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CERTIFICATION AND AFTER-USE MEASUREMENT OF MANILA OTTER-TRAWL COD ENDS

By Ernest J. Medico*

CONTENTS

ABSTRACT

Describes the development and summarizes some results of the program for certifying manila twine cod ends used by the United States trawling fleet in the fishery for haddock, Melanogrammus aeglefinus (Linnaeus), in Northwest Atlantic Fishery Convention Subarea 5. To implement international treaty agreements concerning this fishery and to assist the industry in complying with mesh-size regulations, a program was developed for certifying new dry cod ends, which met certain tests, as having meshes equivalent to $4\frac{1}{2}$ inches when wet after use. Measurements were made of these manila cod ends, after varying amounts of use in the haddock fishery, to determine changes in after-use mesh size.

In June 1953 when regulations implemented the use of meshes for otter trawls fishing in Subarea 5, a mesh size of $5\frac{7}{8}$ inches (dry, knot center to knot center) was recommended for new before-use cod ends. Upon further study the before-use mesh size was lowered to $5\frac{5}{8}$ inches, because the meshes stretched after use to a greater degree than anticipated.

INTRODUCTION

To effect a joint approach to the problems arising in the fisheries of the Northwest Atlantic Ocean, the United States convened a conference of 11 governments at Washington in January 1949. The work of this conference resulted in opening for signature on February 8, 1949, the International Convention for the Northwest Atlantic Fisheries which has as its objective the conservation of the fisheries of the Northwest Atlantic Ocean. The Convention entered into force on July 3, 1950, and the International Commission provided for in Article II held its first meeting in April 1951. Today 12 nations are members of this commission: Canada, Portugal, Denmark, Spain, France, United Kingdom of Great Britain and Northern Ireland, Iceland, United States, Italy, U. S. S. R., Norway, and West Germany.

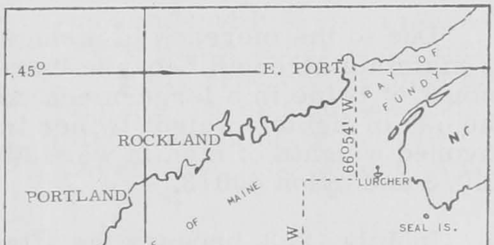


Fig. 1 - International Convention for the Northwest Atlantic Fisheries Subarea 5 where haddock regulations are in effect.

The otter trawl is the major type of fishing gear used in the North Atlantic Ocean and in many instances trawls constructed of small meshes catch and cause to be destroyed fishes that are below the proper size for maximum utilization. Reduction of the loss to the fishery of these small fish may be achieved through mesh-size regulations as there is ample demonstration of the ability of fish to escape through cod ends when an appropriate larger mesh

*Fishery Methods and Equipment Specialist, North Atlantic Exploratory Fishing and Gear Research, Division of Industrial Research and Services, U. S. Bureau of Commercial Fisheries, East Boston, Mass.

size is selected. Therefore, in an attempt to bring about proper management measures in the otter-trawl fishery for haddock, the United States and Canada accepted a proposed experimental mesh-size regulation. To this end the Secretary of the Interior published in the Federal Register on December 30, 1952, a Notice of Proposed Rule Making which, when effective, would prohibit fishermen of the United States from taking haddock in Convention Subarea 5 (fig. 1) with a net having a mesh size of less than $4\frac{1}{2}$-inches internal measure when wet after use. Because net fibers shrink after immersion in water and meshes enlarge due to tightening of knots when hoisting catches, this measurement cannot be used as a specification for a new dry net. Since fishermen engaged primarily in haddock fishing use 5-inch or 6-inch mesh sizes in the forward parts of their nets, the emphasis of the regulation was placed on the cod ends in which 80 percent or more of the fish escapement occurs. The mesh sizes of cod ends in use before regulations became effective were of $3\frac{7}{8}$ inches or smaller. Fishery biologists conducted experiments at sea aboard large otter trawlers using manila cod ends of several mesh sizes ranging from $4\frac{7}{8}$ to $6\frac{3}{8}$ inches. The results of these experiments revealed that the $5\frac{7}{8}$-inch mesh size was optimum at that time.

Because sufficient before-use data had not been developed, the original mesh regulation made no provision for the certification of new nets; however, it was felt that the fishermen could not be expected to determine what mesh size in a new cod end would shrink or stretch to the required minimum of $4\frac{1}{2}$ inches after use. The regulation went into effect at midnight May 31, 1953, and the U. S. Fish and Wildlife Service recommended a mesh size for new before-use double manila twine cod ends of $5\frac{7}{8}$ inches per mesh.

During June 1953, Fish and Wildlife Service personnel held numerous discussions with vessel owners, fishermen, twine dealers, and manufacturers. It was found that a number of different weights of manila, cotton, and some synthetic twines were being used in the cod ends of haddock trawls. These are made primarily of manila for the large trawlers and of cotton and synthetics for the smaller boats. Manila was mostly used, because of its ease of repair and its relatively inexpensive replacement compared with cotton or synthetics. All manila cod ends in use were made of double twine and were imported from either the Netherlands or England. Cotton and synthetic double and single twines used were manufactured in the United States.

Due to the increase in mesh size, it was found that heavier twine was necessary to maintain strength because there are fewer meshes and consequently a reduced amount of twine in a large-mesh cod end. This simplified the problem by eliminating the use of lighter-weight twines in the manufacture of large-mesh cod ends. The favored weights of manila were 45, 50, 75, and 80-yard, four-ply twines, cotton 120/3 and nylon 400/3.

In July 1953, because the after-use behavior of natural and synthetic fibers could not accurately be predicted, a series of tests were made by Service personnel to evaluate the uniformity of individual mesh sizes within a section of hand-knitted cod-end netting and to develop a method for certifying cod ends. Blocks of netting of varying dimensions were stretched under 50, 100, 150, and 200 pounds of tension and each mesh, including one knot, was measured longitudinally. The 200-pound tension gave the most uniform results and was recommended for adoption in the system of dry-mesh measurement for certifying new cod ends.

NEW DRY COD-END MEASUREMENTS FOR CERTIFICATION

In September 1953, a program of measuring and marking cod ends with certification tags was started. This was done to permit use of cod ends of known before-use dimensions, while research was conducted to determine proper new mesh sizes.

Certification tags are made of brass, $\frac{5}{8}$-inch wide, $1\frac{1}{4}$-inches long, and $\frac{1}{32}$-inch thick; the initials "F.W.S." (Fish and Wildlife Service) and a serial number are stamped on each. The metal strips are rolled into tubes with a small opening for insertion of the twine. After each tag is placed on the twine, it is squeezed firmly so that it doesn't slide; the overlapping ends of the strip are then soldered with lead (figure 2).

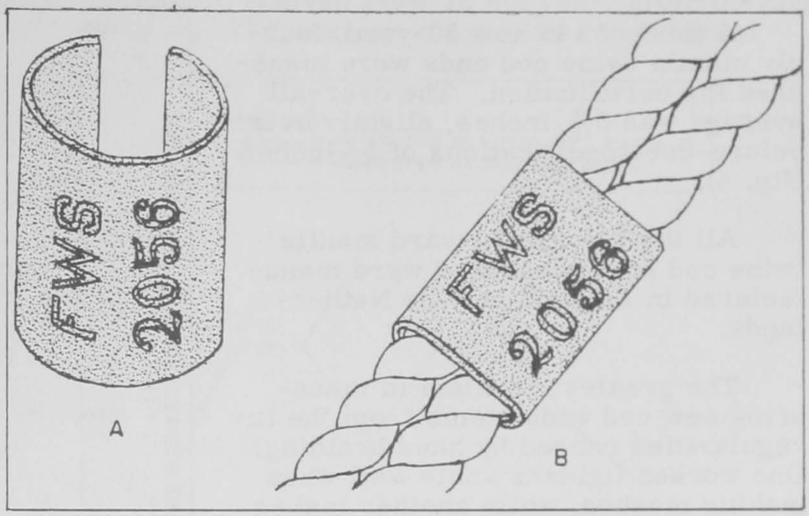


Fig. 2 - Certification tag. A - unattached. B - attached to mesh.

The procedure followed in measuring new dry cod ends is described as follows: A single series of meshes at least midway between the lacings is stretched under 200 pounds tension measured on a spring scale. While under this tension, the length of the row is measured in inches; neither the first half mesh nor the last half mesh is considered because of distortion. The average mesh size is then found by dividing the number of full meshes measured into the measured length of the row.

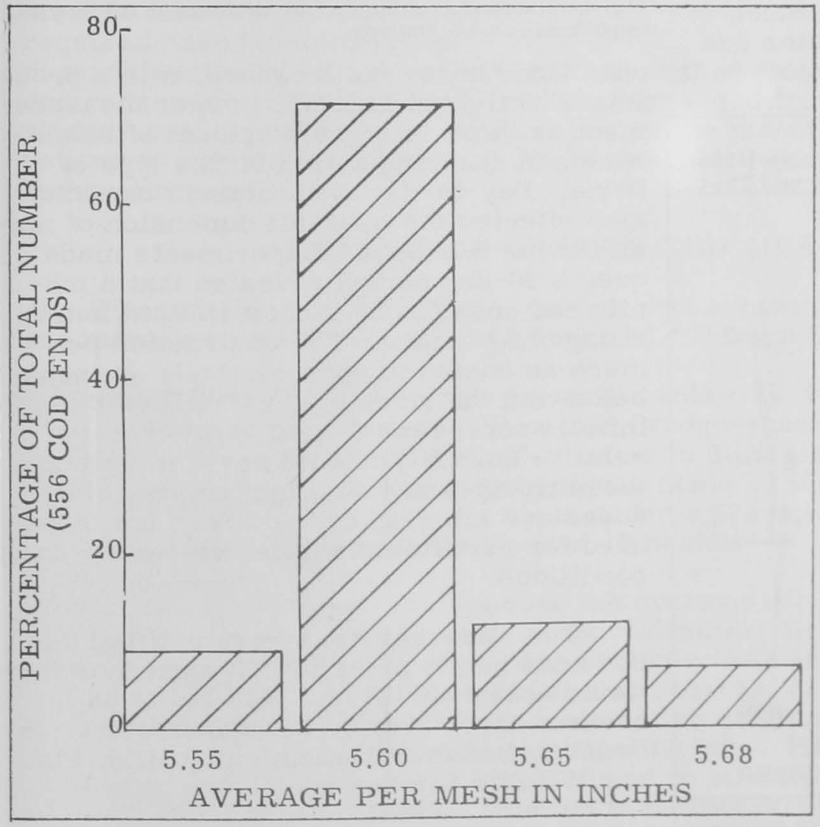


Fig. 3 - Distribution of the average mesh size of 556 50-yard, 4-ply manila twine cod ends.

From September through the end of 1953, wet-mesh measurements of 50-yard, four-ply manila twine cod ends used by the commercial fishing fleet and built on the $5\frac{7}{8}$-inch specifications showed that almost 80 percent were oversize. Experimental cod ends with $5\frac{1}{2}$-inch meshes and cod ends with $5\frac{7}{8}$-inch meshes were $\frac{7}{8}$ inch under and $\frac{1}{4}$ inch over the required $4\frac{1}{2}$-inch minimum. These findings justified a lowering of the new mesh size to $5\frac{5}{8}$-inches in early 1954.

The amended regulation, which became effective January 1, 1954, specified a before-use mesh size for 50-yard, four-ply double manila twine cod ends of $5\frac{5}{8}$ inches, and for 80-yard, four-ply double manila twine cod ends a specification of $5\frac{1}{2}$ inches per mesh. It further provided for the attachment of a seal to such netting which removed the liability of the fishermen for the action of the twine during use.

In 1954, from April through December, 556 new 50-yard, four-ply manila twine cod ends were measured for certification. Cod ends made of this size twine averaged $5\frac{39}{64}$ inches per mesh, $\frac{1}{64}$ inch under before-use specifications of $5\frac{5}{8}$ inches (fig. 3).

A total of 145 new 80-yard, four-ply manila twine cod ends were measured for certification. The over-all average was $5\frac{9}{16}$ inches, slightly over before-use specifications of $5\frac{1}{2}$ inches (fig. 4).

All the 50- and 80-yard manila twine cod ends measured were manufactured in England and the Netherlands.

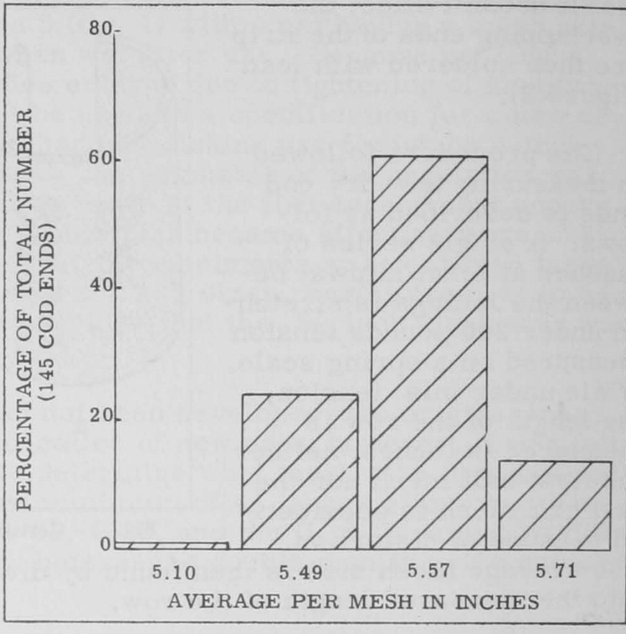


Fig. 4 - Distribution of the average mesh size of 145 80-yard, 4-ply manila twine cod ends.

The greatest problem in measuring new cod ends stems from the irregularities caused by hand braiding. One worker tightens knots well when making meshes, while another makes looser knots. This has a bearing on the final over-all 200-pound tension measure. A cod end that in all probability would meet specifications at the manufacturer's loft, would not meet specifications in the United States due primarily to the loosening of knots in transit. Once knots are loosened, it is a problem to retighten them for proper measurement as there is a great amount of resistance and shearing action in this type of twine. Day-to-day variations in humidity also affected the over-all dimension of manila twine cod-ends. Experiments made over a 30-day period revealed that a manila cod end of $285\frac{3}{8}$ inches in total length changed $5\frac{3}{4}$ inches. The contraction per mesh amounted to approximately $\frac{3}{64}$ inch below and the stretch $\frac{1}{16}$ inch above the initial average mesh size at an average relative humidity of 66.8 percent. Since these changes are so slight and no tolerances are allowed, cod ends are not measured for certification under extremely damp conditions.

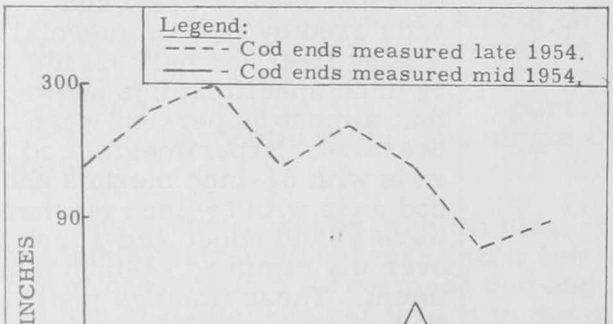


Fig. 6 - English 80-yard, 4-ply manila twine cod-end measurements compared.

The manufacturers were notified that cod ends had to meet specifications or they would not be certified. This led to an increased mesh size by the manufacturer in order to insure certification by U. S. Fish and Wildlife Service agents.

Cod-end specifications for 50-yard, four-ply manila twine manufactured in England were increased $\frac{1}{8}$ inch by the importing net dealer to assure certification upon tightening of knots. Netherlands manufacturers increased their specifications by $\frac{1}{4}$ inch for this weight manila twine.

A comparison of measurements was made on eight Netherlands 50-yard, four-ply manila cod-ends in mid-1954 with eight received later in the year, after the manufacturer increased his dimension (fig. 5). The average mesh size ranged from 5.80 to 6.12 inches.

Manufacturers in Grimsby, England, were requested to measure and mark each cod end placed in a bale for shipment to the United States. Ten cod ends were constructed of 80-yard, four-ply manila twine and each net was marked with the measurement made by the manufacturer. Upon arrival they were measured by U. S. Fish and Wildlife Service agents to compare results (fig. 6).

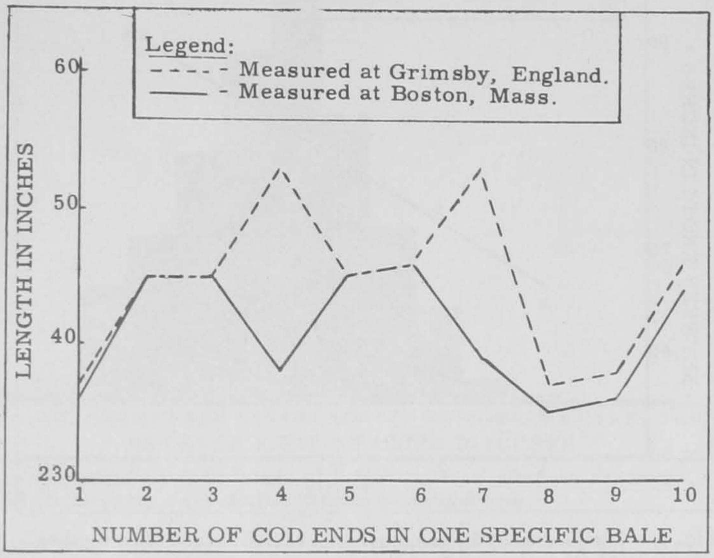


Fig. 6 - English 80-yard, 4-ply manila twine cod-end measurements compared.

During the first 6 months of 1955, 153 50-yard four ply and 164 80-yard four-ply manila twine cod ends were measured. Most of these were above the required specifications because of manufacturers' increased dimensions. The average mesh size in the Grimsby cod ends made from 50-yard manila twine ranged from slightly over $5\frac{5}{8}$ inches to slightly over $5\frac{3}{4}$ inches new, before use, as the manufacturer decreased his specifications to $5\frac{11}{16}$ inches per mesh. Netherlands cod ends averaged between $5\frac{3}{4}$ and $5\frac{7}{8}$ inches per mesh.

WET AFTER-USE COD-END MEASUREMENTS

The gathering of wet, after-use data was accomplished by boarding the trawlers and measuring the trawls on completion of fishing trips.

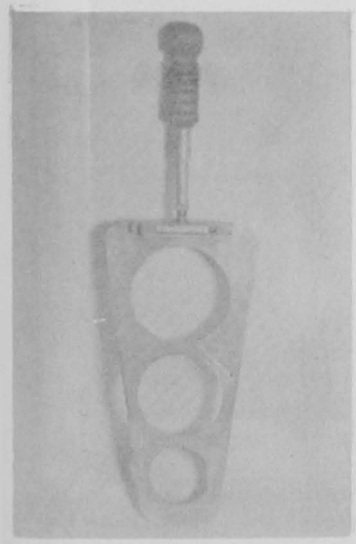


Fig. 7 - Measuring gauge.

All measurements of wet meshes for after-use data were made with a flat, wedge-shaped, spring-loaded gauge having a taper of 2 inches in 8 inches and a thickness of $\frac{3}{32}$-inch. Measurement was made by inserting the blade of the gauge into the mesh under a pressure of not less than 10 pounds nor more than 15 pounds.

Because the average life of original webbing in manila cod ends is approximately 3 trips, and seldom over 4 trips, considerable difficulty was encountered in gathering sufficient reliable data, that is, data from cod ends that are identifiable in their entire original lengths by Fish and Wildlife Service certification tags. Heavy fishing causes the after part of the cod end to stretch more rapidly than the forward part. This led to cutting off the stretched meshes in the after part of the cod end, the area of greatest tension from the hoisting strap to the end. A corresponding number of new meshes would be put on to replace those taken off. The forward part of the original cod end would be used on several more trips because load tension is less in this area and meshes will not stretch until the useful life of the twine is practically gone. These lower meshes may be replaced several times before the entire cod end is replaced. Other factors are severe abrasion which weakens the twine and major alterations through mending. Differences of mesh sizes in forward and after sections can be as much as $\frac{1}{4}$ inch.

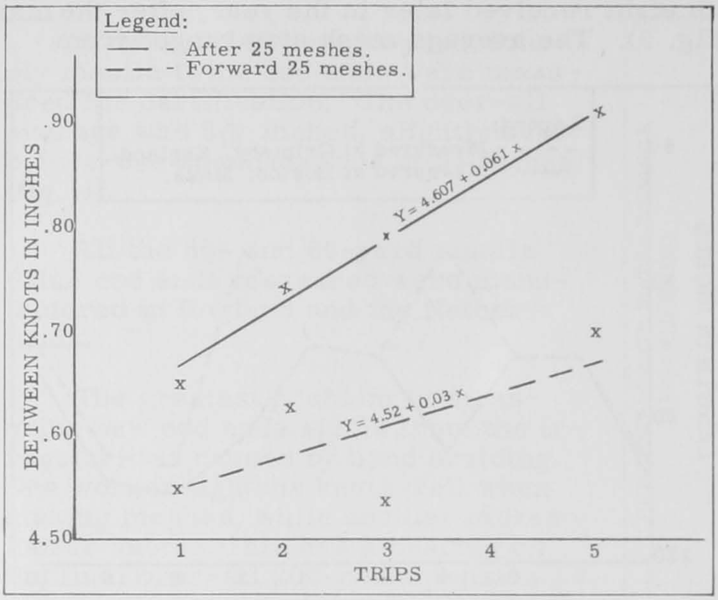


Fig. 8 - Comparison of the changes in size of forward and after meshes of 50-yard, 4-ply double manila twine cod ends.

Rope lines were fastened diagonally across the cod end from one side, lacing to the other from just above the hoisting strap to the end of the cod end. The purpose of these lines from the fisherman's point of view is to retard stretching and to prevent the cod end from bursting while lifting large quantities of fish. These lines and replacing of lower meshes introduce additional bias into the after-use data, as escapement equivalents are based upon the average useful life of the net. Alterations made during that period nullify data upon which certification is based.

Of several hundred cod ends that could be identified and measured during 1954, more than half were under $4\frac{1}{2}$ inches after use. Much of this was due to renewal of after-end meshes or one-trip cod ends. Under normal conditions, the knots in the twine are not sufficiently tightened to give true measure in one trip. Those that exceeded specifications ranged around $4\frac{7}{8}$ inches per mesh.

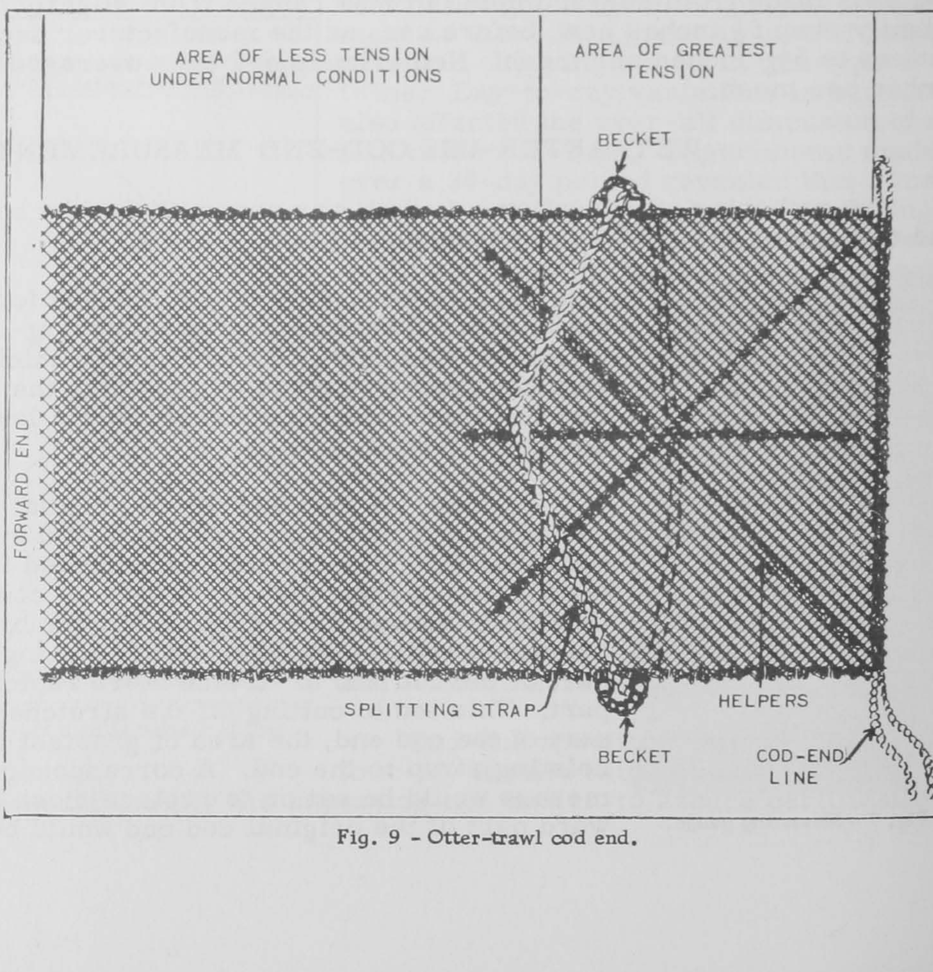


Fig. 9 - Otter-trawl cod end.

Figure 10 demonstrates dispersion about the mean of $4\frac{1}{2}$ inches for meshes in 15 manila cod ends. These cod ends were selected because they had not been cut to replace after-end meshes or altered in any way. These measurements were taken after one trip (at which time after-cod-end meshes are still elongating) through 3 trips, or the average life of a manila cod end under reasonable loads.

After-use data gathered through the years 1955, 1956, and 1957 revealed that cod ends made of 50-yard, four-ply manila twines were practically all within the specifications after use. Unmodified cod ends, identified by F. W. S. tags, used on 1 through 4 trips showed oversize meshes.

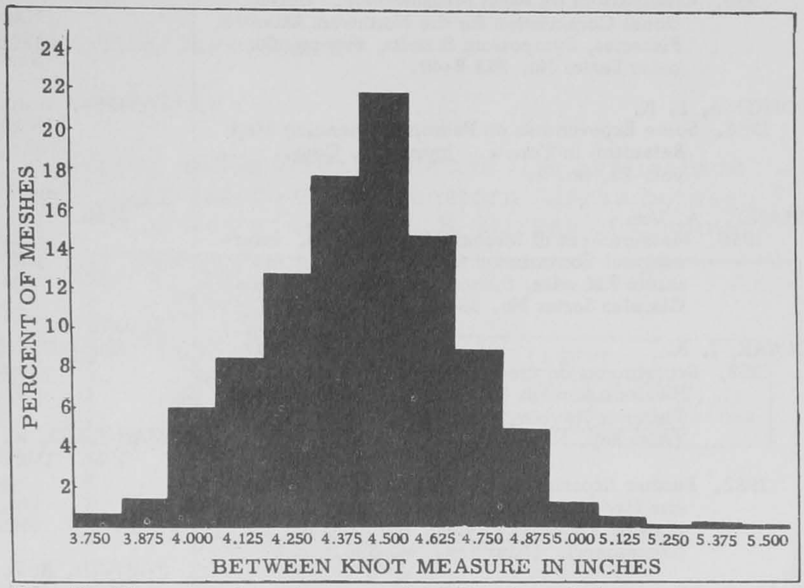


Fig. 10 - Dispersion about the mean of 4.500 inches of after-use measurements of 15 50-yard, 4-ply double manila twine cod ends.

OBSERVATIONS

The consensus of those engaged primarily in the haddock fishery is that the regulation is beneficial. Those engaged in the catching of other species including haddock are critical of the regulation. Their marketable catch is composed of all sizes and species, such as whiting and ocean perch, which either escape or gill in regulation-size haddock meshes.

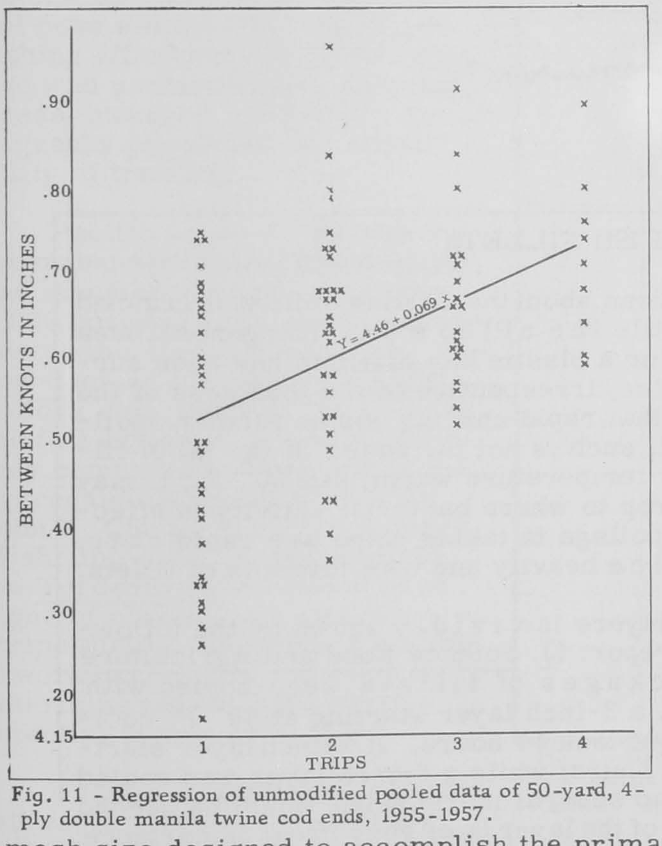


Fig. 11 - Regression of unmodified pooled data of 50-yard, 4-ply double manila twine cod ends, 1955-1957.

To manufacture cod ends with meshes of specified minimum before-use size and not have the meshes much larger than the specified minimum after fabricating is quite difficult. Keeping meshes to the size they were when manufactured is virtually impossible. Loosening of knots caused by handling, packing, and shipping results in a much smaller mesh and conversely the tightening loose knots will allow a gain of several inches in the total cod-end length. Because of this problem, manufacturers have increased mesh sizes to insure certification.

Rapid or slow enlargement of meshes is governed by the way in which a cod end is used. Hoisting of extremely heavy quantities of fish over the trawler's side would naturally stretch the meshes short of the shearing point more quickly, and only intermittent use with light loads will result in less stretch.

The mesh regulation is recognized by all who work with the fishery as a requirement for the use of an average mesh size designed to accomplish the primary objective of releasing haddock of a size sufficient to allow the maximum utilization of the resource.

BIBLIOGRAPHY

BEDFORD, B. C. AND BEVERTON, J. H.
1956. Observations on Mesh Measurement. International Commission for the Northwest Atlantic Fisheries, Symposium Biarritz, France, Circular Series No. 353 B-40.

BOEREMA, L. K.
1956. Some Experiments on Factors Influencing Mesh Selection in Trawls. Journ. du. Cons., vol. 21, no. 2.

BRANDT, A. Von
1956. Measurement of Meshes of Trawl Nets. International Commission for the Northwest Atlantic Fisheries, Symposium Biarritz, France, Circular Series No. 353 B-42.

CLARK, J. R.
1952. Experiments on the Escapement of Undersize Haddock through Otter Trawls. Commercial Fisheries Review, vol. 14, no. 9 (September). (Also Sep. No. 321.)

1952. Further Experiments on the Escape of Undersize Haddock through Otter Trawls. Commercial Fisheries Review, vol. 14, no. 12 (December). (Also Sep. No. 335.)

ELLIS, R. W.
1951. Further Experiments on the Shrinkage of Trawl Cod-End Meshes. Paper presented to Fishing Gear Subcommittee, International Council for the Exploration of the Sea.

GRAHAM, H. W.
1952. Minimum Net-Mesh Size for the New England Haddock Fishery, Commercial Fisheries Review, vol. 14, no. 12 (December). (Also Sep. No. 334.)

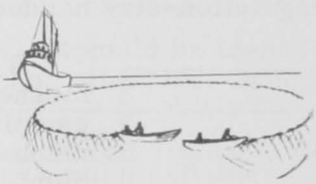
1954. United States Research in Convention Sub-Area 5 During 1953. International Commission for the Northwest Atlantic Fisheries, Ann. Proc. 4.

______ and PREMETZ, E. D.
1955. First Year of Mesh Regulation in the Georges Bank Haddock Fishery. U. S. Department of the Interior, Fish and Wildlife Service, Special Scientific Report--Fisheries No. 142.

KLUST, G.
1956. Changes of Length of Net Lurnes by Water. Protokolls zur Fischereitechnick Bd. 4 in Druck, (17), Hamburg, 1956.

MARGETTS, A. R.
1956. Definitions and Testing of Light Trawls. International Commission for the Northwest Atlantic, Symposium Biarritz, France, Circular Series No. 353 B-45.

PARRISH, B. B.
1950. Experiments on the Shrinkage of Trawl Cod-End Meshes. Paper presented to Comparative Fishing Sub-Committee, International Council for the Exploration of the Sea.



COOLING FISH FILLETS

The fishing industry has false ideas about the cooling ability of crushed ice; also too many believe that a little ice will do a lot. The general idea seems to be that once a fish, a can, or a plastic bag of fillets has been surrounded, even lightly, with crushed ice, irrespective of the thickness of the fish itself or the container of fillets, that rapid chilling and no further spoilage is assured. More often than not, such is not the case. If the lot of fillets happens to be thick and their temperature warm, say 60° F., it may take hours for the temperature to drop to where bacterial activity is effectively slowed down. Meantime, spoilage is taking place at a rapid rate. The answer to this situation is to ice heavily and use thin lots of fillets.

The effectiveness of icing thin layers is vividly shown by the following data taken from an English report (J. Science Food and Agriculture 9(2) 78-82, 1958): "When the packages of fillets were cooled with plenty of ice on both top and bottom, a 3-inch layer starting at 40° F. cooled to 38° F. in 2½ hours; a 6-inch layer took 10 hours. A 3-inch layer starting at 60° F. cooled to 33° F. in 4 hours; while a 6-inch layer was cooled from 60° F. to 36° F. in 10 hours and several more hours would be needed to reach 33° F." Thus the thickness of the layer is of very great importance.