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Pelagic Fish (Northern) Committee

REPORT OF THE WORKING GROUP ON NORTH SEA YOUNG HERRING SURVEYS

19 April - 3 May 1974, Ymuiden, The Netherlands.

CONTENTS

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1. INTRODUCTION AND PARTICIPATION.

At the 61st Statutory Meeting of the I.C.E.S. in Lisbon, it was decided that "The Working Group on North Sea Young Herring Surveys" should meet in Ymuiden for one week in May 1974 in order to consider the interpretation of the results and the proposals for extension of these surveys to include demersal species" (C. Res. 1973/2: 19). Consequently, the Working Group met in Ymuiden from 29 April - 3 May 1974. The meeting was attended by the following participants:

Mr. A.C. Burd .... England

Mr. A. Corten (Chairman) .... The Netherlands

Dr. H. Dornheim .... Germany (F.R.)

Mr. K. Popp Madsen .... Denmark

Mr. K.H. Postuma .... The Netherlands

Mr. A. Saville .... Scotland

Mr. K.A. Smith .... U.S.A.

Mr. Ø. Ulltang .... Norway

Mr. G. Wagner .... Germany (F.R.)

During its first session the Group decided that the emphasis of the meeting should be on evaluating results of the past surveys, and deciding whether the results obtained so far were promising enough to warrant a further continuation of the surveys in future.

2. EVALUATION OF PAST SURVEYS.

2.1. Abundance estimates of I-group herring.

I.C.E.S. Coordinated Young Herring Surveys were first made in 1960 and 1961. After a lapse of five years, the surveys were revived in 1967. Small scale surveys were made in 1965 and 1966 by Dutch and German research vessels.

A list of all International Young Herring Surveys up till the date of the meeting is given in table 1. For each of these surveys, the distribution of I-group herring is represented in figures 1-11.

TABLE 1 - List of International Young Herring Surveys 1960-1974.

Year	Participating countries *)	No. of squares	No. of hauls	Results reported by:
1960	D, E, G, N, S	119	247	Anon. 1969
1961	D, G, N, S	126	286	Anon. 1969
1965	N	22	29	Not published
1966	G, N	14	51	Zijlstra 1966
1967	E, G, N, S	61	96	Saville 1967
1968	E, G, N, S	63	135	Postuma 1968
1969	E, N, S, SW	72	87	Postuma and Zijlstra 1969
1970	E, G, N, S, SW	90	135	Schubert 1970
1971	D, E, G, N, NO, S, U	106	190	Postuma and Kuiter 1971
1972	D, E, G, N, NO, S, SW, U	123	256	Postuma and Kuiter 1972
1973	D, E, G, N, S, SW, U	123	223	Corten and Kuiter 1973
1974	D, E, G, N, S, SW, U, NO			Corten and Kuiter, in preparation

*) Denmark (D); Federal Republic of Germany (G), England (E), The Netherlands (N), Scotland (S), Sweden (SW), USSR (U), Norway (NO).

2.1.1. Correction for standard area.

Over the period 1965 to 1973 more vessels have entered the programme and the area fished has been gradually expanded. This results in difficulties in obtaining comparable abundance indices over longer periods.
In order to obtain estimates in a standardized form, the coverage of each statistical square over various time periods was examined. Squares which have been fished each year during 1965-73, 1967-73 and 1969-73 are represented in figure 12. The different periods give standard areas of 16, 41 and 65 squares respectively.

For each standard area, abundance indices of I-group herring were calculated for the various years:

Year class	Mean abundance indices for Standard area. (squares).		
	16	41	65
1963	3900		
1964	1092		
1965	584	319	
1966	360	285	
1967	121	244	170
1968	180	733	573
1969	2449	1707	1518
1970	1645	1851	1227
1971	722	394	312

The mean abundance indices for 41- and 65-squares have been plotted on the basic 16-squares estimates (Fig. 13). The 41-square estimates tend to be distributed near the bisector. The effect of increasing to 65 squares has been to reduce the abundance indices.

For calculation of North Sea total abundance indices it was decided to take as standard the 41-square distribution and to add to these any square in which a catch of over 1000 herring per haul had been made in any year.
12 further squares were thus added making a total of 53 squares.
Equivalent abundance indices for the 1963 and 1964 year classes were obtained by raising the 16-square abundances by the mean ratio of the 16-square and 41-square abundance indices for the parallel data series.

Because of missed sampling in some of the additional 12 squares in some years it was decided to interpolate estimated values in order to obtain standardization. For those years when catches were recorded the ratio of the abundance in that square to the 41-square abundance was calculated and means were taken for all years. This mean ratio per square was used to calculate an interpolated value by raising by the 41-square mean for that year.

This procedure was also applied to the data from the 1960 and 1961 surveys.

Standardized abundance indices were calculated for each year class of I-group herring by summation of the catches in the standard areas and dividing by 53 : table 2.

TABLE 2 - Abundance indices of I-group as mean number per square.

Year class	Standardized	Uncorrected *)
1958	2413	1269
1959	37	340
1963	4064	2797
1964	815	714
1965	429	245
1966	419	265
1967	320	433
1968	1042	469
1969	2570	1536
1970	1632	922
1971	837	489

*) from Corten and Kuiter, 1973.

2.1.2. Daylight effect.

Participating countries were originally instructed to trawl only during daytime, as herring are known to leave the bottom at night. However, it was suspected that this rule had not always been applied very strictly, in which case both the mean number per haul and the variance on it might have been influenced.

To test whether past results had been affected this way, data for 1971 were split into "daylight" and "darkness" hauls. Daylight hours were defined as hauls between 08.30 - 16.00 G.M.T. in February, and between 08.00 - 16.30 G.M.T. in March.

Two sources of data were then examined.
In 1971 "Anton Dohrn" fished in 7 squares, both in "daylight" and in "darkness" which contained appreciable numbers of herrings. The "daylight" to "dark" ratios of catches for these squares were 1.1, 2.1, 1.9, 4.9, 17.6, 8.0 and 3.1 giving a mean "daylight" to "dark" ratio of 5.5.

The ratios of the mean "daylight" to "dark" catch in all squares which were fished under both conditions in 1971 was also calculated. There were 38 such squares of which only 23 gave higher "daylight" then "dark" catches. The overall mean catch per square of these squares for daylight hauls was 2084 against 1823 for dark hauls; these differences are certainly not significant.

The evidence of the 1971 survey does not prove the hypothesis that past results have been affected by a too liberal interpretation of "daylight". The data from the "Anton Dohrn" might be the more reliable in that they are not affected by differences in fishing power between ships, which may mask the daylight and dark effect in the other data. On the basis of the conflicting data available, it was decided that while any such effect could not currently be corrected for in the past data, more rigid quidelines regarding the times of first and last hauls each day should be applied in future surveys.

2.1.3. Variance in the mean number per haul.

Experience from past surveys has shown that the mean number per haul for the whole North Sea is sometimes influenced very strongly by one or two hauls of exceptional size. Year class 1971 for instance, was sampled in 223 hauls, containing a total of 92 623 herring. This gives a mean number per haul of 415. Out of the 223 hauls, one haul contained 26 166 herring, and another one 16 166. If by chance these two hauls had been omitted, the mean number per haul for the whole North Sea would have been 228 instead of 415.

This consideration indicates that the mean, even of a large number of hauls, may be subject to a considerable variance. For a proper interpretation of data from the IYHS, one should at least have some idea about the level of precision that can be ascribed to the mean number per haul.

Data for the 1971 survey were used to get an estimate of the order of size of the variance in the abundance estimates and to see how the variance in the number per haul varies over the area. As the number of observations within a statistical square is too low for estimating the variance, the North Sea was divided into strata of four squares each.The squares used in the analysis and the stratification are shown in fig. 15. No information about the distribution of herring was used in stratifying the area. Neighbouring squares were simply put together into one stratum.

Table 3 shows the mean number per haul, the estimated standard deviation on an individual haul, and the number of hauls in each stratum. It appears from the table that the standard deviation is of about the same size as the mean which is what one should expect for such a distribution. Using the formulas for stratified sampling, the mean for the whole area ($\overline{Y}_{st}$) and variance of this mean ($S^2_{\overline{Y}st}$) were calculated.

The values found for $\overline{Y}st$ and $S_{\overline{Y}st}$ were 3.1×10^3 and 0.58×10^3 respectively.

Assuming that $\overline{Y}st$ is approximately normal distributed, the 95 % confidence limits for the mean are then given by 3.1 ± 1.2.

TABLE 3 - Stratification of data from the 1971 survey.

Strata h	mean number per haul $=\overline{Y}_h$ (thousands)	standard deviation S_h (thousands)	numbers of hauls	number of hauls if optimum sampling
1	3.7	2.7	5	5
2	8.2	13.5	13	27
3	0.6	0.7	8	2
4	1.1	1.2	15	2
5	2.6	2.7	8	5
6	2.2	4.3	15	8
7	0.8	1.7	9	3
8	7.5	7.9	8	10
9	6.4	7.9	9	16
10	8.0	9.8	4	20
11	0.4	0.4	5	1
12	1.8	4.0	5	8
13	0.1	0.1	4	1

Taking the estimated standard deviation in each stratum as the true standard deviation, it was also calculated what the precision of the estimate would have been if the total number of hauls used in the analysis (108) had been allocated on the different strata in an optimum way, which means that the number of hauls in each stratum should be proportional to the standard deviation. In that case $S_{\overline{Y}st}$ would decrease from 0.58 to 0.40.

In practise we will never be able to distribute the sampling effort in an optimum way because we do not know enough about the distribution of the herring before we start the survey. Past surveys have shown that this distribution varies considerably from year to year. Still, some squares have a rather high abundance each year compared with other ones.

For the selected area of 53 squares, the ratio between the mean abundance in each square and the overall mean was calculated for each year. Indices of relative mean abundance for individual squares were then established by calculating mean ratios over all the years (fig. 16). These indices can be used for future stratification of the sampling area, as further discussed in section 4.1.

2.2. Relation between abundance estimates of I-group herring from Young Herring Surveys and from Virtual Population Analysis.

The estimates of year-class strength, calculated as described in section 2.1.1., for each year-class sampled as I-group are given in table 4. The abundance estimates of the same year-classes as I-group from V.P.A. (C.M. 1973/H : 27) are also given. One would hope to be able to use the Young Herring Survey estimates to predict year-class strength one year earlier than the first estimate is available from VPA. The year-class strength, in VPA equivalents could then be used in setting the total allowable catch (TAC).

TABLE 4 - Abundance I-group from YHS and VPA.

Year-class	Estimated strength from Young Herring Survey	Estimated strength from V.P.A. (X 10^{-9})
1958	2413	7.07
1959	37	1.63
1963	4064	9.44
1964	815	5.07
1965	429	4.44
1966	419	6.30
1967	320	6.29
1968	1042	4.93
1969	2570	7.75
1970	1632	6.29
1971	837	?
1972	1144 *)	?

*) preliminary.

The regression of the V.P.A. estimates on the Young Herring Survey ones has been calculated. The regression equation is $\hat{y} = 0.0013477 X + 4.069$ where $\hat{y}$ is the predicted value of year-class strength for V.P.A. and X is the measured estimate of year-class strength from the Young Herring Surveys (fig. 17). The coefficient of regression is significantly different from zero at less than the 1 % probability level. It should be noted, however, that the constant in the regression accounts for a major part of the predicted value; about 60 % for an average year-class. The standard error of the predicted y is 0.6 for an average year-class.
From the values of the strength of the 1971 and 1972 year-classes given in the table, one can predict the VPA estimates of the strength of these year-classes using the regression equation above. The values are 5.2×10^9 and 5.6×10^9 respectively; that is these year-classes would be expected to be about 23 % and 17 % respectively below the long term mean.

2.3. Relation between YHS estimates and abundance estimates from the Bløden industrial fishery.

Estimates of year-class strength in the commercial young herring fishery from Esbjerg have been made since 1957 and are shown in table 5. Measured in millions of herring caught per 1000 hours of pair trawling they represent straight means derived from the total effort and the total number caught per season. They do not include corrections for the area covered by the fishery or by the herring stock nor has any distinction been made between effort directed towards herring capture and effort which only produced herring as a by-catch. It is likely that an increase in fishing power has taken place in recent years, but neither in this case have any corrections been made.

In figure 18 YHS-indices are plotted against indices of I-group strength obtained from the Bløden fishery in January - April. The lack of correlation between the two sets of indices is obvious and seems mainly to be due to the high Bløden indices for the year-classes 1964-1967. It appears that the YHS give a better estimate of the strength of incoming year-classes than the present estimates from the Bløden fishery. It is likely that the Bløden-indices are heavily influenced by dense coastal concentrations of young herring which sometimes occur in January and February and which were a prominent feature in case of the 1966 year-class.

Figure 19 shows the relation between the YHS-indices and those from the Bløden-fishery in autumn (i.e. July-November). Again the correlation is not significant.

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TABLE 5 - Abundance indices from Bløden fishery (thousands of fish per hour pair-trawling).

Winter rings	0	I		II
Year-class	Autumn	Spring	Autumn	Spring
1956	12.3	67.8	37.7	38.2
1957	1.6	7.2	15.8	7.0
1958	0	26.9	28.8	18.0
1959	3.6	6.7	2.3	0.5
1960	20.2	48.2	34.5	0.2
1961	2.9	17.4	19.6	2.7
1962	8.5	46.8	18.1	15.6
1963	6.1	41.7	17.6	6.9
1964	2.1	44.5	10.1	4.5
1965	8.7	30.2	6.7	7.0
1966	21.9	74.6	7.6	2.3
1967	13.5	34.5	12.3	4.3
1968	3.3	19.7	6.6	4.1
1969	20.9	31.8	15.7	5.9
1970	9.2	39.8	19.1	6.2
1971	11.5	23.3	24.2	22.4
1972	6.5	10.1	-	-
Average	8.2	33.6	17.0	9.1

2.4. Identification of subpopulations in juvenile herring.

Two of the specified objectives of the 1960 and 1961 surveys were to attempt to identify the nursery areas of the Bank, Down and Buchan herring and to attempt to make quantitative estimates of their respective abundances as I-group. A discriminant function analysis was used for the latter purpose and the results were published in Coop. Res. Rep. No. 14.

No satisfactory solution could be found with regard to the spatial distribution of the subpopulations.

During the recent series of surveys meristic characters have also been collected in order to try to obtain further information on the spatial distribution of Downs, Bank and Buchan recruits. At present considerable evidence is available that fish, belonging to spawning stocks to the north and north-west of Scotland are also present in the North Sea. In the absence of any technique for identifying these recruits as I-group, their presence leads to an overestimate of the recruitment to the true North Sea herring populations.

The distribution of meristic characters in the 1971 and 1972 Young Herring Surveys has been examined to see if centres of abundance of herring of relatively homogeneous meristic characters could be identified. The procedure followed was to select a square and to compare the data on length, V.S., and K_2 with those in surrounding squares. If these lay within the variances of the selected square the data were then combined. The combination was made either by addition of length distributions or by calculation of weighted means and variances in the case of V.S. and K_2.

In this summation length played a major part. A number of small loci were established and a simple correlation matrix was calculated. As a result of this some further additions of adjacent areas of similar character was made.

The identification of any centre is dependent on the adequacy of the biological sampling. Figure 20 shows for the 1971 survey the distribution of squares fished and those with stations having sufficient numbers of vertebrae and K_2 counts. The data available consisted of the station sheets reporting the biological samples. In these only means, variances and number of observations are reported for the meristic characters, while length data were reported in full.

The centres of abundance derived for the 1971 survey are shown in figure 21. Within each centre the mean length V.S. and K_2 is given. It is seen that in the north-western North Sea an area of fish with low mean length and high V.S. and K_2 has been delineated from patches of larger fish to the east and west. Mean V.S. and K_2 values are also given from the English O-group surveys made in July preceding the Young Herring Surveys. The O-group from the East Anglia coast are seen to have characters similar to the I-group off the Dutch coast and into the German Bight. The O-group taken between Flamborough and the Wash have similar values to the offshore patch west of the Dogger, and again there is similarity between the offshore north-east English coastal I-group patch and the O-group inshore the previous summer.

The coverage of stations with adequate biological data was somewhat greater in 1972, figure 22. However, as in 1971 there were some areas where large catches had been made in which no biological sampling had been made. The results of the analysis are shown in figure 23 together with the English O-group estimates.

There is in general a similar pattern to that described in 1971, with a I-group patch along the Dutch coast similar to the East Anglia O-group herring. Again there is similarity between the O-group taken south of Flamborough Head and the offshore patch of I-group, while the north-east coast O-group have the high V.S. and low K_2 means similar to the I-group immediately to the north. Two very distinct patches are seen in the Skagerrak.

The population parameters within the patches for the 1970 year-class are calculated in table 6, as example of the effects of grouping. The variances for V.S. and K_2 approach those derived from large samples of pure stocks

TABLE 6 - Population parameters within patches: 1970 year-class.

Patch	Length		V.S.		K_2	
	Mean	Var.	Mean	Var.	Mean	Var.
A	14.16	.78	56.60	.46	14.06	.55
B	15.25	1.53	56.46	.54	14.12	.63
C	14.27	1.56	56.41	.41	14.67	.69
D	17.74	1.77	56.47	.54	14.06	.59
E	18.16	1.06	56.43	.51	14.33	.86
F	19.37	.67	56.67	.55	14.40	.71
G	17.64	1.35	56.44	.44	14.19	.73
H	14.88	1.39	56.27	.61	14.17	.66

Pure stock characters were available for the 1970 year-class from Dutch, Scottish and English sources, table 7, estimated from 2 ringed fish in 1973.

TABLE 7 - Pure stock Characters 1970 Year-class.

Area	Mean V.S.	Mean K_2
Minch	56.50	14.04
Longstone	56.40	14.40
Whitby	56.42	14.55
Flamborough/Whitby	56.36	14.51
Dogger	56.24	14.49
Dowsing	56.27	14.66
Sandettie	56.57	14.79
Channel	56.55	14.54

Comparing these data, patches having the low K_2 characteristic of the Minch spawners are seen in the north-west patch A, the English coastal O-group, and the central North Sea patch D.

There is a closer similarity between the coastal O-group and the offshore I-group than between the offshore patches and the fish recruited to the adult spawning stocks.

The 1969 year-class pure stock characters are shown in table 8.

TABLE 8 - Pure stock characters 1969 year-class.

Area	Mean V.S.	Mean K_2
Minch	56.45	14.10
Flamborough/Whitby	56.49	14.47
Dogger	56.18	14.83
Dowsing	56.41	14.80
Sandettie	56.59	14.78
Channel	56.66	14.69

As with the 1969 year-class, the fish with low K_2 characteristics of the Minch are found in the north-western North Sea, while fish with characteristics similar to the Downs spawning stock are seen in the southern area.

While patches can be delineated in the juvenile herring, no allocation to stock can be made directly though there are indications of areas of lesser mixing. In the central North Sea patches of mixed origin must be expected and it is intended to further investigate the possibilities of discriminating these fish between spawning stocks.

2.5. Distribution of I-group herring in relation to water temperature.

As a preliminary attempt of establishing a possible relationship between young herring abundance and water temperature, the largest catches from the 1971-1973 surveys were plotted on temperature charts for the years concerned (figures 24-26).

These charts indicate that squares of high catches are situated in a temperature range of 4 - 6.5 °C and that the temperature regime at this time of the year may have an important influence upon the distribution area and hence on the density of the young herring. This corroborates the conclusions drawn from another preliminary analysis of the early surveys in 1960 and 1961 (Coop. Res. Rep. Ser. A. nr. 14), and indicates that a full analysis of the relationship between individual catches and temperature observations should be undertaken.
As other factors (e.g. salinity and depth) may influence the distribution pattern of the herring and because of the large amount of data collected up to now, the Working Group felt that further analysis would require the use of automatic data processing.

2.6. Echo surveys

Acoustic surveys carried out by Norwegian vessels in February 1971, February 1972 (BAKKEN et.al, 1972) and in April 1973 show that there exist several methodological problems in using echo sounders and echo integrators as a mean of determining the abundance of young herring in the North Sea.

Herring often constitute only a minor part of the total biomass and therefore contribute little to the total integrator value. This makes it difficult to estimate with reasonable precision how much of the integrator readings should be assigned to herring. This problem may possibly be solved by a combination of improved sampling and refinement of the electronic technique.

Another serious problem is the vertical distribution of herring in the North Sea. In shallow waters and especially at day, the herring stay close to the bottom and it is difficult to discriminate echoes of herring from the bottom echo. This problem might be solved by chosing a time of the year when herring has a more pelagic distribution.

Few attempts have yet been made to measure the abundance of O-group herring in the North Sea by acoustic surveys. When the O-group has a pelagic distribution the problem of bottom echo would be eliminated, but difficulties in allocating the integrator readings to various organisms would still exist.

3. Conclusions

3.1. A highly significant correlation has been demonstrated between corrected YHS-estimates of I-group abundance and VPA values for the same age group. This shows that YHS-estimates can be used in forecasting year-class strength and setting a total allowable catch (TAC). It should be noted, however, that the technique will be misleading at low year-class strength because a zero YHS-estimate will, according to the regression equation, still predict a year-class strength of only 40 % below average.

3.2. Abundance indices from the Bløden industrial fishery which were available to the Working Group are not related to the YHS-estimates. From the nature of the Bløden fishery, which actively searches for herring concentrations, the abundance index derived from it may sometimes not be a good index of year-class strength.

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3.3. The variance on the overall mean number per haul from the YHS is likely to be rather high. This will in some years introduce a considerable error in predictions of year-class strength. It is possible to decrease the variance on the mean by allocating the sampling effort in an optimum way. This can be done by stratifying the area and distributing the hauls in proportion to the expected density in each square. Considering the importance of these surveys for North Sea herring management, every attempt should be made to improve the reliability of the recruitment estimates. A plan for modifying the survey pattern to meet these needs is appended.

3.4. Meristic characters might be useful in identifying subpopulations in young herring by grouping neighbouring squares with similar characters. In the western part of the North Sea, concentrations with uniform meristic characters can be related to O-group herring sampled along the English coast the previous summer, and also to adult stocks spawning in the Flamborough-Whitby area. However, it is not clear whether concentrations of young herring with uniform meristic characters in other parts of the North Sea can also be related to adult stocks. It is recommended that the sampling of meristic characters should be continued in the meantime, pending the results of further analysis.

The Working Group noted that sampling of the area was rather uneven. As this appears to be due to insufficient manpower available to some participants, the Working Group envisaged that exchange of technical personel might be a way to amend this deficiency in sampling.

3.5. From the preliminary appraisals carried out by the Working Group no definite conclusions could be drawn on the effect of daylight and darkness on the catches, nor on the effect of hydrographic factors on the distribution of young herring. The study of these subjects needs a thorough analysis of the basic material, which requires automatic data processing.

3.6. Echo surveys made by various countries have so far failed to prove their usefulness as a means of estimating I-group abundance.

3.7. In view of the modified plan for the Young Herring Surveys (appendix A), the Working Group did not consider that it could take a decision on a possible extension of the survey area in order to obtain a better coverage for demersal species. The Demersal Fish (Northern) Committee should consider how far this modified plan meets their needs for gadoid surveys.

3.8. In view of the need for further analysis of several facets of the past data, the Working Group considers that a further meeting will be required in 1975.

APPENDIX I - Stratification of sampling area for further surveys

Assuming that the mean relative abundance indices for each square calculated for the period 1960-1973 (figure 16) give a representative picture of the distribution of herring, these abundance indices can be used to construct a stratification of the area for future surveys. COCHRAN (1963) has described a method to use the frequency distribution for constructing strata.

Given the frequency distribution f(y), the method is to form a cumulative frequency of $\sqrt{f(y)}$ and choose stratum boundaries Y_1, Y_2, --- Y_r so that they create equal intervals on the cumulative $\sqrt{f(y)}$ scale.

Using this method we will be very near optimum sampling if we take the same sample size in each stratum. Taking into consideration the great variation in distribution of herring from year to year we should not divide the area into too many strata. The Working Group decided to divide the 53 squares into 3 strata. Using the method described above, we then get one stratum containing the squares with mean relative abundances below 1, one stratum for the squares with relative abundance indices in the interval 1-3, and one stratum for squares which have relative abundance greater than 3. This results in 35 squares in the first stratum, 12 squares in the second and 6 squares in the third. The stratification is shown in figure 27. The total number of hauls should be divided equally on the 3 strata. This means that if 210 hauls are taken in the 53 squares, 70 hauls should be taken in each strata. If we will take the same number of hauls in each square within a stratum, the following stratified sampling could be used:

Stratum	No. of squares	Nr. of hauls in each square	Total no. of hauls
1	35	2	70
2	12	6	72
3	6	12	72

APPENDIX II - Standardization of fishing gear.

Sampling trawls

Young Herring Surveys are carried out by participating countries using bottom fishing otter trawls designated as the "Dutch Herring Trawl". It is not clear that all trawls of this designation are of identical design and rigging. On the contrary, since survey trawls are assembled by the separate individual countries in their institutions or by local fishing equipment supply companies, it is quite likely that considerable variation in materials, twine sizes, accessory equipment and even dimensions of the "survey trawls" exists. It is well known and generally accepted that small differences can and do result in significant variations in performance of otter trawls.

In addition it was noted during the current meeting that all countries do not necessarily adhere to the recommended design for Young Herring Surveys. For example, Norway reported to have used on some of the hauls a "small shrimp trawl". Obviously results from surveys with such a trawl cannot be directly compared with those from a large herring trawl of any type.

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In view of the above it is recommended that detailed specifications for the survey trawl used by each nation participating in North Sea Young Herring Surveys be reported. Specifications should include drawings and dimensions of all parts: twine material, type and size; mesh size in all sections; bobbins (if any); headrope; footrope; hanging method and all other details.

Fishing procedure

Survey results, even those obtained with a standard trawl, will not be directly comparable if survey procedures are not also standardized and closely controlled. Fishing practices vary considerably from vessel to vessel and from country to country (even aboard research vessels). In addition the personal preference of individual captains, vessel crews, and research personnel come into play. Accordingly it is recommended that a standardized procedure for conduct of survey trawl tows be established including but not limited to the following factors:

1. time of tow, from the time the trawl has settled to the bottom and is towing in a straight line until it is hauled from the bottom;
2. speed of tow;
3. recording of position at start and completion of tow. (distance covered);
4. Ratio of trawl warp payed out to water depth. This ratio should be established and specified for optimum fishing at the various depths;
5. lengths of bridles and groundropes (between trawl doors and trawl wings);
6. weight (or wire rope diameter) of trawl warps, bridles and accessory rigging devices;
7. specification of time of day (daylight hours) during which survey tows should be conducted.

Ship factors

The size, weight, power and design of research vessels vary greatly. The fishing power of such vessels must also exibit considerable variation. While it is obviously quite impractical to attempt a standardization of research trawlers, some effort to utilize similar vessels would likely be beneficial. Factors for consideration are:

1. total displacement weight;
2. length;
3. draft;
4. propulsion power;
5. propellor thrust while towing trawl;
6. type of trawler, i.e. stern or size mode.

All survey trawlers should as a minimum requirement be equipped with an accurate calibrated speed and distance log and precise navigation system (Decca navigator or equivalent).

APPENDIX III - Sampling of meristic characters in future surveys.

In each square fished all herring up to 100 specimens should be subject to an analysis of meristic characters (V.S. and K_2) in addition to age and length. If the catch contains more than 100 herring a subsample should be drawn at random.
In squares which are covered by more than one vessel, arrangements can be made by radio as to how the meristic sampling will be allocated among the vessels.

All length measurements should be done on fresh material i.e. before this has been frozen or preserved by other means.

For racial analysis, length should be measured to the millimeter below, while bulk measurements are made to the half centimeter below.

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AC/MV

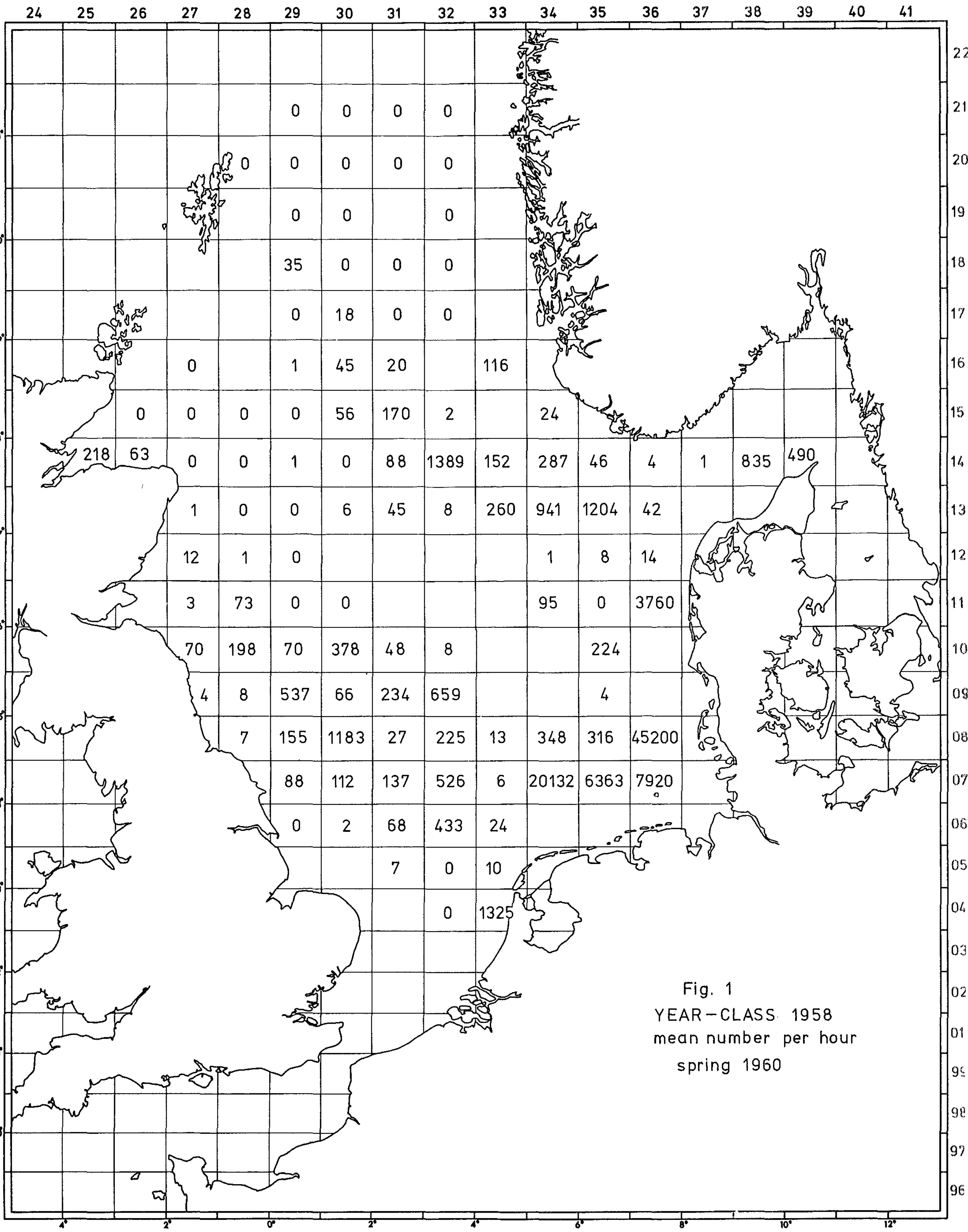


Fig. 1
YEAR–CLASS 1958
mean number per hour
spring 1960

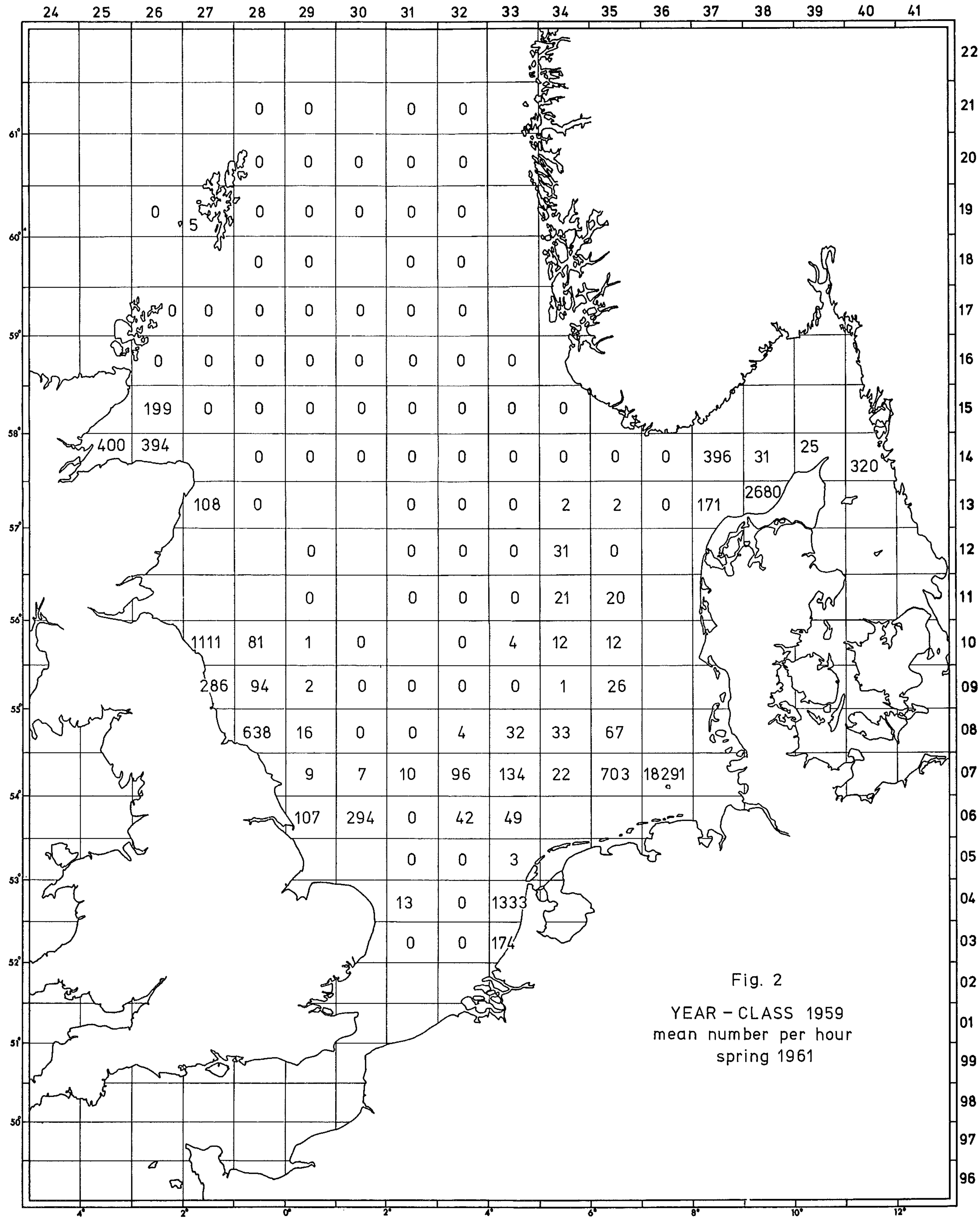


Fig. 2

YEAR – CLASS 1959
mean number per hour
spring 1961

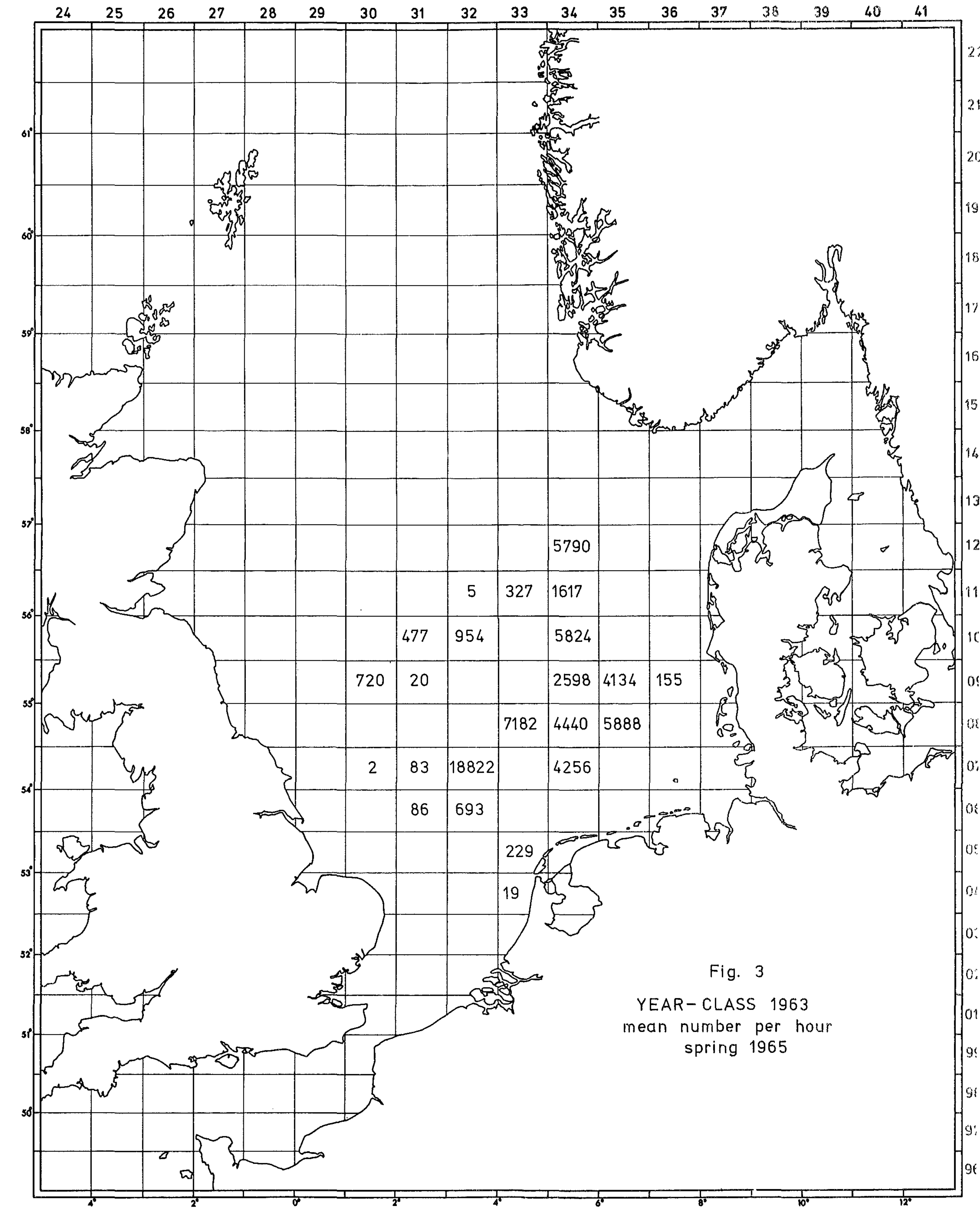


Fig. 3

YEAR-CLASS 1963
mean number per hour
spring 1965

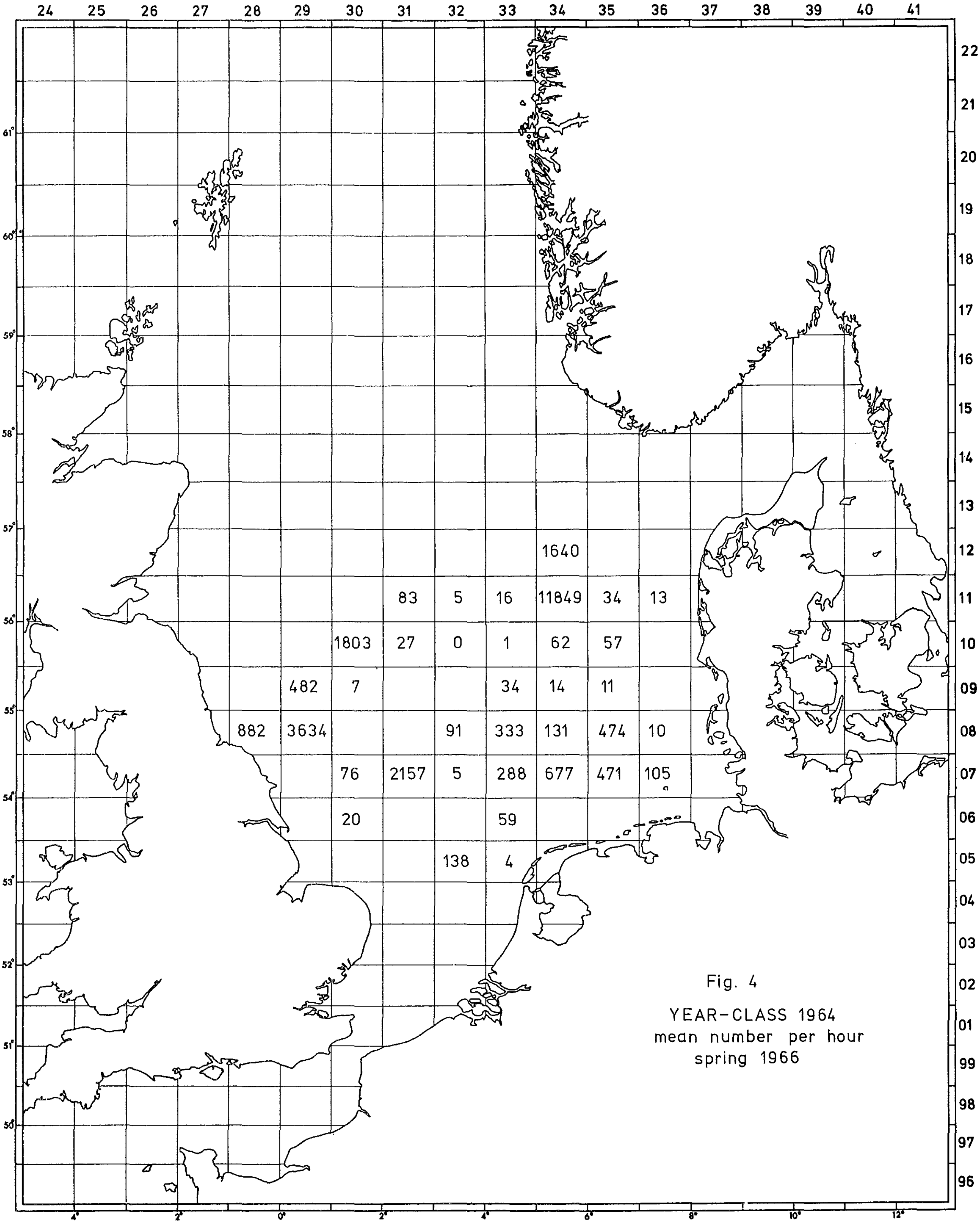


Fig. 4

YEAR-CLASS 1964
mean number per hour
spring 1966

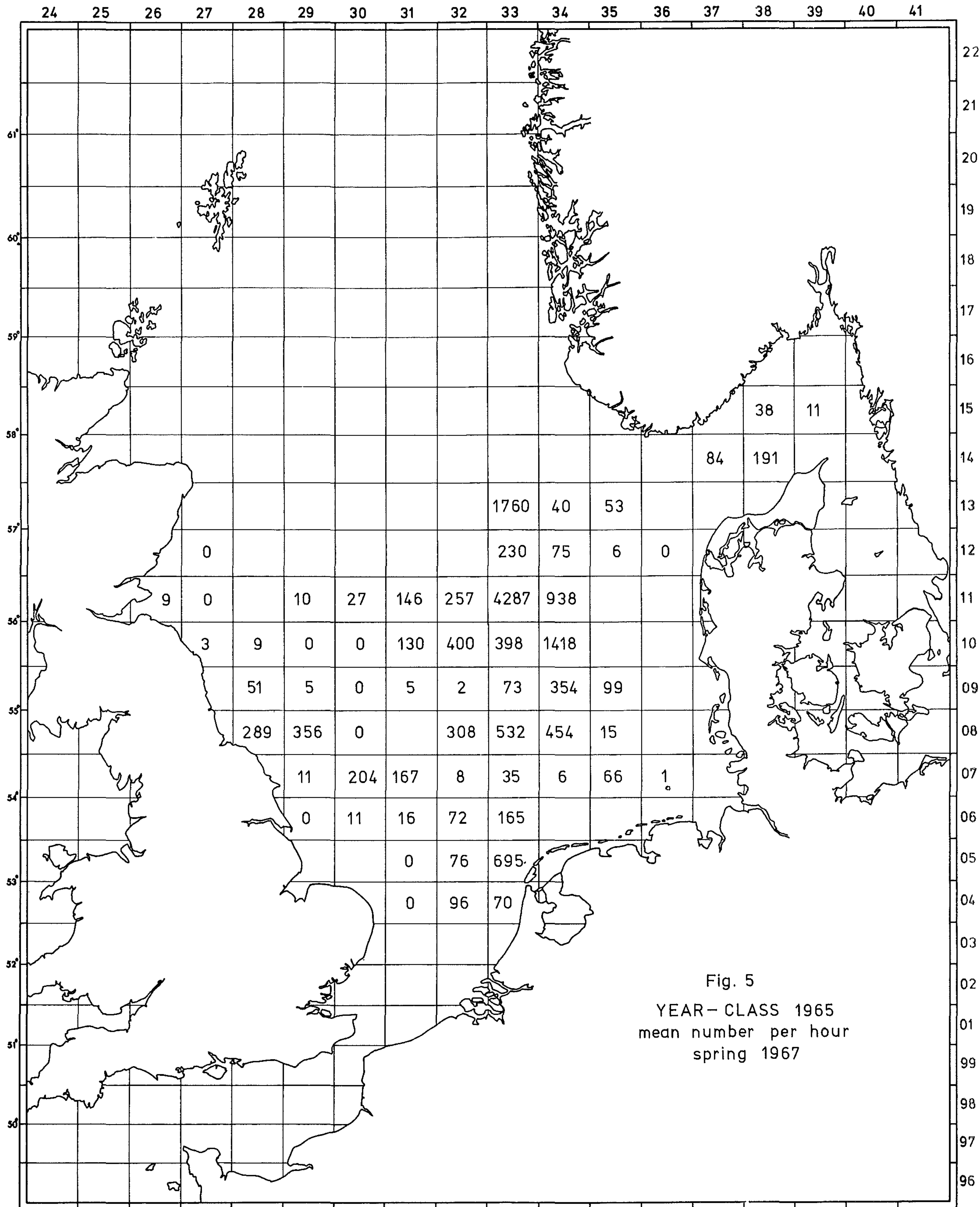


Fig. 5
YEAR-CLASS 1965
mean number per hour
spring 1967

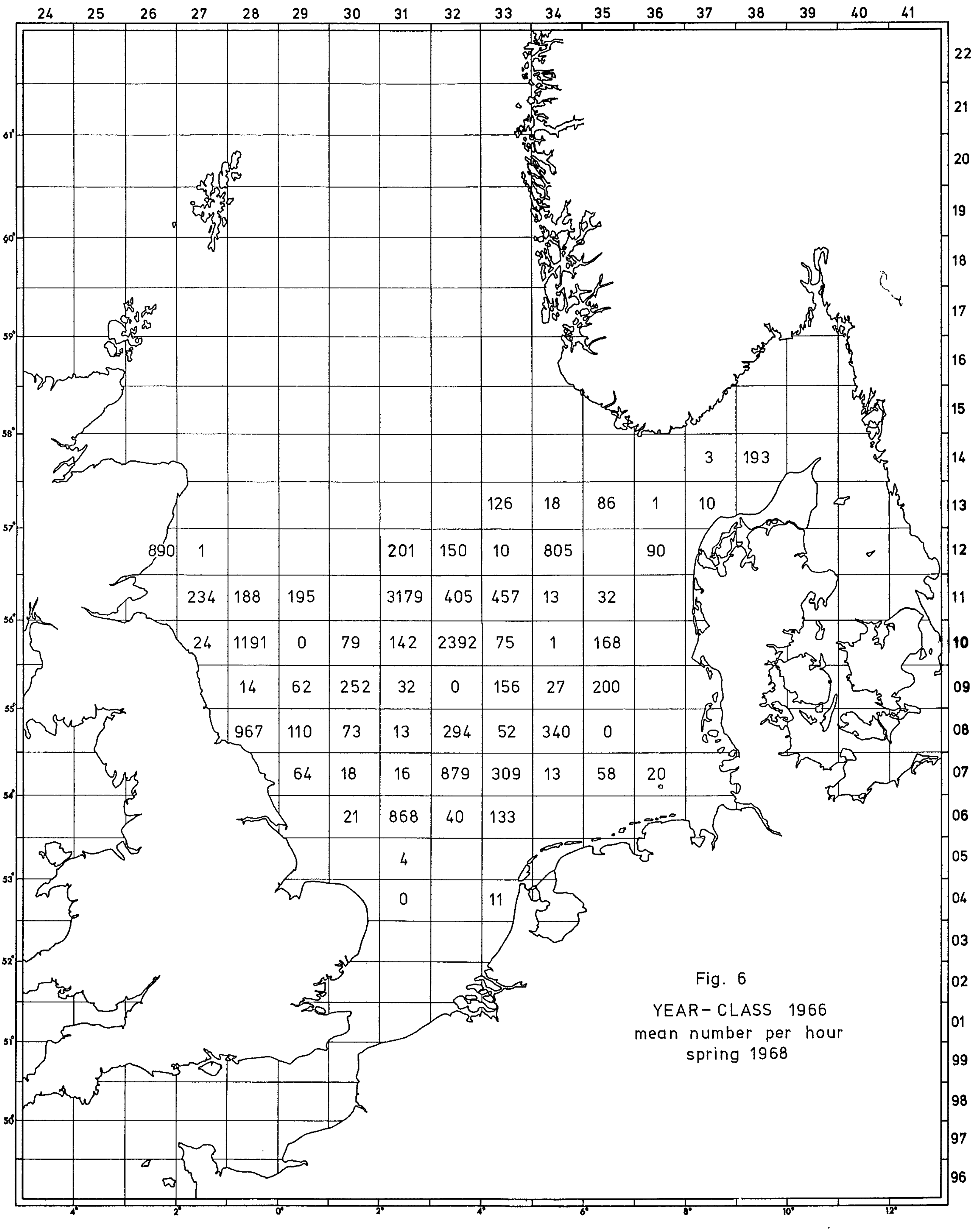


Fig. 6

YEAR-CLASS 1966
mean number per hour
spring 1968

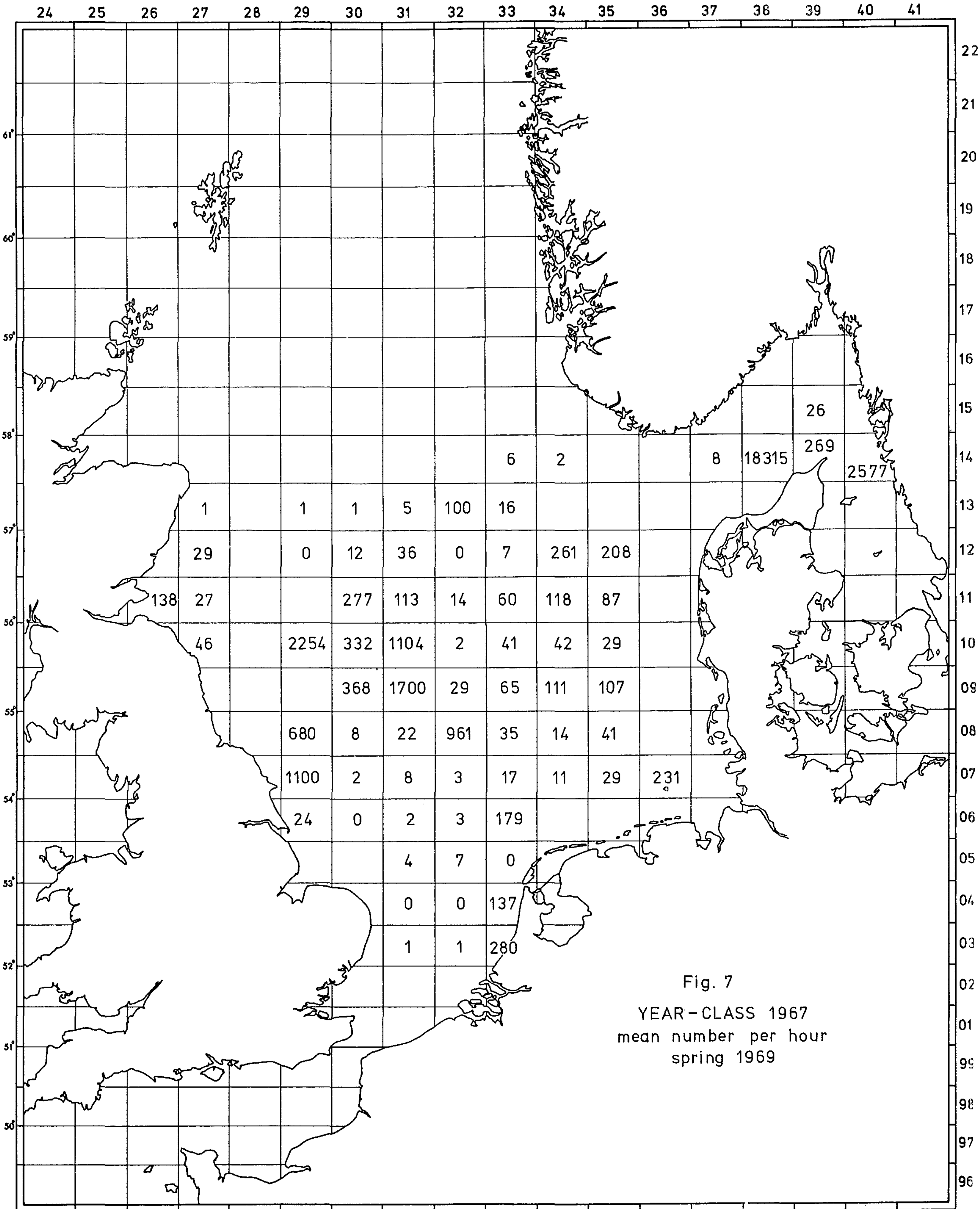


Fig. 7

YEAR-CLASS 1967
mean number per hour
spring 1969

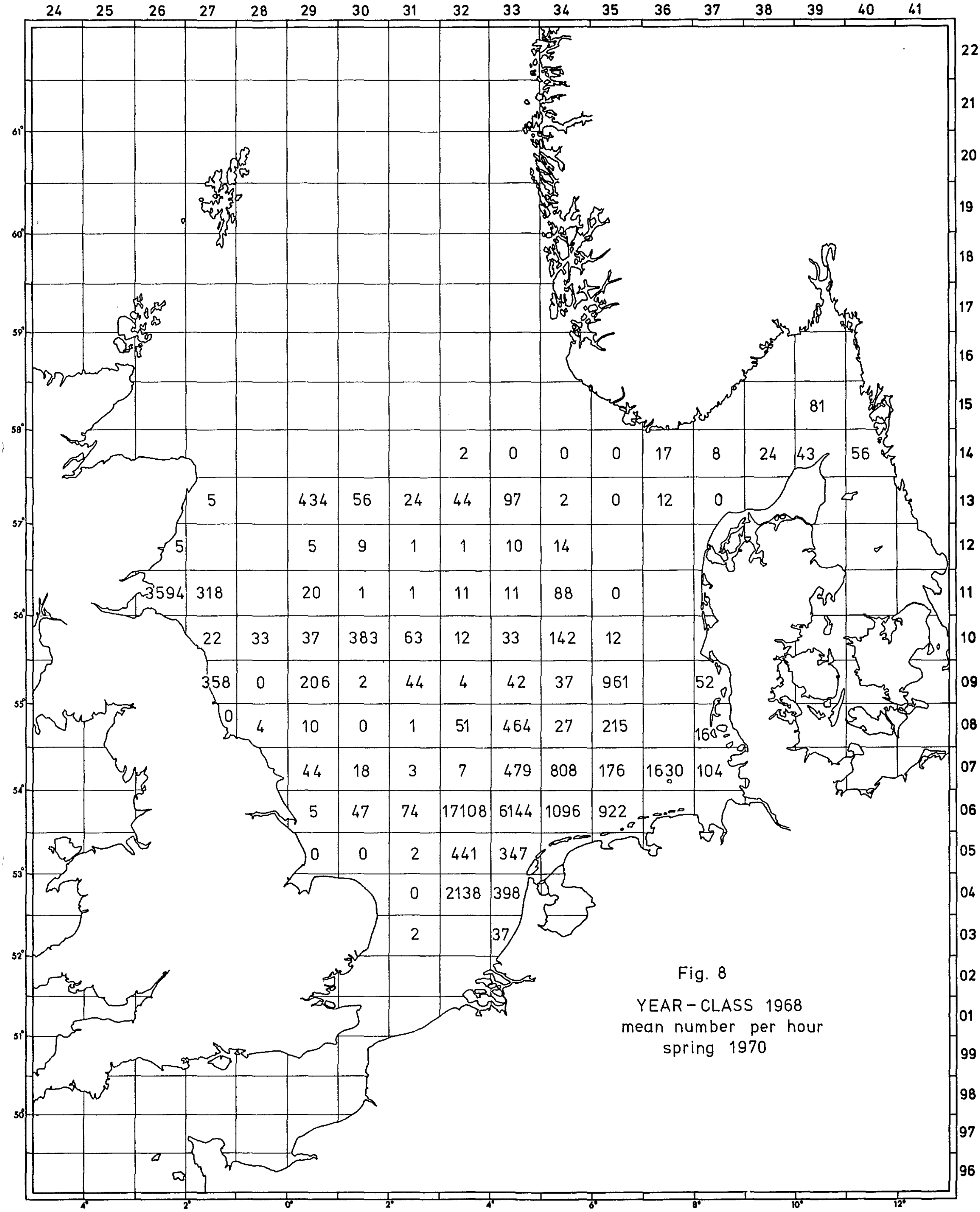


Fig. 8

YEAR-CLASS 1968
mean number per hour
spring 1970

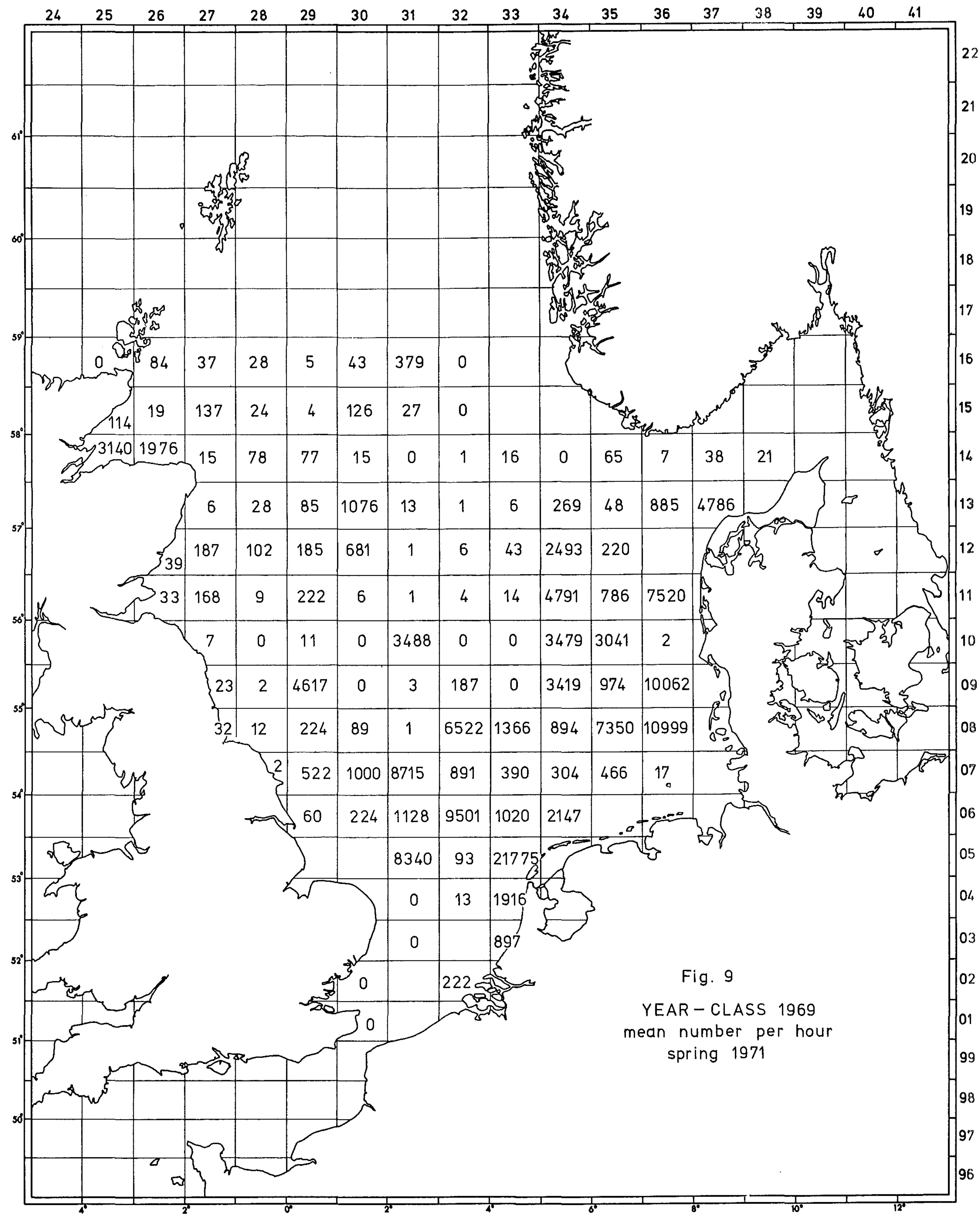


Fig. 9

YEAR – CLASS 1969
mean number per hour
spring 1971

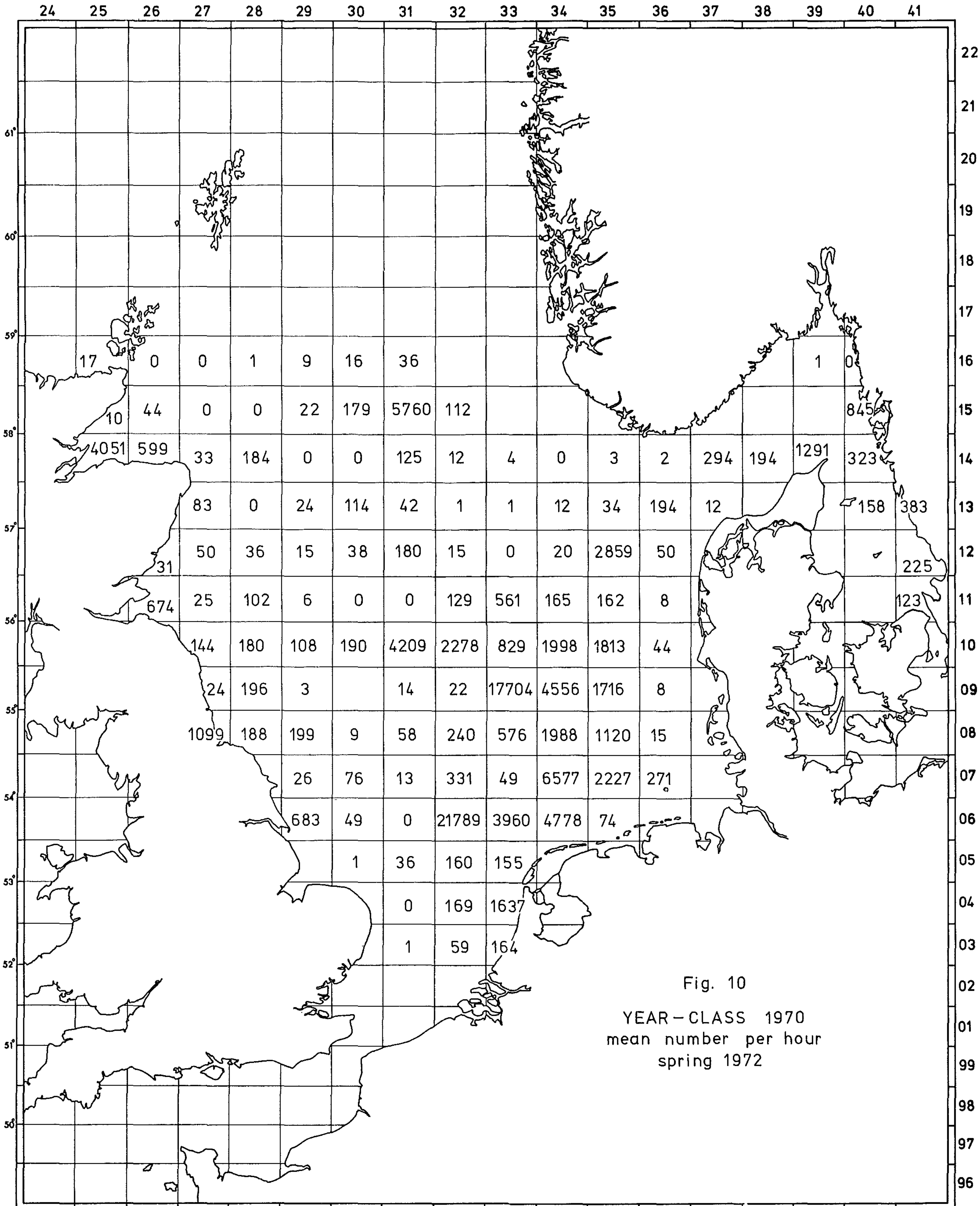


Fig. 10

YEAR – CLASS 1970
mean number per hour
spring 1972

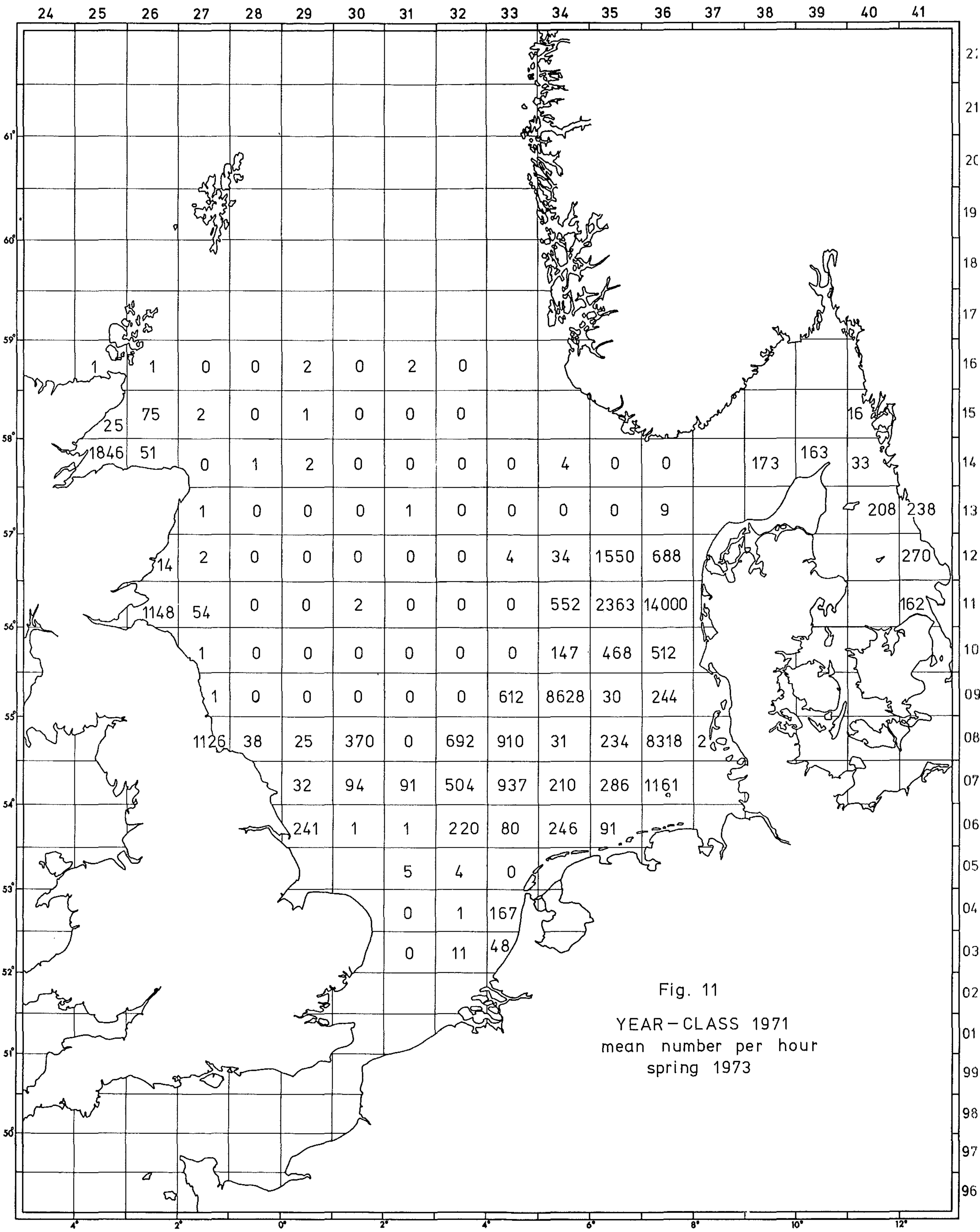


Fig. 11

YEAR-CLASS 1971
mean number per hour
spring 1973

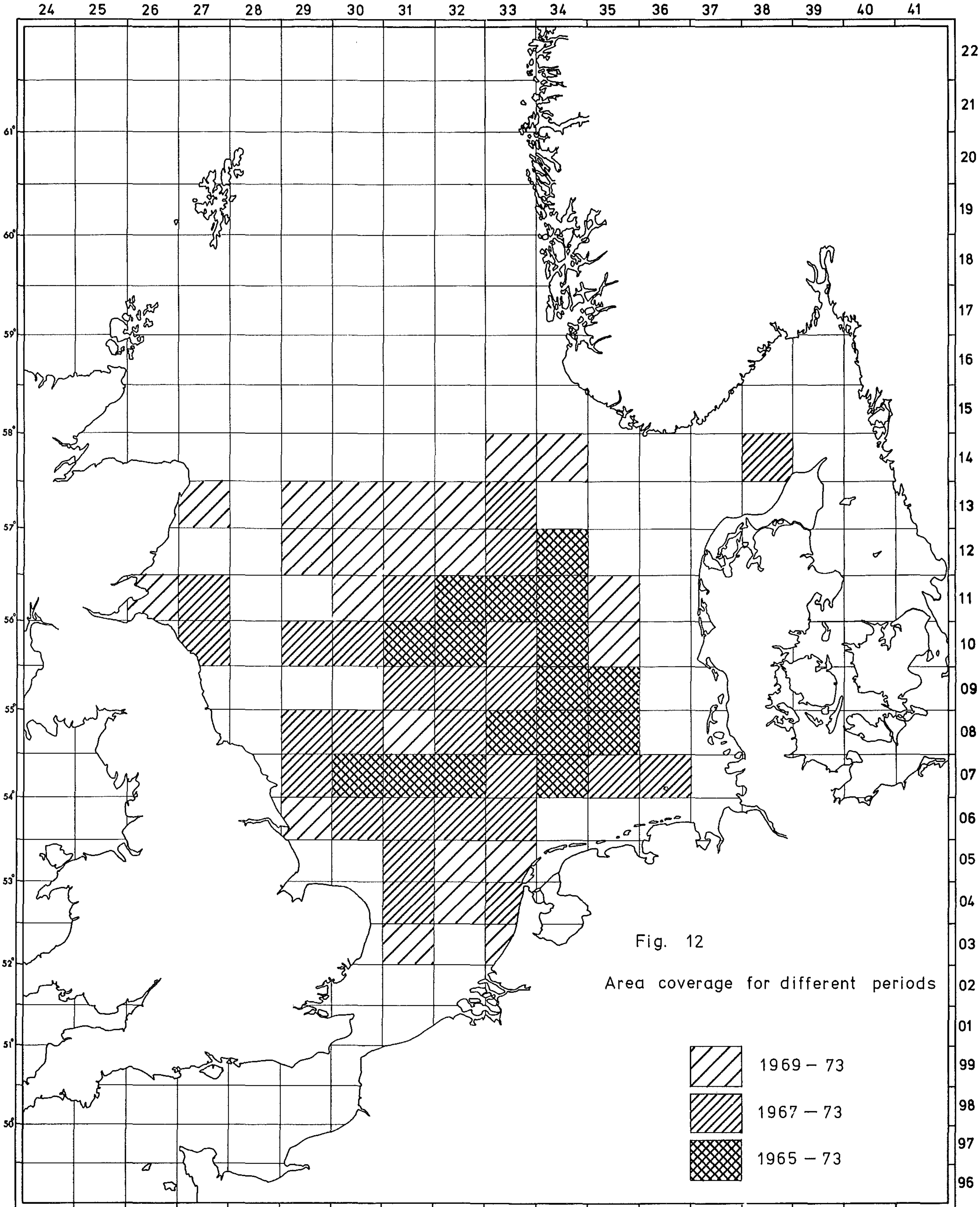


Fig. 12

Area coverage for different periods

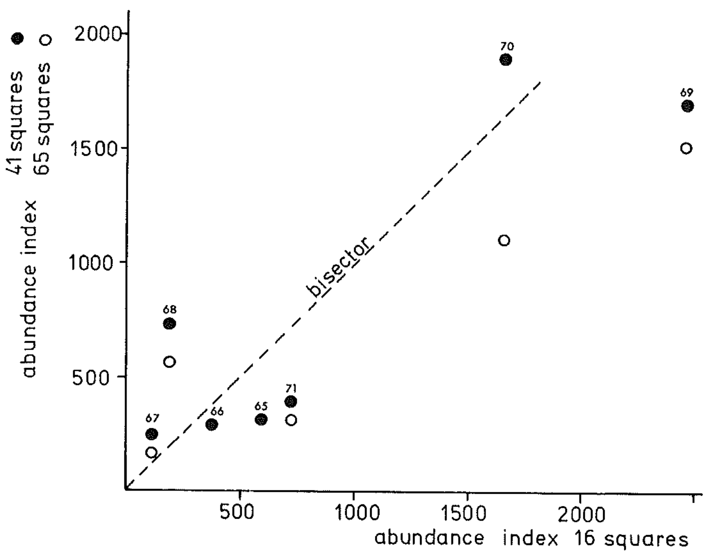


Fig. 13. Comparison of abundance indices based on standard areas of 16, 41, and 65 squares.

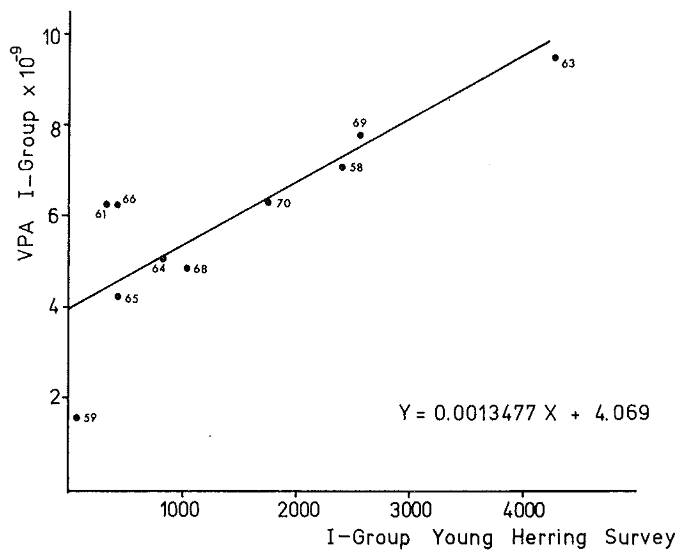


Fig 17. Regression of VPA-values on YHS-estimates

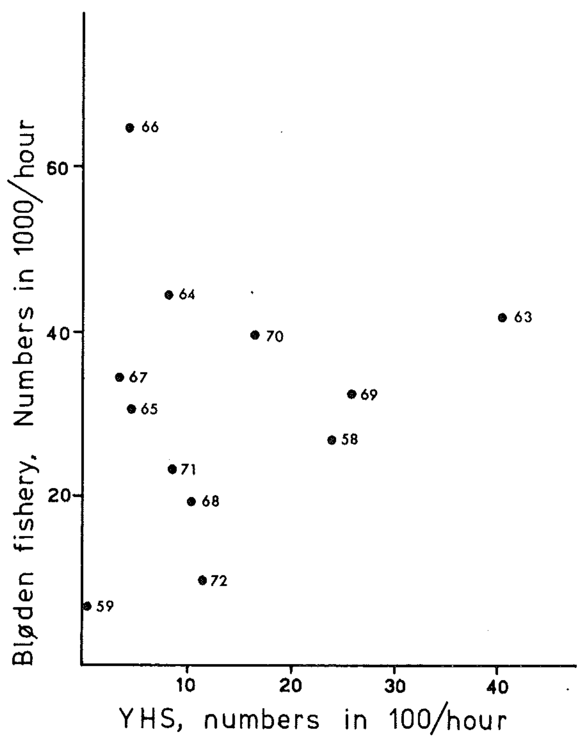


Fig. 18. Comparison of Bløden indices for I-Group in <u>winter/spring</u> with YHS - estimates.

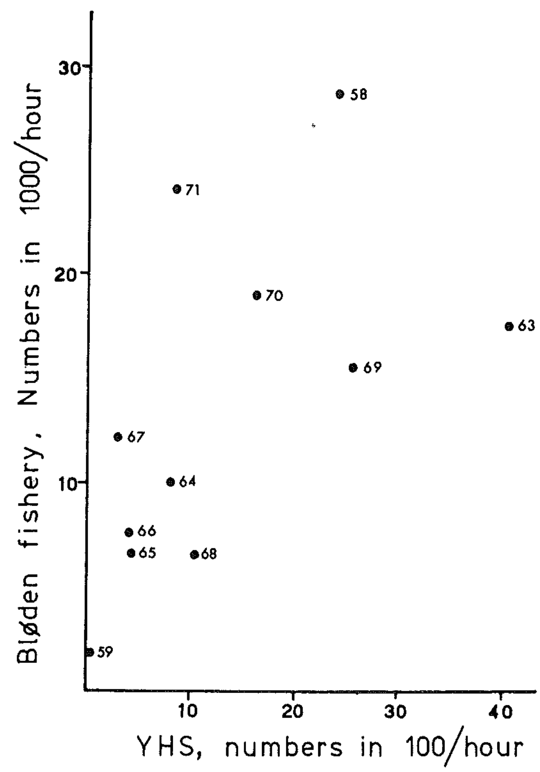


Fig. 19. Comparison of Bløden indices for I-Group in <u>summer/autumn</u> with YHS - estimates.

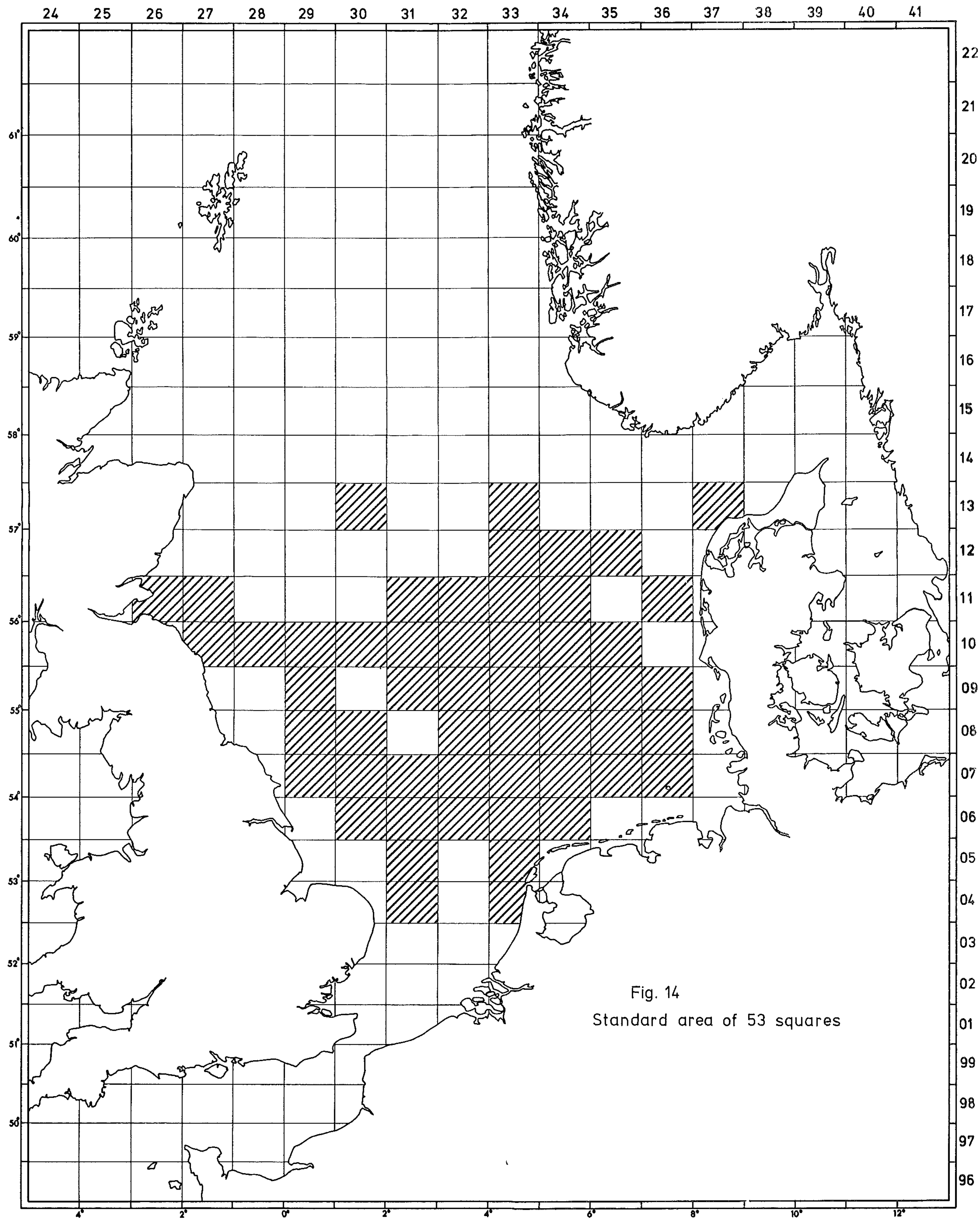


Fig. 14
Standard area of 53 squares

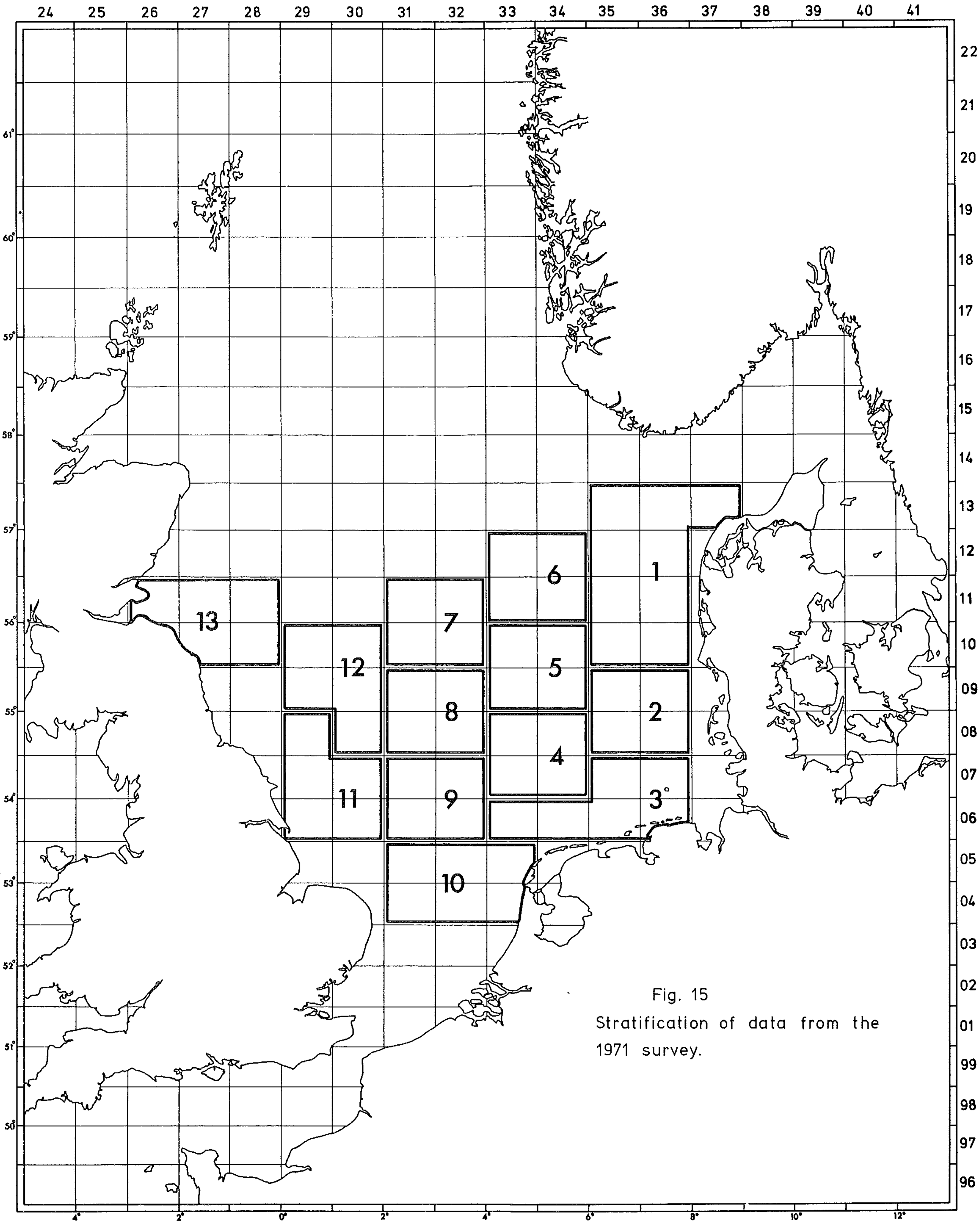


Fig. 15
Stratification of data from the 1971 survey.

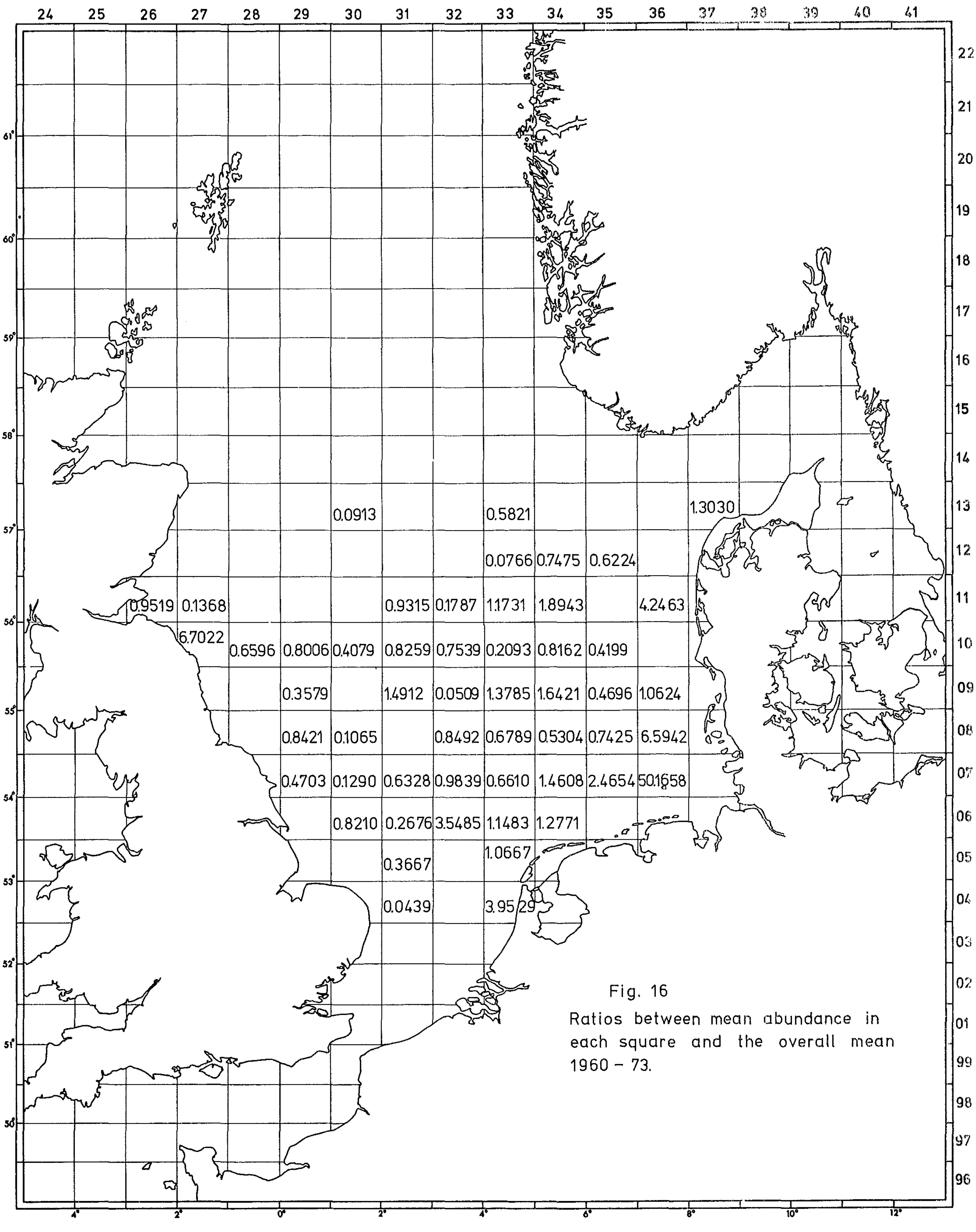


Fig. 16

Ratios between mean abundance in each square and the overall mean 1960 – 73.

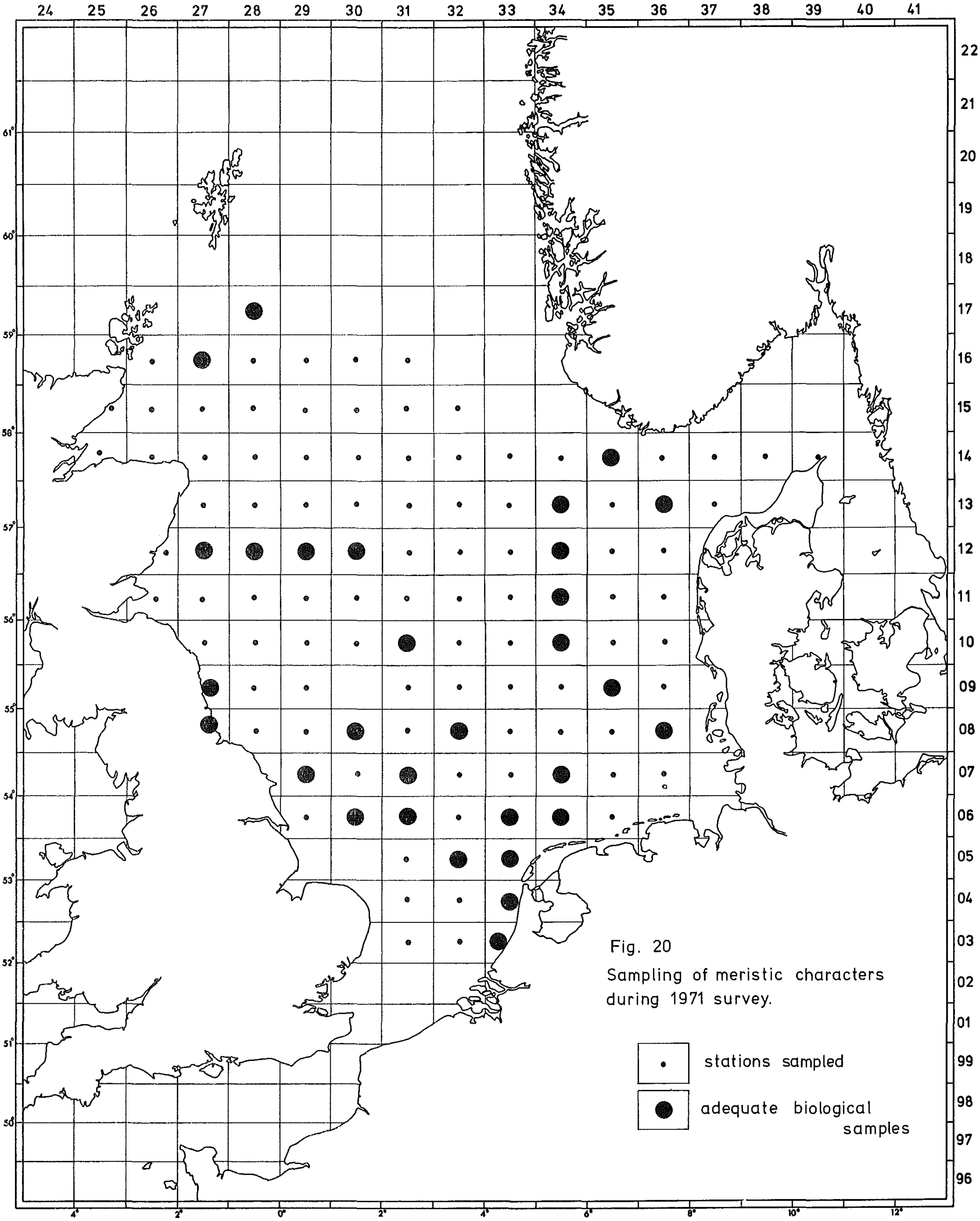


Fig. 20
Sampling of meristic characters during 1971 survey.

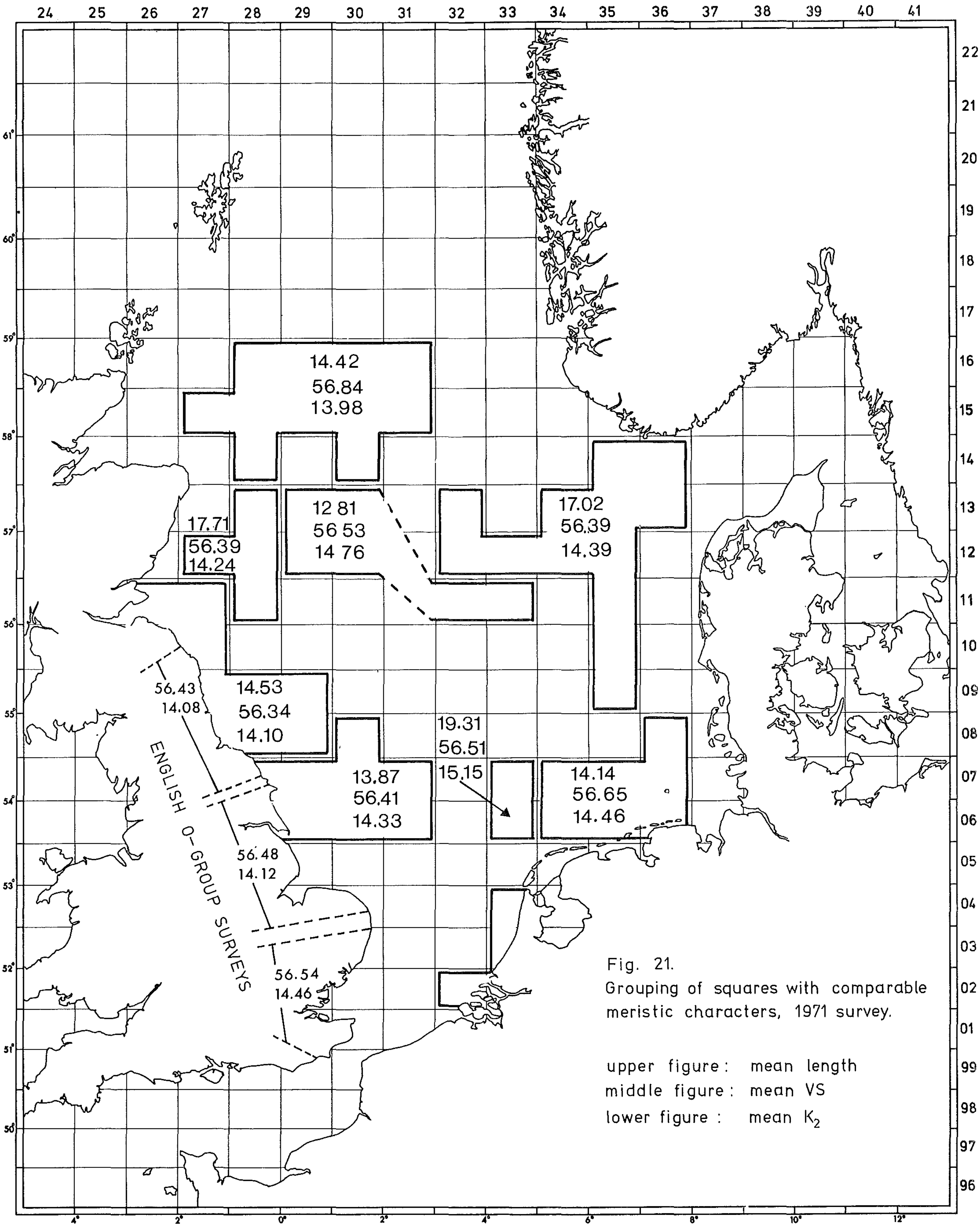


Fig. 21.
Grouping of squares with comparable meristic characters, 1971 survey.

upper figure : mean length
middle figure : mean VS
lower figure : mean K_2

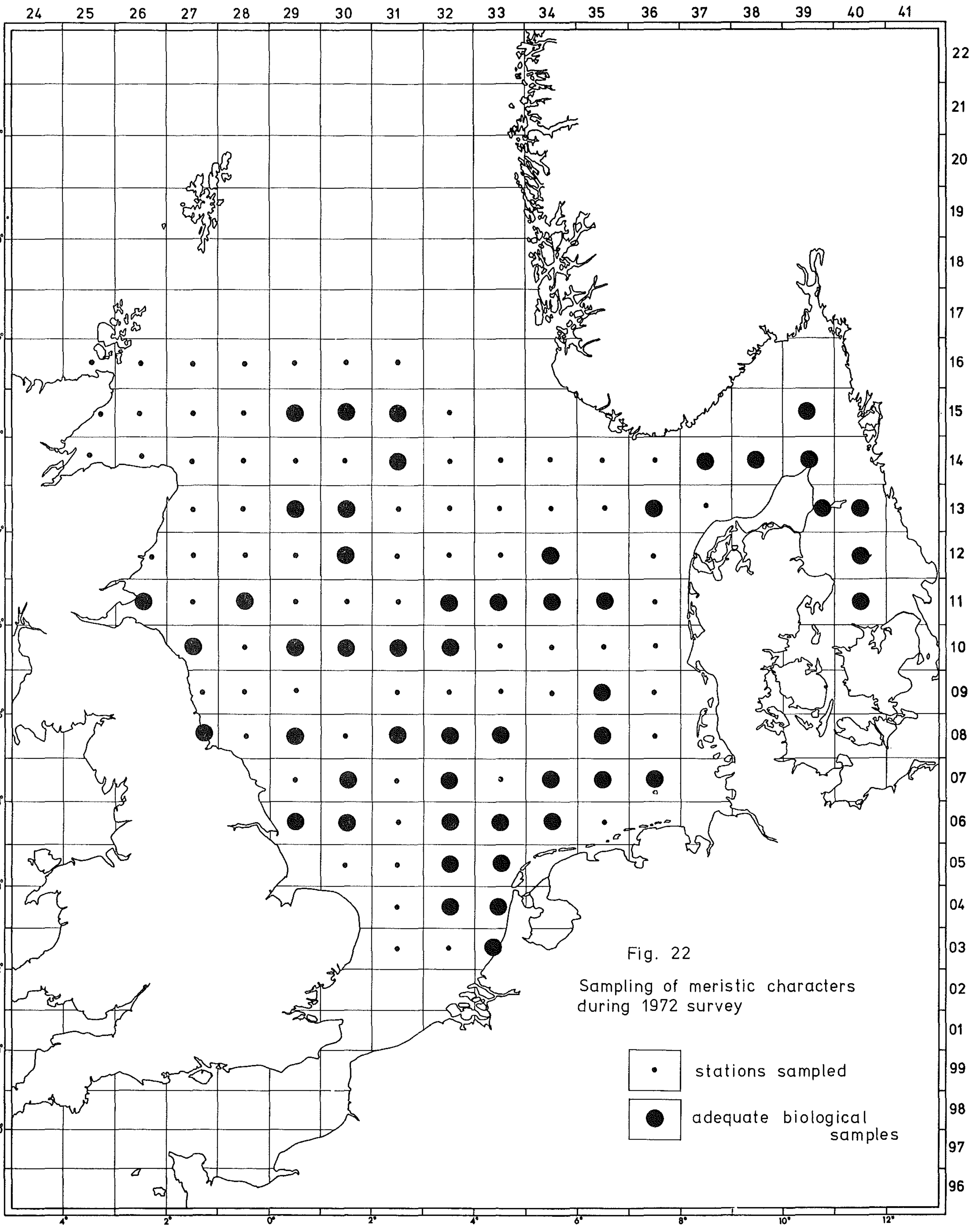


Fig. 22

Sampling of meristic characters during 1972 survey

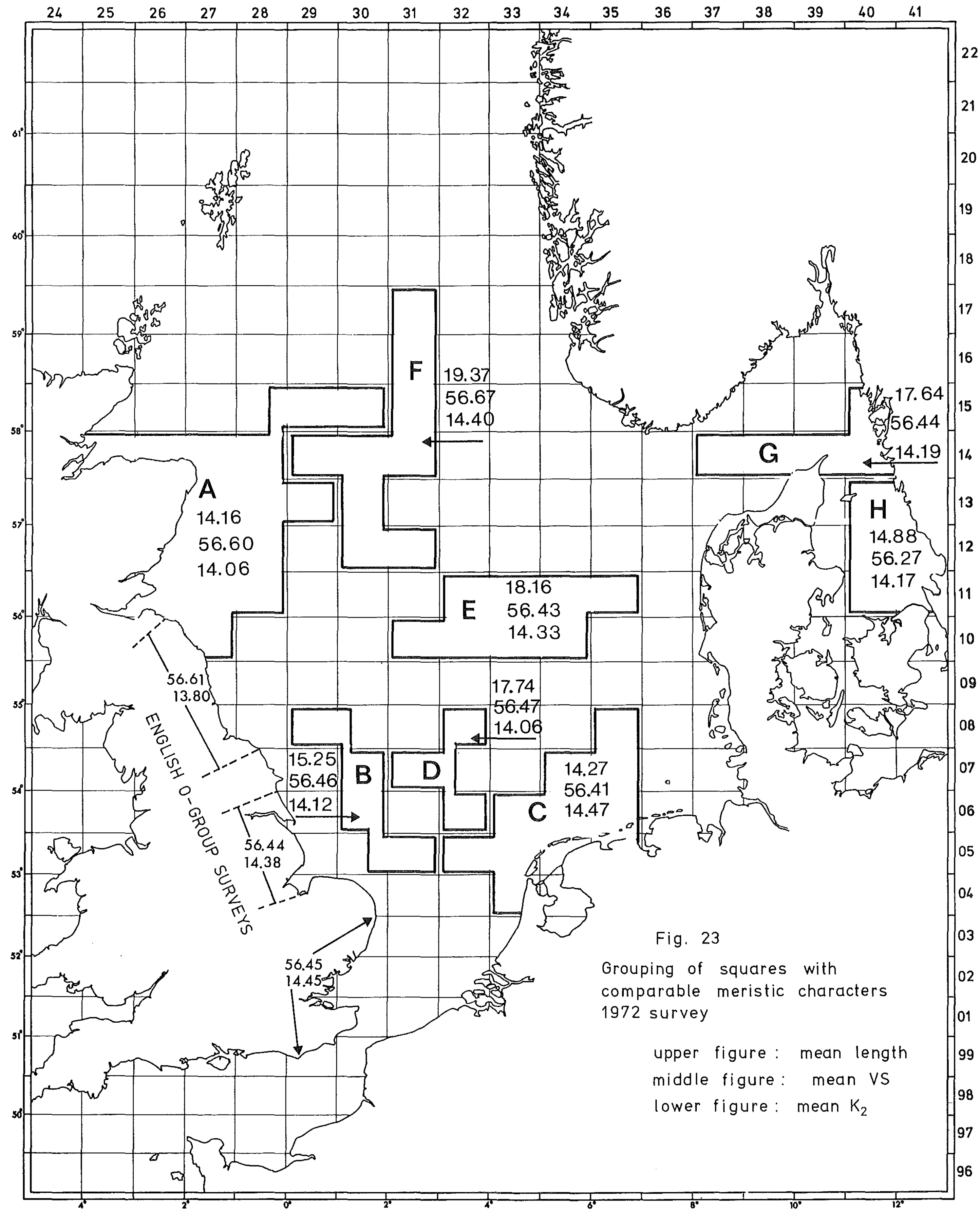


Fig. 23

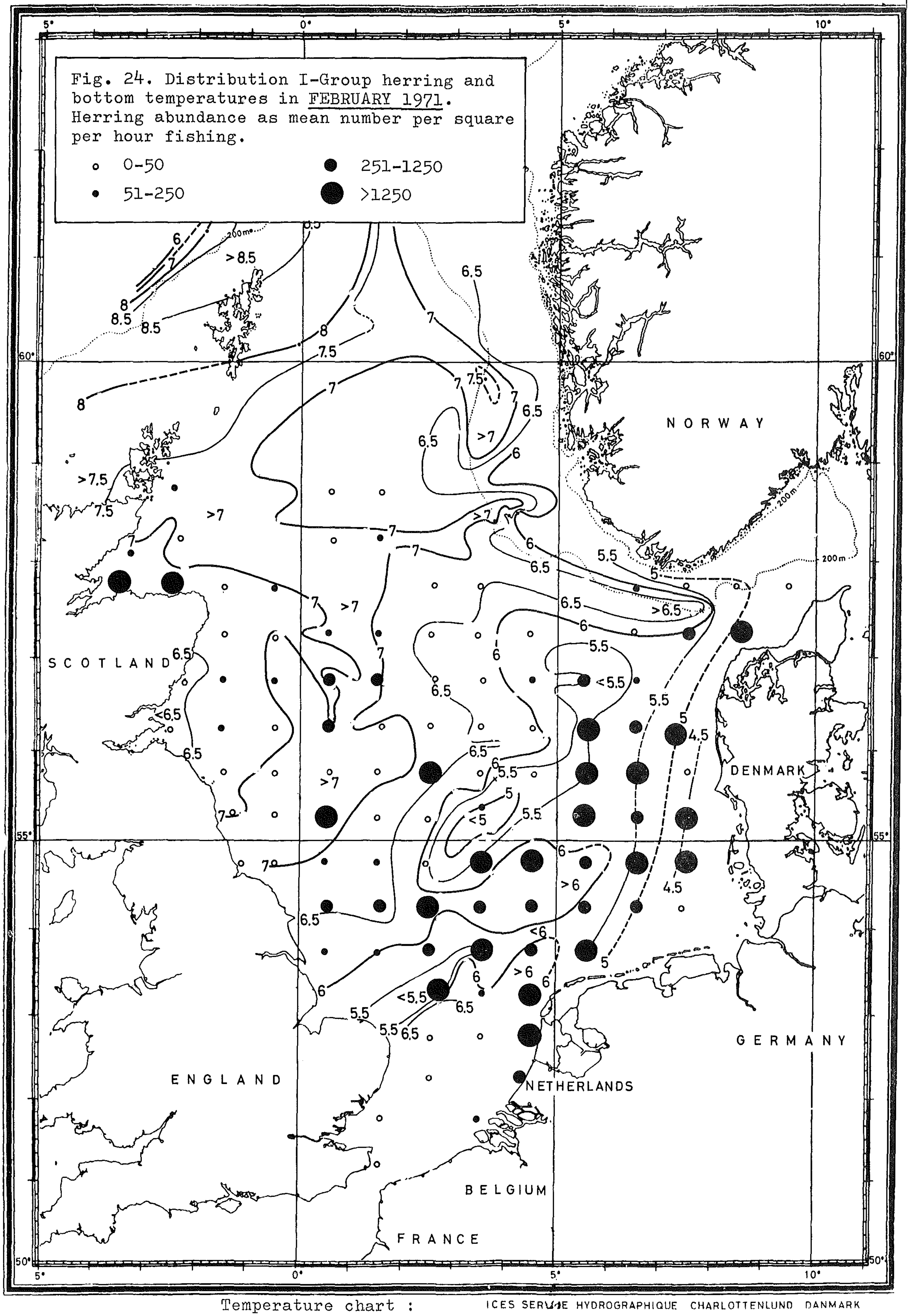
Grouping of squares with comparable meristic characters 1972 survey

upper figure : mean length

middle figure : mean VS

lower figure : mean K_2

Fig. 24. Distribution I-Group herring and bottom temperatures in FEBRUARY 1971. Herring abundance as mean number per square per hour fishing.



Temperature chart : ICES SERVICE HYDROGRAPHIQUE CHARLOTTENLUND DANMARK

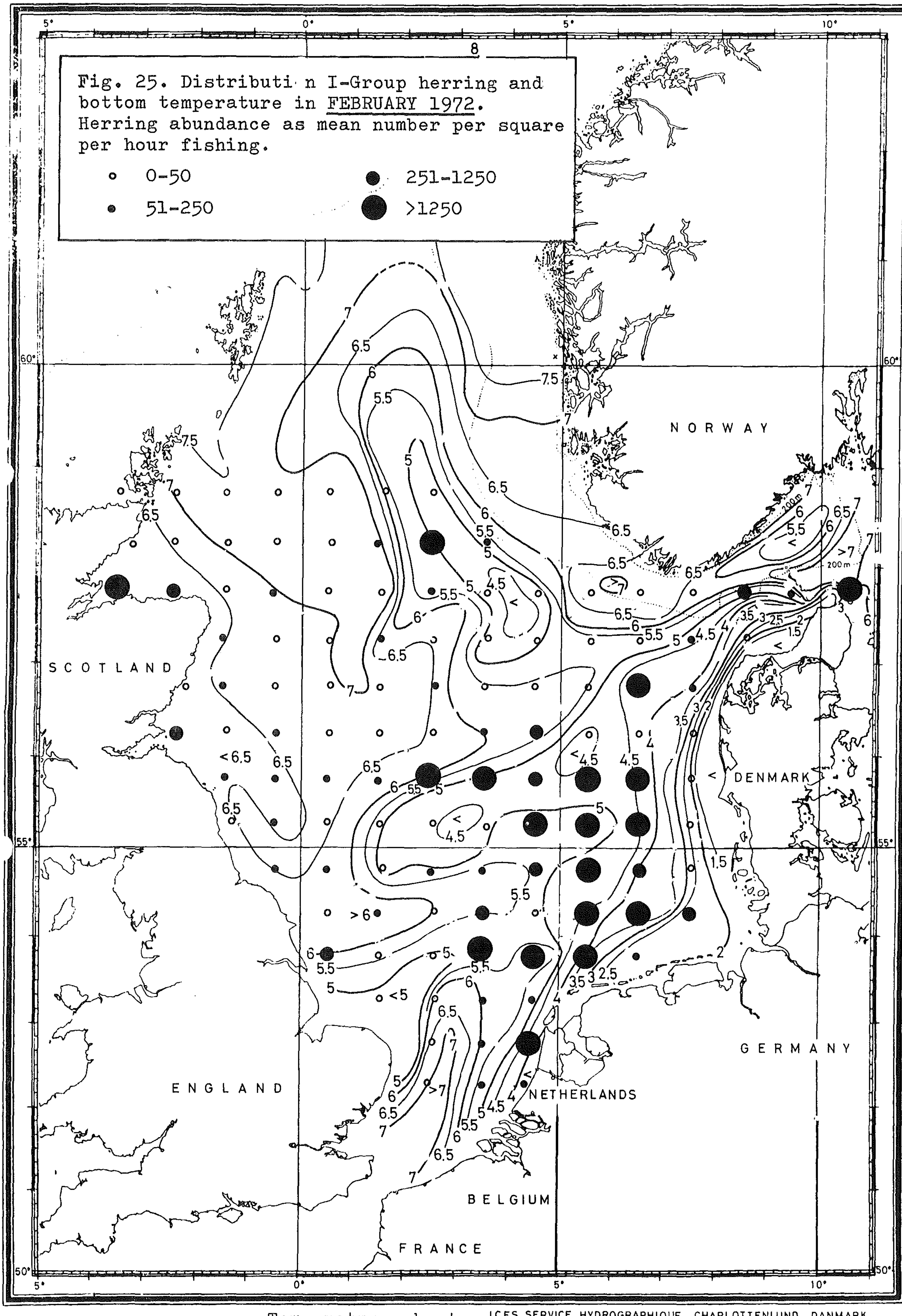
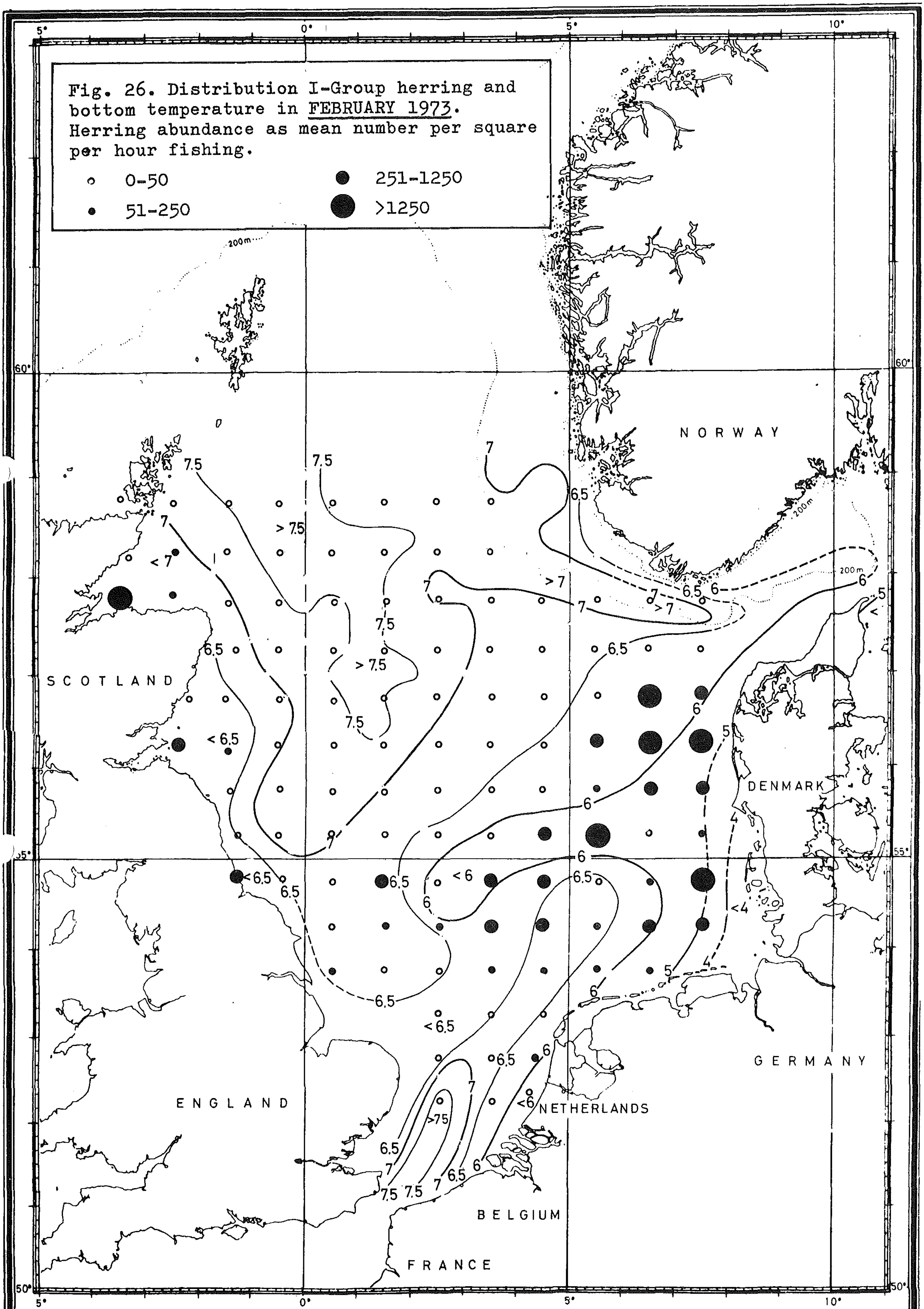


Fig. 25. Distributi n I-Group herring and bottom temperature in FEBRUARY 1972. Herring abundance as mean number per square per hour fishing.

Temperature chart : ICES SERVICE HYDROGRAPHIQUE, CHARLOTTENLUND, DANMARK

Fig. 26. Distribution I-Group herring and bottom temperature in FEBRUARY 1973. Herring abundance as mean number per square per hour fishing.

- 0-50
- 51-250
- 251-1250
- >1250



Temperature chart : ICES SERVICE HYDROGRAPHIQUE, CHARLOTTENLUND DANMARK

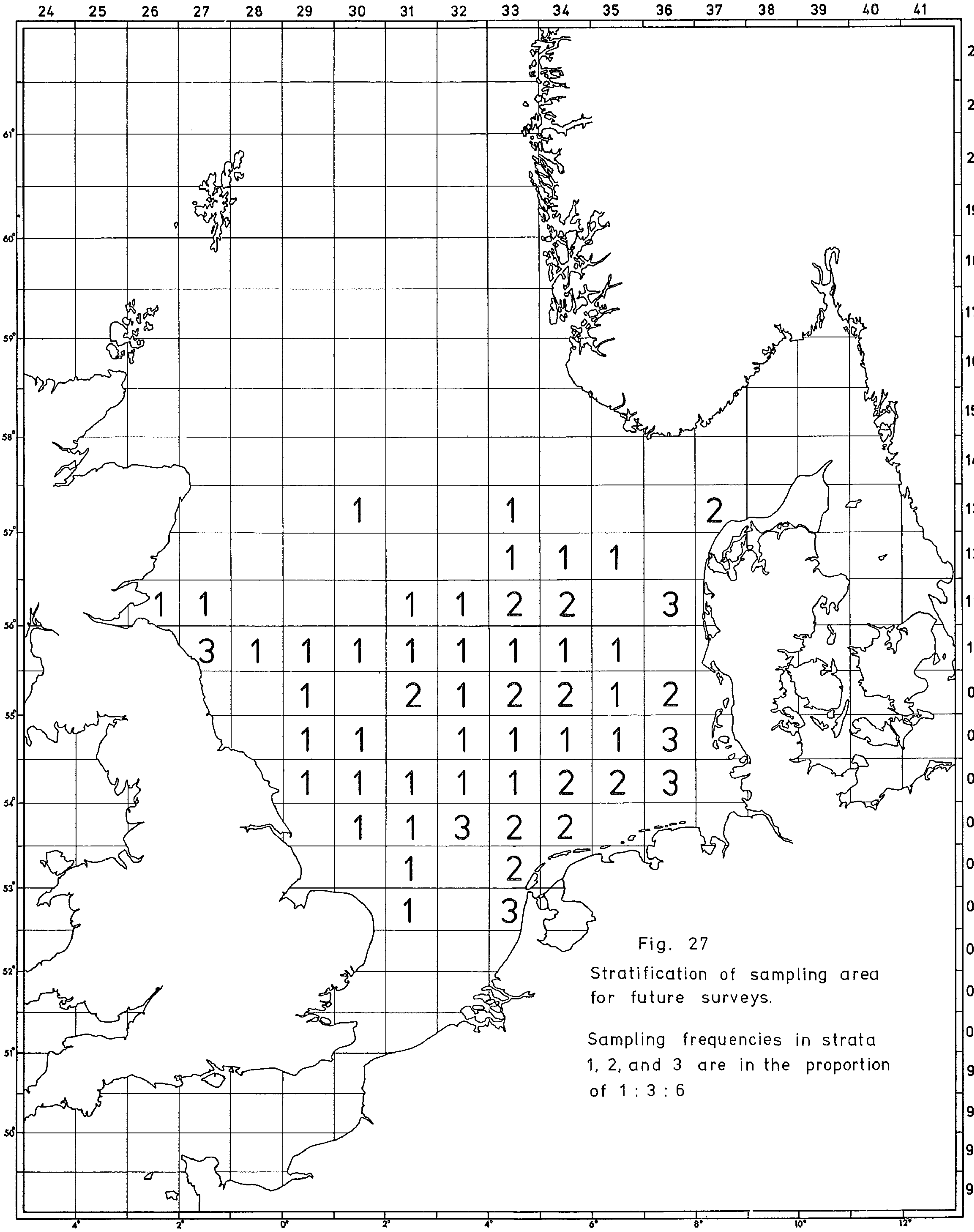


Fig. 27

Stratification of sampling area for future surveys.

Sampling frequencies in strata 1, 2, and 3 are in the proportion of 1 : 3 : 6