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Age, rate of growth and sexual maturity of herring captured on Georges Bank
29 August-1 October 1965

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Materials for the present report were collected during a research voyage of M/T Wieczno from 29 August to 1 October 1965. Fish samples were obtained from bottom trawl catches. Length measurements were made on 24,077 herring while 1,770 herring were analysed for age, growth, stage of gonads and weight.

The highest catch per effort (10,000 kg per one hour trawling) was noted over the northern slopes of Georges Bank at a depth of 60-80 m. An average yield in commercial trawler catches in September amounted to 870 kg per one hour trawling, with lower catches to the southward. Since there were no essential differences in size and sexual maturity of the fish in the catches from various regions of Georges Bank, all samples were combined.

Most abundant in the samples were fish of 28.0 to 30.9 cm in length (65%). If fish weight had to be accepted as a basis for estimating the participation in particular length classes, therefore 85% of the mass of captured fish were herring of the 28.0 to 31.9 length group. Mean length of herring in particular samples ranged from 28.5 to 30.1 cm.

The curve showing the percentage of fish occurring in particular length groups (Fig. 1) has one peak which might indicate that one year-class predominated in the investigated stock. Otoliths were read from 1,452 herring. The age/length key indicates that the 1960 year-class actually predominates. According to Boyar (1965) this year-class occurred in the catches in 1963, and in 1964 it formed 60.2% of the landings. Other year-classes abundant in the catches in 1965 were the 1961 (15.9%) and 1959 (13.09%) year-classes. Mean length for particular age-groups was calculated from the determination of the age of herring of different lengths. Mean length for the most abundant age-group (IV) was 29.0 cm. The difference in length between age-groups IV and V was 1.5 cm. Between older age-groups the difference became smaller. The mean lengths of fish in particular age-groups, given in Table 1, were used to determine the rate of growth of herring according to the von Bertalanffy equation (Beverton and Holt, 1957):

$$L_t = L\infty (1 - e^{-K(t-t_o)})$$

where:

L_t - length at age t

$L\infty$ - asymptote of curve of growth in length

K - one of the two main parameters of the von Bertalanffy growth equation

t_o - arbitrary origin of growth curve

The parameters computed on the basis of empirical data were as follows:
$L\infty$ = 37.6 cm; K = 0.195; t_o = 3.8.

In the calculation the means for age-groups II and III were omitted in order to avoid any possible error caused by the effect of gear selection at sampling. The length values obtained on the basis of the above parameters of the equation proved to be in accordance with empirical data.

The ratio of males to females changed with fish size. In fish up to a length of 28.9 cm the number of females was equal to the number of males; among larger fish, an increasing proportion of females was observed. Predominant portion of investigated herring had gonads in the stages of maturity V and VI. The admixture of fish with gonads in stages VIII-III fluctuated in particular samples from 5 to 25%. Taking into consideration the weight, their participation in the mass of catches ranged in total from 6 to 13%. Among smaller herring (up to 27.9 cm) about 10% of the fish had undeveloped gonads.

Measurements of both the length and weight of individual fish permitted establishment of the relation between these two values by using the following formula:

$$W = kl^n$$

where:

W - weight of individual fish in g

l - length of individual fish in cm

n and k - coefficients constant.

On the basis of empirical data the values of n and k were determined for two groups of herring. The first group included fish, the gonads of which reached the stages of maturity IV-VI, the second group - fish with gonads in the stages VIII-III. The length weight relation was also determined for both groups jointly, having in view participation of herring of particular length classes, with gonads in different stages of development, which was established on the basis of general sample.

Thus, three equations were obtained, characterizing the relation for each of these groups:

1st Group   - log W = $\overline{3}$.3048 + 3.44 log l
2nd Group   - log W = $\overline{3}$.6388 + 3.14 log l
Joint Groups - log W = $\overline{3}$.5056 + 3.29 log l

These equations permit determination of the condition of fish by means of numerical indices. They also allow estimation of the condition of fish according to the stage of their gonads. For example, in the length-class 26.0 to 26.9 cm (mean 26.4 cm) the mean weight of herring with gonads in stages IV-VI is 27 g larger than the weight of fish with gonads in stages VIII-III. The larger the fish the more distinct become these differences.

References

Beverton, R.J.H. and S. Holt. 1957. On the Dynamics of Exploited Fish
                  Populations. London. Her Majesty's Stationery Office.
Boyar, H.C. 1965. Age, length and state of maturity of adult herring in
   Subarea 5. ICNAF Doc. No. 40, Serial No. 1504.

%

30

20

10

n = 24.077

24,0- 25,0- 26,0- 27,0- 28,0- 29,0- 30,0- 31,0- 32,0- 33,0- 34,0- 35,0- 36,0-
-24,9 -25,9 -26,9 -27,9 -28,9 -29,9 -30,9 -31,9 -32,9 -33,9 -34,9 -35,9 -36,9

length in cm
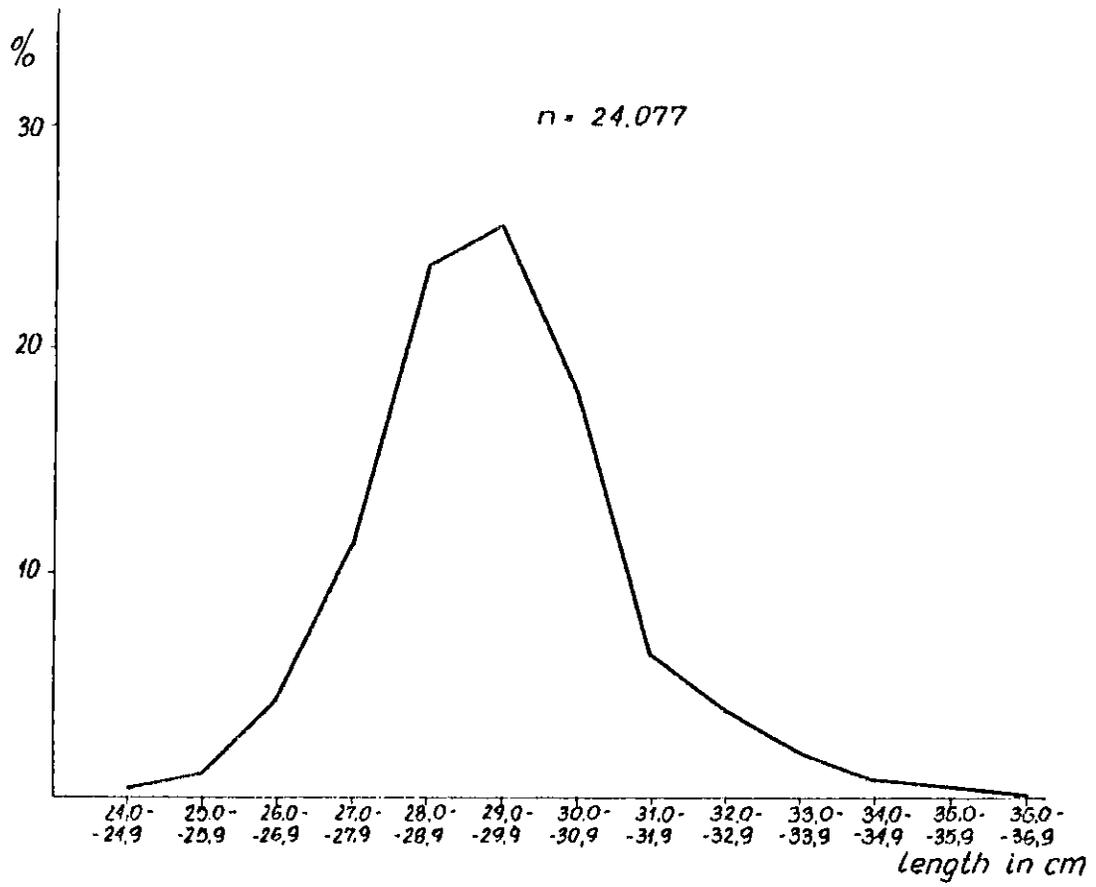
Fig. 1. Length composition of herring on Georges Bank,
August-October 1965.

%

60

50

40

30

20

10

n = 1604

1962 61 60 59 58 57 56 55 *and older*

year classes
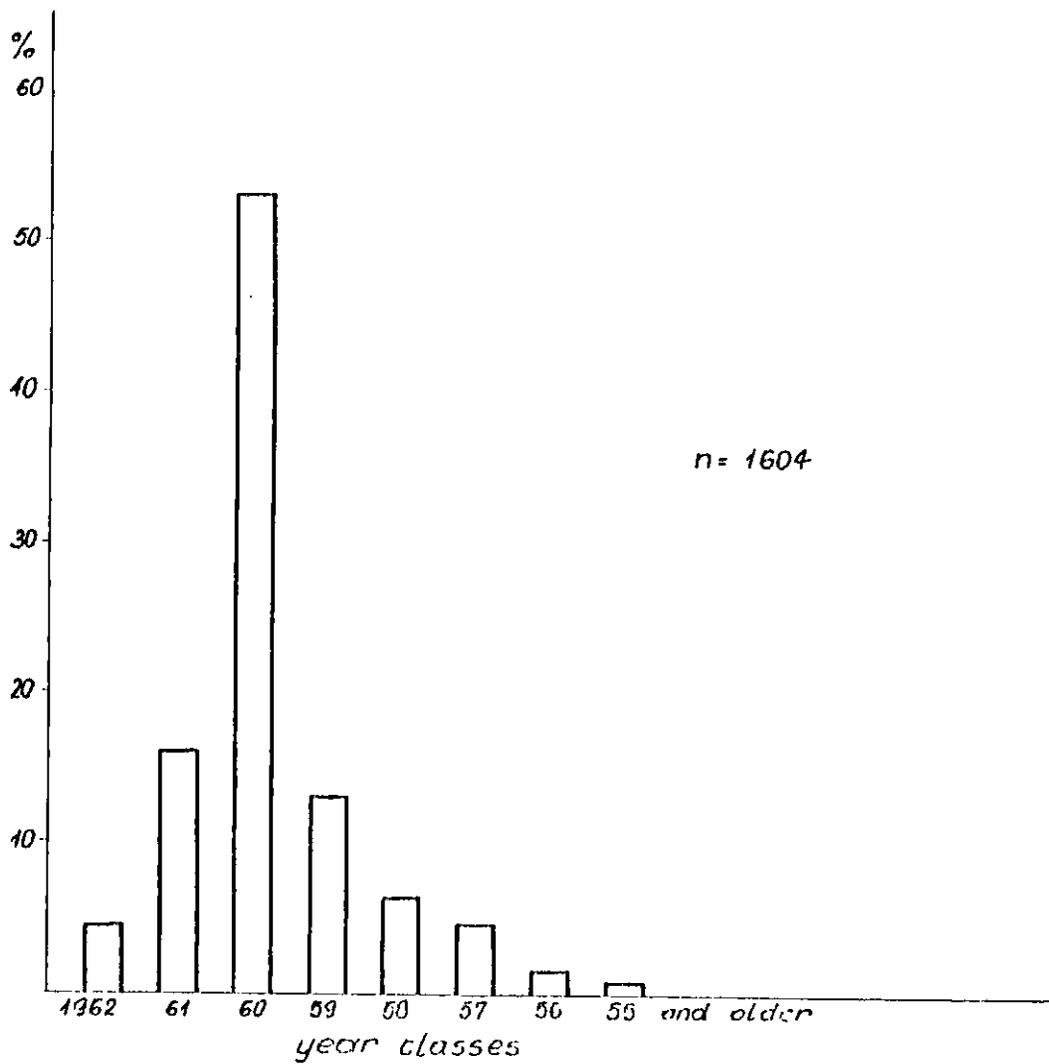
Fig. 2. Age composition of herring on Georges Bank,
August-October 1965.

Table 1. Age/length table for herring on Georges Bank, August and September 1965.

Length cm	Age groups									Total %oo
	I	II	III	IV	V	VI	VII	VIII	VIII+	%oo
24,0-24,9	–	3,4	–	–	–	–	–	–	–	3,4
25,0-25,9	–	7,0	3,0	2,2	–	–	–	–	–	12,2
26,0-26,9	–	26,5	5,7	11,8	–	–	–	–	–	44,0
27,0-27,9	–	10,3	63,1	41,1	–	–	–	–	–	114,5
28,0-28,9	–	–	71,3	157,5	9,3	–	–	–	–	238,1
29,0-29,9	–	–	12,9	195,3	38,3	11,6	–	–	–	258,1
30,0-30,9	–	–	3,3	105,3	57,6	12,5	3,3	–	–	182,0
31,0-31,9	–	–	–	16,0	22,5	17,3	11,3	0,4	–	67,5
32,0-32,9	–	–	–	0,4	2,4	19,2	15,7	3,8	1,0	42,5
33,0-33,9	–	–	–	–	0,3	3,5	13,6	6,8	0,9	25,1
34,0-34,9	–	–	–	–	–	–	2,7	3,4	2,4	8,5
35,0-35,9	–	–	–	–	–	–	1,4	0,6	2,1	4,1
Total o/oo	–	47,2	159,3	529,6	130,4	64,1	48,0	15,0	6,4	1000,0
No of fish invest.	–	152	205	574	166	133	143	55	24	1452
Mean length in cm	–	26,0	27,6	29,0	30,5	31,8	32,8	33,5	34,3	
length according to the Bertalanffy equation	–	–	29,1	29,0	30,5	31,8	32,8	33,6	34,3	