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THIRD ANNUAL MEETING

UNITED STATES RESEARCH IN CONVENTION AREA DURING 1952.*

By Herbert W. Graham, Woods Hole, Mass.; Feb. 27, 1953

Research by the Woods Hole Laboratory of the Fish and Wildlife Service in the Convention Area was directed chiefly toward the two most important species in United States landings, namely, haddock and redfish. In addition to the general studies of factors affecting the abundance, effort was directed toward methods to evaluate the effect of mesh regulation on the haddock fishery. Food habits of haddock and the general biology of whiting were new projects initiated during the year.

Haddock: Georges Bank Population in 1952. The 1948 year class which dominated the fishery in 1951 as two-year-olds, causing a preponderance of scrod over large haddock, failed to maintain its dominance in 1952. The incoming year class of 1950 appeared in great numbers and assumed dominance of the fishery throughout 1952. The proportion of scrod over large haddock in the landings was greater even than in 1951. For the third consecutive year landings of scrod have exceeded landings of large haddock. Total landings from Georges Bank during 1952 were about 80 million pounds, a decrease of 11.5 million pounds from the 1951 landings. With the same amount of fishing as in 1952 the predicted catch for 1953 is 78 million pounds, the lowest catch since 1945.

Haddock: Racial Studies.

Vertebral numbers of haddock in the area from Georges Bank to Newfoundland are being studied to determine the racial identity or degree of independence of the stocks. The Fisheries Research Board of Canada and the United States Fish and Wildlife Service have pooled their data in this study. Over 11,000 counts from 16 fishing grounds have been made at various times since 1932. Determination of age, length, sex and other characters have been made with the most recent samples.

The results show haddock vertebral numbers to vary generally with geographic location and with water temperature. The number of vertebrae increases from Georges Bank northeastward to eastern Nova Scotia. This increase is correlated with decreasing water temperatures during the spawning season. Newfoundland haddock, however, have fewer vertebrae than Georges Bank haddock. Although this breaks the latitudinal relationship, the temperature correlation still holds since spawning occurs at a later date on the Grand Banks when the water temperature is higher than on Georges Bank during the spawning season.

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* All of the investigations were confined to Subarea 5 except the meristic studies of haddock which extended throughout Subareas 3, 4 and 5; and the redfish abundance studies which extended into Subarea 4.

Significant differences exist between vertebral numbers of haddock of New England, Nova Scotia, and Newfoundland, indicating that the haddock of these three major regions are relatively independent. Also, the eastern Nova Scotian stock appears to be distinct from the western Nova Scotian stock.

Various year classes have different numbers of vertebrae. Significant negative correlations were found between the average number of vertebrae of individual year classes from Georges and Browns Banks and the temperature of the water during spawning.

Haddock: Distribution in Subarea 5.

Analysis of the Albatross III census data revealed many interesting features of haddock distribution on Georges Bank and surrounding waters. During the summer months there is a concentration of large haddock in depths over 90 fathoms. These are not fished by the commercial fleet. These fish migrate to shoaler water during the spring spawning season when they appear in the commercial catches. Large concentrations of zero-age haddock in the Gulf of Maine and off Long Island for years of strong year classes on Georges Bank indicate that the Georges Bank stock is recruited at least in part from surrounding waters in Subarea 5. During summer and fall few haddock were found between 60 and 90 fathoms indicating that some ecological factor, possibly food, was unfavourable in that zone.

Sampling at Sea on Commercial Trawlers.

The sea sampling program initiated in 1951 was continued throughout 1952. Data were collected on the numbers, sizes, and ages of haddock discarded relative to those landed. In addition to data required for assessment of the mesh regulation information is obtained in this program on the sub-commercial sizes of haddock which is valuable in prediction of future catches.

Food Habits.

An investigation of the food habits of haddock in Subarea 5 was started in an attempt to determine whether available food is important in relation to fluctuations in abundance.

Effects of Mesh Regulation.

In preliminary investigation of the effect of mesh regulation on the Georges Bank haddock fishery, calculations were based on mortality rates and fishing efforts averaged over an 18-year period. The first step in increasing mesh size is designed primarily to effect a maximum escape of small haddock with a minimum reduction in landings of marketable sizes. The optimum age of first capture to obtain a maximum equilibrium yield at various levels of fishing intensity has been the subject of more recent investigations.

Yield-isopleth diagrams (Beverton, R.J.H., "Some observations on the principles and methods of fishery regulation." International Council Exploration Mer, 1952) have been constructed for the Georges Bank fishery for assumed instantaneous natural mortality rates of 0.1 and 0.2, the latter corresponding to the 15 percent annual natural mortality assumed in earlier calculations.

The eumetric yield curve for the Georges Bank fishery, based on 15 percent annual natural mortality, indicates that at the present level of fishing intensity the optimum age of first capture lies between 3 and 3½ years. The first step in mesh regulation will make the age of first capture about 2½ years, so that a maximum equilibrium yield would require about 50 percent increase in fishing effort. The computations further show that at any age of first capture lying between 3 and 4 years, the yield will be fairly close to maximum over a range of fishing efforts varying from 75 to 200 percent of the present average annual effort.

Among steps taken to observe the actual effect of the regulation, 6 large trawlers from a study group of 23 for which fishing records exist for a period of years, will be licensed to fish with the small mesh presently in use. The composition of the catch of these boats will be compared to that of the remainder of the study group.

The ultimate evaluation of the regulation is considered to be the yield, during their lifetime in the fishery, of year classes of similar size before and after regulation.

Selectivity of Otter Trawl Meshes:

Covered codend experiments were conducted to determine the sizes of haddock which will escape through meshes of different sizes. Four codends were tested. Alternate tow experiments demonstrated that in moderate concentrations of fish the cover had no effect on the escape of haddock through the codend meshes.

The codends were constructed of 50 yard, 4 thread, double Manila twine. When new meshes were first used the meshes decreased in size due to shrinkage of the fibers upon wetting. After the first tow the meshes enlarged due to tightening of the knots. The degree of enlargement depended upon the size of the catches and was greater in the after part of the codend where the strain was greatest in hauling. The 50 percent selection points for various mesh sizes (measured internally) were computed on the basis of the average size of mesh for the entire codend.

Internal mesh size (In.)	50 percent selection size (cm.)
3-3/4	32.0
4-1/8	35.5
4-1/2	37.3
4-3/4	39.9

Distribution of Groundfish.

The problem of sampling groundfish populations by otter trawl has been examined in the light of the data collected by the Albatross III during the census cruises of 1948-1951.

Groundfish are found in schools of varying size, either because of natural gregariousness or because of environmental factors such as favorable patches of bottom. Random sampling of such heterogeneously distributed populations results in many tows with small numbers or no fish, as well as occasional tows with great numbers of a particular species. If the occurrence of the numbers of tows with 0, 1, 2 ....n fish of a species is plotted, the resulting distribution is fitted to a high degree of probability by the negative binomial distribution. The indices, k, of these distributions, in the census data, are always less than 1.0, so that the variences are never less than the mean plus the mean squared. Estimates of density based on the observed mean are, then, subject to so much error as to be of little use.

It was further found that the occurrence of numbers of species per tow is a Poisson distribution, suggesting that the species found in the area sampled tend to be distributed independently of each other.

As a corollary of these distributions, it was further found that the species and numbers of individuals of each were distributed in the logarithmic distribution, as theoretically required.

A simple model to account for the observed distributions is suggested. If one postulates heterogeneity of distribution of each species, so that the mean number observed varies from sample to sample as an Eulerian variable, and that each species is distributed or moves about independently of other species, the three observed distributions may be derived in a manner parallel to that demonstrated by Quenouille (Biometrics, vol. 5, no. 2, 1949).

Whiting: Biology

A study of the general biology of the whiting in Subarea 5 was initiated. Particular emphasis will be placed on the relation of whiting to haddock.

Redfish: Age and Growth

Studies of age and growth have been based on examination of samples of the commercial catch from the Gulf of Maine. Otoliths have been used for most age readings, although scales are used for younger fish. A critical analysis of the validity of the age readings has been hampered by the lack of very small redfish in the market samples. Fishing for small specimens with a research vessel is expected to supply these sizes.

Present interpretation of otolith rings indicates a very slow growth for the redfish. The rate of growth appears to vary from one bank to the other.

Abundance

An index of abundance has been developed and the relative abundance of redfish determined for areas in the Gulf of Maine and on the Nova Scotian shelf. In these areas the catches per unit of effort have decreased as fishing has intensified.

Spawning

Preliminary studies have been made of the spawning habits of redfish in Subareas 4 and 5. With samples from the commercial catch information has been obtained on the time of egg fertilization, length of incubation period, time of spawning of live fry, fecundity as shown by numbers of eggs developed and numbers of fry spawned, and size at maturity. The time of spawning as well as the other aspects of reproduction seem to vary from place to place, each stock appearing to have its particular characteristics.

Migration

Studies of the incidence of the copepod ectoparasite Sphyrion indicate that there is no appreciable migration of redfish out of the Gulf of Maine to other areas. Other evidence indicates that there are no extensive migrations of any of the stocks. There is no evidence of a spawning migration. Conclusions regarding the movements of the redfish, however, are only preliminary. More studies must be made and attention directed toward devising some method of tagging.

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