

A FIELD TEST OF ELECTRICAL GUIDING AND LOUVER DEFLECTION
COMBINED INTO A SINGLE GUIDING SYSTEM

by

Gerald E. Monan

and

John R. Pugh

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INTRODUCTION

Many techniques for deflecting or guiding downstream migrant salmonids have been tried and a wide range of results has been obtained. Among the techniques that have had some success are electrical guiding and deflection with louvers. Both systems have disadvantages which tend to limit their range of application.

Electrical guiding--which has the advantage of a minimum of equipment in the water to interfere with the flow--has shown promise, but primarily in tests with low water velocities^{1/ 2/}. Contrarily, louvers have been effective at higher velocities. However, the need for rather closely spaced louver elements has made debris more of a problem and has added considerably to the overall costs. Bates (1961) reported that with a spacing of 2 inches, the fish-guiding efficiency of the louver system was 98 percent. When the spacing was widened to 10 inches, the efficiency decreased to approximately 63 percent. This decrease in efficiency has caused researchers to seek a simple method of increasing the efficiency without reducing the unobstructed space between the louver elements.

The objective of the research presented here was to determine if the fish-guiding efficiency of a louver system with widely spaced louver slats could be materially increased by applying electrical energy so that the louver slats could function as electrodes in an electrical array.

MATERIALS AND METHODS

The experiment was conducted during April and May 1962 in the Maxwell Irrigation Canal, a diversion of the Umatilla River near Hermiston, Oregon. Juvenile steelhead migrating downstream were the primary fish available during these tests.

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- ^{1/} Mason, James E., and Rea Duncan. The development and appraisal of methods of diverting fingerling salmon with electricity at Lake Tapps. Bureau of Commercial Fisheries Biological Laboratory, Seattle, Washington. Manuscript in preparation.
- ^{2/} Pugh, John R., Gerald E. Monan, and Jim R. Smith. Effect of water velocity on the fish guiding effectiveness of an electrical field. Bureau of Commercial Fisheries, Fish-Passage Research Program, Seattle, Washington. Manuscript in preparation.

The Facility

The facility was the same as described by Bates (1961). The site consisted of a concrete-lined flume 50 feet long, 15 feet wide, and 5 feet deep (fig. 1). A similar but unlined section was immediately adjacent to the concrete canal. By manipulating stop logs in the test channel, all the water (or any portion of it) could be bypassed through the unlined area. The concrete canal was divided longitudinally by a wooden partition which separated the canal into two sections, one 5 feet wide and the other 10 feet wide. During this experiment the narrow section was not used. Fish that escaped through the louvers were captured by fyke nets which screened the entire flow at the downstream end of the canal. Fish deflected by the louvers passed through a 6-inch wide bypass to an inclined screen fish trap.

The Electrified Louver System

A line of vertical louvers, 30 feet long and 5 feet high was placed in the concrete flume on a 20° angle to the flow. Three louver spacings were tested: 4.75 inches, 10.00 inches, and 16.00 inches. Each louver slat was made from sheet steel approximately 0.1046 inch thick and 3 inches wide. These slats were held in position by slotted wooden cross members.

Since the metal louver slats were electrically insulated from one another by the wooden spacers, it was a relatively easy matter to connect the louvers to an electrical source and have each louver slat function as an electrode immersed in a conductive medium. The electrodes were wired alternately positive & negative and energized with pulsed direct current at a rate of 15 pulses per second. Each pulse lasted 20 milliseconds. In order to obtain relatively uniform voltage gradients, the applied voltage was varied from 60 volts at the 4.75 inch spacing to 90 volts at the 10.00 inch and 16.00 inch spacings. The electronic equipment used was the same as described by Volz (1962).

Experimental Design

In order to test the effect of the addition of electricity, the louvers were alternately tested with the power on and off. The three louver spacings (4.75 inches, 10.00 inches, and 16.00 inches) were tested in a randomized pattern during the 20-day testing period. This design allowed the data to be analyzed by analysis of variance tests.

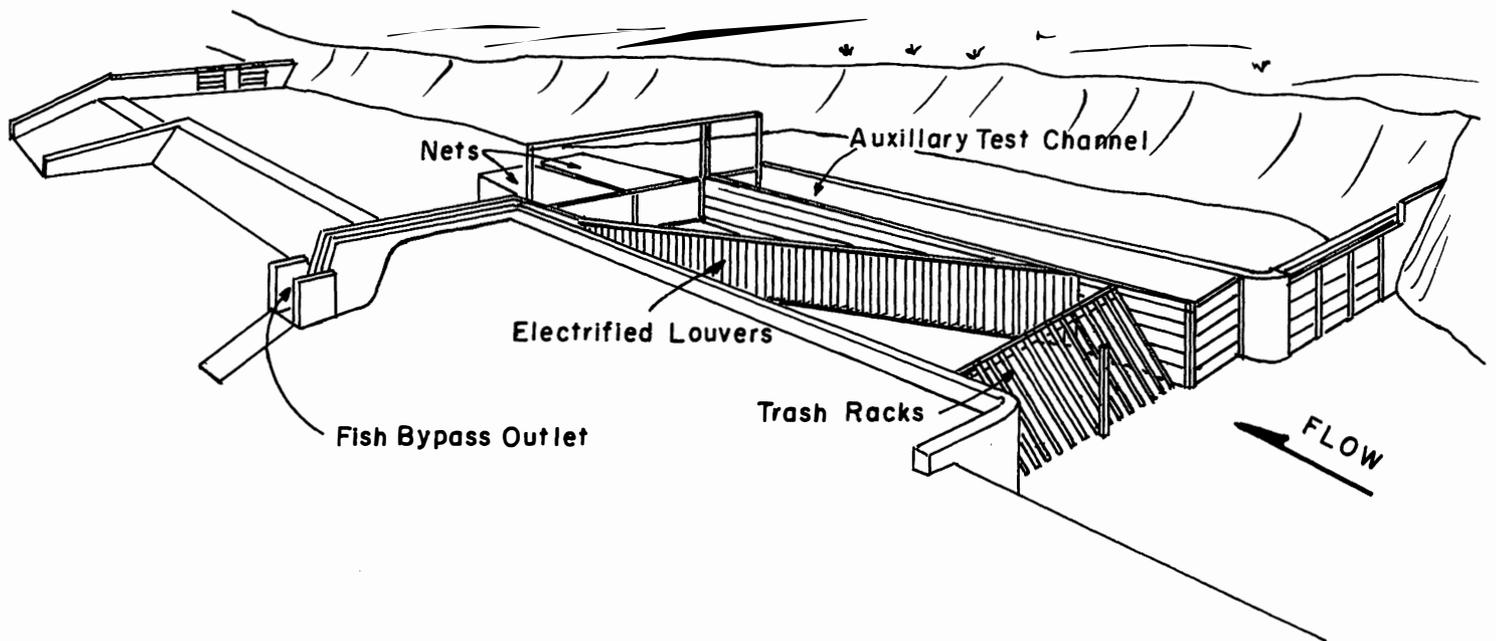


Figure 1.--Diagrammatic sketch of the facilities used in the electrified louver study in the Maxwell irrigation canal, near Hermiston, Oregon.

Experimental Procedure

Each experimental day began at 8:00 a.m. and terminated shortly after midnight. Individual fishing periods lasted 1 hour. At the end of each fishing period, all traps were blocked off and the fish removed and counted. As soon as the traps were emptied and the nets cleaned, the traps were put in fishing position and a new fishing period started. There were approximately twelve fishing periods each day. The water velocity, temperature, turbidity, and conductivity were measured and recorded every 4 hours of the experimental day. The water velocity in the test channel was maintained at approximately 2.5 feet per second throughout the experiment.

RESULTS AND DISCUSSION

During the 20-day testing period a total of 3,526 juvenile steelhead were captured. Table 1 shows the test results.

Analysis of variance tests indicated no significant difference at the 5 percent level between the fish-guiding efficiencies obtained with the power on and those obtained with the power off. However, the analysis of variance tests did indicate a significant difference between the fish-guiding efficiencies obtained at the three louver spacings tested. Water temperature, conductivity, turbidity, and weather data were examined as possible causes of the variance in efficiencies, but no strong correlations were apparent.

It is apparent from the data that the addition of electrical energy to the louvers neither consistently increased nor decreased their fish-guiding efficiency.

LITERATURE CITED

- Bates, Daniel W., and Stanley G. Jewett, Jr.
1961. Louver efficiency in deflecting downstream migrant steelhead. Transactions of the American Fisheries Society, vol. 90, no. 3, p. 336-337.
- Volz, Charles D.
1962. Ignitron-pulsed electric fence guides migrating salmon. Electronics, vol. 35, no. 16, p. 50-52.

Table 1.--Comparison between the fish guiding efficiencies (expressed in percent guided) of the louver spacings tested with the power on and with the power off. The total numbers of fish tested are also shown.

Louver spacing Inches	Power condition	Efficiency ^{1/}				Average	Number of fish tested	
		Test 1 Percent	Test 2 Percent	Test 3 Percent	Test 4 ^{2/} Percent			
4.75	On	82.9	88.5	76.6	--	82.7	471	
	Off	84.3	83.9	85.0	--	84.4	408	
10.00	On	74.4	82.7	80.3	--	79.1	1246	
	Off	77.9	90.4	41.1	--	69.8	481	
16.00	On	19.0	53.8	77.3	53.6	50.9	390	
	Off	41.7	66.9	49.2	67.2	56.3	530	
Number of fish tested		--	455	1936	815	320	--	3526

1/ Numbers of fish in the bypass trap divided by the total number of fish captured during each test.

2/ The 16-inch spacing was the only spacing tested four times.