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The effect of the thickness of cord in Polish topside chafer (large-mesh type) on cod selection factor

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1. Introduction

The selectivity of fishing gear is essential for the protection of younger age-groups of exploited fish stocks. Hence studies on the construction of fishing gear which would combine both great strength and durability and, simultaneously, high selectivity have been carried out in Polish fisheries.

The first investigation on the selectivity and the reinforcement of cod-end was conducted in 1965 and the results obtained were reported at the ICNAF Annual Meeting in 1966 (Strzyzewski, 1966). They showed that the codend with chafer, having mesh of the size twice larger than in the codend itself, gave the selection factor similar to that of unprotected codends. The difference turned out to be less only by 3.8% than the selection factor for unprotected codends.

The investigations on large-mesh type chafer, conducted by Treschev and Naumov (1967), Bohl (1967), Holden and Jones (1967) and Monteiro (1968), gave further evidence to the already established fact that the Polish chafer has only negligible effect on the selectivity as compared with unprotected codend.

There was however a demand from Polish fisheries for stronger chafer of the same type. Often there were cases when the net broke while it was hauled up on deck and the fish poured out. The reason was simply that the chafer, being made of the same twine as used for the codend (diameter 3.5 mm) was too weak to withstand the forces acting on it. This circumstance stimulated a further search for solutions to strengthen the codend. Regrettably, material is not yet available which would permit making comparatively thin and selective nets strong enough not to require chafing gear. Thus the solution lies in strengthening the Polish-type chafer while retaining the highest possible selectivity of the codend. This was thought to be possible by using thick cord and eliminating knots, without, however, reducing the selectivity of the gear.

Selectivity experiments with the Polish chafer, this time knotless, made of the cord of 10 mm diameter, were carried out in 1967 (Bucki et al., 1968). The codend was made of double twine of 3.5 mm diameter. The selection factor obtained from these experiments was comparatively high, amounting to 3.71. Further experiments however were found to be necessary in order to obtain more data.

Recent selection experiments, the results of which are presented in this contribution, were the continuation on a larger scale of 1967 experiments. During this investigation, the selectivities of 1) unprotected codend, ii) codend reinforced with Polish (large-mesh) type chafer made of twine the same as in the codend and iii) the codend with knotless chafer made of cord of 10 mm diameter were compared.

2. Materials and methods

The investigations were carried out on board M/T Apus, a stern trawler 82.0 m long of 2,824 gross tons and 2,400 H.P. The experiments were conducted with a regular commercial trawl used aboard this type of vessel. The codends

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of the trawl could be removed and replaced according to the requirements of the program. For selection experiments they were provided with covers made of twine 1.8 mm thick with mesh size (lumen) of 40 mm. Selective cover was attached to the upper part of the codend, thus leaving free space for fish. The specifications of the codends used for investigation are given in Table 1 and in Fig. 1.

Table 1. Specifications of codends and chafers.

Codend:		A	A1	B	B1	C	C1
Codend:	mesh size (lumen) in mm	108.8	128.3	111.3	126.9	108.8	125.9
	No. of cords	double	double	double	double	double	double
	Nominal diameter of cords in mm	3.50	3.50	3.50	3.50	3.50	3.50
Chafer:	mesh size (lumen) in mm	-	-	223.0	253.0	216.0	250.0
	No. of cords	-	-	double	double	single	single
	Nominal diameter of cord in mm	-	-	3.5	3.5	10.0	10.0

The characteristics of the cords and twines from which codends and their chafers were made are given in Table 2.

Table 2. The characteristics of the cords used for codends and chafers.

	Codends A,A1; B,B1; C,C1; Chafers B,B1	Chafers C,C1
Material	Polyamide	Polyamide
R tex (g/1000 m)	R 7500 tex	R 47000 tex
Runnage (m/kg)	133	21
Construction	twisted	twisted
Wet knot breaking load (kG)	173.0	974.5
Diameter (mm)	3.46	10.8
Elongation at half the wet knot breaking load (%)	24.4	23.6

The above data show that three variants of codends were used for the experiments. Each variant consisted of two codends differing in mesh lumen from each other. The primary netting material for codends was identical in the three variants, namely double cord of nominal diameter 3.5 mm. Also the chafer with mesh lumen twice as large as in codends B and B1 was made of the same material, i.e. double cord 3.5 mm in diameter, whereas the chafer for the codends C and C1 was made of a single cord of nominal diameter 10 mm.

The mesh of 10 mm cord in the chafer was knotless, made in the manner shown in Fig. 1, which gave an increased filtration area of mesh lumen as compared to chafers with knots.

It should be mentioned that the material, of which both codends and chafers were made, had nearly the same elongation. For the cord of 3.5 mm it was 24.4% and for the cord of 10 mm - 23.6%. The manner in which the chafer was attached to the codend is shown in Fig. 1.

The chafer covered two-thirds of the length of the codend and was fastened according to Bohl's (1967) proposal and ICNAF recommendation (1969).

The mesh was measured with an ICES gauge under a load of 4.0 kg. Thirty such measurements were made after each haul.

The duration of the haul is expressed as the actual time used, i.e. from the moment of the shooting of the warps was completed until the moment they were hauled back on deck.

The observations were carried out both day and night between 11 and 18 February on the fishing ground within the coordinates 53°15'N-54°15'N and 053°45'W - 053°20'W and 053°00'W.

During the investigation, length measurements were made on 88,868 cod individuals and girth measurements on 629 individuals. The measurement of girth was performed by means of a tape slightly adhering to fish body. On the basis of these measurements the relationship between length (L) and girth (G) was established as G - 0.5049 L.

3. Results of observations

There were differences between selection factors obtained from particular hauls. These were probably due to the large variation in size composition of the investigated stock of fish.

Table 3. Selection factors obtained from particular hauls with different codends.

Variant of the codend	Number of hauls	Obtained selection factors
A	8	3.53; 3.51; 3.75; 3.83; 3.92; 4.10; 4.17; 4.33
A1	7	3.25; 3.31; 3.39; 3.50; 3.59; 3.60; 3.71
B	5	3.61; 3.61; 3.76; 3.92; 4.09
B1	7	3.20; 3.21; 3.21; 3.36; 3.36; 3.57; 3.70
C	10	3.47; 3.48; 3.64; 3.67; 3.75; 3.77; 3.78; 3.80; 3.90; 4.17
C1	9	3.35; 3.39; 3.41; 3.42; 3.55; 3.60; 3.69; 3.71; 3.79

Data on the results of observations on six variants of the codends are given in Table 4. From this the following selection factors are noted:

Codend A - mesh size (lumen) 108.8 mm - selection factor 3.86
Codend B - mesh size (lumen) 111.3 mm - selection factor 3.81
Codend C - mesh size (lumen) 108.8 mm - selection factor 3.67.

If codend A (without chafer) is assumed to be the standard for comparison with selection factor equal to 100, then the selection factor for codend B equals 99 and for codend C equals 95.

Codends A1, B1 and C1 with larger mesh (128.3, 126.9 and 125.9 mm) had lower selection factors than codends with smaller mesh, namely the selection factors for the codend A1 was 3.46, for the codend B1 - 3.32 and for the codend C1 - 3.51. Assuming the selection factor for the codend A1 to be 100, the selection factors for the other codends investigated were as follows:

for codend B1 - 96
and for codend C1 - 101.

It appears, therefore, that the codend (C1) of the average mesh size (lumen) 125.9 mm with knotless chafer, made of cord 10 mm, showed even higher selectivity than the unprotected codend (A1).

Such a relation of the selectivities of these two types of codends may be accidental, due to the large range of sizes of investigated fish. Still, it points to the higher filtration property of the codend C1, which after all was rigged with chafer of a thicker cord.

It appears from the above data that the selectivity remains on a high level when the codend and the chafer are made of the twine of the same diameter (3.5 mm) and also when the chafer is knotless and made of thicker cord (10 mm). These experiments confirm our previous results, obtained from the experiments conducted in 1965 and 1967. Thus in 1965 (Strzyzewski, 1966) the selection factor established for unprotected codend was 3.92 (100%), while for the codend with chafer - both made of the same twine - it was 3.77 (96%). From the 1967 investigations (Bucki, 1968), the selection factor for the codend protected with chafer, made of cord 10 mm diameter, was 3.71, being therefore even higher than it was in the recent experiments (3.67).

4. Conclusions

I. The results of investigations show that there is no essential difference in gear selectivities between the unprotected codend and the codend protected by the Polish chafer. Anyhow, any difference found would have been of no practical importance in view of its quite negligible magnitude.

II. The difference in selectivity of the knotless chafer, made of single thick cord, compared to the chafer with knots, made of double cord of the same diameter as in the codend, is negligible and therefore it is possible to use thicker cords for this type of chafers.

III. The stretching (adhering) of the meshes of chafer, made of thicker cord, over the meshes of the codend (bar of chafer mesh against bar of codend mesh) is as good as in the case of chafer made of twine of the same diameter as in the codend.

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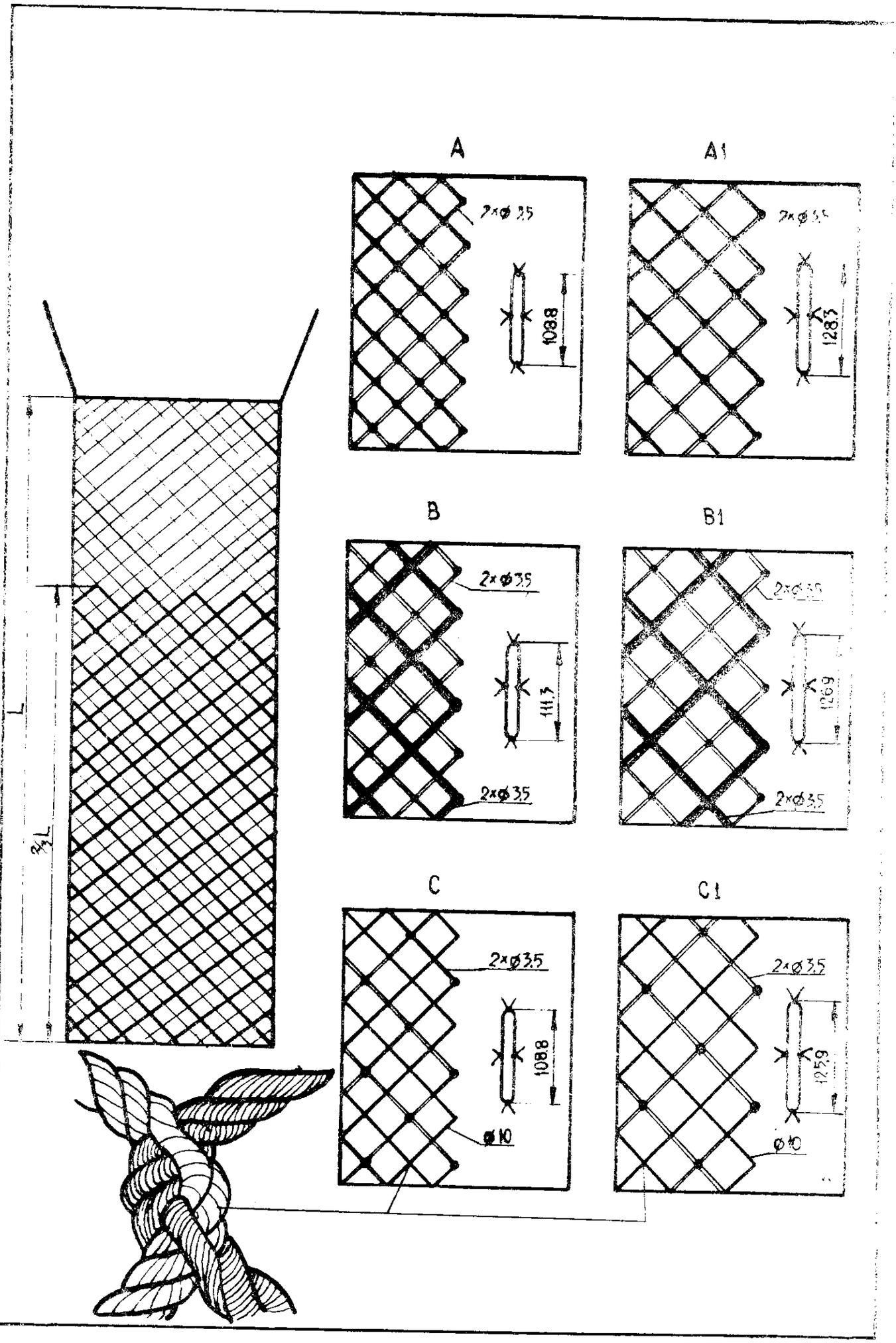
Table 4. Summary of the results of observations on selectivity of six variants of the codends.

The area of fishing operations and selectivity experiments Geographical position Date	Div.2J 53°15'N, 053°45'W - 053°20'W, 053°00'W - 052°30'W 11 - 18.02.1970					
Codend	A	A1	B	B1	C	C1
Number of hauls	8	7	5	7	10	9
Duration of a haul /min/	36.0	46.0	11.0	10.0	21.5	11.0
Speed /kts/	4.2	4.2	4.2	4.2	4.2	4.2
Depth /m/	405-440	380-480	410-430	395-440	370-450	390-420
25-75% selection range /cm/	18.1	13.8	18.1	17.9	27.4	17.2
Number of cod in selection range						
in the codend	4,565	1,468	1,519	2,289	12,954	2,831
in the cover	6,313	2,554	1,856	3,239	15,117	4,671
Total number of cod						
in the codend	7,807	3,062	4,699	4,700	20,810	5,881
in the cover	7,677	8,198	2,110	3,577	15,389	5,158
Weight of the catch /kg/						
in the codend	3,571	978	2,927	4,859	8,119	3,279
in the cover	1,553	1,079	602	3,418	3,157	1,212
Mesh size /mm/	108.8	128.3	111.3	126.9	108.8	125.9
Range of the mesh size /mm/	105-113	124,5-134	108-116	120-133	106-112	122-132
Number of measurements	240 /8x30/	210 /7x30/	270 /9x30/	210 /7x30/	300 /10x30/	270 /9x30/
50% retention length /cm/	42.1	44.5	42.5	42.5	40.1	44.2
Selection factor	3.86	3.48	3.81	3.32	3.67	3.51


A
2×ø 3,5
108,8
A1
2×ø 3,5
128,3
B
2×ø3,5
111,3
2×ø3,5
B1
2×ø3,5
126,9
2×ø3,5
C
2×ø3,5
108,8
ø10
C1
2×ø3,5
125,9
ø10
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