INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA
CONSEIL INTERNATIONAL POUR L´EXPLORATION DE LA MER

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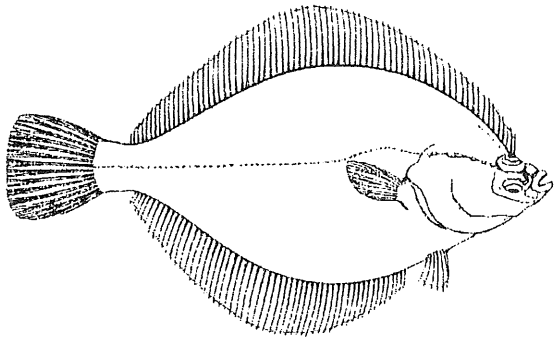
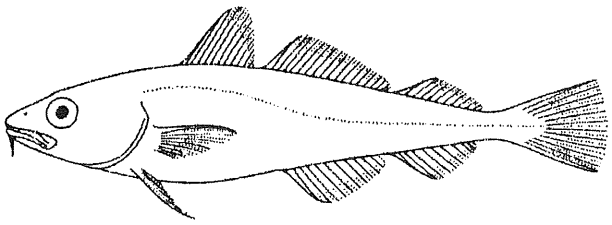
SKAGERRAK

ATTEGAT



Report of Division IIIa Demersal Stocks Working Group
Copenhagen, 25 February - 4 March 1991



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1 INTRODUCTION

1.1 Participation

O. Bagge	Denmark
D. Danielssen	Norway
E. Kirkegaard	Denmark
P.-O. Larsson	Sweden
K. Popp Madsen	Denmark
E. Nielsen (Chairman)	Denmark

1.2 Terms of Reference

At the Statutory Meeting in 1990, it was decided (C.Res.1990/2:5:3) that the Division IIIa Demersal Stocks Working Group will meet at ICES Headquarters from 25 February - 4 March 1991 to:

a) describe the activities of the fleets which catch cod, haddock, whiting, plaice, and sole, and provide catch and effort data disaggregated as far as possible by area, gear, and mesh size;

b) assess the status of and provide catch options for 1992 within safe biological limits for stocks of cod, haddock, whiting, plaice, and sole in Division IIIa.

Following a request from the Commission of the European Community to ICES, the Working Group was asked to reconsider the 1991 TAC advice for demersal stocks in Division IIIa and to provide scientific advice for the hake stock in the Kattegat and the Skagerrak.

The Working Group was also asked to discuss the proposal from ACFM concerning the rearrangement of ICES assessment working groups.

1.3 Research and Data Requirements

As mentioned in earlier Working Group reports, there is an obvious lack of basic biological information on several species in the area. At last year's meeting, the Working Group concluded that spawning areas and drift of eggs and larvae of gadoids in Division IIIa should be eluciated by a 5-year Nordic research programme to be initiated in 1991. A planning meeting for such a Nordic programme was held in Hirtshals in May 1990, and Denmark and Sweden will commence work at sea in March-May 1991.

Another point, which has been brought up repeatedly in earlier reports, is the generally low intensity of sampling of vital parameters for the assessments and the doubtful reliability of the catch statistics.

The biological sampling is deficient in two serious respects. The numbers of fish analysed are too low, especially as regards the older specimens. An example is sole where less than 300 specimens are sampled per quarter for length, weight and age despite the fact that the number of age groups exceeds 15. The samples of sole derive from a harbour in the south of the Kattegat and there is no basis for assuming that these data are also representative of the Skagerrak landings.

Another serious drawback is the lack of identification of samples with the fishing method or gear. This makes the use of tuning methods involving age

compositions very dubious and prevents any analysis of the respective contribution of different fishing methods to the resulting fishing pattern.

The catch figures are influenced by two factors, misreporting of landings and discarding at sea. Misreporting is liable to occur whenever very restrictive catch regulations are introduced, but the amount may depend upon the regulation applied. In this respect, a weekly or monthly boat quotum may, for example, increase the rate of misreporting more than a restriction on the number of days fishing. The former method can be more disruptive to assessments as it makes effort and CPUE data virtually useless.

The Working Group recommends:

a) sampling in Division IIIa be redesigned with special reference to increasing the reliability of the estimates for the older age groups and to describing age distributions aggregated by fishing methods, fleets and areas;

b) investigations should be initiated on the influence of different management methods upon the assessments;

c) discard estimates should be made based on surveys at sea.

1.4 Rearrangement of Working Groups

The Working Group discussed the proposal for rearrangement given by ACFM with special regard to the Division IIIa Demersal Stocks Working Group.

The Working Group found that a reallocation of responsibilities should take relevant factors into account in the following order of priority:

i) Stock units (management units)

ii) Biology (spawning and feeding areas, migration patterns)

iii) Fishery (especially mixed fisheries)

iv) Environmental features

v) Logistical problems (sampling, statistics)

As regards Division IIIa, the Working Group had the following comments to the points set out above:

ad (i) Although there are uncertainties as to stock allocation in the case of several species, the Working Group agreed that the following had more or less definite connections to, and resemblance with, the North Sea stocks: Cod in the Skagerrak and Northern Kattegat; hake, haddock and whiting in all of Division IIIa and plaice in the Skagerrak and Northern Kattegat.

The following have a closer affinity to the Western Baltic - Belt Seas stocks: Cod and plaice in the Southern part of the Kattegat.

Two stocks - Sole and Nephrops - are found in both areas of Division IIIa and probably do not have any important relations to either the North Sea or the areas south of the Kattegat.

Further information on stock identities is provided in some of the sections on assessments in this report.

ad (ii) As mentioned in Section 1.3 there is a severe lack of basic knowledge concerning several species in the area. In the time available for the meeting, no helpful information on this important point could be produced by the Working Group members. It is reasonable to assume, however, that neither hake nor haddock are self-contained stocks but are heavily, or totally, dependent on the inflow of spawning products from the North Sea.

ad (iii) A description of the fishing fleets is given in Section 2 below. In the present context, special attention should be given to the trawl fishery for Nephrops and sole in which both may be alternately target and by-catch species.

ad (iv) The hydrography of the Skagerrak area is strongly influenced by the North Sea. Resembling the circulation in a fjord, the high salinity water mass stretches down the deep eastern part of the Kattegat and into the Sound below the brackish Baltic water which streams northwards like a river. Even though the Kattegat is thus a typical transition area with components from both the North Sea and the Baltic, the major part is dominated by relatively low salinity water. This, together with the increasing nutrification and its impact on the ecosystem, makes the Kattegat resemble the Western Baltic to a much higher degree than the adjacent Skagerrak.

ad (v) For Division IIIa there are particular problems with catch statistics by areas. The dividing line between the Skagerrak and the Kattegat cuts through the important fishing ground around the Skaw which cannot be defined by the statistical rectangle system of ICES. The same is true for the south-western border of the Kattegat and even for the division between the North Sea and the Skagerrak. These difficulties will, of course, exist irrespective of any rearrangements made.

Taking everything into consideration, the Working Group felt that the assessments of the Skagerrak stocks of cod, plaice, haddock, whiting and hake could be transferred to the proposed North Sea Demersal Working Group while the Kattegat stocks of cod and plaice would more appropriately be assessed by the Working Group on Demersal Stocks in the Baltic (or its successor). In the case of Nephrops and sole, the Working Group could not reach full agreement on the most suitable arrangements.

2 THE FISHERIES FOR ROUNDFISH AND FLATFISH IN DIVISION IIIA

2.1 Denmark

2.1.1 Fleet composition

The Danish fisheries on demersal species in Division IIIa are typically carried out by small vessels making short trips, often of only a single day's duration.

Table 2.1.1 shows the number of vessels by categories and home water. The North Sea is included for comparison, while Sub-divisions 24-25 are excluded. It should be noted that the North Sea includes harbours in the western Limfjord which account for some of the smaller vessels.

The Skagerrak fleet comprises a relatively high number of trawlers larger than 60 BR/BRT. These vessels mainly fish for industrial species in the North Sea and some take part in the cod fishery in the Baltic early in the year. Compared to

the North Sea fleet, a higher proportion of small vessels is apparent in the Skagerrak fleet and these comprise the dominant component in the waters inside the Skaw. It is also apparent that nets and lines (especially the former) are of greater importance in the Kattegat and in the Belt Seas - Western Baltic. In the latter area, "other vessels" are mainly boats used in the pound net fisheries and these are not of importance to the fisheries in Division IIIa.

2.1.2 Fishing pattern of the fleets

The fleet structure in Division IIIa has been influenced by substantial changes in the fishing possibilities in the Kattegat and, particularly in the Western Baltic - Belt Seas. During the 1980s there has been a marked reduction in stock size of a number of species. A major reason is probably a deterioration of the environment rather than a high fishing intensity.

This has resulted in a decrease in the number of fishing vessels and has forced the remaining boats to fish in other waters during most of the year. At present, typical fishing patterns are as follows:

i) Small trawlers

Nephrops/sole all year round.

Plaice along the North Sea coast in summer and autumn and some cod fishing in Division IIIa in winter.

Cod and plaice in 1st and 4th quarters and industrial fishing, especially in the 3rd quarter. These boats are especially dependent on the special sprat quota in Division IIIa.

ii) Gill net boats

Cod in the Skagerrak and Northern Kattegat in winter.

Plaice/sole along the North Sea coast in April-May and plaice/sole in the Kattegat in autumn. Some of the gill net fishing boats attempt a plaice/sole fishery in Division IIIa all the year round.

iii) Danish seiners

This fishery is on the decline inside the Skaw. A large seine fishery for plaice used to take place in the southern Kattegat around the Isle of Anholt.

Seiners of more than 20 BR/BRT mainly fish for plaice and cod in the North Sea. Some of the remaining boats in the northern Kattegat land live plaice from the waters around and just south of the Skaw.

In addition to the professional, full time fisherman, a large increase has occurred in the number of persons fishing part-time or for recreation. The fishing is carried out from small motor boats using fykes and set nets. The fishing takes place inshore and, given the number of persons involved, the landings of plaice and other flat fish must be appreciable despite restrictions on the number of gears allowed for each person.

Tables showing the percentage of the landings accounted for by each vessel category are presented in the individual stock sections.

2.2 Norwegian Fishery in the Skagerrak

The small Norwegian catches of cod in the Skagerrak are taken both in gill nets, and on long lines and as by-catches in the deep-water prawn fishery.

Most of the haddock in the Skagerrak is taken as a by-catch in the prawn fishery. Along the Norwegian coast, part of the catch is also taken in the gill net and long-line fisheries.

All the whiting in the whole Skagerrak area is taken in the deep-water prawn fishery as a by-catch.

2.3 Sweden

The Swedish fishery for demersal species in Division IIIa has in recent years been dominated by trawling with Nephrops and cod bottom trawls. About 80% of the cod catch and 85% of the plaice catch, in both the Kattegat and in the Skagerrak, is taken with these gears. Other species, such as haddock, whiting (for consumption) and hake, are caught in that fishery. The Nephrops fleet in the Skagerrak has shown a large increase in effort during the 1980s. In the Kattegat, environmental conditions (low oxygen concentrations) have strongly affected the Nephrops population in the southern part and the Nephrops fishery has been severely reduced there and has moved to the northern part. Total effort in the Kattegat has increased only slightly during the 1980s.

3 COD

3.1 Stock Identity

No additional information about the identification of the cod stocks in the Skagerrak and Kattegat has been obtained beyond what was said in last year's Working Group report (Anon., 1990). Cod in the Skagerrak and Kattegat have, therefore, been assessed separately, as at previous Working Group meetings. As a considerable part of the catches in the Kattegat in recent years has been taken in the northern area where there seems to be mixing with the Skagerrak cod (Anon., 1990), the Working Group decided to make a combined assessment of the two stocks. The results of Hagstrøm et al. (1990) support the use of a combined assessment.

3.2 Kattegat

3.2.1 Landings

Table 3.1 shows the landings for human consumption by country as provided by the Working Group members. The landings for 1990 are preliminary estimates. The landings in 1990 were about 5,900 t, which is somewhat lower than in 1989 (about 8,600 t). Table 3.2 shows the amount of cod taken in the Danish small-meshed fishery; these catches have been decreasing during the 1980s. These data have been revised since the last meeting. The cod catches from the small-meshed fishery are not included in the catch statistics in Table 3.1. The Danish landings distributed by vessel category and gears in 1989 and 1990 are shown in Table 3.3

3.2.2 Effort and CPUE

Swedish and Danish CPUE data for the Kattegat based on logbooks are shown in Tables 3.4 and 3.5. The catch and effort data series, disaggregated on three

commercial fleets and used in the tuning of the VPA are shown in Table 3.6.

3.2.3 Catch and weight at age

The Danish age distributions were used for all landings (Table 3.7). Age distributions were not presented for the Danish by-catches and small mesh fishery, and these were, therefore, not included in the assessment.

Mean weights at age in the landings are given in Table 3.8. The mean weights in the stock were considered to be the same as in the landings.

3.2.4 Natural mortality rates

The natural mortality rate was set at 0.2 for all age groups and years.

3.2.5 Fishing mortality

Even though the catch-at-age figures were not related to the fleets but to the total Danish landings, the Laurec-Shepherd method was used to tune the VPA. The output is given in Table 3.9.

A separable VPA was run with the F for age group 3 set to the average of the last five years and terminal S = 1.2 (Table 3.10).

3.2.6 Results of the VPA

The results are shown in Tables 3.11 and 3.12 and in Figures 3.1A and B. The total stock size in 1990 appears to have increased compared to 1989 due to the good 1989 year class (Tables 3.6 and 3.12). The high F values estimated are consistent with previous years' assessments.

3.2.7 Recruitment

For the cod stocks in both the Kattegat and the Skagerrak, the IYFS indices for 1- and 2-group cod have been used in an attempt to estimate recruitment (Table 3.13). The RCRTINX2 program was used with the following options:

a) calibration regression,

b) shrinkage towards the mean,

c) minimum variance of prediction of 0.2 for any estimate,

d) a minimum of 5 data points in regression,

e) tri-cubic weighting.

The IYFS final index for the 1989 year class is high, and the above-average estimate of this year class from the VPA was used in the prediction. The preliminary IYFS index for the 1990 year class is about 50% of the average. The RCRTINX2 program estimated this year class to be about 12.4 million as 1-group (Table 3.14) and this was adopted for the prediction. The 1991 and 1992 year classes were set to 10 million at age 1, this being the average of the VPA values for the 1985-1988 year classes.

3.2.8 Long-term yield

Input data are shown in Table 3.15. Weights at age for 1990 were used as there is an obvious increasing trend in the data. Results of the yield-per-recruit calculations are plotted in Figure 3.1C.

3.2.9 Short-term forecast

Input data are shown in Table 3.15. The weights at age used are for 1990 as there is a clear trend of increasing weights. This may be a result of more extensive mixing of Skagerrak cod in the Kattegat catches. The exploitation pattern used was the separable pattern, hand-smoothed.

The prediction was carried out with two options for 1991. One assumes the catch to be equal to the TAC of 6,650 t and the other assumes status quo fishing mortality. The results are given in Table 3.16 and Figure 3.2D. Due to the large 1989 year class, catches under the assumption of status quo are predicted to rise to 8,500 t in 1991 and 11,200 t in 1992. The spawning stock biomass is expected to increase from 6,800 t in 1991 to 14,000 t in 1992, and to remain at about that level in 1993.

3.3 Skagerrak

3.3.1 Landings

Table 3.1 shows the landings by country as provided by the Working Group members and revised compared to the 1990 Working Group report. Landings show a slight decrease to about 17,800 t in 1990. The cod catches from the Danish small-meshed fishery (Table 3.2) are not included in the catch statistics in Table 3.1. Cod taken as by-catch in the small-mesh trawl fishery have been decreasing since 1982 and fishing effort has also declined. The cod landings along the Norwegian fjords are also shown in Table 3.1. As these cod are considered to belong to a separate stock, these catches are not included in the assessment.

The Danish landings which account for the largest component of the total catches have been restricted throughout 1990 by monthly boat quotas according to vessel category and time of year as shown below (in tonnes):

Date of regulation vessel length o.a.	1 Jan	1 Jun	1 Oct	17 Oct	1 Nov	15 Nov
<12 m	6	4	5	8	6	10
12-15 m	7	5	6	9	7	11
16-21 m	8	6	7	10	8	12
≥22 m	9	7	8	11	9	13

In July, vessels were only allowed to land 4 t irrespective of size because of the summer vacation in the land-based industries.

These regulations are likely to have distorted landing statistics due to misreporting of landings data and may also have led to an increase in discarding, although the quantities discarded are unknown.

The Danish landings in the Skagerrak according to vessel categories and gears in 1989 and 1990 are shown in Table 3.3.

3.3.2 Effort data and CPUE

Swedish and Danish CPUE data for the Skagerrak are shown in Tables 3.4 and 3.5. The data were based on log books. The catch and effort data series disaggregated by three commercial fleets used in tuning the VPA are shown in Table 3.17.

3.3.3 Catch and weight at age

The Danish age distributions were applied to all catches used in the assessment (Table 3.18) as no other age data were available. Age distributions were not presented for the Danish by-catches in the small-mesh fishery, and these were, therefore, not included in the assessment.

The Danish mean weight-at-age data were used for all catches. The mean weights in the stock were considered to be the same as in the catches and are presented in Table 3.19.

3.3.4 Natural mortality rates

The natural mortality rate was assumed to be 0.2 for all age groups and years.

3.3.5 Fishing mortality

Although the catch-at-age data were not related to the fleet but to the total Danish landings, they were used to tune the VPA. As there was an obvious trend in catchability for the Danish seine fleet, the hybrid method was adopted and a trend allowed for in that fleet. The input is given in Table 3.17 and the output in Table 3.20.

A separable VPA was run with the F for age group 3 set to the average of the last 5 years and terminal S = 0.9 (Table 3.21).

3.3.6 Results of the VPA

The results are shown in Tables 3.22 and 3.23 and Figure 3.2A. The high F values estimated are consistent with previous assessments.

3.3.7 Recruitment

The methods for estimating recruitment were the same as those described Section 3.2.7. The IYFS final index as well as the results of the runs with RCRTINX2 indicate average year classes. Results from the RCRTINX2 analysis (Table 3.24) estimate the 1989 year class to be 16,400 and the 1990 year class to be 17,400, both at age 1. These were adopted for the prediction.

The 1990 year class as 0-group along the Norwegian coast appears very weak (Table 3.13).

3.3.8 Long-term yield

The input data for the yield-per-recruit analysis are shown in Table 3.25. Results are plotted in Figure 3.2C.

3.3.9 Short-term forecast

The input data are shown in Table 3.25. The exploitation pattern used was the separable pattern, hand-smoothed. The weights at age used are the averages for the period 1986-1990. Results from the predictions are shown in Table 3.26. The catch in 1992 under status quo conditions is predicted to be about 17,700 t and the spawning stock biomass to be reduced to about 15,600 t in 1993. As the predicted catch in 1991 under status quo conditions exceeds the TAC by 2,600 t, a second F option with a TAC constraint of 15,000 t in 1991 was run. This resulted in a catch of about 20,000 t in 1992 under status quo F with spawning stock biomass rising to 19,000 t in 1992 and declining to about 17,000 t in 1993 (Table 3.26).

3.4 Kattegat and Skagerrak Combined

Since the main part of the fishery in the Kattegat in recent years has taken place in the northern part where it appears that the two stocks are mixing, a single assessment for the whole of Division IIIa was carried out.

Data on landings, effort and catch per unit effort, catch and weight at age, and recruitment have been combined from the two separate sets of data. Natural mortality was set to 0.2.

3.4.1 Fishing mortality

Even though the catch-at-age figures were not related to the fleets but to the total Danish landings, the Laurec-Shepherd method was used to tune the VPA. The output is given in Table 27.

A separable VPA was run with the F for age group 3 set to the average of the last five years and a terminal S = 1.0 (Table 3.28).

3.4.2 Results of the VPA

The results of the combined VPA based on the separable VPA is shown in Tables 3.29 and 3.30 and in Figure 3.3A. The rather strong 1989 year class yields a high recruitment in 1990, but the average for the last five years was assumed for the prediction.

Under status quo F, the total stock size in 1990 was estimated to be at about the same level as in the previous three years, whereas the spawning stock biomass shows a slight decrease.

3.4.3 Long-term yield

Input data are shown in Table 3.31. The exploitation pattern is the separable pattern. The long-term yield-per-recruit results are plotted against fishing mortality in Figure 3.3C.

3.4.4 Short-term yield

Input data are shown in Table 3.31. The exploitation pattern is the separable pattern. The status quo prediction estimates catches of 23,000 t in 1991 and 25,000 t in 1992, with the spawning stock showing a slight increase (Table 3.32 and Figure 3.3D).

4 HADDOCK

4.1 The Fishery

The landings of haddock by country in Division IIIa for the period 1975-1990 submitted by Working Group members are given in Table 4.1. Landings increased by 35% in 1990 compared to 1989.

In Table 4.2, the landings for 1983-1990 are split into landings for consumption and industrial purposes. From 1987, it is further possible to split the landings according to area. Table 4.4 shows the total Danish consumption landings by vessel category in 1989-1990.

4.1.1 Haddock in the Kattegat

The Danish and Swedish landings in the Kattegat during 1987-1990 are given in Table 4.3, split into landings for consumption and industrial purposes. The landings are small but increasing.

The Danish landings for consumption are mainly taken by trawlers (20-59 BRT) as a by-catch in the non-industrial trawl fisheries.

4.1.2 Haddock in the Skagerrak

Danish landings in 1987-1990 for consumption and industrial purposes are given in Table 4.5, together with the Norwegian and Swedish landings which are exclusively for human consumption.

The total landings increased between 1989 and 1990 by 33%. The Danish landings for human consumption were taken mainly as by-catch in non-industrial trawl fisheries and also by seiners.

4.2 Stock Identity

Due to lack of information, the Working Group was not able to consider this question for haddock in any detail. However, it seems not unreasonable to assume a close link with the North Sea stock.

4.3 Catch at Age

Catch-at-age data are available for the period 1981-1986 based on the Danish landings, including those from the industrial fishery. For 1987-1990, age distributions were not available from the industrial landings, and so age compositions for these years correspond only to Danish landings for human consumption (Table 4.6).

4.4 Weight at Age

Weight-at-age data for 1990 were available from the Danish human consumption fishery. These data, together with data for the period 1981-1989, are given in Table 4.7.

4.5 Recruitment

Recruitment indices are shown in Table 3.12. The index for the 1990 year class as 1-group in 1991 is about average.

4.6 Prediction

No reliable predictions of catches in 1991 and 1992 can be given because the recruitment indices are believed to be unreliable. According to the estimates of recruitment in 1986 and 1987, the catch in 1988 was expected to be above the 1987 catch (5,300 t). In fact, the total catch in 1988 was only 4,380 t, and it remained at that level in 1989. In 1990, the total landings increased by 35% even though indices for the 1988 and 1989 year classes were well below average.

5 WHITING IN DIVISION IIIA

5.1 The Fishery

The landings of whiting in Division IIIa are given in Table 5.1. The Danish data have been revised from 1980 onwards by Working Group members. The landings have been fairly stable from 1984 to 1989 and then an increase of 46% in total landings took place in 1990.

In Table 5.2, the Danish landings for the period 1981-1990 are split into landings for consumption and landings for industrial purposes, and are divided by area. The landings for consumption constitute 4-7% of the total landings and are taken as a by-catch in non-industrial trawl fisheries and by Danish seine.

The Norwegian landings in the Skagerrak are taken mainly as by-catch in the trawl fishery. The Swedish landings in Division IIIa are taken mainly in industrial fisheries and as a by-catch in other trawl fisheries.

6 HAKE

6.1 Stock Identity

The hake in the Skagerrak and the Kattegat belong to the northern hake stock.

6.1.1 Landings

The landings of hake are given in Table 6.1.

6.1.2 The fishery

No directed fishery on hake is carried out in the Skagerrak and the Kattegat. The landings are mainly by-catches in the Pandalus and Nephrops fisheries. The catches of the hake from Division IIIa have very little effect on the stock and a restrictive precautionary TAC will only lead to increased discarding and/or misreporting of landings.

7 PLAICE

7.1 Stock Identity

Two plaice stocks have been identified in Division IIIa: a Skagerrak stock, which spawns in the Skagerrak along the Danish coast, and a Kattegat stock which spawns in the eastern and southern part of the Kattegat and in the northern part of Sub-division 22.

The two stocks overlap in the northern Kattegat, and the catches from this area are likely to be a mixture of fish from the two stocks. No data are available to the Working Group on which to base any split of the catches into stocks, and all plaice caught in the northern Kattegat have in previous assessments been allocated to the Kattegat stock.

The Kattegat stock size has shown a declining trend from a spawning stock biomass of about 25,000 t in the early 1970s to below 5,000 t in recent years. During the same period, the stock of plaice in Sub-division 22 has decreased even more drastically and the catches of plaice from the northern part of that area have been reduced to a minimum. The fishery on plaice in the central and southern Kattegat has, therefore, in recent years changed from a directed fishery to a by-catch fishery. The directed fishery is now conducted in the Læsø region.

These changes are probably related to changes in the environmental conditions. High concentrations of nutrients and oxygen deficits have been an annual phenomenon since 1984 and may have caused the recruitment failure observed in the Kattegat (Bagge et al., 1990).

Studies on growth and meristic characters (Anon., 1988) and analysis of genetic characteristics by electrophoresis (Simonsen et al., 1988) confirm the dominance of the Skagerrak stock in catches from the central and northern Kattegat in recent years.

The Working Group decided to carry out three plaice assessments, one for the Skagerrak alone, one for the Kattegat, as has been the procedure at previous Working Group meetings, and, in addition, an assessment with the catches from Kattegat after 1984 allocated to the Skagerrak stock.

The Working Group is of the opinion that the combination of the Skagerrak and Kattegat catches after 1984 better reflects the present situation where the major part of the recruitment of Kattegat is coming from the Skagerrak stock.

7.2 Kattegat

7.2.1 Landings

The total international landings as provided by Working Group members are shown in Table 7.1. The figures show a small increase from 1989 to 1990. The landings are, however, still well below the level of the 1970s. Nearly all the catches are taken in the northern part of the Kattegat.

The quarterly breakdown of the Danish landings is shown in Table 7.2. The Danish landings distributed on vessel categories and gears in 1989 and 1990 in the Kattegat are shown in Table 7.3.

7.2.2 Effort data and CPUE

Effort and catch per unit effort are available from the Danish gillnet and seine fishery for the period 1983-1990. The data are based on logbooks. Swedish data are available for the Nephrops trawl and cod bottom fishery from 1980. The data are shown in Tables 7.4 and 7.5. The Danish effort data are given as total number of days fishing per year, while the Swedish figures are number of hours fishing. The Danish seines CPUE series shows a peak in 1985, followed by a decrease up to 1989. From 1989 to 1990, the CPUE increased. The gillnet series shows a maximum in 1987. From 1989 to 1990 the CPUE increased by about 20%. Both Swedish data sets show a decreasing trend from 1985 to 1989, followed by an increase from 1989 to 1990.

This year, additional data were available from the Danish trawl survey in May. This survey has taken place each year since 1984 and comprises approximately 20 trawl hauls taken in Kattegat. The data are shown in Table 7.6.

7.2.3 Catch and weight at age

Catch-at-age data are only available for the total Danish landings and were raised to the total international landings (Table 7.7). A SOP check showed deviations between the SOP and landing figures in certain years, and the catch-at-age data were adjusted to correct for this discrepancy. Weight-at-age data are given in Table 7.8.

7.2.4 Natural mortality

Natural mortality was assumed to be 0.10 for all age groups.

7.2.5 Fishing mortality

The VPA was tuned using the Laurec-Shepherd tuning method on Danish seine, Swedish Nephrops trawl and Swedish cod trawl CPUE, and Danish survey data.

No catch-at-age data were available for the commercial effort series and the catch-at-age data used in the tuning were estimated from the catch data per fleet and the age compositions in the total Danish landings. Following the procedure used last year, only data from 1983 and onward were used and all years were given the same weight. The input data are shown in Table 7.9. Terminal q was estimated as the mean in all series. The output of the tuning is given in Table 7.10. The results do not indicate any trend in q.

The lack of representative age compositions for each fleet reduces the validity of the tuning by introducing a correlation between the fleets. As no other data were available for tuning the VPA, the Working Group accepted the results and used the terminal F level as input for the separable VPA.

A separable VPA was run using the terminal F level from the tuning assuming terminal F at age 5 of 0.94 and a terminal S of 0.5. The terminal Fs for the final VPA were estimated using terminal populations. Output from the separable VPA is given in Table 7.11 and the resulting VPA was accepted as the final VPA.

7.2.6 Results of the VPA

The results of the VPA are shown in Tables 7.12 and 7.13 and in Figure 7.1A and B.

The fishing mortality between 1968 and 1990 has not shown a trend but has varied greatly from year to year around a level of about 0.6.

The 1970s was dominated by two strong year classes (1971 and 1974) which provided a relatively large SSB of between 15,000 and 30,000 t. All year classes after 1976 have been very weak and the SSB has fallen to around 5,000 t. As mentioned in Section 7.1, changes in the environment are likely to have caused the decline in recruitment.

7.2.7 Recruitment

Recruitment indices were available for 2-group plaice from the Danish May survey carried out since 1984 and for 1-group plaice from the summer survey in the Kattegat for the period 1984-1990 (Table 7.14).

The indices were analysed using the RCRTINX2 program. The regression assumptions and results are shown in Table 7.15. The correlation between the summer survey series and the VPA estimates is very poor, and this survey is given a very low weight. For the 1988 year class, the weight given to the May survey is equal to that for the mean while the estimate of the 1989 year class is based almost entirely on the mean. The Working Group decided to use a recruitment of 10 million for year classes 1988-1989 and 1990 (mean of 1979-1987).

7.2.8 Long-term prediction

The input data for the yield-per-recruit calculations are given in Table 7.16. The weights at age are the averages for the period 1986-1990 and the exploitation pattern is taken from the separable VPA (Table 7.11). The results are plotted in Figure 7.1C. Assuming an average recruitment of 10 million, the equilibrium yield will be 2,400 t.

7.2.9 Short-term prediction

The input data for the short-term predictions are given in Table 7.16.

The prediction was carried out with two options for 1991, one assuming the catch equal to the TAC of 1,300 t and one assuming status quo fishery equal to F_{3-9} = 0.63 corresponding to a catch of 1,950 t. The results are given in Table 7.17 and a plot of results from the status quo option is shown in Figure 7.1D.

As the major part of the plaice catch in the Kattegat is by-catches, mainly in fisheries directed on cod, the Working Group does not expect any decrease in fishing mortality in 1991. A status quo fishery will lead to a catch of 2,200 t in 1992 and an increase in the SSB in 1993.

7.3 Skagerrak

7.3.1 Landings

The landings of plaice from the Skagerrak as provided by Working Group members are shown in Table 7.18. The figures for the period 1983 to 1988 are very uncertain due to lack of accurate catch statistics. The plaice in the Skagerrak are caught in a mixed cod and plaice fishery. Information from the fishermen and inconsistencies in the catch data for cod, plaice and sole indicate that misreporting has taken place during this period. The Working Group adjusted the landings data as shown in Table 7.18.

The landings increased in 1990 to 10,000 t from a very low level in 1989. Except for the year 1989, landings have been relatively stable since 1976 at around 10,000 t.

The quarterly breakdown of the Danish landings are shown in Table 7.2 and the distribution according to vessel categories and gears in 1989 and 1990 in the Skagerrak is shown in Table 7.3.

7.3.2 Effort and CPUE data

Effort and catch-per-unit effort data are available from the Danish gillnet and seine fisheries for the period 1983-1990. The data are based on logbooks. Swedish data are available for the Nephrops trawl and cod bottom trawl fisheries since 1980 (Table 7.5). The data are shown in Tables 7.4 and 7.5.

The Danish effort is given as total numbers of days fishing, while the Swedish figures are number of hours fishing.

The Danish CPUE series shows a peak in 1986 followed by a decrease until 1989, and from 1989 to 1990 the CPUE has increased. The gill net CPUE series shows a peak in 1987, then a decrease until 1989, followed by an increase to 1990.

The Swedish Nephrops trawl series shows a decrease in CPUE from 1985 to 1987 followed by an increase to 1990. The Swedish cod trawl fishery shows a decrease in CPUE from 1984 to 1987 and it also shows an increasing trend from 1987 to 1990.

Additional data are available from Danish trawl surveys in May. These surveys have taken place since 1984, but consist of only 10 hauls per year in the Skagerrak. The data are shown in Table 7.6.

7.3.3 Catch-and-weight-at-age data

Danish catch and weight-at-age data were raised to total landings. Catch-at-age data are given in Table 7.19, and weight-at-age data are in Table 7.20.

7.3.4 The natural mortality

The natural mortality for all ages was set at 0.1.

7.3.5 The fishing mortality

The VPA was tuned in the same way as for the Kattegat plaice (Section 7.2.5). As for the Kattegat, the catch-at-age data were not derived separately for the different commercial fleets. The input data are shown in Table 7.21 and the output from the tuning is shown in Table 7.22. The result does not indicate a trend in the q.

A separable VPA was run based on the terminal F level from the tuning. The terminal Fs were estimated using terminal populations. Output from the separable VPA is given in Table 7.23 and the resulting VPA was accepted as the final VPA.

7.3.6 Results from the VPA

The results from the VPA are shown in Tables 7.24 and 7.25 and Figure 7.2B.

Both the fishing mortalities and the spawning stock size have fluctuated widely since 1978. However, there has been a clear declining trend in F and a somewhat less pronounced increasing trend in SSB.

7.3.7 Recruitment

Recruitment indices for 2-group were available from "Dana" surveys in the area north of 57^0N in the Kattegat and in the Ålbæk Bay summer survey for 1-group (Table 7.26).

The indices were analysed using RCRTINX2. The results indicate a poor correlation.

The above-mentioned surveys are carried out with two different research vessels and refer to the same year class in two different years. Nevertheless, a close correlation is observed between the two series (R = 0.93). They both indicate the 1988 year class as the largest on record. In the case of the 1-group survey, the 1988 year class is about double the average of the preceding year classes, whereas the 2-group survey indicates that it is about 10 times the average of the preceding year classes. These indications of above-average strength for the 1988 year class are supported by observations from commercial fishermen who reported high catches of plaice just below the minimum landing size in 1990.

Due to the uncertainty about the strength of the 1988 year class, two values were used in the short-term prediction: A) Assuming average recruitment of 40 million 2-group fish (mean 1978-1987) for the 1988-1990 year classes, and B) Assuming the 1988 year class equal to 80 million 2-group fish and the 1989 and 1990 equal to 40 million (mean 1978-1987).

7.3.8 Long-term prediction

Input data for the yield-per-recruit calculations are given in Table 7.27. The weights at age are the averages for 1986-1990 and the exploitation pattern is taken from the separable VPA. The results are plotted in Figure 7.2C. Assuming average recruitment of 40 million, the calculated equilibrium yield is 9,500 t.

7.3.9 Short-term prediction

As mentioned in Section 7.3.7, two different estimates of the strength of the 1988 year class were used in the short-term predictions. Run A assuming a recruitment of 40 million 2-groups plaice in 1990, and Run B with 80 million fish fish. The input data are given in Table 2.27.

For each run, a prediction was carried out with two options for 1991, one assuming the catch in 1991 to be equal to the TAC of 10,000 t and the other assuming a status quo fishery (F_{3-9} = 0.47). The results are shown in Table 7.28 and Figures 7.2D and 7.2E.

Run A

Assuming continued status quo fishing mortality, the catch will be 12,700 t in 1991 and 13,600 t in 1992. Assuming a catch equal to the TAC in 1991 will imply a decrease in F_{3-9} to 0.35, and if this level of F is maintained in 1992 the catch will be 12,000 t and the SSB in 1993 would be 40,000 t.

Run B

Assuming continued status quo fishing mortality, the catch will be 13,400 t in

1991 and 16,000 t in 1992, and the SSB in 1993 will decrease to 41,000 t. If the catch in 1991 is assumed to correspond to the TAC of 10,000 t, F will be reduced to F_{3-9} = 0.33. If this level of F (0.33) is maintained in 1992, the corresponding catch will be 13,000 t.

Thus, the status quo catch in 1992 will be 2,400 t higher than if the 1988 year class is average.

7.4 Plaice in the Kattegat and the Skagerrak Combined

The Working Group decided to carry out an assessment on plaice in the Kattegat and Skagerrak combined as a consequence of the stock identity considerations described in Section 7.1.

7.4.1 Landings

The landings in the Kattegat and the Skagerrak are described in Sections 7.2.1 and 7.3.1.

7.4.2 Effort and catch-per-unit effort data

The development in the CPUE and effort data for the Kattegat and the Skagerrak is described in Sections 7.2.2 and 7.3.2.

7.4.3 Catch at age

The raised catch-at-age data available from the Danish landings in the Kattegat and the Skagerrak were added in order to represent the total landings of Division IIIa (Table 7.29).

7.4.4 Weight-at-age data

The weight-at-age data available from the Danish landings from the Kattegat and from the Skagerrak were combined weighted by the catch at age (Table 7.30).

7.4.5 Natural mortality

The natural mortality was set at 0.1 for all age groups.

7.4.6 Fishing mortality

The VPA as tuned using the Laurec-Shepherd method with data from Danish seiners in the Kattegat and the Skagerrak, the Swedish Nephrops and Swedish cod trawl in the Kattegat and the Skagerrak, respectively, and Danish survey data. For the tuning, the catch-at-age data from Danish landings in the Kattegat and the Skagerrak were also applied to the other fisheries in the two areas.

The input data are shown in Table 7.31. Terminal q was estimated as the mean for all series. The output of the tuning is given in Table 7.32. The results do not indicate any trend in q.

Because of lack of representative age compositions per fleet (they are only available by area and port), tuning is of limited validity. However, in the absence of other data, the Working Group accepted the tuning and used the terminal

F level as input for the separable VPA (Table 7.33).

7.4.7 Results from the VPA

The VPA was run only from 1984 onwards because the Skagerrak component was dominating from the mid-1980s. The results from the VPA are shown in Tables 7.34 and 7.35 and Figures 7.3A and B. The F values fluctuate greatly from year to year, but there may be an increasing trend.

The SSB showed a decreasing trend from 1985 to 1989 and then increased from 1989 to 1990.

7.4.8 Recruitment

Recruitment indices are only available for 1-group plaice in the Ålbæk Bay and for 2-groups from "Dana" surveys in the area north of 57^0 in the Kattegat. They are, however, assumed to be representative for the whole Skagerrak-Northern Kattegat stock and were consequently used to describe the combined stock recruitment (Table 7.26).

A calibration regression was performed by means of the RCRTINX2 program with the options as described in 7.2.7.

Results from the RCRTINX2 analysis show that the correlation beteen the indices and VPA 1-group is poor and, therefore, a mean value from the VPA was used in one prediction. Becuse the recruitment indices used for the combined stock are as those used for the Skagerrak (Section 7.3.7), the Working Group decided to make the same assumptions concerning recruitment for the combined stock as for the Skagerrak stock.

7.4.9 Prediction

Inputs for the yield-per-recruit analysis are given in Table 7.36 and the results are plotted in Figure 7.3C.

The short-term prediction was made using the exploitation pattern from separable VPA and average mean weights for the period 1984-1990.

Two runs were carried out (See Sections 7.3.7 and 7.4.8):

1. using the mean recruitment for the 1988 year class;

2. using twice the mean recruitment for the 1988 year class.

The input data are given in Table 7.36. The results of the predictions are given in Tables 7.37 and 7.38.

Assuming the 1988 year class is of average strength (Run A), the status quo prediction resulted in a catch in 1991 equivalent to the TACs for the Kattegat and the Skagerrak combined, and the catch in 1992 is predicted to be nearly the same. Assuming the 1988 year class is twice the average recruitment (Run B), the status quo prediction is for a catch in 1991 of 12,700 t, and a catch in 1992 of 14,400 t. Assuming catches at the TAC level in 1991, F_{3-9} would be slightly reduced in 1991 to 0.51 (compared to 0.59 at the status quo level) and at F_{3-9} = 0.51 in 1992 the catch would be about 14,000 t.

7.4.10 Comparison of the plaice stocks

Because the main fishery in recent years took place in the northern Kattegat on the Skagerrak component (See Section 7.1), the recruitment in the northern Kattegat has been depending on the Skagerrak component.

The Skagerrak assessment indicates a stronger 1987 year class than the combined assessment and, therefore, the SSBs and catches are higher in the Skagerrak prediction than in the combined prediction.

The sum of the 1991 catches predicted under the status quo assumptions in the separate Kattegat and Skagerrak analyses assuming average recruitment for the 1988 year class is 14,700 t, compared to the equivalent predicted value from the combined analysis of 11,300 t. The equivalent figures for the 1992 catches are 15,800 t and 11,400 t, respectively.

8 DIVISION IIIA SOLE

8.1 Landings

The landings of sole from Division IIIa as provided by Working Group members are given in Table 8.1.

As for plaice, the catch statistics for sole in the Skagerrak are very uncertain, and inconsistencies in catch figures for the different species in Skagerrak suggest that some misreportings have occurred. The Working Group has adjusted the catch data for this, and the estimated amount of misreporting is given in Table 8.1.

Table 8.1 shows an increase in landings from 1982 for 1989 by a factor of four. From 1989 to 1990, a drop in the total catches of about 200 t is seen. Regulations were introduced in the second half of 1989, when landings were restricted to 500 kg per boat per week. All landings were prohibited from the 11 November except for one week in December, when each boat was allowed 100 kg as maximum. In 1990, Danish landings were restricted to 500 kg per boat per week right from the beginning of the year. In late June the maximum was reduced to 300 kg, and this was further restricted to 200 kg from the beginning of September to 5 November, after when only 100 kg were allowed. By the 22 November, further landings were prohibited. In 1991 fishing again started with a weekly limit per boat of 500 kg, but as soon as 25 February boat quotas were reduced to 300 kg.

As sole is to a large extent taken as a by-catch, especially in the trawl fishery for Nephrops, boat quotas are not likely to reduce the actual catch to the level intended. Being a valuable species, it is also likely that non-reporting and misreporting have occurred, but the Working Group was not in a position to estimate these. Discards cannot be estimated either, and the Working Group could consequently not provide any reliable catch or landing figures for 1990.

Table 8.2 shows the reported Danish landings in 1989 and 1990 according to vessel category and area. The figures indicate a reduction in the relative amount taken by gill nets. As this fishery is a directed sole fishery, it shows a greater decrease than the trawl fishery and it is also more seriously affected by the restrictions introduced.

8.2 Catch and Weight at Age

Catch at age and mean weight at age were available for the Danish landings from the Kattegat for the period 1984 to 1990. As the Danish landings from the Kattegat constitute about 70% of the total international landings, the catch at age data were applied to the total landings. The total catch in numbers are given in Table 8.3.

Even though a relatively large proportion of the total landings is sampled, the quality of the sampling programme could be improved. Only one sample of approximately 200 fish was taken per quarter in 1990; this may result in a high variation in the catch at age data given that the age range consists of up to 15 age groups. The weight at age data are given in Table 8.4.

8.3 Natural Mortality

No information on natural mortality rates were available for the Working Group and a value of 0.1, equal to the value used for the North Sea stock, was used for all ages and years.

8.4 Fishing Mortality

A VPA was carried out using the catch in numbers at age data only for the period 1984 to 1989. 1990 was not included in the calculations because of the uncertainty about the total catches in 1990.

No data were available for tuning the VPA and the terminal Fs and population sizes were estimated by running a separable VPA using a terminal F of .5 on age 4 and a terminal S of .7. The results of the separable VPA are given in Table 8.5 and the resulting VPA in Tables 8.6 and 8.7.

The results of the separable VPA show an exploitation pattern with very little exploitation on ages 1 and 2, maximum mortality on age 4 and a decreasing exploitation on the older age groups.

8.5 Results of the VPA

The results of the VPA (Tables 8.6 and 8.7 and Figures 8.1A and B) show an increased spawning stock size from about 800 t in 1984 to 1,700 t in 1986 to 1989. In the same period (1986-1989), the average fishing mortality has been relatively constant at around 0.4. There is some indication of an increase in Fs from 1984-1985 to 1986-1987, but not of the same magnitude as used in the SHOT forecast presented in last year's report (Anon., 1990).

8.6 Recruitment

Recruitment indices for 1-group sole were available from the Danish summer survey on young flatfish for 1984 to 1990 (Table 8.8). The survey data have been re-analyzed since last year's meeting, and a preliminary revised data series was presented to the Working Group. No data were available for 1986 as the revisions of the data from this year have not been finished. The sole caught during the survey have not been aged, and the allocation of total catch to age groups has been based on analyses of the length compositions. This process of splitting into age groups gives problems in certain years, and further analyses are needed before a final data series can be presented.

The indices were analysed using the RCRTINX2 program. The input and the results

are shown in Tables 8.9 and 8.10. The correlation between the survey indices and the VPA estimates of 1-group sole is poor, and the program gives about 75% of the weight to the mean.

Recruitment values of 5 million 1-group in 1990 and 1991 (rounded average for 1984-1989) were used in the predictions.

8.7 Long-term Forecast

The input data for the yield-per-recruit run are given in Table 8.11. The weights at age are averages for the period 1984-1990 and the exploitation pattern is the separable pattern from the separable VPA (Table 8.5). The results are plotted in Figure 8.1C. The current F (F_{3-9} = .42) is is close to F_{max} and, assuming an average recruitment of 5 million and unchanged F level, the equilibrium yield will average 850 t with a corresponding SSB of 1,900 t at time of spawning.

8.8 Short-term Forecast

The input data for the short-term predictions are given in Table 8.11. The exploitation pattern from the separable VPA was used and the mean weights were taken as the average over the years 1984-1990.

Two predictions were run, based on different assumptions concerning the total catch in 1990. Run A is based on a catch in 1990 of 629 t (F_{3-9} = 0.23) which is equal to the officially reported landings. Run B is based on a status quo fishery in 1990, corresponding to F_{3-9} = 0.42 and a catch of 1,050 t.

For each of the two runs, two options were used for 1991, one based on the TAC for 1991 and the likely Swedish catches, and the other assuming the same fishing mortality as in 1989 (F_{3-9} = 0.42). The TAC (EEC Zone only) for 1991 is equal to 800 t and the Swedish catch is expected to be about 30 t, giving a total catch in 1991 of 830 t to be used as the first option.

The output of the predictions are given in Table 8.12 and Figure 8.1D. Assuming a catch of 629 t in 1990 gives a unrealistic drop in fishing mortality of 45% from 1989 to 1990. As explained in Section 8.1, the Working Group expects the effort to have been nearly unchanged from 1989 to 1990, and for that reason the Group believes that Run B gives the better description of the fishery.

Run B predicts a catch of about 1,100 t in 1991 with unchanged fishing effort. A catch equal to the TAC (including a likely Swedish catch of 30 t) would correspond to a reduction in F of about 30%, compared with 1989. With a continuation of the 1989 fishing mortality, the catch is predicted to be around 1,000 t in 1992 with a small decline in SSB from 2,400 t in 1991 to 2,200 t in 1992.

9 REFERENCES

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Table 2.1.1 Number of Danish fishing boats in 1989, according to vessel category and home waters.

Vessel type	North Sea	Skagerrak	Kattegat	Areas 22-23
Trawl <20 BR/BRT	74	129	201	214
<20-39 BR/BRT	14	33	30	11
<40-59 BR/BRT	58	45	32	9
≥60 BR/BRT	191	138	24	1
Danish Seine	64	32	53	8
Gill net/Line	204	148	162	436
Other vessels	30	31	21	132
Total	735	566	523	811

Table 3.1 Cod landings (t) from the Kattegat and Skagerrak as estimated by the Working Group, 1971-1990.

Year	Kattegat			Total
	Denmark	Sweden	Fed.Rep. of Germany[2]	
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	9,396	2,006	89	11,491
1988	4,054	1,359	114	5,527
1989	7,056	1,483	51	8,590
1990[1]	4,705	1,186	33	5,924

Year	Open Skagerrak						Norwegian Fjords
	Denmark	Sweden	Norway	Others	Germany	Total	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	14,806	1,648	392	106		16,952	769
1989	16,634	1,902	256	34	12	18,838	888
1990[1]	15,833	1,694	141	65	110	17,843	847

[1] Preliminary.
[2] Landing statistics incompletely split on the Kattegat and the Skagerrak. The figures are estimated by the Working Group.

Table 3.2 By-catch of cod in the Kattegat and Skagerrak by the Danish industrial fishery (in tonnes) as estimated by the Working Group.

Kattegat	
Year	By-catch
1979	-
1980	-
1981	3,236
1982	5,214
1983	2,179
1984	712
1985	448
1986	610
1987	445
1988	284
1989	398
1990	132
Skaggerak	
1979	4,009
1980	4,036
1981	5,376
1982	9,119
1983	4,384
1984	1,084
1985	1,751
1986	997
1987	491
1988	1,103
1989	428
1990	687

Table 3.3 Cod in Division IIIa. Percentage distribution of Danish landings by vessel category in 1989 and 1990.

Vessel type	Skagerrak		Kattegat	
	1989	1990	1989	1990
Trawler <20 BR/BRT	14.8	14.8	43.9	45.6
20-39 BR/BRT	4.2	4.1	7.4	7.9
40-59 BR/BRT	12.7	12.1	9.9	16.4
⩾ 60 BR/BRT	12.2	15.5	10.4	9.6
Danish Seine	22.3	16.8	12.1	9.4
Net/Line	28.3	30.5	12.4	5.7
Other vessels	3.3	3.3	2.2	1.6
Unidentified	2.2	2.7	1.7	3.9

Table 3.4 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
	Bottom trawl			
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	344	23.9	720	53.5
1989	178	28.2	874	60.5
1990	323	27.3	628	45.3
	Nephrops trawl			
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	1,002	9.2	291	17.3
1989	1,243	12.8	355	18.1
1990	803	11.2	309	21.7

Table 3.5 CPUE data by seiners and gillnet for the Danish cod fishery expressed as catch (kg) per fishing day. Catch (C) expressed as tonnes and effort (f) as days.

	Danish seine			Nets		
	C	f	CPUE	C	f	CPUE
			Kattegat			
1983	584	1,563	374	39	216	180
1984	732	1,852	395	26	220	118
1985	458	522	877	11	25	440
1986	662	1,343	493	35	140	250
1987	451	976	462	80	181	387
1988	337	1,138	296	55	281	196
1989	328	1,320	248	123	508	242
1990[1]	276	1,087	254	51	285	179
			Skagerrak			
1983	177	520	340	148	188	787
1984	659	1,996	330	358	701	511
1985	310	716	433	206	449	459
1986	2,184	3,784	577	2,418	2,560	944
1987	919	2,170	423	384	971	396
1988	964	2,528	381	347	999	347
1989	970	3,316	293	132	480	275
1990[1]	719	3,028	237	202	650	311

[1] Preliminary.

Table 3.6 Cod in the Kattegat. Tuning data.

```
IIIa COD Tuning data Kattegat
103
Swedish bottom trawl
1978,1990
1,1
1,7
20.725,  7.564,517.047,219.283,180.515, 78.481,  7.135,  8.510
15.800, 25.436,377.487,730.733,118.345,124.077, 27.767,  1.314
23.263, 70.078,167.196,689.859,424.910, 45.449, 48.241, 15.234
20.712, 37.426,447.056,271.337,459.379,158.375, 16.659, 10.612
14.774, 43.069,404.852,409.033,271.464, 85.759, 55.103, 14.314
21.966,120.694,960.007,881.639,225.678, 37.705, 36.966, 10.350
35.219, 19.543,665.986,736.001,269.134, 43.240, 12.926,  4.155
29.349, 64.316,294.072,590.866,204.874, 36.336,  7.042,  0.751
20.792, 44.106,180.938,297.563,145.038, 36.926, 12.104,  1.231
19.217, 15.819,718.917,229.752, 83.991, 35.875,  9.699,  0.942
18.082, 23.534,157.486,318.775, 79.872, 20.325,  5.111,  1.902
17.422, 23.304,294.297,156.127,109.519, 15.920,  4.507,  2.110
17.546, 64.348,120.533,168.131, 51.415, 35.089,  3.392,  1.272
Swedish Nephr. trawl
1978,1990
1,1
1,7
17.677,  4.771,326.131,138.314,113.861, 49.502,  4.500,  5.368
17.752, 16.402,243.416,470.969, 76.313, 80.009, 17.711,  0.847
22.147, 39.718, 94.761,390.987,240.823, 25.759, 27.342,  8.634
23.077, 18.905,225.827,137.064,232.052, 80.002,  8.415,  5.360
20.216, 16.448,154.608,156.204,103.669, 32.750, 21.043,  5.466
14.905, 34.869,277.353,254.712, 65.200, 10.893, 10.680,  2.990
25.211,  4.253,144.922,159.488, 58.565,  9.409,  2.813,  0.904
27.230, 30.083,137.546,276.365, 95.825, 16.996,  3.294,  0.351
25.658, 17.349, 71.173,117.048, 57.051, 14.525,  4.761,  0.484
25.876,  6.228,283.048, 90.457, 33.069, 14.125,  3.818,  0.371
22.624,  8.619, 57.677,116.747, 29.252,  7.444,  1.872,  0.696
17.018,  9.016,114.097, 60.406, 42.374,  6.159,  1.744,  0.816
17.993, 31.662, 59.307, 82.727, 25.298, 17.265,  1.669,  0.626
Danish seine
1983,1990
1,1
1,7
99.770,  16.4,165.1,227.6,100.2, 28.9, 26.3, 12.6,  6.7
178.612,  5.1,181.7,304.2,166.3, 44.3, 14.3,  8.0,  7.9
26.411,  13.4, 84.6,199.6,113.3, 32.1,  9.9,  1.8,  3.4
128.292, 19.9, 85.5,249.9,190.0, 73.1, 32.7,  5.8,  5.0
46.847,   3.1,209.5,104.5, 67.4, 41.9, 16.6,  2.0,  6.0
94.599,   5.9, 57.5,163.0, 66.6, 27.2, 10.2,  5.4,  1.3
50.936,   5.7,106.1, 77.4, 98.2, 24.0, 10.1,  4.3,  2.4
72.049   28.3, 52.9, 73.9, 22.6, 15.4,  1.5,  0.6,  0.1
```

Table 3.7 SUM OF PRODUCTS CHECK

Cod in the Kattegat (Part of Fishing Area IIIa)
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: thousands

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	15049	38	5	591	188	166	1	88	213	552	328	340
2	7937	3811	623	4250	3610	4431	2218	6015	3161	1317	3918	3196
3	6936	6422	2167	6943	2906	6983	7078	2551	6116	5434	2378	3229
4	1918	2427	3954	4543	3251	1835	4942	2100	991	3347	4026	2143
5	887	809	2280	1538	661	1039	492	913	1039	358	1388	677
6	207	433	780	349	429	287	376	83	230	380	146	435
7	30	94	212	68	47	189	137	99	11	120	93	113
8+	30	38	160	31	19	52	102	71	47	35	78	36
TOTAL	32994	14072	10181	18313	11111	14982	15346	11920	11808	11543	12355	10169

	1983	1984	1985	1986	1987	1988	1989	1990
1	653	127	685	430	168	179	247	606
2	5194	4328	3132	1764	7635	1203	3122	1135
3	4770	4763	6293	2901	2440	2434	1653	1584
4	1221	1749	2182	1414	892	610	1159	485
5	204	281	387	360	381	155	169	330
6	200	84	75	118	103	39	48	32
7	56	27	8	12	10	15	22	12
8+	25	19	15	10	19	3	10	8
TOTAL	12323	11378	12777	7009	11648	4638	6430	4192

Table 3.8 SUM OF PRODUCTS CHECK

Cod in the Kattegat (Part of Fishing Area IIIa)
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: kilogram

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	.699	.699	.699	.699	.699	.699	.699	.699	.708	.691	.604	.600
2	.880	.880	.880	.880	.880	.880	.880	.880	.868	.893	.799	.784
3	1.069	1.069	1.069	1.069	1.069	1.069	1.069	1.170	1.086	.951	1.123	1.233
4	1.673	1.673	1.673	1.673	1.673	1.673	1.673	1.690	1.890	1.440	1.432	1.391
5	2.518	2.518	2.518	2.518	2.518	2.518	2.518	2.860	2.215	2.478	2.076	2.078
6	3.553	3.553	3.553	3.553	3.553	3.553	3.553	4.120	3.382	3.157	3.532	2.911
7	5.340	5.340	5.340	5.340	5.340	5.340	5.340	5.180	7.314	3.526	4.420	3.698
8+	6.635	6.635	6.635	6.635	6.635	6.635	6.635	6.900	6.101	6.903	4.644	6.480

	1983	1984	1985	1986	1987	1988	1989	1990
1	.595	.711	.606	.671	.483	.541	.621	.618
2	.752	.745	.839	.705	.716	.784	.921	.973
3	1.129	1.133	.986	1.253	1.118	1.099	1.269	1.584
4	1.943	1.687	1.614	1.955	1.972	1.792	2.296	2.323
5	3.348	2.798	2.575	2.956	2.868	2.880	3.856	3.288
6	3.141	3.022	4.090	4.038	4.200	4.283	5.733	5.383
7	5.301	5.273	6.847	7.100	5.185	5.852	5.166	6.412
8+	6.325	7.442	7.133	7.290	8.288	7.073	6.527	10.337

Table 3.9

```
Module run at 17.21.54  26 FEBRUARY 1991
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet  1 ,Swedish bottom trawl, has terminal q estimated as the mean
Fleet  2 ,Swedish Nephr. trawl, has terminal q estimated as the mean
Fleet  3 ,Danish seine        , has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **

Regression weights
      , .010, .061, .162, .298, .451, .601, .733, .839, .915, .964, .989, .999, 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,    89,    90,

    1,  .004,  .022,  .043,  .021,  .018,  .036,  .012,  .090,  .026,  .032,  .022,  .050,  .024,
    2,  .319,  .201,  .183,  .476,  .295,  .421,  .345,  .468,  .348,  .853,  .330,  .631,  .341,
    3,  .741,  .623,  .623,  .578,  .940,  .964,  .873, 1.276, 1.102, 1.182,  .746, 1.044,  .785,
    4,  .698,  .736,  .858, 1.477, 1.857, 1.261, 1.283, 1.484, 1.236, 1.391, 1.172, 1.027, 1.077,
    5,  .940,  .935,  .655, 1.154, 1.195, 1.011, 1.243, 1.223, 1.173, 1.605, 1.034, 1.395,  .977,
    6, 1.459,  .658, 1.166,  .619, 1.734, 1.743, 2.015, 1.607, 2.132, 1.496,  .702, 1.154, 1.215,
    7, 1.032,  .776,  .893, 1.083, 1.596, 1.339, 1.514, 1.438, 1.514, 1.497,  .970, 1.192, 1.090,

Log catchability estimates

 Age  1
 Fleet,    78,    79,    80,    81,    82,    83,    84,    85,    86,    87,    88,    89,    90
_____,_____,_____,_____,_____,_____,_____,_____,_____,_____,_____,_____,_____,_____
    1 ,-10.97, -8.71, -8.36, -9.05, -8.76, -8.11, -9.82, -8.16, -8.94, -8.77, -8.74, -8.21, -8.83
    2 ,-11.27, -9.26, -8.87, -9.84,-10.03, -8.97,-11.01, -8.84,-10.09,-10.00, -9.97, -9.13, -9.57
    3 ,      ,      ,      ,      ,      ,-11.62,-12.79, -9.62,-11.56,-11.29,-11.78,-10.69,-11.07

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,  Slope   ,       ,Intrcpt
_______,________,______,_______,_____,__________,__________,_______,_______
     1 , -8.71  ,  .411, .0029 , .0272,  .000E+00,  .000E+00, -8.710,   .137
     2 , -9.71  ,  .534, .0011 , .0210,  .000E+00,  .000E+00, -9.707,   .178
     3 ,-11.26  ,  .882, .0009 , .0198,  .000E+00,  .000E+00,-11.262,   .311
      Fbar     SIGMA(int.)    SIGMA(ext.)    SIGMA(overall)  Variance ratio
      .024        .306          .983E-01        .306             .103

 Age  2
 Fleet,    78,    79,    80,    81,    82,    83,    84,    85,    86,    87,    88,    89,    90
_____,_____,_____,_____,_____,_____,_____,_____,_____,_____,_____,_____,_____,_____
    1 , -6.63, -6.49, -6.91, -5.94, -5.98, -5.64, -6.50, -6.50, -6.37, -5.48, -6.04, -5.68, -6.18
    2 , -6.93, -7.05, -7.43, -6.73, -7.26, -6.50, -7.69, -7.19, -7.51, -6.71, -7.27, -6.60, -6.92
    3 ,      ,      ,      ,      ,      , -8.92, -9.42, -7.65, -8.94, -7.60, -8.70, -7.77, -8.42

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,  Slope   ,       ,Intrcpt
_______,________,______,_______,_____,__________,__________,_______,_______
     1 , -6.06  ,  .325, .0410 , .3865,  .000E+00,  .000E+00, -6.058,   .108
     2 , -7.05  ,  .327, .0155 , .2973,  .000E+00,  .000E+00, -7.055,   .109
     3 , -8.38  ,  .671, .0166 , .3558,  .000E+00,  .000E+00, -8.377,   .237
      Fbar     SIGMA(int.)    SIGMA(ext.)    SIGMA(overall)  Variance ratio
      .341        .218          .884E-01        .218             .164

 Age  3
 Fleet,    78,    79,    80,    81,    82,    83,    84,    85,    86,    87,    88,    89,    90
_____,_____,_____,_____,_____,_____,_____,_____,_____,_____,_____,_____,_____,_____
    1 , -5.78, -5.36, -5.68, -5.75, -4.82, -4.81, -5.56, -5.50, -5.21, -5.15, -5.22, -5.17, -5.35
    2 , -6.09, -5.91, -6.20, -6.54, -6.10, -5.67, -6.76, -6.19, -6.36, -6.38, -6.45, -6.10, -6.08
    3 ,      ,      ,      ,      ,      , -7.68, -8.07, -6.48, -7.21, -6.83, -7.55, -6.95, -7.58

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,  Slope   ,       ,Intrcpt
_______,________,______,_______,_____,__________,__________,_______,_______
     1 , -5.26  ,  .207, .0911 , .8583,  .000E+00,  .000E+00, -5.261,   .069
     2 , -6.26  ,  .228, .0345 , .6597,  .000E+00,  .000E+00, -6.258,   .076
     3 , -7.26  ,  .505, .0504 ,1.0811,  .000E+00,  .000E+00, -7.264,   .178
      Fbar     SIGMA(int.)    SIGMA(ext.)    SIGMA(overall)  Variance ratio
      .785        .147          .112            .147             .584
```

cont'd.

Table 3.9 Cont'd

Age 4

Fleet,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-5.85,	-5.19,	-5.36,	-4.81,	-4.14,	-4.55,	-5.18,	-5.35,	-5.10,	-4.99,	-4.77,	-5.19,	-5.03
2 ,	-6.15,	-5.75,	-5.88,	-5.60,	-5.42,	-5.40,	-6.37,	-6.04,	-6.24,	-6.22,	-6.00,	-6.12,	-5.77
3 ,	,	,	,	,	,	,	-6.87,	-7.29,	-5.84,	-6.65,	-6.10,	-6.61,	-6.37, -7.27

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-4.98 ,	.260,	.1202 ,	1.1339,	.000E+00,	.000E+00,	-4.983,	.087
2 ,	-5.98 ,	.255,	.0455 ,	.8719,	.000E+00,	.000E+00,	-5.981,	.085
3 ,	-6.61 ,	.515,	.0975 ,	2.0920,	.000E+00,	.000E+00,	-6.605,	.181

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.077	.172	.188	.188	1.196

Age 5

Fleet,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-5.55,	-4.95,	-5.63,	-5.06,	-4.58,	-4.77,	-5.22,	-5.54,	-5.15,	-4.85,	-4.89,	-4.89,	-5.13
2 ,	-5.85,	-5.51,	-6.15,	-5.85,	-5.86,	-5.62,	-6.41,	-6.23,	-6.30,	-6.07,	-6.12,	-5.81,	-5.86
3 ,	,	,	,	,	,	-6.55,	-6.82,	-5.56,	-6.29,	-5.58,	-6.26,	-5.55,	-7.37

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-5.04 ,	.224,	.1138 ,	1.0700,	.000E+00,	.000E+00,	-5.038,	.075
2 ,	-6.04 ,	.201,	.0430 ,	.8227,	.000E+00,	.000E+00,	-6.036,	.067
3 ,	-6.23 ,	.681,	.1425 ,	3.0539,	.000E+00,	.000E+00,	-6.226,	.240

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.977	.146	.199	.199	1.848

Age 6

Fleet,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-5.11,	-5.29,	-5.06,	-5.68,	-4.21,	-4.22,	-4.73,	-5.27,	-4.55,	-4.92,	-5.28,	-5.08,	-4.91
2 ,	-5.41,	-5.86,	-5.58,	-6.47,	-5.48,	-5.08,	-5.92,	-5.96,	-5.70,	-6.15,	-6.51,	-6.01,	-5.65
3 ,	,	,	,	,	,	-6.08,	-6.26,	-4.82,	-5.38,	-5.27,	-6.24,	-5.35,	-7.14

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-4.90 ,	.322,	.1303 ,	1.2291,	.000E+00,	.000E+00,	-4.903,	.107
2 ,	-5.90 ,	.327,	.0493 ,	.9450,	.000E+00,	.000E+00,	-5.900,	.109
3 ,	-5.82 ,	.770,	.2146 ,	4.5782,	.000E+00,	.000E+00,	-5.816,	.271

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.215	.220	.294	.294	1.781

Table 3.10 Cod in the Kattegat. Results from separable VPA.

from 72 to 90 on ages 1 to 7
with Terminal F of 1.011 on age 3 and Terminal S of 1.200

Initial sum of squared residuals was 448.164 and
final sum of squared residuals is 85.879 after 66 iterations

Matrix of Residuals

Years	72/73	73/74	74/75	75/76	76/77	77/78	78/79	79/80
Ages								
1/ 2	-.298	-3.825	.107	-.686	-.113	-6.482	-1.413	.568
2/ 3	.976	-1.675	.084	-.351	-.201	-.147	-.038	-.325
3/ 4	.179	-.772	-.402	-.014	-.207	.354	.100	.025
4/ 5	-.486	.659	.459	.401	.484	.530	-.429	.168
5/ 6	-.463	1.620	-.157	.130	.212	.650	.281	.191
6/ 7	-.041	1.951	.283	-.139	-.319	-.065	.653	-.424
	.000	.000	.000	.000	.000	.000	.000	.000
WTS	.001	.001	.001	.001	.001	.001	.001	.001

Years	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90		WTS
Ages												
1/ 2	.553	.260	-.552	.369	-.817	1.175	-.526	-.141	-.318	.638	.000	.153
2/ 3	-.293	.425	-.580	.007	-.367	-.209	-.387	.601	-.099	.464	.000	.496
3/ 4	-.222	-.552	-.180	-.025	-.180	.180	.116	-.190	.059	.016	.000	1.000
4/ 5	.079	.822	.853	.106	.209	.118	-.105	-.206	.291	-.311	.000	.691
5/ 6	.123	.213	-.269	-.464	.025	-.492	-.166	.336	.191	.105	.000	.572
6/ 7	.382	-.940	.282	.379	.793	-.136	.784	-.329	-.658	-.456	.000	.414
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-7.625	
WTS	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	72	73	74	75	76	77	78	79	80
F-values	.3794	.4326	.8153	.5341	.6194	.7421	.6783	.5754	.6135

	81	82	83	84	85	86	87	88	89	90
F-values	.7632	1.0306	.9584	.9735	1.1701	1.0555	1.2414	.7918	1.0866	1.0110

Selection-at-age (S)

	1	2	3	4	5	6	7
S-values	.0320	.4614	1.0000	1.2357	1.2661	1.4072	1.2000

Table 3.11 VIRTUAL POPULATION ANALYSIS

Cod in the Kattegat (Part of Fishing Area IIIa)

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

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	.002	.000	.022	.008	.017	.000	.004	.022	.043	.021	.018	.036
2	.281	.037	.452	.178	.261	.319	.318	.201	.182	.476	.295	.421
3	.551	.255	.721	.645	.612	.858	.742	.621	.622	.577	.939	.963
4	.512	.800	1.316	.921	1.183	1.281	.681	.737	.852	1.471	1.852	1.258
5	.499	1.416	.870	.673	.892	1.345	.892	.886	.657	1.133	1.176	1.001
6	.521	1.391	.887	.643	.711	1.009	.888	.589	1.009	.622	1.611	1.626
7	.453	.525	.395	.271	.665	.921	.825	.266	.715	.741	1.622	1.010
8+	.453	.525	.395	.271	.665	.921	.825	.266	.715	.741	1.622	1.010
(2- 6)U	.473	.780	.849	.612	.732	.962	.704	.607	.664	.856	1.174	1.054
(2- 8)U	.467	.707	.719	.515	.713	.950	.739	.510	.679	.823	1.302	1.041

	1984	1985	1986	1987	1988	1989	1990	1986-90
1	.012	.090	.027	.032	.023	.057	.032	.034
2	.345	.468	.348	.869	.337	.677	.394	.525
3	.874	1.279	1.104	1.182	.777	1.091	.910	1.013
4	1.280	1.489	1.244	1.403	1.174	1.138	1.228	1.237
5	1.231	1.211	1.188	1.649	1.062	1.401	1.329	1.326
6	1.922	1.544	2.024	1.574	.761	1.252	1.235	1.369
7	1.134	1.159	1.283	1.166	1.154	1.499	1.430	1.306
8+	1.134	1.159	1.283	1.166	1.154	1.499	1.430	1.306
(2- 6)U	1.130	1.198	1.182	1.336	.822	1.112	1.019	
(2- 8)U	1.131	1.187	1.211	1.287	.917	1.222	1.136	

Table 3.12 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

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	22873	15641	30356	26094	11078	29599	23461	10846	14442	17148	20585	20580
2	17097	18693	12801	24320	21194	8920	24233	19128	8688	11325	13743	16546
3	16575	10571	14742	6670	16660	13367	5310	14435	12815	5927	5761	8379
4	6622	7822	6706	5872	2864	7396	4639	2071	6350	5633	2725	1844
5	2254	3248	2879	1473	1914	719	1682	1923	811	2218	1060	350
6	1167	1120	646	987	615	642	153	564	649	344	585	268
7	282	567	228	218	425	247	192	52	256	194	151	96
8+	114	428	104	88	117	184	138	221	75	163	48	43
TOTAL NO	66984	58091	68461	65721	54867	61074	59808	49240	44086	42951	44658	48106
SPS NO	27014	23757	25304	15307	22595	22555	12114	19266	20957	14478	10330	10980
TOT.BIOM	71916	69799	70913	65557	59045	61836	59163	51765	44548	41560	38795	40522
SPS BIOM	40882	42417	38429	25916	32651	33297	21439	27483	26811	22154	15670	15834

	1984	1985	1986	1987	1988	1989	1990	1991
1	11343	8800	17940	5822	8659	4937	21009	0
2	16260	9172	6587	14299	4615	6927	3819	16653
3	8888	9426	4702	3809	4908	2698	2883	2108
4	2619	3035	2148	1276	956	1847	742	950
5	429	596	560	507	257	242	485	178
6	105	103	145	140	80	73	49	105
7	43	13	18	16	24	31	17	12
8+	30	24	15	30	5	14	11	6
TOTAL NO	39718	31168	32116	25898	19502	16769	29015	
SPS NO	12115	13196	7589	5777	6229	4904	4186	
TOT.BIOM	36639	29432	29253	22195	16663	18709	25072	
SPS BIOM	16460	16403	12572	9145	8360	9263	8372	

Table 3.13 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[1]	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
1989	15.9	2,255	8.0
1990	1.9	1,636	74.0

Year class	Kattegat Cod - 1-group	Kattegat 2-group	Skagerrak Cod - 1-group	Skagerrak 2-group
1979	-	131.3		85.0
1980	26.0	32.6	15.0	31.0
1981	104.0	258.0	36.0	30.4
1982	95.5	143.0	28.4	18.6
1983	38.8	106.0	23.4	51.8
1984	9.2	71.8	13.5	10.5
1985	213.0	372.0	77.9	113.0
1986	11.1	27.8	5.4	18.1
1987	68.4	47.8	77.0	23.8
1988	2.8	9.7	56.0	9.6
1989	153.0		30.9	
1990	39.0		42.0	

[1] Norwegian survey.

Table 3.14

Analysis by RCRTINX2 of data from file katiyfs:dat
COD IN THE KATTEGAT AS 1-GROUP, 1 AND 2-GROUP DATA, YEARCLASSES 79-89

Data for 2 surveys over 12 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	1.3350	.703	6.871	.3145	9	7.8096	.71910	.92698	.10538
IYFS2	2.8332	.671	6.345	.6753	9	8.2463	.33776	.44633	.45457
MEAN						9.4480	.45363	.45363	.44005

Yearclass = 1989

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	5.0370	.557	7.436	.5089	10	10.2416	.55234	.62664	.41453
IYFS2									
MEAN						9.3403	.52728	.52728	.58547

Yearclass = 1990

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	3.6889	.520	7.532	.5771	11	9.4493	.48869	.51282	.52401
IYFS2									
MEAN						9.3916	.53807	.53807	.47599

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1988	8.73	6180.02	.30	.46	8.50 4938.00	1.53
1989	9.71	16546.38	.40	.44	9.9521009.98	1.10
1990	9.42	12355.16	.37	.03		.08

Table 3.15

List of input variables for the ICES prediction program.

Cod in the Kattegat
The reference F is the mean F (non-weighted) for the age group range from 2 to 6

The number of recruits per year is as follows:

Year	Recruitment
1991	12300.0
1992	10000.0
1993	10000.0

Proportion of F (fishing mortality) effective before spawning: .0000
Proportion of M (natural mortality) effective before spawning: .0000

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	12300.0	.03	.20	.00	.618	.618
2	13110.0	.44	.20	.00	.973	.973
3	2108.0	.94	.20	1.00	1.584	1.584
4	950.0	1.16	.20	1.00	2.323	2.323
5	178.0	1.20	.20	1.00	3.288	3.288
6	105.0	1.20	.20	1.00	5.383	5.383
7	12.0	1.20	.20	1.00	6.412	6.412
8+	6.0	1.20	.20	1.00	10.337	10.337

For data that can be entered by file or manually by screen the following table gives the method of input by age group. The identifiers in the table are to be interpreted as:

space: not defined or set by the program
M : manual input by screen
F : data read from a file

age	F at age	M at age	maturity ogive	weight in the catch	weight in the stock
1	M	F	F	F	F
2	M	F	F	F	F
3	M	F	F	F	F
4	M	F	F	F	F
5	M	F	F	F	F
6	M	F	F	F	F
7	M	F	F	F	F
8+	M	F	F	F	F

proportion of F before spawning: F
proportion of M before spawning: F

The data from the files were selected as follows:

M at age: year 1990 from file NATMOR
Maturity ogive: year 1990 from file MORPROP
Catch weight: year 1990 from file WECA
Stock weight: year 1990 from file WEST
Proportions of F and M: from file MORPROP

Table 3.16

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

Cod in the Kattegat

Year 1991					Year 1992					Year 1993	
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
.7	.71	27193	6835	6649	.0	.00	31919	16150	0	46317	32171
					.2	.20		16150	3416	41694	27596
					.4	.40		16150	6306	37799	23748
					.6	.59		16150	8760	34507	20503
					.8	.79		16150	10850	31715	17758
					1.0	.99		16150	12636	29340	15430
					1.2	1.19		16150	14169	27313	13449
					1.4	1.38		16150	15489	25577	11758
					1.6	1.58		16150	16630	24084	10311
					1.8	1.78		16150	17620	22796	9068
					2.0	1.98		16150	18484	21680	7998
1.0	.99	27193	6835	8454	.0	.00	29455	13766	0	43344	29198
					.2	.20		13766	3005	39267	25168
					.4	.40		13766	5558	35815	21763
					.6	.59		13766	7735	32882	18878
					.8	.79		13766	9598	30384	16427
					1.0	.99		13766	11197	28248	14338
					1.2	1.19		13766	12576	26416	12552
					1.4	1.38		13766	13769	24839	11020
					1.6	1.58		13766	14804	23476	9703
					1.8	1.78		13766	15707	22294	8567
					2.0	1.98		13766	16498	21266	7583

The data unit of the biomass and the catch is tonnes.
The spawning stock biomass is given for the time of spawning.
The spawning stock biomass for 1993 has been calculated with the same fishing mortality as for 1992.
The reference F is the mean F (non-weighted) for the age group range from 2 to 6

Table 3.17

```
IIIa COD Tuning data Skagerrak
103
Swedish bottom trawl
1979,1990
1,1
1,7
  4.504,  2.908, 29.115, 19.899,  3.231,  1.360,  0.229,  0.222
  7.336, 11.679, 72.230, 52.817, 19.150,  3.824,  1.030,  0.898
 10.675,  4.278,121.314, 68.213, 12.857,  3.168,  0.484,  0.539
 10.534, 19.110, 78.705,117.721, 35.548,  4.282,  3.097,  1.292
 15.158, 26.747, 90.919, 50.866, 24.300,  4.380,  1.284,  0.483
 16.426,  6.360,131.811, 57.951, 13.634,  5.222,  1.306,  0.019
 16.338, 21.877,121.551, 65.373, 20.180,  4.880,  2.923,  0.778
 16.628, 56.150, 70.788, 59.395, 30.172,  5.990,  1.036,  0.673
 16.403,  4.171,310.621, 56.745, 12.714,  3.463,  1.744,  0.430
 17.617, 18.928, 48.354, 96.000, 10.832,  2.736,  1.024,  0.149
  8.449, 13.751,107.954, 54.760, 27.063,  2.989,  1.794,  0.317
 17.795, 17.633,109.279, 69.323, 11.026,  9.004,  1.021,  1.042
Swedish Nephr. trawl
1979,1990
1,1
1,7
 63.247, 26.089,261.191,178.516, 28.988, 12.199,  2.053,  1.993
 52.261, 57.150,353.461,258.462, 93.713, 18.710,  5.039,  4.396
 79.250, 21.782,617.631,347.285, 65.459, 16.127,  2.464,  2.744
 48.185, 57.247,235.773,352.652,106.490, 12.828,  9.276,  3.869
 65.335,100.728,342.397,191.650, 91.514, 16.494,  4.835,  1.820
 95.678, 18.463,382.643,168.229, 39.580, 15.161,  3.790,  1.191
 88.094, 64.125,356.281,191.615, 59.150, 14.304,  8.568,  2.280
104.366,119.097,150.144,125.980, 63.997, 12.704,  2.197,  1.428
113.532,  8.806,655.825,119.809, 26.844,  7.311,  3.682,  0.907
133.819, 54.342,138.222,275.614, 31.099,  7.855,  2.939,  0.427
130.042, 45.300,355.626,180.391, 89.153,  9.848,  5.909,  1.043
107.906, 43.837,271.674,172.342, 27.411, 22.385,  2.539,  2.591
Danish Seine
1983,1990
1,1
1,7
 5.0,   8.2, 47.3,   51.7, 42.0,  13.0,  5.4,  2.1
75.4,   7.2,261.5,  220.8, 86.5,  50.5, 17.9,  7.4
15.3,  10.6, 99.3,  102.0, 53.3,  19.9, 16.9,  5.9
448.6,229.5,479.9,  725.2,476.0, 168.6, 46.7, 36.9
110.8,  4.2,567.5,  183.9, 86.4,  35.3, 24.1,  7.2
164.6, 37.5,179.8,  156.6,100.3,  49.8, 25.8,  4.7
226.4, 24.0,327.7,  266.2,248.9,  48.1, 40.4,  8.7
161.4, 39.3,243.3,  154.3, 24.5,  20.0,  2.3,  2.3
```

Table3.18 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	1989
1	4337	432	1066	389	1080	1771	341	928	3253	165	1035	794
2	11174	4325	6593	11030	4448	6020	7067	5156	4101	12289	2645	6237
3	2889	2956	4821	6202	6653	3368	3107	2773	3441	2245	5251	3163
4	775	480	1748	1169	2009	1609	731	856	1748	503	592	1564
5	182	202	349	288	242	290	280	207	347	137	150	172
6	166	34	94	44	175	85	70	124	60	69	56	104
7	44	33	82	49	73	32	22	33	39	17	8	18
8+	52	28	11	6	27	69	17	9	21	19	13	12
TOTAL	19619	8490	14764	19177	14707	13244	11635	10086	13010	15444	9750	12064

	1990
1	846
2	5243
3	3326
4	529
5	432
6	49
7	50
8+	33
TOTAL	10508

Table 3.19 SUM OF PRODUCTS CHECK

Cod in the Skagerrak (Part of Fishing Area IIIa)
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: kilogram

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	.599	.599	.746	.619	.656	.590	.647	.649	.683	.580	.637	.612
2	.860	.860	1.146	.972	1.204	1.007	1.130	1.094	1.133	1.048	1.195	1.064
3	1.894	1.894	1.570	1.902	1.865	1.967	2.170	2.089	2.040	1.859	1.863	1.704
4	3.498	3.498	3.347	3.711	2.709	3.350	3.616	3.537	2.636	3.896	2.978	3.224
5	5.510	5.510	4.865	5.261	6.107	5.751	5.505	5.472	4.702	5.849	5.830	5.637
6	7.093	7.093	8.932	9.491	8.018	8.074	7.814	7.746	7.538	7.914	8.095	7.890
7	7.304	7.304	8.301	8.514	8.738	8.586	10.319	10.255	9.164	9.607	10.245	9.686
8+	9.888	9.888	11.085	10.094	12.658	11.963	12.856	12.854	9.777	12.467	13.060	10.800

	1990
1	.603
2	1.150
3	2.110
4	3.703
5	4.678
6	5.546
7	8.500
8+	10.745

Table 3.20

Module run at 17.28.45 26 FEBRUARY 1991
DISAGGREGATED Qs
LOG TRANSFORMATION
Explanatory variate TIME
Fleet 1 ,Swedish bottom trawl, has terminal q estimated as the mean
Fleet 2 ,Swedish Nephr. trawl, has terminal q estimated as the mean
Fleet 3 ,Danish Seine , has terminal q estimated from trend
FLEETS COMBINED BY ** VARIANCE **
erminal Fs estimated using Hybrid method
Regression weights
, .012, .075, .193, .348, .515, .670, .798, .893, .954, .986, .998, 1.000,
Oldest age F = 1.000*average of 3 younger ages. Fleets combined by variance of predictions
Fishing mortalities

Age,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89,	90,
1,	.020,	.039,	.031,	.073,	.103,	.026,	.090,	.115,	.018,	.069,	.060,	.057,
2,	.421,	.461,	.679,	.574,	.707,	.744,	.652,	.697,	.808,	.434,	.741,	.687,
3,	.691,	1.216,	1.096,	1.236,	1.239,	1.033,	.753,	1.354,	1.108,	1.041,	1.519,	1.235,
4,	.539,	1.250,	1.215,	1.528,	1.277,	1.056,	.941,	1.900,	.730,	1.060,	1.097,	1.313,
5,	.585,	.995,	.704,	.921,	1.024,	.807,	1.045,	1.457,	.806,	.500,	1.106,	1.118,
6,	.191,	.602,	.309,	1.385,	1.042,	.752,	1.104,	1.056,	1.602,	.959,	.791,	1.211,
7,	.439,	.949,	.742,	1.278,	1.115,	.872,	1.030,	1.471,	1.046,	.840,	.998,	1.214,

Log catchability estimates

Age 1

Fleet,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-10.43,	-9.76,	-10.35,	-9.01,	-9.18,	-10.43,	-8.95,	-9.04,	-10.50,	-9.54,	-9.00,	-9.62
2 ,	-10.88,	-10.14,	-10.73,	-9.44,	-9.32,	-11.13,	-9.56,	-10.12,	-11.68,	-10.51,	-10.54,	-10.51
3 ,	,	,	,	,	-9.25,	-11.83,	-9.61,	-10.92,	-12.40,	-11.09,	-11.73,	-11.03

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-9.53 ,	.509,	.0013 ,	.0619,	.000E+00,	.000E+00,	-9.532,	.175
2 ,	-10.44 ,	.605,	.0031 ,	.0608,	.000E+00,	.000E+00,	-10.442,	.208
3 ,	-11.66 ,	1.080,	.0014 ,	.0301,	-.182E+00,	.158E+00,	-9.291,	1.607

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.057	.366	.161	.366	.194

Age 2

Fleet,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-7.37,	-7.28,	-7.27,	-6.94,	-7.26,	-7.08,	-6.97,	-7.23,	-6.69,	-7.70,	-6.49,	-7.12
2 ,	-7.82,	-7.66,	-7.64,	-7.37,	-7.39,	-7.77,	-7.58,	-8.32,	-7.88,	-8.68,	-8.03,	-8.02
3 ,	,	,	,	,	-6.80,	-7.92,	-7.10,	-8.61,	-8.00,	-8.63,	-8.67,	-8.53

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-7.06 ,	.311,	.0153 ,	.7342,	.000E+00,	.000E+00,	-7.059,	.107
2 ,	-7.97 ,	.336,	.0374 ,	.7210,	.000E+00,	.000E+00,	-7.968,	.116
3 ,	-8.82 ,	.517,	.0237 ,	.5117,	-.221E+00,	.758E-01,	-5.949,	.770

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.687	.209	.924E-01	.209	.195

Age 3

Fleet,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-6.87,	-6.31,	-6.79,	-6.18,	-6.70,	-6.75,	-6.82,	-6.57,	-6.37,	-6.83,	-5.77,	-6.54
2 ,	-7.32,	-6.69,	-7.16,	-6.60,	-6.83,	-7.44,	-7.43,	-7.65,	-7.56,	-7.80,	-7.31,	-7.43
3 ,	,	,	,	,	-5.57,	-6.93,	-6.31,	-7.36,	-7.11,	-8.58,	-7.48,	-7.94

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-6.50 ,	.298,	.0266 ,	1.2774,	.000E+00,	.000E+00,	-6.505,	.102
2 ,	-7.41 ,	.267,	.0650 ,	1.2550,	.000E+00,	.000E+00,	-7.414,	.092
3 ,	-8.20 ,	.653,	.0444 ,	.9569,	-.290E+00,	.958E-01,	-4.429,	.972

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.235	.190	.552E-01	.190	.084

cont'd.

Table 3.20 Cont'd

Age 4

Fleet	79	80	81	82	83	84	85	86	87	88	89	90
1	-7.12	-6.28	-6.68	-5.97	-6.67	-6.73	-6.60	-6.23	-6.79	-6.81	-6.10	-6.48
2	-7.57	-6.66	-7.06	-6.39	-6.80	-7.42	-7.21	-7.31	-7.98	-7.78	-7.64	-7.37
3					-5.01	-6.40	-5.57	-6.77	-6.78	-6.82	-7.17	-7.88

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-6.51	.243	.0265	1.2704	.000E+00	.000E+00	-6.510	.084
2	-7.42	.346	.0647	1.2482	.000E+00	.000E+00	-7.420	.119
3	-7.69	.447	.0741	1.5997	-.323E+00	.655E-01	-3.487	.665

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.313	.182	.623E-01	.182	.118

Age 5

Fleet	79	80	81	82	83	84	85	86	87	88	89	90
1	-7.04	-6.51	-7.23	-6.47	-6.89	-6.99	-6.50	-6.49	-6.69	-7.57	-6.09	-6.64
2	-7.49	-6.89	-7.61	-6.89	-7.02	-7.69	-7.11	-7.58	-7.88	-8.54	-7.63	-7.53
3					-4.69	-6.25	-5.03	-6.45	-6.28	-6.90	-6.60	-8.05

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-6.72	.372	.0215	1.0324	.000E+00	.000E+00	-6.718	.128
2	-7.63	.397	.0526	1.0143	.000E+00	.000E+00	-7.627	.137
3	-7.56	.641	.0844	1.8240	-.366E+00	.940E-01	-2.801	.954

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.118	.250	.147	.250	.344

Age 6

Fleet	79	80	81	82	83	84	85	86	87	88	89	90
1	-8.16	-7.01	-8.05	-6.06	-6.87	-7.07	-6.44	-6.82	-6.00	-6.91	-6.43	-6.56
2	-8.61	-7.39	-8.43	-6.49	-7.01	-7.76	-7.05	-7.90	-7.19	-7.89	-7.97	-7.45
3					-4.32	-5.97	-4.62	-6.30	-5.29	-5.92	-6.60	-7.95

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-6.63	.360	.0236	1.1328	.000E+00	.000E+00	-6.625	.124
2	-7.53	.389	.0576	1.1125	.000E+00	.000E+00	-7.535	.134
3	-7.20	.838	.1206	2.5687	-.385E+00	.123E+00	-2.196	1.247

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.211	.252	.168	.252	.444

Table 3.21 Cod in the Skagerrak (part of fishing area IIIa).

from 78 to 90 on ages 1 to 7
with Terminal F of 1.262 on age 3 and Terminal S of .900

Initial sum of squared residuals was 177.186 and
final sum of squared residuals is 14.772 after 53 iterations

Matrix of Residuals

Years	78/79	79/80
Ages		
1/ 2	1.354	-.135
2/ 3	.219	.147
3/ 4	-.149	.120
4/ 5	-.714	-.178
5/ 6	.007	.570
6/ 7	-.152	-1.151
	.000	.000
WTS	.100	.100

Years	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90		WTS
Ages												
1/ 2	-.491	-.201	.188	.359	-.693	.754	.267	-.867	.404	.028	.000	.368
2/ 3	-.560	.278	-.388	-.127	.508	.118	-.421	.302	-.446	-.018	.000	.651
3/ 4	.005	.154	-.084	-.097	.099	-.596	-.007	.007	.192	.310	.000	1.000
4/ 5	.298	.526	.360	.036	-.017	-.217	.536	-.209	.140	-.265	.000	.620
5/ 6	.927	-.216	-.153	.090	-.117	.461	.015	-.169	-.391	.078	.000	.604
6/ 7	-.587	-1.312	.394	-.083	-.271	.281	-.454	.998	.285	-.550	.000	.348
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-.672	
WTS	.100	.100	.100	.100	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	78	79	80
F-values	1.2555	.5978	1.1041

	81	82	83	84	85	86	87	88	89	90
F-values	.9405	1.2887	1.2776	1.0023	1.0446	1.5288	1.0577	.9626	1.2661	1.2620

Selection-at-age (S)

	1	2	3	4	5	6	7
S-values	.0494	.5970	1.0000	.9797	.8054	.8691	.9000

Table 3.22 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	1989
1	.249	.020	.039	.031	.072	.103	.026	.090	.114	.018	.069	.063
2	.930	.421	.461	.678	.574	.705	.744	.655	.695	.804	.432	.727
3	1.120	.688	1.214	1.095	1.233	1.239	1.027	.753	1.370	1.098	1.026	1.499
4	.907	.549	1.234	1.206	1.522	1.267	1.054	.926	1.894	.753	1.034	1.052
5	.658	.639	1.036	.682	.904	1.013	.790	1.040	1.384	.798	.529	1.030
6	1.022	.240	.710	.333	1.271	.992	.732	1.044	1.044	1.301	.937	.884
7	1.103	.572	1.534	1.063	1.538	.859	.772	.965	1.220	1.015	.483	.939
8+	1.103	.572	1.534	1.063	1.538	.859	.772	.965	1.220	1.015	.483	.939
(2- 6)U	.927	.508	.931	.799	1.101	1.043	.869	.884	1.278	.951	.791	1.038
(2- 8)U	.978	.526	1.103	.874	1.226	.990	.842	.907	1.261	.969	.703	1.010

	1990	1986-90
1	.062	.065
2	.739	.679
3	1.174	1.233
4	1.248	1.196
5	.992	.947
6	.986	1.030
7	1.738	1.079
8+	1.738	1.079
(2- 6)U	1.028	
(2- 8)U	1.231	

Table 3.23 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	21623	24364	31021	14018	17045	19883	14678	11932	33176	10266	17219	14234
2	20059	13802	19558	24436	11126	12981	14681	11709	8932	24229	8256	13164
3	4647	6482	7420	10102	10153	5129	5253	5714	4979	3651	8881	4387
4	1413	1242	2667	1805	2767	2422	1217	1540	2204	1036	997	2607
5	412	467	587	635	442	494	559	347	500	271	399	290
6	281	175	202	171	263	147	147	208	100	102	100	193
7	71	83	113	81	100	60	45	58	60	29	23	32
8+	84	70	15	10	37	130	34	16	32	32	37	21
TOTAL NO	48591	46685	61582	51258	41934	41246	36613	31524	49983	39617	35913	34929
SPS NO	6909	8518	11003	12804	13763	8382	7254	7883	7875	5122	10438	7531
TOT.BIOM	49568	48196	71889	64094	57162	49106	47011	42244	52717	45249	44207	42297
SPS BIOM	19365	21732	26334	31666	32585	24304	20924	21690	19937	13902	23372	19579

	1990	1991
1	15438	0
2	10937	11876
3	5211	4276
4	802	1318
5	745	189
6	85	226
7	65	26
8+	43	16
TOTAL NO	33327	
SPS NO	6952	
TOT.BIOM	40826	
SPS BIOM	18939	

Table 3.24 Cod in the Skagerrak as 1-group, 1- and 2-group data, Year classes 1979-1990.

```
Data for    2 surveys over   12 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER =    3 OVER  12 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN    INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS        .00
MINIMUM OF   5 POINTS USED FOR REGRESSION
```

Yearclass = 1989

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	3.4626	.527	7.883	.5737	9	9.7091	.34817	.37176	.51270
IYFS2									
MEAN						9.6999	.38132	.38132	.48730

Yearclass = 1990

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	3.7612	.526	7.868	.5678	10	9.8448	.33396	.35917	.49640
IYFS2									
MEAN						9.6822	.35659	.35659	.50360

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1989	9.70	16392.77	.27	.00	9.6415438.99	.02
1990	9.76	17377.70	.25	.08		.32

Table 3.25

List of input variables for the ICES prediction program.

PROGNOSES FOR COD IN THE SKAGERRAK
The reference F is the mean F (non-weighted) for the age group range from 2 to 6

The number of recruits per year is as follows:

Year	Recruitment
1991	17000.0
1992	17000.0
1993	17000.0

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	17000.0	.07	.20	.00	.623	.623
2	12600.0	.80	.20	.00	1.118	1.118
3	4276.0	1.15	.20	1.00	1.915	1.915
4	1318.0	1.15	.20	1.00	3.287	3.287
5	189.0	1.15	.20	1.00	5.339	5.339
6	226.0	1.15	.20	1.00	7.397	7.397
7	26.0	1.15	.20	1.00	9.440	9.440
8+	16.0	1.15	.20	1.00	11.370	11.370

For data that can be entered by file or manually by screen the following table gives the method of input by age group. The identifiers in the table are to be interpreted as:

space: not defined or set by the program
M : manual input by screen
F : data read from a file

age	F at age	M at age	maturity ogive	weight in the catch	weight in the stock
1	M	F	F	F	F
2	M	F	F	F	F
3	M	F	F	F	F
4	M	F	F	F	F
5	M	F	F	F	F
6	M	F	F	F	F
7	M	F	F	F	F
8+	M	F	F	F	F

The data from the files were selected as follows:

M at age:	year 1990 from file NATMOR
Maturity ogive:	year 1990 from file MORPROP
Catch weight:	mean values for years 1986 - 1990 from file WECA
Stock weight:	mean values for years 1986 - 1990 from file WEST

Table 3.26

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

PROGNOSES FOR COD IN THE SKAGERRAK

Year 1991					Year 1992					Year 1993	
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
.8	.84	40308	15630	15012	.0	.00	44292	18967	0	71920	45768
					.2	.22			5659	63490	37554
					.4	.43			10329	56575	30853
					.6	.65			14193	50890	25378
					.8	.86			17399	46205	20900
					1.0	1.08			20069	42334	17234
					1.2	1.30			22299	39126	14228
					1.4	1.51			24170	36459	11760
					1.6	1.73			25744	34235	9732
					1.8	1.94			27075	32373	8064
					2.0	2.16			28206	30808	6689
1.0	1.08	40308	15630	17636	.0	.00	40485	15385	0	66917	40765
					.2	.22			4959	59497	33562
					.4	.43			9066	53387	27665
					.6	.65			12478	48344	22832
					.8	.86			15320	44170	18866
					1.0	1.08			17695	40708	15608
					1.2	1.30			19688	37826	12928
					1.4	1.51			21365	35420	10720
					1.6	1.73			22783	33403	8900
					1.8	1.94			23987	31707	7397
					2.0	2.16			25014	30274	6155

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 (non-weighted) for the age group range from 2 to 6

Table 3.27

```
Module run at 14.39.34  04 APRIL 1991
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet  1 ,Swedish bottom trawl, has terminal q estimated as the mean
Fleet  2 ,Swedish Nephr. trawl, has terminal q estimated as the mean
Fleet  3 ,Danish seine Kattega, has terminal q estimated as the mean
Fleet  4 ,Swedish bottom trawl, has terminal q estimated as the mean
Fleet  5 ,Swedish Nephr. trawl, has terminal q estimated as the mean
Fleet  6 ,Danish Seine Skagerr, 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, 1.000, 1.000,
Oldest age F = 1.000*average of 5 younger ages. Fleets combined by variance of predictions
Fishing mortalities

  Age,    78,    79,    80,    81,    82,    83,    84,    85,    86,    87,    88,    89,    90,

    1,  .114,  .020,  .040,  .026,  .042,  .068,  .020,  .090,  .083,  .023,  .055,  .062,  .036,
    2,  .552,  .287,  .367,  .610,  .411,  .536,  .515,  .567,  .535,  .831,  .400,  .740,  .649,
    3,  .887,  .642,  .802,  .872, 1.116, 1.060,  .928, 1.046, 1.223, 1.153,  .941, 1.349, 1.193,
    4,  .733,  .642,  .954, 1.400, 1.674, 1.262, 1.204, 1.264, 1.516, 1.039, 1.137, 1.122, 1.326,
    5,  .803,  .841,  .749, 1.022, 1.088, 1.011,  .957, 1.150, 1.279, 1.252,  .674, 1.316, 1.226,
    6, 1.100,  .454,  .951,  .459, 1.537, 1.357, 1.095, 1.179, 1.540, 1.465,  .828,  .877, 1.557,
    7,  .815,  .573,  .764,  .872, 1.165, 1.045,  .940, 1.041, 1.219, 1.148,  .796, 1.081, 1.190,

Log catchability estimates

 Age  1
 Fleet,    78,    79,    80,    81,    82,    83,    84,    85,    86,    87,    88,    89,    90
______,______,______,______,______,______,______,______,______,______,______,______,______,______
     1 ,-11.57, -9.89, -9.50, -9.64, -9.35, -8.77,-10.65, -9.01, -9.95, -9.76, -9.75, -9.43, -9.32
     2 ,-11.87,-10.44,-10.02,-10.44,-10.62, -9.63,-11.84, -9.70,-11.09,-10.99,-10.97,-10.36,-10.05
     3 ,      ,      ,      ,      ,      ,-12.28,-13.62,-10.47,-12.56,-12.29,-12.78,-11.91,-11.55
     4 ,      ,-10.80,-10.14,-11.15, -9.82, -9.91,-11.01, -9.50, -9.48,-10.94, -9.94, -9.23,-10.62
     5 ,      ,-11.25,-10.52,-11.53,-10.24,-10.05,-11.71,-10.11,-10.57,-12.13,-10.91,-10.78,-11.52
     6 ,      ,      ,      ,      ,      , -9.98,-12.41,-10.16,-11.37,-12.84,-11.49,-11.97,-12.03

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,   Slope  ,       ,Intrcpt
_______,________,______,_______,_______,__________,__________,_______,_______
     1 , -9.74  ,  .746, .0010 , .0234,   .000E+00,   .000E+00, -9.738,   .199
     2 ,-10.62  ,  .746, .0004 , .0202,   .000E+00,   .000E+00,-10.618,   .199
     3 ,-12.18  ,  .980, .0004 , .0189,   .000E+00,   .000E+00,-12.184,   .327
     4 ,-10.21  ,  .693, .0007 , .0538,   .000E+00,   .000E+00,-10.213,   .192
     5 ,-10.94  ,  .707, .0019 , .0633,   .000E+00,   .000E+00,-10.942,   .196
     6 ,-11.53  , 1.078, .0016 , .0585,   .000E+00,   .000E+00,-11.532,   .359
      Fbar      SIGMA(int.)     SIGMA(ext.)     SIGMA(overall)  Variance ratio
      .036         .323            .230            .323             .508

 Age  2
 Fleet,    78,    79,    80,    81,    82,    83,    84,    85,    86,    87,    88,    89,    90
______,______,______,______,______,______,______,______,______,______,______,______,______,______
     1 , -7.13, -7.00, -8.01, -7.04, -6.52, -6.17, -7.07, -7.29, -7.14, -6.46, -7.01, -6.62, -7.27
     2 , -7.43, -7.55, -8.53, -7.83, -7.80, -7.02, -8.26, -7.97, -8.28, -7.69, -8.24, -7.54, -8.00
     3 ,      ,      ,      ,      ,      , -9.44, -9.99, -8.43, -9.71, -8.59, -9.67, -8.71, -9.50
     4 ,      , -8.30, -7.69, -7.68, -7.82, -8.16, -7.92, -7.58, -7.85, -7.14, -8.16, -6.90, -7.38
     5 ,      , -8.75, -8.07, -8.05, -8.24, -8.29, -8.62, -8.19, -8.94, -8.33, -9.14, -8.44, -8.27
     6 ,      ,      ,      ,      ,      , -7.70, -8.76, -7.72, -9.23, -8.45, -9.08, -9.08, -8.78

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,   Slope  ,       ,Intrcpt
_______,________,______,_______,_______,__________,__________,_______,_______
     1 , -6.98  ,  .479, .0164 , .8662,   .000E+00,   .000E+00, -6.977,   .128
     2 , -7.86  ,  .430, .0070 , .7492,   .000E+00,   .000E+00, -7.857,   .115
     3 , -9.25  ,  .626, .0069 , .8313,   .000E+00,   .000E+00, -9.254,   .209
     4 , -7.72  ,  .437, .0079 , .4629,   .000E+00,   .000E+00, -7.716,   .121
     5 , -8.44  ,  .360, .0232 , .5447,   .000E+00,   .000E+00, -8.445,   .100
     6 , -8.60  ,  .637, .0297 , .7781,   .000E+00,   .000E+00, -8.601,   .212
      Fbar      SIGMA(int.)     SIGMA(ext.)     SIGMA(overall)  Variance ratio
      .649         .190            .106            .190             .309
```

cont'd.

Table 3.27 cont'd.

Age 3

Fleet	78	79	80	81	82	83	84	85	86	87	88	89	90
1	-6.36	-5.72	-6.07	-6.62	-5.77	-5.25	-6.01	-6.07	-5.89	-5.83	-6.14	-5.99	-6.06
2	-6.66	-6.28	-6.59	-7.41	-7.04	-6.11	-7.20	-6.75	-7.04	-7.06	-7.37	-6.91	-6.80
3						-8.12	-8.51	-7.05	-7.89	-7.51	-8.46	-7.76	-8.30
4		-8.07	-7.48	-7.34	-6.67	-7.74	-7.78	-7.68	-7.28	-7.07	-7.31	-6.31	-6.96
5		-8.52	-7.86	-7.72	-7.10	-7.87	-8.48	-8.29	-8.37	-8.26	-8.29	-7.85	-7.85
6						-6.61	-7.97	-7.17	-8.07	-7.80	-9.06	-8.02	-8.37

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-5.98	.338	.0443	1.2923	.000E+00	.000E+00	-5.983	.090
2	-6.86	.404	.0188	1.1172	.000E+00	.000E+00	-6.863	.108
3	-7.95	.536	.0254	1.6889	.000E+00	.000E+00	-7.950	.179
4	-7.31	.519	.0119	.8441	.000E+00	.000E+00	-7.309	.144
5	-8.04	.424	.0349	.9936	.000E+00	.000E+00	-8.037	.117
6	-7.88	.783	.0608	1.9349	.000E+00	.000E+00	-7.884	.261

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.193	.185	.102	.185	.303

Age 4

Fleet	78	79	80	81	82	83	84	85	86	87	88	89	90
1	-6.11	-5.72	-5.68	-5.12	-4.90	-5.39	-5.60	-5.84	-5.70	-5.73	-5.48	-5.96	-5.56
2	-6.41	-6.28	-6.20	-5.91	-6.18	-6.24	-6.79	-6.53	-6.84	-6.96	-6.71	-6.88	-6.30
3						-7.71	-7.70	-6.33	-7.25	-6.84	-7.31	-7.14	-7.80
4		-8.07	-7.62	-8.03	-6.60	-7.24	-7.82	-7.57	-7.05	-7.46	-7.45	-6.63	-7.12
5		-8.52	-8.00	-8.41	-7.02	-7.38	-8.51	-8.18	-8.13	-8.64	-8.42	-8.17	-8.01
6						-5.59	-7.49	-6.54	-7.58	-7.45	-7.46	-7.70	-8.52

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-5.60	.338	.0649	1.2808	.000E+00	.000E+00	-5.599	.090
2	-6.48	.341	.0276	1.1077	.000E+00	.000E+00	-6.479	.091
3	-7.26	.531	.0507	2.2727	.000E+00	.000E+00	-7.260	.177
4	-7.39	.503	.0110	1.0119	.000E+00	.000E+00	-7.388	.139
5	-8.12	.501	.0322	1.1911	.000E+00	.000E+00	-8.117	.139
6	-7.29	.926	.1099	4.5499	.000E+00	.000E+00	-7.292	.309

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.326	.183	.151	.183	.685

Age 5

Fleet	78	79	80	81	82	83	84	85	86	87	88	89	90
1	-5.89	-5.24	-6.18	-5.37	-4.98	-5.65	-6.17	-6.03	-5.74	-5.40	-6.00	-5.65	-5.74
2	-6.19	-5.79	-6.70	-6.16	-6.26	-6.50	-7.36	-6.72	-6.88	-6.63	-7.23	-6.57	-6.47
3						-7.43	-7.77	-6.05	-6.88	-6.14	-7.36	-6.31	-7.98
4		-8.49	-7.50	-8.62	-7.64	-7.43	-7.52	-7.46	-7.34	-7.58	-7.98	-6.60	-7.11
5		-8.94	-7.88	-8.99	-8.06	-7.57	-8.22	-8.06	-8.42	-8.77	-8.95	-8.14	-8.01
6						-5.24	-6.77	-5.98	-7.29	-7.17	-7.31	-7.11	-8.52

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-5.69	.382	.0590	1.2820	.000E+00	.000E+00	-5.694	.102
2	-6.57	.447	.0251	1.1087	.000E+00	.000E+00	-6.574	.119
3	-6.99	.801	.0664	3.2879	.000E+00	.000E+00	-6.989	.267
4	-7.61	.575	.0089	.7498	.000E+00	.000E+00	-7.605	.159
5	-8.33	.495	.0259	.8825	.000E+00	.000E+00	-8.334	.137
6	-6.92	1.036	.1588	6.0496	.000E+00	.000E+00	-6.924	.345

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.226	.216	.219	.219	1.025

Age 6

Fleet	78	79	80	81	82	83	84	85	86	87	88	89	90
1	-6.49	-5.80	-5.48	-6.24	-4.67	-4.83	-5.95	-6.56	-5.29	-5.45	-6.01	-6.51	-5.60
2	-6.79	-6.37	-6.00	-7.04	-5.94	-5.68	-7.14	-7.24	-6.43	-6.68	-7.23	-7.43	-6.33
3						-6.68	-7.47	-6.11	-6.12	-5.80	-6.97	-6.77	-7.82
4		-9.34	-8.17	-9.12	-7.21	-7.82	-7.48	-6.85	-7.53	-7.01	-7.59	-6.70	-6.81
5		-9.79	-8.55	-9.50	-7.63	-7.95	-8.18	-7.46	-8.61	-8.19	-8.56	-8.25	-7.70
6						-5.27	-6.38	-5.03	-7.01	-6.29	-6.60	-6.88	-8.20

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-5.76	.638	.0554	1.3220	.000E+00	.000E+00	-5.759	.171
2	-6.64	.584	.0235	1.1423	.000E+00	.000E+00	-6.639	.156
3	-6.72	.742	.0871	4.7008	.000E+00	.000E+00	-6.719	.247
4	-7.64	.900	.0086	.6819	.000E+00	.000E+00	-7.635	.250
5	-8.36	.736	.0251	.8023	.000E+00	.000E+00	-8.364	.204
6	-6.46	1.063	.2530	8.9115	.000E+00	.000E+00	-6.458	.354

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.557	.299	.352	.352	1.382

Table 3.28

Title : Cod in the Kattegat and Skagerrak (Fishing Area IIIa)
At 11.00.24 08 APRIL 1991
from 78 to 90 on ages 1 to 7
with Terminal F of 1.172 on age 3 and Terminal S of 1.000

Initial sum of squared residuals was 163.092 and
final sum of squared residuals is 8.594 after 41 iterations

Matrix of Residuals

Years	78/79	79/80
Ages		
1/ 2	1.144	-.163
2/ 3	.067	-.152
3/ 4	-.099	.000
4/ 5	-.788	-.037
5/ 6	.006	.376
6/ 7	.170	-.446
	.002	.002
WTS	.001	.001

Years	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90		WTS
Ages												
1/ 2	-.079	-.125	-.093	.368	-.695	.798	.216	-.690	.246	.123	.000	.229
2/ 3	-.180	.354	-.448	-.057	.084	-.044	-.302	.354	-.264	.172	.000	.485
3/ 4	-.213	-.157	-.026	-.098	-.037	-.164	.036	-.153	.165	.153	.000	1.000
4/ 5	.017	.651	.638	.116	.239	.032	.108	-.220	.192	-.351	.000	.309
5/ 6	.413	.124	-.108	-.125	.045	-.012	-.065	.178	-.178	.031	.000	.652
6/ 7	.171	-.998	.513	.325	.196	.003	.257	.342	-.142	-.657	.000	.268
	.002	.001	.000	.000	.000	.000	.000	.000	-.001	.000	1.058	
WTS	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	78	79	80
F-values	.9712	.6199	.8052

	81	82	83	84	85	86	87	88	89	90
F-values	.8750	1.1073	1.0682	.9444	1.1318	1.2891	1.2016	.9000	1.2287	1.1720

Selection-at-age (S)

	1	2	3	4	5	6	7
S-values	.0436	.5288	1.0000	1.0964	.9899	1.0579	1.0000

Table 3.29 VIRTUAL POPULATION ANALYSIS

Cod in the Kattegat and Skagerrak (Fishing Area IIIa)

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

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	.114	.020	.040	.026	.042	.068	.020	.090	.083	.023	.053	.059
2	.550	.287	.367	.610	.410	.536	.515	.569	.534	.830	.398	.708
3	.899	.638	.801	.872	1.117	1.058	.928	1.047	1.232	1.143	.938	1.337
4	.728	.659	.941	1.399	1.675	1.263	1.200	1.262	1.521	1.062	1.108	1.111
5	.860	.830	.791	.986	1.086	1.012	.959	1.139	1.271	1.268	.709	1.209
6	1.096	.517	.922	.507	1.359	1.347	1.097	1.185	1.483	1.430	.857	.982
7	.954	.568	.989	.809	1.503	.723	.921	1.048	1.240	1.010	.744	1.184
8+	.954	.568	.989	.809	1.503	.723	.921	1.048	1.240	1.010	.744	1.184
(2- 6)U	.826	.586	.764	.875	1.129	1.043	.940	1.040	1.208	1.147	.802	1.069
(2- 8)U	.863	.581	.828	.856	1.236	.952	.934	1.042	1.217	1.108	.785	1.102

	1990	1986-90
1	.051	.054
2	.594	.613
3	1.068	1.144
4	1.281	1.217
5	1.188	1.129
6	1.148	1.180
7	1.730	1.182
8+	1.730	1.182
(2- 6)U	1.056	
(2- 8)U	1.248	

Table 3.30 VIRTUAL POPULATION ANALYSIS

Cod in the Kattegat and Skagerrak (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	45132	35232	45474	31184	37651	40506	26028	20725	51019	16042	25905	20156
2	44437	32961	28263	35770	24884	29545	30976	20887	15513	38448	12833	20113
3	9976	20995	20256	16038	15918	13515	14148	15155	9684	7450	13724	7054
4	6061	3326	9080	7442	5490	4266	3840	4582	4357	2313	1945	4400
5	2065	2396	1408	2902	1504	842	988	946	1062	779	655	526
6	405	715	856	523	886	416	251	310	248	244	180	264
7	253	111	349	279	258	186	88	68	78	46	48	62
8+	217	189	80	165	87	199	65	40	47	65	33	34
TOTAL NO	108546	95925	105766	94302	86679	89476	76384	62714	82008	65387	55322	52610
SPS NO	18977	27732	32029	27348	24144	19425	19380	21102	15476	10896	16585	12340
TOT.BIOM	106884	98755	119800	106393	98181	91074	84963	70248	83237	66345	61458	61383
SPS BIOM	41233	47937	55538	54149	48390	40870	37199	36325	32866	22416	31626	28572

	1990	1991
1	32102	0
2	15563	24972
3	8111	7037
4	1517	2282
5	1187	345
6	129	296
7	81	33
8+	54	20
TOTAL NO	58743	
SPS NO	11078	
TOT.BIOM	64084	
SPS BIOM	27119	

Table 3.31

List of input variables for the ICES prediction program.

COD IN III A COMBINED
The reference F is the mean F (non-weighted) for the age group range from 2 to 6

The number of recruits per year is as follows:

Year	Recruitment
1991	26700.0
1992	26700.0
1993	26700.0

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	26700.0	.05	.20	.00	.612	.612
2	20827.0	.60	.20	.00	1.025	1.025
3	7037.0	1.13	.20	1.00	1.654	1.654
4	2282.0	1.24	.20	1.00	2.649	2.649
5	345.0	1.12	.20	1.00	4.126	4.126
6	296.0	1.19	.20	1.00	6.026	6.026
7	33.0	1.13	.20	1.00	7.865	7.865
8+	20.0	1.13	.20	1.00	10.163	10.163

For data that can be entered by file or manually by screen the following table gives the method of input by age group. The identifiers in the table are to be interpreted as:

space: not defined or set by the program
M : manual input by screen
F : data read from a file

age	F at age	M at age	maturity ogive	weight in the catch	weight in the stock
1	M	F	F	F	F
2	M	F	F	F	F
3	M	F	F	F	F
4	M	F	F	F	F
5	M	F	F	F	F
6	M	F	F	F	F
7	M	F	F	F	F
8+	M	F	F	F	F

The data from the files were selected as follows:

M at age:	year 1990 from file NATMOR
Maturity ogive:	year 1990 from file MORPROP
Catch weight:	mean values for years 1986 - 1990 from file WECA
Stock weight:	mean values for years 1986 - 1990 from file WEST

Table 3.32

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

COD IN III A COMBINED

Year 1991					Year 1992					Year 1993	
factor	ref. F	stock biomass	sp.stock biomass	catch	factor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
.9	.96	59044	21353	21635	.0	.00	63610	25833	0	100061	61311
					.2	.21			7178	89860	51328
					.4	.42			13150	81421	43105
					.6	.63			18139	74414	36313
					.8	.84			22325	68575	30686
					1.0	1.06			25852	63688	26010
					1.2	1.27			28838	59582	22112
					1.4	1.48			31377	56117	18853
					1.6	1.69			33547	53180	16120
					1.8	1.90			35410	50678	13820
					2.0	2.11			37018	48537	11879
1.0	1.06	59044	21353	23062	.0	.00	61641	23962	0	97570	58819
					.2	.21			6814	87873	49341
					.4	.42			12496	79835	41520
					.6	.63			17251	73147	35046
					.8	.84			21249	67562	29673
					1.0	1.06			24625	62877	25199
					1.2	1.27			27488	58933	21462
					1.4	1.48			29928	55596	18332
					1.6	1.69			32018	52761	15701
					1.8	1.90			33816	50341	13483
					2.0	2.11			35371	48265	11607

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 (non-weighted) for the age group range from 2 to 6

Table 4.1 Nominal landings (in tonnes) of HADDOCK from Division IIIa as supplied by Working Group members.

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	215	9,763
1978	4,978	168	1,435[2]	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	8,297
1986	4,092	226	151	5	4,474
1987	5,033	148	71	36	5,288
1988	4,023	245	64	48	4,380
1989	4,249	138	66	-	4,453
1990[1]	5,855	84	102	-	6,041

[1] Preliminary.
[2] Includes Divisions IVa and IVb.

Table 4.2 Landings of haddock in Division IIIa (in tonnes) as supplied by Working Group members.

	Denmark		Total	Norway	Sweden	Others	Total	Total industrial &
Year	Consumption	Industrial		Consumption			consump.	consumption
1983	1,445	2,225	8,670	756	608	221	2,809	10,255
1984	1,530	2,707	7,837	321	499	30	5,950	8,687
1985	6,698	954	7,652	279	351	15	7,348	8,297
1986	2,410	1,682	4,092	226	151	5	2,792	4,474
1987	3,584	1,449	5,033	148	71	36	3,803	5,288
1988	2,543	1,480	4,023	245	64	48	2,852	4,380
1989	3,889	360	4,249	138	66	-	4,093	4,453
1990	3,887	1,968	5,855	84	102	-	4,073	6,041

Table 4.3 Landings of haddock in the Kattegat (in tonnes) as supplied by Working Group members.

	Denmark		Sweden		Total
Year	Consumption	Industrial	Consumption	Total consump.	
1987	469	338	-	469[1]	806[1]
1988	29	158	15	44	202
1989	111	63	4	115	178
1990	71	297	20	91	388

[1] Swedish landings not split according to area.

Table 4.4 Haddock in Division IIIa. Percentage distribution of Danish landings by vessel category in 1989 and 1990.

Vessel type	1989	1990
Trawler <20 BR/BRT	11.5	7.8
20-39 BR/BRT	5.4	4.6
40-59 BR/BRT	22.6	25.1
≥ 60 BR/BRT	36.9	38.2
Danish Seine	20.7	20.6
Net/Line	2.3	3.3
Other vessels	0.2	0.2
Unidentified	0.3	0.2

Table 4.5 Landings of Haddock in the Skagerrak (in tonnes) as supplied by Working Group members.

	Denmark		Norway/Sweden		Total
Year	Consumption	Industrial	Consumption	Total consump.	
1987	3,117	1,111	219	3,336[1]	4,447
1988	2,514	1,322	309	2,823	4,145
1989	3,773	297	204	3,977	4,274
1990	3,825	1,671	186	4,011	5,682

[1] Swedish landings not split according to area.

Table 4.6 Catch in numbers of HADDOCK in Division IIIa for 1982-1990 ('000).

Age	1982	1983	1984	1985	1986	1987[1]	1988[1]	1989[1]	1990[1]
1	314	1,113	18	-	51	381	375	32	1,040
2	2,299	4,624	6,554	8,279	904	3,282	1,683	1,540	1,347
3	12,055	2,728	4,481	3,687	3,725	866	1,863	2,951	1,578
4	1,113	4,004	713	1,049	686	734	303	510	931
5	209	525	524	78	230	122	158	91	144
6	22	63	91	176	33	42	43	45	43
7	11	11	6	29	27	10	14	12	31
8+	6	6	16	6	28	6	16	6	20
Total	16,029	13,074	12,403	13,304	5,684	5,444	4,455	5,187	5,134

[1] Data from human consumption fishery only.

Table 4.7 Haddock in Division IIIa (Kattegat and Skagerrak). Mean weight at age of the catch. Unit: kilogram.

Age	1981	1982	1983	1984	1985	1986	1987[1]	1988[1]	1989[1]	1990[1]
1	200	200	200	200	200	350	432	412	452	435
2	470	470	470	470	470	530	540	542	533	606
3	679	679	679	679	679	760	810	678	741	923
4	932	932	932	932	932	1.096	1.122	1.047	1.125	1,061
5	1.593	1.593	1.593	1.593	1.593	1.518	1.531	1.394	1.783	1,253
6	2.180	2.180	2.180	2.180	2.180	1.828	1.917	1.670	1.916	1,563
7	2.600	2.600	2.600	2.600	2.600	2.400	1.853	2.324	2.050	1,898
8+	2.770	2.770	2.770	2.770	2.770	2.700	2.155	2.742	2.967	2,300

[1] Data from human consumption fishery only.

Table 5.1 Nominal landings (in tonnes) of WHITING from Division IIIa as supplied by Working Group members.

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	24,942	70	1,054	7	26,073
1982	40,941	40	670	13	41,664
1983	24,816	48	1,061	8	25,933
1984	13,138	51	1,168	60	14,417
1985	12,524	45	654	2	13,225
1986	12,463	64	477	1	13,005
1987	16,323	29	262	43	16,657
1988	11,262	42	435	24	11,764
1989	12,511	31	675	-	13,217
1990[1]	18,760	46	435	-	19,241

[1] Preliminary.

Table 5.2 Danish landings of WHITING in Skagerrak and Kattegat 1981-1989 as supplied by Working Group members.

Year	Kattegat		Skagerrak		Division IIIa		Total
	Consump.	Indust.	Consump.	Indust.	Total consump.	Total indust.	
1981	189	14,010	838	9,905	1,027	23,915	24,942
1982	234	18,917	949	20,841	1,183	39,758	40,941
1983	202	12,285	1,109	11,220	1,311	23,505	24,816
1984	114	7,678	922	4,424	1,036	12,102	13,138
1985	113	5,734	444	6,333	557	11,967	12,524
1986	130	3,755	354	8,284	484	11,979	12,463
1987	184	6,338	259	9,542	443	15,880	16,323
1988	123	2,492	268	8,380	391	10,872	11,263
1989	144	3,954	633	7,708	777	11,662	12,439
1990	103	5,290	828	12,539	931	17,829	18,760

Table 6.1 Hake landings from Kattegat and Skagerrak.

Year	Denmark		Norway	Total	Sweden	Total
	Kattegat	Skagerrak	Skagerrak	Skagerrak	Division IIIa	Div. IIIa
1978	48	1,002				
1979	37	1,007				
1980	21	1,206				
1981	22	1,183				
1982	27	805				
1983	19	786				
1984	34	1,151				
1985	23	930				
1986	43	766				
1987	124	924			71	
1988	46	529	78	653	64	717
1989	79	872	50	1,001	67	1,068
1990	61	1,573	109	1,743	82	1,825

Table 7.1 PLAICE landings from the Kattegat (tonnes) as supplied by Working Group members.

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	2,468	170	+	2,638
1987	2,868	283	104	3,255
1988	1,818	210	2.8	2,031
1989	1,596	135	4.0	1,735
1990[1]	1,829	201	1.8	2,032

[1] Preliminary.

Table 7.2 Danish landings of PLAICE by quarters in the Kattegat and the Skagerrak (tonnes) as supplied by Working Group members.

Quarter	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990[1]
						Kattegat					
Jan-Mar	1,825	1,196	941	531	779	568	480	322	544	250	357
Apr-Jun	1,168	774	619	595	745	594	546	618	413	281	345
Jul-Sep	1,396	1,069	599	1,195	955	704	798	841	468	406	549
Oct-Dec	1,193	764	558	959	773	1,116	664	1,043	395	600	515
Total	5,582	3,803	2,717	3,280	3,252	2,979	2,488	2,834	1,820	1,537	1,765
						Skagerrak					
Jan-Mar	1,042	751	849	895	964	919	1,131	688	1,423	817	750
Apr-Jun	3,325	3,036	3,084	2,729	2,675	2,944	2,779	3,649	3,938	2,104	3,477
Jul-Sep	3,381	2,239	2,583	1,941	2,461	3,511	3,157	3,696	2,874	1,715	3,414
Oct-Dec	1,766	2,089	1,273	1,263	1,460	2,842	3,586	3,332	1,552	778	1,054
Total	9,514	8,115	7,929	6,828	7,560	9,646	10,653	11,365	9,787	5,414	8,695

[1] Preliminary.

Table 7.3 Plaice in Division IIIa. Percentage distribution of Danish landings by vessel category in 1989 and 1990.

	Skagerrak		Kattegat	
Vessel type	1989	1990	1989	1990
Trawler <20 BR/BRT	17.1	14.7	26.9	29.9
20-39 BR/BRT	2.3	2.3	4.6	4.6
40-59 BR/BRT	4.4	5.0	5.9	8.5
⩾ 60 BR/BRT	4.5	17.0	4.9	3.2
Danish Seine	48.0	44.5	32.8	28.7
Gillnet/Line	17.5	13.2	16.5	16.1
Other vessels	3.7	1.9	3.1	3.3
Unidentified	2.5	1.5	5.3	5.7

Table 7.4 Division IIIa PLAICE. Mean catch (kg) per fishing day and gear in the Kattegat and Skagerrak (Danish log-book data).

Kattegat catch in kg (effort in fishing days

Year	Seiners			Gillnet		
	Catch	Effort	CPUE	Catch	Effort	CPUE
1983	331,882	1,811	183.3	22.146	202	109.6
1984	528,702	2,379	222.2	15,577	197	79.1
1985	240,855	885	272.2	8,203	42	195.3
1986	404,093	1,773	227.9	48,897	186	262.9
1987	393,777	1,546	254.7	95,365	291	327.7
1988	235,357	1,370	171.8	64,632	243	265.9
1989	211,646	1,577	134.2	60,236	336	179.3
1990	288,907	1,585	182.3	48,461	230	210.7

Skagerrak catch in kg (effort in fishing days)

Year	Seiners			Gillnet		
	Catch	Effort	CPUE	Catch	Effort	CPUE
1983	407,230	738	551.8	4,278	31	138.0
1984	127,757	2,401	53.2	69,118	235	294.1
1985	749,096	1,231	608.5	50,118	163	307.5
1986	3,440,056	5,330	645.4	404,182	945	427.7
1987	2,373,372	3,977	596.8	638,297	1,037	615.5
1988	2,077,242	3,856	538.7	355,811	911	390.6
1989	1,437,169	4,015	357.9	90,336	340	265.7
1990	1,898,213	4,080	465.2	61,363	218	281.5

[1] No data available.

Table 7.5 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
			Nephrops trawl			
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	184.4	109,337	1.66	66.5	16,802	3.96
1989	202.2	85,833	2.36	39.2	15,565	2.52
1990	208.8	71,715	2.91	47.1	14,211	3.31
			Cod bottom trawl			
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	38.3	14,405	2.66	102.9	13,458	7.65
1989	38.3	11,310	3.39	63.7	13,508	4.72
1990	66.4	11,815	5.62	86.8	13,843	6.27

Table 7.6 The total catches of PLAICE in kg per hour in the Kattegat (DANA May survey).

Year	DANA CPUE (May)	
	Kattegat	Skagerrak
	Catch in kg per hour	Catch in kg per hour
1984	5.83	6.84
1985	17.84	45.80
1986	6.12	18.15
1987	55.65	22.53
1988	10.04	3.56
1989	4.08	2.93
1990	4.14	7.40

Table 7.7 SUM OF PRODUCTS CHECK

Plaice in the Kattegat (Part of Fishing Area IIIa)
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: thousands

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	1	1	1	1	1	1886	59	191	13	10	1	37
2	3790	1180	3660	680	1120	11021	3636	10772	11479	3330	147	859
3	20320	14070	11830	8190	21790	7480	25372	10020	14620	20150	9686	6464
4	10570	10510	9760	23570	17720	8032	4070	11127	2785	9230	27862	17331
5	2280	2840	3140	14170	7910	4016	3073	1422	4058	2680	8685	7984
6	790	760	710	1870	1110	2271	1196	998	572	900	1144	1715
7	500	300	650	350	200	654	868	574	371	230	227	576
8	260	300	370	190	120	231	387	478	274	270	49	105
9	180	270	370	330	80	26	141	205	115	210	48	73
10	70	240	240	260	80	13	94	150	98	130	33	49
11	1	50	80	80	30	38	59	68	13	100	17	38
12+	50	100	140	40	60	38	164	14	17	190	40	16
TOTAL	38812	30621	30951	49731	50221	35706	39120	36020	34416	37430	47939	35247

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	1	2	20	54	7	6	8	0	3	5	5
2	301	191	548	1495	1334	1315	391	575	67	737	1848
3	2855	1817	1326	5029	4408	5052	2304	2327	1151	1633	2306
4	7179	4754	1986	2298	2880	4061	2685	3796	2039	1106	849
5	5355	3198	1935	888	619	434	2072	1487	1385	744	435
6	2310	1056	1011	585	385	84	619	396	538	316	142
7	501	416	380	561	540	80	130	102	247	143	96
8	159	196	157	402	675	115	64	80	150	82	44
9	127	131	63	216	566	89	48	62	70	63	30
10	53	91	23	54	288	100	43	61	64	45	23
11	32	51	25	39	27	66	27	53	23	30	20
12+	17	39	9	71	70	71	22	53	63	78	33
TOTAL	18890	11942	7483	11692	11799	11473	8413	8992	5800	4982	5831

Table 7.8 SUM OF PRODUCTS CHECK

Plaice in the Kattegat (Part of Fishing Area IIIa)
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH 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	1989	1990
1	.120	.180	.260	.275	.235	.247	.229	.000	.272	.229	.246
2	.263	.230	.270	.285	.287	.287	.251	.344	.263	.298	.309
3	.277	.270	.320	.285	.300	.280	.295	.317	.296	.295	.313
4	.300	.290	.330	.298	.318	.310	.302	.322	.308	.324	.341
5	.310	.350	.360	.350	.358	.398	.358	.373	.334	.359	.428
6	.356	.440	.440	.384	.324	.476	.415	.480	.434	.411	.567
7	.500	.530	.580	.402	.316	.503	.484	.634	.562	.476	.634
8	.600	.690	.710	.461	.340	.524	.604	.755	.654	.612	.866
9	.690	.790	.910	.581	.327	.561	.645	.985	.796	.856	.972
10	.810	.900	1.000	1.033	.412	.622	.784	.885	.738	.949	.970
11	.890	.960	1.050	1.182	.876	.652	.872	1.229	.992	.964	1.181
12+	.950	1.050	1.070	1.178	1.136	1.048	1.097	.980	1.119	1.068	1.143

Table 7.9

```
IIIa Plaice Tuning data Kattegat
104
Danish seiners fleet 1
1983,1990
1,1
1,11
10, 30, 824, 2771, 1266, 489, 322, 309, 222, 119,  30, 21
9.31,4, 765, 2527, 1651, 355,  221,310, 387, 325, 165, 15
5.79,3, 612, 2351,  1890, 202, 39,  37,  54,  41,  46, 31
6.096,  4, 204,  1205, 1404, 1084, 324, 68,  33,  25,  22,14
4.38,0, 230,  933, 1520, 596, 158,  41,  32,  25,  25, 21
3.96,1,  23,  388,  686, 466,181,  83,  51,  24,  22,  8
4.376,2, 276, 596, 403, 274, 117, 54, 30,  24,  16, 11
3.27,1, 542,  677,  249, 128,  42,  28,  13,   9,   7, 6
Swedish Nephr. fleet 2
1983,1990
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
20.83,   0,   2,   38,   67,  45,  18,   8,   5,   2,   2,  1
19.06,   0,  21,   45,   30,  21,   9,   4,   2,   2,   1,  1
21.35    0,  64,   80,   30,  15,   5,   3,   2,   1,   1,  1
Swedish Cod fleet 3
1983,1990
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
16.68,   0,   3,   58,  103,   70,  27,  13,   8,   4,   3,   1
16.54,   0,  34,   73,   50,   34,  14,   7,   4,   3,   2,   1
20.78,   0, 118,   148,  54,   28,   9,   6,   3,   2,   1,   1
danasurvey
1984,1990
1,1
2,7
10,  39,  151, 57, 10, .01, 6
19, 603,  808, 131, 49, 13, 9
18, 215,  159,  97, 16, 10, 8
15,  73,  134,  63, 11,  4, 13
16,  10,   29,  29,  4,  1,  3
17,  18,   43,  32,  34, 5,  19
12,  75,   65,   8,   5, 3,   2
```

Table 7.10 PLAICE in the Kattegat. Results of tuning analysis. Disaggregated Qs
Log Transormation

NO explanatory variate (Mean used)
Fleet 1 ,Danish seiners fleet, has terminal q estimated as the mean
Fleet 2 ,Swedish Nephr. fleet, has terminal q estimated as the mean
Fleet 3 ,Swedish Cod fleet 3 , has terminal q estimated as the mean
Fleet 4 ,danasurvey , 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,
Oldest age F = 1.000*average of 5 younger ages. Fleets combined by variance of predictions
Fishing mortalities

Age,	83,	84,	85,	86,	87,	88,	89,	90,
1,	.004,	.001,	.001,	.002,	.000,	.000,	.000,	.001,
2,	.102,	.105,	.125,	.058,	.141,	.018,	.097,	.073,
3,	.680,	.431,	.615,	.297,	.491,	.407,	.672,	.436,
4,	.974,	.954,	.791,	.691,	.983,	.948,	.758,	.799,
5,	.675,	.677,	.311,	1.131,	.938,	1.119,	1.013,	.679,
6,	.474,	.619,	.158,	.850,	.590,	.973,	.738,	.465,
7,	.406,	.960,	.220,	.345,	.281,	.805,	.663,	.457,
8,	.386,	1.088,	.479,	.245,	.328,	.746,	.606,	.386,
9,	.322,	1.304,	.340,	.334,	.353,	.471,	.724,	.412,
10,	.754,	.819,	.747,	.244,	.808,	.657,	.557,	.561,
11,	.469,	.958,	.389,	.404,	.472,	.730,	.657,	.456,

Log catchability estimates

Age 1

Fleet,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-8.51,	-10.27,	-9.61,	-8.90,	-11.41,	-10.45,	-11.05,	-10.05
2 ,	-12.34,	-14.07,	-13.66,	-13.30,	-13.30,	-13.72,	-14.83,	-13.54
3 ,	-11.34,	-14.40,	-13.74,	-13.09,	-12.99,	-13.50,	-14.69,	-13.51
4 ,	No data for this fleet at this age							

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-10.03 ,	1.057,	.0001 ,	.0007,	.000E+00,	.000E+00,	-10.033,	.352
2 ,	-13.60 ,	.751,	.0000 ,	.0007,	.000E+00,	.000E+00,	-13.596,	.250
3 ,	-13.41 ,	1.082,	.0000 ,	.0008,	.000E+00,	.000E+00,	-13.408,	.361
4 ,	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.001	.533	.468E-01	.533	.008

Age 2

Fleet,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-5.18,	-5.04,	-4.60,	-5.31,	-4.35,	-6.46,	-4.79,	-5.02
2 ,	-9.15,	-8.86,	-8.14,	-9.73,	-8.46,	-10.56,	-8.83,	-9.04
3 ,	-8.13,	-8.42,	-7.96,	-9.11,	-7.85,	-9.93,	-8.21,	-8.40
4 ,	,	-8.09,	-5.81,	-6.34,	-6.73,	-8.69,	-8.87,	-8.30

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-5.10 ,	.671,	.0200 ,	.0683,	.000E+00,	.000E+00,	-5.095,	.224
2 ,	-9.10 ,	.802,	.0024 ,	.0691,	.000E+00,	.000E+00,	-9.096,	.267
3 ,	-8.50 ,	.737,	.0042 ,	.0661,	.000E+00,	.000E+00,	-8.502,	.246
4 ,	-7.55 ,	1.314,	.0063 ,	.1559,	.000E+00,	.000E+00,	-7.548,	.465

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.073	.402	.140	.402	.122

Age 3

Fleet,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-3.28,	-3.63,	-3.01,	-3.67,	-3.10,	-3.36,	-2.88,	-3.24
2 ,	-7.24,	-7.44,	-6.54,	-8.07,	-7.19,	-7.35,	-6.94,	-7.25
3 ,	-6.24,	-7.00,	-6.36,	-7.48,	-6.63,	-6.70,	-6.31,	-6.61
4 ,	,	-6.52,	-5.26,	-6.78,	-6.27,	-7.35,	-6.87,	-6.88

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-3.27 ,	.297,	.1240 ,	.4223,	.000E+00,	.000E+00,	-3.272,	.099
2 ,	-7.25 ,	.462,	.0151 ,	.4361,	.000E+00,	.000E+00,	-7.252,	.154
3 ,	-6.67 ,	.435,	.0264 ,	.4119,	.000E+00,	.000E+00,	-6.667,	.145
4 ,	-6.56 ,	.710,	.0169 ,	.6011,	.000E+00,	.000E+00,	-6.563,	.251

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.436	.207	.578E-01	.207	.078

cont'd.

Table 7.10 cont'd.

Age 4

Fleet	83	84	85	86	87	88	89	90
1	-2.93	-2.83	-2.76	-2.82	-2.41	-2.52	-2.76	-2.64
2	-6.89	-6.64	-6.29	-7.23	-6.50	-6.51	-6.83	-6.63
3	-5.88	-6.21	-6.12	-6.64	-5.93	-5.85	-6.18	-6.01
4		-6.27	-6.61	-6.58	-6.82	-7.08	-6.65	-7.37

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-2.71	.185	.2179	.7430	.000E+00	.000E+00	-2.709	.062
2	-6.69	.307	.0265	.7507	.000E+00	.000E+00	-6.691	.102
3	-6.10	.269	.0465	.7314	.000E+00	.000E+00	-6.102	.090
4	-6.77	.387	.0138	1.4604	.000E+00	.000E+00	-6.771	.137

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.799	.129	.123	.129	.912

Age 5

Fleet	83	84	85	86	87	88	89	90
1	-3.29	-3.18	-3.69	-2.33	-2.45	-2.35	-2.46	-2.80
2	-7.28	-6.97	-7.20	-6.74	-6.54	-6.35	-6.50	-6.82
3	-6.24	-6.55	-7.05	-6.14	-5.98	-5.69	-5.88	-6.16
4		-6.82	-6.29	-7.63	-7.68	-8.51	-5.91	-7.34

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-2.82	.541	.1950	.6627	.000E+00	.000E+00	-2.820	.180
2	-6.80	.356	.0238	.6899	.000E+00	.000E+00	-6.800	.119
3	-6.21	.450	.0417	.6475	.000E+00	.000E+00	-6.212	.150
4	-7.17	.954	.0093	.8053	.000E+00	.000E+00	-7.167	.337

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.679	.240	.301E-01	.240	.016

Age 6

Fleet	83	84	85	86	87	88	89	90
1	-3.66	-3.27	-4.37	-2.62	-2.92	-2.49	-2.77	-3.17
2	-7.55	-7.07	-7.99	-7.03	-7.04	-6.46	-6.81	-7.17
3	-6.60	-6.66	-7.66	-6.41	-6.43	-5.83	-6.23	-6.56
4		-13.34	-6.66	-7.18	-7.83	-9.09	-7.28	-7.11

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.16	.653	.1391	.4702	.000E+00	.000E+00	-3.157	.218
2	-7.14	.490	.0169	.4800	.000E+00	.000E+00	-7.141	.163
3	-6.55	.554	.0298	.4695	.000E+00	.000E+00	-6.549	.185
4	-8.36	2.493	.0028	.1335	.000E+00	.000E+00	-8.356	.881

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.465	.317	.925E-01	.317	.085

Age 7

Fleet	83	84	85	86	87	88	89	90
1	-3.80	-2.83	-4.04	-3.52	-3.66	-2.68	-2.86	-3.20
2	-7.77	-6.66	-7.61	-8.05	-7.87	-6.68	-6.94	-7.31
3	-6.74	-6.20	-7.46	-7.32	-7.16	-5.98	-6.23	-6.59
4		-6.84	-6.64	-6.74	-6.04	-7.40	-5.26	-7.14

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.32	.534	.1178	.4038	.000E+00	.000E+00	-3.324	.178
2	-7.36	.579	.0136	.4344	.000E+00	.000E+00	-7.361	.193
3	-6.71	.592	.0253	.4050	.000E+00	.000E+00	-6.711	.197
4	-6.58	.770	.0166	.7984	.000E+00	.000E+00	-6.581	.272

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.457	.301	.138	.301	.209

cont'd.

Table 7.10 cont'd.

Age 8

Fleet,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-3.85,	-2.70,	-3.25,	-3.87,	-3.51,	-2.75,	-2.98,	-3.36
2 ,	-7.89,	-6.53,	-6.79,	-8.08,	-7.47,	-6.73,	-7.16,	-7.10
3 ,	-6.81,	-6.08,	-6.58,	-7.87,	-6.94,	-6.04,	-6.33,	6.67
4 ,	No data for this fleet at this age							

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-3.28 ,	.481,	.1226 ,	.4151,	.000E+00,	.000E+00,	-3.283,	.160
2 ,	-7.22 ,	.593,	.0156 ,	.3439,	.000E+00,	.000E+00,	-7.219,	.198
3 ,	-6.66 ,	.621,	.0265 ,	.3885,	.000E+00,	.000E+00,	-6.665,	.207
4 ,	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.386	.320	.558E-01	.320	.030

Age 9

Fleet,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-4.03,	-2.52,	-3.61,	-3.56,	-3.43,	-3.20,	-2.76,	-3.28
2 ,	-7.86,	-6.34,	-7.06,	-8.18,	-7.43,	-7.35,	-6.72,	-7.35
3 ,	-6.99,	-5.91,	-6.95,	-7.27,	-6.84,	-6.43,	-6.17,	-6.63
4 ,	No data for this fleet at this age							

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-3.30 ,	.509,	.1209 ,	.4028,	.000E+00,	.000E+00,	-3.298,	.170
2 ,	-7.29 ,	.624,	.0146 ,	.4392,	.000E+00,	.000E+00,	-7.285,	.208
3 ,	-6.65 ,	.482,	.0269 ,	.4034,	.000E+00,	.000E+00,	-6.650,	.161
4 ,	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.412	.305	.258E-01	.305	.007

Age 10

Fleet,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-3.18,	-2.99,	-2.82,	-3.89,	-2.58,	-2.86,	-3.10,	-2.95
2 ,	-7.02,	-6.82,	-6.39,	-8.38,	-6.59,	-6.92,	-7.34,	-6.78
3 ,	-6.01,	-6.34,	-6.13,	-7.47,	-6.00,	-6.29,	-6.50,	-6.75
4 ,	No data for this fleet at this age							

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-3.05 ,	.408,	.1553 ,	.5104,	.000E+00,	.000E+00,	-3.047,	.136
2 ,	-7.03 ,	.653,	.0189 ,	.4350,	.000E+00,	.000E+00,	-7.029,	.218
3 ,	-6.44 ,	.518,	.0333 ,	.7651,	.000E+00,	.000E+00,	-6.437,	.173
4 ,	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.561	.288	.153	.288	.282

Table 7.11 PLAICE in the Kattegat. Results of separable VPA.

Title : Plaice in the Kattegat (Part of Fishing Area IIIa)
At 18.35.43 01 MARCH 1991
from 68 to 90 on ages 1 to 11
with Terminal F of .940 on age 5 and Terminal S of .500

Initial sum of squared residuals was 1245.729 and
final sum of squared residuals is 178.051 after 70 iterations

Matrix of Residuals

Years	68/69	69/70
Ages		
1/ 2	-2.674	-3.583
2/ 3	.184	-.623
3/ 4	.620	.482
4/ 5	.431	.487
5/ 6	.019	.490
6/ 7	.196	-.424
7/ 8	.059	-.471
8/ 9	-.535	-.516
9/10	-.684	-.091
10/11	-.286	.670
	.000	.000
WTS	.001	.001

Years	70/71	71/72	72/73	73/74	74/75	75/76	76/77	77/78	78/79	79/80
Ages										
1/ 2	-1.830	-2.828	-5.148	4.085	-.664	-.143	-.992	1.210	-1.953	2.252
2/ 3	.874	-2.256	-.668	.924	.498	.694	1.017	-.051	-1.902	.223
3/ 4	-.672	-1.270	.616	.753	.609	.579	.440	-.868	-.216	-.256
4/ 5	-1.237	-.386	.185	.256	-.101	-.700	-.847	-1.392	.819	.150
5/ 6	-.479	.926	-.230	.356	-.145	-.956	.455	-.807	1.003	.033
6/ 7	.077	1.031	-.589	.444	-.126	-.456	.197	.057	.352	.355
7/ 8	.931	.226	-.919	.330	.084	-.339	-.068	.564	.743	.740
8/ 9	-.229	-.027	.720	.256	.078	.297	-.164	.697	-.470	-.783
9/10	.103	.624	1.110	-1.442	-.530	-.286	-.454	.926	.005	-.172
10/11	.633	1.136	-.220	-1.881	-.366	1.167	-.575	.873	-.333	-.293
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
WTS	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001

Years	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90		WTS
Ages												
1/ 2	-.820	-1.547	.547	1.594	-1.483	.235	.311	-1.920	-.946	-1.728	-3.405	.001
2/ 3	-.292	-.749	-.292	.669	-.511	.949	-.130	.918	-1.658	.059	.000	1.000
3/ 4	-.572	-.430	-.157	.618	-.798	.611	-.403	.119	-.128	.139	.000	1.000
4/ 5	-.113	-.314	.400	.491	-.022	-.189	-.150	.122	-.081	-.568	.000	1.000
5/ 6	.520	-.271	.613	-.102	-.085	-1.413	.734	-.024	.263	.014	.000	1.000
6/ 7	.935	-.086	.296	-.482	-.079	-1.191	1.196	-.218	.506	-.030	.000	1.000
7/ 8	.484	.194	-.042	-.415	.271	-.212	.196	-.747	.627	.319	.000	1.000
8/ 9	-.306	.307	-.347	-.616	.701	.393	-.302	-.272	.347	.098	.000	1.000
9/10	-.067	1.016	.213	-.472	.514	.348	-.475	-.342	.015	.199	.000	1.000
10/11	-.587	.336	-.683	.307	.010	.704	-.666	.446	.111	-.228	.000	1.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-18.009	
WTS	.001	.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	68	69	70
F-values	.6826	.6764	.8438

	71	72	73	74	75	76	77	78	79	80
F-values	1.1446	.9336	.7293	1.0337	1.2190	.7748	.8868	.5283	.7874	.7438

	81	82	83	84	85	86	87	88	89	90
F-values	.7648	.5396	.8547	1.2912	.6701	.6723	.8077	.9792	1.1623	.9400

Selection-at-age (S)

	1
S-values	.0010

	2	3	4	5	6	7	8	9	10	11
S-values	.0937	.5804	1.0697	1.0000	.6794	.5308	.5423	.5295	.5780	.5000

Table 7.12 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	.000	.000	.000	.000	.000	.066	.001	.002	.000	.000	.000	.005
2	.072	.020	.088	.017	.064	.201	.156	.223	.147	.074	.006	.060
3	.718	.364	.252	.257	.882	.667	.830	.719	.468	.365	.282	.345
4	1.121	.914	.411	.984	1.188	.860	.844	.984	.391	.539	1.108	1.021
5	.704	.955	.682	1.643	.971	.850	.859	.717	1.123	.709	1.339	1.029
6	.411	.474	.585	1.027	.453	.737	.584	.671	.628	.714	.668	.958
7	.317	.240	.846	.568	.240	.468	.617	.546	.500	.493	.344	.752
8	.257	.284	.462	.563	.343	.424	.494	.732	.485	.735	.163	.236
9	.265	.410	.593	.859	.435	.102	.440	.469	.341	.748	.241	.344
10	.337	.590	.687	.985	.455	.102	.565	1.046	.380	.701	.216	.367
11	.341	.381	.352	.454	.242	.366	.773	.939	.200	.734	.159	.365
12+	.341	.381	.352	.454	.242	.366	.773	.939	.200	.734	.159	.365
(3- 9)U	.542	.520	.547	.843	.644	.587	.667	.691	.562	.615	.592	.669

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1986-90
1	.000	.000	.001	.004	.001	.001	.002	.000	.000	.000	.001	.001
2	.043	.032	.048	.102	.104	.124	.059	.153	.020	.114	.088	.087
3	.257	.347	.285	.679	.429	.611	.296	.504	.455	.787	.536	.516
4	.701	.771	.693	.991	.951	.784	.682	.979	.999	.942	1.155	.951
5	.933	.694	.740	.682	.704	.309	1.107	.910	1.105	1.173	1.138	1.087
6	.858	.412	.432	.457	.633	.167	.841	.562	.901	.716	.641	.732
7	.732	.317	.227	.402	.889	.227	.371	.276	.731	.563	.433	.475
8	.420	.630	.169	.352	1.063	.413	.256	.365	.724	.504	.298	.430
9	.439	.642	.374	.327	1.062	.326	.269	.374	.555	.681	.309	.437
10	.400	.573	.193	.567	.843	.464	.230	.567	.725	.746	.501	.554
11	.385	.736	.268	.510	.542	.410	.194	.434	.384	.801	.786	.520
12+	.385	.736	.268	.510	.542	.410	.194	.434	.384	.801	.786	.520
(3- 9)U	.620	.545	.417	.556	.819	.405	.546	.567	.782	.767	.644	

Table 7.13 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	69493	50546	48171	20910	70120	31143	62529	97780	54396	28541	17123	8315
2	57350	62879	45735	43586	18919	63446	26387	56523	88293	49207	25816	15492
3	41446	48291	55773	37905	38792	16054	46947	20423	40921	68989	41360	23219
4	16327	18295	30358	39241	26527	14531	7453	18519	9008	23179	43323	28235
5	4712	4814	6635	18220	13275	7316	5565	2901	6261	5512	12236	12946
6	2455	2109	1676	3035	3188	4551	2828	2134	1281	1843	2454	2902
7	1928	1473	1188	845	983	1833	1971	1427	987	618	817	1139
8	1201	1270	1048	461	433	700	1039	963	748	542	342	524
9	811	840	865	598	238	278	414	574	419	417	235	263
10	256	563	505	433	229	139	227	241	325	270	178	167
11	4	165	283	230	146	132	114	117	77	201	121	130
12+	181	331	495	115	292	132	319	23	100	382	285	55
TOTAL NO	196165	191576	192732	165578	173143	140254	155794	201624	202815	179699	144288	93387
SPS NO	69322	78152	98826	101083	84104	45666	66878	47322	60126	101951	101350	69580
TOT.BIOM	47745	48486	49800	45201	42539	35854	38145	46001	49252	46975	36878	24537
SPS BIOM	21578	24310	30209	30930	25601	14956	20728	15057	18223	29995	27515	20131

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	7064	13661	17925	15716	13041	7976	4698	3902	7958	25367	5592	0
2	7488	6391	12359	16200	14169	11793	7211	4244	3530	7198	22949	5055
3	13202	6489	5601	10662	13238	11553	9422	6153	3294	3131	5813	19009
4	14881	9237	4149	3810	4893	7802	5674	6340	3364	1890	1290	3077
5	9206	6678	3866	1877	1280	1710	3223	2596	2156	1121	667	368
6	4186	3277	3019	1669	858	573	1135	964	945	646	314	193
7	1008	1606	1965	1774	957	412	439	443	497	347	286	150
8	486	439	1059	1417	1074	356	297	274	304	217	179	168
9	374	289	211	809	901	336	213	208	172	133	118	120
10	168	218	138	132	528	282	219	147	130	89	61	79
11	105	102	111	103	68	206	160	158	76	57	38	33
12+	56	78	40	185	175	221	131	158	207	148	63	42
TOTAL NO	58224	48466	50444	54355	51181	43220	32824	25586	22634	40345	37370	
SPS NO	43672	28414	20160	22439	23972	23451	20915	17440	11145	7779	8829	
TOT.BIOM	16619	13898	16261	16725	14833	13085	9989	8054	7252	10867	11817	
SPS BIOM	13802	9969	8263	7786	7701	7730	7103	6594	4159	2913	3351	

Table 7.14 PLAICE indices in the Kattegat (Straight mean used).

Year class	Summer survey 1-group	DANA May survey 2-group
1983	5.4	31.7
1984	2.2	11.9
1985	1.3	3.7
1986	3.5	0.6
1987	1.8	1.1
1988	3.5	6.3
1989	3.0	-

Table 7.15

Analysis by RCRTINX2 of data from file survey:data
plaice in the kattegat as 1-group and 2-group data

Data for 2 surveys over 7 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
yngel	1.5041	2.602	5.513	.2064	5	9.4265	1.08547	1.22919	.07170
dana	1.9741	.487	7.980	.6093	5	8.9408	.44336	.48764	.45559
MEAN						8.8303	.47872	.47872	.47271

Yearclass = 1989

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
yngel	1.3863	3.936	3.886	.2197	6	9.3415	1.45370	1.57714	.16006
dana									
MEAN						9.0497	.68846	.68846	.83994

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1988	8.92	7505.50	.33	.11	10.1425367.98	.32
1989	9.10	8923.45	.63	.11	8.63 5593.00	.17

Table 7.16

List of input variables for the ICES prediction program.

Plaice in the Kattegat
The reference F is the mean F (non-weighted) for the age group range from 3 to 9

The number of recruits per year is as follows:

Year	Recruitment
1991	10000.0
1992	10000.0
1993	10000.0

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	10000.0	.00	.10	.00	.244	.244
2	9039.0	.08	.10	.00	.293	.293
3	7497.0	.52	.10	1.00	.303	.303
4	3077.0	.96	.10	1.00	.319	.319
5	368.0	.90	.10	1.00	.370	.370
6	193.0	.61	.10	1.00	.461	.461
7	150.0	.48	.10	1.00	.558	.558
8	168.0	.49	.10	1.00	.698	.698
9	120.0	.48	.10	1.00	.851	.851
10	79.0	.52	.10	1.00	.865	.865
11	33.0	.45	.10	1.00	1.048	1.048
12+	42.0	.45	.10	1.00	1.081	1.081

Table 7.17

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

Plaice in the Kattegat

Year 1991					Year 1992					Year 1993	
factor	ref. F	stock biomass	sp.stock biomass	catch	factor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
.6	.38	9021	3933	1307	.0	.00	10119	5030	0	12658	7567
					.1	.06			344	12289	7198
					.2	.13			665	11946	6856
					.4	.25			1244	11330	6240
					.6	.38			1748	10796	5706
					.8	.51			2190	10331	5241
					1.0	.63			2578	9924	4836
					1.2	.76			2919	9569	4481
					1.4	.88			3221	9256	4169
					1.6	1.01			3489	8981	3894
					1.8	1.14			3727	8737	3651
					2.0	1.26			3939	8521	3435
1.0	.63	9021	3933	1950	.0	.00	9455	4366	0	11955	6864
					.1	.06			295	11642	6551
					.2	.13			570	11350	6259
					.4	.25			1068	10823	5733
					.6	.38			1504	10364	5275
					.8	.51			1888	9963	4874
					1.0	.63			2227	9610	4522
					1.2	.76			2527	9300	4212
					1.4	.88			2793	9026	3939
					1.6	1.01			3031	8783	3696
					1.8	1.14			3243	8567	3481
					2.0	1.26			3433	8375	3289

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 (non-weighted) for the age group range from 3 to 9

Table 7.18 PLAICE landings from the Skagerrak (tonnes) as provided by Working Group members.

Year	Denmark	Sweden	Nether-lands	Germany	Belgium	Norway	Correction	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	-594	7,145
1984	7,560	356	1,580		27	22	-1,580	7,965
1985	9,646	296	2,225		136	18	-2,225	10,096
1986	10,653	215	4,024		505	24	-4,024	11,397
1987	11,370	222	2,209		907	25	-2,209	12,519
1988	9,781	281	2,087		716	41	-2,087	10,819
1989	5,387	320	-	0.1	230	33	-	5,939
1990[1]	8,693	777	-	0.6	461	69	-	10,001

[1] Preliminary.

Table 7.19 SUM OF PRODUCTS CHECK

Plaice 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	1989
2	356	246	62	0	4	74	850	147	4	17	33	308
3	6443	3327	1937	2242	842	5263	8472	3938	2175	1908	1970	2344
4	12771	12331	9242	8381	7667	6845	9675	18487	12864	9285	10335	6259
5	16928	12828	7272	7803	9184	7615	3971	6000	17955	17133	12774	5745
6	7090	5933	3748	3262	4814	2247	1658	1683	4296	10295	6517	2497
7	410	1939	1902	1015	1561	419	366	645	550	2082	2575	1072
8	16	65	794	352	638	161	75	160	209	306	823	486
9	17	2	77	83	253	56	26	120	82	175	261	202
10	16	1	1	28	95	48	12	75	79	65	76	95
11+	5	1	1	7	16	2	10	27	35	59	76	118
TOTAL	44052	36673	25036	23173	25074	22730	25115	31282	38249	41325	35440	19126

	1990
2	1357
3	6687
4	8056
5	9607
6	3191
7	919
8	451
9	330
10	138
11+	203
TOTAL	30939

Table 7.20 SUM OF PRODUCTS CHECK

Plaice in the SkagerraK (Part of Fishing Area IIIa)
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: kilogram

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	.238	.228	.253	.000	.253	.278	.261	.212	.395	.205	.220	.216
3	.261	.249	.270	.258	.270	.263	.290	.290	.258	.247	.251	.240
4	.285	.256	.310	.300	.275	.291	.306	.306	.280	.271	.261	.274
5	.333	.294	.370	.360	.309	.357	.380	.349	.317	.297	.285	.315
6	.410	.388	.450	.430	.375	.433	.442	.435	.396	.370	.343	.372
7	.531	.451	.600	.540	.535	.592	.571	.552	.551	.533	.466	.465
8	.668	.664	.648	.660	.703	.705	.836	.759	.695	.734	.551	.639
9	.869	.983	.856	.850	.789	.900	1.084	.876	.877	.930	.746	.703
10	1.107	1.732	.856	.950	.891	.933	1.256	.929	.905	1.152	.911	.767
11+	.995	1.283	.856	1.000	.840	1.420	1.522	1.229	1.099	1.141	1.313	.983

	1990
2	.267
3	.280
4	.289
5	.333
6	.389
7	.484
8	.667
9	.756
10	.955
11+	1.150

Table 7.21

```
IIIa Plaice Tuning data Skagerrak
104
Danish seiners fleet 1
1983,1990
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
 9.931,183,1397, 3730, 3424,1489, 639, 290, 120,  56
11.470,724,3568,4299,5126,1703,490,241,176,74
Swedish Nephr. fleet 2
1983,1990
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
137.96,   1,  34,  178,  220, 112,  44,  14,   4,   1
111.10,  10,  79,  212,  195,  85,  36,  16,   7,   3
202.57,  80, 394,  475,  566, 188,  54,  26,  19,   1
Swedish Cod fleet 3
1983,1990
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
18.18,   0,   7,   37,   46,   23,   9,   3,   1,   0
14.64    3,  19,   52,   48,   21,   9,   4,   2,   1
33.36   25,  125,  151, 180,   60,   17,  8,   6,   3
danasurvey
1984,1990
1,1
2,8
7,    128,   179,  21,  4,  4,  1,  1
8,    399,  1058, 876, 26, 18,  4,  1
8,     58,   290, 659, 241, 48, 4, 0
8,     23,   274, 219,  74, 15, 0, 0
8,     5,     57,  61,   5,  0, 0, 0
4,     8,     30,  49,  19,  0, 0, 0
5,     7,    105,  65,  37,  6, 3, 1
```

Table 7.22

DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 ,Danish seiners fleet, has terminal q estimated as the mean
Fleet 2 ,Swedish Nephr. fleet, has terminal q estimated as the mean
Fleet 3 ,Swedish Cod fleet 3 , has terminal q estimated as the mean
Fleet 4 ,danasurvey , 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,
Oldest age F = 1.000*average of 5 younger ages. Fleets combined by variance of predictions
Fishing mortalities

Age,	83,	84,	85,	86,	87,	88,	89,	90,
2,	.001,	.015,	.004,	.000,	.000,	.001,	.003,	.002,
3,	.165,	.127,	.079,	.063,	.065,	.053,	.061,	.067,
4,	.588,	.451,	.392,	.349,	.368,	.511,	.210,	.274,
5,	1.178,	.719,	.495,	.722,	.946,	1.113,	.527,	.502,
6,	1.260,	.782,	.679,	.706,	1.106,	1.083,	.586,	.555,
7,	.630,	.611,	.713,	.434,	.797,	.822,	.441,	.392,
8,	.516,	.191,	.522,	.468,	.407,	.760,	.311,	.299,
9,	.963,	.129,	.466,	.492,	.799,	.639,	.371,	.320,
10,	.910,	.486,	.575,	.564,	.811,	.883,	.447,	.413,

Log catchability estimates

Age 2

Fleet,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-9.43,	-9.22,	-8.65,	-13.11,	-10.88,	-10.14,	-8.73,	-9.29
2 ,	-14.84,	-12.54,	-13.56,	-16.58,	-17.16,	-15.61,	-14.05,	-14.37
3 ,	-15.32,	-11.79,	-13.26,	-14.76,	-15.24,	-15.19,	-13.23,	-13.73
4 ,	,	-8.06,	-6.67,	-8.44,	-9.60,	-11.15,	-10.95,	-13.10

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-9.93 ,	1.570,	.0006 ,	.0010,	.000E+00,	.000E+00,	-9.932,	.523
2 ,	-14.84 ,	1.641,	.0001 ,	.0012,	.000E+00,	.000E+00,	-14.838,	.547
3 ,	-14.06 ,	1.351,	.0000 ,	.0014,	.000E+00,	.000E+00,	-14.063,	.450
4 ,	-9.71 ,	2.338,	.0003 ,	.0588,	.000E+00,	.000E+00,	-9.710,	.827

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.002	.814	.730	.814	.805

Age 3

Fleet,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-4.27,	-7.07,	-5.60,	-5.63,	-5.78,	-5.94,	-5.61,	-5.77
2 ,	-9.91,	-10.41,	-10.63,	-11.50,	-11.85,	-11.93,	-10.89,	-10.84
3 ,	-9.63,	-9.53,	-10.51,	-11.09,	-11.31,	-11.49,	-10.29,	-10.19
4 ,	,	-7.87,	-5.94,	-6.85,	-6.75,	-8.57,	-8.54,	-8.46

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-5.71 ,	.802,	.0381 ,	.0714,	.000E+00,	.000E+00,	-5.708,	.267
2 ,	-11.00 ,	.754,	.0034 ,	.0576,	.000E+00,	.000E+00,	-10.996,	.251
3 ,	-10.51 ,	.784,	.0009 ,	.0489,	.000E+00,	.000E+00,	-10.505,	.261
4 ,	-7.57 ,	1.127,	.0026 ,	.1643,	.000E+00,	.000E+00,	-7.569,	.398

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.067	.418	.221	.418	.280

Age 4

Fleet,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-3.00,	-5.80,	-3.99,	-3.96,	-4.04,	-3.66,	-4.38,	-4.36
2 ,	-8.64,	-9.14,	-9.03,	-9.84,	-10.11,	-9.66,	-9.66,	-9.44
3 ,	-8.36,	-8.26,	-8.89,	-9.37,	-9.81,	-9.20,	-9.04,	-8.78
4 ,	,	-8.87,	-6.06,	-6.10,	-6.83,	-7.88,	-7.80,	-7.73

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-4.15 ,	.845,	.1808 ,	.3388,	.000E+00,	.000E+00,	-4.150,	.282
2 ,	-9.44 ,	.509,	.0161 ,	.2733,	.000E+00,	.000E+00,	-9.439,	.170
3 ,	-8.96 ,	.544,	.0043 ,	.2275,	.000E+00,	.000E+00,	-8.965,	.181
4 ,	-7.33 ,	1.106,	.0033 ,	.4081,	.000E+00,	.000E+00,	-7.325,	.391

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.274	.325	.104	.325	.103

cont'd.

Table 7.22 cont'd.

Age 5

Fleet,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-2.31,	-5.33,	-3.76,	-3.20,	-3.10,	-2.88,	-3.45,	-3.76
2 ,	-7.95,	-8.67,	-8.79,	-9.07,	-9.16,	-8.88,	-8.73,	-8.83
3 ,	-7.65,	-7.80,	-8.65,	-8.62,	-8.84,	-8.42,	-8.11,	-8.17
4 ,	,	-9.18,	-8.22,	-6.72,	-7.58,	-9.82,	-7.74,	-7.86

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.47	.944	.3556	.6665	.000E+00	.000E+00	-3.474	.315
2	-8.76	.392	.0317	.5386	.000E+00	.000E+00	-8.762	.131
3	-8.28	.449	.0084	.4500	.000E+00	.000E+00	-8.283	.150
4	-8.16	1.111	.0014	.3716	.000E+00	.000E+00	-8.159	.393

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.502	.273	.796E-01	.273	.085

Age 6

Fleet,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-2.19,	-5.25,	-3.44,	-3.22,	-2.94,	-2.91,	-3.35,	-3.66
2 ,	-7.87,	-8.60,	-8.47,	-9.10,	-9.01,	-8.91,	-8.63,	-8.73
3 ,	-7.62,	-7.72,	-8.30,	-8.61,	-8.71,	-8.47,	-8.00,	-8.07
4 ,	,	-8.22,	-7.00,	-6.92,	-8.51,	-12.39,	-11.35,	-8.48

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.37	.934	.3944	.7391	.000E+00	.000E+00	-3.370	.311
2	-8.66	.410	.0350	.5936	.000E+00	.000E+00	-8.664	.137
3	-8.19	.427	.0093	.4943	.000E+00	.000E+00	-8.186	.142
4	-8.98	2.245	.0006	.3341	.000E+00	.000E+00	-8.982	.794

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.555	.280	.801E-01	.280	.082

Age 7

Fleet,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-2.93,	-5.50,	-3.39,	-3.71,	-3.27,	-3.19,	-3.63,	-4.01
2 ,	-8.56,	-8.84,	-8.40,	-9.61,	-9.33,	-9.19,	-8.92,	-9.08
3 ,	-8.24,	-8.06,	-8.39,	-9.18,	-9.05,	-8.75,	-8.28,	-8.43
4 ,	,	-8.34,	-7.50,	-7.84,	-11.56,	-11.74,	-10.79,	-8.27

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.70	.846	.2829	.5305	.000E+00	.000E+00	-3.703	.282
2	-8.99	.422	.0252	.4290	.000E+00	.000E+00	-8.992	.141
3	-8.55	.426	.0065	.3495	.000E+00	.000E+00	-8.549	.142
4	-9.43	1.976	.0004	.1225	.000E+00	.000E+00	-9.434	.698

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.392	.280	.124	.280	.198

Age 8

Fleet,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-3.13,	-6.68,	-3.71,	-3.63,	-3.94,	-3.26,	-3.98,	-4.27
2 ,	-8.90,	-9.80,	-8.70,	-9.55,	-9.90,	-9.28,	-9.29,	-9.37
3 ,	-8.18,	-8.73,	-8.41,	-8.83,	-9.59,	-8.79,	-8.65,	-8.75
4 ,	,	-7.92,	-7.80,	-9.79,	-10.31,	-10.68,	-10.35,	-8.93

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-4.08	1.185	.1946	.3641	.000E+00	.000E+00	-4.077	.395
2	-9.35	.435	.0176	.3055	.000E+00	.000E+00	-9.350	.145
3	-8.74	.434	.0053	.3005	.000E+00	.000E+00	-8.742	.145
4	-9.40	1.271	.0004	.1871	.000E+00	.000E+00	-9.397	.450

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.299	.290	.681E-01	.290	.055

Age 9

Fleet,	83,	84,	85,	86,	87,	88,	89,	90
1 ,	-2.50,	-7.05,	-3.83,	-3.56,	-3.27,	-3.44,	-3.81,	-4.21
2 ,	-8.32,	-9.83,	-8.82,	-9.66,	-9.18,	-9.55,	-9.07,	-9.31
3 ,	-8.11,	-9.68,	-8.24,	-9.45,	-9.97,	-8.91,	-8.29,	-8.65
4 ,	No data for this fleet at this age							

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.96	1.426	.2192	.4109	.000E+00	.000E+00	-3.958	.475
2	-9.22	.519	.0201	.3495	.000E+00	.000E+00	-9.217	.173
3	-8.91	.756	.0045	.2470	.000E+00	.000E+00	-8.913	.252
4	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.320	.410	.122	.410	.088

Table 7.23

Title : Plaice in the SkagerraK (Part of Fishing Area IIIa)
At 11.58.03 04 MARCH 1991
from 78 to 90 on ages 2 to 10
with Terminal F of .780 on age 6 and Terminal S of .500

Initial sum of squared residuals was 477.437 and
final sum of squared residuals is 74.671 after 50 iterations

Matrix of Residuals

Years	78/79	79/80
Ages		
2/ 3	1.270	1.998
3/ 4	.031	.223
4/ 5	-.798	.409
5/ 6	-.829	.206
6/ 7	-.920	-.185
7/ 8	-.035	-.196
8/ 9	.840	-.715
9/10	1.709	.255
	.000	.000
WTS	.001	.001

Years	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90		WTS
Ages												
2/ 3	.105	-4.522	-3.574	-1.492	2.606	1.232	-1.907	-.604	-.822	.992	.000	.001
3/ 4	-.549	.394	-1.343	-.079	.653	.036	.059	-.341	-.444	.117	.000	1.000
4/ 5	-.263	.124	-.753	-.217	.736	.054	-.010	-.295	.011	-.278	.000	1.000
5/ 6	-.572	-.177	-.456	-.177	.355	-.434	.042	.126	.138	-.048	.000	1.000
6/ 7	-.400	-.172	.252	-.257	.110	.012	-.100	.247	-.047	.035	.000	1.000
7/ 8	.215	-.194	.448	-.148	.091	.136	-.102	-.009	.013	.019	.000	1.000
8/ 9	1.351	.198	1.257	.521	-.735	.165	-.026	-.255	.303	.024	.000	1.000
9/10	.218	-.169	.599	.358	-1.212	.029	.138	.527	.027	.130	.000	1.000
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-4.713	
WTS	.001	.001	.001	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	78	79	80
F-values	1.7004	1.0960	1.2408

	81	82	83	84	85	86	87	88	89	90
F-values	.9584	1.7526	1.2620	.6139	.7318	.7043	.9585	1.1797	.6993	.7800

Selection-at-age (S)

	2	3	4	5	6	7	8	9	10
S-values	.0017	.1023	.4864	.9375	1.0000	.7142	.4707	.4562	.5000

Table 7.24 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	1989
2	.010	.008	.002	.000	.000	.001	.015	.004	.000	.001	.001	.003
3	.196	.114	.076	.097	.048	.164	.126	.079	.065	.071	.070	.078
4	.472	.610	.463	.468	.485	.585	.447	.391	.352	.381	.575	.295
5	.997	1.099	.791	.794	1.268	1.144	.712	.488	.718	.964	1.209	.648
6	1.103	1.085	1.040	.910	1.721	1.173	.727	.667	.687	1.088	1.142	.712
7	.959	.939	1.183	.795	1.518	.590	.517	.616	.421	.751	.788	.494
8	1.337	.333	1.215	.626	1.816	.527	.174	.397	.365	.388	.673	.289
9	1.529	.495	.725	.323	1.166	.700	.133	.408	.323	.522	.590	.302
10	.845	.271	.437	.559	.655	.626	.276	.598	.456	.407	.400	.392
11+	.845	.271	.437	.559	.655	.626	.276	.598	.456	.407	.400	.392
(3- 9)U	.942	.668	.785	.573	1.146	.698	.405	.435	.419	.595	.721	.403

	1990	1986-90
2	.001	.001
3	.080	.073
4	.367	.394
5	.866	.881
6	.818	.889
7	.550	.601
8	.353	.414
9	.290	.406
10	.310	.393
11+	.310	.393
(3- 9)U	.475	

Table 7.25 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	36113	31168	28170	20710	40439	83004	60901	40139	32419	33679	36315	101748
3	37970	32338	27968	25430	18739	36587	75034	54297	36179	29330	30458	32828
4	35511	28240	26101	23466	20880	16156	28108	59847	45388	30669	24726	25687
5	27959	20036	13887	14863	13295	11632	8141	16268	36631	28873	18950	12592
6	11053	9333	6040	5696	6077	3386	3352	3613	9037	16173	9963	5119
7	693	3320	2854	1932	2075	984	948	1466	1678	4116	4932	2876
8	23	241	1175	791	789	411	494	511	716	997	1757	2030
9	23	5	156	315	383	116	220	375	311	450	612	811
10	29	4	3	68	207	108	52	174	226	204	241	307
11+	9	4	3	17	35	4	43	63	100	185	241	381
TOTAL NO	149383	124691	106356	93289	102919	152389	177293	176753	162685	144676	128196	184380
SPS NO	113269	93522	78186	72579	62481	69385	116392	136614	130267	110997	91880	82632
TOT.BIOM	42912	33576	33238	23316	29600	44102	52155	51583	52049	40809	35166	46580
SPS BIOM	34317	26469	26111	23316	19369	21027	36260	43073	39243	33905	27176	24603

	1990	1991
2	1079915	0
3	91772	975857
4	27477	76685
5	17306	17225
6	5961	6589
7	2272	2380
8	1587	1186
9	1376	1009
10	543	932
11+	798	890
TOTAL NO	1229005	
SPS NO	149091	
TOT.BIOM	334690	
SPS BIOM	46353	

Table 7.26 PLAICE indices used in the Skagerrak.

Year class	Ålbæk Bay	Area N.57^0
	Summer survey	Dana May survey
	1-group	2-group
1983	6.58	4.2
1984	9.12	21.4
1985	6.5	0.7
1986	11.7	6.0
1987	8.4	2.0
1988	20.4	76.0
1989	9.5	-

Table 7.27 RUN A

List of input variables for the ICES prediction program.

plaice in the skagerrak
The reference F is the mean F (non-weighted) for the age group range from 3 to 9

The number of recruits per year is as follows:

Year	Recruitment
1991	40000.0
1992	40000.0
1993	40000.0

Proportion of F (fishing mortality) effective before spawning: .0000
Proportion of M (natural mortality) effective before spawning: .0000

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
2	40000.0	.00	.10	.00	.261	.261
3	36143.0*	.08	.10	1.00	.255	.255
4	76678.0	.39	.10	1.00	.275	.275
5	17223.0	.75	.10	1.00	.309	.309
6	6588.0	.80	.10	1.00	.374	.374
7	2379.0	.57	.10	1.00	.500	.500
8	1186.0	.38	.10	1.00	.657	.657
9	1009.0	.36	.10	1.00	.802	.802
10	932.0	.40	.10	1.00	.938	.938
11+	890.0	.40	.10	1.00	1.137	1.137

*Run A value - taken as 72,000 in Run B.

Table 7.28 Run A: Assuming 1988 year class to be average.

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

plaice in the skagerrak

Year 1991					Year 1992					Year 1993	
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
.7	.35	53191	42767	10000	.0	.00	52830	42406	0	64576	54152
					.2	.10		42406	3775	60255	49831
					.4	.19		42406	7107	56456	46032
					.6	.28		42406	10054	53110	42686
					.8	.38		42406	12663	50159	39735
					1.0	.47		42406	14979	47553	37129
					1.2	.57		42406	17037	45247	34823
					1.4	.67		42406	18870	43202	32778
					1.6	.76		42406	20506	41387	30963
					1.8	.86		42406	21969	39772	29348
					2.0	.95		42406	23280	38332	27908
1.0	.47	53191	42767	12720	.0	.00	49840	39416	0	61249	50825
					.2	.10		39416	3418	57348	46924
					.4	.19		39416	6440	53913	43489
					.6	.28		39416	9115	50884	40460
					.8	.38		39416	11489	48208	37784
					1.0	.47		39416	13598	45841	35417
					1.2	.57		39416	15475	43744	33320
					1.4	.67		39416	17150	41881	31457
					1.6	.76		39416	18648	40225	29801
					1.8	.86		39416	19990	38748	28324
					2.0	.95		39416	21194	37429	27005

The data unit of the biomass and the catch is tonnes.
The spawning stock biomass is given for the time of spawning.
The spawning stock biomass for 1993 has been calculated with the same fishing mortality as for 1992.
The reference F is the mean F (non-weighted) for the age group range from 3 to 9

Table 7.28 cont'd. RUN B: Assuming 1988 year class to be 2x average.

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

Plaice in the Skagerrak (Part of Fishing Area IIIa)

Year 1991					Year 1992					Year 1993	
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
.7	.33	62342	51918	10011	.0	.00	61778	51354	0	73736	63312
					.1	.05		51354	2284	71141	60717
					.2	.10		51354	4437	68701	58277
					.4	.19		51354	8378	64245	53821
					.6	.28		51354	11887	60295	49871
					.8	.38		51354	15014	56789	46365
					1.0	.47		51354	17808	53671	43247
					1.2	.57		51354	20307	50894	40470
					1.4	.67		51354	22547	48416	37992
					1.6	.76		51354	24559	46201	35777
					1.8	.86		51354	26369	44217	33793
					2.0	.95		51354	28001	42438	32014
1.0	.47	62342	51918	13406	.0	.00	58060	47636	0	69617	59193
					.1	.05		47636	2060	67285	56861
					.2	.10		47636	4003	65091	54667
					.4	.19		47636	7566	61078	50654
					.6	.28		47636	10743	57514	47090
					.8	.38		47636	13581	54343	43919
					1.0	.47		47636	16121	51518	41094
					1.2	.57		47636	18398	48997	38573
					1.4	.67		47636	20444	46742	36318
					1.6	.76		47636	22284	44722	34298
					1.8	.86		47636	23944	42910	32486
					2.0	.95		47636	25443	41280	30856

The data unit of the biomass and the catch is tonnes.
The spawning stock biomass is given for the time of spawning.
The spawning stock biomass for 1993 has been calculated with the same fishing mortality as for 1992.
The reference F is the mean F (non-weighted) for the age group range from 3 to 9

Table 7.29 SUM OF PRODUCTS CHECK

Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: thousands

	1984	1985	1986	1987	1988	1989	1990
1	7	6	8	0	3	5	5
2	2189	1462	395	681	101	1045	3205
3	12926	8988	4476	4593	3140	3977	8993
4	12608	22534	15034	13664	12478	7365	8905
5	4611	6430	20005	18850	14286	6489	10042
6	2052	1766	4910	10751	7120	2813	3333
7	908	725	679	2199	2848	1215	1015
8	750	275	272	398	981	568	495
9	592	209	130	247	333	265	360
10	301	175	122	136	141	140	161
11	37	93	62	119	99	148	223
12+	70	71	22	60	63	78	33
TOTAL	37049	42732	46115	51698	41594	24108	36770

Table 7.30 SUM OF PRODUCTS CHECK

Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: kilogram

	1984	1985	1986	1987	1988	1989	1990
1	.235	.247	.229	.301	.272	.229	.246
2	.276	.278	.253	.281	.247	.273	.291
3	.293	.285	.274	.269	.266	.261	.288
4	.308	.307	.283	.288	.268	.281	.294
5	.377	.352	.320	.307	.289	.320	.337
6	.423	.437	.398	.377	.349	.376	.397
7	.431	.547	.541	.538	.473	.467	.498
8	.398	.672	.678	.759	.565	.636	.685
9	.366	.757	.807	.895	.755	.739	.774
10	.454	.768	.870	1.107	.840	.825	.957
11	1.075	.844	1.016	1.140	1.248	.979	1.153
12+	1.136	1.048	1.097	.793	1.119	1.068	1.143

Table 7.31 PLAICE Division IIIa. Tuning data Kattegat and Skagerrak.

```
IIIa Plaice Tuning data Kattegat and Skagerrak
107
Danish seiners fleet 1 (Skagerak)
1983,1990
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
 9.931,183,1397, 3730, 3424,1489, 639, 290, 120,  56
11.47 ,724,3568, 4299, 5126,1703, 490, 241, 176,  74
Swedish Nephr. fleet 2 (Skagerak)
1983,1990
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
137.96,   1,  34,  178,  220, 112,  44,  14,   4,   1
111.10,  10,  79,  212,  195,  85,  36,  16,   7,   3
202.57,  80,  394, 475,  566, 188,  54,  26,  19,   1
Swedish Cod fleet 3 (Skagerak)
1983,1990
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
18.18,   0,   7,   37,   46,   23,   9,   3,   1,   0
14.64,   3,  19,   52,   48,   21,   9,   4,   2,   1
33.36,   25,125,  151,  180,   60,  17,   8,   6,   4
Danish seiners fleet 1 (Kattegat)
1983,1990
1,1
2,10
10.690,  824, 2771, 1266, 489, 322, 309, 222, 119,  30
 9.310,  765, 2527, 1651, 355, 221, 310, 387, 325, 165
 5.790,  612, 2351, 1890, 202,  39,  37,  54,  41,  46
 6.096,  204, 1205, 1404,1084, 324,  68,  33,  25,  22
 4.380,  230,  933, 1520, 596, 158,  41,  32,  25,  25
 3.960,  23,  388,  686, 466, 181,  83,  51,  24,  22
 4.376,   276,  596,  403, 274, 117,  54,  30,  24,  16
 3.272,   542,  677, 249,  128, 42,   28,  13,   9,   7
```

cont'd.

Table 7.31 cont'd.

```
Swedish Nephr. fleet 2 (Kattegat)
1983,1990
1,1
2,10
15.46,    24,   82,   37,  14,  10,   9,   6,   4,   1
20.89,   38,  126,   82,  18,  11,  15,  19,  16,   8
22.19,     68,  263,  211,  23,   4,   4,   6,   5,   5
24.82,     10,   60,   70,  54,  16,   3,   2,   1,   1
28.80,     25,  103,  167,  66,  17,   4,   4,   3,   3
20.83,      2,   38,   67,  45,  18,   8,   5,   2,   2
19.06,     21,   45,   30,  21,   9,   4,   2,   2,   1
21.35,     64,   80,   30,  15,   5,   3,   2,   1,   1
Swedish Cod fleet 3 (Kattegat)
1983,1990
1,1
2,10
22.70,     98,  328,  150,   58,  38,  37,  26,  14,   4
28.95,     81,  269,  176,   38,  23,  33,  41,  34,  18
23.97,     88,  339,  272,   29,   6,   5,   8,   6,   7
20.00,     15,   88,  102,   79,  24,   5,   2,   2,   2
21.30,     34,  133,  218,   85,  23,   6,   5,   4,   4
16.68,      3,   58,  103,   70,  27,  13,   8,   4,   3
16.54,     34,   73,   50,   34,  14,   7,   4,   3,   2
20.78,    118,  148,   54,   28,   9,   6,   3,   2,   1
Danasurvey
1984,1990
1,1
2,7
17,        167,  330,  78,  14,  4,  7
27,        1002, 1866, 1007,  75,  31, 13
26,         273,  449,  756, 257, 58,  12
23,         96,   408, 282,  85,  19,  13
22,         15,   86,   90,  9,   1,   3
21,         26,   73,   81,  53,  5,   19
17,         82,  170,   73,  42,  9,    5
```

Table 7.32

```
Module run at 11.25.37  05 MARCH 1991
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet  1 ,Danish seiners fleet, has terminal q estimated as the mean
Fleet  2 ,Swedish Nephr. fleet, has terminal q estimated as the mean
Fleet  3 ,Swedish Cod fleet 3 , has terminal q estimated as the mean
Fleet  4 ,Danish seiners fleet, has terminal q estimated as the mean
Fleet  5 ,Swedish Nephr. fleet, has terminal q estimated as the mean
Fleet  6 ,Swedish Cod fleet 3 , has terminal q estimated as the mean
Fleet  7 ,Danasurvey           , 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,
Oldest age F = 1.000*average of 5 younger ages. Fleets combined by variance of predictions
Fishing mortalities

   Age,    84,    85,    86,    87,    88,    89,    90,

     1,  .000,  .000,  .000,  .000,  .000,  .000,  .001,
     2,  .032,  .029,  .010,  .016,  .003,  .016,  .013,
     3,  .170,  .157,  .106,  .135,  .087,  .151,  .163,
     4,  .522,  .440,  .377,  .473,  .566,  .270,  .513,
     5,  .667,  .488,  .778,  .999, 1.185,  .576,  .627,
     6,  .650,  .515,  .755, 1.194, 1.256,  .686,  .583,
     7,  .690,  .443,  .338,  .815, 1.121,  .647,  .500,
     8,  .714,  .405,  .264,  .301,  .968,  .611,  .527,
     9,  .878,  .387,  .303,  .360,  .393,  .671,  .889,
    10,  .742,  .615,  .365,  .526,  .320,  .253, 1.024,
    11,  .735,  .473,  .405,  .639,  .812,  .574,  .705,

Log catchability estimates

 Age  2
 Fleet,    84,    85,    86,    87,    88,    89,    90
_______,_____,_____,_____,_____,_____,_____,_____
     1 , -9.40, -8.89,-13.30,-10.86, -9.81, -8.19, -8.25
     2 ,-12.72,-13.80,-16.76,-17.14,-15.28,-13.51,-13.32
     3 ,-11.96,-13.50,-14.94,-15.22,-14.86,-12.69,-12.68
     4 , -6.74, -6.16, -7.09, -6.68, -8.60, -6.96, -7.28
     5 ,-10.55, -9.70,-11.51,-10.78,-12.70,-11.01,-11.29
     6 ,-10.12, -9.52,-10.89,-10.17,-12.07,-10.38,-10.65
     7 , -8.86, -7.20, -8.25, -9.21,-10.74,-10.89,-10.82
```

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-9.81	1.971	.0006	.0023	.000E+00	.000E+00	-9.814	.679
2	-14.65	1.881	.0001	.0035	.000E+00	.000E+00	-14.648	.665
3	13.69	1.403	.0000	.0048	.000E+00	.000E+00	-13.694	.496
4	-7.07	.815	.0028	.0164	.000E+00	.000E+00	-7.072	.288
5	-11.08	.990	.0003	.0165	.000E+00	.000E+00	-11.077	.350
6	-10.54	.859	.0005	.0149	.000E+00	.000E+00	-10.544	.304
7	-9.42	1.542	.0014	.0536	.000E+00	.000E+00	-9.425	.545

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.013	.432	.286	.432	.439

```
Age  3
Fleet,    84,    85,    86,    87,    88,    89,    90
_______,_____,_____,_____,_____,_____,_____,_____
     1 , -7.20, -5.73, -5.84, -5.93, -5.89, -5.23, -5.18
     2 ,-10.54,-10.77,-11.70,-11.99,-11.89,-10.52,-10.25
     3 , -9.66,-10.64,-11.30,-11.46,-11.44, -9.92, -9.59
     4 , -5.64, -4.95, -5.36, -5.07, -5.90, -5.27, -5.58
     5 , -9.44, -8.48, -9.77, -9.16, -9.89, -9.32, -9.59
     6 , -9.01, -8.30, -9.17, -8.60, -9.24, -8.70, -8.95
     7 , -8.27,  6.72, -7.80, -7.56, -9.13, -8.93, -8.61
```

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-5.86	.714	.0328	.0827	.000E+00	.000E+00	-5.856	.252
2	-11.09	.789	.0031	.0703	.000E+00	.000E+00	-11.094	.279
3	-10.57	.904	.0009	.0614	.000E+00	.000E+00	-10.574	.320
4	-5.40	.358	.0148	.1971	.000E+00	.000E+00	-5.396	.127
5	-9.38	.501	.0018	.2027	.000E+00	.000E+00	-9.379	.177
6	-8.85	.358	.0030	.1804	.000E+00	.000E+00	-8.854	.127
7	-8.15	.907	.0049	.2607	.000E+00	.000E+00	-8.146	.321

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.162	.198	.162	.198	.671

cont'd.

Table 7.32 cont'd.

Age 4

Fleet	84	85	86	87	88	89	90
1	-5.92	4.07	4.04	-4.18	-3.75	-4.29	3.83
2	-9.26	9.11	-9.92	-10.24	-9.75	-9.57	-8.91
3	-8.38	8.97	-9.45	9.94	-9.29	-8.95	8.25
4	-4.91	-5.06	5.15	4.42	-4.85	-5.69	5.43
5	-8.73	-8.59	9.56	8.51	-8.83	9.76	-9.42
6	-8.29	8.41	-8.96	7.95	-8.18	-9.11	8.81
7	-8.57	-7.22	-7.22	-7.77	8.59	-8.86	8.30

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-4.30	.790	.1560	.3232	.000E+00	.000E+00	-4.297	.279
2	-9.54	.506	.0146	.2740	.000E+00	.000E+00	-9.537	.179
3	-9.03	.636	.0040	.2347	.000E+00	.000E+00	-9.034	.225
4	-5.07	.440	.0205	.7329	.000E+00	.000E+00	-5.073	.156
5	-9.06	.543	.0075	.7386	.000E+00	.000E+00	-9.057	.192
6	-8.53	.465	.0041	.6771	.000E+00	.000E+00	-8.529	.164
7	-8.08	.721	.0053	.6439	.000E+00	.000E+00	-8.077	.255

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.506	.208	.189	.208	.825

Age 5

Fleet	84	85	86	87	88	89	90
1	-5.56	-3.84	-3.23	-3.14	-2.93	-3.49	-3.58
2	-8.90	-8.87	-9.11	-9.20	-8.93	-8.77	-8.65
3	-8.02	-8.74	-8.65	-8.88	-8.47	-8.14	-8.00
4	-5.20	-5.93	-4.97	-4.93	-4.63	-5.19	-6.02
5	-8.99	-9.45	-9.38	-9.02	-8.63	-9.23	-10.03
6	-8.57	-9.30	-8.78	-8.46	-7.96	-8.61	-9.38
7	-9.03	-8.46	-7.86	-8.54	-10.29	-8.40	-8.78

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.68	.941	.2890	.5661	.000E+00	.000E+00	-3.681	.333
2	-8.92	.201	.0271	.4810	.000E+00	.000E+00	-8.919	.071
3	-8.41	.387	.0074	.4128	.000E+00	.000E+00	-8.414	.137
4	-5.27	.556	.0169	1.3230	.000E+00	.000E+00	-5.268	.196
5	9.25	.475	.0021	1.3783	.000E+00	.000E+00	-9.247	.168
6	-8.72	.526	.0034	1.2132	.000E+00	.000E+00	-8.723	.186
7	-8.77	.815	.0026	.6329	.000E+00	.000E+00	-8.767	.288

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.611	.148	.182	.182	1.505

Age 6

Fleet	84	85	86	87	88	89	90
1	-5.65	-3.77	-3.29	-2.91	-2.85	-3.31	-3.65
2	-8.99	-8.79	-9.17	-8.97	-8.85	-8.59	8.73
3	-8.11	-8.63	-8.68	-8.67	-8.41	-7.96	-8.06
4	-4.89	6.23	4.81	-5.52	-4.82	-5.03	6.10
5	-8.70	-9.85	-9.22	-9.63	-8.79	-9.07	-10.10
6	-8.29	-9.53	-8.60	-9.03	-8.16	-8.49	-9.49
7	-9.50	-8.00	-7.98	-9.30	-11.73	-9.75	-9.29

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.63	1.018	.3038	.5945	.000E+00	.000E+00	-3.631	.360
2	-8.87	.206	.0285	.5045	.000E+00	.000E+00	-8.870	.073
3	-8.36	.333	.0078	.4337	.000E+00	.000E+00	-8.360	.118
4	-5.34	.656	.0156	1.2414	.000E+00	.000E+00	-5.343	.232
5	-9.34	.575	.0019	1.2529	.000E+00	.000E+00	-9.338	.203
6	-8.80	.596	.0031	1.1644	.000E+00	.000E+00	-8.796	.211
7	-9.37	1.350	.0015	.5393	.000E+00	.000E+00	-9.365	.477

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.582	.154	.150	.154	.955

cont'd.

Table 7.32 cont'd.

Age 7

Fleet	84	85	86	87	88	89	90
1	6.28	5.98	-4.17	-3.30	-2.98	5.37	-3.86
2	-9.62	8.99	10.08	-9.36	-8.98	-8.67	-8.94
3	-8.85	8.99	-9.64	-9.08	-8.54	8.03	-8.29
4	3.68	5.54	-5.20	-5.66	-4.80	5.03	-5.47
5	-7.51	9.11	9.72	-9.87	-8.80	-9.10	-9.58
6	-7.05	8.97	-8.99	-9.17	-8.09	-8.40	8.86
7	-8.07	8.13	-8.38	-8.47	-9.83	-7.64	-8.84

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.99	1.170	.2116	.4383	.000E+00	.000E+00	-3.993	.414
2	-9.23	.518	.0198	.3720	.000E+00	.000E+00	-9.234	.183
3	-8.77	.577	.0052	.3084	.000E+00	.000E+00	-8.773	.204
4	-5.05	.726	.0209	.7578	.000E+00	.000E+00	-5.053	.257
5	-9.10	.853	.0024	.8071	.000E+00	.000E+00	-9.099	.302
6	-8.50	.794	.0042	.7128	.000E+00	.000E+00	-8.503	.281
7	-8.48	.752	.0035	.7162	.000E+00	.000E+00	-8.480	.266

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.500	.266	.158	.266	.352

Age 8

Fleet	84	85	86	87	88	89	90
1	-7.67	4.50	4.47	-4.51	-3.20	-3.46	3.80
2	-10.79	9.50	-10.39	-10.47	-9.21	-8.77	-8.90
3	-9.72	-9.20	-9.67	-10.16	-8.72	-8.13	-8.27
4	-3.23	-4.29	-5.25	-5.20	-4.36	-4.91	-5.47
5	-7.05	-7.83	-9.46	-9.16	-8.35	-9.09	-9.21
6	-6.61	-7.62	-9.24	-8.64	-7.66	-8.25	-8.78
7	No data for this fleet at this age						

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-4.51	1.592	.1255	.2578	.000E+00	.000E+00	-4.515	.563
2	-9.72	.876	.0122	.2323	.000E+00	.000E+00	-9.717	.310
3	-9.13	.827	.0036	.2247	.000E+00	.000E+00	-9.125	.293
4	-4.67	.830	.0306	1.1651	.000E+00	.000E+00	-4.672	.293
5	-8.59	.948	.0040	.9801	.000E+00	.000E+00	-8.593	.335
6	-8.11	.949	.0062	1.0268	.000E+00	.000E+00	-8.113	.335
7	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.526	.383	.341	.383	.795

Age 9

Fleet	84	85	86	87	88	89	90
1	-8.25	-4.57	-4.51	-4.41	-4.17	-3.49	-3.27
2	-11.03	-9.56	-10.61	-10.32	-10.28	-8.74	-8.37
3	-10.89	-8.97	-10.40	-11.11	-9.64	-7.97	-7.72
4	-2.96	-4.33	-4.65	-4.79	-4.94	-4.28	4.99
5	-6.78	-7.78	-9.27	-8.79	-9.09	-8.23	-9.06
6	-6.35	7.67	-8.37	-8.20	-8.17	-7.69	-8.34
7	No data for this fleet at this age						

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-4.67	1.775	.1079	.2206	.000E+00	.000E+00	4.667	.628
2	-9.85	1.059	.0107	.2033	.000E+00	.000E+00	-9.846	.375
3	-9.53	1.456	.0024	.1456	.000E+00	.000E+00	-9.529	.515
4	-4.42	.749	.0394	1.5747	.000E+00	.000E+00	-4.420	.265
5	-8.43	.962	.0047	1.6774	.000E+00	.000E+00	-8.430	.340
6	-7.83	.760	.0083	1.4904	.000E+00	.000E+00	-7.828	.269
7	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.887	.399	.422	.422	1.116

cont'd.

Table 7.32 cont'd.

Age 10

Fleet	84	85	86	87	88	89	90
1	-8.66	-4.40	-4.30	-4.42	-9.51	-4.58	-3.19
2	-9.83	-9.32	-10.36	-10.45	-11.02	-9.93	-10.37
3	-10.38	-9.94	-10.15	-10.14	-10.60	-9.00	-7.18
4	-3.13	-3.58	-4.53	-3.82	-4.37	-5.02	-4.30
5	-6.96	-7.14	-9.02	-7.82	-8.43	-9.26	8.12
6	-6.48	-6.88	-8.12	-7.23	-7.80	-8.43	-8.09
7	No data for this fleet at this age						

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-5.58	2.618	.0433	.0942	.000E+00	.000E+00	-5.580	.926
2	-10.18	.579	.0077	1.2344	.000E+00	.000E+00	-10.182	.205
3	-9.63	1.275	.0022	.0886	.000E+00	.000E+00	-9.626	.451
4	-4.11	.681	.0539	1.2402	.000E+00	.000E+00	-4.106	.241
5	-8.11	.937	.0064	1.0346	.000E+00	.000E+00	-8.108	.331
6	-7.58	.773	.0107	1.7162	.000E+00	.000E+00	-7.575	.273
7	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.023	.339	.344	.344	1.029

Table 7.33

Title : Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)
At 14.44.48 04 MARCH 1991
from 84 to 90 on ages 1 to 11
with Terminal F of 1.040 on age 6 and Terminal S of .400

Initial sum of squared residuals was 375.103 and
final sum of squared residuals is 53.001 after 38 iterations

Matrix of Residuals

Years	84/85	85/86	86/87	87/88	88/89	89/90		WTS
Ages								
1/ 2	-2.942	-1.553	-1.337	-2.878	-3.410	-3.425	-15.544	.001
2/ 3	.294	.829	-.049	.690	-1.933	.171	.002	.001
3/ 4	-.089	.232	.049	-.069	-.363	.242	.002	1.000
4/ 5	.176	-.021	.026	-.108	.156	-.228	.002	1.000
5/ 6	-.283	-.539	.218	.187	.366	.053	.002	1.000
6/ 7	-.523	-.170	.114	.261	.194	.126	.002	1.000
7/ 8	-.206	-.042	-.039	-.086	.216	.159	.002	1.000
8/ 9	.223	.027	-.178	-.377	.266	.040	.002	1.000
9/10	.240	-.126	-.260	.086	-.095	.157	.002	1.000
10/11	.465	.640	.071	.108	-.735	-.547	.002	1.000
	.000	.000	.000	.000	.000	.000	-15.526	
WTS	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	84	85	86	87	88	89	90
F-values	1.0166	.7110	.6278	.8924	1.0706	.7830	1.0400

Selection-at-age (S)

	1
S-values	.0010

	2	3	4	5	6	7	8	9	10	11
S-values	.0175	.1628	.5359	.9371	1.0000	.7418	.5167	.4345	.3684	.4000

Table 7.34 VIRTUAL POPULATION ANALYSIS

Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)

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

	1984	1985	1986	1987	1988	1989	1990	1984-90
1	.000	.000	.000	.000	.000	.000	.001	.000
2	.031	.030	.011	.021	.003	.016	.097	.030
3	.167	.156	.108	.148	.112	.153	.170	.145
4	.509	.430	.373	.482	.648	.368	.524	.476
5	.673	.468	.746	.977	1.245	.740	1.097	.850
6	.650	.523	.699	1.070	1.173	.777	.972	.838
7	.624	.443	.346	.694	.825	.549	.633	.588
8	.589	.343	.264	.312	.681	.334	.401	.418
9	.607	.284	.241	.360	.413	.346	.325	.368
10	.472	.318	.239	.379	.319	.271	.325	.332
11	.406	.232	.159	.343	.463	.571	.789	.423
12+	.406	.232	.159	.343	.463	.571	.789	.423
(3- 9)U	.546	.378	.397	.578	.728	.467	.589	

Table 7.35 VIRTUAL POPULATION ANALYSIS

Plaice in the Kattegat and Skagerrak (Fishing Area IIIa)

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1984	1985	1986	1987	1988	1989	1990	1991
1	57886	43284	38664	36048	74844	40237	5055	0
2	74497	52370	39159	34977	32617	67719	36403	4570
3	88170	65328	45997	35058	31001	29418	60281	29894
4	33093	67506	50576	37368	27360	25068	22842	46006
5	9833	18007	39732	31513	20871	12956	15701	12237
6	4489	4537	10203	17047	10734	5437	5590	4743
7	2045	2121	2433	4590	5291	3007	2262	1914
8	1761	992	1233	1558	2075	2097	1571	1087
9	1360	884	637	857	1032	950	1359	952
10	836	671	602	453	541	618	608	888
11	116	472	441	429	280	356	427	398
12+	220	360	157	217	178	188	63	201
TOTAL NO	274307	256532	229836	200113	206825	188050	152163	
SPS NO	141924	160877	152012	129088	99363	80094	110704	
TOT.BIOM	78631	76701	66264	62553	59228	53113	47824	
SPS BIOM	44467	51450	47502	41874	30814	25411	35987	

Table 7.36 Run A.

List of input variables for the ICES prediction program.

Plaice in the Kattegat and Skagerrak
The reference F is the mean F (non-weighted) for the age group range from 3 to 9

The number of recruits per year is as follows:

Year	Recruitment
1991	44000.0
1992	44000.0
1993	44000.0

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	44000.0	.00	.10	.00	.251	.251
2	40000.0	.02	.10	.00	.271	.271
3	35000.0*	.16	.10	1.00	.277	.277
4	46006.0	.51	.10	1.00	.290	.290
5	12237.0	.89	.10	1.00	.329	.329
6	4743.0	.95	.10	1.00	.394	.394
7	1914.0	.71	.10	1.00	.499	.499
8	1087.0	.49	.10	1.00	.628	.628
9	952.0	.41	.10	1.00	.728	.728
10	888.0	.35	.10	1.00	.832	.832
11	398.0	.38	.10	1.00	1.065	1.065
12+	201.0	.38	.10	1.00	1.058	1.058

*Run A value. Assumed to be 70,600 for Run B.

Table 7.37 Run A.

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

Plaice in the Kattegat and Skagerrak

Year 1991					Year 1992					Year 1993	
factor	ref. F	stock biomass	sp.stock biomass	catch	factor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.59	54521	32613	11318	.0	.00	52826	30979	0	63572	41715
					.2	.12			2909	60342	38487
					.4	.24			5456	57529	35675
					.6	.35			7693	55070	33219
					.8	.47			9665	52916	31066
					1.0	.59			11408	51022	29174
					1.2	.71			12953	49351	27506
					1.4	.82			14329	47874	26030
					1.6	.94			15558	46562	24720
					1.8	1.06			16659	45393	23553
					2.0	1.18			17649	44349	22511

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 (non-weighted) for the age group range from 3 to 9

cont'd.

Table 7.37 cont'd. RUN B

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

Plaice in the Kattegat and Skagerrak

Year 1991					Year 1992					Year 1993	
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
.9	.51	64373	42465	11302	.0	.00	62286	40437	0	73354	51497
					.2	.12			3837	69112	47257
					.4	.24			7215	65395	43542
					.6	.35			10196	62130	40279
					.8	.47			12834	59255	37405
					1.0	.59			15174	56716	34869
					1.2	.71			17257	54469	32623
					1.4	.82			19114	52475	30631
					1.6	.94			20776	50700	28858
					1.8	1.06			22267	49116	27277
					2.0	1.18			23608	47700	25862
1.0	.59	64373	42465	12667	.0	.00	60826	38979	0	71785	49928
					.2	.12			3648	67758	45903
					.4	.24			6864	64225	42371
					.6	.35			9707	61116	39265
					.8	.47			12226	58375	36526
					1.0	.59			14464	55951	34104
					1.2	.71			16458	53803	31957
					1.4	.82			18239	51893	30049
					1.6	.94			19835	50191	28349
					1.8	1.06			21269	48670	26831
					2.0	1.18			22560	47308	25470

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 (non-weighted) for the age group range from 3 to 9

Table 8.1 Catch (in tonnes) of Sole from Division IIIa. Data provided by Working Group members.

Year	Denmark		Netherlands	Sweden	Germany	Belgium[2]	Working Group corrections	Total
	Skagerrak	Kattegat	Skagerrak	Kattegat	Kattegat	Skagerrak		
1970	25	158	-	-	-	-	-	183
1971	32	242	-	-	9	-	-	283
1972	31	327	-	-	12	-	-	370
1973	52	260	-	-	13	-	-	325
1974	39	388	-	-	9	-	-	436
1975	55	381	9	16	16	-	-9	468
1976	34	367	155	11	21	2	-155	435
1977	91	400	276	13	8	1	-276	513
1978	141	336	141	9	9	-	-141	495
1979	57	301	84	8	6	1	-84	373
1980	73	228	5	9	12	2	-5	324
1981	59	199	-	7	16	1	-	282
1982	52	147	1	4	8	1	-1	212
1983	70	180	31	11	15	-	-31	276
1984	76	235	54	13	13	-	-54	337
1985	102	275	132	19	1	+	-132	397
1986	158	456	109	26	1	2	-109	643
1987	137	564	70	19	-	2	-70	722
1988	138	540	-	24	-	4	-	706
1989	217	578	-	21	7	1	-	824
1990[1]	128[2]	464[2]	-	29	6	2	-	629

[1] Preliminary.
[2] Data as officially reported to ICES.

Table 8.2 Sole in Division IIIa. Percentage distribution of Danish landings by vessel category in 1989 and 1990.

	Skagerrak		Kattegat	
Vessel type	1989	1990	1989	1990
Trawler <20 BR/BRT	17.6	25.8	41.3	46.6
20-39 BR/BRT	2.0	4.8	6.2	4.6
40-59 BR/BRT	4.8	11.3	8.2	7.5
≥ 60 BR/BRT	1.5	13.7	4.4	3.3
Danish Seine	1.0	1.6	0.4	0.7
Net/Line	53.2	26.6	30.5	22.5
Other vessels	11.7	8.1	3.8	5.5
Unidentified	8.3	8.1	5.3	9.3

Table 8.3 SUM OF PRODUCTS CHECK

Sole in the Kattegat and Skagerrak (Fishing Area IIIa)
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: thousands

	1984	1985	1986	1987	1988	1989	1990
1	0	1	0	0	10	3	0
2	64	786	258	391	516	863	724
3	638	594	1255	857	1035	613	779
4	240	190	671	1018	897	847	390
5	117	55	210	434	484	592	338
6	31	60	33	174	129	404	186
7	33	16	36	64	37	83	100
8	40	8	33	31	23	30	16
9	84	29	29	6	8	16	8
10	60	30	18	17	14	7	3
11+	31	10	16	64	38	29	8
TOTAL	1338	1779	2559	3056	3191	3487	2552

Table 8.4 SUM OF PRODUCTS CHECK

Sole in the Kattegat and Skagerrak (Fishing Area IIIa)
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: kilogram

	1984	1985	1986	1987	1988	1989	1990
1	.112	.112	.112	.112	.154	.100	.112
2	.183	.174	.165	.160	.159	.176	.180
3	.213	.234	.231	.194	.197	.221	.228
4	.257	.283	.287	.245	.235	.255	.251
5	.294	.291	.297	.274	.251	.266	.308
6	.297	.335	.409	.319	.335	.271	.333
7	.280	.292	.267	.360	.348	.352	.400
8	.321	.279	.262	.417	.363	.300	.547
9	.323	.320	.365	.357	.336	.364	.752
10	.365	.357	.369	.311	.304	.285	.498
11+	.415	.415	.415	.415	.415	.415	.415

Table 8.5

Title : Sole in the Kattegat and Skagerrak (Fishing Area IIIa)
At 12.32.42 27 FEBRUARY 1991
from 84 to 89 on ages 1 to 10
with Terminal F of .500 on age 4 and Terminal S of .700

Initial sum of squared residuals was 351.427 and
final sum of squared residuals is 52.503 after 48 iterations

Matrix of Residuals

Years / Ages	84/85	85/86	86/87	87/88	88/89		WTS
1/ 2	-4.010	.117	-2.842	-3.441	.910	-9.266	.001
2/ 3	-1.526	.918	-.095	-.176	.881	.001	1.000
3/ 4	.628	.007	.003	-.582	-.055	.001	1.000
4/ 5	.582	-.262	-.072	-.105	-.142	.001	1.000
5/ 6	-.189	.383	-.273	.413	-.333	.001	1.000
6/ 7	-.148	.429	-1.068	.805	-.018	.001	1.000
7/ 8	.691	-.726	-.170	.369	-.163	.001	1.000
8/ 9	-.486	-1.367	1.312	.625	-.084	.001	1.000
9/10	.452	.617	.366	-1.346	-.088	.001	1.000
	.000	.000	.000	.000	.000	-9.257	
WTS	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	84	85	86	87	88	89
F-values	.4245	.3050	.4534	.5342	.4527	.5000

Selection-at-age (S)

	1	2	3	4	5	6	7	8	9	10
S-values	.0010	.2267	.8361	1.0000	.8996	.8084	.7386	.7198	.6359	.7000

Table 8.6 VIRTUAL POPULATION ANALYSIS

Sole in the Kattegat and Skagerrak (Fishing Area IIIa)

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

	1984	1985	1986	1987	1988	1989	1984-89
1	.000	.000	.000	.000	.001	.000	.000
2	.023	.150	.066	.102	.193	.113	.108
3	.510	.276	.336	.285	.374	.327	.351
4	.573	.248	.505	.442	.480	.526	.462
5	.433	.219	.420	.633	.346	.595	.441
6	.234	.368	.177	.649	.344	.480	.375
7	.268	.163	.349	.533	.243	.345	.317
8	.269	.086	.516	.506	.329	.283	.332
9	.339	.284	.446	.146	.209	.355	.297
10	.297	.174	.255	.453	.520	.254	.326
11+	.297	.174	.255	.453	.520	.254	.326
(3- 9)U	.375	.235	.393	.457	.332	.416	

Table 8.7 VIRTUAL POPULATION ANALYSIS

Sole in the Kattegat and Skagerrak (Fishing Area IIIa)

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .300
PROPORTION OF ANNUAL M BEFORE SPAWNING: .400

	1984	1985	1986	1987	1988	1989	1990
1	6543	4724	4700	3408	9369	6307	0
2	2918	5921	4274	4253	3084	8468	5704
3	1670	2580	4611	3622	3477	2301	6842
4	576	907	1771	2982	2464	2165	1501
5	348	294	641	967	1734	1380	1157
6	156	204	214	381	464	1110	689
7	147	111	128	162	180	298	622
8	178	102	86	82	86	128	191
9	306	123	84	46	45	56	87
10	245	197	84	49	36	33	36
11+	126	66	74	184	98	135	118
TOTAL NO	13214	15229	16666	16136	21037	22381	
SPS NO	3156	4076	6598	7211	7327	6382	
TOT.BIOM	1525	2772	2705	2701	3948	4079	
SPS BIOM	838	1079	1715	1709	1721	1642	

Table 8.8 SOLE in Division IIIa. Recruitment index. Danish flatfish survey in Division IIIa.

Survey year (t)	Year class (t-1)	Recruitment index
1984	1983	9.52
1985	1984	16.90
1986	1985	2.04
1987	1986	-
1988	1987	1.20
1989	1988	5.83
1990	1989	7.60

Table 8.9 Input data for the RCRTINX2.

```
sole in the Kattegat and Skagerrak as 1-group yearclasses 83-89
1, 7,  2,
1983, 6543,  9.52
1984, 4724, 16.9
1985, 4700,  2.04
1986, 3408, -11
1987, 9369,  1.20
1988, 6307,  5.83
1989, -11,   7.6
havkatten
```

Table 8.10

```
Analysis by RCRTINX2 of data from file solesurvey:dat
sole in the Kattegat and Skagerrak as 1-group yearclasses 83-89

Data for    1 surveys over    7 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER =    3 OVER  20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN    INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS        .20
MINIMUM OF   5 POINTS USED FOR REGRESSION


Yearclass =   1989

Survey/  Index    Slope  Inter-  Rsquare No.  Predicted  Sigma  Standard  Weight
Series   Value           cept           Pts    Value             Error
havkat   2.1518  -.660    9.911    .2498  5    8.4905   .57438  .64076   .23085

MEAN                                        8.6218   .35103  .35103   .76915


Yearclass      Weighted      Internal    External    Virtual       Ext.SE/
               Average       Standard    Standard    Population    Int.SE
               Prediction    Error       Error       Analysis

1989    8.59    5385.55        .31         .06                      .18
```

Table 8.11

List of input variables for the ICES prediction program.

sole in Kattegat and Skagerrak
The reference F is the mean F (non-weighted) for the age group range from 3 to 9

The number of recruits per year is as follows:

Year	Recruitment
1990	5000.0
1991	5000.0
1992	5000.0
1993	5000.0

Proportion of F (fishing mortality) effective before spawning: .3000
Proportion of M (natural mortality) effective before spawning: .4000

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	5000.0	.00	.10	.00	.116	.116
2	5704.0	.12	.10	.00	.171	.171
3	6842.0	.43	.10	1.00	.217	.217
4	1501.0	.52	.10	1.00	.259	.259
5	1157.0	.46	.10	1.00	.283	.283
6	689.0	.42	.10	1.00	.328	.328
7	622.0	.38	.10	1.00	.328	.328
8	191.0	.37	.10	1.00	.356	.356
9	87.0	.33	.10	1.00	.402	.402
10	36.0	.36	.10	1.00	.356	.356
11+	118.0	.36	.10	1.00	.415	.415

Table 8.12 RUN A.

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

sole in Kattegat and Skagerrak

Year 1991					Year 1992					Year 1993	
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
.6	.26	4676	2933	829	.0	.00	4721	3234	0	5658	4135
					.4	.15		3076	525	5094	3421
					.8	.33		2903	1037	4545	2758
					1.0	.42		2826	1245	4321	2499
					1.2	.50		2747	1447	4106	2254
1.0	.42	4676	2782	1246	.0	.00	4276	2807	0	5212	3705
					.4	.15		2670	459	4717	3075
					.8	.33		2520	907	4235	2489
					1.0	.42		2453	1090	4038	2259
					1.2	.50		2385	1267	3849	2042

The data unit of the biomass and the catch is tonnes.
The spawning stock biomass is given for the time of spawning.
The spawning stock biomass for 1993 has been calculated with the same fishing mortality as for 1992.
The reference F is the mean F (non-weighted) for the age group range from 3 to 9

cont'd.

Table 8.12 cont'd. RUN B.

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

sole in Kattegat and Skagerrak

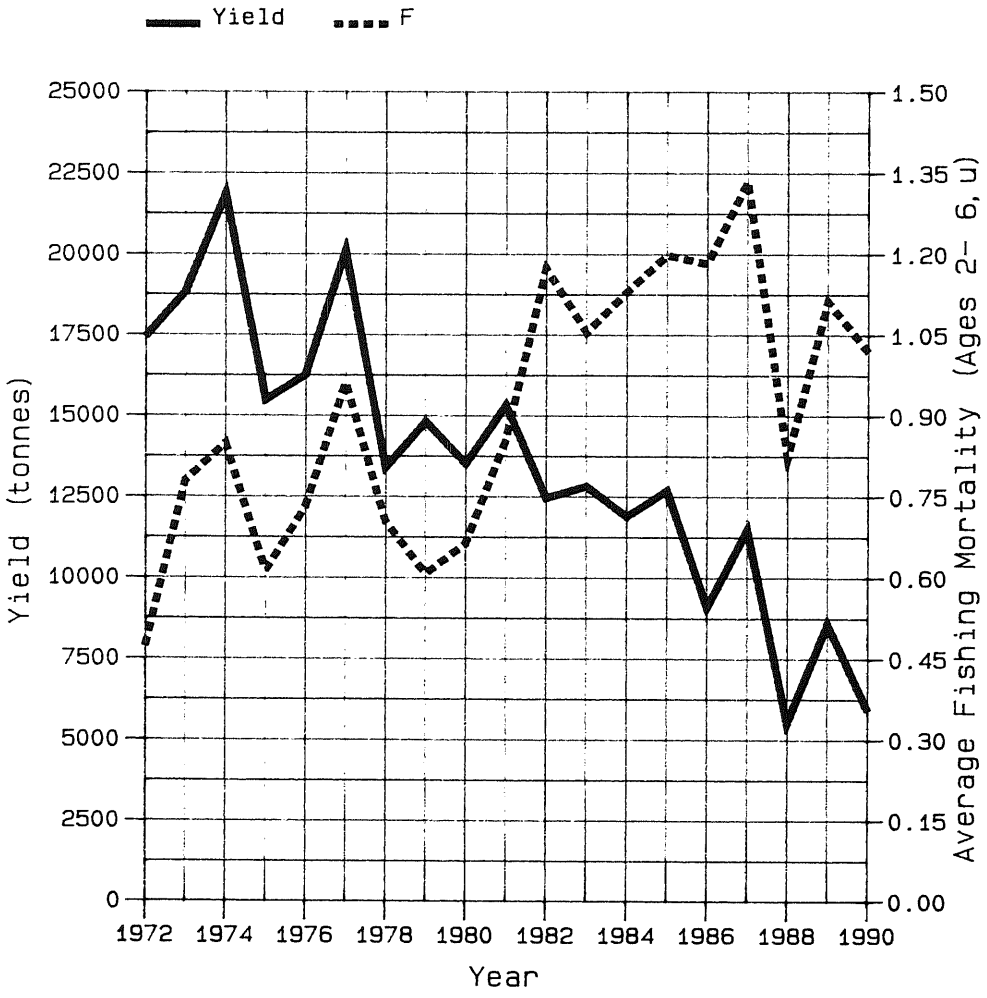
Year 1991					Year 1992					Year 1993	
fac-tor	ref. F	stock biomass	sp.stock biomass	catch	fac-tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
.7	.30	4216	2489	830	.0	.00	4259	2790	0	5198	3692
					.4	.15		2653	458	4703	3062
					.8	.33		2504	905	4222	2477
					1.0	.42		2437	1088	4025	2247
					1.2	.50		2369	1264	3836	2031
1.0	.42	4216	2398	1082	.0	.00	3988	2530	0	4925	3430
					.4	.15		2406	418	4474	2852
					.8	.33		2271	826	4033	2313
					1.0	.42		2211	993	3853	2101
					1.2	.50		2149	1154	3680	1902

The data unit of the biomass and the catch is tonnes.
The spawning stock biomass is given for the time of spawning.
The spawning stock biomass for 1993 has been calculated with the same fishing mortality as for 1992.
The reference F is the mean F (non-weighted) for the age group range from 3 to 9

Figure 3.1

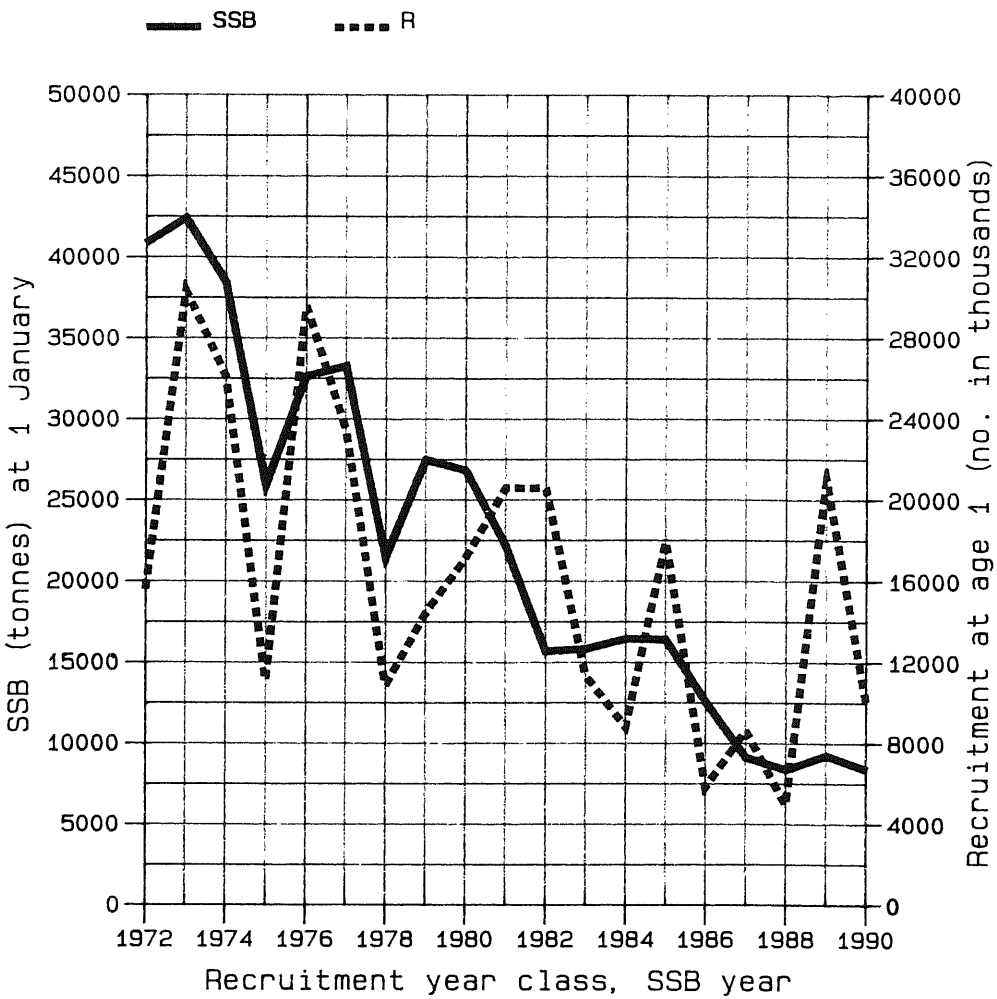
FISH STOCK SUMMARY
Cod in the Kattegat (Part of Fishing Area IIIa)
01-03-1991

Trends in yield and fishing mortality (F)



A

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



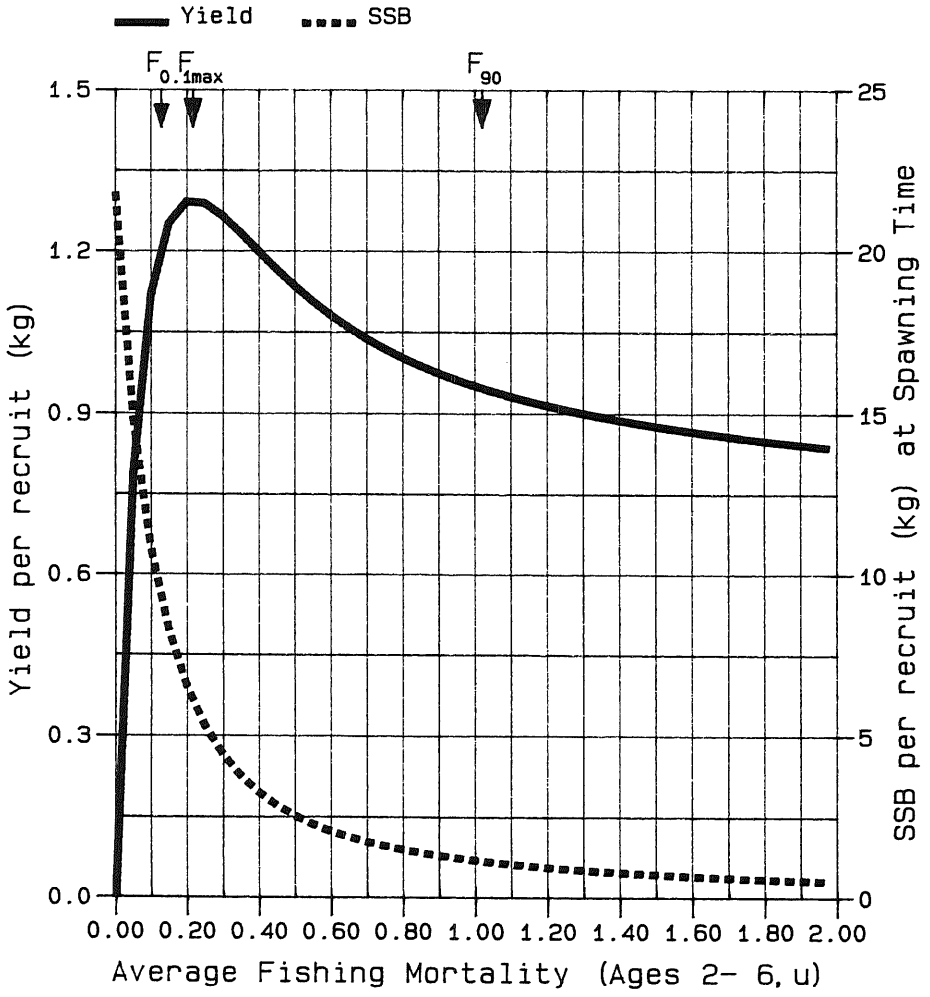
B

cont'd.

Figure 3.1 cont'd.

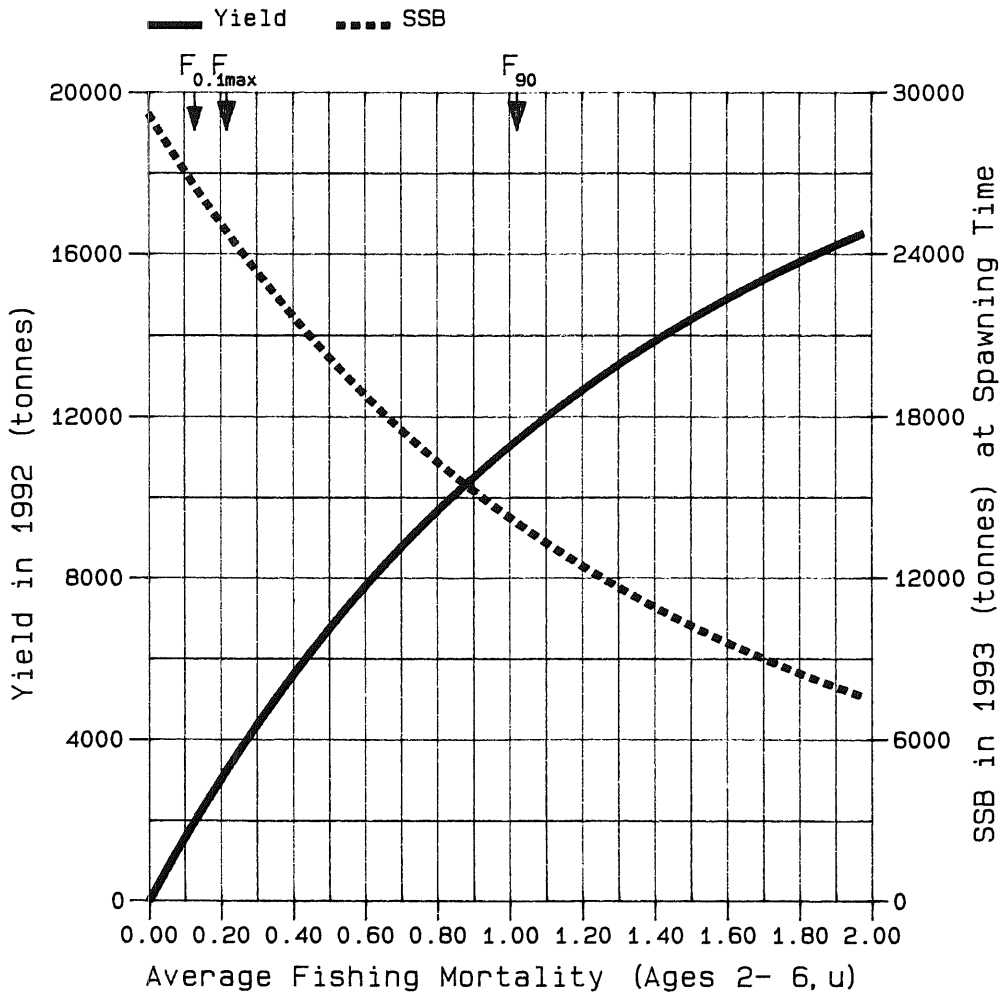
FISH STOCK SUMMARY
Cod in the Kattegat
10-04-1991

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

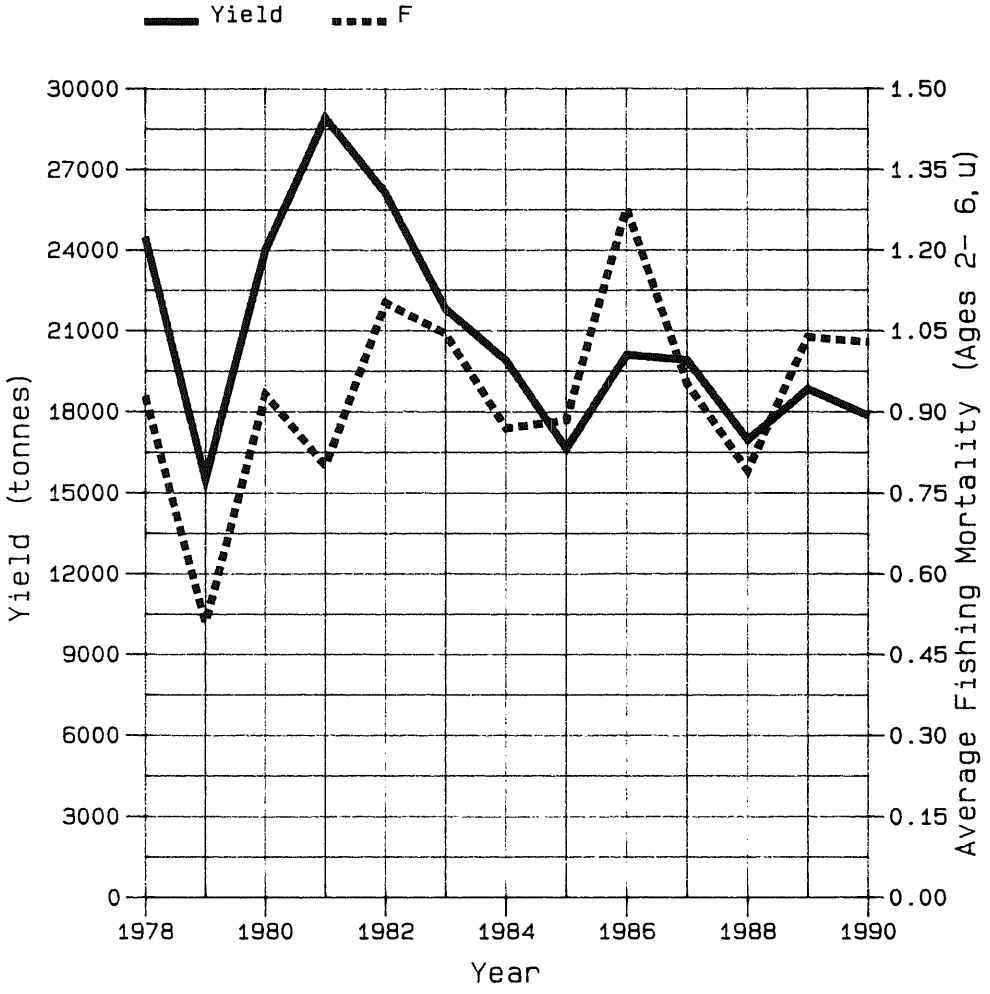
FISH STOCK SUMMARY

Figure 3.2

Cod in the Skagerrak (Part of Fishing Area IIIa)

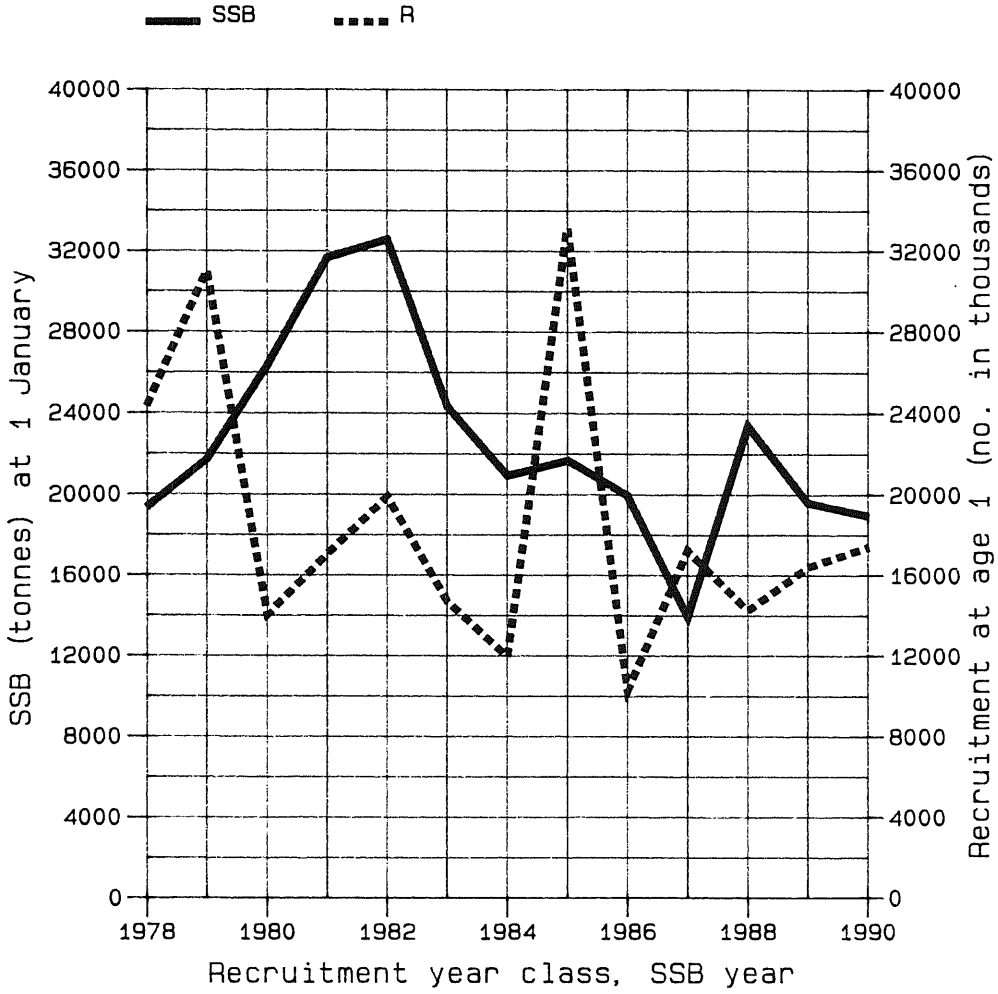
11-04-1991

Trends in yield and fishing mortality (F)



A

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



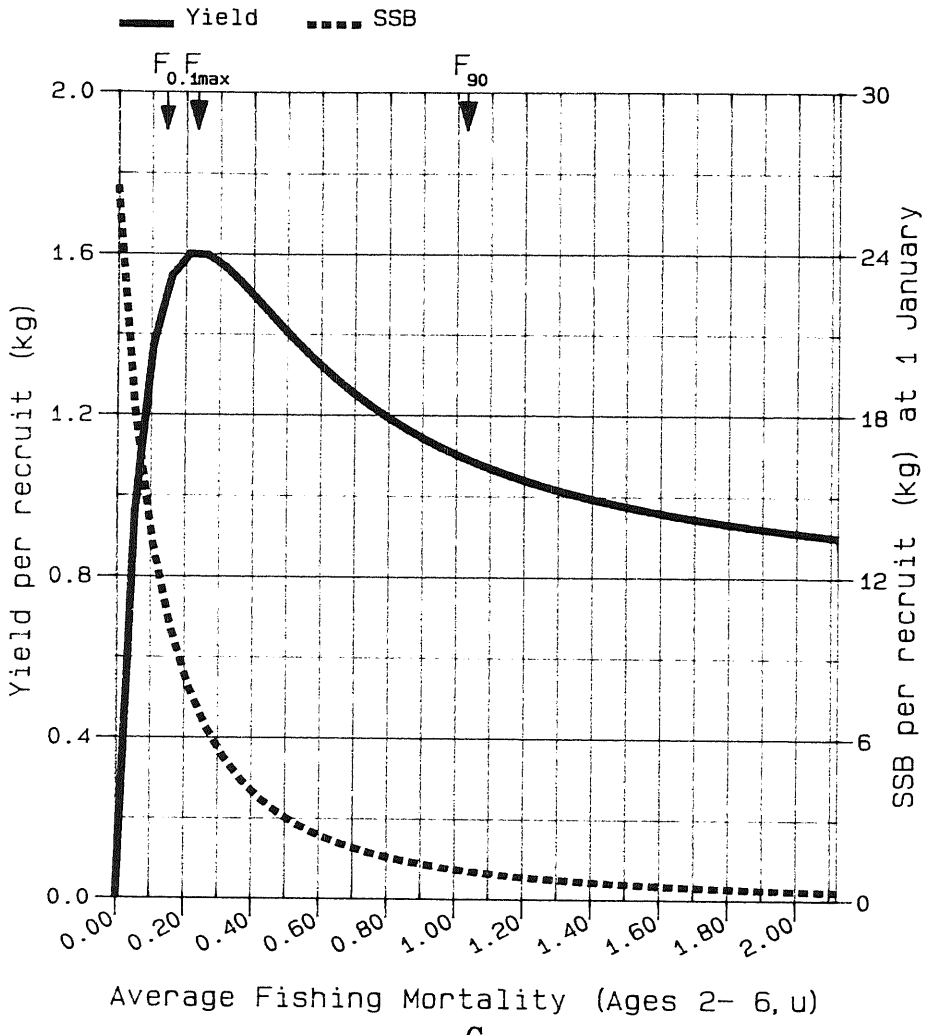
B

cont'd.

Figure 3.2 cont'd.

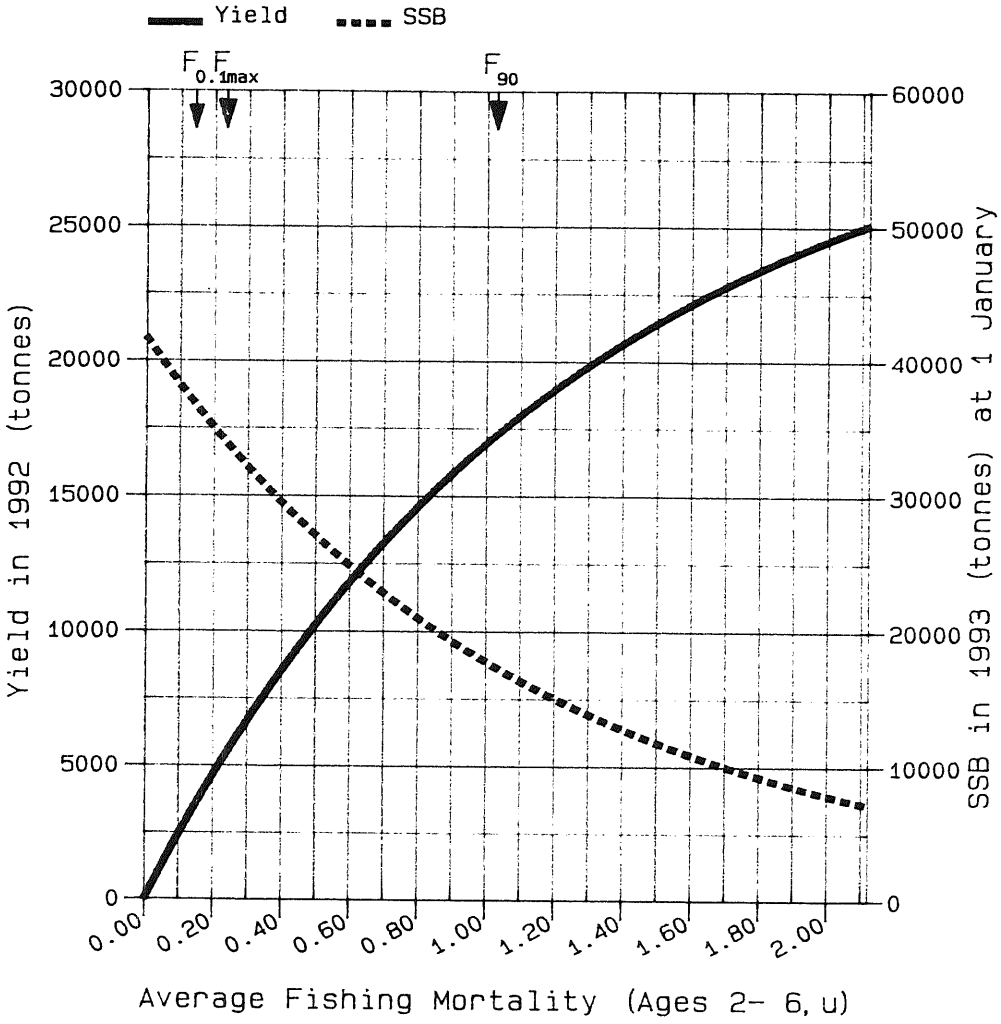
FISH STOCK SUMMARY
PROGNOSES FOR COD IN THE SKAGERRAK
11-04-1991

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass

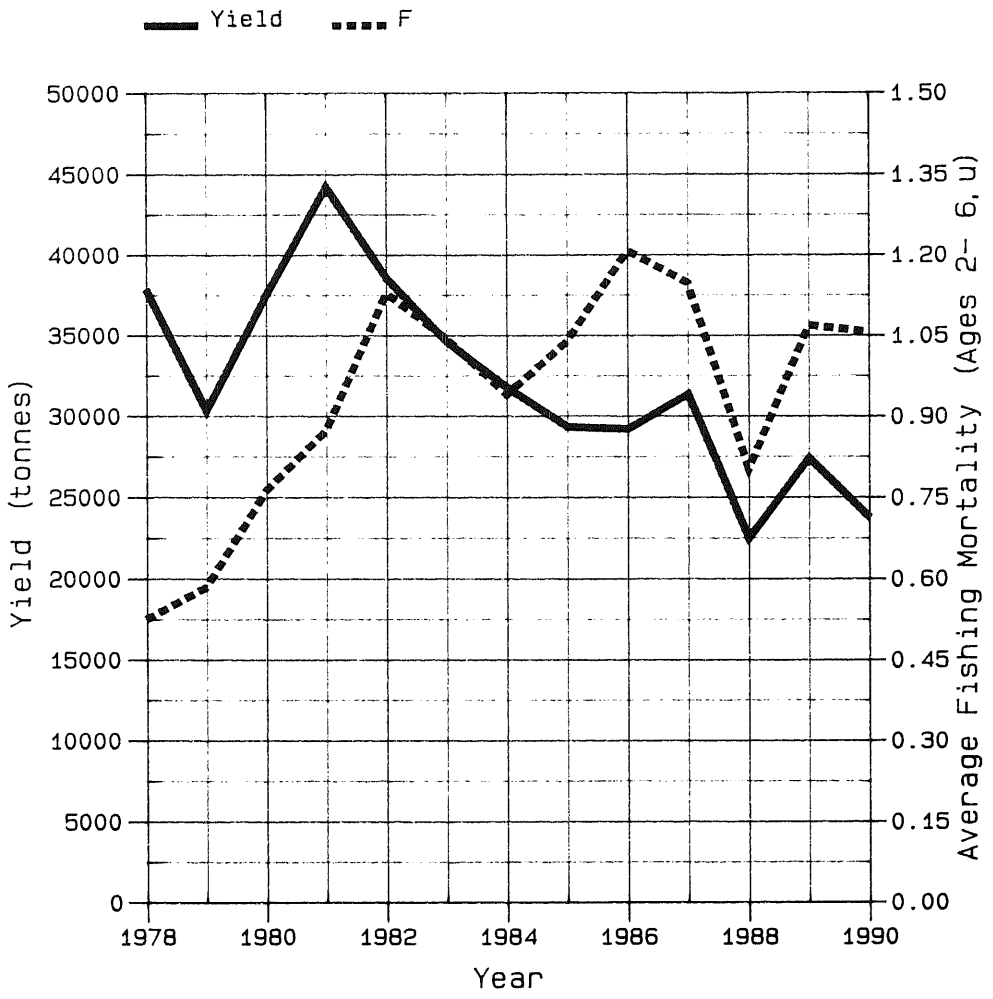


D

Figure 3.3

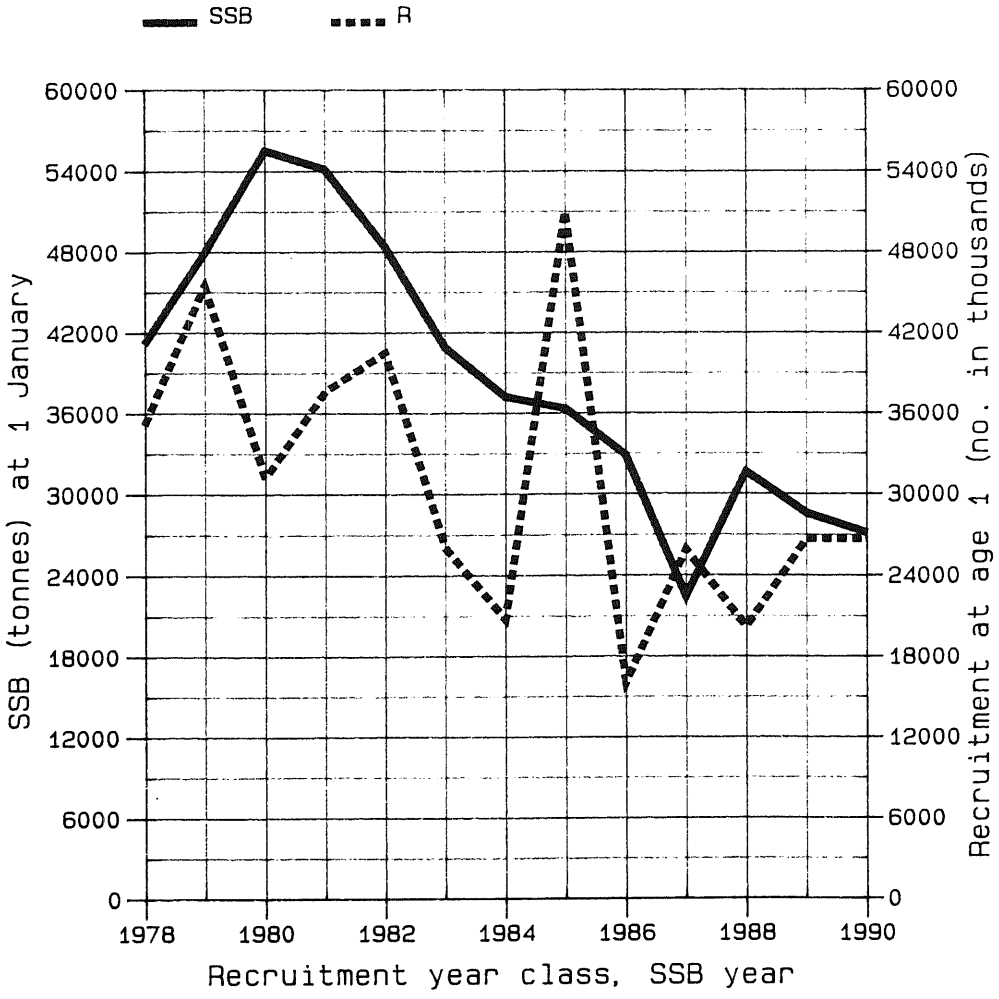
FISH STOCK SUMMARY
Cod in the Kattegat and Skagerrak
11-04-1991

Trends in yield and fishing mortality (F)



A

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



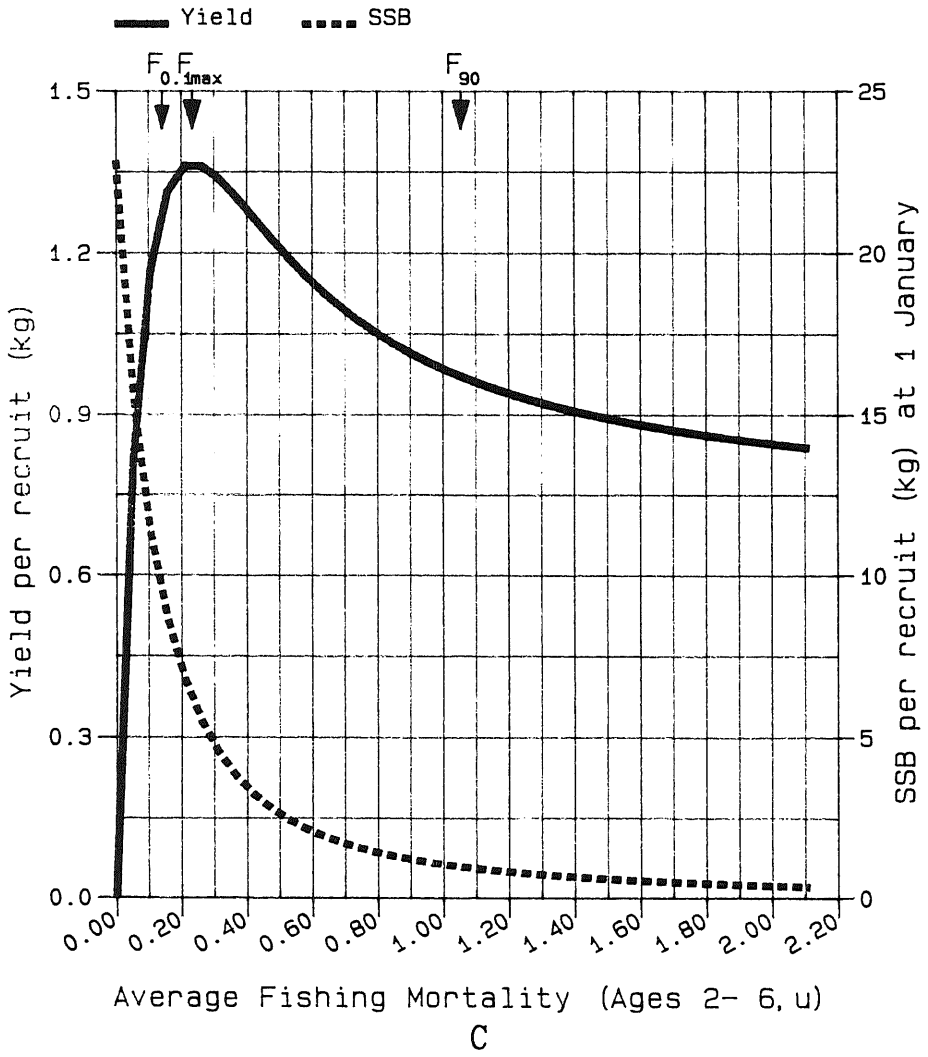
B

cont'd.

Figure 3.3 cont'd.

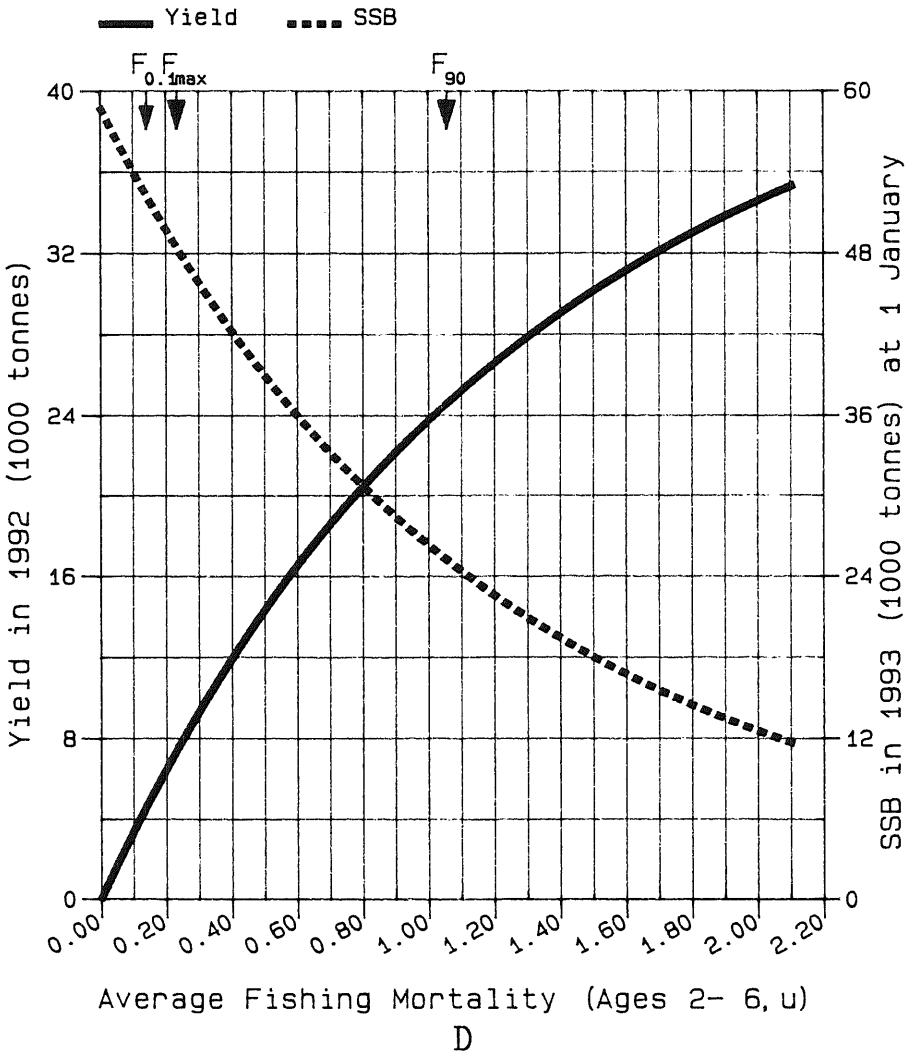
FISH STOCK SUMMARY
COD IN III A COMBINED
11-04-1991

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

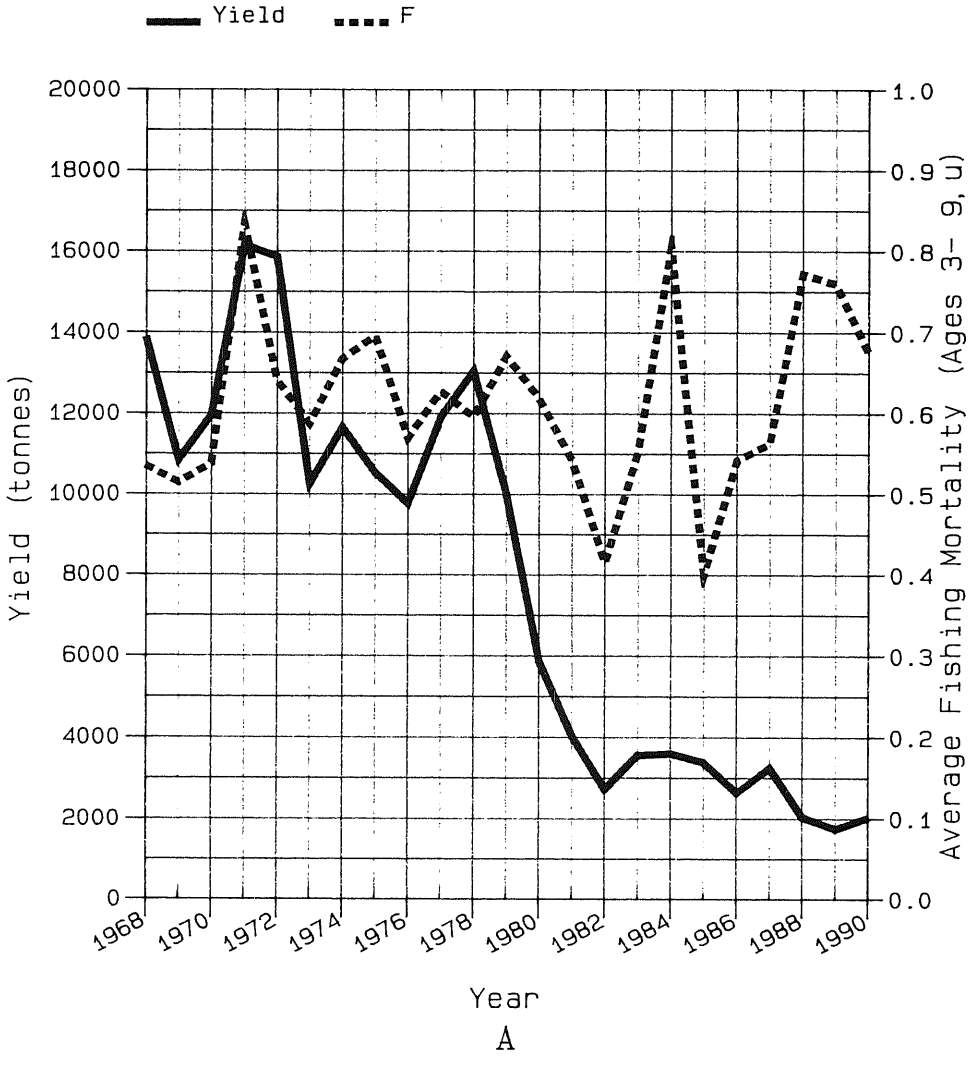
FISH STOCK SUMMARY

Figure 7.1

Plaice in the Kattegat (Part of Fishing Area IIIa)

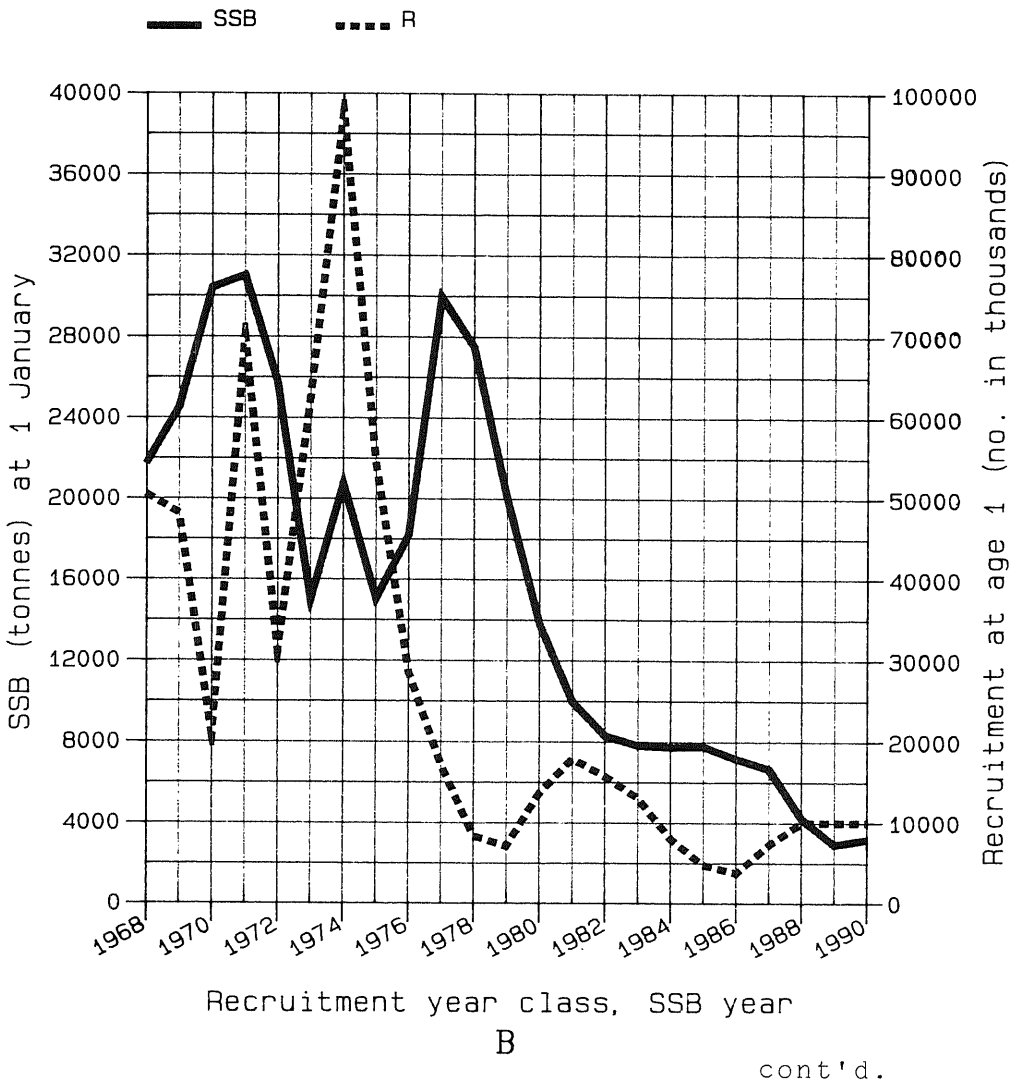
22-03-1991

Trends in yield and fishing mortality (F)



A

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



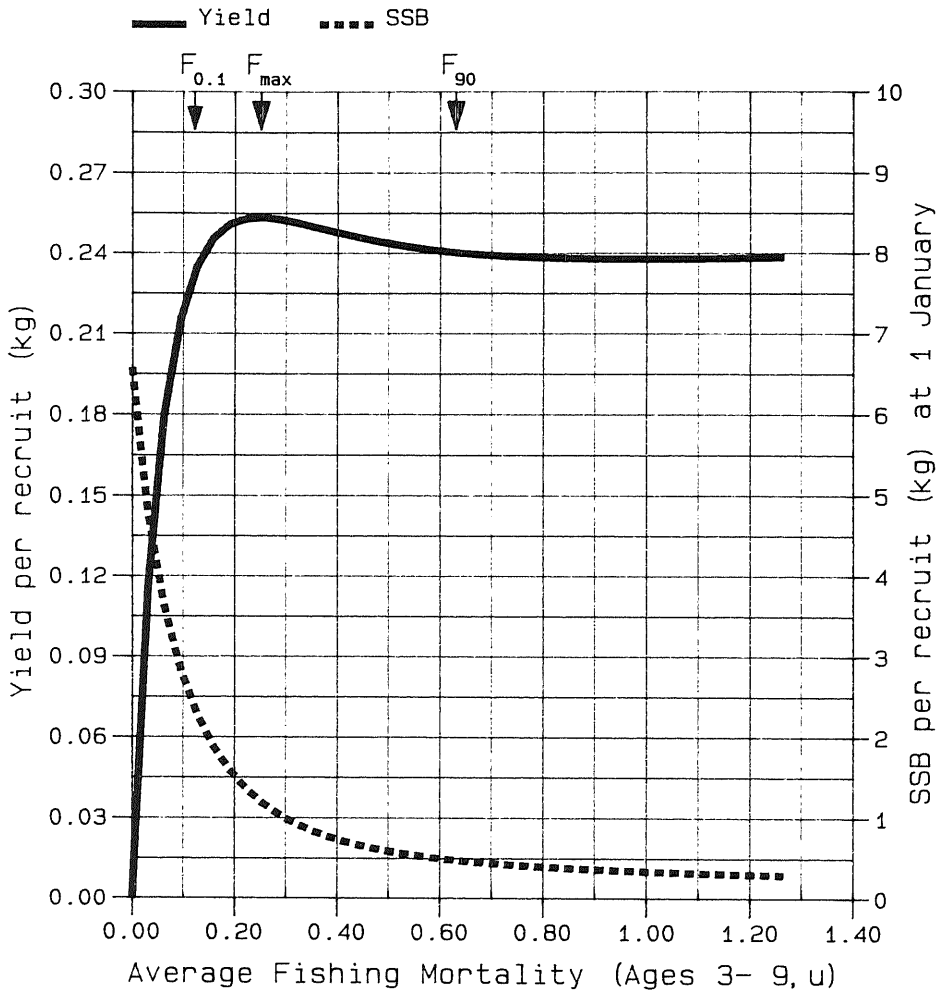
B

cont'd.

Figure 7.1
cont'd.

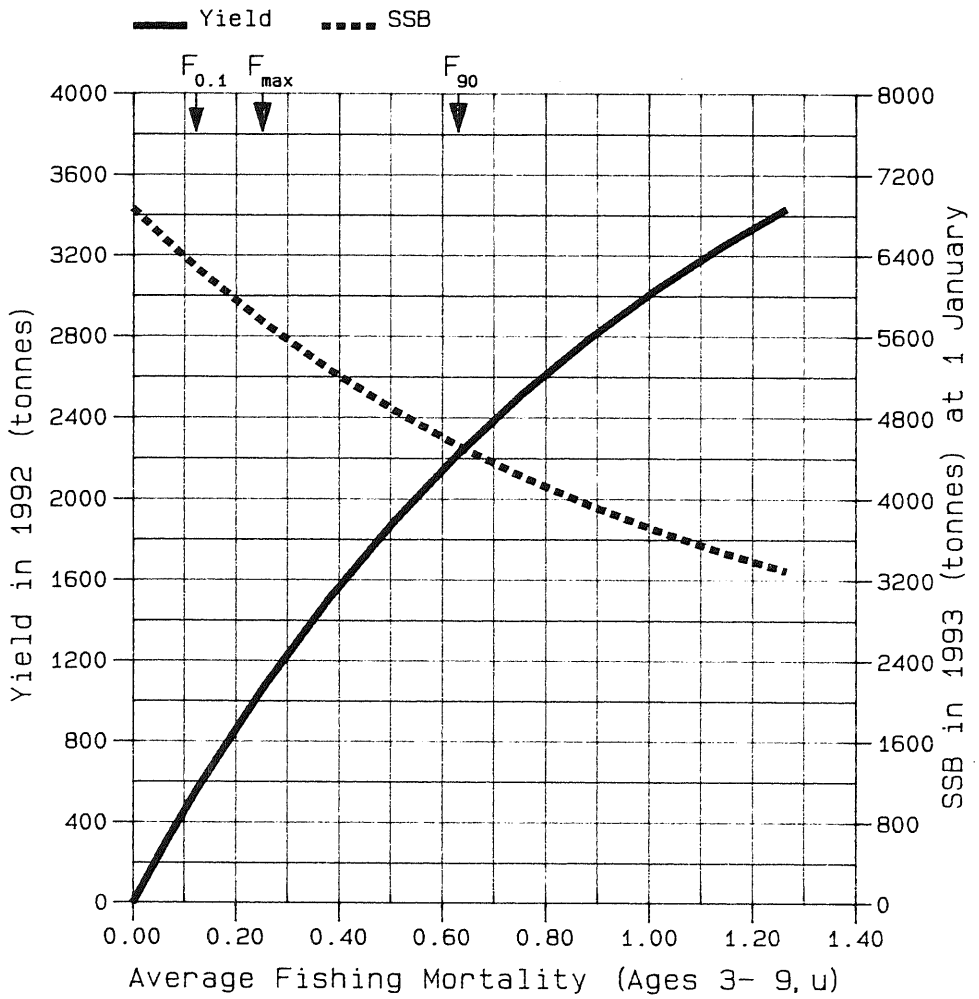
FISH STOCK SUMMARY
Plaice in the Kattegat (Part of Fishing Area IIIa)
23-03-1991

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass

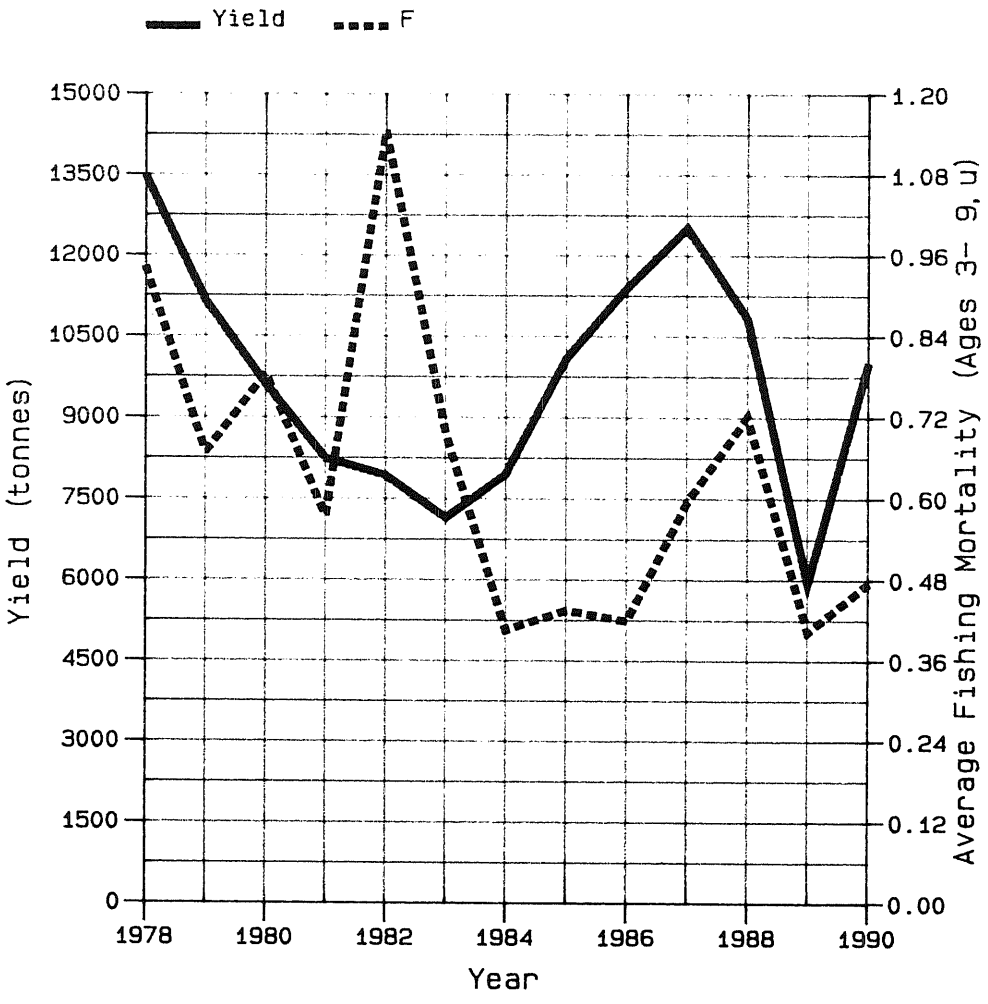


D

Figure 7.2

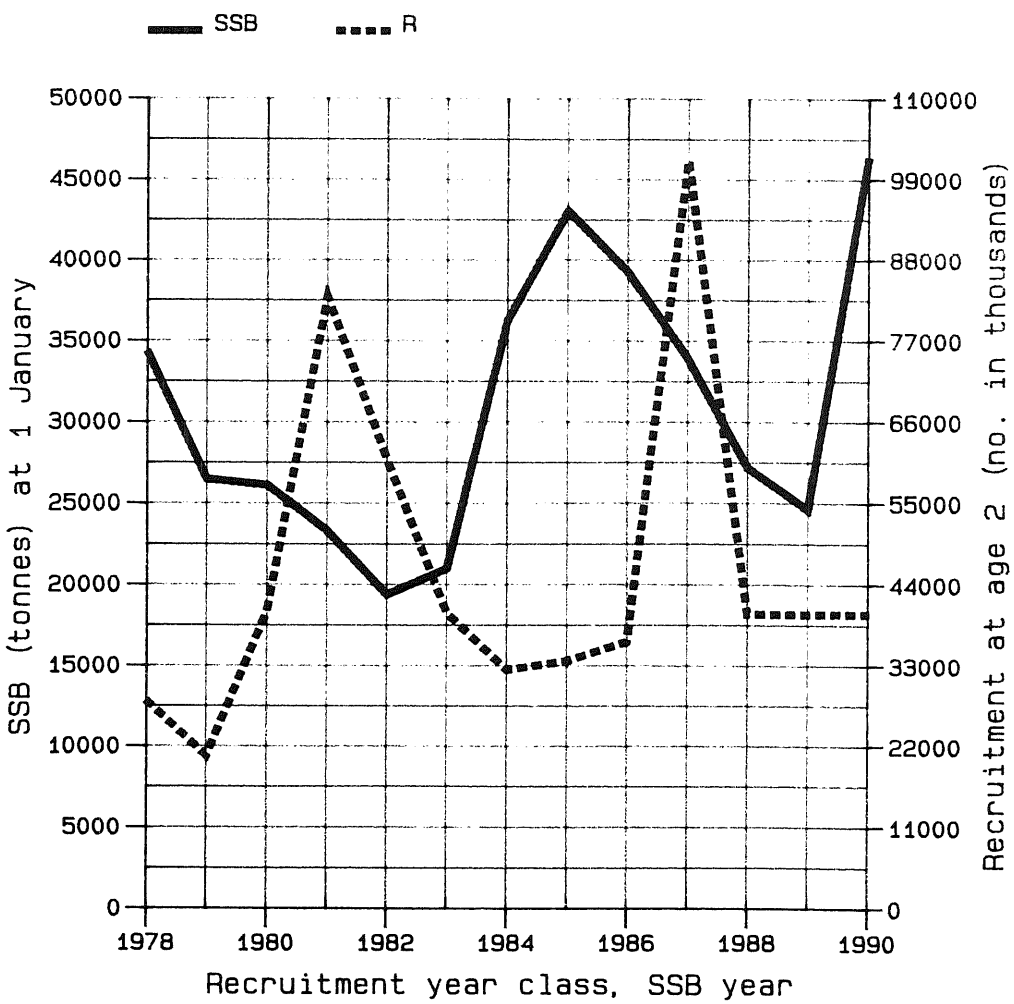
FISH STOCK SUMMARY
Plaice in the Skagerrak
04-03-1991

Trends in yield and fishing mortality (F)



A

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



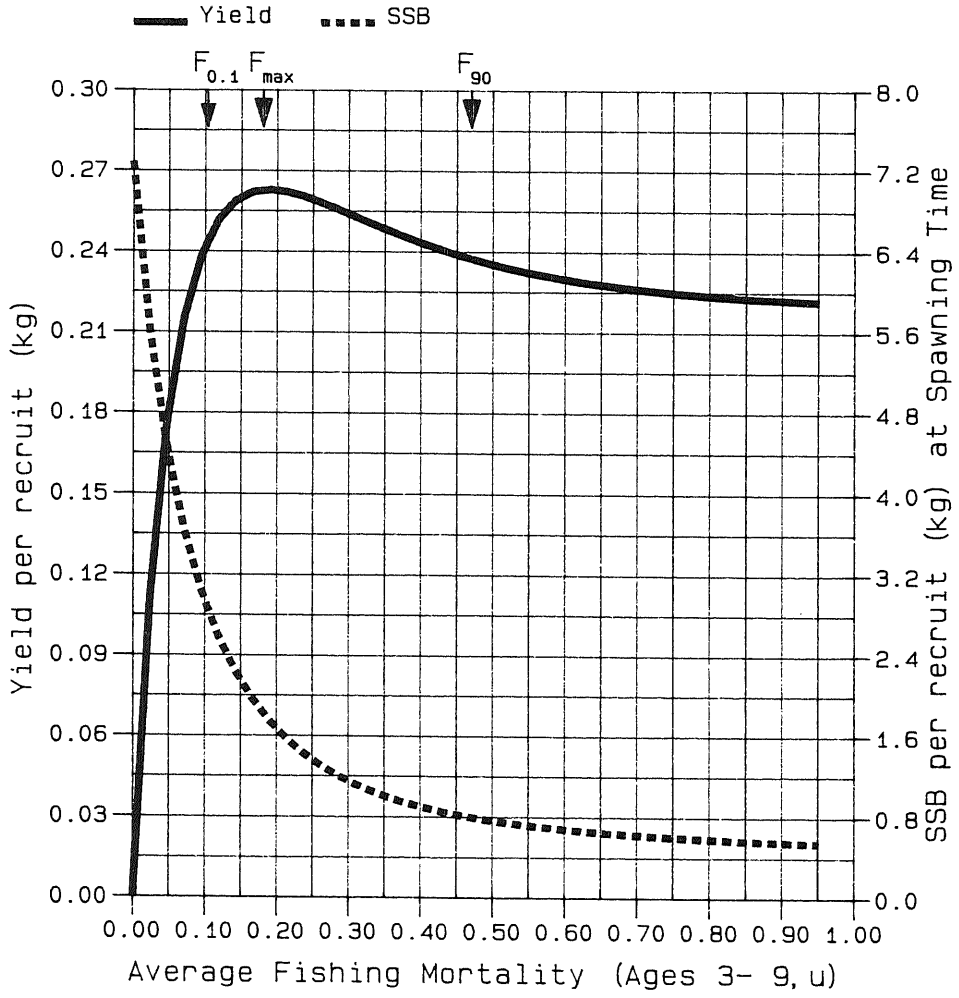
B

cont'd.

Figure 7.2 cont'd. RUN A

FISH STOCK SUMMARY
Plaice in the Skagerrak
23-03-1991

Long-term yield and spawning stock biomass



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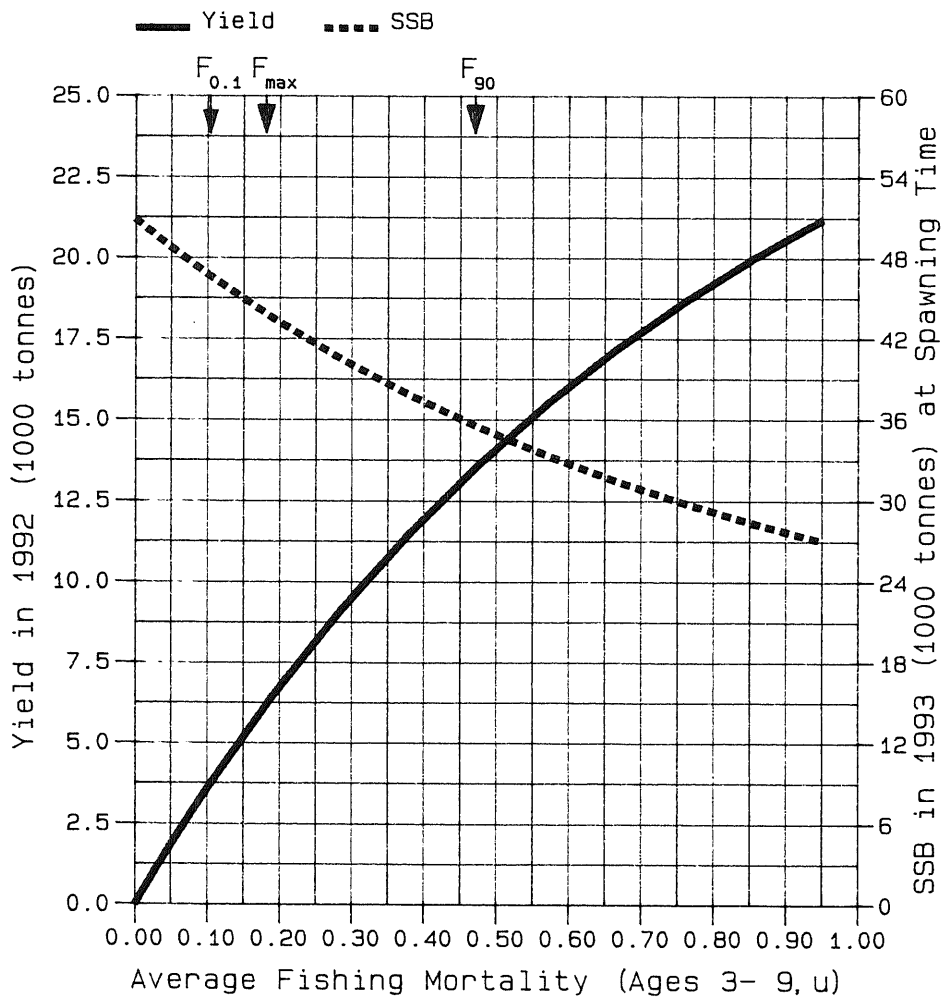
Short-term yield and spawning stock biomass



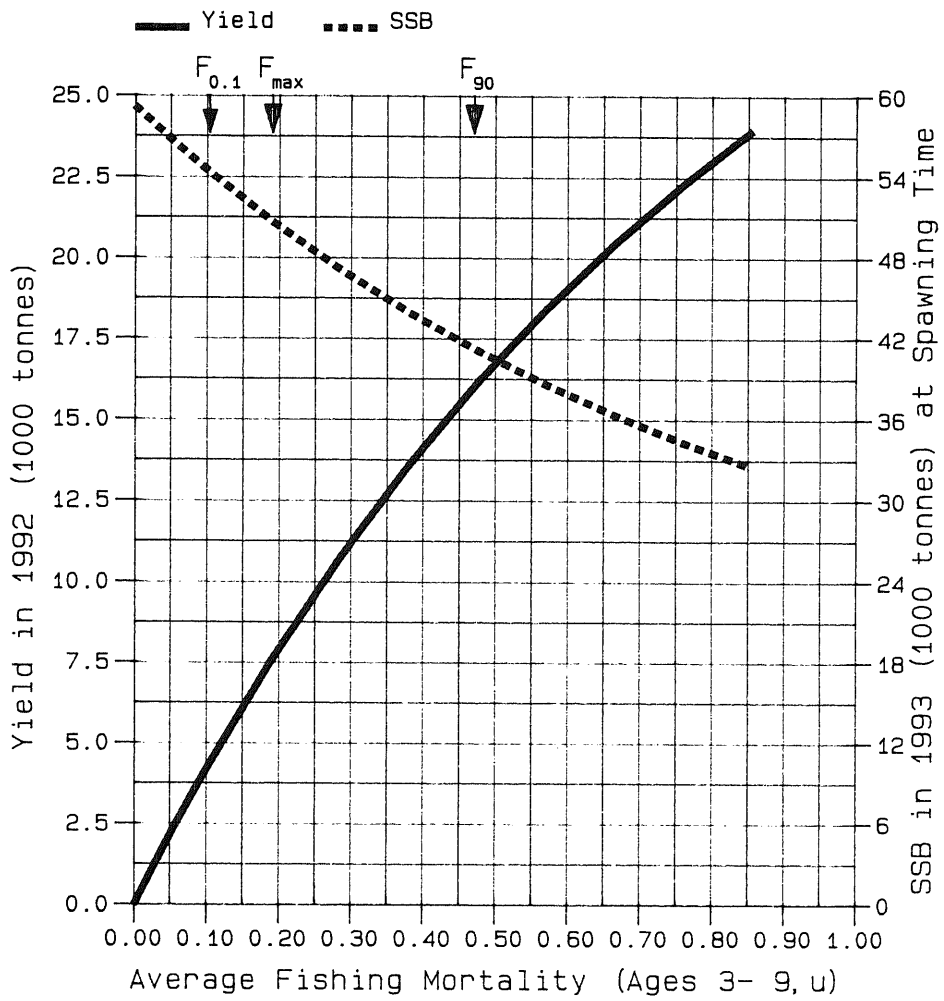
D

cont'd.

Figure 7.2 cont'd. RUN F

FISH STOCK SUMMARY
Plaice in the Skagerrak
23-03-1991

Short-term yield and spawning stock biomass

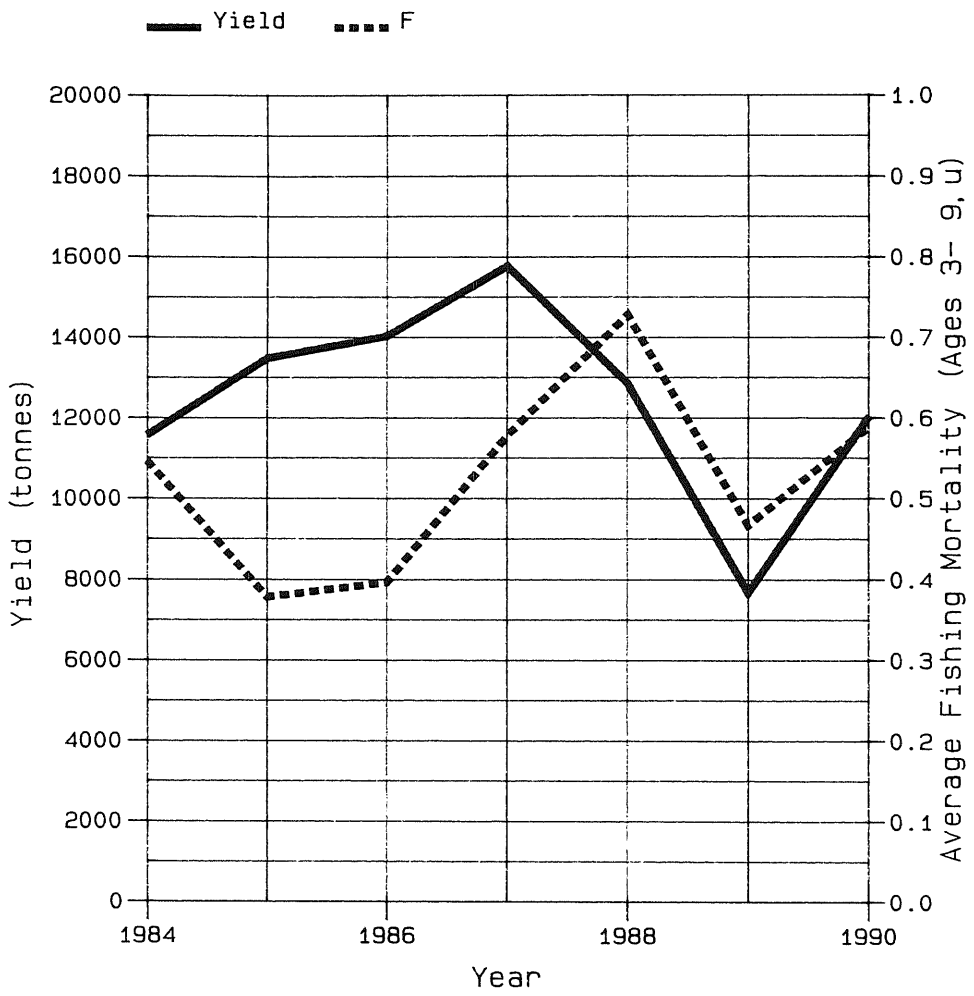


E

Figure 7.3

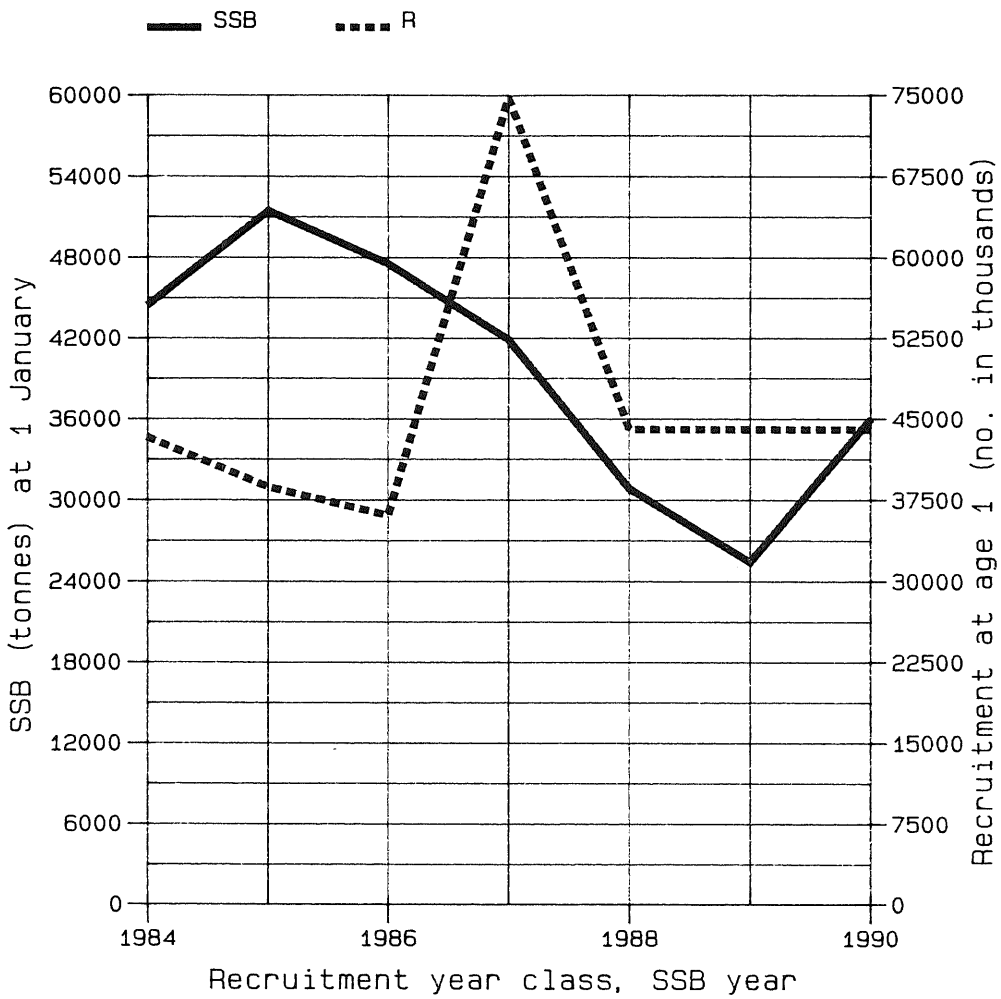
FISH STOCK SUMMARY
Plaice in the Kattegat and Skagerrak
04-03-1991

Trends in yield and fishing mortality (F)



A

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



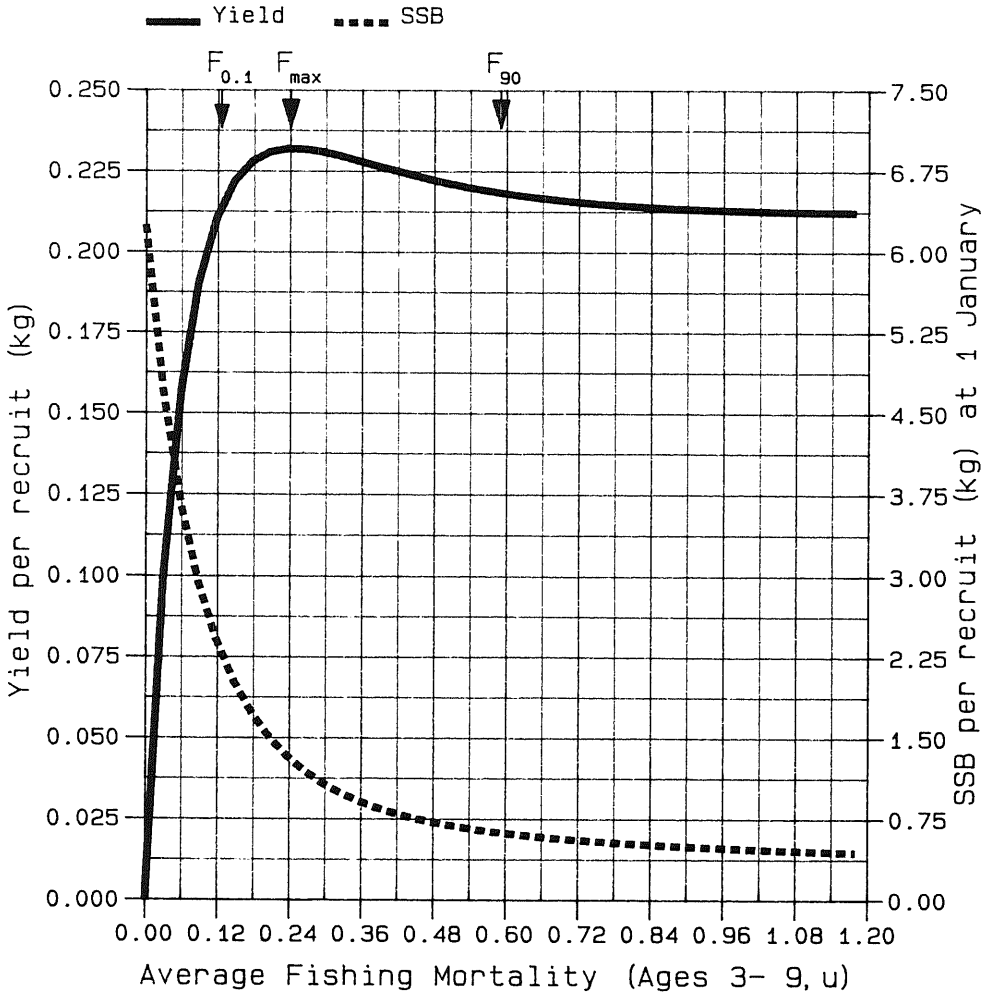
B

cont'd.

FISH STOCK SUMMARY

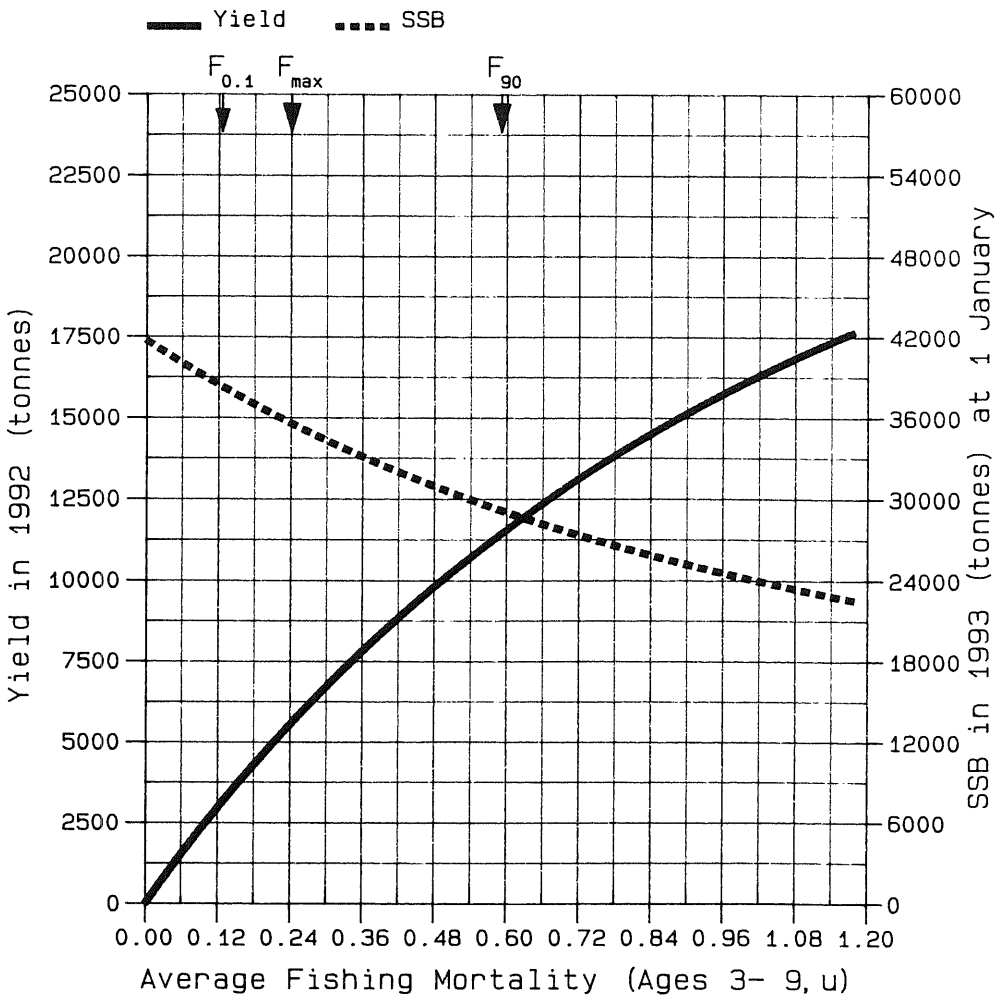
Figure 7.3 cont'd. RUN A Plaice in the Kattegat and Skagerrak
23-03-1991

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



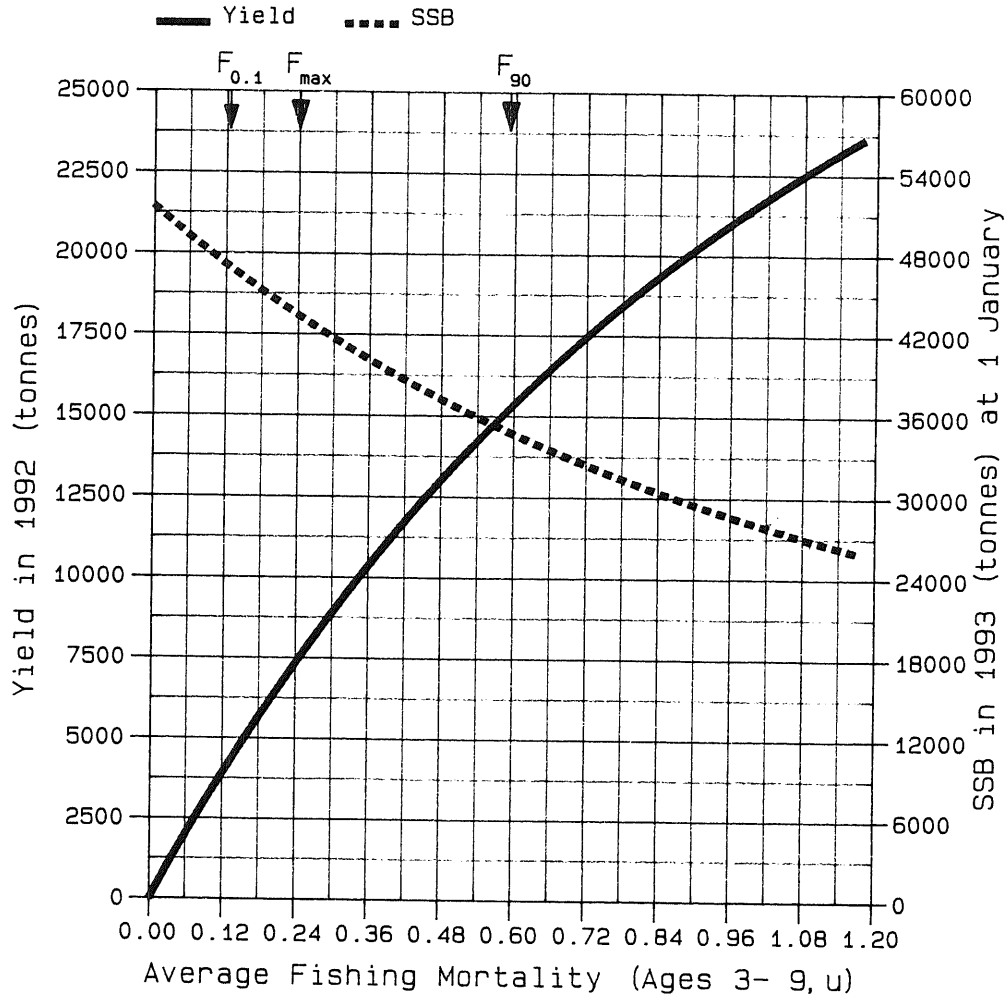
D

cont'd.

Figure 7.3 cont'd. RUN B

FISH STOCK SUMMARY
Plaice in the Kattegat and Skagerrak
23-03-1991

Short-term yield and spawning stock biomass

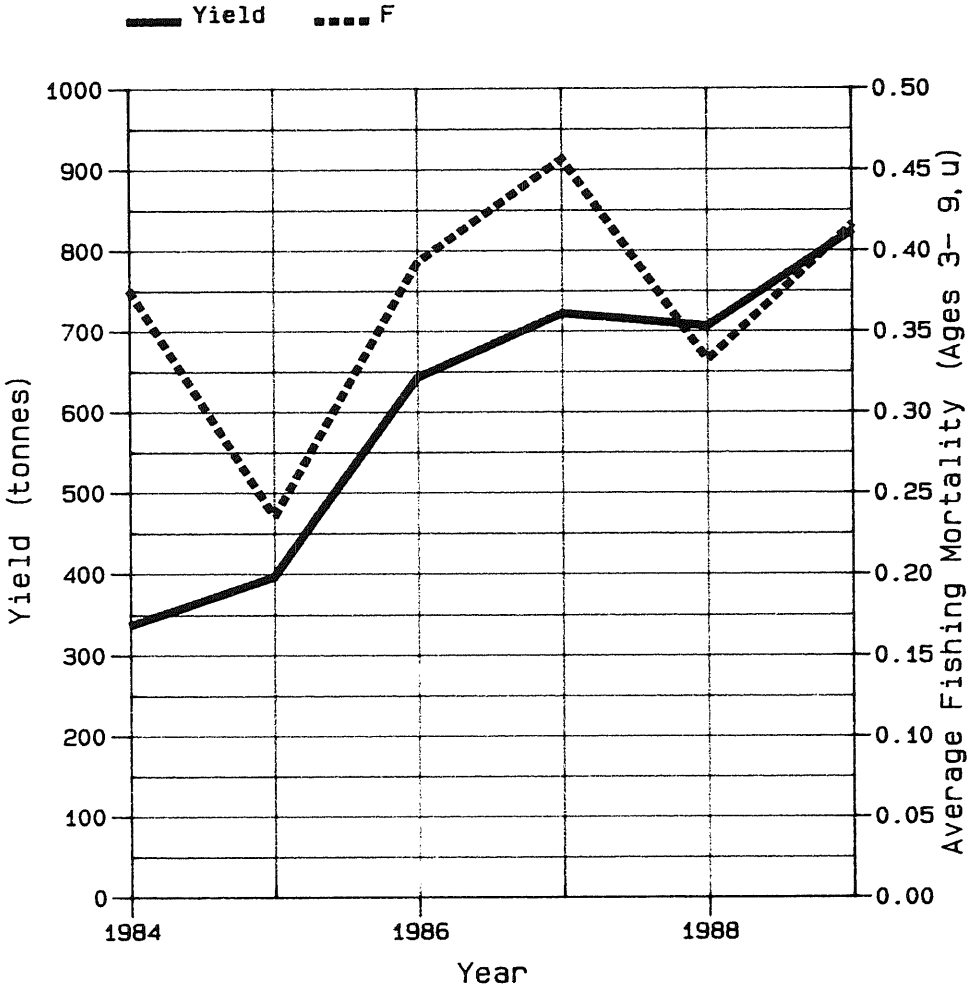


E

Figure 8.1

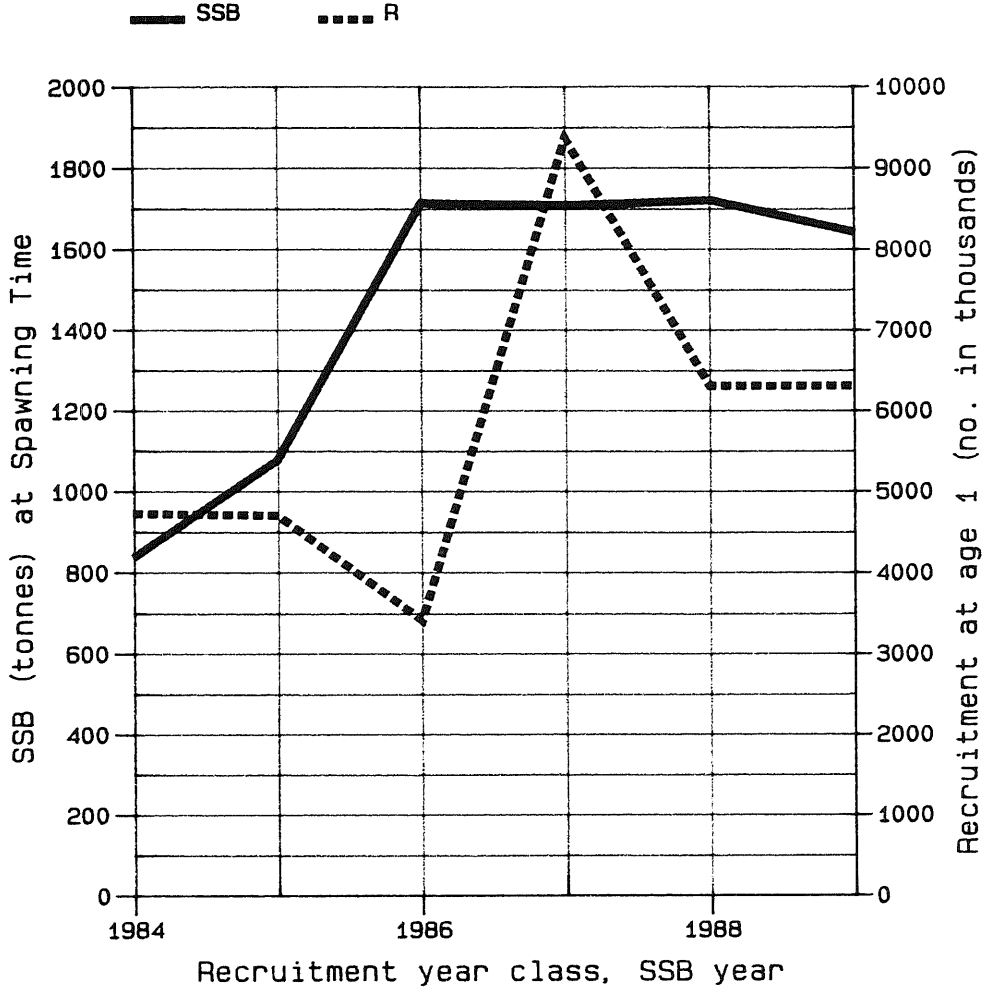
FISH STOCK SUMMARY
Sole in the Kattegat and Skagerrak
01-03-1991

Trends in yield and fishing mortality (F)



A

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



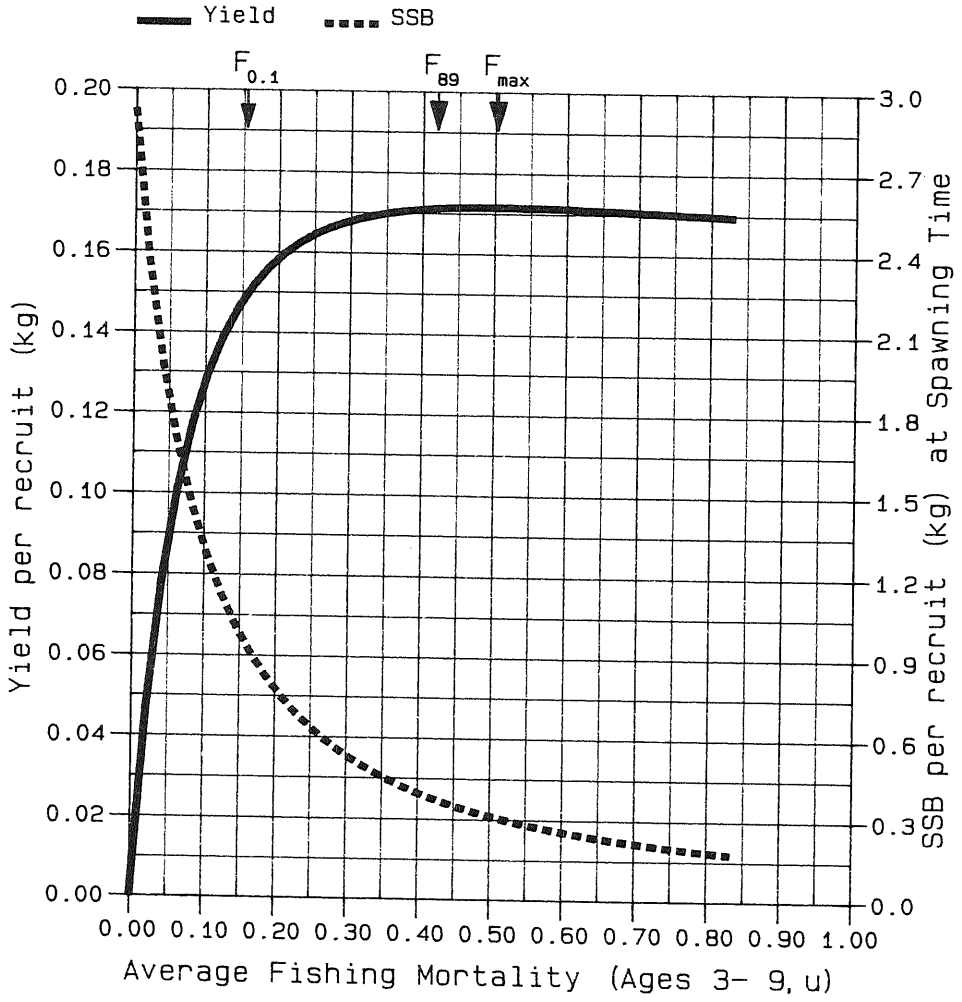
B

cont'd.

Figure 8.1 cont'd.

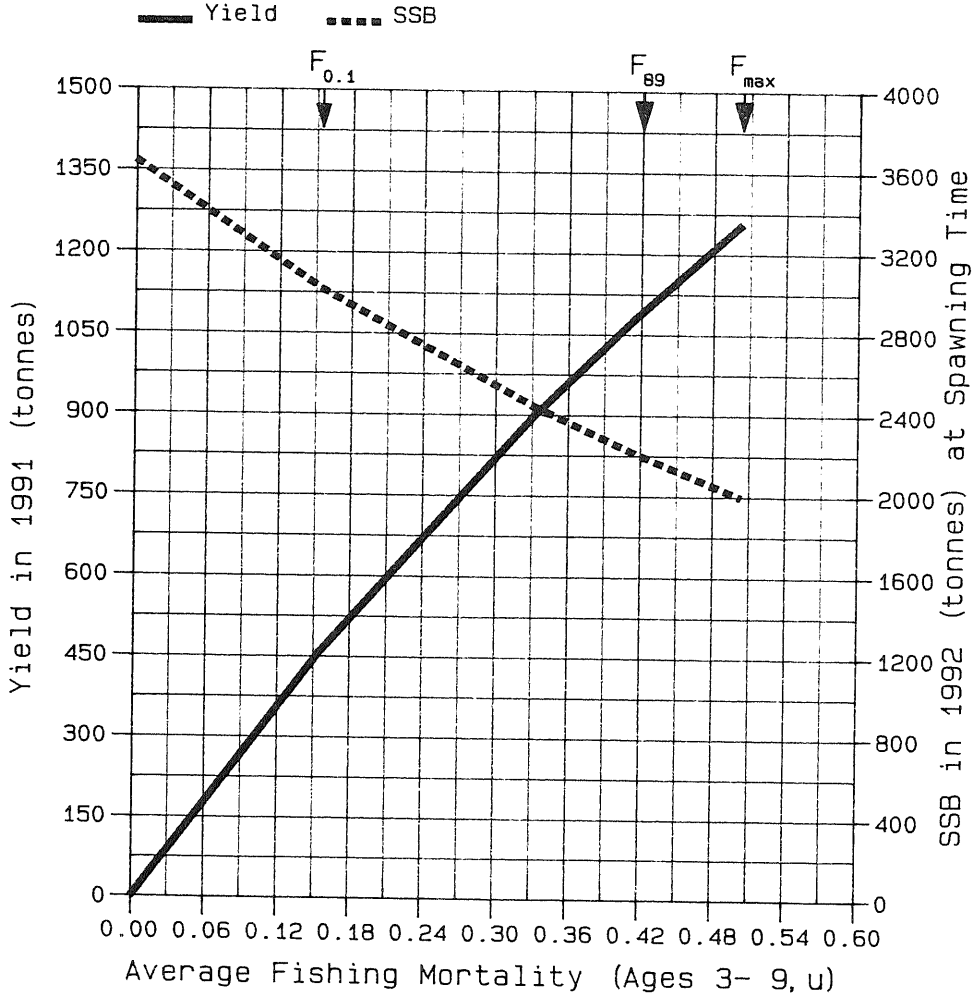
FISH STOCK SUMMARY
sole in Kattegat and Skagerrak
04-03-1991

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D