MANUSCRIPT REPORTS OF THE BIOLOGICAL STATIONS

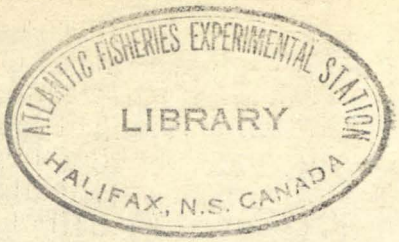
No. 252

THE CANADIAN ATLANTIC COD INVESTIGATIONS

(up to December, 1940)

by

R. A. McKenzie



FISHERIES RESEARCH BOARD OF CANADA

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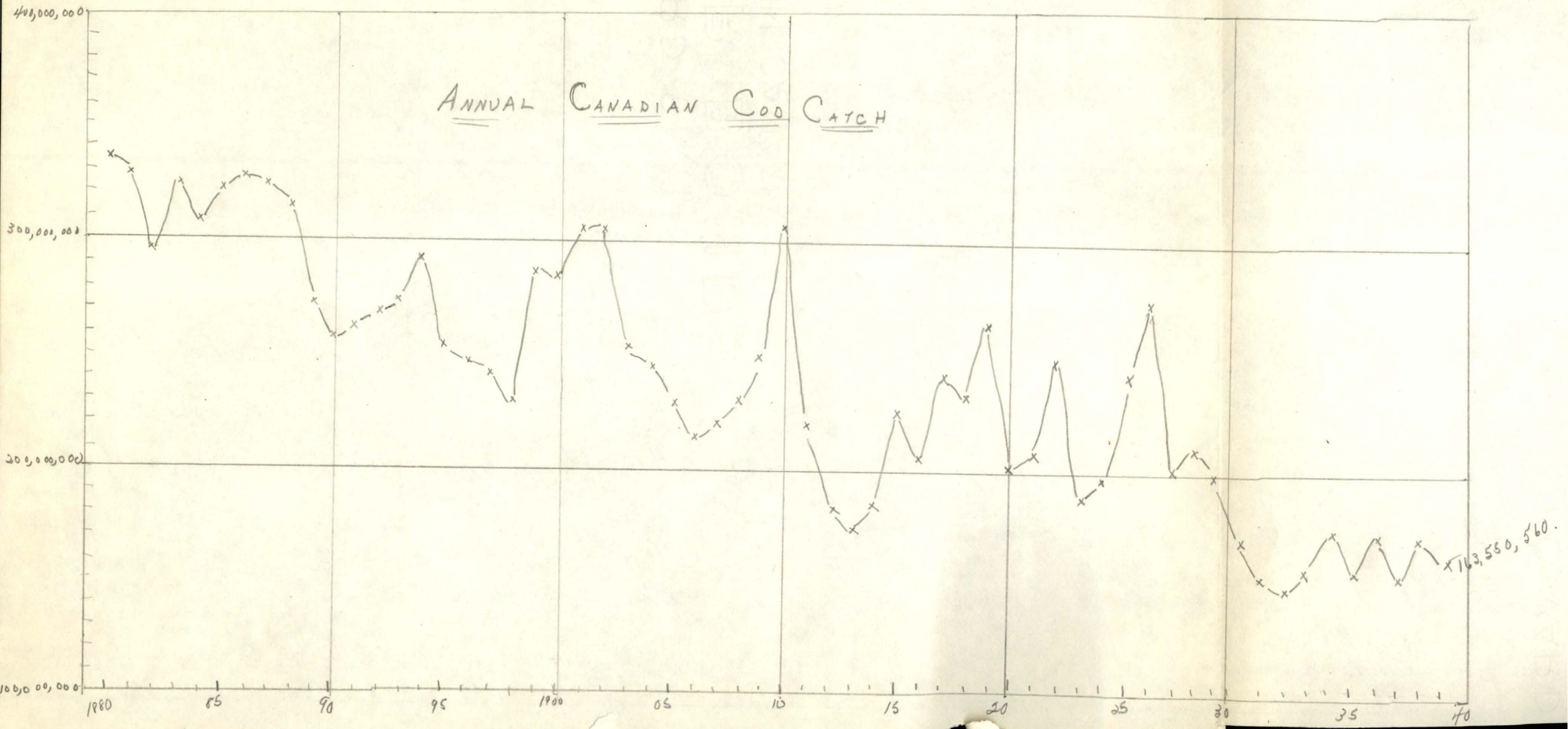
The past history of this great fishery indicates that the catch fifty to sixty years ago (see the accompanying graph) was about twice as great as in recent years. Of late years, when the total catch has been from 150 to 170 million pounds, about 23% was produced in the bay of Fundy and the inshore waters of outer Nova Scotia, 37% in the gulf of St. Lawrence, 13% in the offshore "fresh fishing" operations and 27% in the offshore "salt fishing" operations. Offshore fishing grounds are considered to be those located outside of the fifty fathom contour running along shore.

In the marketing of this catch about 35% is sold in some unsalted form and 67% salted. Most of the unsalted product is sold in Canada and this part of the catch has been increasing in recent years for around 1920 it made up only 10-15% of the catch as compared to the 33% in 1938. This trend has been caused partly through an effort to relieve the pressure on haddock but mostly through declining "salt fish" markets making it more profitable to dispose of the catch in some other way.

Over half of the salted product goes to the United States, the remainder being sold principally in the British West Indies, Cuba and Porto Rico.

lbs.


ANNUAL CANADIAN COD CATCH
400,000,000
300,000,000
200,000,000
100,000,000
1980
85
90
95
1900
05
10
15
20
25
30
35
40
163,550,560.

Investigations

The cod studies carried out under the auspices of the Fisheries Research Board have had as their object the elucidation of the life history of the cod in Canadian waters. These studies have dealt with several phases of the problem.

1. Racial studies to determine whether Canadian cod belong to one population or to several essentially distinct populations and, if the latter, to devise means of recognizing them so as to trace their several life histories including the migrations, spawning grounds, nursery grounds, etc., of each population. These studies are based chiefly on vertebral counts and spawning times.

2. Tagging to trace the migrations of the local populations and check on the racial study conclusions.

3. Year-class studies to determine to what extent particular broods dominate the fishery in different areas and at different times. The ultimate purpose of such studies is to be able to foretell the size of the stocks of different populations from year to year.

4. Environmental studies to determine the effect of temperature on feeding and spawning movements. Such studies have a direct economic application since a knowledge of feeding and spawning movements would enable the fishermen to locate the fish more readily than at present.

Populations

The studies up to the present indicate that the cod off the Atlantic coast of Canada belong to a number of more or less distinct populations rather than to one wide ranging, relatively homogeneous population. At present the principal populations known are:

(a) Autumn Spawners:-
1. Outer Nova Scotian population.
2. Gulf of St. Lawrence population.

(b) Winter-Spring Spawners:-
1. Bay of Fundy population.
2. Outer coast inshore population.
3. Banquereau population.
4. Western Banks population.
5. Cape Breton population.

Migrations

Racial studies afford much information on population movements and indicate possibilities but the most satisfactory evidence is gained through tagging.

Prior to 1933 about 8,774 cod were tagged with 8% being returned. Since 1933 10,412 more cod have been tagged with 9.2% being recaptured up to the present.

So far only two of the above populations (b) 2 and (b) 3 have been tagged at all satisfactorily.

(a) 1. Only several hundred of these fish tagged so far and the meagre returns mean but little.

2. Some four hundred of these have been tagged and the 6% returns indicate that there is no large scale migration out of the gulf of St. Lawrence even in winter.

(b) 1. This population seems to perform a shoreward movement each spring as well as into the bay of Fundy.

2. These fish move on and off shore from the deeper inshore waters with the seasons. A certain drift to the eastward early in the summer seems to be followed by a return in the autumn.

3. This population has a distinct movement into the gulf of St. Lawrence each May and June, even going along the edge of the deep channel up to the middle of the gulf as fas as Gaspe. There also appears to be a shift in the spring of some members of this group to the Newfoundland banks. In October, usually, the cod again congregate on eastern Banquereau gradually moving towards,but not past, Sable island by the late winter when the return migration commences.

4. Some of these fish move towards shore in the early summer while others move eastward over the off-shore banks. The reverse occurs in early winter.

5. Summer tagging off south-eastern Cape Breton has shown that these cod move about off this east coast region during the summer and then a fair number of them moves out onto the offshore banks for the winter.

Off Cheticamp, north-western Cape Breton, the summer fish remain quite stationary until October

and November. Then a considerable body of them moves out around Cape North, along eastern Cape Breton to the south coast, where the majority of these migrants seem to winter in the deeper inshore waters as far west as Liscomb. A very few go to the offshore grounds.

Since the average recapture percentage is about 8.5% it is necessary to tag at least 2,500 fish during any one tagging operation in order to obtain approximately 250 returns over a period of years. This 250 spread over a number of years is a minimum requirement in order to plot out definite routes of migration and check them for several years. Thus, in order to obtain information on migrations on which much reliance can be placed, it is necessary to do far more tagging at any one time and place than has been done in most instances in the past.

When such tagging is done it is of distinct economic importance in that:-

1. It permits the plotting of definite routes of migration so that the fishermen know where the population goes when it leaves a certain ground.

2. It gives an indication of the extent to which an individual population is being fished.

Reproduction

These studies have been carried on mainly with the outer Nova Scotian autumn spawning cod and all the findings are listed below under the same sub-divisions as shown in the "populations" section.

(a) 1. Autumn cod spawning along the outer Nova Scotian coast occurs during October and November to quite an extent in St.Margaret bay, Halifax harbour and Chedabucto bay, and to a lesser extent in certain Cape Breton regions, Country harbour, Jeddore harbour and Green bay.

This spawning takes place on the bottom in temperatures of 8°C. to 12°C. Below and above these temperatures spawning ceases. The eggs, three-quarters of which are found in the upper 15 metres of water, are subjected to a temperature range of 5°C. to 17°C. As they incubate they sink to lower levels and a very high mortality occurs. The young of this spawning are only found in certain small areas of these spawning regions and only until late June.

2. This spawning in the gulf of St. Lawrence occurs in Bay Chaleur and in the Orphan-Bradelle bank regions in August and September.

(b) 1. On the New Brunswick side of the bay of Fundy, spawning has been found to reach its peak in May, while on the Nova Scotian side it occurs about a month earlier. Little spawning takes place either in the middle of this bay or from off Yarmouth out to the northwest edge of Brown's bank.

2. Spawning along the inshore outer Nova Scotian waters as far eastward as Halifax, and including Brown's bank takes place mainly in April and May.

3. No definite study so far on this population but (occasional?) records show that cod spawning does occur on certain parts of Banquereau bank during April and May.

4. In the general region of southern Emerald bank to southwest Sable Island bank, extensive cod and haddock spawning occurs in March and April but no trace of it has been found in that region in June.

5. Nothing is known as yet about the spawning of this population.

Year-Class Abundance

Investigations on the abundance of the various age-groups or year-classes of many European fishes has revealed the fact that there is a great difference in the number of young arising out of the annual spawning from year to year. In some years great numbers of young fish are produced while in others only fair or poor yields result.

On certain occasions, as for instance the banner year of 1904, such tremendous numbers of young cod, herring and other species survived to commercial size that fish from this spawning dominated the catches for as many as ten to fifteen years. Such studies involve determining the age of great numbers of fish from many catches.

Only a few age determinations have been made so far and these all of the autumn spawning outer Nova Scotian population ((a) 1). The collections of 1933 to 1936 inclusive showed that the 1927 brood was prominent in 1933 and 1934 but by 1936 the

1930 brood overshadowed all other year-classes.

Most of these fish show up in the spawning school when they are six years old. Fish of at least twelve different ages are usually found in this spawning school.

Age determinations were made from otoliths.

Environmental Studies

(a) Water Temperature and Feeding

Experiments with captive cod show that too low or too high temperatures cause a cessation in feeding. As the temperature rises from near freezing cod consume more and more per feeding until a maximum is reached. Then with continued rising temperatures their food consumption declines to nil again. Young cod will feed at both lower and higher temperatures than old cod. The optimum temperature for the captive cod caught in Passamaquoddy bay was found to be around 50°F. This may vary, however, with the particularpopulations.

Within this range of feeding temperatures, a sudden rise in temperature usually causes a cessation in feeding, which is resumed again either when the temperature drops or after it has remained steady for some time. Such occurrences have been followed in the commercial fishery in Halifax harbour.

This environmental data together with observations on fishing operations indicates that water temperature has a definite effect on the habits of the cod. Accordingly, through the kindness and cooperation of a number of the fishing Captains a start has already been made in the collection of water temperature versus

catch records in commercial operations. To obtain definite results in this work a very great number of records will be needed.

(b) Water Temperature versus Feeding, Otolith Character and Vertebral Number.

Some progress has been made with studies on otolith character and vertebral numbers in relation to amount of feeding and water temperatures.

Six months old cod fingerlings when held captive without food for ten to fourteen days show definite check zones on their otoliths.

Autumn spawning cod whose eggs are incubated in warmer water than those of the winter-spring spawners have been found to possess lower average vertebral numbers.

(c) Year-Class Vertebral Numbers

In the population studies the vertebral counts have been made on commercial fish. Such fish consist of many age groups and when treated as a whole seem to vary little from year to year.

However, the average vertebral number of an individual year-class may vary one year with another.

Samples of six months old cod from the autumn spawning group over a period of years show considerable variation one year with another but the degree of significance of these differences has not been determined yet.

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