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REPORT OF THE ARCTIC FISHERIES WORKING GROUP

Copenhagen, 21-28 September 1982

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REPORT OF THE ARCTIC FISHERIES WORKING GROUP

1. PARTICIPANTS

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2. TERMS OF REFERENCE

At the 69th Statutory Meeting, the Council decided (C.Res.1981/2:27:17):

"that the Arctic Fisheries Working Group should meet at ICES headquarters from 21-28 September 1982 to assess catch options for 1983 for cod and haddock in Sub-areas I and II, and to specify deficiencies in data required for the assessments".

In addition, the Royal Norwegian Ministry of Fisheries requested a statement from ICES on the abundance and occurrence of cod and haddock in the areas around Spitsbergen in recent years, including an evaluation of the prospects for the immediate future.

This request has been included into the terms of reference of the Working Group by ACFM.

Furthermore, on 6 September 1982 the Council received the following official request from USSR: "USSR Ministry of Fisheries kindly requests a statement from ICES on the effects of spawning cod fishery on the spawning stock biomass reproductive capability and a year class strength for Arcto-Norwegian cod including the medium-term prospects".

This question was also considered by the Working Group.

3. EFFORT IN TRAWL FISHERIES

In recent years the proportion of the catches taken by trawlers has been declining. Catches by trawls and other gears are given in Table 1. In previous years, estimates of total trawler effort in English trawler units have been calculated. A review of English catch per unit effort data in the North-East Arctic fishery has been made by Burd (1982). With the decline in the amount of fishing by English trawlers, their catch per unit effort data are no longer considered representative. English cpue is correlated with Norwegian or USSR cpue in Sub-area I but not with Norwegian data for Division IIa. As this latter area now accounts for about half the cod catch, a transformation from English to alternative effort units cannot be made for the trawl fishery on the total stock. An alternative approach has been to calculate total trawl effort in Norwegian fresh-fish-trawler units and the results are given in Table 2.

4. NORTH-EAST ARCTIC COD

4.1 Status of the Fisheries (Tables 3-6)

The revised figure for cod landings in 1980 is 380 434 tonnes, which is 1 275 tonnes less than the preliminary figure used in the previous Working Group report (C.M.1982/Assess:1). This is 9 566 tonnes less than the 1980 TAC of 390 000 tonnes (Murman cod included).

Provisional figures for 1981 indicate an increase of 18 096 tonnes to a level 398 530 tonnes, which was close to the 400 000 tonnes anticipated by the Working Group at its 1981 meeting and well in excess of the TAC of 300 000 tonnes. The catches in Sub-area I continued to decline and reached a level of 136 350 tonnes. The catches in Division IIA and IIB increased by 46 030 tonnes and 4 387 tonnes, respectively.

Expected total landings for 1982 were estimated to be 366 000 tonnes compared to the TAC of 300 000 tonnes. For assessment purposes this catch was split into regions by countries and gears in order to establish the appropriate age compositions.

Since 1974 an increasing part of the total catch has been taken in Division IIA, reaching a level of 62% in 1981 compared with 11% in 1974. This is a combined effect of a more westward distribution of fish since 1978 due to hydrographical changes, poor year classes among the younger age groups, and reduced fishing effort in Sub-area I and Division IIB.

Catch per unit effort for the trawler fleets continued to decline in the period 1976-79 in Sub-area I and Division IIA. This trend was reversed in 1980. Preliminary data indicate a decrease in 1981. In Division IIB the catch per unit effort continued to decline in the period 1974-78. This trend was reversed in 1979 and later it has been fluctuating. However, the figures since 1978 have been calculated from limited data.

For conventional gears fishing in Division IIA the catch per unit effort continued to decline in the period 1978-80. This trend was reversed in 1981. From 1981 to 1982 cpue decreased for gill-nets. For long-lines and hand-lines it more than doubled in the same years. The different trend for the two gear types was due to the high rate of maturation in 1982 of the 1975 and 1976 year classes. These fish were too small to be caught by gill-nets with the normal mesh size, but they were, however, highly vulnerable to the long-lines and hand-lines.

#### 4.2 Virtual Population Analysis

##### 4.2.1 Age compositions

Age compositions for 1980 were revised and preliminary data were available for 1981. In addition, estimated age compositions for the expected landings in 1982 were prepared.

For 1980, age compositions were available for landings by the Federal Republic of Germany, Norway and USSR. Landings by other countries were assumed to have the same age compositions as the USSR landings. For 1981, age composition data were again available for the Federal Republic of Germany, Norway and USSR. For other countries in Sub-area I and Division IIA age compositions were based on those of Norwegian trawlers fishing outside the 12 m zone. For Division IIB age compositions for other countries were derived by pro-rating the USSR age compositions. For 1982 the procedure was the same as for 1981, using the age compositions which were obtained in the first half of 1982 except for Division IIB, where age compositions for Norwegian scouting vessels have been applied.

It should be noted that the USSR age compositions for Division IIB in 1982 were derived from catches of research vessels which were fishing with standard commercial trawls in shallower areas than the main fishing fleet.

These catch at age data were used as input data for the VPA. A value of 0.2 was used for the natural mortality coefficient.

#### 4.2.2 Age at maturity

For determination of the spawning stock size it is important to know the proportion of mature individuals in each age group. In its previous assessments, the Working Group has taken the mature part of the stock to be all fish of age 8 and older. The Group considered, however, that it would be more realistic to use a maturity ogive as recommended by ACFM. The published data were discussed.

The discussion involved papers by Rollefse (1954), Garrod (1967), Hylen and Dragesund (1973), Hylen and Nakken (1982) and Ponomarenko (1968, 1980, 1981, 1982). The maturity ogives from these publications are summarized in Table 7. An analysis indicated that during the last 40 years (from 1942 to 1981) there has been a slight trend of decreasing age at first maturity. In the 1940s and 1950s, the age at 50% maturity was about 10.5 years, but by the end of the 1970s this age had reduced to 8.5 years. It should be pointed out also that the average age at maturity of 8.5 years remained relatively stable during the period 1966 to 1981. Recent Norwegian investigations carried out in 1982 showed a sharp change in the average age at maturity with 50% maturity at about 6.5 years. In the case of the 1975 year class (7 year olds), this phenomenon was supported by preliminary data by Ponomarenko (1982) according to which about 30% of this year class were mature. Because of the apparent trend in the maturity ogives with time the Group decided that it would be preferable not to use a single ogive for the whole historic period but to use a series of ogives which reflected the observed trend. The ogives adopted for the various time periods are given in Table 8. For the period from 1980 there was a large difference between the data of Ponomarenko for the years 1980-81 and those of Hylen and Nakken for 1982. It was not clear whether this was due to methodology or to a real change in age at maturity in 1982, which may or may not be maintained into the future. The Group decided for 1982 to use an average of the two sets of data, and for 1981 and for the prediction period to use an average giving double weighting to the Ponomarenko data. It is recommended that age at maturity data for the earlier years should be made available in more detail, and that any weight at age data for past years should be provided. On the basis of the data available at the 1983 Working Group meeting, a revision of the maturity ogive towards a more detailed analysis will be undertaken.

#### 4.2.3 Survey data

##### Bottom trawl surveys

Data were taken from reports of the Norwegian groundfish surveys in the Barents Sea (Dalen *et al.*, 1982) and in the Svalbard area (Randa and Smedstad, 1982), and Working Group members provided data from the USSR groundfish survey in the Barents Sea and the Norwegian Sea for the period 1979-82. These surveys give estimates of the relative abundance of cod, and these are given in Tables 9, 10 and 11.

##### Acoustic surveys

The Norwegian acoustic surveys are summarized in Hylen and Nakken (1982) and include surveys in the Barents Sea (Dalen *et al.*, 1982), the Lofoten area (Godø *et al.*, 1982) and the Møre area (Godø *et al.*, 1982). These surveys give estimates of the absolute numbers of cod in the different year classes. In order to get a total stock estimate, Hylen and Nakken (1982) have converted the results for the younger age groups in the groundfish survey in the Svalbard area

(Randa and Smedstad, 1982) to absolute numbers using a swept area method assuming a swept area of 0.0405 square nautical miles for a standard haul and a catchability coefficient of 1.0. The paper also takes into account the catches in the first two months of 1982. The figures in Table 12 differ somewhat from those given by Hylen and Nakken (1982) due to the figures in that paper being based on a preliminary run of the data in the Svalbard area.

#### Young fish surveys

Data from the international 0-group fish survey were taken from Anon. (1982) giving the 0-group index for cod. This index of year class abundance was recalculated by Randa (1982). Results from the USSR young fish surveys were provided by Working Group members. The recalculated 0-group indices and the updated USSR indices are given in Table 13.

#### 4.2.4 Fishing mortalities

To obtain values of fishing mortality in 1982 for input into the VPA, a set of F at age estimates were obtained using estimates of stock size at the beginning of 1982 derived from Norwegian surveys (Hylen and Nakken, 1982). The resultant values of F were used in a trial VPA, which showed that for the youngest and oldest age groups there were large differences between the 1982 F values from the survey data and the calculated values for earlier years. Such differences could not be accounted for by any known changes in the fisheries. The Group had, therefore, to consider the possibility that the oldest and youngest age groups were not well estimated in the surveys.

For the older age groups the most important fisheries are those using conventional gears. In the first run the partitioned F values for this group of gears for age groups 9-12 appeared particularly low for 1982 compared with earlier years. The effort data for these gears are not good, but effort is believed to have been relatively constant since the number of boats using these gears has not changed significantly in recent years. Therefore, the 1982 F values were adjusted to be approximately on the same level as the Fs in 1979-80 (Figure 1). The resulting spawning stock was found to be in good agreement with the development of the cpue of long-line in the spawning fishery (see Table 6 and Figure 2).

For age groups 3 and 4 there was some evidence from the partitioned F values for the Norwegian trawlers that the surveys gave F values which were too high. Also the survey F value on 3- and 4-year olds gave year class strengths for the 1978 and 1979 year classes, which were inconsistent with the estimates from the USSR young fish surveys. The 1982 F values for the 4 year olds were, therefore, calibrated by the USSR young fish survey estimates of year class strength. For the 3 year olds, ratios of 3 to 4 year old fish abundance was determined from both the Norwegian and USSR groundfish surveys in 1982 (Tables 9-11). These ratios were applied to the stock number of 4 year olds to give estimates of the stock of 3 year olds. The resultant values were averaged and were used to determine the corresponding value of F.

The resulting Fs for 1982 are given in Table 15. Figures 3-7 show the partitioned Fs for different fisheries and cpue versus biomass, and Figure 8 shows the resulting exploitation pattern of the total fishery in 1982 compared to the average for 1978-81.

F values for 1982 determined as described above have been used to initiate the VPA. Maturity ogives derived as described in Section 4.2.2 have been used in the spawning stock biomass calculations, but no sums of products (SOPs) corrections have been applied. Input data and calculated fishing mortalities, stock numbers and stock biomass are given in Tables 14-16. The historic trends in fishing mortality, recruitment and spawning stock biomass are plotted in Figure 9, B-D.

#### 4.3 Projection of Catch and Stock Size

The parameters used for calculating catches in 1983 and stock sizes in 1984 are given in Table 17. According to the sum of products check, which resulted in a deviation of only 3.7%, no revision of the weight at age data was required. The exploitation pattern from the 1981 assessment has been adjusted according to the F at age array developed for 1982 by taking the average of the two sets of data, slightly smoothed.

The exploitation pattern emerging from this procedure is believed to reflect the reduction in total trawl effort in recent years. Since no increase in trawl effort is expected to take place in 1983 and the next few years, these relative fishing mortalities are used in the projections.

The size of the 1980 and 1981 year classes at age 3 have been estimated on the basis of the USSR young fish survey. Both these indices are very low (Table 13), indicating that these year classes are very poor and are, therefore, taken as 100 million cod at age 3, the conservative level for poor year classes used by the Working Group in previous assessments. The estimate of the strength of the 1982 year class of 600 million cod at age 3, which are expected to recruit to the fishery in 1985, was derived from the ICES 0-group survey (Table 13). Observations reported from the 1982 USSR egg- and larval survey as well as indications of improved environmental conditions confirm that the 1982 year class might be stronger than the preceding ones. The increase in spawning stock biomass in 1982 due to the contribution of the 1975 year class might also have contributed to the production of a good year class in 1982. The estimate of this year class does not affect the projection for 1983 and only marginally the medium-term projection of the spawning stock biomass for 1986 and 1987.

The results of the catch projection are given in Figure 10. In the text table below, management options for 1983 related to the reference points on the Y/R curve (see Figure 10) and to certain levels of catch and spawning stock biomass in 1983 and 1984 respectively are given.

Management Options

SPECIES: NORTH-EAST ARCTIC COD

Area: ICES Sub-areas I and II

1982				Management option for 1983	1983				1984	
Stock biom. (3+)	Spawn. stock biom.x)	$\bar{F}$ (5-10)	xx) Catch (3+)		Stock biom. (3+)	Spawn. stock biom.x)	$\bar{F}$ (5-10)	xx) Catch (3+)	Stock biom. (3+)	Spawn. stock biom. x)
1 408	377	.508	366	$F_{0.1}$	1 272	372	.14	122	1 380	525
				$F_{max}$			.245	204	1 280	470
				$F_{83} = F_{82}$			.51	380	1 080	365
				TAC 1983 = 300			.38	300	1 180	420
				SSB 1984 = 380			.46	350	1 120	380

Weights in thousands of tonnes.

x) From maturity ogive.

xx) Expected catch estimated by the WG.

4.4 Effects of 1983 TACs on Spawning Stock Biomass and Medium-Term  
Projection of Spawning Stock Biomass

The revised estimate of spawning stock biomass (SSB) (see Section 4.6) indicates that its minimum target level is in the order of about 400 000 tonnes compared to 500 000 tonnes in previous assessments (ICES, C.M.1979/G:20). The early maturation of the 1975 year class observed in 1981 and 1982 has increased the SSB from the very low level of 131 000 tonnes in 1980 to 258 000 tonnes and 377 000 tonnes at the beginning of 1981 and 1982, respectively.

Although the 1982 SSB level is close to the minimum target level, it should be noted that the 1975 year class is followed by a series of at least 6 relatively poor year classes. As a consequence, the present level of spawning stock biomass can only be maintained into 1984, if the level of exploitation in 1983 does not exceed  $F(5-10) = 0.46$ . Increasing this level of spawning stock biomass to 400 000 tonnes in 1984 and maintaining it at that level in the following years would require a fishing mortality of 0.40 in 1984 followed by a gradual reduction in fishing mortality up to at least 1986 (see text table on next page).

Calculated SSB in 1983-87 at the beginning of the year and calculated catch 1982-84 at constant levels of exploitation. (Catch figures for 1985-87 are dependent on recruiting year classes beyond 1981 and are, therefore, not given in the text table.)

$\bar{F}$  refers to  $\bar{F}(5-10)$ , weights are given in thousand tonnes.

Management strategy	$\bar{F}_{0.1}=0.14$		$\bar{F}_{max}=0.245$		$\bar{F}=0.3$		$\bar{F}=0.4$		$\bar{F}=0.5$		SSB=400	
	SSB	Catch	SSB	Catch	SSB	Catch	SSB	Catch	SSB	Catch	SSB	F
Year												
1983	372	122	372	204	372	243	372	310	372	372	372	0.40
1984	542	149	470	226	445	257	401	300	363	330	400	0.38
1985	656		530		475		391		323		400	0.33
1986	756		558		478		364		280		400	0.31
1987	831		568		470		338		250		400	

#### 4.5 Stock and Recruitment Relationship

Until this meeting, the Working Group had used a 'knife-edge' type of maturity pattern for the calculation of spawning stock biomass. This assumed fish of age 7 and younger to be immature and fish of 8 and older to be mature. This year, in order to improve the estimates of spawning stock biomass, a series of maturity ogives were used (see Section 4.2.2). In addition, an examination of the sums of products (SOPs) check showed large discrepancies for the earlier years of the historic series. A single set of weight at age data have been used for the whole period 1946-1982. In reality, it is likely that the weights at age have been changing over the years. Examination of the mean weight of 10 year old cod (relative to 1947-50) and the mean SOPs discrepancy (relative to 1947-50) showed a linear relationship with time (Figure 11). It was considered likely that the main source of the SOPs error was due to changes in the weight at age in the stock, and consequently the computed spawning stock biomass was corrected for the SOPs discrepancy. The combined effects of the changes in the maturity at age data and the SOPs corrections of weight at age data can be seen in Figure 12, where the new estimates of spawning stock biomass can be compared with the previous values.

The corrected spawning stock biomass data have been used together with the current estimates of the numbers of recruits at three years old to calculate a new stock/recruitment relationship (Table 18 and Figure 13). The line on the graph was fitted by the method of Ricker (1975) using the general relationship

$$R = a.P.exp(-bP)$$

where R = number of 3 year old recruits (millions)

P = parent spawning stock biomass (thousands of tonnes)

Transformation to a linear relationship gives

$$\ln R - \ln a = -bP$$

which can be written in the form  $Y = A + BX$  by replacing  $\ln R - \ln a$  by Y, P by X,  $\ln a$  by A and  $-b$  by B. The calculated regression gives values of

$A = 1.3346$ ,  $B = -0.0017$ , and  $r = 0.6$ . Retransformation gives values of  $a = 3.7985$  and  $b = 0.0017$  which gives a stock/recruitment relationship for the North-East Arctic cod of

$$R = 3.7985 P \cdot \exp(-0.0017P).$$

As with previous stock/recruitment plots for the North-East Arctic cod, the revised data show a considerable scatter of points about the fitted line. The curve indicates that maximum recruitment should be produced from a spawning stock biomass of about 600 000 tonnes. It would be preferable to prevent the spawning stock biomass falling below 400 000 tonnes to reduce the probability of poor recruitment.

## 5. NORTH-EAST ARCTIC HADDOCK

### 5.1 Status of the Fisheries (Tables 19 to 21)

Final figures for the catch of haddock of 87 889 tonnes in 1980 differ only slightly from the figure given in the previous Working Group report (C.M.1982/Assess:1). The preliminary figure for 1981 of 76 837 tonnes shows a decrease from 1980 of about 11 000 tonnes (12%).

In the previous Working Group report total landings of haddock for 1981 were estimated as 78 000 tonnes, this is only about 1 200 tonnes less than the reported figure for that year. For the first time in the period for which data are available was the catch of haddock in Division IIA higher than in Sub-area I. This might be due to the more westerly distribution of the fish as well as to the fact that a great proportion of the haddock stock consists of spawning fish exploited mainly in Division IIA.

Expected total catches of haddock in 1982 are estimated as 49 000 tonnes, and for the reasons given above, the catch in Division IIA is expected to be higher than in Sub-area I.

The upward trend in catch per unit effort of Norwegian trawlers in Sub-area I, which was observed since 1977, discontinued in 1982, since a great proportion of the stock has reached the age of maturity, particularly the good year classes 1975 and 1976. These fish migrate to the spawning areas in Division IIA and the further increase in cpue in that area might be explained by this migration.

### 5.2 Virtual Population Analysis (VPA)

#### 5.2.1 Age compositions (Table 22)

Catches in numbers per age group were revised for 1980 according to changes in the catch data and revised age compositions for the Norwegian catches. The data for 1981 given in the previous report, which had been based only on the first six months' sampling, were updated for the total annual sampling.

For 1982 projections of the total annual catch by age were made from the data available for the first half of the year from Norway, USSR and the Federal Republic of Germany.

#### 5.2.2 Age at maturity

In the earlier assessments, the Working Group has taken the mature part of the stock to be all fish of age six and older. In order to obtain a more realistic estimate of the mature part of the stock, it was decided to apply a maturity ogive for the estimate of the spawning stock biomass.

Only two series of data (Sonina, 1982 and Sætersdal, 1954) were available for haddock, but since these are similar the data published by

Søttersdal (1954) are used (Table 25). The Working Group noted that such a limited material is not sufficient, particularly in view of possible trends in time, but even the application of a standard maturity ogive is considered as an improvement compared to the previous approach. It is recommended that existing material should be made available in more detail and further sampling be undertaken.

#### 5.2.3 Fishing mortality in 1982

In the initial run the input Fs for 1982 were chosen so that the stock size and composition in 1980 was equal to that emerging from the ACFM re-assessment in 1981. This resulted in a very unusual exploitation pattern in 1982, which could not be explained by changes in the fishery. Therefore, the input exploitation pattern for 1982 was chosen so that it became close to the average exploitation pattern for the years 1978-81 (Figure 14). Because of the change in the hydrographical climate in 1978, the years prior to 1978 were not included in the comparison of the fishing patterns. The fishing mortalities on the age groups 7 and older were finally taken to be 0.13. The reason for choosing this F at age array is as follows:

Figure 15 shows the relation between the unweighted average fishing mortalities on the 4-6 year olds in Sub-area I and the effort in the same area (1973-82). Both sets of data are derived from the Norwegian trawlers. The Fs generated by the Norwegian trawlers were extracted from the total Fs using the catch by number ratio for each year (1973-82) and age group (3-14). The effort data for the respective areas are derived by dividing the catch (in tonnes) by the Norwegian trawlers by the Norwegian cpue data (Table 21).

Figure 16 shows essentially the same relation as Figure 15 but for Sub-area II these figures both indicate that the relationships are different for the period 1973-77 and more recent years. This might indicate that the cooling of the ocean affected the relations between effort and fishing mortality, in particular in Sub-area I. Therefore, F of 0.13 seems reasonable for ages of 7 and older in 1982. The exploitation pattern for 1982 (Figure 14) generated an exploitation pattern on the 5-9 year olds in 1982 for the Norwegian trawl fishery in Sub-area II that is fairly close to the average for 1978-81 (Figure 17).

As a further check on the input values of the fishing mortalities, the assessments of cod and haddock were compared, as was also done in last year's report. As the trawl catches of haddock are mostly a by-catch in the cod fisheries, this is a legitimate procedure.

In Figure 18 the average fishing mortality on the 5-7 years old haddock in Sub-area II (mainly derived from Division IIa) is compared with the fishing mortality of cod in Division IIa. The catch ratio of the two species in the total trawl fisheries is compared with the estimated biomass ratio as derived from the final runs (see Figure 19). Although the 1982 point is within the variance of the previous points, Figures 18 and 19 indicate that the estimate of the cod biomass may be slightly too low or the estimated biomass of haddock is somewhat high, or a combination of these cases.

Taking into account the preliminary status of the 1982 data, the Group concluded that approximating the exploitation pattern to the average for 1978-81 and taking  $F = 0.13$  on the 7 years and older were consistent with the available data.

The results of the VPA are given in Tables 23 and 24. The time series of spawning stock biomass since 1950 derived from maturity ogive and

corrected for SOPs discrepancies are given in Figure 20 in comparison to the biomass of fish at age six and older, which was used in the past as an index of spawning stock biomass. Historic trends in fishing mortality, recruitment and spawning stock biomass are plotted in Figure 21, B-D.

### 5.3 Catch Projection

The parameters used for calculating catches for 1983 and resulting stock sizes in 1984 are given in Table 25. No changes have been made in the average weight per age group used in the previous assessment, since these parameters have been revised at the May 1980 meeting of the Working Group.

The exploitation pattern emerging from the estimated  $F$  at age array for 1982 was slightly adjusted on ages 7 and 8, since the fishery is expected to concentrate on these abundant age groups (year classes 1975 and particularly 1976). This adjustment accounts for expected future developments in the fishery, i.e., reduced trawl effort and increased efficiency in the fishery with conventional gears.

Recruitment of the 1980 and 1981 year classes has been estimated from the USSR young fish survey and the ICES international 0-group survey, respectively (Table 26). The indices derived from these surveys indicate that both these year classes are very poor and consequently a figure of 50 million haddock was used in the catch prediction.

The results of the catch projection are given in Figure 22. In the text table below, three management options are listed, which are related to reference points on the  $Y/R$  curve (see Figure 22) as well as to the level of fishing mortality in 1982. These options have to be evaluated in the light of the comments made in the following section.

#### Management Options

SPECIES: HADDOCK

Area: ICES Sub-areas I and II

1982				Management option for 1983	1983				1984	
Stock biom. (3+)	Spawn. stock biom. x)	$\bar{F}$ (4-7)	xx) Catch (3+)		Stock biom. (3+)	Spawn. stock biom.	$\bar{F}$ (4-7)	xx) Catch (3+)	Stock biom. (3+)	Spawn. stock biom. x)
428	256	.142	49	$F_{0.1}$	411	285	.18	56	390	265
				$F_{max}$			.39	92	335	215
				$F_{1983}$ = $F_{1982}$			.14	45	405	290

Weights in thousands of tonnes.

x) From maturity ogive.

xx) Expected catch estimated by the Working Group.

5.4 Effects of the 1983 TACs on Spawning Stock Biomass

Following an increase in 1981 from the very low 1980 level, the spawning stock in 1982 has increased further to a level of about 256 000 tonnes due to the contribution by the good 1976 year class in 1982. No further increase in spawning stock biomass can be expected up to about 1987, since all the year classes recruiting to the spawning stock during this period are poor. If management aims at maintaining a reasonable spawning stock size over a longer period, a cautious approach in the long-term policy is advisable.

5.5 By-Catch of Haddock in the Cod Fishery

In setting the TAC for haddock it has to be remembered that a considerable part of the haddock catch is taken as a by-catch in the fisheries for other species (mostly cod) in Sub-areas I and II.

The ratio of cod and haddock in the catches (Figure 19) indicates that, at the present biomass levels, the amount of haddock taken as a by-catch in the fishery for cod is about 1/6 of the cod catches.

6. ABUNDANCE AND OCCURRENCE OF COD AND HADDOCK IN THE AREA AROUND SPITSBERGEN (See Section 6.4)

Cod and haddock in the Spitsbergen area are not self-contained stocks but are part of the more widely distributed Arcto-Norwegian stocks. The young, immature fish at Spitsbergen can be considered to be resident in the area and are vulnerable to fishing in the Spitsbergen area only. The adult fish migrate annually out of the Spitsbergen area to spawn when they become vulnerable to fishing on their migration route and on the spawning grounds. The Norwegian request for information referred to the Spitsbergen area, but as the data are grouped for the whole of the Svalbard region (Division IIB), the assessment relates to the whole Division IIB.

6.1 Cod

Catch statistics are available separately for the Svalbard area (Division IIB). Landings reached a minimum of 10 000 tonnes in 1979 but have since been increasing and a catch of about 25 000 tonnes is expected in 1982 (Table 3).

Age composition data are available for Division IIB separately. In addition, the Group had the results of a Norwegian groundfish stock survey (Høyen and Nakken, 1982). The groundfish survey provided an estimate of cod in the Svalbard area at the beginning of 1982. Fishing mortality can be calculated by VPA, using age composition data for Division IIB catches only. However, such estimates of F on the older age groups will be biased due to migration. For the immature age groups the problem is to obtain values of F for input into VPA for 1982 and for the oldest age group in each year. The estimates of stock numbers at the beginning of 1982 from the groundfish survey provided a means to calibrate the VPA. F values input for 1982 for age groups 2 to 6 were used, which gave estimates of stock numbers equal to those obtained by the groundfish survey. For the older age groups, the input F values were the same as were used in the VPA for the total Arcto-Norwegian stock. The results of the VPA are summarised in Table 27, but these should be interpreted with care. For the immature age groups in 1982, the estimates of F will be valid only if the groundfish survey has correctly estimated the stock size. For earlier years, the results will not be entirely free from bias due to migration. A

Norwegian acoustic survey of the Svalbard area was made in 1976 (Dalen, Rørvik and Smedstad, 1977). Estimates of stock numbers from this survey, projected forward to the beginning of 1977, can be compared with the estimates of stock numbers calculated by VPA for 1977. Agreement is reasonably good for age groups 5 to 7, but for the younger age groups the estimates from the survey are much lower than from VPA. Data of numbers caught per 100 ton-hours fishing by United Kingdom trawlers (Burd, 1982) have been plotted against stock numbers calculated by VPA (Figure 23). A fairly good relationship is obtained for age groups 4 and 5.

## 6.2 Haddock

Both commercial catch data and groundfish survey results indicate that the stock of haddock in the Spitsbergen area is at a very low level. The available data are inadequate for any assessment to be attempted for the Svalbard area alone.

## 6.3 Future Prospects

### 6.3.1 Cod

Figure 24 shows a plot against time of stock abundance from VPA of age groups 2-6 combined, and the catches of 2-6 year olds. The fluctuations relate to the abundance of recruiting year classes. Recruitment in recent years as estimated for Division IIb from international 0-group surveys and from USSR young fish surveys (Table 13) has been poor, although there is some hope that the 1982 year class may be more abundant. The VPA can give only a general indication of the stock situation in Division IIb, but there can be no doubt that the stock of immature cod is at a low level and for the foreseeable future the only hope for an improvement in the stock situation is the possibility of better recruitment from the 1982 year class.

### 6.3.2 Haddock

There are no indications so far of any prospect of improvement in the haddock stock at Spitsbergen.

## 6.4 Statement by Drs Babayan and Mukhin

The Soviet scientists considered it inappropriate to discuss the cod in Division IIb separately from the rest of the stock of North-East Arctic cod. They mentioned that unpublished mark-recapture data at PINRO show a migration between Division IIb and Sub-area I for young fish. This material is under preparation, and it is intended to present it to the Working Group next year.

## 7. DEFICIENCIES IN THE DATA BASE

The Working Group is still faced with the problem of splitting catches without age composition using age composition from other fleets and areas. The text table shows the percentage of the catch in Sub-area I and Divisions IIa and IIb and total reported without age composition.

	<u>COD</u>				<u>HADDOCK</u>			
	<u>SA I</u>	<u>Div.IIa</u>	<u>Div.IIb</u>	<u>Total</u>	<u>SA I</u>	<u>Div.IIa</u>	<u>Div.IIb</u>	<u>Total</u>
1980	7.5	6.1	50.3	8.2	2.7	7.4	-	4.5
1981	6.4	4.8	88.7	8.9	1.0	4.3	100	3.3

From this table it is seen that this problem is greatest in Division IIB for cod, where the catch in both 1980 and 1981 amount to about 15 000 tonnes, and in 1982 25 000 tonnes are expected to be taken.

The following countries have taken substantial catches (more than 1 000 tonnes) in 1982, for which no length or age composition data have been provided:

Faroe Islands	12 825 tonnes
France	2 600 "
Spain	14 500 "
United Kingdom	5 260 "

Further work should be done to improve fisheries-independent data for stock abundance estimates on both cod and haddock. The surveys should cover the total area of distribution for both species. The surveys should aim at obtaining absolute biomass estimates instead of relative indices of abundance. It would be preferable, if all bottom-trawl surveys use a stratified random survey design allowing for proper statistical treatment.

The Working Group also feels that the biological data, such as the maturation ogive, should be revised each year and asks for data on this subject to be presented. The Working Group also feels the need to revise the mean weight at age data used for both cod and haddock. Data should be made available both for the present situation and for the historical record. (See Sections 4.2.2 and 5.2.2.)

If possible, the different laboratories doing age readings on Arctic cod and haddock should try to calibrate their readings to see if any differences exist.

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Table 1 Total nominal catches (thousand tonnes) by trawl and other gear for each area

ICES areas	Sub-Area I				Division IIa				Division IIb	
	Cod		Haddock		Cod		Haddock		Cod	Haddock
Year	Trawl	Others	Trawl	Others	Trawl	Others	Trawl	Others	Trawl	Trawl
1967	238.0	84.8	73.8	34.3	38.7	90.0	20.5	7.5	121.1	0.4
1968	588.1	54.4	98.1	42.9	44.2	118.3	31.4	8.6	269.2	0.7
1969	633.5	45.9	41.3	47.7	119.7	135.9	33.1	7.1	262.3	1.3
1970	524.5	79.4	36.7	22.8	90.5	153.3	20.2	6.4	85.6	0.5
1971	253.1	59.4	27.3	29.0	74.5	245.1	15.0	6.6	56.9	0.4
1972	158.1	38.9	193.4	27.8	49.9	285.4	34.4	7.6	33.0	2.2
1973	459.0	33.7	241.2	42.5	39.4	172.4	13.9	9.4	88.2	13.0
1974	677.0	46.5	133.1	25.9	41.0	83.2	39.9	7.1	254.7	15.1
1975	526.3	35.4	103.5	18.2	33.7	86.6	34.6	9.7	147.4	9.7
1976	466.5	60.2	77.7	16.4	112.3	124.9	28.1	9.5	103.5	5.6
1977	471.5	66.7	57.6	14.6	100.9	156.2	19.9	8.6	110.0	9.5
1978	360.4	57.9	53.9	10.1	117.0	146.2	15.7	14.8	17.3	1.0
1979	161.5	33.7	47.8	16.0	114.9	120.5	20.3	18.9	8.1	0.6
1980	133.3	35.4	30.5	23.7	83.7	115.6	14.8	18.9	12.5	0.1
1981	90.9	45.1	19.0	17.9	77.4	167.9	20.9	18.7	17.2	0.5
1982*	54.9	52.6	8.1	13.8	61.7	172.0	13.9	13.3	24.7	-

\*provisional

Table 2 COD and HADDOCK catches (thousand tonnes) and total trawl effort in Norwegian units

AREAS	SUB-AREA I			DIVISION IIa			DIVISION IIb	Total Trawl effort x 10 <sup>-3</sup>
Year	CPUE x 10 <sup>-3</sup>	Ct x 10 <sup>-3</sup>	Trawl effort x 10 <sup>-3</sup>	CPUE x 10 <sup>-3</sup>	Ct x 10 <sup>-3</sup>	Trawl effort x 10 <sup>-3</sup>	Ct x 10 <sup>-3</sup>	
1972	0.96	351.5	366.15	1.17	84.3	72.05	35.2	473.59
1973	1.40	700.2	500.14	1.09	53.3	48.90	101.2	622.78
1974	2.02	810.1	401.04	1.70	80.9	47.59	269.8	584.48
1975	2.08	629.8	302.79	1.80	68.3	37.94	130.8	404.57
1976	1.96	544.2	277.65	1.93	140.4	72.75	109.1	406.24
1977	1.65	529.1	320.67	1.30	120.8	92.92	119.5	489.64
1978	1.50	414.3	276.20	1.26	132.7	105.32	18.3	394.28
1979	1.21	209.3	172.98	1.24	135.2	109.03	8.7	289.13
1980	1.92	163.8	85.31	1.49	98.5	66.11	12.6	158.69
1981	2.06	109.9	53.35	1.39	98.3	70.72	17.7	134.62
1982*	(2.12)	63.0	29.72	(1.83)	75.6	41.31	(24.7)	(83.69)

\* CPUE figures mainly for the first 3 months of the year

Table 3 COD. Total nominal catch (tonnes) by fishing areas (landings of Norwegian coastal COD not included).

Year	Sub-area I	Division IIb	Division IIa	Total catch
1960	375 327	91 599	155 116	622 042
1961	409 694	220 508	153 019	783 221
1962	548 621	220 797	139 848	909 266
1963	547 469	111 768	117 100	776 337
1964	206 883	126 114	104 698	437 695
1965	241 489	103 430	100 011	444 930
1966	292 253	56 653	134 805	483 711
1967	322 798	121 060	128 747	572 605
1968	642 452	269 160	162 472	1 074 084
1969	679 373	262 254	255 599	1 197 226
1970	603 855	85 556	243 835	933 246
1971	312 505	56 920	319 623	689 048
1972	197 015	32 982	335 257	565 254
1973	492 716	88 207	211 762	792 685
1974	723 489	254 730	124 214	1 102 433
1975	561 701	147 400	120 276	829 377
1976	526 685	103 533	237 245	867 463
1977	538 231	109 997	257 073	905 301
1978	418 265	17 293	263 157	698 715
1979	195 166	9 923	235 449	440 538
1980	168 671	12 450	199 313	380 434
1981*	136 350	16 837	245 343	398 530

\* ) Provisional figures

Expected Catches

1982	107 000	25 000	234 000	366 000
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**Table 4** COD. Nominal catch (tonnes, whole weight) by countries (landings of Norwegian coastal cod not included). (Sub-area I and Divisions IIa and IIb combined.)  
Data provided by Working Group members.

Year	Faroe Islands	France	German Dem. Rep.	Germany Fed. Rep.	Norway	Poland	United Kingdom	USSR	Others	Total all countries
1960	3 306	22 321		9 472	231 997	20	141 175	213 400	351	622 042
1961	3 934	13 755	3 921	8 129	268 377	-	158 113	325 780	1 212	783 221
1962	3 109	20 482	1 532	6 503	225 615	-	175 020	476 760	245	909 266
1963	-	18 318	129	4 223	205 056	108	129 779	417 964	-	775 577
1964	-	8 634	297	3 202	149 878	-	94 549	180 550	585	437 695
1965	-	526	91	3 670	197 085	-	89 962	152 780	816	444 930
1966	-	2 967	228	4 284	203 792	-	103 012	169 300	121	483 704
1967	-	664	45	3 632	218 910	-	87 008	262 340	6	572 605
1968	-	-	255	1 073	255 611	-	140 387	676 758	-	1 074 084
1969	29 374	-	5 907	5 343	305 241	7 856	231 066	612 215	133	1 197 226
1970	26 265	44 245	12 413	9 451	377 606	5 153	181 481	276 632	-	933 246
1971	5 877	34 772	4 998	9 726	407 044	1 512	80 102	144 802	215	689 048
1972	1 393	8 915	1 300	3 405	394 181	892	58 382	96 653	166	565 287
1973	1 916	17 028	4 684	16 751	285 184	843	78 808	387 196	276	792 686
1974	5 717	46 028	4 860	78 507	287 276	9 898	90 894	540 801 <sup>1)</sup>	38 453	1 102 434
1975	11 309	28 734	9 981	30 037	277 099	7 435	101 834	343 580 <sup>1)</sup>	19 368	829 377
1976	11 511	20 941	8 946	24 369	344 502	6 986	89 061	343 057 <sup>1)</sup>	18 090	867 453
1977	9 167	15 414	3 463	12 763	388 982	1 084	86 781	369 876 <sup>1)</sup>	17 771	905 301
1978	9 092	9 394	3 029	5 434	363 088	566	35 449	267 138 <sup>1)</sup>	5 525	698 715
1979	6 320	3 046	547	2 513	294 821	15	17 991	105 846	9 439	440 538
1980	9 981	1 705	233	1 921	232 242	3	10 366	115 194	8 789	380 434
1981*	12 825	2 600	298	2 227	277 818	-	5 262	83 000	14 500	398 530

\* Provisional figures

1) Murman cod included

Table 5 COD. Catch per unit effort  
(tonnes, round fresh)

Year	Sub-area I			Division IIb			Division IIa		
	Norway <sup>1)</sup>	U.K. <sup>2)</sup>	USSR <sup>3)</sup>	Norway <sup>1)</sup>	U.K. <sup>2)</sup>	USSR <sup>3)</sup>	Norway <sup>1)</sup>	U.K. <sup>2)</sup>	Norway <sup>4)</sup>
1960		0.075	0.42		0.105	0.31		0.067	3.1
1961		0.079	0.38		0.129	0.44		0.058	3.7
1962		0.092	0.59		0.133	0.74		0.066	4.0
1963		0.085	0.60		0.098	0.55		0.066	3.1
1964		0.058	0.37		0.092	0.39		0.070	4.8
1965		0.066	0.39		0.109	0.49		0.066	2.9
1966		0.074	0.42		0.078	0.19		0.067	4.0
1967		0.081	0.53		0.106	0.87		0.052	3.5
1968		0.110	1.09		0.173	1.21		0.056	5.1
1969		0.113	1.00		0.135	1.17		0.094	5.9
1970		0.100	0.80		0.100	0.80		0.066	6.4
1971		0.056	0.43		0.071	0.16		0.062	10.6
1972	0.90	0.047	0.34	0.59	0.051	0.18	1.08	0.055	11.5
1973	1.05	0.057	0.56	0.43	0.054	0.57	0.71	0.043	6.8
1974	1.75	0.079	0.90	1.94	0.106	0.77	1.19	0.028	3.4
1975	1.82	0.077	0.85	1.67	0.100	0.43	1.36	0.033	3.4
1976	1.69	0.060	0.66	1.20	0.081	0.30	1.69	0.035	3.8
1977	1.54	0.052	0.50	0.91	0.056	0.25	1.16	0.044	5.0
1978	1.37	0.062	0.37	0.56	0.044	0.08	1.12	0.037	7.1
1979	0.85	0.046	0.36	0.62	-	0.06	1.06	0.042	6.4
1980	1.47	-	0.36	0.41	-	0.16 <sup>5)</sup>	1.27	-	5.0
1981	1.42	-	0.41	(0.96)	-	0.07	1.02	-	6.2
1982 <sup>*)</sup>	1.68	-	0.25 <sup>6)</sup>				1.30		6.4

\*) Projected figures

- 1) Norwegian data - tonnes per 1 000 tonne-hours fishing
- 2) United Kingdom data - tonnes per 100 tonne-hours fishing
- 3) USSR data - tonnes per hour fishing
- 4) Norwegian data - tonnes per gill-net boat week in Lofoten
- 5) Data from redfish fishery in Division IIb, cod is by-catch
- 6) Cod and haddock combined for Jan.-June (Proportion of haddock is about 10%)

Table 6. COL.

Catch per unit effort. Data from the Lofoten fishery are given in gutted weight with head off.

Year	Norwegian vessels		
	Catch (kg per man per day worked in the Lofoten fishery (Division ILa))		
	Gill-net	Long-line	Hand-line
1960	77.8	148.3	56.7
1961	101.5	141.1	75.5
1962	94.9	134.4	57.8
1963	80.8	116.3	56.2
1964	104.5	62.1	51.5
1965	81.8	78.3	68.4
1966	121.8	131.9	72.6
1967	107.9	245.4	120.7
1968	158.0	184.6	61.5
1969	170.6	200.4	142.8
1970	180.3	304.3	127.6
1971	334.3	510.7	192.7
1972	318.7	400.1	110.2
1973	189.7	366.5	112.1
1974	96.3	146.4	63.9
1975	122.0	188.3	96.1
1976	131.4	258.4	134.8
1977	173.2	279.6	143.5
1978	237.6	381.7	134.6
1979	201.3	306.0	125.1
1980	169.9	207.8	100.9
1981	217.0	327.9	109.6
1982	199.1	753.4	252.0

Table 7. North-East Arctic COD. Published maturity ogives

SOURCE:	1	2	3	4	5	3	6	6	5	7
PERIOD:	1942-52	1958-66	1966-78	1965-69	1975-76	1977-78	1977-80	1978-9	1980-81	1982
Age	Percentage mature									
3										
4			1				1	1		5
5			2		1	1	1	1	2	10
6			5		5	3	4	6	6	34
7	3	7	13	7	11	12	13	19	17	65
8	10	26	31	20	21	32	38	36	36	82
9	24	42	57	42	42	56	62	70	61	92
10	42	55	74	63	80	69	67	75	79	100
11	61	68	85	84	90	81	71	81	90	100
12	79	79	85	98	92	82	80	82	92	100
13	92	87	91	100	98	86	60	86	98	100
14	99	92	100	100	96	100		100	96	100
15+	100	100	100	100	100	100	100	100	100	100

Source of data:

- |                             |                          |
|-----------------------------|--------------------------|
| 1) Rollefson 1954           | 5) Ponomarenko 1982      |
| 2) Ponomarenko 1968         | 6) Ponomarenko 1981      |
| 3) Ponomarenko 1980         | 7) Hylen and Nakken 1982 |
| 4) Hylen and Dragesund 1973 |                          |



Table 9. COD. Results from the Norwegian groundfish survey in the Barents Sea. Stratified mean catch in number caught per hour of trawling.

Year	Y E A R C L A S S											TOTAL
	1981	1980	1979	1978	1977	1976	1975	1974	1973	1972	1971	
1981		0.8	13.9	10.8	21.4	43.1	48.1	6.1	1.4	0.3	0.6	143.1
1982	0.2	0.9	15.9	20.2	21.1	15.9	15.6	1.3	0.2	0.0		91.1

Table 10. COD. Results from the Norwegian groundfish survey in the Svalbard area 1981. Stratified mean catch in number caught per hour of trawling.

Year	Y E A R C L A S S										TOTAL
	1980	1979	1978	1977	1976	1975	1974	1973	1972	1971+	
1981	0.1	8.0	12.8	4.4	1.2	3.7	4.1	0.4	0.2	1.2	36.6

Table 11. COD. Results from the USSR groundfish surveys in the Barents Sea and the Norwegian Sea. Mean catch in numbers caught per hour of trawling.

Year	A G E						TOTAL
	3	4	5	6	7	8	
1979	5.9	33.8	9.8	4.3	2.9	2.1	59
1980	5.0	3.8	10.6	2.9	1.0	1.2	25
1981	5.3	3.9	2.2	4.8	0.8	0.5	17
1982	3.1	2.9	1.7	0.4	1.1	0.5	10

Data provided by Working Group members

Table 12. COD. Stock numbers in millions at 1 January 1982 from ICES C.M.1982/G:61 (Eylen and Nakken)

A G E												
1	2	3	4	5	6	7	8	9	10	11	12	13
1	4	81	105	103	95	154	23	12	6	3	2	1

Table 13 COD Year class strength. Number per hour trawling  
for USSR Young Fish Surveys is for 3 year old fish

Year Class	USSR Survey No. per hour trawling			USSR assessment	0-group survey index (Logarithmic) All areas Division IIb		Virtual Population No. of 3 year olds $\times 10^{-6}$ *
	Sub-area I	Division IIb	Mean				
							M = 0.2
1957	12	16	13	- Average			791
1958	16	24	19	+ Average			919
1959	18	14	16	+ Average			730
1960	9	19	13	Poor			473
1961	2	2	2	Poor			340
1962	7	4	6	Poor			779
1963	21	120	76	Rich			1 582
1964	49	45	46	Rich			1 294
1965	<1	<1	<1	Very poor	0.01	0.00	177
1966	2	<1	1	Very Poor	0.03	0.01	115
1967	1	<1	1	Very Poor	0.06	0.00	197
1968	7	1	5	Poor	0.02	0.01	405
1969	11	6	9	Poor	0.31	0.21	1 016
1970	74	86	76	Rich	2.54	2.10	1 818
1971	37	24	32	Average	0.38	0.42	524
1972	53	17	40	Average	0.62	0.14	620
1973	74	5	46	Rich	1.33	0.10	616
1974	6	1	4	Poor	0.55	0.01	372
1975	93	4	62	Rich	0.97	0.08	794
1976	4	<1	3	Poor	0.15	0.00	241
1977	2	1	1	Poor	0.51	0.24	(175)
1978	1	3	2	Poor	0.28	0.36	(257)
1979	<1	8	3	Poor	0.44	0.68	(190)
1980	(<1)	(<1)	(<1)	Poor	0.17	0.23	
1981	(<1)	(<1)	(<1)	Poor	0.11	0.14	
1982					0.73	0.37	

( ) = estimated

\*) USSR Murman cod included for 1974-1978

Table 14. North-East Arctic COD.  
Catch in numbers ('000) from VPA.

	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	55937	34467	3709	2307	7164	7754	35536	294262	91855
4	55644	160048	174585	24545	10792	13739	45431	131493	437377
5	34676	69235	267961	238511	25813	11831	26832	61001	263772
6	42539	22061	107051	181239	137829	9527	12069	20569	47006
7	37169	26295	26701	79363	96420	59291	7918	7248	12630
8	18500	25139	16399	26989	31920	52003	34685	8328	4370
9	5077	11322	11597	13463	8933	12193	22315	19131	2523
10	1495	2329	3657	5092	3249	2434	4572	4499	5607
11	380	687	657	1913	1232	762	1215	677	2127
12	403	316	122	414	260	418	353	195	322
13	77	225	124	121	116	149	315	81	151
14	9	40	70	23	39	42	121	59	83
15+	70	14	46	46	35	25	40	55	62
TOTAL	251976	352179	612679	574026	323792	170067	191622	547596	867885

	1975	1976	1977	1978	1979	1980	1981	1982
3	45282	85337	39594	78822	8600	3911	3406	3460
4	59798	114341	168609	43400	77484	17086	9436	21267
5	226646	79993	136335	88495	42677	81986	20698	21329
6	118567	118236	52925	56823	31943	40061	63349	33282
7	29522	47872	61821	25407	16815	17664	21786	45311
8	9353	13962	23338	31821	8274	7442	9940	7274
9	2617	4051	5659	9408	10974	3508	4269	2541
10	1555	936	1521	1227	1785	3196	1511	532
11	1928	553	610	913	427	678	882	223
12	575	442	271	446	103	79	109	151
13	231	139	122	748	59	24	37	46
14	15	26	92	48	38	26	3	1
15+	37	53	54	51	45	8	1	5
TOTAL	496126	465946	490951	339609	200274	175669	135227	140411

Table 15. North-East Arctic COD.  
Fishing mortalities from VPA (M = 0.2).

	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	0.040	0.051	0.024	0.023	0.041	0.021	0.059	0.190	0.214
4	0.104	0.152	0.207	0.221	0.142	0.103	0.107	0.199	0.496
5	0.212	0.181	0.408	0.481	0.382	0.220	0.298	0.353	0.537
6	0.379	0.202	0.407	0.557	0.571	0.730	0.304	0.392	0.507
7	0.465	0.427	0.401	0.768	0.619	0.518	0.314	0.417	0.445
8	0.566	0.600	0.526	0.927	0.837	0.820	0.607	0.638	0.483
9	0.680	0.855	0.704	1.132	0.959	0.936	1.117	1.011	0.403
10	0.709	0.738	0.725	0.949	0.970	0.771	1.202	0.713	0.957
11	0.460	0.362	0.535	1.128	0.636	0.639	1.216	1.576	0.913
12	0.016	0.389	0.355	0.782	0.432	0.401	0.704	0.635	0.601
13	0.616	0.864	1.151	0.721	0.466	0.474	0.708	1.341	1.739
14	0.370	0.750	0.740	0.680	0.540	0.340	0.910	0.310	0.700
15+	0.370	0.750	0.740	0.680	0.540	0.340	0.910	0.310	0.700
F(5-10),U	0.502	0.517	0.546	0.799	0.723	0.565	0.607	0.586	0.555

	1975	1976	1977	1978	1979	1980	1981	1982
3	0.084	0.105	0.125	0.116	0.040	0.025	0.015	0.051
4	0.211	0.313	0.504	0.200	0.159	0.105	0.077	0.120
5	0.522	0.480	0.759	0.665	0.313	0.252	0.178	0.251
6	0.701	0.573	0.680	0.860	0.530	0.527	0.315	0.480
7	0.714	0.695	0.680	0.859	0.682	0.651	0.618	0.391
8	0.703	0.583	0.906	0.941	0.781	0.750	0.987	0.430
9	0.614	0.774	1.219	1.278	1.069	0.946	1.488	0.751
10	0.466	0.451	0.768	1.004	0.924	1.139	1.258	0.750
11	1.115	0.513	0.605	1.792	1.316	1.216	1.254	0.751
12	0.081	0.059	0.236	1.312	1.189	0.907	0.029	0.750
13	1.255	0.342	0.618	2.149	0.586	1.053	2.440	0.601
14	0.860	0.430	0.400	0.530	0.560	0.560	0.340	0.440
15+	0.860	0.430	0.400	0.530	0.560	0.560	0.340	0.440
F(5-10),U	0.617	0.644	0.830	0.934	0.718	0.711	0.607	0.508

Table 16. North-East Arctic COD.

Stock size in numbers ('000) from VFA at 1 January.

Biomass unit: tonnes.

(The biomass estimates are not corrected for SOP discrepancies.)

	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	1583541	1295354	176165	112218	197121	464961	1115353	1817734	523818
4	623016	1245993	1627772	155920	89793	154922	324503	799630	1223285
5	199356	459914	375926	684297	18191	63796	114450	224756	536293
6	147805	152414	514183	476723	346502	49853	41500	69535	129235
7	119496	82826	36550	161273	228139	161751	32244	23192	38511
8	46806	50523	44227	48539	61248	100490	76182	19283	12486
9	11224	21765	25657	21523	15728	2176	35932	32841	8344
10	3211	4654	7730	9024	5681	4933	7011	9624	9886
11	1129	1294	1734	3665	2859	1762	1868	1691	2863
12	957	533	447	831	612	1239	762	453	778
13	185	423	196	257	311	432	646	319	197
14	32	83	146	51	102	160	226	243	180
15+	248	29	96	162	92	95	72	226	134
TOTAL	2727506	5299637	2554768	1653822	1637479	964633	1653517	2999567	2467000
SPAWN. ST.	28276	31330	32183	39520	54773	52592	43566	30927	23904
Total Biom.	3028463	3856483	3980021	3419435	2427779	1870350	2051996	2971617	3069018
SSB	147768	175059	185914	222216	257826	270861	256070	196833	152846
	1975	1976	1977	1978	1979	1980	1981	1982	1983
3	620045	616413	570860	794749	240564	175067	256698	191230*****	
4	346178	466862	427799	267941	579210	189194	139302	207691	146930
5	619683	229598	279432	199351	178566	464467	139491	115947	151379
6	256032	296193	116292	107150	64142	106893	237349	15564	67555
7	63762	116235	156764	47941	37115	46289	51642	153773	48414
8	20204	25794	42589	50702	10021	15367	17200	22001	83240
9	6316	8196	8089	14697	18118	6229	5942	5246	12143
10	4567	2623	3693	3216	1960	5192	1960	1699	2029
11	3118	2346	1472	1175	636	1145	1335	461	425
12	1270	834	1419	659	160	136	255	312	178
13	349	526	289	918	143	46	43	111	121
14	28	81	306	128	97	66	11	3	50
15+	70	166	186	136	115	26	4	15	10
TOTAL	1932143	1754002	1389122	1492543	1156634	943849	371751	783653	
SPAWN. ST.	25400	29796	56985	50615	36965	3423	81647	107863	
Total Biom.	2734444	2513463	2164050	1913362	1565160	1482778	1454414	1418003	
SSB	137308	146226	246604	237233	163688	130768	258316	376993	

Table 17. North-East Arctic COD.  
Input data for catch predictions.

LIST OF INPUT VARIABLES BY AGE GROUP:

AGE	STOCK SIZE	F-PATTERN	M	MATURITY OGIVE	WEIGHT IN THE CATCH	WEIGHT IN THE STOCK
3	100000.00	0.1300	0.200	0.0000	0.6500	0.6500
4	148930.00	0.2700	0.200	0.0200	1.0000	1.0000
5	150379.00	0.4700	0.200	0.0500	1.5500	1.5500
6	67555.00	0.7100	0.200	0.1500	2.3500	2.3500
7	48414.00	0.9300	0.200	0.3300	3.4500	3.4500
8	85240.00	1.1700	0.200	0.5100	4.7000	4.7000
9	12143.00	1.3400	0.200	0.7100	6.1700	6.1700
10	2029.00	1.4000	0.200	0.8600	7.7000	7.7000
11	425.00	1.3700	0.200	0.9300	9.2500	9.2500
12	178.00	1.2400	0.200	0.9400	10.8500	10.8500
13	121.00	1.0700	0.200	0.9900	12.5000	12.5000
14	50.00	0.8800	0.200	1.0000	13.9000	13.9000
15+	10.00	0.8800	0.200	1.0000	15.0000	15.0000

Table 18 COD biomass (8+). Spawning stock biomass from maturity ogives and recruitment at age 3, originating from the spawning stock for 1946 to 1976 (79).

	$\times 10^3 t$	$\times 10^3 t$	$\times 10^3 nos.$		$\times 10^3 t$	$\times 10^3 t$	$\times 10^3 nos.$
Year	B (8+)	Sp. Stock	Recruitment	Year	B (8+)	Sp. Stock	Recruitment
1946	4 094	1 244	468	1965	214	97	170
1947	3 383	1 073	710	1966	341	139	112
1948	2 351	843	1 090	1967	460	154	197
1949	1 773	621	1 192	1968	440	178	405
1950	1 611	549	1 593	1969	473	194	1 016
1951	1 479	463	644	1970	471	251	1 821
1952	1 195	327	273	1971	683	303	528
1953	920	322	440	1972	68	276	633
1954	842	293	805	1973	399	225	640
1955	887	307	497	1974	238	157	369
1956	1 010	312	685	1975	218	123	794
1957	942	289	791	1976	233	150	243
1958	1 028	307	919	1977	313	246	(165)
1959	870	346	731	1978	407	238	(117)
1960	613	295	474	1979	240	176	(89)
1961	523	258	339	1980	199	127	
1962	477	204	778	1981	226	285	
1963	379	142	1 584	1982	233	391	
1964	243	98	1 293				

Table 19 HADDUCK. Total nominal catch (tonnes) by fishing areas. (Data provided by Working Group members)

Year	Sub-area I	Division IIb	Division IIa	Total
1960	125 675	1 854	27 925	155 454
1961	165 165	2 427	25 642	193 234
1962	160 972	1 727	25 189	187 888
1963	124 774	939	21 031	146 744
1964	79 056	1 109	18 735	98 900
1965	98 505	939	18 640	118 079
1966	124 115	1 614	34 892	160 621
1967	108 066	440	27 980	136 486
1968	140 970	725	40 031	181 726
1969	88 960	1 341	40 208	130 509
1970	59 493	497	26 611	86 601
1971	56 300	435	21 567	78 302
1972	221 183	2 155	41 979	265 317
1973	283 728	12 989	23 348	320 065
1974	159 037	15 068	47 033	221 138
1975	121 686	9 726	44 330	175 742
1976	94 064	5 649	37 566	137 279
1977	72 159	9 547	28 452	110 158
1978	63 965	979	30 478	95 422
1979	63 841	615	39 167	103 623
1980	54 205	68	33 616	87 889
1981*	36 851	455	39 531	76 837

\*Provisional figures

Expected catches

1982	22 000	-	27 000	49 000
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Table 20

HADDOCK. Nominal catch (tonnes) by countries.  
(Sub-area I and Divisions IIA and IIB combined)  
(Data provided by Working Group members)

Year	Faroe Islands	France	German Dem. Rep.	Germany Fed. Rep.	Norway	Poland	U.K.	USSR	Others	Total
1960	172	-	-	5 597	47 263	-	45 469	57 025	125	155 651
1961	295	220	-	6 304	60 862	-	39 650	85 345	558	193 234
1962	83	409	-	2 895	54 567	-	37 486	91 910	58	187 438
1963	17	363	-	2 554	59 955	-	19 809	63 526	-	146 224
1964	-	208	-	1 482	38 695	-	14 653	43 870	250	99 158
1965	-	226	-	1 568	60 447	-	14 345	41 750	242	118 578
1966	-	1 072	11	2 098	82 090	-	27 723	48 710	74	161 778
1967	-	1 208	3	1 705	51 954	-	24 158	57 346	23	136 397
1968	-	-	-	1 867	64 076	-	40 129	75 654	-	101 726
1969	2	-	309	1 490	67 549	-	37 234	24 211	25	130 820
1970	541	-	656	2 119	36 716	-	20 423	26 802	-	87 257
1971	81	-	16	896	45 715	43	16 373	15 778	3	78 905
1972	137	-	829	1 433	46 700	1 433	17 166	196 224	2 231	266 153
1973	1 212	3 214	22	9 534	86 767	434	32 408	186 534	2 501	322 626
1974	925	3 601	454	23 409	66 164	3 045	37 663	78 548 <sup>1)</sup>	7 348	221 157
1975	299	5 191	437	15 930	55 966	1 080	28 677	65 015 <sup>1)</sup>	3 163	175 758
1976	537	4 459	348	16 660	49 492	986	16 940	42 485 <sup>1)</sup>	5 358	137 265
1977	213	1 510	144	4 798	40 118	-	10 778	52 210 <sup>1)</sup>	287	110 158
1978	466	1 411	369	1 521	39 955	1	5 766	45 895 <sup>1)</sup>	38	95 422
1979	343	1 198	10	1 948	66 849	2	6 454	26 365	454	103 623
1980	497	226	15	1 365	61 886	-	2 948	20 706	246	87 889
1981*	381	100	22	2 396	58 856	-	1 682	13 400	-	76 837

\* Provisional figures 1) Murman haddock included

Table 21 HADDOCK  
Catch per unit effort

Year	Sub-area I		Division IIb		Division IIa	
	Norway <sup>1)</sup>	U.K. <sup>2)</sup>	Norway <sup>1)</sup>	U.K. <sup>2)</sup>	Norway <sup>1)</sup>	U.K. <sup>2)</sup>
1960		33		2.8		34
1961		29		3.3		36
1962		23		2.5		42
1963		13		0.9		33
1964		18		1.6		18
1965		18		2.0		18
1966		17		2.8		34
1967		18		2.4		25
1968		19		1.0		50
1969		13		2.0		42
1970		7		1.0		31
1971		8		3.0		25
1972	0.06	14	0.02	23.0	0.09	18
1973	0.35	22	0.18	20.0	0.39	20
1974	0.27	20	0.09	15.0	0.51	74
1975	0.26	15	0.06	4.0	0.44	60
1976	0.27	10	+	3.0	0.24	38
1977	0.11	4	+	0.2	0.14	16
1978	0.13	5	+	4.0	0.14	15
1979	0.36	-	0.07	-	0.18	-
1980	0.45	-	+	-	0.22	-
1981	0.64	-	-	-	0.37	-
1982*	0.44	-	-	-	0.53	-

\* ) Provisional figure

1) Norwegian data - tonnes per 1 000 tonne-hours fishing

2) United Kingdom data - tonnes per 100 tonne-hours fishing

Table 22. North-East Arctic HADDOCK.  
Input catch in numbers ('000) for VPA.

	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	26157	15916	657	1520	23004	1979	230229	70204	9684
4	22469	41373	67632	1963	2418	24359	22246	258773	41701
5	62724	13505	41267	44526	1870	1258	42849	24018	88111
6	28840	25736	7748	18956	21995	918	3196	6872	5827
7	5711	8878	15599	3611	7948	9279	1606	418	4138
8	578	1617	5292	4925	1974	3156	6736	422	382
9	435	218	655	1624	1978	826	2630	1680	617
10	183	176	182	315	726	1143	896	525	2643
11	136	155	101	43	166	369	988	146	935
12	25	76	115	43	26	131	538	341	276
13	8	27	18	14	52	27	53	68	458
14+	7	7	19	2	19	4	42	13	143
TOTAL	147328	107686	139285	77542	62166	43248	312009	363479	154315

	1975	1976	1977	1978	1979	1980	1981	1982
3	10637	13989	55967	47311	17541	627	486	995
4	14089	13449	22043	18312	35290	27878	2559	1440
5	32871	8818	7368	4176	16645	21794	22133	2216
6	49712	20789	2586	1389	1429	2971	10066	11597
7	2135	40644	7781	1626	812	250	1127	3091
8	1236	1247	11043	2596	546	504	160	770
9	92	1349	311	6715	1460	231	101	115
10	131	193	388	162	2310	842	72	56
11	500	279	96	258	181	1299	328	91
12	147	652	101	3	87	111	555	434
13	53	331	84	74	2	35	27	253
14+	92	46	98	65	53	15	42	59
TOTAL	112695	99176	117866	82587	71361	51556	38116	21117

Table 2j. North-East Arctic HADDOCK.  
Fishing mortalities from VPA (M = 0.2).

	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	0.126	0.062	0.037	0.102	0.100	0.023	0.201	0.367	0.209
4	0.388	0.300	0.402	0.149	0.233	0.260	0.303	0.586	0.313
5	0.575	0.427	0.554	0.530	0.207	0.184	1.359	0.941	0.404
6	0.722	0.494	0.467	0.530	0.516	0.148	0.907	0.466	0.676
7	0.800	0.510	0.639	0.413	0.452	0.410	0.416	0.302	0.573
8	0.497	0.554	0.660	0.425	0.420	0.314	0.019	0.182	0.499
9	0.436	0.553	0.457	0.433	0.302	0.311	0.438	0.297	0.437
10	0.359	0.515	0.562	0.417	0.351	0.258	0.056	0.167	0.712
11	0.793	0.563	0.501	0.247	0.405	0.303	0.414	0.206	0.502
12	0.295	0.937	1.160	0.212	0.232	0.645	0.979	0.244	0.741
13	0.000	0.000	0.000	0.400	0.400	0.400	0.000	0.300	0.000
14+	0.000	0.000	0.000	0.400	0.400	0.400	0.000	0.300	0.000
FC (4-7),U	0.621	0.433	0.510	0.402	0.350	0.254	0.705	0.574	0.476

	1975	1976	1977	1978	1979	1980	1981	1982
3	0.250	0.306	0.628	0.272	0.089	0.024	0.026	0.020
4	0.527	0.621	1.139	0.446	0.334	0.160	0.131	0.100
5	0.431	0.528	0.852	0.661	0.492	0.356	0.228	0.160
6	0.419	0.516	0.390	0.374	0.514	0.245	0.295	0.180
7	0.495	0.713	0.370	0.456	0.391	0.156	0.125	0.130
8	0.333	0.009	0.434	0.202	0.271	0.450	0.142	0.130
9	0.212	0.742	0.297	0.467	0.168	0.175	0.252	0.130
10	0.154	0.913	0.491	0.248	0.310	0.137	0.076	0.130
11	0.374	0.564	2.207	0.719	0.483	0.295	0.073	0.130
12	0.134	1.244	0.409	0.382	0.570	0.625	0.198	0.130
13	0.300	0.500	0.500	0.600	0.475	0.475	0.300	0.130
14+	0.300	0.500	0.500	0.600	0.475	0.475	0.300	0.130
FC (4-7),U	0.468	0.594	0.638	0.484	0.433	0.229	0.195	0.142

Table 24. North-East Arctic HADDOCK.

Stock size in numbers ('000) from VPA at 1 January.

Biomass units: tonnes.

(The biomass estimates are not corrected for SOP discrepancies.)

	1966	1967	1968	1969	1970	1971	1972	1973	1974
3	242598	291111	19783	17211	164100	95317	1132120	291144	56569
4	76591	175043	223969	15604	12720	113631	76001	636013	175272
5	156738	42541	160124	122632	11016	8247	71126	42796	291849
6	61148	72202	22716	49948	60558	7328	5519	23137	13672
7	11294	24519	36155	11653	23921	29877	5112	1759	11367
8	1615	4155	11958	15576	6301	12458	16157	2794	1064
9	1349	814	1954	5662	8335	3338	7454	7188	1917
10	634	714	463	1013	2688	5046	2032	3746	4375
11	368	391	477	216	547	1548	3193	863	2594
12	107	136	131	258	136	299	936	1728	575
13	19	65	44	47	173	90	128	288	1119
14+	17	17	46	7	63	13	102	55	346
TOTAL	552529	611488	423726	239275	291556	277743	1226081	1111564	558700
SPAWN. ST.	86354	34404	94209	87591	74432	60348	57381	71597	113978
Total Biom.	713770	713563	644190	477595	422987	385341	1031197	1050220	859406
SSB	190294	202135	227128	220967	210696	180267	167817	151409	230768
	1975	1976	1977	1978	1979	1980	1981	1982	1983
3	49823	58242	131027	218388	227312	28736	21894	55423*****	
4	37597	31762	35112	57240	136255	171266	22961	16668	44478
5	106018	18165	13979	9200	29995	79854	118806	16492	12348
6	159662	56421	8776	4882	5896	15120	45817	77442	11566
7	5904	65033	27573	4864	2750	1905	9024	27916	52966
8	4785	2986	34359	15589	2525	1523	1334	6954	2069
9	529	2807	1330	18226	10426	1576	195	948	4999
10	1018	350	1195	819	9351	7216	1183	516	682
11	1758	707	115	549	517	5580	5149	822	364
12	1286	990	330	11	219	261	3411	3921	591
13	224	921	234	179	6	101	114	2285	2818
14+	390	123	273	157	153	43	178	533	2126
TOTAL	368466	259114	254201	330093	423399	312100	230147	209908	
SPAWN. ST.	125718	119857	71933	47184	41341	52737	73243	86065	
Total Biom.	702291	523030	378312	373624	454933	454195	451670	428185	
SSB	306195	335774	216642	152631	124776	140986	197030	255895	

Table 25. North-East Arctic HADDOCK.  
Input data for catch predictions.

LIST OF INPUT VARIABLES BY AGE GROUP:

AGE	STOCK SIZE	F-PATTERN	M	MATURITY OGIVE	WEIGHT IN THE CATCH	WEIGHT IN THE STOCK
3	50000.00	0.1300	0.200	0.0000	0.6600	0.6600
4	44478.00	0.6500	0.200	0.0500	1.0300	1.0300
5	12348.00	1.0400	0.200	0.2300	1.7900	1.7900
6	11506.00	1.1700	0.200	0.5300	2.3800	2.3800
7	52960.00	1.1200	0.200	0.8800	2.8600	2.8600
8	20069.00	0.9700	0.200	0.9800	3.3300	3.3300
9	4999.00	0.8500	0.200	1.0000	3.7000	3.7000
10	682.00	0.8500	0.200	1.0000	4.4100	4.4100
11	364.00	0.8500	0.200	1.0000	5.4000	5.4000
12	591.00	0.8500	0.200	1.0000	6.7000	6.7000
13	2818.00	0.8500	0.200	1.0000	7.4000	7.4000
14+	2026.00	0.8500	0.200	1.0000	8.0000	8.0000

Table 26 HADDOCK.

Year class strength. The number per hour trawling for  
USSR Young Fish Surveys is for 2 year old fish.

Year class	USSR Survey No.per hour trawling Sub-area I	0-group survey index	Virtual population No. of 3 year olds x 10 <sup>-6</sup> <sub>est</sub>
1957	9		242
1958	4		110
1959	14		241
1960	40		276
1961	50		319
1962	3		100
1963	9		243
1964	12		291
1965	<1	7	20
1966	<1	<1	17
1967	13	42	164
1968	<1	8	96
1969	69	82	1 032
1970	33	115	291
1971	3	73	57
1972	9	46	50
1973	8	54	58
1974	35	147	131
1975	96	170	218
1976	13	112	227
1977	1	116	(29)
1978	<1	61	(21)
1979	<1	69	(55)
1980	<1	54	
1981	(<1)	30	
1982		90	

( ) = Estimated \* = USSR Murman haddock included for 1974-77.

Table 27 North East Arctic COD Division IIB.  
Summarised VPA results.

Year	F (2-6)	Stock size No. $\times 10^3$ age (2-6)	Biomass t. age (2-6)	Catches tonnes		
				Age (2-6)	Total	%
1967	.142	610 026	652 925	72 798	98 672	73.8
1968	.342	423 193	633 857	166 671	174 118	95.7
1969	.433	173 867	295 299	82 266	122 385	67.2
1970	.213	104 096	74 034	11 533	26 614	43.3
1971	.059	287 314	52 085	837	12 648	6.6
1972	.094	666 884	177 887	12 605	20 503	61.5
1973	.149	583 542	434 188	67 983	69 070	98.4
1974	.500	480 929	479 920	184 634	186 822	98.8
1975	.456	282 552	304 124	89 385	94 792	94.3
1976	.368	150 761	176 837	35 598	45 064	79.0
1977	.118	95 054	101 604	57 908	68 803	84.2
1978	.283	30 866	29 141	5 203	6 955	74.8
1979	.096	30 591	23 593	1 473	2 731	53.9
1980	.265	47 194	26 276	4 029	5 562	72.4
1981	.328	46 372	32 530	3 961	5 332	74.3
1982	.692	33 743	35 253	19 518	19 826	98.4

Figure 1. North-East Arctic COD.

The fishing mortalities on 6-12 year olds generated by conventional gears (Danish-seine, gill-net, long and hand-line).

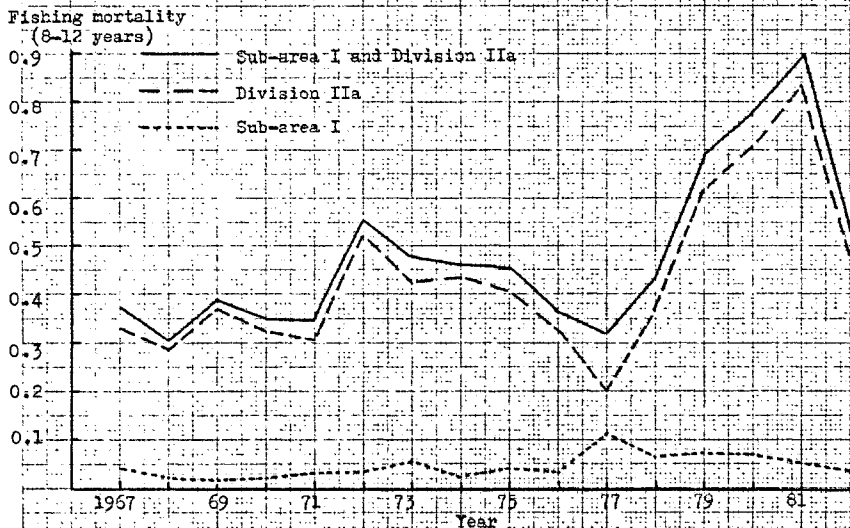


Figure 2. North-East Arctic COD.

The spawning stock biomass (corrected for SCP) versus the opue in the long-line fishery in the Lofoten fishery.

Opue (Kg/Day/Man  
in the Lofoten  
fishery)

700

600

500

400

300

200

100

100

200

300

400

500

Spawning stock biomass ( $\times 10^{-3}$  tonnes)

82

71

72

73

78

79

70

77

67

76

80

75

69

68

74

65

63

85

64

60

61

62

Figure 3. North-East Arctic COD.

Average and unweighted fishing mortality generated by USSR trawlers on the 4 to 6 year-olds in Sub-area I versus effort by the same fleet (USCR units) in this area.

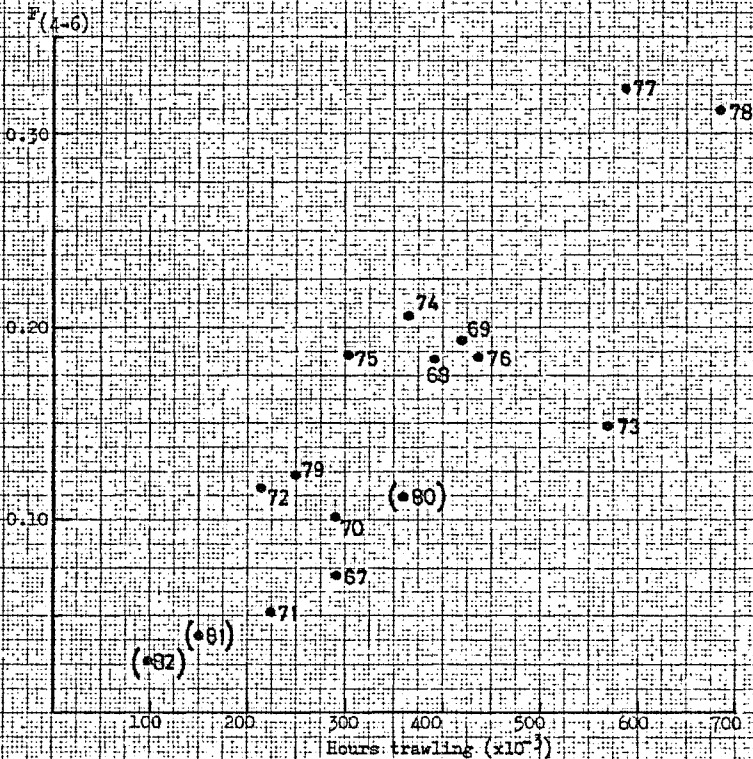


Figure 4. North-East Arctic CQE.  
Fishing mortality on the 4 year olds generated by Norwegian  
trawlers in Sub-area I versus the effort by the same fleet  
(in Norwegian units) in this area.

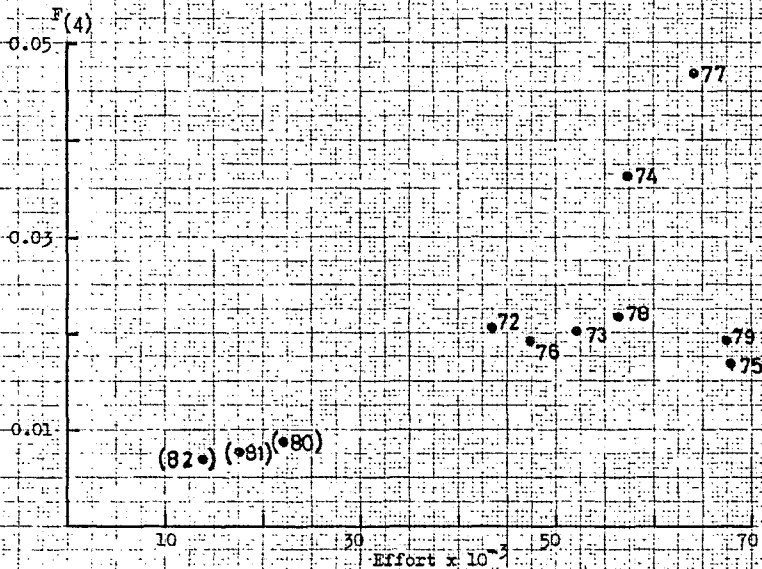


Figure 5. North-East Arctic COD.  
Average unweighted fishing mortality generated by Norwegian trawlers in Sub-area 1 on the 5 and 6 year olds versus effort by the same fleet (in Norwegian units) in this area.

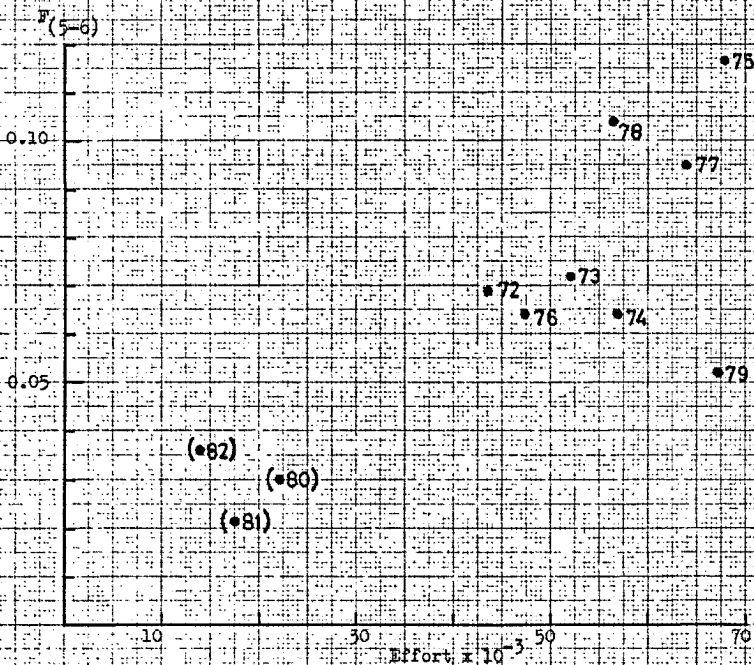


Figure 1. North-East Arctic COD.

Average unweighted fishing mortality generated by Norwegian trawlers in Division IIA on the 5 to 7 year olds versus the effort by the same fleet (Norwegian units) in this area.

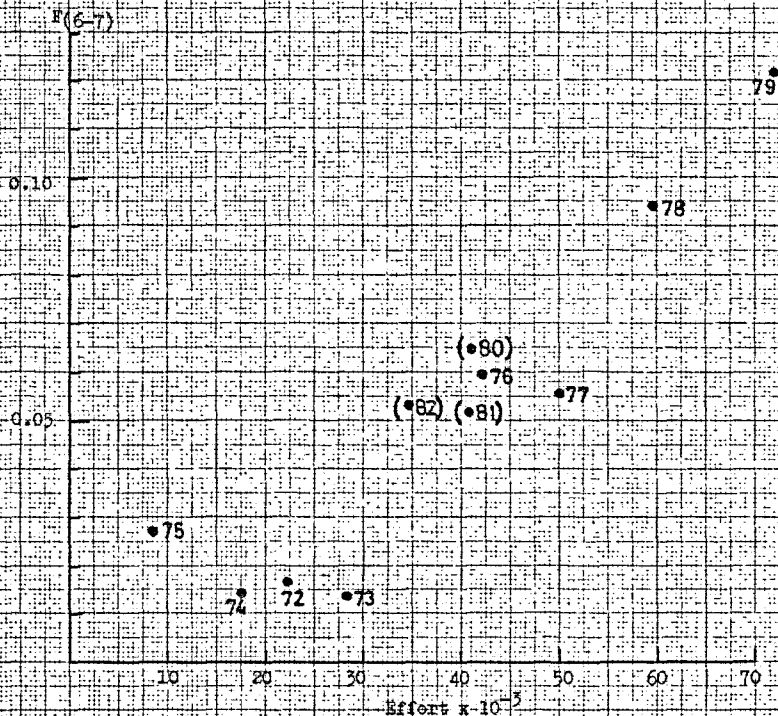


Figure 7. North-East Arctic COD,  
Regression of type of RT-type vessels against biomass of 4-7 year classes.

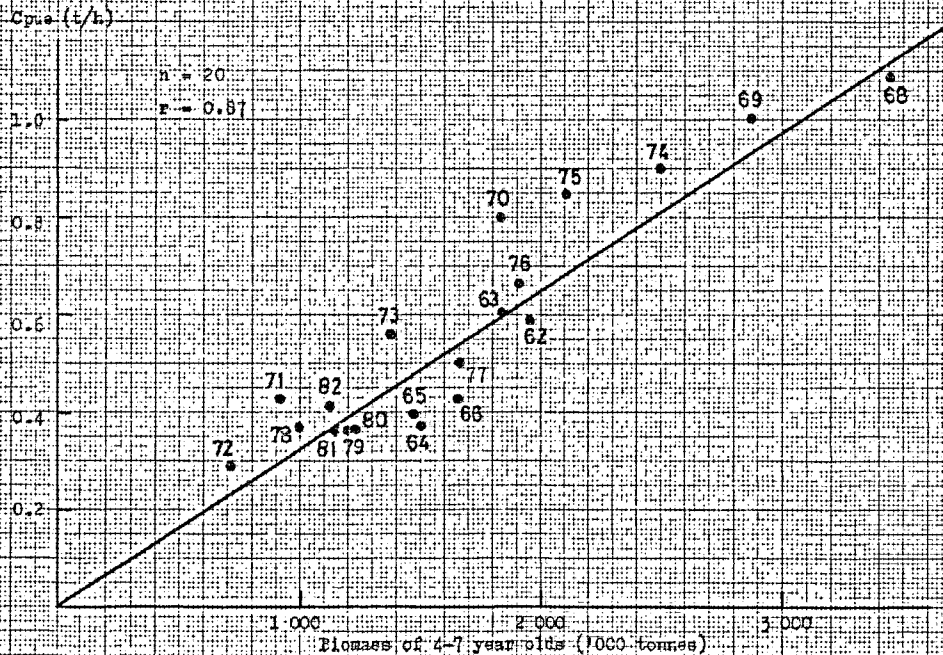


Figure 3. North-East Arctic COB.  
Exploitation pattern for the total fishery in the period  
1978-81 and the input exploitation pattern for 1982 in the  
VPA.

Exploitation pattern

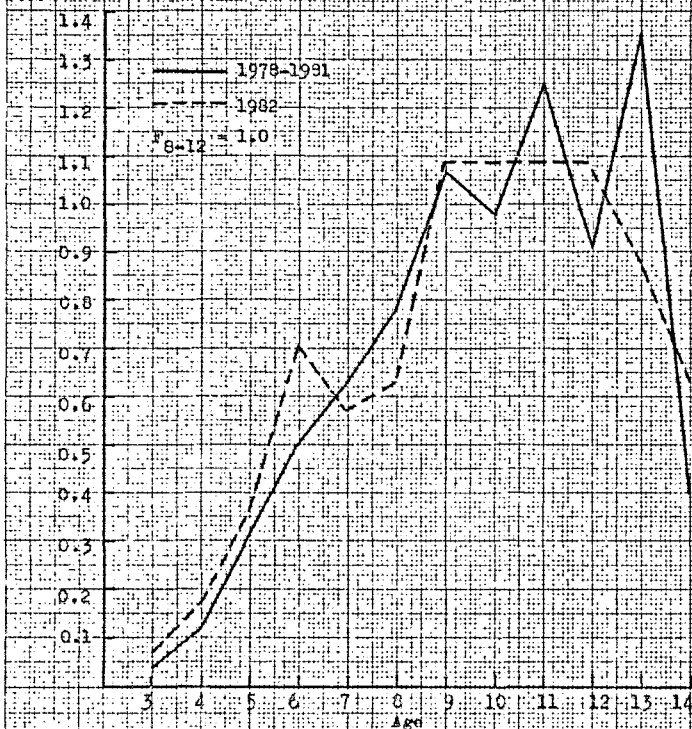


Figure 9. North-East Arctic CUD.

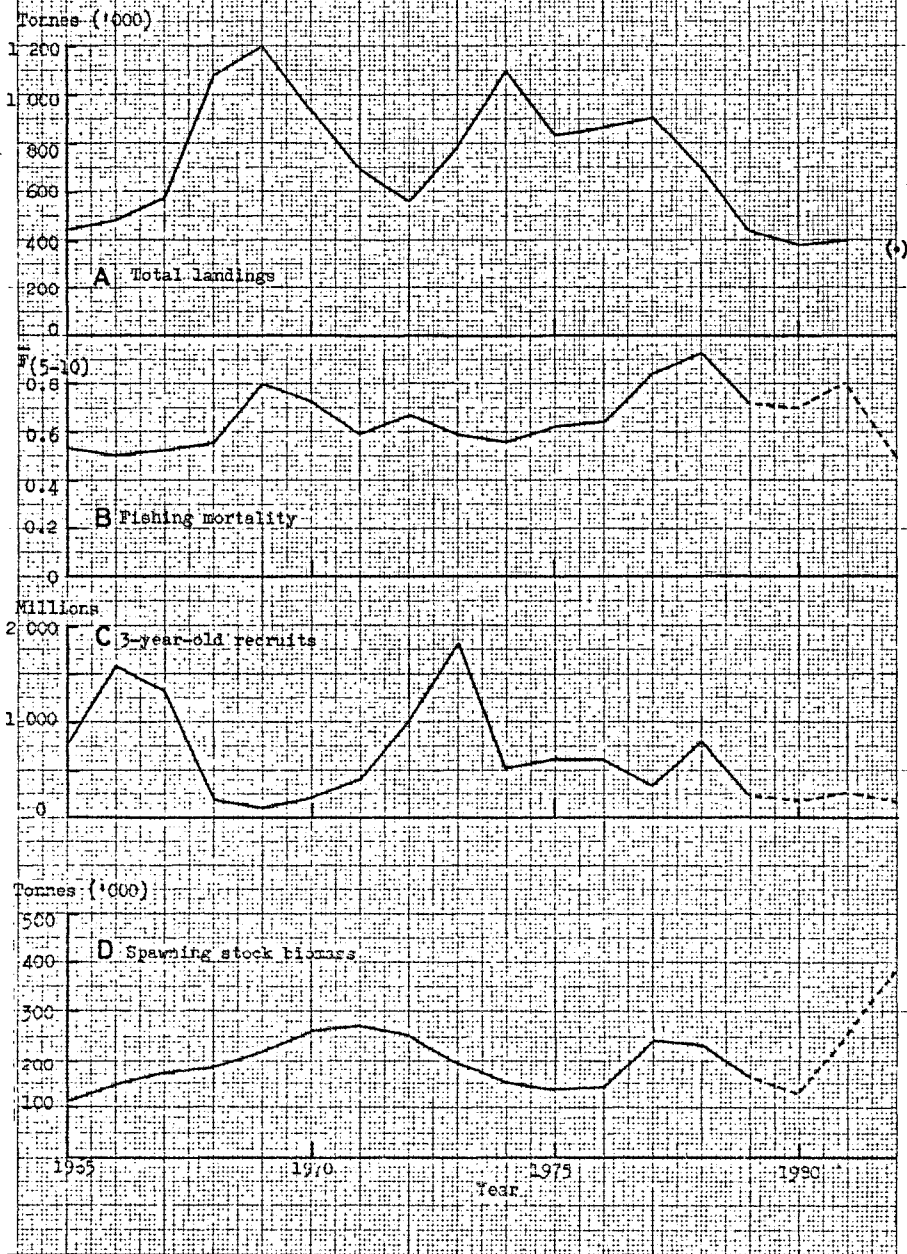


Figure 10. North-East Arctic C.D.  $Y/R$ , 328/R, Yield 1983, total recruited biomass (age 3+) and spawning stock biomass at beginning of 1984 for different levels of fishing mortality in 1983.

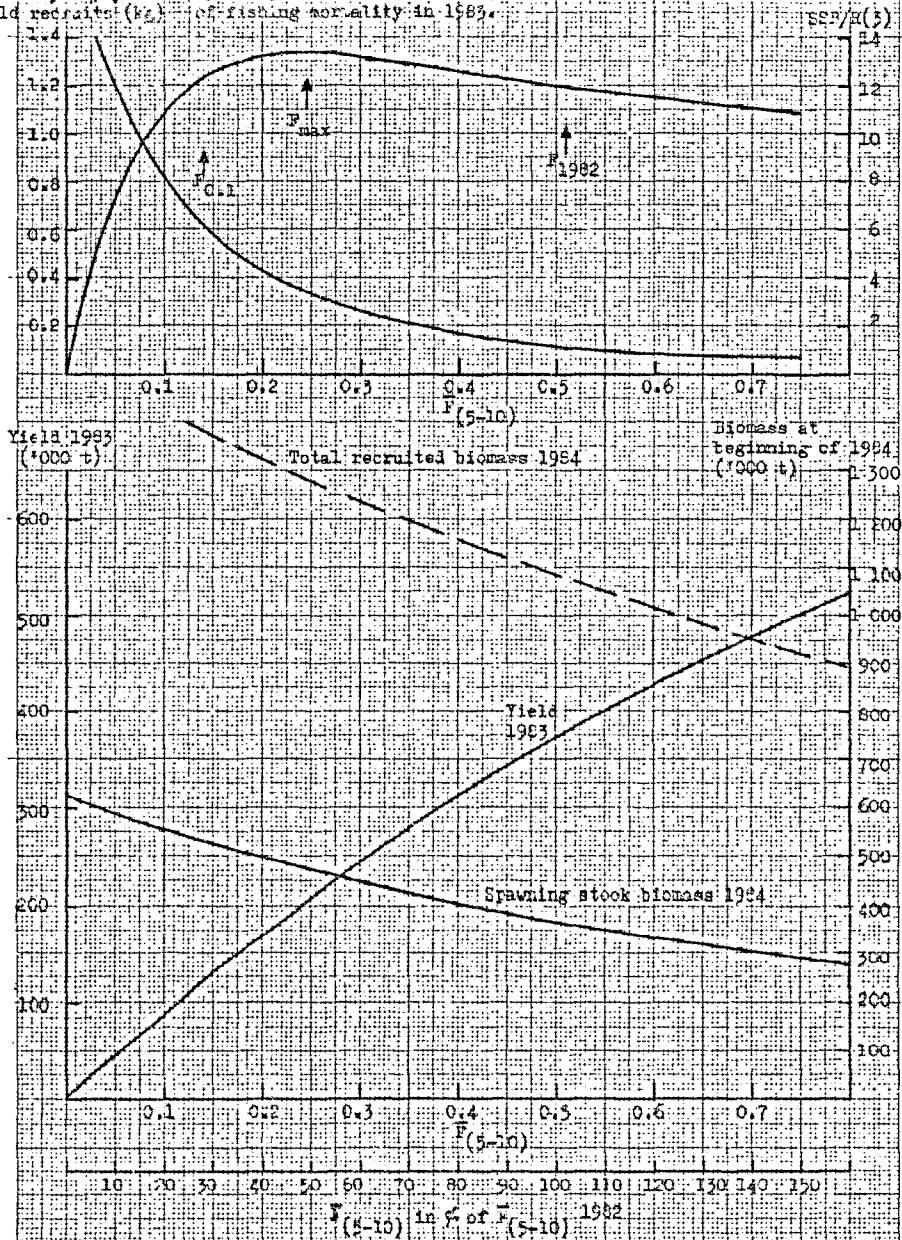
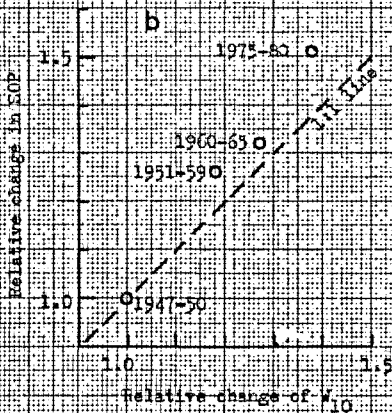
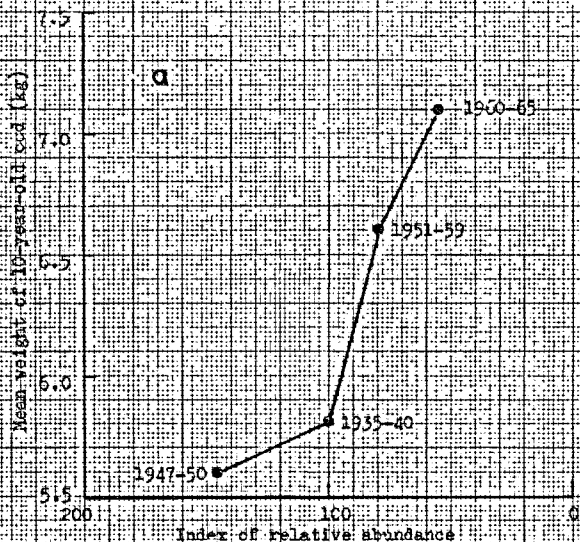


Figure 11a and b.

North-East Arctic COD.

a) The mean weight of 10-year-old fish (from Copey Res. Rep. 6 and 15.16 - 1967 Working Group Report).

b) Comparison of the development of the mean weights of 10-year-old fish and the correction factor for SCP (= Nominal catches/SCP) relative to the period 1947-50.



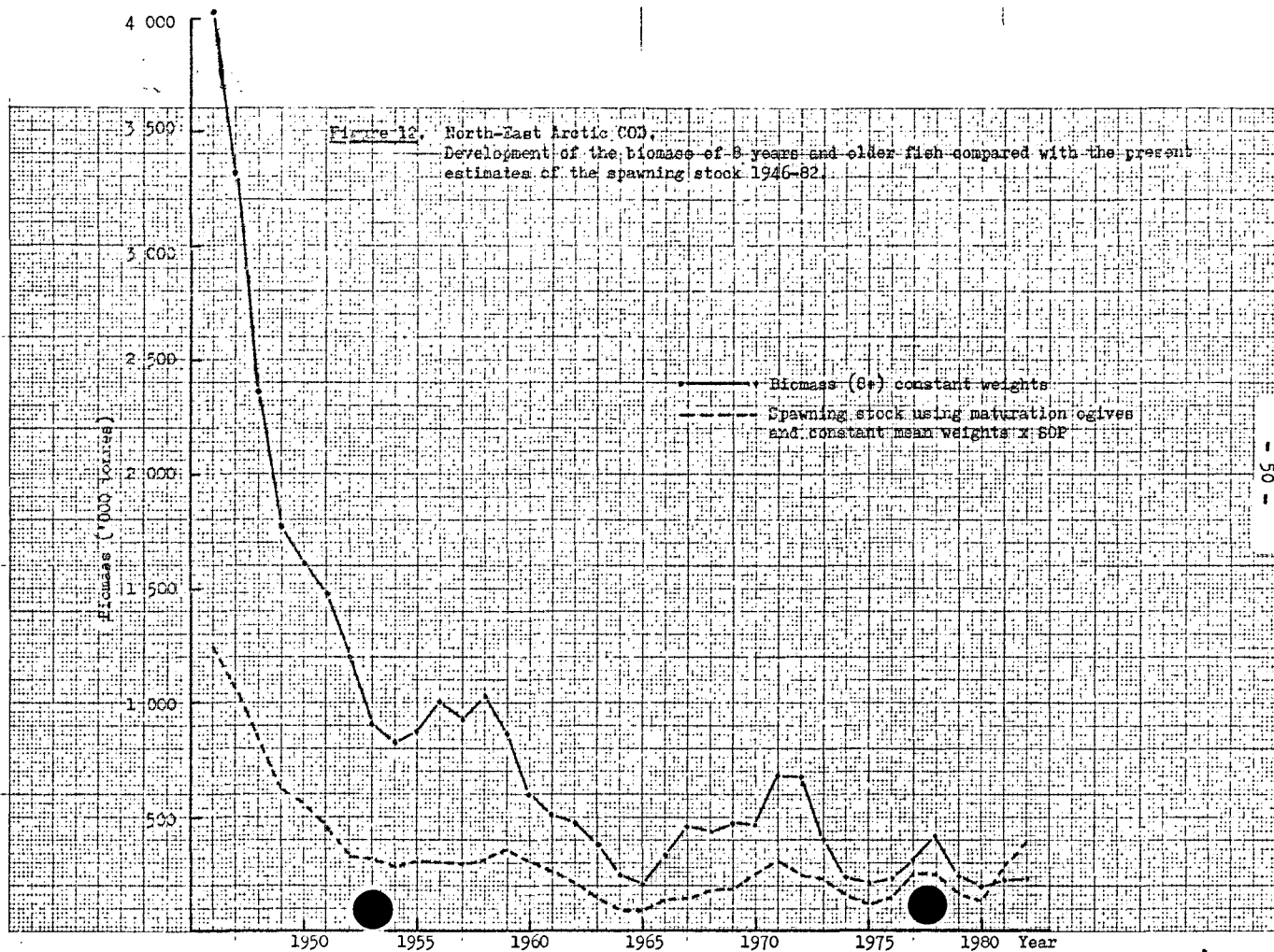


Figure 13. North-East Arctic COD.  
Spawning stock versus recruitment at age 3, year classes 1946-76.

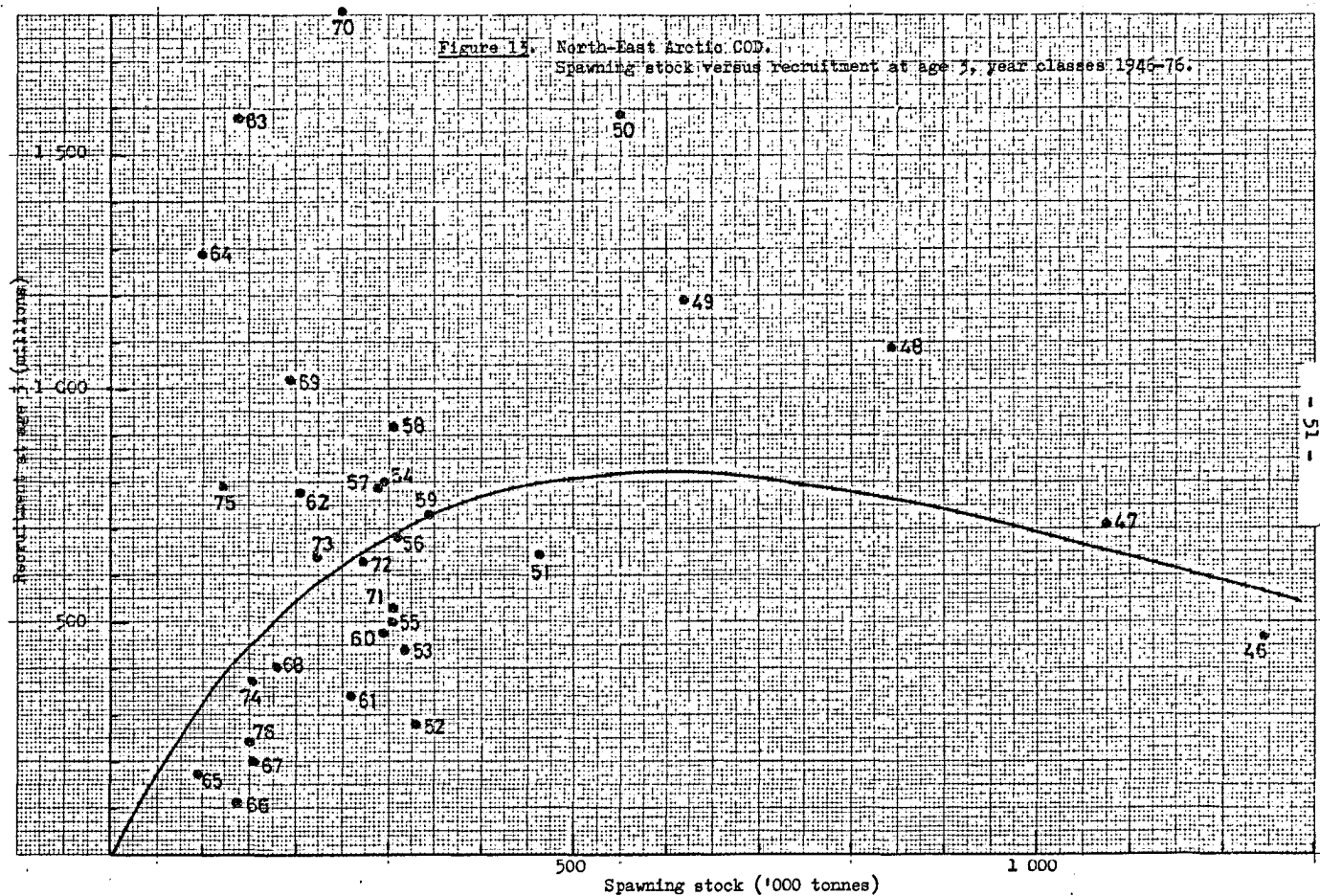


Figure 14. North-East Arctic Haddock.  
Exploitation pattern for the total fishery in the period 1978-81  
and the exploitation pattern for 1982.

Exploitation pattern

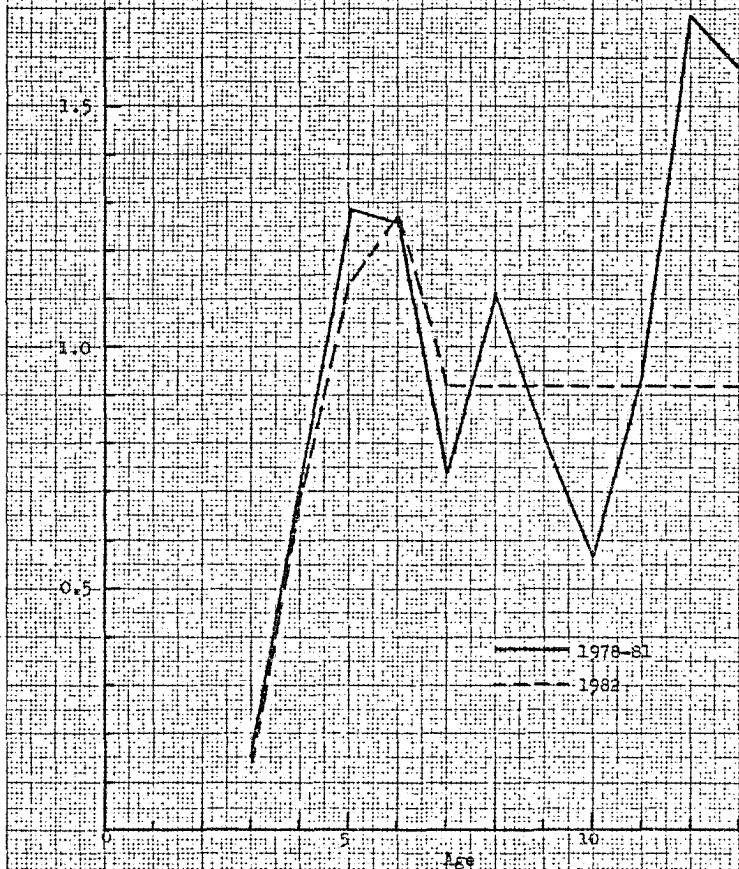


Figure 15. North-East Arctic Haddock. Unweighted fishing mortality on 4-6 year-olds generated by the Norwegian trawlers in Sub-area 1 versus the effort by the same fleet in Sub-area 1. The lines are forced through the origin.

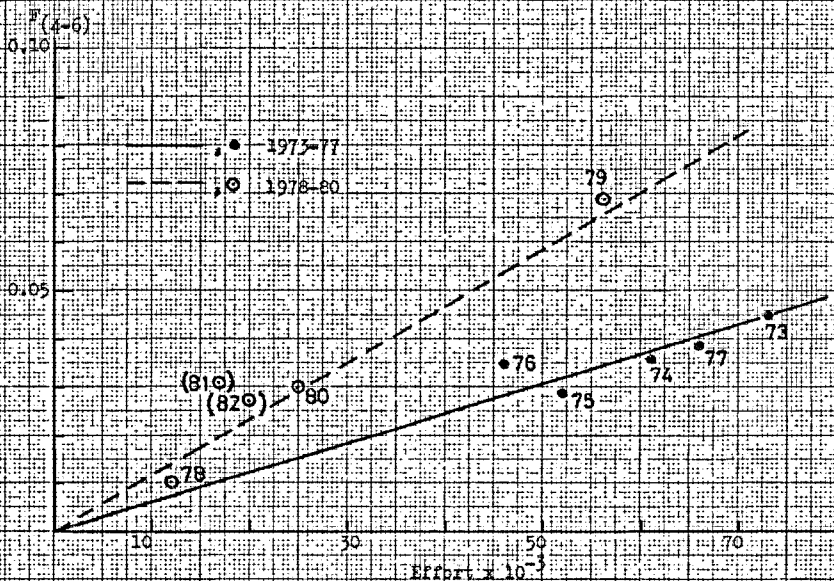


Figure 16. North-East Arctic HALDACK. Unweighted fishing mortality on 5-7 year olds generated by the Norwegian trawlers in Sub-area II versus the effort by the effort by the same fleet in this area. The lines are forced through the origin.

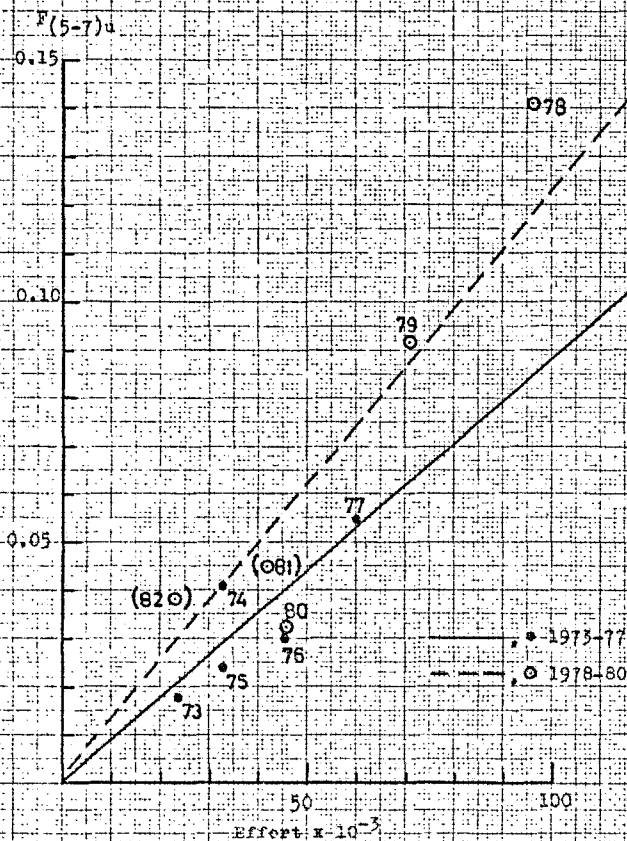


Figure 17. North-East Arctic Haddock.  
Exploitation pattern by Norwegian  
trawlers in Sub-area II.

Exploitation  
pattern

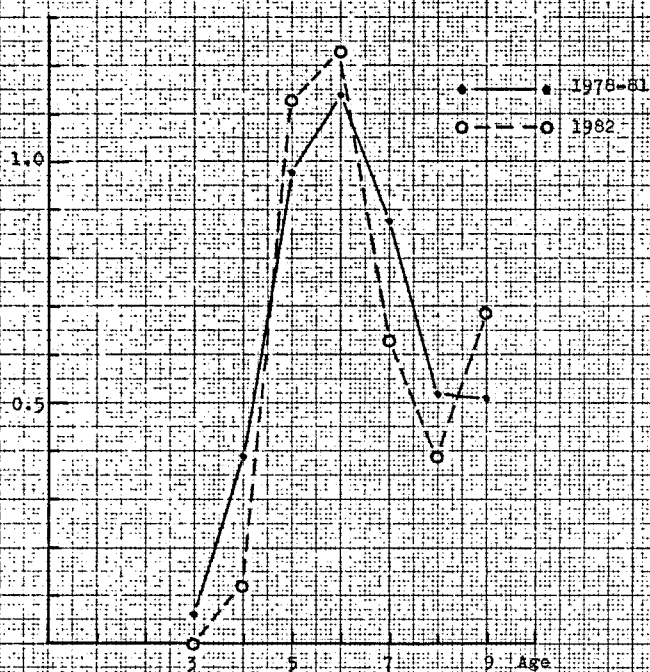


Figure 18. North-East Arctic CCB and HADDOCK. The fishing mortalities generated on cod (6-7 years old) in Division IIIa and haddock (5-7 years old) in Sub-area II. Both sets of data refer to the Norwegian trawlers for the years 1967-82.

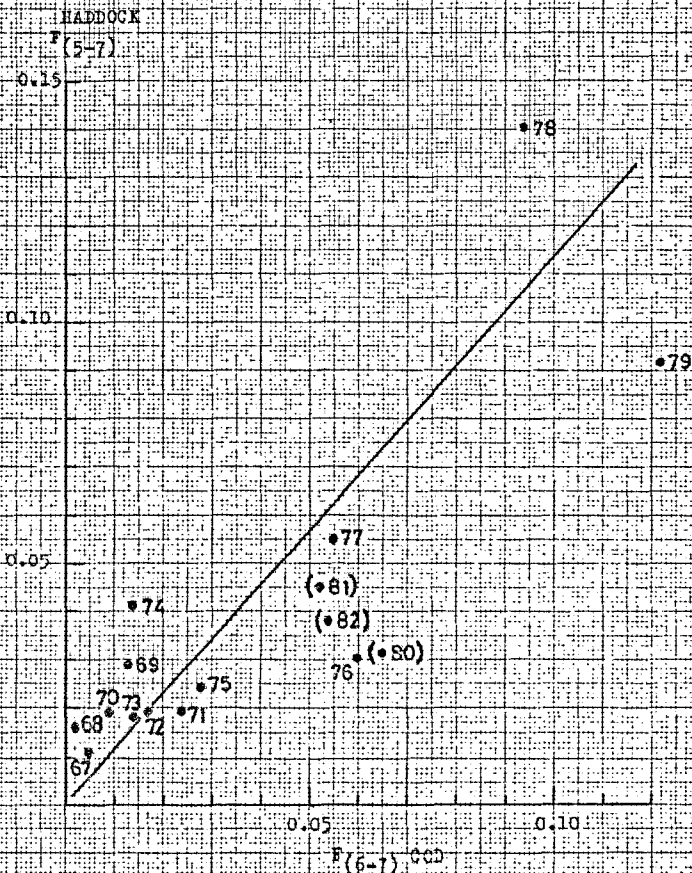


Figure 19. North-East Arctic COD and HADDOCK.  
Total international trawl catch ratios  
versus biomass ratios (3+) for the years  
1967-82.

Trawl/catch ratio  
(COD/HADDOCK)

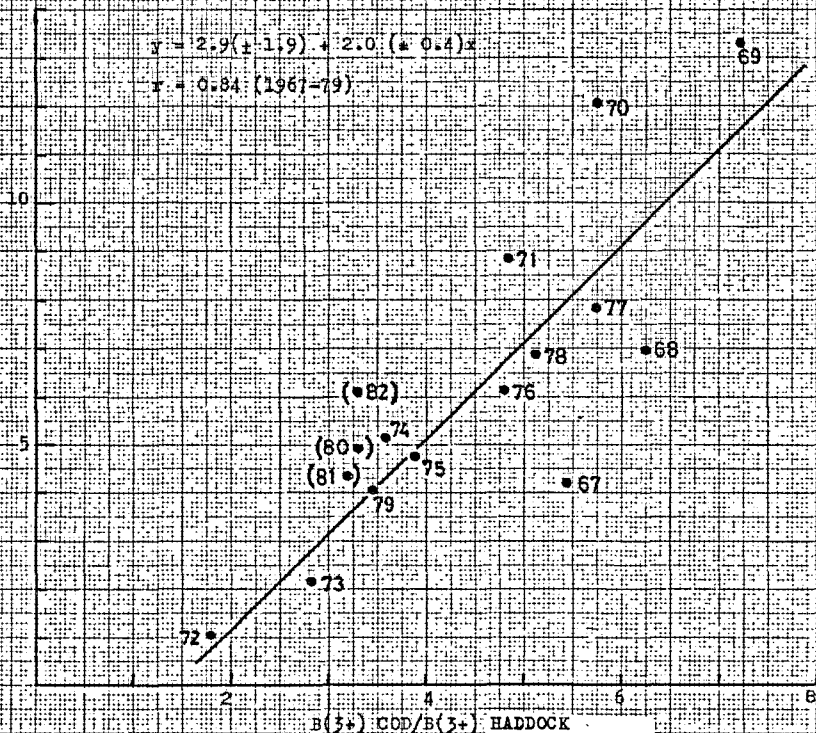


Figure 20. North-East Arctic HALIBUT. Development of the biomass of 6 years and older fish compared with the present estimates of the spawning stock 1950-82.

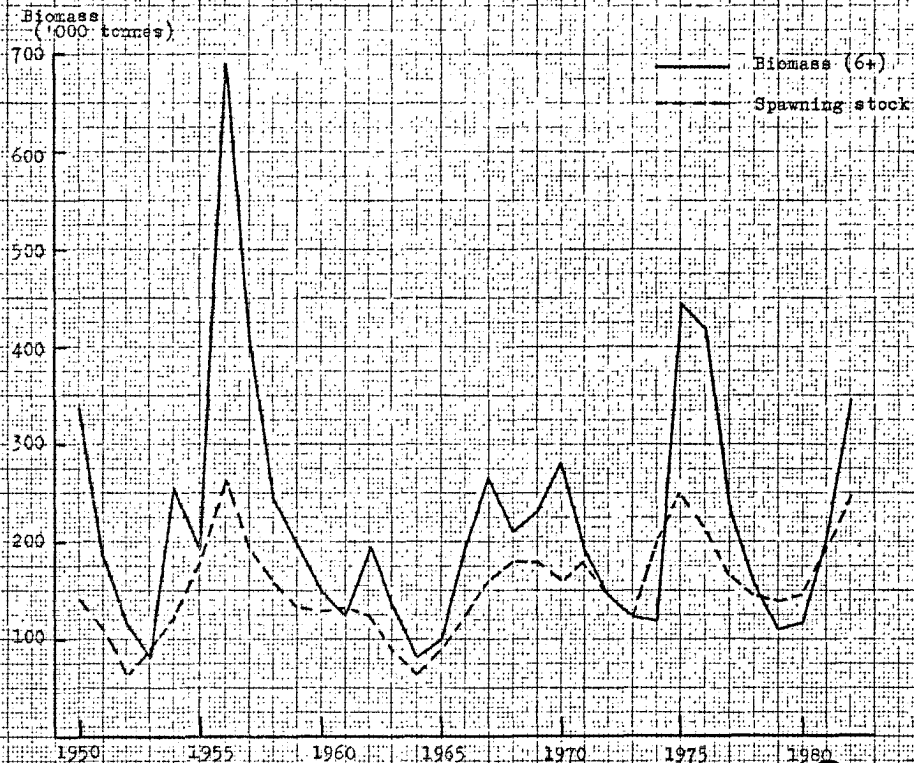


Figure 21. North-East Arctic Haddock.

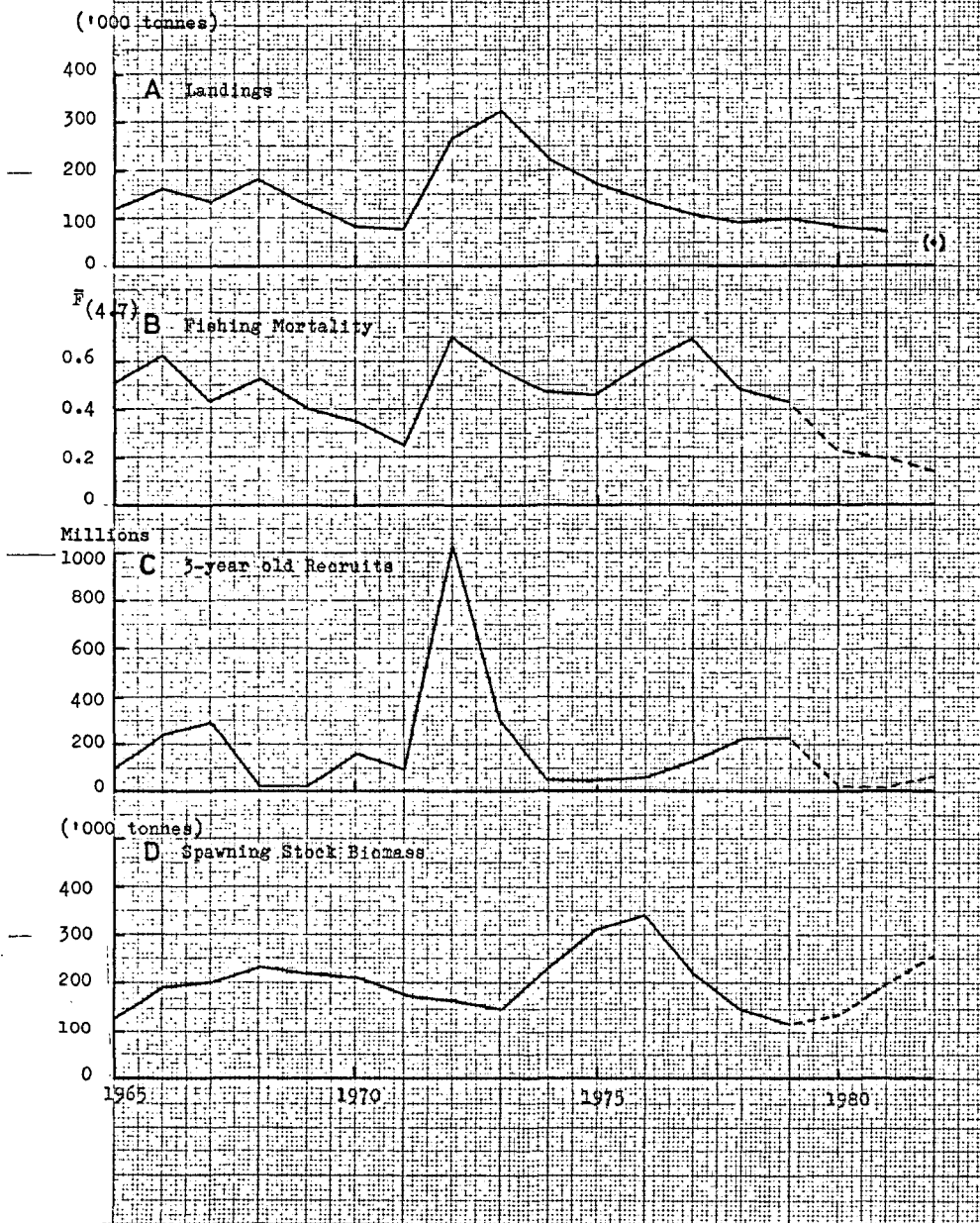


Figure 2. North-East Arctic HADDOCK.  $Y/R$ ,  $SSB/R$ , Yield-1983, total recruited biomass (age 3+) and spawning stock biomass at beginning of 1984 for different levels of fishing mortality in 1983.

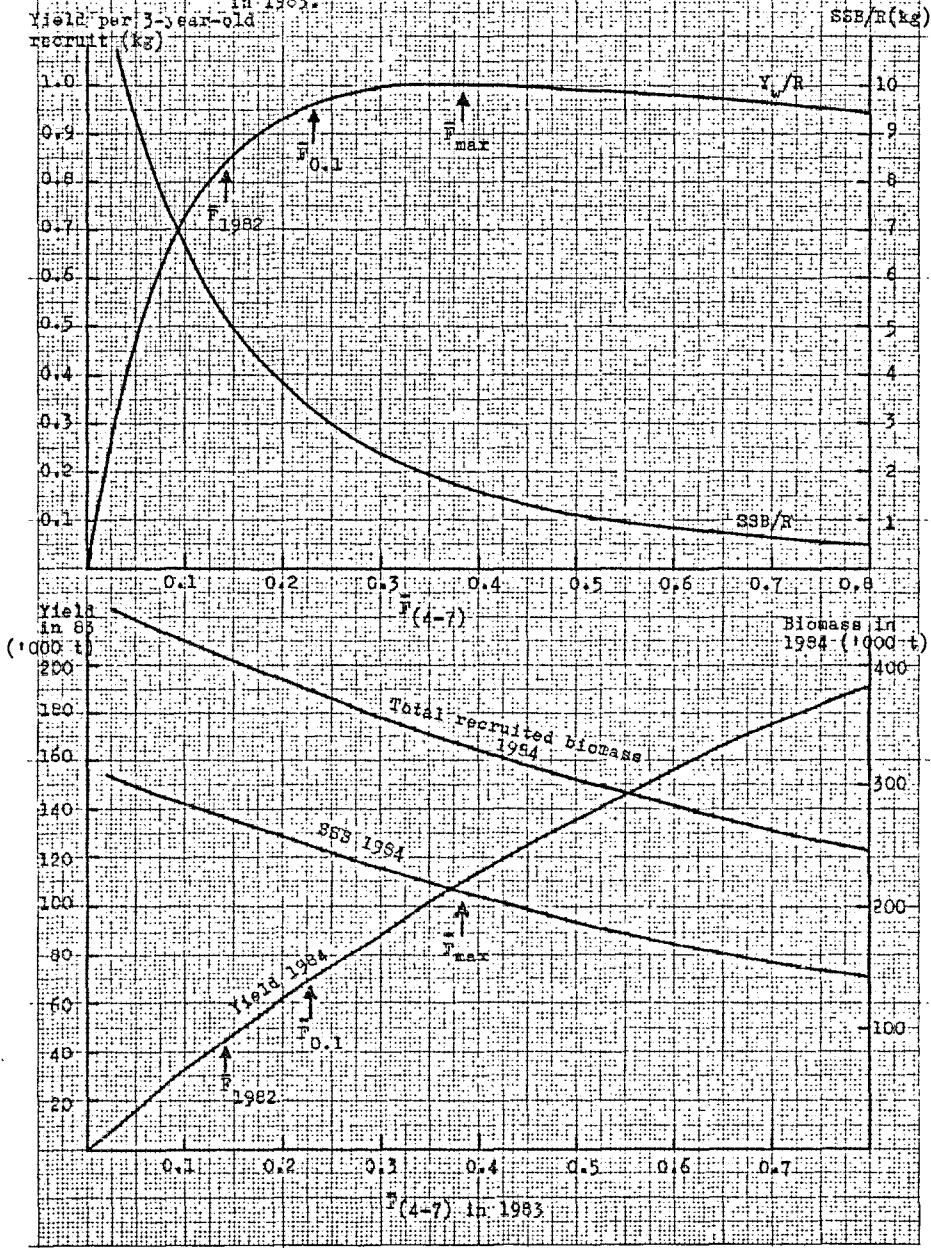


Figure 23. VPA estimates of the stock size in Division 11b versus h.p. per 10 tonnes-hour fishing (Burd, 1982). Numbers on the plots refer to year classes.

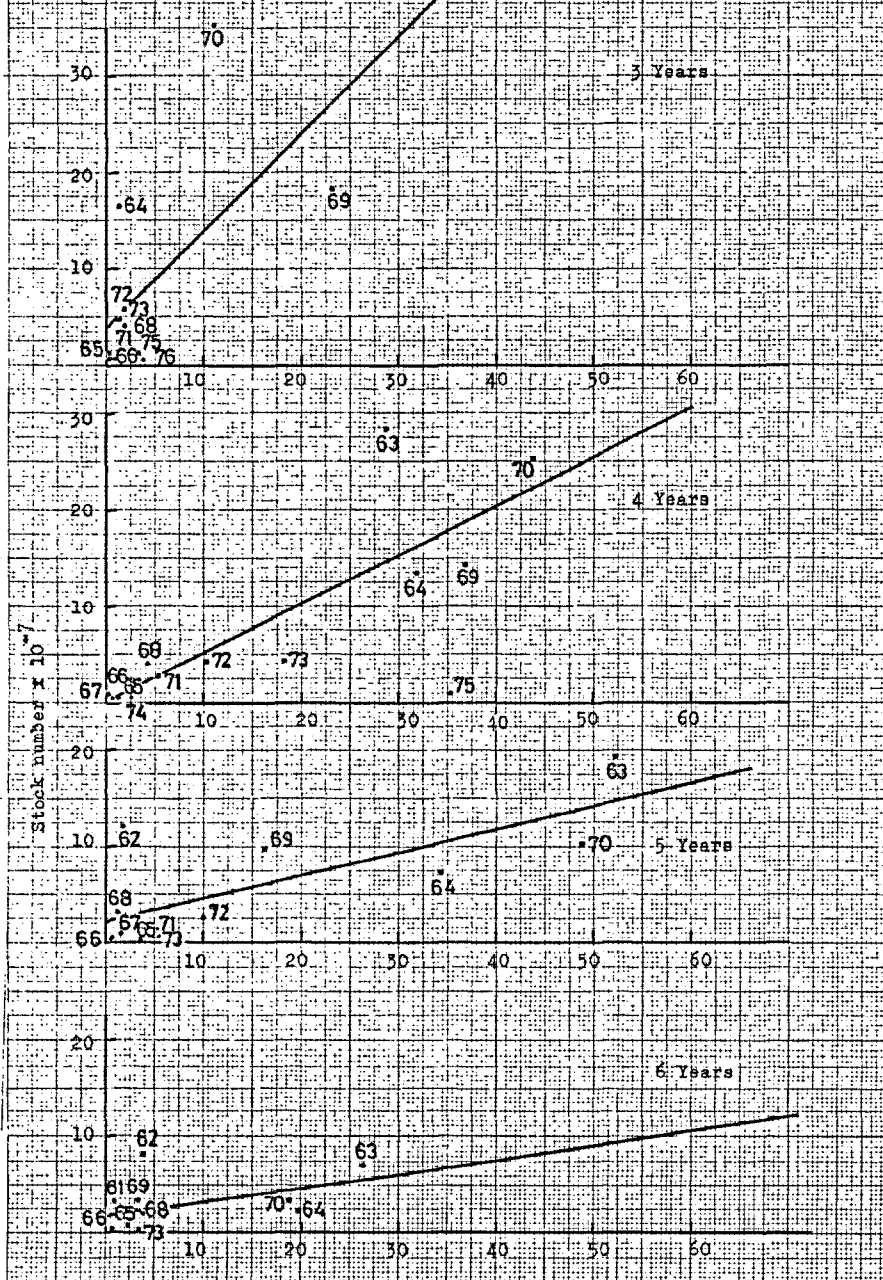


Figure 24. North-East Arctic COD. Division IIb, Run2.  
Stock size of age (2-6) against time.

