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

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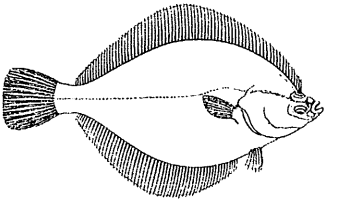
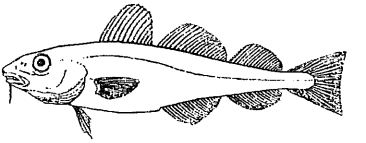
SKAGERRAK KATTEGAT



Report of Division IIIa Demersal Stocks Working Group
Copenhagen, 28 February - 7 March 1990



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1 INTRODUCTION

1.1 Participation

O. Bagge	Denmark
J. Bay	Denmark
D. Danielsen	Norway
P.-O. Larsson	Sweden
P. Lewy	Denmark
E. Nielsen (Chairman)	Denmark

1.2 Terms of Reference

At the Statutory Meeting in 1989, it was decided (C.Res. 1989/2:4:3) that:

The Division IIIa Demersal Stocks Working Group (Chairman: Ms E. Nielsen) will meet at ICES Headquarters from 28 February - 7 March 1990 to:

a) evalute the validity of present stock unit definitions for assessment and management purposes for cod and haddock in Division IIIa, taking into account any relationships with populations in the Baltic Sea and North Sea;

b) describe the fisheries for haddock and whiting, including the extent to which effort is directed on these species;

c) assess the status of and provide catch options for 1991 within safe biological limits for stocks of cod, haddock, whiting, plaice, and sole in Division IIIa;

d) produce a report for ACMP at its 1990 session on the effect of hypoxia in particular, and other forms of pollution, on the relevant fish stocks in Division IIIa based on a review to be produced by Ms E. Nielsen and Dr O. Bagge.

It was recommended by the Demersal Fish Committee at its 1989 meeting that Denmark, Norway, and Sweden should be requested to initiate or continue research programmes to investigate the spawning area, egg and larval drift, and maturity of cod, haddock, and whiting in Division IIIa. This followed a Council Resolution (C.Res.1988/4:2), which requested such research programmes and also, as a first step, a review of all available data.

1.3 Research Requirements

The Working Group discussed the recommendation from the Demersal Fish Committee that "Denmark, Norway, and Sweden should be requested to initiate or continue research programmes to investigate the spawning areas and egg and larval drift of cod, haddock, and whiting in Division IIIa". As mentioned in earlier working group reports, there is an apparent lack of basic biological knowledge of several species in the area. The Working Group's opinion was that the best way of solving the problem would be that the three countries together should carry out a joint in-

vestigation. There was no time during the meeting to go into planning a research programme, but the Group felt that this was a task of great importance to the Group. The conclusion was, therefore, that if the marine research institutions in the three countries are interested in carrying out a joint investigation in the area, which would begin in 1991 and last for a five-year period, planning for such an inter-Nordic research programme could be undertaken at a short meeting in May this year. The Chairman would, therefore, as soon as possible contact the institutions to ascertain whether they are prepared to participate in such a programme. If so, the Chairman will organize the meeting in May.

2 TUNING OF VPA

Initially the Laurec-Shepherd method was used to tune the VPA for both cod and plaice in the Kattegat and the Skagerrak. For cod, however, the diagnostics for age groups 2 and older indicated that the assumptions of the model were not met. As a consequence, the hybrid method was also tried. In fact, this method came out with better diagnostics, but the slopes of the catchability trends of most of the age groups were not found to be significantly different from zero. On this basis, the Laurec-Shepherd method was chosen as its assumption of locally constant catchabilities results in more robust estimates of fishing mortality.

For the cod stocks, a tri-cubic taper was used to estimate mean catchabilities. The fishing mortalities on the oldest ages were estimated as unweighted means of the three younger ages.

For the plaice stocks, the average catchabilities were determined as the unweighted means over the years 1983-1989 in the Kattegat, and 1985-1989 in the Skagerrak.

The fleets for which effort data were used in the tuning procedure are shown in the text table below.

Tuning data used in assessments

	Kattegat		Skagerrak	
Fleet	Cod	Plaice	Cod	Plaice
Swedish bottom trawl	x	x	x	x
Swedish Nephrops tr.	x	x	x	x
Danish seiners	x	x	x	x
IYFS indices	x		x	

3 RECRUITMENT

3.1 Cod

For the cod stocks in both the Kattegat and the Skagerrak, the IYFS indices for 1- and 2-group cod have been used to estimate recruitment. The calibration was performed by means of the RCRTINX2 program 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 minmum of 5 data points in regression,
e. tri-cubic weighting.

The recruitment indices for cod, haddock, and whiting are given in Table 3.1.

3.2 Plaice

For plaice in the Kattegat, only the young fish index was available from the Danish 1-group plaice survey. A regression forced through the origin was used to estimate recruitment.

No recruit indices were available for plaice in the Skagerrak.

4 COD IN THE KATTEGAT

4.1 The Fishery

Table 4.1 shows the landings for human consumption by country. The landings for 1989 are to be considered as preliminary estimates provided by the Working Group members. The landings for 1989, about 8,500 t, are somewhat larger than for 1988 which were 5,500 t. Table 4.2 shows the amounts of cod taken in the Danish small-meshed fishery which 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 4.1.

4.2 Stock Identity

According to Poulsen (1931), the cod spawning in the southern Kattegat lasts from February to May, but the main spawning occurs in February-March. He found cod larvae in the whole area in April-May, although they were scarcer in the northeastern Kattegat. The very few investigations carried out in this area in recent years (Bagge, Nielsen, Mellergaard, and Dahlsgaard 1990, in press) show that the larval distribution has changed as no concentration of larvae has been found in the southwestern part, and no larvae have been found in the southern part of Sub-division 22. The exchange of larvae between the Kattegat and Subdivision 22 and vice versa may be at a very low level. Recent recruitment has been poor. Recruitment to the southern Kattegat and Sub-divisions 22 and 23 is now mainly from larvae coming from the northern part.

In the Kattegat, some tagging experiments have been carried out by Denmark and Sweden but the results have not been published. The Danish experiments were carried out in the northern Kattegat (1981) and in the southwestern Kattegat (1978 and 1980). From the

experiment in the northern Kattegat, 4% of the recaptured cod were taken in the North Sea and 96% in the Kattegat. From the experiments in the southwestern Kattegat, about 5% of the recaptured cod were taken in the northern part of Sub-division 22, 1% in Sub-division 24, and about 95% in the Kattegat, demonstrating a very small migration of adult cod from the Kattegat either northwards or southwards.

Many tagging experiments have been carried out in Sub-divisions 22, 23, and 24. Berner (1981) reviewed tagging experiments made by the German Democratic Republic in Sub-divisions 22 and 24 over the period 1959-1975. Bagge (1987) reviewed all tagging experiments in Sub-divisions 22, 23, and 24 over the period 1958-1981 and found that the input of adult cod from Sub-divisions 22 and 24 to the Kattegat was at a low level (0-10% of recaptured cod). On average, 2% of the recaptures were immigrants from Sub-division 22 and 1% from Sub-division 24, while emigrations from the northern part of Sub-division 23 were quite significant (7-65%; average 39%). The cod stock in Sub-division 23 has been decreasing since 1987.

Sjöstrand (pers. comm.) correlated age group 1 in the Kattegat with age group 1 in Sub-divisions 22 and 24 as estimated from VPA, and he further correlated the indices of that age group from the IYFS surveys in the Kattegat, with the corresponding index from the young fish survey, conducted by the Federal Republic of Germany in Sub-divisions 22 and 24A (Figure 4.1). A significant correlation was found in both runs (R^2 = 0.729, df = 12 and R^2 = 0.834, df = 6, respectively), which may indicate a strong mixing of the stocks. The results of the tagging experiments show, however, that the active migrations of adult cod are at a low level, so that either similar environ-mental conditions during the egg and larval stage or passive migrations of eggs, larvae, and young bottom stages are responsible for the correlation.

According to an analysis of growth patterns (Bagge and Steffensen, 1980; Steffensen and Bagge, 1983), the cod population in the Kattegat might belong to two different stocks, one in the northern part and one in the southern part. Moth-Poulsen (1982) concluded that the cod from the Kattegat and northern Sound genetically belonged to one stock. On the information available, the Working Group concluded that it seems likely that the cod in the Skagerrak and the Kattegat belong to two different stocks.

In view of these considerations, the Working Group again this year decided to assess the Kattegat and Skagerrak cod separately.

4.3 Catch at Age

The Danish age distributions were used for all catches (Table 4.3) as no other age data were available to the Working Group. Age distributions were not presented for the Danish by-catches, and these were, therefore, not included in the assessment.

4.4 Weight at Age

The Danish data on mean weight-at-age 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 4.4.

4.5 Commercial Catch/Effort Data and Survey Indices

The commercial fleet and survey data series, used in tuning the VPA, are shown in the text table in Section 2. The corresponding catch and effort data are given in Table 4.5.

The age distributions for the three commercial fleets were assumed to be the same as the age distribution in the total Danish catches.

4.6 Natural Mortality Rates

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

4.7 VPA Tuning

The Laurec-Shepherd method was used to tune the VPA (see Section 2). The output is given in Table 4.6.

As in last year's assessment, the terminal Fs are very high, at a level of about 1.2 to 1.6 for ages 3 and older. This may be an indication of an overestimation of the landings. As the Working Group had no further information which could supplement the landings data, the terminal Fs estimated by the Laurec-Shepherd method were adopted.

4.8 Results from the VPA

The results are shown in Tables 4.7 and 4.8. The stock size in 1989 is on the same level as the historic minimum from 1988.

4.9 Recruitment

The methods for estimating recruitment are described in Section 3. Results of runs with RCRTINX2 are shown in Table 4.9, and it can be seen that the correlation between the VPA and the indices for the 1- and 2-group was rather poor.

4.9.1 Year class 1988 in 1990

For the 1988 year class in 1990, the method showed that both indices were rejected and only the mean value from VPA was used. The value, 6.3 million estimated from the tuning was, therefore, adopted.

4.9.2 Year class 1989 in 1990

The IYFS value for the 1-group of 131, the second highest on record, indicates a rather strong year class (Table 3.1). The RCRTINX2 method gave the same weight to the VPA mean and the IYFS 1-group index and estimated a value of 14.6 million. This is

only slightly above the average of 1980 to 1989 of 13.2 million, while the index is about double the average index value of 68. The Working Group decided to adopt the conservative value of 14.6 million and thereby accept the risk of underestimating the year-class strength.

4.9.3 Year class 1990 and onwards

These were set to 13.2 million at age 1, the mean value for the period 1980-1989.

4.10 Trends in Yield, Fishing Mortality, Biomass, and Recruitment

Trends in yield and mean fishing mortality are plotted in Figure 4.2A, which shows that the yield has declined, while fishing mortality has increased from 1974 to 1989.

Trends in spawning stock biomass and recruitment are plotted in Figure 4.2B. The figure shows that both spawning stock biomass and recruitment have declined from 1973 to 1989.

4.11 Catch Predictions

Input data are shown in Table 4.10, and the results from the prediction in Table 4.11 and Figure 4.2.D.

4.11.1 Fishing pattern

Fishing pattern was estimated as the average fishing mortality at age from the VPA for the years 1985-1989.

4.11.2 Mean weight at age

Mean weight at age was estimated from Table 4.4 as the average of 1985 to 1989.

4.11.3 Status quo prediction

The landings in 1990 are predicted to about 6,500 t, which is below the TAC of 8,500 t. As the TACs have not been taken since 1983, only the status quo prediction has been considered.

The status quo prediction resulted in landings of about 7,400 t in 1991, which is a little below landings in 1989 and estimated landings in 1990, but is still close to the lowest on record.

5 COD IN THE SKAGERRAK

5.1 The Fishery

Table 5.1 shows the landings by country provided by the Working Group members and revised compared to the 1989 Working Group report. They show a slight increase to about 18,600 t in 1989. The cod catches from the Danish small-meshed fishery (Table 5.2)

are not included in the catch statistics in Table 5.1. Cod taken as by-catch in small-mesh trawl have been decreasing since 1982.

The cod landings along the Norwegian fjords are shown in Table 5.1. As these cod are considered to belong to a separate stock, the figures are not included in the assessment.

5.2 Stock Identity

On the Norwegian Skagerrak coast, the spawning occurs from February to May with the main spawning in March-April (Dannevig, 1966; Dahl, 1906; Dahl et al., 1983). Although there is very little information, it is supposed that the cod is spawning in most of the fjords and in the skerries. The 0-group cod appear to stay in the fjords, and Tveite (1971) has shown that there is a good correlation (r = 0.7 - 0.8) between the index from the 0-group survey along the coast and the year class as 1- to 4-year olds in catches taken in the coastal areas of the Skagerrak. Tagging experiments on the Norwegian Skagerrak coast show that the cod population in the area undertakes only short migrations along the coast (Dahl, 1906; Ruud, 1939; Løversen, 1946; Danielssen and Gjösæter, 1986; Danielssen, unpubl.). Most of the fish (80-90%) were recaptured within a distance 4-5 nm from the release point. This holds good for fish tagged as 0-group and 1- to 2-group.

Very little is known about the spawning on the Danish side of the Skagerrak. From scanty material on the stage of maturity, Poulsen (1931) indicates that the main spawning is finished by the beginning of April. In Anon. (1970) it was concluded that there is no evidence of spawning off the Danish Skagerrak coast even though cod larvae have been found to be abundant in this area (Poulsen, 1931). No larvae were, however, found during a survey in late April 1988 in the Skagerrak (Danielssen, pers. com.). The IYFS shows that the 1-group is found in the area.

Cod tagging experiments on the Danish Skagerrak coast produced no recaptures on the Norwegian Skagerrak coast (Danielssen, 1969). Most of the cod (80%) were recaptured on the Danish side of the Norwegian trench in the Skagerrak. Only 5% of the recaptures (mainly immature fish) came from the Kattegat (north of Læsø), and 14% (mainly mature fish) from the eastern part of the North Sea. Small cod showed no pronounced seasonal movement. Larger cod showed little seasonal movement in the summer and autumn but showed a southward movement towards the North Sea in the winter (Anon., 1971). Danish tagging experiments west of Thorsminde in the North Sea (Bagge, 1973) also indicated a certain connection between the eastern North Sea and the Skagerrak, and even the Kattegat area near Skagen.

Genetic investigations by Moth-Poulsen (1982) showed, however, that the cod stock in the open Skagerrak was genetically distinct from the Kattegat and the northern part of Sub-division 23.

The tagging results clearly indicate that the cod on the Norwegian Skagerrak coast is a separate stock which is independent of the cod on the Danish side of the Skagerrak.

There appears to be a certain connection between the cod in the eastern North Sea and the Skagerrak up to the area north of Læsø

in the Kattegat, but the Working Group felt that more information would be required before conclusions can be drawn about the degree of mixing of the cod in these areas.

5.3 Catch at Age

The Danish age distributions were applied to all catches used in the assessment (Table 5.3) as no other age data were available. Age distributions were not presented for the Danish by-catches in the industrial fishery, and these were, therefore, not included in the assessment.

5.4 Weight at Age

The Danish data for mean weight-at-age 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 5.4.

5.5 Commercial Catch/Effort Data and Survey Indices

The commercial fleets and survey used in the tuning of the VPA are shown in the text table in Section 2. The corresponding catch and effort data are given in Table 5.5. The age distributions for the three commercial fleets were assumed to be the same as the age distribution in the total Danish catches.

5.6 Natural Mortality Rate

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

5.7 VPA Tuning

The Laurec-Shepherd method was used to tune the VPA (see Section 2). The tuning data are shown in Table 5.5. Summary statistics are given in Table 5.6.

5.8 Results from the VPA

The results are shown in Tables 5.7 and 5.8.

5.9 Recruitment

The methods for estimating recruitment are described in Section 3. Results of runs with RCRTINX2 are shown in Table 5.9 for the year classes 1987 and onwards.

5.9.1 Year class 1987 in 1988

This was set to 22.3 million as estimated by the RCRTINX2, corresponding to a stock size at age 2 in 1989 of 17.3 million.

5.9.2 Year class 1988 in 1989

This was set to 15.1 million as estimated by the RCRTINX2.

5.9.3 Year class 1989 in 1990

This was set to 16.7 million as estimated by the RCRTINX2.

5.9.4 Year class 1990 in 1991 and onwards

These were set to 19.4 million at age 1, the mean value for the period 1979-1989.

5.10 Trends in Yield, Fishing Mortality, Biomass, and Recruitment

Trends in yield and mean fishing mortality are plotted in Figure 5.1A; both yield and fishing mortality have remained fairly constant since 1980.

Trends in spawning stock biomass and recruitment are plotted in Figure 5.1B; SSB has declined slightly since 1982, whereas there is no trend in recruitment.

5.11 Catch Predictions

The input data are shown in Table 5.10, and the results from the prediction runs in Table 5.11.

5.11.1 Fishing pattern

Fishing pattern was estimated as the average fishing mortality at age from VPA for the years 1985-1989.

5.11.2 Mean weight at age

Mean weight at age was estimated from Table 5.4 as the average of 1985 to 1989.

5.11.3 Status quo prediction

Only the status quo prediction for 1990 was run because estimated landings in 1990 of about 23,000 t were almost equal to the agreed TAC of 21,500 t.

The status quo prediction resulted in landings of about 19,400 t in 1991, which is similar to those of 1989.

6 HADDOCK

6.1 The Fishery

The landings of haddock by country in Division IIIa for the period 1975-1989 submitted by Working Group members are given in Table 6.1. A small reduction in 1989 compared to 1988 is observed.

In Table 6.2, the landings for 1983-1989 are split into landings for consumption and industrial purposes. From 1987, it is further possible to split the landings according to area.

6.1.1 Haddock in the Kattegat

The Danish and Swedish landings in the Kattegat during 1987-1989 are given in Table 6.3, split into landings for consumption and industrial purposes. The landings are small and decreasing.

50% of the Danish landings for consumption are taken by trawlers (20-59 brt) in the fourth quarter in a directed fishery (more than 40% haddock in the landings) and 50% as by-catch in other non-industrial trawl fisheries.

The Danish landings per day in 1988 and 1989 (all quarters) were 0.144 t and 0.198 t, respectively.

6.1.2 Haddock in the Skagerrak

The Danish landings during 1987-1989 split into landings for consumption and industrial purposes are given in Table 6.4, together with the Norwegian and Swedish landings, which are exclusively for consumption.

The landings for consumption have increased while the industrial landings have decreased. The total landings have decreased slightly by 300 t.

In 1988 and 1989, 50% and 74%, respectively, of the Danish landings for consumption derived from a directed trawl fishery (more than 40% of haddock in the landings), the rest was taken as by-catch in other non-industrial trawl fisheries and by seiners.

The trawlers are mainly in the size category 20-59 brt. The Danish landings per day in 1988 and 1989 were 0.317 t and 0.389 t, respectively.

6.2 Stock Identity

Due to a total absence of data, the Working Group was not able to consider this question for haddock.

6.3 Catch at Age

Catch-at-age data are available for the period 1981-1986 based on the age distribution of the Danish landings, including age distributions of industrial landings. In 1987, 1988, and 1989 no

age distributions of the industrial landings were available, which means that the age distributions in these years are based exclusively on Danish landings for human consumption (Table 6.5). Accordingly, the age composition of the total landings of haddock in Division IIIa for 1987-1989 could not be estimated.

6.4 Weight at Age

Weight-at-age data for 1989 were available from the Danish human consumption fishery. These data, together with data for the period 1981-1988, are given in Table 6.6.

6.5 Recruitment

The recruitment index for the 1989 IYFS survey is shown in Table 3.1. The index of 8 in 1989 is well below the average.

6.6 Prediction

No reliable predictions of catches in 1990 and 1991 can be given. According to the recruitment in 1986 and 1987, the catch in 1988 was expected to be above the 1987 catch (5,300 t). In fact, the total catch in 1988 was only 4,380 t, and it decreased further in 1989 to 4,216 t.

7 WHITING IN DIVISION IIIA

7.1 The Fishery

The landings of whiting in Division IIIa are given in Table 7.1. The Danish data have been revised from 1980 with data provided by Working Group members. The landings have been fairly stable since 1984.

In Table 7.2, the Danish landings for the period 1981-1989 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.

8 PLAICE IN THE KATTEGAT

8.1 The Fishery

The landings from the Kattegat provided by the Working Group are shown in Table 8.1. The landings decreased from 2,031 t in 1988 to 1,701 t in 1989, the lowest on record. The decrease was mainly in the first half of the year, and there was an increase in the fourth quarter. The Danish landings per quarter are shown in Table 8.2.

8.2 Stock Identity

In the Working Group report of 1988 (Anon., 1989), a possible dominance of the Skagerrak stock in the Kattegat was discussed based on results from studies on growth and meristic characters. Analysis of genetic characteristics by electrophoresis (Simonsen et al., 1988) seems to confirm the dominance of the Skagerrak components in the central Kattegat.

As no recruitment indices are available for the Skagerrak and the total landings for the Skagerrak are unknown, the assessments for the Skagerrak and the Kattegat are made separately.

8.3 Catch at Age

Catch-at-age data were available for the Danish landings and were raised to the total landings. The catch in numbers for 1968-1989 is given in Table 8.3.

8.4 Weight at Age

Weight-at-age data were available from the Danish landings for the years 1968-1989 (Table 8.4).

8.5 Catch per Unit Effort

CPUE data were available for 1983-1989 from the Danish logbook system and from Sweden for 1980-1989 (Tables 8.5 and 8.6). The Danish CPUEs are given as average catch in kg per fishing day per year. The Swedish CPUEs are given as average catch per hour for Nephrops and demersal trawlers on a yearly basis. The Swedish data in 1988 have been revised (Table 8.5). In the Swedish Nephrops fishery, a slight decrease in effort was observed from 1987 to 1989. In the cod fleet, the effort in 1988 and 1989 was at about the same level.

Landings from Danish seiners as % of the total landings are as follows:

Year	1983	1984	1985	1986	1987	1988	1989
	60	64	53	56	40	38	37

Since 1987, the landings from Danish seiners have decreased and a directed seine fishery for plaice has terminated. Danish trawlers are not directed on plaice due to the very low level of the stocks since 1982 (because of environmental conditions), but the effort on Nephrops has increased and the by-catch of plaice from that fishery is important.

8.6 Natural Mortality Rate

The natural mortality rate was set to 0.1 for all age groups and years.

8.7 VPA Tuning

The fleets used for the VPA tuning are given in Section 2, and the data are shown in Table 8.7. The Laurec-Shepherd method was used because no apparent trend in the q was seen (Figure 8.1). The results are given in Table 8.8.

8.8 Results from the VPA

The results are shown in Tables 8.9 and 8.10 and Figures 8.2A and 8.2B. The F values and average $F_{(3-9)}$ show an increasing trend from 1985 to 1988 even when a stable level should be expected (Table 8.9).

The exploitation pattern also seems to have changed. The 1987 year class is very well represented in the catches in 1989, even though the recruitment index suggests it is a poor one. This may be due to a rise in by-catches from an increased non-directed trawl fishery. Also, the mean weight of age group 2 is unusually high which may indicate an earlier reruitment in the fishery.

8.9 Recruitment

The 1-group estimated from the VPA and the Danish young fish survey are shown in Table 8.11.

8.9.1 1987 and 1988 year classes in 1988 and 1989

The relation between the survey indices and the VPA is plotted in Figure 8.2. The figure indicates that the correlation is rather poor, especially for small indices. However, forcing a regression line through the origin resulted in estimates of 2 and 4 million 1-groups in 1988 and 1989, respectively, compared to 14 and 5 million produced by the Laurec-Shepherd method. As the index for the 1987 year class in 1988 is the lowest on record, the values estimated from the regression line was adopted by the Working Group.

8.9.2 1989 year class in 1990 and onwards

The average recruitment at age from the VPA for the period 1980-1987 is 11.4 million.

8.10 Trends in Yield, Fishing Mortality, Biomass, and Recruitment

Trends in yield and fishing mortality are plotted in Figure 8.3A, and it can be seen that the yield has continued declining, whereas the fishing mortality has increased from 1985 to 1988. The spawning stock biomass and recruitment are plotted in Figure 8.3B. Spawning stock biomass is currently the lowest on record, and recruitment has been extremely low in recent years.

8.11 Prediction

A prediction was made, using an average exploitation fishing mortality at age (1985-1989). The fishing mortality used in the prediction was scaled according to the level of fishing mortality in 1989 from the VPA. Mean weights for the years 1987-1989 were used. The input table is given in Table 8.12. The catch options are shown in Table 8.13. The spawning stock consists of fish of age 3 and older.

8.12 Status quo Prediction

The landings in 1990 were estimated to be about 1,300 t, which is below the TAC of 2,000 t. The spawning stock biomass is still at a very low level due to low recruitment in the 1980s. The spawning stock biomass in 1988 and 1989 is the lowest on record and less than a third of the levels in the 1970s.

The spawning stock biomass will remain at a low level, i.e., 2,900 t in 1991 and 4,300 t in 1992 with fishing mortality at the 1989 level. The corresponding catch in 1991 is predicted to be 1,400 t.

9 PLAICE IN THE SKAGERRAK

9.1 Landings from the Skagerrak

The landings from the Skagerrak are shown in Table 9.1. The landings have decreased since 1986 from 15,421 t to 5,958 t in 1989. No official catch statistics for Division IIIa in 1989 were reported by the Netherlands. The decrease was seen for all quarters in the Danish landings. The quarterly breakdown of the Danish landings from the Skagerrak is shown in Table 9.2.

9.2 Stock Identity

See Section 8.2.

9.3 Catch at Age

Catch-at-age data were available from the Skagerrak for 1978-1988 for the Danish landings and were applied to the total landings. The total catch in numbers is given in Table 9.3.

9.4 Weight at Age

Weight-at-age data were available from the Danish landings for the period 1978-1989 (Table 9.4).

9.5 Commercial Catch-per-Unit-Effort Data

The commercial fleets used to tune the VPA are shown in the text table in Section 2. The corresponding catch and effort data are given in Table 9.5.

The age distributions in the commercial fleets were assumed to be the same as the age distribution in the total Danish catch.

9.6 Natural Mortality

The natural mortality rate used was 0.1 for all ages and years.

9.7 VPA Tuning

The Laurec-Shepherd method was used, and the results are shown in Table 9.6. Catchability was assumed to be constant from 1985 onwards (Figure 9.1). The Laurec-Shepherd method was chosen for the final VPA.

9.8 Results from the VPA

The results from the VPA are given in Tables 9.7 and 9.8. A great fluctuation in average $F_{(3-9)}$ is evident, and in 1989 it seems to have been extremely low. The spawning stock biomass has been fairrly stable in the last three years.

9.9 Prediction

As information on recruitment was not available, and as the data on total landings were uncertain, no prediction was made.

10 SOLE IN DIVISION IIIa

10.1 The Fishery

Landings in Division IIIa in 1989 were only reported by Denmark and Sweden. Landings in 1952-1989 are shown in Table 10.1. The landings in 1989 are the highest on record. Danish vessels accounted for 98% of the landings.

In 1989 in the Kattegat, 69% of the Danish landings were taken by trawlers, mainly in the fourth quarter (54%), and 22% were taken in set nets, mainly in the third and fourth quarters (78%). In the Skagerrak, the trawl fishery accounts for 80% of the landings and 8% are taken in set nets, mainly in the second and third quarters. The Danish landings from trawlers in the third and fourth quarters are mainly by-catch in the Nephrops fishery. In the first and second quarter it is a directed fishery.

10.2 Catch at Age

Catch-at-age data for 1984-1989 were supplied by Denmark which in 1989 took about 98% of the landings (Table 10.2). The time series is too short to run a VPA.

10.3 Weight at Age

Weight-at-age data were available for the Danish landings 1984-1989 in Division IIIa (Table 10.3).

10.4 Effort and Catch per Unit Effort

During the summer and autumn in recent years, considerable effort from the Baltic and the North Sea has been transferred to the Nephrops fishery in the Kattegat and the Skagerrak. This, together with a shift to the double trawl system, an increase in the size of vessels, and increasing motor power, is likely to have increased the effort since 1984 on sole by a factor of 2-3 (on Nephrops by a factor of 4 due to increased availability of this species caused by low oxygen content in the bottom water).

Comparable data on effort (number of fishing days) are available for 1988 and 1989 for trawl and set nets (Table 10.4). The catch per day in trawls decreased from 69,1 kg in 1988 to 46,8 kg in 1989, while the catch per day in set nets increased from 100,7 kg to 132,8 kg in the same period. These contradictory results may be due to low oxygen conditions in deeper water forcing the sole to crowd in shallow water.

The total trawl effort increased by 61% and set net effort by 20%.

10.5 Recruitment

Data from the Danish survey on young flatfish for 1984-1989 were submitted to the Working Group (Table 10.5).

The strong 1984 year class is still significant and in 1989 contributed 19.3% of the catch by weight (Table 10.6). The 1987 year class in 1989 (age group 2) represented the same proportion (by weight) as the strong 1983 year class in 1985 (18.4% and 15.9%, respectively). This indicates that the 1987 year class is strong, and this is in agreement with the survey index. The 1986 year class is small, the 1985 year class medium.

10.6 Catch Prediction

Based on the recruitment indices shown in Table 10.5 and the landings, a SHOT forecast was performed (Table 10.7). The forecast is based on the following assumptions:

The recruitment indices for year class y are related to the landings in year y+3, the same as in last year's report. The indices were not smoothed this year, so that all weight is given to the 3-group.

The yield/biomass ratio was set to 0.4 for the years 1980 to 1984 as described in last year's report. As the effort apparently has increased in 1984 and 1988 (Section 10.4), the ratio was set to 0.5 from 1989 onwards.

For the years where no survey indices were available, an aritmetric average of 726 for the years 1980-1989 was used as the index value. In last year's report, an average of 380 for the years 1967-1988 was used. The reason for changing this value is that the level of recruitment seems to have been higher during this period.

The estimated status quo landings for 1991 were 751 t, which is close to the average landings of 741 t for the years 1986-1989 when landings were relatively stable.

11 REPORT FOR ACMP

A report on the effects of hypoxia on the relevant fish stocks in the Kattegat by E. Nielsen and O. Bagge is presented to ACMP. The Skagerrak is not dealt with, as data available show no such effects in that area.

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Table 3.1 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

Year class	Kattegat		Skagerrak	
	Cod - 1-group	2-group	Cod - 1-group	2-group
1979	-	131.3		85.0
1980	8.3	32.6	7.6	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	131.0		30.9	

[1] Norwegian survey.

Table 4.1 Cod landings from the Kattegat as estimated by the Working Group, 1971-1989 (t).

Year	Denmark	Sweden	Fed.Rep. of Germany[1]	Total
1971	11,748	3,962	22	15,732
1972	13,451	3,957	34	17,442
1973	14,913	3,850	74	18,837
1974	17,043	4,717	120	21,880
1975	11,749	3,642	94	15,485
1976	12,986	3,242	47	16,275
1977	16,668	3,400	51	20,119
1978	10,293	2,893	204	13,390
1979	11,045	3,763	22	14,830
1980	9,265	4,206	38	13,509
1981	10,673	4,380	284	15,337
1982	9,320	3,087	58	12,465
1983	9,149	3,625	54	12,828
1984	7,590	4,091	205	11,886
1985	9,052	3,640	14	12,706
1986	6,930	2,054	112	9,096
1987	9,396	2,006	89	11,491
1988	4,054	1,359	114	5,527
1989[2]	6,979	1,431	51	8,461

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

Table 4.2 By-catch of cod in the Kattegat by the Danish industrial fishery (tonnes) as estimated by the Working Group.

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

Table 1.3 VIRTUAL POPULATION ANALYSIS

COD IN THE KATTEGAT (PART OF FISHING AREA IIIA)

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
1	653	127	685	430	168	179	243
2	5194	4328	3132	1764	7635	1203	3075
3	4770	4763	6293	2901	2440	2434	1628
4	1221	1749	2182	1414	892	610	1142
5	204	281	387	360	381	155	166
6	200	84	75	118	103	39	47
7	56	27	8	12	10	15	22
8+	25	19	15	10	19	3	10
TOTAL	12323	11378	12777	7009	11648	4638	6333

Table 4.4. VIRTUAL POPULATION ANALYSIS

COD IN THE KATTEGAT (PART OF FISHING AREA IIIA)

MEAN WEIGHT AT AGE OF THE STOCK UNIT: kilogram

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	.450	.699	.699	.699	.699	.699	.699	.699	.708	.691	.604	.600
2	.700	.880	.880	.880	.880	.880	.880	.880	.868	.893	.799	.784
3	1.050	1.069	1.069	1.069	1.069	1.069	1.069	1.170	1.086	.951	1.123	1.233
4	1.450	1.673	1.673	1.673	1.673	1.673	1.673	1.690	1.890	1.440	1.432	1.391
5	2.200	2.518	2.518	2.518	2.518	2.518	2.518	2.860	2.215	2.478	2.076	2.078
6	3.100	3.553	3.553	3.553	3.553	3.553	3.553	4.120	3.382	3.157	3.532	2.911
7	4.350	5.340	5.340	5.340	5.340	5.340	5.340	5.180	7.314	3.526	4.420	3.698
8+	6.000	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
1	.595	.711	.606	.671	.483	.541	.621
2	.752	.745	.839	.705	.716	.784	.921
3	1.129	1.133	.986	1.253	1.118	1.099	1.269
4	1.943	1.687	1.614	1.955	1.972	1.792	2.296
5	3.348	2.798	2.575	2.956	2.868	2.880	3.856
6	3.141	3.022	4.090	4.038	4.200	4.283	5.733
7	5.301	5.273	6.847	7.100	5.185	5.852	5.166
8+	6.325	7.442	7.133	7.290	8.288	7.073	6.527

Table 4.5

```
IIIa COD Tuning data Kattegat
104
Swedish bottom trawl
1978,1989
1,1
1,7
13.446,  7.564,517.047,219.283,180.515, 78.481,  7.135,  8.510
12.231, 25.436,377.487,730.733,118.345,124.077, 27.767,  1.314
14.861, 70.078,167.196,689.859,424.910, 45.449, 48.241, 15.234
12.456, 37.426,447.056,271.337,459.379,158.375, 16.659, 10.612
10.443, 43.069,404.852,409.033,271.464, 85.759, 55.103, 14.314
17.307,120.694,960.007,881.639,225.678, 37.705, 36.966, 10.350
19.172, 19.543,665.986,736.001,269.134, 43.240, 12.926,  4.155
14.118, 64.316,294.072,590.866,204.874, 36.336,  7.042,  0.751
13.159, 44.106,180.938,297.563,145.038, 36.926, 12.104,  1.231
14.446, 15.819,718.917,229.752, 83.991, 35.875,  9.699,  0.942
12.304, 23.534,157.486,318.775, 79.872, 20.325,  5.111,  1.902
13.578, 23.304,294.297,156.127,109.519, 15.920,  4.507,  2.110
Swedish Nephr. trawl
1978,1989
1,1
1,7
11.469,  4.771,326.131,138.314,113.861, 49.502,  4.500,  5.368
13.726, 16.402,243.416,470.969, 76.313, 80.009, 17.711,  0.847
14.148, 39.718, 94.761,390.987,240.823, 25.759, 27.342,  8.634
13.878, 18.905,225.827,137.064,232.052, 80.002,  8.415,  5.360
14.289, 16.448,154.608,156.204,103.669, 32.750, 21.043,  5.466
11.743, 34.869,277.353,254.712, 65.200, 10.893, 10.680,  2.990
13.724,  4.253,144.922,159.488, 58.565,  9.409,  2.813,  0.904
13.099, 30.083,137.546,276.365, 95.825, 16.996,  3.294,  0.351
16.239, 17.349, 71.173,117.048, 57.051, 14.525,  4.761,  0.484
19.452,  6.228,283.048, 90.457, 33.069, 14.125,  3.818,  0.371
15.238,  8.619, 57.677,116.747, 29.252,  7.444,  1.872,  0.696
14.773,  9.016,114.097, 60.406, 42.374,  6.159,  1.744,  0.816
Danish seine
1983,1989
1,1
1,7
1563, 16.4,165.1,227.6,100.2, 28.9, 26.3, 12.6,  6.7
1852,  5.1,181.7,304.2,166.3, 44.3, 14.3,  8.0,  7.9
 522, 13.4, 84.6,199.6,113.3, 32.1,  9.9,  1.8,  3.4
1343, 19.9, 85.5,249.9,190.0, 73.1, 32.7,  5.8,  5.0
 976,  3.1,209.5,104.5, 67.4, 41.9, 16.6,  2.0,  6.0
1138,  5.9, 57.5,163.0, 66.6, 27.2, 10.2,  5.4,  1.3
1320,  5.7,106.1, 77.4, 98.2, 24.0, 10.1,  4.3,  2.4
IYFS
1981,1989
1,1
1,2
12, 100,1573
10,1040, 326
14,1337,3612
14, 543,2002
12,1104,1272
15,3195,1077
16, 178,5952
17,1163, 473
19,  53, 908
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Table 4.6 **Results of tuning analysis for cod in the Kattegat.**

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Module run at 11.05.02  02 MARCH 1990
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
Fleet  4 ,IYFS                , has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **

Regression weights
     , .020, .116, .284, .482, .670, .820, .921, .976, .997, 1.000,
Oldest age F = 1.000*average of 3 younger ages. Fleets combined by variance of predictions
Fishing mortalities

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

    1, .043, .021, .018, .036, .012, .090, .028, .034, .020, .043,
    2, .183, .476, .295, .421, .345, .470, .349, .914, .358, .541,
    3, .623, .578, .940, .964, .874,1.279,1.113,1.189, .873,1.210,
    4, .858,1.477,1.857,1.261,1.284,1.486,1.245,1.443,1.194,1.565,
    5, .655,1.154,1.195,1.011,1.243,1.224,1.180,1.656,1.167,1.435,
    6,1.166, .619,1.734,1.743,2.016,1.609,2.144,1.529, .770,1.680,
    7, .893,1.083,1.596,1.339,1.514,1.440,1.523,1.543,1.044,1.560,

Log catchability estimates

 Age  1
 Fleet,    80,    81,    82,    83,    84,    85,    86,    87,    88,    89
_______,______,______,______,______,______,______,______,______,______,______
     1 , -7.91, -8.54, -8.41, -7.87, -9.21, -7.42, -8.44, -8.41, -8.46, -8.09
     2 , -8.43, -9.33, -9.68, -8.73,-10.40, -8.11, -9.59, -9.64, -9.68, -9.13
     3 ,      ,      ,      ,-14.37,-15.12,-12.60,-13.86,-14.26,-14.37,-14.08
     4 ,      , -7.52, -5.18, -5.26, -5.57, -4.42, -4.29, -6.10, -4.88, -7.61

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          , Slope    ,       ,Intrcpt
_______,________,______,_______,_______,__________,__________,_______,_______
     1 , -8.29  ,  .422, .0034 , .0356,  .000E+00,  .000E+00, -8.288,   .156
     2 , -9.36  ,  .571, .0013 , .0343,  .000E+00,  .000E+00, -9.360,   .212
     3 ,-14.06  ,  .728, .0010 , .0440,  .000E+00,  .000E+00,-14.061,   .278
     4 , -5.52  , 1.077, .0759 , .3480,  .000E+00,  .000E+00, -5.523,   .400
      Fbar     SIGMA(int.)     SIGMA(ext.)     SIGMA(overall)  Variance ratio
      .043        .296            .347            .347            1.376
```

cont'd.

Table 4.6 cont'd.

Age 2

Fleet,	80,	81,	82,	83,	84,	85,	86	87,	88,	89
1 ,	-6.46,	-5.43,	-5.63,	-5.40,	-5.89,	-5.77,	-5.91,	-5.12,	-5.57,	-5.57
2 ,	-6.98,	-6.23,	-6.91,	-6.26,	-7.08,	-6.45,	-7.05,	-6.35,	-6.79,	-6.60
3 ,	,	,	,	-11.67,	-11.76,	-10.62,	-11.28,	-10.57,	-11.11,	-11.17
4 ,	,	-4.14,	-5.81,	-3.87,	-4.47,	-4.14,	-4.26,	-3.11,	-4.79,	-4.78

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-5.60 ,	.235,	.0502 ,	.5244,	.000E+00,	.000E+00,	-5.600,	.087
2 ,	-6.67 ,	.260,	.0187 ,	.5041,	.000E+00,	.000E+00,	-6.672,	.096
3 ,	-11.11 ,	.428,	.0198 ,	.5736,	.000E+00,	.000E+00,	-11.108,	.164
4 ,	-4.29 ,	.618,	.2596 ,	.8793,	.000E+00,	.000E+00,	-4.293,	.229

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.541	.156	.769E-01	.156	.243

Age 3

Fleet,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	-5.24,	-5.24,	-4.47,	-4.58,	-4.96,	-4.77,	-4.75,	-4.86,	-4.68,	-4.76
2 ,	-5.75,	-6.03,	-5.75,	-5.43,	-6.15,	-5.45,	-5.89,	-6.09,	-5.90,	-5.80
3 ,	,	,	,	-10.43,	-10.41,	-9.46,	-9.55,	-9.86,	-9.88,	-10.04
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 ,	-4.77 ,	.121,	.1156 ,	1.2051,	.000E+00,	.000E+00,	-4.766,	.045
2 ,	-5.84 ,	.211,	.0430 ,	1.1598,	.000E+00,	.000E+00,	-5.839,	.078
3 ,	-9.90 ,	.343,	.0663 ,	1.3944,	.000E+00,	.000E+00,	-9.899,	.131
4 ,	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.210	.100	.326E-01	.100	.106

cont'd.

Table 4.6 cont'd.

Age 4

Fleet,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	-4.92,	-4.30,	-3.79,	-4.31,	-4.58,	-4.62,	-4.64,	-4.67,	-4.37,	-4.50
2 ,	-5.43,	-5.09,	-5.07,	-5.16,	-5.77,	-5.30,	-5.78,	-5.90,	-5.58,	-5.54
3 ,	,	,	,	-9.62,	-9.63,	-8.82,	-8.99,	-9.10,	-9.07,	-9.19
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 ,	-4.50 ,	.177,	.1509 ,	1.5738,	.000E+00,	.000E+00,	-4.499,	.066
2 ,	-5.57 ,	.229,	.0562 ,	1.5153,	.000E+00,	.000E+00,	-5.571,	.085
3 ,	-9.16 ,	.273,	.1391 ,	1.6179,	.000E+00,	.000E+00,	-9.158,	.104
4 ,	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.565	.125	.166E-01	.125	.018

Age 5

Fleet,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	-5.19,	-4.55,	-4.23,	-4.53,	-4.61,	-4.81,	-4.69,	-4.53,	-4.39,	-4.59
2 ,	-5.70,	-5.34,	-5.51,	-5.38,	-5.80,	-5.50,	-5.83,	-5.76,	-5.61,	-5.63
3 ,	,	,	,	-9.30,	-9.15,	-8.54,	-8.63,	-8.59,	-8.62,	-8.76
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 ,	-4.57 ,	.133,	.1401 ,	1.4606,	.000E+00,	.000E+00,	-4.574,	.049
2 ,	-5.65 ,	.129,	.0522 ,	1.4064,	.000E+00,	.000E+00,	-5.646,	.048
3 ,	-8.75 ,	.259,	.2099 ,	1.4520,	.000E+00,	.000E+00,	-8.746,	.099
4 ,	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.435	.874E-01	.129E-01	.874E-01	.022

cont'd.

Table 4.6 cont'd.

Age 6

Fleet,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1	-4.61	-5.17	-3.86	-3.98	-4.12	-4.54	-4.09	-4.61	-4.80	-4.43
2	-5.13	-5.96	-5.14	-4.84	-5.31	-5.22	-5.24	-5.84	-6.02	-5.47
3				-8.83	-8.59	-7.81	-7.72	-8.28	-8.64	-8.20
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	-4.40	.277	.1661	1.7317	.000E+00	.000E+00	-4.404	.103
2	-5.48	.322	.0619	1.6672	.000E+00	.000E+00	-5.476	.119
3	-8.26	.397	.3428	1.5950	.000E+00	.000E+00	-8.256	.152
4	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.680	.186	.226E-01	.186	.015

Table 4.7 VIRTUAL POPULATION ANALYSIS

COD IN THE KATTEGAT (PART OF FISHING AREA IIIA)

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

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	.584	.002	.000	.022	.008	.017	.000	.004	.022	.043	.021	.018
2	.362	.283	.038	.456	.179	.263	.319	.319	.201	.183	.476	.295
3	.679	.561	.258	.725	.655	.616	.868	.741	.623	.623	.578	.940
4	.607	.538	.829	1.351	.933	1.229	1.304	.698	.736	.858	1.477	1.857
5	.670	.562	1.631	.948	.721	.922	1.553	.940	.935	.655	1.154	1.195
6	.620	.838	2.034	1.468	.776	.819	1.100	1.464	.658	1.166	.619	1.734
7	.632	.646	1.498	1.256	.810	.990	1.322	1.036	.784	.893	1.083	1.596
8+	.632	.646	1.498	1.256	.810	.990	1.322	1.036	.784	.893	1.083	1.596
(2- 6)U	.587	.557	.958	.989	.653	.770	1.029	.832	.631	.697	.861	1.204
(1- 8)U	.598	.510	.973	.935	.611	.731	.973	.780	.593	.664	.811	1.154

	1983	1984	1985	1986	1987	1988	1989	1985-89
1	.036	.012	.090	.028	.034	.020	.043	.043
2	.421	.345	.470	.349	.914	.358	.541	.526
3	.964	.874	1.279	1.113	1.189	.873	1.210	1.133
4	1.261	1.284	1.486	1.245	1.443	1.194	1.565	1.387
5	1.011	1.243	1.224	1.180	1.656	1.167	1.435	1.332
6	1.743	2.016	1.609	2.144	1.529	.770	1.680	1.546
7	1.339	1.514	1.440	1.523	1.543	1.044	1.560	1.422
8+	1.339	1.514	1.440	1.523	1.543	1.044	1.560	1.422
(2- 6)U	1.080	1.152	1.214	1.206	1.346	.873	1.286	
(1- 8)U	1.014	1.100	1.130	1.138	1.231	.809	1.199	

Table 4.8 VIRTUAL POPULATION ANALYSIS

COD IN THE KATTEGAT (PART OF FISHING AREA IIIA)

STOCK SIZE IN NUMBERS UNIT: thousands

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
1	37168	22784	15533	30232	25949	11082	29550	23439	10841	14437	17140	20590
2	28671	16967	18620	12713	24218	21075	8923	24192	19110	8683	11321	13737
3	15357	16347	10465	14682	6598	16577	13270	5313	14402	12800	5923	5758
4	4607	6377	7637	6619	5823	2805	7328	4561	2073	6323	5622	2722
5	1982	2056	3048	2729	1403	1875	672	1628	1859	813	2196	1050
6	489	831	960	489	866	559	611	116	521	598	346	567
7	70	216	294	103	92	327	202	166	22	221	152	152
8+	70	87	222	47	37	90	150	119	94	64	128	49
TOTAL NO	88415	65665	56778	67613	64987	54390	60705	59535	48923	43940	42828	44625
SPS NO	22575	25914	22626	24668	14820	22233	22232	11904	18971	20819	14367	10298
TOT.BIOM	66202	68860	65335	68556	63597	57754	60889	58419	50437	44134	41147	38722
SPS BIOM	29407	38003	38092	36236	24146	31462	32381	20746	26174	26403	21749	15598

	1983	1984	1985	1986	1987	1988	1989	1990	1980-89
1	20578	11312	8783	17391	5542	10030	6315	0	13212
2	16551	16259	9147	6573	13850	4385	8051	4951	10856
3	8374	8891	9424	4682	3798	4545	2510	3838	6671
4	1842	2614	3038	2147	1259	947	1554	613	2807
5	348	427	593	563	506	244	235	266	697
6	260	104	101	143	142	79	62	46	240
7	82	37	11	17	14	25	30	9	74
8+	37	26	21	14	26	5	14	8	38
TOTAL NO	48071	39671	31119	31529	25136	20261	18770		
SPS NO	10942	12100	13189	7564	5744	5845	4405		
TOT.BIOM	40371	36540	29361	28825	21655	16780	19595		
SPS BIOM	15681	16384	16364	12521	9062	7915	8259		

Table 4.9

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 11 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 11 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN EXCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	4.2399	.551	7.434	.5165	7	9.7698	.55610	.61017	.00000
IYFS2	3.8877	.690	6.200	.6748	8	8.8839	.38148	.43709	.56422
MEAN						9.4522	.49734	.49734	.43578

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	1.3350	.567	7.261	.4899	8	8.0179	.54629	.74447	.00000
IYFS2	2.3702	.636	6.478	.7026	9	7.9861	.34076	.50639	.00000
MEAN						9.3894	.47609	.47609	1.00000

Yearclass = 1989

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	4.8828	.426	7.815	.6335	9	9.8968	.41406	.47749	.51547
IYFS2									
MEAN						9.2650	.49250	.49250	.48453

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1987	9.13	9242.26	.33	.20	9.2110031.01	.61
1988	9.39	11960.90	.48	.00	8.78 6514.00	.00
1989	9.59	14627.69	.34	.32		.92

ple 4.10 **Cod in the Kattegat.**
List of input variables for the ICES prediction program.

COD IN THE KATTEGAT
The reference F is the mean F for the age group range from 2 to 6

The number of recruits per year is as follows:

Year	Recruitment
1990	14628.0
1991	13212.0
1992	13212.0

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	14628.0	.05	.20	.00	.584	.584
2	4951.0	.57	.20	.00	.793	.793
3	3838.0	1.23	.20	1.00	1.145	1.145
4	613.0	1.51	20	1.00	1.926	1.926
5	266.0	1.44	.20	1.00	3.027	3.027
6	46.0	1.68	.20	1.00	4.469	4.469
7	9.0	1.54	.20	1.00	6.030	6.030
8+	8.0	1.54	.20	1.00	7.262	7.262

Table 4.11 · Cod in the Kattegat.

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

A heading is not given

Year 1990					Year 1991					Year 1992	
fac-tor	ref. F	stock biomass	sp.stock biomass	catch	fac-tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	1.29	19173	6698	6455	.0	.00	21804	5022	0	33618	17319
					.1	.13			1071	32145	15886
					.2	.26			2045	30813	14594
					.4	.51			3742	28509	12369
					.6	.77			5163	26601	10541
					.8	1.03			6362	25011	9028
					1.0	1.29			7381	23674	7769
					1.2	1.54			8254	22542	6713
					1.4	1.80			9008	21576	5823
					1.6	2.06			9663	20746	5068
					1.8	2.31			10236	20028	4425
					2.0	2.57			10741	19403	3874

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

Table 5.1 Cod landings from the Skagerrak as estimated by the Working Group, 1971-1989 (t).

Year	Open Skagerrak					Norwegian Fjords
	Denmark	Sweden	Norway	Others	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[1]	16,663	1,778	91	30	18,562	814

[1] Preliminary.

Table 5.2 By-catch of cod in the Skagerrak by the Danish industrial fishery (tonnes) as estimated by the Working Group.

Year	By-catch
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

Table 5.3 VIRTUAL POPULATION ANALYSIS

COD IN THE SKAGERRAK (PART OF FISHING AREA IIIA)

CATCH IN NUMBERS UNIT: thousands

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	432	1066	389	1080	1771	341	928	3253	165	1035	782
2	4325	6593	11030	4448	6020	7067	5156	4101	12289	2645	6139
3	2956	4821	6202	6653	3368	3107	2773	3441	2245	5251	3114
4	480	1748	1169	2009	1609	731	856	1748	503	592	1539
5	202	349	288	242	290	280	207	347	137	150	170
6	34	94	44	175	85	70	124	60	69	56	102
7	33	82	49	73	32	22	33	39	17	8	18
8+	28	11	6	27	69	17	9	21	19	13	11
TOTAL	8490	14764	19177	14707	13244	11635	10086	13010	15444	9750	11875

Table 5.4 VIRTUAL POPULATION ANALYSIS 5.4

10.37.29 02 MARCH 1990

COD IN THE SKAGERRAK (PART OF FISHING AREA IIIA)

MEAN WEIGHT AT AGE OF THE STOCK UNIT: kilogram

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	.599	.746	.619	.656	.590	.647	.649	.683	.580	.637	.612
2	.860	1.146	.972	1.204	1.007	1.130	1.094	1.133	1.048	1.195	1.064
3	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	3.347	3.711	2.709	3.350	3.616	3.537	2.636	3.896	2.978	3.224
5	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	8.932	9.491	8.018	8.074	7.814	7.746	7.538	7.914	8.095	7.890
7	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	11.085	10.094	12.658	11.963	12.856	12.854	9.777	12.467	13.060	10.800

Table 5.5

```
Illa COD Tuning data Skagerrak
104
Swedish bottom trawl
1978,1989
1,1
1,7
  3.510, 15.245, 39.278, 10.155,  2.724,  0.640,  0.584,  0.155
  3.662,  2.908, 29.115, 19.899,  3.231,  1.360,  0.229,  0.222
  6.641, 11.679, 72.230, 52.817, 19.150,  3.824,  1.030,  0.898
  7.294,  4.278,121.314, 68.213, 12.857,  3.168,  0.484,  0.539
  8.177, 19.110, 78.705,117.721, 35.548,  4.282,  3.097,  1.292
  8.479, 26.747, 90.919, 50.866, 24.300,  4.380,  1.284,  0.483
 12.006,  6.360,131.811, 57.951, 13.634,  5.222,  1.306,  0.019
 13.155, 21.877,121.551, 65.373, 20.180,  4.880,  2.923,  0.778
 11.966, 56.150, 70.788, 59.395, 30.172,  5.990,  1.036,  0.673
 13.342,  4.171,310.621, 56.745, 12.714,  3.463,  1.744,  0.430
 13.362, 18.928, 48.354, 96.000, 10.832,  2.736,  1.024,  0.149
 11.847, 13.751,107.954, 54.760, 27.063,  2.989,  1.794,  0.317
Swedish Nephr. trawl
1978,1989
1,1
1,7
 31.429,101.396,261.241, 67.543, 18.119,  4.255,  3.881,  1.029
 34.412, 26.089,261.191,178.516, 28.988, 12.199,  2.053,  1.993
 44.075, 57.150,353.461,258.462, 93.713, 18.710,  5.039,  4.396
 43.757, 21.782,617.631,347.285, 65.459, 16.127,  2.464,  2.744
 40.826, 57.247,235.773,352.652,106.490, 12.828,  9.276,  3.869
 52.500,100.728,342.397,191.650, 91.514, 16.494,  4.835,  1.820
 69.935, 18.463,382.643,168.229, 39.580, 15.161,  3.790,  1.191
 70.926, 64.125,356.281,191.615, 59.150, 14.304,  8.568,  2.280
 75.102,119.097,150.144,125.980, 63.997, 12.704,  2.197,  1.428
 92.435,  8.806,655.825,119.809, 26.844,  7.311,  3.682,  0.907
108.913, 54.342,138.222,275.614, 31.099,  7.855,  2.939,  0.427
 86.154, 45.300,355.626,180.391, 89.153,  9.848,  5.909,  1.043
Danish Seine
1983,1989
1,1
1,7
 520,  8.2,  47.3,  51.7,  42.0,  13.0,  5.4,  2.1
1996,  7.2, 261.5,  220.8, 66.5,  50.5, 17.9,  7.4
 716,  10.6, 99.3,  102.0, 53.3,  19.9, 16.9,  5.9
3784, 229.5,479.9,  725.2,476.0, 168.6, 46.7, 36.9
2170,   4.2,567.5,  183.9, 86.4,  35.3, 24.1,  7.2
2528,  37.5,179.8,  156.6,100.3,  49.8, 25.8,  4.7
3316,  24.0,327.7,  266.2,248.9,  48.1, 40.4,  8.7
IYFS
1981,1989
1,1
1,2
20, 152,1700
13, 468, 403
21, 596, 638
21, 491, 391
22, 297,1140
26,2025, 273
33, 178,3729
21,1617, 340
24,1344, 571
```

Table 5.6 Summary statistics from the tuning for cod in the Skagerrak.

```
Module run at 10.40.48  02 MARCH 1990
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
Fleet  4 ,IYFS                , has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **

Regression weights
     , .015, .093, .233, .409, .588, .744, .863, .940, .982, .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,

     1, .020, .039, .031, .073, .103, .026, .090, .117, .017, .074, .052,
     2, .421, .461, .679, .575, .707, .745, .662, .697, .833, .403, .804,
     3, .691, 1.216, 1.096, 1.236, 1.240, 1.033, .755, 1.413, 1.106, 1.126, 1.222,
     4, .539, 1.250, 1.215, 1.528, 1.278, 1.058, .942, 1.917, .822, 1.056, 1.360,
     5, .585, .995, .704, .921, 1.025, .808, 1.051, 1.465, .830, .627, 1.071,
     6, .191, .602, .309, 1.386, 1.043, .753, 1.107, 1.074, 1.641, 1.033, 1.263,
     7, .439, .949, .742, 1.278, 1.115, .873, 1.033, 1.485, 1.098, .905, 1.231,

Log catchability estimates

 Age  1
 Fleet,    79,    80,    81,    82,    83,    84,    85,    86,    87,    88,    89
_____,_____,_____,_____,_____,_____,_____,_____,_____,_____,_____,_____
    1 ,-10.22, -9.66, -9.97, -8.76, -8.60,-10.11, -8.74, -8.69,-10.35, -9.19, -9.48
    2 ,-10.27, -9.97,-10.13, -9.27, -9.10,-10.81, -9.34, -9.77,-11.54,-10.24,-10.27
    3 ,      ,      ,      ,      ,-13.90,-15.10,-13.46,-13.04,-15.43,-13.75,-14.56
    4 ,      ,      , -7.41, -6.03, -6.40, -6.32, -6.64, -5.88, -7.50, -5.20, -5.60


                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,  Slope   ,       ,Intrcpt
_______,________,______,_______,_______,__________,__________,________,_____
     1 , -9.33  , .563, .0011 , .0597,  .000E+00,  .000E+00, -9.331,   .201
     2 ,-10.15  , .668, .0034 , .0580,  .000E+00,  .000E+00,-10.151,   .238
     3 ,-14.18  , .905, .0023 , .0751,  .000E+00,  .000E+00,-14.180,   .339
     4 , -6.23  , .725, .0474 , .0276,  .000E+00,  .000E+00, -6.226,   .260
      Fbar     SIGMA(int.)    SIGMA(ext.)    SIGMA(overall)  Variance ratio
      .052        .343           .199           .343            .338          cont'd.
```

Table 5.6 cont'd.

Age 2

Fleet,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	-7.16,	-7.18,	-6.88,	-6.69,	-6.68,	-6.76,	-6.74,	-6.90,	-6.45,	-7.50,	-6.73
2 ,	-7.21,	-7.49,	-7.05,	-7.20,	-7.17,	-7.46,	-7.35,	-7.99,	-7.64,	-8.55,	-7.52
3 ,	,	,	,	,	-11.45,	-11.19,	-10.94,	-10.75,	-10.94,	-11.43,	-11.26
4 ,	,	,	-5.25,	-5.52,	-5.64,	-6.23,	-5.01,	-6.33,	-4.87,	-6.00,	-5.77

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-6.84 ,	.273,	.0127 ,	.7240,	.000E+00,	.000E+00,	-6.836,	.097
2 ,	-7.66 ,	.392,	.0407 ,	.7031,	.000E+00,	.000E+00,	-7.657,	.140
3 ,	-11.12 ,	.270,	.0491 ,	.9199,	.000E+00,	.000E+00,	-11.120,	.101
4 ,	-5.66 ,	.510,	.0834 ,	.8972,	.000E+00,	.000E+00,	-5.662,	.183

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.804	.163	.705E-01	.163	.186

Age 3

Fleet,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	-6.67,	-6.21,	-6.41,	-5.92,	-6.12,	-6.43,	-6.61,	-6.20,	-6.17,	-6.48,	-6.31
2 ,	-6.71,	-6.52,	-6.57,	-6.43,	-6.61,	-7.13,	-7.22,	-7.28,	-7.36,	-7.52,	-7.10
3 ,	,	,	,	,	-10.22,	-10.21,	-10.16,	-9.45,	-10.08,	-11.23,	-10.37
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 ,	-6.31 ,	.164,	.0215 ,	1.2224,	.000E+00,	.000E+00,	-6.312,	.058
2 ,	-7.13 ,	.282,	.0688 ,	1.1880,	.000E+00,	.000E+00,	-7.132,	.101
3 ,	-10.26 ,	.558,	.1164 ,	1.3612,	.000E+00,	.000E+00,	-10.258,	.209
4 ,	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.222	.137	.211E-01	.137	.024

cont'd.

Table 5.6 cont'd.

Age 4

Fleet	79	80	81	82	83	84	85	86	87	88	89
1	-6.92	-6.18	-6.30	-5.71	-6.09	-6.41	-6.38	-5.89	-6.46	-6.54	-6.21
2	-6.96	-6.49	-6.47	-6.22	-6.58	-7.11	-6.99	-6.98	-7.65	-7.58	-7.00
3						-9.65	-9.68	-9.41	-8.89	-9.64	-9.56	-9.62
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	-6.26	.222	.0227	1.2908	.000E+00	.000E+00	-6.258	.079
2	-7.08	.365	.0727	1.2544	.000E+00	.000E+00	-7.078	.130
3	-9.48	.289	.2530	1.5641	.000E+00	.000E+00	-9.481	.108
4	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.360	.158	.652E-01	.158	.169

Age 5

Fleet	79	80	81	82	83	84	85	86	87	88	89
1	-6.83	-6.41	-6.85	-6.22	-6.31	-6.68	-6.27	-6.16	-6.45	-7.06	-6.44
2	-6.88	-6.72	-7.01	-6.73	-6.80	-7.38	-6.88	-7.24	-7.64	-8.11	-7.24
3						-9.33	-9.52	-8.87	-8.58	-9.22	-9.40	-9.30
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	-6.49	.259	.0180	1.0233	.000E+00	.000E+00	-6.490	.092
2	-7.31	.379	.0576	.9943	.000E+00	.000E+00	-7.310	.135
3	-9.16	.339	.3475	1.2282	.000E+00	.000E+00	-9.163	.127
4	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.071	.181	.616E-01	.181	.116

cont'd.

Table 5.6 cont'd.

Age 6

Fleet,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	-7.95,	-6.92,	-7.67,	-5.81,	-6.29,	-6.75,	-6.22,	-6.47,	-5.77,	-6.56,	-6.28
2 ,	-8.00,	-7.22,	-7.84,	-6.32,	-6.79,	-7.45,	-6.83,	-7.55,	-6.96,	-7.61,	-7.07
3 ,	,	,	,	,	-8.97,	-9.25,	-8.47,	-8.42,	-8.24,	-8.58,	-8.80
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 ,	-6.35 ,	.358,	.0207 ,	1.1760,	.000E+00,	.000E+00,	-6.351,	,128
2 ,	-7.17 ,	.344,	.0662 ,	1.1428,	.000E+00,	.000E+00,	-7.171,	.123
3 ,	-8.64 ,	.340,	.5877 ,	1.4838,	.000E+00,	.000E+00,	-8.638,	.127
4 ,	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.263	.200	.837E-01	.200	.174

Table 5.7 VIRTUAL POPULATION ANALYSIS

COD IN THE SKAGERRAK (PART OF FISHING AREA IIIA)

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

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1980-89
1	.020	.039	.031	.073	.103	.026	.090	.117	.017	.074	.052	.062
2	.421	.461	.679	.575	.707	.745	.662	.697	.833	.403	.804	.657
3	.691	1.216	1.096	1.236	1.240	1.033	.755	1.413	1.106	1.126	1.222	1.145
4	.539	1.250	1.215	1.528	1.278	1.058	.942	1.917	.822	1.056	1.360	1.242
5	.585	.995	.704	.921	1.025	.808	1.051	1.465	.830	.627	1.071	.950
6	.191	.602	.309	1.386	1.043	.753	1.107	1.074	1.641	1.033	1.263	1.021
7	.439	.949	.742	1.278	1.115	.873	1.033	1.485	1.098	.905	1.231	1.071
8+	.439	.949	.742	1.278	1.115	.873	1.033	1.485	1.098	.905	1.231	1.071
(2- 6)U	.486	.905	.800	1.129	1.058	.879	.903	1.313	1.047	.849	1.144	
(1- 8)U	.416	.807	.690	1.034	.953	.771	.834	1.207	.931	.766	1.029	

Table 5.8 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

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	24356	31001	14013	17014	19865	14566	11909	32477	10847	15919[1]	17152[2]	0[3]
2	13792	19551	24419	11122	12956	14667	11618	8913	23657	8732	12100	13337
3	6461	7412	10096	10140	5126	5232	5702	4905	3635	8418	4775	4434
4	1259	2649	1798	2763	2411	1214	1524	2195	977	985	2235	1152
5	498	601	622	437	491	550	345	486	264	352	280	470
6	215	227	182	252	142	144	201	99	92	94	154	79
7	102	145	102	109	52	41	56	54	28	15	27	36
8+	86	20	12	40	111	32	15	29	31	24	17	11
TOTAL NO	46769	61606	51245	41877	41154	36447	31371	49159	39531	34538	36741	
SPS NO	8621	11055	12813	13741	8332	7214	7843	7769	5027	9887	7489	
TOT.BIOM	48958	72412	64277	57102	48671	46731	41951	51888	44574	42463	41956	
SPS BIOM	22507	26881	31868	32550	23904	20732	21512	19607	13490	21889	18584	

	1980-89
1	18476
2	14773
3	6544
4	1875
5	443
6	159
7	63
8+	33

[1] Revised to 22,336

[2] Revised 15,058

[3] Set to 16,659

Table 5.9

Analysis by RCRTINX2 of data from file SKAGIYFS:DAT
COD IN THE SKAGERRAK AS 1-GROUP, 1- AND 2-GROUP DATA, YEARCLASSES 79-89

Data for 2 surveys over 11 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 11 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN EXCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	4.3567	.479	8.229	.8310	7	10.3144	.19846	.24808	.55647
IYFS2	3.2108	.632	7.529	.6409	8	9.5573	.34434	.37321	.24588
MEAN						9.7362	.41626	.41626	.19765

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	4.0431	.489	8.096	.6073	8	10.0732	.33293	.37462	.34676
IYFS2	2.3609	.618	7.593	.6478	9	9.0514	.31539	.38328	.33127
MEAN						9.7160	.38878	.38878	.32197

Yearclass = 1989

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS1	3.4626	.481	8.065	.5825	9	9.7305	.33310	.35700	.50928
IYFS2									
MEAN						9.7106	.36369	.36369	.49072

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1987	10.01	22336.62	.19	.24	9.6815919.99	1.31
1988	9.62	15058.55	.22	.30	9.7517152.98	1.36
1989	9.72	16659.59	.25	.01		.04

Table 5.10
List of input variables for the ICES prediction program.

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

The number of recruits per year is as follows:

Year	Recruitment
1990	16660.0
1991	19406.0
1992	19406.0

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	16660.0	.07	.20	.00	.632	.632
2	11653.0	.75	.20	.00	1.107	1.107
3	8699.0	1.31	.20	1.00	1.911	1.911
4	1152.0	1.42	.20	1.00	3.254	3.254
5	470.0	1.08	.20	1.00	5.498	5.498
6	79.0	1.16	.20	1.00	7.837	7.837
7	36.0	1.22	.20	1.00	9.791	9.791
8+	11.0	1.22	.20	1.00	11.792	11.792

Table .5.11

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

PROGNOSES FOR COD IN THE SKAGERRAK

Year 1990					Year 1991					Year 1992	
fac-tor	ref. F	stock biomass	sp.stock biomass	catch	fac-tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	1.14	47488	24058	23031	.0	.00	43839	17508	0	73251	43397
					.1	.11			2966	68773	39044
					.2	.23			5630	64763	35157
					.4	.46			10188	57942	28580
					.6	.69			13895	52435	23314
					.8	.92			16929	47966	19083
					1.0	1.14			19424	44321	15672
					1.2	1.37			21491	41330	12913
					1.4	1.60			23212	38862	10673
					1.6	1.83			24656	36813	8848
					1.8	2.06			25875	35100	7356
					2.0	2.29			26912	33658	6133

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

Table 6.1 Nominal landings (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[1]	4,078	78	60	-	4,216

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

Table 6.2 Landings of haddock in Division IIIa in tonnes as supplied by Working Group members.

Year	Denmark		Total	Norway	Sweden	Others	Total	Total Indust.& Consump.
	Consumption	Industrial		Consumption			Consump.	
1983	1,445	2,225	8,670	756	608	221	2,809	10,255
1984	5,130	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	3,718	360	4,078	78	60	-	3,856	4,216

Table 6.3 Landings of haddock in the Kattegat (in tonnes) as supplied by Working Group members.

Year	Denmark		Sweden		Total
	Consumption	Industrial	Consumption	Total Consump.	
1987	469	338	-	469[1]	806[1]
1988	29	158	15	44	202
1989	111	63	-	111[1]	174[1]

[1] Swedish landings not split according to area.

Table 6.4 Landings of Haddock in the Skagerrak (in tonnes) as supplied by Working Group members.

Year	Denmark		Norway/Sweden		Total
	Consumption	Industrial	Consumption	Total Consump.	
1987	3,117	1,111	148	3,265[1]	4,376[1]
1988	2,514	1,322	245	2,808	4,130
1989	3,707	297	78	3,785[1]	4,082[1]

[1] Swedish landings not split according to area.

Table 6.5 Catch in numbers of HADDOCK in Division IIIa for 1981-1989 ('000).

Age	1981	1982	1983	1984	1985	1986	1987[1]	1988[1]	1989[1]
1	30	314	1,113	18	-	51	381	375	32
2	9,903	2,299	4,624	6,554	8,279	904	3,282	1,683	1,518
3	4,962	12,055	2,728	4,481	3,687	3,725	866	1,863	2,898
4	771	1,113	4,004	713	1,049	686	734	303	505
5	151	209	525	524	78	230	122	158	90
6	84	22	63	91	176	33	42	43	45
7	36	11	11	6	29	27	10	14	12
8+	3	6	6	16	6	28	6	16	6
Total	15,940	16,029	13,074	12,403	13,304	5,684	5,444	4,455	5,106

[1] Data from human consumption fishery only.

Table 6.6 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]
1	200	200	200	200	200	350	432	412	452
2	470	470	470	470	470	530	540	542	533
3	679	679	679	679	679	760	810	678	741
4	932	932	932	932	932	1.096	1.122	1.047	1.125
5	1.593	1.593	1.593	1.593	1.593	1.518	1.531	1.394	1.783
6	2.180	2.180	2.180	2.180	2.180	1.828	1.917	1.670	1.916
7	2.600	2.600	2.600	2.600	2.600	2.400	1.853	2.324	2.050
8+	2.770	2.770	2.770	2.770	2.770	2.700	2.155	2.742	2.967

[1] Data from human consumption fishery only.

Table 7.1 Nominal landings (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[2]	65	1,516	3	22,654[2]
1981	24,942[2]	70	1,054	7	26,073[2]
1982	40,941[2]	40	670	13	41,664[2]
1983	24,816[2]	48	1,061	8	25,933[2]
1984	13,138[2]	51	1,168	60	14,417[2]
1985	12,524[2]	45	654	2	13,225[2]
1986	12,463[2]	64	477	1	13,005[2]
1987	16,323[2]	29	262	43	16,657[2]
1988	11,262[2]	42	435	24	11,764[2]
1989[1]	12,516[2]	26	663	-	13,205[2]

[1] Preliminary.
[2] Data revised by the Working Group.

Table 7.2 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	710	7,708	854	11,662	12,516

Table 8.1 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	2,488	170	+	2,658
1987	2,859	283	104	3,246
1988	1,818	210	2.8	2,031
1989[1]	1,571	126	4.0	1,701

[1] Preliminary.

Table 8.2 Danish landings of PLAICE by quarters in the Kattegat and the Skagerrak (tonnes) as supplied by Working Group members.

Quarter	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989[1]
					Kattegat						
Jan-Mar	2,002	1,825	1,196	941	531	779	568	480	322	544	259
Apr-Jun	2,786	1,168	774	619	595	745	594	546	618	413	285
Jul-Sep	2,525	1,396	1,069	599	1,195	955	704	798	841	468	420
Oct-Dec	2,422	1,193	764	558	959	773	1,116	664	1,043	395	608
Total	9,721	5,582	3,803	2,717	3,280	3,252	2,979	2,488	2,834	1,820	1,571

[1] Preliminary.

Table 8.3 VIRTUAL POPULATION ANALYSIS

PLAICE IN THE KATTEGAT (PART OF FISHING AREA IIIA)

CATCH IN NUMBERS UNIT: thousands

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	1	1	1	1	1	1470	50	140	10	10	1	37
2	3790	1180	3660	680	1120	8590	3100	7880	8657	3330	147	859
3	20320	14070	11830	8190	21790	5830	21630	7330	11026	20150	9686	6464
4	10570	10510	9760	23570	17720	6260	3470	8140	2100	9230	27862	17331
5	2280	2840	3140	14170	7910	3130	2620	1040	3060	2680	8685	7984
6	790	760	710	1870	1110	1770	1020	730	431	900	1144	1715
7	500	300	650	350	200	510	740	420	280	230	227	576
8	260	300	370	190	120	180	330	350	207	270	49	105
9	180	270	370	330	80	20	120	150	87	210	48	73
10	70	240	240	260	80	10	80	110	74	130	33	49
11	1	50	80	80	30	30	50	50	10	100	17	38
12+	50	100	140	40	60	30	140	10	13	190	40	16
TOTAL	38812	30621	30951	49731	50221	27830	33350	26350	25955	37430	47939	35247

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	1	2	20	54	7	6	8	0	3	5
2	301	191	548	1495	1334	1315	391	664	67	738
3	2855	1817	1326	5029	4408	5052	2304	2687	1151	1593
4	7179	4754	1986	2298	2880	4061	2685	4379	2039	1080
5	5355	3198	1935	888	619	434	2072	1717	1385	732
6	2310	1056	1011	585	385	84	619	456	538	313
7	501	416	380	561	540	80	130	117	247	145
8	159	196	157	402	675	115	64	92	150	81
9	127	131	63	216	566	89	48	72	70	65
10	53	91	23	54	288	100	43	71	64	44
11	32	51	25	39	27	66	27	61	23	30
12+	17	39	9	71	70	71	22	60	63	85
TOTAL	18890	11942	7483	11692	11799	11473	8413	10376	5800	4911

Table 8.4 VIRTUAL POPULATION ANALYSIS

PLAICE IN THE KATTEGAT (PART OF FISHING AREA IIIA)

MEAN WEIGHT AT AGE OF THE STOCK UNIT: kilogram

	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979
1	.176	.176	.176	.176	.176	.176	.176	.176	.176	.176	.200	.120
2	.243	.243	.243	.243	.243	.243	.243	.243	.243	.243	.230	.220
3	.273	.273	.273	.273	.273	.273	.273	.273	.273	.273	.240	.258
4	.291	.291	.291	.291	.291	.291	.291	.291	.291	.291	.260	.275
5	.325	.325	.325	.325	.325	.325	.325	.325	.325	.325	.300	.303
6	.408	.408	.408	.408	.408	.408	.408	.408	.408	.408	.460	.344
7	.556	.556	.556	.556	.556	.556	.556	.556	.556	.556	.720	.450
8	.686	.686	.686	.686	.686	.686	.686	.686	.686	.686	.780	.650
9	.822	.822	.822	.822	.822	.822	.822	.822	.822	.822	.800	.920
10	.907	.907	.907	.907	.907	.907	.907	.907	.907	.907	.820	1.005
11	.952	.952	.952	.952	.952	.952	.952	.952	.952	.952	.830	1.030
12+	.992	.992	.992	.992	.992	.992	.992	.992	.992	.992	.830	1.061

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
1	.120	.180	.260	.275	.235	.247	.229	.301	.272	.229
2	.263	.230	.270	.285	.287	.287	.251	.283	.263	.297
3	.277	.270	.320	.285	.300	.280	.295	.287	.296	.293
4	.300	.290	.330	.298	.318	.310	.302	.332	.308	.324
5	.310	.350	.360	.350	.358	.398	.358	.426	.334	.360
6	.356	.440	.440	.385	.324	.476	.415	.569	.434	.412
7	.500	.530	.580	.402	.316	.503	.484	.638	.562	.478
8	.600	.690	.710	.461	.340	.524	.604	.855	.654	.619
9	.690	.790	.910	.581	.327	.561	.645	.794	.796	.851
10	.810	.900	1.000	1.033	.412	.622	.784	1.059	.738	.950
11	.890	.960	1.050	1.182	.876	.652	.872	1.039	.992	.964
12+	.950	1.050	1.070	1.178	1.136	1.048	1.097	.793	1.119	1.068

Table 8.5 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
			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

Table 8.6 Division IIIa PLAICE. Mean catch (kg) per fishing day for gears in the Kattegat and Skagerrak (Danish data).

Year	Kattegat catch in kg (effort in fishing days)											
	Seiners			Trawl <30 GRT			Trawl >30 GRT			Gillnet		
	Catch	Effort	CPUE	Catch	Effort	CPUE	Catch	Effort	CPUE	Catch	Effort	CPUE
1983	331,882	(1,811)	183.3	136,430	(2,135)	63.9	59,682	(641)	93.1	22.146	(202)	109.6
1984	528,702	(2,379)	222.2	211,520	(3,114)	67.9	75,775	(995)	76.2	15,577	(197)	79.1
1985	240,855	(885)	272.2	146,150	(1,578)	92.6	60,004	(567)	105.8	8,203	(42)	195.3
1986	404,093	(1,773)	227.9	182,760	(1,828)	100.0	87,450	(882)	99.2	48,897	(186)	262.9
1987	393,777	(1,546)	254.7	120,870	(841)	143.7	388,113	(3,136)	123.8	95,365	(291)	327.7
1988	235,357	(1,370)	171.8	75,572	(701)	107.8	252,615	(2,968)	85.1	64,632	(243)	265.9
1989	211,646	(1,577)	134.2	-[1]	-	-	-[1]	-	-	60,236	(336)	179.3

Year	Skagerrak catch in kg (effort in fishing days)											
	Seiners			Trawl <30 GRT			Trawl >30 GRT			Gillnet		
	Catch	Effort	CPUE	Catch	Effort	CPUE	Catch	Effort	CPUE	Catch	Effort	CPUE
1983	407,230	(738)	551.8	249,099	(1,786)	139.5	190,725	(901)	211.7	4,278	(31)	138.0
1984	127,757	(2,401)	53.2	362,453	(2,780)	130.4	245,755	(1,998)	123.0	69,118	(235)	294.1
1985	749,096	(1,231)	608.5	267,474	(1,456)	183.7	338,315	(1,823)	185.6	50,118	(163)	307.5
1986	3,440,056	(5,330)	645.4	1,271,286	(3,341)	380.5	834,216	(2,259)	369.3	404,182	(945)	427.7
1987	2,373,372	(3,977)	596.8	248,672	(1,114)	223.2	360,284	(2,140)	168.8	638,297	(1,037)	615.5
1988	2,077,242	(3,856)	538.7	254.777	(1,339)	190.3	406,191	(3,961)	102.6	355,811	(911)	390.6
1989	1,437,169	(4,015)	357.9	-[1]	-	-	-[1]	-	-	90.336	(340)	265.7

[1] No data available.

Table 8.7

```
IIIa Plaice Tuning data Kattegat
103
Danish seiners fleet 1
1983,1989
1,1
1,11
10.690, 30, 824, 2771, 1266, 489, 322, 309, 222, 119,  30, 21
 9.310,  4, 765, 2527, 1651, 355, 221, 310, 387, 325, 165, 15
 5.790,  3, 612, 2351, 1890, 202,  39,  37,  54,  41,  46, 31
 6.096,  4, 204, 1205, 1404,1084, 324,  68,  33,  25,  22, 14
 4.380,  0, 230,  933, 1520, 596, 158,  41,  32,  25,  25, 21
 3.960,  1,  23,  388,  686, 466, 181,  83,  51,  24,  22,  8
 4.376,  2, 276,  596,  403, 274, 117,  54,  30,  24,  16, 11
Swedish Nephr. fleet 2
1983,1989
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
Swedish Cod fleet 3
1983,1989
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
```

Table 8.8 Plaice in the Kattegat. Results from tuning analysis.

```
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
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 3 younger ages. Fleets combined by variance of predictions
Fishing mortalities

  Age,    83,    84,    85,    86,    87,    88,    89,

    1,  .003,  .001,  .001,  .002,  .000,  .000,  .001,
    2,  .101,  .099,  .112,  .050,  .159,  .012,  .061,
    3,  .663,  .422,  .573,  .262,  .494,  .401,  .393,
    4,  .965,  .900,  .762,  .605,  .979,  .764,  .714,
    5,  .645,  .663,  .280, 1.031,  .883,  .870,  .608,
    6,  .459,  .569,  .153,  .710,  .581,  .676,  .427,
    7,  .398,  .898,  .194,  .331,  .244,  .637,  .341,
    8,  .363, 1.041,  .421,  .210,  .366,  .497,  .391,
    9,  .330, 1.131,  .313,  .277,  .344,  .464,  .369,
   10,  .771,  .856,  .531,  .218,  .734,  .515,  .528,
   11,  .488, 1.010,  .422,  .235,  .481,  .492,  .429,

Log catchability estimates

 Age  1
 Fleet,    83,    84,    85,    86,    87,    88,    89
_______,______,______,______,______,______,______,______
     1 , -8.62,-10.37, -9.74, -8.93,-11.79,-10.91, -9.84
     2 ,-12.39,-14.17,-13.79,-13.33,-13.68,-14.18,-13.62
     3 ,-11.39,-14.50,-13.87,-13.12,-13.37,-13.96,-13.48
```

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised, F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-10.03	1.179	.0002	.0005,	.000E+00,	.000E+00,	-10.030,	.417
2	-13.59	.652,	.0000	.0006,	.000E+00,	.000E+00,	-13.595,	.231
3	-13.38	1.057,	.0000	.0006,	.000E+00,	.000E+00,	-13.383,	.374

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.001	.502	.654E-01	.502	.017

cont'd.

Table 8.8 cont'd.

Age 2

Fleet,	83,	84,	85,	86,	87,	88,	89
1	-5.26	-5.10	-4.71	-5.45	-4.37	-6.84	-5.26
2	-9.17	-8.91	-8.25	-9.87	-8.48	-10.94	-9.31
3	-8.14	-8.47	-8.07	-9.25	-7.87	-10.32	-8.68

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-5.28	.834	.0222	.0594	.000E+00	.000E+00	-5.284	.295
2	-9.27	.974	.0018	.0629	.000E+00	.000E+00	-9.273	.344
3	-8.69	.912	.0028	.0607	.000E+00	.000E+00	-8.685	.322

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.061	.520	.165E-01	.520	.001

Age 3

Fleet,	83,	84,	85,	86,	87,	88,	89
1	-3.38	-3.65	-3.08	-3.80	-3.24	-3.38	-3.39
2	-7.27	-7.46	-6.61	-8.20	-7.33	-7.36	-7.45
3	-6.26	-7.02	-6.44	-7.60	-6.77	-6.72	-6.82

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.42	.257	.1437	.3841	.000E+00	.000E+00	-3.416	.091
2	-7.38	.496	.0119	.4200	.000E+00	.000E+00	-7.382	.175
3	-6.80	.462	.0183	.4001	.000E+00	.000E+00	-6.805	.163

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.393	.205	.240E-01	.205	.014

cont'd.

Table 8.8 cont'd.

Age 4

Fleet	83	84	85	86	87	88	89
1	-3.00	-2.89	-2.79	-2.96	-2.56	-2.73	-2.80
2	-6.90	-6.70	-6.33	-7.36	-6.65	-6.72	-6.87
3	-5.89	-6.27	-6.15	-6.77	-6.08	-6.07	-6.22

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-2.82	.161	.2610	.6996	.000E+00	.000E+00	-2.819	.057
2	-6.79	.335	.0214	.7716	.000E+00	.000E+00	-6.790	.119
3	-6.21	.296	.0334	.7212	.000E+00	.000E+00	-6.205	.105

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.714	.130	.245E-01	.130	.035

Age 5

Fleet	83	84	85	86	87	88	89
1	-3.41	-3.20	-3.79	-2.42	-2.66	-2.60	-2.96
2	-7.33	-6.99	-7.31	-6.83	-6.74	-6.60	-7.00
3	-6.29	-6.57	-7.15	-6.23	-6.19	-5.94	-6.37

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.01	.523	.2166	.5786	.000E+00	.000E+00	-3.006	.185
2	-6.97	.293	.0179	.6238	.000E+00	.000E+00	-6.971	.104
3	-6.39	.413	.0277	.5965	.000E+00	.000E+00	-6.392	.146

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.608	.217	.211E-01	.217	.009

cont'd.

Table 8.8 cont'd.

Age 6

Fleet,	83,	84,	85,	86,	87,	88,	89
1	-3.74	-3.35	-4.40	-2.80	-3.08	-2.86	-3.31
2	-7.59	-7.16	-8.02	-7.21	-7.19	-6.82	-7.35
3	-6.63	-6.75	-7.70	-6.59	-6.59	-6.20	-6.76

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.36	.599	.1515	.4054	.000E+00	.000E+00	-3.363	.212
2	-7.33	.406	.0124	.4326	.000E+00	.000E+00	-7.334	.143
3	-6.74	.491	.0195	.4352	.000E+00	.000E+00	-6.745	.174

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.427	.277	.196E-01	.277	.005

Age 7

Fleet,	83,	84,	85,	86,	87,	88,	89
1	-3.89	-2.89	-4.16	-3.56	-3.93	-2.92	-3.54
2	-7.79	-6.73	-7.73	-8.09	-8.15	-6.92	-7.61
3	-6.76	-6.27	-7.59	-7.36	-7.44	-6.21	-6.91

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.56	.529	.1248	.3351	.000E+00	.000E+00	-3.557	.187
2	-7.57	.587	.0098	.3548	.000E+00	.000E+00	-7.574	.207
3	-6.93	.595	.0161	.3337	.000E+00	.000E+00	-6.934	.210

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.341	.328	.194E-01	.328	.003

cont'd.

Table 8.8 cont'd.

Age 8

Fleet	83	84	85	86	87	88	89
1	-3.98	-2.75	-3.38	-4.03	-3.54	-3.16	-3.41
2	-7.96	-6.57	-6.92	-8.24	-7.50	-7.14	-7.59
3	-6.87	-6.13	-6.71	-8.02	-6.98	-6.45	-6.75

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.46	.479	.1373	.3708	.000E+00	.000E+00	-3.462	.169
2	-7.42	.624	.0115	.4648	.000E+00	.000E+00	-7.415	.221
3	-6.84	.633	.0176	.3573	.000E+00	.000E+00	-6.843	.224

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.390	.326	.762E-01	.326	.055

Age 9

Fleet	83	84	85	86	87	88	89
1	-4.07	-2.66	-3.69	-3.74	-3.60	-3.21	-3.47
2	-7.83	-6.48	-7.14	-8.37	-7.61	-7.36	-7.43
3	-6.96	-6.05	-7.04	-7.46	-7.02	-6.44	-6.88

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.49	.482	.1329	.3600	.000E+00	.000E+00	-3.494	.170
2	-7.46	.625	.0110	.3568	.000E+00	.000E+00	-7.459	.221
3	-6.84	.486	.0178	.3850	.000E+00	.000E+00	-6.836	.172

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.369	.300	.243E-01	.300	.007

cont'd.

Table 8.8 cont'd.

Age 10

Fleet	83	84	85	86	87	88	89
1	-3.23	-2.94	-3.17	-4.00	-2.83	-3.11	-3.13
2	-7.00	-6.78	-6.73	-8.49	-6.83	-7.17	-7.37
3	-5.99	-6.29	-6.47	-7.59	-6.24	-6.54	-6.54

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.20	.404	.1784	.4906	.000E+00	.000E+00	-3.200	.143
2	-7.20	.659	.0143	.6291	.000E+00	.000E+00	-7.195	.233
3	-6.52	.542	.0243	.5347	.000E+00	.000E+00	-6.523	.192

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.528	.291	.663E-01	.291	.052

Table 8.9 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	.062	.001	.002	.000	.000	.000	.005
2	.073	.020	.092	.018	.079	.193	.161	.184	.113	.074	.006	.060
3	.726	.369	.258	.271	1.015	.634	.888	.607	.373	.365	.282	.345
4	1.131	.937	.418	1.034	1.338	.819	.870	.904	.308	.540	1.108	1.024
5	.701	.979	.721	1.740	1.114	.801	.884	.617	.943	.708	1.349	1.030
6	.399	.470	.617	1.179	.529	.709	.585	.577	.496	.714	.666	.979
7	.332	.231	.832	.626	.312	.437	.649	.449	.402	.477	.344	.746
8	.289	.303	.435	.545	.401	.452	.497	.649	.370	.748	.156	.236
9	.329	.484	.657	.768	.412	.095	.546	.392	.290	.695	.248	.324
10	.427	.848	.941	1.264	.372	.073	.581	1.311	.303	.805	.192	.381
11	.348	.545	.678	.859	.395	.207	.541	.784	.321	.749	.198	.314
12+	.348	.545	.678	.859	.395	.207	.541	.784	.321	.749	.198	.314
(3- 9)U	.558	.539	.563	.880	.731	.564	.703	.599	.455	.607	.593	.669

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1986-88
1	.000	.000	.001	.003	.001	.001	.002	.000	.000	.001	.001
2	.043	.032	.047	.101	.099	.112	.050	.159	.012	.061	.074
3	.257	.341	.281	.663	.422	.573	.262	.494	.401	.393	.385
4	.700	.772	.674	.965	.901	.762	.605	.979	.764	.714	.783
5	.941	.691	.742	.645	.663	.280	1.031	.883	.870	.608	.928
6	.860	.418	.429	.459	.569	.153	.710	.580	.677	.427	.656
7	.772	.318	.232	.398	.898	.194	.331	.244	.636	.341	.404
8	.414	.700	.170	.363	1.041	.421	.210	.366	.497	.390	.358
9	.439	.629	.448	.330	1.131	.313	.277	.344	.464	.369	.362
10	.367	.574	.187	.771	.856	.531	.218	.734	.515	.528	.489
11	.407	.636	.269	.488	1.010	.422	.235	.481	.492	.429	.403
12+	.407	.636	.269	.488	1.010	.422	.235	.481	.492	.429	.403
(3- 9)U	.626	.553	.425	.546	.804	.385	.489	.556	.616	.463	

Table 8.10 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	67963	48448	44296	17154	56780	25704	54520	94441	54319	28569	17111	8430
2	56798	61495	43837	40080	15521	51376	21861	49285	85321	49141	25840	15482
3	41139	47791	54521	36188	35619	12980	38332	16837	37113	68978	41300	23242
4	16246	18018	29906	38108	24974	11682	6230	14267	8300	23130	43312	28182
5	4729	4742	6387	17812	12260	5930	4658	2361	5227	5518	12192	12937
6	2516	2123	1612	2811	2828	3640	2409	1742	1153	1842	2460	2863
7	1853	1528	1201	787	783	1508	1620	1215	885	635	816	1144
8	1086	1202	1098	473	381	518	881	766	701	536	357	523
9	673	736	803	643	248	231	299	485	362	438	229	276
10	211	438	410	377	270	149	190	157	297	245	198	162
11	4	124	170	145	96	168	125	96	38	198	99	148
12+	178	249	297	72	193	168	351	19	50	376	234	62
TOTAL NO	193394	186895	184538	154650	149952	114054	131476	181671	193766	179607	144149	93450
SPS NO	68634	76952	96405	97416	77651	36974	55095	37945	54126	101897	101197	69539
TOT.BIOM	46985	47210	47678	42505	37322	29209	32072	40676	46635	46941	36816	24559
SPS BIOM	21221	23740	29230	29747	23558	12201	17164	12078	16342	29972	27450	20141

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	7147	13889	18125	16406	14356	9275	5235	6349	14479	5257	0
2	7593	6466	12565	16381	14793	12984	8387	4729	5745	13098	4752
3	13192	6584	5669	10848	13402	12118	10499	7217	3649	5134	11151
4	14901	9228	4235	3872	5061	7950	6184	7314	3986	2211	3136
5	9159	6696	3858	1954	1335	1861	3356	3055	2487	1680	980
6	4178	3235	3036	1662	928	623	1272	1083	1143	943	828
7	973	1599	1926	1789	950	475	484	566	549	526	557
8	491	407	1052	1382	1087	350	354	314	401	263	338
9	374	293	183	803	870	347	208	259	197	221	161
10	181	218	142	106	522	254	230	143	166	112	138
11	100	113	111	106	44	201	135	167	62	90	60
12+	53	87	40	192	115	216	110	164	170	255	203
TOTAL NO	58341	48815	50942	55501	53464	46653	36453	31361	33034	29790	
SPS NO	43602	28460	20252	22715	24314	24394	22831	20283	12810	11435	
TOT.BIOM	16631	13964	16373	17033	15366	14044	10999	10958	10186	9376	
SPS BIOM	13776	9977	8268	7853	7747	8027	7695	7708	4736	4282	

Table 8.11 Petersen young fish trawl indices for 1-group plaice in the Kattegat.

Year class	Beam trawl	Petersen young fish trawl	VPA 1-group
1960	-	5.80	-
1961	-	1.87	-
1962	-	7.92	-
1963	-	10.42	-
1964	-	16.22	-
1965	-	45.38	-
1966	-	-	-
1967	-	34.39	67,963
1968	-	26.38	48,448
1969	-	19.37	44,296
1970	-	22.56	17,155
1971	-	73.60	56,780
1972	-	59.10	25,704
1973	-	-	54,519
1974	-	-	94,440
1975	-	-	54,320
1976	-	-	28,568
1977	-	-	17,111
1978	-	-	8,430
1979	-	5.72	7,147
1980	3.6	-	13,889
1981	5.9	-	18,124
1982	23.8	-	16,406
1983	2.2	3.22	14,355
1984	2.55	10.23	9,275
1985	4.41	13.14	5,235
1986	1.29	4.79	6,347
1987	1.55	1.93	1,800[1]
1988	-	4.56	4,000[1]

[1] Predicted, no data available.

Table 8.12 Input table to the prediction.
List of input variables for the ICES prediction program.

PLAICE IN THE KATTEGAT
The reference F is the mean F for the age group range from 3 to 9

The number of recruits per year is as follows:

Year	Recruitment
1990	11400.0
1991	11400.0
1992	11400.0

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: thousand
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	11400.0	.00	.10	.00	.267	.267
2	3655.0	.13	.10	.00	.281	.281
3	1466.0	.39	.10	1.00	.292	.292
4	3136.0	.71	.10	1.00	.321	.321
5	980.0	.68	.10	1.00	.373	.373
6	828.0	.47	.10	1.00	.472	.472
7	557.0	.32	.10	1.00	.560	.560
8	338.0	.35	.10	1.00	.709	.709
9	161.0	.33	.10	1.00	.814	.814
10	138.0	.47	.10	1.00	.916	.916
11	60.0	.38	.10	1.00	1.032	1.032
12+	203.0	.38	.10	1.00	.993	.993

Table .8.13

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

PLAICE IN THE KATTEGAT

Year 1990					Year 1991					Year 1992	
fac-tor	ref. F	stock biomass	sp.stock biomass	catch	fac-tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.46	7334	3264	1363	.0	.00	8846	2904	0	11701	5758
					.1	.05		2904	162	11526	5583
					.2	.09		2904	317	11358	5416
					.4	.19		2904	609	11044	5102
					.6	.28		2904	878	10756	4813
					.8	.37		2904	1126	10490	4548
					1.0	.46		2904	1356	10245	4303
					1.2	.56		2904	1569	10019	4077
					1.4	.65		2904	1767	9810	3868
					1.6	.74		2904	1952	9616	3674
					1.8	.84		2904	2123	9437	3494
					2.0	.93		2904	2283	9270	3327

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 1992 has been calculated with the same fishing mortality as for 1991.
The reference F is the mean F for the age group range from 3 to 9

Table 9.1 PLAICE landings from the Skagerrak (tonnes) as supplied by Working Group members.

Year	Denmark	Sweden	Netherlands	Belgium	Norway	Total
1972	5,095	70	-	-	-	5,165
1973	3,871	80	-	-	-	3,951
1974	3,429	70	-	-	-	3,499
1975	4,888	77	-	-	-	4,965
1976	9,251	81	-	-	-	9,332
1977	12,855	142	-	-	-	12,997
1978	13,383	94	-	-	-	13,477
1979	11,045	105	-	-	-	11,150
1980	9,514	92	-	-	-	9,606
1981	8,115	123	-	-	-	8,238
1982	7,789	140	-	-	-	7,929
1983	6,828	170	594	133	14	7,739
1984	7,560	356	1,580	27	22	9,545
1985	9,646	296	2,225	136	18	12,321
1986	10,653	215	4,024	505	24	15,421
1987	11,370	222	2,209	907	25	14,728
1988	9,781	281	2,087	716	41	12,906
1989[1]	5,414	311	-	200	33	5,958

[1] Preliminary.

Table 9.2 Danish landings of PLAICE by quarters in the Kattegat and the Skagerrak as supplied by Working Group members.

Quarter	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
						Skagerrak					
Jan-Mar	967	1,042	751	849	895	964	919	1,131	688	1,423	817
Apr-Jun	5,097	3,325	3,036	3,084	2,729	2,675	2,944	2,779	3,649	3,938	2,104
Jul-Sep	2,963	3,381	2,239	2,583	1,941	2,461	3,511	3,157	3,696	2,874	1,715
Oct-Dec	2,018	1,766	2,089	1,273	1,263	1,460	2,842	3,586	3,332	1,552	778
Total	11,045	9,514	8,115	7,929	6,828	7,560	9,646	10,653	11,365	9,787	5,414

Table 9.3 VIRTUAL POPULATION ANALYSIS

PLAICE IN THE SKAGERRAK (PART OF FISHING AREA IIIA)

CATCH IN NUMBERS UNIT: thousands

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	356	246	62	2212	4	87	1024	179	5	20	40	307
3	6443	3327	1937	8354	842	6192	10207	4803	2939	2242	2373	2341
4	12771	12331	9242	7800	7667	8053	11657	22545	16708	10924	12452	6252
5	16928	12828	7272	3269	9184	8959	4784	7317	24263	20156	15390	5739
6	7090	5933	3748	1003	4814	2643	1997	2053	5806	12112	7852	2495
7	410	1939	1902	346	1561	493	441	787	743	2449	3103	1071
8	16	65	794	80	638	189	90	195	282	360	991	485
9	17	2	77	28	253	66	31	146	111	206	314	201
10	16	1	1	6	95	33	15	91	107	77	92	95
11+	5	1	1	0	16	2	12	33	47	68	91	122
TOTAL	44052	36673	25036	23098	25074	26717	30258	38149	51011	48614	42698	19108

Table 9.4 VIRTUAL POPULATION ANALYSIS

PLAICE IN THE SKAGERRAK (PART OF FISHING AREA IIIA)

MEAN WEIGHT AT AGE OF THE STOCK UNIT: kilogram

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
2	.238	.228	.253	.220	.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

Table 9.5

```
IIIa Plaice Tuning data Skagerrak
103
Danish seiners fleet 1
1983,1989
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
Swedish Nephr. fleet 2
1983,1989
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
Swedish Cod fleet 3
1983,1989
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
```

Table 9.6 Summary statistics. Plaice in the Skagerrak.

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
FLEETS COMBINED BY ** VARIANCE **

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

Age,	85,	86,	87,	88,	89,
2,	.004,	.000,	.001,	.001,	.000,
3,	.078,	.067,	.053,	.071,	.041,
4,	.381,	.374,	.331,	.402,	.242,
5,	.475,	.797,	.923,	.937,	.291,
6,	.648,	.760,	1.109,	1.058,	.328,
7,	.680,	.454,	.757,	.860,	.336,
8,	.466,	.488,	.368,	.707,	.270,
9,	.381,	.468,	.707,	.560,	.263,
10,	.509,	.470,	.611,	.709,	.289,

Log catchability estimates

Age 2 Fleet,	85,	86,	87,	88,	89
1 ,	-8.90,	-11.87,	-10.77,	-10.52,	-10.43
2 ,	-13.81,	-16.94,	-17.05,	-15.99,	-15.76
3 ,	-13.51,	-15.12,	-15.12,	-15.57,	-14.93

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-10.50 ,	1.162,	.0003 ,	.0005,	.000E+00,	.000E+00,	-10.499,	.475
2 ,	-15.91 ,	1.428,	.0000 ,	.0004,	.000E+00,	.000E+00,	-15.909,	.583
3 ,	-14.85 ,	.859,	.0000 ,	.0005,	.000E+00,	.000E+00,	-14.854,	.351

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.000	.622	.667E-01	.622	.012

cont'd.

Table 9.6 cont'd.

Age 3

Fleet,	85,	86,	87,	88,	89
1	-5.80	-5.88	-6.15	-5.82	-6.00
2	-10.84	-11.75	-12.22	-11.81	-11.28
3	-10.71	-11.35	-11.68	-11.37	-10.68

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-5.93	.159	.0264	.0443	.000E+00	.000E+00	-5.929	.065
2	-11.58	.582	.0010	.0308	.000E+00	.000E+00	-11.579	.238
3	-11.16	.483	.0002	.0257	.000E+00	.000E+00	-11.157	.197

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.041	.146	.123	.146	.702

Age 4

Fleet,	85,	86,	87,	88,	89
1	-4.22	-4.16	-4.31	-4.09	-4.23
2	-9.25	-10.03	-10.37	-10.09	-9.51
3	-9.12	-9.56	-10.08	-9.63	-8.89

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-4.20	.092	.1489	.2495	.000E+00	.000E+00	-4.200	.038
2	-9.85	.500	.0058	.1725	.000E+00	.000E+00	-9.852	.204
3	-9.46	.508	.0011	.1376	.000E+00	.000E+00	-9.456	.207

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.242	.890E-01	.845E-01	.890E-01	.901

Age 5

Fleet,	85,	86,	87,	88,	89
1	-4.00	-3.40	-3.29	-3.24	-4.05
2	-9.03	-9.28	-9.35	-9.24	-9.33
3	-8.89	-8.82	-9.03	-8.78	-8.70

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.59	.433	.2729	.4574	.000E+00	.000E+00	-3.594	.177
2	-9.24	.139	.0107	.3159	.000E+00	.000E+00	-9.245	.057
3	-8.84	.135	.0021	.2525	.000E+00	.000E+00	-8.844	.055

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.288	.947E-01	.106	.106	1.265

cont'd.

Table 9.6 cont'd.

Age 6

Fleet,	85,	86,	87,	88,	89
1 ,	-3.69,	-3.45,	-3.10,	-3.12,	-3.93
2 ,	-8.71,	-9.33,	-9.17,	-9.12,	-9.20
3 ,	-8.55,	-8.84,	-8.87,	-8.68,	-8.58

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-3.46 ,	.392,	.3133 ,	.5249,	.000E+00,	.000E+00,	-3.456,	.160
2 ,	-9.11 ,	.256,	.0123 ,	.3617,	.000E+00,	.000E+00,	-9.107,	.104
3 ,	-8.70 ,	.160,	.0024 ,	.2895,	.000E+00,	.000E+00,	-8.701,	.065

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.326	.128	.134	.134	1.096

Age 7

Fleet,	85,	86,	87,	88,	89
1 ,	-3.64,	-3.96,	-3.48,	-3.33,	-3.90
2 ,	-8.65,	-9.87,	-9.54,	-9.33,	-9.19
3 ,	-8.64,	-9.44,	-9.26,	-8.89,	-8.55

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-3.66 ,	.297,	.2547 ,	.4269,	.000E+00,	.000E+00,	-3.663,	.121
2 ,	-9.32 ,	.495,	.0100 ,	.2972,	.000E+00,	.000E+00,	-9.317,	.202
3 ,	-8.96 ,	.420,	.0019 ,	.2245,	.000E+00,	.000E+00,	-8.957,	.171

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.335	.218	.197	.218	.818

Age 8

Fleet,	85,	86,	87,	88,	89
1 ,	-4.02,	-3.89,	-4.21,	-3.52,	-4.12
2 ,	-9.02,	-9.81,	-10.17,	-9.53,	-9.43
3 ,	-8.72,	-9.09,	-9.85,	-9.05,	-8.79

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-3.95 ,	.293,	.1910 ,	.3194,	.000E+00,	.000E+00,	-3.951,	.119
2 ,	-9.59 ,	.471,	.0076 ,	.2301,	.000E+00,	.000E+00,	-9.591,	.192
3 ,	-9.10 ,	.493,	.0016 ,	.1981,	.000E+00,	.000E+00,	-9.101,	.201

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.270	.222	.144	.222	.419

cont'd.

Table 9.6

Age 9

Fleet	85	86	87	88	89
1	-4.23	-3.91	-3.55	-3.76	-4.15
2	-9.22	-10.02	-9.47	-9.87	-9.40
3	-8.63	-9.81	-10.25	-9.23	-8.63

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-3.92	.303	.1971	.3301	.000E+00	.000E+00	-3.920	.124
2	-9.59	.368	.0076	.2172	.000E+00	.000E+00	-9.595	.15
3	-9.31	.786	.0013	.1331	.000E+00	.000E+00	-9.311	.321

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.262	.224	.200	.224	.793

Table 9.7 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	.013	.008	.002	.090	.000	.001	.014	.004	.000	.001	.001	.000
3	.215	.139	.075	.295	.040	.157	.122	.078	.066	.052	.071	.041
4	.488	.703	.609	.426	.426	.568	.435	.381	.374	.331	.400	.242
5	1.025	1.188	1.087	.398	1.164	1.147	.696	.475	.797	.923	.935	.288
6	1.140	1.175	1.332	.359	1.555	1.204	.757	.648	.760	1.109	1.057	.326
7	1.101	1.032	1.566	.338	1.334	.555	.567	.680	.454	.757	.859	.335
8	1.651	.436	1.677	.196	1.666	.473	.163	.466	.488	.368	.706	.270
9	2.226	.880	1.243	.188	1.386	.682	.116	.381	.468	.707	.560	.262
10	1.659	.783	1.495	.241	1.464	.571	.283	.509	.470	.611	.709	.289
11+	1.659	.783	1.495	.241	1.464	.571	.283	.509	.470	.611	.709	.289
(3- 9)U	1.121	.793	1.084	.314	1.082	.684	.408	.444	.487	.607	.655	.252

Table 9.8 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	30106	31248	37999	27049	49419	103046	75109	53259	50974	40012	67403	662498
3	34953	26902	28041	34324	22373	44712	93157	66988	48021	46118	36186	60951
4	34586	25511	21183	23532	23134	19444	34577	74597	56049	40658	39598	30487
5	27512	19201	11427	10423	13902	13668	9972	20243	46129	34878	26430	24029
6	10851	8932	5294	3486	6333	3929	3928	4501	11387	18820	12539	9393
7	640	3140	2495	1264	2203	1210	1066	1667	2131	4817	5616	3944
8	21	193	1013	471	816	525	628	548	764	1224	2044	2152
9	20	4	113	171	351	140	296	483	311	424	766	913
10	20	2	1	29	128	79	64	239	299	176	189	396
11+	6	2	1	0	22	5	51	87	131	156	187	509
TOTAL NO	138715	115135	107565	100750	118681	186758	218850	222610	216195	187284	190960	795272
SPS NO	108609	83887	69566	73701	69262	83712	143741	169351	165221	147271	123557	132775
TOT.BIOM	40155	31018	32613	28284	33738	53938	64339	64654	69742	52175	50814	181800
SPS BIOM	32990	23894	22999	22334	21235	25291	44735	53363	49607	43973	35985	38700

	1990
2	0
3	599161
4	52925
5	21653
6	16299
7	6134
8	2553
9	1487
10	635
11+	613

Table 10.1 Catches (tonnes) of SOLE from Division IIIa. Data from Bulletin Statistique.

Year	Denmark	Sweden	Fed.Rep.of Germany	Netherlands	Belgium	Others	Total
1952	156	51	59	-	-	-	266
1953	159	48	42	-	-	-	249
1954	177	43	34	-	-	-	254
1955	152	36	35	-	-	-	223
1956	168	30	57	-	-	-	255
1957	265	29	53	-	-	-	347
1958	226	35	56	-	-	-	317
1959	222	30	44	-	-	-	296
1960	294	24	83	-	-	-	401
1961	339	30	61	-	-	-	430
1962	356	-	58	-	-	-	414
1963	338	-	27	-	-	-	365
1964	376	-	45	-	-	-	421
1965	324	-	50	-	-	-	374
1966	312	-	20	-	-	-	332
1967	429	-	26	-	-	-	455
1968	290	-	16	-	-	11	317
1969	261	-	7	-	-	-	268
1970	183	-	-	-	-	-	183
1971	288	-	9	-	-	-	297
1972	376	-	12	-	-	-	388
1973	327	-	13	-	-	-	340
1974	449	-	9	-	-	-	458
1975	458	16	16	9	-	-	498
1976	422	11	21	155	2	-	611
1977	517	13	8	276	1	-	815
1978	502	9	9	141	-	-	661
1979	376	8	6	84	1	-	475
1980	316	9	12	5	2	-	344
1981	271	7	16	-	1	-	295
1982	210	4	8	1	1	-	224
1983	262	11	15	31	-	-	319
1984	326	13	13	54	-	-	406
1985	396	19	1	132	+	-	548
1986	645	26[2]	1	109	2	-	783[2]
1987	623[2]	19[2]	-	70[2]	2	-	714[2]
1988	678	24	-	78	-		652[2]
1989[1]	793	21	-	-	-		814

[1] Preliminary.
[2] Working Group estimate.

Table 10.2 SOLE in Division IIIa. Catch-at-age data (thousands).

Age	1984	1985	1986	1987	1988	1989
1	-	2	-	-	4	2
2	79	1,140	323	386	65	632
3	791	861	1,576	847	959	449
4	297	275	843	1,006	1,097	620
5	145	80	264	429	525	433
6	38	87	42	172	146	296
7	41	23	45	63	75	61
8	50	11	42	31	20	22
9	104	42	37	6	8	12
10	74	44	23	17	13	5
11	10	6	10	16	14	3
12	8	4	-	10	7	8
13	12	4	5	14	9	3
14	3	-	-	5	-	1
15	3	-	5	18	10	4
Total	1,655	2,579	3,134	3,020	2,592	2,551
Catch (t)	406	548	783	714	652	793

Table 10.3 SOLE in Division IIIa. Weight at age (grammes). Sexes combined.

Age	1984	1985	1986	1987	1988	1989
1	-	112	-	-	139	100
2	183	174	165	160	144	176
3	213	234	231	194	184	221
4	257	283	287	245	218	255
5	294	291	257	274	248	266
6	297	335	409	319	274	271
7	380	292	267	360	354	352
8	321	279	262	417	387	300
9	323	320	365	357	338	364
10	365	357	369	311	300	285
11	415	316	266	377	282	185
12	412	345	-	405	429	306
13	412	-	661	357	599	239
14	299	-	-	531	-	390
15+	-	-	463	438	350	254

Table 10.4 Danish effort and CPUE for trawl and set nets in Division IIIa.

Year	Trawl		Set nets	
	Catch/day(Kg)	Days	Catch/day)(Kg)	Days
1988	69.1	7,447	100.7	949
1989	46.8	11,963	132.8	1,194

Table 10.5 SOLE in Division IIIa. Recruitment index. Danish flatfish survey in Division IIIa.

Survey year (t)	Year class (t-1)	Recruitment index
1960	1959	4.05
1961	1960	0.18
1962	1961	0.12
1963	1962	0.85
1964	1963	0.97
1965	1964	0.49
1966	1965	0.28
1967	1966	0.43
1968	1967	0.48
1969	1968	0.55
1970	1969	2.26
1971	1970	0.41
1972	1971	1.54
1973	1972	1.96
1980	1979	3.19
1984	1983	8.19
1985	1984	18.25
1986	1985	1.73
1987	1986	2.12
1988	1987	8.17
1989	1988	9.16

Table 10.6 SOLE in Division IIIa.
Relative importance (%) of the age groups in weight.

Age	1984	1985	1986	1987	1988	1989
1	-	-	-	-	0.1	-
2	8.3	15.9	6.6	8.7	1.4	18.4
3	30.3	32.4	45.1	23.1	27.1	16.4
4	14.6	20.9	29.9	34.7	36.7	26.2
5	13.1	6.4	9.7	16.5	20.0	19.2
6	3.1	9.6	2.1	7.7	6.1	13.3
7	2.4	1.8	1.5	3.2	4.1	3.6
8	5.9	1.7	1.4	1.8	1.2	1.1
9	9.2	3.1	1.7	0.3	0.4	0.7
10	5.8	5.1	1.0	0.8	0.6	0.2
11	1.3	2.0	0.3	0.9	0.6	0.1
12+	5.9	1.0	0.7	0.6	0.5	0.8
Total	100.0	100.0	100.0	98.3	98.8	100.0

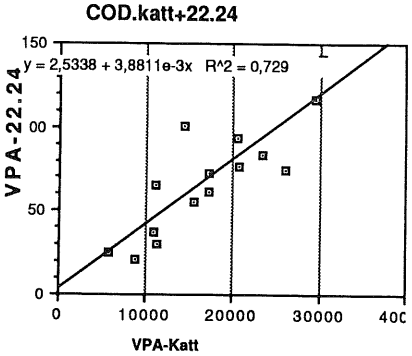
Table 10.7 Sole in Division IIIa. SHOT forecast.

Year	Land-ings	Recrt. index	W'td index	Y/B ratio	Hang-over	Act'l Prodn.	Est'd. Prodn.	Est'd. SQC	Act'l expl. biomass	Est'd. expl. biomass	Est'd. landings
1980	344	726	-	0.40	0.60	-	-	-	860	-	-
1981	295	726	726	0.40	0.60	222	-	-	738	-	-
1982	224	319	319	0.40	0.60	118	-	-	560	-	-
1983	319	726	726	0.40	0.60	462	-	-	798	-	-
1984	406	726	726	0.40	0.60	537	328	323	1,015	807	323
1985	548	726	726	0.50	0.50	690	389	399	1,096	998	499
1986	783	819	819	0.50	0.50	1,018	515	532	1,566	1,063	532
1987	714	1,825	1,825	0.50	0.50	645	1,375	1,079	1,428	2,158	1,079
1988	652	173	173	0.50	0.50	590	109	411	1,304	823	411
1989	814	212	212	0.60	0.40	922	150	401	1,357	802	481
1990	500	817	817	0.60	0.40	-	680	733	-	1,222	733
1991	-	916	916	0.60	0.40	-	762	751	-	1,251	751
1992	-	726	-	0.60	-	-	-	-	-	-	-

Running recruitment weights:

Older	0.00	G.M	0.00
Central	1.00	exp(d)	1.00
Younger	0.00	exp(d/2)	1.00

Figure 4.1 Correlations of abundance of 1 group cod in the Kattegat and Sub-divisions 22,24 as estimated from VPA and young fish survey.



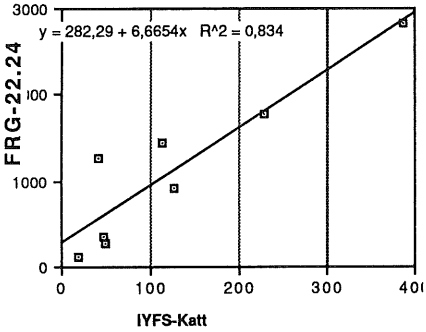
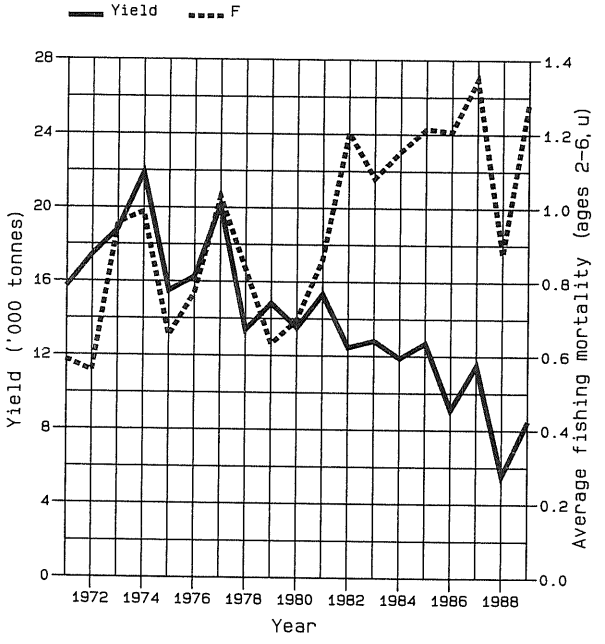


Figure 4.2

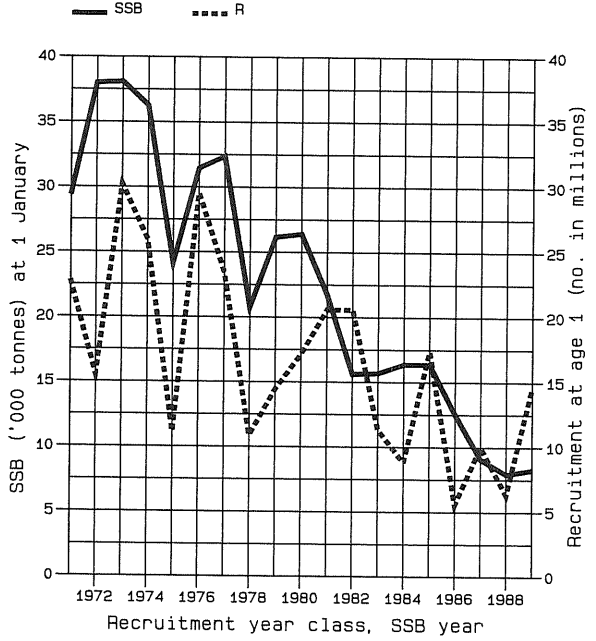
FISH STOCK SUMMARY
STOCK: Cod in the Kattegat
02-04-1990

Trends in yield and fishing mortality (F)



A

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



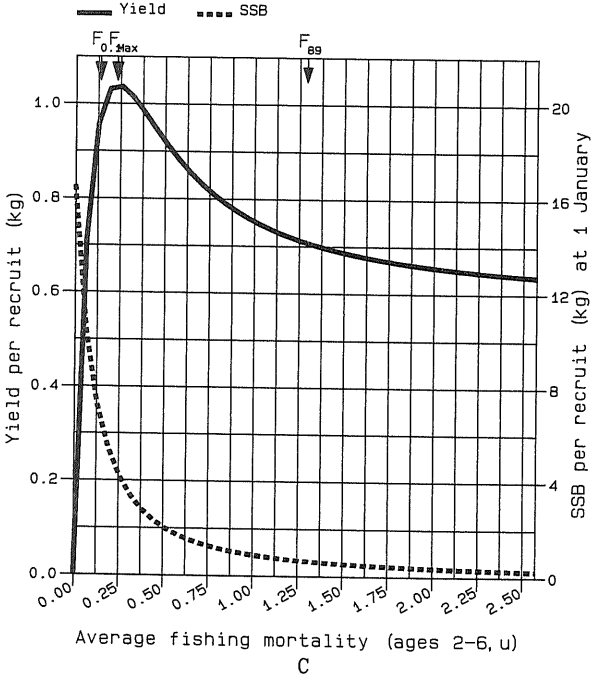
B

cont'd.

Figure 4.2 cont'd.

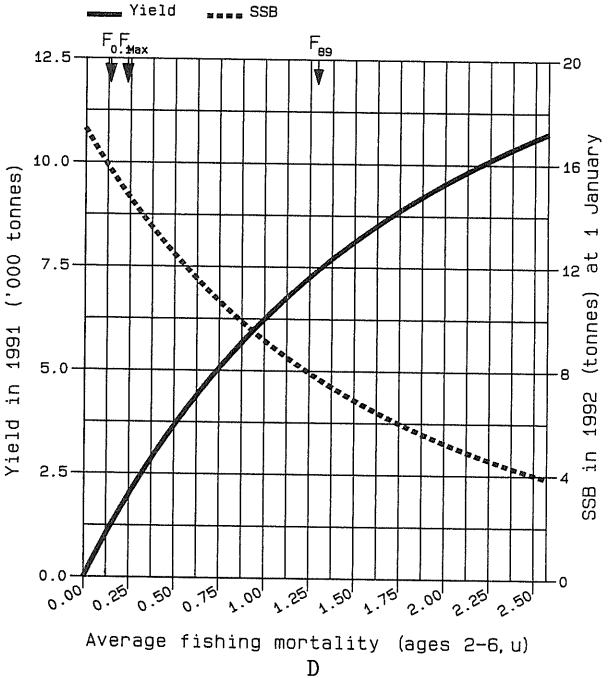
FISH STOCK SUMMARY
STOCK: Cod in the Kattegat
02-04-1990

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass

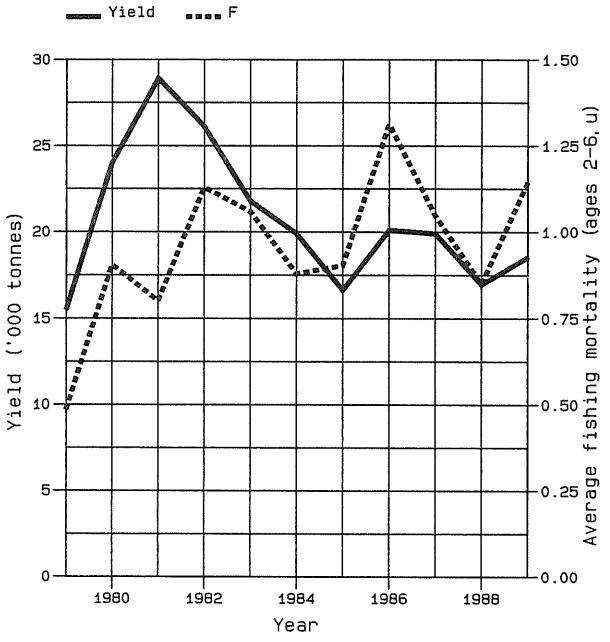


D

Figure 5.1

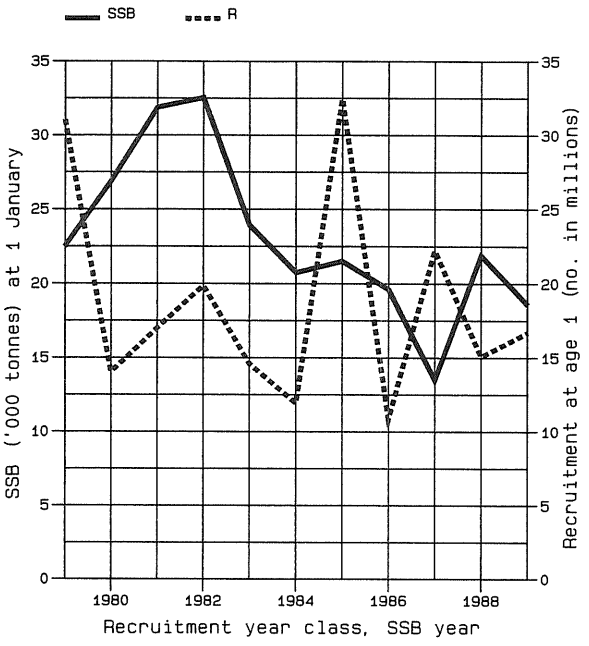
FISH STOCK SUMMARY
STOCK: Cod in the Skagerrak
02-04-1990

Trends in yield and fishing mortality (F)



A

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



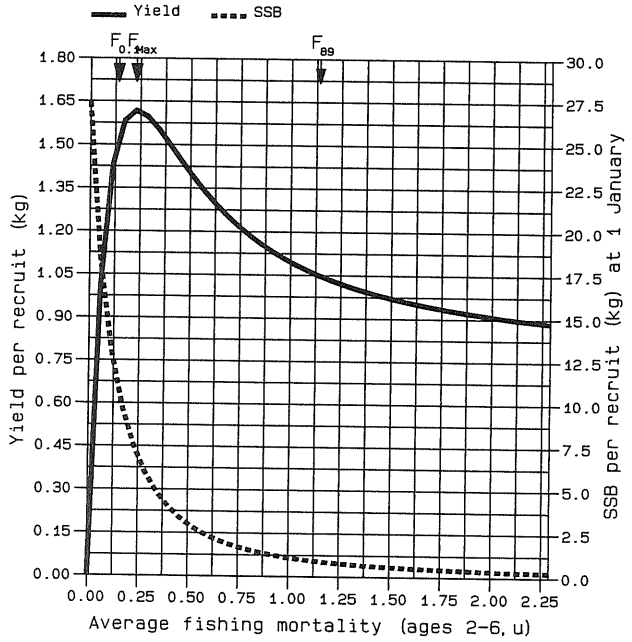
B

cont'd.

Figure 5.1 cont'd.

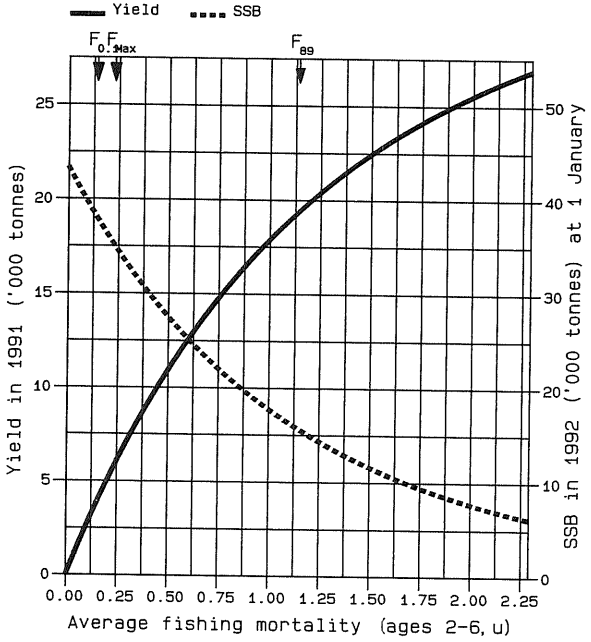
FISH STOCK SUMMARY
STOCK: Cod in the Skagerrak
02-04-1990

Long-term yield and spawning stock biomass



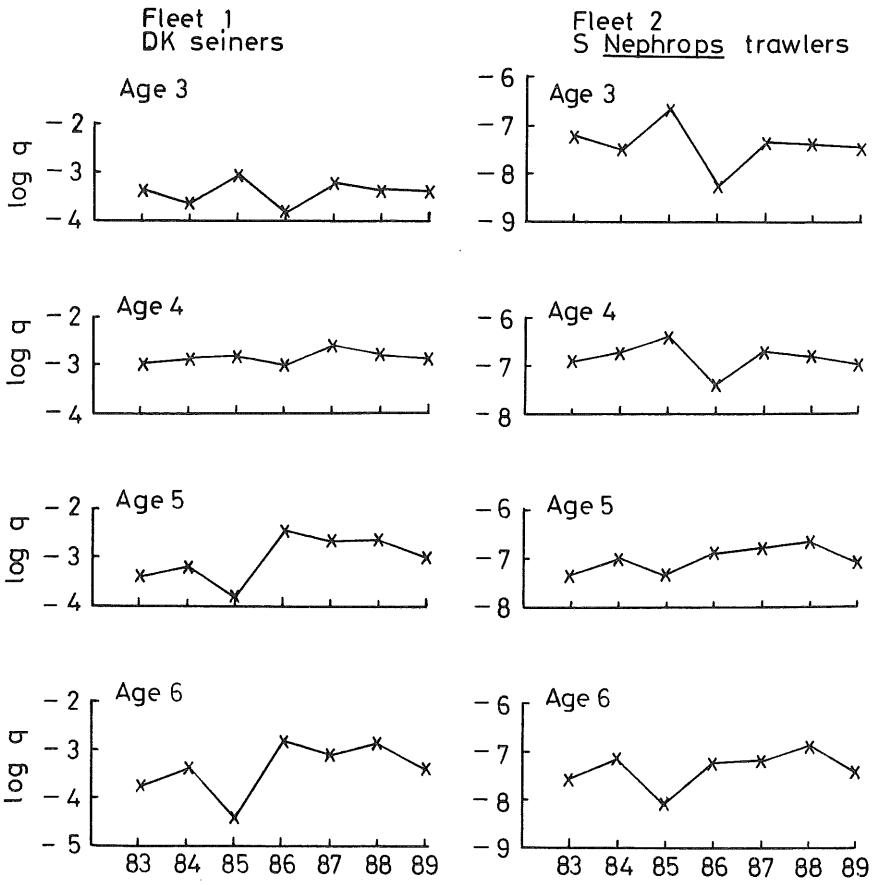
C

Short-term yield and spawning stock biomass



D

Figure 8.1 Plaice in the Kattegat. The log q values vs year for ages 3, 4, 5, and 6 for fleets 1 and 2.



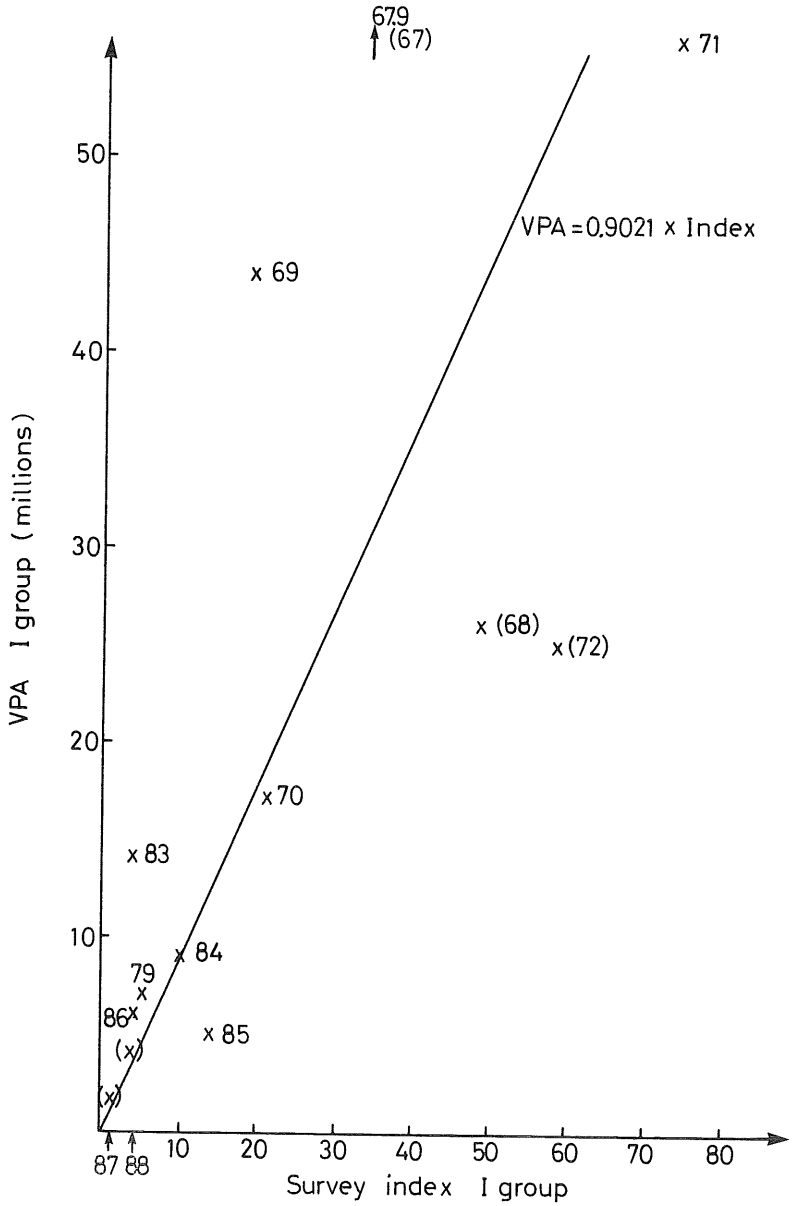
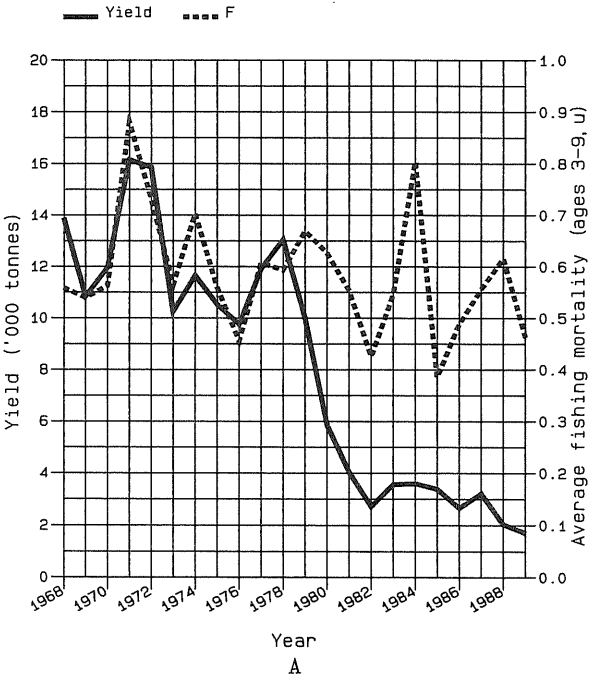


Figure 8.2 Plaice in the Kattegat. Plot of VPA 1 group vs young plaice survey index.

Figure 8.3

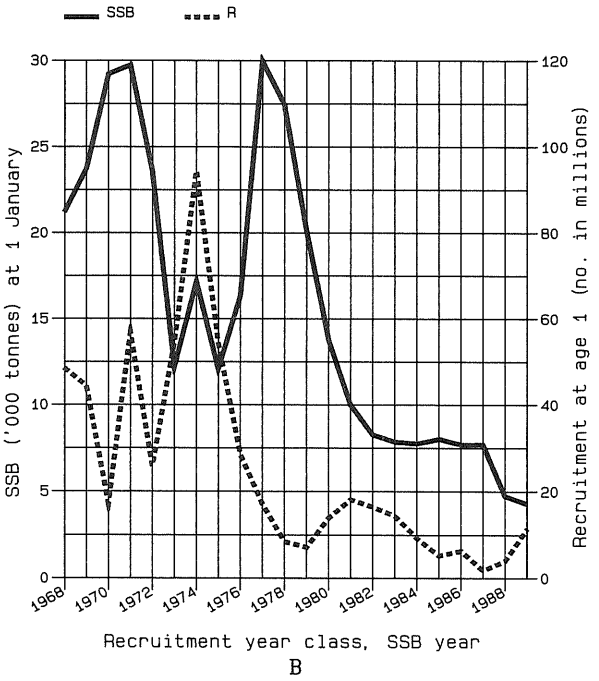
FISH STOCK SUMMARY
STOCK: Plaice in the Kattegat
02-04-1990

Trends in yield and fishing mortality (F)



A

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



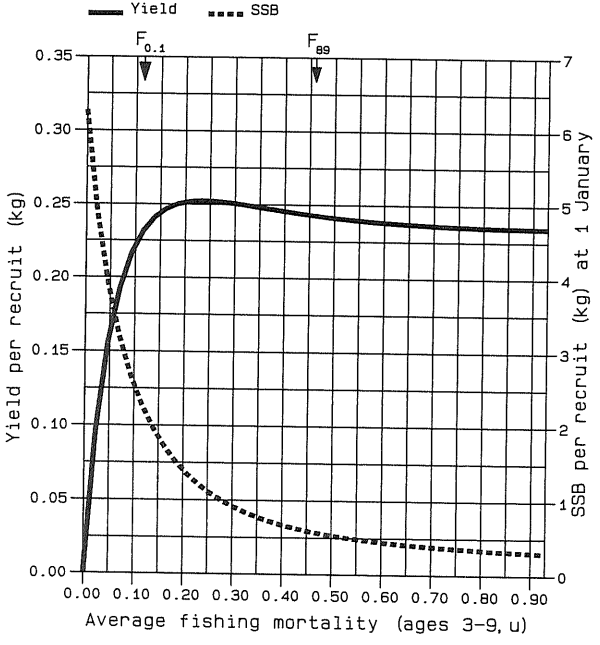
B

cont'd.

Figure 8.3 cont'd.

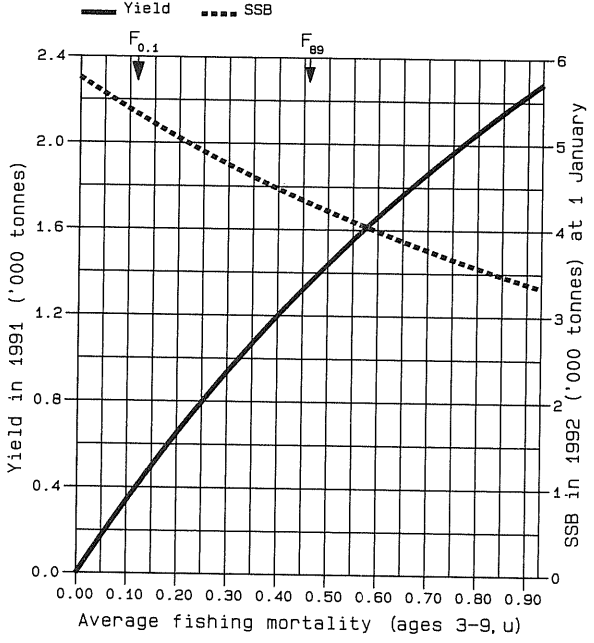
FISH STOCK SUMMARY
STOCK: Plaice in the Kattegat
02-04-1990

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

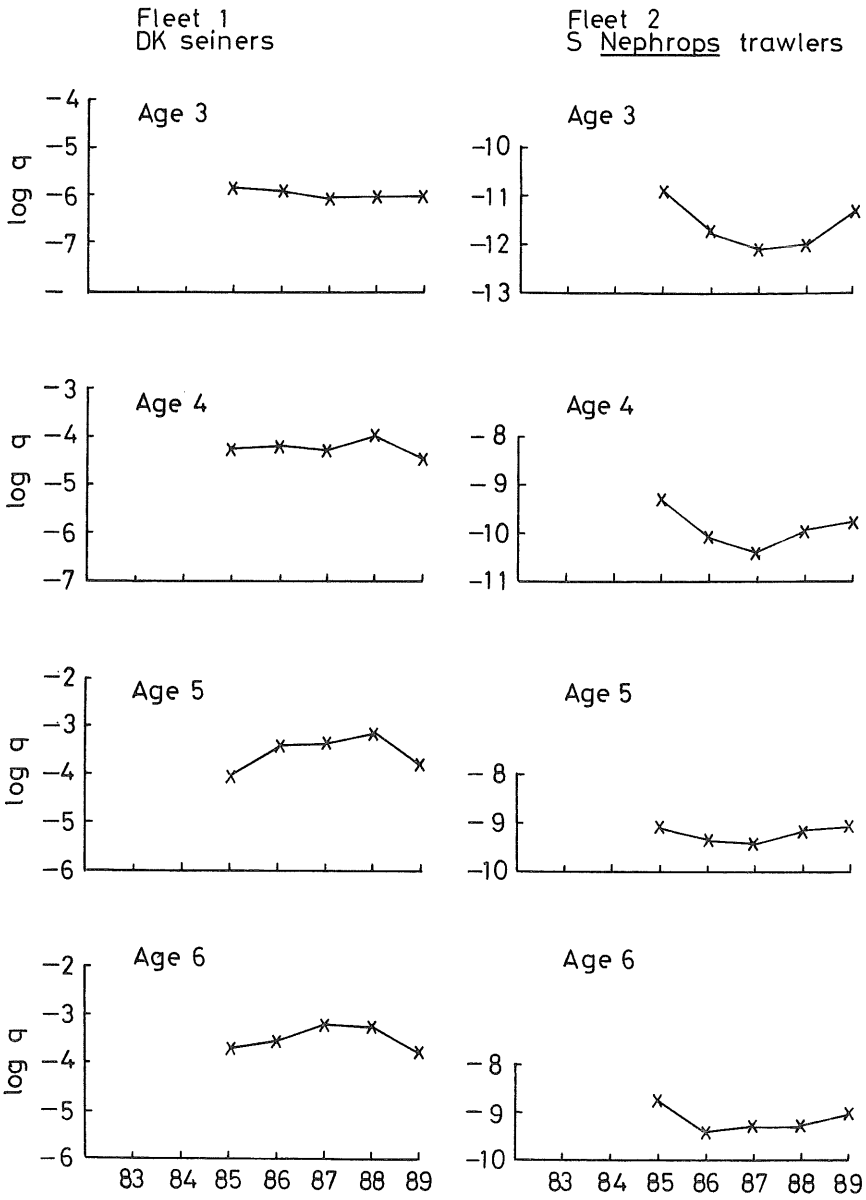


Figure 9.1 Plaice. Skagerrak. The log q values vs year for ages 3, 4, 5, and 6 for fleets 1 and 2.