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ACOUSTIC SURVEYS OF LAKE WENATCHEE IN 1975

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## ACOUSTIC SURVEYS OF LAKE WENATCHEE IN 1975

### INTRODUCTION

Lake Wenatchee, an alpine lake of approximately 10 million square meters surface area, is one of two sockeye salmon producing lakes remaining in the Columbia River drainage. Outmigration of sockeye salmon smolts commences shortly after the winter ice cover begins to break up in late February or early March. Acoustic surveys of Lake Wenatchee sockeye smolts have been conducted during this period since 1972 by personnel from the Fisheries Research Institute. As no data on species composition throughout the year are available, acoustic surveys have been conducted in late spring to examine changes in size distribution following outmigration of smolts. In 1975, the Washington State Department of Fisheries funded surveys which were completed on 6 March and 3 June. Results of these surveys are presented in this report.

### MATERIALS AND METHODS

The procedures used in 1975 were essentially the same as in the previous two years (Dawson, Thorne, and Traynor, 1973; Thorne and Dawson, 1974). The 6 March survey was completed immediately after the central lake area was free of ice cover. By the 3 June survey, it was assumed that all smolts had left the lake.

The acoustic data collection system was the same as that used in 1973 and 1974. Technical descriptions of the system are given in Thorne, Nunnallee, and Green (1972) and Nunnallee (1973). The basic components include an echo sounder operating at 105 kHz and transmitting a 0.6 millisecond pulse through an 8° full angle transducer mounted in a towing vehicle. Data are converted to a 5 kHz signal and attenuated before being recorded on magnetic tape.

Transect locations in Lake Wenatchee were the same as in the previous year (Fig. 1). Boat speed was estimated at about three knots.

The acoustic data analysis techniques were revised from those used in previous years. Counts of acoustic echoes were accumulated over a series of seven thresholds varying in 6 dB steps between -75 dB and -39 dB. These decibel values correspond to fish sizes of about 0.5 cm and 14 cm, respectively. Six depth intervals between 14 and 65 meters were analyzed for the 6 March survey, while three depth intervals between 9 and 35 meters were observed for the 3 June survey due to the position of the population in the water column. Numbers of echoes over each threshold were then accumulated for each depth. Measurements taken from the transducer directivity pattern were used to calculate the expected

number of targets appearing in each succeeding size category. These expected numbers were then removed from the counts accumulated over each threshold, resulting in an estimate of counts of fish in each target strength group. Volumes for each target strength group were calculated from the transducer directivity pattern.

## RESULTS

Estimates of fish density in each size category and depth for the 6 March survey are presented in Table 1. Table 2 contains the estimates from the 3 June survey. The population size during 6 March was calculated to be 1.88 million. The population size increased to an estimated 4.88 million by 3 June.

## DISCUSSION

The population estimate in March was similar to previous years. In fact, the total range of estimates during this time period for the four years of surveys is 1.5 to 2.4 million fish. As in 1974, the number of fish increased between the surveys. The June estimate, 4.9 million, is the highest yet observed.

The shift in acoustic target size between the two dates in 1975 was not as dramatic as in previous years. While the June target strength distribution was similar to that of May 1974, the distribution in March was smaller than in previous years. The significance of this observation is difficult to interpret because of uncertainty as to the precision of the target strength techniques. However, it may indicate either a reduced size of fish this year, or a reduction in the larger fish component of the population.

This year, analysis consisted of direct target counts in various size categories, as opposed to echo integration followed by target strength analysis on subsamples. The new method is more efficient and eliminates some potential sources of variability. Unfortunately, the counts had to be done manually using an oscilloscope, which is very time consuming. However, a program for automatic counting and target strength measurement is nearly complete and should be available for any future surveys of this type. The technique still suffers from lack of precision in size determination, a characteristic of indirect target strength extraction methods (Ehrenberg, 1972). A new direct target strength system employing two transducers has just been developed (Ehrenberg, 1974) and should greatly increase the precision of target strength measurement in future surveys.

As indicated last year (Thorne and Dawson, 1974), the present methods apparently have insufficient precision for estimating sockeye salmon smolts because of the overlap in size classes, the variability

in both population and size estimates, and possibly the relatively small magnitude of the sockeye component. With improved equipment it may be possible to improve the resolution enough to estimate this component, but at present the value of the surveys appears to be limited mainly to their usefulness as an index of the lake productivity.

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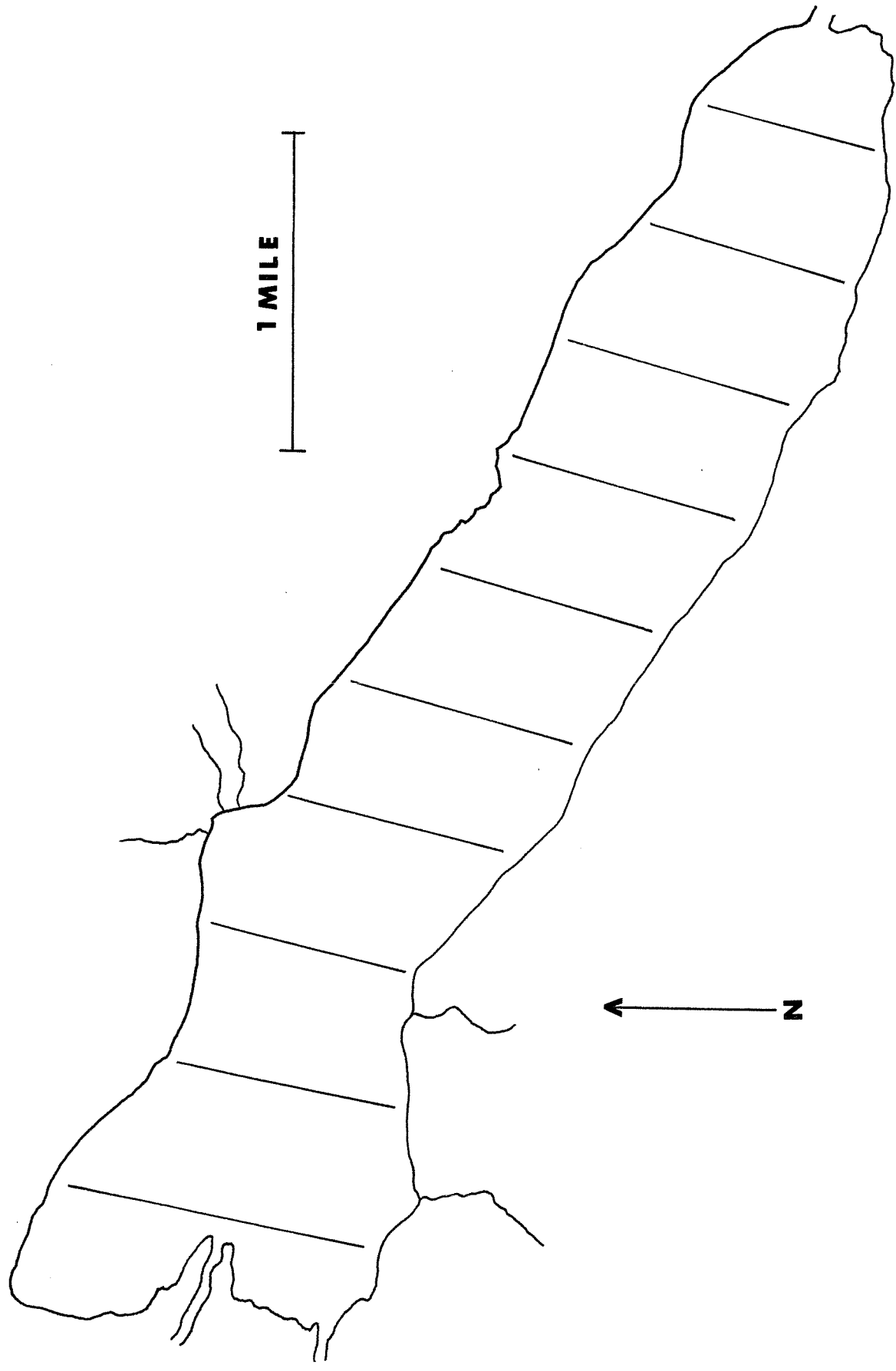


Fig. 1. Location of transects on Lake Wenatchee.

Table 1. Fish densities by size class and depth for the 6 March 1975 survey (in #/1000 m<sup>3</sup>).

Depth in meters	Size category				
	1	2	3	4	5
13-21.6	0.39	0.39	0.26	0.15	--
21.6-30.2	--	3.21	3.16	1.43	0.18
30.2-38.8	--	--	3.89	1.46	0.14
38.8-47.4	--	--	2.98	0.48	0.01
47.4-56.0	--	--	0.52	0.03	--
56.0-64.4	--	--	0.19	0.01	--

Table 2. Fish densities by size class and depth for the 3 June 1975 survey (in #/1000 m<sup>3</sup>).

Depth in meters	Size category				
	1	2	3	4	5
4.3-13	12.8	13.3	6.01	2.09	--
13-21.6	--	17.0	1.34	1.89	0.66
21.6-30.2	--	4.47	0.41	0.54	0.01