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REPORT OF THE JOINT MEETING OF THE INTERNATIONAL YOUNG HERRING SURVEY WORKING GROUP AND THE INTERNATIONAL GADOID SURVEY WORKING GROUP.

IJmuiden, 12 - 14 May 1981.

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REPORT OF THE JOINT MEETING OF THE INTERNATIONAL YOUNG HERRING SURVEY WORKING GROUP AND THE INTERNATIONAL GADOID SURVEY WORKING GROUP

IJmuiden, 12 - 14 May, 1981.

1. Terms of reference and participation.

The ICES Statutory Meeting in 1980 decided that
"A joint meeting of the International Gadoid Survey Working Group and the International Young Herring Survey Working Group should be held in IJmuiden for 3 days in May 1981 in order to discuss methodological aspects of the International Young Fish Surveys which are carried out annually in the North Sea in February, the optimum allocation of sampling effort, and to discuss what new data should be collected from the surveys". (C. Res. 1980/2:23).
Consequently, both Working Groups met in IJmuiden on 12 - 14 May 1981. All discussions were held during joint sessions of both Working Groups, and the results of the meeting are presented in this joint report.

The meeting was attended by the following persons:

T.S. Scott	- Canada
T. Westgård	- Norway
P. Lewy	- Denmark
O. Hagström	- Sweden
N.A. Nielsen	- Denmark
A. Laurec	- France
G. Lefranc	- France
G. Wagner	- Fed. Rep. of Germany
J. Lahn-Johannessen	- Norway
W.G. Parnell	- U.K.

A.C. Burd	- U.K.	
A. Saville	- U.K.	
N. Daan	- The Netherlands	(Chairman Int. Gadoid Survey WG)
A. Corten	- The Netherlands	(Chairman Int. Young Herring Survey W.G.
A. Eltink	- The Netherlands	
H. Heessen	- The Netherlands	

2. Evaluation of results from former surveys.

Before studying the methodological aspects of the surveys, an evaluation was made of the results obtained by the surveys in recent years. For each species of fish sampled, abundance indices from the surveys were compared with estimates of year class strength from other sources.

2.1. Pelagic species.

2.1.1. Herring.

Since the introduction of the ban on directed herring fisheries in the North Sea in 1977, no estimates of the strength of recruiting year classes have become available, either from VPA or from catch per unit of effort. It is not possible, therefore, to compare the IYFS-indices for year classes 1975 - 79 with VPA estimates of year class strength, and to update the regression of VPA year class size on IYFS indices given in the previous report of the WG on North Sea Young Herring Surveys (Anon., 1978). However, the general conclusion from the surveys that the year classes 1975 - 79 have all been weak or very weak, is supported by the slow increase in total stock size as measured by the herring larval surveys, and the age composition of samples collected by research vessels from the central and northern North Sea (Anon., 1981). The Group felt confident, therefore, that the regression equation calculated previously was still applicable in the present situation. The regression line, herring standard area, and basic data used for the regression have been reproduced in this report in figure 1 - 2 and table I (after correction of a misprint for year class 1971 and minor calculation errors).

Year class 1977, which was estimated to be extremely weak, may have been slightly underestimated by the survey in 1979. The high percentage of this year class (about 40%) that occurred in illegal catches of Downs herring taken in November/December 1980 would suggest that the year class strength as 1-ringers was higher than the 0,43 x 10^9 estimated from the IYFS (Anon., 1981).

It was suggested that the large proportion of Downs recruits in year class 1977 could have caused the underestimation of this year class during the 1979 survey. Downs recruits are presumably concentrated in the southern part of the survey area, and possibly even outside the area presently sampled. An alternative explanation for the underestimation of year class 1977 is the extremely low water temperature in the eastern North Sea in February 1979, which most likely has resulted in an unusually western distribution of the fish, and a less effective survey coverage.

Considering the recent recovery of the Downs-population (Anon., 1981) and the expected high proportion of Downs recruits among North Sea juveniles in future years, it was decided that the survey area should be extended south to at least 51°30' N, in order to obtain a better coverage of Downs recruits.

The results of the Isaacs-Kidd net sampling are still too limited to enable an evaluation of this programme to be made. After 3 years of low abundances of pre-metamorphosis larvae in the North Sea (1977 - 79), the IYFS in February 1980 found much higher concentrations of larvae belonging to year class 1979. However, the expectation that year-class 1979 would be a strong one was not confirmed by the IYFS in 1981 (Anon., 1981).
Some participants suspected that not only the absolute number of pre-metamorphosis larvae present in the North Sea in February might determine the year class strength, but also their distribution in relation to coastal (nutrient-rich) waters. It was proposed that national laboratories should collect data on the condition of the larvae, as this parameter might well be related to the chances of survival.

2.1.2. Mackerel.

Walsh (1974, 1977, 1979) has used the data collected on the North Sea International Young Fish Survey in the periode since 1970 to calculate abundance indices for I-group mackerel in each year, and has attempted to relate them to the corresponding estimates of year class strength obtained from the V.P.A.'s, done by the Mackerel Working Group, for the North Sea stock. The resulting relationship was a weak one. It should be noted, however, that the index for the 1969 year class was high compared with those of subsequent year-classes. It is clear from any assessment technique applied to the North Sea mackerel stock that this year class was the last one of any strength to recruit to this stock; all subsequent year classes being rather uniformly weak. In this situation it is somewhat difficult to evaluate any relationship between the two measures of year class strength, and this difficulty is compounded by the fact that the VPA values for this stock cannot be considered as very precise, because of the problems in allocating the catch in numbers in the North Sea area in recent years, to the two stocks which inter-mix these. It is perhaps significant, in this context, that Walsh has demonstrated a close relationship between indices of abundance from these surveys of the same year class as I-group and as 2-group.

At this point in time the usefulness of these surveys for measuring year class strength certainly cannot be demonstrated. In the light of the indications mentioned above, however, that they might be able to give some forecast of the recruitment of strong year classes, in view of the small amount of additional work entailed in deriving these indices, it would appear justified to continue the estimation of these indices for a few more years to get a better measure of their value. Accordingly in section 3 of this report some comment is made on sampling requirements in relation to mackerel.

2.1.3. Sprat.

Since 1972 measurements of length of sprat catches have been made by varying numbers of countries taking part in the IYFS. Johnson (1974 and 1978) has reviewed some of the results. Insufficient data were collected in 1975 to summarise in the same manner as other years. The analysis has been handicapped by the lack of age/length data. Johnson grouped statistical rectangles in order to try to accumulate enough fish to

provide an adequate age/length key. The general distribution charts for 1972 - 1978 show the same features of abundance increasing from the deep waters of the northwestern to the shallower waters of the southeastern North Sea. Associated with it was a decline in mean length for age. Johnson (1974) concluded that ages 2 - 5 were probably best sampled by the bottom trawl. The I-group, for which age group a reliable estimate of abundance is needed for TAC calculation, he believes to be poorly sampled since comparisons made with mid-water trawl catches indicate higher abundances than in bottom trawls. However, there is no independent estimate against which this conclusion can be tested.
No attempt has been made to obtain an overall North Sea abundance index. Johnson (1980) compared the abundance distribution by rectangle from the 1980 IYHS and the acoustic surveys. The two distributions are rather similar, and it would suggest that an estimate of abundance from IYHS could be of some use in stock management.

2.2. Gadoids.

2.2.1. General.

Following the suggestions in the report of the International Gadoid Survey Working Group in 1979 (ICES C.M. 1979/G:35), calculations of the arithmetic and logarithmic means and of the corresponding variances have since been made.
Some discussion has been spent on the a priori theoretical reasoning why one index should yield better results than another. The arithmetic mean abundance (A (1)) is obtained by a straightforward procedure of averaging the catch rates in individual hauls by statistical rectangles and consecutively averaging the catch rates in the rectangles over the standard area:

$$A\ (1) = \frac{1}{N} \sum_{i}^{N} \frac{1}{n_i} \sum_{j=1}^{n_i} X_{i,j}$$

where $X_{i,j}$ is the number of fish caught (per hr) during the j^{th} tow in the i^{th} rectangle, n_i is the number of tows in that rectangle and N is the total number of ractangles in the standard area.
The logarithmic mean abundance (A (2)) is obtained by averaging the log transformed catch rates in individual hauls by rectangles and then averaging these over the standard area:

$$A\ (2) = \frac{1}{N} \sum_{i}^{N} \frac{1}{n_i} \sum_{j=1}^{n_i} \mathrm{Ln}\ (X_{i,j} + 1)$$

This index could be back transformed by an appropriate formula for the variance correction.

At the present meeting the view was expressed that, although within a rectangle catch rates might be more adequately described by a negative binomial distribution, which would justify the log transformation, on a global North Sea scale this might not necessarily be the case, because the geographical pattern of distribution is more likely to yield a compound distribution of catch rates. Therefore, it was suggested to back transform the abundance indices in each rectangle before taking the average over the standard areas:

$$A\ (3) = \frac{1}{N} \sum_{i}^{n} \left(\exp\left(\frac{1}{n_i} \sum_{j=1}^{n_i} \mathrm{Ln}(X_{i,j} + 1) + \frac{S_i^2}{2}\right) - 1\right)$$

Since the Working Group in 1979 was primarily concerned with the estimation of the precision of the different survey indices and because there was no simple way of calculating the variance of A (3) this index was at that time rejected as unsuitable for that purpose. As a consequence the necessary analysis to obtain A (3) and test its significance against VPA results had not been performed before the present meeting.

Although for practical purposes and despite the problems in estimating the associated variance this index might prove useful, it was stressed that:

1. without any specific research it is not possible to confirm the a priori postulation that the catches per haul within a rectangle resemble a negative binomial distribution;
2. even if this would be in general the case, it cannot be expected from the present level of sampling intensity within the strata that a reliable estimate of the associated variance in that rectangle can be obtained;
3. irrespective of any distribution properties of the basic catch rates, the straight arithmetic average yields an unbiased estimate of the mean.

For these reasons the log transformation procedure was rejected for the time being and in section 2.2.2. the validation of the abundance indices against VPA results will only cover the unadjusted and adjusted arithmetic means.

Abundance indices are now available for 11 years of ICES Young Fish Surveys (1969 - 1980) and for each North Sea Roundfish area separately as well as for the standard area which should be representative for the total stock. In addition to indices which are purely based on real data ("unadjusted" indices) an adjustment procedure for missing rectangles in each survey has been applied, which is based on the relative importance of those rectangles according to the long term average abundance per rectangle during the period 1974 - 1979 ("adjusted" indices).

These data can now be compared with the VPA results obtained for cod, haddock and whiting by the recent meeting of the North Sea Roundfish Working Group, which is based on a completely revised data base of input catches.

In section 2.2.3. an alternative method of obtaining more accurate abundance indices from the surveys will be outlined. This approach, which was described in a working paper available to the Group, tries to cut down some of the annual variation between surveys by putting restrictions on the time span of the survey data, which are incorporated in the actual index and by using hydrographical information as a criterion for incorporating certain hauls.

Lastly the Group took notice of the problems met by the North Sea Roundfish Working Group this year in using the survey index for cod year class 1979 for estimating the numbers in the sea at 1 year old from regression analysis of VPA against IYFS indices. It appeared that in 1980 as many individuals of this year class had been caught in the fisheries as there would have been in the sea according to the survey index. In section 2.2.4. this problem is discussed in more detail on the basis of additional evidence.

2.2.2. Evaluation survey results 1970 - 1980.

Tables II - V present the unadjusted and adjusted survey indices for I- and II-group cod, haddock, whiting and Norway pout as well as the VPA estimates of recruitment at age 1 and 2.

Table VI presents the correlation coefficients and the regression parameters between the different sets of indices. Since there is no a priori reason whether the VPA estimate or the survey index is the more reliable piece of information, the survey indices as I-year old and II-years old are of primary interest in order to examine if successive surveys are capable of reproducing similar relative indices of abundance for each year class (fig. 3). For both cod and haddock the correlation coefficients for 10 pairs of observations are significant at the 5% level, whereas for Norway pout the correlation coefficient is even significant at the 1% level. In general the adjustment procedure does have a minor effect except that for Norway pout the correlation is spoilt. This effect is caused by the first three years when the coverage of the Norway pout area was very poor indeed. Recalculating the correlations for year class 1973 onwards gives even better correlations for both unadjusted and adjusted indices. For whiting the correlation is not significant.

Comparing the survey indices with VPA estimates yields rather more variable results. In contrast with formerly obtained results the correlation for I-group cod is not significant. One reason for this might be found in the discard data, which have been entered in the revised data base for assessment purposes. With the growing information on discarding rates in recent years the estimated level of discards has increased. This might seriously affect the comparability of the numbers estimated in the sea between the earlier and the later period. However, for II-group cod the correlation with the VPA estimates is highly significant and, since the correlation coefficient is in this case very much higher than between II-group and I-group survey indices, this suggest than the precision of the survey index for I-group is very much lower due to differing degrees of availability of this age group within the survey area between years.

For haddock the correlation for I-group is the highest one but also for II-group haddock the coefficient is higher than the one between II-group and I-group indices from the surveys. This suggests that in fact some of the discrepancy between I- and II-group might be caused by differential fishing mortality rates between years.

The same argument applies even more strongly to the whiting, where the correlation coefficient between I- and II-group is not significant, although both for I- and II-group the correlation with VPA are significant at the 5% level.

For Norway pout no appropriate independent data were available to check the indices against.

In general the adjustment procedure appears to result in slightly reduced correlation coefficients and on the basis of this set of data there appears to be no gain in pursuing this approach any further.

2.2.3. Alternative indices.

The apparent underestimation of the cod year classes 1977 to 1979 by the young fish survey according to the most recent VPA has been the incentive for one of the members of the Group to investigate the advantages of setting additional criteria for inclusion of data in the ultimate abundance index. One source of variation might originate from the difference in timing from year to year.
Although in planning the survey participating countries are urged to make their ships available in as narrow a time span as possible, in practice the survey may last from 5 weeks at the best to 9 weeks at the worst. In the exersize available as a working paper to the Group only data collected during the month of February were used.
Another source of variation might result from annual differences in distribution of young fish in relation to the hydrographical situation. Evidence was provided that the young cod yielded the highest catches in waters less than 34‰ salinity and this situation coincides with the coastal area in the German Bight which is on occasion insufficiently sampled. Depending on the salinity anomaly in this inshore area the young cod may or may not be available in large numbers to the gear and by excluding the stations below the 34‰ salinity band it was hoped to obtain more stable and comparable indices from year to year.
The correlation between the thus obtained index for cod from the survey and the VPA (year classes 1969 - 1975) went up to .993 whereas excluding the discard data from the input for VPA resulted in a further increase of r to .998. In addition, this exclusion of discard data brought the 1976 year class more in line with the regression line obtained.
Although there appears to be some real gain in pursuing this approach there was no time to do this during the meeting. Some difficulties, however, were stressed. Firstly, by excluding big catches from a restricted area the index may be biassed. Secondly, the final estimate should be corrected for differences in the extension of low salinity water from year to year. Nevertheless, this approach indicates that a more detailed analysis of the factors affecting the distribution is required as well as improved sampling of the inshore area.

For haddock a similar exersize was carried out, based on data from the 35‰ salinity band only, which turned out to yield the highest catches. New haddock abundance indices need to be calculated in order to correct for differences in the area covered by the high salinity water from year to year. For whiting no obvious correlation with salinity was observed and only February data were used to provide a new index. For both species there was no real improvement in the correlation coefficients between VPA estimates of recruitment and survey indices.

2.2.4. The cod year class 1979.

The North Sea Roundfish Working Group (ICES C.M. 1981/G: 8) estimated that the catch in numbers of year class 1979 has been 226 million, whereas according to the regression analysis of VPA estimates of recruitment against survey indices the 1980 survey indicated that only 231 million fish of this year class had been in the sea at the first of February. The Working Group concluded that during the survey this year class had been apparently underestimated and decided on the basis of catch per unit of effort that this year class should in fact be the highest on record (752.10^6 1 year old recruits).

Within the framework of a national sampling programme for cod stomach the Dutch institute made, in addition to its participation in the IYFS in February, 3 similar surveys in the other quarters of 1980, during which the North Sea Roundfish area 6 was covered with one haul per statistical rectangle, applying the standard procedures of the IYFS. Since this area coincides with the main area of distribution of I-group cod the results in terms of nr. of I-group fish per square are given in figure 4 for the first 3 quarters of the year (the survey in November is not yet worked up). These plots show that much larger numbers of this year class turned up in the catches in spring and even more in summer. During the August survey the index of abundance in area 6 was approximately 5 times higher than in February, which does indicate that the fish became more available to the gear in the course of the year. Because comparable data for other years are lacking it cannot be concluded that this in fact is an exceptional situation. In 1981 similar surveys are planned which can be expected to throw more light on the possible peculiarity of this apparent increase. Meanwhile it appears quite possible that indeed the 1980 February survey has underestimated the year class 1979, particularly since the charts indicate a change in distribution: the catches gradually spread out from the most inshore stations fished to a more offshore area. The inshore stations have traditionally yielded large catches of young cod and this observation only confirms that in the survey design more emphasis should be placed on these squares in the German Bight. In section 2.2.3. an analysis has been described which seeks to circumvent the problems of sampling this highly variable area in terms of cod catch rates. Although leaving out these rectangles altogether yielded a higher correlation between index and VPA estimate, it did, however, not resolve the discrepancy between the 1979 year class estimated from the survey and from the cpue. Therefore a closer study of the distribution of year classes in this area in relation to hydrographical circumstances seems unavoidable. Although qualitatively it would seem justified to conclude that the year class was underestimated, it remains to be proven that this year class indeed must be considered as the highest on record. Firstly, with the present state of catch statistics not too much reliance can be put on the estimate of the number of this year class caught in the fishery. Secondly, in comparison with the data for the year classes before 1976 the later year classes turn up in the VPA as disproportionally more abundant than in the surveys. This could simply be caused by underestimated fishing mortalities in recent years and/or the gradually growing component of discarded fish in the input catches, which is due to improved information, but which makes the results over the years incompatible.

2.2.5. Standard areas.

The standard areas used in the analysis for the different species are shown in fig. 5. These were defined during the 1979 meeting of the International Gadoid Survey Working Group (ICES C.M. 1979/G: 35) and have been used since. They have been chosen to incorporate all the statistical rectangles regularly fished (cod and whiting), excluding areas which are of limited or no significance (haddock and Norway pout). Some comments were received about the inclusion of the Skagerak rectangles off the Danish Coast, which are actually lying in assessment area IIIa. The rationale for including these in the standard area has been that this area serves as an overflow for the haddock and Norway pout populations of the North Sea. The young cod in this area have been shown to recruit at least partly to the North Sea stock (ICES C.M. 1971/ F: 5).

For the sake of uniformity, these rectangles had been included in the standard area for all species. Although there is an argument for sticking to the traditional assessment areas when calculating abundance indices, the level of abundance of young fish in these rectangles is not such that the final indices would be seriously affected by incorporating or excluding this area and therefore it was decided not to alter the standard areas.

Table I - Regression of herring VPA year class strength on IYFS abundance indices.

year class	IYFS abundance (corrected for missed sampling) in Nos./h	VPA estimate as 1-ringers in Nos x 10^9
1958	2421	7.07
1959	648	1.63
1968	822	3.35
1969	2647	7.35
1970	1629	5.79
1971	827	3.82
1972	1195	1.75
1973	1529	4.39
1974	452	0.69

Predictive regression of VPA estimates on IYFS indices:

$y = 0.0028\ x + 0.16$ $\qquad$ $r = 0.91$

Functional regression:

$y = 0.0031\ x - 0.20$

TABLE II - Estimates of abundance from YFS surveys and recruitment estimates from VPA for North Sea cod.

Year class	YFS index I-group U. 1)	YFS index I-group A. 2)	YFS index II-group U. 1)	YFS index II-group A. 2)	VPA Nr. at 1 yr old 3)	VPA Nr. at 2 yr old 3)
1968			4.8	5.9		78
1969	73.8	58.8	29.1	25.0	469	282
1970	99.7	116.7	37.5	41.1	493	331
1971	4.1	5.2	10.5	11.9	84	62
1972	37.7	48.3	9.5	9.0	205	105
1973	14.6	19.4	6.1	6.0	135	94
1974	95.7	88.7	20.2	19.2	267	161
1975	8.8	8.4	3.1	3.2	117	85
1976	40.3	39.8	42.3	41.8	575	(328)
1977	14.4	14.5	9.2	9.0	(300)	(189)
1978	9.8	9.9	17.6	17.6	(466)	(163)
1979	26.3	26.3			(752)	(413)

1) unadjusted

2) adjusted

3) from ICES C.M. 1981/G : 8

TABLE III - Estimates of abundance from YFS surveys and recruitment estimates from VPA for North Sea haddock.

Year class	YFS index I-group U. 1)	YFS index I-group A. 2)	YFS index II-group U. 1)	YFS index II-group A. 2)	VPA Nr. at 1 yr old 3)	VPA Nr. at 2 yr old 3)
1968			45	91	453	357
1969	28	50	32	37	333	118
1970	855	1004	299	370	2211	905
1971	740	876	971	1116	2278	1138
1972	187	220	110	107	517	246
1973	1072	1040	385	385	3689	1148
1974	1168	1105	670	682	3791	1772
1975	177	184	84	83	370	179
1976	162	162	108	107	568	(240)
1977	385	382	240	235	(967)	(391)
1978	480	472	402	392	(1493)	(916)
1979	896	876				

1) unadjusted

2) adjusted

3) from ICES C.M. 1981/G : 8

TABLE IV - Estimates of abundance from YFS surveys and recruitment estimates from VPA for North Sea whiting.

Year class	IYFS index I-group U. 1)	IYFS index I-group A. 2)	IYFS index II-group U. 1)	IYFS index II-group A. 2)	VPA Nr. at 1 yr old 3) x 10^6	VPA Nr. at 2 yr old 3) x 10^6
1968			77	69		233
1969	69	55	31	27	1146	399
1970	274	237	190	208	1710	1028
1971	332	281	763	707	2811	1420
1972	1156	926	496	476	3409	1759
1973	322	311	153	155	1611	713
1974	893	892	535	532	3049	1724
1975	679	669	219	215	1934	1196
1976	418	411	293	289	2168	(878)
1977	513	507	183	178	(1762)	(1067)
1978	457	448	391	381	(1671)	(824)
1979	692	681			(2394)	(1701)

1) unadjusted
2) adjusted
3) from ICES C.M. 1981/ G:8

TABLE V - Estimates of abundance from YFS surveys for North Sea Norway pout.

Year class	IYFS index I-group U. 1)	IYFS index I-group A. 2)	IYFS index II-group U. 1)	IYFS index II-group A. 2)
1968			6	311
1969	35	366	22	214
1970	1556	3023	653	3095
1971	3425	6758	438	8010
1972	4207	5783	399	499
1973	25626	20616	2412	3025
1974	4242	4022	385	424
1975	4599	4101	334	333
1976	4813	4752	1215	1202
1977	1913	1892	240	235
1978	2690	2632	611	591
1979	4081	3953		

1) unadjusted
2) adjusted

Table VI

Linear regressions of YFS and VPA estimates of recruitment (N = nr of yearclasses, r = correlation coefficient, P = probability, a and b = regression coefficients).

CORRELATION		Yearclasses	N	r	P	a	b
COD							
I-group VPA-YFS	(U)	1969-1976	8	.65	n.s.	140.46	3.26
id	(A)		8	.62	n.s.	147.10	3.03
II-group VPA-YFS	(U)	1968-1975	8	.96	<0.01	31.93	7.80
id	(A)		8	.94	<0.01	36.63	7.46
II-group-I-Group	(U)	1969-1978	10	.66	<0.05	8.89	0.24
id	(A)		10	.65	<0.05	8.67	0.24
HADDOCK							
I-group VPA-YFS	(U)	1969-1976	8	.99	<0.01	-16.25	3.16
id	(A)		8	.95	<0.01	-44.29	3.04
II-group VPA-YFS	(U)	1968-1975	8	.82	<0.05	266.00	1.44
id	(A)		8	.78	<0.05	288.77	1.24
II-group-I-group	(U)	1969-1978	10	.71	<0.05	59.52	0.52
id	(A)		10	.72	<0.05	28.12	0.73
WHITING							
I-group VPA-YFS	(U)	1969-1976	8	.82	<0.05	1301.64	1.79
id	(A)		8	.79	<0.05	1314.26	1.94
II-group VPA-YFS	(U)	1968-1975	8	.83	<0.05	491.63	1.84
id	(A)		8	.85	<0.01	456.93	2.02
II-group-I-group	(U)	1969-1978	10	.45	n.s.	165.59	0.31
id	(A)		10	.45	n.s.	161.28	0.33
NORWAY POUT							
II-group-I-group	(U)	1969-1978	10	.92	<0.01	211.53	0.09
id	(A)		10	.36	n.s.	930.60	0.15
II-group-I-group	(U)	1973-1978	6	.93	<0.01	241.64	0.09
id	(A)		6	.97	<0.01	48.38	0.15

Figure 1. Standard area for the calculation of abundance indices for herring.

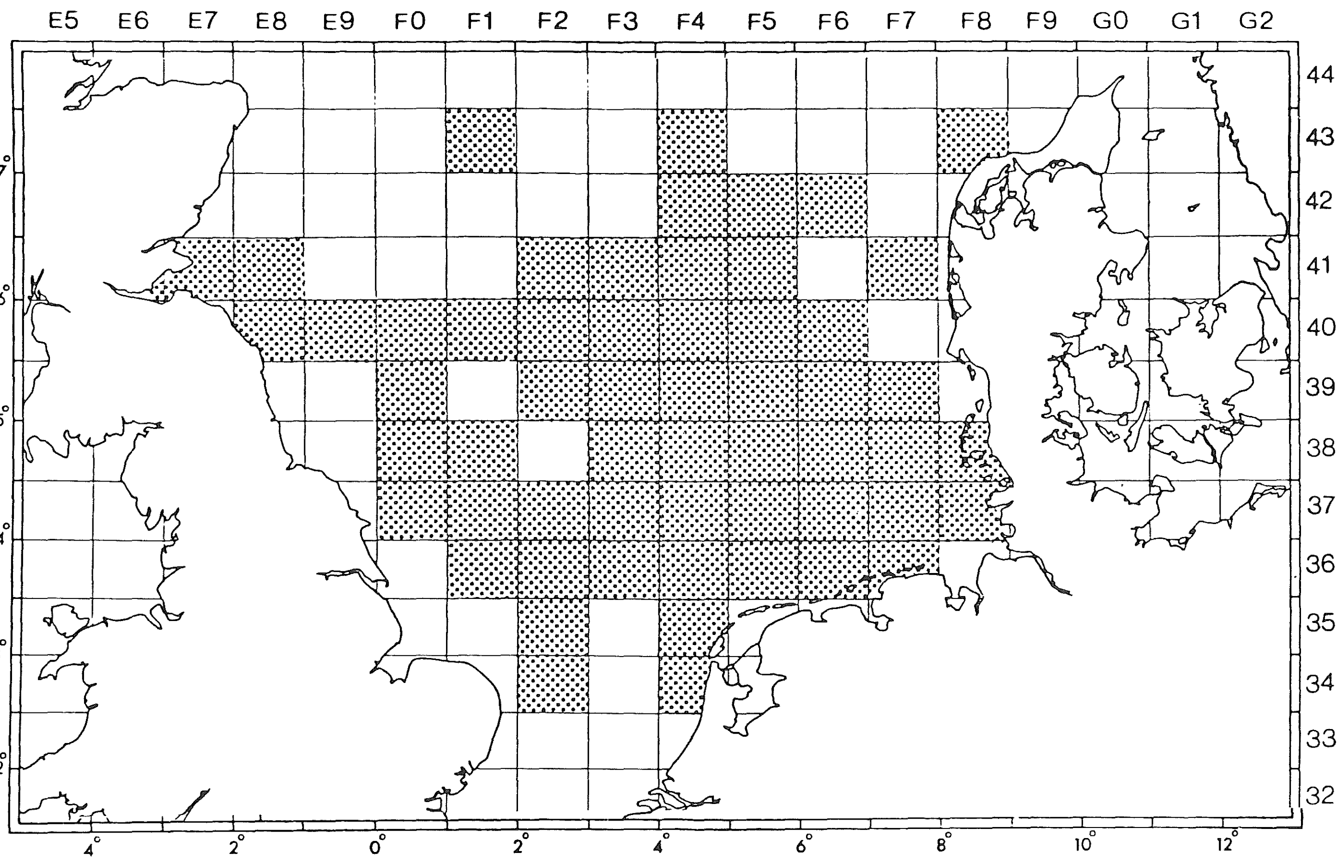
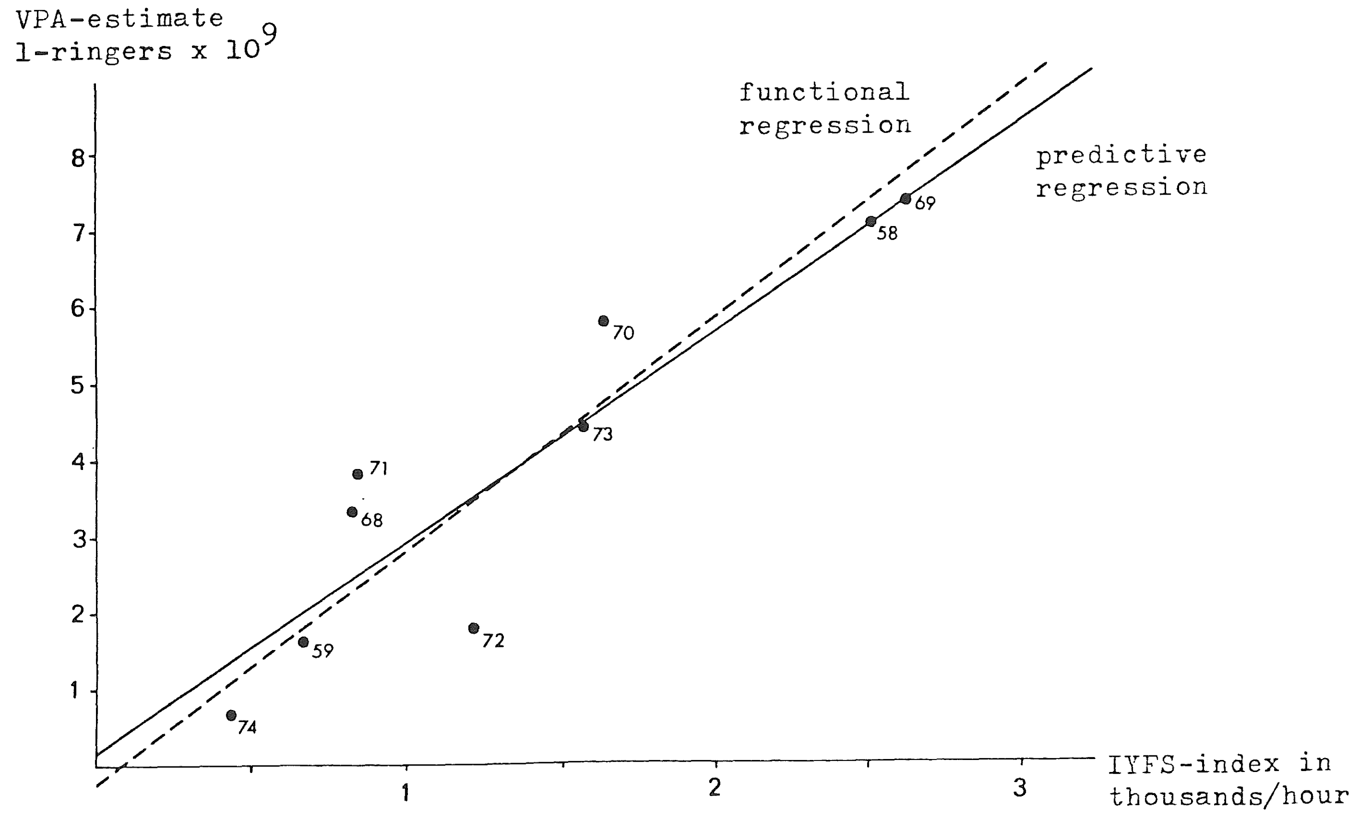


Figure 2. Regression of VPA year class strength on IYFS abundance indices.



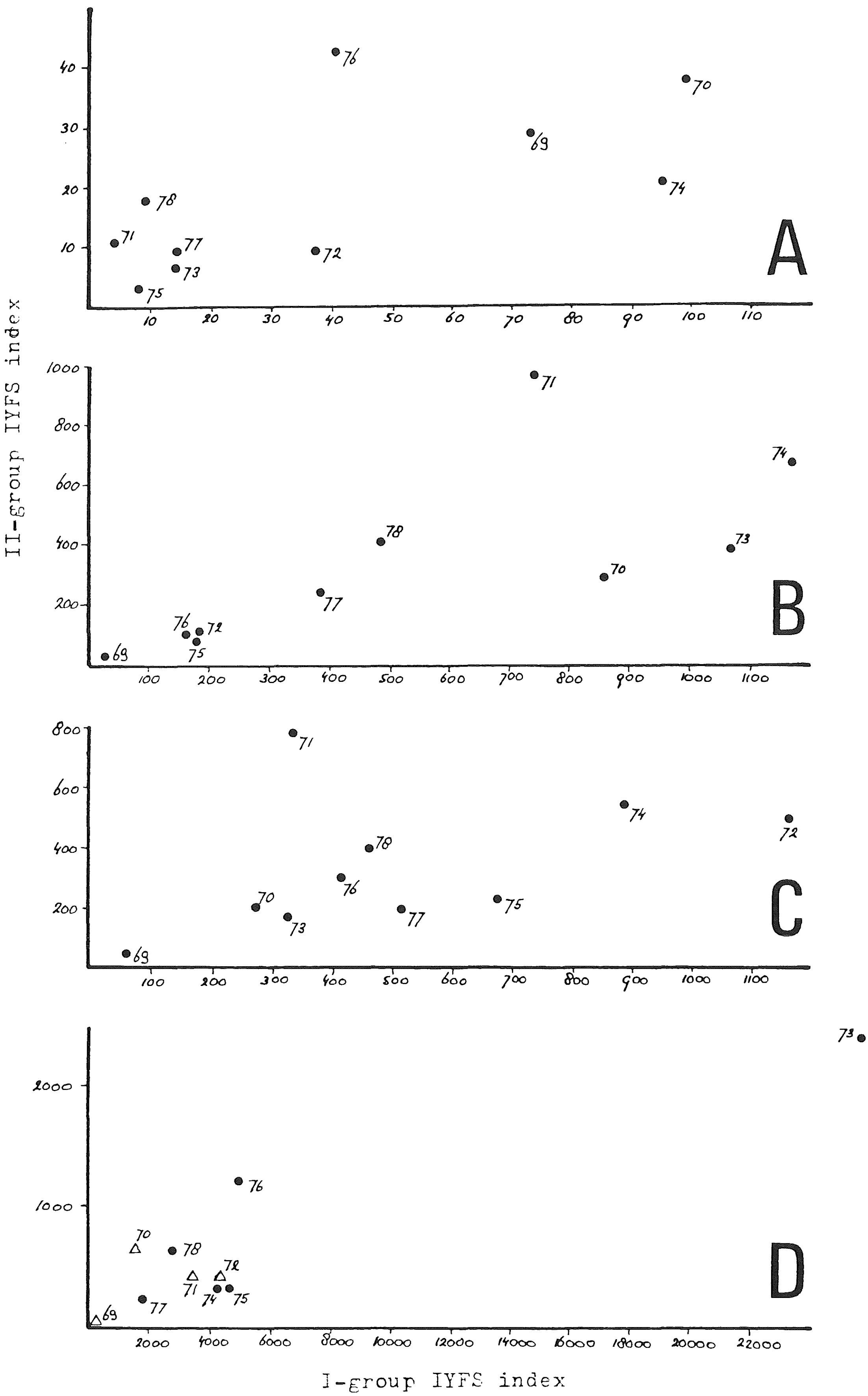


Fig. 3
Correlations between survey indices for individual year classes as I-group and as II-group for Cod (A), Haddock (B), Whiting (C) and Norway pout (D).

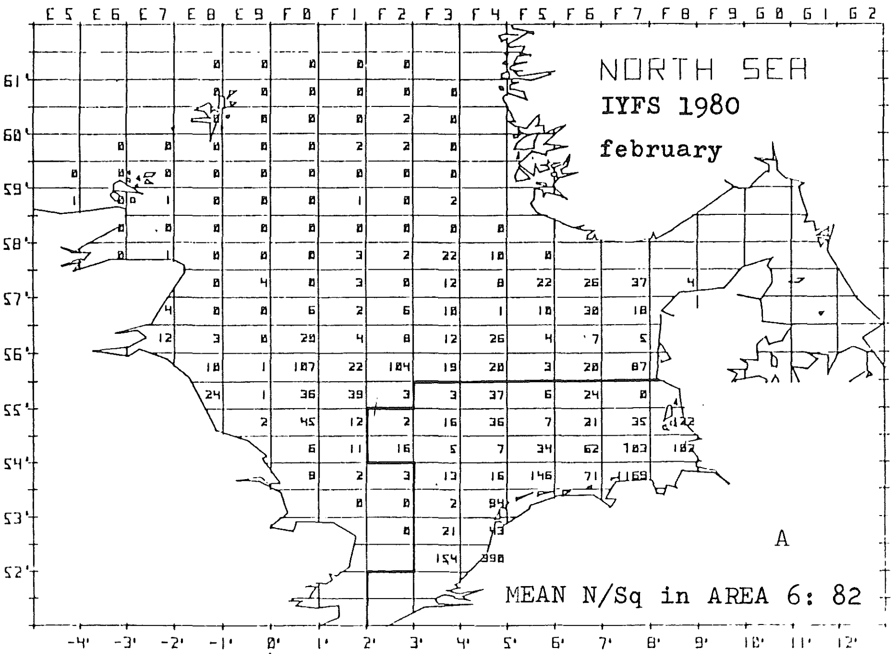
Fig. 4.

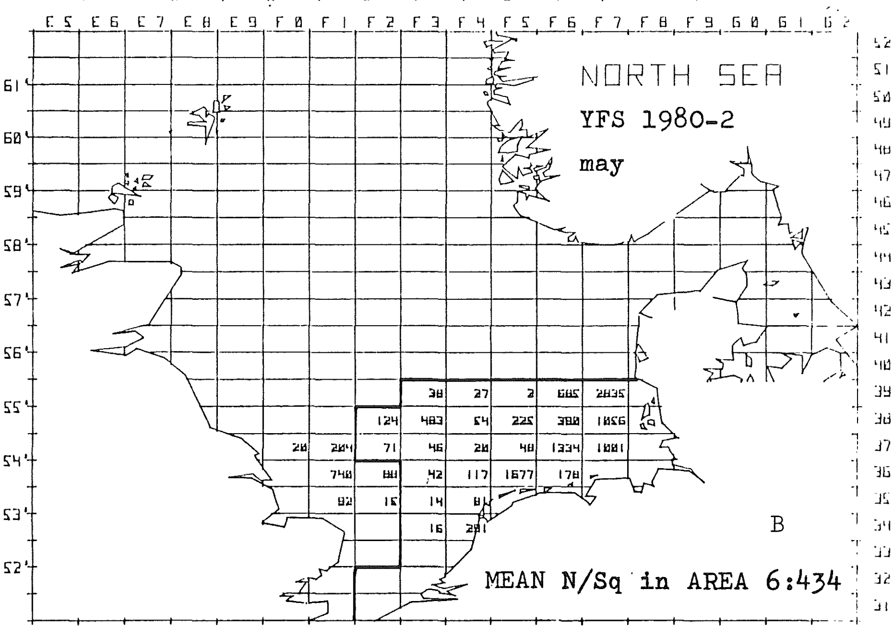
Catches of I-group cod (year class 1979) during 3 surveys in 1980

A IYFS in February

B Dutch GOV survey in May

C Dutch GOV survey in August





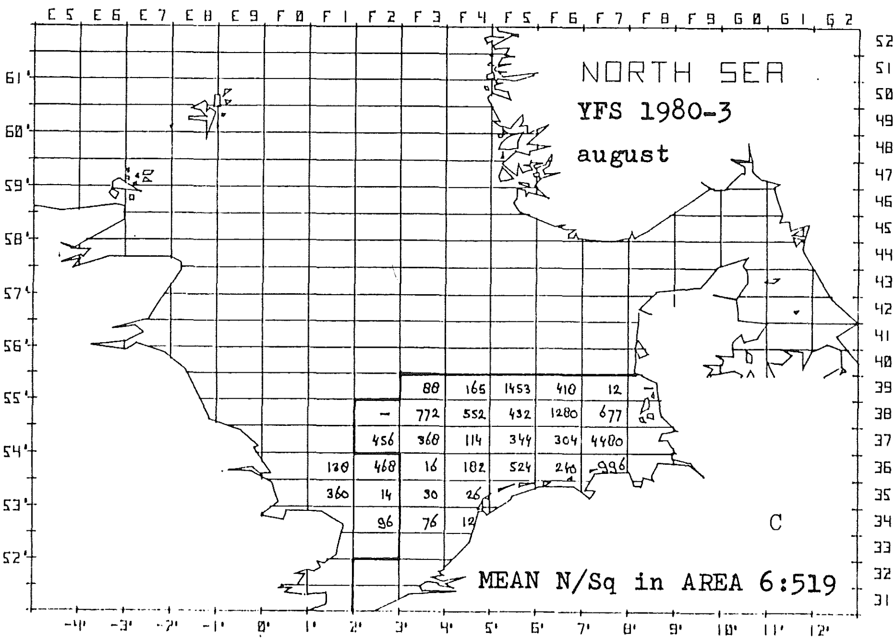
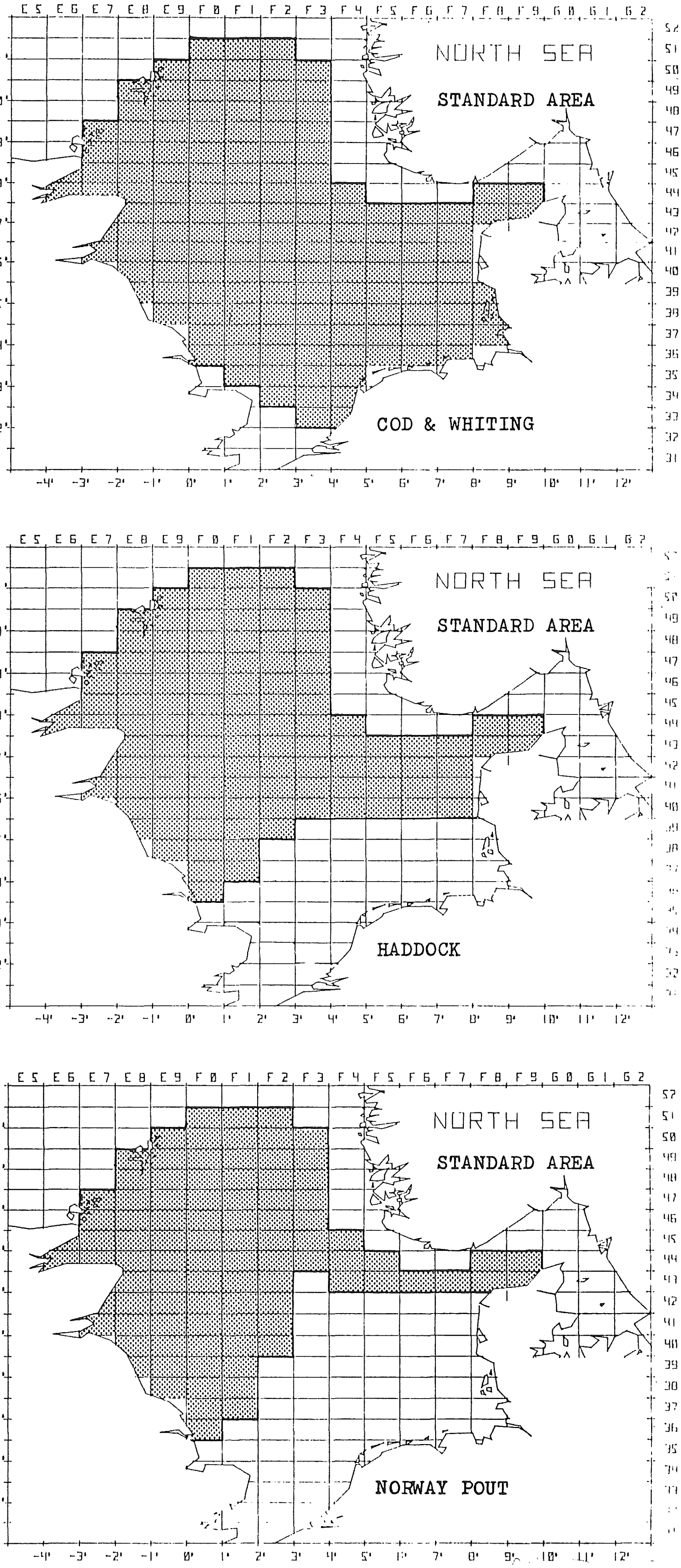


Fig. 5.

Standard areas for the different roundfish species



3. Survey methods.

The Group discussed the set of standard instructions for the survey that has been used in recent years (the "Manual for ICES North Sea Young Fish Surveys") and decided on a number of amendments. A revised version of this manual will be presented as a separate document to the forthcoming ICES Statutory Meeting (ICES C.M. 1981/H: 9). In this report, only the main alterations to the old manual are discussed.

3.1. Standard GOV-trawl and fishing method.

The standard GOV-trawl recommended in the previous report of the Group has now been adopted by all participants, and it appears to be working satisfactorily.

Sweden has slightly modified the recommended design by changing the mesh size in the two last sections of the net from 25 mm bar to 11 mm bar. The reason for this adaptation was the fear that small fish, particularly 0-group sprat, might escape through the front part of the codend, which has no inner lining of smaller mesh size. The other members of the Group, however, saw no reason to adopt this modification, as they thought that an inner lining of 10 mm bar in the last 4 meters of the codend (as specified in the manual) would be sufficient to retain the smallest fish in all catches made during the survey.

One country operating the net from a side trawler, would like to reduce the length of the codend, in order to facilitate the hauling of the net. After consultation with the laboratory in Boulogne, it appeared that the codend could not be shortened by more than 2 meters without altering the fishing properties of the net.

It was pointed out by several participants that the amount of weight in the groundrope (210 kg recommended in the manual) could be reduced on rough or very soft bottom, without causing an appreciable loss of fishing power of the net. A much more critical factor is the proper length of the groundrope and particularly of the upper bridles. Regular checks should be made to ensure that the upper two bridles are of identical length.

Now that the survey area is being extended further south, difficulties may be experienced when fishing in areas with sand dunes. In these circumstances, the recommended length of the first bridles (50 or 100 meter) could be further reduced.

3.2. Standard IKMT and fishing method.

The gear is working satisfactorily on most vessels. The Group decided that in future not only the duration of the tow should be recorded, but also the distance towed, and the maximum depth of the tow. By using the last two parameters, the catches can be expressed as a relative index of abundance per square meter, which might be more accurate than the straightforward number per haul used so far.

3.3. Distribution of sampling effort for herring.

The allocation of sampling effort recommended in the previous report of the Group (Anon., 1978) was reviewed in the light of the results from the most recent surveys. It was noted that in several cases the mean density of fish in the 3 different categories of sampling intensity☆ was not in accordance with the level of sampling intensity recommended. The Group concluded that either the allocation pattern had been calculated on the basis of incomplete data, or else that the average distribution pattern of the fish had changed since the period on which the allocation was based. It was decided to calculate a new allocation of sampling effort, based on the results of the 6 most recent surveys.

The (Neyman) optimum allocation will depend on the standard deviation of the catch rate within each rectangle. These standard deviations per rectangle have been calculated for the years 1976 - 81 for the North Sea south of 57°N. Within each year the standard deviations were, as usual, clearly related to the mean, although they tend to increase slightly faster. The general distribution pattern of these standard deviations was fairly similar from year to year, indicating that the average values could be used for the definition of areas with different levels of sampling intensity. It should be realised, however, that a distribution pattern calculated in this way will not lead to an optimum allocation in each future year, because of random variations in the yearly distribution of the fish.

To calculate the average standard deviation per square over the 6-year period, one can either average the yearly calculated standard deviations, or average the yearly variances, and then take the square root. For theoretical reasons, the second method has been used, although in practice both methods lead to the same overall picture.

For some rectangles, data were not available for all 6-years. In these cases, the mean standard deviation has been based on years for which data were available. It is obvious that this procedure may lead to some bias. If a stratum has been missed during a year of relatively high abundance the variability in this stratum will be underestimated.

If σ_i is standard deviation for rectangle i and S_i is the surface area of rectangle i, than the optimum fraction of the total sample (= total number of hauls) to be taken in rectangle i is:

$$\frac{S_i\ \sigma_i}{\Sigma_i\ S_i\ \sigma_i}$$

Assuming that all rectangles represent the same surface area, this expression may be simplified to :

$$\frac{\sigma_i}{\Sigma_i\ \sigma_i}$$

The optimum allocation of sampling effort, calculated in this way, and

☆ These categories were called "strata" in the previous reports of the Group. However, in the present analysis of the data, each statistical rectangle is considered as a stratum in a statistical sense.

expressed in parts per thousand is shown is figure 6.

The optimum allocation of sampling effort shown in figure 6 would imply practically no sampling in a number of squares. However, sampling for gadoids requires at least 2 hauls per rectangle, which defines the minimum sampling rate.

For practical reasons, it is necessary to restrict the number of categories with different sampling intensity as far as possible. From a calculation of the results obtained with 2 and 3 categories, it appears that the allocation with only 2 categories is far from optimal, and that a number of 3 different categories should be prefered.

It was decided that 6 hauls per rectangle should be made in the category of highest sampling intensity, 4 hauls per rectangle in the category of medium sampling intensity, and 2 hauls per rectangle in the rest of the area. For the sake of simplicity it was decided to group the rectangles into simple geographical units, instead of applying the key given in fig. 6 too rigidly. A simplified pattern may even be preferable from a statistical point of view, considering that some of the local variations in the calculated standard deviations could be unreliable.

Figure 7 shows the new level of sampling effort for each rectangle. All rectangles previously designated as "herring squares" should continue to be sampled during daylight only; other rectangles in the low sampling category may be sampled either by day or by night.

In order to improve the sampling of herring in the southern parts of the North Sea, some rectangles previously designated as "gadoid squares" have now been transformed into daylight haul rectangles.
In addition, some further rectangles not previously sampled have been included in the survey area.

3.4. Sampling of gadoid species.

Starting from the 1981 survey a new area subdivision has been introduced for the sampling of gadoids. This subdivision is the same as the one adopted by the ICES Roundfish Working Group, and the objective of using it during the IYFS is that age-length keys collected during the survey can also be applied on landing data from commercial fisheries, as well as to obtain more detailed information on the age composition of older age groups and on the mature biomasses.

The new subdivision (fig. 8) comprises units of 11 - 40 rectangles.
In each unit area, age samples should be collected comprising 32 fish per cm length group in total. For these fish, also sex and maturity should be recorded (maturity stage only on a 2 point scale).
In the annual survey programme, the task of age sampling in the various unit areas will be allocated to different ships. The total effort spent on age sampling in this new system will remain at approximately the same level as in previous years.

It is recommended that the annual survey programmes are drawn up in such a way that each country is working in at least 4 different roundfish areas.

3.5. Sampling of herring and sprat.

In order to simplify sampling activities during the survey, it was decided to adopt a new area subdivision for herring and sprat sampling, which was based on the area subdivision for gadoids described above.
As differences in length for age and other biological characteristics in herring and sprat are occurring over a smaller geographical range than in gadoids, it was decided to split the gadoid areas into smaller units that could be used for herring. The resulting subdivision for sprat and herring is shown in figure 9.

Each country should collect age samples for herring comprising 3 fish per $\frac{1}{2}$ cm length group in each herring unit area it is working in, or the equivalent by aimed sampling.
For sprat, specifications will be given in the annual report concerning what countries should collect age data in the various rectangles. A country designated to collect sprat age samples in a certain area should collect 3 fish per $\frac{1}{2}$ cm length group for the length range of 5 - 15 cm. This country should then either do the otoliths reading itself, or preserve the fish and send it to the Lowestoft laboratory for futher processing.

3.6. Sampling of mackerel.

It was decided to use the gadoid area subdivision also for length and age samples of mackerel. For this species, 5 otoliths per cm length group should be taken in each sampling area.

3.7. New biological data to be collected.

In order to study the contribution that Downs recruits are presently making to the overall North Sea herring recruitment, it is recommended that otolith nucleus types should be classified, and that otolith measurements should be taken. Further instructions on these procedures will be circulated to participating countries at a later date.

A recommendation was made, that if fish of species other than those mentioned in the above sections are taken during the IYFS, the numbers caught should be recorded, and this information should be included in the standard data set exchanged after each survey. Length distributions should also be given when available. A format included in the new manual has been designed for this purpose.

A similar decision was taken concerning the IKMT catches. A new form will be used to exchange information on numbers of fish by species, taken in each haul. For sprat there is a need for the recording and exchange of length distributions, similar as is being done for herring.
Instructions for sampling programmes that cover only a limited area or period will not be included in the manual for the surveys. Arrangements for this sort of sampling will be made on an ad hoc basis in the annual survey programmes.

Figure 6. Optimum allocation of sampling effort for herring in parts per thousand.

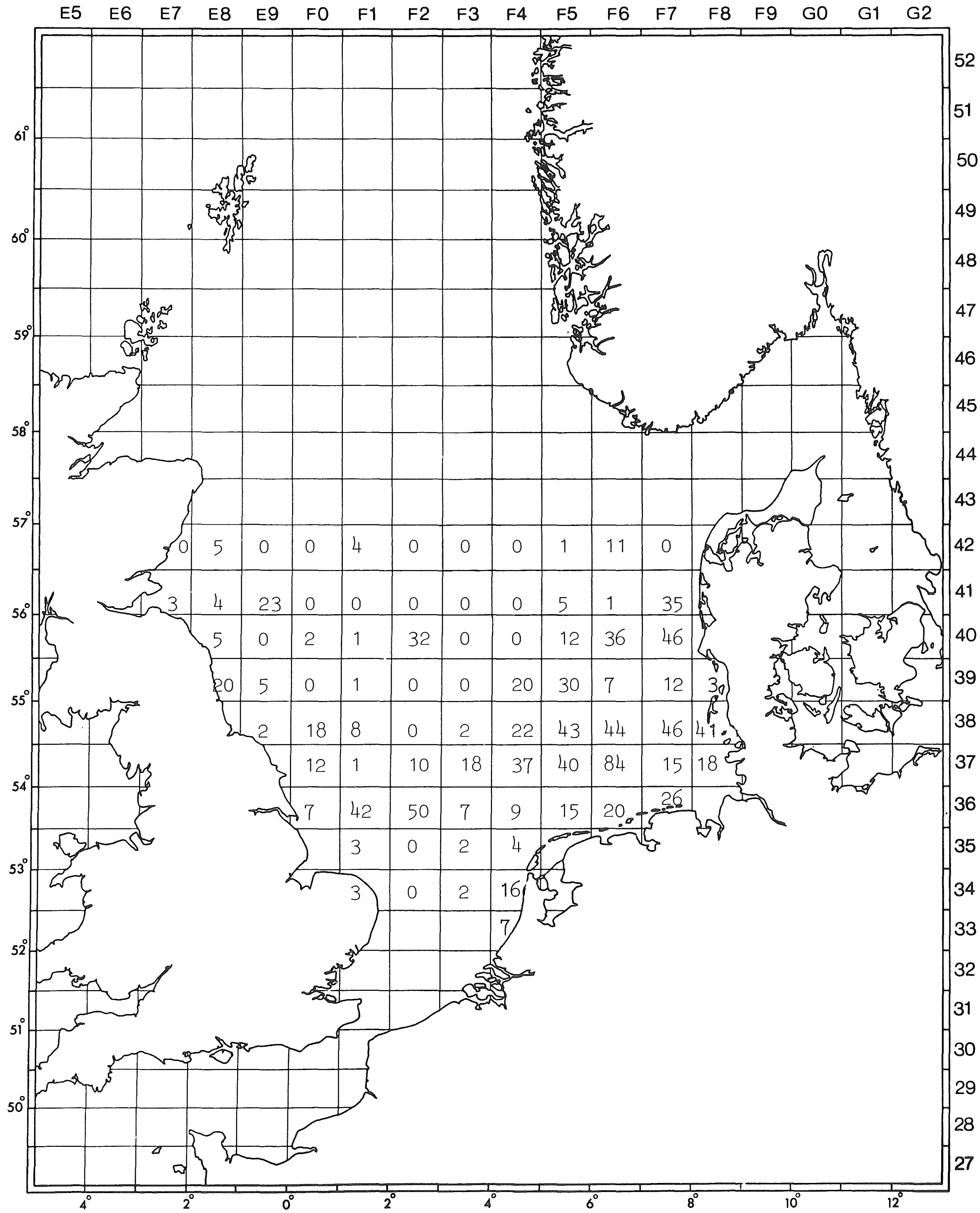
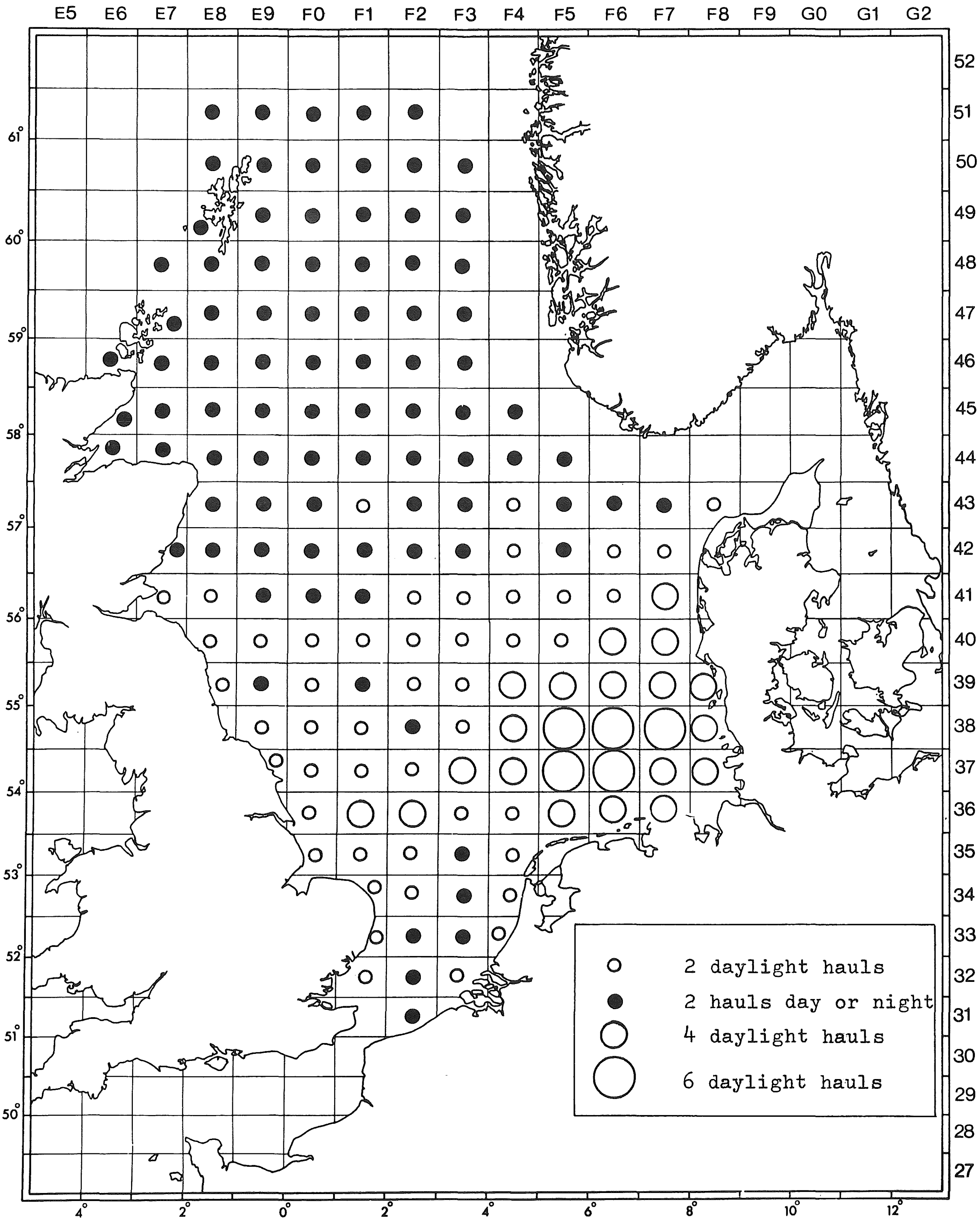


Figure 7. IYFS Area coverage and number of hauls (North Sea only).



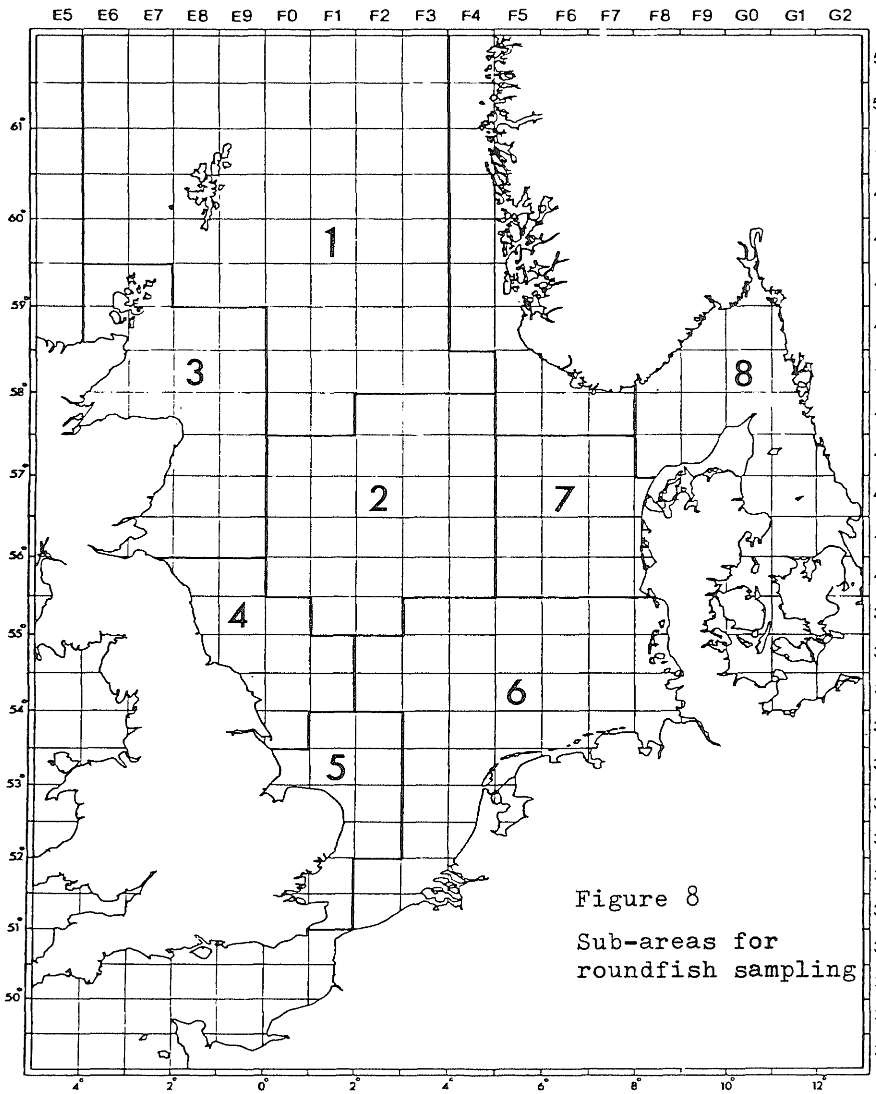


Figure 8

Sub-areas for roundfish sampling

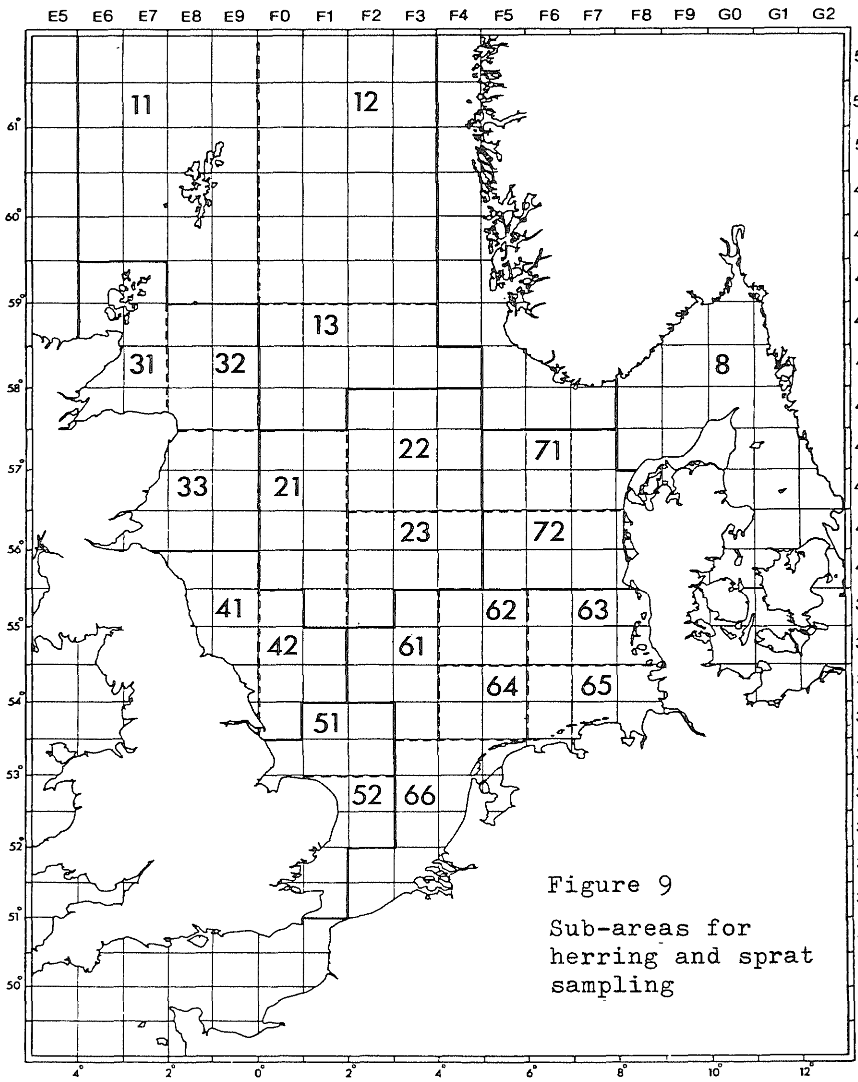


Figure 9

Sub-areas for herring and sprat sampling

4. Survey results.

4.1. Submission of basic information.

Some requests have been brought forward by the fish cttees at the C.M. in 1980 to make more efficient use of the data collected during the surveys (c.f. par. 3.4.). This has resulted in the introduction of new formats and new procedures in reporting in 1981 and these are fully described in the Manual for the ICES North Sea Young Fish Surveys (ICES, C.M. 1981/H:9).

4.2. Exchange of information.

The present situation is that each participating country provides the IJmuiden Laboratory with a complete set of basic information using the standard formats agreed upon. This information is carefully checked for obvious mistakes before and during the process of entering the data in the computer. Up till 1980 the input length distributions were not stored on the computer files but only the statistical parameters by age group for individual hauls have been stored on file. In 1981 the system has been changed to the extent that both the total input length distributions by individual hauls and the sex-maturity-age-length keys (SMALK) by roundfish area are maintained.

The programming package available provides a standard analysis output of the essential basic information, which is laid down in annual data base reports.In addition to a comprehensive survey report to the council meeting each year, each participating country is provided with two of these extensive data base reports. It appears that in general these reports seem to fullfill the request of the participating countries to obtain the essential data. However, in order to facilitate the use of the data for specific purposes most countries would wish to obtain a copy of the complete set of data on appropriate computer tape. This is as yet not feasible because of the limitations of the computer system in use for the analysis.
Since this situation is likely to improve in the near future because of the purchase of a more sophisticated system, some patience is required from the participants unless they find ways to copy the discs by other means.

In the mean time both the Aberdeen and the Lowestoft laboratories expressed their interests in having a complete data set over the years of the surveys of all the data sheets involved and also in obtaining copies of the most recent data as soon as possible after completion of the surveys, if only for reasons of possible hazards when such an unique data set is restricted to one institute only.
It was agreed that this request will be accomodated for in the near future. Still, the IJmuiden laboratory is very much concerned about the homogeneity of the data available to the different countries and therefore will continue to serve a sluice for checking errors before the data are copied and sent off to these institutes.
Other requests for specific data will be handled on an *ad hoc* basis.

4.3. Reporting.

The standard report to the Council Meetings and Annales Biologiques and the data base reports will be continued, although minor changes can be expected because of changes in the sampling and processing system, starting in 1981.

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