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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. í Jakupsstovu	Faroe Islands
B. Kudrin	USSR
K.M. Lehmann	Denmark (Greenland)
M. Liwoch	Poland
M. Meixide	Spain
T. Monstad (Chairman)	Norway
K.J. Ståhr	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 62.3×10^9 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 49.2×10^9 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 25.7×10^9 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) ¹
			2.8(2.1)			4.8(4.5) ¹
			2.4(2.2)			

¹ Includes 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 F s 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 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

¹ Preliminary.

² Including directed fishery also in Division IVa.

³ Including 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	-	-	-

¹ Preliminary.

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	20,737	39,989	30,930	21,962 ³	-
Poland ²	838	601	-	-	229
Sweden ⁴	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 ²	550	-	-	-	-
Sweden ⁴	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

¹ Preliminary.

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	15	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	27	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	857
B) NOMIN.	238013	574812	1091422	1092620	870808	544919	539235	604678	651962	792807
(B/A)	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	UNIT: kilogram									
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	-0.52	-0.52	-0.52	-0.27	-0.27	-0.18	-0.18	-0.27	-0.14	-0.33
1	-0.53	-0.50	-0.50	-0.50	-0.63	-0.49	-0.46	-0.56	-0.38	-0.40
2	-0.64	-0.84	-0.84	-0.79	-0.92	-0.94	-0.94	-0.86	-0.80	-0.81
3	-1.05	-1.05	-1.05	-1.07	-1.18	-1.30	-1.36	-1.04	-1.72	-1.13
4	-1.09	-1.09	-1.09	-1.22	-1.35	-1.52	-1.52	-1.42	-1.20	-1.32
5	-1.27	-1.27	-1.27	-1.35	-1.45	-1.62	-1.62	-1.57	-1.64	-1.68
6	-1.47	-1.47	-1.47	-1.49	-1.55	-1.78	-1.78	-1.64	-1.78	-2.02
7	-1.60	-1.60	-1.60	-1.65	-1.70	-1.95	-1.95	-1.70	-2.00	-2.09
8	-1.70	-1.70	-1.70	-1.76	-1.78	-2.00	-2.00	-1.89	-2.08	-2.43
9	-1.77	-1.77	-1.77	-1.86	-1.87	-2.74	-2.04	-1.86	-2.18	-2.45
10	-1.83	-1.83	-1.83	-1.99	-1.99	-2.13	-2.13	-1.97	-2.25	-2.42
11	-1.95	-1.95	-1.95	-2.02	-2.08	-2.54	-2.34	-2.02	-2.33	-2.55
12	-1.99	-1.99	-1.99	-2.07	-2.28	-2.28	-2.28	-1.94	-2.33	-2.69
13	-2.00	-2.00	-2.00	-2.07	-2.34	-2.58	-2.58	-2.25	-2.43	-2.72
14	-2.00	-2.00	-2.00	-2.07	-2.49	-2.42	-2.42	-2.23	-2.51	-3.02
15+	-2.00	-2.00	-2.00	-2.07	-2.57	-2.58	-2.58	-2.42	-2.79	-3.05

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 Ages	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	WTS
0/ 1	1.388	1.421	-3.322	.346	-4.075	1.914	-.501	-.613	2.214	-.079
1/ 2	1.095	1.683	.800	.541	-1.002	-2.442	-.509	-.390	-.223	-.144
2/ 3	.902	.346	-.358	.303	-.719	-.736	-.051	.066	-.227	-.336
3/ 4	-.516	-.345	.054	.485	-.155	-.103	-.168	-.267	-.279	-.618
4/ 5	.080	.555	.106	-.231	-.126	.038	-.245	.139	-.315	-.666
5/ 6	-.084	.385	.002	-.144	.334	-.224	-.070	-.293	.093	-.764
6/ 7	-.465	.112	-.258	-.029	.278	-.203	-.153	.260	.464	-.594
7/ 8	-.420	.040	-.066	-.021	.095	-.213	.137	.165	.283	-.839
8/ 9	-.033	-.185	.163	-.092	.131	-.171	.143	.277	-.184	1.000
9/10	-.050	-.188	-.229	-.308	.320	.445	.402	.300	-.602	-.469
10/11	.188	-.373	.069	.232	.452	.434	.125	-.357	-.749	-.441
11/12	.535	-.518	-.171	-.050	.132	.703	-.089	-.403	-.162	-.443
12/13	-.025	-.569	.577	.345	.151	.433	-.156	-.434	-.323	-.443
13/14	.161	-.261	.230	-.421	-.513	.553	.369	-.567	.450	-.405
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	-.004
Fishing Mortalities (F)										
F-values	.77 .0468	.78 .1070	.79 .2144	.80 .2597	.81 .2652	.82 .2052	.83 .2077	.84 .1848	.85 .1635	.86 .1007
Selection-at-age (S)										
S-values	0 .0550	1 .2879	2 .2325	3 .3197	4 .4449					
S-values	5 .5967	6 .8108	7 1.0000	8 1.3278	9 1.4966	10 2.2678	11 2.0457	12 2.4548	13 1.3008	14 1.0000

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

UNIT: Year-1											NATURAL MORTALITY COEFFICIENT =	.20
FISHING MORTALITY COEFFICIENT												
	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		11845	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	7335	6692	9879	5263	3911	5726	20188	15030	16816	12321	7472
3		7331	6568	5796	5259	7502	4199	5121	4392	14741	10767	13228	6491
4		7469	5892	5234	4427	3912	5678	5253	2373	3300	10481	7200	5387
5		6967	5938	4446	3852	3244	2947	4212	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		5859	4717	3770	2677	1881	1319	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	119	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 Catch per unit effort in the directed fisheries 1979-1986 (fishing gear - mid-water trawl).

Division IIa - t/hour										
GRT class	Country	Time period	1979	1980	1981	1982	1983	1984	1985	1986
2,000-3,999.9	Norway	Nov	-	-	-	-	-	8.00 ¹	-	-
1,000-1,999.9	USSR	Apr-Oct	-	-	-	-	0.87	-	1.86	1.63
2,000-3,999.9	German Dem.Rep.	May-Jun	2.90	2.79	1.21	1.00	2.35	1.40	2.57	5.40
		Jul-Sep	2.19	3.11	2.25	1.21	1.10	2.57	2.29	2.30
		Oct-Dec	-	3.51	1.04	2.25	2.70	-	1.22	2.70
	USSR	Feb	2.70	6.35	-	-	-	-	-	3.58
		Mar-Apr	2.57	2.38	3.57	1.84	-	7.80	0.87	4.12
		May-Jun	3.04	3.30	2.62	1.35	1.73	3.06	2.48	3.08
		Jul-Sep	3.04	3.82	2.54	2.85	0.60	2.85	3.16	2.27
		Oct-Dec	3.03	3.14	3.01	2.99	-	-	-	1.42
>4,000	USSR	Jan-Sep	-	-	-	-	-	-	-	5.43
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	13.98	9.29	13.40	13.75	18.31	7.01	15.70	-
		Nov	-	-	-	-	-	4.50 ¹	-	-
1,000-1,999.9	Norway	Apr-May	-	-	15.36	15.03	21.19	-	17.26	-
Division Vb - t/hour										
500- 999.9	Faroese	May	10.60	6.20	9.60	-	-	-	-	-
	Norway	Jan	-	-	-	-	-	-	-	11.86
		Apr-May	20.29	18.14	18.94	4.88	-	12.40	16.19	13.43
		Nov-Dec	-	-	-	-	-	25.08	12.55	-
1,000-1,999.9	Norway	Apr-May	-	13.57	29.47	-	-	-	24.85	-
	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
		Jun-Jul	2.20	-	-	-	-	-	3.58	2.50
		Aug	-	-	-	-	-	-	-	2.10
		Nov-Dec	-	-	-	-	-	2.20	1.58	-
	USSR	Jan-Feb	1.64	6.83	6.71	5.16	3.05	1.74	3.71	3.12
		Mar-May	5.83	5.23	5.97	4.58	4.12	4.57	4.99	5.22
		Jul-Aug	5.29	-	3.75	3.03	3.16	4.29	5.33	5.41
		Sep-Dec	-	-	2.72	-	2.77	3.70	-	3.27
>4,000	USSR	Feb-Oct	-	-	-	-	-	-	-	7.50

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)								
<u>Poland</u>								
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	-	-	-	966
December	5,830	1,292	10,704	-	-	-	-	268
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	2.84
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 = Σ (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	weight in the catch	weight in the stock
0	10359.0	.04	.20	.00	.055	.055
1	9296.0	.04	.20	.10	.047	.047
2	8083.0	.04	.20	.37	.081	.081
3	15226.0	.19	.20	.81	.113	.113
4	7290.0	.19	.20	.85	.132	.132
5	7196.0	.19	.20	.91	.153	.153
6	1547.0	.19	.20	.94	.202	.202
7	505.0	.19	.20	1.00	.219	.219
8	722.0	.19	.20	1.00	.243	.243
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 1969				
fac- tor	ref.	stock biomass	sp. stock biomass	catch	fac- tor	ref.	stock biomass	sp. stock biomass	catch	stock biomass	sp. stock biomass	catch	stock biomass	sp. stock biomass
1.0	.19	0105	4449	792	.0	.03	5746	4262	0	6166			4741	
					.1	.02			81	6080			4664	
					.2	.04			160	5906			4588	
					.4	.08			314	5832			4447	
					.6	.11			464	5674			4297	
					.8	.15			608	5522			4157	
					1.0	.19			747	5374			4027	
					1.2	.23			881	5232			3897	
					1.4	.27			1011	5095			3776	
					1.6	.30			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	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 _Y	Y	S _Y	Y	S _Y	Y	S _Y	Y	S _Y	Y	S _Y	Y	S _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

¹ April.

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

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	.055	-.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)

	82	83	84	85	86
F-values	.7485	.8257	.9264	.9856	.8000

Selection-at-age (S)

	0	1	2	3	4	5	6	7
S-values	.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	337	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	.68	.68	.49
3	.88	.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			
	1982	1983	1984	1985
0	1414	1522	1380	1029
1	833	1103	1158	1063
2	391	590	768	747
3	226	157	270	317
4	149	76	67	107
5	45	64	22	24
6	8	17	22	7
7	1	4	6	6
8+	2	1	2	3
TOTAL NO	3069	5534	3695	5302
SPS NO	910	996	1203	1242
TOT. BIOM	139	138	112	127
SPS BIOM	59	53	49	58

ALL VALUES ARE GIVEN FOR 1 JANUARY

1986	1987
507	0
736	385
613	518
310	307
108	105
29	28
7	10
3	1
3	3
2316	
1067	
108	
62	

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

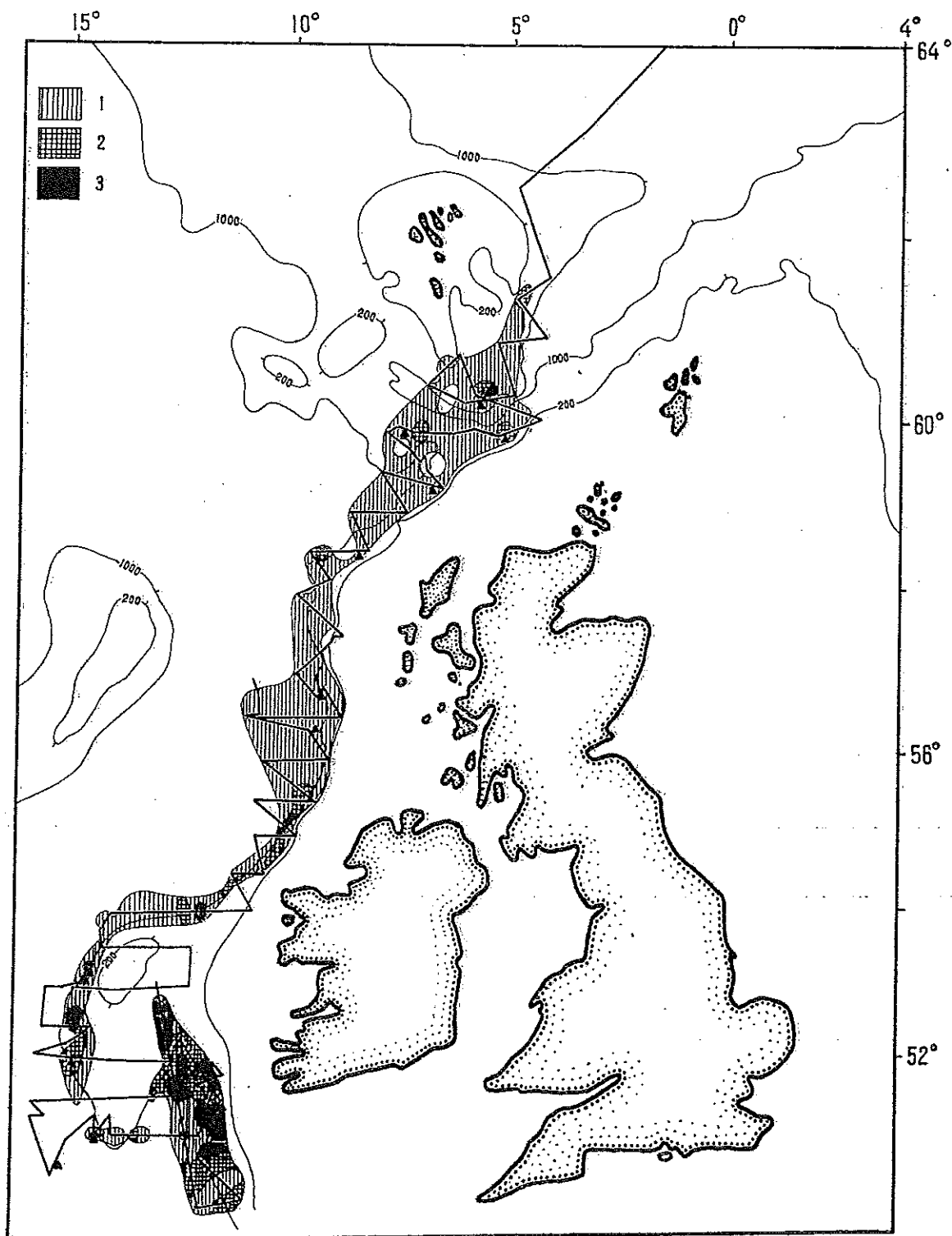
Area	1980	1981	1982	1983	1984	1985	1986
Internat.	18.9	26.0	14.7	5.6	4.8	8.2	8.4
Svalbard ¹	5.4	2.0	1.1	1.1	0.1	-	0.1
Jan Mayen	16.8	8.8	5.9	3.4	0.6	2.5	2.3
Norway	40.7	38.7	45.9	38.2	39.2	22.7	54.5
Iceland	8.6	14.2	10.8	25.0	18.4	13.7	6.8
Greenland	0.1	-	-	-	-	0.9	-
Faroes	4.7	8.3	16.9	19.4	25.9	37.4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

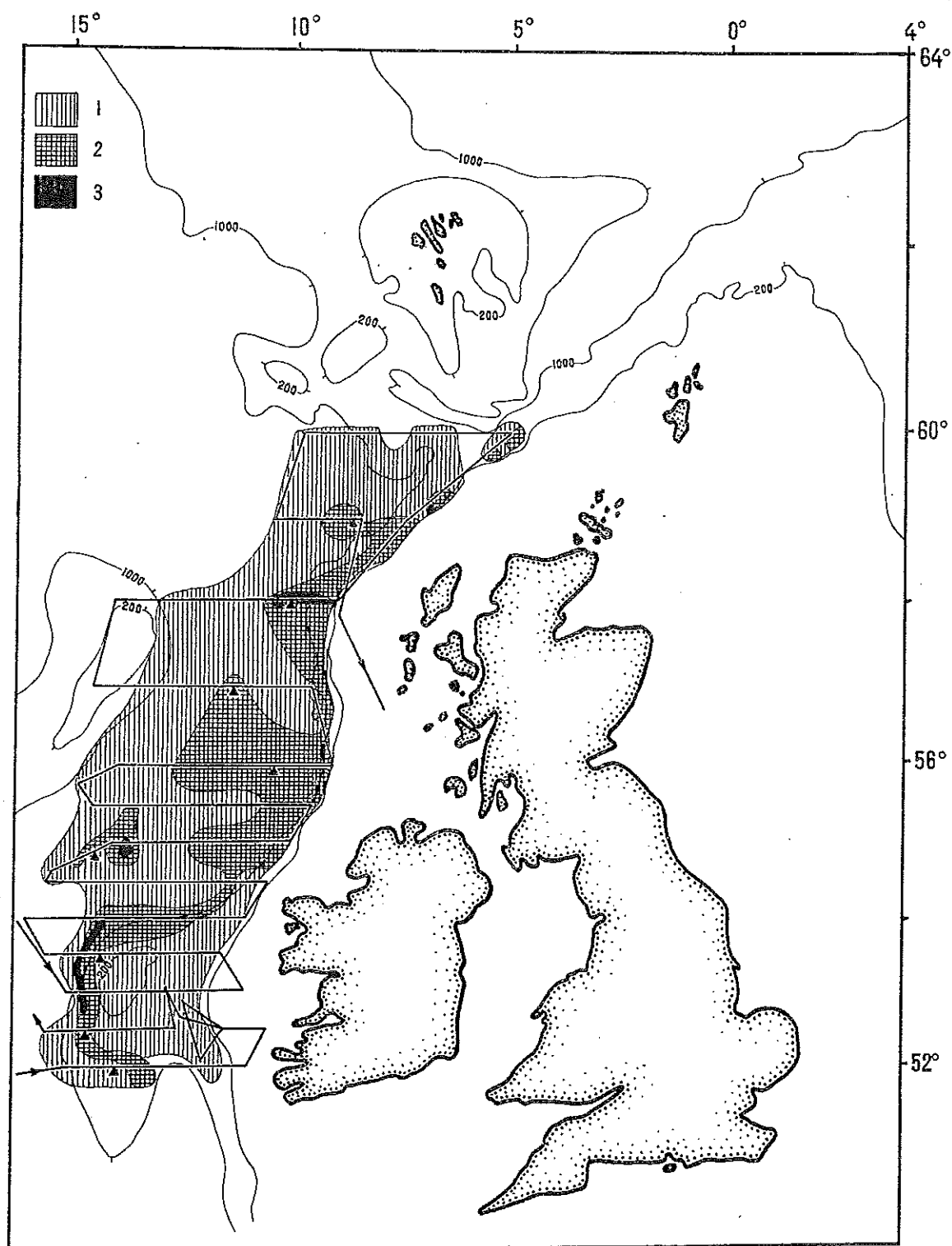
Year	Inter-national	Svalbard	Jan Mayen	Norway	Iceland	Greenland	Faroes	EEC	Total (t)	Total from off. data (t)	%
1978	136,504 (25.52)	-	-	67,391 (12.60)	26,444 (4.94)	6,580 (1.23)	195,361 (36.53)	102,523 (19.17)	534,803	574,812	93.0
1979	614,734 (56.18)	-	-	75,545 (6.90)	15,117 (1.38)	204 (0.02)	224,201 (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 $m^2/n.mile^2$.

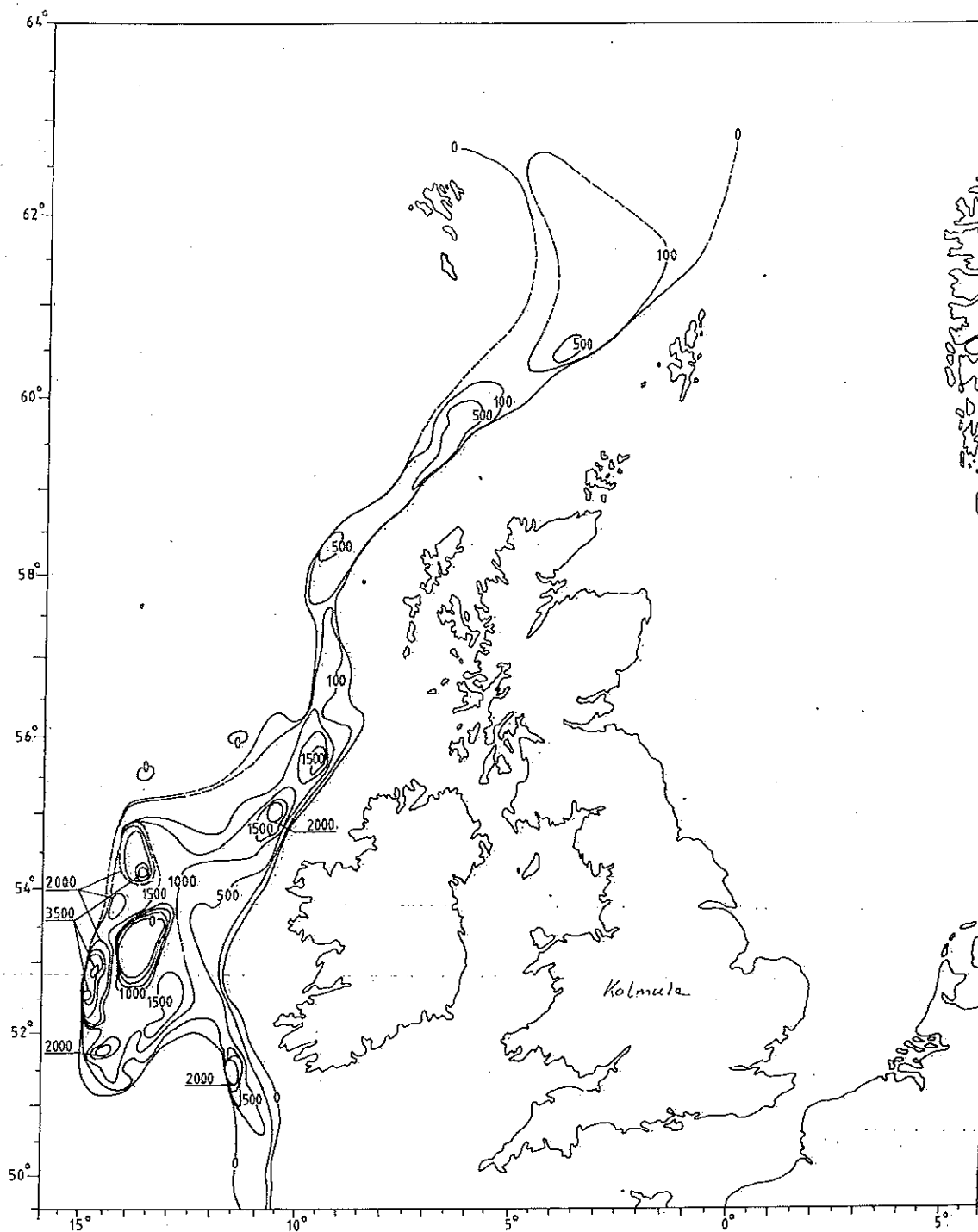


Figure 4.4 Distribution of blue whiting densities observed during the Norwegian survey in the summer of 1987 (10 June - 23 July). Echo intensity in $D^2/3(\text{n.mile})^2$.

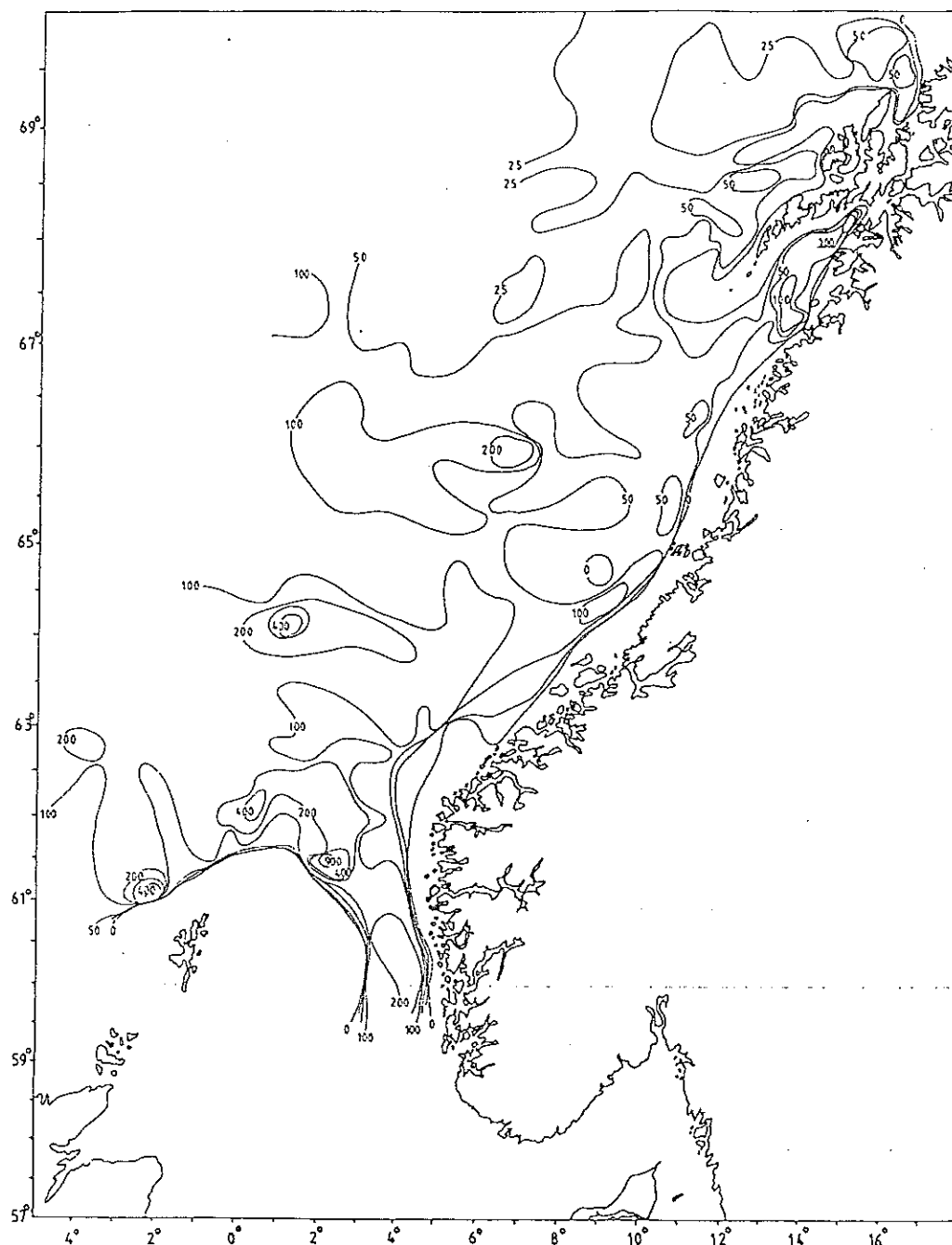
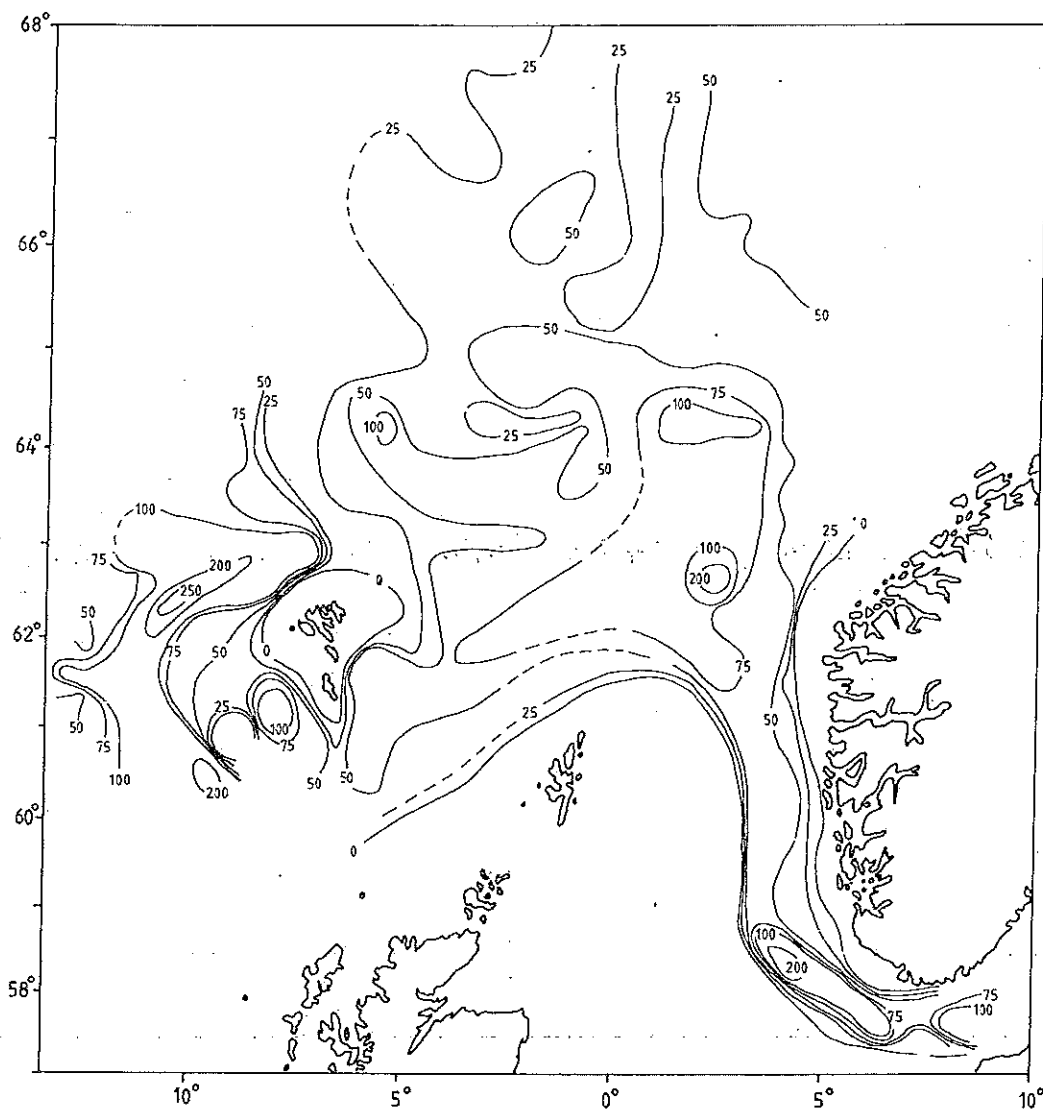


Figure 4.5 Distribution of blue whiting densities observed during the German Democratic Republic survey in the summer of 1987 (August). Echo intensity in $m^2/(n.mile)^2$.



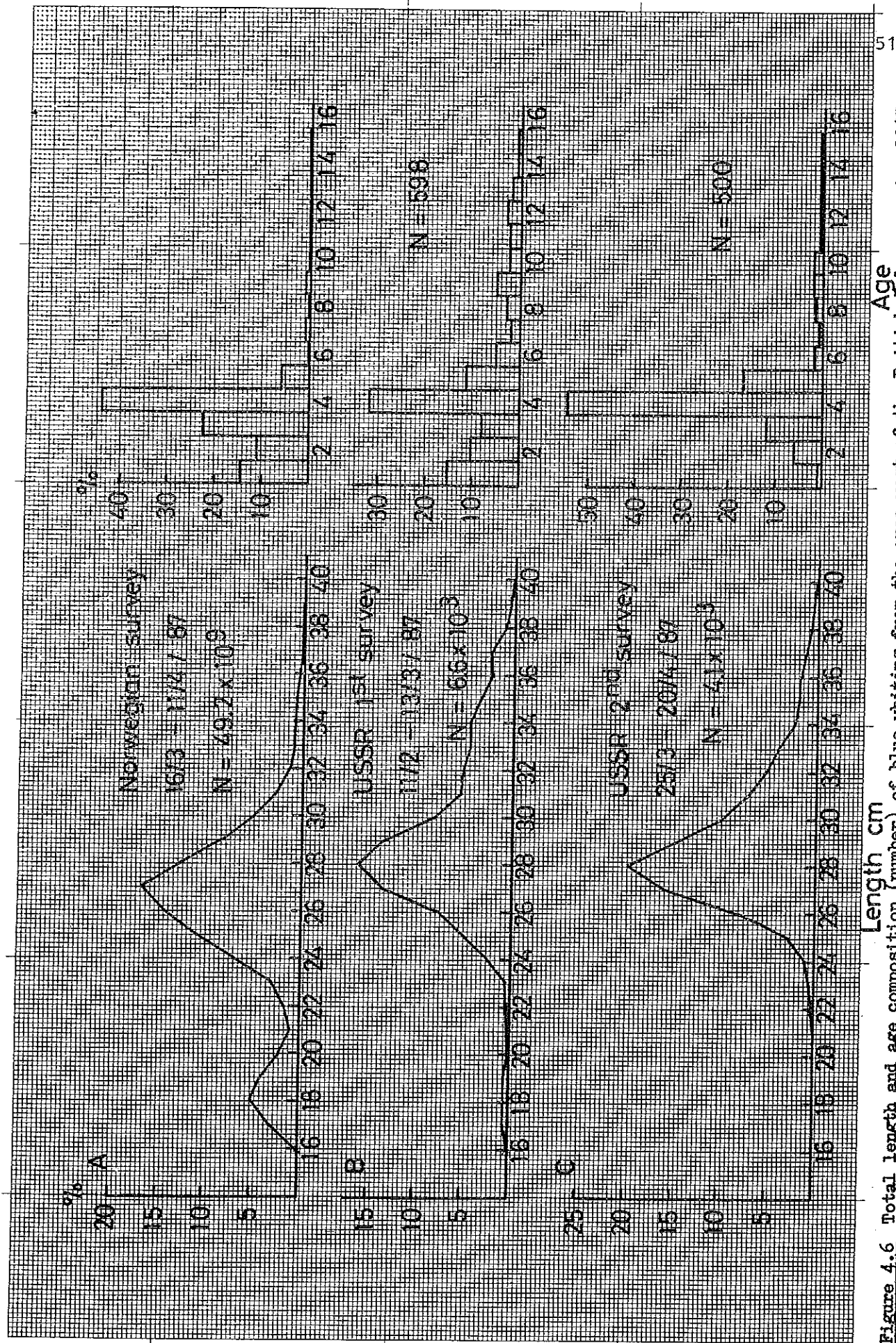
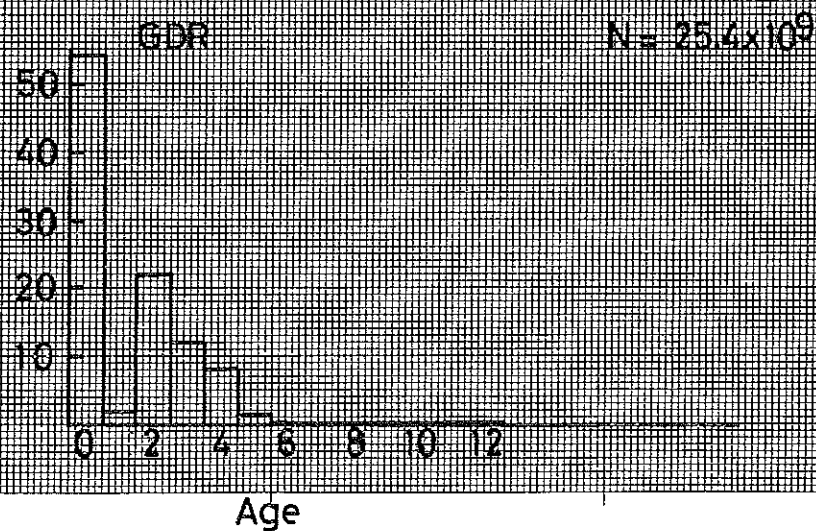
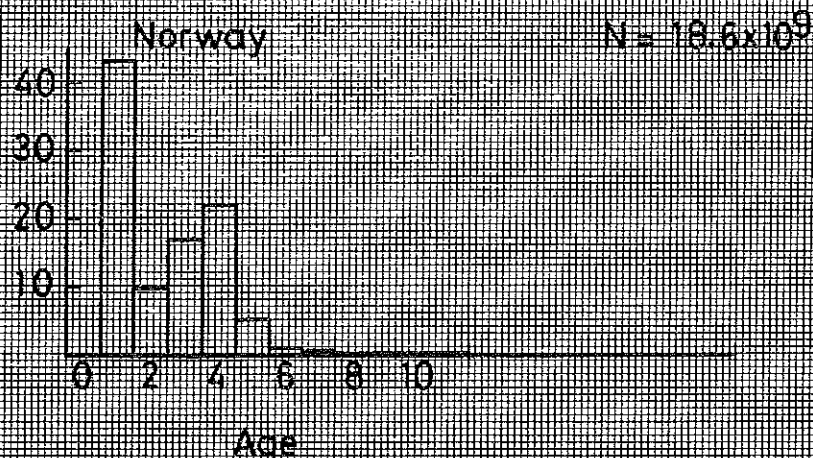
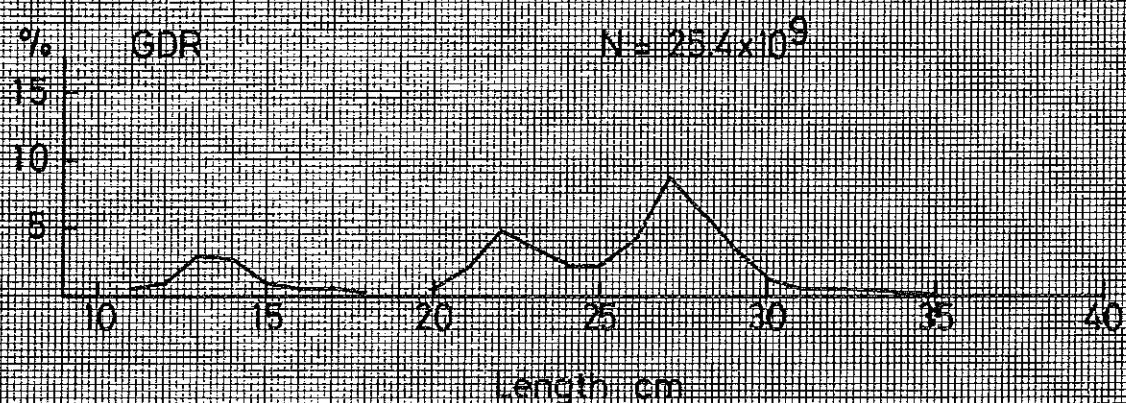
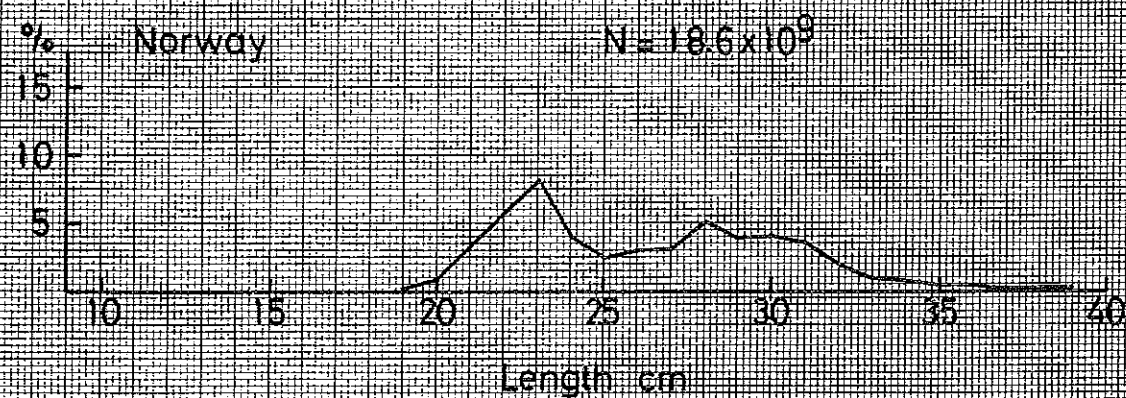


Figure 4.6 Total length and age composition (number) of blue whiting from the area west of the British Isles, spring 1987.
 A: weighted by abundance N (Norway).
 B-C: number of measured and aged specimens (USSR).

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



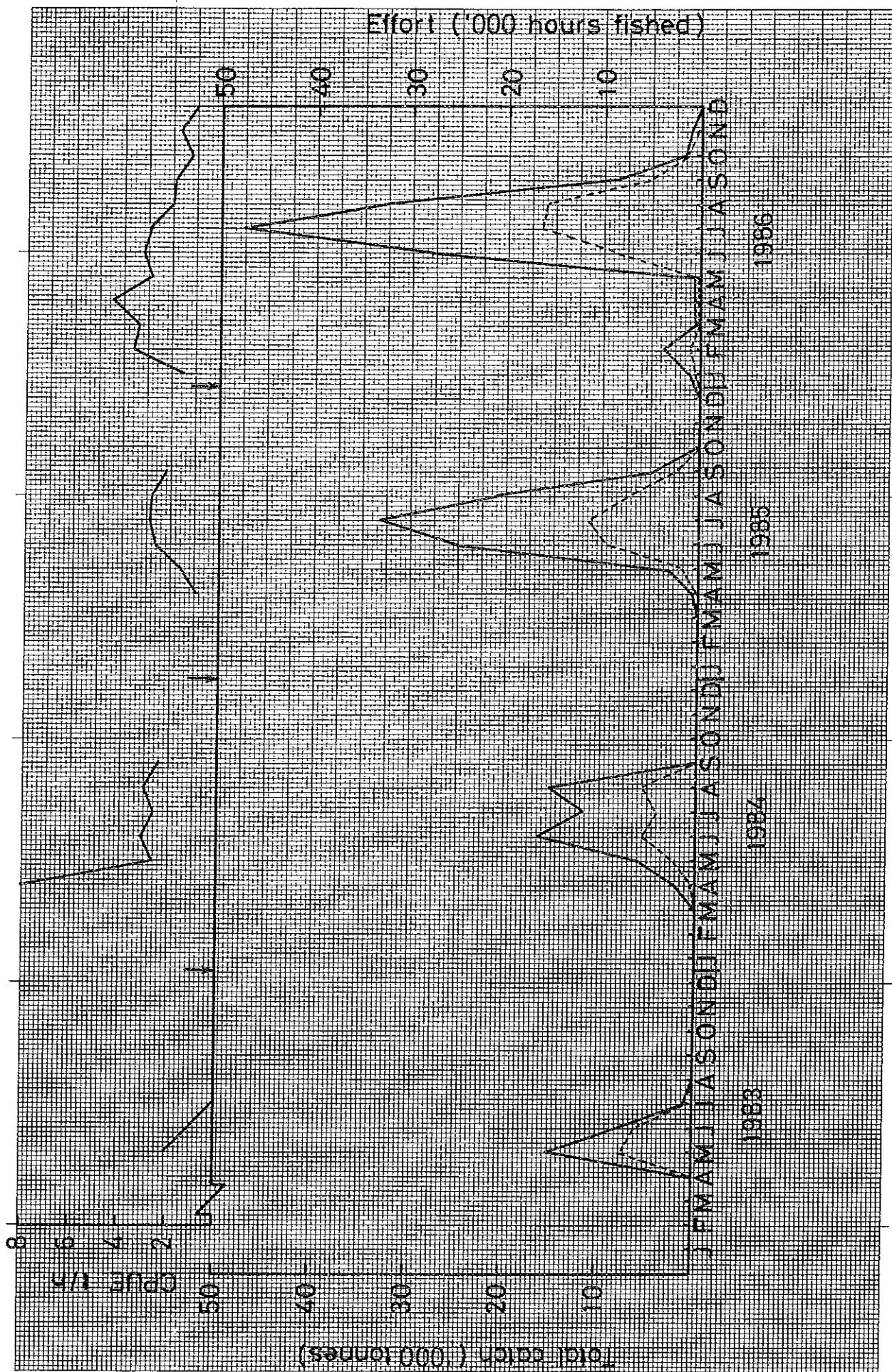


Figure 4.8 Catch, effort, and catch per unit effort by months for the USSR GTR 2000-3999.9t vessel class in Division IIa, 1983-1986.

Figure 4.2 Catch, effort, and CPUE by months for GDR GRT 2000-3999.9t vessel class in Division IIa, 1983-1986.

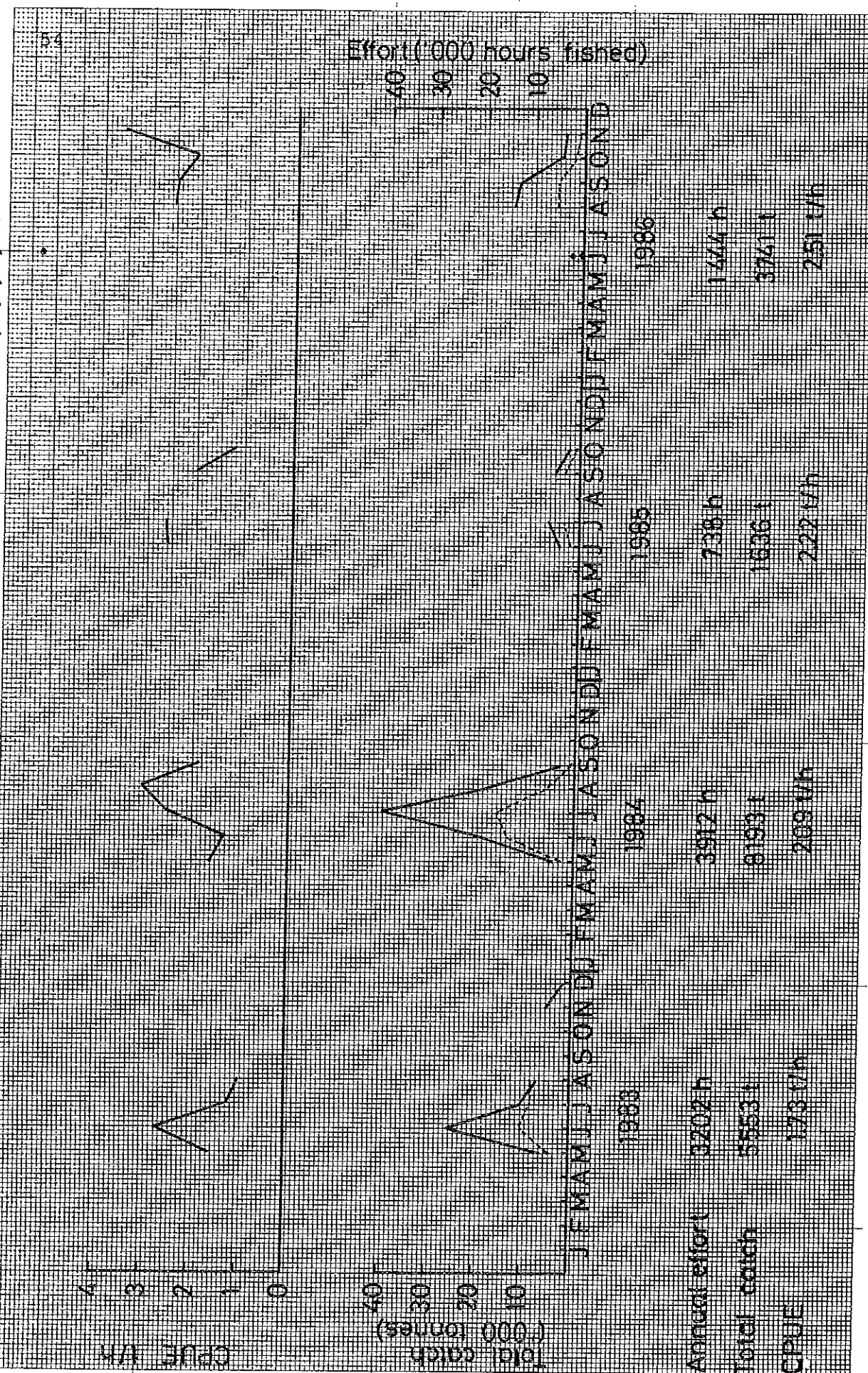
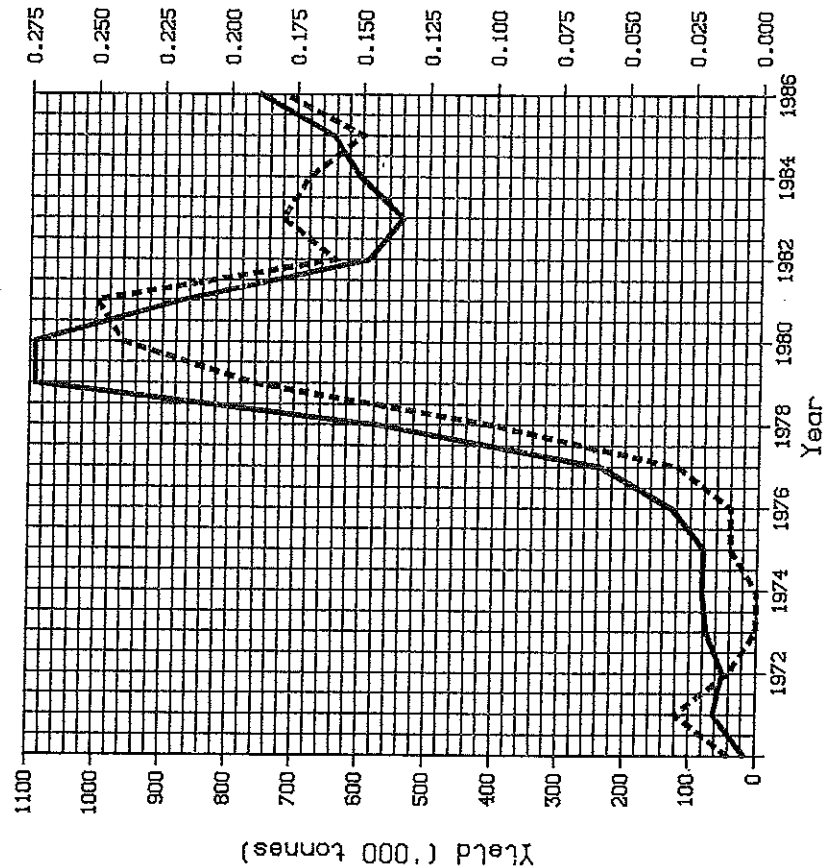


Figure 4.10

FISH STOCK SUMMARY STOCK: Blue Whiting - Northern Area 13-10-1987

Trends in yield and fishing mortality (F)

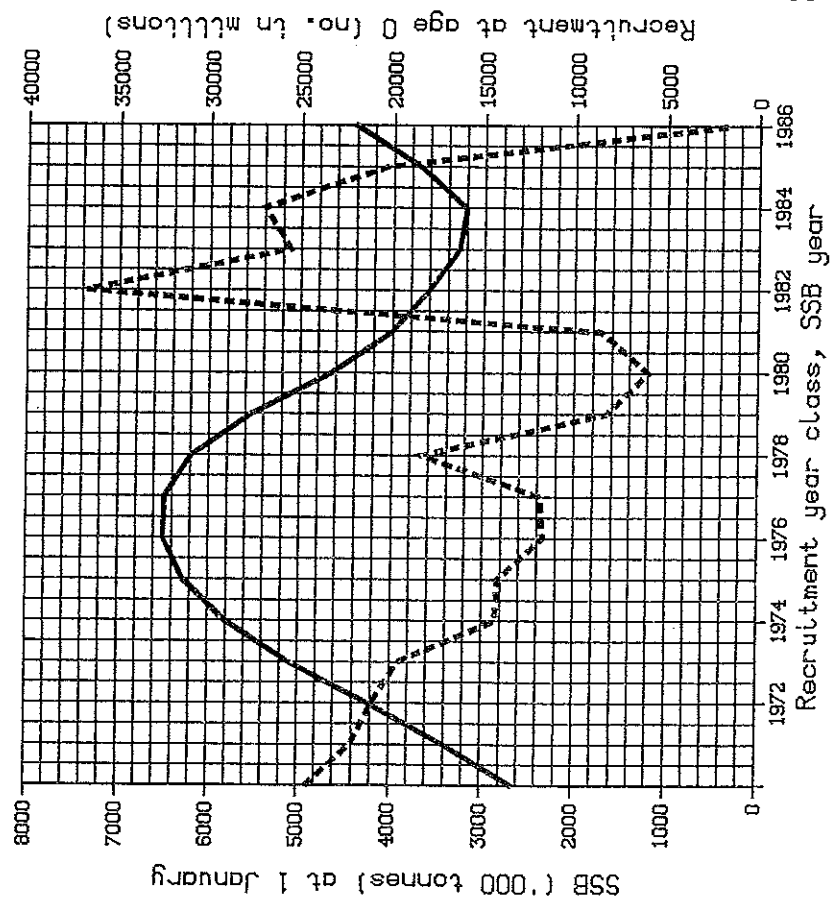
— Yield ---- F



A

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

— SSB ---- R



B

Figure 4.10 (Continued)

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

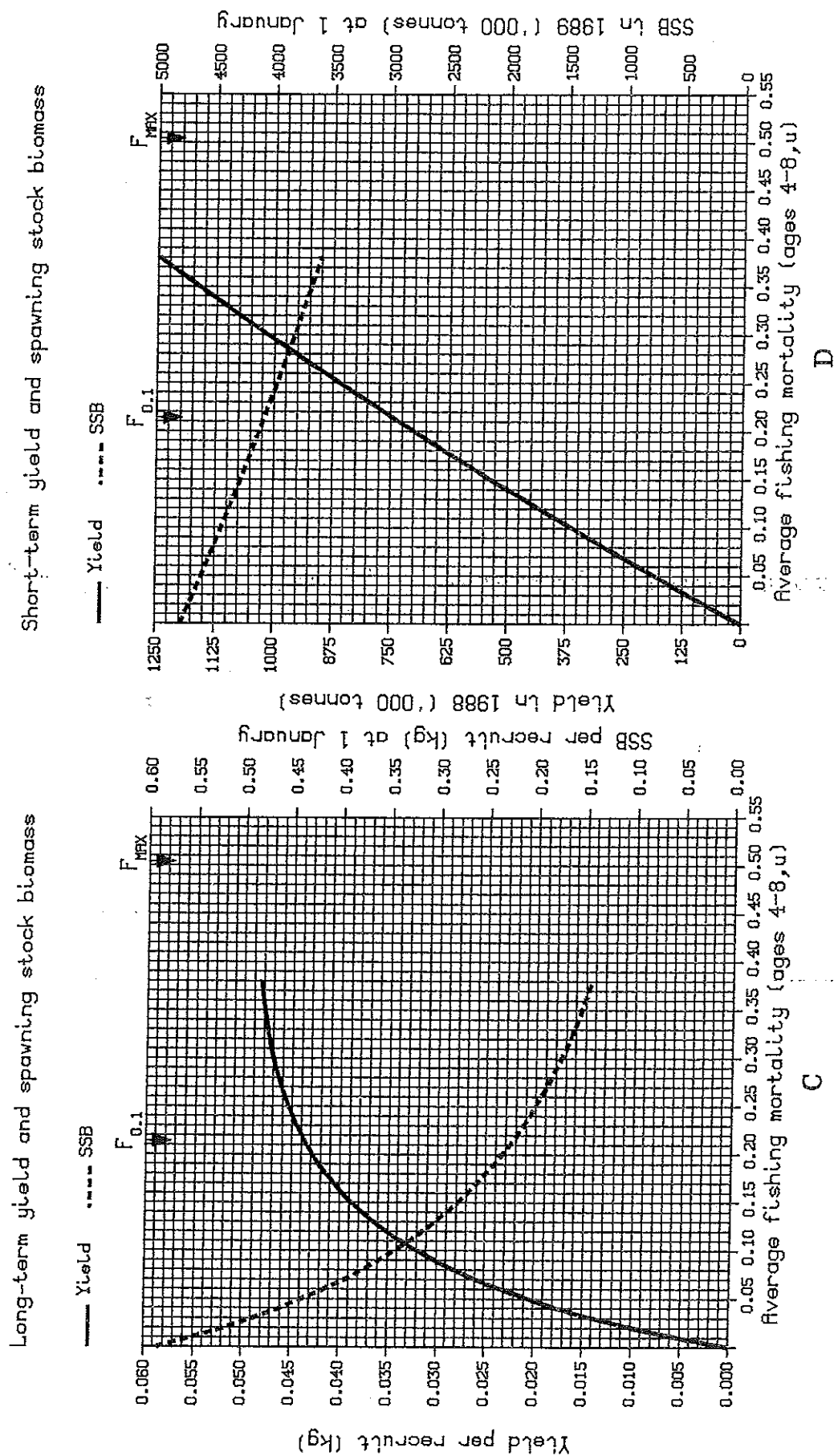


Figure 4.11 F_{med} with F_{high} and F_{low} for the northern blue whiting stock, 1977-1986.

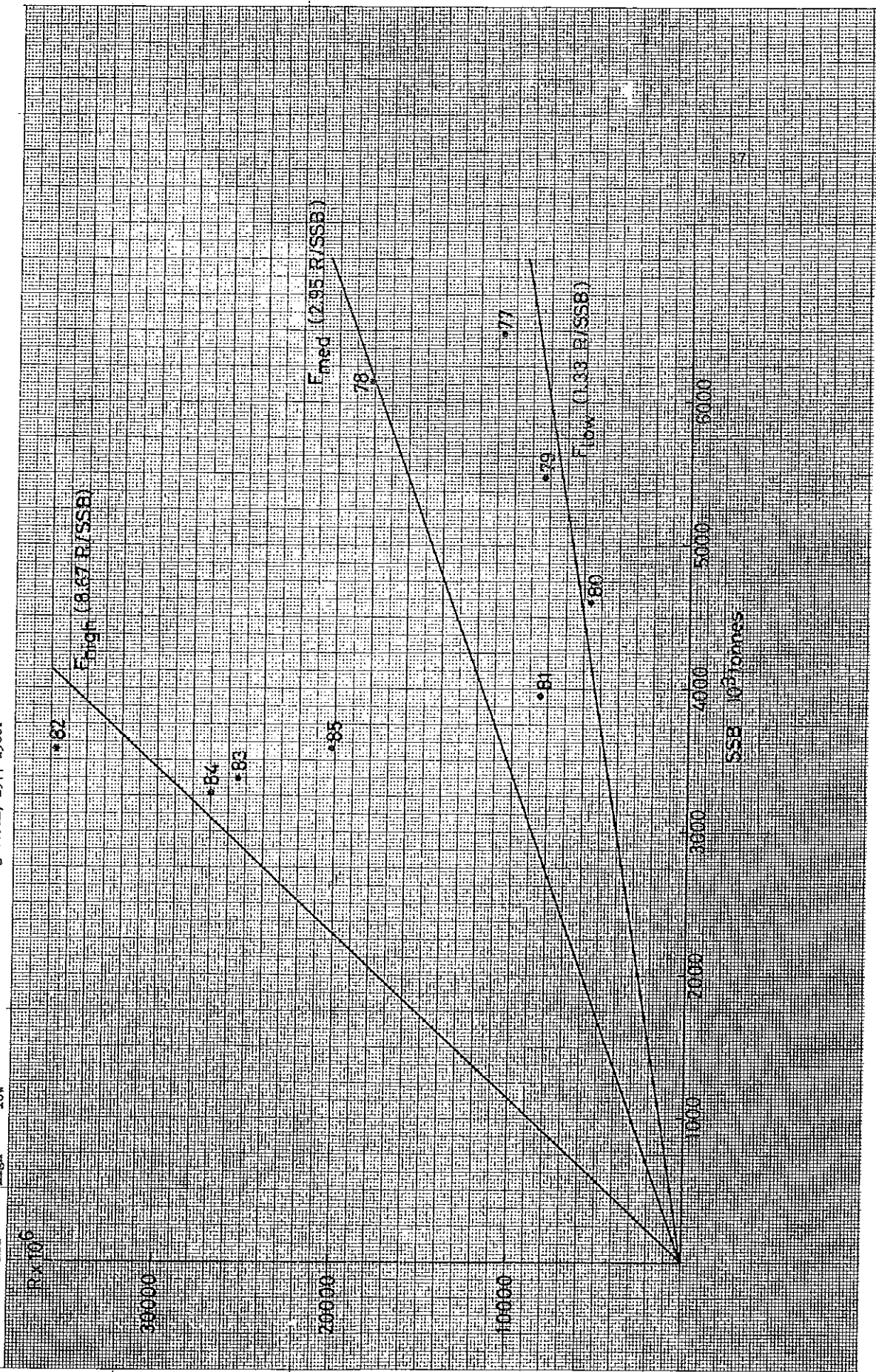


Figure 5.1 Catch, effort, and CPUE of Spanish trawlers for the Southern area.

A: Total in the period 1977-1986.

B: Split into single and pair trawlers in the period 1983-1986.

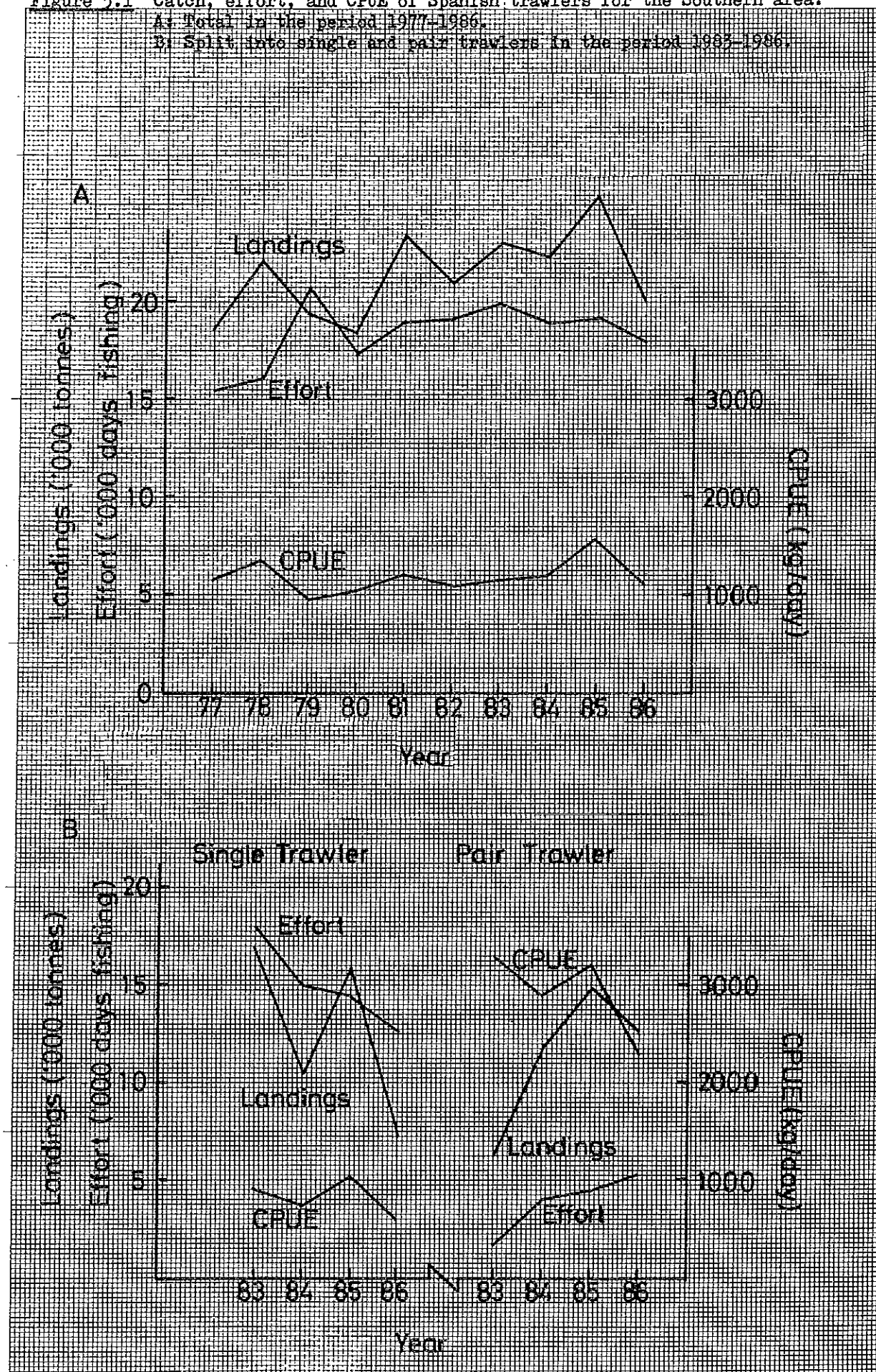


Figure 5.2 Catch curve of Blue Whiting Southern stock.

Relative catch by age group for the combined years 1982-1986.
Regression for years 2-7.

