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*REPORT OF THE DIVISION IIIA DEMERSAL STOCKS WORKING GROUP*

Copenhagen, 23 February - 3 March 1989

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\*General Secretary  
ICES  
Palægade 2-4  
DK-1261 Copenhagen K  
DENMARK

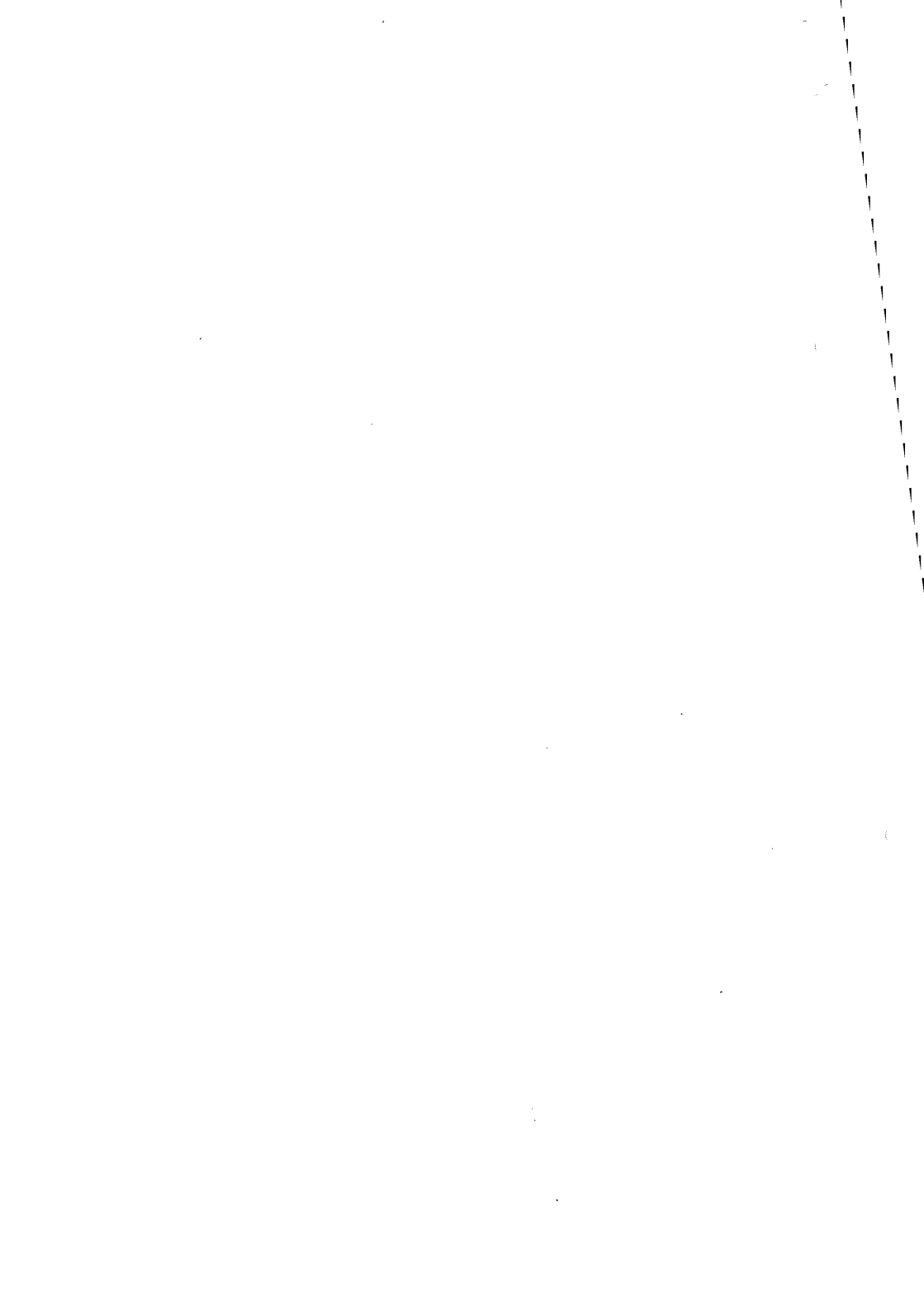


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## 1 INTRODUCTION

### 1.1 Participation

O. Bagge	Denmark
D.S. Danielssen	Norway
P.O. Larsson	Sweden
P. Lewy	Denmark
E. Nielsen (Chairman)	Denmark

### 1.2 Terms of Reference

At the 76th Statutory Meeting in 1988, it was decided (C.Res. 1988/2:4:4) that:

"The Division IIIa Demersal Stocks Working Group (Chairman: Ms E. Nielsen) will meet at ICES Headquarters from 27 February - 3 March 1989 to:

- a) assess the status of and provide catch options for 1990 within safe biological limits for the stocks of cod, haddock, whiting, plaice, and sole in Division IIIa;
- b) analyze the short- and long-term effects on the various stocks of the increase in minimum mesh size from 80 mm to 90 mm."

In C.Res.1988/4:4:2, it was further decided that:

"Denmark, Norway, and Sweden should be requested to initiate research programmes to investigate the spawning areas and egg and larval drift of cod, haddock and whiting in Division IIIa. As a first step, there should be a review of all relevant published and unpublished data."

In addition, the Working Group was asked to estimate the short- and long-term effects on SSB and catch of whiting in Division IIIa of an increase in the current whiting mesh size to 90 mm. This request stemmed from a request to ICES from Sweden.

### 1.3 Research Requirements

Due to a lack of data in Division IIIa and a change in environmental conditions, especially in the Kattegat, in recent years, egg and larvae surveys are badly needed in this area. In addition, the Working Group found a need for data on maturity of demersal species. The Working Group, therefore, recommends that research programmes be initiated by the laboratories in the countries bordering the area.

## 2 TUNING OF VPA

A VPA was performed for each of the stocks of cod and plaice in the Kattegat and Skagerrak.

In contrast to previous years, the Laurec-Shepherd method was used this year to tune the VPAs. For all four stocks, only Danish fleet age distributions were available. The catch-at-age data, which correspond to the Swedish fleets supplying effort data,

were estimated using the Danish age distribution. These data needed as input for the tuning model are given in Tables 2.1-2.4. The fleets with effort data used in the tuning model are shown in the text table below:

Stock	Swedish bottom trawl	Swedish <u>Nephrops</u> trawl	Danish seiners
Cod in the Kattegat	X	X	-
Cod in the Skagerrak	X	X	-
Plaice in the Kattegat	X	X	X
Plaice in the Skagerrak	X	X	X

### 3 COD

#### 3.1 The Fishery

Landings of cod from the Danish and Swedish fisheries were reported from the Skagerrak and Kattegat separately. The Norwegian landings were given for the coastal areas and the open part of the Skagerrak.

Tables 3.1 and 3.2 show the landings by country for the Kattegat and Skagerrak. The landings for 1988 are to be considered as preliminary estimates provided by Working Group members. The amounts of cod taken in the Danish small-meshed trawl fisheries are given in Table 3.3.

#### 3.2 Cod Stock Identity

##### 3.2.1 Skagerrak

No new information about the identity of the cod in the Skagerrak has been obtained in addition to what was said in the Working Group report in 1986 (Anon., 1986).

##### 3.2.2 Kattegat

With no more information available than in its last report (Anon., 1988), the Working Group is still of the same opinion that the cod in the Skagerrak and Kattegat belong to two different stocks. The Working Group, therefore, again decided to assess the Kattegat and Skagerrak cod separately.

### 3.3 Cod in the Kattegat

#### 3.3.1 Catch at age

The Danish age distributions were used for all catches (Table 3.4). Age distributions were not presented for the Danish by-catches and these were, therefore, not included in the assessment.

#### 3.3.2 Weight at age

Mean weights at age in the catches are given in Table 3.5. The mean weights in the stock were considered to be the same as in the catches.

#### 3.3.3 Catch per unit effort

Swedish CPUE data for Kattegat and Skagerrak are shown in Table 3.6. Danish CPUE data were based on logbooks (Table 3.7).

#### 3.3.4 Fishing mortality

The Working Group attempted to tune the VPA by the Laurec/Shepherd method. The natural mortality was set at 0.2. The resulting F values for 1988 were found to be extremely high, above the level of 1.5 (Table 3.8).

Another VPA was run assuming that F in 1988 was equal to the average of 1984-1986. The results are given in Table 3.9. This level of exploitation is a little lower, but still too high.

Inspection of the F values for the last five years indicates that they are extremely high, suggesting that the catch-at-age data, at least for age groups 4 and older, are very poor.

However, the values estimated were adopted in order to perform a prediction.

#### 3.3.5 Results from the VPA

The results are shown in Tables 3.9 and 3.10. The stock size shows a decreasing trend, and was the lowest on record in 1988.

#### 3.3.6 Recruitment

The IYFS index (Table 3.11) was applied for estimating recruitment. The 1988 year class was found to be the lowest on record.

The 1-group estimated from VPA was plotted against the IYFS index on a ln/ln scale in Figure 3.1. It appears that the plot is very poor. For example, the 1979 year class has a very strong impact on the slope of the line. Instead, the year classes were fitted by eye, with the following values used in the prediction.

1988 year class	$e^{+9.0}$	~	8.103 million
1987 year class	$e^{+9.6}$	~	14.765 million

Both year classes are below the 1977-1986 average of 18.630 million.

### 3.3.7 Prediction

The input data are shown in Table 3.12 and the results in Tables 3.13 and 3.14. Stock summary graphs are shown in Figure 3.2.

### 3.3.8 State of the stock

Due to the poor estimate of recruitment and input  $F_s$ , the assessment should be interpreted with some reservation.

The spawning stock biomass in 1989 will be 6,100 t, the lowest on record. The spawning stock biomass in 1991 will be 8,300 t, and the catch in 1990 at the 1988 level of  $F$  (7,800 t) is quite large compared to the spawning stock biomass.

## 3.4 Cod in the Skagerrak

### 3.4.1 Catch at age

Danish age distributions were applied to the total catch. Norwegian catches in the coastal area of the Skagerrak ("fjord cod") were not included in the assessment (Table 3.15).

### 3.4.2 Weight at age

Mean weights at age from the Danish samples were used and are given in Table 3.16. Mean weights for the stock (per 1 January) were considered to be the same as in the catches.

### 3.4.3 Catch per unit effort

The Danish and Swedish data series were updated for 1988 (Tables 3.6 and 3.7).

The downward trends in the two data series (gears combined) are similar (Table 3.17), with the exception of the 1986 Danish CPUE value. It is believed that this value is affected by misreporting and, therefore, should be disregarded.

The 1988 CPUE values are the lowest on record, especially for the trawl and net fisheries, and very low for Danish seiners.

### 3.4.4 Fishing mortality

An attempt to tune the VPA with Swedish CPUE data gave, as for the Kattegat, extremely high  $F_s$  (Table 3.18).



Instead, average F values for 1984-1986 were applied and found to give a reasonable level. The resulting array of  $\bar{F}_{(3-6)}$  can be seen in Table 3.17 together with the effort array.

#### 3.4.5 Recruitment

The IYFS index for the 1987 year class (Table 3.11) was almost as high as for the 1985 year class and was estimated in last year's report to be 31.6 million at age 1. Large catches of the 1987 year class in research fishing along the Norwegian coast confirm the strength of that year class.

The IYFS index for the 1988 year class (Table 3.11) was well above average. From a power curve regression of IYFS indices at age 1 against VPA estimates (Figure 3.3), it was estimated to be 27.0 million compared with 32.0 million for the 1985 year class and 20.7 million as the average for 1978-1986. During a survey in the Skagerrak in mid-April 1988, no cod larvae were found. As the Chrysochromulina bloom was observed in more or less the whole Skagerrak in May, possibly causing high mortality of cod larvae in the area at that time, the cod in the IYFS index may have been due to immigration from the North Sea.

The 0-group index for the 1988 year class along the Norwegian Skagerrak coast was by far the lowest ever recorded and almost zero (Table 3.11). The reason is assumed to be the algal bloom during the pelagic stage of the cod larvae in May, causing extremely high mortality.

#### 3.4.6 Results from VPA

Fishing mortality and stock size estimates are given in Tables 3.19 and 3.20, respectively.

#### 3.4.7 Prediction

Input data are found in Table 3.21 and the results in Tables 3.22 and 3.23. Stock summary graphs are given in Figure 3.4.

#### 3.4.8 State of the stock

Spawning stock biomass was at its lowest level in 1987 (12,700 t), increased to 20,800 t in 1988, and, assuming status quo fishing mortality, will drop to 14,000 t in 1989 and then again rise to 24,000 t in 1990.

Assuming status quo conditions, the catch in 1989 is predicted to be 21,200 t, compared with an agreed TAC of 20,500 t. The expected catch in 1990 will be 25,700 t. There are some indications that the 1988 year class may be overestimated. If average recruitment (25% lower) is assumed, the catch in 1990 will be 23,200 t instead of 25,700 t.

## 4 HADDOCK

### 4.1 The Fishery

Table 4.1 shows the landings of haddock from Division IIIa for the years 1975-1988. Landings decreased from 1987 to 1988.

Before 1987, it was not possible to separate the landings for human consumption from the industrial landings. In 1987, the landings for human consumption amounted to 3,572 t, which means a 19% reduction in 1988 (2,579 t).

### 4.2 Catch at Age

Catch-at-age data are available for the period 1981-1986 based on the age distribution of the Danish landings, including age distributions of industrial landings. In 1987 and 1988, no age distributions of the industrial landings were available, which means that the age distributions in these years are based exclusively on Danish landings for human consumption (Table 4.2). Accordingly, the age composition of the total landings of haddock in Division IIIa for 1987 and 1988 could not be estimated.

### 4.3 Weight at Age

Weight-at-age data for 1988 were available from the Danish human consumption fishery. These data together with data for 1981-1987 are given in Table 4.3.

### 4.4 Recruitment

The recruitment index for the 1988 IYFS survey is shown in Table 3.11. The index of 20 in 1988 is well below the average of 81.2.

No predictions of catches in 1989 and 1990 can be given. According to the recruitment in 1986 and 1987, the catch in 1988 was expected to be above the 1987 catch (5,300 t). The total catch in 1988 was 4,374 t.

## 5 WHITING

The landings of whiting in Division IIIa are given in Table 5.1. The landings decreased from 1987 to 1988 in spite of the high IYFS index.

## 6 PLAICE

### 6.1 The Fishery

#### 6.1.1 Landings from the Kattegat

The landings from the Kattegat are shown in Table 6.1. The landings decreased from 3,221 t in 1987 to 2,089 t in 1988, the lowest on record.

The quarterly breakdown of the Danish landings from the Kattegat is shown in Table 6.4. A decrease was observed in all quarters.

The total landings of plaice from the combined areas (Division IIIa) are shown in Table 6.3.

#### 6.1.2 Landings from the Skagerrak

The landings from the Skagerrak are shown in Table 6.2 for the period 1972-1988. The landings decreased from 14,728 t in 1987 to 12,432 t in 1988.

The quarterly breakdown of the Danish landings from the Skagerrak is shown in Table 6.4.

### 6.2 Stock Assessment for the Kattegat

#### 6.2.1 Catch at age

Catch-at-age data were available for the Danish landings and were raised to the total landings. The catch in numbers for 1968-1988 are given in Table 6.5.

#### 6.2.2 Weight at age

Weight-at-age data were available for each year 1968-1988 (Table 6.6).

#### 6.2.3 Stock identity

In last year's report (Anon., 1988), a possible dominance of the Skagerrak stock in the Kattegat was discussed based on results from studies on growth and meristic characters. Analysis of the genetic characteristics by electrophoresis (Simonsen et al., 1988) seems to confirm the dominance of the Skagerrak component in the central Kattegat.

As no recruitment indices are available for Skagerrak and due to the landing figures in that area being uncertain, the assessments for the Skagerrak and Kattegat are made separately.

#### 6.2.4 Recruitment

The relation between the numbers of 1-group as estimated from VPA and Petersen's young fish trawl survey index is shown in Table 6.7 and Figure 6.1. Applying a regression line forced through the origin, the following estimates of the 1987 and 1988 year classes were obtained.

1-group in 1987 = 4 million  
1-group in 1988 = 2 million

Both year classes are well below the 1980-1986 average of 13.4 million.

From Figure 6.1, it appears that the correlation is very poor, making the precision of the estimated year-class strength very poor too.

#### 6.2.5 Catch per unit effort

CPUE data were available for 1983-1988 from the Danish logbook system and from Sweden from 1980-1988.

The Danish CPUE were given as average catch in kg per fishing day for different years. Data were available for seiners, gillnets, and two size categories of trawlers (Table 6.8).

The Swedish CPUE were given as average catch per hour for Nephrops and demersal trawlers on a yearly basis (Table 6.9).

The combined Danish seiners and Swedish Nephrops and demersal cod series are shown in Table 6.10.

#### 6.2.6 Results from the VPA

The tuning output is given in Table 6.11 and the log  $q$  values are plotted in Figure 6.2.

The results from the VPA are shown in Figure 6.3 and Tables 6.12 and 6.13. The  $F$  values in the last four years were nearly constant and have decreased from the early 1980s, which seems to be reasonable as the effort has decreased in the southern part of the Kattegat due to bad environmental conditions (lack of oxygen).

The spawning stock biomass is still at the lowest level ever recorded.

#### 6.2.7 Prediction

A prediction was made using the exploitation pattern in 1988. The averages of the mean weights at age for the most recent years (1986-1988) were applied in 1989-1990. It was assumed that recruitment will remain at the 1981-1986 average level of 13.4 million.

The input data are given in Table 6.14. The catch options are shown in Tables 6.15 and 6.16. The spawning stock consists of fish age 3 and older.

#### 6.2.8 State of the stock

The spawning stock biomass is still at a very low level compared to the 1970s due to the low recruitment level in the 1980s. The spawning stock biomass is about half of the level in the 1970s.

Using a plot of 1-group from VPA versus the young fish index forced through the origin, the 1986 and 1987 year classes are extremely low. Accordingly, the spawning stock will be 6,600 t in 1989 and 7,200 t in 1991, resulting in a catch in 1990 of 1,500 t with  $F$  at the 1988 level.

### 6.3 Stock Assessment for the Skagerrak

#### 6.3.1 Catch at age

Catch-at-age data were available from the Skagerrak for 1978-1988 for the Danish landings and were applied to the total landings. The total catch in numbers is given in Table 6.17.

#### 6.3.2 Weight at age

Weight-at-age data were available since 1978 and are shown in Table 6.18.

#### 6.3.3 Recruitment

Recruitment indices of 0-group and 1-group were not available.

#### 6.3.4 Catch per unit effort

CPUE data were available from the Swedish Nephrops and demersal trawlers from 1980-1988.

The CPUE data from Denmark were available from 1983-1988 on a yearly basis split into seiners, two size categories of trawlers, and gillnets. All the CPUE series are shown in Tables 6.8-6.10.

#### 6.3.5 Results from the VPA

The tuning output is given in Table 6.19.

Results from the VPA are given in Tables 6.20 and 6.21. The F values have increased in the last two years. The spawning stock in the mid-1980s was high, but a decrease was observed in 1988.

#### 6.3.6 Prediction

As information on recruitment was not available and the data on landings uncertain up to 1987, no prediction was made.

## 7 SOLE

### 7.1 Landings

Landings of sole from Division IIIa are shown in Table 7.1 for the period 1952-1988. The landings increased to 783 t in 1986 and decreased to 652 t in 1988, possibly due to the change in environmental conditions.

### 7.2 Catch at Age

Catch-at-age data for 1984-1988 were supplied by Denmark which takes around 80% of the landings. The data indicated a strong

1984 year class, as observed from the survey, and 1985 was also a good year class, which did not agree with the survey index (Table 7.2).

### 7.3 Weight at Age

Weight-at-age data were available for the Danish landings from 1984-1988 (Table 7.3).

### 7.4 Recruitment

A recruitment series were available from the Danish plaice recruitment survey in the Kattegat (Table 7.5).

Since catch-at-age data were available only for 1984-1988, it is difficult to evaluate the recruitment indices. The 1987 year class seems to be larger than the 1985 and 1986 year classes and on the same level as the 1983 year class.

### 7.5 Exploitation

The Working Group attempted to get a rough idea of the level of exploitation by simple catch curve analysis. The assumption of constant recruitment was not fulfilled and the results are only indicative. The analysis suggests a total mortality of  $Z = 0.4$  for ages 3 and older.

### 7.6 Catch Prediction

Based on the recruitment survey and the landings, a SHOT forecast was performed (Table 7.6).

The forecast is based on a number of assumptions.

The recruitment indices for year class  $t$  are related to the landings for year  $t+3$  because the 3-group in general is most important with respect to weight (see Table 7.4).

The recruitment to the fishery was assumed not to be knife edge. Instead, the indices were smoothed using the relative weights 0.4, 0.5, and 0.1 for the 2-, 3-, and 4-groups, respectively.

The yield/biomass ratio was set to 0.4 for all years so that it corresponds to the magnitude of the level of exploitation estimated above.

For the years when no recruitment indices were available, an average of 380 was used.

For estimating the 1990 catch, the predicted landings for 1989 of 515 t were assumed to be taken.

The estimated status quo landings for 1990 were 422 t. The decline in the landings since 1987 may be caused by the apparently small 1985 and 1986 year classes.

The correlation between the landings and estimated status quo catches seems to be acceptable.

## 8 MESH ASSESSMENTS

### 8.1 Mesh Size Applied

In the Danish trawl fishery for cod and plaice in Division IIIa, mesh sizes of 90 and 110 mm are applied to trawls and Danish seines, respectively. In Swedish bottom trawls, 90 mm mesh is in use, while 80 mm is applied by Norway.

### 8.2 Short-Term Effects on Stocks by Increase in Minimum Mesh Size from 80-90 mm

#### 8.2.1 Cod and plaice

In the plaice and cod fisheries, mesh sizes of 90-110 mm are already applied by Sweden and Denmark making a mesh size assessment with a change from 80-90 mm not necessary. The Norwegian landings of cod and plaice from the Skagerrak are negligible.

#### 8.2.2 Haddock and whiting

Length distributions of haddock and whiting from commercial catches were not available. Accordingly, the Working Group was unable to estimate the short- and long-term effects on SSB and catch of whiting of an increase in mesh size to 90 mm.

#### 8.2.3 Sole

In Danish and Swedish Nephrops trawls, a mesh size of 60 mm is applied.

The catch of sole is mainly taken in set nets and as by-catch in the Nephrops fishery, while the by-catch of other species is negligible.

As the sole is mainly caught as by-catch in the Nephrops fishery, the Working Group did not consider it realistic that the mesh size should be increased to 90 mm in this fishery. The latter mesh size would cause heavy losses of Norway lobster.

However, since the appropriate data were available to the Working Group, a mesh assessment was carried out comparing such a change in mesh size from 60 to 90 mm. Only a short-term effect was considered as no information on the level of exploitation was available.

The short-term effect was estimated by assuming that catch at age for 1988 corresponds to a 60 mm mesh size. The effect of 90 mm being used was estimated by comparison of 60 and 90 mm length-based selection curves.

The selection curves used have the following shape:

$$PR(L) = \frac{1}{2} \left( \tanh \left[ \frac{\ln 3}{SR \times \text{mesh size}} (L - L(50)) \right] + 1 \right)$$

where PR(L) indicates proportion retained in trawl  
 SR indicates selection ratio = range/mesh size  
 L(50) indicates the length where PR(L) = 0.5

The assessment was carried out on a quarterly basis applying quarterly mean length-at-age data supplied by the Danish Institute (Table 8.1).

According to Wileman, (1988) the selection ratio was set to 0.58.

The results are shown in the following table.

Proportion of the estimated landings using a 90 mm mesh size to the observed 1988 landings

Quarter	1	2	3	4	Total
Percent	23	37	44	26	30

The total effect is close to the effect of quarter 4 because this quarter represents 55% of the landings for 1988.

The results show that the sole landings for 1988 would have been reduced by 70% if the mesh size were increased from 60 to 90 mm.

### 9 DISTRIBUTION OF COD, WHITING, AND PLAICE LARVAE IN DIVISION IIIa

In accordance with C.Res.1988/4:4:2, a review of all relevant published and unpublished data on larvae of cod, haddock, and whiting in Division IIIa should be made.

No data on larvae of haddock have been submitted. Larvae of plaice have been dealt with instead.

The following data on distribution of fish larvae in Division IIIa were presented:

- a) Poulsen (1931) showing the distribution of cod larvae in the eastern North Sea, Skagerrak, Kattegat, and Sub-divisions 22 and 23 in April and May 1923. A 2-m ring trawl was used in horizontal hauls of 30 minutes duration.
- b) Unpublished Danish data from Skagerrak, Kattegat, and Sub-division 22 in the period 1938, 1939, and 1949-1964. A 2-m ring trawl was used in horizontal hauls of 20 minutes duration at a depth of 15-20 m covering the months March-July (mainly March and April). Larvae of cod, whiting, plaice, and dab are presented.
- c) Christensen et al. (1983) dealing with Kattegat and part of Skagerrak in April using the Gulf III sampler in double oblique hauls. Larvae of cod, plaice, dab, and sandeel are dealt with.



- d) Unpublished Norwegian data from surveys in March and April 1988 in the Skagerrak area using the Gulf III sampler in double oblique hauls which did not catch any cod larvae, with the exception of an investigated Norwegian Skagerrak fjord.

Since the investigations were quite scattered according to areas, years, and months, only the Danish results from March 1959 and July 1962 were chosen for illustrating the distribution and relative amounts of cod, whiting, and plaice larvae in Skagerrak, Kattegat, and Sub-division 22 (north). The results of Poulsen (1931) and Christensen *et al.* (1983) are dealt with too.

The distribution of cod larvae in April-May 1923, plaice and cod larvae in March 1959 and April 1983, and the distribution of whiting larvae in June 1962 are shown in Figures 9.1 - 9.4.

It is only possible to compare the relative distribution of plaice in 1959 and 1983 since the gear was different (Figures 9.1 and 9.2). It appears that plaice larvae were equally distributed in the southern, eastern, and northern Kattegat in 1959, indicating a spawning in all areas. In 1983, plaice was found only in the northern Kattegat and Skagerrak.

In 1923 (Figure 9.1) and 1959 (Figure 9.2), the distribution and numbers per 20 minute haul of cod larvae are quite similar in all areas, indicating a spawning in the southern Kattegat, Sub-division 22, and Skagerrak. In 1983 (Figure 9.3), the relative numbers in the southern Kattegat were decreased and equally distributed in small amounts. The 1983 year class later proved to be small in the Kattegat as well as in the Skagerrak and Sub-division 22.

In Figure 9.4, the distribution of whiting larvae in June 1962 is shown. A decreasing number per haul from north to south was observed indicating the main spawning area to be in Skagerrak and the northern Kattegat.

## 10 REFERENCES

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Table 2.1 Input data to the tuning model. Cod in the Kattegat.

IIIa COD Tuning data Kattegat							
102							
Swedish bottom trawl							
1978,1988							
1,1							
1,7							
13.446,	7.564,	517.047,	219.283,	180.515,	78.481,	7.135,	8.510
12.231,	25.436,	377.487,	730.733,	118.345,	124.077,	27.767,	1.314
14.861,	70.078,	167.196,	689.859,	424.910,	45.449,	48.241,	15.234
12.456,	37.426,	447.056,	271.337,	459.379,	158.375,	16.659,	10.612
10.443,	43.069,	404.852,	409.033,	271.464,	85.759,	55.103,	14.314
17.307,	120.694,	960.007,	881.639,	225.678,	37.705,	36.966,	10.350
19.172,	19.543,	665.986,	736.001,	269.134,	43.240,	12.926,	4.155
14.118,	64.316,	294.072,	590.866,	204.874,	36.336,	7.042,	0.751
13.159,	44.106,	180.938,	297.563,	145.038,	36.926,	12.104,	1.231
14.446,	15.819,	718.917,	229.752,	83.991,	35.875,	9.699,	0.942
12.304,	23.534,	157.486,	318.775,	79.872,	20.325,	5.111,	1.902
Swedish Nephth. trawl							
1978,1988							
1,1							
1,7							
11.469,	4.771,	326.131,	138.314,	113.861,	49.502,	4.500,	5.368
13.726,	16.402,	243.416,	470.969,	76.313,	80.009,	17.711,	0.847
14.148,	39.718,	94.761,	390.987,	240.823,	25.759,	27.342,	8.634
13.878,	18.905,	225.827,	137.064,	232.052,	80.002,	8.415,	5.360
14.289,	16.448,	154.608,	156.204,	103.669,	32.750,	21.043,	5.466
11.743,	34.869,	277.353,	254.712,	65.200,	10.893,	10.680,	2.990
13.724,	4.253,	144.922,	159.488,	58.565,	9.409,	2.813,	0.904
13.099,	30.083,	137.546,	276.365,	95.825,	16.996,	3.294,	0.351
16.239,	17.349,	71.173,	117.048,	57.051,	14.525,	4.761,	0.484
19.452,	6.228,	283.048,	90.457,	33.069,	14.125,	3.818,	0.371
15.238,	8.619,	57.677,	116.747,	29.252,	7.444,	1.872,	0.696

Table 2.2 Input data to the tuning model.  
Cod in the Skagerrak.

IIIa COD Tuning data Skagerrak								
102								
Swedish bottom trawl								
1978,1988								
1,1								
1,7								
3.510,	15.245,	39.278,	10.155,	2.724,	0.640,	0.584,	0.155	
3.662,	2.908,	29.115,	19.899,	3.231,	1.360,	0.229,	0.222	
6.641,	11.679,	72.230,	52.817,	19.150,	3.824,	1.030,	0.898	
7.294,	4.278,	121.314,	68.213,	12.857,	3.168,	0.484,	0.539	
8.177,	19.110,	78.705,	117.721,	35.548,	4.282,	3.097,	1.292	
8.479,	26.747,	90.919,	50.866,	24.300,	4.380,	1.284,	0.483	
12.006,	6.360,	131.811,	57.951,	13.634,	5.222,	1.306,	0.019	
13.155,	21.877,	121.551,	65.373,	20.180,	4.880,	2.923,	0.778	
11.966,	56.150,	70.788,	59.395,	30.172,	5.990,	1.036,	0.673	
13.342,	4.171,	310.621,	56.745,	12.714,	3.463,	1.744,	0.430	
13.362,	18.928,	48.354,	96.000,	10.832,	2.736,	1.024,	0.149	
Swedish Nephth. trawl								
1978,1988								
1,1								
1,7								
31.429,	101.396,	261.241,	67.543,	18.119,	4.255,	3.881,	1.029	
34.412,	26.089,	261.191,	178.516,	28.988,	12.199,	2.053,	1.993	
44.075,	57.150,	353.461,	258.462,	93.713,	18.710,	5.039,	4.396	
43.757,	21.782,	617.631,	347.285,	65.459,	16.127,	2.464,	2.744	
40.826,	57.247,	235.773,	352.652,	106.490,	12.828,	9.276,	3.869	
52.500,	100.728,	342.397,	191.650,	91.514,	16.494,	4.835,	1.820	
69.935,	18.463,	382.643,	168.229,	39.580,	15.161,	3.790,	1.191	
70.926,	64.125,	356.281,	191.615,	59.150,	14.304,	8.568,	2.280	
75.102,	119.097,	150.144,	125.980,	63.997,	12.704,	2.197,	1.428	
92.435,	8.806,	655.825,	119.809,	26.844,	7.311,	3.682,	0.907	
100.000,	54.342,	138.222,	275.614,	31.099,	7.855,	2.939,	0.427	

Table 2.3 Input data to the tuning model.  
Plaice in the Kattegat.

IIIa Plaice Tuning data Kattegat

103

Danish seiners fleet 1

1983,1988

1,1

1,11

10.690,	30,	824,	2771,	1266,	489,	322,	309,	222,	119,	30,	21
9.310,	4,	765,	2527,	1651,	355,	221,	310,	387,	325,	165,	15
5.790,	3,	612,	2351,	1890,	202,	39,	37,	54,	41,	46,	31
6.096,	4,	204,	1205,	1404,	1084,	324,	68,	33,	25,	22,	14
4.380,	0,	230,	933,	1520,	596,	158,	41,	32,	25,	25,	21
3.960,	1,	23,	388,	686,	466,	181,	83,	51,	24,	22,	8

Swedish Nephth. fleet 2

1983,1988

1,1

1,11

15.46,	1,	24,	82,	37,	14,	10,	9,	6,	4,	1,	1
20.89,	0,	38,	126,	82,	18,	11,	15,	19,	16,	8,	1
22.19,	0,	68,	263,	211,	23,	4,	4,	6,	5,	5,	3
24.82,	0,	10,	60,	70,	54,	16,	3,	2,	1,	1,	1
28.80,	0,	25,	103,	167,	66,	17,	4,	4,	3,	3,	2
29.20,	0,	3,	56,	99,	67,	26,	12,	7,	3,	3,	1

Swedish Cod fleet 3

1983,1988

1,1

1,11

22.70,	4,	98,	328,	150,	58,	38,	37,	26,	14,	4,	3
28.95,	0,	81,	269,	176,	38,	23,	33,	41,	34,	18,	2
23.97,	0,	88,	339,	272,	29,	6,	5,	8,	6,	7,	4
20.00,	0,	15,	88,	102,	79,	24,	5,	2,	2,	2,	1
21.30,	0,	34,	133,	218,	85,	23,	6,	5,	4,	4,	3
24.02,	0,	6,	97,	172,	117,	45,	21,	13,	6,	5,	2

Table 2.4 Input data for the tuning model.  
Plaice in the Skagerrak.

IIa Plaice Tuning data Skagerrak  
103  
Danish seiners fleet 1  
1983,1988  
1,1  
2,10  
5.876, 37,2614, 3399, 3782,1169, 208, 80, 28, 14  
28.477,163,1620, 1850, 759, 317, 70, 14, 5, 2  
9.456, 65,1756, 8242, 2675, 751, 288, 71, 53, 33  
5.920, 0, 728, 4140, 6012,1439, 184, 70, 28, 27  
12.483, 10,1134, 5525,10195,6126,1239, 182, 104, 39  
12.198, 21,1208, 6339, 7835,3998,1580, 505, 160, 0  
Swedish Nephth. fleet 2  
1983,1988  
1,1  
2,10  
70.70, 2, 112, 146, 162, 48, 9, 3, 1, 1  
91.91, 19, 185, 211, 87, 36, 8, 2, 1, 2  
78.71, 4, 95, 446, 145, 41, 16, 4, 3, 2  
94.48, 0, 33, 185, 269, 64, 8, 3, 1, 1  
133.09, 0, 28, 137, 253, 152, 31, 5, 3, 1  
169.18, 1, 45, 238, 295, 150, 59, 19, 6, 2  
Swedish Cod fleet 3  
1983,1988  
1,1  
2,10  
11.41, 0, 24, 31, 35, 10, 2, 1, 0, 0  
15.86, 7, 77, 88, 36, 15, 3, 1, 0, 0  
14.65, 1, 20, 95, 31, 9, 3, 1, 1, 0  
15.33, 0, 8, 48, 69, 17, 2, 1, 0, 0  
19.47, 0, 7, 27, 51, 30, 6, 1, 0, 0  
22.84, 0, 10, 51, 63, 32, 13, 4, 1, 0

Table 3.1 Cod landings from the Kattegat, 1971-1988 (t).

Year	Denmark	Sweden	Fed.Rep. of Germany <sup>1</sup>	Total
1971	11,748	3,962	22	15,732
1972	13,451	3,957	34	17,442
1973	14,913	3,850	74	18,837
1974	17,043	4,717	120	21,880
1975	11,749	3,642	94	15,485
1976	12,986	3,242	47	16,275
1977	16,668	3,400	51	20,119
1978	10,293	2,893	204	13,390
1979	11,045	3,763	22	14,830
1980	9,265	4,206	38	13,509
1981	10,673	4,380	284	15,337
1982	9,320	3,087	58	12,465
1983	9,149	3,625	54	12,828
1984	7,590	4,091	205	11,886
1985	9,052	3,640	14	12,706
1986	6,930	2,054	112	9,096
1987 <sup>2</sup>	9,396	2,006	89	11,491
1988 <sup>2</sup>	4,264	1,587	236	6,087

<sup>1</sup>Landing statistics incompletely split on the Kattegat and the Skagerrak. The figures are estimated by the Working Group.

<sup>2</sup>Preliminary.

Table 3.2 Cod landings from the Skagerrak, 1971-1988 (t).

Year	Open Skagerrak				Total	Norwegian Fjords
	Denmark	Sweden	Norway	Others		Norway
1971	5,914	2,040	1,355	13	9,322	-
1972	6,959	1,925	1,201	22	10,107	-
1973	6,673	1,690	1,253	27	9,643	-
1974	6,694	1,380	1,197	92	9,363	-
1975	14,171	917	1,190	52	16,330	-
1976	18,847	873	1,241	466	21,427	-
1977	18,618	560	-	675	19,853	-
1978	23,614	592	-	260	24,466	1,305
1979	14,007	1,279	-	213	15,499	1,752
1980	21,551	1,712	402	341	24,006	1,580
1981	25,498	2,835	286	294	28,913	1,792
1982	23,377	2,378	314	41	26,110	1,466
1983	18,467	2,803	346	163	21,784	1,520
1984	17,443	1,981	311	156	19,891	1,187
1985	14,521	1,914	193	-	16,628	990
1986	18,424	1,505	174	-	20,103	917
1987	17,824	1,924	152	-	19,900	838
1988 <sup>1</sup>	14,806	1,587	157	106	16,656	1,009

<sup>1</sup>Preliminary.

**Table 3.3** By-catch of cod in Division IIIa by the Danish industrial fishery.

Year	Skagerrak	Kattegat	Division IIIa
1983	4,384	2,179	6,563
1984	1,084	712	1,796
1985	1,751	448	2,199
1986	1,861	553	2,414
1987	499	453	952
1988	1,103	284	1,387

Note: Before 1983, by-catch was probably approximately at the 1983 level.

Table 3.4 VIRTUAL POPULATION ANALYSIS

COD IN THE KATTEGAT (PART OF FISHING AREA IIIA)

CATCH IN NUMBERS	UNIT: thousands											
-----	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	38	5	591	188	166	1	88	213	552	328	340	653
2	3811	623	4250	3610	4431	2218	6015	3161	1317	3918	3196	5194
3	6422	2167	6943	2906	6983	7078	2551	6116	5434	2378	3229	4770
4	2427	3954	4543	3251	1835	4942	2100	991	3347	4026	2143	1221
5	809	2280	1538	661	1039	492	913	1039	358	1388	677	204
6	433	780	349	429	287	376	83	230	380	146	435	200
7	94	212	68	47	189	137	99	11	120	93	113	56
8+	38	160	31	19	52	102	71	47	35	78	36	25
TOTAL	14072	10181	18313	11111	14982	15346	11920	11808	11543	12355	10169	12323
	1984	1985	1986	1987	1988							
1	127	685	430	168	198							
2	4328	3132	1764	7635	1325							
3	4763	6293	2901	2440	2682							
4	1749	2182	1414	892	672							
5	281	387	360	381	171							
6	84	75	118	103	43							
7	27	8	12	10	16							
8+	19	15	10	19	3							
TOTAL	11378	12777	7009	11648	5110							



Table 3.5 VIRTUAL POPULATION ANALYSIS

COD IN THE KATTEGAT (PART OF FISHING AREA IIIA)

MEAN WEIGHT AT AGE OF THE STOCK UNIT: kilogram

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	.699	.699	.699	.699	.699	.699	.699	.708	.691	.604	.600	.595
2	.880	.880	.880	.880	.880	.880	.880	.868	.893	.799	.784	.752
3	1.069	1.069	1.069	1.069	1.069	1.069	1.170	1.086	.951	1.123	1.233	1.129
4	1.673	1.673	1.673	1.673	1.673	1.673	1.690	1.890	1.440	1.432	1.391	1.943
5	2.518	2.518	2.518	2.518	2.518	2.518	2.860	2.215	2.478	2.076	2.078	3.348
6	3.553	3.553	3.553	3.553	3.553	3.553	4.120	3.382	3.157	3.532	2.911	3.141
7	5.340	5.340	5.340	5.340	5.340	5.340	5.180	7.314	3.526	4.420	3.698	5.301
8+	6.635	6.635	6.635	6.635	6.635	6.635	6.900	6.101	6.903	4.644	6.480	6.325

	1984	1985	1986	1987	1988
1	.711	.606	.671	.483	.541
2	.745	.839	.705	.716	.784
3	1.133	.986	1.253	1.118	1.099
4	1.687	1.614	1.955	1.972	1.792
5	2.798	2.575	2.956	2.868	2.880
6	3.022	4.090	4.038	4.200	4.283
7	5.273	6.847	7.100	5.185	5.852
8+	7.442	7.133	7.290	8.288	7.073

**Table 3.6** CPUE data by gear type for the Swedish cod fishery expressed as average catch (kg) per hour.

Year	Skagerrak		Kattegat	
	C (t)	C/f	C (t)	C/f
<u>Bottom trawl</u>				
1978	86	24.5	1,151	85.6
1979	104	28.4	1,771	144.8
1980	263	39.6	1,715	115.4
1981	318	43.6	1,750	140.5
1982	462	56.5	1,579	151.2
1983	329	38.8	2,371	137.0
1984	371	30.9	1,829	95.4
1985	392	29.8	1,193	84.5
1986	347	29.0	933	70.9
1987	503	37.7	1,082	74.9
1988	310	23.2	699	56.0
<u>Nephrops trawl</u>				
1978	572	18.2	726	63.3
1979	936	27.2	1,142	83.2
1980	1,287	29.9	972	68.7
1981	1,619	37.0	884	63.7
1982	1,384	33.9	603	42.2
1983	1,239	23.6	485	41.3
1984	1,077	15.4	398	29.0
1985	1,149	16.2	558	42.6
1986	736	9.8	367	22.6
1987	1,062	11.5	426	21.9
1988	890	8.9	256	16.8

**Table 3.7** CPUE data by gear and size categories for the Danish cod fishery expressed as catch (kg) per fishing day. Catch (C) expressed as tonnes and effort (f) as days.

Year	<30 GRT			30-74 GRT			>75 GRT			Danish seine			Nets		
	C	f	CPUE	C	f	CPUE	C	f	CPUE	C	f	CPUE	C	f	CPUE
<u>Kattegat</u>															
1983	1,436	3,515	408	372	1,084	343	25	51	490	584	1,563	374	39	216	180
1984	1,685	4,510	374	454	1,375	330	63	43	1,465	732	1,852	395	26	220	118
1985	1,552	2,687	578	674	887	760	40	110	363	458	522	877	11	25	440
1986	1,570	3,169	495	1,075	1,432	751	130	158	825	662	1,343	493	35	140	250
1987	1,160	1,727	671	828	632	1,310	727	3,522	206	451	976	462	80	181	387
1988 <sup>1</sup>	682	1,787	382	216	530	409	575	3,510	164	337	1,138	296	55	281	196
<u>Skagerrak</u>															
1983	376	2,245	167	364	1,322	275	170	566	300	177	520	340	148	188	787
1984	523	3,058	171	634	3,053	208	236	937	252	659	1,996	330	358	701	511
1985	361	2,094	172	730	2,752	265	352	1,287	274	310	716	433	206	449	459
1986	915	3,627	252	2,215	4,737	468	1,045	1,778	588	2,184	3,784	577	2,418	2,560	944
1987	250	1,081	232	453	1,286	353	1,070	4,766	224	919	2,170	423	384	971	396
1988 <sup>1</sup>	192	1,264	152	357	1,451	246	983	7,006	140	964	2,528	381	347	999	347

<sup>1</sup> Preliminary.

Table 3.8 Tuning output for cod in the Kattegat.

VPA Version 2.1 - May 1988

Module run at 15.35.35 28 FEBRUARY 1989

DISAGGREGATED Qs

LOG TRANSFORMATION

NO explanatory variate (Mean used)

Fleet 1 ,Swedish bottom trawl, has terminal q estimated as the mean

Fleet 2 ,Swedish Neph. trawl, has terminal q estimated as the mean

FLEETS COMBINED BY \*\* VARIANCE \*\*

Regression weights

, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,

Oldest age F = 1.000\*average of 2 younger ages. Fleets combined by variance of predictions

Fishing mortalities

Age,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,
1,	.004,	.022,	.043,	.021,	.018,	.036,	.012,	.089,	.027,	.033,	.025,
2,	.319,	.201,	.183,	.476,	.295,	.422,	.347,	.468,	.344,	.876,	.386,
3,	.738,	.623,	.623,	.578,	.940,	.964,	.875,	1.289,	1.102,	1.154,	.918,
4,	.689,	.731,	.858,	1.479,	1.857,	1.263,	1.285,	1.490,	1.280,	1.394,	1.303,
5,	.933,	.910,	.646,	1.156,	1.200,	1.011,	1.250,	1.229,	1.191,	1.882,	1.242,
6,	1.460,	.648,	1.082,	.603,	1.749,	1.770,	2.015,	1.644,	2.187,	1.590,	1.477,
7,	1.197,	.779,	.864,	.879,	1.475,	1.390,	1.632,	1.436,	1.689,	1.736,	1.350,

Log catchability estimates

Age 1											
Fleet,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,	-10.54,	-8.45,	-7.91,	-8.54,	-8.41,	-7.87,	-9.21,	-7.43,	-8.47,	-8.45,	-8.34
2,	-10.84,	-9.00,	-8.43,	-9.33,	-9.68,	-8.73,	-10.40,	-8.12,	-9.61,	-9.68,	-9.56

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
,	q	,	F	F	,	Slope	,	Intrcpt
1,	-8.51	.647	.0025	.0208	.000E+00	.000E+00	-8.511	.245
2,	-9.40	.843	.0013	.0290	.000E+00	.000E+00	-9.399	.243
Fvar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.025	.598	.165	.598	.077				

Age 2											
Fleet,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,	-6.20,	-6.23,	-6.46,	-5.43,	-5.63,	-5.40,	-5.88,	-5.77,	-5.92,	-5.17,	-5.59
2,	6.50,	6.79,	6.98,	6.22,	6.91,	6.26,	7.08,	6.46,	7.06,	6.40,	6.81

Table 3.8 cont'd.

SUMMARY STATISTICS												
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE				
	q		F	F		Slope		Intrcpt				
1	-5.79	.414	.0376	.3163	.000E+00	.000E+00	-5.791	.120				
2	-6.68	.334	.0192	.4403	.000E+00	.000E+00	-6.678	.097				
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio							
	.386	.260	.162	.260	.386							

Age 3												
Fleet	78	79	80	81	82	83	84	85	86	87	88	
1	-5.36	-5.10	-5.24	-5.24	-4.47	-4.58	-4.95	4.76	-4.76	-4.89	-4.73	
2	-5.66	-5.66	-5.75	-6.03	-5.75	-5.43	-6.15	-5.44	-5.90	-6.12	-5.94	

SUMMARY STATISTICS												
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE				
	q		F	F		Slope		Intrcpt				
1	-4.92	.302	.0902	.7590	.000E+00	.000E+00	-4.915	.087				
2	-5.80	.260	.0460	1.0562	.000E+00	.000E+00	-5.803	.075				
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio							
	.918	.197	.163	.197	.688							

Age 4												
Fleet	78	79	80	81	82	83	84	85	86	87	88	
1	-5.42	-4.94	-4.92	-4.30	-3.79	-4.31	-4.57	-4.61	-4.61	-4.70	-4.37	
2	-5.73	-5.50	-5.43	-5.09	-5.07	-5.16	-5.77	-5.30	-5.75	-5.93	-5.59	

SUMMARY STATISTICS												
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE				
	q		F	F		Slope		Intrcpt				
1	-4.60	.441	.1242	1.0449	.000E+00	.000E+00	-4.596	.127				
2	-5.40	.311	.0633	1.4546	.000E+00	.000E+00	-5.483	.090				
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio							
	1.303	.254	.156	.254	.375							

Age 5												
Fleet	78	79	80	81	82	83	84	85	86	87	88	
1	-5.12	-4.72	-5.20	-4.55	-4.23	-4.53	-4.60	-4.81	-4.68	-4.40	-4.42	
2	-5.42	-5.28	-5.72	-5.34	-5.51	-5.38	5.79	-5.49	-5.82	-5.63	-5.64	

cont'd.

Table 3.8 cont'd.

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-4.66	.308	.1164	.9796	.000E+00	.000E+00	-4.660	.089	
2	-5.55	.194	.0594	1.3637	.000E+00	.000E+00	-5.548	.056	
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)		Variance ratio		
1.242		.164	.149		.164		.825		

Age 6

Fleet	78	79	80	81	82	83	84	85	86	87	88
1	-4.67	-5.05	-4.68	-5.20	-3.85	-3.97	-4.12	-4.52	-4.07	-4.57	-4.25
2	-4.98	-5.62	-5.20	-5.99	-5.13	-4.82	-5.32	-5.20	-5.22	-5.80	-5.47

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-4.45	.458	.1435	1.2076	.000E+00	.000E+00	-4.451	.132	
2	-5.34	.366	.0731	1.6793	.000E+00	.000E+00	-5.340	.106	
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)		Variance ratio		
1.477		.286	.161		.286		.316		

Table 3.9 VIRTUAL POPULATION ANALYSIS

COD IN THE KATTEGAT (PART OF FISHING AREA IIIA)

FISHING MORTALITY COEFFICIENT	UNIT: Year-1					NATURAL MORTALITY COEFFICIENT = .20						
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	.584	.002	.000	.022	.008	.017	.000	.004	.022	.043	.021	.018
2	.361	.283	.038	.456	.179	.262	.318	.319	.201	.183	.476	.295
3	.678	.559	.258	.727	.655	.616	.863	.738	.623	.623	.578	.940
4	.605	.537	.821	1.354	.940	1.229	1.301	.689	.731	.858	1.479	1.858
5	.686	.560	1.617	.927	.725	.938	1.552	.932	.910	.646	1.156	1.199
6	.656	.883	2.001	1.415	.737	.829	1.155	1.461	.646	1.082	.602	1.749
7	.720	.720	1.810	1.170	.730	.880	1.370	1.200	.780	.860	.880	1.470
8+	.720	.720	1.810	1.170	.730	.880	1.370	1.200	.780	.860	.880	1.470
( 2- 6)U	.597	.564	.947	.976	.647	.775	1.038	.828	.622	.678	.858	1.208
	1983	1984	1985	1986	1987	1988	1984-86					
1	.035	.012	.089	.028	.033	.015	.043					
2	.422	.347	.467	.346	.936	.390	.387					
3	.964	.875	1.293	1.101	1.168	1.090	1.090					
4	1.261	1.283	1.493	1.292	1.387	1.360	1.356					
5	1.013	1.242	1.223	1.200	1.972	1.220	1.222					
6	1.769	2.032	1.603	2.133	1.636	1.920	1.923					
7	1.390	1.630	1.500	1.500	1.500	1.540	1.543					
8+	1.390	1.630	1.500	1.500	1.500	1.540	1.543					
( 2- 6)U	1.086	1.156	1.216	1.214	1.420	1.196						

Table 3.10 VIRTUAL POPULATION ANALYSIS

COD IN THE KATTEGAT (PART OF FISHING AREA IIIA)

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	37155	22738	15533	30251	26021	11101	29544	23433	10840	14437	17141	20578
2	28742	16957	18582	12713	24234	21134	8939	24187	19106	8683	11322	13738
3	15373	16405	10457	14651	6598	16590	13318	5326	14398	12797	5923	5758
4	4615	6391	7683	6612	5798	2805	7338	4600	2084	6320	5619	2721
5	1948	2063	3059	2767	1398	1855	672	1636	1890	822	2193	1049
6	470	803	965	497	897	555	594	116	527	623	353	565
7	64	200	272	107	99	351	198	153	22	226	173	158
8+	64	81	205	49	40	97	148	110	95	66	145	50
TOTAL NO	88430	65636	56756	67646	65084	54488	60751	59563	48963	43974	42868	44617
SPS NO	22533	25941	22641	24682	14830	22252	22268	11942	19017	20854	14406	10302
TOT. BIOM	66074	68692	65185	68683	63767	57944	60873	58383	50544	44257	41333	38738
SPS BIOM	29235	37877	37976	36350	24253	31586	32356	20718	26285	26527	21934	15621
	1983	1984	1985	1986	1987	1988	1989					
1	20502	11357	8837	17141	5679	14670	0					
2	16541	16196	9183	6618	13645	4498	11832					
3	8374	8883	9373	4711	3834	4380	2493					
4	1842	2615	3032	2106	1283	976	1206					
5	348	427	593	558	474	262	205					
6	259	103	101	143	138	54	63					
7	80	36	11	17	14	22	6					
8+	36	25	21	14	26	4	5					
TOTAL NO	47982	39643	31151	31307	25092	24866						
SPS NO	10939	12090	13131	7549	5768	5698						
TOT. BIOM	40301	36504	29360	28632	21555	19169						
SPS BIOM	15664	16363	16300	12466	9042	7707						



Table 3.11 Indices of 0-group cod from the Norwegian Skagerrak coast and 1-group cod, whiting, and haddock in Division IIIa from the International Young Fish Survey.

Year class	Cod 0-group <sup>1</sup>	Whiting 1-group (<20 cm)	Haddock 1-group (<20 cm)
1974	-	499	-
1975	6.1	236	-
1976	11.4	99	-
1977	3.4	392	-
1978	6.0	561	-
1979	21.4	722	40.4
1980	7.1	968	4.3
1981	5.0	690	47.7
1982	12.4	262	33.8
1983	1.9	500	71.7
1984	4.2	940	160.8
1985	20.3	1,379	57.0
1986	4.5	2,178	250.6
1987	10.1	2,978	125.2
1988	0.2	478	20.2

Year class	Kattegat Cod - 1-group (<25 cm)	Skagerrak Cod - 1-group (<25 cm)
1979	386	79.3
1980	42	18.3
1981	126	36.4
1982	113	32.0
1983	49	23.5
1984	18	17.8
1985	229	82.3
1986	48	15.0
1987	76	81.0
1988	6	62.0

<sup>1</sup> Norwegian survey.

Table 3.12

List of input variables for the ICES prediction program.

COD IN THE KATTEGAT

The reference F is the mean F for the age group range from 2 to 6

The number of recruits per year is as follows:

Year	Recruitment
1989	8103.0
1990	17100.0
1991	17100.0

Data are printed in the following units:

- Number of fish: thousands
- Weight by age group in the catch: kilogram
- Weight by age group in the stock: kilogram
- Stock biomass: tonnes
- Catch weight: tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	8103.0	.02	.20	.00	.565	.565
2	11832.0	.39	.20	.00	.735	.735
3	2493.0	1.09	.20	1.00	1.157	1.157
4	1206.0	1.36	.20	1.00	1.906	1.906
5	205.0	1.22	.20	1.00	2.901	2.901
6	63.0	1.92	.20	1.00	4.174	4.174
7	6.0	1.54	.20	1.00	6.046	6.046
8+	5.0	1.54	.20	1.00	7.550	7.550

Table 3.13

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

COD IN THE KATTEGAT

Year 1989					Year 1990					Year 1991	
fac- tor	ref. F	stock biomass	sp.stock biomass	catch	fac- tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	1.20	19389	6115	6624	.0	.00	24364	9899	0	39177	19226
					.1	.12			1160	37510	17574
					.2	.24			2209	36008	16087
					.4	.48			4019	33428	13538
					.6	.72			5512	31319	11459
					.8	.96			6749	29585	9756
					1.0	1.20			7781	28154	8355
					1.2	1.44			8646	26965	7197
					1.4	1.67			9377	25972	6234
					1.6	1.91			9998	25138	5431
					1.8	2.15			10529	24433	4756
					2.0	2.39			10966	23833	4186

The data unit of the biomass and the catch is tonnes.  
 The spawning stock biomass is given for 1 January.  
 The reference F is the mean F for the age group range from 2 to 6

Table 3.14

## Results

14.07.04 08 MARCH 1989  
COD IN THE KATTEGAT

\*\*\*\*\*  
\* Year 1989, F-factor 1.000 and reference F 1.1960 \*

								at 1 January	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass		
1	.0150	109.37	61.79	8103.0	4578.2	.00	.00		
2	.3900	3485.67	2561.97	11832.0	8696.5	.00	.00		
3	1.0900	1526.63	1766.32	2493.0	2884.4	2493.00	2884.40		
4	1.3600	830.45	1582.84	1206.0	2298.6	1206.00	2298.64		
5	1.2200	133.55	387.44	205.0	594.7	205.00	594.70		
6	1.9200	50.21	209.57	63.0	263.0	63.00	262.96		
7	1.5400	4.38	26.47	6.0	36.3	6.00	36.28		
8+	1.5400	3.65	27.55	5.0	37.8	5.00	37.75		
Total		6143.91	6623.94	23913.0	19389.4	3978.00	6114.73		

\*\*\*\*\*  
\* Year 1990, F-factor 1.000 and reference F 1.1960 \*

								at 1 January	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass		
1	.0150	230.80	130.40	17100.0	9661.5	.00	.00		
2	.3900	1925.31	1415.10	6535.4	4803.5	.00	.00		
3	1.0900	4016.40	4646.98	6558.8	7588.5	6558.80	7588.53		
4	1.3600	472.55	900.68	686.3	1308.0	686.25	1307.99		
5	1.2200	165.10	478.96	253.4	735.2	253.42	735.18		
6	1.9200	39.49	164.83	49.6	206.8	49.55	206.83		
7	1.5400	5.52	33.36	7.6	45.7	7.56	45.72		
8+	1.5400	1.41	10.64	1.9	14.6	1.93	14.58		
Total		6856.58	7780.96	31192.9	24363.9	7557.52	9898.84		

\*\*\*\*\*  
\* Year 1991, F-factor 1.000 and reference F 1.1960 \*

								at 1 January	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass		
1	.0150	230.80	130.40	17100.0	9661.5	.00	.00		
2	.3900	4063.04	2986.34	13791.9	10137.0	.00	.00		
3	1.0900	2218.46	2566.76	3622.8	4191.5	3622.75	4191.53		
4	1.3600	1243.23	2369.59	1805.4	3441.2	1805.45	3441.18		
5	1.2200	93.95	272.54	144.2	418.3	144.21	418.34		
6	1.9200	48.82	203.77	61.3	255.7	61.26	255.68		
7	1.5400	4.34	26.24	5.9	36.0	5.95	35.96		
8+	1.5400	1.22	9.18	1.7	12.6	1.67	12.58		
Total		7903.85	8564.82	36533.1	28153.8	5641.28	8355.27		

Table 3.15 SUM OF PRODUCTS CHECK

COD IN THE SKAGERRAK (PART OF FISHING AREA IIIA)  
 CATEGORY: TOTAL

CATCH IN NUMBERS		UNIT: thousands										
-----		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	4337	432	1066	389	1080	1771	341	928	3253	165	1017	
2	11174	4325	6593	11030	4448	6020	7067	5156	4101	12289	2598	
3	2889	2956	4821	6202	6653	3368	3107	2773	3441	2245	5158	
4	775	480	1748	1169	2009	1609	731	856	1748	503	582	
5	182	202	349	288	242	290	280	207	347	137	147	
6	166	34	94	44	175	85	70	124	60	69	55	
7	44	33	82	49	73	32	22	33	39	17	8	
8+	52	28	11	6	27	69	17	9	21	19	13	
TOTAL	19619	8490	14764	19177	14707	13244	11635	10086	13010	15444	9578	

Table 3.16 SUM OF PRODUCTS CHECK

COD IN THE SKAGERRAK (PART OF FISHING AREA IIIA)  
 CATEGORY: TOTAL

	UNIT: kilogram										
MEAN WEIGHT AT AGE IN THE CATCH	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1	.599	.599	.746	.619	.656	.590	.647	.649	.683	.580	.637
2	.860	.860	1.146	.972	1.204	1.007	1.130	1.094	1.133	1.048	1.195
3	1.894	1.894	1.570	1.902	1.865	1.967	2.170	2.089	2.040	1.859	1.863
4	3.498	3.498	3.347	3.711	2.709	3.350	3.616	3.537	2.636	3.896	2.978
5	5.510	5.510	4.865	5.261	6.107	5.751	5.505	5.472	4.702	5.849	5.830
6	7.093	7.093	8.932	9.491	8.018	8.074	7.814	7.746	7.538	7.914	8.095
7	7.304	7.304	8.301	8.514	8.738	8.586	10.319	10.255	9.164	9.607	10.245
8+	9.888	9.888	11.085	10.094	12.658	11.963	12.856	12.854	9.777	12.467	13.060

Table 3.17 COD - Skagerrak. Trend in the Danish and Swedish combined CPUE series.

Year	Sweden			Denmark			Relative F <sub>(3-6)</sub> to 1983
	CPUE all gears combined	Estm. total effort	Effort rel. to 1983	CPUE all years combined	Estm. total effort	Effort rel. to 1983	
1978	19.02	1,286	1.58	-	-	-	0.75
1979	27.32	567	0.70	-	-	-	0.44
1980	31.50	762	0.94	-	-	-	0.89
1981	38.08	759	0.93	-	-	-	0.75
1982	39.56	660	0.81	-	-	-	1.12
1983	26.79	813	1.00	316	68.9	1.00	1.00
1984	19.37	1,027	1.26	283	70.3	1.02	0.79
1985	19.66	846	1.04	296	56.2	0.81	0.83
1986	15.96	1,260	1.55	618	32.5	0.47	1.34
1987	19.88	836	1.03	324	61.3	0.89	1.04
1988	12.59	1,323	1.63	261	63.8	0.93	0.96

Table 3.18 Tuning output for cod in the Skagerrak.

VPA Version 2.1 - May 1988

Module run at 16.23.09 28 FEBRUARY 1989

DISAGGREGATED Qs

LOG TRANSFORMATION

NO explanatory variate (Mean used)

Fleet 1 ,Swedish bottom trawl, has terminal q estimated as the mean

Fleet 2 ,Swedish Neph. trawl, has terminal q estimated as the mean

FLEETS COMBINED BY \*\* VARIANCE \*\*

Regression weights

, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,  
 Oldest age F = 1.000 average of 3 younger ages. Fleets combined by variance of predictions  
 Fishing mortalities

Age,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,
1,	.249,	.020,	.039,	.031,	.073,	.104,	.027,	.093,	.125,	.032,	.084,
2,	.932,	.421,	.461,	.679,	.575,	.707,	.746,	.683,	.735,	.936,	.965,
3,	1.111,	.691,	1.216,	1.096,	1.237,	1.242,	1.036,	.759,	1.554,	1.270,	1.548,
4,	.869,	.539,	1.250,	1.215,	1.529,	1.279,	1.064,	.948,	1.955,	1.109,	1.641,
5,	.564,	.585,	.995,	.704,	.922,	1.027,	.810,	1.069,	1.498,	.891,	1.285,
6,	.897,	.191,	.602,	.309,	1.386,	1.045,	.756,	1.115,	1.128,	1.832,	1.208,
7,	.777,	.439,	.949,	.743,	1.279,	1.117,	.877,	1.044,	1.527,	1.277,	1.378,

Log catchability estimates

Age 1 Fleet,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,	-8.30,	-10.22,	-9.66,	-9.97,	-8.76,	-8.60,	-10.09,	-8.70,	-8.62,	-9.71,	-9.06
2,	-8.59,	-10.27,	-9.96,	-10.13,	-9.27,	-9.10,	-10.79,	-9.31,	-9.70,	-10.89,	-10.01

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial, F	Raised, F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-9.24	.728	.0013	.0695	.000E+00	.000E+00	-9.243	.210
2	-9.82	.742	.0054	.1016	.000E+00	.000E+00	-9.821	.214
Fbar	.094	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio			
		.520	.190	.520	.134			

Age 2 Fleet,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1,	-6.98,	-7.16,	-7.18,	-6.88,	-6.63,	-6.68,	-6.76,	-6.71,	-6.85,	-6.33,	-6.61
2,	-7.27,	-7.21,	-7.49,	-7.05,	-7.26,	-7.17,	-7.46,	-7.31,	-7.93,	-7.52,	-7.57

cont'd.



Table 3.18 cont'd.

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-6.80	.258	.0148	.7972	.000E+00	.000E+00	-6.803	.074	
2	-7.38	.258	.0623	1.1704	.000E+00	.000E+00	-7.381	.075	
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
	.966	.182	.192	.192	1.107				

Age 3

Fleet	78	79	80	81	82	83	84	85	86	87	88
1	-6.80	-6.67	-6.21	-6.41	-5.92	-6.11	-6.43	-6.60	-6.10	-6.03	-6.14
2	-7.10	-6.71	-6.52	-6.57	-6.43	-6.61	-7.13	-7.21	-7.19	-7.22	-7.10

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-6.31	.300	.0243	1.3034	.000E+00	.000E+00	-6.311	.087	
2	-6.89	.330	.1019	1.9063	.000E+00	.000E+00	-6.889	.095	
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
	1.548	.222	.189	.222	.725				

Age 4

Fleet	78	79	80	81	82	83	84	85	86	87	88
1	-7.05	-6.92	-6.18	-6.30	-5.71	-6.08	-6.41	-6.38	-5.87	-6.17	-6.08
2	-7.34	-6.96	-6.49	-6.47	-6.22	-6.58	-7.10	-6.99	-6.96	-7.35	-7.04

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-6.29	.419	.0249	1.3371	.000E+00	.000E+00	-6.286	.121	
2	-6.86	.388	.1045	1.9555	.000E+00	.000E+00	-6.864	.112	
	Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
	1.641	.285	.190	.285	.443				

Age 5

Fleet	78	79	80	81	82	83	84	85	86	87	88
1	-7.48	-6.83	-6.41	-6.85	-6.22	-6.30	-6.68	-6.26	-6.14	-6.38	-6.33
2	-7.76	-6.88	-6.72	-7.01	-6.73	-6.80	-7.37	-6.87	-7.22	-7.57	-7.28

cont'd.

Table 3.18 cont'd.

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-6.53	.414	.0197	.9343	.000E+00	.000E+00	-6.534	.119	
2	-7.11	.375	.0815	1.9254	.000E+00	.000E+00	-7.112	.108	
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio	
1.285		.278		.189		.278		.463	

Age 6

Fleet	78	79	80	81	82	83	84	85	86	87	88
1	-7.01	-7.95	-6.92	-7.67	-5.81	-6.29	-6.75	-6.22	-6.42	-5.66	-6.39
2	-7.31	-8.00	-7.22	-7.84	-6.32	-6.78	-7.44	-6.82	-7.51	-6.85	-7.35

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-6.64	.744	.0174	.9343	.000E+00	.000E+00	-6.644	.215	
2	-7.22	.516	.0730	1.3665	.000E+00	.000E+00	-7.222	.149	
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio	
1.208		.424		.178		.424		.176	

Table 3.19 VIRTUAL POPULATION ANALYSIS

COD IN THE SKAGERRAK (PART OF FISHING AREA IIIA)

FISHING MORTALITY COEFFICIENT      UNIT: Year-1      NATURAL MORTALITY COEFFICIENT = .20

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1984-86
1	.249	.020	.039	.031	.073	.103	.027	.092	.117	.026	.038	.078
2	.932	.421	.461	.677	.574	.707	.744	.680	.718	.836	.710	.714
3	1.111	.691	1.216	1.096	1.229	1.238	1.034	.753	1.530	1.194	1.100	1.106
4	.869	.540	1.250	1.215	1.529	1.253	1.053	.943	1.897	1.051	1.300	1.298
5	.552	.585	.996	.704	.922	1.026	.767	1.038	1.472	.802	1.090	1.092
6	.898	.185	.601	.309	1.387	1.046	.755	.973	1.039	1.675	.920	.922
7	.780	.440	.900	.740	1.280	1.120	.880	1.040	1.000	1.000	.970	.973
8+	.780	.440	.900	.740	1.280	1.120	.880	1.040	1.000	1.000	.970	.973
( 2- 6)U	.872	.484	.905	.800	1.128	1.054	.871	.878	1.331	1.112	1.024	

Table 3.20 VIRTUAL POPULATION ANALYSIS

COD IN THE SKAGERRAK (PART OF FISHING AREA IIIA)

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	21610	24355	31047	14019	17012	19881	14303	11683	32418	6989	30074	0
2	20033	13791	19550	24457	11126	12954	14680	11402	8729	23609	5573	23705
3	4668	6460	7412	10096	10170	5129	5231	5713	4730	3485	8379	2243
4	1452	1259	2649	1798	2762	2435	1217	1523	2203	839	864	2284
5	469	499	601	622	437	490	569	348	485	271	240	193
6	305	221	227	182	252	142	144	216	101	91	99	66
7	88	102	150	102	109	51	41	55	67	29	14	32
8+	105	86	20	13	40	111	32	15	36	33	23	11
TOTAL NO	48729	46773	61657	51287	41909	41195	36217	30956	48769	35346	45267	
SPS NO	7086	8626	11060	12812	13771	8360	7234	7870	7622	4748	9620	
TOT. BIOM	50516	48996	72494	64315	57158	48759	46683	41717	51495	41535	46647	
SPS BIOM	20343	22546	26928	31866	32602	23985	20840	21661	19463	12739	20830	

Table 3.21

List of input variables for the ICES prediction program.

COD IN THE SKAGERRAK

The reference F is the mean F for the age group range from 2 to 6

The number of recruits per year is as follows:

Year	Recruitment
1989	27000.0
1990	20381.0
1991	20381.0

Data are printed in the following units:

Number of fish: thousands  
 Weight by age group in the catch: kilogram  
 Weight by age group in the stock: kilogram  
 Stock biomass: tonnes  
 Catch weight: tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	27000.0	.04	.20	.00	.637	.637
2	23705.0	.71	.20	.00	1.059	1.059
3	2243.0	1.10	.20	1.00	1.919	1.919
4	2284.0	1.30	.20	1.00	3.343	3.343
5	193.0	1.09	.20	1.00	5.487	5.487
6	66.0	.92	.20	1.00	7.983	7.983
7	32.0	.97	.20	1.00	8.940	8.940
8+	11.0	.97	.20	1.00	11.508	11.508

Table 3.22

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

COD IN THE SKAGERRAK

Year 1989					Year 1990					Year 1991		
fac- tor	ref. F	stock biomass	sp.stock biomass	catch	fac- tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass	
1.0	1.02	56241	13938	21250	.0	.00	59441	23921	0	97001	66347	
					.1	.10			3730	91178	60592	
					.2	.20			7133	85879	55359	
					.4	.41			13082	76655	46268	
					.6	.61			18057	68990	38734	
					.8	.82			22229	62605	32480	
					1.0	1.02			25737	57275	27280	
					1.2	1.23			28696	52814	22948	
					1.4	1.43			31200	49072	19334	
					1.6	1.64			33326	45925	16314	
					1.8	1.84			35137	43271	13785	
					2.0	2.05			36686	41026	11665	

The data unit of the biomass and the catch is tonnes.  
 The spawning stock biomass is given for 1 January.  
 The reference F is the mean F for the age group range from 2 to 6

Table 3.23

## Results

14.16.32 08 MARCH 1989  
COD IN THE SKAGERRAK

\*\*\*\*\*  
\* Year 1989, F-factor 1.000 and reference F 1.0240 \*

								----- at 1 January	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass		
1	.0380	913.0	581.6	27000.0	17199.0	.00	.0		
2	.7100	11050.4	11702.4	23705.0	25103.6	.00	.0		
3	1.1000	1380.7	2649.5	2243.0	4304.3	2243.00	4304.3		
4	1.3000	1537.8	5140.8	2284.0	7635.4	2284.00	7635.4		
5	1.0900	118.2	648.5	193.0	1059.0	193.00	1059.0		
6	.9200	36.5	291.6	66.0	526.9	66.00	526.9		
7	.9700	18.3	163.6	32.0	286.1	32.00	286.1		
8+	.9700	6.3	72.4	11.0	126.6	11.00	126.6		
Total		15061.2	21250.3	55534.0	56240.9	4829.00	13938.3		

\*\*\*\*\*  
\* Year 1990, F-factor 1.000 and reference F 1.0240 \*

								----- at 1 January	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass		
1	.0380	689.2	439.0	20381.0	12982.7	.0	.0		
2	.7100	9920.6	10505.9	21281.5	22537.1	.0	.0		
3	1.1000	5873.5	11271.2	9541.8	18310.8	9541.8	18310.8		
4	1.3000	411.6	1375.9	611.3	2043.5	611.3	2043.5		
5	1.0900	312.1	1712.4	509.6	2796.3	509.6	2796.3		
6	.9200	29.4	234.7	53.1	424.1	53.1	424.1		
7	.9700	12.3	110.1	21.5	192.5	21.5	192.5		
8+	.9700	7.6	87.8	13.3	153.6	13.3	153.6		
Total		17256.3	25737.0	52413.2	59440.6	10750.8	23920.9		

\*\*\*\*\*  
\* Year 1991, F-factor 1.000 and reference F 1.0240 \*

								----- at 1 January	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass		
1	.0380	689.2	439.0	20381.0	12982.7	.0	.0		
2	.7100	7488.6	7930.4	16064.4	17012.2	.0	.0		
3	1.1000	5273.0	10118.9	8566.3	16438.7	8566.3	16438.7		
4	1.3000	1750.9	5853.1	2600.5	8693.3	2600.5	8693.3		
5	1.0900	83.5	458.3	136.4	748.4	136.4	748.4		
6	.9200	77.6	619.8	140.3	1119.9	140.3	1119.9		
7	.9700	9.9	88.6	17.3	155.0	17.3	155.0		
8+	.9700	6.2	71.2	10.8	124.6	10.8	124.6		
Total		15378.9	25579.3	47917.0	57274.8	11471.6	27279.9		

**Table 4.1** Nominal landings (tonnes) of HADDOCK from Division IIIa (Bulletin Statistique).

Year	Denmark	Norway	Sweden	Others	Total
1975	5,015	122	921	57	6,115
1976	7,488	191	1,075	301	9,055
1977	6,907	156	2,485 <sup>2</sup>	215	9,763
1978	4,978	168	1,435 <sup>2</sup>	56	6,637
1979	4,120	248	361	56	4,785
1980	7,172	288	373	57	7,890
1981	9,568	271	391	120	10,350
1982	11,151	196	396	329	12,072
1983	8,670	756	608	221	10,255
1984	7,837	321	499	30	8,687
1985	7,652	279	351	15	9,314
1986	4,092	226	151	5	4,474
1987 <sup>1</sup>	5,033	148	71	36	5,288
1988 <sup>1</sup>	4,059	173	94	48	4,374

<sup>1</sup> Preliminary.

<sup>2</sup> Includes Divisions IVa and IVb.

**Table 4.2** Catch in numbers of HADDOCK in Division IIIa for 1981-1988 ('000).

Age	1981	1982	1983	1984	1985	1986	1987 <sup>1</sup>	1988 <sup>1</sup>
1	30	314	1,113	18	-	51	371	375
2	9,903	2,299	4,624	6,554	8,279	904	3,218	1,683
3	4,962	12,055	2,728	4,481	3,687	3,725	851	1,863
4	771	1,113	4,004	713	1,049	686	719	303
5	151	209	525	524	78	230	121	158
6	84	22	63	91	176	33	39	43
7	36	11	11	6	29	27	10	14
8+	3	6	6	16	6	28	5	16
Total	15,940	16,029	13,074	12,403	13,304	5,684	5,334	4,455

<sup>1</sup> Data from human consumption fishery.



Table 4.3 HADDOCK in Division IIIa (Kattegat and Skagerrak).  
Mean weight at age of the catch. Unit: kilogram.

Age	1981	1982	1983	1984	1985	1986	1987 <sup>1</sup>	1988 <sup>1</sup>
1	200	200	200	200	200	350	435	412
2	470	470	470	470	470	530	555	542
3	679	679	679	679	679	760	848	678
4	932	932	932	932	932	1.096	1.169	1.047
5	1.593	1.593	1.593	1.593	1.593	1.518	1.549	1.394
6	2.180	2.180	2.180	2.180	2.180	1.828	1.895	1.670
7	2.600	2.600	2.600	2.600	2.600	2.400	1.824	2.324
8+	2.770	2.770	2.770	2.770	2.770	2.700	2.134	2.742

<sup>1</sup>Data from human consumption fishery.

Table 5.1 Nominal landings (tonnes) of WHITING from  
Division IIIa (Bulletin Statistique).

Year	Denmark	Norway	Sweden	Others	Total
1975	19,018	57	611	4	19,690
1976	17,870	48	1,002	48	18,968
1977	18,116	46	975	41	19,178
1978	48,102	58	899	32	49,091
1979	16,971	63	1,033	16	18,083
1980	21,070	65	1,516	3	22,654
1981	22,880	70	1,054	7	24,011
1982	13,380	40	670	13	14,103
1983	11,519	48	1,061	8	12,636
1984	12,694	51	1,168	60	13,973
1985	12,671	45	654	2	13,372
1986	15,865	64	477	1	16,390
1987	16,463	29	262	43	16,797
1988 <sup>1</sup>	11,328	31	491	24	11,874

<sup>1</sup>Preliminary.

Table 6.1 PLAICE landings from the Kattegat (tonnes).

Year	Denmark	Sweden	Germany	Total
1972	15,504	348	-	15,852
1973	10,021	231	-	10,252
1974	11,401	255	-	11,656
1975	10,158	369	-	10,527
1976	9,487	271	-	9,758
1977	11,611	300	-	11,911
1978	12,685	368	-	13,053
1979	9,721	281	-	10,002
1980	5,582	289	-	5,871
1981	3,803	232	-	4,035
1982	2,717	201	-	2,918
1983	3,280	291	-	3,571
1984	3,252	323	32	3,607
1985	2,979	403	4	3,386
1986	2,488	170	+	2,658
1987 <sup>1</sup>	2,834	283	104	3,221
1988 <sup>1</sup>	1,820	269	-	2,089

<sup>1</sup> Preliminary.Table 6.2 PLAICE landings from the Skagerrak (tonnes).

Year	Denmark	Sweden	Netherlands	Belgium	Norway	Total
1972	5,095	70	-	-	-	5,165
1973	3,871	80	-	-	-	3,951
1974	3,429	70	-	-	-	3,499
1975	4,888	77	-	-	-	4,965
1976	9,251	81	-	-	-	9,332
1977	12,855	142	-	-	-	12,997
1978	13,383	94	-	-	-	13,477
1979	11,045	105	-	-	-	11,150
1980	9,514	92	-	-	-	9,606
1981	8,115	123	-	-	-	8,238
1982	7,789	140	-	-	-	7,929
1983	6,828	170	594	133	14	7,739
1984	7,560	356	1,580	27	22	9,545
1985	9,646	296	2,225	136	18	12,321
1986	10,653	215	4,024	505	24	15,421
1987 <sup>1</sup>	11,365	222	2,209	907	25	14,728
1988 <sup>1</sup>	9,787	300	2,087	212	46	12,432

<sup>1</sup> Preliminary.

**Table 6.3** PLAICE landings in Division IIIa (the Kattegat and the Skagerrak combined).  
Data submitted by Working Group members.

Year	Denmark	Sweden	Others	Total
1971	19,560	395	19	19,974
1972	20,599	418	80	21,097
1973	13,892	311	55	14,258
1974	14,830	325	58	15,213
1975	15,046	446	199	15,691
1976	18,738	352	756	19,846
1977	24,466	442	884	25,792
1978	26,068	462	480	27,010
1979	20,766	386	810	21,962
1980	15,096	381	56	15,533
1981	11,918	355	316	12,589
1982	10,506	345	8	10,859
1983	10,108	461	741	11,310
1984	10,812	679	1,629	13,120
1985	12,625	699	2,383	15,707
1986	13,141	385	4,723	18,183
1987	14,199	505	3,245	17,949
1988 <sup>1</sup>	11,607	569	2,345	14,521

<sup>1</sup> Preliminary.

**Table 6.4** Danish landings of PLAICE by quarters in the Kattegat and the Skagerrak (tonnes).

Quarter	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
<u>Kattegat</u>											
Jan-Mar	2,410	2,002	1,825	1,196	941	531	779	568	480	322	544
Apr-Jun	2,487	2,786	1,168	774	619	595	745	594	546	618	413
Jul-Sep	3,815	2,525	1,396	1,069	599	1,195	955	704	798	841	468
Oct-Dec	3,973	2,422	1,193	764	558	959	773	1,116	664	1,043	39
Total	12,685	9,721	5,582	3,803	2,717	3,280	3,252	2,979	2,488	2,834	1,820
<u>Skagerrak</u>											
Jan-Mar	1,289	967	1,042	751	849	895	964	919	1,131	688	1,423
Apr-Jun	3,522	5,097	3,325	3,036	3,084	2,729	2,675	2,944	2,779	3,649	3,938
Jul-Sep	4,302	2,963	3,381	2,239	2,583	1,941	2,461	3,511	3,157	3,696	2,874
Oct-Dec	4,270	2,018	1,766	2,089	1,273	1,263	1,460	2,842	3,586	3,332	1,552
Total	13,383	11,045	9,514	8,115	7,929	6,828	7,560	9,646	10,653	11,365	9,787

Table 6.5 VIRTUAL POPULATION ANALYSIS

PLAICE IN THE KATTEGAT (PART OF FISHING AREA IIIA)

CATCH IN NUMBERS	UNIT: thousands											
-----	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	1	1	1	1	1	1470	50	140	10	10	1	37
2	3790	1180	3660	680	1120	8590	3100	7880	8657	3330	147	859
3	20320	14070	11830	8190	21790	5830	21630	7330	11026	20150	9686	6464
4	10570	10510	9760	23570	17720	6260	3470	8140	2100	9230	27862	17331
5	2280	2840	3140	14170	7910	3130	2620	1040	3060	2680	8685	7984
6	790	760	710	1870	1110	1770	1020	730	431	900	1144	1715
7	500	300	650	350	200	510	740	420	280	230	227	576
8	260	300	370	190	120	180	330	350	207	270	49	105
9	180	270	370	330	80	20	120	150	87	210	48	73
10	70	240	240	260	80	10	80	110	74	130	33	49
11	1	50	80	80	30	30	50	50	10	100	17	38
12+	50	100	140	40	60	30	140	10	13	190	40	16
TOTAL	38812	30621	30951	49731	50221	27830	33350	26350	25955	37430	47939	35247
	1980	1981	1982	1983	1984	1985	1986	1987	1988			
1	1	2	20	54	7	6	8	0	3			
2	301	191	548	1495	1334	1315	391	664	69			
3	2855	1817	1326	5029	4408	5052	2304	2687	1187			
4	7179	4754	1986	2298	2880	4061	2685	4379	2102			
5	5355	3198	1935	888	619	434	2072	1717	1428			
6	2310	1056	1011	585	385	84	619	456	555			
7	501	416	380	561	540	80	130	117	255			
8	159	196	157	402	675	115	64	92	155			
9	127	131	63	216	566	89	48	72	72			
10	53	91	23	54	288	100	43	71	66			
11	32	51	25	39	27	66	27	61	24			
12+	17	39	9	71	70	71	22	60	65			
TOTAL	18890	11942	7483	11692	11799	11473	8413	10376	5981			

Table 6.6 VIRTUAL POPULATION ANALYSIS

PLAICE IN THE KATTEGAT (PART OF FISHING AREA IIIA)

MEAN WEIGHT AT AGE OF THE STOCK	UNIT: kilogram											
	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	.176	.176	.176	.176	.176	.176	.176	.176	.176	.176	.200	.120
2	.243	.243	.243	.243	.243	.243	.243	.243	.243	.243	.230	.220
3	.273	.273	.273	.273	.273	.273	.273	.273	.273	.273	.240	.258
4	.291	.291	.291	.291	.291	.291	.291	.291	.291	.291	.260	.275
5	.325	.325	.325	.325	.325	.325	.325	.325	.325	.325	.300	.303
6	.408	.408	.408	.408	.408	.408	.408	.408	.408	.408	.460	.344
7	.556	.556	.556	.556	.556	.556	.556	.556	.556	.556	.720	.450
8	.686	.686	.686	.686	.686	.686	.686	.686	.686	.686	.780	.650
9	.822	.822	.822	.822	.822	.822	.822	.822	.822	.822	.800	.920
10	.907	.907	.907	.907	.907	.907	.907	.907	.907	.907	.820	1.005
11	.952	.952	.952	.952	.952	.952	.952	.952	.952	.952	.830	1.030
12+	.992	.992	.992	.992	.992	.992	.992	.992	.992	.992	.830	1.061
	1980	1981	1982	1983	1984	1985	1986	1987	1988			
1	.120	.180	.260	.275	.235	.247	.229	.301	.272			
2	.263	.230	.270	.285	.287	.287	.251	.283	.263			
3	.277	.270	.320	.285	.300	.280	.295	.287	.296			
4	.300	.290	.330	.298	.318	.310	.302	.332	.308			
5	.310	.350	.360	.350	.358	.398	.358	.426	.334			
6	.356	.440	.440	.385	.324	.476	.415	.569	.434			
7	.500	.530	.580	.402	.316	.503	.484	.638	.562			
8	.600	.690	.710	.461	.340	.524	.604	.855	.654			
9	.690	.790	.910	.581	.327	.561	.645	.794	.796			
10	.810	.900	1.000	1.033	.412	.622	.784	1.059	.738			
11	.890	.960	1.050	1.182	.876	.652	.872	1.039	.992			
12+	.950	1.050	1.070	1.178	1.136	1.048	1.097	.793	1.119			

Table 6.7 Petersen young fish trawl indices for 1-group plaice in the Kattegat.

Year class	Beam trawl	Petersen young fish trawl	VPA 1-group
1960	-	5.80	-
1961	-	1.87	-
1962	-	7.92	-
1963	-	10.42	-
1964	-	16.22	-
1965	-	45.38	-
1966	-	-	-
1967	-	34.39	67,966
1968	-	26.38	48,450
1969	-	19.37	44,298
1970	-	22.56	17,157
1971	-	73.60	56,785
1972	-	59.10	25,711
1973	-	-	-
1974	-	-	-
1975	-	-	-
1976	-	-	-
1977	-	-	-
1978	-	-	-
1979	-	5.72	7,341
1980	3.6	-	14,375
1981	5.9	-	19,483
1982	23.8	-	18,557
1983	2.2	3.22	17,263
1984	2.55	10.23	10,762
1985	4.41	13.14	6,247 <sup>1</sup>
1986	1.29	4.79	4,333 <sup>1</sup>
1987	1.55	1.93	2,000 <sup>1</sup>

<sup>1</sup> Predicted.

**Table 6.8** Division IIIa PLAICE. Mean catch (kg) per fishing day for gears in the Kattegat and Skagerrak (Danish data).

Kattegat catch in kg (effort in fishing days)												
Year	Seiners			Trawl <30 GRT			Trawl >30 GRT			Gillnet		
	Catch	Effort	CPUE	Catch	Effort	CPUE	Catch	Effort	CPUE	Catch	Effort	CPUE
1983	331,882	(1,811)	183.3	136,430	(2,135)	63.9	59,682	(641)	93.1	22,146	(202)	109.6
1984	528,702	(2,379)	222.2	211,520	(3,114)	67.9	75,775	(995)	76.2	15,577	(197)	79.1
1985	240,855	(885)	272.2	146,150	(1,578)	92.6	60,004	(567)	105.8	8,203	(42)	195.3
1986	404,093	(1,773)	227.9	182,760	(1,828)	100.0	87,450	(882)	99.2	48,897	(186)	262.9
1987	393,777	(1,546)	254.7	120,870	(841)	143.7	388,113	(3,136)	123.8	95,365	(291)	327.7
1988	235,357	(1,370)	171.8	75,572	(701)	107.8	252,615	(2,968)	85.1	64,632	(243)	265.9

Skagerrak catch in kg (effort in fishing days)												
Year	Seiners			Trawl <30 GRT			Trawl >30 GRT			Gillnet		
	Catch	Effort	CPUE	Catch	Effort	CPUE	Catch	Effort	CPUE	Catch	Effort	CPUE
1983	407,230	(738)	551.8	249,099	(1,786)	139.5	190,725	(901)	211.7	4,278	(31)	138.0
1984	127,757	(2,401)	53.2	362,453	(2,780)	130.4	245,755	(1,998)	123.0	69,118	(235)	294.1
1985	749,096	(1,231)	608.5	267,474	(1,456)	183.7	338,315	(1,823)	185.6	50,118	(163)	307.5
1986	3,440,056	(5,330)	645.4	1,271,286	(3,341)	380.5	834,216	(2,259)	369.3	404,182	(945)	427.7
1987	2,373,372	(3,977)	596.8	248,672	(1,114)	223.2	360,284	(2,140)	168.8	638,297	(1,037)	615.5
1988	2,077,242	(3,856)	538.7	254,777	(1,339)	190/3	406,191	(3,961)	102.6	355,811	(911)	390.6

Table 6.9 Division IIIa PLAICE. Mean catch (kg) per fishing hour for gears in the Kattegat and Skagerrak (Swedish data).

Year	Skagerrak			Kattegat		
	Catch (tonnes)	Effort (hrs)	CPUE	Catch (tonnes)	Effort (hrs)	CPUE
<u>Nephrops trawl</u>						
1980	74.4	42,987	1.73	48.1	14,137	3.40
1981	76.1	43,785	1.03	56.0	13,875	4.04
1982	79.9	40,815	1.95	41.6	14,270	2.92
1983	104.1	52,536	1.98	44.0	11,739	3.75
1984	215.4	69,779	3.09	67.7	13,718	4.94
1985	219.6	70,864	3.10	103.8	13,090	7.93
1986	135.3	74,913	1.81	45.6	16,420	2.78
1987	127.7	91,875	1.39	82.9	19,421	4.27
1988	145.3	99,601	1.46	51.2	15,240	3.36
<u>Cod bottom trawl</u>						
1980	16.6	6,651	2.50	91.0	14,866	6.12
1981	12.7	7,297	1.74	95.8	12,454	7.69
1982	18.3	8,178	2.24	94.5	10,443	9.05
1983	22.3	8,478	2.63	177.6	17,321	10.25
1984	54.4	11,991	4.54	145.6	19,168	7.60
1985	46.7	13,168	3.55	133.7	14,112	9.47
1986	34.4	11,977	2.87	66.4	13,157	5.05
1987	25.7	13,526	1.90	108.3	14,448	7.50
1988	31.0	13,358	2.32	88.7	12,450	7.12



Table 6.10 Catch per unit effort and effort series for plaice in the Kattegat and Skagerrak.

Year	Kattegat							Skagerrak				
	Combined Swedish and Danish series rel. to 1983			Danish seiners		Danish seiners and trawler combined		Combined Swedish and Danish seiners rel. to 1983			Danish seiners	
	Catch	CPUE	Effort	CPUE	Effort	CPUE	Effort	Catch	CPUE	Effort	CPUE	Effort
1983	3,571	1.0	3,571	184	19.0	1.00	3,571	7,739	1.00	7,739	551.8	14.0
1984	3,607	1.12	3,220	222	16.0	1.13	3,192	9,545	1.13	8,447	53.8	179.0
1985	3,386	1.46	2,319	272	12.0	1.42	2,385	12,321	1.42	8,676	608.5	20.3
1986	2,658	0.86	3,090	228	12.0	1.30	2,045	15,421	1.30	11,862	645.4	23.9
1987	3,221	1.22	2,640	255	12.6	1.46	2,206	14,728	1.46	10,087	596.4	24.7
1988	2,089	0.87	2,401	172	12.0	1.02	2,048	12,432	1.02	12,188	538.7	23.1

Table 6.11 Tuning output for plaice in the Kattegat.

VPA Version 2.1 - May 1988

Module run at 16.12.28 28 FEBRUARY 1989

DISAGGREGATED Qs

LOG TRANSFORMATION

NO explanatory variate (Mean used)

Fleet 1 ,Danish seiners fleet, has terminal q estimated as the mean

Fleet 2 ,Swedish Nephth. fleet, has terminal q estimated from trend

Fleet 3 ,Swedish Cod fleet 3, has terminal q estimated from trend

FLEETS COMBINED BY \*\* VARIANCE \*\*

Terminal Fs estimated using Laurec/Shepherd method

Regression weights

, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,

Oldest age F = 1.000\*average of 3 younger ages. Fleets combined by variance of predictions

Fishing mortalities

Age,	83,	84,	85,	86,	87,	88,
1,	.003,	.000,	.001,	.001,	.001,	.001,
2,	.093,	.087,	.093,	.043,	.132,	.067,
3,	.630,	.383,	.480,	.208,	.406,	.326,
4,	.901,	.809,	.643,	.449,	.661,	.567,
5,	.618,	.573,	.234,	.709,	.511,	.413,
6,	.444,	.527,	.124,	.535,	.290,	.273,
7,	.383,	.842,	.174,	.255,	.150,	.234,
8,	.354,	.960,	.374,	.184,	.258,	.294,
9,	.318,	1.073,	.269,	.235,	.290,	.294,
10,	.749,	.799,	.474,	.181,	.565,	.415,
11,	.474,	.944,	.372,	.200,	.371,	.334,

Log catchability estimates

Age 1 Fleet,	83,	84,	85,	86,	87,	88
1,	-8.75,	-10.55,	-9.89,	-9.11,	-10.15,	-9.67
2,	-12.52,	-14.35,	-13.94,	-13.51,	-12.03,	-13.28
3,	-11.51,	-14.68,	-14.02,	-13.29,	-11.73,	-13.08

SUMMARY STATISTICS

Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
, q	, F	, F	, F	, Slope	, Slope	, Intrcpt		
1	-9.69	.720	.0002	.0007	.000E+00	.000E+00	-9.687	.272
2	-13.27	.939	.0001	.0008	.000E+00	.000E+00	-13.273	.355
3	-13.05	1.345	.0001	.0008	.000E+00	.000E+00	-13.054	.509
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio
.001		.526		.115E-01		.526		.000

Age 2 Fleet,	83,	84,	85,	86,	87,	88
1,	-5.34,	-5.22,	-4.90,	-5.60,	-4.56,	-5.17
2,	-9.24,	-9.03,	-8.44,	-10.02,	-8.67,	-9.21
3,	-8.22,	-8.60,	-8.26,	-9.40,	-8.06,	-8.32

cont'd.

Table 6.11 cont'd.

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-5.13	.389	.0234	.0701	.000E+00	.000E+00	-5.133	.147	
2	-9.10	.593	.0033	.0748	.000E+00	.000E+00	-9.102	.224	
3	-8.48	.525	.0050	.0575	.000E+00	.000E+00	-8.476	.199	
	Fbar	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio	
	.067	.277		.710E-01		.277		.066	

Age	Fleet					
	83	84	85	86	87	88
1	-3.43	-3.75	-3.26	-4.03	-3.44	-3.62
2	-7.32	-7.55	-6.79	-8.43	-7.52	-7.55
3	-6.31	-7.12	-6.61	-7.83	-6.97	-6.81

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE	
	q		F	F		Slope		Intrcpt	
1	-3.58	.297	.1099	.3361	.000E+00	.000E+00	-3.585	.112	
2	-7.53	.573	.0157	.3331	.000E+00	.000E+00	-7.527	.216	
3	-6.94	.560	.0232	.2841	.000E+00	.000E+00	-6.942	.212	
	Fbar	SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio	
	.326	.238		.454E-01		.238		.036	

Age	Fleet					
	83	84	85	86	87	88
1	-3.07	-3.00	-2.96	-3.26	-2.95	-3.06
2	-6.97	-6.81	-6.50	-7.66	-7.04	-7.00
3	-5.96	-6.37	-6.32	-7.07	-6.47	-6.25

cont'd.

Table 6.11 cont'd.

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
	q		F	F		Slope		Intrcpt
1	-3.05	.122	.1875	.5744	.000E+00	.000E+00	-3.050	.046
2	-7.00	.411	.0267	.5673	.000E+00	.000E+00	-6.996	.155
3	-6.41	.397	.0396	.4844	.000E+00	.000E+00	-6.407	.150
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio
.566		.112		.325E-01		.112		.084

Age 5						
Fleet	83	84	85	86	87	88
1	-3.45	-3.34	-3.97	-2.80	-3.21	-3.38
2	-7.37	-7.13	-7.49	-7.20	-7.29	-7.32
3	-6.33	-6.71	-7.34	-6.61	-6.74	-6.57

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
	q		F	F		Slope		Intrcpt
1	-3.36	.411	.1378	.4221	.000E+00	.000E+00	-3.358	.155
2	-7.30	.136	.0197	.4201	.000E+00	.000E+00	-7.301	.051
3	-6.71	.363	.0291	.3556	.000E+00	.000E+00	-6.715	.137
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio
.413		.121		.372E-01		.121		.094

Age 6						
Fleet	83	84	85	86	87	88
1	-3.78	-3.43	-4.61	-3.08	-3.77	-3.80
2	-7.62	-7.23	-8.23	-7.49	-7.89	-7.73
3	-6.67	-6.82	-7.90	-6.87	-7.28	-6.99

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
	q		F	F		Slope		Intrcpt
1	-3.74	.550	.0937	.2873	.000E+00	.000E+00	-3.744	.206
2	-7.70	.370	.0132	.2823	.000E+00	.000E+00	-7.700	.140
3	-7.09	.485	.0200	.2470	.000E+00	.000E+00	-7.090	.183
Fbar		SIGMA(int.)		SIGMA(ext.)		SIGMA(overall)		Variance ratio
.273		.259		.448E-01		.259		.030

Age 7						
Fleet	83	84	85	86	87	88
1	-3.93	-2.96	-4.27	-3.82	-4.36	-3.95
2	-7.83	-6.80	-7.84	-6.35	-8.57	-7.88
3	-6.80	-6.33	-7.70	-7.62	-7.86	-7.13

cont'd.

Table 6.11 cont'd.

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE Slope	INTRCPT	SE Intrcpt	
	q		F	F					
1	-7.98	.538	.0817	.2509	.000E+00	.000E+00	-3.881	.203	
2	-7.88	.360	.0111	.2352	.000E+00	.000E+00	-7.878	.250	
3	-7.24	.611	.0172	.2092	.000E+00	.000E+00	-7.240	.242	
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)	Variance ratio			
.233		.350	.537E-01		.350	.024			

Age 8

Fleet	83	84	85	86	87	88
1	-4.00	-2.83	-3.50	-4.16	-3.89	-3.71
2	-7.98	-6.65	-7.04	-8.37	-7.85	-7.70
3	-6.90	-6.21	-6.83	-8.15	-7.33	-6.88

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE Slope	INTRCPT	SE Intrcpt	
	q		F	F					
1	-3.68	.515	.0998	.3032	.000E+00	.000E+00	-3.681	.195	
2	-7.60	.688	.0147	.3244	.000E+00	.000E+00	-7.597	.260	
3	-7.05	.700	.0209	.2487	.000E+00	.000E+00	-7.049	.265	
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)	Variance ratio			
.293		.355	.716E-01		.355	.041			

Age 9

Fleet	83	84	85	86	87	88
1	-4.11	-2.72	-3.84	-3.91	-3.77	-3.70
2	-7.87	-6.54	-7.29	-8.53	-7.78	-7.78
3	-7.00	-6.11	-7.19	-7.62	-7.19	-6.89

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE Slope	INTRCPT	SE Intrcpt	
	q		F	F					
1	-3.68	.530	.1004	.3011	.000E+00	.000E+00	-3.675	.200	
2	-7.63	.721	.0142	.3401	.000E+00	.000E+00	-7.631	.273	
3	-7.00	.544	.0219	.2630	.000E+00	.000E+00	-6.999	.205	
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)	Variance ratio			
.294		.336	.691E-01		.336	.042			

Age 10

Fleet	83	84	85	86	87	88
1	-3.25	-3.01	-3.28	-4.19	-3.09	-3.35
2	-7.02	-6.85	-6.84	-8.68	-7.10	-7.34
3	-6.02	-6.36	-6.58	-7.78	-6.51	-6.64

SUMMARY STATISTICS									
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE Slope	INTRCPT	SE Intrcpt	
	q		F	F					
1	-3.36	.458	.1371	.4112	.000E+00	.000E+00	-3.363	.173	
2	-7.31	.756	.0196	.4313	.000E+00	.000E+00	-7.306	.286	
3	-6.65	.643	.0312	.4112	.000E+00	.000E+00	-6.648	.243	
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)	Variance ratio			
.415		.334	.134E-01		.334	.002			

Table 6.12 VIRTUAL POPULATION ANALYSIS

PLAICE IN THE KATTEGAT (PART OF FISHING AREA IIIA)

FISHING MORTALITY COEFFICIENT	UNIT: Year-1											NATURAL MORTALITY COEFFICIENT = .10
	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	.00	.00	.00	.00	.00	.06	.00	.00	.00	.00	.00	.00
2	.07	.02	.09	.02	.08	.19	.16	.18	.11	.07	.01	.06
3	.73	.37	.26	.27	1.01	.63	.89	.61	.37	.37	.28	.34
4	1.13	.94	.42	1.03	1.34	.82	.87	.90	.31	.54	1.11	1.02
5	.70	.98	.72	1.74	1.11	.80	.88	.62	.94	.71	1.35	1.02
6	.40	.47	.62	1.18	.53	.71	.58	.58	.50	.71	.66	.98
7	.33	.23	.83	.63	.31	.44	.65	.45	.40	.48	.34	.74
8	.29	.30	.44	.54	.40	.45	.50	.65	.37	.74	.16	.23
9	.33	.48	.66	.77	.41	.10	.55	.39	.29	.69	.25	.32
10	.43	.85	.94	1.26	.38	.07	.58	1.31	.30	.81	.19	.38
11	.35	.55	.68	.86	.39	.21	.54	.78	.32	.75	.20	.31
12+	.35	.55	.68	.86	.39	.21	.54	.78	.32	.75	.20	.31
( 3- 9)U	.56	.54	.56	.88	.73	.56	.70	.60	.45	.60	.59	.67
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1983-87		
1	.00	.00	.00	.00	.00	.00	.00	.00	.00 <sup>16</sup>	.00		
2	.04	.03	.05	.09	.09	.09	.04	.13	.019	.09		
3	.26	.34	.27	.63	.38	.48	.21	.41	.33	.42		
4	.69	.77	.66	.90	.81	.64	.45	.66	.57	.69		
5	.93	.68	.73	.62	.57	.23	.70	.51	.41	.53		
6	.85	.41	.42	.44	.53	.12	.53	.29	.27	.38		
7	.77	.31	.23	.38	.84	.18	.25	.16	.23	.36		
8	.41	.69	.16	.35	.96	.37	.19	.26	.29	.43		
9	.43	.62	.44	.32	1.07	.27	.23	.29	.29	.44		
10	.36	.56	.18	.75	.80	.47	.18	.56	.42	.55		
11	.40	.63	.26	.47	.94	.37	.20	.37	.33	.47		
12+	.40	.63	.26	.47	.94	.37	.20	.37	.33	.47		
( 3- 9)U	.62	.55	.42	.52	.74	.33	.37	.37	.34			

Table 6.13 VIRTUAL POPULATION ANALYSIS

PLAICE IN THE KATTEGAT (PART OF FISHING AREA IIIA)

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	67961	48453	44301	17156	56789	25713	54525	94506	54379	28678	17188	8517
2	56797	61493	43841	40084	15523	51384	21869	49289	85379	49195	25939	15551
3	41139	47791	54519	36192	35623	12981	38340	16844	37118	69031	41349	23331
4	16247	18019	29906	38107	24978	11685	6232	14274	8306	23134	43360	28226
5	4729	4742	6387	17812	12258	5933	4661	2363	5233	5524	12195	12979
6	2512	2123	1612	2811	2827	3638	2412	1744	1154	1848	2465	2866
7	1854	1525	1202	787	783	1508	1619	1217	887	636	821	1149
8	1086	1203	1095	473	381	519	881	765	703	538	358	528
9	672	736	804	640	249	231	299	485	361	440	231	277
10	210	438	410	378	267	149	190	157	296	244	200	164
11	4	124	169	145	97	166	125	96	38	198	98	149
12+	177	247	297	72	195	166	351	19	50	376	231	63
TOTAL NO	193389	186894	184543	154658	149970	114073	131503	181759	193906	179841	144436	93800
SPS NO	68630	76948	96401	97417	77658	36976	55109	37964	54147	101969	101310	69732
TOT.BIOM	46982	47207	47678	42506	37327	29211	32080	40695	46667	46996	36886	24644
SPS BIOM	21219	23736	29228	29746	23560	12199	17169	12085	16349	29994	27483	20200
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989		
1	7378	14388	19515	18593	17296	10728	6184	4257	1972	0		
2	7671	6675	13017	17639	16772	15644	9701	5588	3852	1781		
3	13255	6655	5858	11257	14540	13909	12906	8406	4426	3420		
4	14982	9285	4299	4043	5429	8978	7800	9491	5060	2879		
5	9198	6769	3909	2012	1489	2192	4283	4515	4446	2589		
6	4216	3270	3101	1708	980	761	1572	1917	2459	2670		
7	976	1633	1958	1848	992	522	609	836	1302	1699		
8	495	409	1084	1411	1141	388	397	428	645	936		
9	378	297	185	831	896	396	242	298	300	437		
10	182	222	145	108	548	277	273	173	202	203		
11	102	114	114	109	46	224	156	207	89	120		
12+	54	87	41	198	120	241	127	203	242	216		
TOTAL NO	58887	49805	53227	59758	60249	54259	44250	36318	24995			
SPS NO	43837	28742	20696	23526	26181	27887	28365	26473	19171			
TOT.BIOM	16756	14206	17037	18265	17214	16310	13380	13135	8871			
SPS BIOM	13853	10081	8448	8125	8336	9171	9529	10272	7322			

Table 6.14 ,

List of input variables for the ICES prediction program.

PLAICE IN THE KATTEGAT

The reference F is the mean F for the age group range from 3 to 9

The number of recruits per year is as follows:

Year	Recruitment
1989	13400.0
1990	13400.0
1991	13400.0

Data are printed in the following units:

Number of fish: thousands  
 Weight by age group in the catch: kilogram  
 Weight by age group in the stock: kilogram  
 Stock biomass: tonnes  
 Catch weight: tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	13400.0	.00	.10	.00	.267	.267
2	1781.0	.02	.10	.00	.266	.266
3	3420.0	.33	.10	1.00	.293	.293
4	2879.0	.57	.10	1.00	.314	.314
5	2589.0	.41	.10	1.00	.373	.373
6	2670.0	.27	.10	1.00	.473	.473
7	1699.0	.23	.10	1.00	.562	.562
8	936.0	.29	.10	1.00	.704	.704
9	437.0	.29	.10	1.00	.745	.745
10	203.0	.42	.10	1.00	.860	.860
11	120.0	.33	.10	1.00	1.001	1.001
12+	216.0	.33	.10	1.00	1.003	1.003



Table 6.15

Effects of different levels of fishing mortality on catch, stock biomass and spawning stock biomass.

PLAICE IN THE KATTEGAT

Year 1989					Year 1990					Year 1991		
fac- tor	ref. F	stock biomass	sp.stock biomass	catch	fac- tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass	
1.0	.34	10538	6582	1824	.0	.00	12206	5408	0	15697	8893	
					.1	.03			176	15502	8599	
					.2	.07			346	15315	8512	
					.4	.14			670	14959	8157	
					.6	.20			971	14627	7827	
					.8	.27			1253	14318	7518	
					1.0	.34			1517	14029	7230	
					1.2	.41			1764	13759	6962	
					1.4	.48			1995	13507	6711	
					1.6	.55			2211	13271	6476	
					1.8	.61			2414	13050	6256	
					2.0	.68			2604	12843	6050	

The data unit of the biomass and the catch is tonnes.  
 The spawning stock biomass is given for 1 January.  
 The reference F is the mean F for the age group range from 3 to 9

Table 6.16

## Results

14.26.41 08 MARCH 1989  
PLAICE IN KATTEGAT

\* Year 1989. F-factor 1.000 and reference F .3414 \*

								-----+-----	
								at 1 January	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass		
1	.0016	20.39	5.45	13400.0	3582.3	.0	.00		
2	.0190	31.90	8.48	1781.0	473.2	.0	.00		
3	.3300	917.29	268.46	3420.0	1000.9	3420.0	1000.92		
4	.5700	1195.97	375.54	2879.0	904.0	2879.0	904.01		
5	.4100	831.51	309.88	2589.0	964.8	2589.0	964.83		
6	.2700	602.57	284.81	2670.0	1262.0	2670.0	1262.02		
7	.2300	332.84	186.94	1699.0	954.3	1699.0	954.27		
8	.2900	224.77	158.31	936.0	659.3	936.0	659.26		
9	.2900	104.94	78.18	437.0	325.6	437.0	325.57		
10	.4200	66.48	57.20	203.0	174.6	203.0	174.65		
11	.3300	32.19	32.22	120.0	120.1	120.0	120.12		
12+	.3300	57.93	58.11	216.0	216.6	216.0	216.65		
Total		4418.78	1823.57	30350.0	10637.7	15169.0	6582.29		

\* Year 1990. F-factor 1.000 and reference F .3414 \*

								-----+-----	
								at 1 January	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass		
1	.0016	20.39	5.45	13400.0	3582.3	.0	.00		
2	.0190	216.85	57.61	12105.4	3216.0	.0	.00		
3	.3300	424.10	124.12	1581.2	462.8	1581.2	462.76		
4	.5700	924.18	290.19	2224.7	698.6	2224.7	698.57		
5	.4100	473.15	176.33	1473.2	549.0	1473.2	549.02		
6	.2700	350.86	165.84	1554.7	734.8	1554.7	734.85		
7	.2300	361.29	202.93	1844.3	1035.9	1844.3	1035.86		
8	.2900	293.32	206.59	1221.5	860.3	1221.5	860.31		
9	.2900	152.18	113.37	633.7	472.1	633.7	472.13		
10	.4200	96.90	83.37	295.9	254.6	295.9	254.55		
11	.3300	32.37	32.40	120.7	120.8	120.7	120.81		
12+	.3300	58.62	58.80	218.6	219.2	218.6	219.23		
Total		3404.21	1517.00	36673.8	12206.3	11168.4	5408.07		

cont'd.

Table 6.16 cont'd.

\* Year 1991, F-factor 1.000 and reference F .3414 \*

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January	
						sp.stock size	sp.stock biomass
1	.0016	20.39	5.45	13400.0	3582.3	.0	.00
2	.0190	216.85	57.61	12105.4	3216.0	.0	.00
3	.3300	2882.58	843.63	10747.3	3145.4	10747.3	3145.38
4	.5700	427.28	134.17	1028.6	323.0	1028.6	322.97
5	.4100	365.63	136.26	1138.4	424.3	1138.4	424.25
6	.2700	199.65	94.37	884.7	418.1	884.7	418.15
7	.2300	210.37	118.16	1073.9	603.2	1073.9	603.16
8	.2900	318.39	224.26	1325.9	933.9	1325.9	933.86
9	.2900	198.59	147.95	827.0	616.1	827.0	616.11
10	.4200	140.52	120.89	429.1	369.1	429.1	369.14
11	.3300	47.18	47.23	175.9	176.1	175.9	176.08
12+	.3300	59.19	59.37	220.7	221.4	220.7	221.35
Total		5086.62	1989.34	43356.8	14028.7	17851.4	7230.45

Table 6.17 VIRTUAL POPULATION ANALYSIS

PLAICE IN THE SKAGERRAK (PART OF FISHING AREA IIIA)

CATCH IN NUMBERS	UNIT: thousands										
-----	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
2	356	246	62	2212	4	87	1024	179	5	20	39
3	6443	3327	1937	8354	842	6192	10207	4803	2939	2242	2286
4	12771	12331	9242	7800	7667	8053	11657	22545	16708	10924	11995
5	16928	12828	7272	3269	9184	8959	4784	7317	24263	20156	14825
6	7090	5933	3748	1003	4814	2643	1997	2053	5806	12112	7564
7	410	1939	1902	346	1561	493	441	787	743	2449	2989
8	16	65	794	80	638	189	90	195	282	360	955
9	17	2	77	28	253	66	31	146	111	206	302
10	16	1	1	6	95	33	15	91	107	77	89
11+	5	1	1	0	16	2	12	33	47	68	88
TOTAL	44052	36673	25036	23098	25074	26717	30258	38149	51011	48614	41132

Table 6.18 VIRTUAL POPULATION ANALYSIS

PLAICE IN THE SKAGERRAK (PART OF FISHING AREA IIIA)

MEAN WEIGHT AT AGE OF THE STOCK

UNIT: kilogram

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
2	.238	.228	.253	.220	.253	.278	.261	.212	.395	.205	.220
3	.261	.249	.270	.258	.270	.263	.290	.290	.258	.247	.251
4	.285	.256	.310	.300	.275	.291	.306	.306	.280	.271	.261
5	.333	.294	.370	.360	.309	.357	.380	.349	.317	.297	.285
6	.410	.388	.450	.430	.375	.433	.442	.435	.396	.370	.343
7	.531	.451	.600	.540	.535	.592	.571	.552	.551	.533	.466
8	.668	.664	.648	.660	.703	.705	.836	.759	.695	.734	.551
9	.869	.983	.856	.850	.789	.900	1.084	.876	.877	.930	.746
10	1.107	1.732	.856	.950	.891	.933	1.256	.929	.905	1.152	.911
11+	.995	1.283	.856	1.000	.840	1.420	1.522	1.229	1.099	1.141	1.313

Table 6.19 Tuning output for plaice in the Skagerrak.

VPA Version 2.1 - May 1988

Module run at 10.22.14 01 MARCH 1989

DISAGGREGATED Qs

LOG TRANSFORMATION

NO explanatory variate (Mean used)

Fleet 1 ,Danish seiners fleet, has terminal q estimated as the mean

Fleet 2 ,Swedish Nephth. fleet, has terminal q estimated as the mean

Fleet 3 ,Swedish Cod fleet 3, has terminal q estimated as the mean

FLEETS COMBINED BY \*\* VARIANCE \*\*

Regression weights

, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,

Oldest age F = 1.000\*average of 3 younger ages. Fleets combined by variance of predictions

Fishing mortalities

Age,	83,	84,	85,	86,	87,	88,
2,	.001,	.015,	.004,	.000,	.001,	.002,
3,	.155,	.121,	.080,	.071,	.068,	.114,
4,	.569,	.429,	.378,	.385,	.360,	.535,
5,	1.144,	.699,	.464,	.785,	.973,	1.039,
6,	1.198,	.752,	.655,	.728,	1.070,	1.146,
7,	.553,	.561,	.671,	.462,	.692,	.742,
8,	.469,	.162,	.458,	.476,	.378,	.564,
9,	.676,	.115,	.378,	.455,	.677,	.555,
10,	.566,	.279,	.502,	.465,	.583,	.620,

Log catchability estimates

Age 2 Fleet,	83,	84,	85,	86,	87,	88
1,	-9.66,	-9.41,	-8.84,	-13.23,	-10.28,	-9.36
2,	-15.06,	-12.73,	-13.74,	-16.70,	-16.56,	-15.03
3,	-15.54,	-11.97,	-13.45,	-14.88,	-14.64,	-14.64

SUMMARY STATISTICS

Fleet,	Pred.	SE(q)	Partial,	Raised,	SLOPE	SE	INTRCPT,	SE
, q	, F	, F	, F	, F	, Slope	, Slope	, Intrcpt	, Intrcpt
1,	-10.13	1.718	.0005	.0009	.000E+00,	.000E+00,	-10.129,	.650
2,	-14.97	1.677	.0001	.0021	.000E+00,	.000E+00,	-14.971,	.634
3,	-14.19	1.382	.0000	.0031	.000E+00,	.000E+00,	-14.186,	.523
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.002	.906	.357	.906	.155				

Age 3 Fleet,	83,	84,	85,	86,	87,	88
1,	-4.50,	-7.30,	-5.76,	-5.02,	-5.89,	-5.31
2,	-10.13,	-10.64,	-10.82,	-11.68,	-11.96,	-11.23
3,	-9.89,	-9.76,	-10.69,	-11.28,	-11.43,	-10.73

cont'd

Age 3						
Fleet,	83,	84,	85,	86,	87,	88
1,	-4.50,	-7.30,	-5.76,	-5.82,	-5.89,	-5.31
2,	-10.13,	-10.64,	-10.82,	-11.68,	-11.96,	-11.23
3,	-9.85,	-9.76,	-10.69,	-11.28,	-11.43,	-10.73

cont'd

Table 6.19 cont'd.

Fleet	Pred. q	SUMMARY STATISTICS			SLOPE	SE Slope	INTRCPT	SE Intrcpt
		SE(q)	Partial F	Raised F				
1	-5.77	.989	.0382	.0724	.000E+00	.000E+00	-5.765	.374
2	-11.08	.736	.0026	.1330	.000E+00	.000E+00	-11.076	.278
3	-10.62	.754	.0006	.1272	.000E+00	.000E+00	-10.623	.285
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)	Variance ratio		
	.114	.465	.173		.465	.138		

Age 4						
Fleet,	83,	84,	85,	86,	87,	88
1,	-3.20,	-6.04,	-4.23,	-4.13,	-4.23,	-3.76
2,	-8.83,	-9.38,	-9.26,	-10.01,	-10.29,	-9.68
3,	-8.56,	-8.50,	-9.13,	-9.54,	-9.99,	-9.21

Fleet	Pred. q	SUMMARY STATISTICS			SLOPE	SE Slope	INTRCPT	SE Intrcpt
		SE(q)	Partial F	Raised F				
1	-4.26	1.030	.1716	.3248	.000E+00	.000E+00	-4.264	.389
2	-9.57	.571	.0118	.5922	.000E+00	.000E+00	-9.575	.216
3	-9.15	.620	.0024	.5679	.000E+00	.000E+00	-9.155	.234
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)	Variance ratio		
	.535	.389	.144		.389	.138		

Age 5						
Fleet,	83,	84,	85,	86,	87,	88
1,	-2.50,	-5.55,	-4.02,	-3.41,	-3.23,	-3.10
2,	-8.14,	-8.89,	-9.05,	-9.29,	-9.30,	-9.01
3,	-7.85,	-8.01,	-8.92,	-8.83,	-8.98,	-8.55

cont'd.

Table 6.19 cont'd.

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
, q	, F	, F	, F	, F	, Slope	, Slope	, Intrcpt	, Intrcpt
1	-3.64	1.142	.3215	.6084	.000E+00	.000E+00	-3.636	.432
2	-8.95	.462	.0220	1.1078	.000E+00	.000E+00	-8.946	.175
3	-8.52	.524	.0045	1.0698	.000E+00	.000E+00	-8.522	.198
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
1.039	.332	.115	.332	.121				

Age 6

Fleet	83	84	85	86	87	88
1	-2.41	-5.47	-3.68	-3.49	-3.14	-3.00
2	-8.09	-8.82	-8.70	-9.37	-9.20	-8.91
3	-7.83	-7.94	-8.54	-8.88	-8.90	-8.46

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
, q	, F	, F	, F	, F	, Slope	, Slope	, Intrcpt	, Intrcpt
1	-3.53	1.133	.3570	.6754	.000E+00	.000E+00	-3.531	.428
2	-8.85	.485	.0243	1.2231	.000E+00	.000E+00	-8.850	.183
3	-8.42	.492	.0050	1.1843	.000E+00	.000E+00	-8.425	.186
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
1.146	.330	.114	.330	.120				

Age 7

Fleet	83	84	85	86	87	88
1	-3.23	-5.77	-3.65	-3.95	-3.57	-3.44
2	-8.85	-9.11	-8.66	-9.85	-9.63	-9.35
3	-8.53	-8.33	-8.65	-9.42	-9.35	-8.87

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT	SE
, q	, F	, F	, F	, F	, Slope	, Slope	, Intrcpt	, Intrcpt
1	-3.93	1.004	.2387	.4516	.000E+00	.000E+00	-3.934	.380
2	-9.24	.492	.0164	.8296	.000E+00	.000E+00	-9.243	.186
3	-8.86	.477	.0032	.7464	.000E+00	.000E+00	-8.859	.180
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.742	.324	.125	.324	.148				

Age 8

Fleet	83	84	85	86	87	88
1	-3.39	-7.03	-4.04	-3.91	-4.18	-3.71
2	-9.16	-10.15	-9.03	-9.83	-10.14	-9.62
3	-8.43	-9.08	-8.74	-9.11	-9.83	-9.18

cont'd.



Table 6.19 cont'd.

Fleet	SUMMARY STATISTICS				SLOPE	SE Slope	INTRCPT	SE Intrcpt
	Pred. q	SE(q)	Partial F	Raised, F				
1	-4.38	1.435	.1533	.2900	.000E+00	.000E+00	-4.376	.543
2	-9.66	.517	.0108	.5448	.000E+00	.000E+00	-9.656	.195
3	-9.06	.507	.0026	.6324	.000E+00	.000E+00	-9.062	.192
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)	Variance ratio		
.563		.351	.129		.351			.135

Age 9

Fleet	83	84	85	86	87	88
1	-3.02	-7.33	-4.23	-3.94	-3.60	-3.73
2	-8.84	-10.12	-9.22	-10.04	-9.51	-9.64
3	-8.62	-9.97	-8.64	-9.84	-10.30	-9.43

Fleet	SUMMARY STATISTICS				SLOPE	SE Slope	INTRCPT	SE Intrcpt
	Pred. q	SE(q)	Partial F	Raised, F				
1	-4.31	1.660	.1640	.3096	.000E+00	.000E+00	-4.309	.627
2	-9.56	.526	.0119	.5989	.000E+00	.000E+00	-9.562	.199
3	-9.47	.759	.0018	.5343	.000E+00	.000E+00	-9.466	.287
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)	Variance ratio		
.555		.418	.113		.418			.074

Table 6.20 VIRTUAL POPULATION ANALYSIS

PLAICE IN THE SKAGERRAK (PART OF FISHING AREA IIIA)

FISHING MORTALITY COEFFICIENT      UNIT: Year-1      NATURAL MORTALITY COEFFICIENT = .10

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1982-86
2	.01	.01	.00	.09	.00	.00	.01	.00	.00	.00	.00	.00
3	.21	.14	.08	.29	.04	.16	.12	.08	.07	.07	.11	.09
4	.49	.70	.61	.43	.43	.57	.43	.38	.38	.36	.53	.44
5	1.02	1.19	1.09	.40	1.16	1.14	.70	.46	.79	.97	1.04	.85
6	1.14	1.18	1.33	.36	1.55	1.20	.75	.65	.73	1.07	1.15	.98
7	1.10	1.03	1.57	.34	1.33	.55	.56	.67	.46	.69	.74	.72
8	1.65	.44	1.68	.20	1.66	.47	.16	.46	.48	.38	.56	.65
9	2.23	.88	1.24	.19	1.38	.68	.12	.38	.46	.68	.55	.60
10	1.66	.78	1.50	.24	1.47	.57	.28	.50	.46	.58	.62	.66
11+	1.66	.78	1.50	.24	1.47	.57	.28	.50	.46	.58	.62	.66
( 3- 9)U	1.12	.79	1.08	.31	1.08	.68	.41	.44	.48	.60	.67	

Table 6.21 VIRTUAL POPULATION ANALYSIS

PLAICE IN THE SKAGERRAK (PART OF FISHING AREA IIIA)

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	30112	31263	38026	26999	49925	103626	73612	49854	39616	24582	21023	0
3	34958	26908	28054	34348	22328	45170	93682	65634	44940	35841	22223	18986
4	34587	25516	21188	23544	23156	19403	34992	75071	54824	37870	30300	17937
5	27512	19202	11431	10428	13913	13688	9935	20617	46558	33771	23911	16061
6	10851	8933	5295	3490	6338	3939	3946	4467	11725	19206	11544	7658
7	640	3139	2495	1265	2207	1214	1075	1683	2101	5121	5962	3320
8	21	193	1012	472	817	528	632	555	779	1197	2319	2570
9	20	4	113	171	351	140	299	486	318	438	742	1194
10	20	2	1	30	128	80	65	241	301	182	201	385
11+	6	2	1	0	22	5	52	87	132	161	199	195
TOTAL NO	138728	115162	107617	100747	119184	187792	218289	218697	201293	158370	118424	
SPS NO	108615	83899	69591	73748	69259	84167	144676	168843	161678	133788	97401	
TOT. BIOM	40158	31025	32628	28288	33867	54225	64233	63821	64391	45700	33940	
SPS BIOM	32992	23897	23007	22348	21236	25417	45020	53252	48743	40661	29315	

Table 7.1 Catches (tonnes) of SOLE from Division IIIa.

Year	Denmark	Sweden	Fed.Rep.of Germany	Netherlands	Belgium	Others	Total
1952	156	51	59	-	-	-	266
1953	159	48	42	-	-	-	249
1954	177	43	34	-	-	-	254
1955	152	36	35	-	-	-	223
1956	168	30	57	-	-	-	255
1957	265	29	53	-	-	-	347
1958	226	35	56	-	-	-	317
1959	222	30	44	-	-	-	296
1960	294	24	83	-	-	-	401
1961	339	30	61	-	-	-	430
1962	356	-	58	-	-	-	414
1963	338	-	27	-	-	-	365
1964	376	-	45	-	-	-	421
1965	324	-	50	-	-	-	374
1966	312	-	20	-	-	-	332
1967	429	-	26	-	-	-	455
1968	290	-	16	-	-	11	317
1969	261	-	7	-	-	-	268
1970	183	-	-	-	-	-	183
1971	288	-	9	-	-	-	297
1972	376	-	12	-	-	-	388
1973	327	-	13	-	-	-	340
1974	449	-	9	-	-	-	458
1975	458	16	16	9	-	-	498
1976	422	11	21	155	2	-	611
1977	517	13	8	276	1	-	815
1978	502	9	9	141	-	-	661
1979	376	8	6	84	1	-	475
1980	316	9	12	5	2	-	344
1981	271	7	16	-	1	-	295
1982	210	4	8	1	1	-	224
1983	262	11	15	31	-	-	319
1984	326	13	13	54	-	-	406
1985	396	19	1	132	+	-	548
1986	645	26	1	109	2	-	783
1987 <sup>1</sup>	623	19	-	70	2	-	714
1988 <sup>1</sup>	550	24	-	78	-	-	652

<sup>1</sup> Preliminary.  
Data from Bull. Stat.

Table 7.2 SOLE in Division IIIa. Catch-at-age data (thousands).

Age	1984	1985	1986	1987	1988
1	-	2	-	-	4
2	79	1,140	323	386	65
3	791	861	1,576	847	959
4	297	275	843	1,006	1,097
5	145	80	264	429	525
6	38	87	42	172	146
7	41	23	45	63	75
8	50	11	42	31	20
9	104	42	37	6	8
10	74	44	23	17	13
11	10	6	10	16	14
12	8	4	-	10	7
13	12	4	5	14	9
14	3	-	-	5	-
15	3	-	5	18	10
Total	1,655	2,579	3,134	3,020	2,592
Catch (t)	406	548	783	714	652

Table 7.3 SOLE in Division IIIa. Weight at age (grammes). Sexes combined.

Age	1984	1985	1986	1987	1988
1	-	112	-	-	139
2	183	174	165	160	144
3	213	234	231	194	184
4	257	283	287	245	218
5	294	291	257	274	248
6	297	335	409	319	274
7	380	292	267	360	354
8	321	279	262	417	387
9	323	320	365	357	338
10	365	357	369	311	300
11	415	316	266	377	282
12	412	345	-	405	429
13	412	-	661	357	599
14	299	-	-	531	-
15+	-	-	463	438	350

Table 7.4 SOLE in Division IIIa.  
Relative importance (%) of the age groups in weight.

Age	1984	1985	1986	1987	1988
1	-	-	-	-	0.1
2	8.3	15.9	6.6	8.7	1.4
3	30.3	32.4	45.1	23.1	27.1
4	14.6	20.9	29.9	34.7	36.7
5	13.1	6.4	9.7	16.5	20.0
6	3.1	9.6	2.1	7.7	6.1
7	2.4	1.8	1.5	3.2	4.1
8	5.9	1.7	1.4	1.8	1.2
9	9.2	3.1	1.7	0.3	0.4
10	5.8	5.1	1.0	0.8	0.6
11	1.3	2.0	0.3	0.9	0.6
12+	5.9	1.0	0.7	0.6	0.5
Total	100.0	100.0	100.0	98.3	98.8

Table 7.5 SOLE in Division IIIa.  
Recruitment index. Danish  
flatfish survey in  
Division IIIa.

Survey year (t)	Year class (t-1)	Recruitment index
1960	1959	4.05
1961	1960	0.18
1962	1961	0.12
1963	1962	0.85
1964	1963	0.97
1965	1964	0.49
1966	1965	0.28
1967	1966	0.43
1968	1967	0.48
1969	1968	0.55
1970	1969	2.26
1971	1970	0.41
1972	1971	1.54
1973	1972	1.96
1980	1979	3.19
1984	1983	8.19
1985	1984	18.25
1986	1985	1.73
1987	1986	2.12
1988	1987	8.17

Table 7.6 Sole in Division IIIa. SHOT forecast.

Year	Land-ings	Recrt. index	W'td index	Y/B ratio	Hang-over	Act'l Prod'n.	Est'd. Prod'n.	Est'd. SQC	Act'l expl. biomass	Est'd. expl. biomass
1978	661	380	-	0.40	0.60	-	-	-	1,653	-
1979	475	380	380	0.40	0.60	196	-	-	1,188	-
1980	344	380	380	0.40	0.60	148	-	-	860	-
1981	295	380	374	0.40	0.60	222	-	-	738	-
1982	224	319	350	0.40	0.60	118	174	247	560	617
1983	319	380	356	0.40	0.60	462	164	200	798	500
1984	406	380	380	0.40	0.60	537	236	286	1,015	719
1985	548	380	424	0.40	0.60	761	321	372	1,370	930
1986	783	819	744	0.40	0.60	1,136	687	604	1,958	1,509
1987	714	1,825	1,257	0.40	0.60	611	1,328	1,001	1,785	2,502
1988	652	173	838	0.40	0.60	-	755	731	-	1,826
1989	-	212	213	0.40	0.60	-	192	515	-	1,288
1990	-	380	313	0.40	0.60	-	282	422	-	-

Generic example

Running recruitment weights:

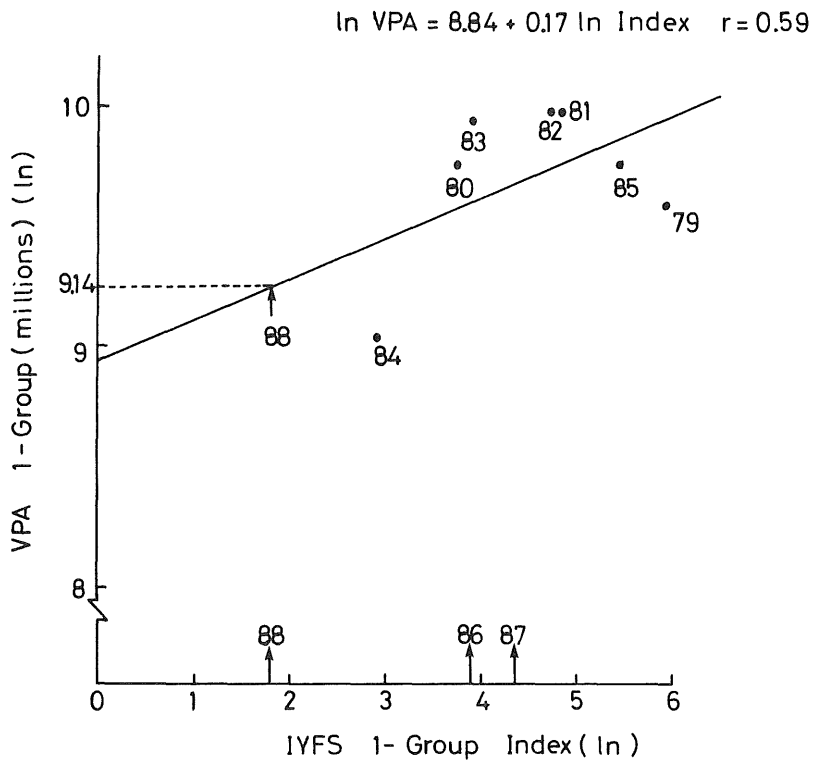
Older	0.40	G.M	=	0.00
Central	0.50	exp(d)		1.00
Younger	0.10	exp(d/2)		1.00

Table 8.1 Mean length (cm) of sole in the Kattegat in 1988 by age and quarter.

Age	Quarter				Total
	1	2	3	4	
1	-	24.550	-	-	25.500
2	23.071	24.393	24.500	24.500	24.082
3	24.603	26.815	26.792	16.169	26.137
4	26.211	29.852	32.344	26.750	27.924
5	27.582	30.660	28.848	28.050	28.482
6	30.250	31.750	28.773	28.631	29.476
7	31.667	31.500	28.833	32.643	32.151
8	28.500	34.500	-	34.000	33.147
9	29.500	31.500	33.500	33.500	32.357
10	35.500	34.500	-	31.250	32.227
11	30.000	29.929	-	31.500	30.333
12	37.167	30.500	30.500	-	33.833
13	31.500	-	-	41.000	38.625
14	-	-	-	-	-
15	-	-	-	35.500	35.500
16	-	-	-	-	-
17	-	-	-	-	-
18	-	-	-	31.500	31.500
<b>Total</b>	<b>26.407</b>	<b>28.782</b>	<b>29.925</b>	<b>27.191</b>	<b>27.685</b>



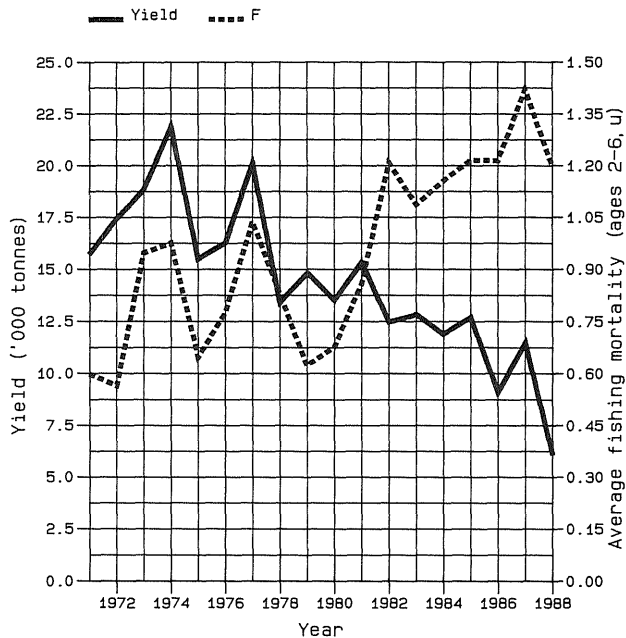
Figure 3.1 Cod - Kattegat. IYFS vs 1-group from the VPA.



FISH STOCK SUMMARY  
 STOCK: Cod in the Kattegat  
 08-03-1989

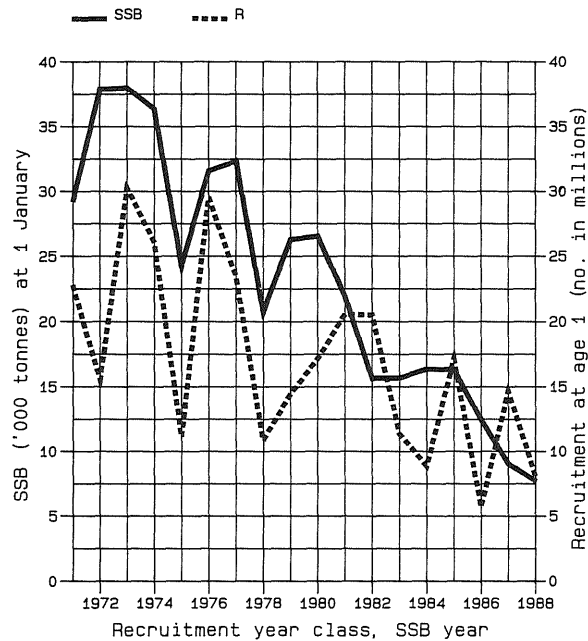
Figure 3.2

Trends in yield and fishing mortality (F)



A

Trends in spawning stock biomass (SSB) and recruitment (R)



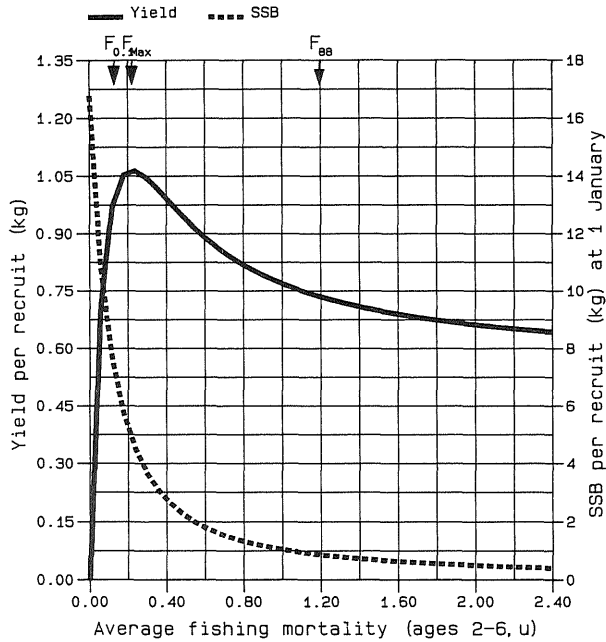
B

cont'd.

FISH STOCK SUMMARY  
 STOCK: Cod in the Kattegat  
 08-03-1989

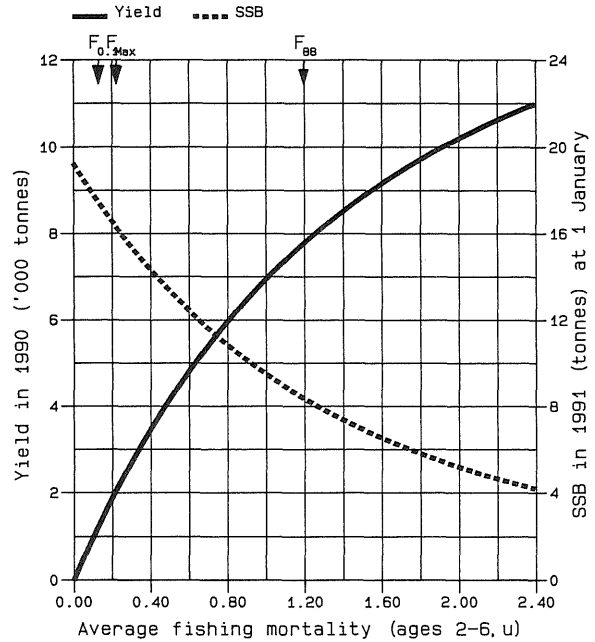
Figure 3.2 cont'd.

Long-term yield and spawning stock biomass



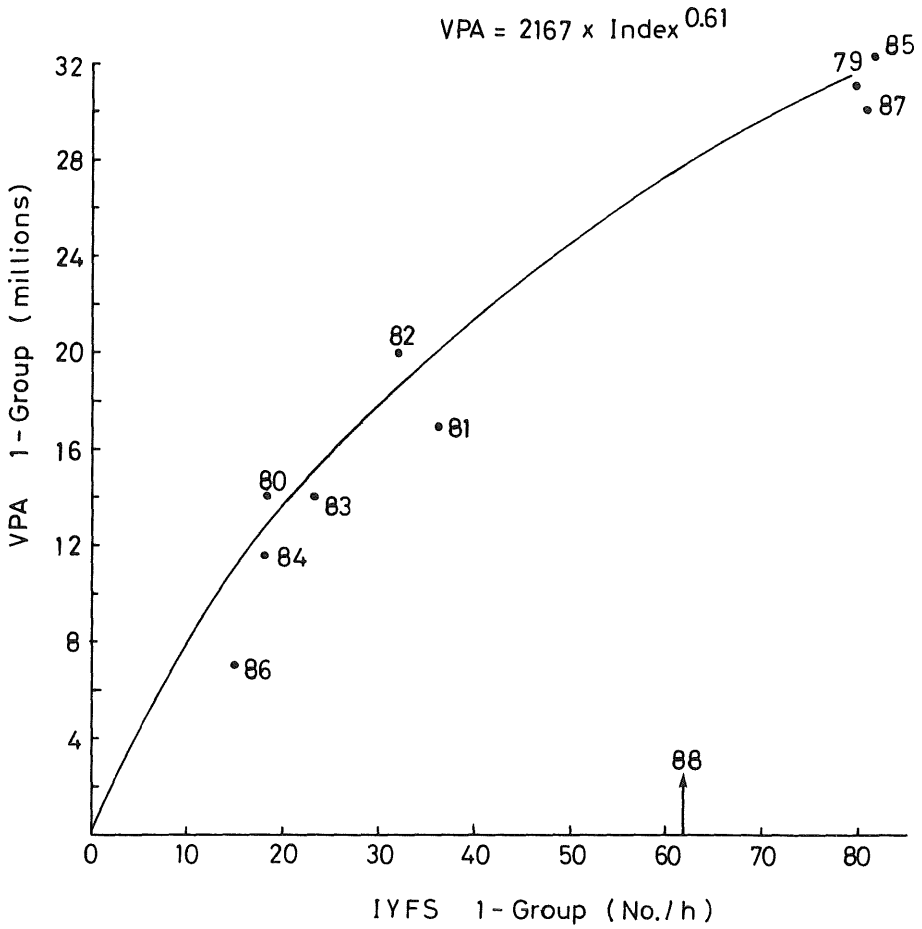
C

Short-term yield and spawning stock biomass



D

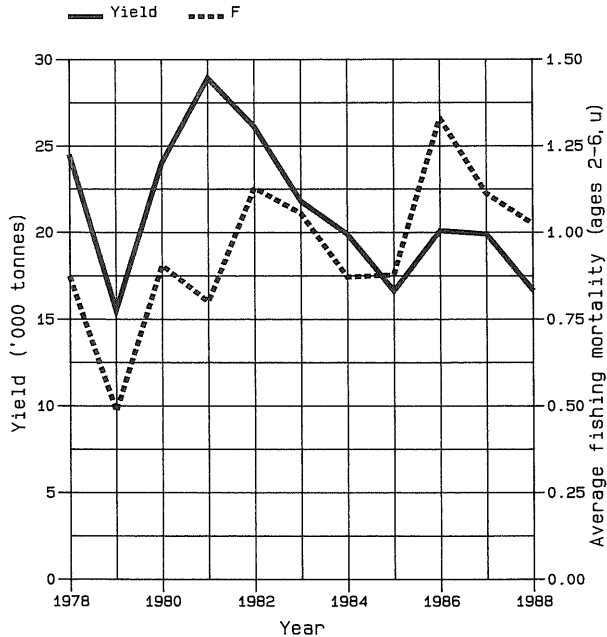
Figure 3.3 Cod - Skagerrak. The IYFS vs VPA 1-group.



**FISH STOCK SUMMARY**  
**STOCK: Cod in the Skagerrak**  
**08-03-1989**

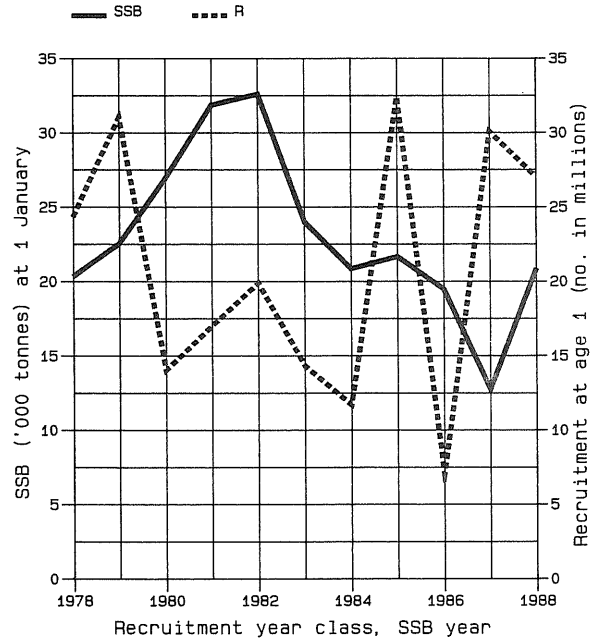
Figure 3.4

Trends in yield and fishing mortality (F)



A

Trends in spawning stock biomass (SSB) and recruitment (R)



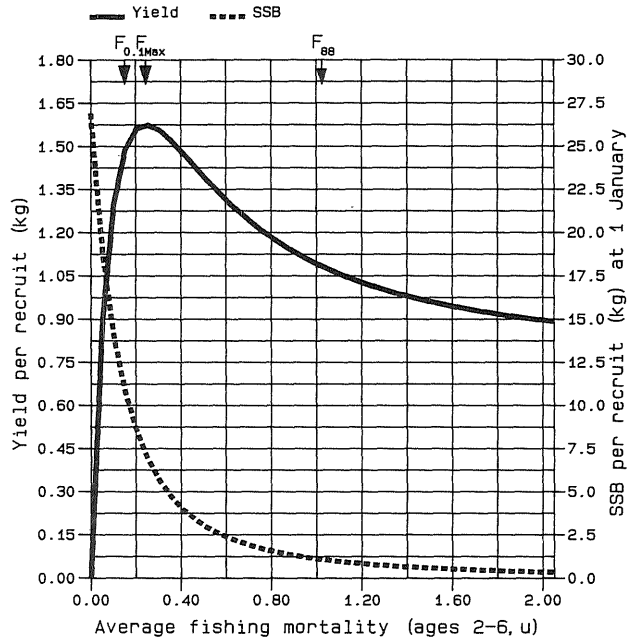
B

cont'd.

FISH STOCK SUMMARY  
 STOCK: Cod in the Skagerrak  
 08-03-1989

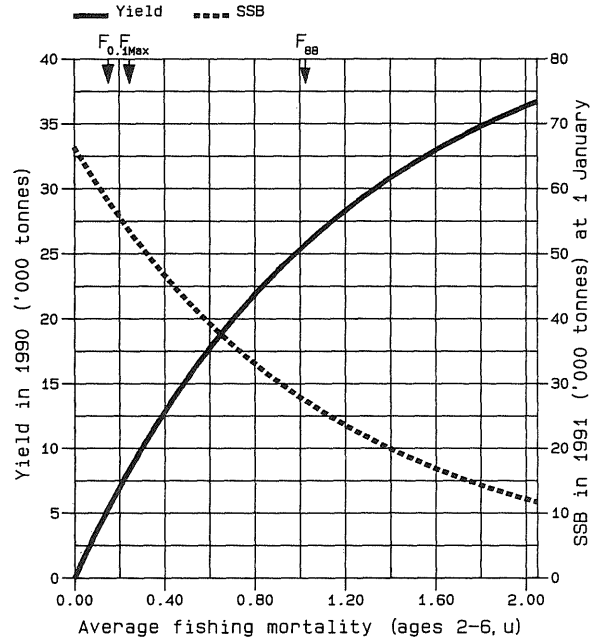
Figure 3.4 cont'd.

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

Figure 6.1 Plaice in the Kattegat. Plot of VPA 1-group vs young plaice survey.

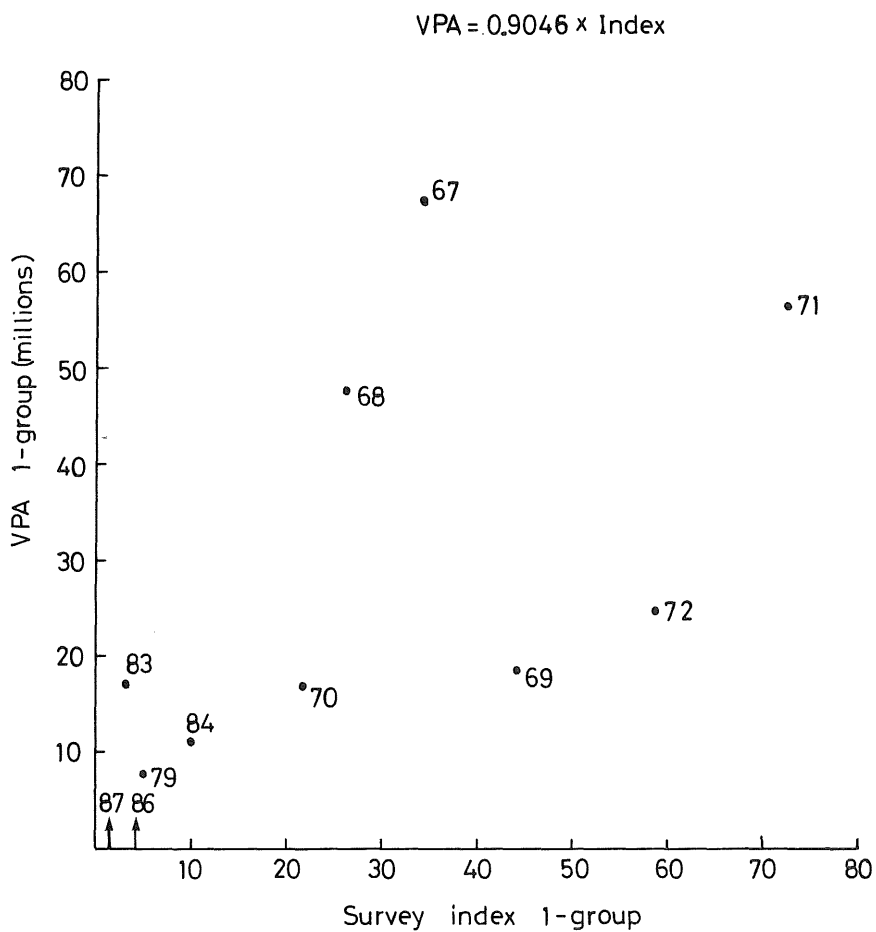
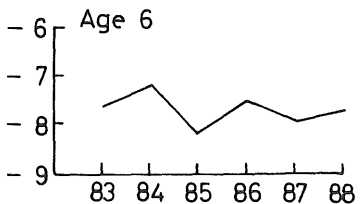
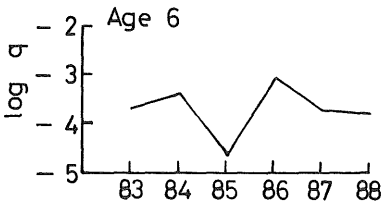
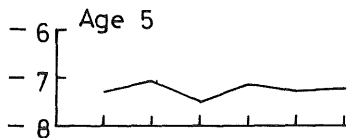
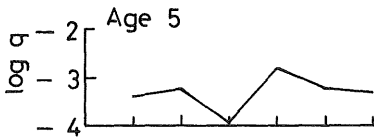
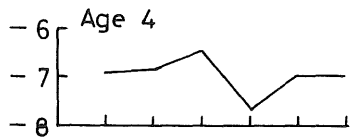
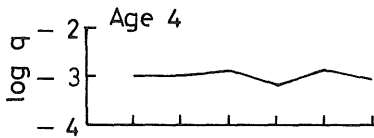
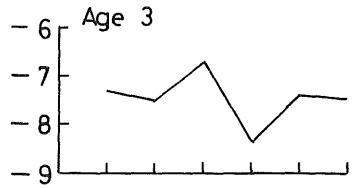
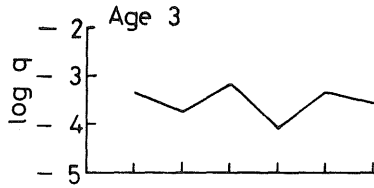


Figure 6.2 Plaice - Kattegat. The log q values vs year for age 3, 4, 5, and 6 for fleets 1 and 2.

Fleet 1  
DK Seiners

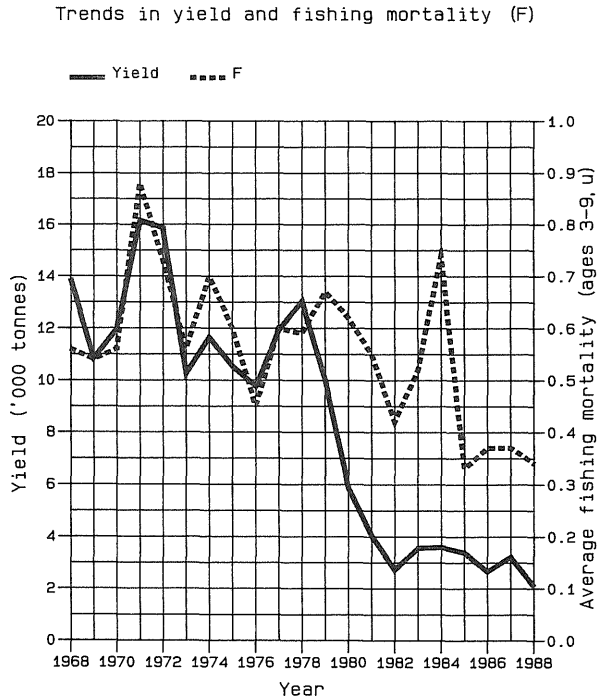
Fleet 2  
Nephrops



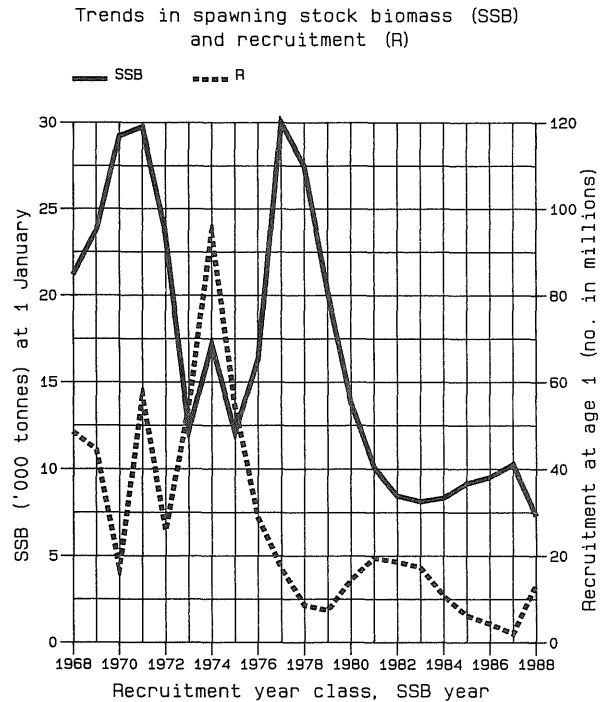


FISH STOCK SUMMARY  
 STOCK: Plaice in the Kattegat  
 08-03-1989

Figure 6.3



A



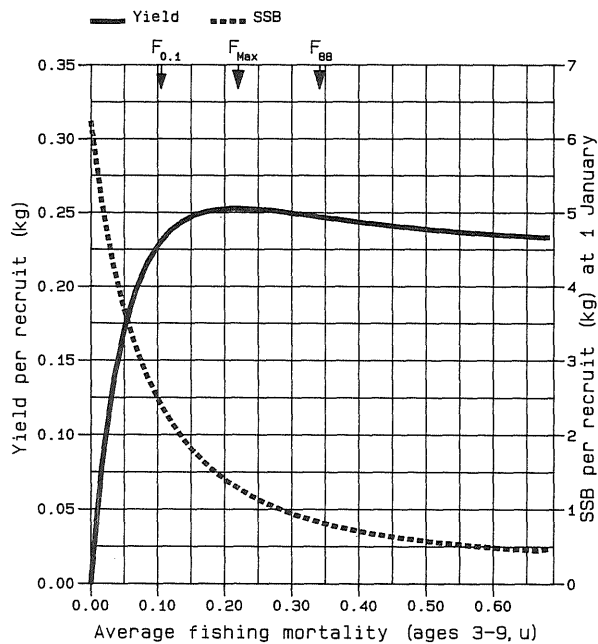
B

cont'd.

FISH STOCK SUMMARY  
 STOCK: Plaice in the Kattegat  
 08-03-1989

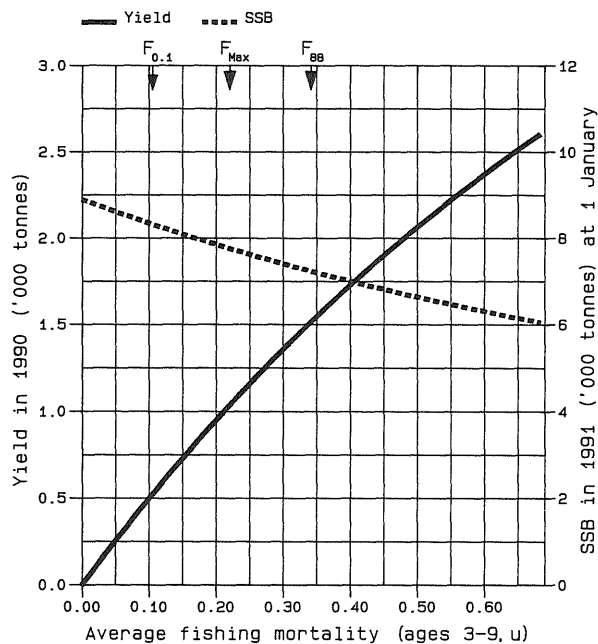
Figure 6.3 cont'd.

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

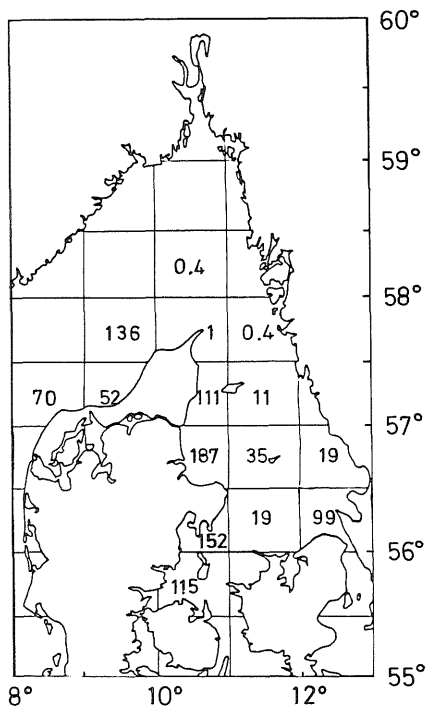


Figure 9.1 Mean numbers of cod larvae per 30 minutes in 2 m ring trawl (horizontal hauls) April-May 1923.

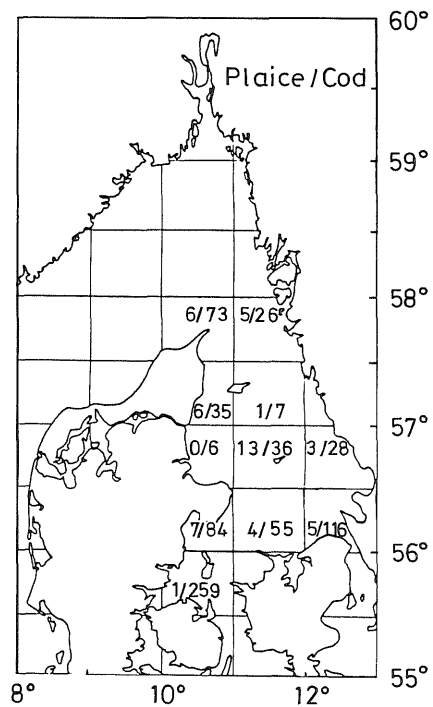


Figure 9.2 Mean numbers of plaice and cod per 20 minutes in ring trawl (horizontal hauls) March 1959.

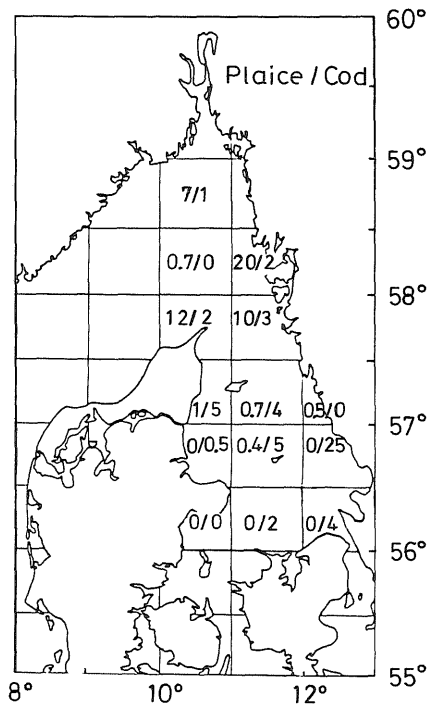


Figure 9.3 Mean numbers of plaice and cod below 1 m<sup>2</sup> April 1983.

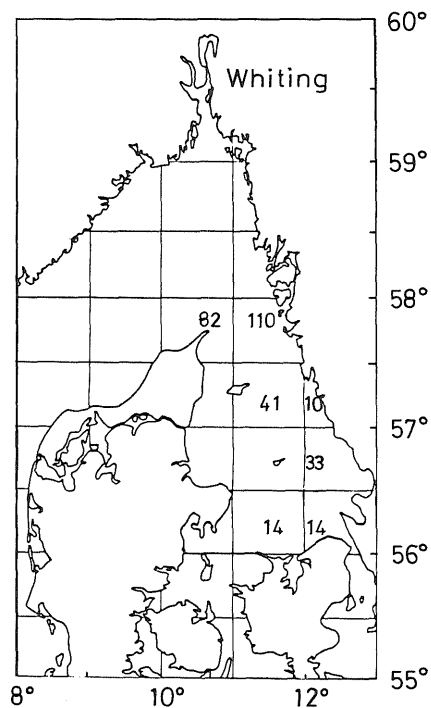


Figure 9.4 Mean numbers of whiting larvae per 20 minutes in 2 m ring trawl (horizontal hauls) June 1962.

3  
5  
r  
1

1

1



