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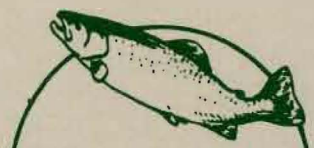
EFFECT OF FISHWAY SLOPE ON RATE OF PASSAGE OF SALMONIDS



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UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

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Fish and Wildlife Service, Arnie J. Suomela, Commissioner
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by

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by
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ABSTRACT

This study on the effect of fishway slope on rate of passage of salmonids was made by comparing passage time of fish in two fishways with different slopes. It is based mainly on steelhead *(Salmo gairdneri)* but includes some chinook *(Oncorhynchus tshawytscha)* and silver *(Oncorhynchus kisutch)* salmon. Both fishways were pool-and-overfall type in which 6 feet of elevation was gained. Passage of steelhead in the 1:8-slope fishway was in general, as fast as or faster than in the 1:16-slope fishway. In the 1:8-slope fishway, the passage time appeared to increase with an increase in rise between pools. In the 1:16-slope fishway, the passage time of steelhead increased as the season progressed.

Slope, inasmuch as it determines the length of a fishway, is one of the key features in fishway design. Three slopes have been used for fishways at dams on the Columbia River during the past 25 years but little or no research has been done to determine which is the most effective. Rock Island Dam fishways have a 1:10 slope, Bonneville and The Dalles Dam a 1:16 slope, and McNary Dam a 1:20 slope. A 1:16 slope has apparently come to be accepted as the standard for fishways at major dams on the Columbia River.

Slope is also one of the main factors in fishway cost. Construction costs have been increasing steadily in recent years. Bonneville Dam fishways, built in the 1930's, cost $7,500,000[2] but The Dalles Dam fishways, completed recently, cost $18,200,000.[3] Fishway costs range from 6 to 16 percent of the total cost of dams on the Columbia and Snake Rivers.

A study to determine the effect of slope on the passage of salmonids is now in progress at the Fisheries-Engineering Research Laboratory at Bonneville Dam. The objectives of this phase of the study are to determine (a) the effect of slope on the rate of passage of salmonids in fishways and (b) other factors that affect rate of passage of salmonids in a fishway. This study is extremely important because slope

[1] Research financed by the U.S. Army Corps of Engineers as a part of a broad program of Fisheries-Engineering Research for the purpose of providing design criteria for more economical and more efficient fish-passage facilities at Corps projects on the Columbia River.

[2] Statement by the Fish and Wildlife Service in response to request, dated November 20, 1953, of Senator Styles Bridges, Chairman, Senate Appropriations Committee, for information on the abundance, distribution, and value of the Columbia River fish runs, the effect of dams on these runs, and certain other related information. U.S. Fish and Wildlife Service, Office of Regional Director, Portland, Oregon. 41 pages, mimeographed.

[3] U. S. Corps of Engineers.

is a major factor in fishway cost. If a steeper slope fishway is found to pass salmonids as efficiently as the standard 1:16-slope fishway, substantial savings in the cost of future fishways will be realized.

The assistance of Dr. Gerald B. Collins and Carl H. Elling in planning these experiments and reviewing the manuscript is gratefully acknowledged. Biologists of the Biometrics Unit of the Seattle Biological Laboratory[4] assisted in the statistical analysis of the data. Corps of Engineers personnel of the Hydraulic Laboratory at Bonneville Dam advised on hydraulic problems encountered. The following individuals participated in the experiment: Richard L. Foust, Robert J. Holcomb, James S. Johnson, Howard L. Raymond, Edwin F. Roby, Robert S. Rupp, and Charles R. Weaver. Credt is due Virginia Coleman for the illustrations and Charles R. Weaver and Edwin F. Roby for the photographs. Acknowledgment is made to Milo C. Bell, who reviewed the manuscript and offered suggestions on its preparation.

EXPERIMENTAL EQUIPMENT

Laboratory

This study was made in the Fisheries-Engineering Research Laboratory at Bonneville Dam during the 1956 fish-migration season. Although it is possible to test full scale fishways in this laboratory, fishway length and gain in elevation were limited in this study by the necessity of using prefabricated fishways that could be readily disassembled. The main features of the laboratory are a collection pool, experimental area, and flow-introduction pool. Fish, diverted from the Washington shore fishway into the collection pool, pass through the experimental area and then are free to continue through the flow-introduction pool into the exit fishway and return to the Washington shore fishway. The fish are not handled during their entrance or exit.

The collection pool was 24 feet wide and 30 feet long and had a water depth of 14 feet during the course of the experiments. A picketed divider at the upstream end controlled the entry of fish into the fishways. The experimental flume (24 feet wide and 104 feet long) was divided into two channels by a center wall. A fishway was installed in each channel. The water supply for the fishways enters through a diffusion chamber at the bottom of the flow-introduction pool. The water comes from the Bonneville forebay through a large pipe into a valve chamber where sliding gate valves control the flow of water entering the diffusion chamber. A detailed description of the laboratory is given by Collins.[5]

Fishways

The test and control fishways were constructed side by side in the experimental flume. The slope was 1:16 in the control (Types 1 and 1A) fishway and 1:8 in the test (Types 2-4) fishway. Both were pool-and-overfall type fishways without submerged orifices. Figure 1 and table 1 give physical comparisons of the test and control fishways.

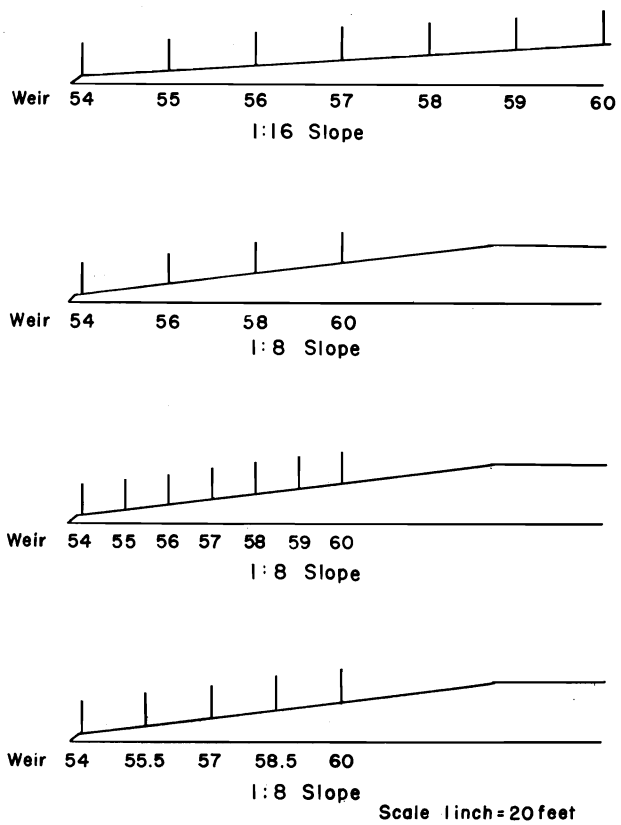

Figure 1.--Diagram of control fishway (top) and the three test fishways, comparing relative distance travelled and gain in elevation. (Weir numbers are elevation of weir above mean sea level).

[4] Formerly Pacific Salmon Investigations.

[5] Collins, Gerald B. Research on fish passage problems. Manuscript in preparation.

Table 1.--Dimensions of fishways used in the slope studies, July to September 1956.

Type	Slope	No. of pools	Pool length	Pool width	Mean pool depth	Rise between pools	Elev. gained
			Feet	Feet	Feet	Feet	
1	1:16	6	16.00	11.5	6.3	1.0	6
1A	1:16	6	16.00	6.0	6.3	1.0	6
2	1:8	6	8.00	11.5	6.3	1.0	6
3	1:8	4	12.00	11.5	6.05	1.0	6
4	1:8	3	16.00	11.5	5.8	2.0	6

One-thousand-watt mercury-vapor lamps suspended 6 feet above the water provided light at an average intensity at the surface of 700 foot candles and in a range from 300 foot candles along the wall to 1000 foot candles directly under the lights.

The head on the weirs, measured 4 feet upstream of the weir crests, was held at 0.8 foot to maintain uniform flow conditions in both fishways. A greater head tended to change the flow at the upper weirs from plunging to streaming at unpredictable times, which interrupted the passage of fish (Elling and Raymond 1959).

PROCEDURE

Types of Tests

Two types of tests were made: one to obtain passage times for individual fish and the other to obtain a passage time for groups of 20 fish. Only salmonids were used for both tests, and only a single species in group tests.

Release of Fish

After the fish entered the release compartment (figure 2) from the collection

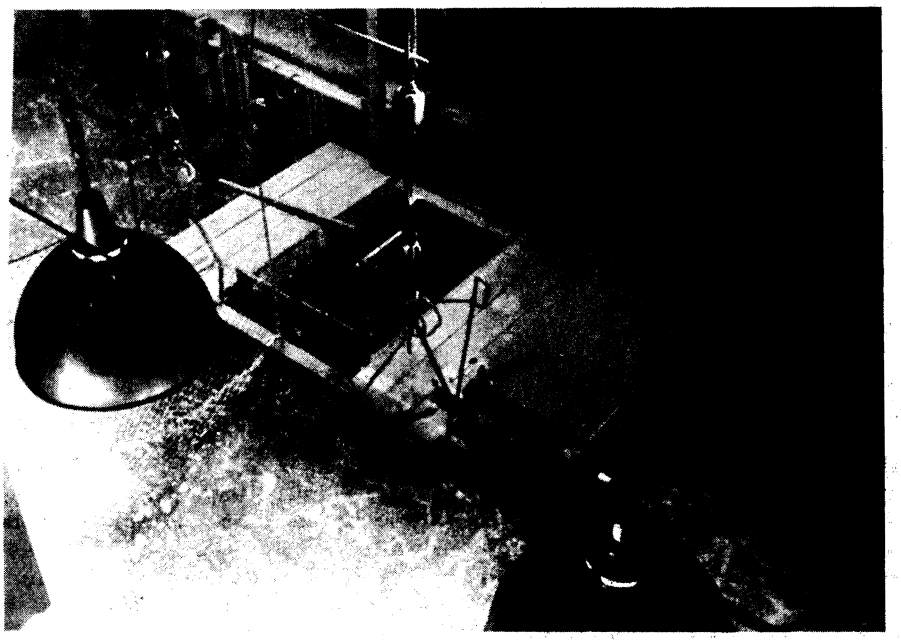

Figure 2.--Release compartment used to identify and release fish.

pool, we recorded species and length and then released the fish into either the test or control fishway. When groups of 20 fish were used, releases of one fish at a time were made alternately into the test and control fishways as rapidly as possible until 20 fish had been introduced into each fishway. Species not used in the tests were returned to the collection pool by use of a brail in the release compartment. When individual fish were timed, the fish passed entirely through the fishway before another was introduced.

Timing of Fish

Timing started when the fish entered the fishway at weir 54[6] and ended when they left at weir 60. Individual fish were timed with stopwatches. Two persons timed fish in each fishway. One recorded total time, and the other recorded the time spent in each pool. Groups were timed with a 20-pen recorder (figure 3). A push button at each counting point activated a pen which recorded the passage of a fish. Counting of fish was done visually.

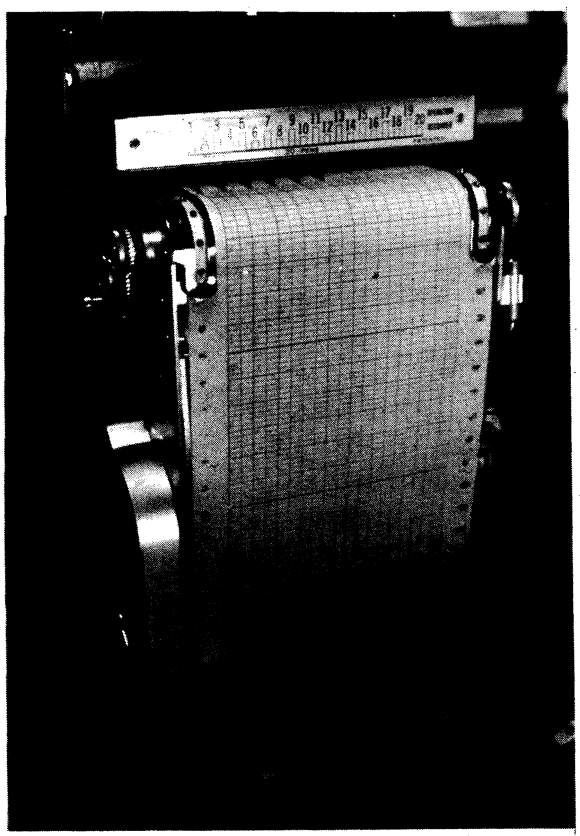

Figure 3.--Twenty pen recorder. (Note six pens are in operation).

[6] Weir numbers refer to elevation above mean sea level.

Analysis of Passage Time

Passage time was used as a basis for comparing the 1:8-slope fishway with the 1:16. The median was the measure used to compare the passage times of individuals and a table of confidence intervals was used to test for differences between medians (Dixon and Massey 1951). A measure termed median elapsed time was used to compare passage times of groups. This measure was determined as follows: time was recorded for each fish as it entered the fishway at weir 54, with the recorder starting at zero when the first fish crossed weir 54. The time from zero was also recorded on the same chart as each fish crossed weir 60 when leaving the fishway. The median elapsed time was then determined by subtracting the time of the median fish at weir 54 from the time of the median fish at weir 60. A t test was used to test for differences between the means of the median times.

Use of the measure, median elapsed time, made it possible to terminate a given test even though some of the slower moving fish had not completed their ascent of the fishway. To have obtained an arithmetic mean of the passage times for each group, it would have been necessary to account for the passage of all fish through the fishway, a condition which on occasion would have necessitated considerable delay in testing. In these experiments, all remaining fish were readily removed from the fishway and a subsequent test was begun as soon as the fishway was cleared.

RESULTS

1:16 Slope, 1.0-foot Rise

Prior to comparing ascent times in fishways of different slopes, two identical 1:16 slope (Type 1) fishways (figure 4) were constructed in the experimental flume. If passage times were comparable in both fishways, then any difference found after slope had been altered would be ascribed to the difference in slope.

Six groups of 20 steelhead (*Salmo gairdneri*) and 6 groups of 30 steelhead were timed up each fishway (table 2). An analysis of variance indicated no significant difference existed between the means of the median elapsed times of the north and south fishways, or between the means of the 20- and 30-fish groups.

Figure 4.--The two 1:16-slope fishways in the experimental flume.

Table 2.--Comparison of steelhead passage time in identical 1:16-slope fishways, July 24-27, 1957.

Date	No. of fish in group	Median elapsed time	
		South fishway	North fishway
		Minutes	Minutes
July 24	20	6.67	3.20
July 24	20	8.48	6.65
July 25	20	8.68	5.92
July 26	20	6.45	8.30
July 26	20	11.73	7.22
July 27	20	9.17	8.97
Mean		8.53	6.71
July 25	30	6.82	7.00
July 25	30	9.25	8.93
July 26	30	10.25	7.97
July 26	30	5.92	7.17
July 27	30	9.43	8.10
July 27	30	7.55	7.72
Mean		8.20	7.82

1:8 Slope, 1.0-foot Rise

This test fishway (figure 5) had a 1:8 slope with a 1.0-foot rise between pools. It is listed as Type 2 in table 1. The control fishway was Type 1.

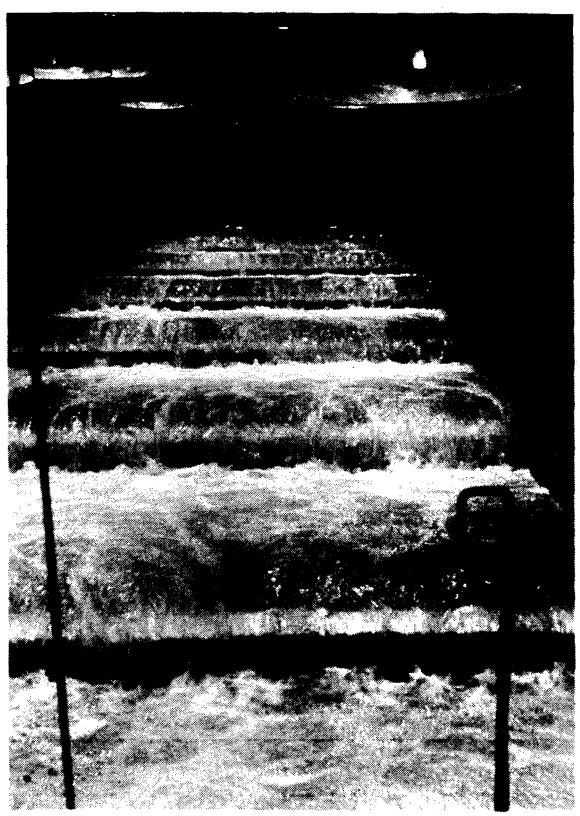

Figure 5.--The 1:8-slope fishway with a 1.0-foot rise between pools.

Steelhead.--Twelve groups of 20 steelhead were timed in each fishway (table 3). The mean of the median elapsed times in the test fishway was 10.21 minutes, and in the control, 15.42 minutes. A *t* test on the means of the median elapsed times indicated that passage time was significantly lesser in the test fishway. Passage times of the individual steelhead timed in these fishways are shown in appendix tables 1 and 2. The median passage time in the test fishway was less than that in the control fishway but the samples were too small to make a statistical test for significance.

Chinook.--Chinook salmon were not abundant enough at this time of year to make group releases. Five individual chinook were timed in the test fishway and three in the control fishway (appendix tables 3 and 4). The passage times were less in the test fishway than the control in this small test.

Table 3.--Passage times of 12 groups of 20 steelhead timed in each fishway, August 15-20, 1956.

Date	Median elapsed time	
	Control fishway (Type 1)	Test fishway (Type 2)
	Minutes	Minutes
August 15	12.18	10.85
August 15	15.97	9.18
August 15	17.28	10.57
August 16	12.17	12.22
August 16	14.85	10.00
August 16	16.65	12.20
August 16	14.38	6.90
August 17	14.90	8.03
August 17	18.63	10.83
August 17	21.80	9.58
August 20	13.15	11.97
August 20	13.07	10.20
Mean	15.42	10.21

1:8 Slope, 1.5-foot Rise

This test fishway had a 1.5-foot rise between pools (figure 6). It is listed as Type 3 in table 1. The control fishway was Type 1. The species composition of the fish run at this time of the season made it impossible to use a group release technique, so tests were conducted with individual fish.

Steelhead.--Sixty-seven steelhead were introduced into the fishways from August 24 to August 29, 37 in the test fishway (appendix table 5) and 30 in the control fishway (appendix table 6). The median passage time was 9.67 minutes in the test fishway and 13.72 minutes in the control. A table of confidence intervals for the median did not show a significant difference between the median passage times of the two fishways.

Other studies necessitated reducing the control fishway width to 6 feet (figure 7) (Type 1-A). The test fishway was not changed. On September 4, 5, and 6, passage times of 21 steelhead were obtained in the test fishway (appendix table 7) and 28 in the control (appendix table 8). The median passage time was 10.90 minutes in the test fishway and 11.93 minutes in the control, thus indicating no significant differences in times between the two fishways.

Chinook.--Forty-two chinook salmon were introduced into the fishways from August 24 to August 29, 18 in the test fishway (appendix table 9) and 24 in the control (appendix table 10). The median passage time was 14.40 minutes in the test fishway and 8.32 minutes in the control fishway. A table of confidence intervals for the median indicates that this is a significant difference.

On September 4, 5, and 6, 24 chinook were introduced into the test fishway (appendix table 11) and 23 chinook into the six-foot-wide control fishway (appendix table 12). The median passage time was 10.83 minutes in the test fishway and 6.67 minutes in the control. The median time the salmon spent in the control fishway was less, but a table of confidence intervals for the median indicates that the difference between median passage times was not significant.

Silvers.--Five silver salmon were tested in the 11.5-foot-wide control fishway and 9 in the test fishway (appendix tables 13 and 14). The median passage time in the test fishway was less but statistical tests were not made.

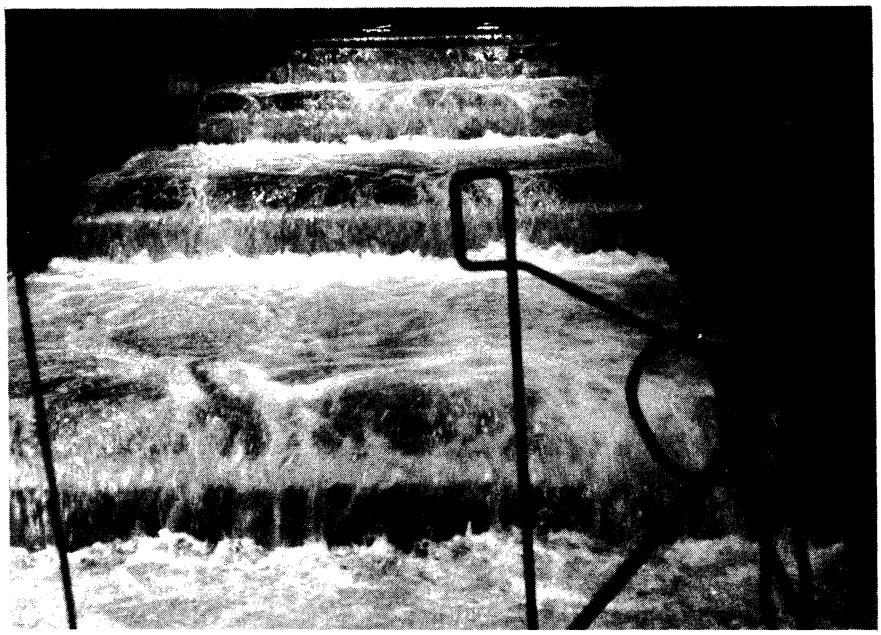

Figure 6.--The 1:8-slope fishway with a 1.5-foot rise between pools.

Figure 7.--The 1:16-slope fishway with the width reduced to 6 feet.

1:8 Slope, 2.0-foot Rise

This test fishway (Type 4) had a 2.0-foot rise between pools (figure 8, Type 4). The control fishway was Type 1 as listed in table 1.

Twelve groups of 20 steelhead were tested in each fishway (table 4). The mean of the median elapsed times of the test fishway was 14.28 minutes and of the control, 12.73 minutes. A t test on the

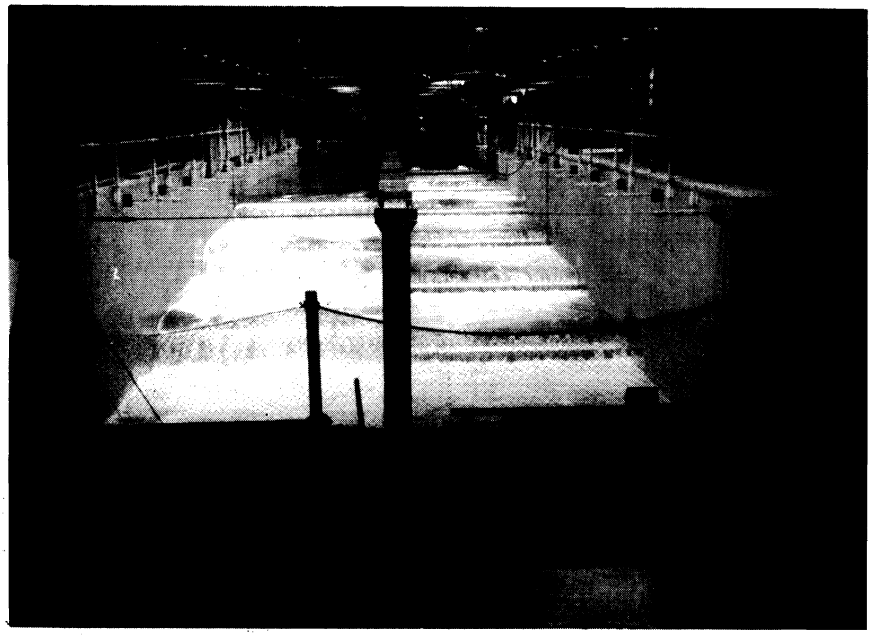

Figure 8.--The 1:8-slope fishway with a 2.0-foot rise between pools on the left and the 1:16-slope fishway with a 1.0-foot rise between pools on the right.

means of the median elapsed times showed that the difference was not significant.

Table 4.--Passage times of 12 groups of 20 steelhead timed in each fishway, August 7-10, 1956.

Date	Median elapsed time	
	Control fishway (Type 1)	Test fishway (Type 4)
	Minutes	Minutes
August 7	14.97	14.37
August 7	13.03	11.92
August 7	8.80	10.92
August 8	12.02	19.12
August 8	12.98	12.10
August 8	18.72	16.62
August 9	12.08	17.58
August 9	8.38	9.75
August 9	11.28	16.63
August 9	15.78	15.77
August 10	11.67	15.72
August 10	13.00	10.80
Mean	12.73	14.28

On August 6, 8 individual steelhead were tested in the control fishway and 15 in the test fishway (appendix tables 15 and 16). The median passage time was 12.36 minutes in the control fishway and 12.52 minutes in the test fishway indicating no significant difference between passage times in the two fishways.

Despite the fact that no significant difference could be shown between passage times in the 2 fishways, there are indications that the test fishway was the more difficult to ascend. It was noted that some fish required more than one attempt to go over a weir. We observed this difficulty in the group tests but only in the individual tests could we obtain a complete record. Of the 15 individuals in the test fishway on August 6, 6 passed the 3 weirs with only one attempt at each weir. The remaining 9 required more than one attempt to go over a weir somewhere in the fishway. The maximum number of attempts at a weir by the same fish was six. The 15 fish averaged 1 1/3 attempts in crossing the weir. None of the eight fish in the control fishway required more than one attempt to cross a weir.

Other Factors Affecting Passage Time

There are numerous factors which possibly influence passage time of sal-

monids. Some of these are discussed briefly in the following section.

Length of fishway.--It was theorized that if length of fishway influenced time per pool, a fish would spend a progressively longer time in each pool as it ascended the fishway. An analysis of variance was made on the pool times of individual chinook salmon and steelhead tested in August and September in both the control and test fishways. There was no significant difference between the means of the pool times (appendix tables give mean pool times). This is not conclusive but admits two possibilities: (1) the higher variances within pools obscured any differences occurring between pools, or (2) the fishways were too short to detect a tiring effect. Additional studies are planned to explore both possibilities.

Seasonal variation.--Data on seasonal variation in passage time are limited to three periods throughout the season when groups of steelhead were tested in the control fishway (July 24-27, August 7-10, and 15-20). There are passage times of 12 groups of steelhead in each of the 3 periods for testing (table 5). An analysis of variance shows a significant difference between the mean times.

Table 5.--Passage times of groups of steelhead in the control fishway (Type 1), July and August 1956.

Median elapsed time		
July 24-27	August 7-10	August 15-20
Minutes	Minutes	Minutes
6.67	14.97	12.18
8.48	13.03	15.97
8.68	8.80	17.28
6.45	12.02	12.17
11.73	12.98	14.85
9.17	18.72	16.65
6.82	12.08	14.38
9.25	8.38	14.90
10.25	11.28	18.63
5.92	15.78	21.80
9.43	11.67	13.15
7.55	13.00	13.07
Mean 8.37	12.73	15.42

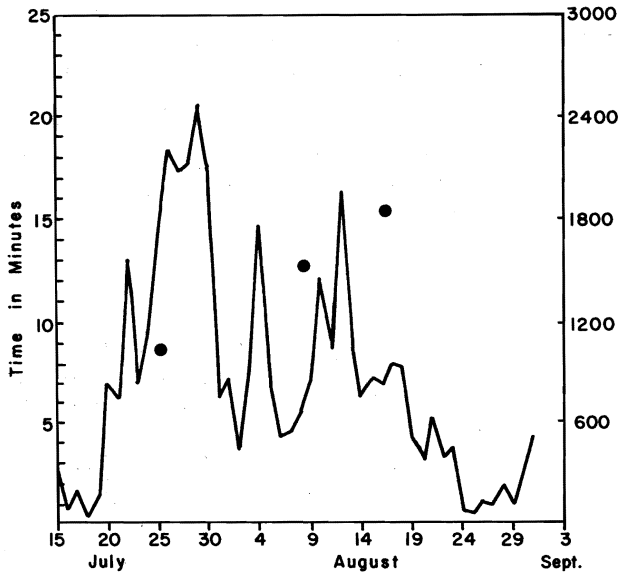

Figure 9.--Mean of median elapsed time (round dots) of three series of groups of steelhead in the 1:16-slope fishway plotted against time of year. Also indicated is the daily count of steelhead (solid line) in the Washington shore fishway for the period July 15-September 1, 1956.

The means of the medians of the three series were plotted against time of year (figure 9). The three points indicate a direct correlation between the median passage time and the number of days elapsed from the start of the run; i.e., steelhead moved progressively slower as the season advanced. Daily counts of steelhead passing through the Washington shore fishway are presented to show the distribution of the run with respect to season.

Time of day.--The median elapsed times of group tests of steelhead made in July and August were divided into morning (8:00 a.m. to 12:00 noon) and afternoon (12:01 p.m. to 4:30 p.m.) periods (table 6).

Although differences existed between fishways, and within fishways at different times, no differences can be shown between morning and afternoon periods in the same fishway on the same dates.

Rise between pools.--There is some evidence that the magnitude of rise be-

tween pools affects passage time in a fishway of a given slope. In the 1:8-slope fishway, three rises between pools (1.0, 1.5, and 2.0 feet) were under study during the season. A fairly large group of fish was timed up the fishway for each rise. Although species composition of each group was not the same (see table 7), it is believed that the median elapsed times may be compared as each time would reflect the passage time, in general, of the fish passing Bonneville during that period. Figure 10 indicates a direct relationship between height of rise between pools and passage time required to ascend a total rise of 6 feet.

Table 6.--Passage times of groups of steelhead in morning and afternoon periods in both fishways, July and August 1956.

	South fishway		North fishway	
	Morning	Afternoon	Morning	Afternoon
	Minutes	Minutes	Minutes	Minutes
July 24-27	8.59	8.08	7.83	6.70
Aug. 7-10	12.02	13.43	14.56	13.99
Aug. 15-20	15.09	16.05	10.56	9.71
Mean 1/	12.22	12.09	10.90	10.19

1/ Number entering fishway; species composition is based on fish leaving fishway during test period.

Table 7.--Passage times and species composition of three groups of fish ascending three variations of a 1:8-slope fishway for a total rise of 6 feet, August 1956.

Date	Rise between pools	Number of 1/ fish	Median elapsed time	Species composition				
				Chinook	Steel-head	Silver	Blue-back	Other 2/
	Feet		Minutes	Number of fish				
8/21	1.0	291	10.63	108	144	-	-	26
8/30	1.5	255	21.61	92	68	48	-	1
8/10	2.0	203	32.47	32	110	-	1	3

1/ Number entering fishway; species composition is based on fish leaving fishway during test period.

2/ Suckers (Catostomus sp) and squawfish (Ptychocheilus sp).

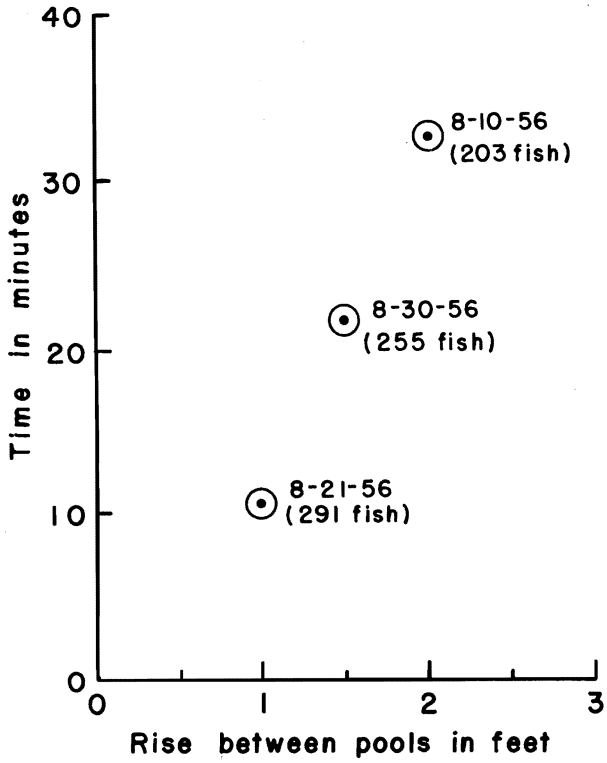

Figure 10.--Comparison of fish ascent (groups of mixed species) in three variations of a 1:8-slope fishway. Ascent plotted as median elapsed time to complete a total rise of 6 feet.

Further evidence is found by comparing passage times of groups of steelhead in the 1:8-slope fishway. The mean time of 12 groups of 20 steelhead was 10.21 minutes in the fishway with a 1.0-foot rise between pools and 14.28 minutes with a 2.0-foot rise between pools.

SUMMARY

The effect of fishway slope on the rate of passage of salmonids was studied at the Fisheries-Engineering Research Laboratory at Bonneville Dam by comparing passage times of fish in a 1:8-slope fishway with passage times in a conventional 1:16-slope fishway. Both fishways were short segments of pool-type fishways without submerged orifices. There was a 6-foot gain in elevation to each fishway.

Steelhead passage times were significantly shorter in the 1:8-slope fishway with a 1.0-foot rise between pools than in the 1:16-slope fishway with a 1.0-foot rise between pools. No significant difference was found in the passage times of steelhead in the 1:8-slope fishway with a 1.5-foot rise between pools and in the 1:16-slope fishway with a 1.0-foot rise between pools. No significant difference was found in the passage time of steelhead in the 1:8-slope fishway with a 2.0-foot rise between pools and in the 1:16-slope fishway with a 1.0-foot rise between pools but observations indicate the test fishway was more difficult to ascend.

Chinook salmon appeared to be slower in the 1:8-slope fishway with a 1.5-foot rise between pools than in the 1:16-slope fishway with a 1.0-foot rise between pools. Further studies are necessary before any clear-cut conclusions can be drawn with respect to chinook salmon passage in the 1:8-slope fishway.

Using time per pool as an index of fatigue, no tiring effect could be shown for chinook salmon and steelhead as they ascended either fishway.

No difference could be shown between median elapsed times of steelhead timed in the morning and in the afternoon.

In the 1:16-slope fishway, the rate of passage of steelhead decreased during the season, the earlier part of the run being faster.

In the 1:8-slope fishway there was a suggested direct relationship between passage time of groups of mixed species and the rise between pools.

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APPENDIX TABLE 1.--Steelhead ascent (time per pool and total time) in a 1:8-slope fishway,[1/] August 1956

Date	Time of day	Length[2/] (inches)	Pool time in minutes between weirs[3/] 54-55	55-56	56-57	57-58	58-59	59-60	Total[4/] time
August 14	11:00 AM	20							6.18[5/]
	11:16 AM	24	1.27	1.37	.57	2.20	2.33	1.48	9.22
	11:35 AM	20	.12	.93	.50	1.12	3.03	1.22	6.92
	12:57 AM	24	.63	.07	.07	.03	.73	7.87	9.40
	1:20 PM	26	1.05	1.67	1.83	1.22	.97	2.90	9.63
August 20	3:30 PM	24	2.52	.53	2.43	1.63	1.78	.37	9.23
	4:05 PM	20	.55	.60	5.28	3.27	2.92	3.00	15.62
	Mean		1.02	.86	1.78	1.58	1.96	2.81	9.46

1/ This was a 6 pool fishway with pools 8 feet long, 11.5 feet wide, and 6.3 feet deep. There was a 1.0-foot rise between pools.

2/ Length of fish was estimated.

3/ Weir numbers are based on elevation of weirs above mean sea level.

4/ May differ slightly from sum of pool times as it was taken independent of pool times.

5/ Pool times not taken.

APPENDIX TABLE 2.--Steelhead ascent (time per pool and total time) in a 1:16-slope fishway[1/], August 1956

Date	Time of day	Length[2/] (inches)	Pool time in minutes between weirs[3/] 54-55	55-56	56-57	57-58	58-59	59-60	Total[4/] time
August 14	11:10 AM	22	.46	.53	.42	.35	.37	1.08	3.17
	12:59 PM	28	4.20	10.90	1.70	4.78	1.70	.13	23.42
	1:30 PM	20	.80	1.18	1.10	.87	1.27	4.20	9.42
August 20	3:24 PM	18	1.35	.77	.67	2.42	2.07	5.18	12.45
	Mean		1.70	3.34	.97	2.10	1.35	2.65	12.12

1/ This was a 6 pool fishway with pools 16 feet long, 11.5 feet wide, and 6.3 feet deep. These was a 1.0-foot rise between pools.

2/ Length of fish was estimated.

3/ Weir numbers are based on elevation of weir above mean sea level.

4/ May differ slightly from sum of pool times as it was taken independent of pool times.

APPENDIX TABLE 3.--Chinook ascent (time per pool and total time) in a 1:8-slope fishway,[1/] August 1956.

Date	Time of day	Length [2/] (inches)	Pool time in minutes between weirs[3/] 54-55	55-56	56-57	57-58	58-59	59-60	Total[4/] time
August 14	10:50 AM	16							5.07[5/]
	1:37 PM	12							3.40[5/]
August 17	2:25 PM	36	3.67	.07	.13	.07	.02	.22	4.17
	2:45 PM	36	2.70	6.30	.12	.10	.03	.73	9.97
	3:00 PM	20	.13	3.30	.12	3.33	3.05	.18	10.12
	Mean		2.17	3.22	.12	1.17	1.03	.38	6.55

1/ This was a 6 pool fishway with pool 8 feet long, 11.5 feet wide, and 6.3 feet deep. There was a 1.0-foot rise between pools.

2/ Length of fish was estimated.

3/ Weir numbers are based on elevation of weirs above mean sea level.

4/ May differ slightly from sum of pool times as it was taken independent of pool times.

5/ Pool times not taken.

APPENDIX TABLE 4.--Chinook ascent (time per pool and total time) in a 1:16-slope fishway[1/], August 1956.

Date	Time of day	Length[2/] (inches)	Pool time in minutes between weirs[3/] 54-55	55-56	56-57	57-58	58-59	59-60	Total[4/] time
August 14	11:00 AM	20	3.58	3.08	.40	.73	1.07	.30	9.17
17	2:40 PM	30	5.33	.60	2.70	6.45	1.00	5.58	21.67
20	3:40 PM	13	3.85	1.48	.77	2.25	.52	.65	9.52
	Mean		4.25	1.72	1.29	3.14	.86	2.18	13.45

1/ This was a 6 pool fishway with pools 16 feet long, 11.5 feet wide, and 6.3 feet deep. There was a 1.0-foot rise between pools.

2/ Length of fish was estimated.

3/ Weir numbers are based on elevation of weir above mean sea level.

4/ May differ slightly from sum of pool times as it was taken independentof pool times.

APPENDIX TABLE 5.--Steelhead ascent (time per pool and total time) in a 1:8-slope fishway[1/]
August 1956

Date	Time of day	Length [2/] (inches)	Pool time in minutes between weirs [3/]				Total [4/] time
			54-55.5	55.5-57	57-58.5	58.5-60	
August 24	11:50 AM	26	.45	.30	3.35	.28	4.37
	12:02 PM	30	.38	.25	.12	.18	.95
	1:00 PM	18	1.22	2.07	3.92	7.07	14.28
	1:20 PM	26	.98	.28	.92	.15	2.33
	1:55 PM	30	1.32	1.97	5.25	4.33	12.83
	2:35 PM	18	.10	.50	11.15	.92	12.67
	3:15 PM	18	1.37	1.48	3.08	.23	6.13
	3:26 PM	20	.46	.75	2.03	4.03	7.27
August 27	8:40 AM	24	.67	.40	4.33	.13	5.53
	8:48 AM	18	.93	1.68	3.72	.22	6.55
	9:23 AM	20	1.63	8.57	4.35	10.75	25.28
	10:19 AM	16	.72	1.10	2.83	4.40	9.05
	10:55 AM	20	1.30	.57	3.43	4.13	9.42
	11:10 AM	22	1.32	2.72	3.46	2.20	9.67
	11:40 AM	24	23.87	2.42	6.38	.27	32.93
	12:38 PM	18	.28	1.53	1.63	2.46	5.92
	12:50 PM	14	.13	11.00	4.88	.45	16.46
	1:30 PM	20	7.28	.25	.33	1.07	8.92
	2:36 PM	24	2.50	3.52	1.37	1.68	9.07
	3:25 PM	28	.23	.46	.30	.20	1.20
	3:48 PM	34	.23	17.02	4.65	2.08	23.97
August 28	8:30 AM	18	.52	.53	.48	.67	2.22
	8:35 AM	24	1.12	1.50	3.63	1.33	7.58
	8:45 AM	20	1.37	2.73	.23	10.43	14.80
	10:30 AM	22	.15	.08	22.93	.13	23.32
	10:55 AM	14	3.03	5.20	2.68	1.52	12.43
	11:15 AM	15	.18	.20	22.68	.48	23.52
	11:40 AM	16					18.25 [5/]
	12:40 PM	12	.68	2.48	6.80	.72	10.70
	12:55 PM	22	1.98	2.60	4.20	4.08	12.87
	1:15 PM	18	5.70	4.97	3.43	1.85	15.95
	3:30 PM	16	.93	1.13	2.35	2.17	6.57
	3:45 PM	18	3.53	1.40	1.83	4.27	11.05
	4:00 PM	18	.80	1.50	5.82	4.15	12.23
August 29	3:15 PM	24	.45	1.03	.52	4.72	6.70
	3:25 PM	22	.67	.60	3.22	15.73	20.20
	3:55 PM	18	1.07	.42	1.58	1.43	4.48
	Mean		1.93	2.37	4.27	2.79	11.56

1/ This was a 4-pool fishway with pools 12 feet long, 11.5 feet wide, and 6.05 feet deep. There was a 1.5-foot rise between pools.

2/ Length of fish was estimated.

3/ Weir numbers are based on elevation of weir above mean sea level.

4/ May differ slightly from sum of pool times as it was taken independent of pool times.

5/ Pool times not taken.

APPENDIX TABLE 6.--Steelhead ascent (time per pool and total time) in a 1:16 slope fishway[1] August 1956

Date	Time of day	Length [2] (inches)	Pool time in minutes between weirs[3]						Total [4] time
			54-55	55-56	56-57	57-58	58-59	59-60	
August 24	11:35 AM	22	7.38	3.27	4.02	3.07	1.70	3.33	22.77
	1:15 PM	24	6.65	2.03	2.10	1.43	2.15	5.52	19.90
	1:50 PM	22	1.00	.83	3.08	2.03	1.43	1.07	9.46
	2:20 PM	26	2.28	2.12	2.07	1.45	.30	2.46	10.68
August 27	10:19 AM	20	.73	.78	.48	1.33	1.25	.87	5.43
	10:29 AM	22	2.97	4.78	3.33	2.52	1.10	1.08	15.73
	11:13 AM	26	16.10	1.85	1.37	2.15	1.07	1.88	24.40
	1:19 PM	16	.50	.46	.90	4.03	.63	4.45	10.98
	2:21 PM	22	.46	.23	.52	.18	5.23	2.60	9.23
	2:36 PM	14	.43	.97	1.10	1.12	1.65	2.50	7.75
	2:47 PM	18	11.40	3.53	3.78	1.25	1.72	1.75	23.42
	3:40 PM	24	1.48	2.93	.33	2.35	2.15	5.08	14.33
August 28	8:13 AM	20	2.07	.88	1.63	1.05	1.13	3.57	10.32
	8:41 AM	22	1.10	1.35	.57	2.46	.65	2.63	8.75
	8:56 AM	26	2.10	5.83	2.32	1.15	4.38	3.50	19.27
	9:28 AM	22	1.17	1.30	1.23	3.50	.13	3.90	11.25
	9:44 AM	24	1.00	2.23	1.87	1.70	2.33	3.97	13.10
	10:42 AM	24	7.67	3.27	1.20	2.80	5.10	7.20	27.23
	12:45 PM	24	5.00	3.38	1.08	.82	1.35	4.12	15.77
	1:05 PM	26	.25	5.55	4.35	1.58	.40	4.17	16.28
	1:26 PM	26	.22	.37	.10	.13	.12	19.45	20.37
	1:55 PM	22	.77	.28	.92	1.77	1.03	1.03	5.83
	2:35 PM	22	.83	.43	.33	.63	.55	.30	3.10
	2:44 PM	26	3.48	5.32	.87	1.42	3.55	4.87	19.52
	3:29 PM	24	.83	1.48	1.08	2.30	1.63	2.08	9.42
	3:41 PM	24	.80	1.55	1.32	2.40	.35	.92	7.33
	3:55 PM	26	3.53	3.52	2.63	1.40	2.42	4.23	17.72
August 29	2:00 PM	30	2.77	3.97	3.13	2.70	3.05	2.78	18.42
	3:32 PM	30							18.75 [5]
	4:10 PM	18	2.73	.75	1.38	2.80	1.27	.22	9.15
	Mean		3.02	2.25	1.69	1.85	1.72	3.50	14.78

1/ This was a 6-pool fishway with pools 16 feet long, 11.5 feet wide, and 6.3 feet deep. There was a 1.0-foot rise between pools.

2/ Length of fish was estimated.

3/ Weir numbers are based on elevation of weir above mean sea level.

4/ May differ slightly from sum of pool times as it was taken independent of pool times.

5/ Pool times not taken.

APPENDIX TABLE 7.--Steelhead ascent (time per pool and total time)in a 1:8-slope fishway [1]
September 1956.

Date	Time of day	Length [2] (inches)	Pool time in minutes between weirs [3]				Total [4] time
			54-55.5	55.5-57	57-58.5	58.5-60	
Sept. 4	8:54 AM	20	1.33	1.40	2.30	.18	5.23
	9:04 AM	24	.27	.23	2.53	7.98	11.00
	9:55 AM	28	1.40	1.73	2.40	3.03	8.60
	10:55 AM	32	4.55	7.93	9.08	5.46	27.05
	11:45 AM	30	.60	.37	6.27	3.32	10.55
	12:45 PM	28	1.25	1.05	1.70	6.92	10.90
	1:37 PM	26	.88	.08	3.03	.15	4.17
	1:48 PM	26	2.78	.95	2.50	.23	6.46
	3:25 PM	30	2.70	5.13	5.55	.50	13.97
Sept. 5	8:52 AM	28					8.44 [5]
	9:20 AM	20	2.23	.10	8.48	7.65	18.46
	10:28 AM	30	.43	.92	5.82	4.32	11.50
	2:29 PM	26	.37	.42	.23	2.43	3.46
	3:40 PM	24	11.25	6.03	3.18	4.33	24.80
Sept. 6	9:37 AM	30	2.67	4.00	5.13	9.50	21.32
	10:35 AM	30	.68	.43	8.45	2.82	12.37
	10:46 AM	28	.83	1.25	1.78	.13	4.02
	10:55 AM	24	3.10	2.48	2.52	2.15	10.23
	1:20 PM	26	3.22	3.67	3.97	4.00	14.85
	1:40 PM	20	2.18	2.33	.15	.13	4.82
	2:25 PM	30	1.18	2.15	3.18	5.93	12.43
	Mean		2.20	2.13	3.91	3.56	11.80

1/ This was a 4-pool fishway with pools 12 feet long, 11.5 feet wide and 6.05 feet deep. There was a 1.5-foot rise between pools.

2/ Length of fish was estimated.

3/ Weir numbers are based on elevation of weir above mean sea level.

4/ May differ slightly from sum of pool times as it was taken independent of pool times.

5/ Pool times not taken.

APPENDIX TABLE 8.--Steelhead ascent (time per pool and total time) in a 1:16-slope fishway 1/ September 1956.

Date	Time of day	Length 2/ (inches)	Pool times in minutes between weirs 3/						Total 4/ time
			54-55	55-56	56-57	57-58	58-59	59-60	
Sept. 4	9:55 AM	22							19.00 5/
	11:15 AM	34	.77	.43	4.07	.38	3.42	3.48	12.57
	11:43 AM	24	2.57	2.13	2.30	2.02	1.62	3.15	13.78
	12:45 PM	24	.30	.45	3.13	1.77	.63	.73	7.02
	2:00 PM	32	.92	.73	.35	4.46	.13	2.63	9.23
	3:32 PM	18	.43	.17	.20	.35	.22	.13	1.50
Sept. 5	8:50 AM	24	1.73	1.77	.40	.27	5.63	.20	10.00
	9:18 AM	18	.22	1.65	1.10	.80	1.22	1.02	6.00
	9:28 AM	24	1.78	4.10	1.53	3.62	2.08	1.93	15.02
	10:20 AM	18	1.63	.37	1.67	1.37	.13	1.37	6.53
	10:29 AM	18	2.46	.60	.28	7.28	.30	3.33	14.28
	10:55 AM	24	2.60	3.10	3.33	2.73	1.46	2.18	15.40
	11:18 AM	24	4.07	3.03	.38	.60	1.27	4.15	13.50
	11:36 AM	30	.78	.33	4.22	1.78	2.42	1.22	10.73
	12:45 PM	20	1.33	.46	9.00	3.08	.90	7.85	22.63
	1:13 PM	18	.73	.57	3.68	1.33	2.38	.27	8.98
	2:42 PM	29	1.03	1.63	2.92	1.67	4.43	2.58	14.27
	3:35 PM	20	.52	.53	.63	.18	.20	.57	2.60
	3:41 PM	24	1.12	.43	.27	1.07	.18	1.82	4.90
	4:00 PM	18	.15	1.22	1.18	23.20	.30	2.15	28.23
Sept. 6	9:37 AM	22	1.12	.57	1.03	.42	1.98	2.25	7.37
	9:50 AM	27	3.23	2.33	2.33	.60	2.27	.46	11.27
	10:34 AM	20	1.46	1.67	1.87	2.30	1.35	2.63	11.30
	11:15 AM	28	.40	.38	.60	11.93	.18	8.05	21.53
	1:10 PM	28							30.00 5/
	1:42 PM	26	2.40	23.42	3.46	2.40	2.85	2.20	36.70
	3:49 PM	24	2.33	3.50	2.62	4.63	2.40	3.07	18.55
	4:15 PM	28	.58	.30	.52	.83	.57	1.57	4.37
	Mean		1.41	2.15	2.04	3.12	1.56	2.35	13.83

1/ This was a 6-pool fishway with pools 16 feet long, 6 feet wide and 6.3 feet deep. There was a 1.0-foot rise between pools.

2/ Length of fish was estimated.

3/ Weir numbers are based on elevation of weir above mean sea level.

4/ May differ slightly from sum of pool times as it was taken independent of pool times.

5/ Pool times not taken.

APPENDIX TABLE 9.--Chinook salmon ascent (time per pool and total time) in a 1:8-slope fishway[1] August 1956.

Date	Time of day	Length [2] (inches)	Pool time in minutes between weirs [3] 54-55.5	55.5-57	57-58.5	58.5-60	Total [4] time
August 24	10:45 AM	30	6.62	40.23	6.98	.12	53.97
	12:07 PM	15	1.83	9.33	5.88	3.33	20.37
	12:30 PM	24	1.33	2.60	6.80	12.63	23.37
	1:31 PM	16	3.05	3.33	5.68	7.08	19.15
	2:14 PM	16	1.68	4.03	4.67	1.25	11.62
	3:40 PM	14	1.70	1.42	3.27	.30	6.68
August 27	9:00 AM	14	2.20	2.33	3.38	.20	8.12
	10:30 AM	12	3.22	2.40	4.38	4.57	14.53
	2:05 PM	30	2.90	5.90	9.75	6.70	25.27
	2:55 PM	16	.57	.57	1.33	.48	2.93
	3:31 PM	14	8.27	.75	2.22	1.92	13.13
August 28	9:05 AM	30	1.17	6.63	6.30	.15	14.27
	9:20 AM	32	2.02	7.82	5.57	9.35	24.75
	1:30 PM	38					45.75 [5]
August 29	1:40 PM	14	1.50	.82	2.17	.53	5.03
	1:49 PM	26	6.50	2.50	1.62	2.78	13.40
	2:07 PM	24	3.60	7.98	5.63	8.43	25.65
	4:11 PM	34	2.00	.32	10.90	.23	13.45
	Mean		2.93	5.82	5.09	3.53	18.97

1/ This was a 4-pool fishway with pools 12 feet long, 11.5 feet wide and 6.05 feet deep. There was a 1.5-foot rise between pools.
2/ Length of fish was estimated.
3/ Weir numbers are based on elevation of weir above mean sea level.
4/ May differ slightly from sum of pool times as it was taken independent of pool times.
5/ Pool times not taken.

APPENDIX TABLE 10.--Chinook salmon ascent (time per pool and total time) in a 1:16-slope fishway 1/ August 1956.

Date	Time of day	Length 2/ (inches)	Pool time in minutes between weirs 3/						Total 4/ time
			54-55	55-56	56-57	57-58	58-59	59-60	
August 24	1:45 PM	14	1.07	0.42	0.60	0.27	0.18	0.15	2.67
	2:05 PM	14	0.63	2.58	1.00	1.46	2.88	1.17	9.75
	2:25 PM	34	0.75	1.00	0.28	0.23	0.18	0.50	2.95
	3:15 PM	15	2.23	0.46	5.12	3.12	3.48	0.55	14.97
August 27	8:40 AM	18	0.75	0.25	1.18	1.30	0.15	0.58	4.22
	8:51 AM	24	0.30	0.30	0.15	0.25	0.22	0.13	1.35
	8:52 AM	15	2.38	2.33	2.52	1.62	1.17	1.88	11.88
	9:06 AM	15	1.48	1.46	1.00	0.98	1.32	1.50	7.77
	9:15 AM	18	1.08	0.42	0.22	0.15	1.08	0.46	3.40
	9:26 AM	16	.65	1.15	0.68	6.32	.73	4.40	13.92
	10:50 AM	18	5.43	3.52	2.00	.35	.53	6.40	18.23
	12:26 PM	28	.33	2.65	.33	.23	.58	11.70	15.83
	12:54 PM	12	1.28	.20	1.58	2.00	1.77	.46	7.30
	1:03 PM	20	2.63	.58	2.02	.27	.20	3.20	8.88
	1:38 PM	12							2.46 5/
	1:57 PM	30	.08	2.13	.18	5.12	2.50	2.87	12.88
	2:13 PM	13	.35	.58	1.22	.18	2.28	.40	5.02
August 28	8:31 AM	14	1.58	1.08	.92	1.02	.93	.46	5.95
	9:24 AM	30	.73	.58	.50	.20	.33	.23	2.58
	11:16 AM	30	5.42	1.88	1.83	1.55	1.63	2.00	14.31
	2:09 PM	28	3.55	6.17	2.67	.35	.53	9.87	23.10
August 29	1:40 PM	13	.13	.17	.27	12.65	.18	.30	13.72
	3:37 PM	16	1.17	4.55	.37	2.07	.27	1.67	10.03
	3:56 PM	20	.17	.35	.20	2.12	.17	.28	3.27
	Mean		1.49	1.51	1.17	1.90	1.01	2.22	9.00

1/ This was a 6-pool fishway with pools 16 feet long, 11.5 feet wide, and 6.3 feet deep. There was a 1.0-foot rise between pools.

2/ Length of fish was estimated.

3/ Weir numbers are based on elevation of weirs above mean sea level.

4/ May differ slightly from sum of pool times as it was taken independent of pool times.

5/ Pool times not taken.

APPENDIX TABLE 11.--Chinook salmon ascent (time per pool and total time) in a 1:8-slope fishway[1] September 1956.

Date	Time of day	Length [2] (inches)	Pool time in minutes between weirs[3] 54-55.5	55.5-57	57-58.5	58.5-60	Total [4] time
Sept. 4	9:15 AM	30	1.10	1.23	1.37	6.27	9.93
	9:27 AM	12	1.46	.30	2.30	.08	4.17
	10:40 AM	30	.10	.17	5.46	5.97	11.68
	11:29 AM	32	1.20	5.30	5.83	.15	12.50
	1:00 PM	19	1.43	3.35	5.40	.37	10.53
	1:15 PM	20	6.05	5.25	3.92	4.15	19.33
	2:02 PM	28	1.43	9.87	4.88	6.03	22.22
	3:50 PM	28	1.67	2.12	3.05	6.83	13.67
Sept. 5	8:52 AM	14	.88	.93	3.15	.43	5.40
	9:02 AM	16	.38	8.15	2.62	.38	11.53
	10:10 AM	14	.33	4.52	5.23	.12	10.20
	10:25 AM	36	1.07	1.13	.23	.12	2.57
	10:45 AM	28	.15	21.57	.17	.25	22.13
	11:10 AM	36	.12	.10	1.50	.07	1.77
	11:15 AM	20	2.88	7.68	5.60	8.83	25.02
	12:45 PM	30	.10	.08	.72	.07	.97
	12:50 PM	15	1.38	3.20	3.92	.46	8.97
	1:00 PM	29	1.28	6.03	8.60	5.67	21.58
	1:35 PM	28	.12	.17	.22	.23	.75
	1:40 PM	30	.12	.10	2.65	.37	3.22
	2:25 PM	20	.27	.17	.17	.57	1.17
Sept. 6	12:50 PM	28	.20	11.55	.22	.27	12.20
	1:50 PM	18	3.95	.27	6.98	.10	11.28
	4:00 PM	24	7.88	2.23	2.75	6.37	19.23
	Mean		1.48	3.98	3.21	2.26	10.92

1/ This was a 4-pool fishway with pools 12 feet long, 11.5 feet wide and 6.05 feet deep. There was a 1.5-foot rise between pools.

2/ Length of fish was estimated.

3/ Weir numbers are based on elevation of weir above mean sea level.

4/ May differ slightly from sum of pool times as it was taken independent of pool time.

APPENDIX TABLE 12.--Chinook salmon ascent (time per pool and total time) in a 1:16-slope fishway[1] September 1956.

Date	Time of day	Length [2] (inches)	Pool times in minutes between weirs [3] 54-55	55-56	56-57	57-58	58-59	59-60	Total [4] time
Sept. 4	8:45 AM	26	.42	.55	.67	.46	.20	.33	2.63
	8:55 AM	26	.38	.15	.13	.28	.17	.18	1.32
	9:00 AM	26	1.27	2.15	1.43	2.22	.32	.63	7.98
	9:10 AM	17	1.85	.28	2.67	.46	1.90	1.20	8.38
	9:20 AM	26	.67	2.45	.17	.58	4.38	.43	8.67
	9:33 AM	16	.27	1.82	.13	9.55	.53	5.70	18.00
	10:50 AM	30	3.52	.77	.58	5.08	1.02	2.18	13.12
	11:33 AM	25	.62	4.46	.28	.43	.38	.50	6.67
	12:58 PM	30	1.42	.37	11.37	2.20	.82	6.08	22.23
	1:28 PM	26	1.67	4.67	2.67	3.10	1.40	2.53	16.03
	1:48 PM	36	.25	.45	.23	1.00	.40	.32	2.67
	3:18 PM	26	1.82	1.12	.97	1.68	2.05	.28	7.92
	3:35 PM	24	.78	1.50	1.22	.50	1.18	.80	5.98
	3:45 PM	26	1.65	.67	.15	.12	.15	3.37	6.07
Sept. 5	8:50 AM								14.00 [5]
	10:10 AM	15	1.02	.83	.73	1.03	.35	1.13	5.10
	10:47 AM	24	.38	.15	1.37	.28	.15	.27	2.67
	1:48 PM	26	3.07	3.67	2.30	1.40	.98	1.83	13.22
	3:48 PM	15	.92	.78	.98	2.90	.20	.25	6.03
Sept. 6	10:48 AM	27	.43	.23	9.60	.65	.55	.17	11.53
	11:04 AM	14	1.37	1.40	.68	.52	.93	.50	5.45
	12:45 PM	34	2.42	2.95	4.28	.22	.13	.43	10.43
	4:10 PM	24	.18	.37	.77	.73	.13	.50	2.67
	Mean		1.20	1.44	1.97	1.61	.83	1.35	8.64

1/ This was a 6-pool fishway with pools 16 feet long, 6 feet wide and 6.3 feet deep. There was a 1.0-foot rise between pools.

2/ Length of fish was estimated.

3/ Weir numbers are based on elevation of weir above mean sea level.

4/ May differ slightly from sum of pool time as it was taken independent of pool times.

5/ Pool times not taken.

APPENDIX TABLE 15.--Steelhead ascent (time per pool and total time) in a 1:16-slope fishway[1] August 1956.

Date	Time of day	Length [2] (inches)	Pool time in minutes between weirs [3]						Total [4] time
			54-55	55-56	56-57	57-58	58-59	59-60	
August 6	10:37 AM	20	7.05	.46	.22	2.12	4.57	.17	14.62
	11:14 AM	18							11.46 [5]
	1:00 PM	18	1.87	2.02	1.68	1.50	2.20	3.97	13.25
	1:20 PM	15	3.68	3.68	2.15	2.33	.97	4.80	17.58
	1:45 PM	18	.63	1.62	.88	.80	1.78	2.33	8.05
	1:55 PM	18	.53	.65	.82	2.97	.72	.87	6.55
	2:06 PM	18	.67	.70	.67	.45	.46	.80	3.70
	2:15 PM	16	4.05	4.13	3.30	3.43	2.08	3.03	20.03
	Mean		2.64	1.89	1.39	1.94	1.83	2.28	11.90

1/ This was a 6-pool fishway with pools approximately 16 feet long, 11.5 feet wide and 6.3 feet deep. There was a 1.0-foot rise between pools.
2/ Length of fish was estimated.
3/ Weir numbers are based on elevation of weirs above mean sea level.
4/ May differ slightly from sum of pool times as it was taken independent of pool times.
5/ Pool times not taken.

APPENDIX TABLE 16.--Steelhead ascent (time per pool and total time) in 1:8-slope fishway 1/ August 1956.

Date	Time of day	Length 2/ (inches)	Pool time in minutes between weirs 3/			Total 4/ time
			54-56	56-58	58-60	
August 6	8:52 AM	19	4.83	.30	19.32	24.45
	9:25 AM	25	3.02	5.53	5.32	13.87
	9:45 AM	24	3.08	15.28	6.73	25.10
	10:38 AM	24	3.02	11.78	6.25	21.03
	11:00 AM	29	1.05	1.17	3.87	6.07
	11:20 AM	25	3.58	3.17	3.67	10.40
	11:33 AM	28	10.33	5.50	8.30	24.10
	12:50 PM	24	1.08	6.60	.83	8.52
	1:05 PM	24	3.55	5.77	3.22	12.52
	1:23 PM	28	.35	.13	.73	1.22
	1:26 PM	26	.73	2.25	4.67	7.67
	1:52 PM	24	2.00	9.48	4.93	16.43
	2:15 PM	26	.80	3.17	10.60	14.57
	2:33 PM	24	.48	1.38	2.02	3.87
	2:38 PM	26	.73	.83	.17	1.73
	Mean		2.58	4.82	5.38	12.77

1/ This was a 3-pool fishway with pools 16 feet long, 11.5 feet wide, and 5.8 feet deep. There was a 2.0-foot rise between pools.
2/ Length of fish was estimated.
3/ Weir numbers are based on elevation of weirs above mean sea level.
4/ May differ slightly from sum of pool times as it was taken independent of pool times.

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APPENDIX TABLE 13.--Silver salmon ascent (time per pool and total time) in a 1:8-slope fishway[1] August and September 1956.

Date	Time of day	Length [2] (inches)	Pool time in minutes between weirs [3] 54-55.5	55.5-57	57-58.5	58.5-60	Total [4] time
August 24	1:26 PM	20					2.73 [5]
28	8:15 AM	22	.48	.95	3.98	2.46	7.87
	2:20 PM	14	1.87	.05	4.63	.08	6.63
	2:40 PM	16	1.87	1.33	2.67	2.58	8.45
August 29	2:35 PM	18	1.30	.50	1.20	5.27	8.27
	3:10 PM	20					1.85 [5]
	3:45 PM	28	1.15	.63	2.55	2.08	6.43
	4:02 PM	18	1.12	.48	1.03	4.33	6.97
Sept. 4	8:45 AM	22	1.48	1.53	2.70	2.20	7.92
	Mean		1.32	.78	2.68	2.71	6.34

1/ This was a 4-pool fishway with pools 12 feet long, 11.5 feet wide and 6.05 feet deep. There was a 1.5-foot rise between pools.

2/ Length of fish was estimated.

3/ Weir numbers are based on elevation of weirs above mean sea level.

4/ May differ slightly from sum of pool times as it was taken independent of pool times.

5/ Pool times not taken.

APPENDIX TABLE 14.--Silver salmon ascent (time per pool and total time) in a 1:16-slope fishway[1] August 1956.

Date	Time of day	Length [2] (inches)	Pool time in minutes between weirs [3] 54-55	55-56	56-57	57-58	58-59	59-60	Total [4] time
August 28	10:27 AM	24	.63	3.35	1.38	2.13	2.45	2.23	12.18
	11:36 AM	14	.12	.22	.20	4.98	3.10	4.46	13.10
August 29	2:27 PM	16	1.73	2.82	.35	2.40	1.65	.90	9.87
	3:15 PM	22	2.33	1.23	.87	1.37	2.17	.83	8.77
	3:24 PM	22	1.77	.80	.77	1.53	1.10	1.82	7.75
	Mean		1.32	1.68	.71	2.48	2.09	2.05	10.33

1/ This was a 6-pool fishway with pools 16 feet long, 11.5 feet wide, and 6.3 feet deep. There was a 1.0-foot rise between pools.

2/ Length of fish was estimated.

3/ Weir numbers are based on elevation of weirs above mean sea level.

4/ May differ slightly from sum of pool times as it was taken independent of pool times.