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TIMING, COMPOSITION, QUANTITY, AND VERTICAL DISTRIBUTION OF DEBRIS IN THE SNAKE RIVER NEAR WEISER, IDAHO--SPRING 1964

by

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INTRODUCTION

The development of a practical method for guiding and collecting downstream-migrating salmonids for safe passage around high dams may be necessary if major losses are to be avoided. A principal consideration in the design, installation, and operation of any fish guiding or collecting system is its ability to cope with debris. Because of differences in principle and design, each fish guiding or collecting system is affected differently by debris. A particular type of debris may limit the application of one system, whereas another system may not be affected or may be only slightly affected by the same material. In order to plan adequately for the collection of downstream migrants in an area, an understanding of the debris problems that will be encountered is necessary.

The objective of the research reported here was to determine the timing, composition, quantity, and vertical distribution of debris encountered in the Snake River above Brownlee Reservoir during the spring migration of downstream migrant salmonids.

MATERIAL AND METHODS

Area and Facilities

The research was conducted in the spring of 1964 in the Snake River near Weiser, Idaho, at a site where the river is approximately 500 feet wide with a relatively uniform depth of 13 feet. The study was carried out in conjunction with another research project, the objective of which was to determine the horizontal and vertical distribution of seaward-migrating juvenile salmonids in the Snake River.

The debris samples collected for this study were gathered with the same sampling nets used in the downstream-migrant distribution study. The majority of the operational techniques and equipment have been described by Monan. (See "Horizontal and Vertical Distribution of Downstream Migrants, Snake River, Spring, 1964," vol. 2, Review of Progress, Fish-Passage Research Program.) Additional equipment and techniques which were used in this study are described below.

Sampling Design

The debris was sampled in a random pattern across the Snake River from April 1 to July 23, 1964. Three fyke nets, each 16 feet long with a 4- by 4-foot mouth, were used one above the other to collect the debris. Because of the vertical arrangement and size of the nets, the debris was sampled at the 0- to 4-, 4- to 8-, and 8- to 12-foot levels. The debris collected during a 1-hour sampling period once each week was separated into categories and weighed.

Sampling Procedure

The debris samples were obtained each week by placing three clean nets in one of the traps normally used to sample fish distribution and lowering them to fishing position. The nets were allowed to fish for approximately 1 hour, and then were raised clear of the water. The water velocity was measured at the mouth of each net immediately after they were lowered to fishing position and immediately before they were raised. After the nets were raised, they were labeled and taken to shore for further processing.

Each net was individually washed in a large tank fitted with a fine-mesh steel brail. After the net was cleaned, it was removed and the brail was raised from the water. The debris was then allowed to drain for 15 minutes. It was then removed from the brail, placed on a large wooden platform, and separated into five main classes: (1) woody (sticks, bark, lumber, etc.), (2) herbaceous (leaves, grass, and other soft terrestrial plants), (3) hydrophytic (moss, algae, etc.), (4) special (items that occurred in large quantities from specific sources--straw, onions, and tumbleweeds), and (5) miscellaneous (items that occurred infrequently in small quantities--silt, rocks, and manmade objects).

In order to compare the amounts of debris taken over the entire sampling period, the data were converted to pounds of debris per volume of water strained, and this information was used to determine timing, quantity, and vertical distribution.

RESULTS AND DISCUSSION

Timing

Figure 1 illustrates the debris load of the Snake River during the sampling period in relation to the river flow. The graph shows that the debris load fluctuates with the flow of the river but the peaks become less pronounced as the system is flushed by each succeeding high-water stage.

Thirty-six percent (62.0 pounds) of the total debris collected was obtained during the first sample period (April 1, 1964). This period coincides with the first high water of the of the 1964 season. Observations by other researchers working in this area indicated that the debris load of the Snake River was relatively light prior to April 1, 1964.

Composition

As previously mentioned, the debris was grouped into five categories. Table 1 shows the composition of the debris load in the Snake River for each sample day and the entire sampling period. The total debris collected during this period was approximately 20 percent woody, 41 percent herbaceous, 11 percent hydrophytic, 20 percent special, and 8 percent miscellaneous.

The items in the special category occurred in relatively abundant quantities during specific conditions caused by high flow, wind storms, or agricultural practices. For example, straw was very abundant during the first high water. Apparently, the straw had been flushed from flooded fields and gravel bars where cattle had been fed during the winter. Tumbleweeds occurred during wind storms throughout the test period. Onions were found in one sample when irrigation ditches were cleaned prior to the watering of fields.

Composition data presented here do not reflect objects that were too large to enter the nets. However, during 1½ hours of observation on April 1, 1964, several large objects such as trees, lumber, etc. floated past the sampling area. Similar large debris was recognized as being relatively abundant throughout the season. Ice is not included in this report as the main ice flow was reported to have gone out of the river during February of 1964.

Quantity

During the sixteen 1-hour sample periods, a total of 7,945,751 cubic feet of water was strained by the sampling nets. In this same period, 173 pounds of debris was collected. This represents an average of 0.2 pounds of debris for each 10,000 cubic feet of water strained.

The highest quantity of debris during any 1-hour sampling period was collected on April 1, during the first high water of 1964. During the season, the amount of debris ranged from a high of 1.17 pounds per 10,000 cubic feet of water strained to a negligible amount during the latter part of July (fig. 1).

Table 1.--The composition of the debris load in the Snake River near Weiser, Idaho, April 1 to July 23, 1964, shown by percentage of the daily sample. The overall composition for the entire sampling period is also shown.

Date of Sample		Composition of debris					
		Woody	Herbaceous	Hydrophytes	Special	Miscel-laneous	Sample weight
		Percent	Percent	Percent	Percent	Percent	Pounds
April	1	16.8	44.7	5.6	28.9	4.0	62.0
	8	21.9	34.3	40.0	0.0	3.8	10.5
	19	9.6	23.1	50.0	13.5	3.8	5.2
	26	8.5	22.1	10.6	49.1	9.7	22.6
May	3	31.4	43.8	12.4	7.6	4.8	10.5
	11	17.0	35.8	34.0	9.4	3.8	5.3
	18	29.0	59.7	6.5	0.0	4.8	6.2
	24	45.3	42.4	6.6	0.0	5.7	10.6
	31	6.1	48.4	17.2	21.2	7.1	9.9
June	11	25.0	45.8	0.0	20.9	8.3	2.4
	18	50.0	45.0	0.0	0.0	5.0	10.0
	25	22.7	42.8	0.0	5.1	29.4	11.9
July	2	12.9	67.8	0.0	16.1	3.2	3.1
	9	0.0	45.0	0.0	0.0	55.0	2.0
	17	0.0	0.0	0.0	0.0	100.0	1.0
	23	0.0	0.0	0.0	0.0	0.0	0.0
Entire sampling period		20.3	40.8	10.7	20.0	8.1	173.2

Vertical Distribution

The debris collected during the entire sampling period was taken as follows: 41 percent from the top 4 feet, 26 percent from the area between 4 and 8 feet of depth, and 33 percent from the 8- to 12-foot level.

The vertical distribution of each class of debris is shown in figure 2. The woody and special classes were found primarily in the surface net, the hydrophytes were taken mostly in the bottom net, and the herbaceous and miscellaneous classes were collected in similar amounts in all three nets.

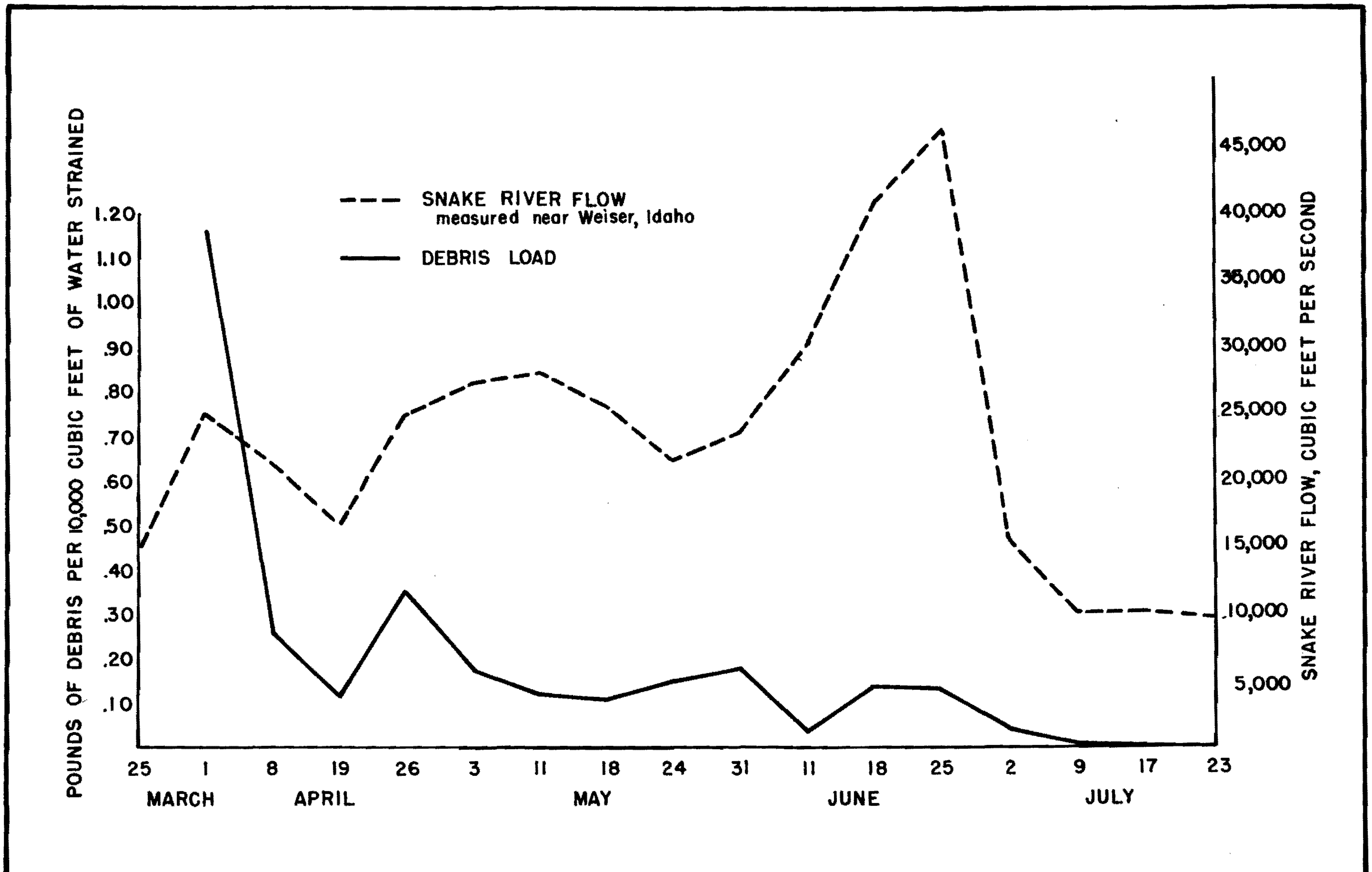

Figure 1.--The debris load in relation to the flow of the Snake River during the sampling period.

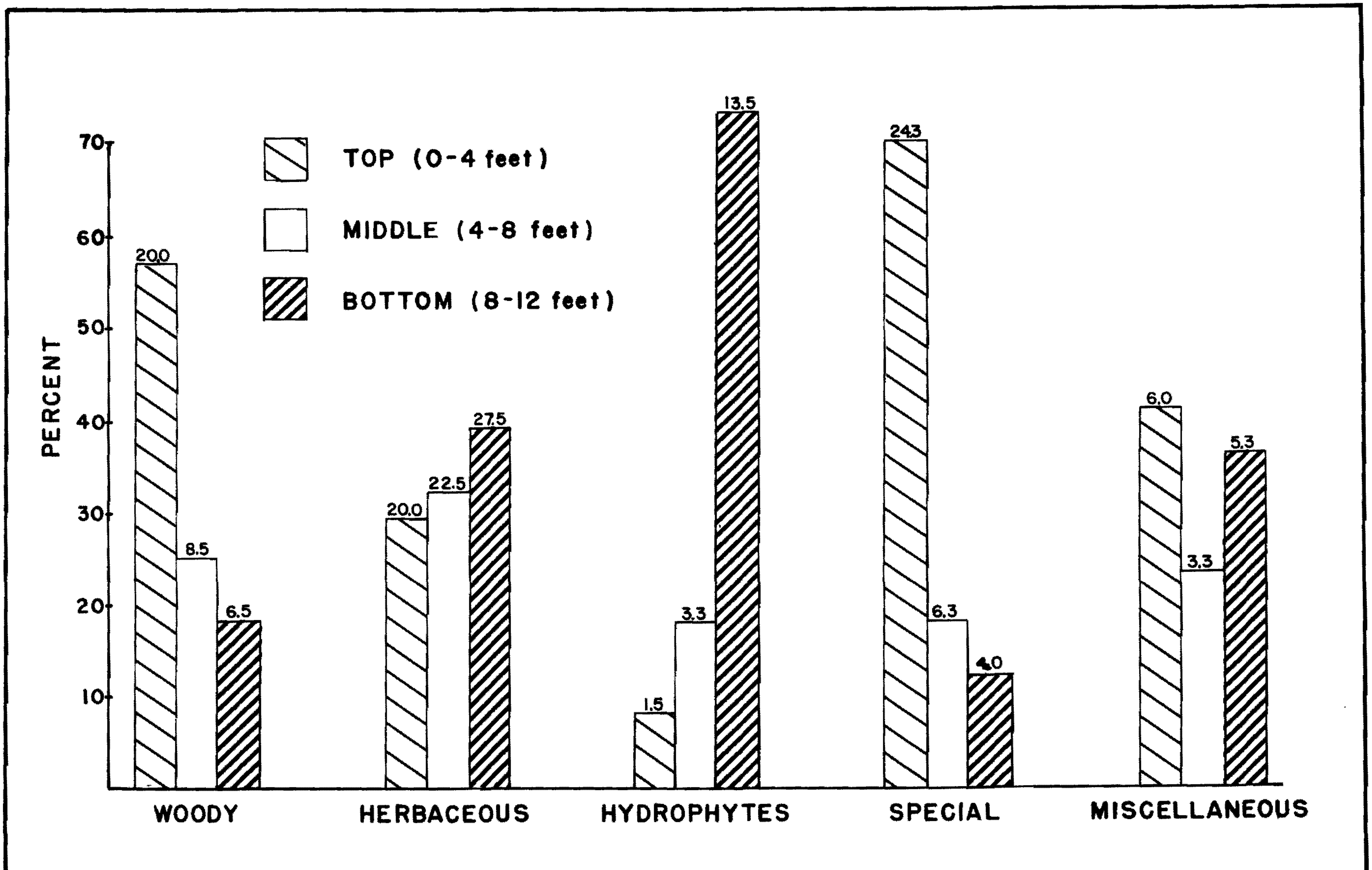

Figure 2.--The vertical distribution of each of the five classes of debris shown by percentage of season's collection. The pounds of debris (that each bar represents) is indicated by numerals above each bar.

The vertical distribution of each sample over the entire sampling period is shown in figure 3. The river flow during this period is also shown. During the early portion of the sampling period, the debris was usually most abundant near the surface in times of increasing flow, but as the flow decreased, the highest concentration of debris was near the bottom of the river. Once the major concentrations of debris were flushed from the river by the early high-water stages, the debris was generally more concentrated near the bottom of the river.

CONCLUSIONS

1. The highest concentration of debris occurs during the first high water.

2. The amount of debris fluctuates with the rise and fall of the river. The range of fluctuation decreases as the loose material along the banks is removed by each successive flushing.

3. Herbaceous material is the most common when debris in the Snake River is placed into five principal categories: woody, herbaceous, hydrophytic, special, and miscellaneous.

4. Debris in the Snake River is a representative cross section of a wide range of materials from algae to parts of buildings.

5. Agricultural practices along the Snake River have a definite influence on the composition of debris.

6. Debris is distributed throughout the water mass. However, the distribution pattern varies according to the time of year and the river flow.

7. Because of such varied conditions as weather, snow pack, agricultural practices, etc. that influence the timing, composition, quantity, and vertical distribution of debris, only general standards will hold true from year to year.

8. The flushing of debris in the middle Snake River takes place when an abundance of downstream migrant salmonids are present. For this reason, debris handling capability must be a major consideration in the design of any proposed downstream migrant guiding or collection facility for the middle Snake River.

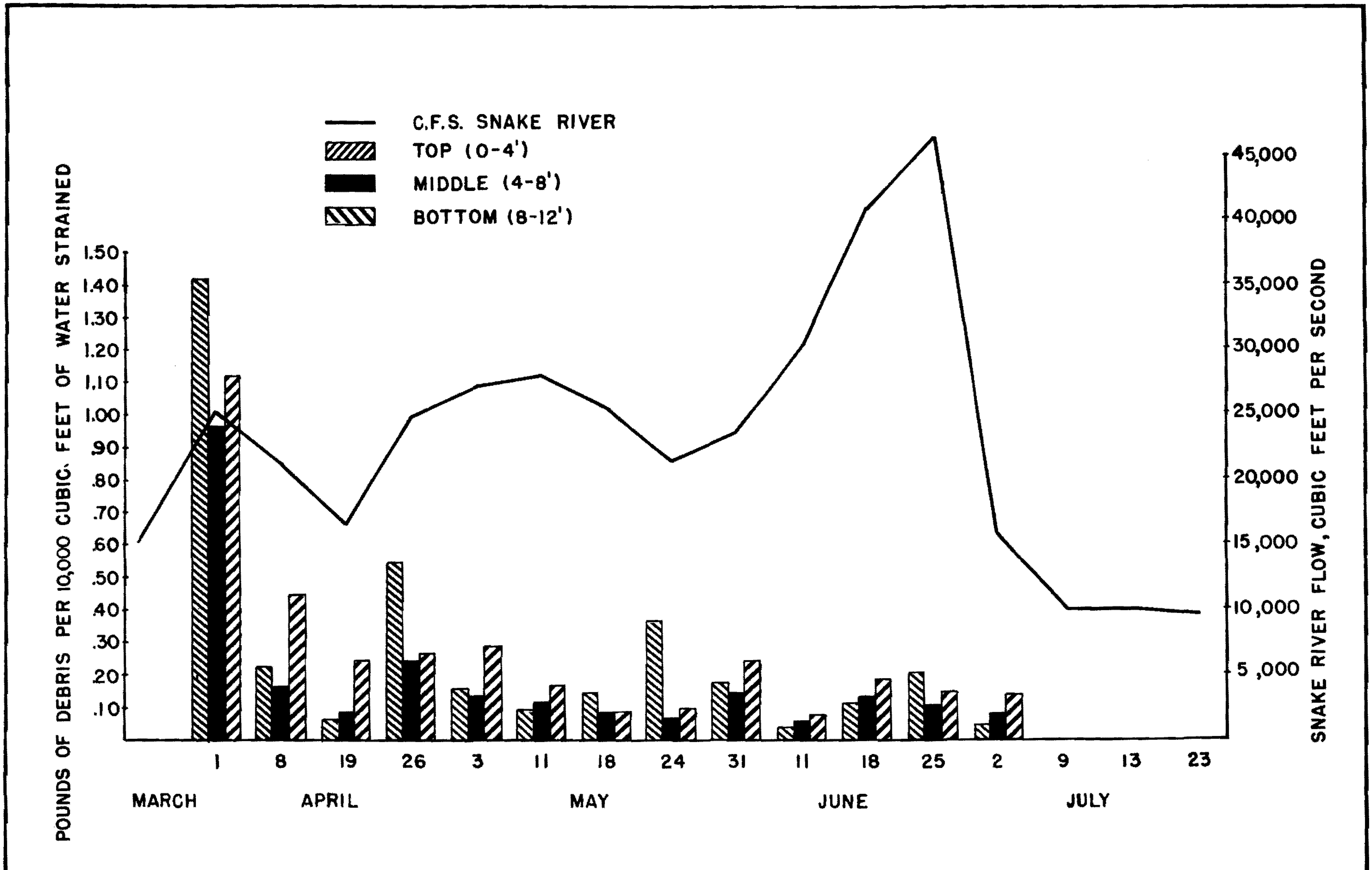

Figure 3.--The vertical distribution of debris in relation to river flow.