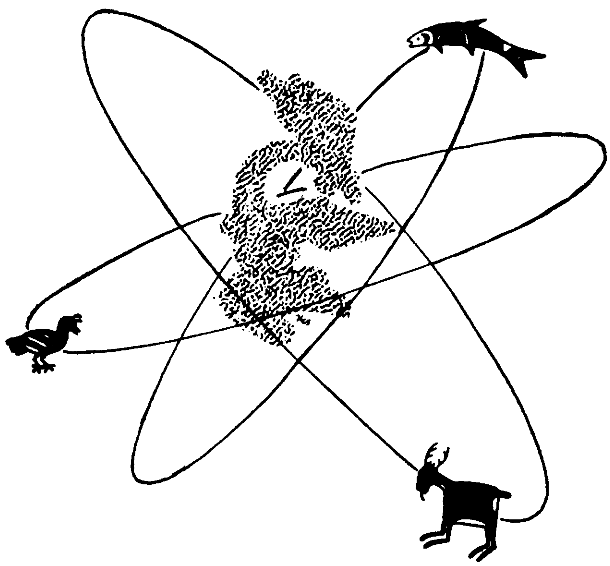
FEDERAL AID PROGRESS REPORTS
FISHERIES
1979



RESEARCH AND DEVELOPMENT SECTION

Oregon Department of Fish and Wildlife
Fish Division

Development of Criteria for Operating the Trash Sluiceway at The Dalles Dam as a Bypass System for Juvenile Salmonids, 1979.

ANNUAL PROGRESS REPORT

FISH RESEARCH PROJECT
OREGON

PROJECT TITLE:	Development of Criteria for Operating the Trash Sluiceway at The Dalles Dam as a Bypass System for Juvenile Salmonids, 1979.
CONTRACT NUMBER:	DACW57-78-C-0058
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INTRODUCTION

Juvenile salmon and steelhead produced in the Columbia River and its tributaries above Bonneville Dam must pass from one to nine dams in their migration to the ocean (Fig. 1). Most migrants passing a dam are carried through the turbines or over the spillway. The proportion of fish using either route varies from year to year depending primarily on the portion of water going through the turbines or over the spillway. Studies at main-stem Columbia River dams (Schoeneman, et al., 1971) have shown that migrants passing through the turbines have a much higher mortality than those using the spillway. As more of the long-planned Columbia River hydroelectric and storage projects have been completed in recent years, spilling has generally decreased, forcing a higher percentage of the migrants through the turbines. The natural spring runoff which once carried juveniles over the spillways has been greatly reduced. This is illustrated in Fig. 2, which shows the general effects of regulated flow at The Dalles Dam. The spring runoff is being stored and used at other times during the year to meet power demand.

In recent years, state and federal fisheries agencies have been developing several techniques at various dams to safely pass juvenile fish around main-stem dams to avoid turbine associated mortalities. These are: (1) collecting of fish at upstream projects and transporting them by truck and barge to the estuary below Bonneville Dam; (2) installing various deflection devices in turbine intakes to guide fish to a bypass system around a project; (3) manipulating powerhouse

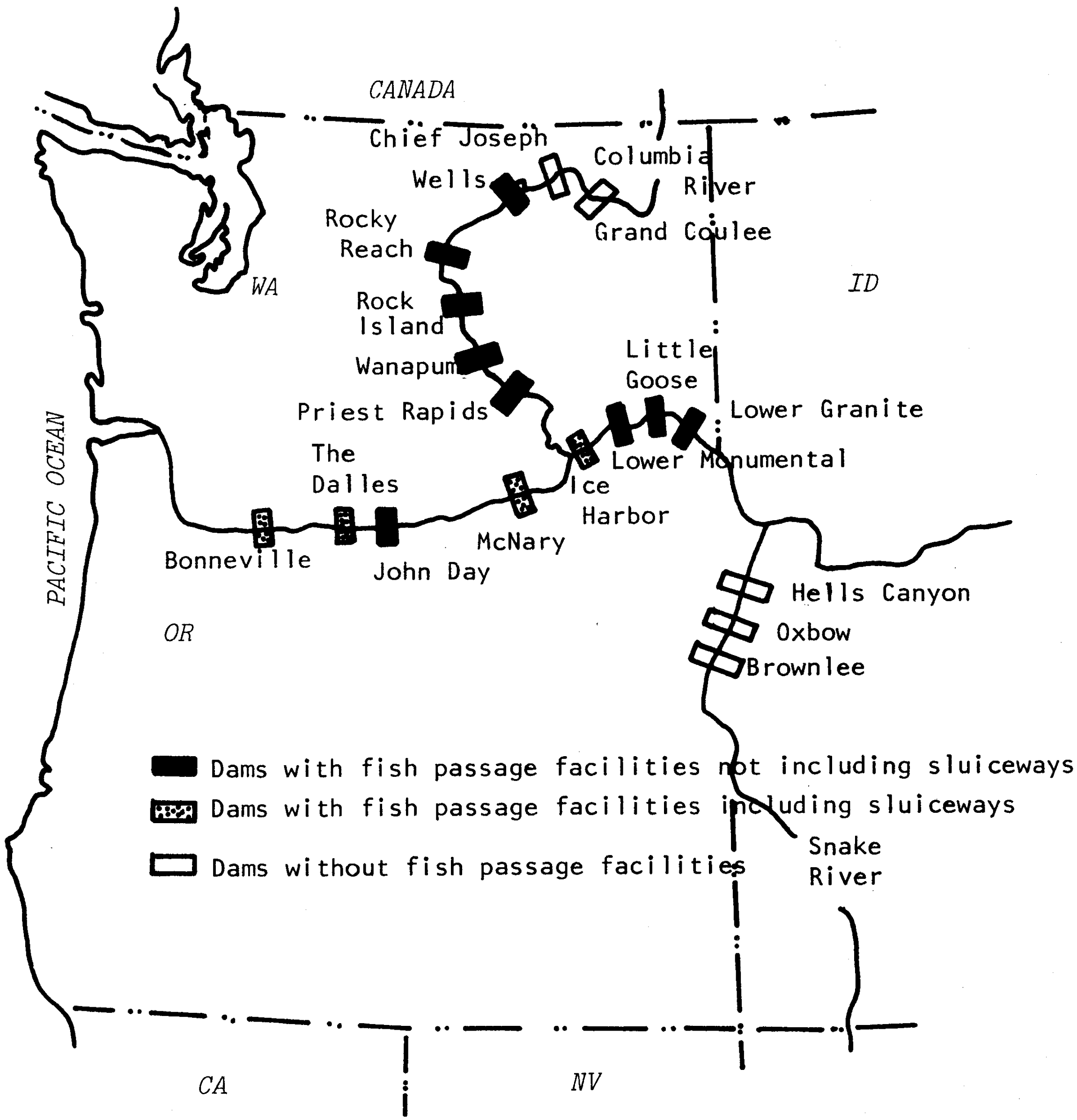

Fig. 1. Columbia River dams with and without fish passage facilities

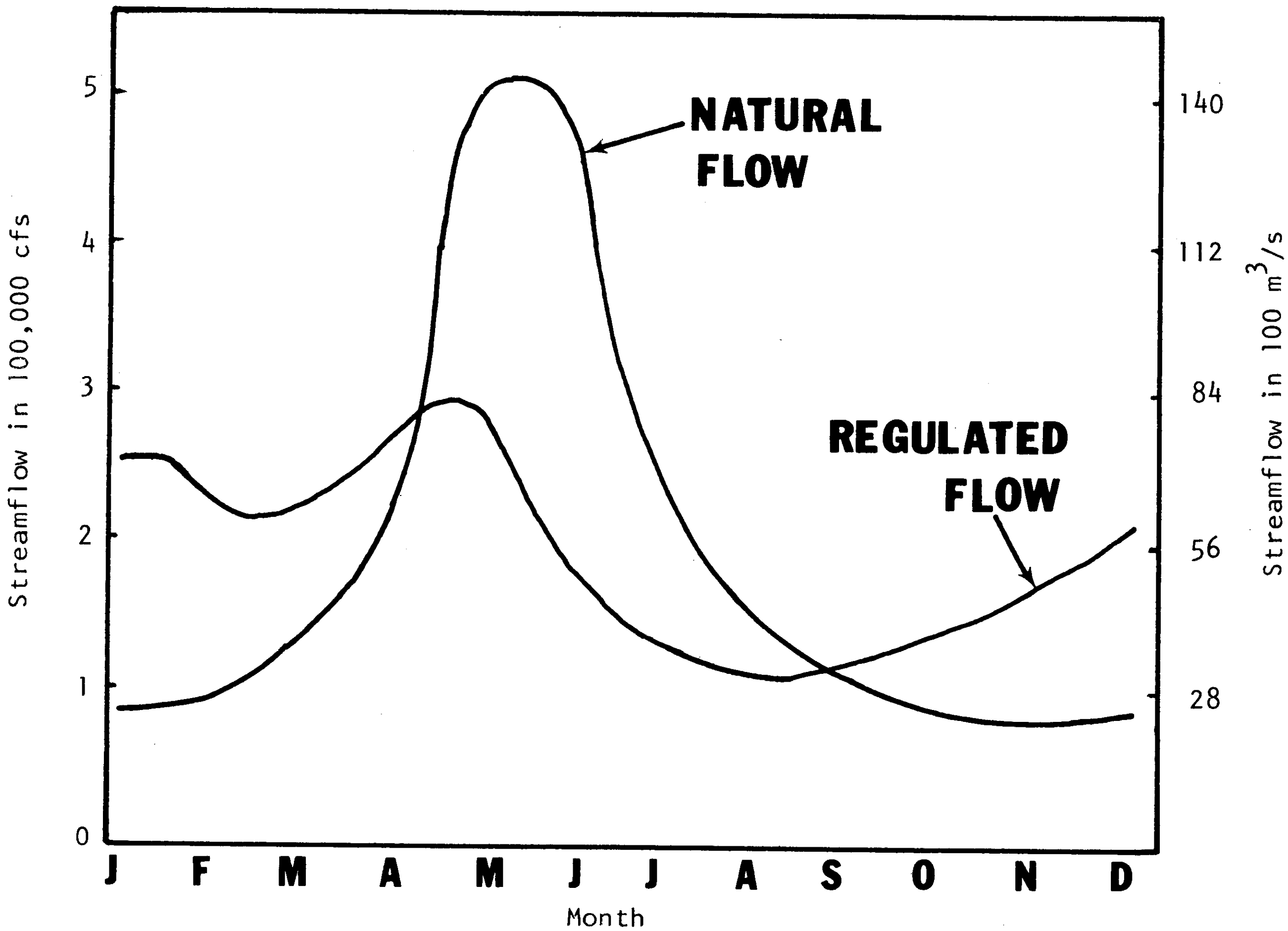

Fig. 2. General effect of reservoir regulations on average Columbia River flows at The Dalles Dam

loadings and flow to spill fish over dams and pass them quickly through slack water reservoirs before they lose their natural urge to migrate; and (4) using the ice-trash sluiceways as surface skimming bypass system.

A study by Michimoto and Korn (1969) first demonstrated the value of using the trash sluiceways for passing downstream migrants at Bonneville Dam. They felt that mortalities to fish passing through the sluiceway would be similar to losses through the spillway (generally less than 1%). They recommended considering the use of sluiceways at other dams on the Columbia and Snake rivers (Fig. 1). A qualitative study by Michimoto and Korn (1971) at The Dalles Dam produced criteria for operating the sluiceway for downstream migrant passage. In recent years, both Bonneville and The Dalles dams have operated the ice-trash sluiceway for downstream migrant use.

During 1977 a study was conducted by ODFW (Nichols, et al., 1978) to determine the number and percentage of downstream migrants using the ice-trash sluiceway at The Dalles Dam under the normal operating criteria established by Michimoto and Korn (1971). Significant numbers of migrants (in excess of 60,000 on peak days) were found to be using the sluiceway during the spring emigration period, but the standard gate settings were not the best for optimum collection efficiency. Large hourly and daily fluctuations in sluiceway passage were observed.

During 1978 a study was conducted by ODFW (Nichols, 1979) to develop operating criteria to maximize the collection efficiency of the sluiceway for downstream migrant salmonids. Passage efficiency was strongly influenced by the location of the opened sluice gates. There was also a strong indication that collection efficiency increased as flow into the sluiceway increased. The largest number of juveniles were collected when we used the largest surface flow possible through several gates over units 1 and 2 (west end of powerhouse). Overall collection efficiency was indirectly estimated at about 80%. The sluiceway was operated 24 hours per day during the season, and over 3½ million fish were estimated to have passed through it.

During 1979 evaluation and development of The Dalles sluiceway continued. A Corps funded study was conducted by ODFW to: (1) determine the gates open over units 1 and 2 which maximize fish passage through the sluiceway; (2) maintain the high collection efficiency of the sluiceway while minimizing the total quantity of water used; (3) determine if there would be sufficient numbers of juvenile salmonids using the sluiceway in July and August to justify its operation; and (4) determine if the gate settings for maximum passage of subyearling chinook were the same as for yearling salmonids.

METHODS

The trash sluiceway at The Dalles Dam is a large rectangular channel which extends along the forebay side of the powerhouse immediately above the penstocks and adjacent to the gatewells (Fig. 3). The sluiceway is 2,200' (670.6 m) long, 16.5' (5.0 m) wide, and 49' (14.9 m) deep from the underside of the deck to the bottom (elevation 134' [40.8 m] above sea level). The forebay side of the sluiceway is composed of 70 adjustable gates. A sill in front of the gates is elevation 151' (46.0 m). Normal forebay level is elevation 155-160' (47.2-48.8 m). Gates can be raised or lowered to allow water and trash to enter the sluiceway submerged or overflow. There are three gates

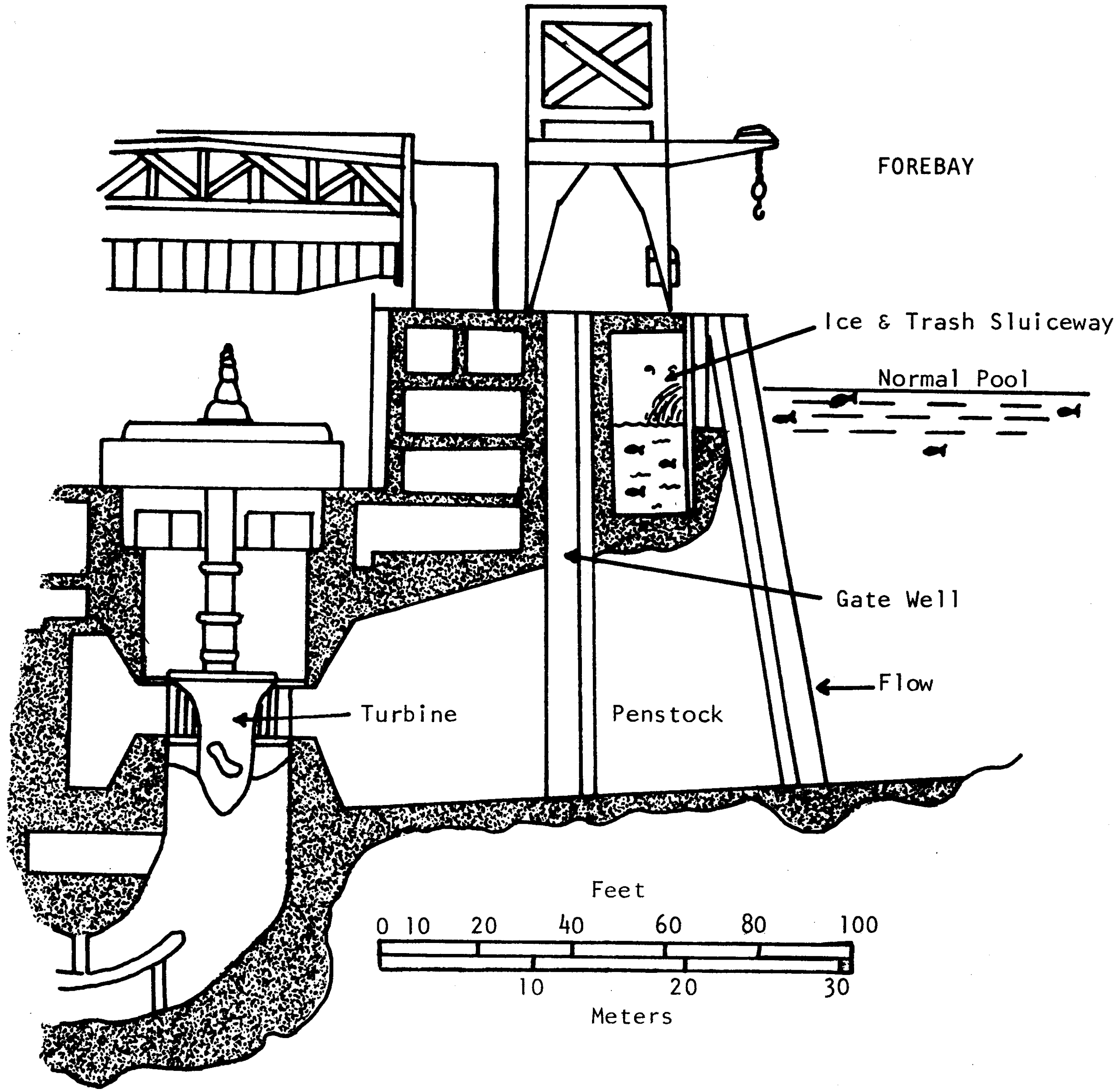

Fig. 3. Cross section of The Dalles Dam sluiceway

for each of the 22 main turbines and two gates each for the two fish turbines which provide auxilliary water for the fishways. The gates are numbered from west to east with each corresponding turbine unit. A gate across the sluiceway at the west end controls water depth and velocity for fixed gate settings. This gate, termed the sluice or end gate, consists of two leaves. It is opened by lowering the bottom leaf, raising the upper, or both. Water entering the sluiceway flows west, plunges over the end gate onto a sloping concrete apron, discharges through a raceway into the tailrace adjacent and at a right angle to the powerhouse.

Since 1971 the ice-trash sluiceway at The Dalles Dam has been operated to pass downstream migrant salmonids. During the peak passage period in spring, the sluiceway provides a skimming attraction in the forebay using up to a maximum of 5,000 cfs (140 m^3/s) from four of the 70 adjustable gates across the pwerhouse. Fish that collect in the bulkhead slots (gatewalls) empty into the sluiceway through 70 6" (15.2 cm) orifice ports passing a total of 280 cfs (7.8 m^3/s). During off-peak passage periods, the sluiceway operates with orifice flow only.

The sluiceway was operated with the forebay skimmer gates from April 10-August 17, 1979, and our testing took place during this time. Average daily fish passage in the sluiceway on Monday, Wednesday, and Friday with one set of gate conditions was compared with passage on Tuesday and Thursday with an alternate set of gates. This method gave approximate differences in daily passage with various gate conditions. However, because of normal fluctuations in daily abundance of fish, this method could not measure small differences in passage efficiency and did not lend itself to rigorous statistical analysis. The effect of changes in daily abundance was minimized by averaging passage on several alternate days. In this manner we tested passage with 3 vs 6 gates and 24-h vs 16-h and 12-h operation.

To estimate the number of downstream migrants using the sluiceway, we fished a fyke net in the sluiceway which sampled about 4% of the cross sectional area. The net was attached to a metal frame suspended by cables which were attached to anchor plates on the sluiceway walls. For fishing, the net was lowered into the sluiceway through holes in the deck. The net (Fig. 4) was divided into two sections with an overall length of 20' (6.1 m). The net entrance was 3½' (1.1 m) square and tapered to an 8" (20.3 cm) cod end. The 10' (3.0 m) front section was composed of 1" (2.5 cm) square nylon mesh and the 10' (3.0 m) back section was ¼" (0.6 cm) square nylon mesh, with the fyke 5' (1.5 m) from the cod end.

The numbers of downstream migrants passing through the sluiceway were estimated hourly from net catches as has been previously described (Nichols, et al., 1978; NIchols 1979). The fishing efficiency of the fyke net was determined by periodic releases and recaptures of marked juvenile salmonids in the sluiceway. Percentage area fished was used to make passage estimates since there was no significant difference between the net efficiency determined from these releases and the percentage area fished (Table 1).

Orifice openings between the gatewells and sluiceway were blocked to prevent any fish from entering the sluiceway except from the forebay. Gatewells were dipped to salvage fish.

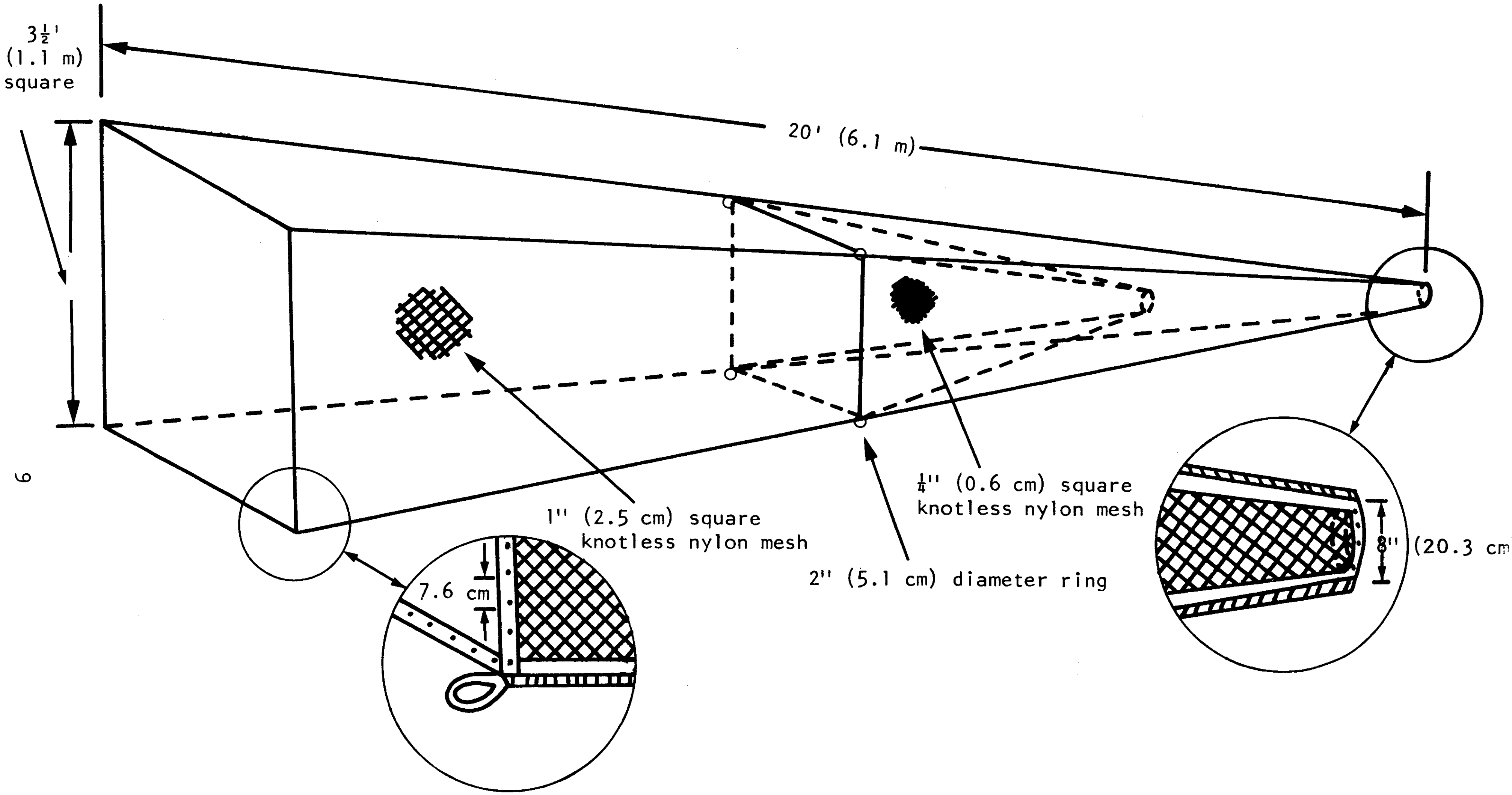

Fig. 4. Schematic diagram of fyke nets used to sample juvenile salmonids in The Dalles trash sluiceway

Table 1. Fyke net sampling efficiency of juvenile salmonids passing through The Dalles sluiceway during 1979

Date	Fish	Gates open	Release site	Number released	Number recovered	Percentage[a] recoveries	% area fished
4/24	Yearlings	$1_1 1_2 1_3$	1_2	108	2	1.9	4.7
4/25	"	$1_1 1_2 1_3 2_1 2_2 2_3$	1_2	209	11	5.3	4.1
4/26	"	$1_1 1_2 1_3$	1_2	202	6	3.0	4.7
4/27	"	$1_1 1_2 1_3 2_1 2_2 2_3$	1_1	194	9	4.6	3.9
4/30	"	"	2_2	252	9	3.6	4.5
5/1	"	"	2_1	143	3	2.1	4.5
5/2	"	"	1_3	202	1	0.5	4.5
5/3	"	"	1_3	177	12	6.8	4.3
5/4	"	"	1_3	415	27	6.5	4.5
5/9	"	"	2_3	471	17	3.6	4.3
5/10	"	"	2_1	248	13	5.2	4.5
5/24	"	"	2_1	409	20	4.9	4.0
5/25	"	"	2_1	338	7	2.1	4.2
5/29	"	"	2_1	719	39	5.4	4.1
				4,087	176	Mean = 3.7[b]	4.3
						95% CI = ±0.6	
8/8	Subyearling	$17_2 17_3 18_1 18_2$	17_2	1,536	283	18.4	4.9
8/10	"	"	"	423	12	2.8	4.4
8/10	"	"	"	271	12	4.3	4.4
				2,230	307	Mean = 7.2[b]	4.6
						95% CI = ±9.8	

[a] *Total number released divided by total number recovered.*

[b] *Arcsin percentage transformation applied before mean and confidence interval calculated.*

We fished the net during all or a portion of 90 out of 130 days between April 10 and August 17, 1979.

RESULTS AND DISCUSSION

Objective 1. Determine the Gates Open Over Units 1 and 2 Which Maximize Fish Passage Through the Sluiceway.

To maximize passage of yearling fish we tested three gates (Unit 1) against six gates (Units 1 and 2) (Table 2) and found no difference in average daily passage (12,300 [95% CI = $\pm$3,950] and 11,600 [95% CI = $\pm$ 4,130], respectively). We also determined there was less than a 10% increase in flow between three and six gates. When two or more adjacent sluice gates were open, the water flowing from east to west in the sluiceway partially backed upstream, reducing the head differential and flow into the easternmost gates. Stair-stepped openings of the skimmer gates could equalize the flow through all gates, but even these would need to be adjusted as the forebay changes to maintain a constant flow. After the hoists are installed on the skimmer gates in 1980, the relative efficiency of multiple gates could be tested with equalized flow conditions.

Objective 2. Maintain the High Collection Efficiency of the Sluiceway While Minimizing the Water Used.

During 1978 our results indicated it might be possible to increase sluiceway collection efficiency by increasing the flow to at least 3,500 cfs (98 m^3/s). Although this represents about $350/h in replacement power (at $.03/kwh), we hope to counter this by shutting the sluiceway down in hours when passage is minimal. We found, for example, that we passed relatively few fish at night.

Table 2. Estimated daily passage of juvenile salmonids through The Dalles trash sluiceway with three and six gates open during 1979

Date		April 16-20		April 23-27	
Test		3 vs 6 Gates		3 vs 6 Gates	
		3 Gates	6 Gates	3 Gates	6 Gates
Gates open[a]		$1_1, 1_2, 1_3$	$1_1, 1_2, 1_3$ $2_1, 2_2, 2_3$	$1_1, 1_2, 1_3$	$1_1, 1_2, 1_3$ $2_1, 2_2, 2_3$
Total Juv.	Mon.	14,600			9,100
	Tues.	12,700		7,400	
	Wed.		9,200		16,700
	Thurs.	11,400		15,500	
	Fri.	______	9,700	______	13,200
	Total	38,700	18,900	22,900	39,000
	Avg.[b]	12,900	9,500	11,500	13,000

[a] *The number defines the turbine unit (one of 22 numbered from west to east) and the subscript defines the particular gate (one of three per turbine unit numbered from west to east).*

[b] *15 hr test (0700-2200 daily).*

During 1979 we wanted to determine if we could reduce the number of hours the sluiceway operated and still maintain a high passage efficiency. We tested 24-h operation against 16 continuous h and 12 intermittent h (Table 3). Sixteen-hour operation was from 6 AM-10 PM and 12-h operation was from 5 AM-8 AM, 10 AM-3 PM, 5 PM-7 PM, and 9 PM-11 PM. Because there were large differences in daily fish passage during the period of these tests, we examined the percentage change in fish passage between consecutive days. We found no change in average daily passage between 24- and 16-h operation (-0.5% change, 95% CI = $\pm$ 22.1%). We did find, however, that daily passage decreased significantly ($p \leq 0.05$) during 12 h operation by an average 28.5% (95% CI = $\pm$15.5%). This magnitude of decrease in passage is not acceptable. Average hourly passage distributions were determined for the 12-h, 16-h, and 24-h periods tested (Fig. 5). All three were similar with passage peaking during the middle of the day. This is the same result we found with the 1978 diel distribution (Nichols 1979).

In terms of total quantity of water used, 16-h operation with 3,250 cfs (91 m^3/s) (3 gates, full surface flow at a midpoint forebay elevation of 157.5' [48 m]) is about the same as standard operating criteria, 24-h operation with 2,140 cfs (59.9 m^3/s) (4 gates, 2' submerged opening at a 157.5' [48 m] forebay). However, with about the same total quantity of water used per day (4,298 and 4,245 acre feet [53,014 and 52,360 hectare m] with 16- and 24-h operation, respectively), overall collection efficiency may be increased by increasing flow for 16 h.

Table 3. Estimated daily passage of juvenile salmonids through The Dalles trash sluiceway with 12-, 16-, and 24-h operation during 1979

16[a] hour vs. 24 hour				12[b] hour vs. 24 hour			
	Estimated Passage				Estimated Passage		
Date	16 h	24 h	% change[c]	Date	12 h	24 h	% change[c]
4/30-5/4				5/22-5/25			
M	21,500		--	M	--	--	--
Tu		22,300	4	Tu	120,700		--
W	24,000		-8	W		145,400	17
Th		20,000	-20	Th	108,700		25
F	29,500		-48	F		116,700	7
5/14-5/18				6/11-6/14			
M	65,300		--	M	12,800		--
Tu		63,800	-2	Tu		23,400	45
W	41,900		34	W	15,000		36
Th		57,200	27	Th		25,400	41
F	67,800		-19	F	--	--	--
			mean -0.5% 95% C.I.= ±22.1%				mean 28.5% 95% C.I. = ±15.5%

a *16-hour test 0600-2200 daily.*

b *12-hour test 0500-0800, 1000-1500, 1700-1900, 2100-2300 daily.*

c *Percentage change = ([24 h total - 16 or 12 h total] ÷ 24 h total) x 100.*

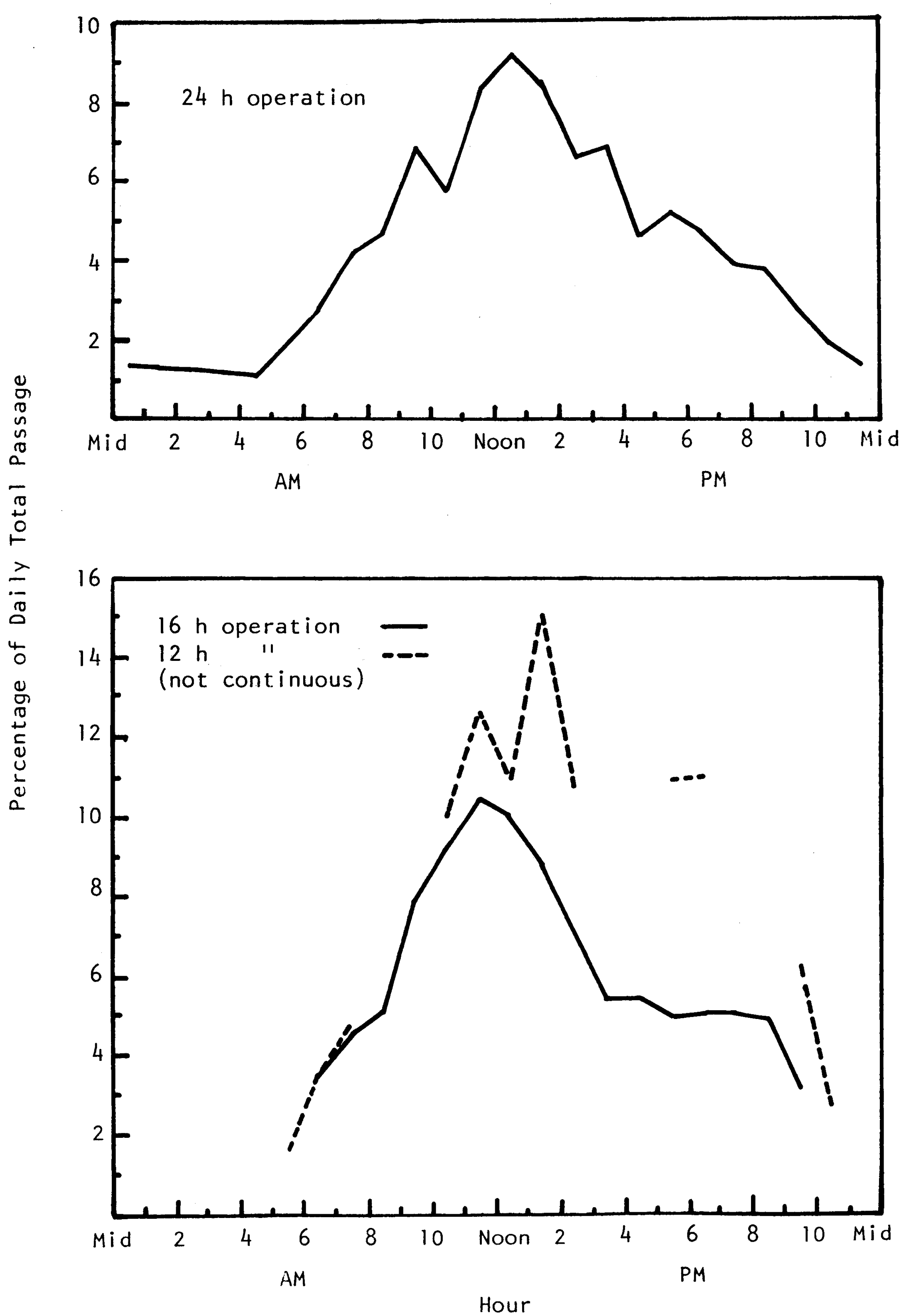

Fig. 5. Hourly passage distributions of yearling salmonids through The Dalles sluiceway with 12-, 16-, and 24-h operation during 1979

Objective 3. Determine the Numbers of Juvenile Salmonids Using the Sluiceway in July and August.

The sluiceway is normally run with its full surface skimming attraction from March 1-June 30 each year. However, with the completion of several large storage projects in recent years and the subsequent reduction in transportation flows to move downstream migrants, there has been concern as to whether June 30 is late enough to protect the later running fall chinook. We continued to operate the sluiceway into August and make passage estimates of all downstream migrants. Between July 1 and August 17, 1979, we passed an additional 1,334,000 fish, primarily subyearling chinook, through the sluiceway (Table 4). Consequently, it is strongly recommended that sluiceway operation continue through mid-August to pass subyearling chinook.

Objective 4. Determine the Optimum Gate Settings for Sluiceway Passage of Subyearling Chinook.

Our studies suggest that sluiceway passage for yearling salmonids is maximized with the largest surface flow possible through several gates open on the west end of the sluiceway (Units 1 and 2). However, these gates may not be the best for the more strongly shore oriented subyearling chinook. We wanted to test an east gate setting (closer to Oregon shore) against Units 1 and 2. Gate 22 is the closest unit to the Oregon shore. Examination of the gatewell dipping data, however, suggested that Units 17 and 18 passed higher numbers of subyearling chinook than Units 21 and 22.

Therefore, we first tested four gates in Units 17 and 18 against four gates in Units 21 and 22 (Table 5). The gates in Units 17 and 18 passed about 150% more fish than Units 21 and 22 (a daily average of 10,100 and 4,100 fish, respectively). Although this difference was far from

Table 4. Total estimated passage of juvenile salmonids through The Dalles trash sluiceway, April 8-August 18, 1979

Date	Yearling chinook	Subyearling chinook	Coho	Sockeye	Steelhead	Total
April 8-14	34,500	--	100	200	10,400	45,200
15-21	54,200	--	--	400	14,500	69,100
22-28	51,300	400	100	500	35,000	87,300
29-May 5	94,400	1,300	--	3,100	64,100	162,900
6-12	182,700	2,900	300	19,200	62,000	267,100
13-19	301,000	6,900	--	41,500	83,200	432,600
20-26	393,200	47,100	4,500	230,300	80,100	755,200
27-June 2	207,200	138,100	135,300	169,100	69,800	719,500
3-9	48,600	254,500	7,100	67,900	18,700	396,800
10-16	13,200	78,400	1,400	28,700	9,300	131,000
17-23	9,800	87,500	200	15,600	3,900	117,000
24-30	4,200	80,700	--	4,400	1,700	91,000
July 1-7	--	117,600	--	3,900	1,400	122,900
8-14	--	155,600	--	2,400	300	158,300
15-21	--	247,600	--	5,300	300	253,200
22-28	--	293,700	--	900	--	294,600
29-Aug. 4	--	307,300	--	300	--	307,600
5-11	--	166,000	--	--	--	166,000
12-18	--	31,400	--	--	--	31,400
Total	1,394,300	2,017,000	149,000	593,700	454,700	4,608,700

Table 5. Estimated daily passage of subyearling chinook through The Dalles trash sluiceway with various combinations of gates open during 1979

Date	July 17-20		July 30-Aug. 3		Aug. 6-10	
Test	East Distribution		West vs East Distribution		West vs East Distribution	
	Unit 17	Unit 22	Unit 1	Unit 17	Unit 1	Unit 17
Gates Open[a]	$17_1, 17_2, 17_3, 18_2$	$21_3, 22_1, 22_2, 22_3$	$1_1, 1_2, 1_3, 2_1$	$17_2, 17_3, 18_1, 18_2$	$1_1, 1_2, 1_3, 2_1$	$17_2, 17_3, 18_1, 18_2$
Total Juv. Mon.				62,000		39,900
Total Juv. Tues.	7,500		12,900		12,500	
Total Juv. Wed.		2,600		28,400		27,500
Total Juv. Thurs.	12,700		48,900		20,000	
Total Juv. Fri.	____	5,500	____	34,700	____	21,500
Total Juv. Total	20,200	8,100	61,800	125,100	32,500	88,900
Total Juv. Avg.	10,100[b]	4,100[b]	30,900[c]	41,700[c]	16,300[c]	29,600[c]

[a] *The number defines the turbine unit (one of 22 numbered from west to east) and the subscript defines the particular gate (one of three per turbine unit numbered from west to east).*

[b] *8 hr test (0800-1600 daily).*

[c] *14 hr test (0800-2200 daily).*

statistical significance because of small sample size, we proceeded on the assumption that passage through Units 17 and 18 was greater than Units 21 and 22.

We then tested four gates in Units 17 and 18 against four gates in Units 1 and 2. Again Units 17 and 18 appeared to pass more fish (a daily average of 35,700 [95% CI = ±15,080] and 23,600 [95% CI = ±27,420], respectively). Again, our small sample size did not enable us to detect a statistically significant difference in passage between the two conditions; however, our test strongly indicates that passage of subyearling chinook is best through gates above Units 17 and 18. Fortunately, the majority of subyearling chinook show up after the passage of other species has peaked, so gate openings may be adjusted to favor yearlings in the spring (Units 1 and 2) and subyearling chinook later in the year.

Overall Sluiceway Passage of Juvenile Salmonids

The sluiceway was very effective in passing downstream migrants during 1979. Between April 10 and August 17, estimated passage for all species was over 4.6 million fish (Table 4). The passage of yearling salmonids, primarily spring chinook, peaked the 3rd week in May with over 3/4 million fish. The later migrating subyearlings (primarily fall chinook) peaked about the 1st week of August with over 300,000 fish. The weekly passage of all juvenile salmonids through the sluiceway is shown in Fig. 6, which clearly shows the seasonal peaks for yearling (May) and subyearling (July-August) fish.

Although determining overall sluiceway collection efficiency was not one of our objectives, it is interesting to consider. An indirect estimate based on estimated sluiceway and turbine passage is presented in Table 6. We estimated sluiceway passage at 3.1758 million fish (all species) from April 17 to June 27. We recovered 22,496 fish (all

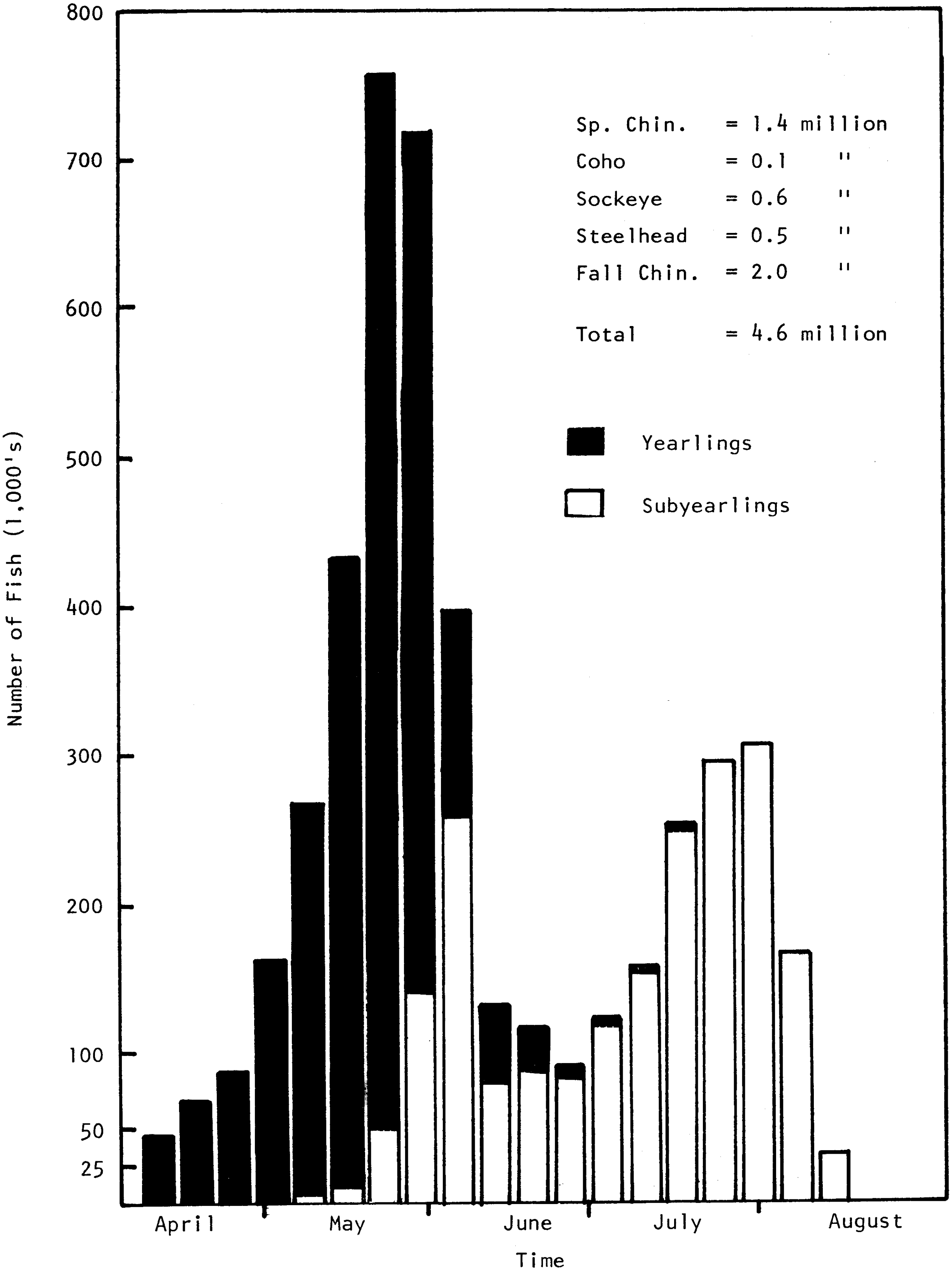

Fig. 6. Weekly passage of juvenile salmonids through The Dalles sluiceway during 1979

Table 6. Estimated collection efficiency of juvenile salmonids through The Dalles trash sluiceway during 1979.

Estimated sluiceway passage of all species juvenile salmonids April 17-June 27.	3,175,800
Actual gatewell recoveries of all species juvenile salmonids April 17-June 27.	22,496
Estimated turbine passage of all species juvenile salmonids April 17-June 27 assuming .039 recovery rate in gatewells (22,496/.039) a/.	576,800
Estimated project passage of all species juvenile salmonids April 17-June 27 (sluiceway + turbine).	3,752,600
Estimated sluiceway collection efficiency for all species juvenile salmonids combined April 17-June 27 (sluiceway passage/project passage)	84.6%

a/ *Raymond, Howard L. 1978. Effects of dams and impoundments on migration of juvenile chinook salmon and steelhead trout from the Snake River, 1966-75. Nat. Mar. Fish. Ser., unpub. rep.*

species) from the gatewells during the same period. Assuming a gatewell usage rate of .039 (Raymond, 1978), we estimate turbine passage at 576,800. Overall sluiceway efficiency is the percentage sluiceway passage (3.1758 million) of total project passage (3.7526 million) or 84.6%. The total yearling passage estimate at The Dalles (sluiceway passage/collection efficiency = 2.6 million/.846 = 3.1 million) agrees reasonably well with the NMFS population estimates to John Day (4.9 million) when a mortality of up to 35% due to passing John Day Dam and The Dalles pool is considered (.65 survival x 4.9 million = 3.185 million). Also, 84.6% agrees closely with the 78.3% estimate made at The Dalles in 1978 by the same method.

We also obtained an indication of sluiceway passage efficiency from studies by Aho et al., 1980. Aho released various groups of marked spring and fall chinook from Pelton Regulating Dam on the Deschutes River to evaluate different rearing techniques and times of release. Pelton Regulating Dam is about 111 mi (179 km) upstream from The Dalles Dam. From our mark recovery data they estimated passage of each group as it moved through the sluiceway. Up to 60% of some release groups were estimated to have passed through the sluiceway. These estimates further substantiate the high collection efficiency of The Dalles trash sluiceway, since mortality and residualism must certainly have reduced the actual numbers of these fish reaching The Dalles Dam.

While we were primarily interested in passing juvenile salmonids through the sluiceway, adult salmonids and other fish species were also passed. Each week we estimated the total miscellaneous species passing through the sluiceway (Table 7). It should be noted that a 3.5" (8.9 cm) square mesh metal grate was generally on the net frame entrance. This excluded most larger fish such as adult spring chinook. Therefore, actual passage of large fish was greater than we estimated. It should also be noted that the grate was not on at all times so large fish were captured during these periods. We estimated that over 30,000 squawfish passed through the sluiceway, primarily in late June and mid-July when large numbers of subyearling chinook were present.

CONCLUSIONS

1. Over 4.6 million downstream migrants passed through the sluiceway between April 10 and August 17, 1979.

Table 7. Estimated passage of miscellaneous species for The Dalles trash sluiceway, April 8-August 18, 1979

Date	Squawfish	Spring chinook Adult	Spring chinook Jacks	Adult steelhead Kelt	Adult steelhead Bright	Adult shad	Walleye	Use of net grate 1/
4/8-14	315			63				On
4/15-21	102			51				On
4/22-28	187			187				On
4/29-5/5	316			225	45			On
5/6-12	343	296		757			59	On through 5/9, off 5/10-12
5/13-19	455	1,194		2,218	228			Off
5/20-26	641	881		2,563	240		80	Off
5/27-6/2	623	125	125	499				On
6/3-9	933		35	242			35	On
6/10-16	1,770	401		134		3,806	67	On 6/10 through noon, off rest
6/17-23	5,628	180	90	180	270	15,172	45	Off
6/24-30	8,405	433	260	260	260	45,405		Off
7/1-7	4,731					75,692		On
7/8-14	274		137			14,645		On
7/15-21	110					1,754		On
7/22-28	3,140					11,841		On
7/29-8/4	1,509		56			17,602		On
8/5-11	951					10,005		On
8/12-18	26					386		On
Total	30,459	3,510	703	7,379	1,043	196,308	286	

1/ *3.5" (8.9 cm) x 3.5" (8.9 cm) square mesh metal grate was periodically placed on net frame entrance.*

2. There was no difference in sluiceway passage between three and six gates when all gates were fully opened.

3. There was no difference in sluiceway passage between 24- and 16-continuous h operations, but 12-intermittent h operation decreased fish passage by an average 28.5% over 24-h operation.

4. Over 1.3 million downstream migrants, primarily subyearling chinook, passed through the sluiceway between July 1 and August 17, 1979, during a time when the sluiceway is not normally operating.

5. Sluiceway collection efficiency for subyearling chinook was highest with gates open in Units 17 and 18, as compared to Units 21 and 22 or Units 1 and 2.

RECOMMENDATIONS

1. Present operating criteria for passing juvenile salmonids through The Dalles sluiceway calls for a 4-month operation (March 1-June 30), 24 h per day with 2' submerged openings on gates 1_1, 1_2, 2_1, and 22_3 which produces an average flow of about 2,140 cfs (59.9 m^3/s). To maximize the number of juvenile salmonids passed by the sluiceway and save water, we recommend it be operated April 1-August 15 (4½ months), 16 h per day (0600-2200), with maximum overflow weir on gates 1_1, 1_2, and 1_3 April 1-June 15 and gates 17_3, 18_1, and 18_2 June 16-August 15. These openings produce an average flow of about 3,250 cfs. These recommendations may be modified as more data are collected with ongoing research.

2. Further research on sluice gate openings, flow, and diel passage distribution is needed before we can develop definitive operating criteria for the sluiceway. We need to determine at what time it is appropriate to switch from west to east gate openings. We

also need to determine the relationship between flow and sluiceway passage so that optimum flow can be identified.

3. The sluiceway was very effective as a surface skimming bypass system with about an 80% collection efficiency. The Corps should consider developing portable or fixed skimmers at other projects where there are not safe passage conditions for downstream migrants such as John Day Dam.

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