HORIZONTAL AND VERTICAL DISTRIBUTION OF DOWNSTREAM MIGRANTS, SNAKE RIVER, SPRING 1964

by

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INTRODUCTION

Research is presently being carried out on several types of guidance and collection systems for juvenile salmonids. To date, no one device has been developed that has universal application. In order to determine what type of collector may be applied in each problem area, many factors must be considered. One of the most important considerations in each potential installation is the distribution of the migrants within the water mass to be strained.

The objective of the research reported here was to determine the vertical and horizontal distribution of downstream migrant salmonids at a site in the Snake River above Brownlee Reservoir with the specific aim of locating an area where the migrants were naturally concentrated.

MATERIALS AND METHODS

The research site located near Weiser, Idaho, was chosen for two principal reasons: (1) It is in a potential collection area for migrants prior to their entry into Brownlee Reservoir, and (2) it is located at the downstream end of a sharp bend in the river where hydraulic conditions might tend to concentrate the migrants.

Three identical electrified traps were used in the study (fig. 1). Each trap has two main components: the barge and the nets. One set of electronic equipment was used to operate all three barges.

Barges

The barges were approximately 28 feet long and 11 feet wide (fig. 2). Two metal-covered styrofoam pontoons provided the flotation. The pontoons were parallel to each other and separated by a 5-foot 10-inch opening. This opening was decked over at the front and rear to provide work space and also to fasten the two pontoons together as a unit. Two 55-gallon drums of water were mounted on the downstream end of each pontoon to provide ballast. This ballast kept the front of the pontoons from sinking into the water due to the drag of the nets.

A large frame, constructed of heavy duty aluminum "I" beams, held the nets between the pontoons. The frame was approximately 27 feet high and 5 feet wide. This frame could be extended down into the water to three different depths: 8 feet, 12 feet, or 14 feet. The frame could also be pivoted forward

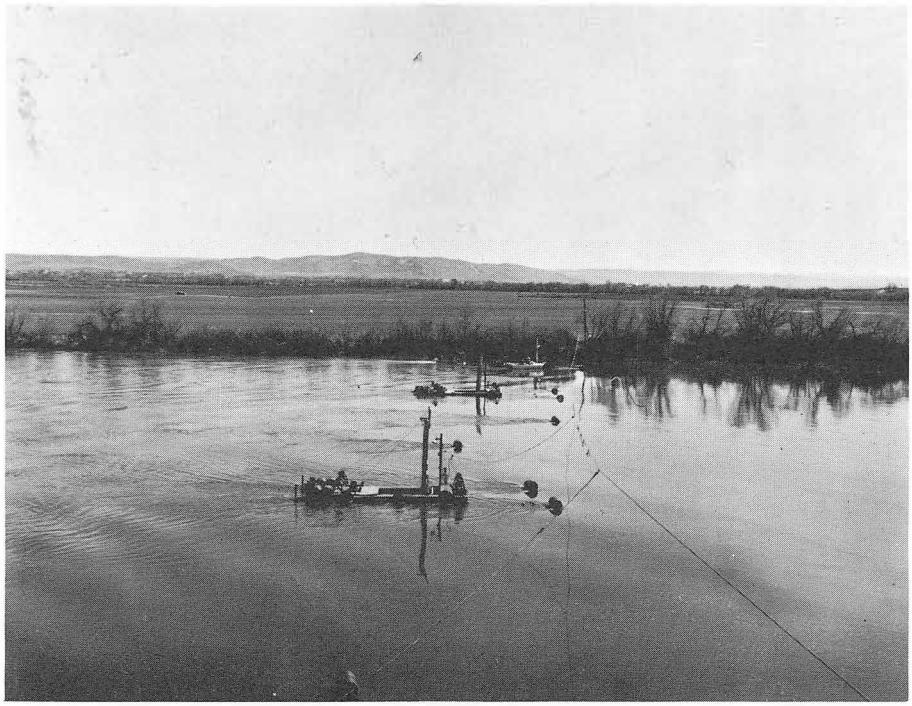

Figure 1.--Fish traps in operation during downstream migrant distribution study in the Snake River near Weiser, Idaho.

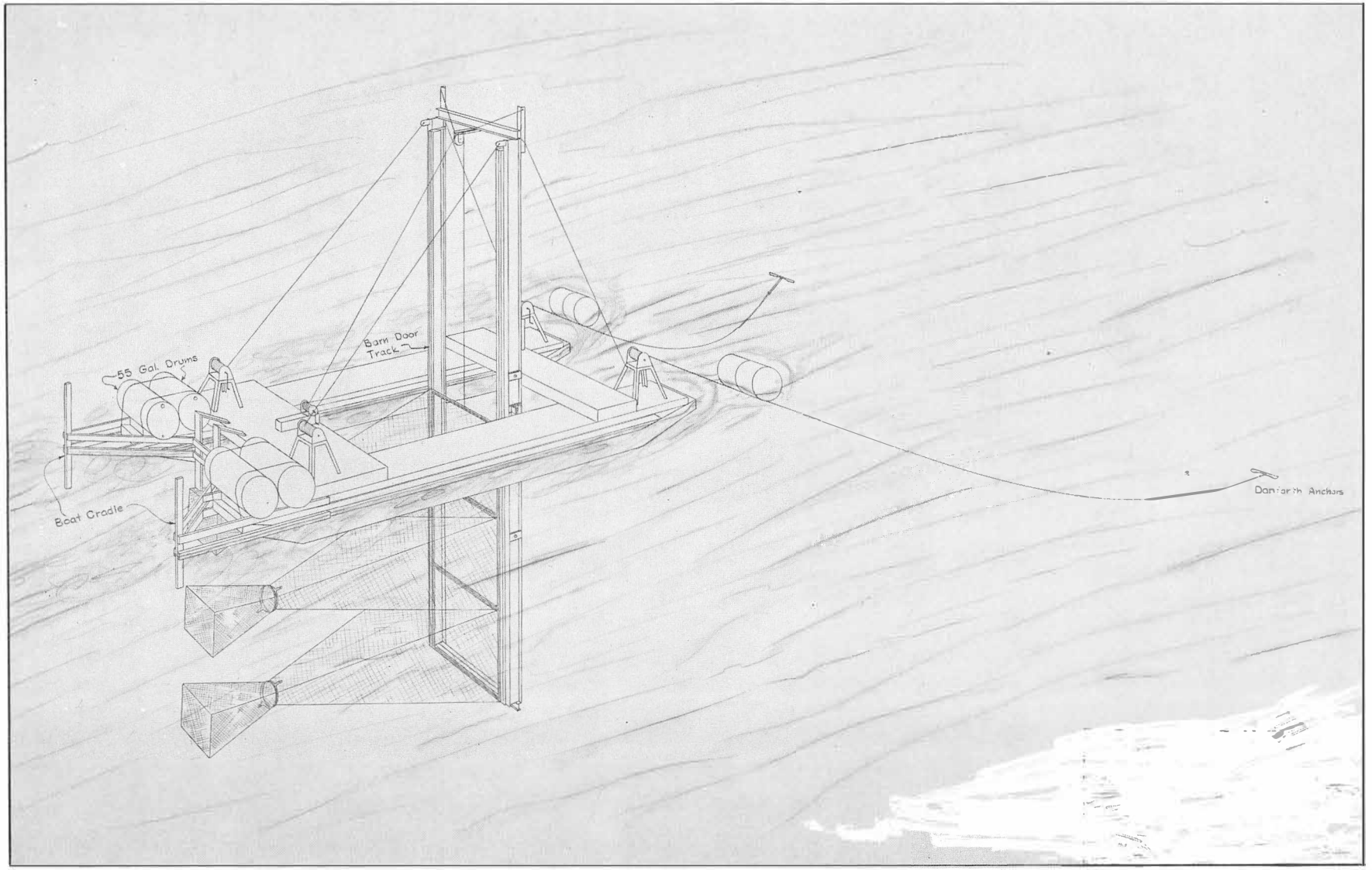

Figure 2.--An electric-fyke trap anchored in the river with its nets lowered into fishing position.

easily, so it would lie almost parallel with the water surface. In this configuration the barges had a shallow draft and presented a minimum of resistance to the flow. This was an important factor when moving the barges.

A trolley track was fastened to each leg of the frame to serve as a guide for the nets. The nets were attached to metal frames equipped with rollers that fit into the track. The nets could be lowered to, or raised from, the desired fishing level by means of a winch and cable system.

Nets

The nets were built in two sections. The front portion was made of knotted nylon webbing (7/8-inch stretched measure). This net was 4 feet square at the mouth, 12 feet long, and tapered to a 16-inch circle at the downstream end. The cod end or bag portion was made of knotless nylon webbing (1/2-inch stretched measure). It was 16 inches in diameter at the mouth, 4 feet long, and enlarged to a 2-foot by 2-foot square at the downstream end. The two nets were joined together by clamping them to an electrode unit. This made the cod ends easily removable and facilitated cleaning and fish handling.

Electrical Equipment

The electrodes were made of stainless steel plate. Each electrode was 18 inches long by 16 inches wide. They were bent to an 8-inch radius along the 16-inch dimension. The electrodes were fastened to, but electrically insulated from, a heavy metal band, 50 inches in circumference and 2 inches wide (fig. 3). The electrodes were attached to the band with the negative electrode extended upstream and the positive electrode extended downstream. While fishing, the electrodes were energized with 125 volts of rectified alternating current. The electrical field was pulsed with a frequency of 60 pulses per second with each pulse having a duration of 4-1/6 milliseconds.

The electronic pulsing equipment and power source were located on shore and the electricity was transmitted to the barges by overhead wires. A 10-kilowatt, gasoline driven generator provided the power for the electrodes and for the work lights on the rafts.

Procedure

The river at the research site was approximately 500 feet wide. The bottom was relatively uniform and the water was

Figure 3.--Cod end of the net being slipped over the electrode prior to clamping it to the lead portion. Gloved hand is grasping negative electrode in the net.

approximately 13 feet deep across the entire river. The daily mean river flow during the study ranged from 16,700 to 29,700 cubic feet per second and averaged 24,414 c.f.s. Water temperatures taken 2 feet below the surface each day at noon in the middle portion of the river ranged from 46 to 60 degrees Fahrenheit and averaged 53° F. For analyzing purposes, the river was divided longitudinally into thirds. Three sections were sampled within each third, thus giving us nine sampling stations across the river. Each barge was assigned a third of the river and moved from station to station within this third in a randomized sampling program. Ten single drum-floats were anchored in the river to provide constant anchor points for the rafts at each of the nine fishing locations.

Each sampling day began at 2:00 p.m. and continued until 11:00 a.m. the following day. At 2:00 p.m. the nets were lowered and fished for approximately 1 hour. The nets were then raised, the fish removed and processed, and the nets cleaned and prepared for the next fishing period. The cleaning and processing of all the nets took about 1½ hours. The nets were alternately fished and cleaned in this manner until approximately 11:00 a.m. the following day. Between 11:00 a.m. and 2:00 p.m. the barges were moved to their next scheduled fishing position and routine maintenance was performed in preparation for the new sampling day.

Trapping was conducted in 3-day cycles. During each cycle all nine sampling stations were fished 1 day. Each raft fished three nets, one above the other, to sample the vertical distribution at each station. The water velocity was measured at the mouth of each net immediately after it was lowered and immediately before it was raised. A measure of the conductivity, turbidity, and temperature of the water was also made for each fishing period.

RESULTS AND DISCUSSION

The distribution of the migrants was analyzed by two measures of fish abundance: (1) The numbers of fish per volume of water strained, and (2) the numbers of fish per unit of time. The distribution figures shown are based upon the combined catches of chinook salmon, silver salmon, and steelhead trout. Distribution by species and the correlations between fish distribution and the many variables such as velocity, fish size, water temperature, etc. have been programed for electronic data processing. However, the analyses have not been completed at this time.

Horizontal Distribution

The horizontal distribution of the migrants is shown in figure 4. This graph indicates the fish were distributed completely across the river with somewhat fewer fish in the middle third of the river than in each of the other thirds. This general pattern was true for all periods of the day (dawn, daylight, dusk, and dark).

Vertical Distribution

The vertical distribution of the migrants at each of the nine trap locations and for the total width of the river in this area is shown in figures 5 and 6. Figure 5 is based on the number of fish caught per unit of water strained, whereas figure 6 is based on the number of fish caught per unit of fishing time. Generally speaking, the vertical distribution was similar for all nine locations. The largest percentage of fish was located in the top 4 feet of water (approximately 60 percent) and the smallest percentage in the bottom layer of the river. Considering the overall catch for the entire width of the river, the top two nets captured approximately 84 percent of the salmonids. The general pattern of the top net catching the most salmonids and the bottom net the least was true for all periods of light (dawn, daylight, and dusk). However, there was a shift in the vertical distribution during the hours of darkness. Between 10:00 p.m. and 4:00 a.m. only 30 percent of the salmonids were captured in the top net, while 70 percent were taken in the bottom two nets (middle net--29 percent, bottom net--41 percent).

CONCLUSIONS

1. Downstream migrant salmonids were distributed throughout the river mass.

2. The majority of the downstream migrants were found in the top 4 feet of water.

3. The vertical distribution of migrants is altered by darkness. During the hours between 10:00 p.m. and 4:00 a.m. the majority of the migrants prefer the bottom 8 feet of water.

4. The salmonids were distributed somewhat evenly across the river despite the location of the site on the terminal end of a sharp bend in the river.

5. In order to efficiently collect the downstream migrant salmonids from this area of the middle Snake River, it appears that the entire water mass would need to be strained in some manner.

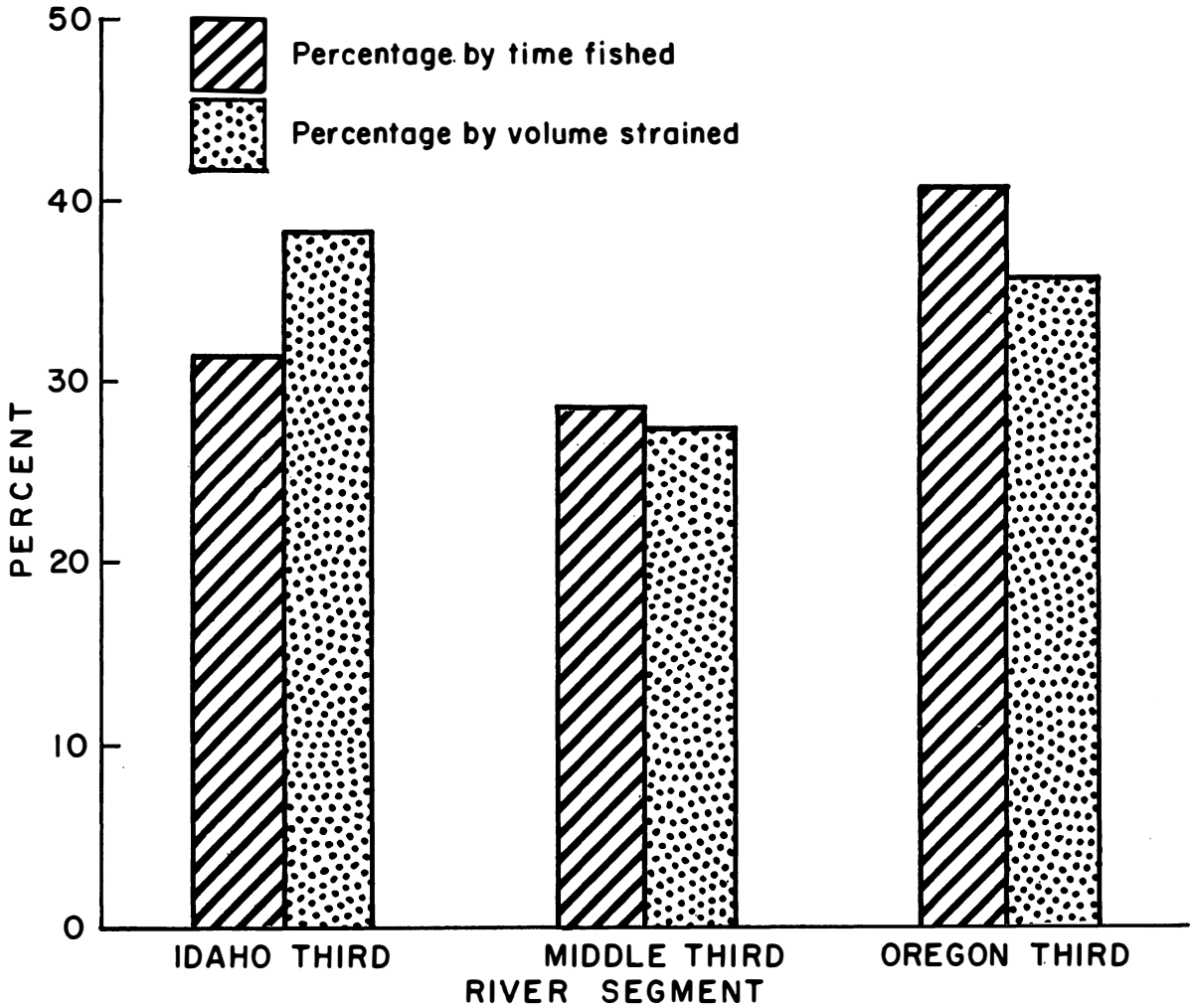

Figure 4.--Horizontal distribution of salmonids captured by electric-fyke nets, expressed in percentage.

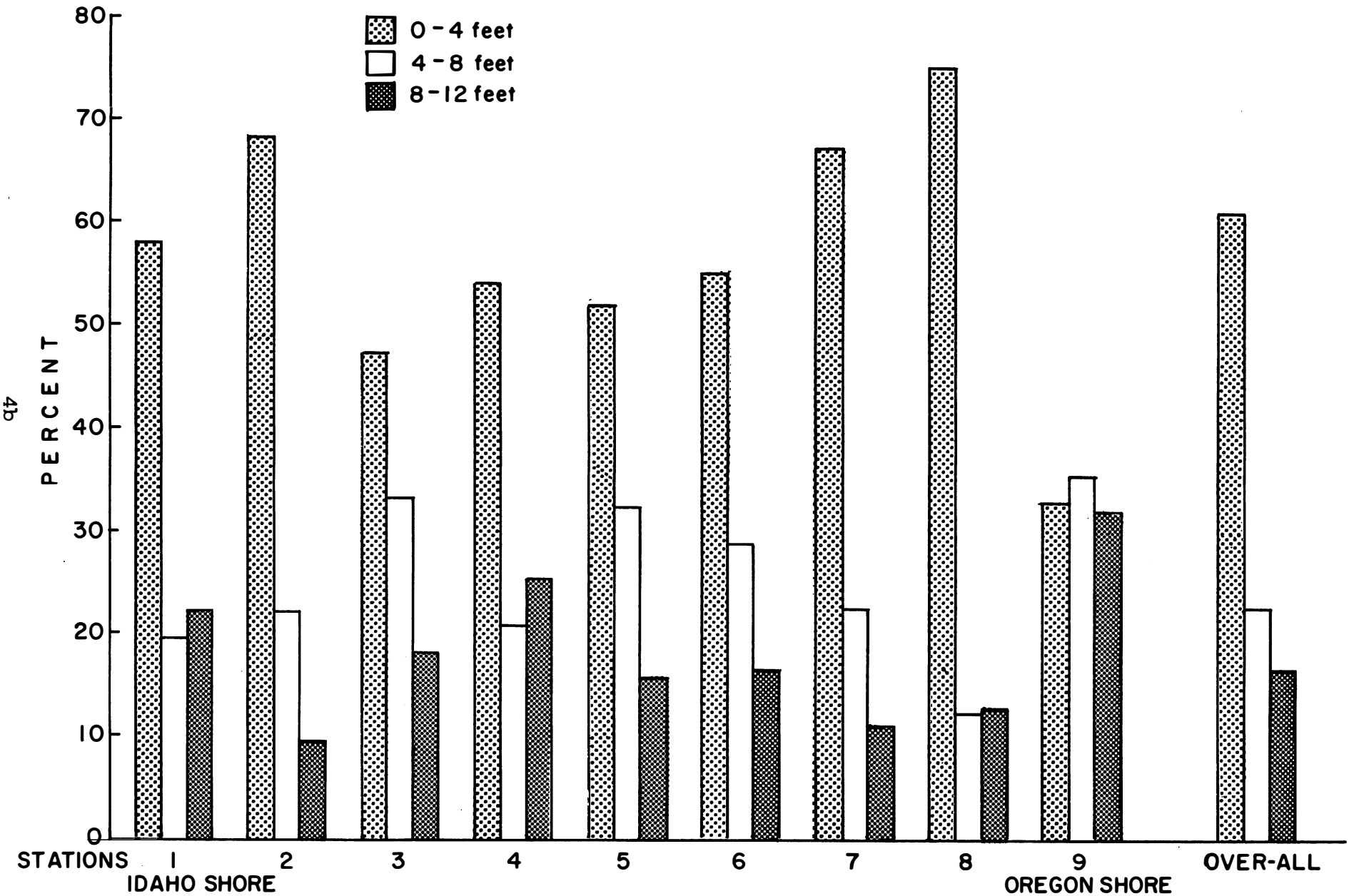

Figure 5.--Vertical distribution of the salmonids captured in electric-fyke nets at each station based on the volume of water strained and expressed in percentage.

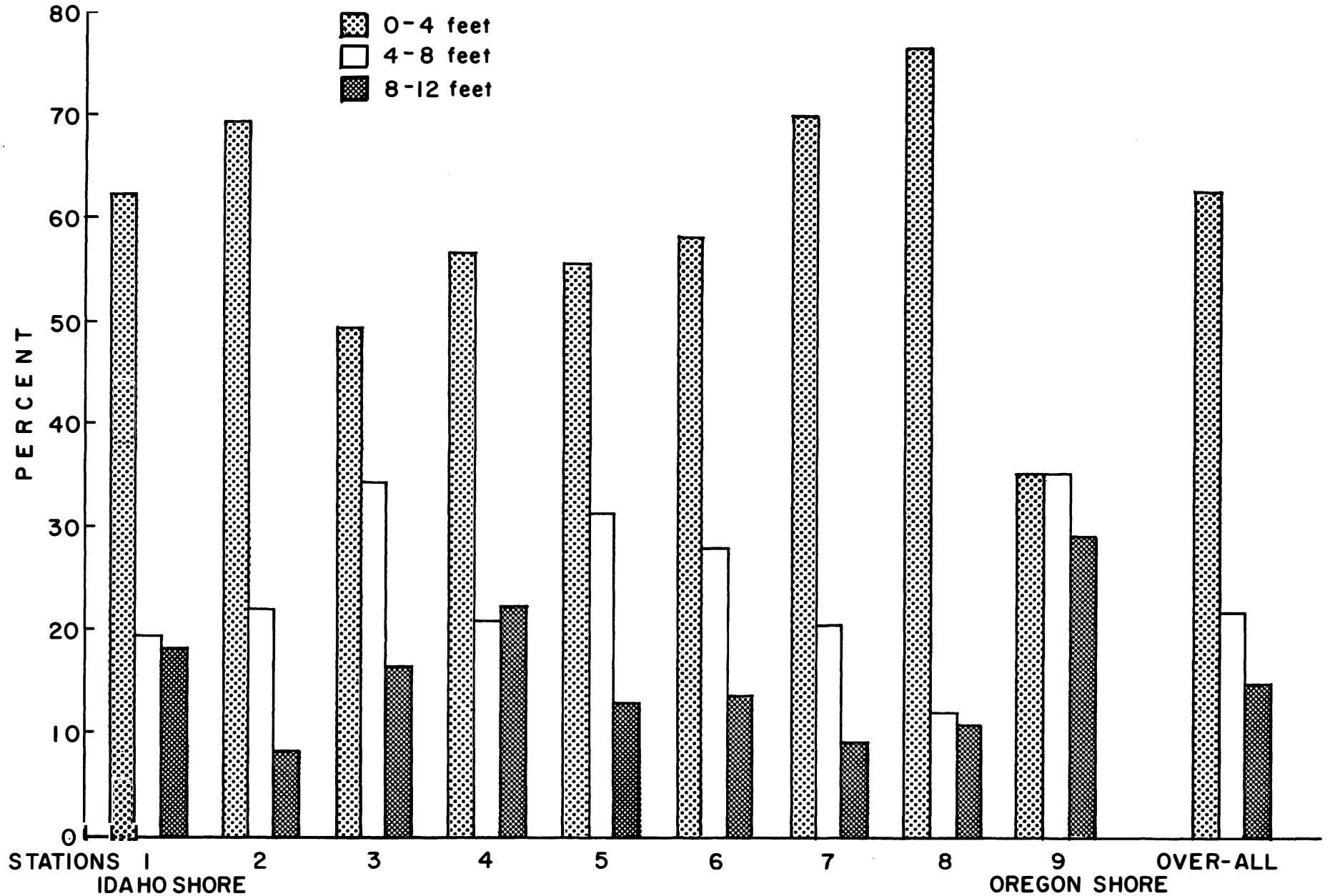

Figure 6.--Vertical distribution of the salmonids captured in electric-fyke nets at each station based on fishing time and expressed in percentage.