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REPORT OF THE BLUE WHITING ASSESSMENT WORKING GROUP

Tórshavn, Faroe Islands, 8-14 September 1993

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1 INTRODUCTION

1.1 Terms of Reference

The Blue Whiting Assessment Working Group (Chairman: Mr. J.A. Jacobsen) met at the Fisheries Laboratory of the Faroes in Tórshavn from 8-14 September 1993 (ICES C.Res. 1992/2:8:12, adjusted by ACFM at its autumn meeting in 1992) to:

a) assess the status of and provide catch options for 1994 and 1995 for the Northern blue whiting stock;

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

c) try to resolve the biological problems which have hampered assessments, particularly of the Southern blue whiting stock;

In addition to the terms of reference listed above, NEAFC made the following request to ICES at its November 1992 meeting, to be considered as an additional term of reference to the Working Group in 1993:

For the northern stock of blue whiting, ICES is requested to evaluate the development of the total stock biomass and spawning stock biomass over a three-year period (1995-1997) assuming:

- recruitment as estimated for the year classes up to and including 1991

- for the year classes 1992 and after average recruitment, excluding the recruitment for the year classes 1982, 1983 and 1989

for each of the following scenarios:

- a TAC of 300,000; 400,000; 500,000; 600,000; 650,000 and 700,000 tonnes

for each year of the three year period and indicate whether these levels are within safe biological limits. The analyses should include a sensitivity analysis related to the VPA resuls.

1.2 Participation

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

2 STOCK IDENTITY AND STOCK SEPARATION

In 1993 investigations of population structure of the Northern blue whiting were continued on a national basis. No single opinion on the population structure of blue whiting is available at present (Belikov, 1993b). Four blue whiting stocks, i.e. the Mediterranean, West Atlantic, Biscay and Hebrido-Norwegian ones, are identified by Zilanov (1984) and Karasev (1987), applying information on parasite-indicators, confirmed differences between the Biscay and the Hebrido-Norwegian populations. Results of multidimensional statistical analysis of morphometric data and studies of the fractional composition of water-soluble white of crystalline eye lens, carried out by Bussmann (1984), suggest that other stocks may exist, i.e. Spitsbergen, East-Greenland, Faroes and West-Ireland.

During 1991-1993 scientists from PINRO (Russia) proceeded with investigations on blue whiting population structure collecting physiological and histological samples of specimens from spawning grounds from 51°-59°N (Mazhirina, 1993). According to these data the areas to the west of the British Isles are the spawning grounds for several blue whiting stocks. Besides the well known Hebrido-Norwegian (northern) and Biscay (southern) blue whiting, so-called "local" fish were found on the spawning grounds, which differed from the populations mentioned above by the maturity rate and condition factor.

The genetic population structure of blue whiting was studied by Norwegian scientists by means of isozyme electrophoresis (Mork and Giæver, 1993). Most of the eastern Atlantic distributional range of the species was sampled from the Barents Sea in the north to the inner Mediterranean (Greece) waters in the southeast. Genetic heterogeneity was generally low between samples from the spawning areas west of the British Isles. Inner Mediterranean blue whiting were somewhat separated genetically, and a genetic substructure on a west-east axis from north of the British Isles was also indicated. The most striking trait in the Norwegian material was differing gene frequencies of the blue whiting from northern Norway and the Barents Sea, which showed very significant signs of being a reproductively isolated stock.

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

3 OTOLITH EXCHANGE PROGRAMME AND OTOLITH READING WORKSHOP

The results obtained in the otolith exchange programme initiated in 1990 and from other samples analyzed at the Otolith Reading Workshop in 1992 (Anon., 1993b) showed that agreement between readers is rather low, especially when reading sectioned otoliths. Analyzing the measurements of the diameters showed that there is no statistically significant systematic missreading among countries, so the low agreement must be explained by the presence of false rings.

From the results of the Workshop, it is seen that there is rather low agreement between age readings from sectioned and whole otoliths for countries that routinely apply the sectioning technique. The relatively good agreement between methods for readers that use whole otoliths can be explained by the inclusion of the first annual ring in the age readings, even if it is not clearly seen in the whole otolith.

At present the Workshop could not advise any particular otolith reading technique to be used for ageing blue whiting; instead it is strongly suggested that different otolith readers be aware of the problems inherent in the different otolith techniques as mentioned above.

Measurements of the inner diameter by all countries show that there is no overlap between at least the first three annual rings, and this may be an important tool, in case of doubt, to decide where the first true annual ring must be.

In analyzing the problem of false rings, the conclusions were that there is no clear pattern in the presence of false rings, and that no simple rule can be applied. However, it might be possible to look for a decreasing width in the increments between consecutive rings.

No statistical differences in mean annual ring diameter in the otoliths between the so-called "northern blue whiting" and "southern blue whiting" could be observed. This was clear after a sample provided by Meixide and Pineiro (1993) from Divisions VIIIc and IXa was analyzed and compared to the measurements from the northern areas. This finding is important in the discussion on the question of stock structure and possible existence of several populations of blue whiting in the north-east Atlantic.

4 NORTHERN BLUE WHITING STOCK

4.1 Landings in 1992-1993

Estimates of total landings in 1992 from various fisheries by countries are given in Tables 4.1.2-4.1.4 and summarized in Table 4.1.1. Catches from the directed fishery in Divisions VIIg-k as well as from sub-area XII continued to be recorded as part of the Northern stock. The total landings from all blue whiting fisheries in 1992 were 474,000 t which is 28% more than in 1991.

The majority of the northern blue whiting catches have been taken in the spawning area. The landings from the industrial mixed fishery increased by 40% compared to the 1991. The catch from the Norwegian Sea slightly decreased from last year.

Preliminary data on the blue whiting catches from January - July 1993 were submitted by Working Group members and the total catch amounted to more than 350,000 t (Table 4.1.5).

4.2 Length Composition of Catches

Data on the length composition of the 1992 catches of the northern blue whiting by division were presented by Russia and Faroes (Tables 4.2.1-4.2.2). For 1993 Russia and Norway presented length compositions (Tables 4.2.3-4.2.5). Length composition of catches varied over seasons and fishing areas. Blue whiting in the length range 17-40cm were taken by the Russian vessels in 1992. The mean length was 28cm (the strong 1989 year class). The blue whiting taken by Faroese fishing vessels in 1992 varied from 21-40cm with fish of lengths 25-30cm predominating. The bulk of Norwegian catches in the traditional fishing areas in 1993 consisted of blue whiting of 23-39cm (mostly 28-32cm), while in the areas of mixed fishery, fish in the length range 21-24cm were frequently taken. The length composition of catches from Russian vessels in the first part of 1993 ranged from 18-41cm and fish in the length range 28-32cm predominated.

4.3 Age Composition of Landings

For the directed fishery in 1992 age compositions were provided by Russia, Norway and Faroes. These countries accounted for 90 % of the landings.

The landings in the directed fishery of Germany, the Netherlands and UK (England and Wales) in Divisions VIIg-k, Estonia in Sub-area XII and Division VIa, and Latvia in Division Vb were allocated to catch in number using Russian age compositions in the same areas. The landings in the directed fishery of the Netherlands and Denmark in Divisions VIIb,c and Germany, the Netherlands, Denmark and UK (Scotland) in Division VIa were allocated to number by use of Norwegian age compositions in the same areas. The Japanese catch in Division Vb was divided into age groups by use of Faroese age compositions. The age composition of the catches on the total directed fisheries is given in Table 4.3.1.

For landings of blue whiting taken in the mixed industrial fisheries, age compositions were provided by Norway and Faroes. The Norwegian landings accounted for approximately 50% of the total.

For the catches of Germany, UK (England and Wales) and the Netherlands in Division IVa and Denmark and Sweden in Division IIIa, Norwegian age compositions were used to convert the landings into catch in numbers. The age composition of the catches in the mixed industrial fisheries in the North Sea and adjacent waters is given in Table 4.3.2.

The combined age compositions for the directed fishery in the spawning area and in the Norwegian Sea as well as the total mixed industrial fishery were assumed to give the total age composition of the total landings from the Northern stock of blue whiting (Table 4.3.3).

4.4 Weight at Age

Data on mean weight at age for 1992 were presented by Russia, Norway and the Faroe Islands. Landings from other countries were assumed to have the same mean weights-at-age when fishing in the same area and period as the sampled catches. The weights-at-age were estimated for each fishery and then combined. For 1992 the total catch landed was compared to the sum of products of the total numbers landed and mean weights at age (SOP). The SOP discrepancy was less than 1% for 1992. The mean weights at age used in the VPA runs are shown in Table 4.4.1.

4.5 Maturity at Age

Data on maturity at age were provided by Norway from an acoustic survey in the feeding area during July/August 1993 (Monstad, 1993). Based on the analysis of 636 specimens from a total of 22 trawl stations, the Working Group decided to change the maturity ogive values used since 1986 for fish aged 3 years and older (Anon., 1987). For the 1- and 2-year olds the values were not changed as the previous percentage maturity was appropriate. The new maturity ogive was used in the VPA and prediction runs in the present report and is given in the text table below:

Age	Percent mature
0	0.00
1	0.10
2	0.37
3	0.96
4	0.99
5	1.00
6	1.00
7+	1.00

The new ogive is considered to be more correct since the 1989 year class entered the fishery. It was observed that high numbers of this year class were already in the fishery as two-year-olds and especially as three- year-olds. As the strong 1989 year class seems to have matured at an earlier age than the previous year classes; it is also considered appropriate to change the age range in the overall fishing mortality estimate (reference F) from ages 4-8 to 3-7, i.e. to use mean F(3-7) instead of mean F(4-8) in the tuning and VPA (see Section 4.6.3.1-4.6.3.4). The new mean F(3-7) is considered to be a better reflection of the fishing level in the blue whiting stock at present.

4.6 Stock Estimates

4.6.1 Acoustic surveys in 1993

4.6.1.1 Surveys in the spawning season

The fourth joint acoustic survey by research vessels from the Institute of Marine Research, Bergen and PINRO, Murmansk on blue whiting in the spawning area was carried out in the period 12 March-11 April 1993 (Monstad and Belikov, 1993; Belikov, 1993a). A post-survey meeting was held in Bergen for discussion and combination of results and for the preparation of a common survey report. Both vessels operated echo-sounders of 38 KHz frequency (SIMRAD EK 500) and pre-calibration using a copper sphere (Foote, 1981) was performed. A ship to ship calibration of the acoustic instruments was conducted on 28 March. The difference was so small that it was taken as an indication that the echosounding systems were in good working condition.

Both countries made separate estimates of the blue whiting biomass and abundance, and the results were combined on a sub-area basis. The survey period was divided into two parts, i.e. before and after 28 March when the two vessels met at latitude 57°00'N. The routes and stations are shown in Figures 4.6.1 and 4.6.2. The density distribution of the blue whiting stock for the first and second survey periods are shown in Figures 4.6.3 and 4.6.4, respectively.

The overall distribution pattern for both periods was very much like the usual one. From the area southwest of Ireland, over Porcupine Bank and further north to the area west of the Hebrides and Faroes/Shetland, high concentrations were located close to the continental slope, while density decreased gradually with the distance from the slope. In both periods the highest abundance was found in the south, i.e. west of Ireland, with rather scattered recordings in the north. During the first period, concentrations were located at 400-500m depth in the area west and north of Porcupine Bank. The recordings of blue whiting made south of 50°30'N were allocated to the southern part of the stock. This was due to the predominance of younger fish in the concentrations, and to the difference in growth pattern and maturity schedule. A considerable proportion of one-year-olds in this area were already mature, and most of them either had running gonads or were spent. However, reliable criteria to distinguish southern from northern blue whiting do not yet exist.

Biomass estimates are shown by rectangle for the first period in Figure 4.6.5. The total biomass and spawning stock biomass in the area surveyed were estimated to be 5.1 and 4.9 million tonnes, respectively. The corresponding numerical abundances were 41.1×10^9 and 39.3×10^9 individuals. The 4-year-olds (1989 year class) predominated and contributed more than 60% to the observed stock (Figure 4.6.6).

The time difference between the first and second coverage of the area in the south was 2-3 weeks. During this period some changes in distribution were observed. As mentioned above, the concentrations south of 50°30'N had vanished from the area, probably as a result of a southward migration after spawning. In the second period the estimate was slightly lower than in the first period, and the estimates for this period are considered to be less representative of the spawning stock size.

During a third period from 15-30 April, the R.V. "Prof. Marti" conducted a survey in the spawning area to the west of the British Isles for investigations on ichthyoplankton and blue whiting (Belikov *et al.*, 1993). In this post-spawning season the blue whiting were mainly found in the north (Figure 4.6.7). In the areas to the west of Ireland only minor concentrations of blue whiting were recorded. The picture of the distribution for this period clearly shows that a northward post-spawning migration had taken place. Owing to insufficient biological data for this coverage, only a very rough estimate of biomass was made, i.e. 3.7 million tonnes (Belikov *et al.*, 1993). The 1989 year class again predominated.

4.6.1.2 Surveys in the feeding season

During the summer of 1993 Norway conducted three separate acoustic surveys on pelagic fish on which blue whiting were observed and recorded (Monstad, 1993):

1) R.V. "Johan Hjort" from 1-16 July in the North Sea between 57° and 62°N from the Norwegian coast to approximately 1°W.

2) R.V. "G.O.Sars" from 24 July to 16 August in the Norwegian Sea between 66°30' and 71°30'N from the Norwegian coast to the Jan Mayen area.

3) R.V "Johan Hjort" from 30 July to 15 August in the Norwegian Sea between 72°30' and 76°00'N from 23°00'E to 01°30'W.

Blue whiting were observed rather evenly through most parts of the area surveyed, and were found north to 74°N in the Norwegian Sea and south to 58°N in the North Sea (Figure 4.6.8). The recordings were rather evenly distributed with scattered traces found mainly between 200 and 400m depth. Owing to lack of survey time a gap in the observations appeared in the area between 62° and 66°N. The limit of the distribution was found in the north and in the south, but was not located to the west between 62°N and the Jan Mayen area, where the distribution continued westward into the Norwegian Sea.

In the Norwegian Sea the observed concentrations of blue whiting were estimated to have a biomass of 1.0 million tonnes with an abundance of 6.5×10^9 individuals. In addition a biomass of 167 thousand tonnes or 1.2×10^9 individuals was estimated from the observations in the North Sea. Combination of these estimates gives a total biomass of <u>1.2 million tonnes</u> and an abundance of <u>7.7×10^9 individuals</u>. A "guesstimate" based on mean values per rectangle could be 0.5 million tonnes in the gap between 62° and 66°N, which would raise the total to 1.7 million tonnes in the eastern area of the Norwegian Sea and in the Norwegian Trench south to the Skagerrak area. The biomass estimate is presented by rectangle in Figure 4.6.9.

The length and age compositions of the observed stock in the Norwegian Sea are given in Figure 4.6.10. The 4-year-old fish (1989 year class) predominated and contributed 60% in number. In the North Sea it contributed 62%.

From analyses of blue whiting from 22 trawl stations in the Norwegian Sea ("G.O.Sars") the following percentages of mature individuals by age were obtained:

Years	% mature	Number examined
1	14.5	55
2	14.3	7
3	96.4	55
4	99.2	381
5	100.0	79
6	100.0	29
7	100.0	18
8	100.0	5
9	100.0	3
10+	100.0	4
	Total	636

4.6.1.3 Discussion

During the joint Norwegian-Russian survey in the spawning season, the type of echo sounder (EK 500) was the same for both countries. Although the ship-to-ship calibration of the acoustic equipment during the survey was mainly based on recordings of plankton, the difference between the vessels was so small that the ratio between them was set at 1:1.

The total biomass estimate (in thousand tonnes) from all years in the spawning area since 1983, and the corresponding spawning stock size given in brackets, are listed in the text table below.

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)

*with calibration factor: 1.38

The high variability between successive survey estimates in the earlier years of the period listed is due to several factors discussed by the Working Group many times before. In this context important factors will be: difference in the acoustic equipment, weather conditions during the surveys, size of the area surveyed and the timing of the survey with respect to the peak of spawning. In recent years the estimates seem to be more "stable" with, however, a downward trend from 1988 to 1991. In 1992 the estimate remained at the same level as the year before, and in 1993 it increased by more than half a million tonnes for the spawning stock. The levelling and increase of the estimates in 1991-1993 are mainly due to the recruitment of the strong 1989 year class to the spawning stock, and the individual growth of this year class. This year class, being the richest blue whiting year class ever recorded, contributed 23% in number to the spawning stock in 1991, 63% in 1992 and 60% in 1993.

As observed in 1992 a northward post-spawning migration was also clearly observed in 1993 (Monstad *et al.*, 1992). This was recorded by mapping the distribution on the three surveys in succession during the period 12 March to 30 April (Figures 4.6.3-4 and 4.6.7). It supports the accepted hypothesis that the majority of the blue whiting concentrations appearing in the Porcupine

Bank area during spring belong to the Northern stock component.

The influence of the North-Atlantic Current during spring 1993 was found to be the same as observed in 1992 (Monstad and Belikov, 1993).

The two surveys in the Norwegian Sea and the one in the North Sea carried out during the summer only covered a part of the total blue whiting stock due to the limited areas surveyed. However, the biomass estimate will be used as an index only. The summer surveys are, however, valuable in the sense that they give information about the immature part of the stock. In that respect the results suggest that the strength of the 1993 year class might well be below average.

The analyses of the blue whiting samples collected in the Norwegian Sea in the summer of 1993 allowed a new maturity ogive to be determined. The age composition, however, included too few 2- year-olds, so that the percentage mature for that group and for the 1-year-olds was not changed. For the age groups 3 years and older the maturity ogive now is changed in accordance with the table presented by Monstad (1993).

4.6.2 Catch per unit effort

No countries submitted catch per unit effort data for 1992, and hence no CPUE tables are given in present report. In last year's report data up to 1991 were presented in the form of a table of the overall aggregated CPUE values across areas in the Norwegian blue whiting fisheries which showed a steady decline from 30t/h in 1983 to about 10 t/h in 1991 (Anon., 1993a).

4.6.3 Virtual population analysis (VPA)

4.6.3.1 Tuning the VPA to survey results

In Section 4.5 the new maturity ogive was presented together with the justification for a change in the age range from 4-8 to 3-7 in the overall fishing mortality level. In support of this decision, the back-calculated F values in a retrospective analysis (Figures 4.6.11-13) showed much larger variation/noise in the mean F(4-8) values than in the corresponding mean F(3-7) values. The Working Group, therefore, decided to change the age range and to use the mean F(3-7) as representing the overall fishing level in the blue whiting stock at present.

The Working Group started out by tuning the VPA with both tuning series provided, i.e. the Russian and Norwegian acoustic surveys in the spawning area (Table 4.6.1). The standard Laurec/Shepherd (L/S-tuning) was used without shrinkage and no down-weighting of older data - the same settings as in the last year's report. It produced a mean F(3-7)= 0.4586 for the terminal year 1992 and poor diagnostics. L/S runs were, therefore, made on each tuning series separately. This produced for the terminal year a mean F(3-7)= 0.3275 from the Norwegian fleet and a mean F(3-7)= 0.5976 for the Russian fleet. The diagnostics for these runs did not improve, and indeed were worse. Apparently the L/S-tuning produced completely different results using the Norwegian and Russian data (see the results of the different trials in the text table below). L/S-tuning is known to be sensitive to observation errors in the data for the final year (which are assumed to be exact) and it fails to utilize the year class strength information contained within the disaggregated catch data. XSA on the other hand is an alternative tuning method which overcomes these deficiencies and it was, therefore, decided to try to use XSA for tuning of the VPA.

Results from standard L/S-tuning, no shrinkage, no downweighting.

Tuning series	Fbar(3-7) in 1992	Fbar(4-8) in 1992		SIGMA (overall)						
				3	4	5	6	7	8	Avg.
N	0.327	0.371		0.806	0.711	0.707	0.967	0.698	0.782	0.779
R	0.597	0.941		0.922	0.994	0.978	0.687	1.000	1.020	0.934
N+R	0.458	0.566		0.627	0.609	0.620	0.548	0.610	0.685	0.617

Results from XSA-tuning, shrinkage CV= 0.5, no down-weighting.

Tuning series	Fbar(3-7) in 1992	Fbar(4-8) in 1992		S.E. of Q						
				3	4	5	6	7	8	Avg.
N	0.394	0.467		0.772	0.676	0.716	0.938	0.696	0.651	0.741
R	0.469	0.577		0.887	0.908	0.847	0.580	0.881	0.910	0.835
N+R	0.365	0.443	N	0.756	0.668	0.723	0.938	0.693	0.624	0.733
			R	0,854	0,872	0,815	0,578	0,853	0,883	0,809

First an XSA run was tried without down-weighting of older data and with a standard shrinkage of CV= 0.5 using both series together and each series alone. Tuning with both Norwegian and Russian data gave a mean F(3-7)for the terminal year of 0.365 and tuning only with the Norwegian series gave a mean F(3-7) of 0.395, while tuning only with the Russian series gave a mean F(3-7) of 0.469 for the terminal year. The diagnostics for all combinations were poor. Since XSA-tuning using both series did not perform any worse than XSA with only one of the series it was decided to use both series in the rest of the tuning.

Next an XSA run was tried with standard tricubic down-weighting of older data and a standard shrinkage of CV= 0.5. This produced a mean F(3-7)= 0.385 for the terminal year. The average S.E. of q's for age groups 3-7 was 0.77 for the Norwegian series and 0.78 for the Russian, which is approximately the same as without down-weighting. ACFM recommends the use of tricubic down-weighting in the "blue pages". In the blue whiting fishery a gradual change in gear and fishing pattern has been observed since the fishery started. A tapered down-weighting of older data, therefore, seems appropriate. However, there appear to have been heavy fluctuations in the catches of the 1982 year class in the catch-at-age data as well as in the tuning data for the years 1988 and 1990, and down-weighting older data may increase the significance of these fluctuations. The quality of catch-at-age and tuning data is poor and, therefore, it is not believed that any other tuning method will produce results that are better than those which can be obtained by standard XSA-tuning with default settings.

Finally, a retrospective analysis was made using XSA with tricubic down-weighting of older data and different degrees of shrinkage: CV= 0.5, CV= 0.3 and CV= 0.1, respectively (Figures 4.6.11-4.6.13).

The retrospective XSA with weak shrinkage of CV= 0.5 showed a very slow convergence and, using 1987, 1988 and 1989 as terminal year, the XSA did not converge at all. With this shrinkage the XSA produced a mean F(3-7)= 0.385 and mean F(4-8)= 0.486 for 1992 as terminal year. From Figure 4.6.11a-b it can be seen that there is a huge gap between the 1991 and 1992 estimates of the mean F for 1990 and the 1990 estimate of the mean F for 1990 and it looks as if the mean F for the terminal years earlier than 1991 are systematically underestimated.

The convergence improved slightly when running a retrospective XSA with average shrinkage of CV= 0.3 and it was only when using 1987 as terminal year that the XSA did not converge (Figure 4.6.12a-b). With this shrinkage the XSA gave a mean F(3-7)= 0.461 and a mean F(4-8)= 0.556 for 1992 as terminal year. The gap between the 1991 and 1992 estimate of mean F for 1990 and the 1990 estimate of mean F for 1990 is approximately the same as for CV= 0.5, but the systematic underestimation of mean F for terminal years prior to 1991 is less pronounced.

When running retrospective XSA with a very heavy shrinkage of CV= 0.1 (Figure 4.6.13a-b), there are no problems with convergence, but in this case the XSA produces very high F-values: mean F(3-7)= 0.518 and mean F(4-8)= 0.619 for 1992 as terminal year. The huge gap between the mean Fs in 1992 and 1991 compared to the mean Fs for 1990 and backwards is about the same as before, indicating a systematic underestimation of mean Fs for terminal year earlier than 1991.

It looks as if different degrees of shrinkage do not change anything other than to make the F values for 1991 and 1992 higher as the CVs gets smaller. Since the

Working Group does not believe in a very high F for 1992 it was decided to use the output from the XSA with standard shrinkage CV= 0.5, and consequently a mean F(3-7)= 0.385, as input for a Separable VPA. The diagnostics from the final XSA-tuning are given in Table 4.6.2. The resulting fishing mortalities and stock estimates are given in Tables 4.6.3-4.6.4. The estimates of the year classes from 1990 onwards are not considered to be substantiated by the tuning and should not be considered further in Table 4.6.4.

Plots of the logarithmic catchability residuals by age group are shown in Figures 4.6.14a-f. There seems to be a slight trend in the log. q residuals, being below 0 from 1982-1986 and above 0 from 1987 and onwards.

4.6.3.2 Separable VPA

As the tuning data (Table 4.6.1) from the Norwegian and Russian acoustic surveys in the spawning area are very noisy, the Working Group preferred to use the separable VPA technique. The separable VPA is less sensitive to errors in both catch and survey data for the final year. A terminal F of 0.455, a reference age of 5 for unit selection and a terminal S of 1.0 produced an unweighted mean F(3-7) for the last year equal to that obtained in the XSA tuning (Table 4.6.5). In the separable analysis the default downweighting was used, i.e. the most recent six years were not downweighted while the older data were. The exploitation pattern from XSA tuning and separable VPA are compared in Figure 4.6.15. As can be seen the exploitation patterns are fairly smooth, although some discrepancies for the oldest ages were observed. The results of the separable VPA are shown in Tables 4.6.6-4.6.8. Trends in yield, fishing mortality, spawning stock biomass and recruitment from separable VPA are shown in Figures 4.6.16A and B, respectively.

Again this year the 1989 year class is very strong as estimated from this year's VPA, and it also contributed most to the spawning stock biomass in 1992 (Table 4.6.7).

The SSB measured acoustically has in some years been much higher than that estimated by VPA (Figure 4.6.17). The reason for this is poorly understood. In 1991 the estimated SSB from separable VPA of 3.2 million t was considered to be fairly realistic, although possibly too high. The combined Norwegian and Russian acoustic estimate of 4.4 million t in 1991 is close to the corresponding SSB from VPA. Generally the mean fishing mortality has been underestimated in the most recent year, and this was also the case in 1991. However, the large 1989 year class was expected to increase the SSB in 1992 and 1993, but as the XSA-tuning for 1992 gave a relatively high mean F, and consequently a low SSB estimate of only 1.8 million t in 1992, the expected increase from last year did not emerge from the VPA.

The Working Group had difficulties in accepting the results of the VPA, but decided to continue the prediction and Y/R calculations based on the estimated VPA results, to complete the assessment.

4.6.3.3 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 4.6.9. and are shown in Figures 4.6.16C and D. The exploitation pattern used was the smoothed fishing pattern (S-values) from the separable VPA (Table 4.6.6), scaled so that the reference F corresponded to that of 1992. The yield-per-recruit calculations gave an $F_{(0.1)}$ of 0.24 which is below the estimated F of 0.385 in 1992.

4.6.3.4 Catch projection and management considerations

Input data for the prediction are given in Table 4.6.9. The initial stock size at the beginning of 1993 for the age groups 3 to 10+ were taken from the separable VPA run (Table 4.6.7). For the ages 0 to 2 the initial stock sizes were calculated as indicated in the text table below.

Recruitment at ages 0 to 3 in 1993

Recruitment at ages 0 to 3 in 1993			
Age	1991	1992	1993
0	11,496	7,920	7,920
1	-	9,266	6,484
2	-	-	7,187
Z values used in calculations (M=0.2)			
0	0.2156	0.2000	
1	-	0.2541	

The recruitment at age 0 in 1993 was set at 7,920 million, which is the 1977-1989 average, excluding the strong 1982, 1983, and 1989 year classes. The strong year classes were excluded from the average as the 1993 year class is considered to be rather poor, from the fact that no 0-group were observed on the acoustic survey in the Norwegian Sea in 1993. For the next age group the total fishing mortality (Z) for age group 0 in 1992 (Table 4.6.6) was applied to the average recruitment of 7,920 million as in 1993. The 1992 year class is also considered to be poor. For age group 2 the Z values for age 0 in 1991 and age 1 in 1992 were applied to an average recruitment of 11,496 million, including the strong year classes, as this year class is considered to be of average size.

The results of the prediction run are given in Tables 4.6.10-4.6.11. $F_{(0.1)}$ was calculated from the Y/R plot (Figure 4.6.16C) to be approximately 0.24. $F_{(med)}$ was estimated to be 0.2 from the recruitment *versus* SSB plot from 1977-1989 (Figure 4.6.18).

A total catch of approximately 450,000 t was assumed for 1993, based on a projection of preliminary catches in the first half of 1993 of 357,000 t (Table 4.1.5). The catch was raised by the preliminary catch per first half of 1992 to the total catch in 1992. The resulting average F(3-7) of 0.37 resulted in a SSB of 1.8 million t at 1 January 1993 (Table 4.6.11). However, owing to the uncertainties in the tuning results, the SSB is considered to be underestimated.

If the average F(3-7) in 1993 was estimated to be, say, 25% too high, then the resulting total stock biomass (TSB) and SSB estimates would be underestimated accordingly. The Working Group, therefore, studied the results of the sensitivity analyses from the TAC-constrained runs requested by NEAFC in Appendix A. The case where the mean F(3-7) level was expected to be overestimated by 25% was studied in detail (Table A.2 in Appendix A). If an assumed catch of about 450,000 t is taken during the next few years, i.e. a nearly *status quo* development from 1992 and onwards, the development in the TSB and SSB from 1993 to 1996 would be approximately as described in the text table below. In the table two recruitment alternatives are used (see Appendix A).

Year	R_{av}=avg(77-89)		$R_{low}=R_{avg}$-(82,83 & 89)	
	TSB	SSB	TSB	SSB
1993	3388	2314	3388	2314
1994	3399	2365	3399	2365
1995	3511	2290	3197	2268
1996	3657	2285	3095	2168

5 SOUTHERN BLUE WHITING STOCK

5.1 Landings

Total landings from the Southern area are given in Table 5.1.1. The Portuguese landings in 1992 were 4,928 t, an increase of 75% over the 1991 values, while landings from Spanish fisheries decreased by more than 18%. Total landings from the Southern blue whiting fisheries showed a decrease of 10%. Spanish landings (83% of the reported total landings in 1992) were mainly made by pair trawlers (58%) in a directed blue whiting fishery, but also as a by-catch by bottom trawlers (42.2%) and long liners (0.4%) in a multispecies fishery (Otero and Meixide, 1993). The Portuguese landings (17% of the total reported landings in 1992) were taken as a by-catch by bottom trawlers.

5.2 Length and Age Composition of Catches

Table 5.2.1 summarizes the length compositions of blue whiting landings in the southern fisheries in recent years. Length compositions of landings by quarter are presented in Tables 5.2.2 and 5.2.3. Annual length compositions by gear and country are shown in Table 5.2.4. Catch-at-age data since 1983 are given in Table 5.2.5. These were calculated using the length compositions provided by both countries and age length keys provided by Spain. Most of the fishery is based on the first five age groups.

5.3 Weight at Age

Weight at age data from the southern fisheries are presented in Table 5.3.1. The SOP discrepancy was 2.8% in 1992.

5.4 Stock Estimates

5.4.1 Acoustic survey in 1993

An acoustic survey was carried out in March-April 1993 in Spanish Atlantic waters, covering the area down to the 1000m isobath. Results were not available to the Working Group.

5.4.2 Bottom trawl surveys

Bottom trawl surveys have been conducted off both the Galician and Portuguese coasts since 1980 and 1979 respectively, following a stratified random sampling design and covering depths down to 500m (Soares and Figueiredo, 1993). Since 1983 the area covered on the Spanish survey was extended to cover the entire Spanish waters in Divisions VIIIc and IXa. The stratified mean catch and standard error on Portuguese groundfish surveys are shown in Table 5.4.1. The stratified mean catches on Spanish bottom trawl surveys (in weight and in numbers by haul) since 1985 are given in Table 5.4.2.

5.4.3 Catch per unit effort

Table 5.4.3 shows the evolution from 1978 to 1992 of the landings, effort and CPUE for vessels of the main Galician ports and for the Portuguese bottom trawl fishery. Table 5.4.4 represents the evolution of CPUE in the main Galician ports split into single trawlers and pair trawlers since 1983. Effort and CPUE indices are given in Tables 5.4.5 and 5.4.6.

6 ZONAL DISTRIBUTION

During the acoustic surveys taking place on the spawning grounds to the west of the British Isles in spring, most of the blue whiting recordings are made within the EEC-zone, e.g. in British and Irish waters. Experience, however, shows that concentrations of blue whiting are also recorded inside other countries' economic zones, though not at the same magnitude. The Working Group concluded that the percentage distribution of concentrations within various zones strongly depends upon the geographical size and location of the survey area. The tables given in Working Group reports up to 1992 (Anon., 1993a) therefore do not give a correct picture of the real situation. It was, therefore, decided not to present this kind of table until more complete data are available.

The observed distribution of blue whiting concentrations during the feeding season is shown in Figure 4.6.8. The same type of map has also been given for previous years (Anon., 1993a). As for the spring situation in the spawning area, the surveys in the Norwegian Sea do not cover the whole stock. The pattern of distribution in 1993 is very much the same as in 1992 when most of the recordings were made in the Norwegian zone. This is, however, not a correct picture of the total situation, and the zonal borders have therefore been deleted from the map.

The total catch of blue whiting in 1978-1992 divided into areas within and beyond national fisheries jurisdiction of NEAFC are presented in Table 6.1, as provided by the Working Group members. The catch of nations not represented at the Working Group meeting have been subjectively allocated to appropriate zones.

7 DISTRIBUTION IN TIME AND SPACE OF THE BLUE WHITING STOCK

Revised maps of the distribution and main fishing areas were presented in the Working Group report of 1990 (Anon., 1991). No new data for updating these maps have been obtained.

7.1 Spawning Area

The observation of the northwards post-spawning migration of the stock during spring 1992 (Anon., 1993a) was repeated in 1993 as described in Section 4.6.1. The three surveys carried out in succession show the northwards shift of positions of the concentrations after spawning. This again gives evidence that the majority of the concentrations appearing in the Porcupine Bank area during spring belong to the northern component. The preliminary results from the analysis of the gene frequencies also indicate that the blue whiting in the area west of the British Isles could belong to one stock only. Anyhow, if several stocks appear in the area, the gene flow between them is obviously too big to get a significantly sustainable difference. The remaining blue whiting which do not migrate northwards from the area west and south of Ireland could belong to local stocks which migrate to nearby areas or further south, as it is suggested that the stock to the west of the British Isles "stretches" southwards through Bay of Biscay up to the mouth of the Mediterranean Sea (Mork and Giæver, 1993).

7.2 Nursery Area

Ichthyoplankton observations were made by R.V. "Prof.Marti" during the period 15-30 April 1993 in the area west and northwest of the British Isles (Belikov et al., 1993).

Blue whiting larvae were present in only 9 out of 48 stations. A total of only 75 larvae were found during the entire survey. The majority of the larvae were between 6.1-6.5 mm long. These were mainly found in shallow water (100-300m) southwest of the Porcupine Bank and to the west of the Outer Hebrides (Figure 7.1). This was in notable contrast to the corresponding surveys in 1990-1992 in which concentrations were much higher and found in deeper water. This could be due to either a poor year class, poor survival of larvae or a later peak in spawning than in previous years. Biological examination of fish collected between 30 March and 10 April suggest that peak spawning was between 20-30 March, some 7-10 days later than in previous years.

7.3 Feeding Area

The surveys in the Norwegian Sea during summer 1993 resulted in a distribution picture of blue whiting quite similar to that obtained in 1992, i.e mainly confined to Norwegian waters. However, the zero-line of the distribution to the west was not found in 1993 and scattered registrations of blue whiting continued further west. In 1992 the westward limit was clearly stated because of the more easterly distribution of the stock in these areas. This again was dependent on the more easterly location of the polar front during 1990-1992, again influenced by the fact that the temperature in the North Atlantic current was higher than previously. In 1993 the distribution may have been influenced by lower temperature conditions in the Norwegian Sea than in recent years, and may well be a sign that a new period of lower average temperatures is starting.

8 BIOLOGICAL UNCERTAINTIES

The Working Group identified three main sources of problems in the assessment of blue whiting in 1992.

Age determination: Several otolith exchanges and workshops have been carried out since 1979 to solve the discrepancies between countries. The results obtained in the workshop in November 1992 (Anon., 1993b) showed that there are no systematic differences between the readers. The structure of the otolith was expected to be different in the Northern and the Southern areas. The results of the workshop proved that there are no differences, as the average diameter of the annual rings is the same in all areas. However, as a result, the Working Group recommends the commencement of a new exchange programme in 1994 to maintain the existing quality of age reading, and to "calibrate" the age readings between different countries on a regular basis, especially between Norway and Russia.

Stock identity: Blue whiting in the Northeast Atlantic have until now been considered as belonging to two stocks, one northern and one southern. This separation was based more on convenience than on scientific evidence. Whether there exist one, two or more populations in this area, their geographical distribution is not clear and may also change over time. In addition, the study on genetic population structure of blue whiting gave no indication of genetic substructure among blue whiting from the west of the British Isles to Gibraltar (Mork and Giæver, 1993). Although this gives no evidence, it reduces the hypothetical possibility of an evolutionary structure. Anyhow, even if there are several local stock units in the area, the gene flow between them is obviously too high to get a significant sustainable difference. For that reason, and considering that there are no differences in the age reading methods between the northern and southern areas, as was established above, the Working Group considers that the blue whiting in the North-East Atlantic should be assessed as one stock (see the combined VPA run in Appendix B). Databases must be collected separately by area (i.e. Hebrides, Porcupine and Biscay) until stronger evidence is available.

Acoustic estimates: Discrepancies between different acoustic estimates cannot be fully explained at present. To elucidate this problem a large range of possibilities have to be considered, such as the influence of biological conditions and fish behaviour on target strength values, the effect of timing and direction of migration of the stock during the survey, the effect of the hydrological situation on fish distribution, trawl sampling problems and age reading errors. The extremely large area to be covered is considered to be an important source of error. The Working Group has recommended investigations to solve these problems for several years, and reiterates this recommendation.

9 RECOMMENDATIONS

1. The Working Group considers it very important that the Northern Blue Whiting Stock is monitored each year. The Working Group, therefore, recommends the continuation of the joint Norwegian-Russian acoustic survey aimed at assessing the stock biomass in the spawning area during spring, and also the continuation of surveys in the Norwegian Sea in the feeding season during summer by all countries involved in the blue whiting fishery.

2. No single opinion on population structure of blue whiting is available at present. Preliminary results of investigations conducted by Russia and Norway during 1991-1993 show the possibility of several populations in the total reproductive area. To settle this problem the Working Group recommends that studies of the population structure of blue whiting should be continued.

3. The Working Group recommends the continuation of the study of egg and larvae distribution of blue whiting and the current system in the area west of the British Isles and in the southern area (Subareas IX, VIII and VII), with a view to understanding the population structure of the Blue whiting stock.

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Table 4.1.1 Landings (tonnes) of BLUE WHITING from the main fisheries, 1983-1992, as estimated by the Working Group.

Area	1983	1984	1985	1986	1987
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	52,963	65,932	90,742	160,061	123,042
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	361,537	421,865[2]	464,265[2]	534,263[2]	445,863[2]
Icelandic industrial fishery (Division Va)	7,000		-	-	-
Industrial mixed fishery (Division IVa-c, Vb, IIIa)	117,737	122,806	97,769	99,580	62,689
Subtotal northern fishery	539,237	610,603	652,776	793,904	631,615
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k	30,835	31,173[3]	42,820[3]	33,082[3]	32,819[3]
Total	570,072	641,776	695,596	826,986	664,434

Area	1988	1989	1990	1991	1992[1]
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	55,829	37,638	2,106	78,703	62,312
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	421,636	473,165	463,495	218,946	317,237
Icelandic industrial fishery (Division Va)	-	4,977	-	-	-
Industrial mixed fishery (Division IVa-c, Vb, IIIa)	45,110	75,958	63,192	39,872	66,174
Subtotal northern fishery	522,575	591,738	528,793	337,521	445,723
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k	30,838	33,695	32,817	32,003	28,722
Total	553,413	625,433	561,610	369,524	474,445

[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, 1983-1992, as estimated by the Working Group.

Country	1983	1984	1985	1986	1987
Faroes	11,316	-	-	-	9,290
France	2,890	-	-	-	-
German Dem.Rep.	5,553	8,193	1,689	3,541	1,010
Germany, Fed.Rep.	2	35	75	106	-
Greenland	-	-	-	10	-
Iceland	-	105	-	-	-
Norway	5,061	689	-	-	-
Poland	-	-	-	-	56
UK (Engl. & Wales)	-	-	-	-	-
USSR	28,141	56,817	88,978	156,404	112,686
Total	52,963	65,932	90,742	160,061	123,042

Country	1988	1989	1990	1991	1992[1]
Faroes	-	1,047	-	-	-
France	-	-	-	-	-
German Dem.Rep.	3	1,341	-	-	-
Germany, Fed.Rep.	-	-	-	-	-
Greenland	-	-	-	-	-
Iceland	-	-	-	-	-
Norway	-	-	566	100	912
Poland	10	-	-	-	-
UK (Engl. & Wales)	-	-	-	-	-
USSR/Russia[2]	55,816	35,250	1,540	78,603	61,400
Total	55,829	37,638	2,106	78,703	62,312

[1]Preliminary.
[2]In 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), 1983-1992, as estimated by the Working Group.

Country	1983	1984	1985	1986	1987
Denmark	28,680	26,445	21,104	11,364	2,655
Faroes	56,168	62,264	72,316	80,564	70,625
France	3,600	3,882	-	-	-
German Dem.Rep.	3,284	1,171	6,839	2,750	3,584
Germany, Fed.Rep.	825	994	626	-	266
Iceland	1,176	-	-	-	-
Ireland	-	-	668	16,440	3,300
Netherlands	150	1,000	1,801	8,888	5,627
Norway	185,646	211,773	234,137	283,162[2]	191,012
Poland	-	-	-	-	-
Spain	318	-	-	-	-
Sweden	-	-	-	-	-
UK (Engl. & Wales)	-	33	2	10	5
UK (Scotland)	-	-	-	3,472	3,310
USSR	81,690	114,303	126,772	127,613	165,497
Total	361,537	421,865	464,265	534,263	445,884

Country	1988	1989	1990	1991	1992[1]
Denmark	797	25	-	-	3,167
Faroes	79,339	70,711	43,405	10,208[2]	12,731[2]
France	-	2,190	-	-	-
German Dem.Rep.	4,663	3,225	230	-	-
Germany, Fed.Rep.	600	848	1,469	349	1,307[4]
Iceland	-	-	-	-	-
Ireland	245	-	-	-	-
Netherlands	800	2,0787	7,280	17,359	11,034
Norway	208,416	258,386	281,036[2]	114,866[2]	148,733[2]
Poland	-	-	-	-	-
Spain	-	-	-	-	-
Sweden	-	-	-	-	-
UK (Engl. & Wales)	3	1,557	13	-	356
UK (Scotland)	5,068	6,463	5,993	3,541	6,493
USSR/Russia[3]	121,705	127,682	124,069	72,623	115,600
Japan	-	-	-	-	918
Estonia	-	-	-	-	6,156
Latvia	-	-	-	-	10,742
Total	421,636	473,165	463,495	218,946	317,237

[1]Preliminary.
[2]Including directed fishery also in Division IVa.
[3]In 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, 1983-1992, as estimated by the Working Group.

Country	1983	1984	1985	1986	1987
Denmark	38,290	49,032	35,843	57,315	28,541
Faroes	12,757	9,740	3,606	5,678	7,051
France	249	-	-	-	-
German Dem.Rep.[2]	-	-	-	-	53
Germany,Fed.Rep.[2]	-	556	52	-	62
Ireland	-	-	-	-	-
Netherlands	-	122	130	1,114	-
Norway	62,591	58,038	54,522	26,941	24,969
Poland[2]	-	-	-	-	-
Sweden	3,850	5,401	3,616	8,532	2,013
UK (Engl. & Wales)[2]	-	-	-	-	-
UK (Scotland)	-	-	-	-	-
Total	117,737	122,806	97,769	99,580	62,689

Country	1988	1989	1990	1991	1992[1]
Denmark	18,114	26,605	27,052	15,538	31,389
Faroes	492	3,325	5,281	355	705
France	-	-	-	-	-
German Dem.Rep.[2]	-	-	-	-	-
Germany,Fed.Rep.[2]	280	3	-	-	25[4]
Ireland	-	-	-	-	-
Netherlands	-	-	20	-	2
Norway	24,898	42,956	29,336[3]	22,644	31,977
Poland[2]	-	-	-	-	-
Sweden	1,226	3,062	1,503	1,000	2,058
UK (Engl. & Wales)[2]	-	7	-	-	17
UK (Scotland)	100	-	-	335	1
Total	45,110	75,958	63,192	39,872	66,174

[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 Preliminary data on landings (t) of BLUE WHITING in 1993 based on information from Working Group members.

Country	Area	Jan	Feb	Mar	Apr	May	June	July	Total
Russia	IIa	-	-	-	-	100	32,700	5,600	38,400
	Vb	8,100	2,400	300	10,800	47,000	-	-	68,600
	VIc	-	-	-	-	-	-	-	-
	VIIb,c	-	-	200	-	-	-	-	200
	VIIg-k	-	1,200	11,300	-	-	-	-	12,500
	XII	-	-	700	2,700	-	-	-	3,400
Sum		8,100	3,600	12,500	13,500	47,100	32,700	5,600	123,100
Faroe Islands	IVa	-	-	-	66	677	297	35	1,075
	Vb	-	-	-	190	41	-	-	231
	VIa-VIIb,c	-	-	-	-	3,640	8,916	-	12,556
Sum		-	-	-	256	4,358	9,213	35	13,862
Norway	IIa	-	-	5	240	-	461	3	709
	IVa	-	-	83	1,000	5,141	2,369	52	8,645
	Vb	-	-	-	-	16,640	-	-	16,640
	VIIb,c	-	2,875	29,431	8,259	-	-	-	40,565
	VIIg-k	-	13,881	19,158	166	-	-	-	33,205
	VIb	-	-	211	589	-	-	-	800
	VIa	-	-	-	90,488	11,860	-	-	102,348
Sum		-	16,756	48,888	100,742	33,641	2,830	55	202,912
Estonia	Vb	-	-	-	-	151	674	208	1,033
Latvia	Vb	-	-	-	2,044	3,966	1,183	538	7,731
Lituania	Vb	-	-	-	-	1,134	912	-	2,046
France	Vb	-	-	-	-	1,200	-	-	1,200
Grand total		8,100	20,356	61.388	116,542	91,550	47,512	6,436	351,884

Table 4.2.1 Length distribution (%) of BLUE WHITING for the Russian directed fishery in 1992.

Length cm	Divisions			
	IIa	Vb_1	VIIb,c	VIIg-k
17	-	-	-	0.3
18	-	-	0.3	3.1
19	-	-	1.0	3.1
20	-	1.0	1.3	2.8
21	-	1.7	1.0	1.9
22	-	1.7	1.3	2.8
23	0.1	0.7	3.0	4.3
24	0.4	0.7	4.3	8.3
25	0.9	3.3	4.0	9.2
26	6.2	7.3	14.3	12.3
27	16.5	16.0	18.3	13.5
28	21.9	16.3	16.7	11.4
29	18.9	22.5	12.3	9.5
30	13.8	8.0	7.7	4.0
31	8.1	5.3	6.0	4.0
32	6.1	2.0	2.7	1.9
33	2.7	3.0	2.7	2.2
34	1.3	1.3	1.7	1.8
35	1.6	4.3	1.0	1.2
36	1.0	1.7	-	1.5
37	0.4	1.3	0.3	0.3
38	0.1	1.3	-	0.6
39	-	0.3	-	-
40	-	0.3	-	-
N	693	300	300	325
Mean length	29.1	28.9	27.6	26.5

Table 4.2.2 Length distribution (%) of BLUE WHITING from Faroes directed fishery in 1992.

Length cm	May Vb	Apr-July IVa	Apr-May VIa-VIIb,c
20	-	-	-
21	0.2	0.4	-
22	0.4	0.5	0.5
23	1.2	1.1	0.9
24	3.0	2.8	2.3
25	10.8	10.3	10.5
26	20.1	19.5	17.9
27	20.8	20.2	19.1
28	15.1	15.2	10.4
29	10.4	10.5	8.6
30	5.0	4.7	8.2
31	3.3	3.5	6.8
32	3.3	3.3	5.4
33	1.7	2.2	4.4
34	2.1	2.6	2.8
35	1.4	1.8	0.9
36	0.8	0.8	0.9
37	0.1	0.3	0.2
38	0.1	0.1	-
39	0.1	0.1	-
40	0.1	0.1	0.2
N	1,419	1,510	570
Mean length	27.7	27.8	28.2

Table 4.2.3 Length distribution (%) of blue whiting from the Russian directed fishery in 1993 (January-June).

Length cm	Divisions					
	IIa	IVa	Vb_1	VIa	VIIb,c	VIIg-k
18	12.0	-	-	-	-	0.5
19	12.0	2.0	-	-	-	2.0
20	40.0	3.0	0.5	-	0.3	4.0
21	36.0	14.0	-	-	1.1	2.5
22	-	7.0	2.0	1.0	1.1	4.5
23	-	5.0	1.0	1.0	3.1	7.5
24	-	1.0	1.0	1.7	2.3	9.0
25	-	1.0	0.5	3.3	2.8	10.5
26	-	5.0	4.5	9.3	2.8	15.0
27	-	11.0	7.5	11.8	5.4	15.0
28	-	17.0	12.0	14.8	19.2	10.0
29	-	10.0	16.0	18.6	16.1	7.0
30	-	6.0	9.5	12.0	10.7	4.5
31	-	8.0	15.0	6.8	10.1	2.5
32	-	3.0	13.5	4.7	6.5	0.5
33	-	1.0	5.5	3.5	4.5	1.5
34	-	4.0	6.5	3.0	3.9	1.0
35	-	-	3.0	3.0	2.8	1.0
36	-	1.0	1.5	1.8	2.8	2.0
37	-	-	-	2.0	2.8	-
38	-	1.0	0.5	0.8	1.1	-
39	-	-	-	0.3	0.6	-
40	-	-	-	0.3	-	-
41	-	-	-	0.3	-	0.5
N samples	25	100	200	399	355	200
Mean length	20.0	26.7	30.0	29.3	29.7	26.1

Table 4.2.4 Length distribution (%) of BLUE WHITING from Norwegian directed fishery in 1993.

Length cm	Division							
	VIIb,c	VIIb,c	VIIb,c	Vb	VIa	VIa	VIIg-k	VIIg-k
	Apr	Mar	Apr	May	Apr	May	Feb	Mar
23	-	-	-	-	0.1	-	-	0.2
24	-	-	-	-	0.1	-	-	0.7
25	-	1.1	-	-	1.4	0.7	-	2.5
26	3.7	8.2	1.6	2.1	3.5	4.1	4.5	11.4
27	10.4	13.7	1.6	6.2	14.0	7.1	13.3	16.4
28	13.4	17.7	11.9	17.5	19.7	15.6	21.3	21.5
29	16.5	15.1	25.3	15.5	16.9	18.1	14.5	15.1
30	16.5	14.2	23.8	17.5	14.6	18.1	14.0	10.8
31	11.2	13.0	18.3	15.5	10.7	15.3	11.9	8.2
32	14.9	9.0	7.1	8.2	7.3	9.9	6.6	4.9
33	11.2	3.8	4.8	9.3	3.6	4.4	6.3	4.3
34	2.2	2.0	1.6	8.2	2.5	4.1	4.2	1.9
35	-	1.1	2.4	-	2.3	1.7	1.4	1.4
36	-	0.8	0.8	-	1.1	-	1.4	0.6
37	-	0.3	-	-	1.1	0.3	0.3	0.1
38	-	-	0.8	-	0.9	0.3	0.3	-
39	-	-	-	-	0.2	0.3	-	-
N	134	656	126	97	982	294	286	879
Mean length	29.9	29.3	30.2	30.2	29.6	29.9	29.7	28.8

Table 4.2.5 Length distribution (%) of BLUE WHITING from Norwegian mixed fishery in 1993.

Length cm	Division		
	IVa	IVa	IVa
	Feb	May	Jun
20	11.2	-	-
21	22.2	13.3	11.7
22	22.2	26.2	14.6
23	-	15.8	25.2
24	-	7.2	13.6
25	11.1	2.5	-
26	5.6	3.9	-
27	5.6	6.5	2.9
28	16.6	8.6	3.9
29	-	3.2	12.6
30	-	5.7	2.9
31	-	3.2	9.7
32	-	2.5	2.9
33	-	1.4	-
34	-	-	-
35	5.6	-	-
N	18	279	103
Mean length	22.2	24.6	25.1

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), 1983 - 1992.

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992[1]
0	2.5	63.6	871.4	51.9	9.1	3.6	36.5	8.4	63.6	-
1	290.4	417.6	127.4	161.9	280.8	93.2	86.4	537.8	33.4	82.4
2	239.1	1,394.1	1,341.6	263.3	361.0	403.2	359.4	353.1	533.2	52.2
3	164.1	277.9	1,588.1	1,559.5	580.2	416.2	1,176.7	565.7	384.4	1,508.5
4	194.1	211.9	199.3	1,464.3	1,780.2	611.2	696.2	709.1	243.9	510.4
5	411.4	259.2	161.0	298.7	680.3	1,238.9	785.7	489.2	329.9	200.1
6	284.4	420.2	303.7	156.4	118.2	584.9	680.7	562.1	235.3	138.8
7	274.0	253.1	248.7	192.2	94.9	77.8	127.2	291.7	149.9	92.0
8	283.5	190.3	167.2	185.8	117.1	50.7	44.8	75.5	39.9	86.7
9	219.9	151.6	91.7	166.4	99.7	32.4	23.8	26.6	4.3	84.6
10	152.6	113.8	87.8	172.1	48.3	28.3	15.2	15.5	6.4	13.1
11	71.5	57.7	73.1	108.7	60.1	8.8	8.9	42.9	5.2	1.0
12+	92.5	79.8	94.5	105.7	86.6	11.8	12.9	33.4	2.4	0.4
Total	2,680.0	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
Tonnes	416,730	481,872	554,640	694,314	571,659	477,552	521,415	465,601	297,649	379,549

[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) 1983 - 1992.

Age	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992[1]
0	336.3	446.4	184.3	-	226.8	12.3	1,871.6	0.5	24.9	-
1	1,844.2	1,650.8	891.4	395.0	174.5	185.1	578.9	874.8	8.4	159.8
2	90.0	587.7	365.0	334.7	105.7	84.3	183.7	167.6	397.9	63.9
3	38.4	49.7	173.8	134.6	85.4	83.4	70.0	49.5	42.3	167.1
4	47.7	12.8	37.4	184.4	88.9	40.2	33.5	11.8	11.4	75.1
5	55.6	12.6	13.4	79.7	32.8	44.0	24.1	7.0	11.3	25.2
6	12.2	10.4	13.9	24.3	15.6	24.0	12.2	3.8	11.2	16.7
7	12.8	6.1	5.8	7.3	9.2	3.3	5.9	4.9	6.2	6.7
8	2.6	2.2	5.6	11.0	5.1	2.1	2.1	0.6	3.4	6.7
9	5.8	2.7	1.8	7.3	3.8	1.0	0.8	0.4	0.7	2.7
10	4.2	2.6	3.0	3.9	0.2	0.2	0.3	-	0	0.9
11	9.6	0.9	1.4	3.8	-	-	0.4	-	0	0.5
12+	4.2	0.7	0.3	3.5	-	-	0.3	-	0.2	0.1
Total	2,463.6	2,785.5	1,697.0	1,189.4	748.0	479.9	2,783.8	1,120.9	517.9	518.7
Tonnes	124,737	122,806	97,769	99,580	59,952	45.110	75,978	63,195	56,852	66,174

[1]Preliminary.

Table 4.3.3 Catch in number at age, Blue Whiting Northern area.

Run title : VPA Blue Whiting North - Index file. I (1993)

At 10/09/1993 21:35

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

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,
AGE						
0,	429,	956,	2,	23,	0,	3451,
1,	468,	1031,	1919,	331,	69,	45,
2,	155,	232,	244,	649,	122,	90,
3,	121,	159,	353,	437,	515,	204,
4,	197,	420,	480,	422,	284,	484,
5,	185,	437,	487,	507,	522,	242,
6,	154,	483,	590,	554,	556,	273,
7,	138,	528,	754,	755,	466,	266,
8,	177,	474,	914,	806,	634,	271,
9,	120,	365,	840,	620,	578,	284,
+gp,	337,	674,	1892,	1963,	1460,	672,
TOTALNUM,	2480,	5758,	8474,	7067,	5206,	6281,
TONSLAND,	238013,	574812,	1091422,	1092620,	870808,	544829,
SOPCOF %,	91612,	91196,	98615,	100160,	98499,	94188,

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
0,	339,	510,	1056,	52,	236,	16,	1908,	9,	88,	0,
1,	2133,	2068,	1019,	557,	455,	278,	664,	1413,	42,	242,
2,	328,	1982,	1707,	598,	467,	488,	541,	521,	931,	116,
3,	202,	328,	1762,	1694,	666,	500,	1238,	615,	427,	1676,
4,	241,	225,	237,	1649,	1869,	651,	725,	728,	255,	585,
5,	465,	272,	174,	378,	713,	1293,	804,	496,	341,	225,
6,	295,	431,	318,	181,	134,	609,	688,	566,	247,	155,
7,	285,	259,	254,	200,	104,	81,	132,	297,	156,	99,
8,	285,	192,	173,	197,	122,	53,	47,	76,	43,	89,
9,	225,	154,	93,	174,	103,	33,	25,	27,	5,	85,
+gp,	334,	255,	259,	398,	195,	50,	37,	92,	13,	15,
TOTALNUM,	5132,	6676,	7052,	6078,	5064,	4052,	6809,	4840,	2548,	3287,
TONSLAND,	539237,	610603,	652776,	739904,	631615,	522575,	591738,	528793,	354501,	447263,
SOPCOF %,	96118,	101774,	99963,	90806,	100293,	99834,	95356,	99924,	100055,	100083,

1991 - Revised

Age	Catch in no. ('000)
0	85
1	41
2	846
3	413
4	251
5	336
6	242
7	154
8	42
9	5
10	6
11	5
12	2
Total	2.428

Table 4.4.1 Mean weight at age in the catch and in the stock, Blue Whiting Northern area.

Run title : VPA Blue Whiting North - Index file. I (1993)

At 10/09/1993 21:35

Table 3 Stock weights at age (kg)

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

Table 3 Stock weights at age (kg)

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
AGE										
0,	.0180,	.0270,	.0140,	.0330,	.0200,	.0240,	.0140,	.0240,	.0390,	.0210,
1,	.0460,	.0360,	.0380,	.0400,	.0560,	.0610,	.0650,	.0450,	.0830,	.0670,
2,	.0940,	.0860,	.0800,	.0810,	.0920,	.0870,	.0890,	.0750,	.1070,	.1020,
3,	.1360,	.1040,	.1020,	.1130,	.1090,	.1070,	.1060,	.1090,	.1200,	.1190,
4,	.1520,	.1420,	.1290,	.1320,	.1250,	.1310,	.1300,	.1240,	.1540,	.1460,
5,	.1620,	.1570,	.1640,	.1680,	.1480,	.1420,	.1500,	.1500,	.1810,	.1680,
6,	.1780,	.1640,	.1780,	.2020,	.1780,	.1580,	.1590,	.1690,	.1970,	.1950,
7,	.1950,	.1760,	.2000,	.2090,	.2090,	.1810,	.1740,	.1750,	.2080,	.2120,
8,	.2000,	.1890,	.2080,	.2430,	.2210,	.1990,	.2060,	.2150,	.2320,	.2240,
9,	.2040,	.1860,	.2180,	.2460,	.2220,	.2220,	.2240,	.2170,	.2500,	.2410,
+gp,	.2262,	.2013,	.2334,	.2532,	.2536,	.2501,	.2383,	.2694,	.2468,	.3040,

1991 - Revised

Age	Mean weight at age (kg)
0	.039
1	.083
2	.105
3	.119
4	.153
5	.181
6	.196
7	.208
8	.231
9	.250
10	.250
11	.235
12	.261

Table 4.6.1 Tuning data for Blue Whiting Northern area, Russian and Norwegian acoustic estimates in spawning area from 1982-1992 for ages 3-11.

```
BLUE WHITING NORTH TUNING DATA 1992. (BWN_TUN2.FLT)
102
USSR, Spaw. Area/Acoustic
1982 1992
1,1
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,  080,  010,  010
1, 10300,  5350, 5130, 2630, 1770,  870,  300,  220,  000
1, 20010,  6700, 1350,  440,  390,  170,  000,  000,  000
Nor., Spaw. Area/Acoustic
1982 1992
1,1
3,11
1,  2431,  6676,  3335, 3470, 3656, 3231, 2239,  384, 985
1,  2108,  2723,  6511, 3735, 3650, 3153, 2279, 1182, 531
1,  1514,  1616,  1719, 1858, 1128,  567,  440,  348,  80
1,  9150,  1336,   999,  985, 1115,  639,  370,  256, 183
1,  7183,  7340,  1159,  383,  251,  373,  151,  174,  73
1,  8050, 22357,  4697,  282,  417,  385,  159,   27, 111
1,  8799, 12271, 20285, 7323,  723,  617,  326,  398, 126
1, 22270,  9973, 10504, 7803,  933,  293,  177,   46, 148
1, 12670, 11228,  5587, 6556, 3273,  516,  183,  108,  81
1,  6340,  8497,  7407, 4558, 2019,  545,   96,   16,  33
1, 26123,  4719,  1574, 1386,  810,  616,  257,   19,   0
```

Table 4.6.2 XSA-tuning results from 2 fleets, Russian and Norwegian acoustic estimates in spawning area.

```
VPA Version 3.1 (MSDOS)  XSA: N+R, CV=0.5, Down-weighting (Tricubic), default Shrinkage (5/5)
==========================================================================================
=                                                                                        =
=  Final run 10/9-93.  As adopted by Blue Whiting WG, F(3-7)= 0.385   (corr. M.Ogive)    =
=                                                     -------------                      =
==========================================================================================

   10/09/1993  21:12

 Extended Survivors Analysis

 VPA Blue Whiting North - Index file.  I (1993)

 CPUE data from file x


Data for    2 fleets over   23 years
Age range from    0 to    9


     Fleet,                  Alpha,    Beta
USSR, Spawning Area/    ,  .000    ,  .500
Norway, Spawning Are    ,  .000    ,  .500


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 converged after   24 iterations


Total absolute residual between iterations
23 and  24 =   .000
```

cont'd.

Table 4.6.2 cont'd.

Regression weights

.670	.751	.820	.877	.921	.954	.976	.990	.997	1.000	1.000

Fishing mortalities

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0	.181	.016	.048	.137	.007	.047	.002	.099	.006	.019	.000
1	.014	.162	.130	.127	.099	.079	.073	.124	.098	.035	.067
2	.044	.131	.222	.150	.102	.113	.115	.197	.135	.087	.130
3	.085	.132	.188	.315	.219	.158	.171	.472	.360	.157	.223
4	.168	.137	.212	.202	.551	.401	.229	.399	.568	.248	.334
5	.129	.241	.227	.253	.571	.491	.538	.491	.528	.575	.361
6	.220	.230	.369	.452	.455	.406	1.083	.623	.787	.550	.564
7	.223	.377	.325	.388	.577	.518	.461	.729	.608	.515	.445
8	.230	.397	.474	.376	.596	.872	.548	.537	1.402	.160	.634
9	.219	.303	.388	.444	.821	.735	.615	.546	.690	.283	.543

XSA population numbers

YEAR	AGE 0	1	2	3	4	5	6	7	8	9	Plus GP
1982	2.31E+04	3.65E+03	2.31E+03	2.76E+03	3.46E+03	2.21E+03	1.53E+03	1.47E+03	1.46E+03	1.59E+03	3.75E+03
1983	2.33E+04	1.58E+04	2.95E+03	1.81E+03	2.08E+03	2.40E+03	1.59E+03	1.00E+03	9.62E+02	9.51E+02	1.40E+03
1984	1.21E+04	1.88E+04	1.10E+04	2.11E+03	1.30E+03	1.48E+03	1.54E+03	1.03E+03	5.62E+02	5.30E+02	8.70E+02
1985	9.11E+03	9.44E+03	1.35E+04	7.20E+03	1.43E+03	8.61E+02	9.67E+02	8.73E+02	6.11E+02	2.87E+02	7.91E+02
1986	8.10E+03	6.50E+03	6.81E+03	9.52E+03	4.30E+03	9.60E+02	5.48E+02	5.04E+02	4.85E+02	3.43E+02	7.74E+02
1987	5.62E+03	6.59E+03	4.82E+03	5.03E+03	6.26E+03	2.03E+03	4.44E+02	2.84E+02	2.32E+02	2.19E+02	4.09E+02
1988	7.71E+03	4.39E+03	4.98E+03	3.52E+03	3.52E+03	3.43E+03	1.02E+03	2.42E+02	1.39E+02	7.94E+01	1.19E+02
1989	2.25E+04	6.29E+03	3.34E+03	3.64E+03	2.43E+03	2.29E+03	1.64E+03	2.82E+02	1.25E+02	6.57E+01	9.62E+01
1990	1.64E+03	1.67E+04	4.55E+03	2.25E+03	1.86E+03	1.34E+03	1.15E+03	7.21E+02	1.11E+02	5.98E+01	2.01E+02
1991	5.14E+03	1.33E+03	1.24E+04	3.26E+03	1.28E+03	8.62E+02	6.45E+02	4.28E+02	3.21E+02	2.24E+01	5.80E+01
1992	7.67E+03	4.13E+03	1.05E+03	9.28E+03	2.28E+03	8.21E+02	3.97E+02	3.05E+02	2.09E+02	2.24E+02	3.91E+01

Population estimates for 1993

0.00E+00	6.28E+03	3.16E+03	7.57E+02	6.08E+03	1.34E+03	4.68E+02	1.85E+02	1.60E+02	9.09E+01	1.25E+02

Taper weighted geometric mean of the VPA populations:

7.93E+03	6.28E+03	4.91E+03	4.15E+03	2.65E+03	1.76E+03	1.15E+03	7.29E+02	4.83E+02	3.04E+02

Standard error of the weighted Log(VPA populations) :

.7605	.7501	.7199	.5418	.5426	.6392	.8023	1.0325	1.3002	1.6875

cont'd.

Table 4.6.2 cont'd.

Log catchability residuals.

Fleet : USSR, Spawning Area/

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
3	-2.17	-.28	-.20	.12	.17	-.64	-.47	.74	.99	.63	.26
4	-1.04	-.47	-1.28	-1.23	.97	.37	-.53	.32	1.17	.64	.31
5	-1.34	.55	-1.12	-1.21	.24	.30	.18	.31	.71	1.05	-.29
6	-.98	.02	.16	-.22	-.72	.04	.72	.66	.06	.60	-.70
7	-.86	-.22	-.15	-.91	-.64	-.30	.78	1.98	-.13	.56	-.63
8	-.45	-.53	-.11	-.89	-.41	.47	.39	2.24	.02	.05	-1.04
9	-.85	-1.11	.28	-.17	-.17	.56	.31	2.50	-.53	1.68	-3.96

Mean catchability and Standard error.

Age	0	1	2	3	4	5	6	7	8	9
Mean Q				.6088	.8948	.9230	.9841	1.0336	1.0336	1.0336
S.E				.8103	.8715	.7965	.5762	.8794	.9218	1.7333

Regression statistics :

Age	Slope	Intercept	S.e.	RSquare	No Pts	Fleet Mean Q
3	.89	.37	.76	.40	11	.61
4	.72	1.53	.65	.42	11	.89
5	.91	-.21	.77	.33	11	.92
6	.75	.99	.43	.63	11	.98
7	4.38	-25.59	3.44	.03	11	1.03
8	2.53	-11.43	2.07	.15	11	1.05
9	2.75	-11.68	4.48	.08	11	.94

Fleet : Norway, Spawning Are

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
3	-.79	-.50	-.97	-.37	-.91	-.18	.27	1.24	1.13	.02	.40
4	-.33	-.73	-.76	-1.05	-.37	.34	.27	.48	.90	.92	-.22
5	-.63	-.02	-.87	-.87	-.75	-.12	.83	.56	.48	1.21	-.34
6	-.16	-.12	-.76	-.91	-1.28	-1.39	1.19	.67	.89	1.05	.35
7	.06	.48	-.74	-.57	-1.47	-.40	.30	.46	.75	.77	.18
8	-.06	.38	-.79	-.77	-1.03	-.19	.72	.07	.95	-.34	.32
9	-.51	.04	-1.00	-.55	-1.53	-1.05	.65	.21	.38	.61	-.64

Mean catchability and Standard error.

Age	0	1	2	3	4	5	6	7	8	9
Mean Q				.7352	1.0813	1.1264	1.0844	.9571	.9571	.9571
S.E				.7720	.6814	.7385	.9713	.7105	.6487	.8098

Regression statistics :

Age	Slope	Intercept	S.e.	RSquare	No Pts	Fleet Mean Q
3	1.16	-2.17	.94	.30	11	.74
4	.90	-.16	.65	.42	11	1.08
5	.72	1.25	.54	.50	11	1.13
6	.69	1.34	.69	.40	11	1.08
7	1.23	-2.60	.91	.34	11	.96
8	1.77	-6.02	1.01	.43	11	.91
9	1.64	-4.41	.99	.64	11	.67

Table 4.6.3 Fishing mortality (F) at age estimated from XSA-tuning, Blue Whiting Northern area.

Run title : VPA Blue Whiting North - Index file. I (1993)

At 10/09/1993 21:13

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,
AGE						
0,	.0494,	.0817,	.0005,	.0072,	.0000,	.1806,
1,	.0695,	.1608,	.2342,	.0820,	.0266,	.0137,
2,	.0230,	.0446,	.0517,	.1155,	.0392,	.0439,
3,	.0175,	.0294,	.0887,	.1235,	.1262,	.0852,
4,	.0239,	.0774,	.1169,	.1453,	.1102,	.1677,
5,	.0203,	.0680,	.1210,	.1745,	.2698,	.1292,
6,	.0182,	.0676,	.1233,	.1971,	.2947,	.2201,
7,	.0134,	.0800,	.1430,	.2294,	.2534,	.2230,
8,	.0266,	.0587,	.1937,	.2240,	.3073,	.2296,
9,	.0205,	.0705,	.1401,	.1949,	.2484,	.2191,
+gp,	.0205,	.0705,	.1401,	.1949,	.2484,	.2191,
FBAR 3- 7,	.0187,	.0645,	.1186,	.1740,	.2109,	.1650,
FBAR 4- 8,	.0205,	.0703,	.1396,	.1941,	.2471,	.1939,

Table 8 Fishing mortality (F) at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	FBAR 90-92
AGE											
0,	.0162,	.0477,	.1371,	.0071,	.0475,	.0023,	.0986,	.0061,	.0191,	.0000,	.0084,
1,	.1618,	.1297,	.1270,	.0994,	.0794,	.0725,	.1240,	.0984,	.0355,	.0670,	.0669,
2,	.1313,	.2223,	.1504,	.1021,	.1132,	.1146,	.1970,	.1352,	.0869,	.1298,	.1173,
3,	.1315,	.1881,	.3152,	.2191,	.1581,	.1705,	.4719,	.3600,	.1566,	.2226,	.2464,
4,	.1373,	.2122,	.2016,	.5509,	.4006,	.2288,	.3994,	.5676,	.2478,	.3335,	.3830,
5,	.2412,	.2267,	.2527,	.5712,	.4911,	.5383,	.4907,	.5280,	.5747,	.3610,	.4879,
6,	.2300,	.3693,	.4516,	.4547,	.4058,	1.0833,	.6227,	.7867,	.5500,	.5642,	.6337,
7,	.3774,	.3248,	.3879,	.5771,	.5175,	.4613,	.7286,	.6079,	.5153,	.4447,	.5226,
8,	.3967,	.4736,	.3755,	.5959,	.8718,	.5481,	.5369,	1.4023,	.1601,	.6345,	.7323,
9,	.3030,	.3877,	.4438,	.8207,	.7345,	.6155,	.5457,	.6904,	.2827,	.5433,	.5055,
+gp,	.3030,	.3877,	.4438,	.8207,	.7345,	.6155,	.5457,	.6904,	.2827,	.5433,	
FBAR 3- 7,	.2235,	.2642,	.3218,	.4746,	.3946,	.4965,	.5426,	.5700,	.4089,	.3852,	
FBAR 4- 8,	.2765,	.3213,	.3339,	.5500,	.5374,	.5720,	.5556,	.7785,	.4096,	.4676,	

Table 4.6.4 Stock size in numbers ('000) at age from XSA-tuning, Blue Whiting Northern area.

Run title : VPA Blue Whiting North - Index file. I (1993)

At 10/09/1993 21:13

Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,
AGE						
0,	9840,	13464,	5683,	3568,	4455,	23085,
1,	7691,	7668,	10158,	4650,	2900,	3647,
2,	7557,	5873,	5345,	6580,	3508,	2312,
3,	7738,	6047,	4599,	4156,	4800,	2761,
4,	9193,	6226,	4807,	3446,	3007,	3464,
5,	10187,	7348,	4717,	3501,	2440,	2205,
6,	9435,	8173,	5621,	3422,	2408,	1525,
7,	11392,	7585,	6254,	4068,	2300,	1468,
8,	7427,	9202,	5733,	4438,	2648,	1462,
9,	6528,	5921,	7105,	3867,	2905,	1594,
+gp,	18281,	10905,	15931,	12189,	7295,	3752,
TOTAL,	105268,	88412,	75954,	53887,	38665,	47276,

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	GM 77-89	AM 77-8'
AGE													
0,	23320,	12096,	9111,	8103,	5624,	7706,	22465,	1637,	5140,	7674,	0,	9564,	11425
1,	15778,	18786,	9442,	6504,	6587,	4391,	6295,	16667,	1332,	4128,	6283,	7004,	8038
2,	2945,	10988,	13510,	6808,	4821,	4982,	3344,	4553,	12367,	1053,	3161,	5362,	6044
3,	1811,	2115,	7203,	9516,	5033,	3525,	3637,	2248,	3256,	9283,	757,	4352,	4842
4,	2076,	1300,	1434,	4303,	6258,	3518,	2433,	1858,	1284,	2280,	6084,	3422,	3959
5,	2398,	1482,	861,	960,	2031,	3433,	2291,	1336,	862,	821,	1337,	2646,	3373
6,	1587,	1543,	967,	548,	444,	1017,	1641,	1148,	645,	397,	468,	1932,	2948
7,	1002,	1032,	873,	504,	284,	242,	282,	721,	428,	305,	185,	1380,	2868
8,	962,	562,	611,	485,	232,	139,	125,	111,	321,	209,	160,	1119,	2617
9,	951,	530,	287,	343,	219,	79,	66,	60,	22,	224,	91,	906,	2338
+gp,	1403,	870,	791,	774,	409,	119,	96,	201,	58,	39,	125,		
TOTAL,	54233,	51303,	45090,	38848,	31943,	29151,	42675,	30540,	25717,	26413,	18651,		

Table 4.6.5 Matrix of residuals, Blue Whiting Northern area.

```
=======================================
= SEP VPA 0.455, corr. M.Ogive        =
=                                     =
= Terminal F= 0.455 gives F(3-7)= 0.385 =
=======================================
```

Title : VPA Blue Whiting North - Index file. I (1993)

At 10/09/1993 21:22

Separable analysis
from 1977 to 1992 on ages 0 to 9
with Terminal F of .455 on age 5 and Terminal S of 1.000

Initial sum of squared residuals was 200.160 and
final sum of squared residuals is 83.216 after 93 iterations

Matrix of Residuals

Years, Ages	1977/78,	1978/79,	1979/80,	1980/81,	1981/82,
0/ 1,	1.257,	1.057,	-3.364,	.164,	-4.010,
1/ 2,	1.872,	2.225,	1.670,	1.272,	-.020,
2/ 3,	1.307,	.509,	.141,	.640,	-.134,
3/ 4,	-.261,	-.538,	.170,	.455,	.060,
4/ 5,	.161,	.384,	.239,	-.248,	.101,
5/ 6,	-.097,	.115,	.029,	-.272,	.445,
6/ 7,	-.788,	-.458,	-.523,	-.454,	.088,
7/ 8,	-.684,	-.443,	-.219,	-.324,	.018,
8/ 9,	-.284,	-.574,	.133,	-.267,	.179,
TOT ,	.002,	.001,	.001,	.001,	.001,
WTS ,	.001,	.001,	.001,	.001,	.001,

Years,	1982/83,	1983/84,	1984/85,	1985/86,	1986/87,	1987/88,	1988/89,	1989/90,	1990/91,	1991/92,	,TOT	,WTS
0/ 1,	2.125,	-.382,	.556,	2.135,	-.973,	1.069,	-2.172,	1.610,	-.955,	.449,	.000,	.135,
1/ 2,	-1.327,	.507,	.443,	1.026,	.365,	.157,	-.126,	.526,	-.012,	-.554,	.000,	.269,
2/ 3,	-.026,	.546,	.478,	.598,	.175,	.254,	-.315,	.216,	-.135,	-.024,	.000,	.620,
3/ 4,	.226,	.027,	.267,	.227,	-.257,	-.093,	-.210,	.391,	.086,	-.174,	.000,	.921,
4/ 5,	.361,	-.077,	.100,	-.418,	.556,	.132,	-.192,	.069,	-.172,	.161,	.000,	.975,
5/ 6,	-.035,	-.065,	-.508,	-.201,	.528,	-.301,	.406,	-.244,	-.484,	.623,	.000,	.708,
6/ 7,	-.319,	-.465,	-.290,	-.158,	-.439,	-.435,	.836,	-.258,	-.429,	.290,	.000,	.644,
7/ 8,	-.216,	-.060,	-.269,	-.221,	-.341,	-.109,	.008,	-.371,	.393,	.081,	.000,	1.000,
8/ 9,	-.054,	.070,	-.037,	-.563,	-.269,	.442,	.143,	-.434,	1.097,	-1.246,	.000,	.483,
,	.001,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	4.067,	
WTS ,	.001,	.001,	.001,	.001,	.001,	1.000,	1.000,	1.000,	1.000,	1.000,		

Fishing Mortalities (F)

	1977,	1978,	1979,	1980,	1981,	1982,
F-values	.0444,	.1049,	.1704,	.2301,	.2281,	.2194,

	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,
F-values	.3233,	.3855,	.3851,	.4963,	.4744,	.4702,	.6500,	.7093,	.3668,	.4550,

Selection-at-age (S)

	0,	1,	2,	3,	4,	5,	6,	7,	8,	9,
S-values	.0322,	.1416,	.2394,	.4811,	.6939,	1.0000,	1.3409,	1.1793,	1.1537,	1.0000,

Table 4.6.6 Fishing mortality (F) at age estimated from separable VPA, Blue Whiting Northern area.

Run title : VPA Blue Whiting North - Index file. I (1993)

At 10/09/1993 21:23

Traditional VPA Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,
AGE						
0,	.0497,	.0790,	.0005,	.0073,	.0000,	.1805,
1,	.0681,	.1618,	.2243,	.0796,	.0270,	.0140,
2,	.0235,	.0436,	.0522,	.1099,	.0380,	.0446,
3,	.0190,	.0302,	.0865,	.1244,	.1194,	.0824,
4,	.0265,	.0843,	.1198,	.1412,	.1112,	.1572,
5,	.0253,	.0756,	.1329,	.1794,	.2598,	.1305,
6,	.0244,	.0851,	.1386,	.2199,	.3044,	.2100,
7,	.0265,	.1086,	.1851,	.2637,	.2909,	.2329,
8,	.0451,	.1196,	.2767,	.3079,	.3698,	.2746,
9,	.0444,	.1234,	.3202,	.3065,	.3789,	.2811,
+gp,	.0444,	.1234,	.3202,	.3065,	.3789,	.2811,
FBAR 3- 7,	.0243,	.0768,	.1326,	.1857,	.2171,	.1626,
FBAR 4- 8,	.0295,	.0946,	.1706,	.2224,	.2672,	.2010,

Table 8 Fishing mortality (F) at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	FBAR 90-92
AGE											
0,	.0165,	.0483,	.1412,	.0068,	.0485,	.0024,	.0898,	.0073,	.0156,	.0000,	.0076,
1,	.1618,	.1324,	.1285,	.1028,	.0762,	.0742,	.1323,	.0889,	.0427,	.0541,	.0619,
2,	.1340,	.2221,	.1540,	.1035,	.1175,	.1094,	.2017,	.1456,	.0777,	.1588,	.1274,
3,	.1335,	.1923,	.3141,	.2250,	.1603,	.1779,	.4406,	.3701,	.1706,	.1953,	.2454,
4,	.1322,	.2157,	.2072,	.5452,	.4140,	.2324,	.4206,	.5062,	.2578,	.3715,	.3785,
5,	.2226,	.2164,	.2578,	.5899,	.4832,	.5661,	.4991,	.5725,	.4736,	.3803,	.4755,
6,	.2323,	.3309,	.4214,	.4658,	.4292,	1.0287,	.6811,	.8068,	.6339,	.4105,	.6171,
7,	.3534,	.3285,	.3318,	.5142,	.5376,	.5030,	.6514,	.7221,	.5438,	.5686,	.6115,
8,	.4197,	.4283,	.3812,	.4650,	.6921,	.5849,	.6206,	1.0269,	.2092,	.6976,	.6446,
9,	.3850,	.4219,	.3806,	.8343,	.4748,	.4024,	.6119,	.9176,	.1579,	.8128,	.6294,
+gp,	.3850,	.4219,	.3806,	.8343,	.4748,	.4024,	.6119,	.9176,	.1579,	.8128,	
FBAR 3- 7,	.2148,	.2568,	.3065,	.4680,	.4049,	.5016,	.5386,	.5955,	.4160,	.3852,	
FBAR 4- 8,	.2720,	.3040,	.3199,	.5160,	.5112,	.5830,	.5745,	.7269,	.4237,	.4857,	

Table 4.6.7 Stock size in numbers ('000) at age from separable VPA, Blue Whiting Northern area.

Run title : VPA Blue Whiting North - Index file. I (1993)

At 10/09/1993 21:23

Traditional VPA Terminal populations from weighted Separable populations

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

YEAR,	1977,	1978,	1979,	1980,	1981,	1982,
AGE						
0,	9749,	13878,	5826,	3509,	4356,	22986,
1,	7831,	7594,	10499,	4767,	2852,	3566,
2,	7367,	5990,	5289,	6869,	3604,	2272,
3,	7119,	5891,	4695,	4110,	5039,	2841,
4,	8290,	5719,	4680,	3525,	2971,	3661,
5,	8175,	6609,	4304,	3399,	2506,	2177,
6,	7073,	6526,	5017,	3085,	2326,	1582,
7,	5811,	5651,	4907,	3576,	2027,	1405,
8,	4421,	4633,	4151,	3339,	2249,	1241,
9,	3050,	3460,	3366,	2577,	2009,	1272,
+gp,	8557,	6390,	7578,	8164,	5075,	3010,
TOTAL,	77442,	72343,	60312,	46920,	35015,	46013,

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	GM 77-89	AM 77-8
AGE													
0,	22796,	11930,	8830,	8405,	5494,	7223,	24463,	1364,	(6283),	0,	0,	9540,	11496,
1,	15711,	18357,	9307,	6278,	6834,	4285,	5899,	18307,	1108,	(5064),	0,	6949,	7983,
2,	2879,	10942,	13166,	6701,	4637,	5185,	3258,	4231,	13714,	870,	(3928),	5338,	6012,
3,	1779,	2062,	7174,	9241,	4947,	3376,	3805,	2180,	2995,	10388,	607,	4314,	4775,
4,	2142,	1275,	1393,	4290,	6041,	3450,	2313,	2005,	1233,	2067,	6996,	3350,	3827,
5,	2561,	1536,	841,	927,	2037,	3270,	2239,	1244,	990,	780,	1167,	2554,	3122,
6,	1564,	1679,	1013,	532,	421,	1028,	1520,	1113,	574,	505,	437,	1823,	2567,
7,	1050,	1015,	987,	544,	273,	224,	301,	630,	407,	250,	274,	1245,	2136,
8,	911,	604,	598,	580,	266,	131,	111,	128,	250,	193,	116,	960,	1787,
9,	772,	490,	322,	335,	298,	109,	60,	49,	38,	166,	79,	736,	1394,
+gp,	1146,	812,	897,	766,	565,	165,	88,	167,	98,	29,	71,		
TOTAL,	53312,	50701,	44528,	38599,	31814,	28447,	44057,	31418,	27690,	20313,	13675,		

Table 4.6.8 Stock size summary table from separable VPA, Blue Whiting Northern area.

Run title : VPA Blue Whiting North - Index file. I (1993)

At 10/09/1993 21:23

Table 16 Summary (without SOP correction)

Traditional VPA Terminal populations from weighted Separable populations

	RECRUITS,	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 7,	FBAR 4- 8,
1977,	9749,	8782,	7738,	238013,	30.7581,	.0243,	.0295,
1978,	13878,	7765,	6690,	574812,	85.9208,	.0768,	.0946,
1979,	5826,	6790,	5955,	1091422,	183.2718,	.1326,	.1706,
1980,	3509,	5902,	5239,	1092620,	208.5504,	.1857,	.2224,
1981,	4356,	4538,	3940,	870808,	220.9921,	.2171,	.2672,
1982,	22986,	3835,	3068,	544829,	177.5584,	.1626,	.2010,
1983,	22796,	3468,	2197,	539237,	245.4727,	.2148,	.2720,
1984,	11930,	3383,	1859,	610603,	328.4785,	.2568,	.3040,
1985,	8830,	3362,	2067,	652776,	315.7931,	.3065,	.3199,
1986,	8405,	3476,	2327,	739904,	318.0009,	.4680,	.5160,
1987,	5494,	2915,	1945,	631615,	324.7498,	.4049,	.5112,
1988,	7223,	2458,	1577,	522575,	331.3179,	.5016,	.5830,
1989,	24463,	2407,	1370,	591738,	431.8022,	.5386,	.5745,
1990,	1364,	2228,	1143,	528793,	462.4452,	.5955,	.7269,
1991,	6283,	2822,	1450,	337521	244.4435,	.4160,	.4237,
1992,	0,	2341,	1927,	445723	232.1113,	.3852,	.4857,
Arith. Mean ,	9818,	4155,	3156,	625920	258.8542,	.3054,	.3564,
Units,	(Thousands),	('000 t),	('000 t),	(Tonnes),			

Table 4.6.9 Input data for prediction and Y/R calculations, Blue Whiting Northern area.

14/09/1993 bw_jan
Northern Blue Whiting

List of input variables:

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

Year	Recruitment	
1993	7920.0	Average of years 1977-1989, excluding the rich 1982, 83 & 89 year classes
1994	11496.0	Average of years 1977-1989
1995	11496.0	Average of years 1977-1989

				All gears		
age	stock size	natural mortality	maturity ogive	fishing pattern	weight in the catch	weight in the stock
0	7920.0	.20	.00	.01	.025	.025
1	6483.0	.20	.10	.06	.065	.065
2	7187.0	.20	.37	.10	.093	.093
3	607.0	.20	.96	.20	.114	.114
4	6996.0	.20	.99	.28	.139	.139
5	1167.0	.20	1.00	.41	.162	.162
6	437.0	.20	1.00	.55	.180	.180
7	274.0	.20	1.00	.48	.192	.192
8	116.0	.20	1.00	.47	.219	.219
9	79.0	.20	1.00	.41	.233	.233
10	71.0	.20	1.00	.41	.265	.265

Table 4.6.10 Standard prediction, Blue Whiting Northern area.

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

14/09/1993
Northern Blue Whiting

Year 1993					Year 1994					Year 1995	
All gears					All gears						
factor	ref. F	catch	stock biomass	sp.stock biomass	factor	ref. F	catch	stock biomass	sp.stock biomass	stock biomass	sp.stock biomass
.9	.37	448	2663	1772	.0	.00	0	2686	1711	3277	2109
					.1	.02	27		1711	3249	2082
					.1	.04	54		1711	3221	2055
					.2	.06	81		1711	3193	2029
					.2	.08	107		1711	3166	2004
					.3	.10	132		1711	3140	1979
					.3	.12	157		1711	3114	1954
					.4	.13	182		1711	3088	1930
					.4	.15	206		1711	3063	1906
					.5	.17	230		1711	3038	1883
					.5	.19	253		1711	3014	1860
					.6	.21	276		1711	2990	1837
					.6	.23	298		1711	2967	1815
					.7	.25	321		1711	2944	1793
					.7	.27	342		1711	2921	1772
					.8	.29	364		1711	2898	1751
					.8	.31	385		1711	2876	1730
					.9	.33	406		1711	2855	1710
					.9	.35	426		1711	2834	1690
					1.0	.37	446		1711	2813	1670
					1.0	.39	466		1711	2792	1651
					1.1	.40	485		1711	2772	1632
					1.1	.42	504		1711	2752	1614
					1.1	.44	523		1711	2732	1595
					1.2	.46	542		1711	2713	1577
					1.2	.48	560		1711	2694	1560
					1.3	.50	578		1711	2675	1542
					1.3	.52	595		1711	2657	1525
					1.4	.54	613		1711	2639	1508
					1.4	.56	630		1711	2621	1492
					1.5	.58	647		1711	2604	1475
					1.5	.60	663		1711	2586	1459
					1.6	.62	680		1711	2569	1444
					1.6	.64	696		1711	2553	1428
					1.7	.65	711		1711	2536	1413
					1.7	.67	727		1711	2520	1398
					1.8	.69	742		1711	2504	1383
					1.8	.71	757		1711	2488	1369
					1.9	.73	772		1711	2473	1354
					1.9	.75	787		1711	2457	1340
					2.0	.77	801		1711	2442	1327

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

Table 4.6.11 Management option table, BLUE WHITING in the northern area. Effects of different levels of fishing mortality on catch, etc.

Year 1993					Year 1994						Year 1995	
F-factor	ref.F	Stock size	SSB	Catch	Basis	F-factor	ref. F	TSB	SSB	Catch	TSB	SSB
.95	.37	2,663	1,772	448	F(med)	.53	.2	2,686	1,711	265	3,002	1,849
					F(0.1)	.63	.24			310	2,956	1,804
					F(93)	.95	.37			446	2,813	1,670
					F(92)	1.0	.39			466	2,792	1,651

SSB given for 1 January (units thousand tonnes). The reference F is the F from the age group range from 3-7.

Table 5.1.1 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) 1983-1992 as estimated by the Working Group.

Country	1983	1984	1985	1986	1987
Germany, Fed. Rep	50	-	-	-	-
Netherlands	-	-	-	-	-
Norway	-	-	-	-	4
Portugal	4,748	5,252	6,989	8,116	9,148
Spain	26,037	25,921	35,828	24,965	23,644
UK (England & Wales)	-	-	3	1	23
France	-	-	-	-	-
Total	30,835	31,173	42,820	33,082	32,819

Country	1988	1989	1990	1991	1992[1]
Germany, Fed. Rep.	-	-	-	-	-
Netherlands	-	-	450	10	-
Norway	-	-	-	-	-
Portugal	5,979	3,557	2,864	2,813	4,928
Spain	24,847	30,108	29,490	29,180	23,794
UK (England & Wales)	12	29	13	-	-
France	-	1	-	-	-
Total	30,838	33,695	32,817	32,003	28,722

[1]Preliminary.

Table 5.2.1 Catch in numbers (thousands) by length group in the Portuguese and Spanish BLUE WHITING fisheries, 1985-1992.

Length cm	1985	1986	1987	1988	1989	1990	1991	1992
10	8	-	1	-	-	0	0	0
1	25	-	33	7	-	3	0	2
2	39	118	37	3	12	62	17	10
3	74	783	1,130	8	247	128	2,607	381
4	498	5,903	16,889	391	864	874	13,445	11,376
5	13,013	7,234	44,625	3,190	1,845	8,066	15,444	13,826
6	31,407	6,394	39,111	11,210	9,649	28,079	23,259	28,732
7	73,885	16,669	52,790	34,392	59,269	74,069	54,277	55,192
8	181,222	49,746	102,112	67.722	85,197	89,504	77,586	85,173
9	235,008	82,458	131,911	95,783	80,280	75,083	75,235	86,438
20	211,958	99,258	116,195	126.949	100,839	90.950	80,281	74,353
1	127,966	126,338	71,862	115.176	100,778	81,597	77,129	53,886
2	69,313	107,413	46,724	69,350	82,438	55,600	69,771	41,024
3	28,905	57,835	35,691	25,146	45,833	30,872	40,146	30,334
4	11,842	23,594	20,522	12,471	22,950	17,051	21,892	19,753
5	5,946	9,840	11,696	7,102	14,428	9,022	10,941	10,608
6	3,089	3,759	7,461	3,961	7,528	4,753	4,209	5,728
7	1,263	2,033	3,717	1,993	3,432	4,391	2,504	3,118
8	899	1,091	1,965	1,434	2,236	1,953	910	1,209
9	622	473	994	799	881	1,196	694	437
30	296	308	918	473	316	552	317	190
1	205	165	177	222	405	459	340	100
2	172	174	119	136	159	225	277	120
3	64	255	46	110	105	276	209	68
4	54	269	30	89	58	97	114	43
5	23	167	12	54	26	53	95	35
6	15	67	6	22	24	25	120	27
7	6	80	1	19	17	17	119	14
8	2	56	5	1	4	8	38	6
9	2	1	-	1	2	3	5	9
40	3	8	-	1	2	0	6	15
1	3	-	-	-	-	-	-	-
2	1	-	-	-	-	-	-	-
3	1	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-
8	1	-	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-	-
Total N	997,830	602.489	707,780	578,215	619,824	574,971	571,988	522,207
Landings (t)	42,817	33.083	32,792	30,732	33,665	32,354	31,993	28,722

Table 5.2.2 Catch in numbers (Thousands) by length group and by quarter in the Spanish BLUE WHITING fisheries, 1992.

Length	Quarter 1	2	3	4	Total
10	0	0	0	0	0
11	1	0	1	0	2
12	2	0	8	0	10
13	334	30	17	0	381
14	2,684	615	13	59	3,371
15	5,217	2,954	146	938	9,255
16	8,653	7,863	1,110	1,420	19,046
17	11,107	17,770	6,861	7,094	42,833
18	8,290	20,911	23,223	17,579	70,003
19	7,249	19,366	27,135	17,256	71,006
20	13,112	15,415	13,594	15,076	57,197
21	12,307	10,663	8,036	9,816	40,822
22	15,191	9,793	5,532	8,371	38,886
23	11,724	6,478	4,010	6,441	28,653
24	8,813	3,478	1,931	4,387	18,609
25	4,398	2,075	1,134	2,511	10,119
26	3,296	1,023	478	883	5,681
27	1,853	298	401	482	3,034
28	627	99	156	283	1,164
29	230	46	66	59	402
30	56	48	44	30	178
31	28	21	23	20	92
32	30	22	47	19	118
33	4	15	42	6	67
34	8	8	21	5	42
35	2	5	25	3	35
36	2	7	18	1	27
37	2	9	2	1	14
38	1	4	1	0	6
39	0	8	0	0	9
40	0	8	1	5	15
TOTAL	115,222	119,033	94,074	92,746	421,075
Landing (Tonnes)	7,174	6,253	5,002	5,366	23,794

Table 5.2.3 Catch in numbers (Thousands) by length group and by quarter in the Portuguese BLUE WHITING fisheries, 1992.

	Quarter				
Length	1	2	3	4	Total
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	7,728	277	8,006
15	76	0	3,312	1,183	4,571
16	942	102	5,654	2,989	9,686
17	1,960	1,373	5,319	3,707	12,359
18	1,075	2,168	8,712	3,214	15,169
19	758	3,274	10,302	1,098	15,432
20	1,284	3,125	12,433	314	17,156
21	1,376	2,234	9,454	0	13,064
22	1,170	214	754	0	2,138
23	541	94	1,044	1	1,680
24	136	101	907	1	1,145
25	30	65	395	1	490
26	19	18	6	5	48
27	11	29	37	7	84
28	10	18	5	12	45
29	5	11	10	9	36
30	3	2	2	6	12
31	3	1	1	3	8
32	1	0	0	0	1
33	1	0	0	0	1
34	1	0	0	0	1
35	0	0	0	0	0
36	0	0	0	0	0
37	0	0	0	0	0
38	0	0	0	0	0
39	0	0	0	0	0
40	0	0	0	0	0
TOTAL	9,400	12,827	66,076	12,829	101,132
Landings (Tonnes)	406	564	3,585	372	4,928

Table 5.2.4 Catch in numbers (Thousands) by length group and by gear in the Southern BLUE WHITING fisheries, 1992.

	SPAIN			PORTUGAL	
	Bottom trawl	Pair trawl	Long line	Bottom trawl	
Length	1	2	3	4	Total
10	0	0	0	0	0
11	1	0	1	0	2
12	3	0	8	0	10
13	365	0	16	0	381
14	3,358	0	13	8,006	11,376
15	7,918	1,295	42	4,571	13,826
16	10,397	8,592	56	9,686	28,732
17	18,528	24,266	39	12,359	55,192
18	32,119	37,852	33	15,169	85,173
19	25,785	45,183	37	15,432	86,438
20	19,973	37,184	40	17,156	74,353
21	15,165	25,606	51	13,064	53,886
22	16,514	22,298	74	2,138	41,024
23	11,868	16,712	73	1,680	30,334
24	7,925	10,623	61	1,145	19,753
25	4,331	5,726	62	490	10,608
26	3,057	2,575	49	48	5,728
27	1,419	1,559	56	84	3,118
28	518	611	35	45	1,209
29	189	189	24	36	437
30	109	36	33	12	190
31	63	14	15	8	100
32	102	0	16	1	120
33	57	0	10	1	68
34	25	7	10	1	43
35	28	1	5	0	35
36	17	3	7	0	27
37	9	1	4	0	14
38	4	0	2	0	6
39	9	0	0	0	9
40	8	0	6	0	15
TOTAL	179,864	240,336	876	101,132	522,207
Landing (Tonnes)	9,966	13,742	86	4,928	28,722

Table 5.2.5 Catch numbers at age of BLUE WHITING in the Southern Area UNIT: millions

YEAR AGE	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0	98	74	118	32	105	30	41	74	70	19
1	150	223	286	93	383	147	200	198	181	139
2	239	349	337	218	111	233	175	182	182	205
3	68	127	171	168	62	114	93	57	70	95
4	45	35	66	68	28	32	61	25	39	43
5	34	13	14	15	13	10	27	24	17	12
6	9	14	3	6	3	9	15	11	8	6
7	2	3	3	1	1	3	6	2	3	2
+gp	1	1	1	1	1	0	3	2	3	1
TOTAL NUM	646	839	999	602	707	578	621	575	573	522

Table 5.3.1 Catch weights at age in the Southern Area (kg)

YEAR AGE	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0	.0290	.0220	.0290	.0260	.0290	.0350	.0300	.0350	.0330	.0240
1	.0390	.0290	.0370	.0420	.0390	.0390	.0410	.0450	.0470	.0370
2	.0460	.0350	.0430	.0520	.0590	.0530	.0500	.0550	.0530	.0490
3	.0660	.0500	.0500	.0630	.0720	.0550	.0670	.0690	.0720	.0670
4	.0760	.0660	.0610	.0730	.0850	.0670	.0720	.0870	.0820	.0820
5	.0840	.0770	.0730	.0900	.0950	.1010	.0850	.0940	.0960	.1020
6	.1040	.0810	.1040	.0970	.1170	.0900	.0950	.1080	.1110	.1130
7	.1240	.0940	.1120	.1560	.1380	.1170	.1110	.1440	.1300	.1370
+gp	.1450	.1310	.1390	.2570	.1610	.2070	.1550	.1620	.1590	.1880

Table 5.4.1 Stratified mean catch and standard error for BLUE WHITING in groundfish surveys by Portugal.

Year	Month	20-100 m		100-200 m		200-500 m		20-500 m	
		y	s_y	y	s_y	y	s_y	y	s_y
1979	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	44.2	22.2
	June	-	-	4.2	1.6	177.5	24.5	33.8	4.5
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	0.0	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

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

Table 5.4.2 Stratified mean catch (kg/haul and Number/haul) and SD of BLUE WHITING in bottom trawl surveys in Spanish waters. All the surveys in September except the 1986 survey which was in April.

Kg/haul	30-100 m		101-200 m		201-500 m		TOTAL 30-500 m	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1985	9.5	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	8.7	36.93	7.95
1987	-	-	-	-	-	-	-	-
1988	2.9	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	53.61	10.62
1990	6.25	3.29	52.54	9	18.8	4.99	37.88	5.66
1991	64.59	34.65	126.41	26.06	46.07	18.99	97.05	17.16
1992	6.37	2.59	44.12	6.64	29.50	6.16	34.60	4.23

Numb/haul	30-100 m		101-200 m		201-500 m		TOTAL 30-500 m	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1985	267	181.71	3669	1578.86	1377	262.98	2644	963.2
1986	368	237.56	2486	1006.67	752	238.87	1763	616.4
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

Table 5.4.3 Catch per unit effort.

a) by Spanish vessels landing in the main Galician ports.

Year	Landings (tonnes)	Effort (days fishing)	CPUE (kg/day)
1978	22,286	16,059	1,388
1979	19,507	20,748	953
1980	18,478	17,229	1,072
1981	23,577	19,112	1,234
1982	20,940	19,320	1,084
1983	23,042	19,948	1,155
1984	22,305	19,015	1,173
1985	30,585	19,209	1,592
1986	19,929	17,985	1,108
1987	19,000	18,358	1,035
1988	21,030	18,598	1,131
1989	19,573	17,728	1,104
1990	21,977	16,641	1,321
1991	19,080	16,940	1,126
1992	16,200	16,340	991

b) by Portuguese bottom-trawl fishery.

Year	Landings (tonnes)	Effort (10^3 h)	CPUE (kg/h)
1978	2,389	228.4	10.5
1979	2,096	220.4	9.5
1980	6,051	211.4	28.6
1981	7,387	201.6	36.6
1982	3,890	225.4	17.3
1983	4,748	176.6	26.9
1984	5,252	154.0	34.1
1985	6,989	147.0	47.5
1986	8,116	155.4	52.2
1987	9,148	137.5	66.5
1988	5,934	127.6	46.5
1989	3,557	179.5	19.8
1990	2,577	101.7	25.3
1991	2,813	238.8	11.8
1992	4,928	-(1)	-(1)

(1)Not available

Table 5.4.4 Catch per unit effort by Spanish single and pair trawlers landing in the main Galician ports.

Year	Landings (tonnes)	Effort (days fishing)	CPUE (kg/day)
Single trawlers			
1983	16,813	18,071	930
1984	10,580	15,004	705
1985	15,752	14,616	1,078
1986	7,182	12,643	568
1987	4,843	13,190	367
1988	8,971	15,093	594
1989	7,868	13,911	566
1990	8,396	12,692	661
1991	4,866	11,669	417
1992	4,940	12,340	400
Pair trawlers			
1983	6,228	1,877	3,318
1984	11,726	4,011	2,924
1985	14,833	4,593	3,230
1986	12,747	5,341	2,387
1987	14,154	5,168	2,739
1988	12,059	3,505	3,441
1989	11,705	3,817	3,067
1990	13,581	3,949	3,439
1991	14,214	5,271	2,697
1992	11,260	4,004	2,812

Table 5.4.5 BLUE WHITING, Bay of Biscay. Number of fishing trips, effort (HP $\times$ fishing days $\times$ 10^{-2}), number of boats and horse power (HP).

Year	F.trip	Effort	No. boats	ΣH.P.	H.P.
1983	2724	12568	20	9260	463
1984	2338	10815	19	8600	453
1985	2207	9856	16	7105	444
1986	2407	10845	15	6645	443
1987	1869	8309	15	6645	443
1988	2077	9047	15	6873	458
1989	1835	8063	14	6015	430
1990	2013	8494	14	5908	422
1991	1795	7677	14	5992	428
1992	1461	12692[1]	14[1]	5992[1]	428[1]

[1]Preliminary

Table 5.4.6 BLUE WHITING, Bay of Biscay. CPUE (in $K/(\Sigma$ HP $\times$ days $\times$ $10^{-2}))$ in Division VIIIc, for bacas (trawlers) of Avilés port.

Quarter	I	II	III	IV	Total	
Year	CPUE	CPUE	CPUE	CPUE	CPUE	Catch (K)
1983	138.44	94.10	106.74	56.52	101.00	1,268,943
1984	155.13	74.20	74.64	51.06	81.86	885,419
1985	285.96	83.66	100.22	65.22	162.54	1,603,305
1986	309.60	67.30	70.62	43.05	142.27	1,542,928
1987	230.29	49.38	56.19	99.86	140.39	1,165,897
1988	340.56	85.30	86.98	96.95	166.89	1,508,809
1989	310.65	37.42	49.72	126.15	151.44	1,220,295
1990	262.13	47.72	36.43	57.42	113.41	467,557
1991	226.42	44.06	29.64	21.41	100.77	773,633
1992	93.87[1]	7.77[1]	4.75[1]	3.07[1]	34.7[1]	440.592

[1]Preliminary

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

Year	International	Svalbard	Jan Mayen	Norway	Iceland	Greenland	Faroes	EEC	Total (t)	Total from off. data (t)	%
1978	136,504	-	-	67,391	26,444	6,580	195,361	102,523	534,803	574,812	93.0
	(25.52)	-	-	(12.60)	(4.94)	(1.23)	(36.53)	(19.17)			
1979	614,734	-	-	75,545	15,117	204	224,201	164,388	1,094,189	1,091,422	100.3
	(56.18)			(6.90)	(1.38)	(0.02)	(20.49)	(15.02)			
1980	567,693	-	-	152,095	4,562	8,757	164,342	130,417	1,027,866	1,092,620	94.1
	(55.23)			(14.80)	((0.44)	(0.85)	(15.99)	(12.69)			
1981	168,681	-	123,000	215,004	7,751	-	174,801	164,475	853,712	870,808	98.0
	(19.76)		(14.41)	(25.18)	(1.09)		(23.50)	(46.58)			
1982	22,993	-	-	130,435	5,797	-	125,072	247,884	532,181	544,919	97.7
	(4.32)			(24.51)	(1.09)		(23.50)	(46.58)			
1983	15,203	-	-	109,675	7,000	-	91,804	294,981	518,663	539,235	96.2
	(2.93)			(21.15)	(1.35)		(17.70)	(56.87)			
1984	18,407	-	-	150,603	105	-	124,905	282,418	576,438	586,504	98.3
	(3.19)			(26.13)	(0.02)		(21.67)	(48.99)			
1985	38,978	-	-	114,785	-	-	196,003	292,345	642,111	644,899	99.6
	(6.07)			(17.88)			(30.52)	(45.53)			
1986	20,665	-	-	187,768	-	116	171,074	375,257	754,880	757,370	99.7
	(2.74)			(24.87)		(0.02)	(22.66)	(49.71)			
1987	103,535	-	-	109,201	-	-	135,980	234,249	582,830	631,610	92.3
	(17.76)			(18.74)			(23.31)	(40.19)			
1988	65,172	-	-	38,449	-	-	157,368	234,344	495,333	522,575	94.8
	(13.2)			(7.8)			(31.8)	(47.3)			
1989	137,093	-	-	68,817	4,977	-	101,177	284,338	596,402	596,402	100.0
	(23.0)			(11.5)	(0.8)		(17.0)	(47.7)			
1990	88,509	-	-	39,160	-	-	115,308	285,893	528,803	528,803	100.0
	(16.7)			(7.4)			(21.8)	(54.1)			
1991	51,950	-	-	72,309	-	-	99,268	165,519	389,046	356,471	109.1
	(13.4)			(18.6)			(25.5)	(42.5)			
1992	47,786	-	-	66,333	-	-	135,294	225,032	474,445	445,723	106.4
	(10.1)			(14.0)			(28.5)	(47.4)			

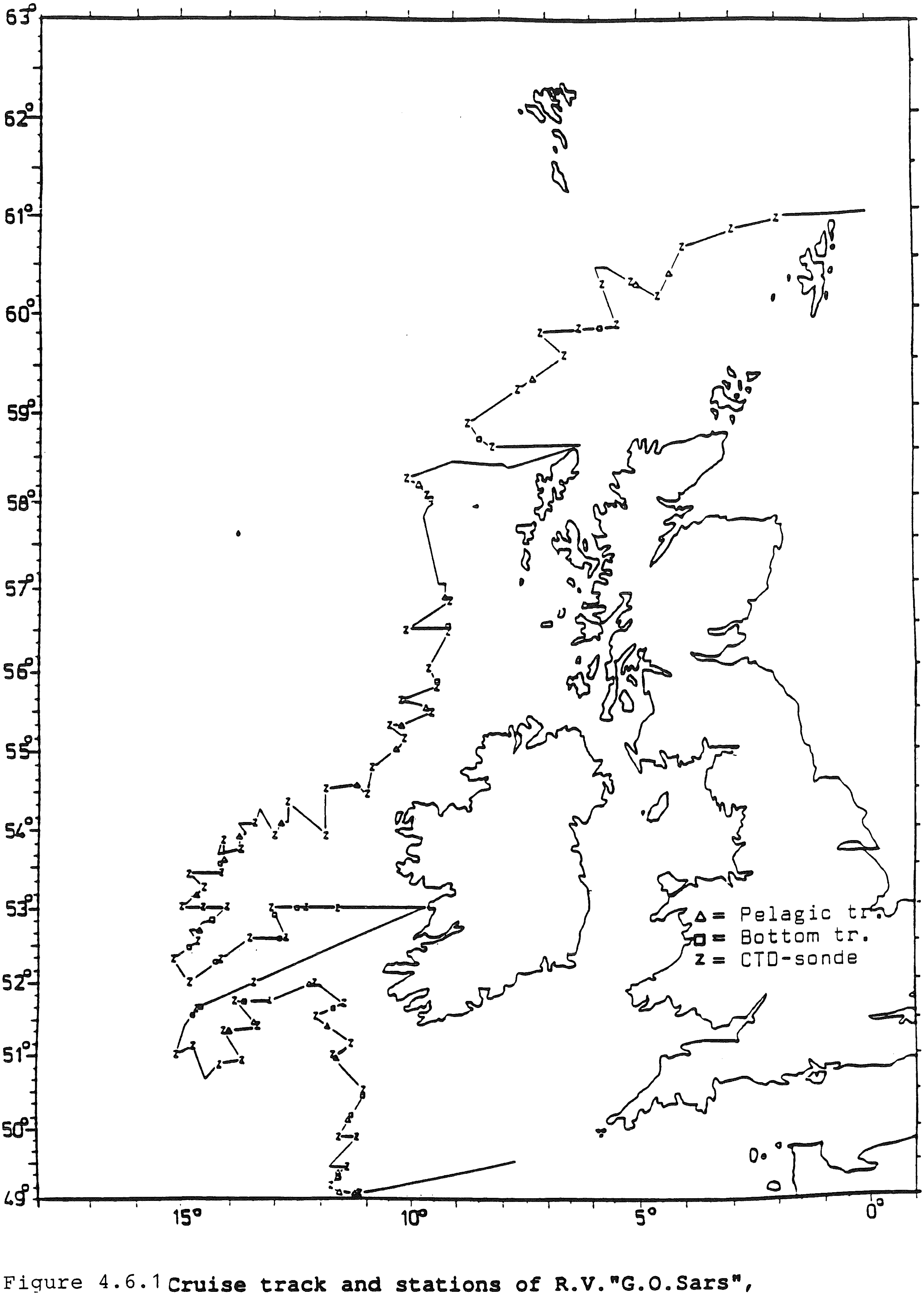


Figure 4.6.1 **Cruise track and stations of R.V."G.O.Sars", 12 March - 3 April 1993.**

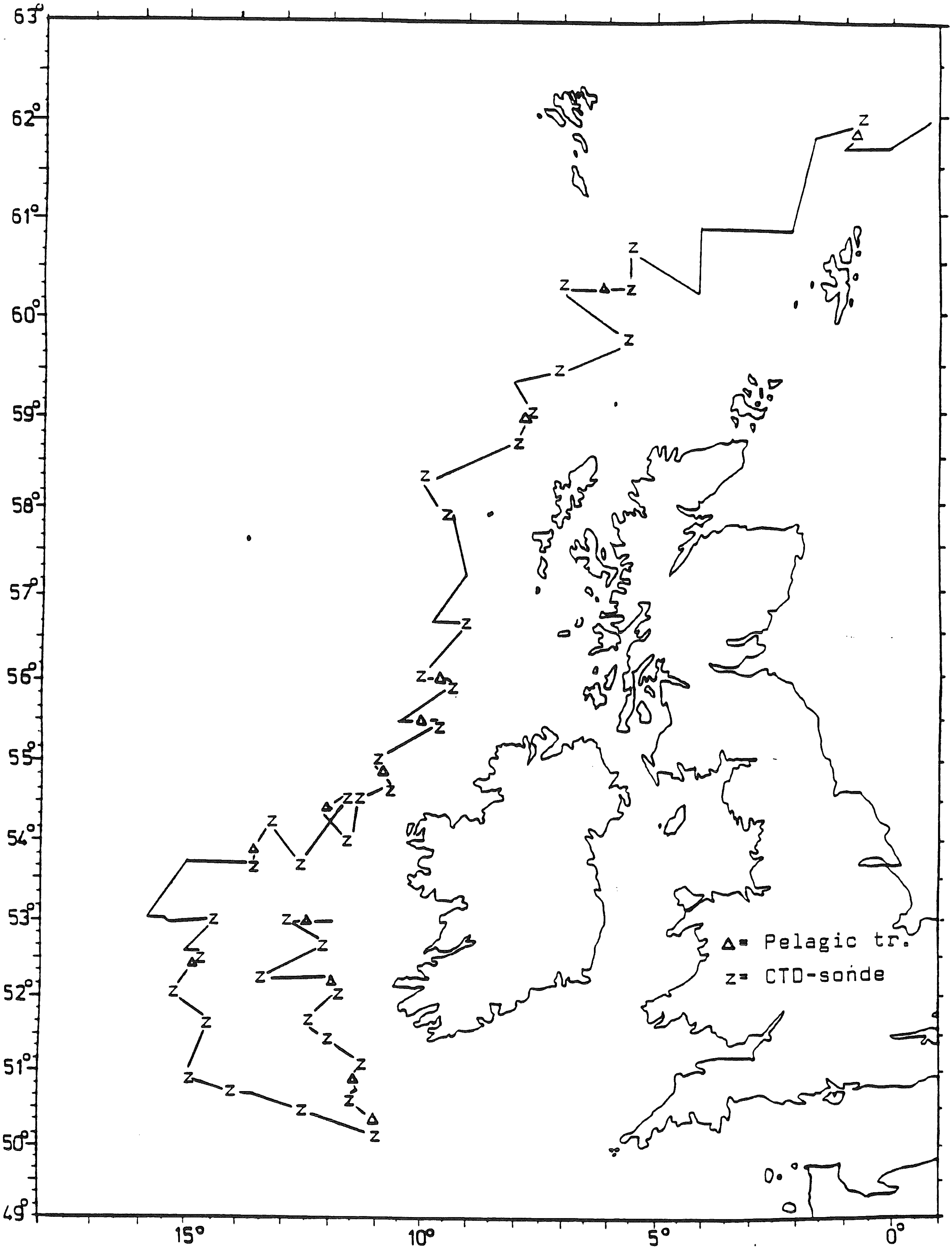


Figure 4.6.2 Cruise track and stations of R.V."Prof.Marti", 21 March - 11 April 1993.

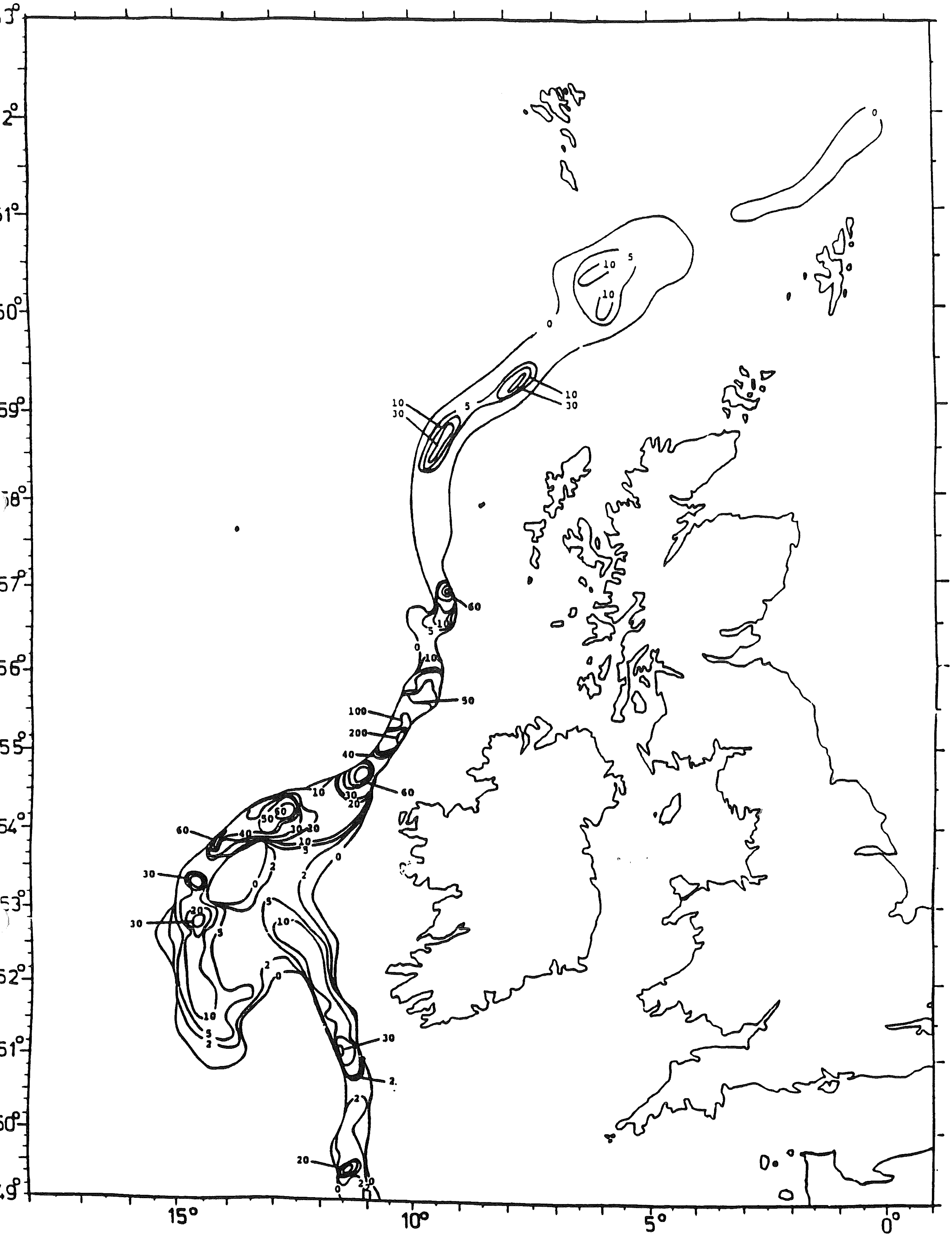


Figure 4.6.3 **Density distribution of blue whiting in spring 1993, 1. period: 12-28 March, combined result. Echo intensity in m² per (n.mile)² x 1/100.**

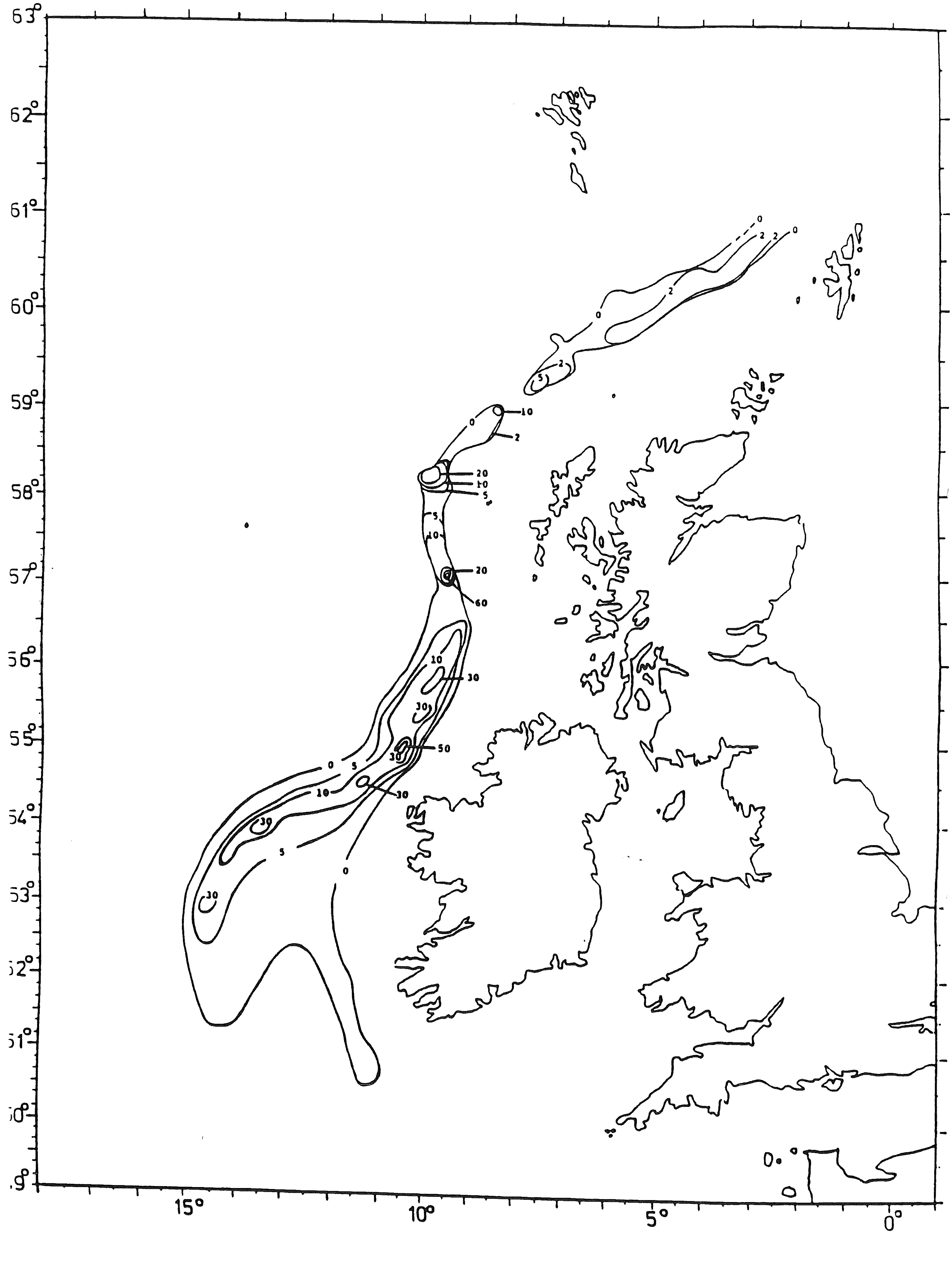


Figure 4.6.4 **Density distribution of blue whiting in spring 1993, 2. period: 28 March-11 April, combined result. Echo intensity in m^2 per $(n.mile)^2$ x 1/100.**

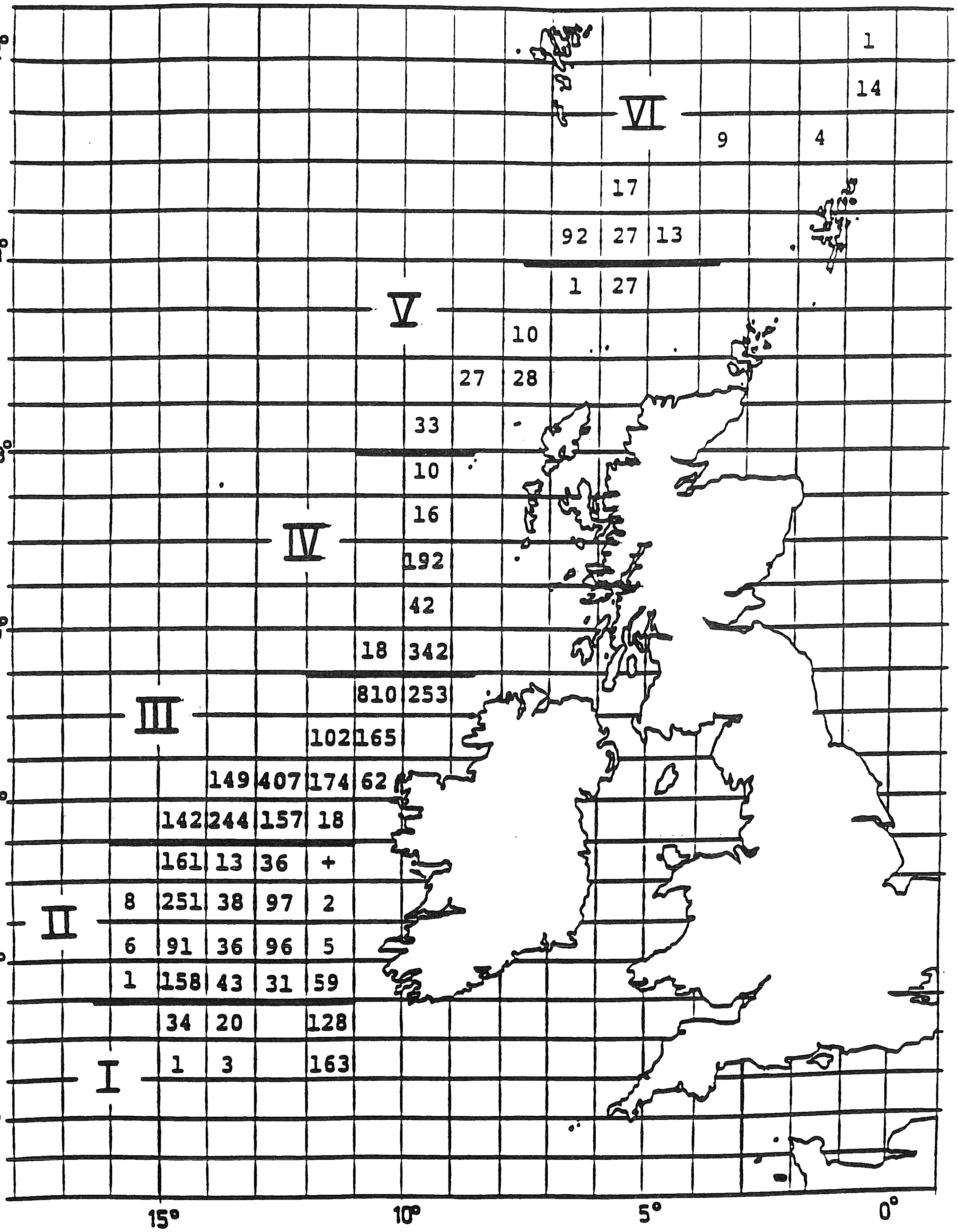


Figure 4.6.5 Blue whiting biomass ('000 tonnes) in spring 1993, 1. period: 12-28 March. Markings of subareas I-VI used in the assessment.

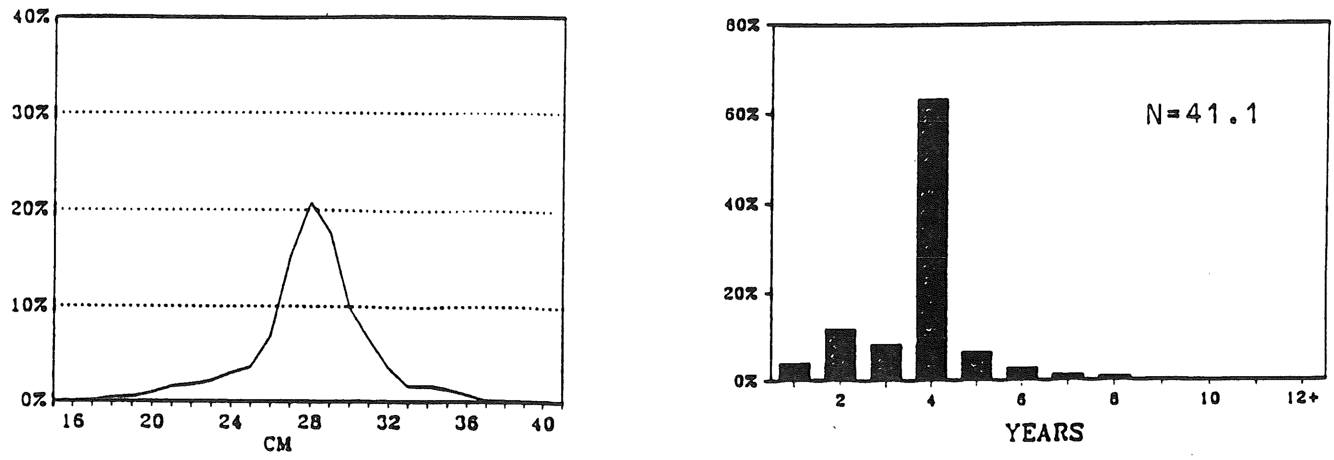


Figure 4.6.6 **Total length and age distribution (N%) of blue whiting in the area to the west of the British Isles, spring 1993, in 1. period: 12-28 March. N x 10^{-9}, combined results, weighted by abundance.**

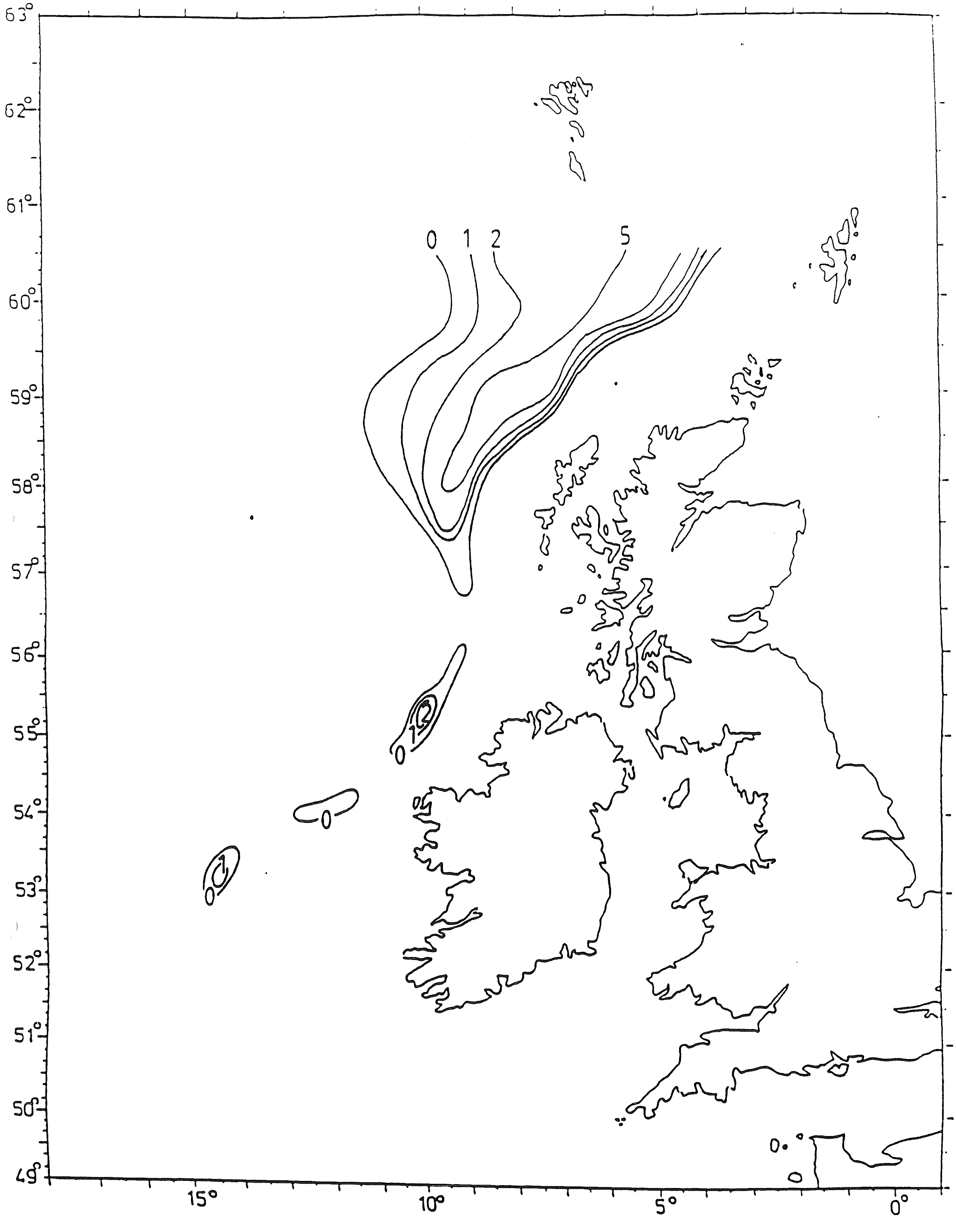


Figure 4.6.7 **Density distribution of blue whiting in spring 1993, recorded by R.V. "Prof.Marti" during the 3. period: 15-30 April. Echo intensity in m² per (n.mile)² x 1/100. From Belikov et al. (1993).**

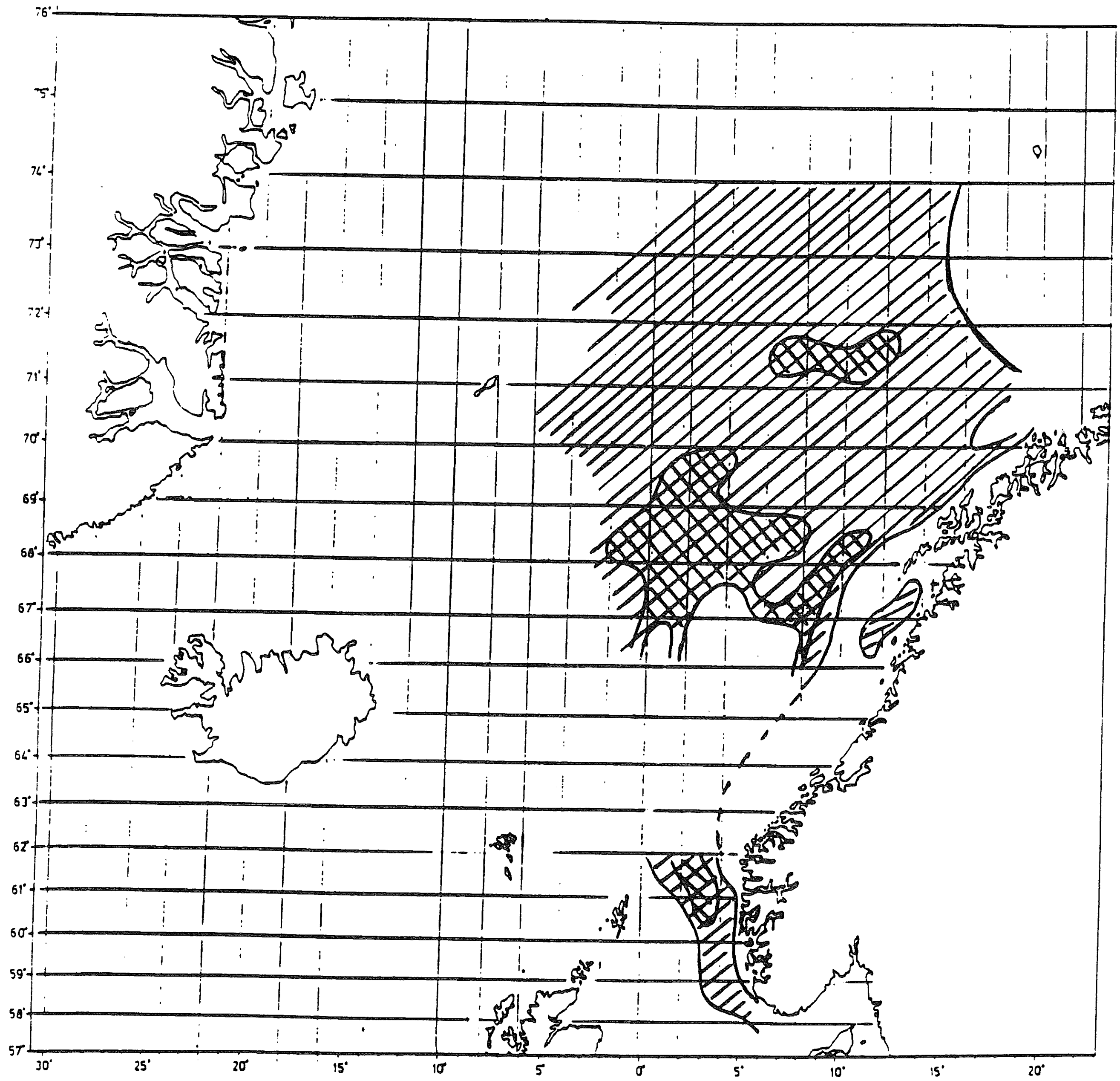


Figure 4.6.8 Distribution of blue whiting observed during summer 1993. Hatched area is weak recordings and dobbel hatched area is better recordings.

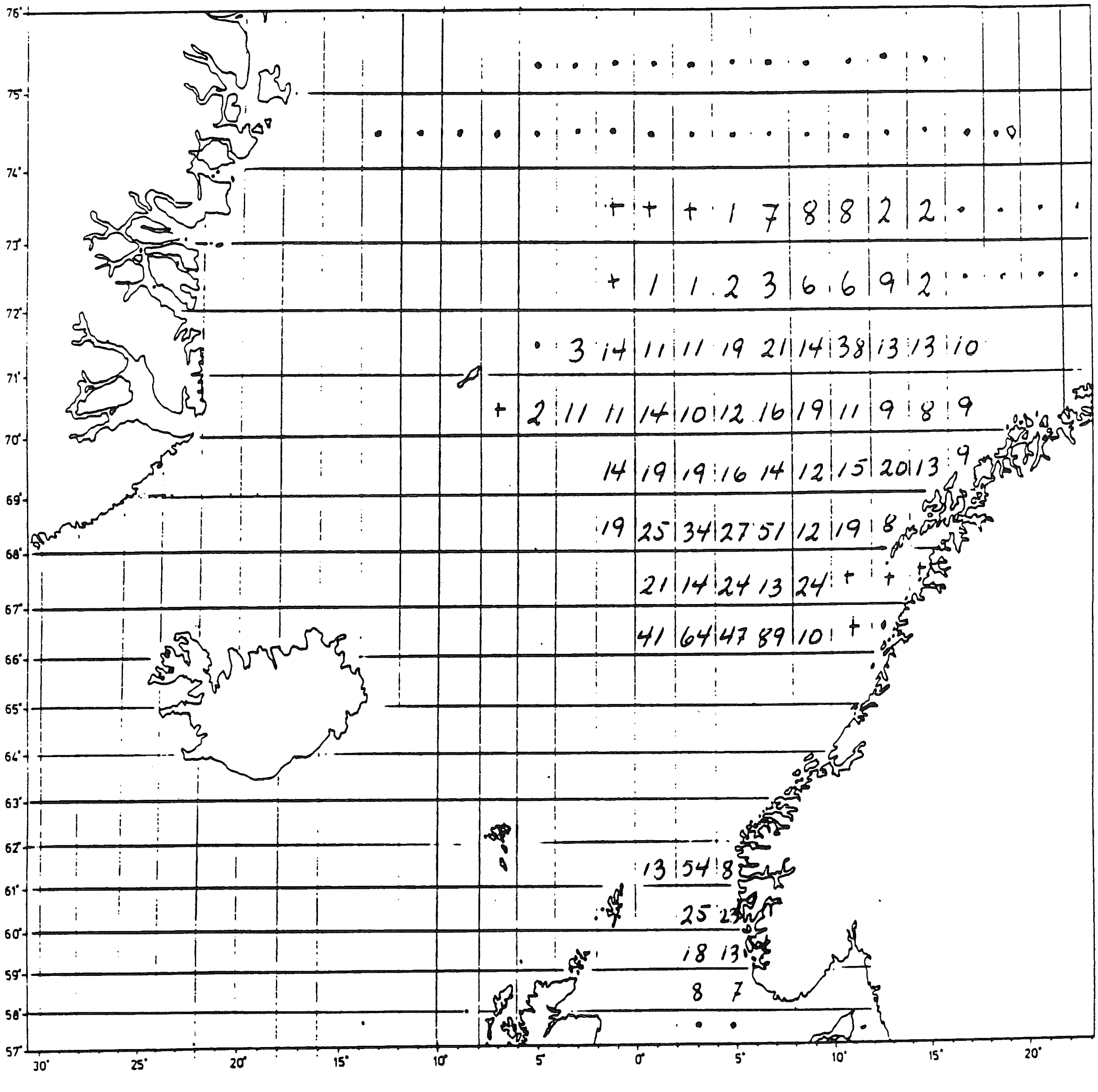


Figure 4.6.9 Biomass estimates, in thousand tonnes, of blue whiting during summer 1993. Symbols: + is low values, a point indicate survying in the rectangle, but no observation of blue whiting.

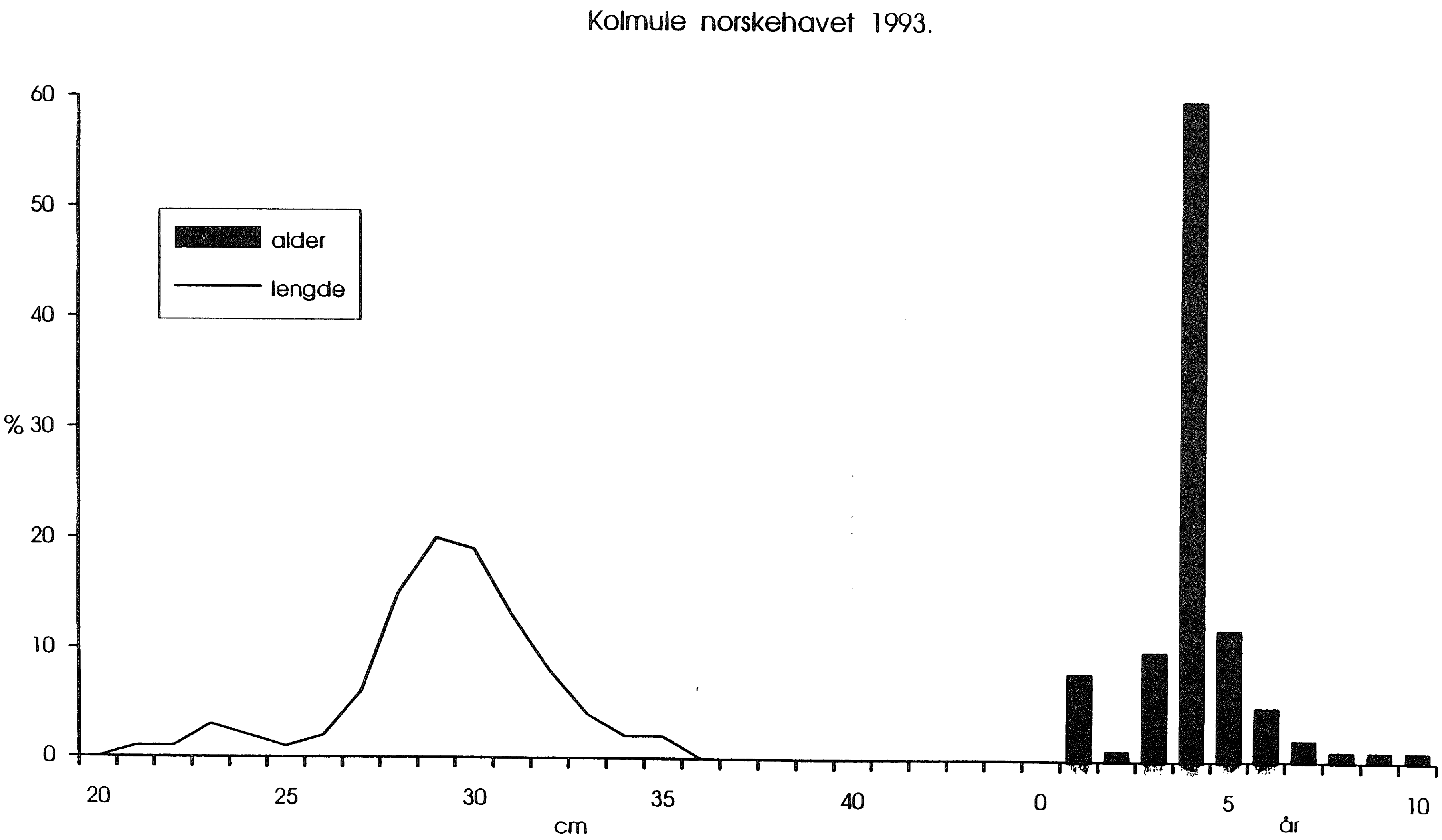
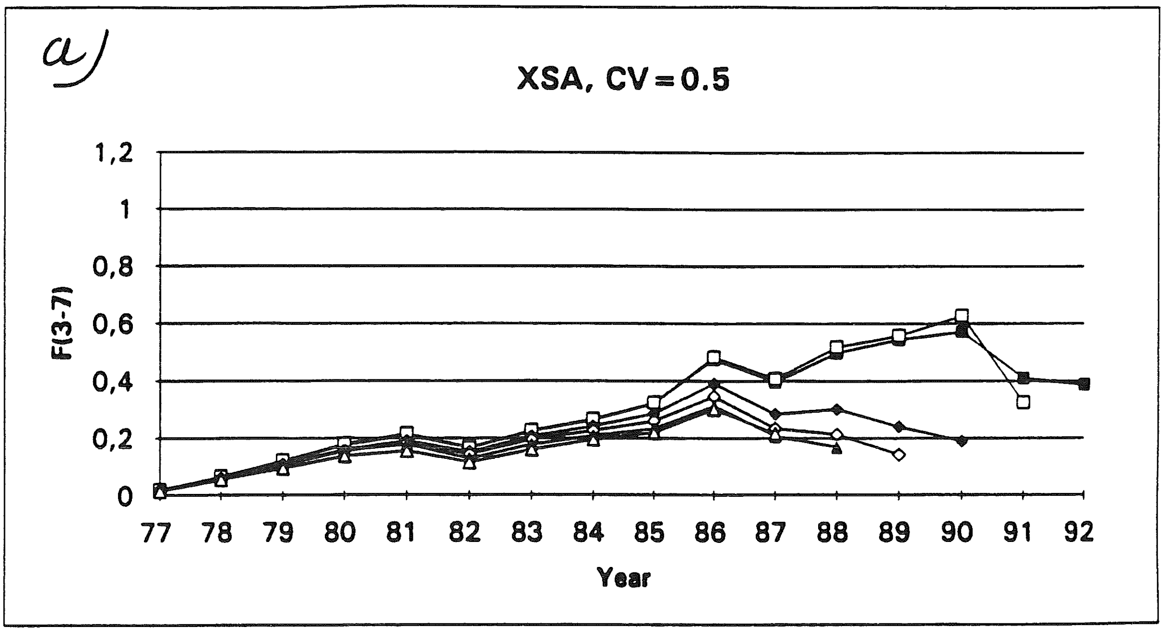


Figure 4.6.10 . Length (left part) and age (right part) composition of blue whiting observed in the Norwegian Sea during summer 1993.



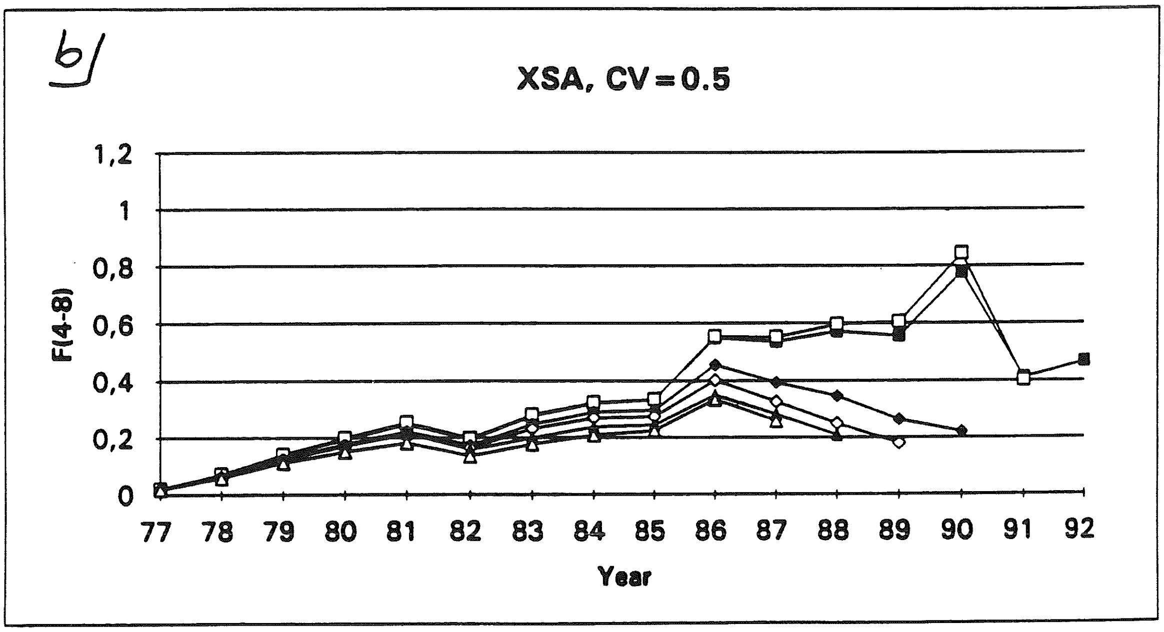
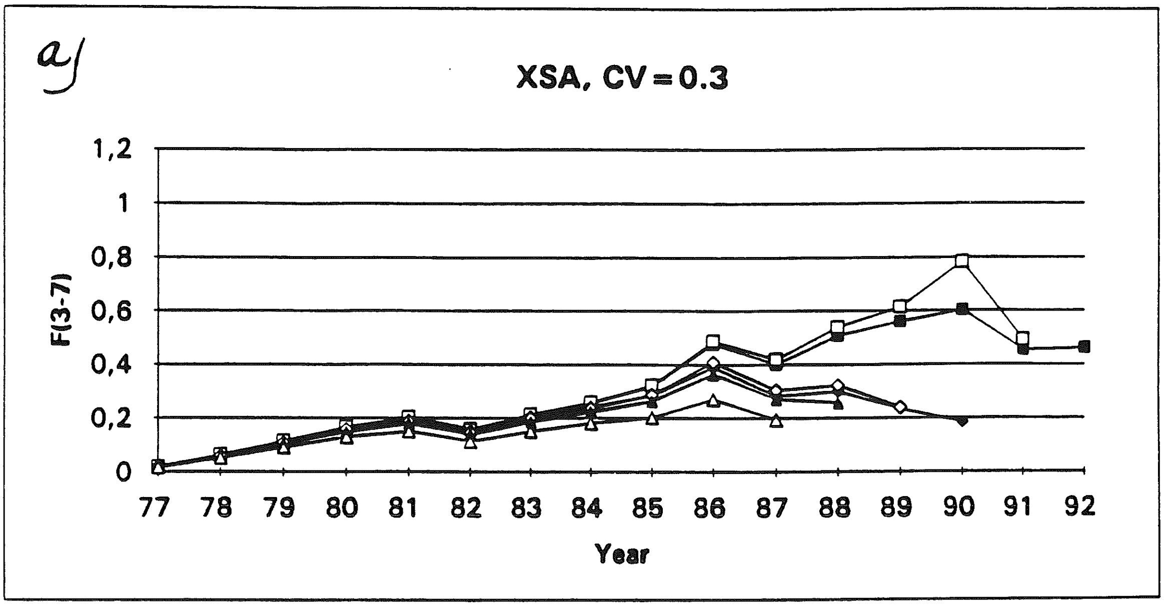


Figure 4.6.11 a-b Retrospective analysis, shrunk XSA (CV= 0.5), Blue Whiting Northern area.



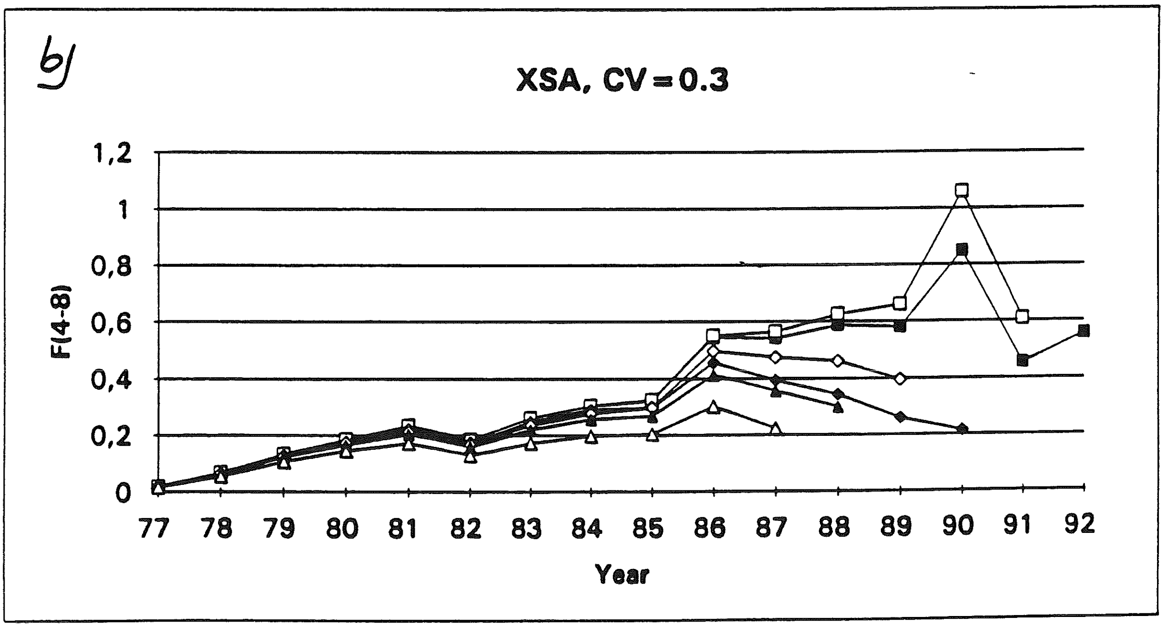
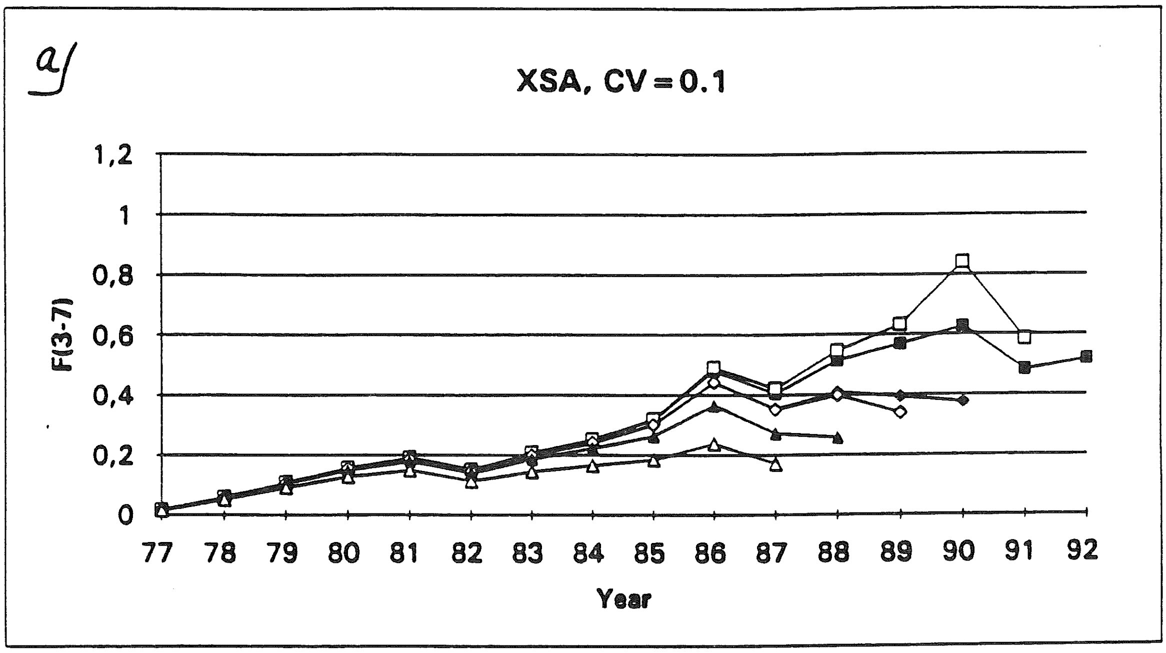
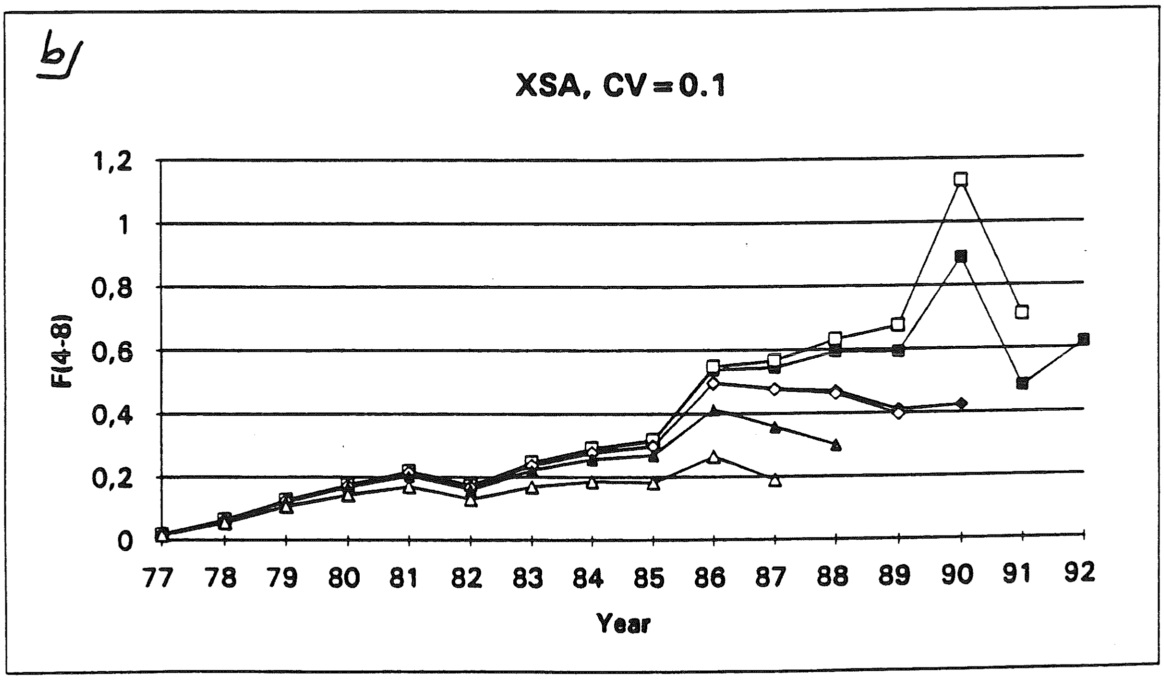


Figure 4.6.12a-b Retrospective analysis, shrunk XSA (CV= 0.3), Blue Whiting Northern area.





:gure 4.6.13a-b Retrospective analysis, shrunk XSA (CV= 0.1), Blue Whiting Northern area.

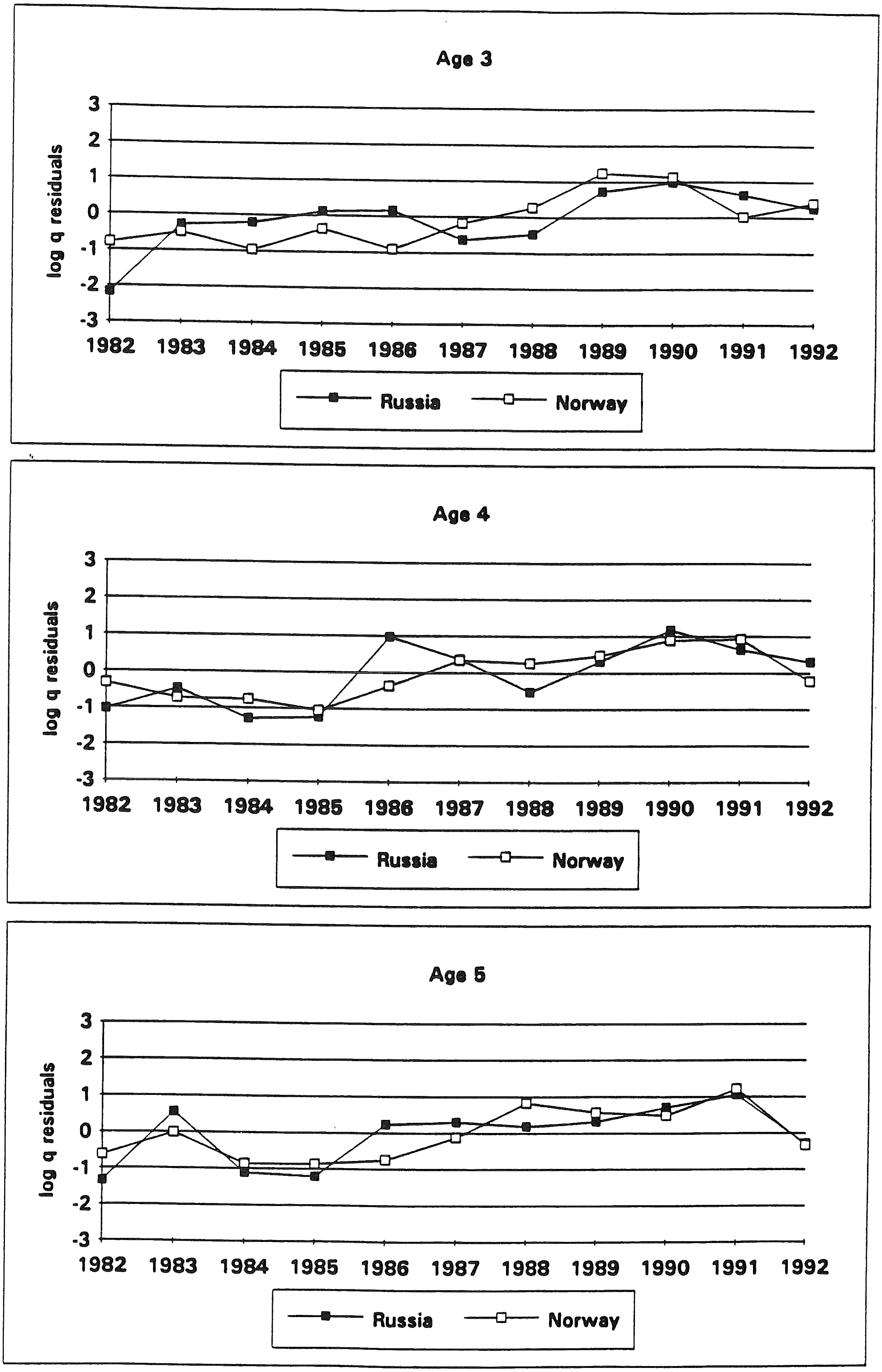


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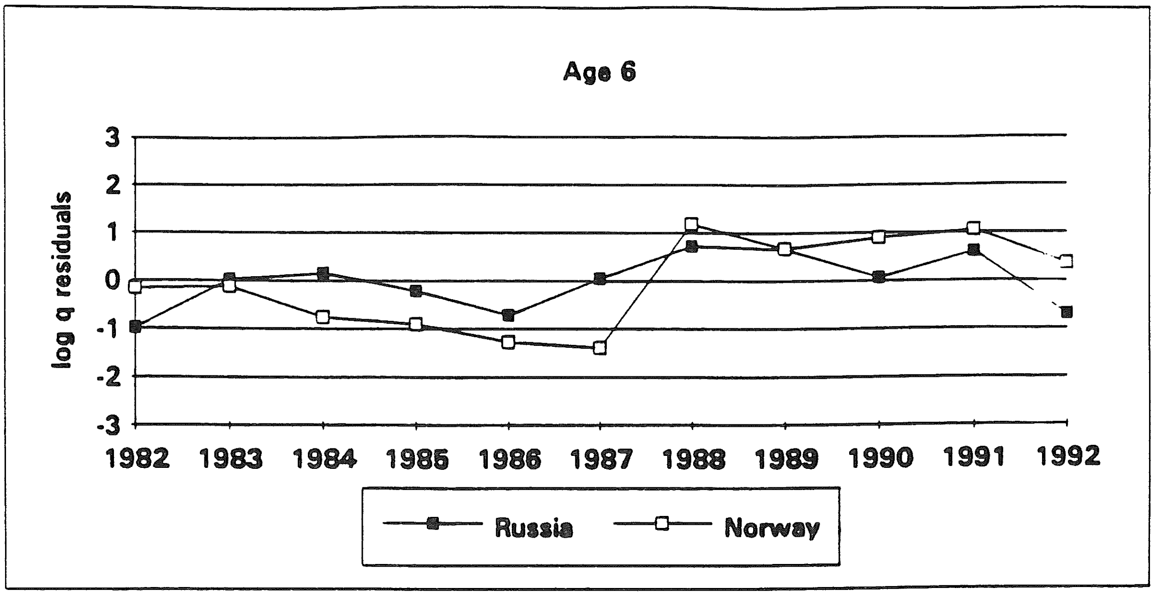
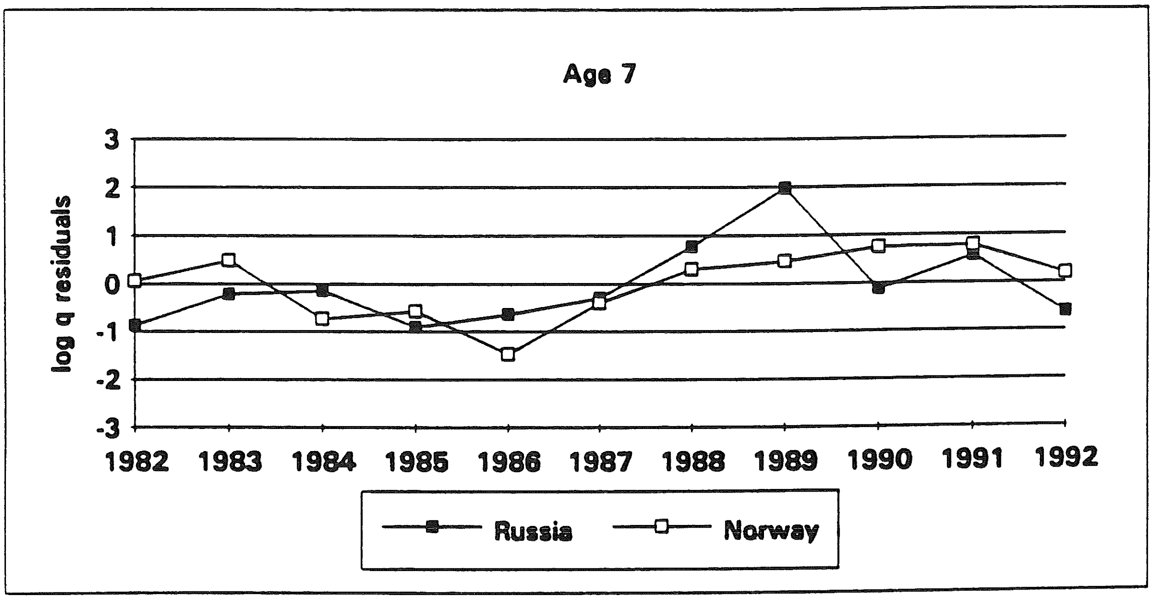
Figure 4.6.14a-f Log. q residuals from XSA-tuning, Blue Whiting Northern area.





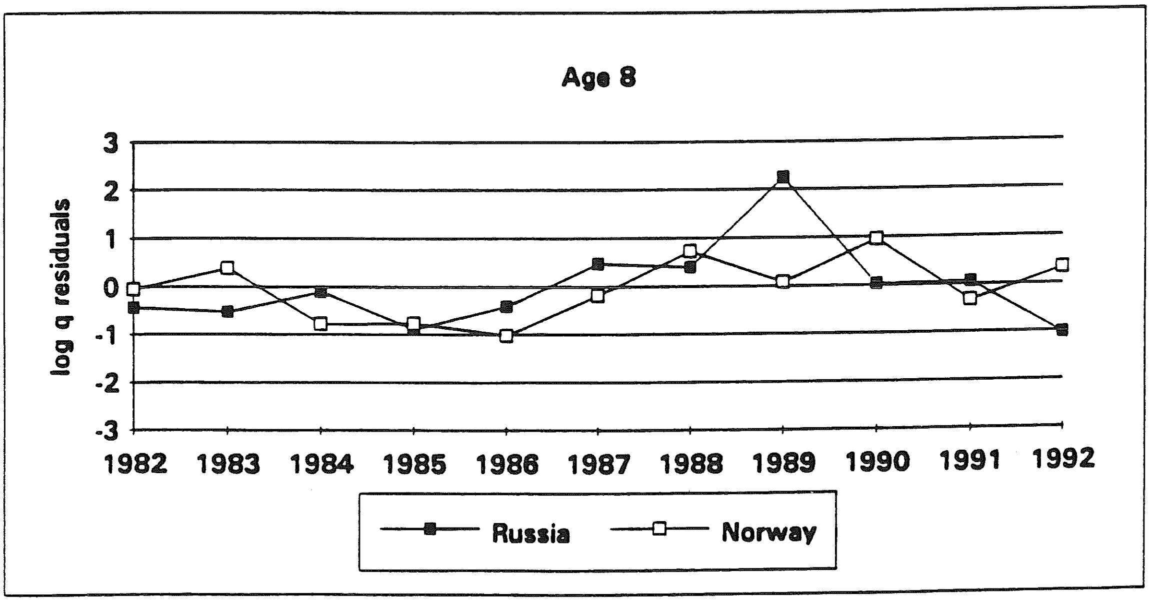


Figure 4.6.14a-f cont'd.

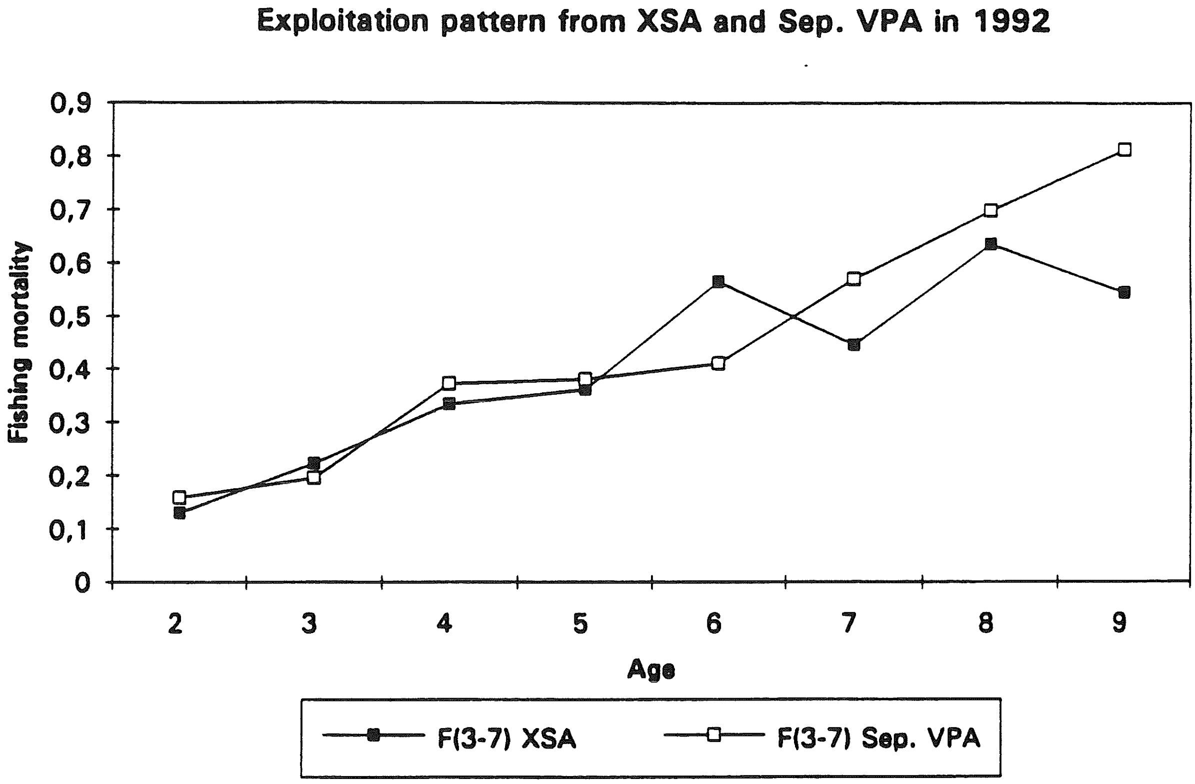
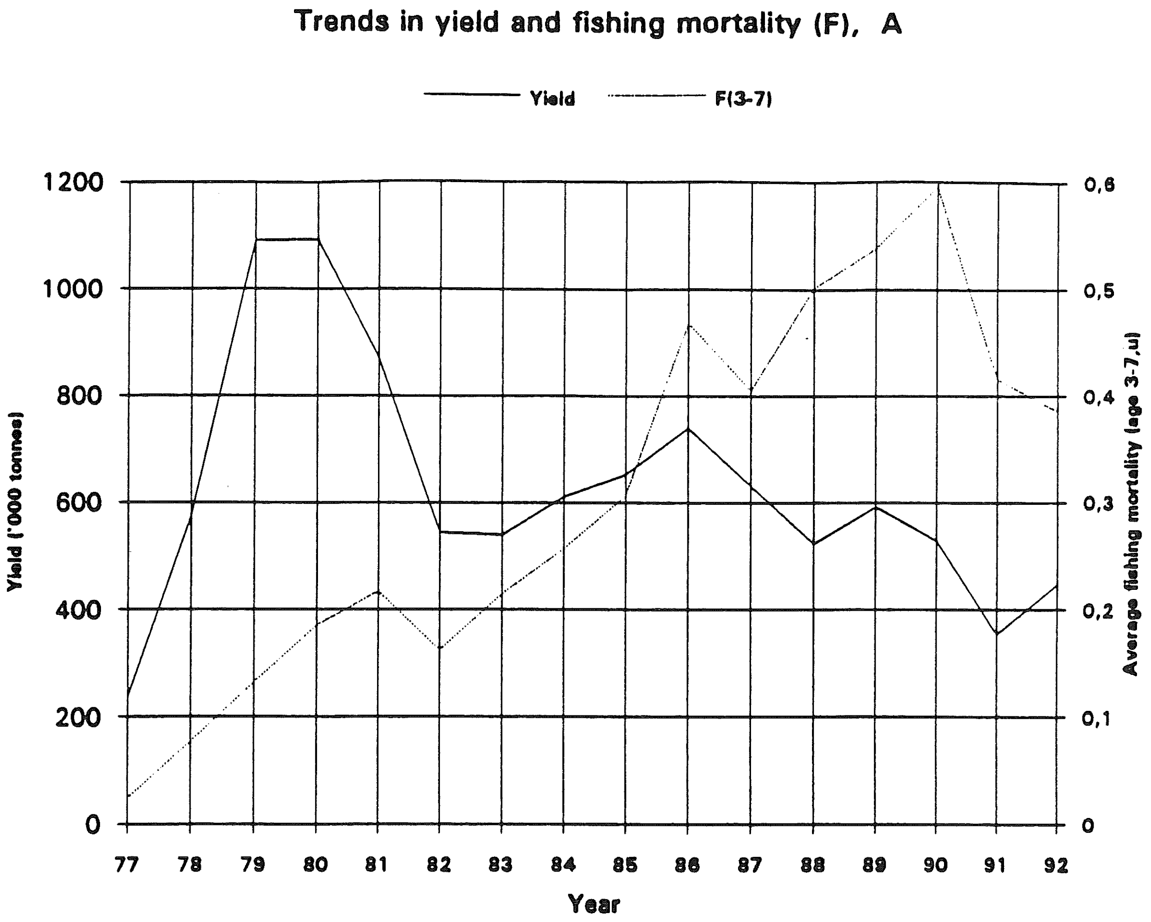


Figure 4.6.15 Exploitation pattern from XSA-tuning and separable VPA, Blue Whiting Northern area.



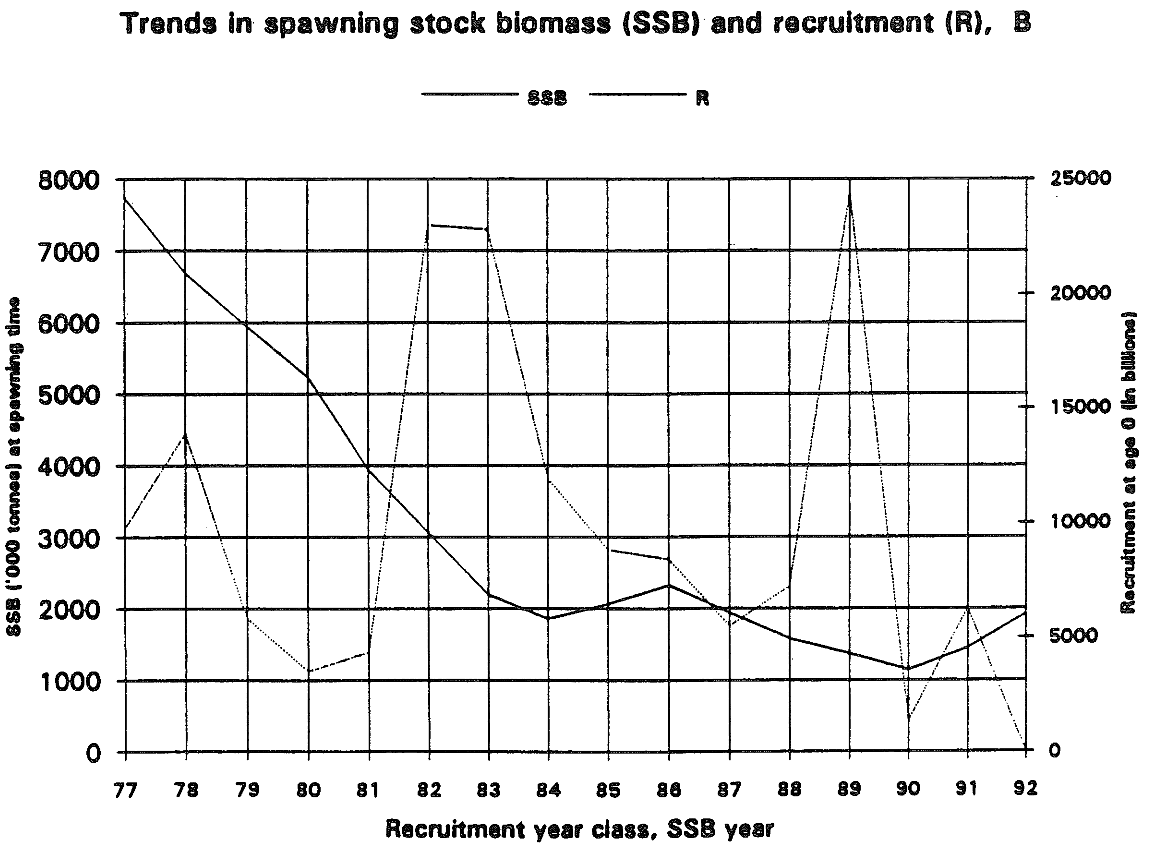
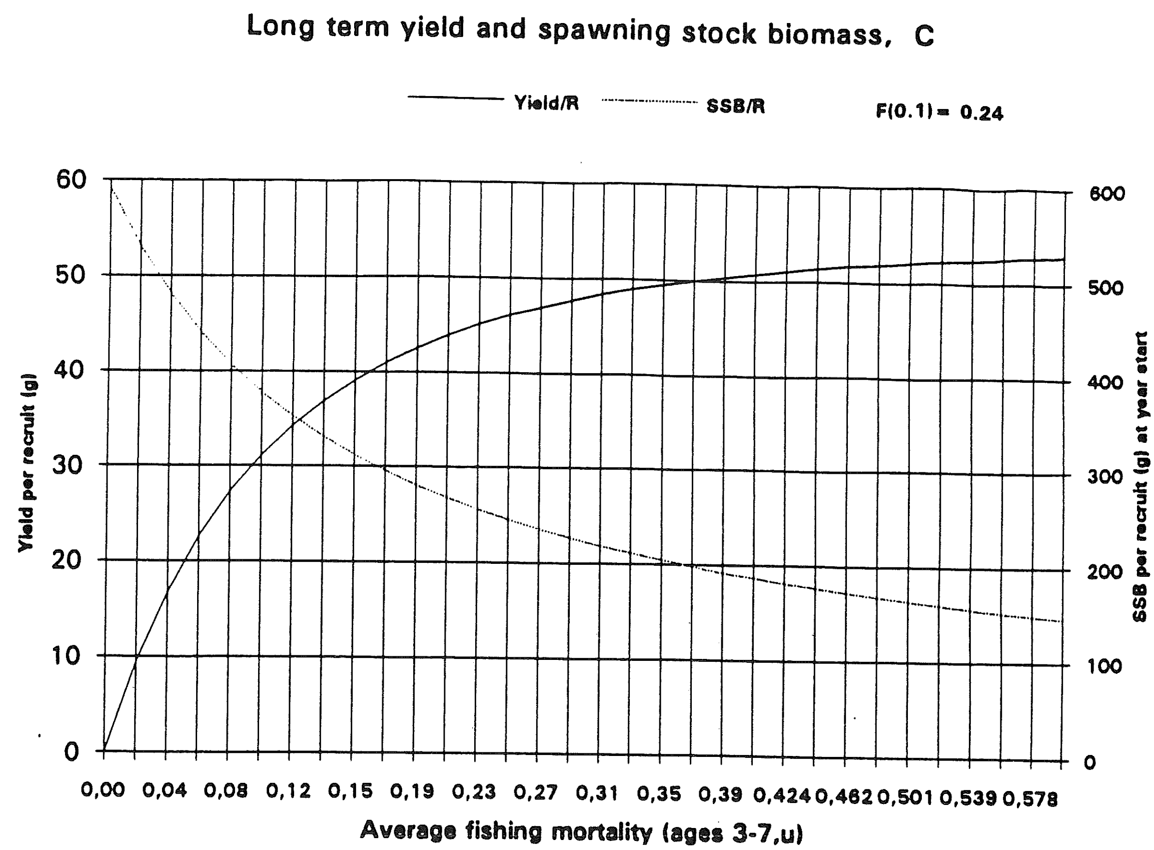


Figure 4.6.16a-b Fish stock summary, Blue Whiting Northern area, 14/9-1993.



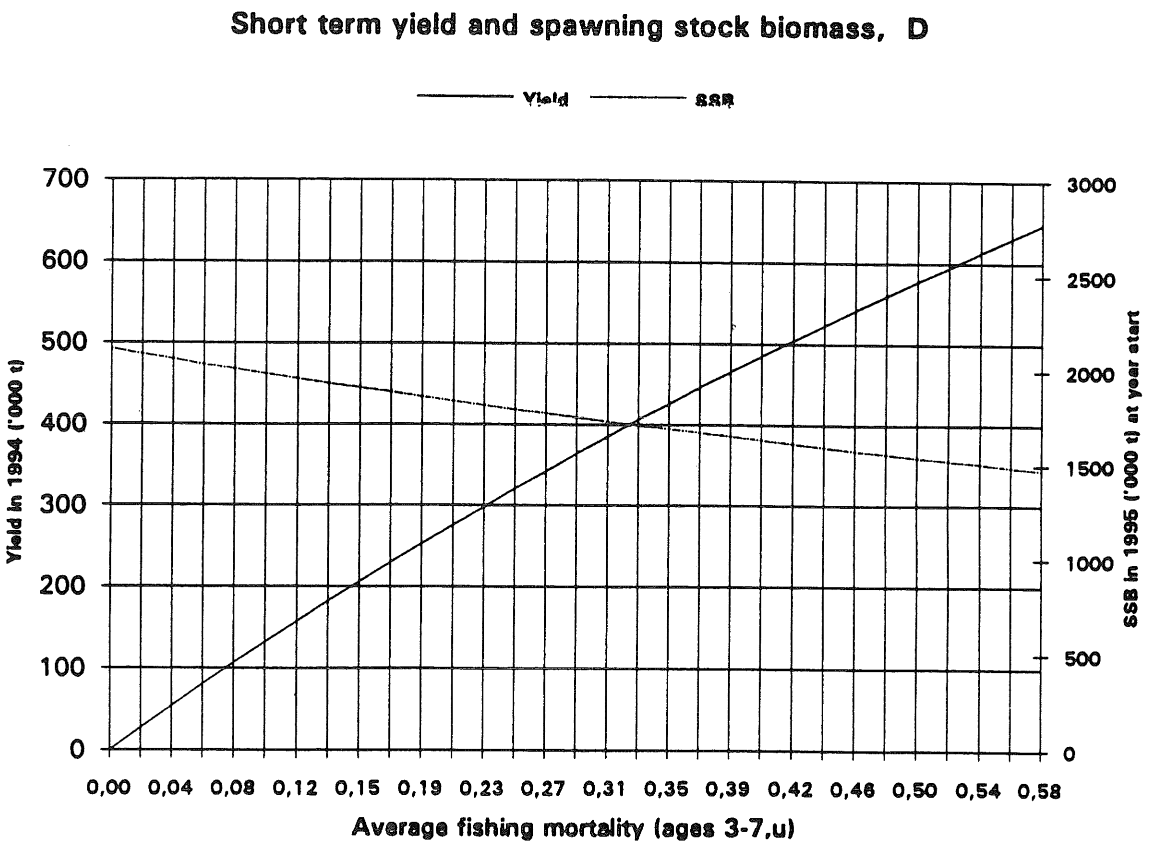


Figure 4.6.16C-D Fish stock summary, Blue Whiting Northern area, 14/9-1993.

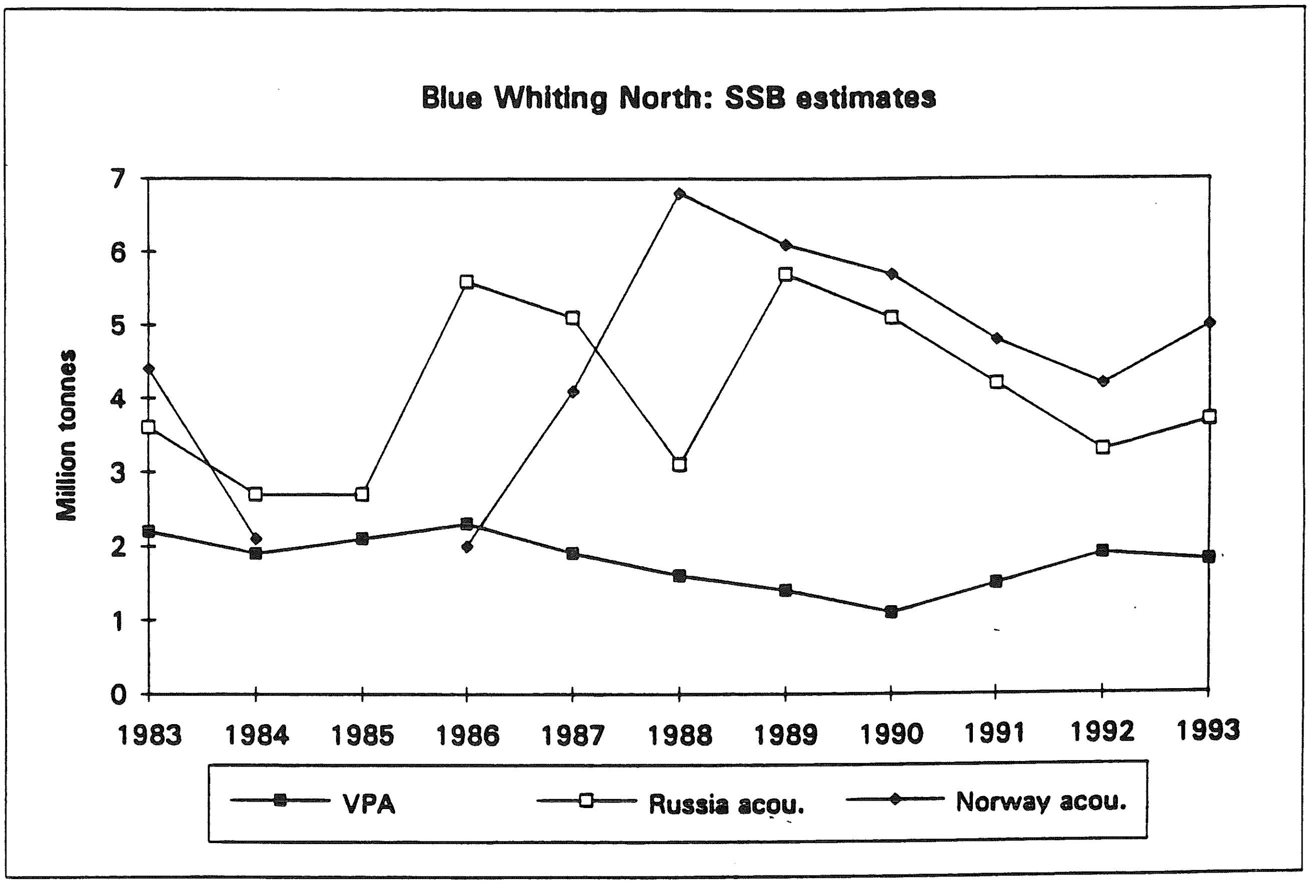


Figure 4.6.17 SSB estimates from acoustic surveys and VPA, Blue Whiting Northern area.

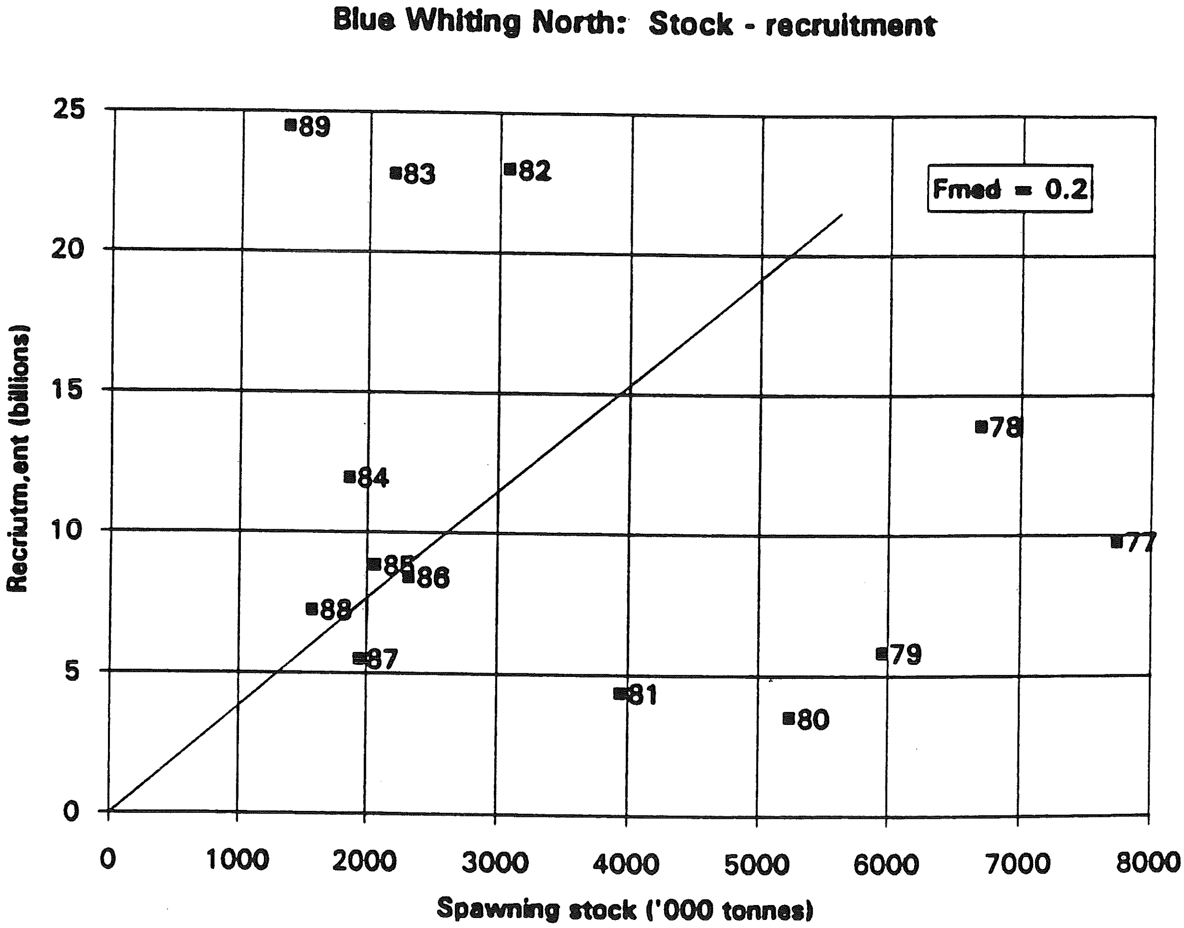


Figure 4.6.18 Stock - recruitment plot, Blue Whiting Northern area.

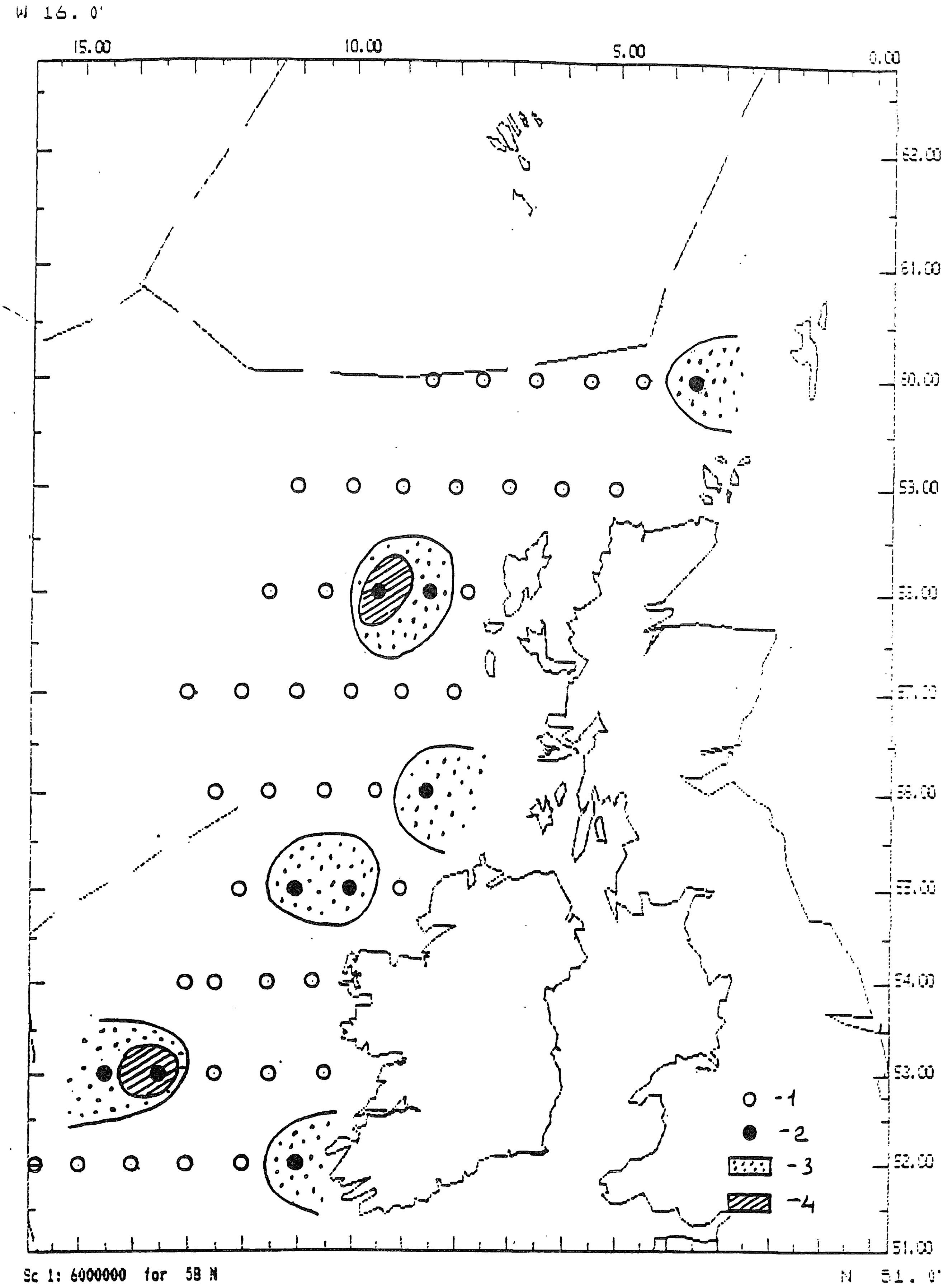


Figure 7.1 Distribution of Blue Whiting larvae 15-30 April 1993, R/V "Prof. Marti".
1- larvaeabsent, 2- larvae present,
3- 1-10 larvae/m^2, 4- >10 larvae/m^2

APPENDIX A

NEAFC-REQUEST TO ICES FOR MEDIUM TERM PREDICTION

The NEAFC-request is quoted in Section 1.1.

The input data for the starting year, as well as for the selection pattern, were the same as for the standard prediction (Table 4.6.9).

For the recruitment in 1993-1997 two options were used:

1) The arithmetic mean of the recruitment in all years 1977-1989 (11,496 x 10^9)

2) The arithmetic mean of the recruitment in all years 1977-1989, excluding the strong 1982, 1983 and 1989 year classes (7,920 x 10^9).

For a sensitivity analysis related to the VPA-result, two additional series of prediction runs, both with "strong" and "poor" recruitment as described in 1) and 2) above, were made:

a) "High" F bar: Input F-value increased by 25 % (1: 11082 and 2: 7,756 x 10^9)

b) "Low" F bar : Input F-value decreased by 25 % (1: 12235 and 2: 8,212 x 10^9)

Assuming a catch in 1993 of 448 thousand tonnes, the spawning stock (SSB) and the total stock (TSB) at 1 January were computed for the years 1993-1997 with TAC constrains of 300, 400, 500, 600 and 700 thousand tonnes.

The results are shown in Tables A1-A3 and in Figures A1.1-A1.6.

Table A.1: Spawning stock biomass (SSB) and total stock biomass (TSB) assuming various levels of a constant TAC for the years 1994-1997.

A: Recruitment for 1994-1997 equals average of yearclasses 77-89.

TAC	300		400		500		600		700	
Year	SSB	TSB	SSB	TSB	SSB	TSB	SSB	TSB	SSB	TSB
1993	1702	2712	1702	2712	1702	2712	1702	2712	1702	2712
1994	1780	2762	1780	2762	1780	2762	1780	2762	1780	2762
1995	1879	3033	1781	2929	1684	2825	1587	2721	1490	2617
1996	2035	3326	1846	3126	1656	2924	1468	2721	1282	2516
1997	2321	3621	2040	3329	1760	3033	1481	2732	1204	2425

B: Recruitment for 1994-1997 equals average of yearclasses 77-81 and 84-88.

TAC	300		400		500		600		700	
Year	SSB	TSB	SSB	TSB	SSB	TSB	SSB	TSB	SSB	TSB
1993	1702	2712	1702	2712	1702	2712	1702	2712	1702	2712
1994	1780	2672	1780	2672	1780	2672	1780	2672	1780	2672
1995	1860	2754	1762	2650	1664	2547	1567	2443	1470	2339
1996	1931	2827	1740	2628	1549	2428	1359	2227	1170	2024
1997	2005	2901	1725	2612	1444	2319	1165	2022	888	1719

Table A.2: Spawning stock biomass (SSB) and total stock biomass (TSB) assuming various levels of a constant TAC for the years 1994-1997. Initial stock, recruits and fishing pattern are from a separable VPA with input Fbar(3-7, low) = 0.75 * 0.385.

A: Recruitment for 1994-1997 equals average of yearclasses 77-89.

TAC	300		400		500		600		700	
Year	SSB	TSB	SSB	TSB	SSB	TSB	SSB	TSB	SSB	TSB
1993	2314	3388	2314	3388	2314	3388	2314	3388	2314	3388
1994	2365	3399	2365	3399	2365	3399	2365	3399	2365	3399
1995	2437	3664	2339	3562	2241	3460	2143	3357	2045	3255
1996	2568	3949	2379	3754	2191	3559	2004	3363	1817	3165
1997	2854	4246	2579	3963	2304	3678	2029	3390	1754	3100

B: Recruitment for 1994-1997 equals average of yearclasses 77-81 and 84-88.

TAC	300		400		500		600		700	
Year	SSB	TSB	SSB	TSB	SSB	TSB	SSB	TSB	SSB	TSB
1993	2314	3388	2314	3388	2314	3388	2314	3388	2314	3388
1994	2365	3299	2365	3299	2365	3299	2365	3299	2365	3299
1995	2415	3350	2317	3248	2219	3146	2121	3044	2023	2942
1996	2451	3386	2262	3192	2073	2998	1884	2803	1696	2607
1997	2499	3434	2223	3153	1948	2870	1673	2586	1399	2299

Table A.3: Spawning stock biomass (SSB) and total stock biomass (TSB) assuming various levels of a constant TAC for the years 1994-1997. Initial stock, recruits and fishing pattern are from a separable VPA with input Fbar(3-7, high) = 1.25 * 0.385.

A: Recruitment for 1994-1997 equals average of yearclasses 77-89.

TAC	300		400		500		600		700	
Year	SSB	TSB	SSB	TSB	SSB	TSB	SSB	TSB	SSB	TSB
1993	1353	2325	1353	2325	1353	2325	1353	2325	1353	2325
1994	1419	2365	1419	2365	1419	2365	1419	2365	1419	2365
1995	1531	2638	1433	2533	1337	2427	1241	2321	1146	2215
1996	1700	2935	1509	2729	1319	2521	1131	2311	946	2097
1997	1983	3229	1698	2927	1413	2619	1131	2304	854	1979

B: Recruitment for 1994-1997 equals average of yearclasses 77-81 and 84-88.

TAC	300		400		500		600		700	
Year	SSB	TSB	SSB	TSB	SSB	TSB	SSB	TSB	SSB	TSB
1993	1353	2325	1353	2325	1353	2325	1353	2325	1353	2325
1994	1419	2281	1419	2281	1419	2281	1419	2281	1419	2281
1995	1512	2379	1415	2274	1318	2169	1222	2063	1126	1958
1996	1601	2471	1408	2267	1216	2062	1026	1854	838	1643
1997	1689	2561	1404	2263	1120	1959	838	1649	564	1328

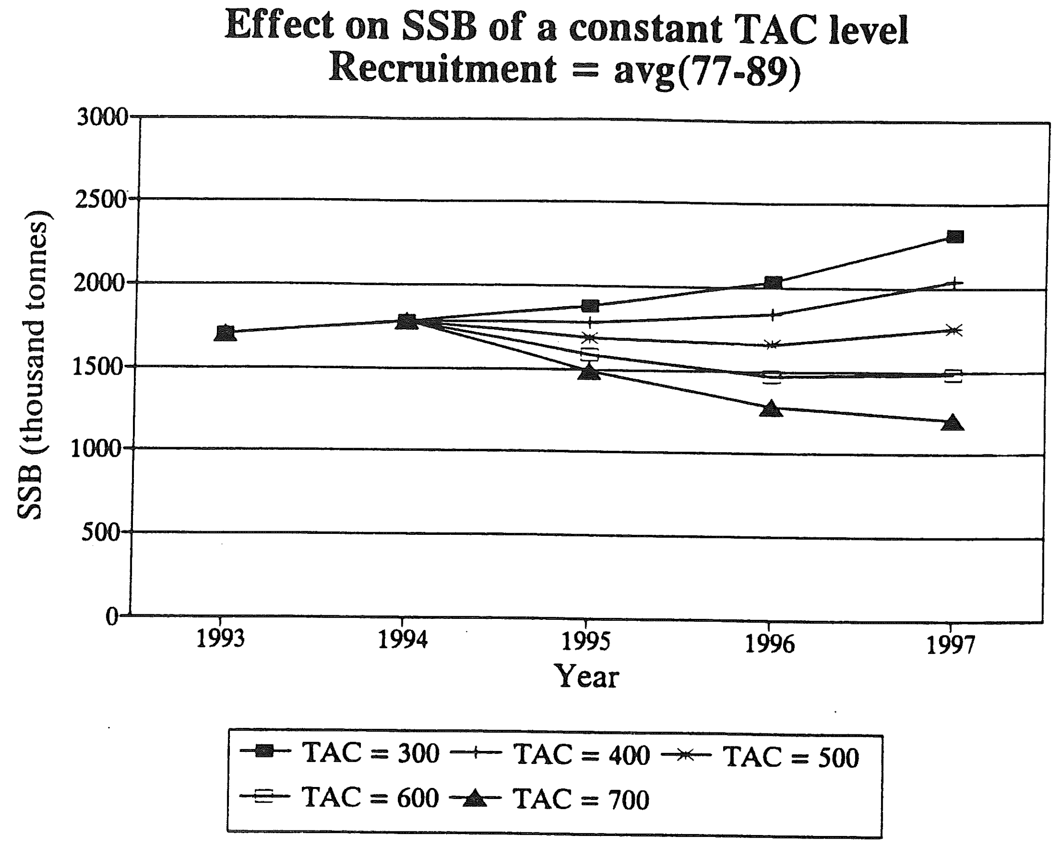


Figure A1.1

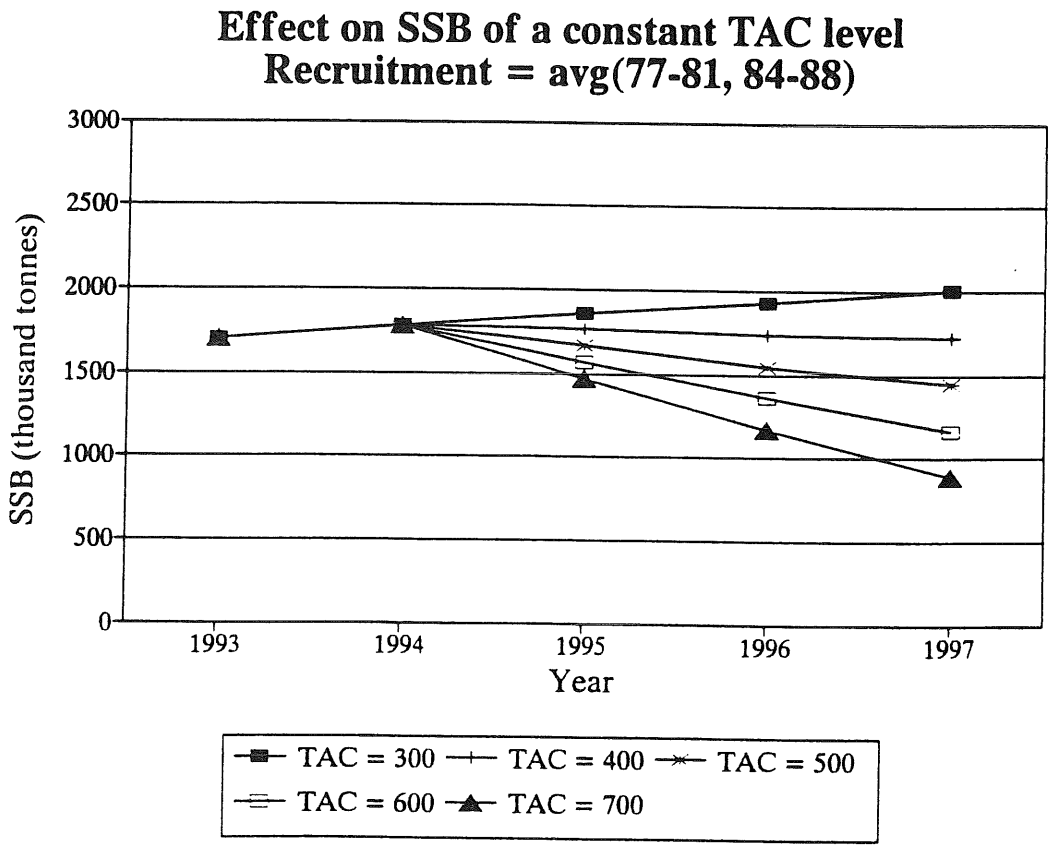


Figure A1.2

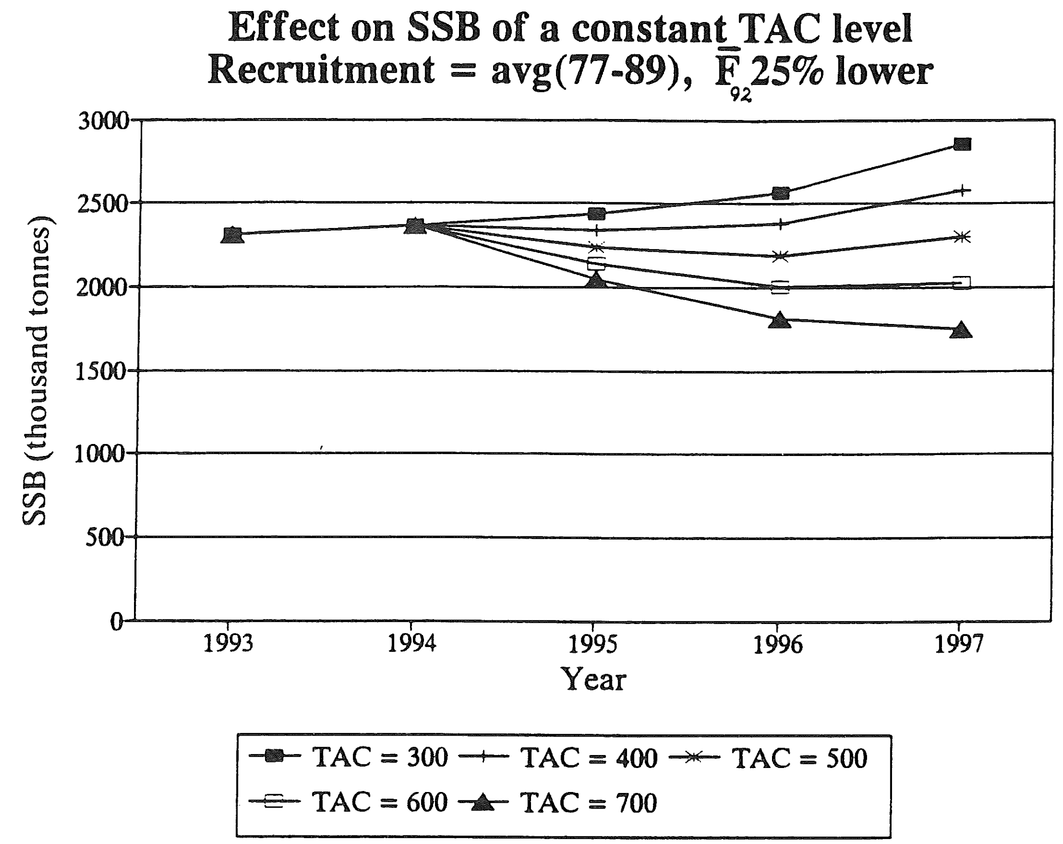


Figure A1.3

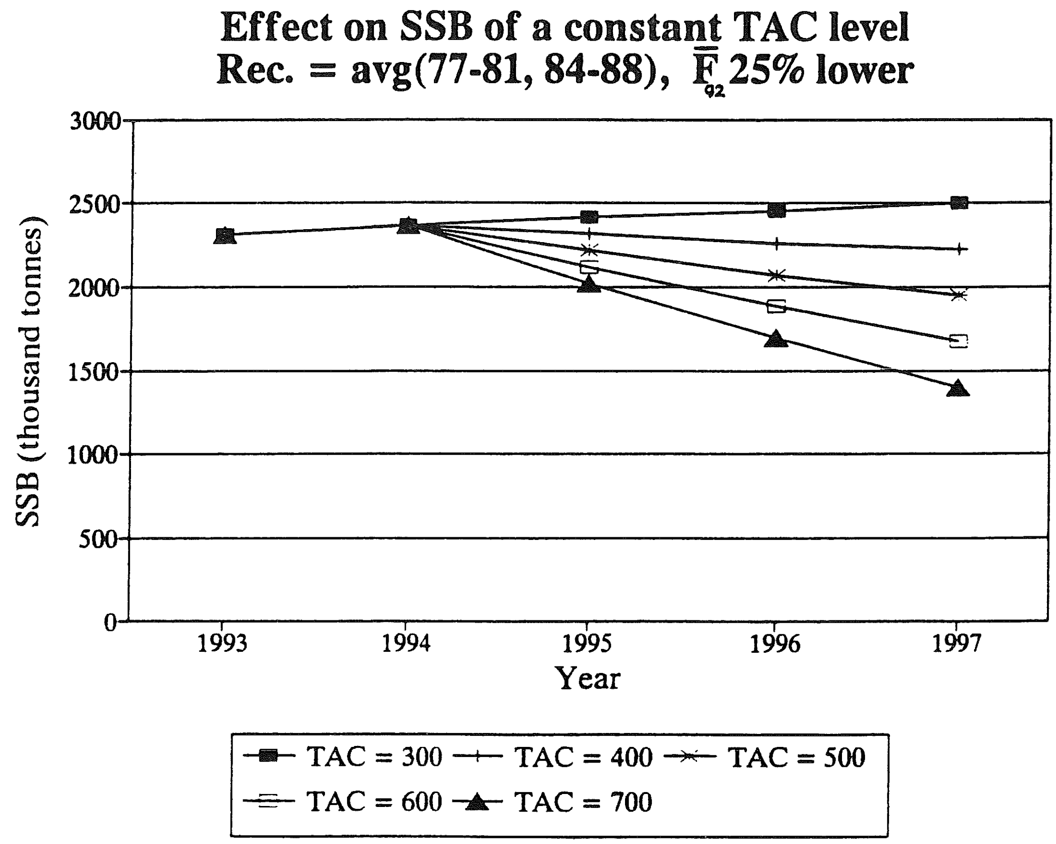


Figure A1.4

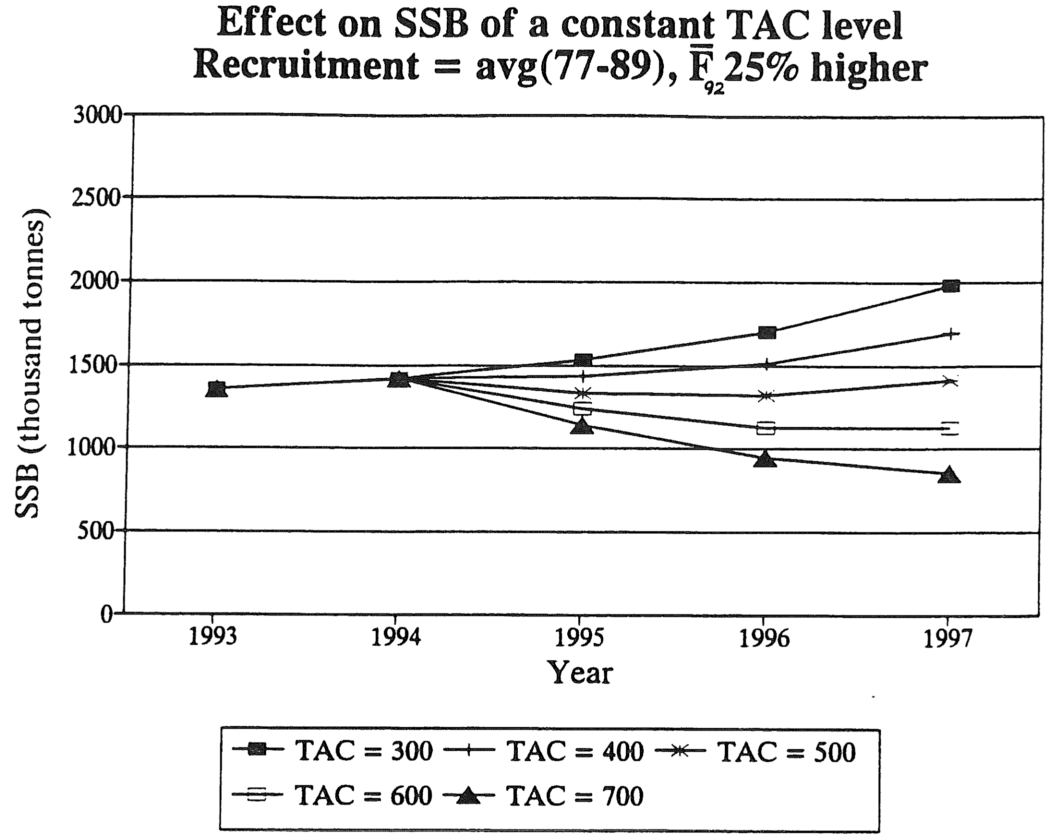


Figure A1.5

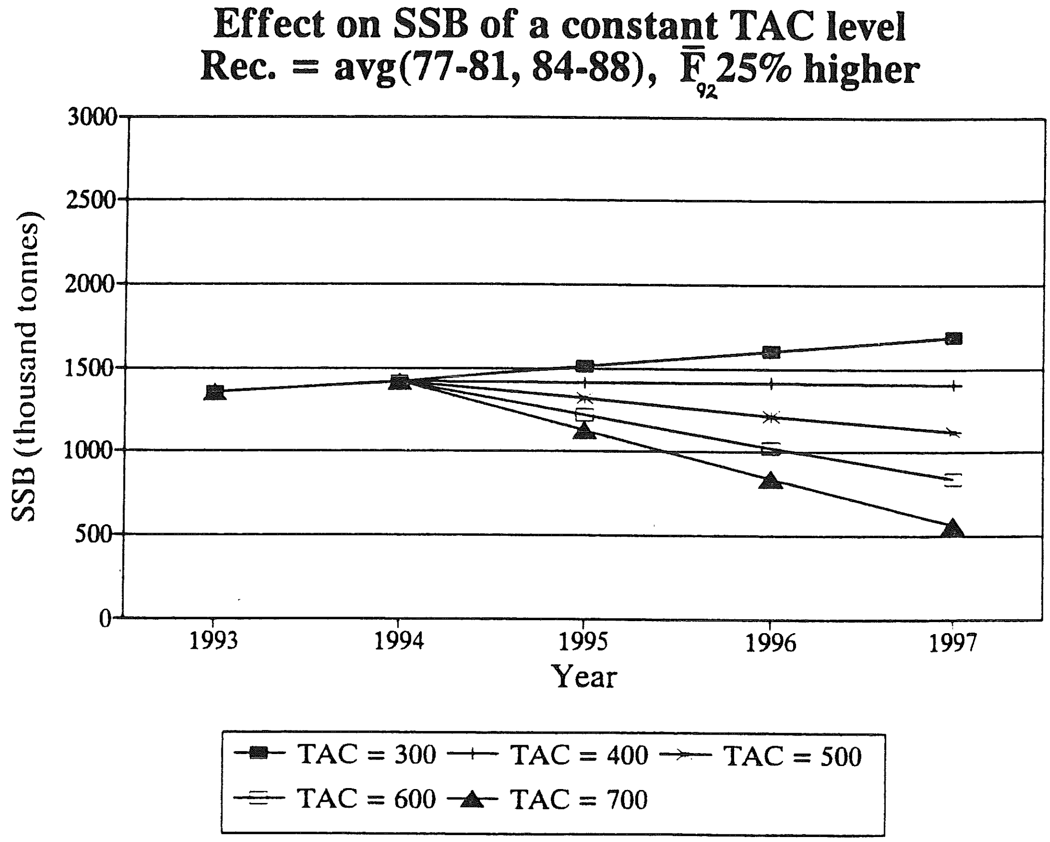


Figure A1.6

APPENDIX B

COMBINED ASSESSMENT

(See discussion in Section 8 - stock identity).

As there is no strong scientific evidence to separate the blue whiting in a northern and a southern stock, a VPA was run to evaluate the changes in the assessment under the hypothesis of a single stock. The resulting SSB shows similar trend as the SSB of the northern stock, but at a slightly higher level, as shown in Figure B.1 and the following Tables B.1-5.

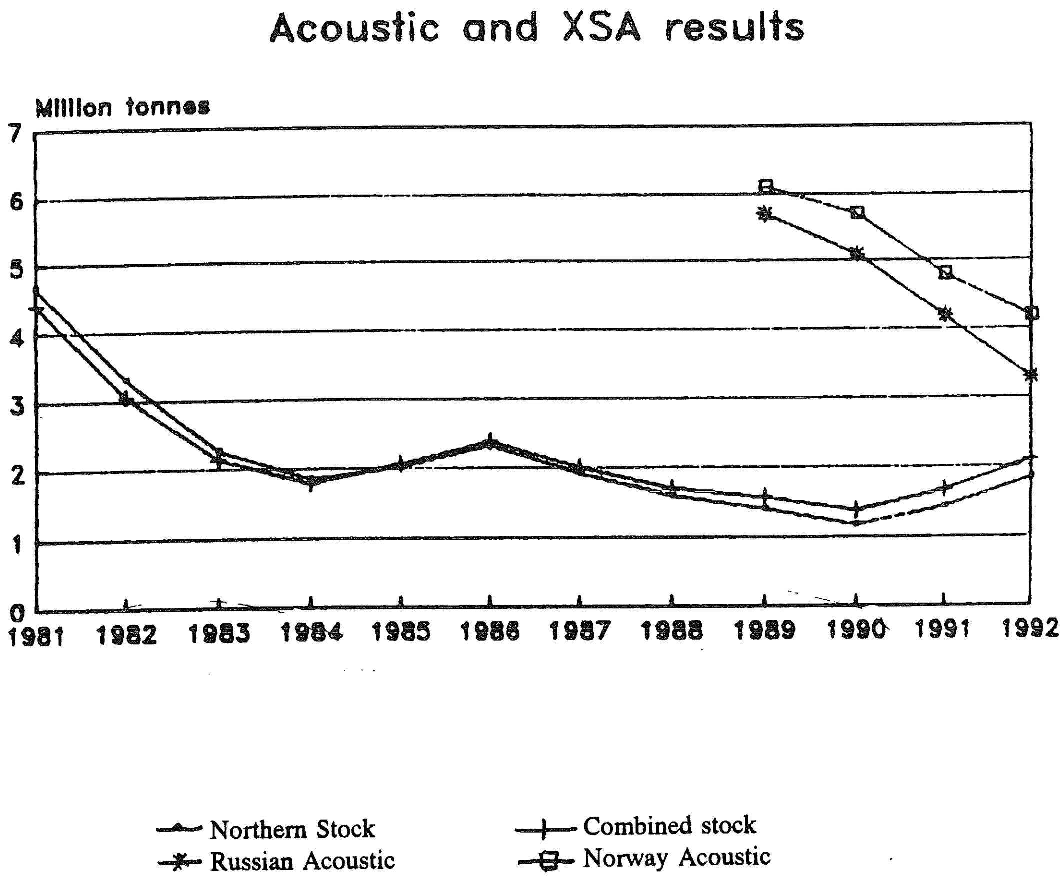


Figure B.1 SSB estimates from acoustic surveys and XSA, Blue Whiting Northern + Southern area combined.

Table B.1 Tuning data for Blue Whiting combined forom the Northern and the Southern areas.

BLUE WHITING-COMBINED: North + South (BW WG 1993)										
105										
Norway Spawning Area/Acoustic										
82	92									
1	1	0.17	0.25							
3	11									
1	2431	6676	3335	3470	3656	3231	2239	384	985	
1	2108	2723	6511	3735	3650	3153	2279	1182	531	
1	1514	1616	1719	1858	1128	567	440	348	80	
1	9150	1336	999	985	1115	639	370	256	183	
1	7183	7340	1159	383	251	373	151	174	73	
1	8050	22357	4697	282	417	385	159	27	111	
1	8799	12271	20285	7323	723	617	326	398	126	
1	22270	9973	10504	7803	933	293	177	46	148	
1	12670	11228	5587	6556	3273	516	183	108	81	
1	6340	8497	7407	4558	2019	545	96	16	33	
1	26123	4719	1574	1386	810	616	257	19	0	
USSR Spawning Area/Acoustic										
82	92									
1	1	0.17	0.25							
3	11									
1	0.54	2.75	1.34	1.38	1.57	2.35	1.73	1.29	0.65	
1	2.33	2.93	9.39	3.88	1.97	1.37	0.78	0.66	0.10	
1	2.90	0.80	1.10	4.20	2.20	1.20	1.70	1.20	0.50	
1	13.22	0.93	0.58	1.78	0.86	0.61	0.58	0.54	0.11	
1	18.75	23.18	2.54	0.61	0.62	0.75	0.64	0.71	0.72	
1	4.48	19.17	5.86	1.07	0.50	0.81	0.86	0.67	0.56	
1	3.71	4.55	8.61	4.13	1.27	0.48	0.25	0.26	0.33	
1	11.91	7.12	6.67	6.97	4.58	2.75	1.88	0.81	0.41	
1	9.74	12.14	5.74	2.58	1.47	0.22	0.08	0.00	0.00	
1	10.30	5.35	5.13	2.63	1.77	0.87	0.30	0.22	0.00	
1	20.01	6.70	1.35	0.44	0.38	0.17	0.00	0.00	0.00	
CPUE Spanish Pair Trawlers										
83	92									
1	1	0	1							
0	7									
1	1140	7196	16392	9311	7476	6326	1718	360		
1	1839	13710	27286	14845	4836	1755	1750	338		
1	3680	14573	23823	14126	6256	1232	217	126		
1	788	3721	14131	14745	7113	1278	505	47		
1	5433	25328	13153	6664	2938	1029	166	43		
1	2545	7778	21473	18436	6391	1300	781	223		
1	2488	15272	18486	17160	8374	3760	1003	771		
1	6703	21444	19407	5194	1803	1357	451	77		
1	8745	15924	15370	4989	2329	1045	440	177		
1	60	19689	36151	15897	8277	2149	1029	260		
CPUE Aviles Trawlers										
83	92									
1	1	0	1							
0	7									
1	44.6	208.4	479.1	240.3	196.0	160.9	52.1	14.4		
1	24.1	190.6	614.8	413.0	86.9	28.5	33.4	10.4		
1	134.3	450.6	973.7	642.0	318.9	67.0	15.9	11.5		
1	191.7	299.7	541.9	445.3	292.9	117.9	51.2	18.1		
1	67.5	381.9	459.9	414.3	273.4	128.9	41.3	14.8		
1	239.4	374.1	738.1	604.4	274.9	210.4	137.9	60.9		
1	118.2	370.2	452.5	398.3	378.7	192.5	127.3	45.8		
1	26.2	369.4	384.1	210.5	107.5	162.3	136.8	44.5		
1	16.9	110.1	130.8	295.9	264.4	132.1	98.0	56.7		
1	3.0	115.8	205.2	95.3	126.8	75.7	73.2	20.7		
Bottom Trawl Survey										
85	92									
1	2	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		
1	3681.3	333.7	73.0	44.1	18.8	9.8	1.6	0.8		
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		

Table B.2 XSA-results, combined Blue Whiting stock.

VPA Version 3.1 (MSDOS) XX92 - Blue Whiting North + South Combined.
==

14/09/1993 10:24

Extended Survivors Analysis

BLUE WHITING COMBINED STOCK,INDEX FILE,UNSEXED,PLUSGROUP

CPUE data from file tunbwco.92

Data for 5 fleets over 12 years
Age range from 0 to 9

Fleet,	Alpha,	Beta
Norway Spawning Area	.170	.250
USSR Spawning Area/A	.170	.250
CPUE Spanish Pair Tr	.000	1.000
CPUE Aviles Trawlers	.000	1.000
Bottom Trawl Survey	.670	.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 = .001

Final year F values

Age	0	1	2	3	4	5	6	7	8	9
Iteration 29	.0106	.0678	.0707	.4050	.3051	.2290	.2850	.2893	.5270	.4711
Iteration 30	.0106	.0677	.0707	.4049	.3050	.2290	.2849	.2891	.5267	.4710

cont'd.

Table B.2 cont'd.

Regression weights

, .670, .751, .820, .877, .921, .954, .976, .990, .997, 1.000, 1.000

Fishing mortalities

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0	.171	.020	.049	.130	.009	.050	.006	.137	.011	.022	.011
1	.036	.161	.135	.148	.099	.116	.082	.136	.160	.038	.068
2	.115	.190	.245	.171	.130	.120	.138	.193	.156	.158	.071
3	.128	.158	.230	.331	.233	.164	.181	.411	.279	.157	.405
4	.200	.159	.226	.236	.554	.396	.228	.373	.429	.189	.305
5	.140	.160	.235	.253	.547	.481	.523	.485	.451	.372	.229
6	.223	.237	.377	.454	.430	.371	1.028	.608	.744	.418	.285
7	.220	.381	.330	.391	.578	.460	.411	.680	.565	.465	.289
8	.226	.391	.480	.382	.598	.879	.447	.461	1.103	.154	.527
9	.232	.296	.378	.450	.839	.733	.619	.392	.488	.171	.471

XSA population numbers

	AGE										
YEAR	0	1	2	3	4	5	6	7	8	9	Plus GP
1982	2.46E+04	4.58E+03	2.79E+03	2.99E+03	3.34E+03	2.24E+03	1.53E+03	1.49E+03	1.49E+03	1.52E+03	3.57E+03
1983	2.50E+04	1.70E+04	3.62E+03	2.04E+03	2.15E+03	2.24E+03	1.59E+03	1.00E+03	9.76E+02	9.71E+02	1.43E+03
1984	1.34E+04	2.01E+04	1.18E+04	2.45E+03	1.42E+03	1.50E+03	1.56E+03	1.03E+03	5.59E+02	5.40E+02	8.88E+02
1985	1.06E+04	1.05E+04	1.43E+04	7.59E+03	1.59E+03	9.30E+02	9.73E+02	8.78E+02	6.06E+02	2.83E+02	7.82E+02
1986	1.04E+04	7.62E+03	7.40E+03	9.90E+03	4.46E+03	1.03E+03	5.91E+02	5.06E+02	4.86E+02	3.39E+02	7.63E+02
1987	7.69E+03	8.46E+03	5.65E+03	5.32E+03	6.42E+03	2.10E+03	4.88E+02	3.15E+02	2.32E+02	2.19E+02	4.09E+02
1988	9.25E+03	5.99E+03	6.17E+03	4.11E+03	3.70E+03	3.54E+03	1.06E+03	2.76E+02	1.63E+02	7.90E+01	1.18E+02
1989	1.69E+04	7.53E+03	4.52E+03	4.40E+03	2.81E+03	2.41E+03	1.72E+03	3.11E+02	1.50E+02	8.52E+01	1.28E+02
1990	8.15E+03	1.21E+04	5.39E+03	3.05E+03	2.39E+03	1.58E+03	1.21E+03	7.66E+02	1.29E+02	7.73E+01	2.69E+02
1991	8.03E+03	6.60E+03	8.41E+03	3.77E+03	1.89E+03	1.27E+03	8.25E+02	4.72E+02	3.56E+02	3.51E+01	9.08E+01
1992	2.00E+03	6.43E+03	5.20E+03	5.88E+03	2.64E+03	1.28E+03	7.18E+02	4.45E+02	2.43E+02	2.50E+02	4.37E+01

Population estimates for 1993

, 0.00E+00, 1.62E+03, 4.92E+03, 3.97E+03, 3.21E+03, 1.59E+03, 8.34E+02, 4.42E+02, 2.73E+02, 1.18E+02, 1.50E+02,

Taper weighted geometric mean of the VPA populations:

, 9.49E+03, 8.31E+03, 6.10E+03, 4.34E+03, 2.75E+03, 1.72E+03, 1.06E+03, 6.04E+02, 3.75E+02, 2.32E+02,

Standard error of the weighted Log(VPA populations) :

, .6823, .4653, .4568, .4553, .4401, .4105, .4690, .6336, .8895, 1.2620,

cont'd.

Log catchability residuals.

Fleet : Norway Spawning Area

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
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	-.79	-.54	-1.04	-.35	-.88	-.16	.19	1.10	.87	-.06	.97
4	-.16	-.63	-.72	-1.02	-.28	.43	.35	.45	.74	.65	-.25
5	-.50	.17	-.75	-.81	-.70	-.03	.93	.64	.43	.91	-.68
6	-.02	.01	-.64	-.78	-1.23	-1.36	1.26	.75	.95	.91	-.17
7	.15	.58	-.64	-.48	-1.38	-.42	.25	.44	.77	.75	-.14
8	.03	.46	-.68	-.66	-.94	-.11	.63	-.03	.82	-.34	.24
9	-.36	.12	-.92	-.44	-1.43	-.96	.75	.02	.17	.25	-.67

Mean catchability and Standard error.

Age	0	1	2	3	4	5	6	7	8	9
Mean Q				.6505	.9392	.9729	.9322	.8391	.8391	.8391
S.E				.7699	.6038	.6991	.9387	.6808	.5768	.7333

Regression statistics :

Age	Slope	Intercept	S.e.	RSquare	No Pts	Fleet Mean Q
3	.94	-.14	.77	.29	11	.65
4	.65	2.12	.38	.61	11	.94
5	.50	3.25	.30	.69	11	.97
6	.47	3.20	.41	.56	11	.93
7	1.03	-1.07	.75	.38	11	.84
8	1.53	-4.27	.83	.49	11	.79
9	1.43	-3.06	.86	.66	11	.53

cont'd.

Table B.2 cont'd.

Fleet : USSR Spawning Area/A

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
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	-2.17	-.31	-.26	.14	.21	-.62	-.55	.60	.74	.55	.83
4	-.86	-.37	-1.24	-1.20	1.05	.47	-.46	.30	1.01	.37	.28
5	-1.21	.74	-.99	-1.15	.29	.40	.27	.39	.66	.74	-.63
6	-.84	.15	.28	-.09	-.67	.07	.78	.74	.12	.46	-1.22
7	-.77	-.11	-.04	-.81	-.55	-.31	.74	1.96	-.10	.55	-.97
8	-.37	-.45	-.01	-.78	-.31	.56	.31	2.14	-.11	.05	-1.12
9	-.69	-1.03	.35	-.06	-.06	.65	.41	2.31	-.73	1.31	99.99

Mean catchability and Standard error.

Age	0	1	2	3	4	5	6	7	8	9
Mean Q				-6.3837	-6.1550	-6.1383	-6.0758	-5.9948	-5.9948	-5.9948
S.E				.8105	.8096	.7604	.6539	.8803	.8870	1.0816

Regression statistics :

Age	Slope	Intercept	S.e.	RSquare	No Pts	Fleet Mean Q
3	.69	7.01	.57	.43	11	-6.38
4	.53	6.98	.40	.60	11	-6.16
5	.65	6.59	.50	.43	11	-6.14
6	.43	6.38	.40	.56	11	-6.08
7	5.60	4.47	4.49	.02	11	-5.99
8	2.21	6.16	1.83	.17	11	-5.97
9	2.02	6.09	1.80	.33	10	-5.68

cont'd.

Table B.2 cont'd.

Fleet : CPUE Spanish Pair Tr

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0		-1.45	-.43	.40	-.87	1.00	.19	-.38	1.10	1.33	-1.30
1		-9.30	.27	1.95	-19.09	10.43	-7.63	2.91	7.83	2.97	6.48
2		.44	-.21	-.57	-.45	-.26	.15	.34	.19	-.48	.81
3		.57	.89	-.25	-.51	-.72	.57	.53	-.36	-.67	.16
4		.58	.59	.74	-.02	-1.34	-.08	.53	-.82	-.44	.55
5		.90	.06	.19	.26	-.70	-.97	.46	-.15	-.23	.42
6		.43	.53	-1.04	.29	-.66	.39	-.01	-.41	-.19	.74
7		.08	-.03	-.83	-1.18	-.85	.91	2.14	-1.11	.16	.53
8	No data for this fleet at this age										
9	No data for this fleet at this age										

Mean catchability and Standard error.

Age	0	1	2	3	4	5	6	7	8	9
Mean Q			1.2596	1.1206	.8388	.3084	-.1474	-.8293		
S.E			.4646	.5890	.7094	.5555	.5730	1.0695		

Regression statistics :

Age	Slope	Intercept	S.e.	RSquare	No Pts	Fleet Mean Q
0	.81	2.92	1.07	.30	10	-1.43
1	15.38	******	9.70	.00	10	.50
2	6.11	-52.61	2.02	.05	10	1.26
3	2.58	-16.17	1.41	.11	10	1.12
4	9.76	-77.41	5.96	.01	10	.84
5	2.06	-8.46	1.12	.14	10	.31
6	.79	1.56	.47	.49	10	-.15
7	-26.48	149.93	26.50	.00	10	-.83

cont'd.

Table B.2   cont'd.

Fleet : CPUE Aviles Trawlers

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0		-1.06	-.88	.64	.88	.43	1.16	.08	-.33	-.63	-.51
1		-1.91	-2.76	3.70	1.13	2.70	2.80	2.67	2.26	-5.63	-5.17
2		.74	-.17	.06	.12	.22	.61	.46	.10	-1.42	-.53
3		.41	.80	.16	-.52	.00	.64	.26	-.07	.00	-1.46
4		.08	-.29	.90	-.07	-.57	-.09	.57	-.50	.52	-.49
5		-.06	-1.36	-.02	.58	-.07	-.09	.19	.43	.40	-.22
6		-.84	-1.20	-1.43	.23	.18	.88	.15	.62	.54	.32
7		-1.25	-1.62	-1.34	-.25	-.03	1.50	1.21	.23	.91	-.11
8	No data for this fleet at this age										
9	No data for this fleet at this age										

Mean catchability and Standard error.

Age	0	1	2	3	4	5	6	7	8	9
Mean Q			-2.5721	-2.3758	-2.2999	-2.3965	-2.3733	-2.7187		
S.E			.6381	.6529	.5155	.5237	.7877	1.0702		

Regression statistics :

Age	Slope	Intercept	S.e.	RSquare	No Pts	Fleet Mean Q
0	.73	6.21	.81	.43	10	-5.14
1	6.70	-29.11	3.84	.01	10	-3.41
2	2.48	-6.63	1.56	.07	10	-2.57
3	3.77	-14.29	2.22	.05	10	-2.38
4	2.00	-3.29	.98	.21	10	-2.30
5	1.18	1.47	.66	.32	10	-2.40
6	2.34	-3.66	1.86	.06	10	-2.37
7	-1.25	10.68	.80	.31	10	-2.72

cont'd.

Table B.2 cont'd.

Fleet : Bottom Trawl Survey

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0				-.31	-.48	.68	.76	-.68	-.26	.70	-.44
1				-2.32	3.47	-1.29	-1.08	.12	1.04	1.36	-1.41
2				.21	-.53	-.19	1.29	-.27	-.58	-.95	1.02
3				.62	-.21	.00	.10	-.07	-.78	-.25	.63
4				.45	.57	-.33	-.86	-1.12	.09	.69	.57
5				.34	-.12	.71	-.96	-.67	-.43	.49	.68
6				-.35	1.09	.75	1.58	-1.17	-2.67	.20	.67
7				-.63	-.86	.92	.04	-.30	-.37	.52	.57
8	No data for this fleet at this age										
9	No data for this fleet at this age										

Mean catchability and Standard error.

Age	0	1	2	3	4	5	6	7	8	9
Mean Q			-3.9315	-4.5359	-5.0771	-5.5981	-6.0662	-6.4257		
S.E			.7996	.4654	.7072	.6494	1.3965	.6275		

Regression statistics :

Age	Slope	Intercept	S.e.	RSquare	No Pts	Fleet Mean Q
0	.98	1.45	.66	.51	8	-1.26
1	-1.84	18.83	2.03	.02	8	-3.60
2	1.35	2.22	1.16	.10	8	-3.93
3	.61	6.11	.26	.72	8	-4.54
4	2.39	1.05	1.70	.08	8	-5.08
5	7.49	-6.04	4.19	.01	8	-5.60
6	-.91	7.44	1.09	.14	8	-6.07
7	3.66	7.24	2.18	.04	8	-6.43

Table B.3 Fishing mortality (F) from XSA, combined Blue Whiting stock.

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

At 14/09/1993 10:26

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age

YEAR,	1981,	1982,
AGE		
0,	.0094,	.1715,
1,	.0804,	.0363,
2,	.1002,	.1149,
3,	.1692,	.1284,
4,	.1267,	.1999,
5,	.2812,	.1397,
6,	.2929,	.2228,
7,	.2497,	.2204,
8,	.3210,	.2259,
9,	.2556,	.2321,
+gp,	.2556,	.2321,
FBAR 3- 7,	.2239,	.1822,
FBAR 4- 8,	.2543,	.2017,

Table 8 Fishing mortality (F) at age

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	FBAR 90-92
AGE											
0,	.0195,	.0492,	.1304,	.0089,	.0503,	.0055,	.1366,	.0113,	.0220,	.0106,	.0146,
1,	.1608,	.1350,	.1481,	.0990,	.1160,	.0817,	.1357,	.1599,	.0381,	.0677,	.0886,
2,	.1902,	.2453,	.1713,	.1300,	.1199,	.1384,	.1932,	.1558,	.1581,	.0707,	.1282,
3,	.1585,	.2298,	.3306,	.2331,	.1640,	.1806,	.4109,	.2792,	.1573,	.4049,	.2805,
4,	.1588,	.2256,	.2359,	.5536,	.3955,	.2284,	.3732,	.4289,	.1888,	.3050,	.3076,
5,	.1595,	.2351,	.2530,	.5473,	.4811,	.5226,	.4846,	.4514,	.3725,	.2290,	.3509,
6,	.2368,	.3775,	.4536,	.4303,	.3714,	1.0284,	.6080,	.7444,	.4180,	.2849,	.4824,
7,	.3813,	.3302,	.3908,	.5780,	.4601,	.4107,	.6804,	.5649,	.4651,	.2891,	.4397,
8,	.3912,	.4801,	.3818,	.5977,	.8790,	.4466,	.4609,	1.1026,	.1539,	.5267,	.5944,
9,	.2958,	.3782,	.4505,	.8391,	.7335,	.6190,	.3920,	.4880,	.1714,	.4710,	.3768,
+gp,	.2958,	.3782,	.4505,	.8391,	.7335,	.6190,	.3920,	.4880,	.1714,	.4710,	
FBAR 3- 7,	.2190,	.2796,	.3328,	.4685,	.3744,	.4742,	.5114,	.4937,	.3204,	.3026,	
FBAR 4- 8,	.2655,	.3297,	.3430,	.5414,	.5174,	.5273,	.5214,	.6584,	.3197,	.3269,	

Table B.4 Stock number ('000), combined Blue Whiting stock.

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

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Terminal Fs derived using XSA (With F shrinkage)

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

YEAR,	1981,	1982,
AGE		
0,	5650,	24633,
1,	3693,	4583,
2,	4035,	2790,
3,	4836,	2989,
4,	3103,	3343,
5,	2471,	2238,
6,	2433,	1527,
7,	2331,	1486,
8,	2552,	1487,
9,	2832,	1515,
+gp,	7111,	3571,
TOTAL,	41046,	50162,

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

YEAR,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	GM 81-89	AM 81-89
AGE													
0,	24978,	13446,	10611,	10422,	7690,	9254,	16874,	8150,	8026,	1997,	0,	12249,	13729,
1,	16990,	20055,	10480,	7625,	8457,	5987,	7535,	12052,	6598,	6428,	1618,	8243,	9489,
2,	3618,	11844,	14347,	7399,	5655,	6165,	4517,	5386,	8410,	5200,	4919,	5853,	6708,
3,	2036,	2449,	7588,	9897,	5320,	4107,	4395,	3049,	3774,	5878,	3968,	4316,	4846,
4,	2152,	1423,	1593,	4464,	6418,	3697,	2807,	2386,	1888,	2640,	3210,	2912,	3222,
5,	2241,	1503,	930,	1030,	2101,	3538,	2409,	1582,	1272,	1280,	1594,	1898,	2051,
6,	1594,	1564,	973,	591,	488,	1063,	1718,	1215,	825,	718,	834,	1189,	1328,
7,	1000,	1030,	878,	506,	315,	276,	311,	766,	472,	445,	442,	705,	904,
8,	976,	559,	606,	486,	232,	163,	150,	129,	356,	243,	273,	533,	801,
9,	971,	540,	283,	339,	219,	79,	85,	77,	35,	250,	118,	409,	763,
+gp,	1432,	888,	782,	763,	409,	118,	128,	269,	91,	44,	150,		
TOTAL,	57989,	55302,	49071,	43521,	37302,	34447,	40929,	35062,	31748,	25122,	17125,		

Table B.5 Stock summary table, combined Blue Whiting stock.

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

At 14/09/1993 10:26

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS,	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 7,	FBAR 4- 8,
1981,	5650,	5158,	4417,	908923,	205.7958,	.2239,	.2543,
1982,	24633,	3989,	3067,	576219,	187.8563,	.1822,	.2017,
1983,	24978,	3626,	2137,	570022,	266.7072,	.2190,	.2655,
1984,	13446,	3428,	1798,	641776,	356.9045,	.2796,	.3297,
1985,	10611,	3411,	2068,	695593,	336.3570,	.3328,	.3430,
1986,	10422,	3595,	2391,	826987,	345.9217,	.4685,	.5414,
1987,	7690,	3093,	2017,	664407,	329.3466,	.3744,	.5174,
1988,	9254,	2742,	1699,	553307,	325.7010,	.4742,	.5273,
1989,	16874,	2605,	1580,	625403,	395.8840,	.5114,	.5214,
1990,	8150,	2501,	1382,	560509,	405.4978,	.4937,	.6584,
1991,	8026,	3196,	1684,	386494,	229.5380,	.3204,	.3197,
1992,	1997,	2835,	2097,	475985,	226.9569,	.3026,	.3269,
Arith. Mean ,	11811,	3348,	2195,	623802,	301.0389,	.3486,	.4006,
Units,	(Millions),	('000 t),	('000 t),	(Tonnes),			