FURTHER EXPERIMENTS ON THE ESCAPE OF UNDERSIZED HADDOCK THROUGH OTTER TRAWLS

By John R. Clark*

INTRODUCTION

The results of the first of a series of recent experiments on the escape of haddock through otter-trawl meshes were reported in the September issue of this journal. In that series of experiments, nets with cod ends of $4\frac{7}{8}$- and $5\frac{1}{2}$-inch mesh (between knot centers, new) were tested on two trips of the otter trawler Michigan in June (1952). This report presents results of experiments with cod ends of $5\frac{7}{8}$- and $6\frac{3}{8}$-inch (between knot centers) mesh aboard another trawler later in the year.

METHODS

The experiments were conducted on a regular fishing trip of the large otter trawler Wisconsin (fig. 1) from October 14 to 23 on Georges Bank. The procedure followed was essentially the same as used on the Michigan cruises.

A $5\frac{7}{8}$-inch (between knot centers) cod end was used on a standard No. 41 otter trawl with a belly of 5-inch (between knot centers) mesh throughout. A $6\frac{3}{8}$-inch

THE OTTER TRAWLER WISCONSIN.

(between knot centers) cod end was used on a Standard $1\frac{1}{2}$ Iceland trawl with a belly of $5\frac{1}{2}$-inch (between knot centers) mesh throughout. Both cod ends were constructed of 50-yard, 4-thread, double twine. The 5-inch belly used on the No. 41 trawl was constructed of 75-yard, 4-thread, single twine; the $5\frac{1}{2}$-inch belly used on the Iceland trawl was constructed of 60-yard, 4-thread, single twine.

The cod ends were covered with a bag of $1\frac{1}{2}$-inch, 24-thread cotton shrimp netting to catch the escaped fish. Results from the previous cruises had shown that

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NOTE: WEIGHT OF TWINE IS EXPRESSED IN NUMBER OF YARDS PER POUND.

the cover did not have any effect on the selectivity of the cod end under normal conditions.

The meshes of the cod ends and bellies were measured frequently throughout the course of the experiments to determine any changes in size of mesh (fig. 2). Measurements were made with a flat wedge-shaped gauge inserted under a pressure of 12 pounds into the meshes of the net while wet and after use, according to the recommendations of the International Commission for the Northwest Atlantic Fisheries.

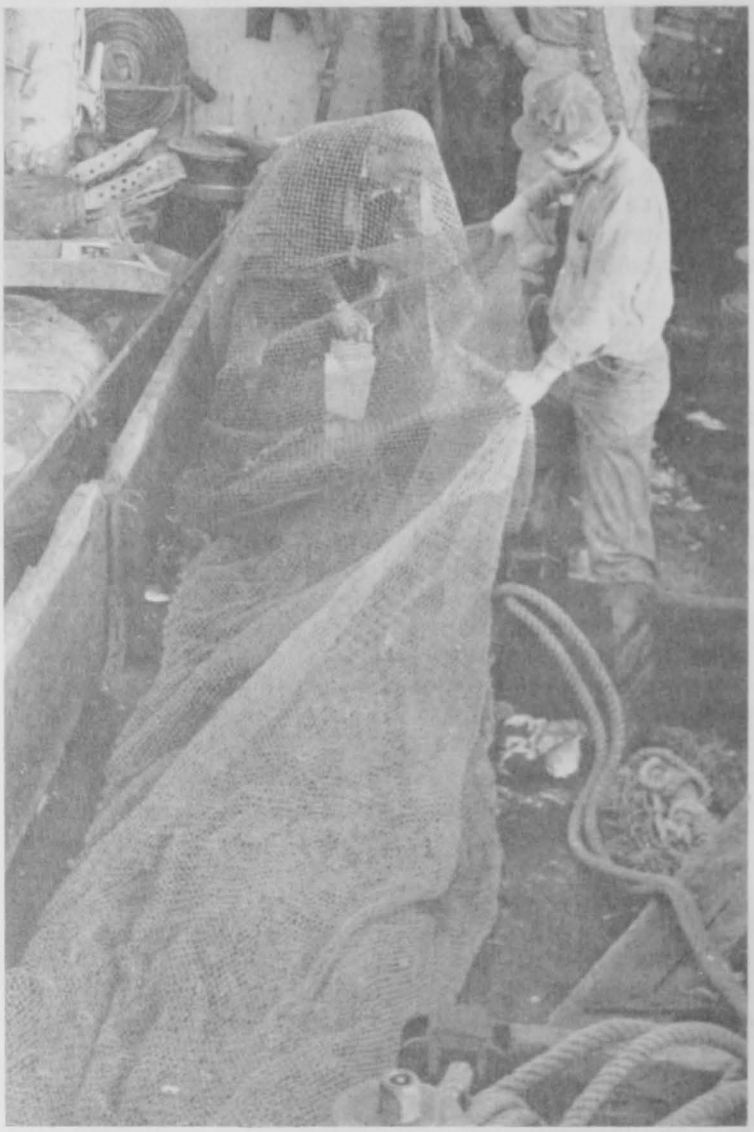

FIG. 2 - IN ORDER TO MEASURE THE MESHES OF THE EXPERIMENTAL COD END IT WAS NECESSARY TO CRAWL INSIDE THE COVER.

The catches from the cod end and cover of each observed tow were kept entirely separate and all haddock from cover and cod end were measured. Certain phases of the operations at sea are shown in figures 3 to 6.

RESULTS

EFFECT OF USE ON MESH SIZE: Of great importance in applying the results of experiments on the selective action of meshes is knowledge of the relation between mesh size in new nets and used nets. Also of importance is the effect of continued use on mesh size. The results of the Michigan experiments showed that mesh size increases with continued use and that the amount of increase depends on the size of the catches. It was also shown that the after part of the cod end stretched more than the forward part.

Table 1 - Sizes of Mesh (Inside Measurements) in a $5\frac{7}{8}$-Inch (Between Knot Centers) Cod End after Use.

When Measured	Part of Cod End Measured — QUARTER				Approximate Average for Entire Cod End
	1st (after)	2nd	3rd	4th (forward)	
After 1 tow	4-3/8	4-1/2	4-1/8	4-1/8	4-1/4
After 10 tows	4-1/2	4-1/2	4-1/4	4-1/8	4-3/8
After 22 tows	4-5/8	4-5/8	4-1/4	4-1/8	4-3/8
After 43 tows	4-3/4	4-3/4	4-1/4	4-1/8	4-1/2
After 57 tows	4-3/4	4-3/4	4-1/4	4-1/4	4-1/2

Similar results were found for the cod ends tested on the Wisconsin cruise. These results are summarized for the $5\frac{7}{8}$-inch cod end in table 1 and for the $6\frac{3}{8}$-

Table 2- Sizes of Mesh (Inside Measurements) in a $6\frac{3}{8}$-Inch (Between Knot Centers) Cod End after Use.

When Measured	Part of Cod End Measured — Q U A R T E R				Approximate Average for Entire Cod End
	1st (after)	2nd	3rd	4th (forward)	
After 2 tows	4-7/8	4-3/4	4-3/4	4-5/8	4-3/4
After 6 tows	4-7/8	4-3/4	4-3/4	4-5/8	4-3/4
After 9 tows	5-1/8	4-3/4	4-5/8	4-3/4	4-3/4

inch cod end in table 2. The average inside measurement of the $5\frac{7}{8}$-inch mesh increased rather regularly from $4\frac{1}{4}$ to $4\frac{1}{2}$ inches throughout the cruise. After the 57th tow, the after meshes averaged $\frac{1}{2}$ inch larger than the forward meshes. The largest catch during these 57 tows was about 4,300 pounds. The $6\frac{3}{8}$-inch cod end was used only a few times and consequently showed very little change in average mesh size. The inside dimensions of the after quarter increased $\frac{1}{4}$ inch after the first two tows and there was only $\frac{3}{8}$ inch difference between the after and forward quarters of the cod end after 9 tows. The largest catch taken was 2,000 pounds.

The 5-inch belly used on the No. 41 trawl measured $4\frac{5}{8}$ inches (inside dimension) after 43 tows. The $5\frac{1}{2}$-inch belly on the Iceland trawl was used for only

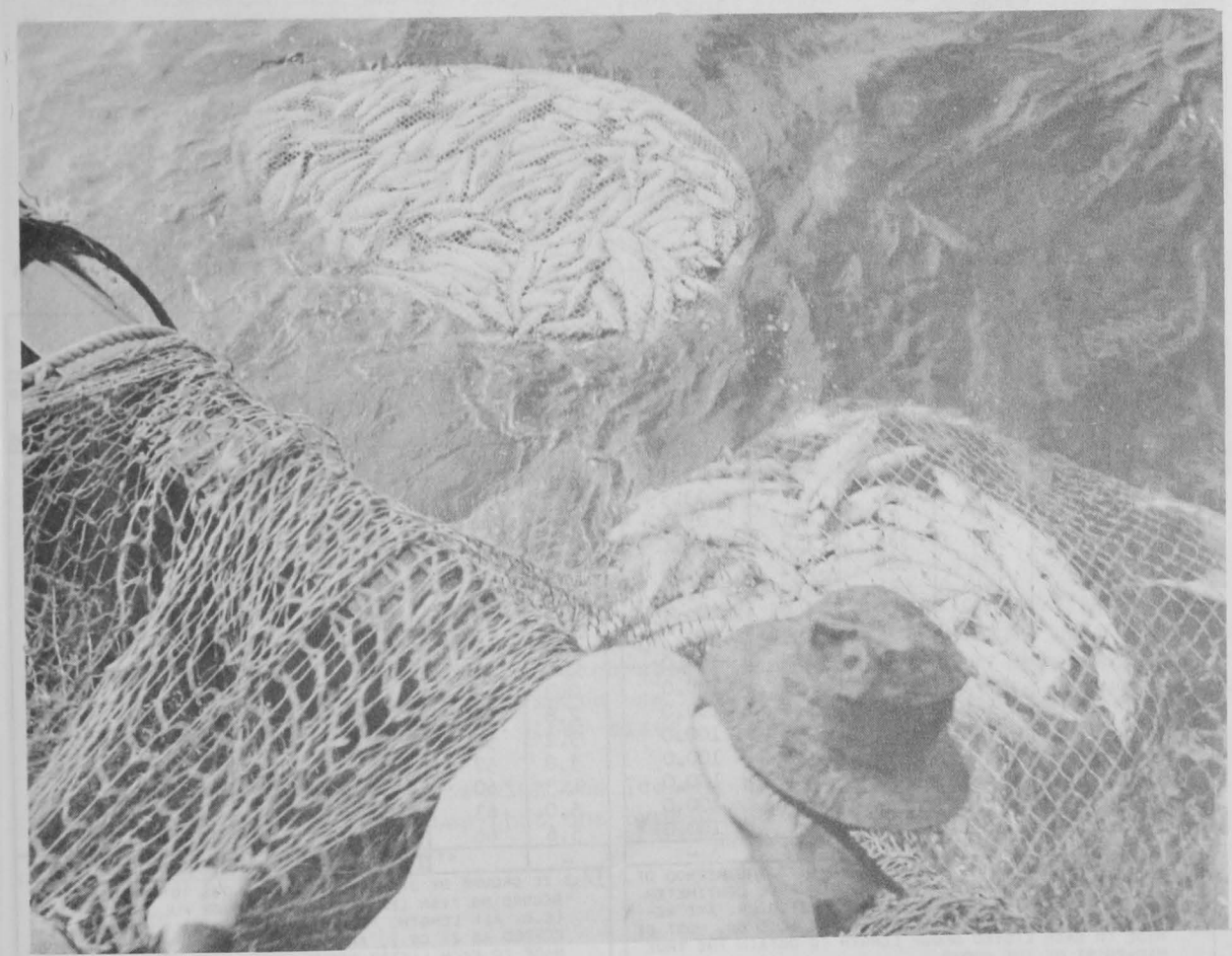

FIG. 3 - A FULL COVER FLOATS ALONGSIDE THE VESSEL.

9 tows, when it also measured $4\frac{5}{8}$ inches inside. These nine tows were not sufficient usage to stretch the belly meshes fully. Another factor tending to equalize the internal mesh size of the two bellies was the use of heavier twine in the $5\frac{1}{2}$-inch belly (60 yard, 4 thread). Heavier twine with consequent larger knots reduces the internal size in relation to the knot center size.

FIG. 4 - THE COVER SWINGS ABOARD.

ESCAPE OF FISH THROUGH THE MESH: The selection of sizes of haddock with the $5\frac{7}{8}$-inch cod end is shown in table 3. The results presented are for eight tows in which a total of 4,117 haddock of 20 cm. (8 inches) and larger were taken. Almost all fish under 0.6 pounds escaped, while almost all over 1.6 pounds were retained in the cod end. The 50-percent selection point came at about 37.3 cm. (14.7 inches). Haddock of this length weigh about 1 pound.

The selective action of the $6\frac{3}{8}$-inch mesh is shown in table 4. A total of 2,632 fish over 20 cm. (8 inches) were taken in six tows. With

Table 3 - Selectivity of the $4\frac{1}{2}$-Inch (Inside Dimensions) Cod End

Gutted Weight	Length[1]	Fish in Cover	Fish in Cod End	Total Caught	Percentage Retained in Cod End
Lbs.	Cm.[2]	No.	No.	No.	%
.2	21	1	-	1	0.0
.3	24	8	-	8	0.0
.5	27	59	2	61	3.3
.6	30	90	14	104	13.5
.8	33	218	73	291	25.1
1.0	36	363	355	718	49.4
1.3	39	382	649	1,031	62.9
1.6	42	144	686	830	82.6
2.0	45	35	413	448	92.2
2.3	48	5	294	299	98.3
2.8	51	-	182	182	100.0
3.2	54	-	87	87	100.0
3.8	57	-	34	34	100.0
4.3	60	-	9	9	100.0
5.0	63	-	4	4	100.0
5.6	66	-	5	5	100.0
6.4	69	-	4	4	100.0
7.2	72	-	1	1	100.0
-	-	1,305	2,812	4,117	-

1/ SIZE GROUPS BY 3-CM. INTERVALS. DUE TO THE METHOD OF RECORDING FISH LENGTHS TO THE LOWER FULL CENTIMETER (E.G. ALL LENGTHS FROM 21.0 CM. TO 21.9 CM. ARE RECORDED AS 21 CM.), AN ADJUSTMENT OF +0.5 CM. MUST BE MADE TO EACH LISTED GROUP LENGTH TO OBTAIN THE TRUE MID-POINT OF THE GROUP.
2/ 2.54 CM. EQUAL 1 INCH.

Table 4 - Selectivity of the $4\frac{3}{4}$-Inch (Inside Dimensions) Cod End

Gutted Weight	Length[1]	Fish in Cover	Fish in Cod End	Total Caught	Percentage Retained in Cod End
Lbs.	Cm.[2]	No.	No.	No.	%
.2	21	1	-	1	0.0
.3	24	10	-	10	0.0
.5	27	56	1	57	1.8
.6	30	115	8	123	6.5
.8	33	212	51	263	19.4
1.0	36	365	135	500	27.0
1.3	39	348	308	656	47.0
1.6	42	119	302	421	71.7
2.0	45	34	203	237	85.7
2.3	48	4	146	150	97.3
2.8	51	1	91	92	98.9
3.2	54	-	64	64	100.0
3.8	57	-	27	27	100.0
4.3	60	-	19	19	100.0
5.0	63	-	6	6	100.0
5.6	66	-	6	6	100.0
-		1,265	1,367	2,632	-

1/ SIZE GROUPS BY 3-CM. INTERVALS. DUE TO THE METHOD OF RECORDING FISH LENGTHS TO THE LOWER FULL CENTIMETER (E.G. ALL LENGTHS FROM 21.0 CM. TO 21.9 CM. ARE RECORDED AS 21 CM.), AN ADJUSTMENT OF +0.5 CM. MUST BE MADE TO EACH LISTED GROUP LENGTH TO OBTAIN THE TRUE MID-POINT OF THE GROUP.
2/ 2.54 CM. EQUAL 1 INCH.

this net practically all fish under 0.8 pounds escaped while almost all over 2.0 pounds were retained. This cod end had a 50-percent selection point at 40.0 cm. (15.7 inches) of 1.4 pounds.

FIG. 5 - DRESSING DOWN THE CATCH.

The 50-percent selection points for the mesh sizes tested on both the Michigan and Wisconsin trips are shown in figure 7. All four points line up quite well with each other and fit well to the theoretical line developed by Beverton and Holt. With such consistency in results one can predict with confidence the selective action of cod-end meshes of other sizes.

The fact that the results with the Iceland trawl conform so well with those of the No. 41 trawls indicates that the type of gear has little effect on the selective action of the meshes.

SUMMARY AND CONCLUSIONS

1. Variations in the inside dimensions of two sizes of cod-end meshes were studied and found to agree with results of our previous experiments.

FIG. 6 - MENDING THE GEAR.

2. The selective actions of cod ends of $5\frac{7}{8}$-inch and $6\frac{3}{8}$-inch mesh were determined and found to be consistent with that of the other sizes tested previously.

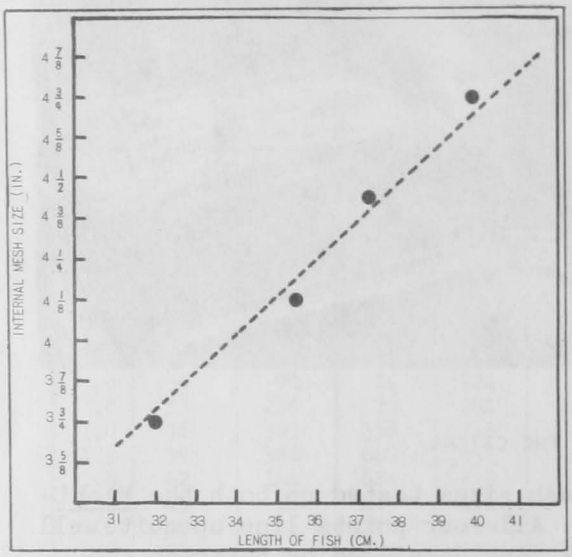

FIG. 7 - THE 50-PERCENT SELECTION POINT FOR EACH MESH SIZE (TO THE NEAREST $\frac{1}{16}$ INCH) TESTED ON THE MICHIGAN AND WISCONSIN. THE DOTTED LINE IS THE THEORETICAL RELATIONSHIP BETWEEN MESH SIZE AND 50-PERCENT SELECTION DEVELOPED BY BEVERTON AND HOLT.

3. A cod end of $5\frac{7}{8}$-inch mesh (measured between knot centers, new) constructed of 50-yard, 4-thread, double-manila twine will, after use and when wet, have an average inside mesh dimension of $4\frac{1}{2}$ inches provided it is used for 20 or more tows in normal fishing operations during which moderately heavy catches of fish are taken.

4. Such a mesh would allow most of the haddock now discarded at sea to escape but would retain most of the marketable-size haddock.

ACKNOWLEDGMENT

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