New England Mesh Selectivity Studies

Experiment Three

Offshore Groundfish

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Contents

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Abstract

This is the preliminary report of results of the tests conducted from the fishing vessels JOSEPH & LUCIA II and JOSEPH & LUCIA III. The tests were conducted on August 13-15, 1978, in the offshore waters of Georges Bank.

Personnel

JOSEPH & LUCIA II

Antonino Brancaleone	- Captain/Chief of Party
Peter Ferrante	- Fisherman
Giuseppe Brancaleone	- Fisherman
Carlo Randazzo	- Fisherman
Giacomo Favazza	- Fisherman
Joseph Brancaleone	- Fisherman
John Novello	- Fisherman
Ronald Smolowitz	- Scientific Advisor (NMFS)
Robert Fawcett	- Scientific Advisor (N. H. Fish & Game Dept.)

JOSEPH & LUCIA III

Gaetano Brancaleone	- Captain/Chief of Party
Tony Brancaleone	- Fisherman
Frank D'Amico	- Fisherman
Gil Goodrick	- Fisherman
Santo Aloi	- Fisherman
Gaspar Palazola	- Fisherman
Joseph Tarantino	- Fisherman
Thurston Burns	- Scientific Advisor (NMFS)
Joseph Pelczarski	- Scientific Advisor (Mass. Div. Marine Fisheries)

Data Processing

Cathy Reardon	- Biological Aid (NMFS)

Introduction

This experiment was the third in a series of four requested by the New England Regional Fisheries Management Council to provide a basis for evaluating the effect on present catches which could result from an increase in cod-end mesh size.

The experimental method was the same used in the previous two experiments. An explanation of the method can be found in the reports from those studies: Woods Hole Laboratory Reference Nos. 78-12 and 78-24.

Cod Ends

The small cod ends used in this experiment were the same used in the first two experiments. The large cod ends were newly constructed for this experiment in an identical manner as the previous large cod ends.

Study Area

The study area was jointly chosen by the captains of the two vessels. It is an area located on Georges Bank commonly referred to as the "ridge." The vessels towed both north and south of the ridge and in the nearby area known as the "mud flats."

Gear

The trawls and associated rigging for the experiment were chosen by the individual captains and were basically 41 Yankee trawls with short wings. Detailed information is presented in Tables 1 and 2 and in Figure 1. The covers were the same as used before.

Procedures

The experiment consisted of three four-tow series by each vessel. The series was initially chosen, as in Experiment Two, to minimize cod-end changes. However, due to problems with the covers and a large catch of pollock on board (from commercial fishing at night) that had to be landed early, the experiment consisted of the following:

Day 1	Day 2	Day 3 (J&L II)	Day 4 (J&L III)
Sm mesh w/cover	Sm mesh	Lg mesh	Sm mesh
Sm mesh	Sm mesh w/cover	Sm mesh	Lg mesh
Lg mesh w/cover	Lg mesh	Lg mesh	Sm mesh
Lg mesh	Lg mesh w/cover	Sm mesh	Lg mesh

On the first two days both vessels towed in the same order; on the third day the vessels alternated uncovered tows. The tows were made within a kilometer of each other at 3.5 knots during daylight hours only.

Table 1. Vessel specifications.

Item	JOSEPH & LUCIA II	JOSEPH & LUCIA III
Type vessel	Eastern rig side trawler	
Home port	Gloucester, Massachusetts	
Call sign	WU 8451	WY 3319
Length	26.8 m (88 ft)	29.3 m (96 ft)
Gross tons	179 tons	192 tons
Draft	4.3 m (14 ft)	4.3 m (14 ft)
Speed	11 knots	11 knots
Engine and Drive	Fairbanks Morse 8 cylinder OP; 4:1 reduction	Fairbanks Morse
Horsepower	680 SHP @ 1300 RPM	900 SHP

Table 2. Gear specifications. (Both vessels had nearly identical trawls.)

Trawl (forward parts)	- 114 mm (4.5 inches) average mesh size; mostly #42 thread nylon twine.
Cod ends	- Type 1: 107 mm average mesh size; 80 meshes around X 50 deep; #102 braided nylon twine; machine-made. Type 2: 138 mm average mesh size; 80 meshes around X 35 deep; #102 braided nylon twine; handmade.
Cover (when used)	- 50 mm average mesh size; 225 meshes around X 133 deep; #72 twisted nylon twine; machine-made.
Headrope	- 19.2 m (63 ft) of 1.5-inch nylon.
Footrope (sweeps)	- 25.3 m (83 ft) of 5/8-inch chain; belly has 18-inch rollers with 2 spacers between each; wings have 14-inch and 18-inch bobbins with 3 spacers between each.
Floats	- 22 on belly and 8 on each wing (8-inch aluminum).
Chafing gear	- Mat of polyethylene strands covering aft half (and underside only) of cod end and cover.
Doors	- Rectangular-shaped of wood and steel construction; 2.7 m (9 ft) long X 1.4 m (4.5 ft) wide; weighing 818 kg (1,800 lb). Bracket triangular-shaped of steel bar.
Backstraps	- Two 2.7-m (9-ft) lengths of 5/8-inch chain.
Bridle wires (legs)	- 18.3 m (60 ft) of 7/8-inch 6 X 19 wire.
Trawl wire	- 7/8-inch 6 X 19 wire.
Ground cables	- 18.3 m (60 ft) of 7/8-inch 6X19 wire.
Miscellaneous	- Trawl equipped with quarter ropes, bullrope, lazy-line, and splitting straps.

Figure 1. Trawl diagram.

#41 Yankee trawl

Headrope: 19.2 m (63 ft)

Footrope: 25.3 m (83 ft)

MESH
TWINE

$\dfrac{114 \text{ mm}}{42\text{-thread nylon}}$

$\dfrac{107 \ (138) \text{ mm}}{\#102 \text{ nylon}}$

60 dogs

100 dogs

10 meters

20

75

220

180

100

cod
end

45

45

170

80 meshes
around

cod
end

50
(35)

50

90

30
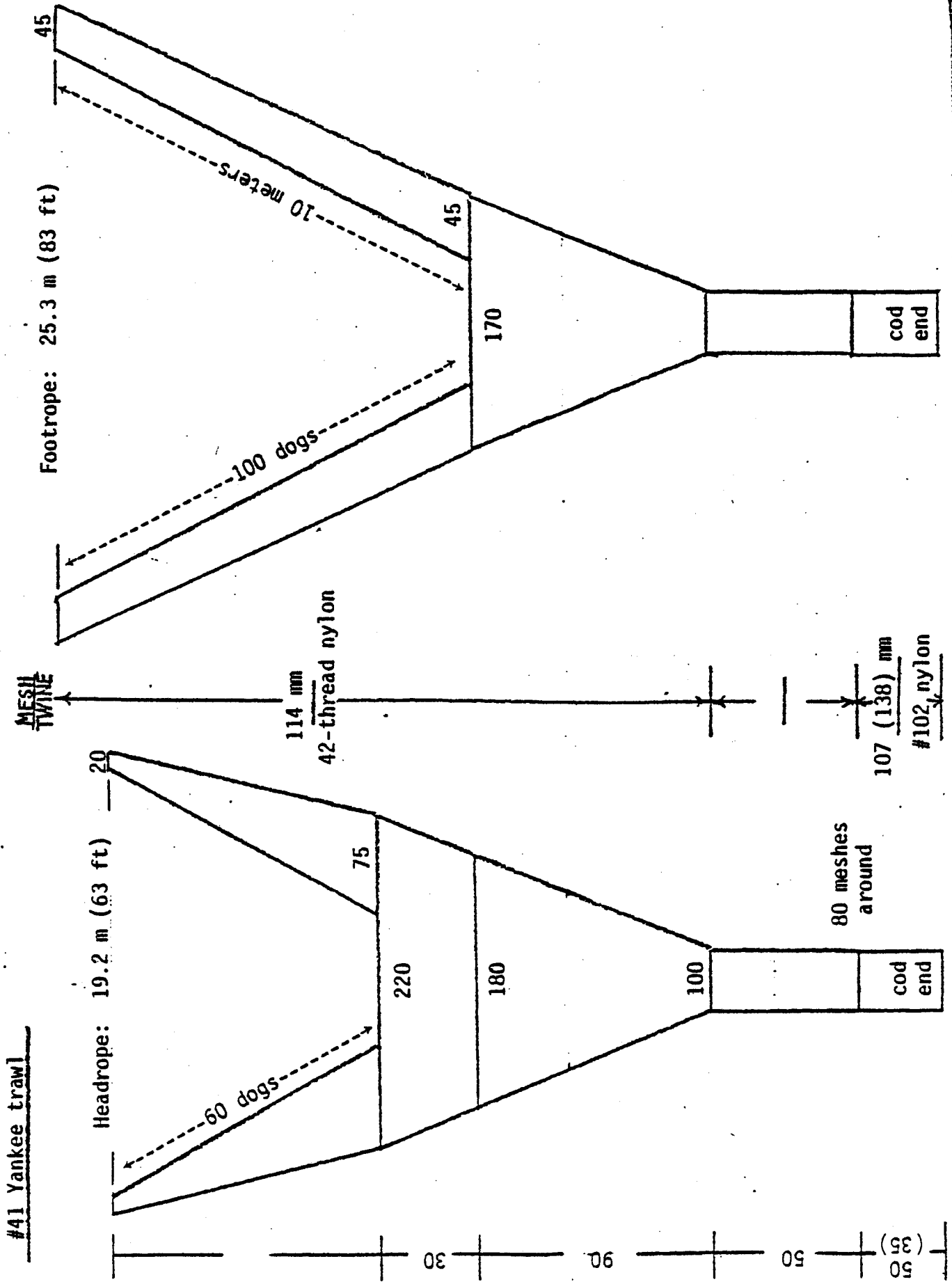
Mesh Measurements

Thirty meshes were measured after each tow; and means, standard deviations, and standard errors calculated (Table 3).

The small cod ends on the JOSEPH & LUCIA II and JOSEPH & LUCIA III had mean mesh sizes of 103.7 mm (4.1 inches) and 109.6 mm (4.3 inches) respectively. These same cod ends averaged 99 mm (3.9 inches) in the second experiment and apparently stretched during the night fishing that preceded the experiment on this trip.

The large cod ends both averaged 140 mm after a 2-hr break-in tow. However during the experiment the mean mesh sizes were 135.9 mm (5.3 inches) and 140.8 mm (5.5 inches) respectively.

In our selection analysis, due to the limited amount of data, we combined both vessels and used an overall average mesh size of 107 mm (4.2 inches) for the small cod ends and 138 mm (5.4 inches) for the large cod ends.

Tow Summary

The tows were conducted as described in the previous experimental reports, the basic tow data being presented in Table 4. The captains followed normal commercial practice of changing course to follow contours, go around hard bottom, and pursue fish traces on the echo sounder.

The area fished had very few small fish of any species and the catch was quite "clean" or lacking much "trash" fish. There was hardly any fish discarded.

The lack of small fish did not provide for a good data base for the use of the covered-tow method. In addition the covers did not seem to function well. The 72-thread twisted cotton twine that the covers were made of apparently filled up with sand and mud particles, causing the covers to become exceptionally heavy. That and the fact that our catches were large tended to cause a masking of the cod ends. We thus switched to alternate tows exclusively on the third day.

The basic catch data is presented in Table 5. Whiting are silver hake, dabs are American plaice, and ling are white and red hakes grouped together. There was a small incidental catch of goosefish, wolffish, cusk, *Illex* squid, grey sole, and halibut.

Table 3. Mesh measurement statistics.

A. Small cod end.

			Trawl stations				
1	2	5	6	10	12	Overall

JOSEPH & LUCIA II

N = 30	N = 30	N = 30	N = 30	N = 30	N = 30	N = 180
$\bar{X}$ = 102.30	$\bar{X}$ = 101.50	$\bar{X}$ = 104.17	$\bar{X}$ = 103.70	$\bar{X}$ = 106.57	$\bar{X}$ = 103.97	$\bar{X}$ = 103.7 mm (4.1 inches)
$S\bar{x}$ = 0.58	$S\bar{x}$ = 0.67	$S\bar{x}$ = 0.69	$S\bar{x}$ = 0.81	$S\bar{x}$ = 0.64	$S\bar{x}$ = 0.63	$S\bar{x}$ = 0.67
Sx = 3.16	Sx = 3.69	Sx = 3.77	Sx = 4.45	Sx = 3.52	Sx = 3.75	Sx = 3.72

			Trawl stations				
1	2	5	6	9	11	Overall

JOSEPH & LUCIA III

N = 30	N = 30	N = 30	N = 30	N = 30	N = 30	N = 180
$\bar{X}$ = 105.80	$\bar{X}$ = 109.83	$\bar{X}$ = 109.70	$\bar{X}$ = 109.03	$\bar{X}$ = 111.97	$\bar{X}$ = 111.47	$\bar{X}$ = 109.6 mm (4.3 inches)
$S\bar{x}$ = 0.60	$S\bar{x}$ = 0.55	$S\bar{x}$ = 0.59	$S\bar{x}$ = 0.78	$S\bar{x}$ = 0.64	$S\bar{x}$ = 0.62	$S\bar{x}$ = 0.63
Sx = 3.30	Sx = 3.01	Sx = 3.25	Sx = 4.25	Sx = 3.48	Sx = 3.40	Sx = 3.45

B. Large cod end.

			Trawl stations				
3	4	7	8	9	11	Overall

JOSEPH & LUCIA II

N = 30	N = 30	N = 30	N = 30	N = 30	N = 30	N = 180
$\bar{X}$ = 140.90	$\bar{X}$ = 137.77	$\bar{X}$ = 134.20	$\bar{X}$ = 135.63	$\bar{X}$ = 133.40	$\bar{X}$ = 133.50	$\bar{X}$ = 135.9 mm (5.3 inches)
$S\bar{x}$ = 0.96	$S\bar{x}$ = 0.62	$S\bar{x}$ = 0.74	$S\bar{x}$ = 0.72	$S\bar{x}$ = 0.59	$S\bar{x}$ = 0.56	$S\bar{x}$ = 0.70
Sx = 5.27	Sx = 3.37	Sx = 4.08	Sx = 3.96	Sx = 3.23	Sx = 3.09	Sx = 3.84

			Trawl stations				
3	4	7	8	10	12	Overall

JOSEPH & LUCIA III

N = 30	N = 30	N = 30	N = 30	N = 30	N = 30	N = 180
$\bar{X}$ = 140.97	$\bar{X}$ = 141.73	$\bar{X}$ = 138.90	$\bar{X}$ = 138.50	$\bar{X}$ = 143.30	$\bar{X}$ = 141.83	$\bar{X}$ = 140.8 mm (5.5 inches)
$S\bar{x}$ = 0.72	$S\bar{x}$ = 0.68	$S\bar{x}$ = 1.02	$S\bar{x}$ = 0.75	$S\bar{x}$ = 0.83	$S\bar{x}$ = 0.79	$S\bar{x}$ = 0.80
Sx = 3.96	Sx = 3.75	Sx = 5.59	Sx = 4.12	Sx = 4.56	Sx = 4.33	Sx = 4.39

N = number of meshes measured.

$\bar{X}$ = average (mean) size of meshes (mm).

$S\bar{x}$ = standard error which is a measure of the preciseness of the mean. Two times $S\bar{x}$, added to and subtracted from $\bar{X}$, gives the 95% confidence limits of $\bar{X}$ shown in this table.

Sx = standard deviation indicating variation in mesh sizes. Two times Sx, added to and subtracted from $\bar{X}$, gives the size limits between which 95% of the meshes fall.

Average mesh sizes, both vessels combined:
Small cod end = 106.6 mm (4.2 inches)
Large cod end = 138.3 mm (5.4 inches)

Table 4. Tow data (all tows 1 hr from set to haul-back). Bottom type: mud and rock.

A. 13 August 1978.

	JOSEPH & LUCIA II	JOSEPH & LUCIA III
Tow 1		
Cod end:	Small mesh covered.	
Wire out:	225 fms	225 fms
Course:	NNW	320
Start time:	0540	0542
Avg. depth:	92 fms	85 fms
Weather:	Wind calm; 68°; overcast.	Seas 1 ft; fog.
Tow 2		
Cod end:	Small mesh uncovered.	
Wire out:	225 fms	225 fms
Course:	SW	270
Start time:	0718	0728
Avg. depth:	93 fms	90 fms
Weather:	Wind calm; 68°; overcast.	Seas 1 ft; fog.

	JOSEPH & LUCIA II	JOSEPH & LUCIA III
Tow 3		
Cod end:	Large mesh covered.	
Wire out:	225 fms	200 fms
Course:	W	200
Start time:	1303	1300
Avg. depth:	74 fms	70 fms
Weather:	Wind calm; overcast.	Fog.
Tow 4		
Cod end:	Large mesh uncovered.	
Wire out:	225 fms	200 fms
Course:	E	110
Start time:	1445	1453
Avg. depth:	74 fms	70 fms
Weather:	Wind calm; overcast.	Seas 1 ft; fog.

B. 14 August 1978.

	JOSEPH & LUCIA II	JOSEPH & LUCIA III
Tow 5		
Cod end:	Small mesh uncovered.	
Wire out:	225 fms	200 fms
Course:	E	260
Start time:	0810	0758
Avg. depth:	81 fms	72 fms
Weather:	Wind calm; overcast.	Seas 3 ft.
Tow 6		
Cod end:	Small mesh covered.	
Wire out:	225 fms	200 fms
Course:	W	270
Start time:	0953	950
Avg. depth:	81 fms	78 fms
Weather:	Wind calm; overcast.	Seas 3 ft; fog.

	JOSEPH & LUCIA II	JOSEPH & LUCIA III
Tow 7		
Cod end:	Large mesh uncovered.	
Wire out:	225 fms	200 fms
Course:	E	120
Start time:	1158	1145
Avg. depth:	81 fms	78 fms
Weather:	Wind calm; overcast.	Seas 2 ft; fog.
Tow 8		
Cod end:	Large mesh covered.	
Wire out:	225 fms	200 fms
Course:	W	270
Start time:	1345	1350
Avg. depth:	83 fms	79 fms
Weather:	Wind calm; overcast.	Seas 2 ft; fog.

C. 15 August 1978.

	JOSEPH & LUCIA II	JOSEPH & LUCIA III
Tow 9		
Cod end:	Large mesh uncovered.	Small mesh uncovered.
Wire out:	225 fms	200 fms
Course:	N	335
Start time:	0830	0835
Avg. depth:	85 fms	84 fms
Weather:	Wind calm; overcast, fog.	Seas 2-3 ft.
Tow 10		
Cod end:	Small mesh uncovered.	Large mesh uncovered.
Wire out:	225 fms	200 fms
Course:	S	040
Start time:	1015	1015
Avg. depth:	84 fms	82 fms
Weather:	Wind calm; overcast.	Seas 1-2 ft; fog.

	JOSEPH & LUCIA II	JOSEPH & LUCIA III
Tow 11		
Cod end:	Large mesh uncovered.	Small mesh uncovered.
Wire out:	225 fms	200 fms
Course:	S	180
Start time:	1155	1155
Avg. depth:	84 fms	82 fms
Weather:	Wind calm; overcast.	Seas 1-2 ft. fog.
Tow 12		
Cod end:	Small mesh uncovered.	Large mesh uncovered.
Wire out:	225 fms	200 fms
Course:	N	350
Start time:	1340	1350
Avg. depth:	85 fms	82 fms
Weather:	Wind calm; overcast.	Seas calm; fog.

Table 5. Catch weight data.

		JOSEPH & LUCIA II		JOSEPH & LUCIA III	
		kg	lb	kg	lb
TOW 1	Haddock –	33.4	73.5	36.7	80.7
Small cod end	Pollock –	32.8	72.2	26.6	58.5
	Cod –	102.7	225.9	168.2	370.0
	Redfish –	3.7	8.1	4.4	9.7
	Whiting –	1.9	4.2	0.5	1.1
	Dabs –	32.8	72.2	13.7	30.1
	Ling –	12.5	27.5	17.0	37.4
	Total –	219.8	483.6	267.1	587.5
TOW 1	Haddock –	0.3	0.7		
Cover	Pollock –	0.6	1.3		
	Cod –			1.7	3.7
	Whiting –	0.2	0.4		
	Dabs –	0.4	0.9	0.4	0.9
	Ling –	5.8	12.8		
	Total –	7.3	16.1	2.1	4.6
TOW 2	Haddock –	71.2	156.6	84.7	186.3
Small cod end	Pollock –	8.1	17.8	46.6	102.5
	Cod –	12.7	27.9	48.6	106.9
	Redfish –	2.4	5.3	7.1	15.6
	Whiting –	2.3	5.1	0.9	2.0
	Dabs –	21.5	47.3	29.3	64.5
	Ling –	17.1	37.6	26.1	57.4
	Total –	135.3	297.6	243.3	535.2
TOW 3	Haddock –	424.0	932.8	494.2	1,087.2
Large cod end	Pollock –	262.7	577.9	364.3	801.5
	Cod –	93.0	204.6	44.8	98.6
	Redfish –	10.4	22.9	6.0	13.2
	Whiting –	4.0	8.8	2.3	5.1
	Dabs –	2.9	6.4	0.3	0.7
	Ling –	0.8	1.8		
	Total –	797.8	1,755.2	911.9	2,006.3
TOW 3	Haddock –	31.1	68.4	47.7	104.9
Cover	Pollock –	39.2	86.2	127.1	279.6
	Cod –	1.2	2.6	1.0	2.4
	Redfish –	21.9	48.2	35.6	78.3
	Whiting –	4.1	9.0		
	Dabs –			2.1	4.6
	Ling –	1.2	2.6	0.5	1.1
	Total –	98.7	217.0	214.0	470.9

Table 5. Catch weight data (continued).

		JOSEPH & LUCIA II		JOSEPH & LUCIA III	
		kg	lb	kg	lb
TOW 4	Haddock -	246.7	542.7	371.3	816.9
Large cod end	Pollock -	237.7	522.9	372.9	820.4
	Cod -	52.8	116.2	179.4	394.7
	Redfish -	7.3	16.1		
	Whiting -		.	0.7	1.5
	Dabs -	3.4	7.5	1.9	4.2
	Total -	547.9	1,205.4	926.2	2,037.7
TOW 5	Haddock -	170.0	374.0	222.3	489.1
Small cod end	Pollock -	74.8	164.6	139.3	306.5
	Cod -	54.4	119.7	35.0	77.0
	Redfish -	95.6	210.3	22.4	49.3
	Whiting -	3.0	6.6		
	Dabs -			13.8	30.4
	Total -	397.8	875.2	432.8	952.3
TOW 6	Haddock -	411.7	905.7	389.4	856.7
Small cod end	Pollock -	30.5	67.1	38.1	83.8
	Cod -	210.3	462.7	119.4	262.7
	Redfish -	3.9	8.6	7.5	16.5
	Whiting -	9.0	19.8	12.6	27.7
	Dabs -	6.1	13.4	8.7	19.1
	Ling -	0.8	1.8	1.0	2.2
	Total -	672.3	1,479.1	576.7	1,268.7
TOW 6	Haddock -	2.2	4.8	2.9	6.4
Cover	Pollock -	0.4	0.9	2.6	5.7
	Redfish -	2.5	5.5	14.8	32.6
	Whiting -	9.1	20.0	11.3	24.9
	Dabs -	0.4	0.9	1.4	3.1
	Ling -	2.1	4.6	0.8	1.8
	Total -	16.7	36.7	33.8	74.5
TOW 7	Haddock -	296.8	653.0	353.0	776.6
Large cod end	Pollock -	77.8	171.2	53.0	116.6
	Cod -	158.5	348.7	48.6	106.9
	Redfish -			1.3	2.9
	Whiting -	2.6	5.7	1.4	3.1
	Dabs -	10.1	22.2	2.8	6.2
	Ling -	2.8	6.2		
	Total -	548.6	1,207.0	460.1	1,012.3

Table 5. Catch weight data (continued).

		JOSEPH & LUCIA II		JOSEPH & LUCIA III	
		kg	lb	kg	lb
TOW 8	Haddock -	317.6	698.7	319.2	702.2
Large cod end	Pollock -	42.3	93.1	42.1	92.6
	Cod -	128.7	283.1	134.3	295.5
	Redfish -	6.2	13.6	13.1	28.8
	Whiting -	4.4	9.7	5.0	11.0
	Dabs -	3.4	7.5	5.0	11.0
	Ling -	2.4	5.3	1.6	3.5
	Total -	505.0	1,111.0	520.3	1,144.6
TOW 8	Haddock -	11.1	24.4	11.0	24.2
Cover	Pollock -	11.2	24.6	1.7	3.7
	Cod -	1.4	3.1	2.3	5.1
	Redfish -	1.4	3.1	1.3	2.9
	Whiting -	3.1	6.8	2.2	4.8
	Dabs -	0.5	1.1	0.2	0.4
	Total -	28.7	63.1	18.7	41.1
		Large cod end		Small cod end	
TOW 9	Haddock -	581.2	1,278.6	569.8	1,253.6
	Pollock -	2.3	5.1	4.8	10.6
	Cod -	183.9	404.6	92.6	203.7
	Redfish -	2.9	6.4	13.2	29.0
	Whiting -	3.1	6.8	5.9	13.0
	Dabs -	5.7	12.5		
	Ling -			2.4	5.3
	Total -	779.1	1,714.0	688.7	1,515.2
		Small cod end		Large cod end	
TOW 10	Haddock -	575.0	1,265.0	527.2	1,159.8
	Pollock -	67.0	147.4	30.8	67.8
	Cod -	68.9	151.6	128.6	282.9
	Redfish -	8.8	19.4		
	Whiting -	20.3	44.7	3.3	7.3
	Dabs -	1.9	4.2	5.7	12.5
	Ling -	2.0	4.4	2.0	4.4
	Total -	743.9	1,636.7	697.6	1,534.7

Table 5. Catch weight data (continued).

		JOSEPH & LUCIA II		JOSEPH & LUCIA III	
		kg	lb	kg	lb
		Large cod end		Small cod end	
TOW 11	Haddock -	181.2	398.6	85.5	188.1
	Pollock -	6.2	13.6		
	Cod -	140.2	308.4	72.7	159.9
	Redfish -	26.4	58.1	75.1	165.2
	Whiting -	0.5	1.1		
	Dabs -	0.7	1.5	1.5	3.3
	Total -	355.2	781.3	234.8	516.5
		Small cod end		Large cod end	
TOW 12	Haddock -	493.1	1,084.8	212.0	466.4
	Pollock -	4.5	9.9	4.7	10.3
	Cod -	119.8	263.6	75.6	166.3
	Redfish -	19.2	42.2	1.5	3.3
	Whiting -	6.1	13.4	0.3	0.7
	Dabs -	3.2	7.0	1.4	3.1
	Ling -	10.9	24.0	3.2	7.0
	Total -	656.8	1,444.9	298.7	657.1

Haddock Selectivity

The tables and graphs in this section represent the data from 24 tows made by both vessels over the 3-day experimental period. The total catch consisted of 4,463 haddock.

Table 6 shows the length frequency distributions of the haddock during the experiment. Looking at the "cod ends and covers" distributions we see that both vessels and both size cod ends sampled the same basic populations. This is further demonstrated in Figure 2.

Reviewing the "cod ends only" distributions we can detect "masking" when comparing the 138-mm covered cod ends to the 138-mm uncovered; a higher percentage of smaller fish were caught in the former.

Selection data for the 107-mm covered cod-end tows are given in Table 7 and the corresponding selection curve, drawn by eye, is shown in Figure 3. The 50% retention length of approximately 34 cm (13.4 inches) gives a selection factor of 3.17.

Selection data for the 138-mm covered cod-end tows are given in Table 8, and the corresponding selection curve is shown in Figure 3. The 50% retention length of approximately 42 cm (16.5 inches) gives a selection factor of 3.04.

Selection data for the 107-mm and 138-mm uncovered tows are given in Table 9. (For a detailed explanation of our methodology refer to Pope et al. 1975.) From this method, a 50% retention length of 48 cm (18.9 inches) is obtained for the 138-mm cod end which gives a selection factor of 3.47.

Figure 4 demonstrates the portion of the available population, represented by the cod-ends-plus-covers curve, that each cod end selects. We can see that very few fish existed below the selection range of the 107-mm cod ends. As expected, the larger cod end caught fewer of the smaller fish.

A review of the length frequency distributions shows that the larger cod end caught more of the larger-size fish than the small cod end. A full discussion of this commonly seen phenomenon will be in the final report of the mesh studies. Table 10 shows the effect of this increased efficiency in higher landings of the large cod end.

Table 6. Length frequency distributions (%)--haddock.

Length interval (cm)	Cod ends and covers					Cod ends only			
	Overall average	107 mm	138 mm	JOSEPH & LUCIA II	JOSEPH & LUCIA III	107 mm covered	107 mm uncovered	138 mm covered	138 mm uncovered
28-30	0.1	0.2		0.1		0.2			
31-33	0.2	0.4	0.1	0.1	0.3	0.0	0.1	0.1	
34-36	0.3	0.6	0.2	0.5	0.1	0.4	0.9	0.0	
37-39	1.2	1.5	1.1	1.6	0.9	0.9	0.9	0.2	
40-42	4.7	5.6	4.2	5.0	4.3	5.3	3.5	2.5	0.6
43-45	5.7	5.9	5.6	6.2	5.2	6.0	6.2	3.9	1.2
46-48	4.5	4.1	4.7	4.5	4.5	4.1	5.9	4.4	2.8
49-51	12.7	13.5	12.2	13.9	11.5	13.6	12.9	12.1	10.7
52-54	26.2	27.2	25.6	24.4	27.7	27.7	26.2	26.7	28.8
55-57	28.2	25.4	29.7	28.4	28.0	25.8	26.9	31.9	34.3
58-60	12.8	11.1	13.7	11.7	13.7	11.3	13.1	14.9	15.8
61-63	2.3	2.6	2.1	2.1	2.4	2.6	2.5	2.3	4.0
64-66	0.6	0.6	0.6	0.5	0.6	0.6	0.9	0.7	0.8
67-69	0.3	0.4	0.3	0.4	0.3	0.4	0.2	0.3	0.1
70-72	0.3	0.7		0.3	0.3	0.8	0.3		0.3
73-75	0.0	0.0		0.0		0.0	0.2		0.3
76-78	0.1	0.4		0.3		0.4	0.1		0.3
79-81									0.0
82-84									0.1
TOTALS	1,547	540	1,007	761	786	531	1,372	915	1,544

Figure 2

VESSEL COMPARISONS – HADDOCK

COD ENDS + COVERS

——— JOSEPH & LUCIA II

----- JOSEPH & LUCIA III

% OF TOTAL CATCH
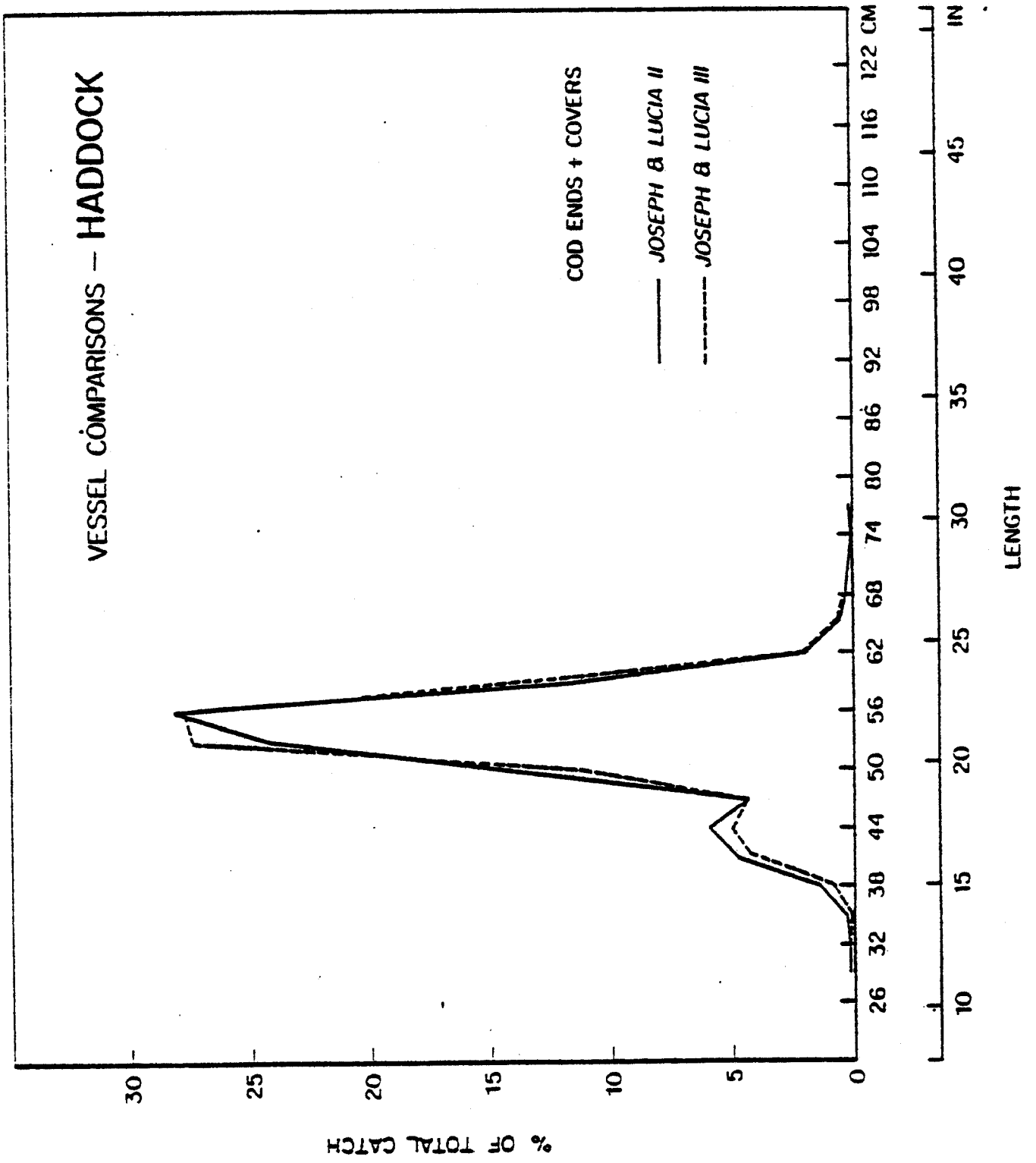
LENGTH

Table 7. Haddock length frequency distributions and percent retained for 107-mm cod end covered tows--both vessels.

Length interval (cm)	Numbers caught		% retained
	107 mm	107 mm plus covers	
28-30	1	1	100.0
31-33	0	2	0.0
34-36	2	3	66.6
37-39	5	8	62.5
40-42	28	30	93.3
43-45	32	32	100.0
46-48	22	22	100.0
49-51	72	73	98.6
52-54	147	147	100.0
55-57	137	137	100.0
58-60	60	60	100.0
61-63	14	14	100.0
64-66	3	3	100.0
67-69	2	2	100.0
70-72	4	4	100.0
73-75	0	0	100.0
76-78	2	2	100.0
TOTALS	531	540	

Table 8. Haddock length frequency distributions and percent retained for 138-mm cod end covered tows--both vessels.

Length interval (cm)	Numbers caught		% retained
	138 mm	138 mm plus covers	
31-33	1	1	100.0
34-36	0	2	0.0
37-39	2	11	18.2
40-42	23	42	54.8
43-45	36	56	64.3
46-48	40	47	85.1
49-51	111	123	90.2
52-54	244	258	94.6
55-57	292	299	97.7
58-60	136	138	98.6
61-63	21	21	100.0
64-66	6	6	100.0
67-69	3	3	100.0
TOTALS	915	1,007	

Table 9. Haddock length frequency distributions and percent retained for the 138-mm uncovered cod end compared with the 107-mm uncovered cod end--both vessels.

Length interval (cm)	Numbers caught		$\frac{B}{A}$	$\frac{B}{1.37A}$ x 100
	(A) 107 mm	(B) 138 mm		
34-36	1	0	0.00	0.0
37-39	13	0	0.00	0.0
40-42	48	10	0.21	15.2
43-45	85	18	0.21	15.5
46-48	81	44	0.54	39.7
49-51	177	165	0.93	68.0
52-54	360	445	1.24	90.2
55-57	369	529	1.43	104.6
58-60	180	244	1.35	98.9
61-63	34	61	1.79	131.0
64-66	12	13	1.08	79.1
67-69	3	2	0.67	48.7
70-72	4	4	1.00	73.0
73-75	3	4	1.34	97.3
76-78	2	0	-	-
79-81	0	1	-	-
TOTALS	1,372	1,544		

(rows 52-54 through 64-66 of the $\frac{B}{A}$ column are braced) Avg. 1.38

$$\sum_{52}^{81} A = 967 \qquad \sum_{52}^{81} B = 1,303 \qquad \frac{B}{A} = 1.35$$

Figure 3

SELECTION CURVES — HADDOCK

% RETENTION

107 MM COVERED
138 MM COVERED
138 MM UNCOVERED

LENGTH

Figure 4

CATCH DISTRIBUTION – HADDOCK

COD ENDS + COVERS
107 MM COD ENDS
138 MM COD ENDS

% OF TOTAL CATCH
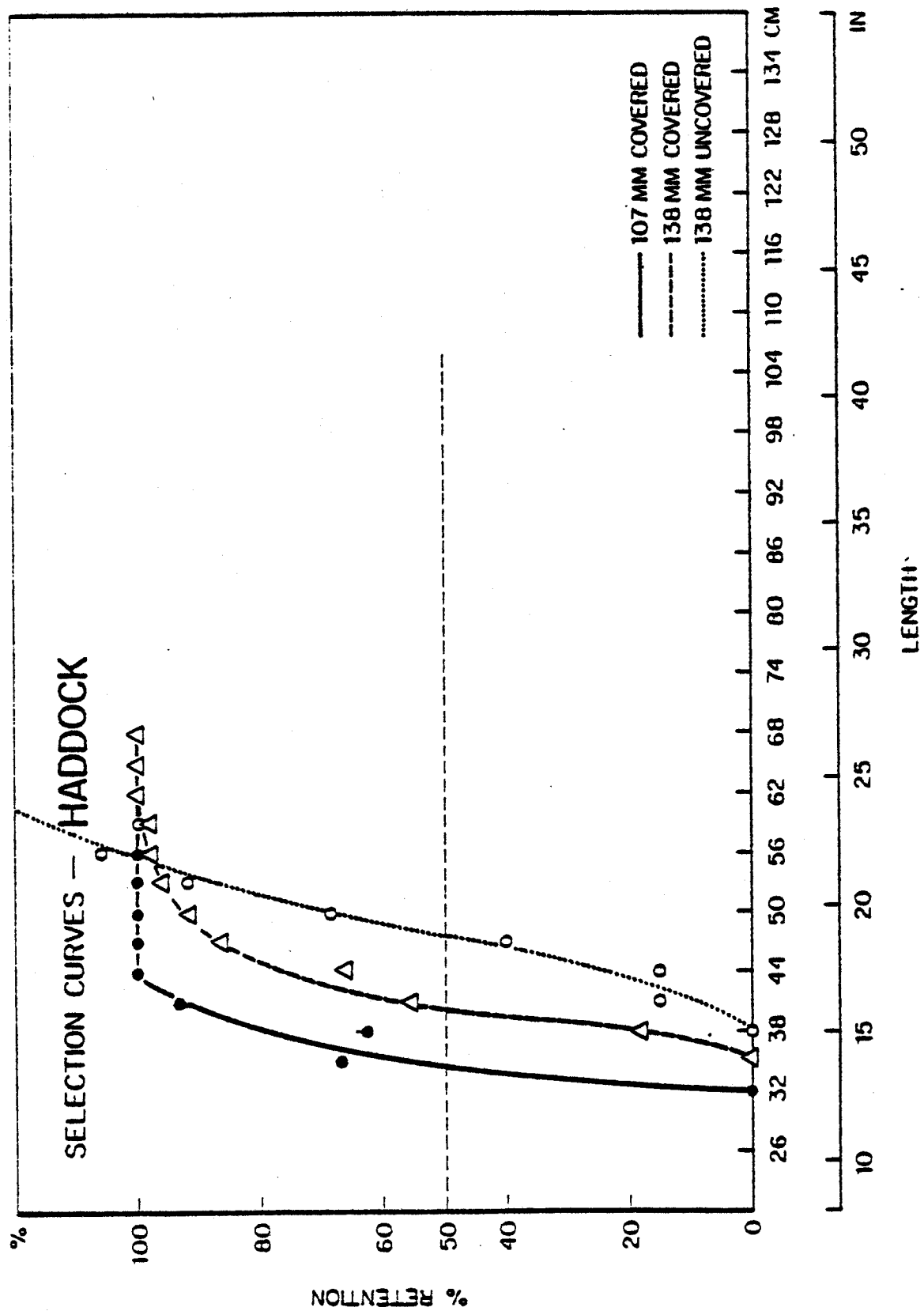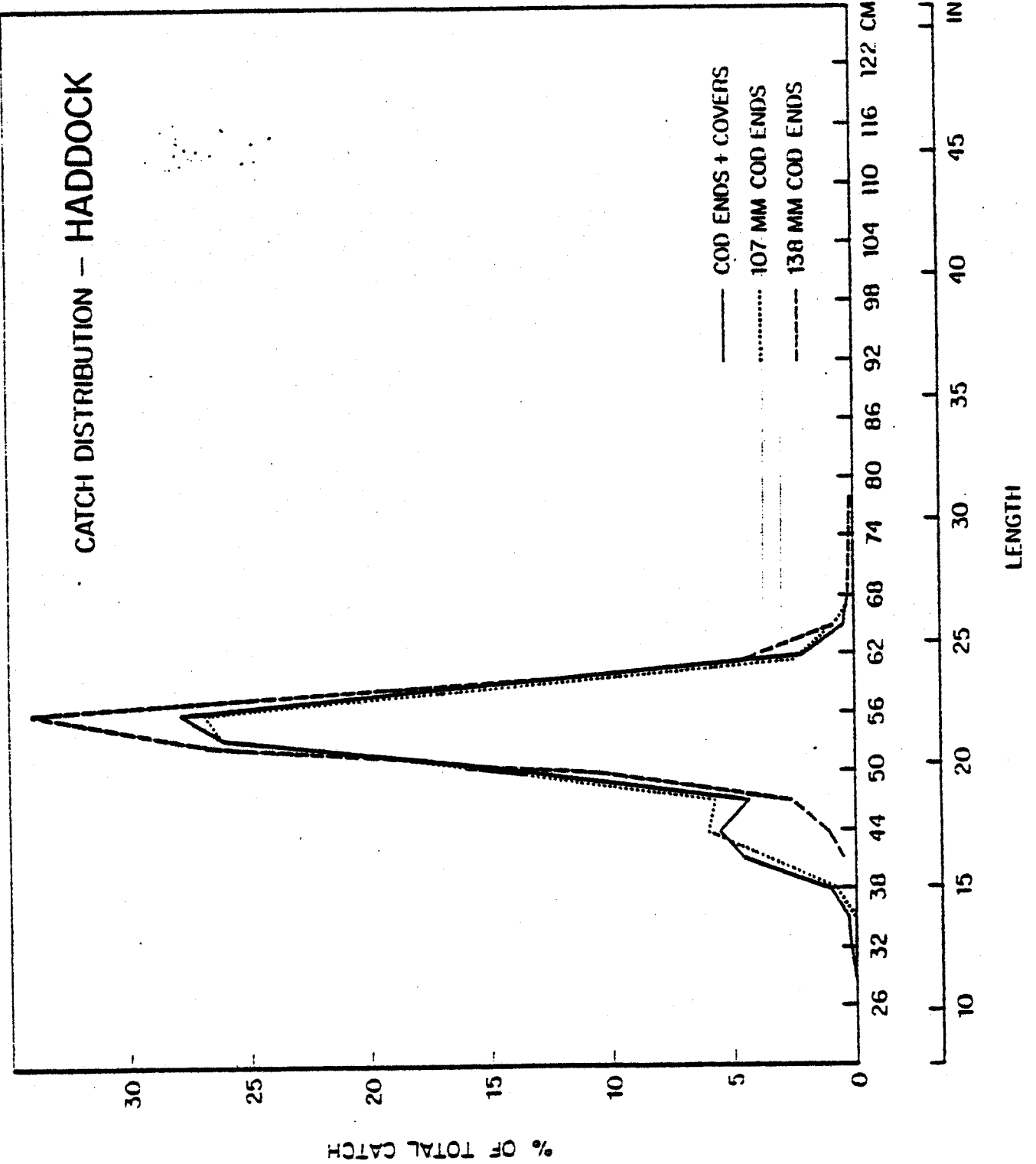
LENGTH

Table 10. Weights of haddock by 3-cm groups.

Length interval (cm)	Kg/fish	Small uncovered No.	Small uncovered Kg	Small covered No.	Small covered Kg	Large uncovered No.	Large uncovered Kg	Large covered No.	Large covered Kg
10-12	0.013								
13-15	0.027								
16-18	0.048								
19-21	0.08								
22-24	0.12								
25-27	0.18								
28-30	0.25			1	0.3				
31-33	0.34			0	0			1	0.3
34-36	0.44	1	0.4	2	0.9			0	0
37-39	0.57	13	7.4	5	2.9			2	1.1
40-42	0.72	48	34.6	28	20.2	10	7.2	23	16.6
43-45	0.90	85	76.5	32	28.8	18	16.2	36	32.4
46-48	1.10	81	89.1	22	24.2	44	48.4	40	44.0
49-51	1.32	177	233.6	72	95.0	165	217.8	111	146.5
52-54	1.58	360	568.8	147	232.3	445	703.1	244	385.5
55-57	1.88	369	693.7	137	257.6	529	994.5	292	549.0
58-60	2.20	180	396.0	60	132.0	244	536.8	136	299.2
61-63	2.56	34	87.0	14	35.8	61	156.2	21	53.8
64-66	2.96	12	35.5	3	8.9	13	38.5	6	17.8
67-69	3.40	3	10.2	2	6.8	2	6.8	3	10.2
70-72	3.88	4	15.5	4	15.5	4	15.5		
73-75	4.41	3	13.2	0	0	4	17.6		
76-78	4.98	2	10.0	2	10.0	4	19.9		
79-81	5.60					0	0		
82-84	6.27					1	6.3		
85-87	6.99								
88-90	7.77								
		1,372	2,271.5	531	871.2	1,544	2,784.8	915	1,556.4
Total weight -			2,271.5		871.2		2,784.8		1,556.4
Landings (discard <52) -			1,829.9		698.9		2,495.2		1,315.5
% discard -			19.4		19.8		10.4		15.5

Cod Selectivity

During the experiment we caught 686 cod. As seen in Table 11 the cod were spread out over a large range of sizes. The lack of small cod made it impossible for us to perform a covered-tow analysis.

Figure 5 shows that both vessels sampled the same population. Using the alternate-tow method we calculated a 50% retention length of 55 cm (21.7 inches) for the 138-mm uncovered cod end which gives a selection factor of 4.0 (Table 12 and Figure 6).

The small amount of data coupled with the lack of small fish in the selection range of the small cod end probably make the above selection data invalid. Figure 7 shows that without the small fish present both size cod ends appear to fish the same.

Table 11. Length frequency distributions (%)--cod.

Length interval (cm)	Cod ends and covers					Cod ends only			
	Overall average	107 mm	138 mm	JOSEPH & LUCIA II	JOSEPH & LUCIA III	107 mm covered	107 mm uncovered	138 mm covered	138 mm uncovered
40-42	0.4	0.7			0.9	0.7			
43-45	0.0	0.0			0.0	0.0			
46-48	0.4	0.0	1.1		0.9	0.0	1.2		
49-51	3.1	4.3	1.1	3.4	2.7	4.3	5.3		2.1
52-54	4.4	5.0	3.4	5.1	3.6	5.1	10.5	2.3	3.8
55-57	8.8	9.4	7.8	9.3	8.2	8.7	8.8	8.1	10.1
58-60	13.6	12.2	15.7	15.3	11.8	12.3	16.4	16.2	12.9
61-63	9.6	9.4	10.1	8.5	10.9	9.4	14.0	10.5	14.6
64-66	8.3	9.4	6.7	7.6	9.1	9.4	11.1	7.0	14.6
67-69	9.6	7.9	12.4	11.9	7.3	9.4	8.2	12.8	13.9
70-72	5.3	4.3	6.7	3.4	7.3	8.0	5.8	7.0	6.3
73-75	5.7	7.2	3.4	5.1	6.4	4.3	5.3	3.5	4.2
76-78	3.1	4.3	1.1	0.0	6.4	7.2	2.9	1.2	2.8
79-81	1.3	1.4	1.1	0.8	1.8	4.3	0.6	1.2	2.4
82-84	3.1	2.2	4.5	2.5	3.6	1.4	2.3	4.7	2.4
85-87	2.6	2.9	2.2	3.4	1.8	2.2	0.6	2.3	1.4
88-90	2.2	2.2	2.2	3.4	0.9	2.9	2.3	2.3	1.7
91-93	2.2	2.9	1.1	2.5	1.8	2.2	2.3	1.2	1.4
94-96	3.1	0.7	6.7	4.2	1.8	2.9	1.2	7.0	1.7
97-99	2.2	3.6	0.0	3.4	0.9	0.7	0.6	0.0	0.0
100-102	3.9	2.9	5.6	2.5	5.5	3.6		5.8	1.4
103-105	3.9	4.3	3.4	4.2	3.6	2.9		3.5	0.0
106-108	1.3	0.7	2.2	1.7	0.9	4.3		2.3	0.7
109-111	0.9	0.7	1.1	0.8	0.9	0.7		1.2	0.7
112-114									0.3
115-117	0.4	0.7			0.9	0.7			
118-120									
121-123				0.8			0.6		
124-126	0.4	0.7				0.7			0.3
TOTALS	228	139	89	118	110	138	171	86	287

Figure 5

VESSEL COMPARISONS — COD

COD ENDS + COVERS

——— JOSEPH & LUCIA II

----- JOSEPH & LUCIA III

% OF TOTAL CATCH
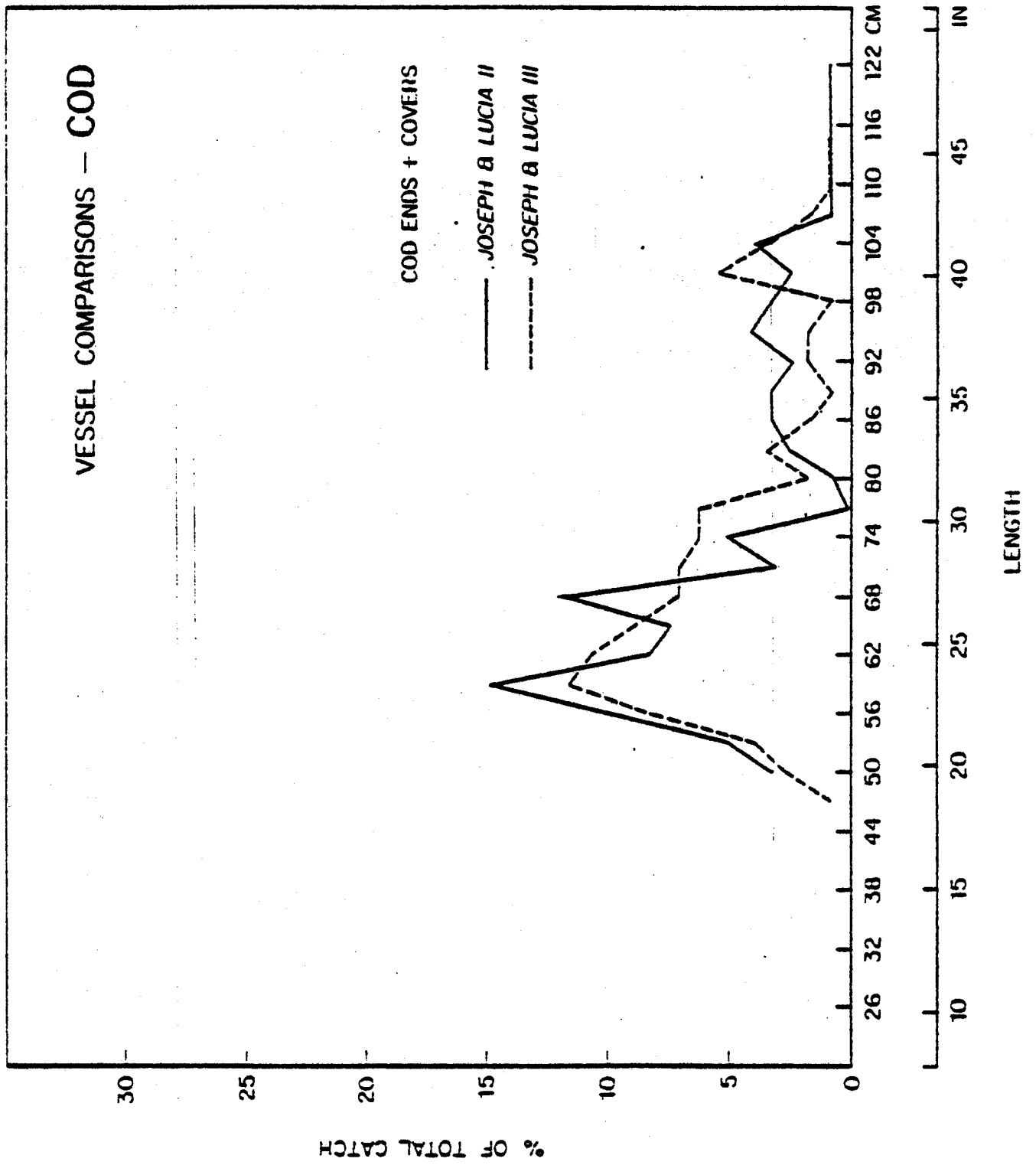
LENGTH

Table 12. Cod length frequency distributions and percent retained for the 138-mm uncovered cod end compared with the 107-mm uncovered cod end--both vessels.

Length interval (cm)	Numbers caught (A) 107 mm	Numbers caught (B) 138 mm	$\frac{B}{A}$	$\frac{B}{1.87A} \times 100$
46-48	2	0	0.00	0.0
49-51	9	6	0.66	35.6
52-54	18	11	0.61	32.7
55-57	15	29	1.93	103.4
58-60	28	37	1.32	70.7
61-63	24	42	1.75	93.6
64-66	19	42	2.21	118.2
67-69	14	40	2.85	152.8
70-72	10	18	1.80	96.3
73-75	9	12	1.33	71.3
76-78	5	8	1.60	85.6
79-81	1	7	7.00	374.0
82-84	4	7	1.75	93.6
85-87	1	4	4.00	213.9
88-90	4	5	1.25	66.8
91-93	4	4		
94-96	2	5		
97-99	1	0		
100-102	0	4		
103-105	0	0		
106-108	0	2		
109-111	0	2		
112-114	0	1		
115-117	0	0		
118-120	0	0		
121-123	1	1		
124-126	0	0		
TOTALS	171	287		

Avg. 1.84 (bracket spanning 55-57 through 76-78)

$$\frac{123}{55} \quad \Sigma A = 142 \qquad \frac{123}{55} \quad \Sigma B = 270 \qquad \frac{B}{A} = 1.90$$

Figure 6

SELECTION CURVE – COD

138 MM UNCOVERED

Figure 7

CATCH DISTRIBUTION — COD

COD ENDS + COVERS
107 MM COD ENDS
138 MM COD ENDS
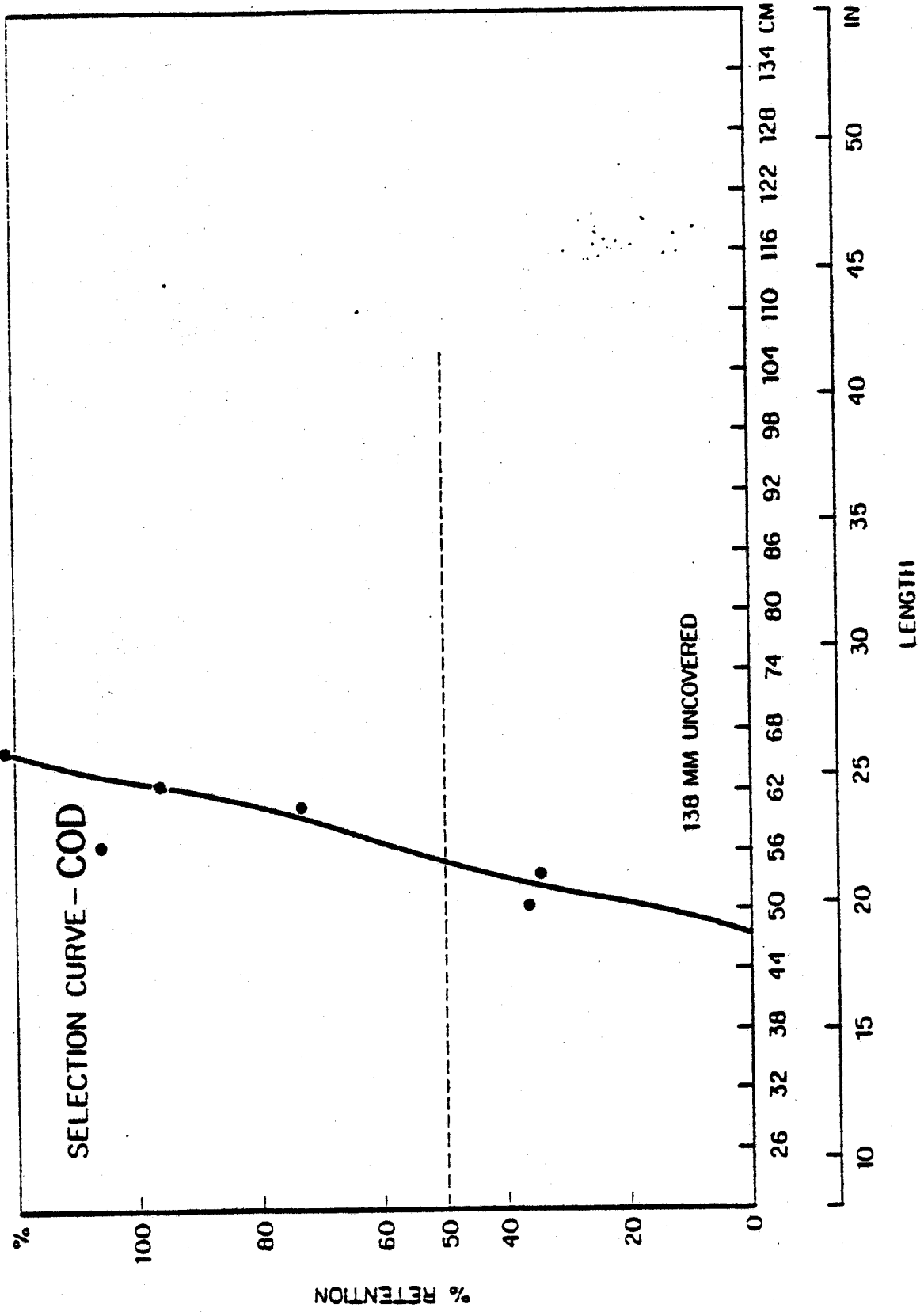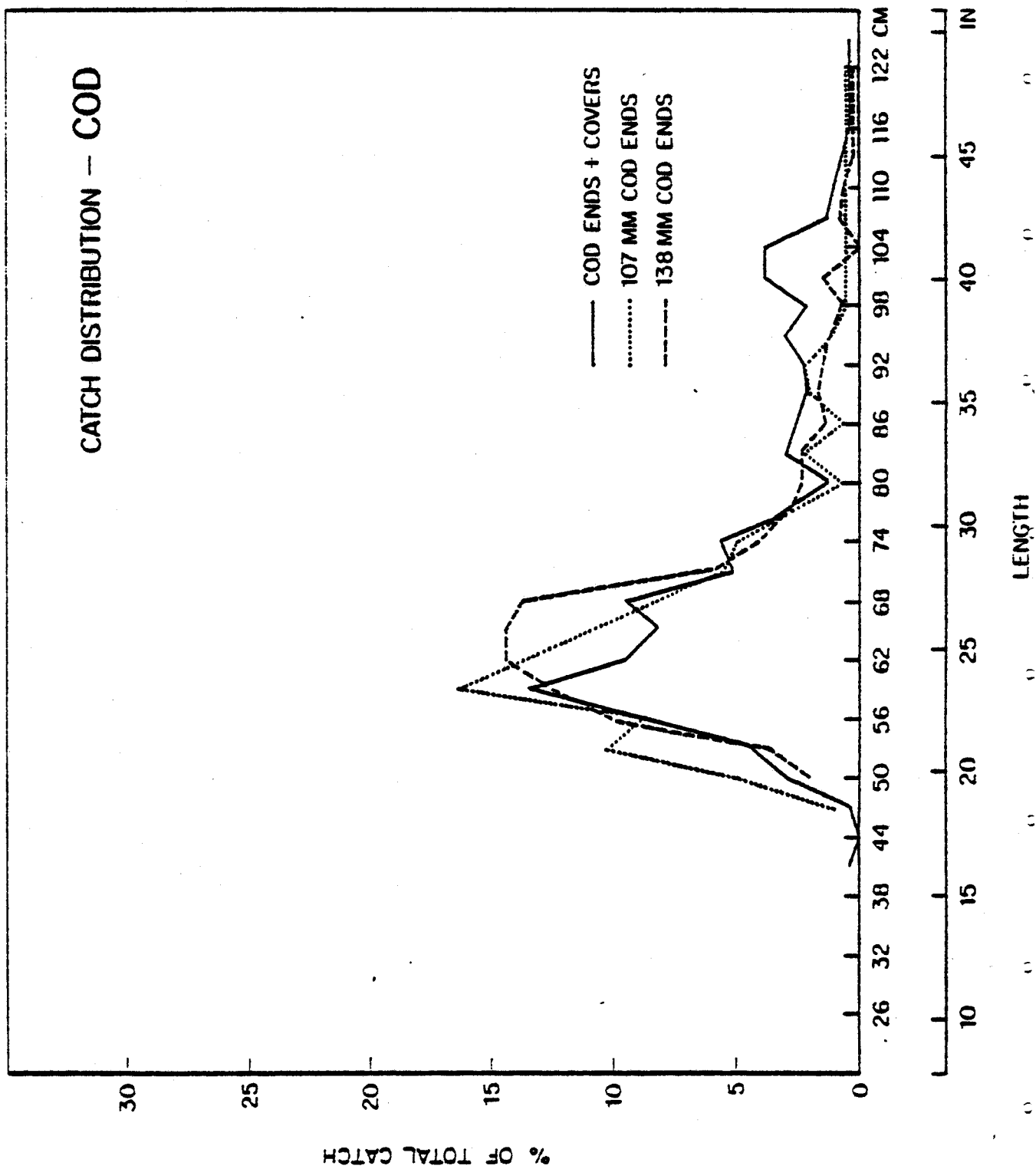
Pollock Selectivity

During the experiment we caught 1,118 pollock. (It should be noted that at night in the same area we made catches of 14,000 lb in 2-3-hr tows.) Table 13 and Figure 8 indicate both vessels fished the same basic population distribution.

We were not able to use the covered-tow method to determine the selection of the small cod end due to lack of small fish.

Selection data for the 138-mm covered cod-end tows are given in Table 14 and Figure 9. The 50% retention length of about 45 cm (17.7 inches) gives a selection factor of 3.26.

Selection data for the 107-mm and 138-mm uncovered tows are given in Table 15 and Figure 9. A 50% retention length of 46 cm (18.1 inches) is obtained for the 138-mm cod end which gives a selection factor of 3.33.

It is interesting to note that the same large covered tows showed a definite masking effect in regard to haddock but it did not show up for pollock. Figure 10 shows the larger cod end catching fewer small fish.

Table 13. Length frequency distributions (%)--pollock.

Length interval (cm)	Cod ends and covers					Cod ends only			
	Overall average	107 mm	138 mm	JOSEPH & LUCIA II	JOSEPH & LUCIA III	107 mm covered	107 mm uncovered	138 mm covered	138 mm uncovered
28-30	0.2	1.7		0.4		1.9			
31-33	0.2	1.7		0.4		0.0			
34-36	0.0	0.0		0.0		0.0			
37-39	0.7	3.4	0.4	0.4	0.9	1.9	0.6	0.3	0.3
40-42	2.1	1.7	2.2	2.2	2.1	1.9	3.0	4.6	1.8
43-45	7.3	6.9	7.3	7.1	7.4	7.4	7.9	13.0	8.7
46-48	16.5	10.3	17.2	12.1	19.4	9.3	14.0	21.1	23.3
49-51	22.5	20.7	22.7	20.5	23.8	20.4	24.4	17.3	20.0
52-54	15.4	6.9	16.4	19.6	12.6	7.4	12.8	11.4	20.0
55-57	9.9	10.3	9.9	15.2	6.5	11.1	12.8	12.7	9.7
58-60	8.9	3.4	9.5	9.4	8.5	3.7	9.1	6.5	6.2
61-63	5.3	10.3	4.7	2.7	7.1	11.1	2.4	7.6	3.8
64-66	5.1	1.7	5.5	3.1	6.5	1.9	3.0	4.1	1.3
67-69	2.8	1.7	3.0	1.3	3.8	1.9	2.4	0.5	1.3
70-72	0.7	3.4	0.4	1.3	0.3	3.7	1.2	0.5	0.3
73-75	0.7	3.4	0.4	1.8	0.0	3.7	1.2	0.0	1.0
76-78	0.5	5.2	0.0	0.9	0.3	5.6	0.6	0.3	0.8
79-81	0.4	1.7	0.2	0.4	0.3	1.9	0.6	0.0	0.8
82-84	0.2	1.7	0.0	0.0	0.3	1.9	0.6	0.3	0.0
85-87	0.2	0.0	0.2	0.4	0.0	0.0	0.6		0.0
88-90	0.0	0.0		0.0	0.0	0.0	1.2		0.8
91-93	0.0	0.0		0.0	0.0	0.0			
94-96	0.4	3.4		0.4	0.3	3.7			
TOTALS	564	58	506	224	340	54	164	370	390

Figure 8

VESSEL COMPARISONS — POLLOCK

COD ENDS + COVERS

——————— JOSEPH & LUCIA II

- - - - - - - JOSEPH & LUCIA III

% OF TOTAL CATCH
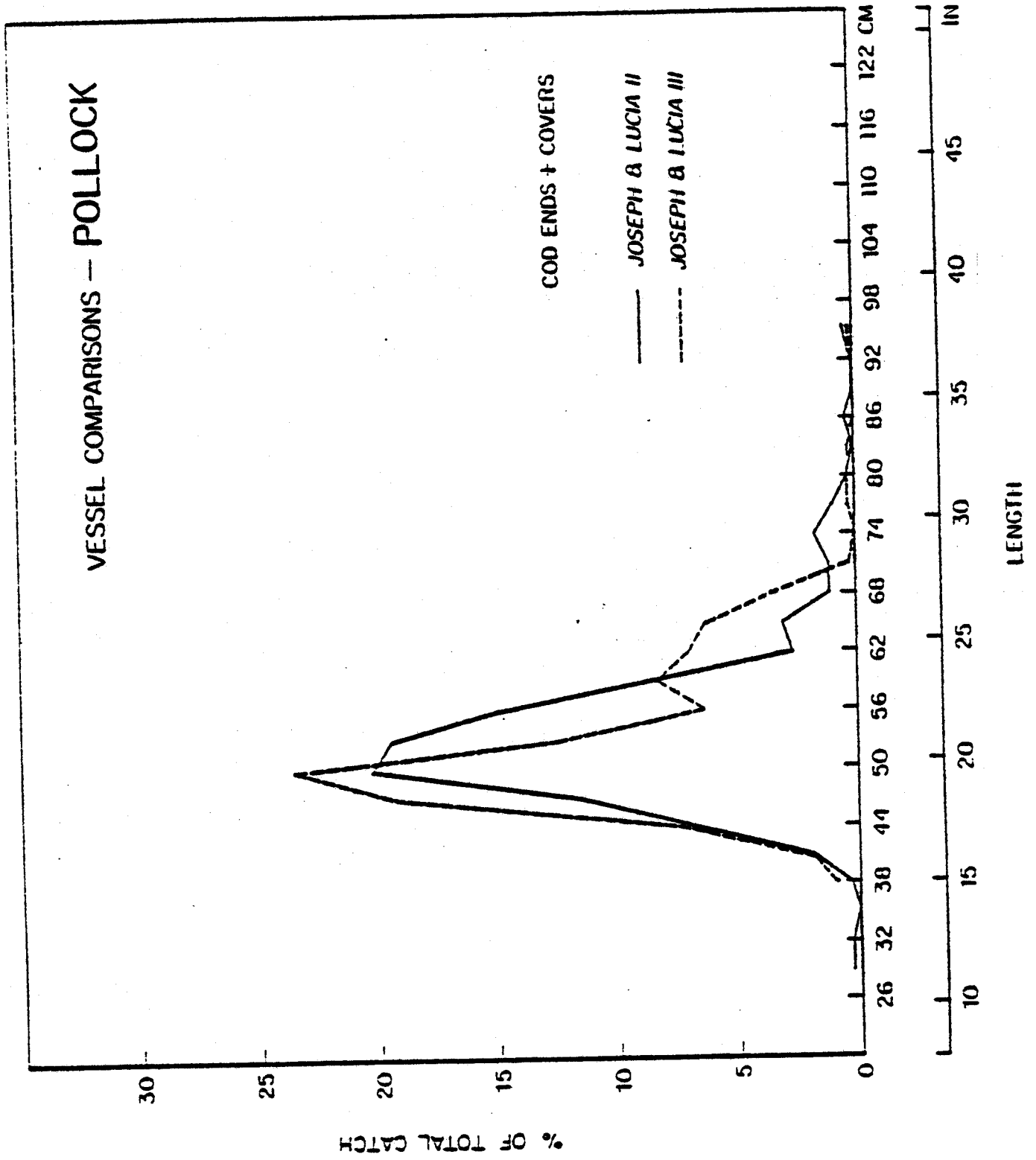
LENGTH

Table 14. Pollock length frequency distributions and percent retained for 138-mm cod end covered tows--both vessels.

Length interval (cm)	Numbers caught		% retained
	138 mm	138 mm plus covers	
37-39	0	2	0.0
40-42	1	11	9.1
43-45	17	37	45.9
46-48	48	87	55.2
49-51	78	115	67.8
52-54	64	83	77.1
55-57	42	50	84.0
58-60	47	48	97.9
61-63	24	24	100.0
64-66	28	28	100.0
67-69	15	15	100.0
70-72	2	2	100.0
73-75	2	2	100.0
76-78	0	0	100.0
79-81	1	1	100.0
82-84	0	0	100.0
85-87	1	1	100.0
TOTALS	370	506	

Table 15. Haddock length frequency distributions and percent retained for the 138-mm uncovered cod end compared with the 107-mm uncovered cod end--both vessels.

Length interval (cm)	Numbers caught (A) 107 mm	(B) 138 mm	$\frac{B}{A}$	$\frac{B}{2.9A} \times 100$
37-39	1	0	0.00	0.0
40-42	5	1	0.20	6.9
43-45	13	7	0.54	18.6
46-48	23	34	1.48	51.0
49-51	40	91	2.28	78.4
52-54	21	78	3.71	128.1
55-57	21	78	3.71	128.1
58-60	15	38	2.53	87.4
61-63	4	24	6.00	206.9
64-66	5	15	3.00	103.4
67-69	4	5	1.25	43.1
70-72	2	5	2.50	86.2
73-75	2	1	0.50	17.2
76-78	1	4	4.00	137.9
79-81	1	3	3.00	103.4
82-84	1	3	3.00	103.4
85-87	1	0	-	
88-90	2	0	-	
91-93	0	3	-	
94-96	0	0	-	
97-99	0	0	-	
100-102	2	0	-	
TOTALS	164	390		

Avg. 2.94 (bracketing intervals 46-48 through 70-72)

$$\frac{102}{\Sigma A} = 122 \qquad \frac{102}{\Sigma B} = 348 \qquad \frac{B}{A} = 2.85$$
$$49 \qquad\qquad\qquad 49$$

Figure 9

SELECTION CURVES — POLLOCK

138 MM COVERED
138 MM UNCOVERED

% RETENTION

%
100
80
60
50
40
20
0

LENGTH

26 32 38 44 50 56 62 68 74 80 86 92 98 104 110 116 122 128 134 CM

10   15   20   25   30   35   40   45   50   IN

Figure 10

CATCH DISTRIBUTION — POLLOCK

COD ENDS + COVERS
107 MM COD ENDS
138 MM COD ENDS

% OF TOTAL CATCH

LENGTH

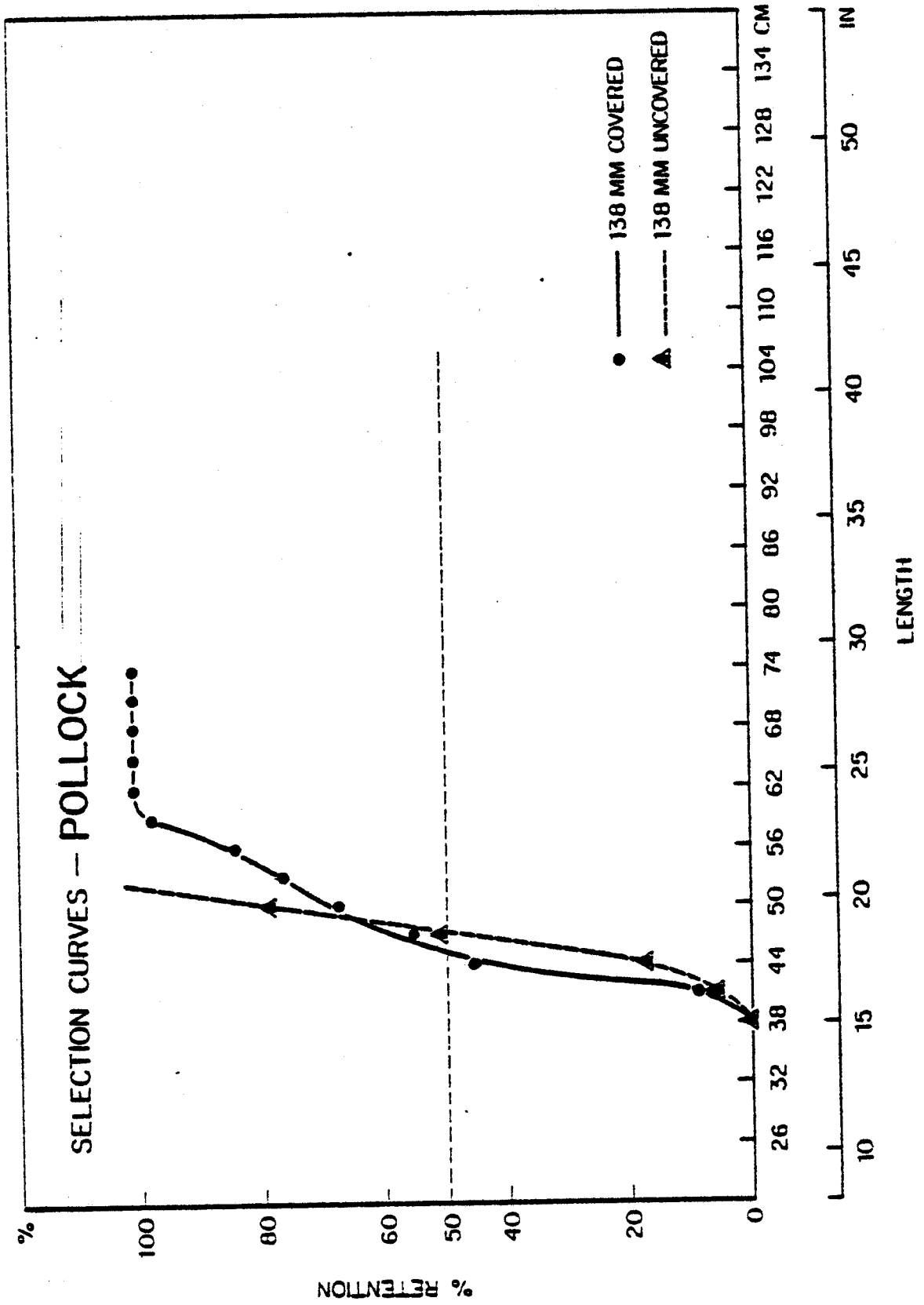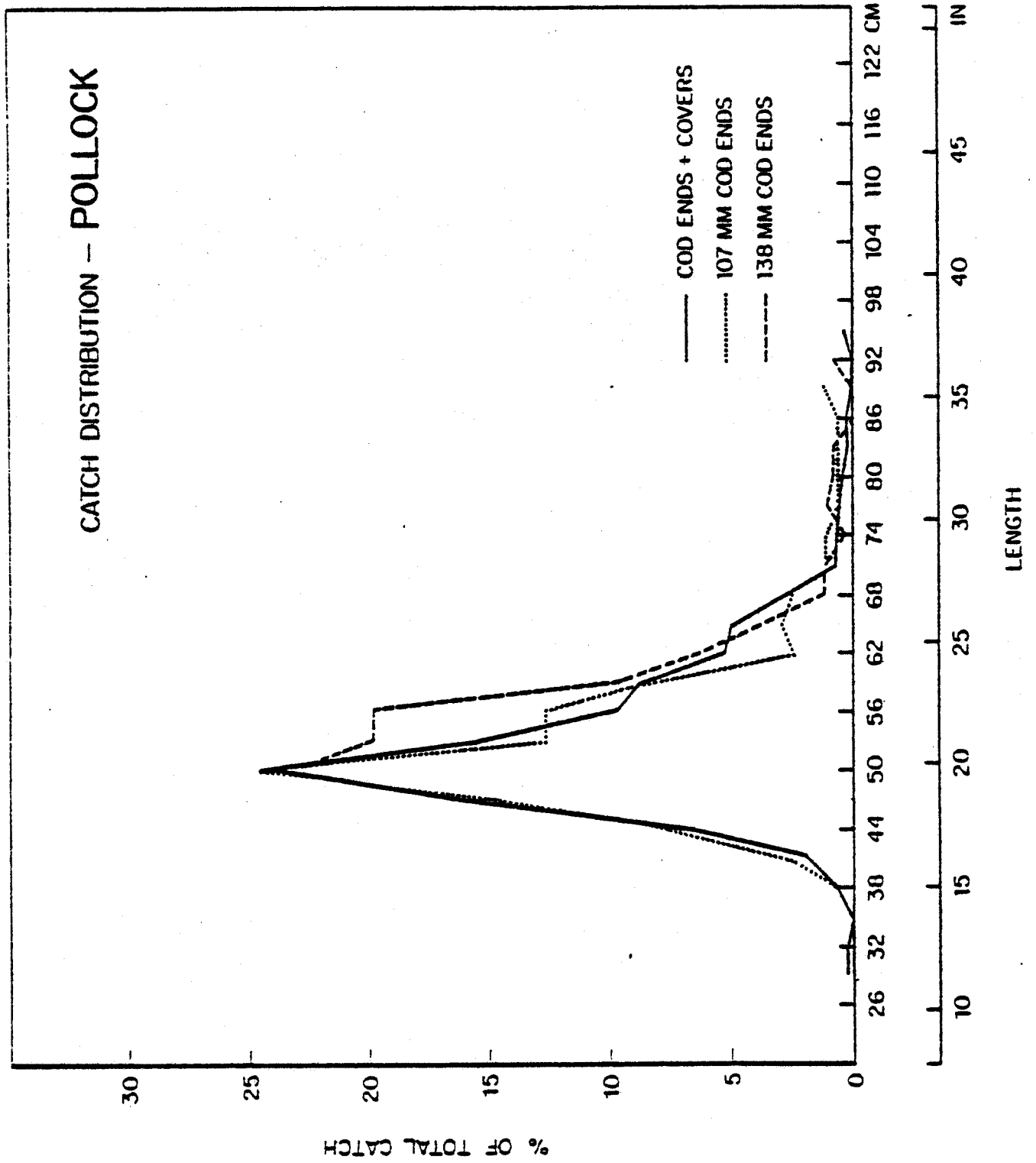## Length Frequency Distributions of Other Species

Tables 16 through 19 show the length frequency distributions of four other commercial species caught during the experiment. Lack of data prevented us from performing any sort of selectivity analysis.

Table 16. Length frequency distributions (%)--whiting.

Length interval (cm)	Cod ends and covers					Cod ends only			
	Overall average	107 mm	138 mm	JOSEPH & LUCIA II	JOSEPH & LUCIA III	107 mm covered	107 mm uncovered	138 mm covered	138 mm uncovered
28-30	5.0	6.2	2.6	6.3	3.6	6.8	1.0	2.2	
31-33	17.1	17.2	16.9	15.2	19.1	13.5	11.8	8.9	3.1
34-36	40.5	40.7	40.3	39.3	41.8	39.2	21.6	40.0	46.9
37-39	21.2	22.1	19.5	23.2	19.1	24.3	32.4	20.0	21.9
40-42	10.8	8.3	15.6	9.8	11.8	9.5	18.6	20.0	18.8
43-45	3.6	3.4	3.9	4.5	2.7	2.7	9.8	6.7	3.1
46-48	0.9	1.4	0.0	0.0	1.8	2.7	2.0	0.0	3.1
49-51	0.9	0.7	1.3	1.8		1.4	2.9		0.0
52-54								2.2	3.1
TOTALS	222	145	77	112	110	74	102	45	32

Table 17. Length frequency distributions (%)--redfish.

Length interval (cm)	Cod ends and covers					Cod ends only			
	Overall average	107 mm	138 mm	JOSEPH & LUCIA II	JOSEPH & LUCIA III	107 mm covered	107 mm uncovered	138 mm covered	138 mm uncovered
19-21	2.1	3.9	1.5		3.1				
22-24	11.8	10.8	12.1	3.3	15.7	6.8	0.4	5.9	
25-27	31.8	33.3	31.3	31.7	31.9	27.3	7.3	20.0	4.5
28-30	30.5	25.5	32.4	29.2	31.1	20.5	22.5	34.1	21.2
31-33	12.6	11.8	12.9	15.0	11.4	13.6	23.8	22.4	9.1
34-36	9.4	12.7	8.1	15.8	6.3	27.3	34.2	14.1	40.9
37-39	1.9	2.0	1.8	5.0	0.4	4.5	11.7	3.5	24.2
TOTALS	374	102	272	120	254	44	453	85	66

Table 18. Length frequency distributions (%)--American plaice (dabs).

Length interval (cm)	Overall average	Cod ends and covers				Cod ends only			
		107 mm	138 mm	JOSEPH & LUCIA II	JOSEPH & LUCIA III	107 mm covered	107 mm uncovered	138 mm covered	138 mm uncovered
16-18	0.6		2.4		1.3		1.1		
19-21	5.8	5.2	7.3	3.8	7.7	1.1	0.0		
22-24	7.1	5.2	12.2	6.4	7.7	1.1	1.1		
25-27	10.9	9.6	14.6	7.7	14.1	5.3	4.4	9.1	
28-30	16.0	16.5	14.6	12.8	19.2	15.8	13.2	13.6	9.8
31-33	12.2	8.7	22.0	14.1	10.3	10.5	9.9	27.3	12.2
34-36	16.7	19.1	9.8	19.2	14.1	23.2	14.3	18.2	14.6
37-39	9.6	10.4	7.3	10.3	9.0	12.6	12.1	13.6	17.1
40-42	5.1	6.1	2.4	3.8	6.4	7.4	12.1	4.5	14.6
43-45	3.2	4.3	0.0	2.6	3.8	5.3	5.5	0.0	9.8
46-48	3.2	3.5	2.4	6.4	0.0	4.2	8.8	4.5	7.3
49-51	3.2	4.3	0.0	3.8	2.6	5.3	3.3	0.0	0.0
52-54	1.3	0.9	2.4	2.6	0.0	1.1	4.4	4.5	9.8
55-57	1.3	1.7	0.0	1.3	1.3	2.1	3.3	0.0	0.0
58-60	1.3	0.9	2.4	1.3	1.3	1.1	4.4	4.5	2.4
61-63	1.9	2.6		2.6	1.3	3.2	1.1		2.4
64-66	0.6	0.9		1.3	0.0	1.1	1.1		
TOTALS	156	115	41	78	78	95	91	22	41

Table 19. Length frequency distributions (%)--lings (white and red hakes).

Length interval (cm)	Cod ends and covers					Cod ends only			
	Overall average	107 mm	138 mm	JOSEPH & LUCIA II	JOSEPH & LUCIA III	107 mm covered	107 mm uncovered	138 mm covered	138 mm uncovered
19-21	1.2	1.3		1.5					
22-24	1.2	1.3		1.5					
25-27	0.0	0.0		0.0					
28-30	8.1	9.3		7.7					
31-33	17.4	20.0		20.0	9.5	4.4			
34-36	17.4	17.3	18.2	15.4	9.5	15.6	9.1	14.3	
37-39	17.4	18.7	9.1	20.0	23.8	13.3	3.0	0.0	
40-42	15.1	13.3	27.3	15.4	9.5	20.0	9.1	14.3	
43-45	12.8	12.0	18.2	10.8	14.3	17.8	18.2	28.6	
46-48	5.8	5.3	9.1	6.2	19.0	17.8	18.2	14.3	
49-51	3.5	1.3	18.2	1.5	4.8	8.9	6.1	28.6	
52-54					9.5	2.2	6.1	0.0	
55-57							15.2		
58-60							0.0		
61-63							0.0		33.3
64-66							0.0		0.0
67-69							3.0		0.0
70-72							3.0		33.3
73-75							0.0		33.3
76-78							0.0		
79-81							0.0		
82-84							0.0		
85-87							3.0		
88-90							0.0		
91-93							0.0		
94-96							0.0		
97-99							0.0		
100-102							3.0		
103-105							0.0		
114							3.0		
TOTALS	86	75	11	65	21	45	33	7	3

Appendix Table A. Weights (kg) of fish by 3-cm groups.

Length interval (cm)	Haddock	Pollock	Cod	Redfish	Whiting	Dabs	Ling
10-12	0.01		0.03		0.05	0.04	
13-15	0.03		0.04		0.05	0.04	
16-18	0.05	0.05	0.04		0.05	0.05	
19-21	0.08	0.09	0.04	0.02	0.07	0.07	0.05
22-24	0.12	0.14	0.09	0.16	0.09	0.09	0.09
25-27	0.18	0.18	0.13	0.27	0.13	0.14	0.14
28-30	0.25	0.25	0.22	0.36	0.16	0.23	0.18
31-33	0.34	0.36	0.34	0.50	0.22	0.27	0.23
34-36	0.44	0.50	0.45	0.65	0.27	0.32	0.32
37-39	0.57	0.63	0.58	0.81	0.36	0.50	0.36
40-42	0.72	0.81	0.67	1.04	0.45	0.68	0.50
43-45	0.90	0.99	0.85	1.26	0.54	0.86	0.63
46-48	1.10	1.22	1.03	1.53	0.68	1.14	0.77
49-51	1.32	1.40	1.21	1.89	0.81	1.40	0.99
52-54	1.58	1.71	1.44		0.99	1.80	1.17
55-57	1.88	1.98	1.71		1.22	2.20	1.44
58-60	2.20	2.34	2.07		1.40	2.70	1.71
61-63	2.56	2.61	2.30		1.62	2.90	1.98
64-66	2.96	2.79	2.66		1.85	2.93	2.25
67-69	3.40	3.42	3.02		2.12		2.57
70-72	3.88	4.50	3.38				2.84
73-75	4.41	4.55	4.10				3.24
76-78	4.98	4.59	4.50				3.51
79-81	5.60	5.85	5.40				4.95
82-84	6.27	6.75	5.90				5.40
85-87	6.99	7.20	6.30				5.85
88-90	7.77	8.10	7.20				6.30
91-93		9.00	7.70				6.75
94-96		9.90	8.60				7.65
97-99		10.80	9.90				8.55
100-102		11.70	10.80				9.45
103-105			11.70				10.80
106-108			12.60				11.70
109-111			13.50				13.50
112-114			14.40				14.90
115-117			16.20				
118-120			17.60				
121-123			19.40				
124-126			21.20				

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