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Exploration of the Sea

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Demersal Fish Committee

REPORT OF THE NORTH SEA ROUNDFISH WORKING GROUP

Copenhagen, 14 - 18 April 1980

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REPORT OF THE NORTH SEA ROUNDFISH WORKING GROUP

1. PARTICIPATION AND TERMS OF REFERENCE

1.1 Participants

D W Armstrong	United Kingdom (Scotland)
H B Becker	Netherlands
T Benjaminsen	Norway
R Boddeke	Netherlands
N Cloet	Belgium
J P Hillis	Ireland
B W Jones, Chairman	United Kingdom (England + Wales)
J Lahn-Johannessen	Norway
F Lamp	Federal Republic of Germany
G Lefranc	France
P Lewy	Denmark
C T Macer	United Kingdom (England + Wales)
F M Serchuk	USA
P Sparre	Denmark
G Wagner	Federal Republic of Germany

V Nikolaev, ICES Statistician, also attended the meeting.

1.2 Terms of Reference

At the 1979 Statutory Meeting, it was decided (C.Res.1979/2:38) that the North Sea Roundfish Working Group should meet at ICES headquarters from 14-19 April 1980 to:

> "assess TACs for 1981 for cod, haddock and whiting in Sub-areas IV, VI and VII (excluding Divisions VIIa, VIIf and VIIg). The Working Group should also consider what additional data would be required to provide more realistic sub-divisions of the total TACs for these species for Sub-area VI between Divisions VIa and VIb".

2. DATA BASE

The data, on which all the analytical assessments are based, are the age compositions of the catches. Where appropriate, national age compositions are summed for each component of the fishery (human consumption, industrial and discards), these sub-totals, which may be raised to take account of catches by countries for which age compositions are unknown, are then summed to give age compositions as total numbers caught by all countries combined for each stock. This data base for most stocks extends back to 1960. However, detailed examination of the historic data series has shown that they were not consistent over the whole time period. In particular, improvements in data collection in recent years have resulted in more extensive data becoming available for the industrial fisheries and for discards. Thus, whereas in recent years the age compositions included industrial by-catches and discards, these were not included for all countries in the earlier years, when such data were not available. In addition, it appears that there have been variations in the method of processing the age composition data from year to year.

A start was made during the last year to revise the catch age composition data for the main stocks. However, this is a formidable job, and decisions have to be made on handling the data which require consultation between members of the Working Group to ensure a consistent agreed treatment for the various stocks. To enable this work to be completed, the Working Group recommends that a special meeting of the Group be convened late in 1980 to complete the revision of the age composition data base.

During the last year, it has been possible to make some improvements for some of the earlier years to the estimates of industrial by-catches and of discards. The resultant revised age compositions have been used in the assessments made at this meeting. As a consequence, there are a number of changes in the estimates of year class strengths and of fishing mortality on the younger age groups in some of the earlier years. There are likely to be further changes after the completion of the revision of the data base. The implications of these changes are discussed in the relevant sections of the report.

With regard to the data for 1978 and 1979, it is believed that the official statistics of catches did not for all countries truly reflect the quantities of fish that had been landed. Where this problem has occurred, the official statistics are given in the main part of the tables of nominal catches, and "corrected" figures representing what the Group considered to be the best estimates of total catches are given in the last line of the tables.

3. NORTH SEA COD

3.1 Catch Trends (Table 3.1 and Figure 3.1.A)

Provisional landings in 1979 of 228 000 tonnes were 13% less than in 1978 and slightly below the ACFM-recommended TAC of 247 000 tonnes agreed between EEC and Norway. In addition, there were discards estimated at about 15 000 tonnes in 1979. The relatively high level of landings was largely maintained by the above-average contribution of the abundant 1976 year class.

3.2 Age Composition

For 1979, provisional age composition data for human consumption landings based on sampling for length and age were provided by Belgium, Denmark, England, France, Netherlands and Scotland. For the latter country an annual estimate was provided based on data for the period January to June. The Federal Republic of Germany commenced age and length sampling of North Sea cod in the last quarter of 1979. Her age compositions for the first three quarters were derived from length compositions estimated from market category data and Dutch age/length keys. Norwegian consumption landings were assumed to have the same age composition as English landings from sample area 1.

Estimates of quantities discarded were provided by England, Netherlands and Scotland, and an age composition provided by the latter country was applied to the two former countries' data. As explained below, the discard data were excluded from the VPA input.

For the industrial fisheries by-catch, estimated quantities were provided by Norway and Denmark. Norway also provided quarterly length data and these were converted to age compositions using appropriate English and Scottish age/length keys.

An inspection of the data base prior to the meeting had indicated that there were inconsistencies, particularly with respect to by-catches in the small-mesh fisheries and to discards in the human consumption fisheries. It now appears that the latter are more important quantitatively than had been previously indicated (Table 3.2), and it is apparent that a revision of the whole data base back to the earliest year (1963) is urgently needed.

Such a revision was not possible at the meeting, but such corrections as were possible were made. These corrections related to the years 1974 to 1978 and they comprised the removal of discards and the inclusion of industrial by-catches. These changes mean that the data base is now more consistent than before, but the exploitation pattern indicated is incorrect in that the exploitation on younger age groups (principally age 1) is underestimated.

3.3 Recruitment

Estimates of 160 million and 208 million at age 1 for the 1978 and 79 year classes respectively were available from the IYHS results (Table 3.3). A value for average recruitment of 207 million was derived from VPA, using the period 1963-76 and this value was used for the 1980 year class recruiting in 1981.

The latest year class for which we have information (1979) appears to be about average. The 1976 year class is now indicated as slightly less abundant than was previously thought, though it is still obviously a strong one. Year classes 1977 and 1978 appear to be below average (Figure 3.1.B).

3.4 Weight at Age

Data for 1979 were available for the consumption fisheries from England, Denmark, France and Scotland. A weighted mean set of values gave a sum of products (SOP) of numbers x mean weight which differed from the reported landings by only 4%. For industrial by-catch landings, data were available from Norway and, when applied to all industrial landings, they gave an SOP discrepancy of only 3%. No data for 1979 were available for discard mean weights.

For use in catch prediction the mean weights were adjusted by the percentages mentioned so that weights of landings and SOP weights were the same.

3.5 Fishing Mortality and Fishing Effort (VPA)

A constant value of M = 0.2 was assumed throughout. A reference level VPA was obtained by firstly using the same input F values for 1979 as were used at the 1979 meeting. The average F values for the period 1974-76 were then introduced iteratively until they stabilised; these F values were used as a reference set.

To determine how F values in 1979 might differ from those in the years 1974-76, data on fishing effort and cpue were analysed and an index of total international effort calculated, as described in Appendix I of last year's report (ICES, Doc. C.M.1979/G:7). Improved data were available, for varying time periods, from Belgium, England, France, Netherlands and Scotland for various gears, and these are shown in Table 3.4.

Two indices of relative international effort were calculated, one using English and Scottish data and another using all available data. These indicated that effort in 1979 was 22% and 11% higher, respectively, than the 1974-76 average, but neither set of data correlated significantly

with VPA weighted average F values, nor did they show any consistent trends. It was decided, therefore, that the effort data provided no justification to alter the reference level F values. The F value for age 1 was adjusted to produce the stock number of the 1978 year class as estimated from the IYHS.

The new VPA (Tables 3.5-3.7) suggests that F values increased in the early 1970s and have remained high. F values on age 1 are almost certainly underestimated, due to omission of discard data.

3.6 Spawning Stock Biomass

The age at first maturity was taken to be knife-edged at age 3, based on the work of Oosthuizen and Daan (1974), who showed that 48% of female cod are mature at age 3 in the southern North Sea. The present value is considered to be more realistic than the age of 4, as used in last year's report.

The trend in spawning biomass is shown in Figure 3.1.C. This indicates a decline from 1973, which is arrested in 1979 and 1980 due to the strong 1976 year class recruiting to the spawning biomass. The data of Oosthuizen and Daan are in the form of a maturity ogive, which will be used to replace knife-edge recruitment to the spawning stock as soon as computational facilities permit.

3.7 Yield per Recruit

Curves for yield per recruit and spawning stock biomass per recruit are shown in Figure 3.1.D. The data used (exploitation pattern, mean weight per age group, M = 0.2) are the same as those in the catch prediction input (Table 3.8). As previously explained, the exploitation pattern excludes discards, and it is expected that a revised data base which includes them would alter the exploitation pattern and mean weight data (and hence the yield per recruit curve) significantly.

3.8 Catch Predictions

The input data which relate to the 1979 landings but which exclude discards, are given in Table 3.8. Inclusion of discard data would modify the catch prediction but the extent to which this would happen cannot be predicted without a revision of the whole data base.

The detailed results of catch predictions are given in Table 3.9 and Figure 3.2. In Option A, it is assumed that the TAC for 1980 of 200 000 tonnes is adhered to and this implies a reduction of F in 1980 of 14% compared to 1979. A full range of relative F options is then shown for 1981, including the resulting spawning stock biomass values in 1982.

In Option B there is no reduction in F in 1980 or 1981, while in Option C there is a 10% reduction in 1980 and no further change in F in 1981. In Option D, a 10% reduction in F in 1980 is followed by a further 10% reduction in 1981.

The F values relating to the industrial fisheries were assumed to remain constant for all predictions over the period 1979-81, as it is not expected that setting cod TACs would affect the level of industrial fishing.

4. COD IN DIVISION VIa

4.1 Catch Trends (Table 4.1, Figure 4.1.A)

Provisional landings in 1979 of 16 078 tonnes were 19% above those in 1978 and well above the ACFM-recommended TAC of 9 200 tonnes (Division VIa only). Landings over the past 10 years have fluctuated between about 11 000 tonnes and 18 000 tonnes, but no marked trend is apparent.

4.2 Age Composition

Data for 1978 were updated and a provisional age composition for 1979 was prepared. Age compositions were provided by England, Ireland, and Scotland, the latter country's data being estimated from the January-June period. France provided quarterly length data which were converted to an age composition using Scottish age/length keys. Discard data were available for the first time from England (total weight) and Scotland (weight and age composition), relating to the years 1978 and 1979. However, the quantities are fairly small and, for the sake of consistency in the data set, were not included in the VPA input data.

4.3 Recruitment (Figure 4.1.B)

No indices of recruitment are available for this area and thus year classes 1978, 1979 and 1980 were assumed to be average. This was calculated at 6 872 x 10^3 at age 1, based on the years 1967-76 inclusive.

VPA data (Table 4.5) indicate that year classes 1974 and 1976 were particularly abundant.

4.4 Weight at Age

In the absence of any revised data, the same set of mean weights as was used last year was adopted. This gave an SOP value which was only 6% different from the reported landings. The mean weights were adjusted by the same percentage in the prediction programme, so that the SOP and weight landed were the same.

4.5 Fishing Mortality and Fishing Effort (VPA)

A reference set of fishing mortalities in 1979 which corresponded to the average for the period 1974-76 was obtained in the manner described in Section 3.5. Data on fishing effort and cpue, which were available from England, France and Scotland, were analysed as described in last year's report (Table 4.2). The data suggest an increase of about 20% in 1979, relative to the period 1974-76. However, the relative effort index does not correlate significantly with VPA F values and it was therefore decided not to adjust the 1979 F values. The results obtained from a similar analysis for Division VIa haddock, which is taken with cod in a mixed fishery, also suggest that F in 1979 should be equal to F for the period 1974-76.

The F value at age 1 in 1979 was adjusted to produce a population size corresponding to average recruitment. This was because the reference level F value for this age is influenced by a high value in 1976 and the resulting recruitment indicated in 1979 is correspondingly low.

Results of VPA are given in Tables 4.3-4.5.

4.6 Spawning Stock Biomass (Figure 4.1.C)

The age at first maturity was taken to be 3 years, the same age as used for the North Sea. Knife-edge recruitment to the spawning stock was assumed in the absence of a maturity ogive.

After a decline in spawning biomass from 1968 to 1970, it has subsequently remained at a fairly steady level. The increase in 1979 is associated with the recruitment to the spawning stock of the strong 1976 year class.

4.7 Yield per Recruit

Curves for yield per recruit and spawning stock biomass are shown in Figure 4.1.D. The data used (exploitation pattern, mean weight per age group, M = 0.2) were the same as those used in the catch prediction (Table 4.6).

4.8 Catch Predictions

The input data (landings, mean weights, F values per age group, for year 1979) are given in Table 4.6. The results of the catch prediction are given in Table 4.7. The predicted catch in 1980, assuming no change in fishing effort from 1979, is 14 800 tonnes, whereas the ACFM-recommended TAC is 10 900 tonnes (Division VIa only). Since the TAC in 1979 was greatly exceeded by the landings, it was considered unlikely that in 1980 it would be possible to reduce effort to the extent necessary to just take the TAC. The predictions for 1981 therefore assume that F in 1980 will be the same as in 1979.

Figure 4.2 shows the relationship between F in 1981 (relative to 1979) and predicted catch/spawning stock biomass. If F remains constant in 1981, the predicted catch is 12 600 tonnes. However, attention is drawn to the decline in spawning stock biomass over the period 1979 to 1982 if F remains constant, and under these circumstances the spawning stock biomass in 1982 would be expected to fall to 62% of the 1979 level.

5. COD IN DIVISION VIb (Table 5)

There were no age composition data for catches of cod taken in Division VIb and no analytical assessment was possible. If a TAC is set for the whole of Sub-area VI some additional allowance will need to be made for Division VIb. As reported catches from Division VIb are so low, there seems to be no point in attempting to assess data for this area separately.

6. COD IN SUB-AREA VII

6.1 Cod in Divisions VIId and VIIe

6.1.1 Catch trends

Table 6.1 gives landings since 1970. Mean value of landings during the last ten years is 5 150 tonnes with, however, 11 293 tonnes in 1978 which is apparently due to the abundant 1976 year class.

6.1.2 Age composition

French age compositions are available from 1974 for Division VIId only; they represent each year nearly 70% of the international catch.

In numbers, cod of ages 1, 2 and 3 are predominant and they represent 90% of the number of cod landed.

6.1.3 VPA

In using the French age composition raised to total catch in Division VIId a VPA was attempted (Table 6.3). A trial VPA was carried out using the same input F values as were used at the 1979 meeting for North Sea cod. The average values for the period 1974-76 were then computed and reintroduced iteratively as input F values until they stabilised. After four runs the results in Table 6.3 were obtained.

No data on fishing effort are available to enable a correction to the 1979 input F values. Similarly, no recruitment data are available.

However, the recruitment at age 1 in Table 6.3 shows the same variations as in the North Sea except for the year 1975. This is probably due to emigration of cod from the North Sea. This emigration is also probably connected with a hydrographical component. Migration between Divisions VIId and VIIe and the North Sea may significantly bias estimates of fishing mortality for Division VIId.

In view of the above, no analytical assessment was carried out.

6.2 Cod in Divisions VIIb, c and VII g-k (Table 6.2)

Landings since 1970 show a decline from about 5 600 tonnes in 1970-72 to nearly 3 000 tonnes in 1977-79.However, in 1976 and 1975 a peak was observed, probably associated with the 1974 year class.

The bulk of the catch is taken by France, about 75% calculated on the ten years' basis.

No data are available for an analytical assessment to be done.

7. NORTH SEA HADDOCK

7.1 Catch Trends

Total international landings and total international catch (including estimated discards and Norwegian industrial by-catch) are shown in Table 7.1. Figure 7.1.A shows the estimated total landings (discards excluded) for the period 1965-79.

7.2 Age Composition

The historical data set was extensively revised during the past year to take account of the following factors:

1) Amendments to Bulletin Statistique data and arithmetic errors,
2) Estimates of total international discards by the human consumption fishery,
3) Estimation of the age composition in the Danish industrial fishery for the period 1960-71.

A description of the methods involved in making this revision is given in Annex 1.

For 1978 Belgium, England, France, Netherlands and Scotland provided age composition data on human consumption landings. These accounted for 93% of the human consumption landings. Denmark and Norway provided age composition data on industrial by-catch, accounting for 100% of reported landings of the fishery. Netherlands and Scotland provided age composition data on discards which were raised to total discards for all nations.

For 1979 Belgium, England, France, Netherlands and Scotland provided data on human consumption landings accounting for 96% of this component of the fishery. Denmark, Norway and Scotland provided age composition data on industrial by-catch accounting for 100% of the reported landings. Scotland provided age composition data on discards which were raised to total discards for all nations.

7.3 Weight at Age

Mean weight at age in the human consumption, discard and industrial by-catch components of the fishery are shown in Table 7.7.

For 1978 the SOP for the human consumption fishery exceeded the reported landings by 8%, while that for the industrial by-catch exceeded the reported landings by 11%. The estimated total weight of haddock discarded was 57 000 tonnes.

For 1979 the SOP for the human consumption fishery exceeded the reported landings by 6%, while that for the industrial by-catch was 31% lower than the reported landings. The estimated total weight of haddock discarded was 36 000 tonnes.

Catch at age data for the industrial by-catch and human consumption landings were adjusted throughout the total data set to compensate for the SOP discrepancies.

7.4 Fishing Mortality and Fishing Effort (VPA) (Tables 7.3-7.5)

A value of M = 0.2 was assumed for all ages.

7.4.1 F at age in 1979: ages 2 to 10

The VPA was initiated using the same input F values as those used at the 1979 meeting. The average values of F at age for the period 1974 to 1976 were then computed and reintroduced iteratively as input F values for the next run.

Weighted mean F values for ages 1 and older for the period 1963-76 were then plotted against corresponding indices of total international fishing effort (see Table 7.2 for derivation of index of effort). No clearly defined relationship was discernible from this plot. However, the effort index indicated that the 1979 level of effort should be somewhat lower than that in the period 1974 to 1976. On this basis the values of F at ages 2 to 10 obtained by the iterative technique described above were reduced by 15% and used as input F values for the final VPA.

7.4.2 F at age in 1979: ages 0 and 1

F at age 1 was adjusted to produce the IYHS estimate of the 1978 year class at age 1 mentioned in Section 7.5. Similarly, F at age 0 was adjusted to produce a number of fish in the sea at age 0 in 1979 such that the number of survivors at age 1 at the start of 1980 is equal to the IYHS estimate of the 1979 year class in 1980.

7.5 Recruitment

Data on recruitment of North Sea haddock were available from the IYHS for 1979 and 1980 (Table 7.6, Figure 7.2). The estimated level of recruitment at age 1 in 1979 is 1 576 million, while that for 1980 is 2 232 million.

As stated in paragraph 7.4.2 F at ages 0 and 1 in 1979 was adjusted to agree with these data. The implied number of fish in the sea at age 0 in 1978 and 1979 are 2 203 million and 3 011 million respectively.

A value of 2 088 million fish at age 0 has been assumed for making prediction runs, this value being the average number of 0 groups from the VPA for the period 1960-76, excluding the very high values for the 1962 and 1967 year classes.

Figure 7.1.B shows the historical series of recruitment at age 1 from 1960-79.

It should be noted that the revision to the historical data sets resulted in greatly increased numbers of young fish being input to the VPA. This has had the effect of greatly increasing the absolute values of recruitment at age 1; relative values of recruitment are largely unchanged.

7.6 Spawning Stock Biomass

Historical spawning stock biomass levels (age groups 2 and older) are shown in Figure 7.1.C. Biomass was very high in 1969 when the very abundant 1967 year class recruited to the spawning stock. Spawning stock biomass levels fluctuated between 300 and 600 thousand tonnes in the period 1971 to 1977. Current spawning stock biomass level is 200 000 tonnes, which is only slightly in excess of the lowest levels on record,which occurred in 1962 and 1963.

7.7 Yield per Recruit

The yield and spawning stock (age groups 2 and older) biomass per recruit curves are shown in Figure 7.1.D. Current levels of F are far in excess of F_{max}.

7.8 Catch Predictions

Input data for the catch predictions are given in Table 7.7.

The TAC for 1979 (83 000 tonnes) was exceeded by about 5 000 tonnes. The estimated weight of haddock discarded in 1979 was about 36 000 tonnes.

The TAC for 1980 is 69 000 tonnes. Assuming that the industrial fishing effort will not change in 1980, the results of the current assessment imply that the human consumption fishery will have to reduce its fishing effort on haddock by more than 60% if the TAC is not to be exceeded. (It should be noted that, in the case of haddock, assumptions involving the level of F in the industrial fishery are relatively unimportant since that fishery does not currently account for a large proportion of the total haddock landings.)

The difference between current predictions of the 1980 catch and last year's prediction has arisen mainly as a result of including total international discards for the period 1960 to 1979 and revised estimates of Danish industrial age compositions for the period 1960 to 1971 in the assessment. These changes in the data set increased the estimates of catches of young fish so that estimates of absolute recruitment level have increased substantially. Three effects result from this change:

1) The average recruitment level used for prediction is increased;

2) The relationship between IYHS indices and VPA recruitment estimates has changed (but is still highly significant), and IYHS indices now give higher estimates of recruitment than would previously have been the case;

3) The F at age values estimated for 1979 are higher than those which the Working Group in 1979 assumed would be the case in 1980.

In addition to these changes, it appears that the 1978 and 1979 year classes are of above average abundance.

The net result of these factors is to predict substantially higher catches in 1980 than were predicted last year.

The Working Group noted, however, that F in 1979 is far in excess of F_{max} and suggested that some reduction in F might be brought about in 1980. The predicted landings for 1980 on the assumption that human consumption F in 1980 = 0.8 x human consumption F in 1979 and industrial F in 1980 equals industrial F in 1979 and is 130 000 tonnes (Table 7.8). Table 7.8 and Figure 7.3 show a

range of catch predictions for 1981 and associated spawning stock biomass predictions for 1982, based on the afore-mentioned contingency for 1980.

The Group would like to stress, however, that the changed predictions resulting from the changes in the data base have given rise to, hopefully temporary, doubts about the validity of the assessment. This should be borne in mind when deciding on TACs for 1981.

8. HADDOCK IN DIVISION VIa

8.1 Catch Trends

Landings of haddock from Division VIa are shown in Table 8.1 and Figure 8.1.A. Landings have declined from 19 000 tonnes in 1977 to about 14 000 tonnes in 1979.

8.2 Age Composition

The historical age composition data set for the period 1965 to 1977 was amended to take into account a number of arithmetical errors and also various amendments to landings data. The resultant data were very similar to those used in last year's report.

For 1978 and 1979 age composition data were submitted by England, Scotland and Ireland. France submitted length frequency data which were converted to age frequencies using Scottish age/length keys. The age composition data thus obtained accounted for 99% of total weight landed.

Scottish discard age composition data were available for 1978 and 1979. The estimated weights of haddock discarded by English vessels for the period 1972 to 1979 were also available. No attempt was made to include discard age frequencies in the input data set used for VPA, since this would make the data for 1978 and 1979 incompatible with those for earlier years.

8.3 Weight at Age

The weight at age data used in prediction of catch and biomass and also to estimate historical biomass data are shown in Table 8.7. These values are unchanged from those used last year.

The sum of products of numbers landed with mean weight at age differed from the reported landings by 2% for 1978 and 18% for 1979. The numbers were adjusted by the same percentage in the prediction program, so that the SOP and weight landed were the same.

8.4 Fishing Mortality and Fishing Effort (VPA) (Tables 8.2-8.4)

Natural mortality rate was assumed to be 0.2 for all ages.

8.4.1 Input F values for 1979 ages 3 and older

Trial VPA runs were initiated using the same set of input F values for 1979 as those used in the final VPA in last year's Working Group. Average values of F at age for the period 1974-76 were then calculated, smoothed slightly and were used to initiate the next run. This procedure converged to a constant result after three iterations. Weighted mean F values for ages 2 and older for the period 1965-76

were then regressed against an index of total international effort derivation of which is shown in Table 8.5 (computational details of this index are shown in the Appendix to last year's report.) The correlation coefficient for this data set is 0.65, which is significant at the 5% level. The regression line is shown in Figure 8.2. It can be seen from this figure that the weighted mean values of F for the period 1977-79 are in good agreement with data for earlier years. On this basis, the mean F at age values for the period 1974-76 were used as input for the final VPA for ages 3 to 8.

8.4.2 Input F values for 1974, ages 1 and 2

For ages 1 and 2, input F values in 1979 were adjusted to produce the recruitment values at age 1 of the 1977 and 1978 year classes mentioned in Section 8.5.

8.5 Recruitment

Estimates of Division VIa haddock recruitment at age 1 as from VPA are shown in Table 8.6 and Figure 8.1.B.

In recent years the 1974 year class was of above average abundance, while the 1975 and 1976 year classes were of below average abundance.

The abundance of the 1978 and 1979 year classes at age 1 was estimated using the relationship between North Sea and Division VIa recruitment values shown in Figure 8.3. The estimated recruitment values are 53.7×10^6 and 94.5×10^6 respectively.

The average recruitment at age 1 for the period 1965-77 (year classes 1964 to 1976) excluding the very abundant 1967 year class is 44.9×10^6.

8.6 Spawning Stock Biomass

Spawning stock biomass (age 2 and older) data are shown in Figure 8.1.C. Biomass was about 140 000 tonnes in the period 1969 to 1971, when the very abundant 1967 year class was present in the stock. Since then, biomass has declined to a level of about 53 000 tonnes.

8.7 Yield per Recruit

Yield and spawning stock biomass per recruit curves are shown in Figure 8.1.D. The yield per recruit curve has a maximum at a value of F = 0.6. The current estimate of F in 1979 is 0.5. It should be remembered, however, that no account of mortality due to discarding is included in this yield per recruit curve.

8.8 Catch Predictions

Input data for the catch predictions are shown in Table 8.7.

The recommended TAC for Division VIa for 1979 was exceeded by 56%. In the light of this result, the Group assumed that F in 1980 will be equal to F in 1979 (0.50). The predicted catch in 1980 is 13 100 tonnes (Table 8.8). This is considerably in excess of predictions made for 1980 at last year's meeting and is probably due to the revised estimate of the 1979 year class which has been assessed to be of above average abundance.

Figure 8.4 and Table 8.8 show catch predictions for 1981 and spawning stock biomass predictions for the start of 1982.

9. HADDOCK IN DIVISION VIb

Age composition data were available from England since 1975. It was considered that it would not be valid to raise these data to a total international age composition for years 1975 and 1976, since the English landings in these years formed only a small proportion of the total (Table 9.1). Because VPA results would not be reliable for the later years no such analysis was attempted. However, a VPA should be possible in the near future and this will require that sampling for length and age be continued, or started, by all countries which fish in this Division.

In the absence of an analytical assessment, an appropriate allowance for Division VIb in a TAC for Sub-area VI will have to be made based on past landings data.

10. HADDOCK IN SUB-AREA VII (excluding Divisions VIIa, VIIf and VIIg)

No biological data were available to the Group for this Sub-area, and it is suggested that TACs be set based on past landings data, which are given in Tables 10.1 and 10.2. It should be noted that Division VIIg is included in the latter table.

11. NORTH SEA WHITING

11.1 Trends in Landings

Total international landings in the period 1970-78 fluctuated between 109 000 tonnes and 190 000 tonnes, averaging 143 000 tonnes (Table 11.1, Figure 11.1.A). Provisional landing figures in 1979 amounted to 133 000 tonnes, which are 22 000 tonnes above the TAC agreed between EEC and Norway, and represent an increase of 30 000 tonnes compared with 1978.

11.2 Age Composition

The historical data set was revised to take account of the following factors:

1) Amendments to Bulletin Statistique data and arithmetical errors;
2) Estimation of total international discards by the human consumption fishery (see Annex 1).

The age compositions for landings in 1978 were updated and the 1979 input catch at age data for VPA are given in Table 11.3. Age compositions of human consumption fisheries, industrial trawl landings and discards are presented in Table 11.7. The catch in numbers was nearly 45% above the 1978 level, due mainly to the increased contribution from 1 and 2 group fish.

For the human consumption fisheries in 1979 data on age compositions were available from Belgium, England, France, Netherlands and Scotland, accounting for 98% of the landings.

Age compositions for industrial trawl landings were provided by Denmark, Norway and Scotland accounting for all reported landings. Discard estimates including numbers per age group and mean weight at age were submitted by Scotland and total weight of discards by England. Assuming that Dutch discards were as estimated in 1978 (which were estimated from observations made in 1977), and using the weight at age data from last year, reported discards were raised to total discards for all countries.

11.3 Recruitment (Table 11.6 and Figure 11.1.B)

VPA recruitment figures correlated with recruitment indices derived from the IYHS for the years 1964-76 indicate that the year classes 1977, 1978, and 1979 at 1 year of age were 2 047 x 10^6, 1 932 x 10^6 and 2 408 x 10^6, respectively (Table 11.6). These values are close to the mean of 2 213 x 10^6 for the period 1959-76.

11.4 Weight at Age

The weight at age data for the human consumption fisheries, the industrial trawl landings and the discards are presented in Table 11.7. The weight at age data for the human consumption fishery were those used last year adjusted by an SOP discrepancy of 4%. The data for industrial landings were based on observations provided by Denmark and Norway. Discard weight at age data were the same as last year.

11.5 Fishing Mortality and Fishing Effort (VPA) (Tables 11.3 - 11.5)

A value of M = 0.2 was assumed for all age groups. A trial VPA was carried out using the same input F values as were used at the 1979 meeting. The average values for the period 1974-76 were then computed and reintroduced iteratively as input F values.

Relative fishing effort values were computed using the method described in Appendix 1 of the 1979 report. These values are shown in Table 11.2. The effort in 1979 appears to be only half of that in the reference period 1974-76. However, the figures of Table 11.2 are based on total landings whereas the effort data only refer to landings for human consumption. Further, landings for human consumption do not show the trend which is expected from the effort data. The Working Group, therefore, found it difficult to interpret the effort data, in terms of trend in fishing mortalities.

In order to make a proper analysis of the relationship between effort and fishing mortalities, estimates of effort in industrial fisheries must be taken into account, and relative effort calculation must be based on total catches (discards and consumption landings and industrial landings).

It was decided to assume the fishing mortalities for 1979 for the older age groups to be of the same magnitude as those for the period 1974-79. F values for 0 and 1 group were adjusted to produce the recruitment values at age 1 predicted from the regression of IYHS indices on VPA results.

11.6 Spawning Stock Biomass

Knife-edge recruitment at age 2 to the spawning stock was assumed in the absence of a suitable maturity ogive. After a decline from 1974 to 1977, the spawning stock biomass slowly increased in the following years to a level of 300 000 tonnes in 1979. The mean level over the period 1974-79 is about 50 000 tonnes higher than reported in the 1979 Working Group report (Figure 11.1.C) due to the revision of data on discards and industrial landings (see Annex 1).

11.7 Yield per Recruit

Curves for yield per recruit and spawning stock biomass per recruit are shown in Figure 11.2 based on the exploitation pattern in 1979.

As discards are estimated to constitute about 70% of the total catch in 1979, the yield per recruit curve should be treated with some

reservation, even if it is considered that the yield per recruit approach is a useful method.

11.8 Catch Predictions

Input data for catch predictions are given in Table 11.7.

The present assessment indicates that to take the TAC for 1980 (105 000 tonnes) would require an effort reduction of about 45% in 1980 compared to that of 1979.

The Working Group considered such a reduction in effort to be unlikely. It was decided to assume a reduction by only 20% from the 1979 level for effort in 1980. The discrepancy between the results of this year's report and last year's report is caused by the revision of VPA input as explained in Annex 1. In all prediction runs fishing mortalities caused by the industrial fisheries were assumed to remain constant and equal to those estimated for 1979, as TACs are not expected to be effective as a regulating factor for the industrial by-catches.

Predicted catches in consumption fisheries and industrial fisheries in 1981 are given in Table 11.8 for a range of F_{81}/F_{79} values (for consumption fisheries), together with estimates of spawning stock biomasses at the beginning of 1982. Figure 11.3 presents a graphical version of the predictions for 1981.

The Group would like to stress, however, that the changed predictions resulting from the changes in the data base have given rise to, hopefully temporary, doubts about the validity of the assessment. This should be borne in mind when deciding on TACs for 1981.

12. WHITING IN DIVISION VIa

12.1 Catch Trends (Table 12.1, Figure 12.1.A)

The downward trend in the catch apparent since 1976 showed a check in 1979, rising from 14 677 to 16 379 tonnes due to recruitment of the better than average 1977 year classes. This was mainly due to increases in the Scottish and Irish catches, whilst the French catch with a lower proportion of the younger age groups declined to 2 640 tonnes from its uniformly high level of 3 400 - 3 700 tonnes over 1976-78. Whilst a catch was estimated by the 1979 Working Group for Spain for 1978, no Spanish landings have subsequently been reported for 1978 or 1979.

12.2 Age Composition

Age composition data for 1978 and 1979 were available for Scotland, France and Ireland. Industrial fish landings in this area are very low and neither they nor discards were used in the assessment.

12.3 Recruitment

The year class strength in Division VIa during 1964 to 1977 is highly significantly correlated with that in the North Sea (Table 12.3 and Figure 12.2). Based on this, year class strengths for the 1978 and 1979 year classes were calculated at 81.5 and 110.9 million fish respectively at the beginning of the year in age group 1. For the 1980 year class the mean value for 1964-77 of 96 million fish was adopted.

12.4 Weight at Age

The values used by the 1979 Working Group were maintained unchanged, numbers being adjusted to obtain sum of products equal to reported landings; this involved use of factors of 1.09 and 1.19 for data of 1978 and 1979, respectively.

12.5 Fishing Mortality and Fishing Effort (VPA)

The F values adopted were based on the mean for years 1974-76 in the absence of the correlation between relative fishing effort (Table 12.4) and fishing mortality. In general, mean F values for fully recruited year classes have been in decline since 1972-73.

Catch input data for VPA are given in Table 12.5 and calculated estimates of fishing mortality and stock size in Tables 12.6 and 12.7.

12.6 Yield per Recruit

The yield and spawning stock biomass per recruit curves evaluated on the basis of the present exploitation pattern (in 1979) are given in Figure 12.1.D. Spawning stock biomass is estimated for 2 year old and older fish.

12.7 Catch Predictions

Input data for catch predictions are given in Table 12.8, and the results in Table 12.9 and Figure 12.3.

A reduction of F values for 1980 to 55% of those for 1979 would be required to take the TAC recommended in 1979 (10 500 tonnes). The recommended TAC for 1979 was exceeded by 37%. In the light of this the Group assumed that F in 1980 will be equal to F in 1979 (1.2).

The predicted catch in 1980 is 16 400 tonnes. This is considerably in excess of predictions made for 1980 at last year's meeting, when appreciably lower values of fishing mortality were assumed.

12.8 Whiting in Division VIb

There are no significant landings of whiting from Division VIb. Therefore a TAC calculated for Division VIa would be applicable to the whole of Sub-area VI.

13. WHITING IN SUB-AREA VII

13.1 Whiting in Divisions VIId and VIIe

Landings of whiting follow fluctuations similar to those in the North Sea. After declining from a peak of 11 400 tonnes in 1975 to 9 148 tonnes in 1978, they rose to 10 665 tonnes in 1979 (Table 13.1). France has for some years taken in the region of 85% of the landings and England nearly all of the rest, but in 1979 Denmark took 2 572 tonnes (24.1%) compared to 7 374 tonnes (69%) for France and 930 tonnes (9%) for England. Existing data collected by England and France do not yet permit the use of VPA techniques, but it is hoped that this will become possible in several years.

13.2 Whiting in Divisions VIIb,c and VIIg-k

Fluctuations in landings of whiting have followed those in Division VIa closely since about 1974, decreasing,however, more sharply since 1976 when they peaked at 9 715 tonnes, though they recovered more markedly between 1978 and 1979, when they rose from 5 204 tonnes to 6 701 tonnes (Table 13.2). From 1977 onwards, France (with 60-75%) and Ireland (with 20-40%) have together accounted for over 95% of the landings reported. Irish age at length data collected in recent years are not yet sufficient to permit application of VPA techniques to the material.

Table 3.1 Nominal catch (in tonnes) of COl n Sub-area IV, 1970-1979 (Data for 70-78 as officially reported to ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
Belgium	8 076	19 334	21 133	11 741	10 253	7 566	7 483	10 346	17 473	12 370
Denmark	40 017	68 179	72 520	47 950	54 207	46 344	53 277	42 582	41 858	47 773
Faroe Islands	78	123	284	803	416	732	448	260	56	78
France	16 058	24 769	24 038	13 247	7 275	8 667	8 079	7 511	11 944	11 742
German Dem. Rep.[a]	3	18	122	343	132	223	69	21	75	27
Germany, Fed.Rep.of	20 093[b]	46 647	49 431	21 410	17 089	16 457	24 445	22 663	37 040	20 454
Iceland	+	1	-	-	+	-	-	-	-	-
Ireland	-	-	-	-	-	-	98	136	174	-
Netherlands	25 212	46 614	47 634	25 758	24 029	23 263	21 835	29 903	48 817	34 027
Norway[c]	5 374	7 732	4 377	4 831	2 481	1 528	1 877	1 449	2 747	3 277
Poland	219	178	189	1 551	4 750	2 991	2 961	381	115	142
Spain	-	-	91	90	80	63	14	-	-	-
Sweden	2 946	3 060	2 887	2 534	2 071	900	597	36	...[e]	299
UK (England & Wales)	38 464	55 525	62 503	47 327	39 857	33 615	46 475	35 424	59 127	54 896
UK (Scotland)	30 079	37 229	55 190	48 844	39 887	37 308	39 597	34 406	41 984	42 833
USSR	32 147	5 153	774	2 497	2 667	6 796	6 187	-	17	12
Total IV	218 766	314 562	341 173	228 926	205 194	186 453	213 442	185 118	261 427	227 930
Total IVa	73 627	61 368	74 768	64 017	66 309	58 343	68 352	55 623	43 357	
Total IVb	110 271	184 957	215 160	134 953	114 087	107 227	126 218	100 191	164 388	
Total IVc	34 868	68 237	51 245	29 956	24 798	20 883	18 872	29 304	53 682	
W.G. Total Catch[d]					206 456	189 151	214 926	186 133	272 787	267 736

*) Prov. figs. a) 1970-72 incl. IIIa b) Incl. misc. products c) Figs. from Norway do not incl. Cod caught in Rec.2 fisheries d) Incl. discards e) Incl. in IIIa

Table 3.2 Estimates of numbers of COD discarded in North Sea fisheries (Age groups 0-2)

Year	Countries Reporting	Number x 10^{-3} Discarded	Number x 10^{-3} Landed[1]
1974	E N	810	72 780
1975	E N	8 685	86 030
1976	E N	2 282	104 023
1977	E N	26 784	131 400
1978	E N S	18 828	193 555
1979	E N S	79 797	141 389

1) Human consumption and industrial fisheries
E) England
N) Netherlands
S) Scotland

Table 3.3 North Sea COD. Estimates of Year class strength at 1-year-old

Year Class	IYHS Index[1]	VPA Number x 10^{-6}
1962	-	104
1963	-	234
1964	16.0	222
1965	20.2	314
1966	28.5	283
1967	5.4	92
1968	6.5	86
1969	71.5	366
1970	85.0	469
1971	4.1	81
1972	37.7	162
1973	14.6	134
1974	95.7	234
1975	8.8	111
1976	40.3	414 (average 1963-76 = 207)
1977	14.4	173*)
1978	9.8	160*)
1979	26.4	208*)

1) Unadjusted arithmetic mean number per hour per statistical rectangle

Year classes 1964-76: VPA = IYHS x 2.889 + 131.8
r = 0.688 P = 0.01

*) Predicted from regression

Table 3.4 Catch and Effort Data in sel ted NORTH SEA COD fisheries

Year	SCOTLAND									BELGIUM					
	Motor Trawl			Seine			Light Trawl			Ottertrawl			Danish Seine		
	C	E	CPUE	C	E	CPUE	C	E	CPUE	C	E	CPUE	C	E	CPUE
1970	8 558	133	6 435	17 814	427	4 172	2 482	69	3 597						
1971	8 648	175	4 942	21 848	416	5 252	4 145	105	3 947	13 979	317	4 413			
1972	14 377	201	7 153	31 490	393	8 013	6 700	121	5 537	15 630	344	4 538			
1973	12 557	183	6 862	27 835	415	6 707	7 226	152	4 754	7 706	303	2 544	909	9.9	9 220
1974	10 747	182	5 905	21 263	356	5 973	5 089	118	4 313	2 984	174	1 718	4 027	38.3	10 560
1975	7 739	151	5 125	22 036	342	6 444	5 764	161	3 580	2 307	163	1 419	2 338	17.8	13 130
1976	6 353	122	5 207	23 774	308	7 719	5 096	153	3 331	1 823	142	1 293	3 274	18.6	17 650
1977	3 820	90	4 244	18 971	312	6 080	6 628	224	2 959	3 660	155	2 357	2 554	21.2	12 070
1978	4 369	135	3 236	24 122	325	7 422	10 117	239	4 233	5 784	163	3 540	3 546	17.4	20 330
1979	3 464	87	3 982	21 679	316	6 861	11 702	287	4 077	4 778	148	3 220	4 165	22.9	18 192

Year	ENGLAND AND WALES									FRANCE	
	Motor Trawl			Seine			Pair Trawl				
	C	E[1]	CPUE[2]	C	E[1]	CPUE[2]	C	E[1]	CPUE[2]	C	E[3]
1970	19 578	4 069	4 812	13 932	656	21 238	2 692	65	41 428		
1971	31 313	3 946	7 935	16 960	695	24 402	4 634	100	46 340		
1972	33 810	4 372	7 733	21 661	792	27 350	4 169	118	35 229		
1973	24 038	3 789	6 344	16 349	833	19 626	3 329	92	36 183		
1974	21 020	3 500	6 005	12 284	758	16 206	3 700	112	33 032		
1975	17 372	2 629	6 608	9 340	771	12 114	5 051	180	28 060		
1976	20 263	3 107	6 522	15 930	824	19 333	8 069	271	29 774	4 718	90 667
1977	15 290	3 110	4 917	10 216	804	12 706	7 727	678	11 396	4 554	83 576
1978	24 364	3 192	7 633	18 427	854	21 578	12 335	270	45 680	8 796	96 982
1979	22 666	2 986	7 591	16 588	767	21 627	11 905	336	35 432	7 623	141 167

C) Catch in tonnes, live weight

E) Effort in thousand hours fishing

CPUE) Catch in kg per 100 hours fishing

1) Effort in 10^5 t hours

2) CPUE in 10^{-4} kg per t hour

3) Index for fishing effort calculated from catch and CPUE investigations in different areas.

... cont'd

Table 3.4. cont'd

	Netherlands								
	Beamtrawl			Trawl			Pairtrawl		
	C	E	CPUE	C	E	CPUE	C	E	CPUE
1970	6 428	721	892	12 964	185	7 014	5 401	28.6	18 887
1971	16 110	824	1 954	22 832	177	12 891	6 950	36.5	19 046
1972	13 117	829	1 583	26 702	187	14 244	7 502	30.9	24 286
1973	10 482	942	1 113	11 116	167	6 656	4 000	23.4	17 115
1974	9 890	895	1 105	9 696	185	5 238	4 352	31.1	13 988
1975	10 981	880	1 248	9 904	164	6 036	2 204	24.4	9 036
1976	7 380	769	960	10 708	134	7 965	3 933	23.6	16 638
1977	11 051	698	1 582	15 010	129	11 627	3 988	15.3	26 006
1978	13 067	595	2 195	27 674	166	16 661	7 984	27.2	29 399
1979	10 457	639	1 636	16 465	146	11 312	7 354	29.1	25 289

RELATIVE FISHING EFFORT NORTH SEA COD

	Tot. Int. Catch	Weighted RCPUE 1)	Weighted RCPUE 2)	Relative Eff. 1)	Relative Eff. 2)
1963	105 921	.62		.65	
1964	121 550	.63		.74	
1965	179 469	.74		.93	
1966	220 033	.89		.95	
1967	249 803	1.01		.95	
1968	285 314	1.16		.94	
1969	199 258	.96		.79	
1970	224 745	.88		.98	
1971	320 564	.93		1.32	
1972	347 055	1.24		1.07	
1973	234 466	1.06	.92	.85	.97
1974	211 291	.95	.80	.85	1.01
1975	186 453	.89	.77	.80	.93
1976	213 442	.95	.84	.86	.97
1977	185 118	.68	.69	1.04	1.03
1978	261 427	1	1	1	1
1979	252 355	.95	.89	1.02	1.08

1) Based on Scottish and English Data

2) Based on all countries

Table 3.5 North Sea COD. Input catch data for VPA.

AGE	1968	1969	1970	1971	1972	1973
0	0	0	0	0	0	0
1	9941	5109	47304	61347	6317	33809
2	79589	23009	27373	149128	195922	30551
3	36676	31590	16392	14385	43709	52648
4	11078	14959	12179	5952	5095	13163
5	5623	5190	6867	6028	2406	1905
6	1275	2842	1963	2394	2802	1038
7	623	688	1051	760	1449	988
8	314	379	207	394	545	486
9	154	170	221	182	339	38
10	103	54	136	82	102	41
11	21	110	46	53	5	64
12+	9	17	24	26	11	73

AGE	1974	1975	1976	1977	1978	1979
0	254	274	174	112	0	0
1	16165	35643	6581	79909	31039	42466
2	56361	50113	97268	51379	162516	98923
3	10846	17579	19345	22560	14241	39396
4	14529	4217	6469	4170	7934	3465
5	4131	6272	1415	1748	2618	2777
6	832	1608	2257	595	842	657
7	430	330	730	811	343	336
8	357	155	96	273	320	102
9	279	170	54	187	116	110
10	66	65	54	23	33	31
11	25	34	14	8	15	2
12+	26	8	14	58	19	13

Table 3.6 North Sea COD.
Fishing mortalities from VPA (M = 0.2).

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976
0	.000	.000	.000	.000	.000	.000	.001	.002	.000
1	.127	.068	.153	.156	.090	.260	.142	.184	.068
2	.697	.477	.610	.992	1.041	.797	.909	.849	1.086
3	.662	.670	.753	.772	.935	.923	.752	.832	.991
4	.639	.630	.598	.691	.701	.844	.719	.761	.875
5	.608	.715	.677	.681	.677	.625	.713	.809	.632
6	.497	.724	.660	.533	.805	.713	.621	.682	.792
7	.422	.551	.654	.585	.730	.761	.746	.541	.779
8	.463	.493	.316	.551	1.169	.583	.700	.671	.296
9	.591	.493	.604	.507	1.436	.213	.805	.887	.524
10	.463	.425	.963	.472	.600	.653	.694	.437	.809
11	.594	1.413	.793	1.450	.046	.986	1.140	.985	.156
12	.550	.550	.660	.660	.660	.660	.660	.660	.700
MEAN F FOR AGES >= 2 AND <= 8 (WEIGHTED BY STOCK IN NUMBERS)									
	.673	.598	.647	.934	1.004	.859	.838	.831	1.042

AGE	1977	1978	1979
0	.000	.000	.000
1	.238	.148	.340
2	1.066	1.079	.950
3	.817	1.035	.860
4	.596	.783	.780
5	.623	.969	.710
6	.603	.709	.700
7	.757	.868	.700
8	.775	.787	.700
9	1.621	.931	.700
10	.445	2.037	.700
11	.258	.589	.700
12	.700	.700	.700
MEAN F FOR AGES >= 2 AND <= 8 (WEIGHTED BY STOCK IN NUMBERS)			
	.937	1.056	.913

Table 3.7 North Sea COD.
Stock size in numbers from VPA.

AGE	1968	1969	1970	1971	1972	1973
0	104577	447552	572511	98861	198475	163940
1	92066	85620	366424	463732	80941	162498
2	173032	66416	65490	257380	328492	60571
3	82710	70591	33755	29140	78175	94939
4	25621	34946	29572	13011	11027	25119
5	13490	11074	15238	13318	5337	4478
6	3565	6016	4433	6341	5519	2220
7	1984	1777	2389	1876	3048	2021
8	927	1065	839	1017	856	1202
9	377	478	533	501	480	218
10	304	171	239	238	247	93
11	51	157	91	75	122	111
12	12	23	31	34	14	95

AGE	1974	1975	1976	1977	1978	1979
0	285644	135938	505681	303268	197432	0
1	134222	233636	111049	413860	248194	161643
2	102633	95324	159186	84981	266941	175235
3	22352	33867	33402	44002	23962	74299
4	30883	8623	12064	10152	15918	6969
5	8839	12315	3298	4116	4582	5957
6	1963	3548	4492	1435	1807	1423
7	891	864	1469	1665	643	728
8	773	346	412	552	640	221
9	550	314	145	251	208	238
10	144	201	106	70	41	67
11	40	59	106	39	37	4
12	34	10	18	75	24	17

Table 3.8 NORTH SEA COD. 1979 Input data for catch prediction

Age	Consumption Landings			Discards			Industrial Landings			Total		
	Catch No (000)	$\bar{w}$ (kg)	F	Catch No (000)	$\bar{w}$ (kg)	F	Catch No (000)	$\bar{w}$ (kg)	F	Catch No (000)	$\bar{w}$ (kg)	F
1	41 505	.533	.332				961	.208	.008	42 466	0.526	.34
2	94 951	.984	.912				3 972	.494	.038	98 923	0.964	.95
3	39 184	2.306	.855				212	1.604	.005	39 396	2.302	.86
4	3 456	4.158	.778				9.3	3.084	.002	3 465.3	4.155	.78
5	2 776	6.409	.710	No data			0.8	6.419	.000	2 776.8	6 409	.71
6	657	8.229	.700							657	8.229	.70
7	336	9.810	.700							336	9.810	.70
8	102	10.399	.700							102	10.399	.70
9	109	12.067	.700							109	12.067	.70
10	31	12.877	.700							31	12.877	.70
11	2	14.398	.700							2	14.398	.70
12+	13	14.802	.700							13	14.802	.70

Year	1979	1980	1981
Recruits at age 1 (000)	160 000	208 000	207 000

Table 3.9 NORTH SEA COD. Results of Catch Predictions (1 000 tonnes)

		Option A	Option B	Option C	Option D
1979	SSB	263.5	263.5	263.5	263.5
	TB	517.5	517.5	517.5	517.5
	F	0.95	0.95	0.95	0.95
	Yw	252.1	249.8	249.8	249.8
1980	SSB	282.9	282.9	282.9	282.9
	TB	481.7	481.7	481.7	481.7
	F	0.82	0.95	0.86	.86
	Yw	200.4	222.5	206.9	206.9
1981	SSB	261.8	232.8	253.2	253.2
	TB	493.1	458.6	482.8	482.8
	F		0.95	0.86	0.77
	Yw		209.8	206.7	191.7

F_{81}/F_{79} (Consumption)	Yw 1981				1982	
	Industrial	Consumption	Discards	Total	SSB	TB
0.1	2.7	30.7	-	33.4	508.8	774.4
.2	2.6	59.1	-	61.7	467.9	728.5
.5	2.3	133.0	-	135.3	364.2	610.4
1.0	1.9	225.4	-	227.4	240.2	465.3
1.5	1.6	290.4	-	292.0	158.7	366.0
2.0	1.4	336.6	-	338.0	105.0	297.2

SSB = Spawning Stock Biomass (ages 3+)
TB = Total Stock Biomass
F = Fishing mortality on age-group subject to maximum exploitation
Yw = Yield in weight

Table 4.1. Nominal catch (in tonnes) of COD in Division VIa, 1970-79
(Data for 1970-78 as officially reported to ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979[*)]
Belgium	61	41	39	75	174	49	71	-	-	4
Denmark	-	-	-	-	-	7	-	-	-	-
Faroe Islands	-	-	-	7	13	3	39	43	-	-
France	1 161	1 054	2 360	3 445	3 678	3 546	5 611	3 583	4 499	4 436
German Dem.Rep.	-	-	-	-	-	2	-	-	-	-
Germany, Fed.Rep.of	136[b)]	46	3	15	6	12	1	3	31	63[a,c)]
Iceland	-	+	-	-	-	-	-	-	-	-
Ireland	1 135	888	686	583	883	1 141	1 341	984	1 214	2 237
Netherlands	5	10	21	4	5	5	11	5	3	24
Norway	-	-	-	13	14	17	22	29	40	35
Poland	199	154	491	184	175	68	18	-	-	-
Spain	-	-	102	208	137	180	15	20[a)]	108[a)]	-
UK (England + Wales)	2 602	2 414	3 371	2 074	2 467	2 217	2 742	2 434	2 082	2 348
UK (Scotland)	7 382	5 732	7 018	5 645	6 084	5 806	7 475	5 513	5 539	6 929
UK (N. Ireland)	1	2	2	3	3	3	13	5	5	2
USSR	-	325	606	7	13	107	46	-	-	-
Total VIa	12 682	10 666	14 699	12 263	13 652	13 163	17 405	12 619	13 521	16 078
Working Group total catch[c)]									14 247	16 110

*) Preliminary

a) Includes VIb

b) Including miscellaneous products

c) Includes discards.

Table 4.2. COD in Division VIa.
Catch and effort data.

Year	Scotland											
	Motor trawl			Seine			Light trawl			Nephrops trawl		
	Catch (1)	Effort hours x 10^{-3}	c/f	Catch (1)	Effort hours x 10^{-3}	c/f	Catch (1)	Effort hours x 10^{-3}	c/f	Catch (1)	Effort hours x 10^{-3}	c/f
1970	2 050	41	50.000	1 820	96	18.958	1 517	115	13.191	-	-	-
1971	1 576	42	37.523	1 073	99	10.838	1 364	129	10.574	970	128	7.578
1972	1 695	56	30.268	1 027	71	14.465	2 149	142	15.134	926	185	5.005
1973	1 251	55	22.745	934	59	15.831	1 481	91	16.275	689	215	3.205
1974	1 843	56	32.911	718	57	12.596	1 519	86	17.663	903	150	6.020
1975	1 232	37	33.297	809	56	14.446	1 879	129	14.566	848	202	4.198
1976	1 607	35	45.914	885	57	15.526	2 357	139	16.957	1 105	225	4.911
1977	528	22	24.000	565	42	13.452	2 261	143	15.811	906	196	4.622
1978	1 535	52	29.519	643	34	18.911	1 624	127	12.787	662	219	3.023
1979	978	33	29.636	888	38	23.368	1 867	100	18.670	878	274	3.204

Year	France			England & Wales		
	Trawl			Motor trawl		
	Catch (1)	Effort (2)	c/f	Catch (1)	Effort "tonnes x 10^{-4} hours"	c/f
1970	-	-	-	2 167	1 249	1.735
1971	1 449	47 800	0.030	2 010	805	2.497
1972	1 458	51 912	0.028	2 405	1 225	1.963
1973	1 479	53 363	0.028	1 680	1 080	1.556
1974	1 525	57 411	0.026	1 945	1 032	1.885
1975	2 179	57 159	0.038	1 821	1 068	1.705
1976	3 425	70 500	0.049	2 775	1 259	1.807
1977	1 748	59 886	0.029	1 932	1 823	1.060
1978	2 300	65 137	0.035	1 648	1 613	1.022
1979	2 259	58 374	0.039	871	698	1.248

Year	International catch Whole weight	Weighted mean Icpue Relative	Relative effort
1970	12 682	1.395	0.669
1971	10 666	1.461	0.537
1972	14 699	1.282	0.844
1973	12 263	1.078	0.837
1974	13 652	1.319	0.761
1975	13 163	1.224	0.791
1976	17 405	1.468	0.872
1977	12 619	1.066	0.871
1978	13 592	1.000	1.000
1979*)	16 110	1.203	0.985

(1) = Gutted weight

(2) = $f = \frac{\Sigma H.P \times \Sigma \text{ Fishing days}}{100}$

*) = Preliminary

Table 4.3 COD in Division VIa.
Input catch data for VPA.

AGE	1968	1969	1970	1971	1972	1973
1	222	84	92	335	220	153
2	859	986	272	884	2264	504
3	1862	970	944	523	1068	1271
4	1296	1519	457	709	483	518
5	112	624	356	220	405	145
6	121	104	133	185	91	161
7	72	84	24	68	72	42
8+	18	53	39	36	47	47

AGE	1974	1975	1976	1977	1978	1979
1	727	1260	1988	1179	680	491
2	1841	2043	4753	1183	1792	1441
3	752	1217	1362	1497	1035	2091
4	874	506	585	590	728	696
5	235	269	255	245	289	350
6	53	60	185	81	96	144
7	52	11	58	49	49	27
8+	22	19	18	13	30	37

Table 4.4 COD in Division VIa.
Fishing mortalities from VPA (M = 0.2).

AGE	1968	1969	1970	1971	1972	1973	1974	1975	1976
1	.040	.032	.020	.043	.057	.025	.100	.111	.316
2	.280	.248	.139	.272	.449	.179	.461	.443	.767
3	.481	.587	.398	.428	.614	.491	.438	.638	.604
4	.730	.943	.615	.593	.912	.696	.757	.599	.740
5	.384	.994	.600	.691	.828	.792	.813	.556	.702
6	.537	.751	.590	.734	.699	.978	.776	.499	.970
7	.665	.913	.382	.696	.724	.843	1.061	.355	1.402
8	.700	.700	.700	.700	.700	.700	.700	.700	.700
MEAN F FOR AGES >= 2 AND <= 6 (WEIGHTED BY STOCK IN NUMBERS)									
	.472	.566	.382	.416	.553	.421	.527	.517	.731

AGE	1977	1978	1979
1	.118	.152	.080
2	.315	.264	.550
3	.589	.501	.560
4	.577	.646	.760
5	.820	.629	.760
6	.505	.934	.760
7	.758	.661	.760
8	.700	.700	.760
MEAN F FOR AGES >= 2 AND <= 6 (WEIGHTED BY STOCK IN NUMBERS)			
	.472	.385	.599

Table 4.5 COD in Division VIa.
Stock size in numbers from VPA.

AGE	1968	1969	1970	1971	1972	1973
1	6266	2912	5080	8743	4383	6835
2	3859	4930	2308	4076	6855	3390
3	5340	2387	3149	1645	2543	3583
4	2727	2704	1087	1731	878	1127
5	385	1076	862	481	783	289
6	319	215	326	388	197	280
7	162	153	83	148	152	80
8	23	68	50	46	60	60

AGE	1974	1975	1976	1977	1978	1979
1	8432	13195	8053	11655	5297	7037
2	5458	6248	9667	4807	8480	3724
3	2321	2818	3283	3675	2873	5331
4	1794	1226	1220	1470	1670	1425
5	460	689	551	477	676	716
6	107	167	324	224	172	295
7	86	40	83	101	111	55
8	28	24	23	17	39	47

Table 4.6. COD in Division VIa.
1979 input data for catch prediction.

Age	Consumption landings			Discards			Industrial landings			Total		
	Catch ('000)	$\bar{w}$ (kg)	F	Catch ('000)	$\bar{w}$ (kg)	F	Catch ('000)	$\bar{w}$ (kg)	F	Catch ('000)	$\bar{w}$ (kg)	F
1	491	.606	.08	NO DATA			NO LANDINGS			491	.606	.08
2	1 441	1.372	.55							1 441	1.372	.55
3	2 091	2.988	.56							2 091	2.988	.56
4	696	5.052	.76							696	5.052	.76
5	350	6.573	.76							350	6.573	.76
6	144	7.966	.76							144	7.966	.76
7	27	8.807	.76							27	8.807	.76
8+	37	9.664	.76							37	9.664	.76

Year	1979	1980	1981
Recruits at age 1 ('000)	6 872	6 872	6 872

Table 4.7. COD in Division VIa.
Results of catch predictions ('000 tonnes).

1979	SSB	31.4
	TB	40.8
	F	.76
	Yw	16.1
1980	SSB	25.1
	TB	36.4
	F	0.76
	Yw	14.8
1981	SSB	20.9
	TB	32.2

F_{81}/F_{79}	Yw in 1981				1982	
	Industrial	Consumption	Discards	Total	SSB	TB
0.01	-	0.2	-	0.2	36.1	43.8
.2	-	3.2	-	3.2	32.0	39.6
.5	-	7.3	-	7.3	26.5	32.2
1.0	-	12.6	-	12.6	19.4	26.5
1.5	-	16.5	-	16.5	14.3	21.1
2.0	-	19.4	-	19.4	10.5	17.1

NOTES: SSB = Spawning stock biomass (ages 3+)
TB = Total stock biomass
F = Fishing mortality on age group subject to maximum exploitation
Yw = Yield in weight.

Table 5 Nominal catch (in tonnes) of COD in Division VIb, 1970 - 1979
(Data for 1970 - 1978 as officially reported to ICES).

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
Belgium	-	-	-	-	-	1	-	-	-	-
Faroe Islands					5	3	22	40	10	92
France	745	-	1 659	320	1 128	4	4	3	1	1
Germany,Fed.Rep.of					-	-	-	-	-	...
Ireland									3	-
Norway	-	-	-	-	3	-	8	3	69	108
Poland	-	-	-	8	-	-	-	-	-	
Spain	-	-	-	-	-	-	-	... a)	... a)	
U.K. (Engl.+Wales)	28	37	32	1	-	28	77	89	285	129
U.K. (Scotland)	102	57	175	128	39	98	61	33	384	198
U.S.S.R.	-	-	701	26	-	110	1 398	-	-	-
Total VIb	875	94	2 567	483	1 175	243	1 571	168	752	528

*) Preliminary.

a) Included in VIa.

Table 6.1 Nominal catch (in tonnes) of COD in Divisions VIId and VIIe, 1970 - 1979. (Data for 1970 - 1978 as officially reported to ICES).

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
Belgium	132	213	124	93	67	59	65	53	435	696
Denmark	-	-	-	-	-	2 718	1 506	1 120	2 160	1 986
France	2 139	4 544	2 658	1 425	3 099	2 143	1 646	5 185	8 044	4 632
Germany,Fed.Rep.of	-	+	-	-	-	-	-	-	-	-
Netherlands	3	13	30	2	4	+	2	1	+	-
Poland	-	-	7	13	6	-	-	-	-	-
U.K. (Engl.+Wales)	279	662	717	499	260	159	142	581	654	485
U.S.S.R.			8	45	-	3	4	-	-	-
Total VIId,e	2 553	5 432	3 544	2 077	3 436	5 082	3 365	6 940	11 293	7 799

*) Preliminary.

Table 6.2 Nominal catch (in tonnes) of COD in Divisions VIIb,c and VIIg-k, 1970-1979 (Data for 1970-1978 as officially reported to ICES).

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
Belgium	223	295	77	323	167	116	159	85	52	45
Faroe Islands	-	-	-	256	-	-	-	-	-	-
France	4 320	5 570	4 168	2 791	2 302	2 877	3 196	1 972	2 192	2 838
Germany,Fed.Rep.of	2	2	-	1	-	-	-	-	3 a)	-
Ireland	537	347	352	568	283	474	506	315	323	530
Netherlands	38	81	22	14	9	54	46	291	279	-
Norway	-	-	-	-	-	1	-	+	-	-
Poland	59	33	130	75	39	19	40	6	-	2
Spain	-	-	137	301	232	588	1 140	51	11	
U.K. (Engl.+Wales)	72	13	56	60	26	73	44	33	28	34
U.K. (Scotland)	-	-	-	-	-	-	-	-	2	1
U.S.S.R.	116	24	139	10	72	134	203	-	-	-
Total VIIb,c, g-k	5 367	6 365	5 081	4 399	3 130	4 336	5 234	2 753	2 890	3 450

*) Preliminary

a) Catch in VIIg only.

Table 6.3.A COD in Division VIId.
Input catch data for VPA.

AGE	1974	1975	1976	1977	1978	1979
1	20.7	574.2	38.2	4612.6	632.8	372.7
2	465.4	1221.4	523.3	4582.7	3960.8	1306.8
3	527.7	340.3	459.3	263.7	1530.5	818.2
4	256.8	213.1	175.2	36.8	290.2	291.1
5	87.6	106.3	64.7	15.5	52.1	86.6
6	30.1	46.1	17.1	6.4	4.8	28.4
7+	9.4	16.1	6.2	1.7	1.8	2.0

Table 6.3.B COD in Division VIId.
Fishing mortalities from VPA (M = 0.2).

AGE	1974	1975	1976	1977	1978	1979
1	.009	.278	.005	.524	.170	.100
2	.502	.937	.439	1.059	1.252	.626
3	.886	.865	1.235	.414	1.445	1.000
4	.969	1.203	1.908	.277	1.145	1.400
5	.846	1.704	1.932	.990	.795	1.500
6	.860	1.847	2.104	1.274	1.021	1.600
7	.900	.900	.900	.900	.900	1.000

MEAN F FOR AGES >= 2 AND <= 7 (WEIGHTED BY STOCK IN NUMBERS)

1974	1975	1976	1977	1978	1979
.728	.996	.832	.981	1.288	.822

Table 6.3.C COD in Division VIId.
Stock size in numbers from VPA.

AGE	1974	1975	1976	1977	1978	1979
1	2688.8	2601.7	9333.5	12372.3	4442.3	4314.0
2	1290.1	2182.7	1613.8	7607.1	5998.8	3067.1
3	976.3	639.3	700.5	852.0	2159.2	1405.0
4	449.4	329.5	220.3	166.8	461.0	416.8
5	167.0	139.6	81.0	26.8	103.5	120.1
6	56.8	58.7	20.8	9.6	8.1	38.3
7	11.5	19.7	7.6	2.1	2.2	2.4

Table 7.1 Nominal catch (in tonnes) of HADDOCK in Sub-area IV, 1970-1979 (Data for 1970 1978 as officially reported to ICES).

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
Belgium	3 691	971	1 601	2 385	1 137	2 209	2 166	2 293	1 295	466
Denmark	158 276	31 043	34 858	13 118	44 342	32 930	46 899	20 069	8 093	7 849
Faroe Islands	-	-	5	1 198	435	267	183	385	12	27
France	10 392	8 738	7 814	4 695	4 020	4 646	5 500	6 914	5 122	6 548
German Dem. Rep.[a]	2	3	90	22	8	44	20	8	37	5
Germany, Fed.Rep. of	5 075	3 045	4 020	4 587	3 478	2 396	3 433	3 744	2 589	2 349
Iceland	+	1	-	-	-	-	-	-	-	-
Ireland	-	-	-	-	-	-	31	53	101	-
Netherlands	8 278	6 914	5 188	3 185	3 035	1 901	1 728	1 598	857	735
Norway[b]	963	1 063	1 146	5 611	5 954	331	367	374	690	908
Poland	-	-	38	2 553	3 001	1 485	1 155	485	62	106
Spain	-	-	-	101	210	-	-	-	-	-
Sweden[c]	8 704	5 857	5 305	4 550	3 098	2 083	2 455	113	-	896
U.K. (Engl.+Wales)	19 500	16 648	20 827	16 586	10 798	11 499	17 238	17 167	12 200	10 773
U.K. (Scotland)	112 952	121 539	96 197	88 132	71 679	64 686	80 576	89 465	58 406	54 155
U.S.S.R.	344 000	62 398	36 467	49 356	42 234	49 686	42 852	8 010	54	49
Total IV	671 833	258 220	213 556	196 079	193 429	174 163	204 603	150 678	89 518	84 866
Total IVa	455 649	197 306	135 095	131 819	128 607	110 848	138 591	116 577	57 967	
Total IVb	212 646	58 270	75 325	62 288	63 695	62 761	65 594	34 030	31 457	
Total IVc	3 538	2 644	3 136	1 972	1 127	554	418	71	94	
W.G. Total Catch[d]	709 852	302 048	277 863	230 656	364 750	352 810	290 240	187 505	139 330	123 956

*) Provisional figures; a) 1970-1972 includes IIIa; b) Figures from Norway do not include haddock caught in Rec. 2. fisheries;

c) 1970-1974 includes IIIa; d) Includes discards.

Table 7.2 North Sea HADDOCK. Relative Fishing effort

Year	SCOTLAND [1, 2]												ENGLAND [3,4,5,6]									All fisheries			"Complete Data Sets" 1963-1979		
	Motor Trawl			Seine			Light Trawl			Nephrops Trawl			Motor Trawl >40 pt			N. Shields Seine			Pair Trawl			Totals			Totals		
	C	C/E	σ	C	C/E	σ	C	C/E	σ	C	C/E	σ	C	C/E	σ	C	C/E	σ	C	C/E	σ	Total Catch	Relative C/E	Relative Effort	Total Catch	Relative C/E	Relative Effort
1963	12 715	69.9	0.74	16 568	26.9	0.25	60	9.9	0.29				4 979	7.0	0.28	606	18.2	0.20				59 398	0.43	1.56	59 398	0.43	1.56
1964	20 933	108.5	1.15	40 733	63.6	0.60	431	17.2	0.50				10 862	17.7	0.72	2 567	83.6	0.92				198 706	0.78	2.88	198 706	0.78	2.88
1965	21 670	125.3	1.32	57 617	98.8	0.93	1 220	22.2	0.65				9 395	17.1	0.70	2 863	100.5	1.10				221 699	1.00	2.51	221 699	1.00	2.51
1966	30 716	158.3	1.67	43 992	87.8	0.83	680	18.9	0.55				8 140	14.7	0.60	3 037	111.9	1.23				268 958	1.12	2.71	268 958	1.12	2.71
1967	31 370	145.9	1.54	38 321	74.6	0.70	530	18.9	0.55				6 247	13.0	0.53	1 172	50.0	0.55				167 408	1.02	1.86	167 408	1.02	1.86
1968	25 758	118.2	1.25	37 798	68.8	0.65	797	16.6	0.49				6 454	14.1	0.57	1 535	52.4	0.58				139 469	0.85	1.86	139 469	0.85	1.86
1969	15 971	129.8	1.37	49 652	101.1	0.95	2 861	45.4	1.33				9 593	23.3	0.95	2 464	68.5	0.75	54	6.8	2.06	639 195	1.04	6.95	639 195	1.04	6.95
1970	35 646	268.0	2.83	70 188	164.4	1.55	6 209	90.0	2.63				13 328	32.8	1.33	3 768	131.1	1.44	356	5.5	1.67	671 831	1.93	3.94	671 831	1.93	3.94
1971	47 097	269.1	2.84	63 381	152.4	1.44	10 196	97.1	2.84	489	6.7	5.15	12 284	31.1	1.26	2 978	98.5	1.08	326	3.3	1.00	258 220	2.01	1.45	258 220	2.01	1.45
1972	35 593	177.1	1.87	50 281	127.9	1.21	9 519	78.7	2.30	335	4.7	3.62	15 108	34.5	1.40	3 806	105.7	1.16	294	2.5	0.76	213 556	1.53	1.58	213 556	1.53	1.58
1973	24 014	131.2	1.39	54 095	130.3	1.23	9 233	60.7	1.77	366	4.6	3.54	10 434	27.5	1.12	4 232	105.9	1.16	256	2.8	0.85	196 079	1.31	1.69	196 079	1.30	1.70
1974	18 338	100.8	1.07	44 827	125.9	1.19	7 479	63.4	1.85	242	3.5	2.69	7 230	20.7	0.84	2 438	74.2	0.81	233	2.1	0.64	193 429	1.18	1.85	193 429	1.18	1.85
1975	15 885	105.2	1.11	39 233	114.7	1.08	8 849	55.0	1.61	161	1.4	1.08	7 627	29.0	1.18	2 770	76.5	0.84	366	2.0	0.61	174 163	1.15	1.71	174 163	1.15	1.71
1976	16 983	139.2	1.47	51 901	168.5	1.59	10 117	66.1	1.93	458	3.2	2.46	11 442	36.8	1.50	4 080	116.0	1.27	606	2.2	1.67	204 603	1.58	1.46	204 603	1.58	1.46
1977	12 096	134.4	1.42	53 249	170.7	1.61	14 738	65.8	1.92	249	2.6	2.00	12 198	39.2	1.59	3 059	102.4	1.12	1 195	1.8	1.55	150 678	1.60	1.06	150 678	1.62	1.05
1978	11 248	83.3	0.88	36 811	113.3	1.07	8 809	36.9	1.08	98	1.0	0.77	9 098	28.5	1.16	1 745	62.0	0.68	952	3.5	1.06	195 569	1.04	1.04	95 569	1.04	1.04
1979	8 229	94.6	1.00	33 461	105.9	1.00	9 825	34.2	1.00	151	1.3	1.00	7 350	24.6	1.00	2 059	91.1	1.00	1 112	3.3	1.00	88 429	1.00	1.00	88 429	1.00	1.00

1) Scottish landings in tonnes (live weight).

2) Scottish catch per unit effort is in tonnes/10^{-3} hours.

3) English landings in tonnes (live weight).

4) English motor trawl catch per unit effort is in tonnes/tonne-hours x 10^{-5}.

5) English N. Shields seine catch per unit effort in tonnes/10^{-3} hours.

6) English pair trawl catch per unit effort is in tonnes/tonne-hours x 10^{-4}.

Table 7.3 North Sea HADDOCK.
Input catch data for VPA.

AGE	1962	1963	1964	1965	1966	1967
0	12960	15354	554928	439823	1196296	192440
1	451832	175380	476608	564228	278587	884285
2	64785	187110	1315305	4032	15503	41270
3	42420	16865	101157	598958	5769	4302
4	17664	12580	11406	34223	371017	3159
5	1081	5760	3749	4741	9560	168904
6	601	526	2027	2663	1459	2663
7	3059	339	198	529	757	316
8	222	811	282	178	130	291
9	24	7	7	11	7	49
10+	4	10	3	3	6	4

AGE	1968	1969	1970	1971	1972	1973
0	54597	89549	3251126	260206	153694	38160
1	3332692	1515158	128043	693082	692558	95731
2	298580	2331889	257209	34014	381361	450985
3	17159	334743	1330052	44407	31226	272136
4	2003	14369	59581	353962	20639	4515
5	1790	3733	2307	10281	142976	6252
6	52224	4765	1717	636	3246	1605
7	440	34350	441	206	115	40
8	61	482	8261	1641	423	2
9	12	42	123	821	11	4
10+	7	5	21	192	117	22

AGE	1974	1975	1976	1977	1978	1979
0	434302	55425	131996	48121	226193	257622
1	2062862	1174697	124697	164042	497913	275605
2	95656	646526	833879	89649	149940	237809
3	280418	72678	209761	345385	28621	43682
4	54160	136027	11026	39833	106749	8551
5	3674	18273	32802	3779	8305	24885
6	1440	1206	5843	6659	1175	4919
7	11379	742	220	1206	1814	349
8	306	3366	84	112	378	413
9	22	135	834	32	110	107
10+	63	99	82	166	83	85

Table 7.4 North Sea HADDOCK.
Fishing mortalities from VPA (M = 0.2).

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970
0	.003	.025	.569	.659	.420	.017	.023	.270	.931
1	.669	.045	2.438	2.582	1.255	.634	.453	1.488	.771
2	.821	.657	.542	.119	.549	.614	.455	.670	1.251
3	.914	.522	.943	.511	.248	.286	.563	1.501	1.079
4	.933	.782	.829	1.042	.699	.209	.209	1.440	1.423
5	.612	.952	.568	1.058	.985	.825	.175	.745	1.009
6	.531	.695	1.144	1.073	1.219	.848	.665	.952	.967
7	1.434	.657	.620	1.146	1.101	1.002	.317	1.385	.201
8	2.811	6.729	2.523	2.496	1.035	2.574	.527	.686	2.053
9	.978	.961	.961	.820	.795	1.755	.978	.869	.370
10	.700	.700	.700	.700	.700	.700	.700	.700	.700
MEAN F FOR AGES >= 2 AND <= 8 (WEIGHTED BY STOCK IN NUMBERS)									
	.985	.804	.564	.524	.685	.737	.476	.746	1.118

AGE	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	.102	.306	.010	.113	.141	.217	.036	.120	.100
1	.516	.425	.317	.992	.500	.533	.456	.623	.210
2	.477	.603	.544	.604	1.047	.821	.951	1.021	.700
3	.755	1.132	1.252	.793	1.429	1.307	1.026	.965	1.000
4	1.000	1.014	.470	.942	1.243	.898	.989	1.124	.900
5	1.100	1.817	1.050	.897	1.034	1.294	.939	.568	.900
6	.887	1.463	.075	.744	.874	1.223	1.075	.896	.800
7	.276	.382	.052	1.098	1.174	.376	.934	1.030	.750
8	3.444	1.528	.010	.688	1.272	.375	.334	.897	.700
9	1.757	.300	.044	.145	.762	1.492	.239	.642	.700
10	.700	.700	.700	.700	.700	.700	.700	.700	.700
MEAN F FOR AGES >= 2 AND <= 8 (WEIGHTED BY STOCK IN NUMBERS)									
	.916	.827	.718	.768	1.103	.910	1.008	1.031	.754

Table 7.5 North Sea HADDOCK.
Stock size in numbers from VPA.

AGE	1962	1963	1964	1965	1966	1967
0	5380212	695318	1398066	994539	3823262	12446197
1	1010966	4393239	555414	648045	421247	2057064
2	125930	424029	3438572	39710	40116	98278
3	76955	45363	179964	1637702	28877	18966
4	31643	25255	22037	57361	804334	18452
5	2580	10192	9458	7878	16569	327219
6	1595	1145	3221	4388	2240	5067
7	64421	768	468	840	1229	542
8	250	12576	326	206	219	334
9	42	12	12	21	14	64
10	5	13	4	4	8	5

AGE	1968	1969	1970	1971	1972	1973
0	2635410	415254	5831197	2965598	640746	4389750
1	10016297	2108391	259452	1881693	2193371	386465
2	893684	5212634	389644	98213	919835	1174557
3	43558	463997	2184395	91312	49925	412015
4	11660	20306	84659	607848	35141	13181
5	12264	7744	3941	16704	183090	10433
6	117379	8428	3009	1176	4553	24372
7	1776	49440	2663	937	397	863
8	163	1059	10131	1783	582	222
9	21	79	436	1065	47	103
10	9	6	27	247	150	28

AGE	1974	1975	1976	1977	1978	1979
0	4466613	464371	743918	1485832	2203045	2981946
1	3559558	3265373	330245	490262	1173054	1599781
2	230388	1080778	1621069	158726	254324	515232
3	557907	103074	310703	584026	50219	75011
4	96419	206741	20222	68844	171336	15666
5	6745	30764	48830	6742	20958	45591
6	2990	2252	8957	10959	2158	9727
7	18506	1163	770	2158	3061	721
8	671	5054	294	433	694	895
9	180	276	1159	166	254	232
10	81	127	105	213	107	109

Table 7.6 North Sea HADDOCK
Estimates of year class strength at 1 year old

Year class	IYHS Index[1)]	VPA Number x 10^{-6}
1965	12	421
1966	62	2 057
1967	5 855	10 016
1968	81	2 108
1969	27	259
1970	873	1 882
1971	740	2 193
1972	187	386
1973	1 072	3 560
1974	1 168	3 265
1975	177	330
1976	162	490
1977	385	1 173
1978	478	1 576[*)]
1979	871	2 232[*)]

1) Unadjusted arithmetic mean number per hour per statistical rectangle.

Year classes 1965 - 1977 : VPA = IYHS x 1.669 + 778

$r = 0.96$ $P < 0.001$

*) Predicted from regression.

Table 7.7 North Sea HADDOCK. 1979 Input data for catch predictions

Age	Consumption landings Catch No. (10^{-3})	Mean Weight (kg)	F	Industrial Landings Catch No. (10^{-3})	Mean Weight (kg)	F	Discards Catch No.(10^{-3})	Mean Weight (kg)	F	Total F
0	-	-	-	257 437	0.0035	0.11	185	0.08	-	0.0996
1	14 384	0.23	.011	65 714	0.0361	0.052	195 507	0.091	.147	0.21
2	125 998	0.28	.369	12 175	0.1628	.037	99 836	0.171	.293	0.70
3	38 163	0.41	.872	1 754	0.2966	.042	3 765	0.208	.086	1.00
4	8 391	0.58	.883	119	0.489	.013	41	0.228	.004	0.90
5	24 368	0.71	.881	457	0.362	.017	60	0.275	.002	0.90
6	4 894	0.94	.796	25	0.443	.004	-	-	0	0.80
7	349	1.21	.750	-	-	0	-	-	0	0.75
8	410	1.44	.695	3	1.44	.005	-	-	0	0.70
9	106	1.50	.693	1	1.50	.007	-	-	0	0.70
10+	85	1.60	.70	-		0			0	0.70

Recruits at age 0 in 1979 = 3 011 000
1980 = 2 088 000
1981 = 2 088 000

Table 7.8 North Sea HADDOCK
Results of catch predictions ('000 tonnes)

1979	Spawning Stock Biomass: (Age 2+)	199.9
	Total Stock Biomass:	347.1
	F:	1.0
	Consumption Landings:	82.3
	Industrial Landings:	6.1
	Discards:	35.7
1980	Spawning Stock Biomass: (Age 2+)	362.8
	Total Stock Biomass:	555.9
	F*):	
	Consumption Landings:	119.7
	Industrial Landings:	9.9
	Discards:	51.8
1981	Spawning Stock Biomass: (Age 2+)	603.7
	Total Stock Biomass	740.7

Yield in 1981					1982 Spawning Stock Biomass (Age 2+)	1982 Total Biomass
$F_{81/79}$	Indust.	Consumption	Discards	Total		
0.01	17.1	3.5	0.9	21.5	1 021.9	1 158.9
0.20	16.1	64.9	17.8	98.8	912.5	1 049.6
0.50	14.7	145.2	41.1	201.0	768.2	905.2
1.00	12.8	244.1	72.6	329.4	587.3	724.3
1.50	11.3	312.0	96.9	420.3	459.6	596.6
2.00	10.0	359.3	116.2	485.6	368.1	505.2

F = Fishing mortality on age groups subject to maximum exploitation.

*) $F_{81} = F_{80} = F_{79}$ for industrial landings, for consumption landings and discards $F_{1980} = 0.8 \times F_{1979}$.

Table 8.1 Nominal catch (in tonnes) of HADDOCK in Division VIa, 1970-1979
(Data for 1970-1978 as officially reported to ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*
Belgium	13	9	44	45	98	23	45	-	-	2
Denmark	-	-	-	-	-	-	13	-	-	-
Faroe Islands	-	-	-	2	1	-	-	-	-	
France	785	2 354	5 014	5 141	3 979	2 328	3 026	3 401	4 255	4 788
German Dem.Rep.	-	10	87	-	-	9	-	-	-	-
Germany,Fed.Rep.	9	15	7	15	18	3	30	+	20	5
Iceland	-	+	-	-	-	-	-	-	-	-
Ireland	2 720	4 316	3 982	2 631	1 715	599	1 115	616	441	877
Netherlands	126	78	205	169	63	19	30	28	13	2
Norway	-	-	-	-	-	-	3	7	13	11
Poland	-	10	-	402	97	20	-	-	-	-
Spain	-	-	101	497	540	-	-		-	-
Sweden	-	-	-	-	-	-	-	-	-	-
U.K.(Engl.+Wales)	1 785	1 491	2 393	2 187	1 512	1 214	1 971	3 827	2 805	1 654
U.K.(Scotland)	28 724	33 087	27 730	17 631	9 583	8 973	11 992	11 422	9 629	7 461
U.K.(N. Ireland)	12	2	1	-	-	-	-	-	-	-
U.S.S.R.	4	4 927	1 480	110	364	495	533	-	-	-
Total VIa	34 178	46 299	41 044	28 830	17 970	13 683	18 758	19 301	17 176	14 800
Working Group Total Catch								19 301	17 178	14 199

* Preliminary

Table 8.2 HADDOCK in Division VIa.
Input catch data for VPA.

AGE	1965	1966	1967	1968	1969	1970
1	4	280	595	10551	0	241
2	1402	362	13177	8370	58329	172
3	71550	1173	1430	3665	7068	74912
4	3981	47981	275	474	1653	3975
5	175	1618	21665	664	417	221
6	143	77	291	13291	687	96
7	118	30	23	742	4037	103
8+	19	103	32	41	179	474

AGE	1971	1972	1973	1974	1975	1976
1	1924	474	867	1325	4928	1170
2	2235	17840	4681	2397	9047	19698
3	5208	1786	11235	6662	2623	14972
4	71815	2326	189	4846	3191	1661
5	464	45638	824	67	1981	1774
6	68	491	22857	314	98	1113
7	5	30	100	8840	118	35
8+	76	46	82	130	3783	2445

AGE	1977	1978	1979
1	393	549	368
2	1364	789	9721
3	31486	757	1585
4	6069	21544	432
5	741	3027	12069
6	527	403	1323
7	387	294	177
8+	632	514	323

Table 8.3 HADDOCK in Division VIa.
Fishing mortalities from VPA (M = 0.2)

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973
1	.001	.011	.019	.019	.000	.020	.032	.015	.055
2	.232	.093	.960	.389	.142	.006	.265	.446	.208
3	.449	.310	.623	.796	.671	.274	.242	.351	.566
4	.622	.622	.110	.432	1.100	1.057	.458	.162	.056
5	.475	.560	.645	.418	.861	.402	.316	.598	.079
6	.707	.396	.182	1.121	1.048	.488	.207	.649	.693
7	.365	.308	.196	.948	1.440	.419	.041	.132	.260
8	.150	.150	.150	.150	.150	.150	.150	.150	.150
MEAN F FOR AGES >= 2 AND <= 6 (WEIGHTED BY STOCK IN NUMBERS)									
	.450	.589	.704	.698	.167	.265	.426	.507	.473

AGE	1974	1975	1976	1977	1978	1979
1	.020	.024	.218	.054	.018	.008
2	.210	.180	.128	.424	.147	.500
3	.509	.374	.503	.308	.442	.490
4	.513	.492	.431	.392	.359	.490
5	.025	.408	.564	.348	.346	.350
6	.039	.047	.424	.323	.324	.250
7	.639	.019	.021	.255	.301	.230
8	.150	.150	.150	.150	.150	.150
MEAN F FOR AGES >= 2 AND <= 6 (WEIGHTED BY STOCK IN NUMBERS)						
	.339	.245	.213	.323	.345	.400

Table 8.4 HADDOCK in Division VIa.
Stock size in numbers from VPA.

AGE	1965	1966	1967	1968	1969	1970
1	5516	28637	35409	602663	39962	13133
2	7445	4513	23193	28453	483890	32718
3	216573	4834	3368	7271	15783	343610
4	9384	113161	2903	1479	2685	6608
5	507	4123	49748	2129	786	731
6	308	258	1928	21366	1148	272
7	423	124	142	1316	5704	329
8	44	240	75	96	418	1106

AGE	1971	1972	1973	1974	1975	1976
1	68388	34062	17936	75432	226312	6572
2	10535	54254	27459	13902	60562	180839
3	26632	6615	28423	18268	9224	41436
4	213961	17119	3812	13216	8989	5197
5	1881	110794	11920	2950	6480	4500
6	401	1123	49889	9016	2355	3528
7	137	267	480	20432	7098	1840
8	177	107	191	303	8827	5705

AGE	1977	1978	1979
1	8174	33625	53621
2	4328	6338	27034
3	130302	2320	4478
4	20512	78385	1221
5	2766	11347	44831
6	2097	1599	6572
7	1890	1243	947
8	1475	1199	754

Table 8.5 HADDOCK in Division VIa
Catch and Effort Data for Calculation of Relative Total International Fishing Effort

Year	Scotland												England							
	Motor Trawl				Seine				L. Trawl				Motor Trawl							
	L	E	L/E	γ	L	E	L/E	γ	L	E	L/E	γ	L	E	L/E	γ	ΣC_{13}	Γ_j	C_j	E_j
1963	4 647	37			5 274	165			273	38										
1964	11 114	75			9 894	181			396	44										
1965	10 269	73	141	1.28	16 065	153	105	2.28	801	37	21.6	1.73	2 438	2 958	0.82	0.55	29 572	1.78	32 467	1.23
1966	12 078	72	168	1.53	11 585	157	74	1.61	444	41	10.8	0.86	2 659	2 486	1.07	0.72	26 766	1.47	29 881	1.37
1967	8 324	54	154	1.40	6 850	159	43	0.93	380	83	4.6	0.37	2 674	2 304	1.16	0.78	18 228	1.11	20 302	1.23
1968	8 732	50	175	1.59	6 557	150	44	0.96	272	66	4.1	0.33	3 128	2 443	1.28	0.86	18 689	1.23	20 469	1.12
1969	7 946	43	185	1.68	11 701	140	84	1.83	827	105	7.9	0.63	3 294	2 049	1.61	1.08	23 768	1.63	26 273	1.09
1970	11 465	41	280	2.55	14 211	96	148	3.22	2 178	115	18.9	1.51	1 783	1 249	1.43	0.96	29 637	2.70	34 178	0.85
1971	14 786	42	352	3.20	14 304	99	144	3.13	3 546	129	27.5	2.20	1 490	805	1.85	1.24	34 126	2.98	45 323	1.30
1972	15 903	56	284	2.58	6 917	71	97	2.11	4 523	142	31.9	2.55	2 347	1 225	1.92	1.29	29 690	2.36	40 152	1.15
1973	12 932	55	235	2.14	3 165	59	54	1.17	1 214	91	13.3	1.06	2 166	1 080	2.01	1.35	19 477	1.82	28 535	1.06
1974	6 498	56	116	1.05	1 189	57	33	0.72	1 040	86	12.1	0.97	1 508	1 032	1.46	0.98	10 937	0.98	17 744	1.22
1975	4 857	37	131	1.19	2 329	56	42	0.91	1 616	129	12.5	1.00	1 213	1 068	1.14	0.77	10 015	1.04	13 683	0.89
1976	5 342	35	153	1.39	3 904	57	69	1.50	2 430	139	17.5	1.40	1 962	1 259	1.56	1.05	13 638	1.37	18 755	0.92
1977	3 895	22	177	1.61	3 025	42	72	1.57	2 082	143	14.6	1.17	3 724	1 823	2.04	1.37	12 726	1.46	19 301	0.89
1978	6 962	52	134	1.22	1 229	34	36	0.78	1 235	127	9.7	0.78	2 784	1 613	1.73	1.16	12 210	1.12	17 176	1.03
1979	3 615	33	110	1	1 753	38	46	1	1 253	100	12.5	1	1 040	698	1.49	1	7 661	1.00	14 812	1.00

Table 8.6 HADDOCK. Estimates of year class strength at age 1 for North Sea and West of Scotland from VPA

Year Class	Numbers x 10^{-6}	
	North Sea	West of Scotland
1964	648	5.5
1965	421	28.6
1966	2 057	35.4
1967	10 016	602.7
1968	2 108	40.0
1969	259	13.1
1970	1 882	68.4
1971	2 193	33.6
1972	386	17.4
1973	3 560	72.7
1974	3 265	211.0
1975	330	6.2
1976	490	7.2
1977	1 173	28.6*
1978	1 576	53.7*
1979	2 232	94.5*

Functional regression 1964-76: VIA = IV x 0.0623 - 44.5
$r = 0.955$ $P < 0.001$

* Predicted from regression

Table 8.7. HADDOCK in Division VIa, 1979
Input Data for Catch Predictions

Age	Consumption Landings		
	Catch No. ($\times 10^{-3}$)	Mean Weight (kg)	F
1	368	0.23	0.0076
2	9 721	0.28	0.50
3	1 585	0.41	0.49
4	432	0.58	0.49
5	12 069	0.71	0.35
6	1 323	0.94	0.25
7	177	1.21	0.23
8+	323	1.44	0.15

Year	1979	1980	1981
Recruits at age 1(000)	53 900	94 500	44 900

Table 8.8 HADDOCK in Division VIa
Results of Catch Predictions (1 000 tonnes)

1979	SSB	50.4
	TB	62.7
	F	0.50
	Yw	14.2
1980	SSB	50.5
	TB	72.3
	F	0.50
	Yw	13.1
1981	SSB	60.5
	TB	70.8

Notes:

SSB = Spawning stock biomass (ages 2+)

TB = Total stock biomass

F = Fishing mortality on age-group subject to maximum exploitation

Yw = Yield in weight

F_{81}/F_{79}	Yw in 1981 consumption landings	SSB 1982	TB 1982
0.01	0.2	74.9	85.2
0.2	4.0	70.3	80.6
0.5	9.4	63.7	74.0
1.0	17.0	54.5	64.8
1.5	23.3	47.0	57.4
2.0	28.4	41.0	51.3

Table 9.1 Nominal catch (in tonnes) of HADDOCK in Division VIb, 1970-1979
(Data for 1970-1978 as officially reported to ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*
Belgium	-	-	-	-	-	-	33	-	-	-
Faroe Islands	-	-	-	-	2	1	8	3	11	20
France	12	182	1 527	600	353	21	4	4	3	18
Ireland							-	-	61	-
Norway	-	-	-	-	-	-	-	+	4	11
Poland	-	-	-	54	-	-	-	-	-	-
U.K.(Engl.+Wales)	220	117	27	1	-	5	2 111	2 694	2 365	1 654
U.K.(Scotland)	608	313	616	72	22	71	640	297	2 060	548
U.S.S.R.	-	9	7 304	3 291	48 911	49 830	40 447	-	-	-
Total VIb	840	621	9 474	4 018	49 288	49 928	43 243	2 998	4 504	2 251

* Preliminary

Table 10.1 Nominal catch (in tonnes) of HADDOCK in Divisions VIId and VIIe, 1970-1979
(Data for 1970-1978 as officially reported to ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
Belgium	3	1	2	1	+	+	+	1	-	-
Denmark	-	-	-	-	-	-	-	2	22	21
France	295	97	224	208	487	868	405	438	356	315
Germany,Fed.Rep.of	-	1	-	-	-	+	-	-	-	-
Ireland	-	-	-	-	-	-	-	4	-	-
Netherlands	5	-	9	1	-	1	-	-	-	-
Poland	-	-	-	12	-	-	-	-	-	-
U.K. (Engl.+Wales)	118	71	166	135	113	99	45	29	22	51
U.S.S.R.	-	-	10	2	33	3	-	-	-	-
Total VIId,e	421	170	411	359	633	971	450	474	400	387

*) Preliminary.

Table 10.2 Nominal catch (in tonnes) of HADDOCK in Divisions VIIb,c and VIIg-k, 1970-1979
(Data for 1970-78 as officially reported to ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*
Belgium	31	23	45	65	35	33	19	13	5	-
Faroe Islands	-	-	-	3	-	-	-	-	-	-
France	3 823	3 652	6 456	5 524	6 057	4 583	3 726	2 244	1 479	1 851
Germany,Fed.Rep.of	1	1	-	1	-	+	3	-	-	-
Ireland	783	947	1 103	1 348	829	507	287	153	111	150
Netherlands	98	66	56	12	2	4	14	1	-	+
Poland	-	3	-	62	143	-	-	-	-	-
Spain	-	-	733	890	1 100	-	-	294	-	-
U.K. (Engl.+Wales)	46	25	107	24	39	46	24	18	13	20
U.K. (Scotland)	-	-	-	-	-	-	-	-	8	22
U.S.S.R.	27	136	253	24	456	1 290	183	-	-	-
Total VIIb,c and g-k	4 809	4 853	8 753	7 953	8 661	6 463	4 256	2 723	1 616	2 043

*) Preliminary.

Table 11.1 Nominal catch (in tonnes) of WHITING in Sub-area IV, 1970-1979
(Data for 1970-1978 as officially reported to ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*
Belgium	2 799	2 108	2 745	3 387	3 156	3 279	2 640	3 275	3 304	3 561
Denmark	102 698	55 618	50 109	73 928	109 654	61 941	116 973	46 479	15 741	41 890
Faroe Islands	-	-	-	1 453	1 126	764	1 262	472	42	7
France	25 842	16 668	19 822	20 353	19 825	20 079	19 557	17 592	22 525	22 558
German Dem.Rep.	-	-	-	5	-	3	18	-	22	3
Germany, Fed. Rep.	392	233	264	403	454	446	302	461	348	1 044
Iceland	-	-	-	-	-	-	4	9	38	-
Netherlands	10 115	6 322	7 613	8 811	12 057	14 078	12 274	9 406	11 030	10 981
Norway[a)]	43	25	28	1 527	4 990	55	71	33	70	55
Poland	-	-	-	7	1 002	888	509	445	8	3
Spain	-	-	107	119	110	65	18	-	-	-
Sweden[b)]	820	616	596	2 328	2 440	255	153	341	...	31
U.K.(Engl. + Wales)	3 398	4 158	3 789	4 592	5 519	5 246	5 112	6 185	7 542	7 581
U.K. (Scotland)	21 080	26 755	23 846	20 756	25 274	27 696	26 167	33 017	42 779	44 840
U.S.S.R.	14 319	541	613	3 522	2 978	5 098	5 612	2 413	-	-
Total IV	181 506	113 044	109 532	141 191	188 585	140 166	190 672	120 128	103 449	132 554
Total IVa	32 185	23 451	32 932	31 104	81 693	75 444	100 001	61 499	42 843	
Total IVb	126 024	70 728	66 789	96 678	87 842	41 930	69 908	42 911	40 943	
Total IVc	23 297	18 865	9 811	13 409	19 050	22 792	20 763	15 718	19 663	
Working Group Total Catch[c)]	305 259	163 156	216 334	272 345	280 868	335 982	264 632	201 648	191 312	275 156

*) Provisional figures
a) Figures from Norway do not include Whiting caught in Rec. 2 fisheries
b) 1970-1974 includes IIIa, 1978 included in IIIa
c) Includes discards

Table 11.2 North Sea WHITING. Catch and Effort Data

Year	SCOTLAND									ENGLAND			r relative cpue	Total*) catch 1 000 tonnes	Relative effort
	Motor Trawl			Light Trawl			Seine			Motor Trawl					
	C	E	C/E	C	E	C/E	C	E	C/E	C	E	C/E			
1963	6 578	182	36.1	80	6	13.3	24 609	617	39.9	1 487	7 161	.21	.57	99	1.18
1964	5 340	193	29.2	393	25	15.7	20 868	640	32.6	1 286	6 130	.21	.46	88	1.30
1965	4 505	173	26.0	912	55	16.6	29 584	583	50.7	2 010	5 494	.37	.71	110	1.05
1966	5 329	194	27.5	681	36	18.9	31 886	501	63.6	1 631	5 534	.29	.88	158	1.22
1967	6 942	215	32.3	424	28	15.1	22 244	514	43.3	2 126	4 799	.44	.58	121	1.42
1968	8 434	218	38.7	624	48	13.0	20 447	549	37.2	1 965	4 577	.43	.53	145	1.86
1969	4 475	123	36.4	1 095	63	17.4	14 274	491	29.1	1 375	4 110	.33	.43	215	3.40
1970	4 394	133	33.0	1 891	69	27.4	14 190	427	33.2	2 247	4 069	.55	.48	181	2.56
1971	5 774	175	33.0	3 494	105	33.3	17 066	416	41.0	2 267	3 946	.57	.57	113	1.35
1972	5 770	201	28.7	4 146	121	34.3	13 764	393	35.0	2 149	4 376	.49	.49	110	1.53
1973	4 940	183	27.0	3 830	152	25.2	17 717	415	28.2	2 475	3 789	.65	.56	141	1.71
1974	5 157	182	28.3	3 960	118	33.6	14 367	356	40.4	3 525	3 500	1.01	.57	189	2.26
1975	4 922	151	32.6	6 492	161	40.3	14 802	342	43.3	3 294	2 629	1.25	.64	140	1.49
1976	4 355	122	35.7	6 390	153	41.8	13 034	308	42.3	3 371	3 107	1.08	.64	191	2.03
1977	3 704	90	41.2	10 827	224	48.3	14 326	312	45.9	4 453	3 110	1.43	.75	120	1.09
1978	7 398	135	54.8	15 151	239	63.4	18 830	325	57.9	5 504	3 192	1.72	.94	122	.88
1979	7 308	87	84.0	16 275	287	56.7	19 576	315	62.1	5 748	2 986	1.92	1.00	147	1.00

*) Excluding discards.

Table 11.3 North Sea WHITING.
Input catch data for VPA.

AGE	1962	1963	1964	1965	1966	1967
0	114298	181370	257125	117178	267143	294765
1	508301	705405	253027	336549	449191	396601
2	229172	1588930	410859	515796	743979	369625
3	284029	156618	273308	331417	173043	243467
4	59718	75614	32814	95341	218400	40890
5	6754	12749	16573	9827	43425	65331
6	278	1862	4233	4993	3268	9414
7	990	10	529	914	1511	953
8+	117	140	60	136	432	156

AGE	1968	1969	1970	1971	1972	1973
0	140939	1250760	1272540	957971	507612	161635
1	647772	425056	637087	334170	873186	1030760
2	539415	1726670	194955	209044	612439	787306
3	172330	230799	829842	29502	69296	209486
4	78136	47542	52825	137258	8842	23524
5	10273	24231	15701	15211	63302	7527
6	31640	2499	4178	2293	8246	19422
7	2047	10030	1274	822	1124	2756
8+	126	4588	1212	599	653	680

AGE	1974	1975	1976	1977	1978	1979
0	447566	256952	382893	316633	402682	437621
1	798250	1055100	390301	610428	281975	732666
2	970535	821530	977750	408497	492201	669229
3	272877	412066	151115	238058	205226	183734
4	47323	68946	78063	29288	74556	80291
5	6627	9967	14692	19754	8370	24003
6	2063	2570	3502	4614	6154	3391
7	5738	869	737	423	2125	1132
8+	624	2412	604	335	477	305

Table 11.4 North Sea WHITING.
Fishing mortalities from VPA (M = 0.2).

AGE	1962	1963	1964	1965	1966	1967	1968	1969	1970
0	.039	.113	.111	.072	.132	.053	.145	.676	.526
1	.177	.355	.228	.207	.430	.295	.159	.837	.912
2	.621	1.290	.361	.997	.947	.769	.833	.806	1.302
3	1.159	1.244	.815	.557	1.199	.996	1.068	1.127	1.280
4	1.229	1.238	1.007	.771	.907	1.108	1.103	1.032	.880
5	1.106	1.001	1.072	1.009	1.031	.777	.977	1.421	1.295
6	1.238	1.142	1.191	1.222	1.222	.655	1.174	.683	1.092
7	1.805	.116	1.339	.932	2.071	1.861	.284	1.937	.935
8	.900	.900	.900	.900	.900	.900	.900	.900	.900
MEAN F FOR AGES >= 2 AND <= 5 (WEIGHTED BY STOCK IN NUMBERS)	.898	1.282	.503	.783	.975	.856	.903	.847	1.260

AGE	1971	1972	1973	1974	1975	1976	1977	1978	1979
0	.283	.130	.062	.123	.137	.173	.129	.173	.177
1	.252	.451	.418	.479	.470	.318	.456	.161	.540
2	.910	1.004	.973	.895	1.433	1.115	.645	.834	.700
3	.692	.918	1.272	1.185	1.368	1.270	.944	.808	.900
4	.752	.457	.976	1.235	1.204	1.138	.940	.920	.900
5	.689	.994	.911	.843	.992	.942	1.068	.789	.900
6	.650	1.056	1.014	.691	.983	1.291	.917	1.288	.900
7	.653	.791	1.433	1.004	.718	1.004	.501	1.793	.900
8	.900	.900	.900	.900	.900	.900	.900	.900	.900
MEAN F FOR AGES >= 2 AND <= 5 (WEIGHTED BY STOCK IN NUMBERS)	.823	.984	1.026	.959	1.396	1.132	.753	.834	.753

Table 11.5 North Sea WHITING.
Stock size in numbers from VPA.

AGE	1962	1963	1964	1965	1966	1967
0	3289910	1863153	2704626	1849712	2375853	6264076
1	3452513	2590369	1361892	1982519	1408693	1704395
2	540858	2368861	1487340	887322	1320177	750451
3	448189	237910	533662	848805	268057	419130
4	91315	115148	56120	193319	398305	66155
5	10938	21878	27323	16788	73236	131721
6	424	2962	6582	7658	5012	21386
7	1271	101	774	1638	1848	1209
8	143	171	73	166	528	191

AGE	1968	1969	1970	1971	1972	1973
0	1151765	2778041	3405275	4270784	4599906	2980807
1	4862557	815977	1157127	1648424	2635312	3308530
2	1038930	3397513	289331	380400	1049011	1374702
3	284717	369941	1242392	64429	125399	314606
4	126766	80116	98171	282868	26402	41003
5	17884	34458	23363	33340	109128	13689
6	49577	5509	6815	5238	13711	33083
7	9097	12547	2279	1872	2239	3903
8	154	5608	1481	732	798	831

AGE	1974	1975	1976	1977	1978	1979
0	4255275	2205854	2650164	2890632	2788301	2967704
1	2294618	3080452	1574417	1824886	2081236	1920158
2	1784100	1163289	1576343	938306	946822	1449938
3	425514	596733	227137	423211	403115	336612
4	72185	106565	124417	52224	134743	147098
5	12656	17195	26168	32637	16704	43975
6	4509	4458	5219	8355	9184	6213
7	9829	1849	1365	1175	2735	2074
8	763	2948	738	409	583	373

Table 11.6 North Sea WHITING
Estimates of year class strength at one year old

Year class	IYHS Index[1)]	VPA Number x 10^{-6}
1959	-	2 831
1960	-	1 307
1961	-	3 453
1962	-	2 590
1963	-	1 362
1964	418	1 983
1965	600	1 409
1966	501	1 704
1967	2 019	4 863
1968	19	816
1969	70	1 157
1970	223	1 648
1971	339	2 635
1972	1 159	3 309
1972	322	2 295
1974	893	3 080
1975	679	1 574
1976	427	1 825 Average 1959 - 76 = 2 213
1977	513	2 047*)
1978	457	1 932*)
1979	690	2 408*)

1) Unadjusted arithmetic mean number per hour per statistical rectangle.

Year classes 1964 - 1976 : VPA = IYHS x 2.04 + 1 008
r = 0.895 P < 0.001

*) Predicted from regression.

Table 11.7 North Sea WHITING. 1979 Data for Catch Predictions

Age	Consumption landings			Industrial Landings			Discards			Total		
	Catch No. (000)	$\bar{w}$(kg)	F	Catch No. (000)	$\bar{w}$(kg)	F	Catch No. (000)	$\bar{w}$(kg)	F	Catch No. (000)	$\bar{w}$(kg)	F
0	0	-	0	427 422	.008	.174	10 199	.034	.003	437 621	.008	.177
1	18 426	.180	.013	121 337	.069	.104	592 903	.110	.423	732 666	.104	.540
2	106 859	.219	.106	211 529	.141	.249	350 841	.154	.345	669 229	.159	.700
3	138 211	.258	.675	5 596	.252	.032	39 927	.184	.193	183 734	.242	.900
4	68 468	.309	.761	4 205	.418	.055	7 618	.208	.084	80 291	.306	.900
5	21 233	.365	.788	1 382	.449	.061	1 388	.227	.051	24 003	.362	.900
6	3 301	.450	.873	60	.412	.019	30	.241	.008	3 391	.447	.900
7	1 122	.596	.873	26	.609	.024	4	.250	.003	1 152	.595	.900
8+	274	.673	.838	17	.469	.064		-		291	.659	.900

Year	1979	1980	1981
Recruits at age 0 (millions)	3 500	3 110	3 110
Recruits at age 1 (millions)	1 932	2 400	-

Table 11.8 North Sea WHITING
Results of Catch Predictions ('000 tonnes)

1979	SSB:	390
	F:	0.9
	Consumption landings:	93.6
	Industrial landings	53.8
	Discards	128.0
1980	SSB:	360
	F*:	
	Consumption landings:	97
	Industrial landings:	45
	Discards:	106
1981	SSB:	404

F_{81}/F_{79}	Yield in 1981			SSB 1982
	Consumption landings	Industrial landings**)	Discards	
.01	1.6	61.3	1.6	639
.2	30.6	58.8	30	594
.5	69	55.1	70.2	485
1	116.5	49.7	126.3	369
1.5	149.8	45.1	171.3	283
2.0	173.4	41.2	208	219

SSB = Spawning Stock Biomass (ages 2 and older)

F* = Fishing mortality on age groups subject to maximum exploitation

**) = For industrial landings, $F_{81} = F_{80} = F_{79}$

For consumption landings and discards, $F_{1980} = 0.8 \times F_{1979}$.

Table 12.1 Nominal catch (in tonnes) of WHITING in Divisions VIa, 1970-1979
(Data for 1970-1978 as officially reported to ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
Belgium	12	9	7	5	10	1	14	-	-	-
Denmark	-	-	-	121	-	-	-	-	119	-
Faroe Islands	-	-	-	5	1	30	2	-	-	-
France	1 851	2 507	1 662	2 777	2 983	2 763	3 655	3 395	3 610	2 640
German Dem. Rep.	-	-	-	-	-	-	31	-	-	-
Germany, Fed.Rep.of	-	+	148	127	80	62	1	1	2	4
Iceland	-	-	-	-	-	-	-	-	-	-
Ireland	2 420	1 178	1 122	2 117	2 431	2 429	3 255	2 752	2 080	2 785
Netherlands	24	28	40	57	23	85	255	78	23	16
Norway	-	-	-	-	-	-	1	-	-	-
Poland	-	2	-	10	9	-	-	-	-	-
Spain	-	-	1 397	1 540	1 479	1 871	821	763[a]	-	-
U.K. (Engl.+Wales)	76	66	102	91	112	132	244	520	669	320
U.K. (Scotland)	6 839	11 435	10 707	9 796	9 929	12 668	16 658	9 873	8 174	10 614
U.S.S.R.	-	-	128	-	-	-	-	-	-	-
Total VIa	11 222	15 225	15 313	16 646	17 057	20 041	24 937	17 382	14 677	16 379
Working Group total catch								17 384	14 677	16 379

*) Preliminary a) Includes VIb

Table 12.2 Nominal catch (in tonnes) of WHITING in Division VIb, 1970-1979
(Data for 1970-1978 as officially reported to ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
Faore Islands	-	-	-	-	1	-	-	+	-	-
France	1 265	800	69	62	-	-	-	-	-	-
Ireland	-	-	-	-	-	-	-	-	1	-
Spain	-	-	-	-	-	-	-	... b)	-	-
U.K. (Engl.+Wales)	+	+	+	+	-	-	3	2	5	1
U.K. (Scotland)	12	7	12	1	+	12	15	5	24	1
Total VIb	1 277	807	81	63	1	12	18	7	30	2

x) Preliminary b) Included in VIa

Table 12.3 Estimates of WHITING year class strength at age 1 from VIa VPA and from North Sea (IV) WHITING VPA

Year Class	North Sea (IV)	VIa	
1964	1 983	62.2	$N_{VIa} = N_{IV} + b$
1965	1 403	70.1	
1966	1 704	78.1	where
1967	4 863	246.7	a = 0.06187
1968	816	16.6	b =-38.0791
1969	1 157	25.7	r = 0.927108
1970	1 648	38.1	(significant @ .001 level
1971	2 635	89.3	for 1964-1977
1972	3 309	204.5	Mean N_{VIa} 1964-1977
1973	2 295	73.0	= 96.171
1974	3 080	176.9	(SD = 69.4).
1975	1 574	55.9	
1976	1 825	69.3	
1977	2 081	140.0	
1978	1 932*)	(81.5)	
1979	2 408*)	(110.9)	

*) Data from predictive regression on IYHS data.

( ) Data from his predictive regression on North Sea values.

Table 12.4 WHITING in Division VIa. Catch and Effort Data

Year	SCOTLAND												ENGLAND								
	Motor Trawl				Seine				Light Trawl				Motor Trawl								
	L	E	$\frac{L}{E}$	γ	L	E	$\frac{L}{E}$	γ	L	E	$\frac{L}{E}$	γ	L	E	$\frac{L}{E}$	γ	Σ Cij	Γ_j	Cj	Cj/Γ_j	E_j *)
1963	567	37	15.3	.27	5 762	165	34.9	.29	533	38	14.1	.50	-	-	-	-	-	-	-	-	
1964	1 156	75	15.4	.27	5 662	181	31.3	.26	569	44	12.9	.46	-	-	-	-	-	-	-	-	
1965	1 343	73	18.4	.33	6 446	153	42.2	.35	1 318	37	35.6	1.27	426	2 958	.144	.39	9 534	0.476	19 179	40 292	2.4600
1966	2 071	72	28.8	.51	7 089	157	45.1	.37	2 227	41	54.3	1.93	511	2 486	.205	.55	11 898	0.694	15 542	22 395	1.3673
1967	1 145	54	21.3	.38	7 723	159	48.6	.40	2 348	83	28.2	1.00	304	2 304	.132	.35	11 520	0.519	17 586	33 884	2.0687
1968	1 464	50	29.3	.52	5 951	150	39.7	.33	1 956	66	29.6	1.05	298	2 443	.122	.33	9 669	0.504	13 989	27 756	1.6946
1969	1 097	43	25.5	.45	4 749	140	33.9	.28	2 449	105	23.3	.83	180	2 049	.088	.24	8 475	0.460	12 181	26 480	1.6167
1970	865	41	21.1	.37	2 860	96	29.8	.24	2 573	115	22.4	.80	76	1 249	.061	.16	6 374	0.483	11 222	23 234	1.4185
1971	783	42	18.7	.33	5 923	99	59.8	.49	4 050	129	31.4	1.12	65	805	.081	.22	10 821	0.661	15 225	23 033	1.4063
1972	864	56	15.4	.27	4 376	71	61.6	.51	4 395	142	30.9	1.10	100	1 225	.082	.22	9 375	0.781	15 313	19 607	1.1971
1973	1 135	55	20.6	.36	4 846	59	82.1	.67	2 250	91	24.7	.88	90	1 080	.083	.22	8 322	0.680	16 646	24 479	1.4945
1974	987	56	17.7	.31	5 292	57	92.8	.76	2 566	86	29.8	1.06	111	1 032	.108	.29	8 956	0.791	17 057	21 564	1.3166
1975	762	37	20.6	.36	5 591	56	99.8	.82	4 471	129	34.7	1.23	132	1 068	.124	.33	10 955	0.949	20 041	21 118	1.2893
1976	1 422	35	40.6	.72	7 764	57	136.2	1.12	5 618	139	40.4	1.44	240	1 259	.190	.51	15 043	1.192	24 937	20 920	1.2772
1977	621	22	28.2	.20	3 830	42	91.1	.75	3 765	143	26.3	.94	513	1 823	.281	.76	8 729	0.793	17 382	21 919	1.3382
1978	1 803	52	34.7	.61	2 334	34	68.6	.56	2 794	127	22.0	.78	665	1 613	.412	1.11	7 597	0.701	14 677	20 937	1.2783
1979	1 862	33	56.5	1.00	4 629	38	121.8	1.00	2 812	100	28.1	1.00	259	698	.371	1.00	9 692	1.000	16 379	16 379 *)	1.0000

*) Provisional

Table 12.5 WHITING in Division VIa.
Input catch data for VPA.

AGE	1965	1966	1967	1968	1969	1970
0	0	0	0	0	0	0
1	2921	1726	5356	7333	734	733
2	6356	19753	31587	26193	28111	2802
3	54044	3417	12510	10125	10768	34479
4	6978	37769	1020	3828	3098	5389
5	1033	2301	18082	284	1424	948
6	286	277	879	5133	120	249
7	38	45	92	287	1906	16
8+	16	22	23	34	170	446

AGE	1971	1972	1973	1974	1975	1976
0	0	0	0	4	54	6
1	2858	13337	14363	7618	17523	7962
2	8455	12407	30540	43269	18683	44566
3	4273	4793	7969	12381	39415	16756
4	36928	1486	2184	2070	3238	22205
5	1774	19069	556	515	307	2512
6	311	1119	6495	65	60	223
7	56	85	332	1407	6	38
8+	73	85	42	62	194	127

AGE	1977	1978	1979
0	14	1	11
1	3077	14468	1707
2	17449	15504	33623
3	33253	7256	16525
4	3308	13754	3866
5	5702	1626	4858
6	384	2110	355
7	7	77	519
8+	5	11	13

Table 12.6 WHITING in Division VIa.
Fishing mortalities from VPA (M = 0.2).

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973
0	.000	.000	.000	.000	.000	.000	.000	.000	.000
1	.053	.028	.079	.033	.050	.032	.086	.179	.081
2	.663	.592	.954	.660	.172	.272	.602	.641	.786
3	.481	.954	.971	.981	.635	.330	.858	.844	1.200
4	.868	.745	.873	.951	.975	.778	.710	.860	1.318
5	1.066	.813	1.034	.646	1.267	.960	.644	1.045	.973
6	1.409	.979	.880	.992	.632	.796	1.035	1.172	1.438
7	.856	.913	1.118	.828	1.443	.156	.410	.933	1.618
8	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200	1.200
MEAN F FOR AGES >= 2 AND <= 5 (WEIGHTED BY STOCK IN NUMBERS)									
	.528	.703	.978	.751	.252	.362	.698	.853	.876

AGE	1974	1975	1976	1977	1978	1979
0	.000	.001	.000	.000	.000	.001
1	.122	.116	.170	.050	.121	.023
2	.367	.489	.475	.679	.378	.450
3	.893	.675	1.149	.801	.681	.900
4	1.328	.622	1.077	.843	.965	1.000
5	1.540	.708	1.632	.938	1.286	1.200
6	.271	.751	2.234	1.469	1.202	1.200
7	1.865	.036	1.904	.398	1.698	1.200
8	1.200	1.200	1.200	1.200	1.200	1.200
MEAN F FOR AGES >= 2 AND <= 5 (WEIGHTED BY STOCK IN NUMBERS)						
	.454	.606	.699	.776	.598	.607

Table 12.7 WHITING in Division VIa.
Stock size in numbers from VOA.

AGE	1965	1966	1967	1968	1969	1970
0	85568	95434	301289	20287	31438	46535
1	62194	70057	78135	246674	16610	25739
2	14312	48284	55800	59140	195339	12936
3	154840	6039	21861	17593	25015	134610
4	13087	78340	1905	6776	5403	10855
5	1709	4500	30437	652	2143	1669
6	408	482	1633	8859	280	494
7	74	82	148	555	2691	122
8	19	26	27	40	198	520

AGE	1971	1972	1973	1974	1975	1976
0	109068	249740	89154	216025	68359	84674
1	38100	89298	204470	72993	176863	55919
2	20412	28616	61099	154448	52894	129004
3	8072	9150	12339	22790	87603	26565
4	79233	2802	3221	3042	7637	36512
5	4081	31900	971	706	660	3357
6	523	1755	9182	301	124	266
7	182	152	445	1784	188	48
8	85	99	49	72	226	148

Age	1977	1978	1979
0	171063	101133	12143
1	69320	140042	82800
2	38611	53977	101613
3	65677	16025	30275
4	6893	24126	6639
5	10183	2429	7523
6	537	3265	550
7	23	101	804
8	6	13	15

Table 12.8. Whiting in Division VIa

1979 Input Data for Catch Prediction
(No data on discards or industrial landings)

Age	Catch No * (000)	$\bar{w}$ (kg)	F
1	1 707	.213	.023
2	33 623	.241	.450
3	16 525	.267	.900
4	3 866	.310	1.000
5	4 858	.377	1.200
6	355	.471	1.200
7	519	.563	1.200
8+	10	.690	1.200

Year	1979	1980	1981
Recruits at age 1 (000)	81 500	110 900	96 000

* Adjusted so that sum of products equals landings

Table 12.9. WHITING in Division VIa
Results of Catch Predictions (1 000 tonnes)

1979	SSB	38.2
	TB	55.5
	F	1.2
	Yw	16.4
1980	SSB	34.8
	TB	58.5
	F	1.2
	Yw	16.4
1981	SSB	37.7
	TB	58.1

F_{81}/F_{79}	Yw in 1981 consumption landings	SSB 1982	TB 1982
0.01	0.2	53.9	74.3
0.2	4.3	49.6	70.1
0.5	9.8	44.0	64.4
1.0	16.7	36.9	57.4
1.5	21.7	31.9	52.4
2.0	25.4	28.3	48.8

SSB = Spawning stock biomass (ages 2+)

TB = Total stock biomass

F = Fishing mortality on age groups subject to maximum exploitation

Yw = Yield in weight

Table 13.1 Nominal catch (in tonnes) of WHITING in Division VIId and VIIe in 1970-1979
(Data for 1970-1978 as officially reported to ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
Belgium	41	25	19	38	39	70	103	36	85	88
Denmark	-	-	-	-	-	-	18	-	1	2 572
France	4 029	2 999	3 121	5 050	7 917	10 060	8 390	8 886	8 010	7 374
Netherlands	2	1	21	42	12	14	5	1	2	1
Ireland	-	-	-	-	-	-	-	11	12	-
U.K. (Engl.+Wales)	753	567	515	498	579	1 255	1 504	1 342	1 038	930
Germany,Fed.Rep. of	-	+	-	-	25	1	-	-	-	-
U.S.S.R.	-	-	-	19	-	-	-	-	-	-
Total VIId,e	4 825	3 592	3 676	5 647	8 572	11 400	10 020	10 276	9 148	10 665

*) Preliminary

Table 13.2 Nominal catch (in tonnes) of WHITING in Divisions VIIb,c and VIIg-k
(Data for 1970-1978 as officially reported to ICES)

Country	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979*)
Belgium	113	54	20	124	75	83	97	60	37	22
France	3 066	4 893	5 695	4 035	4 331	3 637	4 731	3 962	3 848	3 980
Germany,Fed.Rep. of	1	-	-	+	-	2	-	1	45	-
Ireland	712	482	1 141	1 894	1 641	2 562	1 980	1 201	1 172	2 674
Netherlands	73	100	377	2 080	915	66	112	86	63	2
Poland	-	-	-	14	-	-			-	-
Spain	-	-	1 491	1 121	1 367	2 974	2 772		-	-
U.K. (Engl.+Wales)	80	17	34	21	15	61	21	26	38	22
U.K. (Scotland)	-	-	-	-	-	-	-	2	1	1
U.S.S.R.	-	-	3	16	-	64	2	-	-	-
Total VIIb,c and g-k	4 045	5 546	8 761	9 305	8 344	9 449	9 715	5 338	5 204	6 701

*) Preliminary

Figure 3.1 North Sea COD.

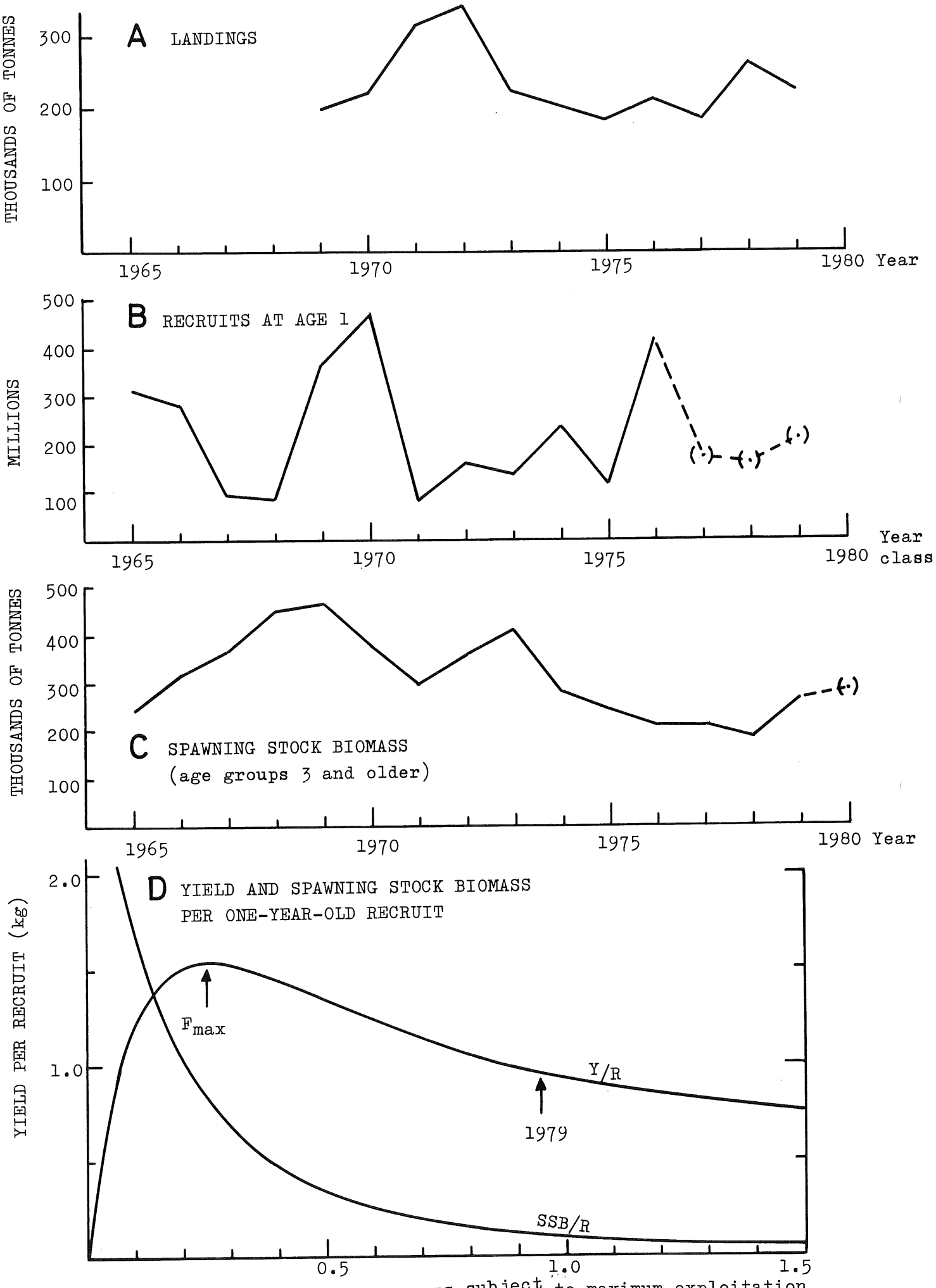


Figure 3.2 North Sea COD.
Catch predictions.

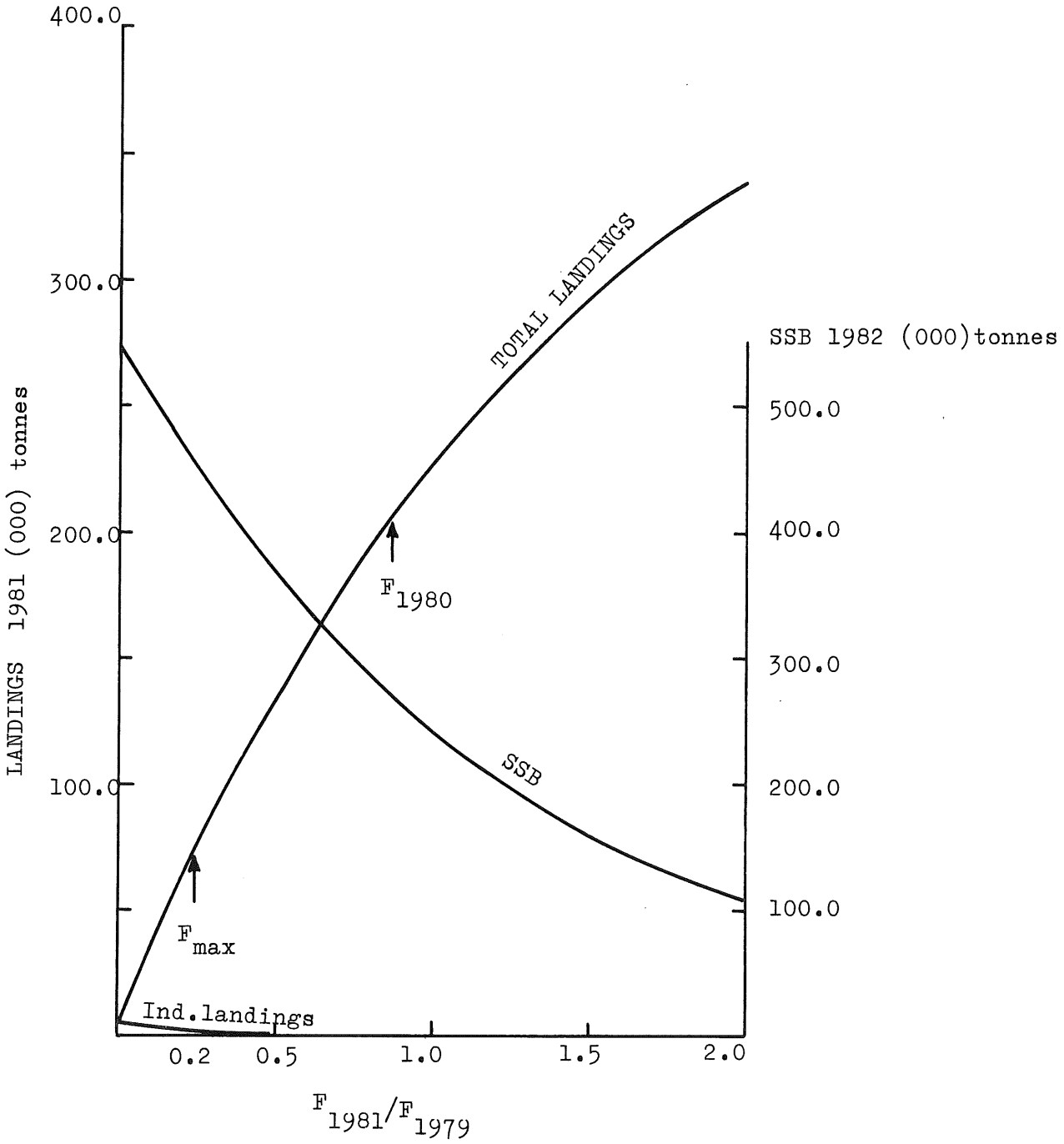


Figure 4.1 COD in Division VIa.

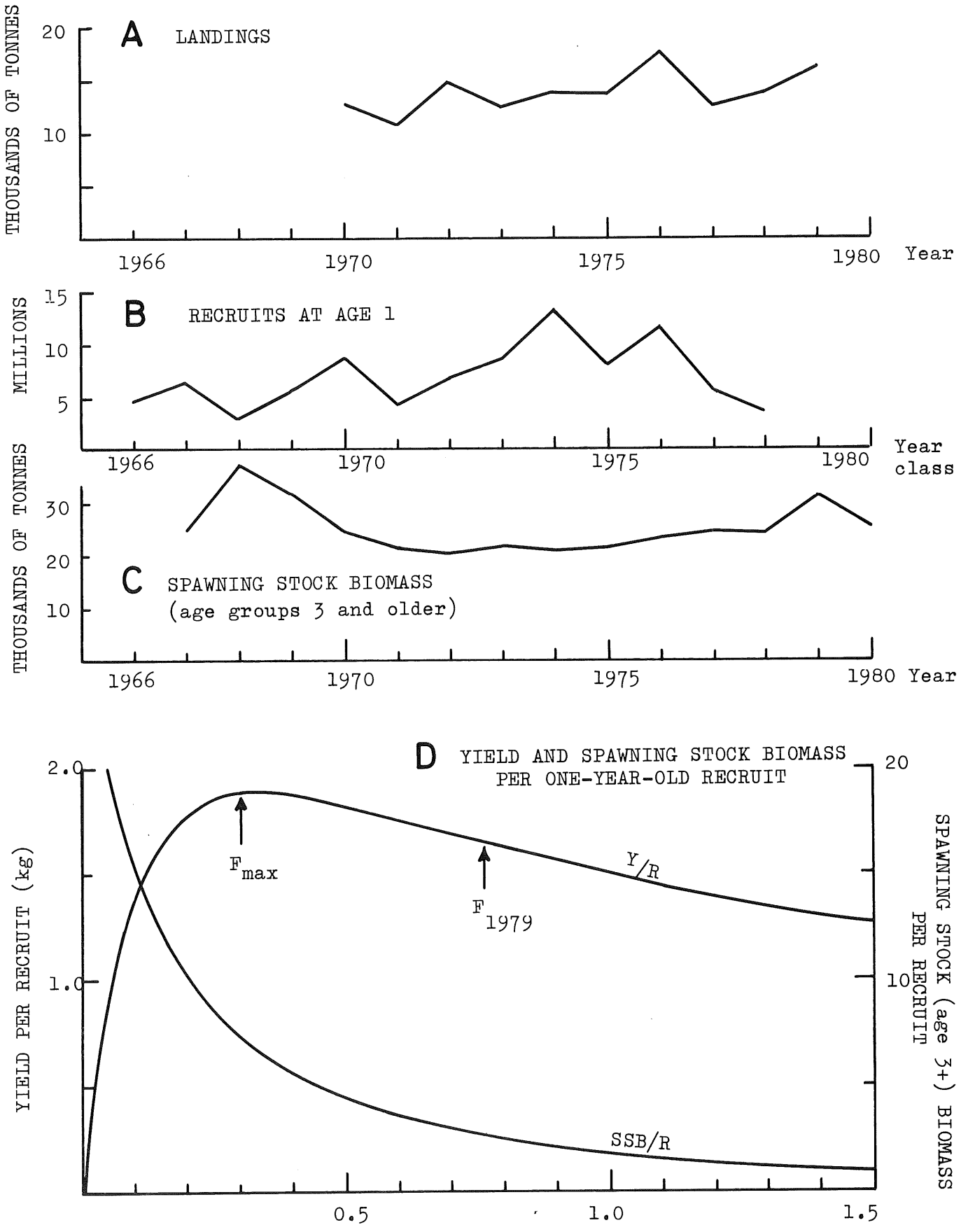


Figure 4.2 COD in Division VIa.
Catch predictions.

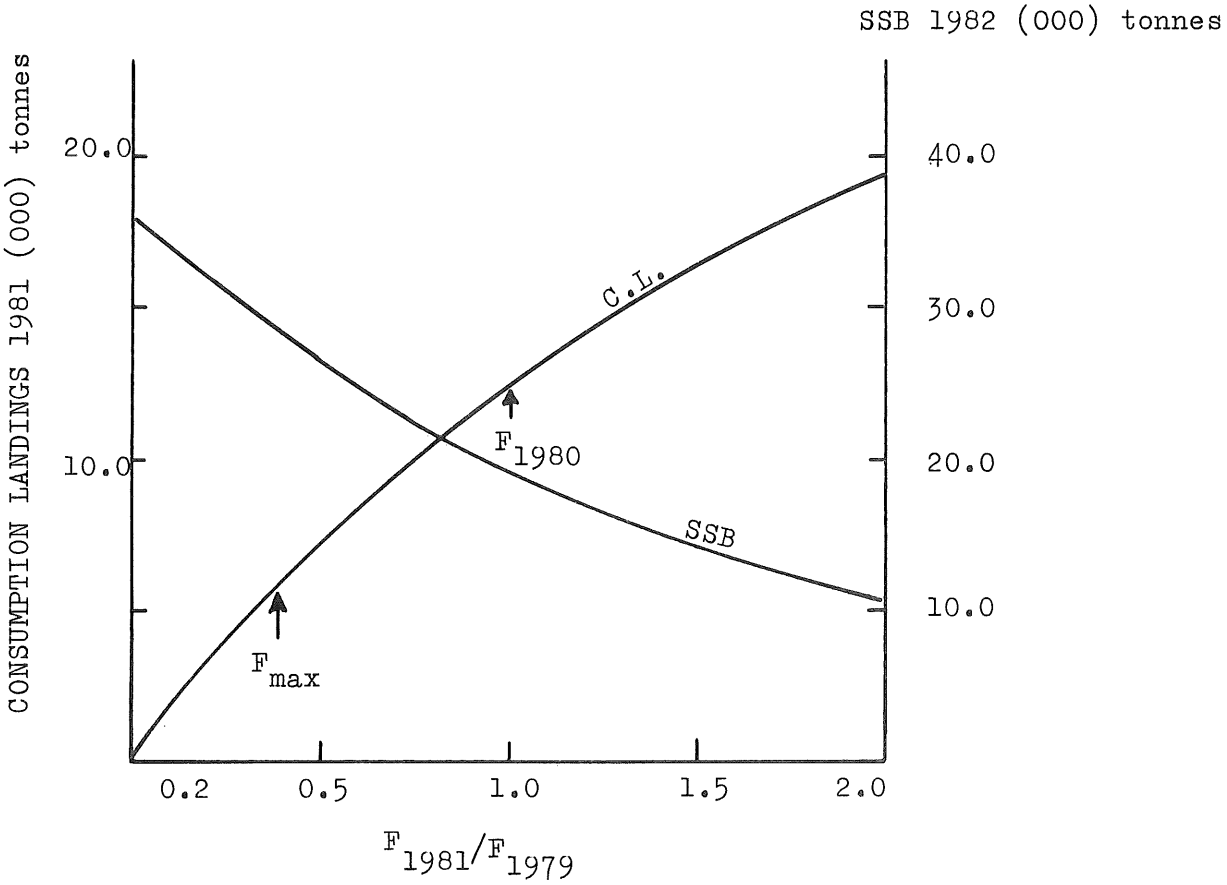


Figure 7.1 North Sea HADDOCK.

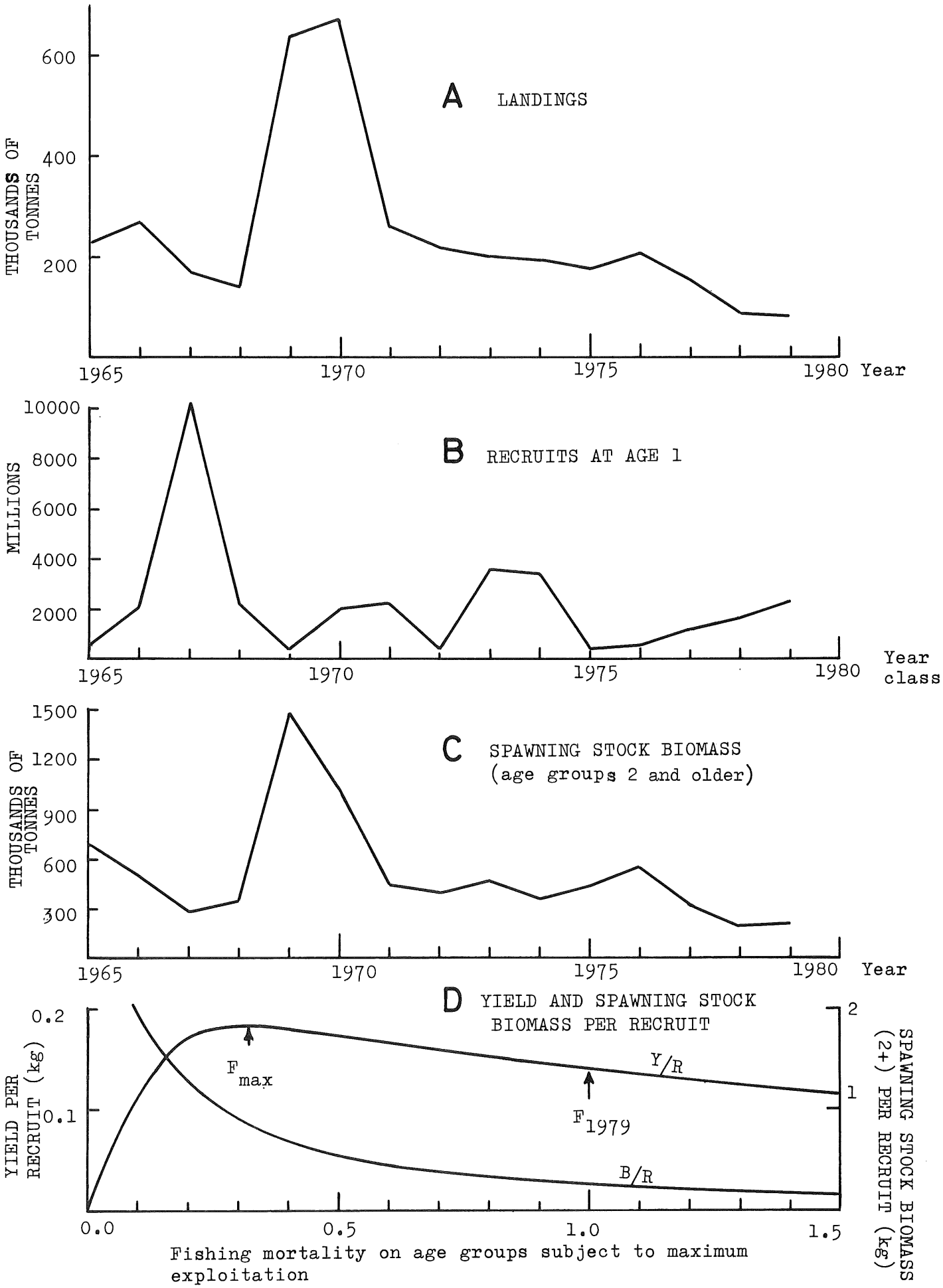


Figure 7.2 North Sea HADDOCK.
IYHS abundance indices VS
VPA results.

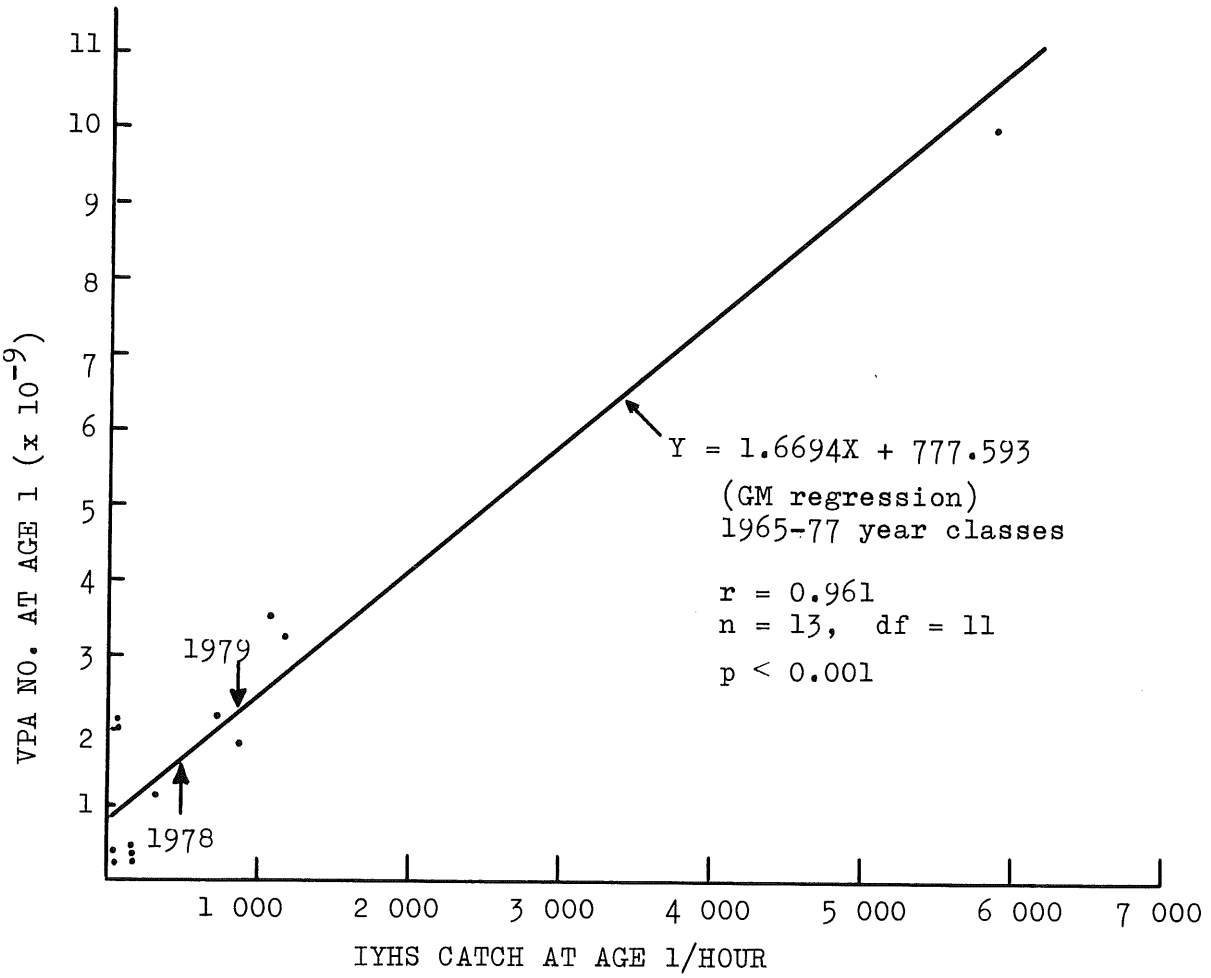
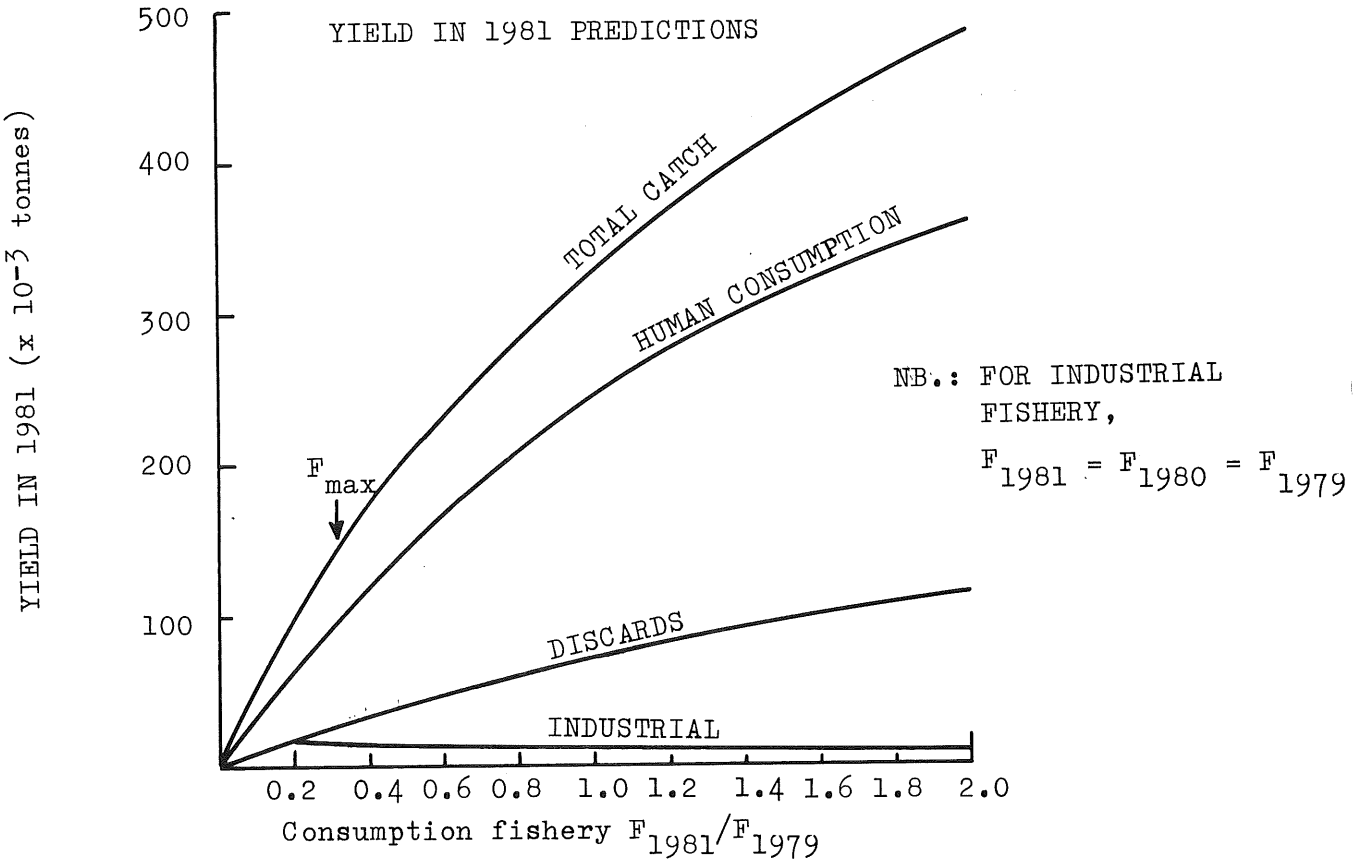


Figure 7.3 North Sea HADDOCK.
Catch predictions.



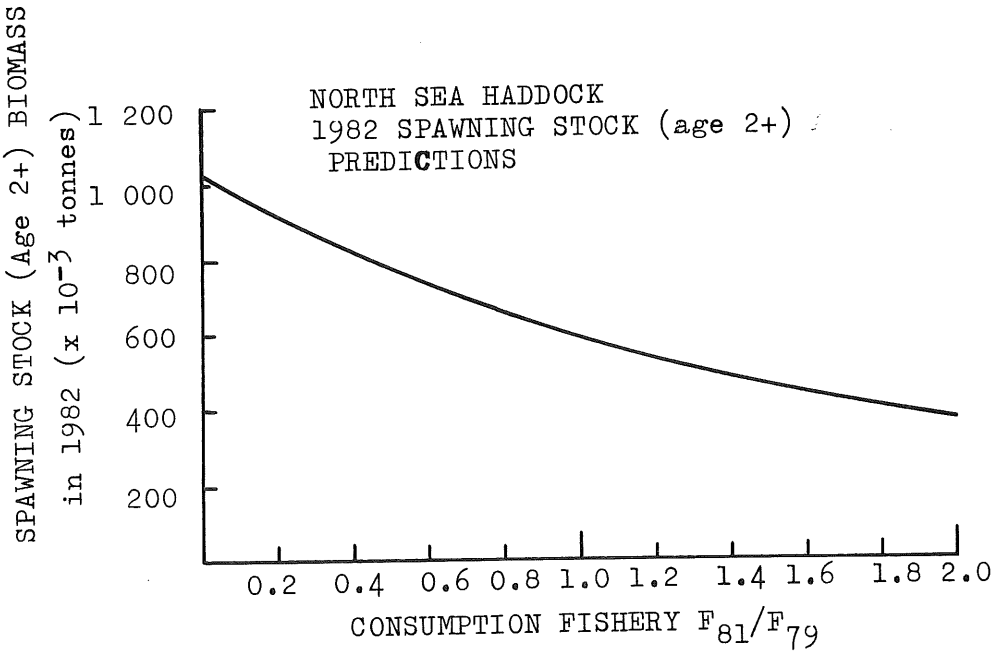


Figure 8.1 HADDOCK in Division VIa.

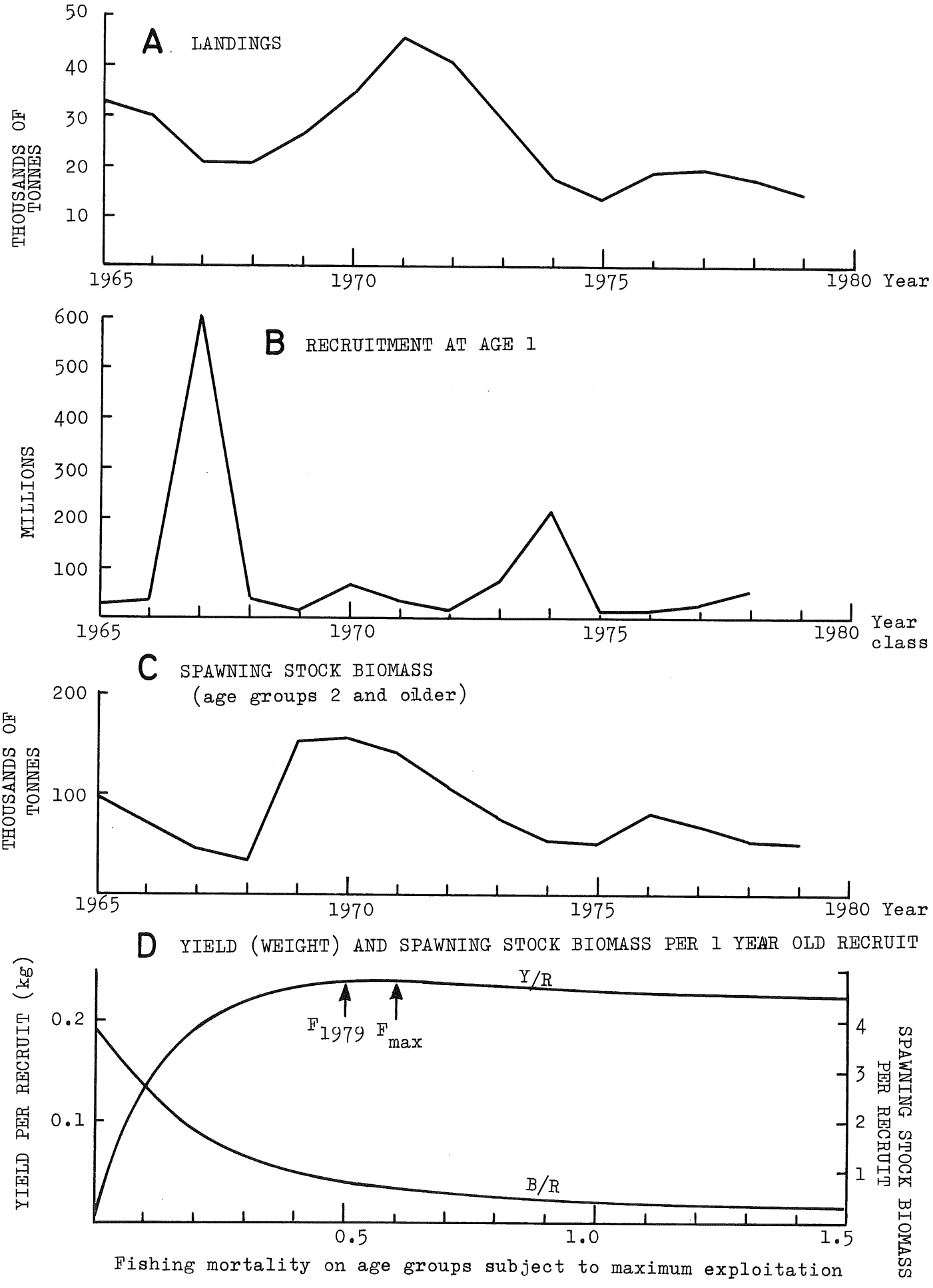


Figure 8.2 HADDOCK in Division VIa.
Mean F vs fishing effort.

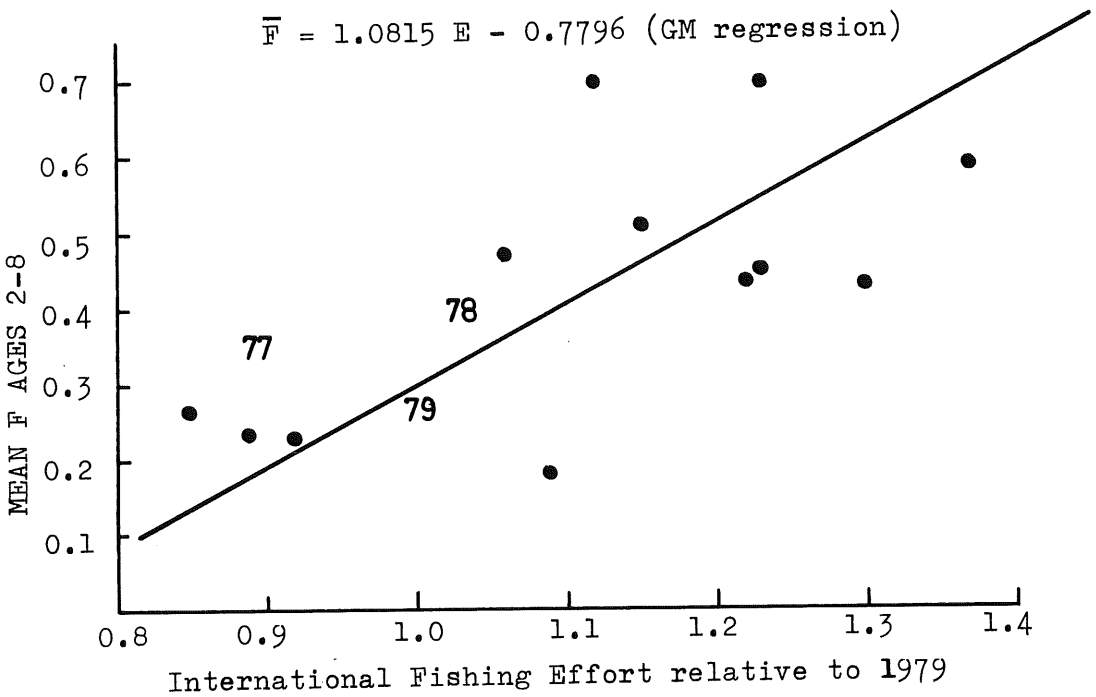


Figure 8.3 HADDOCK year class strength at age 1 (from VPA results) North Sea (IV) vs VIa.

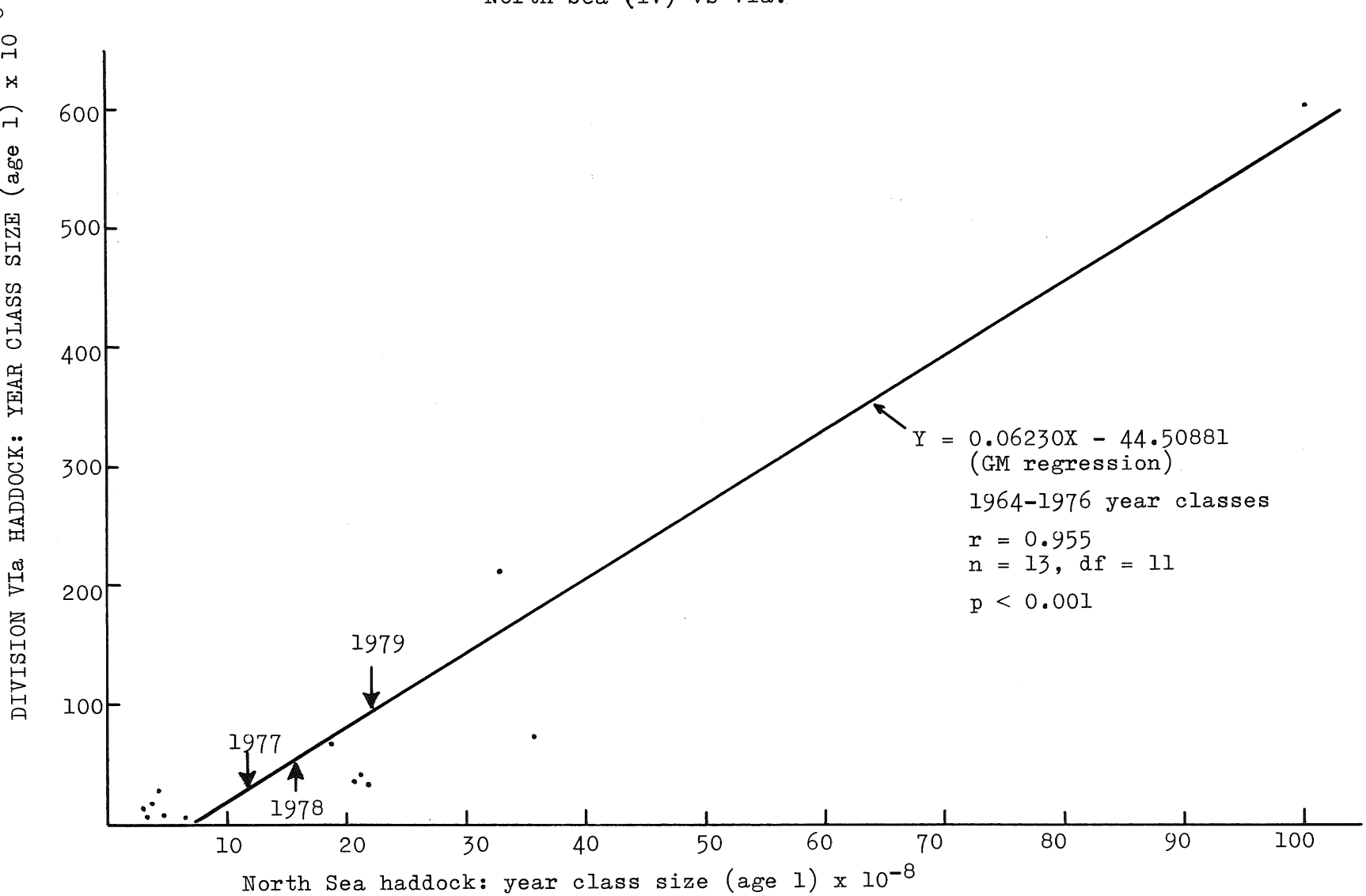


Figure 8.4 HADDOCK in Dibision VIa.
Catch predictions.

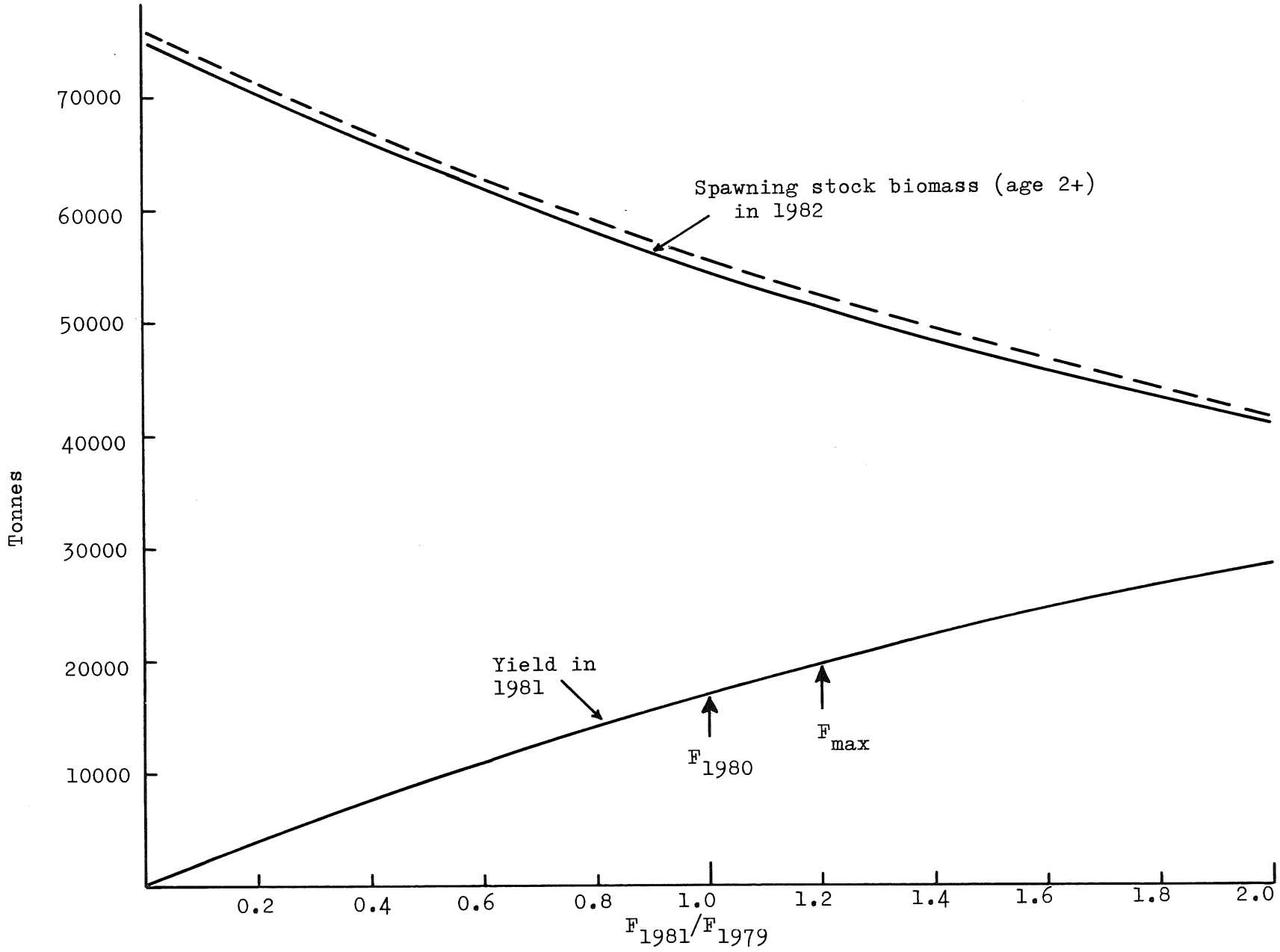


Figure 11.1 North Sea WHITING.

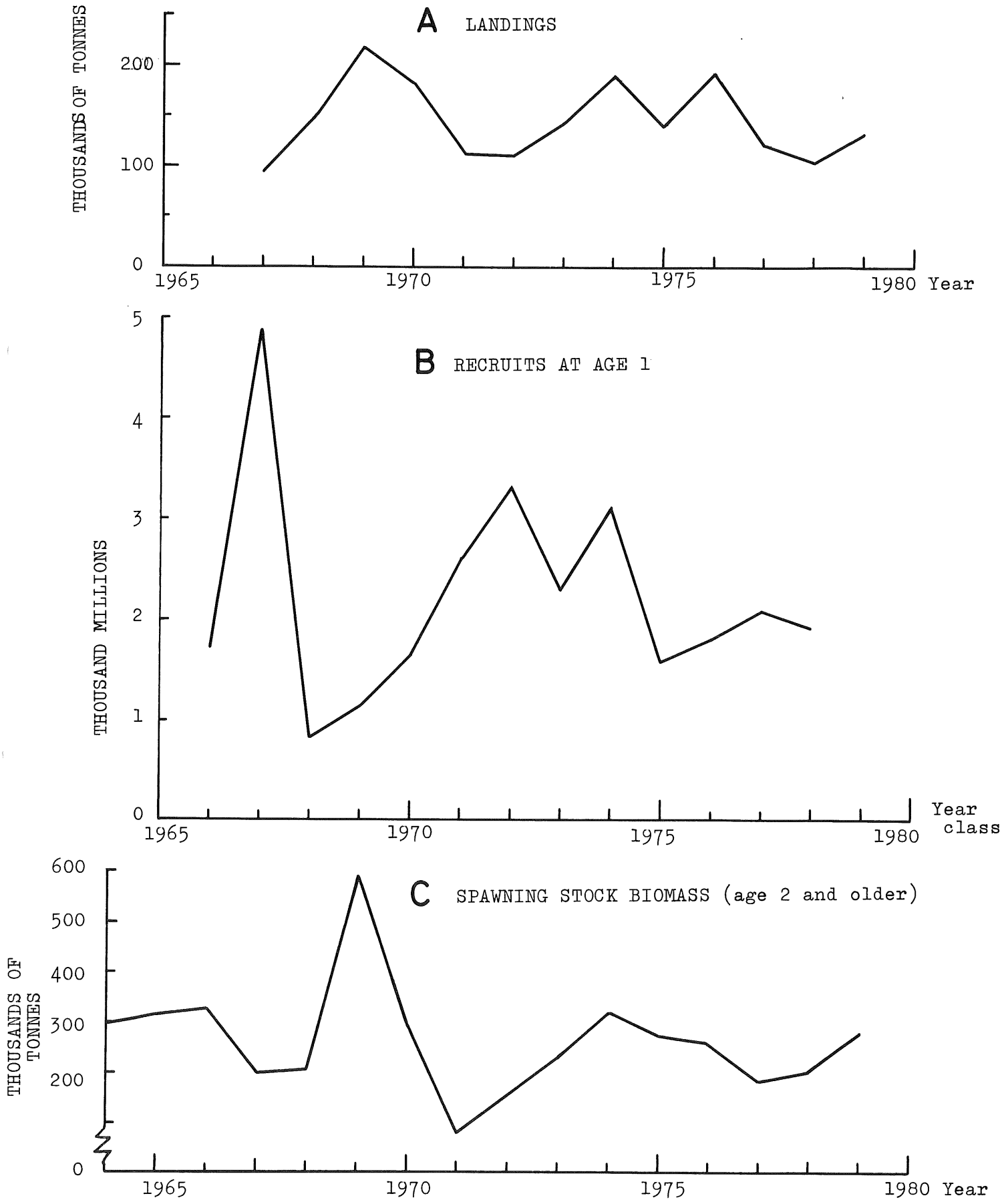
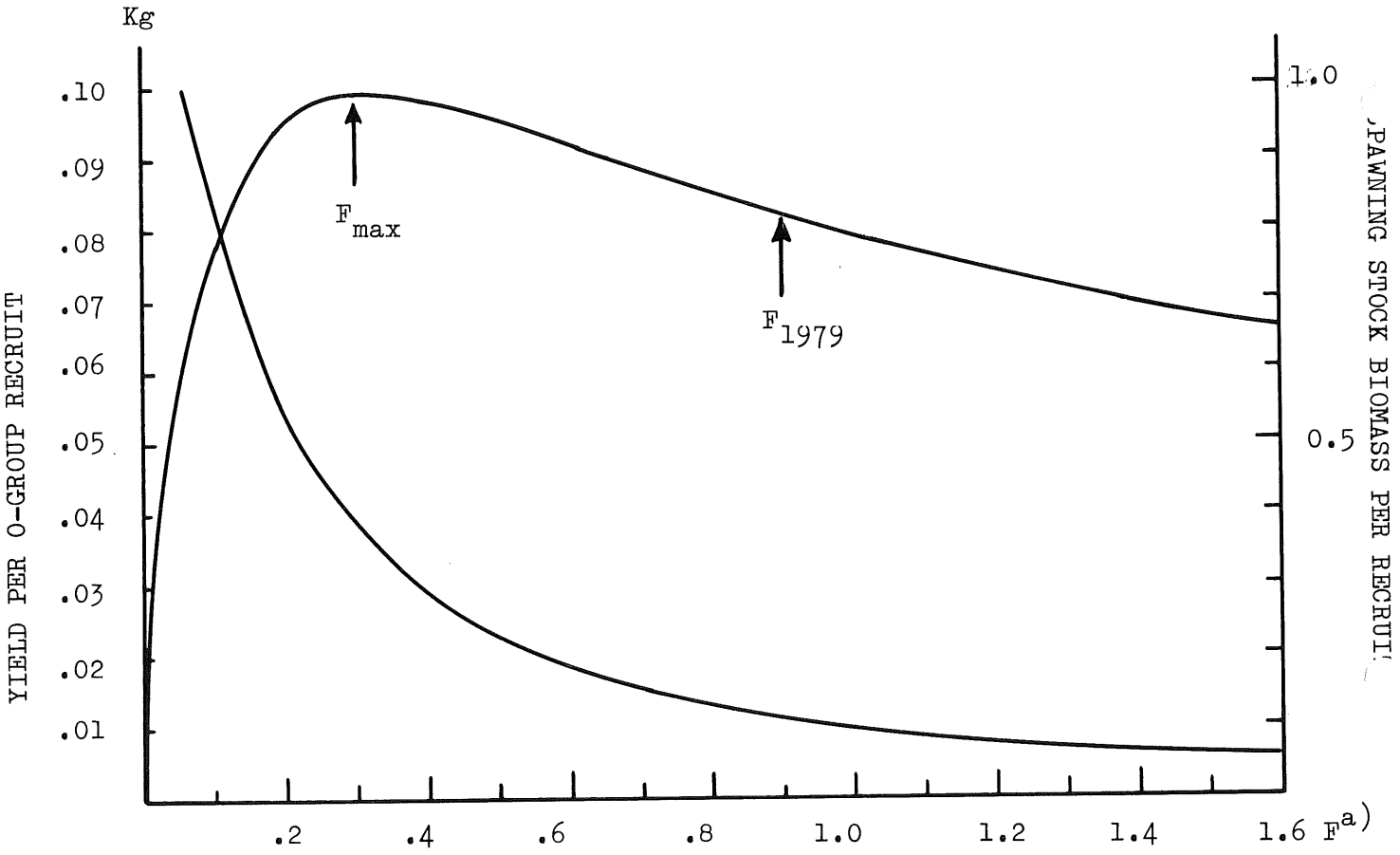


Figure 11.2 North Sea WHITING.
Yield and spawning stock biomass per 0-group recruit.



a) F accounts for consumption fishery, discards and industrial fishery.

Figure 11.3 North Sea WHITING.
Catch precictions.

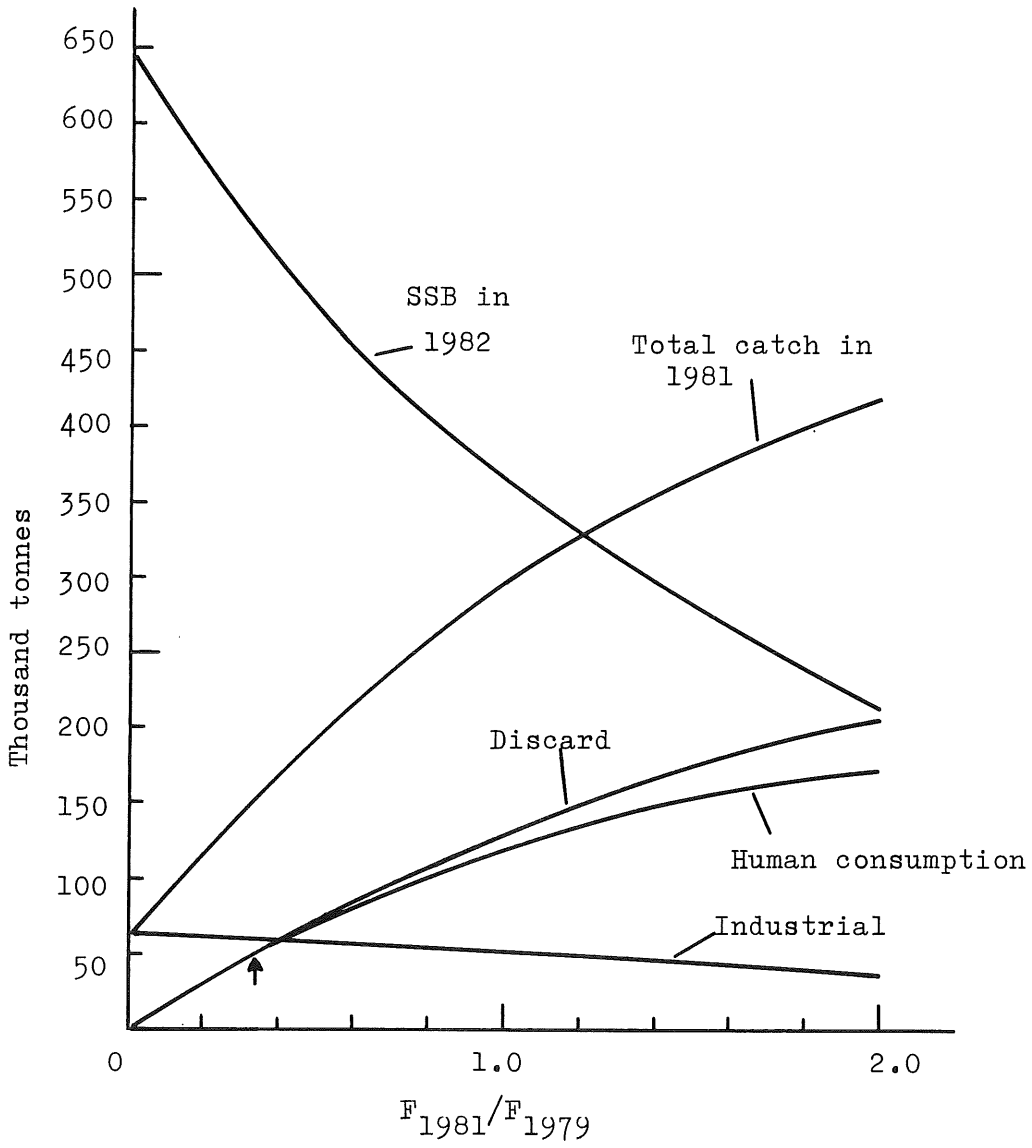
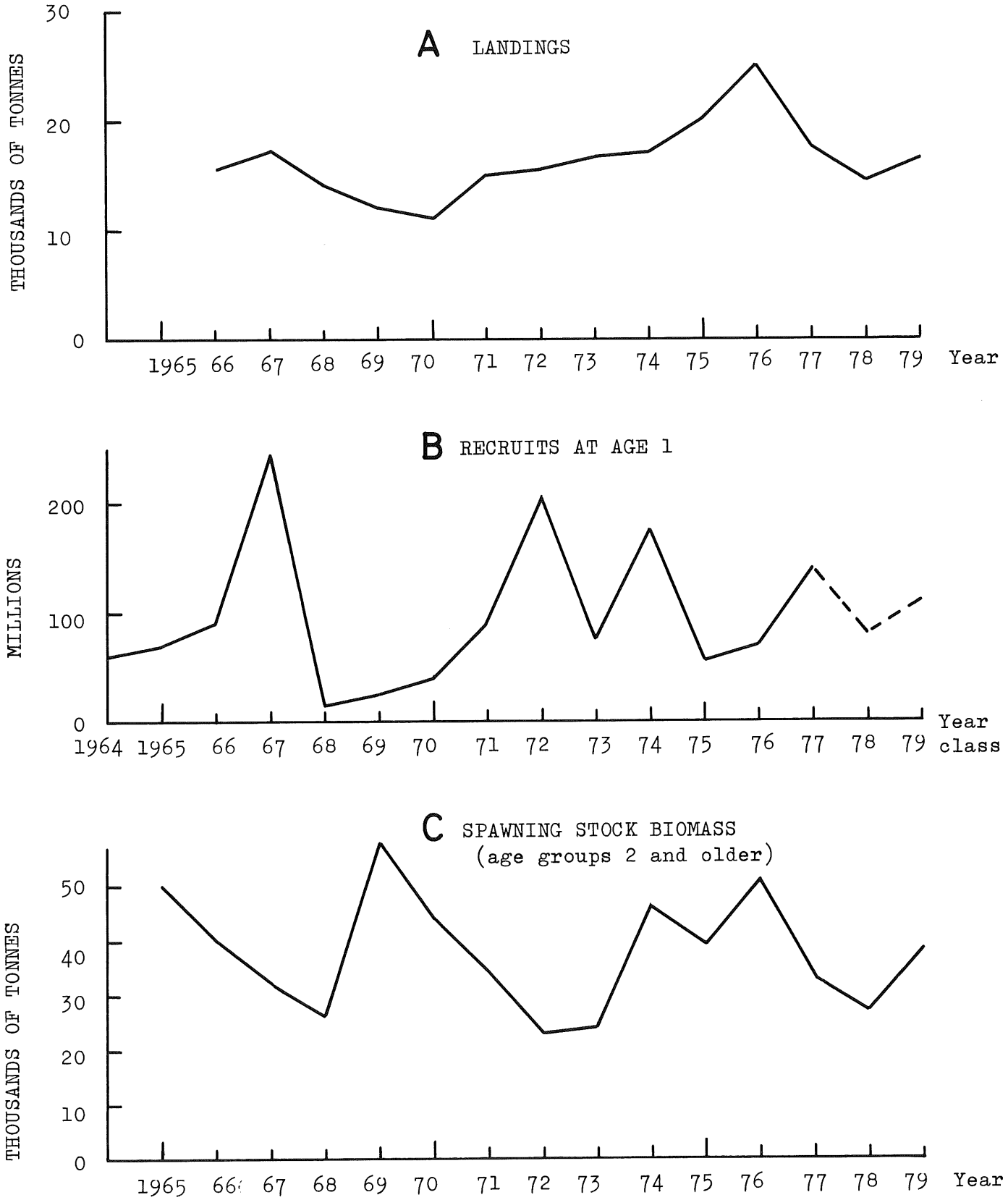


Figure 12.1 WHITING in Division VIa.



continued

Figure 12.1 (continued) WHITING in Division VIa.

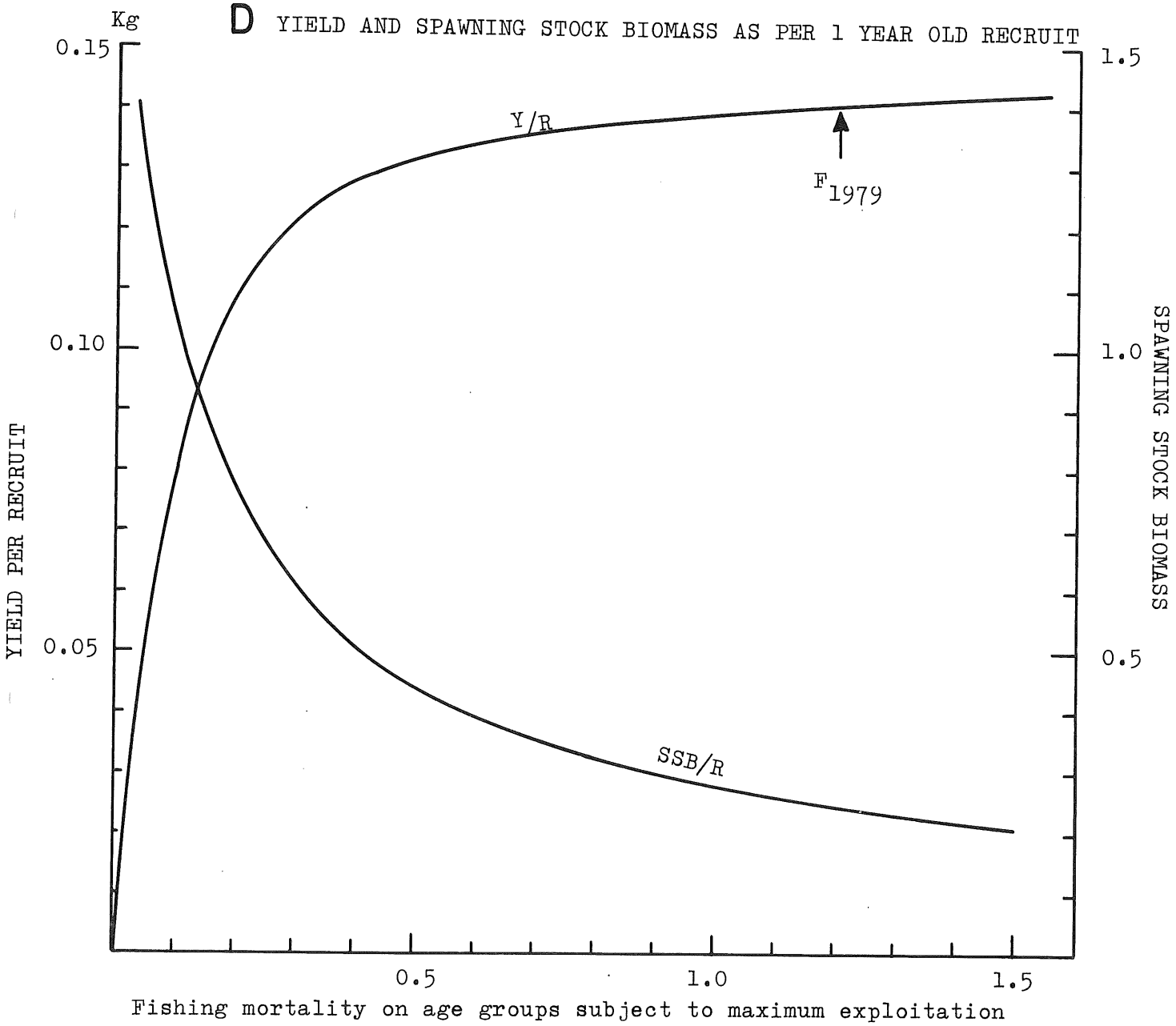


Figure 12.2 Relationship between year class strength of WHITING in Sub-area IV and Division VIa, within years.

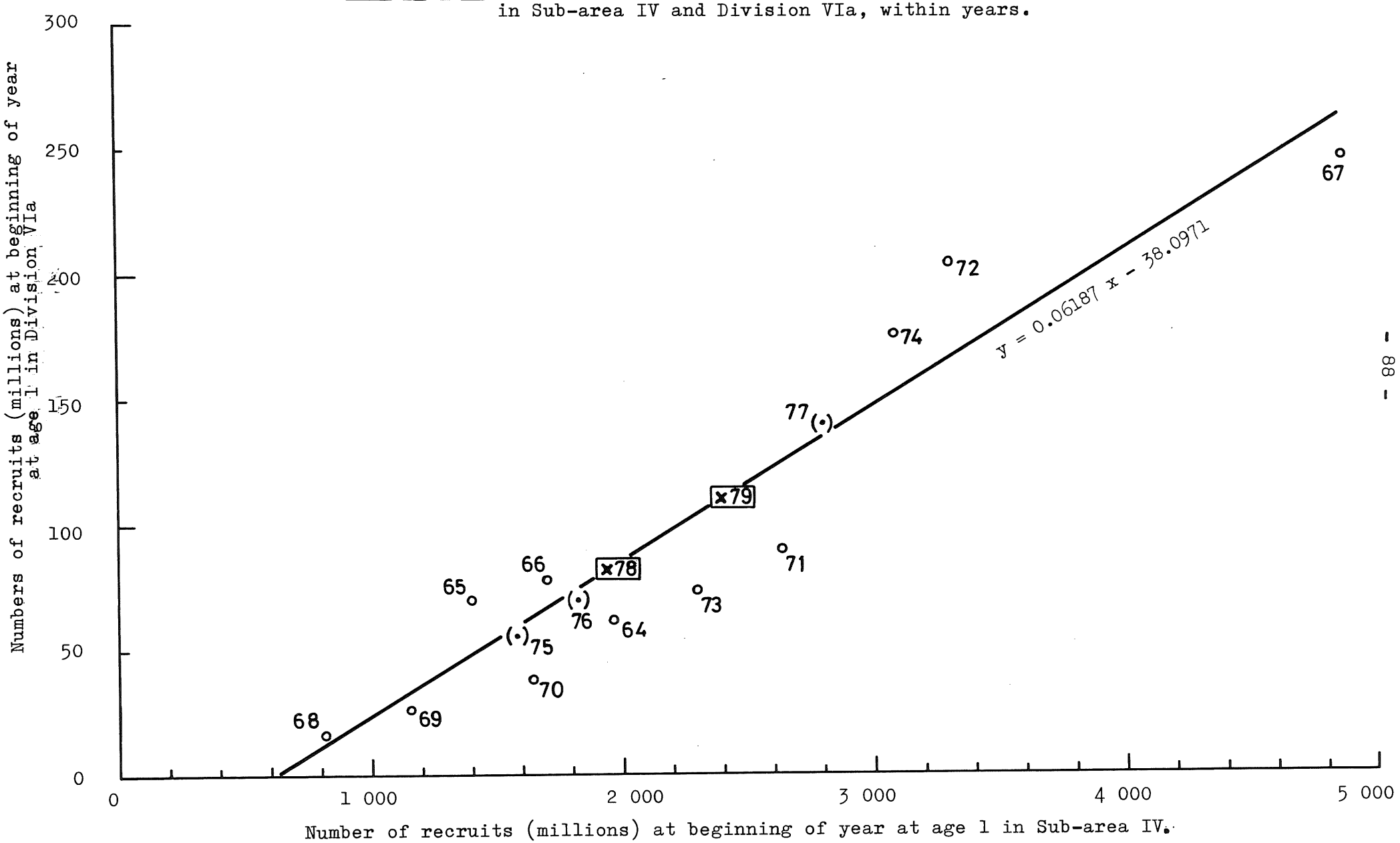
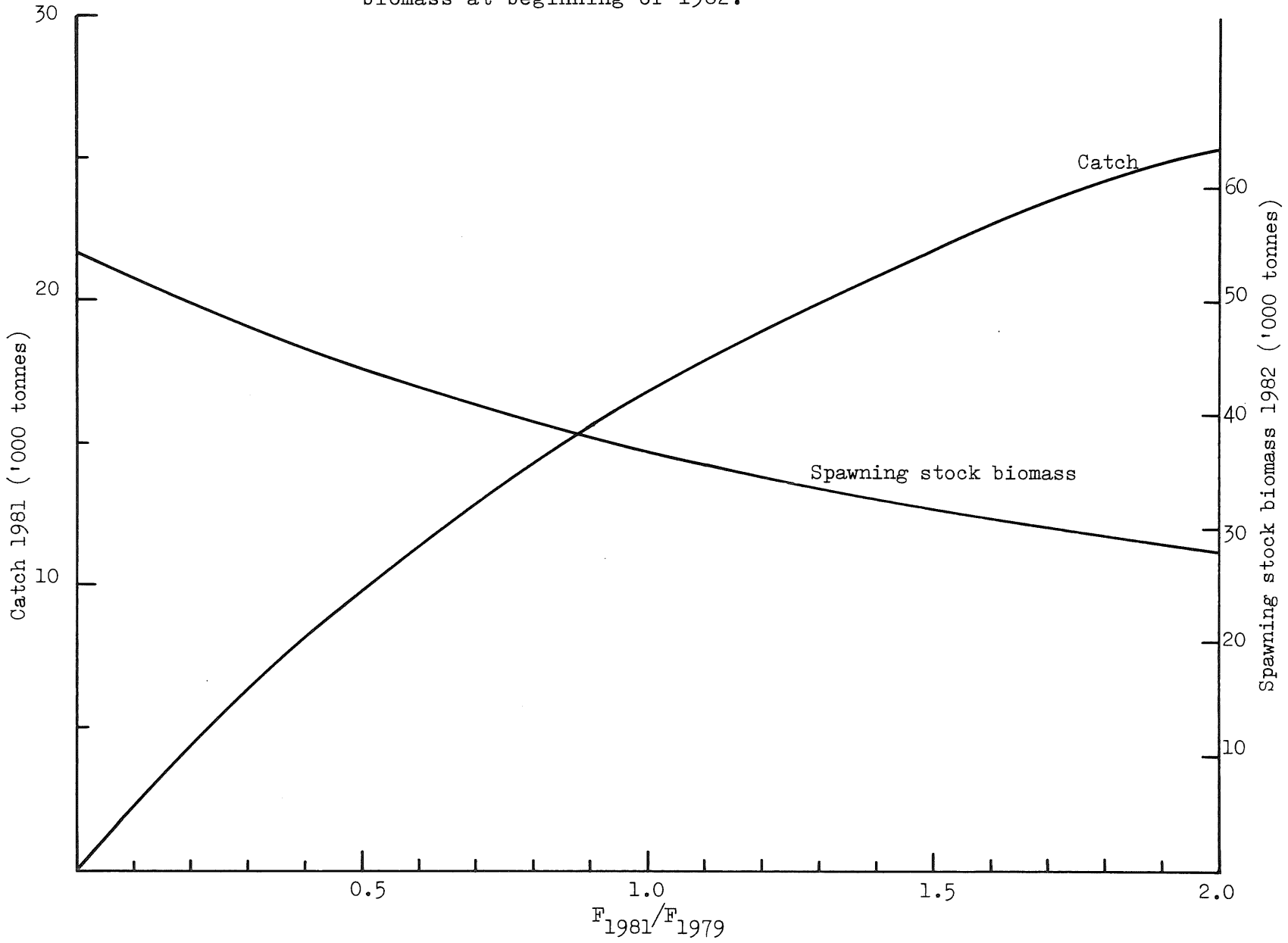


Figure 12.3 WHITING in Division VIa.
Catch predictions for 1981 and spawning stock biomass at beginning of 1982.



ANNEX 1

Revisions to Historical Data Sets for Haddock and Whiting in the North Sea

North Sea

The amendments described below were made prior to the meeting of the Working Group. The historical data sets were corrected to take account of arithmetical errors and to include previously submitted updatings of Bulletin Statistique data.

Discards of Haddock and Whiting

For the period 1960 to 1975, Dutch discard data (N. Daan (1976), "Report on discards of cod, haddock and whiting in the North Sea by the Dutch Fleet 1958-1975", ICES C.M. 1976/F:8, Demersal Fish (Northern) Committee) were raised to total international discards using the factor

$$T_i/D_i$$

For 1976 and 1977, Dutch and Scottish discard data were raised to total international discards using the factor

$$T_i / (D_i + S_i)$$

T_i = Total weight landed by human consumption fisheries in year i,
D_i = Weight landed by Dutch human consumption fishery,
S_i = Weight landed by Scottish human consumption fishery.

Danish Industrial landings of Haddock for the Period 1960 to 1971

In the previously used data set, it had been assumed that the Danish landings age composition for the period 1960 to 1971 was the same as that estimated for the human consumption fishery. From 1972 and onwards, data are available to assess the actual age composition of the Danish industrial landings. Inspection of these data show that the Danish industrial landings of haddock consist predominantly of young fish (ages 0, 1, 2, 3).

To estimate a more appropriate age composition for the Danish industrial landings for the period 1960 to 1971 the following procedures were adopted:

1) It was assumed that the nominal weight landed by Denmark as shown in Bulletin Statistique consisted entirely of industrial by-catch.

2) For the period 1972 to 1977 the ratio of the number per tonne in the Danish industrial catch to the number per tonne in the total human consumption landings was computed for ages 1 to 7. A mean of the ratios was derived from this data set (Annex 1, Table 1).

3) Using these values the estimated number per tonne for ages 1 to 7 in the Danish industrial catch for the period 1960 to 1971 were derived from corresponding values of numbers per tonne in the total human consumption landings. The total estimated number of haddock landed as industrial by-catch was then obtained by multiplying by the appropriate weight landed.

4) Using data for the period 1972 to 1977 the ratio of the number per tonne in the Danish industrial landings at age 0 in year t to the corresponding value at age 1 in year t + 1 was evaluated. A mean value was then obtained (Annex 1, Table 2).

5) These values were then used to estimate the number at age 0 in the Danish industrial catch from the number at age 1 as estimated in paragraph 3) above.

6) The numbers at age in the Danish industrial landings were then adjusted by S.O.P. to agree with the Bulletin Statistique Danish landings. The mean weights at age used to evaluate S.O.P.s are shown in Annex 1, Table 3.

It should be added that the procedure described above is far from satisfactory, especially since very large S.O.P. corrections were required to make the estimated Danish age compositions agree with Bulletin Statistique data. However, the method does at least produce Danish age compositions which are more realistic than those used previously. In addition, the method also ensures that relative year class abundances are preserved in the estimated Danish age composition.

ANNEX 1, Table 1 HADDOCK North Sea 1972-1977
Estimated no./tonne in Danish industrial landings:
No/tonne in total human consumption landings.

Age	1972	1973	1974	1975	1976	1977	Mean 1972-1977
0							
1	155.84	71.50	34.92	70.07	88.82	62.60	80.6
2	1.88	1.75	2.15	1.04	2.75	3.70	2.2
3	0.23	.25	0.64	0.32	0.60	1.12	0.53
4	0.05	.13	0.26	0.15	0.02	0.26	0.15*)
5	0.02	.07	-	0.02	0.32	0.29	0.15*)
6	-	.59	0.17	0.01	0.02	0.23	0.15*)
7	-	1.5	0.08	-	-	-	0.15*)
8	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-
10+	-	-	-	-	-	-	-

*) Smoothed value.

ANNEX 1, Table 2 HADDOCK North Sea 1972-1977
No/tonne at age 0 in year t: No/tonne at age 1 in year t + 1 in Danish industrial landings.

1972/73	1973/74	1974/75	1975/76	1976/77	Mean
2.37	2.20	0.87	1.25	0.85	1.50

ANNEX 1, Table 3 HADDOCK North Sea. Mean weight at age in Danish industrial landings.

Age	Mean weight
0	.027
1	.074
2	.161
3	.267
4	.357
5	.341
6	(.380)
7	.438

ANNEX II

The following note was contributed to the Working Group by P. Sparre. Unfortunately there was insufficient time for discussion of it in the meeting.

GENERAL MANAGEMENT CONSIDERATIONS

by Per Sparre

In last year's report the working group expressed its doubt about the validity of the scientific basis of current advice on fish stock regulation.
Especially the long term predictions based on yield per recruit curves were considered a questionable approach.
During the last year some workers have developed alternative methods (Pope, 1979, Helgason & Gislason, 1979 and Sparre 1980). The three works are based on the same basic model, namely the species interaction cohort analysis (also called "legion analysis").
The models by Pope and Helgason & Gislason are extensions of the ordinary VPA to take predation induced species interaction into consideration.
The model by Sparre is an extension of legion analysis, which makes it possible to run the model in prognostic mode and to take technical interaction (mixed fisheries) into account.
The models are still developing, and the data base is not satisfactory yet. To run the model we thus have to make educated guesses on a number of parameters.
The traditional yield per recruit curve method appears to require fewer data than the legion analysis (in the prognosis mode) and thus does not force us to make any guess work. But this is only apparently the case. Actually the Y/R-method is based on a number of tacit assumptions (i.e. a number of guessed parameters) E.g.:

1) Each stock is in a steady state situation (i.e., constant age distribution of population and catch, constant recruitment and constant mortalities year to year).

2) Natural mortality is independent of abundance of predators. (i.e., it is ignored that fish eat fish).

3) The fishery on one stock can be managed independently of the management of other fisheries (e.g. it is assumed that the North Sea fishery on whiting can be managed independently of the North Sea cod fishery).

Two advantages of using legion analysis for long term prognosis instead of Y/R-curves are:

I: The underlying model is closer to the generally accepted opinion on what actually goes on in (and on) the sea.

II: The assumptions and guesswork are not concealed to the user of the model to the same degree as in the traditional Y/R-model.

Thus taking the alternative method into consideration I felt it reasonable to present some preliminary result from the legion analysis applied in the prognosis mode.

A detailed explanation will appear as an ICES paper this year. Table 1 shows the assumed technical interaction. Table 1 is not based on real technical measurements, but should rather be considered as a hypothetical example given for illustrative purposes. But the technical parameters are calibrated such that the resulting fishing mortalities correspond to those used in ICES W.G. reports.

Information given in ICES W.G. reports on the North Sea fish stocks is used as input. A number of parameters are educated guesswork, e.g. the so-called "food suitability matrix", which determines the predation patterns.

Two options of fishing strategy is considered.

Option A: All fishing mortalities unchanged compared to 1978.

Option B: F for the round fish fleet is reduced by 10 % every year (from 1980-85).

To evaluate the two strategies the yields in 1985 is considered. This exercise shows that Option A yields a higher total return than Option B (see Table 2). The present exercise assumes a rebuilding of the herring and mackerel stocks. However, the opposite assumption would not change the general conclusion.

Table 3 shows the yields of the five fleets for both fishing strategies.

The conclusion of this exercise is that if a 10 % reduction in roundfish effort should result in a hihger long term yield, this gain is not obtained in the nearest future. There may be some gain obtained by the increased cpue for the round fish fleet, but the evaluation of this depends on what we actually try to achieve by the fishery regulation.

Maybe the most important conclusion from this exercise is that today it is possible to base the advice on fishery regulation upon models containing fewer tacit assumptions of dubious nature.

FLEET/ SPECIES	Round fish fleet	Flat fish fleet	Pelagic fish fleet	Industrial fleet	Sandeel fleet
Cod	1.0	0.2	0	0.1	0
Haddock	1.0	0.2	0	0.3	0
Whiting	1.0	0.2	0	0.5	0
Saithe	0.7	0	0	0.3	0
Herring	0	0	0.5	0.1	0
Mackerel	0	0	1.0	0.2	0
Plaice	0.2	0.6	0	0	0
Sole	0.1	1.0	0	0	0
N. Pout	0	0	0	1.0	0
Sprat	0	0	0.5	1.0	0
Sandeel	0	0	0	0	1.0

ANNEX II TABLE 1 TECHNICAL INTERACTION. Example:

If F on cod exerted by the round fish fleet is .7 then F on whiting becomes .7, F on saithe becomes .7 x .7 = .49, F on plaice exerted by the round fish fleet becomes .7 x .2 = .14 etc. Total F on, e. g.- plaice is the sum of Fs from the round fish-, the flat fish- and the industrial fleet. (The figures are not estimated from real observations).

	OPTION A		OPTION B		
	F unchanged		F-roundfish reduced by 10% per year		Difference
	Yield	SSB	Yield	SSB	Yield
Cod	300	347	297	621	-3
Haddock	80	141	69	186	-11
Whiting	111	170	95	245	-16
Saithe	82	204	71	328	-11
Herring	216	709	180	612	-36
Mackerel	536	1496	478	1392	-58
Plaice	91	313	80	316	-11
Sole	13	25	11	23	-2
N. Pout	634	800	547	696	-87
Sprat	486	417	450	377	-36
Sandeel	423	198	379	160	-44
Total consumption	1429		1281		-148
Total industrial	1543		1376		-167
Total	2972		2657		-315

ANNEX II TABLE 2. Yield (landings + discards) in 1985 for two alternative fishing strategies, taking species interaction and technical interaction into account.

Fleet/year	1980	1981	1982	1983	1984	1985
Round Fish	593	514	459	419	394	367
Fleet	644	588	528	484	448	418
Flat Fish	111	110	107	110	114	118
Fleet	109	102	94	89	86	84
Pelagic Fish	229	290	325	344	358	399
Fleet	229	291	331	359	388	451
Norway Pout + Sprat	1344	1296	1285	1290	1292	1285
Indust. fleet	1347	1311	1327	1369	1413	1449
Sandeel	647	468	411	392	383	379
Fleet	649	476	426	418	419	423

ANNEX II Table 3 Landings (1000 tonnes) of each fleet.

Upper Figure: Option B (F for the round fish fleet reduced by 10% per year).

Lower Figure: Option A (constant F).