

International Commission for



the Northwest Atlantic Fisheries

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(Corrigendum)

ANNUAL MEETING - JUNE 1978

Subarea 1 cod: Data for 1976-77 and first months of 1978,
and estimates of biomass and yield, 1978-80

by

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Table 16, page 35 of Res. Doc. 78/VI/44:

The upper part of the table should for Strategy 3 read as follows:

	F	0.40
1981	sp. stock	160(37)
	F	0.40
1982	sp. stock	119(28)



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1. Nominal catches 1976 and 1977

TAC for Subarea 1 cod was 45 100 tons for 1976 and 31 000 tons for 1977. Total nominal catch in 1976 was 33 286 tons (Table 1), i.e. about 11 800 tons below the allowance. Some countries were, however, fishing very close to their quota so that although the total catch was below TAC the regulation may, nevertheless, have influenced the total catch. For 1977 the provisional, nominal catch is about 35 600 tons (Table 2), i.e. exceeding the TAC by about 4 600 tons. Since some fleets, amongst these also the Greenland trawlers, were actually stopped in their direct cod fishing for the last half of the year it may be concluded, that catches would have been higher, if the TAC had been higher. Trends in nominal catches over the last years can, therefore, not be used directly as indices of trends in stock abundance and/or availability, but it is (as usual) necessary to include effort figures when making comparison between years. However, the local, inshore fishery by Greenland fishermen has not been restricted, and their catch, mainly by pound nets, decreased steadily since 1968 to a low of 5 174 tons in 1976 but increased to about 14 000 tons in 1977, mainly as a result of the recruitment of the 1973 year class to the fishery.

The increase in inshore catches and the restrictions on trawling caused some changes from 1976 to 1977 in the ratio between various gears' catches. About 58% of the 1976 catch but probably only 34%^{x)} of the 1977 catch were taken by trawlers, and only for these vessels does it seem possible to consider trends in effort.

2. Trends in catch per unit effort

Table 3 gives figures by divisions for the FRG trawlers' catch and effort in 1975, -76 and -77 (figures for 1977 are provisional figures as supplied by Dr. Messtorff, FRG, for the April 1978 Assessment Meeting).

^{x)} This figure may increase when detailed information on Faroese catch in 1977 becomes available.

Table 4 gives the data for the Greenland trawlers for the same years. The overall catch per unit effort of cod for FRG decreased by about 30% from 1975 to 1976 but was rather stable for the Greenland trawlers. However, for both countries there was a steep decline in catch rate in Div. 1C between the two years. A further abrupt decrease in catch rate is noted for FRG from 1976 to 1977, but this is not reflecting a change in the cod stock; rather it is due to the fact that fishing for cod was restricted and that the fleet went fishing for redfish instead. The FRG catch of redfish in the Subarea increased from 5 000 to 25 000 tons from 1976 to 1977, the highest catch since 1964. Also the Greenland trawlers had their cod fishery restricted in the last part of the year, and some of them went fishing for shrimp instead or to East Greenland waters. Effort of their shrimp fishery is not included in Table 4 but still the change in c.p.u.e. figures from 1976 to 1977 cannot be used directly as indices of abundance of cod since distribution of effort between months was not the same for the two years. A better comparison may, therefore, be made by comparing on a monthly or quarterly basis. Data for the Greenland trawlers for January-February are listed in Table 5, including data for January and for a few trawlers part of February 1978. The table shows the same steep decline in catch rate for Div. 1C from 1975 to 1976 as does Table 4, and also a considerable increase in catch rate in Div. 1E between the two years. From 1976 to 1977 the overall catch rate for the two months increased by 65%. The increase was more pronounced for Divs. 1E and 1D than for Div. 1C. Comparing January-February of 1978 to 1977 there is a further 30% increase in overall catch rate, but comparing by divisions, there is a decrease in Divs. 1D and 1E but a considerable increase (56%) in Div. 1C. The overall increase is achieved by concentrating effort in Div. 1C. Figs. 1 and 2 shows the distribution of the fishing in January-February of 1978. Evidently cod was concentrated on the slopes of the Banana Bank and of the southern part of Lille Hellefiskebanke. This is discussed further in the next section.

As mentioned above the FRG effort in 1977 as listed in Table 3 was to a great extent spent on fishing for redfish, and the effort figures cannot be used to compare effort in the cod fishery between the two years. Assuming, however, that the Greenland trawlers' catch rate can be taken as an index for the total fishery, then it is likely that total effort on cod was about halved from 1976 to 1977. However, in terms of fishing mortality the situation is rather complicated because trawlers' effort apply for only about 1/3 of the overall effort in 1977. The two other components of the fishery, i.e. the offshore gill net and long line fishery and the inshore fishery, mainly by pound net, accounting for about 1/4 and 1/3 of the total catch, respectively, but have completely different fishing pattern (in terms of age distribution of catches) differing also from that of the trawlers.

3. The stock by January-February 1978

As demonstrated by Table 5 and Figs. 1 and 2 there is (was) a concentration on cod in the southern part of Div. 1C in the first part of

1978, and Greenland trawlers (only Greenland is allowed some fishing in 1978) concentrated here. Two samples of their landings are shown in Table 6 and illustrated in Fig.3.

Due to the concentration of the limited amount of effort in a rather narrow area it is at present not known to what extent cod is distributed in a wider area than the one fished. A survey is in progress, but results will not be available until later. Tables 4 and 5 will, however, suggest that during 1977 a general improvement in catch rate and thereby possibly also in stock abundance took place, and that by the winter 1977/78 the major concentrations of the offshore stock was found in the southern part of Div. 1C. These concentrations seem to be spawning shoals. This latter fact may explain the rather sudden increase in mean length and weight of the 1973 year class (age group V in Table 6) compared to figures obtained from samples in 1977 (Tables 7 and 9-10). It is suggested that the fastest growing individuals of the 1973 year class matured in the winter of 1977/78 and joined the spawning concentrations.

It is further suggested, that the general increase in stock abundance is due to a migration of adult cod from East to West Greenland waters during 1977, caused by an extraordinary heavy inflow of warm water at the western slope of the West Greenland fishing banks (to be described in the Danish Research Report, 1977). The trawlers have also observed haddock in the catches.

The warm water by itself may also have caused an increase in growth rate, but most likely the observed high mean weight of the 1973 individuals by January-February 1978 is due to a separation of the year class in a widely distributed (to a great extent inshore) immature component and a component of faster growing mature individuals, the latter being the one fished at present by trawlers, the former possibly to contribute to the inshore pound net fishery later this year.

4. Mean length and weight of age groups in 1976 and first part of 1978

Age and length samples of cod in Subarea 1 and at East Greenland for 1977 has been provided by Denmark(G) and FRG. Also Denmark(F) has been sampling off East Greenland.

Portugal supplied length samples of their gill net catches.

The FRG and Portuguese samples provide figures for mean length and weight for each total sample, but time has not allowed the author to make a break down by age groups. The samples by Denmark(G) give mean length and weight by age groups as listed in Table 7, while Table 8 gives the overall mean length and weight in the FRG samples. Table 8 has been extended to include also samples from the last quarter of 1976 since these were not available at last year's Assessment Meeting of ICNAF.

The mean weights listed in Table 8 have been used to calculate numbers caught by FRG and Portugal while the data in Table 7 were used on the Greenland samples and catches. The Portuguese samples were considered also to cover the Faroese and the Norwegian gill net fisheries from where no samples were available.

As will be seen from Table 7 the material for age groups older than 7 years is very limited. For age groups 3 to 7 the quarterly mean weight figures from the Greenland material are given in Table 9 and 10 for the offshore and inshore samples, respectively. The weighted annual mean for the offshore samples has been obtained by weighting factors as given in Table 11, being the quarterly catch distribution. As shown in Table 9, for age groups 3 to 7 in the offshore fishery the 1977 mean weight was generally below that of 1976. The reason for this is to some extent due to the fact that by far most of the offshore fishery in 1977 took place in the first half of the year.

The 1978 samples (January-February), Table 6, show much higher mean weight for the various age groups represented in Tables 9 and 10. The possible reason for this has been discussed in Section 3.

These variations in weight by age do not matter much when calculating numbers in the catch provided that sampling is representing all gears and seasons. However, the situation is more complicated when forecasts are made. It seems necessary to obtain a weighted overall mean weight for each age group, where the weighting factor is the catch by gear and season. It seems likely that some strict quotas will be set for the next few years. This could mean, that trawlers (if allowed fishing) will concentrate their effort in the first part of the year as in 1977 and probably even more so in 1978 so that for this fishery the weight figures in Table 6 might be the most proper. It should be remembered, however, that the slower growing individuals of the year class 1973 are likely to join the spawning shoals by 1979 so that the high figures for age group 5 may not be projected to a much higher figure for age group 6 in 1979. The greatest uncertainty for the 1979 situation is whether the 1975 year class will form immature concentrations worth while fishing (in terms of catch rate) compared to the spawning schools to give a situation similar to the 1973 year class in the 1977 fisheries. In Table 14 it has been supposed that trawling in 1978 will continue to fish spawning schools as long as it is allowed to take place, whereas in 1979, when the 1975 year class enters the fishery, the situation may be somewhere in between the 1977 fishery and the 1978 fishery.

For gill net fisheries in both years it seems likely that the weight by age will continue to be relatively high for the younger age groups due to the selectivity of the gear. For these gears the figures in Table 6 may be proper although used on the Portuguese 1977 samples they lead to somewhat lower mean weight than given by Portugal (14-23% below). For the inshore fishery the figures in Table 10 are suggested.

For age groups older than 7 years the 1977 material is so sparse that instead the previous figures (Res.Doc. 77/VI/8, table on page 3) is used.

Table 14 shows how the overall weights by age for the forecast years have been derived at. For 1979 two options are given, but several more could be constructed.

5. Numbers landed by age groups in 1976 and 1977

Numbers landed per age group for the years 1965-73 are found in Res.Doc. 75/31, for 1974 in Res.Doc. 76/VI/17 and for 1975 in Res.Doc. 77/VI/8 together with provisional figures for 1976.

Revised figures for 1976 and provisional figures for 1977 are found in Table 12. As expected the 1973 year class, which started recruiting to the fishery in 1976, was by far the most abundant in the 1977 landings from Subarea 1, accounting for about 76% (by number) of the total landings.

The fisheries by otter trawl off Southeast Greenland, conducted by FRG (3 385 tons) and Denmark(G) (775 tons) was well sampled by FRG. The estimated numbers landed per age group in this area are also listed in Table 12. The total does not include catches by a Faroese long-liner, which made a survey in the area between 62°30'N lat. and 66°N lat. in the period 29 August to 13 October and caught about 27 000 cod or close to 100 tons (Hoydal, 1977). The mean weight of ^{cod in} the long-liner's daily catch ranged from 2.8 to 5.7 kg, indicating that the catch contained more older individuals than the trawl catches, probably many individuals of the 1968 year class (details of samples are not yet available).

The trawl catches off Southeast Greenland, taken mainly south of 63°N lat., contain relatively less individuals of the 1973 year class than the Subarea 1 catches (59% versus 76%). The 1973 year class has probably not yet started a spawning migration to Southeast Greenland (but some grew up there), and especially in the winter of 1977/78 the tendency would not have been pronounced due to the inflow of warm water from Southeast Greenland to West Greenland, see Section 3. Rather it seems likely that a further inflow of the year class from Southeast to West Greenland may have taken place recently, partly explaining the surprisingly high estimate of the absolute strength of the 1973 year class in the analyses.

6. Information on future recruitment

Recruitment of Subarea 1 cod to the fisheries normally starts at an age of 3-4 years. Even 2-years old fish may be seen in the pound net catches, but they will normally be discarded. The year classes in question for the 1978-80 fisheries are thus year classes 1974-77.

The strength of the 1977 year class can at present be made only on hydrographic and plankton observations in 1977. These will be described in details in the Danish Research Report, 1977. In brief, following an unusually mild winter the water temperatures in the spring and summer of 1977 were very favourable. The number of cod larvae in the plankton was, however, low. The plankton contained many Ctenophores (Beroe), and plankton nets may, therefore, not have fished as effectively as usual. However, the low number of larvae may also confirm the general concern that the spawning biomass was very low in 1977, the 1973 year class not yet being mature at that time. It will, however, be very interesting to get further information on the 1977 year class when it enters the research catches this year and in 1979.

The 1976 year class did not have the same good environmental conditions in its larval stage as the 1977 year class. Only in one of the research

catches (FRG in Div. 1E in December, 1977) does the year class occur as 15-24 cm long individuals, making up 7% of the sample. So far it is considered as a poor year class.

For the 1975 year class it has been stated earlier that the environmental conditions in 1975 were such that the year class could be of moderate to average size. In 1977 the year class has turned up in the inshore pound net catches, from which it has been discarded, being only small fish in the range of 15-30 cm. Its relatively greatest inflow seems to occur in the Div. 1B catches (up to 69% by number in one case), but a discard rate of 50% for some inshore pound net catches in Div. 1D also points to a relatively good abundance here. Unfortunately, pound net catches were not sampled in Divs. 1E-1F. It is remarkable, however, that the year class was not observed in the FRG research catches in December in Divs. 1E-1F, not even in the catch which contained some 1-year old cod (see above for year class 1976). Danish research hauls (shrimp trawl) in Div. 1E showed some individuals of the year class to occur here in April, but none were caught in October. In Div. 1D some few individuals were found in March-April (no hauls here in the autumn). This could indicate, that the year class has its present distribution in Divs. 1B-1D, probably as a relatively good year class. The hydrographic development in the autumn of 1977 may have contributed to the northern distribution, especially if the year class was relatively scarce at Southeast Greenland. There is, however, a lack of knowledge regarding its inshore occurrence in Divs. 1E-1F. The 1978 pound net catches will most likely contain many individuals of this year class, partly as fish to be discarded (below 40 cm total length), and the fishery will reveal whether the year class is also occurring in Divs. 1E-1F. So far it is considered as a relatively good year class (relative to present very low level of year classes) in the northern divisions and probably as a moderate one in the southern divisions. It is thus expected to be a year class to contribute to the fishery from 1978/79 and to the spawning biomass from 1980/81 together with what is left of the 1973 year class at that time.

The 1974 year class started recruiting to the fishery in 1977, especially to the pound net fishery, whereas its occurrence in the commercial landings by trawlers was negligible.

The pound net catches sampled in Div. 1B and 1D contained from 18-28% (by number) of this year class, the individuals ranging from 24-45 cm so that a good part of them was discarded. Landings from pound nets contained about 10% by numbers in Div. 1B. The year class was also observed in offshore research hauls (shrimp trawl) in Divs. 1D and 1E in March-April (15-35%, 21-45 cm) and in research catches by hand line in Div. 1D in October-November (4-7%, 33-48 cm). In the samples from January-February 1978, Table 6, the year class accounts for about 11% by numbers of the landings.

The FRG research hauls in December 1976 showed the year class to occur in Divs. 1C-1F (3-10%, 21-45 cm) and also the December 1977 research hauls in Div. 1D and 1E caught individuals of the year class (2%, 30-45 cm). Commercial landings of the FRG showed none or very few individuals of the 1974 year class, both at West and at Southeast Greenland.

The 1974 year class thus seems to be rather evenly distributed between divisions, but not to be as abundant as the two year classes on either side (the 1973 and the 1975 year classes).

Taking into consideration the results of the VPA analyses regarding the possible size of the 1973 year class the following values of recruitment (thousand of 3-years old fish) have been tentatively estimated and used in the forecasts.

Number $\times 10^{-3}$ at age 3 (beginning of the year)

Year class	1A - 1D	1E - 1F	Subarea 1
1974	25 000	15 000	40 000
1975	50 000	25 000	75 000
1976	10 000	10 000	20 000
1977	25 000	25 000	50 000

7. Values of instantaneous fishing mortality rate (F) for virtual population analyses

On the basis of analyses of trends in fishing effort and catches it was concluded last year (Res.Doc. 77/VI/8) that effort had decreased by about 25% from 1975 to 1976, and a set of F values was proposed for the years 1965-76, F in 1976 considered to be about 0.25 in Divs. 1A-1D as well as in Divs. 1E-1F.

The trends in effort and catches as described in Sections 1 and 2 and illustrated in Tables 1-5 suggest that although total catch increased slightly from 1976 to 1977 the total effort decreased further, anyway in the offshore fishery. Raising the Greenland trawlers effort to total offshore effort (raising factor being total offshore catch over the Greenland trawlers' catch) for 1976 and for 1977 leads to figures of 46 191 and 17 877 hours for the two years respectively (Table 13). It has to be considered, however, that there was considerable difference between the two years in terms of the distribution of effort by time of the year. Table 13 illustrates that, whereas the effort in 1976 was rather evenly distributed throughout the year, the 1977 effort falls nearly entirely in the two first quarters of the year, where concentrations of cod occur with resultant higher fishing mortality per hour trawled than in the last half of the year. Adopting the seasonal variation in catchability coefficient used (for Divs. 1A-1D by the ICES/ICNAF Working Group on Cod Stocks in the North Atlantic (Anon., 1973, Table 14)) the difference in offshore fishing mortality between 1976 and 1977 is less than the difference between absolute fishing hours. Furthermore, the Greenland fishery in the third quarter of 1976 did to some extent fish for groundfish other than cod so that the raised figure for this quarter may be too high. Supposing that this figure should be reduced by 50% then the total weighted figure for 1976 would be 105 000, and the 1977 offshore effort would be 35% below that of 1976.

At the same time inshore catches were about 2.7 times higher than in 1976. This is primarily due to better catch rate. However, the good fishing may by itself have stimulated inshore fishing activity so that effort in this fishery may have increased somewhat, but it is impossible to say exactly how much.

In total it seems reasonable to suggest that the overall F in Subarea 1 decreased further from 1976 to 1977, probably from the supposed value of $F = 0.25$ in 1976 to a range of 0.16 - 0.20 in 1977.

The set of F values used in the VPA analyses is as follows with two options for 1977

	1965	1966	1967	1968	1969	1970-75	1976	1977a	1977b
1. Subarea 1	0.45	.54	.62	.80	.55	.35	.25	0.16	0.20
2. Divs.1A-1D	0.45	.52	.68	1.00	.59	.35	.25	0.16	0.20
3. Divs.1E-1F	0.49	.61	.55	.50	.50	.35	.25	0.16	0.20

8. Partial recruitment

Last year it was argued (Res.Doc. 77/VI/8) that recruitment pattern had changed in the last few years since fishing on the 1973 year class started. For 1977 the pound net samples suggest that the year class was more than 90% recruited to this fishery, and the same is supposed to have been the case for fisheries by otter trawl. On the other hand it seems likely that the year class was less than 25% recruited to the fisheries by long lines and gill nets. Taking into consideration the ratio between various gears' catches (Table 2) it is suggested that the 1973 year class was about 72% recruited to the overall 1977 fishery. This corresponds very closely to one of the two options suggested for partial recruitment in last years' paper (Res.Doc. 77/VI/8, page 6, Option C), and this option has, therefore, been used in the present assessment, i.e.

Age group	Partial recruitment %
3	60
4	72
5	88
6+	100

9. Other parameters for VPA and prognoses

As previously the natural mortality is set at $M = 0.20$. A coefficient of emigration for Divs. 1E-1F cod seven years or older has earlier been assumed to have a value of 0.15, and there is at present no new information which suggest a change in this parameter. For Subarea 1 as a whole the coefficient is again set at a value of 0.05.

Weight-by-age values for prognoses are given in Table 14.

Recruitment figures for prognoses are given in Section 6, page 8. The model further has to get an input for recruitment in 1976, i.e. of year class 1973. This has initially been set at a value of 60 mill fish in Divs. 1A-1D as well as in Divs. 1E-1F. However, VPA-runs indicate that the actual value may be as high as about 100 mill fish in each of the areas, and also this set of figures has been used.

10. Results and discussion

1) The virtual population analyses

The various VPA-runs are appended as Tables 15a-f, each table listing the resultant F-values and stock in numbers by age groups. The runs are denoted N for Divs. 1A-1D, S for Divs. 1E-1F and NS for Subarea 1 as a whole.

For each set the F_{1977} input value is either 0.16 (denoted by A1) or 0.20 (denoted by A2).

The results of the VPA-runs are rather similar to those previously obtained for the years 1965-75. The remarkable new fact is the estimate of the size of the 1976 stock influenced by the new estimate of the 1973 year class, other year classes being rather similar to estimates of last year. As described in former sections the 1977 fisheries had three distinct components : offshore trawling, offshore gill netting and long lining, and inshore fisheries mainly by pound net. These three components were not sufficiently sampled, and some bias may, therefore, well be present in the estimates, e.g. on partial recruitment. It is, nevertheless, possible that the 1973 year class has been underestimated previously and/or that it has received some further immigrants from Southeast Greenland.

ii) Forecasts

Forecasts of catches, stock sizes and spawning biomass will, of course, differ between the various runs due to differences in estimated recruitment, included the estimates of the 1973 year class, and other parameters. Whether one or the other set of input reflects the true situation could be discussed. In terms of advice on future management it is, however, important to note that the relative changes between years of catches and spawning stock size have the same pattern by the various strategies analyzed. In all strategies analyzed it has been attempted to keep the catch in 1978 at a level of 25 000 tons. Table 16 lists results of four of the strategies analyzed, but several more runs have been made by intermediate values of F. The four strategies listed in Table 16 are:

Strategy	1	2	3	4
1978	F calculated to give catch of 25 000 tons in all strategies			
1979	F = F in 1978	F = 0.30	F = 0.40	F = F in 1978
1980	F = F in 1978	F = 0.30	F = 0.40	F = 0.40

These four strategies have all been analyzed by two values of recruitment by the 1973 year class, viz. 120 mill and 200 mill, each combined with two values of F in 1977, viz. 0.16 and 0.20. Furthermore each set has been analyzed with two sets of weight by age for 1979 and subsequent years as given in Table 14. However, the difference in runs due to these two sets is so small that only results with the first set shown in Table 14 for year 1979 are listed in Table 16. The other runs are available at the Assessment Meeting, April 1978. Concerning the four combinations of F in 1977 and recruitment of the 1973 year class only those giving upper and lower values of spawning stock by 1981 are listed. The lower values are for $F_{1977} = 0.20$, recruitment of 1973 year class = 120 mill, while the upper values are found by $F = 0.16$, recruitment of 1973 year class = 200 mill.

Forecast for catches are made for 1979-80 only, but not for 1981-82 because catches in the latter period will depend much upon the 1977-79 year classes. Estimates of spawning biomass are given up to 1982, when the 1976 year class recruits to the spawning stock.

Spawning biomass has been defined as all cod 6 years or older, no younger cod included. As seen in 1978 some cod do, in fact, mature already as five

years old. The spawning stock by 1978 may, therefore, be somewhat underestimated in the analyses so that the relative increase in spawning stock from 1978 to 1979 may be less than shown in the table. However, the relative development of the spawning biomass from 1979 to 1980 should not be effected by this bias.

The results indicate, as previously expected, that the spawning stock will increase when the 1973 year class recruits to it. As just stated this has partly taken place in 1978 although in the table there is supposed to be knife-edge recruitment to the spawning stock in 1979. By 1979 about 60% of the spawning biomass is expected to be made up of year class 1973. For fishing mortalities below 0.30 the rebuilding should continue from 1979 to 1981. A fishing mortality about 0.30 seems to stabilize spawning biomass at the level which will be achieved by 1979 while any fishing above this level in 1979 and subsequent years will result in decreasing spawning biomass from 1979 to 1980 and further to 1981-82. By 1981-82 the 1973 year class will contribute less than 50% to the spawning, but the absolute level of the spawning biomass will still depend very much upon the rate by which the year class (and the totalstock) is fished. Fishing at the $F_{0.1}$ level from 1979 and onwards will result in a spawning stock by 1981-82 of about 40-70% (varying by inputs) compared to that achieved by fishing at the 1978 level.

11. Cod at East Greenland

Samples taken by FRG has made it possible to estimate the numbers by age group in the landings from Southeast Greenland for 1976 and 1977. The figures are presented in Table 12. The results seems to confirm that the stock in this area normally contains relatively more older cod than the West Greenland stock. Also the Faroese survey in 1977 seems to confirm this (Hoydal, 1977). The author has not found any basis for a suggestion of values of fishing mortality in this region. Hence no VPA-runs have been made. Attention is drawn to the previous conclusions, based on the report of the ICES North-Western Working Group, 1976, that a catch for the Greenland area as a whole would be about 25% greater than that in Subarea 1 for the same level of F at East and West Greenland. The importance of the East Greenland area as a potential spawning area for the West Greenland stock should, however, be born in mind.

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Table 1. Nominal catch (metric tons x 10^{-3}) of cod in Subarea 1, 1976 according to ICNAF Stat. Bull. Vol.26. Catches reported as taken by unknown gear apply to Denmark(G) small-boat catches. Most of these will have been taken by inshore pound nets. Catches by Denmark(F) are not specified by gear in Stat. Bull., but information supplied to the 1977 Assessment Meeting showed that only 70 tons were taken by trawl, the remainder by gill nets. The 70 tons have been allocated to Div. 1D.

Div.	Otter trawl.	Set gill net.	Long line.	Unknown.	TOTAL
1A	-	-	-	204	204
1B	29	394	28	644	1095
1C	3676	1191	567	1224	6658
1D	6889	3689	126	904	11608
1E	6833	912	901	1367	10013
1F	1975	58	844	831	3708
TOTAL	19402	6244	2466	5174	33286

Table 2. Provisional nominal catch (metric tons x 10^{-3}) of cod in Subarea 1, 1977. Catches are those reported for the Assessment Meeting, April 1978, or estimated and/or allocated to divisions by the author on the basis of monthly catch quota, reports. Catches listed under gill net may contain some catches taken by otter trawl and or long line.

Div.	Otter trawl.	Set gill net.	Long line.	Unknown.	TOTAL
1A	-	-	-	411	411
1B	3	-	-	339	342
1C	2514	1604	-	2558	6676
1D	4282	2107	-	3546	9935
1E	4298	2107	780	3392	10577
1F	1044	1605	1020	4034	7703
TOTAL	12141	7423	1800	14280	35644

Table 3. Total effort (hours fished), catch of cod and catch per unit effort for the FRG trawlers in 1975-77. Total catch of redfish is also listed.

Div.	1975			1976			1977(provisional)		
	hours	tons cod	kg/hr.	hours	tons cod	kg/hr.	hours	tons cod	kg/hr.
1B	-	-	-	-	-	-	104	3	29
1C	1549	5143	3320	345	292	846	985	303	308
1D	646	1125	1741	1350	1693	1254	6276	986	157
1E	1672	2020	1208	1400	1896	1354	1792	390	218
1F	2177	2554	1173	1562	1961	1255	7620	771	101
TOTAL	6044	10842	1794	4657	5842	1254	16777	2453	146
Total redfish		3120			5074			25094	

Table 4 Effort (hours fished), catch of cod and catch per unit effort for the Greenland trawlers in 1975-77. Effort for shrimp not included. Catches are uncorrected catches as recorded on board in vessel's logbook, converted to round fresh fish, but not revised to correspond with landed weight as reported to ICNAF Stat. Bull. Estimates made on board are normally 5-10 % below actual landings.

Div.	1975			1976			1977 (provisional)		
	hours	tons	kg/hour	hours	tons	kg/hour	hours	tons	kg/hour
B	1132	65	57	201	9	45	0	0	-
C	6666	9776	1467	3997	2815	704	2331	2211	949
D	4896	1436	293	5141	3040	591	2993	3296	1101
E	3154	1332	422	5478	4813	879	2619	3908	1492
F	243	84	346	23	2	69	136	273	2007
TOTAL	16091	12693	789	14840	10679	720	8079	9688	1199

Table 5 Effort (hours fished), catch of cod and catch per unit effort for the Greenland trawlers in January - February of 1975, -76 and -77, and in January and for some trawlers also part of February 1978. See text to Table 4 for further explanation.

Div.	1975			1976			1977			1978		
	hours	tons	kg/hour	hours	tons	kg/hour	hours	tons	kg/hour	hours	tons	kg/hour
1 C	2992	4688	1567	2216	1709	771	1506	1709	1135	1075	1899	1767
1 D	347	206	594	767	445	580	1240	1511	1219	34	30	882
1 E	107	50	465	203	180	887	252	399	1583	226	181	801
TOTAL	3446	4944	1435	3186	2334	733	2998	3619	1207	1335	2110	1581

Table 6. Age distribution and mean length and weight of age groups in samples from January and February, 1978 of Greenland trawlers' landings of cod from Div. 1G. Weight has been converted from gutted, head on, to round fresh weight.

Age	Age frequency (°/oo)		Mean length (cm)	Mean weight (kg)
	January 1978	February 1978.		
IV	106	115	53.0	1.20
V	749	743	66.9	2.45
VI	76	78	68.6	2.64
VII	48	45	78.7	4.16
VIII	18	14	87.0	5.64
IX	1	+	92.0	6.15
X	3	2	92.3	6.64
Overall	-	-	66.6	3.04

Table 7. Subarea 1 cod, 1977. Danish samples. Only fish which were aged and weighted are given here and since these were sampled stratified the table does not give the length nor the age frequency. Overall mean lengths and weights are, however, calculated on basis of the total (random) length sample.
 cm= uncorrected mean total length in cm (below)± standard deviation.
 kg= mean weight in kg round, fresh weight ± standard deviation. Most fish from commercial samples were actually weighted as gutted iced fish and were converted to round, fresh weight by a conversion factor of 1.22.
 Information on discard obtained through vessels' logbooks is indicated by x) whereas information obtained through direct observation is indicated by xx). Samples are from offshore areas unless otherwise indicated.

Age group	Divs. Month Year	1C+1D+1E February		1E March		1E June		1E+1F July		1F August	
		OTB	comm.	OTB	comm.	OTB	comm.	OTB	comm.	OTB	comm.
III	Nos.	25		18		-		-		-	
	cm	40.8	1.3	41.1	1.1						
	kg	0.61	0.07	0.63	0.05						
IV	Nos.	150		147		192		214		214	
	cm	47.5	3.6	49.4	4.0	47.8	3.9	48.5	4.3	48.7	5.1
	kg	0.97	0.23	1.10	0.27	0.94	0.18	1.09	0.22	1.10	0.26
V	Nos.	29		29		29		24		24	
	cm	52.1	4.8	54.4	4.1	55.0	4.4	50.5	3.9	52.4	5.2
	kg	1.31	0.34	1.47	0.30	1.40	0.27	1.19	0.21	1.34	0.32
VI	Nos.	1		1		5		6		6	
	cm	59.0	-	59.0	-	62.0	3.6	60.5	13.4	55.1	10.7
	kg	1.70	-	1.70	-	1.90	0.28	2.12	1.00	1.61	0.77
VII	Nos.	2		2		1		4		4	
	cm	75.0	-	68.1	-	74.0	-	80.0	7.6	79.3	7.8
	kg	3.43	-	3.07	-	3.42	-	4.24	0.88	4.13	0.89
VIII	Nos.	-		-		-		-		-	
	kg										
IX	Nos.	-		-		-		1		7	
	cm							84.0	-	88.1	10.5
	kg							4.88	-	4.93	1.08
X	Nos.	-		-		-		-		-	
	kg										
XI	Nos.	-		-		-		-		-	
	kg										
XII	Nos.	-		-		1		-		-	
	cm					90.0	-				
	kg					5.86	-				
XIII	Nos.	-		-		-		-		-	
	kg										
XIV	Nos.	-		-		-		-		-	
	kg										
XV+	Nos.	-		-		-		-		-	
	kg										
Overall mean length		47.7		50.4		48.3		48.9		49.4	
Overall mean weight		0.99		1.18		0.97		-		1.23	
Discard, cod		none x		none x		none x		none x		no info.	
nos. aged and weighted		227		197		228		249		255	
Ref. no.		2648		2652		2672		2679A		5452	

TABLE 7. cont

Age group	Divs. Month Gear	1D March		1D April		1E April		1E October	
		OTB	res.	OTB	res.	OTB	res.	OTB	res.
III	Nos.	87		77		6		-	
	cm	36.1	4.7	29.1	3.2	26.8	2.6		
	kg	0.45	0.15	0.21	0.08	0.15	0.06		
IV	Nos.	150		122		26		75	
	cm	46.5	4.3	37.2	4.0	43.4	3.7	54.0	4.2
	kg	0.92	0.26	0.46	0.16	0.72	0.20	1.50	0.34
V	Nos.	30		2		2		5	
	cm	51.9	6.5	40.1	-	56.5	-	59.8	4.5
	kg	1.31	0.41	0.56	-	1.54	-	1.93	0.36
VI	Nos.	1		-		1		-	
	cm	59.0	-			57.0	-		
	kg	1.70	-			2.15	-		
VII	Nos.	2		-		-		-	
	cm	69.5	-						
	kg	3.28	-						
VIII	Nos.	-		-		-		-	
	cm								
	kg								
IX	Nos.	-		-		-		-	
	cm								
	kg								
X	Nos.	-		-		-		-	
	cm								
	kg								
XI	Nos.	-		-		-		-	
	cm								
	kg								
XII	Nos.	-		-		-		-	
	cm								
	kg								
XIII	Nos.	-		-		-		-	
	cm								
	kg								
XIV	Nos.	-		-		-		-	
	cm								
	kg								
XV+	Nos.	-		-		-		-	
	cm								
	kg								
Overall mean length		44.5		34.3		38.3		54.4	
Overall mean weight		0.84		0.37		0.62		1.52	
Discard, cod		none(res.)		none(res.)		none(res.)		none(res.)	
Nos. aged and weighted		274		204		41		80	
Ref. no.		5369		5372		5371		5494	

TABLE 7 cont.

Age group	Divs. Month	1D October		1B inshore June		1B inshore July		1B inshore July		1D inshore May	
		HL	res.	FPN	land.	FPN	land.	FPN	catch	FPN	catch.
III	Nos.	3		18		22		146		162	
	cm	47.0	1.7	42.4	1.2	41.8	1.2	32.1	3.3	33.2	0.7
	kg	1.10	0.26	0.85	0.06	-	-	-	-	0.43	0.16
IV	Nos.	56		129		58		60		368	
	cm	57.9	4.1	47.3	4.3	47.9	4.9	45.7	5.5	47.0	5.1
	kg	1.92	0.36	1.13	0.26	-	-	-	-	1.09	0.44
V	Nos.	8		38		1		1		78	
	cm	60.4	4.1	56.2	5.5	54.0	-	54.0	-	55.9	4.7
	kg	2.36	0.27	1.91	0.45	-	-	-	-	1.90	0.50
VI	Nos.	8		22		5		5		41	
	cm	73.9	6.4	57.3	5.7	64.6	4.11	64.0	3.3	59.6	4.4
	kg	3.82	0.66	2.01	0.50	-	-	-	-	2.33	0.60
VII	Nos.	3		2		-		-		2	
	cm	81.3	4.2	69.2	11.5	-	-	-	-	61.8	-
	kg	4.50	0.50	3.41	1.27	-	-	-	-	2.51	-
VIII	Nos.	-		-		-		-		-	
	cm	-		-		-		-		-	
	kg	-		-		-		-		-	
IX	Nos.	-		3		1		1		-	
	cm	-		68.5	8.1	73.0	-	73.0	-	-	
	kg	-		3.33	0.88	-	-	-	-	-	
X	Nos.	-		-		-		-		-	
	cm	-		-		-		-		-	
	kg	-		-		-		-		-	
XI	Nos.	-		1		-		-		-	
	cm	-		73.0	-	-		-		-	
	kg	-		2.68	-	-		-		-	
XII	Nos.	-		2		-		-		-	
	cm	-		69.5	-	-		-		-	
	kg	-		2.56	-	-		-		-	
XIII	Nos.	-		-		-		-		-	
	cm	-		-		-		-		-	
	kg	-		-		-		-		-	
XIV	Nos.	-		-		-		-		-	
	cm	-		-		-		-		-	
	kg	-		-		-		-		-	
XV+	Nos.	-		-		-		-		-	
	cm	-		-		-		-		-	
	kg	-		-		-		-		-	
Overall mean length		60.3		49.3		54.8		24.8		45.8	
Overall mean weight		2.23		1.30		no info.		no info.		1.10	
Discard, cod		none(res.)		ab.50% by nos ^{**}		ab.50% by nos ^{**}		none(catch)		none(catch)	
nos. aged and weighted		78		215		87		313		616	
Ref. no.		5489, - 91		5412, -13, -19		5420		2680		5408, - 09	

TABLE 7 cont.

Age Group	Divs. Month Year	1D inshore June		1D inshore June		1D inshore October		1D inshore November	
		FPN	catch	SGN	comm.	SGN	res.	SGN	res.
III	Nos.	162		-		1		-	
	cm	32.5	3.7			47.0	-		
	kg	0.40	0.13			1.26	-		
IV	Nos.	369		7		201		30	
	cm	48.5	5.0	53.7	3.8	54.2	4.3	57.6	3.8
	kg	1.24	0.37	1.75	0.23	1.63	0.33	1.93	0.36
V	Nos.	87		20		3		-	
	cm	56.1	4.6	57.6	3.6	62.7	0.6		
	kg	1.90	0.48	2.23	0.42	2.39	0.01		
VI	Nos.	53		8		-		-	
	cm	60.4	4.6	57.4	4.1				
	kg	2.36	0.59	2.14	0.58				
VII	Nos.	13		2		-		-	
	cm	69.1	4.7	70.0	15.6				
	kg	3.42	0.73	3.71	2.10				
VIII	Nos.	-		-		-		-	
	cm								
	kg								
IX	Nos.	2		5		-		-	
	cm	79.0	2.0	71.0	4.6				
	kg	4.93	0.15	4.04	0.57				
X	Nos.	-		-		-		-	
	cm								
	kg								
XI	Nos.	-		-		-		-	
	cm								
	kg								
XII	Nos.	-		-		-		-	
	cm								
	kg								
XIII	Nos.	1		-		-		-	
	cm	107.0	-						
	kg	-							
XIV	Nos.	-		-		-		-	
	cm								
	kg								
XV+	Nos.	-		-		-		-	
	cm								
	kg								
Overall mean length		47.5		59.1		54.4		57.6	
Overall mean weight		1.25		2.42		1.64		1.93	
Discard, cod		none (catch)		none ^{xx}		none (res.)		none (res.)	
nos. aged and weighted		697		42		205		30	
Ref. no.		2671, - 74		2670		2713, -14, -16, -17, -18		2720, -21	

TABLE 7 cont.

Age group	Divs. Month Gear	1D inshore October		1D inshore November				
		HL	res.	HL	res.			
III	Nos.	49		49				
	cm	40.8	3.6	40.9	3.9			
	kg	0.67	0.20	0.70	0.28			
IV	Nos.	381		381				
	cm	53.0	4.2	54.4	4.2			
	kg	1.45	0.33	1.57	0.36			
V	Nos.	26		24				
	cm	59.7	7.2	60.1	7.0			
	kg	2.22	0.89	2.22	0.84			
VI	Nos.	29		24				
	cm	66.2	7.0	63.5	6.5			
	kg	2.96	0.53	2.58	0.85			
VII	Nos.	5		2				
	cm	76.7	5.2	78.5	-			
	kg	4.62	1.07	4.69	-			
VIII	Nos.	1		-				
	cm	83.0	-					
	kg	6.20	-					
IX	Nos.	3		1				
	cm	80.5	9.9	78.0	-			
	kg	4.85	1.82	4.70	-			
X	Nos.	-		-				
	cm							
	kg							
XI	Nos.	2		-				
	cm	88.5	-					
	kg	6.0	-					
XII	Nos.	1		-				
	cm	94.0	-					
	kg	8.0	-					
XIII	Nos.	-		-				
	cm							
	kg							
XIV	Nos.	-		-				
	cm							
	kg							
XV+	Nos.	-		-				
	cm							
	kg							
Overall mean length		53.4		54.6				
Overall mean weight		1.56		1.62				
Discard, cod		none (res.)		none (res.)				
Nos. aged and weighted								
Ref. no.		5492,-93,-95,-2711		5510,-13,-19.				

Table 8. Overall mean length and weight of samples from FRG fisheries by otter trawl (commercial and research samples) and Portuguese fisheries by gill nets (commercial). Comm.= commercial, res.= research.

Year	Month	Division and type of sample.	Mean length (cm)	Mean weight (kg)
<u>FRG (otter trawl)</u>				
1976	Nov.	1C, res.	54.7	2.75
-	Nov.	1D, res.	45.5	0.91
-	Nov.	1E, res.	42.6	0.77
-	Nov.	1F, res.	43.9	0.85
1977	Dec.	1D, res.	56.7	1.72
-	Dec.	1E, res.	50.3	1.50
-	Jan.	1F, comm.	51.1	1.11
-	Dec.	1F, res.	53.7	1.34
-	Feb.	East Grl., comm.	64.5	2.29
-	March.	" " , "	60.2	1.29
-	April.	" " , "	54.1	1.23
-	May.	" " , "	64.1	1.85
-	July.	" " , "	58.0	1.51
-	July.	" " , res.	54.6	1.65
-	August.	" " , comm.	57.5	1.67
-	Oct.	" " , res.	50.5	1.40
-	Nov.	" " , "	55.7	2.51
<u>Portugal (gill net)</u>				
1977	July.	1B, comm.	82.1	5.21
-	June.	1C, comm.	76.9	4.50
-	July.	1C, comm.	73.5	3.94
-	July.	1D, comm.	73.5	4.27

Table 9. Mean weight (kg round, fresh) by age as obtained from offshore commercial samples plus research samples from October as listed in Table 7. The weighted annual mean figure is obtained by weighting with factors according to the distribution by quarter of the 1977 offshore catch as given in Table 11. The weighted mean figures for 1976 (Res. Doc. 77/VI/8) are shown for comparison. Figures in brackets are based on less than five fish.

Age group.	Unweighted mean by quarter				Weighted annual mean, 1977	1976 mean
	1	2	3	4		
III	0.62	-	-	(1.10)	0.66	0.85
IV	1.04	0.94	1.10	1.71	1.03	1.21
V	1.39	1.40	1.26	2.15	1.43	2.03
VI	(1.70)	1.90	1.87	3.82	1.87	2.71
VII	(3.25)	(3.42)	4.19	(4.50)	3.39	3.42
VIII +	Sufficient material not available					

Table 10 Mean weight (kg round, fresh) by age as obtained from inshore samples representing landings, including research samples by gill net or hand line, and age groups V and older from pound nets, Div. 1 D (see Table 7). Mean is straight mean of figures by quarters. Figures in brackets are based on less than five fish.

Age group	Unweighted mean by quarter				Overall straight mean
	1	2	3	4	
III		0.85		0.87	0.86
IV		1.44		1.65	1.55
V		1.99		2.28	2.14
VI	No samples	2.21	No samples	2.77	2.49
VII		3.26		4.65	3.95
VIII		-		(6.20)	-
IX		4.10		(4.77)	4.44

Table 11 Nominal catch of Subarea 1 cod by quarter of the year. For 1977 the offshore and inshore (Greenland small boats) components are shown separately. 1977 catches by Portugal (1006 tons) were allocated to second quarter, and those by the Faroese (6417 tons) were allocated by 3417 to first quarter, 3000 to second quarter. Most other catches were reported by month.

Quarter		1	2	3	4	Total specified catch in % of total nominal catch
1976 TOTAL	Tons	7004	4707	8513	8623	86.6
	%	24.3	16.3	29.5	29.9	
1977 offshore	Tons	10842	9208	470	844	100
	%	50.7	43.1	2.2	4.0	
1977 inshore	Tons	74	2507	6189	1160	69.5
	%	0.7	25.2	62.3	11.7	
1977 TOTAL	Tons	10916	11715	6659	2004	87.8
	%	34.9	37.4	21.3	6.4	

Table 12. Number of cod (in thousands) per age group in nominal catches 1976 and provisional figures for 1977.

Age group	1976				1977			
	Divs. 1A-1D	1E-1F	Subarea 1	SE Greenl.	Divs. 1A-1D	1E-1F	Subarea 1	SE Greenl.
III	5259	5501	10760	6	227	34	261	1
IV	2473	1553	4026	64	9257	8273	17530	1240
V	1612	631	2243	37	1192	1279	2571	303
VI	774	442	1216	34	572	629	1201	138
VII	181	121	302	8	195	269	464	176
VIII	950	644	1594	17	144	219	363	57
IX	85	54	139	3	155	204	359	116
X	84	64	148	1	50	60	110	47
XI	31	22	53	+	25	33	58	22
XII	16	11	27	1	29	34	63	8
XIII	10	7	17	-	9	12	21	3
XIV	8	6	14	+	-	-	-	-
XV +	16	10	26	+	-	-	-	1
TOTAL	11499	9066	20565	172	11955	11046	23001	2112
Nominal catch (tons)	19565	13721	33286	364	17364	18280	35644	4600
Calculated mean weight (kg)	1.70	1.51	1.62	2.12	1.45	1.65	1.55	2.18

Table 13 The quarterly distribution of Greenland trawlers catch of cod (tons) and effort (hours fished, except for shrimp) in 1976 and 1977. These figures are raised by total offshore catch to a total effort. Catchability coefficient is obtained from Table 14, Div. 1A-1D, ICES/ICNAF Working Group on Cod Stocks in the North Atlantic. (Anon.1973)

Quarter of the year		1	2	3	4	TOTAL
1976	Greenland catch of cod (tons)	3985	2281	897	3516	10679
	Greenland effort (hours)	4615	4157	2809	3259	14840
	Total offshore catch of cod (tons)	7823	4610	6440	9239	28112
	Raised effort (hours)	9060	8401	20167	8563	46191
	-"- weighted by catchability coeff.					123432
1977	Greenland catch of cod (tons)	4357	4267	404	660	9688
	Greenland effort (hours)	4353	2650	428	648	8079
	Total offshore catch of cod (tons)	10842	9208	470	844	21364
	Raised effort (hours)	10832	5719	497	829	17877
	-"- weighted by catchability coeff.					67919
Mean catchability coefficient		4.221	3.377	1.798	2.401	

Table 14 Weight (kg round, fresh) used in the forecast for catches in 1978 and 1979. For age-groups VIII-XV+ the weights used are those from previous years' assessment.

Age Group	Basic weight data				1978 forecast		1979 forecast	
	1 Offshore 1977 (Table 9)	2 Offshore Jan.-Feb. 1978 (Table 6)	3 Mean of 1 and 2	4 Inshore 1977 (Table 10)	60% trawl (col.2) 40% inshore (col.4)	50% trawl (col.3) 25% gill net/lines (col.2) 25% inshore (col.4)	60% trawl (col.3) 40% inshore (col.4)	
III	0.66	-	0.66	0.86	0.86	0.73	0.74	
IV	1.03	1.20	1.12	1.55	1.34	1.25	1.29	
V	1.43	2.45	1.94	2.14	2.33	2.12	2.02	
VI	1.87	2.64	2.25	2.49	2.58	2.41	2.35	
VII	3.39	4.16	3.78	3.95	4.08	3.92	3.85	
VIII	4.58				as previously	as previously	as previously	
IX	5.06							
X	5.60							
XI	6.00							
XII	6.60							
XIII	7.70							
XIV	9.00							
XV+	10.50							

Table 15(a). Virtual population analysis - Cod.

SUBAREA 1

FISHING MORTALITIES BY YEAR AND BY AGE

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	0.08	0.01	0.03	0.05	0.01	0.00	0.00	0.00	0.01	0.02
4	0.18	0.06	0.10	0.18	0.25	0.06	0.10	0.18	0.18	0.09
5	0.34	0.31	0.34	0.37	0.30	0.34	0.33	0.64	0.48	0.28
6	0.40	0.46	0.57	0.65	0.52	0.37	0.58	0.84	0.42	0.38
7	0.55	0.51	0.60	0.77	0.82	0.57	0.61	0.56	0.44	0.28
8	0.46	0.64	0.49	0.56	0.77	0.67	1.03	0.74	0.41	0.67
9	0.63	0.40	0.63	0.72	0.62	0.42	0.86	1.12	1.06	0.46
10	0.45	0.72	0.66	0.63	0.52	0.35	0.57	0.75	0.81	0.50
11	0.63	0.46	0.46	0.77	0.39	0.29	0.52	0.72	0.48	0.73
12	0.53	0.36	0.29	0.51	0.59	0.25	0.26	1.03	0.41	1.26
13	0.19	0.61	1.20	0.19	0.21	0.35	0.25	1.00	0.37	1.36
14	0.09	0.70	0.69	1.41	0.57	0.22	0.44	0.51	0.99	2.11
15	0.46	0.54	0.62	0.80	0.55	0.35	0.35	0.35	0.35	0.35
MEAN-F A>= 6	0.47	0.48	0.58	0.69	0.63	0.49	0.71	0.79	0.49	0.43

AGE	1975	1976	1977
3	0.01	0.05	0.10
4	0.22	0.16	0.12
5	0.35	0.20	0.14
6	0.35	0.27	0.16
7	0.67	0.09	0.16
8	0.68	0.41	0.16
9	0.55	0.14	0.16
10	0.32	0.26	0.16
11	0.45	0.09	0.16
12	0.36	0.27	0.16
13	0.22	0.28	0.16
14	0.18	0.67	0.16
15	0.35	0.25	0.16
MEAN-F A>= 6	0.56	0.26	0.16

THE LAST AGEGROUP IS A PLUS GROUP

RUN: 780329 / 1515
 RUN NO. : NS-A1

Table 15(a). Continued

SUBAREA 1

STOCK IN NUMBERS AT BEGINNING OF YEAR

AGE	1965	1966	1967	1968	1969
3	200215	216356	68394	79766	63184
4	376799	151146	175756	54437	61910
5	201604	257228	116644	130287	37386
6	30270	117943	154763	68141	73747
7	26023	16657	60759	71367	29135
8	47141	11660	7820	25965	25614
9	6776	23290	4777	3738	11517
10	1735	2802	12105	1986	1415
11	1163	857	1064	4880	823
12	5216	482	421	522	1766
13	480	2399	262	246	243
14	506	308	1015	61	160
15	426	361	119	398	12
TOTAL	898355	801488	603899	441794	306911

AGE	1970	1971	1972	1973	1974
3	37284	84059	19281	16278	25172
4	51133	30481	68576	15772	13209
5	39533	39366	22684	47103	10840
6	22780	23077	23092	9825	23887
7	35811	12847	10588	8196	5294
8	9998	15725	5453	4696	4111
9	9196	3997	4353	2036	2430
10	4812	4710	1316	1102	549
11	655	2629	2066	484	380
12	434	380	1218	782	233
13	763	264	228	337	402
14	154	419	161	65	182
15	70	96	209	75	19
TOTAL	212624	218049	159226	106751	86707

AGE	1975	1976	1977
3	37818	228906	3141
4	20299	30714	177702
5	9841	13384	21519
6	6731	5653	8938
7	13329	3892	3535
8	3130	5298	2766
9	1634	1233	2735
10	1195	734	838
11	259	676	442
12	143	128	480
13	51	78	76
14	80	32	46
15	17	52	13
TOTAL	94527	290780	222230

RUN: 780329 / 1516
 RUN NO. : NS-A1

Table 15(b). Virtual population analysis - Cod

SUBAREA 1

FISHING MORTALITIES BY YEAR AND BY AGE

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	0.08	0.01	0.03	0.05	0.01	0.00	0.00	0.00	0.01	0.02
4	0.18	0.06	0.10	0.18	0.25	0.06	0.10	0.18	0.19	0.10
5	0.34	0.31	0.34	0.37	0.30	0.34	0.34	0.66	0.50	0.31
6	0.40	0.46	0.57	0.65	0.52	0.37	0.59	0.85	0.44	0.40
7	0.55	0.51	0.60	0.77	0.82	0.57	0.61	0.59	0.46	0.30
8	0.46	0.64	0.49	0.56	0.77	0.67	1.04	0.75	0.44	0.72
9	0.63	0.40	0.63	0.72	0.62	0.42	0.86	1.14	1.10	0.51
10	0.45	0.72	0.66	0.63	0.52	0.35	0.57	0.75	0.84	0.54
11	0.63	0.46	0.46	0.77	0.39	0.29	0.52	0.72	0.49	0.79
12	0.53	0.36	0.29	0.51	0.59	0.25	0.26	1.03	0.41	1.30
13	0.19	0.61	1.20	0.19	0.21	0.35	0.25	1.00	0.37	1.36
14	0.09	0.70	0.69	1.41	0.57	0.22	0.44	0.51	0.99	2.11
15	0.46	0.54	0.62	0.80	0.55	0.35	0.35	0.35	0.35	0.35
MEAN-F A>= 6	0.47	0.48	0.58	0.69	0.64	0.50	0.71	0.80	0.51	0.46

AGE	1975	1976	1977
3	0.01	0.07	0.12
4	0.25	0.19	0.14
5	0.40	0.24	0.18
6	0.41	0.32	0.20
7	0.74	0.11	0.20
8	0.77	0.48	0.20
9	0.62	0.16	0.20
10	0.37	0.31	0.20
11	0.51	0.11	0.20
12	0.40	0.32	0.20
13	0.23	0.34	0.20
14	0.18	0.73	0.20
15	0.35	0.25	0.20
MEAN-F A>= 6	0.63	0.31	0.20

THE LAST AGE GROUP IS A PLUS GROUP

RUN: 780329 / 1520
 RUN NO.: NS-A2

Table 15(b). Continued

SUBAREA 1

STOCK IN NUMBERS AT BEGINNING OF YEAR

AGE	1965	1966	1967	1968	1969
3	200186	216237	68245	79058	62671
4	376799	151122	175658	54315	61330
5	201604	257228	116624	130207	37286
6	30270	117943	154763	68125	73682
7	26023	16657	60759	71367	29122
8	47141	11660	7820	25965	25614
9	6776	23290	4777	3738	11517
10	1735	2802	12105	1986	1415
11	1163	857	1064	4880	823
12	5216	482	421	522	1766
13	480	2399	262	246	243
14	506	308	1015	61	160
15	426	361	119	398	12
TOTAL	898325	801346	603633	440868	305640

AGE	1970	1971	1972	1973	1974
3	36537	82162	17812	14817	22156
4	50713	29869	67023	14570	12012
5	39059	39022	22183	45832	9856
6	22698	22690	22811	9417	22851
7	35758	12780	10273	7969	4962
8	9988	15684	5401	4451	3935
9	9196	3989	4322	1996	2240
10	4812	4710	1310	1078	519
11	655	2629	2066	480	362
12	434	380	1218	782	230
13	763	264	228	337	402
14	154	419	161	65	182
15	70	96	209	75	19
TOTAL	210837	214693	155018	101870	79724

AGE	1975	1976	1977
3	31858	187586	2542
4	17830	25834	143873
5	8862	11364	17526
6	5927	4853	7286
7	12483	3235	2881
8	2871	4646	2254
9	1498	1034	2229
10	1048	629	683
11	235	562	360
12	129	110	391
13	49	67	62
14	80	30	37
15	17	52	11
TOTAL	82886	240001	180135

RUN: 780329 / 1520
 RUN NO. : NS-A2

Table 15 (c). Virtual population analysis - Cod

1A-1D

FISHING MORTALITIES BY YEAR AND BY AGE

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	0.12	0.00	0.05	0.06	0.01	0.00	0.01	0.00	0.01	0.02
4	0.25	0.07	0.18	0.31	0.31	0.07	0.12	0.20	0.26	0.13
5	0.38	0.31	0.50	0.60	0.43	0.38	0.40	0.81	0.57	0.42
6	0.43	0.55	0.69	0.85	0.63	0.46	0.62	1.01	0.44	0.45
7	0.51	0.50	0.64	0.89	1.10	0.62	0.60	0.67	0.43	0.37
8	0.49	0.41	0.49	0.61	0.88	0.54	0.97	0.78	0.51	0.81
9	0.53	0.38	0.71	0.82	0.76	0.24	0.73	1.14	0.98	0.68
10	0.41	0.54	0.71	0.81	0.63	0.24	0.53	0.76	0.59	0.74
11	0.66	0.46	0.60	0.91	0.43	0.15	0.51	0.82	0.57	0.78
12	0.51	0.30	0.26	0.79	0.69	0.24	0.25	1.19	0.52	1.73
13	0.21	0.64	1.30	0.20	0.14	0.26	0.19	1.04	0.45	1.51
14	0.05	0.88	0.74	1.48	0.69	0.09	0.45	0.59	1.06	1.93
15	0.45	0.52	0.68	1.00	0.59	0.35	0.35	0.35	0.35	0.35
MEAN-F A>= 6	0.47	0.52	0.67	0.82	0.79	0.47	0.66	0.91	0.49	0.53

AGE	1975	1976	1977
3	0.01	0.05	0.10
4	0.36	0.19	0.12
5	0.58	0.29	0.14
6	0.69	0.39	0.16
7	0.83	0.14	0.16
8	1.04	0.55	0.16
9	0.91	0.19	0.16
10	0.57	0.34	0.16
11	0.38	0.12	0.16
12	0.48	0.39	0.16
13	0.00	0.34	0.16
14	0.32	0.95	0.16
15	0.35	0.25	0.16
MEAN-F A>= 6	0.81	0.37	0.16

THE LAST AGE GROUP IS A PLUS GROUP

RUN: 780329 / 1523
 RUN NO. : N-A1

Table 15(c). Continued

1A-1D

STOCK IN NUMBERS AT BEGINNING OF YEAR

AGE	1965	1966	1967	1968	1969
3	136567	112966	37137	66106	49570
4	271510	99044	92173	28891	50734
5	163409	173282	75788	62838	17379
6	22581	91494	103863	37641	28231
7	13003	12061	43270	42651	13134
8	32550	6365	5998	18657	14379
9	3154	16407	3473	3014	8327
10	1110	1520	9232	1391	1092
11	748	601	723	3702	506
12	3726	317	309	326	1220
13	304	1833	193	195	121
14	268	201	790	43	131
15	247	208	69	310	8
TOTAL	649178	516300	373019	265764	184831

AGE	1970	1971	1972	1973	1974
3	29305	51995	13153	9865	15117
4	39986	23949	42324	10756	7962
5	30522	30395	17396	28265	6790
6	9258	17049	16760	6367	13079
7	12316	4763	7504	5012	3344
8	3593	5414	2144	3156	2668
9	4873	1710	1673	803	1552
10	3201	3148	676	439	248
11	474	2052	1517	258	200
12	269	333	1011	546	120
13	501	173	211	253	267
14	86	317	118	61	133
15	53	64	165	53	17
TOTAL	134438	141361	104653	65835	51495

AGE	1975	1976	1977
3	19616	120412	2732
4	12158	15928	93838
5	5730	6969	10814
6	3667	2621	4257
7	6831	1508	1451
8	1896	2448	1072
9	970	548	1154
10	643	319	372
11	97	298	186
12	75	54	216
13	17	38	30
14	48	14	22
15	16	29	4
TOTAL	51765	151187	116148

RUN: 780329 / 1524
 RUN NO. : N-A1

Table 15(d). Virtual population analysis - Cod

1A-1D

FISHING MORTALITIES BY YEAR AND BY AGE

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	0.12	0.00	0.05	0.06	0.01	0.00	0.01	0.00	0.02	0.02
4	0.25	0.07	0.18	0.31	0.31	0.07	0.12	0.21	0.27	0.14
5	0.38	0.31	0.50	0.60	0.43	0.38	0.40	0.82	0.58	0.45
6	0.43	0.55	0.69	0.85	0.63	0.47	0.63	1.02	0.46	0.47
7	0.51	0.50	0.64	0.89	1.10	0.62	0.60	0.68	0.44	0.38
8	0.49	0.41	0.49	0.61	0.88	0.54	0.98	0.79	0.53	0.84
9	0.53	0.38	0.71	0.82	0.76	0.24	0.73	1.15	1.00	0.73
10	0.41	0.54	0.71	0.81	0.63	0.24	0.53	0.77	0.61	0.79
11	0.66	0.46	0.60	0.91	0.43	0.15	0.51	0.82	0.57	0.82
12	0.51	0.30	0.26	0.79	0.69	0.24	0.25	1.19	0.52	1.77
13	0.21	0.64	1.30	0.20	0.14	0.26	0.19	1.04	0.45	1.51
14	0.05	0.88	0.74	1.48	0.69	0.09	0.45	0.59	1.06	1.93
15	0.45	0.52	0.68	1.00	0.59	0.35	0.35	0.35	0.35	0.35
MEAN-F A>= 6	0.47	0.52	0.67	0.82	0.79	0.47	0.66	0.92	0.50	0.56

AGE	1975	1976	1977
3	0.01	0.06	0.12
4	0.40	0.23	0.14
5	0.64	0.35	0.18
6	0.78	0.46	0.20
7	0.89	0.17	0.20
8	1.15	0.64	0.20
9	1.00	0.22	0.20
10	0.65	0.40	0.20
11	0.43	0.15	0.20
12	0.53	0.46	0.20
13	0.00	0.40	0.20
14	0.32	1.02	0.20
15	0.35	0.25	0.20
MEAN-F A>= 6	0.89	0.44	0.20

THE LAST AGE GROUP IS A PLUS GROUP

RUN: 780329 / 1526
RUN NO. : N-A2

Table 15(d). Continued

1A-1D

STOCK IN NUMBERS AT BEGINNING OF YEAR

AGE	1965	1966	1967	1968	1969
3	136561	112926	37094	65856	49390
4	271510	99039	92140	28856	50529
5	163409	173282	75784	62811	17350
6	22581	91494	103863	37637	28209
7	13003	12061	43270	42651	13131
8	32550	6365	5998	18657	14379
9	3154	16407	3473	3014	8327
10	1110	1520	9232	1391	1092
11	748	601	723	3702	506
12	3726	317	309	326	1220
13	304	1833	193	195	121
14	268	201	790	43	131
15	247	208	69	310	8
TOTAL	649171	516255	372939	265448	184393

AGE	1970	1971	1972	1973	1974
3	29015	51267	12607	9262	13677
4	39839	23712	41728	10309	7468
5	30354	30275	17202	27777	6425
6	9235	16912	16662	6210	12681
7	12298	4744	7392	4933	3215
8	3590	5400	2129	3065	2604
9	4873	1708	1661	790	1478
10	3201	3148	674	430	237
11	474	2052	1517	257	192
12	269	333	1011	546	119
13	501	173	211	253	267
14	86	317	118	61	133
15	53	64	165	53	17
TOTAL	133790	140103	103078	63947	48514

AGE	1975	1976	1977
3	16620	98592	2210
4	10980	13476	75974
5	5326	6007	8807
6	3369	2292	3470
7	6507	1266	1183
8	1791	2186	874
9	917	464	940
10	584	277	303
11	88	249	152
12	69	47	176
13	17	33	24
14	48	14	18
15	16	29	4
TOTAL	46332	124931	94136

RUN: 780329 / 1527
 RUN NO. : N-A2

Table 15(e). Virtual population analysis - Cod

1E-1F

FISHING MORTALITIES BY YEAR AND BY AGE

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
4	0.03	0.04	0.01	0.04	0.01	0.02	0.01	0.13	0.01	0.04
5	0.18	0.29	0.09	0.18	0.18	0.19	0.14	0.21	0.34	0.07
6	0.36	0.23	0.36	0.41	0.43	0.29	0.44	0.46	0.34	0.29
7	0.59	0.64	0.53	0.60	0.58	0.50	0.55	0.30	0.42	0.11
8	0.42	1.08	0.62	0.49	0.63	0.69	1.00	0.64	0.19	0.40
9	0.71	0.54	0.42	0.48	0.35	0.69	0.91	1.05	1.01	0.12
10	0.62	0.96	0.53	0.28	0.24	0.72	0.69	0.67	0.94	0.30
11	0.60	0.56	0.20	0.42	0.33	1.38	0.65	0.47	0.35	0.62
12	0.65	0.53	0.48	0.14	0.42	0.28	0.67	0.48	0.19	0.80
13	0.15	0.58	0.99	0.17	0.29	0.68	0.41	0.77	0.16	1.06
14	0.12	0.40	0.59	1.28	0.11	0.44	0.53	0.32	0.00	2.83
15	0.49	0.61	0.55	0.50	0.50	0.35	0.35	0.35	0.35	0.35
MEAN-F A>= 6	0.50	0.44	0.41	0.49	0.48	0.49	0.73	0.57	0.45	0.29

AGE	1975	1976	1977
3	0.01	0.06	0.10
4	0.04	0.12	0.12
5	0.10	0.11	0.14
6	0.04	0.17	0.16
7	0.49	0.06	0.16
8	0.25	0.28	0.16
9	0.15	0.09	0.16
10	0.07	0.18	0.16
11	0.45	0.07	0.16
12	0.21	0.17	0.16
13	0.31	0.22	0.16
14	0.00	0.42	0.16
15	0.35	0.25	0.16
MEAN-F A>= 6	0.31	0.17	0.16

THE LAST AGE GROUP IS A PLUS GROUP

RUN: 780329 / 1529
 RUN NO.: S-A1

Table 15(e). Continued

1E-1F

STOCK IN NUMBERS AT BEGINNING OF YEAR

AGE	1965	1966	1967	1968	1969
3	66955	108595	33200	14137	14060
4	107306	54818	87845	27138	11567
5	36485	85645	43079	70955	21321
6	6871	25065	52289	32374	48445
7	13423	3929	16384	29888	17559
8	13557	5263	1466	6776	11604
9	3804	6282	1264	555	2933
10	563	1320	2591	586	241
11	410	214	356	1072	311
12	1344	159	86	205	496
13	183	495	66	37	125
14	245	111	196	17	22
15	180	153	52	76	3
TOTAL	251326	292049	238875	183817	128689

AGE	1970	1971	1972	1973	1974
3	8416	33326	6632	6538	10043
4	11511	6890	27285	5429	5349
5	9342	9270	5582	19685	4391
6	14604	6302	6582	3713	11506
7	25890	8969	3309	3401	2160
8	6956	11031	3630	1721	1567
9	4354	2454	2859	1343	1002
10	1463	1534	699	708	344
11	134	501	543	253	196
12	157	24	184	240	126
13	229	83	9	80	139
14	66	82	39	3	48
15	14	30	34	20	2
TOTAL	83136	80498	57386	43134	36873

AGE	1975	1976	1977
3	18201	108495	409
4	8131	14785	83863
5	4196	6413	10705
6	3347	3108	4681
7	7070	2623	2146
8	1357	3067	1747
9	739	743	1628
10	625	449	479
11	180	411	263
12	74	81	271
13	40	42	48
14	34	21	24
15	2	24	10
TOTAL	43996	140261	106275

RUN: 780329 / 1530
 RUN NO.: S-A1

Table 15(f). Virtual population analysis - Cod

1E-1F

FISHING MORTALITIES BY YEAR AND BY AGE

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
4	0.03	0.04	0.01	0.04	0.01	0.02	0.01	0.13	0.01	0.05
5	0.18	0.29	0.09	0.18	0.18	0.20	0.15	0.22	0.36	0.09
6	0.36	0.23	0.36	0.41	0.43	0.29	0.48	0.48	0.38	0.31
7	0.59	0.64	0.53	0.60	0.58	0.50	0.56	0.34	0.46	0.13
8	0.42	1.08	0.62	0.49	0.63	0.69	1.01	0.66	0.22	0.45
9	0.71	0.54	0.42	0.48	0.35	0.69	0.91	1.06	1.06	0.14
10	0.62	0.96	0.53	0.28	0.24	0.72	0.69	0.68	0.98	0.32
11	0.60	0.56	0.20	0.42	0.33	1.38	0.65	0.47	0.36	0.68
12	0.65	0.53	0.48	0.14	0.42	0.28	0.67	0.48	0.19	0.84
13	0.15	0.58	0.99	0.17	0.29	0.68	0.41	0.77	0.16	1.06
14	0.12	0.40	0.59	1.28	0.11	0.44	0.53	0.32	0.00	2.83
15	0.49	0.61	0.55	0.50	0.50	0.35	0.35	0.35	0.35	0.35
MEAN-F A>= 6	0.50	0.44	0.41	0.50	0.48	0.49	0.74	0.60	0.50	0.32

AGE	1975	1976	1977
3	0.01	0.07	0.12
4	0.04	0.15	0.14
5	0.12	0.14	0.18
6	0.05	0.21	0.20
7	0.55	0.07	0.20
8	0.30	0.34	0.20
9	0.17	0.11	0.20
10	0.08	0.22	0.20
11	0.52	0.08	0.20
12	0.24	0.21	0.20
13	0.33	0.26	0.20
14	0.00	0.47	0.20
15	0.35	0.25	0.20
MEAN-F A>= 6	0.36	0.20	0.20

THE LAST AGE GROUP IS A PLUS GROUP

RUN: 780329 / 1532
 RUN NO. : S-A2

Table 15(f). Continued

STOCK IN NUMBERS AT BEGINNING OF YEAR

	1965	1966	1967	1968	1969
	66902	108467	33029	13488	13612
	107306	54775	87740	26997	11035
	36485	85645	43044	70869	21206
	6871	25065	52289	32345	48374
	13423	3929	16384	29888	17535
	13557	5263	1466	6776	11604
	3804	6282	1264	555	2933
	563	1320	2591	586	241
	410	214	356	1072	311
	1344	159	86	205	496
	183	495	66	37	125
	245	111	196	17	22
	180	153	52	76	3
L	251273	291877	238563	182912	127500
	1970	1971	1972	1973	1974
	7848	31956	5610	5653	8465
	11145	6426	26163	4592	4624
	8907	8970	5201	18767	3705
	14510	5945	6337	3402	10756
	25833	8892	3018	3200	1905
	6939	10991	3576	1517	1427
	4354	2443	2831	1305	858
	1463	1534	691	690	318
	134	501	543	247	183
	157	24	184	240	122
	229	83	9	80	139
	66	82	39	3	48
	14	30	34	20	2
L	81599	77878	54235	39715	32554
	1975	1976	1977		
	15237	98994	331		
	6840	12358	67898		
	3602	5355	8719		
	2786	2622	3816		
	6457	2163	1749		
	1178	2638	1424		
	640	617	1326		
	523	380	390		
	162	340	215		
	65	68	221		
	37	36	39		
	34	19	20		
	2	24	8		
	37563	115613	86155		

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U. S-A2

Table 16 Predicted catches and spawning biomass (at the beginning of each year) by various fishing strategies (F values) and by various assumptions of F in 1977 and of the size of the 1973 year class at age 3. Figures outside brackets are thousands of tons, figures in brackets show the percentage which the 1973 year class makes up of the catch and spawning stock. For strategies see text on page 10

Strategies			1	2	3	4
Year-class 1973: 120 mill (3 years old) F in 1977 = 0.20	1978	F	0.107	0.107	0.107	0.107
		catch	25 (46)	25 (46)	25 (46)	25 (46)
		sp. stock	81 (0)	81 (0)	81 (0)	81 (0)
	1979	F	0.107	0.30	0.40	0.107
		catch	26 (38)	67 (38)	86 (38)	26 (38)
		sp. stock	181 (59)	181 (59)	181 (59)	181 (59)
	1980	F	0.107	0.30	0.40	0.40
		catch	31 (37)	69 (36)	81 (35)	103 (37)
		sp. stock	227 (57)	188 (57)	170 (57)	227 (57)
	1981	F	0.107	0.30	0.40	0.40
		sp. stock	275 (38)	231 (38)	192 (37)	207 (38)
	1982	F	0.107	0.30	0.40	0.40
sp. stock		269 (30)	207 (30)	157 (29)	153 (30)	
Strategies			1	2	3	4
Year-class 1973: 200 mill (3 years old) F in 1977 = 0.16	1978	F	0.075	0.075	0.075	0.075
		catch	25 (55)	25 (55)	25 (55)	25 (55)
		sp. stock	104	104	104	104
	1979	F	0.075	0.30	0.40	0.075
		catch	26 (49)	93 (48)	118 (48)	26 (49)
		sp. stock	287 (66)	286 (66)	287 (66)	287 (66)
	1980	F	0.075	0.30	0.40	0.40
		catch	31 (49)	92 (47)	108 (46)	143 (48)
		sp. stock	357 (66)	286 (66)	259 (66)	357 (66)
	1981	F	0.075	0.30	0.40	0.40
		sp. stock	397 (50)	259 (49)	214 (48)	289 (50)
	1982	F	0.075	0.30	0.40	0.40
sp. stock		378 (42)	200 (40)	151 (40)	201 (41)	

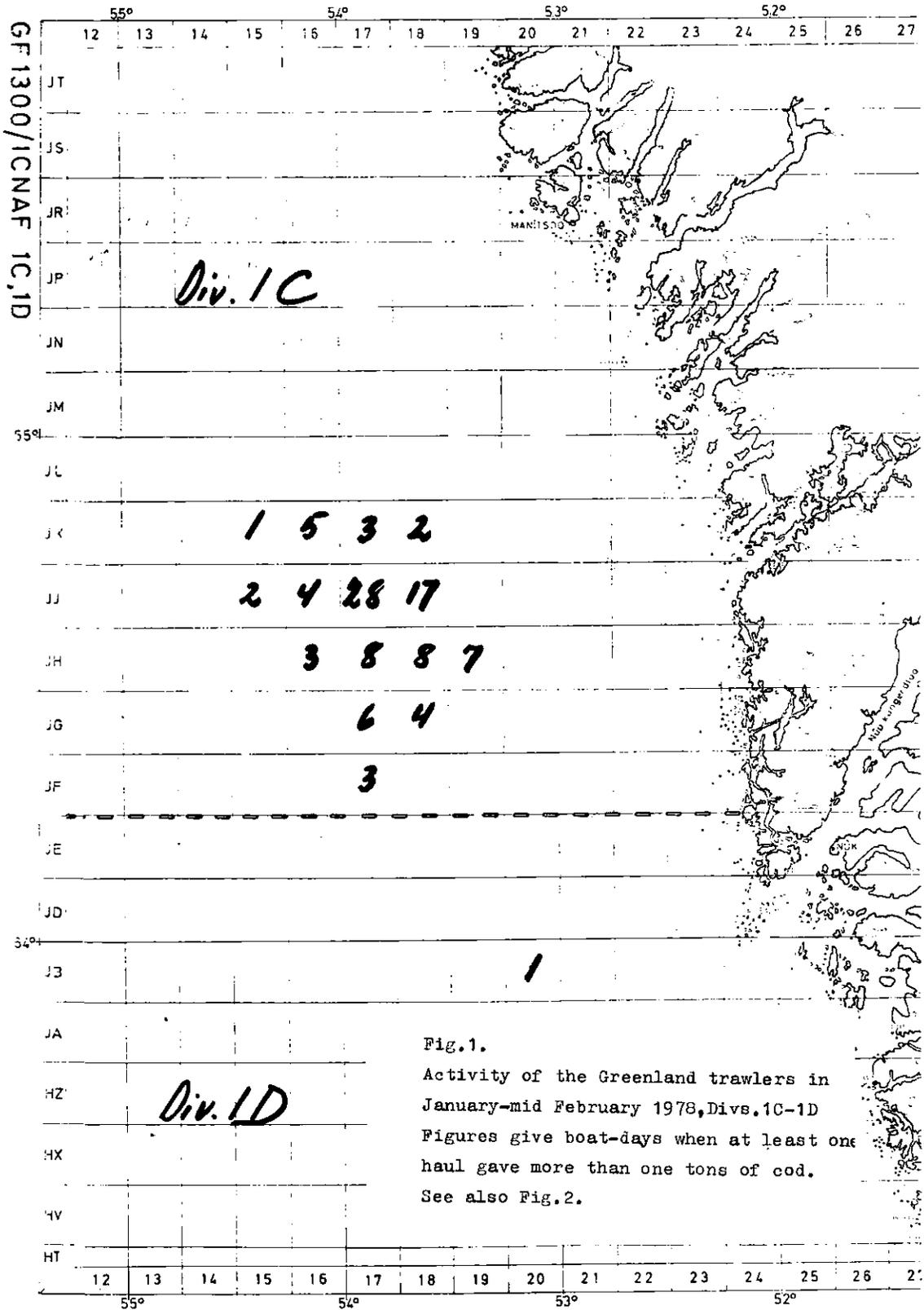
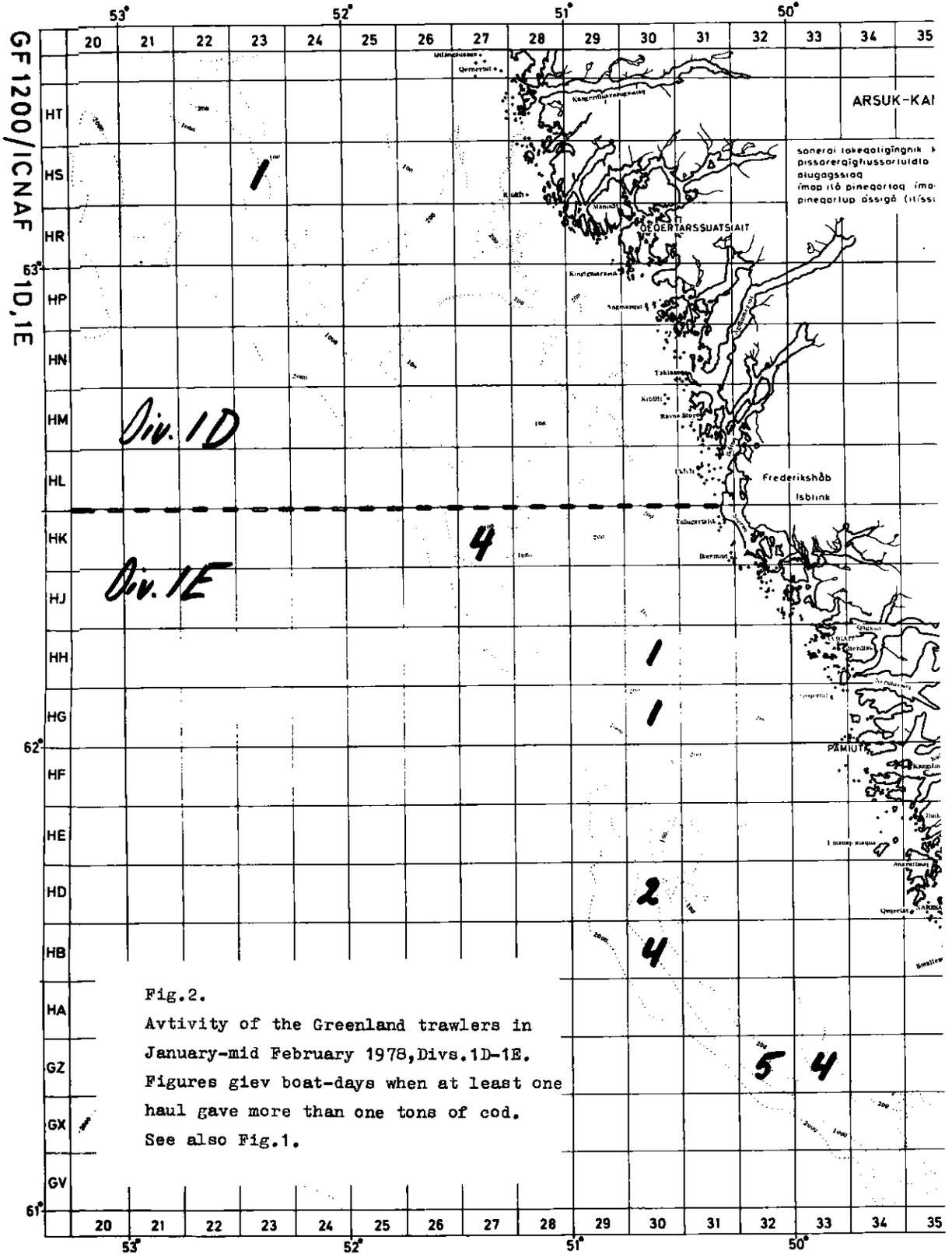


Fig.1.
 Activity of the Greenland trawlers in
 January-mid February 1978, Divs. 1C-1D
 Figures give boat-days when at least one
 haul gave more than one tons of cod.
 See also Fig.2.



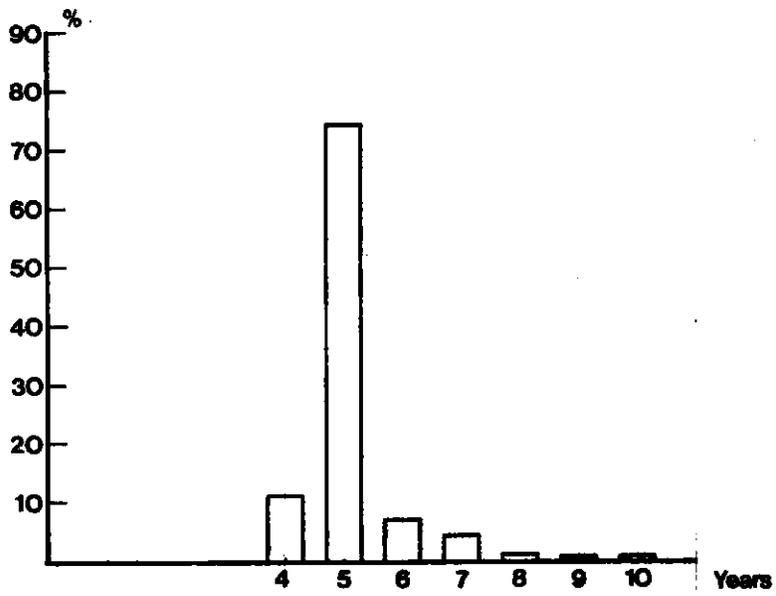
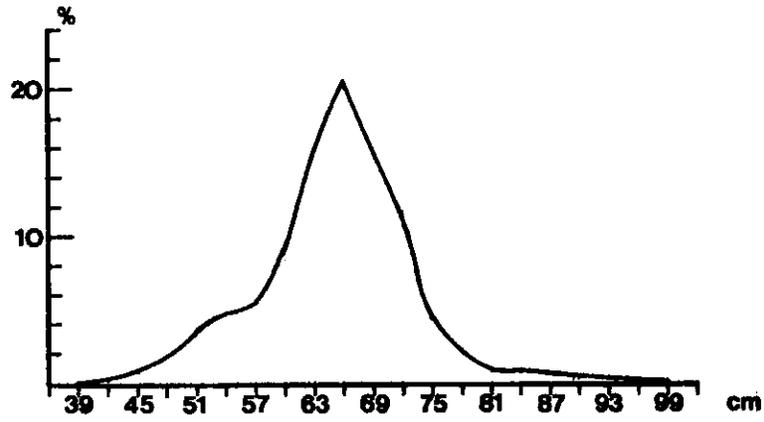


Fig. 3 Length- and age composition of ood,
Div. 1C, January - February 1978.
Gear: OTB, 130 mm.