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Exploration of the Sea

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REPORT OF THE WORKING GROUP ON NORWAY POUT AND SANDEELS IN THE NORTH SEA

30 January - 3 February 1978, Charlottenlund

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REPORT OF THE WORKING GROUP ON NORWAY POUT AND SANDEELS IN THE NORTH SEA.

1. Introduction.

1.1. Participation.

Dr. R.S. Bailey	United Kingdom
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Mr. J. Lahn-Johannessen	Norway
Dr. M.G. Pawson	United Kingdom
Mr. J.G. Pope	United Kingdom
Mr. K. Popp Madsen (Chairman)	Denmark
Mr. C.J. Rørvik	Norway
Mr. P. Sparre	Denmark
Mr. W. Weber	F.R.G.

Dr. V. Nikolaev assisted the Working Group in his capacity as ICES Statistician.

1.2. Terms of Reference.

At its first meeting in 1977 the Working Group established part of the data base necessary to assess the state of the stocks of Norway pout and sandeels in the North Sea. Time, however, did not allow the Working Group to make more than rather crude estimates of vital stock parameters. Estimates of total mortality could not be divided into components due to fishing and to natural causes and no estimates of stock sizes were attempted.

At the 65th Statutory Meeting of ICES it was consequently decided (C.Res. 1977/2:26), that:

"in view of additional information available, and the intention to make more effective use of data previously presented, the Working Group on Norway Pout and Sandeels in the North Sea should meet 30 January - 3 February 1978 at Charlottenlund to improve the assessments of the state of these stocks".

## 2. The Norway Pout.

### 2.1. The Fishery.

#### 2.1.1. Landings.

From data available to the Working Group a corrected table of annual landings by countries was prepared for the North Sea (Table 2.1.1.). Compared with 1976 the total annual landings in 1977 decreased from about 436 000 tons to 387 000 tons. Except for Sweden, which showed a minor increase, landings from other countries went down. Since the peak in 1974 the total annual landings of Norway pout have gradually decreased.

For 1977 a further breakdown of landings by month for each country is given in Table 2.1.2. This table shows that the monthly landings fluctuated markedly. The highest quantities were landed during the first quarter and the latter half of the year. The comparatively small landings in the second quarter corresponds with high landings of sandeel in the same period (cf. Table 3.1.2.). This clearly indicates the relationship between the fisheries and shows how the fleet of industrial trawlers may partly switch from one resource to the other.

#### 2.1.2. Distribution of catch in 1977.

The distribution of Norway Pout catches by statistical rectangles for the months January to October 1977 inclusive made by Denmark, Norway and the United Kingdom is shown in Figure 2.1.6. For comparison, the catch distributions for 1972, 1973 and 1974 included in the previous report (C.M.1977/F:7) are shown in Figures 2.1.1.-2.1.3 and revised catch distributions for 1975 and 1976 are shown in Figures 2.1.4. and 2.1.5. The monthly catch distributions in 1977 are given in Figures 2.1.7-2.1.17.

The fishing area in 1977 was in general similar to that in the previous years. However, in the period October-December the Norway Pout Box and Norwegian regulations concentrated the effort into a narrow band of rectangles between 0<sup>0</sup> and 2<sup>0</sup>E.

## 2.2. Distribution of Stock.

### 2.2.1. Distribution of 0-group.

Recent observations on the distribution of the 0-group are available from the International 0-Group Gadoid Surveys in summer (Figure 2.2.1-2.2.4). As indicated by these the 0-group has



been found almost exclusively in the Northern North Sea in the past four years.

#### 2.2.2. Distribution of older age groups.

Since 1974 data on the distribution of older age groups have been collected regularly during the International Young Herring Surveys in winter. From 1974 onwards almost the entire North Sea has been investigated, thus providing for the first time sufficient coverage of the actual distribution area of these age groups.

The charts reveal that the older age groups are more widely distributed than the 0-group, extending south along the British coast and southeast along the Norwegian Deep into the Skagerrak (Figure 2.2.5-2.2.15).

### 2.3. Growth.

#### 2.3.1. Length and Weight.

There are differences in growth between the various year classes of Norway pout as shown in Table 2.3.1. A negative correlation between growth and year class strength is suggested by the low length and weight at age 2 in the strong 1973 year class. There also seem to be differences in the growth rates of single year classes between the main catching areas east and west of 2<sup>0</sup>E. The mean length at age for the years 1974 to 1977 is the same, however, and there is no evidence to support a splitting of the stock on this basis. The monthly length data (Fig. 2.3.1 and Table 2.3.2) indicate that Norway pout only grow during a period of about 3 months, June-August.

Although there appears to be considerable variation between the weight of the fish in different year classes from the areas mentioned above, the mean values do not support any firm conclusions. The trend in the mean monthly individual weights (Fig. 2.3.2. and Table 2.3.3) follow the corresponding length values. Norway pout increase in weight during the same three-month period after which the weight remains more or less constant until the end of the year. The apparent decrease from January to May could be due to the release of spawning products combined with a general decrease in the fat content.

### 2.3.2. Growth\_Parameters.

From the mean lengths at age given in Table 2.3.1 the following average values were calculated for half-year periods:

Age	Jan-Jun.	Jul.-Dec.
0	-	9.92 cm
1	11.75 cm	15.51 "
2	16.25 "	18.19 "
3	18.12 "	19.69 "

A von Bertalanffy growth curve fitted to these values (unweighted) had the following parameters:

$$L_{\infty} = 21.9 \text{ cm}, k = 0.54, T_0 = -0.58 \text{ yrs.}$$

The values so obtained are very similar to those based on Scottish data given in the previous report and for the time being the Working Group therefore decided to adopt the von Bertalanffy weight parameters stated in its first report i.e.  $W_{\infty} = 58 \text{ g}$  and  $k = 0.6 \text{ yrs}^{-1}$ .

### 2.4. Mortality estimates.

#### 2.4.1. Catch at age data.

For the northwestern North Sea ( $57^{\circ}30'N-62^{\circ}N$ .Lat. and  $4^{\circ}W-2^{\circ}E$ .Long.) catch at age data were constructed as follows.

Monthly catches in numbers at age for the area were available for Denmark and Scotland from 1974 to 1977. The distribution of Norwegian monthly catches for 1975 to 1977 were used to apportion the Norwegian quarterly catches for 1974, by month. The Danish monthly data were raised using the ratio of Danish plus Norwegian plus Faroese catches to Danish catch, and grossed with the Scottish data. Thus the final figures are the Scottish age distribution plus the other international catches in the area based on Danish samples. Table 2.4.1. shows the catch at age by month and year for all age groups.

In the case of the northeastern North Sea ( $57^{\circ}30'N-62^{\circ}N$ .Lat. and  $2^{\circ}-7^{\circ}E$ .Long.) the Danish catch in numbers at age data agreed with the corresponding Norwegian age distributions, and were therefore raised using the ratio of total quarterly Danish + Norwegian + Faroese

catches to quarterly Danish catch for 1974 to 1977.

Table 2.4.2. shows the catch at age by quarter and year in the northeastern area, while table 2.4.3 shows the final input figures for V.P.A.s carried out on a yearly basis for the two regions separately.

#### 2.4.2. Mortality estimates from V.P.A.

Since four years of catch at age data were available, the Working Group felt it worthwhile to attempt a Virtual Population Analysis for the Norway pout. The rate of convergence of the F values towards a stabilised level of F in this technique depends on the level of fishing mortality. Since the fishing mortality on Norway pout may be rather high (see previous report of the Working Group) estimates of fishing mortality could be obtained for the age groups 0,1 and 2 in 1974 and 1975 which would be only slightly influenced by the values of fishing mortality chosen for the oldest ages of each year class. Consequently, arbitrary values of fishing mortality were chosen to initiate the V.P.A.. The level of fishing mortality applied in 1977 was not based on considerations of fishing effort.

The Working Group made a number of trial runs using different input F's and assuming different levels of natural mortality. The runs were made for the regions east and west of 2<sup>0</sup> E separately in order to see whether significant differences in the calculated F-values could indicate that these included components of emi- or immigration rates. Time, however, did not permit the Working Group to pursue this aspect in any detail.

Tables 2.4.4. and 2.4.5. show the results of a V.P.A. run assuming  $M=1.6$ , the value given by Raitt (1968).

The results for the years 1976-77 and ages 3 and 4 should be disregarded as being affected by the assumptions of fishing mortality on the oldest ages. The values of fishing mortality for ages 0, 1 and 2 in 1974 and 1975 will, as mentioned, be largely independent of the initial values of fishing mortality used in the V.P.A. In order to study the effect of M on estimates of Z, the V.P.A. was also run under the assumption of  $M = 1.0$ . The two levels of natural mortality used result in different estimates of fishing mortality at age. The level of total mortality Z on ages 1 and 2, however, is largely unaffected by the value of M used, as may be seen in the table below. These are in general agreement with levels of Z calculated in previous

years using catch in numbers at age per unit of effort.

Z	West of 2°E		East of 2° E.	
Age	1974	1975	1974	1975
0	1.16	1.21	1.03	1.05
M=1.0 1	2.58	2.17	3.05	3.14
2	4.47	3.08	2.67	3.40
0	1.64	1.68	1.61	1.62
M=1.6 1	2.64	2.00	3.13	3.06
2	3.88	2.98	3.17	3.38

#### 2.4.3. Estimates from catch per unit effort.

Estimates of Z derived from catch per unit effort data over the period 1976-77 were only possible using the Scottish commercial fishery data, owing to the lack of Danish effort data for 1976. The new estimates are compared with the estimates given in the previous report below.

Period of mortality		Age groups					1 and over
		0/1	1/2	2/3	3/4	4/5	
1973-74	Mean Z	0.54	1.74	3.50	3.16	-	2.16
1974-75	" "	0.72	1.90	2.57	3.60	2.07	1.93
1975-76	" "	-0.49	2.00	2.70	2.54	-	2.14
1976-77	" "	-1.88	1.07	1.67	3.06	-1.50	1.28

Comparison with estimates for previous years indicates a generally lower total mortality between 1976 and 1977 in the age groups 1-2 and 2-3. It is important to note, however, that the Scottish catch per unit effort data cover the fringe of the species' North Sea distribution and they may therefore not be entirely representative.

#### 2.5. Prognosis.

##### 2.5.1. Estimates of recruitment.

Independent estimates of year class strength are available from the International 0-Group Gadoid Survey in summer, from Scottish research surveys in autumn and from the International Young Herring Surveys in

winter. Indices of recruitment based on these sources are given in Table 2.5.1. The areas from which these indices are derived are shown in the previous report.

There were several rich year classes in the early 60's, followed by a series of poor broods from 1963-66. These were succeeded by an exceptionally rich year class in 1967 and several more rich year classes since. Of the most recent year classes, the 1976 one appears to have been fairly strong, while the 1977 year class appears to be average.

Comparison between the sources of indices from recent years indicates a fairly good correspondence between the autumn and winter surveys while the results from the summer 0-group surveys seem to be less consistent.

The large annual variation in recruitment is reflected in the fluctuations in catches of Norway pout and in the age composition, thus indicating that a considerable component of the variation in total catches, including the recent overall increase, can be attributed to recruitment.

#### 2.5.2. Forecast.

It appears that effort in the Norway pout fishery has remained roughly constant over the period 1974-1977. The drop in catches over this period can therefore be explained by the lower recruitment levels in the years after 1973.

In the absence of a reliable estimate of the strength of the 1977 year class, it is not at present possible to predict the likely level of catch in 1978 with any accuracy. There is, however, no indication that this year class is particularly weak or particularly strong and so the catches might be expected to maintain their recent levels assuming there is no major change in fishing effort.

### 3. The Sandeel.

#### 3.1. The Fishery.

##### 3.1.1. Landings.

A corrected table of annual landings by countries from 1952-1977 was prepared for the North Sea (Table 3.1.1). The high landings in 1977 of nearly 780 000 tons by far exceed the comparatively high landings in the years 1974-76, which, on average, were about 447 000 tons. All countries participating in the fishery experienced an increase in annual landings in 1977. The monthly breakdown by countries (Table 3.1.2) show a marked seasonality with maximum landings of 241 000 and 228 000 tons in May and June respectively. As pointed out above these high landings correspond with declines in the monthly landings of Norway pout.

##### 3.1.2. Distribution of catch in 1977.

The distribution of catches by statistical rectangles in each month in 1977 made by Denmark, Norway and the United Kingdom is shown in Figures 3.1.1-3.1.8, and that for the total catch by these countries in 1977 in Figure 3.1.9. The area of the fishery was very similar to that in 1976, and increases in catch occurred in almost all areas. The most noticeable increases, however, were recorded at Viking Bank, on Ling Bank, in the approaches to the Skagerrak and on the northeastern part of the Dogger Bank. There was no overall increase in catches from the area southwest of Dogger Bank. In general, therefore, the biggest increases in catch came from the newer fishing grounds in the northern and eastern parts of the North Sea.

In 1977 the fishery developed on Ling and Viking Banks in March and southwest of Dogger in April. During May and June there was a widespread fishery while in July and August most catches were from between Ling Bank and the Danish coast. There were no landings from the southwestern area after July. In September and October there was a new fishery on the northeastern edge of Dogger Bank, the catches consisting mostly of 0-group fish.

#### 3.2. Growth.

##### 3.2.1. Length at age.

A cursory examination of the available data on length at age indicated that growth parameters of sandeels were different in different areas of the North Sea. Although no detailed analysis of

the data was possible, length and weight at age were calculated for each month from Danish and Scottish data for three separate areas: 1A, 2A, 4, 5 and 6, offshore grounds in area 1, 2 and 3 (see Fig. 3.2.1). The results are shown graphically in Figure 3.2.2. and tabulated in tables 3.2.1-3.2.3.

The salient features are the marked difference in length and age in the three areas, and the marked seasonal fluctuations. Length at age was much higher in the northern North Sea than in the south and that in the Shetland landings was even lower.

In both the southern and northern North Sea, there was a progressive increase in mean length at age during the spring and summer. The following spring, however, the mean lengths of the same year class show a decrease. This change is difficult to explain, but probably indicates a change in the component of the population fished at different times of the year in each area. By contrast, in the Shetland area, the mean length at age decreases even during the fishing season. The Working Group was not able to explain these differences from the data available, but, in view of the marked area and seasonal differences, recognises the need for a full investigation of this problem. Whatever the explanation, it is clear that the sand-eels living in offshore areas of the northern North Sea grow very much more rapidly than those in the southern North Sea and than those around the Shetlands.

### 3.2.2. Weight at age.

Weights at age submitted by Denmark and Scotland shown graphically in figure 3.2.3 and tabulated in tables 3.2.4-3.2.6 show the area and seasonal differences even more markedly than does length at age. The seasonal differences are dependent both on the unexplained differences in length at age and on superimposed changes in condition factor. There is, as a result, an approximate doubling in weight at age between the spring and autumn. This applies to both the southern and northern North Sea although the annual mean weights at age in the two areas are very different. In the Shetland fishery the pattern is less clear.

As a result of the analyses of growth data described above, the Working Group concluded that it is not possible to calculate average growth parameters for the whole of the North Sea. For this reason assessments of yield per recruit need to be carried out

Separately for the three areas. Mean weights at age of fish caught in the fishery during the year calculated by weighting each monthly mean in the years 1976 and 1977 by the number caught, are given for each main area in the text below:

Age gr.	<u>Mean weight in grammes.</u>		
	<u>Northern area</u> (Subareas 1,2,3) <sup>x)</sup>	<u>Southern area</u> (Subareas 1A,2A, 4,5,6) <sup>x)</sup>	<u>Shetland</u>
0	3.11	3.81	1.32
1	8.49	6.88	2.84
2	23.78	10.09	4.97
3	37.76	13.63	9.30
4	47.43	17.06	12.68
5	50.01	17.40	14.44
6	48.92	18.84	15.68
7	-	20.08	17.82

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x) See fig. 3.2.1.

### 3.2.3. Growth parameters.

From the mean length and mean weight at age von Bertalanffy parameters were estimated for both the northern and southern areas (Table 3.2.7). Differences between the estimates are in some cases rather large and there is a strong correlation between the different parameters.

The average values for the length fit (Table 3.2.7) are based on those months where the standard error of  $L_{\infty}$  is less than 10% of  $L_{\infty}$ . For the weight fit, the average values (Table 3.2.7) are based on those months where the standard error of  $W_{\infty}$  is less than 2% of  $W_{\infty}$ .

The average values of  $L_{\infty}$  and  $W_{\infty}$  also clearly indicate that the sandeel achieve a larger size in the northern area compared with the southern area. The data do not indicate a different growth rate (k-value) in the two areas.

### 3.2.4. Yield per recruit.

From the new average figures for  $W_{\infty}$  and k, yield per recruit curves were constructed using the same values of natural mortality as in the previous report. While the new parameters give much smaller yields in grammes per recruit the actual shape of the yield curve is roughly



the same. For values of  $M$  between 0.5 and 1.0 the curves are flat topped and reach a maximum at high values of  $Z$ .

### 3.3. Mortality Estimates.

#### 3.3.1. Catch at age data.

Catch at age data were constructed for the northern and southern regions as follows. Age distributions for areas 1, 2 and 3 in Fig. 3.2.1 were available by month from 1970 for Denmark, and from 1974 for Scotland. For the years 1970 and 1971, the area split of catches were not available and consequently no catch at age data were constructed for these two years. For the years 1972-73, Danish age distributions for Area 1, 2 and 3 were summed for each month. Where one or two areas had not been sampled in a month, the age distribution of the other area(s) was grossed up to give the total Danish catch for all areas. This was then grossed up to the total international catch in Areas 1, 2 and 3. Where no samples were available in a month, the distribution for an adjacent month was used and raised to the international catch total. In the years 1974 to 1977, the procedure was similar, except that Scottish catches were first removed from the total international catches and worked up separately. Thus, the final figures are the Scottish age distribution plus the other international catch in the area based on Danish samples.

Table 3.3.1. shows the catch at age by month and year for all ages.

The same procedure was adopted in constructing catch at age data for the southern areas 1A, 2A, 4, 5 and 6. In the southern region, only Danish catch at age by month distributions were available and these were raised to total international catch using the ratio of the annual total international catch to the annual Danish catch.

Table 3.3.2 shows the catch at age by month and year.

#### 3.3.2. Mortality estimates from V.P.A.

V.P.A.s were carried out on data from the northern and southern areas separately using the input data given in tables 3.3.3 and 3.3.4 respectively. Estimated fishing mortalities are shown for the northerly sampling areas in table 3.3.5 and for the southerly sampling areas in table 3.3.6 and stock in number in table 3.3.7 and 3.3.8. Estimates were initially obtained assuming a natural mortality on all ages of 0.5. Fishing mortality on the oldest ages of each year class were chosen arbitrarily at 1.4 for the northerly areas and 0.7 for the southerly areas. These values were modified in the younger ages to take account of the fishing pattern indicated

in the earlier years. Given the levels of fishing mortality encountered, the levels of fishing mortality on ages of 5 and less for the year 1972 to 1975 will be largely unaffected by the choice of fishing mortality on the oldest ages of year classes. The results indicate an exploitation pattern which generates equal amounts of fishing mortality on ages 1 to 4. In the southern area, no significant mortality occurs on 0-group fish, but in the northern area 0-group fish have a mortality of about  $\frac{1}{4}$  of that on the 1 to 4 year olds. Fishing mortality on the 5 year olds in both areas seems to be rather higher than on the younger ages, which could be an effect of a decrease in availability of the older sandeels.

In the previous report it was suggested that the natural mortality in the northern area could be in the range of 0.5-1.0. Consequently a run was also made assuming  $M=1.0$  for that area. In the table below the calculated fishing mortalities are compared and shown together with the total fishing effort calculated from Danish c.p.u.e. data for the two areas respectively.

Year	Northern area			Southern area	
	Effort in trawling hrs ( $\times 10^{-3}$ )	Calculated F's M=0.5 M=1.0		Effort in trawling hrs ( $\times 10^{-3}$ )	Calculated F's M=0.5
1971	-	-	-	101.5	0.37
1972	96.5	0.45	0.17	144.9	0.49
1973	60.4	0.45	0.20	151.4	0.40
1974	109.5	0.87	0.50	88.6	0.29
1975	118.7	1.20	0.74	94.5	0.20
1976	-	-	-	-	-
1977	195.9	-	-	154.6	-

The figures indicate a relationship between the fishing effort and the fishing mortality and that this feature is most pronounced in the southern area. On the assumption that the same effort produces reasonably equal fishing mortalities in the two areas, the table also suggests that natural mortality is higher in the northern than in the southern area. This is compatible with other evidence as mentioned above.

### 3.3.3. Estimates of total mortality from catch per unit effort data.

Z was evaluated as the log ratio of the catch per unit effort of one

year class between the same month in two successive years. The Danish catch and effort data were used, and the calculation was done for each of the 8 areas separately. The results are summarised in Table 3:3.9 for the northern areas (1, 2 and 3) and the southern areas (1A, 2A, 4, 5, 6) of the North Sea. Each value is the average of all Z-estimates within those two larger areas, irrespective of the month or area considered. The numbers in parentheses are the numbers of Z-values on which the averages are based. This averaging procedure somewhat reduces the large variance of the Z estimates. The negative Z values from age 0 to 1 are caused by incomplete recruitment to the fishery in the first year of life.

The estimated mean total mortality and its standard error for the age groups 1 to 6 for the years 1971-75 is  $1.01 \pm 0.23$  for the northern areas. In the southern areas the estimated mean total mortality for age 1 to 7 for the years 1970-75 is  $0.53 \pm 0.37$ .

Total mortality estimates were also estimated in the previous years report from this Working Group (Doc. C.M.1977/F:7). From the British commercial landings of the different age groups per hours trawling from Area 4 in 1970-74 an average Z of 1.05 was estimated. From the Danish catch curves for 1974-76 an average Z of 1.20 was estimated for the northern area, and 0.92 for the southern area. The present estimates are somewhat lower than these previous estimates, although not significantly different.

The present estimates, nevertheless, support the suggestion in last year's report that Z is higher in the northern than in the southern areas, however, the present estimates are not completely independent of the previous ones.

#### 3.4. Prognosis.

The large catches of 0-group sandeels in 1977 suggest the possibility of a strong year class. Danish catch-per-unit effort data, however, also indicate a marked increase in effort in 1977 over the level recorded in 1975, particularly in the northern North Sea.

The exceptional catches in 1977 may therefore have been due to a combination of the two factors. Unfortunately, there is at present no reliable means of obtaining an estimate of recruitment without using commercial fishery data. V.P.A. provides historic values of recruitment which under the given assumptions, are reliable for the period more than two years before, but gives unreliable estimates of recruitment in the most recent years. For this reason no prediction of the likely catch in 1978 has been attempted.

#### 4. Summary and Conclusions.

##### 4.1. Norway Pout.

Further data on length and weight of Norway Pout were compiled and the growth parameters recalculated. The new values are almost identical with those obtained earlier from less extensive material. Catches in numbers at age were made available for the years 1974-77 and treated by the V.P.A.-technique. Estimates of total mortality for the younger age-groups in 1974-75 were in general agreement with estimates calculated from catch per unit of effort data. On this basis the Working Group can repeat its previous conclusion that no significant gain in long-term yield by changing the present fishing intensity can be demonstrated at present.

##### 4.2. Sandeel.

The treatment of expanded data on length and weight revealed some features in the yearly growth pattern of the sandeel which can not at present be explained. Growth parameters estimated from monthly and from yearly average weights respectively result in yield per recruit curves of the same general shape but with very different levels of yield for identical assumption of natural and fishing mortalities.

V.P.A. technique was applied to catch in numbers at age for the years 1971/72-1977. The results indicate a relation between fishing mortality and effort. The level of the former can not be established, as yet, since no reliable estimates of natural mortality are available. At present no significant gain in long-term yield by changing the present fishing intensity can be demonstrated.

#### 5. Future Research Requirements.

##### 5.1. Norway Pout.

- 5.1.1. In order to study the movement of Norway pout (and cod, haddock and whiting) in the northern North Sea it is recommended that the International Young Gadoid Surveys be increased to one survey per quarter in two successive years.
- 5.1.2. Sampling the commercial landings should be increased and even initiated in the case of some of the countries involved in order to achieve data by statistical rectangles and months on biological parameters of Norway pout and of the by-catch in the fishery for this species.

5.1.3. Investigations of growth differentials by yearclasses and areas are needed.

5.1.4. Independent estimates of stock size are wanted. Egg and larval surveys are recommended.

5.1.5. It is recommended that eventual future meetings of the Working Group should be held after the completion of the International Young Gadoid Surveys in February so that the Group may benefit from the most recent estimates of recruitment to the Norway pout stock.

## 5.2. Sandeel.

5.2.1. Sampling of biological parameters and of data on effort and distribution of the fishery is highly inadequate in the case of some countries participating in the sandeel fisheries.

5.2.2. The present compilation of data has revealed some features in the growth pattern of the sandeel which are inexplicable at present. Consequently it is recommended that detailed studies of growth be undertaken including age reading techniques. Such studies should also include the growth pattern on selected individual fishing grounds.

5.2.3. In order to obtain estimates of stock size and fishing mortality it is recommended that coordinated tagging experiments should be carried out by the countries involved.

Table 2.1.1. Norway pout. Annual landings (in thousand tons) by countries. North Sea 1957-77.

	Belgium	Denmark	Faroes	Nether-lands	Norway	Poland	Sweden	UK Eng-land + Wales	Uk Scot-land	USSR	Total
1957					0.2						0.2
58											
59		61.5			7.8						69.3
1960		17.2			13.5						30.7
61		20.5			8.1						28.6
62		121.8			27.9						149.7
63		67.4			70.4						137.8
64		10.4			51.0						61.4
1965		8.2			35.0						43.2
66	+	35.2			17.8						53.0
67	+	169.6			12.9						182.6
68	+	410.8			40.9						451.8
69	+	52.5	19.6		41.4						113.5
1970	0.2	142.1	32.0		63.5				0.2		238.0
71	0.2	178.5	47.2		79.3				0.1		305.3
72	0.2	259.6	56.8		120.5		6.8		0.9		444.8
73	0.4	215.2	51.2		63.0		2.9	0.2	13.0		345.8
74	0.5	464.5	85.0		154.2	2.7	2.1	+	26.7		735.9
1975	0.6	251.2	63.6	0.4	218.9		2.3		22.7	+	559.7
76	-	244.9	64.6	+	108.9		+		17.3	-	435.7
77	-	232.2	50.9x)	0.1	98.3		2.0		4.2	-	387.4

x) including VI a

Table 2.1.2. Norway pout. Monthly breakdown of catches  
(in tons) by countries in 1977.

	Denmark	Faroes <sup>x)</sup>	Netherland	Norway	Sweden	UK(Scotl.)	Total
January	18354	3918	-	4800	50	1120	28242
February	22882	4432	68	4363	86	668	32499
March	23899	3203	41	5547	115	233	33038
April	5364	2218	-	5630	232	11	13455
May	640	1813	5	9113	104	-	11675
June	5611	2954	-	13837	353	+	22755
July	17459	3962	-	5981	134	67	27603
August	44368	4269	-	18164	+	75	66876
September	19546	5685	-	5948	52	-	31231
October	18806	7314	-	12051	155	540	38866
November	28959	4358	-	6070	385	805	40577
December	26360	6810	-	6787	-	638	40595
Total	232248	50936	114	98291	1666	4157	387412

<sup>x)</sup> including landings from VIa

Table 2.3.1. Norway pout. Mean length and weight by yearclass and age in Oct./Nov-January, in the areas west and east of 2<sup>0</sup> E.

Mean length (Oct.-Jan.)

winter-rings	1	2	3	4
Year-class				
Area 14				
1972			18.38 (4)	
1973		15.26 (4)	18.13 (4)	20.08 (3)
1974	11.35 (4)	16.32 (4)	18.28 ( )	(19.50)(2)
1975	10.60 (4)	15.80 (3)	(18.47)(2)	
1976	10.23 (2)	(15.94)(2)		
1977	(10.87)(2)			
Area 11				
1972			18.63 (2)	
1973		15.17 (2)	18.01 (4)	
1974	10.70 (3)	16.20 (4)	(19.58)(1)	
1975	10.71 (4)	16.00 (2)	(17.63)(1)	
1976	10.78 (2)	(15.91)(1)		
1977	-			
Area 14	10.79	15.82	18.29	20.75
Area 11	10.72	15.82	18.31	

Mean weight (Nov.-Jan.)

winter-rings	1	2	3	4
Year-class				
Area 14				
1972			46.42 (3)	
1973		25.66 (3)	46.74 (3)	53.50 (2)
1974	9.70 (3)	32.43 (3)	38.22 (2)	
1975	7.31 (3)	26.15 (2)	(46.83)(1)	
1976	6.95 (2)	(28.14)(1)		
1977	(7.96)(1)			
Area 11				
1972			(54.00) (1)	
1973		23.25 (2)	41.56 (3)	
1974	8.26 (2)	29.75 (3)	(54.66)(1)	
1975	7.02 (3)	28.13 (2)		
1976	7.54 (2)			
1977				
Area 14	8.10	28.30	44.75	53.50
Area 11	7.52	27.43	46.67	



Table 2.3.2. Norway pout. Mean length by month and age in the western North Sea, 1974-77. (number of years in brackets).

Age	0	1	2	3	4
Month					
1		11.15 (4)	15.86 (4)	18.11 (3)	(20.25) (1)
2		11.30 (4)	15.90 (4)	18.55 (3)	
3		11.25 (4)	15.88 (4)	17.98 (3)	
4		11.63 (3)	16.02 (3)	17.72 (2)	
5		(11.57)(1)	(16.00)(1)	(18.25)(1)	
6		(13.58)(1)	(17.83)(1)	-	
7	8.39 (2)	14.86 (3)	16.85 (3)	(17.63)(2)	
8	9.11 (4)	15.16 (4)	18.24 (4)	(20.25)(2)	
9	9.85 (4)	15.76 (4)	18.86 (4)	20.32 (3)	
10	10.16 (4)	15.81 (4)	18.17 (4)	19.75 (2)	
11	10.82 (4)	15.86 (4)	18.39 (4)	19.92 (3)	
12	11.22 (2)	15.62 (2)	18.63 (2)	-	

Table 2.3.3. Norway pout. Mean weight by month and age in the western North Sea, 1974-77. (Number of years in brackets).

Age	0	1	2	3	4
Month					
1		7.95 (4)	28.77 (3)	42.59 (3)	62.00 (1)
2		8.51 (4)	25.61 (4)	42.49 (3)	
3		8.08 (4)	23.48 (4)	33.77 (3)	
4		8.40 (3)	21.11 (3)	26.72 (2)	
5		8.29 (1)	20.14 (1)	29.00 (1)	
6		15.21 (1)	37.16 (1)	-	
7	3.76 (2)	21.68 (3)	33.23 (3)	38.00 (2)	
8	4.16 (4)	23.14 (4)	43.05 (4)	56.00 (2)	
9	5.45 (4)	27.16 (4)	46.04 (4)	63.00 (3)	
10	6.18 (4)	27.96 (4)	43.85 (4)	55.75 (2)	
11	6.72 (4)	28.25 (4)	45.06 (4)	55.33 (3)	
12	8.76 (2)	27.70 (2)	47.38 (2)		

Table 2.4.1. Norway pout. Catch in numbers at age ( $\times 10^{-6}$ ) by month.  
West of 2° E. Long.

Age	0	1	2	3	4	5	
Month							
1974	1		2313.44	26.69	0.18		
	2		3680.80	54.15	4.83	0.08	
	3		3357.65	283.27	13.09	0.43	
	4		1354.00	108.80	14.60	0.45	
	5		995.07	78.19	10.18	0.15	
	6		629.96	6.10	0.87		
	7	120.09	1592.97	80.40	5.65		
	8	68.68	3969.03	148.64	16.52		
	9	274.88	2078.42	196.67	122.67		
	10	510.77	3488.27	104.34			
	11	2565.74	3081.70	25.01	4.37		
	12	2221.77	728.46	4.14			
Total	5761.93	27269.77	1116.40	192.96	1.11	0	
1975	1		719.62	618.87	4.95	0.09	
	2		1118.29	438.63	1.29	0.30	
	3		416.84	222.55	0.90	0.09	0.09
	4		449.53	194.02	0.08	0.01	
	5		502.37	63.72	0.67		
	6		259.39	117.59	1.06		
	7	217.60	1756.55	32.26	0.34		
	8	348.43	2054.90	39.64			
	9	179.90	1099.52	232.95			
	10	3288.36	865.61	293.92	1.00		
	11	3716.16	658.07	93.71	0.22	0.11	
	12	1811.42	177.09	8.55	0.07	0.04	
Total	9561.87	10077.78	2356.41	10.58	0.64	0.09	
1976	1		854.74	138.56	19.51	0.00	
	2		1255.89	192.62	27.69	0.13	
	3		669.34	176.75	38.27	0.09	
	4		1506.12	339.09	29.19	0.01	
	5		1996.77	85.99	12.50		
	6		621.09	29.12	4.84		
	7	3.87	891.38	240.42			
	8	83.25	1801.94	120.99			
	9	102.65	1563.77	204.03	2.25	0.03	
	10	418.26	1163.49	120.46	3.23	0.08	
	11	3024.98	928.05	122.06	7.10		
	12	2331.40	696.43	59.28	4.57		
Total	5964.41	13949.01	1829.37	149.15	0.34	0	
1977	1		2296.64	236.63	15.48	1.55	
	2		2446.65	284.68	4.51	0.13	0.13
	3		1404.03	254.28	4.44	0.04	0.04
	4		486.71	30.90	0.01		
	5		370.22	23.38			
	6		403.06	23.68			
	7		572.57	290.51	13.13		
	8	14.13	1776.05	225.03	5.68		
	9	40.39	816.51	41.56	1.08		
	10	272.79	821.47	51.20	2.29		
	11	369.52	1102.95	38.71	0.65		
	12						
Total	(696.83)	(12496.86)	(1500.56)	(47.27)	(1.72)	(0.17)	

Table 2.4.2. Norway pout. Catch in numbers ( $\times 10^{-6}$ ) at age by quarters. East of  $2^{\circ}$  E. Long.

Age		0	1	2	3	4	5
1974	Quarter						
	1		4098.54	49.79	8.37		
	2		4893.52				
	3	381.89	2325.50	62.83			
	4	421.93	510.16	6.58			
Total		803.82	11827.72	119.20	8.37	0	0
1975	1		1486.97	446.40	6.05		
	2		5994.53	7.86			
	3	142.67	2205.63	44.09			
	4	1151.71	326.67	64.48			
	Total		1294.38	10013.80	562.83	6.05	0
1976	1		2169.82	81.25	5.88		
	2		3456.14	193.35	11.37		
	3	7.38	1091.43	24.09	0.07		
	4	210.49	368.99	18.07	0.30		
	Total		217.87	7096.38	316.76	17.62	0
1977	1		3023.53	174.01	8.98	0.79	
	2		2317.34	289.10	8.13		
	3	6.15	414.53	303.56	25.04		
	4	34.26	477.60	41.72	0.07		
	Total		40.41	6233.00	808.39	42.22	0.79

Table 2.4.3. Norway Pout.

Input Data. Catch in numbers ( $\times 10^{-6}$ ) by year and by age.

Age	West of 2° E. Long.				East of 2° E. Long.			
	1974	1975	1976	1977	1974	1975	1976	1977
0	5761.93	9561.87	5964.41	696.83	803.82	1294.38	217.87	40.41
1	27269.8	10077.8	13949	12496.9	11827.7	10013.8	7096.38	6233
2	1116.4	2356.41	1829.37	1500.56	119.2	562.83	316.76	808.39
3	192.96	10.58	149.15	476.27	8.37	6.05	17.62	42.22
4	1.11	0.64	0.34	1.72	0.1	0.1	0.1	0.79
5	0.1	0.09	0.1	0.17				

Table 2.4.4. Norway Pout.

Calculated fishing mortalities by year and by age (for  $M = 1.6$ ).

Age	West of 2° E. Long.				East of 2° E. Long.			
	1974	1975	1976	1977	1974	1975	1976	1977
0	0.04	0.08	0.07	0.10	0.01	0.02	0.00	0.02
1	1.04	0.40	0.80	1.00	1.53	1.46	0.67	0.75
2	2.28	1.38	0.58	1.00	1.57	1.77	0.82	0.75
3	2.93	0.67	2.05	2.00	2.75	2.28	1.50	1.50
4	0.81	0.47	0.18	0.60	2.70	2.30	1.50	1.50
5	0.70	0.70	0.60	0.60				

Mean  $F A \gg = 1$  (Sum of F's weighted by stock in numbers).

1.07	0.49	0.77	1.02	1.53	1.48	0.67	0.75
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Table 2.4.5. Norway Pout.  
 Calculated stock in numbers ( $\times 10^{-6}$ ) at beginning of year.

Age	West of 2° E. Long				East of 2° E. Long.			
	1974	1975	1976	1977	1974	1975	1976	1977
0	297420	247963	185703	14494	110501	136166	107367	4081
1	74786	57728	46232	35099	25322	21985	26969	21589
2	1940	5363	7778	4214	251	1109	1027	2800
3	302	40	273	881	13	11	38	91
4	4	3	4	7	0	0	0	2
5	0	0	0	1				

Table 2.5.1 . Recruitment indices of Norway pout 1959-1977, as shown by number per hour's fishing on research vessel surveys

Year class	Abundance on pelagic 0-group surveys	Abundance in northwestern North Sea in Scottish autumn surveys		Abundance on international young herring surveys	
	0-group	0-group	I-group	I-group	II-group
1959		-	106.8 (22)		
1960		10.9 (22)	28.1 (14)		
1961		59.6 (14)	181.7 (15)		
1962		25.0 (15)	141.8 (15)		
1963		8.5 (15)	6.6 (14)		
1964		14.0 (14)	18.6 (11)		
1965		1.2 (11)	6.1 (13)		
1966		16.4 (13)	-		
1967		-	243.2 ( 7)		
1968		4.5 ( 7)	-		
1969		-	33.1 ( 4)		
1970		101.7 ( 4)	111.7 (12)		
1971	3 347 (26)	16.7 (12)	328.8 (22)		
1972	545 (28)	36.3 (22)	16.6 (10)		692 (40)
1973	2 558 (28)	224.4 (10)	121.6 (22)	37 666 (40)	2148 (45)
1974	3 237 (28)	84.4 (22)	9.5 (11)	6 656 (45)	312 (44)
1975	3 623 (28)	41.2 (11)	-	6 073 (44)	408 (46)
1976	10 884 (28)	-	131.5 (16)	8 653 (46)	-
1977	1 521 (28)	77.7 (16)			

NB. Number of statistical rectangles sampled shown in brackets.

Table 3.1.1. Landings of sandeel from the North Sea  
1952-1977, in thousand tons.

Year	Denmark	F.R.G.	Faroes	Nether- lands	Norway	Sweden	U.K.	Total
1952	1.6	0	0	0	-	0	0	1.6
1953	4.5	+	0	0	-	0	0	4.5
1954	10.8	+	0	0	-	0	0	10.8
1955	37.6	+	0	0	-	0	0	37.6
1956	81.9	5.3	0	+	1.5	0	0	88.7
1957	73.3	25.5	0	3.7	3.2	0	0	105.7
1958	74.4	20.2	0	1.5	4.8	0	0	100.9
1959	77.1	17.4	0	5.1	8.0	0	0	107.6
1960	100.8	7.7	0	+	12.1	0	0	120.6
1961	73.6	4.5	0	+	5.1	0	0	83.2
1962	97.4	1.4	0	0	10.5	0	0	109.3
1963	134.4	16.4	0	0	11.5	0	0	162.3
1964	104.7	12.9	0	0	10.4	0	0	128.0
1965	123.6	2.1	0	0	4.9	0	0	130.6
1966	138.5	4.4	0	0	0.2	0	0	143.1
1967	187.4	0.3	0	0	1.0	0	0	188.7
1968	193.6	+	0	0	0.1	0	0	193.7
1969	112.8	+	0	0	0	0	0.5	113.3
1970	187.8	+	0	0	+	0	3.6	191.4
1971	371.6	0.1	0	0	2.1	0	8.3	382.1
1972	329.0	+	0	0	18.6	8.8	2.1	358.5
1973	273.0	0	1.4	0	17.2	1.1	4.2	296.9
1974	424.1	0	6.4	0	78.6	0.2	15.5	524.8
1975	355.6	0	4.9	0	54.0	0.1	13.6	428.2
1976	424.7	0	-	0	44.2	-	18.7	487.6
1977	662.3	0	11.4	0	78.6	1.7	25.5	779.5

+ = less than half unit

- = no information



Table 3.1.2. Sandeel. Monthly breakdown of catches  
(in tons) by countries in 1977.

	Denmark	Faroes	Norway	Sweden	Eng.&Wales	Scotland	Total
January	8	-	32	-	-	-	40
February	698	430	334	-	-	-	1462
March	28032	125	1072	159	-	890	30278
April	55648	50	2145	78	364	2997	61282
May	200930	4812	30449	792	1296	2946	241225
June	188826	2553	30226	434	1396	4950	228385
July	29763	3422	2974	+	602	4899	41660
August	23961	-	700	+	-	3062	27723
September	82758	-	6687	+	-	1602	91047
October	49779	-	4018	205	-	524	54526
November	1926	-	-	1	-	-	1927
December	-	-	-	-	-	-	-
Total	662329	11392	78637	1669	3658	21870	779555

Table 3.2.1. Sandeel.Northern area.

Mean length at age (1974-77) in cm. Number of fish in brackets.

Winter rings	0	1	2	3	4	5	6	7
Month								
1								
2								
3		12.97 (4882)	17.77 (127)	19.37 (86)	21.38 (8)	21.25 (5)	18.25 (1)	
4		12.76 (3686)	17.58 (525)	19.33 (170)	22.79 (22)	22.25 (5)	21.13 (4)	
5	8.22 (16)	14.03 (3549)	17.32 (1087)	20.71 (277)	21.65 (95)	21.22 (15)	20.25 (5)	
6	7.91 (374)	15.44 (3229)	18.80 (667)	21.13 (209)	21.50 (76)	22.45 (23)	23.25 (3)	
7	11.47 (558)	16.25 (226)	18.95 (126)	20.83 (98)	24.54 (12)	22.42 (6)	23.00 (4)	
8	10.60 (1481)	18.00 (664)	22.15 (31)	23.50 (6)	25.00 (4)	26.63 (4)	26.25 (1)	
9	10.82 (1854)	18.83 (630)	20.90 (220)	23.83 (46)	24.50 (10)	25.25 (2)		
10	11.31 (343)	20.06 (48)	23.67 (42)	24.82 (24)	26.00 (2)			
11	13.28 (236)	19.00 (2)						
12	13.33 (375)	18.38 (114)	21.40 (7)		21.75 (1)			





Table 3.2.5. Sandeel. Northern area. Mean weight in grammes (1974-1977)  
Number of fish in brackets.

Winter rings	0	1	2	3	4	5	6	7	8 +
Month									
1									
2									
3		5.94 (4882)	15.37 (127)	21.90 (86)	28.78 (8)	30.20 (5)	18.50 (1)		
4		5.70 (3686)	16.28 (525)	19.45 (170)	26.13 (22)	31.40 (5)	26.50 (4)		
5	1.31 (16)	9.99 (3549)	17.62 (1087)	29.72 (277)	32.82 (95)	32.54 (15)	27.70 (5)		
6	1.36 (374)	14.01 (2629)	26.46 (667)	36.16 (209)	40.75 (76)	44.99 (23)	49.33 (3)		44.00 (1)
7	5.34 (558)	14.21 (226)	25.89 (126)	33.66 (98)	56.16 (12)	42.50 (6)	44.63 (4)		
8	4.32 (1481)	22.85 (664)	46.14 (31)	52.50 (6)	65.50 (4)	76.25 (4)	81.00 (1)		
9	4.21 (1854)	26.06 (630)	37.45 (220)	58.04 (46)	64.15 (10)	73.00 (2)			
10	4.45 (343)	29.44 (48)	52.45 (42)	61.79 (24)	67.00 (2)				
11	7.69 (236)	28.00 (2)							
12	7.21 (375)	21.80 (114)	35.93 (7)		37.50 (1)				



Table 3.2.7. Sandeel. von Bertalanffy parameters estimated from monthly length and weight data 1974-77.

Month	Length observations			Weight observations				
	$L_{\infty}$	K	$t_0$	$W_{\infty}$	K	$t_0$		
Northern Area	March	20.8 <sup>+0.7</sup>	0.93 <sup>+0.18</sup>	0.16 <sup>+0.15</sup>	30.3 <sup>+0.6</sup>	0.72 <sup>+0.12</sup>	0.00 <sup>+0.13</sup>	
	April				22.9 <sup>+0.5</sup>	1.21 <sup>+0.27</sup>	0.47 <sup>+0.14</sup>	
	May	25.7 <sup>+3.9</sup>	0.36 <sup>+0.17</sup>	0.83 <sup>+0.55</sup>	58.2 <sup>+4.5</sup>	0.33 <sup>+0.17</sup>	-1.09 <sup>+0.68</sup>	
	June	23.3 <sup>+0.76</sup>	0.56 <sup>+0.09</sup>	-0.44 <sup>+0.21</sup>	49.3 <sup>+0.2</sup>	0.61 <sup>+0.03</sup>	-3.05 <sup>+0.06</sup>	
	July	26.0 <sup>+4.2</sup>	0.33 <sup>+0.21</sup>	-1.41 <sup>+1.10</sup>				
	Aug.	26.8 <sup>+1.2</sup>	0.61 <sup>+0.15</sup>	-0.20 <sup>+0.31</sup>	75.8 <sup>+1.1</sup>	0.73 <sup>+0.15</sup>	0.10 <sup>+0.24</sup>	
	Sept.							
	Oct.				67.1 <sup>+0.2</sup>	1.11 <sup>+0.06</sup>	0.51 <sup>+0.06</sup>	
	Southern Area	March	21.0 <sup>+9.6</sup>	0.23 <sup>+0.28</sup>	-1.89 <sup>+1.96</sup>	10.1 <sup>+0.5</sup>	0.62 <sup>+0.19</sup>	-7.3 <sup>+0.3</sup>
		April	17.4 <sup>+0.3</sup>	0.70 <sup>+0.09</sup>	-0.27 <sup>+0.18</sup>			
May		18.2 <sup>+0.3</sup>	0.50 <sup>+0.05</sup>	-0.92 <sup>+0.15</sup>	17.9 <sup>+0.1</sup>	0.55 <sup>+0.03</sup>	-0.80 <sup>+0.09</sup>	
June		17.6 <sup>+0.3</sup>	0.69 <sup>+0.12</sup>	-0.57 <sup>+0.30</sup>	17.9 <sup>+0.2</sup>	0.66 <sup>+0.12</sup>	-0.67 <sup>+0.31</sup>	
July		23.5 <sup>+15.1</sup>	0.12 <sup>+0.26</sup>	-6.4 <sup>+8.4</sup>				
Aug.		19.8 <sup>+0.17</sup>	1.26 <sup>+0.18</sup>	0.33 <sup>+0.17</sup>				
Sept.								
Oct.								
Northern Area		Average for March-Aug. incl.	23.6	0.70	-0.16	55.6	0.79	-0.61
		Average for April-Aug. incl.	18.3	0.79	-0.36	17.9	0.61	-0.74

Table 3.3.1. Sandeel. Northern North Sea. Catch in numbers ( $\times 10^{-6}$ )  
at age by month and year.

Age	0	1	2	3	4	5	6	7	8 +
<u>1972</u>									
Month									
1									
2									
3		23.0	19.6	0.5	0.3	0.1			
4		1575.4	1344.5	33.7	20.3	6.8			
5		34.7	477.8	3.3	3.3				
6		1765.0	202.6	77.0	55.0	55.0	60.4		16.5
7	510.6	810.0							
8	2609.8	21.3							
9	990.1	8.1							
10	791.2	6.5							
11	27.6	0.2							
12	0.7	0.0							
Total	4930.0	4244.3	2044.5	114.5	78.8	61.9	60.4		16.5
<u>1973</u>									
1		1.7	0.1						
2									
3		887.5	76.3						
4		915.7	128.8	38.3					
5		737.5	1081.9	601.1	89.2	45.5	0.5		
6		1514.9	369.6	197.0		12.4			
7		134.7	32.9	17.5		1.1			
8	38.1	1.0	3.9	0.3					
9	159.8	4.1	16.5	1.4					
10	95.8	2.5	9.9	0.8					
11	43.7	1.1	4.5	0.4					
12									
Total	337.3	4200.7	1724.4	856.8	89.2	59.0	0.5		
<u>1974</u>									
1									
2									
3		636.1	19.8	50.9	5.6	3.2	0.8		
4		1770.2	410.5	952.1	11.6	10.7			
5	33.9	6299.9	233.2	172.6	50.1	19.4	0.9	0.2	
6	438.2	11150.4	735.7	259.9	215.6	44.7	1.2	5.8	
7	4132.6	167.1	71.1	15.6	24.4	5.0	0.1	0.6	
8	6276.2	422.9	15.9	7.9	1.2		0.3		
9	324.5	529.7		0.9	0.7				
10	170.5	84.0		0.5	0.4				
11	28.9	14.2		0.1	0.1				
12									
Total	11404.8	21074.7	1486.1	1460.4	309.6	82.9	3.3	6.5	



Table 3.3.1. Sandeel. continued.

Age	0	1	2	3	4	5	6	7	8+
Month									
1									
2									
3		2488.6	396.0	165.4	10.0	0.3	0.2	0.1	0.1
4		1024.5	535.4	51.8	3.3	1.3	0.9	0.5	0.3
5	99.1	2640.7	3957.0	964.8	129.2	16.0			
6		1148.9	912.5	405.0	117.2	76.8	2.9	1.7	1.3
1975 7	6620.6	2073.6	59.2						
8	2695.9	1705.3	73.6	30.4	10.35		2.5		
9	1.1	472.8	33.6	8.4	2.4		0.6		
10	0.2	78.2	2.3	1.4	0.5		0.1		
11									
12									
Total	9416.9	11632.6	5969.5	1627.1	272.8	94.4	7.2	2.3	1.6
1									
2									
3		872.0	6.8	0.1					
4		4218.3	197.7	101.5	10.0	7.0	4.0		
5		1322.3	695.7	179.6	39.3	16.6	7.7	0.4	
1976 6	323.1	974.6	524.1	278.7	64.8	26.2	7.9	1.3	0.2
7	2251.9	414.9	66.8	248.0	23.5	11.9	9.4		
8	2473.5	566.1	79.6	9.9	1.2	1.2			
9	4439.8	101.5	50.1	31.7	4.6	0.4			
10	1231.2	84.9	38.0	38.0	4.1				
11	118.9	1.9	0.1	0.0					
12	108.4	5.6	0.9		0.3				
Total	10946.8	8561.9	1659.6	887.4	147.9	63.3	29.0	1.7	0.2
1									
2		42.2	0.4		0.0	0.0			
3		7715.9	70.5		2.5	1.8			
4		6528.0	462.8	26.5	13.7	3.6		0.5	
5	4.9	5824.4	742.1	166.6	92.5	2.7	1.1	0.4	
1977 6	4145.7	7025.9	1738.2	363.7	59.8	14.7	9.2	2.0	4.0
7	4293.2	1064.8	527.3	72.4	93.3	7.1	11.6	0.5	
8	2957.7	1060.4	90.5	11.2	14.7	17.8	4.4		
9	1136.4	1137.8	402.0	63.0	14.4	4.1			
10	312.3	100.8	39.3	6.5	2.3	0.4			
11	11.7	16.8	7.0	1.2	0.3	0.1			
12									
Total	12861.9	30517.0	4080.2	711.0	293.5	52.3	26.2	3.4	4.0

Table 3.3.2. Sandeel. Southern North Sea. Catch in numbers ( $\times 10^{-6}$ ) at age by month and year.

Age	0	1	2	3	4	5	6	7	8+
Month									
1									
2									
3		8.0	154.0	7.8					
4		221.9	4267.7	217.2					
5		2281.4	6892.8	61.7	37.1	31.7	20.2	3.0	
6		327.4	4381.1	131.2	90.7	61.8			28.9
1972		38.8	518.2	15.6	10.7	7.3			
8		30.2	403.9	12.1	8.3	5.7			
9		16.9	225.5	6.8	4.7	3.2			
10									
11									
12									
Total		2924.6	16843.2	542.3	151.6	109.7	20.2	3.0	28.9
1									
2									
3		204.0	150.5	291.4	14.8				
4		1804.6	197.2	521.7	12.2	4.3	4.5	0.3	0.1
5	12.5	9779.7	1473.2	1029.7	95.5	51.0	6.2		12.8
6		2709.0	694.3	1989.3	60.7	33.7	20.2	6.8	40.5
1973		206.1	52.9	151.3	4.6	2.6	1.5	0.5	3.1
8									
9									
10									
11									
12									
Total	12.5	14703.4	2568.0	3983.4	187.8	91.5	32.5	7.5	56.5
1									
2									
3		1.3	7.8	0.8	2.6	0.2	0.0		0.0
4		273.7	1628.0	162.5	540.6	32.0	1.6	0.6	3.1
5	412.9	4899.1	2262.1	333.2	1413.9	172.7	20.1	10.1	70.1
6	257.2	814.4	32.0		10.7				
1974	70.0	221.5	8.7		2.9				
8	5.5	4.6	1.2		0.1				
9	0.4	0.3	0.1						
10									
11									
12									
Total	746.0	6214.9	3939.8	496.4	1970.8	204.8	21.7	10.7	73.2

Table 3.3.2. Sandeel continued.

Age	0	1	2	3	4	5	6	7	8+
Month									
1									
2									
3		39.2	60.3	4.2					
4		474.6	158.2	335.4	59.8	29.3	4.0		
5		5647.3	536.1	711.4	84.3	60.7			
6		5296.5	939.6	1786.7	384.8	575.5	86.8	2.3	3.4
7		479.9	1043.8	168.1	252.1				
8			2.2	2.2	1.1				
9									
10									
11									
12									
<u>1975</u>									
Total		11937.4	2740.2	3008.1	782.1	665.4	90.8	2.3	3.4
1									
2									
3									
4		1205.9	993.2	193.0	200.3	20.7	22.5	0.6	
5		3453.3	7481.4	1041.6	762.0	150.3	46.2		
6	3.7	11649.1	6080.4	287.1	271.7		3.7		
7		226.7	2151.8	357.5	93.1	17.9	52.7	14.9	
8		11.8	112.0	18.6	4.8	1.0	2.7	0.8	
9		10.2	94.6	15.7	4.1	0.8	2.3	0.7	
10									
11									
12									
<u>1976</u>									
Total	3.7	16557.0	16913.5	1913.5	1336.1	190.6	130.1	16.9	
1									
2		7.7	3.0	20.6	1.5	1.0	0.2		
3		3.2	1.2	8.5	0.6	0.4	0.1		
4		2247.6	501.0	1462.8	210.6	89.5	32.2	4.7	4.7
5		10471.0	3298.8	2838.2	593.2	274.7	146.7	28.0	
6		6770.0	1791.6	1970.2	159.0	79.6	60.1	91.0	31.0
7		241.1	25.1	7.5	7.5	2.5	2.5		
8		19.0	1.9	0.6	0.6	0.2	0.2		
9	13262.7	9.2							
10									
11									
12									
<u>1977</u>									
Total	13262.7	19768.7	5622.6	6308.3	972.9	447.8	242.1	123.7	35.6

Table 3.3.3. Sandeel. Northern North Sea.

Input Data. Catch in numbers by year and by age ( $\times 10^{-6}$ )

Age	1972	1973	1974	1975	1976	1977
0	4929	337	11404	9326	10946	12861
1	4244	4200	21074	11632	8561	30517
2	2044	1724	1486	5969	1659	4080
3	114	856	1460	1627	887	711
4	78	89	309	272	148	293
5	61	58	82	0	63	52
6	60	0	2	7	28	26
7	1	1	6	2	1	3

Table 3.3.4. Sandeel. Southern North Sea.

Input Data. Catch in numbers by year and by age ( $\times 10^{-6}$ )

Age	1971	1972	1973	1974	1975	1976	1977
0	0	0	13	749	0	4	15068
1	27967	2064	14706	6237	11322	16581	22459
2	1056	19002	2568	3954	2599	16938	6388
3	198	510	3984	498	2854	1916	7168
4	133	171	188	1978	742	1338	1106
5	123	124	92	205	631	191	509
6	105	22	33	22	86	130	276
7	48	3	8	11	2	17	141

Table 3.3.5. Sandeel. Northern North Sea.  
 Calculated Fishing Mortality by year and by age (for M = 0.5).

Age	1972	1973	1974	1975	1976	1977
0	0.22	0.01	0.35	0.29	0.16	0.35
1	0.39	0.43	0.92	1.16	0.69	1.40
2	0.60	0.39	0.38	1.21	0.74	1.40
3	0.25	0.83	1.05	1.55	0.88	1.40
4	0.52	0.44	1.42	0.87	0.84	1.40
5	1.09	1.64	1.67	0.00	0.76	1.40
6	2.68	0.03	0.37	1.01	1.59	1.40
7	0.43	0.51	0.89	1.05	1.10	1.40
Mean F A <sub>&gt;=1</sub> (Sum of F's weighted by stocks in numbers)						
	0.45	0.45	0.87	1.20	0.71	1.40

Table 3.3.6. Sandeel. Southern North Sea.  
 Calculated Fishing Mortality by year and by age (for M = 0.5).

Age	1971	1972	1973	1974	1975	1976	1977
0	0.00	0.00	0.00	0.01	0.00	0.00	0.05
1	0.37	0.12	0.43	0.28	0.16	0.59	0.50
2	0.27	0.69	0.29	0.27	0.25	0.55	0.70
3	0.25	0.28	0.42	0.11	0.46	0.43	0.70
4	0.24	0.52	0.22	0.56	0.35	0.59	0.70
5	0.72	0.53	0.92	0.58	0.50	0.20	0.70
6	2.03	0.38	0.37	0.91	0.79	0.25	0.70
7	0.29	0.40	0.32	0.28	0.26	0.50	0.70
Mean F A <sub>&gt;=1</sub> (Sum of F's weighted by stocks in numbers)							
	0.37	0.49	0.40	0.29	0.20	0.55	0.57

Table 3.3.7. Sandeel. Northern North Sea.  
 Calculated stock in numbers at beginning of year.

Age	1972	1973	1974	1975	1976	1977
0	30994	70946	48199	46854	94112	54553
1	16282	15034	42771	20570	21315	48700
2	5602	6657	5937	10295	3917	6511
3	658	1860	2730	2473	1860	1135
4	242	312	490	577	320	468
5	113	87	121	72	147	83
6	75	23	10	14	43	42
7	4	3	14	4	3	5

Table 3.3.8. Sandeel. Southern North Sea.  
 Calculated stock in numbers at beginning of year.

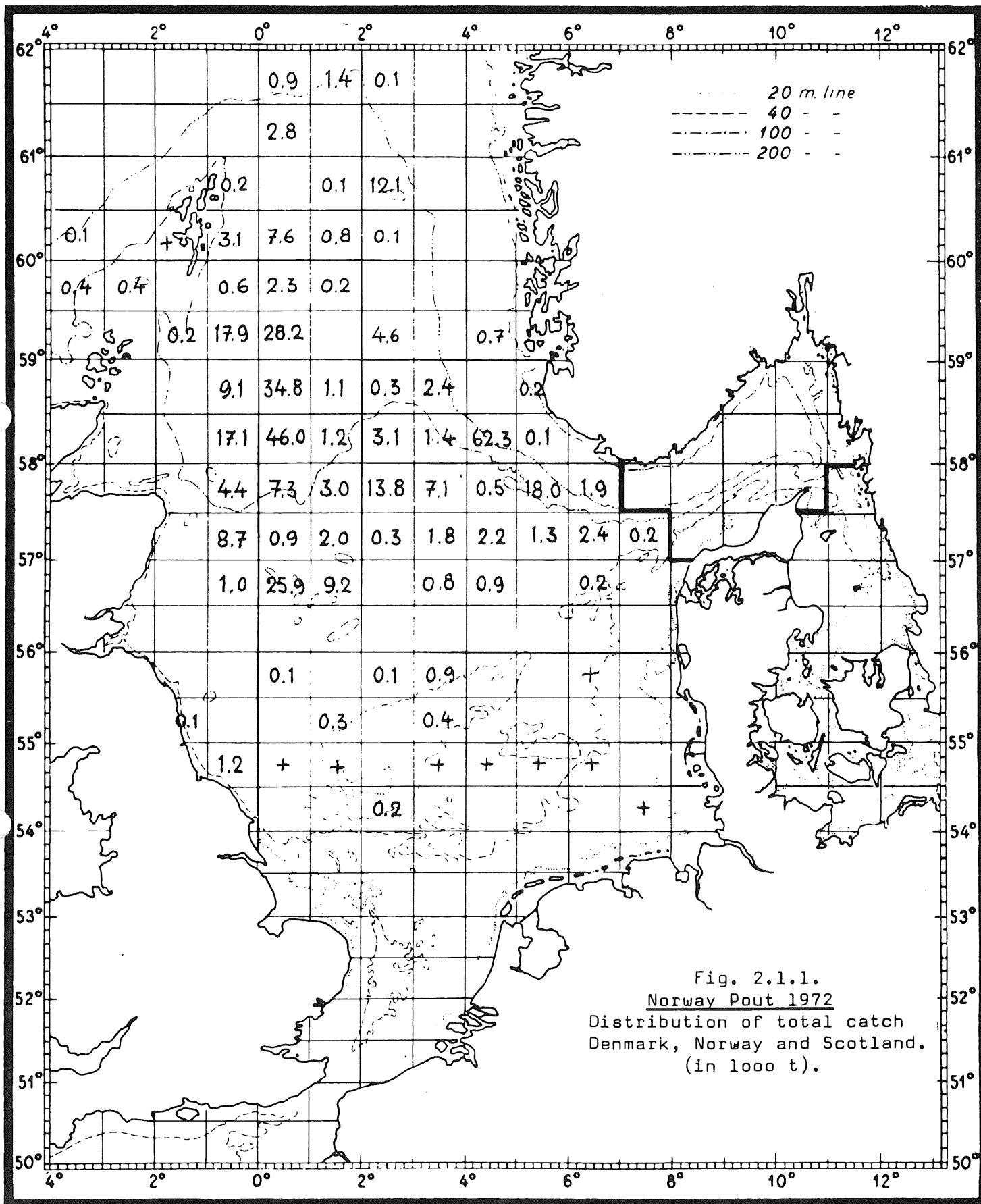
Age	1971	1972	1973	1974	1975	1976	1977
0	39292	87206	52586	160536	76513	117162	391793
1	112990	23832	52893	31885	96793	46408	71059
2	5604	47303	12872	20944	14588	50039	15671
3	1108	2594	14450	5851	9689	6866	17584
4	787	521	1185	5746	3167	3718	2713
5	297	376	187	575	1995	1357	1249
6	142	88	135	45	195	734	677
7	237	11	37	57	11	54	346

Table 3.3.9. Sandeel. Total mortality (Z) estimated from c.p.u.e. data.

		Age groups						
		0/1	1/2	2/3	3/4	4/5	5/6	6/7
Years								
Northern North Sea	1970/71							
	1971/72	-1.36(1)	3.62(2)					
	1972/73		0.04(2)	1.39(1)	-2.57(1)	-1.87(1)		
	1973/74		2.10(6)	1.19(6)	1.12(4)	1.09(3)	0.59(1)	
	1974/75	-3.24(1)	0.88(5)	-0.29(5)	1.15(4)	1.70(2)		
Southern North Sea	1970/71		2.11(2)	1.24(1)	2.01(1)	1.54(1)	-0.20(1)	0.73(1)
	1971/72		1.50(1)	0.59(1)				
	1972/73		-0.85(1)	0.82(1)	0.82(1)	1.12(1)	1.22(1)	
	1973/74							
	1974/75	-1.49(1)	0.58(2)	-2.21(2)		-2.46(1)		







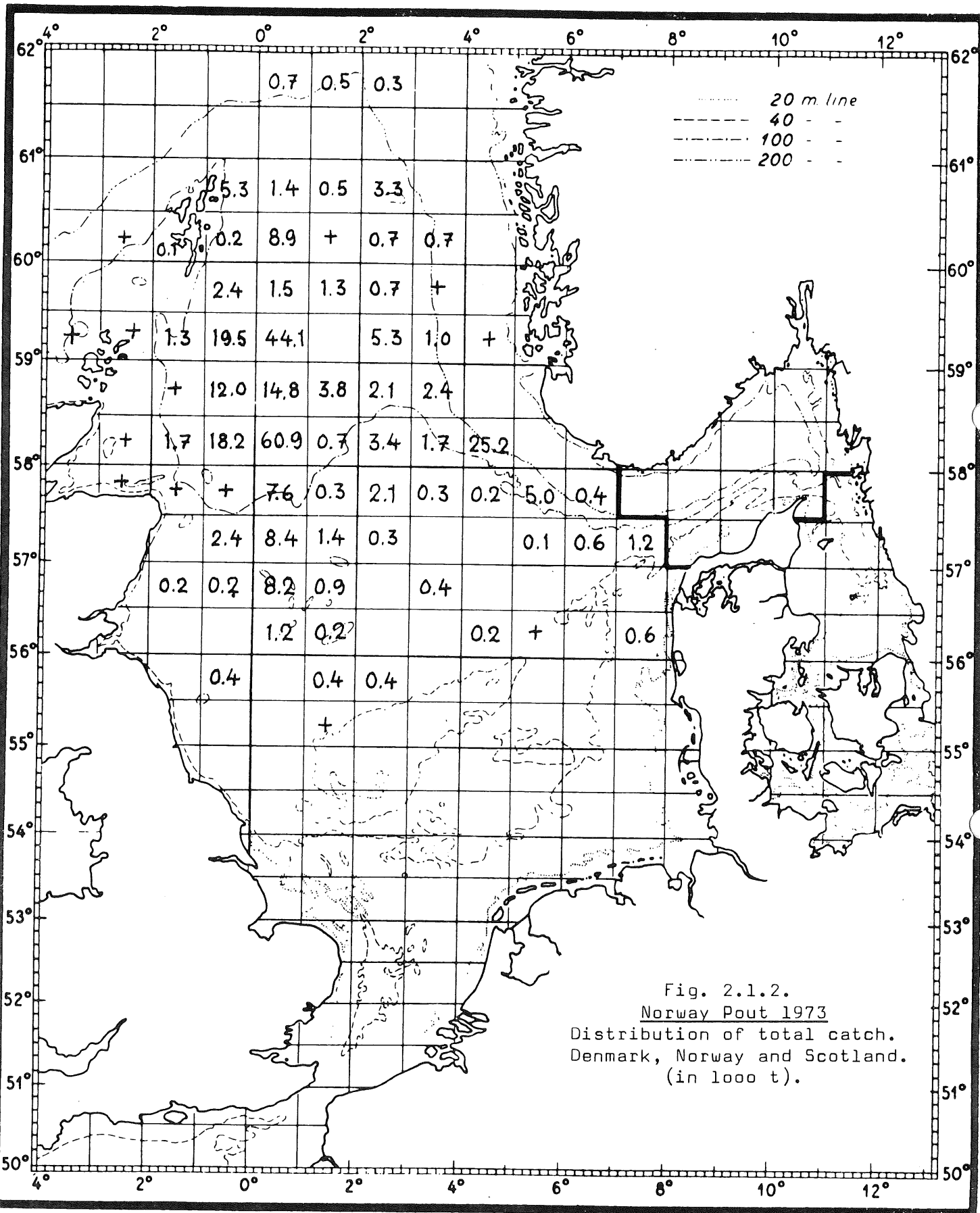
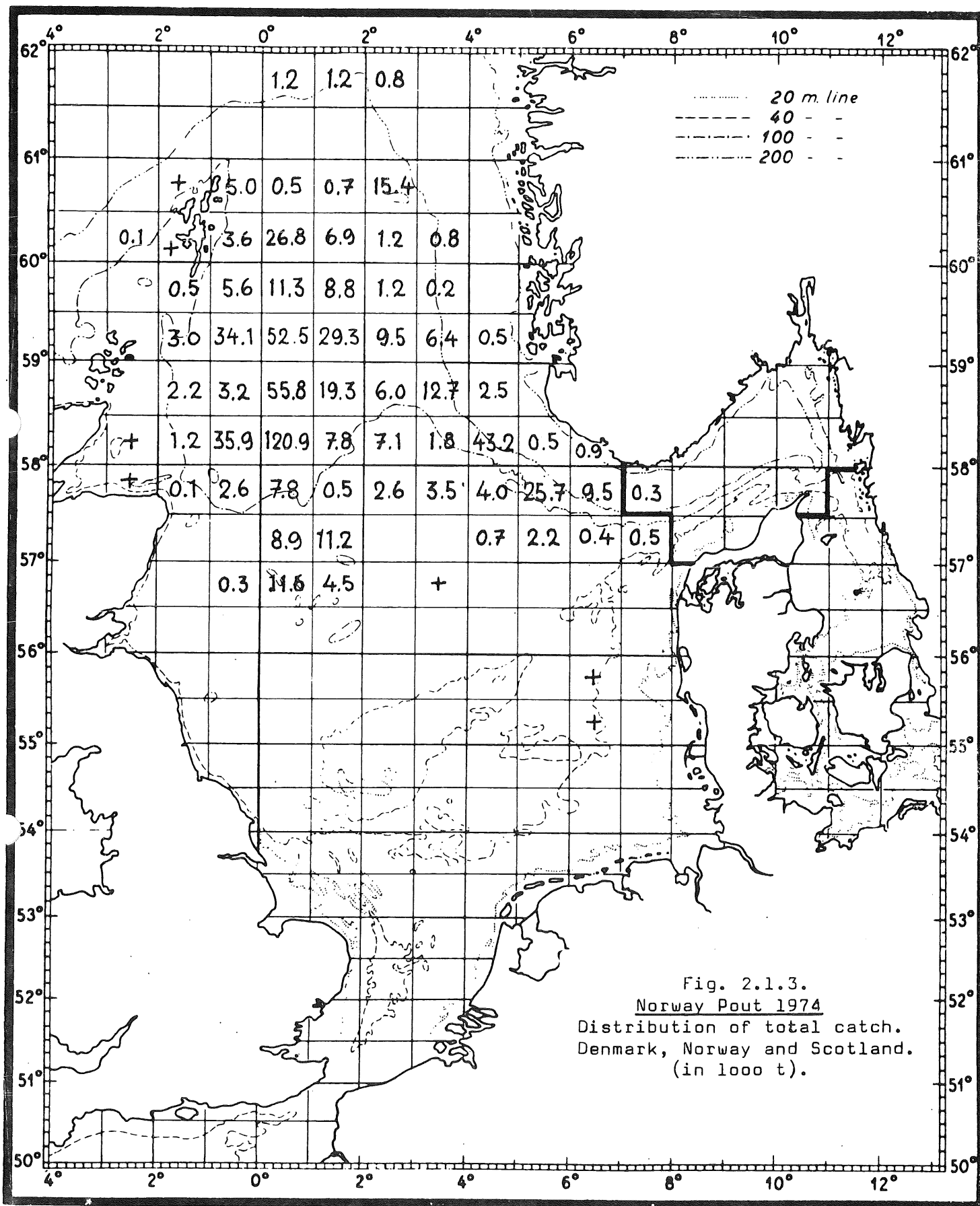


Fig. 2.1.2.  
Norway Pout 1973  
 Distribution of total catch.  
 Denmark, Norway and Scotland.  
 (in 1000 t).



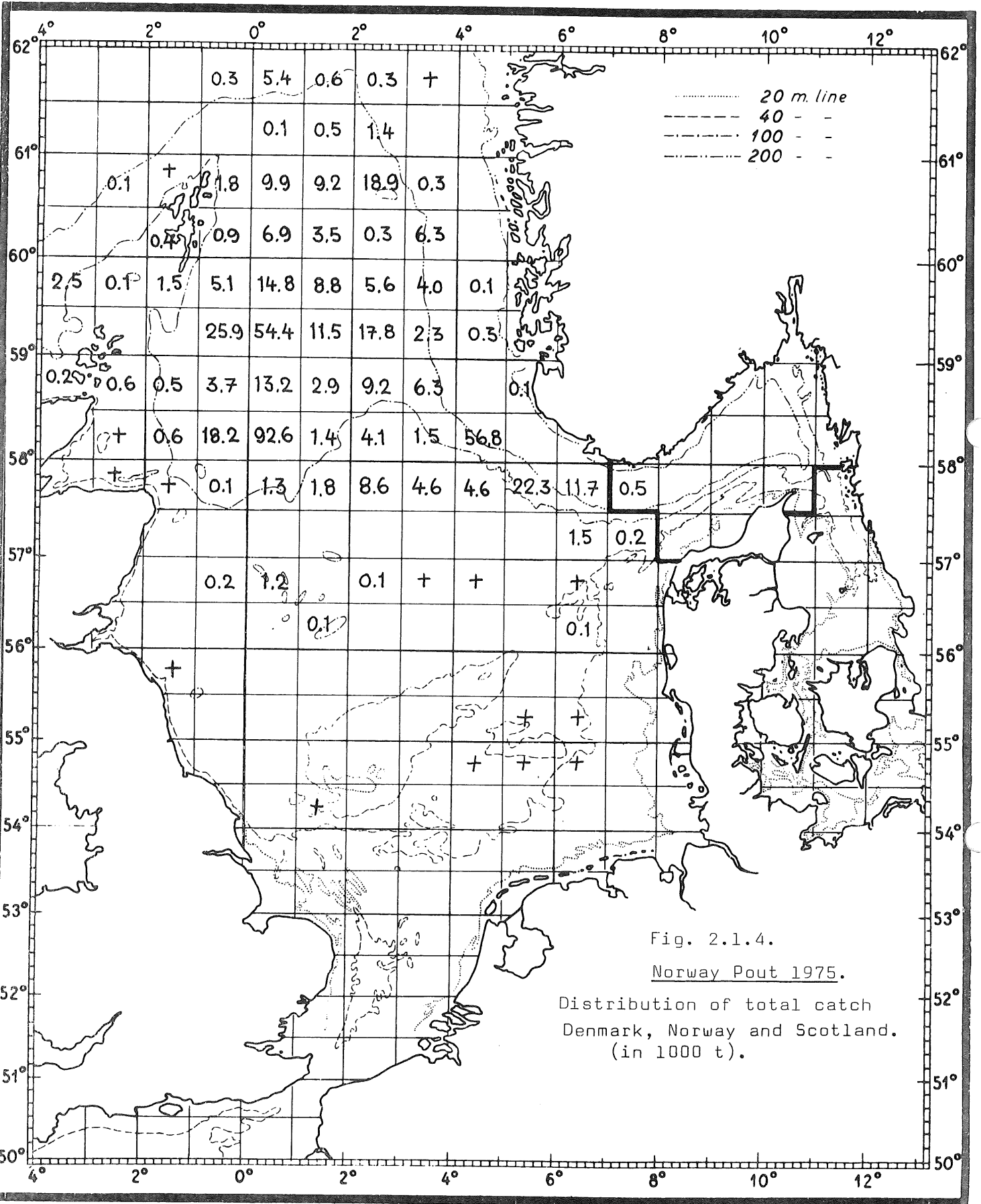


Fig. 2.1.4.

Norway Pout 1975.

Distribution of total catch  
Denmark, Norway and Scotland.  
(in 1000 t).

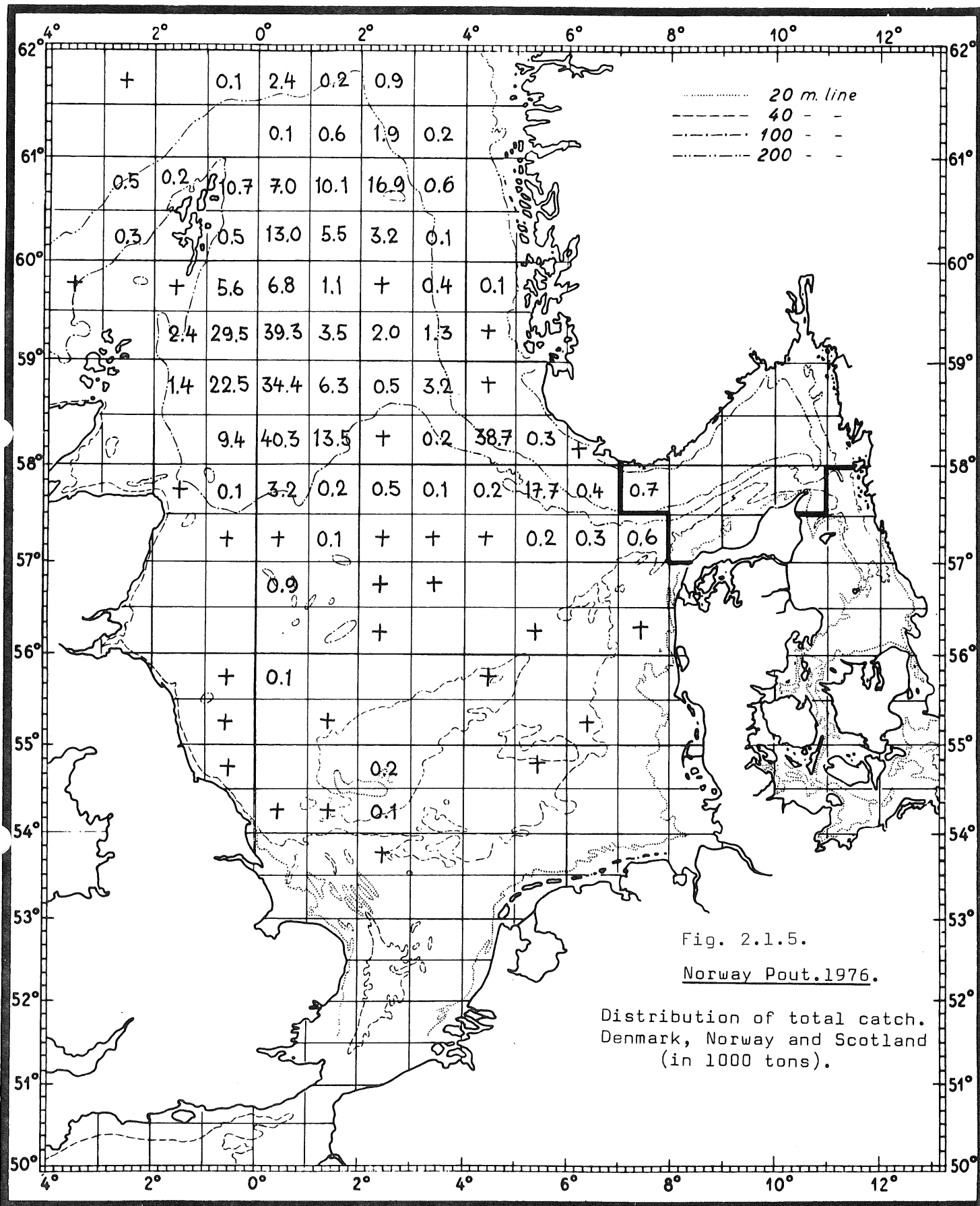
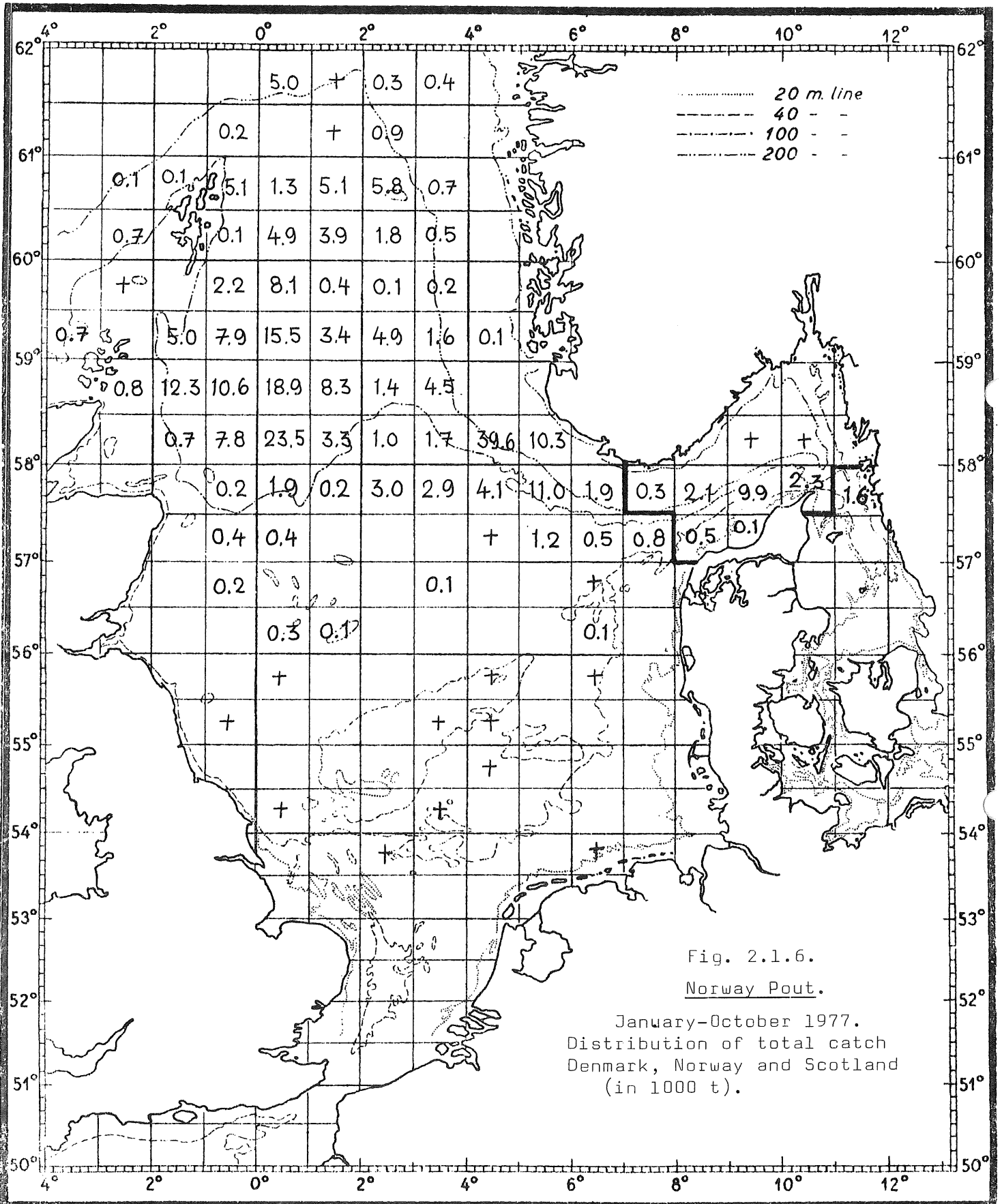


Fig. 2.1.5.  
Norway Pout. 1976.

Distribution of total catch.  
Denmark, Norway and Scotland  
(in 1000 tons).



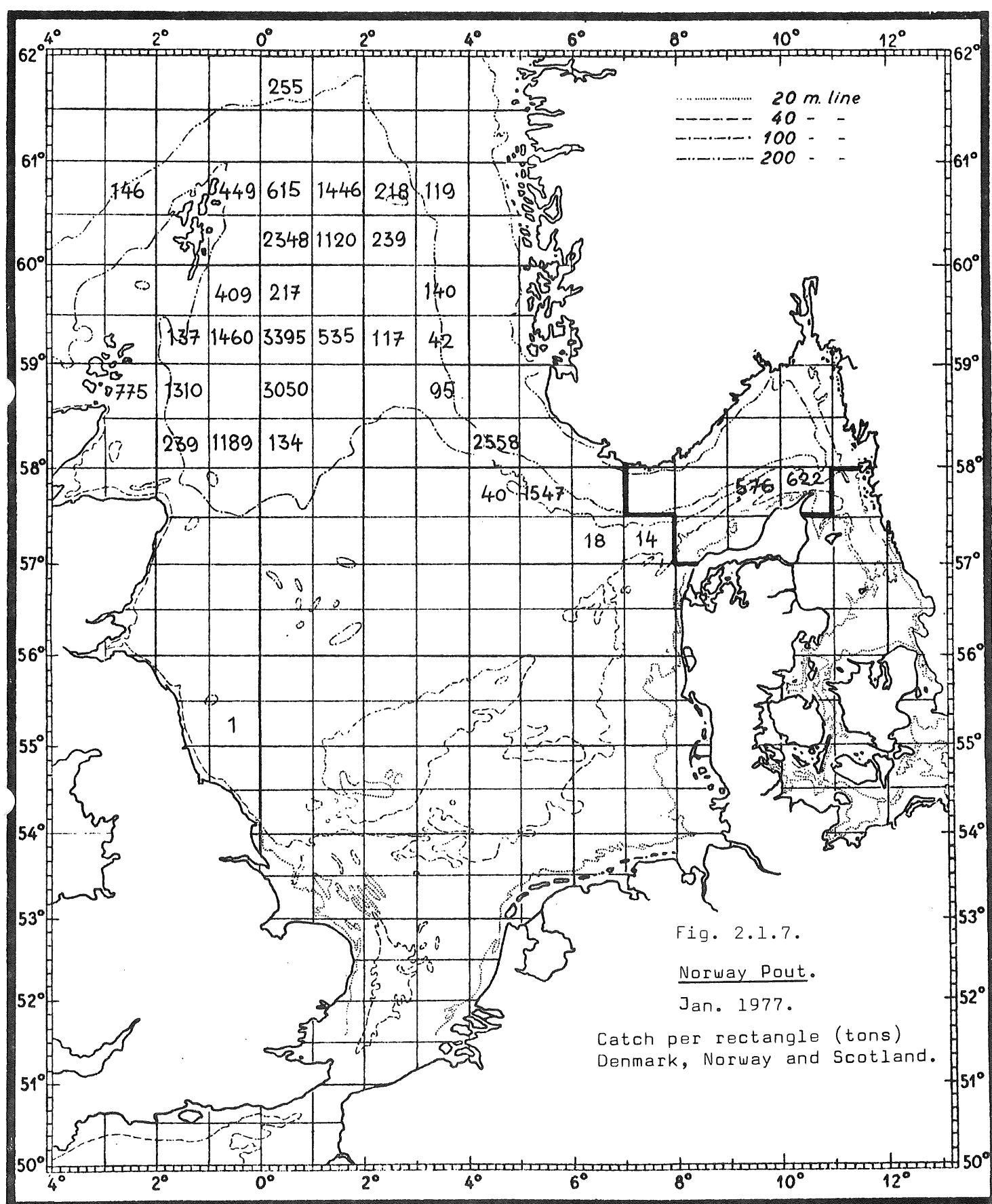


Fig. 2.1.7.  
 Norway Pout.  
 Jan. 1977.

Catch per rectangle (tons)  
 Denmark, Norway and Scotland.

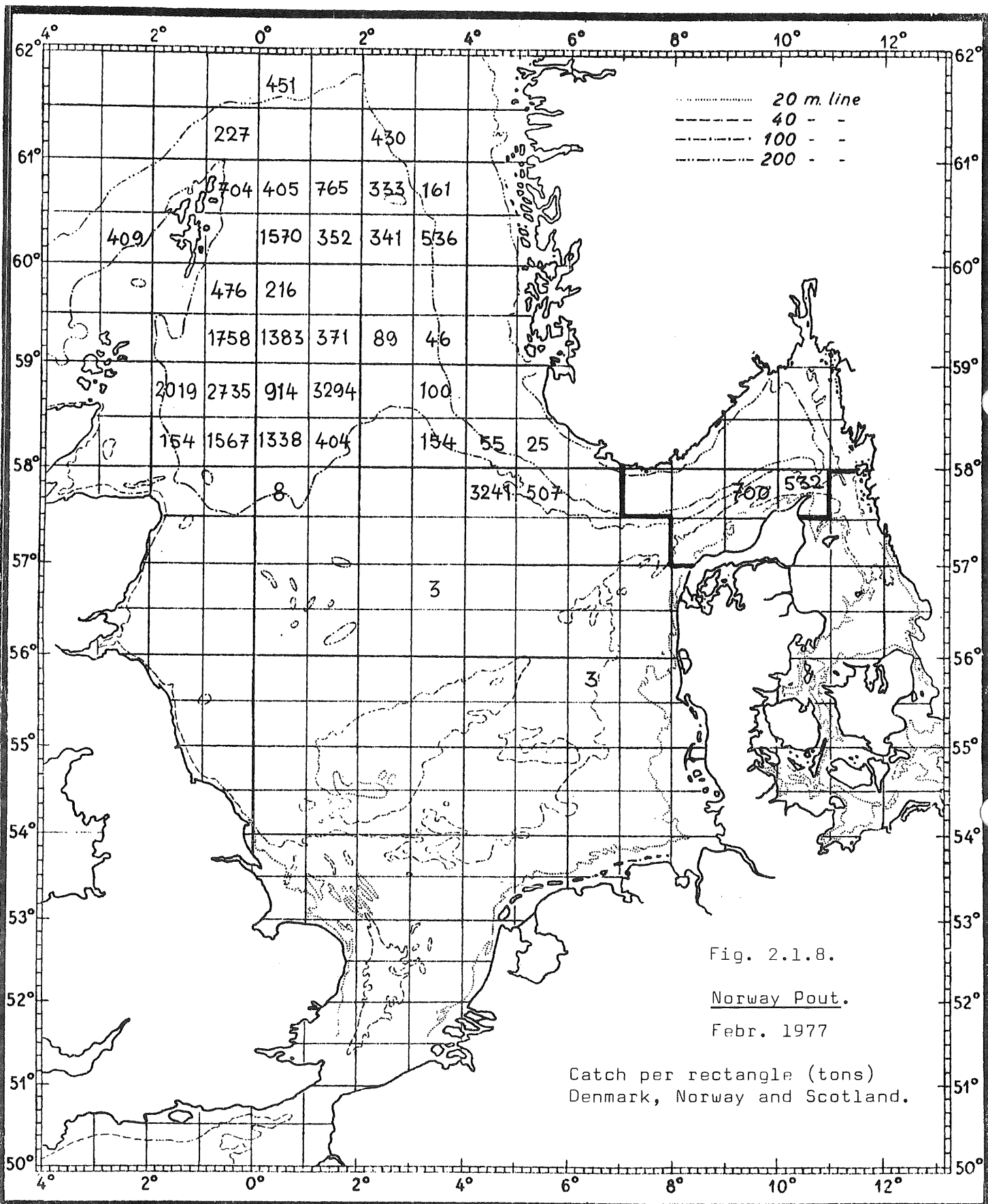


Fig. 2.1.8.

Norway Pout.

Febr. 1977

Catch per rectangle (tons)  
Denmark, Norway and Scotland.



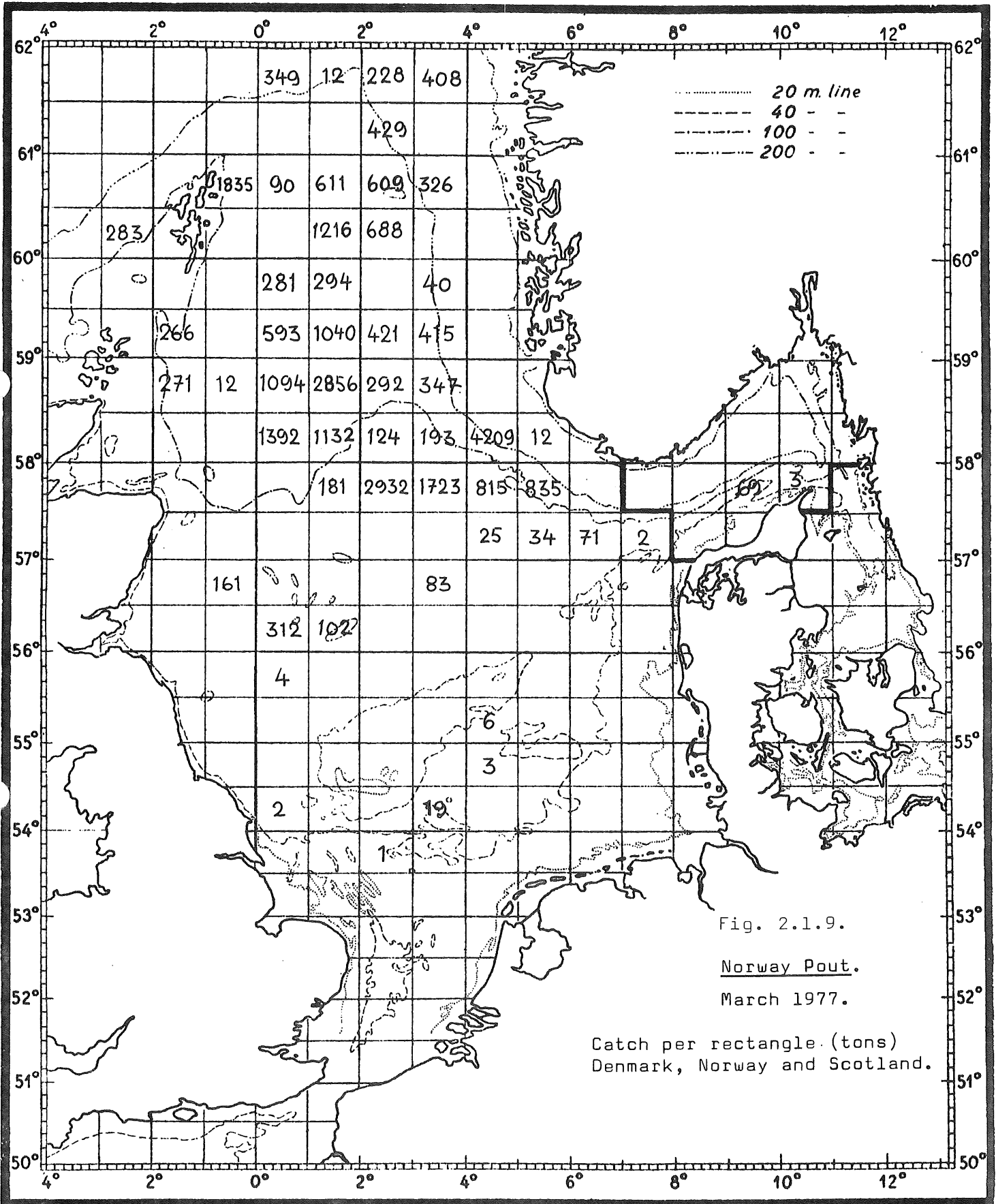
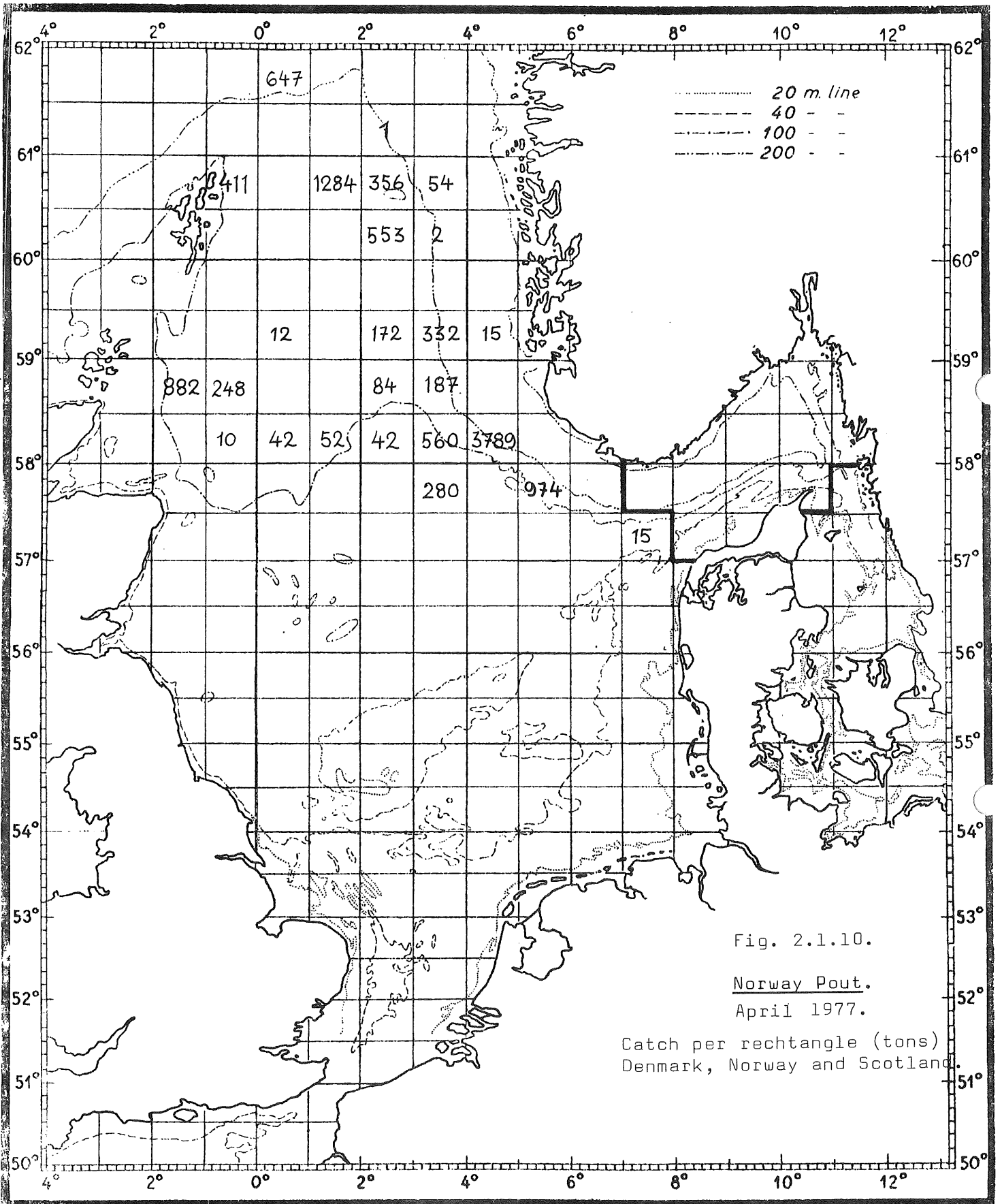


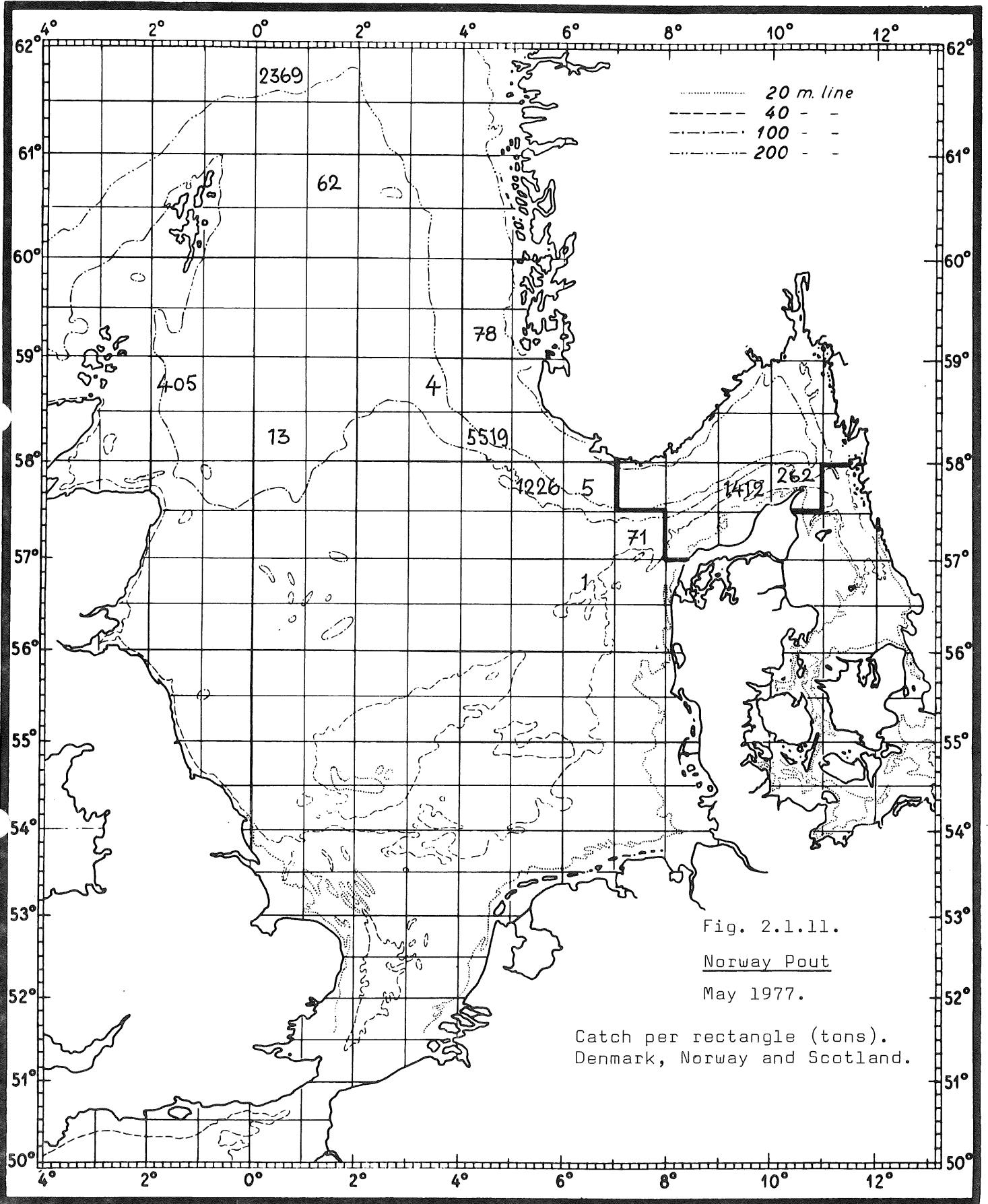
Fig. 2.1.9.

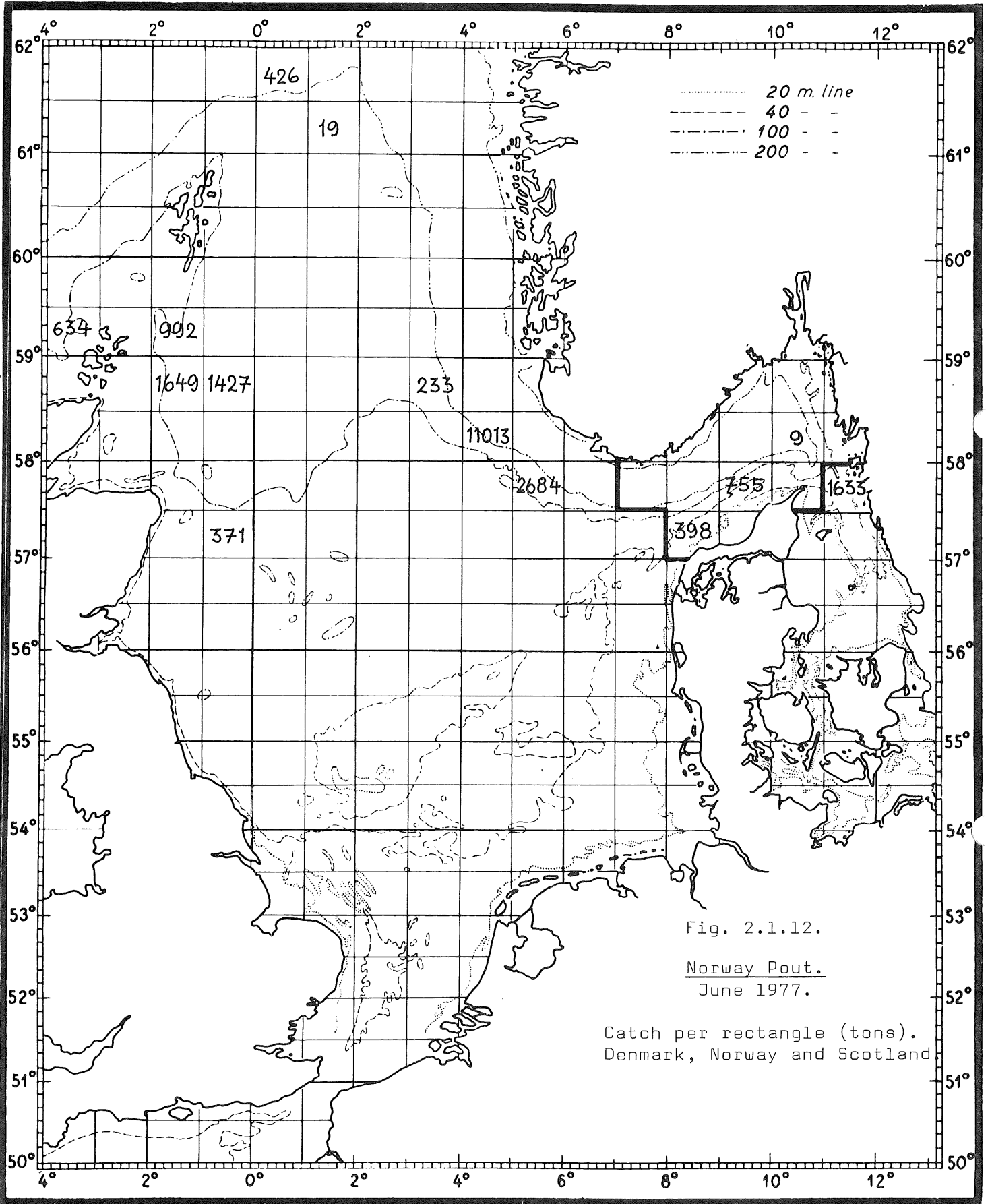
Norway Pout.

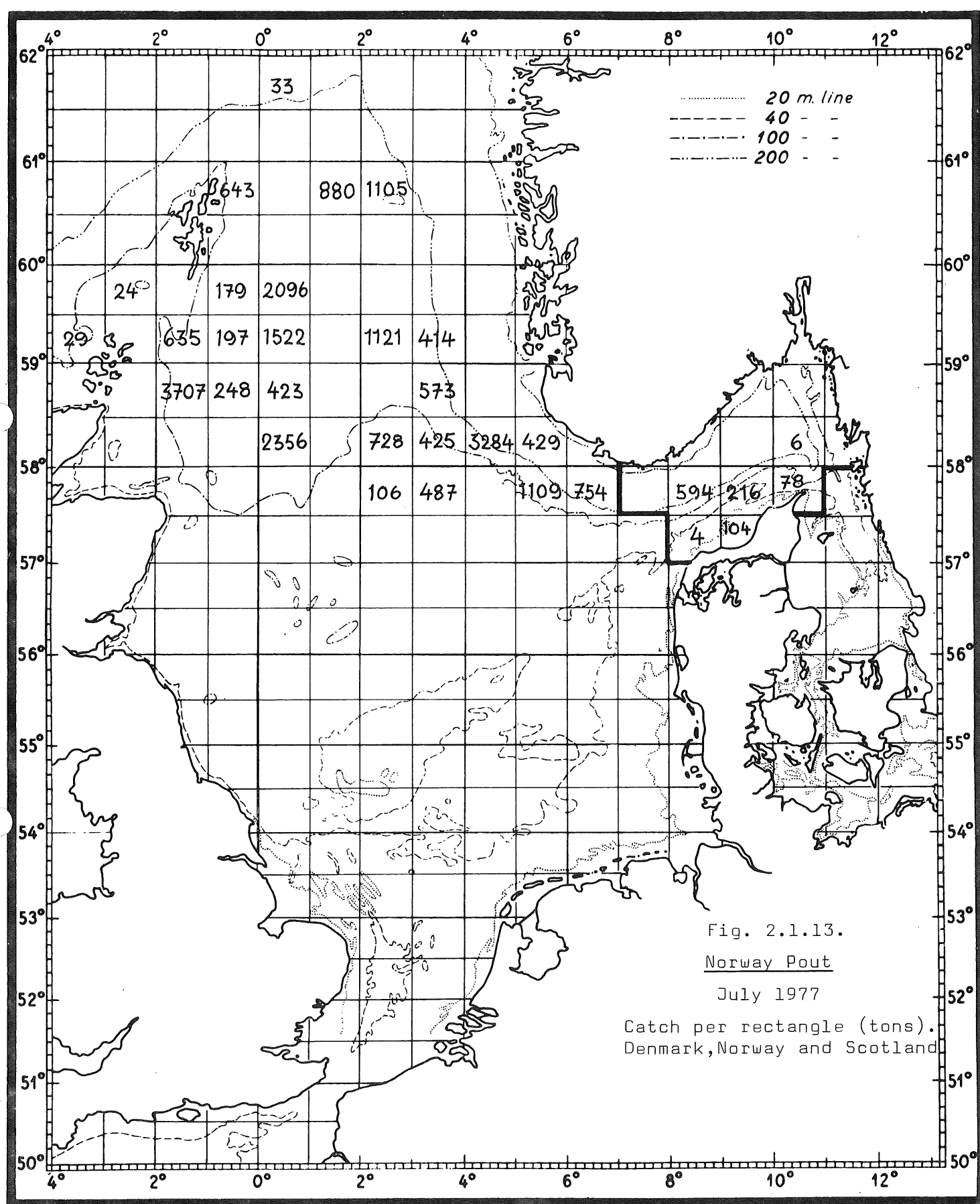
March 1977.

Catch per rectangle (tons)  
Denmark, Norway and Scotland.









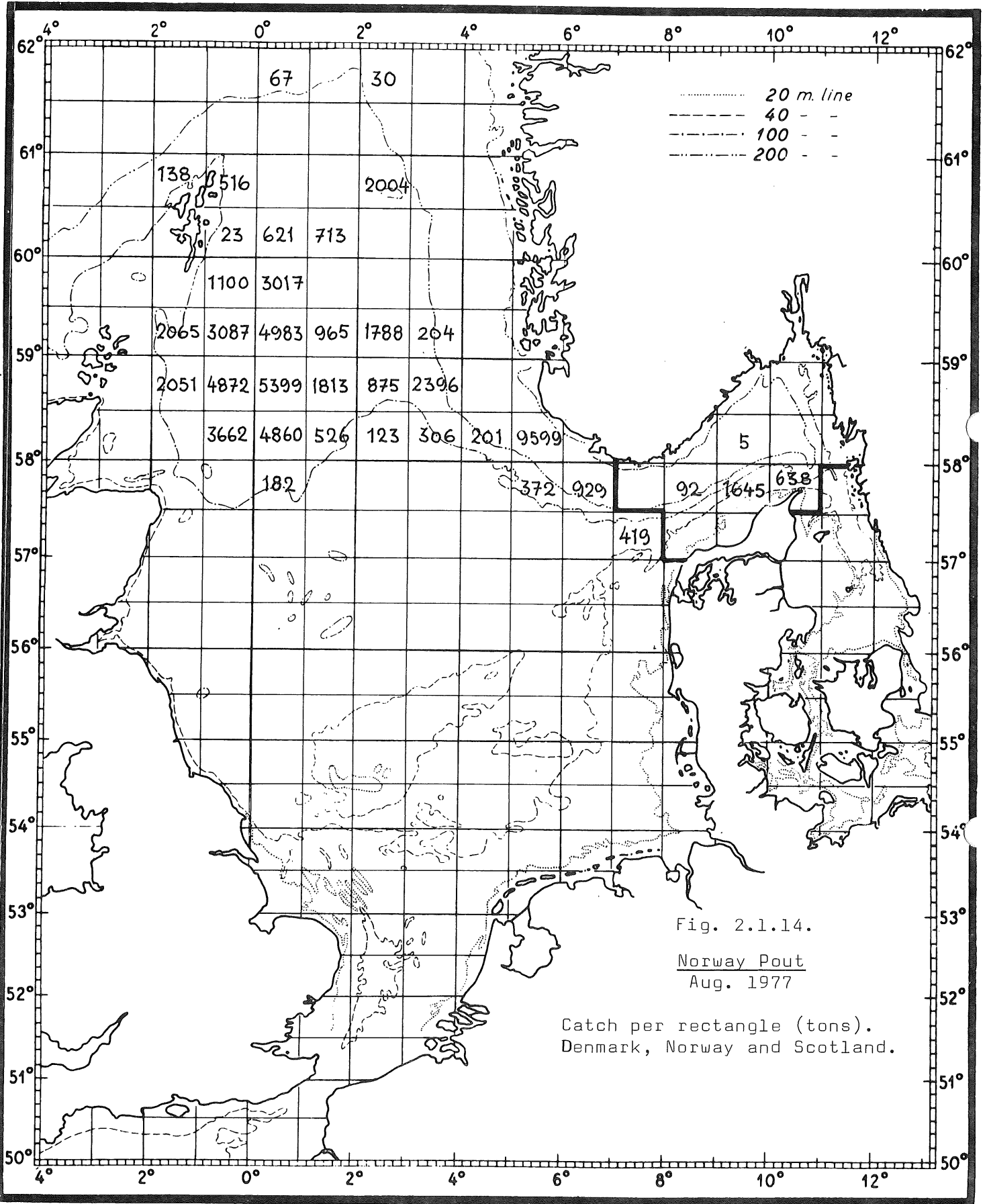
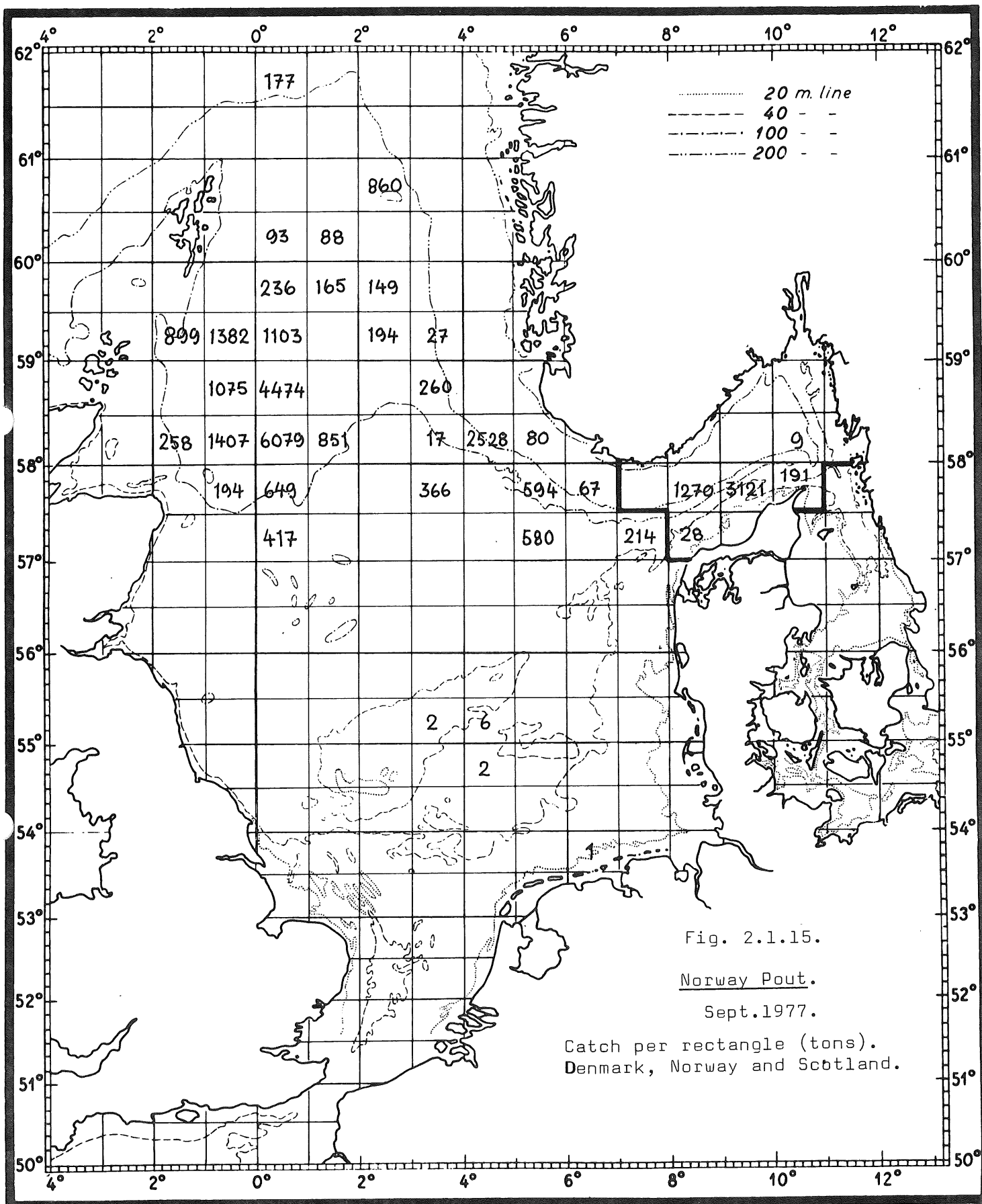
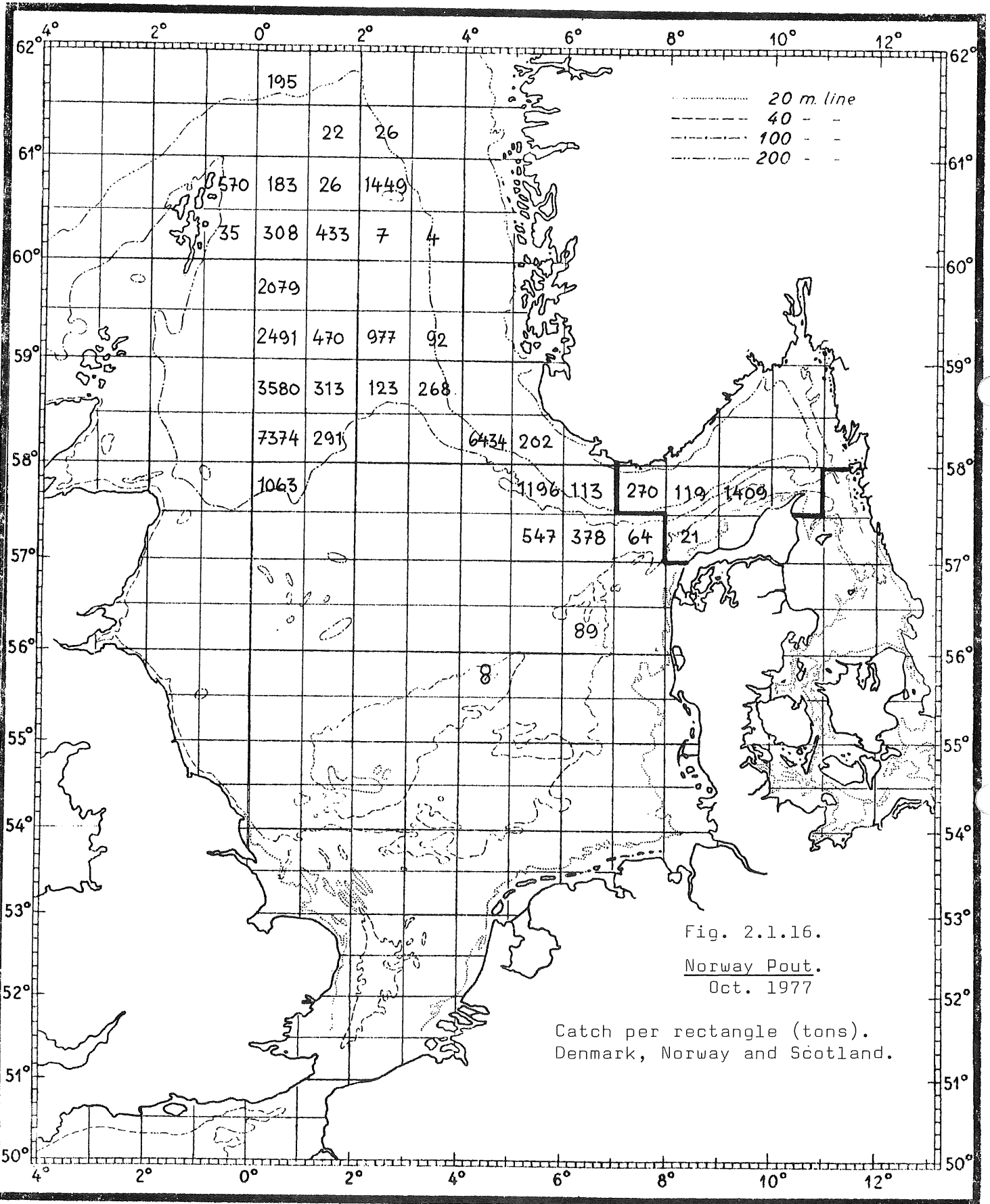


Fig. 2.1.14.

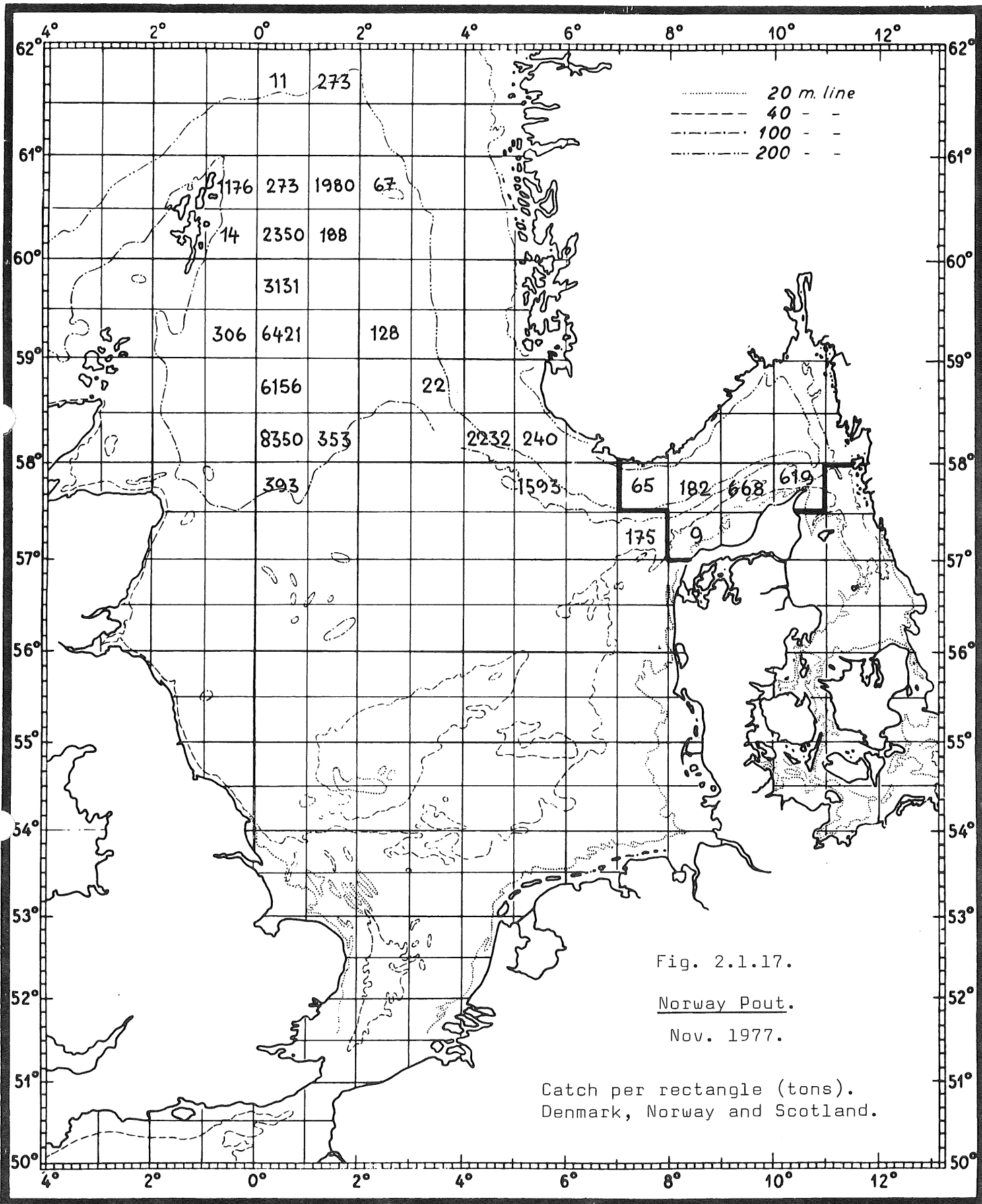
Norway Pout  
Aug. 1977

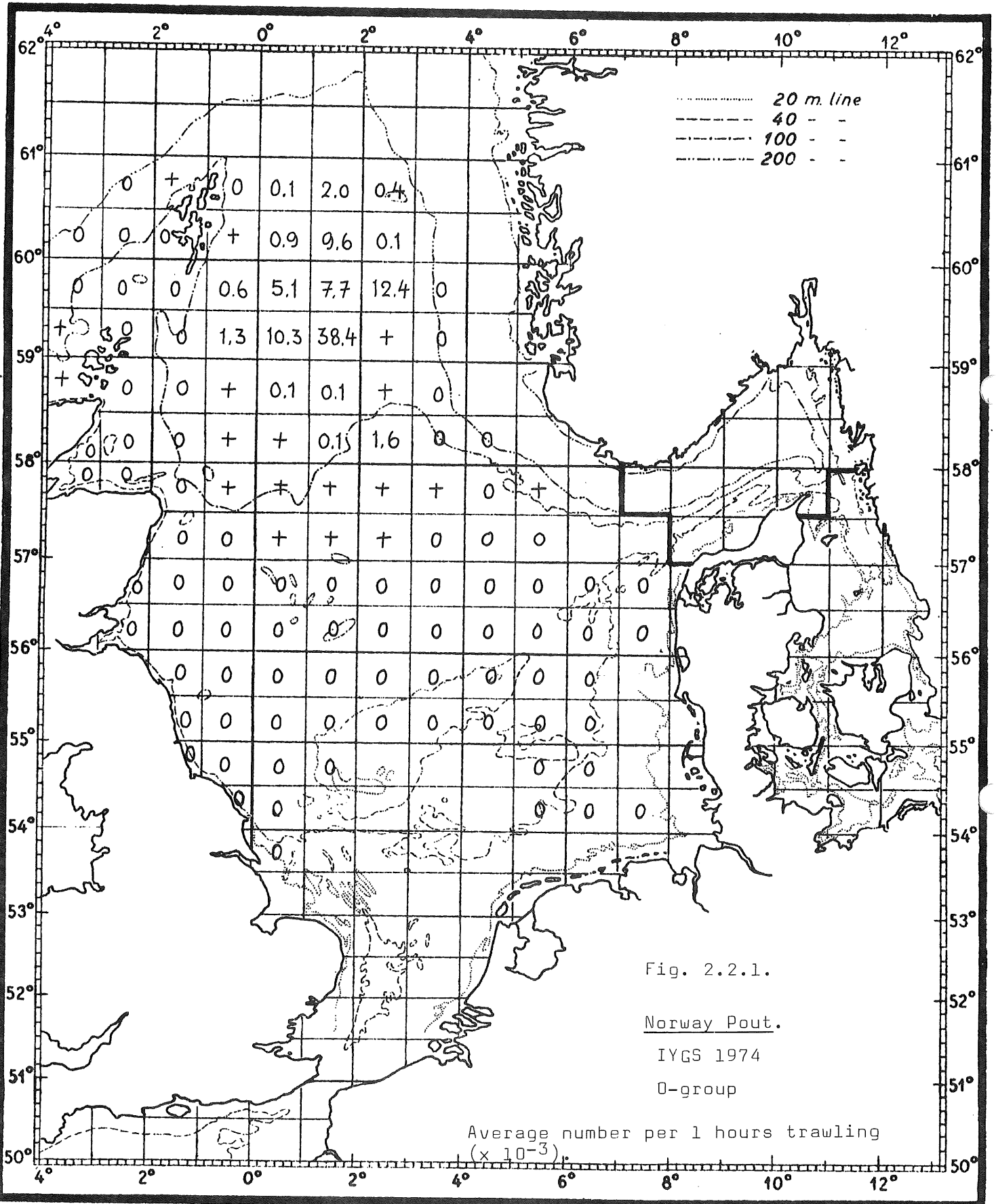
Catch per rectangle (tons).  
Denmark, Norway and Scotland.

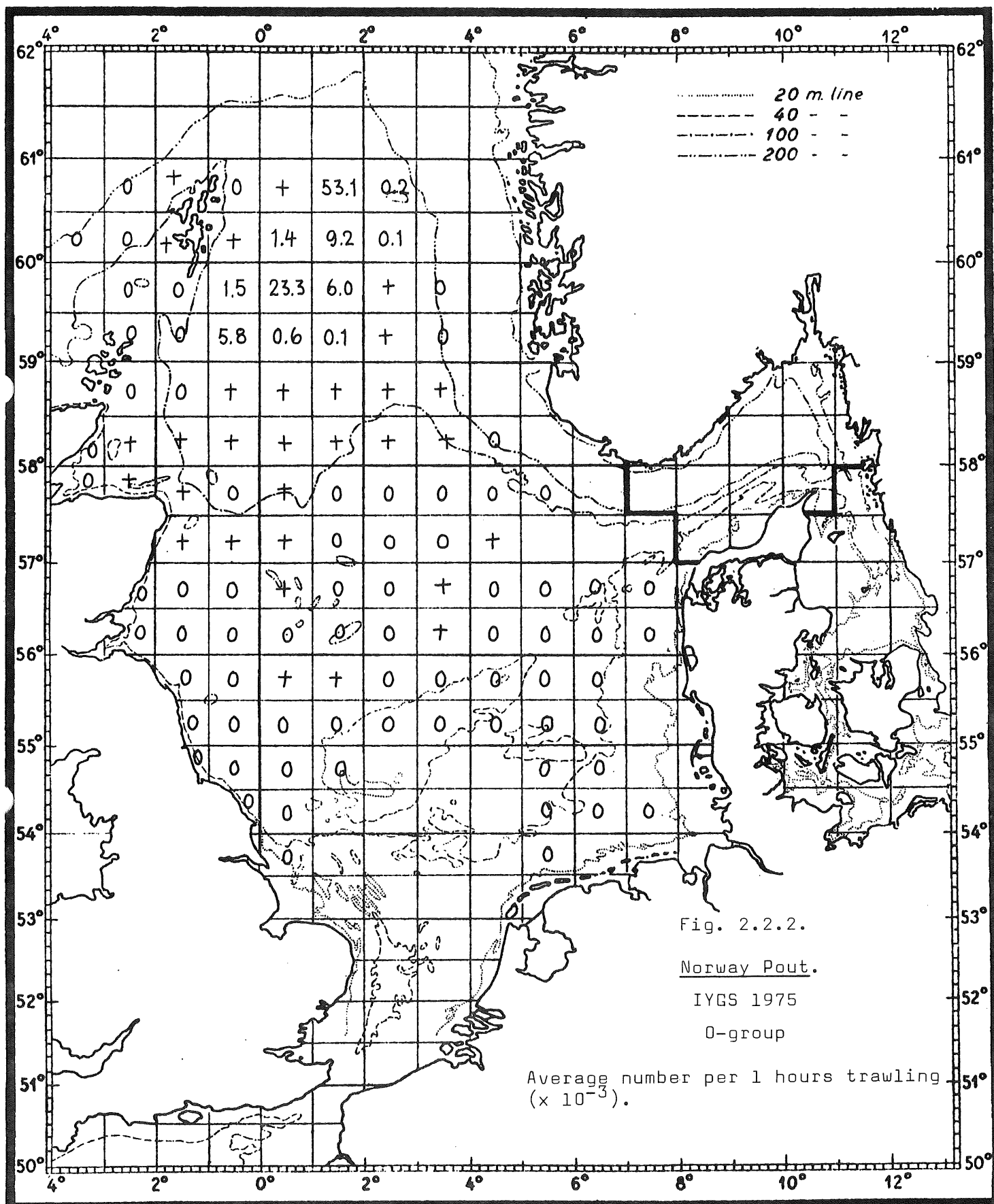


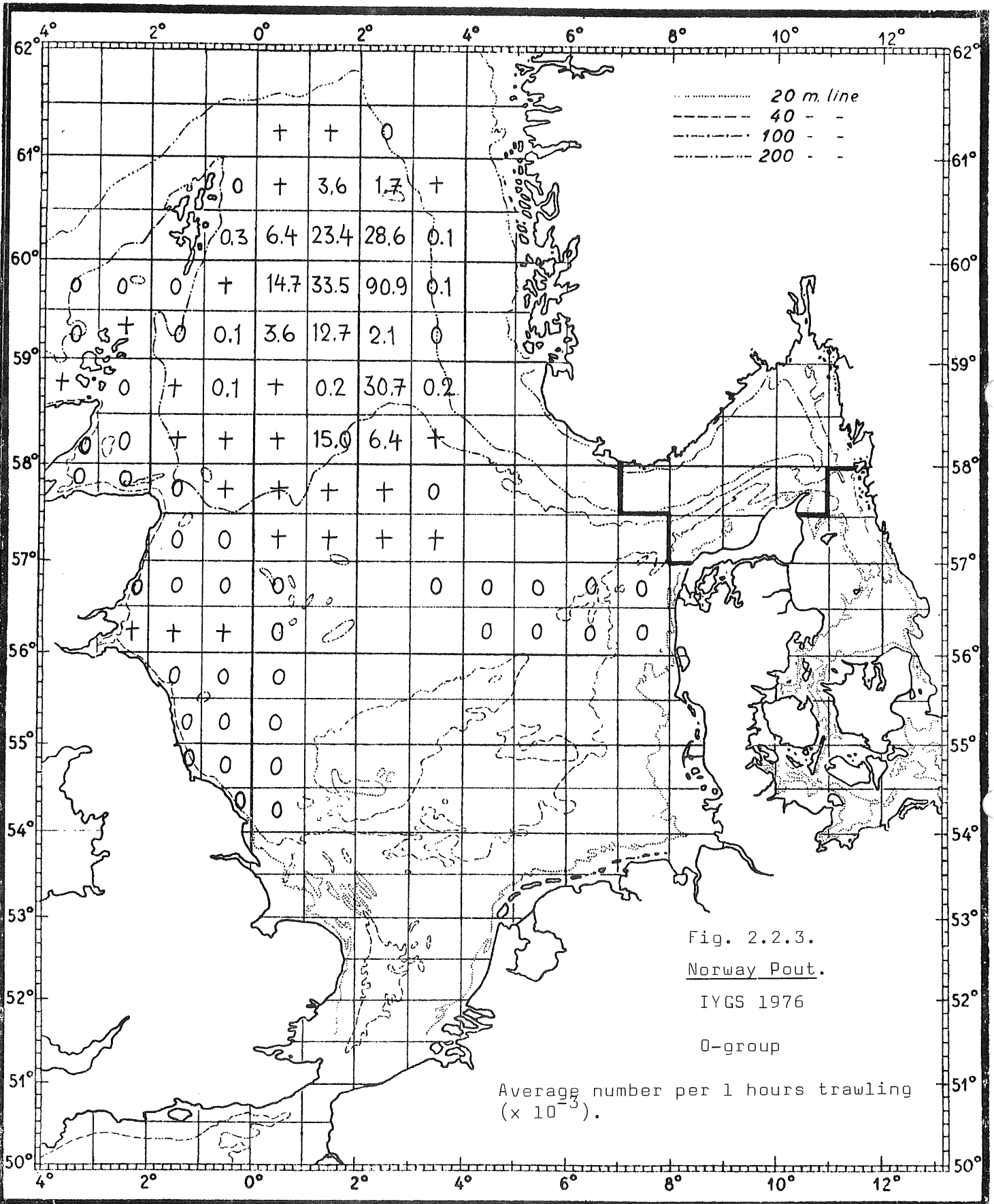


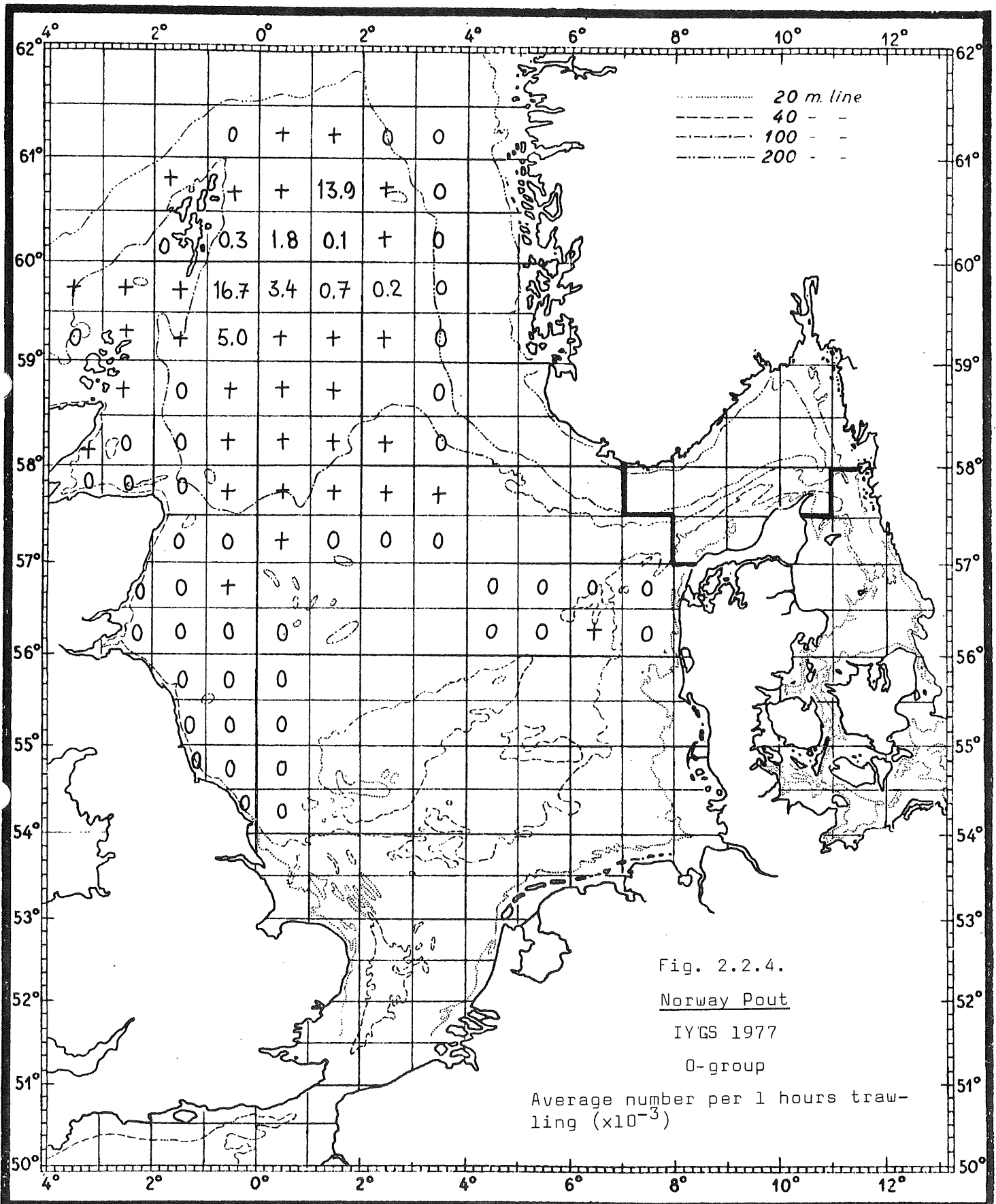


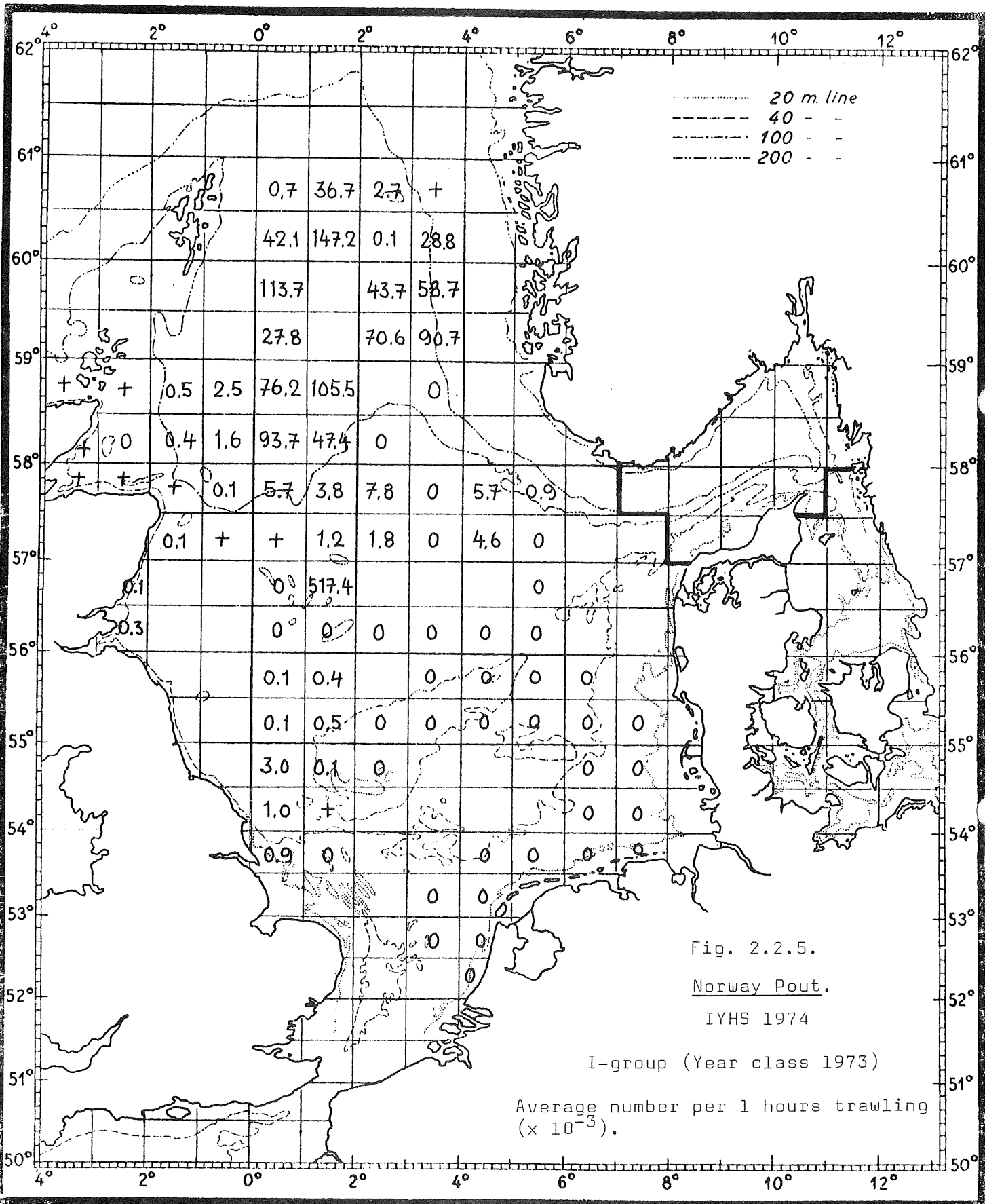


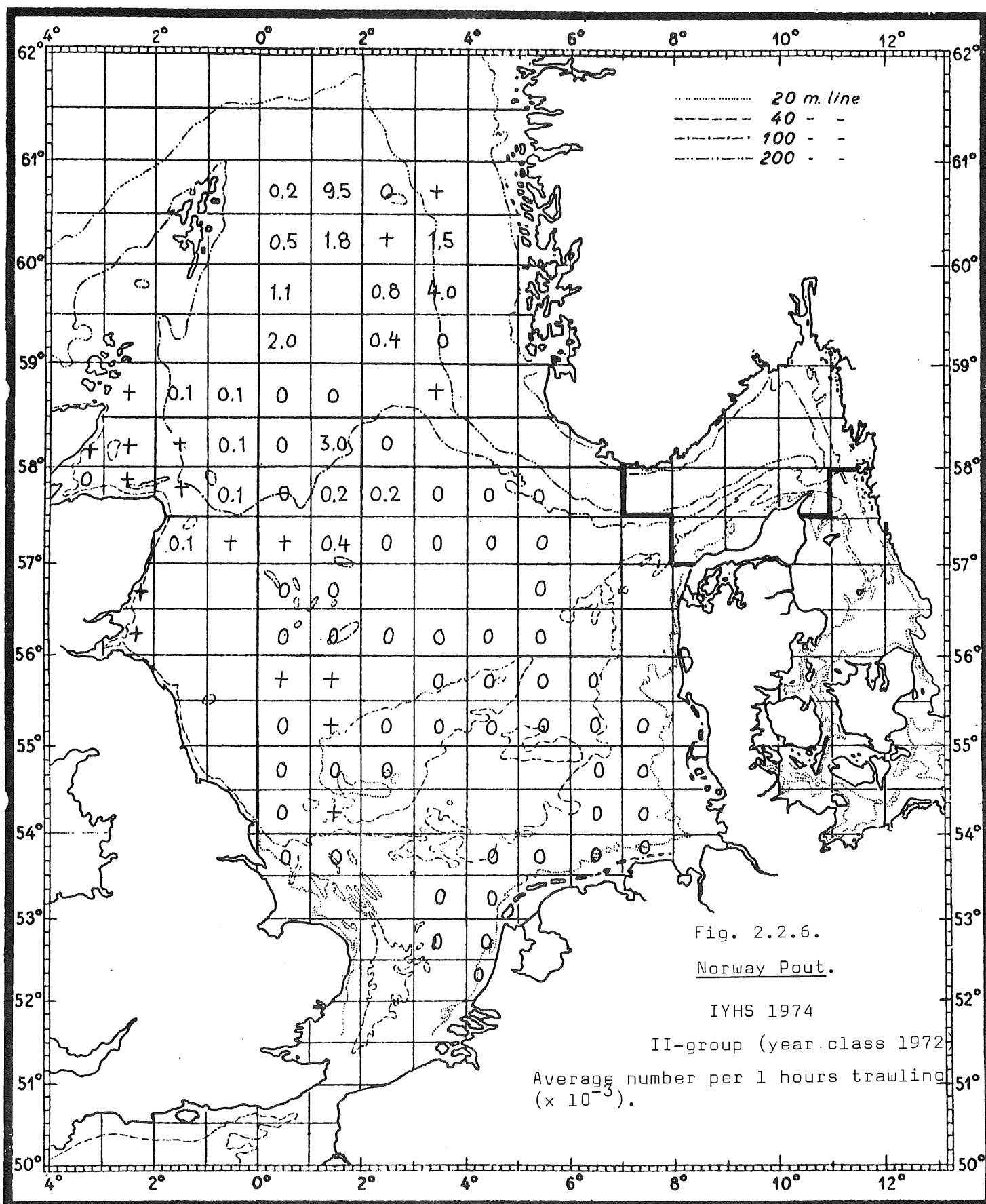












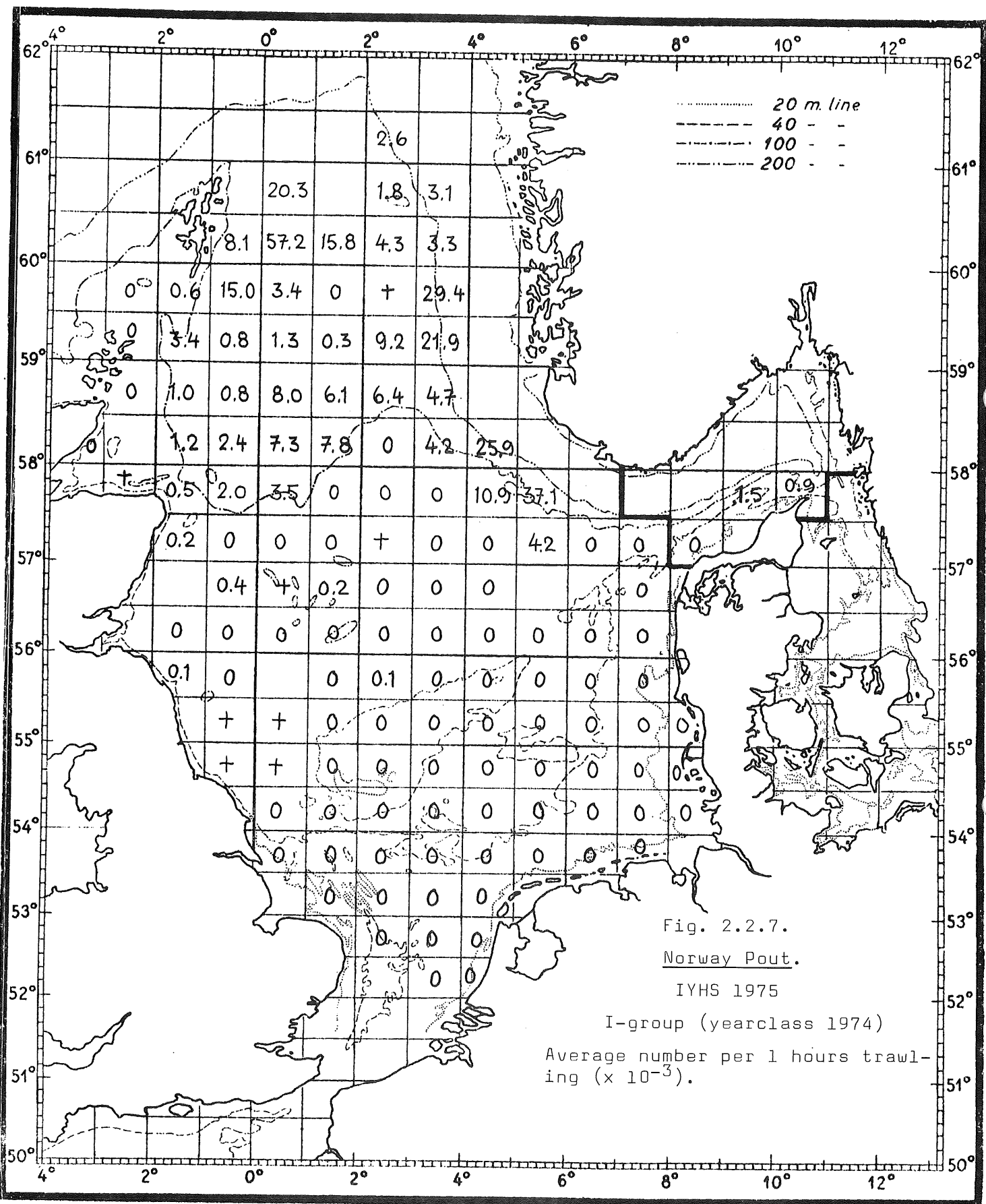
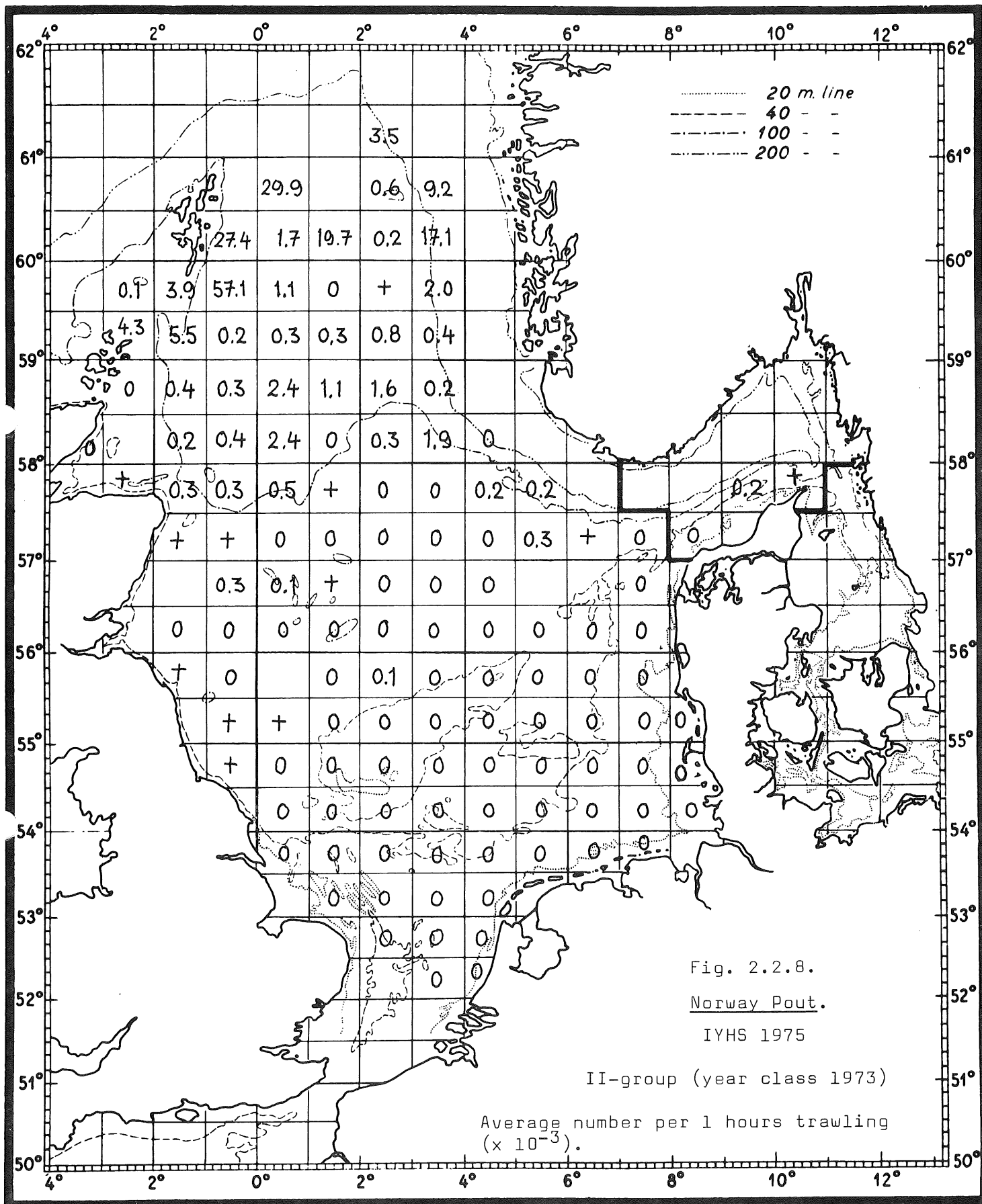


Fig. 2.2.7.  
 Norway Pout.  
 IYHS 1975  
 I-group (yearclass 1974)

Average number per 1 hours trawling ( $\times 10^{-3}$ ).





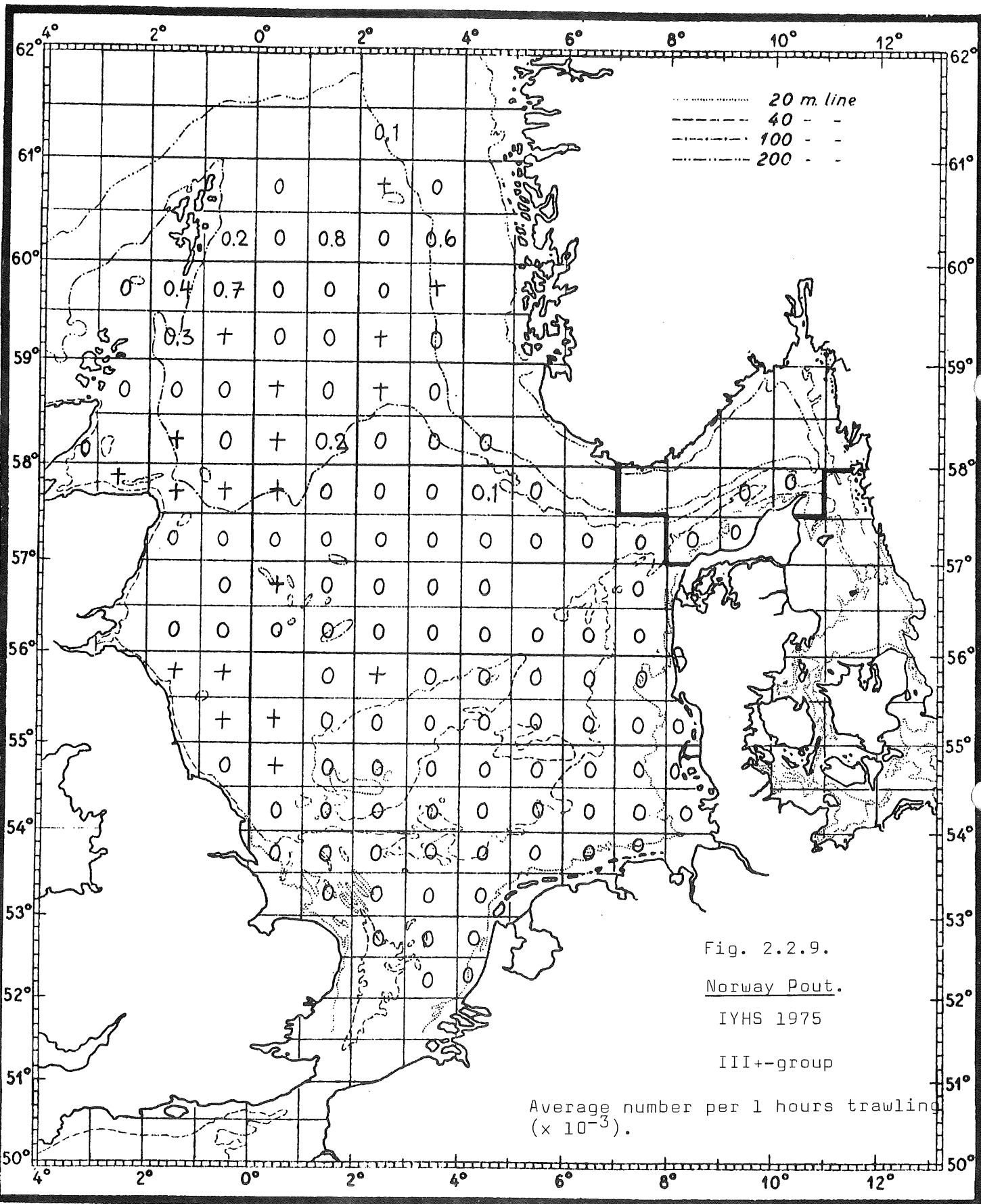
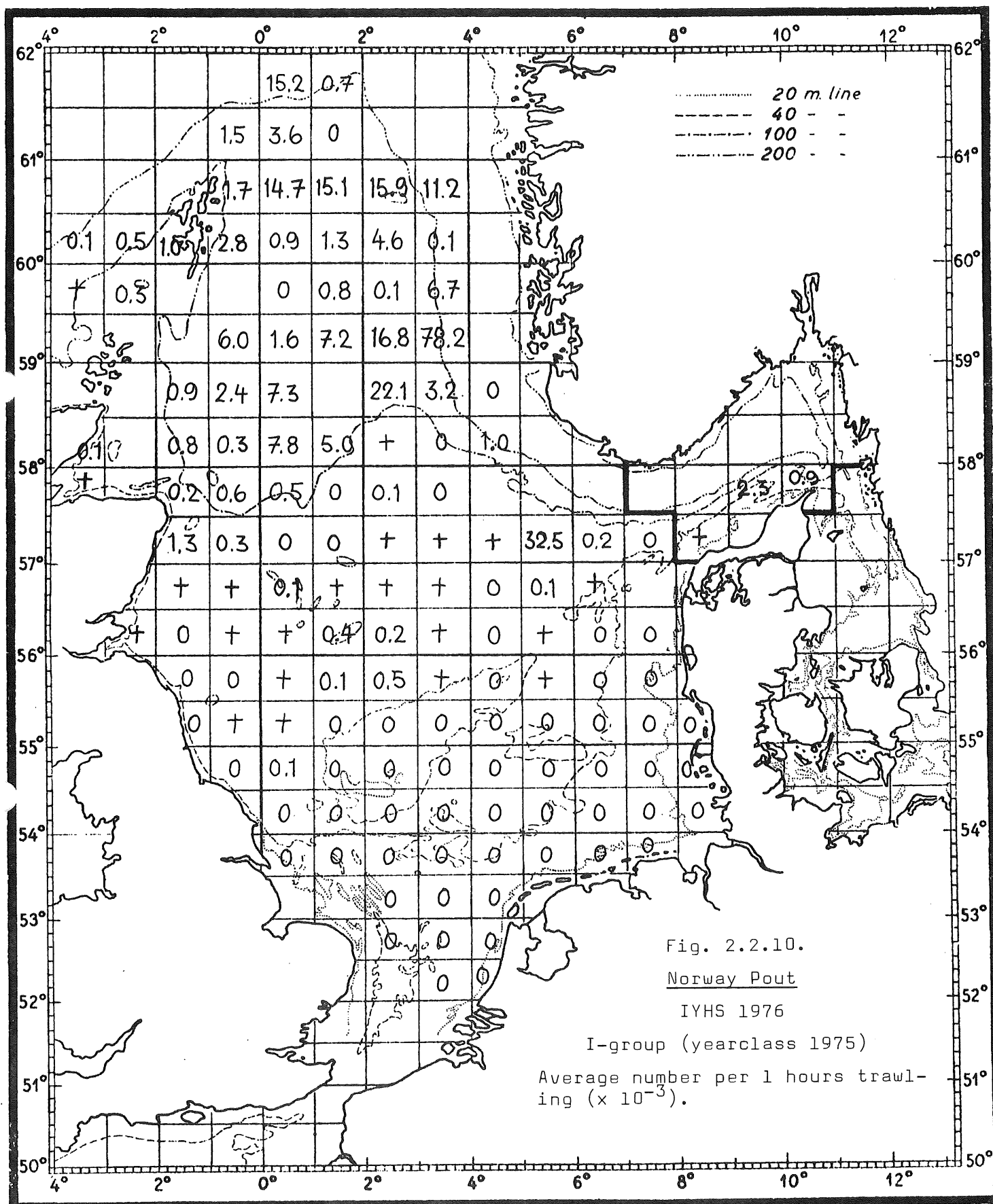
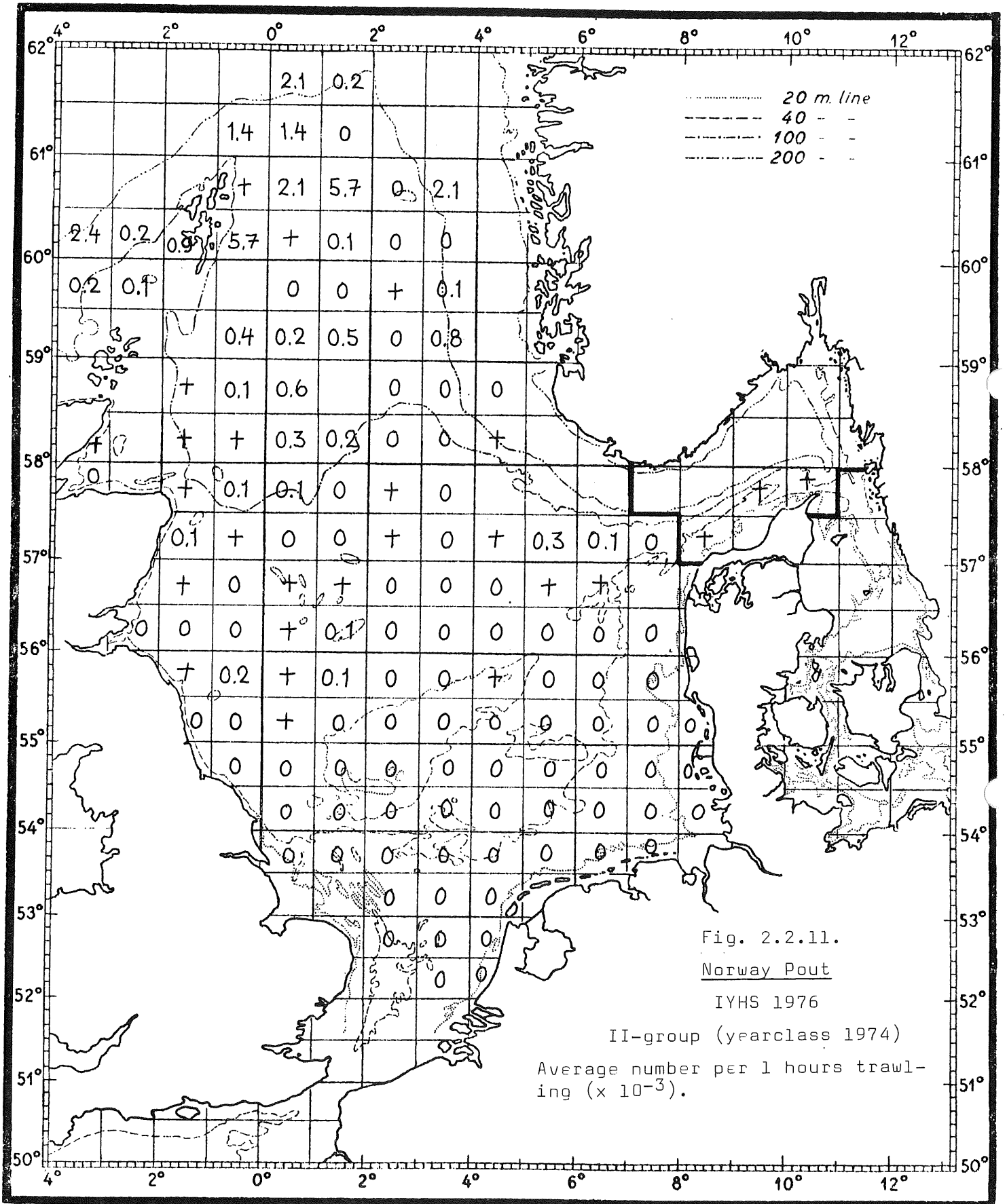
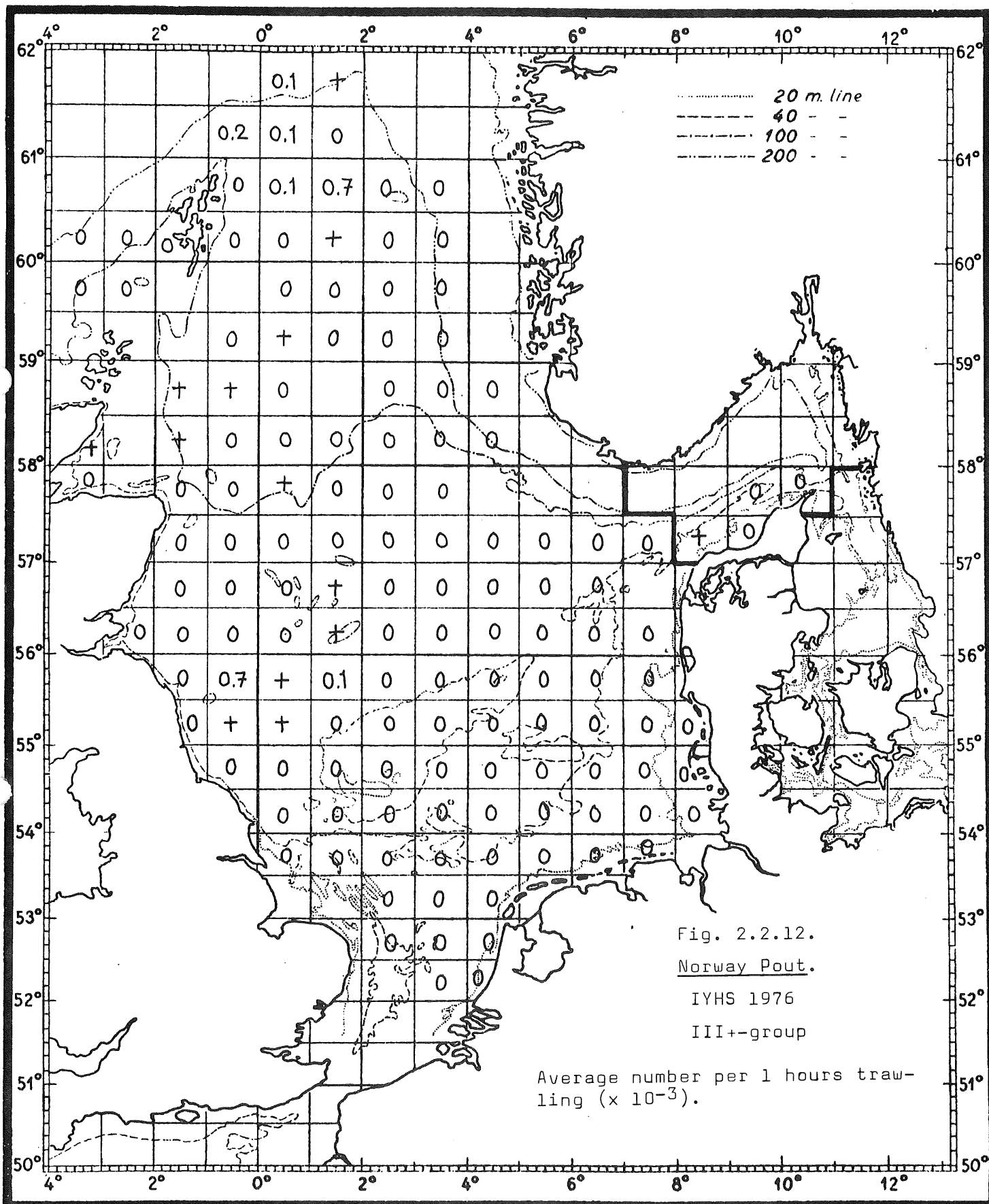


Fig. 2.2.9.  
 Norway Pout.  
 IYHS 1975  
 III+-group

Average number per 1 hours trawling  
 ( $\times 10^{-3}$ ).







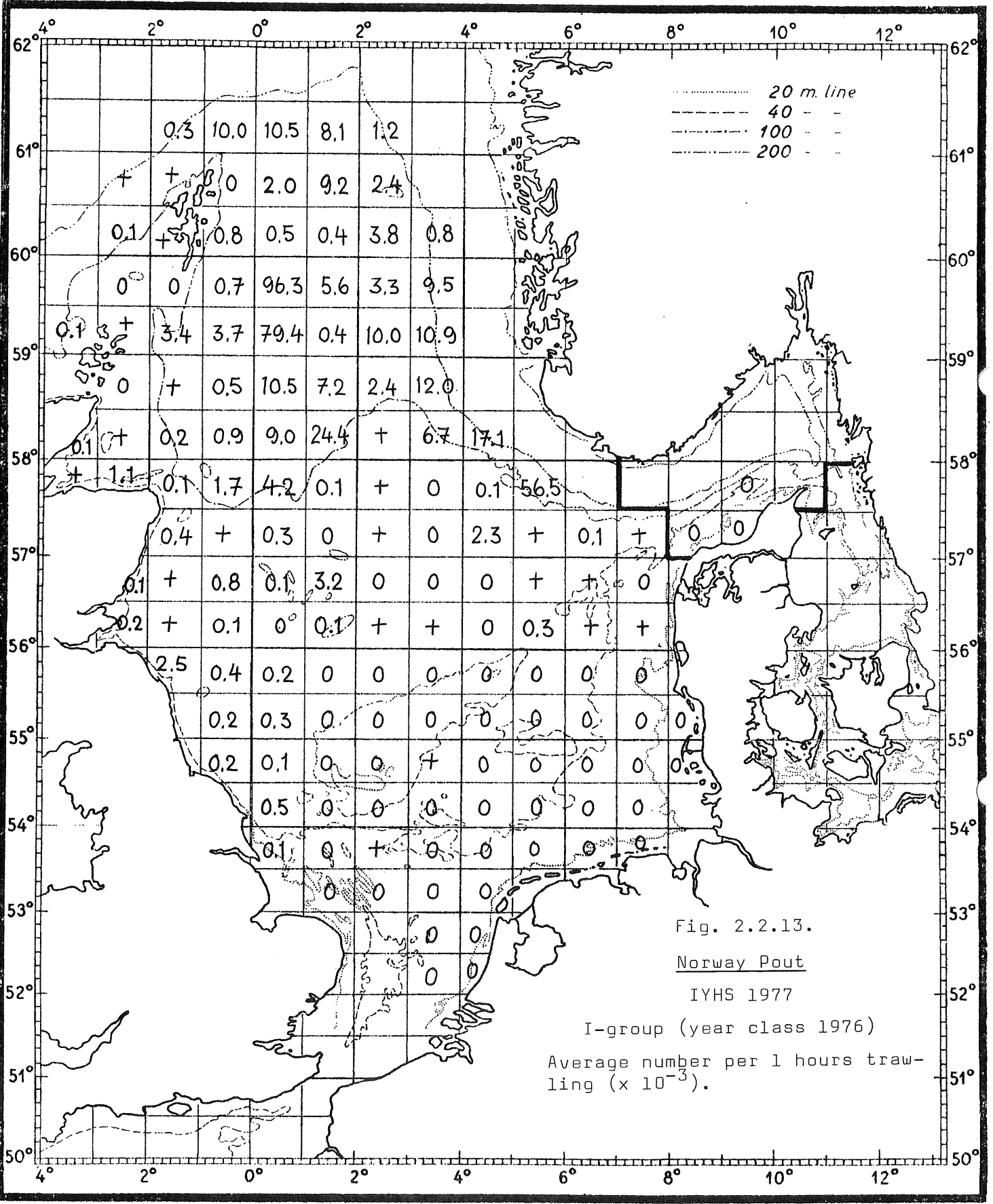
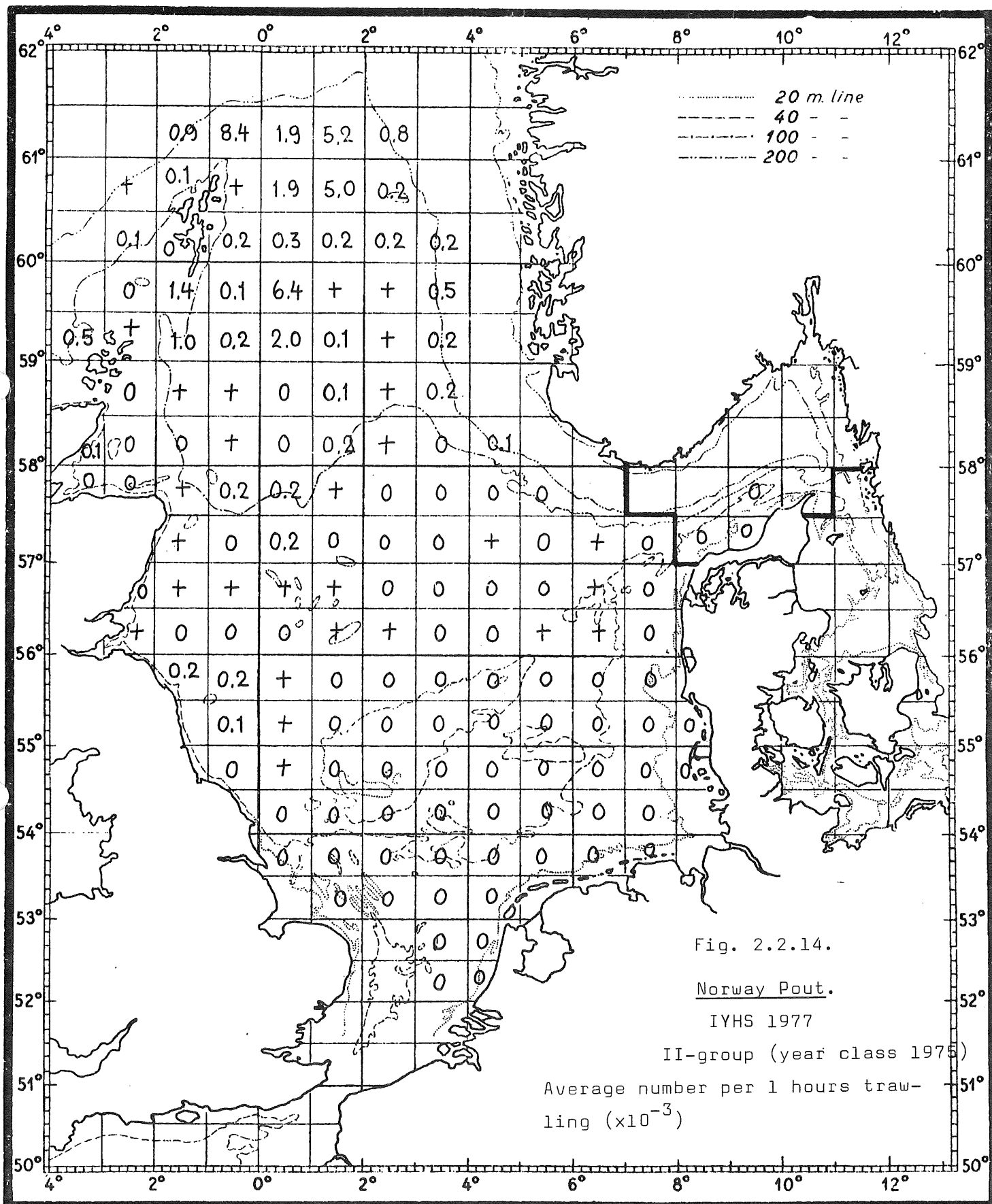


Fig. 2.2.13.  
 Norway Pout  
 IYHS 1977  
 I-group (year class 1976)  
 Average number per 1 hours trawling ( $\times 10^{-3}$ ).



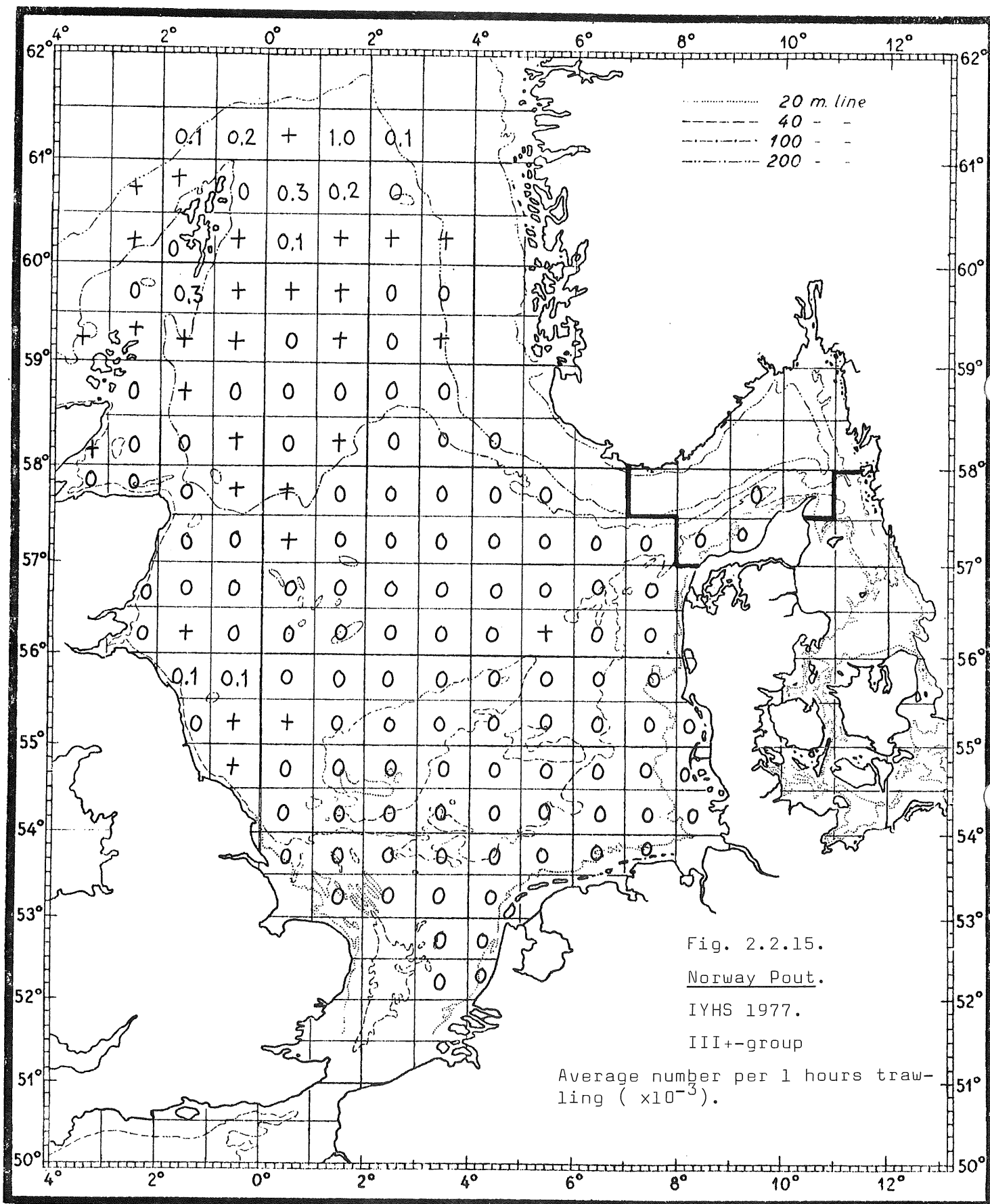




Fig. 2.3.1 Norway Pout. Mean length at age.

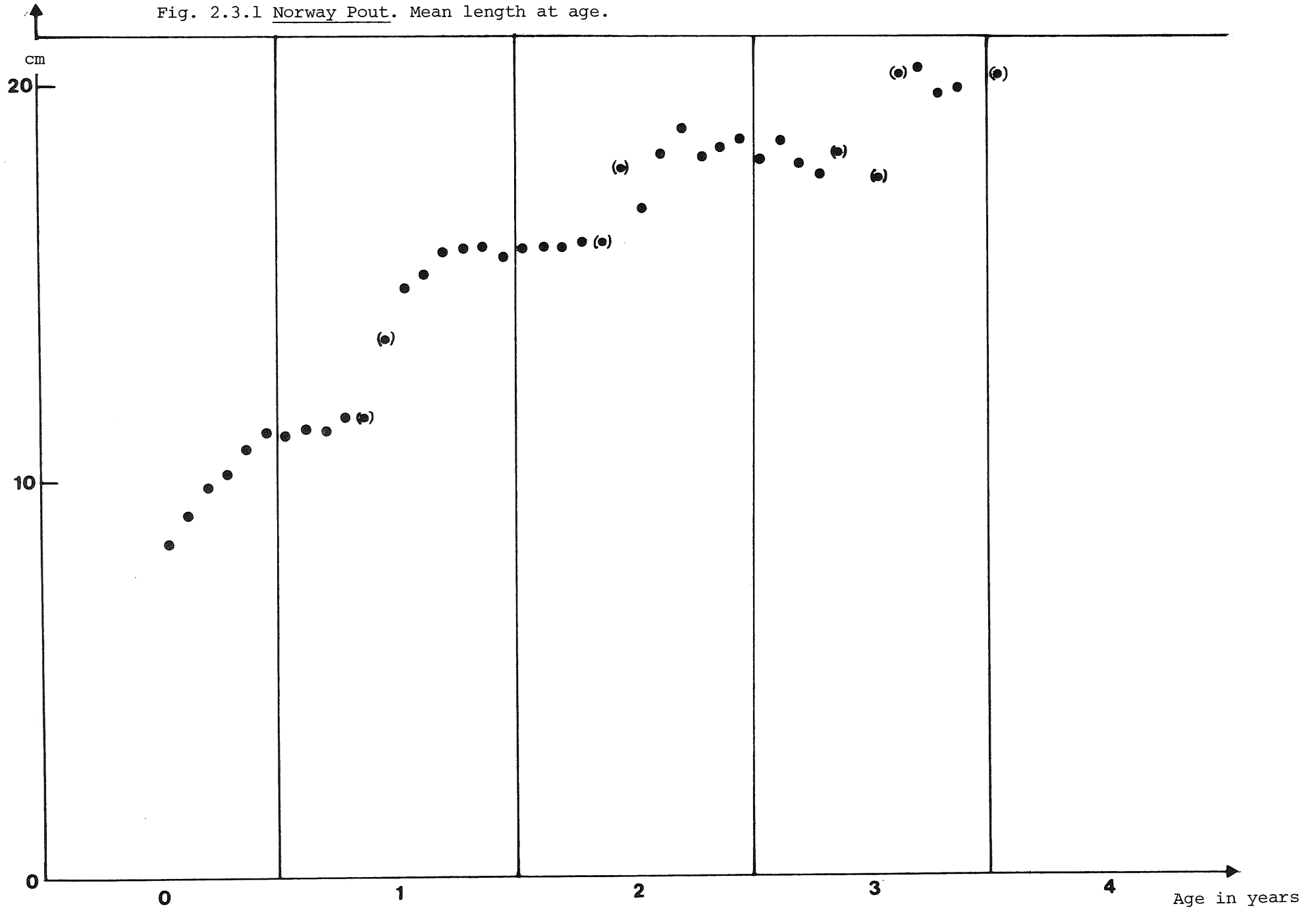
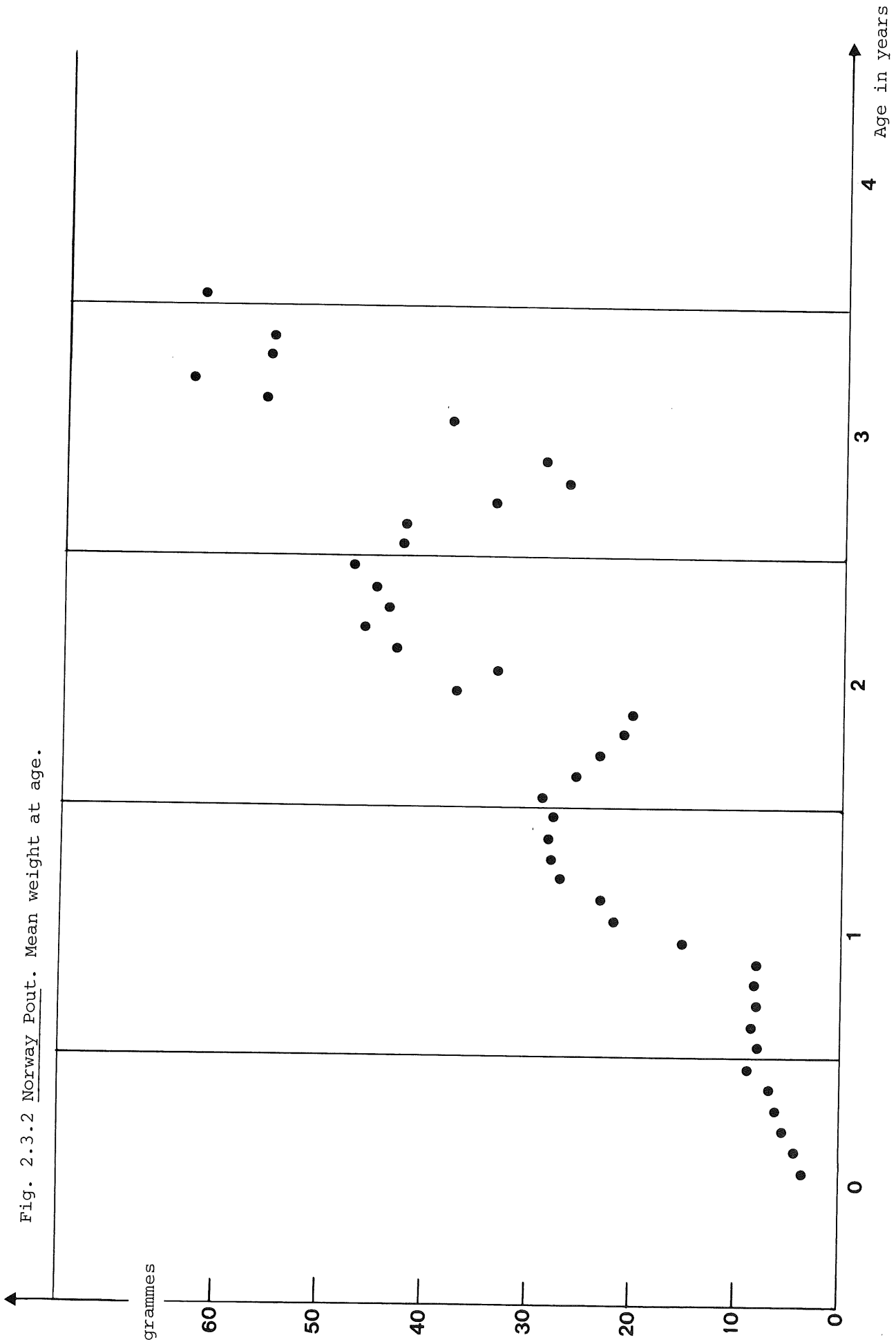
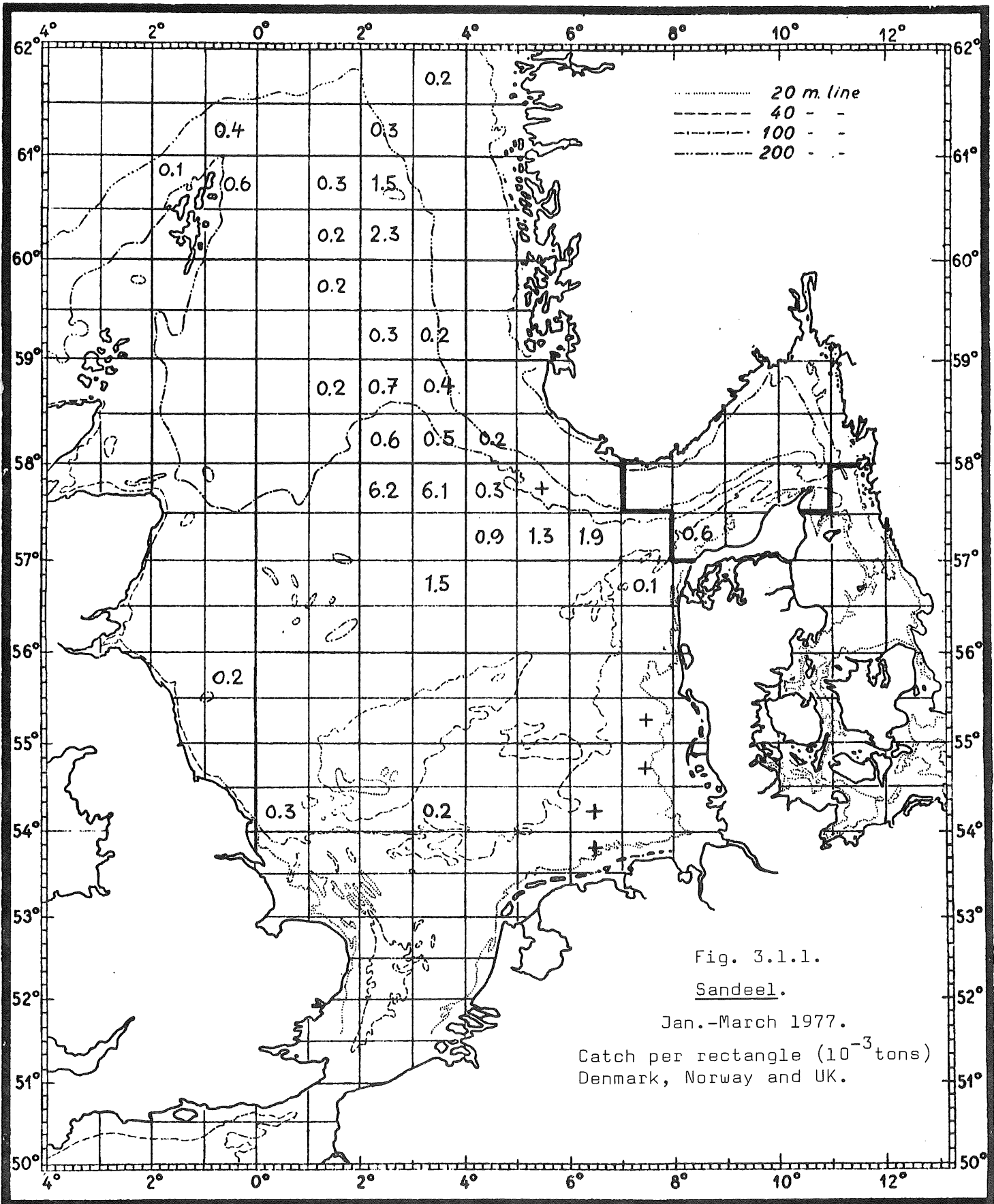


Fig. 2.3.2 Norway Pout. Mean weight at age.





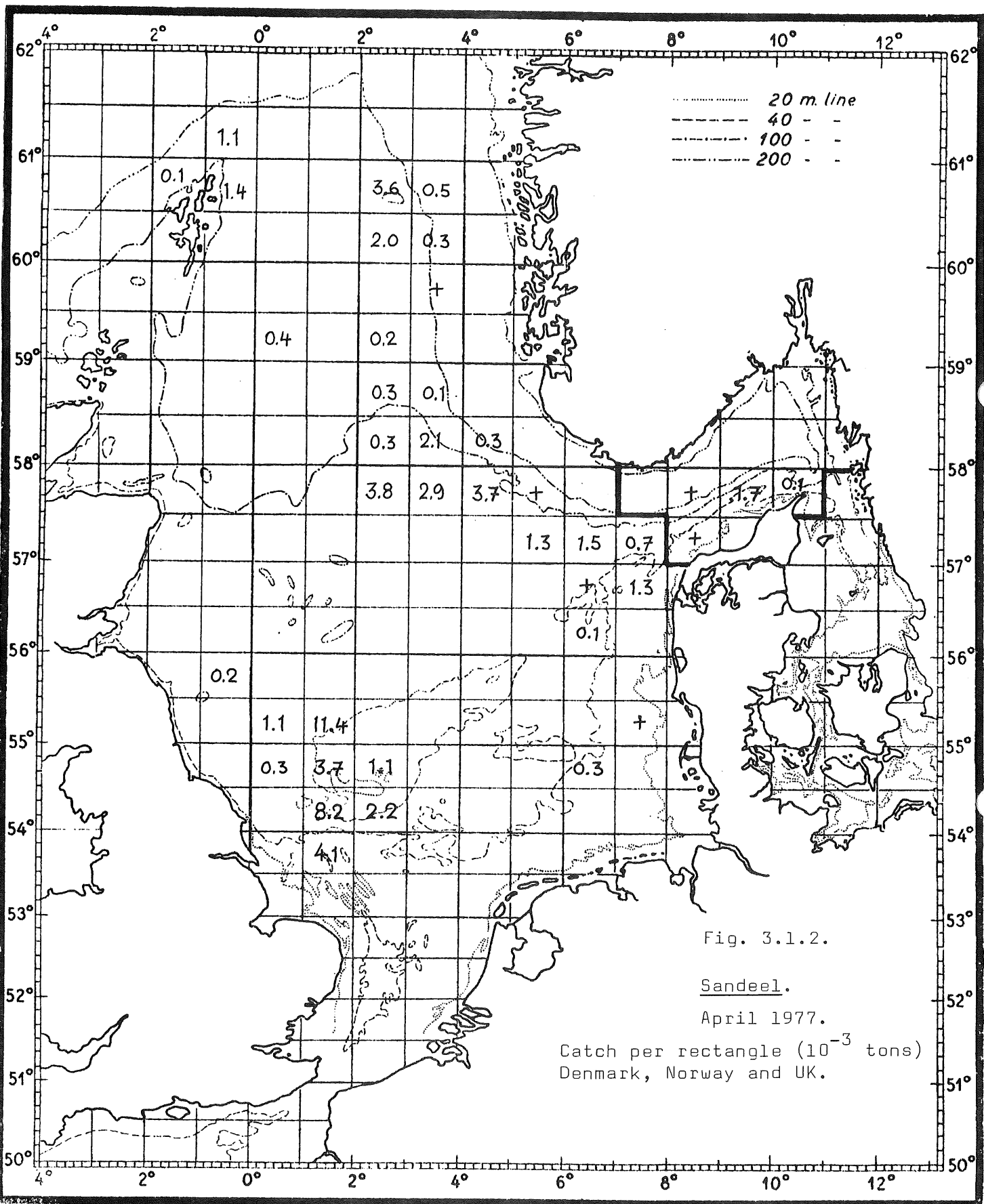


Fig. 3.1.2.

Sandeel.

April 1977.

Catch per rectangle (10<sup>-3</sup> tons)  
Denmark, Norway and UK.

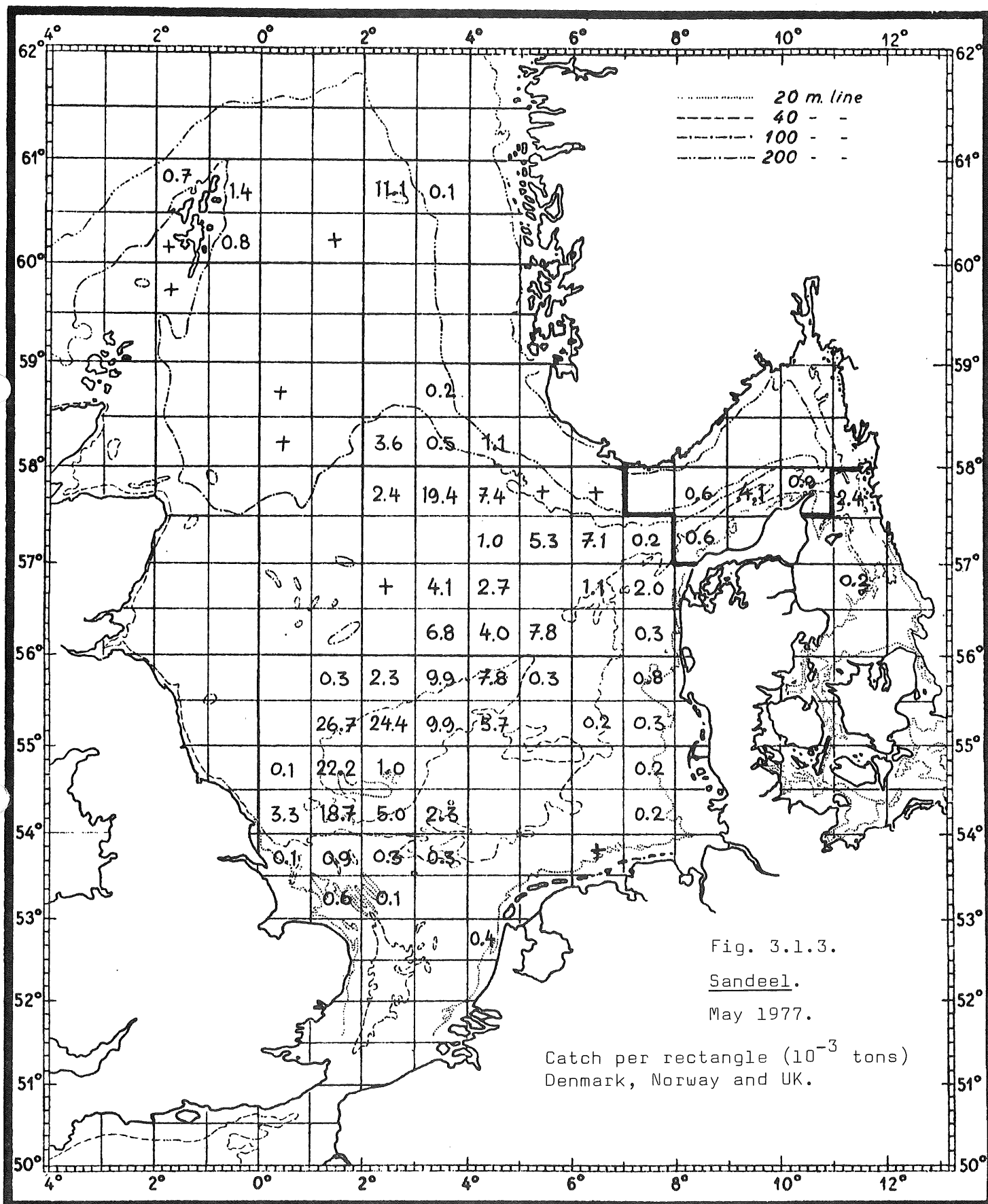


Fig. 3.1.3.

Sandeel.

May 1977.

Catch per rectangle ( $10^{-3}$  tons)  
 Denmark, Norway and UK.

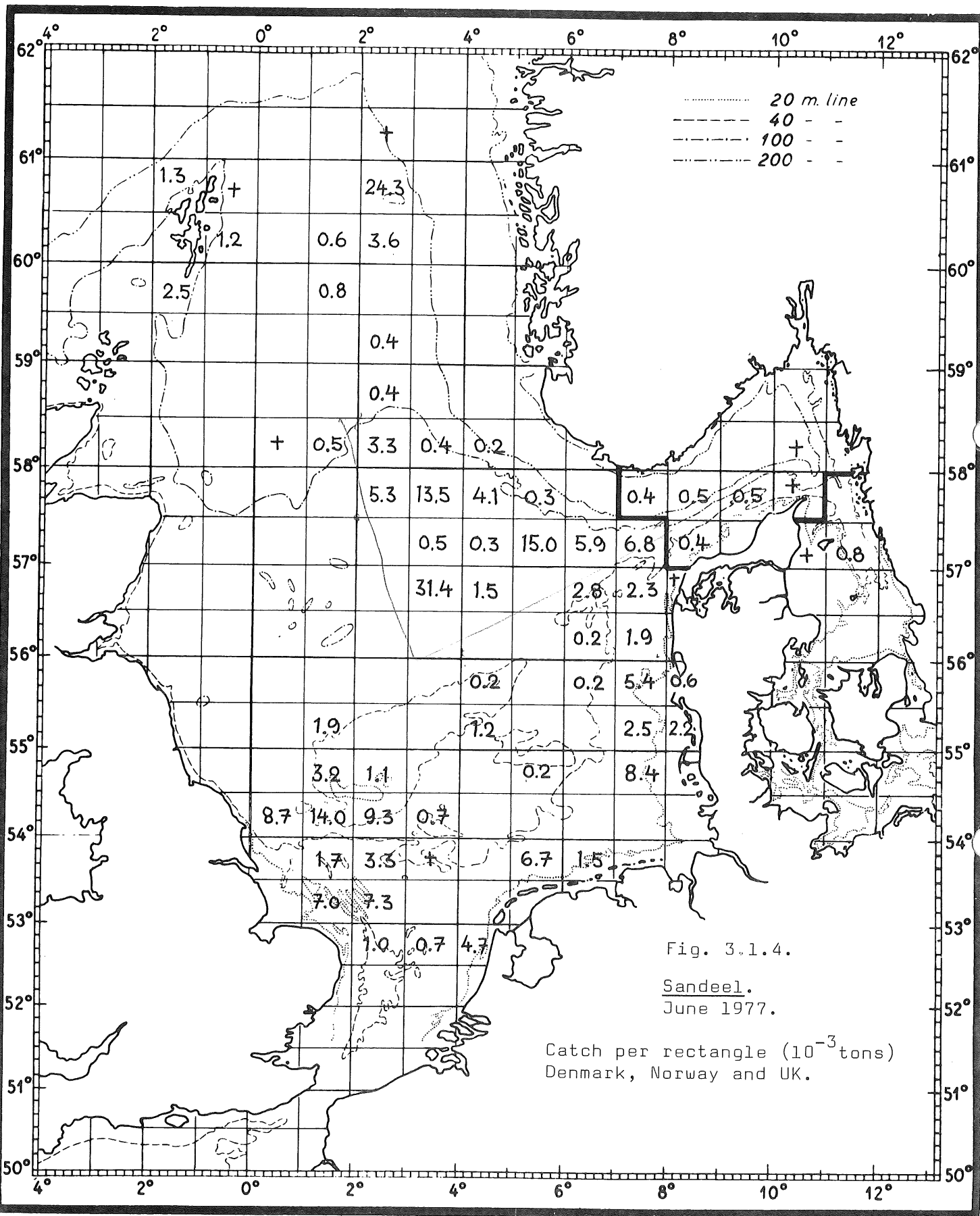


Fig. 3.1.4.

Sandeel.  
June 1977.

Catch per rectangle ( $10^{-3}$  tons)  
Denmark, Norway and UK.

580

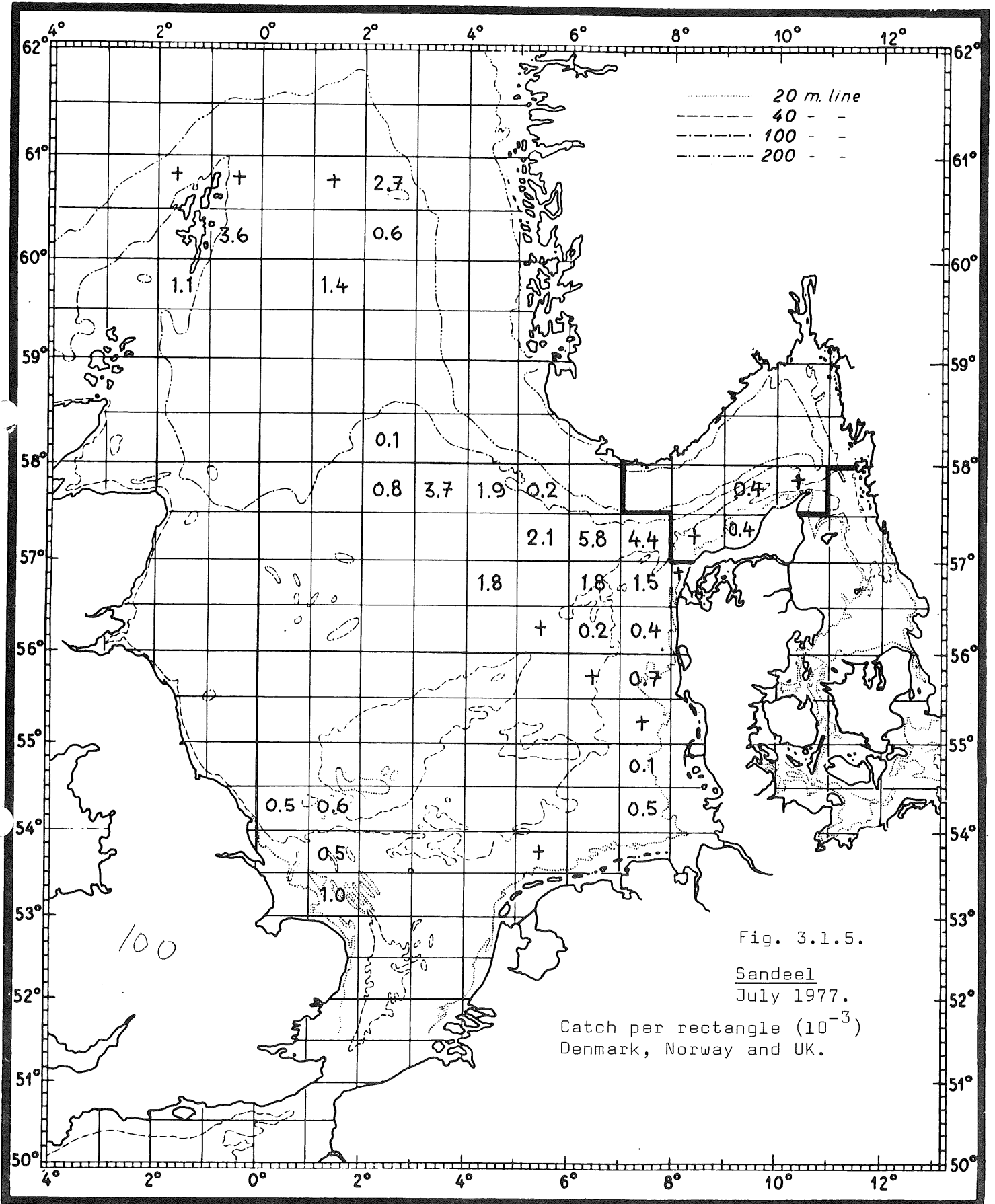
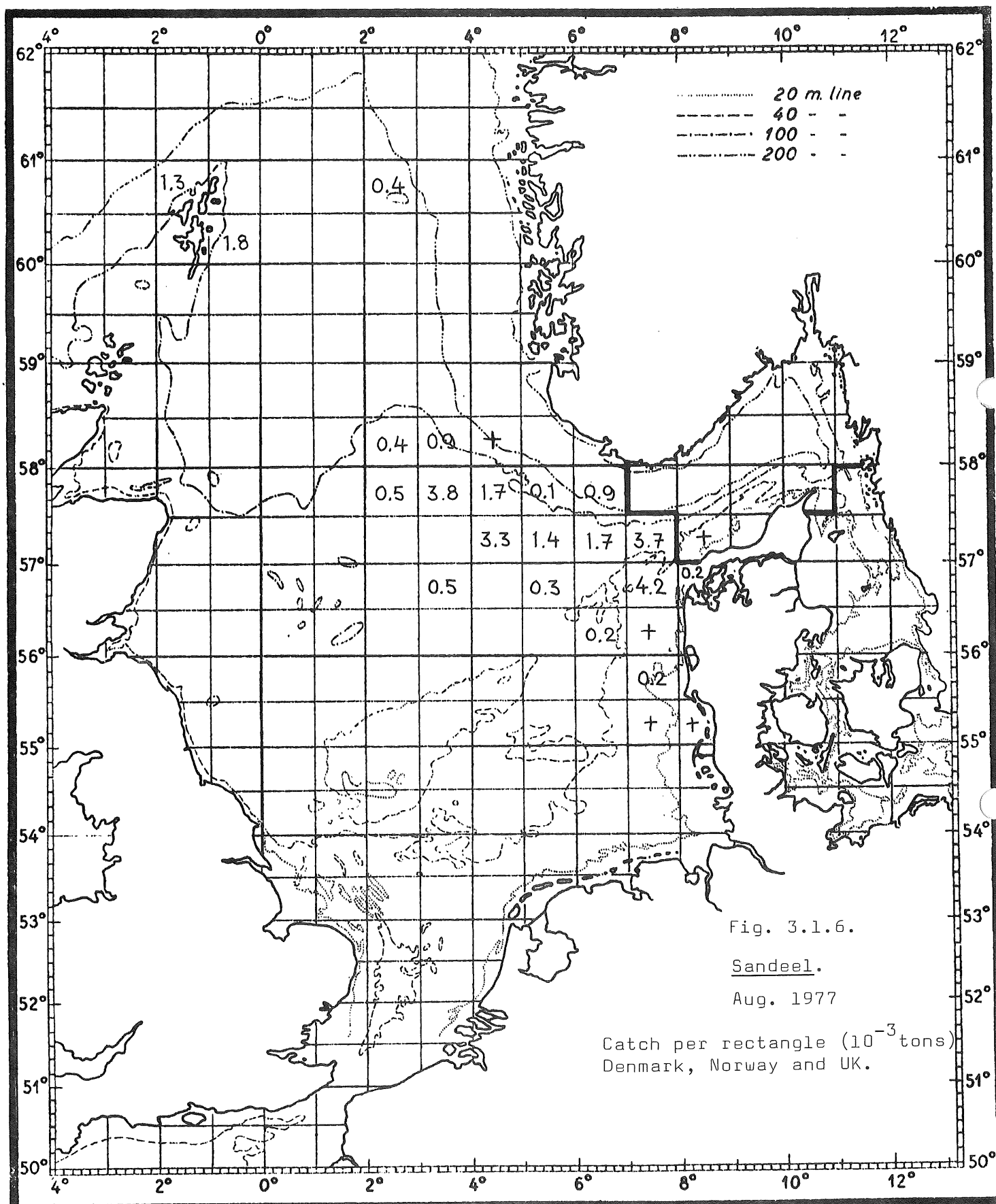


Fig. 3.1.5.

Sandeel  
July 1977.

Catch per rectangle ( $10^{-3}$ )  
Denmark, Norway and UK.





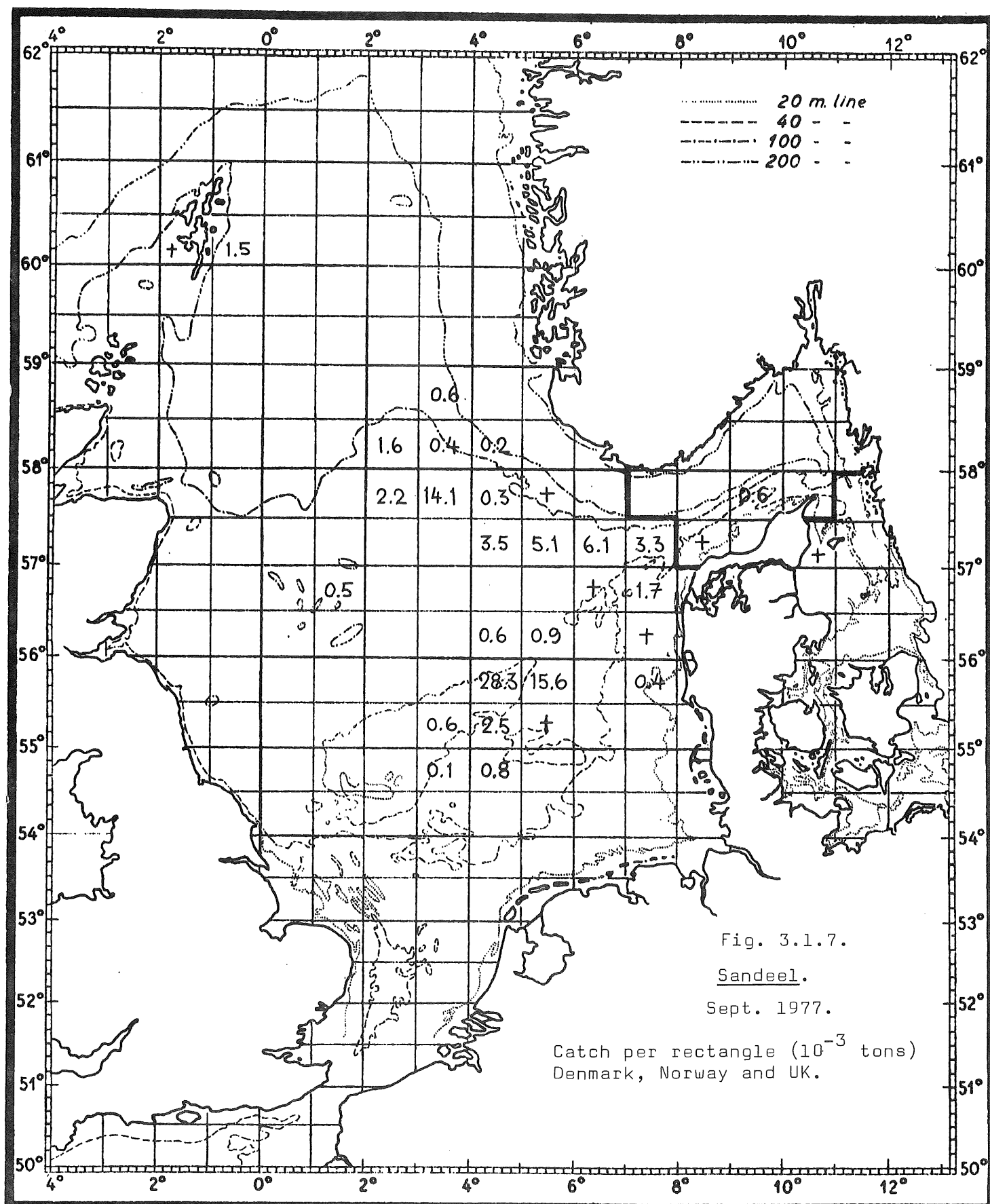
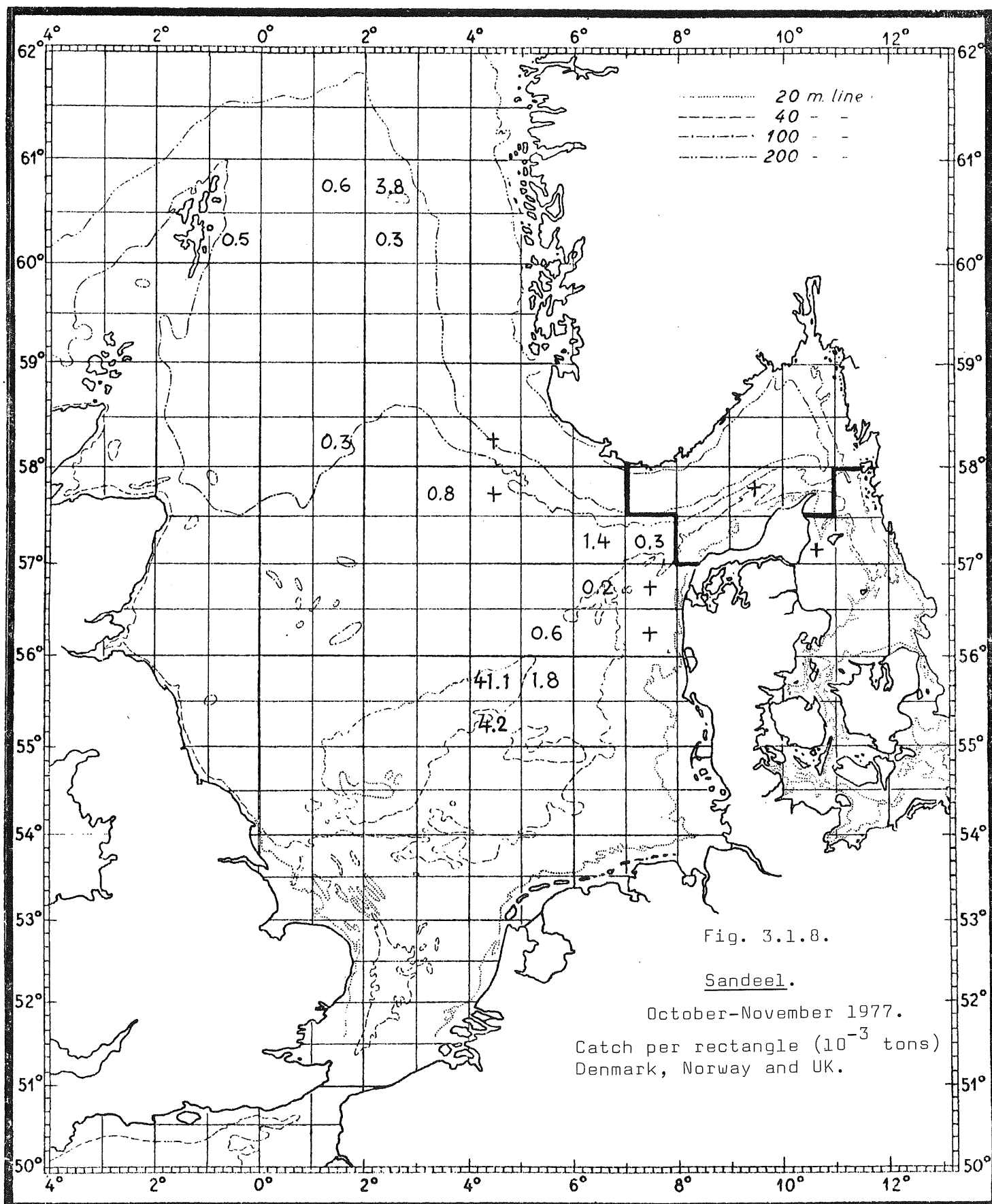


Fig. 3.1.7.

Sandeel.

Sept. 1977.

Catch per rectangle ( $10^{-3}$  tons)  
 Denmark, Norway and UK.



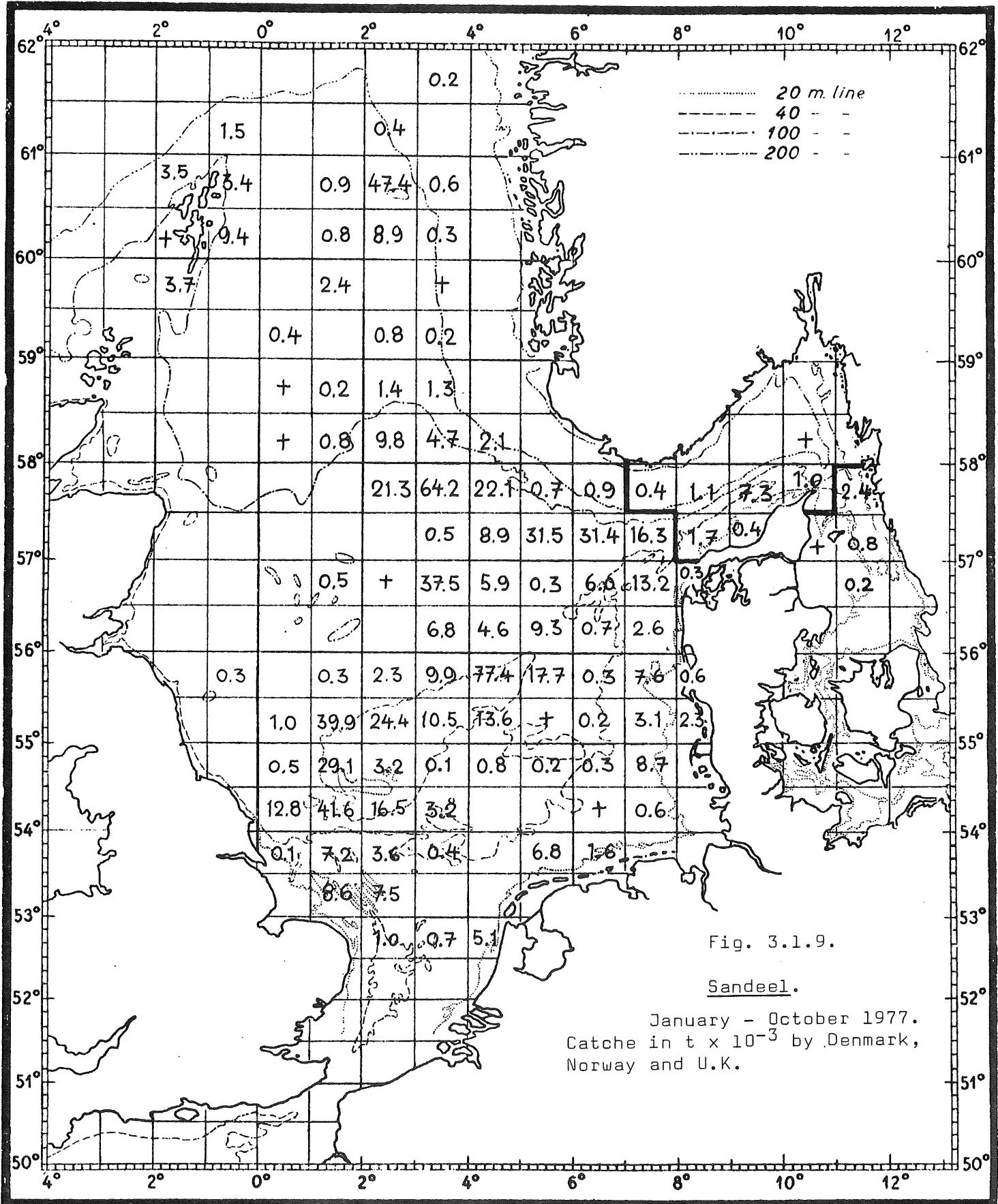


Fig. 3.1.9.

Sandeel.

January - October 1977.  
 Catches in  $t \times 10^{-3}$  by Denmark,  
 Norway and U.K.



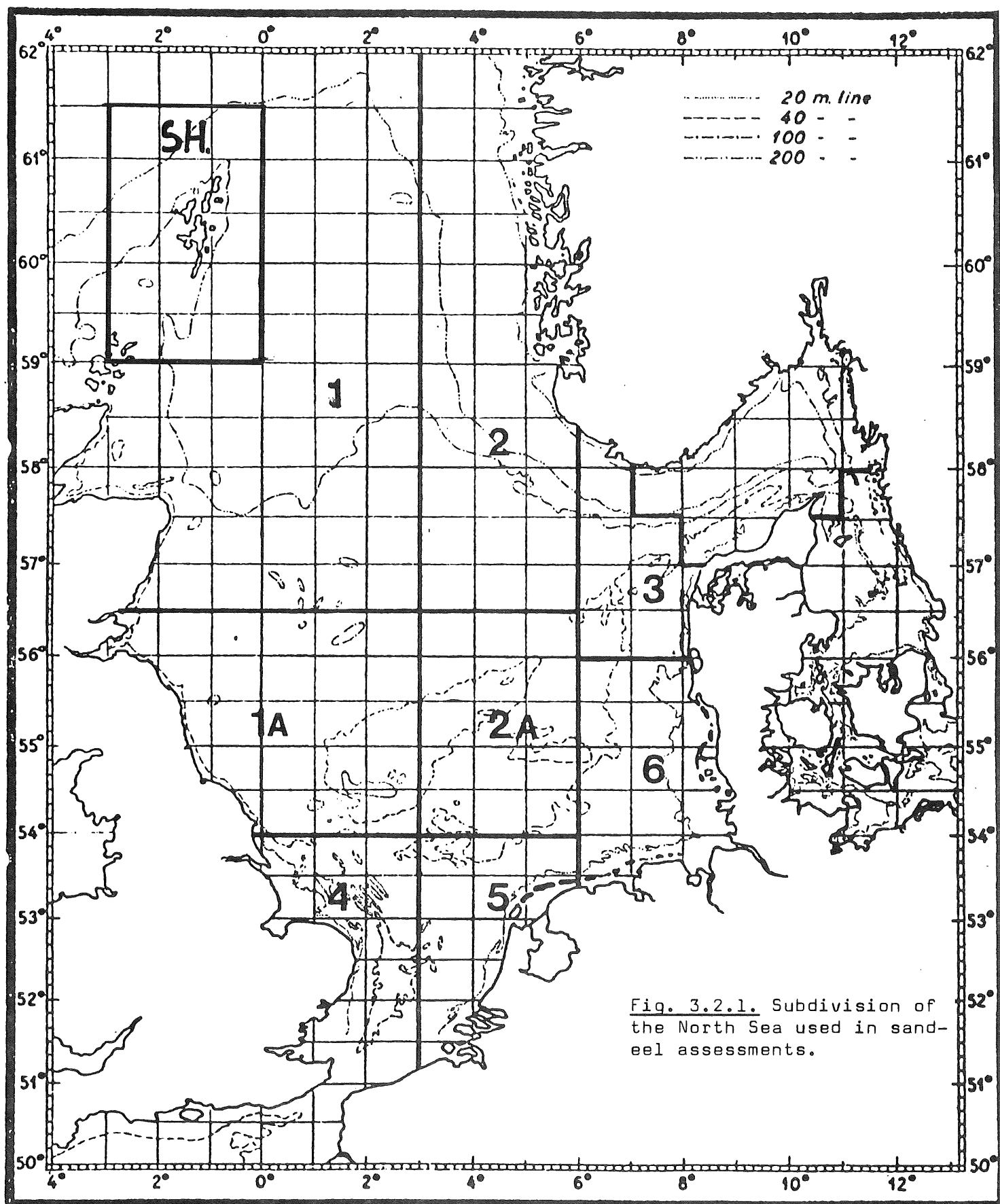


Fig. 3.2.2 Sandeel. Mean length at age.

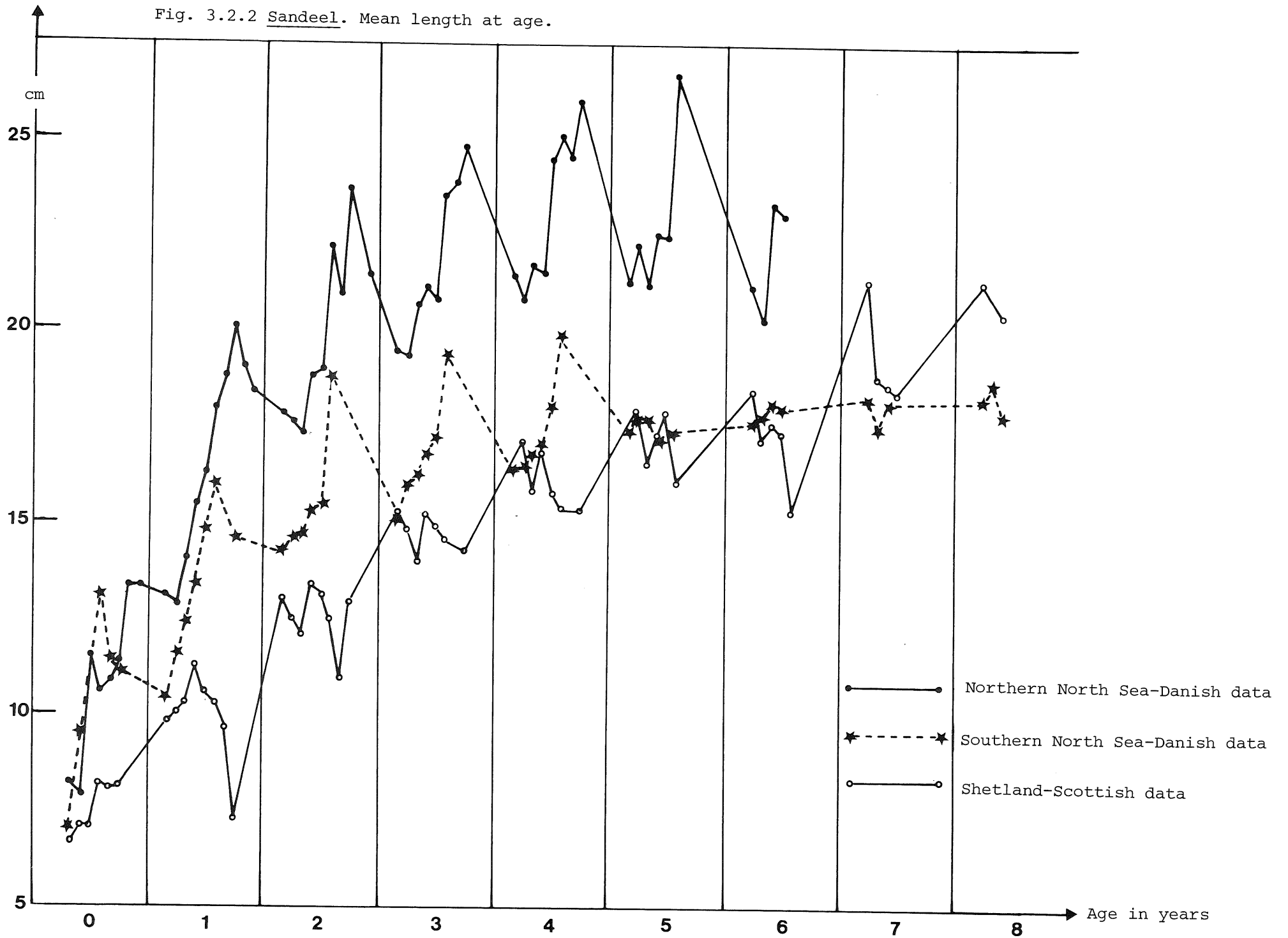


Fig. 3.2.3 Sandeel. Mean weight at age.

