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A MINIMUM NET-MESH SIZE FOR THE NEW ENGLAND HADDOCK FISHERY

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INTRODUCTION

Haddock support the most valuable fishery in New England today. The average annual landings over the last ten years have been about 150 million pounds, with an ex-vessel value of $12,000,000. About 67 percent of this quantity is taken from the rich Georges Bank area lying off Cape Cod.

The method by which these fish are taken today is very wasteful. The gear in common use for catching haddock on Georges Bank is the otter trawl. These nets are made with a small mesh which retains undersized fish. The small haddock have little or no market value and are discarded at sea in a dead or dying condition. The destruction of baby haddock is sometimes tremendous, and annually amounts to 5 million pounds or 15 million individual fish. The fishing industry and government have been greatly concerned about this wasteful practice for many years and have repeatedly called for the protection of these young fish.

INTERNATIONAL COMMISSION

Since the fishing banks in question lie in international waters, it was not possible to bring them under regulation until the organization of the International Commission for the Northwest Atlantic Fisheries. With the activation of this body all countries fishing in the northwest Atlantic have agreed to abide by any regulations promulgated upon the recommendation of the Commission.

The United States Commissioners have appointed an industry advisory committee which advises these Commissioners as to the problems of the United States fishing industry and reviews all recommendations of the Commission which pertain to the areas in which United States vessels fish.

At the request of the industry, the United States Government presented the haddock problem to the Commission at its First Annual Meeting held in Washington in April 1951. The Commission considered the problem and at its Second Annual Meeting held at St. Andrews, New Brunswick, in July 1952, recommended that the baby haddock on Georges Bank and the Gulf of Maine be saved by limiting the size of mesh used in otter-trawl nets. The United States has promulgated a regulation to implement this recommendation. Canada is expected to follow.

SAVING SMALL FISH

Taking small fish is generally assumed to be a wasteful practice. However, nature is sometimes so prolific that the loss of a considerable proportion of the young of a population does not seriously affect the continued abundance of the species. There is always the possibility that man can make considerable inroads into a population without seriously jeopardizing replacement. A scientific study of the dynamics of a population is necessary before the effects of such inroads can

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be predicted. To make such a study it is necessary to know the fecundity of a species, the growth rate, and the mortality rates, as well as other aspects of the biology of the species.

Such a study of the Georges Bank haddock population has been made by the U. S. Fish and Wildlife Service and the results have been reviewed by the scientific advisers to the Commission. The results of these studies indicate that the Georges Bank stock probably can withstand present fishing pressure indefinitely but that the production from this stock could be substantially increased if the smaller fish were not taken. It was found that the best age at which to begin catching these fish is three years. The present age of first capture is somewhat under 1½ years. Thus, a considerably larger-mesh net than the one now in use is required to obtain the maximum sustained yield from the Georges Bank haddock.

INITIAL EFFECT

An abrupt change in age of first capture to age three would inflict a hardship on the industry as considerable quantities of two- and three-year-old haddock are now marketed. There is at present a good market for haddock as small as 1½ pounds. Fish weighing between 1½ and 2½ pounds are classified as "scrod" haddock and bring a lower price than fish weighing over 2½ pounds which are classified as "large" haddock. According to an agreement among the members of the New England Fish Exchange, haddock under 1½ pounds are not to be sold. However, fish under that size are sometimes landed, especially when there is a scarcity of larger sizes.

At the end of their second year haddock average slightly less than one pound (about 0.9 pounds) in weight. None of these should be taken. At the end of their third year they average slightly less than two pounds (about 1.9 pounds) and all are of marketable size. It is obvious that limiting the catch to sizes over 1.9 pounds (three-year-old fish) would lower the landings during the early phase of the regulation.

MINIMIZING INITIAL EFFECT

It was the desire of the Commission that the first step in regulating the Georges Bank haddock fishery should be to require the use of a net with a mesh size which would allow a maximum proportion of unmarketable-sized haddock to escape with minimal effect on the catch of marketable-sized fish. In this connection we are confronted with the fact that no net is perfectly selective. No net has been designed that will release all fish under a certain size and retain all fish over that size.

The selectivity of nets is designated by the 50-percent point. This is the size of fish of which 50 percent are retained by the net. Increasing percentages of the larger sizes are retained, while decreasing percentages of the smaller sizes are retained. The selectivity chosen to satisfy the requirements of the Commission has a 50-percent point at about 1.1 pounds. With a mesh of this selectivity some fish of unmarketable size will still be taken, but this cannot be prevented if we are to avoid a serious reduction in landings during the first year or two of the regulation.

The actual reduction in landings the first year of regulation will depend upon the size of the haddock available on the banks during that year. If the fish are running larger than average, the regulation will have very little effect on landings. If the fishery is depending largely upon small scrod, as it was during the summer of 1952, the effect will be greater. Indications are that the sizes of haddock available on Georges Bank in the coming year will be about the same as in 1951.

If this is the case, the initial effects of the use of the new mesh (having 50-percent selection at 1.1 pounds) would be to reduce landings (in pounds) about 13 percent if the market accepted fish as small as some of those landed during 1952.

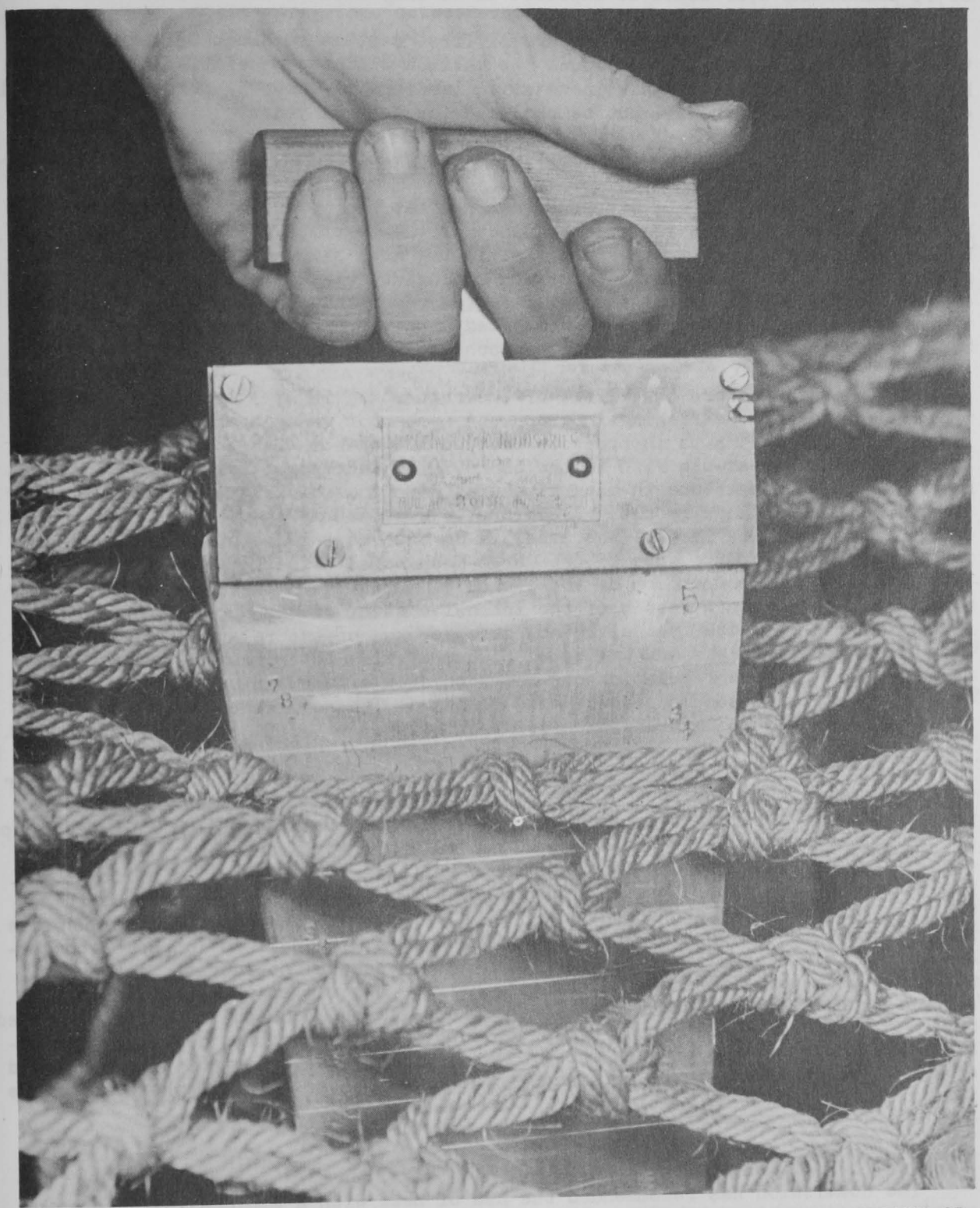


FIGURE 1 - INDICATES HOW THE PRESSURE GAUGE WILL BE USED TO MEASURE THE INSIDE DIMENSIONS OF MESH UNDER A PRESSURE OF 12 POUNDS. A PRESSURE OF 12 POUNDS BRINGS THE NOTCH IN THE INDICATOR TO THE NOTCH IN THE PLATE.

The reduction in landings of fish of 1½ pounds and over, however, would be only about 5 percent. If the size of fish during the first year of regulation is close to the average for the past 20 years, the initial reduction in landings of fish of 1½ pounds and over would be expected to be only about 3 percent.

The new mesh will advance the age of first capture to about 2½ years rather than 3 years and so will not produce the maximum ultimate benefit. It should, however, result in an ultimate increase in landings of about 35 percent. The full effect of the new mesh will not be realized for several years.

ASSESSING THE EFFECT OF THE REGULATION

It is the Commission's expressed desire that the effect of this regulation be carefully measured. Scientific evidence of the benefits of the first step must be presented before any further increase in the mesh size of nets will be recommended. U. S. Fish and Wildlife Service biologists will make a continuous study of the fishery and the Commission will review the situation annually. Modifications in the regulation will be recommended whenever they appear desirable on the basis of any new evidence which may be found.

In order to measure the effect of the regulation it will be necessary to have the cooperation of the fishing industry. A number of vessels must continue to fish with small-mesh nets in order to provide biologists with a measure of the abundance of two-year-old fish in the banks. The success of spawning varies so much from year to year due to natural causes that considerable variations in subsequent annual landings result. Therefore, the effect of the regulation cannot be determined by a comparison of the landings in the years immediately preceding and immediately following the use of the large-mesh nets. The best test of the regulation will be the comparison of the yields of individual year classes before and after regulation. As a result of the intensive study of the Georges Bank haddock fishery over the past 20 years, we now have records of the relative strengths of each incoming year class and the total pounds of fish which each contributed to the landings. If the regulation has the predicted effect, an entering year class of a given strength should produce more pounds of landed fish than did any incoming year class of equal strength before regulation.

In order to make this comparison it is necessary to measure the incoming year classes after regulation in the same manner in which they are measured now. The present measure consists of computing the average catch per day of a selected group of trawlers. The youngest haddock that can be measured adequately are two-year olds, since one-year olds are not landed in sufficient numbers. Not all of the two-year olds are landed, but so long as the size of mesh remains constant this does not matter as the abundance index is only relative. However, if the mesh size is increased, the measure of abundance of two-years olds will no longer be comparable. For this reason it is necessary that some vessels continue to fish nets with the old mesh. The Fish and Wildlife Service has called upon the industry to select six boats for this purpose. These boats will be licensed to use small-meshed nets and will comprise a "study group" to supply the information necessary for establishing the strength of each incoming year class. The information on the yield of these year classes can be obtained from samples of the catch of the rest of the fleet.

SIZE OF MESH

The Commission has recommended the use of nets with a minimum inside opening of 4½ inches when in use. This dimension is measured by inserting a flat gauge into the mesh under a pressure of 12 pounds (figure 1). It is the size of this

inside opening which determines the selectivity of the net. Any mesh regulation must be based on this dimension.

Unfortunately this is not the measurement which is used in the trade. Net manufacturers use the dimension "between knot centers." The relation between the two measurements is not constant but depends upon the size of twine and number of strands used. The use of large twine results in larger knots which increase the difference between the two dimensions. Doubling the twine has the same effect.

Using the net also changes the relation between the two measurements. When a new net is immersed in water the twine shrinks. As the net is used, however, the knots tighten and the inside dimension increases. This continues for some time or until very heavy catches are hauled aboard when the knots may tighten to their maximum and the internal opening thereafter remains fairly constant. Since in present fishing practices the after part of the cod end of the net is subjected to greater strains than the forward part, the openings of the meshes are usually larger in the after part after use.

To obtain 50-percent selection of haddock at 1.1 pounds, it is necessary to use a cod end with an average inside dimension of $4\frac{1}{2}$ inches. The meshes may be somewhat smaller in the forward part and somewhat larger in the after part.

Experiments have been conducted on board commercial trawlers during normal fishing operations on Georges Bank in order to determine the size of mesh which will, after use, have an inside dimension of $4\frac{1}{2}$ inches. These experiments show that 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 in normal fishing operations during which moderately heavy catches of fish are taken.

The results also showed that bellies of trawls of 5-inch mesh (measured between knot centers) constructed of 75-yard, 4-thread single twine will, after use and when wet, have an average inside dimension of $4\frac{5}{8}$ inches. Bellies of $5\frac{1}{2}$-inch mesh (measured between knot centers) constructed of 60-yard, 4-thread, single twine, will under the same conditions have a somewhat larger inside dimension.

The regulation prescribes only the size of the internal mesh opening. Various sizes of mesh as measured between knot centers can be used to produce the $4\frac{1}{2}$-inch inside measurement depending upon the size of twine. The experiments reported above can be used as a guide in the manufacture of a net which will meet the requirements of the regulation.

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

SELECTED BIBLIOGRAPHY

BOWMAN, A.
1928. THE QUALITATIVE EFFECT OF DIFFERENT FISHING GEARS ON THE STOCK OF THE MARKETABLE SPECIES. CONS. PERM. INTERNAT. EXPLOR. MER., RAP. PROC.-VERB., VOL. 52, PP. 227-238.

CLARK, JOHN R.
1952. EXPERIMENTS ON THE ESCAPE OF UNDERSIZED HADDOCK THROUGH OTTER TRAWLS. U. S. FISH AND WILDLIFE SERVICE, COMMERCIAL FISHERIES REVIEW, VOL. 14, NO. 9 (SEPT. 1952), PP. 1-7.

DAVIS, F. M.
1934. MESH EXPERIMENTS WITH TRAWLS, 1928-1933. MINISTRY AGRIC. AND FISH., FISH. INVEST., SER. II, VOL. 14, NO. 1, 56 PP.

FULTON, T. WEMYSS
1921. REPORT ON HERRING TRAWLING INVESTIGATIONS. FISH. BD., SCOTLAND, SCI. INVEST., 1921, NO. II, 363 PP.

HERRINGTON, WILLIAM C.
1932. CONSERVATION OF IMMATURE FISH IN OTTER TRAWLING. TRANS. AMER. FISH. SOC., VOL. 62, PP. 57-63.

1935. MODIFICATIONS IN GEAR TO CURTAIL THE DESTRUCTION OF UNDERSIZED FISH IN OTTER TRAWLING. BUREAU OF FISHERIES, U. S. DEPT. OF COMMERCE, INVESTIGATIONAL REPORT NO. 24, 48 PP.

1936. DECLINE IN HADDOCK ABUNDANCE ON GEORGES BANK AND A PRACTICAL REMEDY. BUREAU OF FISHERIES, U. S. DEPT. OF COMMERCE, FISHERY CIRCULAR NO. 23, 22 PP.

1941. A CRISIS IN THE HADDOCK FISHERY. FISH AND WILDLIFE SERVICE, U. S. DEPT. OF THE INTERIOR, FISHERY CIRCULAR NO. 4, 14 PP.

1944. FACTORS CONTROLLING POPULATION SIZE. TRANS. NINTH NORTH AMER. WILDLIFE CONF., 1944, PP. 250-263.

SELECTED BIBLIOGRAPHY (CONTD.)

NEEDLER, A. W. H.
1930. THE MIGRATIONS OF HADDOCK AND THE INTERRELATIONSHIPS OF HADDOCK POPULATIONS IN NORTH AMERICAN WATERS. CONTR. CANAD. BIOL. FISH., N. S., VOL. 6, NO. 10, PP. 243-313.

PARRISH, B. B. AND POPE, J. A.
1951. FURTHER RESULTS ON THE EFFECTS OF USING SMALL-MESH COVERS: EFFECTS ON THE CATCHES OF THE ESCAPE SIZES OF FISH. PAPER PRESENTED AT 1951 MEETING OF INT. COUNCIL EXP. SEA, MIMEOGRAPHED, 12 PP.

RUSSELL, E. S. AND EDSER, T.
1926. THE RELATION BETWEEN COD-END MESH AND SIZE OF FISH CAUGHT. PRELIMINARY EXPERIMENTS WITH THE TROUSER TRAWL. JOUR. CONS., CONS. PERM. INTERNAT. EXPLOR. MER., VOL. 1, NO. 1, PP. 39-54.

SCHROEDER, WILLIAM C.
1942. RESULTS OF HADDOCK TAGGING IN THE GULF OF MAINE FROM 1923 TO 1932. SEARS FOUNDATION: JOUR. MARINE RES., VOL. 5, NO. 1, JUNE 1942, PP. 1-19.

SCHUCK, HOWARD A.
1949. RELATIONSHIP OF CATCH TO CHANGES IN POPULATION SIZE OF NEW ENGLAND HADDOCK. AMER. STAT. ASSN: BIOMETRICS, VOL. 5, NO. 3 (SEPT. 1949), PP. 213-231.

1951. STUDIES OF GEORGES BANK HADDOCK. PART I: LANDINGS BY POUNDS, NUMBERS, AND SIZES OF FISH. U. S. FISH AND WILDLIFE SERVICE, FISHERY BULLETIN, 66, VOL. 52. PP. 151-176.

_____ AND ARNOLD, EDGAR L. JR.
1951. COMPARISON OF HADDOCK FROM GEORGES AND BROWNS BANKS. U.S. FISH AND WILDLIFE SERVICE, FISHERY BULLETIN 67, VOL. 52, PP. 177-185.

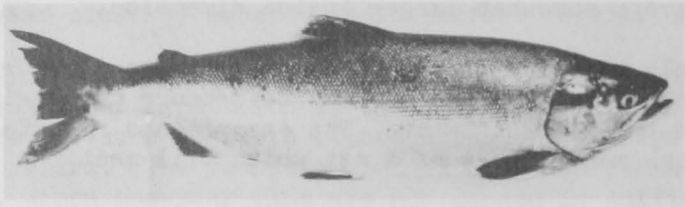
THOMPSON, HAROLD
1939. THE OCCURRENCE AND BIOLOGICAL FEATURES OF HADDOCK IN THE NEWFOUNDLAND AREA. NEWFOUNDLAND DEPT. NAT. RESOURCES, RESEARCH BULLETIN NO. 6, PP. 1-31.

TODD, R. A.
1911. COVERED NET EXPERIMENTS. NORTH SEA FISH. INVEST. COMM, 1906-1908. THIRD REPORT. (SOUTHERN AREA) ON FISHERY AND HYDROGRAPHICAL INVESTIGATIONS IN THE NORTH SEA AND ADJACENT WATERS. MAR. BIOL. ASSOC., UNITED KINGDOM, PP. 177-206.

VLADYKOV, VADIM D.
1935. HADDOCK RACES ALONG THE NORTH AMERICAN COAST. BIOL. BD. CAN. PROG. REPORT, NO. 14, PP. 3-7.

ARE SALMON SUPERSENSITIVE

During research of the salmon run in Stamp River, Vancouver, British Columbia, Canada, a man was walking barefooted in the water 20 feet above the salmon ladder. It was noticed at once that the number of salmon traveling upstream was reduced. Other trials showed the same result. One observer held his hand in the water for one minute above the place where the counting of the fish took place. An instant reduction in the number of fish going upstream was noticed--from 34 fish in 10 minutes down to 4 fish in 10 minutes. One hour later the same experiment was repeated with the same result, states the October 1952 issue of Svenska Vastkustifiskaren, a Swedish trade periodical.



RED OR SOCKEYE SALMON (ONCORHYNCHUS NERKA).