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REPORT OF THE NORTH-EAST ARCTIC FISHERIES WORKING GROUP

Charlottenlund, 6 - 10 March 1978

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REPORT OF THE NORTH-EAST ARCTIC FISHERIES WORKING GROUP

1. PARTICIPANTS

A Hysten (Chairman)	Norway
J Janusz	Poland
B W Jones	U.K. (England)
A I Mukhin	USSR
V P Ponomarenko	USSR
C J Rørvik	Norway
H Schultz	German Democratic Republic
A Schumacher	Germany, Federal Republic of
G Speiser	Germany, Federal Republic of
M Volodarsky	USSR

V M Nikolaev (ICES Statistician) also participated in the meeting.

2. TERMS OF REFERENCE

At the 1977 Statutory Meeting of ICES it was decided (C.Res.1977/2:21) that:

"the North-East Arctic Fisheries Working Group should meet at Charlottenlund 6-10 March 1978 to:

- (a) assess TACs for 1979 for cod and haddock,
- (b) examine any new data from midwater trawl fisheries and study the effect on the exploitation of these species,
- (c) assess, if possible, the effective mesh size in use, and report on the effects of increases in mesh size,
- (d) identify and specify in detail shortcomings and gaps in data required for stock assessment work,
- (e) review and update the "Review of Fish Resources" given in the Appendix to the 1977 Working Group Report".

3. STATUS OF THE FISHERIES

3.1 Cod (Tables 1-4)

The preliminary figure for the total catch in 1976 was 859 153 tons, which was close to the final figure of 867 463 tons. The final figure for the landings from Sub-area I was 12 439 tons lower than the preliminary figure. For Division IIb, there was only a minor change. For Division IIa, however, the final figure was 20 866 tons higher than the preliminary one.

The 1977 fishery was limited by the same Total Allowable Catch (TAC) as in 1976. For both years, the annual TAC was 810 000 tons for North-East Arctic cod. In addition, Norway and USSR could add 40 000 tons to their quota. This covered their catch of Norwegian coastal cod and Murman cod, respectively. As was the case last year, the Norwegian coastal cod was treated as an independent unit for management purposes. The USSR landings of Murman cod were included in the assessment for North-East Arctic cod. The TAC for the present management unit was 850 000 tons in both 1976 and 1977. This total TAC was exceeded by 17 463 tons in 1976. The preliminary catch figure for 1977 is 34 459 tons above the TAC.

Total landings are given in Table 1 for Sub-area I and Divisions IIa and IIb. Totals for each country are given in Table 2. The landings in 1977, compared with 1976, decreased by 3% in Sub-area I, while in Divisions IIa and IIb the landings increased by 2% and 27%, respectively.

Comparing the catch per unit effort (c.p.u.e.) in 1976 and 1977 (Table 4), there has been a decrease in Sub-area I and Division IIb both for the United Kingdom and USSR trawlers, while there has been an increase in c.p.u.e. for United Kingdom trawlers and Norwegian gill-net boats in Division IIa.

The estimated total international effort in Sub-area I increased by 19%, taking the average change measured by United Kingdom and USSR units (Table 3). In Division IIb, the estimated total international effort increased by 64%, although the estimate in USSR units may be affected by low catch rates, because most of the catch was taken as by-catch in the redfish fishery. In Division IIa, the estimated total international effort decreased by 23%, taking the average change measured by United Kingdom and Norwegian units (Table 3).

Thus, the increase in the catches in Division IIb of 27% resulted from an increased effort in this area. However, the catch per unit effort data (Table 4) suggest a decrease from 1976 to 1977 in the recruited stock biomass available to the fishery in Sub-area I and Division IIb, while an increase is observed in Division IIa in the same period. The most abundant year class in the catches in 1977 in Sub-area I and Division IIb was the 1973 year class. The 1970 year class was the most abundant one in Division IIa.

3.2 Haddock (Tables 5-7)

The final catch figure for 1976 was 137 279 tons (Table 5), 6 305 tons below the preliminary figure in the 1977 report.

The Total Allowable Catch (TAC) in 1977 for North-East Arctic haddock was 110 000 tons. The preliminary figure for the total landings in 1977 is 101 977 tons, about 8 000 tons below the TAC.

There was a progressive decrease in the landings from Sub-area I from 1973 (283 728 tons) to 1977 (66 946 tons). For Division IIa, there was a decline since 1974, while the rather small catches in Division IIb showed an increase from 1976 to 1977 (Table 5).

The total catches, however, were decreasing continuously from the high catch of 320 065 tons in 1973 to 101 977 tons in 1977. This decrease was mainly caused by the reducing abundance of the very rich 1969 year class and the lower abundance of subsequent year classes. The available catch per unit effort data (Table 7) show a decrease in all areas from 1974, and a relative decrease is the greatest from 1976 to 1977.

4. VIRTUAL POPULATION ANALYSIS (VPA)

4.1 Age Compositions (Tables 8 + 13)

Age compositions of catches in 1976 were updated and new preliminary data were available for catches in 1977. Although the revised age composition data for cod landings in 1976 were little changed from the preliminary data presented to last year's meeting of the Working Group, the revised haddock data differed substantially from the preliminary data.

4.2 Natural Mortality

Assessments were made using values for the coefficient of natural mortality $M = 0.3$ and 0.2 for cod and $M = 0.2$ for haddock.

4.3 Fishing Mortality in 1977

At the 1977 meeting, the Working Group considered that after a period of instability, the exploitation pattern on cod had reverted to something similar to that in earlier years. Therefore, the exploitation pattern used at the 1977 meeting was based on the average of the years 1970-74. This exploitation pattern was maintained unchanged this year for the VPA input fishing mortality values for 1977. The level of fishing mortality was taken as $F = 0.55$ for $M = 0.3$ and $F = 0.65$ for $M = 0.2$ on age groups subject to maximum exploitation. Recruitment estimates from pre-recruit surveys can also provide some check on the suitability of the input F values used for partially recruited age groups. The adopted input F values gave estimates of stock size which were reasonably consistent with the pre-recruit survey year class strength estimates. A further check was made with a cohort analysis by length, using the average length composition for the period 1975-77. The results from this method are much less dependent on the starting F value, the estimated average F value for the fully exploited length range was 0.54 ($M = 0.3$) and $F = 0.64$ ($M = 0.2$).

For haddock, a procedure similar to that for cod was adopted. The exploitation pattern was unchanged from last year and $F = 0.55$ was used for age groups subject to maximum exploitation.

The calculated estimates of F for the earlier years resulting from the Virtual Population Analysis are given in Tables 9, 11 and 14, and stock size estimates in Tables 10, 12 and 15.

5. STATE OF THE STOCKS

5.1 Fishing Mortality

The changes in the exploitation pattern for 1976-77 compared with the earlier years make it difficult to make comparisons of changes in the overall fishing mortality over the last few years. However, there appears to have been no major change in the level of fishing mortality in 1977. For haddock, the average level of fishing mortality on age groups 7-12 appears to oscillate from year to year.

5.2 Recruitment

Abundance estimates of pre-recruit year classes are available from International 0-Group Surveys and USSR young fish surveys (Tables 16 and 17). Estimates of absolute year class strength calculated by VPA are given in Tables 18 and 19.

5.2.1 Cod

The most recent assessment indicates that the 1973 year class is an abundant one and that it might be about 19% less abundant than the outstanding 1970 year class. Assessments indicate that the 1974 year class is far below average. In the 0-Group Survey the 1975 year class was rich, and data from the most recent USSR survey support this. Abundance indices from the 0-Group Survey and the USSR young fish survey indicate that the 1976 year class is poor. In the 0-Group Survey the 1977 year class appears to be average, while the USSR young fish survey indicates a poor one. Estimates of absolute year class strength used in catch prediction calculations are given in Table 18.

5.2.2 Haddock

The most recent assessment indicates that the 1973 year class is a poor one and that the 1974 year class is about average. Both the 0-Group Survey and the most recent USSR young fish survey indicate that the 1975 year class is an abundant one. It may be near to the same strength

as the 1969 year class which was an outstanding one. The following 1976 and 1977 year classes were recorded to be rich in the O-Group Surveys, but this has not been confirmed in the most recent USSR young fish surveys. Estimates of absolute year class strength used in the catch prediction calculations are given in Table 19.

5.3 Spawning Stock Biomass

Spawning stock biomass was estimated by using stock numbers in each year, as calculated by VPA, and weight-at-age data given in Table 20. The mature stock has been taken as 8 years and older for cod and 6 years and older for haddock, and the spawning stock biomass estimates relate to the biomass of the adult stock at the beginning of each year. Estimates of the spawning stock biomass for cod are given in Table 18, and in Table 19 for haddock.

For cod, the spawning stock biomass reached a very low level in 1974-76. Due to improved recruitment to the adult stock from the 1969 year class, the spawning stock started to increase in 1977. It is expected to improve further in 1978 when the rich 1970 year class reach maturity. It is expected to reach 700 - 800 000 tons in 1979 under the TAC scheme of 850 000 tons in 1978. If the catches in 1979 do not exceed 850 000 tons of cod, the adult stock is expected to recover to over 1 000 000 tons.

The spawning stock of haddock was at a level of about 100 000 tons in 1973-74. An increase was observed in 1975 and 1976 due to improved recruitment from the very rich 1969 and the average 1970 year classes. As later year classes are less abundant, the spawning stock is expected to decrease up to 1979 when the declining trend should be reversed.

6. YIELD PER RECRUIT (Figures 1 and 2)

Last year, the yield per recruit curves were estimated for cod and haddock using the exploitation pattern and weight-at-age data given in Table 20. From the curves for cod, $F_{max} = 0.3$ ($M = 0.2$) and 0.6 ($M = 0.3$). The values for the fishing mortality corresponding to $F_{0.1}$ were estimated to be 0.26 ($M = 0.30$) and 0.15 ($M = 0.20$). For haddock, $F_{max} = 0.3$ and $F_{0.1}$ was estimated to be 0.15 . All F values refer to age groups subject to maximum exploitation.

7. CATCH PREDICTIONS AND TOTAL ALLOWABLE CATCHES (TACs)

Data used in calculating predicted catches are given in Table 20. Estimates of stock sizes in 1978 were derived from stock size estimates and fishing mortality rates in 1977. TACs for cod and haddock for 1978 are 850 000 tons and 150 000 tons, and for the calculation of catches for 1979 it has been assumed that the 1978 TACs would be taken in full. To do this with the present exploitation pattern would require fishing mortality rates in 1978 on age groups subject to maximum exploitation of $F = 0.45$ ($M = 0.3$) or $F = 0.51$ ($M = 0.2$) for cod and $F = 0.55$ for haddock.

7.1 Cod (Table 21)

In making a recommendation for a TAC for cod for 1979, the Group had to consider the need to allow the spawning stock to increase to, and be maintained at, a reasonable level as well as the most appropriate level of fishing mortality to maximise yield per recruit or optimize catch rates. The spawning stock size estimated for the beginning of 1978 is 813 000 tons for $M = 0.3$ and 699 000 tons for $M = 0.2$, which is less than had been anticipated in the previous report of the Working Group (1.122 or 1.047 million tons), but for the range of F values considered for 1979 and 1980, the spawning stock is expected to increase in size and should exceed 1 million tons by the beginning of 1980. To fish at $F_{0.1}$ in 1979 would involve a substantial reduction in fishing mortality compared with the expected level in 1978 and a consequent reduction in catch.

For $M = 0.3$, if fishing mortality was allowed to increase to $F_{max} = 0.6$, larger catches would be taken, but in the long term the average spawning stock size would be expected to decline below 1 million tons. At an intermediate value of $F = 0.4$, the expected catch in 1979 would be 822 000 tons and if this level of F was maintained into 1980, the expected catch would increase to 897 000 tons. Thus, an average catch for these two years would be close to the present TAC of 850 000 tons. The Group therefore examined the effects in terms of fishing mortality rates and resulting spawning stock biomass of maintaining the TAC at the 1978 level for 1979 and 1980.

This strategy would result in a progressive reduction in fishing mortality from $F = 0.55$ in 1977 to 0.45 in 1978, 0.42 in 1979 and 0.38 in 1980 ($M = 0.3$). The 1979-80 levels of F would be about midway between the $F_{0.1}$ and F_{max} values on the yield per recruit curve.

For $M = 0.2$, maintaining the 1978 TAC through 1979 and 1980, the sequence of fishing mortality rates in 1977-80 would be 0.65, 0.51, 0.44, and 0.37. Although the F levels in 1979-80 would still be above the F_{max} level, this strategy would result in a progressive reduction in fishing mortality towards F_{max} .

The spawning stock biomass with this strategy would be expected to increase up to the beginning of 1981, at least. This strategy is summarised in the table below:

	<u>$M = 0.3$</u>	<u>$M = 0.2$</u>
1979 F on age groups subject to maximum exploitation	0.42	0.44
Catch (thousands of tons)	850	850
Spawning stock at beginning of year (thousands of tons)	868	784
1980 F on age groups subject to maximum exploitation	0.38	0.37
Catch (thousands of tons)	850	850
Spawning stock at beginning of year (thousands of tons)	1 291	1 305
1981 Spawning stock at beginning of year (thousands of tons)	1 816	2 056

The Working Group recommends that the TAC for North-East Arctic Cod for 1979 should be set at 850 000 tons.

The recommendation for 1980 would, however, depend on catches actually taken in 1978 and 1979.

7.2 Haddock (Table 22)

For haddock, in addition to the management considerations mentioned for cod, the Group also had to take into account the effects on haddock as a by-catch species of fishing effort levels which are likely to prevail when fishing for the TAC recommended for cod. To take the TAC of 150 000 tons, the fishing mortality rate in 1978 on the age group subject to maximum exploitation would be $F = 0.55$ (i.e., at the same level as in 1977). The spawning stock biomass had been declining but this trend is expected to be reversed in 1979 when more abundant year classes recruit

to the spawning stock. With the present exploitation pattern the yield per recruit curve has a maximum value at $F = 0.3$; thus, the present level of fishing mortality is in excess of this value. In order to reduce fishing mortality on haddock towards the F_{max} level and bearing in mind the expected reduction in fishing mortality required to take the recommended TAC for cod, the Working Group considers that a reduction in fishing mortality in 1979 to $F = 0.45$ would be appropriate. This would be expected to yield a catch of 170 000 tons as indicated in the summary table below.

1978	F on age group subject to maximum exploitation	0.55
	Catch (thousands of tons)	150
	Spawning stock at beginning of year (thousands of tons)	147
1979	F on age group subject to maximum exploitation	0.45
	Catch (thousands of tons)	170
	Spawning stock at beginning of year (thousands of tons)	133
1980	Spawning stock at beginning of year (thousands of tons)	189

The Working Group therefore recommends that the TAC for North-East Arctic Haddock for 1979 should be 170 000 tons.

8. MIDWATER TRAWL

It was reported to the Working Group that in the fishery for cod in the North-East Arctic, vessels from the German Democratic Republic, the United Kingdom and USSR are using midwater trawls occasionally, but the quantities taken by this gear are comparatively small. Norwegian vessels may use midwater trawls outside the 12-mile zone of Norway but the catches taken by this gear cannot be quantified at present.

Vessels of the Federal Republic of Germany have used midwater trawls in the North-East Arctic since 1974, mainly in Sub-area I and Division IIb. Catches of this fishery in comparison to the total Federal Republic of Germany and the total international fisheries are given in Table 23. The proportion of the midwater trawl catches of cod in the Federal Republic of Germany fishery showed an increasing trend since 1975, while the midwater trawl component compared to the total catch of cod in the North-East Arctic was of about 1 to 2% in this period.

From the fishery in 1977, length and age composition data for both bottom- and midwater trawl catches were available to the Working Group. The mean length and age data compared to the data from all fisheries are given in Table 24. These data indicate that there are significant differences in the length and age composition of catches from different gears in the Federal Republic of Germany landings of cod. However, compared to the total catch from the North-East Arctic, the difference is comparatively small and the average length of midwater trawl catches in Sub-area I, Division IIb and in the combined average for all areas is still higher than in the total catches. Only in Division IIa is the mean length of midwater trawl catches significantly smaller than in the total international landings, but this is the region in which the midwater trawl component is the smallest, only

809 tons representing 29.3% of the Federal Republic of Germany catches and 0.34% of the total catch of cod in Division IIa in 1977.

The average age in the midwater trawl catches of cod is lower than in the bottom trawl catches of the Federal Republic of Germany fishery and except Sub-area I also lower than in the total catches. This supports the results of selection experiments with midwater and bottom trawls indicating that the average length per age group is higher in midwater catches than of those taken at the bottom. A similar observation, i.e. that faster growing fish of the same year class tend to stay in the midwater and slower growing fish at the bottom, was also made in the haddock catches from these experiments (Annales Biologiques, 1975, 32:81).

In the catches of haddock which are mainly taken as by-catch in the cod fishery, the average length and the average age of midwater trawl catches is also smaller than in the bottom trawl catches of the Federal Republic of Germany fishery. However, compared to the total haddock catch in all areas, the average values in the midwater trawl catches are higher.

The data of the Federal Republic of Germany fishery in 1977 show that there are differences in the length and age composition of catches taken by different gears in the Federal Republic of Germany fishery, but the length and age composition of midwater trawl catches are still within the range of the total international fishery.

One sample available from the German Democratic Republic fishery for cod in Division IIb in September 1977 shows an opposite result. The mean length in the midwater trawl catch was 82.3 cm compared to 70.7 cm from the bottom trawl fishery at the same time in the same area, the average age was 6.9 and 6.1 years, respectively. This result is similar to the results obtained by Bohl in selectivity experiments (Doc. C.M.1975/B:24).

All these results indicate that the effect of midwater trawls on the stock might differ depending on the time and area distribution of the fishery. A more full analysis of the effect of midwater trawling on the stock in the North-East Arctic might become obtainable when the fishery with midwater trawls can be incorporated as a separate fishery in the model to assess the effective mesh size in use (see Section 9 of this report).

9. MESH ASSESSMENT

The 1977 report of this Working Group stated the intention to assess the effective mesh sizes in use in the trawl fisheries for North-East Arctic cod and haddock. The method was developed by Mr K P Andersen of the Danish Institute for Fisheries and Marine Research, and it is based on the length composition of the catches.

Mr Hylén and Mr Rørvik have worked with this method since the 1977 meeting of the Working Group, and they met with Mr K P Andersen in January this year. A preliminary mesh assessment for North-East Arctic cod was presented to the members of the Working Group together with the data base, an outline of the theory, and a listing of the computer programme used.

The results were discussed, and it was agreed that the method looked promising. The data base, however, needed updating. Some of the input parameters needed to be revised. Moreover, the reliability of the best estimates should be evaluated by some sort of sensitivity analysis. A mesh assessment for North-East Arctic haddock is also needed. The results from these two mesh assessments should be

comparable. This can be done at a future meeting of this Working Group, and by then more members of the Group would have had the opportunity to familiarise themselves with the technique.

10. TIMING OF THE WORKING GROUP MEETINGS

The current practice of holding the Working Group meetings in the spring of each year creates a number of assessment problems resulting from the incompleteness and poor quality of the provisional data on the most recent year's fisheries. These difficulties would be reduced, if Assessment Working Groups' meetings were held later in the year, and the present time period between estimating TACs and the year in which they are applied would be reduced, hopefully reducing the need for revisions of TAC recommendations. Additional information would be available from the fishery in the year of the assessment and more up-to-date pre-recruit survey data would be available, all of which would contribute to the improved reliability of the assessments.

Because of holiday commitments it would be necessary to avoid the summer period. However, if the time-tables of the management bodies permitted it, there would be advantages in holding any subsequent meetings of the North-East Arctic Fisheries Working Group in the early autumn to provide advice for management of the stocks in the following year.

11. SHORTCOMINGS AND GAPS IN DATA REQUIRED FOR STOCK ASSESSMENT PURPOSES

The Working Group identified the following gaps and shortcomings in the 1977 data for the North-East Arctic cod and haddock assessments:

11.1 Nominal Catches

- a) Preliminary nominal catch data are required from Faroe Islands, France, Portugal and Spain;
- b) Separate figures for the bottom and midwater trawl nominal catches are required from all other countries than the Federal Republic of Germany which has provided such data.

11.2 Age and Length Compositions

- a) Age and length composition data were missing for the Faroese, French, the German Democratic Republic, Portuguese and Spanish catches;
- b) Separate age and length compositions for the bottom and midwater trawl catches were available only for the Federal Republic of Germany;
- c) Age/length keys should cover sufficiently the extreme length groups in the catches.

11.3 Discards

The amount of fish discarded or used for fish meal reduction should be reported by year, together with observations on any changes in discarding practices by length groups.

11.4 Fecundity

Fecundity data are required for stock and recruitment studies.

12. REFERENCES

Bohl, H. J., 1975. Preliminary results of comparative selection experiments with midwater trawls and bottom trawls in the North-East Atlantic. ICES, Doc. C.M.1975/B:24 (mimeo.).

Meyer, A., 1977. Investigations by the Federal Republic of Germany on Arcto-Norwegian cod in 1975. ICES, Annls.biol., 32 (for 1975), pp.80-81.

Table 1. COD. Total nominal catch (metric tons)
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*	512 208	130 931	241 320	884 459

* Provisional figures.

Table 2. COD. Nominal catch (metric tons, 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 ¹⁾	38 453	1 102 434
1975	11 309	28 734	9 981	30 037	277 099	7 435	101 834	343 580 ¹⁾	19 368	829 377
1976	11 511	20 941	8 946	24 369	344 502	6 986	89 061	343 057 ¹⁾	18 090	867 463
1977*	9 222	12 756	3 463	12 691	382 407	1 084	85 281 ²⁾	368 121 ¹⁾	9 434	884 459

* Provisional figures.

1) Murman cod included.

2) United Kingdom (England and Wales) only.

Table 3. COD. Estimates of total international effort in Sub-area I and Divisions IIa and IIb.

Year	SUB-AREA I				DIVISION IIb				DIVISION IIa			
	National effort		Total inter-national effort		National effort		Total inter-national effort		National effort		Total inter-national effort	
	U.K. ¹⁾	USSR ²⁾	U.K. units	USSR units	U.K.	USSR	U.K. units	USSR units	U.K.	Norway ³⁾	U.K. units	Norwegian units
1960	95	43	500	89	42	11	87	30	39	9 489	232	52
1961	94	53	519	108	51	22	171	50	30	8 410	264	41
1962	93	61	596	93	51	16	166	30	34	7 812	212	35
1963	78	62	644	91	45	9	114	20	29	7 153	177	38
1964	42	30	357	56	49	17	137	32	36	6 103	150	22
1965	42	25	366	62	37	11	95	21	33	6 883	152	34
1966	63	33	395	70	23	16	73	30	46	6 796	201	34
1967	51	30	399	61	10	12	114	14	50	7 153	248	37
1968	86	45	584	59	9	24	156	22	52	7 930	290	32
1969	115	45	601	68	24	19	194	22	73	6 747	272	43
1970	122	35	604	75	24	15	86	11	55	6 893	369	38
1971	82	23	558	73	4	27	80	36	48	6 913	516	30
1972	71	41	419	58	7	11	65	18	35	8 674	610	29
1973	96	61	864	88	18	12	163	15	27	9 156	492	31
1974	92	48	916	80	9	18	240	33	29	6 590	444	37
1975	109	31	729	66	5	19	147	34	28	4 906	364	35
1976	96	44	878	80	21	18	128	35	34	5 862	678	62
1977*	82	56	966	102	44	31	230	52	37	6 583	525	48

* Provisional figures.

1) Hours fishing x average tonnage x 10^{-6} = millions on ton-hours.

2) Hours fishing (catch/catch per hour fishing) x 10^{-4} .

3) Gill net boat week at Lofoten.

Table 4. COD. Catch per unit effort (metric tons, round fresh) in Sub-area I and Divisions IIa and IIb.

Year	SUB-AREA I		DIVISION IIb		DIVISION IIa	
	U.K. ¹⁾	USSR ²⁾	U.K.	USSR	U.K.	Norway ³⁾
1960	0.075	0.42	0.105	0.31	0.067	3.0
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	0.047	0.34	0.051	0.18	0.055	11.5
1973	0.057	0.56	0.054	0.57	0.043	6.8
1974	0.079	0.90	0.106	0.77	0.028	3.4
1975	0.077	0.85	0.100	0.43	0.033	3.4
1976	0.060	0.66	0.081	0.30	0.035	3.8
1977*	0.053	0.50	0.057	0.25	0.046	5.0

* Provisional figures.

1) United Kingdom data - tons per 100 ton-hours fishing.

2) USSR data - tons per hour fishing.

3) Norwegian data - tons per gill-net boat week at Lofoten.

Table 5. HADDOCK. Total nominal catch (metric tons) 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*	66 946	12 227	22 804	101 977

* Provisional figures.

Table 6. HADDOCK. Nominal catch (in metric tons) 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	91 940	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	-	181 726
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	49	16 373	15 778	3	78 911
1972	137	-	829	1 433	46 700	1 433	17 166	196 224	2 223	266 145
1973	1 212	3 214	22	9 583	86 767	325	32 408	186 534	-	320 065
1974	925	3 601	454	23 409	66 164	3 045	36 293	78 548 ¹⁾	8 699	221 138
1975	299	5 191	437	15 930	55 966	1 080	28 661	65 015 ¹⁾	3 163	175 742
1976	537	4 459	348	16 660	49 492	986	16 954	42 485 ¹⁾	5 358	137 279
1977*	131	1 198	144	4 752	39 600	-	10 632 ²⁾	45 173 ¹⁾	347	101 977

* Provisional figures.

1) Murman haddock included.

2) United Kingdom (England and Wales) only.

Table 7. HADDOCK. Catch per unit effort and estimated total international effort.

Year	Catch per effort (U.K.) Kilos/100 ton-hours			Estimated total international effort in U.K. units $\frac{\text{Total catch in tons} \times 10^{-3}}{\text{Tons/100 ton-hours in Sub-area I}}$
	Sub-area I	Divisions		
		IIa	IIb	
1960	33	34	2.8	4.7
1961	29	36	3.3	6.7
1962	23	42	2.5	8.2
1963	13	33	0.9	11.3
1964	18	18	1.6	5.5
1965	18	18	2.0	6.6
1966	17	34	2.8	9.4
1967	18	25	2.4	7.6
1968	19	50	1.0	9.6
1969	13	42	2.0	10.0
1970	7	31	1.0	12.4
1971	8	25	3.0	9.8
1972	14	18	23.0	19.0
1973	22	20	20.0	14.5
1974	20	74	15.0	11.1
1975	15	60	4.0	11.7
1976	10	38	3.0	13.7
1977*	4.3	16	0.2	23.7

* Provisional figure.

Table 8. COD.
Catch in numbers by year and by age (thousands)

AGE	1960	1961	1962	1963	1964	1965
1	465.0	1.0	1.0	1.0	103.0	1.0
2	7147.0	1699.0	1713.0	4.0	675.0	2522.0
3	37882.0	45478.0	42416.0	13196.0	5298.0	15725.0
4	97865.0	132655.0	170566.0	106984.0	45912.0	25999.0
5	64222.0	123458.0	167241.0	205549.0	97950.0	78299.0
6	67425.0	51167.0	89460.0	95498.0	58575.0	68511.0
7	23117.0	38740.0	28297.0	35518.0	19642.0	25444.0
8	8429.0	17376.0	21996.0	16221.0	9162.0	8438.0
9	7240.0	5791.0	7956.0	11894.0	6196.0	3569.0
10	11675.0	6778.0	2728.0	3884.0	3553.0	1467.0
11	4504.0	5560.0	2603.0	1021.0	783.0	1161.0
12	1843.0	1682.0	1647.0	1025.0	172.0	131.0
13	354.0	910.0	392.0	498.0	387.0	67.0
14	102.0	280.0	280.0	129.0	264.0	91.0
15+	226.0	108.0	103.0	157.0	131.0	179.0

AGE	1966	1967	1968	1969	1970	1971
1	1.0	1.0	1.0	1.0	1.0	38.0
2	869.0	151.0	1.0	275.0	591.0	2210.0
3	55937.0	34467.0	3709.0	2307.0	7164.0	7754.0
4	55644.0	160048.0	174585.0	24545.0	10792.0	13739.0
5	34676.0	69235.0	267961.0	238511.0	25813.0	11831.0
6	42539.0	22061.0	107051.0	181239.0	137829.0	9527.0
7	37169.0	26295.0	26701.0	79363.0	96420.0	59290.0
8	18500.0	25139.0	16399.0	26989.0	31920.0	52000.0
9	5077.0	11323.0	11597.0	13463.0	8933.0	12093.0
10	1495.0	2329.0	3657.0	5092.0	3249.0	2434.0
11	380.0	687.0	657.0	1913.0	1232.0	762.0
12	403.0	316.0	122.0	414.0	260.0	418.0
13	77.0	225.0	124.0	121.0	106.0	149.0
14	9.0	40.0	70.0	23.0	39.0	42.0
15+	70.0	14.0	46.0	46.0	35.0	25.0

AGE	1972	1973	1974	1975	1976	1977
1	1.0	1.0	115.0	1.0	706.0	1.0
2	4701.0	8277.0	21347.0	1184.0	1908.0	10693.0
3	35536.0	294262.0	91855.0	45282.0	85337.0	38557.0
4	45431.0	131493.0	437377.0	59798.0	114341.0	168530.0
5	26832.0	61000.0	203772.0	226646.0	79993.0	135324.0
6	12089.0	20569.0	47006.0	118567.0	118236.0	52261.0
7	7918.0	7248.0	12630.0	29522.0	47872.0	57615.0
8	34885.0	8328.0	4370.0	9353.0	13962.0	21303.0
9	22315.0	19130.0	2523.0	2617.0	4051.0	5041.0
10	4572.0	4499.0	5607.0	1555.0	936.0	1341.0
11	1215.0	677.0	2127.0	1928.0	558.0	541.0
12	353.0	195.0	322.0	575.0	442.0	221.0
13	315.0	81.0	151.0	231.0	139.0	110.0
14	121.0	59.0	83.0	15.0	26.0	72.0
15+	40.0	55.0	62.0	37.0	53.0	47.0

Table 9. COD.
Fishing mortalities by year and by age (M = 0.3)

AGE	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
3	.04	.04	.05	.02	.01	.02	.03	.02	.02	.02
4	.19	.23	.25	.18	.11	.08	.08	.12	.17	.17
5	.29	.43	.56	.61	.28	.31	.16	.15	.34	.40
6	.38	.44	.72	.86	.39	.37	.31	.17	.40	.46
7	.37	.45	.53	.84	.48	.33	.40	.36	.35	.68
8	.42	.60	.57	.77	.62	.44	.49	.58	.46	.81
9	.33	.65	.71	.82	.90	.60	.60	.73	.68	1.02
10	.62	.68	.87	1.11	.72	.63	.63	.71	.64	.86
11	.77	.80	.69	1.20	.82	.63	.37	.77	.50	.97
12	.60	.88	.67	.75	.76	.34	.53	.69	.33	.80
13	.46	.80	.60	.50	.85	.91	.39	.75	.74	.74
14	.44	.94	.71	.45	.62	.56	.32	.41	.63	.32
15+	.65	.65	.65	.65	.65	.65	.65	.65	.65	.65

MEAN F FOR AGES ≥ 8 AND ≤ 12 (NOT WEIGHTED BY STOCK IN NUMBERS)
.55 .72 .70 .93 .76 .53 .52 .70 .52 .89

AGE	1970	1971	1972	1973	1974	1975	1976	1977
1	.00	.00	.00	.00	.00	.00	.00	.00
2	.00	.00	.00	.01	.01	.00	.00	.01
3	.03	.01	.03	.14	.12	.03	.05	.06
4	.10	.08	.13	.16	.36	.11	.12	.14
5	.31	.18	.24	.28	.44	.35	.24	.22
6	.48	.20	.31	.32	.40	.58	.36	.28
7	.55	.45	.29	.35	.38	.55	.53	.33
8	.74	.75	.59	.64	.42	.61	.62	.55
9	.82	.82	1.02	.90	.45	.55	.66	.55
10	.86	.64	1.05	.66	.87	.65	.43	.55
11	.59	.58	.91	.47	.90	1.02	.58	.55
12	.37	.46	.66	.40	.49	.76	.81	.55
13	.55	.42	.88	.35	.70	.92	.47	.55
14	.64	.50	.83	.45	.84	.15	.27	.55
15+	.65	.65	.80	.70	.70	.70	.60	.55

MEAN F FOR AGES ≥ 8 AND ≤ 12 (NOT WEIGHTED BY STOCK IN NUMBERS)
.68 .65 .85 .61 .63 .72 .62 .55

Table 10. COD (M = 0.3)

Stock in numbers at beginning of year (thousands)

AGE	1960	1961	1962	1963	1964	1965
1	1908488.3	1276404.4	966262.6	2119425.8	4111024.7	3320013.1
2	1697737.1	1413444.2	945582.8	715824.1	1570108.4	3045433.7
3	1059541.6	1251586.8	1045648.4	699036.2	530292.1	1162586.1
4	663086.9	752478.5	888243.2	738307.7	506549.6	383308.4
5	296447.6	407697.5	444340.1	512674.2	455630.8	336000.5
6	242181.4	164935.0	197278.6	187745.6	206181.7	254139.5
7	85788.1	122145.5	78786.6	70793.2	58903.1	103004.6
8	28233.2	43912.0	57638.0	34417.3	22610.5	26952.9
9	29529.7	13762.6	17850.4	24102.7	11247.3	9013.3
10	28816.1	15718.7	5309.1	6519.5	7360.1	3579.1
11	9500.5	11488.3	5928.6	1643.3	1588.0	2829.9
12	4640.7	3248.7	3835.5	2197.7	366.9	518.4
13	1107.0	1880.9	995.3	1452.3	785.3	127.1
14	329.9	519.9	628.2	406.1	654.1	242.0
15+	330.3	157.8	150.5	229.5	191.5	261.6

AGE	1966	1967	1968	1969	1970	1971
1	444928.8	312409.2	542350.0	1104299.3	2632770.8	4755064.8
2	2459525.3	329610.5	231437.6	401781.9	818084.2	1950403.8
3	2253950.3	1821316.0	244052.0	171452.3	297411.5	605544.9
4	847786.3	1621837.0	1319725.4	177619.1	125037.5	214189.2
5	265416.8	580435.2	1064660.1	828587.9	110627.2	83400.3
6	182292.8	167012.1	370847.3	560884.4	411334.7	59991.3
7	130061.0	98851.0	104886.2	183846.1	261871.4	187944.2
8	54669.8	64792.0	50885.9	55001.6	69268.5	112428.4
9	12840.4	24828.0	26751.9	23794.7	18061.0	24439.3
10	3661.9	5223.0	8856.8	10039.3	6366.1	5873.1
11	1412.9	1450.5	1906.7	3474.2	3161.5	1988.5
12	1116.2	723.8	496.6	856.1	971.9	1300.9
13	272.6	485.9	269.8	264.1	286.1	499.1
14	38.0	136.6	170.5	95.5	53.8	122.3
15+	102.3	20.5	67.2	67.2	51.2	36.5

AGE	1972	1973	1974	1975	1976	1977
1	1783803.3	3072377.7	3841583.9	1397291.0	1679489.5	1158.0
2	3522606.1	1321473.1	2276072.6	2845816.8	1035137.8	1243591.0
3	1442999.7	2605579.9	971875.2	1667856.2	2107217.7	765213.0
4	441952.2	1038550.7	1678811.1	641444.8	1196780.4	1487977.2
5	146916.8	288572.1	657066.1	871942.4	424063.2	788835.8
6	51684.5	85965.2	161833.7	313924.9	453307.0	245977.1
7	36314.4	28003.0	46187.2	79985.1	132299.7	235323.8
8	88953.7	20161.3	14584.2	23487.0	34280.1	57498.6
9	39507.7	36420.1	7905.9	7095.9	9498.5	13606.1
10	7943.0	10600.8	10335.4	3717.7	3042.9	3619.5
11	2296.5	2062.6	4057.7	3394.6	1441.8	1460.2
12	828.9	682.4	954.2	1221.9	902.3	596.5
13	609.4	316.3	340.0	434.1	421.3	296.9
14	243.3	187.1	165.5	124.6	127.9	194.3
15+	55.0	78.6	88.6	52.9	79.5	72.6

Table 11. COD.

Fishing mortalities by year and by age (M = 0.2)

AGE	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00
3	.05	.06	.07	.03	.02	.02	.04	.03	.03	.02
4	.23	.27	.31	.24	.14	.11	.10	.15	.21	.23
5	.35	.49	.65	.74	.35	.39	.21	.18	.41	.48
6	.46	.51	.82	1.00	.48	.45	.38	.20	.47	.54
7	.43	.53	.61	.96	.57	.40	.47	.43	.40	.77
8	.48	.68	.65	.87	.72	.52	.57	.67	.52	.92
9	.39	.73	.79	.93	1.03	.70	.69	.84	.78	1.14
10	.71	.77	.96	1.26	.83	.75	.72	.82	.73	.98
11	.88	.92	.79	1.33	.98	.73	.43	.90	.58	1.13
12	.69	1.02	.78	.86	.87	.42	.61	.80	.39	.92
13	.52	.91	.70	.58	.98	1.06	.47	.86	.87	.84
14	.51	1.07	.81	.53	.71	.65	.38	.48	.73	.38
15+	.75	.75	.75	.75	.75	.75	.75	.75	.75	.75
MEAN F FOR AGES \geq 8 AND \leq 12 (NOT WEIGHTED BY STOCK IN NUMBERS)										
	.63	.82	.80	1.05	.89	.62	.61	.81	.60	1.02
AGE	1970	1971	1972	1973	1974	1975	1976	1977		
1	.00	.00	.00	.00	.00	.00	.00	.00		
2	.00	.00	.00	.01	.02	.00	.00	.01		
3	.04	.02	.04	.18	.16	.04	.06	.07		
4	.14	.10	.16	.20	.45	.15	.15	.17		
5	.40	.23	.30	.34	.52	.44	.30	.26		
6	.57	.25	.39	.39	.48	.67	.43	.33		
7	.62	.52	.35	.43	.45	.64	.63	.39		
8	.84	.83	.67	.75	.51	.71	.73	.65		
9	.94	.93	1.14	1.01	.54	.65	.78	.65		
10	.99	.73	1.21	.75	.97	.76	.52	.65		
11	.69	.67	1.07	.56	1.03	1.15	.69	.65		
12	.44	.53	.78	.48	.57	.90	.94	.65		
13	.64	.48	1.01	.40	.85	1.09	.56	.65		
14	.74	.57	.94	.52	.95	.18	.32	.65		
15+	.75	.75	.90	.80	.80	.80	.70	.65		
MEAN F FOR AGES \geq 8 AND \leq 12 (NOT WEIGHTED BY STOCK IN NUMBERS)										
	.78	.74	.97	.71	.72	.83	.73	.65		

Table 12. COD (M = 0.2)
Stock in numbers at beginning of year (thousands)

AGE	1960	1961	1962	1963	1964	1965
1	1092193.7	708419.7	506747.5	1162320.1	2363820.2	1930092.0
2	1130537.0	893792.6	580004.1	414888.8	951626.3	1935239.3
3	790570.8	919150.1	730240.8	473319.9	339679.6	778516.0
4	531469.9	613075.5	711493.1	559597.1	375607.4	273320.9
5	240315.0	347058.0	382651.4	429223.1	361895.5	266147.2
6	200177.7	139072.6	173530.0	163820.8	167979.8	208329.3
7	72082.9	103446.9	68034.3	62346.9	49256.3	85037.0
8	24084.4	38283.4	50003.7	30394.5	19461.9	22751.4
9	24717.1	12165.1	15323.3	21283.0	10439.0	7755.2
10	25037.9	13738.4	4791.3	5861.1	6843.7	3043.1
11	8392.2	10075.5	5202.4	1497.0	1360.7	2437.1
12	4035.9	2860.3	3301.2	1938.2	322.9	418.0
13	952.7	1658.2	847.4	1234.1	673.8	111.2
14	278.7	463.0	547.7	343.8	564.8	207.6
15+	286.3	136.8	130.5	198.9	165.9	226.7

AGE	1966	1967	1968	1969	1970	1971
1	245493.7	165628.0	294254.7	619188.8	1543543.9	2915989.9
2	1530224.8	200992.4	135603.9	240914.5	506948.0	1263746.0
3	1582161.8	1292993.7	164422.2	111022.2	196995.7	414520.1
4	623195.4	1244868.4	1027494.0	131268.5	88814.1	154819.4
5	200333.7	460050.9	875002.2	684074.3	85385.9	62989.3
6	147628.1	132805.2	314303.6	475968.7	346325.7	46745.4
7	109133.5	82682.1	88870.1	161371.8	227422.5	160210.9
8	46789.0	56033.5	44109.3	48800.0	61327.5	39987.5
9	11070.3	21751.5	23417.7	21427.2	15937.7	21768.8
10	3162.3	4529.5	7719.4	8829.5	5604.5	5102.1
11	1182.4	1254.6	1632.7	3055.9	2702.4	1700.8
12	959.2	627.3	415.7	748.9	805.4	1112.2
13	224.7	424.9	231.8	230.8	244.7	426.2
14	31.5	115.0	147.5	79.4	81.2	105.6
15+	88.7	17.7	58.3	58.3	44.3	31.7

AGE	1972	1973	1974	1975	1976	1977
1	1031899.7	1777663.7	2303138.7	940208.4	1448755.8	1103.9
2	2387376.3	844847.1	1455427.0	1885546.6	769776.6	1185503.2
3	1032671.4	1950372.0	684226.8	1172324.7	1542685.5	628516.3
4	332378.3	813395.8	1331814.7	477442.4	918943.3	1186037.2
5	114365.8	231200.3	547559.7	698208.0	337012.5	649332.2
6	40925.0	69516.2	134499.2	265814.6	368392.8	204023.7
7	29702.1	22656.8	38454.8	67994.1	111696.2	195572.1
8	78068.8	17206.4	12049.1	20159.0	29281.3	48652.6
9	35525.6	32749.9	6656.6	5950.3	8153.5	11512.8
10	7062.9	9297.4	9813.5	3190.9	2533.0	3062.6
11	2004.9	1732.3	3597.8	3049.1	1225.2	1235.6
12	711.7	562.9	812.3	1056.1	787.1	504.7
13	536.3	267.9	286.1	376.9	352.8	251.2
14	215.4	159.2	146.7	99.7	103.6	164.4
15+	48.9	68.8	77.5	46.3	68.1	61.5

Table 13. HADDOCK.
Catch in numbers by year and by age (thousands).

AGE	1960	1961	1962	1963	1964	1965
1	2319.0	362.0	1.0	3.0	149.0	1.0
2	3632.0	5531.0	4536.0	2151.0	831.0	3483.0
3	40117.0	15430.0	39604.0	28567.0	22305.0	5911.0
4	71280.0	56859.0	30947.0	72995.0	49162.0	46161.0
5	13717.0	63354.0	49028.0	19035.0	30592.0	40032.0
6	7138.0	8706.0	33922.0	13627.0	5800.0	12578.0
7	6267.0	3578.0	3209.0	9290.0	3519.0	1672.0
8	1587.0	4407.0	1344.0	1243.0	2709.0	970.0
9	2352.0	787.0	1778.0	561.0	832.0	893.0
10	2015.0	527.0	243.0	409.0	104.0	123.0
11	497.0	1287.0	247.0	79.0	206.0	204.0
12	70.0	67.0	482.0	84.0	234.0	123.0
13	30.0	60.0	20.0	169.0	121.0	14.0
14	12.0	20.0	8.0	41.0	67.0	205.0

AGE	1966	1967	1968	1969	1970	1971
1	1.0	1.0	1.0	1.0	480.0	15.0
2	2559.0	53.0	33.0	1058.0	276.0	3535.0
3	26157.0	15918.0	657.0	1520.0	23004.0	1979.0
4	22469.0	41373.0	67632.0	1963.0	2408.0	24359.0
5	62724.0	13505.0	41267.0	44526.0	1870.0	1258.0
6	28840.0	25736.0	7748.0	18956.0	21995.0	918.0
7	5711.0	8878.0	15599.0	3611.0	7948.0	9279.0
8	578.0	1617.0	5292.0	4925.0	1974.0	3056.0
9	435.0	218.0	655.0	1624.0	1978.0	826.0
10	188.0	176.0	182.0	315.0	726.0	1043.0
11	186.0	155.0	101.0	43.0	166.0	369.0
12	25.0	76.0	115.0	43.0	26.0	130.0
13	8.0	27.0	18.0	14.0	52.0	27.0
14	7.0	7.0	19.0	2.0	19.0	4.0

AGE	1972	1973	1974	1975	1976	1977
1	133.0	1.0	281.0	1321.0	3475.0	149.0
2	9369.0	5915.0	3713.0	4355.0	7496.0	15095.0
3	230229.0	70204.0	9684.0	10037.0	13989.0	46442.0
4	22246.0	258773.0	41701.0	14089.0	13449.0	19347.0
5	42849.0	24018.0	88111.0	33871.0	6808.0	6660.0
6	3196.0	6872.0	5827.0	49712.0	20789.0	2407.0
7	1606.0	418.0	4138.0	2135.0	40044.0	7404.0
8	6736.0	422.0	382.0	1236.0	1247.0	10469.0
9	2630.0	1680.0	617.0	92.0	1349.0	288.0
10	896.0	525.0	2043.0	131.0	193.0	387.0
11	988.0	146.0	935.0	500.0	279.0	94.0
12	538.0	340.0	276.0	147.0	652.0	99.0
13	53.0	68.0	458.0	53.0	331.0	83.0
14	42.0	13.0	143.0	92.0	46.0	98.0

Table 14. HADDOCK.

Fishing mortalities by year and by age. (M = 0.2)

AGE	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969
1	.01	.00	.00	.00	.00	.00	.00	.00	.00	.00
2	.03	.02	.01	.01	.01	.01	.01	.00	.00	.01
3	.20	.17	.20	.12	.08	.07	.13	.06	.04	.10
4	.38	.49	.59	.68	.31	.24	.39	.30	.40	.15
5	.51	.69	1.06	.92	.69	.46	.58	.43	.56	.50
6	.61	.71	1.04	1.02	.83	.69	.71	.50	.47	.54
7	.50	.71	.63	.94	.83	.61	.80	.49	.65	.42
8	.57	.82	.65	.53	.82	.57	.44	.56	.62	.44
9	.63	.62	.97	.62	.85	.71	.55	.29	.46	.39
10	.52	.28	.40	.62	.22	.28	.31	.45	.42	.42
11	1.02	.77	.20	.22	.74	.86	.89	.46	.51	.16
12	.54	.35	.75	.10	1.90	1.54	.23	1.24	.75	.43
13	.44	1.32	.17	.66	.20	.55	.35	.42	1.22	.18
14	.60	.60	.60	.60	.60	.60	.60	.60	.60	.40

MEAN F FOR AGES ≥ 7 AND ≤ 12 (NOT WEIGHTED BY STOCK IN NUMBERS)

.63	.59	.60	.50	.89	.76	.54	.58	.57	.38
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AGE 1970 1971 1972 1973 1974 1975 1976 1977

1	.00	.00	.00	.00	.00	.00	.01	.00
2	.00	.00	.03	.10	.06	.04	.02	.06
3	.17	.02	.28	.31	.22	.23	.17	.20
4	.22	.27	.39	.58	.31	.59	.53	.37
5	.20	.17	1.04	.97	.40	.44	.64	.55
6	.50	.15	.82	.45	.66	.41	.54	.49
7	.48	.41	.41	.23	.54	.55	.67	.37
8	.42	.32	.60	.18	.34	.30	.74	.37
9	.31	.31	.51	.29	.43	.13	.63	.37
10	.30	.27	.66	.18	.69	.15	.42	.37
11	.41	.25	.45	.21	.56	.35	.54	.37
12	.14	.66	.68	.27	.76	.16	1.09	.37
13	1.49	.21	.62	.16	.72	.32	.62	.37
14	.40	.40	.60	.30	.60	.30	.50	.37

MEAN F FOR AGES ≥ 7 AND ≤ 12 (NOT WEIGHTED BY STOCK IN NUMBERS)

.34	.37	.55	.23	.55	.27	.68	.37
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Table 15. HADDOCK. (M = 0.2)
Stock in numbers at beginning of year (thousands).

AGE	1960	1961	1962	1963	1964	1965
1	369122.5	417926.7	479318.4	150285.3	365236.8	438429.8
2	137842.5	300117.4	341842.5	392431.8	123040.5	298896.0
3	241519.8	109576.6	240720.7	275780.5	319353.1	99986.5
4	247621.4	161622.1	75814.3	161428.5	200036.4	241342.3
5	37829.6	138749.5	81374.1	34387.4	66962.3	119597.6
6	17164.7	18684.4	57014.9	23091.8	11216.0	27501.6
7	17369.7	7669.5	7524.4	16550.1	6799.7	4014.2
8	3995.6	8606.7	3084.7	3291.5	5286.2	2431.2
9	5494.3	1851.1	3118.5	1324.3	1581.9	1913.4
10	5397.3	2395.7	811.9	972.2	582.7	553.9
11	842.8	2614.5	1487.6	446.7	430.3	383.4
12	184.6	248.5	992.6	995.5	294.6	168.4
13	92.0	88.5	143.3	382.6	739.3	36.0
14	29.1	48.4	19.4	99.3	162.2	496.4

AGE	1966	1967	1968	1969	1970	1971
1	29781.2	27374.0	247973.1	141724.1	1556426.7	442530.5
2	358955.1	24381.9	22411.0	203022.3	116032.9	1273860.8
3	241569.8	291576.2	19914.3	18318.8	165265.0	94750.4
4	76528.4	174202.0	224358.1	15711.4	13627.3	114584.7
5	156058.9	42489.5	105438.0	122999.6	11094.5	8989.7
6	62028.5	71648.4	22674.2	49390.0	60816.0	7399.9
7	11282.8	25034.1	35603.9	11619.1	23466.9	30088.1
8	1781.2	4146.1	12541.4	15209.3	6273.4	12088.3
9	1122.5	948.2	1947.2	5536.0	8035.0	3365.5
10	769.3	529.7	580.3	1007.0	3074.9	4801.5
11	343.8	460.9	275.8	311.9	541.9	1865.0
12	132.2	115.9	238.4	135.4	216.6	294.7
13	29.5	85.8	27.6	92.6	72.3	153.9
14	16.9	16.9	46.0	6.6	63.2	13.3

AGE	1972	1973	1974	1975	1976	1977
1	87063.2	86567.3	154133.0	431861.7	352794.0	164475.8
2	362299.8	71161.2	70874.4	125939.6	352385.2	285704.8
3	1039755.3	288166.7	52927.2	54676.3	99179.2	281739.9
4	75788.1	644267.5	172840.3	34617.8	35732.4	68599.7
5	71906.8	42083.5	295944.6	104031.8	15738.7	17212.4
6	6226.9	20815.1	13098.7	163225.2	54800.0	6800.3
7	5231.3	2249.6	10880.3	5517.9	89032.4	26252.8
8	16309.1	2842.1	1465.6	5203.1	2606.5	37120.5
9	7151.3	7327.9	1946.8	856.8	3149.0	1021.2
10	2013.2	3499.4	4489.3	1040.5	618.6	1372.2
11	2993.2	847.7	2392.2	1850.8	733.9	333.3
12	1194.9	1564.8	562.6	1121.7	1066.2	351.0
13	125.1	497.7	975.4	214.4	785.9	294.3
14	101.7	55.1	346.2	389.7	127.9	347.5

Table 16. COD.
 Year class strength. The 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	Virtual Population No. of 3 year olds x 10 ^{-6*}	
	Sub-area I	Division IIb	Mean			M = 0.2	M = 0.3
1957	12	16	13	-Average		791	1 060
1958	16	24	19	+Average		919	1 252
1959	18	14	16	+Average		730	1 046
1960	9	19	13	Poor		473	699
1961	2	2	2	Poor		340	530
1962	7	4	6	Poor		779	1 163
1963	21	120	76	Rich		1 582	2 254
1964	49	45	46	Rich		1 293	1 821
1965	<1	<1	<1	Very poor	6	164	244
1966	2	<1	1	Very poor	<1	111	171
1967	1	<1	1	Very poor	34	197	297
1968	7	1	5	Poor	25	415	606
1969	11	6	9	Poor	93	1 033	1 443
1970	74	86	76	Rich	606	1 950	2 606
1971	37	24	32	Average	157	684	972
1972	53	17	40	Average	140	(1 172)	(1 668)
1973	74	5	46	Rich	684	(1 543)	(2 107)
1974	6	1	4	Poor	51	(629)	(765)
1975	(60)	(1)	(34)	Rich	343	(1 200)	(1 500)
1976	(2)	(1)	(3)	Poor	43	(380)	(700)
1977	(1)	(1)	(1)	Poor	173	(850)	(1 200)

() = estimated.

*USSR Murman cod included for 1974-77.

Table 17. 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 ⁻⁶ *
1957	9		242
1958	4		110
1959	14		241
1960	40		276
1961	50		319
1962	3		100
1963	9		242
1964	12		292
1965	<1	7	20
1966	<1	<1	18
1967	13	42	165
1968	<1	8	95
1969	69	82	1 040
1970	33	115	288
1971	3	73	(53)
1972	9	46	(55)
1973	8	54	(99)
1974	35	147	(281)
1975	(96)	170	(900)
1976	(<1)	112	(270)
1977	(1)	116	(275)

() = estimated.

* USSR Murman haddock included for 1974-77.

Table 18. Estimates of spawning stock and year class strength for COD. Estimates from VPA.

M = 0.2			
Year	Spawning stock biomass tons x 10 ⁻³ at beginning of year (age groups 8+)	Year class	Year class strength at 3 years old Millions
		1947	705
		1948	1 097
		1949	1 192
1950	1 458	1950	1 593
1951	1 385	1951	645
1952	1 155	1952	273
1953	403	1953	441
1954	827	1954	805
1955	869	1955	498
1956	993	1956	685
1957	929	1957	791
1958	1 019	1958	919
1959	837	1959	710 ⁷³¹
1960	600	1960	473 ⁴⁷³
1961	514	1961	340 ³³⁹
1962	474	1962	779 ⁷⁷⁸
1963	377	1963	1 582
1964	243	1964	1 293
1965	213	1965	164
1966	338	1966	111
1967	458	1967	197
1968	437	1968	415
1969	471	1969	1 033
1970	468	1970	1 950
1971	679	1971	684
1972	677	1972	(1 172) ⁶¹¹
1973	383	1973	(1 543) ⁶¹⁵
1974	222	1974	(629) ³⁵⁰
1975	202	1975	(1 200) ⁶⁵⁰
1976	234	1976	(380) ²¹⁴
1977	347	1977	(850) ¹⁶⁵
1978	(699)		
1979	(784)		
1980	(1 305)		

M = 0.3			
Year	Spawning stock biomass tons x 10 ⁻³ at beginning of year (age groups 8+)	Year class	Year class strength at 3 years old Millions
		1947	1 070
		1948	1 666
		1949	1 773
1950	1 731	1950	2 333
1951	1 645	1951	958
1952	1 359	1952	411
1953	1 079	1953	649
1954	979	1954	1 133
1955	1 012	1955	697
1956	1 161	1956	932
1957	1 098	1957	1 060
1958	1 212	1958	1 252
1959	1 014	1959	1 046
1960	698	1960	699
1961	587	1961	530
1962	542	1962	1 163
1963	427	1963	2 254
1964	280	1964	1 821
1965	251	1965	244
1966	395	1966	171
1967	527	1967	297
1968	502	1968	606
1969	530	1969	1 443
1970	531	1970	2 606
1971	765	1971	972
1972	765	1972	(1 668)
1973	435	1973	(2 107)
1974	257	1974	(765)
1975	235	1975	(1 500)
1976	275	1976	(700)
1977	410	1977	(1 200)
1978	(813)		
1979	(868)		
1980	(1 291)		

() = provisional figures.

Table 19. Estimates of the spawning stock and the year class strength for HADDOCK. Estimated from VPA for M = 0.2

Year	Spawning stock biomass tons x 10 ⁻³ at the beginning of the year (age groups 6+)	Year class	Year class strength at 3 years old Millions
		1947	67
		1948	552
		1949	63
1950	270	1950	1 029
1951	151	1951	127
1952	95	1952	52
1953	66	1953	169
1954	179	1954	53
1955	156	1955	69
1956	474	1956	325
1957	324	1957	242
1958	202	1958	110
1959	160	1959	240
1960	129	1960	276
1961	105	1961	319
1962	147	1962	100
1963	106	1963	242
1964	67	1964	292
1965	76	1965	20
1966	140	1966	18
1967	193	1967	165
1968	166	1968	95
1969	174	1969	1 040
1970	216	1970	288
1971	161	1971	53
1972	127	1972	(55)
1973	107	1973	(99)
1974	104	1974	(281)
1975	(316)	1975	(900)
1976	(334)	1976	(270)
1977	(192)	1977	(275)
1978	(147)		
1979	(133)		
1980	(189)		

() = provisional figures.

Table 20. Parameters used in the catch predictions.

Age	COD			HADDOCK		
	Stock size beginning of 1979 (millions of fish)*	Relative F (1978-1980)	Mean weight per age (kgs)	Stock size beginning of 1979 (millions of fish)	Relative F (1978-1980)	Mean weight per age (kgs)
3	700.0 380.0	0.10	0.65	270	0.37	0.41
4	1 062.3 934.1	0.26	1.00	601	0.67	0.62
5	353.6 339.2	0.40	1.55	107	1.00	0.97
6	590.0 550.2	0.50	2.35	18.3	0.90	1.59
7	277.4 260.7	0.60	3.45	4.1	0.67	2.33
8	79.5 73.9	1.00	4.70	1.9	0.67	2.72
9	59.2 53.8	1.00	6.17	8.4	0.67	3.56
10	11.6 10.3	1.00	7.70	11.9	0.67	4.41
11	2.7 2.4	1.00	9.25	0.3	0.67	5.40
12	0.7 0.6	1.00	10.85	0.4	0.67	6.70
13	0.3 0.3	1.00	12.50	0.1	0.67	7.40
14	0.1 0.1	1.00	13.90	0.1	0.67	8.00
15	0.1 0.1	1.00	15.00			

*Upper figure: for M = 0.3
Lower figure: for M = 0.2

Table 21. COD. Catch predictions.

M = 0.3				
<u>1978</u>				
F on age groups subject to maximum exploitation	0.45	0.45	0.45	0.45
Catch (tons)	850 000	850 000	850 000	850 000
Spawning stock biomass (tons) ¹⁾	813 000	813 000	813 000	813 000
<u>1979</u>				
F on age groups subject to maximum exploitation	0.26	0.4	0.6	0.42
Catch (tons)	556 000	822 000	1 166 000	850 000
Spawning stock biomass (tons) ¹⁾	868 000	868 000	868 000	868 000
<u>1980</u>				
F on age groups subject to maximum exploitation	0.26	0.4	0.6	0.38
Catch (tons)	657 000	897 000	1 141 000	850 000
Spawning stock biomass (tons) ¹⁾	1 454 000	1 305 000	1 121 000	1 291 000
<u>1981</u>				
Spawning stock biomass (tons) ¹⁾	2 014 000	1 805 000	1 411 000	1 816 000
M = 0.2				
<u>1978</u>				
F on age groups subject to maximum exploitation	0.51	0.51	0.51	0.51
Catch (tons)	851 000	851 000	851 000	851 000
Spawning stock biomass (tons) ¹⁾	699 000	699 000	699 000	699 000
<u>1979</u>				
F on age groups subject to maximum exploitation	0.18	0.3	0.5	0.44
Catch (tons)	378 000	608 000	955 000	850 000
Spawning stock biomass (tons) ¹⁾	784 000	784 000	784 000	784 000
<u>1980</u>				
F on age groups subject to maximum exploitation	0.18	0.3	0.5	0.37
Catch (tons)	507 000	759 000	1 063 000	850 000
Spawning stock biomass (tons) ¹⁾	1 575 000	1 436 000	1 233 000	1 305 000
<u>1981</u>				
Spawning stock biomass (tons) ¹⁾	2 787 000	2 350 000	1 774 000	2 056 000

1) At beginning of year.

Table 22. HADDOCK. Catch predictions. (M = 0.2)

<u>1978</u>				
F on age groups subject to maximum exploitation	0.55	0.55	0.55	0.55
Catch (tons)	151 000	151 000	151 000	151 000
Spawning stock biomass (tons) ¹⁾	147 000	147 000	147 000	147 000
<u>1979</u>				
F on age groups subject to maximum exploitation	0.15	0.3	0.45	0.55
Catch (tons)	63 000	120 000	170 000	203 000
Spawning stock biomass (tons) ¹⁾	133 000	133 000	133 000	133 000
<u>1980</u>				
F on age groups subject to maximum exploitation	0.15	0.3	0.35	0.55
Catch (tons)	96 000	164 000	170 000	233 000
Spawning stock biomass (tons) ¹⁾	243 000	214 000	189 000	173 000
<u>1981</u>				
Spawning stock biomass (tons) ¹⁾	735 000	572 000	491 000	378 000

¹⁾At beginning of year.

Table 23. Midwater trawl fishery of the Federal Republic of Germany trawlers in Sub-area I and Divisions IIa and IIb compared to Bottom trawl fishery.

<u>Landings (1 000 tons) 1975-77</u>								
Year	<u>COD</u>				<u>HADDOCK</u>			
	Midwater trawl	Bottom trawl	Total FRG	Total all countries	Midwater trawl	Bottom trawl	Total FRG	Total all countries
1975	9.8	20.2	30.0	892.4	4.4	11.5	15.9	175.7
1976	14.4	10.0	24.4	867.5	12.0	4.6	16.6	137.3
1977	8.0	4.6	12.6	884.5	3.0	1.8	4.8	102.0

The Federal Republic of Germany Midwater trawl component (in %)

Year	<u>In German landings</u>		<u>In total landings</u>	
1975	33		1	
1976	59		2	
1977	64		1	

Table 24. Mean length and mean age in catches taken by different gears in the Federal Republic of Germany fishery 1977 compared to the total international landings.

	<u>Mean Length</u>					
	<u>COD</u>			<u>HADDOCK</u>		
	Bottom trawl	Midwater trawl	Total inter-national	Bottom trawl	Midwater trawl	Total inter-national
Sub-area I	77.9	62.5	53.3	64.1	61.4	42.6
Div.IIa	78.7	62.4	67.5	63.5	61.9	60.0
Div.IIb	62.1	54.1	53.9	63.6	61.4	58.4
Total area	75.7	56.0	55.9	63.6	61.5	45.2

	<u>Mean Age</u>					
	<u>COD</u>			<u>HADDOCK</u>		
	Bottom trawl	Midwater trawl	Total inter-national	Bottom trawl	Midwater trawl	Total inter-national
Sub-area I	6.9	5.2	4.7	7.0	6.6	3.6
Div.IIa	7.0	5.2	5.9	7.1	6.6	6.2
Div. IIb	7.0	4.8	5.0	7.1	6.6	6.5
Total area	7.0	4.9	5.0	7.1	6.6	4.1

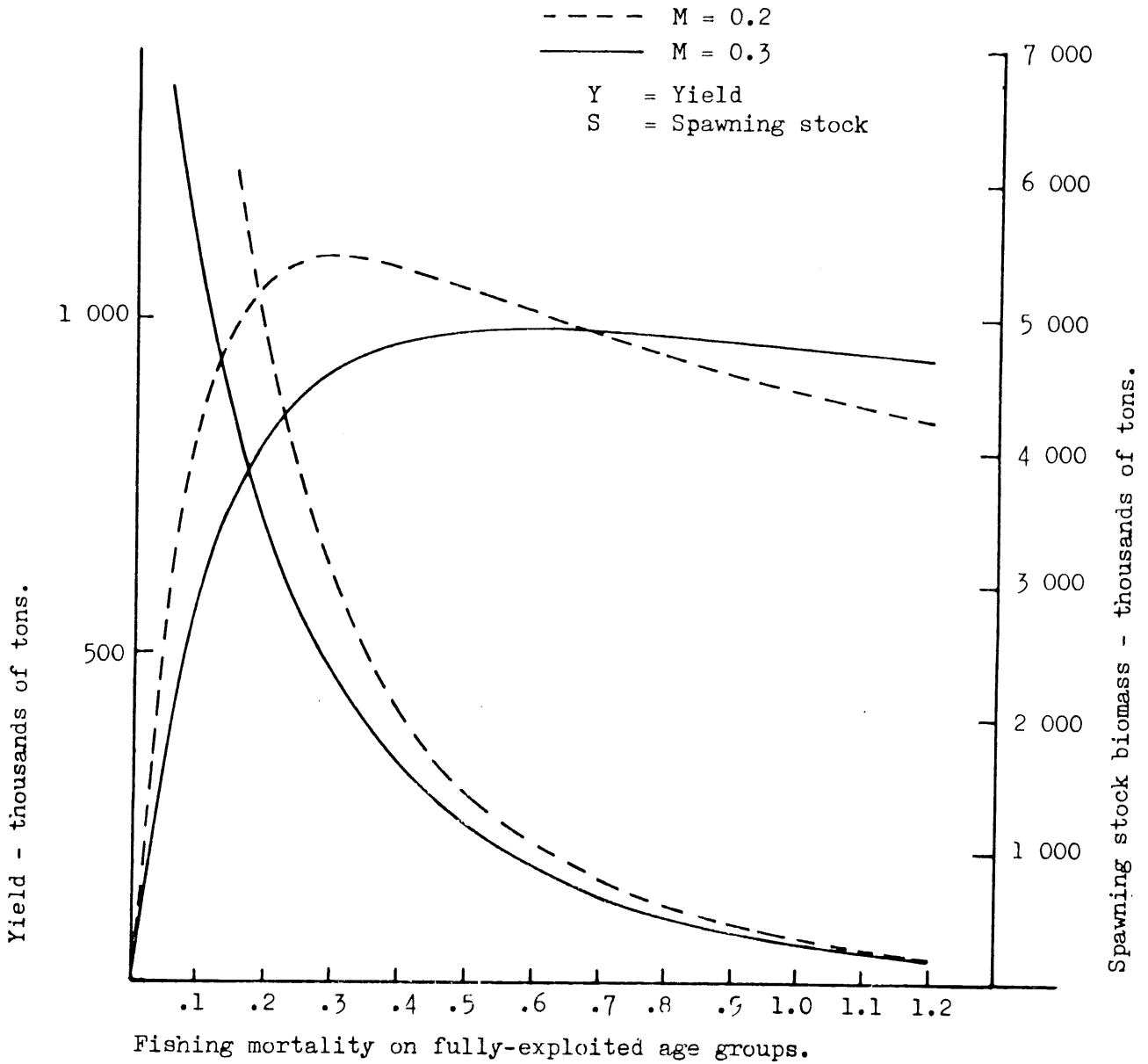


Figure 1. COD.
Curves of yield and spawning stock biomass
for the present exploitation pattern
assuming average recruitment.

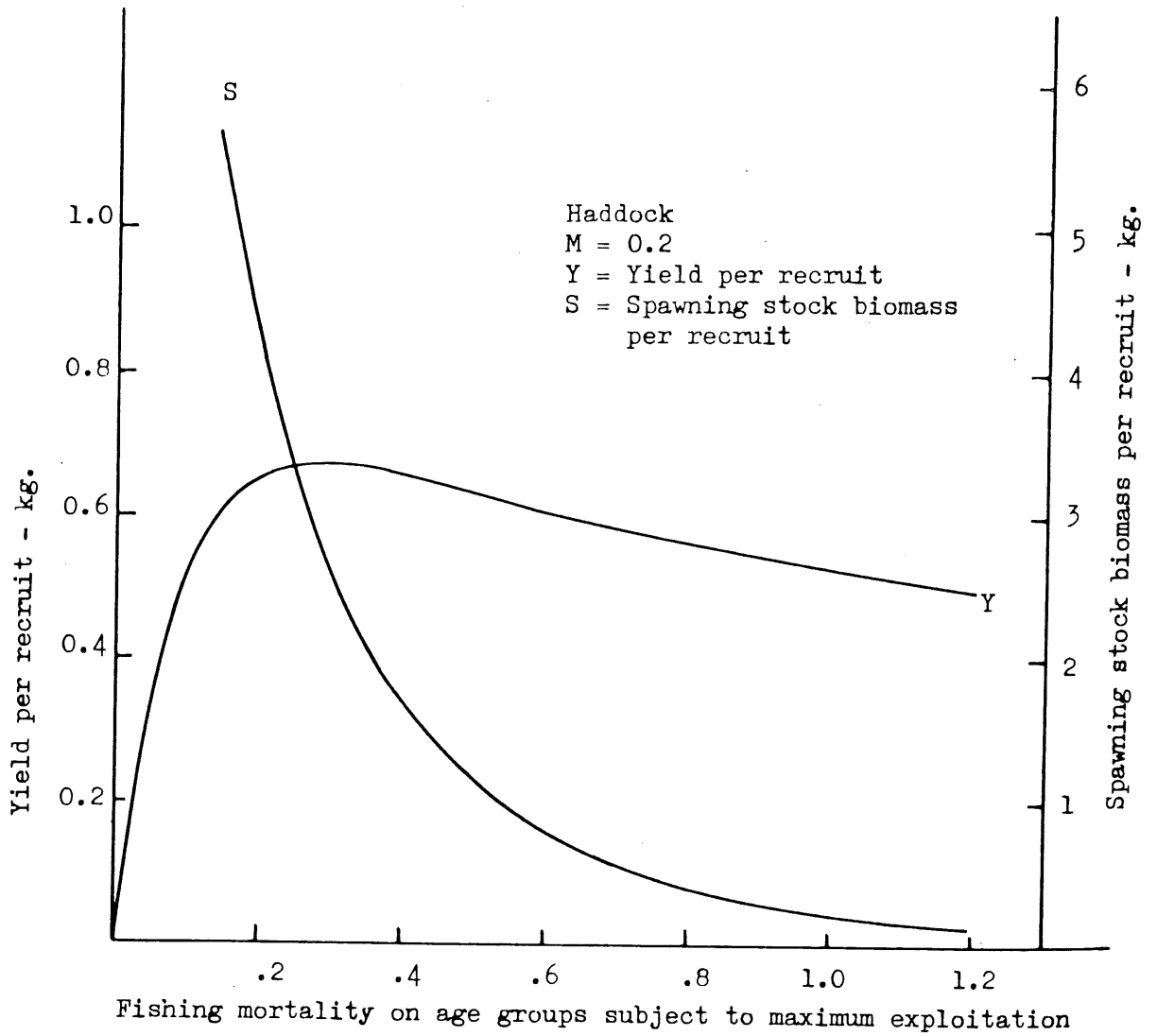


Figure 2. HADDOCK.
Curves of yield per recruit and spawning stock biomass per recruit for the present exploitation pattern. Age of recruitment = 3 years.