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C.M.1979/G:7
Demersal Fish Committee

ERRATA SHEET

Table of Contents: add paragraph "3.2.7. Catch predictions".

Page 34, Table 3.2.3: in the sub-heading of the third column from the left change "tonnes/hours" to read "ton-hours".

Page 49, Table 4.1.10: total landings in 1978 should read "95.7".

Page 71, Table 5.2.8: in Option A4, mesh size should be "75" mm instead of "80" mm.

Page 76, Figure 3.2.1.D: F_{78} arrow should be at 0.7.

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International Council for the
Exploration of the Sea

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REPORT OF THE NORTH SEA ROUNDFISH WORKING GROUP

Charlottenlund, 7 - 11 May 1979

This Report has not yet been approved by the International Council for the Exploration of the Sea; it has therefore at present the status of an internal document and does not represent advice given on behalf of the Council. The proviso that it shall not be cited without the consent of the Council should be strictly observed.

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REPORT OF THE NORTH SEA ROUNDFISH WORKING GROUP

1. PARTICIPATION AND TERMS OF REFERENCE

1.1 Participants

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J E Beyer	Denmark
R de Clerck	Belgium
N Daan	Netherlands
J P Hillis	Ireland
T Jakobsen	Norway
B W Jones (Chairman)	UK (England)
F Lamp	Federal Republic of Germany
G Lefranc	France
P Lewy	Denmark
C T Macer	UK (England)
P Sparre	Denmark
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V M Nikolaev attended part of the meeting as ICES Statistician.

1.2 Terms of Reference

At the 1978 Statutory Meeting it was decided (C.Res.1978/2:47) that the North Sea Roundfish Working Group should meet at ICES headquarters on 7-11 May 1979 to:

(a) assess TACs for 1980 for cod, haddock and whiting in Sub-areas IV, VI and VII (excluding VIIa, VIIf and VIIg);

(b) assess the current exploitation status of the stocks of skates and rays in Sub-areas IV and VI and advise on regulatory measures needed, if any;

(c) determine year class strengths for cod, haddock and whiting from data collected from the North Sea Young Herring Surveys.

Subsequently, ACFM asked the Group:

1. What reduction in recruitment might be expected, due to a possible increase in predation, from reducing F to the F_{max} level on each of the three gadoid species?

2. Should the North Sea fisheries for cod, haddock and whiting be treated as a mixed fishery; to what extent are the Fs on the three species inter-related?

3. Is the North Sea haddock stock suffering from recruitment overfishing?

In addition, ACFM asked the Group to consider, time permitting, the following questions:

1. Are there any sequential tagging experiment data available which should be re-examined with a view to estimating natural mortality rate, and to obtain better insight into the terminal F problem?

2. What spawning stock biomass yields the maximal recruitment?
3. What are the present effective mesh sizes in use, as estimated from the age of recruitment in cohort analysis?

2. GENERAL MANAGEMENT CONSIDERATIONS

Currently much of the advice on the regulation of fish stocks is based on the most recent stock assessment interpreted in relation to a yield per recruit curve. This approach has a number of serious shortcomings. At the simplest level a single stock yield per recruit curve is only one of a family of curves and the appropriate curve will vary according to changes in the exploitation pattern and/or weight at age data. Each yield per recruit curve will have a singular value of F_{max} and $F_{0.1}$. Changes in yield per recruit curves from one year to another may result in significant changes in the estimate of F_{max} and this will result in different management recommendations when these are determined on the basis of yield per recruit curves.

An improvement would be to determine management advice in relation to a yield curve. A yield curve would incorporate a stock/recruitment relationship, corrections for predation of young age groups by older age groups, density dependent growth, and age or density dependent natural mortality etc. To be able to refer to a yield curve when considering management advice would obviously represent a major advance, but at the present time there are very few stocks, if any, where the science is sufficiently far advanced for an approximately true yield curve to be constructed. Changes in exploitation pattern would, however, also result in a range of yield curves for a single stock.

A yield curve such as described above on a single stock basis would still suffer from the disadvantage that interactions between species are ignored and some kind of multi-species assessment technique is required to overcome this limitation.

A number of workers have drawn attention to the limitations of the yield per recruit model. One consequence of low levels of fishing mortality predicted by a yield per recruit model is an increase, often a considerable increase, in stock biomass. Workers have questioned whether the ecosystem is capable of supporting such large stock biomasses.

This aspect was discussed by R Jones (1976, 1978) and Andersen and Ursin (1977). In the introduction of his 1976 paper Jones writes:

> "An essential feature of the Beverton & Holt 'constant parameter model' is that in its simplest form, it is an unlimited food model. Beverton and Holt were well aware of this, as are most fishery biologists who use this model. The problem however, has always been to know when results are acceptable, and when they ought to be modified to take account of the effects of food limitation. The greatest difficulty arises when forecasting yields for levels of fishing effort or mesh size very different from those in current use. If fishing effort is made very small for example, an unlimited food model usually predicts relatively large increases in stock biomass. If such results are applied to several species simultaneously, the possibility of food limitation invalidating the overall result could be a very important one." ......

and from page 7:

"The object of this paper is simply to point out that food for North Sea demersal fish may be more limiting than hitherto supposed. Consequently, catch predictions for small values of F, using an unlimited food model, should be treated with reservation."

Similar conclusions were given by Andersen and Ursin (1977), based on their multi-species model.

A second aspect of this problem was discussed by Daan (1975), R Jones (1954, 1975 and 1978), Corp and Houghton (1976) and Andersen and Ursin (1977).

Assuming the ecosystem can supply the round fish stocks with food, what will the effect of effort reductions on round fish be on the commercial prey species of round fish?

Sparre had considered this problem in relation to the North Sea roundfish stocks, basing his study on data from the 1978 Working Group report. He summarises his findings in Tables 2.1, 2.3 and as follows:

"Adult cod and whiting are known to be predators on fish, whereas haddock seem to prefer benthic animals. Daan (1975) found that on average about 50% of the food of adult cod consisted of mackerel, cod, whiting, haddock, herring, plaice and sole. Also, commercially important crustaceans, such as <u>Nephrops</u> and shrimps, contribute to the diet of cod.

If F is reduced to $F_{max} = 0.3$, the spawning stock biomass of cod will be 1.3 million tonnes, according to yield per recruit considerations.

A cod eats three times its own weight per year (Daan, 1975, Table VIII), e.g. in the North Sea a stock of 1.3 million tonnes of cod would eat about 3.9 million tonnes of food. Assuming 35% of cod food to be commercial species (Daan, 1975, Tables VIII and XIII), the effect of a reduction of effort on the cod stock can be summarised as shown in Table 2.3. Thus, if yield per recruit considerations are applicable to cod, a gain in the cod fishery (from a reduction of F_{1977} to F_{max}) of 91 000 tonnes would at the same time lead to losses of at least ten times this magnitude in other fisheries. If the extra 1 145 thousand tonnes of fish eaten by a cod stock of 1 264 thousand tonnes were not eaten by cod, they could later be caught, and the yield from these fish would be more than 1 145 thousand tonnes (according to yield per recruit considerations for prey of cod, if not eaten by cod)."

By drawing attention to the limitations of the yield per recruit model the Group wishes to emphasise the potential dangers of extrapolating from the present level of exploitation on a particular yield per recruit curve to values beyond a limited range around that present level and particularly of basing stock management on a potentially variable F_{max} criterion.

The Group hopes that every encouragement will be given to the development of alternative models and assessment techniques with particular emphasis on stock and recruitment studies, predation models and multi-species assessment techniques.

Apart from the problems raised above, it should be pointed out that, especially in the case of haddock and whiting, to regulate the fishery through limitations on total allowable catches is, in fact, not feasible. This is because the mesh sizes currently in use in these fisheries are such that undersized fish are caught and discarded and also because discarding of legal-sized fish also occurs on quite a large scale. The degree to which fish are discarded depends on many factors. Of these the only one which can be controlled is the size of mesh used in the fishery. Given that mesh sizes are increased sufficiently, all fish caught would be of legal size or greater and thus, at least potentially, total allowable catch might equal total allowable landings. The level of the latter can be regulated.

A secondary problem in fisheries with high discard rates is that any enforced reduction in fishing mortality, by whatever means, will probably result in a change in discarding practice as regards the legal-sized fish. At present, this Working Group assumes that discarding practice will be unchanged if fishing effort is reduced. If this is not the case and, in particular, if the fishermen decide to keep only (say) the larger fish, then the basis on which the TAC has been worked out is invalidated.

3. COD STOCKS

3.1 North Sea Cod

3.1.1 Catch trends (Table 3.1.1 and Figure 3.1.1.A)

After a period of declining landings from the peak in 1972, provisional landings of 260 000 tonnes in 1978 showed an increase of about 40% over those in 1977. The 1978 figure is about 10% higher than the TAC agreed between EEC and Norway (236 000 tonnes). The increase is partly due to the recruitment of the 1976 year class, which appears from the present data to be the largest on record.

3.1.2 Age composition

Data for the years up to and including 1975 were unchanged. The data for 1976 were modified to include Dutch discards. Data for 1977 were updated and a provisional age composition for 1978 produced. Age composition data for 1978 consumption landings were provided by Belgium, Denmark, England, France, Netherlands and Scotland. For industrial landings, Norway supplied length data and for discards Netherlands supplied age data. Age compositions for countries supplying only weights landed/discarded were derived by comparison with similar fleets. Age composition data used in VPA are given in Table 3.1.4.

3.1.3 Recruitment

Estimates of 163 million and 130 million for the 1977 and 1978 year classes respectively at age 1 were available from the IYHS results (Table 3.1.2). A value for average recruitment of 216 million was derived from VPA using the period 1963-75 and this value was used for the 1979 year class in 1980.

Recruitment has shown considerable fluctuation in recent years (Figure 3.1.1.B) but no trend is discernible. The year classes of 1969, 1970 and 1976 have been particularly strong.

3.1.4 Weight at age

Values for consumption landings were the same as those used last year; they gave a close sum-of-products (SOP) comparison with reported landings. The values for industrial landings were obtained from Norwegian length data and those for diacards from Dutch length data. For converting to weight, the relationship $W = 0.0104\ L^3$ was used throughout. For use in the catch prediction programme, mean weights were adjusted so that the SOP equalled the reported weights landed or discarded. The maximum adjustment necessary was only 3% (Table 3.1.7).

No adjustment to mean weights was made in considering an increase in mesh size of 5 mm, since the effect on cod is judged to be negligible.

3.1.5 Fishing mortality and stock size

A value of M = 0.2 was used throughout. A preliminary VPA run was made using input F values in 1978 which were the same as those used as 1977 input values last year. From the results of this run, average F values for the years 1973-75 were calculated and used as new input values. This procedure was repeated until input values stabilised, and these values were taken as a reference point.

In order to determine what changes in F values might have occurred in 1978 relative to the period 1973-75, trends in effort were examined (Table 3.1.3) using the method described in Appendix 1. The data suggest that effort has decreased; there is a clear trend and the 1978 value is about 20% less than in the period 1973-75. The correlation between the effort index and VPA F values since 1970 is not statistically significant, but there appears to be a common trend. In the absence of better indications of trend in F, it was decided to reduce the reference level (73-75) F values by 20% in arriving at estimates of F in 1978. The F value at age 1 in 1978 was adjusted to correspond to the population number estimated from IYHS. VPA input values used for 1978 and calculated for earlier years are given in Table 3.1.5. Values from VPA of stock size in numbers are given in Table 3.1.6.

3.1.6 Yield per recruit

Curves for yield per recruit and stock biomass per recruit are given in Figure 3.1.1.D. The data used (exploitation pattern, mean weight per age group, M = 0.2) are as used in the catch predictions (Table 3.1.7). It is assumed that these parameters are unaffected by a mesh change in 1980.

Although the conventional yield per recruit curve is given, the Group has severe reservations about its applicability, as explained in Section 2.

3.1.7 Catch predictions

The input data for catch predictions were the catches, mean weights and F values per age group in the consumption (landings, discards) and industrial fisheries in 1978 (Table 3.1.7). Discards and industrial values are relatively unimportant in this stock.

Forecasts were made under 2 assumptions for 1979 and 4 assumptions for 1980. An increase in mesh size to 75/80 mm will have a negligible effect on cod, so no changes in exploitation patterns were necessary. The results of catch predictions are given in Table 3.1.8.

Two options were necessary for 1979, since the revised data indicate that the TAC recommended by ACFM (183 000 tonnes) does not correspond to their management objectives. Option A assumes that the TAC will be adhered to in 1979 and this necessitates an F value of 0.45, a reduction of 39% on 1978. The ACFM management objective of a 10% reduction in F from 1978 to 1979 is given in Option B, in which an F of 0.67 yields a catch of 248 thousand tonnes.

The reason for the increase in the predicted catch in 1979 for a stated management option is that the predicted spawning stock biomass (age 4 and older fish) at the start of 1979 is now much larger than was indicated by last year's assessment. In particular, the 1976 year class is indicated as being extremely abundant. It should be noted, however, that the new predicted biomass depends to a large extent on the reduced 1978 input F values.

For 1980, there are four options for which catches have been calculated. Option 4 assumes no increase in mesh size but this has no effect for this stock. Options 1 to 3 involve F changes relative to 1979 of nil, a 20% reduction and a 34% reduction to the F_{max} level as requested by ACFM.

3.1.8 Management options

All options considered involve reductions in fishing effort in 1980 compared to the level in 1978, which was estimated to have become reduced relative to the period 1973-75. Of these options B1 requires the smallest reduction in effort but even this one should lead to an increase in biomass in 1981 beyond the level observed in the early 1970s. All other options are expected to lead to even larger increases in biomass.

Although the effect of such increase on other fish stocks cannot at present be evaluated quantitatively, it is bound to result in a corresponding increase in the food consumption by the cod stock. A considerable proportion of this increased food requirement will have to come from commercially important species (cf. Section 2). In managing the cod stock some caution is required.

In this respect option B1, which would require a revised TAC for 1979 of 247 000 tonnes and allows for 220 000 tonnes to be taken in 1980 would limit the biomass increase. Alternatively to stabilise the catch a TAC of 230 000 tonnes for both years could be preferable.

However, if the 1979 TAC is adhered to it could be argued that the 1980 TAC should be increased considerably in order to prevent the biomass from building up rapidly.

The spawning stock-recruitment scatter diagram is shown in Figure 3.1.2.

3.2 Cod in Division VIa

3.2.1 Catch trends

Landings (Table 3.2.1 and Figure 3.2.1.A) have remained fairly constant at around 13 thousand tonnes since 1970. The 1978 landings figure of nearly 15 thousand tonnes is about 36% higher than the revised figure recommended by ACFM (11 000 tonnes).

3.2.2 Age composition (Table 3.2.4)

Pre-1977 data were as used previously. 1977 data were revised and provisional age compositions for 1978 were provided by England, Scotland and Ireland. France provided a length composition which was converted to age with English age/length keys.

3.2.3 Recruitment

In the absence of (1) a recruitment survey and (2) correlation between recruitment in Sub-area IV and Division VIa, average recruitment of

7.2 million fish at age 1 was assumed for the year classes 1977, 1978 and 1979. This was calculated as the average VPA value for the period 1966-75. There is an indication of a slightly increasing trend in recruitment in Figure 3.2.1.B but it was thought advisable not to allow for this in predicting recruitment in 1979 and 1980.

3.2.4 Weight at age

The data used in last year's report gave a 14% discrepancy in SOP and it was therefore decided to try a new set. English mean length data for 1977 and 1978 were averaged and converted to weight using the relationship $W = 0.0104\ L^3$, bias being corrected by the method of Houghton and Flatman (1978). This set of mean weights gave an SOP value which differed by 6% from the reported landings and it was therefore adopted. The weights were adjusted by 6% in the prediction programme (Table 3.2.7).

No adjustment to mean weights was made in considering mesh changes to 75/80 mm, which will have a negligible effect on this stock.

3.2.5 Fishing mortality and stock size

A value of $M = 0.2$ was used throughout. A reference level of F values for the period 1973-75 was calculated as described in para. 3.1.5. An index of international effort for the period 1970-78 was calculated in the same manner as for North Sea cod (Appendix 1) and the data are given in Table 3.2.3. The effort index in 1978 is 53% greater than the average for the period 1973-75. However, the validity of this increase is open to question, since it results largely from the data for one fleet (England) which takes a small part of the catch and in addition the international effort index does not correlate with VPA F values. In these circumstances, it was decided to use the average F values for the period 1973-75 as input to VPA (Table 3.2.5).

The F value at age 1 in 1978 was adjusted to produce a stock number corresponding to average recruitment. Values from VPA of stock in numbers are given in Table 3.2.6.

3.2.6 Yield per recruit

This is shown in Figure 3.2.1.D. The parameters used were the same as those used in the catch prediction (Table 3.2.7). The reservations referred to in para. 3.1.6 also apply to this stock.

3.2.7 Catch predictions (Table 3.2.8)

Prediction options were the same as in para. 3.1.7. The new assessment indicates that a catch of 8 000 tonnes in 1979 (the recommended TAC) will necessitate a reduction in fishing mortality of 50% relative to 1978. The F value necessary is 0.35 which is below the F_{max} of 0.36. Of the standard options for 1980, only that for Option 3 (F_{max}) has been included since the others also involve F values below F_{max}.

A revised TAC for 1979 with the same objective as was previously used ($F_{79} = 0.9\ F_{78}$) would yield a catch of 13.0 thousand tonnes.

3.2.8 Management options

In 1980, the management options included give predicted catches ranging from 8.5 to 13.4 thousand tonnes. In recent years, the spawning stock biomass (age 4 and older fish) has been increasing and for all options considered the prediction is for this trend to continue. There appears to be no need to reduce fishing mortality to safeguard the spawning stock.

A spawning stock-recruitment scatter diagram is shown in Figure 3.2.2.

No account is taken in the above assessment of the stock in Division VIb. No analytical assessment was possible for Division VIb, so that if the TAC is set for the whole of Sub-area VI an allowance will have to be made for Division VIb on the basis of average catches (see Table 3.2.2). A value of 1 200 tonnes was suggested last year as an appropriate allowance for Division VIb.

3.3 Cod in Divisions VIId and VIIe

Table 3.3.1, which gives landings since 1969, shows the mean landings during the last ten years to be of the order of 4 700 tonnes with, however, 6 940 tonnes in 1977 and 11 147 tonnes in 1978 which are apparently due to the abundant 1976 year class which was also very strong in the North Sea. French data indicate that year class strengths in the English Channel are correlated with those in the North Sea. French biostatistical data collected since 1974 do not yet constitute a long enough series for use in VPA. Enough data to carry out a stock assessment for this region should be available in a few years.

3.4 Cod in Divisions VIIb,c and VIIg-k

Landings in the last decade (Table 3.4.1) have declined from 8 830 tonnes in 1969 to about 2 300 tonnes in 1978, with a mean level of about 5 000 tonnes. The bulk of the catch is taken by France (over 80% up to 1972 and 60-75% since then). Some data have been collected on the mainly inshore Irish component of the catch but not enough so far to permit the use of VPA.

4. HADDOCK STOCKS

4.1 North Sea Haddock

4.1.1 Catch trends

Total international landings (Figure 4.1.1.A and Table 4.1.1) declined continuously from approximately 670 000 tonnes in 1970, when the abundant 1967 year class predominated in the fishery, to about 175 000 tonnes in 1975. In 1976, when the 1974 year class first entered the human consumption fishery, catches increased to 205 000 tonnes. During 1977 and 1978, catches again declined. The 1978 catch level of 90 000 tonnes is the lowest in the last ten years.

4.1.2 Age composition

Age composition data for 1977 were revised and preliminary data were compiled for 1978 (Table 4.1.4). Data submitted to the Working Group accounted for 85% of the total landed weight for 1977. In addition, Netherlands and United Kingdom (Scotland) provided age composition data on discards while United Kingdom (England) provided an estimate of the weight of haddock discarded by English vessels.

For 1978, Belgium, France, Netherlands, United Kingdom (England) and United Kingdom (Scotland) provided age composition data for their human consumption fisheries and Denmark and Norway provided age composition data on the industrial fishery by-catch. Together, these data accounted for 91% of the total landings. Scotland provided age composition data on discards and Netherlands and United Kingdom (England) provided estimates of the total weight of haddock discarded in their respective fisheries.

4.1.3 Recruitment

Data on recruitment of North Sea haddock were available from the International Young Herring Surveys for 1978 and 1979 (Table 4.1.2). The estimated level of recruitment at age 1 in 1978 was 678 million and that for 1979 was 793 million. Both of these year classes are of above average abundance.

As stated in para. 4.1.5, F at ages 0 and 1 in 1978 was adjusted to agree with these data. The implied number of fish in the sea at age 0 in 1977 and 1978 are 882 million and 1244 million, respectively. A value of 622 million fish at age 0 has been assumed for the purpose of making prediction runs, this value being the average number of 0 group from the VPA for the period 1960-75, excluding the very high values for the 1962, 1967 and 1974 year classes.

Figure 4.1.1.B and Table 4.1.2 show the historical series of recruitment at age 1 from 1964 to 1978. Figure 4.1.2 shows the stock and recruitment scatter diagram for North Sea haddock.

4.1.4 Weight at age

Values of mean weight at age in the consumption, industrial and discard components of the catch are shown in Table 4.1.9.

For the 1977 data the sum of products for the human consumption fishery was 1% higher than the landed weight. The corresponding sum of products for the industrial fishery was 4% lower than the landings.

For 1978, the consumption fishery sum of products was 9% higher than the landings figure and the industrial fishery sum of products was 10% higher than the landings. The values of mean weight at age shown in Table 4.1.9 for consumption and industrial catches for 1978 have been appropriately adjusted to make the sum of products agree with the estimated total landings.

4.1.5 Fishing mortality and stock size

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 1978 meeting. The average values for the period 1973-75 were then computed and reintroduced iteratively as input F values.

Relative fishing effort values were computed using the method described in Appendix 1. These values are shown in Table 4.1.3. There is a clearly declining trend in these values, although the Group could not accept that the level of effort in 1978 was as low as 30-40% of that in the period 1973-75. The landings data for 1978 do, however, substantiate the belief that effort in 1978 is lower than that in the period 1973-75. Only France, Belgium, Federal Republic of Germany and United Kingdom landed amounts in 1978 similar to those in 1973 to 1975. The Group, lacking other precise information, decided that input F values for 1978 should be 20% less than the average value from the VPA for the period 1973 to 1975 (Table 4.1.5).

F values at ages 0 and 1 were adjusted to produce the recruitment values at age 1 as described in para. 4.1.3.

Values of spawning stock (age 2 and older fish) biomass are shown in Figure 4.1.1.C and Table 4.1.7. Spawning stock size declined greatly between 1969 and 1972 as the exceptionally large 1967 year class passed out of the fishery. Since 1972, the spawning stock has been at a fairly stable level of 200 to 300 thousand tonnes except in 1976 when the large 1974 year class first recruited to the spawning stock and increased the latter to approximately 440 000 tonnes.

4.1.6 Yield per recruit

Yield and biomass per recruit curves were estimated on the basis ofthe exploitation pattern which is expected to exist in 1980 (Table 4.1.8). The yield per recruit curve was calculated using the total fishing mortality rates (Table 4.1.9), and yield, therefore, includes discards as well as landings. It is expected that a legal minimum mesh size of 80 mm will be enforced for vessels fishing for human consumption in 1980.

On this basis the F at age array estimated for 1978 was changed to allow for an increase in mesh size in the human consumption fishery from 75 to 80 mm in 1980. To do this, the mean length of haddock caught by the human consumption fishery was estimated from the human consumption mean weight values shown in Table 4.1.9 using the equation $\bar{L} = (\bar{w}/0.009)^{1/3}$.

The proportion retained at each mean length by an 80 mm mesh was divided by corresponding values for a 75 mm mesh (selection factor = 3.4, selection range for 75 mm = 2.1 cm. Selection range for 80 mm = 2.3 cm (ICES, Doc. C.M.1974/F:36)). This resulted in the following correction factors:

Age	Correction for mesh change
0	0.00
1	0.57
2	0.73
3	0.98
≥4	1.00

Human consumption Fs and industrial by-catch Fs were then calculated for 1978 using the relationship:

$$F_{h,t} = (C_{h,t} / (C_{h,t} + C_{i,t})) \times F_{o,t}$$

$$F_{i,t} = F_{o,t} - F_{h,t}$$

where $F_{h,t}$ = human consumption F at age t

$F_{i,t}$ = industrial by-catch F at age t

$F_{o,t}$ = total international F at age t in 1978

$C_{h,t}$ = human consumption catch in number at age t

$C_{i,t}$ = industrial by-catch in numbers at age t

The values of human consumption F in 1978 were then multiplied by the corresponding retention ratios listed above to produce a set of human consumption Fs modified in accordance with the proposed mesh changes. These values were then added to the industrial Fs to give the modified total international F at age array for 1980.

Using this F at age array and the values of mean weight at age shown in Table 4.1.8, a yield per recruit curve and a biomass per recruit curve were calculated. These are shown in Figure 4.1.1.D. F_{max} on the yield per recruit curve is 0.26. This is a considerable change from that estimated last year when F_{max} was 0.5.

The yield per recruit curve was calculated using the total fishing mortality rates (Table 4.1.9) and yield, therefore, includes discards as well as landings.

4.1.7 Catch predictions

In all of the catch forecasts it was assumed that the recommended TAC for 1979 of 83 000 tonnes would be taken. This implies that F at age in 1979 will be reduced by 5% from the estimated 1978 level.

For 1980, four options were assessed:

1) $F_{80} = F_{79}$; mesh change 75 to 80 mm in 1980
2) $F_{80} = 0.8 \times F_{79}$; mesh change 75 to 80 mm in 1980
3) $F_{80} = F_{max}$; mesh change 75 to 80 mm in 1980
4) $F_{80} = F_{79}$; no mesh change in 1980.

Option 4 thus provides a set of baseline statistics from which to assess short-term losses as a result of the assumed mesh and effort changes. The results of these options are shown in Table 4.1.10.

It should be noted that the option discussed for other stocks where $F_{79} = 0.9 \times F_{78}$ (essentially a revision of the 1979 TAC) is not required for North Sea haddock since taking the 1979 TAC will produce an almost identical reduction in F in 1979.

4.1.8 Management options

The acceptable option would appear to lie somewhere between Options A1 and A2, i.e. a TAC between 78 000 and 66 000 tonnes. Adopting the upper limit should ensure that F does not increase from the expected 1979 level and will result in a spawning stock biomass at the start of 1981 at the same level as that estimated for the start of 1979. Choosing the lower level of TAC would result in a somewhat increased spawning stock biomass at the start of 1981.

Option A3 involves a severe reduction in catch and appears to be unjustified as there seems at present to be no reason to build up the spawning stock biomass to substantially higher levels as there is no evidence of recruitment overfishing (see Section 9).

4.2 Haddock in Division VIa

4.2.1 Catch trends

Landings of haddock from the West of Scotland (Division VIa) (Table 4.2.1, Figure 4.2.1.A) increased to 46 000 tonnes in 1971 when the very abundant 1967 year class was contributing to the fishery. Subsequently, catches declined to a minimum of 13 500 tonnes in 1975 after which catches again showed an improvement for two years when the 1974 year class recruited to the fishery. Provisional catches reported for 1978 were 16 000 tonnes compared with 19 000 tonnes in 1977. The

ACFM-recommended TAC for Sub-area VI (i.e., including an allowance for Div. VIb) for 1978 was 12 000 tonnes.

No data were available for by-catches of haddock which may have been taken by industrial fisheries in the area.

4.2.2 Age composition

Age composition data for landings in 1977 were updated and new data were available for 1978. Age compositions of landings were submitted by England, Ireland and Scotland. For France, length composition data were available and these were converted into age compositions using Scottish age/length keys. Thus, age compositions were available for all the major fleets covering over 99% of the total landings. Very little information on discarding was available. There were estimates of quantities of haddock discarded by English trawlers for two years only: 1 778 tonnes in 1977 and 39 tonnes in 1978. For Scotland, an age composition for discarded fish was available for 1978 only. No attempt was made to include discard data in the age compositions used as input for VPA, because this would make the data for the last year incompatible with those for earlier years. Age compositions used as input for the VPA are given in Table 4.2.3.

4.2.3 Recruitment

Estimates of Division VIa haddock recruitment at one year old from VPA are available in Table 4.2.5 and Figure 4.2.1.B. In recent years the fishery has been influenced by the extremely abundant 1967 year class which was estimated to be 685 x 10^6 compared with a long-term average level (excluding the 1967 year class) of 32 x 10^6. The 1974 year class was also abundant at 175 x 10^6. The 1975, 1976 and 1977 year classes all appear to have been below average. For the most recent years there are no independent survey data of pre-recruits in the VIa area and as in past years recruitment has been estimated from North Sea year class strengths. These latter are determined from International Young Herring Surveys, and Division VIa year class strengthsare estimated from a regression of VIa year class strength on year class strength in the North Sea (Figure 4.2.2). The predicted values for the 1977 and 1978 year classes in Division VIa are 41 x 10^6 and 49 x 10^6 at one year old. Average recruitment of 32 x 10^6 has been assumed for the 1979 year class in the catch predictions.

4.2.4 Weight at age

The weight at age data used in the catch predictions are given in Table 4.2.6. These are the same as were used last year. A check of sums of products of numbers landed x average weight gave values which differed from the reported landings by 6% in 1977 and 0% in 1978.

4.2.5 Fishing mortality and stock size

4.2.5.1 Natural mortality has been taken to be M = 0.2 in all assessments.

4.2.5.2 Input F values for 1978 for VPA - An initial VPA run was made using for 1978 the same input F values as were used for 1977. Further runs were made adjusting the 1978 values until they were equal to the average values for 1973-75. Attempts were then made to evaluate how F in 1978 may have changed in relation to the base period 1973-75. The method described in Appendix 1 using English and Scottish data gave a trend in estimated effort which bore no relationship to the trend in estimated fishing mortality. There was a correlation between

Scottish catch per unit effort and adult stock biomass by which Scottish c.p.u.e. in 1978 could give an estimate of stock biomass in that year. Input fishing mortalities in 1978 equal to the average for 1973-75 gave a stock biomass close to that predicted from Scottish c.p.u.e., and it was concluded that F in 1978 had not changed greatly from the level in 1973-75. Average 1973-75 values were therefore used as VPA input for 1978. The 1978 input F values and values for earlier years calculated by VPA are given in Table 4.2.4.

4.2.5.3 Exploitation pattern - As a result of this approach described above, the final 1978 input F values gave an exploitation pattern which differed from that used last year.

4.2.5.4 Stock numbers calculated by VPA are given in Table 4.2.5.

4.2.6 Yield per recruit

Curves of yield per recruit against F and total stock biomass against F are plotted in Figure 4.2.1.D. The reservations referred to in para. 3.1.6 also apply to these curves. These curves are the ones relating to the 1980 situation when it is expected that a 75/80 mm (single/double twine) mesh size will be in operation. Thus, the exploitation pattern used in calculating the curves is derived from the F values used as an input for VPA adjusted for an increase in mesh size in 1980. The factors used to adjust the exploitation 1978 pattern were as follows:

Age group	F_{80}/F_{78}
1	0.84
2	0.93
3	0.99
4+	1

Selection factor = 3.4

The weight at age data used are those given in Table 4.2.6.

Yield and stock biomass per recruit have been calculated using a model which allows F to vary with age rather than by the Beverton and Holt equation. The F values plotted on the abscissa are the F values associated with the age group(s) subject to the highest level of F_{max} and are not average values.

From the yield per recruit curve the value of F_{max} = 0.5 compared with the 1978 value of F = 0.61.

4.2.7 Catch predictions

Input data for catch predictions (Table 4.2.6) were catch numbers in 1978, F values in 1978, and weight at age data. As there was no difference between reported landed weight in 1978 and sums of products (SOP) no correction to the weight at age data was necessary.

The recommended TAC for 1979 for total Sub-area VI is 11 000 tonnes. Assuming an allowance of 2 600 tonnes was made for catches in Division VIb, the corresponding TAC for Division VIa would be 8 400 tonnes. If the catch in 1979 is limited to this level, it will require a reduction in fishing mortality from F = 0.61 (on age groups subject to maximum exploitation) in 1978 to F = 0.49 in 1979. This reduction is greater than the 10% reduction envisaged by ACFM. Consequently, two options were considered for 1979:

(A) F_{79} = 0.49 (catch in 1979 = 8 500 tonnes ≏ recommended TAC)

(B) F_{79} = 0.55 = 0.9 x F_{78}

No change in mesh size has so far been introduced, and it seems unlikely that there will now be any change before the end of 1979. Consequently no catch predictions have been made for a mesh size change in 1979.

For each of the above options for 1979 four options were examined for 1980:

1) Minimum mesh size increased to 75/80 mm. Fishing mortality at the 1979 level.

2) Minimum mesh size increased to 75/80 mm. Fishing mortality reduced by 20% compared with 1979.

3) Minimum mesh size increased to 75/80 mm. Fishing mortality at the F_{max} level.

4) No change in minimum mesh size. Fishing mortality at the 1979 level.

The factors applied to the F values to allow for the increase in mesh size are those given in para. 4.2.6.

The results of the catch predictions are given in Table 4.2.7.

4.2.8 Management options

The change in exploitation pattern has resulted in a value of F_{max} = 0.5 on the current yield per recruit curve compared with F_{max} = 0.32 on the yield per recruit curve in last year's report. The level of fishing mortality estimated for 1978 (F = 0.61) is 20% above the F_{max}. Spawning stock biomass, i.e. age 2 and older fish (Figure 4.2.1.C) was as calculated from stock numbers (Table 4.2.5) x average weight at age (Table 4.2.6) at a high level in the period 1969-73 after the recruitment to the adult stock of the exceptionally abundant 1967 year class. At an average level of recruitment with fishing mortality maintained at the 1978 level (F = 0.61), the equilibrium spawning stock biomass would be expected to be about 26 000 tonnes. In the catch prediction options considered the minimum value for the spawning stock biomass in 1981 is 34 000 tonnes. There appears to be no indication of a collapse in spawning stock size.

With the more recent data it is difficult to make comparisons with the previous assessment. The ACFM objective in recommending the TAC for 1979 was to reduce F in 1979 to 90% of the 1977 level. The current assessments indicate that to take 1979 TAC (8 500 tonnes) will require a 20% reduction in F compared with 1978 which would reduce F to the F_{max} level. A 10% reduction in F from 1978 to 1979 would be expected to yield 9 300 tonnes. The choice of TAC for 1980 depends on catches in 1979 and the management strategy adopted. However, for the range of options considered all the predicted catches fall in the range 9 000 - 10 000 tonnes.

A spawning stock-recruitment scatter diagram is shown in Figure 4.2.3.

No account is taken in the above assessment of the stock in Division VIb. No analytical assessment was possible for Division VIb so that if the TAC is set for the whole of Sub-area VI an allowance will have to be made for Division VIb on the basis of average catches (see Table 4.2.2). A value of 2 600 tonnes was suggested last year as an appropriate allowance for Division VIb.

4.3 Haddock in Divisions VIId and VIIe

Haddock landings in the English Channel (Table 4.3.1) over ten years had a mean level of about 500 tonnes, with, however, 971 tonnes in 1975. Nearly all of this small catch comes from the western part of the area (Division VIIe).

There is no evidence that haddock in the English Channel is a self-contained stock and catches are most likely to result from fish overflowing from adjacent areas. There is no biological basis for setting a separate TAC in these circumstances.

4.4 Haddock in Divisions VIIb,c and VIIg-k

Landings rose during 1969-71 from 3 724 tonnes to 4 853 tonnes and then further to the 8 000 - 9 000 tonnes level during 1972-74; from 1975 to 1978 they were declining from 6 500 tonnes to 2 500 tonnes (Table 4.4.1). The high level during 1972-74 and to some extent 1975 may be ascribed to the effect of the very strong 1967 year class. French landings comprised 65-90% of the total catch during this period; some data have been collected on the Irish component, but insufficient for VPA purposes.

5. WHITING STOCKS

5.1 North Sea Whiting

5.1.1 Catch trends

Landings in 1969-77 fluctuated between 109 000 tonnes and 216 000 tonnes, averaging 156 000 tonnes over the period (Table 5.1.1, Figure 5.1.1.A). Provisional figures for landings in 1978 give a total of 100 000 tonnes which is 15 000 tonnes above the recommended TAC and represents a reduction of 20 000 tonnes from 1977. However, catches of industrial trawl (by-catches) in 1978 reported to ICES differed greatly from estimates obtained from biological sampling programmes. The Group considered the latter estimates to be more reliable and they were accordingly used in the assessments, raising total landings to 118 000 tonnes. Of the total landings 28% or 15%, depending on the catch figures, were industrial trawl by-catches compared with 40% in 1977. Discards were estimated to have been 50 280 tonnes in 1977 and 52 367 tonnes in 1978.

5.1.2 Age composition

Input catch at age for VPA is given in Table 5.1.3. Age compositions of human consumption fisheries, industrial trawl by-catches and discards in 1978 are given in Table 5.1.6.

There are no radical changes from the catch in numbers in 1977 used as input for the VPA in the 1978 Working Group report.

For human consumption fisheries in 1978, age or length compositions were available from Belgium, France, Netherlands, England and Scotland, accounting for 98% of the landings.

For industrial by-catches an age composition from Denmark and a length composition from Norway were available. This accounts for all reported catches.

Estimates of numbers of whiting discarded of each age group and weight at age data were available from Scotland. From England an estimate of the total weight of discards was available and the Scottish age distribution was used. From Netherlands no data were available and the discard was estimated by assuming that the ratio between the number landed for human consumption and the number discarded was the same as in 1977 for each age group.

5.1.3 Recruitment

The results from the IYHS, using the same correlation as last year, indicate that the year classes 1977 and 1978 at 1 year were 1 248 million and 1 287 million, respectively, compared to the average 1 234 million for 1960-74. Input Fs for VPA on 0 and 1 group fish were adjusted to give the estimated recruitment from IYHS. Recruitment figures from VPA and IYHS are given in Table 5.1.2. There is no apparent relationship between the spawning stock biomass (age 2 and older fish) and recruitment (see Figure 5.1.1B and C and Figure 5.1.2).

5.1.4 Weight at age

Three sets of weight-at-age data are given in Table 5.1.6. For human consumption fisheries no changes are made in the weight-at-age data except for a slight increase on the 8+ group. The sum of products (SOP) of catch in number and weight at age gave 1.6% above the reported catch. For industrial trawl by-catches the numbers were adjusted to make the SOP correspond to the landings.

For discards the weight-at-age data were kept at the same level as last year, but were slightly smoothed. As no Dutch weight-at-age data were available, the Dutch discards by weight were set to make the total discards equal to the SOP.

5.1.5 Fishing mortality and stock size

Except for the age groups 0 and 1 (see para. 5.1.3), two different approaches were used to estimate the Fs in 1978. One was to assume that fishing mortalities in 1978 were 20% below the average for 1973-75. This gave F = 0.78 on the fully exploited age groups and this was accepted as input F for the VPA (Table 5.1.4). The other approach was to try to correlate weighted Fs on the age groups 2-8 from VPA with total effort based on Scottish data (Figure 5.1.3). For the years 1967-76, excluding 1969 when the estimated effort was unusually high, a significant correlation (r = 0.73) was found, but both linear and functional regression analysis have an intercept on the y-axis much above 0. Estimated effort for 1978 gave for the linear regression a weighted F = 0.72 which corresponds exactly to F = 0.78 for the fully exploited age groups, whereas functional regression gave weighted F = 0.66. In neither case will the apparent reduction in effort from 1977 be borne out by the VPA. Although the effort data clearly do not give an accurate basis for estimating input Fs, they indicate that the chosen F values are on a reasonable level and that if they are wrong, they are most likely to be too high.

The spawning stock biomass has fluctuated between 130 000 and 400 000 tonnes after 1965 (Figure 5.1.1.C). There is a stable trend after 1976, and the spawning stock in 1978 appears to be at about 300 000 tonnes, which is close to the average of 240 000 tonnes for 1966-75.

5.1.6 Yield per recruit

The reservations expressed in para. 3.1.6 also apply here.

Figure 5.1.1.D shows yield per recruit for the North Sea whiting based on the 1978 exploitation pattern, but with the reductions of Fs on the younger age groups estimated to be the effect of an increase in legal mesh size to 80 mm for human consumption fisheries (see para. 5.1.7). On the curve F_{max} = 0.3 compared with the estimated present level of F = 0.78 on age groups subject to maximum exploitation. The yield per recruit curve was calculated using the total fishing mortality rates (Table 5.1.6) and yield therefore includes discards as well as landings.

5.1.7 Catch prediction

Two options have been considered for the catch in 1979:
1) the TAC of 85 000 tonnes is taken. This means that fishing effort in 1979 will be reduced to 65% of the 1978 level.
2) Fishing effort in 1979 is reduced to 90% of the 1978 level. This gives estimated landings of 111 000 tonnes in 1979.

Catch predictions for 1980 were made on the three assumptions $F_{80} = F_{79}$, $F_{80} = 0.8 \cdot F_{79}$ and $F_{80} = F_{max}$. Input for the predictions is given in Table 5.1.6 and the results are shown in Table 5.1.7. In all cases spawning stock biomass increases from 1980 to 1981.

The legal mesh size for human consumption fisheries is expected to increase to 80 mm for the whole area in 1980 and this has been taken into account in the predictions. The estimated changes in Fs resulting from the increased meshes are shown in Table 5.1.8. The changes were calculated in the same way as described for North Sea haddock in para. 4.1.6, using a selection factor of 3.8 (C.M.1974/F:36). No account was taken of the 80 mm mesh size introduced in the Norwegian zone in 1979, as this is not expected to greatly affect the whiting fishery as only a small proportion of the stock occurs in the Norwegian zone.

5.1.8 Management options

The seven options for catch prediction presented in Table 5.1.7 give landings in 1980 varying from 50 000 to 105 000 tonnes.

In the choice of a TAC for whiting in Sub-area IV for 1980 the following points should be considered: 1) there is no imminent danger of recruitment overfishing; 2) catch and landings of whiting are to a large extent dependent on fishing effort on other species, e.g., cod and haddock; 3) estimated discards are about 30% of the total catch and are likely to prevent a restrictive TAC from being effective.

5.2 Whiting in Division VIa

5.2.1 Catch trends (Table 5.2.1 and Figure 5.2.1.A)

The catch has declined steadily since its peak in 1976 which was due to the two exceptionally strong year classes of 1972 and 1974; in fact, the French catch, which normally has a higher age composition than the other main components, Scottish, English and Welsh and Irish, showed some increase. The small Dutch catch of earlier years did not materialise as the herring fishery of which whiting were a by-catch has now ceased.

Spanish landings were estimated as French landings x 0.225, the level recorded in the previous two years.

5.2.2 Age composition (Table 5.2.3)

Age composition data for 1977 and 1978 were available only for United Kingdom (Scotland), Ireland and France. The extremely small Division VIb catches (Table 5.2.2) were omitted from the calculations, a departure from procedure in previous years.

Discards and by-catch landings of whiting were not recorded for Division VIa.

5.2.3 Recruitment (Figure 5.2.1.B)

A significant correlation was found between the VPA abundance at age 1 in the North Sea and in Division VIa (Figure 5.2.2). Based on this, estimates of the strength of the 1977, 1978 and 1979 year classes in Division VIa gave 74 million, 77 and 77 million at age 1 respectively.

No relationship was discernible between spawning stock biomass (age 2 and older fish) and recruitment class strength (Figure 5.2.3).

5.2.4 Weight at age (Table 5.2.7)

Weight-at-age data for 1978 were available for Ireland only, and since these represented only 15% of the landings, with an apparently lower growth rate than other components of the fishery, it was decided to retain the values used by the previous Working Groups.

Sum of products (SOP) checks gave 92% of observed landed weights in 1978, and 88% for revised 1977 data

5.2.5 Fishing mortality and stock size (Tables 5.2.4 and 5.2.5)

The value of M used was 0.2 in all cases.

In the absence of any indication of trends in effort for the stock, mean F values for the period 1973-75 were used for age groups 2-7 for 1978. Input F values for 1978 were adjusted on age 1 taking into account the estimated year class strength.

Mean F values for fully recruited age groups since 1971 have ranged between 0.45 and 0.85 with a reduction from 0.75 - 0.85 during 1971-73 to about 0.55 - 0.70 during 1975-77. These values, very close to those for the North Sea during 1971-73, have been much lower in 1974-76 when North Sea values lay in the range 0.90 - 1.05.

5.2.6 Yield per recruit

The yields and stock biomass per recruit curves evaluated on the basis of the expected exploitation pattern in 1980 (Table 5.2.6) and weight-at-age data (Table 5.2.7) are shown in Figure 5.2.1.D.

5.2.7 Catch prediction (Table 5.2.8)

Input data for the catch predictions are given in Table 5.2.7. Two options were used for F in 1979; Option A being to give the 1979 TAC which required a 20% reduction in F compared with the 1978 value; Option B representing a 10% reduction on the 1978 F value. The corresponding catches predicted for 1979 for these options were 12 100 tonnes and 13 300 tonnes. Option A gives a spawning stock biomass rising to 28 400 tonnes at the beginning of 1980; with Option B its level stays at 27 100 tonnes.

For 1980 the same options were made as for North Sea whiting, with the exception of the option for $F = F_{max}$. The exploitation pattern used for the 80 mm mesh size is given in Table 5.2.6; this was derived in the same way as described for North Sea whiting, using the same selection factor of 3.8. Catches for 1980 are projected slightly lower, at values ranging from 10 500 to 11 300 tonnes with F at its 1979 value, and 8 700 to 9 200 tonnes if F is reduced to its 1979 value x 0.8

For all options considered, the predicted values of the spawning stock biomass do not differ significantly.

5.3 Whiting in Divisions VIId and VIIe

As with cod, landings of whiting follow the same fluctuations as those in the North Sea, indicating a close relationship between stocks in the two areas. Landings during 1969-78 fluctuated between 3 600 tonnes (1971) and 11 400 tonnes (1975) with a mean of 7 100 tonnes (Table 5.3.1). The biostatistical data collected by England and France are not yet available for a long enough period for use in a VPA, but this should become possible with the collection of a few years' more data.

5.4 Whiting in Divisions VIIb,c and VIIg-k

From 1969 to 1978 landings lay in the 4 000 - 10 000 tonnes range with the years 1970-71 and 1977-78 at the lower end of the range (Table 5.4.1). By analogy with Division VIa landings, the high 1969 landings would appear to be due to the strong 1967 year class and 1972-76 landings (apart from 1972) partly due to the combined strength of the 1972 and 1974 year classes, and partly due to Spanish landings reported in these years only. During the period France had the largest single landings of any country, with 38-52% of the total during 1973-76 and 65-88% during other years. Some Irish data have been collected, but not enough to date to permit the use of a VPA.

6. SKATES AND RAYS

No data on skates and rays were available other than data on quantities landed. These are summarised in Tables 6.1 (for Sub-area IV) and 6.2 (for Sub-area VI). These are the data for all species combined, and it is not possible to separate the catches by species.

There are no major directed fisheries on skates and rays in Sub-areas IV and VI and most of the landings are the result of by-catches in other fisheries. Landings from Sub-area VI have remained remarkably stable at about 3 500 tonnes. In the North Sea there is a slight downward trend in landings from about 5 500 tonnes in the early 1970s to about 4 500 tonnes in the latter part of the decade.

The Working Group cannot at this stage make any scientifically based recommendations on the management of these species but doubts whether any regulation is required at the present time.

7. REDUCTION IN RECRUITMENT DUE TO INCREASED PREDATION AT HIGH BIOMASS LEVELS

No specific calculations were made in the Working Group meeting to assess the effects of increased predation at high stock biomass levels. Workers in national laboratories are studying this problem and the results of calculations by Sparre are referred to in Section 2 on general management considerations. It is anticipated that the results of these and other current studies will be presented in detail at the 1979 Statutory Meeting.

8. SHOULD THE NORTH SEA FISHERIES FOR COD, HADDOCK AND WHITING BE TREATED AS A MIXED FISHERY; TO WHAT EXTENT ARE THE Fs ON THE THREE SPECIES INTERRELATED?

In view of the geopgraphical distribution of haddock and cod and the distribution of the catches of these two species among the different countries and different fleets within countries, there can be little doubt that treatment of these two fisheries as a mixed fishery would raise more problems than it would solve. Despite the fact that potentially the fleets might be directed towards either one depending on the relative abundance, this is not likely to occur at any large scale due to traditionally-determined fleet habits with respect of distance between fishing grounds and harbour and also due to rather fixed marketing possibilities for each individual species.

However, whiting is distributed over the entire North Sea and thus is taken as a by-catch in both the haddock and cod fisheries. In fact, directed whiting fisheries are very limited in magnitude and therefore management of this stock by means of TACs which are aimed at regulating the fishing mortality cannot be expected to have actually that effect. If the TAC for whiting was reached and enforced independently of the cod and haddock TACs, fishing for other demersal species could continue and the associated whiting catch would be discarded.

Not only is fishing mortality on whiting thus dependent on the fisheries for cod and haddock, and also on the industrial fisheries, but in addition the landings have always been restricted by a very limited market demand, resulting in a high discard rate. Under such conditions a management strategy, which supposedly optimises yield, appears to be irrational.

9. IS THE NORTH SEA HADDOCK STOCK SUFFERING FROM RECRUITMENT OVERFISHING?

In Figure 4.1.2 the recruitment figures from VPA as numbers of 1 year old haddock are plotted against the spawning stock biomass, from which the year classes originated. Before 1964 the spawning stock biomass of North Sea haddock was at the level of approximately 100 000 tonnes and in this period the extremely good year class 1962 was born, which resulted in an increase in biomass to over 500 000 tonnes. By the time this biomass had decreased to 300 000 tonnes, the even richer year class of 1967 was born and the resulting biomass in 1969 reached nearly 1 million tonnes. Another good year class 1974 was born when the biomass had decreased again to 300 000 tonnes.

The present spawning stock biomass is estimated at approximately 200 000 tonnes and this is in fact in the middle of the range which has produced the outstanding year classes. There is no indication that smaller biomasses result in smaller year classes (Figure 4.1.2).

Thus, the apparent answer has to be that the North Sea haddock stock is not suffering from recruitment overfishing. The large annual variations in biomass and landings are induced by the unpredictable variations in year class strength, particularly at the present level of exploitation which reduces the buffering capacity of the population against variations in year class strength.

Attention is drawn here to the correlation between haddock recruitment in the North Sea and Division VIa (Figure 4.2.2) and also between spawning stock biomass in both areas. This perhaps indicates that the two stocks are strongly interrelated and the conclusion drawn above for the North Sea can probably be extended to include Division VIa.

10. SEQUENTIAL TAGGING EXPERIMENTS

Roundfish tagging experiments have been carried out in the past by a number of countries, but these have never been designed as sequential experiments specifically to deal with problems of natural mortality rate or to estimate terminal F values. Perhaps a re-analysis of the available data could throw more light on these problems; however, the Group was not in a position to draw any firm conclusions about the possibilities in this respect.

11. SPAWNING STOCK BIOMASS AND RECRUITMENT

In each of the sections on individual species in the two areas, plots are presented of recruitment against spawning stock biomass (Figures 3.1.2, 3.2.2, 4.1.2, 4.2.3, 5.1.2 and 5.2.3). In all cases recruitment appears to be highly variable, outstanding year classes appearing now and again over considerable ranges of biomasses. For haddock the data indicate that high biomasses never produced outstanding year classes, but the number of points at high biomasses are few, because only for a very short period following an outstanding year class does the spawning stock biomass remain high. In Division VIa cod there is a suggestion of lower recruitment at higher biomass, which could reflect a density-dependent control, but this remains rather hypothetical.

In none of the cases can the estimated biomass in 1978 be considered to be at a level, where recruitment can be expected to be adversely influenced.

12. EFFECTIVE MESH SIZES IN USE

The Group had no opportunity to consider this problem in any detail. However, estimating the age of recruitment in cohort analysis seems to present an intractable problem in relation to North Sea roundfish, because essentially it requires reliable discard data, which are only available for a limited number of countries, and the recruitment pattern to different fleets, about which even less is known.

Still, according to the scattered data available to the members it is obvious that a number of roundfish fleets actually use mesh sizes above the legal minimum one. This has been taken into consideration qualitatively in assessing the effects of the effectualised and proposed changes in 1978 and 1979.

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Table 2.1 Spawning stock biomass. Derived from Figures 1, 2, 3 and Table 5.2 of the Roundfish Working Group Report 1978 (ICES C.M.1978/G:7)

North Sea		Cod	Haddock	Whiting	Total
Spawning stock biomass per recruit Kg	1977 level of F	.8	.22	.12	-
	F = .3 ($F = F_{max}$)	5.8	.86	.45	-
Average recruitment (from VPA) millions		218	1 128	1 360	-
Spawning stock biomass per 000' tonnes	1977 level of F	174	248	163	585
	F = .3	1 264	970	612	2 846

Table 2.2 Yield per recruit and yield. Derived from the Roundfish Working Group Report 1978 (ICES C.M.1978/G:7)

North Sea		Cod	Haddock	Whiting	Total
Yield per recruit kg	1977 level of F	.98	.13	.087	-
	F = .3	1.40	.19	.103	-
Yield 000' tonnes	1977 level of F	214	147	118	479
	F = .3	305	214	140	659

Table 2.3 Comparison between the yield and the food consumption of the North Sea COD stock. 000'tonnes

	Spawning stock biomass	Total consumption	Consumption of commercial fish species	Yield of cod
1977 level of F	174	522	183	214
F = .3	1 264	3 793	1 328	305
		Gain:	- 1 145	91

Table 3.1.1 Nominal catch (in tonnes) of COD in Sub-area IV, 1969-1978
(Data for 1969-1977 as officially reported to ICES)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*
Belgium	13 470	8 076	19 334	21 133	11 741	10 253	7 566	7 483	10 346	16 089
Denmark	36 986	40 017	68 179	72 520	47 950	54 207	46 344	53 277	42 582	41 318
Faroe Islands	52	78	123	284	803	416	732	448	260	49
France	10 460	16 058	24 769	24 038	13 247	7 275	8 667	8 079	7 511	12 143
German Dem Rep. a)	223	3	18	122	343	132	223	69	21	75
Germany, Fed. Rep.of	20 625 b)	20 093 b)	46 647	49 431	21 410	17 089	16 457	24 445	22 658	37 099
Iceland	+	+	1	-	-	+	-	-	-	-
Ireland	-	-	-	-	-	-	-	98	136	...
Netherlands	19 511	25 212	46 614	47 634	25 758	24 029	23 263	21 835	29 903	48 725
Norway c)	8 953	5 374	7 732	4 377	4 831	2 481	1 528	1 877	1 449	2 724
Poland	136	219	178	189	1 551	4 750	2 991	2 961	381	115
Spain	-	-	-	91	90	80	63	14	-	...
Sweden d)	8 401	8 925	9 062	8 769	8 074	8 168	900	597	36	442
U.K.(England+Wales)	44 263	38 464	55 525	62 503	47 327	39 857	33 615	46 475	35 424	59 127
U.K.(Scotland)	33 208	30 079	37 229	55 190	48 844	39 887	37 308	39 597	34 406	41 984
U.S.S.R.	2 970	32 147	5 153	774	2 497	2 667	6 796	6 187	-	9
Total IV	199 258	224 745	320 564	347 055	234 466	211 291	186 453	213 442	185 118	259 899
Total IVa	56 015	79 606	67 370	80 650	69 557	72 406	58 343	68 352	55 623	
Total IVb	122 027	110 271	184 957	215 160	134 953	114 087	107 227	126 218	100 191	
Total IVc	21 216	34 868	68 237	51 245	29 956	24 798	20 883	18 872	29 304	
W.G. Total Catch							188 452 e)	214 398 e)	186 654 e)	265 702 e)

* Provisional figures
a) 1969-1972 includes IIIa
b) Incl. miscellaneous products
c) Figures from 1969-72 do not include Cod caught in Rec. 2 fisheries
d) 1969-1974 includes IIIa
e) includes discards.

Table 3.1.2 Revised estimates of year class strength COD Sub-area IV

Year class	IYHS[a)]	VPA ($M = 0.2$)[b)]
1964	17.1	222
1965	12.8	315
1966	30.5	283
1967	5.5	92
1968	6.3	87
1969	59.9	368
1970	89.4	451
1971	2.8	83
1972	31.5	160
1973	11.2	145
1974	54.5	245
1975	6.1	124
1976	44.2	582
1977	12.4	163*
1978	(6.1)	130*

a) Geometric mean number per hour fishing during the International Young Herring Surveys (cf. ICES Doc. C.M.1978/G:51)

Figure in brackets represents preliminary estimate based on number of cod < 25 cm caught in 1979

b) Millions of fish at age 1. Figures with an asterisk (*) estimated from predictive regression (cf. Table 5.3 in ICES Doc. C.M.1977/F:19).

Table 3.1.3 A). Catch and effort data in selected North Sea COD fisheries (C = catch in tonnes live weight; E = effort in thousand hours fishing; CPUE = catch in kg per 100 hours fishing)

Year	Scotland			Belgium						Netherlands								
	Seine			Ottertrawl			Danish Seine			Beamtrawl			Trawl			Pairtrawl		
	C	E	CPUE	C	E	CPUE	C	E	CPUE	C	E	CPUE	C	E	CPUE	C	E	CPUE
1963	19 757	616	3 207															
1964	15 235	640	2 380															
1965	17 680	583	3 033															
1966	18 303	502	3 646															
1967	21 704	514	4 223															
1968	28 828	549	5 251															
1969	21 400	491	4 358															
1970	17 814	426	4 182							6 428	721	892	12 964	185	7 014	5 401	28.6	18 887
1971	21 847	416	5 252	13 979	317	4 413				16 110	824	1 954	22 832	177	12 891	6 950	36.5	19 046
1972	31 491	393	8 013	15 630	344	4 538				13 117	829	1 583	26 702	187	14 244	7 502	30.9	24 286
1973	26 635	415	6 418	7 706	303	2 544	909	9.9	9.220	10 482	942	1 113	11 116	167	6 656	4 000	23.4	17 115
1974	21 262	356	5 972	2 984	174	1 718	4 027	38.3	10 500	9 890	895	1 105	9 696	185	5 238	4 352	31.1	13 988
1975	22 037	342	6 444	2 307	163	1 419	2 338	17.8	13 130	10 981	880	1 248	9 904	164	6 036	2 204	24.4	9 036
1976	23 775	308	7 719	1 823	142	1 293	3 274	18.6	17 650	7 380	769	960	10 708	134	7 965	3 933	23.6	16 638
1977	18 971	312	6 080	3 660	155	2 357	2 554	21.2	12 070	11 051	698	1 582	15 010	129	11 627	3 988	15.3	26 006
1978	28 892	325	8 890	5 784	163	3 540	3 546	17.4	20 330	13 067	595	2 195	27 674	166	16 661	7 984	27.2	29 399

Year	England and Wales		
	Trawl + Seine		
	C	E[1)]	CPUE[2)]
1963	26 546	1 088	2 439
1964	25 709	937	2 743
1965	37 195	819	4 539
1966	49 769	813	6 122
1967	48 220	696	6 930
1968	61 616	657	9 382
1969	44 263	601	7 360
1970	38 464	607	6 341
1971	55 525	590	9 410
1972	62 503	663	9 422
1973	47 327	619	7 648
1974	39 857	574	6 943
1975	33 615	447	7 525
1976	46 475	515	9 029
1977	35 424	571	6 201
1978	62 474	606	10 303

1) Effort in 10^5 tonnes hours

2) CPUE in 10^{-4} kg per tonnes hours

B). Weighted relative indices of CPUE and total international effort in the North Sea COD fishery

Year	Relative CPUE	Relative Effort
1970	0.83	1.47
1971	1.31	1.32
1972	1.40	1.34
1973	1.03	1.23
1974	0.92	1.24
1975	0.99	1.02
1976	1.21	0.96
1977	1.00	1.00
1978	1.52	0.94

Table 3.1.4 North Sea COD

Input catch data for VPA

AGE	1963	1964	1965	1966	1967	1968
0	0	0	0	0	0	0
1	18622	47311	40500	75633	65388	9941
2	37798	23681	68149	65705	81282	79589
3	6192	15976	14441	26341	26741	36676
4	3069	3439	6715	5896	9265	11078
5	2360	1513	1783	2513	2698	5623
6	1404	1652	873	1065	1750	1275
7	67	433	510	409	655	623
8	485	99	275	362	304	314
9	4	390	14	77	148	154
10	5	1	81	64	36	103
11	1	1	1	25	2	21
12+	2	2	4	8	6	9

AGE	1969	1970	1971	1972	1973	1974
0	0	0	0	0	0	0
1	5109	47304	61347	6317	33809	15715
2	23009	27373	149128	195922	30551	53537
3	31590	16332	14385	43709	52648	11799
4	14959	12179	5952	5035	13163	5180
5	5190	6867	6028	2406	1905	4397
6	2842	1963	2394	2802	1038	974
7	688	1051	760	1449	988	472
8	379	207	394	545	486	373
9	170	221	182	339	38	310
10	54	136	82	102	41	65
11	110	46	53	5	64	35
12+	17	24	26	11	73	27

AGE	1975	1976	1977	1978
0	274	174	112	0
1	35086	7165	109448	38575
2	54771	97453	51760	169055
3	17597	19330	22560	15242
4	4078	6463	4170	8378
5	6401	1414	1748	2531
6	1662	2254	595	888
7	378	729	811	354
8	144	96	273	338
9	175	54	167	126
10	73	54	23	32
11	29	14	8	14
12+	20	14	53	18

Table 3.1.5 North Sea COD

Fishing mortalities from VPA

AGE	1963	1964	1965	1966	1967	1968	1969	1970	1971
0	.000	.000	.000	.000	.000	.000	.000	.000	.000
1	.220	.251	.224	.306	.292	.126	.067	.153	.162
2	.631	.479	.689	.678	.629	.696	.476	.601	.984
3	.401	.605	.610	.631	.659	.659	.669	.751	.749
4	.443	.407	.558	.543	.477	.639	.626	.596	.687
5	.420	.409	.383	.419	.517	.601	.717	.669	.678
6	.737	.590	.440	.416	.582	.496	.709	.663	.522
7	.208	.530	.362	.381	.490	.422	.549	.629	.589
8	.556	.535	.777	.475	.543	.463	.493	.315	.513
9	.176	1.279	.131	.516	.362	.591	.493	.604	.504
10	.456	.061	1.079	1.455	.488	.463	.425	.963	.472
11	.285	.153	.079	1.309	.137	.594	1.413	.793	1.450
12	.550	.550	.550	.550	.550	.550	.550	.660	.660

MEAN F FOR AGES >= 2 AND <= 8 (WEIGHTED BY STOCK IN NUMBERS)

	1963	1964	1965	1966	1967	1968	1969	1970	1971
	.569	.512	.651	.642	.617	.672	.596	.641	.925

AGE	1972	1973	1974	1975	1976	1977	1978
0	.000	.000	.000	.002	.000	.001	.000
1	.087	.264	.127	.172	.066	.232	.301
2	1.128	.762	.862	.849	.987	.896	.670
3	.917	1.155	.774	.798	.858	.651	.740
4	.660	.806	.308	.682	.794	.447	.540
5	.669	.558	.705	.777	.536	.514	.540
6	.797	.696	.628	.641	.705	.454	.540
7	.702	.745	.815	.536	.657	.598	.540
8	1.192	.542	.714	.636	.248	.554	.540
9	1.195	.221	.817	.905	.526	1.092	.540
10	.594	.422	.720	.455	.800	.446	.540
11	.046	.962	.787	.852	.146	.256	.540
12	.660	.660	.660	.660	.600	.550	.540

MEAN F FOR AGES >= 2 AND <= 8 (WEIGHTED BY STOCK IN NUMBERS)

	1972	1973	1974	1975	1976	1977	1978
	1.062	.940	.761	.816	.939	.767	.665

AGE-NATURAL MORTALITY

0	1	2	3	4	5	6	7	8	9	10
.200	.200	.200	.200	.200	.200	.200	.200	.200	.200	.200

11	12
.200	.200

Table 3.1.6 North Sea COD

Stock size in numbers from VPA

AGE	1963	1964	1965	1966	1967	1968
0	286337	271476	384868	345947	112578	105664
1	103683	234433	222266	315103	283238	92171
2	88204	68128	149377	145527	190009	173114
3	20549	38425	34555	61433	60453	82900
4	5395	11267	17172	15377	26749	25600
5	7536	4940	6139	8049	7311	13597
6	2936	4052	2687	3426	4335	3570
7	393	1151	1840	1417	1850	1984
8	1243	261	555	1049	793	927
9	27	584	125	209	534	377
10	15	19	133	90	102	304
11	4	8	14	37	17	51
12	3	3	5	11	8	12

AGE	1969	1970	1971	1972	1973	1974
0	449364	550719	101613	195753	176553	298726
1	86510	367908	450390	83194	160269	144549
2	66502	66219	258595	313890	62415	100810
3	70658	33826	29732	79153	83218	23847
4	35100	29627	13068	11507	25909	21457
5	11058	15364	13362	5383	4869	9478
6	6103	4420	6444	5555	2258	2261
7	1780	2459	1865	3132	2050	922
8	1065	842	1074	847	1270	797
9	478	533	503	526	210	605
10	171	239	238	249	130	138
11	157	91	75	122	112	70
12	23	31	34	14	95	35

AGE	1975	1976	1977	1978
0	151797	710728	199125	0
1	244576	124033	581737	162929
2	104181	168638	95084	377798
3	34853	36503	51444	31773
4	9001	12846	12669	21957
5	12912	3726	4755	6633
6	3834	4862	1785	2327
7	997	1653	1968	928
8	334	478	702	886
9	319	145	305	330
10	219	100	70	84
11	55	114	39	37
12	26	19	80	25

Table 3.1.7 North Sea COD. 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	33 950	0.541	0.265	3 316	0.163	0.026	1 309	0.267	0.010	38 575	0.499	0.301
2	163 253	0.921	0.647	3 316	0.445	0.013	2 486	0.532	0.010	169 055	0.906	0.670
3	19 206	2.023	0.738				36	2.018	0.002	15 242	2.023	0.740
4	8 375	3.826	0.540				3	3 107	+	8 378	3.826	0.540
5	2 531	5.759	0.540							2 531	5.759	0.540
6	888	7.652	0.540							888	7.652	0.540
7	354	9.125	0.540							354	9.125	0.540
8	338	10.387	0.540							338	10.387	0.540
9	126	11.258	0.540							126	11.258	0.540
10	32	12.019	0.540							32	12.019	0.540
11	14	12 510	0.540							14	12.510	0.540
12	18	12 921	0.540							18	12 921	0.540

Year	1978	1979	1980	1981
Recruits (000) at age 1	163 000	130 000	216 000	216 000

Table 3.1.8 North Sea COD.
Results of catch predictions (in thousand tonnes)

1978:	F*	0.74							
	Spawning stock biomass	164.0							
	Industrial by-catch	1.8							
	Consumption landings	261.9							
	Total landings	263.7							
	Discards	2.0							
1979:	Option	A				B			
	F*	$0.45 = 0.61 \times F_{78}$ (to take TAC)				$0.67 = 0.9 \times F_{78}$			
	Spawning stock biomass	154.5				154.5			
	Industrial by-catch	0.7				0.9			
	Consumption landings	181.8				246.5			
	Total landings	182.5				247.4			
	Discards	0.5				0.8			
1980:	Option	A 1	A 2	A 3	A 4	B 1	B 2	B 3	B 4
	Mesh size (mm)	80	80	80	75	80	80	80	75
	F*	$0.45=F_{79}$	$0.36=0.8 \times F_{79}$	$0.25=F_{max}$		$0.67=F_{79}$	$0.54=0.8 \times F_{79}$	$0.25=F_{max}$	
	Spawning stock biomass	436.6	436.6	436.6		358.1	358.1	358.1	
	Industrial by-catch	0.6	0.5	0.4	as A 1	0.8	0.7	0.3	as B 1
	Consumption landings	187.4	155.4	112.2		217.9	182.4	95.1	
	Total landings	188.0	155.9	112.6		218.7	183.1	95.4	
	Discards	0.7	0.6	0.4		0.9	0.8	0.4	
1981:	Spawning stock biomass	473.7	555.0	603.3		327.7	364.0	454.8	

*Fishing mortality on age groups subject to maximum exploitation.

Table 3.2.1 Nominal catch (in tonnes) of COD in Division VIa, 1969 - 1978
(Data for 1969-1977 as officially reported to ICES)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978[*]
Belgium	107	61	41	39	75	174	49	71	-	-
Denmark	-	-	-	-	-	-	7	-	-	-
Faroe Islands	-	-	-	-	7	13	3	39	43	-
France	2 496	1 161	1 054	2 360	3 445	3 678	3 546	5 611	3 583	5 904
German Dem. Rep.	-	-	-	-	-	-	2	-	-	-
Germany, Fed. Rep.	209[b]	136[b]	46	3	15	6	12	1	3	32
Iceland	-	-	+	-	-	-	-	-	-	-
Ireland	538	1 135	888	686	583	883	1 141	1 341	984	1 211
Netherlands	10	5	10	21	4	5	5	11	5	
Norway	48	-	-	-	13	14	17	22	29	99[a]
Poland	142	199	154	491	184	175	68	18	-	
Spain	-	-	-	102	208	137	180	15	20[a]	
U.K. (England+Wales)	7 463	2 602	2 414	3 371	2 074	2 467	2 217	2 742	2 434	2 082
U.K. (Scotland)	10 714	7 382	5 732	7 018	5 645	6 084	5 806	7 475	5 513	5 610
U.K. (N. Ireland)	10	1	2	2	3	3	3	13	5	5
U.S.S.R.	-	-	325	606	7	13	107	46	-	-
Total VIa	21 739	12 682	10 666	14 699	12 263	13 652	13 163	17 405	12 619	14 943
Working Group total catch									12 615	14 868

*) preliminary

a) includes VIb

b) including miscellaneous products

Table 3.2.2. Nominal catch (in tonnes) of COD in Division VIb, 1969-1978
(Data for 1969-1977 as officially reported to ICES)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*
Belgium	-	-	-	-	-	-	-	1	-	-
Faroe Islands						5	3	22	40	10
France	2 372	745	-	1 659	320	1 128	4	4	3	1
Norway	-	-	-	-	-	3	-	8	3	...[a]
Poland	-	-	-	-	8	-	-	-	-	-
Spain	-	-	-	-	-	-	-	-	...[a]	
U.K.(Engl.+Wales)	30	28	37	32	1	-	28	77	89	285
U.K. (Scotland)	131	102	57	175	128	39	98	61	33	384
U.S.S.R.	-	-	-	701	26	-	110	1 398	-	-
Total VIb	2 533	875	94	2 567	483	1 175	243	1 571	168	680

*) preliminary

a) included in VIa

Table 3.2.3 COD in Division VIa
Effort Data

Year	England + Wales			Scotland			Relative CPUE	Relative Effort
	Catch (tonnes)	Trawl Effort tonnes/hours x 10^{-4}	c/f	Catch (tonnes)	Seine Effort hours x 10^{-3}	c/f		
1970	2 602	1 250	2.08	2 153	96	22.43	1.54	0.65
1971	2 414	806	3.00	1 269	99	12.82	1.84	0.46
1972	3 371	1 495	2.25	1 215	71	17.11	1.60	0.73
1973	2 074	1 270	1.63	1 105	60	18.42	1.25	0.78
1974	2 467	1 092	2.26	849	56	15.16	1.58	0.68
1975	2 217	1 099	2.02	971	56	17.34	1.45	0.72
1976	2 742	1 259	2.18	1 062	57	18.63	1.57	0.88
1977	2 437	1 944	1.25	678	42	16.14	1.00	1.00
1978	2 082	1 784	1.17	773	34	22.74	1.06	1.11

Table 3.2.4 COD in Division VIa. Input Catch Data for VPA

AGE	1967	1968	1969	1970	1971	1972
1	101	222	84	92	335	220
2	1004	859	986	272	884	2264
3	1427	1862	970	944	523	1068
4	141	1296	1519	457	709	483
5	140	112	624	356	220	405
6	104	121	104	133	185	91
7	21	72	84	24	68	72
8+	12	18	53	39	36	47

AGE	1973	1974	1975	1976	1977	1978
1	153	727	1260	1988	1179	373
2	504	1841	2043	4753	1183	1602
3	1271	752	1217	1362	1497	978
4	518	874	506	585	590	882
5	145	235	269	255	245	400
6	161	53	60	185	81	145
7	42	52	11	58	49	88
8+	47	22	19	18	13	61

Table 3.2.5 COD in Division VIa. Fishing Mortalities from VPA

AGE	1967	1968	1969	1970	1971	1972	1973	1974	1975
1	.023	.040	.032	.020	.042	.054	.024	.095	.107
2	.156	.280	.248	.139	.272	.438	.167	.429	.414
3	.385	.481	.587	.398	.428	.614	.473	.399	.565
4	.285	.730	.943	.615	.593	.912	.696	.704	.516
5	.333	.384	.994	.600	.691	.828	.792	.813	.487
6	.455	.537	.751	.590	.734	.699	.978	.776	.499
7	.594	.665	.913	.382	.696	.724	.843	1.061	.355
8	.700	.700	.700	.700	.700	.700	.700	.700	.700

MEAN F FOR AGES >= 2 AND <= 6 (WEIGHTED BY STOCK IN NUMBERS)

.256	.472	.566	.382	.416	.545	.404	.490	.470

AGE	1976	1977	1978
1	.317	.157	.059
2	.727	.317	.330
3	.540	.531	.470
4	.589	.476	.700
5	.536	.530	.700
6	.744	.323	.700
7	1.402	.445	.700
8	.700	.700	.700

MEAN F FOR AGES >= 2 AND <= 6 (WEIGHTED BY STOCK IN NUMBERS)

.665	.427	.457

AGE-NATURAL MORTALITY

1	2	3	4	5	6	7	8
.200	.200	.200	.200	.200	.200	.200	.200

Table 3.2.6 COD in Division VIa. Stock Size in Numbers from VPA

AGE	1967	1968	1969	1970	1971	1972
1	4825	6266	2912	5080	8910	4653
2	7628	3859	4930	2308	4076	6993
3	4895	5340	2387	3149	1645	2543
4	625	2727	2704	1087	1731	878
5	543	385	1076	862	481	783
6	312	319	215	326	388	197
7	51	162	153	83	148	152
8	15	23	68	50	46	60

AGE	1973	1974	1975	1976	1977	1978
1	7232	8863	13641	8027	8936	7176
2	3611	5783	6600	10032	4786	6254
3	3695	2503	3083	3571	3971	2855
4	1127	1886	1374	1435	1704	1911
5	289	460	764	672	652	867
6	280	107	167	384	322	314
7	80	86	40	83	149	191
8	60	28	24	23	17	78

Table 3.2.7 COD in Division VIa. 1978 Input Data for Catch Prediction

Age	Consumption Landings			Discards			Industrial Landings			Total		
	Catch No. (000)	$\overline{W}$ (kg)	F	Catch No. (000)	$\overline{W}$ (kg)	F	Catch No. (000)	$\overline{W}$ (kg)	F	Catch No. (000)	$\overline{W}$ (kg)	F
1	373	0.604	.059							373	0.604	.059
2	1 602	1.367	.33							1 602	1.367	.33
3	978	2.979	.47							978	2.979	.47
4	882	5.035	.70	No Data			No Landings			882	5.035	.70
5	400	6.551	.70							400	6.551	.70
6	145	7.939	.70							145	7.939	.70
7	88	8.777	.70							88	8.777	.70
8+	61	9.387	.70							61	9.387	.70

Year	1978	1979	1980
Recruits at age 1 (000)	7 200	7 200	7 200

Table 3.2.8 COD in Division VIa. Results of Catch Predictions (000 tonnes)

1978: F^*	0.70							
Spawning stock biomass	20.7							
Landings	14.9							
1979: Option	A (to take TAC)				B			
F^*	0.35				$0.63=0.9xF_{78}$			
Spawning stock biomass	17.6				17.6			
Landings	8.0				13.0			
1980: Option	A 1	A 2	A 3	A 4	B 1	B 2	B 3	B 4
Mesh size (mm)	80	80	80	75	80	80	80	75
F^*			$0.36=F_{max}$		$0.63=F_{79}$	$0.50=0.8xF_{79}$	$0.36=F_{max}$	as B 1
Spawning stock biomass	NA	NA	24.3	NA	19.2	19.2	19.2	"
Landings			10.1		13.4	11.1	8.5	"
1981: Spawning stock biomass			29.3		19.4	21.6	24.3	19.4

*) Fishing mortality on age groups subject to maximum exploitation.

NA = not applicable.

Table 3.3.1 Nominal catch (in tonnes) of COD in Divisions VIId and VIIe, 1969-1978.
(Data for 1969-1977 as officially reported to ICES)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*
Belgium	132	132	213	124	93	67	59	65	53	419
Denmark	-	-	-	-	-	-	2 718	1 506	1 120	2 137
France	3 501	2 139	4 544	2 658	1 425	3 099	2 143	1 646	5 185	7 939
Germany, Fed.Rep.	+	-	+	-	-	-	-	-	-	-
Netherlands	1	3	13	30	2	4	+	2	1	-
Poland	-	-	-	7	13	6	-	-	-	
U.K.(Engl.+Wales)	222	279	662	717	499	260	159	142	581	652
U.S.S.R.				8	45	-	3	4	-	
Total VIId,e	3 856	2 553	5 432	3 544	2 077	3 436	5 082	3 365	6 940	11 147

*) preliminary.

Table 3.4.1 Nominal catch (in tonnes) of COD in Divisions VIIb,c and VIIg-k, 1969-1978. (Data for 1969-1977 as officially reported to ICES).

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*
Belgium	196	223	295	77	323	167	116	159	85	53
Faroe Islands	-	-	-	-	256	-	-	-	-	-
France	7 893	4 320	5 570	4 168	2 791	2 302	2 877	3 196	1 972	1 869
Germany, Fed. Rep.	4	2	2	-	1	-	-	-	-	3[a]
Ireland	445	537	347	352	568	283	474	506	315	328
Netherlands	128	38	81	22	14	9	54	46	291	
Norway	-	-	-	-	-	-	1	-	+	-
Poland	45	59	33	130	75	39	19	40	6	
Spain	-	-	-	137	301	232	588	1 140	51	
U.K. (Engl.+Wales)	119	72	13	56	60	26	73	44	33	29
U.K. (Scotland)	-	-	-	-	-	-	-	-	-	2
U.S.S.R.		116	24	139	10	72	134	203	-	
Total VIIb,c,g-k	8 830	5 367	6 365	5 081	4 399	3 130	4 336	5 234	2 753	2 284

*) preliminary.

a) catch in VIIg only.

Table 4.1.1 Nominal catch (in tonnes) of HADDOCK in Sub-area IV, 1969-1978
(Data for 1969-1977 as officially reported to ICES)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*
Belgium	4 753	3 691	971	1 601	2 385	1 137	2 209	2 166	2 293	1 072
Denmark	316 516	158 276	31 043	34 858	13 118	44 342	32 930	46 899	20 069	8 122
Faroe Islands	-	-	-	5	1 198	435	267	183	385	5
France	7 562	10 392	8 738	7 814	4 695	4 020	4 646	5 500	6 914	5 064
German Dem.Rep.[a]	20	2	3	90	22	8	44	20	8	37
Germany, Fed. Rep.	3 376	5 075	3 045	4 020	4 587	3 478	2 396	3 433	3 744	2 573
Iceland	-	+	1	-	-	-	-	-	-	-
Ireland	-	-	-	-	-	-	-	31	53	...
Netherlands	13 233	8 278	6 914	5 188	3 185	3 035	1 901	1 728	1 598	798
Norway[b]	792	963	1 063	1 146	5 611	5 954	331	367	374	546
Poland	4	-	-	38	2 553	3 001	1 485	1 155	485	62
Spain	-	-	-	-	101	210	-	-	-	...
Sweden[c]	5 108	8 704	5 857	5 305	4 550	3 098	2 083	2 455	113	866
U.K.(Engl.+Wales)	14 090	19 500	16 648	20 827	16 586	10 798	11 499	17 238	17 167	12 200
U.K. (Scotland)	70 253	112 952	121 539	96 197	88 132	71 679	64 686	80 576	89 465	58 405
U.S.S.R.	203 488	344 000	62 398	36 467	49 356	42 234	49 686	42 852	8 010	44
Total IV	639 195	671 833	258 220	213 556	196 079	193 429	174 163	204 603	150 678	89 794
Total IVa	271 953	455 649	197 306	135 095	131 819	128 607	110 848	138 591	116 577	
Total IVb	361 836	212 646	58 270	75 325	62 288	63 695	62 761	65 594	34 030	
Total IVc	5 406	3 538	2 644	3 136	1 972	1 127	554	418	71	
Working Group total catch									178 154[d]	117 977[d]

*) provisional figures; a) 1969-1972 includes IIIa; b) Figures from 1969-1972 do not include haddock caught in Rec. 2 fisheries; c) 1969-1974 includes IIIa; d) includes discards.

Table 4.1.2 North Sea HADDOCK

Revised estimates of year class strength

Year class	IYHS[a)]	VPA ($M = 0.2$)[b)]
1964		63
1965	25	147
1966	91	767
1967	7 628	6 296
1968	119	386
1969	35	111
1970	1 545	901
1971	957	1 324
1972	230	256
1973	1 314	1 278
1974	1 370	2 557
1975	212	302
1976	189	577
1977	458	678[*]
1978	(600)	793[*]

a) Arithmetic mean number per hour fishing during the International Young Herring Surveys (c.f. ICES Doc. C.M. 1978/G:51).

Figure in brackets represents preliminary estimate based on number of haddock <20 cm caught in 1979.

b) Millions of fish at age 1.

*) Estimated from prediction regression (of Table 5.3 in ICES Doc. C.M.1977/F:19).

Table 4.1.3 North Sea HADDOCK. Relative Fishing Effort*

Year	Scotland Seine		England Trawl		Total Fishery	Effort relative to 1978
	Landings (tonnes)	Landings/1 000 hrs	Landings (tonnes)	Landings/10^7 tonnes/hrs	Landings/tonnes	
1963	22 284	36.2				
1964	40 733	63.7				
1965	57 639	98.8				
1966	44 002	87.7				
1967	38 321	74.5				
1968	37 797	68.9				
1969	49 652	101.0				
1970	70 187	164.9	19 500	4.25	671 833	7.3
1971	63 381	152.3	16 648	3.61	258 220	3.2
1972	50 281	128.0	20 827	3.92	213 556	2.6
1973	54 094	130.4	16 586	3.47	196 079	2.7
1974	44 826	125.9	10 798	2.38	193 429	3.0
1975	39 233	114.8	11 499	3.18	174 163	2.6
1976	51 901	168.5	17 238	4.03	204 603	2.2
1977	53 248	170.9	17 167	3.84	150 678	1.6
1978	59 628	183.5	12 536	2.81	89 151	1.0

* See Appendix I for method of calculation.

Table 4.1.4 North Sea HADDOCK

Input Catch Data for VPA

AGE	1961	1962	1963	1964	1965	1966
0	0	0	0	0	0	0
1	20452	64398	25016	11	24631	11741
2	64283	23710	118135	426452	3723	6651
3	65993	32655	13487	146416	460835	17676
4	3884	18585	12228	17136	33171	410528
5	2326	1186	6490	9540	6839	24649
6	7350	679	533	4319	3817	4302
7	813	3436	362	323	672	408
8	398	260	919	532	259	79
9	59	26	9	60	18	5
10+	1	4	9	11	1	1

AGE	1967	1968	1969	1970	1971	1972
0	0	0	0	0	0	161936
1	101980	375954	96450	6270	48309	194924
2	25414	190064	1728521	119108	22735	222225
3	3332	26678	181820	1501064	37464	27356
4	6684	2336	26798	34647	372836	20070
5	194803	2244	5169	594	11383	147479
6	4836	66077	2252	512	675	3277
7	498	566	42461	235	206	123
8	259	72	5051	2584	1827	433
9	42	11	13	19	864	8
10+	3	6	1	3	211	142

AGE	1973	1974	1975	1976	1977	1978
0	41834	386956	70051	147446	45221	248588
1	21985	241173	776653	103177	137100	206962
2	265206	78126	416471	601124	73290	121704
3	240903	252116	53422	211482	316963	31072
4	8952	43950	116929	12607	39904	108089
5	6147	2636	16760	33469	3805	9064
6	1572	1136	708	5543	6715	1220
7	39	9621	489	228	1217	1956
8	1	236	3098	85	113	410
9	4	15	111	815	33	122
10+	23	40	64	83	167	90

Table 4.1.5 North Sea HADDOCK

Fishing Mortalities from VPA

AGE	1961	1962	1963	1964	1965	1966	1967	1968	1969
0	.000	.000	.000	.000	.000	.000	.000	.000	.000
1	.173	.119	.009	.000	.559	.092	.158	.068	.321
2	.560	.310	.331	.214	.076	.285	.294	.491	.499
3	.943	.625	.291	.890	.376	.609	.226	.572	1.313
4	.758	.777	.508	.736	.510	.682	.491	.244	2.543
5	.687	.553	.697	.982	.755	.916	.833	.302	1.331
6	.838	.437	.520	1.646	1.650	1.908	.449	.775	.563
7	1.204	1.356	.441	.699	1.590	.813	1.683	.085	2.288
8	2.245	2.284	2.596	3.152	3.173	.838	2.892	1.495	2.672
9	2.473	1.153	.483	3.797	2.655	.814	1.625	2.211	1.444
10	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100

MEAN F FOR AGES >= 2 AND <= 8 (WEIGHTED BY STOCK IN NUMBERS)

	1961	1962	1963	1964	1965	1966	1967	1968	1969
	.730	.528	.352	.295	.381	.684	.682	.537	.574

AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978
0	.000	.000	.449	.029	.128	.190	.207	.058	.248
1	.065	.061	.177	.099	.232	.405	.468	.302	.405
2	.833	.348	.432	.386	.597	.791	.635	.725	.480
3	1.137	.694	.932	1.225	.783	1.130	1.353	.842	.800
4	1.008	1.028	1.055	.954	.915	1.106	.930	1.091	.800
5	.396	1.192	1.947	1.200	.855	.982	1.222	.836	.800
6	.418	1.102	1.614	.084	.749	.590	1.118	.891	.720
7	.102	.295	.599	.062	1.034	.879	.382	.809	.720
8	1.106	3.648	1.961	.008	.629	1.239	.359	.331	.720
9	.066	1.710	.235	.074	.164	.698	1.535	.230	.720
10	1.100	1.100	1.100	1.100	1.100	1.100	1.100	1.100	.720

MEAN F FOR AGES >= 2 AND <= 8 (WEIGHTED BY STOCK IN NUMBERS)

	1970	1971	1972	1973	1974	1975	1976	1977	1978
	1.106	.933	.774	.627	.759	.875	.781	.840	.627

AGE-NATURAL MORTALITY

0	1	2	3	4	5	6	7	8	9	10
.200	.200	.200	.200	.200	.200	.200	.200	.200	.200	.200

Table 4.1.6 North Sea HADDOCK

Stock Size in Numbers from VPA

AGE	1961	1962	1963	1964	1965	1966
0	772302	3670249	83268	76795	179312	937054
1	141708	632308	3004946	68174	62875	146809
2	163962	97599	459632	2437647	55806	29432
3	117468	76706	58599	270185	1611915	42331
4	7962	37472	33606	35853	90859	906026
5	5106	3054	14104	16561	14060	44676
6	14102	2103	1439	5752	5078	5410
7	1257	4997	1113	701	908	799
8	475	308	1054	586	285	152
9	68	41	26	64	21	10
10	1	5	11	13	1	1

AGE	1967	1968	1969	1970	1971	1972
0	7690049	471462	135013	1100531	1617552	490055
1	767195	6296079	386000	110540	901038	1324339
2	109607	536247	4815567	229366	84844	694113
3	18117	66893	268740	2394062	81655	49046
4	18850	11835	30895	59215	628904	33395
5	375091	9444	7588	1989	17694	184147
6	14643	133515	5715	1642	1096	4400
7	657	7652	50378	2664	885	298
8	290	100	5755	4184	1969	539
9	54	13	18	326	1133	42
10	4	7	1	4	249	168

AGE	1973	1974	1975	1976	1977	1978
0	1607549	3548969	446177	867278	881734	1243611
1	256025	1278378	2556844	302219	577332	681093
2	908713	189789	829628	1396484	154952	349453
3	368980	505949	85505	307887	665986	61444
4	15817	88745	189401	22824	65146	213743
5	9521	4988	29097	51322	7307	17924
6	21517	2349	1736	8924	12377	2592
7	717	16199	909	788	2389	4155
8	134	552	4717	309	441	871
9	62	109	241	1119	177	259
10	27	47	76	98	197	115

Table 4.1.7 North Sea HADDOCK

Spawning Stock Biomass

Year	Spawning Stock Biomass (Tonnes x 10^{-3})
1961	94
1962	74
1963	144
1964	626
1965	613
1966	512
1967	292
1968	261
1969	1 166
1970	893
1971	380
1972	299
1973	343
1974	278
1975	322
1976	444
1977	286
1978	220

Table 4.1.8 North Sea HADDOCK

Data for Assessment of Yield per Recruit Curves

(M = 0.2 for all ages)

Age	Expected Relative F in 1980	Mean Weight (kg)
0	.31	.0143
1	.41	.0728
2	.45	.2056
3	.98	.3366
4	1.0	.505
5	1.0	.643
6	.9	.810
7	.9	1.102
8	.9	1.312
9	.9	1.369
10+	.9	1.460

Table 4.1.9 North Sea HADDOCK, 1978. Input Data for Catch Predictions*)

Age	Industrial Landings			Consumption Landings			Discards		Total		
	Catch No. (.000)	$\bar{W}$ (kg)	F	Catch No. (.000)	$\bar{W}$ (kg)	F	Catch No. (.000)	$\bar{W}$ (kg)	Catch No. (.000)	$\bar{W}$ (kg)	F
0	241 333	0.012	0.248	0	0.000	0.000	6 040	0.080	247 373	0.014	0.248
1	108 245	0.041	0.215	12 233	0.210	0.190	85 938	0.091	206 416	0.072	0.405
2	10 161	0.165	0.040	49 482	0.256	0.440	62 011	0.171	121 654	0.205	0.480
3	666	0.274	0.020	23 759	0.374	0.780	6 645	0.208	31 070	0.336	0.800
4	829	0.440	0.010	98 809	0.529	0.790	8 451	0.228	108 089	0.505	0.800
5	66	0.326	0.010	8 939	0.648	0.790	59	0.275	9 064	0.643	0.800
6	9	0.399	-	1 113	0.858	0.720	98	0.300	1 220	0.810	0.720
7	5	0.399	-	1 951	1.104	0.720	0	0.000	1 956	1.102	0.720
8	1	0.399	-	409	1.314	0.720	0	0.000	410	1.312	0.720
9	0	0.000	-	122	1.369	0.720	0	0.000	122	1.369	0.720
10	0	0.000	-	90	1.460	0.720	0	0.000	90	1.460	0.720

*) Adjusted so that the sum of products equals landings.

Year	1979	1980
Recruitment at age 0	622 000	622 000

Table 4.1.10 North Sea HADDOCK
Results of Catch Predictions (in thousands of tonnes)

1978:	F^*	0.8							
	Spawning stock biomass	220							
	Industrial by-catch	9.6							
	Consumption landings	86.1							
	Total landings	25.7							
	Discards	22.3							
1979:	Option	A				B			
	F^*	$0.76 = 0.95 \times F_{78}$ (to take TAC)				The option $F_{79} = 0.9\ F_{78}$ was not run since it is virtually identical to option A.			
	Spawning stock biomass	207							
	Industrial by-catch	8.7							
	Consumption landings	74.5							
	Total landings	83.2							
	Discards	24.0							
1980:	Option	A 1	A 2	A 3	A 4	B 1	B 2	B 3	B 4
	Mesh size (mm)	80	80	80	75	80	80	80	75
	F^*	$0.76=F_{79}$	$0.61=0.8 \times F_{79}$	$0.26=F_{max}$	$0.76=F_{79}$				
	Spawning stock biomass	224	224	224	224				
	Industrial by-catch	6.9	5.7	2.6	6.7				
	Consumption landings	70.7	59.8	29.5	75.2				
	Total landings	77.6	65.5	32.1	81.9				
	Discards	17.5	14.6	6.9	22.6				
1981:	Spawning stock biomass	209	230	287	195				

* Fishing mortality on age groups subject to maximum exploitation.

Table 4.2.1 Nominal catch (in tonnes) of HADDOCK in Division VIa, 1969-1978
(Data for 1969-1977 as officially reported to ICES)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*)
Belgium	34	13	9	44	45	98	23	45	-	
Denmark	-	-	-	-	-	-	-	13	-	-
Faroe Islands	-	-	-	-	2	1	-	-	-	-
France	224	785	2 354	5 014	5 141	3 979	2 328	3 026	3 401	3 572
German Dem.Rep.	-	-	10	87	-	-	9	-	-	-
Germany,Fed. Rep.	14	9	15	7	15	18	3	30	+	19
Iceland	-	-	+	-	-	-	-	-	-	-
Ireland	1 618	2 720	4 316	3 982	2 631	1 715	599	1 115	616	443
Netherlands	40	126	78	205	169	63	19	30	28	
Norway	-	-	-	-	-	-	-	3	7	9
Poland	-	-	10	-	402	97	20	-	-	
Spain	-	-	-	101	497	540	-	-		
Sweden	-	-	-	-	-	-	-	-	-	
U.K.(Engl.+Wales)	3 296	1 785	1 491	2 393	2 187	1 512	1 214	1 971	3 827	2 805
U.K.(Scotland)	21 034	28 724	33 087	27 730	17 631	9 583	8 973	11 992	11 422	9 629
U.K.(N. Ireland)	13	12	2	1	-	-	-	-	-	
U.S.S.R.	-	4	4 927	1 480	110	364	495	533	-	
Total VIa	26 273	34 178	46 299	41 044	28 830	17 970	13 683	18 758	19 301	16 477
Working Group Total Catch									19 301	16 925

*) Preliminary

Table 4.2.2 Nominal catch (in tonnes) of HADDOCK in Division VIb, 1969-1978
(Data for 1969-1977 as officially reported to ICES)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*)
Belgium	-	-	-	-	-	-	-	33	-	-
Faroe Islands	-	-	-	-	-	2	1	8	3	-
France	320	12	182	1 527	600	353	21	4	4	3
Norway	-	-	-	-	-	-	-	-	+	-
Poland	-	-	-	-	54	-	-	-	-	-
U.K.(Engl.+Wales)	262	220	117	27	1	-	5	2 111	2 694	2 365
U.K.(Scotland)	543	608	313	616	72	22	71	640	297	2 059
U.S.S.R.	-	-	9	7 304	3 291	48 911	49 830	40 447	-	-
Total VIb	1 125	840	621	9 474	4 018	49 288	49 928	43 243	2 998	4 427

*) Preliminary.

Table 4.2.3 HADDOCK in Division VIa

Input Catch Data for VPA

AGE	1965	1966	1967	1968	1969	1970
1	5	278	516	9311	0	230
2	1654	359	11419	7387	48921	164
3	84419	1164	1239	3234	5928	71520
4	4697	47424	238	418	1386	3795
5	206	1606	18775	586	350	211
6	169	76	252	11729	576	92
7	139	30	20	655	3386	98
8+	23	102	28	36	150	453

AGE	1971	1972	1973	1974	1975	1976
1	2448	590	1208	1970	4861	779
2	2844	22221	6520	3425	9519	21547
3	6627	2225	15648	9411	2773	12098
4	91387	2897	263	6131	3427	1548
5	590	56846	1147	97	1980	1440
6	86	612	31836	447	106	885
7	6	37	139	11488	122	27
8+	97	57	114	189	3770	1298

AGE	1977	1978
1	368	775
2	1279	926
3	29515	696
4	5689	21280
5	695	2884
6	494	416
7	363	268
8 +	592	502

Table 4.2.4 HADDOCK in Division VIa
Fishing Mortalities from VPA

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973
1	.001	.012	.017	.015	.000	.018	.033	.016	.074
2	.283	.101	.923	.361	.103	.007	.312	.458	.253
3	.543	.329	.589	.747	.553	.214	.391	.429	.688
4	.745	.681	.103	.402	.868	.856	.463	.295	.081
5	.578	.621	.639	.392	.702	.300	.300	.591	.182
6	.848	.436	.182	1.132	.849	.398	.192	.583	.798
7	.421	.345	.194	.980	1.343	.329	.040	.118	.250
8	.150	.150	.150	.150	.150	.150	.150	.150	.150

MEAN F FOR AGES >= 2 AND <= 6 (WEIGHTED BY STOCK IN NUMBERS)

	1965	1966	1967	1968	1969	1970	1971	1972	1973
	.544	.645	.688	.670	.120	.212	.450	.531	.595

AGE	1974	1975	1976	1977	1978
1	.035	.031	.186	.077	.021
2	.308	.232	.187	.524	.280
3	.700	.440	.517	.419	.610
4	.642	.601	.472	.492	.610
5	.039	.441	.550	.403	.500
6	.100	.054	.361	.368	.450
7	.772	.036	.017	.246	.350
8	.150	.150	.150	.150	.150

MEAN F FOR AGES >= 2 AND <= 6 (WEIGHTED BY STOCK IN NUMBERS)

	1974	1975	1976	1977	1978
	.500	.307	.263	.431	.573

AGE-NATURAL MORTALITY

1	2	3	4	5	6	7	8
.200	.200	.200	.200	.200	.200	.200	.200

Table 4.2.5 HADDOCK in Division VIa

Stock Size in Numbers from VPA

AGE	1965	1966	1967	1968	1969	1970
1	5028	25456	33211	685402	33729	14487
2	7377	4112	20591	26725	552751	27615
3	220246	4552	3043	6698	15247	408438
4	9750	104745	2681	1383	2598	7177
5	513	3791	43396	1981	757	893
6	322	235	1668	18748	1096	307
7	443	113	125	1139	4947	384
8	54	238	65	84	350	1057

AGE	1971	1972	1973	1974	1975	1976
1	83620	39816	18655	63889	175299	5049
2	11653	66252	32066	14183	50529	139134
3	22461	6985	34321	20388	8534	32804
4	270024	12442	3723	14124	8289	4501
5	2496	139154	7582	2811	6084	3721
6	541	1513	63078	5175	2214	3205
7	169	366	691	23260	3834	1717
8	226	133	266	441	8797	3029

AGE	1977	1978
1	5492	41133
2	3432	4164
3	94510	1665
4	16022	50901
5	2297	8020
6	1758	1257
7	1830	995
8	1381	1171

Table 4.2.6 HADDOCK in Division VIa
Input Data for Catch Predictions

Age	1978 Catch Number x 10^{-3}	1978 F	75/80 mm Mesh Change Coefficients	$\bar{w}$	Exploitation Pattern
1	775	0.021	0.84	0.23	0.03
2	926	0.28	0.93	0.28	0.43
3	696	0.61	0.99	0.41	1
4	21 280	0.61	1	0.58	1
5	2 884	0.50	1	0.71	0.82
6	416	0.45	1	0.94	0.74
7	268	0.35	1	1.21	0.57
8+	502	0.15	1	1.44	0.25

Recruitment at age 1 : 1977 year class = 41×10^6
1978 year class = 49×10^6
1979 year class = 32×10^6

Table 4.2.7 HADDOCK in Division VIa
Results of Catch Predictions (in thousand tonnes)

1978:	F^{*}	0.61							
	Spawning stock biomass	45							
	Landings	16.5							
1979:	Option	A				B			
	F^{*}	0.49(to take TAC)				0.55 (F_{78} x 0.9)			
	Spawning stock biomass	32				32			
	Landings	8.5				9.3			
1980:	Option	A 1	A 2	A 3	A 4	B 1	B 2	B 3	B 4
	Mesh size (mm)	80	80	80	75	80	80	80	75
	F^{*}	$0.49=F_{79}$	$0.39=0.8xF_{79}$	$0.5=F_{max}$	$0.49=F_{79}$	$0.55=F_{79}$	$0.44=0.8xF_{79}$	$0.5=F_{max}$	$0.55=F_{79}$
	Spawning stock biomass	34		34	34	33		33	33
	Landings	9	($F_{80} < F_{max}$)	9	9.2	9.6	($F_{80} < F_{max}$)	8.9	9.8
1981:									
	Spawning stock biomass	36		36	36	34		35	34

*F on age groups subject to maximum exploitation.

Table 4.3.1 Nominal catch (in tonnes) of HADDOCK in Divisions VIId and VIIe, 1969-1978
(Data for 1969-1977 as officially reported to ICES)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*)
Belgium	10	3	1	2	1	+	+	+	1	–
Denmark	–	–	–	–	–	–	–	–	2	18
France	736	295	97	224	208	487	868	405	438	364
Germany, Fed.Rep.	–	–	1	–	–	–	+	–	–	–
Ireland	–	–	–	–	–	–	–	–	4	–
Netherlands	–	5	–	9	1	–	1	–	–	–
Poland	–	–	–	–	12	–	–	–	–	–
U.K.(Engl.+Wales)	65	118	71	166	135	113	99	45	29	22
U.S.S.R.	–	–	–	10	2	33	3	–	–	–
Total VIId,e	811	421	170	411	359	633	971	450	474	404

Table 4.4.1 Nominal catch (in tonnes) of HADDOCK in Divisions VIIb,c and VIIg-k, 1969-1978
(Data for 1969-1977 as officially reported to ICES)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*
Belgium	22	31	23	45	65	35	33	19	13	4a)
Faroe Islands	–	–	–	–	3					
France	2 941	3 823	3 652	6 456	5 524	6 057	4 583	3 726	2 244	2 313
Germany, Fed.Rep.	2	1	1	–	1	–	+	3	–	–
Ireland	635	783	947	1 103	1 348	829	507	287	153	127
Netherlands	80	98	66	56	12	2	4	14	1	
Poland	–	–	3	–	62	143	–	–	–	
Spain	–	–	–	733	890	1 100	–	–	294	
U.K.(Engl.+Wales)	44	46	25	107	24	39	46	24	18	16
U.K.(Scotland)	–	–	–	–	–	–	–	–	–	8
U.S.S.R.	–	27	136	253	24	456	1 290	183	–	–
Total VIIb,c and g-k	3 724	4 809	4 853	8 753	7 953	8 661	6 463	4 256	2 723	2 468

*) Preliminary
a) VIIg only

Table 5.1.1 Nominal catch (in tonnes) of WHITING in Sub-area IV, 1969-1978
(Data for 1969-1977 as officially reported to ICES)

	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*)
Belgium	2 410	2 799	2 108	2 745	3 387	3 156	3 279	2 640	3 275	3 191
Denmark	142 622	102 698	55 618	50 109	73 928	109 654	61 941	116 973	46 479	15 525
Faroe Islands	-	-	-	-	1 453	1 126	764	1 262	472	-
France	25 602	25 842	16 668	19 822	20 353	19 825	20 079	19 557	17 592	19 868
German Dem. Rep.	-	-	-	-	5	-	3	18	-	22
Germany, Fed. Rep.	542	392	233	264	403	454	446	302	461	348
Iceland	-	-	-	-	-	-	-	4	9	...
Netherlands	15 181	10 115	6 322	7 613	8 811	12 057	14 078	12 274	9 406	...
Norway a)	32	43	25	28	1 527	4 990	55	71	33	93
Poland	-	-	-	-	7	1 002	888	509	445	8
Spain	-	-	-	107	119	110	65	18	-	...
Sweden b)	1 090	820	616	596	2 328	2 440	255	153	341	50
U.K. (Engl. + Wales)	2 268	3 398	4 158	3 789	4 592	5 519	5 246	5 112	6 185	7 541
U.K. (Scotland)	20 573	21 080	26 755	23 846	20 756	25 274	27 969	26 167	33 017	42 779
U.S.S.R.	5 509	14 319	541	613	3 522	2 978	5 098	5 612	2 413	-
Total IV	215 829	181 506	113 044	109 532	141 191	188 585	140 166	190 672	120 128	100 066
Total IVa	49 839	32 185	23 451	32 932	31 104	81 693	75 444	100 001	61 499	
Total IVb	157 568	126 024	70 728	66 789	96 678	87 842	41 930	69 908	42 911	
Total IVc	8 422	23 297	18 865	9 811	13 409	19 050	22 792	20 763	15 718	
Working Group Total Catch									172 378 c)	170 819 c)

*) Provisional figures.
a) Figures from 1969-1972 do not include Whiting caught in Rec. 2 fisheries.
b) 1969-1974 includes IIIa.
c) includes discards.

Table 5.1.2 North Sea WHITING
Revised estimates of year class strength

Year class	IYHS[a)]	VPA (M = 0.2)[b)]
1964	418	680
1965	600	775
1966	519	975
1967	2 066	2 609
1968	18	860
1969	71	776
1970	225	825
1971	356	1 784
1972	1 161	2 322
1973	325	1 606
1974	943	2 241
1975	832	1 333
1976	436	1 442
1977	473	1 248*
1978	(505)	1 287*

a) Arithmetic mean number per hour fishing during the International Young Herring Surveys (c.f. ICES Doc. C.M.1978/G:51)
Figure in brackets represents preliminary estimate based on numbers of whiting < 20 cm caught in 1979.

b) Millions of fish at age 1. Figures with an asterisk (*) estimated from predictive regression (c.f. Table 53 in ICES Doc. C.M.1977/F:19).

Table 5.1.3 North Sea WHITING

Input Catch Data for VPA

AGE	1963	1964	1965	1966	1967	1968
0	64257	198791	35800	26864	225344	149071
1	271742	61465	80050	267347	187736	425514
2	220766	157203	53023	187031	163927	317412
3	59022	113598	222525	72901	123885	101396
4	36292	22679	61271	188881	28061	48832
5	8838	11698	8466	33896	59486	10730
6	1893	2904	3873	3226	7714	23612
7	11	501	928	1540	923	2130
8+	151	63	141	451	150	138

AGE	1969	1970	1971	1972	1973	1974
0	114392	105852	969531	478565	201785	492277
1	513060	486258	208832	642039	638510	873497
2	790117	172353	90844	235436	446112	745235
3	133868	401920	22821	41610	108925	190795
4	30646	34378	115699	6816	18653	32495
5	11183	10568	13065	51901	5305	5000
6	3807	4051	2241	5971	18094	1779
7	7248	504	801	843	2638	5409
8+	3499	1673	662	575	635	578

AGE	1975	1976	1977	1978
0	181773	311435	264876	394280
1	602340	306092	326782	270143
2	273809	756273	310316	400877
3	255145	128010	200190	194005
4	60267	72995	26474	68918
5	11565	14483	18150	7440
6	2487	3478	4324	5802
7	781	795	401	1860
8+	1651	591	318	397

Table 5.1.4 North Sea WHITING

Fishing Mortalities from VPA

AGE	1963	1964	1965	1966	1967	1968	1969	1970	1971
0	.151	.234	.041	.025	.075	.145	.125	.109	.397
1	.223	.211	.139	.474	.238	.198	1.042	1.135	.325
2	.515	.194	.284	.548	.605	.796	.677	1.382	.664
3	.795	.551	.460	.792	.885	.978	.981	.914	.669
4	.942	.843	.659	.920	.839	1.148	.948	.745	.748
5	.918	.957	.924	.988	.869	.949	.926	1.090	.721
6	1.168	.925	1.042	1.217	.637	1.105	1.151	1.116	.722
7	.119	1.257	.902	2.102	1.741	.371	1.401	.436	.691
8	.800	.800	.800	.800	.800	.800	.800	.800	.800

MEAN F FOR AGES >= 2 AND <= 5 (WEIGHTED BY STOCK IN NUMBERS)

	1963	1964	1965	1966	1967	1968	1969	1970	1971
	.599	.305	.454	.731	.740	.865	.721	1.014	.706

AGE	1972	1973	1974	1975	1976	1977	1978
0	.170	.107	.181	.116	.178	.174	.240
1	.500	.359	.895	.349	.291	.286	.270
2	.747	.795	.941	.809	1.006	.538	.680
3	.747	.981	1.002	1.057	1.227	.827	.780
4	.429	.933	.935	1.090	1.067	.945	.780
5	.935	.828	.707	1.111	.871	.869	.780
6	.886	1.071	.645	.971	1.370	.709	.780
7	.667	1.441	1.201	.665	1.021	.542	.780
8	.800	.800	.800	.800	.800	.800	.780

MEAN F FOR AGES >= 2 AND <= 5 (WEIGHTED BY STOCK IN NUMBERS)

	1972	1973	1974	1975	1976	1977	1978
	.762	.831	.951	.937	1.035	.649	.718

AGE-NATURAL MORTALITY

0	1	2	3	4	5	6	7	8
.200	.200	.200	.200	.200	.200	.200	.200	.200

Table 5.1.5 North Sea WHITING

Stock Size in Numbers from VPA

AGE	1963	1964	1965	1966	1967	1968
0	504463	1049066	985704	1220927	3435016	1214352
1	1495430	355120	680024	774709	975353	2609047
2	599819	979789	235419	484612	394664	629632
3	117178	293358	660635	145073	229340	176514
4	64633	43312	138494	341394	53773	77468
5	15993	20634	15256	58640	111434	19024
6	2974	5229	6490	4958	17880	38259
7	108	757	1697	1874	1202	7744
8	189	79	176	564	187	172
TOTAL	2800788	2747345	2723896	3032749	5218850	4772213
SPAWNING STOCK (AGE >= 2)	800894	1343159	1058168	1037114	808481	948813

AGE	1969	1970	1971	1972	1973	1974
0	1074186	1124145	3241938	3362559	2183986	3278622
1	859892	776350	824927	1784215	2321951	1606143
2	1752989	248352	204379	487765	885600	1327691
3	232495	729403	51055	86162	189267	327310
4	54373	71345	239503	21412	33415	58125
5	20128	17258	27735	92851	11417	10763
6	6032	6529	4751	11045	29847	4085
7	10374	1563	1752	1889	3727	8374
8	4374	2081	827	719	794	722
TOTAL	4014841	2977036	4596867	5848617	5660003	6621836
SPAWNING STOCK (AGE >= 2)	2080763	1076541	530003	701842	1154066	1737070

AGE	1975	1976	1977	1978
0	1827909	2103357	1823045	2030676
1	2240953	1332680	1441585	1254005
2	537413	1293770	815935	886478
3	424102	195919	387200	390194
4	98419	120674	47039	138612
5	18680	27094	33995	14964
6	4348	5034	9285	11669
7	1755	1348	1048	3741
8	2064	739	397	499
TOTAL	5155642	5080615	4559530	4730637
SPAWNING STOCK (AGE >= 2)	1086780	1644577	1294899	1446157

Table 5.1.6 North Sea WHITING, 1978. Input Data for Catch Predictions

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
0	0	-	0	23 563	.034	.01	370 725	.012	.23	394 288	.013	.24
1	13 924	.187	.01	58 177	.110	.06	197 800	.057	.20	269 901	.075	.27
2	117 034	.228	.20	226 108	.154	.39	55 666	.159	.10	398 808	.176	.68
3	118 044	.269	.48	46 333	.184	.19	27 541	.243	.11	191 918	.245	.78
4	56 337	.322	.65	8 299	.208	.10	3 286	.322	.04	67 922	.308	.78
5	6 375	.380	.68	303	.227	.03	649	.380	.07	7 329	.374	.78
6	5 148	.468	.70	107	.241	.02	456	.468	.06	5 711	.464	.78
7	1 446	.620	.62	0	-	0	388	.620	.17	1 834	.620	.78
8	259	.900	.52	0	-	0	133	.900	.26	392	.900	.78

Year class	1978	1979	1980
Recruits (000) at age 0	2 030 700	1 750 000	1 750 000

*) adjusted so that sum of products equals landings.

Table 5.1.7 North Sea WHITING. Results of Catch Predictions (in thousand tonnes)

<table>
<tr><td rowspan="6">1978:</td><td>F*</td><td colspan="7">0.78</td></tr>
<tr><td>Spawning stock biomass</td><td colspan="7">306</td></tr>
<tr><td>Industrial by-catch</td><td colspan="7">33</td></tr>
<tr><td>Consumption landings</td><td colspan="7">85</td></tr>
<tr><td>Total landings</td><td colspan="7">118</td></tr>
<tr><td>Discards</td><td colspan="7">52</td></tr>
<tr><td rowspan="7">1979:</td><td>Option</td><td colspan="4">A</td><td colspan="3">B</td></tr>
<tr><td>F*</td><td colspan="4">$0.51 = 0.65 \times F_{78}$ (to take TAC)</td><td colspan="3">$0.70 = 0.90 \times F_{78}$</td></tr>
<tr><td>Spawning stock biomass</td><td colspan="4">299</td><td colspan="3">299</td></tr>
<tr><td>Industrial by-catch</td><td colspan="4">23</td><td colspan="3">30</td></tr>
<tr><td>Consumption landings</td><td colspan="4">63</td><td colspan="3">81</td></tr>
<tr><td>Total landings</td><td colspan="4">86</td><td colspan="3">111</td></tr>
<tr><td>Discards</td><td colspan="4">35</td><td colspan="3">45</td></tr>
<tr><td rowspan="8">1980:</td><td>Option</td><td>A 1</td><td>A 2</td><td>A 3</td><td>A 4</td><td>B 1</td><td>B 2</td><td>B 3</td></tr>
<tr><td>Mesh size (mm)</td><td>80</td><td>80</td><td>80</td><td>75</td><td>80</td><td>80</td><td>80</td></tr>
<tr><td>F*</td><td>$0.51=F_{79}$</td><td>$0.41=0.8xF_{79}$</td><td>$F_{max}=0.3$</td><td>$0.51=F_{79}$</td><td>$0.70=F_{79}$</td><td>$0.56=0.8xF_{79}$</td><td>$F_{max}=0.3$</td></tr>
<tr><td>Spawning stock biomass</td><td>358</td><td>358</td><td>358</td><td>358</td><td>315</td><td>315</td><td>315</td></tr>
<tr><td>Industrial by-catch</td><td>26</td><td>21</td><td>16</td><td>25</td><td>31</td><td>25</td><td>14</td></tr>
<tr><td>Consumption landings</td><td>67</td><td>56</td><td>42</td><td>70</td><td>74</td><td>62</td><td>36</td></tr>
<tr><td>Total landings</td><td>93</td><td>77</td><td>58</td><td>95</td><td>105</td><td>87</td><td>50</td></tr>
<tr><td>Discards</td><td>31</td><td>25</td><td>19</td><td>32</td><td>36</td><td>30</td><td>17</td></tr>
<tr><td>1981:</td><td>Spawning stock biomass</td><td>408</td><td>434</td><td>465</td><td>403</td><td>328</td><td>357</td><td>420</td></tr>
</table>

* Fishing mortality on age groups subject to maximum exploitation.

Table 5.1.8 North Sea WHITING
Exploitation pattern for 1980

Age	Current F			F at 80 mm mesh		
	Consumption	Industrial	Discard	Consumption	Industrial	Discard
0	0	.23	.01	0	.23	0
1	.01	.20	.06	.01	.20	.04
2	.20	.10	.39	.15	.10	.29
3	.48	.11	.19	.40	.11	.16
4	.65	.04	.10	.57	.04	.08
5	.68	.07	.03	.64	.07	.03
6	.70	.06	.02	.67	.06	.01
7	.62	.17	0	.62	.17	0
8	.52	.26	0	.52	.26	0

Table 5.2.1 Nominal catch (in tonnes) of WHITING in Division VIa, 1969-1978
(Data for 1969-1977 as officially reported to ICES)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*)
Belgium	12	12	9	7	5	10	1	14	-	-
Denmark	-	-	-	-	121	-	-	-	-	-
Faroe Islands	-	-	-	-	5	1	30	2	-	-
France	1 176	1 851	2 507	1 662	2 777	2 983	2 763	3 655	3 395	4 225
German Dem. Rep.	-	-	-	-	-	-	-	31	-	-
Germany, Fed. Rep.	19	-	+	148	127	80	62	1	1	2
Iceland	-	-	-	-	-	-	-	-	-	-
Ireland	1 836	2 420	1 178	1 122	2 117	2 431	2 429	3 255	2 752	2 080
Netherlands	12	24	28	40	57	23	85	255	78	-
Norway	-	-	-	-	-	-	-	1	-	-
Poland	-	-	2	-	10	9	-	-	-	-
Spain	-	-	-	1 397	1 540	1 479	1 871	821	763a)	949
U.K. (Engl.+Wales)	180	76	66	102	91	112	132	244	520	669
U.K. (Scotland)	8 946	6 839	11 435	10 707	9 796	9 929	12 668	16 658	9 873	8 174
U.S.S.R.	-	-	-	128	-	-	-	-	-	-
Total VIa	12 181	11 222	15 225	15 313	16 646	17 057	20 041	24 937	17 382	16 099
Working Group total catch									17 384	16 196

Table 5.2.2 Nominal catch (in tonnes) of WHITING in Division VIb, 1969-1978
(Data for 1969-1977 as officially reported to ICES)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*)
Faroe Islands	-	-	-	-	-	1	-	-	+	-
France	364	1 265	800	69	62	-	-	-	- b)	-
Spain	-	-	-	-	-	-	-	-	...	-
U.K. (Engl.+Wales)	-	+	+	+	+	-	-	3	2	5
U.K. (Scotland)	5	12	7	12	1	+	12	15	5	24
Total VIb	369	1 277	807	81	63	1	12	18	7	29

*) preliminary
a) includes VIb
b) included in VIa

Table 5.2.3 WHITING in Division VIa
Input Catch Data for VPA

AGE	1965	1966	1967	1968	1969	1970
0	0	0	0	0	0	0
1	2239	1126	4261	7037	684	697
2	4857	12935	25182	18154	25631	2676
3	41177	2454	10755	9729	9753	30312
4	5299	28248	857	3583	2794	4514
5	784	1767	16762	267	1276	818
6	68	213	803	4772	109	210
7	185	36	84	269	1708	14
8+	12	17	23	31	155	392

AGE	1971	1972	1973	1974	1975	1976
0	0	0	0	4	54	6
1	2640	11964	13009	7577	17551	7961
2	7712	9657	27463	42873	18712	44563
3	3936	3447	6758	12215	39477	16757
4	30759	1168	1831	2035	3243	22197
5	1394	12800	469	505	307	2509
6	249	712	5293	68	60	222
7	47	58	273	1387	6	38
8+	78	64	33	64	194	127

AGE	1977	1978
0	23	0
1	12920	12753
2	11210	15355
3	25655	7938
4	2953	14368
5	4905	1732
6	275	2124
7	12	76
8+	4	10

Table 5.2.4 WHITING in Division VIa

Fishing Mortalities from VPA

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973
0	.000	.000	.000	.000	.000	.000	.000	.000	.000
1	.052	.021	.081	.039	.051	.036	.095	.160	.073
2	.647	.471	.864	.569	.191	.289	.671	.579	.736
3	.448	.821	.934	1.039	.697	.362	.904	.736	1.095
4	.809	.640	.783	.990	1.025	.840	.772	.764	1.206
5	1.005	.709	1.037	.604	1.315	1.019	.689	.892	.824
6	.592	.858	.847	1.002	.535	.803	1.072	.956	1.284
7	2.128	.735	1.055	.790	1.385	.119	.414	.797	1.369
8	.700	.700	.700	.700	.700	.700	.700	.700	.700

MEAN F FOR AGES >= 2 AND <= 5 (WEIGHTED BY STOCK IN NUMBERS)

.494	.593	.927	.719	.280	.394	.760	.736	.810

AGE	1974	1975	1976	1977	1978
0	.000	.001	.000	.000	.000
1	.118	.115	.195	.263	.200
2	.360	.473	.472	.460	.570
3	.890	.663	1.066	.556	.700
4	1.307	.630	1.029	.533	.700
5	1.532	.696	1.689	.669	.700
6	.260	.761	2.047	.911	.700
7	1.772	.033	2.011	.607	.700
8	.700	.700	.700	.700	.700

MEAN F FOR AGES >= 2 AND <= 5 (WEIGHTED BY STOCK IN NUMBERS)

.446	.594	.680	.538	.645

AGE-NATURAL MORTALITY

0	1	2	3	4	5	6	7	8
.200	.200	.200	.200	.200	.200	.200	.200	.200

Table 5.2.5 WHITING in Division VIa

Stock Size in Numbers from VPA

AGE	1965	1966	1967	1968	1969	1970
0	72137	73956	250778	18405	26634	39350
1	48480	59061	60550	205320	15069	21806
2	11129	37671	47338	45730	161749	11720
3	124802	4771	19249	16329	21195	109349
4	10404	65258	1719	6192	4728	8644
5	1343	3794	28179	643	1884	1389
6	166	402	1529	8183	288	414
7	224	75	140	536	2459	138
8	15	22	30	40	199	504

AGE	1971	1972	1973	1974	1975	1976
0	100600	249587	91247	217206	60402	74968
1	32217	82364	204345	74707	177830	49404
2	17224	23996	57466	155566	54334	129771
3	7190	7212	11006	22540	88869	27713
4	62310	2383	2828	3014	7579	37486
5	3055	23579	909	694	668	3306
6	410	1256	7910	326	123	273
7	152	115	395	1793	206	47
8	100	82	42	82	249	163

AGE	1977	1978
0	94520	0
1	61373	77366
2	33281	38628
3	66287	17198
4	7813	31129
5	10973	3753
6	500	4602
7	29	165
8	5	13

Table 5.2.6 WHITING in Division VIa
Exploitation pattern for 1980

Age	Current F	Equivalent F at 80 mm mesh
1	.20	.14
2	.57	.43
3	.70	.56
4	.70	.62
5	.70	.66
6	.70	.68
7	.70	.69
8	.70	.70

Table 5.2.7 WHITING in Division VIa, 1978. Input Data for Catch Predictions

Age	Consumption Landings			Discards			Industrial Landings		
	Catch No.* (000)	$\bar{w}$ (kg)	F	Catch No. (000)	$\bar{w}$ (kg)	F	Catch No. (000)	$\bar{w}$ (kg)	F
1	14 057	.213	.20	NO DATA			NO DATA		
2	16 925	.241	.57						
3	8 750	.267	.70						
4	15 837	.310	.70						
5	1 909	.377	.70						
6	2 341	.471	.70						
7	84	.563	.70						
8	11	.690	.70						

*adjusted so that sum of products equals landings.

Year class	1978	1979	1980
Recruits (000) at age 1	77 000	77 000	77 000

Table 5.2.8 WHITING in Division VIa, 1978

Results of Catch Predictions (in thousand tonnes)

1978:							
Spawning stock biomass	30						
F*	0.70						
Landings	16.2						
1979:							
Option	A				B		
Spawning stock biomass	27.1				27.1		
F*	0.56 = (0.8 x F_{78}) (to take TAC)				0.63 = (0.9 x F_{78})		
Landings	12.1				13.3		
1980:							
Option	A 1	A 2	A 3**	A 4	B 1	B 2	B 3**
Spawning stock biomass	28.4	28.4	28.4	28.4	27.1	27.1	27.1
Mesh (mm)	80	80	(80)	80	80	80	(80)
F	0.56=F_{79}	0.45=0.8xF_{79}	-	0.56=F_{79}	0.63=F_{79}	0.50=0.8xF_{79}	-
Landings	10.5	8.7	-	11.3	11.1	9.2	-
1981:							
Spawning stock biomass	31.0	32.9	-	31.3	29.2	31.1	-

*Fishing mortality on age groups subject to maximum exploitation

**$F_{max} > 1.5$

Table 5.3.1 Nominal catch (in tonnes) of WHITING in Division VIId and VIIe in 1969-1978
(Data for 1969-1977 as officially reported to ICES)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*)
Belgium	32	41	25	19	38	39	70	103	36	80
Denmark	-	-	-	-	-	-	-	18	-	-
France	4 022	4 029	2 999	3 121	5 050	7 917	10 060	8 390	8 886	6 791
Netherlands	5	2	1	21	42	12	14	5	1	
Ireland	-	-	-	-	-	-	-	-	11	
U.K. (Engl.+Wales)	1 007	753	567	515	498	579	1 255	1 504	1 342	1 037
Germany, Fed. Rep.	+	-	+	-	-	25	1	-	-	-
U.S.S.R.	-	-	-	-	19	-	-	-	-	-
Total VIId,e	5 066	4 825	3 592	3 676	5 647	8 572	11 400	10 020	10 276	7 908

Table 5.4.1 Nominal catch (in tonnes)of WHITING in Division VIIb,c and VIIg-k
(Data for 1969-1977 as officially reported to ICES)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*)
Belgium	98	113	54	20	124	75	83	97	60	39
France	7 891	3 066	4 893	5 695	4 035	4 331	3 637	4 731	3 962	3 475
Germany, Fed. Rep.	5	1	-	-	+	-	2	-	1	19
Ireland	985	712	482	1 141	1 894	1 641	2 562	1 980	1 201	1 227
Netherlands	107	73	100	377	2 080	915	66	112	86	
Poland	-	-	-	-	14	-	-			
Spain	-	-	-	1 491	1 121	1 367	2 974	2 772		
U.K. (Engl.+ Wales)	89	80	17	34	21	15	61	21	26	38
U.K. (Scotland)	-	-	-	-	-	-	-	-	2	1
U.S.S.R.	-	-	-	3	16	-	64	2	-	-
Total VIIb,c and g-k	9 175	4 045	5 546	8 761	9 305	8 344	9 449	9 715	5 338	4 799

*) preliminary

Table 6.1 Nominal catch (in tonnes) of RAYS and SKATES in Sub-area IV, 1969-1977 (as officially reported to ICES)

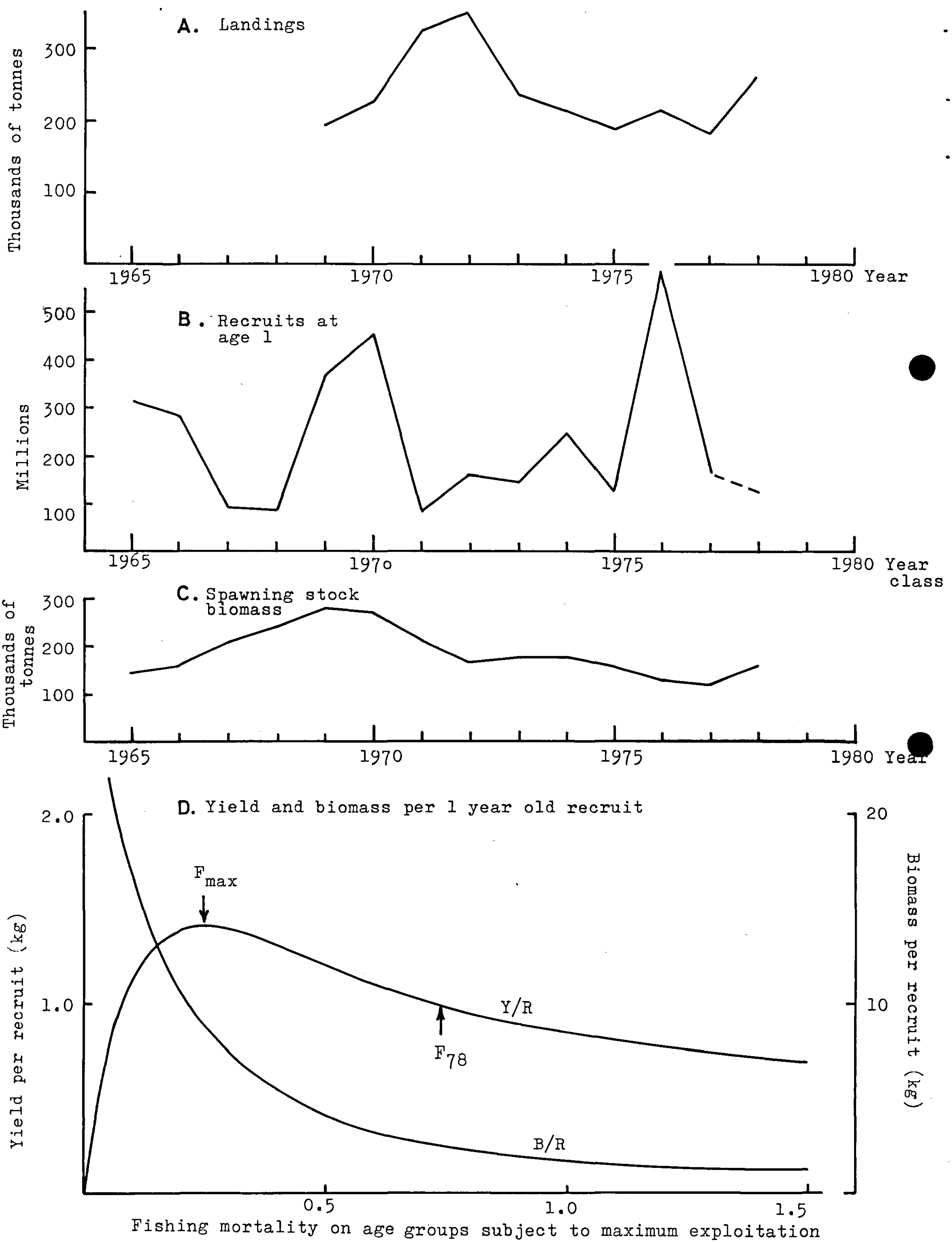
Country	1969	1970	1971	1972	1973	1974	1975	1976	1977
Belgium	1 728	1 255	1 180	1 046	941	659	461	725	769
Denmark	123	104	125	115	97	77	55	48	39
Faroe Islands	-	-	-	-	23	19	3	8	14
France	676	487	270	255	231	353	169	171	162
German Dem. Rep.	-	-	-	-	-	-	-	3	-
Germany, Fed. Rep.	27	16	19	24	159	24	20	14	2
Iceland	-	-	-	-	+	-	-	-	-
Ireland	-	-	-	-	-	-	-	-	1
Netherlands	132	111	139	171	185	283	283	325	287
Norway	351	222	194	206	377	223	454	479	362
Poland	-	-	-	-	-	33	-	-	-
Sweden[a)]	-	+	1	1	2	-	-	-	-
U.K. (Engl.+ Wales)	1 861	1 380	1 567	1 516	1 360	1 227	1 235	1 366	1 290
U.K. (Scotland)	2 598	2 092	2 263	2 148	1 826	1 582	1 496	1 594	1 887
U.S.S.R.	220	-	-	-	-	-	-	-	-
Total IV	7 716	5 667	5 758	5 482	5 201	4 480	4 176	4 733	4 813

Table 6.2 Nominal catch (in tonnes) of RAYS and SKATES in Sub-area VI, 1969-1977 (as officially reported to ICES)

Country	1969	1970	1971	1972	1973	1974	1975	1976	1977
Belgium	7	7	8	6	13	10	3	4	-
Faroe Islands	-	-	-	-	109	95	43	43	24
France	527	459	362	587	861	1 330	816	962	663
Germany, Fed. Rep.	3	+	+	+	-	1	+	+	1
Ireland	271	395	453	318	281	336	458	425	342
Netherlands	-	-	-	1	-	-	-	1	-
Norway	27	125	194	49	116	127	193	122	156
Poland	-	-	-	-	64	-	-	-	-
U.K. (Engl.+Wales)	556	477	345	320	275	266	264	373	400
U.K. (N. Ireland)	1	-	-	-	-	-	-	-	-
U.K. (Scotland)	2 397	2 051	2 060	2 585	1 864	1 308	1 700	1 869	1 884
Total VI	3 789	3 514	3 422	3 866	3 583	3 473	3 477	3 799	3 470

a) 1970-1974 includes IIIa

Figure 3.1.1 North Sea COD.



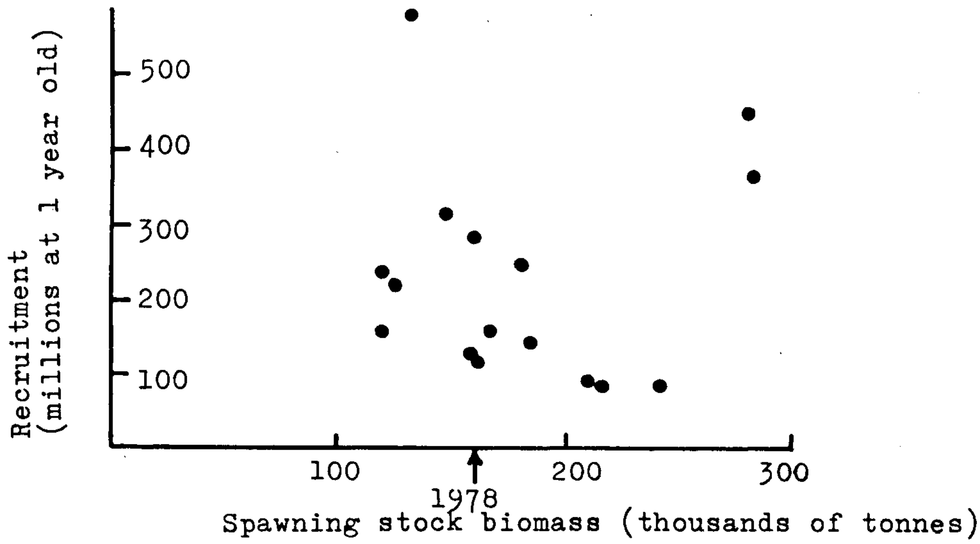
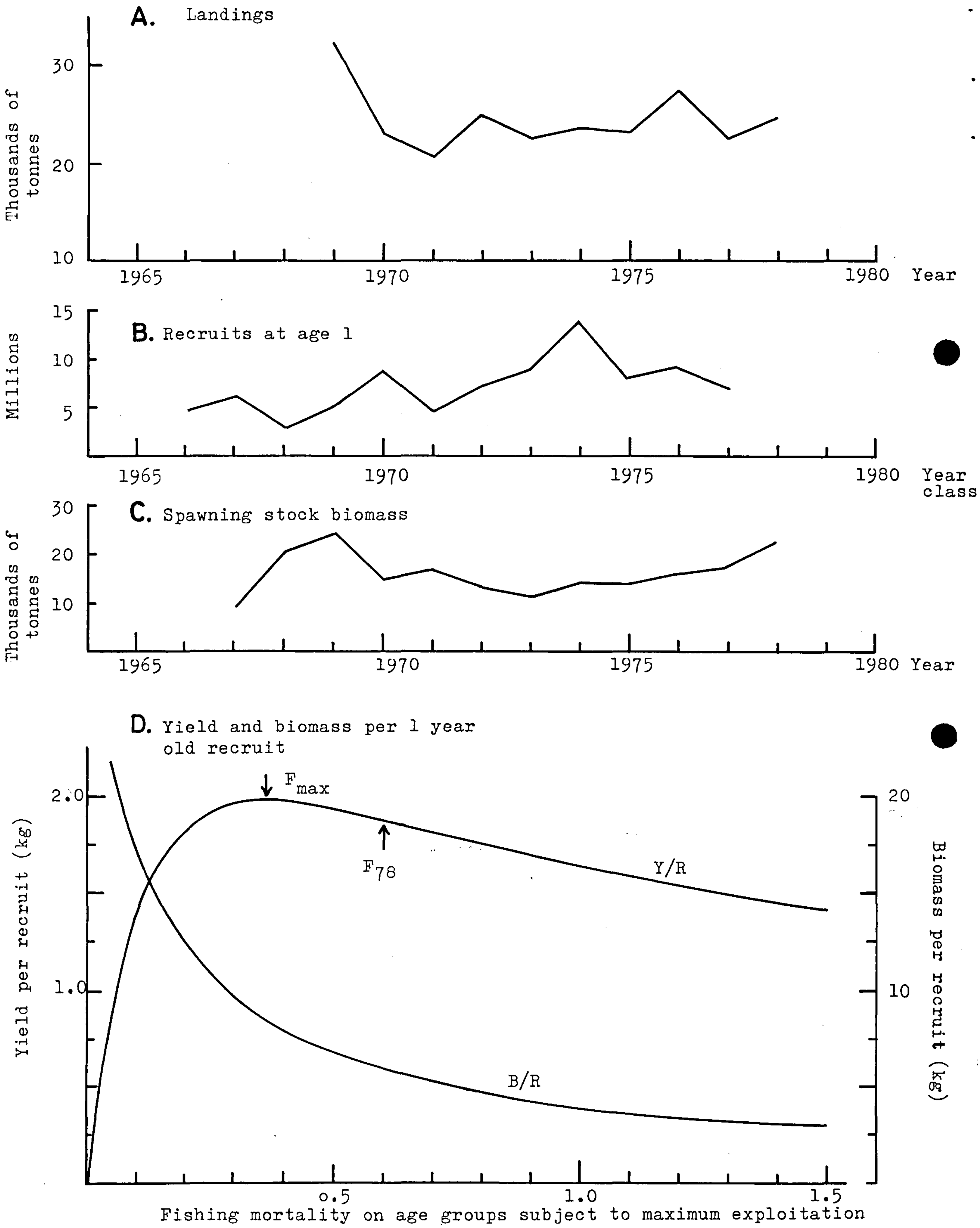


Figure 3.1.2 North Sea Cod.
Stock-recruitment plot.

Figure 3.2.1 COD in Division VIa.



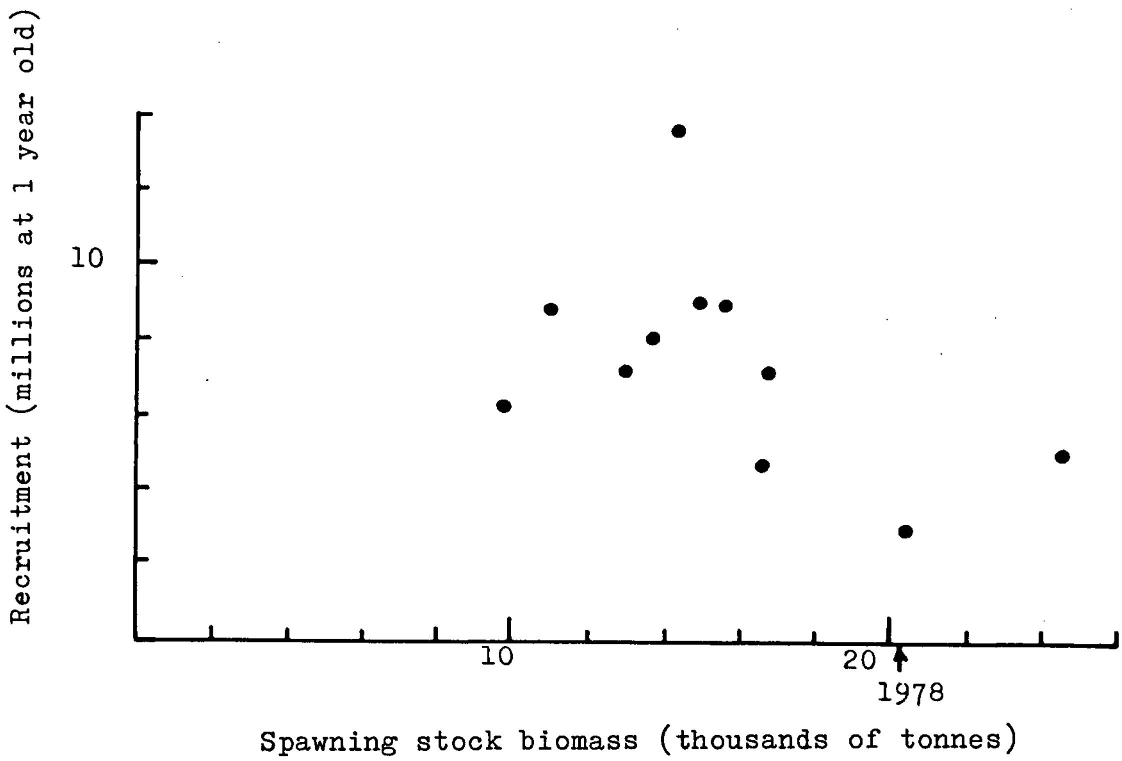
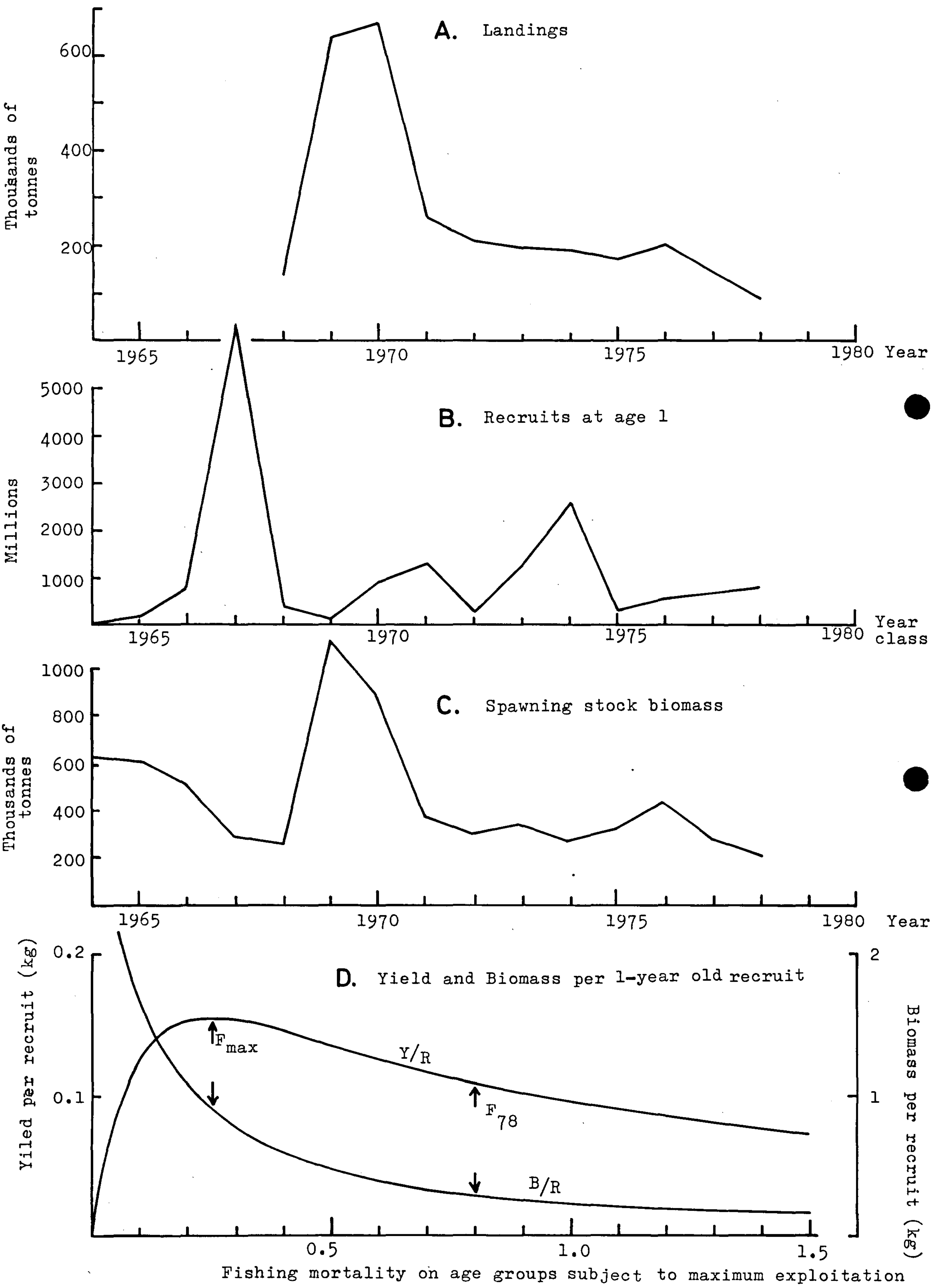
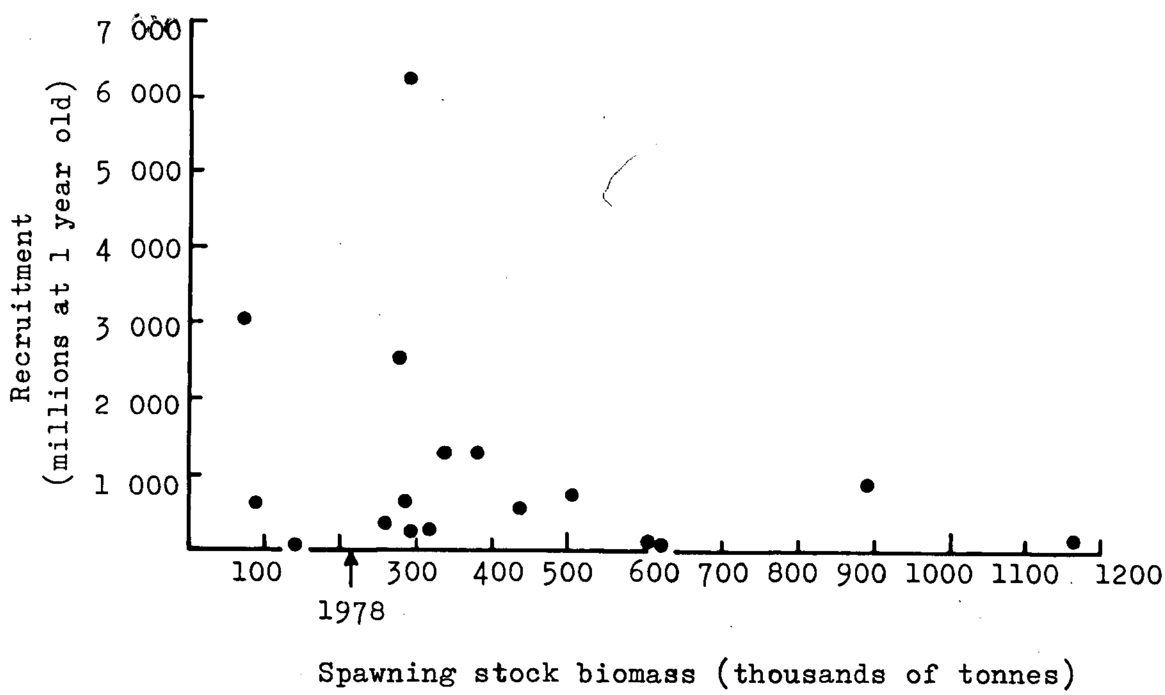


Figure 3.2.2 Stock-recruitment plot
for Division VIa Cod.

Figure 4.1.1 North Sea HADDOCK.





<u>Figure 4.1.2</u> North Sea haddock stock-recruitment plot.

Figure 4.2.1 HADDOCK in Division VIa.

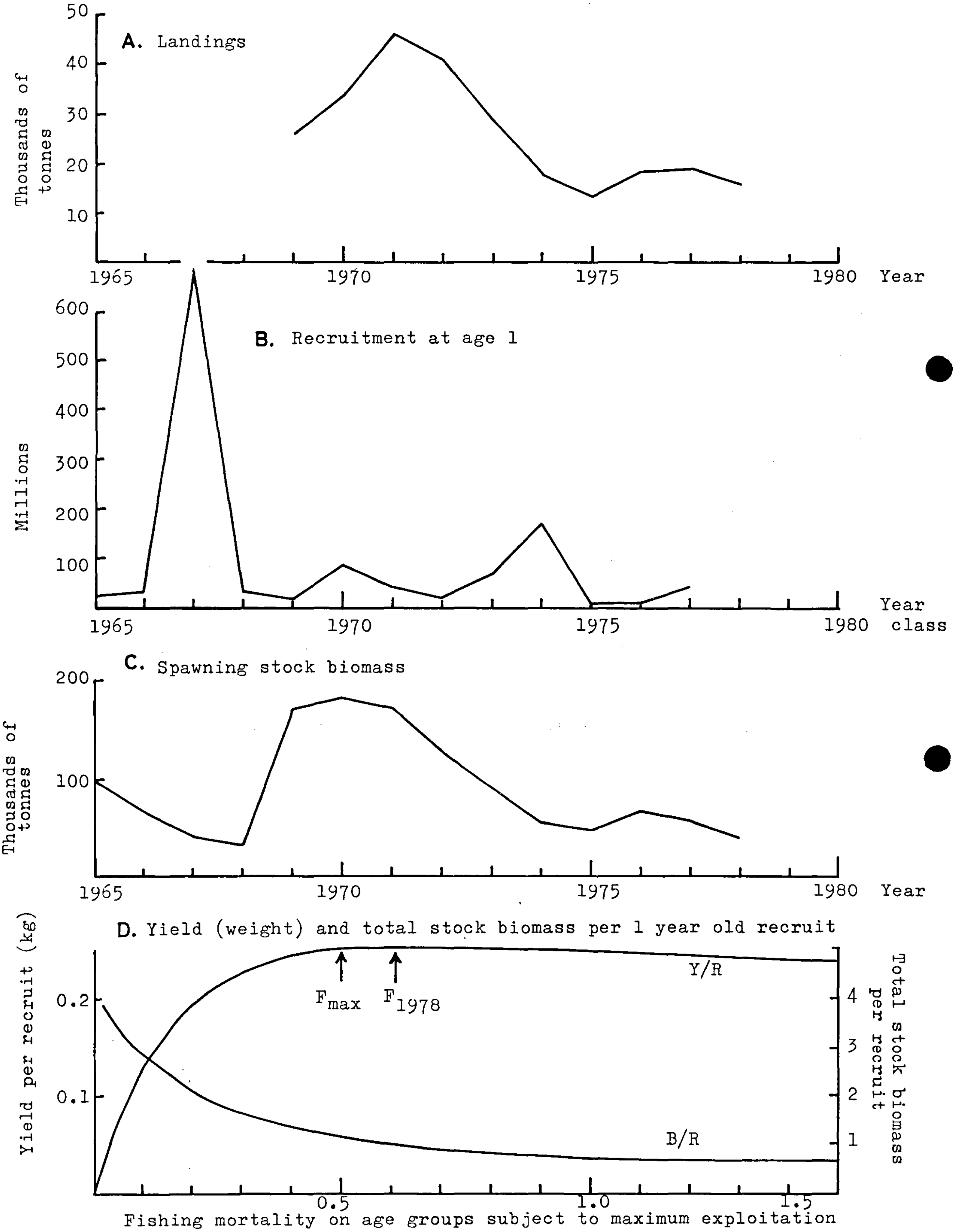
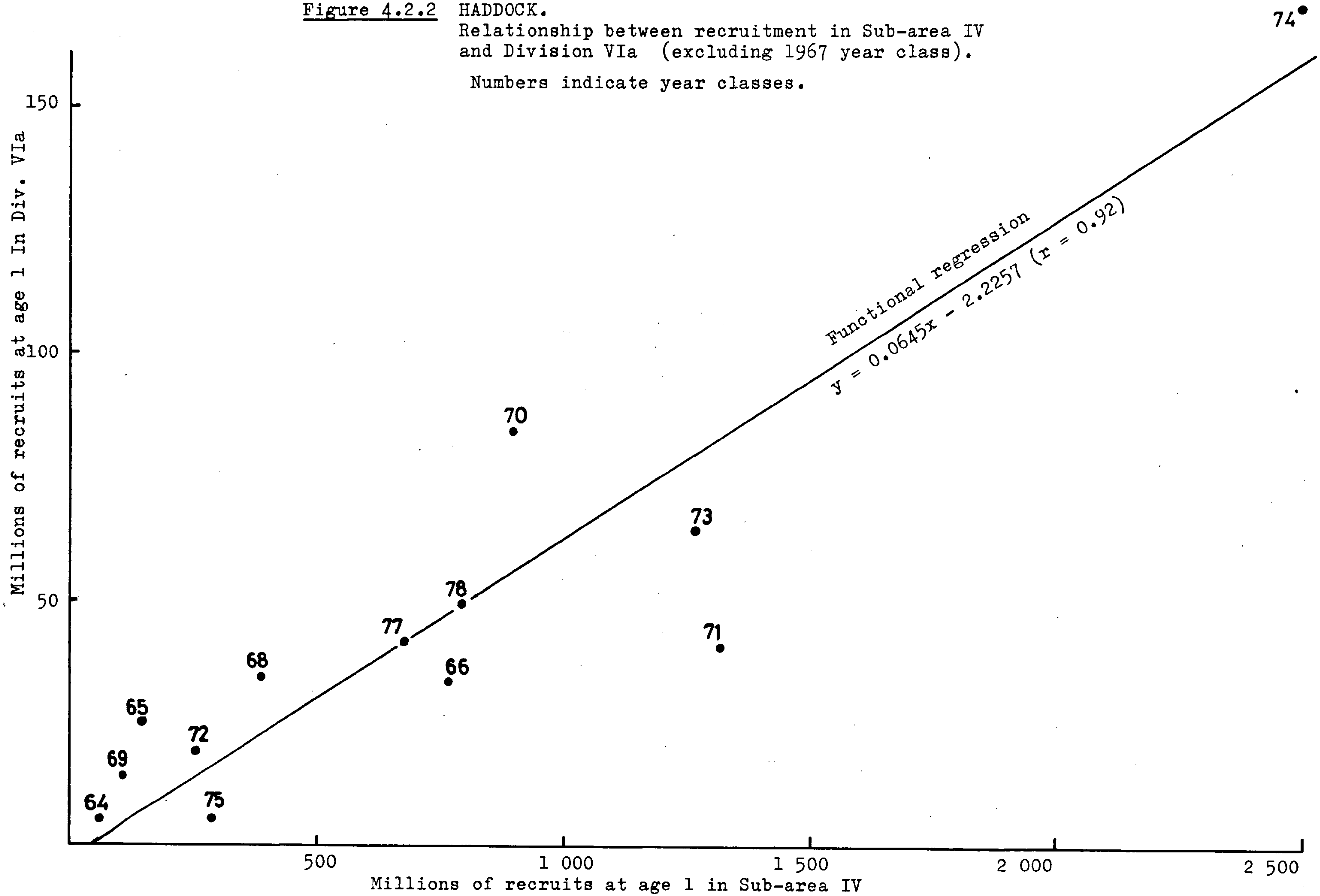
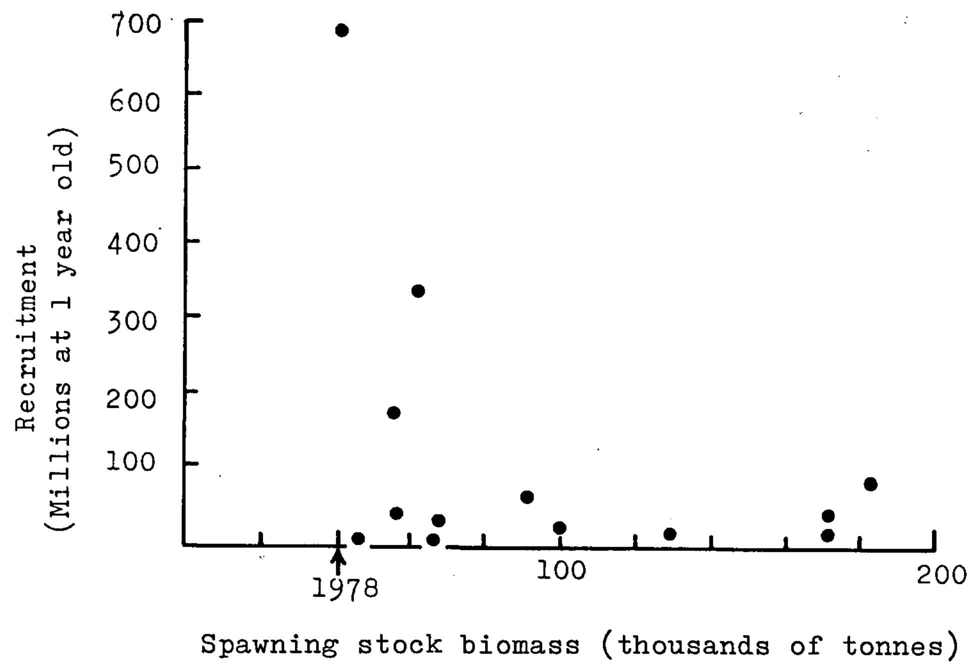


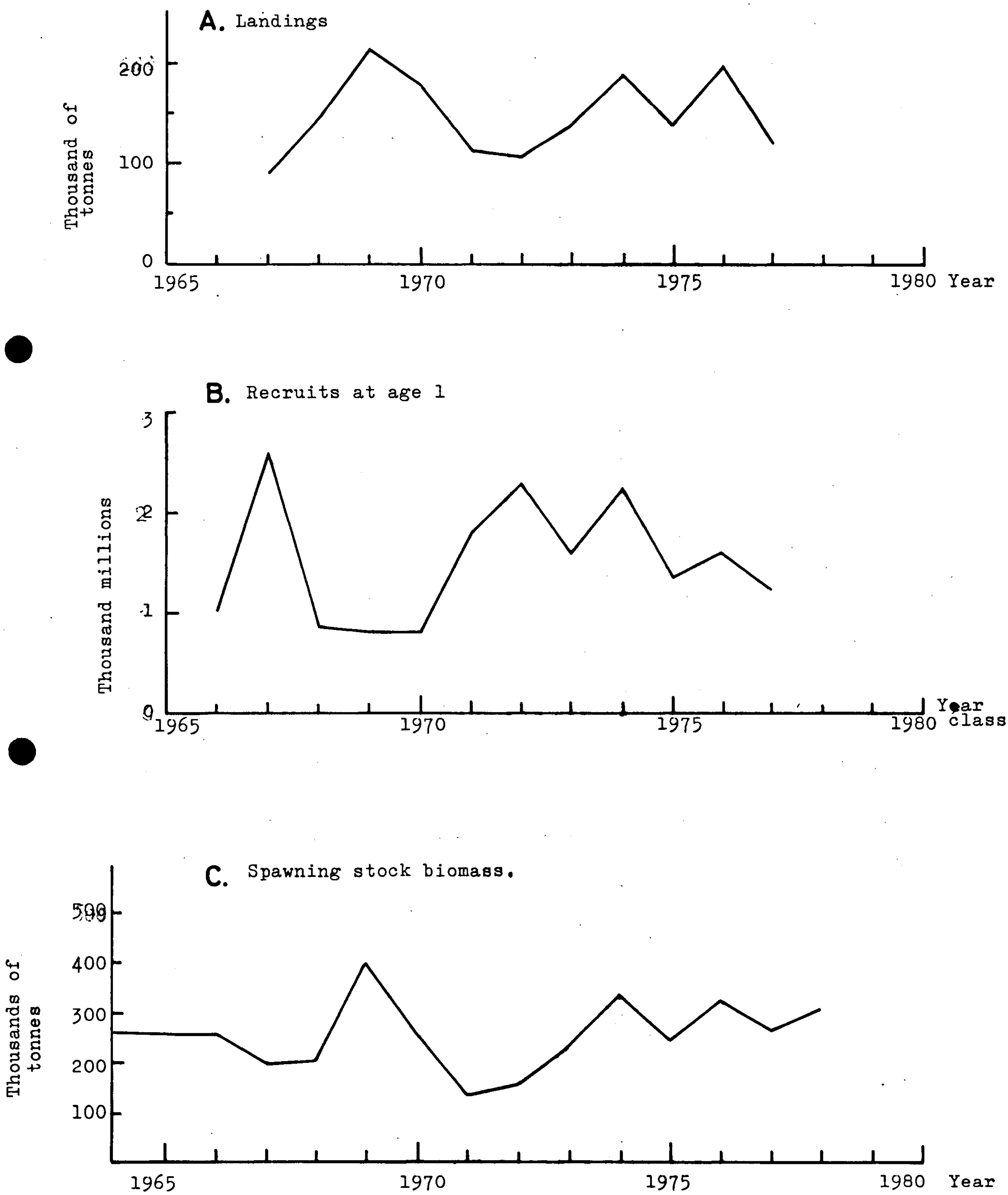
Figure 4.2.2 HADDOCK.
Relationship between recruitment in Sub-area IV
and Division VIa (excluding 1967 year class).
Numbers indicate year classes.





<u>Figure 4.2.3</u> Haddock in Division VIa.
Stock-recruitment plot.

<u>Figure 5.1.1</u> North Sea WHITING.



continued...

Figure 5.1.1 (ctd)

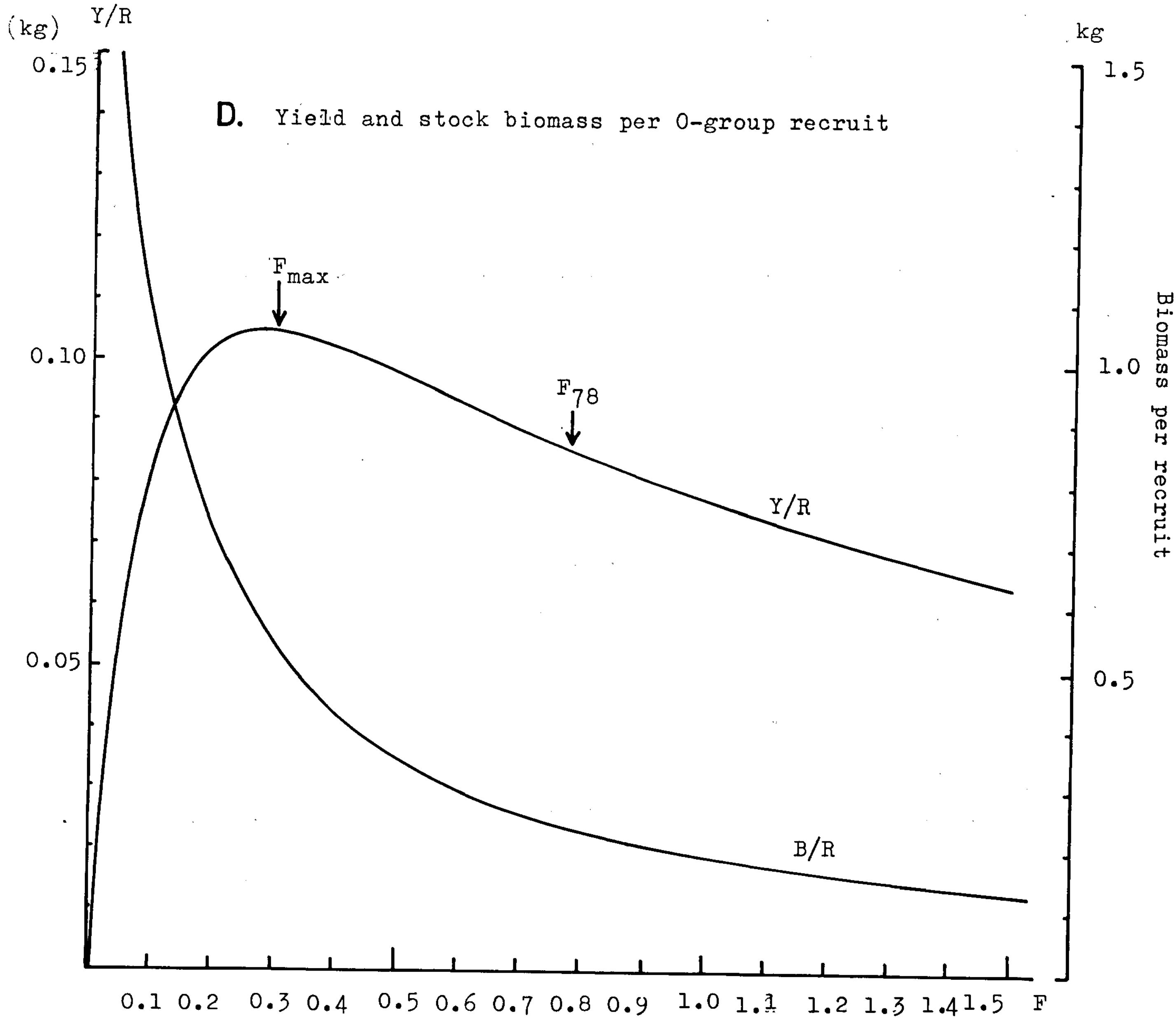


Figure 5.1.2 North Sea WHITING.
Stock/recruitment plot.

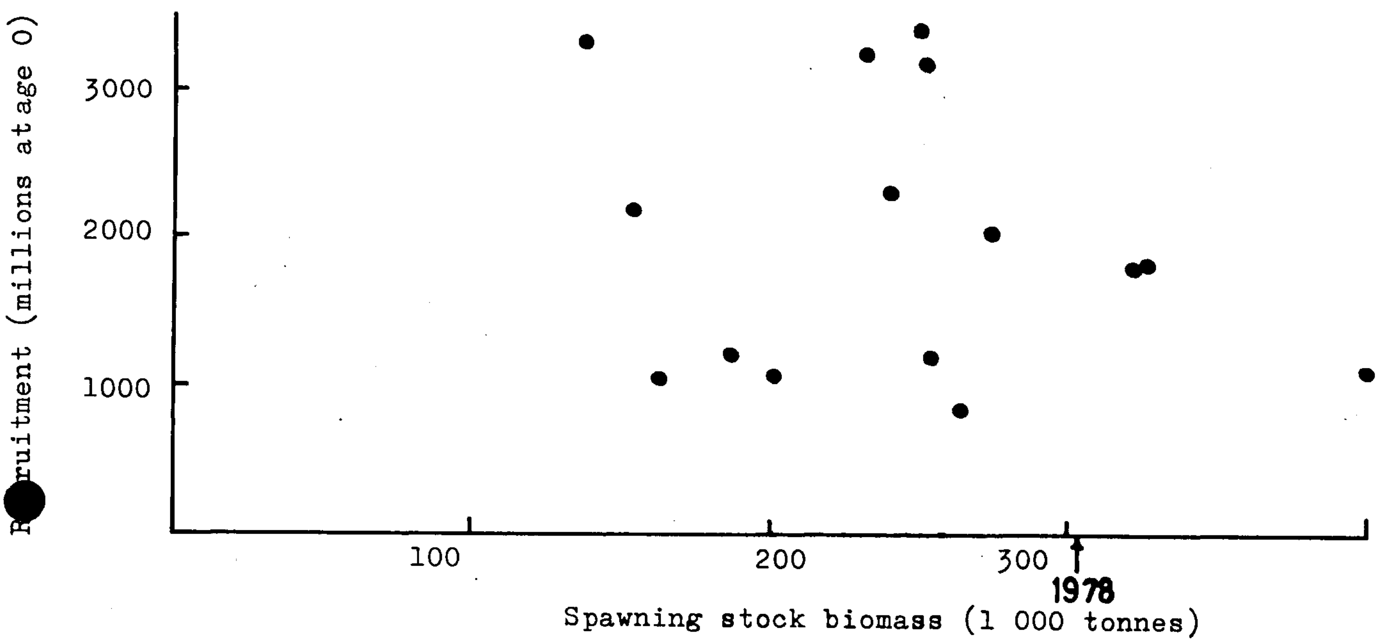


Figure 5.1.3 North Sea WHITING.
Relationship between fishing mortality from VPA and total fishing effort in Scottish units 1969-76.

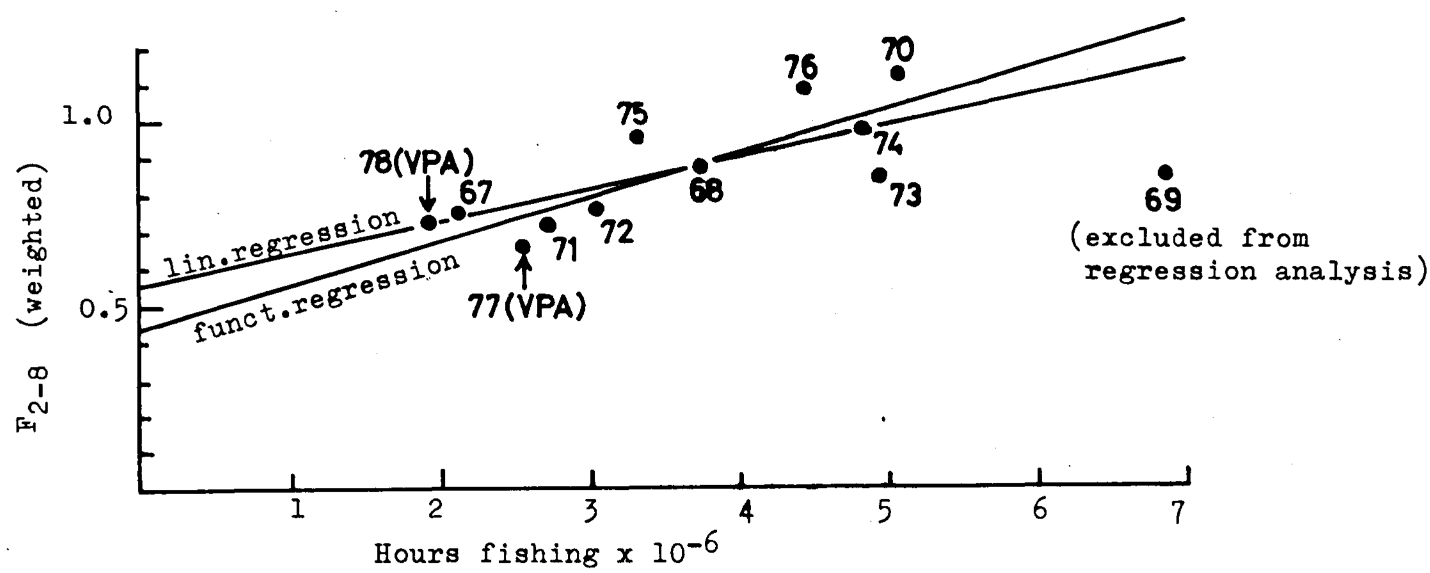
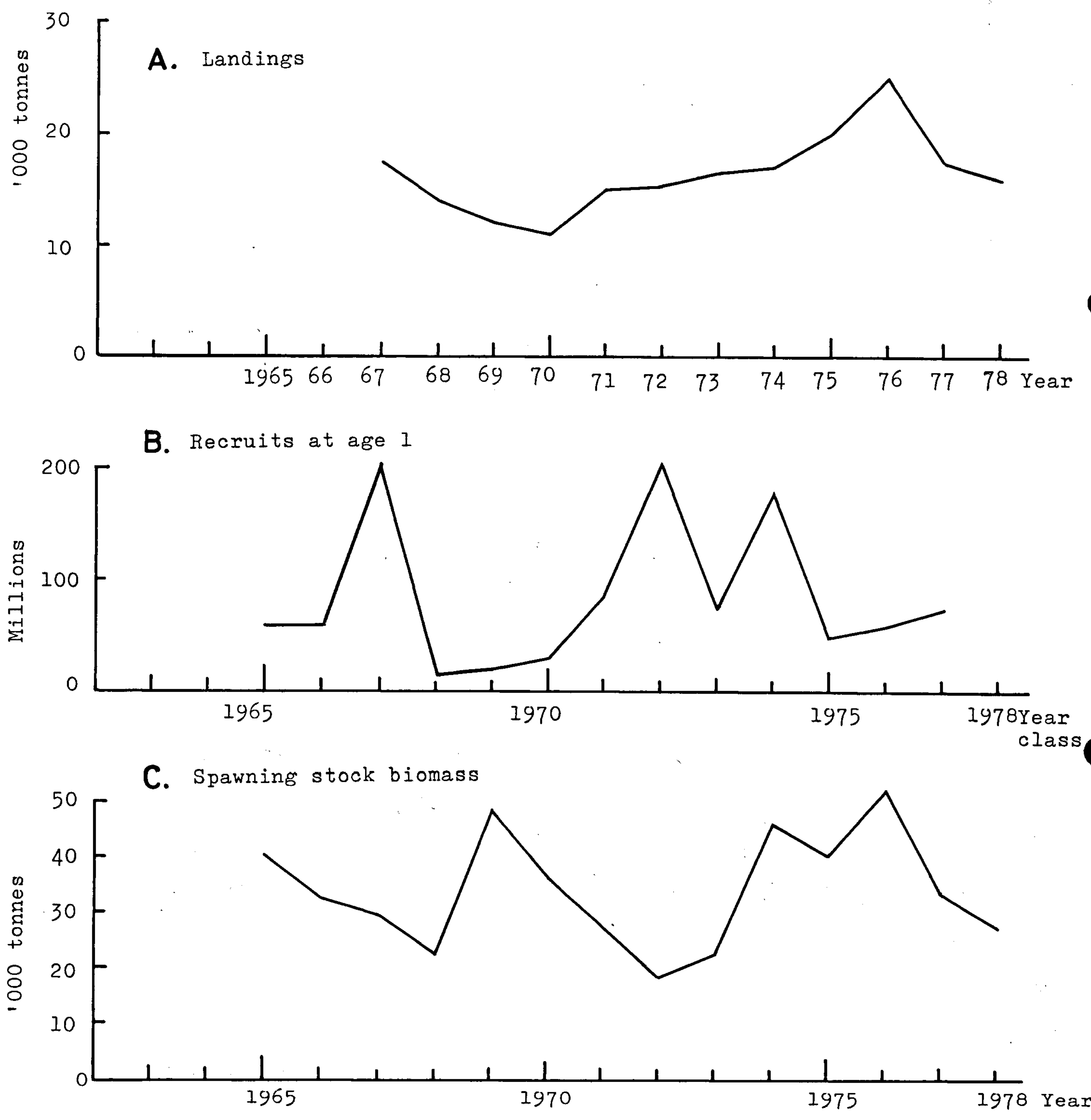


Figure 5.2.1 WHITING in Division VIa.



continued...

Figure 5.2.1 (continued)

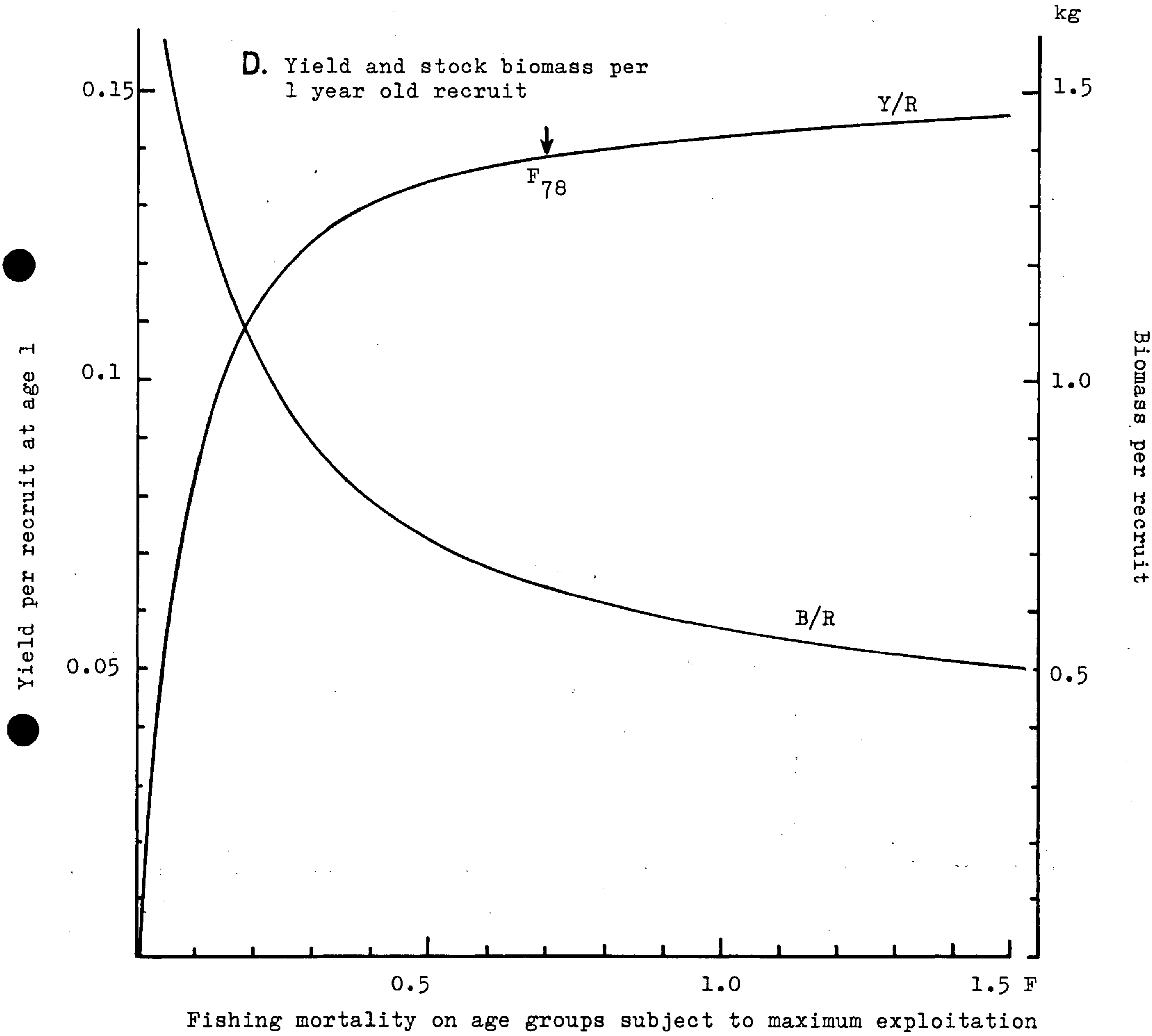
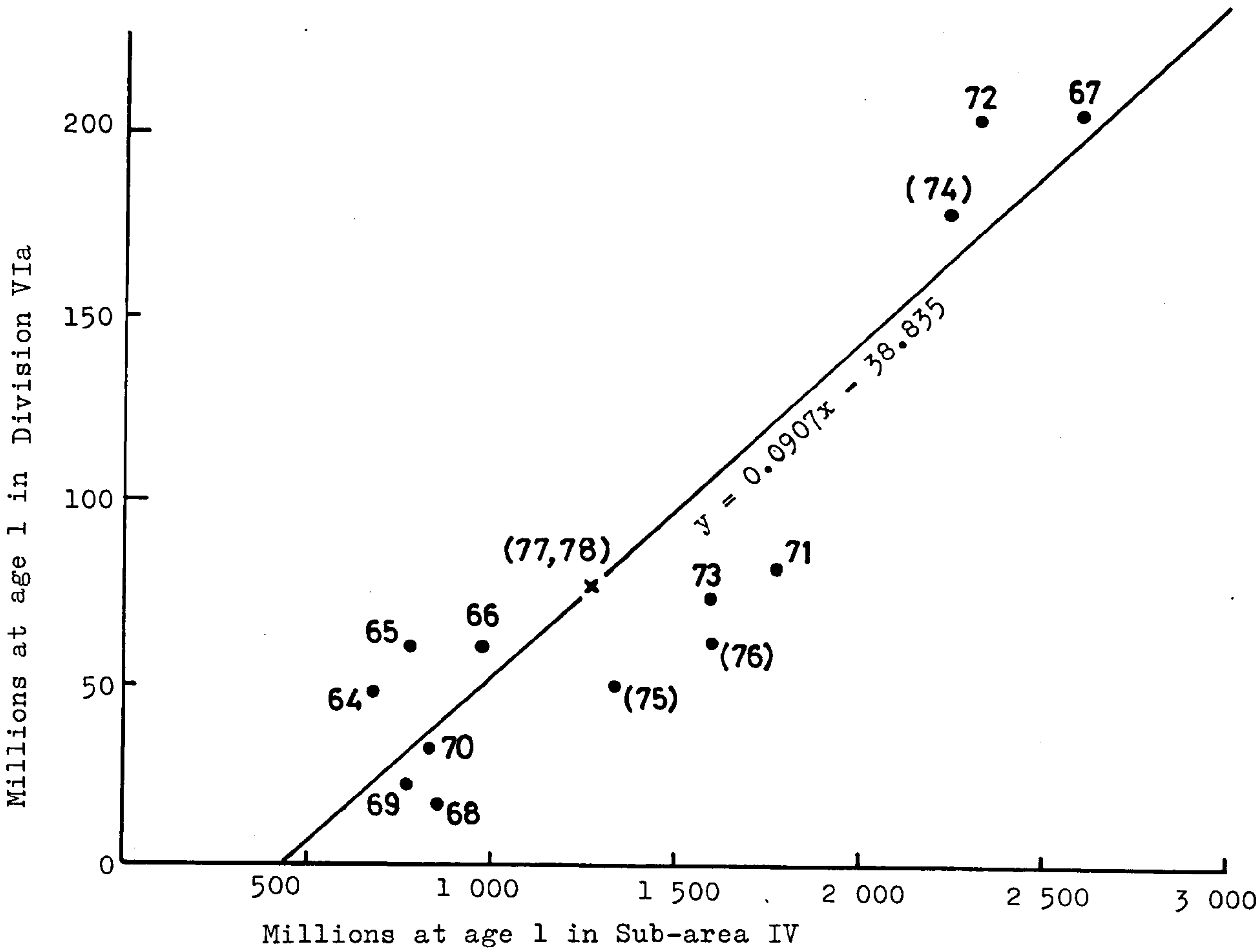


Figure 5.2.2 Relationship between year class strength of whiting in Sub-area IV and Division VIa



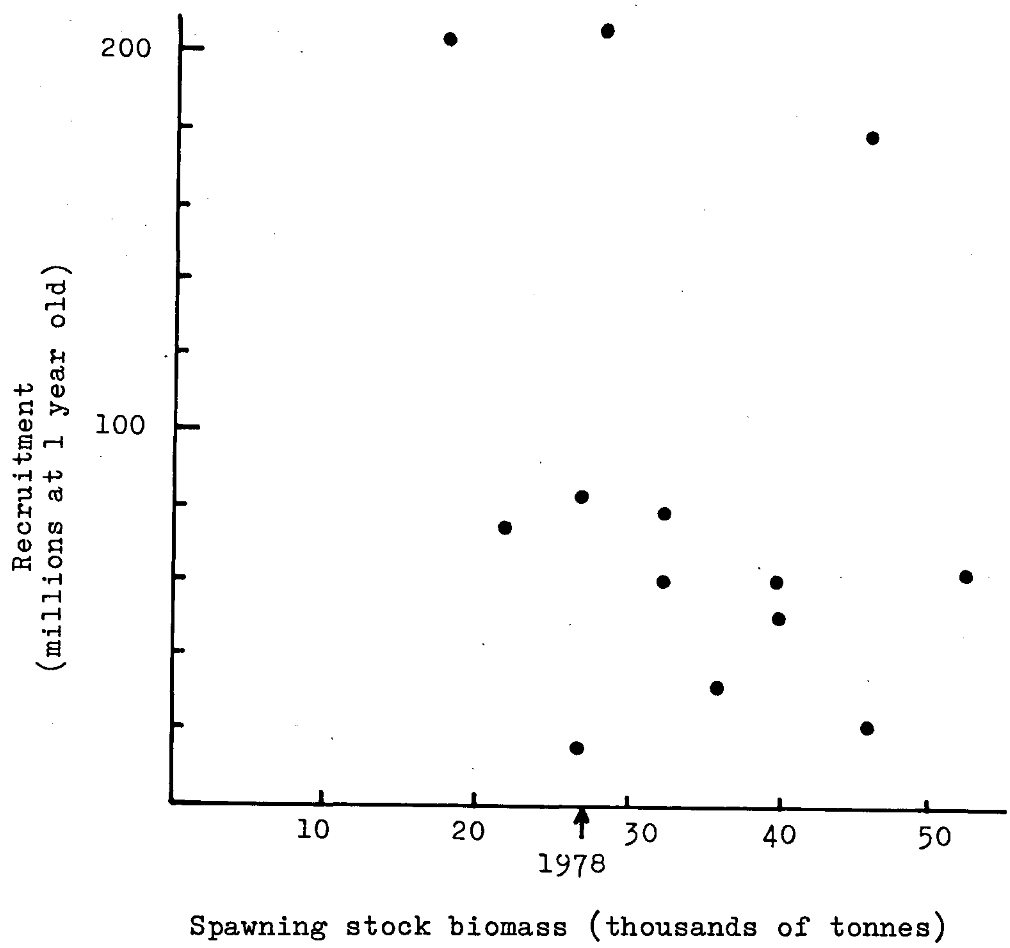


Figure 5.2.3 Whiting in Division VIa.
Stock-recruitment plot.

APPENDIX 1

RELATIVE MEASURES OF INTERNATIONAL EFFORT

The problem of catch and effort data from selected fisheries is that effort is measured in specific units, which do not allow calculations of total effort in one common unit. Also, these data refer only to specific components of the total stock and the magnitude of each fishery has to be taken into account when trying to obtain an average value of the catch per unit effort for each fishery.

The method applied in this report to interpret the available data in terms of overall trends in effort basically operates by eliminating the units of measurement in each fishery by calculating an index (γ) of the c.p.u.e in each fishery i for each year j, relative to an arbitrarily chosen reference year$_\blacktriangledown$:

$$\gamma_{ij} = cpue_{i,j}/cpue_{i,\blacktriangledown}$$

The overall index of c.p.u.e. (Γ) for year j is then calculated from the sum of all the γ_{ij}, weighted by the catch (C) taken in each fishery:

$$\Gamma_j = \sum_i \gamma_{i,j} * c_{i,j} / \sum_i c_{i,j}$$

The relative measure of total international effort (E_j) is given by the total catch (C_j), divided by the catch in the reference year ($C_\blacktriangledown$) times the relative index of c.p.u.e. (Γ_j).

$$E_j = C_j/(C_\blacktriangledown * \Gamma_j)$$

Nominal catches of COD (tonnes) from Recommendation 2 fisheries in Sub-area IV
(data taken from NEAFC reports unless otherwise indicated).

Country	1973		1974		1975		1976		1977		1978[x]
	legal-sized	under-sized	legal-sized	under-sized	legal-sized	under-sized	legal-sized	under-sized	legal-sized	under-sized	
Belgium	...	...	...	...	13	-	7	-	...	...	
Denmark	5 189	1 313	4 215	2 498	...	...	...	...	...	...	
Faroe Isl.	-	-	415[e]	1[e]	...	...	...	...	...	...	
German Dem.Rep.	...	...	...	...	37	-	5	-	...	...	
Germany, Fed. Rep.of	?	?	-	1	249	60	45	420	...	...	
Netherlands	5 931	67	7 679	-	4 303[f]	-	4 228[f]	-	4 509[f]	-	
Norway(IVa)	480	659	733	368	965	223	757	27	...	...	
Poland	?	?	210	11	150	7[d]	148	7[d]	19	3[d]	
Sweden[a]	-	-	8 260	...	6 247	-	...	...	...	...	
UK(England)	-	-	6	-	-	-	...	...	...	...	
UK(Scotland)	-	-	741	-	522[g]	-	1 357	...	391	...	
Total[b]	11 600	2 039	22 259	2 879	12 486	290	6 547	454	4 919	3	...

Nominal catches of HADDOCK (tonnes) from Recommendation 2 fisheries in Sub-area IV
(data taken from NEAFC reports unless otherwise stated)

Country	1973		1974		1975		1976		1977		1978
Belgium	...	...	...	...	-	-	-	-	...	...	
Denmark	771	3 155	9 364	27 785	26 540[xx]		38 871[xx]		13 271[xx]		6 862[xx]
Faroe Isl.	-	-	20[e]	186[e]	4 015[xx]		4 567[xx]		2 087[xx]		238[xx]
German Dem.Rep.	...	...	...	...	27	-	3	-	...	...	...
Germany,F.Rep.	?	?	+		-	-	-	-	...	...	...
Netherlands	2 088	1	2 237	-	1 039[f]	-	246[f]	-	65[f]	...	...
Norway (IVa)	1 055	4 102	3 379	2 356	2 613	7 227	1 737	1 396	474[xx]		953[xx]
Poland	?	?	115	7	77	3[d]	58	3[d]	24	5[d]	...
Sweden[a]	-	-	2 954	...	2 978	...	...	...	...	...	...
UK(Scotland)	-	-	553	1 842	346[g]	1 582	992	546	274[h]	...	43[xx]
Total	3 914	7 258	18 622	32 176	46 447		48 410		16 200		8 096

For footnotes, see next page.

APPENDIX 2

Nominal catches of WHITING (tonnes) from Recommendation 2 fisheries in Sub-area IV
(data taken from NEAFC reports unless otherwise indicated).

COUNTRY	1973		1974		1975		1976		1977		1978x)
	legal-sized	under-sized	legal-sized	under-sized	legal-sized	under-sized	legal-sized	under-sized	legal-sized	under-sized	
Belgium	...	...	...	...	94	-	42	-	...	...	...
Denmark	57 194	16 081	84 448	24 578	61	267xx)	123	161xx)	45 620xx)		35 483xx)
Faroe Isl.	-	-	31e)	494e)	8	867xx)	12	988xx)	3 236xx)		547xx)
German D.R.	...	...	...	...	3	-	18	-	...	...	...
Germany,F.R.	?	?	1 081c)		368	27	254	594	...	...	...
Netherlands	2 153	14	4 281	-	5 059f)	-	1 423f)		756f)	...	...
Norway(IVa)	1 322	166	4 710	312	12 550	693	6 744	-	1 662xx)		1 226xx)
Poland	?	-	74	4	45	2d)	25	-	22	3d)	...
Sweden a)	-	-	860	...	845	-	...	...	...	...	...
UK(Scotland)	-	-	1 442	559	1 420g)	940	2 135		437h)		14xx)
Total	60 669	16 261	95 847	25 947	92 180		147 451		51 736		37 270

x) Provisional data.

xx) Data from the report of an ad hoc Working Group on the Norway Pout Box Problem (C.M.1979/G:2).

a) Division IIIa inclusive.

b) Total of available data only.

c) Excluded from totals.

d) Estimated discards.

e) Divisions IIIa and VIa inclusive.

f) Includes catches by midwater-, pair- and shrimp trawls.

g) Besides, 1 461 t of cod, 306 t of haddock and 2 021 t of whiting were taken by Nephrops trawl in Divisions IVa, IVb and VIa combined.

h) The exact fishing area is not indicated.