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On selectivity of bottom trawls in the Northwest Atlantic (Division 4W)

by

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The studying and control of the fishery selectivity are important measures of fishery regulation. The studies of trawl selectivity generally comprise the determination of the optimum age of a fishing object entering the fishery and the selection of the gear construction approximating the requirements of the rational fishery.

In estimating the selectivity rate of the bottom trawl codend the following points were considered: selectivity parameters (a selectivity factor; the length of the fish at 50% retention rate by the mesh-size; the selectivity range and flactuation) and variation of the catch depending on the mesh-size; recommendations on the selection of rational mesh-size for the trawl codend. The experiments were carried out during two expeditions on board the stern and side trawlers. Small-meshed chafers were used.

1. According to the Bilateral Agreement between the USSR and Canada, the observations on the selectivity of three trawl codends made of synthetic fibre with varying inside mesh-size: B = 60, 70, 120 mm (manufacturing size) were made in the Nova Scotia area in October-November 1977 in the silver hake (Merluccius bilinearis) fishery. A bottom trawl of 28/31.4 m with standard fitting was used from the side trawler of SRTM class (No. 8024, FOTON).

In order to determine the variation of selectivity factors depending on the catch composition, a number of fishing areas with different types of bottom and varying fish species compos-

ition was chosen in Div. 4W (62-63°W) according to the Program. In each area the operations were carried out for four days. Each day was subdivided into two ten-hour periods: from 8 a.m. to 6 p. m. - a day-time period;
8 p.m. to 6 a.m. - a night period. The number of haulings was the same in all the areas. A total of 103 haulings was made at the towing velocity of 3.5-3.7 knots, each of 45-60 min duration. The results of the material treatment are presented as the series of the day-time and night hauling data by area. The haulings made in the areas 3 and 4 are combined in Series 3, since the species composition of the catches appeared to be similar. Series 4 includes repeated haulings made in the area 1 in order to specify the variations arising due to the stretch of the netting. The results of the mesh-size measurements in Series 4 differ from those in Series 1 by 3.3% (60.6-62.6 mm) for 60 mm mesh-size, by 3.1% (70.2-72.4 mm) for 70 mm mesh-size and by 2.3% (120.4-123.2 mm) for 120 mm mesh-size.

The statistical treatment of the material was made according to "The Methods of the Trawl Codend Studies", AtlantNIRO, 1972. In the given paper based on the experimental data mean retention rates of the fish by the codend were calculated, the selectivity curves were built for determination of fish lengths corresponding to 50% retention rate by the codends ($\bar{L}_{50\%}$) and the selectivity factors determined. The selectivity factor was deduced from the formula:

$$K_s = \frac{\bar{L}_{50\%}}{B}$$

where $\bar{L}_{50\%}$ is the length of the fish corresponding to 50% retention point in the codend; B-is the inside mesh-size in mm.

Shown in Figs. 2, 3, 4, 5 are the codend selectivity curves in the silver hake fishery, experimental data on selectivity are given in Table I.

Table 1.

Day time	Experimental series															
	1				2				3				4			
	mesh-size, mm	$L_{50\%}$ cm	K_s	selectivity range, cm	mesh-size, mm	$L_{50\%}$ cm	K_s	selectivity range, mm	mesh-size, mm	$L_{50\%}$ cm	K_s	selectivity range, cm	mesh-size, mm	$L_{50\%}$ cm	K_s	selectivity range, cm
Day		19.3	3.18	14.6–24		18.7	3.04	14.6–		22.1	3.53	18.5–		23.7	3.79	16.8–
Night	60.6	15.6	2.57		61.6	20.3	3.3	–23.6	62.3	19.8	3.18	–25	62.6	21.9	3.5	–26.0
Mean		18.5	3.05			19.6	3.18			21.4	3.43			22.6	3.61	
Day		22.4				15.7	2.21			24.1	3.36			23.0	3.18	
Night	70.2	15.1	2.15	14.2–	71.2	22.5	3.16	16.0–	71.7	21.3	2.97	20.5–	72.4	23.1	3.19	17.3–
Mean		18.4	2.62	–23.7		19.3	2.71	25.5		22.3	3.11	–25.1		23.1	3.19	–25.8
Day		39.5	3.28			37.6	3.09			40.9	3.32					
Night	120.4	38.5	3.20	33.3				34.2					34.1			
Mean		39.1	3.25	–42.2	121.7	38.3 38.3	3.15 3.15	–41.3	123.2	– 40.9	– 3.32		–43.8			

Table 2 shows the specific composition of catches (percentage) taken by day and night hauls.

Table 2.

Experiment series	Mesh size	Time	SPECIES					
			Hake	squid	Haddock	Pollack	Redfish	Others
I	60	Day	28,5	22,2	8,9	20,2	I6,5	3,7
		Night	4I,0	9,9	I5,3	-	9,3	24,5
	70		59,2	I4,7	-	-	I8,2	7,9
			49,I	I4,I	-	-	2,2	34,6
	I20		59,8	8,0	-	2,6	-	30,5
			47,5	2,5	2,5	-	-	47,5
2	60		20,0	5I,4	-	-	-	28,6
			I8,7	6I,9	-	-	-	I9,4
	70		3I,3	59,7	-	-	-	9,0
			54,4	I8,I	-	-	-	27,5
	I20		30,I	57,3	-	-	-	I2,6
			49,7	27,3	-	-	-	23,0
3	60		5,4	II,9	49,6	-	I0,I	23,0
			2,6	I7,2	56,8	I2,2	-	II,2
	70		9,2	26,3	46,4	-	-	28,I
			6,3	33,7	42,7	-	-	I7,3
	I20		6,2	I8,8	56,9	-	-	I8,I
			5,I	39,5	42,I	-	-	I3,3
4	60		66,6	20,5	-	-	-	I2,9
			57,4	I9,2	2,3	-	-	22,I
	70		63,6	I9,3	-	-	-	I6,I
			68,3	9,5	-	-	-	2I,2

It can be seen from Table 2 that it was only in 8 cases out of 22 that the amount of hake in catch was over 50 percent. In many instances catches contained hake taken incidentally.

The volume of silver hake seaved from the trawl codend versus the total catch size is given in table 3.

The codend seaving rates for silver hake relative to the total catch size are given in table 2.

Table 3.

Mesh-size, mm	Codend seaving rate (%)		
	day	night	mean
60.6-62.6	10.3	11.6	10.9
70.2-72.4	9.8	8.3	9.0
120.4-123.2	70.4	82.9	76.6

As is evident from table 3, the length of fish retained in the codend with the mesh-size B = 70 mm exceeds insignificant-

ly the retention length $\bar{L}_{50\%}$ by 60 mm mesh-size. This can be accounted for the fact that the codend of 70 mm mesh-size is made of thicker thread 93.5 TEX x 24, of 2.6 mm in diameter, while the codend of 60 mm mesh-size is made of 93.5 TEX x 18, of 2.1 mm in diameter.

For the codend having 123.2 mm mesh-size the fish length $\bar{L}_{50\%}$ is 40.9 cm, while the mode of silver hake is 28.0 cm. This is the reason why the bulk of the fish (80%) is sieved through the codend.

In Figs. 6, 7 the percentage of silver hake distribution by length is shown in the codend and in the chafer. The number of fish both in the codend and in the chafer is taken as 100% . A solid vertical line shows the length of the fish at 50% retention rate, broken lines indicate the 25% and 75% retention points.

Together with the codend selectivity determinations the biometrical measurements were made to find out a dependence of the maximum circumference of the fish ^{body} on the length. The data are given in Fig. 8.

2. In July 1977, in the area between 43°10 - 43°20N and 61°00 - 61°30W at the depth of 80-100 m the observations were made on selectivity of the conventional trawl codend with the mesh-size B = 62.3 mm, and on selectivity of the fore-part netting of the trawl HAKE-2M fitted with the standard trawl rigging. The haulings were made at the towing velocity of 4.0-4.2 knots from the stern trawler of BMRT class (No. 240, Yu. VAREIKIS). A selectivity curve for four comparative haulings is shown in Fig.9. The length of the silver hake $\bar{L}_{50\%}$ = 26.7 cm, the selectivity factor K_s = 4.3, the seaving rate is 8.6%.

The primary data received were processed by the method of three-component weighing (Cooperative Research Report, Series A, N25, p. 29) by the formula:

$$\bar{K}_s = \frac{n_1 t_1 N_1 k_1 + n_2 t_2 N_2 k_2 + \ldots + n_n t_n N_n k_n}{n_1 t_1 N_1 + n_2 t_2 N_2 + \ldots + n_n t_n N_n}$$

where $\bar{K}_s$ is the mean weighed selectivity parameter;

$n_1, n_2 \ldots n_n$ is the respective number of hauls in the 1st, 2nd, ... experiments

$t_1, t_2 \ldots t_n$ is the fishing time during one cycle in the 1st, 2nd, ... experiments;

$N_1, N_2 \ldots N_n$ is the number of fish in the selectivity range in the 1st, 2nd, ... experiments.

$k_1, k_2 \ldots k_n$ is the selectivity rate in the 1st, 2nd, ... n-M experiments.

Finally the following selectivity rates were obtained:

3,95 - for 60 mm mesh, with due regard to "Vareikis" data;

2,88 - for 70 mm mesh

3,24 - for 120 mesh

The summary selectivity rate for all mesh sizes is 3,52.

CONCLUSIONS

1. The major reason for the low selectivity rates on SRTM "Foton" was that the work was done on mixed concentrations of fish with little hake (the areas were suggested by the Canadian Side). Squid made up considerable share in catches. It "blocked" mesh and was a noticeable obstacle to the natural seaving of hake from the codend. For example, in the first series in night hauls with codend mesh size of 60 mm (K9 = 2,57) the share of hake in catches varied from 25% to 69% (average 41%), while it was 10% for squid. In the same series of trawlings night operations with 70 mm mesh codend K - 2,15, at the same time the share of hake in the codend was 49,1% and that of squid - 14,1% on the average. In the second series of trawlings the squid number reached 60% in day hauls (mesh 70 mm) and that of hake - 30%, K_s = 2,21. In the third series of trawlings the hake number did not exceed 9%. The mean weighed selectivity coefficients got after treatment for 60 mm mesh are almost equal to the mean data for the kapron codends. These coefficients are much lower for 70 mm and 120 mm mesh size. Throughout the working time of SRTM "Foton" it was determined that the silver hake was at the post-spawning condition: 27% of silver hake were at VI-LL maturity stage, 45% - at II one, 21% - at III and 7% - were juvenile fish.

2. The results of investigations showed at a special hake fishery (BMRT "Vareykis") that the selectivity factor K_s = 4,3. At the same time, the hake number in catches were 92 - 95%. The silver hake were at the spawning and post-spawning condition.

3. To obtain more truly selectivity factor, investigations should be repeated at the earlier terms (August-September), and it should be a special silver hake fishery.

Trawls with double codends should be used while assessing the truth of the results of trawl codend with chafing gear selectivity.

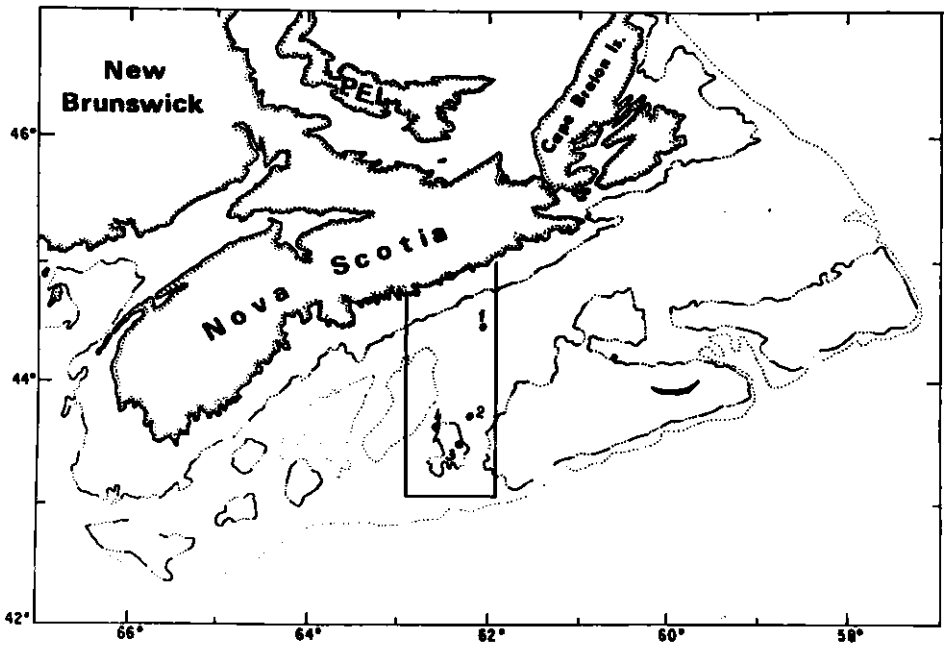

Fig. 1. The area of selectivity studies.

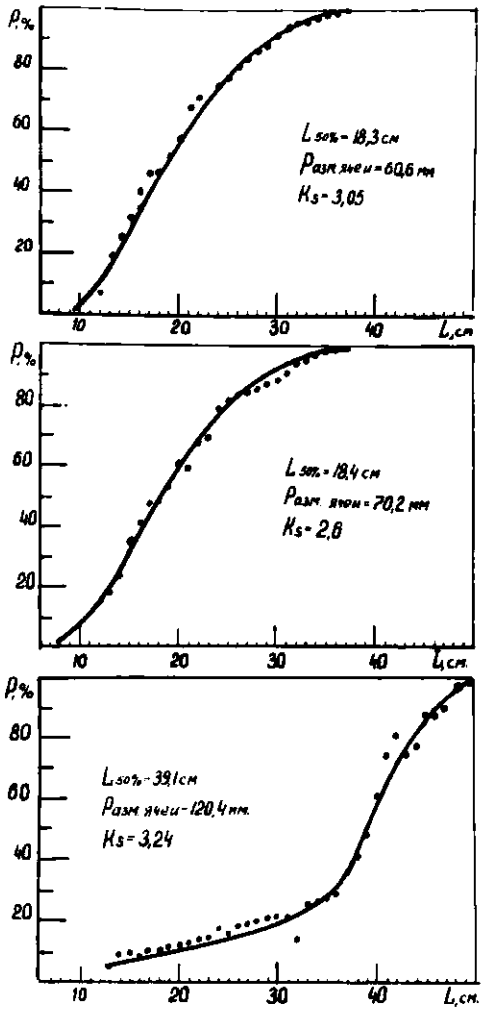

Fig. 2. The curves of the codend selectivity for silver hake (Series 1).

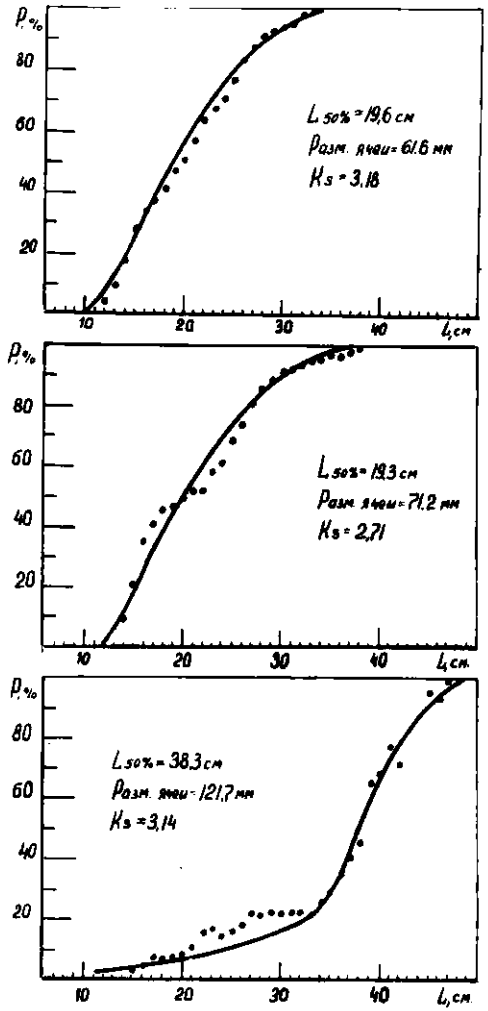

Fig. 3. The curves of the codend selectivity for silver hake (Series 2).

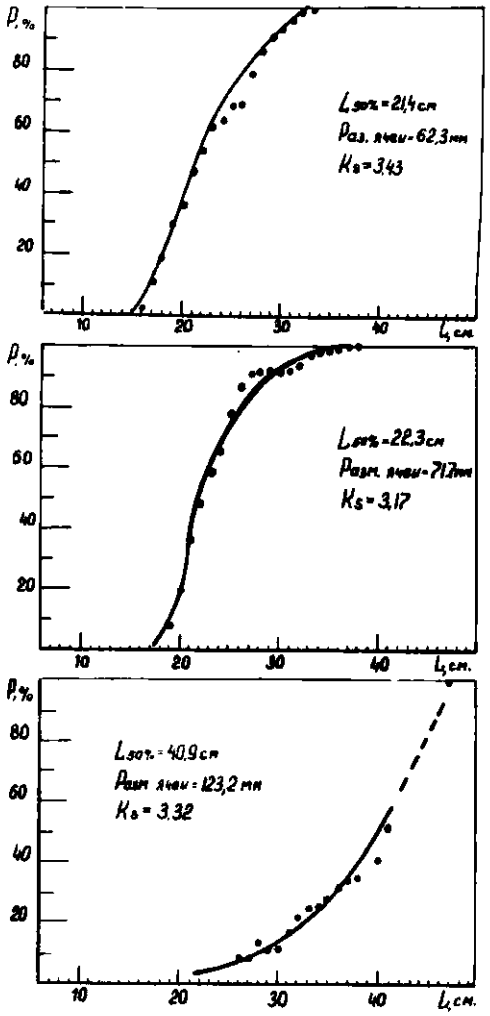

Fig. 4. The curves of the codend selectivity for silver hake (Series 3).

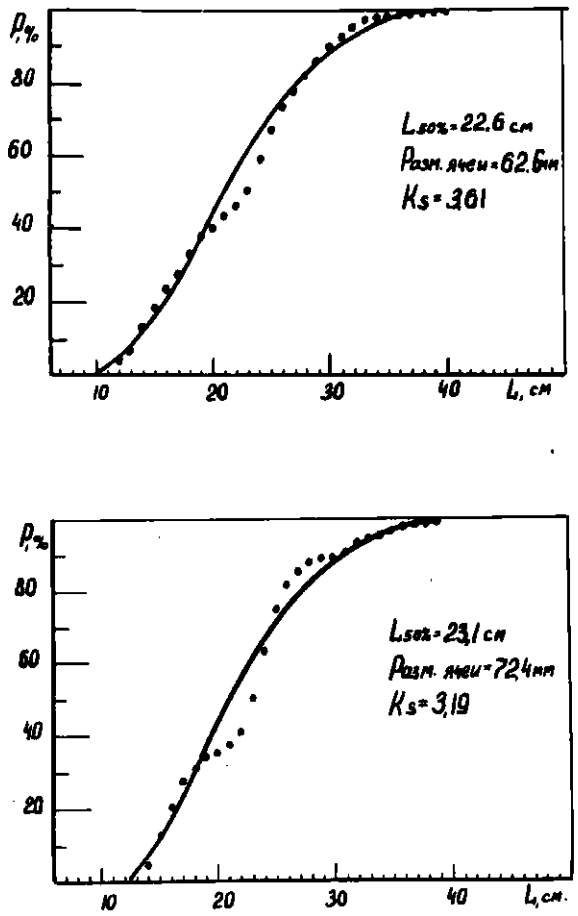

Fig. 5. The curves of the codend selectivity for silver hake (Series 4).

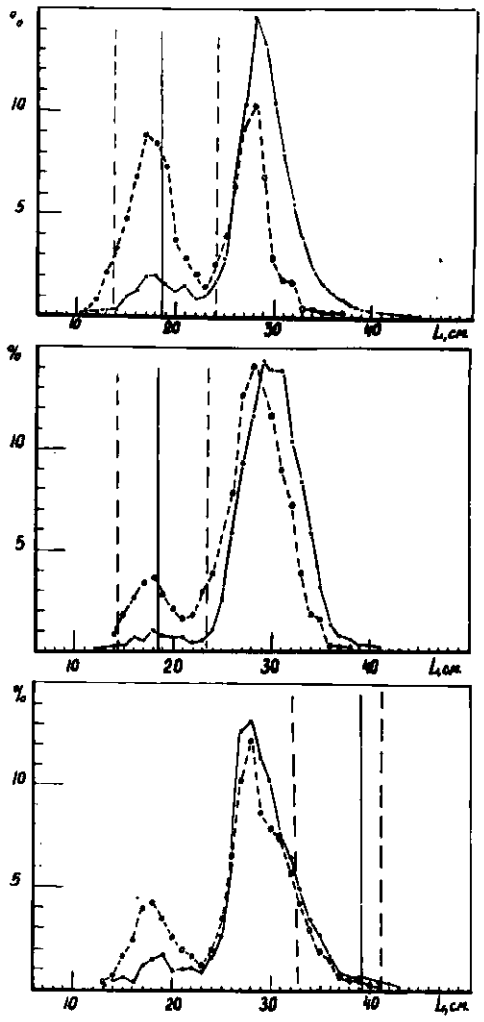

Fig. 6. The percentage of hake distribution in the codend and in the chafer (Series 1)
1 - 60 mm mesh size
2 - 70 mm mesh size
3 - 120 mm mesh size

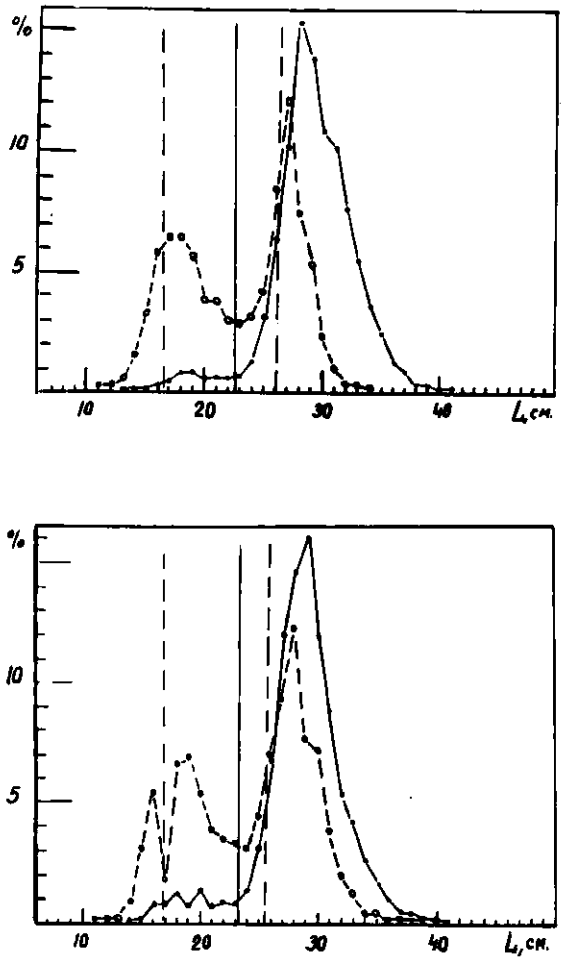

Fig. 7. The percentage of the hake distribution in the codend and in the chafer (Series 3)
1 - 60 mm mesh size
2 - 70 mm mesh size

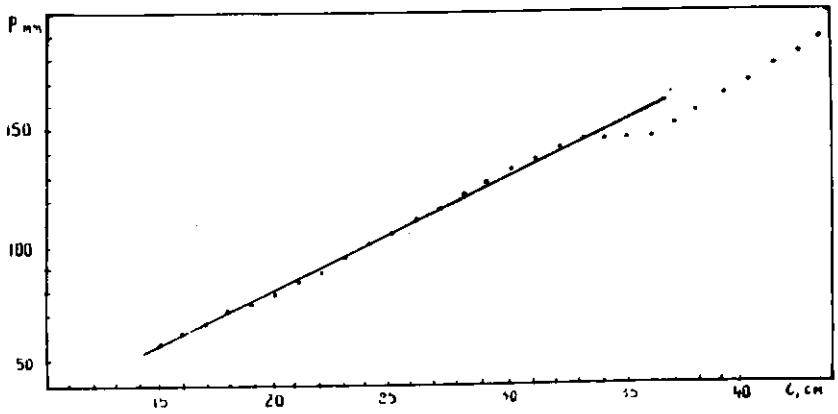

Fig. 8. A dependence of the hake circumference on the length.

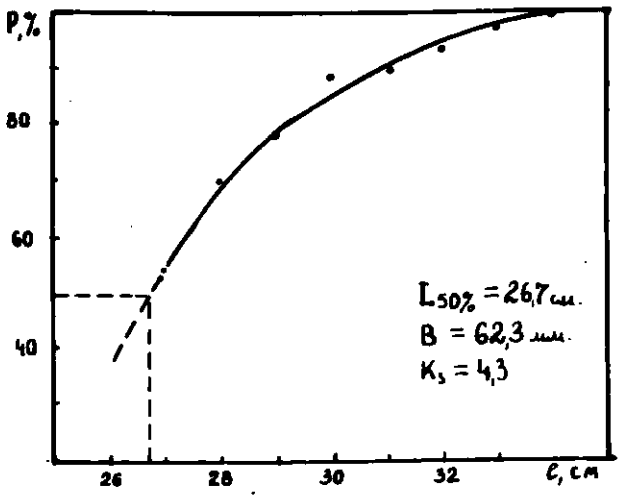

Fig. 9. The selectivity curve of the convectional trawl codend in the hake fishery.