,242
No. morts.	6	21	6	5	321	359	Jun		143	349	30	38	561	1,121	
% descaled	20.2	4.5	9.1	2.0	46.5	17.4	6		6.2	1.2	7.4	1.9	29.2	6.4	
% mortality	2.1	5.0	3.0	0.5	32.8	12.2			1.3	2.8	2.1	0.8	22.9	3.5	
No. captured	46	520	28	271	138	1,003	Jun		10,992	13,082	1,491	5,121	2,589	33,275	
No. examined	45	400	28	271	113	857	9		3,993	4,335	1,402	2,638	1,475	13,843	
No. descaled	7	12	0	8	62	89		96	252	59	101	53	460	925	1,338
No. morts.	1	7	0	0	25	33	Jun		144	356	30	38	586	1,154	
% descaled	15.6	3.0	0.0	3.0	54.9	10.4	13		6.3	1.4	7.2	2.0	31.2	6.7	
% mortality	2.2	1.3	0.0	0.0	18.1	3.3			1.3	2.7	2.0	0.7	22.6	3.5	

Appendix Table 3.—cont.

	Weekly Totals								Cumulative Totals						
	"1" chin.	"0" chin.	Sthd.	Coho	Sock.	Total	1986 date	Hours fished	"1" chin.	"0" chin.	Sthd	Coho	Sock	Total	Hours fished
No. captured	1	281	---	35	2	319	Jun		10,993	13,363	1,491	5,156	2,591	33,594	
No. examined	1	253	---	35	1	290	16		3,994	4,588	1,402	2,673	1,476	14,133	
No. descaled	0	0	–	0	0	0		96	252	59	101	53	460	925	1,434
No. morts.	0	2	---	0	1	3	Jun		144	358	30	38	587	1,157	
% descaled	0.0	0.0	---	0.0	0.0	0.0	20		6.3	1.3	7.2	2.0	31.2	6.5	
% mortality	0.0	0.7	---	0.0	50.0	0.9			1.3	2.7	2.0	0.7	22.7	3.4	
No. captured	---	690	---	6	---	696	Jun		10,993	14,053	1,491	5,162	2,591	34,290	
No. examined	---	391	---	6	---	397	23		3,994	4,979	1,402	2,679	1,476	14,530	
No. descaled	---	8	---	1	---	9		96	252	67	101	54	460	934	1,530
No. morts.	---	9	---	0	---	9	Jun		144	367	30	38	587	1,166	
% descaled	---	2.0	---	16.7	---	2.3	27		6.3	1.3	7.2	2.0	31.2	6.4	
% mortality	---	1.3	---	0.0	---	1.3			1.3	2.6	2.0	0.7	22.7	3.4	
No. captured	---	101	---	---	---	101	Jun		10,993	14,154	1,491	5,162	2,591	34,391	
No. examined	---	100	---	---	---	100	30		3,994	5,079	1,402	2,679	1,476	14,630	
No. descaled	---	2	---	---	---	2		70	252	69	101	54	460	936	1,600
No. morts.	---	1	---	---	---	1	Jul		144	368	30	38	587	1,167	
% descaled	---	2.0	---	---	---	2.0	3		6.3	1.4	7.2	2.0	31.2	6.4	
% mortality	---	1.0	---	---	---	1.0			1.3	2.6	2.0	0.7	22.7	3.4	
No. captured	---	64	---	---	---	64	Jul		10,993	14,218	1,491	5,162	2,591	34.455	
No. examined	---	64	---	---	---	64	7		3,994	5,143	1,402	2,679	1,476	14,694	
No. descaled	---	0	---	---	---	0		96	252	69	101	54	460	936	1,696
No. morts.	---	0	---	---	---	0	Jul		144	368	30	38	587	1,167	
% descaled	---	0.0	---	---	---	0.0	11		6.3	1.3	7.2	2.0	31.2	6.4	
% mortality	---	0.0	---	---	---	0.0			1.3	2.6	2.0	0.7	22.7	3.4	
No. captured	1	546	---	1	1	549	Jul		10,994	14,764	1,491	5,163	2,592	35,004	
No. examined	1	358	---	1	1	361	14		3,995	5,501	1,402	2,680	1,477	15,055	
No. descaled	0	9	---	0	0	9		96	252	78	101	54	460	945	1,792
No. morts.	0	10	---	0	0	10	Jul		144	378	30	38	587	1,177	
% descaled	0.0	2.5	---	0.0	0.0	2.5	18		6.3	1.4	7.2	2.0	31.1	6.3	
% mortality	0.0	1.8	---	0.0	0.0	1.8			1.3	2.6	2.0	0.7	22.6	3.4	

Appendix Table 3.--cont.

	Weekly Totals								Cumulative Totals						
	"1" chin.	"0" chin.	Sthd.	Coho	Sock.	Total	1986 date	Hours fished	"1" chin.	"0" chin.	Sthd	Coho	Sock	Total	Hours fished
No. captured	---	846	2	16	3	867	Jul		10,994	15,610	1,493	5,179	2,595	35,871	
No. examined	---	400	2	16	3	421	21		3,995	5,901	1,404	2,696	1,480	15,476	
No. descaled	---	14	0	0	0	14		96	252	92	101	54	460	959	1,888
No. morts.	---	23	1	0	1	25	Jul		144	401	31	38	588	1,202	
% descaled	---	3.5	0.0	0.0	0.0	3.3	25		6.3	1.6	7.2	2.0	31.1	6.2	
% mortality	---	2.7	50.0	0.0	33.3	2.9			1.3	2.6	2.1	0.7	22.7	3.4	
No. captured	1	442	---	18	4	465	Jul		10,995	16,052	1,493	5,197	2,599	36,336	
No. examined	1	395	---	18	3	417	28		3,996	6,296	1,404	2,714	1,483	15,893	
No. descaled	0	11	---	0	0	11		96	252	103	101	54	460	970	1,984
No. morts.	0	10	---	0	1	11	Aug		144	411	31	38	589	1,213	
% descaled	0.0	2.8	---	0.0	0.0	2.6	1		6.3	1.6	7.2	2.0	31.0	6.1	
% mortality	0.0	2.3	---	0.0	25.0	2.4			1.3	2.6	2.1	0.7	22.7	3.3	
No. captured	---	64	---	1	---	65	Aug		10,995	16,116	1,493	5,198	2,599	36,401	
No. examined	---	61	---	1	---	62	4		3,996	6,357	1,404	2,715	1,483	15,955	
No. descaled	---	2	---	0	---	2		96	252	105	101	54	460	972	2,080
No. morts.	---	3	---	0	---	3	Aug		144	414	31	38	589	1,216	
% descaled	---	3.3	---	0.0	---	3.2	8		6.3	1.7	7.2	2.0	31.0	6.1	
% mortality	---	4.7	---	0.0	---	4.6			1.3	2.6	2.1	0.7	22.7	3.3	
No. captured	---	39	---	---	---	39	Aug		10,995	16,155	1,493	5,198	2,599	36,440	
No. examined	---	38	---	---	---	38	11		3,996	6,395	1,404	2,715	1,483	15,993	
No. descaled	---	2	---	---	---	2		96	252	107	101	54	460	974	2,176
No. morts.	---	1	---	---	---	1	Aug		144	415	31	38	589	1,217	
% descaled	---	5.3	---	---	---	5.3	15		6.3	1.7	7.2	2.0	31.0	6.1	
% mortality	---	2.6	---	---	---	2.6			1.3	2.6	2.1	0.7	22.7	3.3	
No. captured	---	10	---	---	---	10	Aug		10,995	16,165	1,493	5,198	2,599	36,450	
No. examined	---	10	---	---	---	10	18		3,996	6,405	1,404	2,715	1,483	16,003	
No. descaled	---	0	---	---	---	0		96	252	107	101	54	460	974	2,272
No. morts.	---	0	---	---	---	0	Aug		144	415	31	38	589	1,217	
% descaled	---	0.0	---	---	---	0.0	22		6.3	1.7	7.2	2.0	31.0	6.1	
% mortality	---	0.0	---	---	---	0.0			1.3	2.6	2.1	0.7	22.7	3.3	

Appendix Table 3.—cont.

	Weekly Totals								Cumulative Totals						
	"1" chin.	"0" chin.	Sthd.	Coho	Sock.	Total	1986 date	Hours fished	"1" chin.	"0" chin.	Sthd	Coho	Sock	Total	Hours fished
No. captured	—	159	—	1	—	160	Aug		10,995	16,324	1,493	5,199	2,599	36,610	
No. examined	—	157	—	1	—	158	25		3,996	6,562	1,404	2,716	1,483	16,161	
No. descaled	—	0	—	0	—	0		96	252	107	101	54	460	974	2,368
No. morts.	—	2	—	0	—	2	Aug		144	417	31	38	589	1,219	
% descaled	—	0.0	—	0.0	—	0.0	29		6.3	1.6	7.2	2.0	31.0	6.0	
% mortality	—	1.3	—	0.0	—	1.3			1.3	2.6	2.1	0.7	22.7	3.3	
No. captured	—	109	—	2	—	111	Sep		10,995	16,433	1,493	5,201	2,599	36,721	
No. examined	—	109	—	2	—	111	2		3,996	6,671	1,404	2,718	1,483	16,272	
No. descaled	—	4	—	0	—	4		72	252	111	101	54	460	978	2,440
No. morts.	—	0	—	0	—	0	Sep		144	417	31	38	589	1,219	
% descaled	—	3.7	—	0.0	—	3.6	5		6.3	1.7	7.2	2.0	31.0	6.0	
% mortality	—	0.0	—	0.0	—	0.0			1.3	2.5	2.1	0.7	22.7	3.3	
No. captured	—	115	—	2	—	117	Sep		10,995	16,548	1,493	5,203	2,599	36,838	
No. examined	—	114	—	2	—	116	8		3,996	6,785	1,404	2,720	1,483	16,388	
No. descaled	—	0	—	0	—	0		96	252	111	101	54	460	978	2,536
No. morts.	—	1	—	0	—	1	Sep		144	418	31	38	589	1,220	
% descaled	—	0.0	—	0.0	—	0.0	12		6.3	1.6	7.2	2.0	31.0	6.0	
% mortality	—	0.9	—	0.0	—	0.9			1.3	2.5	2.1	0.7	22.7	3.3	
No. captured	—	139	—	1	—	140	Sep		10,995	16,687	1,493	5,204	2,599	36,978	
No. examined	—	137	—	1	—	138	14		3,996	6,922	1,404	2,721	1,483	16,526	
No. descaled	—	3	—	0	—	3		120	252	114	101	54	460	981	2,656
No. morts.	—	2	—	0	—	2	Sep		144	420	31	38	589	1,222	
% descaled	—	2.2	—	0.0	—	2.2	19		6.3	1.6	7.2	2.0	31.0	5.9	
% mortality	—	1.4	—	0.0	—	1.4			1.3	2.5	2.1	0.7	22.7	3.3	
No. captured	—	63	—	—	—	63	Sep		10,995	16,750	1,493	5,204	2,599	37,041	
No. examined	—	63	—	—	—	63	22		3,996	6,985	1,404	2,721	1,483	16,589	
No. descaled	—	2	—	—	—	2		96	252	116	101	54	460	983	2,752
No. morts.	—	0	—	—	—	0	Sep		144	420	31	38	589	1,222	
% descaled	—	3.2	—	—	—	3.2	26		6.3	1.7	7.2	2.0	31.0	5.9	
% mortality	—	0.0	—	—	—	0.0			1.3	2.5	2.1	0.7	22.7	3.3	

Appendix Table 3.--cont.

	Weekly Totals								Cumulative Totals						
	"1" chin.	"0" chin.	Sthd.	Coho	Sock.	Total	1986 date	Hours fished	"1" chin.	"0" chin.	Sthd	Coho	Sock	Total	Hours fished
No. captured	---	13	---	---	---	13	Sep		10,995	16,763	1,493	5,204	2,599	37,054	
No. examined	---	13	---	---	---	13	29		3,996	6,998	1,404	2,721	1,483	16,602	
No. descaled	---	0	---	---	---	0		96	252	116	101	54	460	983	2,848
No. morts.	---	0	---	---	---	0	Oct		144	420	31	38	589	1,222	
% descaled	---	0.0	---	---	---	0.0	3		6.3	1.7	7.2	2.0	31.0	5.9	
% mortality	---	0.0	---	---	---	0.0			1.3	2.5	2.1	0.7	22.7	3.3	
No. captured	8	40	---	338	---	386	Oct		11,003	16,803	1,493	5,542	2,599	37,440	
No. examined	8	40	---	337	---	385	6		4,004	7,038	1,404	3,058	1,483	16,987	
No. descaled	0	1	---	0	---	1		96	252	117	101	54	460	984	2,944
No. morts.	0	0	---	1	---	1	Oct		144	420	31	39	589	1,223	
% descaled	0.0	2.5	---	0.0	---	0.3	10		6.3	1.7	7.2	1.8	31.0	5.8	
% mortality	0.0	0.0	---	0.3	---	0.3			1.3	2.5	2.1	0.7	22.7	3.3	
No. captured	---	2	---	40	---	42	Oct		11,003	16,805	1,493	5,582	2,599	37,482	
No. examined	---	2	---	40	---	42	14		4,004	7,040	1,404	3,098	1,483	17,029	
No. descaled	---	0	---	0	---	0		72	252	117	101	54	460	984	3,016
No. morts.	---	0	---	0	---	0	Oct		144	420	31	39	589	1,223	
% descaled	---	0.0	---	0.0	---	0.0	17		6.3	1.7	7.2	1.7	31.0	5.8	
% mortality	---	0.0	---	0.0	---	0.0			1.3	2.5	2.1	0.7	22.7	3.3	
No. captured	---	---	---	12	---	12	Oct		11,003	16,805	1,493	5,594	2,599	37,494	
No. examined	---	---	---	12	---	12	20		4,004	7,040	1,404	3,110	1,483	17,041	
No. descaled	---	---	---	0	---	0		96	252	117	101	54	460	984	3,112
No. morts.	---	---	---	0	---	0	Oct		144	420	31	39	589	1,223	
% descaled	---	---	---	0.0	---	0.0	24		6.3	1.7	7.2	1.7	31.0	5.8	
% mortality	---	---	---	0.0	---	0.0			1.3	2.5	2.1	0.7	22.7	3.3	
No. captured	4	28	---	247	---	279	Oct		11,007	16,833	1,493	5,841	2,599	37,773	
No. examined	3	28	---	231	---	262	27		4,007	7,068	1,404	3,341	1,483	17,303	
No. descaled	0	0	---	2	---	2		96	252	117	101	56	460	986	3,208
No. morts.	1	0	---	0	---	1	Oct		145	420	31	39	589	1,224	
% descaled	0.0	0.0	---	0.9	---	0.8	31		6.3	1.7	7.2	1.7	31.0	5.7	
% mortality	25.0	0.0	---	0.0	---	0.4			1.3	2.5	2.1	0.7	22.7	3.2	

Appendix Table 3.—cont.

	Weekly Totals								Cumulative Totals						
	"1" chin.	"0" chin.	Sthd.	Coho	Sock.	Total	1986 date	Hours fished	"1" chin.	"0" chin.	Sthd	Coho	Sock	Total	Hours fished
No. captured	4	30	1	44	—	79	Nov		10,999	16,793	1,494	5,240	2,599	37,133	
No. examined	4	30	1	44	—	79	3		4,000	7,028	1,405	2,765	1,483	16,681	
No. descaled	0	1	0	0	—	1		96	252	117	101	54	460	984	3,384
No. morts.	0	0	0	0	—	0	Nov		144	420	31	38	589	1,222	
% descaled	0.0	3.3	0.0	0.0	—	1.3	7		6.3	1.7	7.2	2.0	31.0	5.9	
% mortality	0.0	0.0	0.0	0.0	—	0.0			1.3	2.5	2.1	0.7	22.7	3.3	
No. captured	3	94	—	13	—	110	Nov		11,002	16,887	1,494	5,261	2,599	37,243	
No. examined	3	94	—	13	—	110	10		4,003	7,122	1,405	2,778	1,483	16,791	
No. descaled	0	1	—	0	—	1		96	252	118	101	54	460	985	3,400
No. morts.	0	0	—	0	—	0	Nov		144	420	31	38	589	1,222	
% descaled	0.0	1.1	—	0.0	—	0.9	14		6.3	1.7	7.2	1.9	31.0	5.9	
% mortality	0.0	0.0	—	0.0	—	0.0			1.3	2.5	2.1	0.7	22.7	3.3	
No. captured	3	128	1	194	—	326	Nov		11,005	17,015	1,495	5,455	2,599	37,569	
No. examined	3	128	1	194	—	326	17		4,006	7,250	1,406	2,972	1,483	17,117	
No. descaled	0	2	0	0	—	2		96	252	120	101	54	460	987	3,496
No. morts.	0	0	0	0	—	0	Nov		144	420	31	38	589	1,222	
% descaled	0.0	1.6	0.0	0.0	—	0.6	21		6.3	1.7	7.2	1.8	31.0	5.8	
% mortality	0.0	0.0	0.0	0.0	—	0.0			1.3	2.5	2.1	0.7	22.7	3.3	

Appendix Table 4.--Availability of the Bonneville Dam First Powerhouse juvenile sampling facility during 1986.

Dates	Comment
24 April	Contract and COE work on the bypass system is completed.
25 April - 6 May	NMFS installing new flumes and sample tank.
7 May	Facility is available for sampling.
8 May	Link in trash sweep drive chain breaks, facility is dewatered for repairs.
9 May	Repairs completed.
12 May	Facility is available for sampling.
13 May	Facility is dewatered for further work on the trash sweep drive chain.
19 May - 4 June	Facility is avialable for sampling.
4 June	Trash sweep gearbox fails at 2030 h. Facilitly is out of service pending receipt of a replacement gearbox.
4 August	Installation of the replacement gearbox is completed.
4 August - 18 August	Facility is available for sampling.
18 August	Trash sweep brush carrying chain breaks at 1145 h.
29 August - 30 November	Facility is available for sampling. End of season.

Appendix Table 5.--Modifications to sampling equipment at the Bonneville Dam First Powerhouse juvenile salmonid collection facility, 1984 -1986.

EQUIPMENT	MODIFICATION	PURPOSE
Sample flumes	Replaced original single flume with three flumes capable of sampling either 16.7 or 100% of flow.	Evaluate precision of the 16.7% sample flume.
	Mounted flumes on screen assembly. Added variable slope feature controlled by raising or lowering sample tank.	Improved ease of operation. Control amount of water dissipated through flumes without having to change emergency or add-in gate settings.
	Installed pneumatic cylinders to raise and lower flumes.	Ease of operation. Eliminate equipment damage. Safety.
Sample tank	Replaced original sample tank.	New features were more easily built into a new tank than added to the original.
	Replaced separate pendant controls for each hoist with a single pendant control operating both.	Ease of operation, safety.
	Fabricated removable inner sample basket.	Segregate catch for evaluation of the 16.7% sample flume.
	Increased overflow capacity.	Longer fishing time before debris plugs screens.
	Installed guides and fabricated blocking plates to cover overflow screens.	Provide for variable water depth in tank withoutreducing overflow capacity. Baffle flow on downstream side of tank.
	Added guides to downwell walls and matching wheel assemblies to the tank.	Positive placement of sample tank, stabilize tank, safety.
	Increased slope of tank bottom. Added slope plates in tank corners.	Improve dumping of fish.
	Added access hatch on side of tank opposite release gate.	Easier flusing of residual fish and debris.
	Installed wedge wire screen on upstream 16 inches of tank.	Supplement dewatering capacity of flumes.
	Hinged grader bars on top of tank.	Improve access to inside of tank.
	Added a rubber curtain inside tank, downstream end.	Secondary deflection of fish away from the interior tank wall.

Appendix Table 5.--cont.

EQUIPMENT	MODIFICATION	PURPOSE
Holding tank	Installed four removable screens.	Segregation of catch.
Recovery tanks	Fabricated aluminum standpipes.	Original standpipes were not screened, had no removable inner pipe for varying depth, and were very heavy.
	Added sloped false floor.	Improved dumping of fish.
Anesthetic tank	Added divider screens.	Segregate catch.
Process water	Extended pipe line towards downwell, installed hose reel.	Provide means to clean sample tank and flumes.
Facility	Added 8-foot fluorescent fixture over the anesthetic tank.	Improve lighting.
	Installed temporary air supply line.	Provide air supply for pneumatic cylinders.

Appendix Table 6.--Juvenile salmonid catch data for the First Powerhouse collection facility, 1986. Species indicated are: "1" chin. = yearling chinook, "0" chin. = subyearlings. Sthld. = Steelhead, Sock. = Sockeye.

	"1" chin.	"0" chin.	Sthd.	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	965	179	271	362	110	1,887	May	0800	1.33
No. examined	0	0	0	0	0		12	1600	
% descaled	-	-	-	-	-				
% mortality	0.1	0.0	0.0	0.0	0.0				
No. captured	334	974	156	166	172	1,802	May	0800	0.83
No. examined	100	100	106	100	84		19	1600	
% descaled	9.0	1.0	10.4	1.0	19.0				
% mortality	0.3	0.0	0.0	0.6	0.0				
No. captured	1,090	1,374	366	373	131	3,334	May	0800	2.25
No. examined	100	104	105	100	69		20	1600	
% descaled	12.0	2.9	6.7	3.0	33.3				
% mortality	0.1	0.0	0.0	0.3	0.0				
No. captured	1,362	2,234	502	1,267	401	5,766	May	0700	2.00
No. examined	100	100	100	100	100		21	1600	
% descaled	6.0	1.0	3.0	1.0	46.0				
% mortality	0.0	0.0	0.2	0.0	0.0				
No. captured	1,068	1,660	431	1,093	342	4,594	May	1600	0.80
No. examined	0	0	0	0	0		21	2400	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	0.0	0.0	0.0				
No. captured	693	935	246	756	134	2,764	May	2400	1.45
No. examined	0	0	0	0	0		22	0700	
% descaled	-	-	-	-	-				
% mortality	0.0	0.5	0.0	0.0	0.0				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	1,032	1,426	476	792	104	3,830	May	0700	1.42
No. examined	100	100	100	100	90		22	1600	
% descaled	9.0	0.0	5.0	5.0	41.0				
% mortality	0.0	0.4	0.2	0.0	0.0				
No. captured	441	384	322	304	200	1,651	May	0800	0.75
No. examined	0	0	0	0	0		23	1600	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	0.0	0.0	0.0				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	661	260	415	1,184	346	2,866	May	0800	1.00
No. examined	100	100	103	105	101		27	1600	
% descaled	12.0	3.0	4.9	1.9	52.5				
% mortality	0.0	1.2	0.0	0.0	0.6				
No. captured	683	331	311	1,765	345	3,435	May	0800	1.67
No. examined	104	100	100	101	100		28	1600	
% descaled	14.4	14.0	6.0	7.9	64.0				
% mortality	0.0	0.3	0.0	0.3	0.6				
No. captured	520	637	244	1,129	2,697	5,227	May	1700	0.83
No. examined	0	0	0	0	0		28	2400	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	0.0	0.0	0.0				
No. captured	680	391	291	1,078	440	2,880	May	0800	2.50
No. examined	104	103	100	103	100		29	1600	
% descaled	14.4	8.7	4.0	6.8	57.0				
% mortality	0.4	1.0	0.0	0.1	1.6				
No. captured	755	733	303	1,198	404	3,393	May	1700	2.00
No. examined	0	0	0	0	0		29	2400	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	0.0	0.0	0.0				
No. captured	881	373	388	1,110	395	3,147	May	0800	1.83
No. examined	100	100	100	100	100		30	1600	
% descaled	19.0	2.0	4.0	3.0	43.0				
% mortality	0.3	0.8	0.3	0.1	1.3				
No. captured	367	653	361	624	211	2,216	Jun	0800	2.08
No. examined	100	100	100	100	100		2	1600	
% descaled	18.0	13.0	14.0	4.0	69.0				
% mortality	0.5	0.2	0.3	0.2	0.0				
No. captured	115	469	163	667	110	3,552	Jun	0800	1.92
No. examined	90	100	100	100	81		3	1600	
% descaled	22.2	6.0	15.0	1.0	86.4				
% mortality	0.0	0.6	0.6	0.4	0.0				
No. captured	102	914	175	583	254	2,028	Jun	1700	2.67
No. examined	0	0	0	0	0		3	2400	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	0.0	0.0	0.0				
No. captured	107	303	86	306	68	870	Jun	0100	2.50
No. examined	0	0	0	0	0		4	0700	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	0.0	0.0	0.0				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	288	1,047	228	663	266	1,289	Jun	0800	2.75
No. examined	100	100	100	100	100		4	1700	
% descaled	19.0	7.0	12.0	3.0	63.0				
% mortality	1.4	1.4	0.8	0.7	6.3				
No. captured	39	176	14	50	54	333	Jun	1700	0.75
No. examined	0	0	0	0	0		4	2000	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	0.0	0.0	0.0				
No. captured	0	1,663	0	2	0	1,665	Aug	1000	2.00
No. examined	-	104	-	0	-		4	1600	
% descaled	-	3.8	-	-	-				
% mortality	-	0.0	-	0.0	-				
No. captured	0	2,085	0	0	0	2,085	Aug	0800	2.67
No. examined	-	118	-	-	-		5	1600	
% descaled	-	5.1	-	-	-				
% mortality	-	0.1	-	-	-				
No. captured	0	1,503	2	7	1	1,513	Aug	0800	2.67
No. examined	-	217	0	0	0		6	1600	
% descaled	-	0.9	-	-	-				
% mortality	-	0.3	0.0	0.0	0.0				
No. captured	1	481	0	5	2	489	Aug	0800	2.67
No. examined	0	139	-	0	0		7	1600	
% descaled	-	5.0	-	-	-				
% mortality	0.0	0.6	-	0.0	0.0				
No. captured	0	257	0	1	2	260	Aug	0930	2.17
No. examined	-	100	-	0	0		8	1600	
% descaled	-	2.0	-	-	-				
% mortality	-	0.4	-	0.0	0.0				
No. captured	2	925	0	1	1	929	Aug	0800	2.67
No. examined	0	125	-	0	0		11	1600	
% descaled	-	3.2	-	-	-				
% mortality	0.0	0.2	-	0.0	0.0				
No. captured	0	535	0	7	4	546	Aug	0900	2.33
No. examined	-	100	-	0	0		12	1600	
% descaled	-	6.0	-	-	-				
% mortality	-	0.2	-	0.0	0.0				
No. captured	0	1,759	0	6	10	1,775	Aug	1600	2.67
No. examined	-	0	-	0	0		12	2400	
% descaled	-	-	-	-	-				
% mortality	-	0.1	-	0.0	0.0				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	0	1,852	1	12	1	1,866	Aug	2400	2.67
No. examined	-	0	0	0	0		13	0800	
% descaled	-	-	-	-	-				
% mortality	-	0.0	0.0	0.0	0.0				
No. captured	0	1,386	0	9	5	1,400	Aug	0800	2.67
No. examined	-	100	-	9	5		13	1600	
% descaled	-	4.0	-	11.1	60.0				
% mortality	-	0.0	-	0.0	0.0				
No. captured	0	2,011	0	21	6	2,038	Aug	1600	2.67
No. examined	-	0	-	0	0		13	2400	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	0.0	0.0				
No. captured	0	2,978	0	8	0	2,986	Aug	2400	2.67
No. examined	-	0	-	0	-		14	0800	
% descaled	-	-	-	-	-				
% mortality	-	0.1	-	0.0	-				
No. captured	0	2,257	0	5	2	2,264	Aug	0800	2.67
No. examined	-	100	-	5	2		14	1600	
% descaled	-	4.0	-	0.0	50.0				
% mortality	-	0.6	-	0.0	0.0				
No. captured	0	291	0	0	1	292	Aug	0800	2.33
No. examined	-	100	-	-	1		15	1600	
% descaled	-	4.0	-	-	0.0				
% mortality	-	1.7	-	-	0.0				
No. captured	0	72	0	0	0	72	Aug	0800	1.00
No. examined	-	72	-	-	-		18	1100	
% descaled	-	1.4	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	106	0	0	0	106	Aug	1200	2.67
No. examined	-	91	-	-	-		29	2000	
% descaled	-	5.5	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	22	0	0	0	22	Sep	0800	2.67
No. examined	-	22	-	-	-		1	1600	
% descaled	-	13.6	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	196	0	0	0	196	Sep	0800	2.67
No. examined	-	100	-	-	-		2	1600	
% descaled	-	9.0	-	-	-				
% mortality	-	0.0	-	-	-				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	0	139	0	0	0	139	Sep	0800	2.67
No. examined	-	100	-	-	-		3	1600	
% descaled	-	1.0	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	239	0	0	2	241	Sep	1600	2.67
No. examined	-	0	-	-	0		3	2400	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	0	0.0				
No. captured	0	140	0	2	0	142	Sep	2400	2.67
No. examined	-	0	-	0	-		4	0800	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	0.0	-				
No. captured	0	132	0	1	0	133	Sep	0800	2.67
No. examined	-	100	-	1	-		4	1600	
% descaled	-	8.0	-	0.0	-				
% mortality	-	0.8	-	0.0	-				
No. captured	0	514	0	1	0	515	Sep	1600	2.67
No. examined	-	0	-	0	-		4	2400	
% descaled	-	-	-	-	-				
% mortality	-	3.7	-	0.0	-				
No. captured	0	269	0	0	0	269	Sep	2400	2.67
No. examined	-	0	-	-	-		5	0800	
% descaled	0	-	-	-	-				
% mortality	-	1.5	-	-	-				
No. captured	0	148	0	1	0	149	Sep	0800	2.67
No. examined	-	100	-	0	-		5	1600	
% descaled	-	6.0	-	-	-				
% mortality	-	0.0	-	0.0	-				
No. captured	0	62	0	0	0	62	Sep	0800	2.67
No. examined	-	61	-	-	-		8	1600	
% descaled	-	1.6	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	37	0	0	0	37	Sep	0800	2.67
No. examined	-	37	-	-	-		9	1600	
% descaled	-	0.0	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	18	0	0	0	18	Sep	0800	2.67
No. examined	-	0	-	-	-		10	1600	
% descaled	-	0.0	-	-	-				
% mortality	-	0.0	-	-	-				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	0	99	0	0	0	99	Sep	1600	2.67
No. examined	-	0	-	-	-		10	2400	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	125	0	1	0	126	Sep	2400	2.67
No. examined	-	0	-	0	-		11	0800	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	0.0	-				
No. captured	0	41	0	0	0	41	Sep	0800	2.67
No. examined	-	41	-	-	-		11	1600	
% descaled	-	12.2	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	199	0	0	0	199	Sep	1600	2.67
No. examined	-	0	-	-	-		11	2400	
% descaled	-	-	-	-	-				
% mortality	-	0.5	-	-	-				
No. captured	0	162	0	0	1	163	Sep	2400	2.67
No. examined	-	0	-	-	0		12	0800	
% descaled	-	-	-	-	-				
% mortality	-	0.6	-	-	0.0				
No. captured	0	45	0	0	0	45	Sep	0800	2.67
No. examined	-	45	-	-	-		12	1600	
% descaled	-	0.0	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	32	1	0	0	33	Sep	0800	2.33
No. examined	-	31	0	-	-		15	1600	
% descaled	-	9.4	-	-	-				
% mortality	-	3.1	0.0	-	-				
No. captured	0	14	0	0	0	14	Sep	0800	1.00
No. examined	-	14	-	-	-		16	1600	
% descaled	-	14.3	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	28	0	1	0	29	Sep	0800	2.67
No. examined	-	28	-	0	-		17	1600	
% descaled	-	3.6	-	-	-				
% mortality	-	0.0	-	0.0	-				
No. captured	0	50	0	1	0	51	Sep	1600	2.67
No. examined	-	0	-	0	-		17	2400	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	0.0	-				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	0	70	0	1	0	71	Sep	2400	2.67
No. examined	-	0	-	0	-		18	0800	
% descaled	-	-	-	-	-				
% mortality	-	1.4	-	0.0	-				
No. captured	0	28	0	0	0	28	Sep	0800	2.67
No. examined	-	28	-	0	-		18	1600	
% descaled	-	7.1	-	-	-				
% mortality	-	0.0	-	0.0					
No. captured	0	95	0	1	0	96	Sep	1600	2.67
No. examined	-	0	-	0	-		18	2400	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	0.0	-				
No. captured	0	55	0	0	0	55	Sep	2400	2.67
No. examined	-	0	-	-	-		19	0800	
% descaled	-	-	-	-	-				
% mortality	-	1.8	-	-	-				
No. captured	0	65	0	0	0	65	Sep	0800	2.67
No. examined	-	65	-	-	-		19	1600	
% descaled	-	0.0	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	17	0	0	0	17	Sep	0800	2.67
No. examined	-	17	-	-	-		22	1600	
% descaled	-	11.8	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	17	0	0	0	17	Sep	0800	2.67
No. examined	-	17	-	-	-		23	1600	
% descaled	-	17.6	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	40	0	0	0	40	Sep	0900	2.33
No. examined	-	40	-	-	-		24	1600	
% descaled	-	7.5	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	94	0	0	0	94	Sep	1600	2.67
No. examined	-	60	-	-	-		24	2400	
% descaled	-	6.7	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	79	0	0	0	79	Sep	2400	2.67
No. examined	-	0	-	-	-		25	0800	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	-	-				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	0	25	0	0	0	25	Sep	0800	2.67
No. examined	-	25	-	-	-		25	1600	
% descaled	-	28.0	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	105	0	0	1	106	Sep	1600	2.67
No. examined	-	0	-	-	0		25	2400	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	-	0.0				
No. captured	0	145	0	0	0	145	Sep	2400	2.67
No. examined	-	145	-	-	-		26	0800	
% descaled	-	3.4	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	43	0	0	0	43	Sep	0800	2.67
No. examined	-	43	-	-	-		26	1600	
% descaled	-	9.3	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	16	0	0	0	16	Sep	0800	2.67
No. examined	-	16	-	-	-		29	1600	
% descaled	-	6.3	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	22	0	0	0	22	Sep	0800	2.67
No. examined	-	22	-	-	-		30	1600	
% descaled	-	0.0	-	-	-				
% mortality	-	0.0	-	-	-				
No. captured	0	37	0	4	1	42	Oct	0800	2.67
No. examined	-	37	-	4	1		1	1600	
% descaled	-	10.8	-	25.0	0.0				
% mortality	-	0.0	-	0.0	0.0				
No. captured	0	62	0	21	0	83	Oct	1600	2.67
No. examined	-	61	-	0	-		1	2400	
% descaled	-	1.6	-	0.0	-				
% mortality	-	1.6	-	0.0	-				
No. captured	0	38	0	6	1	45	Oct	2400	2.67
No. examined	-	38	-	6	1		2	0800	
% descaled	-	0.0	-	0.0	0.0				
% mortality	-	0.0	-	0.0	0.0				
No. captured	0	31	0	27	0	58	Oct	0800	2.67
No. examined	-	31	-	27	-		2	1600	
% descaled	-	0.0	-	0.0	-				
% mortality	-	0.0	-	0.0					

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	0	76	0	39	2	117	Oct	1600	2.67
No. examined	-	0	-	0	0		2	2400	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	7.7	0.0				
No. captured	0	84	0	37	1	122	Oct	2400	2.67
No. examined	-	69	-	29	1		3	0800	
% descaled	-	0.0	-	0.0	0.0				
% mortality	-	0.0	-	0.0	0.0				
No. captured	0	52	0	38	0	90	Oct	0800	2.67
No. examined	-	52	-	38	-		3	1600	
% descaled	-	3.8	-	0.0	-				
% mortality	-	0.0	-	0.0	-				
No. captured	0	10	0	12	0	22	Oct	1900	0.33
No. examined	-	0	-	0	-		4	2000	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	0.0	-				
No. captured	0	10	0	22	0	32	Oct	1900	0.33
No. examined	-	0	-	0	-		5	2000	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	0.0	-				
No. captured	0	17	0	18	0	35	Oct	0800	2.67
No. examined	-	17	-	18	-		6	1600	
% descaled	-	0.0	-	0.0	-				
% mortality	-	0.0	-	0.0	-				
No. captured	0	30	0	36	0	66	Oct	0800	2.67
No. examined	-	29	-	36	-		7	1600	
% descaled	-	0.0	-	0.0	-				
% mortality	-	3.3	-	0.0	-				
No. captured	0	11	0	19	0	30	Oct	0800	2.67
No. examined	-	11	-	19	-		8	1600	
% descaled	-	9.1	-	0.0	-				
% mortality	-	0.0	-	0.0	-				
No. captured	10	19	0	98	0	127	Oct	1600	2.67
No. examined	10	19	-	98	-		8	2400	
% descaled	0.0	10.5	-	1.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	0	34	0	66	0	100	Oct	2400	2.67
No. examined	-	0	-	0	-		9	0800	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	0.0	-				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	0	10	0	17	0	27	Oct	0800	2.67
No. examined	-	10	-	16	-		9	1600	
% descaled	-	0.0	-	0.0	-				
% mortality	-	0.0	-	5.9	-				
No. captured	19	45	0	126	1	191	Oct	1600	2.67
No. examined	19	44	-	100	1		9	2400	
% descaled	0.0	4.5	-	0.0	100.0				
% mortality	0.0	2.2	-	0.0	0.0				
No. captured	0	73	0	126	0	199	Oct	2400	2.67
No. examined	-	0	-	0	-		10	0800	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	0.0	-				
No. captured	12	15	0	21	0	48	Oct	0800	2.67
No. examined	12	15	-	21	-		10	1600	
% descaled	0.0	13.3	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	18	23	0	15	0	56	Oct	0800	2.67
No. examined	18	23	-	15	-		14	1600	
% descaled	0.0	0.0	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	30	29	0	47	0	106	Oct	0800	2.67
No. examined	30	29	-	47	-		15	1600	
% descaled	0.0	0.0	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	8	47	0	155	1	211	Oct	1600	2.67
No. examined	0	0	-	0	0		15	2400	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	-	0.0	0.0				
No. captured	22	87	0	216	1	326	Oct	2400	2.67
No. examined	0	0	-	0	0		16	0800	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	-	0.0	0.0				
No. captured	13	40	0	28	1	82	Oct	0800	2.67
No. examined	13	39	-	28	1		16	1600	
% descaled	0.0	2.6	-	0.0	0.0				
% mortality	0.0	2.5	-	0.0	0.0				
No. captured	18	95	3	315	0	431	Oct	1600	2.67
No. examined	0	0	0	0	-		16	2400	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	0.0	0.0	-				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	25	105	1	260	0	391	Oct	2400	2.67
No. examined	0	0	0	0	-		17	0800	
% descaled	-	-	-	-	-				
% mortality	0.0	1.0	100.0	0.0	-				
No. captured	10	56	1	40	0	107	Oct	0800	2.67
No. examined	10	56	1	40	-		17	1600	
% descaled	0.0	7.1	0.0	0.0	-				
% mortality	0.0	0.0	0.0	0.0	-				
No. captured	9	24	0	21	0	54	Oct	0800	2.67
No. examined	9	24	-	20	-		20	1600	
% descaled	0.0	4.2	-	0.0	-				
% mortality	0.0	0.0	-	4.8	-				
No. captured	17	27	0	15	0	59	Oct	0800	2.67
No. examined	17	27	-	15	-		21	1600	
% descaled	11.8	0.0	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	6	26	1	4	0	37	Oct	0800	2.67
No. examined	6	26	1	4	-		22	1600	
% descaled	0.0	0.0	0.0	0.0	-				
% mortality	0.0	0.0	0.0	0.0	-				
No. captured	5	23	0	21	1	50	Oct	1600	2.67
No. examined	0	0	-	0	0		22	2400	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	-	0.0	0.0				
No. captured	31	25	0	24	0	80	Oct	2400	2.67
No. examined	0	0	-	0	-		23	0800	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	11	21	0	11	0	43	Oct	0800	2.67
No. examined	11	21	-	11	-		23	1600	
% descaled	0.0	0.0	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	9	43	0	18	0	70	Oct	1600	2.67
No. examined	0	0	-	0	-		23	2400	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	23	39	0	22	0	82	Oct	2400	2.67
No. examined	0	0	-	0	-		24	0800	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	-	0.0	-				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	14	19	0	10	0	43	Oct	0800	2.67
No. examined	14	19	-	10	-		24	1600	
% descaled	0.0	0.0	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	13	21	0	24	0	58	Oct	0800	2.67
No. examined	13	21	-	24	-		27	1600	
% descaled	0.0	9.5	-	4.2	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	10	32	0	94	0	136	Oct	0800	2.67
No. examined	10	32	-	94	-		28	1600	
% descaled	0.0	6.3	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	5	30	0	50	0	85	Oct	0800	2.33
No. examined	5	30	-	49	-		29	1600	
% descaled	0.0	0.0	-	0.0	-				
% mortality	0.0	0.0	-	2.0	-				
No. captured	10	76	1	177	0	264	Oct	1600	2.67
No. examined	10	76	0	100	-		29	2400	
% descaled	0.0	1.3	-	2.0	-				
% mortality	0.0	0.0	0.0	0.0	-				
No. captured	18	39	0	72	0	129	Oct	2400	2.67
No. examined	0	0	-	0	-		30	0800	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	5	35	0	48	0	88	Oct	0800	2.67
No. examined	5	35	-	48	-		30	1600	
% descaled	0.0	2.9	-	4.2	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	7	143	3	284	0	437	Oct	1600	2.67
No. examined	0	0	0	0	-		30	2400	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	0.0	0.0	-				
No. captured	10	63	2	162	2	239	Oct	2400	2.67
No. examined	0	0	0	0	0		31	0800	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	0.0	0.0	0.0				
No. captured	10	46	0	509	1	566	Oct	0800	2.67
No. examined	10	46	-	100	0		31	1600	
% descaled	0.0	2.2	-	1.0	-				
% mortality	0.0	0.0	-	0.0	0.0				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	5	28	1	35	1	70	Nov	0800	2.67
No. examined	5	28	1	35	1		3	1600	
% descaled	0.0	0.0	0.0	0.0	0.0				
% mortality	0.0	0.0	0.0	0.0	0.0				
No. captured	12	44	0	29	0	85	Nov	0800	2.67
No. examined	12	44	-	29	-		4	1600	
% descaled	0.0	0.0	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	5	58	0	13	0	76	Nov	0800	2.67
No. examined	5	58	-	13	-		5	1600	
% descaled	0.0	1.7	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	13	125	0	23	0	161	Nov	1600	2.67
No. examined	0	0	-	0	-		5	2400	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	-	4.3	-				
No. captured	13	75	0	7	0	95	Nov	2400	2.67
No. examined	0	0	-	0	-		6	0800	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	2	79	0	10	0	91	Nov	0800	2.67
No. examined	2	79	-	10	-		6	1600	
% descaled	0.0	1.3	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	9	46	1	30	2	88	Nov	1600	2.67
No. examined	0	0	0	0	0		6	2400	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	0.0	0.0	0.0				
No. captured	11	54	0	22	0	87	Nov	2400	2.67
No. examined	0	0	0	0	0		7	0800	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	4	102	0	51	0	157	Nov	0800	2.67
No. examined	4	102	-	51	-		7	1600	
% descaled	25.0	2.9	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	14	210	0	29	0	253	Nov	0800	2.67
No. examined	14	100	-	29	-		10	1600	
% descaled	7.1	2.0	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	5	130	0	37	0	172	Nov	0900	2.33
No. examined	5	130	-	37	-		11	1600	
% descaled	0.0	2.3	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	23	227	0	40	0	290	Nov	0800	2.67
No. examined	23	124	-	40	-		12	1600	
% descaled	8.7	0.8	-	2.5	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	14	313	0	25	1	353	Nov	1600	2.67
No. examined	0	100	-	25	0		12	2400	
% descaled	-	1.0	-	0.0	-				
% mortality	0.0	0.3	-	0.0	0.0				
No. captured	7	100	0	21	0	128	Nov	2400	2.67
No. examined	0	0	-	0	-		13	0800	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	9	171	0	22	0	202	Nov	0800	2.67
No. examined	9	100	-	22	-		13	1600	
% descaled	0.0	1.0	-	0.0	-				
% mortality	0.0	0.6	-	0.0	-				
No. captured	14	174	0	13	0	201	Nov	1600	2.67
No. examined	0	0	-	0	-		13	2400	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	11	91	0	32	0	134	Nov	2400	2.67
No. examined	0	0	-	0	-		14	0800	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	8	139	0	38	0	185	Nov	0800	2.67
No. examined	8	103	-	38	-		14	1600	
% descaled	12.5	1.0	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	15	175	1	342	0	533	Nov	0800	2.67
No. examined	15	112	0	121	-		17	1600	
% descaled	0.0	2.7	-	0.0	-				
% mortality	0.0	0.0	0.0	0.3	-				
No. captured	7	82	1	66	0	156	Nov	0800	2.67
No. examined	7	82	0	66	-		18	1600	
% descaled	0.0	1.2	-	0.0	-				
% mortality	0.0	0.0	0.0	0.0	-				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	2	105	0	127	0	234	Nov	0800	2.67
No. examined	2	105	-	106	-		19	1600	
% descaled	50.0	2.9	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	5	109	1	47	0	162	Nov	1600	2.67
No. examined	0	102	0	46	-		19	2400	
% descaled	-	2.9	-	0.0	-				
% mortality	0.0	0.0	0.0	0.0	-				
No. captured	3	63	0	38	0	104	Nov	2400	2.67
No. examined	0	0	-	0	-		20	0800	
% descaled	-	-	-	-	-				
% mortality	33.3	0.0	-	0.0	-				
No. captured	3	39	0	30	0	72	Nov	0800	2.67
No. examined	3	39	-	30	-		20	1600	
% descaled	33.3	5.1	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	4	39	1	62	0	106	Nov	1600	2.67
No. examined	0	0	0	0	-		20	2400	
% descaled	-	-	-	-	-				
% mortality	0.0	0.0	0.0	0.0	-				
No. captured	0	42	3	21	0	65	Nov	2400	2.67
No. examined	-	0	0	0	-		21	0800	
% descaled	-	-	-	-	-				
% mortality	-	9.0	0.0	0.0	-				
No. captured	3	59	0	64	0	126	Nov	0800	2.67
No. examined	3	59	-	64	-		21	1600	
% descaled	0.0	0.0	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	1	9	0	11	0	21	Nov	0800	2.67
No. examined	1	9	-	11	-		24	1600	
% descaled	0.0	0.0	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				
No. captured	0	8	1	36	0	45	Nov	2400	2.67
No. examined	-	0	0	0	-		25	0800	
% descaled	-	-	-	-	-				
% mortality	-	0.0	0.0	0.0	-				
No. captured	1	10	0	15	0	26	Nov	0800	2.67
No. examined	1	10	-	15	-		25	1600	
% descaled	0.0	0.0	-	0.0	-				
% mortality	0.0	0.0	-	0.0	-				

Appendix Table 6.--cont.

	"1" chin.	"0" chin.	Sthd	Coho	Sock.	Total	Date	Shift	Hours fished
No. captured	0	8	0	8	0	16	Nov	1600	2.67
No. examined	-	8	-	8	-		25	2400	
% descaled	-	12.5	-	0.0	-				
% mortality	0	0.0	-	0.0	-				
No. captured	0	9	0	18	0	27	Nov	2400	2.67
No. examined	-	0	0	0	0		26	0800	
% descaled	-	-	-	-	-				
% mortality	-	0.0	0	0.0	-				
No. captured	0	7	0	17	0	24	Nov	0800	2.67
No. examined	-	7	-	17	-		26	1600	
% descaled	-	0.0	-	0.0	-				
% mortality	-	0.0	-	0.0	-				
No. captured	0	8	0	13	0	21	Nov	1600	2.67
No. examined	-	0	-	0	-		26	2400	
% descaled	-	-	-	-	-				
% mortality	-	0.0	-	0.0	-				

Appendix Table 7.--Percentages of 24-h chinook and coho salmon catches taken in 8-h sample periods starting at 1600, 2400, and 0800 h at the Bonneville Dam First Powerhouse juvenile collection system from 3 September to 21 November, 1986.

	Subyearling Chinook				Yearling Chinook				Coho			
		Percent				Percent				Percent		
Date[1]	24-h Catch	1600 2400	2400 0800	0800 1600	24-h Catch	1600 2400	2400 0800	0800 1600	24-h Catch	1600 2400	2400 0800	0800 1600
03-03 Sep	511	46.8	27.4	25.8								
04-05	931	55.2	28.9	15.9								
10-11	265	37.3	47.2	15.5								
11-12	406	49.0	39.9	11.1								
17-18	148	33.8	47.3	18.9								
18-19	215	44.2	25.6	30.2								
24-25	198	47.5	39.9	2.6								
25-26	293	35.8	49.5	14.7								
01-02 Oct	131	47.3	29.0	23.7					54	38.9	11.1	50.0
02-03	212	35.9	39.6	24.5					114	34.2	32.5	33.3
08-09	63	30.1	54.0	15.9					181	54.1	36.5	9.4
09-10	133	33.8	54.9	11.3					273	46.2	46.2	7.6
15-16	174	27.0	50.0	23.0	43	18.6	51.2	30.2	399	38.9	54.1	7.0
16-17	256	37.1	41.0	21.9	53	33.9	47.2	18.9	615	51.2	42.3	6.5
22-23	69	33.3	36.2	30.5	47	10.6	66.0	23.4	56	37.5	42.9	19.6
23-24	101	42.6	38.6	18.8	46	19.6	50.0	30.4	50	36.0	44.0	20.0
29-30	150	50.7	26.0	23.3	33	30.3	54.6	15.1	297	59.6	24.2	16.2
30-31	252	26.8	25.0	18.2	27	26.0	37.0	37.0	955	29.7	17.0	53.3
05-06 Nov	279	44.8	26.9	28.3	28	46.4	46.4	7.2	40	57.5	17.5	25.0
06-07	202	22.8	26.7	50.5	24	37.5	45.8	16.7	103	29.1	21.4	49.5
12-13	584	53.6	17.1	29.3	30	46.7	23.3	30.0	68	36.8	30.9	32.3
13-14	404	43.1	22.5	34.4	33	42.4	33.3	24.3	83	15.7	38.5	45.8
19-20	211	51.7	29.8	18.5					115	40.9	33.0	26.1
20-21	140	27.9	30.0	42.1					147	42.2	14.3	43.5
Totals	6328				364				3550			
Mean		41.2	35.5	23.3		31.2	45.5	23.3		40.5	31.7	27.8
SE of the mean		1.94	2.20	1.96		4.14	3.96	2.99		2.84	3.22	4.15

[1]Each 24-h sample day started at 1600 h.

Appendix Table B.--Daily estimates of chinook and coho salmon passage through the Bonneville Dam First Powerhouse juvenile bypass system, during fall 1986. n = number of samples used in estimate.

		Subyearling Chinook			Yearling Chinook			Coho		
Date[1]	n[2]	Sample catch[3]	Expansion factor[4]	Passage est.	Sample catch	Expansion factor	Passage est.	Sample catch	Expansion factor	Passage est.
Aug 31	8	22	12.9	284						
Sep 1	8	196	12.9	2,528						
2	8	139	12.9	1,793						
3	24	511	3.0	1,533				3	3.0	9
4	24	931	3.0	2,793				2	3.0	6
	5 day totals			8,931						15
Sep 7	8	62	12.9	800						
8	8	37	12.9	477						
9	8	18	12.9	232						
10	24	265	3.0	795				1	3.0	3
11	24	406	3.0	1,218						
	5 day totals			3,522						3
Sep 14	7	37	12.9	477						
15	3	37	12.9	477						
16	8	28	12.9	361				1	10.8	11
17	24	148	3.0	444				1	3.0	6
18	24	215	3.0	645				1	3.0	3
	5 day totals			2,404						20
Sep 21	8	17	12.9	219						
22	8	17	12.9	219						
23	7	46	12.9	593						
24	24	198	3.0	594						
25	24	293	3.0	879						
	5 day totals			2,504						

Appendix Table B.--cont.

		Subyearling Chinook			Yearling Chinook			Coho		
Date[1]	n[2]	Sample catch[3]	Expansion factor[4]	Passage est.	Sample catch	Expansion factor	Passage est.	Sample catch	Expansion factor	Passage est.
Sep 28	8	16	12.9	206						
29	8	22	12.9	284						
30	8	37	12.9	477				4	10.8	43
Oct 1	24	131	3.0	393				54	3.0	162
2	24	212	3.0	636				114	3.0	342
	5 day totals			1,996						547
Oct 5	8	17	12.9	219				18	10.8	194
6	8	30	12.9	387				36	10.8	389
7	8	11	12.9	142				19	10.8	205
8	24	63	3.0	189	10	3.0	30	181	3.0	543
9	24	133	3.0	399	31	3.0	93	273	3.0	819
	5 day totals			1,336			123			2,150
Oct 13	8	23	12.9	297	18	12.9	232	15	10.8	162
14	8	29	12.9	374	30	12.9	387	47	10.8	508
15	24	174	3.0	522	43	3.0	129	399	3.0	1,197
16	24	256	3.0	768	53	3.0	159	615	3.0	1,845
	4 day totals			1,961			907			3,712
Oct 19	8	24	12.9	310	9	12.9	116	21	10.8	227
20	8	27	12.9	348	17	12.9	219	15	10.8	162
21	8	26	12.9	335	6	12.9	77	4	10.8	43
22	24	69	3.0	207	47	3.0	141	56	3.0	168
23	24	101	3.0	303	46	3.0	138	50	3.0	150
	5 day totals			1,503			691			750

Appendix Table 8.--cont.

		Subyearling Chinook			Yearling Chinook			Coho		
Date[1]	n[2]	Sample catch[3]	Expansion factor[4]	Passage est.	Sample catch	Expansion factor	Passage est.	Sample catch	Expansion factor	Passage est.
Oct 26	8	21	12.9	271	13	12.9	168	24	10.8	259
27	8	32	12.9	413	10	12.9	129	94	10.8	1,015
28	8	34	12.9	439	6	12.9	77	57	10.8	616
29	24	150	3.0	450	33	3.0	99	297	3.0	891
30	24	252	3.0	756	27	3.0	81	955	3.0	2,865
	5 day totals			2,329			554			5,646
Nov 2	8	28	12.9	361	5	12.9	65	35	10.8	378
3	8	44	12.9	568	12	12.9	155	29	10.8	313
4	8	58	12.9	748	5	12.9	65	13	10.8	140
5	24	279	3.0	837	28	3.0	84	40	3.0	120
6	24	202	3.0	606	24	3.0	72	103	3.0	309
	5 day totals			3,120			441			1,260
Nov 9	8	210	12.9	2,709	14	12.9	181	29	10.8	313
10	8	149	12.9	1,922	6	12.9	77	42	10.8	454
11	8	227	12.9	2,928	23	12.9	297	40	10.8	432
12	24	584	3.0	1,752	30	3.0	90	68	3.0	204
13	24	404	3.0	1,212	33	3.0	99	83	3.0	249
	5 day totals			10,523			744			1,652
Nov 16	8	175	12.9	2,258	15	12.9	194	342	10.8	3,694
17	8	82	12.9	1,058	7	12.9	90	66	10.8	713
18	8	105	12.9	1,355	2	12.9	26	127	10.8	1,372
19	24	211	3.0	633	11	3.0	33	115	3.0	345
20	24	140	3.0	420	7	3.0	21	147	3.0	441
	5 days totals			5,724			364			6,565

Appendix Table 8.--cont.

Appendix Table 8.--cont.

		Subyearling Chinook			Yearling Chinook			Coho		
Date[1]	n[2]	Sample catch[3]	Expansion factor[4]	Passage est.	Sample catch	Expansion factor	Passage est.	Sample catch	Expansion factor	Passage est.
Nov 23	8	9	12.9	116	1	12.9	13	11	10.8	119
24	8	10	12.9	120	1	12.9	13	15	10.8	162
25	8	7	12.9	90				17	10.8	184
	3 day totals			335			26			465

[1]Daily passage estimates were calculated starting at 1600 h on the dates listed.

[2]If n $\leq$ 8, samples were of 20 minute duration taken from 0800-1600 h. If n = 24 20 minute samples were taken hourly.

[3]If < 8 samples were taken, the catch listed is the observed catch X (8 samples / number of samples taken).
expansion factors were calculated as follows: for sample days with 8 samples from 0800-1600 h, factor = (8h / h fished) X (100 / mean percentage of 24 h catch for that species taken from 0800-1600); and for sample days with 24 h samples, factor = 24h / h fished.

Table 12.--Estimated weekly passage of yearling and subyearling chinook salmon and coho salmon through the Bonneville Dam First Powerhouse juvenile bypass system, 31 August to 1 December 1986 (n = number of samples used in estimate, d = number of weekdays sampled, t = fishing time in hours).

	Sample effort			Calculation of 7-d estimates								
				Subyearling chinook			Yearling chinook			Coho		
Date[a]	n	d	t	3- to 5-d estimate	Expansion factor	7-d estimate	3- to 5-d estimate	Expansion factor	7-d estimate	3- to 5-d estimate	Expansion factor	7-d estimate
Aug 31	72	5	24.00	8,931	1.40	12,503				15	1.40	21
Sep 7	72	5	24.00	3,522	1.40	4,931				3	1.40	4
Sep 14	66	5	66.00	2,404	1.40	3,366				20	1.40	28
Sep 21	71	5	23.67	2,504	1.40	3,506				0	----	0
Sep 28	72	5	24.00	1,996	1.40	2,794				547	1.40	766
Oct 5	72	5	24.00	1,336	1.40	1,870	123	1.40	172	2,150	1.40	3,010
Oct 12	64	4	21.33	1,961	1.75	3,432	907	1.75	1,587	3,712	1.75	6,496
Oct 19	72	5	24.00	1,503	1.40	2,104	691	1.40	967	750	1.40	1,050
Oct 26	71	5	23.67	2,329	1.40	3,261	554	1.40	776	5,646	1.40	7,904
Nov 2	72	5	24.00	3,120	1.40	4,368	441	1.40	617	1,260	1.40	1,764
Nov 9	71	5	23.67	10,523	1.40	14,732	744	1.40	1,042	1,652	1.40	2,313
Nov 16	72	5	24.00	5,724	1.40	8,014	364	1.40	510	6,565	1.40	9,191
Nov 23	24	3	8.00	335	2.33	781	26	2.33	61	465	2.33	1,083
Totals						65,662			5,732			33,630

a/ Weekly passage estimates were calculated starting at 1600 h on the dates listed.