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International Council for the
Exploration of the Sea

C.M.1970/F:15
Demersal Fish (Northern) Committee

INTERIM REPORT OF THE NORTH SEA COD WORKING GROUP

^{x)} General Secretary
ICES
Charlottenlund Slot
2920 Charlottenlund
Denmark

INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA

Interim Report of the North Sea Cod Working Group

Explanatory Note

During the four days at its disposal, the Working Group reviewed what was known of the spawning and nursery grounds of the cod and carried out a preliminary analysis of the very extensive cod tagging data available to the Group. As a result, it became clear that a further, and more comprehensive analysis of the tagging data would be necessary, and this has subsequently been done using the computer at the Marine Laboratory, Aberdeen.

This analysis has provided further information on the seasonal movements of tagged fish and on their degree of dispersion about their centres of density at different times after liberation. These data contain results of considerable interest, but their interpretation with respect to stock separation is something that cannot readily be done by correspondence. The Group therefore recommends that they meet again for a further two days before the next ICES meeting to examine and discuss the results of the further analysis of the tagging data.

Attached is an incomplete report, dealing only with the survey of spawning and nursery grounds.

R. JONES
Convener

INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA

Interim Report of the North Sea Cod Working Group

The Working Group was set up at the 1969 ICES Meeting (C.Res.1969/2:6) and was convened at Charlottenlund from April 14 to 17.

The following members participated:-

R. Jones, United Kingdom, Chairman
C. Bannister, United Kingdom
O. Bagge, Denmark
N. Daan, Netherlands
G. Lefranc, France
H. Lybaert, Belgium
D. Danielssen, Norway
F. Lamp, Germany
G. Wagner, Germany

The resolution passed by ICES was that the Group should study, in the first instance, the interrelationships between the cod in different parts of the North Sea, with a view to reconsidering on a regional basis, the assessments made by the "Working Group on Assessment of Demersal Stocks in the North Sea", on the North Sea cod stocks as a whole.

The Group took, as its primary objective, a review of what was known of the spawning and nursery grounds of the cod and attempted, from the returns of tagging experiments, to assess the interrelationships between the various spawning and juvenile stocks.

Spawning areas were reviewed on the basis of egg and larval data, and on the distribution of large, mature, cod during the spawning season.

Distribution of Eggs and Larvae

Spawning occurs from the beginning of January to April, with small variations in the time of peak of spawning in the different areas. According to Meek (1924), the eggs, which are pelagic, hatch in about 12 days at an average temperature of 5.5°C, although Wise (1961) gives 17 days at 5°C. The larvae are pelagic and do not become demersal for about 2½ months.

A difficulty of using egg distribution data to determine the positions of the main spawning grounds is that cod eggs are virtually indistinguishable from haddock eggs until pigmentation develops just before hatching (Graham, 1934). This means that only the distribution of the late stage eggs can be used to provide information about the spawning regions of cod in the northern North Sea where cod and haddock eggs are liable to be taken together. In the southern North Sea this problem does not arise.

In division IVB, results obtained by earlier workers and in particular those of Damas (1909) and Schmidt (1909) show the occurrence of larvae over a wide area of the eastern North Sea between latitudes 54° and 57°N, becoming denser from west to east. Larvae were found from March to August, maximum numbers being taken in April and May. Graham (1934) gives a similar account and also refers to the occurrence of larvae at Flamborough and south of the Fisher Bank.

In the southern North Sea, concentrations of cod eggs have been found in the White Bank area but very few in the southern Bight (Bückman *et al.* 1955 and Aurich 1941). More recently, however, egg surveys carried out by Daan from January to March 1970 indicated considerable numbers of cod eggs in coastal waters near Texel, and also near the French coast (Fig. 1).

Off the Danish North Sea coast, larvae have also been observed, although there the typical situation is less certain. Poulsen (1931) found larvae around the Danish coast in March-April 1923 both in the North Sea and round into the Kattegat but with negative hauls in the northern Kattegat. In 1924 however, he found no larvae off the Danish North Sea coast and in 1925 only a few were taken. Bagge (unpublished data) found larvae in April 1952 and 1953 in the North Sea (Fig. 2) and in the Kattegat in March-May 1960 (Fig. 3). Lindquist (1970) states that vertical Hensen net hauls off the Danish North Sea coast and in the north Skagerak in May gave negative results for cod although other species were present.

Off the Scottish north and north-west coast, cod larvae have been recorded by Schmidt (1909). More recently, Raitt (1967) has described the occurrence of larvae in Scottish waters from surveys made in the years 1953-1956. Larvae were found around the Scottish coasts and over most of division IVA. Maximum larval concentrations in March and April were distributed in patches extending north-easterly from the Butt of Lewis and Scottish north coast (XX16 to ZZ17) to the north of the Shetlands (D20). Concentrations of larvae were also observed in the vicinity of the Moray Firth (B15). In May and June the larvae were mainly concentrated to the east of the Greenwich meridian and south of latitude 59°N, although small patches of larvae were also found north and west of this region.

Distribution of Large Cod and Spawning Areas

Further evidence on the likely positions of the spawning grounds comes from the distribution of large, mature cod at spawning time during the early months of the year.

In the central North Sea, Graham (1924, 1934) identified four major spawning areas from the distribution of high landings per unit effort of mature cod (over 70 cm in length) from English statistics for the period 1920-1930. These, the Ling Bank, Fisher Bank, Forties and Flamborough areas, are shown in Figure 4. The members of the Group confirmed the importance of these as spawning grounds, as well as other grounds, including the Silver Pit (E7, G7), the Clay Deep (H7,8 and J7,8) and the Tail End (J9) which Graham also referred to but considered of less importance at the time. In addition to these grounds, spawning in the Southern Bight has been reported as long ago as 1902-1906 by Redeke (1909). More recent statistics (Bannister, personal communication) are given in Figures 5-10 showing landings of large cod by English vessels during the spring of 1963. The landings are expressed as cwt per 10 hours' fishing and are given separately for various statistical rectangles, mainly in division IVB. These confirm the importance of the area to the south-east of the Dogger Bank during February. They also indicate a tendency for the regions of greatest importance to move north and north-east during the period from February to April.

There is evidence, too, of spawning as far south as Bassurelle at least until 1965. After 1967, French and Belgian observations suggest that spawning in this region may have occurred further north off the Belgian coast. These conclusions were based on the relatively high landings per unit effort by French vessels working off the Belgian coast from January to May 1968, when many mature fish were captured. The possibility that this may include

a spawning region is strengthened by Belgian data showing that the percentage of cod over 70 cm in landings from this region was 8.4% in the winter and spring compared with 1.5% in the summer, from 1967 to 1969.

Off the Danish North Sea coast in the Skagerak there is no evidence of spawning. It was considered that larvae observed in the Kattegat were the products of spawning in the southern Kattegat and Belt Sea and formed part of a stock that was separate from that in the North Sea.

Spawning is known to occur on the Norwegian Skagerak coast, but the stock there is considered to be independent of those on the Danish side of the Skagerak (Dahl 1906, Løversen 1946 and Ruud 1939).

Off the Scottish north and east coasts, maximum landings per unit effort of large cod from January to April were observed as long ago as 1901-6 by D'Arcy Thompson (1909). More recent statistics (West 1970) are given in Figures 11-18, showing the landings per unit effort of cod over 50 cm in length by Scottish vessels. Cod in Scottish waters begin to mature at about this length and it is considered that a large proportion of the cod over 50 cm taken in the spring would consist of maturing fish. These data show peak landings per unit effort off the Scottish north and east coasts, including the Moray Firth. Subsidiary concentrations were noted in G18, F18, E19 and E20. Concentrations were also noted in G13 and H13, G14, F14, corresponding with Graham's Ling Bank area.

Nursery Grounds

According to Russell (1922), cod become demersal at an age of 2 to 2½ months and an average length of 2.5 cm, but observations by members of the Group suggested that this was probably the minimum length at which codling took to the bottom and that cod spawned over deeper water were liable to take to the bottom at a larger size and after a longer period. German catches of 0-group cod in the German Bight shrimp fishery showed that the smallest cod were 4 cm with a mean of 5-6 cm. Scottish data of 0-group cod taken pelagically in division IVA in June 1969 showed that their lengths ranged from 2 to 10 cm (Hislop, unpublished data).

According to Hjort and Petersen (1905), 0-group cod were taken in quantities in the central North Sea, along the coasts in the neighbourhood of large estuaries, and on banks as far north as the Great Fisher Bank. Further north, in deeper water, only single individuals were encountered. More recently, Dutch and German data for 1966, 1968 and 1969 show that small numbers of 0-group cod are found in the Silver Pit and considerable numbers, up to 2,400 per 10⁵m² fished along the Dutch, German and Danish coasts. 0-group cod were also recorded in the mouths of the Schelde (20 per 10⁵m² fished) and in the Waddensea (up to 1,400 per 10⁵m² fished) and the occurrence and distribution of young cod in the latter area have been described by Daan (1969) (Fig. 19). In the autumn of 1969, a small number of 0-group cod were taken by otter trawl in Aberdeen Bay (Jones, unpublished communication).

The probability that many of the 0-group cod north and east of the Dogger Bank come from the main spawning regions in division IVB as a result of larval drift is argued by Graham, Carruthers and Goodchild (1926). Along the Norwegian Skagerak coast, Norwegian sampling in September/October with a beach seine has yielded numbers of 0-group cod, 4-12 cm in length (Danielssen, unpublished communication).

For the I-group, information is available for the central North Sea from the results of the International Young Herring Surveys carried out in February and March 1965-70. These results show that although the concentrations are again most marked along the Dutch and Danish coasts, there are nevertheless some years when I-group cod are distributed over most of division IVB to a depth of 80m as far north as latitude 58°N.

In February 1970 (Fig. 20) there were clearly secondary concentrations in the Clay Deep (J9,10), the North West Rough (F9, G9, G8), the Norfolk Banks (F5) off Whitby and over a wide area from south of the Fladen to the Fisher Bank.

Data from the catches in a small meshed codend during recent English trawl surveys gave similar results (Bannister, unpublished communication).

The Group noted incidentally, the coincidence between the distribution of young cod and herring in the neighbourhood of the Dutch, German and Danish coasts.

Between 1965 and 1967, I-group cod were found along the French and Belgian coasts (Lefranc and Lybaert, unpublished communications).

In Scottish waters, small numbers of I-group cod are landed by commercial vessels (Raitt and Symonds, 1967). The largest numbers of these come from the Scottish north and east coasts, including the Moray Firth. From the more offshore grounds in division IVA the numbers of I-group fish are relatively small. The general distribution of 0- and I-group cod is indicated in Figure 21.

Young codling, mainly 2 years of age, are taken extensively in the commercial trawl fisheries throughout the North Sea and off the Scottish north coast. Graham (1934) indicates a wide distribution of "small" cod (mainly 2 years of age) in the central North Sea, an interesting feature of his observations being that comparatively few "small" cod were taken off the Belgian and Dutch coasts where the greatest density of I-group fish had been observed.

German data showing that II-group cod are absent from the German Bight suggest that cod emigrate from that area before they become II-group. The emigration of I-group cod from the coast has been noted by Daan (1969) in the case of the Dutch coast, and Lefranc (1970) in the case of the English Channel French coast.

Spawning Grounds

On the basis of the data described above, the overall picture of the major spawning grounds shown in Figure 22 was finally accepted by the Group. This shows that the spawning grounds can be grouped into three main regions, centred as follows:

- (a) in the central North Sea between latitude 54° and 58°30'N and west of longitude 5°E,
- (b) off the Dutch and Belgian coasts where spawning seems to have become relatively more important during the 1960s,
- and (c) around the Scottish east and north coasts.

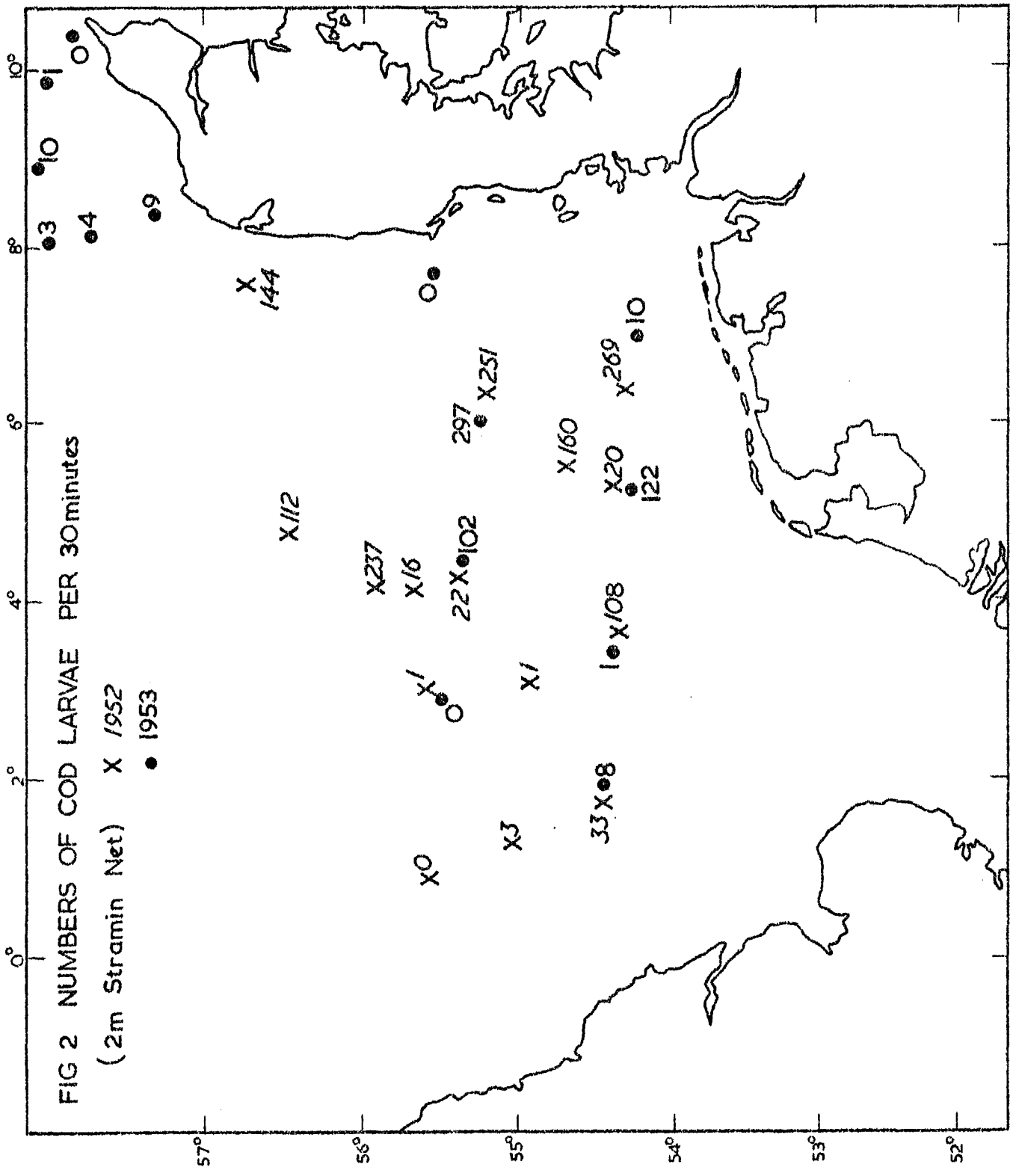
Meristic Characters

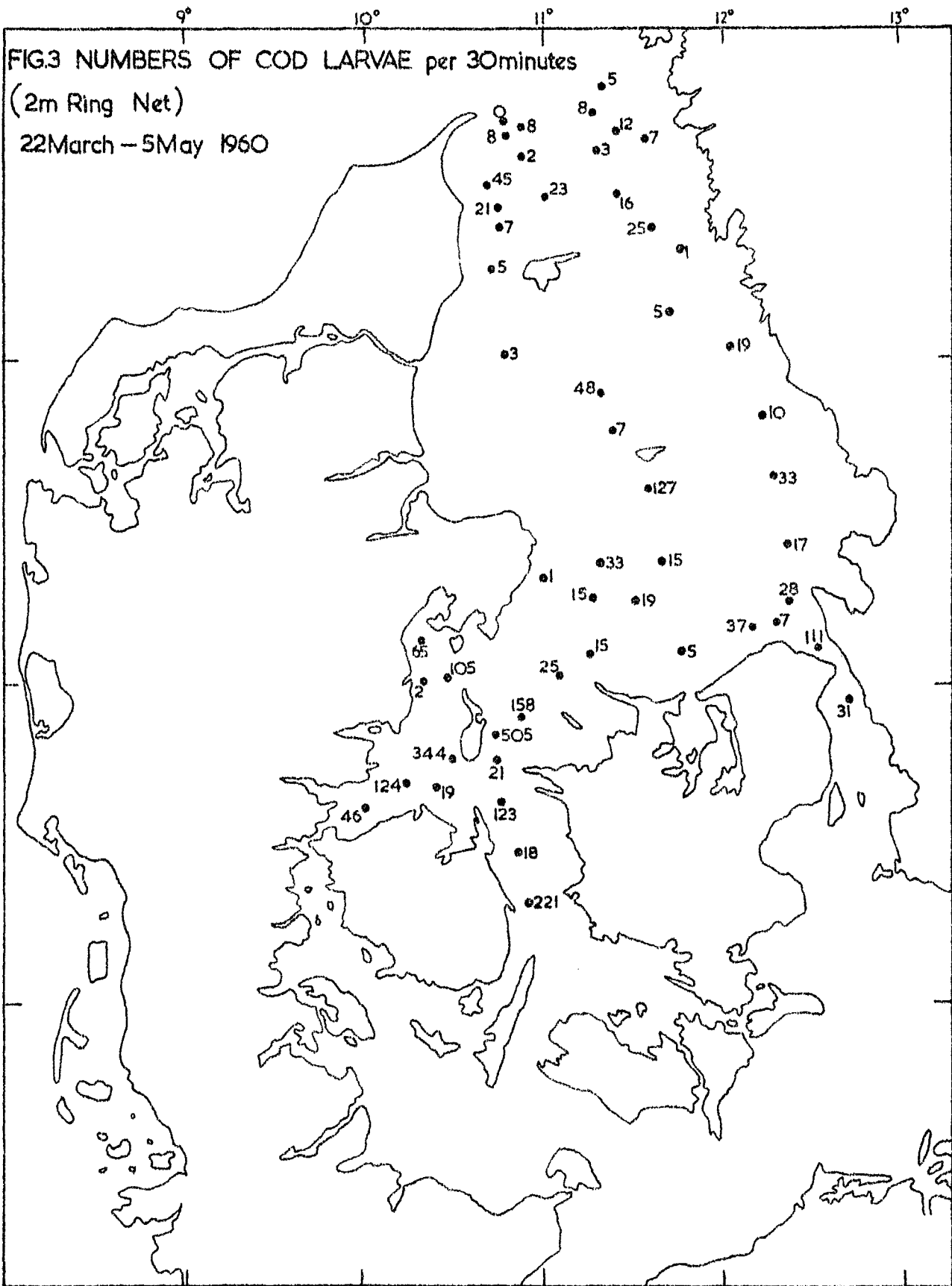
Variations in the mean number of vertebrae of cod from different regions were examined to see if these could be of any value for stock separation. It was concluded, however, that insufficient data were available to enable valid conclusions to be drawn.

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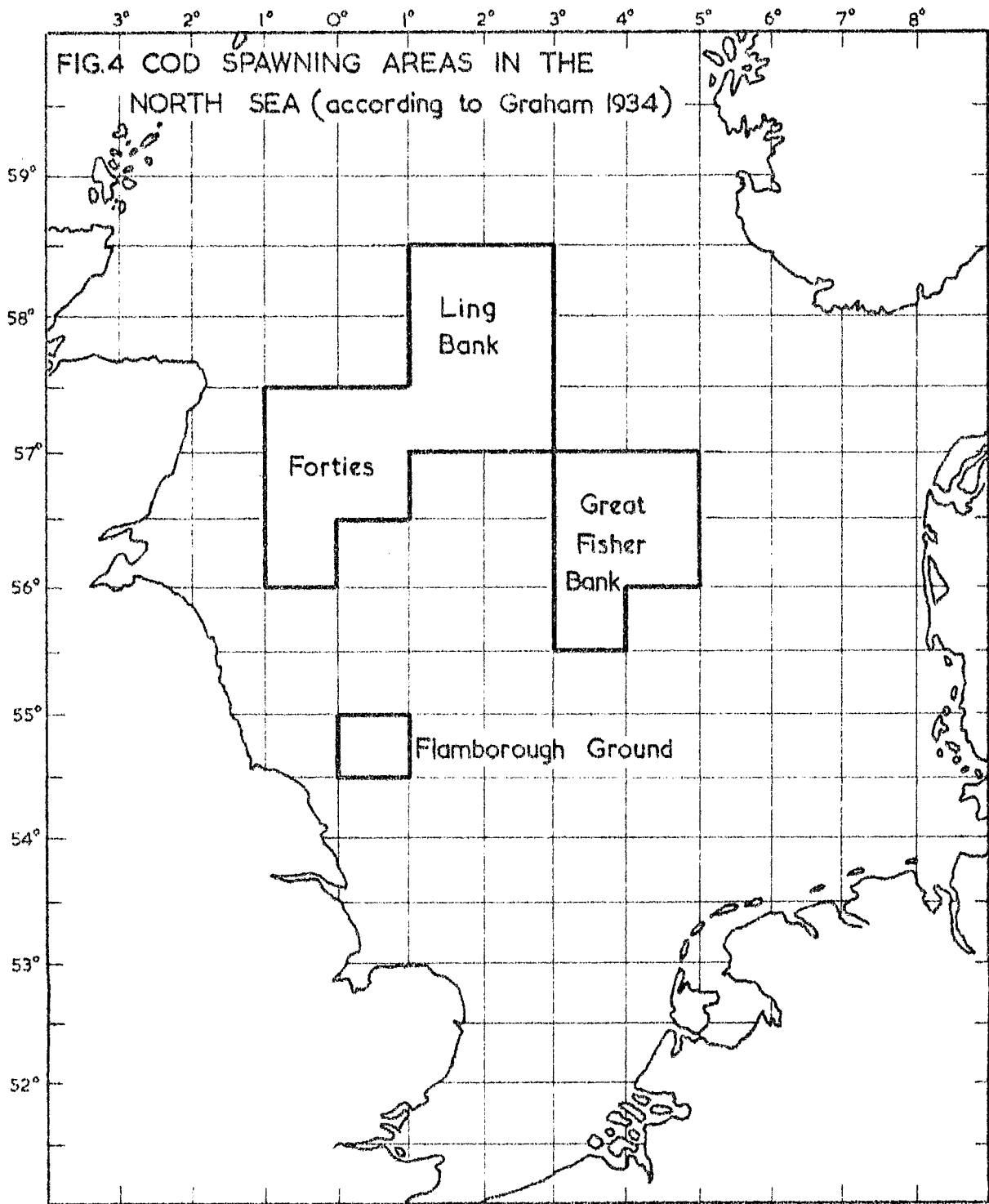


FIG.5 MEAN CATCH PER 10HOURS FISHING OF LARGE COD BY MOTOR TRAWLERS IN ENGLAND 1963

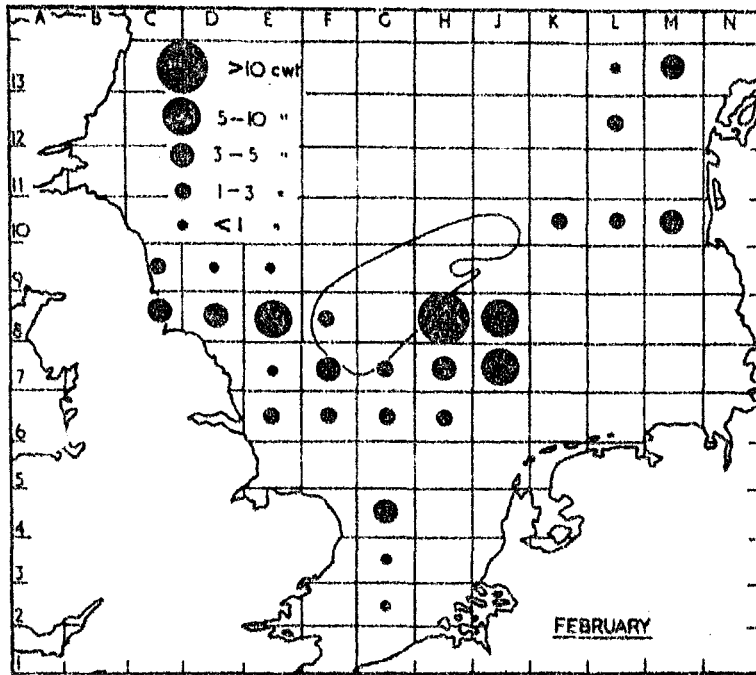


FIG.6 MEAN CATCH PER 10HOURS FISHING OF LARGE COD BY MOTOR TRAWLERS IN ENGLAND 1963

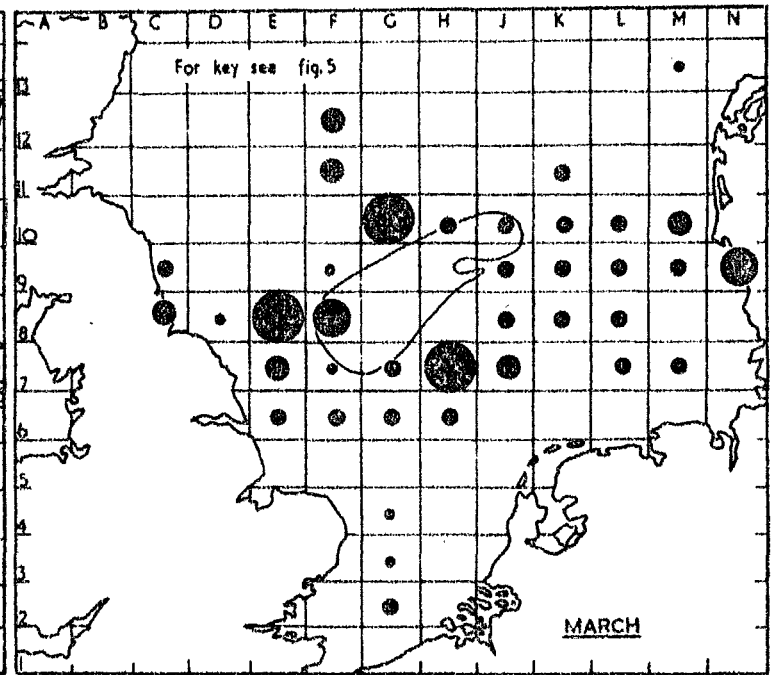


FIG.7 MEAN CATCH PER 10HRS FISHING OF LARGE COD BY MOTOR TRAWLERS IN ENGLAND 1963.

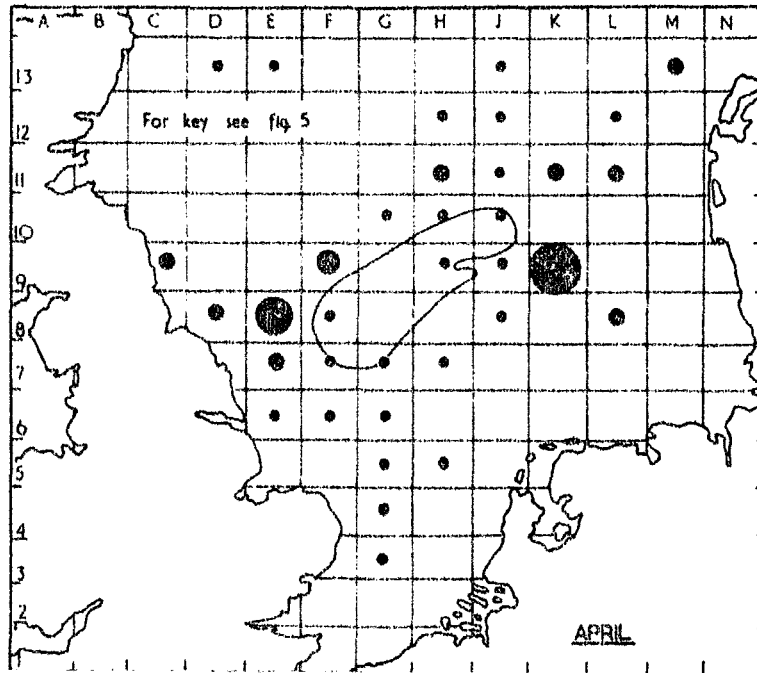


FIG.8 MEAN CATCH PER 10 HOURS FISHING OF LARGE COD BY MOTOR SEINERS IN ENGLAND 1963

FIG.9 MEAN CATCH PER 10 HOURS FISHING OF LARGE COD BY MOTOR SEINERS IN ENGLAND 1963

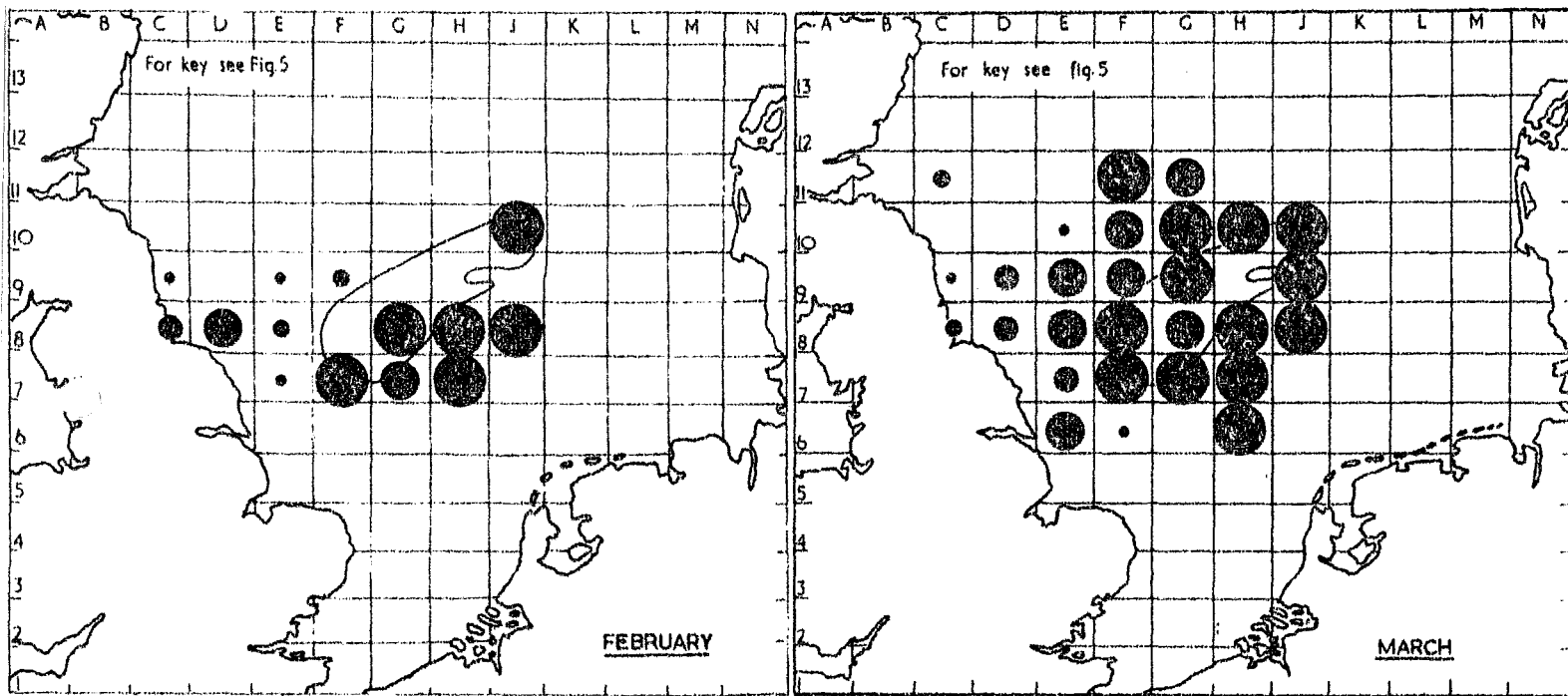
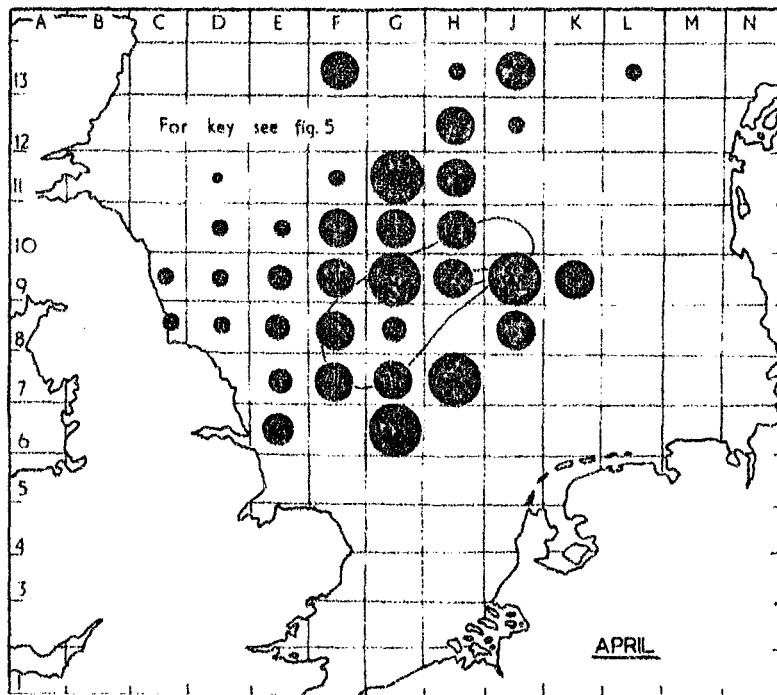
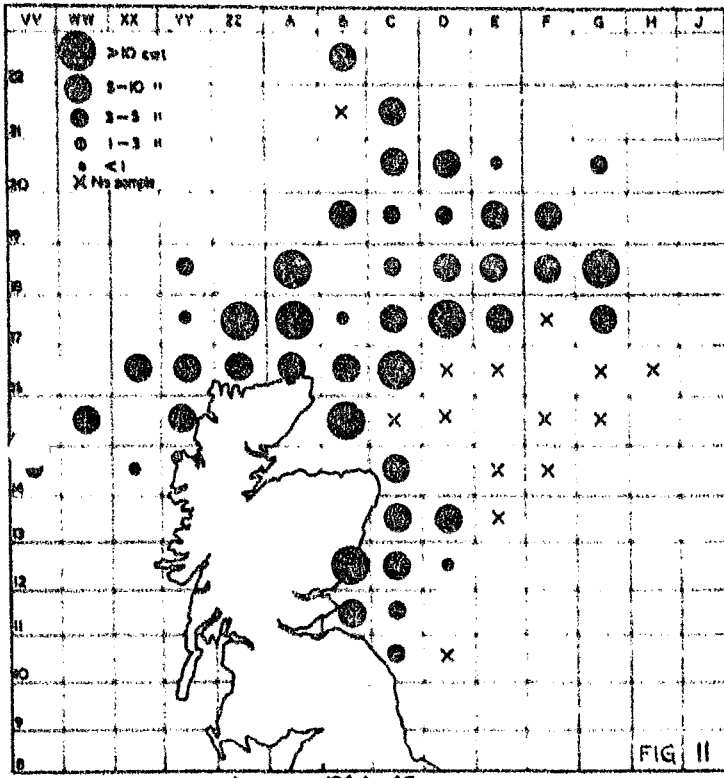


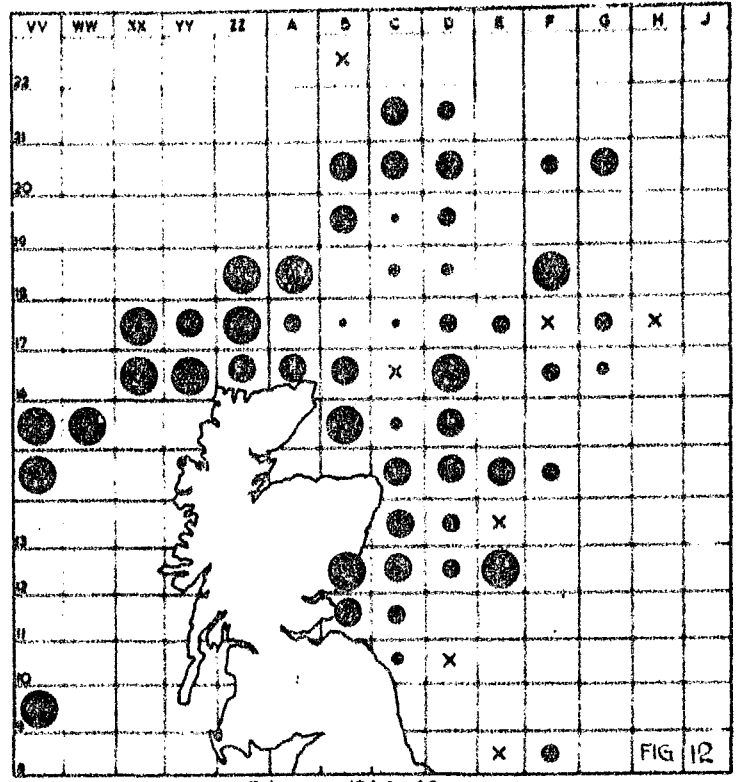
FIG.10 MEAN CATCH PER 10 HOURS FISHING OF LARGE COD BY MOTOR SEINERS IN ENGLAND 1963



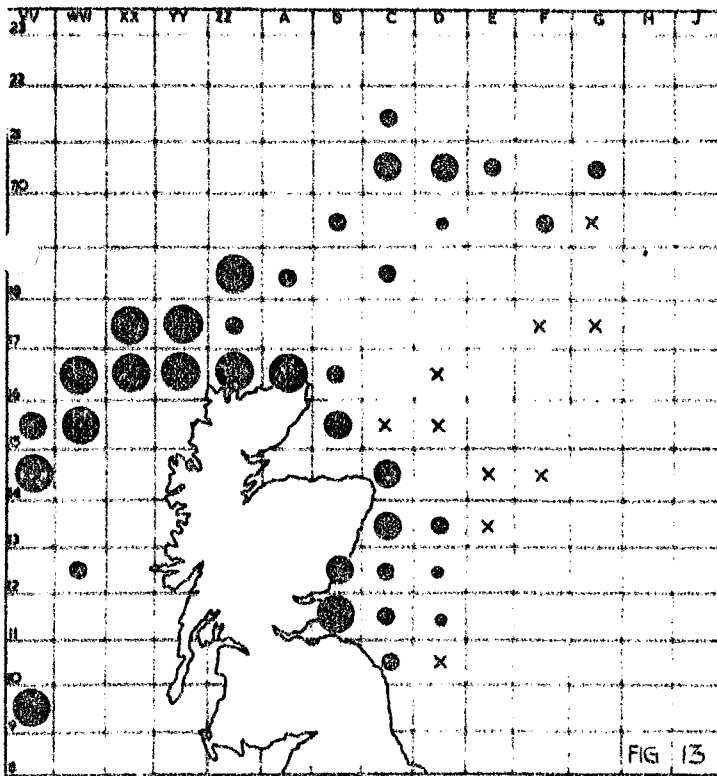
MEAN CATCH PER 10HRS FISHING OF COD LANDED OVER 50cm BY MOTOR TRAWLERS IN SCOTLAND



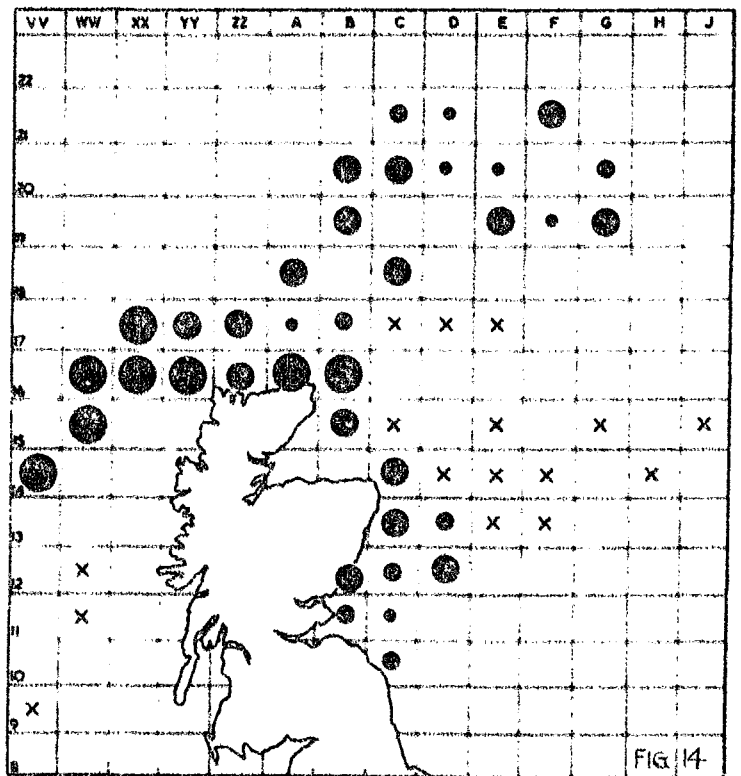
January 1964-68



February 1964-68

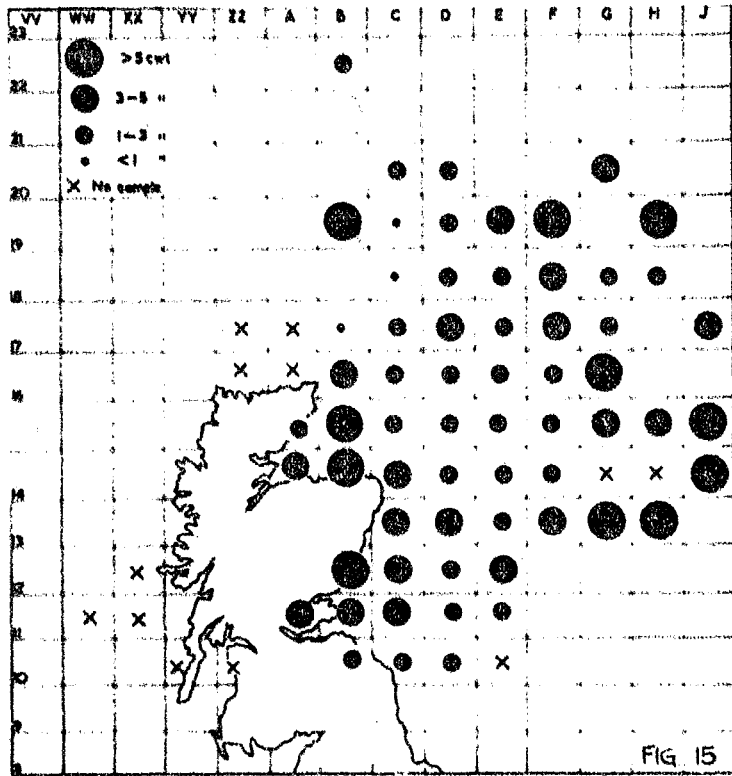


March 1964-68



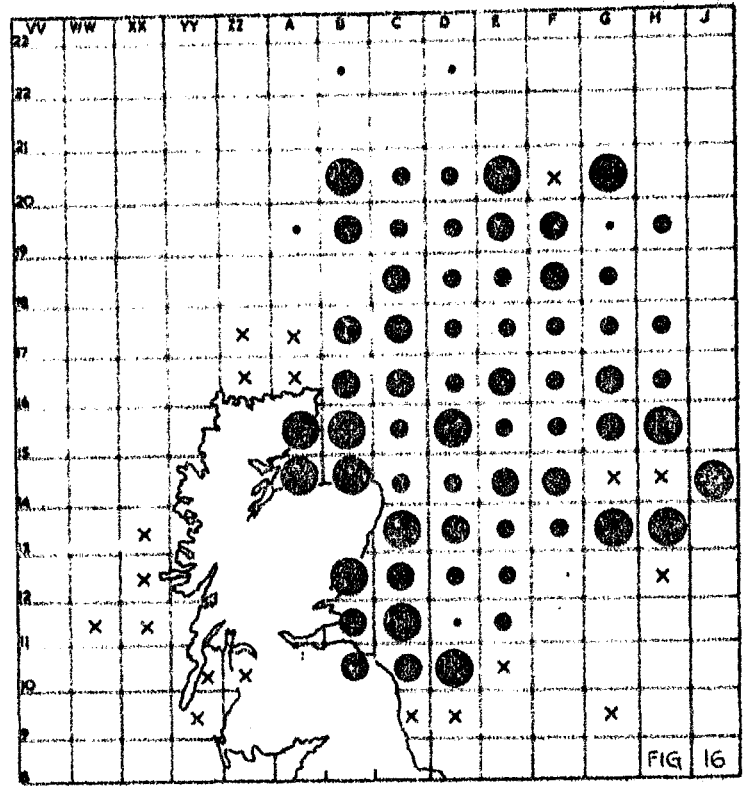
April 1964-68

MEAN CATCH PER 10 HRS. FISHING OF COD OVER 50cm LANDED BY SEINERS IN SCOTLAND



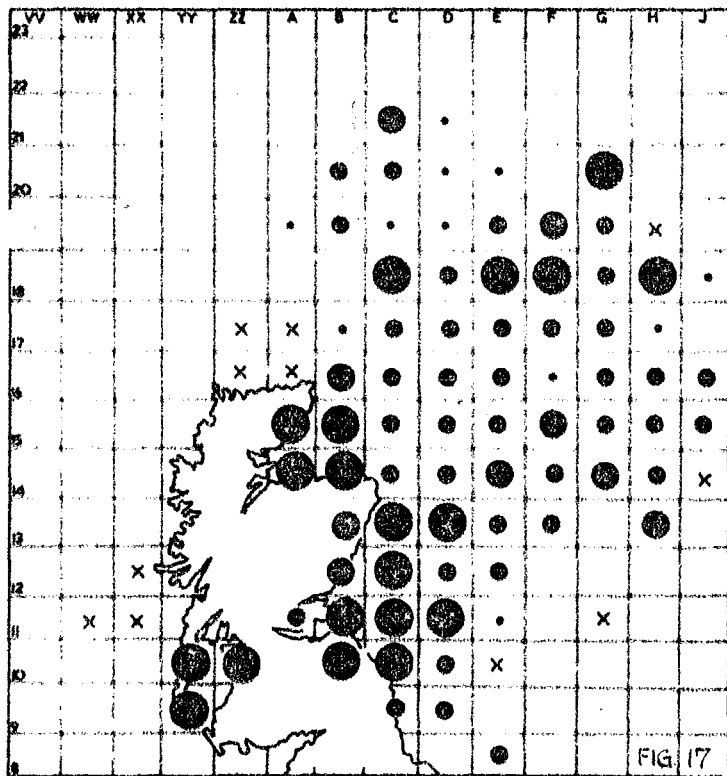
January 1965-68

FIG 15



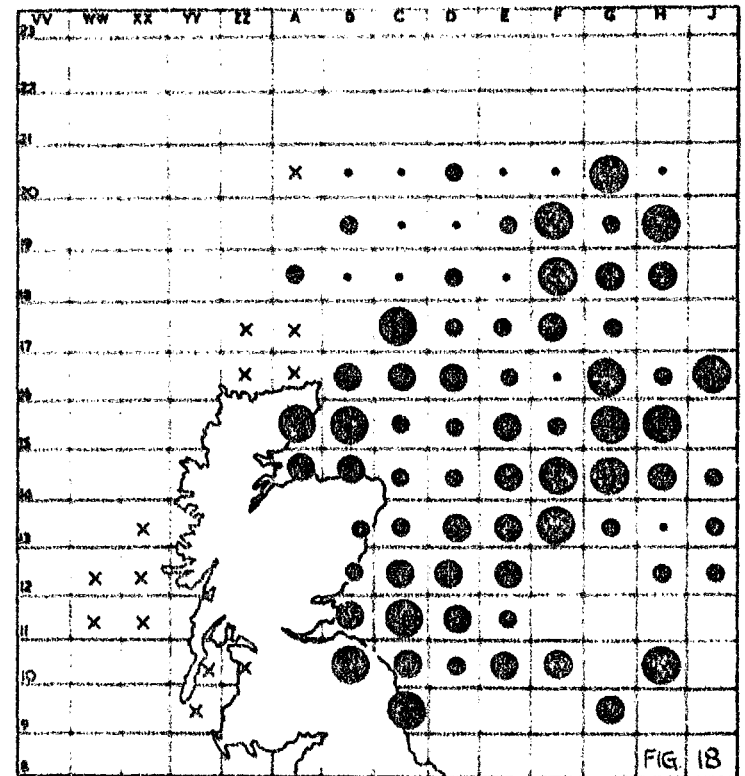
February 1964-68

FIG 16



March 1964-68

FIG 17



April 1964-68

FIG 18

FIG.19

No. OF O-GROUP COD
(Yearclass 1969) per
100 000m² fished
Beam Trawl survey Sept./Oct.1969
(from Daan unpublished data.)

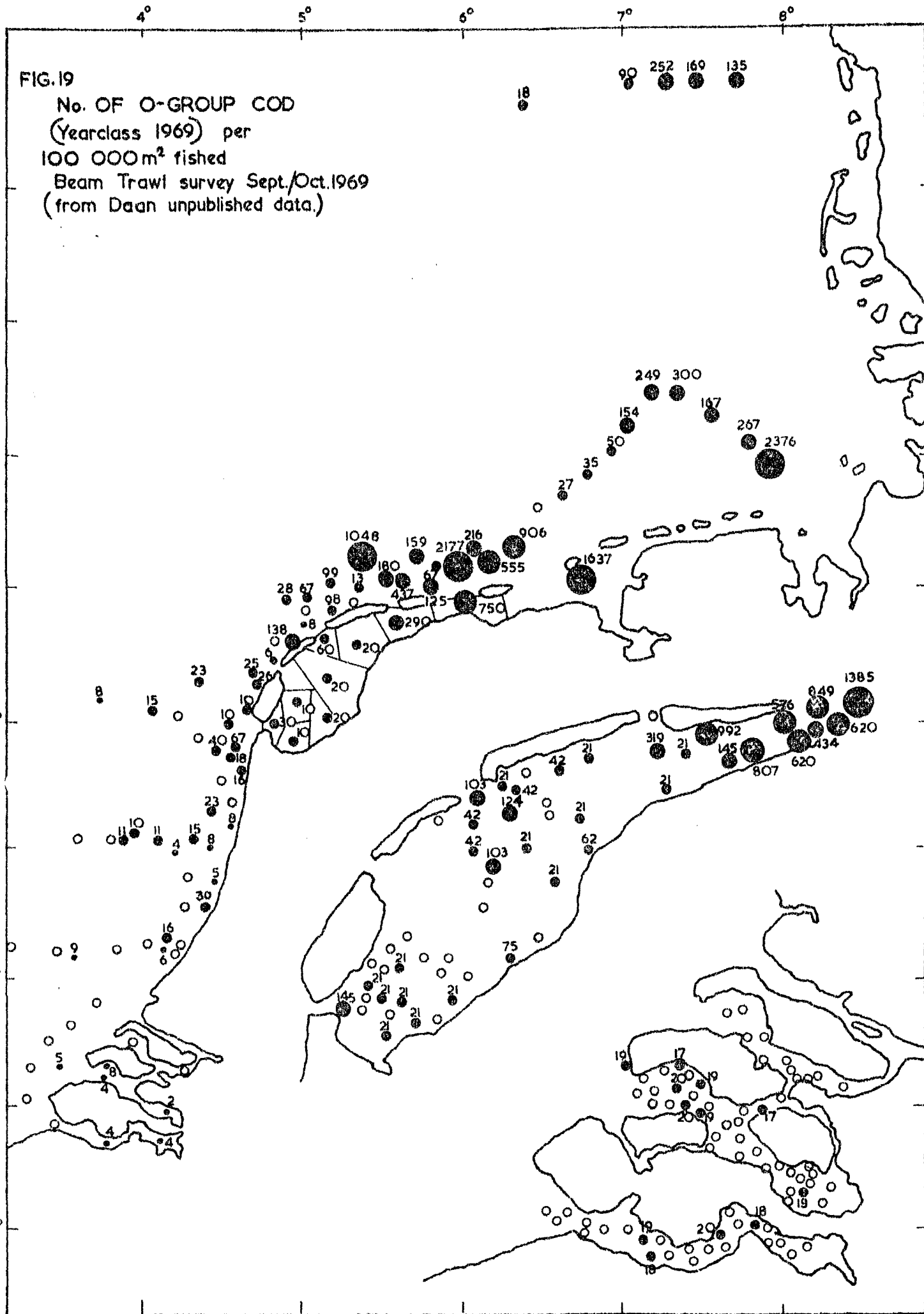


FIG.21 GENERAL DISTRIBUTION OF YOUNG COD from Graham(1938) and additional data supplied by members of working group

