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REPORT OF THE BLUE WHITING ASSESSMENT WORKING GROUP

Copenhagen, 16 - 22 September 1987

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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 16-22 September 1987 (C.Res.1986/2:5:24) to assess the status of and provide catch options for 1988 within safe biological limits for the northern and southern blue whiting stocks.

In addition, NEAFC, at its meeting in November 1986, asked ICES to continue the work on the zonal distribution of blue whiting. This request was passed on to the Blue Whiting Assessment Working Group by ACFM.

1.2 Participants

| | |
|-----------------------|----------------------------|
| L. Danke | German Democratic Republic |
| H.J.L. Heessen | Netherlands |
| H. i Jákupsstovu | Faroe Islands |
| B. Kudrin | USSR |
| K.M. Lehmann | Denmark (Greenland) |
| M. Liwoch | Poland |
| M. Meixide | Spain |
| T. Monstad (Chairman) | Norway |
| K.J. Stæhr | Denmark |
| S. Voronovskaya | USSR |

2 STOCK IDENTITY AND STOCK SEPARATION

No investigations on stock identity and stock separation of the blue whiting stocks were reported to the Working Group in 1987.

It was observed, as in previous years, that there were many specimens in the spawning areas to the west of Ireland, which differ by their physiological state and might belong to the southern (or local) population (Monstad, 1987a). The existence of some morphological differences of blue whiting from the Rockall and Porcupine Bank areas indicates the presence of such populations (Lysenko and Malkov, 1984; Lysenko and Sauskan, 1985; Ehrich and Schöne, 1983). On the other hand, ecological analysis and age-length composition have not confirmed the existence of separate populations (Zilanov, 1984; Giedz, 1983).

The Working Group recommends that research in stock separation and stock identity is continued and that the data are brought to the Working Group meetings.

3 OTOLITH EXCHANGE PROGRAMME

In last year's report (Anon., 1987), the Blue Whiting Assessment Working Group recommended that a new international otolith exchange programme be set up.

This work is going on and some preliminary results were presented to the Working Group and were discussed.

The results show that there are still some discrepancies in the results obtained when different countries are ageing the same otolith samples.

The Otolith Exchange Programme is expected to be completed next year, and a report will then be presented to the Working Group.

4 NORTHERN STOCK

4.1 Landings in 1986

Estimates of total landings in 1977-1986 by countries from the various fisheries are given in Tables 4.2-4.5 and summarized in Table 4.1.

The total landings from all northern blue whiting fisheries in 1986 were estimated at 757,370 t. There was an increase of about 20% in the total landings from the directed fisheries and an increase of about 2% in the landings in the mixed industrial fisheries.

Similarly, as in 1985, in some landings from the directed fishery in Divisions VIa and VIIb,c, great silver smelt (Argentina silus) were caught as a by-catch and some corrections for this have been made. In the Norwegian landings in 1986, this amounted to 2,300 t, and in the Scottish landings, a total by-catch of 556 t was estimated. Compared to the total landings, however, the total by-catch of silver smelt was less than 1%.

4.2 Landings in 1987

Preliminary information on blue whiting submitted by Working Group members and by some countries reporting on ICES Data Form 5 (407,798 t, January-July) is presented in Table 4.6.

4.3 Age Composition of Landings

For the directed fisheries in 1986, age compositions were provided by the Faroes, the German Democratic Republic, Norway, and the USSR. These data together accounted for 94% of the landings in the directed fisheries.

For Danish 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. Some of the landings reported from Divisions VIIg-k (Table 5.1) were considered to have been from the northern stock and are, therefore, included in the catch-in-number figures.

For landings of blue whiting taken in the mixed industrial fisheries, data were available for Norwegian catches only. These accounted for 27% of the total landings. Landings from other

countries were assumed to have the same age composition as the Norwegian landings in the same area and months (Table 4.8).

The raised age compositions for the directed fisheries and the mixed industrial 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 1986 were presented by the Faroe Islands, Norway, and the 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 for the directed fishery and the mixed industrial fishery. An overall mean was calculated, weighted by the total landings in numbers in each fishery. The total catch landed in 1986 was compared to the sum of products (SOP) of total numbers landed in 1986 and mean weight at age. The calculated SOP was within 3% 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 1987

4.5.1.1 Surveys during the spawning season

During the spawning season of 1987, USSR and Norway conducted surveys in the area west of the British Isles to assess the blue whiting spawning stock (Kudrin, pers. comm.; Monstad, 1987a).

USSR covered the area twice. The first survey took place from 19 February to 13 March in a north-south direction from 62° to 50° N (Figure 4.1). The biomass of blue whiting was estimated to be 5.4 million tonnes (t) representing 40.8×10^9 individuals. The biomass of the spawning stock was estimated at 5.1 million t.

The second survey was performed from 25 March to 20 April in a south-north direction between 52° and 60° N, but extended further west than the first survey (Figure 4.2). During this survey, the total biomass was estimated to be 7.4 million t, representing 6.3×10^9 individuals. Of this, 6.9 million t belonged to the spawning stock.

The 1983 year class was found to be the most abundant one, contributing to the stock in number with 31.8 and 54.4% in the first and the second surveys, respectively. The 1982 year class was found to be significantly lower represented with 11.2 and 17.0%, respectively (Figure 4.6).

The Norwegian survey was carried out from south to north from 16 March to 11 April and covered the shelf edge area from 50° N to 62° N. The biomass of blue whiting, recorded more or less contin-

uously over the whole area (Figure 4.3), was estimated to be 4.8 million t, representing 49.2×10^3 individuals. In the Porcupine Bank area, blue whiting from the southern stock were also included in this estimate. Based on the assumption that there is a difference in the spawning peaks of the northern and the southern stocks, the component of the southern and/or the local stocks was calculated to be 0.5 million t. The biomass estimate of the northern stock was hence reduced to 4.3 million t of which 4.1 million t belonged to the spawning stock.

For the total area surveyed, the 1983 year class was found to dominate with 43% in numbers, while the 1982 year class represented only 6% of the stock. In the north, however, in the area at Shetland/Faroes and off the Hebrides, the 1986 year class was the most numerous one (Figure 4.6).

4.5.1.2 Surveys in the feeding season

Working papers of acoustic surveys in the Norwegian Sea during the summer of 1987 were brought to the Working Group meeting by two countries.

For the period 10 June to 23 July, Norway surveyed the area along the Norwegian coast from the North Sea to north of the Lofoten Islands twice (Monstad, 1987b). Blue whiting were recorded over much of the area investigated. The recordings of the two coverages were combined on one map as shown in Figure 4.4. Blue whiting were found from near the coast and westward into the Norwegian Sea, with highest concentrations in the south. The overall recordings were rather moderate with some small areas of higher densities. The total biomass was estimated at 1.7 million t, equivalent to 25.7×10^3 individuals. The length and age distribution weighted by abundance is shown in Figure 4.7. The 1986 year class was found to be the most numerous one and contributed almost 70% in number in the southern area. In the two other areas, the 1983 and 1984 year classes were most abundant, while the 1982 year class contributed only to a small extent to the stock observed.

In August, the German Democratic Republic carried out a hydro-acoustic survey within an area between 57° and 69° N, from east of the Faroe Islands to the coast of Norway (Danke, 1987). Blue whiting were found in dispersed concentrations, with some high densities in areas west of the Faroe Islands and west and south of the Norwegian coast (Figure 4.5). The recorded blue whiting were estimated to be 1.4 million t, and the 1987 year class was found to be the most numerous one (Figure 4.7). In the Faroese area, the 1987 year class predominated (more than 70% in number); in the Norwegian Sea, the 1983-1985 year classes were most abundant, and in the North Sea, the 1985 year class was dominant.

4.5.1.3 Discussion

The acoustic surveys during the 1987 spawning season covered large areas and are hence considered to have surveyed the major part of the spawning stock. The three different estimates obtained are listed in the table below (in millions of t) together

with the estimates from the spawning area since 1981. The spawning stock is given in parentheses.

| 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
|----------|------|----------|----------|----------|----------|-----------------------|
| 6.1(5.4) | 2.5 | 4.7(4.4) | 2.7(2.4) | 6.4(1.7) | 6.4(5.6) | 5.4(5.1) |
| | | 3.6(3.5) | 3.4(2.7) | 2.8(2.7) | 2.6(2.0) | 7.4(6.9) |
| | | | 2.8(2.1) | | | 4.8(4.5) ¹ |
| | | | 2.4(2.2) | | | |

¹Includes some southern blue whiting.

During the USSR surveys, no indications of contribution from blue whiting of stocks other than the northern one were observed. For the Norwegian survey which took place after the first USSR survey was completed, an amount totalling 0.5 million t was considered to belong to the southern and/or local stocks and hence was subtracted from the total estimate of 4.8 million t.

The second USSR survey was considered to be an overestimate. This could be due to the possibility of having recorded some of the fish two times while surveying in a south-north direction at the same time as postspawners migrated northward. The first USSR survey of 5.4 million t was considered by the Working Group to be the most appropriate of the two. The area covered extended from the Faroe Islands to south of the Porcupine Bank and compared to the Norwegian survey; both the area extension and the distribution pattern are rather similar.

The difference between the estimates by the Norwegian survey and the first USSR survey is 0.6 million t if no subtraction for the southern stock is made.

The Working Group, however, agreed upon an estimate between the first USSR survey result of 5.4 million t and the Norwegian survey result representing the northern stock, i.e., 4.3 million t. The corresponding estimate would then be between 4.1 and 5.1 million t. The VPA run was then tuned against a spawning stock at the beginning of 1987 of 4.6 million t.

The age composition of the stock was found to vary for the three different surveys (Figure 4.6). The weak contribution of the 1982 year class is rather significant for all three surveys, with the Norwegian results showing the lowest contribution with only 6%, compared to 11% for the first USSR survey and 17% for the second USSR survey.

The Working Group noted discrepancies in the relative contributions of the 1982 and 1983 year classes in the surveys and the VPA results (Section 4.5.2.2).

Besides age reading problems, the difference in the age composition might be due to differences in either the fishing methods, the gear used, or the sampling methods. The peak in the length distribution of the Norwegian sample is 27 cm compared to 28 cm in the two USSR results (Figure 4.6). The 1983 year class, however, was found by both countries to be the strongest one in the stock.

For the first time since 1981, an ICES-coordinated acoustic survey on blue whiting was not carried out in the Norwegian Sea in the summer of 1987. Due to the present methodology, the Working Group concluded in 1986 that such surveys could not give estimates of the total stock when it is dispersed over wide areas in the Norwegian Sea. This is especially the case for the older year classes (Anon., 1987). The national surveys carried out in the current year, however, give information on the distribution and relative abundance of the part of the stock observed. The estimates of 1.7 and 1.4 million t, respectively, are, therefore, considered to only be indicative.

The absence of the 1986 year class in the 1986 catches of the mixed industrial fisheries in the North Sea and the relative strength of it found in the Norwegian summer survey of 1987 illustrate that the younger age groups might be unevenly distributed in the North-East Atlantic from year to year.

To what extent recruitment indices could be drawn from the summer surveys should be analyzed at the next meeting of the Working Group.

4.5.2 Virtual population analysis (VPA)

4.5.2.1 VPA calibration

In the past, the Working Group has calibrated the VPA to the results from the acoustic assessments of the spawning stock during the spawning period using repetitive traditional VPA runs.

This approach was commented on by ACFM in 1986 and it was suggested that the Working Group in the future should also try separable VPA.

The basic assumption for the separable VPA is that there is a stable exploitation pattern for a number of years. This was discussed by the Working Group and it was concluded that it was probably valid for the older age groups ($= >5$) but not for the younger ones. In any mixed fishery, the effort on any stock will vary with the relative availability of individual stocks. In the mixed industrial fishery in the North Sea, the blue whiting catches consist to a large extent of age groups 0-2, and in the past, the F on these age groups has varied from year to year. The very strong year classes from 1982 and 1983 have been fished extensively since they appeared, and it is fair to assume that the F on these in 1986 was of the same order of magnitude as the F on the 1978-1981 year classes.

Based on these considerations, a preliminary separable VPA was run for the period 1977 to 1986 with a terminal F of 0.19 on age 7 and a terminal S of 1.0. The resulting separable fishing mortalities matrix is shown in Table 4.11. From this run, the Fs on the oldest age groups were adopted as input Fs in a traditional VPA run and similarly the Fs on ages 5 and older for the last year (1986). For age groups 0-2, an F of 0.04 similar to a high F

in the past was adopted. In the preliminary runs, it became clear that the estimates of the spawning stock were very sensitive to the input Fs chosen for the 3- and 4-year-olds. In the final run, an F of 0.19 was adopted for these ages partly because this was the average for the 5-8-year-olds in the separable VPA run and, as mentioned above, the Working Group considered this to be a valid assumption. Furthermore, this yielded an estimate of the spawning stock at 1 January 1987 close to the acoustic estimates in the spring of 1987 (see Section 4.5.1.3).

In the text table below, a comparison is given of the spawning stock biomass at 1 January for the years 1983 to 1987 estimated by the VPA and the acoustic surveys in the spring for the same period.

| Estimate | 1983 | 1984 | 1985 | 1986 | 1987 |
|----------|---------|---------|------------------|---------|---------|
| Survey | 3.6-4.4 | 2.2-2.7 | 4.1 ¹ | 2.0-5.6 | 4.1-5.1 |
| VPA | 3.3 | 3.2 | 3.7 | 4.4 | 4.7 |

Biomass in million t.

¹ Combined from two surveys.

Despite some discrepancies, the two time series of data seem quite consistent and the Working Group accepted the VPA assessment for the predictions. It is, however, recommended that the acoustic estimates divided into stock in number by age group are made available for the next meeting of the Working Group. This would enable the Working Group to better tune the VPA to the acoustic surveys.

4.5.2.2 VPA results (Tables 4.12 - 4.13)

The VPA results show that the total biomass decreased steadily from 1977 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 1987, the total stock biomass and the spawning stock biomass were at a level of 6.1 million t and 4.7 million t, respectively.

The average fishing mortality on age groups 4-8 increased steadily from 1977 to 1981 when a level of 0.26 was reached. Since then, the average fishing mortality appears to have stabilized at a lower level. The average fishing mortality in 1986 on ages 4-8 is estimated to be equal to 0.18.

4.5.2.3 Yield per recruit

Yield per recruit and spawning stock biomass per recruit have been calculated using the data given in Table 4.16 and are shown in Figure 4.10. As there are no clear indications of the strength of the incoming year classes, the exploitation pattern chosen is the same as used in the VPA runs for 1986 for age groups 0-2. For

age groups 3-15+, an F of 0.19 equal to the F in 1986 on age groups 3-8 was chosen. F_{max} corresponds to 0.5 which, compared to previous estimates, is very high. $F_{0.1}$ equals 0.21, only 10% higher than the fishing mortality estimated for the fully-recruited age groups in 1986.

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 effort and catch per unit effort from the directed blue whiting fisheries for 1986 were submitted by three countries, i.e., the German Democratic Republic, Norway, and the USSR. These countries presented their data broken down by vessel tonnage class, area, and month.

Comparative time series of CPUE data for Divisions IIa, IVa, Vb, VIa,b, VIIb,c, and VIIg-k, which may be indicative of changes in stock abundance, are compiled in Tables 4.14 and 4.15 (Figures 4.8 and 4.9).

In Division IIa, the blue whiting fisheries season in 1986 was prolonged on the feeding and winter grounds compared with the years 1983-1985. Mean CPUE of the USSR vessels which carried out fisheries during all the seasons increased as a whole above the CPUE of the five previous years. CPUE of the German Democratic Republic increased in 1986 by more than twice in May-June, and in October-December, it was comparable with the same seasons of the previous year. In July-September, it stayed at the same level.

From 1983 onwards, Poland did not take part in the fishery and Iceland had no data presented since 1981 (Table 4.14b).

In Division Vb, the USSR catches decreased by 6% in January-February 1986 compared with 1985. The German Democratic Republic catches decreased more than half.

In the spring-summer season (March-August), CPUE of the USSR vessels (GRT 2,000-3,999.9) increased constantly from 1983 to 1986. CPUE of the Norwegian vessels increased slightly in March-May 1986 compared with March-April 1985. At the same time, CPUE of the GDR vessels decreased considerably in June-July 1986 compared with 1985, but this might be due to the relatively small fleet of GDR vessels fishing in Division Vb.

Data on catch per unit effort from spawning fisheries (Divisions VIa,b, VIIb,c, and VIIg-k) are contradictory to some extent. CPUE of Norwegian vessels increased in March-April 1986 compared with 1985, but decreased in Divisions VIIb,c.

Due to the fact that this is a directed fishery which takes place when the stock is congregated in dense spawning concentrations, the CPUE results from it cannot be used for any precise characterizing.

A considerable decrease (almost 50%) in the CPUE of the USSR vessels was noted in Divisions VIIb,c and VIIg-k. Taking into account, however, the increase in the total catch of blue whiting in these divisions by the USSR fleet, this decrease might be explained by a more dispersed distribution of blue whiting due to the hydrographic conditions in 1986 (Anon., 1986; Anon., 1987).

Taking into account the analysis of the CPUE in 1986, it should be noted that, on a whole, the increase in catches in absolute values was followed by an increase in the CPUE. The duration of the fishery season increased as well as the CPUE in the northern part of the area (Divisions IIa and Vb). This fact might indicate a positive trend in the state of the northern blue whiting stock.

The Working Group appreciates the usefulness of the CPUE data for the common distribution and as an indication of the status of the blue whiting stock and considers it important to continue the exchange of these data. If it is possible for the different countries to split the data in numbers at age, the data could possibly be used to tune the VPA.

4.6 Catch Projections and Management Considerations

A projection of catches in 1988 and resulting stock biomass and spawning stock biomass in 1989 were made using the stock size estimate at the beginning of 1987 and the parameters given in Table 4.16. In the projections, a recruitment equal to the mean of the period 1975-1981 of 10,839 million at age 0 was used for the 1987, 1988, and 1989 year classes.

For 1987, it was assumed that the fishing mortality will remain at the same level as in 1986, i.e., 0.19. The expected catch in 1987 associated with that fishing mortality corresponds to 792,000 t. The results of the catch projections are given in Table 4.17 and shown in Figure 4.10D. It can be seen that a continuation of the present F level would result in a catch of 747,000 t in 1988. Fishing at $F_{0.1}$ in 1988 is associated with a catch of 832,000 t.

A plot of recruitment versus spawning stock biomass for the period 1977-1986 is shown in Figure 4.11. The F_{med} , F_{high} , and F_{low} were obtained after the method described in Anon. (1983). The low number of points, however, is rather few and very dispersed to give any illustrative picture of this relationship.

5 SOUTHERN AREA

5.1 Landings

Landings of blue whiting from the southern area were available to the Working Group from the Portuguese and Spanish fisheries (Table 5.1). The Spanish landings decreased in 1986 by 30% to the level of previous years. Landings from Divisions VIIg,k, also given in Table 5.1, are included in the assessment of the northern stock (see also Section 4.4).

5.2 Catch Composition

Table 5.2 provides the length composition of blue whiting from the Spanish and Portuguese fisheries in the years 1983-1986.

5.3 Age Composition of Landings

Data on age composition were available for the Spanish landings in 1986. The Portuguese catch in numbers by length group 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 1985 and 1986 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 0.05% in 1985 and 2.7% in 1986 of the nominal landings.

5.5 Catch per Unit Effort

CPUE data for the main Galician ports in the period 1977-1986 are presented in Table 5.5 and in Figure 5.1. CPUE figures for the period 1983-1986 for single and pair trawlers separately are presented in Table 5.6. These data have been revised since last year. The effort of the single trawlers decreased in those years, while that of the pair trawlers increased.

5.6 Bottom Trawl Survey

Bottom trawl surveys have also been conducted in 1986 off both the Galician and Portuguese coasts, following a stratified random sampling design covering depths up to 500 m. Data for these surveys going back to 1980 and 1979 are given in Tables 5.7 and 5.8 (Vasconcelas, 1987). As in previous years, the results obtained in Galician waters indicate a greater abundance in shallow waters (less than 200 m), whereas the survey in the Portuguese waters indicates a greater abundance in deeper waters of 200 - 500 m.

5.7 Age at Maturity

A maturity ogive showing 20, 78, 92, 97, 99, and 100% maturity at ages 1-6, respectively, was available to the Working Group. These values were calculated from the maturity/length ogive reported by Ehrich and Robles (1982) for the southern area (February and March 1982) using the growth parameters: $K = 0.136$, $L_{\infty} = 33.3$.

The maturity ogive used for the assessment is the one showing 20, 80, 90, and 100% maturity at ages 1-4, respectively.

5.8 Virtual Population Analysis (VPA)

For the first time, a VPA was run for the southern blue whiting stock. However, only five years of catch-at-age data were available. The catch curve provided a value of $Z = 1$ (Figure 5.2), and assuming the same natural mortality as used in the northern stock ($M = 0.2$), a separable VPA was carried out with terminal $F = 0.80$ on age 4 and terminal $S = 1$ (Table 5.9). The fishing mortalities obtained were used in a traditional VPA run (Tables 5.10-5.13). The VPA results show that the total biomass decreased slowly from 1982 to 1986 except in 1985 when some increase was observed. The spawning stock biomass does not show clear trends, with values between 49,000 and 62,000 t.

At present, it is very difficult to interpret the results of the VPA, due to the short period of the catch-at-age data and to the fact that acoustic surveys to provide stock size estimates were not carried out. Investigations on stock separation and migration are also needed, because the F values may be too high due to a migration of the older individuals. In view of the uncertainties associated with the assessment, it must be regarded as very provisional.

5.9 Assessment

The VPA was only run using five years of data, and this period is too short for a reliable analytical assessment to be made.

Since the only acoustic survey carried out on the Cantabrian and Galician coasts (in 1985) only covered a part of the area in which the southern blue whiting stock is distributed, the biomass estimate obtained could not be used for the assessment. The Working Group reiterates its statement of previous years that acoustic surveys of southern blue whiting stock are needed.

6 ZONAL DISTRIBUTION OF BLUE WHITING

Since an ICES-coordinated acoustic survey did not take place in the Norwegian Sea during the 1987 feeding season, it is not possible to add new information on the distribution. Therefore, Table 6.1 giving the acoustic stock estimates divided into areas within and beyond areas of national fisheries jurisdiction of NEAFC member countries could not be updated.

The total landings of blue whiting during 1978-1986 are divided into national fishery zones in Table 6.2. 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

- 1) 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 are done to investigate the total distribution area for the southern stock.
- 2) 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 conduct of the surveys.
- 3) 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 1981-1986 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 1988 summer/autumn season should be carried out on a national basis, however, with coordination and exchange of information between the vessels at sea.
- 4) The Working Group recommends that the countries deliver their monthly CPUE data split into age groups in number per hour, that is, for Division IIa in July - September back from 1979. The split on age groups is also needed for the different acoustic stock estimates back from 1981. These will enable the Working Group to make more detailed use of the data for tuning the VPA.
- 5) In 1986, NEAFC adopted a recommendation to use a 35-mm minimum 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 be performed on selectivity of the blue whiting using mesh sizes used in the mixed industrial fisheries and in the directed fisheries in the northern area.

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Table 4.1 Landings (tonnes) of BLUE WHITING from the main fisheries, 1977-1986.

| Area | 1977 | 1978 | 1979 | 1980 | 1981 |
|---|---------|---------|-----------|-----------|---------|
| Norwegian Sea fishery (Sub-areas I+II and Divisions Va, XIVa+XIVb) | 56,999 | 236,226 | 741,042 | 766,798 | 520,738 |
| Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc) | 136,787 | 229,228 | 284,547 | 250,693 | 288,316 |
| Icelandic industrial fishery (Division Va) | 5,838 | 9,484 | 2,500 | - | - |
| Industrial mixed fishery (Divisions IVa-c,Vb,IIIa) | 38,389 | 99,874 | 63,333 | 75,129 | 61,754 |
| Subtotal northern fishery | 238,013 | 574,812 | 1,091,422 | 1,092,620 | 870,808 |
| Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k) | 30,723 | 33,898 | 27,176 | 29,944 | 38,748 |
| Total | 268,736 | 608,710 | 1,118,598 | 1,122,564 | 909,556 |

| Area | 1982 | 1983 | 1984 | 1985 | 1986 ¹ |
|---|---------|---------|---------|---------|-------------------|
| Norwegian Sea fishery (Sub-areas I+II and Divisions Va, XIVa+XIVb) | 110,685 | 52,961 | 65,932 | 90,742 | 160,061 |
| Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc) | 361,656 | 361,537 | 415,940 | 456,388 | 497,729 |
| Icelandic industrial fishery (Division Va) | - | 7,000 | - | - | - |
| Industrial mixed fishery (Divisions IVa-c,Vb,IIIa) | 117,578 | 117,737 | 122,806 | 97,769 | 99,580 |
| Subtotal northern fishery | 589,919 | 539,235 | 604,678 | 644,899 | 757,370 |
| Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k) | 31,590 | 30,835 | 37,098 | 51,292 | 69,605 |
| Total | 621,509 | 570,070 | 641,776 | 696,191 | 826,975 |

¹ Preliminary.

Table 4.2 Landings (tonnes) of BLUE WHITING from the Norwegian Sea (Sub-areas I and II, Divisions Va, XIVa and XIVb) fisheries, 1977-1986, as estimated by the Working Group.

| Country | 1977 | 1978 | 1979 | 1980 | 1981 |
|--------------------------------|--------|---------|---------------------|---------|---------|
| Denmark | - | - | - | - | - |
| Faroes | 593 | 2,810 | 762 | - | 11,131 |
| France | - | - | - | - | 5,093 |
| German Dem.Rep. | 2,031 | 7,301 | 22,502 | 14,234 | 15,607 |
| Germany, Fed.Rep. ² | 6,777 | 8,421 | 1,157 | 8,919 | 17,385 |
| Greenland | - | - | - | - | - |
| Iceland | 4,768 | 17,756 | 12,428 | 4,562 | 4,808 |
| Norway | - | - | 33,588 ³ | 902 | 187 |
| Poland | 1,536 | 5,033 | 4,346 | 11,307 | 2,434 |
| UK (Engl.& Wales) | 165 | 11 | - | - | - |
| USSR | 41,129 | 194,844 | 666,259 | 726,874 | 464,093 |
| Total | 56,999 | 236,226 | 741,042 | 766,798 | 520,738 |

| Country | 1982 | 1983 | 1984 | 1985 | 1986 ¹ |
|--------------------------------|---------|--------|--------|--------|-------------------|
| Denmark | 473 | - | 93 | - | - |
| Faroes | - | 11,316 | - | - | - |
| France | 2,067 | 2,890 | - | - | - |
| German Dem.Rep. | 3,042 | 5,553 | 8,193 | 1,689 | 3,541 |
| Germany, Fed.Rep. ² | 890 | 2 | 35 | 75 | 106 |
| Greenland | - | - | - | - | 10 |
| Iceland | - | - | 105 | - | - |
| Norway | - | 5,061 | 689 | - | - |
| Poland | 443 | - | - | - | - |
| UK (Engl.& Wales) | - | - | - | - | - |
| USSR | 103,770 | 28,141 | 56,817 | 88,978 | 156,404 |
| Total | 110,685 | 52,961 | 65,932 | 90,742 | 160,061 |

¹ Preliminary.

² Including catches off East Greenland (Division XIVb) (3,217 t in 1977, 698 t in 1978, 204 t in 1979, and 8,757 t in 1980).

³ 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 and VIIb,c), 1977-1986, as estimated by the Working Group.

| Country | 1977 | 1978 | 1979 | 1980 | 1981 |
|-------------------|----------------|----------------|----------------|----------------|----------------|
| Denmark | 18,745 | 23,498 | 21,200 | 19,272 | 11,361 |
| Faroes | 29,096 | 39,491 | 35,780 | 37,488 | 23,107 |
| France | - | - | - | - | - |
| German Dem.Rep. | 1,094 | 1,714 | 172 | 181 | 6,562 |
| Germany, Fed.Rep. | 3,260 | 6,363 | 3,304 | 709 | 935 |
| Iceland | 5,172 | 7,537 | 4,864 | 5,375 | 10,213 |
| Ireland | - | - | - | - | - |
| Netherlands | - | 1,172 | 154 | - | 222 |
| Norway | 38,214 | 116,815 | 186,737 | 133,754 | 166,168 |
| Poland | 3,996 | 2,469 | 4,643 | - | 2,279 |
| Spain | 183 | 14 | - | - | - |
| Sweden | 6,391 | 6,260 | - | 3,185 | - |
| UK (Engl.& Wales) | 1,475 | 5,287 | 4,136 | 3,878 | 6,000 |
| UK (Scotland) | 3,001 | 1,599 | 1,466 | 6,819 | 2,611 |
| USSR | 26,160 | 17,009 | 22,091 | 40,032 | 58,858 |
| Total | 136,787 | 229,228 | 284,547 | 250,693 | 288,316 |

| Country | 1982 | 1983 | 1984 | 1985 | 1986 ¹ |
|-------------------|----------------|----------------|----------------|----------------|----------------------|
| Denmark | 23,164 | 28,680 | 26,445 | 21,424 | 11,364 |
| Faroes | 38,958 | 56,168 | 62,264 | 72,316 | 80,564 |
| France | 1,212 | 3,600 | 3,882 | - | - |
| German Dem.Rep. | 7,771 | 3,284 | 1,171 | 6,427 | 1,753 |
| Germany, Fed.Rep. | 701 | 825 | 693 | 626 | - |
| Iceland | 1,689 | 1,176 | - | - | - |
| Ireland | - | - | - | 668 | 16,440 |
| Netherlands | 200 | 150 | 1,000 | 1,248 | 5,283 |
| Norway | 169,700 | 185,646 | 211,773 | 234,137 | 283,162 ² |
| Poland | - | - | - | - | - |
| Spain | - | 318 | - | - | - |
| Sweden | - | - | - | - | - |
| UK (Engl.& Wales) | - | - | - | - | - |
| UK (Scotland) | - | - | - | - | 3,472 |
| USSR | 73,171 | 81,690 | 108,712 | 119,542 | 95,691 ³ |
| Total | 316,656 | 361,537 | 415,940 | 456,388 | 497,729 |

¹Preliminary.

²Including directed fishery also in Division IVa.

³Including directed fishery also in Sub-area XII.

Table 4.4 Landings (t) of BLUE WHITING from the Icelandic mixed industrial trawl fisheries in Division Va, 1977-1986.

| Country | 1977 | 1978 | 1979 | 1980 | 1981 |
|---------|-------|-------|-------|-------|------|
| Iceland | 8,220 | 5,838 | 9,484 | 2,500 | - |

| Country | 1982 | 1983 | 1984 | 1985 | 1986 ¹ |
|---------|------|-------|------|------|-------------------|
| Iceland | - | 7,000 | - | - | - |

¹Preliminary.

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, 1977-1986, as estimated by the Working Group.

| Country | 1977 | 1978 | 1979 | 1980 | 1981 |
|---------------------------------|---------------|---------------|---------------|---------------------|---------------|
| Denmark | 16,071 | 54,804 | 28,932 | 49,947 | 35,066 |
| Faroes | - | 1,177 | 1,489 | 1,895 | 3,133 |
| France | - | - | - | - | - |
| German Dem.Rep. ² | - | 988 | 49 | - | - |
| Germany, Fed.Rep. ² | 76 | 1,514 | 13 | 252 | - |
| Ireland | - | - | - | - | 2,744 |
| Netherlands | - | - | - | - | 18,627 |
| Norway ² | 20,737 | 39,989 | 30,930 | 21,962 ³ | - |
| Poland ⁴ | 838 | 601 | - | - | 229 |
| Sweden | 639 | 648 | 1,249 | 1,071 | 1,955 |
| UK (Engl. & Wales) ² | 3 | + | - | - | - |
| UK (Scotland) | 25 | 153 | 37 | 2 | - |
| USSR ² | - | - | 634 | - | - |
| Total | 38,389 | 99,874 | 63,333 | 75,129 | 61,754 |

| Country | 1982 | 1983 | 1984 | 1985 | 1986 ¹ |
|---------------------------------|----------------|----------------|----------------|--------------------|--------------------|
| Denmark | 34,463 | 38,290 | 48,939 | 35,843 | 57,315 |
| Faroes | 27,269 | 12,757 | 9,740 | 3,606 ⁵ | 5,678 ⁵ |
| France | 1,417 | 249 | - | - | - |
| German Dem.Rep. ² | - | - | - | - | - |
| Germany, Fed.Rep. ² | 93 | - | 566 | 52 | - |
| Ireland | - | - | - | - | - |
| Norway | 47,856 | 62,591 | 58,038 | 54,522 | 26,941 |
| Netherlands | - | - | 122 | 130 | 1,114 |
| Poland ⁴ | 550 | - | - | - | - |
| Sweden | 1,241 | 3,850 | 5,401 | 3,616 | 8,532 |
| UK (Engl. & Wales) ² | 4,689 | - | - | - | - |
| UK (Scotland) | - | - | - | - | - |
| USSR ² | - | - | - | - | - |
| Total | 117,578 | 117,737 | 122,806 | 97,769 | 99,580 |

¹ Preliminary.

² Reported landings in human consumption fisheries.

³ Including mixed industrial fishery in the Norwegian Sea.

⁴ Reported landings assumed to be from human consumption fisheries.

⁵ Including catches in Division Vb.

Table 4.6 Preliminary data on landings of BLUE WHITING in 1987 based on returns on ICES Data Form 5 for 1987 and information from Working Group members.

| Country | Area | Jan | Feb | Mar | Apr | May | Jun | Jul | Total |
|-----------------|-----------------|-------|-------|--------|--------|--------------------|--------|--------|---------------------|
| Faroe Islands | Vb+VI | - | - | - | - | - | - | - | 75,538 |
| German Dem.Rep. | Vb ¹ | 7 | 353 | 275 | - | - | - | - | 635 |
| | VIIg-k | - | - | 1,390 | - | - | - | - | 1,390 |
| | IV | - | - | - | - | - | - | 62 | 62 |
| | VI | - | 265 | - | - | - | - | - | 265 |
| Ireland | VIa | - | - | - | - | 3,699 ² | - | - | 3,699 |
| Netherlands | Vb-VII | - | - | 2,065 | 1,316 | 5,745 | - | 88 | 9,214 |
| Norway | IV | 64 | 642 | 3,489 | 6,401 | 7,452 | 766 | 498 | 19,312 ³ |
| | Vb | 121 | - | - | 732 | 808 | 244 | - | 2,923 |
| | VI | - | 4,863 | 767 | 62,985 | 9,293 | - | 53 | 77,961 |
| | VIIc | - | - | 36,676 | 26,563 | - | - | - | 63,239 |
| | VIIg-k | - | - | 18,331 | - | - | - | - | 18,331 |
| UK (Scotland) | VIa | - | - | - | - | - | - | - | 2,873 |
| USSR | I + II | - | - | 10 | 2 | 2,233 | 32,837 | 22,590 | 57,672 |
| | Vb | 3,280 | 6,942 | 2,016 | 7,450 | 30,457 | 14,267 | 10,272 | 74,684 |
| Total | | | | | | | | | 407,798 |

¹ Fishery zone Faroes.

² May also include April.

³ Directed and mixed industrial.

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), 1977 - 1986.

| Age | 1977 | 1978 | 1979 | 1980 | 1981 |
|--------|---------|---------|-----------|-----------|---------|
| 0 | - | - | - | - | - |
| 1 | - | - | - | 55.1 | 4.0 |
| 2 | 44.0 | 63.6 | 69.9 | 319.5 | 40.1 |
| 3 | 87.5 | 69.0 | 165.0 | 362.0 | 322.8 |
| 4 | 164.8 | 345.8 | 457.5 | 399.1 | 225.3 |
| 5 | 184.9 | 436.9 | 468.3 | 478.3 | 501.5 |
| 6 | 154.3 | 483.1 | 569.0 | 530.9 | 539.0 |
| 7 | 137.6 | 527.9 | 743.2 | 725.3 | 448.5 |
| 8 | 176.7 | 474.3 | 904.8 | 779.2 | 618.3 |
| 9 | 120.1 | 364.8 | 826.4 | 694.5 | 573.2 |
| 10 | 132.0 | 307.6 | 797.0 | 1,008.7 | 718.3 |
| 11 | 110.1 | 157.4 | 473.2 | 398.1 | 343.6 |
| 12 | 56.3 | 121.8 | 359.2 | 394.2 | 232.6 |
| 13 | 18.2 | 50.4 | 142.7 | 66.8 | 73.9 |
| 14 | 13.5 | 20.5 | 69.3 | 64.6 | 49.5 |
| 15+ | 6.9 | 16.1 | 39.0 | 4.7 | 30.6 |
| Total | 1,406.9 | 3,439.2 | 6,405.4 | 6,191.0 | 4,721.2 |
| Tonnes | 193,786 | 465,454 | 1,025,599 | 1,017,491 | 809,054 |

| Age | 1982 | 1983 | 1984 | 1985 | 1986 ¹ |
|--------|---------|---------|---------|---------|-------------------|
| 0 | 1.2 | 2.5 | 63.6 | 871.4 | 51.9 |
| 1 | 1.7 | 290.4 | 417.6 | 127.4 | 161.9 |
| 2 | 48.6 | 239.1 | 1,394.1 | 1,341.6 | 263.3 |
| 3 | 123.1 | 164.1 | 277.9 | 1,588.1 | 1,559.5 |
| 4 | 371.0 | 194.1 | 211.9 | 199.3 | 1,464.3 |
| 5 | 212.6 | 411.4 | 259.2 | 161.0 | 298.7 |
| 6 | 251.0 | 284.4 | 420.2 | 303.7 | 156.4 |
| 7 | 250.7 | 274.0 | 253.1 | 248.7 | 192.2 |
| 8 | 259.3 | 283.5 | 190.3 | 167.2 | 185.8 |
| 9 | 278.7 | 219.9 | 151.6 | 91.7 | 166.4 |
| 10 | 259.8 | 152.6 | 113.8 | 87.8 | 172.1 |
| 11 | 158.5 | 71.5 | 57.7 | 73.1 | 108.7 |
| 12 | 133.6 | 45.4 | 50.0 | 51.4 | 65.6 |
| 13 | 41.0 | 25.0 | 15.0 | 21.1 | 25.2 |
| 14 | 45.3 | 12.1 | 8.1 | 12.5 | 6.8 |
| 15+ | 28.0 | 10.0 | 6.7 | 9.5 | 8.1 |
| Total | 2,464.1 | 2,680.0 | 3,890.9 | 5,355.3 | 4,886.9 |
| Tonnes | 427,341 | 416,730 | 481,872 | 554,640 | 694,314 |

¹ 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) 1977-1986.

| Age | 1977 | 1978 | 1979 | 1980 | 1981 |
|---------------|----------------|----------------|----------------|---------------|---------------|
| 0 | 428.9 | 956.2 | 2.4 | 23.2 | - |
| 1 | 467.5 | 1,030.9 | 1,849.0 | 276.1 | 65.1 |
| 2 | 111.4 | 168.2 | 78.8 | 329.9 | 81.4 |
| 3 | 33.8 | 89.7 | 32.3 | 74.8 | 191.9 |
| 4 | 31.8 | 74.0 | 22.3 | 22.6 | 58.4 |
| 5 | - | - | 18.2 | 29.1 | 20.1 |
| 6 | - | - | 20.8 | 23.1 | 16.7 |
| 7 | - | - | 10.8 | 29.3 | 17.8 |
| 8 | - | - | 8.8 | 26.8 | 15.7 |
| 9 | - | - | 14.0 | 15.2 | 4.4 |
| 10 | - | - | 6.2 | 13.8 | 4.9 |
| 11 | - | - | 1.0 | 6.4 | 3.6 |
| 12 | - | - | 4.4 | 1.8 | 1.5 |
| 13 | - | - | - | 2.2 | 1.2 |
| 14 | - | - | - | 1.4 | 0.1 |
| 15+ | - | - | - | 0.4 | 0.2 |
| Total | 1,073.4 | 2,319.0 | 2,069.0 | 860.8 | 483.0 |
| Tonnes | 44,227 | 109,358 | 94,995 | 75,129 | 61,754 |

| Age | 1982 | 1983 | 1984 | 1985 | 1986 ¹ |
|---------------|----------------|----------------|----------------|----------------|-------------------|
| 0 | 3,450.1 | 336.3 | 446.4 | 184.3 | - |
| 1 | 45.3 | 1,844.2 | 1,650.8 | 891.4 | 395.0 |
| 2 | 41.3 | 90.0 | 587.7 | 365.0 | 334.7 |
| 3 | 80.9 | 38.4 | 49.7 | 173.8 | 134.6 |
| 4 | 112.8 | 47.7 | 12.8 | 37.4 | 184.4 |
| 5 | 29.2 | 55.6 | 12.6 | 13.4 | 79.7 |
| 6 | 21.6 | 12.2 | 10.4 | 13.9 | 24.3 |
| 7 | 14.8 | 12.8 | 6.1 | 5.8 | 7.3 |
| 8 | 12.0 | 2.6 | 2.2 | 5.6 | 11.0 |
| 9 | 5.2 | 5.8 | 2.7 | 1.8 | 7.3 |
| 10 | 1.8 | 4.2 | 2.6 | 3.0 | 3.9 |
| 11 | - | 9.6 | 0.9 | 1.4 | 3.8 |
| 12 | 2.4 | 3.3 | 0.3 | 0.3 | 1.4 |
| 13 | 0.6 | 0.6 | 0.3 | - | 1.0 |
| 14 | 0.6 | 0.3 | 0.1 | - | 1.1 |
| 15+ | - | - | - | - | - |
| Total | 3,816.6 | 2,463.6 | 2,785.5 | 1,697.0 | 1,189.4 |
| Tonnes | 117,578 | 124,737 | 122,806 | 97,769 | 99,580 |

¹Preliminary.

Table 4.9 Sum of Products Check

BLUE WHITING, Northern Area

CATEGORY: Total

CATCH WEIGHT AND SOP CHECK

SUM OF PRODUCTS UNIT: thousand tonnes
 NOMINAL CATCH UNIT: tonnes

| | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
|-----------|--------|--------|---------|---------|--------|--------|--------|--------|--------|--------|
| 0 | 14 | 31 | 0 | 1 | 0 | 62 | 6 | 14 | 15 | 2 |
| 1 | 14 | 31 | 58 | 12 | 4 | 2 | 98 | 74 | 39 | 22 |
| 2 | 13 | 19 | 20 | 51 | 11 | 8 | 31 | 170 | 137 | 48 |
| 3 | 13 | 17 | 37 | 47 | 61 | 28 | 27 | 34 | 180 | 191 |
| 4 | 21 | 46 | 52 | 51 | 38 | 74 | 37 | 32 | 31 | 217 |
| 5 | 24 | 56 | 63 | 68 | 76 | 39 | 75 | 43 | 29 | 64 |
| 6 | 23 | 71 | 87 | 83 | 86 | 49 | 53 | 71 | 57 | 36 |
| 7 | 22 | 84 | 121 | 125 | 79 | 52 | 56 | 46 | 51 | 42 |
| 8 | 30 | 81 | 155 | 142 | 113 | 54 | 57 | 36 | 36 | 48 |
| 9 | 21 | 65 | 149 | 115 | 108 | 58 | 46 | 29 | 20 | 43 |
| 10 | 25 | 58 | 151 | 203 | 144 | 56 | 33 | 23 | 20 | 43 |
| 11 | 21 | 30 | 92 | 82 | 72 | 37 | 19 | 12 | 17 | 29 |
| 12 | 11 | 24 | 72 | 82 | 53 | 31 | 11 | 10 | 12 | 17 |
| 13 | 4 | 10 | 29 | 14 | 18 | 11 | 7 | 3 | 5 | 7 |
| 14 | 3 | 4 | 14 | 14 | 12 | 11 | 3 | 2 | 3 | 24 |
| 15+ | 1 | 3 | 3 | 1 | 8 | 7 | 3 | 2 | 3 | 25 |
| A) SUP | 260 | 630 | 1107 | 1091 | 884 | 578 | 561 | 600 | 653 | 957 |
| B) NOMIN. | 238013 | 574812 | 1091422 | 1092620 | 870808 | 544919 | 539235 | 604678 | 651962 | 792897 |
| (B/A) 4 | 91612 | 91196 | 98615 | 100160 | 98499 | 94203 | 96117 | 100787 | 99838 | 92539 |

Table 4.10 Sum of Products Check.

BLUE WHITING, Northern Area.

CATEGORY: Total

| | MEAN WEIGHT AT AGE IN THE CATCH | | | | | | | | | |
|-----|---------------------------------|------|------|------|------|------|------|------|------|------|
| | ----- | | | | | | | | | |
| | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
| 0 | .052 | .052 | .052 | .027 | .027 | .018 | .018 | .027 | .014 | .033 |
| 1 | .053 | .050 | .050 | .036 | .063 | .045 | .046 | .056 | .038 | .047 |
| 2 | .084 | .084 | .084 | .079 | .092 | .094 | .094 | .086 | .087 | .081 |
| 3 | .105 | .105 | .105 | .107 | .118 | .136 | .136 | .104 | .102 | .113 |
| 4 | .109 | .109 | .109 | .122 | .135 | .152 | .152 | .142 | .129 | .132 |
| 5 | .127 | .129 | .129 | .155 | .145 | .152 | .162 | .157 | .164 | .163 |
| 6 | .147 | .147 | .147 | .149 | .155 | .173 | .178 | .164 | .173 | .202 |
| 7 | .160 | .160 | .160 | .165 | .170 | .195 | .195 | .175 | .200 | .207 |
| 8 | .170 | .170 | .170 | .176 | .178 | .200 | .200 | .189 | .203 | .243 |
| 9 | .177 | .177 | .177 | .186 | .187 | .204 | .204 | .186 | .213 | .245 |
| 10 | .183 | .183 | .183 | .199 | .199 | .213 | .213 | .197 | .225 | .242 |
| 11 | .193 | .193 | .193 | .202 | .203 | .234 | .234 | .202 | .233 | .255 |
| 12 | .199 | .199 | .199 | .207 | .223 | .223 | .223 | .194 | .233 | .267 |
| 13 | .200 | .200 | .200 | .207 | .234 | .253 | .253 | .225 | .243 | .272 |
| 14 | .200 | .200 | .200 | .207 | .249 | .242 | .242 | .223 | .251 | .302 |
| 15+ | .200 | .200 | .200 | .207 | .257 | .250 | .250 | .242 | .279 | .305 |

Table 4.11

Title : BLUE WHITING, NORTHERN AREA
 At 11.06.46 22 SEPTEMBER 1987
 from 77 to 86 on ages 0 to 14
 with Terminal F of .190 on age 7 and Terminal S of 1.000

Initial sum of squared residuals was 150.626 and
 final sum of squared residuals is 65.196 after 81 iterations

Matrix of Residuals

| Years | 77/78 | 78/79 | 79/80 | 80/81 | 81/82 | 82/83 | 83/84 | 84/85 | 85/86 | WTS | |
|-------|-------|-------|--------|-------|--------|--------|-------|-------|-------|-------|-------|
| Ages | | | | | | | | | | | |
| 0/ 1 | 1.388 | 1.421 | -5.322 | .346 | -4.075 | 1.914 | -.501 | .613 | 2.214 | -.001 | .079 |
| 1/ 2 | 1.095 | 1.685 | .800 | .541 | -1.002 | -2.442 | -.509 | -.390 | .223 | -.001 | .144 |
| 2/ 3 | .902 | .346 | -.358 | .373 | -.719 | -.736 | -.051 | .066 | .227 | .000 | .336 |
| 3/ 4 | -.516 | -.345 | .054 | -.485 | -.155 | -.105 | -.168 | .267 | .279 | .000 | .618 |
| 4/ 5 | .080 | .555 | .106 | -.251 | -.126 | .038 | -.245 | .139 | -.315 | .000 | .666 |
| 5/ 6 | -.084 | .385 | .002 | -.144 | .354 | -.224 | -.070 | -.293 | .093 | .000 | .764 |
| 6/ 7 | -.465 | .112 | -.253 | -.029 | .278 | -.203 | -.155 | .260 | .464 | .000 | .594 |
| 7/ 8 | -.420 | .040 | -.066 | -.021 | .095 | -.215 | .137 | .165 | .283 | .000 | .839 |
| 8/ 9 | -.033 | -.185 | .163 | -.092 | .151 | -.171 | .145 | .277 | -.184 | .000 | 1.000 |
| 9/10 | -.050 | -.188 | -.229 | -.398 | .320 | .445 | .402 | .300 | -.602 | .000 | .469 |
| 10/11 | .188 | -.375 | .069 | .232 | .452 | .434 | .125 | -.357 | -.749 | .000 | .441 |
| 11/12 | .535 | -.518 | -.171 | -.050 | .152 | .703 | -.089 | -.403 | -.162 | .000 | .445 |
| 12/13 | -.025 | -.569 | .577 | .345 | .151 | .435 | -.156 | -.434 | -.323 | .000 | .443 |
| 13/14 | .161 | -.261 | .250 | -.421 | -.515 | .555 | .369 | -.567 | .450 | .000 | .405 |
| | -.002 | -.001 | -.001 | .000 | .000 | .000 | .001 | .000 | .000 | -.004 | |
| WTS | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | | |

Fishing Mortalities (F)

| F-values | 77 | 78 | 79 | 80 | 81 | 82 | 83 | 84 | 85 | 86 |
|----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | .0463 | .1070 | .2144 | .2597 | .2662 | .2052 | .2077 | .1848 | .1655 | .1000 |

selection-at-age (S)

| S-values | 0 | 1 | 2 | 3 | 4 |
|----------|-------|-------|-------|-------|-------|
| | .0550 | .2879 | .2325 | .3197 | .4449 |

| S-values | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|----------|-------|-------|-------|--------|--------|--------|--------|--------|-------|--------|
| | .5967 | .8108 | .0000 | 1.3278 | 1.4966 | 2.2673 | 2.0457 | 2.4548 | 30.08 | 1.0000 |

Table 4.12 Virtual Population Analysis.
 BLUE WHITING, Northern Area.

| | FISHING MORTALITY COEFFICIENT | | | | | NATURAL MORTALITY COEFFICIENT = .20 | | | | | |
|----------|-------------------------------|------|------|------|------|-------------------------------------|------|------|------|------|---------|
| | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1977-83 |
| 0 | .04 | .06 | .00 | .00 | .00 | .11 | .01 | .02 | .06 | .04 | .03 |
| 1 | .06 | .13 | .16 | .06 | .02 | .01 | .09 | .12 | .05 | .04 | .07 |
| 2 | .02 | .04 | .04 | .08 | .03 | .03 | .07 | .11 | .13 | .04 | .04 |
| 3 | .02 | .03 | .07 | .10 | .08 | .06 | .07 | .09 | .14 | .19 | .06 |
| 4 | .03 | .08 | .11 | .11 | .08 | .10 | .09 | .11 | .08 | .19 | .09 |
| 5 | .03 | .08 | .13 | .16 | .19 | .09 | .13 | .13 | .12 | .18 | .12 |
| 6 | .03 | .10 | .16 | .21 | .26 | .15 | .16 | .17 | .22 | .17 | .15 |
| 7 | .03 | .12 | .23 | .31 | .28 | .19 | .23 | .21 | .14 | .21 | .20 |
| 8 | .05 | .12 | .31 | .40 | .46 | .26 | .31 | .23 | .21 | .16 | .27 |
| 9 | .05 | .14 | .31 | .36 | .56 | .39 | .35 | .28 | .17 | .33 | .31 |
| 10 | .10 | .17 | .53 | .78 | .93 | .54 | .38 | .31 | .27 | .56 | .49 |
| 11 | .12 | .16 | .42 | .57 | .67 | .53 | .32 | .24 | .33 | .61 | .40 |
| 12 | .10 | .18 | .69 | .75 | .77 | .62 | .31 | .33 | .35 | .56 | .49 |
| 13 | .07 | .12 | .34 | .26 | .30 | .29 | .22 | .15 | .23 | .29 | .23 |
| 14 | .05 | .10 | .25 | .26 | .31 | .30 | .13 | .10 | .17 | .13 | .20 |
| 15+ | .05 | .10 | .25 | .26 | .31 | .30 | .13 | .10 | .17 | .13 | .20 |
| (0- 2)U | .04 | .07 | .07 | .04 | .01 | .05 | .06 | .08 | .08 | .04 | |
| (4- 8)U | .03 | .10 | .19 | .24 | .25 | .16 | .18 | .17 | .15 | .18 | |

Table 4.13 Virtual Population Analysis.
BLUE WHITING, Northern Area.

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: thousand tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

| | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1977-81 |
|-----------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|---------|
| 0 | 11843 | 18370 | 8300 | 5954 | 8603 | 36787 | 25578 | 27021 | 20295 | 1462 | 0 | 10614 |
| 1 | 9474 | 9309 | 14177 | 6793 | 4853 | 7044 | 27007 | 20635 | 21662 | 15663 | 1150 | 8921 |
| 2 | 8195 | 7355 | 6692 | 9879 | 5263 | 3911 | 5726 | 20188 | 15030 | 16816 | 12371 | 7472 |
| 3 | 7351 | 6568 | 5796 | 5259 | 7502 | 4199 | 5121 | 4397 | 14741 | 10767 | 13228 | 6491 |
| 4 | 7469 | 5892 | 5254 | 4427 | 3912 | 5678 | 3253 | 2373 | 3300 | 10481 | 7200 | 5387 |
| 5 | 6907 | 5938 | 4446 | 3852 | 3244 | 2947 | 4217 | 2446 | 1740 | 2488 | 7096 | 4889 |
| 6 | 6504 | 5538 | 4467 | 3201 | 2697 | 2186 | 2194 | 3029 | 1758 | 1268 | 1697 | 4481 |
| 7 | 5913 | 5186 | 4098 | 3126 | 2122 | 1708 | 1544 | 1531 | 2092 | 1153 | 875 | 4089 |
| 8 | 3859 | 4717 | 3770 | 2677 | 1881 | 1310 | 1159 | 1008 | 1020 | 1484 | 764 | 3381 |
| 9 | 2814 | 3000 | 3434 | 2265 | 1468 | 972 | 835 | 693 | 652 | 680 | 1037 | 2596 |
| 10 | 1549 | 2196 | 2127 | 2057 | 1298 | 685 | 541 | 482 | 429 | 450 | 400 | 1845 |
| 11 | 1104 | 1149 | 1520 | 1023 | 772 | 420 | 326 | 303 | 290 | 269 | 211 | 1113 |
| 12 | 649 | 804 | 799 | 819 | 475 | 322 | 202 | 194 | 195 | 171 | 110 | 709 |
| 13 | 305 | 481 | 549 | 329 | 318 | 180 | 142 | 121 | 114 | 113 | 80 | 396 |
| 14 | 325 | 233 | 348 | 321 | 208 | 193 | 110 | 93 | 86 | 75 | 69 | 287 |
| 15+ | 166 | 183 | 196 | 25 | 129 | 117 | 92 | 81 | 64 | 75 | 108 | 140 |
| TOTAL NO | 74465 | 76897 | 65954 | 52007 | 44745 | 68666 | 76044 | 84590 | 83469 | 63414 | | |
| SPS NO | 47714 | 44435 | 39720 | 32960 | 27116 | 22353 | 22100 | 26007 | 30651 | 33344 | | |
| TOT. BIOM | 7683 | 7532 | 6638 | 5619 | 5024 | 4890 | 5261 | 5733 | 5887 | 6378 | | |
| SPS BIOM | 6481 | 6185 | 5530 | 4657 | 4005 | 3602 | 3275 | 3202 | 3710 | 4416 | | |

Table 4.14a (cont'd)

| | | | Division VIa - t/hour | | | | | | | | |
|---------------|------------------|-------------|--------------------------|-------|-------|-------|-------|-------------------|-------|-------------------|--|
| GRT class | Country | Time period | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | |
| 100- 499.9 | Norway | Feb | - | - | - | - | - | 31.35 | - | - | |
| 500- 999.9 | Faroes | Apr | 21.40 | 16.40 | - | - | - | - | - | - | |
| | Norway | Jan-Feb | - | - | - | - | - | - | - | 11.90 | |
| | | Mar-Apr | 30.27 | 26.56 | 34.96 | 36.30 | 49.04 | 25.21 | 20.05 | 21.50 | |
| | | May | - | - | - | - | - | - | - | 22.38 | |
| 1,000-1,999.9 | Norway | Mar-Apr | - | 23.92 | 57.13 | 42.38 | 42.83 | 28.78 | 22.29 | - | |
| 2,000-3,999.9 | USSR | Mar | - | - | - | - | - | 3.92 | - | - | |
| | | | Division VIb - t/hour | | | | | | | | |
| 2,000-3,999.9 | USSR | Apr-Jun | - | - | - | - | - | - | - | 4.80 | |
| | | | Division VIIb,c - t/hour | | | | | | | | |
| 100- 499.9 | Norway | Mar | - | - | - | - | - | 21.08 | - | - | |
| 500- 999.9 | Norway | Mar-Apr | - | - | - | - | - | 27.74 | 26.83 | 25.35 | |
| 1,000-1,999.9 | Norway | Nov | - | - | - | - | - | 8.00 ¹ | 32.08 | - | |
| 2,000-3,999.9 | USSR | Feb-Mar | - | - | - | - | - | 4.72 | 6.21 | 3.83 ² | |
| >4,000 | USSR | Feb-Mar | - | - | - | - | - | - | - | 10.20 | |
| | | | Division VIIg-k - t/hour | | | | | | | | |
| 500- 999.9 | Norway | Mar | - | - | - | - | - | 14.58 | - | - | |
| 2,000-3,999.9 | German Dem. Rep. | Feb-Mar | - | - | - | - | - | - | - | 7.20 | |
| | USSR | Feb-Mar | - | - | - | - | - | 3.85 | 12.30 | 6.96 | |

¹One trawl only.²Refers to Feb-Apr.

Table 4.14b CPUE in directed Blue Whiting fisheries 1977-1982. t/day.

| Division | GRT class | Country | Time period | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 |
|----------|---------------|---------|-------------|-------|-------|-------|-------|-------|------|
| IIa | 2,000-3,999.9 | Poland | May-Jun | - | - | 21.90 | 8.00 | 16.10 | 6.50 |
| | | | Jul-Aug | - | 14.00 | 17.80 | 24.00 | 19.70 | 4.50 |
| | | | Sep-Nov | - | - | - | 21.40 | 13.30 | 7.90 |
| Vb | 500- 999.9 | Iceland | May | 55.60 | 57.50 | 33.80 | 43.30 | 79.20 | - |

Table 4.15 Catch per unit effort in the BLUE WHITING directed fisheries in Division IIa for 2,000 - 3,999.9 GRT, using mid-water trawls, 1979-1986.

| Month | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
|------------------------|----------|--------|--------|-------|-------|-------|-------|-------|
| Catch (tonnes) | | | | | | | | |
| <u>German Dem.Rep.</u> | | | | | | | | |
| January | - | - | - | - | - | - | - | - |
| February | - | - | - | - | - | - | - | - |
| March | - | - | - | - | - | - | - | - |
| April | - | - | - | - | - | - | - | - |
| May | 407 | 546 | 159 | 289 | 613 | 351 | - | - |
| June | 2,548 | 3,025 | 2,566 | 1,148 | 2,524 | 1,876 | 393 | 150 |
| July | 2,317 | 3,523 | 5,951 | 1,226 | 1,026 | 3,947 | 642 | - |
| August | 64 | 2,871 | 4,130 | - | 764 | 1,779 | - | 1,441 |
| September | 862 | 605 | 1,481 | 113 | - | 240 | 490 | 1,335 |
| October | - | 1,128 | 55 | 266 | - | - | 111 | 403 |
| November | - | 1,380 | - | - | 494 | - | - | 412 |
| December | - | 754 | - | - | 132 | - | - | - |
| All months | 6,198 | 13,832 | 14,310 | 3,042 | 5,553 | 8,193 | 1,636 | 3,741 |
| May - Oct | 6,198 | 11,698 | 14,310 | 3,042 | 4,917 | 8,193 | 1,636 | 3,179 |
| Effort (hours) | | | | | | | | |
| January | - | - | - | - | - | - | - | - |
| February | - | - | - | - | - | - | - | - |
| March | - | - | - | - | - | - | - | - |
| April | - | - | - | - | - | - | - | - |
| May | 127 | 279 | 210 | 152 | 393 | 219 | - | - |
| June | 893 | 999 | 2,046 | 1,280 | 945 | 1,371 | 153 | 28 |
| July | 792 | 902 | 2,596 | 1,045 | 831 | 1,596 | 247 | - |
| August | 39 | 965 | 2,079 | - | 801 | 598 | - | 563 |
| September | 430 | 248 | 627 | 54 | - | 128 | 247 | 546 |
| October | - | - | 53 | 118 | - | - | 91 | 192 |
| November | - | - | - | - | - | - | - | 115 |
| December | - | - | - | - | - | - | - | - |
| All months | 2,281 | 4,322 | 7,611 | 2,649 | 3,202 | 3,912 | 738 | 1,444 |
| May - Oct | 2,281 | 3,817 | 7,611 | 2,649 | 2,970 | 3,912 | 738 | 1,301 |
| CPUE (tonnes/hour) | | | | | | | | |
| January | - | - | - | - | - | - | - | - |
| February | - | - | - | - | - | - | - | - |
| March | - | - | - | - | - | - | - | - |
| April | - | - | - | - | - | - | - | - |
| May | 3.21 | 1.96 | 0.76 | 1.90 | 1.56 | 1.60 | - | - |
| June | 2.85 | 3.03 | 1.25 | 0.90 | 2.67 | 1.37 | 2.57 | 5.36 |
| July | 2.93 | 3.91 | 2.29 | 1.17 | 1.24 | 2.47 | 2.60 | - |
| August | 1.64 | 2.98 | 1.99 | - | 0.95 | 2.97 | - | 2.56 |
| September | 2.01 | 2.44 | 2.36 | 2.09 | - | 1.88 | 1.98 | 2.45 |
| October | - | - | 1.04 | 2.25 | - | - | 1.22 | 2.10 |
| November | - | - | - | - | - | - | - | 3.58 |
| December | - | - | - | - | - | - | - | - |
| All months | 2.72 | 3.20 | 1.88 | 1.15 | 1.73 | 2.09 | 2.22 | 2.59 |
| May - Oct | (1) 2.72 | 3.06 | 1.88 | 1.15 | 1.66 | 2.09 | 2.22 | 2.51 |
| | (2) 2.53 | 2.83 | 1.62 | 1.66 | 1.61 | 2.06 | 2.09 | 3.12 |

Table 4.15 (cont'd)

| Month | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
|-------------------|-------|--------|-------|------|------|------|------|------|
| Catch (tonnes) | | | | | | | | |
| Poland | | | | | | | | |
| January | - | - | - | - | - | - | - | - |
| February | - | - | - | - | - | - | - | - |
| March | - | - | - | - | - | - | - | - |
| April | - | - | - | - | - | - | - | - |
| May | 948 | - | - | - | - | - | - | - |
| June | 2,216 | 200 | 210 | 163 | - | - | - | - |
| July | 896 | 1,405 | 369 | 113 | - | - | - | - |
| August | 264 | 3,269 | 569 | - | - | - | - | - |
| September | - | 3,123 | - | 99 | - | - | - | - |
| October | - | 1,757 | 526 | 36 | - | - | - | - |
| November | - | 1,383 | 178 | - | - | - | - | - |
| December | - | - | - | - | - | - | - | - |
| All months | 4,324 | 11,137 | 1,852 | 411 | - | - | - | - |
| May - Oct | 4,324 | 9,754 | 1,676 | 411 | - | - | - | - |
| Effort (day) | | | | | | | | |
| January | - | - | - | - | - | - | - | - |
| February | - | - | - | - | - | - | - | - |
| March | - | - | - | - | - | - | - | - |
| April | - | - | - | - | - | - | - | - |
| May | 21 | - | - | - | - | - | - | - |
| June | 80 | 25 | 13 | 25 | - | - | - | - |
| July | 59 | 62 | 30 | 25 | - | - | - | - |
| August | 13 | 130 | 21 | - | - | - | - | - |
| September | - | 128 | - | 13 | - | - | - | - |
| October | - | 93 | 43 | 4 | - | - | - | - |
| November | - | 72 | 10 | - | - | - | - | - |
| December | - | - | - | - | - | - | - | - |
| All months | 173 | 510 | 117 | 67 | - | - | - | - |
| May - Oct | 173 | 438 | 107 | 67 | - | - | - | - |
| CPUE (tonnes/day) | | | | | | | | |
| January | - | - | - | - | - | - | - | - |
| February | - | - | - | - | - | - | - | - |
| March | - | - | - | - | - | - | - | - |
| April | - | - | - | - | - | - | - | - |
| May | 45.1 | - | - | - | - | - | - | - |
| June | 27.7 | 8.0 | 16.1 | 6.5 | - | - | - | - |
| July | 15.2 | 22.7 | 12.3 | 4.5 | - | - | - | - |
| August | 20.3 | 25.2 | 27.1 | - | - | - | - | - |
| September | - | 24.4 | - | 7.6 | - | - | - | - |
| October | - | 18.9 | 12.2 | 9.0 | - | - | - | - |
| November | - | 19.2 | 17.8 | - | - | - | - | - |
| December | - | - | - | - | - | - | - | - |
| All months | - | 21.8 | 15.8 | 6.1 | - | - | - | - |
| May - Oct | (1) | - | 22.3 | 15.6 | 6.1 | - | - | - |
| | (2) | - | 19.8 | 16.9 | 6.9 | - | - | - |

Table 4.15 (cont'd)

| Month | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
|--------------------|----------|---------|---------|--------|--------|--------|--------|---------|
| Catch (tonnes) | | | | | | | | |
| USSR | | | | | | | | |
| January | 8,992 | 2,927 | - | 8,003 | - | - | - | 1,069 |
| February | 4,959 | 2,153 | - | - | - | - | - | 3,622 |
| March | 5,520 | 16,811 | 3,886 | 375 | - | - | - | 463 |
| April | 3,382 | 36,284 | 45,645 | 618 | - | 1,782 | 62 | 529 |
| May | 51,409 | 125,988 | 88,754 | 46,089 | 15,188 | 6,131 | 3,289 | 455 |
| June | 110,918 | 114,117 | 78,727 | 27,617 | 7,919 | 16,564 | 25,031 | 27,967 |
| July | 124,618 | 121,463 | 87,582 | 6,820 | 1,172 | 11,842 | 33,177 | 47,485 |
| August | 142,962 | 114,505 | 63,889 | - | - | 15,609 | 20,969 | 32,608 |
| September | 106,606 | 79,504 | 37,960 | 2,921 | - | 492 | 5,311 | 9,269 |
| October | 57,562 | 50,954 | 11,560 | 1,121 | - | - | - | 1,812 |
| November | 16,317 | 17,543 | 4,778 | 379 | - | - | - | 96 |
| December | 5,830 | 1,292 | 10,704 | - | - | - | - | 261 |
| All months | 639,129 | 683,541 | 433,485 | 93,943 | 24,279 | 52,420 | 87,839 | 126,520 |
| May - Oct | 594,075 | 606,531 | 368,472 | 84,568 | 24,279 | 50,638 | 87,777 | 119,596 |
| Effort (hours) | | | | | | | | |
| January | - | - | - | 1,045 | - | - | - | 622 |
| February | 1,833 | 339 | - | - | - | - | - | 1,013 |
| March | 1,538 | 6,151 | 1,208 | 285 | - | - | - | 135 |
| April | 1,933 | 16,119 | 12,666 | 256 | - | 222 | 68 | 119 |
| May | 15,336 | 25,244 | 25,912 | 17,106 | 7,300 | 2,247 | 1,900 | 160 |
| June | 38,069 | 47,634 | 37,919 | 14,209 | 6,094 | 5,160 | 9,550 | 8,616 |
| July | 42,166 | 42,319 | 39,039 | 5,983 | 1,963 | 4,315 | 11,600 | 16,490 |
| August | 47,395 | 28,293 | 29,528 | - | - | 5,292 | 7,350 | 16,014 |
| September | 33,755 | 17,499 | 11,745 | 640 | - | 194 | 2,360 | 5,252 |
| October | 16,574 | 16,072 | 3,270 | 341 | - | - | - | 1,579 |
| November | 6,841 | 5,710 | 1,455 | 161 | - | - | - | 544 |
| December | 2,867 | 413 | 4,263 | - | - | - | - | 255 |
| All months | 210,936 | 206,372 | 167,005 | 40,026 | 15,357 | 17,430 | 32,828 | 50,799 |
| May - Oct | 193,295 | 177,061 | 147,413 | 38,279 | 15,357 | 17,208 | 32,760 | 48,111 |
| CPUE (tonnes/hour) | | | | | | | | |
| January | - | - | - | 7.66 | - | - | - | 1.72 |
| February | 2.70 | 6.35 | - | - | - | - | - | 3.58 |
| March | 3.59 | 2.73 | 3.22 | 1.32 | - | - | - | 3.43 |
| April | 1.74 | 2.25 | 3.60 | 2.41 | - | 8.01 | 0.91 | 4.44 |
| May | 3.35 | 4.99 | 3.42 | 2.69 | 2.08 | 2.73 | 1.56 | 2.81 |
| June | 2.91 | 2.39 | 2.08 | 1.94 | 1.30 | 3.21 | 2.62 | 3.25 |
| July | 2.95 | 2.87 | 2.24 | 1.14 | 0.60 | 2.74 | 2.86 | 2.88 |
| August | 3.01 | 4.05 | 2.16 | - | - | 2.95 | 2.84 | 2.04 |
| September | 3.16 | 4.54 | 3.23 | 4.56 | - | 2.54 | 2.25 | 1.77 |
| October | 3.47 | 3.17 | 3.53 | 3.29 | - | - | - | 1.15 |
| November | 2.39 | 3.07 | 3.28 | 2.35 | - | - | - | 1.78 |
| December | 2.03 | 3.13 | 2.51 | - | - | - | - | 1.05 |
| All months | 3.03 | 3.31 | 2.60 | 2.35 | 1.58 | 3.01 | 2.68 | 2.49 |
| May - Oct | (1) 3.07 | 3.43 | 2.50 | 2.21 | 1.58 | 2.94 | 2.68 | 2.49 |
| | (2) 3.14 | 3.67 | 2.78 | 2.72 | 1.33 | 2.83 | 2.17 | 2.32 |

(1) CPUE = total catch/total effort.

(2) CPUE = I(monthly CPUE)/no. of months.

Table 4.16

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 |
|------|-------------|
| 1937 | 10359.0 |
| 1938 | 10359.0 |
| 1939 | 10359.0 |

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: 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 | 10359.0 | .04 | .20 | .00 | .055 | .055 |
| 1 | 9293.0 | .04 | .20 | .10 | .047 | .047 |
| 2 | 8003.0 | .04 | .20 | .37 | .051 | .051 |
| 3 | 6523.0 | .19 | .20 | .81 | .115 | .115 |
| 4 | 7290.0 | .19 | .20 | .85 | .152 | .152 |
| 5 | 7090.0 | .19 | .20 | .91 | .158 | .158 |
| 6 | 6547.0 | .19 | .20 | .94 | .202 | .202 |
| 7 | 505.0 | .19 | .20 | 1.00 | .209 | .209 |
| 8 | 722.0 | .19 | .20 | 1.00 | .253 | .253 |
| 9 | 742.0 | .19 | .20 | 1.00 | .246 | .246 |
| 10 | 565.0 | .19 | .20 | 1.00 | .242 | .242 |
| 11 | 175.0 | .19 | .20 | 1.00 | .255 | .255 |
| 12 | 100.0 | .19 | .20 | 1.00 | .261 | .261 |
| 13 | 67.0 | .19 | .20 | 1.00 | .272 | .272 |
| 14 | 60.0 | .19 | .20 | 1.00 | .302 | .302 |
| 15+ | 101.0 | .19 | .20 | 1.00 | .305 | .305 |

Table 4.17

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

BLUE WHALING - NORTHERN STOCK

| Year 1967 | | | | | Year 1968 | | | | | Year 1989 | | |
|-------------|-----------|------------------|---------------------|-------|-------------|-----------|------------------|---------------------|-------|------------------|---------------------|--|
| 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 | .19 | 6185 | 4449 | 792 | .0 | .03 | 5746 | 4262 | 0 | 6166 | 4741 | |
| | | | | | .1 | .02 | | | 81 | 5080 | 4654 | |
| | | | | | .2 | .04 | | | 160 | 5996 | 4588 | |
| | | | | | .4 | .08 | | | 314 | 5832 | 4447 | |
| | | | | | .6 | .11 | | | 464 | 5674 | 4297 | |
| | | | | | .8 | .15 | | | 608 | 5522 | 4157 | |
| | | | | | 1.0 | .19 | | | 747 | 5374 | 4027 | |
| | | | | | 1.2 | .25 | | | 881 | 5232 | 3897 | |
| | | | | | 1.4 | .27 | | | 1111 | 5095 | 3776 | |
| | | | | | 1.6 | .31 | | | 1136 | 4963 | 3657 | |
| | | | | | 1.8 | .34 | | | 1253 | 4835 | 3542 | |
| | | | | | 2.0 | .38 | | | 1375 | 4712 | 3432 | |

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 5.1 Landings (tonnes) of BLUE WHITING from the southern areas (Sub-areas VIII and IX and Divisions VIIG-k and VIId,e), 1977-1986, as estimated by the Working Group.

| Country | 1977 | 1978 | 1979 | 1980 | 1981 |
|--------------------|---------------|---------------|---------------|---------------|---------------|
| Denmark | - | - | - | - | - |
| German Dem.Rep. | - | - | - | - | - |
| Germany, Fed.Rep | - | 25 | - | - | - |
| Ireland | - | - | 1 | - | - |
| Netherlands | - | 7 | - | 31 | 633 |
| Poland | 169 | 53 | - | - | - |
| Portugal | 1,557 | 2,381 | 2,096 | 6,051 | 7,387 |
| Spain ² | 25,259 | 31,428 | 25,016 | 23,862 | 30,728 |
| UK (Engl. & Wales) | + | - | - | - | - |
| UK (Scotland) | - | - | 63 | - | - |
| USSR | 3,738 | 4 | - | - | - |
| Total | 30,723 | 33,898 | 27,176 | 29,944 | 38,748 |

| Country | 1982 | 1983 | 1984 | 1985 | 1986 ¹ |
|--------------------|---------------|---------------|---------------------|--------------------|---------------------|
| Denmark | - | - | - | 280 ³ | - |
| German Dem.Rep. | - | - | - | 412 ³ | 997 ³ |
| Germany, Fed.Rep. | - | 50 | 301 ³ | - | - |
| Ireland | - | - | - | - | - |
| Netherlands | 200 | - | - | 553 ³ | 3,605 ³ |
| Poland | - | - | - | - | - |
| Portugal | 3,890 | 4,748 | 5,252 | 6,989 | 8,116 |
| Spain ² | 27,500 | 26,037 | 25,921 ³ | 35,828 | 24,965 |
| UK (Engl. & Wales) | - | - | 33 ³ | - | - |
| UK (Scotland) | - | - | - | - | - |
| USSR | - | - | 5,591 ³ | 7,230 ³ | 31,922 ³ |
| Total | 31,590 | 30,835 | 37,098 | 51,292 | 69,605 |

¹ Preliminary.

² Significant quantities taken in Divisions VIIG-k not included in the table are discarded every year.

³ Catches supposed to be taken from the northern stock.

Table 5.2 Catch in numbers (thousands) by length group in the Portuguese and Spanish blue whiting fisheries, 1983-1986.

| Length (cm) | 1983 | 1984 | 1985 | 1986 |
|--------------|---------|---------|---------|---------|
| 10 | - | - | 8 | - |
| 1 | - | 3 | 25 | - |
| 2 | 13 | 41 | 39 | 118 |
| 3 | 253 | 337 | 74 | 783 |
| 4 | 1,390 | 13,263 | 498 | 5,903 |
| 5 | 18,613 | 48,364 | 13,013 | 7,234 |
| 6 | 63,241 | 88,023 | 31,407 | 6,394 |
| 7 | 67,446 | 142,003 | 73,885 | 16,669 |
| 8 | 95,625 | 154,385 | 181,222 | 49,746 |
| 9 | 97,379 | 128,950 | 235,008 | 82,458 |
| 20 | 81,201 | 91,952 | 211,958 | 99,258 |
| 1 | 66,757 | 69,370 | 127,966 | 126,338 |
| 2 | 58,748 | 44,241 | 69,313 | 107,413 |
| 3 | 43,069 | 27,623 | 28,905 | 57,835 |
| 4 | 25,651 | 16,420 | 11,842 | 23,594 |
| 5 | 10,990 | 7,744 | 5,946 | 9,840 |
| 6 | 5,221 | 3,309 | 3,089 | 3,759 |
| 7 | 3,670 | 1,194 | 1,263 | 2,033 |
| 8 | 2,855 | 854 | 899 | 1,091 |
| 9 | 1,465 | 800 | 622 | 473 |
| 30 | 1,381 | 199 | 296 | 308 |
| 1 | 342 | 216 | 205 | 165 |
| 2 | 58 | 103 | 172 | 174 |
| 3 | 8 | 117 | 64 | 255 |
| 4 | 1 | 16 | 54 | 269 |
| 5 | 4 | 22 | 23 | 167 |
| 6 | - | 32 | 15 | 67 |
| 7 | 4 | 20 | 6 | 80 |
| 8 | - | 2 | 2 | 56 |
| 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 |
| Landings (t) | 30,785 | 31,173 | 42,817 | 33,083 |

Table 5.3 Catch in numbers (millions) by age group in the Portuguese and Spanish blue whiting fisheries, 1982-1986.

| Age | 1982 | 1983 | 1984 | 1985 | 1986 |
|-------------|--------|--------|--------|--------|--------|
| 0 | 61.1 | 98.0 | 73.9 | 118.3 | 32.4 |
| 1 | 102.5 | 149.7 | 223.2 | 285.9 | 93.2 |
| 2 | 183.5 | 238.5 | 349.0 | 337.2 | 218.2 |
| 3 | 121.8 | 68.2 | 127.4 | 170.5 | 167.6 |
| 4 | 64.3 | 45.1 | 35.0 | 65.9 | 68.1 |
| 5 | 22.1 | 34.0 | 13.2 | 13.6 | 15.1 |
| 6 | 3.2 | 8.8 | 13.8 | 3.0 | 5.7 |
| 7 | 0.3 | 2.3 | 3.3 | 2.4 | 1.0 |
| 8+ | 1.0 | 0.8 | 0.8 | 1.1 | 1.0 |
| Total | 559.9 | 645.4 | 839.6 | 997.8 | 602.5 |
| Nominal (t) | 31,390 | 30,785 | 31,173 | 42,817 | 33,083 |
| SOP | 33,660 | 31,805 | 31,370 | 42,839 | 33,981 |
| w (g) | 60.0 | 49.3 | 37.4 | 44.0 | 56.4 |

Table 5.4 Mean length and mean weights of BLUE WHITING landed by Portugal and Spain in the period 1982-1986.

| Age | 1982 | | 1983 | | 1984 | | 1985 | | 1986 | |
|-----|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| | \bar{L} | \bar{w} | \bar{L} | \bar{w} | \bar{L} | \bar{w} | \bar{L} | \bar{w} | \bar{L} | \bar{w} |
| 0 | 17.3 | 32 | 16.5 | 28.6 | 15.7 | 21.6 | 17.2 | 28.6 | 16.8 | 26.3 |
| 1 | 19.5 | 45 | 18.3 | 39.0 | 17.3 | 28.7 | 18.7 | 36.9 | 19.4 | 41.7 |
| 2 | 21.7 | 61 | 19.5 | 46.5 | 18.4 | 34.6 | 19.6 | 43.4 | 20.8 | 52.1 |
| 3 | 22.5 | 69 | 21.9 | 65.8 | 20.8 | 50.5 | 20.5 | 49.9 | 22.1 | 63.2 |
| 4 | 23.4 | 77 | 23.0 | 75.6 | 22.8 | 65.9 | 21.9 | 61.2 | 23.1 | 72.8 |
| 5 | 24.2 | 85 | 23.8 | 84.4 | 24.0 | 77.0 | 23.2 | 73.4 | 24.7 | 90.2 |
| 6 | 25.8 | 103 | 25.6 | 104.5 | 24.4 | 81.1 | 25.8 | 103.9 | 25.3 | 97.4 |
| 7 | 29.8 | 156 | 27.1 | 123.5 | 25.7 | 94.1 | 26.4 | 111.6 | 29.3 | 155.6 |
| 8+ | 35.8 | 269 | 28.7 | 145.4 | 28.7 | 131.4 | 28.3 | 139.1 | 34.3 | 257.4 |

Table 5.5 Catch per unit effort by Spanish vessels landing in the main Galician ports, 1977-1986.

| 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 |

Table 5.6 Catch per unit effort by Spanish single and pair trawlers landing in the main Galician ports, 1983-1986.

| 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 |
| <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 |

Table 5.7 Stratified mean catch (kg/h) and standard deviation of BLUE WHITING in bottom trawl surveys by Spain in Galician waters. All the surveys were in September-October except the first 1986 survey which was in April.

| Strata → | Division IXa | | | | Division VIIIC | | | | Divisions VIIIC + IXa | | | | Total | |
|-------------------|--------------|---------------|-------|---------------|----------------|---------------|-------|---------------|-----------------------|---------------|-------|---------------|-------|---------------|
| | <200 | | >200 | | <200 | | >200 | | <200 | | >200 | | <500 | |
| Year | Y | $s_{\bar{y}}$ | Y | $s_{\bar{y}}$ | Y | $s_{\bar{y}}$ | Y | $s_{\bar{y}}$ | Y | $s_{\bar{y}}$ | Y | $s_{\bar{y}}$ | Y | $s_{\bar{y}}$ |
| 1980 | 80.0 | 64.4 | - | - | 120.7 | 114.9 | - | - | 101.4 | 19.3 | - | - | - | - |
| 1981 | 20.2 | 19.0 | 53.9 | 41.4 | 70.8 | 75.0 | 59.0 | 27.3 | 46.8 | 12.2 | 57.6 | 16.2 | - | - |
| 1982 | 82.1 | 61.5 | - | - | 118.5 | 70.8 | - | - | 101.2 | 12.9 | - | - | - | - |
| 1983 | 224.3 | 224.5 | 40.55 | 10.7 | 275.6 | 192.9 | 144.0 | 143.6 | 251.2 | 38.7 | 116.2 | 37.2 | 189.1 | 24.2 |
| 1984 | 180.2 | 49.3 | 23.1 | 21.6 | 125.0 | 19.6 | 93.9 | 74.4 | 151.2 | 25.6 | 74.9 | 15.9 | 131.2 | 15.5 |
| 1985 | 295.5 | 153.8 | 212.8 | 241.6 | 129.9 | 23.3 | 126.3 | 160.4 | 208.6 | 74.1 | 149.5 | 41.9 | 163.6 | 39.7 |
| 1986 ¹ | 213.7 | 85.2 | 78.9 | 60.7 | 98.6 | 16.0 | 41.4 | 41.6 | 153.3 | 41.4 | 51.4 | 11.7 | 101.5 | 21.9 |
| 1986 | 96.8 | 26.2 | 52.9 | 43.9 | 248.1 | 108.4 | 48.2 | 49.3 | 176.1 | 58.2 | 49.5 | 6.4 | 112.2 | 30.4 |

¹April.

Table 5.8 Stratified mean catch and standard error for BLUE WHITING in groundfish surveys by Portugal.

| Year | Month | 20-100 m | | 100-200 m | | 200-500 m | | 20-500 m | |
|---------------------|---------|----------|----------------|-----------|----------------|-----------|----------------|----------|----------------|
| | | Y | S _Y | Y | S _Y | Y | S _Y | Y | S _Y |
| 1979 | Jun | 0.2 | 0.2 | 32.8 | 22.7 | 86.3 | 34.6 | 31.2 | 11.5 |
| | Oct/Nov | 5.1 | 4.9 | 17.2 | 7.6 | 102.9 | 47.9 | 27.8 | 9.3 |
| 1980 | Mar | - | - | 178.0 | 173.0 | 4.7 | 0.7 | 71.7 | 68.5 |
| | May/Jun | 0.9 | 0.7 | 4.0 | 1.5 | 45.4 | 18.2 | 10.7 | 3.5 |
| | Oct | 3.6 | 2.7 | 9.9 | 4.4 | 586.7 | 305.9 | 117.3 | 58.3 |
| 1981 | Mar | - | - | 23.5 | 17.4 | 185.5 | 112.7 | 44.2 | 22.2 |
| | Jun | - | - | 4.2 | 1.6 | 177.5 | 24.6 | 33.8 | 4.5 |
| 1982 | Apr/May | - | - | 3.2 | 2.6 | 136.4 | 39.3 | 26.0 | 7.2 |
| | Sep | 0.6 | 0.5 | 85.1 | 42.3 | 271.4 | 122.6 | 85.7 | 28.7 |
| 1983 ¹ | Mar | 0.7 | 0.6 | 14.0 | 9.5 | 259.2 | 96.1 | 54.3 | 18.3 |
| | Jun | - | - | 22.6 | 8.4 | 177.2 | 46.9 | 42.2 | 9.3 |
| 1985 ^{1/3} | Jun | 0.1 | 0.1 | 194.4 | 145.9 | 404.8 | 161.5 | 159.0 | 67.9 |
| | Oct | 3.5 | 3.1 | 126.2 | 80.3 | 360.6 | 46.9 | 123.6 | 34.4 |
| 1987 ^{1/2} | May | - | - | 0.2 | 0.3 | 32.9 | 44.5 | 30.6 | 42.7 |
| | Sep | - | - | 8.10 | 92.9 | 66.0 | 106.3 | 70.7 | 100.2 |

¹Data unpublished.

²Coverage incomplete.

³Codend mesh size 20 mm, otherwise 40 mm.

Table 5.9

Title : BLUE WHITING, SOUTHERN AREA

At 09.19.12 22 SEPTEMBER 1987

from 82 to 86 on ages 0 to 7

with Terminal F of .800 on age 4 and Terminal S of 1.000

Initial sum of squared residuals was 24.614 and
 final sum of squared residuals is 3.088 after 63 iterations

Matrix of Residuals

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| Years | 82/83 | 83/84 | 84/85 | 85/86 | | WTS | | |
|-------------------------|-------|-------|-------|-------|--------|-------|-------|--------|
| Ages | | | | | | | | |
| 0/ 1 | -.093 | -.019 | -.614 | .726 | .000 | .434 | | |
| 1/ 2 | -.269 | -.297 | .051 | .515 | .000 | .635 | | |
| 2/ 3 | .386 | -.028 | -.056 | -.303 | .000 | .839 | | |
| 3/ 4 | .349 | -.039 | -.173 | -.138 | .000 | 1.000 | | |
| 4/ 5 | -.257 | .266 | -.153 | .144 | .000 | .976 | | |
| 5/ 6 | .053 | -.034 | .411 | -.431 | .000 | .693 | | |
| 6/ 7 | -.533 | .049 | .682 | -.198 | .000 | .467 | | |
| | .000 | .000 | .000 | .000 | .000 | | | |
| WTS | 1.000 | 1.000 | 1.000 | 1.000 | | | | |
| Fishing Mortalities (F) | | | | | | | | |
| F-values | .82 | .83 | .84 | .85 | .86 | | | |
| | .7485 | .8257 | .9264 | .9856 | .8000 | | | |
| Selection-at-age (S) | | | | | | | | |
| S-values | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| | .0914 | .2590 | .7493 | .8428 | 1.0000 | .9832 | .9865 | 1.0000 |

Table 5.10 Virtual Population Analysis.

BLUE WHITING, Southern Area.

| MEAN WEIGHT AT AGE IN THE CATCH | UNIT: kilogram | | | | |
|---------------------------------|----------------|------|------|------|------|
| ----- | 1982 | 1983 | 1984 | 1985 | 1986 |
| 0 | .032 | .029 | .022 | .029 | .026 |
| 1 | .045 | .039 | .029 | .037 | .042 |
| 2 | .061 | .046 | .055 | .043 | .052 |
| 3 | .069 | .066 | .050 | .050 | .063 |
| 4 | .077 | .076 | .066 | .061 | .073 |
| 5 | .085 | .084 | .077 | .073 | .090 |
| 6 | .103 | .104 | .081 | .104 | .097 |
| 7 | .156 | .124 | .094 | .112 | .156 |
| 8+ | .269 | .145 | .131 | .139 | .257 |

Table 5.11 Sum of Products Check.

BLUE WHITING, Southern Area.

CATEGORY: Total

| CATCH IN NUMBERS | UNIT: millions | | | | |
|------------------|----------------|------|------|------|------|
| ----- | 1982 | 1983 | 1984 | 1985 | 1986 |
| 0 | 61 | 98 | 74 | 118 | 32 |
| 1 | 103 | 150 | 223 | 286 | 93 |
| 2 | 184 | 239 | 349 | 357 | 218 |
| 3 | 122 | 68 | 127 | 171 | 168 |
| 4 | 64 | 45 | 35 | 66 | 68 |
| 5 | 22 | 34 | 13 | 14 | 15 |
| 6 | 3 | 9 | 14 | 3 | 6 |
| 7 | 0 | 2 | 3 | 2 | 1 |
| 8+ | 1 | 1 | 1 | 1 | 1 |
| TOTAL | 560 | 645 | 840 | 998 | 602 |

Table 5.12 Virtual Population Analysis.

BLUE WHITING, Southern Area.

| FISHING MORTALITY COEFFICIENT | | UNIT: Year ⁻¹ | | | | NATURAL MORTALITY COEFFICIENT = |
|-------------------------------|------|--------------------------|------|------|------|---------------------------------|
| ----- | | | | | | .20 |
| | 1982 | 1983 | 1984 | 1985 | 1986 | |
| 0 | .05 | .07 | .06 | .14 | .07 | |
| 1 | .15 | .16 | .24 | .35 | .15 | |
| 2 | .72 | .58 | .63 | .68 | .49 | |
| 3 | .83 | .65 | .72 | .88 | .88 | |
| 4 | .64 | 1.03 | .84 | 1.10 | 1.15 | |
| 5 | .77 | .86 | 1.02 | .97 | .83 | |
| 6 | .57 | .82 | 1.11 | .68 | 1.73 | |
| 7 | .75 | 1.09 | .86 | .58 | .51 | |
| 8+ | .75 | 1.09 | .86 | .58 | .51 | |

Table 5.13 Virtual Population Analysis.

BLUE WHITING, Southern Area.

| STOCK SIZE IN NUMBERS | | UNIT: millions | | | | |
|------------------------------------|------|-----------------------|------|------|------|------|
| ----- | | | | | | |
| BIOMASS TOTALS | | UNIT: thousand tonnes | | | | |
| ----- | | | | | | |
| ALL VALUES ARE GIVEN FOR 1 JANUARY | | | | | | |
| | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 |
| 0 | 1414 | 1522 | 1380 | 1029 | 507 | 0 |
| 1 | 833 | 1103 | 1158 | 1063 | 736 | 385 |
| 2 | 391 | 590 | 768 | 747 | 613 | 518 |
| 3 | 226 | 157 | 270 | 317 | 310 | 307 |
| 4 | 149 | 76 | 67 | 107 | 108 | 105 |
| 5 | 45 | 64 | 22 | 24 | 29 | 28 |
| 6 | 8 | 17 | 22 | 7 | 7 | 10 |
| 7 | 1 | 4 | 6 | 6 | 3 | 1 |
| 8+ | 2 | 1 | 2 | 3 | 3 | 3 |
| TOTAL NO | 3069 | 3534 | 3695 | 3302 | 2316 | |
| SPS NO | 910 | 996 | 1203 | 1242 | 1067 | |
| TOT. BIOM | 139 | 138 | 112 | 127 | 108 | |
| SPS BIOM | 59 | 53 | 49 | 58 | 62 | |

Table 6.1 Biomass estimates of BLUE WHITING obtained during the acoustic surveys in the Norwegian Sea, 1980-1986, divided into national zones.

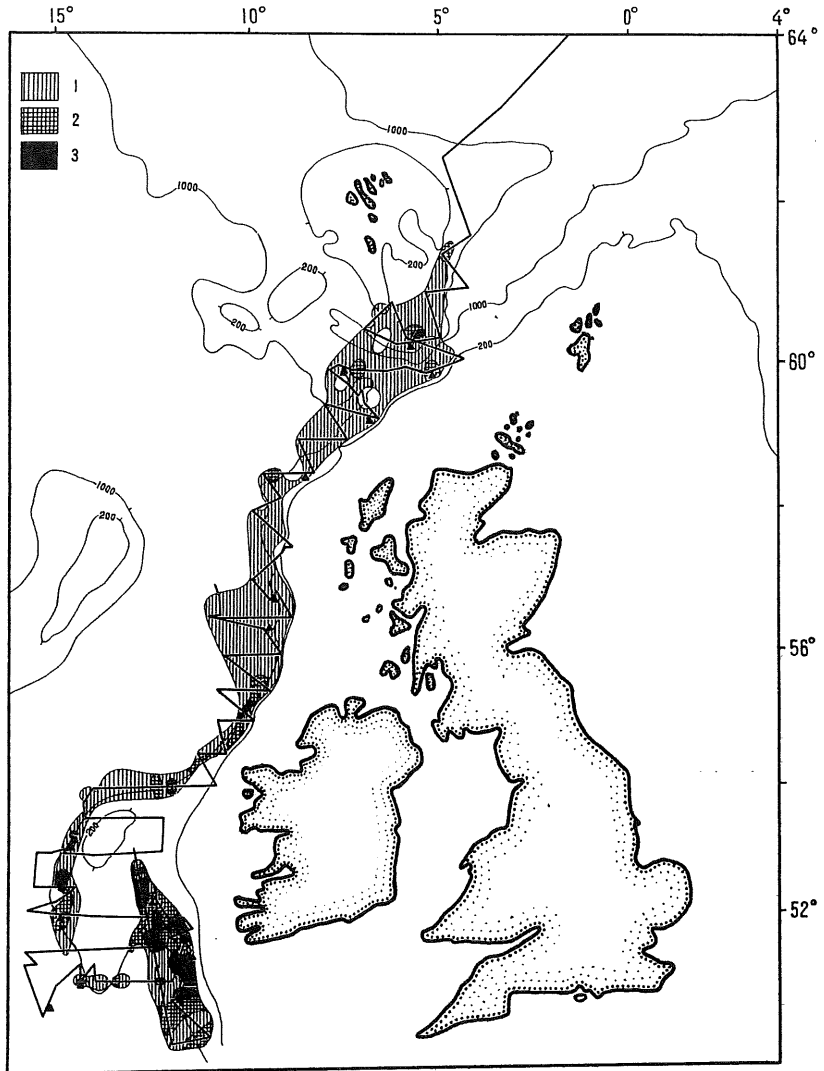
| Area | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 |
|-----------------------|------|------|------|------|------|------|------|
| Internat. | 18.9 | 26.0 | 14.7 | 5.6 | 4.8 | 8.2 | 8.4 |
| Svalbard ¹ | 5.4 | 2.0 | 1.1 | 1.1 | 0.1 | - | 0.1 |
| Jan Mayen | 16.8 | 8.8 | 5.9 | 3.4 | 0.6 | 2.5 | 2.3 |
| Norway | 40.7 | 38.7 | 45.9 | 38.2 | 39.2 | 22.7 | 54.5 |
| Iceland | 8.6 | 14.2 | 10.8 | 25.0 | 18.4 | 13.7 | 6.8 |
| Greenland | 0.1 | - | - | - | - | 0.9 | - |
| Faroes | 4.7 | 8.3 | 16.9 | 19.4 | 25.9 | 37.4 | 19.2 |
| EEC | 4.8 | 2.0 | 7.7 | 7.2 | 11.1 | 14.7 | 7.8 |
| Sweden | - | - | - | - | - | - | 0.9 |

¹Spitsbergen, Bear Island, and Hopen Island.

Table 6.2 Total catches of BLUE WHITING in 1978-1988 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 |

Figure 4.1 Distribution of blue whiting densities observed during the first USSR survey in the spring of 1987 (19 February - 13 March).



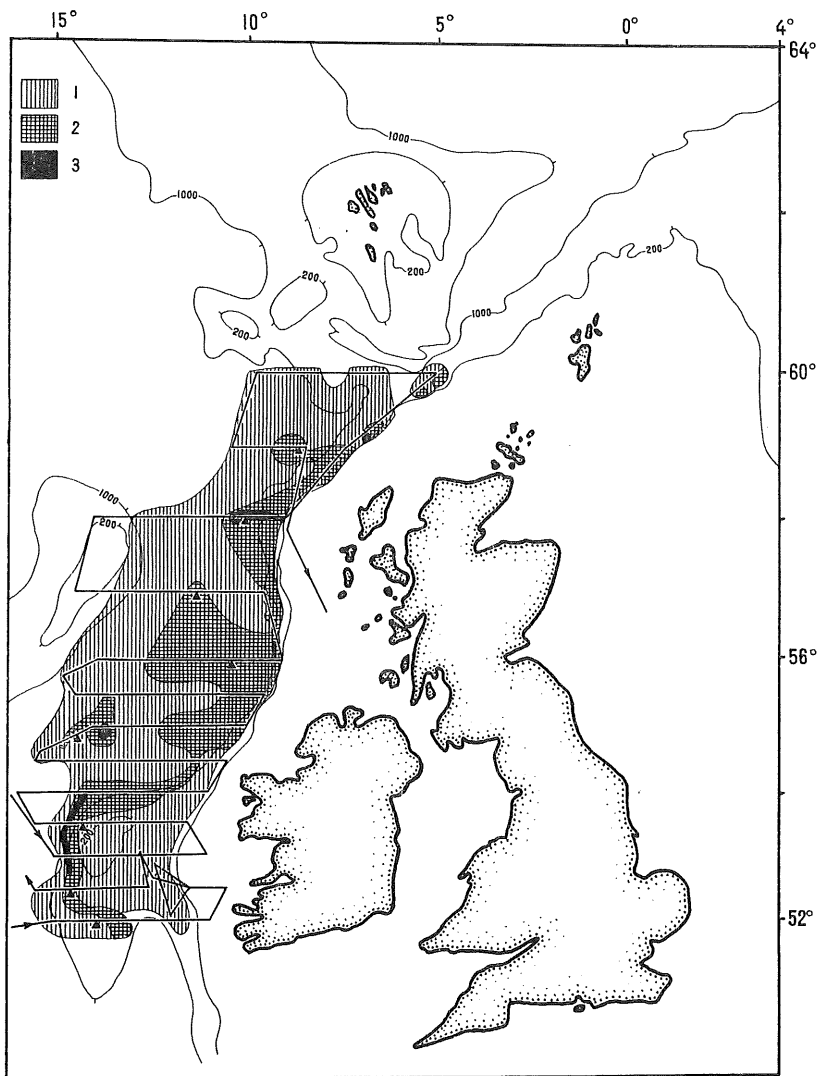
1 less than 150t/square mile.

2 150-500t square mile.

3 over 500t/square mile.

▲ test trawling.

Figure 4.2 Distribution of blue whiting densities observed during the second USSR survey in the spring of 1987 (25 March - 20 April).



- 1 less than 150t/square mile
- 2 150-500t/square mile
- 3 over 500t/square mile
- ▲ test trawlings

Figure 4.3 Distribution of blue whiting densities observed during the Norwegian survey in the spring of 1987 (16 March - 11 April). Echo intensity in $m^2/n.mile^2$.

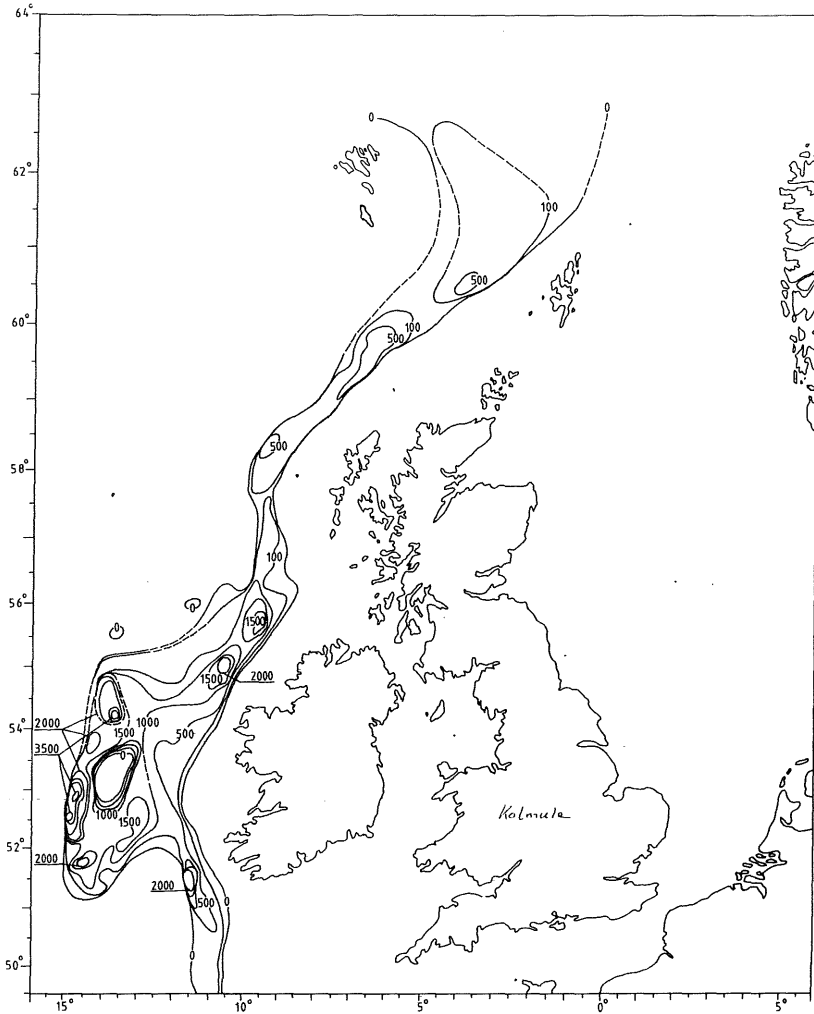


Figure 4.4 Distribution of blue whiting densities observed during the Norwegian survey in the summer of 1987 (10 June - 23 July). Echo intensity in $n^2/3(\text{n.mile})^2$.

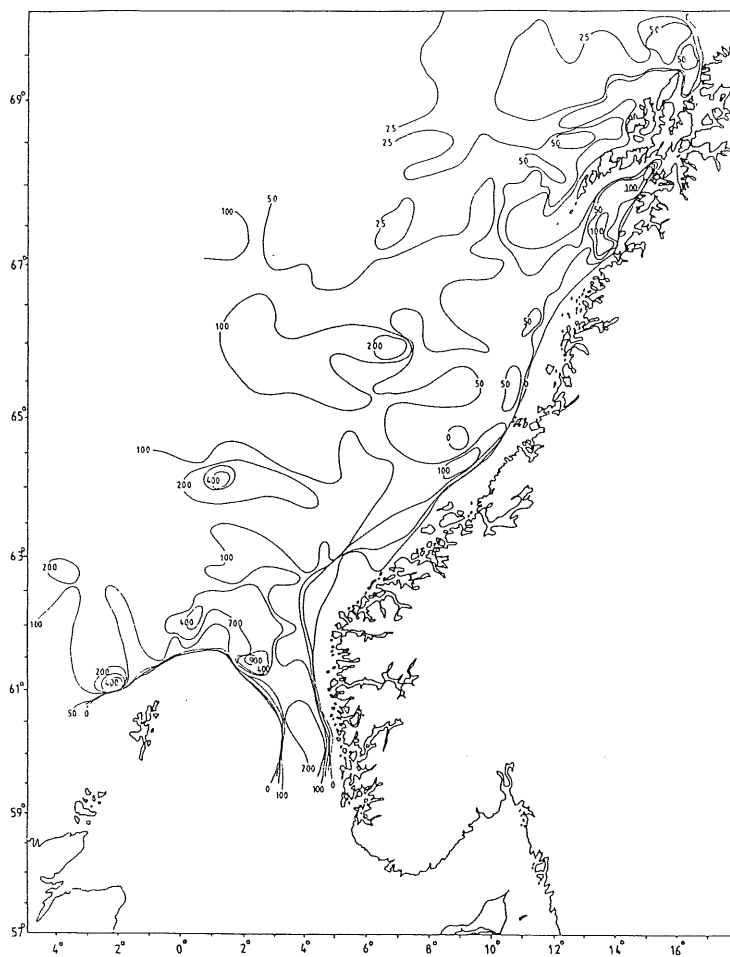
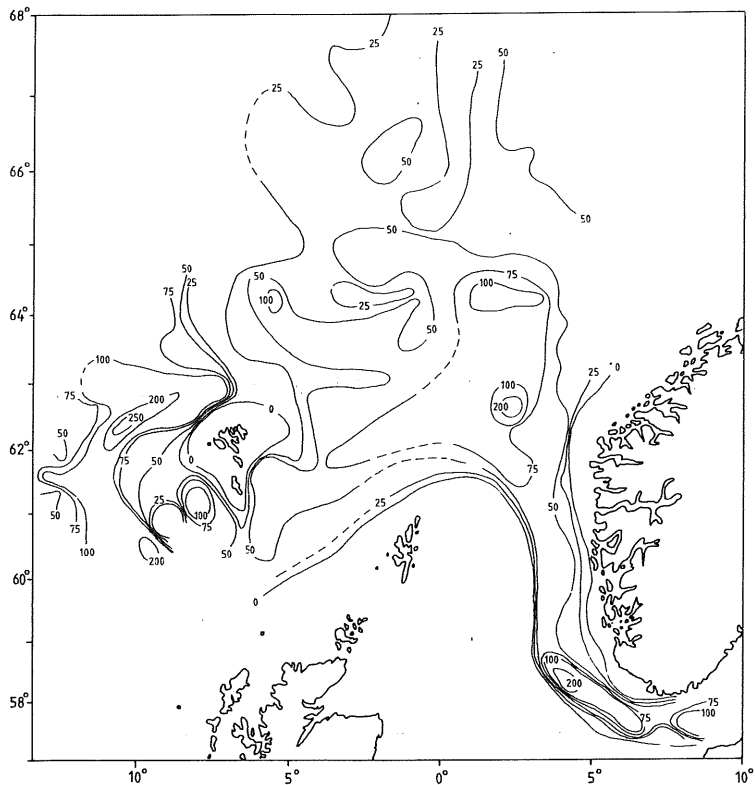


Figure 4.5 Distribution of blue whiting densities observed during the German Democratic Republic survey in the summer of 1987 (August). Echo intensity in $m^2/(n.mile)^2$.



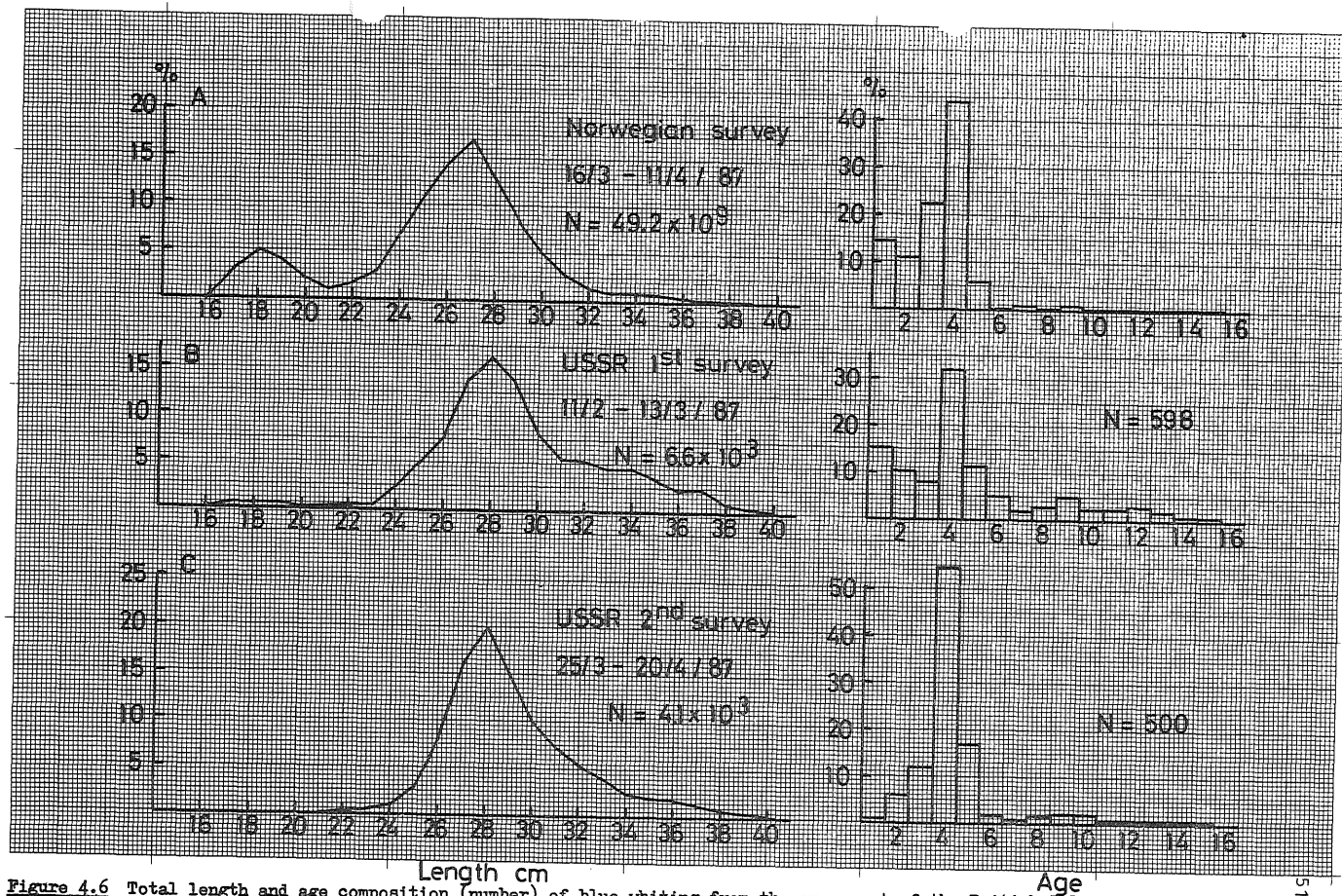
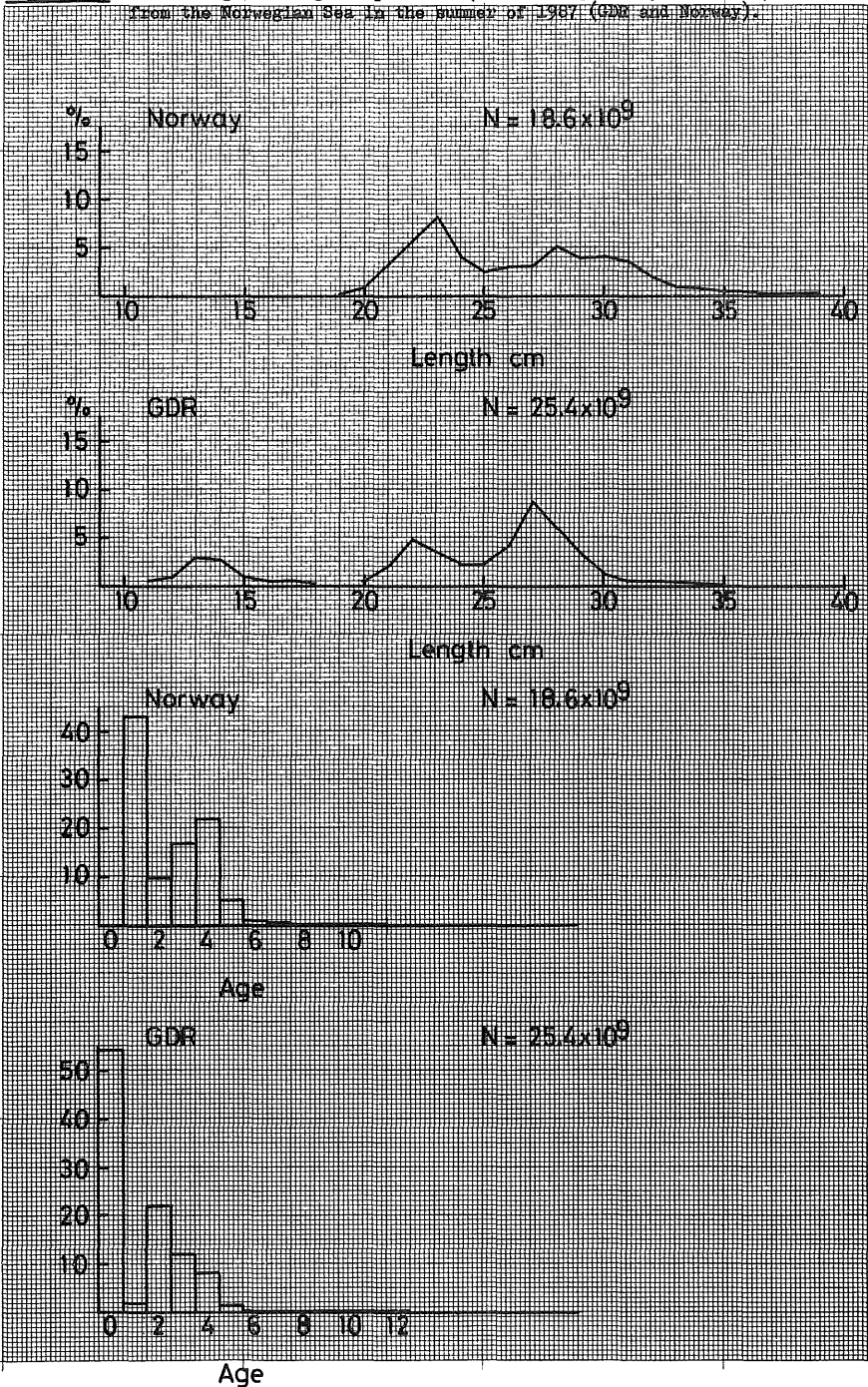


Figure 4.6 Total length and age composition (number) of blue whiting from the area west of the British Isles, spring 1987.
 A: weighted by abundance N (Norway).
 B-C: number of measured and aged specimens (USSR).

Figure 4.7 Total length and age composition (number weighted by abundance) from the Norwegian Sea in the summer of 1987 (GDR and Norway).



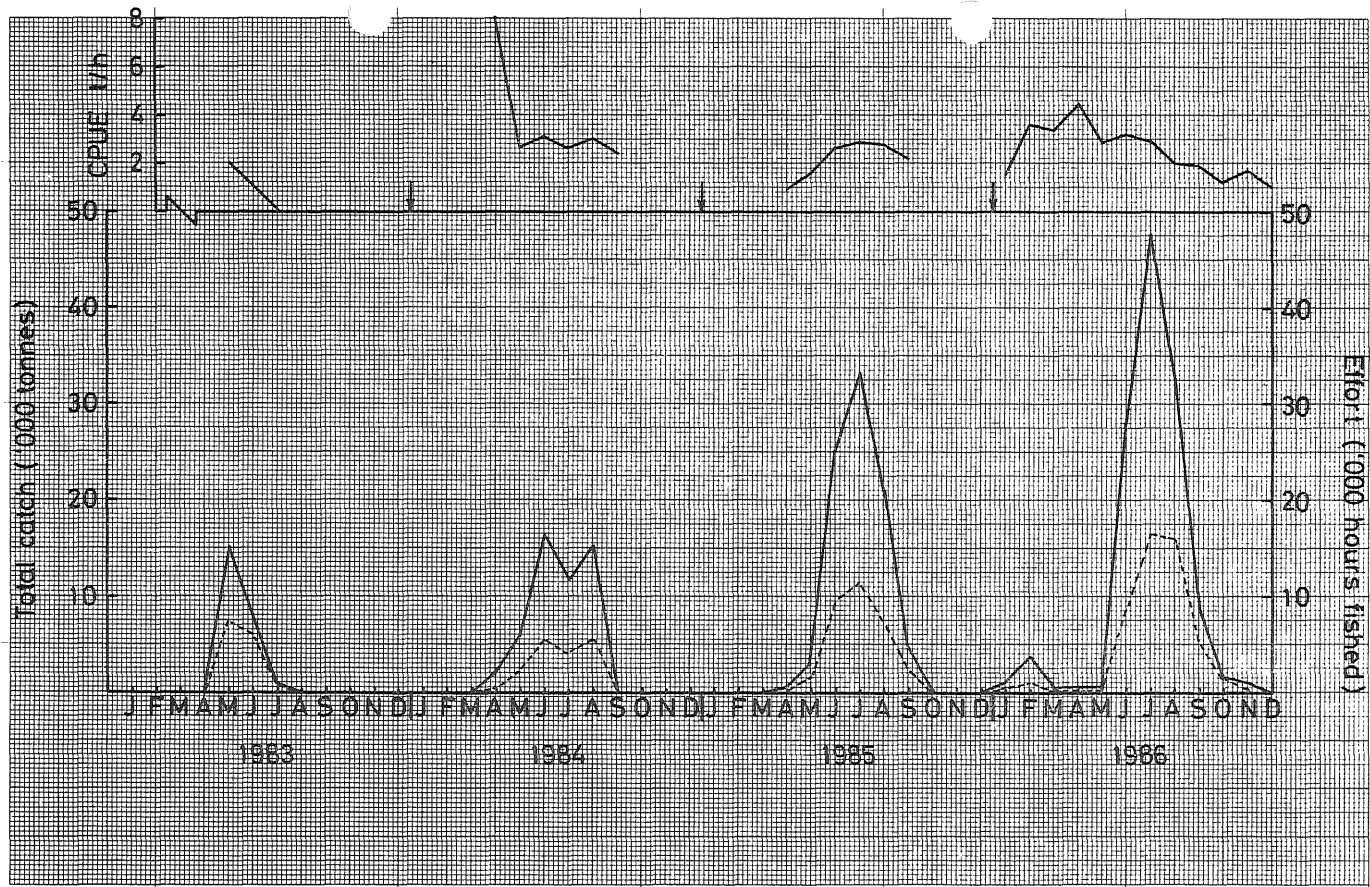


Figure 4.8 Catch, effort, and catch per unit effort by months for the USSR GTR 2000-3999.9t vessel class in Division IIa, 1983-1986.

Figure 4.9 Catch, effort, and CPUE by months for GDR GRT 2000-3999.9t vessel class in Division IIa, 1983-1986.

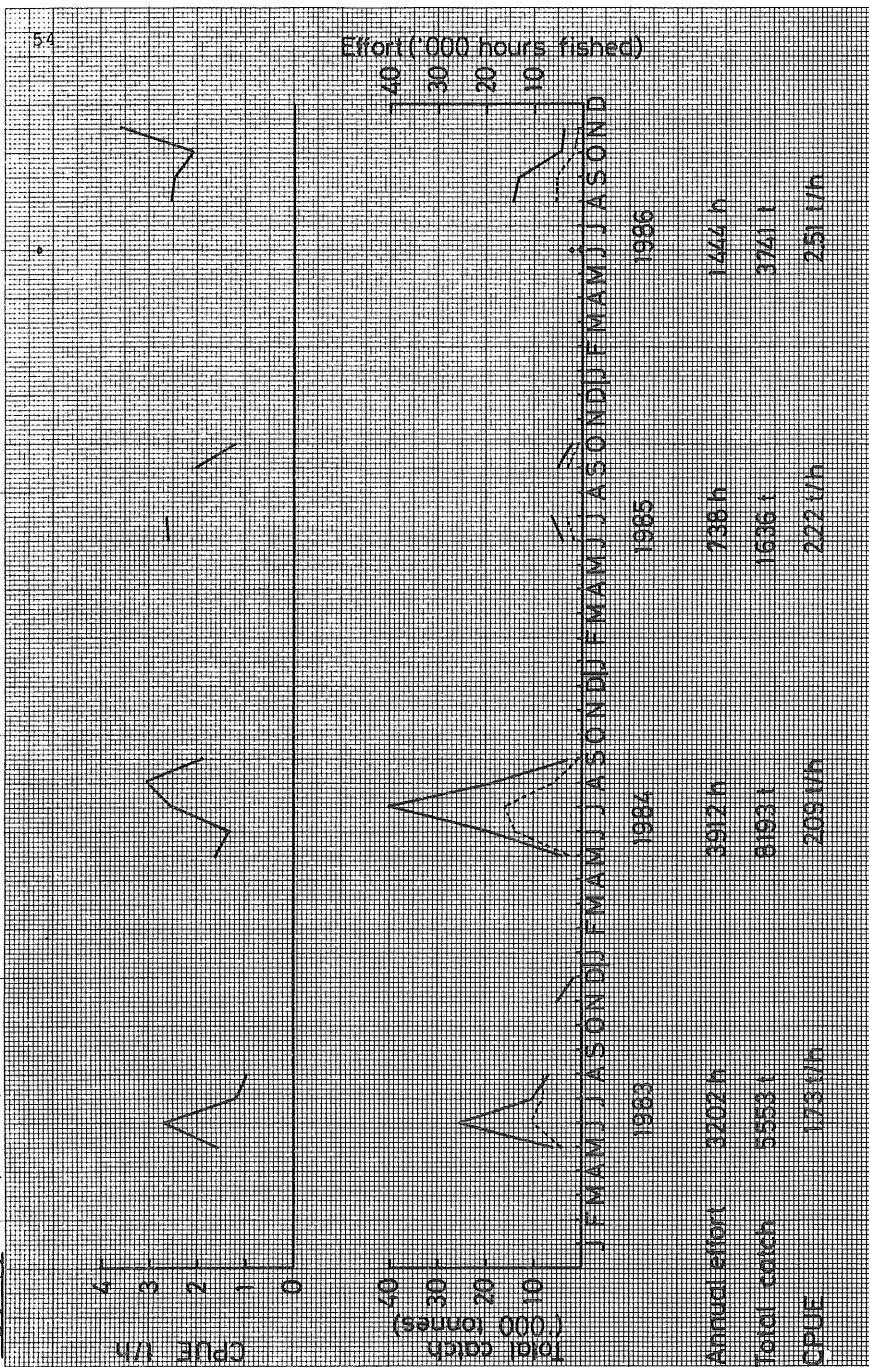


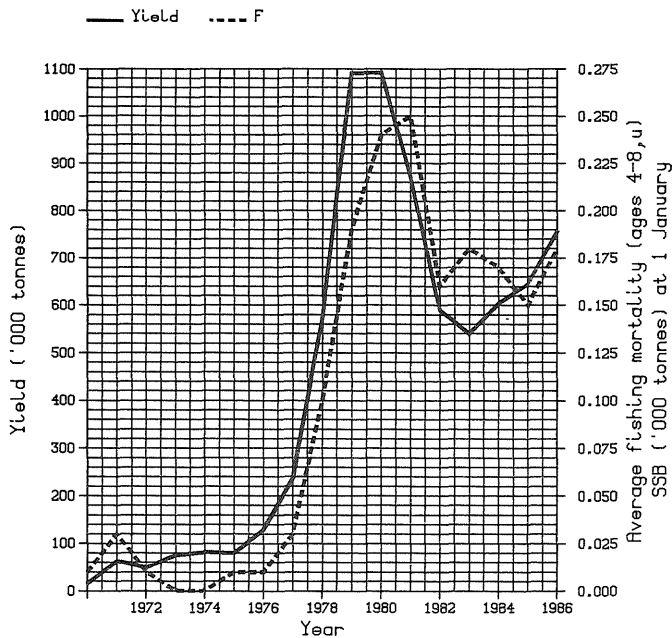
Figure 4.10

FISH STOCK SUMMARY

STOCK: Blue Whiting – Northern Area

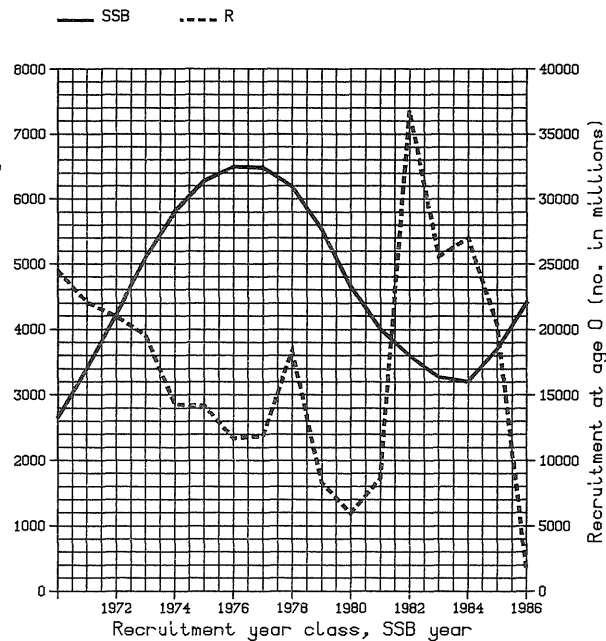
13–10–1987

Trends in yield and fishing mortality (F)



A

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

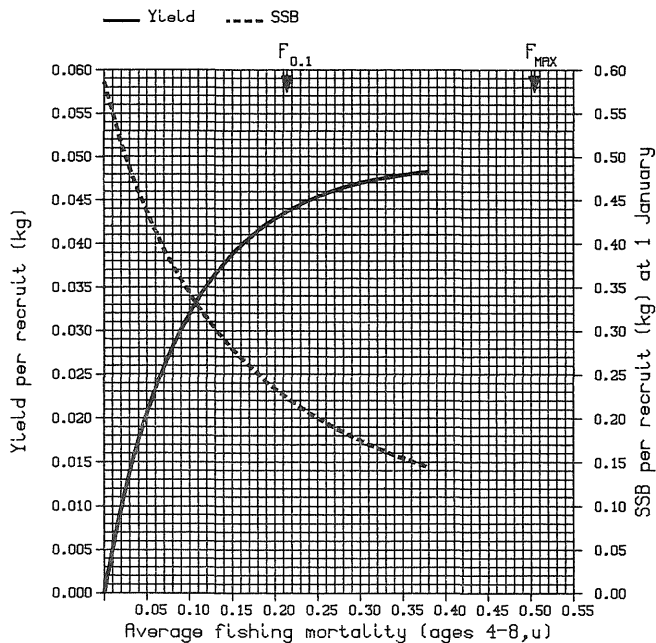


B

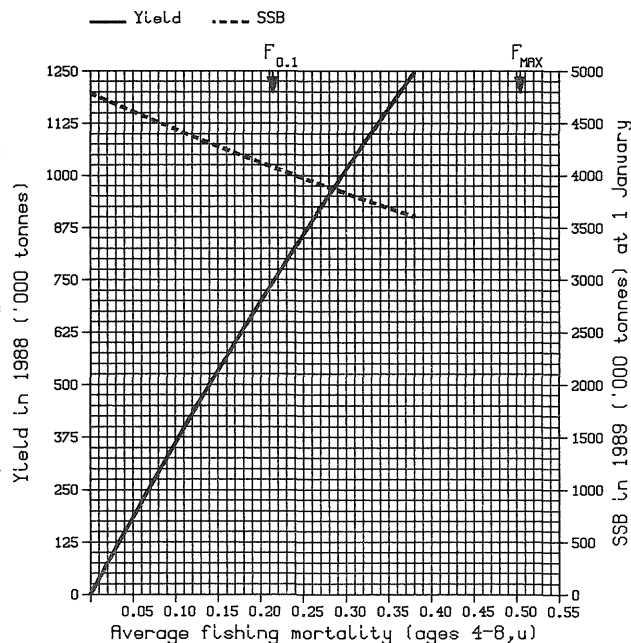
Figure 4.10 (Continued)

FISH STOCK SUMMARY
 STOCK: Blue Whiting – Northern Area
 22-09-1987

Long-term yield and spawning stock biomass



Short-term yield and spawning stock biomass



D

Figure 4.11 F_{med} with F_{high} and F_{low} for the northern blue whiting stock, 1977-1986.

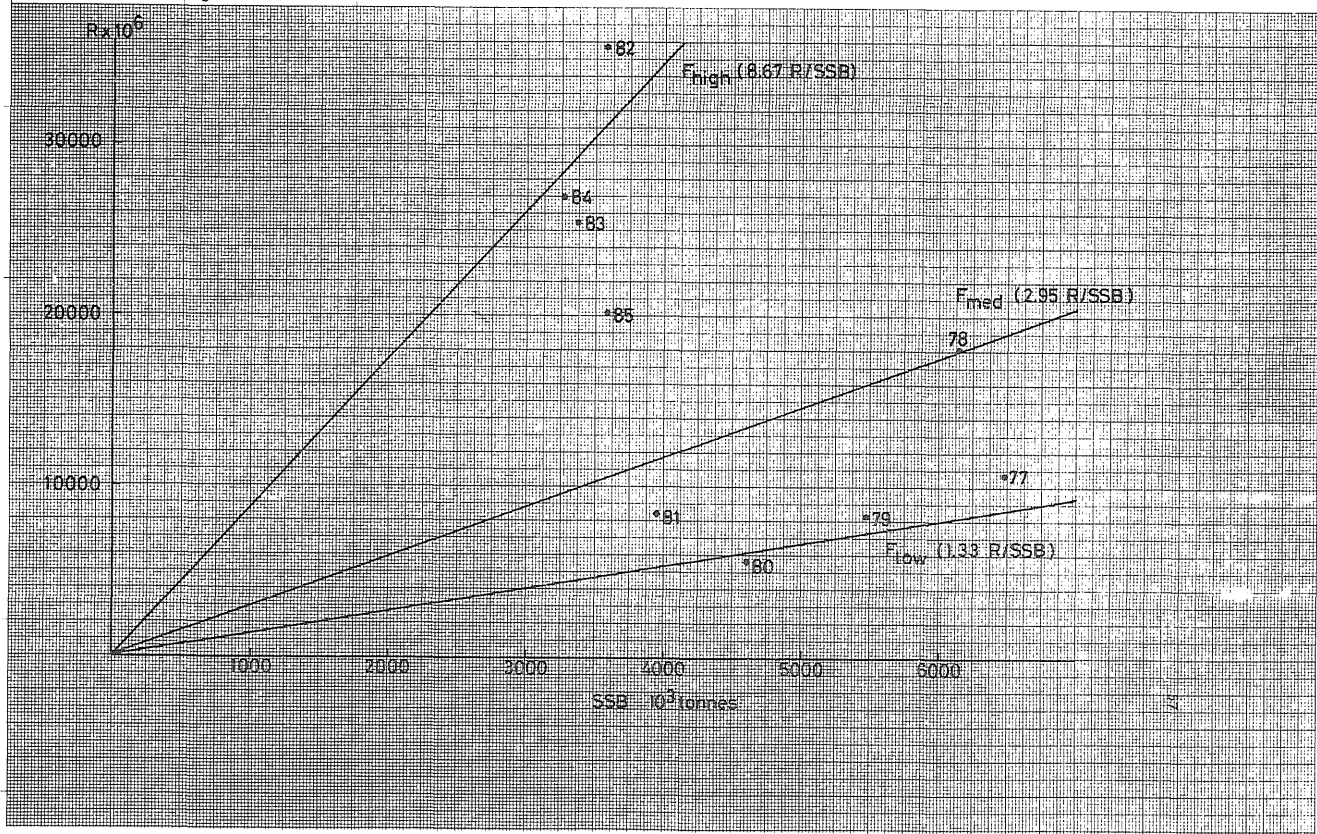


Figure 5.1 Catch, effort, and CPUE of Spanish trawlers for the Southern area.

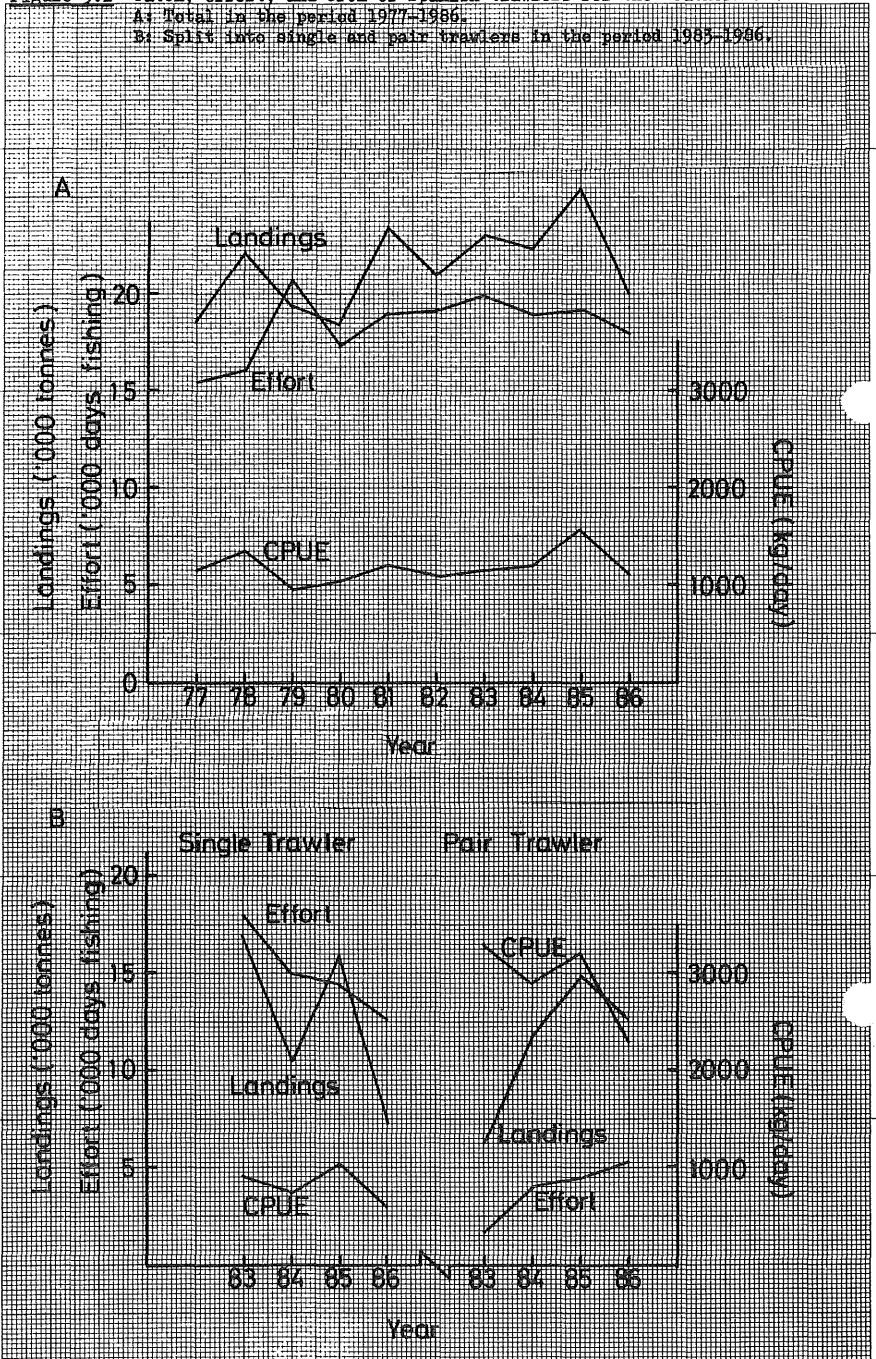


Figure 5.2 Catch curve of Blue Whiting Southern stock.

Relative catch by age group for the combined years 1962-1986.
Regression for years 2-7.

