

ANNUAL MEETING - JUNE 1969Results of Studies on Herring fromthe Region of Nova Scotia, Georges Bank and Statistical Subarea 6

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In 1968 Polish vessels operated in various fishing grounds, extending from Banquereau Bank in the Subarea 4 to Cape Charles in the statistical Subarea 6. Though fishermen were in the first rate interested in herring catches they also caught other fishes. The catches of herring and other species in particular Subareas are given in the Table 1.

Table 1

Subarea	Catch in metric tons			
	Herring	%	Other species	%
4	737	57.8	538	42.2
5	63,498	79.3	16,527	20.7
6	11,582	92.9	886	7.1
Total	75,817	80.9	17,951	19.1

These data show that most of herring were caught in the Subarea 5, i.e. on Georges Bank and that the more southwards was situated the fishing ground the higher percent of herring was found in the catches.

Five types of vessels took part in the catches. The fish landed by these vessels and the fishing effort are given in the Table 2.

Table 2

Type of vessel	Catch in metric tons		No.hours fishing	No.days fished
	Herring	Other species		
Factory-trawlers	5,457	967	876	153
Large freezer-trawlers	11,116	9,550	6,489	834
Smaller freezer-trawlers	3,620	1,657	3,474	301
Side motor trawlers	23,740	4,627	11,125	2,108
Steam side trawlers	31,884	1,150	28,322	3,215
All types of vessels together	75,817	17,951	50,286	6,611

Though the largest amount of herring had been landed by steam trawlers, still the importance of this type of vessel in Polish fisheries is gradually decreasing, whereas motor

trawlers become more and more important. Hence the latter type has been accepted as a basis for determination of the standard fishing effort of the whole fishing fleet operating for herring.

Mean fishing yield and fishing effort have been calculated on the basis of fishing results. These data, related to side motor trawler, as a standard unit, are given in the Table 3.

Table 3

Subarea	Catch of herring in metric tons	Fishing yield of a standard trawler in metric tons per day	The number of standard days fished
4	737	11.4	64.7
5	63,498	10.8	5,881.6
6	11,582	13.6	852.3
4 - 6	75,817	11.2	6,798.6

It appears from these data that with different fishing yield in particular Subareas 6,798.6 fishing days would have to be used in order to catch 75,817 tons of herring.

The length of herring

In the fishing grounds of Nova Scotia 4495 herring of the length from 26 to 39 cm. were measured in June and July. On Georges Bank 23,970 herring were measured in the period from June till September. The length of the fish ranged between 22.0 - 35.5 cm.; the mean length was 31.25 cm. In the statistical Subarea 6 the measurements were performed in February and April. Total of 7,026 fish were measured. The range of their lengths was between 22 - 36 cm. and the mean length - 30.08 cm. The results of these measurements are given in the form of curves in the Figure 1. The shape of the curves shows that the largest herring occurred in the fishing grounds of Nova Scotia. The curve representing the length of herring of this Subarea has two peaks. The first peak relates to the length 29.0 - 31.0 cm., the second to the length 32.5 - 34.0 cm. The fish of the length 29.0 - 35.0 cm. comprised 892.3% of the sample.

On Georges Bank the herring were of medium length and the largest group among them /828.2%/ comprised fish of the length 29.5 - 33.0 cm.

The smallest herring were caught in the fishing grounds of the Subarea 6. The most frequent were the lengths 29.5 - 30 cm.; they made up 690.3% of the sample. The descending slopes of the curves, corresponding to the most frequent fish lengths are almost parallel for herring caught on ~~XXXX~~ Georges Bank and herring caught in Subarea 6, but the distance between these slopes shows that the length increase between them

amounted to abt. 0.5 cm. /i.e. between the measurements performed in the periods February-April in the Subarea 6 and June-September on Georges Bank/. The parts of the curves, which correspond to the smallest herring, both in Subarea 6 and on Georges Bank, seem to show that only some of the smallest herring, which in winter seas occurred in the Subarea 6, migrated into Georges Bank.

Age composition

The otoliths for age readings were taken simultaneously with fish measurements. The following number of otoliths were read in particular Subareas: Nova Scotia - 300, Georges Bank - 2150 and Subarea 6 - 1000. The reading of otoliths was performed according to the method of zone interpretation described by Chrzan and Draganik /Redbook 1968, Part III/. The age composition is given in the Figure 2. Moreover, in order to stress the importance of particular age-groups in respect of weight and the number of fish caught by standard motor trawler per day the corresponding data have been given in the Tables 4 and 5. The data from the Table 5 may also be used for calculation of fishing mortality of particular year-classes.

Both the graph in the Figure 2 and the data in the Tables 4 and 5 show that in the fishing ground of Nova Scotia most of fish belonged to the year-class 1963. It made up 32% of the total weight of fish landed. The next was the year-class 1960, comprising 19.7% of the catch. Also year-classes 1959, 1958 and 1957 were comparatively abundant. In total four oldest year-classes 1960 - 1957 made up 47% of the landed mass of fish, whereas the year-class 1961 was rather poor, comprising only 8.2% of the catch.

The catch composition of herring on Georges Bank was different. Similarly to previous years predominated the year-class 1960, making up 40.7% of the catch in 1968. The next /20.2%/ was the year-class 1961, which in respect of number was almost as abundant as the year-class 1963, though the latter was in the third place in respect of weight /16.9%/. On the whole there were considerably fewer older fish /9, 10 and 11 years old/ in the fishing grounds of Georges Bank than they were in the fishing grounds of Nova Scotia.

In the Subarea 6, similarly as on Georges Bank, in the first place there was the year-class 1960, making up 33.6% of the catch in weight. The next was the year-class 1961 - 25.3% of weight. Comparatively good abundance was noted in younger age-groups. It seems probable that the year-classes 1963 and 1964 may be of considerable importance in the catches on Georges Bank in 1969.

T a b l e 4

The participation of particular age-groups/year-classes
in herring catches / in metric tons

Subarea	A g e s										
	III 1965	IV 1964	V 1963	VI 1962	VII 1961	VIII 1960	IX 1959	X 1958	XI 1957		
Nova Scotia	-	2.9	236.0	89.9	60.5	145.2	94.3	60.4	47.8		
Georges Bank	381.0	2.349.3	10.731.1	6.921.3	12.826.5	25.843.7	3.682.9	635.2	127.0		
Subarea 6	208.4	1.019.2	1.355.0	1.586.8	2.930.3	3.891.5	498.0	92.8	-		

T a b l e 5

The number of herring of particular age-groups/year-classes
in catch of a standard motor trawler per day

Subarea	A g e s										
	III 1965	IV 1964	V 1963	VI 1962	VII 1961	VIII 1960	IX 1959	X 1958	XI 1957		
Nova Scotia	-	253	17.376	5.274	2.775	7.238	4.520	2.688	2.200		
Georges Bank	587	2.370	8.170	4.698	8.133	15.348	2.020	346	54		
Subarea 6	2.307	9.894	9.850	9.743	16.817	20.836	2.400	390	-		

In the Figure 2 there is also given the age composition of the spawning stock, based on the sample from Georges Bank taken in September. In this stock predominated year-classes 1960 and 1959. In the third place there was the year-class 1963, which seemed to be of a rather average abundance.

In the Figure 3 there are shown the changes in length composition of particular year-classes of herring caught on Georges Bank in the years 1965 - 1968. There may be noted gradual shifting of the curves characterizing both the length of fish and the abundance of particular year-classes. First of all we note that the year-class 1960 was predominant in these years. Most of the fish of this year-class were caught in 1966. In 1967 some decrease of this year-class was noted in the catches and still further decrease in 1968, whereas along with this year-class appeared the year-classes 1961 and 1963, being however less abundant.

Sexual maturity and feeding of herring

The observations on the stage of maturity of gonads and feeding of herring were carried out during research trips. In February it was found that all the herring had gonads in virgin and recovering stage /II/. In April about 15% of fish on Georges Bank had gonads in developing stage /III/, whereas the rest of fish had still gonads in recovering stage.

In the second half of June, during investigations carried out in the fishing grounds of Nova Scotia, the following stages of maturity were determined - in males: virgin and recovering spent about 3%, developing /III/ - 45%, developed - 46% and gravid /V/ - 6%; in females: virgin and recovering - 5%, developing - 63% and developed - 32%. With these stages of maturity herring were feeding very intensively. About 92% had food in their stomachs, whereas only 8% were with empty stomachs. Mean degree of filling of stomachs was found in 40% of fish.

The observations carried out on Georges Bank showed that herring were maturing here later than in the region of Nova Scotia. In June the stages of maturity were: males - virgin and recovering abt. 10%, developing - 55% and developed - 35%; females: virgin and recovering - 10%, developing - 85% and developed - 5%. In July 45% of males and 70% of females had gonads in developing stage, while 40% of males and 20% of females had developed gonads. In August predominated fish with developed gonads, when simultaneously considerable number of fish had gonads in gravid stage. There were hardly any fish encountered with gonads in developing stage. In July intensive feeding of herring was noted on Georges Bank. In the contents of stomachs there was most often found the crustacean *Thysanoessa* sp. In August the concentrations of fish in

the southern part of Georges Bank began to disperse. Except fish still remaining in the north-western regions, the feeding of herring became less intensive and the mean filling of stomachs was found in only 10% of fish in the samples. Towards the end of August most of fish had empty stomachs.

Rate of growth

Similarly as in the years 1966 and 1967 /according to Draganik, B. and Żukowski, Cz./ the rate of growth was determined from the mean length of particular age-groups. These lengths were calculated separately for males and females. The figures show that in the same age-groups in the three Subareas the females were of a slightly greater length /on average by 0.2 - 0.4 cm./. The values of mean lengths in particular age-groups were used for the curves of growth of herring in the three Subareas. The numerical data are given in the Table 6 and the curves in the Figure 4. Besides the von Bertalanffy equation for determination of the rate of growth also Gompertz's equation

$$l_t = ab^{ct}$$

was used.

Also the parameters of this equation were calculated on the basis of mean lengths of herring, though the data related to herring caught in 1967. The values of these parameters were: $a = 37.0$ cm., $b = 0.594$, $c = 0.819$. The two curves - one plotted according to the von Bertalanffy equation and another according to Gompertz's equation - are given in the Figure 6. We note that they are almost identical in their spread relating to the older age-groups.

Reference

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T a b l e 6

Mean length of herring in particular age-groups / both sexes /
 caught in 1968 and parameters of the von Bertalanffy formula

Subarea	Sex	II	III	IV	V	VI	VII	VIII	IX	X	XI	L_{∞}	K	t_0
NOVA	♂	-	-	27.9	29.4	31.6	31.9	32.9	33.8	33.9	34.5	-	-	-
	♀	-	-	28.0	29.5	31.7	32.2	33.8	34.0	34.8	35.4	36.1	0.266	- 1.5
Georges Bank	♂	17.9	24.2	27.2	29.5	30.7	31.5	32.3	33.2	34.0	34.5	-	-	-
	♀	17.9	24.7	27.5	29.6	31.0	31.8	32.6	33.3	34.5	34.8	35.3	0.305	- 0.95
Subarea 6	♂	-	23.5	26.0	28.3	30.3	31.0	31.9	33.3	34.5	-	-	-	-
	♀	-	23.6	26.2	28.8	30.4	31.2	31.9	33.3	34.6	-	-	38.4	0.188

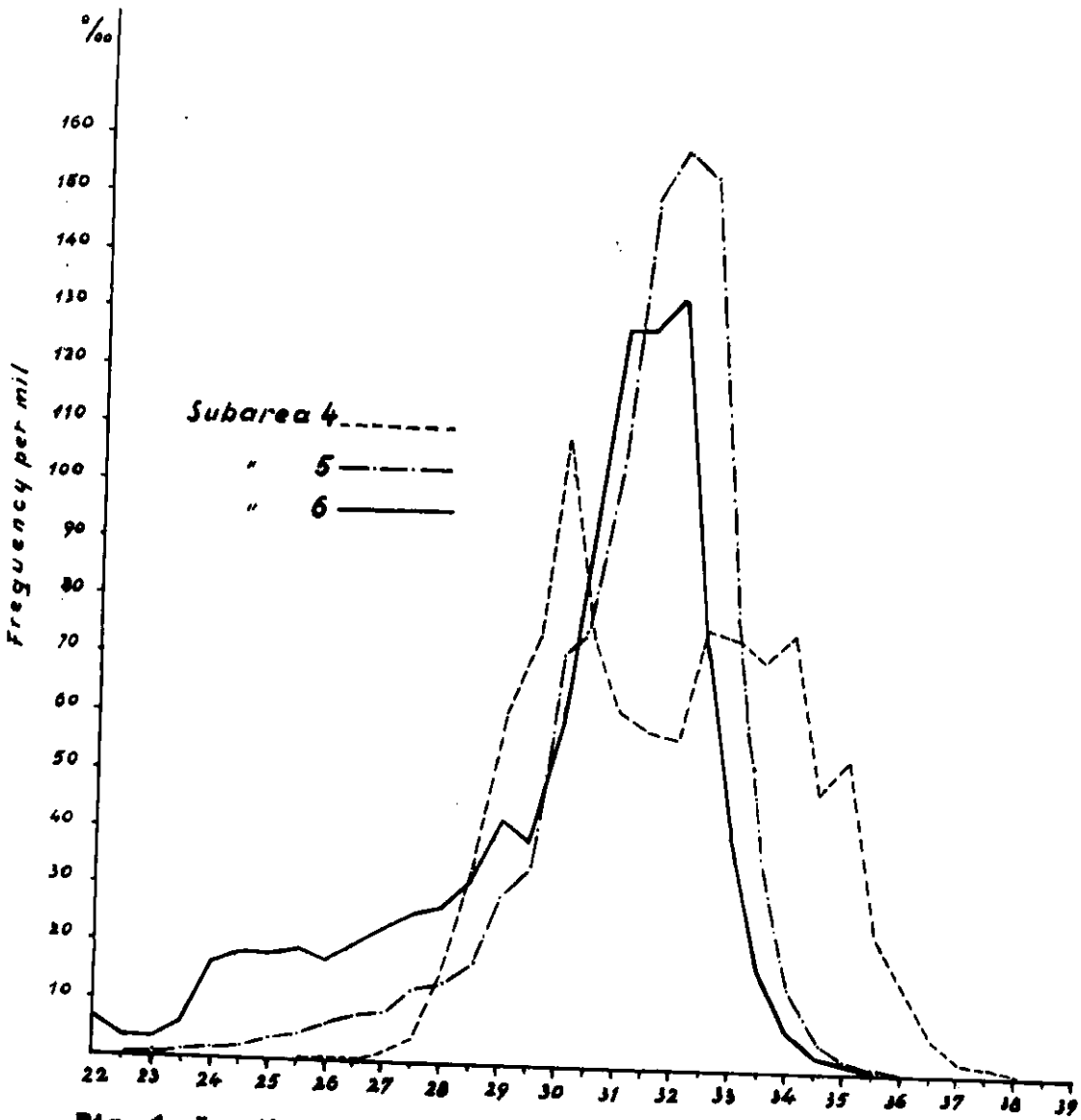


Fig. 1. Length composition of herring caught in three Subareas

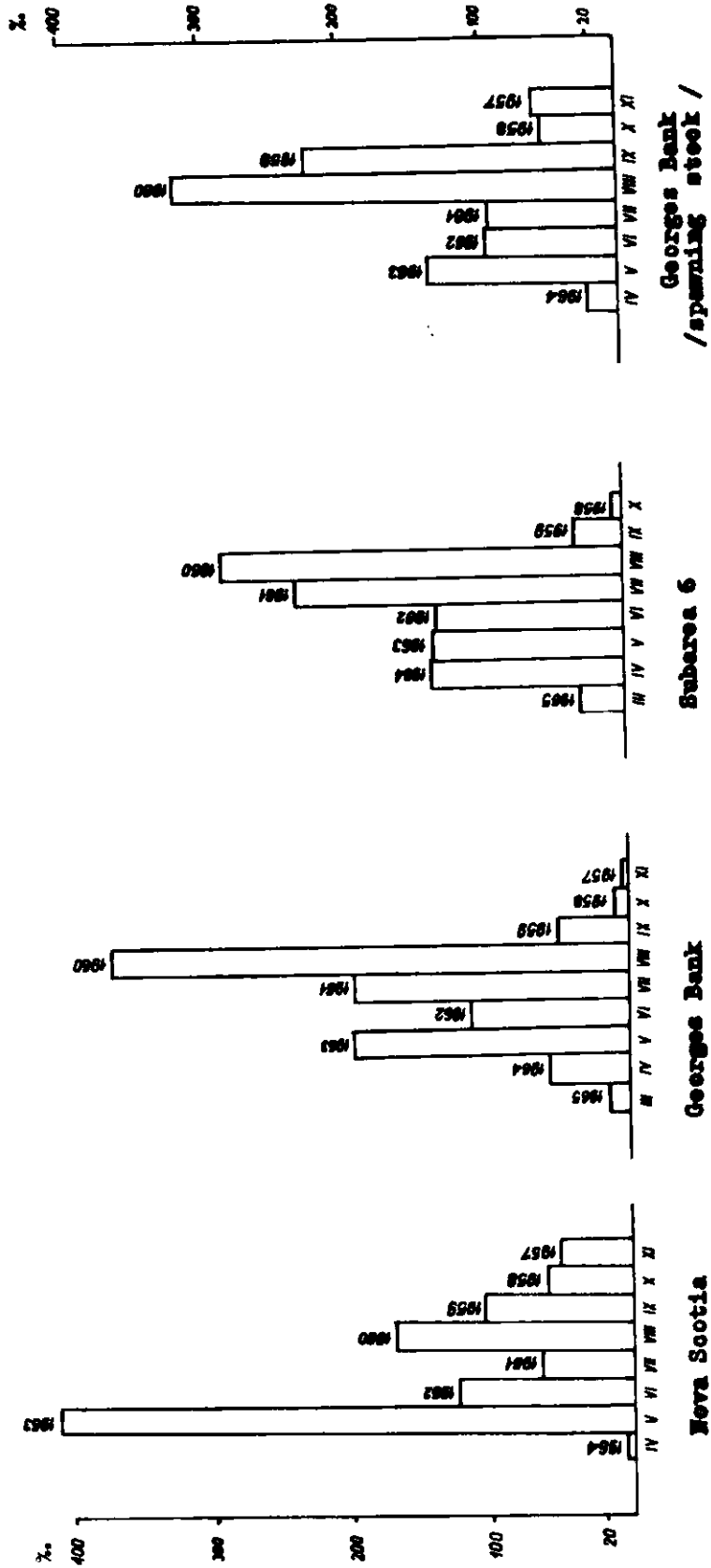


Fig. 2. Age-composition of herring caught in 1968 in three Subareas

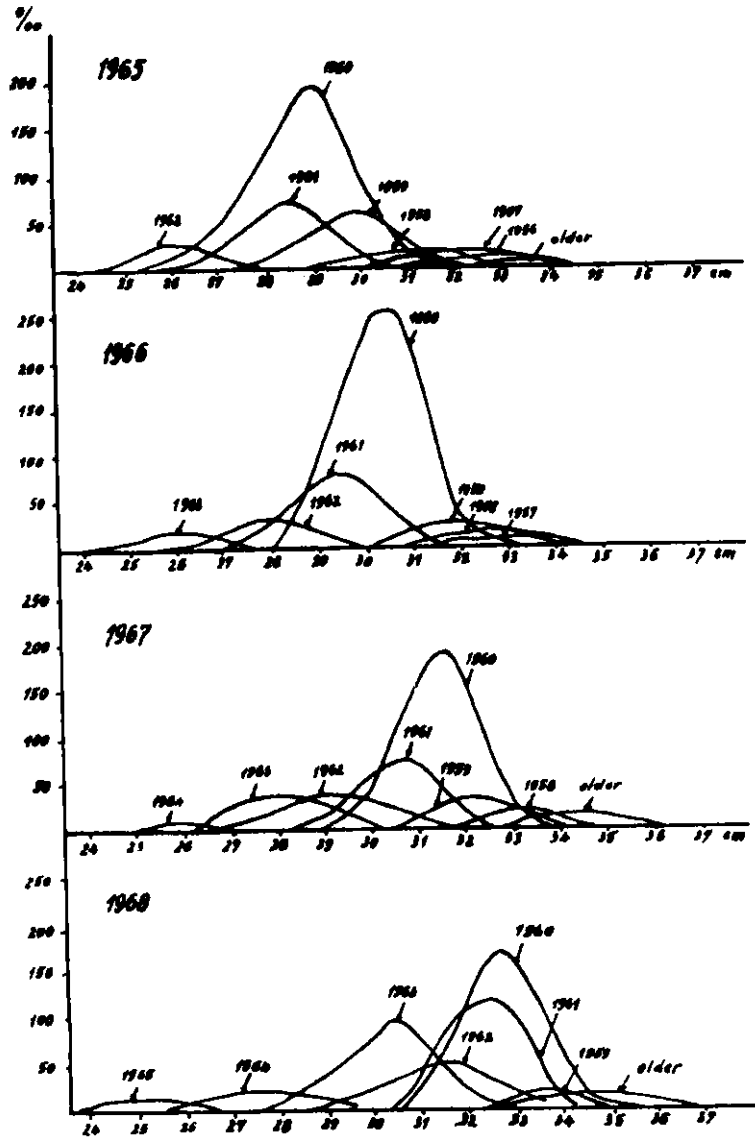


Fig. 3. Length frequencies of the year classes of herring in the 1965, 1966, 1967 and 1968 catches

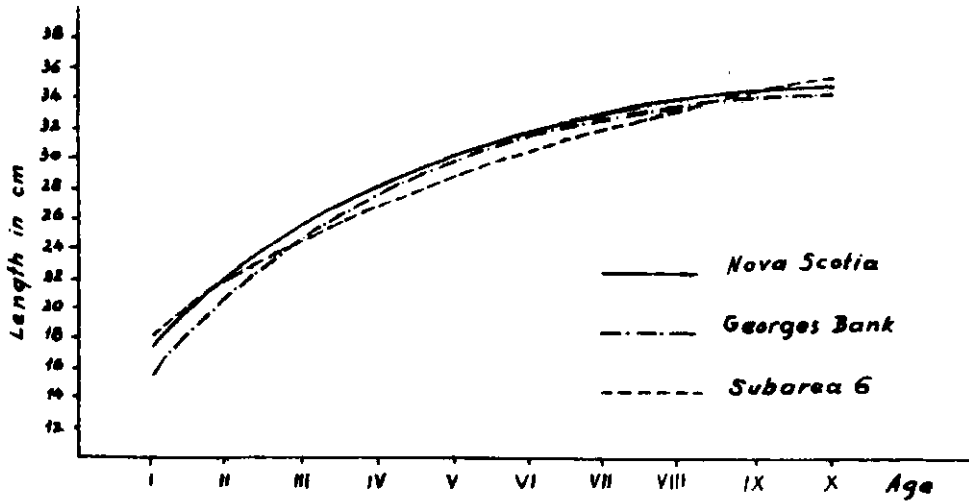


Fig. 4. Rate of growth of herring caught in 1968

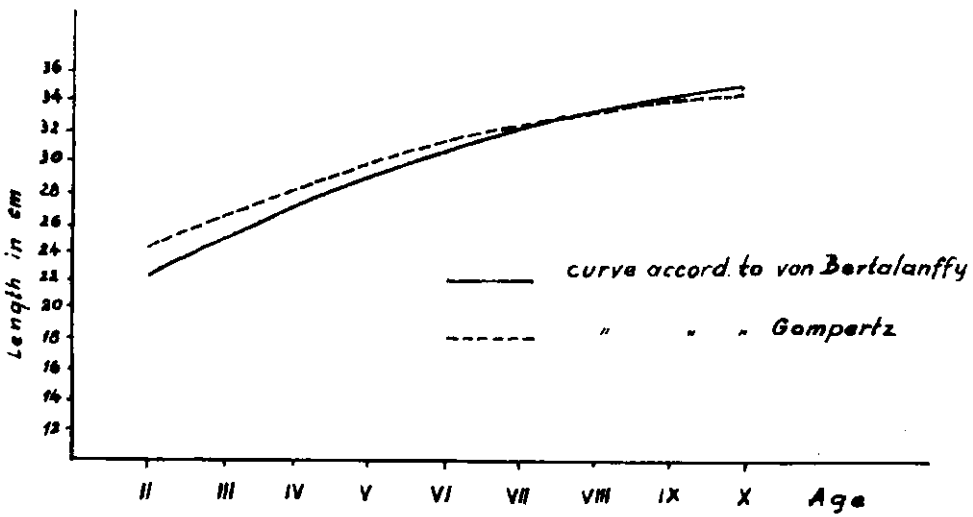


Fig. 5. Rate of growth of herring plotted according to formulas of von Bertalanffy and Gompertz