A REGULATION TO INCREASE THE YIELD OF THE NEW ENGLAND HADDOCK FISHERY

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The New England groundfish fishery has been an important industry since the earliest period in this country's history. In the early days the fish were taken with hook and line, first with hand lines and later with line trawls. In both of these methods baited hooks are used.

In 1905 the fishing on New England banks was revolutionized by the introduction of the otter trawl. This new method met with a great deal of opposition from many members of the industry. They maintained that this new device with its heavy otter boards and wide dragging net would destroy the fishery by killing the small fish and ruining the bottom itself. They foresaw the destruction of the bottom food and natural habitat of the important groundfish.

In spite of this opposition the fleet of trawlers increased slowly from 1905 to 1925 (Herrington, 1932) when the filleting of cod and haddock was initiated. This new marketing procedure greatly increased the demand for haddock which formerly had only a limited market. As a result of this the fleet of otter trawlers was greatly expanded until in 1930 there were 323 working out of New England ports. Today there

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are more than 600 otter trawlers of various sizes landing at New England ports and practically no large line trawlers; only two remain in Boston.

Opposition to the otter trawl is still heard but this gear is now accepted as the standard method of fishing for groundfish by the New England fleet. There is no evidence to prove or disprove the theory that this trawl is damaging to the food and habitat of groundfish.

The other objection to the otter trawl, that it destroys large quantities of small fish, is valid. It does destroy large quantities of immature fish. Herrington (1932) reported that in the years 1913 and 1930-31 otter trawlers fishing out of New England ports captured between two and three times as many undersized or trash haddock as marketable haddock. In 1930 there were 37 million haddock landed while somewhere between 70 million and 90 million undersized haddock were caught and destroyed at sea. This destruction continues. During the last five years the annual destruction of small haddock by the New England fleet of otter trawlers has averaged over five million pounds.

Because of present socio-economic conditions there appears to be no way to provide a utilization of this now wasted food resource. Under present economic conditions it is not profitable for the haddock fishermen to land these small haddock which are

caught in such great numbers. There remains only the possibility of preventing their capture.

We are now faced with the problem of whether this destruction of baby scrod is detrimental to the haddock fishery. Has the great wastage of undersized fish contributed to the decline of the New England haddock fishery and does the continued destruction of these sizes threaten present production?

Let us examine first the record of this fishery since the start of intensive fishing by otter trawlers. As the demand for haddock increased fishing was intensified and landings increased accordingly. Until 1928 haddock was plentiful on Georges Bank (off Cape Cod) and most of the catch was taken there.

A peak was reached in 1929 when over 250 million pounds of haddock were landed in New England ports. About 223 million pounds of this were taken on Georges Bank. During the five following years there was a rapid decline in landings from Georges Bank, reaching the alarming figure of 50 million pounds in 1934. This was due to a scarcity of fish. In that year only about one-third as many haddock were caught per day's fishing as in earlier years.

Because of the scarcity of fish on Georges Bank the trawlers extended their fishing to the Nova Scotian Banks. In that year (1934) almost twice as much haddock was landed in

the New England ports from Nova Scotian Banks as from Georges Bank. Fishing on these more distant banks, of course, involves longer trips with greater production costs. Furthermore, the quality of the fish suffers when too great a time elapses between catching and landing.

In 1934 it appeared certain that the haddock fishery on the New England Banks was doomed unless drastic measures were taken to conserve the rapidly depleting stocks of fish. However, 1934 proved to be a low point in the production of haddock from Georges Bank.

The records show that from 1934 to 1941 there was a rather steady increase in landings from Georges Bank from the low figure of 50 million pounds to a value of 122 million pounds. Furthermore these landings were not made at the expense of a diminishing stock. The catch per day's fishing also increased during that period from 10 thousand pounds to 17 thousand pounds. The Georges Bank haddock stocks effected a partial recovery without the aid of man. The fishing effort was intense during this period, and rather constant from year to year. Evidently the decline in the Georges Bank haddock stock in the thirties was due partly to natural causes. Likewise, natural causes probably brought about an improvement in the stocks later in the face of continued fishing pressure.

However, the annual production of Georges Bank has never returned to the high values attained in the late twenties nor has the index of abundance. Intensive fishing is holding the stocks at a reduced level. The average annual landings for the past ten years was 96 million pounds while the annual catch per day's fishing averaged 15.1 thousand pounds. The year to year landings and indices of abundance over the past ten years do not show any definite trends either downward or upward. We must conclude that the Georges Bank haddock fishery has reached a stage of equilibrium. The annual production, the fishing effort, and the abundance of stock have entered a rather stable state when viewed over a period of a number of years. Fluctuations occur in accordance with fluctuations in recruitment due to natural causes but for the long term there seems to be a certain stability.

Under present socio-economic conditions it is apparently less profitable for fishermen to fish the Georges Bank stocks below their present level than to move to more distant banks of higher abundance.

Thus, without any management, it is probable that the haddock production on Georges Bank would continue at about its present level, barring any drastic change in the socio-economic relations or the occurrence of some unusual natural phenomenon.

The problem, then, for the fishery managers is to determine whether the present average annual production could be increased by some management procedure. Is it possible to stabilize the fishery at a higher level of production? If so, how can this be accomplished?

The Fish and Wildlife Service initiated an intensive investigation of the haddock fishery in 1931. Through this program which was developed and carried on for many years by W. C. Herrington and continued by Howard A. Schuck, a fine body of statistics has been accumulated on this fishery. In the study of the vast quantity of data collected on the New England haddock fishery, attention was directed primarily toward the analysis of the stocks on Georges Bank since that bank is the most important to New England because of its proximity.

Data now available for the Georges Bank haddock for the years 1931 to the present include accurate information on landings, by pounds, numbers, and sizes of fish; on year-class strength, growth rate, mortality rate, index of abundance, and degree of independence of stock.

As a result of these investigations the Fish and Wildlife Service has for many years advocated a minimum mesh size for vessels fishing haddock on Georges Bank (Herrington, 1932, 1936, 1941; Schuck, 1947, 1948; Royce and Schuck, 1950). However,

no regulatory measures were ever taken and the waste of small fish continued year after year.

At the first meeting of the International Commission for the Northwest Atlantic Fisheries at Washington, D. C. in April 1951 this issue received considerable attention. The Commission agreed that the waste of small fish should be stopped. The question was raised, however, as to whether it was economic to select a mesh size which would protect undersized fish which are now being landed, as well as the fish which are discarded at sea.

A group of Canadian and American scientific advisers was instructed to review the whole problem, to formulate a regulation, and to develop a research program to be carried on before and after regulation in order to assess accurately the effects of the regulation.

The group consists of members of the Fishery Research Board of Canada and members of the Fish and Wildlife Service of the United States.

This group first explored the various possibilities of increasing the level of production.

There seemed to be no reason to recommend a closed season for Georges Bank. There is no evidence to indicate that the loss of production during the closed period would be more than compensated for by any increase in weight which the fish might

attain during that protective period.

There is also no evidence to indicate that protection of spawning fish would be beneficial. Fluctuation in recruitment seems to be unrelated to size of spawning population. Schuck's unpublished data show that recruitment as expressed by abundance of two-year old haddock varies as much as 35 times during a period in which the spawning population remains comparatively uniform. Fluctuations in amount of recruitment due to environmental conditions are so great that it is not possible to assess the importance to recruitment of size of spawning stock at this time.

There remains the problem of the great waste of immature haddock which are being discarded at sea. Is this jeopardizing the full utilization of the haddock resource? Obviously it has not had the extreme effects which were feared back in 1934. However, we must consider the possibility of increasing the landings by elimination of this tremendous waste.

The destruction of a certain number of young fish does not necessarily result in a reduction in total landings. Much of the information necessary to appraise the effect of this destruction of the Georges Bank haddock population is now at hand. Details of this study will be published by Schuck and Widrig.

First of all it is now known that the haddock stocks on Georges Bank are rather independent of those on neighboring banks. Peculiarities of growth and vertebral counts, as well as limited marking experiments show this (Herrington, 1944; Needler, 1930; Schroeder, 1942; Vladykov, 1935; Schuck and Arnold, 1951; Clark and Vladykov, ms.). The discreteness of the Georges Bank stock greatly facilitates the study of these populations.

The growth rate of Georges Bank haddock is unusually high, especially in the first few years of life (Schuck and Arnold, 1951). There is a corresponding rapid increase in weight during these years. Thus great benefits might be expected by saving these immature fish.

Schuck has determined the total mortality rate of Georges Bank haddock for three-year old and older fish to be about 45 per cent per year.

Unfortunately, it is not possible to separate the mortality due to natural causes from that due to fishing. However, it has been found that lack of accurate information on natural mortality rate is not too serious in the study of this particular problem.

Widrig (unpublished manuscript) studied the effect of varying the age at which the haddock are first captured. He constructed a number of theoretical models to show the expected yield from a year class throughout its entire life based on the

known growth rate of Georges Bank haddock and a total mortality rate of 45 per cent. He constructed models for varying proportions of natural and fishing mortality.

If the natural mortality is very low it pays to leave the fish in the sea until they have attained most of their growth. The chances of their being available later are great. If the natural mortality is very high it pays to catch the fish at a very early age. The chances, then, of their being in the sea at a later date are slight.

For purposes of argument it was necessary to assume a natural mortality rate. It was the opinion of the various biologists studying this problem that the natural mortality rate was not likely to be more than 15 per cent. With such a natural mortality rate and with present fishing effort the highest yield would result if the fish were first captured at the age of three years or a little older. This is assuming that a net is used which has a 50 per cent selection point for three-year old fish. That is, 50 per cent of the three-year olds entering the net are retained and at each larger size an increasing percentage is retained.

The present age of first capture of haddock on Georges Bank is about one and one-half years and most of the fish of this age are discarded. Thus, on the basis of these above theoretical considerations the present fishing methods are definitely detrimental to the production of the fishery. The

age of first capture should be advanced by about one and one-half years to bring about the maximum utilization of these stocks. This can be done by increasing the size of mesh used in the otter trawls.

The above calculations assume a natural mortality rate of 15 per cent. Widrig's figures show that if the natural mortality rate is more than 15 per cent very little change will result by advancing the age of first capture. On the other hand if the natural mortality is less than 15 per cent a considerably greater advantage will result in any advance of first age of capture over the present one. Thus, there will be nothing to lose and possibly much to gain by advancing the age of first capture, whatever the natural mortality.

Since some fish between the ages of one and one-half and three years are now landed, advancing the age of first capture to age three would have a temporary adverse effect on landings. Widrig calculated the annual changes which would result in total landings if the age of first capture were suddenly changed from the present one and one-half years to the theoretical optimum of three years. The first year the reduction in total landings would amount to about 25 per cent. The second year the reduction would be about 15 per cent. Not until the third year could any benefit be expected to result. In succeeding years there would be an increasing benefit until a new equilibrium would be established when production would be

increased by about 50 per cent over present landings.

The calculations hold only for an average year, of course. Natural fluctuations in abundance might mask the effect of the increased mesh size in any particular year. The effect would be evident to the fisherman only over a number of years although the biologist could assess its effect on year classes of known strengths immediately.

An expected increase in production of 50 per cent would definitely warrant a regulation of the fishery. However, the initial consequences of such a step as outlined would work a considerable hardship on the industry during the first two years especially if enactment of a regulation happened to coincide with a year of low natural abundance.

For this reason it was considered unwise to recommend advancing the age of first capture to age three at this time. Rather, it was decided to select an age which would have the effect of catching hardly any of the fish now being discarded and continuing to catch about 90 per cent by weight of those fish which are now landed. Widrig calculated this age to be a little less than two and one-half years. His theoretical models show that in this case the decline in landings the first year would amount to less than 10 per cent and by the second year would be back to average. In following years there would be an increasing benefit reaching a value of about 35 per cent about

six years after the change is made. By this method it is hoped that the fishery can be brought into a new equilibrium at a higher level of production without decreasing the annual landings materially during the period of adjustment.

The feasibility of advancing the age of first capture to the theoretical optimum of three years can be considered after the effects of the first change are observed.

As a result of the report of the scientific advisers to Panel 5 of the Commission, that Panel will recommend to the Commission at its meeting at St. Andrews in June that a minimum mesh regulation be instituted for International Subarea 5 which includes Georges Bank and the Gulf of Maine. They will recommend a minimum mesh size of 3-3/4 inches, inside stretched measurement. A mesh of that size retains 50 per cent of the haddock of about two and one-half years of age. The Panel is also recommending that intensive research be conducted to assess accurately the effect of the regulation. The Fish and Wildlife Service will conduct this research. The present intensive program which the Service is conducting on the haddock problem will be continued and possibly expanded so that the effect of the regulation can be accurately measured and the whole problem kept under continual review by the Commission.

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