Serial No. 104

INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

Document No. 33

THIRD ANNUAL MEETING

Knowledge of Divisions of Stocks of Cod, Haddock, Redfish and American Plaice of Subareas 3 and 2 of the Northwest Atlantic Convention Area

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C O D

The cod provides the most important fishery in Subareas 2 and 3, considerably more important than the sum of all other fisheries both inshore and offshore. The international nature of the fishery in this area is mostly due to the large supplies of cod. Information on continuity or divisions of the cod stocks in these Subareas has been obtained from average vertebral numbers, growth rates, studies of sexual maturity, from the distribution of parasites such as the cod-worm and Lernaeocera, and from tagging. In the following account it will be necessary to discuss the west coast of Newfoundland part of Subarea 4 also since at the northern and southern ends of this area there are cod migrations between areas 3 and 4. Subareas 2 and 3 and the west coast of Newfoundland part of Subarea 4 have been referred to in this paper as the Labrador-Newfoundland fishing area.

Vertebral Studies Over twelve thousand vertebral columns in more than 130 different samples well scattered over the Labrador-Newfoundland fishing area have been studied. The averages of vertebral numbers (not including the hypural) in the Newfoundland area are over 54 inshore and offshore along the east coast of Newfoundland to the northern edge of the Grand Bank and along the coast of Labrador. The vertebral average drops to usually below 53 on the central and southern part of the Grand Bank and the southern half of the west coast of Newfoundland with intermediate values elsewhere.

Vertebral averages in the Labrador area inshore and offshore, the Newfoundland east coast inshore and offshore, and the northern edge of the Grand Bank are not statistically different so that the population could be the same. As we shall see later, however, from other evidence there are differences between various parts of this stock which show that while some mixing occurs it is very incomplete. Vertebral averages, on the other hand, show this northern stock to be distinct from that occupying the body of the Grand Bank generally and particularly from the cod stocks on the southern part of the Grand Bank.

Vertebral averages show a fairly distinct stock in the southern half of the Newfoundland west coast. Gradually declining vertebral averages from the Strait of Belle Isle inward along the northern part of the Newfoundland west coast indicate an apparently seasonal extension of the east coast population into the northern part of the Gulf of St. Lawrence providing good fisheries in the Belle Isle Strait area. The cod stocks of the Labrador area, Subarea 2, are distinct from those of West Greenland, having considerably higher vertebral averages.

Growth Rates The slow-growing Labrador cod show distinct differences in growth rate from the Newfoundland east coast cod which grow somewhat faster. The growth rate of the cod on the

north and north-eastern part of the Grand Bank is still more rapid. The cod on the south and south-western part of the Grand Bank are by far the fastest growing in the whole Labrador-Newfoundland area. Thus from growth studies it is seen that the Labrador-Newfoundland east coast and northern edge of the Grand Bank cod which show no readily recognizable differences in vertebral averages are yet distinct enough to show considerably different growth rates. Hence the stocks cannot be very greatly intermingled.

Sexual Maturities The size at first sexual maturity in the cod of the Labrador area appears to be small, that on the east coast of Newfoundland and on the northern and western edges of the Grand Bank intermediate, and that on the southern part of the Grand Bank is by far the largest of all. Age of cod at first sexual maturity does not show such great differences as does size.

Distribution of the cod nematode Porrocaecum in cod flesh The distribution of the nematode parasite Porrocaecum has been studied in the fillets of over ten thousand cod. The parasite appears to have a long living period in the flesh and even the dead parasites can be recognized since the cuticle remains. Infection with this parasite is at its highest point, from 25 to 50 per cent of the fish infected, on the southern half of the west coast of Newfoundland and on the western half of the south coast. This population is shown to be somewhat distinct also by vertebral number and by tagging.

On the east coast of Newfoundland infection is low usually 1 to 5 per cent of the fish. Infection of the Grand Bank is typically low, mostly 1 to 3 per cent of the fish. On St. Pierre Bank infection on the northern part which is near a grey-seal colony is high - about 20 per cent while on the southern part it is lower, about 4 per cent infection. Thus even on an area as small as St. Pierre Bank the northern and southern populations of cod apparently show considerable distinctness. The cod of the southern part of St. Pierre Bank with about 4 per cent infection show considerable distinctness from those of the neighbouring Banquereau with over 20 per cent infection.

Distribution of the cod copepod parasite Lernaeocera. The distribution of this parasite has also been studied in over ten thousand cod well distributed over the Newfoundland-Labrador area.

High infestation with Lernaeocera is characteristic of the inshore areas. The life of the parasite appears to be moderately long and even after the parasite has disappeared, the neck can be found embedded at the apex of the gills. It is a parasite very suitable for studies of the relationship of inshore and offshore cod populations. Infestation is low in Labrador mostly 0 to 3% of fish and moderately high in the coastal areas of Newfoundland ranging from 1 to 28 and averaging between five and ten per cent of the fish infected. The central, north-east, east, south and south-west parts of the Grand Bank have a very low infestation considerably less than an average of 0.5 per cent infection and usually zero infection in a sample of over a hundred fish. On the northwestern edge of the Grand Bank, however, infection is high, many samples showing over 5 per cent of the cod infected with Lernaeocera. This is in agreement with rates of infection several times as high in the neighbouring coastal cod of the Avalon Peninsula and indicates relationship between the coastal stocks of the extreme south-east Newfoundland area and those of the western edge of the Grand Bank. This relationship has been shown also by recaptures of tagged fish.

Tagging About sixteen thousand cod have been tagged in the Labrador-Newfoundland area - eight thousand since 1947. The percentage returns from the inshore tagging are, with the best varieties of tags, thirty per cent or higher while returns from tagging on the Grand Bank are usually considerably less than five per cent.

Tag returns have shown considerable individual movement along the east coast of Newfoundland and some movement southward from Labrador to the east coast. In a great part of this area there is deep warmer Atlantic water close to the coast and the fish can apparently move considerably in this layer over winter. Tagging returns also show considerable autumn and winter movement of cod from the southern part of the east coast to the western and north-western edge of the Grand Bank for spawning, followed by an on-shore movement of these fish with the capelin in June. In the same way that the vertebral numbers show a barrier to exist at the northern edge of the Grand Bank between high vertebral count northern and low vertebral count southern cod stocks so it is that cod from inshore tagging on the southern part of the east coast of Newfoundland are often returned from the northern and north-western edges of the bank but no recaptures are obtained on the south-eastern part of the bank. Similarly from tagging on the north-western edge of the Grand Bank there is a high percentage of recaptures inshore along the Avalon Peninsula and further north while from tagging on the southern part of the Grand Bank there are few inshore recaptures, none along the east coast, and a few along the south coast of the island.

Tagging at Bay of Islands has shown a stock which migrates southward out of the Gulf in the early winter to the Rose Blanche Bank area, not beyond Burgeo Bank and Hermitage, providing a good winter fishery on the western part of the south coast of Newfoundland, a return migration to the southern half of the west coast taking place again in late spring. Tag returns also indicate a movement of east coast cod into the Gulf of St. Lawrence through the Strait of Belle Isle. To judge by the fishery this movement is inward in June and out in the autumn.

Tagging on St. Pierre Bank has shown a fairly widespread movement of fish from this bank mostly to the south coast of Newfoundland, some to the Grand Bank and two across the Laurenian Channel to Banquereau. Apart from fish tagged on St. Pierre Bank it is very unusual for any fish tagged in Newfoundland to cross the Laurentian Channel to the Nova Scotia banks or to the southern side of the Gulf of St. Lawrence.

HADDOCK

In the Newfoundland area haddock are found in abundance only on the southern part of the Grand Bank and on St. Pierre Bank. There is some coastward movement of the mature and large immature fish during the summer time. There is another small population on the western part of the south coast and the southern part of the west coast of Newfoundland. A few haddock apparently of still a fourth stock occur on the Flemish Cap. Studies of growth, year class abundance and vertebral number and tagging experiments have been carried out.

Vertebral Numbers Vertebral studies have shown no distinction between Grand Bank and St. Pierre Bank haddock. The haddock of the south-western angle of the coast of Newfoundland, on the basis of several samples only, have vertebral numbers lower than

those of the other two stocks and hence may be distinct from them. This stock is, however, of little importance. The possession of lower vertebral numbers by the Newfoundland haddock stocks show that they are distinct from the Banquereau stocks across the Laurentian Channel.

Tagging Tagging of about a thousand otter-trawl-caught haddock on the Grand Bank has given no returns. A small amount of inshore tagging near Burin of trap-caught haddock gave several recaptures, one from St. Pierre Bank.

Growth Rates and Year Classes Growth rate studies and the maintenance over a considerable number of years of year-class differences show that the Grand Bank and the St. Pierre Bank haddock are relatively distinct. There appears to be some intermingling south of Green Bank and the few very large haddock caught on the Grand Bank where growth is slow appear to be of the St. Pierre Bank type. On the Grand Bank itself there is apparently considerable intermingling of stocks and no considerable differences exist between the stocks on the different parts of the bank.

A very small stock of haddock with a distinctly different growth rate pattern exists on the Flemish Cap.

REDFISH

Evidence for distribution of stocks of redfish has mainly come from two sources, vetebral numbers and distribution of the redfish copepod parasite Sphyrion lumpi. Over eight thousand vertebral columns have been studied from Cape Chidley to George's Bank.

Vertebral Numbers The northern stocks from Labrador-Newfoundland and from the Gulf of St. Lawrence generally have vertebral counts higher than those of the Nova Scotian shelf area and the vertebral number is slightly lower still in the Gulf of Maine. Even in the northern areas, however, redfish with very low vertebral averages will often be found quite near redfish populations with very high vertebral averages indicating either very little movement of redfish or considerable differences between vertebral numbers in different year classes.

Distribution of Sphyrion lumpi For many years it has been known that a heavy infection of redfish with the copepod parasite Sphyrion lumpi existed in the Gulf of Maine. Another centre of heavy infection by the parasite has been found in the redfish populations of Labrador while a minor centre exists on the eastern edge of the Grand Bank. Very low infestation by Sphyrion is found on the western part of the Grand Bank and in the Gulf of St. Lawrence and apparently none in the eastern Nova Scotia area. The external body of the individual Sphyrion parasite while certainly lost in time would appear to have an existence long enough for it to act as a tag. In fact the head remains embedded for a long time or indefinitely after the death of the parasite and by candling the fillets a very useful check on Sphyrion infestation can be obtained. The fact that high infestation can exist in populations of redfish while within a very short distance other populations show very low or no infestation is an indication that redfish do not migrate freely over large areas.

Age and Growth and Maturity Differences Theses are being studied. There are differences in various areas in sizes at maturity and growth differences undoubtedly exist but age reading of redfish otoliths is not yet on a completely firm foundation.

AMERICAN PLAICE
(Hippoglossoides platessoides)

Vertebral and fin ray counts of large numbers of American plaice have shown no statistical differences within areas 2 and 3. Maturity and size differences exist which allow some differentiation of stocks. The American plaice of the large population commercially fished on the eastern side of the Grand Bank mature at a considerably larger size and grow much larger than inshore plaice. Age studies have been begun but because of the small otoliths and the great age (20-40 years) of commercial plaice accurate and reproducible age readings are difficult to obtain.

SUMMARY

Cod Three well marked divisions of the cod stock in the Labrador-Newfoundland area have been shown by vertebral counts and tagging returns - the Newfoundland southern west coast and western south coast stock, the Labrador-East Coast Newfoundland and northern edge Grand Bank stock and the southern and central Grand Bank stock. These three stocks, the latter two of major importance, are well separated by migratory and vertebral pattern and migration between them is hindered by natural barriers apparently mainly bottom temperature barriers. Growth rate studies show enough distinctions within these stocks to indicate that complete intermingling within a stock does not occur. This is well illustrated in the considerable growth differences between the Labrador, Nfld. East Coast and Northern Grand Bank sections of the northern stock. Within a stock, however, the lack of intermingling is due more to distance than to a temperature or depth barrier.

Tagging and cod-worm and Lernaeocera infestation show the relation of the cod of the western edge of the Grand Bank and those of the southern part of the east coast of Newfoundland and the lack of relation of cod in this area to the southern Grand Bank cod populations. The inter-relationships of the St. Pierre Bank, South Coast and Southern Grand Bank areas are complex. Some intermingling is shown and further study is needed. There is considerable intermigration between St. Pierre Bank and the South Coast cod stocks. The deep warm water of the Laurentian Channel is to a considerable degree a barrier to southward movement of the Newfoundland stocks of cod. In the north the cod stocks of the Labrador area, Subarea 2, are shown by highly different vertebral averages and lack of any considerable intermigration of tagged fish and be distinct from those of West Greenland.

Haddock There are two large haddock stocks the Grand Bank and the St. Pierre Bank stocks with a minor stock at the southwestern corner of the island and a very minor stock on the Flemish Cap. The Newfoundland haddock populations are separated from those of the Nova Scotian Banks judging by average vertebral numbers and