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Exploration of the Sea

C.M.1971/F:4

Demersal Fish (Northern) Committee

PRELIMINARY REPORT OF THE NORTH SEA ROUNDFISH WORKING GROUP

Effect of Recommendation 2 Fisheries on the Gadoid Stocks

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PRELIMINARY REPORT OF THE NORTH SEA ROUNDFISH WORKING GROUP

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Effect of Recommendation 2[x] Fisheries on the Gadoid Stocks

1. Introduction

At the 1970 Council Meeting it was recommended (C.Res.1970/2:7) that "The North Sea Roundfish Working Group should meet to make further assessments of the state of the demersal gadoid stocks in the North Sea, taking account of the exceptionally large catches of certain species reported in "Bulletin Statistique" in recent years".

The meeting was held in Copenhagen from 20-22 January 1971 with the following participants:

R. Jones, U.K. (Chairman)
R. C. A. Bannister, U.K.
H. Knudsen, Denmark
R. de Clerck, Belgium
N. Daan, Netherlands
G. Wagner, Germany
A. Hylen, Norway
D. S. Danielssen, Norway
G. Lefranc, France
S. S. Fedorov, USSR
O. V. Bakurin, USSR
J. Møller Christensen (ICES).

In the Report of the Working Group on Assessment of Demersal Species in the North Sea (Anon., 1969), the assessments included the effects of changes in mesh size and changes in fishing effort on the haddock, whiting and cod fishery of the North Sea. To achieve this, mortality rates were required for the part of the life of a haddock, whiting or cod, after it had assumed the demersal habit but before it had grown large enough to be fully exploited by the Recommendation 4[xx] fisheries.

In the case of whiting, it was recognised that some fishing mortality would occur before and during the period up to the time when the fish were fully exploited by the Recommendation 4 fishery, due to the activities of vessels engaged in Recommendation 2 fisheries. To allow for this, values of total mortality equal to 0.4 and 0.6 were adopted to provide a suitable range of values for assessment purposes.

In the case of haddock and cod it was assumed that only natural mortality would operate during this period, and values of 0.1 and 0.25 were adopted to provide a probable range of values.

In view of the recent increase in the landings of certain Recommendation 2 fisheries, the Working Group was set up to review the validity of the mortality estimates, and, if necessary, to consider the effect of changes in them on the assessments made at the previous meeting.

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x) Recommendation 2 = Article 6 = Mixed Fisheries

xx) Recommendation 4 = Annex II = Fisheries for protected Species

The "exceptionally large catches of certain species" mentioned in the Recommendation refer in particular to the landings of 469 000 tons of Norway pout landed from the North Sea in 1968, according to "Bulletin Statistique".

Norway pout are captured by vessels fishing for industrial purposes, using small-meshed nets and classed as Recommendation 2 fisheries. In 1968, it was known that there were exceptionally large numbers of haddock in the North Sea. These were members of the 1967 year class which was known to be one of the outstanding year classes of the century and which, in 1968, would have been subject to exploitation in the Norway pout fishery. At the time of the 1970 Council Meeting, data relating to the relative strength of the 1967 Norway pout year class, which would have been the important one in the 1968 Norway pout fishery, had not been worked up. As there was no evidence at the time to suggest that the 1967 Norway pout year class was other than average, the suggestion was made that the 1968 Norway pout landings might in fact have been composed of more than the permissible 10% undersized protected species. If that were so, the fear was expressed that a considerable number of young haddock might have been destroyed in the 1968 Norway pout fishery and the Working Group was asked to assess the effect of this with a view to considering the effect of Recommendation 2 fisheries on the Recommendation 4 fisheries.

2. Landings from the Recommendation 2 Fisheries

Details of landings from the Recommendation 2 fisheries, as reported to the Liaison Committee for the years 1965-69, are given in Table 1. This Table is incomplete, not all countries having submitted data.

2.1 Norway pout

The principal Norway pout fishery in the North Sea are carried out by vessels landing in Denmark and Norway.

Danish vessels mainly fish in Divisions IVa and IVb and the distribution of landings at one factory in Esbjerg is shown in Figure 1. These relate to the landings of Recommendation 2 species, excluding herring, sprat and sandeel. Observations on the likely species composition of these landings are given in a later section.

From 1965-69, the landings of Recommendation 2 species classed by Denmark as Norway pout in Table 1, ranged from 8 000 to 170 000 tons except in 1968, when landings of 411 000 tons were recorded.

The fishery for Norway pout by Norwegian vessels in the period 1965-69 came mainly from Division IVa, particularly from fishing grounds bordering the Norwegian Deeps in depths ranging from 175-275 m (Fig.2). Landings during the period 1965-69 ranged from 10 000 to 62 000 tons, including also other small fish, mainly gadoids. The landings in 1968 amounted to 58 000 tons. It may be noticed that the Norwegian fishery statistics overestimate the true landings of Norway pout due to the presence of blue whiting (Lahn-Johannessen et al., 1964).

2.2 Species composition of the Danish landings of Norway pout

As the Danish sampling programme in recent years was concentrated on herring landings in connection with the ICES Herring Tagging Experiment, no actual data are available on the species composition of the Norway pout landings in these years in Danish ports. With regard to the very large Norway pout landings in 1968, however, it is relevant to consider the relative strengths of different Norway pout year classes.

Information on the year class strengths of Norway pout is available from two sources. From Scottish data, records are available of the number of group 1+ Norway pout caught per hour's fishing by research vessels for the year classes 1959-69 (Fig.3). In addition, Lahn-Johannessen and Radhakrishnan (1970) give data on the relative strengths of the 1959-69 year classes.

The Scottish data show that the 1961 and 1967 year classes were very good and the other year classes poor or average. From the table in the paper by Lahn-Johannessen and Radhakrishnan, the 1961 year class is also considered as very good, and the year classes 1960, 1963, 1964, 1965 and 1968 as poor. No data are given by these authors for the 1966 and 1967 year classes. The two sets of data only differ with respect to the relative strengths of the 1962 and 1969 year classes. These would both appear to be poor or average from the Scottish data, but good according to Lahn-Johannessen and Radhakrishnan. Overall, the agreement between the two sets of data is very good.

In Figure 3 are shown the landings of Norway pout by Denmark superimposed on the estimates of the relative strengths of different Norway pout year classes. These have been displaced one year with respect to the Danish landings, since each Norway pout year class makes its main contribution to the fishery when it is one year old, i.e. the relative strength of the 1959 year class is plotted against the Danish landings in 1960 and so on.

This Figure clearly shows that the fluctuations in year class strengths and fluctuations in the Danish landings closely parallel each other. In particular the rise in landings in 1962 can be accounted for by a good year class in 1961. The rise in landings in 1967 and 1968 can be accounted for by the good and very good year classes of 1966 and 1967, respectively.

In the absence of evidence to the contrary, the Working Group decided that for assessment purposes, the Danish landings recorded as Norway pout in Table 1 contained no more than the permissible 10% of undersized protected species.

2.3 Species composition of the Norwegian landings of Norway pout

Estimates derived from samples of Norwegian landings indicate that the percentage by weight of Norway pout in the landings has decreased since 1962 from 75 to 40%, due to an increase in the percentage of blue whiting. (Lahn-Johannessen and Radhakrishnan).

The landings in 1968 amounted to 58 000 tons, and it is known that in this year some small gadoids were included in the catch. On the basis of sampling in 1969, when the fishery was in the same region as in 1968, the composition of the total catches from the Recommendation 2 fisheries amounted to 38% Norway pout and 47% blue whiting. The sampling showed a content of 1.7% haddock and 0.6% others. It was considered that to take 5% of the Norwegian pout landings as haddock ought to give an overestimate of quantity of haddock in the 1968 landings (Table 2).

2.4 Other Recommendation 2 species

Details of the landings of Recommendation 2 species other than those classed as Norway pout are given in Table 1.

Belgium - Landings given for Belgian vessels ranged from 2 000 to 3 000 tons from 1965-69 and mainly relate to the landings by vessels engaged in fishing for herring, sprat and shrimps. The by-catch of haddock and whiting by these vessels is considered to be negligible.

Denmark - Landings by Danish vessels ranged from 275 000 tons to 386 000 tons. 95% or more were herring and sandeel, sandeel being the most important in 1966 and 1967, and herring in the other years. By-catches of whiting in these fisheries are included in the column headed "Whiting". The by-catches of both haddock and whiting are included in the Danish landings of these species given in "Bulletin Statistique" (Tables 3 and 5), and are excluded from the figures in the column headed "Other Recommendation 2 Species".

Germany - Landings by German vessels from 1965-68 ranged from 70 000 to 102 000 tons. These landings came mainly from vessels engaged in fishery for shrimps, herring and sprats and the by-catch of all protected species in 1968 and 1969 was less than 7% (Tiews, 1968 and 1969).

237-17000 Norway - Landings by Norwegian vessels from 1965-69 ranged from ~~350 000 to 18 000~~ tons. These relate to landings of herring and sandeels by vessels fishing for Recommendation 2 species.

Poland - Catches ranged from 9 000 to 95 000 tons for 1965-69, being mainly herring, sprat and mackerel. By-catches of haddock and whiting are given in Table 1. No data on catches of protected species were submitted for 1969.

United Kingdom - Values ranged around 1-200 tons for 1965-69 and consisted mainly of shrimps. The by-catch of protected species in these fisheries was negligible.

Netherlands - Values ranged from 33 000 to 96 000 tons and consisted only of herring and mackerel. The by-catch of haddock and whiting taken in these fisheries are included in the Table in the columns headed "Haddock" and "Whiting".

3. The Effect of the Recommendation 2 Fisheries on the Recommendation 4 Fisheries

3.1 Haddock

Tables 3 and 4 show the total North Sea landings of haddock according to "Bulletin Statistique" for the period 1956-69. The total catch averaged 79 000 tons up to 1963, but showed a substantial increase to 272 000 tons between 1964 and 1966 due to the influence of the 1962 year class, and a further steep rise to 639 000 tons in 1969, following the entry of the outstanding 1967 year class.

Although the Recommendation 2 fisheries data are available for the whole of the period 1965-69, it is not relevant to make an assessment on the basis of the average landings because of the influence of the two very strong year classes. It was decided to consider only the 1967 year class of haddock which would have been most affected by the Recommendation 2 fisheries in 1968. It was, therefore, decided to make an assessment for this year only. Before an assessment could be made, it was necessary to estimate its size of the year class relative to that of an average year class and then to convert this into absolute numbers of fish.

3.1.1 The Relative year class strengths of haddock

Data relating to the relative year class strengths of haddock are available from annual trawling surveys made by the Scottish research vessels. The results for the year classes from 1954 to 1969 are plotted in Figure 4. These show that:

the year classes of:	1956, 1957, 1959, 1960, 1963, 1964 and 1965 were relatively poor;
the year classes of:	1954, 1955, 1958, 1961, 1968 and 1969 were relatively good;
the year-classes of:	1962 and 1967 were outstandingly good.

Similar results were obtained by sampling with German research vessels (Wagner).

The mean number per hour's fishing of each of these groups of year classes were:-

for the poor year classes	13	number/hours fishing
for the good year classes	130	
for the 1962 year class	1 200	
for the 1967 year class	2 000	

These data show that the 1967 year class was about 150 times as good as an average poor year class and about 15 times as good as an average good year class.

During the period 1956-63, during which the total annual landings of haddock remained approximately constant, the fishery was mainly dependent on the 1954-61 year classes. The average strength of these was 81 fish per hour's fishing. It follows, therefore, that the 1967 year class was about 25 times as large as an average year class for the years 1954-61. Data relating to the distribution of haddock 1967 year class in the Central and Southern North Sea are given in Figures 5 and 6.

In the case of the 1962 year class its strength was about 15 times average. Confirmation of the relative strength of the 1962 year class comes from samples of the landings of this year class by Scottish vessels in 1966. At that time, the trawl landings per 100 hours of the 1962 year class, which was then four years of age, were approximately 15 times as great as the average trawl landings per 100 hours fishing of four year old haddock during preceding years. Before this, in 1964 and 1965, landings of the 1962 year class by Scottish vessels were considerably below expectation, due to the rejection of very large quantities of this year class at sea (Jones). Total landing statistics alone cannot therefore be used as a reliable guide to the relative strength of an outstandingly good year class, such as that of 1962 and 1967, and research vessel estimates are to be preferred.

In this Report assessments have been made for 1968, and for this an estimate of the relative strength of the outstanding 1967 haddock year class is required. In view of the above considerations the research vessel estimate of 25 times average for the 1967 year class has been used in the calculation set out below.

3.1.2 Estimation of the number of recruits in the 1967 year class

The absolute number of recruits one year of age necssary to account for the landings as recorded in the "Bulletin Statistique" in an average year over the period 1956-63 is calculated below, using the method outlined in Appendix I. This is then raised by a factor of 25 to estimate the number of 1967 recruits at that age. Values are calculated for the range of $\bar{w}$, M, and E specified below, where

$\bar{w}_1$ = 340 g = mean weight of haddock in Recommendation 4 landings by Scotland, England and Netherlands between 1958 and 1961;

$\bar{w}_2$ = 440 g = mean weight of haddock in landings by the same countries in 1968;

M = 0.1 or 0.25 = assumed value of natural mortality between ages 1.0 and 2.0;

E = 0.7 or 0.9 = rate of exploitation of fish of 2.0 years and older. (Anon., 1969).

Year Classes 1954-1961	Subarea IV	Division IVa
Average Recommendation 4 landings by all nations 1956-63 (metric tons)	79 290	49 600
Equivalent numbers of haddock landed, using the range of mean weights $\bar{w}_1$ and $\bar{w}_2$	180-233 x 10^6	146-113 x 10^6
Equivalent numbers of recruits R_2 at the mean age of entry into the Recommendation 4 fisheries (i.e. at 2.0 years of age)		
when E = 0.7	333-257 x 10^6	209-161 x 10^6
when E = 0.9	259-200 x 10^6	162-126 x 10^6
Equivalent numbers of recruits $R_1 = R_2 e^M$ (i.e. at 1.0 year of age)		
M = 0.1		
E = 0.7	368-284 x 10^6	231-178 x 10^6
E = 0.9	286-221 x 10^6	179-139 x 10^6
M = 0.25		
E = 0.7	428-330 x 10^6	268-207 x 10^6
E = 0.9	333-257 x 10^6	208-162 x 10^6
1967 Year Class		
Absolute number of recruits R_1 in 1967, = R_1 (1954-61) x 25		
M = 0.1		
E = 0.7	9200-7100 x 10^6	5775-4450 x 10^6
E = 0.9	7150-5525 x 10^6	4475-3475 x 10^6
M = 0.25		
E = 0.7	10700-8250 x 10^6	6700-5175 x 10^6
E = 0.9	8325-6425 x 10^6	5200-4050 x 10^6
Total range	10.7-5.5 x 10^9	6.7-3.5 x 10^9

3.1.3 The Haddock assessment

This assessment assumes that 10% of the Norway pout landed by Denmark and 5% of those landed by Norway were in fact haddock. The number of haddock landed in the Recommendation 2 fisheries is therefore estimated as follows:-

	Total Weight of Norway Pout Catches in 1968 in Tons		Numbers landed, assuming Individual Fish Weight 70 g	Estimated Number of Haddock landed
Division IVa	Denmark	335 534	$4\ 793 \times 10^6$	479×10^6
	Norway	60 228	860×10^6	43×10^6
	Combined	395 762	$5\ 653 \times 10^6$	522×10^6
Total North Sea	Denmark	411 000	$5\ 868 \times 10^6$	587×10^6
	Norway	60 228	860×10^6	43×10^6
	Combined	471 228	$6\ 728 \times 10^6$	630×10^6

At 1 year of age the Working Group's estimates of the abundance of the 1967 year class of haddock from the previous section were:

Total North Sea	$5.5 - 10.7 \times 10^9$
Division IVa	$3.5 - 6.7 \times 10^9$

The Danish and Norwegian Recommendation 2 fisheries are therefore estimated to have taken the following percentages of that year class:

	Division IVa	Total North Sea
Danish landings	13.7 - 7.2%	10.7 - 5.5%
Norwegian landings	1.2 - 0.6%	0.8 - 0.4%
Combined landings	14.9 - 7.8%	11.5 - 5.9%

It is emphasized that these estimates are based on assumptions about the species compositions of the Danish and Norwegian Norway pout fisheries for which there is no direct evidence.

Because of this, it was considered that there was insufficient evidence to justify any recalculation of the haddock assessment made in the Report of the Working Group on Assessment of Demersal Species.

3.2 Whiting

Landings of whiting from 1956-69 according to "Bulletin Statistique" are shown in Table 5. During the period 1956-63 landings fluctuated about a level of 80 000 tons. After that, landings increased to 158 000 tons due to the effect of a good year class in 1962. Landings declined until 1967, and then increased again to 199 000 tons due to the effect of another good year class in 1967.

Details of the landings, separated into North Sea Divisions IVa, IVb and IVc are shown in Table 6. This shows that the majority of the whiting landed from the North Sea come from Divisions IVa and IVb. It was noted that landings were particularly large in 1969.

3.2.1 Year class strengths of whiting

Data relating to the relative year class strengths of whiting are available from annual trawling surveys made by Scottish research vessels. The results for the year classes from 1954 to 1969 are plotted in Figure 4. These show that:

the year classes of: 1954-61, 1963, 1965, 1966, 1968 and 1969 were relatively poor;

the year classes of: 1962 and 1967 were very good.

Similar results were obtained by sampling with German research vessels. The mean number per hours fishing of each of these groups of year classes were:

for the poor year classes	20)	
for the 1962 year class	217)	numbers/hours fishing
for the 1967 year class	137)	

These data show that the 1967 year class was about 7 times as good as an average poor year class.

During the period 1956-63, during which the total annual landings of whiting remained approximetaly constant, the fishery was dependent on the 1954-61 year classes. The average strength of these was 18 fish per hour's fishing. It follows, therefore, that the 1967 year class was about 8 times as large as an average year class for the years 1954-61.

In the case of the 1962 year class, its strength was about 12 times average.

Fluctuations in the landings from 1956-69 can therefore be explained, just as for haddock, in terms of the effects of good year classes in 1962 and 1967.

3.3.2 The whiting assessment

In the previous Report account was taken of the effect of Recommendation 2 fisheries on the mortality rate of young whiting. To allow for this it was assumed that the total mortality rate during the period immediately prior to exploitation by the fisheries for protected species was in the range of 0.4-0.6.

With the mesh sizes in use at present in the fisheries for protected species, 50% of whiting are retained at an age of 3.0 years. With a total mortality rate of 0.4-0.6 between 1.0 and 3.0 years of age, it follows that 55-70% of whiting die. Of these about 38-83% are assumed to die due to fishing. It follows from the assumptions made in the assessments of the previous Working Group Report that about 21-58% of each year class are removed by the Recommendation 2 fisheries before they are large enough to be taken in the fisheries for protected species (see Appendix II for details of these calculations).

The Group considered that the data at their disposal, although sufficient for making approximate calculations, were not detailed enough to necessitate any changes in these assumptions and therefore in the whiting assessments made in the previous Report (Anon., 1969).

In the case of cod, there was no reason to suppose that these were taken in any but very small quantities in the Recommendation 2 fisheries. The Group concluded that there was no need to alter any of the cod assessments made in their previous Report.

4. The Soviet Fishery for Gadoids in the North Sea

Since 1965, gadoid fishes made up an important part of the catches by Soviet vessels in the North Sea. There was no special Soviet fishery for gadoid fishes in the North Sea before that year, and they were previously caught as by-catch during the bottom trawling for herring. No estimates are available of the quantities or size composition of the quantities caught before 1964.

Since February 1966 trawl fishery for gadoid fishes gradually developed, especially for haddock (Fig. 7).

Details of haddock and whiting catches taken by USSR are shown in Tables 3&5 Haddock catches per hour's fishing are shown in Table 7.

From 1966-68 haddock and whiting fishery was carried out northward of 58°-59°N Lat. and westward of 2°E Long. in autumn, winter and spring periods and northward of 57°N Lat. and westward of 3°E Long. in the summertime (June-August). In 1969 the fishery for haddock and whiting started mainly from September and were carried out to the west of 2°E Long. and to the north of 54°N Lat. In 1970 the fishery for haddock and whiting embraced all areas to 55°-56°N Lat.

Details of the length and age composition of haddock taken in the Soviet fisheries are shown in Tables 7-10. Length compositions were particularly affected by the entry of the good 1967 year class into the fishery in 1968. In that year 86% of the haddock caught (by numbers) were 27 cm or less in length. In 1969 and 1970 most of the individuals of this year class were of marketable size and 70% and 81% of the fish caught were 28 cm or more in length. These data on the Soviet haddock fisheries are summarized in Figure 7. Landings increased in 1966, declined until 1968, and then increased considerably in 1969 and 1970. The mean length and mean age of fish in the landings declined to a minimum in 1968 and then increased again as the 1967 year class entered and passed through the fishery.

5. Summary

The terms of reference and objectives of the Working Group are set out in the Introduction.

Fluctuations in the North Sea haddock and whiting fisheries from 1956-69 were considered. For both species it was noted that the year classes of 1962 and 1967 had been very good, and had caused landings to increase up to 1966 and again up to 1969.

Data on Recommendation 2 fisheries were available for the period 1965-69. Of particular importance were the landings of Norway pout which attained the abnormally high value of 469 000 tons in 1968.

Information on by-catch of Recommendation 4 species in the landings from the Recommendation 2 fisheries was reviewed. It was noted, however, that insufficient data were available to enable proper assessments to be made of the by-catches of haddock and whiting from all the mixed fisheries.

The year class strengths of Norway pout were reviewed, and it was noted that the 1967 year class was exceptionally strong, and that it could have been large enough to account for the very high landings of Norway pout in 1968.

It was also noted that there were no samples of the species composition of Danish Norway pout landings in 1968.

In the absence of evidence to the contrary, it was decided that for assessment purposes, the Danish landings recorded as Norway pout, contained no more than the permissible 10% of undersized Recommendation 4 species.

It was noted that 1968 was an exceptional year, due to the very strong 1967 year classes of haddock and whiting, and Norway pout. This meant that an average assessment of the effect of Recommendation 2 fisheries on Recommendation 4 fisheries could not be made for the period 1965-69 for which data on Recommendation 2 fisheries were available. It was decided, therefore, simply to make an assessment for the year 1968.

5.1 Haddock

A haddock assessment was made on the assumptions that 10% of the Danish and 5% of the Norwegian 1968 Norway pout landings consisted of haddock of the 1967 year class.

This was done by

(a) determining the total number of haddock of the 1967 year class at one year of age,

and (b) determining the total number of haddock taken by the Danish and Norwegian Norway pout fisheries.

The numbers arrived at for (b) were then expressed as percentages of that obtained for (a). The following results were obtained:

For the Danish fishery	Division IVa	7-14%
For the Danish fishery	Total North Sea	5-11%
For the Norwegian fishery	Division IVa	0.6-1.2%
For the Norwegian fishery	Total North Sea	0.4-0.8%

With regard to the likely catches of the 1967 year class of haddock in the other Recommendation 2 fisheries, estimates were not made due to lack of data on the by-catch of this year class in all the fisheries.

It is emphasized that the estimates that were made were based on assumptions for which there was no direct evidence about the species composition of the Danish Norway pout fisheries. Because of this it was not considered that there was sufficient evidence to justify any re-calculation of the haddock assessments made in the Report of the Working Group on Assessment of Demersal Species in the North Sea (Anon., 1969).

5.2 Whiting

In the previous Report account was taken of the effect of Recommendation 2 fisheries on the mortality rate of young whiting. To allow for this it was assumed that the total mortality rate during the period immediately prior to exploitation by the fisheries for protected species was in the range of 0.4-0.6.

With the mesh sizes in use at present in the fisheries for protected species, 50% of whiting are retained at an age of 3.0 years. With a total mortality rate of 0.4-0.6 between 1.0 and 3.0 years of age, it follows that 55-70% of whiting die. Of these about 38-83% is assumed to be due to fishing. It is implicit in the assumptions made in the assessments in the previous Working Group Report that about 21-58% of each year class are removed by the Recommendation 2 fisheries before they are large enough to be taken in the fisheries for protected species (see Appendix II).

The Group considered that the data at their disposal, although sufficient for making approximate calculations, were not detailed enough to necessitate changes in these assumptions and therefore in the assessments made in the previous Report.

5.3 Cod

In the case of cod, there was no reason to suppose that these were taken in any but very small quantities in the Recommendation 2 fisheries. The Group concluded that there was no need to alter any of the cod assessments made in their previous Report.

6. Recommendation

It was recommended that further data on the species composition of landings from Recommendation 2 fisheries be collected so that proper assessments of the effect of these fisheries on the Recommendation 4 fisheries can be made.

7. References

Anon.	1969	"Report of the Working Group on Assessment of Demersal Species in the North Sea". Coop.Res.Rep., Series A, No.9.
Lahn-Johannessen, J., Olsen, S. and Stålesen, O.	1964	"The Norwegian fisheries for Norway Pout". ICES, C.M.1964, Gadoid Fish Cttee., Doc.No.120 (mimeo.).
Lahn-Johannessen, J. and Radhakrishnan, N.	1970	"Further investigations on Norway pout from the North Sea". ICES, C.M.1970/F:18. (mimeo.).
Tiews, K.	1969 1968	1) By-catch in German industrial fisheries in 1969, in 1968. 2) By-catch in the German shrimp fisheries in 1969, in 1968 Cons.int.Explor.Mer, Annls.biol., 25 and 26 (1968, 1969).

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8. Appendix I

Method of estimating the absolute number of recruits necessary to account for the landings recorded in "Bulletin Statistique"

Let R_2 be the absolute number of recruits at the mean age of entry into the Recommendation 4 fisheries. As a convenient approximation it will be assumed that this relates to the mean number of fish at the 50% selection age of the mesh size in use, i.e. to the mean number at age t_2.

During its progress through the fishery the total number of fish caught will be given by

$$\text{total number caught} \quad \frac{F}{Z} R_2 = ER_2$$

If the average weight of fish caught in the Recommendation 4 fisheries is given by $\overline{w}$, it follows that

$$\text{total weight caught } (C) = ER_2\overline{w}$$

Re-arranging terms gives

$$R_2 = \frac{C}{E\,\overline{w}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

This provides a way of estimating the number of recruits at (t_2), the mean age of entering into the Recommendation 4 fisheries, from the total catch in that fishery (C), the mean weight of an individual fish caught in that fishery $(\overline{w})$ and the rate of exploitation (E).

The next step in the calculation is to determine R_1, the mean number of recruits at some arbitrary younger age t_1 years.

It follows then, that if natural mortality alone is allowed for between t_1 and t_2 years

$$R_1 = R\, e^{M(t_2 - t_1)} \quad \ldots\ldots\ldots\ldots\ldots \quad (2)$$

where M is the instantaneous natural mortality rate between t_1 and t_2 years, R_1 is then an estimate of the number of one year old fish necessary to account for the Recommendation 4 fisheries alone. To allow for Recommendation 2 fisheries, the number of fish caught in the Recommendation 2 fisheries should, as a first approximation, be added to this estimate of R_1.

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9. Appendix II

Effect of Recommendation 2 fisheries on the recruitment of whiting to the Recommendation 4 fisheries

Let R_1 be the number of whiting at age t_1 and R_2 be the number at age t_2 years, where t_2 is the mean age of entry into the Recommendation 4 fisheries. Then the catch of whiting by Recommendation 2 fisheries is given by

$$\frac{F}{Z} R_1 \left(1-e^{-Z(t_2-t_1)}\right)$$

i.e. the percentage of the one year old recruits taken by the Recommendation 2 fisheries is given by

$$100 \frac{F}{Z} \left(1-e^{-Z(t_2-t_1)}\right)$$

Values of Z and t_2 have been taken as:

$Z = 0.4$ or 0.6
$t_2 = 3.0$ years
} Anon. (1969)

Values of M and t_1 were measured to be:

$M = 0.1$ or 0.25

$t_1 = 1.0$ year

The estimates obtained are tabulated below.

			Proportion of fish dying between t_1 and t_2 years	Proportion of deaths due to fisheries	Percentage of R_1 caught by fishery
Z	M	F	$\left[1-e^{-Z(t_2-t_1)}\right]$	F/Z	$100\frac{F}{Z}\left[1-e^{-Z(t_2-t_1)}\right]$
0.4	0.1	0.3	0.55	0.75	41
0.6	0.1	0.5	0.70	0.83	58
0.4	0.25	0.15	0.55	0.38	21
0.6	0.25	0.35	0.70	0.58	41

Table 1. Recommendation 2 fisheries, catch in tons by species and categories as reported to the Liaison Committee 1965-69.

1969 Country	Norway Pout	Other Rec.2 Species	Haddock	Whiting	Other Rec.4 Species	Non Rec.2 Species Non Rec.4 Species	Species not specified
Belgium	-	2 266	3	42	132	12	264[1]
Denmark	52 483	323 858	-	140 718	2 260	47 257	-
Germany	-	-	-	-	-	-	-
Netherlands	-	33 628	1 653	2 626	3 725	13 505	6
Norway:							
Norwegian vessels	62 416[2,6]	246	-	-	-	-	6 054[7]
Foreign vessels	1 459	99	-	-	-	-	-
Poland	-	9 233	-	-	-	-	-
U.K.	-	1 247[3]	-	-	194	-	-
1968							
Belgium	-	1 486	1	62	141	12	295[1]
Denmark	410 827	385 933	-	57 235	2 632	23 568	-
Germany	-	68 372	1 305	2 657	299	620	441
Netherlands	-	33 549	3 476	4 884	10 630	13 668	1 327
Norway:							
Norwegian vessels	57 833[6]	237	-	-	-	-	5 311[7]
Foreign vessels	2 395	430	-	-	-	-	-
Poland	-	13 561	24	8	671	45	-
U.K.	-	1 290	-	-	25	-	-
1967							
Belgium	-	1 995	14	53	234	19	265[1]
Denmark	169 611	354 832	-	22 762	1 899	21 072	-
Germany	-	-	-	-	-	-	-
Netherlands	-	46 462	7 387	2 639	8 968	10 634	649
Norway:							
Norwegian vessels	9 835[6]	1 178	-	-	-	-	11 171[1]
Foreign vessels	449	531	-	-	-	-	52
Poland	-	40 083	123	16	1 863	151	-
U.K.	-	1 272	-	-	10	-	-

For footnotes, see page 15

Table continued .....

1966 Country	Norway Pout	Other Rec.2 Species	Haddock	Whiting	Other Rec.4 Species	Non Rec.2 Species Non Rec.4 Species	Species not specified
Belgium	-	2 758	1	50	429	11	-
Denmark	35 162	274 988	-	50 753	1 868	16 580	-
Germany		98 645	985	2 572	2 518	-	4 517
Netherlands	-	71 115	15 699	3 125	9 441	7 630	990
Norway:							
Norwegian vessels	17 250[6]	2 730	-	-	-	-	10 966[7]
Foreign vessels	810	591	-	-	-	-	133
Poland	-	76 297	1 438	229	13 562	799	-
U.K.	-	1 311[3]	-	-	94[4]	-	-
1965							
Belgium	-	2 843	8	81	1 011	33	-[5]
Denmark	8 171	305 509	-	21 563	1 477	15 034	
Germany	-	102 159	983	4 780	3 037	7 802	341
Netherlands	-	95 809	20 313	4 367	7 909	9 411	832
Norway:							
Norwegian vessels	42 927[6]	16 907	-	-	-	-	15 855
Foreign vessels	414	1 076	-	-	-	-	207
Poland	-	95 418	402	717	6 236	3	-
U.K.	-	1 421[3]	-	-	10[4]	-	-

1) Nephrops fishery.

2) According to sampling: 42% Norway pout and 52% blue whiting.

3) Include some Irish Sea catches.

4) Not specified, include Irish Sea catches.

5) Nephrops fishery excluded.

6) Include unknown quantities of other small fish, mainly gadoids.

7) Norway pout, other gadoids, and probably silver smelt. Some part of this quantity used for furred animal food. Prawns and Nephrops excluded.

Table 2. Total quantities (in tons) landed by Norwegian trawlers from the Recommendation 2 fisheries in the North Sea.

Year	Norway [1] Pout	Sandeel	Herring	Silver Smelt	Other [2] Species	Total
1960	22 337	10 856	11 158	500	774	45 625
1961	13 485	5 238	10 035	274	259	29 291
1962	35 715	11 199	7 634	125	1 261	55 934
1963	99 263	11 511	21 854	-	3 262	135 890
1964	69 476	10 402	23 624	416	9 424	113 342
1965	42 927	4 921	11 986	-	15 855	75 689
1966	17 250	207	2 523	-	10 966	30 946
1967	9 835	976	202	-	11 171	22 184
1968	57 833	60	177	-	5 311	63 381
1969	62 416	-	246	-	6 054	68 716
1970 [3]	94 919	3	24	237	5 264	100 447

1) Include unknown quantities of other small fish, mainly gadoids.

2) Mainly gadoids.

3) Preliminary figures.

Table 3. Nominal catch of North Sea haddock by country in metric tons according to Coop.Res.Rep., Series A, No.9, Table 2 for 1956-65, and "Bulletin Statistique" for 1966-69.

Year	Belgium	Denmark	England	France	Germany	Netherlands	Norway	Scotland	Sweden	Others	USSR	Total
1956	1 925	831	8 117	5 451	1 808	13 306	4 340	53 201	8 979	-	-	97 958
1957	1 101	675	11 131	6 170	1 791	14 158	3 301	61 207	7 981	15	-	107 530
1958	972	920	8 122	5 233	3 419	11 477	1 854	59 125	6 900	-	-	98 022
1959	997	1 545	7 659	5 774	1 652	9 072	1 514	47 076	6 231	-	-	81 520
1960	595	1 932	5 968	165	1 057	8 542	896	42 268	6 092	24	-	67 539
1961	868	2 261	6 485	7 524	890	7 642	934	35 840	6 617	29	-	69 090
1962	783	2 157	5 485	189	543	6 592	960	31 924	4 469	7	-	53 109
1963	1 768	2 722	7 262	131	979	9 384	1 116	36 189	Not Av.	-	-	59 551
1964	4 219	72 223	19 208	14 248	2 095	16 918	2 134	63 784	6 707	6	-	201 542
1965	2 508	65 077	14 672	14 565	3 134	27 983	1 249	81 466	7 978	-	5 900	224 621
1966	1 705	48 189	12 679	12 540	2 635	19 355	1 135	76 468	11 800	1 200	84 400	272 086
1967	1 218	25 010	8 367	8 325	1 872	8 856	787	70 916	7 633	91	34 333	167 408
1968	873	39 101	8 800	4 788	2 268	7 301	524	65 304	5 770	16	4 724	139 469
1969	4 753	316 516	14 090	7 562	3 376	13 233	792	70 253	5 108	4	203 488	639 175

Table 4. Nominal catch of haddock in the North Sea by Divisions in 100 metric tons (according to Coop.Res.Rep., Series A, No.9, Table 6, for 1959-65, and to "Bulletin Statistique" for 1966-69).

Year	IVa	IVb	IVc	Not split	T o t a l
1956	450	226	11	252	939
1957	455	338	14	246	1 053
1958	687	236	15	24	962
1959	474	231	10	82	797
1960	390	199	1	74	664
1961	321	195	1	155	672
1962	255	199	0.3	70	524
1963	324	230	3	37	594
1964	499	556	8	924	1 987
1965	829	453	5	930	2 217
1966	906	231	4	1 549	2 690
1967	1 225	448	0.5	-	1 674
1968	753	627	14	-	1 395
1969	2 719	3 618	54	-	6 392

Table 5. Nominal catch of North Sea whiting by country in metric tons according to Coop.Res.Rep., Series A, No.9, Table 3 for 1956-65 and "Bulletin Statistique" for 1966-69.

Year	Belgium	Denmark	England	France	Germany	Netherlands	Norway	Scotland	Sweden	Poland	USSR	T o t a l
1956	1 903	2 730	4 398	24 194	1 183	6 741	41	36 739	1 314	-	-	79 243
1957	1 760	19 424	3 580	23 690	957	5 474	14	33 785	1 056	-	-	89 740
1958	2 087	2 752	3 045	25 861	693	7 162	21	37 666	1 953	-	-	81 241
1959	2 369	4 359	3 259	22 573	1 084	10 157	1 308	35 005	1 384	-	-	84 498
1960	2 393	7 641	2 529	2 358	1 075	9 225	243	28 009	1 034	1	-	54 508
1961	3 385	16 359	3 378	15 103	1 489	10 228	67	34 057	1 216	19	-	85 301
1962	3 866	8 878	3 147	2 560	1 276	11 898	111	32 643	-	16	-	64 395
1963	3 860	41 786	4 127	2 290	1 115	12 318	130	31 594	-	-	1 730	98 950
1964	2 074	26 279	4 321	15 179	2 703	7 155	42	27 376	2 174	-	361	87 664
1965	2 426	21 985	5 061	25 104	542	9 695	39	35 467	2 207	131	7 396	110 053
1966	2 771	51 164	4 391	19 872	1 292	10 244	100	38 879	2 638	71	26 507	157 929
1967	3 063	22 952	3 580	16 683	612	9 567	55	30 266	1 771	2	2 694	91 245
1968	2 978	57 367	3 123	25 267	698	13 127	55	30 286	1 501	-	10 518	144 920
1969	2 410	142 622	2 268	8 802	542	15 181	32	20 573	1 090	-	5 509	199 029

Table 6. Nominal catch of whiting in the North Sea by Divisions in 100 metric tons. According to Table 6 in Cop.Res.Res Rep., No.9 for 1959-65 and to"Bulletin Statistique" for 66-69.

Year	IVa	IVb	IVc	Not split	T o t a l
1956	322	229	103	95	749
1957	247	187	175	234	843
1958	447	202	101	25	775
1959	417	199	113	76	905
1960	275	125	43	88	531
1961	296	171	59	307	833
1962	311	157	83	90	641
1963	315	145	90	437	987
1964	228	174	38	415	855
1965	285	202	46	534	1 067
1966	296	215	64	977	1 552
1967	432	414	66	-	912
1968	517	769	163	-	1 449
1969	296	1 582	112	-	1 990

Table 7. Haddock catches per hour's trawling by Soviet vessels SRT and SRTR types (in kgs) in the North Sea.

Month	Y e a r s 1966	1967	1968	1969
January	-	790	320	-
February	640	570	90	20
March	730	510	180	-
April	850	500	70	-
May	130	120	80	-
June	200	210	130	-
July	210	130	50	-
August	320	150	20	10
September	470	190	20	420
October	670	200	-	710
November	1 910	450	-	1 090
December	1 360	390	-	1 090
Mean catch per year	300	240	80	570

Table 8. Percentages by numbers of haddock of different sizes caught in the Soviet North Sea fisheries.

	Years						
	1964	1965	1966	1967	1968	1969	1970 x)
⩽ 27 cm	4.8	1.9	0.7	11.5	85.7	29.9	18.6
≥ 28 cm	95.2	98.1	99.3	88.5	14.3	70.1	81.4
%	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Catch 10^3 tons	+	5.9	84.4	34.3	4.7	203.5	~286.0

x) January-October.

Table 9. Length composition of haddock 1964-1970 in the Soviet fishery.

Length in cm	Years						
	1964	1965	1966	1967	1968	1969	1970 1)
10-11	-	-	+	-	0.1	-	-
12-13	-	-	0.2	0.3	2.1	+	-
14-15	-	-	0.2	1.7	5.6	0.1	+
16-17	-	-	0.1	1.5	3.7	0.3	0.1
18-19	-	-	+	0.8	8.6	0.9	0.3
20-21	-	-	+	0.8	20.0	2.9	0.4
22-23	-	0.1	+	2.0	26.5	6.9	1.3
24-25	0.5	0.6	0.1	2.6	14.5	7.8	3.8
26-27	4.3	1.2	0.1	1.8	4.6	10.0	12.7
28-29	26.5	2.9	0.4	1.7	2.4	23.0	18.9
30-31	42.0	11.0	2.9	1.1	1.5	25.7	20.4
32-33	21.6	21.8	12.4	1.4	1.4	11.2	17.3
34-35	3.9	27.5	26.6	6.9	1.8	3.8	12.5
36-37	1.1	19.0	26.4	19.2	1.6	1.6	7.0
38-39	0.1	9.8	16.5	22.3	1.3	0.9	3.0
40-41	-	3.9	8.0	16.0	1.1	0.8	1.4
42-43	-	1.4	3.4	9.3	0.9	1.0	0.6
44-45	-	0.4	1.4	5.7	0.6	0.9	0.2
46-47	-	0.2	0.7	2.7	0.5	0.6	0.1
48-49	-	0.1	0.4	1.5	0.4	0.6	+
50-51	-	0.1	0.1	0.4	0.3	0.4	+
52-53	-	+	0.1	0.2	0.2	0.3	+
54-55	-	+	+	0.1	0.2	0.2	+
56-57	-	+	+	+	0.1	0.1	+
58-59	-	+	+	+	+	+	+
60-61	-	+	+	+	+	+	-
62-63	-	-	+	-	+	+	-
64-65	-	+	+	-	+	+	-
66-67	-	-	+	-	+	+	-
68-69	-	-	-	-	-	+	-
70-71	-	-	-	-	-	-	-
72-73	-	-	-	-	-	-	-
74-75	-	-	-	-	-	+	-
No. sampled	1 614	6 889	85 562	6 452	27 518	42 184	46 615
Mean Length	30.4	34.5	36.2	37.0	23.4	29.7	30.9
Catch in 10^3 tons	+	5.9	84.4	34.3	4.7	203.5	~286.0 2)

1) Samples from January-September only.

2) Landings from January-October.

Table 10. Percentage age composition of haddock from 1966-69 in the North Sea caught by USSR trawlers.

Age	Years 1966			1967			1968			1969			1970
	%	Year class	Nos. sampled	%	Year class	Nos. sampled	%	Year class	Nos. sampled	%	Year class	Nos. sampled	%
0	0.4	1966	344	3.8	1967	243	1.5	1968	396	-	1969	-	-
1	0.1	1965	59	9.8	1966	637	82.3	1967	22 162	5.3	1968	2 256	0.3
2	0.6	1964	560	2.1	1965	133	11.0	1966	2 947	86.7	1967	36 551	8.4
3	6.6	1963	5 561	0.6	1964	40	0.9	1965	234	4.2	1966	1 774	90.0
4	82.5	1962	70 471	5.6	1963	362	0.1	1964	34	1.3	1965	535	1.3
5	8.3	1961	7 141	73.9	1962	4 767	+	1963	15	0.3	1964	109	+
6	1.5	1960 and older	1 326	3.9	1961	250	3.8	1962	1 028	+	1963	17	+
7	-	-	-	0.3	1960	20	0.4	1961 and older	102	1.9	1962	796	-
8	-	-	-	-	1959 and older	-	-	-	-	0.3	1961 and older	146	+
Mean Year	4.0	-	85 462	4.3	-	6 452	1.3	-	26 918	2.1	-	42 184	3.0

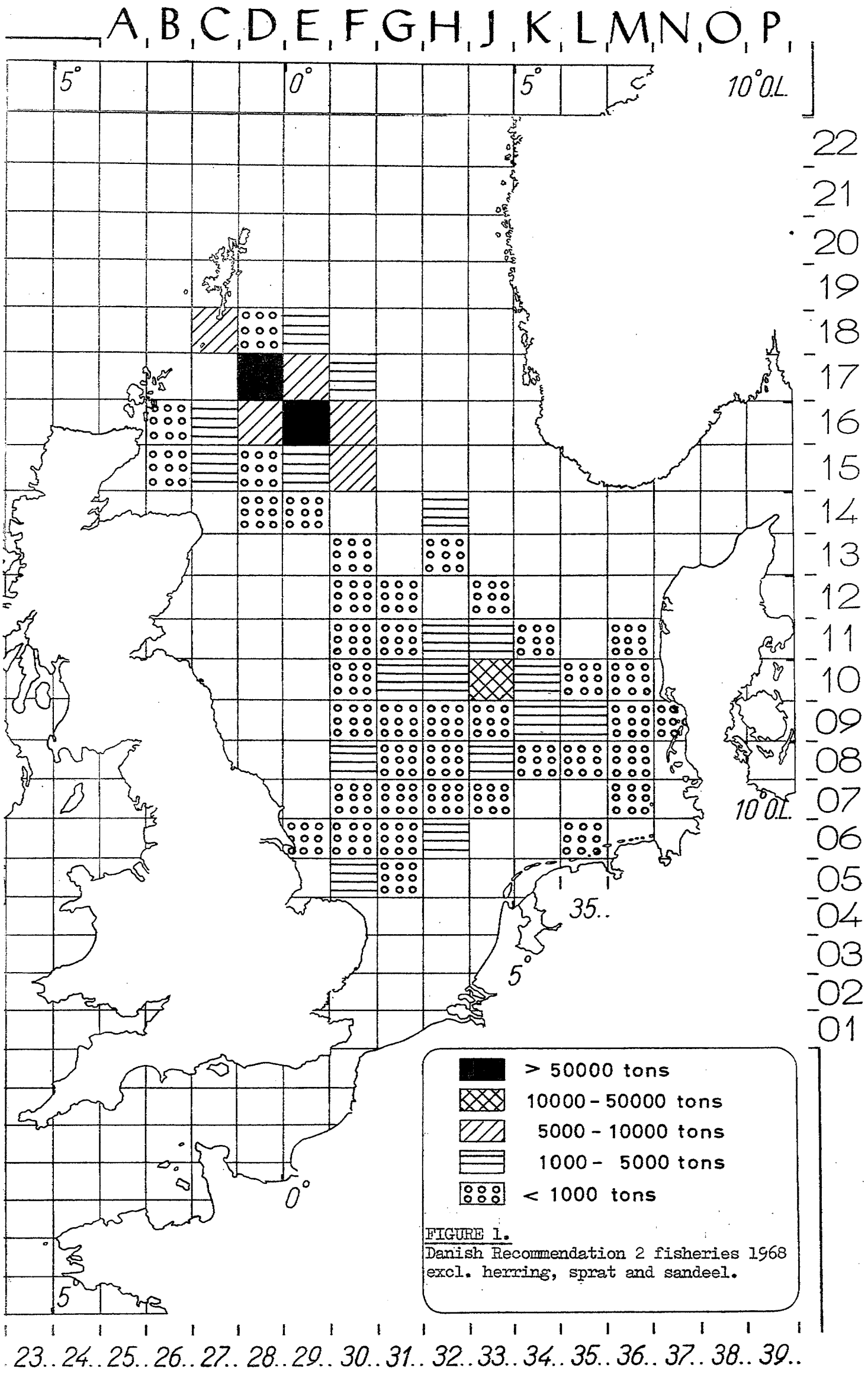


FIGURE 1.
Danish Recommendation 2 fisheries 1968 excl. herring, sprat and sandeel.

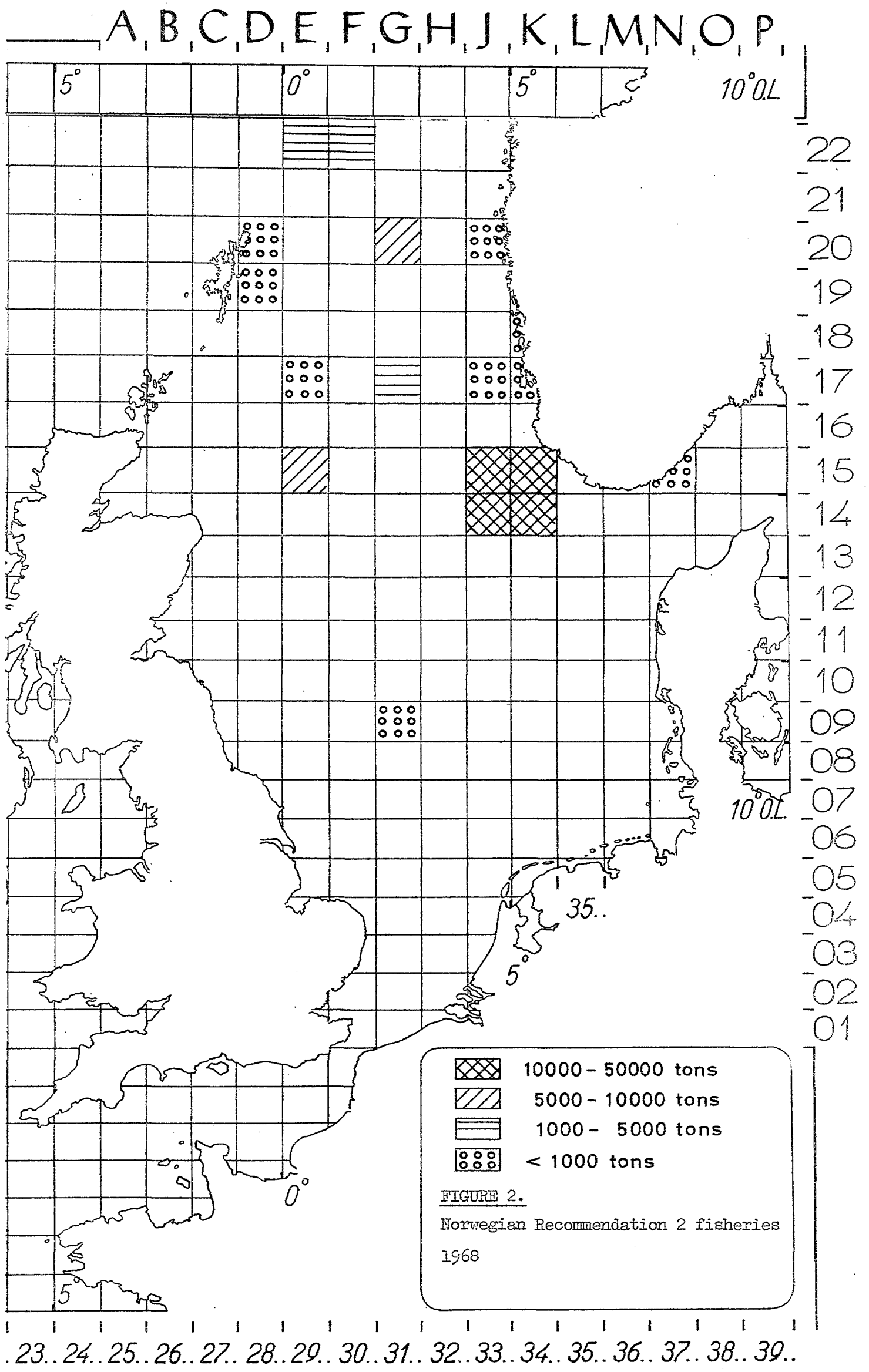
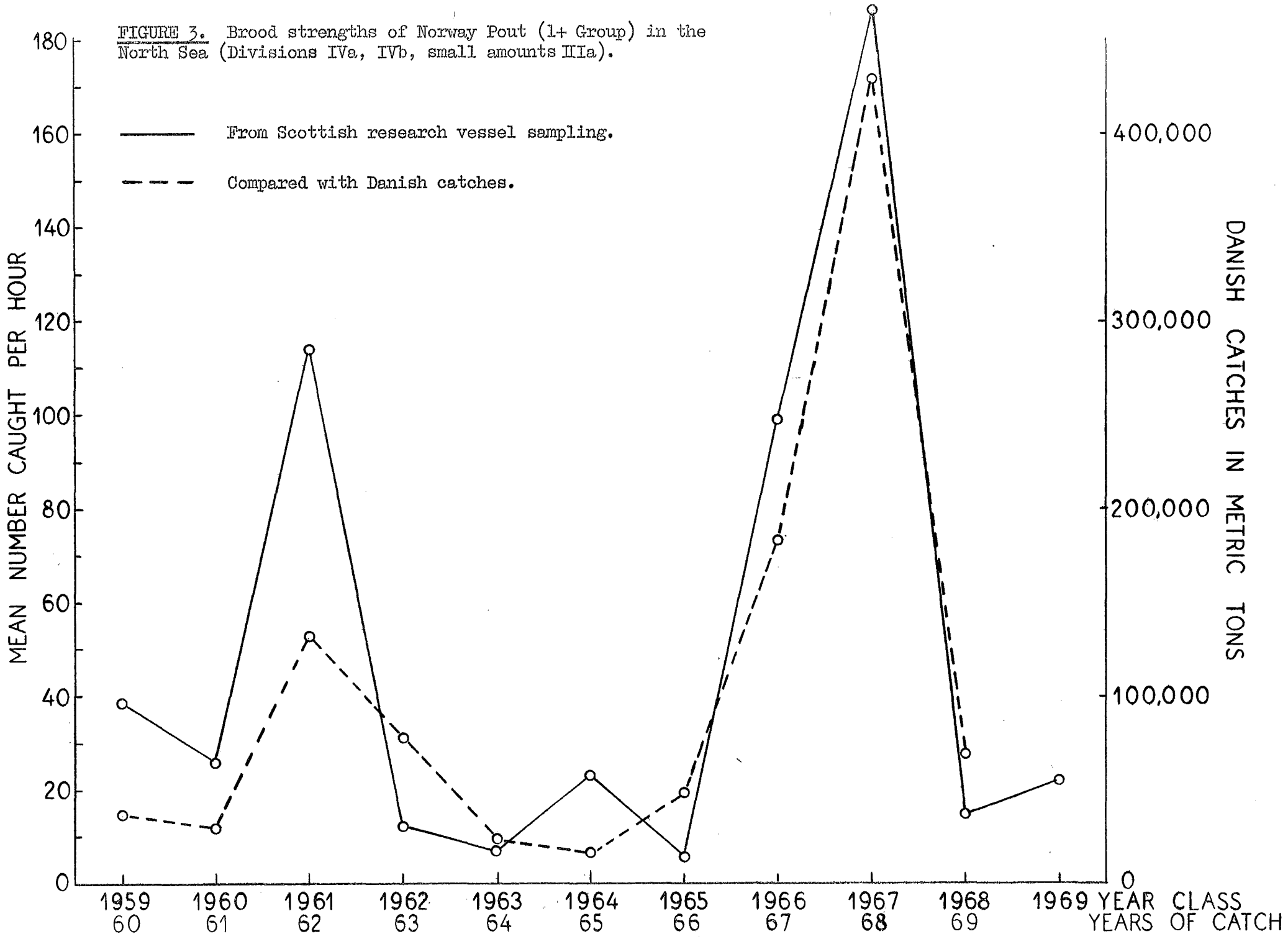


FIGURE 2.

Norwegian Recommendation 2 fisheries

1968

FIGURE 3. Brood strengths of Norway Pout (1+ Group) in the North Sea (Divisions IVa, IVb, small amounts IIIa).



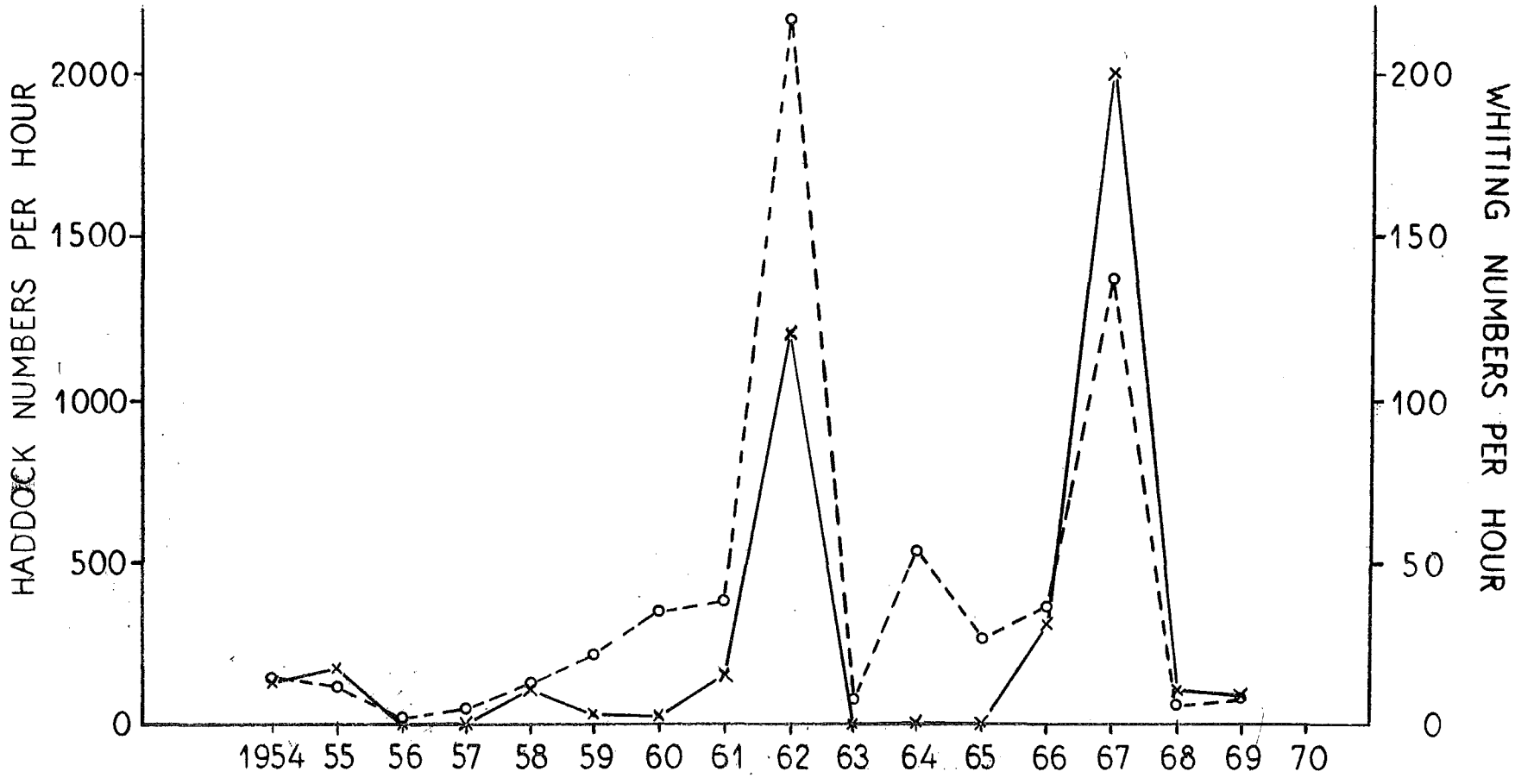
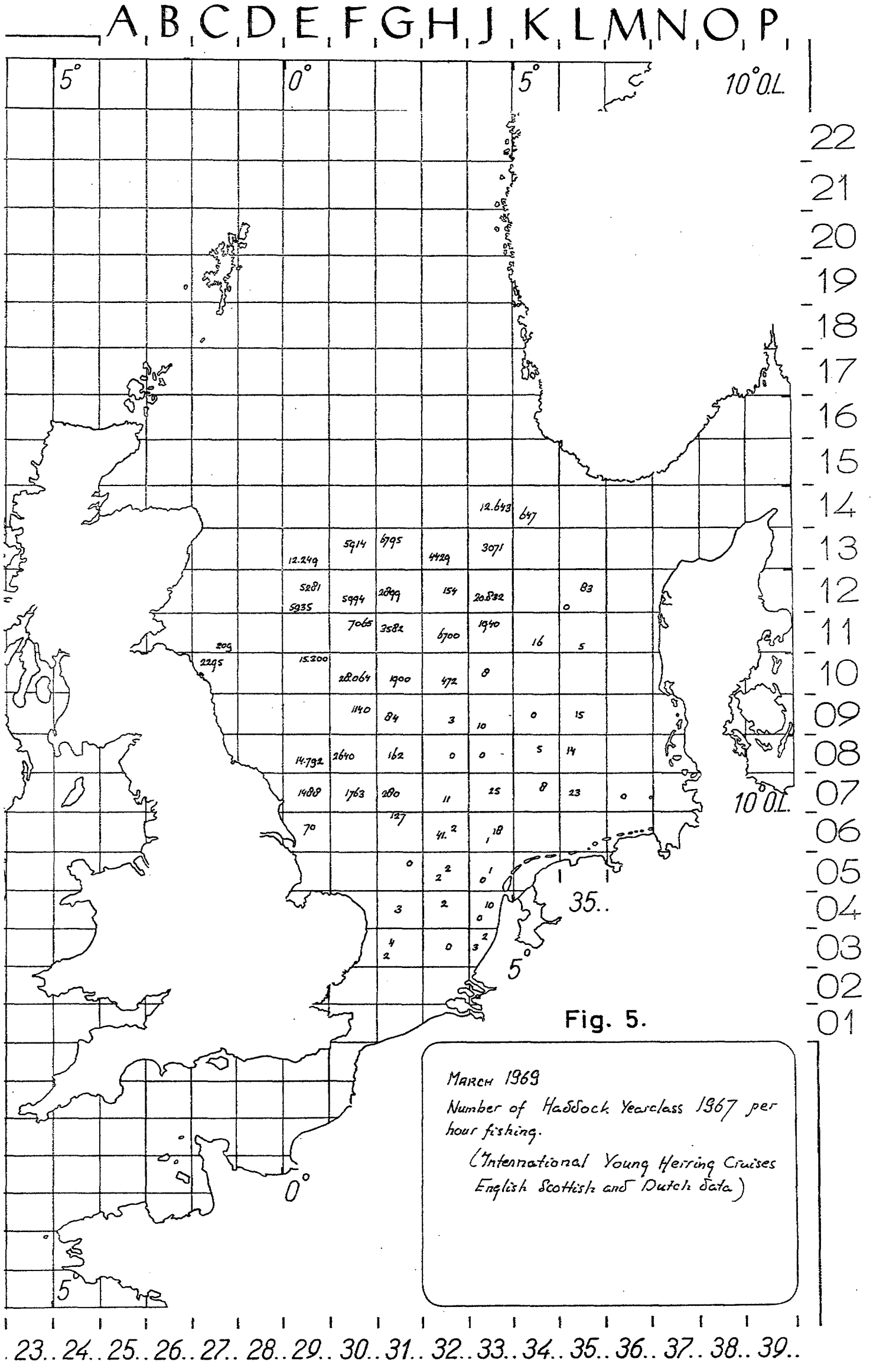


FIGURE 4. Relative year class strength of haddock (——) and whiting (- - - - - -) from unpublished Scottish data.


A B C D E F G H J K L M N O P
5°
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22
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02
01
12.643
647
12.249
5914
6795
4429
3071
5281
5935
5994
2899
154
20832
83
0
7065
3582
6700
1940
16
5
209
2295
15.200
28.064
1900
472
8
1140
84
3
10
0
15
14.792
2640
162
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11
25
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Fig. 5.
MARCH 1969
Number of Haddock Yearclass 1967 per hour fishing.
(International Young Herring Cruises English Scottish and Dutch data)
23.. 24.. 25.. 26.. 27.. 28.. 29.. 30.. 31.. 32.. 33.. 34.. 35.. 36.. 37.. 38.. 39..

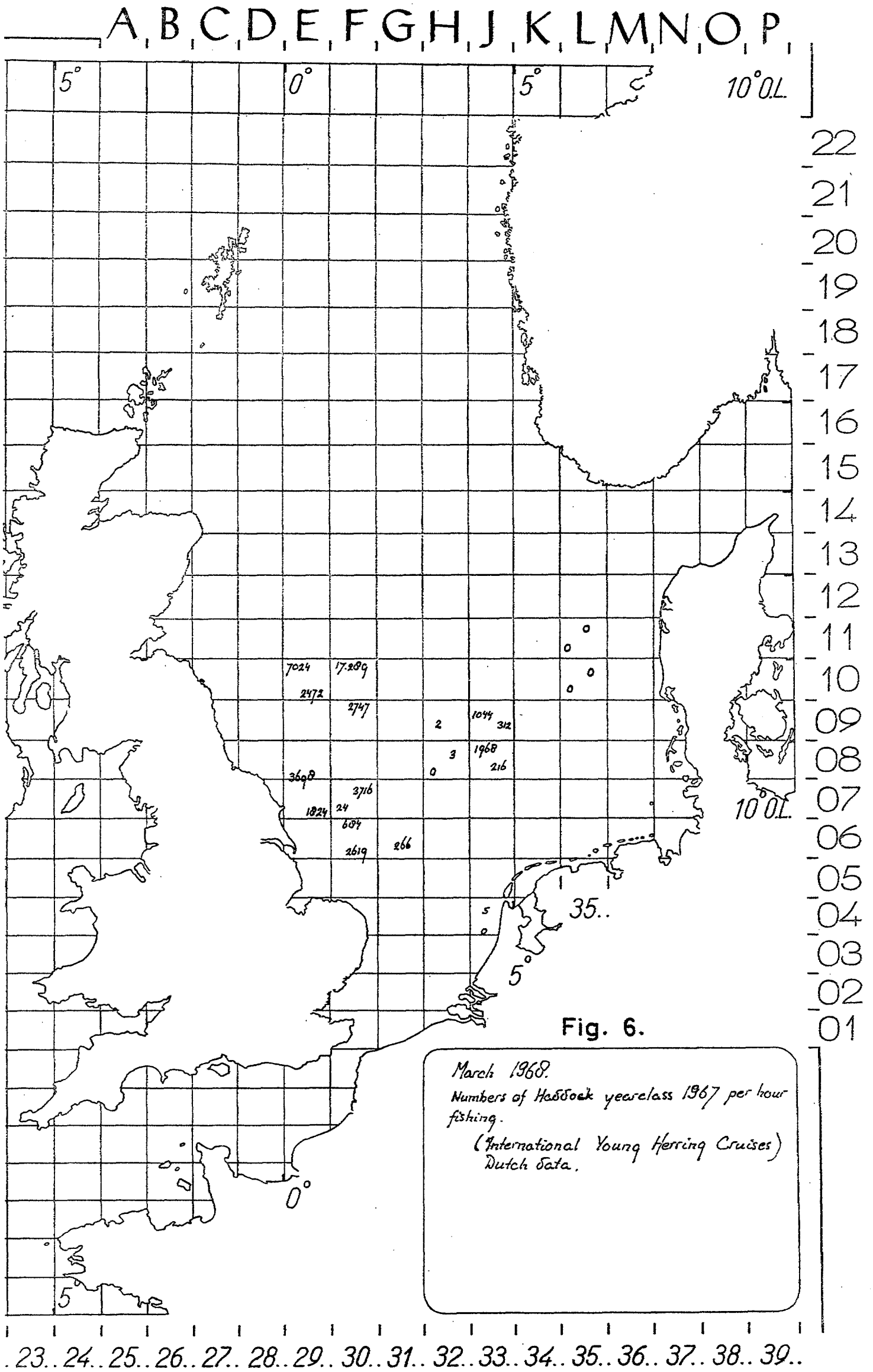


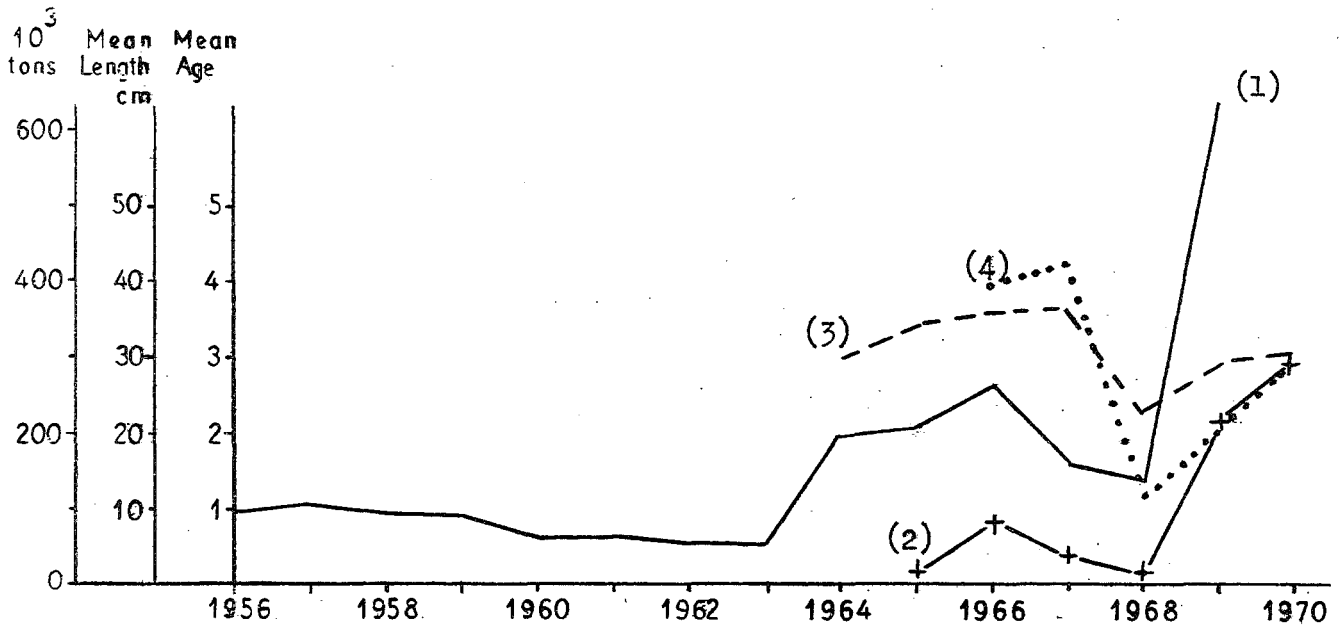
Fig. 6.

March 1968.

Numbers of Haddock yearclass 1967 per hour fishing.

(International Young Herring Cruises)
Dutch data.

FIGURE 7. Showing details of the Soviet fishery for haddock in the North Sea.



(1) ———— Total international landings (from "Bulletin Statistique")

(2) +———+ U.S.S.R. landings.

(3) — — —— Mean length of haddock in U.S.S.R. landings.

(4) ..... Mean age of haddock in U.S.S.R. landings.

International Council for the
Exploration of the Sea

C.M.1971/F:4
Demersal Fish (Northern) Committee

S U P P L E M E N T

ERRATA

The Chairman of the North Sea Roundfish Working Group has informed us that, after careful scrutiny, the following changes should be inserted in the Report :

1. Page 4, Norway

   Please insert instead of "from 1965-1969 ranged from 350 000 to 18 000 tons"

   237 to 17 000 tons

2. Page 4, United Kingdom

   Please insert a hyphen between 1 and 200 tons, i.e.

   1 - 200 tons

3. Page 4

   3.1 Haddock

   Last line but two of the second paragraph:

   please delete "its"

4. Page 4

   Section 3.1.1

   In the group of year classes, please include

   1966 as relatively good

5. Page 5

   In the paragraph commencing "During the period 1956-63.." last line but two, where it says "....the years 1954-61", should read

   the year classes 1954-61

   Same paragraph : Last line but one. Please insert"of the" between haddock and 1967, i.e.

   haddock of the 1967 year class

6. Page 6

   Please see new page 6 added to this Supplement.

7. Page 7

   First paragraph after Table :
   Division IVa 3.5 - 6.7 x 10^9 should be replaced by
   Division IVa 2.9 - 5.7 x 10^9

   Same page, second paragraph. Please replace percentages under Div. IVa to read as follows :

	Division IVa
Danish landings	16.5 - 8.4%
Norwegian landings	1.5 - 0.8%
Combined landings	18.0 - 9.2%

8. Page 8

Section 4

First paragraph, please insert :

a by-catch

Second paragraph, please insert :

Since February 1966 the trawl fishery...

9. Page 9

Second paragraph, second line, instead of Tables 7-10, this should read :

Tables 8-10

10. Page 10

Please change "For the Danish fishery Division IVa 7-14%" to

For the Danish fishery Division IVa 8-17%

and for "The Norwegian fishery Division IVa 0.6-1.2%" to

For the Norwegian fishery Division IVa 0.8-1.5%.

This page replaces page 6 of the Preliminary Report of the North Sea Roundfish Working Group, as mentioned under item 6 in the Supplement.

Year Classes 1954-1961	Subarea IV	Division IVa
Average Recommendation 4 landings by all nations 1956-63 (metric tons)	79 290	41 900
Equivalent numbers of haddock landed, using the range of mean weights $\bar{w}_1$ and $\bar{w}_2$	$180\text{-}233 \times 10^6$	$123\text{-}95 \times 10^6$
Equivalent numbers of recruits R_2 at the mean age of entry into the Recommendation 4 fisheries (i.e. at 2.0 years of age)		
when E = 0.7	$333\text{-}257 \times 10^6$	$176\text{-}136 \times 10^6$
when E = 0.9	$259\text{-}200 \times 10^6$	$137\text{-}106 \times 10^6$
Equivalent numbers of recruits $R_1 = R_2 e^M$ (i.e. at 1.0 year of age)		
M = 0.1		
E = 0.7	$368\text{-}284 \times 10^6$	$195\text{-}150 \times 10^6$
E = 0.9	$286\text{-}221 \times 10^6$	$151\text{-}117 \times 10^6$
M = 0.25		
E = 0.7	$428\text{-}330 \times 10^6$	$226\text{-}175 \times 10^6$
E = 0.9	$333\text{-}257 \times 10^6$	$176\text{-}136 \times 10^6$
1967 Year Class		
Absolute number of recruits R_1 in 1967 = R_1 (1954-61) x 25		
M = 0.1		
E = 0.7	$9200\text{-}7100 \times 10^6$	$4875\text{-}3750 \times 10^6$
E = 0.9	$7150\text{-}5525 \times 10^6$	$3775\text{-}2925 \times 10^6$
M = 0.25		
E = 0.7	$10700\text{-}8250 \times 10^6$	$5650\text{-}4375 \times 10^6$
E = 0.9	$8325\text{-}6425 \times 10^6$	$4400\text{-}3400 \times 10^6$
Total range	$10.7\text{-}5.5 \times 10^9$	$5.7\text{-}2.9 \times 10^9$

3.1.3 The Haddock assessment

This assessment assumes that 10% of the Norway pout landed by Denmark and 5% of those landed by Norway were in fact haddock. The number of haddock landed in the Recommendation 2 fisheries is therefore estimated as as follows:-