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An approximate estimate of the abundance indices for red hake of age-group I
in view of specifying the total abundance indices and possibility of
forecasting the stock size two years ahead.

by

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Abstract

        A specified estimate of the abundance index for age-group I of red hake from southern New England
is presented. This value gives a more precise reflection of the abundance ratio of fish in the age of 1+
and 2+ years. New total indices of abundance are calculated and a preliminary estimate of a minimal stock
early in 1974 is made.

Introduction

        Evaluation and long-term forecasting of stock size is an extremely important task of fishery investi-
gations and should be based upon as precise indices of abundance as possible for both total stock and individual
age-groups. Concerning the main object of the present paper, $i.e.$ red hake from southern New England, it was
determined earlier that the abundance indices for age-group I were underestimated and that index ratio between
age-groups I+ and II+ absolutely disagreed with the actual ratio (Rikhter, 1971). An attempt was made to
obtain abundance indices for age-group I, which should be closer to the actual indices, and on this base to
approach the solution of the problems cited in the title.

Methods

        The use of a fine-meshed chafer (mesh size of 8 mm) for the trawl cod-end should provide similar
catchability for all red hake age-groups beginning with group I, but in fact this does not appear to be so.
In virtue of some behavioural and distributional patterns, the catches of young fish of age 1+ are considerably
poor when compared with those of older age-groups. This defect can be eliminated by Tjurin's method (1972)
which uses a nomograph in full logarithmic scale to reveal the dependence between population and age-group
abundances and to extrapolate missing data.

        The abundance indices of 4 age-groups (from 2 to 5) averaged by 4 year-classes (1965-1968), were
used as a basis to fit the regression line. The indices were increased by 10 times to avoid negative logarithm
values. Then the ratio between the observed mean abundance indices for fish of ages 1+ and 2+ years and those
estimated by index plot for age-group I was determined. The preliminary value of the red hake stock in southern
New England early in 1974 was calculated by Halliday's scheme (1970).

        Age samples were collected by Soviet vessels during the joint USA - USSR surveys in 1967-1972. For
each survey year the length-age keys were compiled to convert size composition (according to $Albatross\ IV$ data)
into age composition.

        Table 1 gives abundance indices for separate age-groups which served as a basis for further calcu-
lations.

Table 1. Mean catch per haul of separate age-groups of red
hake (numbers) from southern New England, 1967–
1972.

Year of survey	Age (years)				
	1	2	3	4	5
1967	3.28	2.80	2.18	0.96	0.36
1968	4.81	4.02	3.01	1.05	0.42
1969	5.33	3.88	4.59	1.86	0.79
1970	4.69	9.11	2.15	1.53	0.56
1971	3.12	12.03	1.42	0.84	0.28
1972	5.78	11.58	12.49	3.97	2.10

The catchability for all age-groups from age 2+ onwards was assumed to be equal on the average, despite the inconformities observed in some years.

Results

The mean index of abundance for age-group I obtained by extrapolation of the line (Fig. 1) appeared to be 28.4, that is 6.3 and 3.9 times higher than the observed indices for ages 1+ and 2+ years respectively. Applying the factor 6.3 to the observed indices for age-group I, new values of indices for this age-group in numbers and weight were estimated (Table 2).

Table 2. Observed and estimated abundance indices for age-group 0 by years.

Year	Observed indices		Estimated indices	
	number	weight (g)	number	weight (g)
1967	3.28	239	20.62	1505
1968	4.81	322	30.30	2030
1969	5.33	320	33.58	2018
1970	4.69	188	29.59	1182
1971	3.12	100	19.63	628
1972	5.78	289	36.40	1820

The difference between estimated and observed values indicate how much the total indices of abundance obtained during the joint USA – USSR surveys (Table 3) should be increased.

Table 3. The observed and specified total indices of
abundance (pounds) for red hake from southern
New England, 1967–1972.

Year	1967	1968	1969	1970	1971	1972
Observed indices	7.0	10.3	13.5	8.5	7.6	12.2
Specified indices	9.8	14.1	17.3	10.7	8.8	15.6

On the average the new values exceeded the previous ones by 22.5%. While these figures are only preliminary, there is no doubt that the previous abundance indices are underestimated. Correspondingly, the values of stocks estimated by these indices using the catchability factor (Rikhter, 1972) are underestimated as well.

The well known correlations between the reconstructed abundance index for age-group I and the observed indices for fish of ages 1+ and 2+ years enable one to conduct simple calculations by Halliday's method (1970) for preliminary estimate of the red hake stock early in 1974. The abundance index for red hake in the age of 2+ years old is estimated as 9.4 in 1973 (36.4:3.9). Total abundance of this age-group of about 25,000 tons was estimated with the help of the catchability factor of 0.07 (Edwards, 1968) and mean weight of 134 grams. Total size of the exploited stock (excluding fish in the age of 1+) estimated by the same methods was about 110,000 tons early in 1973. The mean value of the total instantaneous mortality being 1.1 (Rikhter, 1972) by the beginning of 1974, the remainder will be 37,000 tons and the total stock will reach 62,000 tons. The value obtained should be considered as minimum, because in 1974 the exploited stock can be considerably contributed to by 1972 year-class, the abundance of which is not yet known. Recent surveys have revealed that the importance of 2-year-old fish in the fishery is much higher now (Rikhter; Report of modern tendencies in the abundance dynamics). This fact can be explained by a higher proportion of young fish and by a number of strong year-classes.

Mean biomass of red hake in the age of 1+ can be obtained by calculating the mean reconstructed index of abundance and a mean weight of fish of this age-group for all six years of surveys. The following values were used for biomass estimate of the first age-group: abundance index 28.5 specimens, weight 54 g, catchability coefficient 0.07, and the area swept by 36 trawl during one tow 0.011 sq. miles. The mean biomass value was 30,000 tons. By adding this value to that calculated earlier (62,000 tons), we obtain a tentative estimate of the total commercial stock at the beginning of 1974 equal to 92,000 tons. Taking into consideration the fact that the southern part of the area of distribution of red hake overlaps the area southwest of Hudson Canyon (strata 61-76), where the biomass was about 5,000-10,000 tons during the survey period, we can assume that the total abundance of the commercial stock concerned is equal to 100,000 tons. Based on this estimate, a total catch of 50,000 tons from the area west of 69°W can be recommended for 1974.

Conclusion

Method of reconstruction of the abundance indices, that is determination of such values which correctly reflect the ratio of age-groups in nature enables the calculation of specified abundance indices for age-group I. Although still approximate, these indices are characterized by a higher precision than those calculated by the material of quantitative surveys. In their turn, the results obtained offer an opportunity to make a preliminary 2-year forecast of the stock size and to correct the total indices of abundance in the direction of their increase.

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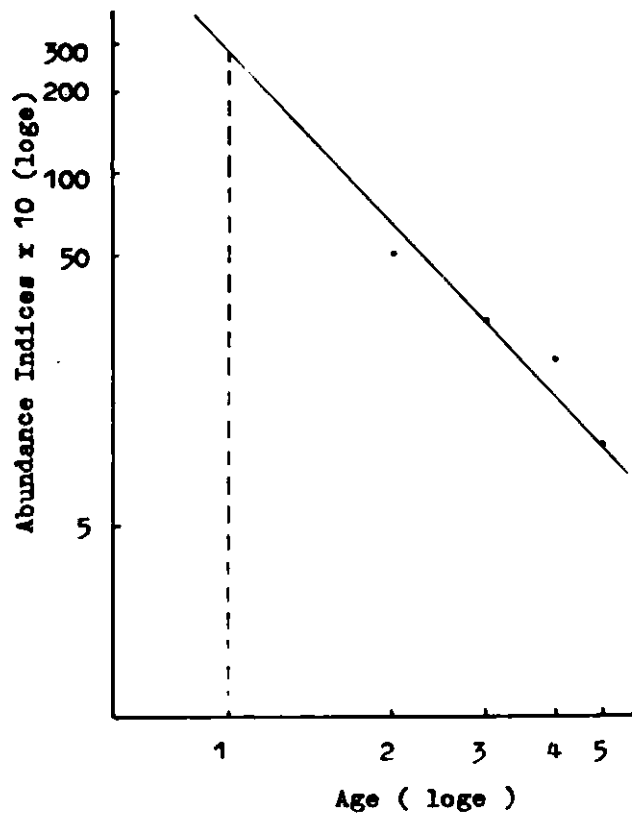
Fig. 1. Logarithmic monogram of red hake abundance and
age in southern New England.