

FRI-UW-7923
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LAKE WASHINGTON
SOCKEYE SALMON STUDIES
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Albert W. Drew
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FINAL REPORT

Service Contract No. 1074
Washington State Department
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For the Period January 1, 1979 to June 30, 1979

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INTRODUCTION

This report summarizes the acoustical and trawl data for the 1977 year class of Lake Washington sockeye salmon. Acoustic techniques developed under the University of Washington Sea Grant Program have provided population estimates of this fish stock since 1969. These studies are providing part of an expanding data base which should supply much of the knowledge necessary to effectively manage this important fishery resource. The support for these acoustical studies has been provided by the Washington State Department of Fisheries (WDF).

MATERIALS AND METHODS

Survey Equipment and Procedure

The acoustic data acquisition system consisted of a prototype dual-beam 105 kHz echosounder developed by Mr. Alan Wirtz at the University of Washington with support from the Washington Sea Grant Program. This sounder is similar to that described by Wirtz and Acker (1979), but differs in having a fixed bandwidth of 4 kHz, a fixed transmitter power of 500 watts and two receiver channels, one for the wide-beam element and one for the narrow-beam element of the dual-beam transducer. For this report the data from the narrow-beam channel with a time varied gain of $20 \log R$ were recorded on a Sony TC 854 tape deck using Ampex 766 instrumentation tape run at a speed of 15 ips.

Two acoustic surveys, on February 9 and March 17, 1979, were conducted. Both surveys followed the standard 16 diagonal transect

pattern (Fig. 1). The surveys were made at night to obtain data during maximal dispersal of the fish. The R.V. MALKA was used as the acoustic survey boat. The boat speed during the surveys was approximately 6 knots.

The trawl data were collected on two nights, February 12 and 13, 1979, using the standard 3 m IKMT from the R.V. COMMANDO. The trawl sample station's location and depth remained the same as previous years (Fig. 2). Boat speed was estimated to be 4 to 4.5 knots.

The acoustic data were analyzed by the usual digital echo integration techniques (Thorne et al. 1975). The integration data were calibrated by counts obtained from an echo counting software system on the PDP 11/45 computer. The use of the counting program allowed for a larger number of larger samples to be analyzed than with the previous oscilloscope manual method. In testing these methods it was found that there was far less variability with the computer counting system. This year there appeared to be little difference of the size of fish targets at various depths and only one regression relationship was derived (Fig. 3). The result of this calibration was used to calculate estimations of total fish density for each depth stratum for each area of the lake.

The estimation of 1977 year class sockeye salmon density was made by multiplying the percentage of these salmon in the trawl samples times the fish density for the corresponding depth and area. This

sockeye density was then multiplied by the volume of each stratum to calculate total abundance per stratum. These abundance estimators were summed for the resultant total abundance estimator for each acoustical survey.

The net trawl data were utilized to calculate an additional abundance estimator as in previous years. On the basis of estimated net mouth opening and boat speed, a swept volume of 820 m³ per min of tow was assumed. From this swept volume and the catch data another estimator of sockeye density was determined. This density was extrapolated over the volumes of each stratum as described in the 1978 report for the total net abundance estimator.

RESULTS AND DISCUSSION

The results of the two acoustic surveys and the trawl sampling are shown in Table 1. The total estimates for the 1977 year class sockeye salmon were 3.11 and 2.75 million for the February and March acoustic surveys and 1.28 million for the February trawl sampling. The center of the lake, areas 2, 3, and 4 had the highest abundance of this year class.

The listing of the total catch of all fish species is given in the Appendix, and a comparison of catch-per-unit-of-effort (CPUE), based on a standardized 10-min trawl, of the five most common species for 1978 and 1979 is given in Table 2. Interestingly, for all but the age 0+ smolt the average CPUE was 3.37 (fish per trawl) for 1979, down from

8.78 for 1978 or a drop of 62%. This strongly suggests that there was a sharp drop in the efficiency of the net, possibly due to the reduction this year to a boat speed of approximately 4.3 knots from 5.2 knots in 1978. Using a correction factor 2.61, the value needed to normalize the 1979 CPUE to the 1978 CPUE, on the net abundance would increase this estimator from 1.28 to 3.31 million.

As in 1978 it is suggested that a greater reliance be placed on the acoustic abundance estimators because of the larger sampling volume, greater aerial coverage, and probable higher sampling efficiency of the acoustic surveys. The mean acoustic estimation for the two nights is 2.93 million. Assuming a marine survival of 8%, there should be a return of approximately 230 thousand adults.

Unfortunately, this estimated return is from a parent stock with the largest escapement, 435 thousand, in the recent history of Lake Washington sockeye. The spawning success of this parent stock was hindered by several factors described by Stober et al. 1978. First the spawning area in the Cedar River was still reduced in size from the 1975 flood, and spawning success in a limited area probably is density-dependent. Secondly, there was a heavy infestation of Salmincola, a parasitic copepod, on this stock and a high female mortality resulting in an effective escapement of 290 thousand spawners. Another estimator of the escapement, 275 thousand, was provided by a study conducted by WDF (Jim Ames, personal communication). A third factor hindering the reproductive success of

this stock was the flood in the Cedar River in December 1977. There was no study of fry production conducted on the 1977 year class so a measure of the combined effects of the above factors on this production is unavailable.

LITERATURE CITED

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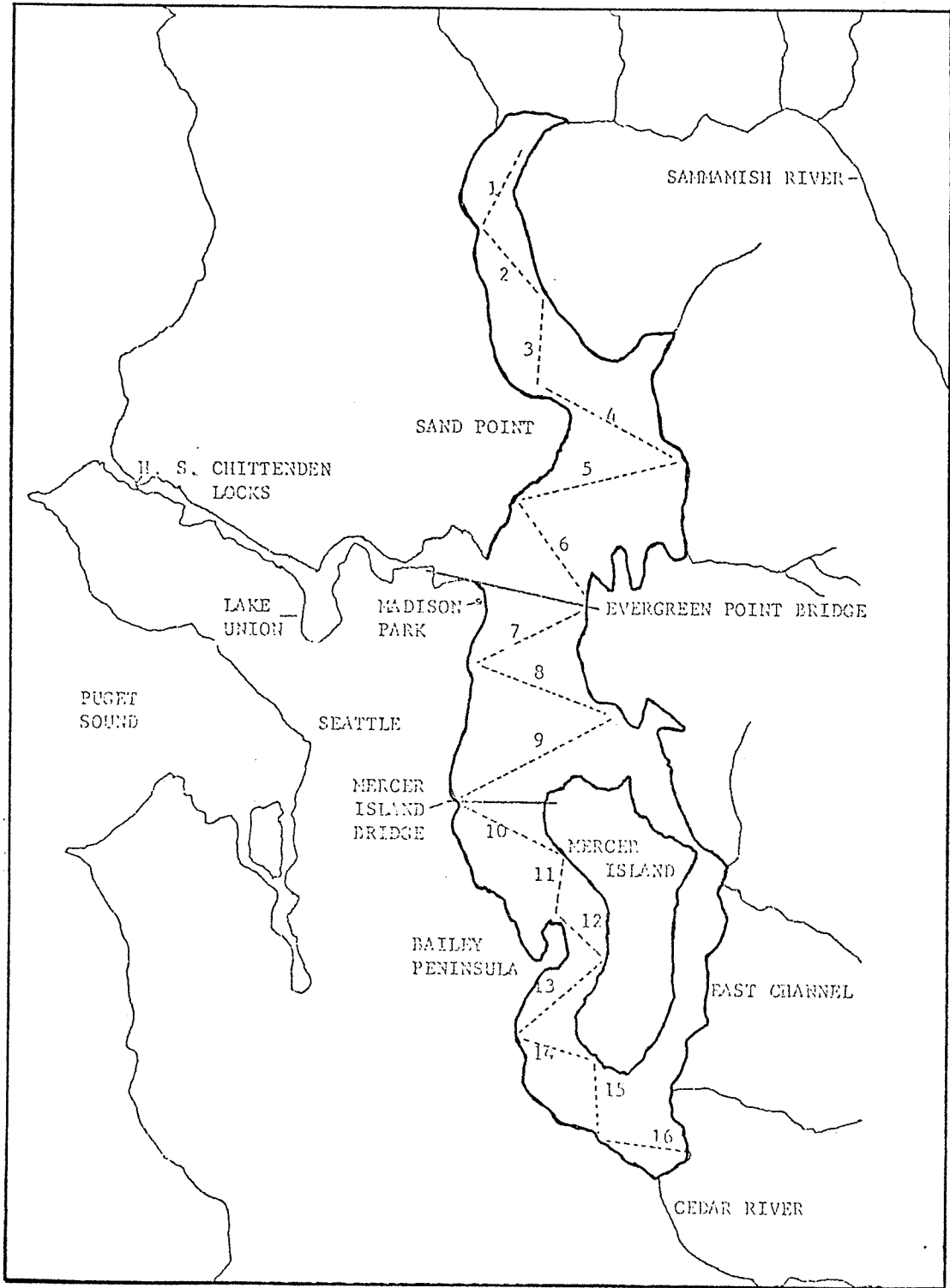


Fig. 1. Map of Lake Washington showing transect pattern.

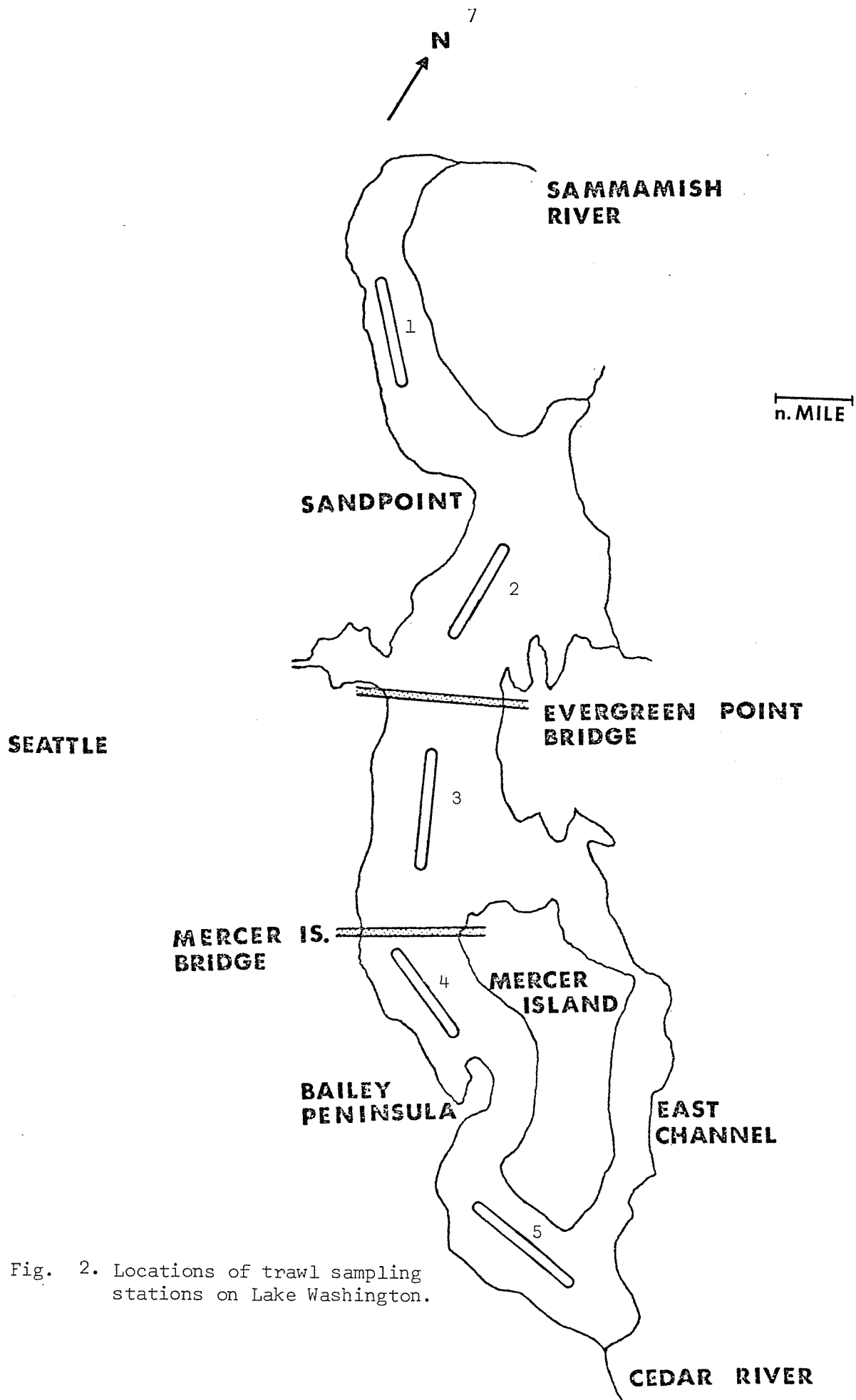


Fig. 2. Locations of trawl sampling stations on Lake Washington.

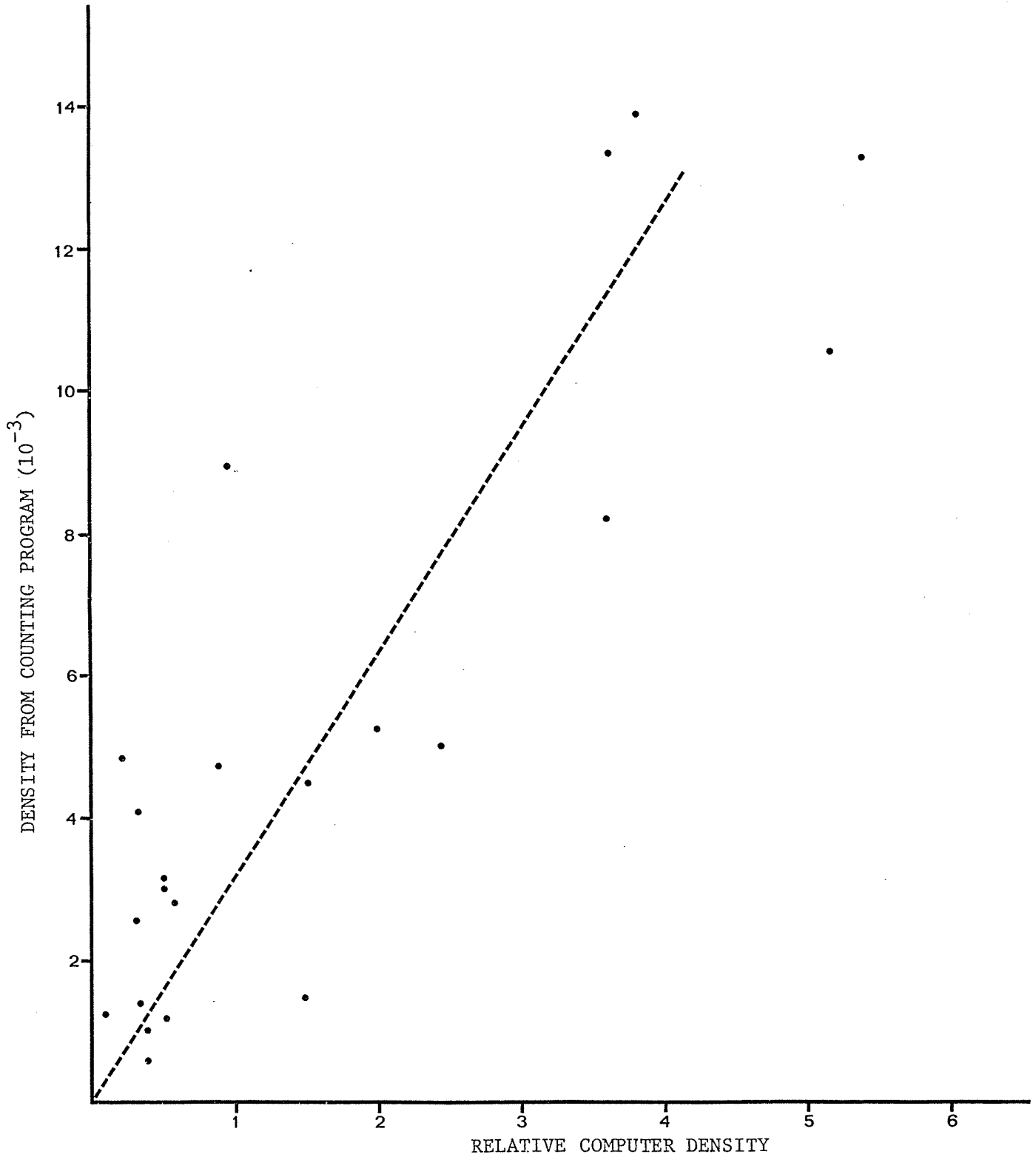


Fig. 3. Regression of relative densities of fish measured by the computer against density estimates from computer counting program.

Table 1. Population estimates of 1977 year class.

Area	Acoustic estimates		Net estimate
	Feb 9, 1979	Mar 17, 1979	Feb 12-13, 1979
	10^6	10^6	10^6
I	.02	.02	.01
II	.55	.68	.15
III	1.38	1.09	.50
IV	.67	1.16	.56
V	.12	.15	.07
Total	2.75	3.11	1.28

Table 2. CPUE of five pelagic fish species in Lake Washington (normalized to 10 min. tows at 5.2 knots as in 1978 data).

Species	Feb 1978	Feb 1979	Percentage 1979/1978 x 100
Sockeye 1+	16.9	5.84	34.6
Smelt 0+	4.41	5.72	129.6
Smelt 1+	5.03	1.88	37.5
Stickleback	15.56	6.08	39.1
Cottids	1.65	.66	40.1
Peamouth Chub	4.74	2.35	49.6

Appendix Table A-1. Catches of fish from 10 min net tows in Lake Washington, February 12-13, 1979.

Haul	Area	Depth	Sockeye			Smelt			Peamouth		
			1978 YC	1977 YC	1976 YC	1978 YC	1977 YC	1976 YC	Stickleback	Cottids	Chub
1	5	15	3	2	0	1	0	0	4	0	0
2		22	6	0	0	0	0	0	4	0	2
3		28	4	0	1	1	1	1	27	1	9
4		28	4	4	4	1	1	0	16	4	14
5		22	17	3	0	1	0	0	14	4	7
6		15	4	2	0	1	0	0	4	2	0
7	4	15	1	5	0	14	0	0	18	0	0
8		22	0	1	1	10	1	1	7	0	0
9		28	0	9	1	13	1	0	6	0	0
10		35	1	27	3	6	3	0	3	0	3
11		35	0	21	3	15	3	0	1	0	0
12		28	0	12	2	4	2	0	4	0	0
13		22	0	9	0	14	0	0	9	0	0
14		15	0	2	0	2	0	0	2	0	0
15		35	0	19	2	16	2	0	4	0	2
16	3	15	0	0	0	0	0	0	0	0	0
17		22	0	0	0	18	0	0	5	0	0
18		15	0	1	0	4	0	0	2	0	0
19		22	0	0	1	3	1	0	7	0	0
20		28	0	1	3	4	3	0	9	0	2
21		35	0	5	0	3	0	0	3	1	5
22		50	0	18	3	2	3	0	0	1	0
23		28	0	5	4	3	3	0	8	1	1
24		35	0	2	2	2	1	0	0	0	13
25		50	1	15	0	3	0	0	1	0	4
26	2	15	0	2	0	12	0	0	0	0	0
27		22	0	2	3	7	3	0	13	0	0
28		28	0	1	3	0	0	0	6	3	0
29		35	0	2	2	0	0	0	4	1	4
30		50	0	6	3	1	3	0	0	1	1
31		15	0	0	7	1	0	0	0	0	0
32		22	0	0	4	7	4	0	5	0	0
33		28	0	2	3	3	3	0	1	1	0
34		35	0	0	0	3	0	0	2	1	1
35		50	0	2	0	2	0	0	0	0	3
36	1	15	0	1	4	2	4	0	2	0	0
37		22	0	0	1	1	1	0	2	0	1
38		28	1	0	2	2	1	0	1	0	0
39		35	0	0	4	0	4	0	0	0	3
Total			42	183	60	182	182	60	194	21	75