New England Mesh Selectivity Studies

Experiment Four

Offshore Groundfish

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Abstract

This is the preliminary report of results of the tests conducted from the fishing vessels VALKYRIE and GEN. GEORGE S. PATTON. The tests were conducted on October 8-11, 1978, in the waters east of Nantucket Shoals.

Personnel

VALKYRIE

Lars Sovik	- Captain/Chief of Party
Otelius Storoy	- Mate
Arthur Souza	- Cook
Stanly Sivertsen	- Engineer
Oli Larsen	- Fisherman
Joseph Porier	- Fisherman
Tor Ruben	- Fisherman
Ronald Smolowitz	- Scientific Advisor (NMFS)
Bradford Haskell	- Scientific Advisor (NMFS)

PATTON

Peter Jacobsen	- Captain/Chief of Party
Kaare Hemnes	- Mate
Joseph Bergeron	- Cook
Kristopher Birkeland	- Engineer
Ingolv Josange	- Fisherman
Oivind Ulland	- Fisherman
George Bell	- Scientific Advisor (NMFS)
Robert Boeri	- Scientific Advisor (NMFS)

Data Processing

Cathy Rearden	- Fishery Biologist (NMFS)

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Introduction

This experiment was the last 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 experiments of this series. An explanation of the method and results of those tests can be found in Woods Hole Laboratory Reference Nos. 78-12, 78-24, and 78-48.

Cod Ends

The small cod ends used in this experiment were the same ones used in the previous experiments. The large cod ends were the same ones used in the third experiment but had decreased, by shrinkage, in mesh size.

Study Area

The study area was jointly chosen by the captains of the two vessels. It was just east of Nantucket Shoals in the traffic lane to Boston Harbor, an area commonly called the "half-moon."

Gear

The trawls and associated rigging for the experiment were chosen by the individual captains and were basically #41 Yankee trawls with heavy (hard-bottom roller gear. Detailed information is presented in Tables 1 and 2 and in Figure 1. The covers used were newly constructed of polypropylene mesh.

Procedures

The experiment consisted of four four-tow series by each vessel. The four-tow series was chosen to minimize cod-end changes during the experiment and thus consisted of the following:

Day 1	Day 2	Day 3	Day 4
Sm mesh	Lg mesh w/cover	Sm mesh w/cover	Lg mesh
Sm mesh w/cover	Lg mesh	Sm mesh	Lg mesh w/cover
Lg mesh	Sm mesh w/cover	Lg mesh w/cover	Sm mesh
Lg mesh w/cover	Sm mesh	Lg mesh	Sm mesh w/cover

Both vessels towed in the same order, usually within a kilometer of each other. Vessel speed was maintained at 3.0-3.5 knots. The tows were conducted during daylight hours only.

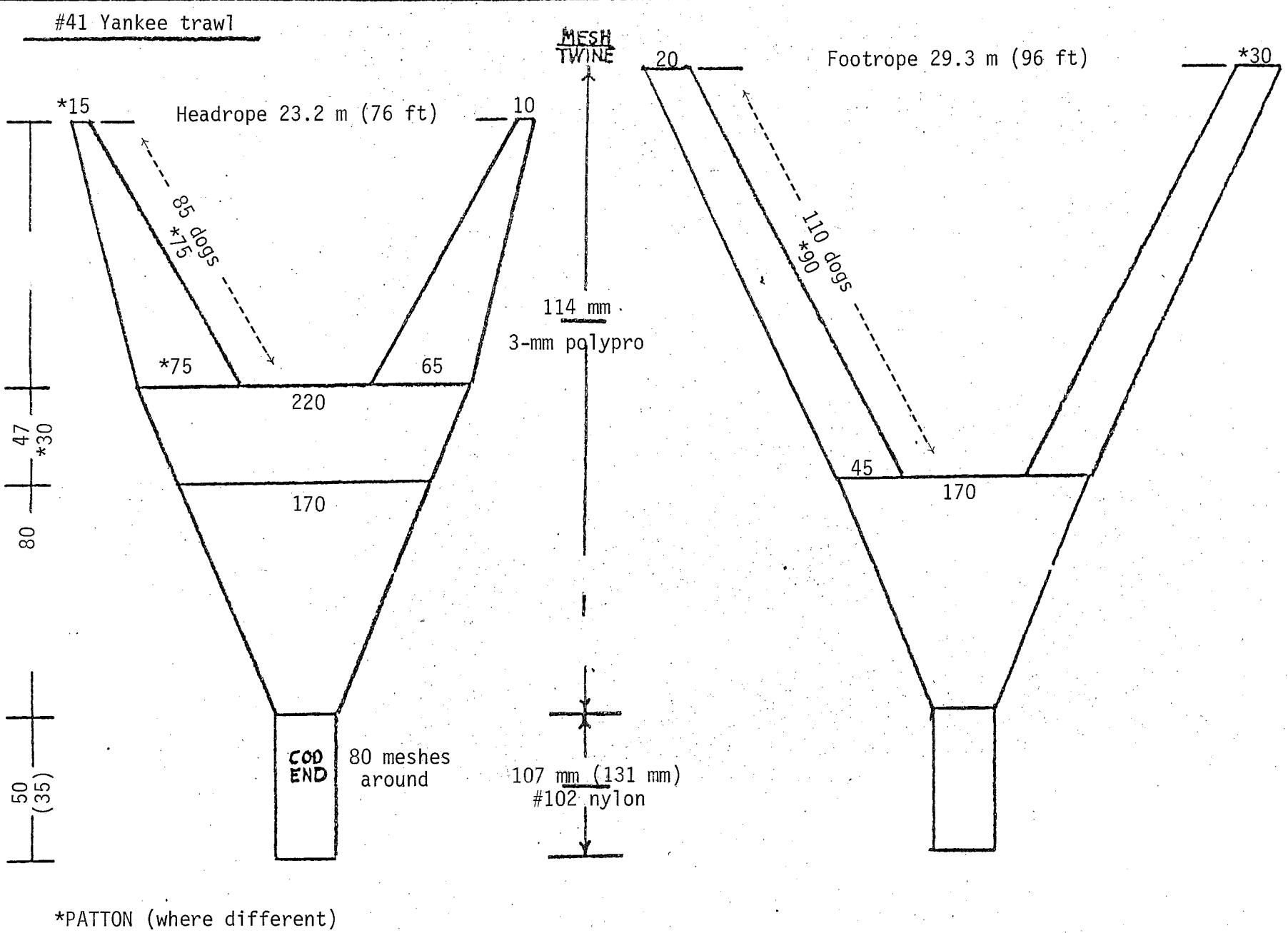
Table 1. Vessel specifications.

Item	VALKYRIE	PATTON
Type vessel	Stern drum trawler	
Home port	New Bedford, Massachusetts	
Call sign	WX 8041	WYP 2632
Length	29.9 m (98 ft)	23.7 m (77.6 ft)
Gross tons	198 tons	155 tons
Draft	3.7 m (12 ft)	3.4 m (11.3 ft)
Speed	10.5 knots	10.5 knots
Engine and Drive	CAT. 398 3.5:1 reduction	CAT. 850 3:1 reduction
Horsepower		

Table 2. Gear specifications.

	VALKYRIE	PATTON
Trawl	- 114 mm (4.5 inches) average mesh size; 3-mm polypropylene twine.	
Cod ends	- Type 1: 107 mm average mesh size; 80 meshes around x 50 deep; #102 braided nylon twine; machine-made.	
	Type 2: 131 mm average mesh size; 80 meshes around x 35 deep; #102 braided nylon twine; handmade.	
Cover (when used)	- 45 mm average mesh size; 270 meshes around x 150 deep; polypropylene.	
Headrope	- 23.2 m (76 ft) of 1-inch combination rope.	
Footrope (sweeps)	- 29.3 m (96 ft) of 5/8-inch chain with heavy rollers and bobbins wing-to-wing.	
Floats	- 45 (8-inch aluminum).	24 on wings, 14 on belly (galvanized).
Chafing gear	- Mat of polyethylene strands covering aft half (and underside only) of cod end and cover.	
Doors	- Slotted semi-oval steel doors (made in Portugal).	
	3.1 m (10 ft) long x 2.1 m (7 ft) wide; 650 kg.	2.7 m (8.8 ft) long x 1.4 m (4.7 ft) wide; 500 kg.
Backstraps	- Two 2.4-m (8-ft) lengths of 5/8-inch chain.	
Bridle wires (legs)	- 9.1 m (30 ft). Top of 5/8-inch wire; bottom of 7/8-inch wire.	Top 9.1 m (30 ft) of 1/2-inch wire; bottom 9.4 m (31 ft) of 3/4-inch wire.
Trawl warp	- 1-inch wire.	7/8-inch wire.
Ground cables	- 5.2 m (17 ft) of 7/8-inch wire.	4.3 m (14 ft) of 3/4-inch wire.

Figure 1. Trawl Diagram



Mesh Measurements

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

The small cod ends on the VALKYRIE and PATTON had mean mesh sizes of 108.3 mm (4.3 inches) and 106.0 mm (4.2 inches), respectively.

The large cod end on the VALKYRIE averaged 127.4 mm (5.0 inches) and on the PATTON averaged 134.6 mm (5.3 inches).

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 131 mm (5.2 inches) for the large cod ends.

Table 3. Mesh measurement statistics.

A. Small cod end.

Trawl stations	1	2	7	8	9	10	15	16	Overall
VALKYRIE									
N	30	30	30	30	30	30	30	30	240
$\overline{X}$	107.4	108.8	112.5	106.3	105.3	111.1	107.4	107.3	108.3
$S\overline{x}$	0.67	0.62	1.09	0.60	0.68	0.67	0.75	0.96	0.76
Sx	3.67	3.38	5.95	3.27	3.71	3.66	4.12	5.25	4.13
PATTON									
N	30	30	30	30	30	30	30	30	240
$\overline{X}$	105.8	105.4	105.6	105.1	106.7	106.1	106.7	106.6	106.0
$S\overline{x}$	0.65	0.75	0.66	0.65	0.49	0.57	0.70	0.67	0.64
Sx	3.57	4.09	3.61	3.54	2.71	3.14	3.81	3.64	3.51

B. Large cod end.

Trawl stations	3	4	5	6	11	12	13	14	Overall
VALKYRIE									
N	30	30	30	30	30	30	30	30	240
$\overline{X}$	127.2	125.2	128.0	126.1	128.5	128.3	127.9	127.7	127.4
$S\overline{x}$	0.75	0.63	0.87	0.81	1.47	0.96	0.97	1.24	0.96
Sx	4.11	3.46	4.78	4.46	8.05	5.26	5.34	6.77	5.28
PATTON									
N	30	30	30	30	30	30	30	30	240
$\overline{X}$	132.7	133.9	137.4	132.8	135.2	134.0	136.2	134.8	134.6
$S\overline{x}$	1.08	1.09	1.10	0.76	1.42	0.98	1.40	0.81	1.08
Sx	5.92	5.97	6.00	4.16	7.76	5.34	7.65	4.42	5.90

N = number of meshes measured.

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

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

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

Average mesh sizes, both vessels combined:
Small cod end = 107.2 mm (4.2 inches)
Large cod end = 131.0 mm (5.2 inches)

Tow Summary

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

During the nonexperimental commercial tows the vessels fished the hard bottom of Nantucket Shoals making good catches of cod and winter flounder. However, they tore up their nets on almost every tow. Since tear-ups invalidate experimental tows, we had to conduct our selectivity experiment on smoother bottom. Here our catches were poor and highly variable. There were very few small fish.

The basic catch data are presented in Table 5. There were incidental catches of skates, goosefish, sculpins, squid, scallops, herring, lobster, and halibut.

The PATTON hardly caught any cod, compared to the VALKYRIE, on Tows 5, 7, 14, and 16. In one case it can be attributed to a tear-up (Tow 14) and in one case to a foul-up (Tow 16). Both vessels had numerous small "hangs."

All the problems added together make the data questionable in regard to catch comparisons and selectivity analysis. The reader must keep this in mind when reviewing the following sections.

Table 4. Tow data. Bottom type: sand.

A. 8 October 1978.

	VALKYRIE	PATTON
Tow 1		
Cod end:	Small mesh uncovered.	
Wire out:	60 fms	60 fms
Course:	S	175°
Start time:	0745	0740
Avg. depth:	22 fms	25 fms
Weather:	50°; clear. Seas 2-3 ft.	
Tow 2		
Cod end:	Small mesh covered.	
Wire out:	150 fms	150 fms
Course:	S	140°-360°
Start time:	0935	0940
Avg. depth:	52 fms	56 fms
Weather:	52°; clear. Seas 2-3 ft.	
Tow 3		
Cod end:	Large mesh uncovered.	
Wire out:	130 fms	120 fms
Course:	N	345°
Start time:	1130	1125
Avg. depth:	45 fms	40 fms
Weather:	59°; clear. Seas 3-4 ft.	
Tow 4		
Cod end:	Large mesh covered.	
Wire out:	150 fms	150 fms
Course:	N	340°
Start time:	1405	1407
Avg. depth:	52 fms	56 fms
Weather:	60°; partly cloudy. Seas 3-4 ft.	

B. 9 October 1978.

	VALKYRIE	PATTON
Tow 5		
Cod end:	Large mesh covered.	
Wire out:	60 fms	55 fms
Course:	N	345°
Start time:	0730	0730
Avg. depth:	20 fms	20 fms
Weather:	52°; partly cloudy. Seas 3-5 ft.	
Tow 6		
Cod end:	Large mesh uncovered.	
Wire out:	60 fms	55 fms
Course:	N	360°
Start time:	0855	0855
Avg. depth:	18 fms	18 fms
Weather:	50°; partly cloudy. Seas 3-6 ft.	
Tow 7		
Cod end:	Small mesh covered.	
Wire out:	60 fms	55 fms
Course:	E	120°
Start time:	1050	1055
Avg. depth:	29 fms	31 fms
Weather:	46°; partly cloudy. Seas 3-6 ft.	
Tow 8		
Cod end:	Small mesh uncovered.	
Wire out:	100 fms	120 fms
Course:	W	260°
Start time:	1230	1230
Avg. depth:	40 fms	41 fms
Weather:	52°; partly cloudy. Seas 3-6 ft.	

C. 10 October 1978.

	VALKYRIE	PATTON
Tow 9		
Cod end:	Small mesh covered.	
Wire out:	70 fms	80 fms
Course:	N	010°
Start time:	0715	0715
Avg. depth:	26 fms	23 fms
Weather:	58°; clear. Seas 2-5 ft.	
Tow 10		
Cod end:	Small mesh uncovered.	
Wire out:	70 fms	70 fms
Course:	S	170°
Start time:	0905	0905
Avg. depth:	25 fms	25 fms
Weather:	60°; clear. Seas 3-6 ft.	
Tow 11		
Cod end:	Large mesh covered.	
Wire out:	120 fms	120 fms
Course:	N	340°
Start time:	1055	1100
Avg. depth:	43 fms	44 fms
Weather:	60°; clear. Seas 3-7 ft.	
Tow 12		
Cod end:	Large mesh uncovered.	
Wire out:	110 fms	120 fms
Course:	W	270°
Start time:	1230	1235
Avg. depth:	38 fms	37 fms
Weather:	62°; clear. Seas 3-7 ft.	

D. 11 October 1978.

	VALKYRIE	PATTON
Tow 13		
Cod end:	Large mesh uncovered.	
Wire out:	90 fms	90 fms
Course:	N	180°
Start time:	0735	0735
Avg. depth:	30 fms	31 fms
Weather:	60°; partly cloudy. Seas 2-3 ft.	
Tow 14		
Cod end:	Large mesh covered.	
Wire out:	90 fms	90 fms
Course:	N	360°
Start time:	0905	0910
Avg. depth:	35 fms	30 fms
Weather:	71°; clear. Seas 2-3 ft.	
Tow 15		
Cod end:	Small mesh uncovered.	
Wire out:	90 fms	90 fms
Course:	N	350°
Start time:	1045	1240
Avg depth:	30 fms	30 fms
Weather:	70°; partly cloudy. Seas 2-3 ft.	
Tow 16		
Cod end:	Small mesh covered.	
Wire out:	90 fms	90 fms
Course:	N	360°
Start time:	1215	1415
Avg. depth:	30 fms	31 fms
Weather:	70°; clear. Seas 1-2 ft.	

Table 5. Catch weight data.

			VALKYRIE kg	VALKYRIE lb	PATTON kg	PATTON lb
TOW 1 Small cod end	Cod	-	16.2	35.6	68.9	151.6
	Yellowtail	-	11.5	25.3	8.6	18.9
	Winter flounder	-	6.1	13.4		
	Spiny dogfish	-	8.3	18.3		
	Total	-	42.1	92.6	77.5	170.5
TOW 2 Small cod end	Haddock	-	35.6	78.3	27.6	60.7
	Cod	-	74.5	163.9	40.9	90.0
	Yellowtail	-	6.0	13.2	4.3	9.5
	American plaice	-	17.4	38.3	9.0	19.8
	Winter flounder	-			0.9	2.0
	Whiting (silver hake)	-	9.4	20.7		
	Spiny dogfish	-	9.1	20.0		
	Total	-	152.0	334.4	82.7	182.0
TOW 2 Cover	Haddock	-	9.6	21.1	4.0	8.8
	Cod	-	2.3	5.1	14.5	31.9
	Yellowtail	-			0.6	1.3
	American plaice	-	3.6	7.9	0.8	1.8
	Whiting (silver hake)	-	21.6	47.5		
	Spiny dogfish	-	3.2	7.0		
	Total	-	40.3	88.6	19.9	43.8
TOW 3 Large cod end	Haddock	-	14.2	31.2	10.3*	22.7
	Cod	-	32.8	72.2	9.1	20.0
	Yellowtail	-	3.0	6.6		
	American plaice	-	5.0	11.0	*	
	Winter flounder	-	1.1	2.4		
	Whiting (silver hake)	-	1.2	2.6		
	Spiny dogfish	-	2.2	4.8		
	Total	-	59.5	130.8	19.4	42.7
TOW 4 Large cod end	Haddock	-	28.1	61.8	50.3	110.7
	Cod	-	53.0	116.6	73.0	160.6
	Yellowtail	-	1.1	2.4		
	American plaice	-	5.2	11.4		
	Whiting (silver hake)	-	2.7	5.9		
	Total	-	90.1	198.1	123.3	271.3

*Cod end torn up.

Table 5. Catch weight data (continued).

			VALKYRIE kg	VALKYRIE lb	PATTON kg	PATTON lb
TOW 4 Cover	Haddock	-	6.5	14.3	16.2	35.6
	Cod	-	5.9	13.0	18.8	41.4
	American plaice	-	3.1	6.8		
	Whiting (silver hake)	-	2.9	6.4		
	Spiny dogfish	-	2.8	6.2		
	Total	-	21.2	46.7	35.0	77.0
TOW 5 Large cod end	Cod	-	478.5	1,052.7	1.0	2.2
	Yellowtail	-	5.3	11.7	6.7	14.7
	Winter flounder	-	10.5	23.1		
	Spiny dogfish	-	16.0	35.2		
	Total	-	510.3	1,122.7	7.7	16.9
TOW 5 Cover	Yellowtail	-	3.0	6.6		
	Winter flounder	-	4.4	9.7		
	Whiting (silver hake)	-	0.3	0.7		
	Spiny dogfish	-	13.7	30.1		
	Total	-	21.4	47.1		
TOW 6 Large cod end	Cod	-	24.4	53.7	63.1	138.8
	Yellowtail	-	2.5	5.5	1.3	2.9
	Winter flounder	-	73.5	161.7	41.8	92.0
	Spiny dogfish	-	107.7	236.9		
	Total	-	208.1	457.8	106.2	233.7
TOW 7 Small cod end	Cod	-	1,443.6	3,175.9	*	
	Yellowtail	-	7.9	17.4	1.4	3.1
	Winter flounder	-	9.9	21.8	0.9	2.0
	Spiny dogfish	-	4.1	9.0		
	Total	-	1,465.5	3,224.1	2.3	5.1
TOW 7 Cover	Yellowtail	-	0.1	0.2		
	Spiny dogfish	-	0.8	1.8		
	Total	-	0.9	2.0		

*Trawl apparently wasn't fishing.

Table 5. Catch weight data (continued).

			VALKYRIE kg	VALKYRIE lb	PATTON kg	PATTON lb
TOW 8 Small cod end	Haddock	-	1.6	3.5	0.4	0.9
	Cod	-	40.8	89.8	15.5	34.1
	Yellowtail	-	5.4	11.9	7.5	16.5
	Winter flounder	-	11.9	26.2	8.5	18.7
	Spiny dogfish	-	0.6	1.3		
	Total	-	60.3	132.7	31.9	70.2
TOW 9 Small cod end	Cod	-	79.1	174.0	26.7	58.7
	Yellowtail	-	10.7	23.5	7.3	16.1
	Winter flounder	-	11.7	25.7	2.2	4.8
	Spiny dogfish	-	308.4	678.5		
	Total	-	409.9	901.7	36.2	79.6
TOW 9 Cover	Cod	-	2.6	5.7		
	Yellowtail	-	0.1	0.2		
	Spiny dogfish	-	72.3	159.1		
	Total	-	75.0	165.0		
TOW 10 Small cod end	Cod	-	499.8	1,099.6	422.5	929.5
	Yellowtail	-	16.2	35.6	7.0	15.4
	Winter flounder	-	12.1	26.6	6.7	14.7
	Spiny dogfish	-	27.8	61.2		
	Total	-	555.9	1,223.0	436.2	959.6
TOW 11 Large cod end	Haddock	-	18.4	40.5	3.8	8.4
	Cod	-	178.4	392.5	274.2	603.2
	Yellowtail	-	1.8	4.0	3.9	8.6
	Winter flounder	-	49.1	108.0	35.8	78.8
	Whiting (silver hake)	-	0.4	0.9		
	Total	-	248.1	545.9	317.7	699.0
TOW 11 Cover	Haddock	-	14.1	31.0	13.7	30.1
	Cod	-	4.2	9.2	19.4	42.7
	Yellowtail	-	0.4	0.9	0.7	1.5
	Winter flounder	-	0.6	1.3	0.9	2.0
	Spiny dogfish	-	0.6	1.3		
	Total	-	19.9	43.7	34.7	76.3

Table 5. Catch weight data (continued).

			VALKYRIE kg	VALKYRIE lb	PATTON kg	PATTON lb
TOW 12	Haddock	-	3.9	8.6	7.3	16.1
Large cod end	Cod	-	599.5	1,318.9	730.8	1,607.8
	Yellowtail	-	5.3	11.7	4.7	10.3
	Winter flounder	-	60.0	132.0	67.7	148.9
	Spiny dogfish	-	3.7	8.1		
	Total	-	672.4	1,479.3	810.5	1,783.1
TOW 13	Haddock	-	1.9	4.2		
Large cod end	Cod	-	256.4	564.1	173.3	381.3
	Yellowtail	-	6.6	14.5	2.7	5.9
	Winter flounder	-	87.9	193.4	66.8	147.0
	Total	-	352.8	776.2	242.8	534.2
TOW 14	Cod	-	807.6	1,776.7	12.8*	28.2
Large cod end	Yellowtail	-	8.2	18.0		
	Winter flounder	-	110.0	242.0	1.9	4.2
	Spiny dogfish	-			5.5	12.1
	Total	-	925.8	2,036.7	20.2	44.5
TOW 14	Cod	-	**		2.1	4.6
Cover	Total	-			2.1	4.6
TOW 15	Cod	-	285.6	628.3	125.3	275.7
Small cod end	Yellowtail	-	3.2	7.0	2.9	6.4
	Winter flounder	-	112.0	246.4	73.8	162.4
	Total	-	400.8	881.7	202.0	444.5
TOW 16	Cod	-	572.8	1,260.2	137.8	303.2
Small cod end	Yellowtail	-	6.2	13.6	3.3	7.3
	Winter flounder	-	96.2	211.6	60.0	132.0
	Total	-	675.2	1,485.4	201.1	442.5
TOW 16	Haddock	-	0.1	0.2		
Cover	Cod	-	2.8	6.2	1.5	3.3
	Yellowtail	-	0.1	0.1	0.1	0.2
	Whiting (silver hake)	-	0.1	0.2		
	Total	-	3.0	6.7	1.6	3.5

*Large tear in belly.
**Cover torn up.

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

Length interval (cm)	Cod ends and covers					Cod ends only			
	Overall average	107 mm	131 mm	VALKYRIE	PATTON	107 mm covered	107 mm uncovered	131 mm covered	131 mm uncovered
13-15	0.1	0.2		0.1					
16-18	0.1	0.2		0.1					
19-21	0.1	0.2		0.1					
22-24	0.2	0.3		0.1	0.5				
25-27	0.3	0.7		0.1	1.4				
28-30	0.7	0.3	1.1	0.3	2.3				
31-33	1.5	1.7	1.3	1.0	3.6				
34-36	1.4	1.0	1.8	1.5	0.9		0.6		
37-39	1.1	1.2	1.1	0.8	2.7		0.6		0.2
40-42	0.9	0.8	0.9	0.8	1.4	0.5	0.6	0.4	
43-45	0.9	0.5	1.3	0.4	2.7	0.5	0.8	0.4	0.4
46-48	0.8	0.7	0.9	0.8	0.9	0.7	0.8	0.8	0.2
49-51	1.4	1.7	1.1	0.9	3.6	1.8	1.4	0.8	1.2
52-54	1.8	0.8	2.9	1.3	4.1	0.7	2.8	2.4	2.7
55-57	3.3	3.7	2.9	2.7	5.9	3.8	3.9	2.6	2.7
58-60	4.0	3.2	5.0	3.3	7.2	3.1	4.4	4.9	4.1
61-63	4.5	2.8	6.2	3.3	9.5	3.1	5.5	6.5	6.8
64-66	7.7	7.0	8.4	7.3	9.5	7.4	7.2	9.4	10.4
67-69	11.1	11.0	11.2	11.1	11.3	11.8	11.3	12.2	12.5
70-72	13.7	12.0	15.6	13.0	16.7	12.9	13.8	17.3	17.0
73-75	11.2	12.7	9.5	12.8	4.5	13.6	12.4	10.4	17.4
76-78	11.3	11.9	10.6	12.8	5.0	12.7	10.5	11.8	9.7
79-81	8.1	8.5	7.7	9.8	1.4	9.2	8.8	8.6	7.5
82-84	4.6	5.0	4.2	5.4	1.4	9.2	8.8	8.6	7.5
85-87	2.3	2.7	1.8	2.7	0.5	2.9	4.4	2.0	1.5
88-90	1.5	1.5	1.5	1.5	1.4	1.6	0.8	1.6	1.4
91-93	1.8	2.8	0.7	2.2	0.5	3.1	1.1	0.8	0.8
94-96	1.1	1.2	1.1	1.2	0.9	1.3	1.7	1.2	0.2
97-99	0.6	1.2		0.8		1.3	1.1		0.2
100-102	0.6	0.8	0.4	0.8		0.9	0.3	0.4	0.2
103-105	0.5	0.8	0.2	0.7		0.9	0.8	0.2	
106-108	0.3	0.5	0.2	0.3	0.5	0.5	0.6	0.2	0.4
109	0.2	0.3		0.2		0.4	0.6		
112							0.3		
135							0.3		
137	0.1		0.2		0.5			0.2	
TOTALS	1,143	598	545	921	222	557	363	491	518

Figure 2

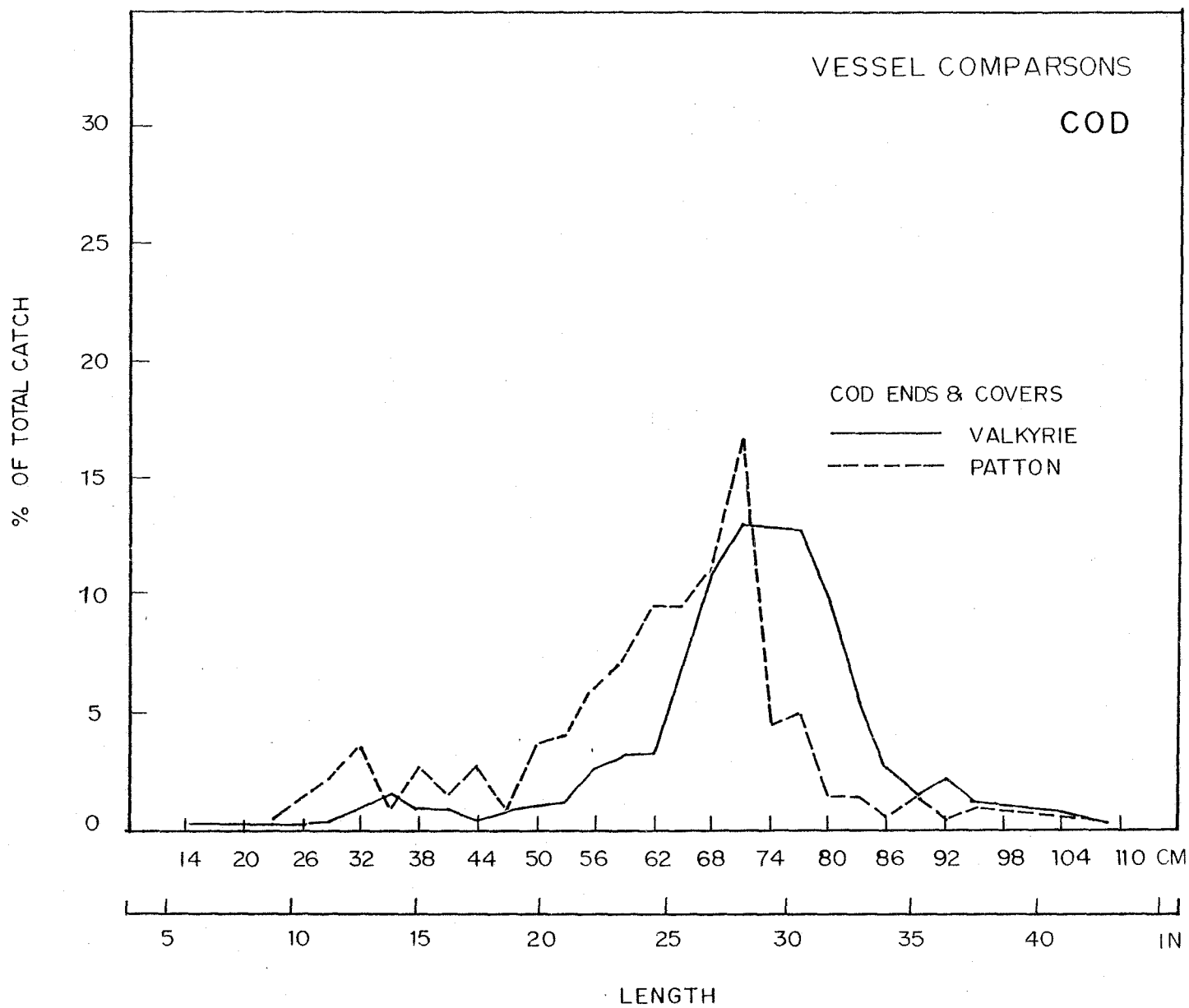

VESSEL COMPARSONS
COD
COD ENDS & COVERS
VALKYRIE
PATTON
% OF TOTAL CATCH
30
25
20
15
10
5
0
14 20 26 32 38 44 50 56 62 68 74 80 86 92 98 104 110 CM
5 10 15 20 25 30 35 40 IN
LENGTH

Table 7. Cod 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	
13-15	0	1	0.0
16-18	0	1	0.0
19-21	0	1	0.0
22-24	0	2	0.0
25-27	0	4	0.0
28-30	0	2	0.0
31-33	0	10	0.0
34-36	0	6	0.0
37-39	0	7	0.0
40-42	3	5	60.0
43-45	3	3	100.0
46-48	4	4	100.0
49-51	10	10	100.0
52-54	4	5	80.0
55-57	21	22	95.5
58-60	17	19	89.5
61-63	17	17	100.0
64-66	41	42	97.6
67-69	66	66	100.0
70-72	72	72	100.0
73-75	76	76	100.0
76-78	71	71	100.0
79-81	51	51	100.0
82-84	30	30	100.0
85-87	16	16	100.0
88-90	9	9	100.0
91-93	17	17	100.0
94-96	7	7	100.0
97-99	7	7	100.0
100-102	5	5	100.0
103-105	5	5	100.0
106-108	3	3	100.0
109	2	2	100.0
TOTALS	557	598	

Table 8. Cod length frequency distributions and percent retained for 131-mm cod end covered tows--both vessels.

Length interval (cm)	Numbers caught		% retained
	131 mm	131 mm plus covers	
28-30	0	6	0.0
31-33	0	7	0.0
34-36	0	10	0.0
37-39	0	6	0.0
40-42	2	5	40.0
43-45	2	7	28.6
46-48	4	5	80.0
49-51	4	6	66.7
52-54	12	16	75.0
55-57	13	16	81.3
58-60	24	27	88.9
61-63	32	34	94.1
64-66	46	46	100.0
67-69	60	61	98.4
70-72	85	85	100.0
73-75	51	52	98.1
76-78	58	58	100.0
79-81	42	42	100.0
82-84	23	23	100.0
85-87	10	10	100.0
88-90	8	8	100.0
91-93	4	4	100.0
94-96	6	6	100.0
97-99	0	0	0.0
100-102	2	2	100.0
103-105	1	1	100.0
106-108	1	1	100.0
109	0	0	0.0
137	1	1	100.0
TOTALS	491	545	

Table 9. Cod length frequency distributions and percent retained for the 131-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) 131 mm	$\frac{B}{A}$		$\frac{B}{1.48A} \times 100$
34-36	2	0	0.00		0.0
37-39	2	1	0.50		33.8
40-42	2	0	0.00		0.0
43-45	3	2	0.67		45.0
46-48	3	1	0.33		22.5
49-51	5	6	1.20		81.1
52-54	10	14	1.40		94.6
55-57	14	14	1.00		67.6
58-60	16	21	1.31		88.7
61-63	20	35	1.75		118.2
64-66	26	54	2.08	Avg.	140.3
67-69	41	65	1.59	1.49	107.1
70-72	50	88	1.76		118.9
73-75	45	90	2.00		135.1
76-78	38	50	1.32		88.9
79-81	32	39	1.22		82.4
82-84	11	14	1.27		86.0
85-87	16	8	0.50		33.8
88-90	3	7	2.33		157.7
91-93	4	4	1.00		67.6
94-96	6	1	0.17		11.3
97-99	4	1	0.25		16.9
100-102	1	1	1.00		67.6
103-105	3	0	0.00		0.0
106-108	2	2	1.00		67.6
109	2	0	0.00		0.0
112	1	0	0.00		0.0
135	1	0	0.00		0.0
TOTALS	363	518			
	$\Sigma A = 336$ 55	$\Sigma B = 494$ 55	$\frac{B}{A} = 1.47$		

Figure 3

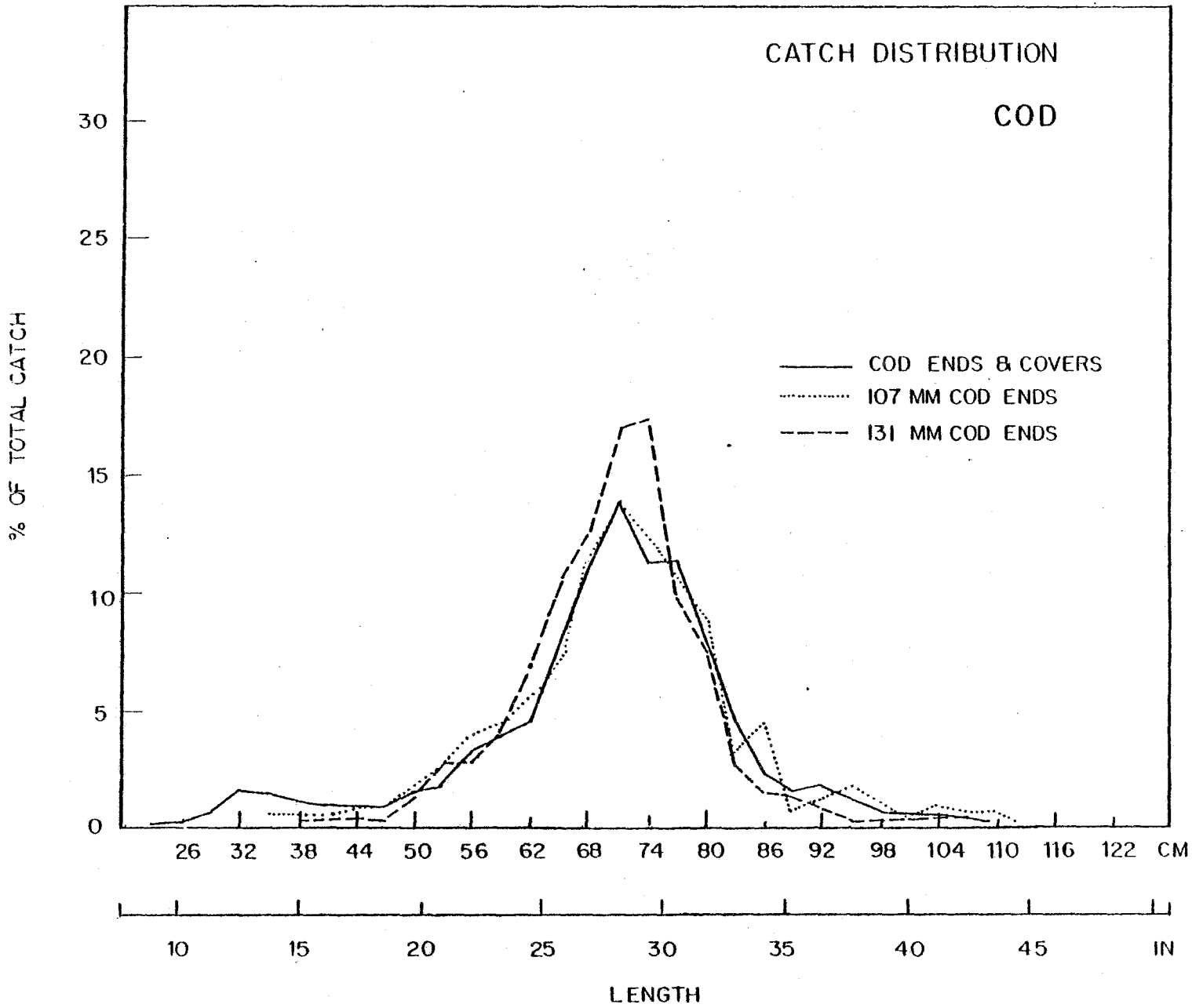

CATCH DISTRIBUTION
COD
COD ENDS & COVERS
107 MM COD ENDS
131 MM COD ENDS
% OF TOTAL CATCH
30
25
20
15
10
5
0
26 32 38 44 50 56 62 68 74 80 86 92 98 104 110 116 122 CM
10 15 20 25 30 35 40 45 IN
LENGTH

Table 10. Length frequency distributions (%)--winter flounder.

Length interval (cm)	Cod ends and covers					Cod ends only			
	Overall average	107 mm	131 mm	VALKYRIE	PATTON	107 mm covered	107 mm uncovered	131 mm covered	131 mm uncovered
22-24									0.2
25-27	0.3	0.6			1.2	0.6			
28-30	1.4	1.7	1.0	1.8		1.7		1.1	0.7
31-33	5.7	2.8	8.3	7.0	1.2	2.8	0.5	5.5	10.0
34-36	9.5	6.8	12.0	11.3	3.5	6.8	2.7	10.5	23.0
37-39	13.3	16.4	10.4	13.4	12.9	16.4	19.9	11.0	15.5
40-42	24.4	28.8	20.3	23.9	25.9	28.8	35.3	21.0	20.5
43-45	20.9	20.9	20.8	20.8	21.2	20.9	24.0	22.1	13.7
46-48	10.3	11.9	8.9	8.8	15.3	11.9	10.9	9.4	8.9
49-51	7.3	7.3	7.3	7.4	7.1	7.3	2.7	7.7	3.4
52-54	3.5	1.1	5.7	2.8	5.9	1.1	2.3	6.1	3.0
55-57	2.2	1.1	3.1	1.8	3.5	1.1	1.4	3.3	1.4
58-60	1.1	0.6	1.6	0.7	2.4	0.6	0.5	1.7	
61-63	0.3		0.5	0.4				0.6	
TOTALS	369	177	192	284	85	177	221	181	439

Figure 4

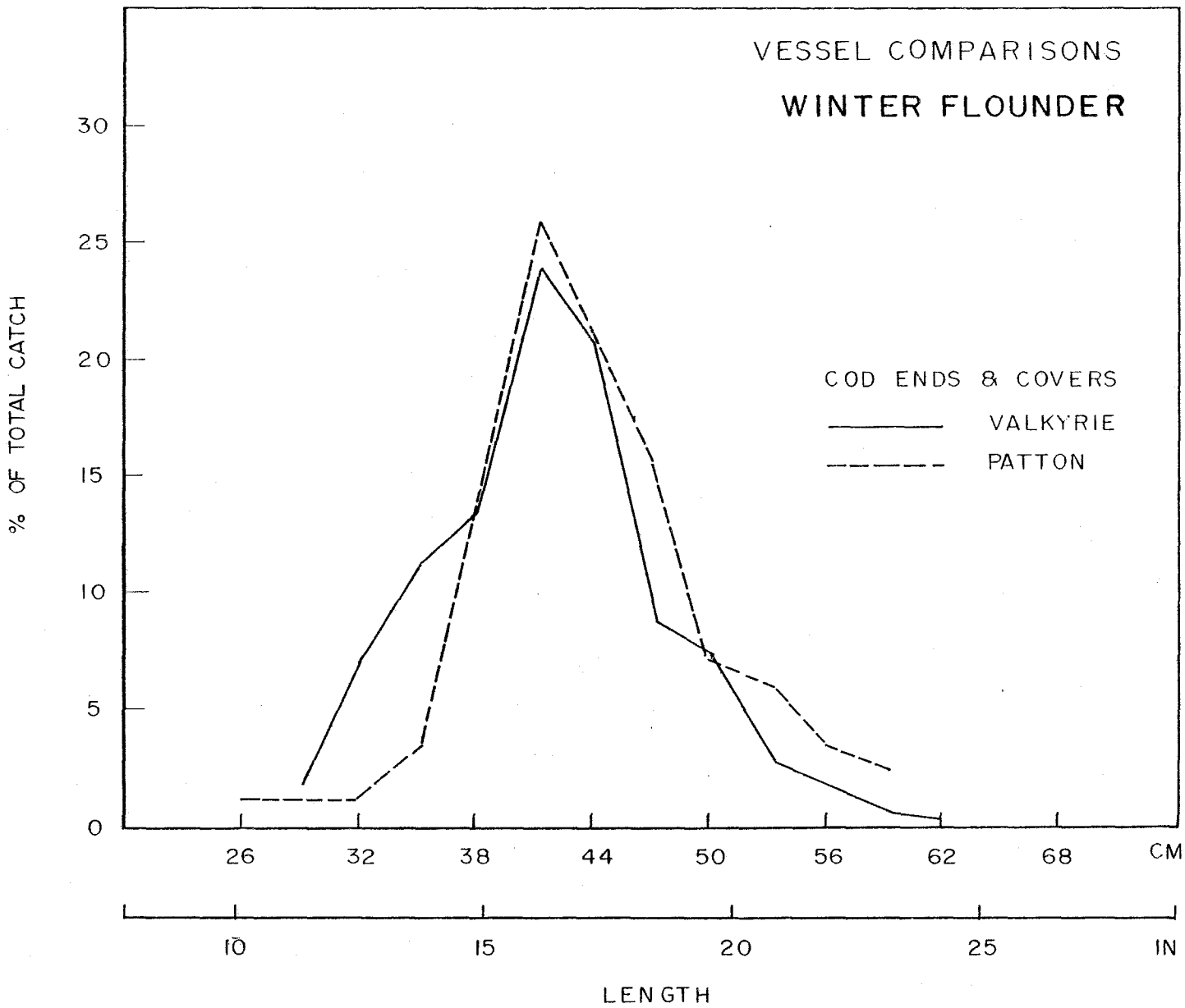

VESSEL COMPARISONS
WINTER FLOUNDER
COD ENDS & COVERS
VALKYRIE
PATTON
% OF TOTAL CATCH
30
25
20
15
10
5
0
26
32
38
44
50
56
62
68
CM
10
15
20
25
IN
LENGTH

Table 11. Winter flounder 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	
25-27	1	1	100.0
28-30	3	3	100.0
31-33	5	5	100.0
34-36	12	12	100.0
37-39	29	29	100.0
40-42	51	51	100.0
43-45	37	37	100.0
46-48	21	21	100.0
49-51	13	13	100.0
52-54	2	2	100.0
55-57	2	2	100.0
58-60	1	1	100.0
TOTALS	177	177	

Table 12. Winter flounder length frequency distributions and percent retained for 131-mm cod end covered tows--both vessels.

Length interval (cm)	Numbers caught		% retained
	131 mm	131 mm plus covers	
28-30	2	2	100.0
31-33	10	16	62.5
34-36	19	23	82.6
37-39	20	20	100.0
40-42	38	39	97.4
43-45	40	40	100.0
46-48	17	17	100.0
49-51	14	14	100.0
52-54	11	11	100.0
55-57	6	6	100.0
58-60	3	3	100.0
61-63	1	1	100.0
TOTALS	181	192	

Table 13. Winter flounder length frequency distributions and percent retained for the 131-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) 131 mm	$\frac{B}{A}$		$\frac{B}{1.37A} \times 100$
28-30	0	3	-		-
31-33	1	44	44.00		3,211.7
34-36	6	101	16.83		1,228.7
37-39	44	68	1.55		112.8
40-42	78	90	1.15	Avg.	84.2
43-45	53	60	1.13	1.37	82.6
46-48	24	39	1.63		118.6
49-51	6	15	2.50		182.5
52-54	5	13	2.60		189.8
55-57	3	6	2.00		146.0
58-60	1	0	0.00		0.0
TOTALS	221	439			

$$\sum_{37}^{60} A = 214 \qquad \sum_{37}^{60} B = 291 \qquad \frac{B}{A} = 1.36$$

Figure 5

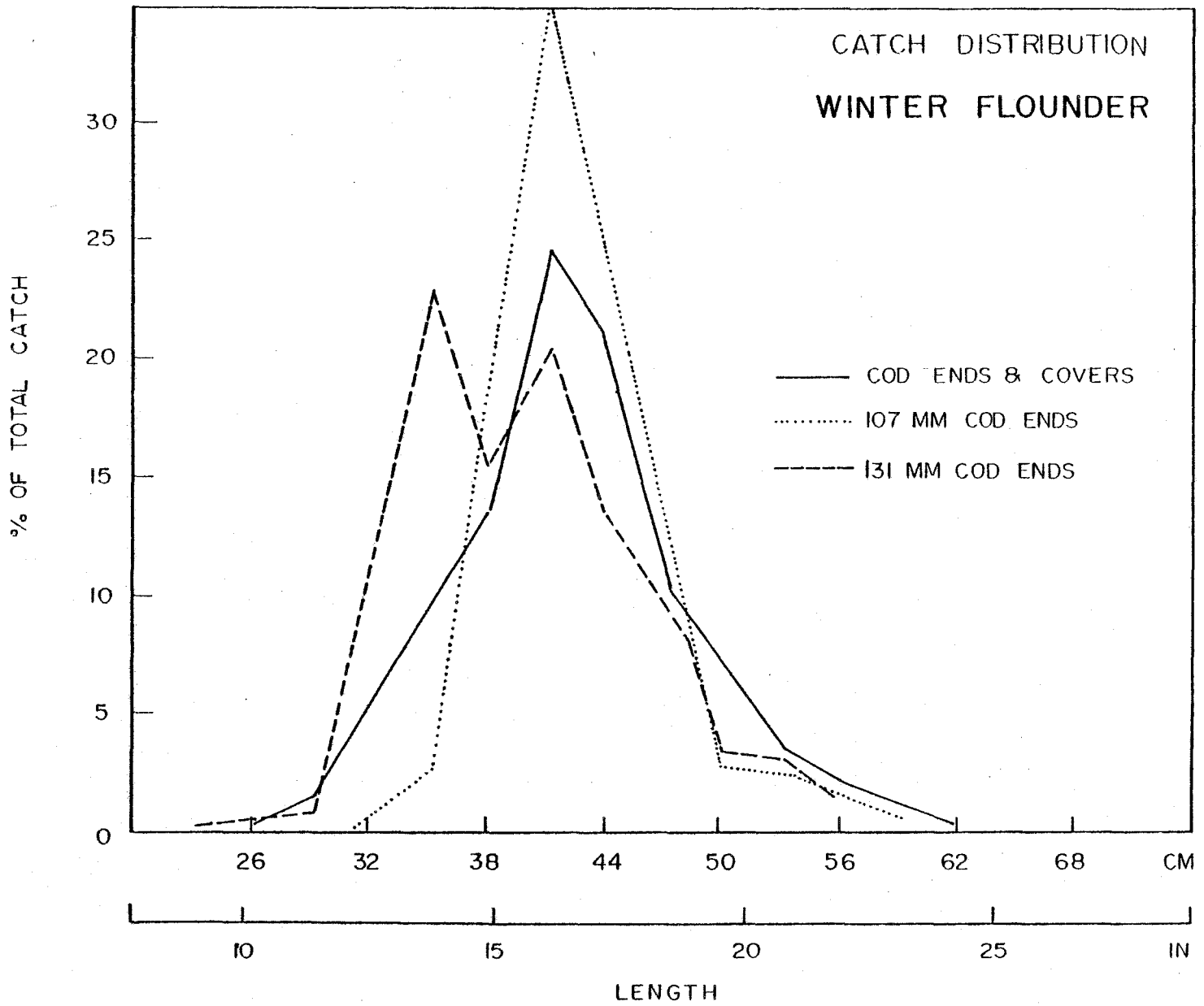

CATCH DISTRIBUTION
WINTER FLOUNDER
COD ENDS & COVERS
107 MM COD ENDS
131 MM COD ENDS
% OF TOTAL CATCH
30
25
20
15
10
5
0
26
32
38
44
50
56
62
68
CM
10
15
20
25
IN
LENGTH

Table 14. Length frequency distributions (%)--haddock.

Length interval (cm)	Cod ends and covers					Cod ends only			
	Overall average	107 mm	131 mm	VALKYRIE	PATTON	107 mm covered	107 mm uncovered	131 mm covered	131 mm uncovered
13-15	0.6			1.0					
16-18	0.6	1.3	1.0	1.0					
31-33	0.6		1.0	1.0					
34-36	3.4	5.3	2.0	3.0	3.9	1.8	33.3		
37-39	10.7	16.0	6.7	15.0	5.2	12.7		2.0	4.8
40-42	17.5	21.3	14.7	19.0	15.6	18.2	33.3	4.1	4.8
43-45	18.1	20.0	16.7	17.0	19.5	20.0	33.3	12.2	4.8
46-48	10.7	9.3	11.8	12.0	9.1	10.9		6.1	4.8
49-51	10.2	10.7	9.8	8.0	13.0	14.5		10.2	9.5
52-54	3.4	4.0	2.9	3.0	3.9	5.5		4.1	14.3
55-57	7.3	5.3	8.8	9.0	5.2	7.3		18.4	14.3
58-60	8.5	4.0	11.8	6.0	11.7	5.5		16.3	23.8
61-63	3.4	2.7	3.9	3.0	3.9	3.6		8.2	19.0
64-66	2.8		4.9	2.0	3.9			10.2	
73-75	0.6		1.0		1.3			2.0	
76-78	0.6		1.0		1.3			2.0	
79-81			2.0		2.6			4.1	
TOTALS	177	75	102	100	77	55	3	49	21

Table 15. Length frequency distributions (%)--whiting (silver hake).

Length interval (cm)	Cod ends and covers					Cod ends only			
	Overall average	107 mm	131 mm	VALKYRIE	PATTON	107 mm covered	107 mm uncovered	131 mm covered	131 mm uncovered
16-18	0.9	1.1		1.1					
22-24	2.7	1.1	11.1	1.1	11.1				
25-27	2.7	3.2		3.2		3.7			
28-30	6.3	6.4	5.6	6.4	5.6	7.4			
31-33	16.1	18.1	5.6	18.1	5.6	14.8		12.5	
34-36	20.5	24.5		24.5		25.9			
37-39	17.9	13.8	38.9	13.8	38.9	7.4		37.5	
40-42	18.8	16.0	33.3	16.0	33.3	18.5		50.0	
43-45	14.3	16.0	5.6	16.0	5.6	22.2			50.0
46-48									50.0
TOTALS	112	94	18	94	18	27		8	2

Table 16. Length frequency distributions (%)--American plaice (dabs).

Length interval (cm)	Cod ends and covers					Cod ends only			
	Overall average	107 mm	131 mm	VALKYRIE	PATTON	107 mm covered	107 mm uncovered	131 mm covered	131 mm uncovered
16-18	2.1	1.9	3.0	2.7					
19-21	6.4	5.6	9.1	8.1		1.3		6.3	
22-24	3.6	4.7		4.5					
25-27	16.4	14.0	24.2	19.8	3.4	9.0		6.3	9.1
28-30	31.4	34.6	21.2	29.7	37.9	38.5		31.3	18.2
31-33	18.6	16.8	24.2	16.2	27.6	20.5		18.8	27.3
34-36	6.4	7.5	3.0	5.4	10.3	10.3		6.3	9.1
37-39	6.4	4.7	12.1	6.3	6.9	6.4		25.0	18.2
40-42	4.3	4.7	3.0	2.7	10.3	6.4		6.3	
43-45	3.6	4.7		3.6	3.4	6.4			
46-48									18.2
49-51	0.7	0.9		0.9		1.3			
TOTALS	140	107	33	111	29	78		16	11

Table 17. Length frequency distributions (%)--yellowtail flounder.

Length interval (cm)	Cod ends and covers					Cod ends only			
	Overall average	107 mm	131 mm	VALKYRIE	PATTON	107 mm covered	107 mm uncovered	131 mm covered	131 mm uncovered
16-18	0.6	1.1		0.9					
19-21	0.6		1.4	0.9					
22-24	2.5	2.2	2.9	2.7	2.0		1.7	1.9	
25-27	6.2	5.4	7.2	8.1	2.0	4.5	1.7	1.9	
28-30	3.7	2.2	5.8	5.4		2.3	5.1	1.9	2.5
31-33	12.3	10.8	14.5	12.6	11.8	11.4	15.3	13.2	12.5
34-36	28.4	22.6	36.2	27.9	29.4	23.9	25.4	41.5	7.5
37-39	20.4	26.9	11.6	20.7	19.6	27.3	20.3	13.2	22.5
40-42	16.0	19.4	11.6	13.5	21.6	20.5	16.9	15.1	27.5
43-45	6.8	7.5	5.8	5.4	9.8	8.0	9.3	7.5	20.0
46-48	1.2	2.2		1.8		2.3	3.4		2.5
49-51	1.2		2.9		3.9		0.8	3.8	5.0
TOTALS	162	93	69	111	51	88	118	53	40

Table 18. Length frequency distributions (%)--spiny dogfish.

Length interval (cm)	Cod ends and covers					Cod ends only			
	Overall average	107 mm	131 mm	VALKYRIE	PATTON	107 mm covered	107 mm uncovered	131 mm covered	131 mm uncovered
49-51	1.1	0.8	6.3	1.1					
52-54	2.5	2.6		2.5				12.5	
55-57	2.8	2.6	6.3	2.9		1.6	5.9		
58-60	6.7	7.1		6.8		2.6			
61-63	7.8	8.3		7.9		5.7			
64-66	8.5	8.6	6.3	8.6		5.7	5.9		
67-69	6.0	6.4		6.1		4.7	5.9		
70-72	10.3	10.9		10.4		10.4	11.8		
73-75	16.7	17.3	6.3	16.8		21.4	11.8		
76-78	22.0	22.2	18.8	21.8	50.0	29.7	23.5	12.5	2.9
79-81	10.6	11.3		10.7		15.6	5.9		5.7
82-84	1.1	0.8	6.3	1.1		1.0		12.5	8.6
85-87									11.4
88-90	1.4	0.4	18.8	1.4		0.5		12.5	25.7
91-93	1.1		18.8	1.1			17.6	37.5	17.1
94-96	1.1	0.4	12.5	0.7	50.0	0.5		12.5	8.6
97-99	0.4	0.4		0.4		0.5	11.8		11.4
100-102									8.6
TOTALS	282	266	16	280	2	192	17	8	35

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

Length interval (cm)	Haddock	Cod	Yellowtail	American plaice	Winter flounder	Whiting	Spiny dogfish
10-12	0.01	0.03		0.04	0.05	0.05	
13-15	0.03	0.04	0.02	0.04	0.07	0.05	
16-18	0.05	0.04	0.04	0.05	0.09	0.05	
19-21	0.08	0.04	0.07	0.07	0.11	0.07	
22-24	0.12	0.09	0.09	0.09	0.18	0.09	
25-27	0.18	0.13	0.13	0.14	0.23	0.13	
28-30	0.25	0.22	0.22	0.23	0.36	0.16	0.09
31-33	0.34	0.34	0.31	0.27	0.45	0.22	0.09
34-36	0.44	0.45	0.41	0.32	0.55	0.27	0.14
37-39	0.57	0.58	0.59	0.50	0.77	0.36	0.18
40-42	0.72	0.67	0.68	0.68	0.91	0.45	0.23
43-45	0.90	0.85	0.86	0.86	1.14	0.54	0.27
46-48	1.10	1.03	1.04	1.14	1.36	0.68	0.36
49-51	1.32	1.21	1.17	1.40	1.68	0.81	0.45
52-54	1.58	1.44	1.44	1.80	2.05	0.99	0.54
55-57	1.88	1.71	1.67	2.20	2.43	1.22	0.63
58-60	2.20	2.07	2.14	2.70	2.93	1.40	0.77
61-63	2.56	2.30		2.90	3.42	1.62	0.90
64-66	2.96	2.66		2.93		1.85	1.08
67-69	3.40	3.02				2.12	1.26
70-72	3.88	3.38					1.44
73-75	4.41	4.10					1.67
76-78	4.98	4.50					1.80
79-81	5.60	5.40					2.16
82-84	6.27	5.90					2.43
85-87	6.99	6.30					2.70
88-90	7.77	7.20					3.15
91-93		7.70					3.33
94-96		8.60					3.74
97-99		9.90					4.14
100-102		10.80					4.50
103-105		11.70					
106-108		12.60					
109-111		13.50					
112-114		14.40					
115-117		16.20					
118-120		17.60					
121-123		19.40					
124-126		21.20					
135		29.70					
137		31.50					

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