Evaluation of the Rehabilitated Juvenile Salmonid Collection and Passage System at John Day Dam – 1985

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COASTAL ZONE AND ESTUARINE STUDIES

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INTRODUCTION

Improvement of the juvenile salmonid collection and bypass system at John Day Dam on the Columbia River (River Kilometer 347) is a major concern of fishery agencies and the U.S. Army Corps of Engineers (CofE). Construction began in 1984 to rebuild this system. The portion of the system that was completed prior to the smolt migration in spring 1985 included the following:

1. New 12-inch diameter orifices in Units 1 through 9 (10 through 16 will not be completed until 1986).

2. Enlarged orifice bypass gallery for Units 1 through 9.

3. Vertical barrier screens and submersible traveling screens (STS) in Units 1 through 9.

4. A transportation channel to carry the fish from the gallery to the river.

5. A fingerling sampler and a juvenile fish evaluation facility located in the lower portion of the transportation channel.

The National Marine Fisheries Service, under contract to the CofE, conducted studies to evaluate the above system. There were four objectives to the research: (1) determine the fish guiding efficiency (FGE) of the STS and, if needed, use vertical distribution tests to determine how close the actual FGE was to its maximum potential; (2) monitor the quality (descaling rate) of the guided fish; (3) evaluate the efficiency of the orifice passage system (OPE); and (4) determine the effectiveness of the sampling and fish handling facilities.

MATERIALS AND METHODS

FGE Tests

All FGE tests were conducted in Unit 7B from 1930 h to about 2300 h with turbine loads of 135 MW. To evaluate all salmonid species which pass John Day Dam, FGE tests were conducted during two different date periods. The first series of tests (Phase I) were conducted from 8 through 23 May and targeted yearling chinook salmon though large numbers of sockeye salmon and steelhead were also present. The second series of tests (Phase II) were conducted from 15-17 July and targeted subyearling chinook salmon. During Phase I, three STS operating angles were evaluated (48°, 54°, and 59°), and tests for each angle were replicated three to five times. During Phase II, one operating angle (54°) was used.

A composite of nets attached to the STS (Fig. 1) were used to recover unguided fish (guided fish are recovered from the gatewell above the STS). The net configuration used is illustrated in Figure 2 and consisted of: gap nets (two) attached near the top of the STS to capture fish which pass through the space between the top of the STS and the concrete beam that divided the operating gate slot and the bulkhead gate slot; closure nets (two) attached to the back of the STS; and 5 rows of fyke nets suspended on a net frame below the STS. The top three rows of fyke nets contained three nets, with each row extending completely across the intake; the bottom two rows contained only the center net. The fyke nets of row one were about one-half the size of the other fyke nets (2.5 feet by 6.5 feet versus 6.5 feet square).

During Phase I, when FGEs approaching 75% were expected for the target species, the cod ends of all nets were left intact to assure an adequate

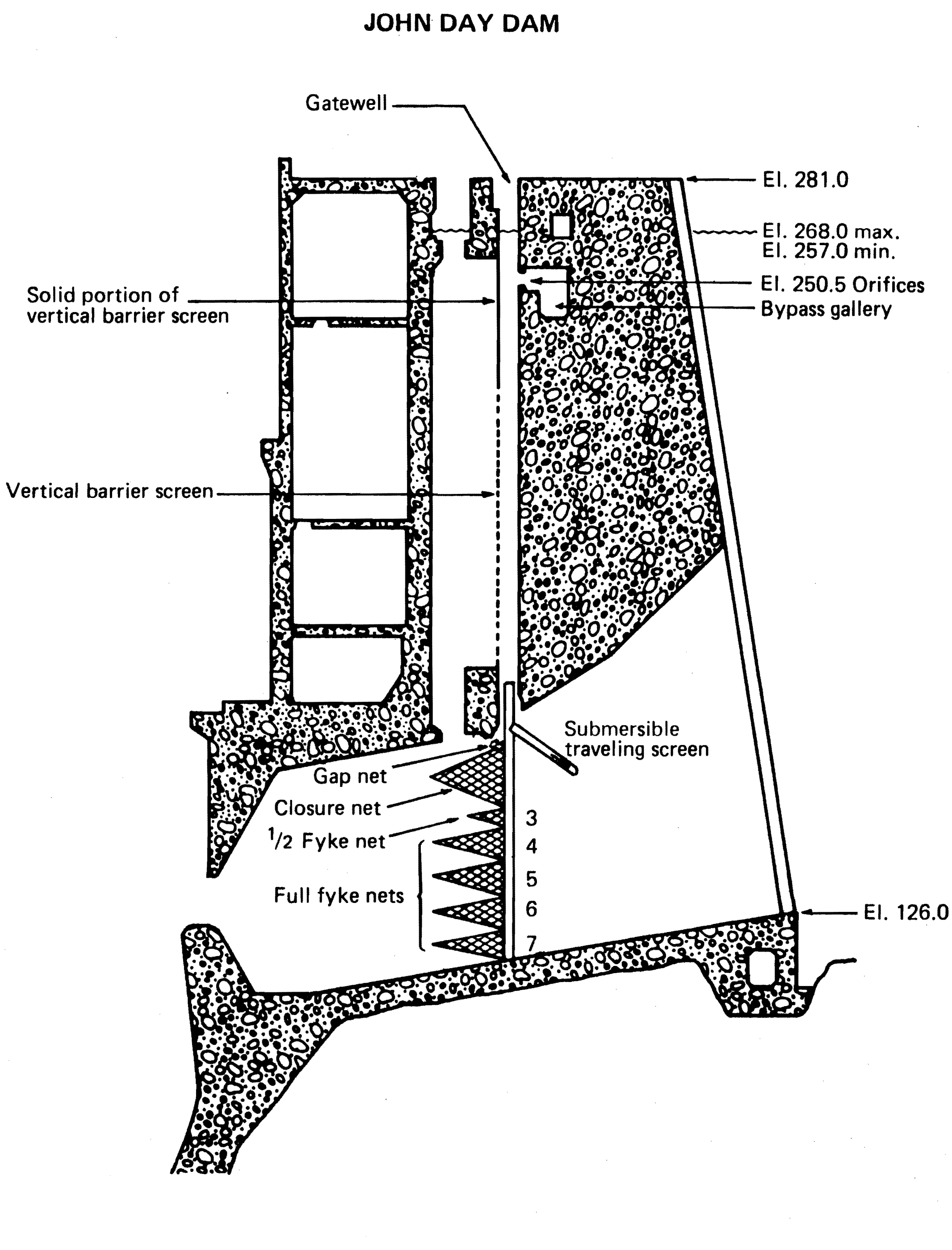


Figure 1.--Cross section of a typical turbine intake at John Day Dam showing STS and fyke nets.

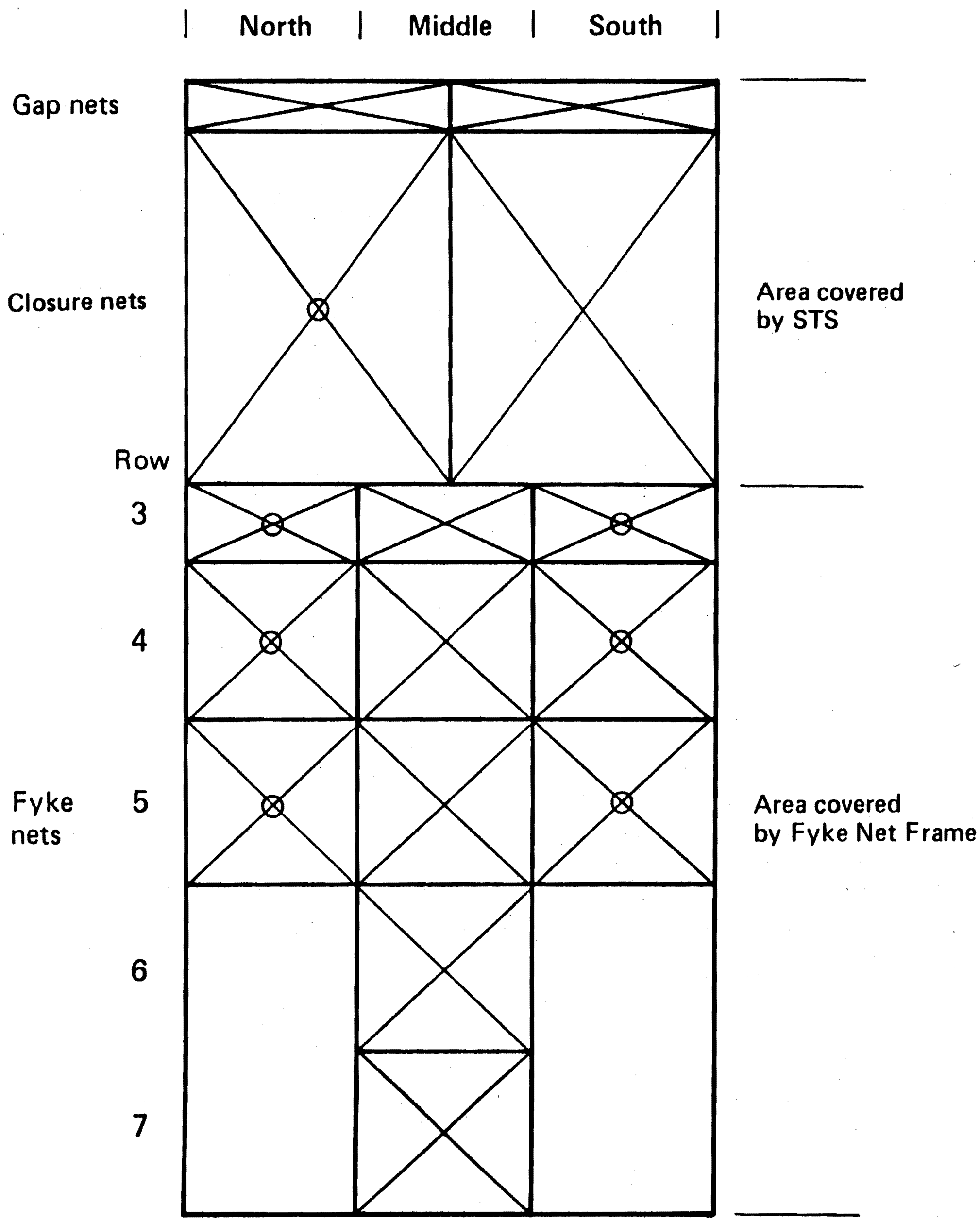


Figure 2.--Layout of fyke nets used to measure FGE at John Day Dam. (Nets with the image " " indicate nets that were fished without cod ends beginning 16 July).

sample of unguided fish and to provide a statistical evaluation for distribution of fish passing through the test unit. Beginning with the second day of Phase II, the cod ends were removed from the left closure net and all outside fyke nets to avoid sacrificing more fish than necessary.

The following sequence of events was typical for conducting an FGE test:

1. The STS with attached fyke net frames was lowered into position with the gantry crane (turbine off).

2. The bypass orifice was closed, and the gatewell was dipped to remove all fish.

3. The unit was brought to full load (135 MW).

4. The number of fish entering the unit was monitored by periodic dipnetting of guided fish from the gatewell.

5. The test was terminated when adequate numbers of fish for statistical needs were collected.

6. The turbine was shut down and all remaining fish were dipped from the gatewell.

7. The STS with attached nets was brought to deck level and the fish removed for identification and enumeration.

The methods for determining FGE were similar to those used in previous experiments of this type (Swan et al. 1983). Gatewell dipnet catches provide the number of guided fish; catches from the gap, closure, and fyke nets provide data for estimating the number of unguided fish. The FGE was calculated as gatewell catch divided by the total number of fish passing through the intake during the test period:

$$\text{FGE \%} = \left(\frac{\text{Gatewell Catch}}{\text{Gatewell catch + Adjusted total net catch}}\right) \times 100$$

where:

Adjusted total net catch = total catch by net row adjusted for any missing nets.

The effects of the STS on fish quality were determined from descaling information. Descaling was determined by visually dividing each side of the fish into five equal areas; if any two areas on a side were 40% or more descaled, the fish was classified as descaled.

Vertical Distribution Tests

Vertical distribution tests using procedures similar to FGE tests were conducted in Unit 7B from 19 to 24 July with subyearling chinook salmon the target species. The STS frame and fyke nets were replaced with a structure that supported an array of fyke nets as shown in Figure 3. Each net was about 6.5 feet square. Each row of nets sampled one-third of the flow from the ceiling to the floor of the intake. To minimize sacrificing fish, the cod ends of the outside rows of nets were removed. Total numbers collected in the center row of nets were then multiplied by 3 to obtain the estimate of total numbers passing at the various depths in the intake. The cumulative percentage of fish captured from the gatewell plus the number estimated from the first 2-1/2 rows of nets provided the measure of theoretical potential that could be intercepted by an STS (Fig. 3).

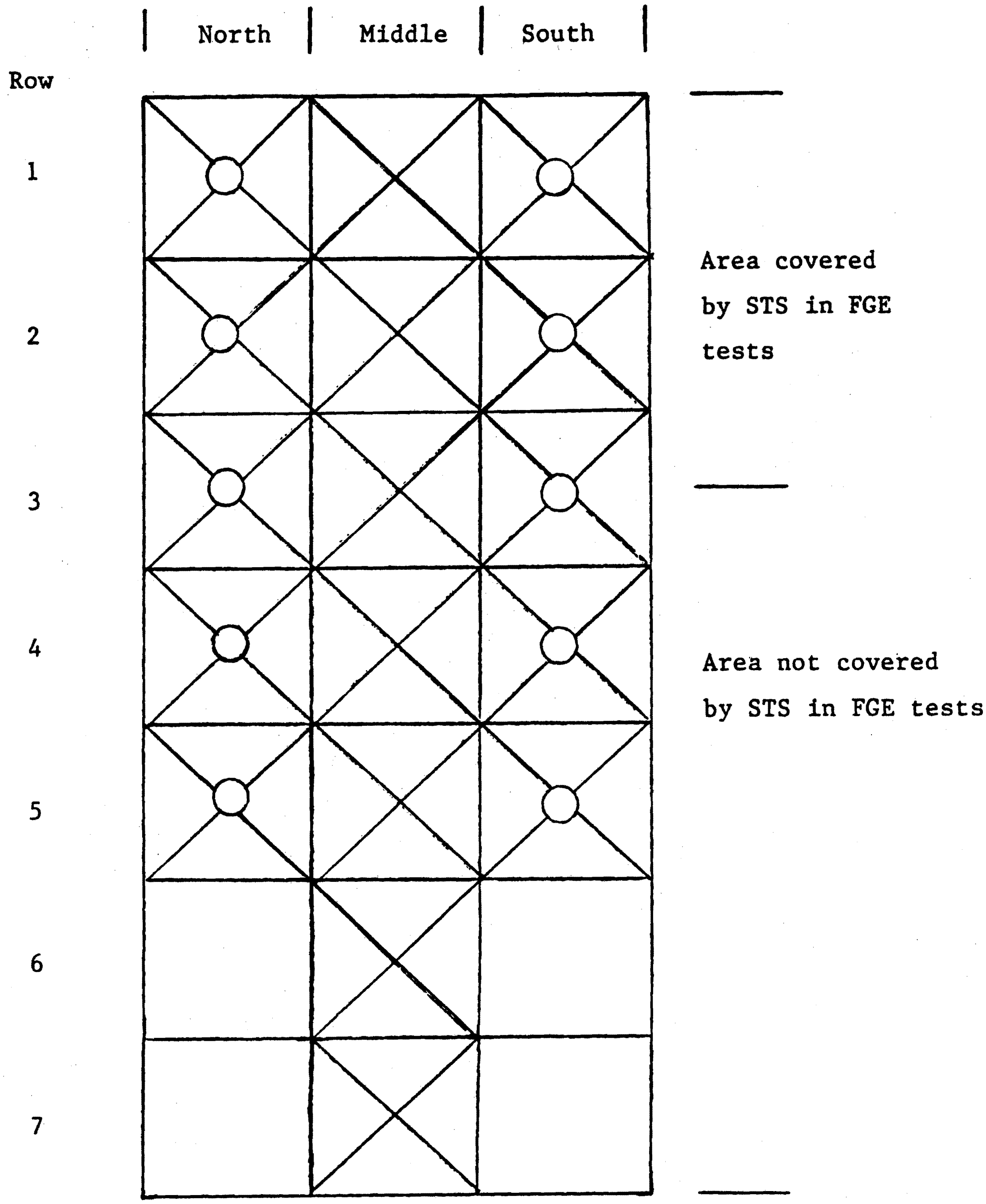


Figure 3.--Layout of fyke nets used to measure vertical distribution at John Day Dam. (Nets with the image "" indicate nets that were fished without cod end bags.)

OPE Tests

The design for the new bypass gallery precludes the installation of an orifice trap normally required for OPE evaluation. The new gallery which is totally enclosed is 8 feet wide and varies in height from 17 feet at Unit 1 to 13 feet at Unit 9. Without the option of an orifice trap to provide absolute numbers it was necessary to use other methods for estimating OPE. Two methods, indirect and direct, were used. Using the indirect method, we compared catches of juvenile salmonids (volitional migrants) in two adjacent gatewells (B and C) of the three gatewells in each turbine unit tested. In one gatewell, the orifice to the bypass was closed, and in the other the orifice was open. The direct method was based on the recovery of marked fish that had been released into the two gatewells. We assumed OPE estimates were relatively accurate if both methods resulted in similar values.

Fish used for these tests were those species migrating through the dam from 29 May through 13 June. Indirect OPE estimates were made for yearling and subyearling chinook salmon, sockeye salmon, and steelhead; direct OPE estimates were obtained for yearling chinook salmon (29 May through 7 June) and steelhead (8 through 13 June).

Test turbines were maintained at normal full-operating capacity to provide a standardized gatewell condition for all replicates during the 2-week evaluation. Unit 5 (Station Service) was originally selected for the tests; however, excessive numbers of fish dictated a shift to a more mid-river unit (Unit 8). Smaller numbers of fish enter John Day Dam in the middle of the river (Johnsen 1985[1/]).

1/ R. Johnsen, Environmental and Technical Services Division, NWR, NMFS, P.O. Box 67, Rufus, OR 97050, pers. commun, May 1985.

During the indirect OPE tests, the orifice in Gatewell B was open, and the orifice in Gatewell C was closed. Fish were removed from the gatewells using a dip basket (Swan et al. 1979). A typical test began during mid-day (time of minimal fish passage) by removing all fish from both gatewells, waiting 24 h, removing all fish from each gatewell, and enumerating the catch by species.

Adjustment factors for the total number of fish entering open gatewells were required to calculate indirect OPE because the number of fish entering individual gatewells can vary from one end of the powerhouse to the other and between gatewells of the same unit (Krcma et al. 1982). The adjustment factors for each species were the proportions of fish dipnetted from Gatewells B and C on alternate days when the orifice in Gatewell B as well as C was closed for 24 h (see Appendix Table A4 for adjustment factor calculations). The formula for calculating indirect OPE was as follows:

$$OPE_i = 100 - [B_i/(2F_i)(C_i)\ 100]$$

where:

OPE_i = orifice passage efficiency for fish species i

F_i = adjustment factor for total number of fish species i entering Gatewell B

B_i = total number of fish species i dipped from open Gatewell B

C_i = total number of fish species i dipped from closed Gatewell C.

Direct OPE estimates were obtained in conjunction with the indirect estimates and were based on the recovery of marked fish released directly into gatewells with the orifices either opened or closed. The recovery of marked fish was also useful for evaluating rates of fish escapement from the gatewell and for evaluating dip basket efficiency. These tests were conducted in Gatewell C with the orifice closed immediately after open to closed tests.

After 1 h in the gatewell, all fish were removed and counted; the number of marked fish not recovered provided an estimate of escapement and dip basket efficiency. Marked fish recovered from these tests were not included in the counts of volitional migrants collected during the indirect estimates.

A dye, bismark brown y, was used to mark fish (Deacon 1961). Fish selected for dyeing were dipped from gatewells (normally fish from closed Gatewell C were used), anesthetized, and two lots of 112 fish or less were held in approximately 690-l tanks with circulating river water. Descaled or marked fish (except for adipose fin-clipped steelhead) were excluded from dyeing.

Fish were generally held overnight and the dye procedure started the next morning by turning off the circulating water, adding oxygen through submerged air stones, and reducing the water volume in the tank to about 270 l. A weighed quantity of dye was dissolved in a small quantity of ethanol, then stirred into the holding tank to make a 1 to 70,000 concentration (g dye to ml water). The tank was covered, and after 1 h, river water was again circulated through the tank to remove the dye (it required about 10 minutes to flush the dye from the tanks). Fish were allowed to recover for at least 1 h before being released into the gatewell. After the recovery period, 12 control fish were removed from most dye groups and held until the next day to evaluate dye retention and mortality.

A chi-square test was used to detect significant differences in catch rates and OPE estimates between species and gatewells.

RESULTS AND DISCUSSION

FGE Tests

During Phase I the 54° angle provided the highest FGE without excessive descaling (Table 1). The mean FGE weighted by number of fish in each replicate were: yearling chinook salmon 72%, sockeye salmon 41%, and steelhead 86%. Descaling rates were 5.4, 7.8, and 1.6%, respectively. A screen angle of 59° angle resulted in somewhat lower FGEs with little change in descaling. The 48° angle screen also produced acceptable FGEs for yearling chinook salmon and steelhead, however, descaling rates were about doubled for all three species. Because of the favorable results of the FGE tests at the 54° angle for yearling chinook and steelhead (FGE over 70%), vertical distribution tests originally scheduled were cancelled and this screen angle was used for all Phase II testing.

There was a dramatic drop in FGE for subyearling chinook salmon during Phase II tests; mean FGE for three replicates was only 21%. Descaling was low, only 1.1%.

The first test (15 July) was the only test during the Phase II testing with a full complement of nets. Guidance was very low (22%), and there were more than adequate numbers of fish in the nets for test validation. A decision was made to remove the cod ends of the left and right fyke nets and one of the closure nets to avoid sacrificing fish unnecessarily for the remaining tests (Fig. 2). This decision was based on an analysis of the net distribution data from this test and the Phase I tests that also used a full complement of nets. These data (Table 2) showed that collections of fish in the middle row of nets was about the expected 33% of the total net catch. Therefore, by using only the middle row of nets, we could obtain statistically

Table 1.—Fish guiding efficiency and descaling rate of juvenile salmonids at various screen angles—John Day Dam, 1985

Item	Yearling chinook salmon			Sockeye salmon			Steelhead			Subyearling chinook salmon
Date of tests	08 May to 15 May	14 May to 20 May	21 May to 23 May	08 May to 13 May	14 May to 20 May	21 May to 23 May	08 May to 13 May	14 May to 20 May	21 May to 23 May	15 Jul[a/] to 17 Jul
STS guiding angle ($^{\circ}$)	59	54	48	59	54	48	59	54	48	54
FGE (%)[b/]	63	72	73	30	41	31	84	86	84	21
$\pm$ 0.90% CI	$\pm$6.7	$\pm$6.0	$\pm$1.9	$\pm$11.7	$\pm$16.2	$\pm$7.6	$\pm$5.4	$\pm$5.5	$\pm$2.4	$\pm$7.8
Descaling	4.4	5.4	14.1	8.4	7.8	16.6	2.8	1.6	4.3	1.1
$\pm$ 0.90% CI	$\pm$4.0	$\pm$2.5	$\pm$5.6	$\pm$8.0	$\pm$4.4	$\pm$6.0	$\pm$3.6	$\pm$2.0	$\pm$4.9	$\pm$0.3
Number of fish	1,923	896	426	1,241	825	538	346	222	139	13,358
Replicates	4	5	3	4	5	3	4	5	3	3

a/ Testing with subyearling chinook salmon was done only for the 54° angle STS.

b/ Represents the weighted mean of the replicates.

Table 2.--Evaluation of the proportions of fish in the middle net versus left and right nets for net levels 1, 2, and 3 when all nets were fished, John Day Dam 1985.

	Yearling Chinook	Subyearling Chinook
Total Tests	12 a/	1 b/
Total Catch Middle Nets	260	1930
Total Catch Left & Right Nets	496	3821
% Middle Nets	34.9 c/	33.6 c/

a/ Combined replicates for tests conducted 8 May through 23 May.

b/ One replicate for test conducted with full complement of nets, 15 July.

c/ Using a test of binomial proportions (Snedecor and Cochran 1967), the catch in the middle nets was not significantly different than 33% ($P \leq 0.05$).

valid results by multiplying the catch by 3 to estimate the numbers of unguided fish in each test.

Vertical Distribution Tests

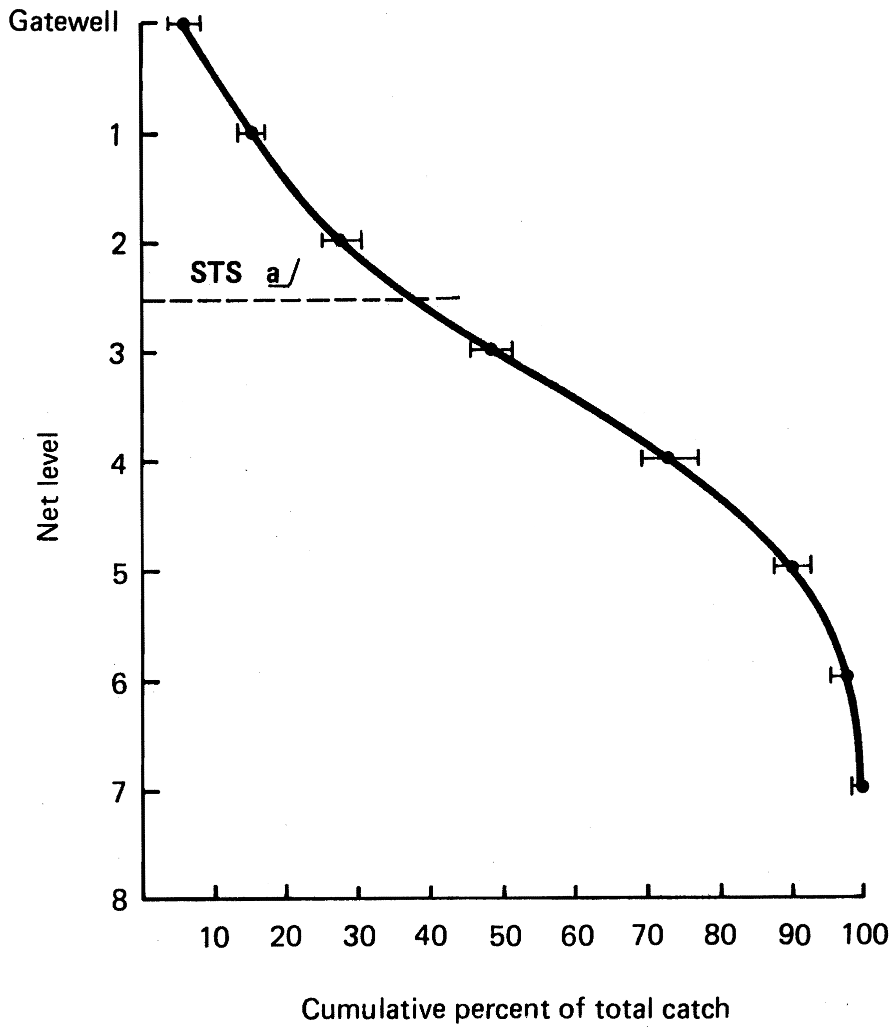
Vertical distribution tests were conducted to verify the depth subyearling chinook salmon enter the turbine unit and to determine the theoretical FGE (Fig. 4). Tests showed that only 40% of the fish entering the Unit were available for interception by the STS. The 21% FGE for subyearling chinook salmon was, therefore, only about half of what it theoretically should have been which suggests that a large amount of fish were rejecting or avoiding the STS. These data indicated that to achieve the desired 70% FGE it would be necessary to intercept subyearling chinook salmon 10 feet deeper in the intake. To guide fish from this depth, an STS more than double the present length and intercepting nearly 50% of the flow of the turbine intake would be required.

It also appears that the presence of the STS tends to force a proportion of subyearling chinook salmon deeper as shown by comparing net catches from the vertical distribution tests (Fig. 4) to corresponding net levels for the FGE tests (Fig. 5). Less than 10% of the fish were found in the bottom three nets during vertical distribution tests; however, over 35% were found at this level of the intake during the FGE testing.

Individual test data for FGE and vertical distribution tests are recorded in Appendix Tables A1 and A2.

OPE Tests

Results of OPE tests showed no significant differences ($P < 0.05$) in OPE estimates between species. The mean OPE, $\pm$ 90% confidence limits, for all species was 73.3% $\pm$ 4.7, which is near the acceptable standard of 75% OPE.



a/ Approximate level of intercept with STS at 54° angle.

Figure 4.--Vertical distribution curve for subyearling chinook salmon at John Day Dam, 1985. The symbol ├──┤ represents upper and lower 90% confidence limits on the mean net catch at each level.

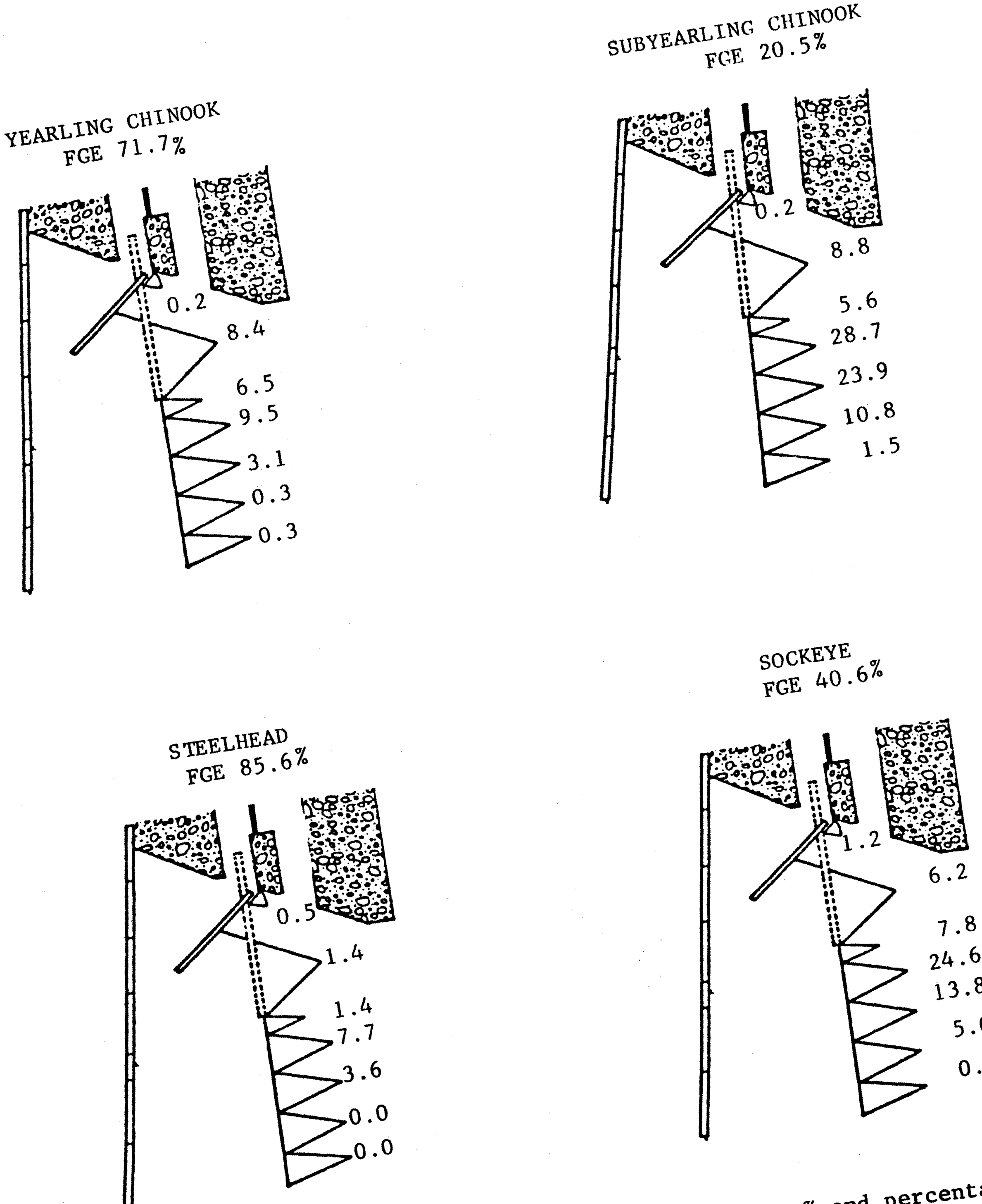


Figure 5.--Results of STS tests (54° angle) showing FGE % and percentage of fish captured at each net level, John Day Dam, 1985.

Indirect OPE estimates for yearling chinook salmon and sockeye salmon exceeded the standard (76.8 and 78.4%), but subyearling chinook salmon and steelhead were slightly below the standard (71.3 and 66.5%) (Table 3). In general, OPE results obtained by the indirect method were higher than results obtained under simulated John Day Dam conditions for tests conducted at McNary Dam during 1981 (Swan et al. 1982).

Direct OPE estimates using dyed fish were obtained only for yearling chinook salmon (five replicates) and steelhead (three replicates) (Table 3). The direct OPE estimates were not significantly different ($P < 0.05$) than the indirect OPE estimates. OPE for yearling chinook salmon was 71.7% $\pm$ 25 and for steelhead was 53.2% $\pm$ 14.9 (mean value $\pm$ 90% confidence limits).

Considerably more variability occurred between individual test replicates for the direct method than the indirect method. In comparing individual test days, however, we found that similar differences also occurred for the indirect OPE estimates but not necessarily of the same magnitude (Table 4). This suggests that fish behavior or differences in the fish population approaching the dam from day to day can influence OPE. Daily test data are shown in Appendix Tables A3 and A4.

Percent recovery of dyed fish released into the gatewell (dip basket efficiency) was 98 to 100% (five replicates). Delayed mortality for samples of dyed control fish was 2.6% indicating virtually no loss or escapement. Additional support for a low escapement rate was also obtained from closed gatewell conditions during direct OPE tests; only 3% of those fish were not recovered. Therefore, no adjustments were made in either the indirect or direct OPE estimates for escapement and/or dip basket efficiency.

Table 3.--Indirect and direct OPE estimates for juvenile salmonids at John Day Dam, 1985.

Species	Mean OPE (%)	No. of replicates	90% confidence limits
	Indirect Method		
Subyearling chinook salmon	71.3	8	±8.9
Yearling chinook salmon	76.8	8	±16.1
Sockeye salmon	78.4	8	±10.6
Steelhead	66.5	8	±7.5
	Direct method		
Yearling chinook salmon	71.7	5	±25.0
Steelhead	53.2	3	±14.9

Table 4.--Individual test days of direct OPE estimates and corresponding indirect OPE estimates for yearling chinook salmon and steelhead.

Species	Date	Direct OPE (%) dyed fish tests	Indirect OPE (%)
Yearling chinook salmon	29 May	92.7	98.4
" "	31 May	89.0	94.4
" "	04 June	44.6	77.7
" "	06 June	57.0	65.8
" "	07 June	75.0	88.3
Steelhead	08 June	53.5	61.9
"	11 June	47.0	67.7
"	13 June	59.0	80.5

Although the OPE appeared to be acceptable in 1985, it must be noted that the bypass system was not operating at full capacity; only 27 of the 48 orifices were operational. To maintain orifice head equal to a fully operational system required a smaller tainter gate opening in the collection channel. However, when the gate was adjusted for this condition, excessive shear planes appeared to be developing, and it was decided that it would be safer for fish if a larger gate setting was used. Consequently, the tainter gate was adjusted to about 1.6 feet; this resulted in an orifice head of about 5.8 feet. When the entire bypass is completed and operating at full capacity (414 ft^3/s), the operating orifice head will be about 3.7 feet. Therefore, the OPE testing in 1985 was conducted with a much higher head than there will be when the total bypass system is completed.

Fingerling Bypass Sampling Facility

Field testing of the fingerling sampling facility could not be completed this year. Limited testing was conducted toward the latter part of the subyearling chinook salmon migration. This delay was due in part to the delivery and installation of the drive mechanism on the regulating gate at the lower end of the outfall chute. However, the sampler was run continuously for 24 h, from 12 to 13 August. During this test the sample cone gates were open for 30 minutes during each hour. A total of 84 subyearling chinook salmon were collected; 8 (9.5%) were descaled. During this same period fish were also collected from a gatewell in Unit 3 with an air lift pump to obtain fingerling data for the Smolt Monitoring Program. These fish represented a group that did not negotiate the collection system. A total of 181 fish were collected during this same 24-h period; 9 (5%) were descaled. The sampler also caught 15 juvenile shad, of which one was descaled. It is difficult to conclude much from this limited information. However, it would appear that the system is not severely injuring fish.

An extensive evaluation program for the fingerling sampling facility is scheduled for 1986.

A number of modifications to the original design were needed for proper function of the system. The following modifications were made:

1. Installation of air-operated slide gates on the inclined screen to provide the capability for adjusting water flow through the screen.

2. Installation of an air-operated closure gate on the sample cone to prevent fish from entering the sample cone when each sample period was terminated. This also allowed the system to be flushed of any fish that were holding in the upwell.

3. The installation of a larger air compressor and valves to control the slide gates and closure gates.

4. The sanctuary tank on the inclined screen was lowered 6 inches to prevent fish from swimming back up the inclined screen.

5. A sloping bottom and valve assembly was added to the fish transfer tank so fish could be transferred directly to the holding tanks in the building without extra handling.

6. The guide rails of the transfer tank were extended to allow it to be raised the extra height for gravity flow into the building.

7. Installation of heavy-duty clamps on the 10-inch diameter flex hose connecting the sample cone to the upwell; the original clamps failed to hold the hose.

8. Exposed pipe flanges in the flume were covered with rubber material to prevent injury to fish.

9. A drip pan was attached to the overhead gearboxes to collect dripping oil and grease.

10. Rigid conduit (500 feet) was installed for a phone line from the bypass evaluation building to the main gate control box to permit direct telephone communication with the control room.

11. The fence was extended to restrict access to the pit area by unauthorized personnel.

12. Aluminum pipe protectors were added to the threaded weir gate systems to replace fragile plexiglas units.

CONCLUSIONS AND RECOMMENDATIONS

1. The 54° guiding-angle STS produced the highest FGE while not causing excessive descaling. At 54°, FGEs for yearling chinook salmon, sockeye salmon, and steelhead were 72, 41, and 86%.

2. The FGE for subyearling chinook salmon was a disturbingly low 21%. Maximum theoretical FGE (based on vertical distribution data) was about 40%. A lowered or longer STS would be required to improve FGE for subyearling fish which apparently migrate deeper in the intake than yearling fish.

3. The direct and indirect methods of measuring OPE were not significantly different ($P < 0.05$). Estimates of OPE for most of the salmonid fingerlings were of an acceptable level (> 70%). The OPEs measured by the indirect method were: subyearling chinook salmon, 71.3%; yearling chinook salmon, 76.8%; sockeye salmon, 78.4%; and steelhead, 66.5%.

4. Orifice head during the 1985 OPE tests was about 7.1 feet. Normal operating head on the orifices when the total bypass system is completed will be about 3.7 feet. Further OPE testing should be conducted when normal operating orifice head can be attained.

5. Field testing of the fingerling sampling facility was not completed this year; further testing should be conducted.

6. The following modifications are needed to make the operation of the fingerling sampler and evaluation building more efficient, practical, and comfortable:

a. Replacement of the rollaway door with a plywood (or similar construction) wall containing one or more of the following:

(1) Personnel size sliding door.

(2) Opening in the wall for sluicing catch from outside holding tank to inside holding tank.

(3) Windows for added light.

b. Added lighting inside and outside of building.

c. A wind barrier on the cyclone fence at the west side of pit area.

d. An air-operated valve on the bottom flange of the flume to shut off the water flow in case of an emergency and/or for operations.

e. A pipe or hose added to the fish release pipe in the flume below the weir gate to safely release fish into the flume.

f. A more sloping bottom to the sanctuary tank on the separator.

g. A modified sorting trough.

h. A rubber mat on the concrete floor to prevent foot fatigue and slipping when the floor becomes wet.

ACKNOWLEDGMENTS

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APPENDIX A

Data Tables

Appendix Table A1.—Juvenile salmonid catches during fish guiding efficiency tests at John Day Dam, 1985.

		Yearling chinook salmon						Sockeye salmon						Steelhead					
Date	Screen angle	Gatewell Catch	Gap net catch	Fyke net catch a/	Total unguided (Est.) b/	Total guided + unguided	% FGE	Gatewell catch	Gap net catch	Fyke net catch a/	Total unguided (Est.) b/	Total guided + unguided	% FGE	Gatewell catch	Gap net catch	Fyke net catch a/	Total unguided (Est.) b/	Total guided + unguided	% FGE
5/8	59°	197	1	109	114	311	63.3	115	2	221	237	352	32.7	68	0	13	13	81	85.9
5/9	59°	306	2	243	249	555	55.1	20	0	74	78	98	20.4	90	0	21	25	115	78.3
5/10	59°	346	1	184	185	531	65.2	38	0	194	206	244	15.6	39	0	8	8	47	83.0
5/13	59°	360	0	164	166	526	68.4	198	3	333	344	542	36.5	92	1	10	11	103	89.3
5/14	54°	51	0	27	27	78	65.4	27	0	88	98	125	21.6	16	0	3	3	19	84.2
5/15	54°	184	0	100	104	288	65.2	38	1	37	44	82	46.3	49	1	12	13	62	79.0
5/16	54°	271	0	76	76	347	78.1	162	5	85	92	254	63.8	70	0	9	9	79	88.6
5/17	54°	76	1	23	24	100	76.0	61	0	133	137	198	30.8	37	0	6	6	43	86.0
5/20	54°	60	1	22	23	83	72.3	47	4	105	119	166	28.3	18	0	1	1	19	94.7
5/21	48°	119	1	40	43	162	73.5	32	1	75	84	116	27.6	69	0	12	12	81	85.2
5/22	48°	112	0	38	38	150	74.6	60	2	97	105	165	36.4	28	0	6	6	34	82.4
5/23	48°	82	0	28	32	114	71.9	77	0	172	180	257	30.0	20	0	4	4	24	83.3

a/ Fyke net catch includes catch from closure nets, half fyke nets, and full fyke nets.

b/ Includes expanded fyke net catch for net rows with only a single center net.

Appendix Table A2.--Subyearling chinook salmon catches during fish guiding efficiency and vertical distribution tests at John Day Dam, 1985.

Fish Guiding Efficiency

Date	Screen angle	Gatewell catch	Gap net catch	Fyke net catch a/	Total unguided (Est.) b/	Total guided + unguided	% FGE
7/15	54°	2209	18	7059	7849	10058	22.0
7/16	54°	353	2	558	1588	1941	18.2
7/17	54°	174	1	414	1185	1359	12.8

a/ Net catch includes catch from closure nets, half fyke nets, and full fyke nets.

b/ Includes expanded fyke net catch for net rows with only a single net.

Vertical Distribution

Date	Gatewell catch	Level 1 catch	Level 2 catch	Level 3 catch	Level 4 catch	Level 5 catch	Level 6 catch	Level 7 catch	Total net catch	Expanded net catch c/
7/19	69	18	37	49	61	53	26	5	249	747
7/22	11	3	4	12	18	16	16	2	71	213
7/23	127	56	85	129	148	104	25	10	557	1671
7/24	9	3	4	4	2	1	3	1	18	54

c/ Cod ends were removed from outside net rows during vertical distribution tests.

Appendix Table A3. Orifice bypass efficiency test results for John Day Dam, 29 May through 14 June 1985.

		Volitional migrants captured				Dyed fish			
Date	Gatewell	Yearling Chinook	Subyearling Chinook	Steelhead	Sockeye	Released	Species[a/] code	Recovered	Purpose
29 May	5B	48	9	451	110	96	5	7	Open to Closed
29 May	5C	3157	21	2138	1096	100	5	89	Open to Closed
29 May	5C	14	2	93	2	100	5	98	Escapement
30 May	5B	1074	8	1086	793	0		0	Closed to Closed
30 May	5C	1116	11	1364	835	0		0	Closed to Closed
31 May	5B	34	6	286	259	100	5	11	Open to Closed
31 May	5C	614	22	1104	1298	100	5	98	Open to Closed
31 May	5C	5	2	33	3	100	5	99	Escapement
04 June	8B	37	4	105	155	112	5	62	Open to Closed
04 June	8C	237	40	345	593	100	5	99	Open to Closed
04 June	8C	12	8	18	9	95	5	95	Escapement
05 June	8B	265	11	93	483	0		0	Closed to Closed
05 June	8C	393	19	160	498	0		0	Closed to Closed
06 June	8B	127	5	69	237	100	5	43	Open to Closed
06 June	8C	531	20	217	531	97	5	63	Open to Closed
07 June	8B	41	35	60	60	100	5	25	Open to Closed
07 June	8C	499	199	238	413	100	5	98	Open to Closed
08 June	8B	44	13	8	46	99	6	46	Open to Closed
08 June	8C	175	45	30	507	100	6	93	Open to Closed
10 June	8B	140	111	123	524	0	6	1	Closed to Closed
10 June	8C	319	120	238	632	0	6	7	Closed to Closed
11 June	8B	13	8	7	28	100	6	53	Open to Closed
11 June	8C	90	30	31	212	100	6	100	Open to Closed
11 June	8C	0	6	3	2	81	6	81	Escapement
12 June	8B	61	26	3	103	0		0	Closed to Closed
12 June	8C	126	27	11	138	0		0	Closed to Closed
13 June	8B	51	5	3	28	100	6	41	Open to Closed
13 June	8C	136	13	22	120	100	6	105	Open to Closed
13 June	8C	3	0	3	0	100	6	98	Escapement
14 June	8B	31	9	21	59	0	6	1	Closed to Closed
14 June	8C	76	18	41	102	0		0	Closed to Closed

a/ Species code 5 = yearling chinook salmon, species code 6 = steelhead

Appendix Table A4.--Daily salmonid catches from open Gatewell B and closed gatewell C with indirect orifice passage efficiency estimates and water height differential between the gatewell and the bypass gallery.

Date	Gatewell B	Gatewell C	Adjustment factor	OPE (%)	Water (m)
Subyearling chinook salmon					
29 May	9	21	0.50	57.14	--
31 May	6	22	0.50	72.73	1.71
04 June	4	40	0.46	89.13	1.53
06 June	5	20	0.46	72.83	1.59
07 June	35	199	0.46	80.88	1.70
08 June	13	45	0.46	68.60	1.64
11 June	8	30	0.46	71.01	1.77
13 June	5	13	0.46	58.19	1.53
Yearling chinook salmon					
29 May	48	3157	0.49	98.45	--
31 May	34	614	0.49	94.35	1.71
04 June	37	237	0.35	77.70	1.53
06 June	127	531	0.35	65.83	1.59
07 June	41	499	0.35	88.26	1.70
08 June	44	175	0.35	64.08	1.64
11 June	13	90	0.35	79.37	1.77
13 June	51	136	0.35	46.43	1.53
Sockeye salmon					
29 May	110	1096	0.49	89.76	--
31 May	259	1298	0.49	79.64	1.71
04 June	155	593	0.46	71.59	1.53
06 June	237	531	0.46	51.49	1.59
07 June	60	413	0.46	84.21	1.70
08 June	46	507	0.46	90.14	1.64
11 June	28	212	0.46	85.64	1.77
13 June	28	120	0.46	74.64	1.53
Steelhead					
29 May	451	2138	0.44	76.03	--
31 May	286	1104	0.44	70.56	1.71
04 June	105	345	0.35	56.52	1.53
06 June	69	217	0.35	54.58	1.59
07 June	60	238	0.35	63.98	1.70
08 June	8	30	0.35	61.90	1.64
11 June	7	31	0.35	67.74	1.77
13 June	3	22	0.35	80.52	1.53