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International Council for the
Exploration of the Sea

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REPORT OF THE BLUE WHITING ASSESSMENT WORKING GROUP

Vigo, Spain 8 - 14 September 1994

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1 INTRODUCTION

1.1 Terms of Reference

The Blue Whiting Assessment Working Group (Chairman: Mr. J.A. Jacobsen) met in Vigo, Spain from 8–14 September 1994 (ICES C.Res. 1993/2:6:5) to:

a) assess the status of and provide catch options for 1995 and 1996 for the blue whiting stocks;

b) update the information on the spatial and temporal distributions of the stock and of the fisheries on blue whiting.

In addition the following request to ICES from NEAFC was added as an additional term of reference to the Working Group in 1994:

c) For blue whiting stocks, evaluate the development of the total stock biomass and spawning stock biomass over a three–year period (1995–1997) if at all possible.

The Working Group was also asked by ACFM (in the Minutes of the ACFM Meeting November 1993) to reconsider the question about the transfer of the Blue Whiting Assessment Working Group to either the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy Working Group or the Atlanto–Scandian Herring and Capelin Working Group.

1.2 Participation

Belikov S.	Russia
Jacobsen J.A. (**Chairman**)	Faroes
Meixide M.	Spain
Monstad T.	Norway

2 STOCK IDENTITY AND STOCK SEPARATION

In last year's Working Group Report (Anon., 1994) it was argued that there was no strong scientific evidence to maintain the division of the blue whiting stock into one Northern stock and one Southern stock. Results from the Blue Whiting Otolith Reading Workshop in 1992 showed no statistical differences in mean annual ring diameter in the otoliths between the Northern and Southern Blue Whiting Stocks (Anon., 1993a).

Preliminary results of investigations conducted by Russian and Norwegian scientists (Mazhirina, 1993; Belikov, 1993; Mork and Giæver, 1993) in 1991-1993 indicate that several populations could appear in the reproductive area. There were, however, no indications of genetic substructure among the blue whiting from west of the British Isles to Gibraltar.

In 1994 investigations of population structure of blue whiting were continued by Norwegian scientists on a genetic basis. The work is now concentrated on finding the southern border of the population off the Northern Norwegian coast; accordingly the project has been expanded with more detailed sampling from this area. More sensitive methods will also be used, e.g. DNA-analysis (J. Mork, pers. comm.).

ACFM also agreed at its November 1993 meeting that the two stocks should be combined for assessment purposes, but that the catch predictions could still be done by area.

However, the prediction in the present report is only for the combined stock. The reason is mainly due to the poor results of the tuning of the Northern stock this year, as has been the problem in previous stock assessments. Therefore, in this report the blue whiting stock will be treated as one stock in the assessment and the prediction, but for comparison with previous data from the Working Group, a separate assessment will also be made for the Northern stock and presented only in limited form (see Appendix A).

For the first time an acoustic survey was carried out during the spawning season in 1994 covering Spanish waters (Divisions IXa and VIIIc) and French waters (Divisions VIIIa,b) in the Bay of Biscay (Solá *et al.*, 1994). Postlarvae of blue whiting were recorded in this area, but it is not possible to make any conclusions based on this observation as to whether this will form part of the so called Southern blue whiting stock or whether the fish will migrate to the north at a later stage.

The Blue Whiting Assessment Working Group, ACFM and NEAFC adhere to the idea of a single blue whiting stock. However, it is considered necessary to continue the study of this species' population structure.

3 TRANSFER OF THE BLUE WHITING ASSESSMENT WORKING GROUP

This issue was addressed by the Blue Whiting Assessment Working Group in 1992 (Anon., 1993b).

4 BLUE WHITING STOCK

4.1 Landings in 1993–1994

Estimates of total landings of blue whiting in 1993 from various fisheries by countries are given in Tables 4.1.2-5 and summarised in Table 4.1.1. The total landings from all blue whiting fisheries in 1993 were 514,779 t which is 8.5% more than in 1992.

The majority of the blue whiting catches have been taken in the spawning area. The landings from the directed fishery increased by 8% and from the industrial mixed fishery by 40% respectively compared to 1991.

Preliminary data on the blue whiting catches from January to July 1994 were submitted by Working Group members and the total catch amounted to more than 365,000 t (Table 4.1.6).

Landings from the southern area, i.e. from Spain and Portugal, were 32,256 t in 1993 which is 12% more than in 1992.

Portuguese data on landings and length composition were available to the Working Group (Pestana, pers. comm.). Portuguese landings in 1993 were 1,236 t, with a decrease of 75% from the 1992 landings while landings from Spanish fisheries were 31,020 t, with an increase of 30%.

Spanish landings (96% of the reported total landings from the Southern fisheries in 1992) were made mainly by pair trawlers (66%) in a directed blue whiting fishery, but also as a by-catch by bottom trawlers (33%) and long liners (0.2%) in a multispecies fishery. The Portuguese landings (4% of the total reported landings in 1993) are taken as a by-catch by bottom trawlers.

The amount of discards in the Southern fisheries is unknown, but in some fleets it is believed to be high. Spanish scientists started research on discards in 1994, and results will be available for the next Working Group meeting.

4.2 Length Composition of Catches

Data on length composition of the 1993-1994 catches of the northern blue whiting stock by ICES division were presented by Russia, Norway and Faroe (Tables 4.2.1-9). Length composition of the catches varied over seasons and areas.

Blue whiting in the length range 18-41 cm were taken by Russian vessels in 1993. The length composition of catches of blue whiting taken by Faroese vessels in 1993 varied in the directed fishery from 17-39 cm, and in the mixed fishery from 14-21 cm. The Norwegian directed fishery in 1993 was based on blue whiting with length 22-39 cm and the mixed fishery - 12-39 cm.

The bulk of the Norwegian catches in the directed fishery in 1994 consisted of blue whiting from 23-40 cm and in the mixed fishery from 20-38 cm. The length composition of catches from Russian vessels in the first part of 1994 ranged from 17-37 cm, with fish of length 24-25 cm dominating. Length composition of catches of blue whiting taken by Faroese vessels in 1994 varied from 15-40 cm.

Spanish and Portuguese length compositions of landings by quarter are presented in Tables 4.2.10-11. Annual length compositions by gear and country are shown in Table 4.2.12. The length composition of catches from the Spanish fishery in 1993 ranged from 14-40 cm, with fish of length 21-22 cm dominating. Blue whiting in the length range 15-29 cm were taken by Portuguese vessels, with the bulk at 17-18 cm.

4.3 Age Composition of Catches

For the directed fishery in 1993 age compositions were provided by Russia, Norway, the Faroes and Spain. These countries accounted for 77% of the landings.

The landings in the directed fisheries of Latvia, Lithuania, Estonia and France in Sub-area XII and Division Vb were allocated to catch in numbers using Russian age compositions in the same areas, and the landings in the directed fisheries of the Netherlands in Division VIa, and of Denmark in Divisions IVa and IIIa were allocated to catch in numbers by use of Norwegian age compositions in the same areas (Table 4.3.1).

For landings of blue whiting taken in the mixed industrial fisheries, age compositions were provided by Norway and the Faroes (Table 4.3.2).

Catch-at-age data for the Southern fisheries were calculated using the length compositions provided by Portugal and Spain, and age length keys provided by Spain (Table 4.3.3).

The combined age composition for the directed fishery in the spawning area and in the Norwegian Sea, as well as the total mixed industrial fishery, together with the age composition for the landings in the southern area, were assumed to give the total age composition of the total landings from the blue whiting stock (Table 4.3.4).

4.4 Weight at Age

Data on mean weight at age for 1993 were presented by Russia, Norway and Spain. Landings from other countries were assumed to have the same mean weight at age composition when fished in the same area and period as the sampled catches. The weights at age were calculated for each fishery, and the mean weights (in grams) for the southern and northern stocks, as well as for the combination of the two stocks are shown for 1993 in the text table below:

Age	Stocks		
	Southern	Northern	Combined
0	45	34	34
1	57	67	66
2	62	101	84
3	66	136	117
4	84	144	141
5	106	157	155
6	121	182	180
7	141	207	206
8	146	243	241
9	194	228	228
10+	251	308	308

Table 4.4.1 shows the mean weight-at-age from 1981-93 as used in the VPA run.

4.5 Maturity at Age

New data on maturity obtained during the surveys in the Norwegian Sea in summer 1994 (Monstad, 1994), were rather similar to the data presented last year, which gave a basis for revising the maturity ogive (Anon., 1994). The 1994 data, however, were too few to justify any new adjustment for the northern stock data set.

For combination of the data set of the southern and the northern stock, the maturity ogive for the combined stock was made by weighting the two stocks maturity ogives by catch at age. The results are given in Figure 4.5.1 and in the text table below:

Age	Stocks		
	Southern	Northern	Combined
0	0	0	0
1	0.18	0.10	0.11
2	0.48	0.37	0.42
3	0.91	0.96	0.95
4	0.98	0.99	0.99
5+	1.00	1.00	1.00

Table 4.5.1 shows the maturity-at-age from 1981-93 as used in the VPA run.

4.6 Stock Estimates

4.6.1 Acoustic surveys

4.6.1.1 Surveys in the spawning season

During the period from 25 March to 15 April 1994 Norway carried out an acoustic survey in the shelf edge area to the west of the British Isles to record the distribution and assess the size of the blue whiting spawning stock (Monstad *et al.* 1994). The survey was included in the SEFOS-programme (Shelf Edge Fisheries and Oceanographic Studies), and hence studies of blue whiting eggs and larvae also took place. However, due to extremely bad weather conditions the survey was notably, curtailed causing the rate of area coverage and numbers of stations to become rather low.

The cruise track and stations are shown in Figure 4.6.1, and the density distribution in Figure 4.6.2.

The distribution pattern was very much the same as recorded in previous years, i.e. the blue whiting were mainly found along the continental slope from south-west of Ireland to the Faroe/Shetland area. In the Porcupine bank area the zero-line of the distribution was not located to the west and south, or to the west in the area between the latitudes 55° and 56° N. The densest concentrations during this period were found on the north-western part of the Porcupine bank and along the slope northwest of Ireland, mainly at depths between 450-600 m which is somewhat deeper than observed during the last few years' surveys.

The spawning stock biomass was estimated at 4.1 million t representing an abundance of 26.1×10^9 individuals. The biomass estimates by rectangle are shown in Figure 4.6.3. The 5-year-olds (1989 year class) dominated and contributed almost 45% by numbers to the observed stock (Figure 4.6.4).

For the first time an acoustic survey was carried out during the spawning season as part of the SEFOS programme in 1994 covering Spanish waters (Divisions IXa and VIIIc) and French waters (Divisions VIIIa,b) in the Bay of Biscay. Divisions VIIIa,b,c were covered twice from North to South to study the blue whiting movements in the area, and higher densities were recorded in the second coverage, mainly in the northern part (Figure 4.6.5). The estimated biomass on the first trip (Divisions IXa North, VIIIa,b,c) was 279,105 t corresponding to 5210 million fish. The biomass estimated on the first coverage, by ICES rectangles is shown in Figure 4.6.3. Due to bad weather the area covered on the second trip was reduced.

Results of spring acoustic surveys (Meixide and Carrera, 1994) in the period 1991-1994 in Spanish waters (only in Divisions VIIIc and IXa) are shown in the text table below.

Year	1991	1992	1993	1994
Number (millions)	4,424	7,370	4,211	1,634
Biomass (tonnes)	162,283	267,866	221,000	90,327

The biomass and number of fish by age group from these surveys are shown in Figure 4.6.6. In 1994 the estimates can be considered underestimates due to weather conditions and the degree of coverage. Lower values in 1991 and 1994 also can be explained because they were carried out earlier in the season.

Eggs and larvae were also studied during the first cruise (Solá *et al.*, 1994). The largest concentrations were found in the northern area, with a size range of 2.9 - 6 mm. A concentration of blue whiting postlarvae (mean length 25 mm) was also located in the inner part of the Bay of Biscay (Figures 4.6.7 - 4.6.9).

4.6.1.2 Surveys in the feeding season

During the summer of 1994 Norway carried out three separate acoustic surveys (Monstad, 1994) and the Faroes one acoustic survey (J.A.Jacobsen, pers. comm.) in the Norwegian Sea. The area from mid-Norway, Faroe Isles and Iceland was covered up to the western coast of Spitsbergen (Figure 4.6.10), and the aim was to record concentrations of pelagic fish and study environmental factors. Blue whiting were observed during all four surveys. The Norwegian R.V. "G.O.Sars" worked from 30 May -27 June, "Johan Hjort" from 5 - 22 July and the "Michael Sars" from 16 July - 15 August, while the Faroese R.V. "Magnus Heinason" conducted the survey in August.

The recordings of blue whiting obtained within a great part of the investigated area were mostly of very scattered nature (Figure 4.6.11). Concentrations of medium density were found only at a few localities, i.e. at the slope north of the Faroe Isles, at the Norwegian continental slope around latitudes 66° and 69° N and in the open sea area at the positions 68°N, 4°E and 71°N, 11°W.

Zero-lines of the distribution were found towards the north and west, but not in the south where blue whiting concentrations seemed to be distributed further into the area south of the Faroes and in the North Sea.

The total length and age compositions of blue whiting in all the samples obtained by the Norwegian vessels are shown in Figure 4.6.12. The 5-year-olds (1989 year class) dominated and contributed 45% by number, and the total length distribution had a peak at 31 cm, i.e. 2 cm larger than in 1993 when the 1989 year class contributed 60% to the stock in the Norwegian Sea.

4.6.1.3 Discussion

In the text table below the total biomass estimates (in million tonnes) in the spawning area since 1983 are given. The corresponding spawning stock sizes are given in brackets.

Year	Russia	Norway	Faroes	Russia + Norway combined
1983	3.6 (3.6)	4.7 (4.4)	-	-
1984	3.4 (2.7)	2.8 (2.1)	2.4 (2.2)	-
1985	2.8 (2.7)		6.4 (1.7)	-
1986	6.4 (5.6)	2.6 (2.0)	-	-
1987	5.4 (5.1)	4.3 (4.1)	-	-
1988	3.7 (3.1)	7.1 (6.8)	-	-
1989	6.3 (5.7)	7.0 (6.1)	-	-
1990	5.4 (5.1)	6.3 (5.7)	-	-
1991	4.6 (4.2)	5.1 (4.8)	-	4.7 (4.4)
1992	3.6 (3.3)	4.3 (4.2)	-	4.6 (4.3)*
1993	3.8 (3.7)	5.2 (5.0)	-	5.1 (4.9)
1994	-	4.1 (4.1)	-	-

* with calibration factor: 1.38

As mentioned and discussed at previous Working Group meetings the main factors accounting for variability between successive survey estimates will be differences in acoustic equipment, weather condition during the surveys, size of the area surveyed and timing of the survey with respect to spawning progression.

From 1988/89 up to 1992 there has been a downward trend in the spawning stock estimates. In 1993 the stock increased a little due to the notable recruitment to the spawning stock of the rich 1989 year class, but in 1994 it again was estimated to be lower, being at the same level as in 1992. Although the spawning stock acoustic estimates are all underestimates in general, due to the continuous long lasting pre- and post-spawning migration through the season, the 1994 estimate of 4.1 million t, has to be considered as more severely underestimated than normal. This is because of the extremely bad weather conditions during this year's survey.

The 1989 year class, which is among the most numerous blue whiting year classes ever recorded, also dominated the spawning stock in 1994, but the contribution was reduced from 60% in 1993 to 45% in 1994.

The four surveys during the summer of 1994 covered a rather large area of the Norwegian Sea. As it is believed that the main feeding area for the "Northern stock" is in the Norwegian Sea, one should expect to observe a greater part of the stock. However, as experienced in earlier years, only weak recordings of blue whiting were obtained. That leads to the conclusion that, either a greater part of the stock may stay outside the surveyed area, or the fish behave in a way that makes them difficult to observe, e.g. scattered over vast areas at great depths. Such a conclusion has also been made earlier, i.e. during the Workshop of the Acoustic Surveys of Blue Whiting in the Norwegian Sea (Anon., 1985).

4.6.2 Bottom trawl surveys in the southern area

Bottom trawl surveys have been conducted off both the Galician (NW Spain) and Portuguese coast since 1980 and 1979 respectively, following a stratified random sampling design and covering depths down to 500 m. Since 1983, the area covered in the Spanish survey was extended to completely cover the Spanish waters in Division VIIIc. Stratified mean catch and standard error in Portuguese groundfish surveys are shown in Table 4.6.1. Stratified mean catch and standard error in Spanish bottom trawl surveys (in weight and in number by haul) since 1985 are shown in Table 4.6.2.

4.6.3 Catch per unit effort

Data on catch per unit of effort were submitted only by Norway. These data, which were from the directed fishery in 1992 and 1993, were broken down by vessel tonnage class, area and month. The data were combined and added to the time series of overall aggregated CPUE values across areas in the Norwegian blue whiting directed fisheries, and are presented in Figure 4.6.13. There has been a decline from 33 t/h in 1983 to 10 t/h in 1991, after which the data indicate an increase for 1992 and 1993 to 25 and 28 t/h respectively.

Data on CPUE from three fleets were submitted by Spain (Galician single and pair trawl and Biscay bottom trawl). CPUE data from these fleets are shown in Figure 4.6.14. CPUE data from Portuguese bottom trawl were also available to the Working Group (Pestana, pers. comm.). Unfortunately the calculations for 1992 (85.4 kg/h) and 1993 (47.1 kg/h) were made in a different way from those presented previously (Anon., 1994) and are not therefore comparable.

4.6.4 Virtual population analysis (VPA)

In the present assessment blue whiting in the North Atlantic is treated as one stock (see Section 2). The Blue Whiting Assessment Working Group decided to use only standard and default methods and values in the present assessment of the blue whiting stock. It seems that input data such as tuning series and catch-at-age data do not justify delicate and specialised treatment in the VPA. This was also the conclusion from last year's assessment, which explored several tuning methods with varying shrinkage and down weighting scenarios. These runs were extensively discussed in last year's report (Anon., 1994), and resulted in standard settings during that assessment.

4.6.4.1 Tuning the VPA to survey results

Altogether six tuning series were available to the Working Group (Table 4.6.3): two series from the spawning area west of the British isles (Norwegian acoustic and Russian acoustic surveys, previously used in the tuning of the Northern stock), three from Spain (CPUE from pair trawlers, bottom trawl survey, and CPUE from "Aviles" trawlers) and one new series from the acoustic surveys in the Norwegian Sea during the feeding season in the summer. The CPUE from the Spanish "Aviles" trawlers was excluded from the tuning data due to large errors (S.E. of log q) and as the q's were all negative for 1992 and 1993, i.e. not following the trend in the rest of the tuning data sets. This is most probably due to difficulties in measuring the effort as many of the "Aviles" trawlers have now changed to pair trawling. The inclusion of the acoustic surveys in the Norwegian Sea with estimates of recruits (age range 0–11) from 1980 to 1993, especially seems to improve the tuning, particularly for the younger ages.

The full diagnostics of an XSA–tuning with five fleets are presented in Table 4.6.4 and Figure 4.6.15. The SE's of log q were acceptable for most of the fleets and age groups. Exceptions were log q values for age 0 from the Spanish pair trawlers, which fluctuated (Table 4.6.4 and Figure 4.6.15). The effect from this is minimal as this age group will be scaled down in the estimation of survivors for that age (Table 4.6.4). The log q residuals for the series from the Norwegian Sea are very small for young ages (Figure 4.6.15).

The resulting estimate of terminal F from XSA (mean F(3-7,u)) was 0.3729 and was accepted as an estimate of the average fishing level in 1993. In previous years a separable VPA had been run as the input data had been considered to be "noisy". This was also tried in the present VPA, but the resulting separably generated fishing mortalities in 1993 were not improved in relation to the fishing pattern from the XSA (Figure 4.6.16). On the contrary the separable F–pattern had a high jump at age 6 (Figure 4.6.16), and was therefore not considered further.

A retrospective analysis was undertaken in order to check the present tuning results with previous runs (Figure 4.6.17A and B). The retrospective XSA–runs converged faster for the combined stock (Figure 4.6.17A) than for the Northern stock (Figure 4.6.17B). Although the retrospective analysis shows that the estimates for the years 1989 and 1990 are far apart from the more recent estimates of the stock, it is clearly seen that the combined stock behaves much better in retrospective ways than the Northern stock, especially for the years 1989 and 1990 with estimates of the fishing mortality closer to the estimates from the most recent runs, i.e. 1991–1993. The estimates from 1991 and onwards are also in good agreement. This does, however, not imply that the resulting stock estimates from the tuning are correct.

The resulting stock estimates from the XSA are shown in Tables 4.6.5–7. Trends in yield, fishing mortality, spawning stock biomass and recruitment from XSA are shown in Figures 4.6.18A and B, respectively.

4.6.4.2 Yield per recruit

Yield per recruit (Y/R) and spawning stock biomass per recruit (SSB/R) have been calculated using the input values in Table 4.6.8 and are shown in Figures 4.6.18C and D. The exploitation pattern used was the resulting fishing pattern from the XSA run (Table 4.6.5). The yield–per–recruit calculations gave an F(0.1) of 0.19 which is below the estimated mean F(3–7) of 0.3729 in 1993.

4.6.4.3 Prediction and management considerations

Input data for the prediction are given in Table 4.6.8. The initial stock size at the beginning of 1994 for age groups 1 to 10+ was taken from the XSA–tuning (Table 4.6.6). The recruitment at age 0 in 1994 was set at 11.7 billion which is the geometric mean from 1981–1990, including strong year classes (Table 4.6.6). The Working Group decided to use the XSA–generated stock numbers for ages 1–10, as the recruitment seemed to be reasonable estimates for the year classes 1992 and 1993 of 5,676 and 8,589 billion respectively. These two year classes are considered to be poor and below average respectively based on observations from the acoustic surveys. As no conclusive information on the strength of the 1994 year class was available, a geometric mean of the recruitment from 1981–1990 was used in the prediction.

Usually the basis for prediction has been a TAC–constrained prediction based on a projection of the preliminary catch in the first half of the year in which the prediction starts, i.e. 1994. A total catch of approximately 470,000 t is assumed for 1994, based on the preliminary catch in first half of 1994 (Table 4.1.6) raised by the preliminary catch in the first half of 1993. The resulting average F(3–7) of 0.37 is practically the same as a *status quo* catch in 1994 of 472,000 t. Therefore a *status quo* scenario for 1994 (F factor of 1.0) will be used as basis for the prediction.

The results of the prediction are given in Table 4.6.9. The usual options which might be used in management considerations are indicated in Table 4.6.10. F(0.1) was calculated from the Y/R run to be 0.19 and F(med) was estimated to be 0.3 from the R *versus* SSB plot from 1981–1993 (Figure 4.6.19). A *status quo* fishing level in 1994 gives a catch of 472,000 t and a SSB of 1.6 million t. Continuing at this fishing level in 1995 gives a catch of 433,000 t and an SSB in 1995 of 1.4 million t, and a resulting SSB in 1996 of 1.5 million t (Table 4.6.10), i.e. no significant change in the SSB (see Appendix B for medium–term prediction and Appendix C for medium–term simulations at F *status quo*).

Based on the information available to the Working Group, a *status quo* development might seem plausible. It should, however, be noted that the Working Group considers the VPA estimates of the spawning stock to be underestimated and consequently F to be overestimated. The SSB measured acoustically has in most years been much higher than that estimated from VPA (Figure 4.6.20). The reason for this has been discussed in previous reports and is poorly understood.

5 ZONAL DISTRIBUTION

During the acoustic survey conducted by the Norwegian R.V. "Johan Hjort" at the spawning grounds to the west of the British Isles in spring 1994, most of the blue whiting recordings were made within the EU zone, e.g. in British and Irish waters. The Working Group, however, concludes every year that the percentage distribution of concentrations within various zones strongly depends upon the geographical size and location of the survey area.

The observed distribution of blue whiting concentrations during the feeding season is shown in Figure 4.6.11. The same kind of map has also been given for previous years (Anon., 1994). As for the spring time situation in the spawning area, the surveys in the Norwegian Sea conducted by Norwegian and Faroese vessels did not cover the whole stock. Most of the blue whiting concentrations were observed in the Norwegian zone which, however, may not be the correct picture of the total situation.

Total catches of blue whiting in 1978–1993 divided into areas within and beyond national fisheries jurisdiction within the NEAFC area are presented in Table 5.1, as provided by the Working Group members. Catches of nations not attending the Working Group meeting have been subjectively allocated to appropriate zones.

6 DISTRIBUTION IN TIME AND SPACE OF THE BLUE WHITING STOCK

The available knowledge from various sources on the distribution and main fishing areas of blue whiting in the northern area was summarised and presented in the Working Group Report of 1985 (Anon., 1985), and revised maps were presented in the report of 1990 (Anon., 1991). As the main assessment is now presented as a combined assessment, the maps are adjusted accordingly (Figures 6.1-2).

6.1 Spawning Area

During the acoustic surveys in springtime in the areas west and southwest of the British Isles, the southern limit is not found for the blue whiting distribution along the continental slope south of Ireland. Concentrations are distributed further southwards, and are again recorded in the Bay of Biscay, i.e. from off the coast of France and further south along the slope off Spain and Portugal.

As the majority of the blue whiting appearing in the Porcupine bank area during spring migrate northwards after spawning, the remaining smaller part could belong to local populations or populations belonging further south (Anon., 1994), i.e. all the way up to the Gibraltar area (Mork and Giæver, 1993).

6.2 Nursery Area

Ichthyoplankton observations were made during spring 1994 by R.V "Johan Hjort" and R.V. "Cornide de Saavedra" (Monstad *et al.*, 1994; Sola *et al.*, 1994).

Blue whiting eggs were taken in increasing abundance from the surface to a maximum at 380-400 m depth off the British Isles. However, due to the very bad weather conditions during the survey the observations were significantly reduced.

Larvae of blue whiting were taken at the shelf edge and over the Porcupine Bank and off the north Atlantic coast of Spain and the Biscay coast of France. Mean lengths of blue whiting larvae west of the British Isles were around 3.5 mm and near the Spanish coast from 6.5-7.0 mm. A concentration of blue whiting postlarvae with mean length 25 mm was located in the inner part of the Bay of Biscay.

6.3 Feeding Area

The four surveys in the Norwegian Sea during summer 1994 did not give any new information on the total distribution pattern of the blue whiting stock. Although the recordings were rather weak and scattered, zero-lines of the distribution were located to the north and west, but not to the south. The majority of the distribution, however, seemed to be located more to the north and northeast than in recent years.

7 BIOLOGICAL UNCERTAINTIES

The Working Group has nothing to add to the factors given in Section 8 of last year's report (Anon., 1994).

8 RECOMMENDATIONS

1. The Working Group considers it very important that the blue whiting stock is monitored each year, and therefore recommends the continuation of the joint Norwegian-Russian acoustic survey aimed at assessing the stock size in the spawning area during spring. As the blue whiting is now assessed as a combined stock, it is of great importance that the whole stock is synoptically monitored during the spawning season. For that reason the joint investigations should also include Spain and other countries surveying in the Bay of Biscay and further south. The survey areas in the north and south, respectively, should be extended in a way to ensure that the whole shelf edge between Ireland and the northern coast of Spain would be covered.

2. The acoustic surveys in the Norwegian Sea in the feeding season during summer should be continued on a national basis. The results will be used by the Working Group for assessment of the stock.

3. The present study by Russia and Norway of the blue whiting population structure shows preliminary indications of the existence of several populations mixing in the reproductive area. The Working Group considers these studies very important for the assessment work, and therefore recommends that they be continued.

4. Investigation on discards of blue whiting in all areas south of the Porcupine Bank are needed to get a more accurate estimate of catches at age in the younger ages.

5. The study of the eggs and larvae distribution of blue whiting and the current system along the shelf edge area from west of the British Isles to Portugal should be continued.

9 REFERENCES

Anon., 1985. Report of the Workshop on the Acoustic Surveys of Blue Whiting in the Norwegian Sea, Bergen 6-11 May 1985. ICES, Doc. C.M. 1985-/H:6.

Anon., 1991. Report of the Blue Whiting Assessment Working Group, Copenhagen, 12-18 September 1990. ICES, Doc. C.M. 1991/Assess:2.

Anon., 1992. Report of the Blue Whiting Assessment Working Group, Copenhagen, 11-17 September 1991. ICES, Doc. C.M. 1992/Assess:3.

Anon., 1993a. Report of the Blue Whiting Otolith Reading Workshop. Tórshavn, Faroe Islands 2-6 November 1992. ICES, Doc. C.M. 1993/H:6.

Anon., 1993b. Report of the Blue Whiting Assessment Working Group, Copenhagen, 9-15 September 1992. ICES, Doc. C.M. 1993/Assess:4.

Anon., 1994. Report of the Blue Whiting Assessment Working Group, Tórshavn 8-14 September 1993. ICES, Doc. C.M. 1994/Assess:4.

Belikov, S.V. 1993. On population structure of Blue Whiting in the Northeast Atlantic. Working note to the Blue Whiting Assessment Working Group Meeting, Tórshavn, 8-14 September 1993.

Mazhirina, G.P. 1993. Peculiarities of intermittent spawning and fecundity of blue whiting. Murmansk 1993 (in Russian).

Meixide, M. and Carrera, P. 1994. Blue Whiting acoustic abundance estimate preliminary data, spring 1991-1994. Working document to the Blue Whiting Working Group Meeting in Vigo, Spain 8-14 September 1994.

Monstad, T., Belikov, S.V. and Coombs, S.M. 1994. Investigations on Blue Whiting in the area west of the British Isles, spring 1994. ICES, Doc. 1994-/H:12.

Monstad T. 1994. Norwegian observations of Blue Whiting, summer 1994. Working note for the Blue Whiting Assessment Working Group meeting in Vigo, Spain 8-14 September 1994.

Mork, J. and Giæver, M. 1993. The genetic population structure of the Blue Whiting (*Micromesistius potassou*). ICES, Doc. C.M. 1993/H:5.

Sola, A., Franco, C., Lago de Lanzos, A. and Valdes, L. 1994. Abundance and distribution of Blue Whiting larvae (*Micromesistius potassou*) off the North Atlantic Coast of Spain and the Biscay Coast of France. Working document to the Blue Whiting Working Group Meeting in Vigo, Spain 8-14 September 1994.

Table 4.1.1. Landings (tonnes) of BLUE WHITING from the main fisheries, 1984-1993, as estimated by the Working Group.

Area	1984	1985	1986	1987	1988
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	65,932	90,742	160,061	123,042	55,829
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	421,865[2]	464,265[2]	534,263[2]	445,863[2]	421,636
Icelandic industrial fishery (Division Va)		-	-	-	-
Industrial mixed fishery (Division IVa-c, Vb, IIIa)	122,806	97,769	99,580	62,689	45,110
Subtotal northern fishery	610,603	652,776	793,904	631,615	522,575
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k	31,173[3]	42,820[3]	33,082[3]	32,819[3]	30,838
Total	641,776	695,596	826,986	664,434	553,413

Area	1989	1990	1991	1992	1993 [1]
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	37,638	2,106	78,703	62,312	43,240
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	473,165	463,495	218,946	317,237	346,803
Icelandic industrial fishery (Division Va)	4,977	-	-	-	-
Industrial mixed fishery (Division IVa-c, Vb, IIIa)	75,958	63,192	39,872	66,174	92,480
Subtotal northern fishery	591,738	528,793	337,521	445,723	482,523
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k	33,695	32,817	32,003	28,772	32,256
Total	625,433	561,610	369,524	474,495	514,779

[1]Preliminary.
[2]Including directed fishery also in Divisions VIIg-k, IVa and Sub-area XII.
[3]Excluding directed fishery also in Divisions VIIg-k.

Table 4.1.2. Landings (tonnes) of BLUE WHITING from the directed fishery in the Norwegian Sea (Sub-areas I and II, Divisions Va, XIVa and XIVb) fisheries, 1984-1993, as estimated by the Working Group.

Country	1984	1985	1986	1987	1988
Faroes	-	-	-	9,290	-
France	-	-	-	-	-
German Dem.Rep.	8,193	1,689	3,541	1,010	3
Germany, Fed.Rep.	35	75	106	-	-
Greenland	-	-	10	-	-
Iceland	105	-	-	-	-
Norway	689	-	-	-	-
Poland	-	-	-	56	10
UK (Engl. & Wales)	-	-	-	-	-
USSR	56,817	88,978	156,404	112,686	55,816
Total	65,932	90,742	160,061	123,042	55,829

Country	1989	1990	1991	1992	1993 [1]
Faroes	1,047	-	-	-	-
France	-	-	-	-	-
German Dem.Rep.	1,341	-	-	-	-
Germany, Fed.Rep.	-	-	-	-	-
Greenland	-	-	-	-	-
Iceland	-	-	-	-	-
Norway	-	566	100	912	240
Poland	-	-	-	-	-
UK (Engl. & Wales)	-	-	-	-	-
USSR/Russia[2]	35,250	1,540	78,603	61,400	43,000
Total	37,638	2,106	78,703	62,312	43,240

[1]Preliminary.
[2]From 1991.

Table 4.1.3. Landings (tonnes) of BLUE WHITING from directed fisheries in the spawning area (Divisions Vb, VIa,b, VIIb,c and since 1984 Divisions VIIg-k and Sub-area XII), 1984-1993, as estimated by the Working Group.

Country	1984	1985	1986	1987	1988
Denmark	26,445	21,104	11,364	2,655	797
Faroes	62,264	72,316	80,564	70,625	79,339
France	3,882	-	-	-	-
German Dem.Rep.	1,171	6,839	2,750	3,584	4,663
Germany, Fed.Rep.	994	626	-	266	600
Ireland	-	668	16,440	3,300	245
Netherlands	1,000	1,801	8,888	5,627	800
Norway	211,773	234,137	283,162[1]	191,012	208,416
UK (Engl. & Wales)	33	2	10	5	3
UK (Scotland)	-	-	3,472	3,310	5,068
USSR	114,303	126,772	127,613	165,497	121,705
Total	421,865	464,265	534,263	445,884	421,636

Country	1989	1990	1991	1992	1993[1]
Denmark	25	-	-	3,167	-
Faroes	70,711	43,405	10,208[2]	12,731	14,984
France	2,190	-	-	-	1,195
German Dem.Rep.	3,225	230	-	-	-
Germany, Fed.Rep.	848	1,469	349	1,307	91
Ireland	-	-	-	-	-
Netherlands	2,0787	7,280	17,359	11,034	18,436
Norway	258,386	281,036[2]	114,866[2]	148,733	198,916
UK (Engl. & Wales)	1,557	13	-	356	2
UK (Scotland)	6,463	5,993	3,541	6,493	2,030
USSR/Russia[3]	127,682	124,069	72,623	115,600	96,000
Japan	-	-	-	918	1,742
Estonia	-	-	-	6,156	10,328
Latvia	-	-	-	10,742	2,046
Total	473,165	463,495	218,946	317,237	346,803

[1]Preliminary.
[2]Including directed fishery also in Division IVa.
[3]From 1991.

Table 4.1.4. 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, 1984-1993, as estimated by the Working Group.

Country	1984	1985	1986	1987	1988
Denmark	49,032	35,843	57,315	28,541	18,114
Faroes	9,740	3,606	5,678	7,051	492
German Dem.Rep.[2]	-	-	-	53	-
Germany,Fed.Rep.[2]	556	52	-	62	280
Netherlands	122	130	1,114	-	-
Norway	58,038	54,522	26,941	24,969	24,898
Sweden	5,401	3,616	8,532	2,013	1,226
UK (Engl. & Wales)[2]	-	-	-	-	-
UK (Scotland)	-	-	-	-	100
Total	122,806	97,769	99,580	62,689	45,110

Country	1989	1990	1991	1992	1993 [1]
Denmark	26,605	27,052	15,538	31,389	41,053
Faroes	3,325	5,281	355	705	1,522
German Dem.Rep.[2]	-	-			
Germany,Fed.Rep.[2]	3	-	-	25[4]	9[4]
Netherlands	-	20	-	2	46
Norway	42,956	29,336[3]	22,644	31,977	12,333
Sweden	3,062	1,503	1,000	2,058	37,265
UK (Engl. & Wales)[2]	7	-	-	17	-
UK (Scotland)	-	-	335	1	2,52
Total	75,958	63,192	39,872	66,174	92,480

[1]Preliminary.
[2]Including directed fishery also in Division IVa.
[3]Including mixed industrial fishery in the Norwegian Sea.
[4]Germany

Table 4.1.5. Landings (tonnes) of BLUE WHITING from the Southern areas (Sub-areas VIII and IX and Divisions VIIg-k and VIId,e; from 1984, the Divisions VIIg-k are not included) 1984-1993 as estimated by the Working Group.

Country	1984	1985	1986	1987	1988
Netherlands	-	-	-	-	-
Norway	-	-	-	4	-
Portugal	5,252	6,989	8,116	9,148	5,979
Spain	25,921	35,828	24,965	23,644	24,847
UK (England & Wales)	-	3	1	23	12
France	-	-	-	-	-
Total	31,173	42,820	33,082	32,819	30,838

Country	1989	1990	1991	1992	1993 [1]
Netherlands	-	450	10	-	-
Norway	-	-	-	-	-
Portugal	3,557	2,864	2,813	4,928	1,236
Spain	30,108	29,490	29,180	23,794	31,020
UK (England & Wales)	29	13	-	-	-
France	1	-	-	-	-
Total	33,695	32,817	32,003	28,722	32,256

[1]Preliminary.

Table 4.1.6 Preliminary data on landings (t) of BLUE WHITING in 1994 based on information from WG members.

Country	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Total
Russia	IIa	-	-	-	-	-	13.100	6.100	19.200
	Vb	5.541	1.470	-	7.301	39.284	16.307	15.525	85.428
	VI	-	-	-	-	-	-	-	0
	VIIb,c	-	-	2.900	-	-	-	-	2.900
	VIIg-k	-	700	3.200	-	-	-	-	3.900
	XII	-	-	-	-	-	-	-	0
Sum		5.541	2.170	6.100	7.301	39.284	29.407	21.625	111.428
Faroe Islands	IVa	-	-	-	103	1.063	162	156	1.484
	Vb	-	-	-	-	1.364	-	-	1.364
	VIa	-	-	-	9.100	2.310	-	-	11.410
	VIIb,c,g-k	-	2.100	6.190	-	-	-	-	8.290
Sum		0	2.100	6.190	9.203	4.737	162	156	22.548
Norway	IIa	-	-	-	-	-	-	-	0
	IVa	12	-	-	32	5.804	2.349	58	8.255
	Vb	-	-	-	-	18.846	-	-	18.846
	VIa	-	-	-	70.339	5.799	-	-	76.138
	VIb	-	-	1.330	-	1.087	-	-	2.417
	VIIb,c	1.331	14.169	65.490	14.896	-	-	-	95.886
	VIIg-k	-	1.410	4.285	-	-	-	-	5.695
Sum		1.343	15.579	71.105	85.267	31.536	2.349	58	207.237
Estonia	Vb	-	-	-	348	2.850	-	-	3.198
Latvia	Vb	-	-	-	-	1.502	884	83	2.469
Lithuania	Vb	-	-	-	-	-	-	-	0
France	Vb	-	-	-	-	885	-	-	885
Spain	VIIIc, IXa	1.745	2.759	2.702	2.061	2.716	2.845	2.431	17.259
Grand total		8.629	22.608	86.097	104.180	83.510	35.647	24.353	365.024

Table 4.2.1. Length distribution of blue whiting from Russian directed fishery in 1993.

Length, cm	IIa	IVa	Divisions Vb	VIa	VIIb-c	VIIg-k
18	3	-	-	-	-	1
19	3	2	-	-	-	4
20	10	3	1	-	1	8
21	9	14	-	-	3	5
22	-	7	4	4	3	9
23	-	5	2	4	9	15
24	-	1	2	7	8	18
25	-	1	1	13	10	21
26	-	5	9	37	11	30
27	-	11	15	47	26	30
28	-	17	24	59	75	20
29	-	10	32	74	58	14
30	-	6	19	48	43	9
31	-	8	30	28	30	5
32	-	3	27	20	19	1
33	-	1	11	14	14	3
34	-	4	13	12	12	2
35	-	-	6	12	10	2
36	-	1	3	7	9	4
37	-	-	-	8	9	-
38	-	1	1	3	3	-
39	-	-	-	1	2	-
40	-	-	-	1	-	-
41	-	-	-	1	-	1
Total	25	100	200	400	355	200
N Sampl	1	1	2	4	3	2

Table 4.2.2. Length distribution of blue whiting from Russian directed fishery in 1994 (January-April)

Length cm	Division IIa
17	17
18	110
19	121
20	85
21	68
22	50
23	40
24	68
25	58
26	34
27	35
28	26
29	27
30	28
31	37
32	32
33	13
34	7
35	3
36	1
37	1
Total	867
N Sampl	4

Table 4.2.3. Length distribution of blue whiting from Norwegian directed fishery in 1993.

	FEB VIIg-k	MARS VIIg-k	MARS VIIbc	APRIL VIIbc	APRIL VIa	MAY VIa	MAY Vb
22							
23		2			1		
24		6			1		
25		22	7		15	2	
26	13	100	54	7	36	15	15
27	38	144	90	16	148	32	46
28	61	189	116	33	234	54	61
29	41	133	99	54	205	59	71
30	40	95	93	52	173	86	82
31	34	72	86	38	143	59	89
32	19	43	59	29	87	45	46
33	18	38	25	21	42	21	43
34	12	17	13	5	35	11	36
35	4	12	7	3	27	15	2
36	4	5	5	1	11	2	3
37	1	1	2		12	2	
38	1			1	10		
39					2	1	
40							
No tot	285	879	656	260	1182	404	474
No samp	3	8	6	2	11	4	5

Table 4.2.4. Length distribution of blue whiting Norwegian industrial fishery in 1993.

	FEB IVa	APR IVa	MAY IVa	JUN IVa	AUG IVa	SEPT IVa	OKT IVa	NOV IVa
12								1
13								
14						2		
15						37	1	
16						53	2	11
17						22	3	4
18						15	4	8
19	1							3
20	2	1						
21	3	3	5					1
22	4	5	23	1				
23	1	4	17	4	1			
24	1	3	5	2	2			
25		1	6		1		2	1
26		2	7		2			
27	3	5	13	2			2	3
28	1	4	22	11	3		8	4
29		5	9	8			7	6
30			9	3			18	5
31			4	3	1	3	11	6
32			3					3
33	1		1				4	2
34							4	3
35								3
36								
37								
38								
39							2	
40								
N tot	17	33	124	34	10	132	68	64
N sampl	1	1	5	3	1	2	3	2

Table 4.2.5. Length distribution of blue whiting from Norwegian directed fishery in 1994.

	VIIbc Janu	VIIbc Feb	VIIg-k March	VIb March	VIIbc March	VIa April	VIa May	Vb May
20								
21								
22								
23		3						
24		7		2		1		
25		7		1	2	3		
26		22	3		4	3		1
27	1	31	4		24	15	4	6
28	8	71	4	1	66	53	14	16
29	9	89	13	11	110	89	26	38
30	15	120	24	21	139	176	44	63
31	23	112	20	14	155	174	46	37
32	25	109	16	16	129	131	23	44
33	37	62	6	9	61	99	15	15
34	29	56	9	3	50	89	18	9
35	21	32	10	3	51	70	18	4
36	15	23	4	1	37	37	6	6
37	6	19	3	2	28	12	2	
38	13	4	2		8	12	3	
39	3	1	1		4	1		1
40		1	1		1	1		
N tot	205	769	120	84	869	966	219	240
N sampl	2	8	1	1	9	13	3	2

Table 4.2.6 Length distribution of blue whiting from Norwegian industrial fisheries in 1994.

	IVa April	IVa Mai	IVa June
18			
19	12		3
20	40	8	24
21	25	19	45
22	17	18	17
23	3	4	5
24	1		10
25	2	1	20
26	8		17
27	5		14
28	3		12
29	6		6
30	4		6
31	3		4
32	3		1
33	1		2
34	2		
35	3		
36	2		1
37	1		
38	1		
39			
40			
N tot	142	50	187
N sampl	4	1	7

Table 4.2.7. Length distribution of blue whiting from Faroes directed fishery in 1993.

Length cm	Apr VIa	May Vb	July Vb	July Vb
17	-	-	-	1
18	-	-	-	2
19	-	-	-	1
20	2	1	-	1
21	2	-	-	-
22	1	-	-	-
23	-	2	-	-
24	1	3	-	-
25	4	-	-	1
26	13	8	-	-
27	15	31	5	-
28	23	77	20	-
29	23	128	39	-
30	25	89	50	-
31	11	76	37	-
32	8	43	21	-
33	7	22	7	-
34	7	12	2	-
35	7	11	2	-
36	-	4	3	-
37	-	2	1	-
38	2	1	-	-
39	-	1	-	-
Total	151	511	187	6
N sampl	2	6	3	1

Table 4.2.8. Length distribition of blue whiting from Faroes mixed fishery in 1993.

Length cm	Oct Vb	Nov Vb	Dec Vb
14	-	-	4
15	2	1	17
16	11	3	57
17	16	10	107
18	11	21	76
19	15	11	46
20	1	10	15
21	-	2	1
N tot	56	58	324
N sampl	1	1	3

Table 4.2.9. Length distribution of blue whiting from Faroes directed fishery in 1994.

Length cm	Jan-Feb Vb	Mar-Apr VIa	May Vb
15	1		
16	5		
17	19		
18	12		
19	40		
20	4		1
21	1	1	2
22	1	1	2
23	2	4	1
24		5	1
25		5	2
26		3	2
27		29	14
28		39	28
29		54	37
30		53	36
31		62	51
32		60	34
33		28	17
34		22	15
35		18	6
36		6	6
37		3	1
38		-	2
39		2	3
40		-	1
Total	55	395	262
N sampl	3	4	2

Table 4.2.10. Catch in numbers (Thousands) by length group and by quarter in Spanish BLUE WHITING fisheries (Division VIIIc and IXa), 1993.

	Quarter				
Length	1	2	3	4	Total
10	0	0	0	0	0
11	0	0	0	0	0
12	2	0	0	0	2
13	2	0	0	0	2
14	4	35	0	37	76
15	54	117	0	194	366
16	272	407	0	171	851
17	3830	1942	2	316	6090
18	20150	3299	1062	2666	27176
19	24481	6029	2016	6385	38910
20	23751	21652	6714	16778	68896
21	17176	35723	17067	21710	91676
22	13904	25108	23659	22676	85347
23	11670	12860	16887	12904	54321
24	9041	7814	13936	7096	37888
25	3964	3285	5102	3448	15799
26	2395	1289	2881	1487	8052
27	807	457	691	452	2406
28	618	1010	447	329	2406
29	96	1314	110	84	1604
30	285	674	77	47	1083
31	135	98	21	43	297
32	13	43	52	12	121
33	12	16	13	4	45
34	4	12	8	1	25
35	4	2	8	1	14
36	0	5	3	0	9
37	1	7	2	0	10
38	1	5	1	0	7
39	0	1	0	0	2
40	0	3	0	0	3
Total	132673	123208	90761	96841	443483
Landings (t)	8364	8700	7133	6823	31020
N samples	77	82	75	81	315
Fish sampled	6639	5865	5561	6900	24965

Table 4.2.11 Catch in numbers (Thousands) by length group and by quarter in the Potuguese BLUE WHITING fisheries (Division IXa) . 1993.

	Quarter				
Length	1	2	3	4	Total
10	-	-	-	-	-
11	-	-	-	-	-
12	-	-	-	-	-
13	-	-	-	-	-
14	-	-	-	-	-
15	116	76	716	21	929
16	1761	538	1350	231	3880
17	5683	1116	1387	1001	9188
18	5849	1345	1614	1250	10059
19	3097	470	936	716	5219
20	815	380	434	196	1825
21	6	305	88	487	886
22	151	158	57	735	1102
23	20	56	22	320	418
24	25	43	10	89	167
25	24	34	1	107	166
26	16	17	2	66	100
27	7	12	0	48	68
28	6	5	0	31	42
29	4	2	0	15	20
11	2	0	0	3	5
31	0	0	0	7	7
32	1	1	0	2	4
33	-	-	-	-	-
34	-	-	-	-	-
35	-	-	-	-	-
36	-	-	-	-	-
37	-	-	-	-	-
38	-	-	-	-	-
39	-	-	-	-	-
40	-	-	-	-	-
TOTAL	17584	4557	6619	5325	34084
Landings (tonnes)	548	178	247	263	1236
N samples	11	10	7	10	38
Fish sampled	815	659	549	705	2728

Table 4.2.12 Catch in numbers (Thousands) by length group and by gear in the Southern BLUE WHITING fisheries (VIIIc and IXa) , 1993.

	SPAIN			PORTUGAL	
Length	Bottom trawl	Pair trawl	Long line	Bottom trawl	TOTAL
10	-	-	- -	-	-
11	-	-	- -	-	-
12	-	-	2	-	2
13	-	-	2	-	2
14	72	-	4	-	76
15	357	-	9	929	1295
16	801	46	4	3880	4730
17	5967	110	13	9188	15278
18	19036	8130	10	10059	37235
19	20472	18426	13	5219	44129
20	28783	40082	31	1825	70721
21	28443	63194	38	886	92562
22	25246	60051	51	1102	86449
23	14748	39516	57	418	54739
24	7814	30024	50	167	38055
25	4631	11130	38	166	15965
26	2283	5721	49	100	8153
27	1194	1183	29	68	2474
28	741	1634	30	42	2447
29	310	1269	25	20	1625
30	219	849	15	5	1088
31	138	146	13	7	304
32	96	5	20	4	124
33	32	3	10	-	45
34	5	1	19	-	25
35	5	2	7	-	14
36	-	-	9	-	9
37	-	-	10	-	10
38	-	-	7	-	7
39	-	-	2	-	2
40	-	-	3	-	3
TOTAL	161393	281522	568	34084	477567
Landing (tonnes)	10363	20586	71	1236	32256
N samples	185	93	37	38	353
Fish sampled	14081	9571	1313	2728	27693

Table 4.3.1. 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), 1984 - 1993.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993 [1]
0	63.6	871.4	51.9	9.1	3.6	36.5	8.4	63.6	-	25,2
1	417.6	127.4	161.9	280.8	93.2	86.4	537.8	33.4	82.4	77,5
2	1,394.1	1,341.6	263.3	361.0	403.2	359.4	353.1	533.2	52.2	276,4
3	277.9	1,588.1	1,559.5	580.2	416.2	1,176.7	565.7	384.4	1,508.5	515.5
4	211.9	199.3	1,464.3	1,780.2	611.2	696.2	709.1	243.9	510.4	1,410,4
5	259.2	161.0	298.7	680.3	1,238.9	785.7	489.2	329.9	200.1	388,0
6	420.2	303.7	156.4	118.2	584.9	680.7	562.1	235.3	138.8	202,8
7	253.1	248.7	192.2	94.9	77.8	127.2	291.7	149.9	92.0	110,0
8	190.3	167.2	185.8	117.1	50.7	44.8	75.5	39.9	86.7	60,4
9	151.6	91.7	166.4	99.7	32.4	23.8	26.6	4.3	84.6	38,1
10	113.8	87.8	172.1	48.3	28.3	15.2	15.5	6.4	13.1	6,3
11	57.7	73.1	108.7	60.1	8.8	8.9	42.9	5.2	1.0	3,7
12+	79.8	94.5	105.7	86.6	11.8	12.9	33.4	2.4	0.4	3,8
Total	3,890.9	5,355.3	4,886.9	4,316.5	3,571.0	4,054.4	3,711.0	2,031.8	2,707.2	3,118,1
Tonnes	481,872	554,640	694,314	571,659	477,552	521,415	465,601	297,649	379,549	390,043

[1]Preliminary.

Table 4.3.2. BLUE WHITING. Catch in number (millions) by age group in the mixed industrial fisheries (Sub-area IV, Divisions IIIa, Vb, and Va) 1984 - 1993.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993 [1]
0	446.4	184.3	-	226.8	12.3	1,871.6	0.5	24.9	-	305,1
1	1,650.8	891.4	395.0	174.5	185.1	578.9	874.8	8.4	159.8	246,7
2	587.7	365.0	334.7	105.7	84.3	183.7	167.6	397.9	63.9	64,2
3	49.7	173.8	134.6	85.4	83.4	70.0	49.5	42.3	167.1	145,3
4	12.8	37.4	184.4	88.9	40.2	33.5	11.8	11.4	75.1	157,3
5	12.6	13.4	79.7	32.8	44.0	24.1	7.0	11.3	25.2	26,0
6	10.4	13.9	24.3	15.6	24.0	12.2	3.8	11.2	16.7	11,0
7	6.1	5.8	7.3	9.2	3.3	5.9	4.9	6.2	6.7	15,8
8	2.2	5.6	11.0	5.1	2.1	2.1	0.6	3.4	2.7	-
9	2.7	1.8	7.3	3.8	1.0	0.8	0.4	0.7	0.9	-
10	2.6	3.0	3.9	0.2	0.2	0.3	-	-	0.5	-
11	0.9	1.4	3.8	-	-	0.4	-	-	-	-
12+	0.7	0.3	3.5	-	-	0.3	-	0.2	0.1	
Total	2,785.5	1,697.0	1,189.4	748.0	479.9	2,783.8	1,120.9	517.9	518.7	971,4
Tonnes	122,806	97,769	99,580	59,952	45.110	75,978	63,195	39,872	66,174	92,480

[1]Preliminary.

Table 4.3.3. BLUE WHITING. Catch in number (millions) by age group in the Southern area (Divisions VIIIc and IXa) 1984-1993.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993 [1]
0	74	118	32	105	30	41	74	70	19	25
1	223	286	93	383	147	200	198	181	139	41
2	349	337	218	111	233	175	182	182	205	146
3	127	171	168	62	114	93	57	70	95	181
4	35	66	68	28	32	61	25	39	43	62
5	13	14	15	13	10	27	24	17	12	12
6	14	3	6	3	9	15	11	8	6	7
7	3		1	1	3	6	2	3	2	2
8+	1	3 1	1	1	0	3	2	3	1	1
Total	839	999	602	707	578	621	575	573	522	478
Tonnes	31,173	42,820	33,082	32,819	30,838	33,695	32,817	32,003	28,722	32,256

[1]Preliminary

Table 4.3.4. Blue Whiting Combined stock. Catch in number at age 1981-1993.

Run title : BLUE WHITING COMBINED STOCK

At 9/09/1994 15:14

Table 1 Catch numbers at age Numbers*10**-6

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
AGE													
0	48	3512	437	584	1174	84	341	46	1949	83	158	19	330
1	258	148	2283	2291	1305	650	838	425	865	1611	223	381	324
2	348	274	567	2331	2044	816	578	721	718	703	1113	321	341
3	681	326	270	455	1933	1862	728	614	1340	672	497	1771	661
4	334	548	286	260	303	1717	1897	683	791	753	294	628	1568
5	548	264	299	285	188	393	726	1303	837	520	358	237	414
6	559	276	304	445	321	187	137	618	708	577	255	161	214
7	466	266	287	262	257	201	105	84	139	299	159	101	126
8	634	272	286	193	174	198	123	53	50	78	46	90	60
9	578	284	225	154	93	174	103	33	25	27	5	85	38
+gp	1460	673	334	255	259	398	195	50	38	95	13	15	14
TOTALNUM	5914	6843	5578	7515	8051	6680	5771	4630	7460	5418	3121	3809	4090
TONSLAND	909556	576419	570072	641776	695596	826986	664434	553413	625433	561610	369524	474445	514779
SOPCOF %	98736	94246	101531	101943	99931	97507	100295	100040	95191	99891	83374	84757	100004

Table 4.4.1. Blue Whiting Combined stock. Mean weight at age in the catch and in the stock 1981-1993.

Run title : BLUE WHITING COMBINED STOCK

At 9/09/1994 15:14

Table 2 Catch weights and stock weights at age (kg)

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
AGE													
0	0.038	0.018	0.020	0.026	0.016	0.030	0.023	0.031	0.014	0.034	0.036	0.024	0.034
1	0.052	0.045	0.046	0.035	0.038	0.040	0.048	0.053	0.059	0.045	0.054	0.078	0.066
2	0.065	0.072	0.074	0.078	0.074	0.073	0.086	0.076	0.079	0.070	0.151	0.074	0.084
3	0.103	0.111	0.118	0.089	0.097	0.108	0.106	0.097	0.103	0.106	0.113	0.142	0.117
4	0.125	0.143	0.140	0.132	0.114	0.130	0.124	0.128	0.126	0.123	0.144	0.162	0.141
5	0.141	0.156	0.153	0.153	0.157	0.165	0.147	0.142	0.148	0.147	0.177	0.190	0.155
6	0.155	0.177	0.176	0.161	0.177	0.199	0.177	0.157	0.158	0.168	0.194	0.208	0.180
7	0.170	0.195	0.195	0.175	0.199	0.209	0.208	0.179	0.171	0.175	0.207	0.223	0.206
8	0.178	0.200	0.200	0.189	0.208	0.243	0.221	0.199	0.203	0.214	0.227	0.240	0.241
9	0.187	0.204	0.204	0.186	0.218	0.246	0.222	0.222	0.224	0.217	0.250	0.307	0.228
+gp	0.211	0.228	0.226	0.201	0.233	0.253	0.254	0.250	0.238	0.269	0.114	0.259	0.307

Table 4.5.1. Blue Whiting Combined stock. Maturity at age 1981-1993.

Run title : BLUE WHITING COMBINED STOCK

At 9/09/1994 15:14

Table 5 Proportion mature at age

YEAR	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
AGE													
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.13	0.11
2	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.44	0.42
3	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.96	0.95
4	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.86	0.99	0.99
5	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	1.00	1.00
6	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	1.00	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
+gp	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 4.6.1. Stratified mean catch and standard error for BLUE WHITING in groundfish surveys by Portugal.

Year	Month	20-100 m		100-100 m		200-500 m		20-500 m	
		y	s_y	y	s_y	y	s_y	y	s_y
1979	June	0.2	0.2	32.8	22.7	86.3	34.6	31.2	11.5
	October-November	5.1	4.9	17.2	7.6	102.9	47.9	27.8	9.3
1980	March	-	-	178.0	173.0	4.7	0.7	71.7	68.5
	May/June	0.9	2.7	4.0	1.5	45.4	18.2	10.7	3.5
	October	3.6	2.7	9.9	4.4	586.7	305.9	117.3	58.3
1981	March	-	-	23.5	17.4	185.5	112.7	42.2	22.2
	June	-	-	4.2	1.6	177.5	24.5	33.8	4.4
1982	April/May	-	-	3.2	2.6	136.4	39.3	26.0	7.2
	September	0.6	0.5	85.1	42.3	271.4	122.6	85.7	28.7
1983 [1]	March	0.7	0.6	14.0	9.5	259.2	96.1	54.3	18.3
	June	-	-	22.6	8.4	177.2	46.9	42.2	9.3
1985 [1,2]	June	0.1	0.1	194.4	145.9	404.8	161.5	159.0	67.9
	October	3.5	3.1	126.2	80.3	360.6	46.9	123.6	34.4
1986	June	4.1	1.1	59.2	18.5	196.3	30.9	64.8	9.8
1986 [2]	October	2.4	1.2	357.0	144.4	650.2	111.0	276.2	63.2
1987 [2]	October	4.0	0	256.8	63.5	811.0	267.4	267.4	58.9
1989	June	-	-	39.4	14.3	312.5	128.5	76.1	26.0
	October	-	-	64.2	22.4	261.3	47.0	75.2	12.7
1990	July	2.1	1.8	153.1	103.3	241.5	41.5	96.3	34.5
	October	11.0	5.3	90.2	28.1	761.5	233.9	152.5	35.3
1991	July	0.9	0.7	140.3	39.6	267.7	38.3	98.4	14.6
	October	8.1	4.7	82.5	18.3	258.7	53.2	90.7	11.4
1992	February	7.3	7.3	42.8	34.5	249.2	21.0	67.7	12.0
	July	1.4	1.2	29.0	18.0	215.5	42.5	46.8	8.6
	October	0.7	0.5	22.1	7.0	208.3	43.6	54.2	6.8
1993	February	-	-	18.6	14.1	104.5	30.6	42.3	9.5
	July	-	-	3.0	2.6	150.7	28.2	34.3	4.3
	November	-	-	90.3	0.3	188.6	42.8	85.8	9.2

[1]Data unpublished.
[2]Codend mesh size 20 mm, otherwise 40 mm

Table 4.6.2. Stratified mean catch (Kg/haul and Number/haul) and standard error of BLUE WHITING in bottom trawl surveys in Spanish waters. All surveys in September except the 1986 survey which was in April.

Kg/haul	30-100 m		101-200 m		201-500 m		TOTAL 300-500 m	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1985	9.50	5.87	119.75	45.99	68.18	13.79	92.83	28.24
1986	9.74	7.13	45.41	12.37	29.54	8.70	36.93	7.95
1987	-	-	-	-	-	-	-	-
1988	2.90	2.59	154.12	38.69	183.07	141.94	144.87	45.89
1989	14.17	12.03	76.92	17.08	18.79	6.23	53.60	10.62
1990	6.25	3.29	52.54	9.00	18.80	4.99	37.88	5.66
1991	64.59	34.65	126.41	26.06	46.07	18.99	27.05	17.16
1992	6.37	2.59	44.12	6.64	29.50	6.16	34.60	4.23
1993	1.06	0.63	14.07	3.73	51.08	22.02	22.59	6.44

Numb/haul	30-100 m		101-200 m		201-500 m		TOTAL 300-500 m	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1985	267	181.71	3669	1578.86	1377	262.98	2644	963.20
1986	368	237.56	2486	1006.67	752	238.87	1763	616.40
1987	-	-	-	-	-	-	-	-
1988	83	71.74	6112	1847.36	7276	6339.88	5746	2087.74
1989	629	537.29	3197	876.75	566	213.11	2173	539.98
1990	220	115.48	2219	426.46	578	185.43	1535	264.74
1991	2922	1645.73	5563	1184.69	1789	847.33	4214	780.88
1992	124	50.81	1412	233.99	845	199.12	1069	146.87
1993	14	8.61	257	69.61	894	427.77	401	124.53

Table 4.6.3. Blue Whiting Combined stock: Tuning data from 5 fleets. Norwegian and Russian acoustic estimates in the spawning area from 1980(82)-1993 for ages 2(3)-11. CPUE from Spanish pair-trawlers 1983-1993 for ages 3-6. Spanish bottom trawl survey from 1985-1993 for ages 0-7. Combined acoustic survey in the Norwegian Sea during summer from 1980-1993 for ages 0-11.

```
BLUE WHITING COMBINED, Tuning data
     105
Norway Spawning Area/Acoustic
     80         93
      1          1      0.17      0.25
      2         11
      1       3300    3663    4026    5577  5115  4719  3036  1485   627   693
      1       2368    7511    3219    3626  4551  4625  3626  2590  1776  1332
      0          0       0       0       0     0     0     0     0     0     0
      1        297    2108    2723    6511  3735  3650  3153  2279  1182   531
      1      11130    1514    1616    1719  1858  1128   567   440   348    80
      0          0       0       0       0     0     0     0     0     0     0
      1        954    7183    7340    1159   383   251   373   151   174    73
      1       4042    8050   22357    4697   282   417   385   159    27   111
      1       6960    8799   12271   20285  7323   723   617   326   398   126
      1       6745   22270    9973   10504  7803   933   293   177    46   148
      1      14169   12670   11228    5587  6556  3273   516   183   108    81
      1      11147    6340    8497    7407  4558  2019   545    96    16    33
      1       1232   26123    4719    1574  1386   810   616   257    19     0
      1       4489    3321   26771    2643  1270   557   426   108    22    12
USSR Spawning Area/Acoustic
     82         93
      1          1      0.17      0.25
      3         11
      1     540     2750     1340     1380     1570     2350     1730     1290     650
      1    2330     2930     9390     3880     1970     1370      780      660     100
      1    2900      800     1100     4200     2200     1200     1700     1200     500
      1   13220      930      580     1780      860      610      580      540     110
      1   18750    23180     2540      610      620      750      640      710     720
      1    4480    19170     5860     1070      500      810      860      670     560
      1    3710     4550     8610     4130     1270      480      250      260     330
      1   11910     7120     6670     6970     4580     2750     1880      810     410
      1    9740    12140     5740     2580     1470      220       80       10      10
      1   10300     5350     5130     2630     1770      870      300      220       0
      1   20010     6700     1350      440      390      170        0        0       0
      1    4728    12337     5304     2249     1316      621      386      150       0
CPUE Spanish Pair Trawlers
     83         93
      1          1         0          1
      0          6
      1       1140      7196     16392      9311      7476      6326      1718
      1       1839     13710     27286     14845      4836      1755      1750
      1       3680     14573     23823     14126      6256      1232       217
      1        788      3721     14131     14745      7113      1278       505
      1       5433     25328     13153      6664      2938      1029       166
      1       2545      7778     21473     18436      6391      1300       781
      1       2488     15272     18486     17160      8374      3760      1003
      1       6703     21444     19407      5194      1803      1357       451
      1       8745     15924     15370      4989      2329      1045       440
      1         36     10007     24235      9671      4316      1194       462
      1       1793      4036     13991     22493      7979      1354       658
Spanish bottom Trawl Survey
     85         93
      1          1      0.67      0.75
      0          7
      1     1748.4     508.3     266.4     104.0     11.4     3.5     1.0     0.5
      1     1572.8      26.7      67.5      63.2     28.7     2.0     2.6     0.2
      0          0         0         0         0        0       0       0       0
      1     4979.6     368.7     344.9      37.3      7.2     3.0     5.0     0.3
      1     1923.3     163.0      51.2      28.6      3.8     2.8     0.7     0.2
      1     1525.0      74.9      46.1      10.7     10.4     2.4     0.1     0.5
      1     4003.2      95.2      49.6      24.5     17.9     5.1     1.5     0.8
      1      299.8     428.2     233.3      77.0     20.4     6.9     2.3     0.9
      1      115.7     107.5     150.8      19.4      5.5     1.6     0.2     0.2
Norwegian Sea acoustic - Blue Whiting
     80         93
      1          1     0.6    0.75
      0         11
      1      0.001    1400   10192    4536  4704  7056  8232  6944  5432  2688  1792  1848
      1      0.001   · 182     728    4542  3874  2678  2834  2964  2756  2054  1300  1092
      1       3680     184     460    1242  4715  3611  3128  2323  1679   874   414   253
      1       8280   22356     396     468   756  1404   576   468   432   324   216   108
      1       1862   30380   13916     833   392   539   539   343    49    49    49    49
      1       2256    5969   23876   12502   658   423   188   235   141   376   141    47
      1       5040    2324    2380    7224  6944  1876   952   336   308   140   196    56
      1       3192    8204    4032    5180  5572  1204   224   168    56    84    28    28
      1       8760    4992    2880    2640  3480   912   120    96    24    48 0.001 0.001
      1      20430    1172    1125     812   379   410   212    22    32     0     8     1
      0          0       0       0       0     0     0     0     0     0     0     0     0
      0          0       0       0       0     0     0     0     0     0     0     0     0
      1      0.001     792    1134    6939   766   247   172    90    11    18     1     3
      1      0.001     830     125    1070  6392  1222   489   248    58    88    71 0.001
```

Table 4.6.4. Blue Whiting Combined stock. XSA results with full diagnostics from 5 fleets.

Lowestoft VPA Version 3.1

23/09/1994 9:25

Extended Survivors Analysis

BLUE WHITING COMBINED STOCK,INDEX FILE,UNSEXED,PLUSGROUP

CPUE data from file TUNBWCO.93

Catch data for 13 years. 1981 to 1993. Ages 0 to 10.

Fleet,	First, year,	Last, year,	First, age ,	Last, age	Alpha,	Beta
Norway Spawning Area,	1981,	1993,	2,	9,	.170,	.250
USSR Spawning Area/A,	1982,	1993,	3,	9,	.170,	.250
CPUE Spanish Pair Tr,	1983,	1993,	0,	6,	.000,	1.000
Spanish bottom Trawl,	1985,	1993,	0,	7,	.670,	.750
Norwegian Sea acoust,	1981,	1993,	0,	9,	.600,	.750

Time series weights :

Tapered time weighting applied
Power = 3 over 20 years

Catchability analysis :

Catchability dependent on stock size for ages < 2

Regression type = C
Minimum of 5 points used for regression
Survivor estimates shrunk to the population mean for ages < 2

Catchability independent of age for ages >= 7

Terminal population estimation :

Survivor estimates shrunk towards the mean F
of the final 5 years or the 5 oldest ages.

S.E. of the mean to which the estimates are shrunk = .500

Minimum standard error for population
estimates derived from each fleet = .300

Prior weighting not applied

Tuning had not converged after 30 iterations

Total absolute residual between iterations
29 and 30 = .00022

Final year F values

Age ,	0,	1,	2,	3,	4,	5,	6,	7,	8,	9
Iteration 29,	.0434,	.0805,	.1104,	.2361,	.3720,	.4123,	.3932,	.4511,	.4362,	.4614
Iteration 30,	.0434,	.0805,	.1104,	.2361,	.3720,	.4123,	.3931,	.4511,	.4362,	.4614

Table 4.6.4. cont'd.

Regression weights

	.751	.820	.877	.921	.954	.976	.990	.997	1.000	1.000

Fishing mortalities

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	.049	.136	.009	.053	.006	.102	.013	.029	.004	.043
1	.136	.148	.104	.119	.086	.147	.115	.043	.091	.080
2	.246	.173	.130	.127	.142	.205	.171	.109	.080	.110
3	.235	.332	.235	.164	.192	.426	.301	.175	.253	.236
4	.230	.243	.557	.401	.229	.406	.454	.208	.350	.372
5	.235	.259	.572	.486	.534	.487	.515	.406	.258	.412
6	.369	.452	.446	.398	1.052	.633	.751	.517	.322	.393
7	.316	.379	.575	.487	.456	.718	.608	.472	.397	.451
8	.439	.359	.568	.869	.489	.545	1.272	.171	.540	.436
9	.386	.392	.751	.665	.604	.452	.651	.225	.546	.461

XSA population numbers (Thousands)

	AGE									
YEAR	0	1	2	3	4	5	6	7	8	9
1984	1.34E+04	1.99E+04	1.18E+04	2.40E+03	1.40E+03	1.51E+03	1.59E+03	1.07E+03	6.00E+02	5.32E+02
1985	1.02E+04	1.05E+04	1.42E+04	7.56E+03	1.55E+03	9.09E+02	9.75E+02	9.01E+02	6.37E+02	3.17E+02
1986	1.02E+04	7.28E+03	7.38E+03	9.81E+03	4.44E+03	9.97E+02	5.74E+02	5.08E+02	5.05E+02	3.64E+02
1987	7.34E+03	8.26E+03	5.37E+03	5.31E+03	6.34E+03	2.08E+03	4.61E+02	3.01E+02	2.34E+02	2.34E+02
1988	8.60E+03	5.70E+03	6.01E+03	3.88E+03	3.69E+03	3.48E+03	1.05E+03	2.53E+02	1.51E+02	8.04E+01
1989	2.21E+04	7.00E+03	4.28E+03	4.27E+03	2.62E+03	2.40E+03	1.67E+03	3.00E+02	1.31E+02	7.60E+01
1990	7.25E+03	1.64E+04	4.95E+03	2.86E+03	2.28E+03	1.43E+03	1.21E+03	7.26E+02	1.20E+02	6.24E+01
1991	6.07E+03	5.86E+03	1.19E+04	3.42E+03	1.73E+03	1.19E+03	6.98E+02	4.67E+02	3.24E+02	2.75E+01
1992	5.68E+03	4.83E+03	4.60E+03	8.77E+03	2.35E+03	1.15E+03	6.46E+02	3.41E+02	2.38E+02	2.23E+02
1993	8.59E+03	4.63E+03	3.61E+03	3.47E+03	5.58E+03	1.35E+03	7.28E+02	3.84E+02	1.88E+02	1.14E+02

Estimated population abundance at 1st Jan 1994

	0.00E+00	6.73E+03	3.50E+03	2.64E+03	2.25E+03	3.15E+03	7.34E+02	4.02E+02	2.00E+02	9.93E+01

Taper weighted geometric mean of the VPA populations:

	9.92E+03	7.67E+03	5.84E+03	4.32E+03	2.84E+03	1.63E+03	9.80E+02	5.47E+02	3.33E+02	1.99E+02

Standard error of the weighted Log(VPA populations) :

	.5168	.5310	.5054	.4905	.4872	.4189	.4852	.6441	.8937	1.2711

Table 4.6.4. cont'd.

Blue Whiting Combined stock - Log catchability residuals.

Fleet : Norway Spawning Area

Age	1981	1982	1983
0	No data for this fleet at this age		
1	No data for this fleet at this age		
2	-.17	99.99	-2.10
3	-.16	99.99	-.54
4	-1.04	99.99	-.82
5	-.63	99.99	.05
6	-.29	99.99	-.11
7	-.14	99.99	.47
8	-.48	99.99	.42
9	-.86	99.99	.02

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	.33	99.99	-1.68	.08	.52	.84	1.43	.29	-.96	.58
3	-1.04	99.99	-.89	-.17	.23	1.12	.93	.03	.52	-.62
4	-.89	99.99	-.47	.26	.17	.34	.61	.55	-.31	.56
5	-.85	99.99	-.77	-.12	.84	.54	.44	.88	-.67	-.28
6	-.75	99.99	-1.29	-1.39	1.18	.70	.87	1.01	-.15	-.34
7	-.72	99.99	-1.43	-.42	.30	.44	.79	.72	.10	-.38
8	-.81	99.99	-1.03	-.17	.66	.07	.88	-.29	.22	.07
9	-.95	99.99	-1.57	-1.09	.68	.09	.37	.45	-.59	-.80

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8	9
Mean Log q	-.2980	.6677	1.1261	1.0779	1.0216	.8881	.8881	.8881
S.E(Log q)	1.0686	.7236	.5938	.6566	.9269	.6869	.5904	.8402

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.87	.168	1.40	.18	11	.99	-.30
3	.94	.121	-.12	.34	11	.72	.67
4	.76	.720	1.02	.55	11	.47	1.13
5	.59	1.326	2.44	.57	11	.37	1.08
6	.58	1.167	2.26	.51	11	.53	1.02
7	1.07	-.166	-1.39	.41	11	.78	.89
8	1.66	-1.898	-5.21	.52	11	.86	.88
9	1.60	-2.141	-3.93	.63	11	1.01	.54

Table 4.6.4. cont'd.

Fleet : USSR Spawning Area/A

Age	1981	1982	1983
0	No data for this fleet at this age		
1	No data for this fleet at this age		
2	No data for this fleet at this age		
3	99.99	-2.17	-.30
4	99.99	-.95	-.44
5	99.99	-1.35	.61
6	99.99	-.97	.04
7	99.99	-.86	-.27
8	99.99	-.51	-.54
9	99.99	-.86	-1.18

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	No data for this fleet at this age									
1	No data for this fleet at this age									
2	No data for this fleet at this age									
3	-.24	.15	.22	-.62	-.48	.64	.81	.66	.40	-.12
4	-1.29	-1.24	.99	.41	-.52	.30	.99	.39	.34	.09
5	-1.11	-1.24	.21	.29	.17	.28	.66	.71	-.63	.61
6	.18	-.17	-.72	.06	.72	.69	.05	.56	-1.19	.34
7	-.18	-.94	-.65	-.36	.74	1.91	-.14	.46	-.75	.36
8	-.19	-.94	-.46	.45	.29	2.18	-.10	.05	-1.20	.32
9	.27	-.28	-.25	.47	.29	2.33	-.59	1.47	99.99	.35

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	3	4	5	6	7	8	9
Mean Log q	.5227	.8238	.8859	.9128	1.0133	1.0133	1.0133
S.E(Log q)	.7315	.7779	.7528	.6355	.8384	.9009	1.0677

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
3	.78	.588	1.46	.45	12	.59	.52
4	.63	1.206	2.45	.55	12	.48	.82
5	.76	.525	1.11	.36	12	.59	.89
6	.73	.800	1.19	.51	12	.47	.91
7	4.59	-1.814	-27.02	.03	12	3.45	1.01
8	2.65	-1.871	-12.07	.13	12	2.12	1.01
9	2.16	-2.264	-8.76	.34	11	1.82	1.29

Table 4.6.4. cont'd.

Fleet : CPUE Spanish Pair Tr

Age	1981	1982	1983
0	99.99	99.99	-2.43
1	99.99	99.99	-1.48
2	99.99	99.99	.47
3	99.99	99.99	.56
4	99.99	99.99	.63
5	99.99	99.99	.91
6	99.99	99.99	.40
7	No data for this fleet at this age		
8	No data for this fleet at this age		
9	No data for this fleet at this age		

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	-.31	2.21	-2.69	3.61	1.06	.19	4.21	5.23	-11.56	.05
1	-.40	.38	-1.99	1.68	-.31	.87	.66	1.03	.36	-1.40
2	-.20	-.55	-.44	-.19	.19	.41	.30	-.85	.55	.26
3	.89	-.27	-.53	-.74	.60	.54	-.31	-.59	-.83	.93
4	.66	.82	.04	-1.27	-.03	.66	-.71	-.29	.08	-.16
5	.08	.24	.33	-.67	-.92	.49	.00	-.12	-.03	.01
6	.52	-1.04	.33	-.59	.42	.03	-.40	.03	.06	.33
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6
Mean Log q	1.2478	1.1457	.7874	.2835	-.1500
S.E(Log q)	.4727	.6883	.6416	.4925	.4786

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
0	3.06	-.577	-14.19	.01	11	5.09	-1.54
1	1.97	-1.203	-9.61	.16	11	1.24	.43

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	5.89	-4.671	-50.04	.10	11	1.53	1.25
3	5.80	-2.184	-46.91	.03	11	3.35	1.15
4	3.52	-1.965	-22.75	.07	11	1.96	.79
5	1.69	-1.046	-5.55	.22	11	.83	.28
6	.81	.622	1.40	.58	11	.40	-.15

Table 4.6.4. cont'd.

Fleet : Spanish bottom Trawl

Age	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993
0 ,	99.99,	.62,	.28,	99.99,	2.45,	-.03,	.57,	2.45,	-2.03,	-4.05
1 ,	99.99,	-3.19,	3.80,	99.99,	-1.77,	-.25,	.68,	1.29,	-1.94,	1.19
2 ,	99.99,	.07,	-.67,	99.99,	1.17,	-.35,	-.62,	-1.48,	1.01,	.83
3 ,	99.99,	.70,	-.13,	99.99,	.25,	.05,	-.62,	-.06,	.20,	-.27
4 ,	99.99,	.57,	.66,	99.99,	-.76,	-.94,	.24,	.89,	.81,	-1.35
5 ,	99.99,	.48,	.05,	99.99,	-.82,	-.55,	-.16,	.70,	.93,	-.59
6 ,	99.99,	-.09,	1.39,	99.99,	1.87,	-.86,	-2.40,	.69,	1.06,	-1.45
7 ,	99.99,	-.54,	-.75,	99.99,	.27,	-.12,	-.16,	.65,	1.03,	-.55
8 ,	No data for this fleet at this age									
9 ,	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age ,	2,	3,	4,	5,	6,	7
Mean Log q,	-3.7885,	-4.6102,	-5.1692,	-5.7172,	-6.3255,	-6.5424,
S.E(Log q),	.9607,	.3834,	.9023,	.6557,	1.5132,	.6308,

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
0,	1.74,	-.340,	-3.56,	.04,	8,	2.42,	-1.82,
1,	-2.23,	-1.513,	20.49,	.04,	8,	2.36,	-3.64,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	31.92,	-1.348,	******,	.00,	8,	28.93,	-3.79,
3,	.69,	1.569,	5.80,	.82,	8,	.24,	-4.61,
4,	-3.63,	-1.938,	17.96,	.03,	8,	2.75,	-5.17,
5,	-15.44,	-2.615,	31.62,	.00,	8,	7.38,	-5.72,
6,	-1.06,	-1.257,	7.28,	.06,	8,	1.54,	-6.33,
7,	2.59,	-1.083,	7.27,	.08,	8,	1.61,	-6.54,

Table 4.6.4. cont'd.

Fleet : Norwegian Sea acoust

Age	1981	1982	1983
0	-.63	-.36	-.29
1	-.25	-.47	-.05
2	-.55	-.61	-.97
3	.50	-.34	-.89
4	.59	.78	-.63
5	.65	.97	.04
6	.98	1.44	-.27
7	.99	1.23	.05
8	.86	.85	.08
9	.49	.15	-.34

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
0	.16	.46	.55	.82	.78	-.06	99.99	99.99	-.65	-1.06
1	-.11	-.04	-.03	.30	.49	-.22	99.99	99.99	.00	.05
2	1.43	1.73	.05	.90	.46	-.10	99.99	99.99	-.25	-2.19
3	-.44	1.18	.31	.54	.20	-.91	99.99	99.99	.39	-.56
4	-.81	-.38	1.13	.45	.41	-1.35	99.99	99.99	-.57	.70
5	-.45	-.17	1.44	.20	-.56	-1.02	99.99	99.99	-.94	.60
6	-.21	-.72	1.43	.17	-.84	-1.02	99.99	99.99	-.49	.49
7	-.30	-.47	.59	.37	-.04	-1.51	99.99	99.99	-.44	.49
8	-1.59	-.65	.51	-.23	-.89	-.43	99.99	99.99	-2.09	-.26
9	-1.50	1.05	.17	.04	.51	99.99	99.99	99.99	-1.53	.68

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6	7	8	9
Mean Log q	-.9630	-.3229	-.1757	-.2857	-.4868	-.4849	-.4849	-.4849
S.E(Log q)	1.1590	.6780	.8240	.8145	.8745	.7639	1.0387	.9139

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
0	.12	1.880	8.77	.39	11	.71	-4.81
1	.36	3.435	6.02	.80	11	.27	-.86

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	.34	3.828	5.99	.83	11	.24	-.96
3	.52	2.724	4.26	.82	11	.26	-.32
4	.46	2.800	4.45	.79	11	.28	-.18
5	1.75	-.646	-5.11	.09	11	1.48	-.29
6	1.42	-.477	-2.21	.15	11	1.31	-.49
7	.69	1.207	2.27	.69	11	.51	-.48
8	.68	1.455	2.56	.74	11	.58	-.94
9	1.14	-.361	-.22	.52	10	1.11	-.53

Table 4.6.4. cont'd.

Blue Whiting Combined stock - Terminal year survivor and F summaries :

Age 0 Catchability dependent on age and year class strength

Year class = 1993

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
Norway Spawning Area,	1.,	.000,	.000,	.00,	0,	.000,	.000
USSR Spawning Area/A,	1.,	.000,	.000,	.00,	0,	.000,	.000
CPUE Spanish Pair Tr,	7073.,	5.337,	.000,	.00,	1,	.004,	.000
Spanish bottom Trawl,	117.,	3.083,	.000,	.00,	1,	.011,	.000
Norwegian Sea acoust,	2331.,	.838,	.000,	.00,	1,	.151,	.000
P shrinkage mean ,	7671.,	.53,,,,				.392,	.038
F shrinkage mean ,	9532.,	.50,,,,				.442,	.031

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
6733.,	.33,	.70,	5,	2.103,	.043

Age 1 Catchability dependent on age and year class strength

Year class = 1992

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
Norway Spawning Area,	1.,	.000,	.000,	.00,	0,	.000,	.000
USSR Spawning Area/A,	1.,	.000,	.000,	.00,	0,	.000,	.000
CPUE Spanish Pair Tr,	557.,	1.417,	2.057,	1.45,	2,	.023,	.423
Spanish bottom Trawl,	2673.,	1.871,	1.603,	.86,	2,	.013,	.104
Norwegian Sea acoust,	3401.,	.282,	.222,	.79,	2,	.572,	.083
P shrinkage mean ,	5838.,	.51,,,,				.194,	.049
F shrinkage mean ,	2886.,	.50,,,,				.198,	.097

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
3497.,	.22,	.21,	8,	.960,	.080

Age 2 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
Norway Spawning Area,	4732.,	1.123,	.000,	.00,	1,	.036,	.063
USSR Spawning Area/A,	1.,	.000,	.000,	.00,	0,	.000,	.000
CPUE Spanish Pair Tr,	3572.,	.462,	.274,	.59,	3,	.212,	.083
Spanish bottom Trawl,	5350.,	.902,	.725,	.80,	3,	.055,	.056
Norwegian Sea acoust,	2299.,	.291,	.527,	1.81,	2,	.493,	.126
F shrinkage mean ,	2023.,	.50,,,,				.204,	.142

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
2644.,	.21,	.19,	10,	.883,	.110

Table 4.6.4. cont'd.

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
Norway Spawning Area,	1091.,	.630,	.155,	.25,	2,	.098,	.437
USSR Spawning Area/A,	1986.,	.765,	.000,	.00,	1,	.068,	.263
CPUE Spanish Pair Tr,	4638.,	.390,	.178,	.46,	4,	.246,	.121
Spanish bottom Trawl,	2102.,	.371,	.270,	.73,	4,	.284,	.250
Norwegian Sea acoust,	1382.,	.617,	.134,	.22,	2,	.102,	.360
F shrinkage mean ,	1921.,	.50,,,,				.201,	.271

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
2246.,	.20,	.15,	14,	.754,	.236

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
Norway Spawning Area,	5275.,	.448,	.061,	.14,	3,	.147,	.238
USSR Spawning Area/A,	3977.,	.562,	.153,	.27,	2,	.093,	.305
CPUE Spanish Pair Tr,	1823.,	.343,	.208,	.61,	5,	.226,	.576
Spanish bottom Trawl,	2519.,	.349,	.354,	1.02,	5,	.217,	.447
Norwegian Sea acoust,	4646.,	.461,	.204,	.44,	3,	.124,	.266
F shrinkage mean ,	3608.,	.50,,,,				.191,	.332

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
3149.,	.18,	.13,	19,	.740,	.372

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1988

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
Norway Spawning Area,	660.,	.384,	.260,	.68,	4,	.139,	.450
USSR Spawning Area/A,	1266.,	.467,	.093,	.20,	3,	.096,	.259
CPUE Spanish Pair Tr,	761.,	.296,	.133,	.45,	6,	.227,	.400
Spanish bottom Trawl,	637.,	.321,	.215,	.67,	6,	.181,	.463
Norwegian Sea acoust,	713.,	.271,	.250,	.92,	4,	.200,	.422
F shrinkage mean ,	671.,	.50,,,,				.158,	.443

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
734.,	.15,	.08,	24,	.572,	.412

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1987

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
Norway Spawning Area,	435.,	.363,	.319,	.88,	5,	.135,	.368
USSR Spawning Area/A,	486.,	.391,	.279,	.72,	4,	.131,	.336
CPUE Spanish Pair Tr,	447.,	.263,	.119,	.45,	7,	.272,	.360
Spanish bottom Trawl,	375.,	.320,	.368,	1.15,	6,	.146,	.417
Norwegian Sea acoust,	525.,	.281,	.271,	.96,	5,	.168,	.314
F shrinkage mean ,	207.,	.50,,,,				.149,	.661

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
402.,	.14,	.12,	28,	.812,	.393

Table 4.6.4. cont'd.

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1986

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
Norway Spawning Area,	243.,	.367,	.257,	.70,	6,	.154,	.384
USSR Spawning Area/A,	188.,	.389,	.436,	1.12,	5,	.140,	.473
CPUE Spanish Pair Tr,	198.,	.283,	.139,	.49,	7,	.202,	.455
Spanish bottom Trawl,	203.,	.349,	.235,	.67,	7,	.161,	.445
Norwegian Sea acoust,	229.,	.339,	.210,	.62,	6,	.147,	.404
F shrinkage mean ,	161.,	.50,,,,				.196,	.535

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
200.,	.16,	.10,	32,	.613,	.451

Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1985

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
Norway Spawning Area,	122.,	.356,	.106,	.30,	7,	.215,	.368
USSR Spawning Area/A,	111.,	.400,	.241,	.60,	6,	.146,	.397
CPUE Spanish Pair Tr,	107.,	.281,	.141,	.50,	7,	.138,	.411
Spanish bottom Trawl,	169.,	.372,	.249,	.67,	7,	.120,	.279
Norwegian Sea acoust,	79.,	.370,	.160,	.43,	7,	.138,	.523
F shrinkage mean ,	65.,	.50,,,,				.242,	.609

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
99.,	.17,	.09,	35,	.500,	.436

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1984

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated
,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
Norway Spawning Area,	59.,	.372,	.231,	.62,	8,	.228,	.460
USSR Spawning Area/A,	51.,	.445,	.269,	.60,	7,	.145,	.512
CPUE Spanish Pair Tr,	50.,	.274,	.167,	.61,	7,	.086,	.526
Spanish bottom Trawl,	65.,	.473,	.383,	.81,	6,	.066,	.423
Norwegian Sea acoust,	51.,	.472,	.396,	.84,	8,	.135,	.513
F shrinkage mean ,	67.,	.50,,,,				.340,	.416

Weighted prediction :

Survivors,	Int,	Ext,	N,	Var,	F
at end of year,	s.e,	s.e,	,	Ratio,	
59.,	.21,	.10,	37,	.478,	.461

Table 4.6.5. Blue Whiting Combined stock. Fishing mortality at age 1981-1993 (from XSA).

Run title : BLUE WHITING COMBINED STOCK,INDEX FILE,UNSEXED,PLUSGROUP

At 23/09/1994 9:26

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1981,	1982,	1983,
AGE			
0,	.0096,	.1718,	.0197,
1,	.0814,	.0370,	.1612,
2,	.1000,	.1165,	.1938,
3,	.1673,	.1282,	.1611,
4,	.1237,	.1972,	.1585,
5,	.2717,	.1360,	.1569,
6,	.2951,	.2133,	.2292,
7,	.2412,	.2225,	.3594,
8,	.3041,	.2163,	.3964,
9,	.2606,	.2163,	.2796,
+gp,	.2606,	.2163,	.2796,
FBAR 3- 7,	.2198,	.1794,	.2130,

Table 8 Fishing mortality (F) at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	FBAR 91-93
AGE											
0,	.0493,	.1362,	.0092,	.0527,	.0059,	.1023,	.0127,	.0292,	.0037,	.0434,	.0254,
1,	.1359,	.1483,	.1039,	.1189,	.0860,	.1468,	.1152,	.0430,	.0913,	.0805,	.0716,
2,	.2460,	.1728,	.1303,	.1266,	.1423,	.2050,	.1707,	.1087,	.0803,	.1104,	.0998,
3,	.2352,	.3319,	.2355,	.1644,	.1925,	.4265,	.3012,	.1752,	.2525,	.2361,	.2213,
4,	.2301,	.2429,	.5570,	.4011,	.2291,	.4065,	.4542,	.2080,	.3504,	.3720,	.3101,
5,	.2346,	.2595,	.5719,	.4862,	.5344,	.4868,	.5153,	.4062,	.2583,	.4123,	.3589,
6,	.3695,	.4521,	.4461,	.3983,	1.0524,	.6328,	.7508,	.5171,	.3220,	.3931,	.4107,
7,	.3163,	.3787,	.5747,	.4871,	.4563,	.7179,	.6076,	.4724,	.3969,	.4511,	.4401,
8,	.4389,	.3593,	.5679,	.8686,	.4893,	.5455,	1.2721,	.1709,	.5404,	.4362,	.3825,
9,	.3856,	.3920,	.7507,	.6651,	.6040,	.4519,	.6510,	.2245,	.5459,	.4614,	.4106,
+gp,	.3856,	.3920,	.7507,	.6651,	.6040,	.4519,	.6510,	.2245,	.5459,	.4614,	
FBAR 3-7,	.2771,	.3330,	.4771,	.3874,	.4930,	.5341,	.5258,	.3558,	.3160,	.3729,	

Table 4.6.6. Blue Whiting Combined stock. Stock size in number at age 1981-1993 (from XSA).

Run title : BLUE WHITING COMBINED STOCK,INDEX FILE,UNSEXED,PLUSGROUP

At 23/09/1994 9:26

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR,	1981,	1982,	1983,
AGE			
0,	5560,	24587,	24816,
1,	3647,	4509,	16952,
2,	4041,	2753,	3557,
3,	4886,	2994,	2006,
4,	3172,	3384,	2156,
5,	2545,	2295,	2275,
6,	2418,	1588,	1640,
7,	2403,	1474,	1051,
8,	2672,	1546,	966,
9,	2784,	1614,	1019,
+gp,	6990,	3805,	1504,
TOTAL,	41119,	50547,	57942,

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	GMST81-90	AMST81
AGE													
0,	13423,	10189,	10185,	7338,	8604,	22145,	7251,	6068,	5676,	8589,	0,	11696,	13410
1,	19922,	10461,	7280,	8263,	5700,	7003,	16368,	5861,	4825,	4630,	6733,	8627,	10010
2,	11814,	14238,	7384,	5372,	6007,	4282,	4951,	11943,	4597,	3606,	3497,	5658,	6440
3,	2400,	7563,	9808,	5307,	3875,	4265,	2856,	3417,	8771,	3473,	2644,	4090,	4596
4,	1398,	1553,	4443,	6345,	3686,	2617,	2280,	1730,	2348,	5579,	2246,	2814,	3103
5,	1506,	909,	997,	2084,	3478,	2400,	1427,	1185,	1151,	1354,	3149,	1842,	1992
6,	1592,	975,	574,	461,	1049,	1669,	1208,	698,	646,	728,	734,	1185,	1317
7,	1068,	901,	508,	301,	253,	300,	726,	467,	341,	384,	402,	705,	898
8,	600,	637,	505,	234,	151,	131,	120,	324,	238,	188,	200,	461,	756
9,	532,	317,	364,	234,	80,	76,	62,	27,	223,	114,	99,	347,	708
+gp,	874,	876,	821,	438,	120,	114,	217,	71,	39,	41,	80,		
TOTAL,	55128,	48619,	42870,	36378,	33005,	45004,	37464,	31792,	28855,	28684,	19784,		

Table 4.6.7. Blue Whiting Combined stock. Summary table from 1981-1993 (from XSA).

Run title : BLUE WHITING COMBINED STOCK,INDEX FILE,UNSEXED,PLUSGROUP

At 23/09/1994 9:26

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

,	RECRUITS, Age 0	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3-7,
1981,	5560,	5173,	4435,	909556,	205.0901,	.2198,
1982,	24587,	4091,	3172,	576419,	181.7097,	.1794,
1983,	24816,	3661,	2179,	570072,	261.6330,	.2130,
1984,	13423,	3428,	1805,	641776,	355.5745,	.2771,
1985,	10189,	3425,	2096,	695596,	331.8000,	.3330,
1986,	10185,	3578,	2397,	826986,	345.0707,	.4771,
1987,	7338,	3042,	1999,	664434,	332.3387,	.3874,
1988,	8604,	2655,	1658,	553413,	333.8503,	.4930,
1989,	22145,	2572,	1518,	625433,	412.0228,	.5341,
1990,	7251,	2550,	1315,	561610,	427.0071,	.5258,
1991,	6068,	3504,	1790,	369524,	206.4038,	.3558,
1992,	5676,	3044,	2336,	474445,	203.1248,	.3160,
1993,	8589,	2597,	1829,	514779,	281.4032,	.3729,
Arith. Mean ,	11879,	3332,	2195,	614157,	298.2330,	.3603,
Units,	(Millions),	('000 tonnes),	('000 tonnes),	(Tonnes),		

Table 4.6.8. Blue Whiting Combined stock. Input data for prediction and Y/R calculations, 1994.

14/09/1994
Blue Whiting Combined Stock (Bwh_p.dat)

List of input variables:

Proportion of F (fishing mortality) effective before spawning: .0000
Proportion of M (natural mortality) effective before spawning: .0000

Year	Recruitment
1995	11696
1996	11696

age	stock size	natural mortality	maturity ogive	Combined fishing pattern	Combined weight in the catch	weight in the stock
0	11696.0	.20	.00	.043	.034	.034
1	6733.0	.20	.11	.081	.066	.066
2	3497.0	.20	.42	.110	.084	.084
3	2644.0	.20	.95	.236	.117	.117
4	2246.0	.20	.99	.372	.141	.141
5	3149.0	.20	1.00	.412	.155	.155
6	734.0	.20	1.00	.393	.180	.180
7	402.0	.20	1.00	.451	.206	.206
8	200.0	.20	1.00	.436	.241	.241
9	99.0	.20	1.00	.461	.228	.228
10	80.0	.20	1.00	.461	.307	.307

Table 4.6.9. Blue Whiting Combined stock. Results from standard prediction.

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

14/09/1994
Blue Whiting Combined Stock (Bwh_p.dat)

Year 1994					Year 1995					Year 1996	
Combined					Combined						
factor	ref. F	catch	stock biomass	sp.stock biomass	factor	ref. F	catch	stock biomass	sp.stock biomass	stock biomass	sp.stock biomass
1.0	.373	472	2560	1578	.00	.00	0	2662	1460	3304	1951
					.05	.02	25		1460	3277	1927
					.10	.04	50		1460	3250	1903
					.15	.06	74		1460	3224	1879
					.20	.07	98		1460	3198	1856
					.25	.09	122		1460	3172	1833
					.30	.11	145		1460	3147	1811
					.35	.13	168		1460	3122	1789
					.40	.15	191		1460	3098	1767
					.45	.17	213		1460	3074	1746
					.50	.19	235		1460	3050	1725
					.55	.21	257		1460	3026	1704
					.60	.22	278		1460	3003	1684
					.65	.24	299		1460	2981	1664
					.70	.26	320		1460	2958	1644
					.75	.28	340		1460	2936	1625
					.80	.30	360		1460	2914	1606
					.85	.32	380		1460	2893	1587
					.90	.34	399		1460	2872	1568
					.95	.35	418		1460	2851	1550
					1.00	.37	437		1460	2830	1532
					1.05	.39	456		1460	2810	1515
					1.10	.41	474		1460	2790	1497
					1.15	.43	493		1460	2770	1480
					1.20	.45	510		1460	2751	1464
					1.25	.47	528		1460	2732	1447
					1.30	.48	545		1460	2713	1431
					1.35	.50	563		1460	2694	1415
					1.40	.52	579		1460	2676	1399
					1.45	.54	596		1460	2658	1384
					1.50	.56	612		1460	2640	1368
					1.55	.58	629		1460	2623	1353
					1.60	.60	645		1460	2605	1339
					1.65	.62	660		1460	2588	1324
					1.70	.63	676		1460	2571	1310
					1.75	.65	691		1460	2555	1296
					1.80	.67	706		1460	2538	1282
					1.85	.69	721		1460	2522	1268
					1.90	.71	736		1460	2506	1255
					1.95	.73	750		1460	2490	1241

The ref. F for Combined is the mean F (non-weighted) for the age group range from 3 to 7

Table 4.6.10. Management option table, BLUE WHITING combined. Effects of different levels of fishing mortality on catch, etc.

1994					1995						1996	
F factor	Ref F	Catch	TSB	SSB	Basis	F factor	Ref F	Catch	TSB	SSB	TSB	SSB
1.00	0.373	472	2560	1578	F(0.1)	0.52	0.194	241	2649	1447	3022	1698
					F(med)	0.81	0.300	358	2649	1447	2896	1587
					F(93),F(94)	1.00	0.373	433	2649	1447	2815	1517

Table 5.1. Total catches of BLUE WHITING in 1978-1993 divided into areas within and beyond areas of national fisheries jurisdiction of NEAFC contracting parties, as estimated by the Working Group members.

Year	International	Jan Mayen	Norway	Iceland	Greenland	Faroes	EU	Total (t)
1978	136,504	-	67,391	26,444	6,580	195,361	136,421	568,701
	(24%)		(12%)	(5%)	(1%)	(34%)	(24%)	
1979	614,734	-	75,545	15,117	204	224,201	191,564	1,121,365
	(55%)		(7%)	(1%)	(0%)	(20%)	(17%)	
1980	567,693	-	152,095	4,562	8,757	164,342	160,361	1,057,810
	(54%)		(14%)	(0%)	(1%)	(16%)	(15%)	
1981	168,681	123,000	215,004	7,751	-	174,801	203,223	892,460
	(19%)	(14%)	(24%)	(1%)		(20%)	(23%)	
1982	22,993	-	130,435	5,797	-	125,072	279,474	563,771
	(4%)		(23%)	(1%)		(22%)	(50%)	
1983	15,203	-	109,675	7,000	-	91,804	325,816	549,498
	(3%)		(20%)	(1%)		(17%)	(59%)	
1984	18,407	-	150,603	105	-	124,905	313,591	607,611
	(3%)		(25%)	(0%)		(21%)	(52%)	
1985	38,978	-	114,785	-	-	196,003	335,162	684,928
	(6%)		(17%)			(29%)	(49%)	
1986	20,665	-	187,768	-	116	171,074	408,338	787,961
	(3%)		(24%)		(0%)	(22%)	(52%)	
1987	103,535	-	109,201	-	-	135,980	267,045	615,761
	(17%)		(18%)			(22%)	(43%)	
1988	65,172	-	38,449	-	-	157,368	265,182	526,171
	(12%)		(7%)			(30%)	(50%)	
1989	137,093	-	68,817	4,977	-	101,177	318,033	630,097
	(22%)		(11%)	(1%)		(16%)	(50%)	
1990	88,509	-	39,160	-	-	115,308	318,710	561,687
	(16%)		(7%)			(21%)	(57%)	
1991	51,950	-	72,309	-	-	99,268	197,522	421,049
	(12%)		(17%)			(24%)	(47%)	
1992	47,786	-	66,333	-	-	135,294	253,754	503,167
	(9%)		(13%)			(27%)	(50%)	
1993	69,213	-	47,917	-	-	112,773	286,359	516,262
	(13%)		(9%)			(22%)	(55%)	

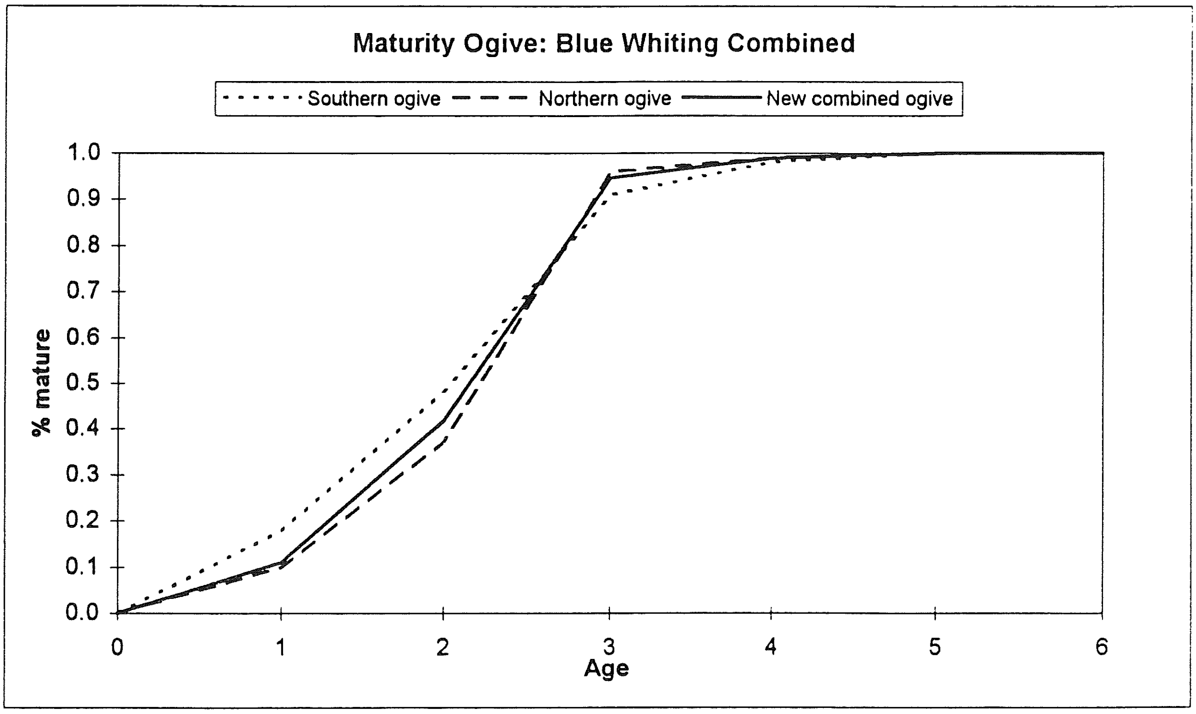


Figure 4.5.1. Blue Whiting. Maturity ogives from the Northern area and the Southern area, and the new Combined maturity ogive, as used in the assessment.

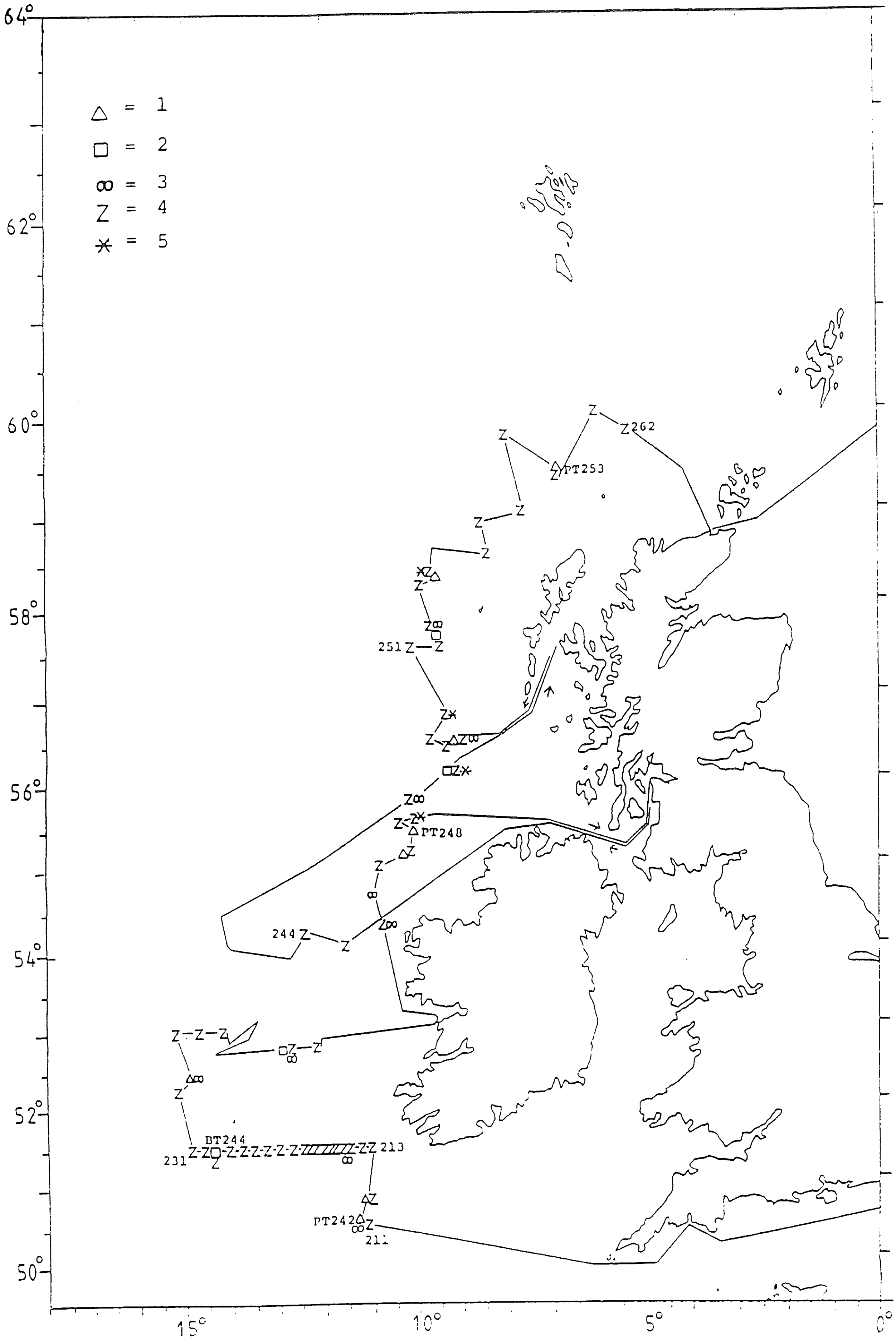


Figure 4.6.1. Cruise track and stations of R.V. "Johan Hjort", 25 March- 15 APRIL 1994. Symbols: 1) Pelagic trawl, 2) Bottom trawl, 3) Bongo net, 4) CTD sonde, 5) LHPR (Longhurst Plankton Recorder).

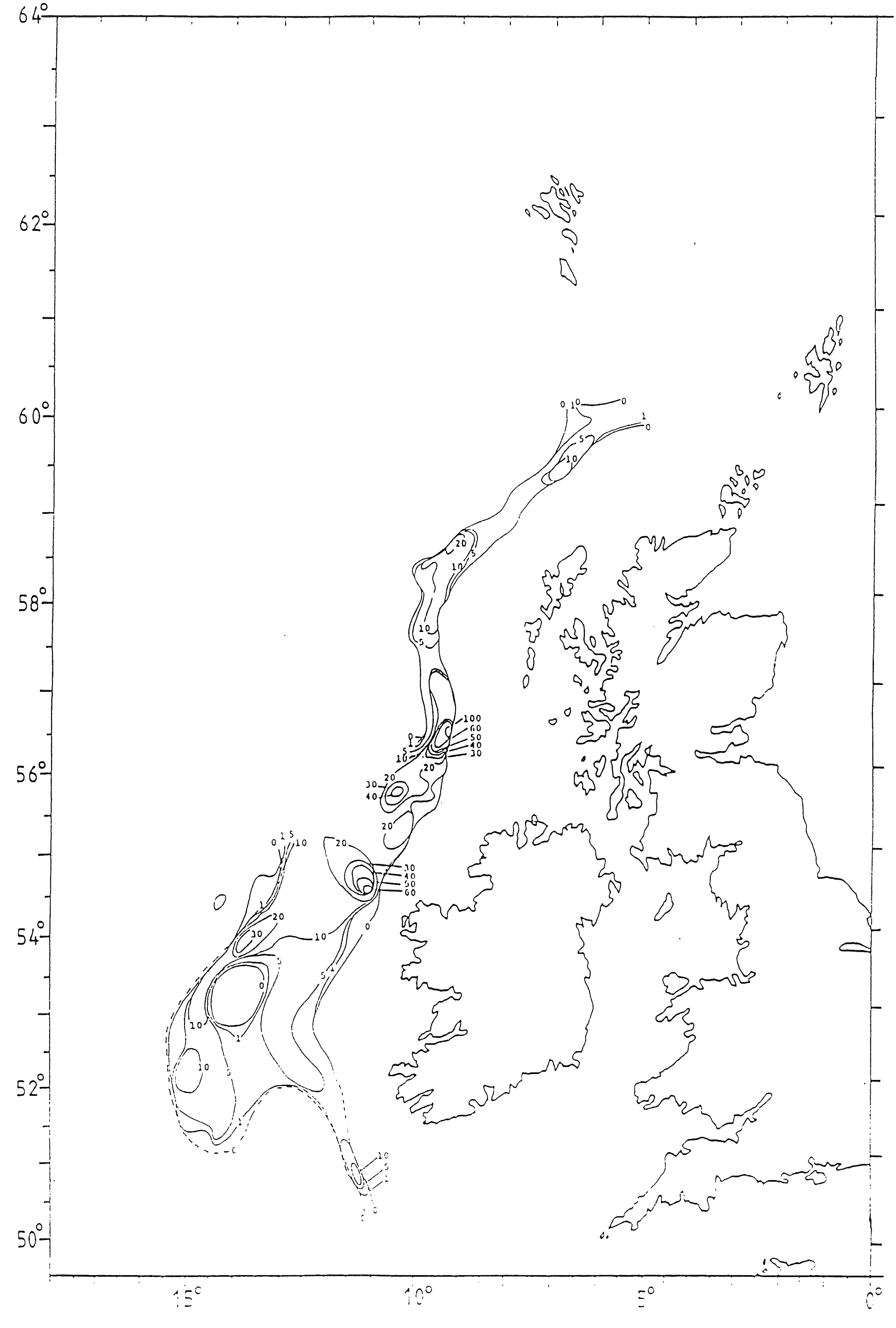


Figure 4.6.2. Density distribution of blue whiting in spring 1994. Echo intensity in square m per square nautical mile x 1/100.

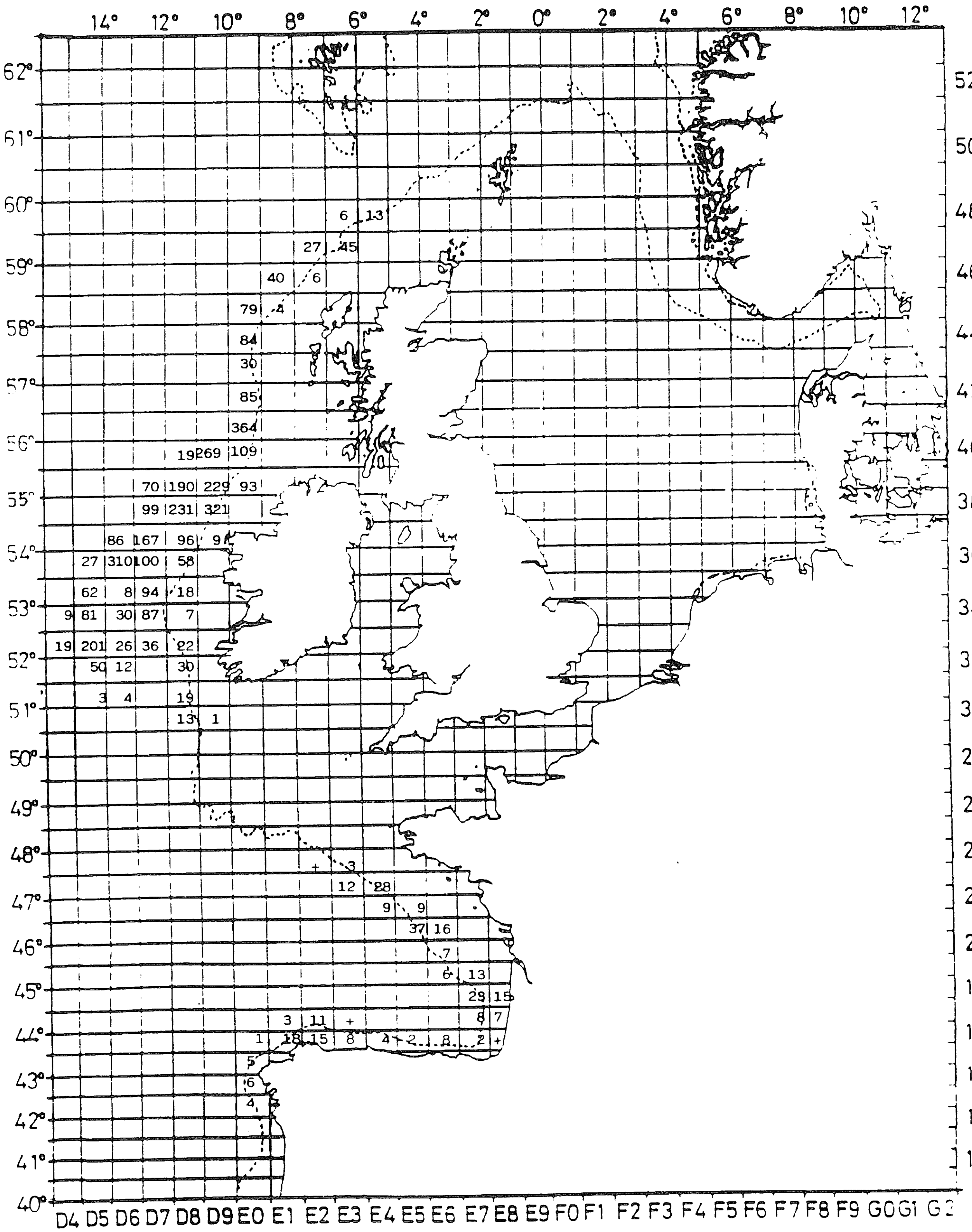


Figure 4.6.3. Blue Whiting biomass estimates ('000 tonnes) in spring 1994. The area between Biscaya and Porcupine was not surveyed.

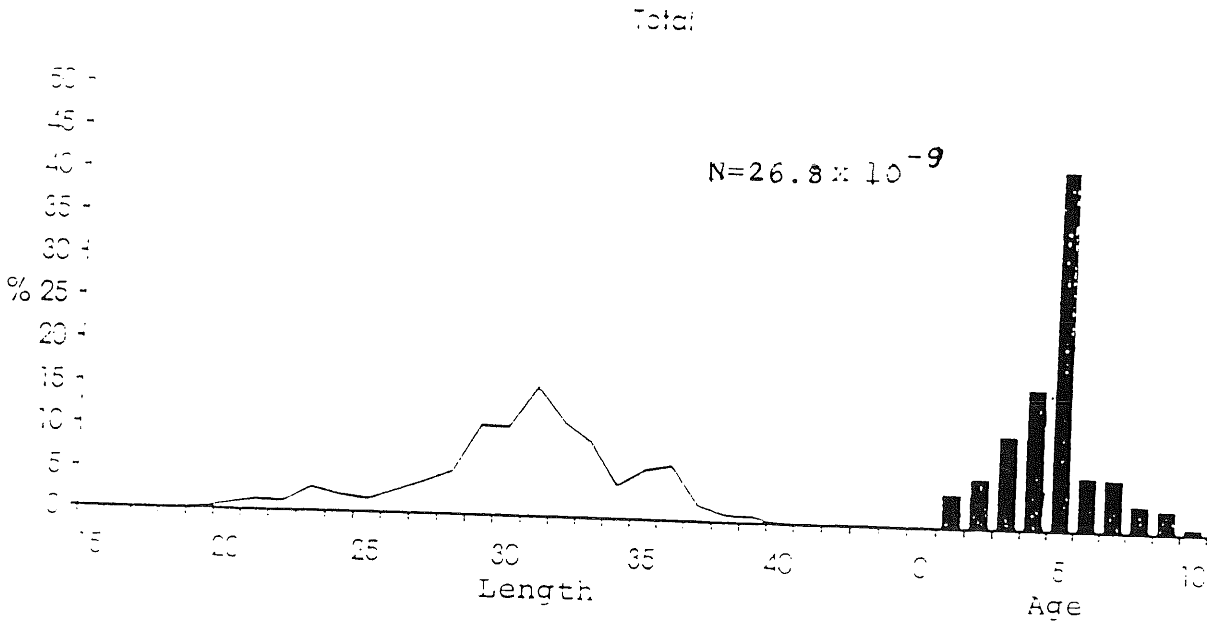
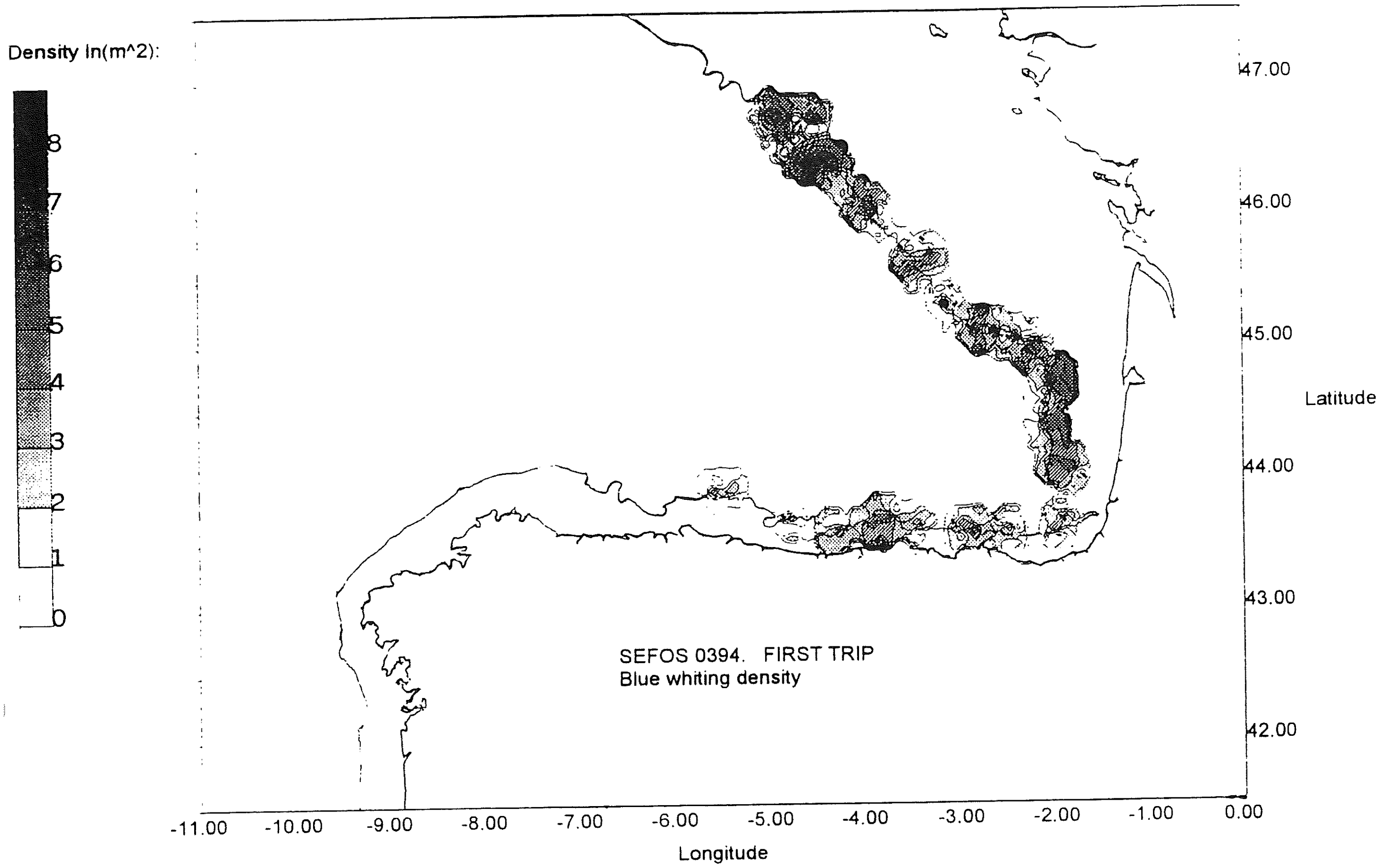


Figure 4.6.4. Total length and age distribution (N%) of blue whiting in the area west of The British Isles, spring 1994, weigthed by abundance.



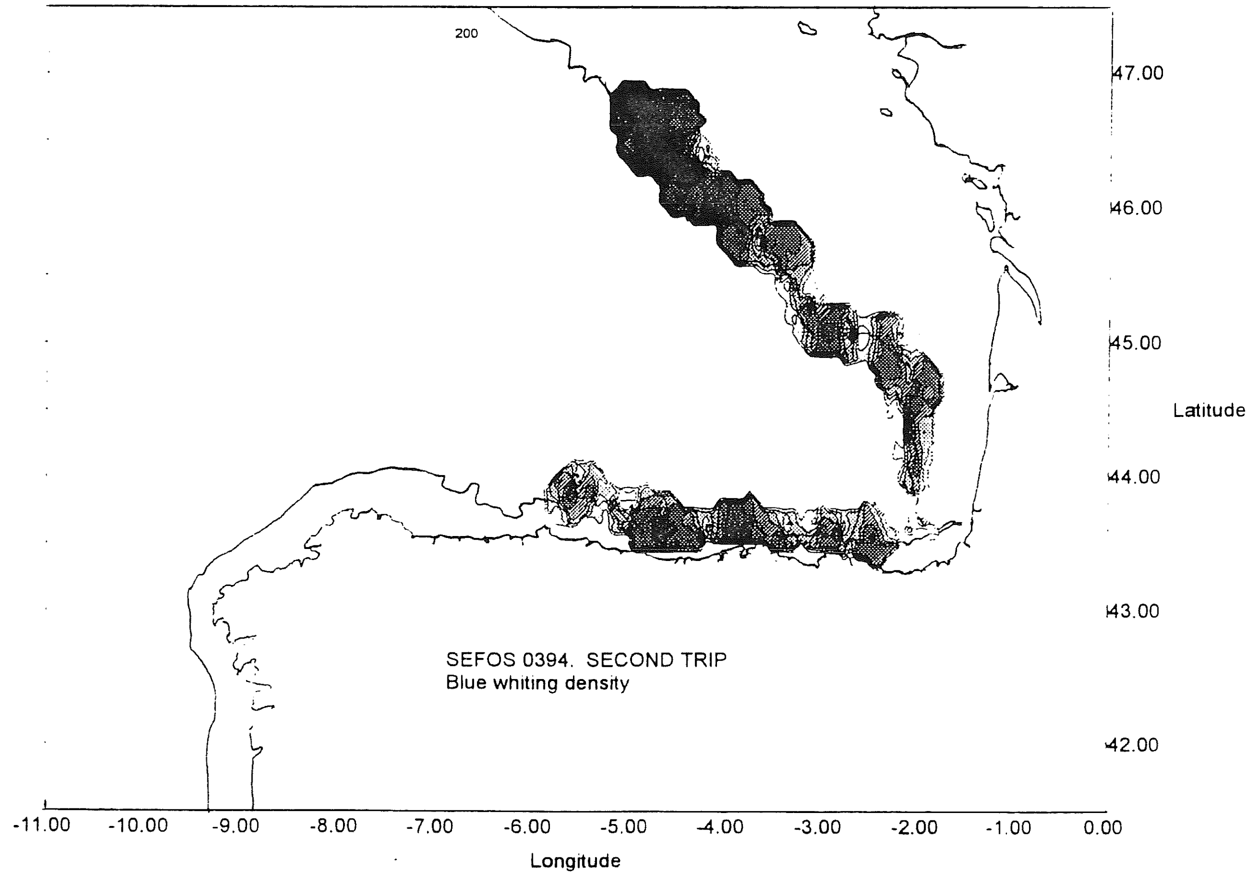
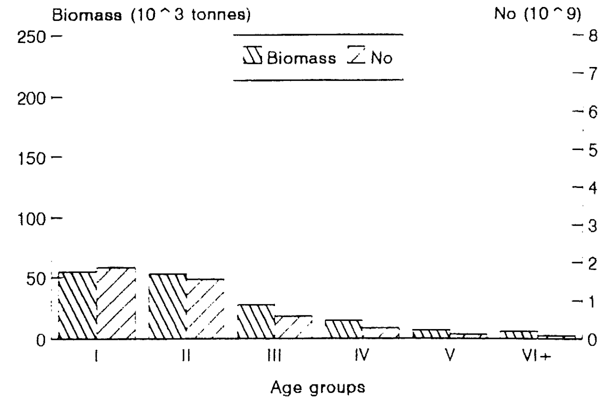
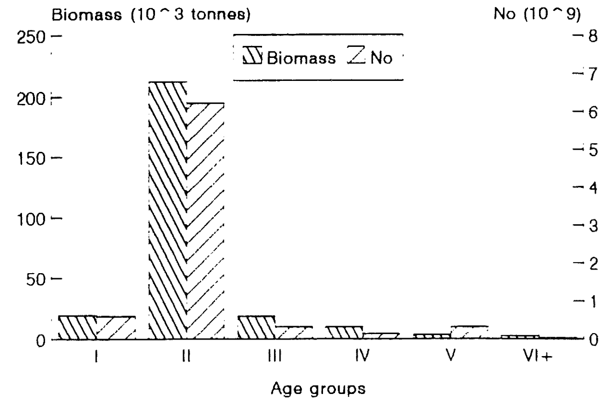


Figure 4.6.5. Blue Whiting in the Southern area. Density distribution in spring 1994. Comparison of areas covered tvice (15 March-14 April and 15-28 April).

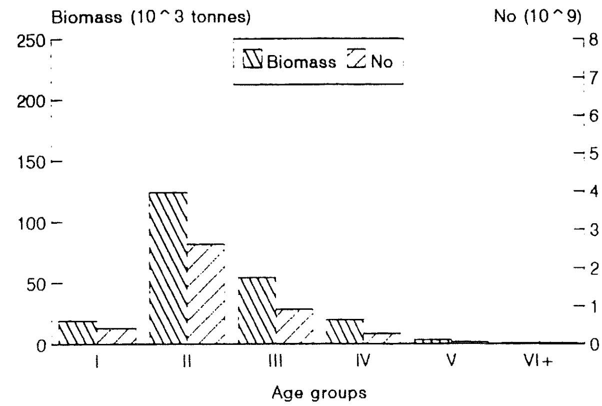
SURVEY: PELACUS 0391



SURVEY: PELACUS 0492



SURVEY: PELACUS 0493



SURVEY: SEFOS 0394

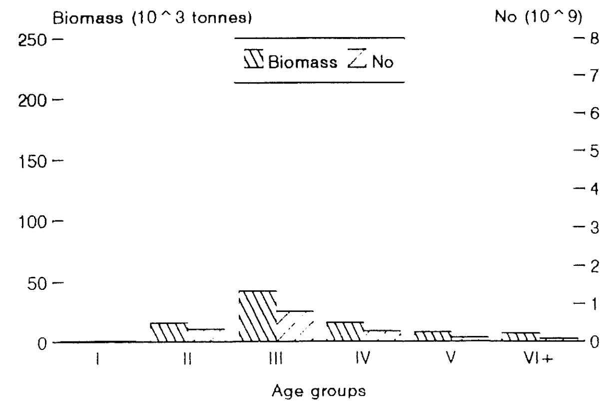


Figure 4.6.6. Blue Whiting in the Southern area. Biomass estimates and number by age group in spring surveys (only Divisions VIIIc and Ixa North).

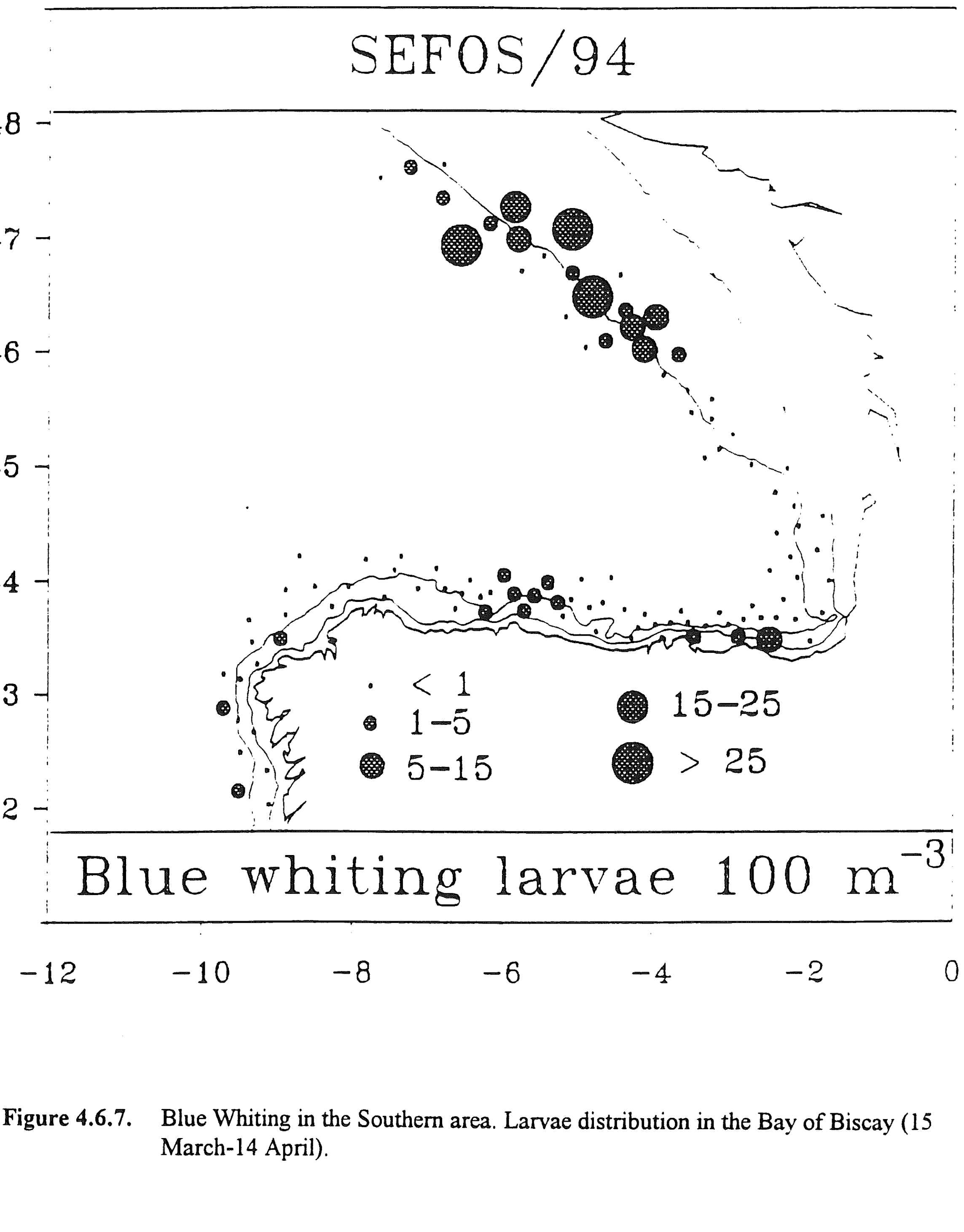


Figure 4.6.7. Blue Whiting in the Southern area. Larvae distribution in the Bay of Biscay (15 March-14 April).

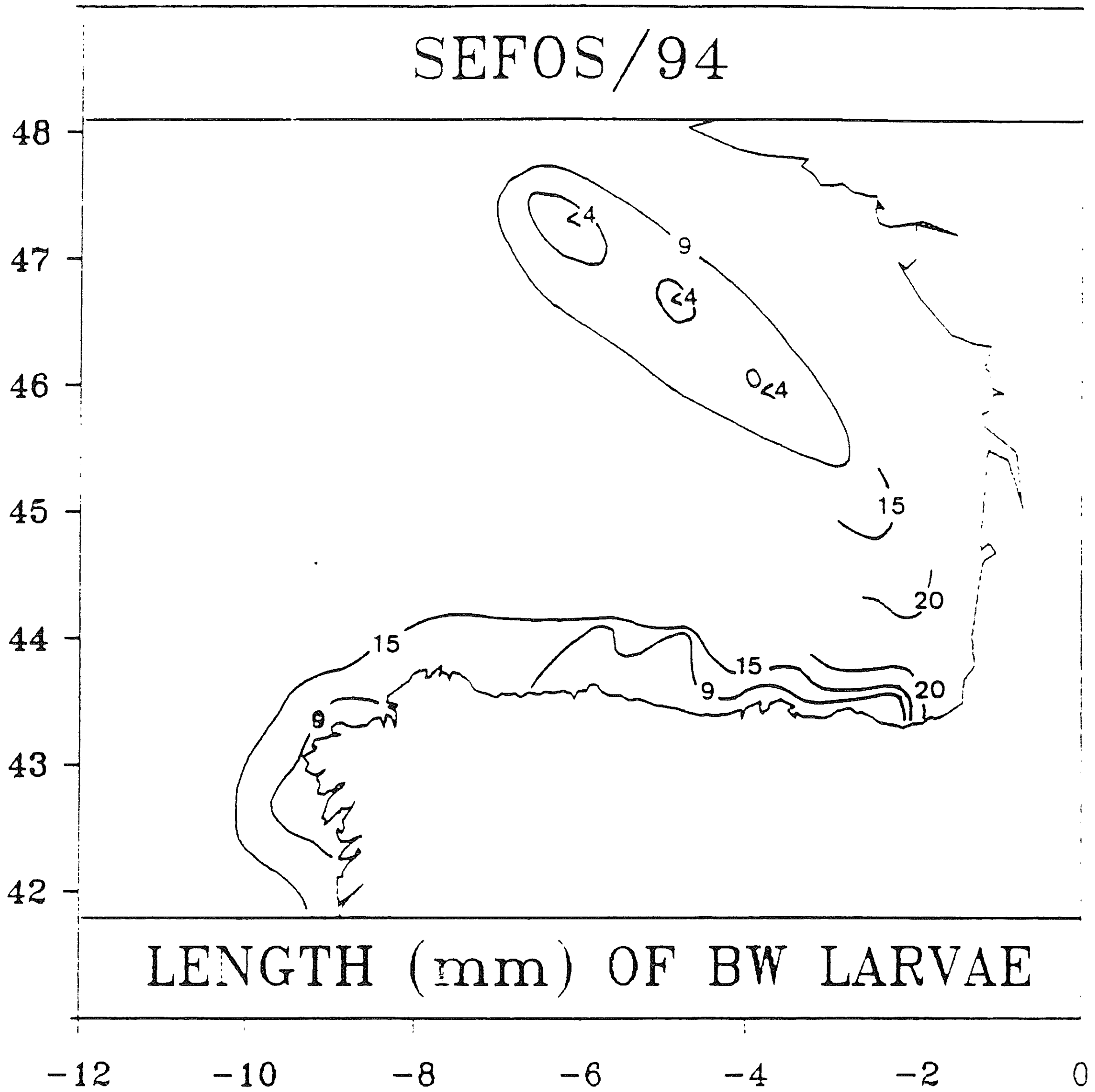


Figure 4.6.8. Blue Whiting in the Southern area. Size of larvae in the Bay of Biscay (15 March-14 April).

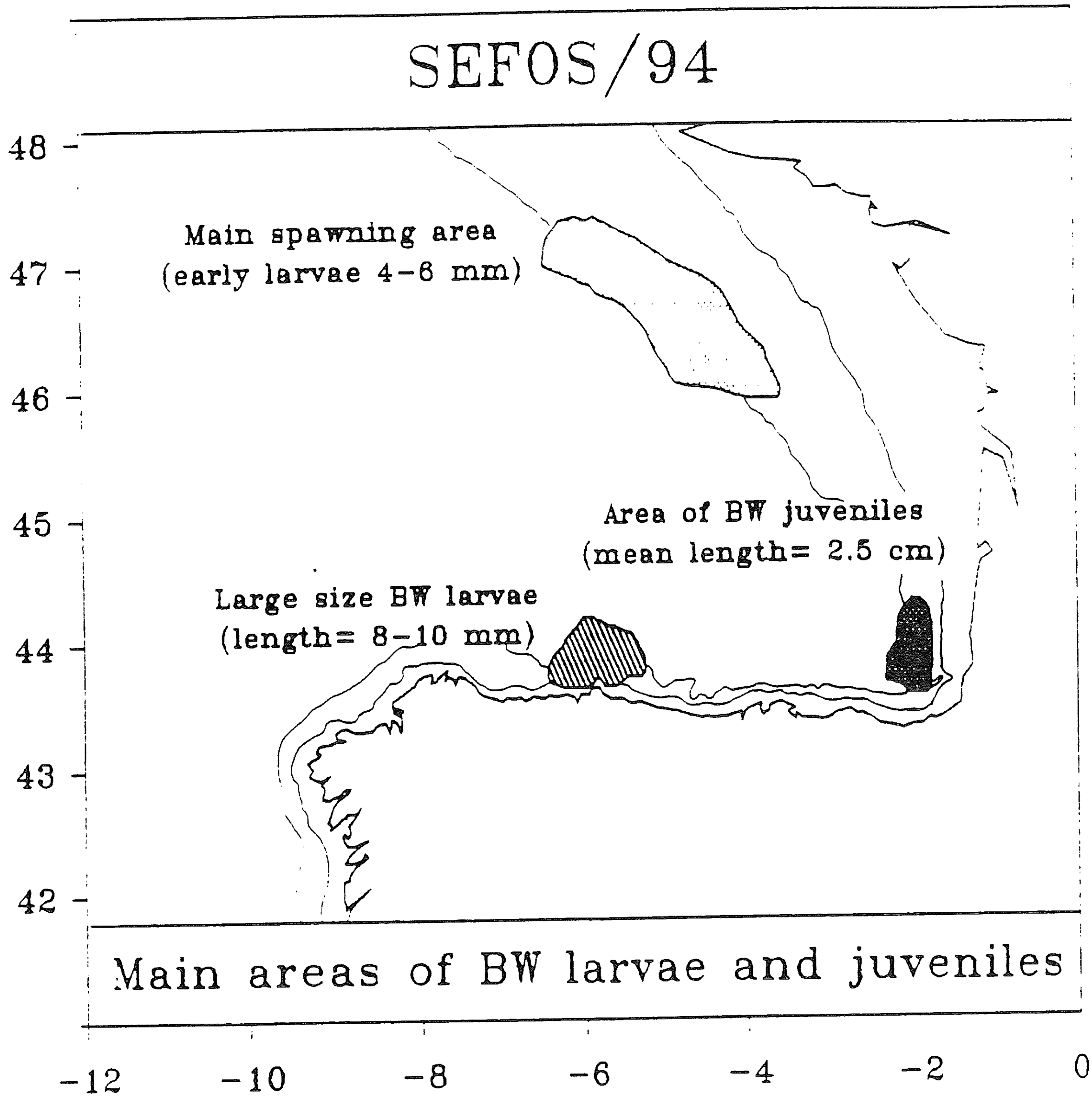


Figure 4.6.9. Blue Whiting in the Southern area. Distribution of larvae and postlarvae in the Bay of Biscay (15 March-14 April).

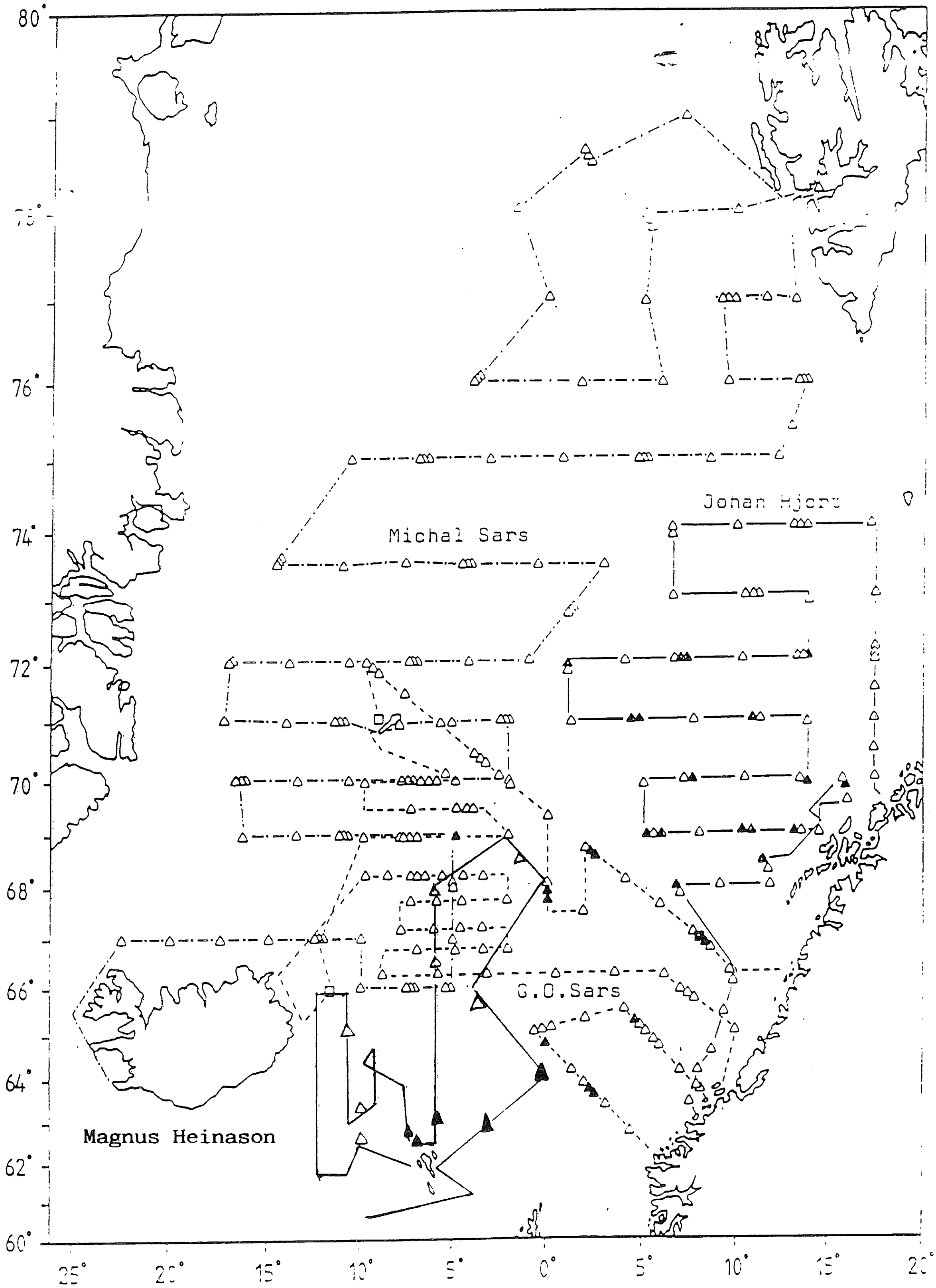


Figure 4.6.10. Cruise tracks and trawl stations of research vessels "G.O. Sars" 30 May-27 June, "Johan Hjort" 5-22 July, "Michael Sars" 16 July-15 August and "Magnus Heinason" August 1994. Triangle represents pelagic trawl and square bottom trawl stations.

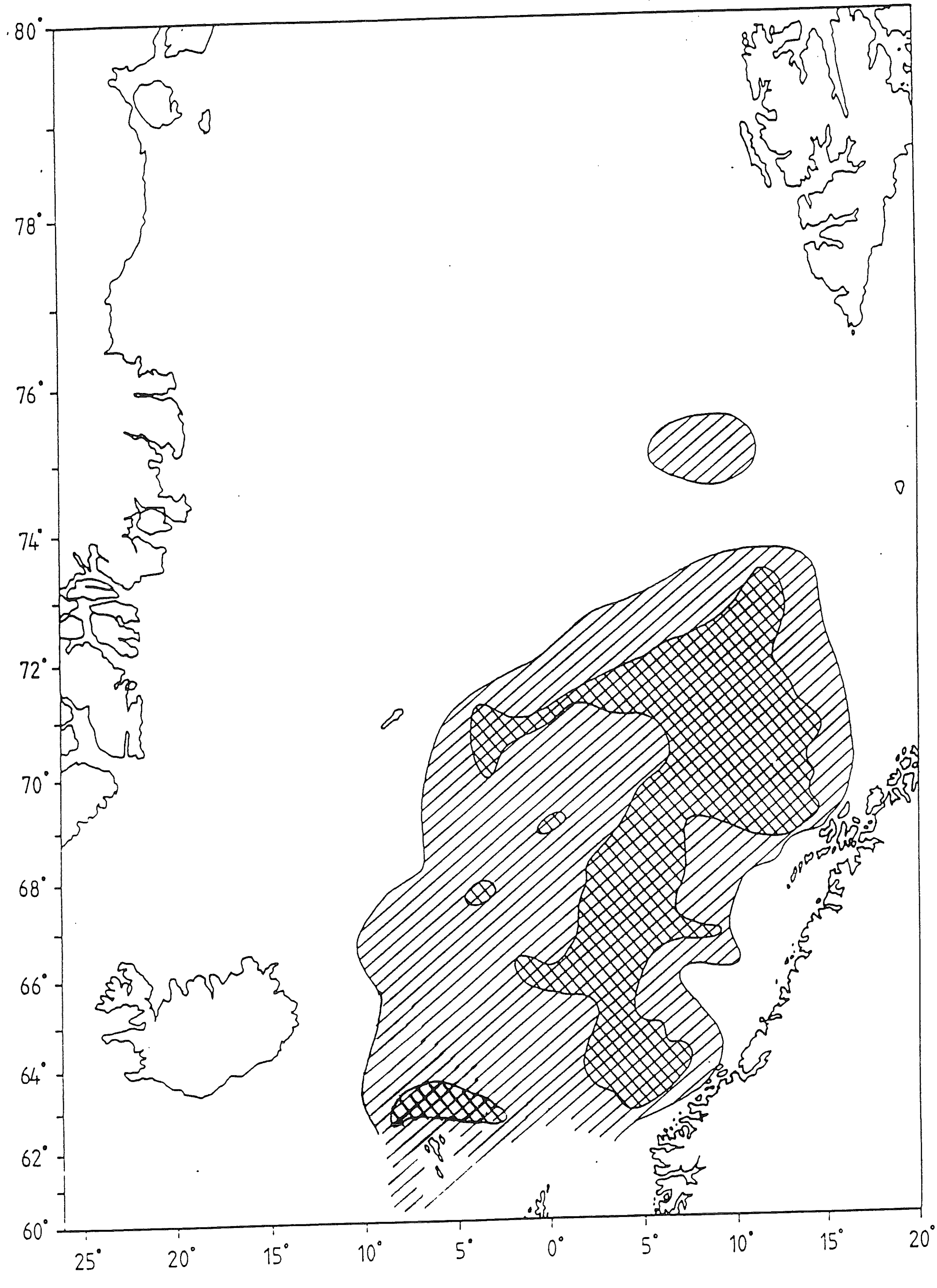


Figure 4.6.11. Disribution of blue whiting concentrations observed during summer 1994. Hatched area is weak recordings, with dobbel hatched some better.

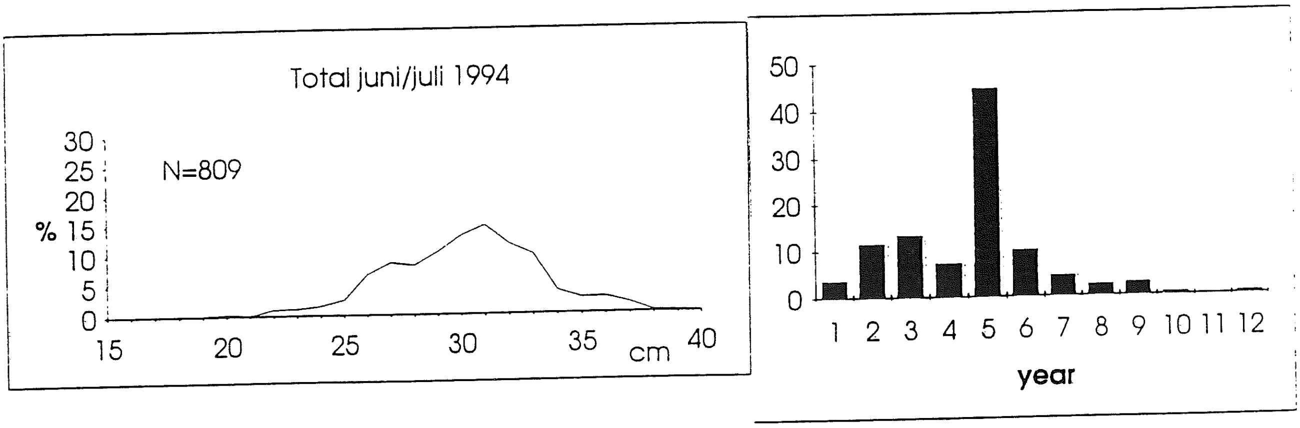


Figure 4.6.12. Total length and age composition of blue whiting in trawl catches from the Norwegian Sea during summer 1994.

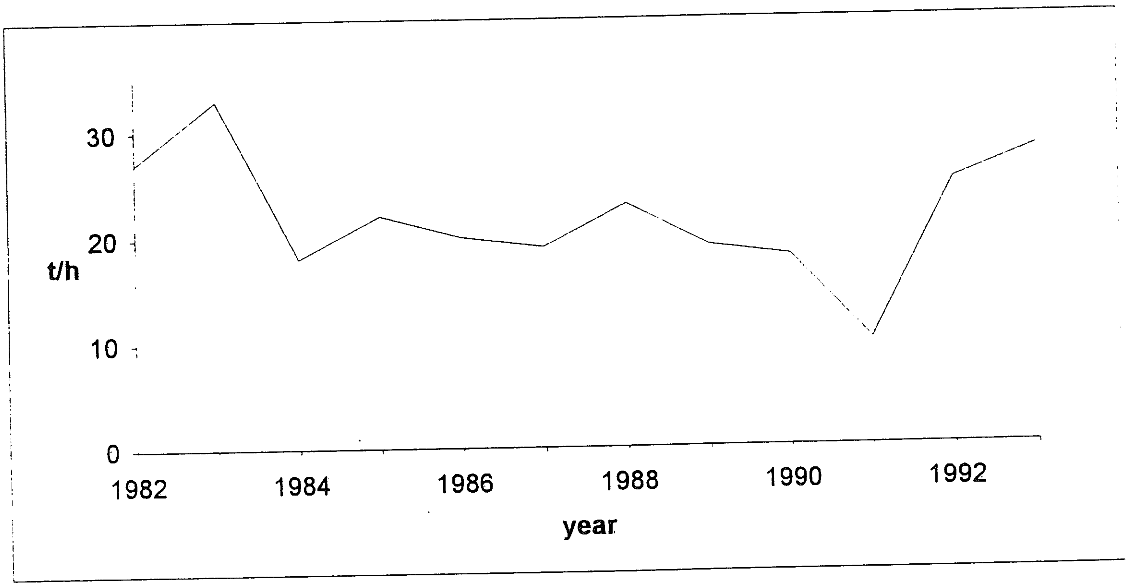


Figure 4.6.13. Blue Whiting. Overall aggregated CPUE from the Norwegian directed fishery from 1982-1993 (tonnes/hour).

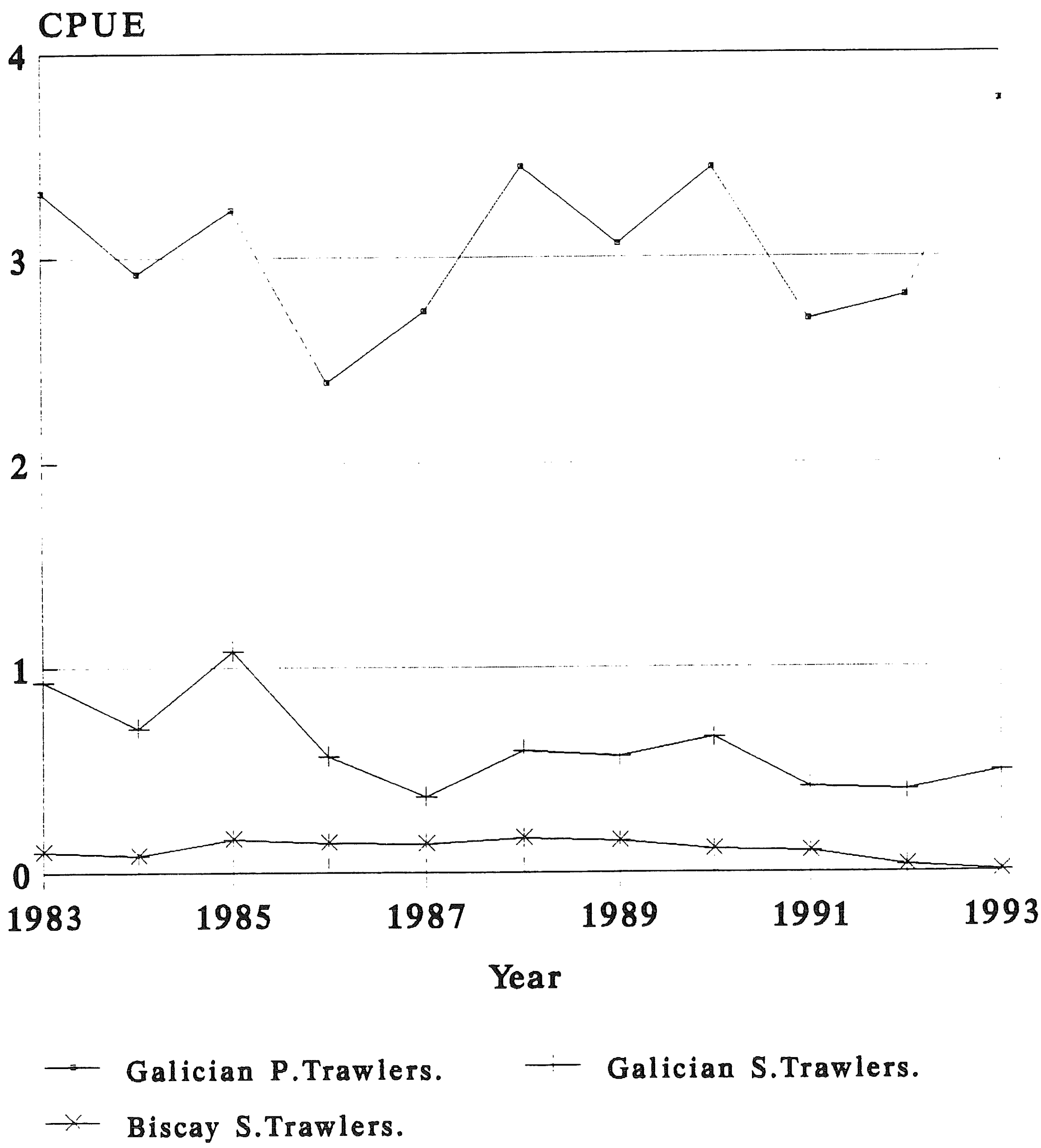


Figure 4.6.14. BLUE WHITING–CPUE of Spanish trawlers for Southern area
Galician Single and Pair trawlers in t/day
Bay of Biscay Single trawlers in t/(HPxdayx10^-2)

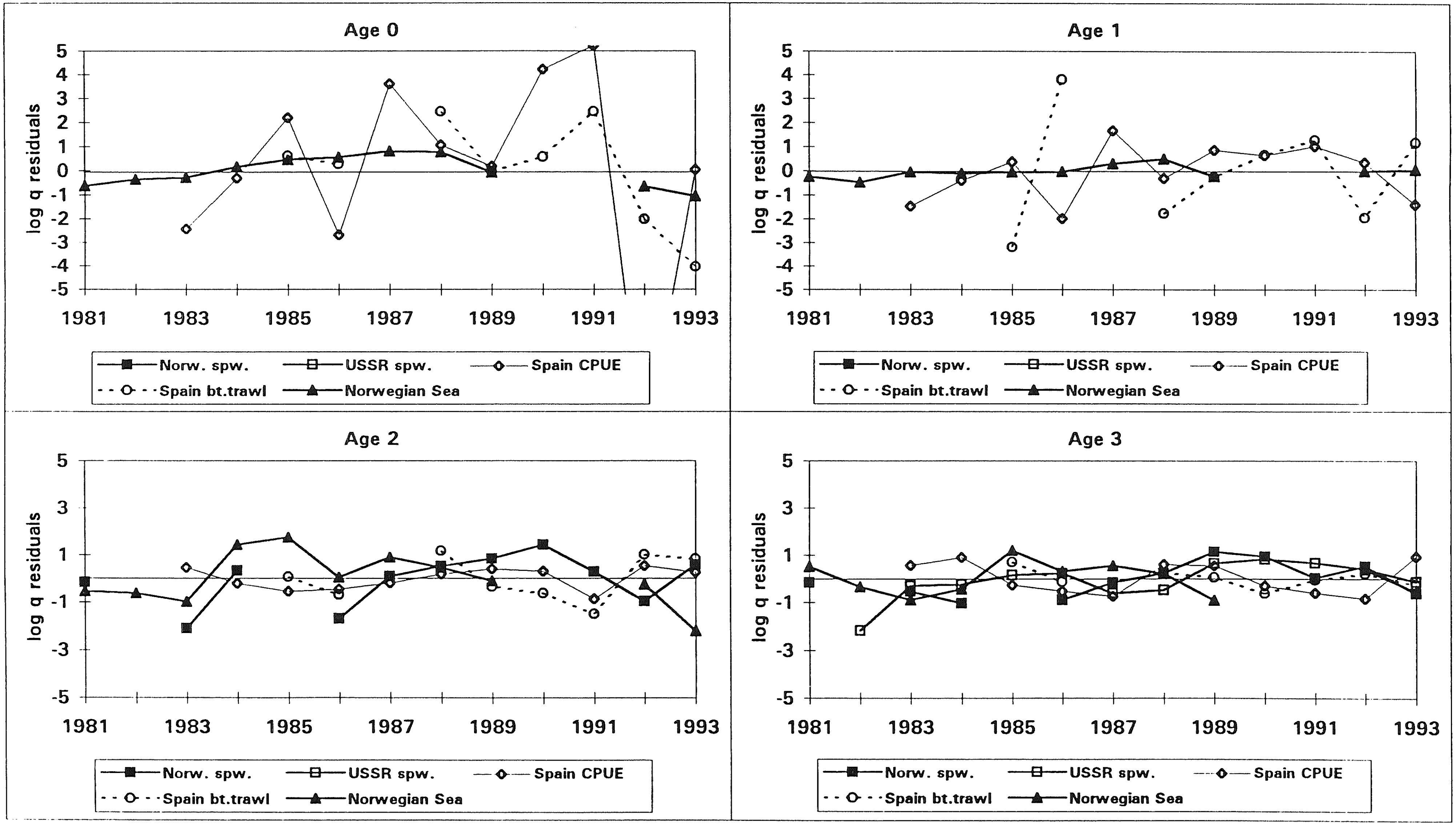


Figure 4.6.15. Blue Whiting Combined stock. Log q residuals for ages 0-9 from XSA-tuning.

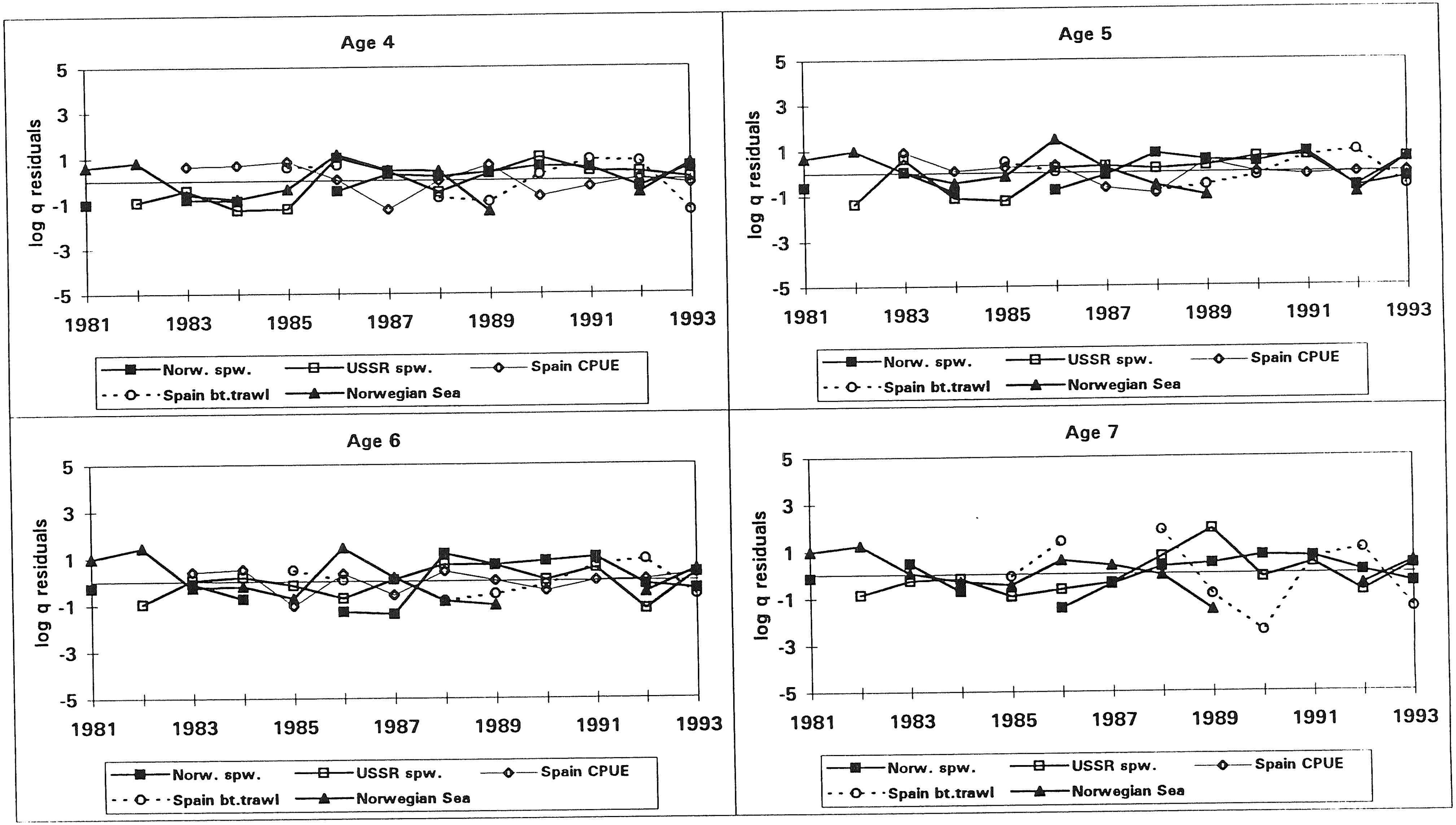


Figure 4.6.15. cont'd.

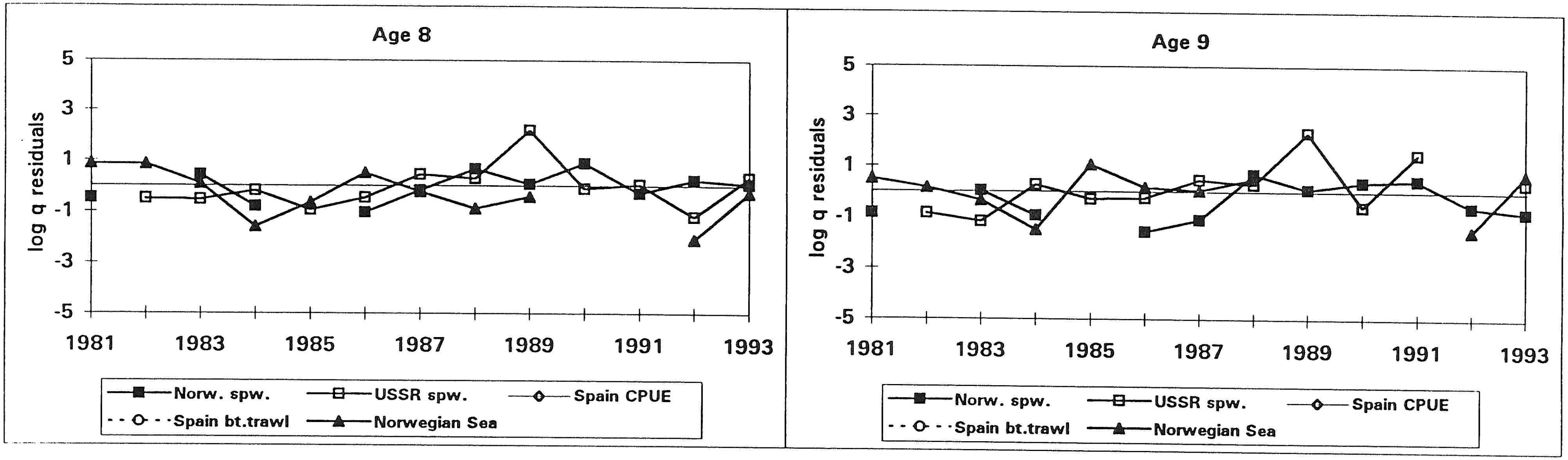


Figure 4.6.15. cont'd.

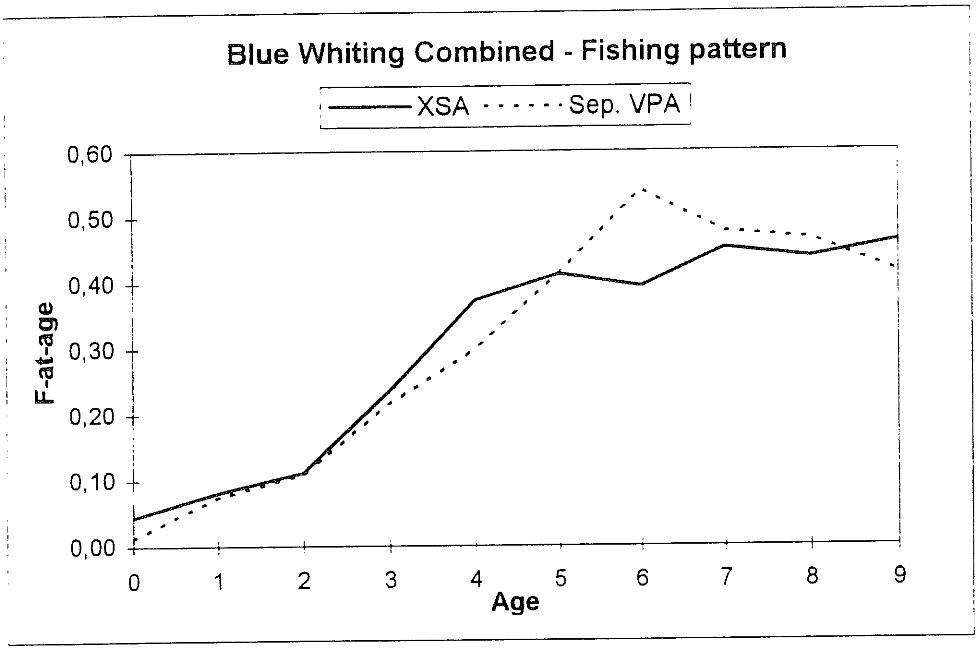
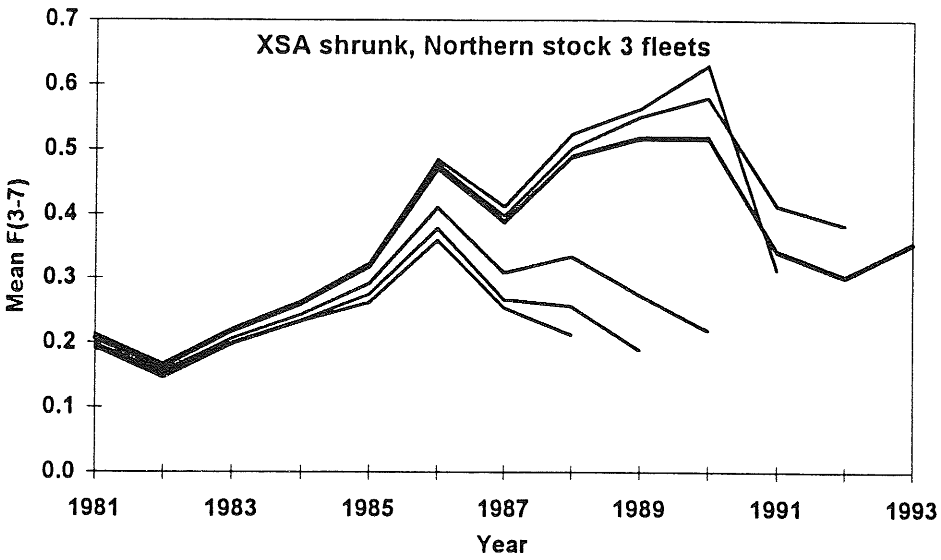


Figure 4.6.16. Blue Whiting Combined stock. Comparison of exploitation pattern from XSA and separable VPA.

a)



b)

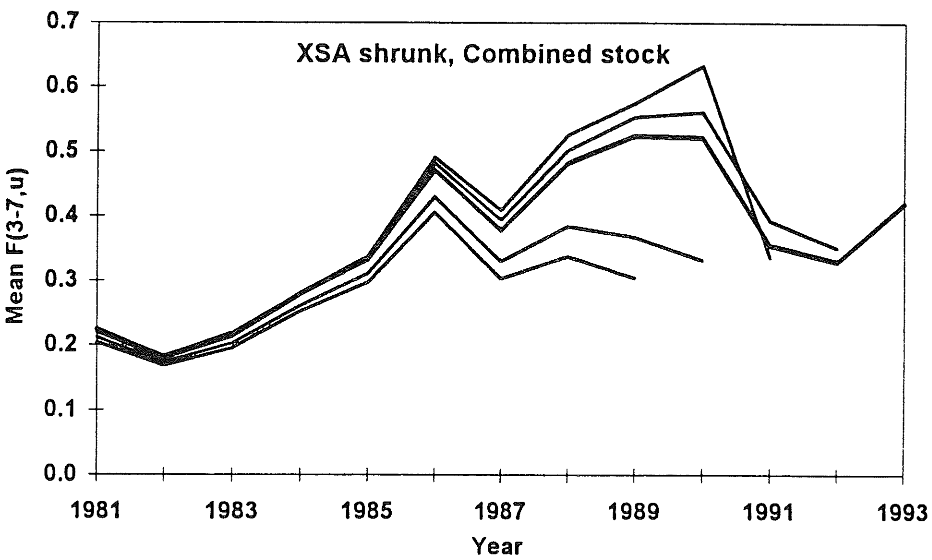


Figure 4.6.17 a-b. Blue Whiting. Comparison of retrospective analysis, shrunk XSA, from the Northern stock and the Combined stock.

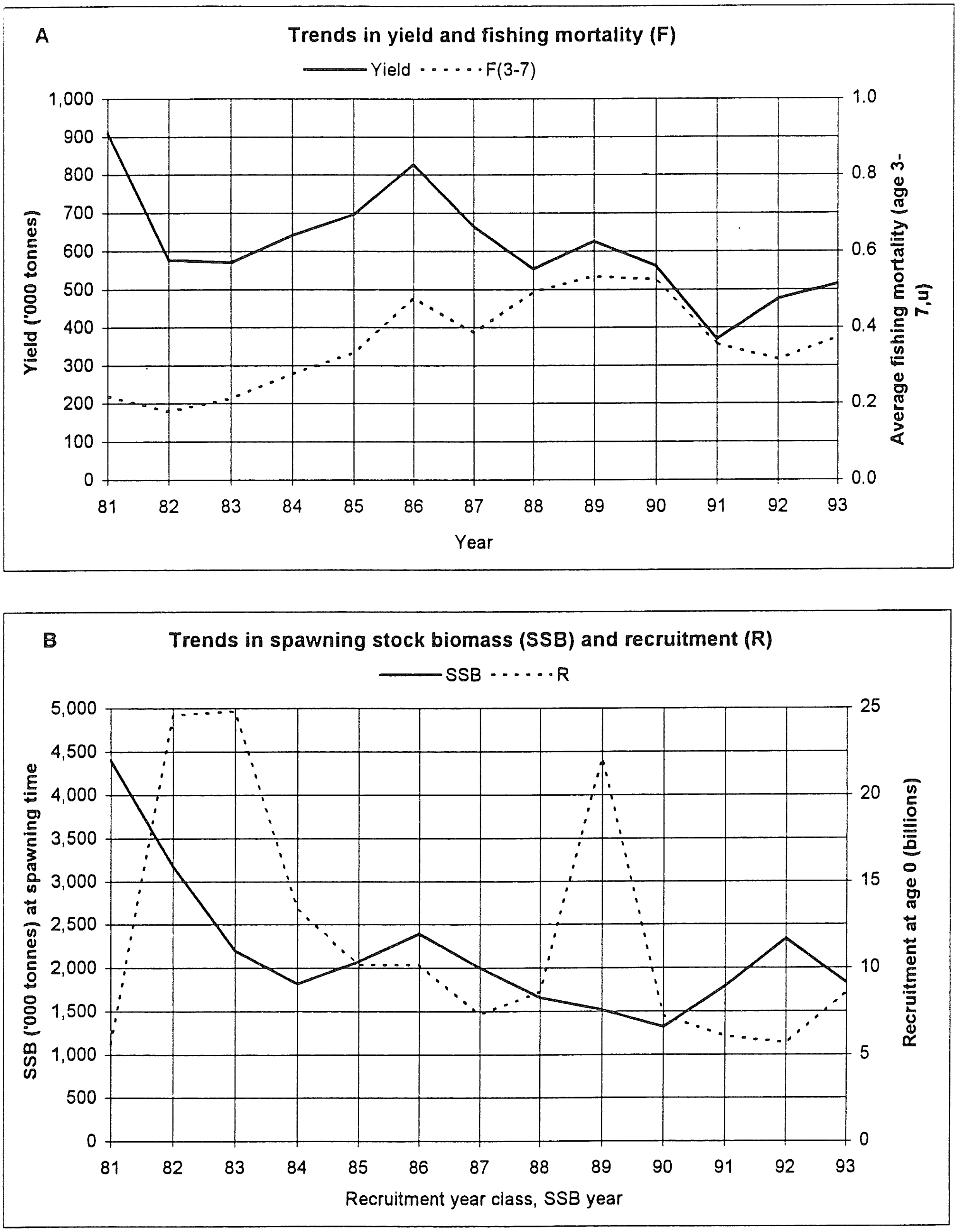
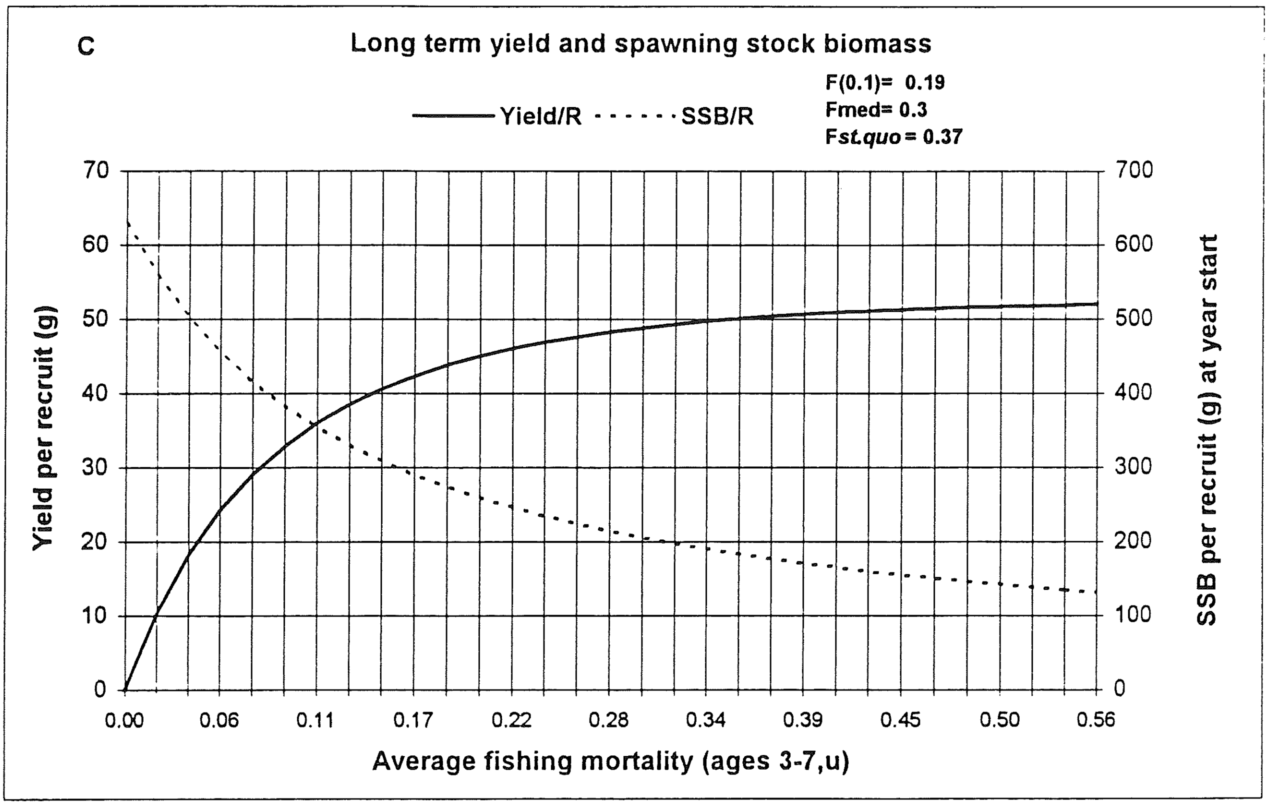


Figure 4.6.18 A-B. Blue Whiting Combined stock summary, 20/9-1994.



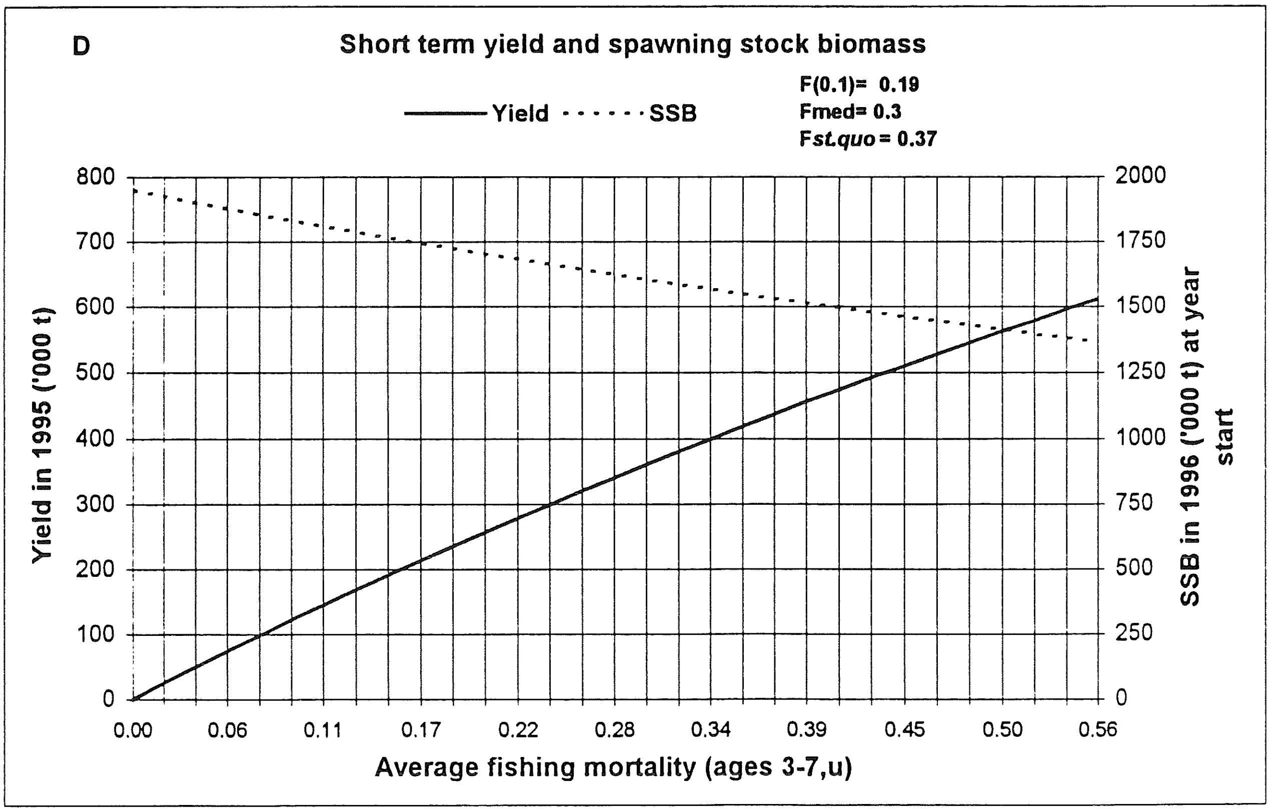


Figure 4.6.18 C-D. Blue Whiting Combined stock summary, 20/9-1994.

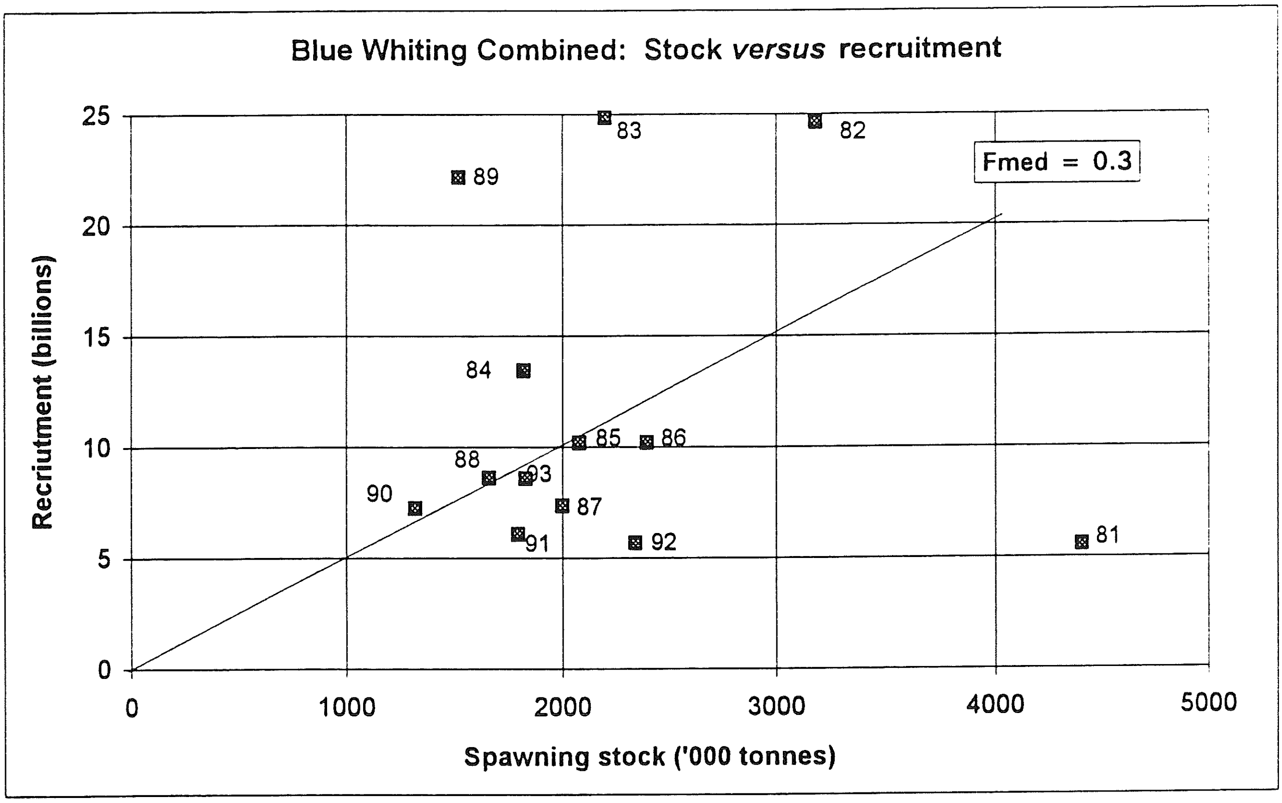


Figure 4.6.19. Blue Whiting Combined stock. Stock *versus* recruitment plot.

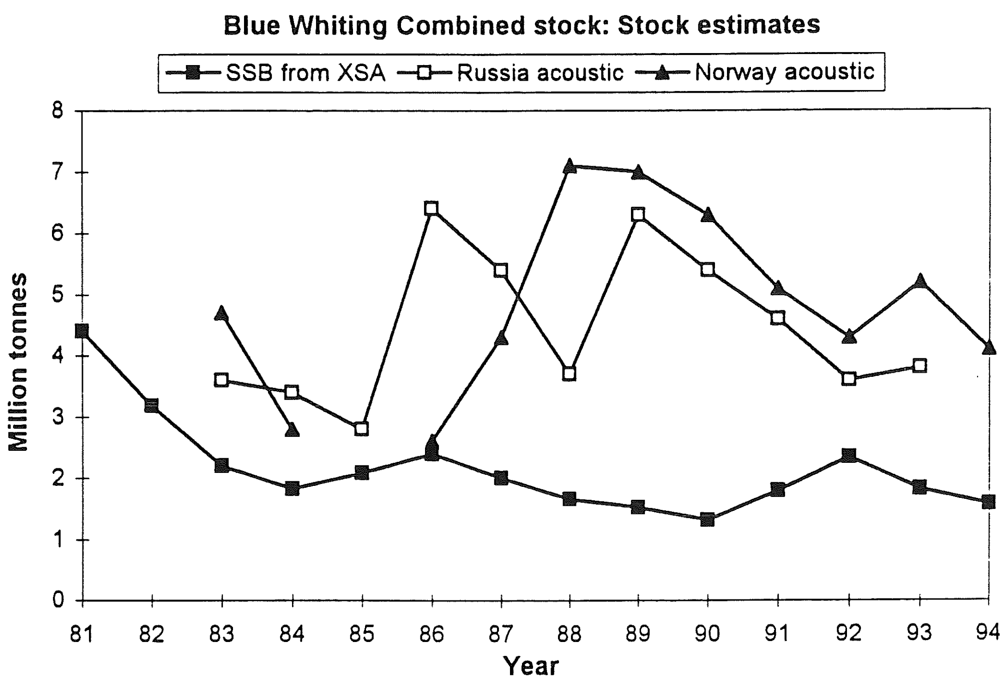


Figure 4.6.20. Blue Whiting Combined stock. SSB estimates from acoustic surveys and VPA.

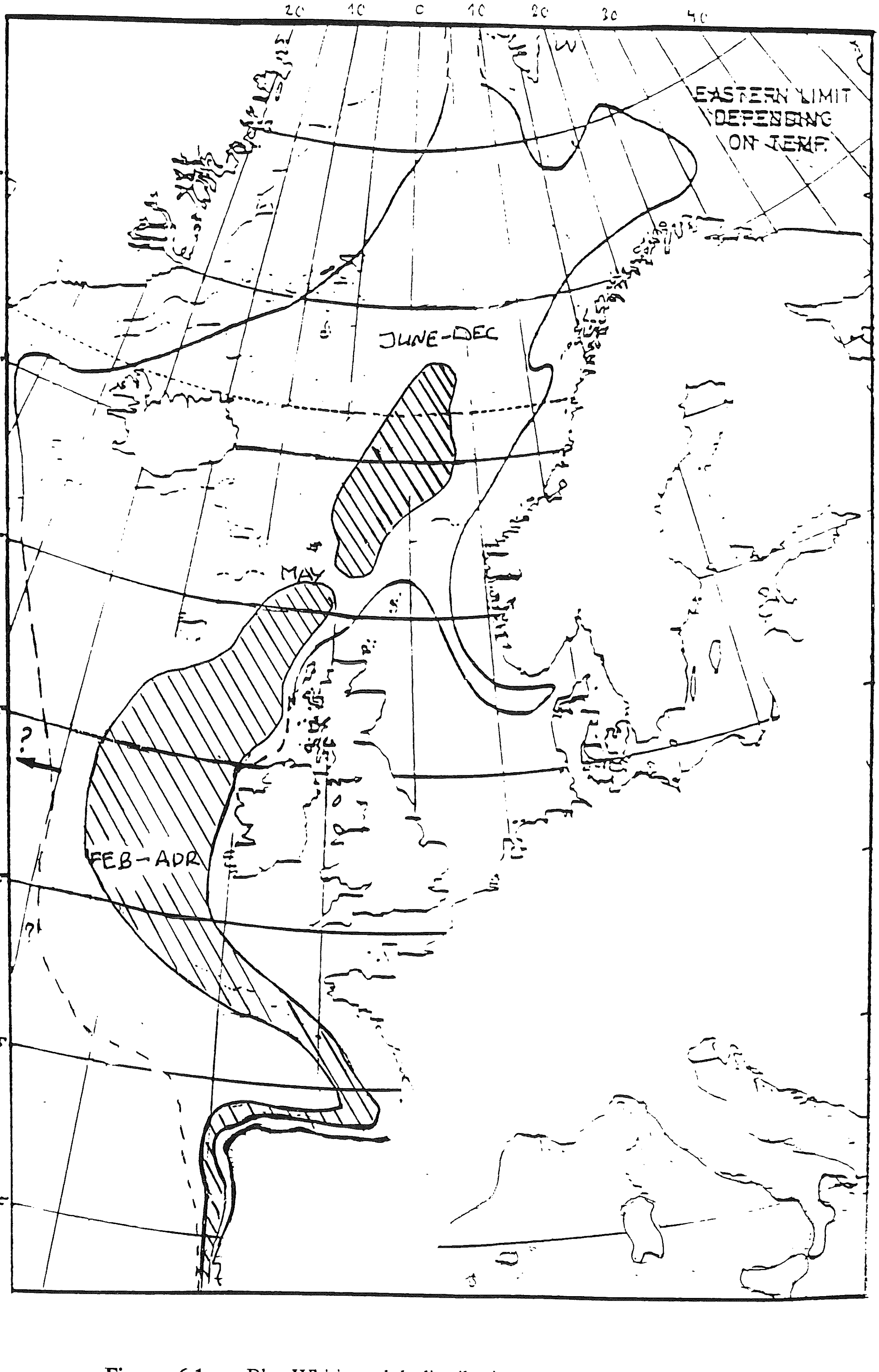


Figure 6.1. Blue Whiting adult distribution.

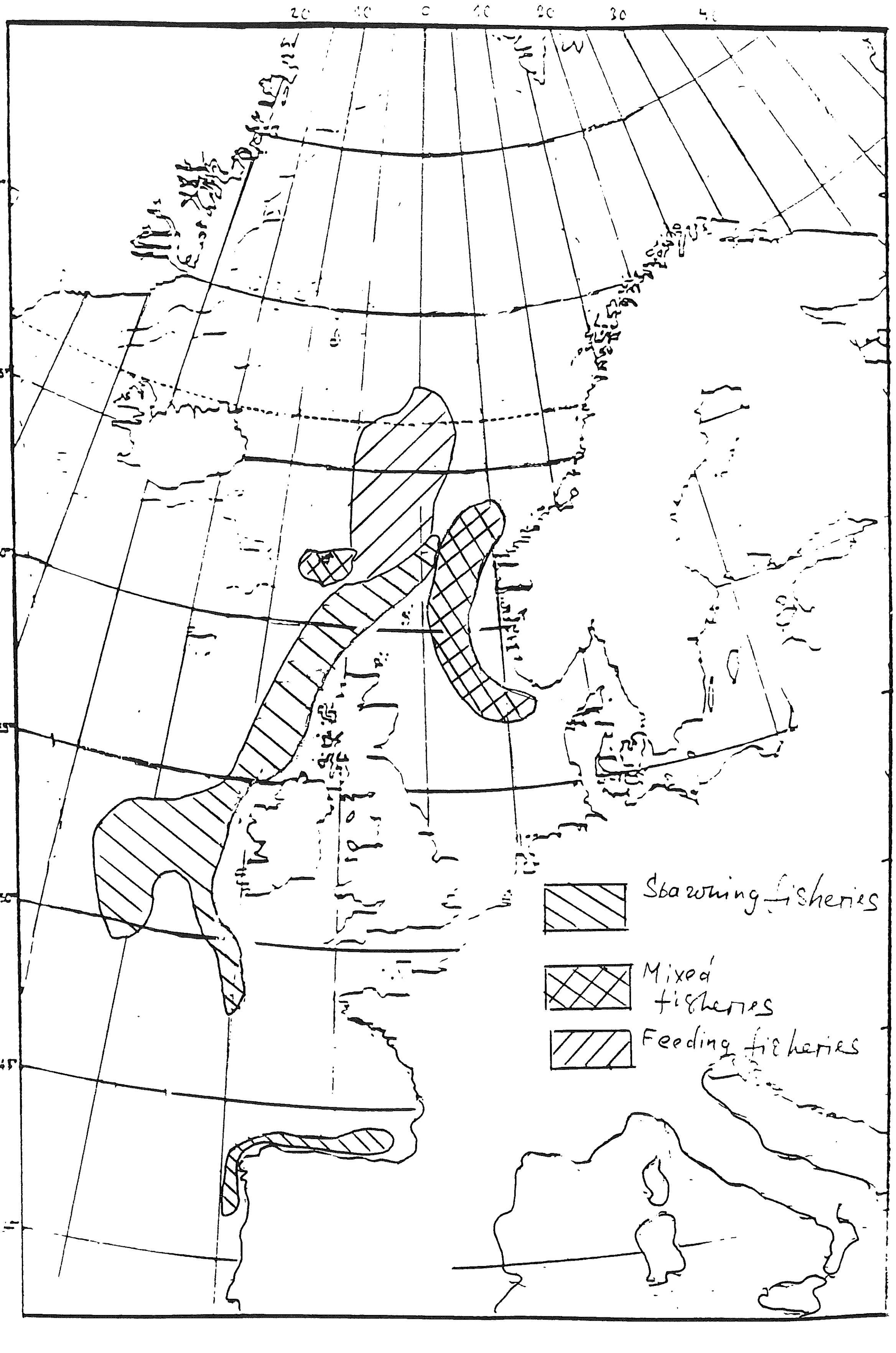


Figure 6.2. Fishing areas for the various fisheries on the blue whiting stock.

APPENDIX A

Input data to VPA (catch-at-age, weight-at-age, etc.) for the "Northern stock"

Blue Whiting Northern stock: Input data for VPA, i.e. catch-at-age, mean weight-at-age, tuning data, etc. These data are only provide to continue the time series from the Northern stock from 1970 and onwards (while the Combined stock contains age segregated data back to only 1981 at present).

Table A.1 Blue Whiting Northern stock: Tuning data from 3 fleets. Norwegian and Russian acoustic estimates in the spawning area from 1980(82)-1993 for ages 2(3)-11. Combined acoustic survey in the Norwegian Sea during summer from 1980-1993 for ages 0-11.

```
BLUE WHITING NORTHERN STOCK (file: BWH_TUN.NEW)
       103
Norway Spawning Area/Acoustic
       80         93
        1          1     0.17       0.25
        2         11
        1       3300     3663     4026     5577  5115  4719  3036  1485   627  693
        1       2368     7511     3219     3626  4551  4625  3626  2590  1776 1332
        0          0        0        0        0     0     0     0     0     0    0
        1        297     2108     2723     6511  3735  3650  3153  2279  1182  531
        1      11130     1514     1616     1719  1858  1128   567   440   348   80
        0          0        0        0        0     0     0     0     0     0    0
        1        954     7183     7340     1159   383   251   373   151   174   73
        1       4042     8050    22357     4697   282   417   385   159    27  111
        1       6960     8799    12271    20285  7323   723   617   326   398  126
        1       6745    22270     9973    10504  7803   933   293   177    46  148
        1      14169    12670    11228     5587  6556  3273   516   183   108   81
        1      11147     6340     8497     7407  4558  2019   545    96    16   33
        1       1232    26123     4719     1574  1386   810   616   257    19    0
        1       4489     3321    26771     2643  1270   557   426   108    22   12
USSR Spawning Area/Acoustic
       82         93
        1          1     0.17       0.25
        3         11
        1    540     2750     1340     1380     1570     2350     1730     1290     650
        1   2330     2930     9390     3880     1970     1370      780      660     100
        1   2900      800     1100     4200     2200     1200     1700     1200     500
        1  13220      930      580     1780      860      610      580      540     110
        1  18750    23180     2540      610      620      750      640      710     720
        1   4480    19170     5860     1070      500      810      860      670     560
        1   3710     4550     8610     4130     1270      480      250      260     330
        1  11910     7120     6670     6970     4580     2750     1880      810     410
        1   9740    12140     5740     2580     1470      220       80       10      10
        1  10300     5350     5130     2630     1770      870      300      220       0
        1  20010     6700     1350      440      390      170        0        0       0
        1   4728    12337     5304     2249     1316      621      386      150       0
Norwegian Sea acoustic - Blue Whiting
       80         93
        1          1     0.6       0.75
        0         11
   1  0.001    1400   10192    4536  4704  7056  8232  6944  5432  2688  1792  1848
   1  0.001     182     728    4542  3874  2678  2834  2964  2756  2054  1300  1092
   1   3680     184     460    1242  4715  3611  3128  2323  1679   874   414   253
   1   8280   22356     396     468   756  1404   576   468   432   324   216   108
   1   1862   30380   13916     833   392   539   539   343    49    49    49    49
   1   2256    5969   23876   12502   658   423   188   235   141   376   141    47
   1   5040    2324    2380    7224  6944  1876   952   336   308   140   196    56
   1   3192    8204    4032    5180  5572  1204   224   168    56    84    28    28
   1   8760    4992    2880    2640  3480   912   120    96    24    48 0.001 0.001
   1  20430    1172    1125     812   379   410   212    22    32     0     8     1
   0      0       0       0       0     0     0     0     0     0     0     0     0
   0      0       0       0       0     0     0     0     0     0     0     0     0
   1  0.001     792    1134    6939   766   247   172    90    11    18     1     3
   1  0.001     830     125    1070  6392  1222   489   248    58    88    71 0.001
```

Table A.2 Blue Whiting Northern stock: Catch in number at age 1970-1993.

Run title : VPA Blue Whiting North - Index file. BWN_IND.DAT

At 18/08/1994 11:33

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1970,	1971,	1972,	1973,
AGE				
0,	0,	17,	1067,	1820,
1,	0,	11,	99,	354,
2,	15,	18,	54,	50,
3,	20,	55,	19,	28,
4,	25,	75,	24,	21,
5,	29,	88,	28,	12,
6,	18,	74,	28,	11,
7,	12,	59,	21,	15,
8,	7,	37,	19,	7,
9,	5,	20,	6,	10,
+gp,	2,	20,	4,	22,
TOTALNUM,	132,	472,	1370,	2348,
TONSLAND,	15162,	54213,	49566,	75564,
SOPCOF %,	90987,	88293,	79253,	83180,

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
0,	379,	814,	128,	429,	956,	2,	23,	0,	3451,	339,
1,	481,	223,	765,	468,	1031,	1919,	331,	69,	45,	2133,
2,	54,	78,	112,	155,	232,	244,	649,	122,	90,	328,
3,	18,	57,	61,	121,	159,	353,	437,	515,	204,	202,
4,	23,	41,	77,	197,	420,	480,	422,	284,	484,	241,
5,	20,	25,	26,	185,	437,	487,	507,	522,	242,	465,
6,	16,	34,	52,	154,	483,	590,	554,	556,	273,	295,
7,	14,	33,	69,	138,	528,	754,	755,	466,	266,	285,
8,	15,	27,	58,	177,	474,	914,	806,	634,	271,	285,
9,	4,	28,	65,	120,	365,	840,	620,	578,	284,	225,
+gp,	14,	53,	175,	337,	674,	1892,	1963,	1460,	672,	334,
TOTALNUM,	1038,	1413,	1589,	2480,	5758,	8474,	7067,	5206,	6281,	5132,
TONSLAND,	81780,	80330,	128942,	238013,	574812,	1091422,	1092620,	870808,	544829,	539237,
SOPCOF %,	168295,	96634,	100280,	91612,	91196,	98615,	100160,	98499,	94188,	96118,

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
0,	510,	1056,	52,	236,	16,	1908,	9,	85,	0,	305,
1,	2068,	1019,	557,	455,	278,	664,	1413,	41,	242,	284,
2,	1982,	1707,	598,	467,	488,	541,	521,	846,	116,	194,
3,	328,	1762,	1694,	666,	500,	1238,	615,	423,	1676,	480,
4,	225,	237,	1649,	1869,	651,	725,	728,	251,	585,	1505,
5,	272,	174,	378,	713,	1293,	804,	496,	336,	225,	402,
6,	431,	318,	181,	134,	609,	688,	566,	242,	155,	207,
7,	259,	254,	200,	104,	81,	132,	297,	154,	99,	124,
8,	192,	173,	197,	122,	53,	47,	76,	42,	89,	60,
9,	154,	93,	174,	103,	33,	25,	27,	5,	85,	38,
+gp,	255,	259,	398,	195,	50,	37,	92,	13,	15,	14,
TOTALNUM,	6676,	7052,	6078,	5064,	4052,	6809,	4840,	2438,	3287,	3613,
TONSLAND,	610603,	652776,	793904,	631615,	522575,	591738,	528793,	337521,	445723,	482523,
SOPCOF %,	101774,	99963,	97433,	100293,	99834,	95356,	99924,	99647,	99738,	99490,

Table A.3 Blue Whiting Northern stock: Mean weight at age in the catch and in the stock 1970-1993.

Run title : VPA Blue Whiting North - Index file. BWN_IND.DAT

At 18/08/1994 11:33

Table 2 Catch weights at age (kg)

YEAR,	1970,	1971,	1972,	1973,
AGE				
0,	.0320,	.0320,	.0320,	.0320,
1,	.0300,	.0300,	.0300,	.0300,
2,	.0840,	.0840,	.0840,	.0840,
3,	.1050,	.1050,	.1050,	.1050,
4,	.1090,	.1090,	.1090,	.1090,
5,	.1290,	.1290,	.1290,	.1290,
6,	.1470,	.1470,	.1470,	.1470,
7,	.1600,	.1600,	.1600,	.1600,
8,	.1700,	.1700,	.1700,	.1700,
9,	.1770,	.1770,	.1770,	.1770,
+gp,	.1890,	.1905,	.1905,	.1934,
SOPCOFAC,	*******,	*******,	*******,	*******,

Table 2 Catch weights at age (kg)

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
0,	.0320,	.0320,	.0320,	.0320,	.0320,	.0320,	.0270,	.0270,	.0180,	.0180,
1,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0360,	.0630,	.0460,	.0460,
2,	.0840,	.0840,	.0840,	.0840,	.0840,	.0840,	.0790,	.0920,	.0940,	.0940,
3,	.1050,	.1050,	.1050,	.1050,	.1050,	.1050,	.1070,	.1180,	.1360,	.1360,
4,	.1090,	.1090,	.1090,	.1090,	.1090,	.1090,	.1220,	.1350,	.1520,	.1520,
5,	.1290,	.1290,	.1290,	.1290,	.1290,	.1290,	.1350,	.1450,	.1620,	.1620,
6,	.1470,	.1470,	.1470,	.1470,	.1470,	.1470,	.1490,	.1550,	.1780,	.1780,
7,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1650,	.1700,	.1950,	.1950,
8,	.1700,	.1700,	.1700,	.1700,	.1700,	.1700,	.1760,	.1780,	.2000,	.2000,
9,	.1770,	.1770,	.1770,	.1770,	.1770,	.1770,	.1860,	.1870,	.2040,	.2040,
+gp,	.1943,	.1950,	.1936,	.1928,	.1927,	.1930,	.2018,	.2105,	.2276,	.2262,
SOPCOFAC,	*******,	*******,	*******,	*******,	*******,	*******,	*******,	*******,	*******,	*******,

Table 2 Catch weights at age (kg)

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
0,	.0270,	.0140,	.0330,	.0200,	.0240,	.0140,	.0240,	.0390,	.0210,	.0340,
1,	.0360,	.0380,	.0400,	.0560,	.0610,	.0650,	.0450,	.0830,	.0670,	.0670,
2,	.0860,	.0800,	.0810,	.0920,	.0870,	.0890,	.0750,	.1050,	.1020,	.1010,
3,	.1040,	.1020,	.1130,	.1090,	.1070,	.1060,	.1090,	.1190,	.1190,	.1360,
4,	.1420,	.1290,	.1320,	.1250,	.1310,	.1300,	.1240,	.1530,	.1460,	.1440,
5,	.1570,	.1640,	.1680,	.1480,	.1420,	.1500,	.1500,	.1810,	.1680,	.1570,
6,	.1640,	.1780,	.2020,	.1780,	.1580,	.1590,	.1690,	.1960,	.1950,	.1820,
7,	.1760,	.2000,	.2090,	.2090,	.1810,	.1740,	.1750,	.2080,	.2120,	.2070,
8,	.1890,	.2080,	.2430,	.2210,	.1990,	.2060,	.2150,	.2310,	.2240,	.2430,
9,	.1860,	.2180,	.2460,	.2220,	.2220,	.2240,	.2170,	.2500,	.2410,	.2280,
+gp,	.2013,	.2334,	.2532,	.2536,	.2501,	.2383,	.2694,	.2459,	.3040,	.3075,
SOPCOFAC,	*******,	*******,	*******,	*******,	*******,	*******,	*******,	*******,	*******,	*******,

APPENDIX B

Medium-term prediction of the combined blue whiting stock

Blue Whiting Combined stock. Medium-term prediction for the years 1995-1997 constrained by different TAC values (300, 400, 500, 600, 700 thousand tonnes respectively). Input data were the same as for the prediction (Table 4.6.6). The resulting trend in SSB from the various TAC constrains is shown in Figure B.1.

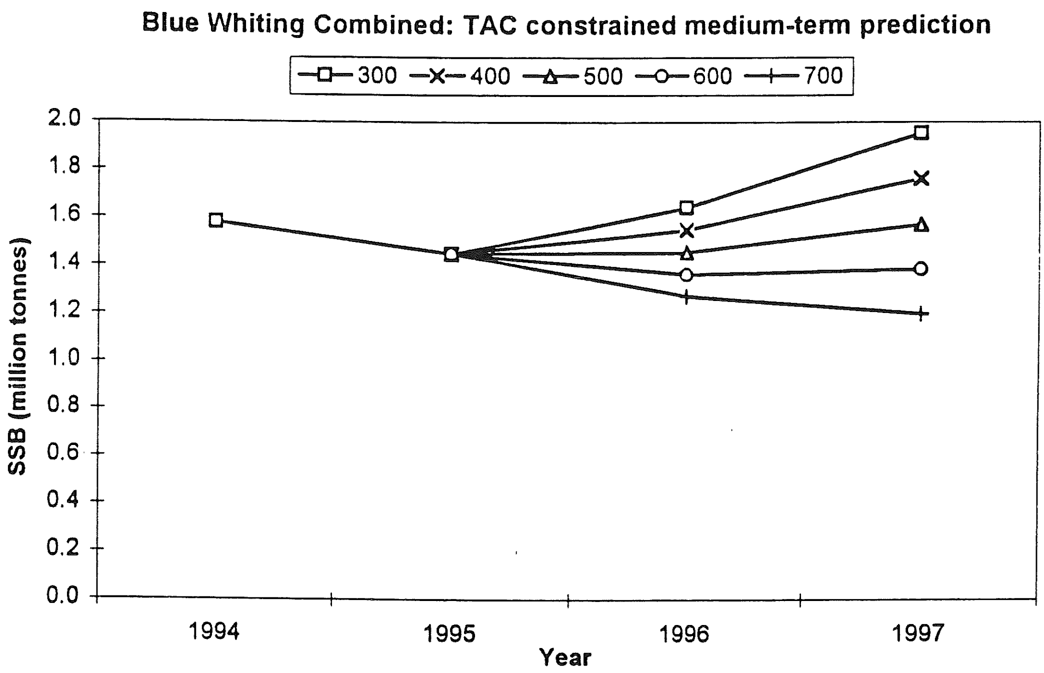


Figure B.1 Blue Whiting Combined: Medium-term prediction (1995-1997) for different TAC values (300, 400, 500, 600, 700 thousand tonnes). Input data were the same as for the prediction (Table 4.6.6).

Table A.4 Blue Whiting Northern stock: Maturity-at-age 1970-1993.

Run title : VPA Blue Whiting North - Index file. BWN_IND.DAT

At 18/08/1994 11:33

Table 5 Proportion mature at age

YEAR,	1970,	1971,	1972,	1973,
AGE				
0,	.0000,	.0000,	.0000,	.0000,
1,	.1000,	.1000,	.1000,	.1000,
2,	.4000,	.4000,	.4000,	.4000,
3,	.8000,	.8000,	.8000,	.8000,
4,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.0000,	1.0000,	1.0000,	1.0000,
6,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,
AGE										
0,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
1,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,
2,	.4000,	.4000,	.4000,	.4000,	.4000,	.4000,	.4000,	.4000,	.4000,	.4000,
3,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,	.8000,
4,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
5,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,
AGE										
0,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
1,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,
2,	.4000,	.3700,	.3700,	.3700,	.3700,	.3700,	.3700,	.3700,	.3700,	.3700,
3,	.8000,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,	.8100,	.9600,	.9600,
4,	1.0000,	.8500,	.8500,	.8500,	.8500,	.8500,	.8500,	.8500,	.9900,	.9900,
5,	1.0000,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	1.0000,	1.0000,
6,	1.0000,	.9400,	.9400,	.9400,	.9400,	.9400,	.9400,	.9400,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

APPENDIX C

Trend in SSB from medium-term simulations of the combined blue whiting stock
by
Jan Arge Jacobsen

Blue Whiting Combined stock. Medium-term simulation based on a *status quo* fishing level from 1994-1997 and the resulting trend in SSB with 5% percentiles (Figure C.1). Input data, except recruitment, were the same as for the prediction (Table 4.6.6). The recruitment for the years 1994-1997 was allowed to vary according to the mean recruitment and its standard deviation for the years 1977-1993 from a lognormal distribution fitted to the recruitment values. The resulting trend in SSB is shown in Figure C.1 with lower and upper 5% percentile lines. The 5% percentiles equals the probability that the SSB fall outside each of these lines during the time span considered.

From this simulation it is seen that at *status quo* fishing level the SSB is likely to improve slightly or at least not to collapse.

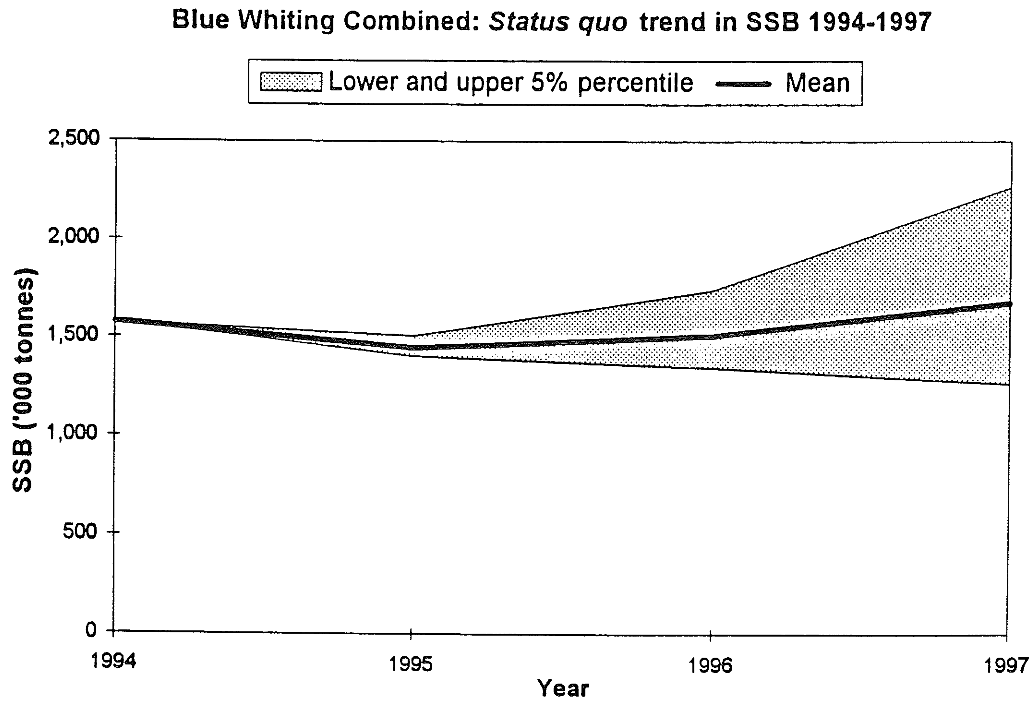


Figure C.1 Blue Whiting Combined: Medium-term simulation based on a *status quo* fishing level from 1994-1997, trend in SSB (mean) with lower and upper 5% percentile.