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REPORT OF THE BLUE WHITING ASSESSMENT WORKING GROUP

Copenhagen, 24 - 30 September, 1986

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1 INTRODUCTION

1.1 Terms of Reference

The Blue Whiting Assessment Working Group (Chairman: Mr H.1. Jakupsstovu) met at ICES headquarters from 24 to 30 September 1986 (C.Res.1985/2:3:20) to:

- a) assess the status and provide catch options inside safe biological limits for the Northern and Southern blue whiting stocks in 1987;
- b) assess the effect of small-meshed industrial fisheries on the yield of the blue whiting stocks.

However, when ACFM discussed the 1985 report of the Blue Whiting Assessment Working Group, it was decided that item (b) could be ignored since the Working Group completed that assignment at its 1985 meeting.

Furthermore, NEAFC, at its November 1985 meeting, asked ICES to "make further observations on the northern blue whiting stock including the zonal distribution of the biomass and the fisheries". This question was passed to the Blue Whiting Working Group by ACFM.

1.2 Participants

H.J.L. Heessen	Netherlands
H.1. Jakupsstovu (Chairman)	Faroe Islands
A. Kharlamov	USSR
B. Kudrin	USSR
M. Meixide	Spain
T. Monstad	Norway
K.J. Støhr	Denmark
B. Vaske	German Democratic Republic

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 1986.

The high concentrations of blue whiting observed during the acoustic survey by the USSR in the spring of 1986 off the Porcupine Bank (see Section 4.7.1), previously considered a transition area between the northern and southern blue whiting stocks, clearly demonstrates the need for further research in stock separation and stock identity, and the Working Group recommends that this should be undertaken.

3 OTOLITH EXCHANGE PROGRAM

The Blue Whiting Assessment Working Group in 1983 (Anon., 1984a) recommended that an international otolith exchange program be set

up to achieve and maintain consistency in the ageing of blue whiting with V. Shleinik as coordinator. The program has now been completed and a preliminary report submitted to the Working Group (Seliverstova et al., 1986).

The results show that there are still very great discrepancies in the results obtained when different readers are ageing the same otolith samples. The results from the two major nations fishing blue whiting (USSR and Norway), however, were in good agreement.

With the very strong 1982 and 1983 year classes, a new opportunity has arisen for studying the formation of rings in blue whiting otoliths. The Working Group recommends that this opportunity is taken and that such studies are reported to the Working Group as soon as possible. Furthermore, the Working Group recommends that a new otolith exchange program is set up to monitor the consistency in blue whiting ageing with T. Monstad as coordinator. The Working Group is of the opinion that in this program the coordinator will be provided with results of the age readings, supported by identifications of rings marked on photos or other means.

4 NORTHERN STOCK

4.1 Landings in 1984

Estimates of landings in 1984 have been slightly revised and this resulted in total landings from all northern blue whiting fisheries of 604,678 tonnes (t) in 1984.

4.2 Landings in 1985

Estimates of total landings in 1976-1985 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 1985 were estimated at 644,899 t. There was an increase of about 15% in the total landings from the directed fisheries, whereas the landings in the mixed industrial fisheries decreased by approximately 20%.

Similarly, as was mentioned by the Working Group last year, in some landings from the directed fishery in Division VIa, great silver smelt (Argentina silus) constituted a significant part of the catch. The by-catch appeared only in restricted areas. In the Norwegian landings when the by-catch of great silver smelt was above some minimum level, this was recorded and the by-catch estimated. In 1986, this amounted to 2,500 t indicating a total by-catch in such Norwegian landings in the order of 1-2%. In the Scottish landings, a total by-catch of 556 t was estimated from samples out of a total catch of 4,028 t. No estimates were provided from other countries on the by-catch of great silver smelt, and the landing figures in Table 4.1-4.5 are as provided to the Working Group.

4.3 Landings in 1986

Preliminary information on landings of blue whiting submitted by Working Group members and by some countries reporting on ICES Data Form 5 (540,000 t) are presented in Table 4.6.

4.4 Age Composition of Landings

For 1984, data were made available to the Working Group on the age composition of the Danish mixed industrial fisheries.

For the directed fisheries in 1985, age compositions were provided by the Faroe Islands, the German Democratic Republic, Norway and the USSR. These data together accounted for 95% of the landings in the directed fisheries. As the Working Group had no possibility to correct the age readings brought to the meeting by different countries, the catch in numbers by age group used in the assessment are as provided. Landings from directed fisheries by Denmark were supposed to have the same relative age composition as the Norwegian landings from the same area and quarter. Other landings from the directed fisheries were assumed to have the same relative age composition as the total sampled part. The age composition of the catches in the directed fisheries is given in Table 4.7. In the USSR catch-in-number figures from Division Vb, higher-than-normal catches of 0-group blue whiting were reported. This was caused by the sampling of catches from research vessels. 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 made available for Danish and Norwegian catches and for a part of the Faroese landings. Together, this accounted for 94% of the total landings. Landings from other countries were assumed to have the same age composition as the sampled part (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).

4.5 Weight at Age

Mean weight-at-age data for 1984 for the Danish mixed industrial fisheries were made available and used to revise the weight-at-age data for 1984.

Mean weight-at-age data for 1985 were presented by Denmark, the Faroe Islands, the German Democratic Republic, Norway, and the USSR. 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 1985 was compared to the sum of products (SOP) of total numbers landed in 1985 and mean weight at age. The calculated SOP was within 1% of the nominal landings. The mean weights at age used in the VPA runs are shown in Table 4.10.

4.6 Age at Maturity

In 1985, the Working Group decided to change the maturity ogive from a knife-edge maturity at age 3 to one showing 10, 40, 80, and 100% maturity at ages 1-4, respectively. This was based on observations from the spawning seasons of 1984 and 1985 (Anon., 1986a). Investigations on age at maturity were also performed during the spawning season of 1986 (Monstad, 1986) and during the ICES coordinated acoustic survey in the Norwegian Sea in August 1986 (Monstad, pers. comm.).

In the text table below, the percentage maturity is given by year class during the two surveys.

Survey	1	2	3	4	5	6	7
Spring, W of Norw.	-	43.5	79.1	91.6	94.4	100.0	100.0
Spring, W of Br. Isl.	9.1	76.5	94.9	99.6	100.0	100.0	100.0
Aug., Norw. Sea	9.5	37.4	81.2	85.2	90.5	94.0	96.1

The percentage maturity observed for ages 2-3 in the spring west of Norway and in the summer in the Norwegian Sea are quite similar, whereas the observations from the spawning area in the spring indicate a higher maturity rate for the 2-year-olds. Taking into account that only a fraction of the immature fish would be found at the spawning area during the time of spawning, the Working Group considered that the observations made during the summer at the feeding area would most correctly reflect the age at maturity for the blue whiting stock as a whole. The maturity ogive obtained from this survey was used in the assessment.

4.7 Stock Estimates

4.7.1 Acoustic surveys in 1985

4.7.1.1 Surveys during the spawning season

During the spawning season of 1986, two independent surveys for assessing the blue whiting stock were conducted in the area west and north of the British Isles by the USSR and Norway. In addition, a Norwegian survey was conducted in the north to cover the eastern part of the Norwegian Sea up to 68°N (Monstad, 1986).

The USSR survey took place from 13 March to 6 April west and north of the British Isles between latitude 50°N and 62°N (Kudrin, pers. comm.). Blue whiting were recorded along the whole shelf-edge area (Figure 4.1), with the highest concentration distributed south of 53°30'N, this being more than 50% of the total estimated biomass of 6.4 million t representing 51.32×10^9 individuals. The immature part of this was 0.8 million t and the ma-

ture part 5.6 million t. The 1982 and 1983 year classes were by far the most dominating ones.

The Norwegian survey west of the British Isles took place from 12 March to 6 April between 53°N and 62°N. In continuation with this, another survey took place from 1-19 April in the shelf-edge area west of Norway up to 68°N (Monstad, 1986). Blue whiting were recorded, mostly scattered, over the larger part of the area surveyed (Figure 4.2). The total biomass recorded was 2.6 million t representing 25.0×10^9 specimens, the mature part of which was 2.0 million t. In the southern part, i.e., in the spawning area west of the British Isles, the biomass was assessed to be 1.6 million t, of which 1.4 million t belonged to the spawning stock. The remaining 1.0 million t, of which 0.6 million t were mature, were found west of the Norwegian coast. The 1982 and 1983 year classes were found to be dominating. In the north, however, the 1985 year class was also quite numerous.

In addition to these surveys, a Faroese survey was carried out on blue whiting during the spawning season in the area west of the British Isles. Due to technical problems, no biomass estimate was obtained. The survey was extended to cover also the area west of the Rockall Bank from Hatton Bank to Lousy Bank. Blue whiting were only recorded in the Rockall Channel and along the British shelf (Jákupsstovu, pers. comm.).

The results of the three assessment surveys are listed below.

Country	Time of survey	Area	Biomass in million t		
			Young	Adult	Total
USSR	13/3 - 6/4	50°00' - 62°00'N	0.8	5.6	6.4
Norway, south	12/3 - 6/4	53°00' - 62°00'N	0.2	1.4	1.6
Norway, north	1/4 - 19/4	62°00' - 68°00'N	0.4	0.6	1.0

4.7.1.2 Surveys in the feeding season

From 4-8 June, Iceland carried out a survey in the shelf-edge area off the Icelandic southeast coast (Anon., 1986b). Dense recordings of blue whiting were observed in a restricted area (Figure 4.3). The biomass of this was estimated to be 869,000 t, representing 7.4×10^9 individuals. The overall echo abundance of blue whiting within the same area was found to be 5-6 times higher than in the last 3 years (Sveinbjörnsson, pers. comm.). The 1983 year class dominated in the samples with 83%, the 1984 year class comprised 13%, and the rest were 1- and 2-year-old fish.

In July/August 1986, the fifth ICES-coordinated acoustic survey was carried out in the Norwegian Sea in which six countries participated with eight vessels (Anon., 1986c). The cruise tracks and trawl stations are shown in Figure 4.4 and the distribution and relative abundance of blue whiting in Figure 4.5. The distribution pattern was very much the same as during the previous years, with the highest concentrations to the south, but the

overall recordings, however, were weaker than in the last two years (Anon., 1984 and 1985a).

The zero line of the distribution was defined to the west, but not to the north or to the southwest.

The same methods for assessment were used as in previous years (Anon., 1982), resulting in a total estimate of 3.0 million t of blue whiting, which is equivalent to 28×10^9 individuals. The total biomass estimate divided into rectangles and areas is presented in Figure 4.6. The total length distribution weighted by abundance is shown in Figure 4.7, and the age composition estimated from the length composition using age/length keys from the Norwegian-sampled otoliths is shown in Figure 4.8 and also in the text table below.

Year class	Number $\times 10^9$	Biomass ('000 t)
1986	5.0	74.5
1985	2.0	132.5
1984	2.1	169.3
1983	5.9	714.2
1982	7.9	1,047.3
1981+	5.1	885.2
Total	28.0	3,023.0

4.7.1.3 Discussion

The various estimates (million t) obtained in the spawning area and in the Norwegian Sea since 1982 are listed in the following table (the adult component is given in brackets):

Area	1982	1983	1984	1985	1986
Spawning area	2.5	4.7(4.4) 3.6(3.6)	2.7(2.4) 3.4(2.7) ¹ 2.8(2.1) ¹ 2.4(2.2) ¹	6.4(1.7) ¹ 2.8(2.7) ²	6.4(5.6) 2.6(2.0)
Norwegian Sea	4.6(4.1)	2.8(1.1) ¹	3.8(0.4) ¹	4.9(0.5) ¹	3.0(0.9) ¹

¹ 1981 year class and older.

² 1982 year class and older.

The two acoustic surveys during the spawning season of 1986 both covered large areas. While the Norwegian survey extended northward into the Norwegian Sea, the USSR survey extended southward to south of the Porcupine Bank. Half of the biomass estimated from the USSR survey was distributed in the area not surveyed by Norway (50°00'N-53°30'N). As the Porcupine Bank area is considered to be a mixing area for the northern stock, the southern stock, and for local stocks as well, it is not possible to indicate what proportion of this biomass estimate belongs to the

northern stock. However, biological samples indicated that approximately 5% of the total USSR biomass estimate might belong to stocks other than the northern one.

Weather conditions during the survey were very bad, especially in the first half of the survey period, creating problems for the acoustic integration. Due to this and to insufficient area coverage, the Norwegian survey is considered an underestimate.

From the Norwegian survey, only 1.6 million t of biomass were found distributed in the area between the Faroe Islands and the Porcupine Bank, this being only half of the USSR estimate within the same area approximately at the same time. While the USSR surveyed the stock from north to south, Norway surveyed it from south to north.

Spawning of blue whiting also took place along the Norwegian shelf area. Although most of the estimated 0.6 million t of mature fish in this area were expected to migrate further south in the season, specimens with either ripe, running, or spent gonads were found all the way north to the Lofoten Islands.

The Norwegian Sea survey in 1986 was considered an underestimate by the Norwegian Sea Survey Workshop meeting prior to the Working Group (Anon., 1986c) as have all the previous ICES-coordinated Norwegian Sea surveys (Anon., 1986a). As discussed in detail during a workshop in 1985 (Anon., 1985b), one of the main problems is the vessel's threshold effect. This was clearly demonstrated by an intercalibration between two of the vessels during the 1986 survey. On the basis of this, the Working Group concluded that, with the present methodology, it is not possible to estimate the total stock, especially the older year classes of blue whiting, during the feeding season.

4.7.2 Virtual population analysis (VPA)

4.7.2.1 VPA calibration

As in the past, the Working Group tried to calibrate the VPA according to the results from the acoustic surveys on blue whiting.

The fifth ICES-coordinated acoustic survey carried out in the Norwegian Sea and adjacent waters in August-September 1986 gave a total biomass estimate of 3.0 million t. However, the Working Group concluded that this value must be an underestimate of the actual stock biomass (see Section 4.7.1.3). In addition, estimates of spawning stock were obtained during the spawning season from a USSR survey (5.6 million t) and a Norwegian survey (2.0 million t). Because of the large discrepancies between the results from the two surveys during the spawning season, the question was raised how reliable these estimates are (see Section 4.7.1.3). It was agreed that the spawning stock biomass estimate of 2.0 million t from the Norwegian survey was an underestimate and that, on the other hand, the level of 5.6 million t from the USSR survey could be somewhat too high. The Working Group, therefore, decided that, for tuning the VPA, the spawning stock bio-

mass estimate of 4.1 million t in 1985 calculated from the surveys conducted in that year would be the most reliable one and was finally accepted for 1985.

This spawning stock size of 4.1 million t is associated with a fishing mortality of $F = 0.14$ on the fully-recruited age groups (ages 3 and older) in 1985. The fishing mortalities of 0.08 and 0.10 for age groups 0 and 1, respectively, in 1985 were selected in order to get an average recruitment level for these two year classes (15×10^5 at age 0). Using these terminal F values, the VPA provides an average fishing mortality of $\bar{F}_{(3-12)} = 0.15$ in 1984, i.e., a value which is very close to the 1985 level. From the information available on effort and CPUE (see Section 4.7.3), an unchanged F level over the period 1984-1985 is also expected.

Based on this VPA, the spawning stock biomass at the beginning of 1986 was estimated at 4.5 million t compared with 5.6 million t estimated from the USSR survey in March-April 1986 and the 2.0 million t estimated from the Norwegian survey at the same time. A comparison of the spawning stock biomasses estimated from the VPA and the various acoustic surveys in recent years is given in the text table below:

Estimate	1983	1984	1985	1986
Survey	3.6-4.4	2.2-2.7	4.1 ¹	2.0-5.6
VPA	3.8	3.6	4.1	4.5

Biomass in million t.

¹ Combined from two surveys.

Despite the discrepancy observed for 1984, this is probably the best agreement which can be achieved for the two series over the whole 4-year period and, therefore, the terminal F chosen for 1985 seems to be appropriate.

4.7.2.2 VPA results (Tables 4.11 - 4.13)

The VPA results show that the total biomass decreased steadily from 1976 to 1982. From 1983 onwards, an increase is again observed, which is 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 1986, the total stock biomass and the spawning stock biomass were at a level of 6.0 million t and 4.5 million t, respectively.

The average fishing mortality on age groups 3-12 increased steadily from 1976 to 1981 where a level of $F = 0.40$ was reached. After 1981, a continuous reduction in fishing mortality has taken place as a consequence of decreased catches and increased stock size. The average fishing mortality in 1985 is estimated to be equal to 0.14.

4.7.2.3 Yield per recruit

Yield per recruit and spawning stock biomass per recruit have been calculated using the data given in Table 4.14 and are shown in Figure 4.9C. The yield-per-recruit curve is flat topped and has an F_{max} corresponding to 0.29. $F_{0.1}$ is equal to 0.17 and, therefore, 21% higher than the fishing mortality estimated for 1986 [$(\bar{F}(3-12) = 0.14]$. It should be noted that the present level of $F_{0.1}$ is lower than that estimated in last year's assessment ($F_{0.1} = 0.21$). This reduction has been caused by the increased exploitation rate on age groups 0 and 1. As the high numbers of 0-group fished in 1985 might have been caused by an artifact in sampling (see Section 4.4), the $F_{0.1}$ calculated last year is probably the most appropriate.

4.7.3 Catch per unit effort

Data on effort and catch per unit effort from the directed blue whiting fisheries for 1985 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, Vb, VIa, and IVa, which may be indicative of changes in stock abundance, are compiled in Tables 4.15 and 4.16.

In the Norwegian Sea (Division IIa), the German Democratic Republic catch rates increased considerably from 1984 to 1985 for the period May-June, whereas for July-September, some decrease in CPUE was observed. If all months (June-October) are included in the calculations, then catch per hour increased by 6% from 1984 to 1985. In contradiction to this trend, the CPUE for the USSR fleet in Division IIa decreased during May-June and increased for the period July-September, comparing the years 1984 and 1985. If the whole fishing season is taken into account, the USSR catch rate declined by 11% from 1984 to 1985. This decline might be explained by a differential distribution due to the hydrographic conditions.

The Polish CPUE series stopped in 1982 since, from 1983 onwards, the fleet did not take part in the fishery.

In Division Vb, the USSR catch rates increased over the last two years for all types of fisheries (pre-spawning, spawning, and feeding). For the Norwegian spawning fishery in Division Vb, an increase in CPUE was also observed in 1985 compared with 1984. In Division VIa, however, the declining trend in catch rates observed from 1983 to 1984 in this type of Norwegian fishery continued in 1985. It should be noted that this is in contradiction to the calculated increase in spawning stock biomass from 1984 to 1985.

On the other hand, in Divisions VIIb,c, g-k, the catch rates in the Norwegian and the USSR spawning fisheries increased tremendously from 1984 to 1985.

Taking into account all information available on CPUE, no firm conclusion can be drawn concerning recent trends in stock size, since different changes in catch rates were observed. However, the overall indication is that there was obviously no marked change in stock biomass from 1984 to 1985, and the stock size was probably more or less of the same order of magnitude in both years.

4.8 Catch Projections and Management Considerations

Based on stock size estimates at the beginning of 1986, projections of catches in 1987 and resulting stock biomass and spawning stock biomass in 1988 were made using the parameters given in Table 4.14. In the projections, an average recruitment level of 15×10^9 at age 0 was used for the 1986, 1987, and 1988 year classes.

For 1986, it was assumed that the fishing mortality will remain at the same level as in 1985, i.e., equal to 0.14. The expected catch in 1986 associated with that fishing mortality corresponds to 670,000 t. The results of the catch projections are given in Table 4.17 and shown in Figure 4.9D. It can be seen that a continuation of the present F level would result in a catch of 660,000 t in 1987. Fishing at $F_{0.1} = 0.21$ in 1987 is associated with a catch of 950,000 t.

5 SOUTHERN STOCK

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 increased in 1985 by 38%. Part of this increase was probably caused by changes in fleet efficiency. 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 1983-1985.

5.3 Age Composition of Landings

The age composition of the Spanish landings was available for the period 1982-1985. The Portuguese catch in numbers by length group was converted to catch in numbers by age group using Spanish age/length keys and are presented in Table 5.3.

5.4 Weight at Age

Mean weight-at-age data from 1982-1985 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 was within 7% (1982), 3% (1983), and 0.6% (1984) of the nominal landings. In 1985, the SOP was within 20% of the landings and the numbers by length were revised accordingly.

5.5 Catch per Unit Effort

CPUE figures for the main Galician ports in the period 1977-1985 are presented in Table 5.5. The increase in the CPUE in 1985 (36%) was probably caused by changes in fleet efficiency due to a shift from single to pair trawling by a number of vessels. CPUE figures for the period 1983-1985 for the single and pair trawlers separately are presented in Table 5.6.

5.6 Length at Maturity

Maturity/length ogives are shown in Figures 5.1 and 5.2 for blue whiting males and females separately (Vasconcelos, 1986). Males reached 50% maturity at a mean length of 16.8 cm, whereas 50% maturity for females is reached at a mean length of 18.7 cm. For assessment purposes, however, maturity age data are also needed.

5.7 Acoustic Survey off the Cantabrian and Galician Coast

During the acoustic survey of the sardine stock off the Cantabrian and Galician coast in 1985, the blue whiting biomass in the area surveyed was estimated to be 280,000 t (Meixide, pers. comm.). As not all of the area of blue whiting distribution was covered, this must be considered an underestimate.

5.8 Bottom Trawl Surveys in Galician and Portuguese Waters

Bottom trawl surveys have been conducted off both the Galician and Portuguese coasts since 1980 and 1979, respectively, following a stratified random sampling design covering depths up to 500 m. The results obtained in Galician waters indicate a greater abundance in shallow water (less than 200 m), whereas the surveys in the Portuguese waters indicate a greater abundance in deeper waters of 200-500 m (Tables 5.7 and 5.8).

5.9 Assessment

The number of years with estimates of catch in number by age group is too small to allow for an analytical assessment to be made. However, with data for two or three more years, this will be possible.

As the acoustic survey only covered a part of the area in which the southern blue whiting stock is distributed, the biomass estimate obtained also could not be used for assessing the southern blue whiting stock. The Working Group reiterates its statements of previous years that acoustic surveys of the southern blue whiting stock are needed.

6 DISTRIBUTION IN TIME AND SPACE OF DIFFERENT LIFE STAGES OF BLUE WHITING

This question was addressed by the Blue Whiting Assessment Working Group in 1985, and a general outline of the migration and distribution of different life stages of blue whiting was given in the report of that meeting (Anon., 1986a).

The Working Group considered the general description given in 1985 to be as accurate as is possible with the present knowledge and, therefore, the two tables were only updated in this report (Tables 6.1 and 6.2).

From Norwegian acoustic surveys in 1980 and 1981 and international acoustic surveys coordinated by ICES since 1982 in the Norwegian Sea and adjacent waters, estimates of the blue whiting biomass have been obtained.

These estimates divided on areas within and beyond areas of national fisheries jurisdiction of NEAFC member countries are presented in Table 6.1 as percentages of the total biomass estimate.

The Working Group, however, wants to underline the fact that the distribution in the fishing areas might change considerably from one year to another due to hydrographical changes (Monstad and Blindhem, 1986; Shevchenko and Isaev, 1985).

The total landings of blue whiting during 1978-1985 are divided into national fishery zones in Table 6.2. The table was derived from data brought by the Working Group members and some assumptions had to be made. For this reason, the totals for each year deviate somewhat from the official total.

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 this were actually taken in this zone.

7 RESEARCH RECOMMENDATIONS

- 1) The results of surveys and investigations have provided evidence of a separate southern blue whiting stock, but further research in stock separation is necessary. In order to assess and manage the southern stock, data series on age composition of landings are required and acoustic surveys are needed.
- 2) The Working Group considers it very important that the northern blue whiting stock is monitored continuously. The surveys of the spawning stock during the spring have proved to be very valuable and the Working Group recommends that they be continued.

- 3) The Working Group recommends that investigations be performed on selectivity of blue whiting using mesh sizes used in the mixed industrial fisheries and the directed fisheries in the northern area.
- 4) The Working Group recommends that a new otolith exchange program be set up to monitor the consistency in blue whiting ageing with T. Monstad as coordinator. The Working Group is of the opinion that in this program the coordinator shall be provided with results of the age readings, supported by identifications of the rings, marked on photos or other means.
- 5) In accordance with the conclusions given in the report on the acoustic blue whiting survey in the Norwegian Sea during the summer of 1986 (Anon., 1986c), the Working Group recommends that further studies concerning the accuracy of target strength values used for blue whiting are undertaken and the results exchanged.

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Table 4.1 Landings (tonnes) of BLUE WHITING from the main fisheries, 1976-1985.

Area	1976	1977	1978	1979	1980
Norwegian Sea fishery (Sub-areas I+II and Divisions Va, XIVa+XIVb)	3,336	56,999	236,226	741,042	766,798
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	81,362	136,787	229,228	284,547	250,693
Icelandic industrial fishery (Division Va)	8,220	5,838	9,484	2,500	-
Industrial mixed fishery (Divisions IVa-c, Vb, IIIa)	36,024	38,389	99,874	63,333	75,129
Subtotal northern fishery	128,942	238,013	574,812	1,091,422	1,092,620
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k)	35,035	30,723	33,898	27,176	29,944
Total	163,977	268,736	608,710	1,118,598	1,122,564

Area	1981	1982	1983	1984	1985 ¹
Norwegian Sea fishery (Sub-areas I+II and Divisions Va, XIVa+XIVb)	520,738	110,685	52,961	65,932	90,742
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	288,316	361,656	361,537	415,940	456,388
Icelandic industrial fishery (Division Va)	-	-	7,000	-	-
Industrial mixed fishery (Divisions IVa-c, Vb, IIIa)	61,754	117,578	117,737	122,806	97,769
Subtotal northern fishery	870,808	589,919	539,235	604,678	644,899
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k)	38,748	31,590	30,835	37,098	51,292
Total	909,556	621,509	570,070	641,776	696,191

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, 1976-1985, as estimated by the Working Group.

Country	1976	1977	1978	1979	1980
Denmark	-	-	-	-	-
Faroes	-	593	2,810	762	-
France	-	-	-	-	-
German Dem.Rep.	90	2,031	7,301	22,502	14,234
Germany, Fed.Rep. ²	33	6,777	8,421	1,157	8,919
Iceland	569	4,768	17,756	12,428 ³	4,562
Norway	737	-	-	33,588 ³	902
Poland	95	1,536	5,083	4,346	11,307
UK (Engl.& Wales)	60	165	11	-	-
USSR	1,752	41,129	194,844	666,259	726,874
Total	3,336	56,999	236,226	741,042	766,798

Country	1981	1982	1983	1984	1985 ¹
Denmark	-	473	-	93	-
Faroes	11,131	-	11,316	-	-
France	5,093	2,067	2,890	-	-
German Dem.Rep.	15,607	3,042	5,553	8,193	1,689
Germany, Fed.Rep. ²	17,385	890	2	35	75
Iceland	4,808	-	-	105	-
Norway	187	-	5,061	689	-
Poland	2,434	443	-	-	-
UK (Engl.& Wales)	-	-	-	-	-
USSR	464,093	103,770	28,141	56,817	88,978
Total	520,738	110,685	52,961	65,932	90,742

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), 1976-1985, as estimated by the Working Group.

Country	1976	1977	1978	1979	1980
Denmark	-	18,745	23,498	21,200	19,272
Faroes	12,826	29,096	39,491	35,780	37,488
France	-	-	-	-	-
German Dem.Rep.	4,971	1,094	1,714	172	181
Germany, Fed.Rep.	85	3,260	6,363	3,304	709
Iceland	-	5,172	7,537	4,864	5,375
Ireland	160	-	-	-	-
Netherlands	-	-	1,172	154	-
Norway	24,853	38,214	116,815	186,737	33,754
Poland	10,950	3,996	2,469	4,643	-
Spain	5,910	183	14	-	-
Sweden	-	6,391	6,260	-	3,185
UK (Engl.& Wales)	341	1,475	5,287	4,136	3,878
UK (Scotland)	1,488	3,001	1,599	1,466	6,819
USSR	19,778	26,160	17,009	22,091	40,032
Total	81,362	136,787	229,228	284,547	150,693

Country	1981	1982	1983	1984	1985 ¹
Denmark	11,361	23,164	28,680	26,445	21,424
Faroes	23,107	38,958	56,168	62,264	72,316
France	-	1,212	3,600	3,882	-
German Dem.Rep.	6,562	7,771	3,284	1,171	6,427
Germany, Fed.Rep.	935	701	825	693	626
Iceland	10,213	1,689	1,176	-	-
Ireland	-	-	-	-	668
Netherlands	222	200	150	1,000	1,248
Norway	166,168 ²	169,790 ³	85,646 ⁴	211,773	234,137
Poland	2,279	-	-	-	-
Spain	-	-	318	-	-
Sweden	-	-	-	-	-
UK (Engl.& Wales)	6,000	-	-	-	-
UK (Scotland)	2,611	-	-	-	-
USSR	58,858	73,171	81,690	108,712	119,542
Total	288,316	316,656	361,537	415,940	456,388

¹ Preliminary.

² Including 28,466 t from directed fisheries in Division IVa.

³ Including 35,001 t from directed fisheries in Division IVa.

⁴ Including 32,043 t from directed fisheries in Division IVa.

Table 4.4 Landings (t) of BLUE WHITING from the Icelandic mixed industrial trawl fisheries in Division Va, 1976-1985.

Country	1976	1977	1978	1979	1980
Iceland	8,220	5,838	9,484	2,500	-

Country	1981	1982	1983	1984	1985 ¹
Iceland	-	-	7,000	-	-

Table 4.5 Landings (tonnes) of BLUE WHITING from the mixed industrial fisheries and caught as by-catch in ordinary fisheries in Divisions IVa-c, Vb and IIa, 1976-1985, as estimated by the Working Group.

Country	1976	1977	1978	1979	1980
Denmark	-	16,071	54,804	28,932	49,947
Faroës	1,254	-	1,177	1,489	1,895
France	-	-	-	-	-
German Dem.Rep. ²	-	-	988	49	-
Germany, Fed.Rep. ²	-	76	1,514	13	252
Ireland	-	-	-	-	-
Netherlands	-	-	-	-	-
Norway ²	34,600	20,737	39,989	30,930	21,962 ³
Poland ²	45	838	601	-	-
Spain	47	-	-	-	-
Sweden ⁴	-	639	648	1,249	1,071
UK (Engl.& Wales) ²	-	3	+	-	-
UK (Scotland)	58	25	153	37	2
USSR ²	20	-	-	634	-
Total	36,024	38,389	99,874	63,333	75,129

Country	1981	1982	1983	1984	1985 ¹
Denmark	35,066	34,463	38,290	48,939	35,843 ⁵
Faroës	3,133	27,269	12,757	9,740	3,606 ⁵
France	-	1,417	249	-	-
German Dem.Rep. ²	-	-	-	-	-
Germany, Fed.Rep. ²	-	93	-	566	52
Ireland	2,744	-	-	-	-
Norway	18,627	47,856	62,591	58,038	54,522
Netherlands	-	-	-	122	130
Poland ²	229	550	-	-	-
Spain	-	-	-	-	-
Sweden ⁴	1,955	1,241	3,850	5,401	3,616
UK (Engl.& Wales) ²	-	4,689	-	-	-
UK (Scotland)	-	-	-	-	-
USSR ²	-	-	-	-	-
Total	61,754	117,578	117,737	122,806	97,769

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 1986 based on returns on ICES Data Form 5 for 1986 and information from Working Group members.

Country	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Faroe Islands	Vb+VI	-	-	-	-	-	-	-	-	70,950
German Dem.Rep.	Vb	83	-	-	-	43	1,600	-	-	1,726
	VIIg-k	-	94	904	-	-	-	-	-	998
Netherlands	Vb-VII	-	-	-	-	-	-	-	-	3,000
Norway	IV	350	1,385	344	7,915	11,225	3,020	2,266	547	27,052
	Vb	2,633	145	-	-	16,018	-	-	-	18,796
	VI	1,580	16,413	12,175	95,557	60,268	-	-	-	185,993
	VIIc	-	-	28,701	28,876	-	-	-	-	57,577
UK (Scotland)	Vb+VI	-	-	-	-	-	-	-	-	3,472
USSR	I + II	294	2,938	55	1,069	128	32,925	56,420	-	93,829
	Vb	2,831	12,744	3,349	19,600	30,648	9,499	120	-	78,791

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), 1976 - 1985.

Age	1976	1977	1978	1979	1980
0	-	-	-	-	-
1	4.5	-	-	-	55.1
2	13.1	44.0	63.6	69.9	319.5
3	24.1	87.5	69.0	165.0	362.0
4	54.6	164.8	345.8	457.5	399.1
5	26.4	184.9	436.9	468.3	478.3
6	52.3	154.3	483.1	569.0	530.9
7	69.1	137.6	527.9	743.2	725.3
8	57.6	176.7	474.3	904.8	779.2
9	65.2	120.1	364.8	826.4	694.5
10	73.0	132.0	307.6	797.0	1,008.7
11	30.2	110.1	157.4	473.2	398.1
12	36.7	56.3	121.8	359.2	394.2
13	18.8	18.2	50.4	142.7	66.8
14	9.9	13.5	20.5	69.3	64.6
15+	6.3	6.9	16.1	39.0	4.7
Total	541.8	1,406.9	3,439.2	6,405.4	6,191.0
Tonnes	84,698	193,786	465,454	1,025,599	1,017,491

Age	1981	1982	1983	1984	1985 ¹
0	-	1.2	2.5	63.6	871.4
1	4.0	1.7	290.4	417.6	127.4
2	40.1	48.6	239.1	1,394.1	1,341.6
3	322.8	123.1	164.1	277.9	1,588.1
4	225.3	371.0	194.1	211.9	199.3
5	501.5	212.6	411.4	259.2	161.0
6	539.0	251.0	284.4	420.2	303.7
7	448.5	250.7	274.0	253.1	248.7
8	618.3	259.3	283.5	190.3	167.2
9	573.2	278.7	219.9	151.6	91.7
10	718.3	259.8	152.6	113.8	87.8
11	343.6	158.5	71.5	57.7	73.1
12	232.6	133.6	45.4	50.0	51.4
13	73.9	41.0	25.0	15.0	21.1
14	49.5	45.3	12.1	8.1	12.5
15+	30.6	28.0	10.0	6.7	9.5
Total	4,721.2	2,464.1	2,680.0	3,890.9	5,355.3
Tonnes	809,054	427,341	416,730	481,872	554,640

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)
1976-1985.

Age	1976	1977	1978	1979	1980
0	128.1	428.9	956.2	2.4	23.2
1	760.7	467.5	1,030.9	1,849.0	276.1
2	98.7	111.4	168.2	78.8	329.9
3	36.9	33.8	89.7	32.3	74.8
4	22.4	31.8	74.0	22.3	22.6
5	-	-	-	18.2	29.1
6	-	-	-	20.8	23.1
7	-	-	-	10.8	29.3
8	-	-	-	8.8	26.8
9	-	-	-	14.0	15.2
10	-	-	-	6.2	13.8
11	-	-	-	1.0	6.4
12	-	-	-	4.4	1.8
13	-	-	-	-	2.2
14	-	-	-	-	1.4
15+	-	-	-	-	0.4
Total	1,046.8	1,073.4	2,319.0	2,069.0	860.8
Tonnes	44,244	44,227	109,358	94,995	75,129

Age	1981	1982	1983	1984	1985 ¹
0	-	3,450.1	336.3	446.4	184.3
1	65.1	45.3	1,844.2	1,650.8	891.4
2	81.4	41.3	90.0	587.7	365.0
3	191.9	80.9	38.4	49.7	173.8
4	58.4	112.8	47.7	12.8	37.4
5	20.1	29.2	55.6	12.6	13.4
6	16.7	21.6	12.2	10.4	13.9
7	17.8	14.8	12.8	6.1	5.8
8	15.7	12.0	2.6	2.2	5.6
9	4.4	5.2	5.8	2.7	1.8
10	4.9	1.8	4.2	2.6	3.0
11	3.6	-	9.6	0.9	1.4
12	1.5	2.4	3.3	0.3	0.3
13	1.2	0.6	0.6	0.3	-
14	0.1	0.6	0.3	0.1	-
15+	0.2	-	-	-	-
Total	483.0	3,816.6	2,463.6	2,785.5	1,697.0
Tonnes	61,754	117,578	124,737	122,806	97,769

¹ Preliminary.

Table 4.9 Virtual Population Analysis.

BLUE WHITING, NORTHERN AREA

CATCH IN NUMBERS UNIT: millions

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	128	429	956	2	23	0	3451	339	510	1056
1	765	468	1031	1919	331	69	45	2133	2068	1019
2	112	155	232	244	649	122	90	328	1982	1707
3	61	121	159	353	437	515	204	202	328	1762
4	77	197	420	480	422	284	484	241	225	237
5	26	185	437	487	507	522	242	465	272	174
6	52	154	483	590	554	556	273	295	431	318
7	69	138	528	754	755	466	266	285	259	254
8	58	177	474	914	806	634	271	285	192	173
9	65	120	365	840	620	578	284	225	154	93
10	73	132	308	803	1023	723	262	156	116	91
11	50	110	157	474	405	347	159	81	59	74
12	37	56	122	364	396	234	136	49	50	52
13	19	18	50	143	69	75	42	26	15	21
14	10	14	21	69	66	50	46	12	8	12
15+	6	7	16	39	5	31	28	10	7	9
TOTAL	1589	2480	5758	8474	7067	5206	6281	5132	6676	7052

Table 4.10 SUM OF PRODUCTS CHECK.

BLUE WHITING, NORTHERN AREA
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH	UNIT: kilogram									
	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	.032	.032	.032	.032	.027	.027	.018	.018	.027	.014
1	.030	.030	.030	.030	.036	.063	.046	.046	.036	.038
2	.084	.084	.084	.084	.079	.092	.094	.094	.086	.080
3	.105	.105	.105	.105	.107	.118	.136	.136	.104	.102
4	.109	.109	.109	.109	.122	.135	.152	.152	.142	.129
5	.129	.129	.129	.129	.135	.145	.162	.162	.157	.164
6	.147	.147	.147	.147	.149	.155	.178	.178	.164	.178
7	.160	.160	.160	.160	.165	.170	.195	.195	.176	.200
8	.170	.170	.170	.170	.176	.178	.200	.200	.189	.208
9	.177	.177	.177	.177	.186	.187	.204	.204	.186	.218
10	.188	.188	.188	.188	.199	.199	.213	.213	.197	.225
11	.193	.193	.193	.193	.202	.208	.234	.234	.202	.233
12	.199	.199	.199	.199	.207	.228	.228	.228	.194	.233
13	.200	.200	.200	.200	.207	.234	.258	.258	.225	.243
14	.200	.200	.200	.200	.207	.249	.242	.242	.223	.251
15+	.200	.200	.200	.200	.207	.257	.258	.258	.242	.279

Table 4.11 VIRTUAL POPULATION ANALYSIS.

BLUE WHITING, NORTHERN AREA		UNIT: Year-1										
FISHING MORTALITY COEFFICIENT		NATURAL MORTALITY COEFFICIENT =										
-----		1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1980-83
0		.01	.03	.06	.00	.00	.00	.11	.01	.04	.08	.03
1		.07	.05	.11	.16	.04	.02	.01	.09	.09	.10	.04
2		.01	.02	.03	.03	.07	.02	.03	.10	.11	.10	.06
3		.01	.01	.02	.06	.08	.08	.04	.09	.14	.14	.07
4		.01	.03	.07	.09	.10	.07	.10	.06	.13	.14	.08
5		.00	.03	.07	.10	.12	.18	.07	.13	.09	.14	.13
6		.01	.03	.10	.13	.16	.20	.13	.12	.17	.14	.15
7		.02	.05	.12	.21	.25	.20	.15	.20	.15	.14	.19
8		.02	.05	.12	.30	.37	.34	.17	.21	.20	.14	.27
9		.04	.04	.15	.32	.35	.50	.25	.21	.17	.14	.33
10		.06	.10	.15	.54	.83	.89	.44	.21	.15	.14	.59
11		.04	.12	.16	.35	.58	.76	.49	.24	.11	.14	.52
12		.10	.10	.19	.68	.56	.80	.79	.27	.23	.14	.61
13		.05	.07	.12	.36	.26	.19	.31	.33	.13	.14	.27
14		.03	.05	.10	.24	.28	.30	.17	.14	.16	.14	.22
15+		.03	.05	.10	.24	.28	.30	.17	.14	.16	.14	.22
(0-3)U		.02	.03	.06	.06	.05	.03	.05	.07	.10	.10	
(3-12)U		.03	.05	.11	.28	.34	.40	.26	.17	.15	.14	

Table 4.12 VIRTUAL POPULATION ANALYSIS.

BLUE WHITING, NORTHERN AREA		UNIT: millions										
STOCK SIZE IN NUMBERS		ALL VALUES ARE GIVEN FOR 1 JANUARY										
		1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0		12510	14013	18566	11361	5209	5702	36979	32633	14969	15134	0
1		12902	10126	11086	14337	9299	4243	4668	27164	26411	11795	11438
2		11102	9872	7869	8147	10010	7315	3412	3781	20316	19758	8738
3		10673	8988	7943	6233	6450	7609	5879	2712	2800	14846	14637
4		8980	8684	7250	6359	4785	4887	5765	4629	2038	1997	10567
5		8069	7282	6932	5557	4774	3537	3745	4284	3572	1466	1421
6		7110	6583	5795	5281	4111	3451	2426	2848	3088	2679	1044
7		4752	5774	5250	4309	3792	2866	2325	1740	2065	2140	1907
8		5958	3828	4603	5822	2849	2426	1927	1664	1168	1458	1523
9		1975	3172	2975	3341	2308	1609	1417	1333	1106	784	1038
10		1374	1558	2489	2107	1980	1333	800	905	889	767	558
11		842	1059	1157	1761	1006	710	448	420	600	624	546
12		419	662	768	805	1016	461	272	225	271	458	444
13		393	310	491	519	534	477	169	101	140	177	312
14		369	305	237	557	297	212	323	101	60	101	126
15+		235	156	186	201	23	131	197	84	52	76	126
TOTAL NO		85643	82373	83596	74497	58242	46970	70751	84625	79546	74240	
SPS		52726	51526	48743	44098	37368	31539	26348	24733	28058	32629	

Table 4.13 VIRTUAL POPULATION ANALYSIS.

BLUE WHITING, NORTHERN AREA

STOCK BIOMASS UNIT: thousand tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	400	448	594	364	141	182	666	587	404	212
1	387	304	333	430	335	267	215	1250	951	448
2	933	829	661	684	791	673	321	355	1747	1581
3	1121	944	834	654	690	898	799	369	291	1514
4	979	947	790	693	584	660	876	704	289	258
5	1041	939	894	717	644	513	607	694	561	240
6	1045	968	852	776	612	535	432	507	506	477
7	760	924	840	689	626	487	453	339	364	428
8	670	651	782	650	501	432	385	333	221	303
9	350	562	526	591	429	301	289	272	206	171
10	258	293	468	396	394	265	170	193	175	173
11	163	204	223	340	203	148	105	98	121	145
12	83	132	153	160	210	105	62	51	53	102
13	79	62	98	104	69	112	44	26	32	43
14	74	61	47	71	61	53	78	24	13	25
15+	47	31	37	40	5	34	51	22	13	21
TOT-BIOM	8389	8298	8154	7361	6296	5665	5553	5824	5947	6142
SPS BIOM	6856	6890	6677	6069	5242	4658	4342	3825	3580	4154

Table 4.14

List of input variables for the ICES prediction program.

BLUE WHITING

The reference F is the mean F for the age group range from 3 to 12

The number of recruits per year is as follows:

Year	Recruitment
1986	15000.0
1987	15000.0
1988	15000.0

Data are printed in the following units:

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

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
0	15000.0	.08	.20	.00	.014	.014
1	11438.0	.10	.20	.10	.038	.038
2	8738.0	.10	.20	.37	.080	.080
3	14637.0	.14	.20	.81	.102	.102
4	10567.0	.14	.20	.85	.129	.129
5	1421.0	.14	.20	.91	.164	.164
6	1044.0	.14	.20	.94	.178	.178
7	1907.0	.14	.20	1.00	.200	.200
8	1523.0	.14	.20	1.00	.208	.208
9	1038.0	.14	.20	1.00	.218	.218
10	558.0	.14	.20	1.00	.225	.225
11	546.0	.14	.20	1.00	.233	.233
12	444.0	.14	.20	1.00	.233	.233
13	312.0	.14	.20	1.00	.243	.243
14	126.0	.14	.20	1.00	.251	.251
15+	126.0	.14	.20	1.00	.279	.279

Table 4.15 Catch per unit effort in the directed BLUE WHITING fisheries, 1977-1985. (Fishing gear: mid water trawl.)

Divi- sion	GRT class	Country	Time period	Year											Units
				1977	1978	1979	1980	1981	1982	1983	1984	1985			
IIa	2,000 - 3,999.9	German Dem.Rep.	May-Jun	-	3.43 ⁵	2.90	2.79	1.21	1.00	2.35	1.40	2.57	t/hour		
			Jul-Sep	-	1.99 ¹⁰	2.19	3.11	2.25 ¹³	1.21 ¹³	1.10	2.57	2.29	t/hour		
		Poland	Oct-Dec	-	-	-	3.51	1.04 ¹³	2.25 ⁵	2.70 ¹⁵	-	1.22	t/hour		
			May-Jun	-	-	21.90	8.00 ⁵	16.10 ⁵	6.50 ⁵	-	-	-	t/day		
			Jul-Aug	-	14.00	17.80	24.00	19.70	4.50 ⁶	-	-	-	t/day		
			Sep-Nov	-	-	-	21.40	13.30 ¹⁴	7.90 ¹²	-	-	-	t/day		
		USSR	Feb	-	-	2.70	6.35	-	-	-	-	-	t/hour		
			Mar-Apr	-	-	2.57	2.38	3.57	1.84	-	7.80	0.87	t/hour		
			May-Jun	-	-	3.04	3.30	2.62	2.35	1.73	3.06	2.48	t/hour		
			Jul-Sep	-	-	3.04	3.82	2.54	2.85	0.60 ⁶	2.85	3.16	t/hour		
		USSR	Oct-Dec	-	-	3.03	3.14	3.01	2.99 ¹⁴	-	-	-	t/hour		
			Aug-Oct	2.38	2.79	-	-	-	-	0.87 ⁴	-	1.86 ¹⁶	t/hour		
			Nov	-	-	-	-	-	-	-	8.00 ²	-	t/hour		
				-	-	-	-	-	-	-	-	-	t/hour		
Vb	2,000 - 3,999.9	German Dem.Rep.	Jan-May	-	-	-	-	3.88	2.12	2.08	-	3.50	t/hour		
			Jun-Jul	1.38	1.77	2.20	-	-	-	-	-	3.58	t/hour		
		Poland USSR	Nov-Dec	-	-	-	-	-	-	-	2.20	1.58	t/hour		
			May-Jun	36.70	17.20	43.60 ⁷	-	-	-	-	-	-	t/day		
			Jan-Feb	-	-	1.64 ³	6.83	6.71	5.16	3.05 ³	1.74 ³	3.71	t/hour		
			Mar-May	-	-	5.83 ¹⁰	5.23	5.97	4.58	4.12	4.57 ⁷	4.99	t/hour		
		Norway USSR	Jun-Aug	-	-	5.29 ¹⁰	-	3.75 ⁵	3.03	3.16 ¹²	4.29	5.33	t/hour		
			Sep-Dec	-	-	-	-	2.72 ¹¹	-	2.77 ¹²	3.70	-	t/hour		
			Apr-May	-	-	-	13.57	29.47	-	-	-	24.85 ¹⁷	t/hour		
			Jun-Jul	2.98	4.62	-	-	-	-	0.38 ⁸	-	1.05 ¹⁷	t/hour		
		Faroes Iceland Norway	May	17.60	13.60	10.60	6.20	9.60	-	-	-	-	t/hour		
			May	55.60	57.50	33.80	43.30	79.20	-	-	-	-	t/day		
			Apr-May	-	21.35	20.29	18.14	18.94	4.88	-	12.40	16.19	t/hour		
			Nov-Dec	-	-	-	-	-	-	-	25.08	12.55	t/hour		

(cont'd)

Table 4.15 (cont'd)

Divi- sion	GRT class	Country	Time period	Year											Units
				1977	1978	1979	1980	1981	1982	1983	1984	1985			
VIa	2,000 - 3,999.9	USSR	Mar	-	-	-	-	-	-	-	-	-	3.92	-	t/hour
	1,000 - 1,999.9	Norway	Mar-Apr	-	-	-	23.92	57.13	42.38	42.83	28.78	22.29	-	-	t/hour
	500 - 999.9	Faroes	Apr	17.40	19.80	21.40	16.40	-	-	-	-	-	-	-	t/hour
	100 - 499.9	Norway	Mar-Apr	-	24.93	30.27	26.56	34.96	36.30	49.04	25.21	20.05	-	-	t/hour
		Norway	Feb	-	-	-	-	-	-	-	31.35	-	-	-	t/hour
IVa	1,000 - 1,999.9	Norway	Mar-Apr	-	-	24.93	13.53	23.59	31.00	41.84	19.89	-	-	-	t/hour
			Apr-May	-	-	-	-	15.36	15.03	21.19	-	17.26	-	-	t/hour
	500 - 999.9	Norway	Apr-May	-	-	13.98	9.29	13.40	13.75	18.31	7.03 ⁴	15.70	-	-	t/hour
	100 - 499.9	Norway	Nov	-	-	-	-	-	-	-	4.50 ²	-	-	-	t/hour
			Apr-May	-	-	-	-	7.18	17.39	16.51	8.68 ⁴	-	-	-	t/hour
VIIb,c	2,000 - 3,999.9	USSR	Feb-Mar	-	-	-	-	-	-	-	-	-	4.72	6.21	t/hour
	1,000 - 1,999.9	Norway	Mar	-	-	-	-	-	-	-	-	-	8.00 ²	32.08	t/hour
	500 - 999.9	Norway	Mar	-	-	-	-	-	-	-	-	-	27.74	26.83	t/hour
	100 - 499.9	Norway	Mar	-	-	-	-	-	-	-	-	-	21.08	-	t/hour
			Feb-Mar	-	-	-	-	-	-	-	-	3.85	12.30	t/hour	
VIIg-k	2,000 - 3,999.9	USSR	Feb-Mar	-	-	-	-	-	-	-	-	-	-	-	t/hour
	500 - 999.9	Norway	Mar	-	-	-	-	-	-	-	-	-	14.58	-	t/hour

¹ Hyphen means no fishing.² One trawl only.³ Refers to February only.⁴ Refers to May only.⁵ Refers to June only.⁶ Refers to July only.⁷ Refers to April-May period.⁸ Refers to May-June period.⁹ Refers to May-July period.¹⁰ Refers to June-July period.¹¹ Refers to September-November period.¹² Refers to September-October period.¹³ Refers to October only.¹⁴ Refers to October-November period.¹⁵ Refers to November-December period.¹⁶ Refers to July-September period.¹⁷ Refers to April-June period.

Table 4.16 Catch per unit effort in the BLUE WHITING directed fisheries in Division IIA for 2,000 - 3,999.9 GRT, using mid water trawls, 1979-1985.

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

(cont'd)

Table 4.16 (cont'd)

Month	Catch					Effort								
	1979	1980	1981	1982	1983	1984	1985	1979	1980	1981	1982	1983	1984	1985
	(tonnes)					(hours)								
USSR														
January	8,992	2,927	-	8,003	-	-	-	-	-	-	1,045	-	-	-
February	4,959	2,153	-	-	-	-	-	1,833	339	-	-	-	-	-
March	5,520	16,811	3,886	375	-	-	-	1,538	6,151	1,208	285	-	-	-
April	3,382	36,284	45,645	618	-	-	62	1,933	16,119	12,666	256	-	-	-
May	51,409	125,988	88,754	46,089	15,188	1,782	3,289	15,336	25,244	25,912	17,106	7,300	222	68
June	110,918	114,117	78,727	27,617	7,919	16,564	25,031	38,069	47,634	37,919	14,209	6,094	5,160	9,550
July	124,618	121,463	87,582	6,820	1,172	11,842	33,177	42,166	42,319	39,039	5,983	1,963	4,315	11,600
August	142,962	114,505	63,889	-	-	15,609	20,969	47,395	28,293	29,528	-	-	5,292	7,350
September	106,606	79,504	37,960	2,921	-	492	5,311	33,755	17,499	11,745	640	-	194	2,360
October	57,562	50,954	11,560	1,121	-	-	-	16,574	16,072	3,270	341	-	-	-
November	16,317	17,543	4,778	379	-	-	-	6,841	5,710	1,455	161	-	-	-
December	5,830	1,292	10,704	-	-	-	-	2,867	413	4,263	-	-	-	-
All months	639,129	683,541	433,485	93,943	24,279	52,420	87,839	210,936	206,372	167,005	40,026	15,357	17,430	32,828
May - Oct	594,075	606,531	368,472	84,568	24,279	50,638	87,777	193,295	177,061	147,413	38,279	15,357	17,208	32,760

(cont'd)

(cont'd)

Table 4.16 (cont'd)

Month	CPUE						
	1979	1980	1981	1982	1983	1984	1985
(tonnes/hour)							
<u>USSR</u>							
January	-	-	-	7.66	-	-	-
February	2.70	6.35	-	-	-	-	-
March	3.59	2.73	3.22	1.32	-	-	-
April	1.74	2.25	3.60	2.41	-	-	-
May	3.35	4.99	3.42	2.69	2.08	8.01	0.91
June	2.91	2.39	2.08	1.94	1.30	2.73	1.56
July	2.95	2.87	2.24	1.14	0.60	3.21	2.62
August	3.01	4.05	2.16	-	-	2.74	2.86
September	3.16	4.54	3.23	4.56	-	2.95	2.84
October	3.47	3.17	3.53	3.29	-	2.54	2.25
November	2.39	3.07	3.28	2.35	-	-	-
December	2.03	3.13	2.51	-	-	-	-
All months	3.03	3.31	2.60	2.35	1.58	3.01	2.68
May - Oct	(1)	3.07	3.43	2.50	2.21	1.58	2.94
	(2)	3.14	3.67	2.78	2.72	1.33	2.83
							2.17

(1) CPUE = Total catch/total effort.

(2) CPUE = Σ (Monthly CPUE)/No. of months.

Table 4.17

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

BLUE WHITING

Year 1986				Year 1987				Year 1988			
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	.14	6042	4480	670	.0	.00	5936	4462	0	6490	4964
					.1	.01			70	6411	4898
					.2	.03			139	6334	4834
					.4	.06			274	6181	4707
					.6	.08			405	6032	4584
					.8	.11			533	5888	4465
					1.0	.14			653	5746	4348
					1.2	.17			780	5609	4234
					1.4	.20			899	5475	4124
					1.6	.22			1015	5344	4016
					1.8	.25			1128	5217	3911
					2.0	.28			1238	5093	3809
					2.2	.31			1345	4972	3710
					2.4	.34			1449	4854	3613
					2.6	.36			1551	4739	3519
					2.8	.39			1651	4627	3428
					3.0	.42			1748	4518	3339
					3.2	.45			1842	4412	3252
					3.4	.48			1934	4309	3167
					3.6	.50			2024	4208	3085

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 3 to 12

Table 5.1 Landings (tonnes) of BLUE WHITING from the southern areas (Sub-areas VIII and IX and Divisions VIIg-k and VIId,e), 1976-1985, as estimated by the Working Group.

Country	1976	1977	1978	1979	1980
Denmark	-	-	-	-	-
German Dem.Rep.	-	-	-	-	-
Germany, Fed.Rep.	-	-	25	-	-
Ireland	-	-	-	1	-
Netherlands	-	-	7	-	31
Poland	385	169	53	-	-
Portugal	-	1,557	2,381	2,096	6,051
Spain ²	29,470	25,259	31,428	-	23,862
UK (Engl.& Wales)	-	+	-	-	-
UK (Scotland)	-	-	-	63	-
USSR	5,180	3,738	4	-	-
Total	35,035	30,723	33,898	27,176	29,944

Country	1981	1982	1983	1984	1985 ¹
Denmark	-	-	-	-	280 ³
German Dem.Rep.	-	-	-	-	412 ³
Germany, Fed.Rep.	-	-	50	301 ³	-
Ireland	-	-	-	-	-
Netherlands	633	200	-	-	553 ³
Poland	-	-	-	-	-
Portugal	7,387	3,890	4,748	5,252	6,989
Spain ²	30,728	27,500	26,037	25,921	35,828
UK (Engl.& Wales)	-	-	-	33 ³	-
UK (Scotland)	-	-	-	-	-
USSR	-	-	-	5,591 ³	7,230 ³
Total	38,748	31,590	30,835	37,098	51,292

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, 1983-1985.

Length cm	1983	1984	1985
10	-	-	7
1	-	3	21
2	13	41	33
3	253	337	61
4	1,390	13,263	415
5	18,613	48,364	10,833
6	63,241	88,023	26,146
7	67,446	142,003	62,937
8	95,625	154,385	156,831
9	97,379	128,950	222,108
20	81,201	91,952	215,009
1	66,757	69,370	134,387
2	58,748	44,241	78,728
3	43,069	27,623	36,094
4	25,651	16,420	13,984
5	10,990	7,744	9,241
6	5,221	3,309	2,572
7	3,670	1,194	1,051
8	2,855	854	748
9	1,465	800	518
30	1,381	199	246
1	342	216	171
2	58	103	143
3	8	117	137
4	1	16	45
5	4	22	19
6	-	32	13
7	4	20	5
8	-	2	2
9	8	2	2
40	-	4	3
1	-	-	3
2	-	-	1
3	-	2	1
4	-	-	-
5	-	-	-
6	-	-	-
7	-	-	-
8	-	-	1
9	-	-	-
50	-	-	-
Total N	645,393	839,611	972,516
Landings (t)	30,785	31,173	42,817

Table 5.3 Catch in numbers (millions) by age group in the Portuguese and Spanish blue whiting fisheries, 1982-1985.

Age	1982	1983	1984	1985
0	61.1	98.0	73.9	103.5
1	102.5	149.7	223.2	263.4
2	183.5	238.5	349.0	332.2
3	121.8	68.2	127.4	177.5
4	64.3	45.1	35.0	73.5
5	22.1	34.0	13.2	15.5
6	3.2	8.8	13.8	3.2
7	0.3	2.3	3.3	2.7
8+	1.0	0.8	0.8	1.0
Total	559.9	645.4	839.6	972.5
Nominal (t)	31,390	30,785	31,173	42,817
SOP	33,660	31,805	31,370	-
W (g)	60	49.3	37.4	44

Table 5.4 Mean length and mean weights of BLUE WHITING landed by Portugal and Spain in the period 1982-1985.

Age	1982		1983		1984		1985	
	\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	17.3	29.1
1	19.5	45	18.3	39.0	17.3	28.7	18.7	37.2
2	21.7	61	19.5	46.5	18.4	34.6	19.7	43.7
3	22.5	69	21.9	65.8	20.8	50.5	20.7	51.2
4	23.4	77	23.0	75.6	22.8	65.9	21.9	61.9
5	24.2	85	23.8	84.4	24.0	77.0	23.1	73.2
6	25.8	103	25.6	104.5	24.4	81.1	25.5	100.1
7	29.8	156	27.1	123.5	25.7	94.1	25.9	105.3
8+	35.8	269	28.7	145.4	28.7	131.4	27.9	132.9

Table 5.5 Catch per unit effort by Spanish vessels landing in the main Galician ports, 1977-1985.

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	20,528	1,123
1984	22,305	19,015	1,173
1985	30,585	19,209	1,592

Table 5.6 Catch per unit effort by single and pair trawlers landing in the main Galician ports, 1983-1985.

Year	Landings (tonnes)	Effort (days fishing)	CPUE (kg/day)
<u>Single trawlers</u>			
1983	18,743	18,791	998
1984	16,085	16,573	971
1985	20,944	16,150	1,297
<u>Pair trawlers</u>			
1983	4,299	1,747	2,461
1984	6,220	2,442	2,547
1985	9,641	3,059	3,152

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 in September-October except the 1986 survey which was in April.

Strata + Year	Division IXa				Division VIIIc				Divisions VIIIc + IXa				Total	
	<200		>200		<200		>200		<200		>200		<500	
	\bar{y}	$s_{\bar{y}}$	\bar{y}	$s_{\bar{y}}$	\bar{y}	$s_{\bar{y}}$	\bar{y}	$s_{\bar{y}}$	\bar{y}	$s_{\bar{y}}$	\bar{y}	$s_{\bar{y}}$	\bar{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	40.5	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	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

Table 5.8 Stratified mean catch and standard error for BLUE WHITING in groundfish surveys by Portugal (Vasconcelas, 1986).

Year	Month	20-100 m		100-200 m		200-500 m		20-500 m	
		\bar{y}	$s_{\bar{y}}$	\bar{y}	$s_{\bar{y}}$	\bar{y}	$s_{\bar{y}}$	\bar{y}	$s_{\bar{y}}$
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/June	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

¹ Data unpublished.

² Coverage incomplete.

³ Codend mesh size 20 mm, otherwise 40 mm.

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

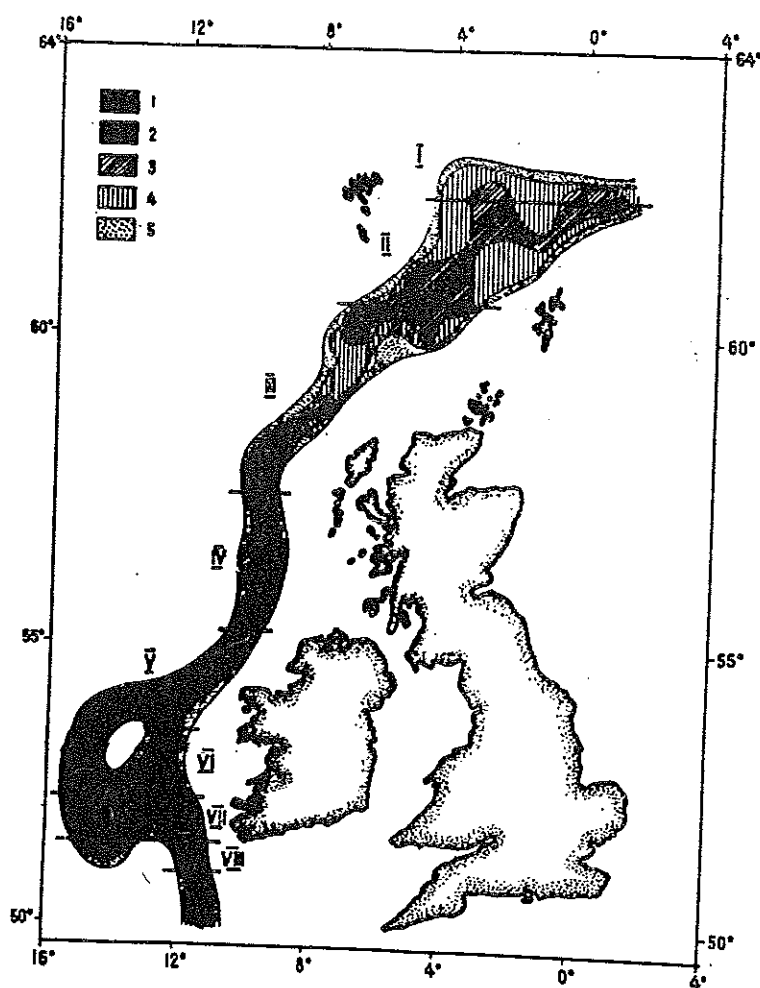
Area	1980	1981	1982	1983	1984	1985	1986
Internat.	18.9	26.0	14.7	5.6	4.8	8.2	8.4
Svalbard ¹	5.4	2.0	1.1	1.1	0.1	-	0.1
Jan Mayen	16.8	8.8	5.9	3.4	0.6	2.5	2.3
Norway	40.7	38.7	45.9	38.2	39.2	22.7	54.5
Iceland	8.6	14.2	10.8	25.0	18.4	13.7	6.8
Greenland	0.1	-	-	-	-	0.9	-
Faroes	4.7	8.3	16.9	19.4	25.9	37.4	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 1978-1985 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

Figure 4.1 Distribution of blue whiting densities observed during the USSR survey in the spring of 1986.



- 1: the densest concentrations (>2000).
- 2: dense concentrations (500-2000).
- 3: average concentrations (200-500).
- 4: poor concentrations (50-200).
- 5: scattered concentrations (<50).

Figure 4.2 Blue Whiting observations during the Norwegian surveys in the spring of 1986. Echo intensity in $\text{m}^2/\text{n.mile}^2$.

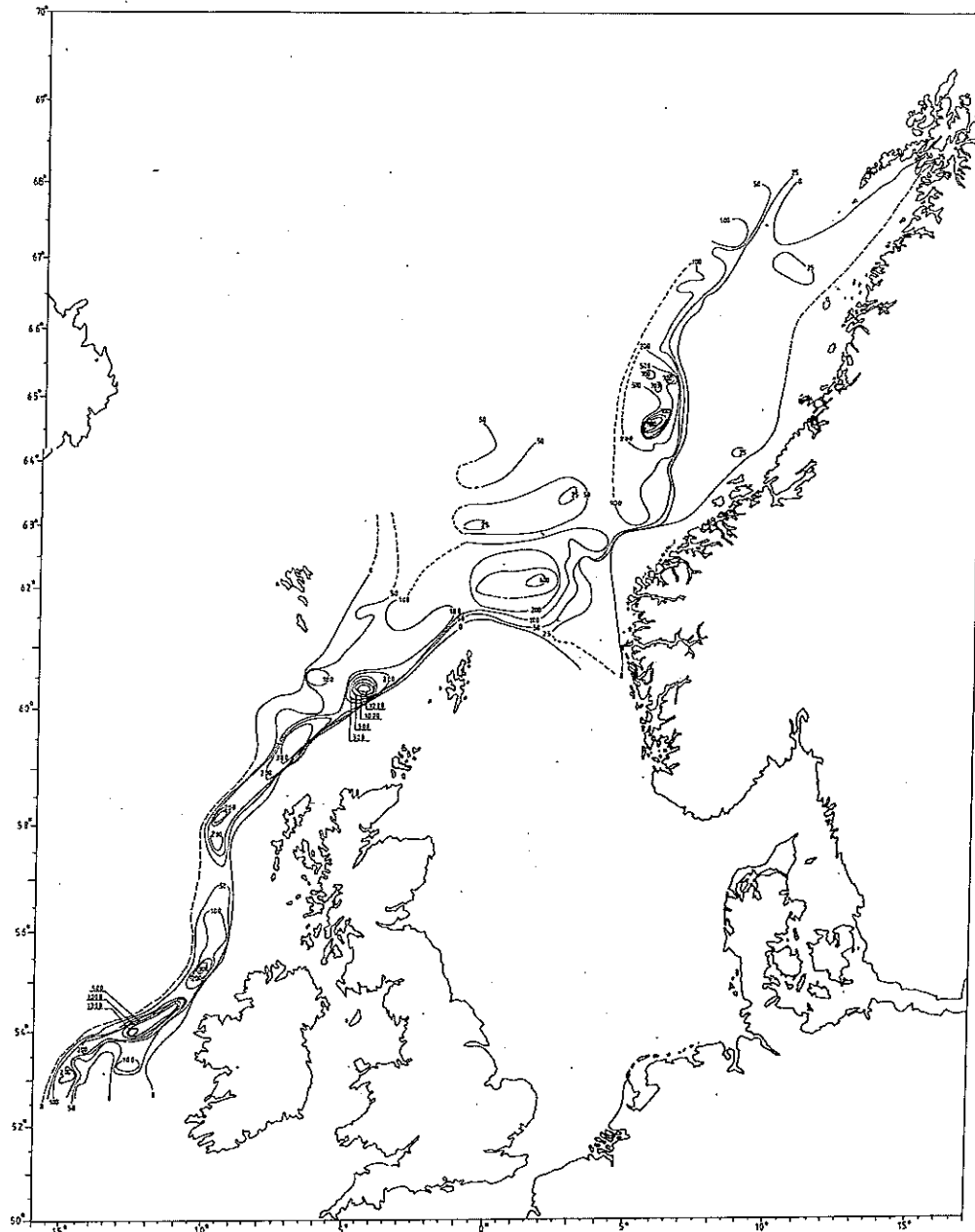


Figure 4.3 Distribution and relative abundance of Blue Whiting, R/V "Bjarni Sæmundsson", 4-8 June 1986. Echo intensity expressed as square m reflection per square nautical mile x 10.

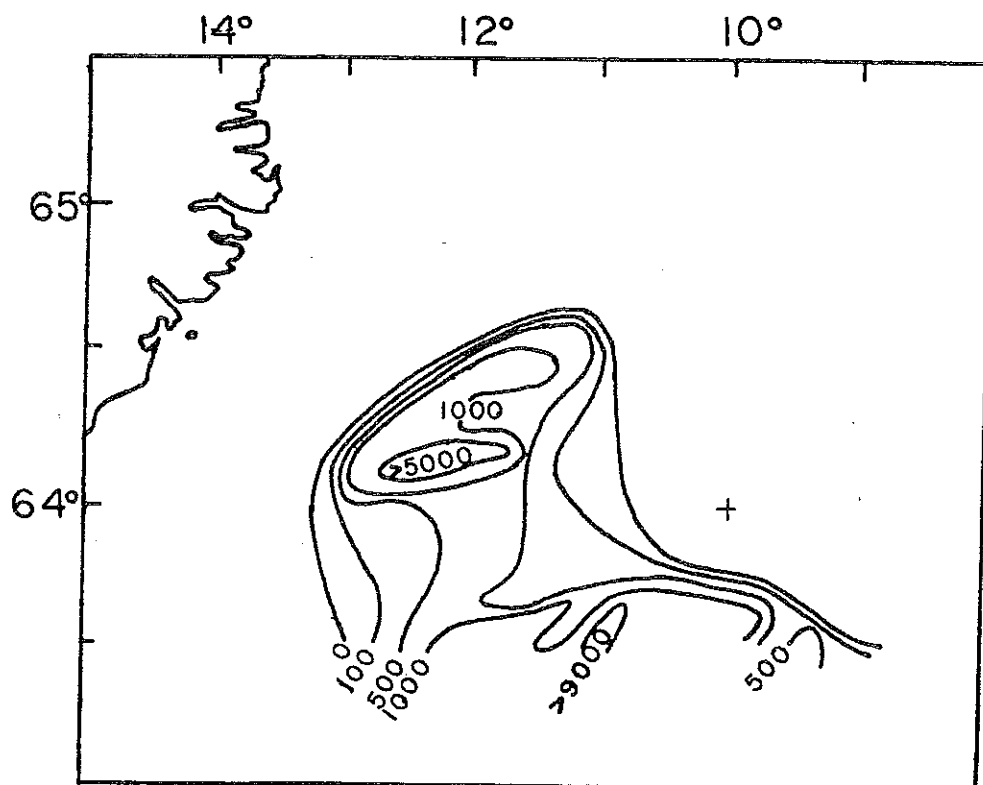


Figure 4.4 Cruise tracks and trawl stations of the eight research vessels, August (22.07-31.08) 1986. Symbols: Triangle - pelagic trawl, square - bottom trawl.

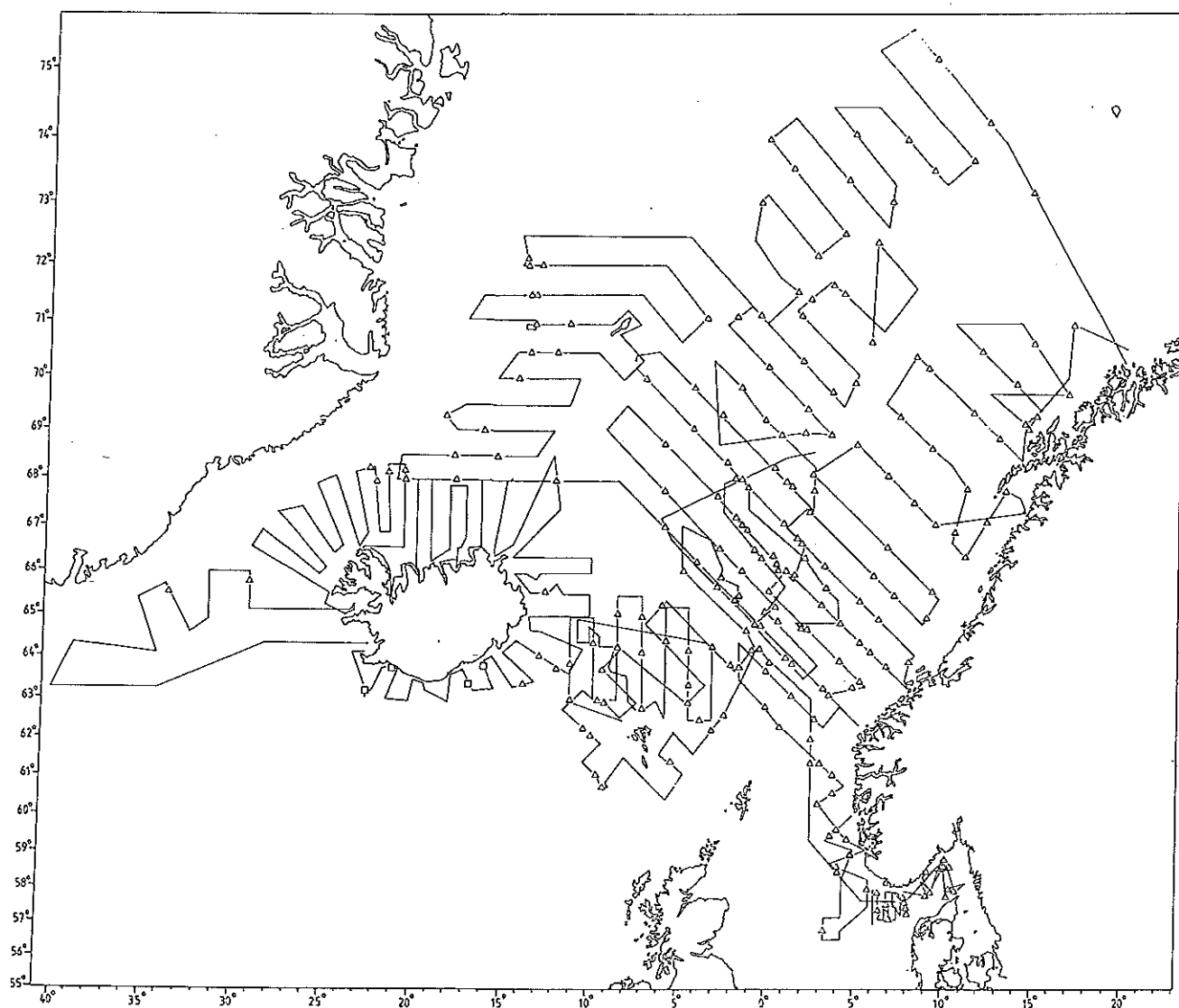


Figure 4.5 Distribution and density values of Blue Whiting, August 1986. Echo intensity in $\text{m}^2/(\text{n.mile})^2$. Hatched area in Skagerrak indicates distribution only.

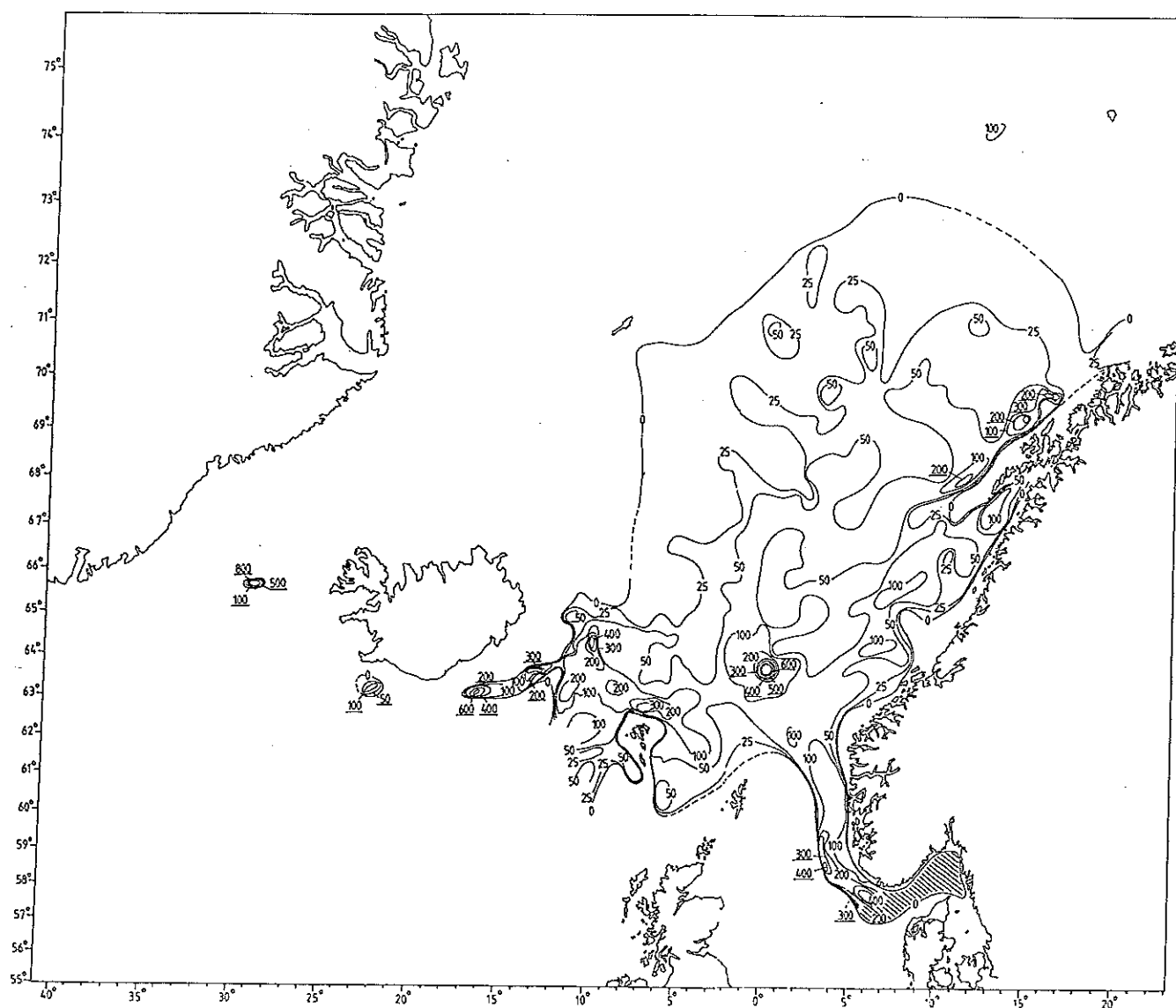


Figure 4.7 Total length distribution of Blue Whiting weighted by abundance, Norwegian Sea, August 1986. N: 28.0×10^9 specimens.

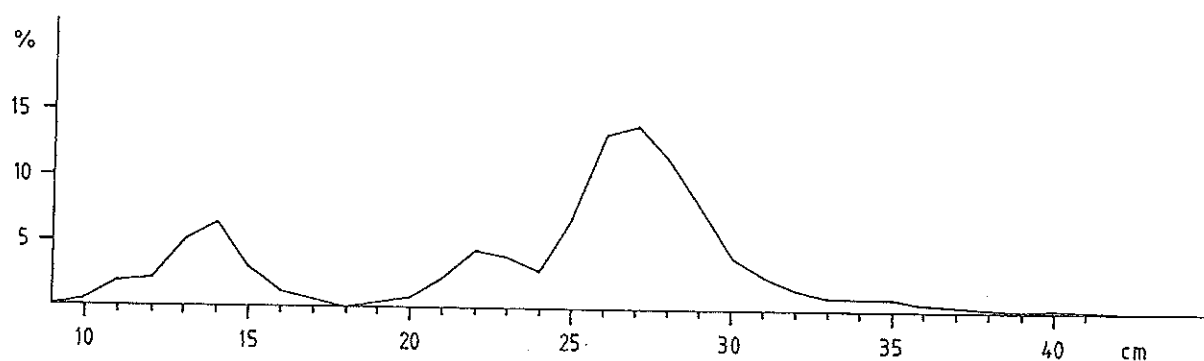
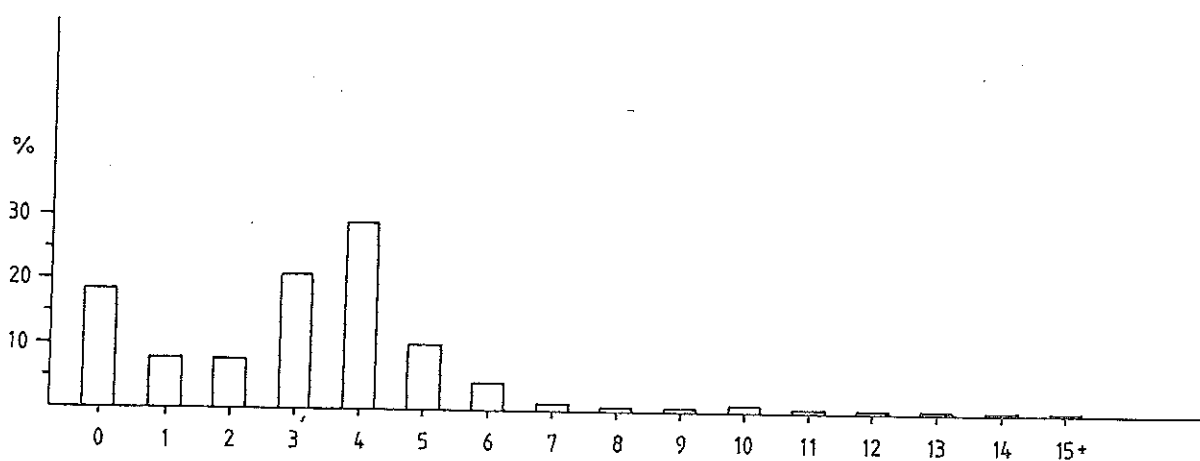


Figure 4.8 Total age composition of Blue Whiting, Norwegian Sea, August 1986. N: 28.0×10^9 specimens.

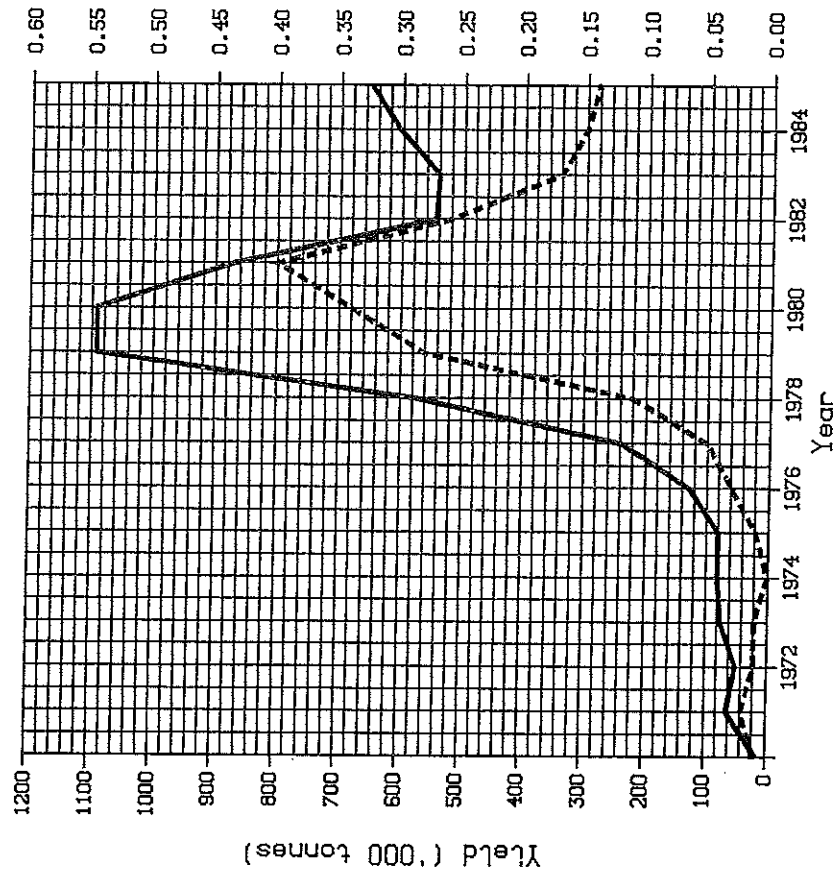


FISH STOCK SUMMARY STOCK: Blue Whiting - Northern Area 01-10-1986

Figure 4.9

Trends in yield and fishing mortality (F)

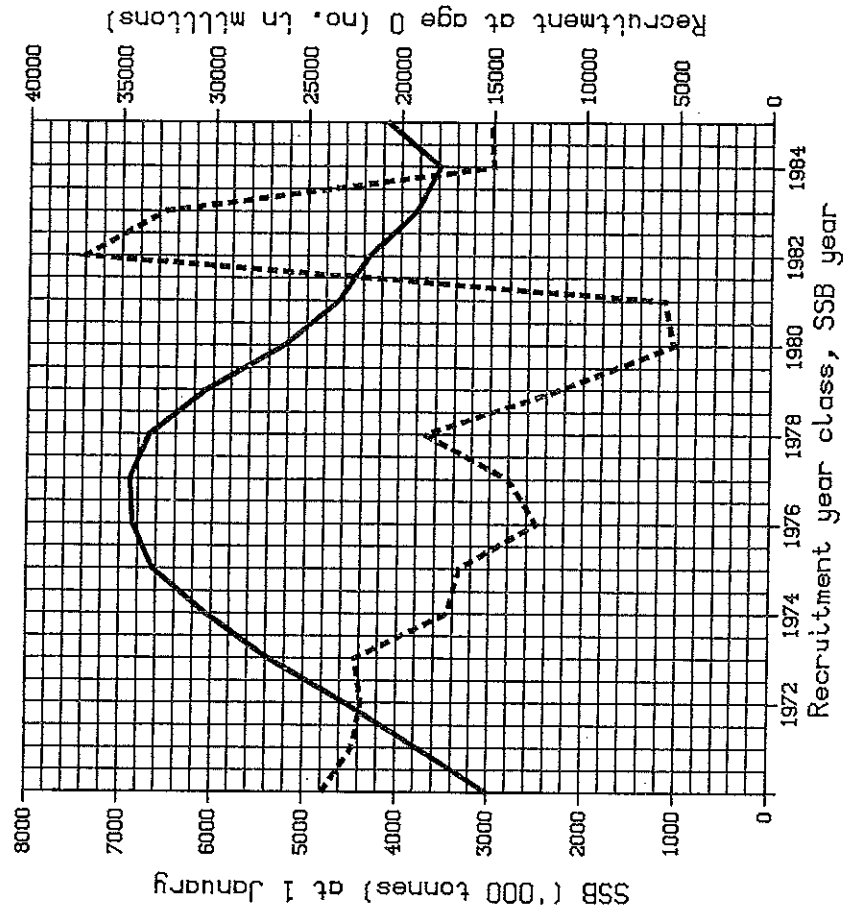
— Yield ---- F



A

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

— SSB ---- R



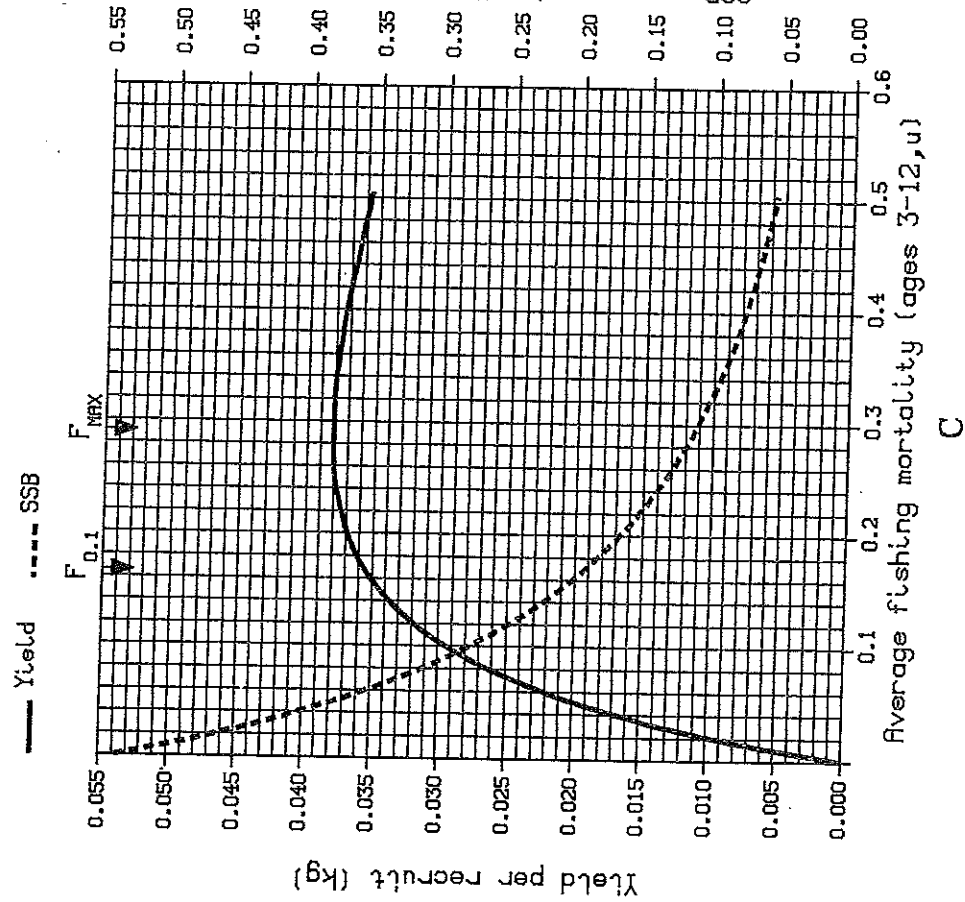
B

(cont'd)

Figure 4.9 (cont'd)

FISH STOCK SUMMARY
STOCK: Blue Whiting - Northern Area
01-10-1986

Long-term yield and spawning stock biomass



Short-term yield and spawning stock biomass

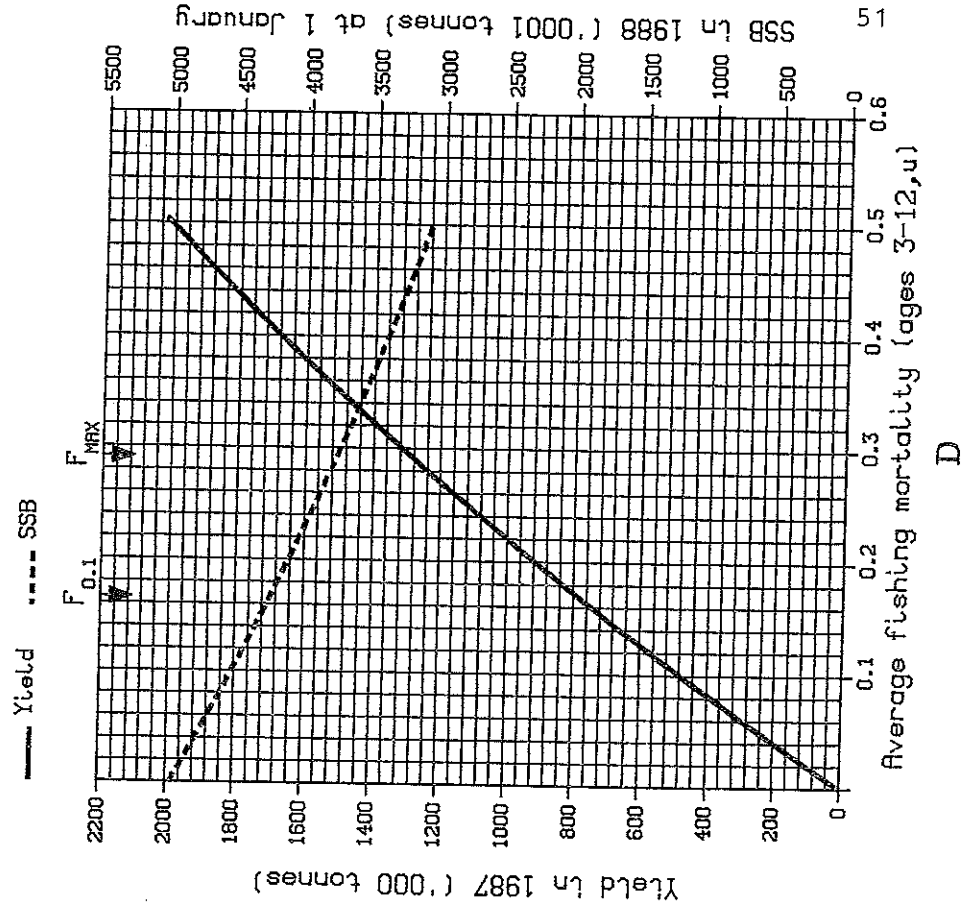


Figure 5.1 Maturity/length ogive for male Blue Whiting of the southern stock.

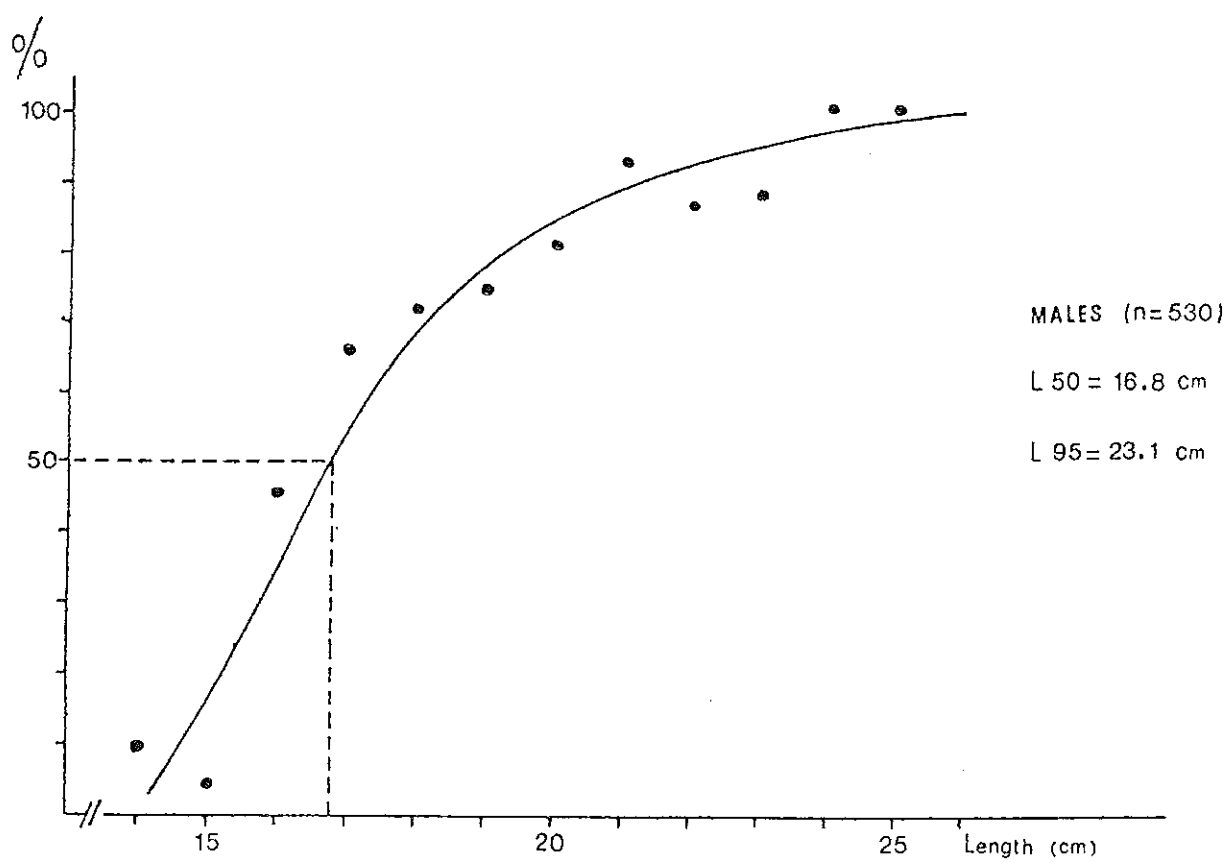


Figure 5.2 Maturity/length ogive for female Blue Whiting of the southern stock.

