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**REPORT OF THE BLUE WHITING ASSESSMENT WORKING GROUP**

Copenhagen, 21 - 27 September 1988

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## 1 INTRODUCTION

### 1.1 Terms of Reference

The Blue Whiting Assessment Working Group (Chairman: Mr T. Monstad) met at ICES Headquarters from 21-27 September 1988 (C.Res.1987/2:3:23) to:

- a) assess the status of and provide catch options for 1989 within safe biological limits for the northern and southern blue whiting stocks;
- b) update the information on zonal distribution of the stock and the fisheries of the northern blue whiting stock.

### 1.2 Participants

L. Danke	German Democratic Republic
E. Egorov	USSR
J.A. Jacobsen	Faroe Islands
H. Jakupsstovu	Faroe Islands
B. Kudrin	USSR
T. Linkowski	Poland
M. Meixide	Spain
T. Monstad (Chairman)	Norway
K.-J. Ståhr (part-time)	Denmark

## 2 STOCK IDENTITY AND STOCK SEPARATION

In previous years, it was assumed that the Porcupine Bank area is a mixing area for the northern stock, southern stock, and local populations (Anon., 1987, 1988).

During the spring 1988 acoustic survey at Porcupine Bank, the USSR and Norwegian scientists did not find any substantial differences which could suggest the existence of two different populations in the area analyzed.

The research of Karasev (1988), who studied blue whiting material from 1974-1986, used the method of parasitological indicators, and confirmed the Zilanov (1984) hypothesis on the population structure of blue whiting and showed the possibility of differentiating a northern and a southern stock on the basis of the infestation by microsporidium Myxobolus aeglefini. According to his results, blue whiting spawning on Porcupine Bank belong to the northern stock.

## 3 OTOLITH EXCHANGE PROGRAMME

In 1986, the Working Group (Anon., 1987) recommended a third otolith exchange programme to be set up as the results of previous exercises showed very great discrepancies among the readers ageing the same otolith. The idea of this new otolith exchange programme, coordinated by T. Monstad, was to support ageing results

by identification of the counted rings on photos. As the programme has just been completed, only preliminary results were available. A working note was made of the results and submitted to the Working Group (Monstad and Linkowski, 1988).

The exchanged material, Sample A from the Norwegian Sea in August and Sample B from Porcupine Bank in March, had 100 otoliths each.

The results supplied by five countries (the Faroes, Iceland, USSR, German Democratic Republic, and Norway) were compared individually and are presented in a matrix for each sample in Table 3.1. Generally the agreement in ageing was highest in Sample B. The overall age composition as well as the mean sample age and percentage agreement reached in the particular age groups were presented in Table 3.2.

High agreement among countries was obtained only for the youngest part of the population, i.e., up to age 4. This explains the high agreement in ageing of Sample B consisting mainly of ages 2-4.

Discrepancy among readers is much higher in ageing of older fish. In Sample A, consisting of 13 age groups but predominantly ages 2-3, the agreement was generally lower. An average of only 27.4% of the older fish (5 years and older) were aged properly, i.e., results overlapped.

The present results, together with results of previous otolith exchange programmes, indicate that ageing of older specimens of blue whiting by traditional methods may be questionable. An attempt to solve this problem in a non-conventional way, i.e., by using objective criteria for age determination, should be made. The Working Group agreed that such an investigation should be initiated by T. Linkowski on the basis of Norwegian otolith samples. The preliminary results should be presented for discussion at the next Working Group meeting.

#### 4 NORTHERN STOCK

##### 4.1 Landings in 1987

Estimates of total landings in 1978-1987 from the various fisheries by countries are given in Tables 4.2-4.5 and summarized in Table 4.1. While most catches in Divisions VIIg-k are taken in the northern part (catches of the USSR, Norway, and the German Democratic Republic), the Working Group decided that from 1984 onwards Divisions VIIg-k as well as Sub-area XII (catches of USSR) should be confined as a whole to the northern stock.

The total landings from all northern blue whiting fisheries in 1987 were estimated at 631,610 t. There was a decrease from 1986 of about 17% in the total landings from the directed fisheries and of about 37% in the landings of the mixed industrial fisheries.

Similarly, as in 1986, some landings from the directed fishery contained by-catch of great silver smelt especially in Division VIa. However, no data for it were available and, therefore, no correction was made. The Working Group considered the by-catch to be at the same level as in 1986, i.e., estimated to be less than 1%.

#### 4.2 Landings in 1988

Preliminary data on the blue whiting catch in 1988 submitted by Working Group members and by some countries (388,903 t, January-July) are presented in Table 4.6.

#### 4.3 Age Composition of Landings

For the directed fisheries in 1987, age compositions were provided by the Faroes, the German Democratic Republic, Norway, and the USSR. These data together accounted for 96% of the landings of the directed fisheries. Some German Democratic Republic landings from Divisions VIb and VIIg-k were raised to catch in number by age group by USSR data from the same area and month.

For Danish, Dutch, Irish, and UK landings, age compositions of Norwegian landings in the same area and month were used.

Other landings from the directed fisheries were assumed to have the same relative age compositions as the total sampled part. The age composition of the catches in the directed fisheries is given in Table 4.7.

For landings of blue whiting taken in the mixed industrial fisheries in the North Sea (Divisions IVa and IIIa), data were available for Norwegian catches only. These accounted for 42% of the total landings. Landings from other countries in these areas were assumed to have the same age compositions as the Norwegian landings in the same area and months (Table 4.8). In a new mixed industrial fishery in Division Vb, blue whiting landings by Faroese vessels were raised to catch in number by age group from Faroese samples. These landings are included in Table 4.8.

The raised age compositions for the directed fisheries were assumed to give the total age composition in the northern area (Table 4.9).

#### 4.4 Weight at Age

Mean weight-at-age data for 1987 were presented by the Faroe Islands, the German Democratic Republic, Norway, and USSR. Landings from other countries were assumed to have the same mean weight at age when fished in the same area and period as the sampled part. Weighted mean weights were calculated and were weighted by the total landings in numbers in each fishery. The total catch landed in 1987 was compared to the sum of products (SOP) of the total numbers landed in 1987 and mean weight at age. The calculated SOP was within 1% of the nominal landings. The mean weights at age used in the VPA runs are shown in Table 4.10.

## 4.5 Stock Estimates

### 4.5.1 Acoustic surveys in 1988

#### 4.5.1.1 Surveys in the spawning season

During the spawning season of 1988, USSR and Norway carried out acoustic surveys in the area west of the British Isles to assess the size of the blue whiting spawning stock (Belikov et al., 1988; Monstad, 1988a).

The USSR, which surveyed the area twice, made the first coverage in the period 4-27 March from north to south along the continental shelf edge from the Faroes/Shetland Channel to south of Ireland, i.e., between 49° and 62°N. The total biomass observed was estimated at 2.0 million t, corresponding to  $14.3 \times 10^9$  individuals, including a spawning stock of 1.9 million t or  $11.7 \times 10^9$  individuals (Figure 4.1). The second coverage was carried out in the period 28 March - 21 April from south to north between 52° and 60°N, extending westwards to approximately 16°W. It was made concurrently with an ichthyoplankton survey. The biomass of blue whiting observed during the second coverage was estimated at 3.7 million t or  $31.2 \times 10^9$  individuals (Figure 4.2). Of this amount, 3.1 million t or  $29.9 \times 10^9$  individuals belonged to the spawning stock.

In the area south of Ireland, blue whiting were observed to start spawning on 20-25 February, and massive spawning occurred west of Ireland during the first and second decades of March. In the area west of the Hebrides and in the Rockall Bank area, spawning lasted until the second half of April.

The distribution of larval blue whiting (Figure 4.3) corresponded to the pattern observed in previous years, but larvae were found to be more abundant than in 1987.

The Norwegian survey took place from 25 March - 24 April and was carried out in a south-north direction from south of Porcupine Bank to the Faroe/Shetland area, i.e., between 51° and 62°N, extending westwards to the Rockall Bank area. The blue whiting stock observed (Figure 4.4) was estimated at 7.1 million t or  $63.7 \times 10^9$  individuals. Of this amount, 6.8 million t or  $58.4 \times 10^9$  individuals belonged to the spawning stock.

The length and age compositions are given in Figure 4.5 for the three various surveys. This shows that the 1983 year class was found to predominate (32% of the total) both the Norwegian survey and the second USSR survey. The 1986 year class was also found in notable numbers, mainly within the Faroe/Shetland area.

#### 4.5.1.2 Surveys in the feeding season

Four countries carried out acoustic surveys in the Norwegian Sea during the summer of 1988 to, among other things, estimate blue whiting distribution and abundance. Working notes and information on the results were submitted to the Working Group. The cruise tracks are shown in Figure 6.1A, and the area where blue whiting were observed is shown in Figure 6.1B.



From 18 July - 21 August, a Norwegian research vessel surveyed the area from the North Sea to northern Norway, extending westwards to the area between the Faroes and Iceland. In addition, information of blue whiting was also obtained from another Norwegian research vessel aiming at other objectives in the Jan Mayen area.

Blue whiting were observed over greater parts of the area surveyed, but the recordings, mostly found between 200 and 400 m depth, were very scattered. Consequently, the estimate was also very low and was considered an underestimate. Length and age compositions are shown in Figure 4.6. The 1987 year class was found in greatest numbers, while the 1983 year class gave the highest contribution to the biomass observed (Monstad, 1988b).

From 26 July - 19 August, the USSR carried out an acoustic survey in the Norwegian Sea within the area  $62^{\circ}$ - $69^{\circ}$ N and  $10^{\circ}$ - $5^{\circ}$ W. Only scattered recordings of blue whiting were made, with an estimate of a corresponding low figure, also considered an underestimate. Length and age compositions of blue whiting are given in Figure 4.7. The 1983 year class was found in highest numbers, followed by the 1986 year class (Kudrin, pers. comm.).

The Faroe Islands carried out an acoustic survey in the area north of the Faroes between  $62^{\circ}$ - $66^{\circ}$ N and  $13^{\circ}$ - $4^{\circ}$ W. Blue whiting were recorded in most of the area surveyed except in the north-western part. However, the recordings were generally very low, with the highest concentration on the warmer side of the polar front (Jacobsen, 1988).

Iceland also aimed for blue whiting while conducting their annual O-group fish survey along the Icelandic coast during August. The area between  $63^{\circ}$ - $68^{\circ}$ N and from  $10^{\circ}$ W to the Greenland coast was surveyed (Figure 6.1), but no blue whiting were observed (Vilhjalmsson, pers. comm.).

#### 4.5.1.3 Discussion

In the period when the acoustic surveys were conducted during spring 1988, the weather conditions were very favourable, enabling the vessels to obtain recordings without acoustic disturbances. The stock was distributed along the continental shelf west of the British Isles and also more westwards than usual over deep sea areas.

The three estimates obtained are listed in the text table below (in millions of t) together with the estimates from the spawning area since 1981. The spawning stock is given in brackets:

Year	Estimates
1981	6.1(5.4)
1982	2.5
1983	4.7(4.4), 3.6(3.5)
1984	2.7(2.4), 3.4(2.7), 2.8(2.1), 2.4(2.2)
1985	6.4(5.6), 2.6(2.0)
1986	6.4(5.6), 2.6(2.0)
1987	5.4(5.1), 7.4(6.9), 4.8(4.5) <sup>1</sup>
1988	2.0(1.9), 3.9(3.1), 7.1(6.8)

<sup>1</sup>Includes some southern blue whiting.

The first USSR survey (2.0 million t) was considered an underestimate due to the area of coverage being only along the shelf edge. The second USSR survey (3.9 million t), being more westward, included also the part of the stock distributed over deeper water and was, therefore, considered to be more accurate.

The Norwegian survey, also covering the area westwards from the shelf and more to the north than the second USSR survey, measured the biomass at 7.1 million t. However, due to the possibility of having recorded some of the fish concentrations more than one time while surveying in a south-north direction at the same time as post-spawners migrated northwards, this estimate was considered an overestimate. On the other hand, the second USSR survey was also in a south-north direction and took place at the same time.

The two countries' age compositions of blue whiting from the spawning were found to be similar (Figure 4.5). The 1982 year class was observed by both countries to contribute about 15% to the stock, while the 1983 year class predominated with two times that contribution.

The Norwegian surveys in August 1988 all obtained weak recordings of blue whiting, and the respective estimates were considered to be underestimates. In 1985, the Norwegian Sea Survey Workshop discussed in detail various estimates obtained during the feeding season of several years. It was then concluded that one of the main problems for not recording the total stock properly was the vessels' threshold effect (Anon., 1985; Anon., 1987). Due to the present methodology, the Working Group concluded in 1986 that such surveys could not give estimates of the total stock when dispersed over wide areas and great depths. Therefore, the ICES-coordinated acoustic survey, conducted every summer since 1982, did not take place in 1987.

However, NEAFC asked ICES to provide information on zonal distribution of the northern blue whiting stock updated for 1988. The Working Group, therefore, recommended that surveys in the Norwegian Sea should take place on a national basis, and that the results should be brought to the meeting for discussion. This was done, and from the discussion, it was concluded that it was not possible to present any reliable estimate of the total stock size from the summer surveys of 1988, and hence no updating of the biomass in economic zones. The overall geographic distribution observed, however, is presented in Figure 6.1.

The length and age composition of blue whiting in the Norwegian Sea, however, differs between USSR and Norwegian observations (Figures 4.6 and 4.7). Norway, however, surveyed a larger area than the USSR which explains some of the difference in the total results. The most notable difference is the observation of the 1982 year class which the USSR found to contribute approximately 15% to the stock, while Norway only found approximately 5% of it. This again indicates a problem which most probably is an ageing problem, discussed in Section 3, but which could also be differences in the sampling technique.

#### 4.5.2 Virtual population analysis (VPA)

##### 4.5.2.1 Tuning the VPA to survey results

It was decided by the Working Group to use the tuning module of the ICES VPA program to obtain initial VPA results. The age range chosen for tuning was 3-14 years, and data from 1982-1987 were used (Table 4.11). The only data set covering the entire period is the USSR acoustic surveys of the spawning stock at the spawning area west of the British Isles during the spawning period. For the Norwegian surveys, data were available for the period 1982-1986 and 1988. For the tuning, the 1987 data were assumed to be the average for 1986 and 1988 for the same year classes. The Norwegian surveys of the spawning stock at the spawning area were not conducted in 1982 and 1985, and for these years, the data similarly were assumed to be the average of the two neighbouring years. The USSR CPUE data for July were not available for 1982 and 1987, and for those years, data from August for the USSR and German Democratic Republic trawlers combined were used.

The results of the analysis are presented in Tables 4.12-4.14 and in Figure 4.8.

##### 4.5.2.2 Estimation of fishing mortality using separable VPA

From the F values given in Table 4.11, it was decided to use  $F = 0.25$  at age 7 and a selection factor of  $S = 1.0$  as input to the separable VPA. It should be noted that all the years 1978-1987 have been given the same weight in the analysis. The matrix of residuals (Table 4.15) does not show any large residuals or pattern in the residuals which would suggest rejection of the results.

##### 4.5.2.3 Virtual population analysis

The option of the program to use the final population of the separable VPA as input to an ordinary VPA was chosen. The results are given in Tables 4.16 and 4.17 and in Figure 4.9.

##### 4.5.2.4 Discussion of the stock size estimates

For a number of years, the Working Group has calibrated the VPA to the results from the acoustic assessments of the spawning stock during the spawning period using repetitive VPA runs. This procedure has been commented on by the ACFM, and suggestions have

been made to the Working Group to use both the separable VPA method and the tuning method.

The results of this exercise presented above indicate a spawning stock at 1 January 1987 which is very close to the lower estimate obtained during the spawning surveys in 1987 back-calculated to 1 January 1987. Furthermore, the spawning stock size estimates obtained from the VPA reflect, with few exceptions, very closely the acoustic survey results obtained in previous years and also in 1988, as shown in the text table below.

Estimate	1983	1984	1985	1986	1987	1988
Survey	3.6-4.4	2.2-2.7	4.1	2.0-5.6	4.1-5.1	3.1-6.8
VPA	2.6	2.6	3.5	4.4	4.2	4.3

Biomass in millions of t.

Based on this, the Working Group resolved that the stock size estimate obtained from the VPA gave a realistic picture of the present situation, and that it could be used for prediction of the future catch levels.

#### 4.5.2.5 VPA results (Tables 4.16 and 4.17)

The VPA results show that the total biomass decreased steadily from 1978 to 1982. From 1983 onwards, an increase is again observed, which was an effect of the strong incoming 1982 and 1983 year classes. The spawning stock biomass shows a similar picture. However, the declining trend reversed only in 1985 when the two strong year classes started to contribute to the spawning stock. At the beginning of 1988, the total stock biomass and the spawning stock biomass were at a level of 5.8 and 4.3 million t, respectively.

The average fishing mortality on ages 4-8 increased steadily from 1978-1981 when a level of 0.27 was reached. Since then, the average fishing mortality has fluctuated between 0.18 and 0.30.

#### 4.5.2.6 Yield per recruit

Yield per recruit and spawning stock per recruit have been calculated using the data given in Table 4.18 and are shown in Figure 4.9. As there are no clear indications of the strength of the incoming year classes, the exploitation pattern chosen for ages 0-2 is the 1978-1985 average. For ages 3-15+, the exploitation pattern estimated by the separable VPA was chosen, with the  $F$  values scaled so that the mean  $F$  at ages 4-8 corresponded to the 1987 level.  $F_{max}$  corresponds to  $F = 0.55$  which is very close to the  $F_{max}$  calculated in 1987.  $F_{0.1}$  equals 0.17, which is slightly lower than the average  $F$  on ages 4-8.

The yield-per-recruit calculations on blue whiting are very sensitive to the exploitation pattern on the younger age groups (0-2) due to the high growth rate in the first years.

#### 4.5.3 Catch per unit effort

Data on catch per unit effort from the directed fisheries in 1987 were submitted by the German Democratic Republic, Norway, and the USSR. These countries presented their data broken down by vessel tonnage class, area, and month.

Comparable time series of CPUE data for Divisions IIa, IVa, Vb, VIa,b, VIIb-c, and VIIg-k which could be indicative of changes in stock abundance are compiled in Tables 4.19 and 4.20 and Figure 4.10.

In Division IIa, the blue whiting fishing season in 1987 again was prolonged compared with the years 1983-1985. The mean CPUE of the USSR vessels as a whole decreased slightly from 1984 to 1987. The CPUE of the German Democratic Republic vessels decreased distinctly in 1987, mainly due to a relatively small fleet fishing in Division IIa.

From 1983 onwards, Poland has not taken part in the blue whiting fishery, and from 1981, Iceland has not presented data. Their earlier data are given in the 1987 Working Group report (Anon., 1988).

In Division Vb, the CPUE decreased for all countries which reported, with the exception of summer catches by USSR vessels (2,000-3,999 GRT) for which the constant increase in CPUE in July-August since 1982 also continued in 1987.

The data from the spawning fishery (Divisions VIa,b, VIIb,c, and VIIg-k) are difficult to interpret. Noticeable are the high values for Norwegian vessels in Divisions VIIg-k, whereas the CPUE of German Democratic Republic and USSR vessels in the same area declined in 1987 compared to 1986. In Divisions VIIb,c, the CPUE of the smaller Norwegian ships decreased since 1984; in comparison, the USSR (2,000-3,999 GRT) CPUE increased from 1986 to 1987.

The Working Group recognized the difficulties in interpretation of CPUE data as a sign for stock variation. The decrease in total catch in most divisions, an increase in some of them, and the variable year-to-year differences in CPUE among countries underlines the difficulties in obtaining a clear picture of stock variations from the data.

The Working Group, however, used the only long-term series of CPUE of large vessels (2,000-3,999 GRT) for July 1983-1986 to tune the VPA. The Working Group considers it important to continue the exchange of CPUE data.

#### 4.6 Catch Projections and Management Considerations

A projection of catches in 1989 and resulting total and spawning stock biomass in 1990 was made using the stock size estimates at the beginning of 1988 and the parameters given in Table 4.21. In the projections, a recruitment equal to the 1978-1985 average, excluding the strong year classes of 1982 and 1983, of 11,000 million at age 0 was used for the 1986-1990 year classes.

It was assumed that the catch in 1988 would be about 600,000 t, corresponding to  $F = 0.17$  for ages 4-8. The results of the catch projections are given in Tables 4.22 and 4.23 and shown in Figure 4.9. It can be seen that a continuation of the assumed 1988  $F$  level would result in a catch of 631,000 t in 1989, whereas fishing at the 1987  $F$  level would result in a catch of 780,000 t in 1989.

In Figure 4.11 is given a plot of recruitment versus spawning stock biomass from 1977, when the blue whiting fishery was at full exploitation, to 1987.  $F_{med}$ ,  $F_{high}$ , and  $F_{low}$  are estimated and shown in the figure. The number of points, however, are rather few and dispersed, and the picture does not illustrate any trend in this relationship.

## 5 SOUTHERN STOCK

### 5.1 Landings

Total landings from the southern area are given in Table 5.1. The Spanish landings decreased in 1987 by 5% and the Portuguese landings increased by 18%.

### 5.2 Catch Composition

Table 5.2 provides the length composition of blue whiting from the Spanish and Portuguese fisheries in the years 1983-1987.

### 5.3 Age Composition of Landings

Data on age composition were available for the Spanish landings in 1981 and 1987. The Portuguese catch in numbers by length group in these years was converted to catch in numbers by age group using Spanish age/length keys. The results are presented in Table 5.3.

### 5.4 Weight at Age

Mean weight-at-age data for 1981-1987 were calculated for the landings from the Spanish and Portuguese fisheries (Table 5.4). The total catch landed was compared to the sum of products (SOP) of total numbers landed and mean weight at age. The calculated SOP discrepancy was 1.3% in 1981 and 0% in 1987 of the nominal landings.

### 5.5 Catch per Unit Effort

CPUE data for the main Galician ports in the period 1977-1987 are presented in Table 5.5 and in Figure 5.1. CPUE data for the period 1983-1987 for single and pair trawlers separately are also presented in Table 5.6 and in Figure 5.1. The effort in 1987 was at the same level as that in 1986 for both single and pair trawlers. In the period 1983-1986, effort increased in the pair trawlers and decreased in the single trawlers.

### 5.6 Age at Maturity

Last year, a maturity/age ogive was used with values calculated from the maturity/length ogive reported by Ehrich and Robles (1982) using the growth parameters  $K = 0.136$  and  $L = 33.3$ . In 1988, a maturity ogive showing 18, 48, 91, 98, and 100% maturity at ages 1-6, respectively, was presented to the Working Group. These values were calculated with the maturity and age data of a sample of  $n = 277$  collected in a Spanish bottom trawl survey during the spawning season in March 1987. This maturity ogive was considered more appropriate and was used for the assessment for the entire period.

### 5.7 Virtual Population Analysis (VPA)

The tuning method was applied to provide a preliminary estimate of terminal F values. Unfortunately, fleet data disaggregated by age group were only available for the CPUE of the Spanish trawlers in the period 1981-1987 (Table 5.7). The final F values of the tuning module were used to carry out a separable VPA, with terminal  $F = 0.72$  at age 2 and terminal  $S = 1$  (Table 5.8). The fishing mortalities obtained were used in the final VPA run (Tables 5.9 and 5.10). In last year's VPA run, some increase in the biomass in 1985 was observed. It was also shown in the CPUE data of the Spanish trawlers (Figure 5.1) and the biomass indices of the Spanish and Portuguese bottom trawl surveys. However, the VPA does not show any increase in the 1985 biomass. The reason could be that the 1982, 1983, and 1984 year classes contributed 80% and 75% to the catch in numbers in 1985 and 1986, respectively, but only 15% in 1987. The catch-at-age data of the Spanish and Portuguese trawlers which covered the continental shelf area, where the youngest age groups are distributed, did not give any information on the older year classes which are distributed in deeper waters and in the shelf edge area.

### 5.8 Assessment

The VPA was run using seven years of data. No acoustic surveys were carried out covering all the area in which the southern blue whiting stock is distributed. The VPA results show that the total biomass decreased in the years 1984-1986 and increased in 1987. The spawning stock biomass decreased in the period 1981-1987. Acoustic surveys to provide stock size estimates and investigations on stock separation and migration are needed. This is because the F values may be too high due to a migration of the older individuals out of the fishing area. It is not possible to make a reliable analytical assessment without more supporting information.

## 6 ZONAL DISTRIBUTION OF BLUE WHITING

The four hydroacoustic surveys which took place in the Norwegian Sea during the summer of 1988 did not obtain any reliable estimates of the total stock size (see Section 4.5.1.3). Therefore, the acoustic estimates of the northern stock divided into areas within and beyond areas of national fisheries jurisdiction of

NEAFC member countries could not be updated. The overall geographical distribution obtained and the various survey cruise tracks are shown in Figure 6.1.

The total landings of blue whiting from 1978-1987 are divided into national fishery zones in Table 6.1. The table was derived from data brought to the meeting by Working Group members, and some assumptions had to be made. For this reason, the totals for each year deviate somewhat from the official totals.

The fishery zone of Jan Mayen was not declared until 1981, and an unknown part of the catches allocated to international waters in the years prior to 1981 was actually taken in this zone.

## 7 RESEARCH RECOMMENDATIONS

- a) The results of surveys and investigations have provided evidence of a separate southern stock. In order to assess and manage the southern stock, data series on age composition of landings are required, and acoustic surveys are needed. The Working Group recommends that more surveys be done to investigate the total distribution area for the southern stock.
- b) The Working Group considers it very important that the northern blue whiting stock is monitored each year. The surveys of the spawning stock during the spring have proved to be very valuable and the Working Group recommends that they be continued with coordination between research vessels during the surveys in the sea.
- c) Although it is difficult at present to indicate the precision of the stock estimates obtained by the acoustic surveys in the Norwegian Sea, the results from the 1981-1987 surveys have given appreciable information, especially about the younger year classes of the blue whiting stock. The Working Group, therefore, recommends that acoustic surveys during the summer/autumn season of 1989 should be carried out on a national basis.
- d) The Working Group recommends that the countries deliver the CPUE and survey data for the southern area into age groups in number per hour to be used for tuning the VPA.
- e) As pointed out by ACFM, the difference in the range of ages in the catch between the northern (ages 0-15) and southern stocks (ages 0-8) may be due to ageing problems, because the length compositions are similar. The Working Group recommends an otolith exchange between the southern and northern areas.
- f) As in 1986, NEAFC adopted a recommendation to use 35-mm mesh size in directed blue whiting fisheries, which is expected to have a positive influence on stock size. The Working Group recommends that further investigations should be carried out on selectivity of blue whiting using mesh sizes used in the mixed industrial fisheries and in the directed fisheries in the northern area.



- g) Due to great discrepancies in ageing of older blue whiting specimens (ages 5 and older) the Working Group recommends that attempts be initiated to solve this problem in a non-conventional way, e.g., by using objective criteria for age determination.

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Table 3.1 Agreement in ageing between countries (in percent).

Country	Faroes	German Dem. Republic	Iceland	Norway
<u>Sample A:</u>				
USSR	64	44	68	69
Norway	73	50	74	x
Iceland	69	51	x	
Ger.Dem.Rep.	53	x		
<u>Sample B:</u>				
USSR	88	86	89	90
Norway	94	87	87	x
Iceland	91	85	x	
Ger.Dem.Rep.	84	x		

Table 3.2 Age composition obtained by countries.

Age	Countries					Overlapping of results (in %)	
	Faroes	Ger. Dem. Republic	Iceland	Norway	USSR	Mean	Range
<u>Sample A:</u>							
1	7	-	8	9	8	71.4	0-100
2	34	24	38	39	34	75.2	38-97
3	34	50	28	28	26	74.4	46-93
4	4	8	5	3	9	60.1	0-100
5 and older	21	18	21	21	23	27.4	13-43
Sample mean age	3.77	3.77	3.29	3.54	3.79	-	-
<u>Sample B:</u>							
1	3	3	3	3	3	100	-
2	11	11	13	11	10	85.9	76-100
3	70	82	69	73	72	92.3	83-99
4	15	3	14	11	14	70.0	18-100
5	-	-	-	1	-	-	-
Sample mean age	2.98	2.86	2.95	2.96	2.98	-	-

Table 4.1 Landings (tonnes) of BLUE WHITING from the main fisheries, 1978-1987.

Area	1978	1979	1980	1981	1982
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XI Va + XI Vb)	236,226	741,042	766,798	520,738	110,685
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	229,228	284,547	250,693	288,316	316,566
Icelandic industrial fishery (Division Va)	9,484	2,500	-	-	-
Industrial mixed fishery (Divisions IVa-c, Vb, IIIa)	99,874	63,333	75,129	61,754	117,578
Subtotal northern fishery	574,812	1,091,422	1,092,620	870,808	589,919
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k)	33,898	27,176	29,944	38,748	31,590
Total	608,710	1,118,598	1,122,564	909,556	621,509

Area	1983	1984	1985	1986	1987 <sup>1</sup>
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XI Va + XI Vb)	52,961	65,932	90,742	160,061	123,042
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	361,537	421,865 <sup>2</sup>	464,263 <sup>2</sup>	534,253 <sup>2</sup>	445,879 <sup>2</sup>
Icelandic industrial fishery (Division Va)	7,000	-	-	-	-
Industrial mixed fishery (Divisions IVa-c, Vb, IIIa)	117,737	122,806	97,769	99,580	62,689
Subtotal northern fishery	539,235	604,678	644,899	757,370	631,610
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k)	30,835	31,173 <sup>3</sup>	42,817 <sup>3</sup>	33,081 <sup>3</sup>	32,796 <sup>3</sup>
Total	570,070	635,851	687,716	790,451	664,406

<sup>1</sup> Preliminary.

<sup>2</sup> Including directed fishery also in Divisions VIIg-k and Sub-area XII.

<sup>3</sup> Excluding directed fishery also in Divisions VIIg-k.

**Table 4.2** Landings (tonnes) of BLUE WHITING from the Norwegian Sea (Sub-areas I and II, Divisions Va, XIVa and XIVb) fisheries, 1978-1987, as estimated by the Working Group.

Country	1978	1979	1980	1981	1982
Denmark	-	-	-	-	473
Faroes	2,810	762	-	11,131	-
France	-	-	-	5,093	2,067
German Dem.Rep.	7,301	22,502	14,234	15,607	3,042
Germany, Fed.Rep. <sup>2</sup>	8,421	1,157	8,919	17,385	890
Greenland	-	-	-	-	-
Iceland	17,756	12,428 <sup>3</sup>	4,562	4,808	-
Norway	-	33,588 <sup>3</sup>	902	187	-
Poland	5,083	4,346	11,307	2,434	443
UK (Engl.& Wales)	11	-	-	-	-
USSR	194,844	666,259	726,874	464,093	103,770
<b>Total</b>	<b>236,226</b>	<b>741,042</b>	<b>766,798</b>	<b>520,738</b>	<b>110,685</b>

Country	1983	1984	1985	1986	1987 <sup>1</sup>
Denmark	-	93	-	-	-
Faroes	11,316	-	-	-	9,290
France	2,890	-	-	-	-
German Dem.Rep.	5,553	8,193	1,689	3,541	1,010
Germany, Fed.Rep. <sup>2</sup>	2	35	75	106	-
Greenland	-	-	-	10	-
Iceland	-	105	-	-	-
Norway	5,061	689	-	-	-
Poland	-	-	-	-	56
UK (Engl.& Wales)	-	-	-	-	-
USSR	28,141	56,817	88,978	156,404	112,686
<b>Total</b>	<b>52,961</b>	<b>65,932</b>	<b>90,742</b>	<b>160,061</b>	<b>123,042</b>

<sup>1</sup> Preliminary.

<sup>2</sup> Including catches off East Greenland (Division XIVb) (698 t in 1978, 204 t in 1979, and 8,757 t in 1980).

<sup>3</sup> Including purse seine catches of 29,162 t of juvenile blue whiting.

**Table 4.3** Landings (tonnes) of BLUE WHITING from directed fisheries in the spawning area (Divisions Vb, VIa,b, VIIb,c and since 1984 Divisions VIIg-k and Sub-area XII), 1978-1987, as estimated by the Working Group.

Country	1978	1979	1980	1981	1982
Denmark	23,498	21,200	19,272	11,361	23,164
Faroes	39,491	35,780	37,488	23,107	38,958
France	-	-	-	-	1,212
German Dem.Rep.	1,714	172	181	6,562	7,771
Germany, Fed.Rep.	6,363	3,304	709	935	701
Iceland	7,537	4,864	5,375	10,213	1,689
Ireland	-	-	-	-	-
Netherlands	1,172	154	-	222	200
Norway	116,815	186,737	133,754	166,168	169,700
Poland	2,469	4,643	-	2,279	-
Spain	14	-	-	-	-
Sweden	6,260	-	3,185	-	-
UK (Engl. & Wales)	5,287	4,136	3,878	6,000	-
UK (Scotland)	1,599	1,466	6,819	2,611	-
USSR	17,009	22,091	40,032	58,858	73,171
<b>Total</b>	<b>229,228</b>	<b>284,547</b>	<b>250,693</b>	<b>288,316</b>	<b>316,566</b>

Country	1983	1984	1985	1986	1987 <sup>1</sup>
Denmark	28,680	26,445	21,104	11,364	2,655
Faroes	56,168	62,264	72,316	80,564	70,625
France	3,600	3,882	-	-	-
German Dem.Rep.	3,284	1,171	6,839	2,750	3,584
Germany, Fed.Rep.	825	994	626	-	266
Iceland	1,176	-	-	-	-
Ireland	-	-	668	16,440	3,300
Netherlands	150	1,000	1,801	8,888	5,627
Norway	185,646	211,773	234,137	283,162 <sup>2</sup>	191,012
Poland	-	-	-	-	-
Spain	318	-	-	-	-
Sweden	-	-	-	-	-
UK (Engl. & Wales)	-	33	-	-	3
UK (Scotland)	-	-	-	3,472	3,310
USSR	81,690	114,303	126,772	127,613 <sup>3</sup>	165,497
<b>Total</b>	<b>361,537</b>	<b>421,865</b>	<b>464,263</b>	<b>534,253</b>	<b>445,879</b>

<sup>1</sup> Preliminary.

<sup>2</sup> Including directed fishery also in Division IVa.

**Table 4.4** Landings (t) of BLUE WHITING from the Icelandic mixed industrial trawl fisheries in Division Va, 1978-1987.

Country	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Iceland	9,484	2,500	-	-	-	7,000	-	-	-	-

**Table 4.5** Landings (tonnes) of BLUE WHITING from the mixed industrial fisheries and caught as by-catch in ordinary fisheries in Divisions IIIa, IVa-c, Vb and IIa, 1978-1987, as estimated by the Working Group.

Country	1978	1979	1980	1981	1982
Denmark	54,804	28,932	49,947	35,066	34,463
Faroes	1,177	1,489	1,895	3,133	27,269
France	-	-	-	-	1,417
German Dem.Rep. <sup>2</sup>	988	49	-	-	-
Germany, Fed.Rep. <sup>2</sup>	1,514	13	252	-	93
Ireland	-	-	-	2,744	-
Netherlands	-	-	-	18,627	47,856
Norway	39,989	30,930	21,962 <sup>3</sup>	-	-
Poland <sup>2</sup>	601	-	-	229	550
Spain	-	-	-	-	-
Sweden <sup>4</sup>	648	1,249	1,071	1,955	1,241
UK (Engl. & Wales) <sup>2</sup>	+	-	-	-	4,689
UK (Scotland)	153	37	2	-	-
USSR <sup>2</sup>	-	634	-	-	-
<b>Total</b>	<b>99,874</b>	<b>63,333</b>	<b>75,129</b>	<b>61,754</b>	<b>117,578</b>

Country	1983	1984	1985	1986	1987 <sup>1</sup>
Denmark	38,290	48,939	35,843	57,315	28,541
Faroes	12,757	9,740	3,606 <sup>5</sup>	5,678 <sup>5</sup>	7,051 <sup>5</sup>
France	249	-	-	-	-
German Dem.Rep. <sup>2</sup>	-	-	-	-	53
Germany, Fed.Rep. <sup>2</sup>	-	566	52	-	62
Ireland	-	-	-	-	-
Norway	62,591	58,038	54,522	26,941	24,969
Netherlands	-	122	130	1,114	-
Poland <sup>2</sup>	-	-	-	-	-
Spain	-	-	-	-	-
Sweden <sup>4</sup>	3,850	5,401	3,616	8,532	2,013
UK (Engl. & Wales) <sup>2</sup>	-	-	-	-	-
UK (Scotland)	-	-	-	-	-
USSR <sup>2</sup>	-	-	-	-	-
<b>Total</b>	<b>117,737</b>	<b>122,806</b>	<b>97,769</b>	<b>99,580</b>	<b>62,689</b>

<sup>1</sup> Preliminary.

<sup>2</sup> Reported landings in human consumption fisheries.

<sup>3</sup> Including mixed industrial fishery in the Norwegian Sea.

<sup>4</sup> Reported landings assumed to be from human consumption fisheries.

<sup>5</sup> Including catches in Division Vb.





Table 4.7 BLUE WHITING.

Catch in number (millions) by age group in the directed fisheries (Sub-areas I and II, Divisions Va, XIVA + b, Vb, VIA + b, VIIb,c and VIIg,h,j,k), 1978 - 1987.

Age	1978	1979	1980	1981	1982
0	-	-	-	-	1.2
1	-	-	55.1	4.0	1.7
2	63.6	69.9	319.5	40.1	48.6
3	69.0	165.0	362.0	322.8	123.1
4	345.8	457.5	399.1	225.3	371.0
5	436.9	468.3	478.3	501.5	212.6
6	483.1	569.0	530.9	539.0	251.0
7	527.9	743.2	725.3	448.5	250.7
8	474.3	904.8	779.2	618.3	259.3
9	364.8	826.4	694.5	573.2	278.7
10	307.6	797.0	1,008.7	718.3	259.8
11	157.4	473.2	398.1	343.6	158.5
12	121.8	359.2	394.2	232.6	133.6
13	50.4	142.7	66.8	73.9	41.0
14	20.5	69.3	64.6	49.5	45.3
15+	16.1	39.0	4.7	30.6	28.0
Total	3,439.2	6,405.4	6,191.0	4,721.2	2,464.1
Tonnes	465,454	1,025,599	1,017,491	809,054	427,341

Age	1983	1984	1985	1986	1987 <sup>1</sup>
0	2.5	63.6	871.4	51.9	9.1
1	290.4	417.6	127.4	161.9	280.8
2	239.1	1,394.1	1,341.6	263.3	361.0
3	164.1	277.9	1,588.1	1,559.5	580.2
4	194.1	211.9	199.3	1,464.3	1,780.2
5	411.4	259.2	161.0	298.7	680.3
6	284.4	420.2	303.7	156.4	118.2
7	274.0	253.1	248.7	192.2	94.9
8	283.5	190.3	167.2	185.8	117.1
9	219.9	151.6	91.7	166.4	99.7
10	152.6	113.8	87.8	172.1	48.3
11	71.5	57.7	73.1	108.7	60.1
12	45.4	50.0	51.4	65.6	41.6
13	25.0	15.0	21.1	25.2	21.1
14	12.1	8.1	12.5	6.8	10.9
15+	10.0	6.7	9.5	8.1	13.0
Total	2,680.0	3,890.9	5,355.3	4,886.9	4,316.5
Tonnes	416,730	481,872	554,640	694,314	571,659

<sup>1</sup> Preliminary.

**Table 4.8 BLUE WHITING.**  
 Catch in number (millions) by age group  
 in the mixed industrial fisheries (Sub-  
 area IV, Divisions IIIa, Vb, and Va)  
 1978 - 1987.

Age	1978	1979	1980	1981	1982
0	956.2	2.4	23.2	-	3,450.1
1	1,030.9	1,849.0	276.1	65.1	45.3
2	168.2	78.8	329.9	81.4	41.3
3	89.7	32.3	74.8	191.9	80.9
4	74.0	22.3	22.6	58.4	112.8
5	-	18.2	29.1	20.1	29.2
6	-	20.8	23.1	16.7	21.6
7	-	10.8	29.3	17.8	14.8
8	-	8.8	26.8	15.7	12.0
9	-	14.0	15.2	4.4	5.2
10	-	6.2	13.8	4.9	1.8
11	-	1.0	6.4	3.6	-
12	-	4.4	1.8	1.5	2.4
13	-	-	2.2	1.2	0.6
14	-	-	1.4	0.1	0.6
15+	-	-	0.4	0.2	-
<b>Total</b>	<b>2,319.0</b>	<b>2,069.0</b>	<b>860.8</b>	<b>483.0</b>	<b>3,816.6</b>
<b>Tonnes</b>	<b>109,358</b>	<b>94,995</b>	<b>75,129</b>	<b>61,754</b>	<b>117,578</b>

Age	1983	1984	1985	1986	1987 <sup>1</sup>
0	336.3	446.4	184.3	-	226.8
1	1,844.2	1,650.8	891.4	395.0	174.5
2	90.0	587.7	365.0	334.7	105.7
3	38.4	49.7	173.8	134.6	85.4
4	47.7	12.8	37.4	184.4	88.9
5	55.6	12.6	13.4	79.7	32.8
6	12.2	10.4	13.9	24.3	15.6
7	12.8	6.1	5.8	7.3	9.2
8	2.6	2.2	5.6	11.0	5.1
9	5.8	2.7	1.8	7.3	3.8
10	4.2	2.6	3.0	3.9	0.2
11	9.6	0.9	1.4	3.8	-
12	3.3	0.3	0.3	1.4	-
13	0.6	0.3	-	1.0	-
14	0.3	0.1	-	1.1	-
15+	-	-	-	-	-
<b>Total</b>	<b>2,463.6</b>	<b>2,785.5</b>	<b>1,697.0</b>	<b>1,189.4</b>	<b>748.0</b>
<b>Tonnes</b>	<b>124,737</b>	<b>122,806</b>	<b>97,769</b>	<b>99,580</b>	<b>59,952</b>

<sup>1</sup>Preliminary.

Table 4.9 VIRTUAL POPULATION ANALYSIS

## BLUE WHITING, NORTHERN AREA

CATCH IN NUMBERS	UNIT: millions									
-----	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
0	956	2	23	0	3451	339	510	1056	52	236
1	1031	1919	331	69	45	2133	2068	1019	557	455
2	232	244	649	122	90	328	1982	1707	598	467
3	159	353	437	515	204	202	328	1762	1694	666
4	420	480	422	284	484	241	225	237	1649	1869
5	437	487	507	522	242	465	272	174	378	713
6	483	590	554	556	273	295	431	318	181	134
7	528	754	755	466	266	285	259	254	200	104
8	474	914	806	634	271	285	192	173	197	122
9	365	840	620	578	284	225	154	93	174	103
10	308	803	1023	723	262	156	116	91	176	48
11	157	474	405	347	159	81	59	74	113	60
12	122	364	396	234	136	49	50	52	67	41
13	50	143	69	75	42	26	15	21	26	21
14	21	69	66	50	46	12	8	12	8	11
15+	16	39	5	31	28	10	7	9	8	13
TOTAL	5758	8474	7067	5206	6281	5132	6676	7052	6078	5063

Table 4.10 VIRTUAL POPULATION ANALYSIS

BLUE WHITING, NORTHERN AREA

MEAN WEIGHT AT AGE OF THE STOCK

UNIT: kilogram

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
0	.032	.032	.027	.032	.018	.018	.027	.014	.033	.021
1	.030	.030	.036	.063	.046	.046	.036	.038	.040	.056
2	.084	.084	.079	.092	.094	.094	.086	.080	.081	.092
3	.105	.105	.107	.118	.136	.136	.104	.102	.113	.109
4	.109	.109	.122	.135	.152	.152	.142	.129	.132	.125
5	.129	.129	.135	.145	.162	.162	.157	.164	.168	.148
6	.147	.147	.149	.155	.178	.178	.164	.178	.202	.178
7	.160	.160	.165	.170	.195	.195	.176	.200	.209	.209
8	.170	.170	.176	.178	.200	.200	.189	.208	.243	.221
9	.177	.177	.186	.187	.204	.204	.186	.218	.246	.222
10	.188	.188	.199	.199	.213	.213	.197	.225	.242	.251
11	.193	.193	.202	.208	.234	.234	.202	.233	.255	.249
12	.199	.199	.207	.228	.228	.228	.194	.233	.260	.252
13	.200	.200	.207	.234	.258	.258	.225	.243	.272	.274
14	.200	.200	.207	.249	.242	.242	.223	.251	.302	.242
15+	.200	.200	.207	.257	.258	.258	.242	.279	.305	.266

Table 4.11

NORWEGIAN BLUE WHITING TUNING DATA 1988.

104

Norwegian Sea Acoustic

82,87

1,1

3,14

1, 1254,4778,3652,3172,2339,1692,887,425,263,271,86,51

1, 456, 779,1425, 594, 487, 450,346,222,105, 88,38, 7

1, 826, 393, 534, 544, 325, 56, 53, 61, 24, 45, 0, 0

1,12525, 682, 418, 203, 245, 127,381,153, 59, 31,79,65

1, 7201,6924,1863, 962, 348, 317,143,207, 54,152,27, 8

1, 4894,5173,1383, 542, 219, 167, 99,103, 30, 87,15, 4

USSR,Spawning Area/Acoustic

82,87

1,1

3,14

1, 0.54, 2.75,1.34,1.38,1.57,2.35,1.73,1.29,0.65,.38,.11,.11

1, 2.33, 2.93,9.59,3.88,1.97,1.37, .78, .66,0.10,.07,.09, 0

1, 2.90, 0.80,1.10,4.20,2.20,1.20,1.70,1.20,0.50,.30, 0, 0

1,13.22, 0.93,0.58,1.78,0.86,0.61,0.58,0.54,0.11,.22,.06,.05

1,18.75,23.18,2.54,0.61,0.62,0.75,0.64,0.71,0.72,.50,.33,.11

1, 4.48,19.17,5.86,1.07,0.50,0.81,0.86,0.67,0.56,.53,.24,.03

Norway,Spawning Area/Acoustic

82,87

1,1

3,14

1,2431, 6676, 3335,3470,3656,3231,2239, 384,985,643,446,174

1,2108, 2723, 6511,3735,3650,3153,2279,1182,531,360, 69, 69

1,1514, 1616, 1719,1858,1128, 567, 440, 348, 80,122, 16, 14

1,9150, 1336, 999, 985,1115, 639, 370, 256,183, 43, 67, 8

1,7183, 7340, 1159, 383, 251, 373, 151, 174, 73, 18, 4, 6

1,8050,22357, 4697, 282, 417, 385, 159, 27,111, 31, 12, 0

USSR cpue Div Iia, July

82,87

1,1

3,14

1, .12, .85,1.42,1.35,1.37, .46, .66, 0, 0,.11, .38, 0

1, .31, .59,1.00, .92, .77, .96, .83, .54,.15,.22, 0,.05

1, .56, .08, .22, .20, .06, .14, .08, .14, 0, 0, 0, 0

1, 5.84, .32, .03, .73, .57, .64, .57, .86,.19,.10, 0, 0

1,14.64,4.41, .55, 0, .10, 0, 0, 0, 0, 0, 0, 0

1, 8.49,7.95,0.44, 0, 0, . 0, .34, 0, 0, 0, 0, 0

A VPA Version 2.1 - may 1988

Table 4.12 Tuning results.

model run at 13.32.02 27 SEPTEMBER 1988

DISAGGREGATED 05  
 LOG TRANSFORMATION  
 Explanatory variate TIME  
 Fleet 1 ,norwegian Sea Acoust, has terminal q estimated as the mean  
 Fleet 2 ,USSR,Spawning Area/A, has terminal q estimated as the mean  
 Fleet 3 ,norway,Spawning Area, has terminal q estimated as the mean  
 Fleet 4 ,USSR cpe div IIa, J, has terminal q estimated from trend  
 FLEETS COMBINED BY \*\* VARIANCE \*\*

Terminal Fs estimated using hybrid method

Regression weights

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

Oldest age F = 1.000/average of 5 younger ages. Fleets combined by variance of predictions

Fishing mortalities

Age,	82,	83,	84,	85,	86,	87,
0,	.144,	.007,	.028,	.170,	.009,	.050,
1,	.012,	.124,	.055,	.073,	.123,	.100,
2,	.035,	.114,	.162,	.058,	.056,	.150,
3,	.059,	.102,	.160,	.212,	.076,	.081,
4,	.136,	.092,	.157,	.166,	.314,	.112,
5,	.107,	.188,	.142,	.176,	.433,	.217,
6,	.149,	.184,	.266,	.246,	.279,	.208,
7,	.169,	.229,	.243,	.248,	.241,	.256,
8,	.244,	.276,	.238,	.255,	.310,	.227,
9,	.414,	.329,	.236,	.173,	.439,	.264,
10,	.695,	.422,	.281,	.213,	.570,	.206,
11,	.690,	.479,	.278,	.292,	.444,	.387,
12,	1.039,	.472,	.621,	.422,	.467,	.285,
13,	.008,	.562,	.257,	.564,	.387,	.260,
14,	.709,	.453,	.335,	.337,	.461,	.281,

Log catchability estimates

Age 3						
Fleet,	82,	83,	84,	85,	86,	87
1,	-1.01,	-1.47,	-.91,	.41,	-1.14,	-.52
2,	-8.76,	-6.75,	-6.56,	-6.44,	-7.09,	-7.52
3,	-.35,	.06,	-.30,	.10,	-1.14,	-.02
4,	-10.27,	-8.76,	-8.20,	-7.26,	-7.33,	-6.88

SUMMARY STATISTICS									
Fleet,	Preo,	SE(q),	Partial,	Raised,	SLOPE	SE	INTRCPT,	SE	
q		F	F	F		Slope	Intcpt	Intcpt	
1,	-.77	.709	.4617	.0628	.000E+00	.000E+00	-.773	.260	
2,	-7.19	.934	.0008	.1126	.000E+00	.000E+00	-7.186	.353	
3,	-.28	.498	.7587	.0829	.000E+00	.000E+00	-.276	.188	
4,	-6.59	.586	.0015	.1141	.634E+00	.113E+00	-12.871	.872	
Fbar		SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.060		.315	.168	.315	.284				

Age 4						
Fleet,	82,	83,	84,	85,	86,	87
1,	-.30,	-1.21,	-1.29,	-.74,	.28,	-1.17
2,	-7.16,	-6.80,	-7.49,	-7.33,	-5.42,	-6.77
3,	.63,	.04,	.12,	-.06,	.33,	.29
4,	-8.34,	-8.81,	-9.79,	-8.40,	-7.08,	-7.65

SUMMARY STATISTICS									
Fleet,	Preo,	SE(q),	Partial,	Raised,	SLOPE	SE	INTRCPT,	SE	
q		F	F	F		Slope	Intcpt	Intcpt	
1,	-.64	.803	.5272	.1905	.000E+00	.000E+00	-.640	.303	
2,	-6.83	.805	.0011	.1054	.000E+00	.000E+00	-6.829	.304	
3,	.23	.269	1.2529	.1047	.000E+00	.000E+00	.225	.102	
4,	-7.63	1.061	.0005	.1140	.286E+00	.205E+00	-10.490	1.580	
Fbar		SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.111		.237	.971E-01	.237	.168				

Age 5						
Fleet,	82,	83,	84,	85,	86,	87
1,	.48,	-.55,	-1.28,	-.86,	.76,	-.87
2,	-7.43,	-5.57,	-7.46,	-7.44,	-5.84,	-6.33
3,	.39,	.97,	-.11,	.01,	.28,	.36
4,	-7.37,	-7.81,	-9.07,	-10.41,	-7.37,	-8.92

SUMMARY STATISTICS									
Fleet,	Preo,	SE(q),	Partial,	Raised,	SLOPE	SE	INTRCPT,	SE	
q		F	F	F		Slope	Intcpt	Intcpt	
1,	-.39	.882	.6792	.3502	.000E+00	.000E+00	-.387	.333	
2,	-6.68	.543	.0013	.1528	.000E+00	.000E+00	-6.680	.356	
3,	.32	.466	1.3716	.2082	.000E+00	.000E+00	.316	.153	
4,	-9.64	1.548	.0001	.1912	-.221E+00	.300E+00	-6.654	2.566	
Fbar		SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.215		.335	.130	.335	.150				

Table 4.12 cont'd.

Age 6 Fleet.	82,	83,	84,	85,	86,	87
1,	.55,	-.99,	-1.09,	-1.85,	-.39,	.08
2,	-7.19,	-6.83,	-5.95,	-6.59,	-6.97,	-6.15
3,	.84,	.84,	-.14,	-.27,	-.53,	-0.57
4,	-7.21,	-7.46,	-9.00,	-7.48,	-11.59,	-11.33

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT.	SE
q			F	F		Slope		Intrcpt
1	-.49	1.042	.6154	.1522	.000E+00	.000E+00	-.485	.394
2	-6.48	.561	.0015	.1922	.000E+00	.000E+00	-6.479	.212
3	.04	.650	1.0424	.4953	.000E+00	.000E+00	.042	.246
4	-11.26	1.497	.0000	.2877	-.899E+00	.290E+00	-2.273	2.229
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.265	.380	.273	.380	.513				

Age 7 Fleet.	82,	83,	84,	85,	86,	87
1,	.40,	-.94,	-1.19,	-1.43,	-.87,	-.62
2,	-6.91,	-6.45,	-6.18,	-7.08,	-7.20,	-6.70
3,	.85,	1.08,	.06,	.09,	-1.20,	.03
4,	-7.04,	-7.39,	-9.78,	-7.49,	-9.02,	-11.12

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT.	SE
q			F	F		Slope		Intrcpt
1	-.77	.689	.4613	.2191	.000E+00	.000E+00	-.774	.260
2	-6.75	.419	.0012	.2428	.000E+00	.000E+00	-6.753	.159
3	.15	.861	1.1610	.2895	.000E+00	.000E+00	.149	.326
4	-10.29	1.445	.0000	.5910	-.658E+00	.280E+00	-3.711	2.153
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.254	.322	.121	.322	.141				

Age 8 Fleet.	82,	83,	84,	85,	86,	87
1,	.42,	-.83,	-2.67,	-1.68,	-.70,	-1.17
2,	-6.16,	-6.63,	-6.51,	-7.02,	-6.74,	-6.50
3,	1.07,	1.12,	-.35,	-.06,	-.53,	-.33
4,	-7.79,	-6.98,	-8.66,	-6.97,	-11.57,	-11.40

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT.	SE
q			F	F		Slope		Intrcpt
1	-1.10	1.117	.3318	.2424	.000E+00	.000E+00	-1.103	.422
2	-6.59	.508	.0014	.2666	.000E+00	.000E+00	-6.592	.116
3	.15	.805	1.1626	.3684	.000E+00	.000E+00	.151	.304
4	-11.05	1.864	.0000	.5236	-.861E+00	.361E+00	-2.435	2.777
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.225	.276	.112	.276	.165				

Age 9 Fleet.	82,	83,	84,	85,	86,	87
1,	.26,	-.68,	-2.51,	-.34,	-1.02,	-1.37
2,	-5.98,	-6.78,	-5.95,	-6.83,	-6.43,	-6.12
3,	1.18,	1.20,	-.40,	-.37,	-.97,	-.90
4,	-6.95,	-6.72,	-9.01,	-6.85,	-11.10,	-11.08

SUMMARY STATISTICS								
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE	INTRCPT.	SE
q			F	F		Slope		Intrcpt
1	-.95	1.027	.3886	.4043	.000E+00	.000E+00	-.945	.398
2	-6.35	.423	.0018	.2096	.000E+00	.000E+00	-6.348	.160
3	-.04	1.066	.9600	.6219	.000E+00	.000E+00	-.041	.403
4	-10.68	1.702	.0000	.3258	-.905E+00	.350E+00	-1.831	2.535
Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio				
.262	.359	.220	.359	.377				

cont'd.

Table 4.12 cont'd.

Age 10 Fleet,	82,	83,	84,	85,	86,	87
1,	.12,	-.51,	-1.91,	-1.03,	-.40,	-.81
2,	-5.68,	-6.39,	-5.64,	-6.67,	-6.08,	-5.85
3,	.02,	1.16,	-.17,	-.51,	-.57,	-2.15
4,	-11.05,	-6.53,	-7.99,	-6.21,	-10.85,	-6.53

SUMMARY STATISTICS							
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE Slope	INTRCPT, SE Inrcrpt
	q		F	F			
1,	-.76	.744	.4690	.2185	.000E+00	.000E+00	-.757, .281
2,	-6.07	.401	.0023	.1649	.000E+00	.000E+00	-6.074, .151
3,	-.37	1.151	.6897	1.2251	.000E+00	.000E+00	-.371, .439
4,	-7.38	2.950	.0006	.0884	.326E+00	.571E+00	-10.638, 4.395
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)		Variance ratio
	.205	.335	.321		.335		.919

Age 11 Fleet,	82,	83,	84,	85,	86,	87
1,	.14,	-.48,	-2.18,	-1.46,	-1.55,	-1.64
2,	-5.87,	-7.43,	-6.05,	-7.74,	-5.87,	-5.62
3,	1.46,	1.15,	-.98,	-.33,	-1.25,	-.33
4,	-10.55,	-7.03,	-10.47,	-7.20,	-10.66,	-10.16

SUMMARY STATISTICS							
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE Slope	INTRCPT, SE Inrcrpt
	q		F	F			
1,	-1.20	.923	.3026	.6052	.000E+00	.000E+00	-1.195, .349
2,	-6.43	.505	.0016	.1726	.000E+00	.000E+00	-6.431, .372
3,	-.05	1.198	.9537	.5155	.000E+00	.000E+00	-.047, .453
4,	-9.75	2.362	.0001	.5044	-.161E+00	.457E+00	-8.134, 3.518
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)		Variance ratio
	.383	.570	.328		.570		.331

Age 12 Fleet,	82,	83,	84,	85,	86,	87
1,	.73,	-.16,	-.58,	-1.38,	-.06,	-.50
2,	-5.84,	-7.30,	-5.59,	-6.33,	-5.66,	-5.60
3,	1.59,	1.24,	.42,	-1.05,	-2.08,	-1.53
4,	-7.08,	-6.16,	-9.50,	-7.12,	-10.08,	-10.08

SUMMARY STATISTICS							
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE Slope	INTRCPT, SE Inrcrpt
	q		F	F			
1,	-.31	.762	.7358	.3468	.000E+00	.000E+00	-.307, .288
2,	-6.05	.724	.0023	.1817	.000E+00	.000E+00	-6.054, .274
3,	-.23	1.652	.7907	1.0458	.000E+00	.000E+00	-.235, .524
4,	-10.08	1.606	.0000	.2864	-.697E+00	.311E+00	-3.109, 2.393
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)		Variance ratio
	.282	.478	.286		.478		.557

Age 13 Fleet,	82,	83,	84,	85,	86,	87
1,	.38,	-.20,	-4.29,	.79,	-.91,	-1.68
2,	-6.28,	-6.21,	-9.18,	-6.40,	-5.32,	-5.82
3,	2.03,	.40,	-1.29,	.62,	-2.82,	-1.91
4,	-5.04,	-8.95,	-9.18,	-8.70,	-9.32,	-9.51

SUMMARY STATISTICS							
Fleet	Pred.	SE(q)	Partial	Raised	SLOPE	SE Slope	INTRCPT, SE Inrcrpt
	q		F	F			
1,	-.99	1.994	.3731	.5223	.000E+00	.000E+00	-.986, .754
2,	-6.54	1.463	.0014	.1264	.000E+00	.000E+00	-6.540, .553
3,	-.50	1.959	.6091	1.0859	.000E+00	.000E+00	-.496, .740
4,	-10.09	1.611	.0000	.1450	-.656E+00	.312E+00	-3.529, 2.460
Fbar		SIGMA(int.)	SIGMA(ext.)		SIGMA(overall)		Variance ratio
	.256	.856	.498		.856		.338



Table 4.13 VIRTUAL POPULATION ANALYSIS from tuning.

BLUE WHITING, NORTHERN AREA

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

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1978-85
0	.07	.00	.01	.00	.14	.01	.03	.17	.01	.05	.05
1	.14	.20	.06	.02	.01	.12	.05	.07	.13	.10	.09
2	.04	.04	.10	.03	.03	.11	.16	.06	.05	.15	.07
3	.03	.07	.11	.11	.06	.10	.16	.21	.08	.08	.10
4	.08	.10	.11	.09	.14	.09	.16	.17	.31	.11	.12
5	.09	.13	.15	.20	.11	.19	.14	.17	.43	.21	.15
6	.11	.16	.20	.24	.15	.18	.27	.24	.28	.26	.19
7	.12	.24	.32	.27	.17	.23	.24	.25	.24	.25	.23
8	.12	.32	.43	.48	.24	.27	.24	.25	.31	.23	.30
9	.16	.33	.38	.65	.41	.33	.23	.17	.44	.26	.33
10	.19	.59	.87	1.05	.69	.42	.28	.21	.57	.20	.54
11	.20	.49	.69	.86	.69	.48	.28	.29	.44	.38	.50
12	.29	.99	1.01	1.20	1.04	.47	.62	.42	.46	.28	.75
13	.24	.63	.50	.52	.71	.56	.26	.56	.39	.26	.50
14	.21	.61	.69	.86	.71	.45	.33	.34	.46	.28	.53
15+	.21	.61	.69	.86	.71	.45	.33	.34	.46	.28	.53
( 0- 2)0	.08	.08	.05	.02	.06	.08	.08	.10	.06	.10	
( 4- 8)0	.10	.19	.24	.25	.16	.19	.21	.22	.31	.21	

Table 4.14 VIRTUAL POPULATION ANALYSIS from tuning.

13.30.38 27 SEPTEMBER 1988

BLUE WHITING, NORTHERN AREA

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: thousand tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1978-85
0	15052	7805	4467	5066	28494	53014	20361	7416	6450	5335	0	17709
1	8610	11461	6388	3636	4147	20219	43098	16210	5120	5267	4155	14221
2	7309	6120	7656	4931	2915	3355	14631	33419	12352	3690	3902	10042
3	6956	5775	4791	5682	3927	2305	2451	10193	25821	9573	2600	5260
4	6026	5552	4409	3528	4188	3031	1705	1711	6759	19612	7237	3769
5	5817	4555	4113	3230	2633	2993	2264	1193	1188	4052	14372	3350
6	5279	4369	3291	2910	2174	1937	2032	1609	820	633	2676	2950
7	5020	3886	3045	2195	1882	1535	1320	1276	1031	509	398	2520
8	4504	3635	2503	1815	1378	1302	1000	848	816	664	323	2123
9	2792	3260	2155	1327	918	884	810	646	539	491	434	1599
10	1982	1557	1914	1208	570	497	522	524	445	285	309	1147
11	939	1346	884	656	347	233	267	323	347	207	190	624
12	539	627	677	362	228	142	118	165	198	183	115	357
13	258	332	190	202	89	66	73	52	89	102	113	158
14	117	166	144	94	99	36	31	46	24	49	65	92
15+	92	94	11	58	60	30	27	35	24	58	67	51
TOTAL NO	71293	60939	46638	36903	54650	91579	90709	75666	62062	50710		
SPS NO	42715	37992	30870	24469	19289	17895	22292	30210	37107	33148		
TOT. BIOM	7085	6236	5166	4401	4109	4770	5327	5974	6427	5541		
SPS BIOM	5857	5248	4373	3626	3153	2727	2575	3366	4682	4323		

Table 4.15

Title : BLUE WHITING, NORWICH AREA  
 At 13.35.31 27 SEPTEMBER 1988  
 from 78 to 87 on ages 0 to 14  
 with Terminal F of .250 on age 7 and Terminal S of 1.000

Initial sum of squared residuals was 127.920 and  
 final sum of squared residuals is 62.567 after 113 iterations

Matrix of Residuals

Years	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87		wTS
Ages											
0/ 1	1.652	-3.058	.592	-3.801	2.229	-.208	.900	2.496	-.804	.000	.055
1/ 2	1.836	.985	.706	-.809	-2.209	-.300	-.189	.418	-.438	.000	.106
2/ 3	.456	-.202	.418	-.576	-.552	.108	.218	.370	-.240	.000	.304
3/ 4	-.361	.060	.467	-.146	-.054	-.147	.260	.260	-.379	.000	.417
4/ 5	.494	.064	-.300	-.168	.034	-.280	.094	-.375	.436	.000	.393
5/ 6	.295	-.070	-.245	.257	-.266	-.146	-.381	-.014	.569	.000	.394
6/ 7	.054	-.296	-.097	.232	-.223	-.206	.192	.374	-.031	.000	.535
7/ 8	-.002	-.085	-.071	.064	-.218	.069	.098	.169	-.063	.000	1.000
8/ 9	-.173	.201	-.091	.149	-.131	.134	.247	-.247	-.089	.000	.675
9/10	-.253	-.269	-.473	.254	.394	.294	.164	-.776	.663	.000	.264
10/11	-.323	.155	.266	.494	.503	.129	-.386	-.820	-.040	.000	.280
11/12	-.447	-.069	.058	.209	.790	-.071	-.418	-.226	.196	.000	.326
12/13	-.496	.679	.411	.230	.528	-.124	-.433	-.359	-.434	.000	.265
13/14	-.219	.296	-.386	-.458	.636	.407	-.548	.444	-.172	.000	.276
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	
wTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

F-values	78	79	80	81	82	83	84	85	86	87
	.1122	.2275	.2687	.3047	.2490	.2796	.2709	.2597	.3271	.2500

Selection-at-age (S)

S-values	0	1	2	3	4					
	.0421	.2746	.2564	.3933	.5417					
S-values	5	6	7	8	9	10	11	12	13	14
	.6894	.8602	1.0000	1.2632	1.4217	1.9585	1.7865	2.2347	1.2536	1.0000

Table 4.16 VIRTUAL POPULATION ANALYSIS from separable VPA.

BLUE WHITING, NORTHERN AREA

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

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1978-85
0	.07	.00	.01	.00	.10	.01	.03	.07	.01	.01	.04
1	.15	.21	.07	.02	.01	.08	.07	.08	.05	.09	.09
2	.04	.05	.10	.03	.04	.10	.10	.08	.06	.05	.07
3	.03	.07	.12	.11	.07	.11	.14	.13	.10	.10	.10
4	.08	.11	.12	.10	.14	.11	.16	.14	.17	.16	.12
5	.09	.13	.16	.21	.12	.20	.18	.18	.35	.10	.16
6	.10	.16	.22	.27	.16	.21	.28	.32	.30	.20	.22
7	.12	.23	.32	.29	.20	.26	.30	.27	.34	.28	.25
8	.12	.32	.42	.49	.27	.34	.28	.33	.35	.36	.32
9	.15	.32	.37	.61	.43	.38	.31	.21	.65	.31	.35
10	.17	.54	.80	.99	.62	.44	.35	.31	.77	.37	.53
11	.17	.42	.58	.71	.61	.40	.30	.39	.78	.66	.45
12	.19	.70	.74	.82	.68	.38	.46	.47	.76	.75	.56
13	.12	.36	.27	.30	.32	.26	.19	.36	.46	.57	.27
14	.11	.25	.28	.32	.30	.15	.12	.23	.22	.36	.22
15+	.11	.25	.28	.32	.30	.15	.12	.23	.22	.36	.22
( 0- 2)u	.09	.09	.06	.02	.05	.06	.07	.08	.04	.05	
( 4- 8)u	.10	.19	.25	.27	.18	.22	.24	.25	.30	.22	

**Table 4.17** VIRTUAL POPULATION ANALYSIS from separable VPA.

BLUE WHITING, NORTHERN AREA

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: thousand tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1978-85
0	14653	6678	4307	5669	39426	40871	17666	17291	6884	24847	0	18320
1	7912	11134	5466	3505	4642	29167	33156	14003	13204	5590	20130	13623
2	6872	5549	7389	4176	2807	3760	21955	25260	10546	10308	4166	9724
3	6356	5417	4323	5464	3309	2217	2782	16188	19158	8094	8018	5757
4	5724	5060	4117	3146	4009	2525	1633	1982	11666	14157	6026	3525
5	5759	4308	3710	2990	2319	2846	1850	1134	1409	8066	9907	3115
6	5382	4321	3089	2581	1978	1681	1912	1270	772	815	5961	2777
7	5096	3971	3006	2030	1613	1374	1111	1178	754	469	546	2422
8	4671	3696	2572	1783	1243	1081	869	677	736	438	291	2074
9	2965	3397	2205	1383	892	774	629	539	398	425	249	1598
10	2263	2099	2026	1249	615	476	432	377	357	171	256	1184
11	1137	1526	999	747	380	270	250	249	227	136	97	695
12	765	789	824	456	302	169	148	151	138	85	57	451
13	476	517	321	321	165	126	95	77	77	53	33	262
14	213	344	295	201	196	98	79	64	44	40	25	186
15+	167	194	23	125	119	81	69	48	44	47	50	103
TOTAL NO	70350	59000	44672	55826	64016	87516	84637	80509	66414	73740		
SPS NO	43182	37688	30148	23404	18066	17696	23401	31136	35439	32932		
TOT. BIOM	7200	6247	5089	4276	4129	4799	5381	5836	6369	6198		
SPS BIOM	6038	5339	4353	3536	2979	2583	2639	3458	4455	4248		

Table 4.18

List of input variables for the ICES prediction program.

BLUE WHITING - NORTHERN STOCK

The reference F is the mean F for the age group range from 4 to 8

Data are printed in the following units:

Total yield and weight by age group in the catch: kilogram

Total biomass and weight by age group in the stock: kilogram

age	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
0	.04	.20	.00	.021	.021
1	.09	.20	.10	.056	.056
2	.07	.20	.37	.092	.092
3	.10	.20	.81	.109	.109
4	.14	.20	.85	.125	.125
5	.17	.20	.91	.148	.148
6	.22	.20	.94	.178	.178
7	.25	.20	1.00	.209	.209
8	.32	.20	1.00	.221	.221
9	.36	.20	1.00	.222	.222
10	.50	.20	1.00	.251	.251
11	.45	.20	1.00	.249	.249
12	.57	.20	1.00	.252	.252
13	.32	.20	1.00	.274	.274
14	.25	.20	1.00	.242	.242
15+	.25	.20	1.00	.266	.266

**Table 4.19** Catch per unit effort in the directed fisheries 1980-1987 (fishing gear - mid-water trawl).

Division IIA - t/hour										
GRT class	Country	Time period	1980	1981	1982	1983	1984	1985	1986	1987
2,000-3,999.9	Norway	Nov	-	-	-	-	8.00 <sup>1</sup>	-	-	-
1,000-1,999.9	USSR	Apr-Oct	-	-	-	0.87	-	1.86	1.63	2.47
2,000-3,999.9	German Dem. Rep.	May-Jun	2.79	1.21	1.00	2.35	1.40	2.57	5.40	1.63
		Jul-Sep	3.11	2.25	1.21	1.10	2.57	2.29	2.30	0.80
		Oct-Dec	3.51	1.04	2.25	2.70	-	1.22	2.70	0.94
	USSR	Feb	6.35	-	-	-	-	-	3.58	2.21
		Mar-Apr	2.38	3.57	1.84	-	7.80	0.87	4.12	3.54
		May-Jun	3.30	2.62	1.35	1.73	3.06	2.48	3.08	2.34
		Jul-Sep	3.82	2.54	2.85	0.60	2.85	3.16	2.27	2.28
Oct-Dec	3.14	3.01	2.99	-	-	-	1.42	1.90		
4,000 and more	USSR	Jan-Sep	-	-	-	-	-	-	5.43	2.51
Division IVA - t/hour										
100- 499.9	Norway	Apr-May	-	7.18	17.39	16.51	8.68	-	2.18	-
500- 999.9	Norway	Apr-May	9.29	13.40	13.75	18.31	7.01	15.70	-	7.91
		Nov	-	-	-	-	4.50 <sup>1</sup>	-	-	-
1,000-1,999.9	Norway	Mar	-	-	-	-	-	-	-	7.93
		Apr-May	-	15.36	15.03	21.19	-	17.26	-	5.27
Division Vb - t/hour										
500- 999.9	Faroes	May	6.20	9.60	-	-	-	-	-	-
	Norway	Jan	-	-	-	-	-	-	11.86	-
		Apr-May	18.14	18.94	4.88	-	12.40	16.19	13.43	-
1,000-1,999.9	German Dem. Rep	Nov-Dec	-	-	-	-	25.08	12.55	-	-
		Jan-Mar	-	-	-	-	-	-	-	1.47
		Dec	-	-	-	-	-	-	-	1.13
	Norway	Apr-May	13.57	29.47	-	-	-	24.85	-	13.96
	USSR	Apr-Jun	-	-	-	0.38	-	7.05	-	-
2,000-3,999.9	German Dem. Rep.	Jan-May	-	3.88	2.12	2.08	-	3.50	1.40	0.18
		Jun-Jul	-	-	-	-	-	3.58	2.50	1.86
		Aug	-	-	-	-	-	-	2.10	0.97
		Sep-Dec	-	-	-	-	-	-	-	0.64
		Nov-Dec	-	-	-	-	2.20	1.58	-	-
	USSR	Jan-Feb	6.83	6.71	5.16	3.05	1.74	3.71	3.12	2.37
		Mar-May	5.23	5.97	4.58	4.12	4.57	4.99	5.22	4.87
4,000 and more	USSR	Jul-Aug	-	3.75	3.03	3.16	4.29	5.33	5.41	5.45
		Sep-Dec	-	2.72	-	2.77	3.70	-	3.27	2.06
4,000 and more	USSR	Feb-Oct	-	-	-	-	-	-	7.50	3.20

Table 4.19 (cont'd)

Division VIa - t/hour											
GRT class		Country	Time period	1980	1981	1982	1983	1984	1985	1986	1987
100-	499.9	Norway	Feb	-	-	-	-	31.35	-	-	-
500-	999.9	Faroes	Apr	16.40	-	-	-	-	-	-	-
		Norway	Jan-Feb	-	-	-	-	-	-	11.90	14.84
			Mar-Apr	26.56	34.96	36.30	49.04	25.21	20.05	21.50	24.78
			May	-	-	-	-	-	-	22.38	10.62
1,000-	1,999.9	Norway	Feb	-	-	-	-	-	-	-	10.81
			Mar-Apr	23.92	57.13	42.38	42.83	28.78	22.29	-	20.53
			May	-	-	-	-	-	-	-	12.07
2,000-	3,999.9	USSR	Mar	-	-	-	-	3.92	-	-	-
Division VIb - t/hour											
2,000-	3,999.9	German Dem. Rep.	Mar-Apr	-	-	-	-	-	-	-	2.49
		USSR	Apr-Jun	-	-	-	-	-	-	4.80	4.42
Division VIIb,c - t/hour											
100-	499.9	Norway	Mar	-	-	-	-	21.08	-	-	-
500-	999.9	Norway	Mar-Apr	-	-	-	-	27.74	26.83	25.35	21.74
1,000-	1,999.9	Norway	Mar	-	-	-	-	-	-	-	24.02
			Apr	-	-	-	-	-	-	-	38.35
			Nov	-	-	-	-	8.00 <sup>1</sup>	32.08	-	-
2,000-	3,999.9	USSR	Feb-Mar	-	-	-	-	4.72	6.21	3.83 <sup>2</sup>	4.49 <sup>2</sup>
4,000 and more		USSR	Feb-Mar	-	-	-	-	-	-	10.20	-
Division VIIg-k - t/hour											
500-	999.9	Norway	Mar	-	-	-	-	14.58	-	-	35.54
1,000-	1,999.9	Norway	Mar	-	-	-	-	-	-	-	35.24
2,000-	3,999.9	German Dem. Rep.	Feb-Mar	-	-	-	-	-	-	7.20	3.21
		USSR	Feb-Mar	-	-	-	-	3.85	12.30	6.96	4.96 <sup>3</sup>

<sup>1</sup>One trawl only.<sup>2</sup>Refers to Feb-Apr.<sup>3</sup>Refers to Mar-Apr.



**Table 4.20** Catch per unit effort in the BLUE WHITING directed fisheries in Division IIA for 2,000 - 3,999.9 GRT, using mid-water trawls, 1980-1987.

Month	1980	1981	1982	1983	1984	1985	1986	1987
Catch (tonnes)								
<u>German Dem.Rep.</u>								
January	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-	-
May	546	159	289	613	351	-	-	-
June	3,025	2,566	1,148	2,524	1,876	393	150	432
July	3,523	5,951	1,226	1,026	3,947	642	-	111
August	2,871	4,130	-	764	1,779	-	1,441	70
September	605	1,481	113	-	240	490	1,335	139
October	1,128	55	266	-	-	111	403	258
November	1,380	-	-	494	-	-	412	-
December	754	-	-	132	-	-	-	-
All months	13,832	14,310	3,042	5,553	8,193	1,636	3,741	1,010
May - Oct	11,698	14,310	3,042	4,917	8,193	1,636	3,179	1,010
Effort (hours)								
January	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-	-
May	279	210	152	393	219	-	-	-
June	999	2,046	1,280	945	1,371	153	28	265
July	902	2,596	1,045	831	1,596	247	-	163
August	965	2,079	-	801	598	-	563	60
September	248	627	54	-	128	247	546	175
October	-	53	118	-	-	91	192	274
November	-	-	-	-	-	-	115	-
December	-	-	-	-	-	-	-	-
All months	4,322	7,611	2,649	3,202	3,912	738	1,444	937
May - Oct	3,817	7,611	2,649	2,970	3,912	738	1,301	937
CPUE (tonnes/hour)								
January	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-	-
May	1.96	0.76	1.90	1.56	1.60	-	-	-
June	3.03	1.25	0.90	2.67	1.37	2.57	5.36	1.63
July	3.91	2.29	1.17	1.24	2.47	2.60	-	0.68
August	2.98	1.99	-	0.95	2.97	-	2.56	1.17
September	2.44	2.36	2.09	-	1.88	1.98	2.45	0.79
October	-	1.04	2.25	-	-	1.22	2.10	0.94
November	-	-	-	-	-	-	3.58	-
December	-	-	-	-	-	-	-	-
All months	3.20	1.88	1.15	1.73	2.09	2.22	2.59	1.08
May - Oct	3.06	1.88	1.15	1.66	2.09	2.22	2.51	1.08
	2.83	1.62	1.66	1.61	2.06	2.09	3.12	1.04

Table 4.20 (cont'd)

Month	1980	1981	1982	1983	1984	1985	1986	1987
Catch (tonnes)								
<b>USSR</b>								
January	2,927	-	8,003	-	-	-	1,069	-
February	2,153	-	-	-	-	-	3,622	2,423
March	16,811	3,886	375	-	-	-	463	1,483
April	36,284	45,645	618	-	1,782	62	529	9,182
May	125,988	88,754	46,089	15,188	6,131	3,289	455	5,104
June	114,117	78,727	27,617	7,919	16,564	25,031	27,967	31,833
July	121,463	87,582	6,820	1,172	11,842	33,177	47,485	34,022
August	114,505	63,889	-	-	15,609	20,969	32,608	23,594
September	79,504	37,960	2,921	-	492	5,311	9,269	6,256
October	50,954	11,560	1,121	-	-	-	1,812	2,944
November	17,543	4,778	379	-	-	-	966	-
December	1,292	10,704	-	-	-	-	268	-
All months	683,541	433,485	93,943	24,279	52,420	87,839	126,520	111,995
May - Oct	606,531	368,472	84,568	24,279	50,638	87,777	119,596	103,753
Effort (hours)								
January	-	-	1,045	-	-	-	622	-
February	339	-	-	-	-	-	1,013	1,093
March	6,151	1,208	285	-	-	-	135	437
April	16,119	12,666	256	-	222	68	119	2,578
May	25,244	25,912	17,106	7,300	2,247	1,900	160	2,001
June	47,634	37,919	14,209	6,094	5,160	9,550	8,616	13,790
July	42,319	39,039	5,983	1,963	4,315	11,600	16,490	14,734
August	28,293	29,528	-	-	5,292	7,350	16,014	9,526
September	17,499	11,745	640	-	194	2,360	5,252	3,087
October	16,072	3,270	341	-	-	-	1,579	1,581
November	5,710	1,455	161	-	-	-	544	-
December	413	4,263	-	-	-	-	255	-
All months	206,372	167,005	40,026	15,357	17,430	32,828	50,799	48,827
May - Oct	177,061	147,413	38,279	15,357	17,208	32,760	48,111	44,719
CPUE (tonnes/hour)								
January	-	-	7.66	-	-	-	1.72	-
February	6.35	-	-	-	-	-	3.58	2.22
March	2.73	3.22	1.32	-	-	-	3.43	3.40
April	2.25	3.60	2.41	-	8.01	0.91	4.44	3.57
May	4.99	3.42	2.69	2.08	2.73	1.56	2.84	2.55
June	2.39	2.08	1.94	1.30	3.21	2.62	3.25	2.31
July	2.87	2.24	1.14	0.60	2.74	2.86	2.88	2.31
August	4.05	2.16	-	-	2.95	2.84	2.04	2.50
September	4.54	3.23	4.56	-	2.54	2.25	1.77	2.03
October	3.17	3.53	3.29	-	-	-	1.15	1.86
November	3.07	3.28	2.35	-	-	-	1.78	-
December	3.13	2.51	-	-	-	-	1.05	-
All months	3.31	2.60	2.35	1.58	3.01	2.68	2.49	2.29
May - Oct (1)	3.43	2.50	2.21	1.58	2.94	2.68	2.49	2.32
(2)	3.14	3.67	2.78	2.72	1.33	2.83	2.17	2.26

(1) CPUE = total catch/total effort.

(2) CPUE =  $\bar{I}$ (monthly CPUE)/no. of months.

Table 4.21

List of input variables for the ICES prediction program.

BLUE WHITING - NORTHERN STOCK

The reference F is the mean F for the age group range from 4 to 8

The number of recruits per year is as follows:

Year	Recruitment
1988	11000.0
1989	11000.0
1990	11000.0

Data are printed in the following units:

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

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
0	11000.0	.04	.20	.00	.021	.021
1	8653.0	.09	.20	.10	.056	.056
2	6475.0	.07	.20	.37	.092	.092
3	8018.0	.10	.20	.81	.109	.109
4	6026.0	.14	.20	.85	.125	.125
5	9907.0	.17	.20	.91	.148	.148
6	5961.0	.22	.20	.94	.178	.178
7	546.0	.25	.20	1.00	.209	.209
8	291.0	.32	.20	1.00	.221	.221
9	249.0	.36	.20	1.00	.222	.222
10	256.0	.50	.20	1.00	.251	.251
11	97.0	.45	.20	1.00	.249	.249
12	57.0	.57	.20	1.00	.252	.252
13	33.0	.32	.20	1.00	.274	.274
14	25.0	.25	.20	1.00	.242	.242
15+	50.0	.25	.20	1.00	.266	.266

Table 4.22

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

## BLUE WHITING - NORTHERN STOCK

Year 1988					Year 1989					Year 1990		
fac- tor	ref. F	stock biomass	sp.stock biomass	catch	fac- tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass	
.8	.17	5831	4314	600	.0	.00	5640	4235	0	6026	4634	
					.1	.02			85	5936	4552	
					.2	.04			169	5848	4472	
					.4	.09			330	5676	4318	
					.6	.13			486	5511	4169	
					.8	.17			631	5358	4032	
					.8	.18			636	5352	4027	
					1.0	.22			780	5200	3890	
					1.2	.26			918	5053	3759	
					1.4	.31			1052	4912	3633	
					1.6	.35			1180	4776	3512	
					1.8	.40			1303	4645	3396	
					2.0	.44			1422	4518	3284	

The data unit of the biomass and the catch is 1000 tonnes.

The spawning stock biomass is given for 1 January.

The reference F is the mean F for the age group range from 4 to 8

Table 4.23

## Results

09.41.36 18 OCTOBER 1988  
 BLUE WHITING - NORTHERN STOCK

\*\*\*\*\*  
 \* Year 1988, F-factor .793 and reference F .1744 \*  
 \*-----\*  
 \* Run depending on a TAC value \*  
 \*\*\*\*\*

								-----+-----	
								at 1 January	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass		
0	.0317	311.29	6.537	11000.0	231.00	.0	.00		
1	.0713	540.60	30.274	8653.0	484.57	865.3	48.46		
2	.0555	317.03	29.166	6475.0	595.70	2395.8	220.41		
3	.0785	549.15	59.857	8018.0	873.96	6494.6	707.91		
4	.1086	563.01	70.377	6026.0	753.25	5122.1	640.26		
5	.1379	1159.40	171.591	9907.0	1466.24	9015.4	1334.27		
6	.1720	856.17	152.397	5961.0	1061.06	5603.3	997.39		
7	.2005	90.22	18.856	546.0	114.11	546.0	114.11		
8	.2528	59.17	13.077	291.0	64.31	291.0	64.31		
9	.2845	56.15	12.466	249.0	55.28	249.0	55.28		
10	.3923	75.79	19.023	256.0	64.26	256.0	64.26		
11	.3575	26.58	6.619	97.0	24.15	97.0	24.15		
12	.4478	18.79	4.735	57.0	14.36	57.0	14.36		
13	.2513	6.67	1.828	33.0	9.04	33.0	9.04		
14	.2005	4.13	1.000	25.0	6.05	25.0	6.05		
15+	.2005	8.26	2.198	50.0	13.30	50.0	13.30		
Total		4642.41	600.000	57644.0	5830.64	31100.4	4313.58		

cont'd.

Table 4.23 cont'd.

\*\*\*\*\*  
 \* Year 1989, F-factor 1.000 and reference F .2200 \*  
 \*\*\*\*\*

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January	
						sp.stock size	sp.stock biomass
0	.0400	391.18	8.215	11000.0	231.00	.0	.00
1	.0900	681.64	38.172	8725.0	488.60	872.5	48.86
2	.0700	404.68	37.231	6596.7	606.90	2440.8	224.55
3	.0990	429.15	46.777	5015.2	546.65	4062.3	442.79
4	.1370	705.87	88.234	6069.2	758.65	5158.8	644.85
5	.1740	642.50	95.091	4426.0	655.05	4027.7	596.09
6	.2170	1253.83	223.182	7066.2	1257.79	6642.3	1182.32
7	.2530	836.03	174.731	4109.3	858.84	4109.3	858.84
8	.3190	91.03	20.118	365.8	80.84	365.8	80.84
9	.3590	50.88	11.296	185.0	41.08	185.0	41.08
10	.4950	54.72	13.735	153.4	38.50	153.4	38.50
11	.4510	46.93	11.685	141.6	35.25	141.6	35.25
12	.5650	21.94	5.528	55.5	14.00	55.5	14.00
13	.3170	7.38	2.023	29.8	8.17	29.8	8.17
14	.2530	4.28	1.035	21.0	5.09	21.0	5.09
15+	.2530	10.22	2.719	50.2	13.37	50.2	13.37
Total		5632.28	779.772	54010.0	5639.76	28316.0	4234.59

\*\*\*\*\*  
 \* Year 1990, F-factor 1.000 and reference F .2200 \*  
 \*\*\*\*\*

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January	
						sp.stock size	sp.stock biomass
0	.0400	391.18	8.215	11000.0	231.00	.0	.00
1	.0900	676.01	37.857	8652.9	484.56	865.3	48.46
2	.0700	400.50	36.846	6528.6	600.63	2415.6	222.23
3	.0990	430.92	46.970	5035.8	548.90	4079.0	444.61
4	.1370	432.54	54.068	3719.0	464.88	3161.2	395.15
5	.1740	628.98	93.089	4332.8	641.26	3942.9	583.55
6	.2170	540.30	96.174	3045.0	542.01	2862.3	509.49
7	.2530	947.43	198.013	4656.8	973.27	4656.8	973.27
8	.3190	650.10	143.673	2612.3	577.33	2612.3	577.33
9	.3590	59.87	13.291	217.7	48.33	217.7	48.33
10	.4950	37.74	9.474	105.8	26.55	105.8	26.55
11	.4510	25.37	6.318	76.5	19.06	76.5	19.06
12	.5650	29.16	7.347	73.8	18.61	73.8	18.61
13	.3170	6.40	1.753	25.8	7.08	25.8	7.08
14	.2530	3.62	.876	17.8	4.30	17.8	4.30
15+	.2530	9.22	2.452	45.3	12.05	45.3	12.05
Total		5269.34	756.414	50146.1	5199.82	25158.2	3890.06

**Table 5.1** Landings (tonnes) of BLUE WHITING from the southern areas (Sub-areas VIII and IX and Divisions VIIg-k and VIId,e and since 1984, the Divisions VIIg-k are not included), 1978-1987, as estimated by the Working Group.

Country	1978	1979	1980	1981	1982
Germany, Fed.Rep	25	-	-	-	-
Ireland	-	1	-	-	-
Netherlands	7	-	31	633	200
Poland	53	-	-	-	-
Portugal	2,381	2,096	6,051	7,387	3,890
Spain	31,428	25,016	23,862	30,728	27,500
UK (Scotland)	-	63	-	-	-
USSR	4	-	-	-	-
<b>Total</b>	<b>33,898</b>	<b>27,176</b>	<b>29,944</b>	<b>38,748</b>	<b>31,590</b>

Country	1983	1984	1985	1986	1987 <sup>1</sup>
Germany, Fed.Rep.	50	-	-	-	-
Ireland	-	-	-	-	-
Netherlands	-	-	-	-	-
Norway	-	-	-	-	4
Poland	-	-	-	-	-
Portugal	4,748	5,252	6,989	8,116	9,148
Spain	26,037	25,921	35,828	24,965	23,644
UK (Scotland)	-	-	-	-	-
USSR	-	-	-	-	-
<b>Total</b>	<b>30,835</b>	<b>31,173</b>	<b>42,817</b>	<b>33,081</b>	<b>32,796</b>

<sup>1</sup> Preliminary.

<sup>2</sup> Significant quantities taken in Divisions VIIg-k not included in the table are discarded every year.

**Table 5.2** Catch in numbers (thousands) by length group in the Portuguese and Spanish blue whiting fisheries, 1983-1987.

Length (cm)	1983	1984	1985	1986	1987
10	-	-	8	-	1
1	-	3	25	-	33
2	13	41	39	118	37
3	253	337	74	783	1,130
4	1,390	13,263	498	5,903	16,889
5	18,613	48,364	13,013	7,234	44,625
6	63,241	88,023	31,407	6,394	39,111
7	67,446	142,003	73,885	16,669	52,790
8	95,625	154,385	181,222	49,746	102,112
9	97,379	128,950	235,008	82,458	131,911
20	81,201	91,952	211,958	99,258	116,195
1	66,757	69,370	127,966	126,338	71,862
2	58,748	44,241	69,313	107,413	46,724
3	43,069	27,623	28,905	57,835	35,691
4	25,651	16,420	11,842	23,594	20,522
5	10,990	7,744	5,946	9,840	11,696
6	5,221	3,309	3,089	3,759	7,461
7	3,670	1,194	1,263	2,033	3,717
8	2,855	854	899	1,091	1,965
9	1,465	800	622	473	994
30	1,381	199	296	308	918
1	342	216	205	165	177
2	58	103	172	174	119
3	8	117	64	255	46
4	1	16	54	269	30
5	4	22	23	167	12
6	-	32	15	67	6
7	4	20	6	80	1
8	-	2	2	56	5
9	8	2	2	1	-
40	-	4	3	8	-
1	-	-	3	-	-
2	-	-	1	-	-
3	-	2	1	-	-
4	-	-	-	-	-
5	-	-	-	-	-
6	-	-	-	-	-
7	-	-	-	-	-
8	-	-	1	-	-
9	-	-	-	-	-
50	-	-	-	-	-
Total N	645,393	839,611	997,830	602,489	707,780
Landings (t)	30,785	31,173	42,817	33,083	32,792



**Table 5.3** Catch in numbers (millions) by age group in the Portuguese and Spanish blue whiting fisheries, 1981-1987.

Age	1981	1982	1983	1984	1985	1986	1987
0	48.0	61.1	98.0	73.9	118.3	32.4	105.3
1	189.1	102.5	149.7	223.2	285.9	93.2	382.6
2	226.2	183.5	238.5	349.0	337.2	218.2	110.6
3	166.4	121.8	68.2	127.4	170.5	167.6	61.6
4	50.0	64.3	45.1	35.0	65.9	68.1	28.2
5	25.9	22.1	34.0	13.2	13.6	15.1	13.4
6	3.0	3.2	8.8	13.8	3.0	5.7	3.4
7	0.2	0.3	2.3	3.3	2.4	1.0	1.0
8+	0.2	1.0	0.8	0.8	1.1	1.0	1.0
<b>Total</b>	<b>709</b>	<b>559.9</b>	<b>645.4</b>	<b>839.6</b>	<b>997.8</b>	<b>602.5</b>	<b>707.1</b>
<b>Nominal (t)</b>	<b>38,115</b>	<b>31,390</b>	<b>30,785</b>	<b>31,173</b>	<b>42,817</b>	<b>33,083</b>	<b>32,792</b>
<b>SOP</b>	<b>37,624</b>	<b>33,660</b>	<b>31,805</b>	<b>31,370</b>	<b>42,839</b>	<b>33,981</b>	<b>32,792</b>
<b>w (g)</b>	<b>53.1</b>	<b>60.0</b>	<b>49.3</b>	<b>37.4</b>	<b>44.0</b>	<b>56.4</b>	<b>46.4</b>

**Table 5.4** Mean length and mean weights of BLUE WHITING landed by Portugal and Spain in the period 1981-1987.

Age	1981		1982		1983		1984		1985		1986		1987	
	$\bar{L}$	$\bar{w}$	$\bar{L}$	$\bar{w}$	$\bar{L}$	$\bar{w}$	$\bar{L}$	$\bar{w}$	$\bar{L}$	$\bar{w}$	$\bar{L}$	$\bar{w}$	$\bar{L}$	$\bar{w}$
0	18.0	37.6	17.3	32	16.5	28.6	15.7	21.6	17.2	28.6	16.8	26.3	17.3	28.9
1	19.7	48.1	19.5	45	18.3	39.0	17.3	28.7	18.7	36.9	19.4	41.7	19.0	39.0
2	20.1	50.6	21.7	61	19.5	46.5	18.4	34.6	19.6	43.4	20.8	52.1	21.6	58.8
3	21.0	57.6	22.5	69	21.9	65.8	20.8	50.5	20.5	49.9	22.1	63.2	23.0	71.8
4	22.2	67.7	23.4	77	23.0	75.6	22.8	65.9	21.9	61.2	23.1	72.8	24.2	84.5
5	22.6	69.9	24.2	85	23.8	84.4	24.0	77.0	23.2	73.4	24.7	90.2	25.1	94.9
6	24.1	83.7	25.8	103	25.6	104.5	24.4	81.1	25.8	103.9	25.3	97.4	26.8	117
7	30.0	154.5	29.8	156	27.1	123.5	25.7	94.1	26.4	111.6	29.3	155.6	28.2	137
8+	32.9	200.4	35.8	269	28.7	145.4	28.7	131.4	28.3	139.1	34.3	257.4	29.6	160.8

Table 5.5 Catch per unit effort by Spanish vessels landing in the main Galician ports, 1977-1987.

Year	Landings (tonnes)	Effort (days fishing)	CPUE (kg/day)
1977	18,449	15,515	1,189
1978	22,286	16,059	1,388
1979	19,507	20,748	953
1980	18,478	17,229	1,072
1981	23,577	19,112	1,234
1982	20,940	19,320	1,084
1983	23,042	19,948	1,155
1984	22,305	19,015	1,173
1985	30,585	19,209	1,592
1986	19,929	17,985	1,108
1987	19,000	18,358	1,035

Table 5.6 Catch per unit effort by Spanish single and pair trawlers landing in the main Galician ports, 1983-1987.

Year	Landings (tonnes)	Effort (days fishing)	CPUE (kg/day)
<u>Single trawlers</u>			
1983	16,813	18,071	930
1984	10,580	15,004	705
1985	15,752	14,616	1,078
1986	7,182	12,643	568
1987	4,843	13,190	367
<u>Pair trawlers</u>			
1983	6,228	1,877	3,318
1984	11,726	4,011	2,924
1985	14,833	4,593	3,230
1986	12,747	5,341	2,387
1987	14,154	5,168	2,739

Table 5.7

SOUTHERN BLUE WHITING TUNING DATA

101

cpue Spanish Trawl

81,87

1,1

0,7

1,1714,6109, 7081,5110,1550, 809, 86,6

1,1512,3201, 6608,4962,3979,1998,249,9

1,2780,5025, 8283,2635,1777,1328,315,68

1,2416,7290,12205,5115,1472, 556,582,138

1,4039,9274,13795,7760,3513, 748,154,131

1, 706,1934, 5687,5530,2812, 607,246,40

1,1911,9794, 4317,2563,1307, 529,122,40

Table 5.8

Title : BLUE WHITING, SOUTH SEA AREA

At 11.37.40 26 SEPTEMBER 1988

from 81 to 87 on ages 0 to 7

with Terminal F of .720 on age 2 and Terminal S of 1.000

Initial sum of squared residuals was 44.617 and  
final sum of squared residuals is 8.901 after 49 iterations

Matrix of Residuals

---

Years	81/82	82/83	83/84	84/85	85/86	86/87		WTS
Ages								
0/ 1	.016	.264	.368	-.215	1.259	-1.691	.000	.296
1/ 2	.173	-.310	-.323	.010	.547	-.098	.000	.874
2/ 3	-.368	.452	.044	-.021	-.232	.125	.000	1.000
3/ 4	-.201	.307	-.079	-.261	-.213	.447	.000	.953
4/ 5	-.453	-.155	.366	-.106	.199	.149	.000	.972
5/ 6	.646	-.033	-.124	.262	-.581	-.171	.000	.688
6/ 7	.760	-.723	-.125	.471	-.398	.015	.000	.524
	.000	.000	.000	.000	.000	.000	.000	
WTS	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	81	82	83	84	85	86	87
F-values	.7169	.5490	.6209	.7415	.8622	.9025	.7200

Selection-at-age (S)

	0	1	2	3	4	5	6	7
S-values	.0931	.3672	1.0000	1.1830	1.3242	1.4352	1.3368	1.0000

Table 5.9 VIRTUAL POPULATION ANALYSIS

BLUE WHITING, SOUTHERN AREA

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

	1981	1982	1983	1984	1985	1986	1987	1981-87
0	.05	.05	.08	.08	.23	.02	.07	.08
1	.36	.15	.16	.26	.50	.28	.43	.31
2	.64	.71	.60	.70	.79	.91	.64	.71
3	.70	.90	.64	.76	.92	1.30	.72	.85
4	.69	.65	1.06	.81	1.26	1.31	.80	.94
5	1.24	.77	.89	1.13	.90	1.21	1.05	1.03
6	1.29	.47	.82	1.24	.87	1.34	1.06	1.01
7	.71	.40	.74	.88	.75	.83	.93	.75
8+	.71	.40	.74	.88	.75	.83	.93	.75
( 0- 3)W	.34	.24	.23	.35	.56	.33	.26	
( 4- 7)W	.85	.67	.96	.95	1.15	1.29	.88	

Table 5.10 VIRTUAL POPULATION ANALYSIS

BLUE WHITING, SOUTHERN AREA

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: thousand tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE

USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .250  
 PROPORTION OF ANNUAL M BEFORE SPAWNING: .250

	1981	1982	1983	1984	1985	1986	1987	1988
0	1054	1399	1409	1056	637	1513	1790	0
1	688	820	1090	1066	798	415	1209	1370
2	520	393	579	758	672	397	256	647
3	361	224	158	261	309	249	131	111
4	109	147	75	69	100	101	56	52
5	39	45	63	21	25	23	22	21
6	4	9	17	21	6	8	6	6
7	0	1	5	6	5	2	2	2
8+	0	3	2	1	2	2	2	1
TOTAL NO	2777	3041	3397	3258	2553	2711	3473	
SPS NO	689	604	643	736	681	460	446	
TOT. BIOM	131	138	134	101	102	105	132	
SPS BIOM	39	40	35	31	33	28	26	

Table 6.1 Total catches of BLUE WHITING in 1978-1987 divided into areas within and beyond areas of national fisheries jurisdiction of NEAFC contracting parties. Percentage in ( ).

Year	Inter-national	Svalbard	Jan Mayen	Norway	Iceland	Greenland	Faroes	EEC	Total (t)	Total from off. data (t)	%
1978	136,504 (25.52)	-	-	67,391 (12.60)	26,444 (4.94)	6,580 (1.23)	195,361 (36.53)	102,523 (19.17)	534,803	574,812	93.0
1979	614,734 (56.18)	-	-	75,545 (6.90)	15,117 (1.38)	204 (0.02)	224,201 (20.49)	164,388 (15.02)	1,094,189	1,091,422	100.3
1980	567,693 (55.23)	-	-	152,095 (14.80)	4,562 (0.44)	8,757 (0.85)	164,342 (15.99)	130,417 (12.69)	1,027,866	1,092,620	94.1
1981	168,681 (19.76)	-	123,000 (14.41)	215,004 (25.18)	7,751 (0.91)	-	174,801 (20.48)	164,475 (19.27)	853,712	870,808	98.0
1982	22,993 (4.32)	-	-	130,435 (24.51)	5,797 (1.09)	-	125,072 (23.50)	247,884 (46.58)	532,181	544,919	97.7
1983	15,203 (2.93)	-	-	109,675 (21.15)	7,000 (1.35)	-	91,804 (17.70)	294,981 (56.87)	518,663	539,235	96.2
1984	18,407 (3.19)	-	-	150,603 (26.13)	105 (0.02)	-	124,905 (21.67)	282,418 (48.99)	576,438	586,504	98.3
1985	38,978 (6.07)	-	-	114,785 (17.88)	-	-	196,003 (30.52)	292,345 (45.53)	642,111	644,899	99.6
1986	20,665 (2.74)	-	-	187,768 (24.87)	-	116 (0.02)	171,074 (22.66)	375,257 (49.71)	754,880	757,370	99.7
1987	103,535 (17.76)	-	-	109,201 (18.74)	-	-	135,980 (23.31)	234,249 (40.19)	582,830	631,610	92.3



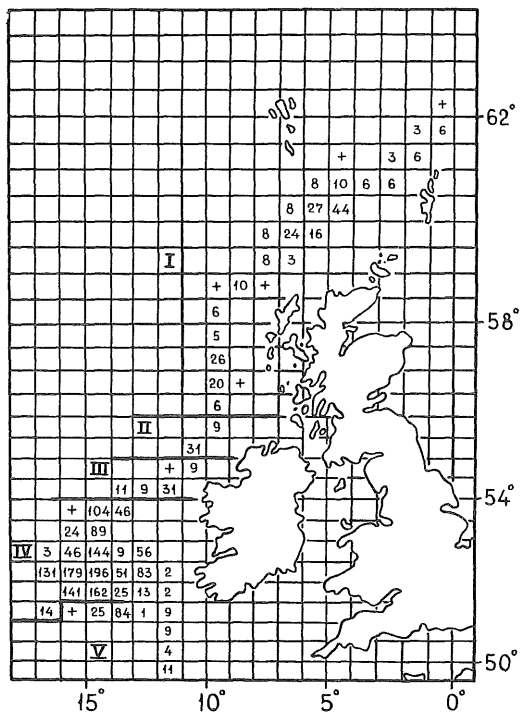


Figure 4.1 Distribution of blue whiting biomass ('000 t) observed during the first USSR survey in spring of 1988 (4-27 March).

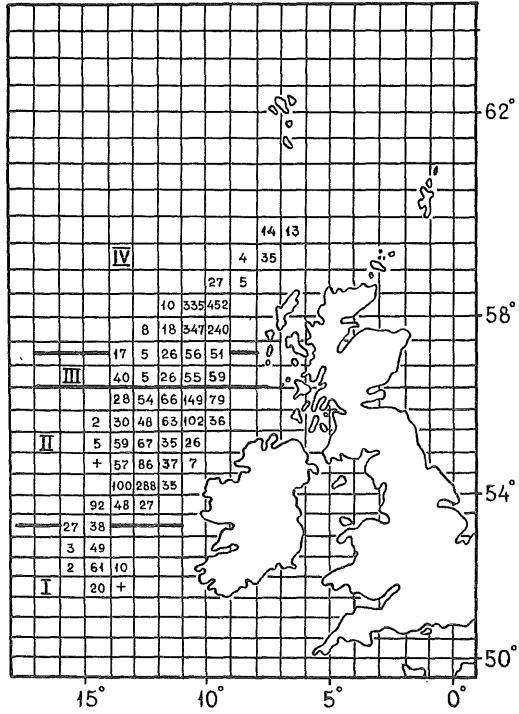


Figure 4.2 Distribution of blue whiting biomass ('000 t) observed during the second USSR survey in spring of 1988 (28 March - 21 April).

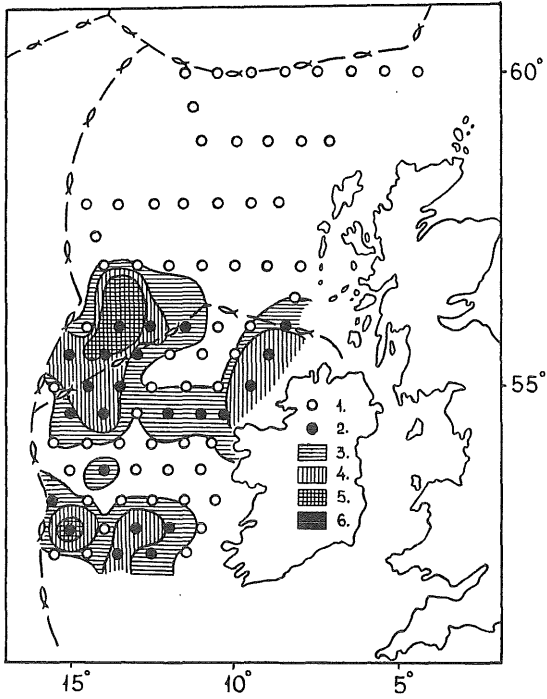


Figure 4.3 Distribution of larval blue whiting (ind./m<sup>2</sup>) during the second USSR survey (28 March - 21 April)

- 1 = negative fishing set
- 2 = positive fishing set
- 3 = 1-10 fish/m<sup>2</sup>
- 4 = 11-100 fish/m<sup>2</sup>
- 5 = 101-1000 fish/m<sup>2</sup>
- 6 = over 1000 fish/m<sup>2</sup>

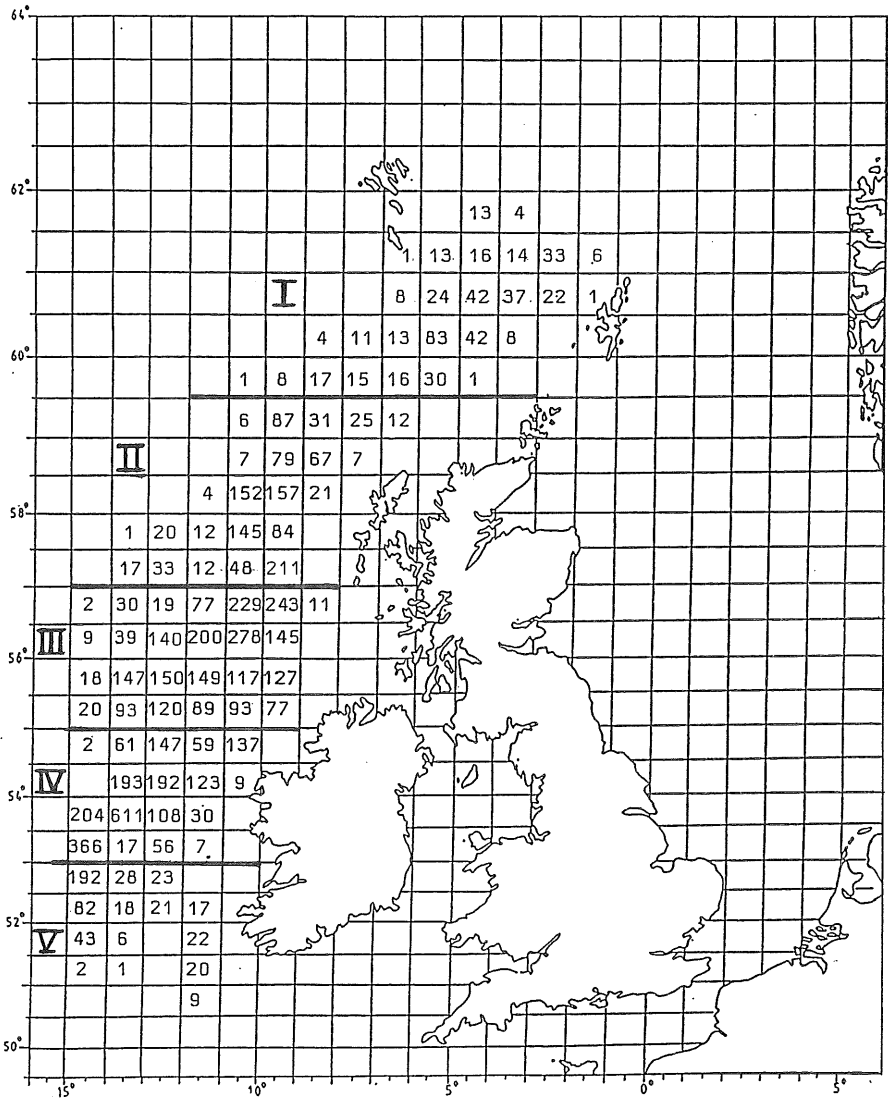


Figure 4.4 Distribution of blue whiting biomass ('000 t) observed during the Norwegian survey in spring of 1988 (25 March - 24 April).

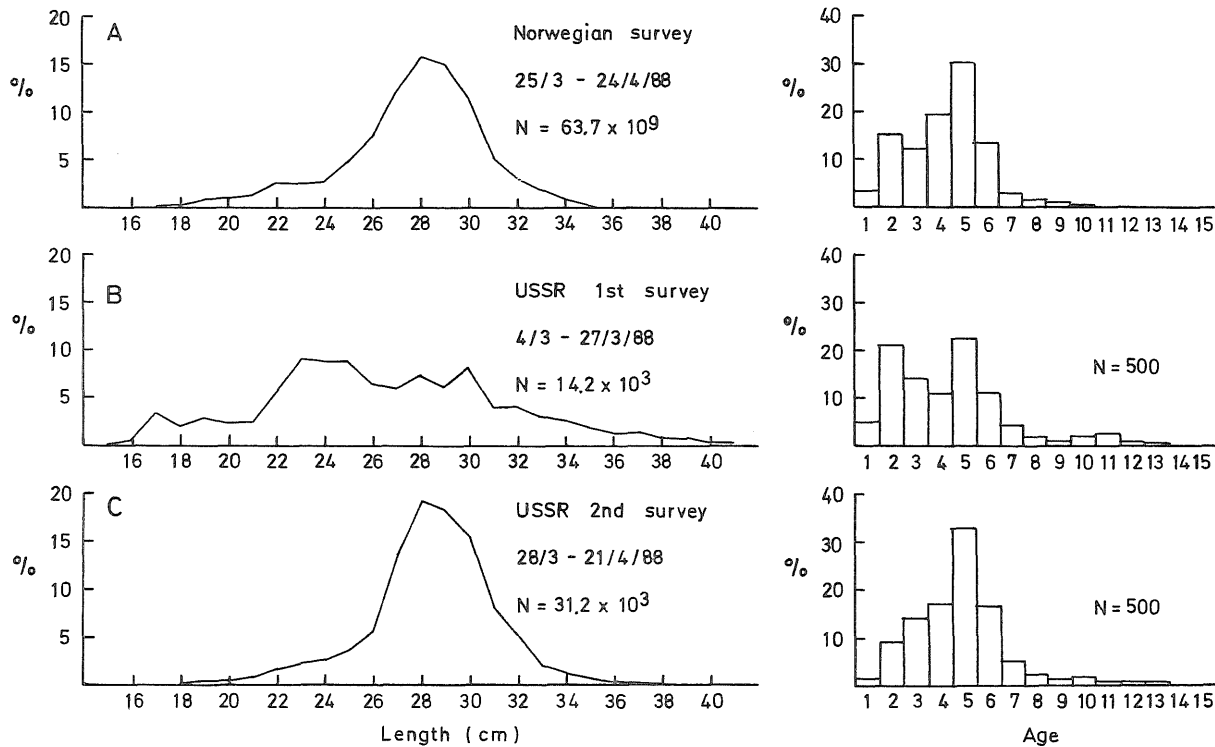


Figure 4.5 Total length and age composition (number) of blue whiting from the area west of the British Isles during spring of 1988.

A: weighted by abundance N (Norway)  
 B-C: number of measured and aged specimens (USSR)

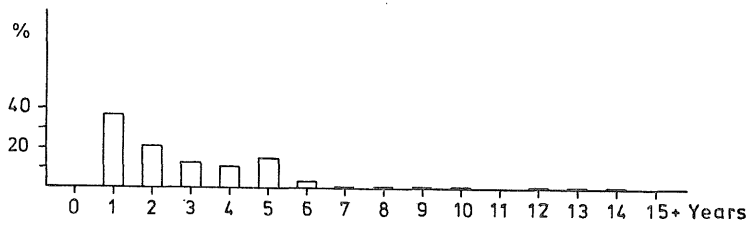
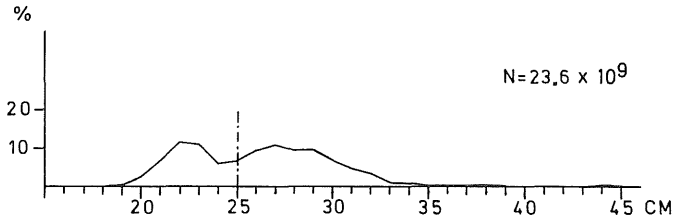


Figure 4.6 Total length and age compositions (number weighted by abundance) of blue whiting from the Norwegian survey in the Norwegian Sea, summer 1988 (18 July - 21 August).

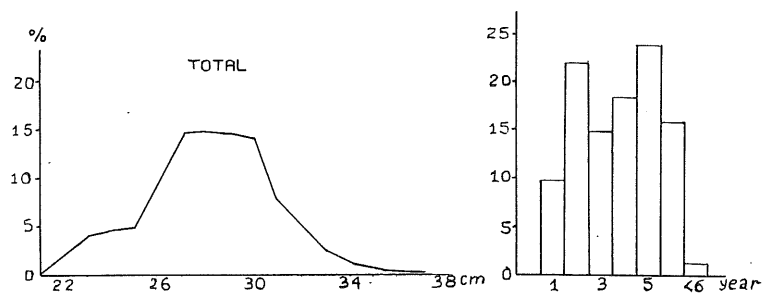
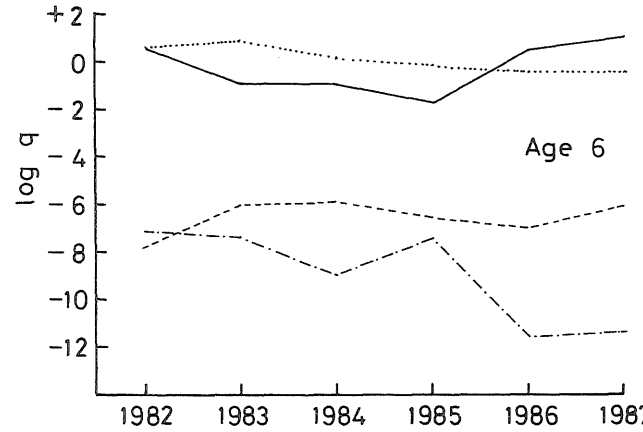
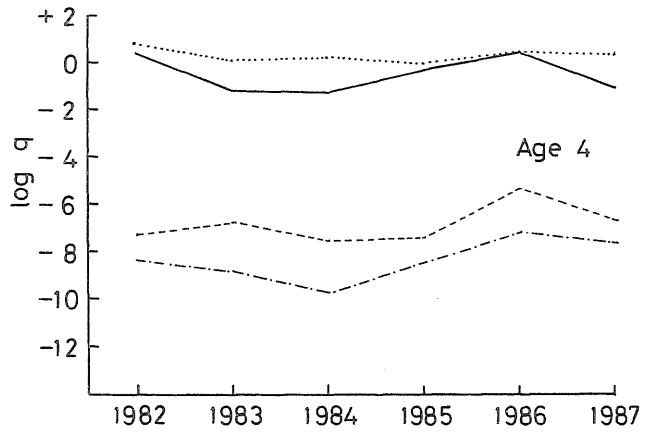
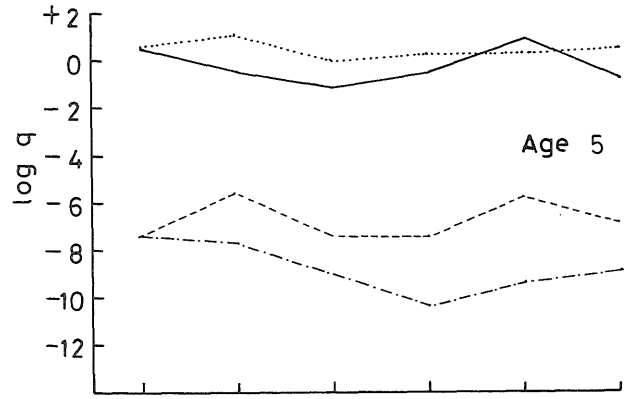
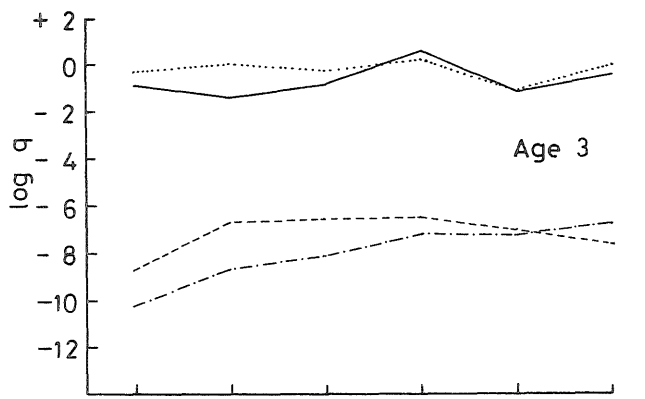


Figure 4.7 Total length and age composition (number of blue whiting from the USSR survey in the Norwegian Sea, summer 1988 (26 July - 19 August)).



— fleet 1    - - - fleet 2    ..... fleet 3    - · - · - fleet 4

Figure 4.8. Log catchability plots for four different fleets for the northern blue whiting stock (see Table 4.12).

cont'd



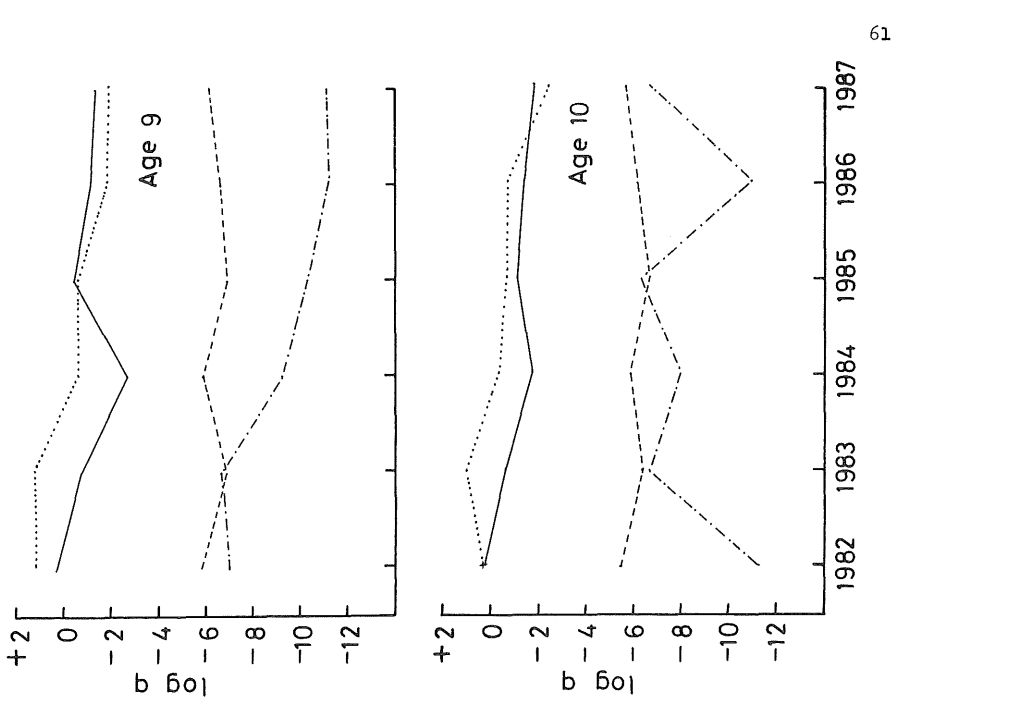


Figure 4.8 cont'd.

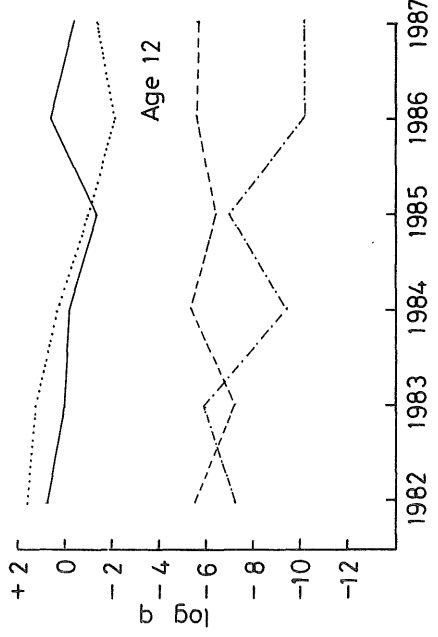
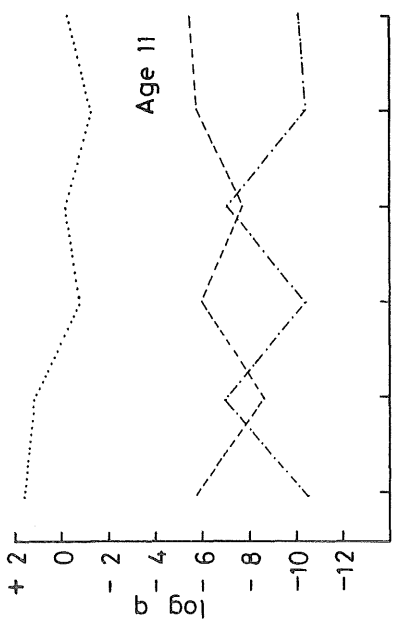
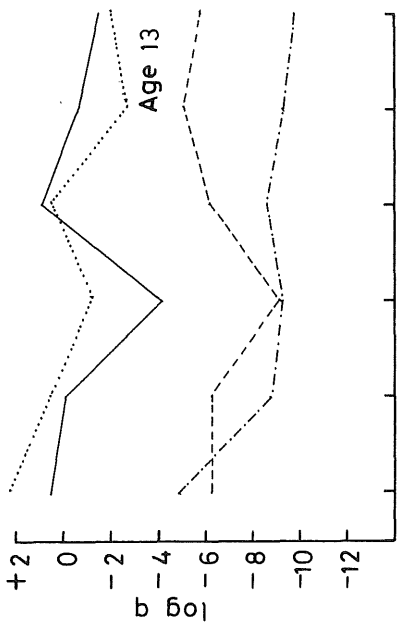


Figure 4.8 cont'd.

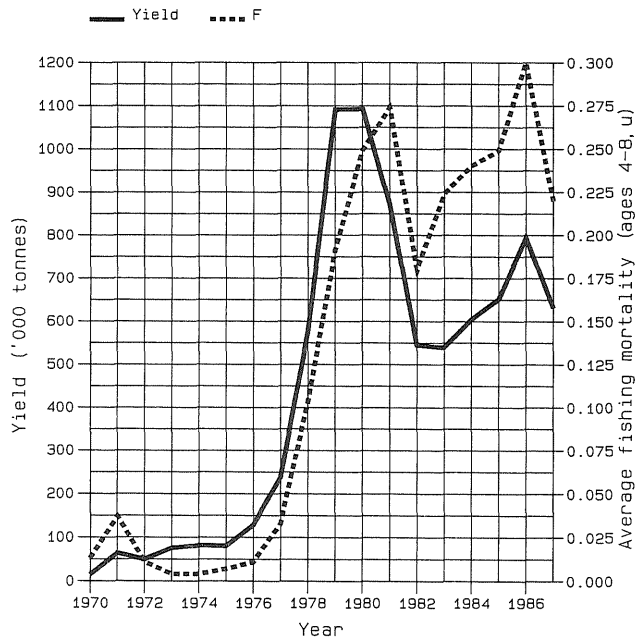
Figure 4.9

# FISH STOCK SUMMARY

## STOCK: Blue Whiting - Northern Area

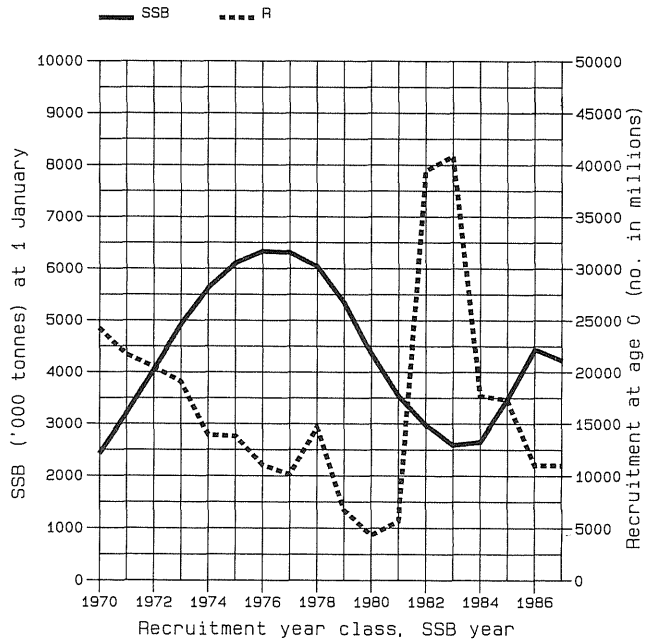
19-10-1988

Trends in yield and fishing mortality (F)



A

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



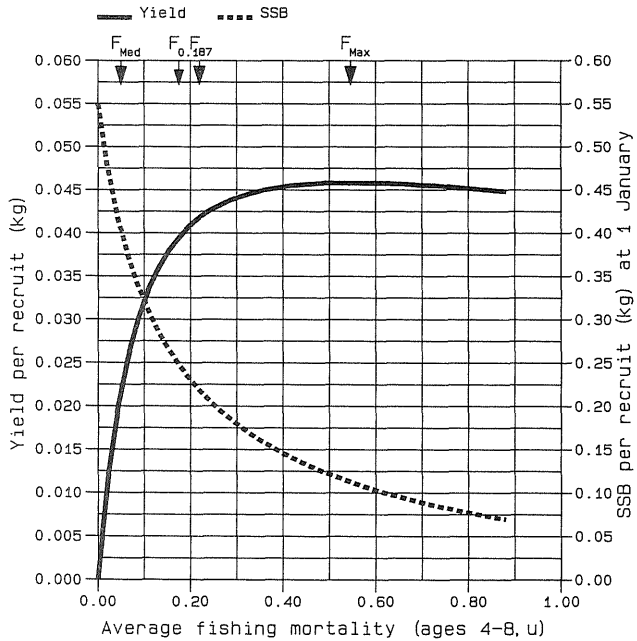
B

etd.

Figure 4.9 (ctd.)

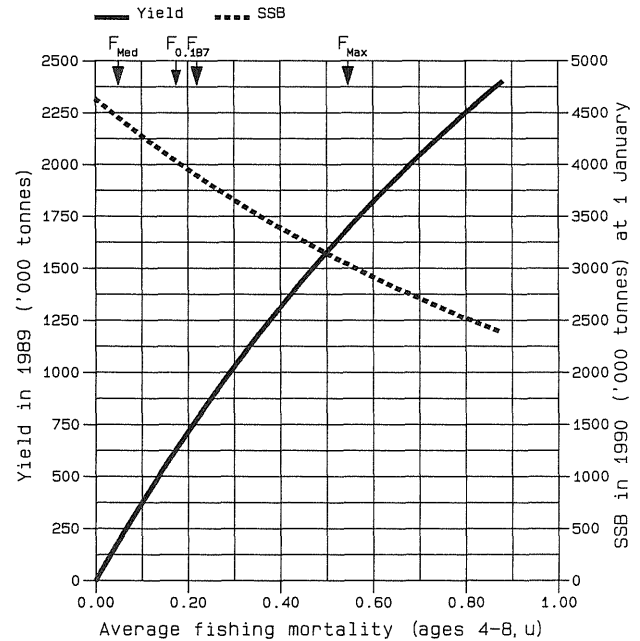
FISH STOCK SUMMARY  
STOCK: Blue Whiting - Northern Area  
19-10-1988

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

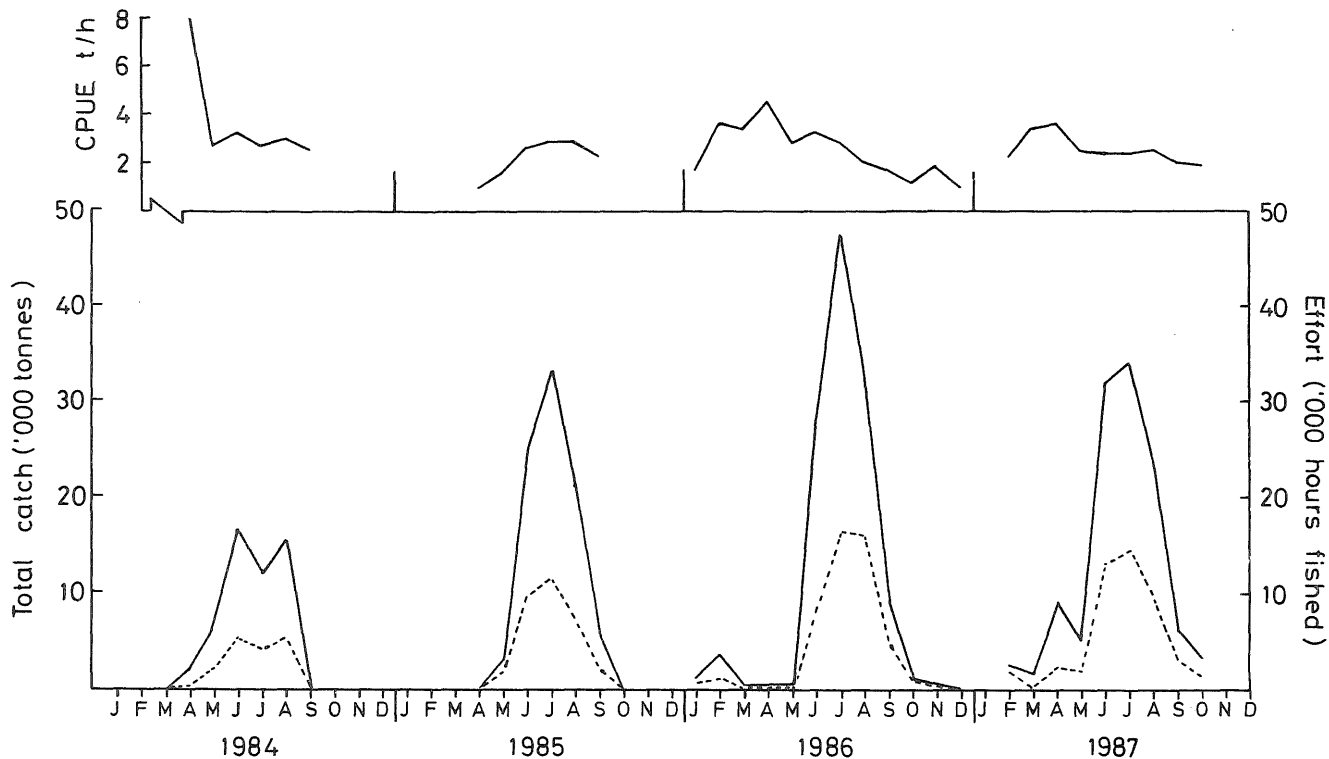


Figure 4.10 Catch, effort, and CPUE by month for the USSR - GRT 2,000-3,999 t vessel class in Division IIa, 1984-1987.

Figure 4.11  $F_{med}$ ,  $F_{high}$  and  $F_{low}$  for the northern blue whiting stock, 1977-1987.

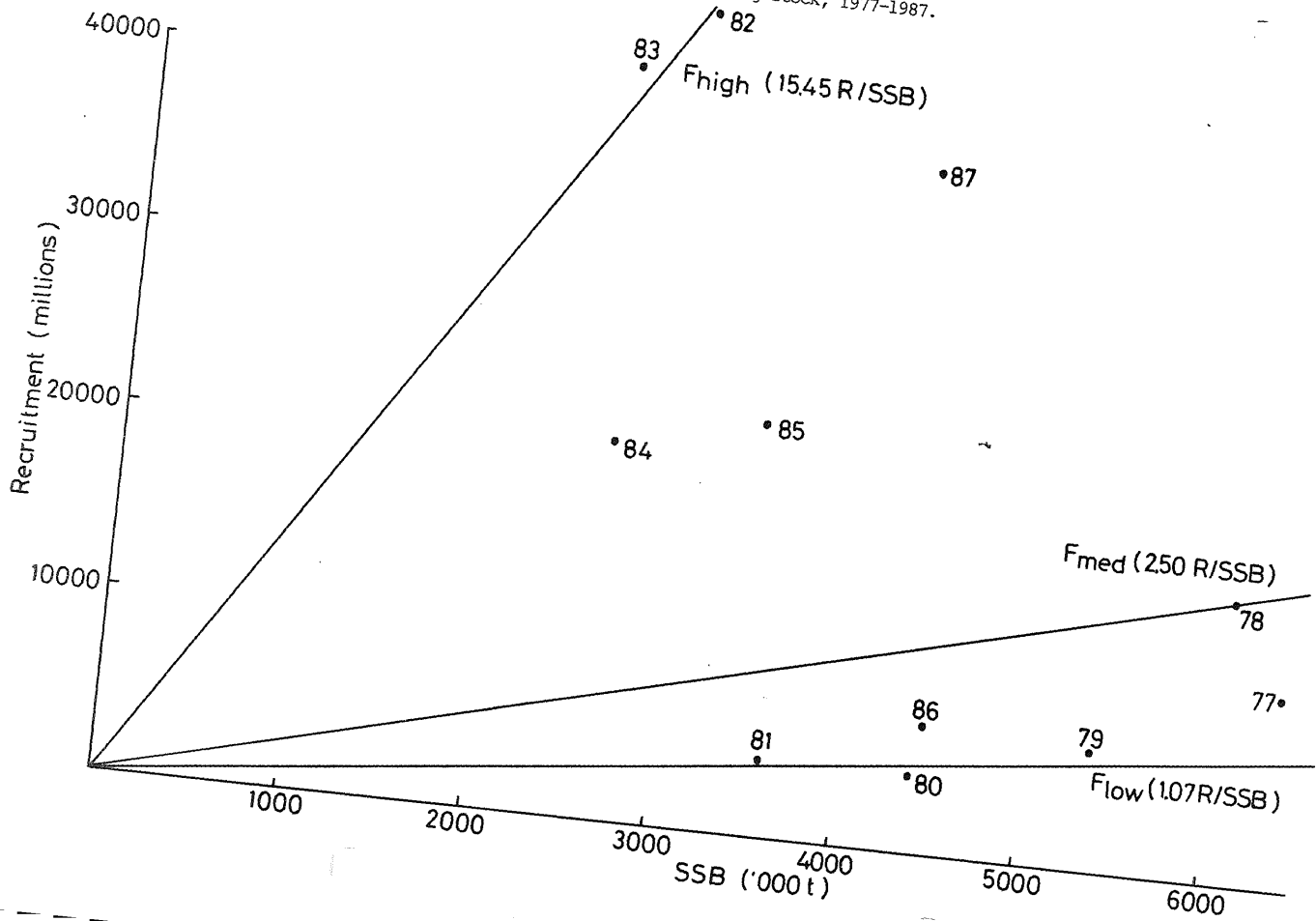


Figure 5.1 Catch, effort, and CPUE of Spanish trawlers for the southern area.

A: Total in the period 1977-1987

B: Split into single and pair trawlers in the period 1983-1987

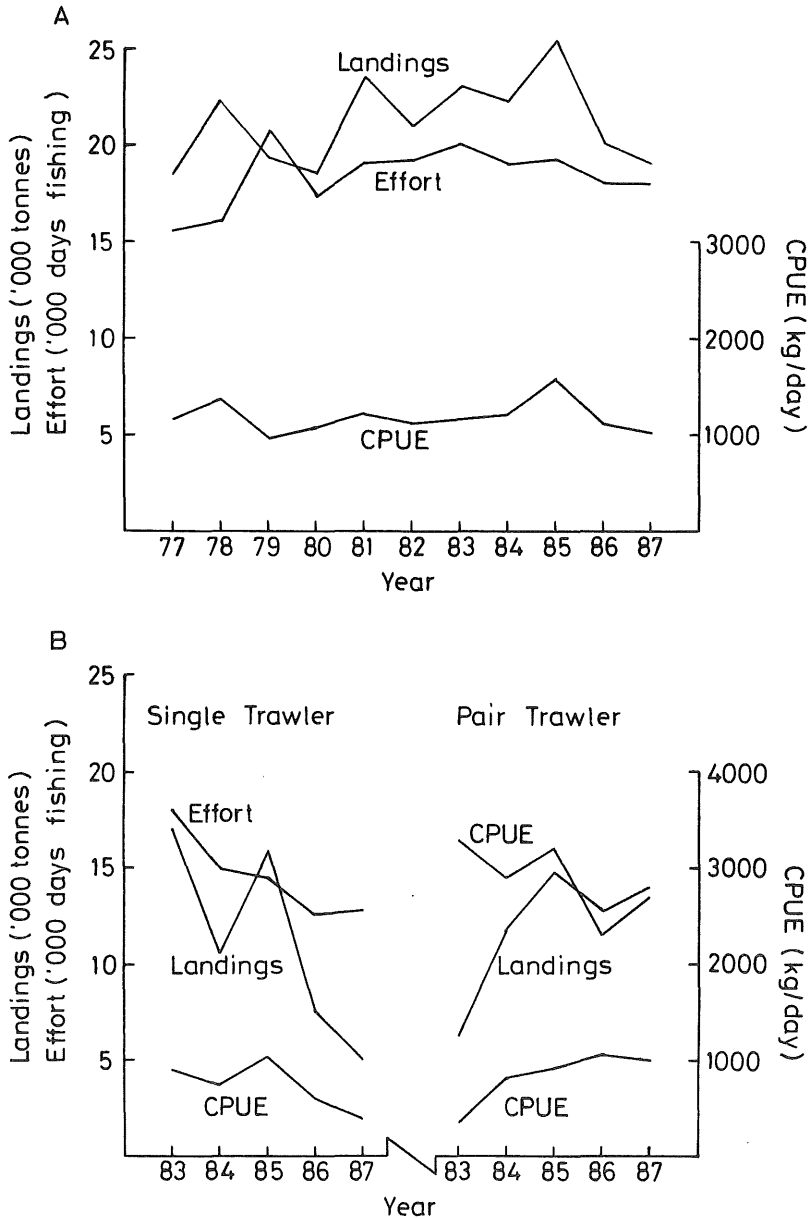
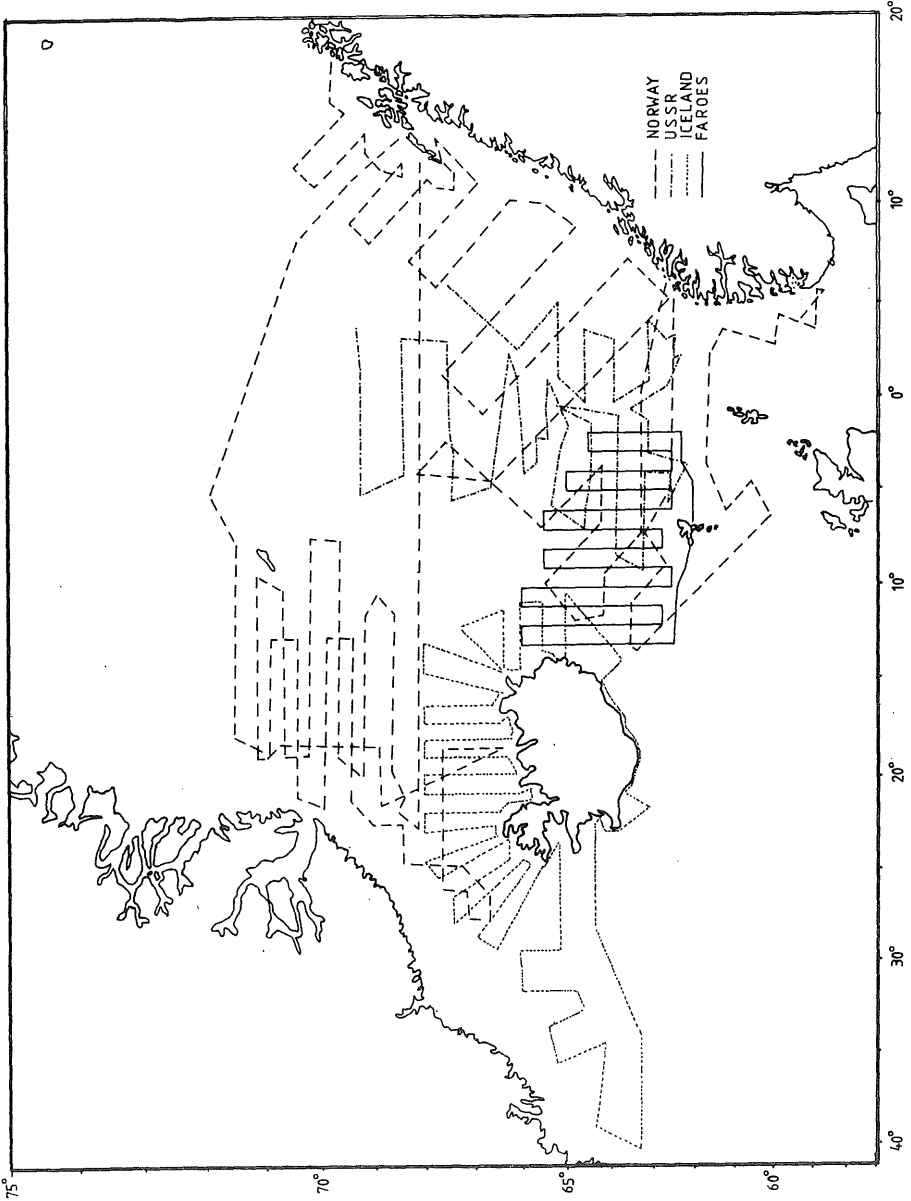
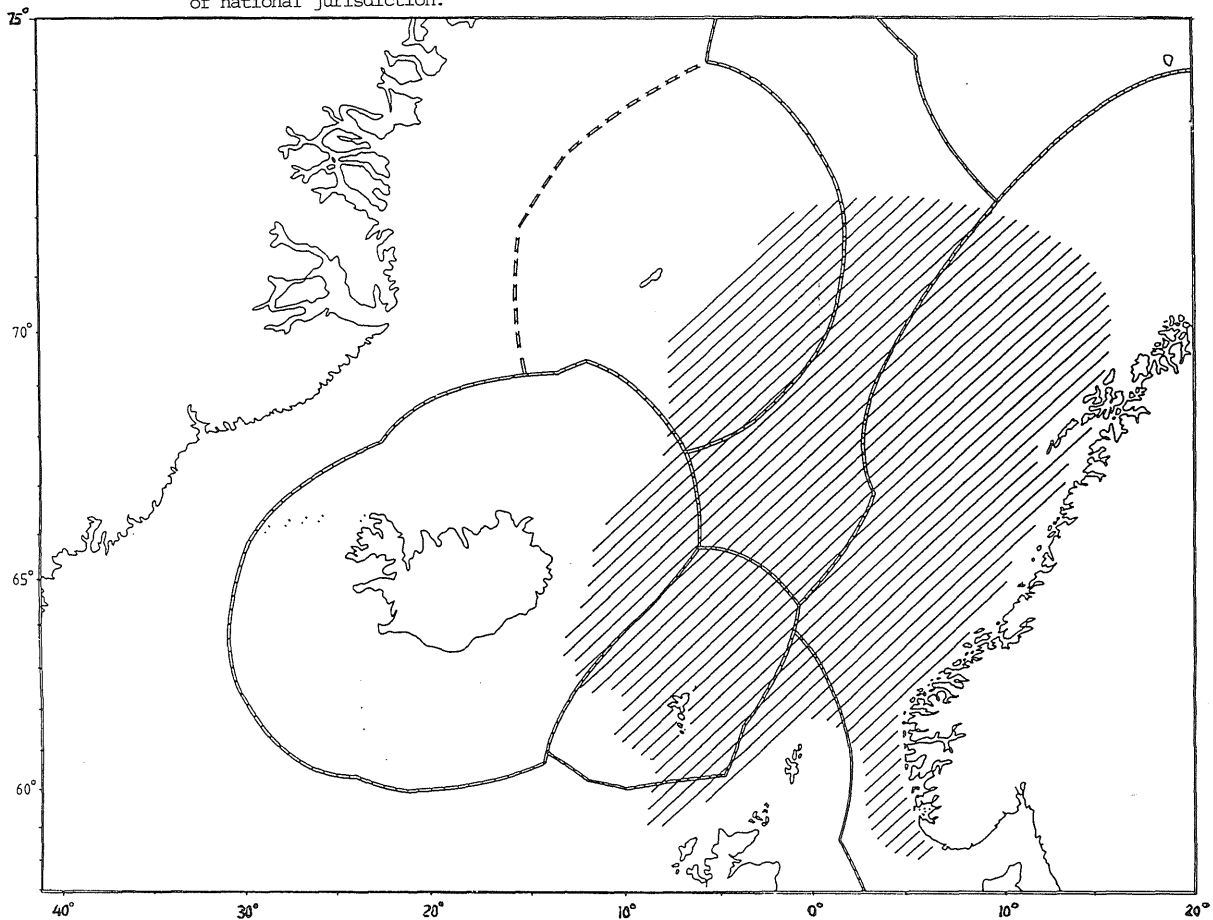


Figure 6.1A Cruise tracks from surveys by Norway, Faroe Islands, USSR, and Iceland during summer 1988.





**Figure 6.1B** Area of blue whiting distribution observed (shaded) during the summer 1988 surveys, together with boundaries of national jurisdiction.



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