Plaice/Cod Separation in Otter Trawls

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

W.M. Hickey and G. Brothers. 1998. Plaice/Cod Separation in Otter Trawls.
Can. Tech. Rep. Fish. Aquat. Sci. 2031.

The exclusion of cod in the American plaice (Hippoglossoides platessoides) otter trawl fishery was measured for two designs of separator trawls during two 10-day commercial fishing trips on the southern Grand Banks. A modified 96' headline groundfish trawl was used for both experiments. During the first trip in July, 1992, a 183mm square mesh codend was tested. A second trip was completed in October, 1992, using a horizontal separator panel. The 183mm square mesh codend was not effective in releasing cod since the area fished contained mostly fish over 70cm which were all retained. High losses of commercial size plaice were also experienced. The horizontal separator trawl was tested with the separator panel at four different heights above the footrope. The separation of plaice and cod with this method was also not commercially acceptable. To prevent high losses of commercial size plaice it would be necessary to have a separator panel height which would result in over 50% of the cod being retained. These findings indicate that large square mesh codends and horizontal separator panel trawls are not reliable solutions to the cod by-catch problem on the southern Grand Banks. However these methods could possibly be used to enhance the effectiveness of other devices such as rigid grates.

RÉSUMÉ

W.M. Hickey and G. Brothers. 1998. Plaice/Cod Separation in Otter Trawls. Rapp. techn. can. des sciences halieut. et aquat. 2031.

On a mesuré l'exclusion de la morue dans la pêche de la plie canadienne (*Hippoglossoides platessoides*) au chalut à panneaux pour deux modèles de chaluts séparateurs, au cours de deux sorties de pêche commerciale de dix jours effectuées dans le sud des Grands Bancs de Terre-Neuve. Dans les deux cas, on a utilisé un chalut à poisson de fond modifié, à ralingue supérieure de 96 pi. Au cours de la première sortie, en juillet 1992, on a utilisé un cul-de-chalut à mailles carrées de 183 mm. La deuxième sortie, effectuée en octobre 1992, a servi à faire l'essai d'une nappe séparatrice horizontale. Le cul-de-chalut à mailles carrées de 183 mm n'a pas permis une bonne évasion de la morue, puisque dans la zone de pêche la plupart des poissons avaient plus de 70 cm et qu'ils ont tous été retenus. Par ailleurs, les pertes de plie de taille commerciale ont été élevées. Dans l'expérience avec le chalut séparateur, on a fait l'essai de la nappe séparatrice à quatre hauteurs différentes par rapport à la ralingue supérieure. Là aussi, la séparation morue-plie s'est avérée insatisfaisante sur le plan commercial. Pour empêcher les fortes pertes de plie de taille commerciale, il faudrait placer la nappe séparatrice à une hauteur à laquelle plus de 50 % des morues seraient retenues. Il ressort de ces constatations que les culs-de-chalut à grand maillage et les chaluts à nappe séparatrice horizontale ne constituent pas des solutions fiables au problème des prises accessoires de morue dans le sud des Grands Bancs de Terre-Neuve. Ils pourraient toutefois servir à améliorer l'efficacité d'autres dispositifs, comme les grilles rigides.

INTRODUCTION

Fishing for plaice on the southern Grand Banks is conducted mainly by vessels owned and operated by Fishery Products International (FPI). The catch in this fishery is frequently comprised of cod, haddock, yellowtail flounder and hake. When stocks were abundant these by-catches, especially cod, were often welcome supplements to marginal catches of plaice. In recent years however, with cod quotas being severely reduced because of stock decline, FPI has had to catch its plaice quota with minimal cod by-catch. The method presently being used to reduce this cod by-catch, is to move to another area when concentrations are high. This solution is not always effective, since both species often inhabit the same areas.

Canadian research studies on otter trawl selectivity has focused mainly on size selectivity. Experiments carried out with square mesh and increased diamond mesh codends have shown these methods to be effective in reducing the catch of juvenile cod and haddock and are therefore in widespread use throughout Atlantic Canada. Research on species separation has been minimal and positive results have, generally, not been incorporated into commercial fishing practices. The main reason for this is mandatory limits on by-catches have only been recently implemented - the introduction of the Nordmore grate for the reduction of by-catch in the shrimp and silver hake fisheries being notable exceptions.

The Marine Laboratory in Aberdeen Scotland has conducted tests on trawls fitted with horizontal separator panels to separate cod, haddock, whiting and flatfish. Controlled experiments at sea produced almost 100% separation of cod and flatfish from haddock but

the complicated design and the requirement for precise adjustment of the separator panels in trawls, discouraged commercial acceptance (Main & Sangster 1982). Experiments, using this concept, have also been conducted in Canada (Flynn & Cooper 1992) with similar results.

Comparison of the selectivity characteristics of square and diamond mesh codends with similar mesh sizes shows that, for roundfish like cod, the 50% retention length is higher and selection range lower when square mesh is used. For flatfish the 50% retention length and the selection range are both lower for square mesh codends (Walsh & Millar, 1992). This suggests that large square mesh codends might be used to catch a high percentage of commercial sized plaice while excluding more cod and small plaice. Of course this depends on the length distribution of cod and would not be effective in areas where older year classes predominate.

Based on the results of the experiments described above, the Department of Fisheries and Oceans (DFO) and Fishery Products International (FPI) agreed that large square mesh codends and horizontal panel trawls would be an appropriate first step in attempting to reduce the by-catch of cod while fishing for plaice on the southern Grand Banks. This paper describes the testing of both methods during two fishing trips; one in July and one in October, 1992.

MATERIALS AND METHODS

To carry out these experiments, a 96 model groundfish trawl was modified at the Memorial University Fisheries and Marine Institute's flume tank (Anon 1992). The modifications were carried out in two stages, with a week each devoted to the 183mm square mesh codend trawl and the horizontal panel trawl. The changes required for the square mesh codend experiment included: (1) replacing the last belly section with a divided extension to accommodate twin codends (Fig.1a); and (2) the insertion of a vertical divider panel from the headline to the divided extension (Fig.1b).

For the horizontal separator trawl experiment divided codends (Fig.2a) and a horizontal separator panel (Fig.2b) were fitted. The panel was attached at the wing ends and extended to the divided codends. The fixed position chosen for sea trials was approximately 1.5 meters above and 15cm behind the footrope. A provision was made for additional height adjustments by attaching strops from the quarters of the trawl to a corresponding position on the separator panel. Four panel heights were tested during sea trials: (1) 41cm; (2) 64cm; (3) 97cm; (4) 107cm.

Underwater cameras were deployed during sea trials for both experiments. Observations of the 183mm square mesh codends were recorded with a low light Osprey SIT camera mounted on an underwater remote operated vehicle (ROV) called "Mermaid Explorer". Recording of observations of the horizontal panel and of fish behaviour when in contact with it were attempted using a Benthos 4204 colour CCD camera and recording unit and Deep Sea Power and Light lighting system. The unit was attached to the panels top side at the starboard quarter.

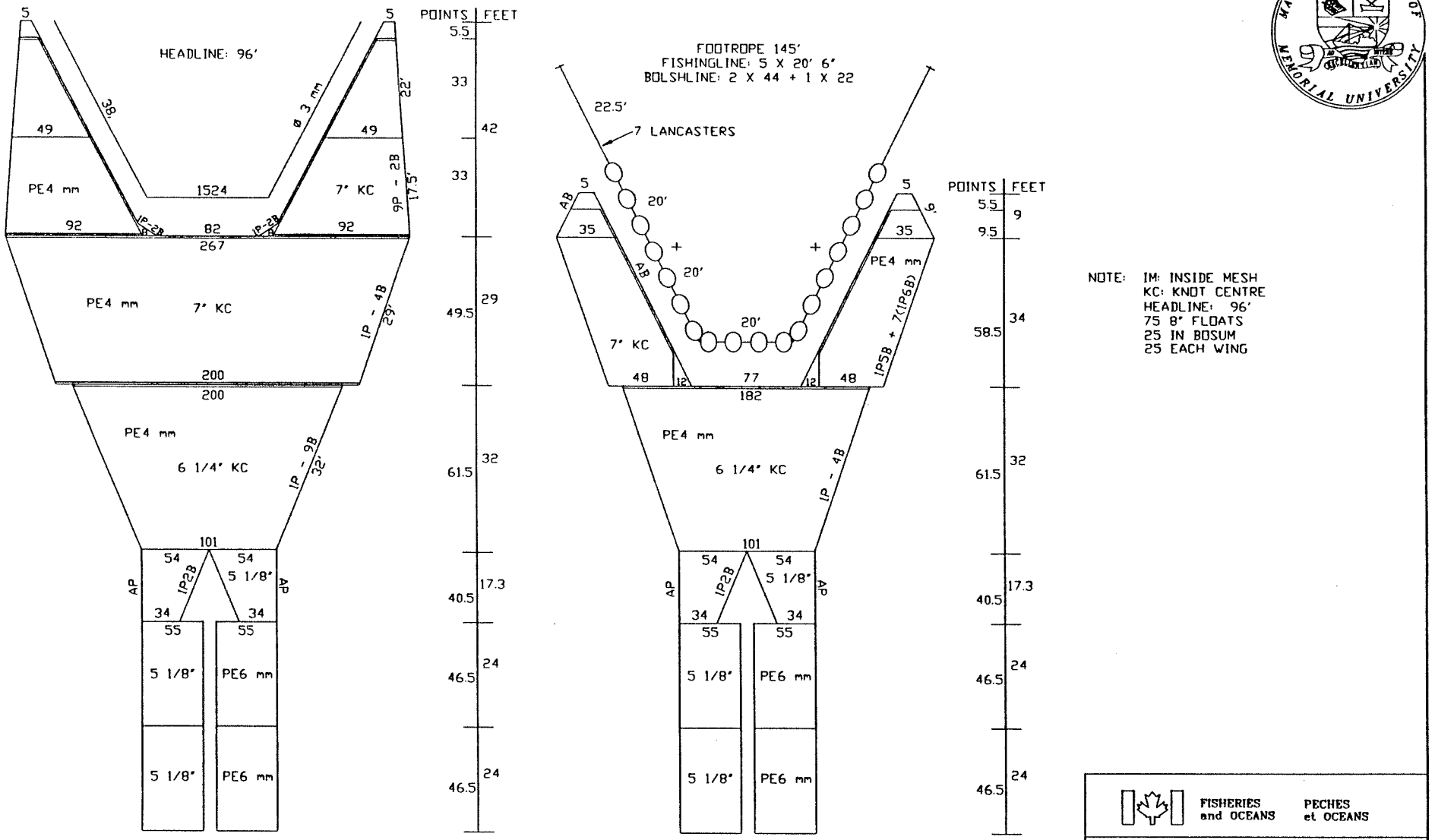
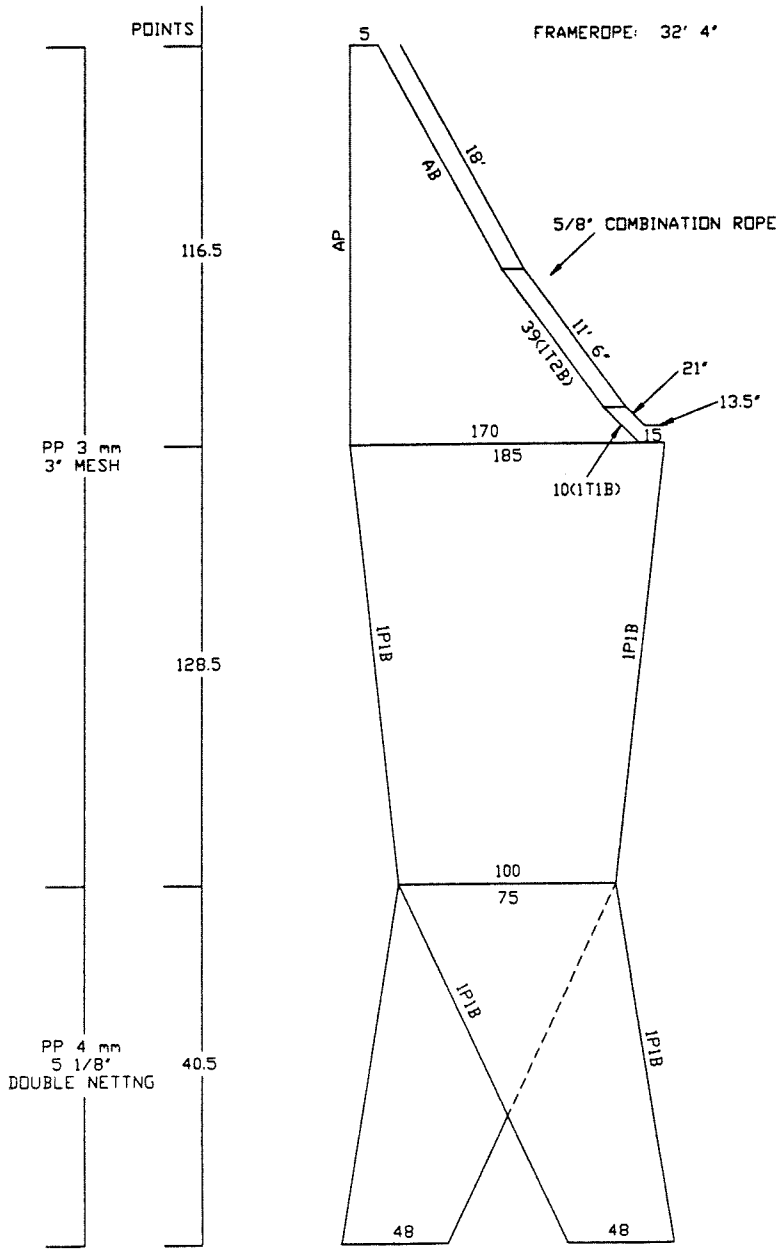


FIGURE 1A: NET DRAWING OF THE TROUSER TRAWL WITH VERTICAL PANEL



FISHERIES and OCEANS / PECHES et OCEANS

VERTICAL SEPARATOR PANEL

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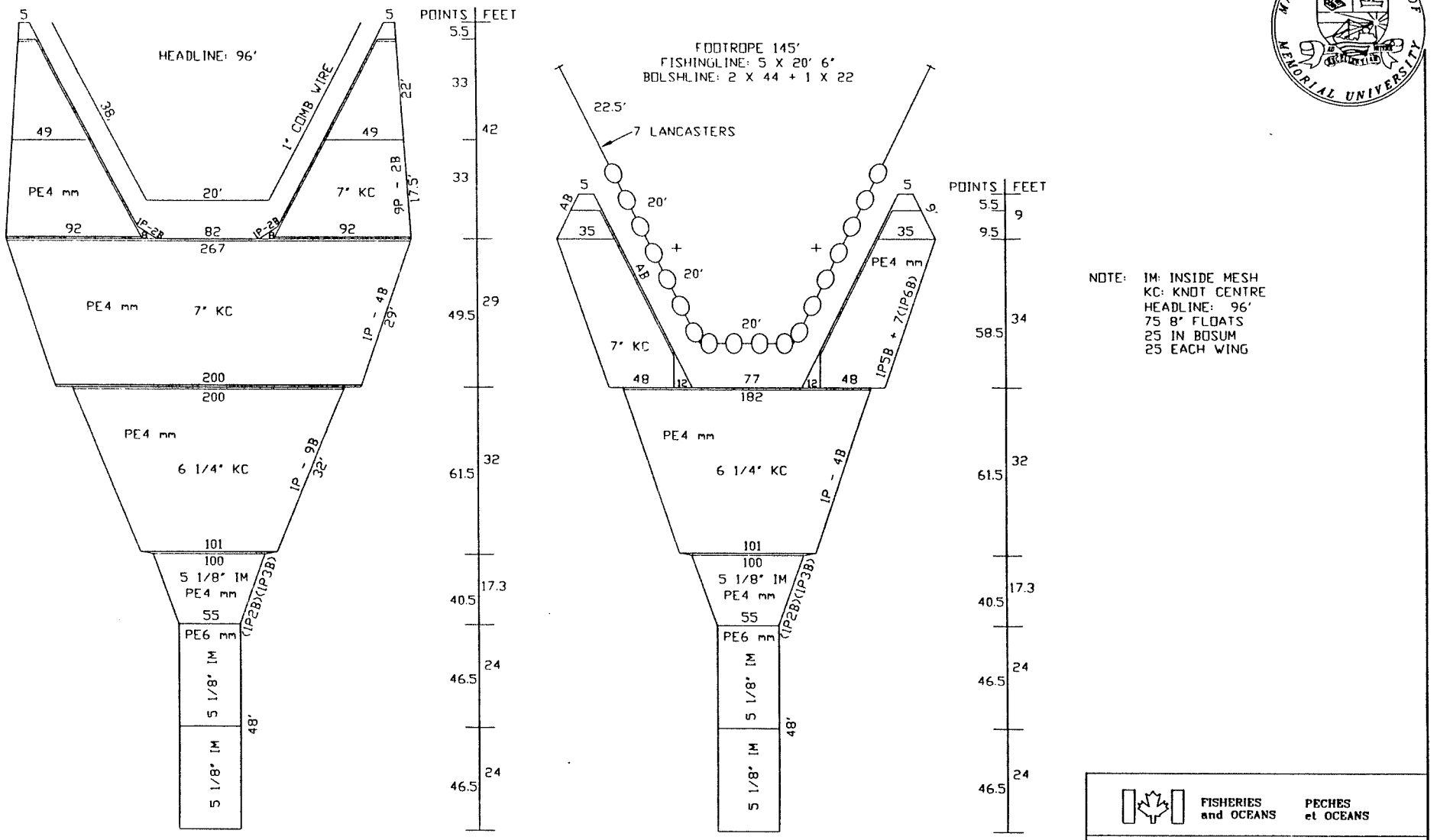
FIGURE 1B: NET DRAWING OF THE VERTICAL DIVIDER PANEL



NOTE: IM: INSIDE MESH
KC: KNOT CENTRE
HEADLINE: 96'
75 8" FLOATS
25 IN BOSUM
25 EACH WING

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HORIZONTAL SEPARATOR TRAWL

96' HEADLINE

MAT POLYETHYLENE 4 - 6 mm

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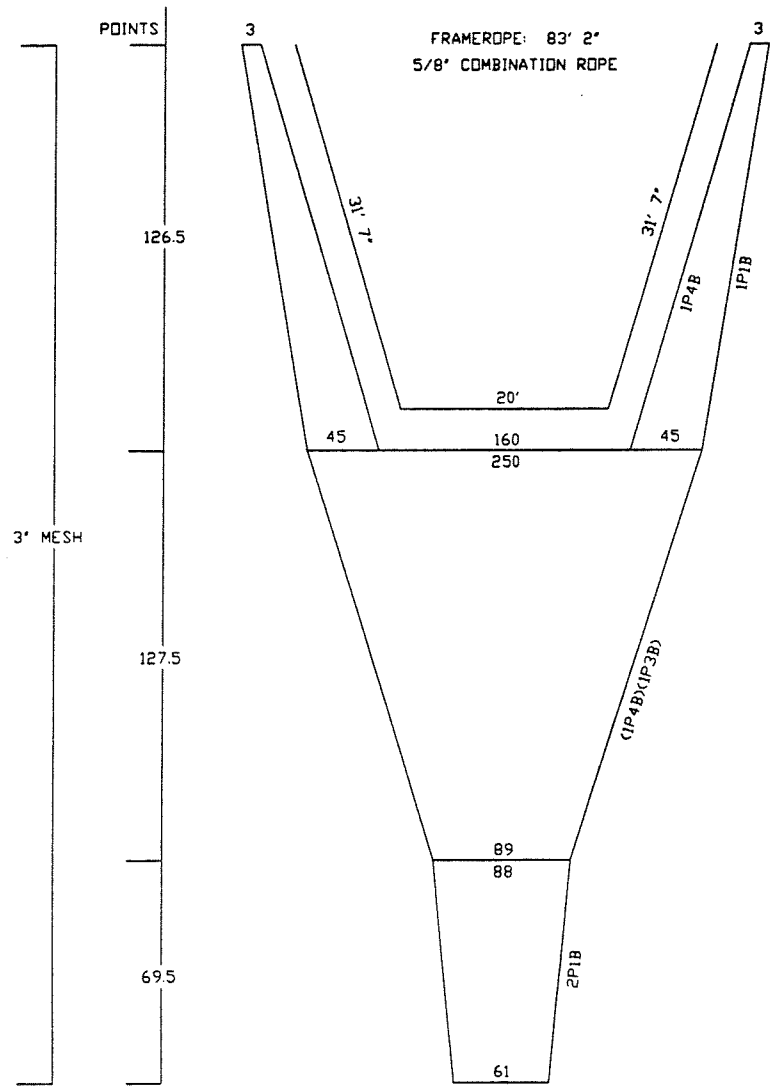
FIGURE 2A: NET DRAWING OF THE HORIZONTAL SEPARATOR TRAWL



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HORIZONTAL SEPARATOR PANEL

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FIGURE 2B: NET DRAWING OF THE HORIZONTAL SEPARATOR TRAWL

Scanmar height and spread sensors were used during both experiments to measure headline heights and door and wing spreads. During both trips, all successful sets were sampled. Three hundred to five hundred samples of each of the following species: cod, haddock, plaice and yellowtail were measured for length from each codend. In addition, total weights for both codends were recorded for all species. Fishing was conducted on a 24 hour basis with fishing areas and fishing patterns determined by the vessel captain.

Data analysis for trip number one consisted of selectivity curves for yellowtail and plaice using the method of Cadigan and Boulos, 1996 and frequency distributions for the control codend and the experimental codend were compared for cod, plaice and yellowtail. Analysis of data for trip two consisted of percentages by weight in each codend of cod, plaice and yellowtail.

The vessel used for both experiments was the 46 meter M/V "NFLD HAWK" based at FPI's plant in Burin Nfld.

RESULTS

Large Square Mesh Codend Experiment

A 183mm square mesh codend was tested during a 10-day trip to the southern Grand Banks (Fig.3a) on a 46m stern trawler, the " Newfoundland Hawk ". A total of 28 successful sets (Table 1) were completed using the experimental trawl in water depths ranging from 50 to 85 metres. Towing speed ranged from 3 to 3.3 knots over the ground, and towing duration varied from one and a half hours to two hours.

Underwater camera observations confirmed that the experimental trawl was a close duplicate of the flume tank model, requiring only a few minor adjustments. When the underwater camera was deployed only small amounts of plaice and yellowtail were detected and no cod were encountered. Therefore, minimal information on fish behaviour was recorded.

The length composition of cod in population samples taken during the experiment was mostly above 80cm or below 50cm (Fig. 4) making it impossible to generate selectivity curves from the cod data. Comparisons of cod length distributions found in the control codend and the 183 mm square mesh codend indicate that the large square mesh codend was excluding most of the smaller cod, but none of those above 80cm (Table 2).

The average mean lengths of cod, plaice and yellowtail caught in the 183mm square mesh codend were 84cm, 46cm and 40cm respectively (Table 2). In the small mesh

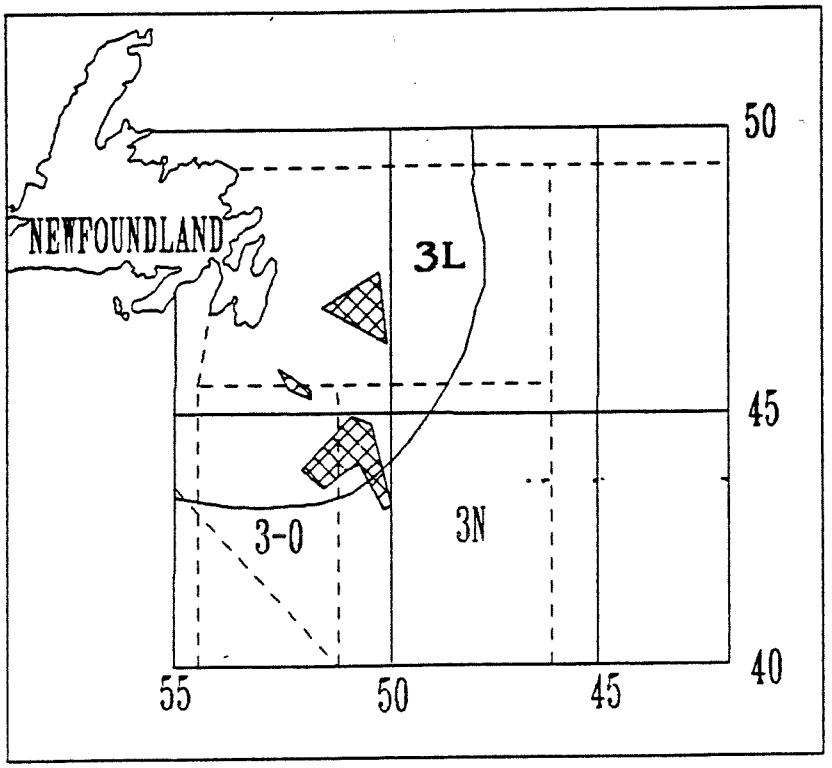


Figure 3A: Area fished during the 183mm square mesh codend experiment

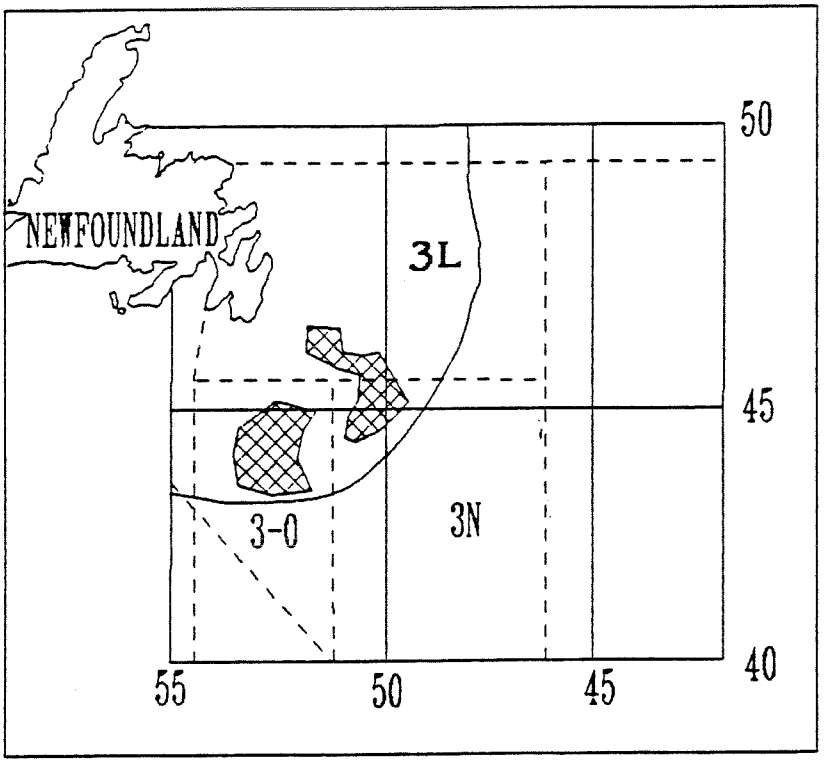


Figure 3B: Area fished during the 183mm square mesh codend experiment

DETAILS OF EXPERIMENTAL CRUISES

TABLE 1

CRUISE #	ARE A	GEAR	EXPERIMENT	# OF SETS	CODEND MESH SIZE
1	3LNO	Model 96 trouser trawl	183mm square mesh codend	28	183mm square versus 40 mm control
2	3LNO	Model 96 with twin codends	Horizontal separator	26	40mm control versus 40 mm control

CATCH RESULTS FOR 28 SETS USING A 183MM SQUARE MESH CODEND VERSUS A 40MM CONTROL

TABLE 2

Species	Codend #	Length Range (cm)	Mean Length (cm)	Total Catch (kg)
Cod	1	25-127	84	1558
	2	15-124	32	4292
Plaice	1	22-72	46	3314
	2	11-73	32	6868
Yellowtail	1	22-51	40	11915
	2	12-51	34	37656

Codend # 1 = 183mm square mesh
Codend # 2 = 40mm control codend

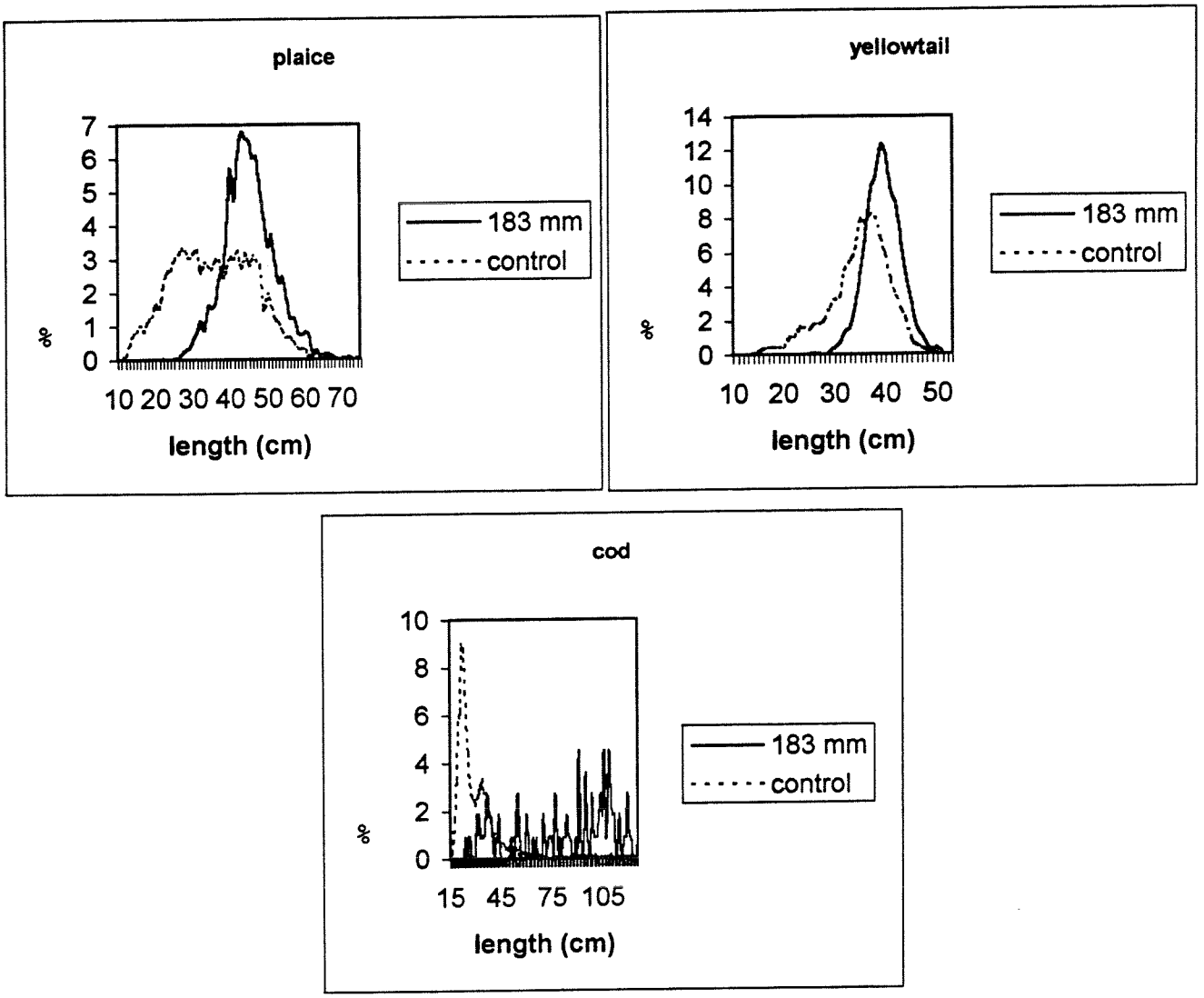


Fig. 4.Length frequency distributions for plaice, yellowtail and cod caught in a 183 mm square mesh codend and in a small mesh control codend.

control codend the average mean lengths were 32cm, 32cm, and 34cm respectively.

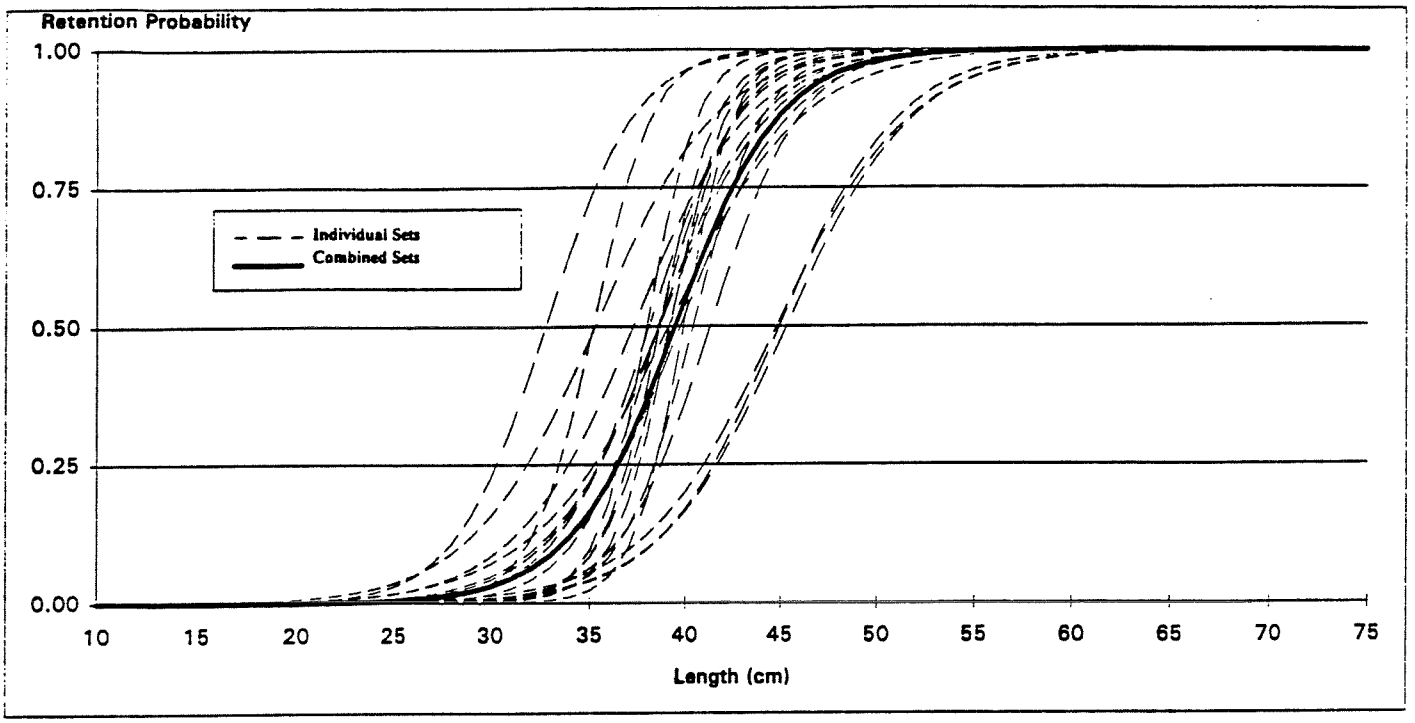
The length distributions (Fig. 4) of plaice and yellowtail caught in the 183mm square mesh codend and the control codend were adequate for deriving selectivity curves. For plaice (Fig. 5), the combined L50 was 39.5cm, combined selection range was 6.0cm and combined selection factor was 2.2. For individual sets the L50 ranged from 32.8 to 45.3cm, the selection range from 2.9 to 7.7 and the selection factor from 1.8 to 2.5. The combined L50 for yellowtail was 38.8cm, the combined selection range was 5.2cm and the combined selection factor was 2.1. The L50 for individual sets ranged from 33.1 to 45.0cm, the selection range ranged from 2.5 to 9.9cm and the selection factor from 1.8 to 2.5 (Fig.6).

As can be seen from figures 5 and 6, almost none of the plaice or yellowtail are being retained below 35cm, which FPI says is an unacceptable loss of commercial size flatfish.

Horizontal Separator Trawl Experiment

The horizontal separator trawl was tested during a second 10 day trip to the southern Grand Banks (Fig.3b) in October, 1992 on board the "Newfoundland Hawk". A total of 26 successful sets (Table 1) were completed in depths ranging from 53 to 256 metres. Set duration ranged from two hours and thirty minutes to three hours.

Attempts to videotape underwater camera observations of the separator panel were not successful and therefore estimated panel positions and heights are based on flume tank measurements.



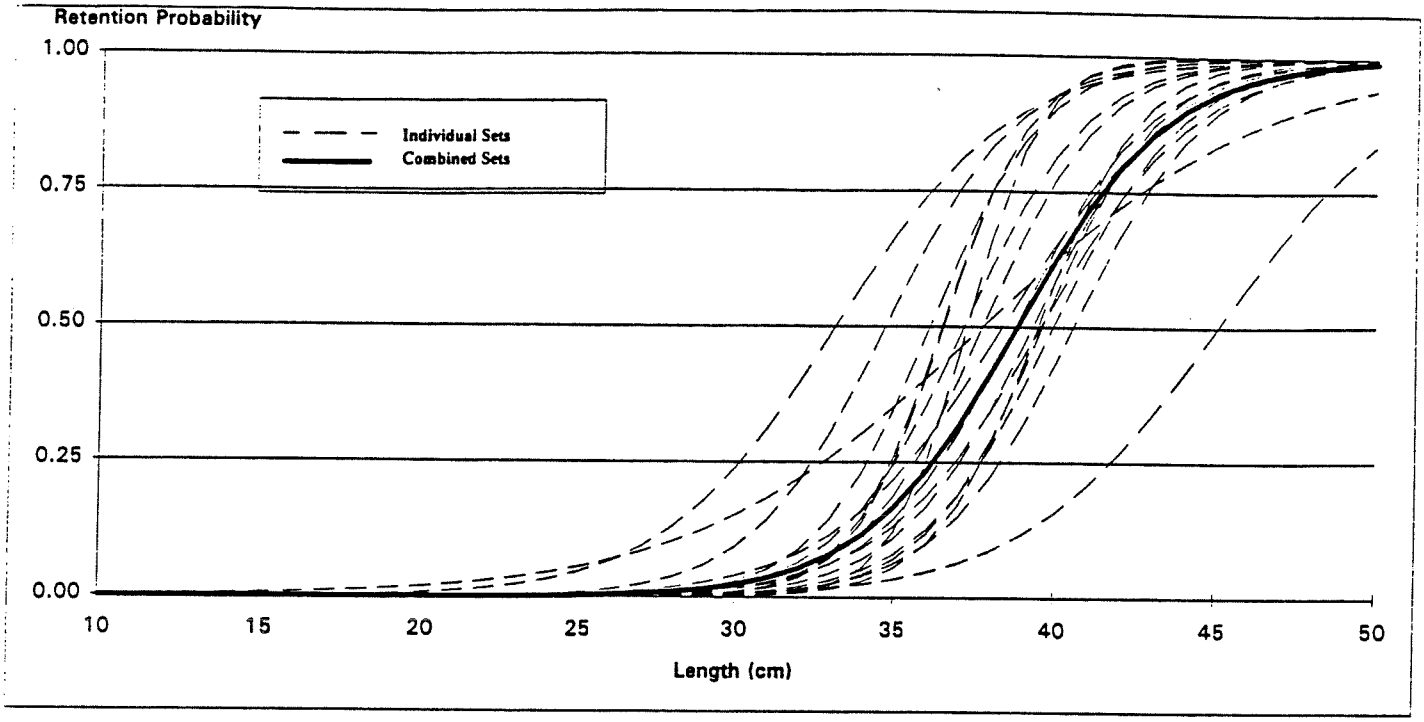
	Set 1	Set 2	Set 3	Set 5	Set 7	Set 9	Set 11
a	-18.54 (3.01)	-22.62 (8.50)	-22.06 (9.45)	-26.74 (12.38)	-28.67 (8.67)	-30.41 (5.47)	-11.09 (1.30)
b	0.48 (0.09)	0.58 (0.23)	0.55 (0.25)	0.68 (0.33)	0.76 (0.25)	0.76 (0.15)	0.28 (0.05)
p	0.78 (0.04)	0.50 (0.05)	0.45 (0.05)	0.37 (0.04)	0.72 (0.05)	0.84 (0.04)	0.71 (0.07)
L25 (cm)	36.3 (1.27)	37.3 (1.11)	38.4 (1.11)	37.6 (1.07)	36.5 (1.10)	38.5 (0.89)	35.2 (1.84)
L50 (cm)	38.6 (1.57)	39.2 (1.56)	40.4 (1.47)	39.2 (1.37)	38.0 (1.42)	39.9 (1.11)	39.1 (2.34)
L75 (cm)	40.8 (1.92)	41.1 (2.19)	42.4 (2.17)	40.8 (1.95)	39.4 (1.81)	41.4 (1.35)	43.0 (2.89)
S.R. (cm)	4.6 (0.87)	3.8 (1.54)	4.0 (1.82)	3.2 (1.56)	2.9 (0.96)	2.9 (0.58)	7.7 (1.26)
S.F.	2.1	2.1	2.2	2.1	2.1	2.2	2.1

	Set 12	Set 13	Set 14	Set 16	Set 17	Set 19	Set 23
a	-11.27 (2.29)	-12.30 (3.79)	-14.64 (5.92)	-12.91 (4.20)	-13.38 (5.33)	-23.00 (12.54)	-13.93 (4.35)
b	0.32 (0.08)	0.33 (0.11)	0.45 (0.20)	0.29 (0.11)	0.35 (0.15)	0.65 (0.38)	0.35 (0.12)
p	0.52 (0.05)	0.63 (0.04)	0.52 (0.02)	0.59 (0.07)	0.45 (0.04)	0.43 (0.04)	0.36 (0.06)
L25 (cm)	31.8 (1.33)	33.9 (1.73)	30.3 (1.45)	41.0 (1.94)	35.5 (1.62)	33.5 (1.53)	36.6 (1.75)
L50 (cm)	35.3 (1.88)	37.3 (2.32)	32.8 (1.86)	44.8 (2.79)	38.7 (1.96)	35.2 (2.01)	39.7 (2.45)
L75 (cm)	38.7 (2.59)	40.6 (3.24)	35.2 (2.67)	48.6 (3.98)	41.8 (2.95)	36.8 (2.76)	42.9 (3.38)
S.R. (cm)	6.9 (1.67)	6.7 (2.32)	4.9 (2.15)	7.6 (2.82)	6.3 (2.70)	3.4 (1.96)	6.3 (2.23)
S.F.	1.9	2.0	1.8	2.4	2.1	1.9	2.2

	Set 24	Set 25	Set 26	Set 28	Set 29	Set 30	Combined
a	-25.37 (6.17)	-17.71 (4.61)	-14.47 (2.12)	-13.78 (1.70)	-14.09 (2.51)	-16.11 (2.05)	-14.40 (0.35)
b	0.66 (0.17)	0.43 (0.13)	0.32 (0.07)	0.30 (0.05)	0.37 (0.07)	0.42 (0.07)	0.36 (0.01)
p	0.62 (0.05)	0.48 (0.07)	0.87 (0.06)	0.86 (0.04)	0.70 (0.03)	0.81 (0.04)	-
L25 (cm)	37.0 (0.83)	38.8 (1.59)	41.5 (3.06)	41.7 (1.76)	35.6 (1.02)	35.5 (1.16)	36.5 (0.32)
L50 (cm)	38.7 (1.10)	41.3 (2.08)	44.9 (3.58)	45.3 (2.18)	38.6 (1.40)	38.0 (1.47)	39.5 (0.40)
L75 (cm)	40.3 (1.47)	43.9 (2.71)	48.4 (4.15)	48.9 (2.66)	41.6 (1.90)	40.6 (1.81)	42.5 (0.48)
S.R. (cm)	3.3 (0.88)	5.1 (1.52)	6.8 (1.38)	7.2 (1.14)	6.0 (1.23)	5.2 (0.81)	6.0 (0.19)
S.F.	2.1	2.3	2.5	2.5	2.1	2.1	2.2

Plaice

Figure 5: Estimated selectivity of plaice in a 183mm square mesh codend in a trouser trawl experiment. The estimated selectivities from individual sets and sets combined are plotted.



	Set 1	Set 2	Set 3	Set 4	Set 5	Set 6	Set 7
a	-25.27 (4.62)	-32.96 (4.82)	-26.16 (4.02)	-19.39 (2.86)	-22.25 (3.29)	-18.48 (3.05)	-19.30 (4.09)
b	0.64 (0.13)	0.89 (0.14)	0.72 (0.12)	0.52 (0.09)	0.56 (0.09)	0.48 (0.09)	0.49 (0.12)
p	0.80 (0.06)	0.74 (0.03)	0.75 (0.03)	0.74 (0.04)	0.75 (0.05)	0.73 (0.05)	0.77 (0.06)
L25 (cm)	37.7 (0.95)	36.0 (0.37)	34.9 (0.49)	35.0 (0.79)	37.6 (0.84)	36.5 (0.95)	37.1 (1.11)
L50 (cm)	39.5 (1.22)	37.2 (0.49)	36.4 (0.67)	37.1 (1.04)	39.6 (1.08)	38.8 (1.29)	39.3 (1.53)
L75 (cm)	41.2 (1.53)	38.5 (0.65)	38.0 (0.89)	39.2 (1.34)	41.6 (1.36)	41.1 (1.67)	41.5 (2.01)
S.R. (cm)	3.4 (0.71)	2.5 (0.39)	3.1 (0.51)	4.2 (0.71)	3.9 (0.66)	4.6 (0.88)	4.5 (1.09)
S.F.	2.2	2.0	2.0	2.0	2.2	2.1	2.1

	Set 8	Set 10*	Set 11*	Set 19	Set 20	Set 21	Set 22
a	-20.37 (3.90)	-8.41 (7.20)	-14.65 (7.59)	-16.49 (2.04)	-26.79 (4.56)	-16.86 (2.60)	-12.28 (1.71)
b	0.54 (0.12)	0.22 (0.24)	0.38 (0.23)	0.42 (0.06)	0.73 (0.13)	0.49 (0.08)	0.37 (0.06)
p	0.69 (0.06)	0.49 (0.24)	0.61 (0.17)	0.81 (0.05)	0.71 (0.03)	0.70 (0.04)	0.69 (0.04)
L25 (cm)	35.7 (0.82)	32.8 (5.21)	35.4 (2.79)	36.9 (1.24)	35.0 (0.48)	32.4 (0.72)	30.2 (1.04)
L50 (cm)	37.7 (1.14)	37.7 (9.50)	38.3 (4.18)	39.5 (1.55)	36.5 (0.65)	34.7 (0.97)	33.1 (1.39)
L75 (cm)	39.7 (1.53)	42.6 (14.48)	41.2 (5.77)	42.2 (1.90)	38.0 (0.87)	37.0 (1.29)	36.1 (1.81)
S.R. (cm)	4.1 (0.88)	9.9 (10.61)	5.7 (3.51)	5.3 (0.81)	3.0 (0.55)	4.5 (0.79)	5.9 (1.01)
S.F.	2.1	2.1	2.1	2.2	2.0	1.9	1.8

	Set 24	Set 25	Set 26	Set 28	Combined
a	-19.76 (2.65)	-20.78 (6.23)	-14.97 (2.20)	-19.77 (4.73)	-16.41 (1.00)
b	0.49 (0.08)	0.58 (0.18)	0.33 (0.08)	0.50 (0.14)	0.42 (0.03)
p	0.86 (0.04)	0.53 (0.04)	0.93 (0.08)	0.63 (0.09)	-
L25 (cm)	38.3 (1.17)	34.1 (0.87)	41.7 (4.96)	37.7 (1.26)	36.2 (0.28)
L50 (cm)	40.6 (1.45)	36.1 (1.13)	45.0 (5.64)	39.9 (1.72)	38.8 (0.40)
L75 (cm)	42.8 (1.76)	38.0 (1.59)	48.4 (6.36)	42.1 (2.25)	41.4 (0.56)
S.R. (cm)	4.5 (0.73)	3.8 (1.22)	6.6 (1.61)	4.4 (1.21)	5.2 (0.36)
S.F.	2.2	2.0	2.5	2.2	2.1

Yellowtail

Figure 6: Estimated selectivity of yellowtail flounder in a 183mm square mesh codend in a trouser trawl experiment. The estimated selectivities from individual sets and sets combined are plotted.

Eight sets were made with the panel at height #1, 41cm. This setting resulted in 16% of the cod, 69% of plaice, 33% of yellowtail and 8% of haddock in the bottom codend (Table 3). Three sets were made with the separator panel at height #2, 64cm resulting in 42% of cod, 71% of plaice and 66% of yellowtail in the bottom codend (Table 4). Three sets with the separator panel at height #3, 97cm resulted in 51% of cod, 93% of plaice and 92% of yellowtail in the bottom codend (Table 5). At this setting only 49% of the cod were excluded. Twelve sets were made with the panel at height #4 107cm and resulted in 75% of cod, 98% of plaice, 99% of yellowtail and 54% of haddock in the bottom codend (Table 6). This was the natural height of the separator panel which was achieved without the use of restraining ropes. Most of the catch of all species was contained in the lower codend and indicates that this setup would not be effective for the separation of cod and flatfish.

HORIZONTAL SEPARATOR PANEL SET AT 41cm ABOVE THE FOOTROPE
RESULTS FROM 8 SETS

TABLE 3

SPECIES	TOP			BOTTOM			TOTAL CATCH
	% OF TOTAL CATCH	LENGTH RANGE (cm)	MEAN LENGTH (cm)	% OF TOTAL CATCH	LENGTH RANGE (cm)	MEAN LENGTH	
Cod	84	22-53	34.7	16	17-86	34.0	2780
Plaice	31	12-68	33.7	69	11-68	35.5	4181
Yellowtail	67	13-49	34.7	33	9-50	32.3	6632
Haddock	92	25-82	-	8	39-65	-	278

HORIZONTAL SEPARATOR PANEL SET AT 64cm ABOVE THE FOOTROPE
RESULTS FROM 3 SETS

TABLE 4

SPECIES	TOP			BOTTOM			TOTAL CATCH
	% OF TOTAL CATCH	LENGTH RANGE (cm)	MEAN LENGTH (cm)	% OF TOTAL CATCH	LENGTH RANGE (cm)	MEAN LENGTH	
Cod	68	18-105	41.1	42	19-67	40.8	140
Plaice	29	10-56	25.2	71	12-57	30.6	2172
Yellowtail	34	29-47	37.3	66	29-45	36.9	113
Haddock	-	-	-	-	-	-	-

HORIZONTAL SEPARATOR PANEL SET AT 97cm ABOVE THE FOOTROPE
RESULTS FROM 3 SETS

TABLE 5

SPECIES	TOP			BOTTOM			TOTAL CATCH
	% OF TOTAL CATCH	LENGTH RANGE (cm)	MEAN LENGTH (cm)	% OF TOTAL CATCH	LENGTH RANGE (cm)	MEAN LENGTH	
Cod	49	20-113	45.9	51	19-128	45.3	1678
Plaice	7	15-63	35.0	93	12-64	34.3	866
Yellowtail	8	23-49	36.9	92	17-48	34.9	336
Haddock		-	-	-	-	-	

HORIZONTAL SEPARATOR PANEL SET AT 107cm ABOVE THE FOOTROPE
RESULTS FROM 12 SETS

TABLE 6

SPECIES	TOP			BOTTOM			TOTAL CATCH
	% OF TOTAL CATCH	LENGTH RANGE (cm)	MEAN LENGTH (cm)	% OF TOTAL CATCH	LENGTH RANGE (cm)	MEAN LENGTH	
Cod	25	22-84	37.1	75	17-86	35.4	246
Plaice	2	11-73	28.1	98	11-72	29.1	5227
Yellowtail	1	-	-	99	18-76	-	75
Haddock	46	21-76	39.0	54	20-81	39.6	1155

DISCUSSION

Large square mesh codends can be useful in reducing cod by-catches in areas of mixed cod and plaice populations only when cod less than 60cm predominate. If cod are extremely large, as was experienced during this experiment, the square mesh size required to exclude them would also release unacceptable amounts of commercial size plaice and yellowtail flounder.

Selection ranges for plaice and yellowtail are slightly different than those obtained during previous studies using square mesh codends. Walsh et al (1992) reported combined selection ranges of 4.2, 4.0 and 4.2 cm for three experiments using 130mm, 140mm and 155mm respectively as compared to 6.0 cm during this study using 183 mm square mesh.

Results from the horizontal separator trawl experiment suggests that this method will not achieve the level of cod/plaice separation required by FPI. To prevent an unacceptable loss of plaice a panel setting would have to be used which would result in over 50% of the cod being caught. The results obtained are similar to those reported in the UK (Main and Sangster, 1982, 1985).

These results suggest that using square mesh codends or horizontal separator panels will not solve the cod by-catch problem on the southern Grand Banks. However, the positive aspects of these devices could very well be enhanced by a combination of the two, or in combination with methods such as rigid grates.

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