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The effect on stock size from various assumptions of
year-class strengths for the Div. 5Z and Statistical Area 6 herring stock

by

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The Assessments Subcommittee in April 1976 requested STACRES at its 1976 Annual Meeting to examine more fully the effect on stock size of assumptions on year-class strength (ICNAF Summ.Doc. 76/VI/22, page 42) for the herring in Div. 5Z + Statistical Area 6. The assessment of this stock (and also for Div. 5Y) for 1977 is based in large part on the assumptions of year-class strength at age 3 for year-classes 1971-1974 (beginning in 1974). Eighty percent of the stock size (age 4 and older) by weight at the beginning of 1977, as given in the last assessment (Summ.Doc. 76/VI/22), is due to assuming that the year-class sizes of the 1971, 1972, and 1973 year-classes at age 3 were 550 million fish each. This level which was chosen as an arbitrary level to apply to poor year-classes was the size of the poorest year-class (1969) observed in the fishery as calculated from an earlier assessment. The poor catches of herring in spring herring surveys in 1975 and particularly in 1976 raise doubts as to this assumption. This is shown in Fig. 1 using results from the *Albatross IV* surveys. The catch in numbers per tow stratified by area at age 3 was 3.13 (averaged over Blocks 3 and 4 (Fig. 2)) for the 1969 year-class, while for the 1971, 1972, and 1973 year-classes the stratified numbers per tow were 0.08, 0.05, and 0.47, respectively.

The following examines options of abundance other than 550 million fish for year-classes 1971-1974 and indicates the effect on stock size.

1. Estimate of age 3 abundance from the young herring surveys

The stratified numbers per tow of age 3 herring from the *Walther Herwig* and *Ernst Haeckel* were combined (Table, page 40, Summ.Doc. 76/VI/22) for Georges Bank and Southern New England and are given below:

Table 1

<u>Year-class</u>	<u>Stratified numbers per tow of <i>Walther Herwig</i> and <i>Ernst Haeckel</i></u>	<u>Estimated age 3 abundance</u> <u>(10⁶) (000 tons)</u>		
1970	4,288	3,222	452	} estimated
1971	1,532	1,151	161	
1972	47	35	5	
1973	44 ¹	35	5	

¹ The *Anton Dohrn* was used in place of the *Walther Herwig* in 1976.

The ratio of the abundance of the 1970 year-class ($3,222 \times 10^6$) to the stratified number per tow (4,288) was applied to the stratified numbers per tow for year-classes 1971, 1972, and 1973 to obtain the estimates of 1,151, 35 and 35. The size of the 1970 year-class at age 3 appears to have been assumed correctly as estimates from the cohort analysis are 3,440 to 3,118 for starting F's of 0.8 to 1.2 in 1975.

The consequence of these alternative sizes for the 1971-1973 year-classes on stock size (age 4+) and catch (age 3+) for the years 1975-1978 is as follows:

Table 2

<u>Year</u>	<u>New stock size (age 4+) (000 tons)</u>	<u>Stock size as assumed in assessment</u>	<u>Catch (age 3+) (000 tons)</u>
1975	366	285	143.3
1976	202	204	60 (assumed)
1977	129	225	0 (assumed)
1978	199	225	-

2. Estimates of year-class abundance in 1976 from young herring surveys

Table 3. Stratified numbers per tow of herring in 1976 by year-class from surveys for the Georges Bank and Southern New England areas.

	<u>Year-classes</u>				
	<u>1974</u>	<u>1973</u>	<u>1972</u>	<u>1971</u>	<u>1970 and older</u>
<u>Albatross IV</u>					
Georges Bank	0	.54	.06	.02	.50
S. New England	.13	.39	.09	.18	.89
Average	.07	.47	.08	.10	.70
%	5	33	6	7	49
<u>Walther Herwig</u>					
Georges Bank	0	4.1	.61	5.24	8.71
S. New England	0	11.22	.93	2.50	63.04
Average	0	7.66	.77	3.87	35.88
%	0	16	2	8	74
<u>Ernst Haeckel</u>					
Georges Bank	0	5.69	.77	.60	3.07
S. New England	0	21.62	.84	.94	4.51
Average	0	13.66	.81	.77	3.79
%	0	72	4	4	20

The stratified numbers per tow as percentages by year-class are given in Fig. 3 for each vessel. The relative year-class size as predicted by the three vessel surveys agree quite well, particularly with the very low 1971, 1972, and 1974 year-classes.

The abundance of size groups 6 to 8+ in 1976, as assumed in the April assessment (Summ.Doc. 76/VI/5) is 248, 15, 5, and 3 million fish for a total of 271 million. The ratio of year-class size of the 1970 year-class and older to the stratified number per tow for these year-classes for each vessel was applied to the other year-classes to estimate their abundance in 1976.

The estimates of year-class size (millions) in 1976 for each vessel are:

	<u>Year-class</u>				<u>1970 and older</u>
	<u>1974</u>	<u>1973</u>	<u>1972</u>	<u>1971</u>	
<i>Albatross IV</i>	182	182	31	39	271
<i>Walther Herwig</i>	0	58	6	29	271
<i>Ernst Haeckel</i>	0	977	58	55	271

This procedure assumes that herring of age 2 and 4 are as available in the survey area as the older ages. Since the survey covers a large area (Blocks 3 and 4 in Fig. 2), this may be so but it is still uncertain. Assuming equal availability, the size of the year-classes averaged over these vessels is:

<u>Year-class</u>	<u>1974</u>	<u>1973</u>	<u>1972</u>	<u>1971</u>	<u>1970 and older</u>
<u>Abundance (million fish)</u>	61	406	32	41	271

These year-classes give a stock size (age 4+) in 1976 of 81,000 tons and a stock size (age 3+) of 138,000 tons instead of 204,000 and 281,000-291,000 tons, respectively, as assumed in the April assessment. Assuming these new levels of stock size for 1976, a catch of 60,000 tons in 1976 would require an $F_{100\%}$ of 1.24 and the stock size (age 4+) in 1977 would be reduced to 74,000 tons. With the assumed poor 1974 year-class entering the spawning stock in 1978, even a TAC of zero in 1977 would not allow the stock to rebuild in 1977 toward the minimum stock size constraint of 225,000 tons and the desired level of 500,000 tons.

3. Assumption of 250 million fish at age 3 for the 1971 and 1972 year-classes (550 million used in the assessment)

The level of 250 million fish is arbitrarily chosen at about one-half of the level used in the April assessment to show the effect on stock size by a 50% over-estimate in the assumed year-class size. These assumptions would produce the following stock sizes (age 4+):

<u>Year</u>	<u>Stock size (age 4+) (000 tons)</u>	<u>Assumed catch (000 tons)</u>
1976	155 (204 used in assessment)	60
1977	120	0
1978	192	

Under these circumstances, the minimum stock size of 225,000 tons in 1977 and 1978 could not be maintained even with zero TACs in 1976 and 1977.

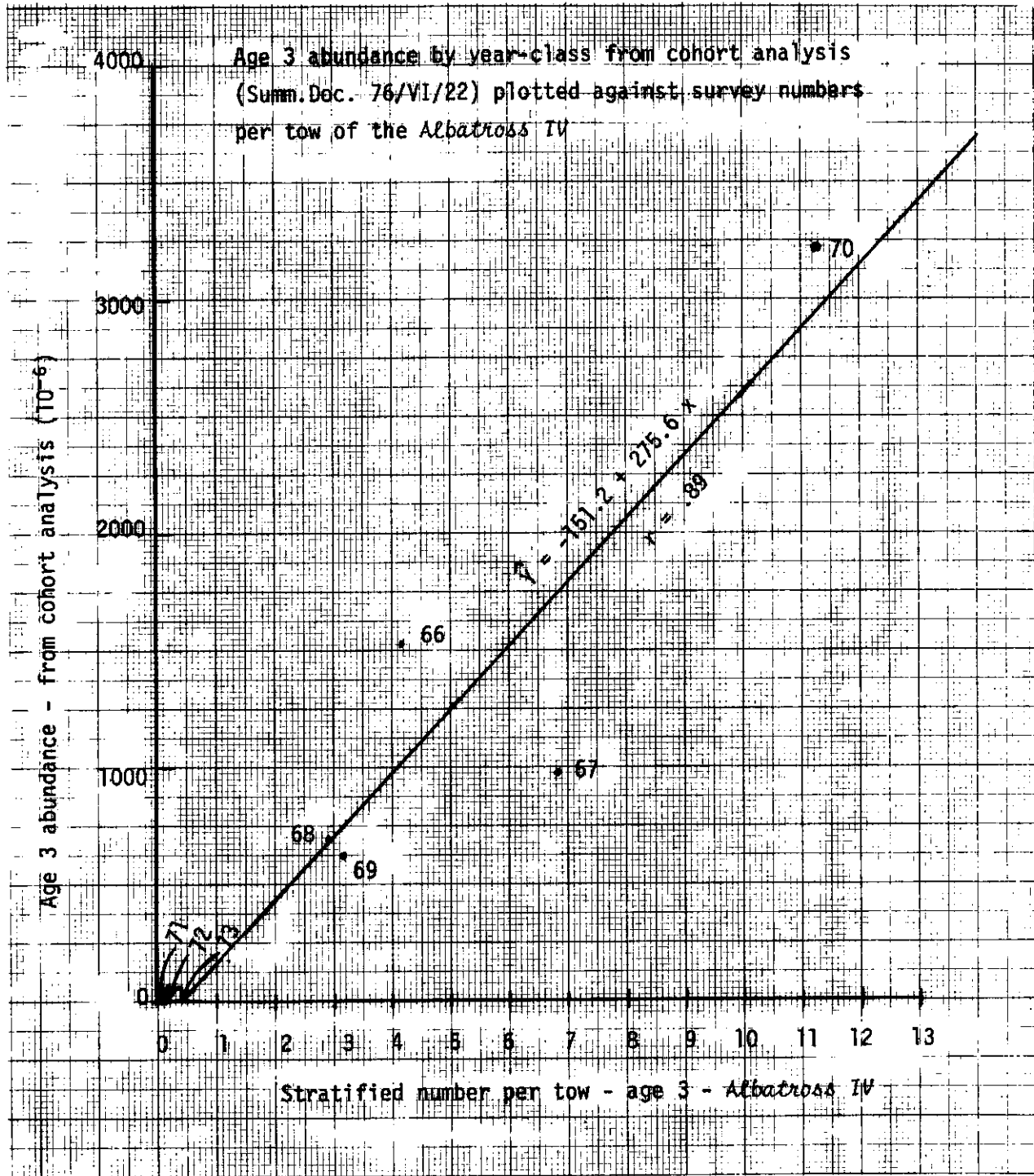


Fig. 1

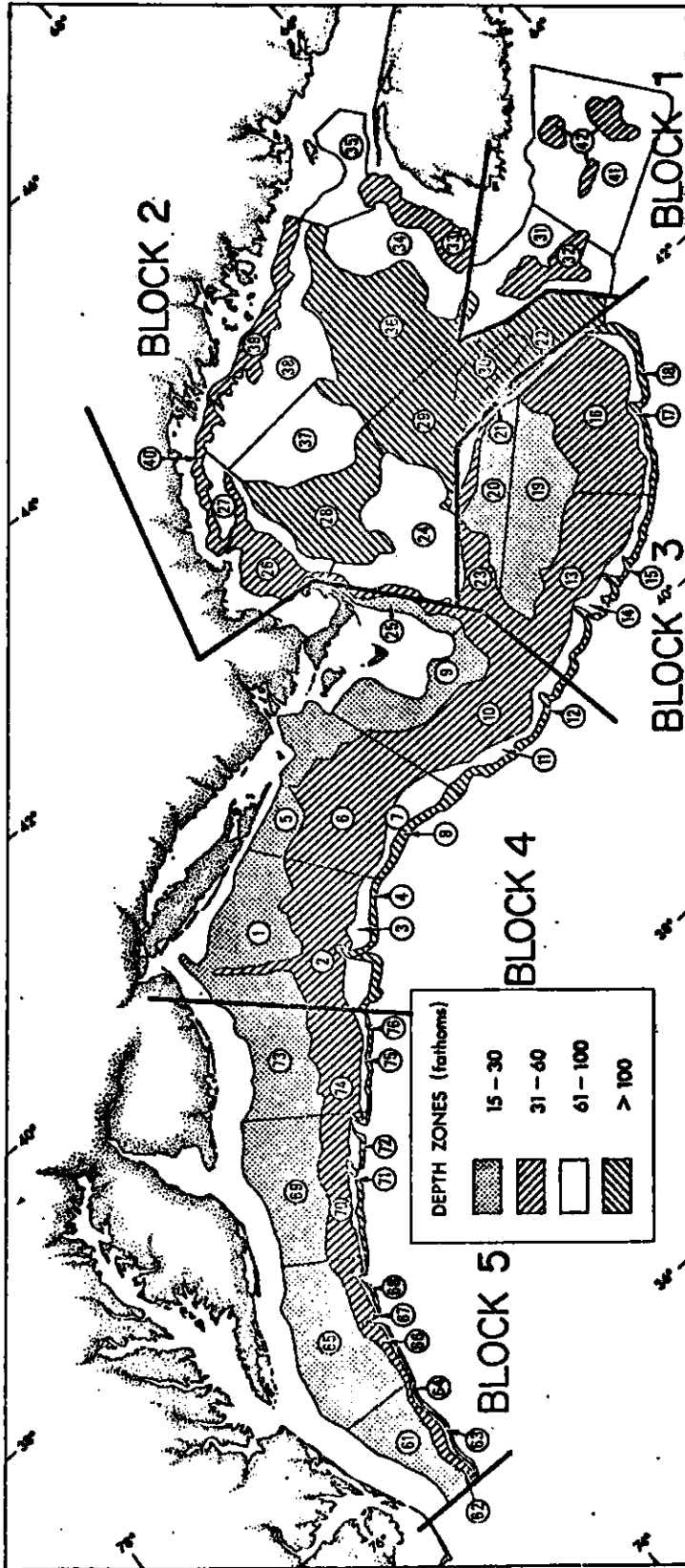


Fig. 2. Bottom trawl survey sampling strata and blocks used for estimating relative indices of herring abundance.

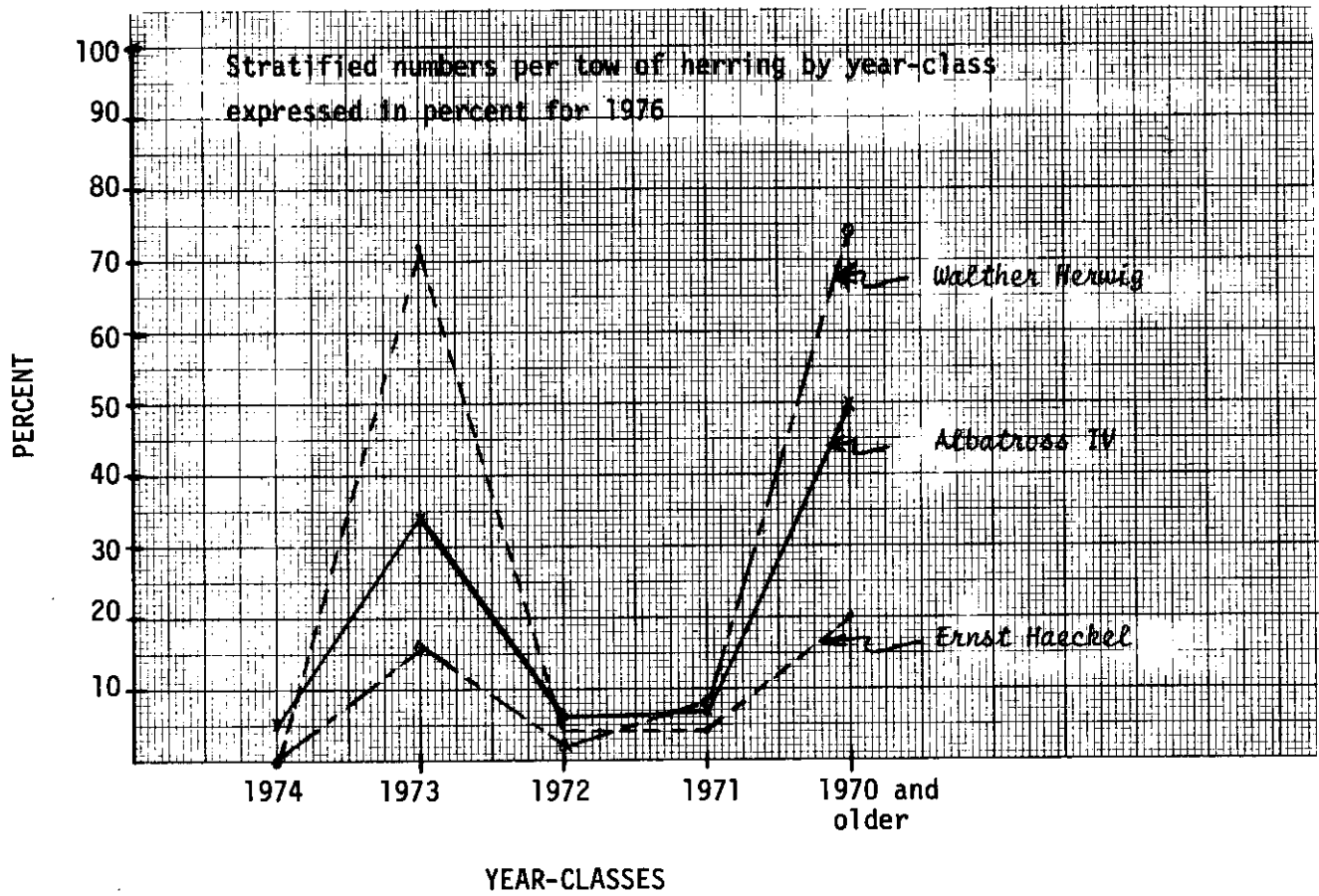


Fig. 3

