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International Council for the
Exploration of the Sea

C.M.1978/G:5

Demersal Fish Committee





# 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 Hylen (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 0-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:

| | | M = 0.3 | M = 0.2 |
|---|---|---|---|
| 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 Hylen 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.

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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 international effort | | National effort | | Total international effort | | National effort | | Total international 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) | USSR2) | U.K. | USSR | U.K. | Norway3) |
| 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 $\frac{\text{Total catch in tons x } 10^{-3}}{\text{Tons/100 ton-hours in Sub-area I}}$ |
|---|---|---|---|---|
| | 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 | 6136.0 | 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 | 25133.0 | 16399.0 | 26989.0 | 31920.0 | 52003.0 |
| 9 | 5077.0 | 11323.0 | 11597.0 | 13463.0 | 8933.0 | 12093.0 |
| 10 | 1455.0 | 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 | 79393.0 | 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 | .61 |
| 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)

| | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 |
|---|---|---|---|---|---|---|---|---|---|---|
| | .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 | .56 | .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)

| | 1970 | 1971 | 1972 | 1973 | 1974 | 1975 | 1976 | 1977 |
|---|---|---|---|---|---|---|---|---|
| | .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 | 26992.9 |
| 9 | 29529.7 | 13762.6 | 17850.4 | 24102.7 | 11847.3 | 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 | 765.3 | 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 | 6856.8 | 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 | 130.6 | 170.5 | 95.5 | 63.8 | 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 | 296.3 |
| 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 >= 8 AND <= 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 >= 8 AND <= 12 ( NOT WEIGHTED BY STOCK IN NUMBERS)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| .78 | .74 | .97 | .71 | .72 | .83 | .73 | .65 |

<u>Table 12.</u> 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 | 339678.6 | 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 | 15823.3 | 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 | 1580224.8 | 200992.4 | 135603.9 | 240914.5 | 506948.0 | 1263746.0 |
| 3 | 1582161.8 | 1292993.7 | 164422.2 | 111022.2 | 196995.7 | 414520.1 |
| 4 | 623155.4 | 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 | 99987.5 |
| 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 | 368393.8 | 204023.7 |
| 7 | 29702.1 | 22656.8 | 38454.8 | 67994.1 | 111696.2 | 195572.1 |
| 8 | 78068.8 | 17206.4 | 12049.1 | 20159.0 | 29281.8 | 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 | 122.0 |
| 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 |

| 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 | .46 | .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 |

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 | 7663.5 | 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 | 62038.5 | 71648.4 | 22674.2 | 49390.0 | 60816.0 | 7399.9 |
| 7 | 11282.8 | 25034.1 | 35603.9 | 11619.1 | 23466.9 | 30088.1 |
| 8 | 1791.2 | 4146.1 | 12541.4 | 15209.3 | 6273.4 | 12088.3 |
| 9 | 1122.5 | 948.2 | 1947.2 | 5536.0 | 8035.8 | 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 | 235944.6 | 104031.8 | 15738.7 | 17212.4 |
| 6 | 6226.9 | 20815.1 | 13098.7 | 163225.2 | 54809.0 | 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 | 3143.0 | 1021.2 |
| 10 | 2013.2 | 3495.4 | 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 |
| 1960 | 600 | 1960 | 473 |
| 1961 | 514 | 1961 | 340 |
| 1962 | 474 | 1962 | 779 |
| 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) |
| 1973 | 383 | 1973 | (1 543) |
| 1974 | 222 | 1974 | (629) |
| 1975 | 202 | 1975 | (1 200) |
| 1976 | 234 | 1976 | (380) |
| 1977 | 347 | 1977 | (850) |
| 1978 | (699) | | |
| 1979 | (784) | | |
| 1980 | (1 305) | | |

( ) = provisional figures.

| 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) | | |

Table 19. Estimates of the spawning stock and the year class strength for HADDOCK. Estimated from 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<br>380.0 | 0.10 | 0.65 | 270 | 0.37 | 0.41 |
| 4 | 1 062.3<br>934.1 | 0.26 | 1.00 | 601 | 0.67 | 0.62 |
| 5 | 353.6<br>339.2 | 0.40 | 1.55 | 107 | 1.00 | 0.97 |
| 6 | 590.0<br>550.2 | 0.50 | 2.35 | 18.3 | 0.90 | 1.59 |
| 7 | 277.4<br>260.7 | 0.60 | 3.45 | 4.1 | 0.67 | 2.33 |
| 8 | 79.5<br>73.9 | 1.00 | 4.70 | 1.9 | 0.67 | 2.72 |
| 9 | 59.2<br>53.6 | 1.00 | 6.17 | 8.4 | 0.67 | 3.56 |
| 10 | 11.6<br>10.3 | 1.00 | 7.70 | 11.9 | 0.67 | 4.41 |
| 11 | 2.7<br>2.4 | 1.00 | 9.25 | 0.3 | 0.67 | 5.40 |
| 12 | 0.7<br>0.6 | 1.00 | 10.85 | 0.4 | 0.67 | 6.70 |
| 13 | 0.3<br>0.3 | 1.00 | 12.50 | 0.1 | 0.67 | 7.40 |
| 14 | 0.1<br>0.1 | 1.00 | 13.90 | 0.1 | 0.67 | 8.00 |
| 15 | 0.1<br>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 | | | | |
|---|---|---|---|---|
| **1978** | | | | |
| 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 |
| **1979** | | | | |
| 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 |
| **1980** | | | | |
| 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 |
| **1981** | | | | |
| Spawning stock biomass (tons)[1] | 2 014 000 | 1 805 000 | 1 411 000 | 1 816 000 |

| M = 0.2 | | | | |
|---|---|---|---|---|
| **1978** | | | | |
| 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 |
| **1979** | | | | |
| 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 |
| **1980** | | | | |
| 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 |
| **1981** | | | | |
| 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)

| | | | | |
|---|---|---|---|---|
| 1978 | | | | |
| 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 |
| 1979 | | | | |
| 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 |
| 1980 | | | | |
| 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 |
| 1981 | | | | |
| 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.

Landings (1 000 tons) 1975-77

| Year | COD Midwater trawl | COD Bottom trawl | COD Total FRG | COD Total all countries | HADDOCK Midwater trawl | HADDOCK Bottom trawl | HADDOCK Total FRG | HADDOCK 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 | COD In German landings | COD In total landings | HADDOCK In German landings | HADDOCK In total landings |
|---|---|---|---|---|
| 1975 | 33 | 1 | 28 | 3 |
| 1976 | 59 | 2 | 72 | 9 |
| 1977 | 64 | 1 | 63 | 3 |

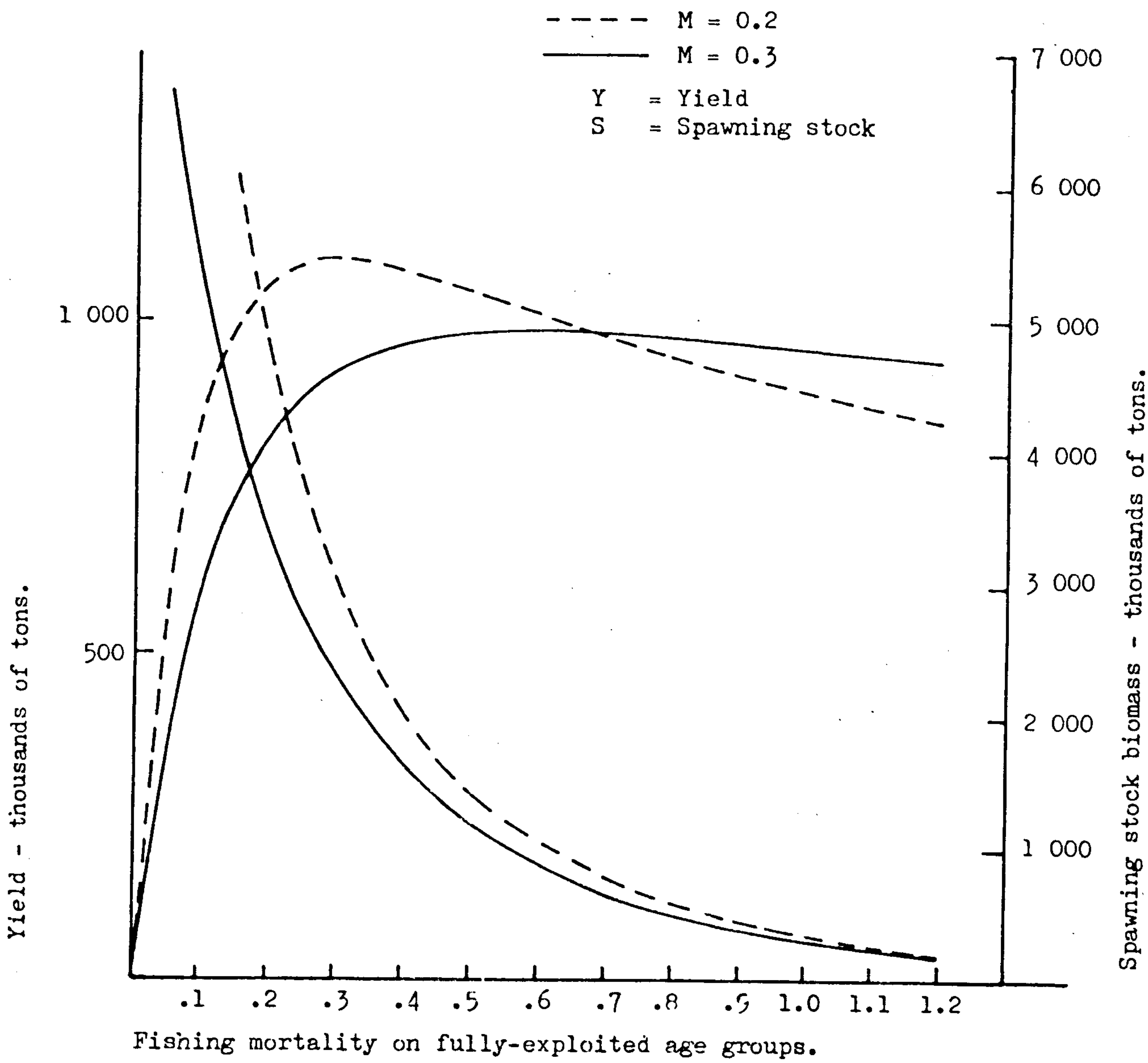
Table 24. Mean length and mean age in catches taken by different gears in the Federal Republic of Germany fishery 1977 compared to the total international landings.

Mean Length

| | COD Bottom trawl | COD Midwater trawl | COD Total international | HADDOCK Bottom trawl | HADDOCK Midwater trawl | HADDOCK Total international |
|---|---|---|---|---|---|---|
| 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 |

Mean Age

| | COD Bottom trawl | COD Midwater trawl | COD Total international | HADDOCK Bottom trawl | HADDOCK Midwater trawl | HADDOCK Total international |
|---|---|---|---|---|---|---|
| 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 |




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

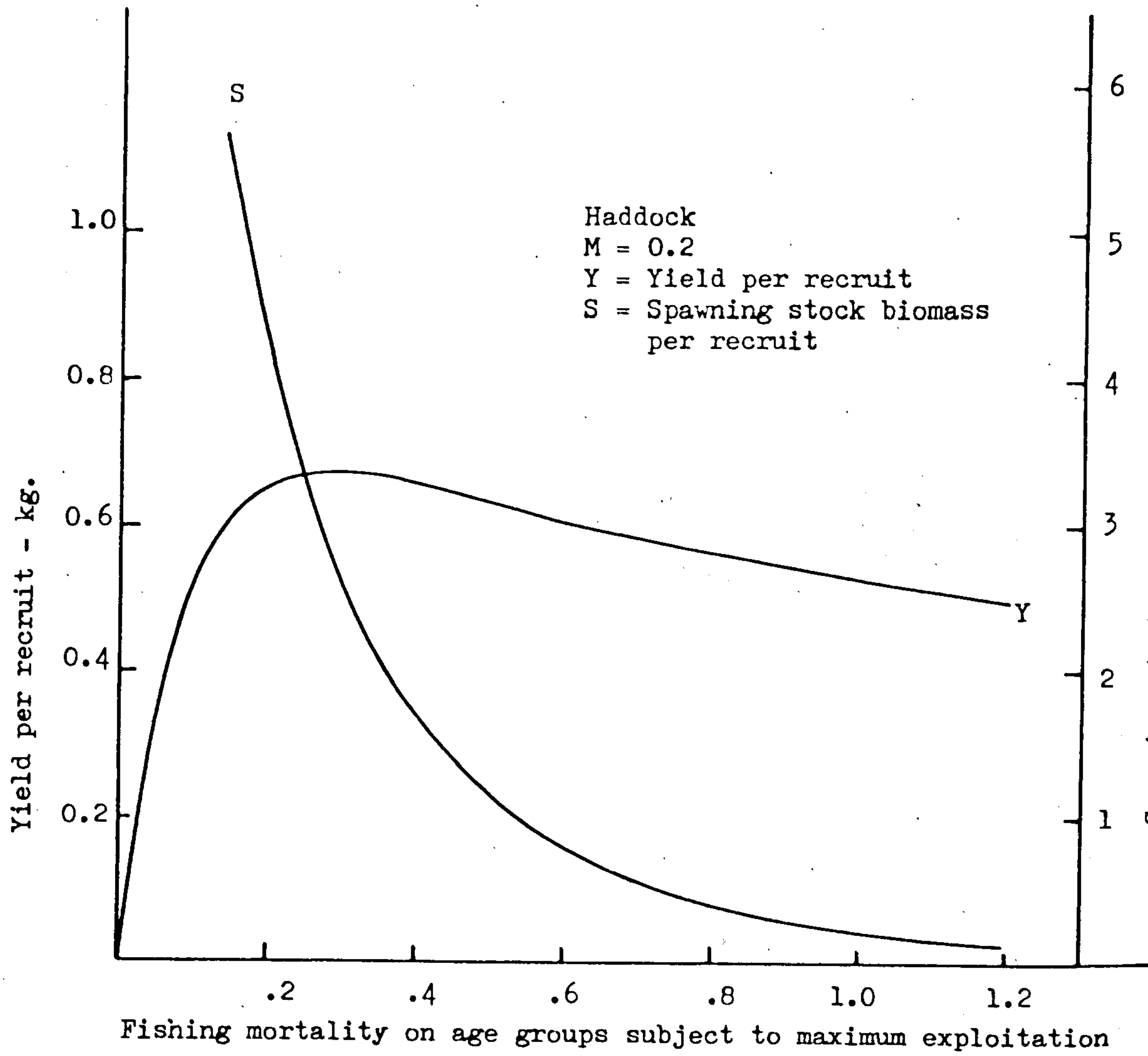



Figure 2. HADDOCK.
Curves of yield per recruit and spawning stock biomass per recruit for the present exploitation pattern. Age of recruitment = 3 years.