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Selectivity experiments with topside chafers and round straps

by

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INTRODUCTION

The North-East Atlantic Fisheries Commission has for years been concerned with the effects on trawl codend selectivity by the use of topside chafers, and more recently the possible effects on selectivity by using round straps have further complicated the matter. Last year Norwegian Authorities therefore decided that a special study of these problems should be conducted.

MATERIAL AND METHODS

The experiments were carried out during a cruise to the Barents Sea in September/October 1976 with M/S "Vikheim", a commercial stern trawler of 41 metres length o.a., 297 BRT and 1250 h.p.

The trawl used was a standard "Granton" bottom trawl with a 63 feet ground rope. Some physical properties of the netting yarns used in the codend, topside chafers and topside cover are given in Table 1.

Three topside chafers of different mesh sizes, 2, 3 and 4 times that of the codend mesh size were tested. The chafers, having approximately the same length and width as the codend, were fitted to the codend along the forward, lateral and rear edges, as recommended by NEAFC (Recommendation no. 3A).

The round straps used were of 22 mm twisted polyamide. The straps were only fixed through loops on the lacing ropes of the codend. The distance between each round strap was in all hauls 1.1 metre. The selectivity was examined for three different strap lengths, i.e. 50, 45 and 40% respectively of the circumference of the codend (stretched meshes).

The mesh opening of the codend was determined immediately after each haul by measuring 3 rows of consecutive meshes of the upper panel. The measurements were made with an ICES gauge at 4 kg pressure.

The length compositions of fish in the codend and topside cover were determined separately by measuring the total length to the centimetre below.

To study the girth/length relationship of cod, the unrestricted maximum body girth was measured to the nearest centimetre below. This was done for each area fished, as well as when there were suspicion of changes in the girth/length relationship.

For comparisons, the selection factor was estimated from standard covered codend hauls without topside chafers or round straps. The standard hauls were taken in between hauls with topside chafer or round straps.

The towing speed was about 3.5 knots in all trawl hauls.

RESULTS

Fishing was started at Bear Island, but these grounds had to be abandoned because the cod there were too large for the experiments. However, in the areas of Tiddly- and Thor Iversen Banks fairly good concentrations of medium and large cod were found and fiftyfive successful trawl hauls were made. To collect enough cod within the selection range rather long tows were necessary. Although some haddock were also caught, too few were within the selection range to provide data for selectivity estimates. Apart from cod and haddock small quantities (never more than a few boxes) of other species were caught, mainly long rough dab, small redfish and small skates. The quantities of each catch were measured in boxes of about 45 kg. Cod and haddock were gutted before measuring.

The experiments were carried out on Tiddly Bank from 18. September to 1. October and on Thor Iversen Bank from 1. to 6. October.

Some variations in the girth/length ratio for cod were noticed. Thus the regression line $G = 0.424L + 3.955$ was established for Tiddly Bank in the periods of 18. to 22. September and 28. September to 1. October ($N = 556$), but for the same bank in the period 25. to 27. September ($N = 266$) this was estimated as $G = 0.510L - 1.165$ and for Thor Iversen Bank in the period 1. to 6. October ($N = 157$) the equation $G = 0.421L + 4.157$ was found. These estimates were based on fish between 35 and 65 cm. The corresponding regression lines are shown in Fig. 1.

It is evident therefore that during the period 25. to 27. September on the Tiddly Bank the cod were more slender than before and after this time and on the Thor Iversen Bank. Because of this difference the catches from 25. to 27. September were excluded in estimation of selectivity factors. There were no difference at all between the girth of cod caught at the other periods on Tiddly Bank and Thor Iversen Bank so catches from these two areas were grouped together.

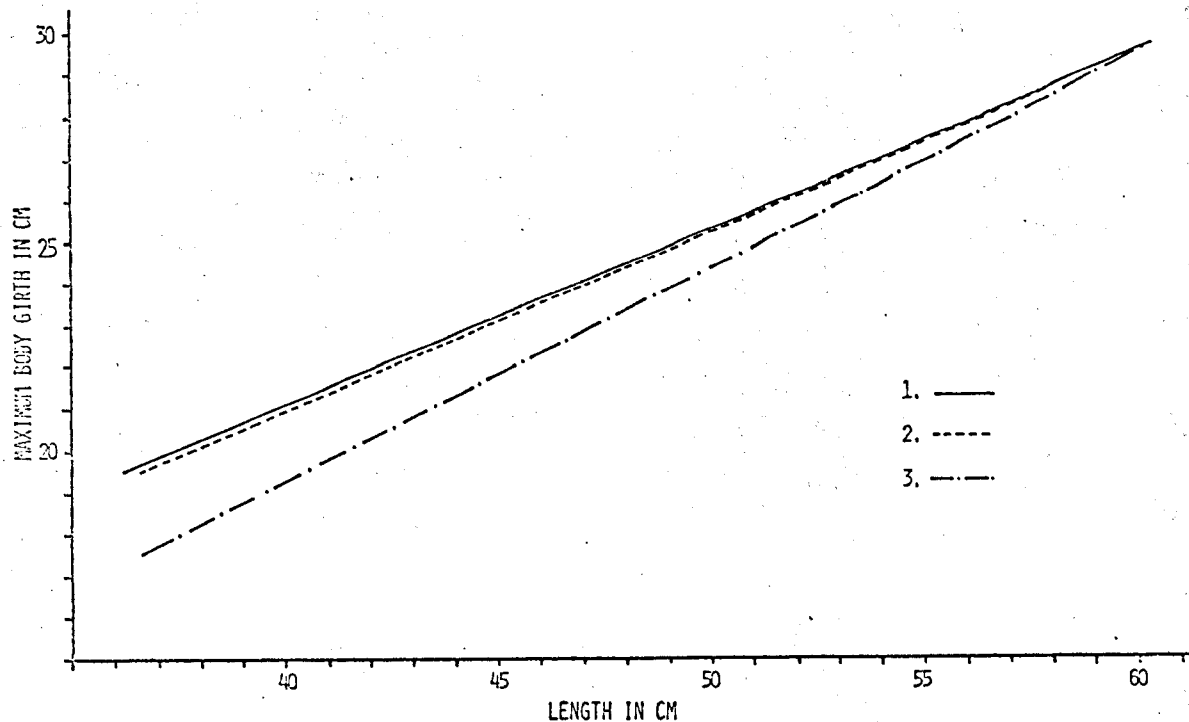


Fig. 1. Comparison of cod girth/length relationships.
 1. = Thor Iversen Bank in the period 1. to 6. October
 2. = Tiddly Bank in the periods 18. to 22. September and 28. September to 1. October
 3. = Tiddly Bank in the period 25. to 27. September

The relative length distribution of cod catch (codend + cover) from Tiddly Bank and Thor Iversen Bank are shown in Fig. 2 below, from which it can be seen that the bulk of the catch consisted of fish between about 40 and 75 cm.

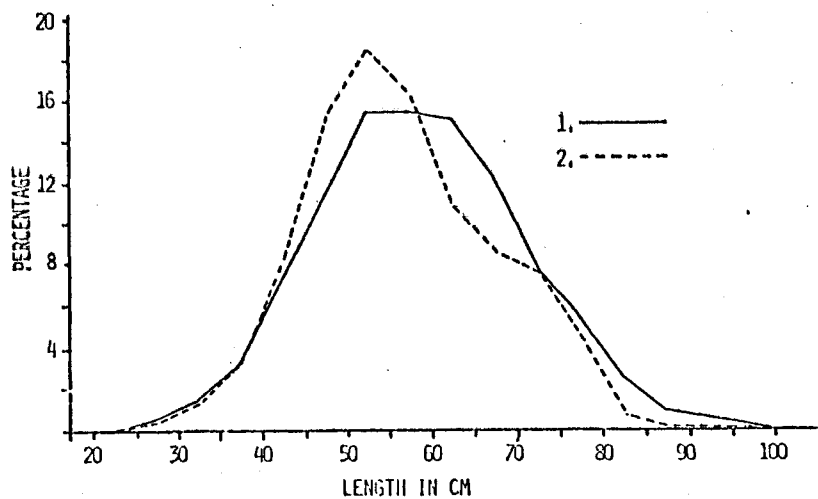


Fig. 2. Relative length composition of cod (codend plus cover).
 1. = Thor Iversen Bank (N = 14025)
 2. = Tiddly Bank (N = 18939)

The cod were a lot smaller on Tiddly Bank than on Thor Iversen Bank, but the difference is not so great that catch from these two areas could not be grouped together.

The total catches ranged from 0.4 to 3.6 metric tons per 2-4 hours fishing time. For the analysis the hauls were grouped in intervals of 10 boxes total catch (codend + cover). The selection data obtained from these grouped hauls are compiled in Tables 2 - 8. The selection factors were estimated from selection curves fitted by eye with the aid of three-point moving average. In Fig. 3 are plotted the selection factors against the average total catch for standard hauls and for hauls with topside chafers.

The results indicate that for standard hauls the selection factor was reduced with increasing catch. A twofold increase in catch leads to about a 5% reduction in selection factor. The same reduction in selection factor with increasing catch was also seen when topside chafers with mesh size 2 and 3 times that of the codend were used. The use of topside chafer causes also a reduction in estimated selection factor relative to that of standard hauls of the same catch size. This reduction is about 2% for chafer of mesh size 2 times that of the codend and about 5% for chafer of mesh size 3 times that of the codend. In the experiments with chafer of mesh size 4 times that of the codend the range in catch size was too small to demonstrate any reduction in selection factor with increased catch, but although the data are few they indicate clearly that the use of this topside chafer also leads to reduction in selection factors in relation to standard hauls.

In Fig. 4 the selection factor is plotted against average total catch for standard hauls and for hauls with round straps. The material is rather scanty but indicates that in relation to standard hauls there is no reduction in selection factor within the same catch range for round straps with strap lengths of 50 and 45% of the codend circumference. The estimated selection factors were rather higher than for standard hauls. For a strap length of 40% of the codend circumference there is a clear reduction in selection factors

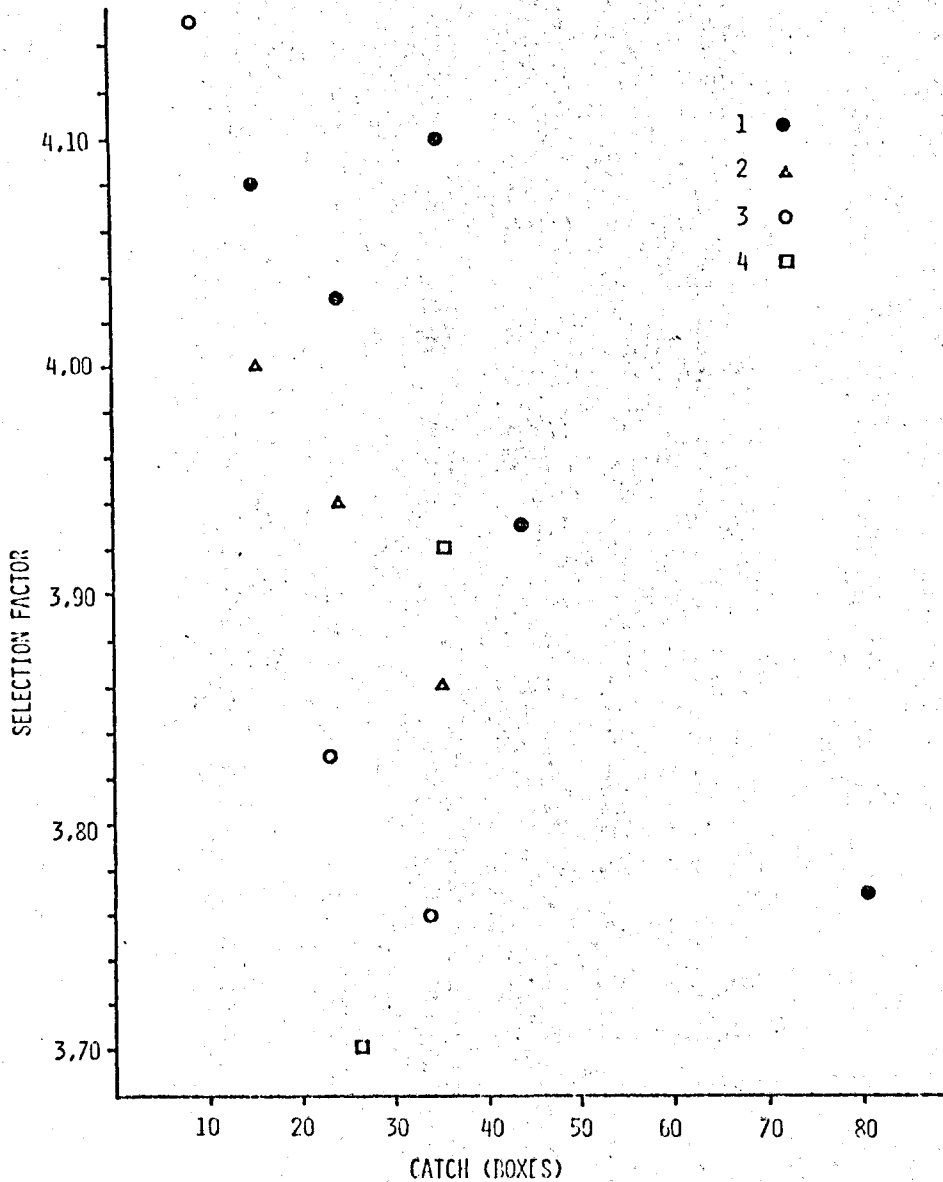


Fig. 3. Relation between selection factor and average total catch for standard hauls and topside chafers.

- 1 = Standard hauls
- 2 = With chafers two times mesh size of the codend
- 3 = " " three " " " " " "
- 4 = " " four " " " " " "

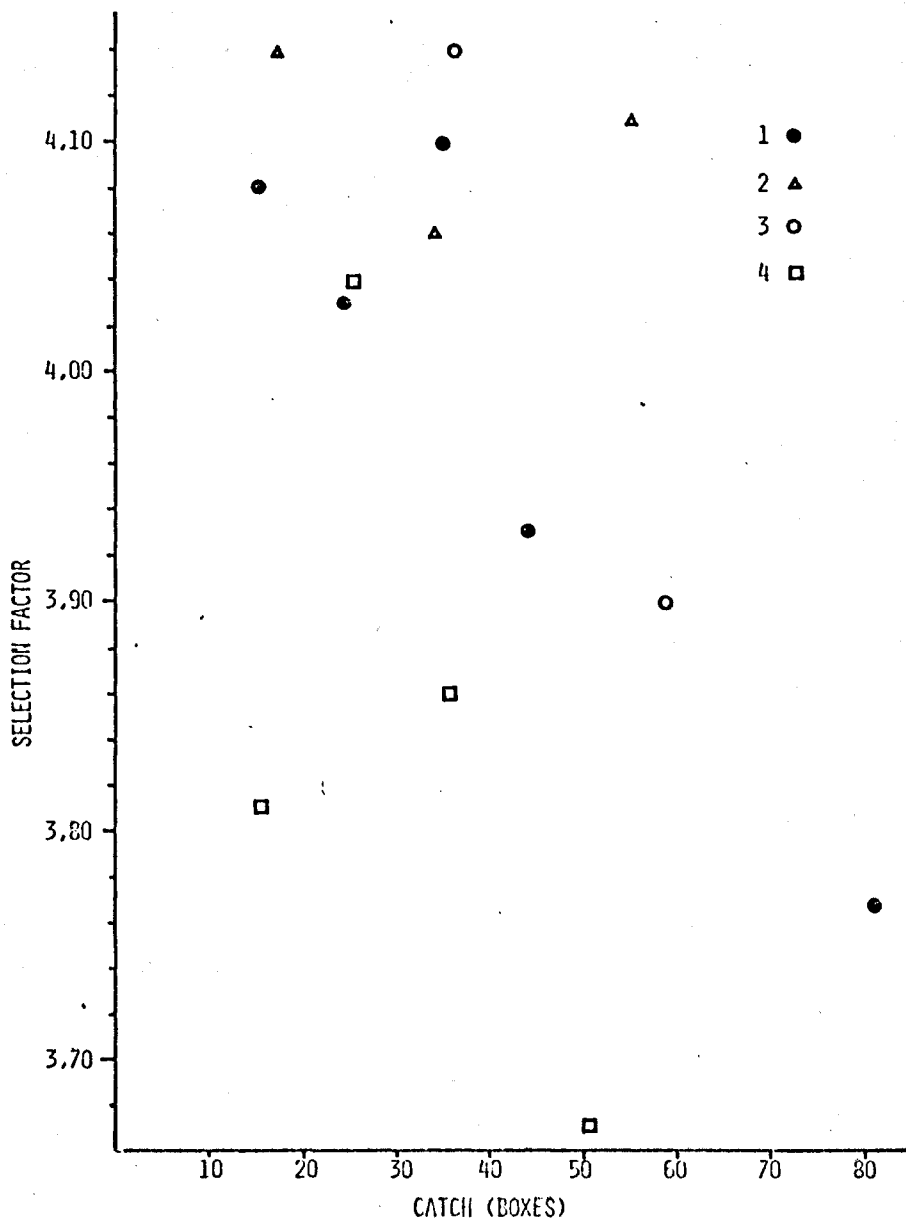


Fig. 4. Relation between selection factor and average total catch for standard hauls and round straps.

1 = Standard hauls

2 = Strap lengths of 50% of the codend circumference

3 = " " " 45% " " " "

4 = " " " 40% " " " "

in relation to standard hauls especially for greater hauls. This reduction in selection factor is about 6% for a catch size of about 50 boxes.

DISCUSSION

From 25. to 27. September the fishing area was on the South-Eastern side of the Tiddly Bank, during the other period the fishing was done on the North-West side of the bank. The great difference in girth/length relationship between the two periods might be due to the fact that the cod on the two sides of the Tiddly Bank had immigrated from different feeding areas.

A reduction in selection factor with increasing catch was also reported by MAGRETTIS et. al. (1964). POPE (1966) stated that this reduction in selection factor may be due to change in mesh shape, the blocking of meshes or change in fish behaviour with large catches.

The observed effect on selectivity by use of topside chafers with a mesh size about twice as large as the codend mesh size was rather small and within the limit of the experimental error. The size of catch seems to be of much greater importance, thus a twofold increase in catch was found to have greater effect on the selectivity than the use of topside chafers. These experiments therefore seem to confirm the results reported by HYLEN (1967), OLSEN (1967) and TRESCHEV & NAUMOV (1967) that chafers with meshes twice as large as the codend mesh size have negligible effect on codend selectivity.

It is surprising that a larger reduction in selection factor was found when using topside chafers with mesh size 3 and 4 times that of the codend. A possible explanation is that the meshes in the codend, when such large topside chafers are used, are being squeezed through the chafer meshes during trawling.

The higher selection factor in relation to standard hauls observed when using round straps with lengths of 50 and 45% of the codend circumference suggests that this arrangement somehow allow the codend meshes to stay more open, but when shorter straps are used, the meshes are constrained from opening fully.

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Table 1. Details about codend, topside chafer, round straps and cover.

	Codend	Topside chafer		
		2x130 mm	3x130 mm	4x130 mm
Diameter (mm)	4	8	10	12
Material and type of fibre	Polyamide continuous			
Construction of netting yarn	Braided	Twisted	Twisted	Twisted
Method of manufacture	Machine made	Hand made		
Treatment of netting	Tarred (Stenoline 80°C)			
Rtex (g/1000 m)	6.667	-	-	-
Runnage (m/kg)	150	-	-	-
Weaver-knot breaking load, wet (kg)	195	-	-	-
Breaking load, without knot, dry (kg)	393	-	-	-
Breaking load, without knot, wet (kg)	349	940	1460	2500
Breaking length, dry (km)	59	-	-	-
" " wet (km)	51	-	-	-
<u>C O V E R</u>				
Type	Topside cover of ICES specification			
Material and type of fibre	Polyetylen			
Diameter (mm)	3			
Mesh opening (mm)	60			

Table 2. Compilation of selection data for grouped hauls.
Standard hauls.

	Catch intervals (boxes)				
	10-20	20-30	30-40	40-50	80-90
Date	18/9-30/9	18/9-30/9	19/9-5/10	20/9	1/10
Locality (central position)	72°10'N 32°20'E	72°00'N 33°10'E	72°50'N 32°30'E	72°14'N 32°31'E	73°08'N 32°48'E
Depth range (meter)	270-296	284-312	282-353	293-305	223-255
Number of hauls	6	5	3	2	1
Towing time per haul (minutes)	120-240	165-180	180-215	150-180	180
Average duration of haul (minutes)	170	177	191	165	180
Range of total catch/haul (boxes)	12-20	20,5-30	33,5-36	42,5-45,5	81
Average total catch (boxes)	15,4	24,5	35,0	44,0	81
Type of mesh gauge	I C E S gauge, 4 kgs pressure				
Codend mesh opening:					
- mean (mm)	130,28	130,74	130,99	130,58	131,03
- range (mm)	125-139	121-139	125-138	122-136	122-135
- no. measured	240	200	120	85	40
Species studied: C O D					
Range of catch/haul (boxes):					
- codend	5-12	8-19	23-26	34-37	69
- cover	1,5-4	3-9	3-4	3,5-4	3
Average catch/haul (boxes):					
- codend	8,2	13,4	25,0	35,5	69
- cover	2,8	4,3	3,7	3,8	3
25-75% selection range (mm)	76	73	94	90	86
No. of cod in the selection range:					
- codend	353	412	261	291	108
- cover	394	532	312	317	90
Total number of cod:					
- codend	1476	2013	1622	1831	1518
- cover	1168	1438	737	669	190
50% retention, length (mm)	531	527	537	514	494
Selection factor	4,08	4,03	4,10	3,93	3,77

Table 3. Compilation of selection data for grouped hauls.
With topside chafer with mesh size two times that of the codend.

	Catch intervals (boxes)		
	10-20	20-30	30-40
Date	21/9-28/9	21/9-28/9	20/9-21/9
Locality (central position)	72°15'N 32°20'E	72°00'N 32°55'E	72°13'N 32°31'E
Depth range (meter)	263-302	270-308	285-303
Number of hauls	4	3	2
Towing time per haul (minutes)	150-180	175-180	165-180
Average duration of haul (minutes)	173	178	173
Range of total catch/haul (boxes)	14,5-17	20,5-26,5	32,0-38,5
Average total catch (boxes)	15,5	24,4	35,3
Type of mesh gauge	I C E S gauge, 4 kgs pressure		
Codend mesh opening:			
- mean (mm)	130,63	130,23	130,46
- range (mm)	124-137	121-137	122-135
- no. measured	161	120	80
Av. chafer mesh size (mm)	288	288	288
Species studied: C O D			
Range of catch/haul (boxes):			
- codend	8-10	9-15	24-32
- cover	1,5-4	4-7	3-4
Average catch/haul (boxes):			
- codend	9,0	6,0	28,0
- cover	2,5	4,3	3,5
25-75% selection range (mm)	65	70	73
No. of cod in the selection range:			
- codend	205	291	255
- cover	264	279	289
Total number of cod:			
- codend	975	1304	1617
- cover	744	875	655
50% retention, length (mm)	523	513	504
Selection factor	4,00	3,94	3,86

Table 4. Compilation of selection data for grouped hauls.
 With topside chafer with mesh size three times that of the codend.

	Catch intervals (boxes)		
	10-20	20-30	30-40
Date	1/10	29/9-30/9	29/9
Locality (central position)	72°00'N 32°34'E	71°56'N 32°25'E	71°55'N 32°22'E
Depth range (meter)	270-315	252-281	272-275
Number of hauls	1	2	2
Towing time per haul (minutes)	180	135-150	150-180
Average duration of haul (minutes)	180	143	165
Range of total catch/haul (boxes)	8	20,8-25,5	33,5-35,0
Average total catch (boxes)	8	23,2	34,3
Type of mesh gauge	I C E S gauge, 4 kgs pressure		
Codend mesh opening:			
- mean (mm)	130,43	131,85	130,50
- range (mm)	125-135	126-138	124-136
- no. measured	40	80	80
Av. shafer mesh size (mm)	410	410	410
Species studied: C O D			
Range of catch/haul (boxes):			
- codend	3	9-14	19-20
- cover	3	4-4	4,5-6,0
Average catch/haul (boxes):			
- codend	3	11,5	19,5
- cover	3	4	5,3
25-75% selection range (mm)	81	90	94
No. of cod in the selection range:			
- codend	38	229	354
- cover	45	278	378
Total number of cod:			
- codend	92	930	1374
- cover	137	517	666
50% retention, length (mm)	541	505	491
Selection factor	4,15	3,83	3,76

Table 5. Compilation of selection data for grouped hauls.
With topside chafer with mesh size four times that of the codend.

	Catch intervals (boxes)	
	20-30	30-40
Date	4/10	5/10-6/10
Locality (central position)	73°32'N 32°14'E	73°35'N 31°44'E
Depth range (meter)	305-310	352-372
Number of hauls	1	3
Towing time per haul (minutes)	180	155-180
Average duration of haul (minutes)	180	163
Range of total catch/haul (boxes)	26,5	32,5-40
Average total catch (boxes)	26,5	35,7
Type of mesh gauge	I C E S gauge, 4 kgs pressure	
Codend mesh opening:		
- mean (mm)	130,23	130,60
- range (mm)	125-138	135-138
- no. measured	40	120
Av. chafer mesh size (mm)	480	480
Species studied: C O D		
Range of catch/haul (boxes):		
- codend	22	22-30
- cover	3	2,5-4,0
Average catch/haul (boxes):		
- codend	22	26,0
- cover	3	3,5
25-75% selection range (mm)	86	89
No. of cod in the selection range:		
- codend	111	307
- cover	92	357
Total number of cod:		
- codend	393	1227
- cover	202	768
50% retention, length (mm)	48,2	51,2
Selection factor	3,70	3,92

Table 6. Compilation of selection data for grouped hauls.
With round straps. Strap length 50% of the codend circumference.

	Catch intervals (boxes)		
	10-20	30-40	50-60
Date	2/10-3/10	2/10	2/10
Locality (central position)	73°07'N 32°33'E	73°07'N 32°36'E	73°07'N 32°46'E
Depth range (meter)	212-270	214-242	213-220
Number of hauls	2	2	1
Towing time per haul (minutes)	165-180	150-250	150
Average duration of haul (minutes)	173	200	150
Range of total catch/haul (boxes)	15,3-19,0	33-35	55
Average total catch (boxes)	17,2	34	55
Type of mesh gauge	I C E S gauge, 4 kgs pressure		
Codend mesh opening:			
- mean (mm)	130,63	130,73	131,20
- range (mm)	123-137	125-136	122-135
- no. measured	80	80	40
Species studied: C O D			
Range of catch/haul (boxes):			
- codend	7-11	20-25	36
- cover	2-2	3,0-5,5	5
Average catch/haul (boxes):			
- codend	9,0	22,5	36
- cover	2,0	4,3	5
25-75% selection range (mm)	53	89	110
No. of cod in the selection range:			
- codend	46	224	145
- cover	57	296	163
Total number of cod:			
- codend	380	1166	765
- cover	229	642	316
50% retention, length (mm)	541	531	542
Selection factor	4,14	4,06	4,13

Table 7. Compilation of selection data for grouped hauls.
With round straps. Strap length 45% of the codend circumference.

	Catch intervals (boxes)	
	30-40	50-60
Date	3/10-4/10	3/10
Locality (central position)	73°15'N 32°17'E	73°14'N 32°10'E
Depth range (meter)	290-295	288-290
Number of hauls	2	1
Towing time per haul (minutes)	120-180	165
Average duration of haul (minutes)	150	165
Range of total catch/haul (boxes)	33,8-38,0	58,5
Average total catch (boxes)	35,9	58,5
Type of mesh gauge	I C E S gauge, 4 kgs pressure	
Codend mesh opening:		
- mean (mm)	130,90	130,15
- range (mm)	124-137	125-138
- no. measured	80	40
Species studied: C O D		
Range of catch/haul (boxes):		
- codend	29,0-31,0	54
- cover	3,5-4,0	3
Average catch/haul (boxes):		
- codend	30,0	54
- cover	3,8	3
25-75% selection range (mm)	94	125
No. of cod in the selection range:		
- codend	170	140
- cover	243	118
Total number of cod:		
- codend	1285	667
- cover	554	188
50% retention, length (mm)	542	507
Selection factor	4,14	3,90

Table 8. Compilation of selection data for grouped hauls.
With round straps. Strap length 40% of the codend circumference.

	Catch intervals (boxes)			
	10-20	20-30	30-40	50-60
Date	5/10	5/10	5/10	4/10
Locality (central position)	73°27'N 32°17'E	73°25'N 31°50'E	73°25'N 32°00'E	73°30'N 31°54'E
Depth range (meter)	300-302	300-310	300-303	304-305
Number of hauls	1	1	1	1
Towing time per haul (minutes)	120	180	150	135
Average duration of haul (minutes)	120	180	150	135
Range of total catch/haul (boxes)	15,5	25,3	35,5	50,5
Average total catch (boxes)	15,5	25,3	35,5	50,5
Type of mesh gauge	I C E S gauge, 4 kgs pressure			
Codend mesh opening:				
- mean (mm)	130,70	130,85	130,73	130,58
- range (mm)	125-136	125-135	125-135	125-135
- no. measured	40	40	40	40
Species studied: C O D				
Range of catch/haul (boxes):				
- codend	13	21	30	43
- cover	1	2	2,5	5
Average catch/haul (boxes):				
- codend	13	21	30	43
- cover	1	2	2,5	5
25-75% selection range (mm)	84	82	103	137
No. of cod in the selection range:				
- codend	39	45	77	259
- cover	33	60	94	318
Total number of cod:				
- codend	192	268	405	855
- cover	68	133	159	379
50% retention, length (mm)	498	529	505	479
Selection factor	3,81	4,04	3,86	3,67