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International Council for the
Exploration of the Sea

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REPORT OF THE BLUE WHITING ASSESSMENT WORKING GROUP

Copenhagen, 9 - 15 September 1992

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1 INTRODUCTION

1.1 Terms of Reference

The Blue Whiting Assessment Working Group (Chairman: Mr T. Monstad) met at ICES Headquarters from 9 - 15 September 1992 (C.Res.1991/2:7:12, adjusted by ACFM at its meeting in autumn 1991) to:

a) assess the status of and provide catch options for 1993 and 1994 within safe biological limits 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) prepare for transfer of its work to area-based working groups, advise how this might be best achieved, and consider what difficulties might arise and how these could be overcome.

A difference from the terms of reference in previous years is that the Working Group was not asked to attempt an assessment of the Southern stock in 1992. It should rather try to resolve some of the biological problems (or specify how to resolve them) and uncertainties that have already been identified for this stock.

There were also the following NEAFC requests as additional terms of reference for the Working Group:

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 (1994-1996) assuming:

- recruitment as estimated for the year classes up to and including 1990,

- for the year classes 1991 and after average recruitment, excluding the recruitment for the year classes 1982, 1983 and 1989,

  for the following scenarios:

- a 1993-1995 TAC for each year of 300,000; 400,000; 500,000; 600,000 and 700,000 t.

1.2 Participation

Belikov, S.	Russia
Blinov, V.	Russia
Hanchet, S.	Norway
Jacobsen, J.A.	Faroes
Meixide, M.	Spain
Monstad, T. (Chairman)	Norway
Skagen, D.	Norway

2 STOCK IDENTITY AND STOCK SEPARATION

In 1992, investigations of population structure of the Northern blue whiting were continued on a national basis. Russian scientists have taken several samples for histological and physiological analyses during the spring acoustic survey. These samples were taken from various regions of the spawning area of blue whiting over an area between 51° - 58°N. Preliminary results show that in the region of the Porcupine Bank there is a mixture of individual blue whiting showing different rates of maturation (Belikov, pers. comm.).

Besides this, Russian and Irish scientists have continued the research work studying water circulation in the region where blue whiting spawn. These investigations are of importance for understanding the migrational routes of blue whiting during the post-spawning period (Titov *et al.*, 1992).

In 1990-1992, Norwegian scientists have taken samples of blue whiting for genetic analyses. These samples have been taken in the area west of the British Isles, Norwegian Sea, Spitsbergen, the Bay of Biscay and the Mediterranean Sea, and are at present being analyzed (Monstad, pers. comm.).

3 OTOLITH EXCHANGE PROGRAMME

A selection of otoliths from various areas has been collected for an Otolith Exchange Programme recommended in the Working Group report of 1990 (*Anon.*, 1991). At present the otoliths have not reached all of the countries concerned. The final results will hopefully be brought to the Workshop on Blue Whiting Otolith Reading which is to be held in Torshavn, Faroes, from 2-6 November 1992. A part of the terms of reference of the Workshop is to evaluate the result of the otolith exchange programme carried out during 1988-1990, and the one presently taking place.

4 NORTHERN STOCK

4.1 Landings in 1991

Estimated total landings in 1982-1991 from various fisheries by countries are given in Tables 4.1.2-4.1.4 and summarized in Table 4.1.1. Catches from directed fisheries in Divisions VIIg-k and from Sub-area XII are also related to the Northern stock. The total landings from all Northern blue whiting fisheries in 1991 were estimated to be 356,471 t which is 33% less than those in 1990. Landings from the directed fishery in the spawning area showed a decrease of 52% over the 1990 values, while the landings from the industrial mixed fishery decreased by less than 10%. Both Russia and Norway, which together account for more than 80% of the landings, had a significant decrease in the landings from the directed fishery. There might be several reasons for this, one of which is the more easterly distribution of the concentrations than in previous years in the Porcupine Bank area (Monstad and Belikov, 1991). A significant part of the concentrations was thus to be found within the restricted area east of 12°W. The Norwegian fleet, whose landings declined from 280,000 t in 1990 to 115,000 in 1991, was also engaged in the re-opened capelin fishery in the Barents Sea, and, therefore, fished blue whiting later than usual. Landings from the Norwegian Sea fishery in 1991 have increased sharply after the declining trend during the last 5 years.

4.2 Landings in 1992

Preliminary data on the blue whiting catches from January to July 1992 were submitted by Working Group members, and the total catch amounted to about 350,000 t (Table 4.2.1).

As seen from Table 4.1.1 there is a redistribution of catches of Northern blue whiting in 1991, namely a fair amount of the catch has been taken in the Norwegian Sea (mainly in the Norwegian Economic Zone). This meant that five years drop in catches in this area has ceased. At the same time catches of Northern blue whiting in the spawning area have sharply decreased in 1991 (Table 4.1.1) concurrently with the downward trend in CPUE (Figure 4.6.13).

The Working Group believes that the spawning areas for the Northern blue whiting will still remain the main fishery areas during the coming years due to dense fish concentrations and relatively low moving behaviour.

However, if the hydrological situation which appeared in 1991 and 1992 will not change notably in the next few forthcoming years, a successful fishing in the feeding season of blue whiting (Division IIa) may be fairly possible.

4.3 Length Composition of Catches

Data on length composition of the 1991 catches of the Northern blue whiting from the directed fisheries by area are given for Russia (Table 4.3.1), the Faroes (Table 4.3.2), and the Netherlands (Table 4.3.3). Data on length composition of the 1991 catches in the mixed fisheries are given for Denmark (Table 4.3.4) and the Faroes (Table 4.3.5). Data on length composition of the Northern blue whiting for the directed fisheries in the 1992 catches are given for Russia (Table 4.3.6) and Norway (Table 4.3.7), and for the mixed fisheries by Norway (Table 4.3.8).

4.4 Age Composition of Landings

For the directed fishery in 1991 age compositions were provided by Russia, Norway and the Faroes. These countries accounted for 90% of the landings.

The landings for the directed fishery of UK (Scotland) and the Netherlands were allocated to catch in numbers by use of Norwegian age compositions of catches, while the Russian age composition data were applied to the German landings. The age composition of the catches in the directed fisheries is given in Table 4.4.1.

For landings of blue whiting taken in the mixed industrial fisheries, age compositions were provided by Norway and Faroes. These accounted for 41% of the total landings in these fisheries. For catches of Denmark, UK (Scotland) and Sweden, Norwegian age composition data for the mixed fisheries were used to allocate landings to 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 4.4.2.

The combined age compositions for the directed fishery in the spawning area as well as the industrial mixed fishery were assumed to give the total age composition of the total landings from the Northern stock of blue whiting (Table 4.4.3).

4.5 Weight at Age

Mean weight at age data for 1991 were presented by Russia, the Faroe Islands and Norway. Landings from other countries were assumed to have the same mean weight-at-age composition when fished in the same area and period as the sampled catches. Mean weights at age were calculated, weighted by the total landings in numbers in each fishery. The total catch landed in 1991 was compared to the sum of products of the total number landed and mean weights at age (SOP). The SOP discrepancy did not exceed 6% for the period 1979-1991, except for 1986, and increased to about 9% for 1977, 1978 and 1986. The mean weights at age used in the VPA runs are shown in Table 4.5.2.

4.6 Stock Estimates

4.6.1 Acoustic surveys in 1992

4.6.1.1 Surveys in the spawning season

The third joint acoustic survey by research vessels from IMR, Bergen and PINRO, Murmansk on blue whiting in the spawning area was carried out in the period 17 March - 12 April 1992 (Monstad et al. 1992). A post-survey meeting was held in Bergen for discussion and combination of results and for the preparation of a common survey report.

A ship to ship calibration of the acoustic instruments was conducted on 28 March resulting in a conversion factor of:

$Sa_{J.Hjort} = 1.38 \times Sa_{PINRO}$

used for obtaining a common estimate. (For future tuning in connection with VPA runs, however, the intercalibrated results will be used.)

Estimates of abundance and biomass were made separately by each country, and the results combined on a sub-area basis. This way of surveying the area, with vessels starting simultaneously from the north and the south, enabled the results to be combined for two separate rather short periods, i.e., before and after 28 March when the two vessels met at latitude 55°30'N. The routes and stations are shown in Figures 4.6.1 and 4.6.2.

During the first period the majority of the stock was distributed in the southern part, i.e., over the Porcupine Bank area west and southwest of Ireland (Figure 4.6.3). The highest density was actually found along the slope southwest of Ireland, but dense recordings were also obtained around 54°N 13'W. South of 55°30'N the biomass was more than 5 times higher than in the area to the north. Negligible amounts of blue whiting were recorded on the Rockall Bank. Biomass estimates are shown by rectangle for the first period in Figure 4.6.4. The total biomass and spawning stock biomass in the surveyed area were estimated to be 4.6 and 4.3 million t, respectively. The corresponding abundances were 40.2 x 10**9 and 36.9 x 10**9 individuals. The 1989 year class (3 years old) predominated, contributing to 63% of the stock (Figure 4.6.5).

During the second period the pattern of distribution had changed considerably (Figure 4.6.6). The highest density of blue whiting was then found north of the Porcupine bank. A stock size of 4.2 million t was estimated for the second period. However, due to insufficient biological data, this estimate can not be regarded as reliable.

Two further surveys were carried out in the post-spawning period. During 17 April - 2 May a Russian-Irish survey was conducted in the area west and northwest of the British Isles (Borkin *et al.*, 1992). The densest concentrations were found along a narrow strip between 55°30' - 61°00'N (Figure 4.6.7) and a preliminary estimate of about 4 million t was obtained (Belikov, pers. comm.). The length distribution for blue whiting was 17-40 cm with a modal length of 27 cm. The 3 and 4-year-olds were found to be the most common comprising 39% and 24% by number, respectively.

During 21 April - 4 May 1992, the Norwegian R/V "M. Sars" conducted an acoustic survey in the continental shelf and shelf edge area off the Norwegian coast (Monstad, 1992a). The densest concentrations were found at 65°N 07°E (Figure 4.6.8). The total biomass was estimated to be 675,000 t comprising 6.3 x 10**9 individuals. The 1989 year class again dominated.

4.6.1.2 Surveys in the feeding season

During 29 July-16 August the Norwegian R/V "G.O. Sars" conducted an acoustic survey on blue whiting in the Norwegian Sea (Monstad, 1992b). Blue whiting was observed over the entire area with highest densities obtained in the south (Figures 4.6.9 and 4.6.10). The total biomass in the surveyed area was estimated to be 1.1 million t comprising 8.5 x 10**9 individuals. An additional 90,000 t or 1.1 x 10**9 individuals were observed during an acoustic herring survey in the North Sea, south of 60°N, a few weeks earlier (Dommasnes, pers.comm.). When the two surveys are combined a total biomass of 1.2 million t is estimated. Biomass estimates are presented by rectangle in Figure 4.6.11. In the Norwegian Sea the 3 year old fish (1989 year class) predominated with a total of 75% by number. In the North Sea, however, the 1991 and 1990 year classes predominated with 45% and 36% by number respectively.

During 3-18 August the Russian R/V "Prof. Marti" conducted an acoustic survey in the Norwegian Sea between 64°40'-72°45'N and 7°W-10°E (Belikov and Ushakov, 1992). Only scattered recordings of blue whiting were obtained (Figure 4.6.10) resulting in a low biomass estimate of 88,400 t or 0.7 x 10**9 individuals. The 1989 year class was the most abundant accounting for 56% by number.

4.6.1.3 Discussion

The intercalibration of the acoustic instruments during the Norwegian-Russian joint survey in 1992 resulted in a ratio of 1 : 1.38 between "Johan Hjort" and "Pinro" (Monstad *et al.*, 1992). This differs from the 1 : 1 ratio obtained between the same two vessels in 1991 (Monstad and Belikov 1991). The reason to this difference is at present not known.

Total biomass estimates from all years in the spawning area since 1983 are listed in the text table below (in millions of tonnes). The spawning stock biomass is given in brackets.

Year	Russia	Norway	Faroes	Russia + Norway comb.
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	-	-	-	4.7 (4.4)
1992	-	-	-	4.6 (4.3)

The 1992 estimate was very similar to that in 1991. This is noteworthy considering the high variability between successive survey estimates in earlier years. The results indicate that there has been a downward trend in the biomass since 1988. This could have continued for the 1992 season as well, but due to the strong influx of the 1989 year class to the spawning area, the estimate remained at the same level as in 1991. This year class, which was the most numerous one in both years, contributed 23 % of the spawning stock in 1991 and 63 % in 1992.

The northmost post-spawning migration pattern was clearly observed during the spring surveys in 1992. The dense concentrations of blue whiting occurred south of Ireland in the second half of March, west of Ireland in early April and off the Hebrides and south of The Faroes in late April (Figures 4.6.3, 4.6.6 and 4.6.7).

In the past three years the main aggregation of blue whiting in the Porcupine Bank area has been further east than observed in previous years. This is probably due to the higher temperature and hence a more easterly influence of the North-Atlantic current in recent years (Monstad *et al.*, 1992).

The peak of spawning was found to be approximately two weeks earlier than in 1991, and closer to that of previous years.

During the two national surveys carried out in the feeding season in the Norwegian Sea, blue whiting was observed mostly as scattered recordings over the greater part of the area surveyed. The best recordings, however, were obtained in the Norwegian Trench and near the shelf edge north of Shetland. The biomass estimates made by Russia and Norway were both from limited geographical areas, and hence represent only part of the total stock. These summer surveys, however, give valuable information about the immature part of the stock. The preliminary results suggest that the 1992 year class was a poor one.

This variability in the acoustic estimates within a year might be due to the influence of several factors and this has been discussed by the Working Group over several years. In 1985, a special Workshop was set up to study and try to explain these problems (Anon., 1985). However, as mentioned in 1991 in the Special comments to the ACFM, the acoustic assessment method is under continuously improvement. New and better technology gives more detail and better relative estimates of the stock.

The acoustic estimates of the SSB, however, should be considered as indices for the stock size rather than as absolute values. To re-examine these problems more extensive analysis is needed than is possible during an ordinary assessment meeting.

At present the Working Group has no definite explanation for the great variability in earlier years, however there seems to be less variability in recent years (Figure 4.6.17). The Working Group recommends that countries involved in blue whiting fisheries, especially Russia and Norway which have joint surveys on several fish species, further strengthen their ongoing efforts to improve the efficiency of acoustic estimates for pelagic fish stocks.

4.6.2 Catch per unit of effort

Data on catch per unit of effort from the directed fishery in 1991 were only submitted by Norway. Those data were broken down by vessel tonnage class, area and month.

Time series of catch per hour fished in the Norwegian Sea, the Faroes area and the area west of the British Isles are given in Table 4.6.1, and for the Norwegian fleet are shown in Figures 4.6.12 and 4.6.13.

CPUE for both GRT-classes of the Norwegian fleet in Division IVa show considerable variation during the period 1980-1991 with present values being slightly below the average (Figures 4.6.12A).

In Division VIa, CPUE values for both GRT-classes peaked at 50 t/h in the years 1981-1983, showed a steady decline down to about 15 t/h in 1989 (Figure 4.6.12B) and since then have remained more stable.

In Divisions VIIb,c, the CPUE values for Norwegian vessels of both GRT-classes have steadily declined during the period 1984-1991 for class 2 and 1987-1991 for class 3 (Figures 4.6.13A).

In Divisions VIIg-k, CPUE values for GRT-class 2 seem to have remained stable since 1988 whereas those for class 3 have revealed a sharp decrease from peak of over 50 t/h in 1988 to less than 10 t/h in 1991 (Figure 4.6.13 B).

CPUE indices for both GRT-classes of the Norwegian fleet in the Northern blue whiting fishery were combined across areas to give overall aggregated CPUE values (Figure 4.6.14 and Table 4.6.2). There has been a steady decline from about 30 t/h in 1983 to about 10 t/h in 1991 in this fishery.

4.6.3 Virtual Population analysis (VPA)

4.6.3.1 Tuning the VPA to survey results.

The selection of fleets to be included in the tuning, and the selection of age range for the VPA, were discussed extensively in the 1991 Working Group report (Anon. 1992a). It was recognized that several of the available tuning series were of such poor quality that it was not advisable to use them. In addition, due to the problems with age reading, it was decided to reduce the oldest age in the VPA from 12 to 10 years. The tuning series that were rejected last year have not been updated this year, and the Working Group saw no reason to include them again.

Therefore, this years Working Group decided to adopt the procedure arrived at last year, using the Laurec-Shepherd tuning with the Norwegian and the Russian acoustic survey data in the spawning season, and the age range 0-10+ years. However, the analysis was extended backwards in time, starting in 1977, at which time the present fishery was well established. Tuning data are given in Table 4.6.3 and the diagnostics from the tuning are given in Table 4.6.4. As can be seen from the diagnostics the variance ratios lie between 0.4 and 0.6, indicating that the tuning data might not be of the best quality. The resulting fishing mortality and stock estimates are given in Tables 4.6.5-4.6.6. Since the lowest age in the tuning series is 3 years, the terminal Fs for ages 0-2 have to be entered manually. Average Fs over the years 1981-1988 were used from last years assessment (0.044, 0.069 and 0.095 for ages 0-2 respectively). This implies that the estimates for the most recent year classes (1989-1991) are not substantiated by data, and should not be considered further (Table 4.6.5). A plot of the logarithmic catchability residuals by age group is shown in Figures 4.6.15A-F. There seems to be a slight trend in the log q residuals, being below 0 from 1982 to 1986 and above 0 from 1986 and onwards. However, most residuals are between ± 1.

The estimated mean fishing mortalities for ages 4-8 are now markedly higher for the years 1987-1991 as compared to last years assessment. This is largely due to the increased Fs estimated for the older ages. Accordingly, the estimated stock numbers, in particular at older age, as well as the estimated spawning stock biomasses, are reduced for the most recent year's, compared to last year's assessment.

It seems that this discrepancy is caused by inconsistencies in the age composition of the tuning data. As shown in Table 4.6.3, there was a marked drop from 1990 to 1991 in the numbers at age within all cohorts older than 6 years in 1991, which, in the tuning, induced higher terminal Fs for the older ages, higher estimated catchabilities and lower population numbers backwards in time (Table 4.6.6). A similar phenomenon appeared in the Russian survey data from 1989 to 1990, but this had less effect on the 1991 assessment because this series was downweighted due to a larger variance. While there were great differences in the raised Fs between the two tuning series in last years assessment, these were very close this year for most ages.

The Working Group considers such inconsistencies from year to year in the assessment to be a reflection of the present precision level of the tuning data, in particular in the age distributions. Inconsistency in the catch at age data might also add to the uncertainties of the stock size estimates.

4.6.3.2 Separable VPA

For the separable VPA, a selection pattern was chosen using a reference age of 5 and a terminal S of 1.5, which is the same as used in last years assessment. This gave a fairly smooth selection pattern (Figure 4.6.16). As can be seen from the plot, discrepancies were observed for older ages. Lower values for the terminal S resulted in a dome-shaped selection pattern. A terminal F of 0.124 was then selected which gave an unweighed mean F(4-8) for the last year equal to that obtained in the tuned VPA (Table 4.6.7). The results are presented in Table 4.6.8-4.6.10. Trends in yield and fishing mortality, and in spawning stock biomass and recruitment from separable VPA are shown in Figure 4.6.18A-B respectively.

It was found that the estimate of the rich 1989 year class was very sensitive to downweighting of the catch data from earlier years. The fishery on this cohort has been unusual, the 0-group catches being higher than the 1-group catches. This is not reflected in the selection pattern, which makes the estimate of this cohort very sensitive to the balance between 0-group and 1-group in the selection pattern. A similar phenomenon occurred for the 1982 and 1985 year classes. Including these years in the separable analysis will tend to bring the selection pattern closer to that of the 1989 year class. It was, therefore, decided not to downweight the selection patterns for the years 1982 and onwards, which is also in accordance with previous practise by this Working

Group. Before 1982 the downweighting factor was set at 0.001 (Table 4.6.7).

The text table below shows the ranges of the acoustic spawning stock estimates together with this year's VPA result from 1983-1992.

Estimates	1983	1984	1985	1986	1987
Survey min.	3.6	2.1	1.7	2.0	4.1
Survey max.	4.4	2.7	2.7	5.6	5.1
VPA	2.1	1.8	2.1	2.4	2.2
Estimates	1988	1989	1990	1991	1992
Survey min.	3.1	5.7	5.1	4.4[1]	4.3[1]
Survey max.	6.8	6.1	5.7	4.4[1]	4.3[1]
VPA	2.0	2.0	2.0	3.2	3.8[2]

Biomass in million tonnes.
[1]Joint surveys. [2]Predicted SSB.

The 1989 year class is very strong according to this separable VPA, and, although it is not fully recruited, contributes substantially to the spawning stock biomass (Table 4.6.9). Over the years, the spawning stock biomasses measured acoustically have tended to increase compared to those estimated by the VPAs (Figure 4.6.17 and the text table above). The reasons for this are poorly understood. For 1991, the spawning stock biomass estimate by the separable VPA of 3.2 million t is closer to the acoustic estimate of 4.4 million t in recent years. A possible explanation can be that the 1989 year class comprised only a minor part of the spawning stock in the acoustic estimate, while it represents a large contribution to the spawning stock in the separable VPA. In the 1992 survey, the fractional abundance of this year class is close to that estimated in the stock for the beginning of 1992 by the separable VPA (68% and 70% of the numbers at age 3-10 years respectively).

The Working Group would like to draw attention to the problems that arise when a large year class is at an age where it will contribute substantially both to the fishery and the spawning stock, but where the information about the strength of that year class is still very sparse. It has hitherto not entered the fishery to any large extent, and it is still not included in the tuning data. Since the assessment is done on a yearly basis late in the year, the information obtained from the present year's fishery and surveys is not utilized. It would be an advantage to make full use of these data, preferably in a half-yearly assessment routine.

4.6.3.3 Alternative assessment procedures.

An attempt was made to use the Extended Survivors Analysis (XSA) as an alternative assessment approach, using the same tuning data. Stock independent catchability for all ages and age-independent catchabilities for ages above 6 years were assumed. The fishing mortalities by this approach were markedly higher than for the other approaches, in particular for 1991. It was found, however, that these results were strongly dependent on the use of the option to shrink the terminal population estimates towards the mean. The Fs increased as fewer years and ages were included in the shrinking, and when shrinking over 2 years or less was applied, the iteration did not converge. This is shown in the text table below.

The effect on mean estimated F-values of shrinkage towards the mean in the XSA.

Year/age included	F_{3-6} 1990	F_{3-6} 1991	F_{4-8} 1990	F_{4-8} 1991
5/5	.62	.43	1.13	.67
4/4	.66	.49	1.17	.75
3/3	.69	.51	1.27	.90
2/2	No convergence			

The catches in 1991 were markedly reduced compared to the previous years (Tables 4.1.1 and 4.1.3). This is mainly because at least some of the fleets have had the opportunity to take part in alternative fisheries, which they have preferred. Therefore, a decline in the fishing mortality level is to be expected for 1991. Under this circumstance, shrinking towards the mean might not be appropriate, and will tend to conceal this reduction in F.

The Working Group, therefore, did not explore this approach further during the meeting.

4.6.3.4 Yield per recruit

Yield per recruit and spawning stock biomass per recruit have been calculated using data in Table 4.6.11 and are shown in Figure 4.6.18. Exploitation pattern used was the smoothed fishing pattern (S-values) from separable VPA (Table 4.6.7). The yield-per-recruit calculations gave an $F_{0.1}$ of 0.2411 which is well above present fishing level about 0.16.

4.6.3.5 Catch projections and management considerations

Input data for prediction is given in Table 4.6.11. The initial stock size at the beginning of 1992 for the age groups 3 to 10+ were taken from the separable VPA run

(Table 4.6.9). The recruitment at age 0 in 1992 was set equal to 8,677 millions, which is the 1977-1988 average, excluding the two rich 1982 and 1983 year classes. The two year classes were excluded from the mean, as the 1992 year class is considered to be below average or even poor. For the next age group the total fishing mortality for age group 0 in 1991 (Table 4.6.8) was applied to the average recruitment of 10,279 millions for the years 1977-1988, resulting in 8,357 millions at age 1 in 1992. For age group 2 the total fishing mortalities for age group 0 in 1990 and age group 1 in 1991 were applied to an average recruitment of 8,677 millions (average 1977-1988 excluding 1982 and 1983 year classes) resulting in 5,530 millions in 1992. The 1990 year class is also considered to be below average.

A total catch of 440,000 t were assumed to be caught in 1992, based on projections of preliminary catches per 1. September 1992 of 375,000 t. The catch was raised by the same level as the preliminary catch per 1 September 1991 to the total catch in 1991. The resulting average F_{4-8} level of 0.1824 resulted in a SSB of 3.8 million t per 1 January 1993 (Table 4.6.12).

The results of the prediction run are given in Figure 4.6.18 and Table 4.6.12-4.6.13. A continuation of the assumed 1992 fishing level would result in a catch of about 490,000 t in 1993 and a spawning stock estimate of 3.8 million t 1 January 1994; whereas a fishery at the 1991 level would have resulted in a catch of 430 t and an SSB of 3.9 million t (Table 4.6.13). Fishing at the $F_{0.1}$ level in 1993 would yield a catch of 630,000 t in 1993 and a resulting SSB of 3.7 million t at the beginning of 1994.

A plot of recruitment *versus* spawning stock biomass from 1977 to 1988 is shown in Figure 4.6.19. The estimated F_{med} was 0.323 and is indicated on the plot. Fishing at F_{med} level in 1993 will result in a catch of about 820,000 t and a resulting SSB of 3.5 million t in the beginning of 1994 (Table 4.6.13).

The Working Group considers the most likely fishing level in 1993 to be *status quo* (F=0.1824) which will give a catch of about 490,000 t in 1993. It is expected that the strong 1989 year class will result in high catches in the years to come. The Working Group recommends, however, that the TAC could be set at level of about 600,000 t in 1993 corresponding to an average fishing mortality not exceeding the $F_{0.1}$ level.

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 1991 were 2,813 t, which were similar to the 1990 level. The Spanish landings were 29,180 t, remaining at the same level than in 1990. Spanish landings (91% of the reported total landings in 1991) were mainly taken by pair trawlers (58%) in a directed blue whiting fishery, but also as a by catch by bottom trawlers (41%) and long liners (1%), in a multispecies fishery. In this fishery the discards have decreased in recent years, and are assumed to be negligible. The Portuguese landings (9% of the total reported landings in 1991) are taken as a by-catch by bottom trawlers. The amount of discards in this fishery is unknown.

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 composition 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 1982 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. As can be observed, most of the fishery was 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 is very small for 1991.

5.4 Stock Estimates

5.4.1 Acoustic survey in 1992

Acoustic surveys have been carried out in Spanish Atlantic waters since 1983, but until 1992 those surveys did not reach the outer limit of the possible distribution area of blue whiting. In 1992, with the introduction of the Simrad EK 500 echosounder, it was possible to extend the area covered to the 1000 m isobath and further if blue whiting was present. The estimated biomass was 272,000 t corresponding to 6738 million fish. These values represent an increase of 60% and 40% respectively in relation to the 1991 survey (Meixide, pers. comm.)

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 500 m. Since 1983, the area covered in the Spanish survey was extended to completely cover the Spanish waters in Division VIIIc. Stratified mean catch and standard error in Portuguese groundfish surveys are shown in Table 5.4.1. Stratified mean catch in Spanish bottom-trawl surveys (in weight and in number by haul) since 1985 are shown in Table 5.4.2.

5.4.3 Catch per unit effort.

Table 5.4.3 shows the evolution from 1978 to 1991 of the landings, effort and CPUE for vessels of the main Galician ports and for the Portuguese bottom-trawl fishery. Table 5.4.4 also represents the evolution of CPUE in the main Galician ports split in single trawlers and in pair trawlers since 1983. Other series of CPUE of bottom trawlers in the Bay of Biscay since 1983 is represented in Tables 5.4.5 and 5.4.6.

6 ZONAL DISTRIBUTIONS

The acoustic surveys conducted in 1992 confirmed that during spring most of the blue whiting stock is mainly in the EC zone (Table 6.1). Only 13% of the blue whiting stock was observed within the Norwegian zone, 4% in Faroes zone and 0.4% in the international zone.

The distribution of the blue whiting aggregations during the feeding season is shown in Figure 4.6.10. The blue whiting concentration is observed mainly in the national zones of Norway, Faroes as well as in the international waters of the Norwegian Sea. Only an insignificant part of the stock is found in the EC zone at this time.

Total catches of blue whiting in 1978-1991 divided into areas within and beyond the national fisheries jurisdiction of NEAFC are presented in Table 6.2.

7 DISTRIBUTION IN TIME AND SPACE OF THE BLUE WHITING STOCK

During 1992, information about blue whiting distribution was obtained in both the spawning season and in the feeding season. In last year's report (Anon., 1992a) the difficulty in obtaining information and data from a stock with a geographical distribution as large as for blue whiting was discussed.

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

7.1 Spawning Area

As stated in last year's report, the distribution of blue whiting within the spawning area is largely influenced by the North-Atlantic current. In 1992 this current was weaker than observed in 1990 (Titov *et al.*, 1992). Due to the hydrological situation, the fish distribution south of the Porcupine Bank (Monstad *et al.*, 1992) was more easterly than in 1991 and 1990 (Monstad and Belikov, 1991).

In spring 1992, more convincing evidence for the northwards migration was obtained. The result of three short consecutive surveys this year clearly demonstrated a northward migration of the main fish concentrations. Although the biomass estimate of the second survey is considered to be somewhat unreliable, it is very consistent with the first one, i.e., 4.6 and 4.2 million t, respectively, and indicates that the main part of the blue whiting spawning in the Porcupine Bank area belongs to the northern stock. In addition, an estimate of about 4 million t (Belikov, pers. comm.) during the third coverage further strengthens this conclusion.

7.2 Nursery Area

The nursery area of the Northern blue whiting population is situated in the southern part of the Norwegian Sea, in the northern part of the North Sea, especially in the Norwegian Trench. The incubation time of the blue whiting eggs is 7-10 days at temperatures from 9-11°C (Bailey, 1982). Most of the larvae hatched in the area west of the British Isles from the Porcupine Bank and the Hebrides drift in a northward direction.

Ichthyoplankton observations were made by R/V Pinro during the period 17 April to 2 May in the area west and northwest of the British Isles. (Borkin *et al.*, 1992). The survey area in 1992 was approximately 46% of that surveyed in 1991 and the total number of stations sampled in 1991 was twice that sampled this year. Blue whiting larvae were present at 14 stations. The highest concentrations of larvae were collected between 52° - 54°N, 10° -13°W and from 56° - 59°N, 08° - 12°W (Figure 7.2.1). The larval distribution in the south was similar to that recorded during surveys made in 1990 and 1991, whilst the distribution in the north was similar to that recorded in 1986 (Belikov and Shevchenko, 1989).

The number of blue whiting larvae taken was 165 ranging from 1.6 to 14 mm in length. The majority of the larvae were 3.6-5.5 mm long. Mean length was slightly higher than last year (4.8 mm compared with 4.6 mm).

In some years (e.g., 1990), O-group blue whiting have been observed in the Barents Sea (*Anon.*, 1990). The results of the international 0-group fish survey in the Barents Sea and adjacent waters in August-September 1992 have shown that 0-group blue whiting were absent (*Anon.*, 1992b).

7.3 Feeding Area

The distribution of blue whiting concentrations in the Norwegian Sea during the feeding season depends on the position of the Polar front (Schevchenko and Isaev, 1985). During 1989 and 1990, only weak aggregations of blue whiting were observed in this feeding area (Monstad, 1990), and consequently only low fishing activity took place. However, with the recruitment of the strong 1989 year class to the fishery in 1991 and 1992 the situation has improved. Due to the location of the Polar front in 1990-1992, the distribution pattern was observed to be more easterly than before. During the summer of 1991 and 1992 the temperature in the main stream of the North-Atlantic current was higher than earlier (Belikov, pers. comm.).

8 BIOLOGICAL UNCERTAINTIES

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

Age determination

Several otolith exchanges and workshops have been carried out since 1979, but there are still discrepancies between the different countries. The new otolith exchange and the workshop in November 1992 are likely to elucidate this problem.

Stock identity

Blue whiting in the North-East Atlantic is presently assessed as two stocks, one northern and one southern. This separation was based more on convenience than on scientific evidence. Some investigations on this subject have shown (small) differences in growth rate and maturity at length, while in other studies such differences were not found. Whether there exist one, two or more stocks in this area, the geographical distribution of such stocks, is anyhow not clear, and may also change over time. To solve this problem, the available tools are biological tagging (parasites), and morphometric and genetic studies, including mitochondrial DNA analysis. Such studies have started in some countries, but results are not available yet.

Acoustic estimates

Discrepancies between different acoustic estimates, and between acoustic and VPA- estimates, can not be explained at present. To elucidate this problem, a large range of possibilities have to be considered, such as target strength, the behaviour of the fish, the effect of depth and of direction of migration of the stock during the survey. Furthermore, the effect of the natural mortality on the VPA estimate should be considered.

The Working Group has recommended investigations to solve these problems for several years, and reiterates this recommendation.

9 RECOMMENDATIONS

1. The Working Group recommends the continuation of the joint Norwegian-Russian acoustic survey aimed at assessing the blue whiting stock biomass in the spawning area during spring, and also the continuation of acoustic surveys in the Norwegian Sea in the feeding period during summer by all countries involved in the fishery.

2. The Working Group recommends to continue investigations of the blue whiting population structure on a national basis and recommends that one person (S. Belikov, Russia) should collate and summarize all the available data on stock separation and present them at the next meeting of the Working Group.

3. The Working Group recommends the continuation of the study of egg and larval distribution of blue whiting and the current system in the area west of the British Isles, with a view to understanding the population structure of the Northern stock. Research efforts of all countries taking part in Northern blue whiting fisheries should be combined to meet this aim.

4. The Working Group strongly recommends that the countries participating in the fishery of blue whiting frequently sample the catch and provide biological data as well as catch data to ICES. This goes especially for the mixed industrial fishery, as a very high number of the youngest age groups is taken in this fishery. Sufficient length- and age-measurements are required to obtain the age composition of the catch for this fishery.

5. The Working Group recommends that acoustic and larval surveys be carried out in the southern area (Sub-areas IX, VIII and VII), and stresses the importance of investigating the larval drift and the distribution of blue whiting in the area for studying stock identity of the species.

10 RE-ARRANGEMENT OF ICES WORKING GROUPS

The proposed re-arrangement of the Blue Whiting Assessment Working Group was discussed at great length by the Group. The Group feels that the re-arrangement of other working groups will not be finalized for a number of years which makes it difficult to understand where the Group will fit in.

Because of its large distribution area, the blue whiting can be regarded as rather different from the other pelagic or semi-pelagic species. Although the Working Group was relatively small in the last two years, this reflects the current low exploitation on the stocks. It is expected that the number of countries participating in the fishery will increase in the next few years, and so the Working Group participation would also be expected to increase. The members of the Working Group are concerned that if it is moved into a larger group the number of participants involved in the blue whiting assessment would decline further and result in a less comprehensive assessment. The preferred option of the Working Group is, therefore, to remain as a single species Working Group.

If this option is not tenable, then blue whiting could be merged with either the Working Group on the Assessment of Mackerel, Sardine and Anchovy or the Atlanto-Scandian Herring and Capelin Working Group. Mackerel has a similar summer and winter distribution pattern as that of blue whiting; however, that assessment is based predominantly on egg and larval surveys. In contrast, the distribution of the Atlanto-Scandian herring only overlaps with blue whiting during the summer period, but is assessed, as blue whiting, using acoustic surveys. On balance, the Working Group believes that if it must be merged with another group, then that group should be the Atlanto-Scandian Herring and Capelin Working Group.

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Table 4.1.1 Landings (tonnes) of BLUE WHITING from the main fisheries, 1982-1991, as estimated by the Working Group.

Area	1982	1983	1984	1985	1986
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	110,685	52,963	65,932	90,742	160,061
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	316,566	361,537	421,865[2]	464,265[2]	534,263[2]
Icelandic industrial fishery (Division Va)		7,000		-	-
Industrial mixed fishery (Division IVa-c, Vb, IIIa)	117,578	117,737	122,806	97,769	99,580
Subtotal northern fishery	544,829	539,237	610,603	652,776	793,904
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k	31,590	30,835	31,173[3]	42,820[3]	33,082[3]
Total	576,419	570,072	641,776	695,596	826,986

Area	1987	1988	1989	1990	1991[2]
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	123,042	55,829	37,638	2,106	78,703
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	445,863[2]	421,636	473,165	463,495	220,689
Icelandic industrial fishery (Division Va)	-	-	4,977	-	-
Industrial mixed fishery (Division IVa-c, Vb, IIIa)	62,689	45,110	75,958	63,192	57,079
Subtotal northern fishery	631,615	522,575	591,738	528,793	356,471
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k	32,819[3]	30,838	33,695	32,817	32,003
Total	664,434	553,413	625,433	561,610	388,474

[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, Division Va, XIVa and XIVb) fisheries, 1982-1991, as estimated by the Working Group.

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

Country	1987	1988	1989	1990	1991[1]
Faroes	9,290	-	1,047	-	-
France	-	-	-	-	-
German Dem.Rep.	1,010	3	1,341	-	-
Germany, Fed.Rep.[2]	-	-	-	-	-
Greenland	-	-	-	-	-
Iceland	-	-	-	-	-
Norway	-	-	-	566	100
Poland	56	10	-	-	-
UK (Engl. & Wales)	-	-	-	-	-
USSR/Russia	112,686	55,816	35,250	1,540	78,603
Total	123,042	55,829	37,638	2,106	78,703

[1]Preliminary.
[2]Including catches off East Greenland (Division XIVb) (698 t in 1978, 204 t in 1979, and 8,757 t in 1980).

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), 1982-1991, as estimated by the Working Group.

Country	1982	1983	1984	1985	1986
Denmark	23,164	28,680	26,445	21,104	11,364
Faroes	38,958	56,168	62,264	72,316	80,564
France	1,212	3,600	3,882	-	-
German Dem.Rep.	7,771	3,284	1,171	6,839	2,750
Germany, Fed.Rep.	701	825	994	626	-
Iceland	1,689	1,176	-	-	-
Ireland	-	-	-	668	16,440
Netherlands	200	150	1,000	1,801	8,888
Norway	169,700	185,646	211,773	234,137	283,162[2]
Poland	-	-	-	-	-
Spain	-	318	-	-	-
UK (Engl. & Wales)	-	-	33	2	-
UK (Scotland)	-	-	-	-	10
USSR	73,171	81,690	114,303	126,772	3,472
					127,613
Total	316,566	361,537	421,865	464,265	534,263

Country	1987	1988	1989	1990	1991[1]
Denmark	2,655	797	25	-	-
Faroes	70,625	79,339	70,711	43,405	10,208[2]
France	-	-	2,190	-	-
German Dem.Rep.	3,584	4,663	3,225	230	-
Germany, Fed.Rep.	266	600	848	1,469	349
Iceland	-	-	-	-	-
Ireland	3,300	245	-	-	-
Netherlands	5,627	800	2,0787	7,280	17,359
Norway	191,012	208,416	258,386	281,036[2]	114,866[2]
Poland	-	-	-	-	-
Spain	-	-	-	-	-
Sweden	-	-	-	-	-
UK (Engl. & Wales)	5	3	1,557	13	-
UK (Scotland)	3,310	5,068	6,463	5,993	3,541
USSR/Russia	165,497	121,705	127,682	124,069	74,366
Total	445,884	421,636	473,165	463,495	220,689

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

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, 1981-1991, as estimated by the Working Group.

Country	1982	1983	1984	1985	1986
Denmark	34,936	38,290	49,032	35,843	57,315
Faroes	27,269	12,757	9,740	3,606	5,678
France	1,417	249	-	-	-
German Dem.Rep.[2]	-	-	-	-	-
Germany,Fed.Rep.[2]	93	-	556	52	-
Ireland	-	-	-	-	-
Netherlands	-	-	122	130	1,114
Norway	47,856	62,591	58,038	54,522	26,941
Poland[2]	550	-	-	-	-
Sweden[4]	1,241	3,850	5,401	3,616	8,532
UK (Engl. & Wales)[2]	-	-	-	-	-
UK (Scotland)	-	-	-	-	-
Total	117,578	117,737	122,806	97,769	99,580
Country	**1987**	**1988**	**1989**	**1990**	**1991[1]**
Denmark	28,541	18,114	26,605	27,052	15,538
Faroes	7,051	492	3,325	5,281	356
France	-	-	-	-	-
German Dem.Rep.[2]	53	-	-	-	-
Germany,Fed.Rep.[2]	62	280	3	-	-
Ireland	-	-	-	-	-
Netherlands	-	-	-	20	-
Norway	24,969	24,898	42,956	29,336[3]	23,205
Poland[2]	-	-	-	-	-
Sweden[4]	2,013	1,226	3,062	1,503	17,980
UK (Engl. & Wales)[2]	-	-	7	-	-
UK (Scotland)	-	100	-	-	-
	62,689	45,110	75,958	63,192	57,079

[1]Preliminary.
[2]Including directed fishery also in Division IVa.
[3]Including mixed industrial fishery in the Norwegian Sea.
[4]Reported landings assumed to be from human consumption fisheries.

Table 4.2.1 Preliminary data on landings (t) of BLUE WHITING in 1992 based on information from Working Group members.

Country	Area	Jan	Feb	Mar	Apr	May	June	July	Total
Russia	IIa	-	-	-	-	8,690	32,201	15,583	56,474
	Vb	1,787	1,786	135	23,325	45,619	2,017	-	74,579
	VIc	-	-	2,334	1,087	-	-	-	3,421
	VIIb,c	-	-	5,700	1,437	-	-	-	7,137
	VIIg-k	-	-	12,065	-	-	-	-	12,065
	XII	-	-	4,472	-	-	-	-	4,442
Sum									158,148
Faroe Islands	IVa	-	-	-	-	-	-	-	-
	Vb	-	-	-	-	1,196	-	-	1,196
	VIa	-	-	-	706	1,953	10	-	2,669
	VIIb,c	-	-	-	3,275	1,880	-	-	5,155
	VIIg-k	-	-	-	3,275	-	-	-	3,275
Sum									12,295
Norway	IIa	-	-	-	-	-	-	-	1,426
	IVa	-	-	-	-	-	-	-	40,500
	Vb	-	-	-	-	-	-	-	1,141
	VIIb,c	-	-	-	-	-	-	-	133,869
Sum									180,800
Grand total									351,243

Table 4.3.1 Length distribution (%) of BLUE WHITING for the Russian directed fishery in 1991.

Length cm	Divisions			
	IIa	Vb_1	VIb	VIIg-k
17	0.3	-	-	0.2
18	1.2	-	-	0.5
19	3.7	-	1.0	1.2
20	2.2	-	10.0	3.4
21	3.1	-	9.0	4.7
22	5.5	0.3	25.0	5.4
23	8.9	0.3	29.0	5.4
24	4.6	2.1	14.0	6.1
25	8.3	5.8	7.0	5.8
26	14.8	11.1	3.0	3.3
27	15.4	15.2	-	5.0
28	14.5	13.2	-	6.4
29	6.5	10.8	1.0	9.0
30	4.3	8.3	1.0	11.3
31	2.5	8.0	-	8.4
32	1.5	7.2	-	8.7
33	1.5	5.4	-	5.0
34	0.6	5.8	-	3.7
35	0.3	2.9	-	3.1
36	0.3	1.5	-	1.6
37	-	1.2	-	0.6
38	-	0.8	-	0.2
39	-	0.1	-	0.2
40	-	-	-	0.3
41	-	-	-	0.3
42	-	-	-	0.1
43	-	-	-	-
44	-	-	-	0.1
N	325	650	100	644
Mean length	25.9	29.2	22.8	28.1

Table 4.3.2 Length distribution (%) of BLUE WHITING from Faroes directed fishery in 1991.

Length cm	May Vb	Feb VII
20	0.25	-
21	0.25	-
22	0.25	-
23	7.75	-
24	17.50	1.82
25	15.25	1.82
26	7.75	4.54
27	4.00	8.18
28	6.25	17.27
29	8.25	30.00
30	8.00	11.82
31	9.25	3.64
32	7.00	6.36
33	5.25	6.36
34	1.50	3.64
35	1.00	3.64
36	-	0.91
37	0.50	-
N	400	110
Mean length	27.5	29.5

Table 4.3.3 Length distribution (%) of BLUE WHITING from the Netherlands fishery in 1991.

Length cm	VIIb,c Qua.1	VIIb,c Qua.2	VIa Qua.2
20	-	0.2	-
21	-	0.6	-
22	-	1.0	-
23	-	1.9	-
24	-	1.0	-
25	-	1.4	-
26	-	2.1	-
27	-	9.5	-
28	3.4	12.4	2.6
29	5.9	14.4	-
30	20.2	14.6	2.6
31	10.1	10.9	6.4
32	16.0	8.2	1.3
33	14.3	9.7	14.1
34	13.4	4.7	11.5
35	7.6	3.7	7.7
36	5.0	1.9	20.5
37	2.5	0.6	19.2
38	1.7	0.6	9.0
39	-	0.2	2.6
40	-	-	1.3
41	-	-	1.3
N samples	119		78
Mean length	32.3	30.0	35.1

Table 4.3.4 Length distribution (%) of BLUE WHITING from Danish fishery in 1991.

Length cm	IIIa			IVa		IVb
	IIQ	IIIQ	IVQ	IQ	IVQ	
15	-	-	-	-	4.55	-
16	-	-	-	-	-	-
17	-	-	15.4	-	4.55	-
18	-	-	-	-	9.09	-
19	-	-	-	-	4.55	-
20	-	-	7.7	-	13.63	-
21	-	-	7.7	4.0	-	-
22	-	-	-	2.0	-	-
23	-	-	-	24.0	-	-
24	-	6.03	7.7	32.0	4.55	-
25	-	20.26	-	26.0	-	10.00
26	15.4	34.9	-	2.0	13.63	15.00
27	-	22.84	-	2.0	-	10.00
28	7.7	5.60	-	-	18.16	15.00
29	7.7	3.90	-	6.0	-	10.00
30	30.7	-	15.4	-	4.55	15.00
31	15.4	3.45	-	2.0	4.55	15.00
32	7.7	2.16	7.7	-	-	-
33	-	0.86	7.7	-	-	10.00
34	-	-	23.0	-	-	-
35	-	-	7.7	-	4.55	-
36	-	-	-	-	4.55	-
37	-	-	-	-	-	-
38	-	-	-	-	-	-
39	-	-	-	-	-	-
40	-	-	-	-	-	-
41	-	-	-	-	-	-
42	-	-	-	-	-	-
43	-	-	-	-	-	-
44	-	-	-	-	9.09	
N samples	13	232	13	50	22	20
Mean length	29.8	26.5	27.8	24.4	26.4	28.7

Table 4.3.5 Length distribution (%) of BLUE WHITING from Faroes mixed fishery in Division Vb in 1991.

Length cm	Jan	Mar	Oct
10	14.7	-	-
11	-	1.4	-
12	-	-	-
13	-	-	-
14	-	-	-
15	-	-	22.2
16	2.9	-	33.3
17	-	-	22.2
18	2.9	2.9	11.1
19	5.9	5.7	11.1
20	23.7	31.4	-
21	14.7	37.2	-
22	11.8	18.6	-
23	11.8	-	-
24	-	1.4	-
25	2.9	-	-
26	-	-	-
27	2.9	1.4	-
28	2.9	-	-
29	-	-	-
30	-	-	-
31	-	-	-
32	-	-	-
33	2.9	-	-
N samples	34	70	9
Mean length	20.0	20.7	16.6

Table 4.3.6 Length distribution (%) of blue whiting from the Russian directed fishery in 1992 (January-June).

Length cm	Divisions				
	IIa	Vb_1	VIa	VIIb,c	VIIg-k
17	-	-	-	-	0.3
18	-	-	-	0.3	3.1
19	-	-	0.3	1.0	3.1
20	-	1.0	0.6	1.3	2.8
21	-	1.7	0.3	1.0	1.9
22	-	1.7	1.5	1.3	2.8
23	0.5	0.7	1.5	3.0	4.3
24	0.5	0.7	2.1	4.3	8.3
25	-	3.3	5.1	4.0	9.2
26	9.5	7.3	13.0	14.3	12.3
27	22.5	16.0	15.9	18.3	13.5
28	23.0	16.3	15.6	16.8	11.4
29	15.5	22.5	9.3	12.3	9.5
30	12.5	8.0	4.5	7.7	4.0
31	5.5	5.3	7.5	6.0	4.0
32	4.5	2.0	4.5	2.7	1.9
33	3.0	3.0	3.6	2.7	2.2
34	0.5	1.3	4.2	1.7	1.8
35	2.0	4.3	3.3	1.0	1.2
36	-	1.7	3.3	-	1.5
37	0.5	1.3	2.4	0.3	0.3
38	-	1.3	0.3	-	0.6
39	-	0.3	0.6	-	-
40	-	0.3	0.6	-	-
N	200	300	334	300	325
Mean length	28.7	28.9	29.0	27.6	26.5

Table 4.3.7 Length distribution (%) of BLUE WHITING from Norwegian directed fishery in 1992.

	Division					
Length cm	VIIb,c	VIIb,c	VIIb,c	Vb	VIa	VIa
	Feb	Mar	Apr	May	Apr	May
20						
21						
22		0.3				0.6
23		1.0			0.9	
24	2.0	3.4	1.0		1.4	2.4
25	8.0	15.8	5.9	3.0	3.6	5.5
26	12.0	19.2	15.8	4.0	12.1	10.3
27	26.0	16.2	10.9	5.0	16.1	12.1
28	18.0	10.4	14.9	10.0	12.1	12.7
29	4.0	7.4	7.9	7.0	5.9	6.2
30	6.0	6.7	5.9	14.0	7.7	7.3
31	8.0	6.4	7.9	11.0	8.0	7.3
32	2.0	3.4	11.9	9.0	5.8	10.3
33	8.0	4.4	8.9	12.0	7.7	10.3
34		3.7	3.0	9.0	6.8	4.8
35		0.7	2.0	5.0	5.4	3.0
36	4.0	0.4	3.0	7.0	2.3	3.0
37	2.0		1.0	2.0	2.3	1.8
38		0.3		1.0	0.5	1.8
39		0.3				0.6
40					1.4	
41						
42				1.0		
N samples	100	297	101	100	222	165
Mean length	28.6	27.9	29.4	31.3	29.9	29.9

Table 4.3.8 Length distribution (%) of BLUE WHITING from Norwegian mixed fishery in 1992.

Length cm	Division				
	IVa	IVa	IVa	IVa	IVa
	Feb	Apr	May	Jun	Aug
19	11.8				
20	35.3	6.3			
21	29.4	25.4	6.0	1.5	
22	11.8	34.9	32.0	7.5	
23		25.4	35.0	16.5	
24			21.0	14.5	
25	5.9	3.2	3.0	6.5	
26	5.8	1.6		15.5	
27		1.6		21.0	7.7
28			2.0	10.5	7.7
29		1.6	1.0	3.0	7.8
30				2.5	26.9
31				1.0	26.9
32					3.9
33					7.7
34					3.8
35					3.8
36					
37					3.8
N samples	17	63	100	200	26
Mean length	21.1	22.2	23.0	25.4	30.7

Table 4.4.1 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), 1982 - 1991.

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991[1]
0	1.2	2.5	63.6	871.4	51.9	9.1	3.6	36.5	8.4	63.6
1	1.7	290.4	417.6	127.4	161.9	280.8	93.2	86.4	537.8	33.4
2	48.6	239.1	1,394.1	1,341.6	263.3	361.0	403.2	359.4	353.1	533.2
3	123.1	164.1	277.9	1,588.1	1,559.5	580.2	416.2	1,176.7	565.7	384.4
4	371.0	194.1	211.9	199.3	1,464.3	1,780.2	611.2	696.2	709.1	243.9
5	212.6	411.4	259.2	161.0	298.7	680.3	1,238.9	785.7	489.2	329.9
6	251.0	284.4	420.2	303.7	156.4	118.2	584.9	680.7	562.1	235.3
7	250.7	274.0	253.1	248.7	192.2	94.9	77.8	127.2	291.7	149.9
8	259.3	283.5	190.3	167.2	185.8	117.1	50.7	44.8	75.5	39.9
9	278.7	219.9	151.6	91.7	166.4	99.7	32.4	23.8	26.6	4.3
10	259.8	152.6	113.8	87.8	172.1	48.3	28.3	15.2	15.5	6.4
11	158.5	71.5	57.7	73.1	108.7	60.1	8.8	8.9	42.9	5.2
12+	247.6	92.5	79.8	94.5	105.7	86.6	11.8	12.9	33.4	2.4
Total	2,464.1	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
Tonnes	427,341	416,730	481,872	554,640	694,314	571,659	477,552	521,415	465,601	297,649

[1]Preliminary.

Table 4.4.2 BLUE WHITING. Catch in number (millions) by age group in the mixed industrial fisheries (Sub-area IV, Divisions IIIa, Vb, and Va) 1982 - 1991.

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991[1]
0	3,450.1	336.3	446.4	184.3	-	9.1	3.6	36.5	8.4	24.9
1	45.3	1,844.2	1,650.8	891.4	395.0	280.8	93.2	86.4	537.8	8.4
2	41.3	90.0	587.7	365.0	334.0	361.0	403.2	359.4	353.1	397.9
3	80.9	38.4	49.7	173.8	1,559.5	580.2	416.2	1,176.7	565.7	42.3
4	112.8	47.7	12.8	37.4	1,464.3	1,780.2	611.2	696.2	709.1	11.4
5	29.2	55.6	12.6	13.4	298.7	680.3	1,238.9	785.7	489.2	11.3
6	21.6	12.2	10.4	13.9	156.4	118.2	584.9	680.7	562.1	11.2
7	14.8	12.8	6.1	5.8	192.2	94.9	77.8	127.2	291.7	6.2
8	12.0	2.6	2.2	5.6	185.8	117.1	50.7	44.8	75.5	3.4
9	5.2	5.8	2.7	1.8	166.4	99.7	32.4	23.8	26.6	0.7
10	1.8	4.2	2.6	3.0	172.1	48.3	28.3	15.2	15.5	0
11	-	9.6	0.9	1.4	108.7	60.1	8.8	8.9	42.9	0
12+	3.6	4.2	0.7	0.3	105.7	86.6	11.8	12.9	33.4	0.2
Total	3,816.6	2,463.6	2,785.5	1,697.0	4,886.9	4,316.5	3,571.0	4,054.4	3,711.0	517.9
Tonnes	117,578	124,737	122,806	97,769	694,314	571,659	477,552	521,415	465,601	56,852

[1]Preliminary.

Table 4.4.3 Catch in numbers at age, BLUE WHITING in the northern area.

Run title : Blue Whiting in the Northern Area (run name: JACOBSEN)

At 14/09/1992 16:40

Traditional vpa Terminal Fs estimated using Laurec-Shepherd

Table 1 Catch numbers at age

YEAR,	1977,	1978,	1979,	1980,	1981,
AGE					
0,	428900,	956200,	2400,	23200,	0,
1,	467500,	1030900,	1918900,	331200,	69000,
2,	155400,	231800,	243800,	649400,	122000,
3,	121300,	158700,	353200,	436800,	515000,
4,	196600,	419800,	479800,	421700,	284000,
5,	184900,	436900,	486500,	507400,	522000,
6,	154300,	483100,	589800,	554000,	556000,
7,	137600,	527900,	754000,	754600,	466000,
8,	176700,	474300,	913600,	806000,	634000,
9,	120100,	364800,	840400,	619700,	578000,
+gp,	337000,	673800,	1892000,	1963100,	1460000,
TOTALNUM,	2480300,	5758200,	8474400,	7067100,	5206000,
TONSLAND,	238013,	574812,	1091422,	1092620,	870808,
SOPCOF %,	92,	91,	99,	100,	98,

Table 1 Catch numbers at age

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,
AGE										
0,	3451300,	339000,	510000,	1056000,	52000,	236000,	16000,	1908000,	9000,	88000,
1,	45000,	2133000,	2068000,	1019000,	557000,	455000,	278000,	664000,	1413000,	42000,
2,	89900,	328000,	1982000,	1707000,	598000,	467000,	488000,	541000,	521000,	931000,
3,	204000,	202000,	328000,	1762000,	1694000,	666000,	500000,	1238000,	615000,	427000,
4,	483800,	241000,	225000,	237000,	1649000,	1869000,	651000,	725000,	728000,	255000,
5,	241800,	465000,	272000,	174000,	378000,	713000,	1293000,	804000,	496000,	341000,
6,	272600,	295000,	431000,	318000,	181000,	134000,	609000,	688000,	566000,	247000,
7,	265500,	285000,	259000,	254000,	200000,	104000,	81000,	132000,	297000,	156000,
8,	271300,	285000,	192000,	173000,	197000,	122000,	53000,	47000,	76000,	43000,
9,	283900,	225000,	154000,	93000,	174000,	103000,	33000,	25000,	27000,	5000,
+gp,	671600,	334000,	255000,	259000,	398000,	195000,	50000,	37000,	92000,	13000,
TOTALNUM,	6280700,	5132000,	6676000,	7052000,	6078000,	5064000,	4052000,	6809000,	4840000,	2548000,
TONSLAND,	544829,	539237,	610603,	652776,	739904,	631615,	522575,	591738,	528793,	354501,
SOPCOF %,	94,	96,	102,	100,	91,	100,	100,	95,	100,	100,

Table 4.5.2 Mean weight at age in the catch, BLUE WHITING in the northern area.

Run title : Blue Whiting in the Northern Area (run name: JACOBSEN)

At 14/09/1992 16:40

Traditional vpa Terminal Fs estimated using Laurec-Shepherd

Table 3 Stock weights at age (kg)

YEAR,	1977,	1978,	1979,	1980,	1981,
AGE					
0,	.0320,	.0320,	.0320,	.0270,	.0270,
1,	.0300,	.0300,	.0300,	.0360,	.0630,
2,	.0840,	.0840,	.0840,	.0790,	.0920,
3,	.1050,	.1050,	.1050,	.1070,	.1180,
4,	.1090,	.1090,	.1090,	.1220,	.1350,
5,	.1290,	.1290,	.1290,	.1350,	.1450,
6,	.1470,	.1470,	.1470,	.1490,	.1550,
7,	.1600,	.1600,	.1600,	.1650,	.1700,
8,	.1700,	.1700,	.1700,	.1760,	.1780,
9,	.1770,	.1770,	.1770,	.1860,	.1870,
+gp,	.1930,	.1930,	.1930,	.2020,	.2110,

Table 3 Stock weights at age (kg)

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,
AGE										
0,	.0180,	.0180,	.0270,	.0140,	.0330,	.0200,	.0240,	.0140,	.0240,	.0390,
1,	.0460,	.0460,	.0360,	.0380,	.0400,	.0560,	.0610,	.0650,	.0450,	.0830,
2,	.0940,	.0940,	.0860,	.0800,	.0810,	.0920,	.0870,	.0890,	.0750,	.1070,
3,	.1360,	.1360,	.1040,	.1020,	.1130,	.1090,	.1070,	.1060,	.1090,	.1200,
4,	.1520,	.1520,	.1420,	.1290,	.1320,	.1250,	.1310,	.1300,	.1240,	.1540,
5,	.1620,	.1620,	.1570,	.1640,	.1680,	.1480,	.1420,	.1500,	.1500,	.1810,
6,	.1780,	.1780,	.1640,	.1780,	.2020,	.1780,	.1580,	.1590,	.1690,	.1970,
7,	.1950,	.1950,	.1760,	.2000,	.2090,	.2090,	.1810,	.1740,	.1750,	.2080,
8,	.2000,	.2000,	.1890,	.2080,	.2430,	.2210,	.1990,	.2060,	.2150,	.2320,
9,	.2040,	.2040,	.1860,	.2180,	.2460,	.2220,	.2220,	.2240,	.2170,	.2500,
+gp,	.2280,	.2260,	.2010,	.2330,	.2530,	.2540,	.2500,	.2380,	.2690,	.2470,

Table 4.6.1 Catch per unit hour in the directed fisheries 1982-1991 (fishing gear: mid-winter trawl). GRT-classes 1-5 are given at bottom of the table.

GRT class	Country	Time period	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
						Division IIa - t/hour						
3	USSR	Apr-Oct	-	0.87	-	1.86	1.63	2.47	-	2.29	1.50	-
3	German Dem.rep.	Jul-Sep	-	-	-	-	-	-	0.82	0.83	-	-
4	German Dem.Rep.	May-Jun	1.00	2.35	1.40	2.57	5.40	1.63	-	-	-	-
		Jul-Sep	1.21	1.10	2.57	2.29	2.30	0.80	-	1.34	-	-
		Oct-Dec	2.25	2.70	-	1.22	2.70	0.94	-	-	-	-
4	USSR	Feb	-	-	-	-	3.58	2.21	0.73	-	-	-
		Mar-Apr	1.84	-	7.80	0.87	4.12	3.54	3.55	1.96	4.88	-
		May-Jun	1.35	1.73	3.06	2.48	3.08	2.34	2.57	-	1.94	-
		Jul- Sep	2.85	0.60	2.85	3.16	2.27	2.28	2.02	2.48	1.96	-
		Oct-Dec	2.99	-	-	-	1.42	1.90	2.12	-	-	-
5	USSR	Jan-Sep	-	-	-	-	5.43	2.51	-	-	-	-
						Division IVa - t/hour						
1	Norway	Apr-May	17.39	16.51	8.68	-	2.18	-	18.40	-	-	-
2	Norway	Apr-May	13.75	18.31	7.01	15.70	-	7.91	7.64	5.03	-	9.30
		Nov	-	-	4.50[1]	-	-	-	-	-	-	-
3	Norway	Mar	-	-	-	-	-	7.93	-	-	-	-
		Apr-May	15.03	21.19	-	17.26	-	5.27	17.86	9.39	-	7.54
						Division Vb - t/hour						
1	Norway	Jan	-	-	-	-	11.86	-	-	-	-	-
		Apr-May	4.88	-	12.40	16.19	13.43	-	10.47	-	-	-
		Nov-Dec	-	-	25.08	12.55	-	-	-	-	-	-
2	Norway	May	-	-	-	-	-	-	-	-	8.77	9.58
3	German Dem.Rep.	Jan-Mar	-	-	-		-	1.47	-	-	-	-
		Dec	-	-	-	-	-	1.13	-	-	-	-
	Norway	Apr-May	-	-	-	24.85	-	13.96	16.47	6.37	15.55	15.33
		Jun	-	-	-	-	-	-	-	-	20.24	-
	USSR	Apr-Jun	-	0.38	-	7.05	-	-	-	3.91	2.91	-
		Jul-Dec	-	-	-	-	-	-	-	-	1.80	-
4	German Dem.Rep.	Jan-May	2.12	2.08	-	3.50	1.40	0.18	-	-	-	-
		Jun-Jul	-	-	-	3.58	2.50	1.86	1.52	0.89	-	-
		Aug	-	-	-	-	2.10	0.97	2.58	-	-	-
		Sep-Oct	-	-	-	-	-	0.64	-	1.28	-	-
		Nov-Dec	-	-	2.20	1.58	-	-	-	-	-	-
	USSR	Jan-Feb	5.16	3.05	1.74	3.71	3.12	2.37	2.15	-	3.91	-
		Mar-May	4.58	4.12	4.57	4.99	5.22	4.87	4.75	6.01	3.99	-
		Jun-Aug	3.03	3.16	4.29	5.33	5.41	5.45	2.36	3.51	3.87	-
		Sep-Dec	-	2.77	3.70	-	3.27	2.06	3.65	-	3.47	-
5	USSR	Feb-Oct	-	-	-	-	7.50	3.20	5.67	-	5.41	-
						Division VIa - t/hour						
2	Norway	Jan-Feb	-	-	-	-	11.90	14.84	-	-	-	-
		Mar-Apr	36.30	49.04	25.21	20.05	21.50	24.78	15.94	12.33	13.29	12.83
		May	-	-	-	-	22.38	10.62	21.15	7.97	9.31	9.33
3	Norway	Feb	-	-	-	-	-	10.81	-	-	-	-
		Mar-Apr	42.38	42.83	28.78	22.29	-	20.53	23.36	14.41	15.25	14.34
		May	-	-	-	-	-	12.07	26.18	15.87	12.91	11.79
						Division VIb - t/hour						
2	Norway	Mar	-	-	-	-	-	-	-	-	9.68	-
3	German Dem. Rep.	Mar-Apr	-	-	-	-	-	-	-	3.11	-	-
4	USSR	Apr-Jun	-	-	-	-	4.80	4.42	5.60	6.11	3.07	-
						Division VIIb,c - t/hour						
1	Norway	Mar	-	-	21.08	-	-	-	25.09	-	-	-
2	Norway	Jan	-	-	-	-	-	-	-	-	12.80	-
		Feb-Apr	-	-	27.74	26.83	25.35	21.74	18.29	25.26	14.66	
3	Norway	Jan-Feb	-	-	-	-	-	-	-	30.00	22.40	6.98
		Mar	-	-	-	-	-	24.02	32.29	37.61	21.69	13.48

Table 4.6.1 (Continued)

GRT class	Country	Time period	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
						Division VIIb,c - t/hour						
3	Norway	Apr	-	-	-	-	-	38.35	29.55	34.26	22.29	11.43
		Nov	-	-	8.00[1]	32.08	-	-	-	-	-	-
	German Dem.Rep	Mar	-	-	-	-	-	-	-	1.68	-	-
	USSR	Mar-Apr	-	-	-	-	-	-	-	-	2.35	-
4	USSR	Feb-Mar	-	-	4.72	6.21	3.83[2]	4.49[2]	5.61	6.64	6.32[2]	-
5	USSR	Feb-Mar	-	-	-	-	10.20	-	6.48	-	5.85	-
						Division VIIg-k - t/hour						
2	Norway	Jan	-	-	-	-	-	-	-	-	46.00	-
		Feb-Mar	-	-	14.58	-	-	35.54	25.93	26.45	25.74	-
3	Norway	Jan	-	-	-	-	-	-	-	-	12.65	-
		Feb-Mar	-	-	-	-	-	-	53.71	34.41	16.00	9.57
	German Dem.Rep.	Feb-Mar	-	-	-	-	-	-	-	3.76	-	-
	USSR	Feb-Apr	-	-	-	-	-	-	-	-	3.35	-
4	German Dem.Rep.	Feb-Mar	-	-	-	-	7.20	3.21	5.09	-	-	-
	USSR	Feb-Apr	-	-	3.85	12.30	6.96	4.96[3]	6.13	7.88	6.34	-
		Dec	-	-	-	-	-	-	-	-	1.85	-
5	USSR	Feb-Apr	-	-	-	-	-	-	-	-	7.12	-
						Division XII - t/hour						
3	German Dem.Rep	Mar-Apr	-	-	-	-	-	-	-	2.25	-	-
4	USSR	Feb-Apr	-	-	-	-	-	-	-	-	3.74	-
5	USSR	Apr	-	-	-	-	-	-	-	-	4.88	-

[1]One trawl only.
[2]Refers to Feb-Apr.
[3]Refers to Mar-Apr.
GRT-class 1: 100 - 499.9.
GRT-class 2: 500 - 999.9.
GRT-class 3: 1,000 - 1,999.9
GRT-class 4: 2,000 - 3,999.5.
GRT-class 5: 4,000 - and more

Table 4.6.2 Aggregated CPUE for Norwegian fleet in the Northern BLUE WHITING fishery, 1982-1991.

GRT-Class	Year									
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
2	25.03	33.68	18.64	20.86	20.28	19.24	17.79	15.41	17.53	8.40
3	28.71	32.01	18.39	24.12	-	18.69	28.49	22.79	17.58	11.50
Overall CPUE	26.87	32.85	18.52	22.49	20.28	18.97	23.14	19.10	17.56	9.95

Table 4.6.3 Tuning data for BLUE WHITING in the northern area, Russian and Norwegian acoustic estimates in spawning area.

Blue Whiting in the Northern Area (run name: JAN1) File: tuning.dat

FLT01: USSR, Spawning Area/Acoustic

	3	4	5	6	7	8	9	10	11
1982	0.54	2.75	1.34	1.38	1.57	2.35	1.73	1.29	0.65
1983	2.33	2.93	9.39	3.88	1.97	1.37	0.78	0.66	0.10
1984	2.90	0.80	1.10	4.20	2.20	1.20	1.70	1.20	0.50
1985	13.22	0.93	0.58	1.78	0.86	0.61	0.58	0.54	0.11
1986	18.75	23.18	2.54	0.61	0.62	0.75	0.64	0.71	0.72
1987	4.48	19.17	5.86	1.07	0.50	0.81	0.86	0.67	0.56
1988	3.71	4.55	8.61	4.13	1.27	0.48	0.25	0.26	0.33
1989	11.91	7.12	6.67	6.97	4.58	2.75	1.88	0.81	0.41
1990	9.74	12.14	5.74	2.58	1.47	0.22	0.08	0.01	0.01
1991	10.30	5.35	5.13	2.63	1.77	0.87	0.30	0.22	0.00

FLT02: Norway, Spawning Area/Acoustic

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

Table 4.6.4 Tuning results from 2 fleets, Russian and Norwegian acoustic estimates in the spawning area.

```
At 14/09/1992  16:40

Blue Whiting in the Northern Area (run name: JACOBSEN)

CPUE data from file J:\IFAPWORK\WG_116\WHB_NRTH\FLEET.J

Disaggregated Qs
Log transformation
The final F is the (reciprocal variance-weighted) mean of the raised fleet F's.
No trend in Q (mean used)

Terminal Fs estimated using  Laurec-Shepherd


Tuning converged after    9 iterations


Total of the absolute F residuals for all ages in the
last year, between iterations  8 and   9 =   .000

Regression weights
      , 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

Oldest age F = 1.000*average of 5 younger ages.
```

Fishing mortalities

Age,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991
0,	.181,	.016,	.041,	.105,	.004,	.023,	.001,	.106,	.012,	.044
1,	.014,	.162,	.131,	.108,	.074,	.045,	.034,	.077,	.107,	.069
2,	.044,	.129,	.222,	.152,	.085,	.082,	.062,	.086,	.080,	.095
3,	.085,	.130,	.184,	.314,	.221,	.129,	.118,	.218,	.133,	.087
4,	.159,	.136,	.209,	.197,	.545,	.405,	.179,	.251,	.193,	.075
5,	.113,	.227,	.225,	.248,	.546,	.484,	.546,	.349,	.273,	.130
6,	.193,	.197,	.339,	.443,	.440,	.379,	1.030,	.638,	.445,	.212
7,	.188,	.317,	.265,	.343,	.558,	.490,	.416,	.653,	.637,	.210
8,	.190,	.315,	.366,	.285,	.488,	.810,	.501,	.454,	1.034,	.173
9,	.169,	.238,	.281,	.303,	.516,	.514,	.534,	.469,	.516,	.160

Log catchability residuals

Fleet : FLT01: USSR, Spawning area.

Age ,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991
3 ,	-1.81,	.09,	.18,	.55,	.59,	-.45,	-.44,	.43,	.44,	.43
4 ,	-.70,	-.10,	-.90,	-.87,	1.43,	.82,	-.38,	.30,	.56,	-.15
5 ,	-1.23,	.76,	-.86,	-.95,	.54,	.62,	.53,	.30,	.39,	-.09
6 ,	-1.01,	-.04,	.21,	-.08,	-.59,	.12,	.96,	.88,	-.28,	-.17
7 ,	-.92,	-.24,	-.21,	-.88,	-.48,	-.17,	.85,	2.09,	.12,	-.16
8 ,	-.62,	-.70,	-.29,	-1.12,	-.50,	.56,	.39,	2.16,	-.02,	.13

Fleet : FLT02: Norway, Spawning area.

Age ,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991
3 ,	-.43,	-.13,	-.60,	.05,	-.50,	.00,	.30,	.93,	.57,	-.19
4 ,	-.08,	-.43,	-.46,	-.76,	.02,	.71,	.35,	.37,	.22,	.05
5 ,	-.53,	.17,	-.63,	-.63,	-.46,	.18,	1.17,	.54,	.14,	.06
6 ,	-.07,	-.06,	-.59,	-.65,	-1.04,	-1.20,	1.55,	1.01,	.67,	.39
7 ,	.05,	.50,	-.76,	-.49,	-1.26,	-.23,	.41,	.63,	1.05,	.10
8 ,	-.04,	.39,	-.78,	-.81,	-.94,	.08,	.90,	.18,	1.09,	-.08

Table 4.6.4 (cont'd)

```
                          SUMMARY STATISTICS FOR AGE  3
Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
     ,   q    ,      ,   F   ,   F   ,              ,  Slope  ,       ,Intrcpt
 1  ,-13.50  ,  .774, .0000 , .0566,   .120E+00,  .751E-01,-13.505,   .233
 2  , -6.47  ,  .510, .0016 , .1045,   .971E-01,  .453E-01, -6.469,   .154
 Fbar     SIGMA(int.)   SIGMA(ext.)    SIGMA(overall)  Variance ratio
   .087       .426           .282            .426            .438

                          SUMMARY STATISTICS FOR AGE  4
Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
     ,   q    ,      ,   F   ,   F   ,              ,  Slope  ,       ,Intrcpt
 1  ,-13.21  ,  .809, .0000 , .0874,   .997E-01,  .829E-01,-13.209,   .244
 2  , -6.04  ,  .470, .0024 , .0713,   .846E-01,  .430E-01, -6.042,   .142
 Fbar     SIGMA(int.)   SIGMA(ext.)    SIGMA(overall)  Variance ratio
   .075       .407          .882E-01         .407            .047

                          SUMMARY STATISTICS FOR AGE  5
Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
     ,   q    ,      ,   F   ,   F   ,              ,  Slope  ,       ,Intrcpt
 1  ,-13.05  ,  .776, .0000 , .1425,   .109E+00,  .774E-01,-13.053,   .234
 2  , -5.93  ,  .609, .0027 , .1227,   .103E+00,  .572E-01, -5.927,   .184
 Fbar     SIGMA(int.)   SIGMA(ext.)    SIGMA(overall)  Variance ratio
   .130       .479          .724E-01         .479            .023

                          SUMMARY STATISTICS FOR AGE  6
Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
     ,   q    ,      ,   F   ,   F   ,              ,  Slope  ,       ,Intrcpt
 1  ,-12.83  ,  .629, .0000 , .2518,   .787E-01,  .642E-01,-12.829,   .190
 2  , -5.94  ,  .945, .0026 , .1431,   .144E+00,  .922E-01, -5.937,   .285
 Fbar     SIGMA(int.)   SIGMA(ext.)    SIGMA(overall)  Variance ratio
   .212       .524           .261            .524            .248

                          SUMMARY STATISTICS FOR AGE  7
Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
     ,   q    ,      ,   F   ,   F   ,              ,  Slope  ,       ,Intrcpt
 1  ,-12.79  ,  .933, .0000 , .2460,   .160E+00,  .871E-01,-12.789,   .281
 2  , -6.01  ,  .731, .0025 , .1903,   .906E-01,  .748E-01, -6.007,   .220

 Fbar     SIGMA(int.)   SIGMA(ext.)    SIGMA(overall)  Variance ratio
   .210       .575           .125            .575            .047

                          SUMMARY STATISTICS FOR AGE  8
Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
     ,   q    ,      ,   F   ,   F   ,              ,  Slope  ,       ,Intrcpt
 1  ,-12.70  ,  .965, .0000 , .1513,   .178E+00,  .871E-01,-12.697,   .291
 2  , -6.05  ,  .729, .0024 , .1862,   .944E-01,  .740E-01, -6.049,   .220
 Fbar     SIGMA(int.)   SIGMA(ext.)    SIGMA(overall)  Variance ratio
   .173       .582           .100            .582            .030
```

Table 4.6.5 Fishing mortality (F) at age estimated from tuning, BLUE WHITINBG in the northern area.

Run title : Blue Whiting in the Northern Area (run name: JACOBSEN)

At 14/09/1992 16:41

Traditional vpa Terminal Fs estimated using Laurec-Shepherd

Table 8 Fishing mortality (F) at age

YEAR,	1977,	1978,	1979,	1980,	1981,
AGE					
0,	.0457,	.0796,	.0005,	.0072,	.0000,
1,	.0651,	.1474,	.2264,	.0816,	.0264,
2,	.0212,	.0416,	.0470,	.1112,	.0390,
3,	.0160,	.0270,	.0823,	.1112,	.1209,
4,	.0213,	.0705,	.1065,	.1336,	.0981,
5,	.0186,	.0601,	.1091,	.1568,	.2430,
6,	.0168,	.0619,	.1076,	.1745,	.2572,
7,	.0122,	.0732,	.1296,	.1951,	.2179,
8,	.0242,	.0532,	.1747,	.1990,	.2496,
9,	.0186,	.0638,	.1256,	.1722,	.2142,
+gp,	.0186,	.0638,	.1256,	.1722,	.2142,
FBAR 0- 2,	.0440,	.0895,	.0913,	.0666,	.0218,
FBAR 4- 8,	.0186,	.0638,	.1255,	.1718,	.2132,

Table 8 Fishing mortality (F) at age

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	FBAR 89-91
AGE											
0,	.1805,	.0164,	.0411,	.1051,	.0041,	.0231,	.0015,	.1061,	.0116,	.0440,	.0539,
1,	.0135,	.1618,	.1309,	.1078,	.0741,	.0446,	.0342,	.0769,	.1067,	.0690,	.0842,
2,	.0435,	.1292,	.2221,	.1519,	.0851,	.0820,	.0615,	.0862,	.0797,	.0950,	.0870,
3,	.0847,	.1300,	.1842,	.3142,	.2215,	.1287,	.1184,	.2184,	.1334,	.0867,	.1462,
4,	.1594,	.1364,	.2090,	.1966,	.5454,	.4050,	.1790,	.2513,	.1928,	.0751,	.1731,
5,	.1134,	.2265,	.2245,	.2477,	.5463,	.4835,	.5464,	.3493,	.2726,	.1299,	.2506,
6,	.1931,	.1968,	.3387,	.4435,	.4400,	.3791,	1.0300,	.6382,	.4447,	.2117,	.4315,
7,	.1878,	.3166,	.2652,	.3426,	.5585,	.4903,	.4158,	.6533,	.6366,	.2098,	.4999,
8,	.1902,	.3152,	.3656,	.2846,	.4881,	.8098,	.5007,	.4544,	1.0340,	.1727,	.5537,
9,	.1688,	.2383,	.2806,	.3030,	.5156,	.5136,	.5344,	.4693,	.5162,	.1598,	.3818,
+gp,	.1688,	.2383,	.2806,	.3030,	.5156,	.5136,	.5344,	.4693,	.5162,	.1598,	
FBAR 0- 2,	.0792,	.1025,	.1314,	.1216,	.0544,	.0499,	.0324,	.0897,	.0660,	.0693,	
FBAR 4- 8,	.1688,	.2383,	.2806,	.3030,	.5156,	.5136,	.5344,	.4693,	.5161,	.1598,	

Table 4.6.6 Stock size in numbers (*10**-5) at age from tuning, BLUE WHITING in the northern area.

Run title : Blue Whiting in the Northern Area (run name: JACOBSEN)

At 14/09/1992 16:41

Traditional vpa Terminal Fs estimated using Laurec-Shepherd

Table 10 Stock number at age (start of year) Numbers*10**-5

YEAR,	1977,	1978,	1979,	1980,	1981,
AGE					
0,	105863,	137694,	56901,	35910,	45061,
1,	81723,	82802,	104108,	46565,	29191,
2,	81858,	62691,	58503,	67967,	35136,
3,	84319,	65617,	49234,	45698,	49792,
4,	103038,	67939,	52289,	37123,	33476,
5,	110425,	82585,	51836,	38484,	26593,
6,	102332,	88738,	63672,	38053,	26937,
7,	124836,	82389,	68293,	46812,	26165,
8,	81406,	100964,	62691,	49117,	31532,
9,	71774,	65054,	78382,	43098,	32957,
+gp,	201400,	120157,	176462,	136528,	83248,
TOTAL,	1148974,	956630,	822372,	585357,	420088,

Table 10 Stock number at age (start of year) Numbers*10**-5

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	GMST 77-88	GMST 77-89
AGE													
0,	229834,	230385,	139770,	116625,	141127,	114031,	120848,	208844,	8579,	22541,	0,	107003,	112651,
1,	36893,	157089,	185561,	109830,	85962,	115076,	91230,	98797,	153782,	6942,	17660,	82681,	83822,
2,	23277,	29799,	109397,	133285,	80733,	65354,	90109,	72183,	74898,	113165,	5305,	62344,	63050,
3,	27666,	18246,	21441,	71729,	93743,	60704,	49295,	69371,	54218,	56621,	84255,	47591,	48990,
4,	36123,	20811,	13118,	14600,	42893,	61504,	43697,	35851,	45654,	38847,	42506,	37425,	37302,
5,	24846,	25216,	14866,	8714,	9820,	20355,	33585,	29913,	22831,	30823,	29504,	28297,	28419,
6,	17076,	18162,	16461,	9724,	5569,	4656,	10276,	15922,	17270,	14232,	22162,	21112,	20658,
7,	17053,	11526,	12214,	9605,	5109,	2937,	2609,	3004,	6886,	9064,	9429,	17412,	15210,
8,	17228,	11571,	6876,	7670,	5583,	2393,	1472,	1409,	1279,	2983,	6017,	15304,	12739,
9,	20113,	11662,	6912,	3906,	4725,	2806,	872,	731,	733,	372,	2055,	13542,	10818,
+gp,	47580,	17312,	11446,	10877,	10807,	5311,	1321,	1081,	2496,	968,	936,		
TOTAL,	497688,	551779,	538062,	496565,	486071,	455127,	445313,	537107,	388625,	296558,	219828,		

Table 4.6.7 Matrix of residuals, BLUE WHITING in the northern area.

```
Title : Blue Whiting in the Northern Area (run name: JACOBSEN), at 14/09/1992  17:00

Separable analysis from 1977 to 1991 on ages  0 to  9
with Terminal F of  .124 on age  5 and Terminal S of 1.500

Initial sum of squared residuals was   151.196 and
  final sum of squared residuals is     79.866 after 102 iterations
```

Matrix of Residuals

Years, Ages	1977/78,	1978/79,	1979/80,	1980/81,
0/ 1,	1.030,	.822,	-3.615,	-.071,
1/ 2,	1.795,	2.140,	1.568,	1.187,
2/ 3,	1.182,	.378,	-.007,	.509,
3/ 4,	-.296,	-.577,	.118,	.420,
4/ 5,	.117,	.340,	.185,	-.283,
5/ 6,	-.048,	.166,	.073,	-.206,
6/ 7,	-.615,	-.288,	-.365,	-.274,
7/ 8,	-.526,	-.302,	-.103,	-.192,
8/ 9,	-.252,	-.566,	.108,	-.284,
,	.001,	.000,	.000,	.000,
WTS ,	.001,	.001,	.001,	.001,

Years, Ages	1981/82,	1982/83,	1983/84,	1984/85,	1985/86,	1986/87,	1987/88,	1988/89,	1989/90,	1990/91,		,,WTS
0/ 1,	-4.279,	1.870,	-.643,	.298,	1.871,	-1.275,	.749,	-2.567,	1.156,	-1.453,	.000,	.131,
1/ 2,	-.140,	-1.431,	.397,	.337,	.916,	.218,	-.005,	-.356,	.248,	-.332,	.000,	.266,
2/ 3,	-.299,	-.172,	.396,	.334,	.453,	-.004,	.065,	-.557,	-.056,	-.460,	.000,	.565,
3/ 4,	-.008,	.179,	-.018,	.229,	.194,	-.319,	-.161,	-.315,	.284,	-.073,	.000,	.911,
4/ 5,	.032,	.319,	-.112,	.076,	-.433,	.520,	.095,	-.247,	.040,	-.259,	.000,	.952,
5/ 6,	.478,	.026,	.011,	-.417,	-.097,	.621,	-.202,	.505,	-.078,	-.369,	.000,	.814,
6/ 7,	.236,	-.151,	-.285,	-.091,	.046,	-.239,	-.224,	1.041,	.038,	-.134,	.000,	.668,
7/ 8,	.120,	-.102,	.049,	-.149,	-.103,	-.237,	.013,	.119,	-.184,	.595,	.000,	1.000,
8/ 9,	.132,	-.088,	.017,	-.086,	-.615,	-.348,	.384,	.071,	-.447,	1.113,	.000,	.582,
,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	.000,	-.459,	
WTS ,	.001,	1.000,	1.000,	1.000,	1.000,	1.000,	1.000,	1.000,	1.000,	1.000,		

Fishing Mortalities (F)

	1977,	1978,	1979,	1980,	1981,
F-values	.0384,	.0917,	.1495,	.1994,	.1987,

	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,
F-values	.1854,	.2691,	.3145,	.3087,	.3885,	.3483,	.3171,	.3703,	.3184,	.1245,

Selection-at-age (S)

	0,	1,	2,	3,	4,	5,	6,	7,	8,	9,
S-values	.0564,	.1962,	.3050,	.5357,	.7370,	1.0000,	1.3817,	1.4327,	1.6534,	1.5000,

Table 4.6.8 Fishing mortality (F) at age estimated from separable VPA, BLUE WHITING in the northern area.

Run title : Blue Whiting in the Northern Area (run name: JACOBSEN)

At 14/09/1992 17:00

Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR,	1977,	1978,	1979,	1980,	1981,
AGE					
0,	.0504,	.0816,	.0005,	.0073,	.0000,
1,	.0707,	.1644,	.2332,	.0808,	.0270,
2,	.0241,	.0454,	.0531,	.1151,	.0386,
3,	.0194,	.0309,	.0904,	.1269,	.1258,
4,	.0264,	.0863,	.1231,	.1483,	.1137,
5,	.0267,	.0753,	.1363,	.1852,	.2759,
6,	.0267,	.0902,	.1379,	.2266,	.3171,
7,	.0300,	.1200,	.1979,	.2622,	.3024,
8,	.0562,	.1369,	.3127,	.3355,	.3669,
9,	.0577,	.1573,	.3801,	.3623,	.4287,
+gp,	.0577,	.1573,	.3801,	.3623,	.4287,
FBAR 0- 2,	.0484,	.0972,	.0956,	.0678,	.0219,
FBAR 4- 8,	.0332,	.1017,	.1816,	.2316,	.2752,

Table 8 Fishing mortality (F) at age

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	FBAR 89-91
AGE											
0,	.1742,	.0156,	.0418,	.1077,	.0045,	.0279,	.0016,	.0454,	.0074,	.0070,	.0199,
1,	.0136,	.1552,	.1240,	.1099,	.0761,	.0492,	.0416,	.0853,	.0429,	.0431,	.0571,
2,	.0445,	.1302,	.2111,	.1428,	.0870,	.0844,	.0683,	.1063,	.0892,	.0359,	.0772,
3,	.0838,	.1332,	.1859,	.2942,	.2056,	.1319,	.1223,	.2465,	.1691,	.0981,	.1712,
4,	.1669,	.1347,	.2151,	.1988,	.4939,	.3663,	.1841,	.2612,	.2242,	.0981,	.1945,
5,	.1337,	.2394,	.2213,	.2569,	.5552,	.4122,	.4671,	.3624,	.2868,	.1554,	.2682,
6,	.2267,	.2393,	.3647,	.4345,	.4635,	.3890,	.7533,	.4891,	.4699,	.2260,	.3950,
7,	.2457,	.3916,	.3417,	.3809,	.5402,	.5333,	.4320,	.3560,	.4051,	.2266,	.3292,
8,	.2892,	.4525,	.5005,	.4034,	.5758,	.7588,	.5766,	.4823,	.3576,	.0930,	.3110,
9,	.2781,	.4141,	.4740,	.4851,	.9297,	.6857,	.4732,	.5964,	.5696,	.0354,	.4005,
+gp,	.2781,	.4141,	.4740,	.4851,	.9297,	.6857,	.4732,	.5964,	.5696,	.0354,	
FBAR 0- 2,	.0775,	.1003,	.1256,	.1201,	.0559,	.0539,	.0372,	.0790,	.0465,	.0287,	
FBAR 4- 8,	.2124,	.2915,	.3287,	.3349,	.5257,	.4919,	.4826,	.3902,	.3487,	.1598,	

Table 4.6.9 Stock size in numbers (*10**-4) at age from separable VPA, BLUE WHITING in the northern area.

Run title : Blue Whiting in the Northern Area (run name: JACOBSEN)

At 14/09/1992 17:00

Traditional vpa Terminal populations from weighted Separable populations

Table 10 Stock number at age (start of year) Numbers*10**-4

YEAR,	1977,	1978,	1979,	1980,	1981,
AGE					
0,	961263,	1343809,	574343,	351569,	447354,
1,	754484,	748304,	1013958,	470016,	285745,
2,	718844,	575538,	519790,	657489,	354938,
3,	696980,	574508,	450288,	403564,	479757,
4,	832224,	559685,	456039,	336807,	291036,
5,	774447,	663616,	420364,	330120,	237754,
6,	645062,	617368,	503906,	300317,	224585,
7,	513673,	514200,	461884,	359407,	196023,
8,	356422,	408137,	373399,	310271,	226388,
9,	236270,	275866,	291406,	223613,	181624,
+gp,	662973,	509536,	656046,	708365,	458774,
TOTAL,	7152642,	6790567,	5721423,	4451536,	3383978,

Table 10 Stock number at age (start of year) Numbers*10**-4

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	GMST 77-88	GMST 77-89
AGE													
0,	2374364,	2422453,	1372947,	1139336,	1281918,	944891,	1094102,	4740782,	135077,	1388089,	0,	1027902,	1156168,
1,	366263,	1633100,	1952722,	1078037,	837589,	1044849,	752303,	894330,	3709200,	109779,	1128523,	794999,	802231,
2,	227718,	295806,	1144886,	1412330,	790741,	635508,	814382,	590839,	672319,	2909288,	86088,	601366,	600550,
3,	279585,	178325,	212621,	758940,	1002485,	593463,	478184,	622727,	434954,	503455,	2297874,	455560,	466647,
4,	346367,	210503,	127793,	144541,	462976,	668263,	425856,	346429,	398471,	300711,	373685,	352613,	352133,
5,	212674,	239999,	150624,	84376,	97002,	231306,	379317,	290034,	218424,	260722,	223204,	259584,	261809,
6,	147718,	152329,	154657,	98840,	53430,	45584,	125408,	194658,	165268,	134238,	182737,	183122,	183985,
7,	133913,	96409,	98174,	87924,	52403,	27519,	25295,	48340,	97724,	84577,	87676,	134465,	124289,
8,	118605,	85753,	53355,	57114,	49186,	24998,	13219,	13445,	27724,	53360,	55207,	105596,	90114,
9,	128427,	72716,	44656,	26482,	31237,	22642,	9583,	6080,	6796,	15873,	39809,	78848,	64742,
+gp,	303810,	107943,	73943,	73752,	71451,	42867,	14519,	8999,	23155,	41271,	45161,		
TOTAL,	4639445,	5495337,	5386377,	4961672,	4730418,	4281891,	4132168,	7756663,	5889111,	5801363,	4519964,		

Table 4.6.10 Stock size summary table, BLUE WHITING in the northern area.

Run title : Blue Whiting in the Northern Area (run name: JACOBSEN)

At 14/09/1992 17:00

Table 16 Summary (without SOP correction)

Traditional vpa Terminal populations from weighted Separable populations

	RECRUITS,	TOTALBIO,	TOTSPBIO,	LANDINGS,	FBAR 0- 2,	FBAR 4- 8,
1977,	9612631,	7849539,	6829561,	238013,	.0484,	.0332,
1978,	13438088,	7103088,	6060309,	574812,	.0972,	.1017,
1979,	5743434,	6333247,	5519154,	1091422,	.0956,	.1816,
1980,	3515687,	5505312,	4860091,	1092620,	.0678,	.2316,
1981,	4473541,	4323070,	3731118,	870808,	.0219,	.2752,
1982,	23743636,	3777126,	2993628,	544829,	.0775,	.2124,
1983,	24224528,	3439552,	2112067,	539237,	.1003,	.2915,
1984,	13729473,	3456299,	1817935,	610603,	.1256,	.3287,
1985,	11393364,	3498131,	2060060,	652776,	.1201,	.3349,
1986,	12819183,	3900056,	2443931,	739904,	.0559,	.5257,
1987,	9448914,	3536347,	2168541,	631615,	.0539,	.4919,
1988,	10941020,	3365965,	2002743,	522575,	.0372,	.4826,
1989,	47407820,	3772721,	2003849,	591738,	.0790,	.3902,
1990,	1350772,	4088597,	2025842,	528793,	.0465,	.3487,
1991,	13880888,	5990345,	3163245,	354501,	.0287,	.1598,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 4.6.11 Input data for prediction and Y/R calculations.

Blue whiting in the northern area.
The reference F is the mean $F_{4\text{-}8}$ for the age groups 4-8 (non-weighted).

The number of recruits per year in the prediction is as follows:

Year	Recruitment (millions)
1992	8,677 awerage of years 1977-1988 excluding the rich 1982 and 1983 year classes
1993	10,279 awerage of years 1977-1988
1994	10,279 awerage of years 1977-1988

Age	Stock size	Fishing pattern	Natural mortality	Maturity ogive	Weight in the catch	Weight in the stock
0	8,677	0.0564	.2	.00	.025	.025
1	8,357	0.1962	.2	.10	.064	.064
2	5,530	0.3050	.2	.37	.089	.089
3	22,978	0.5357	.2	.81	.111	.111
4	3.737	0.7370	.2	.85	.135	.135
5	2.232	1.0000	.2	.91	.156	.156
6	1.827	1.3817	.2	.94	.171	.171
7	877	1.4327	.2	1.0	.184	.184
8	552	1.6534	.2	1.0	.213	.213
9	398	1.5000	.2	1.0	.228	.228
10+	452	1.5000	.2	1.0	.243	.243

Table 4.6.12 Standard prediction. BLUE WHITING in the Northern Area.

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

F factor 1992	Reference F 1992	Stock biomass 1992	Sp.stock biomass 1992	Catch weight 1992	F factor 1993	Reference F 1993	Stock biomass 1993	Sp.stock biomass 1993	Catch weight 1993	Stock biomass 1994	Sp.stock biomass 1994
0.1470	0.1824	5426872	3810404	438910	0.0500	0.0620	5385836	3851824	173602	5552049	4094300
.	.	.	.	.	0.0550	0.0683	.	3851824	190531	5534542	4078419
.	.	.	.	.	0.0600	0.0745	.	3851824	207384	5517116	4062614
.	.	.	.	.	0.0650	0.0807	.	3851824	224161	5499769	4046885
.	.	.	.	.	0.0700	0.0869	.	3851824	240862	5482502	4031230
.	.	.	.	.	0.0750	0.0931	.	3851824	257488	5465313	4015650
.	.	.	.	.	0.0800	0.0993	.	3851824	274038	5448202	4000144
.	.	.	.	.	0.0850	0.1055	.	3851824	290514	5431170	3984712
.	.	.	.	.	0.0900	0.1117	.	3851824	306916	5414215	3969353
.	.	.	.	.	0.0950	0.1179	.	3851824	323244	5397337	3954068
.	.	.	.	.	0.1000	0.1241	.	3851824	339499	5380535	3938854
.	.	.	.	.	0.1050	0.1303	.	3851824	355681	5363810	3923713
.	.	.	.	.	0.1100	0.1365	.	3851824	371790	5347161	3908643
.	.	.	.	.	0.1150	0.1427	.	3851824	387827	5330587	3893645
.	.	.	.	.	0.1200	0.1489	.	3851824	403792	5314088	3878718
.	.	.	.	.	0.1250	0.1551	.	3851824	419686	5297663	3863861
.	.	.	.	.	0.1300	0.1613	.	3851824	435508	5281313	3849074
.	.	.	.	.	0.1350	0.1675	.	3851824	451260	5265037	3834357
.	.	.	.	.	0.1400	0.1737	.	3851824	466942	5248834	3819710
.	.	.	.	.	0.1450	0.1799	.	3851824	482554	5232704	3805131
.	.	.	.	.	0.1500	0.1861	.	3851824	498096	5216647	3790622
.	.	.	.	.	0.1550	0.1923	.	3851824	513569	5200662	3776180
.	.	.	.	.	0.1600	0.1986	.	3851824	528974	5184749	3761806
.	.	.	.	.	0.1650	0.2048	.	3851824	544310	5168907	3747500
.	.	.	.	.	0.1700	0.2110	.	3851824	559577	5153137	3733261
.	.	.	.	.	0.1750	0.2172	.	3851824	574778	5137437	3719088
.	.	.	.	.	0.1800	0.2234	.	3851824	589910	5121808	3704983
.	.	.	.	.	0.1850	0.2296	.	3851824	604976	5106248	3690943
.	.	.	.	.	0.1900	0.2358	.	3851824	619975	5090758	3676968
.	.	.	.	.	0.1950	0.2420	.	3851824	634908	5075337	3663060
.	.	.	.	.	0.2000	0.2482	.	3851824	649775	5059985	3649216
.	.	.	.	.	0.2050	0.2544	.	3851824	664577	5044702	3635436
.	.	.	.	.	0.2100	0.2606	.	3851824	679313	5029487	3621721
.	.	.	.	.	0.2150	0.2668	.	3851824	693984	5014339	3608070
.	.	.	.	.	0.2200	0.2730	.	3851824	708591	4999259	3594483
.	.	.	.	.	0.2250	0.2792	.	3851824	723133	4984246	3580959
.	.	.	.	.	0.2300	0.2854	.	3851824	737612	4969299	3567497
.	.	.	.	.	0.2350	0.2916	.	3851824	752027	4954419	3554098
.	.	.	.	.	0.2400	0.2978	.	3851824	766379	4939605	3540762
.	.	.	.	.	0.2450	0.3040	.	3851824	780668	4924856	3527487
.	.	.	.	.	0.2500	0.3102	.	3851824	794895	4910173	3514274

Run name : JAJ-OK
Computation of ref. F: Unweighted mean of age 4 - 8
Unit of measurement : Tonnes

Table 4.6.13 Management option table, BLUE WHITING in the northern area. Effects of different levels of fishing mortality on catch, etc.

Year 1992					Year 1993						Year 1994	
F-factor	ref.F	Stock size	SSB	Catch	Basis	F-factor	ref. F	TSB	SSB	Catch	TSB	SSB
.147	.1824	5,427	3,810	440	F(91)	.129	.160	5,386	3,852	431	5,286	3,854
					F(92)	.147	.182			489	5,226	3,799
					F(0.1)	.194	.241			630	5,080	3,670
					F(med)	.260	.323			823	4,881	3,488

SSB given for 1 January (units thousand tonnes). The reference F is the F from the age group range from 4-8.

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) 1982-1991 as estimated by the Working Group.

Country	1982	1983	1984	1985	1986
Germany, Fed. Rep	-	50	-	-	-
Netherlands	200	-	-	-	-
Norway	-	-	-	-	-
Portugal	3,890	4,748	5,252	6,989	8,116
Spain	27,500	26,037	25,921	35,828	24,965
UK (England & Wales)	-	-	-	3	1
France	-	-	-	-	-
Total	31,590	30,835	31,173	42,820	33,082

Country	1987	1988	1989	1990	1991[1]
Germany, Fed. Rep.	-	-	-	-	-
Netherlands	-	-	-	450	10
Norway	4	-	-	-	-
Portugal	9,148	5,979	3,557	2,864	2,813
Spain	23,644	24,847	30,108	29,490	29,180
UK (England & Wales)	23	12	29	13	-
France	-	-	1	-	-
Total	32,819	30,838	33,695	32,817	32,003

[1]Preliminary.

Table 5.2.1 Catch in numbers (thousands) by length group in the Portuguese and Spanish BLUE WHITING fisheries, 1984-1991.

Length cm	1984	1985	1986	1987	1988	1989	1990	1991
10	-	8	-	1	-	-	0	0
1	3	25	-	33	7	-	3	0
2	41	39	118	37	3	12	62	17
3	337	74	783	1,130	8	247	128	2,607
4	13,263	498	5,903	16,889	391	864	874	13,445
5	48,364	13,013	7,234	44,625	3,190	1,845	8,066	15,444
6	88,023	31,407	6,394	39,111	11,210	9,649	28,079	23,259
7	142,003	73,885	16,669	52,790	34,392	59,269	74,069	54,277
8	154,385	181,222	49,746	102,112	67,722	85,197	89,504	77,586
9	128,950	235,008	82,458	131,911	95,783	80,280	75,083	75,235
20	91,952	211,958	99,258	116,195	126,949	100,839	90,950	80,281
1	69,370	127,966	126,338	71,862	115,176	100,778	81,597	77,129
2	44,241	69,313	107,413	46,724	69,350	82,438	55,600	69,771
3	27,623	28,905	57,835	35,691	25,146	45,833	30,872	40,146
4	16,420	11,842	23,594	20,522	12,471	22,950	17,051	21,892
5	7,744	5,946	9,840	11,696	7,102	14,428	9,022	10,941
6	3,309	3,089	3,759	7,461	3,961	7,528	4,753	4,209
7	1,194	1,263	2,033	3,717	1,993	3,432	4,391	2,504
8	854	899	1,091	1,965	1,434	2,236	1,953	910
9	800	622	473	994	799	881	1,196	694
30	199	296	308	918	473	316	552	317
1	216	205	165	177	222	405	459	340
2	103	172	174	119	136	159	225	277
3	117	64	255	46	110	105	276	209
4	16	54	269	30	89	58	97	114
5	22	23	167	12	54	26	53	95
6	32	15	67	6	22	24	25	120
7	20	6	80	1	19	17	17	119
8	2	2	56	5	1	4	8	38
9	2	2	1	-	1	2	3	5
40	4	3	8	-	1	2	0	6
1	-	3	-	-	-	-	-	-
2	-	1	-	-	-	-	-	-
3	2	1	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-	-
8	-	1	-	-	-	-	-	-
9	-	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-	-
Total N	839,611	997,830	602,489	707,780	578,215	619,824	574,971	571,988
Landings (t)	31,173	42,817	33,083	32,792	30,732	33,665	32,354	31,993

Table 5.2.2 Catch in numbers (Thousands) by length group and by quarter in the Spanish BLUE WHITING fisheries, 1991.

Length	Quarter 1	2	3	4	Total
10	0	0	0	0	0
11	0	0	0	0	0
12	1	0	0	16	17
13	19	0	3	2585	2607
14	520	13	9	12903	13445
15	3160	1265	26	10937	15388
16	9061	6595	67	6241	21964
17	28078	13790	880	3032	45780
18	29091	19139	8796	2677	59703
19	14501	21270	17310	5148	58228
20	13816	20937	21446	10717	66916
21	16979	19397	21580	13110	71066
22	22533	17124	15549	12372	67577
23	12944	9812	7419	9118	39293
24	8948	5147	3359	4404	21858
25	3225	2891	1718	3098	10932
26	1169	1181	610	1246	4206
27	751	688	182	881	2502
28	145	457	80	225	908
29	177	232	39	245	693
30	50	141	40	86	316
31	109	123	25	82	340
32	40	140	18	79	277
33	25	59	26	100	209
34	27	46	5	37	114
35	11	48	0	36	95
36	9	26	0	84	120
37	8	1	0	110	119
38	2	1	0	35	38
39	0	0	0	5	5
40	1	0	0	5	6
TOTAL	165401	140522	99185	99615	504722
Landing (Tonnes)	9292	8197	6155	5536	29180

Table 5.2.3 Catch in numbers (Thousands) by length group and by quarter in the Portuguese BLUE WHITING fisheries, 1991.

	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	0	0	0
15	1	0	55	0	56
16	398	788	0	110	1295
17	2797	4225	728	748	8497
18	4885	9125	2097	1775	17883
19	5576	6423	2859	2149	17007
20	3512	4861	3340	1651	13365
21	755	1470	3576	262	6063
22	166	31	1998	0	2194
23	14	27	812	0	853
24	10	4	20	0	34
25	4	0	5	0	9
26	2	0	1	0	3
27	1	0	1	0	1
28	2	0	0	0	2
29	1	0	0	0	1
30	1	0	0	0	1
31	0	0	0	0	0
32	0	0	0	0	0
33	0	0	0	0	0
34	0	0	0	0	0
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	18125	26953	15492	6695	67265
Landings (Tonnes)	740	1028	779	265	2813

Table 5.2.4 Catch in numbers (Thousands) by length group and by gear in the Southern BLUE WHITING fisheries, 1991.

	SPAIN			PORTUGAL	
	Bottom trawl	Pair trawl	Long line	Bottom trawl	
Length					Total
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	17	0	17
13	623	1978	6	0	2607
14	4875	8529	41	0	13445
15	7640	7675	73	56	15444
16	12241	9661	62	1295	23259
17	26751	18975	53	8497	54277
18	23687	35920	96	17883	77586
19	13723	44351	154	17007	75235
20	18698	48074	144	13365	80281
21	26564	44289	213	6063	77129
22	29780	37515	283	2194	69771
23	18584	20461	248	853	40146
24	10352	11261	245	34	21892
25	5599	5169	164	9	10941
26	1959	2051	195	3	4209
27	1425	969	108	1	2504
28	580	248	79	2	910
29	413	197	82	1	694
30	214	33	70	1	317
31	210	37	94	0	340
32	160	43	74	0	277
33	91	2	116	0	209
34	66	1	47	0	114
35	57	3	36	0	95
36	45	0	75	0	120
37	23	1	95	0	119
38	12	0	26	0	38
39	4	0	1	0	5
40	5	0	2	0	6
TOTAL	204381	297442	2900	67265	571988
Landing (Tonnes)	11969	16863	348	2813	31993

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

YEAR AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	61	98	74	118	32	105	30	41	74	70
1	103	150	223	286	93	383	147	200	198	181
2	184	239	349	337	218	111	233	175	182	182
3	122	68	127	171	168	62	114	93	57	70
4	64	45	35	66	68	28	32	61	25	39
5	22	34	13	14	15	13	10	27	24	17
6	3	9	14	3	6	3	9	15	11	8
7	0	2	3	3	1	1	3	6	2	3
+gp	1	1	1	1	1	1	0	3	2	3
TOTAL NUM	560	646	839	999	602	707	578	621	575	573

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

YEAR AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	.0320	.0290	.0220	.0290	.0260	.0290	.0350	.0300	.0350	.0330
1	.0450	.0390	.0290	.0370	.0420	.0390	.0390	.0410	.0450	.0470
2	.0610	.0460	.0350	.0430	.0520	.0590	.0530	.0500	.0550	.0530
3	.0690	.0660	.0500	.0500	.0630	.0720	.0550	.0670	.0690	.0720
4	.0770	.0760	.0660	.0610	.0730	.0850	.0670	.0720	.0870	.0820
5	.0850	.0840	.0770	.0730	.0900	.0950	.1010	.0850	.0940	.0960
6	.1030	.1040	.0810	.1040	.0970	.1170	.0900	.0950	.1080	.1110
7	.1560	.1240	.0940	.1120	.1560	.1380	.1170	.1110	.1440	.1300
+gp	.2690	.1450	.1310	.1390	.2570	.1610	.2070	.1550	.1620	.1590

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

[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

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

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

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

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
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

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

Year	F.trip	Effort	No. boats	H.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

Table 5.4.6 BLUE WHITING, Bay of Biscay. CPUE (in K/(Σ HP × days × 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

Table 6.1 The percentage distribution of acoustic biomass estimates of BLUE WHITING from various surveys in the spawning season divided on areas (%) within and beyond areas of national economic zones of NEAFC member countries.

Year	International	Faroes	Norway	EEC	Surveys
1981	0.8	20.7	6.0	72.5	Norwegian and Scottish
1982	-	8.4	-	91.6	Norwegian
1983	-	4.5	-	95.5	Norwegian
1983	-	12.7	0.2	87.1	USSR
1984	1.9	10.4	-	87.7	USSR
1985	-	7.0	6.6	86.4	Norwegian
1986	-	9.5	25.4	65.1	Norwegian
1987	-	2.9	-	97.1	USSR
1988	-	2.6	-	97.4	Norwegian
1988	-	-	-	100.0	USSR
1989	-	1.5	-	98.5	Norwegian
1990	3.2	2.4	9.7	84.7	Norwegian and USSR
1991	5.5	2.6	10.1	81.8	Norwegian and USSR
1992	0.4	3.8	13.2	82.6	Norwegian and Russian

Table 6.2 Total catches 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	3.0
	(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	-	-	60,253	165,519	350,031	356,471	98.0
	(14.8)			(20.7)			(17.2)	(47.3)			

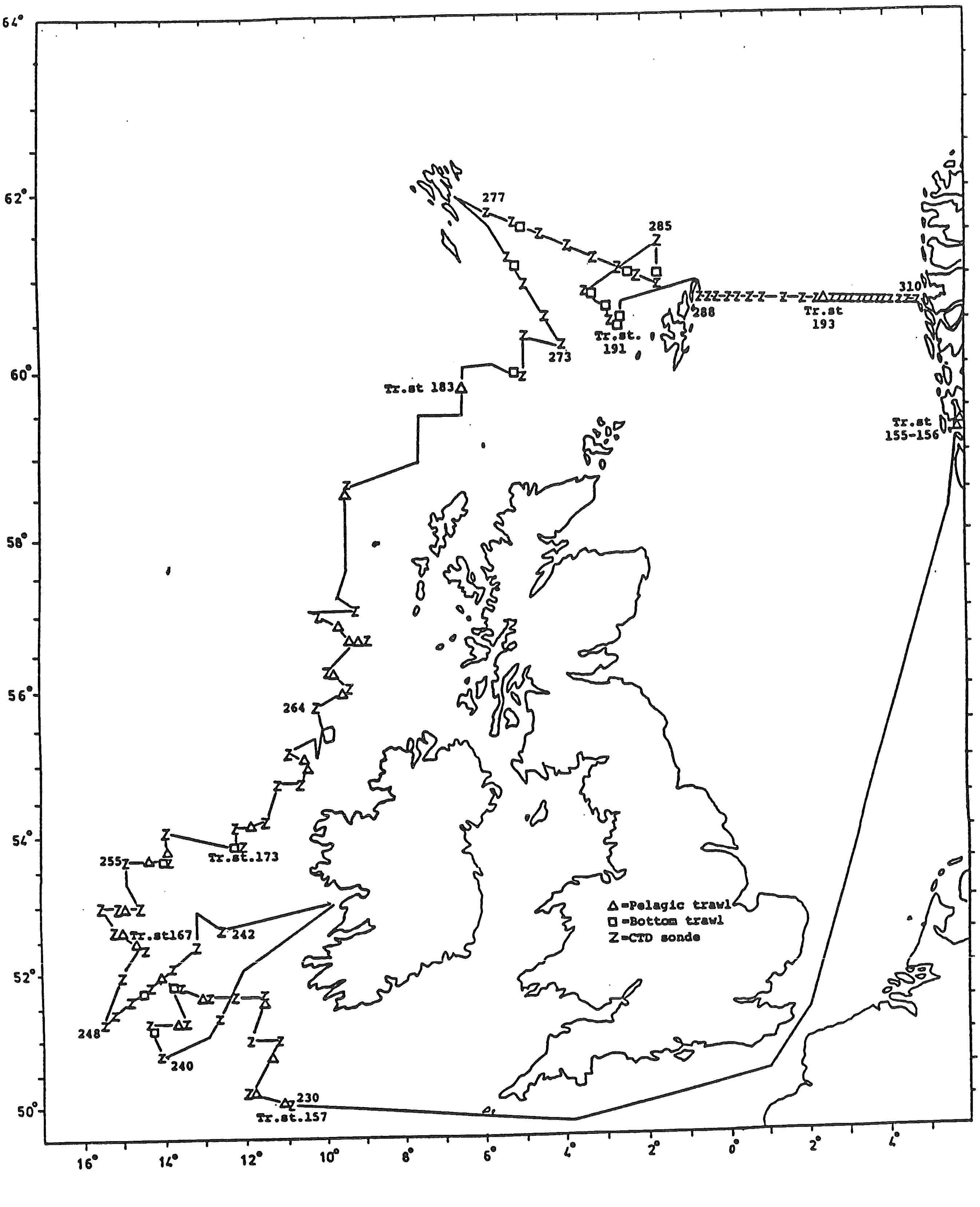


Figure 4.6.1 Cruise track and stations of R/V "Johan Hjort" 10 March - 6 April 1992.

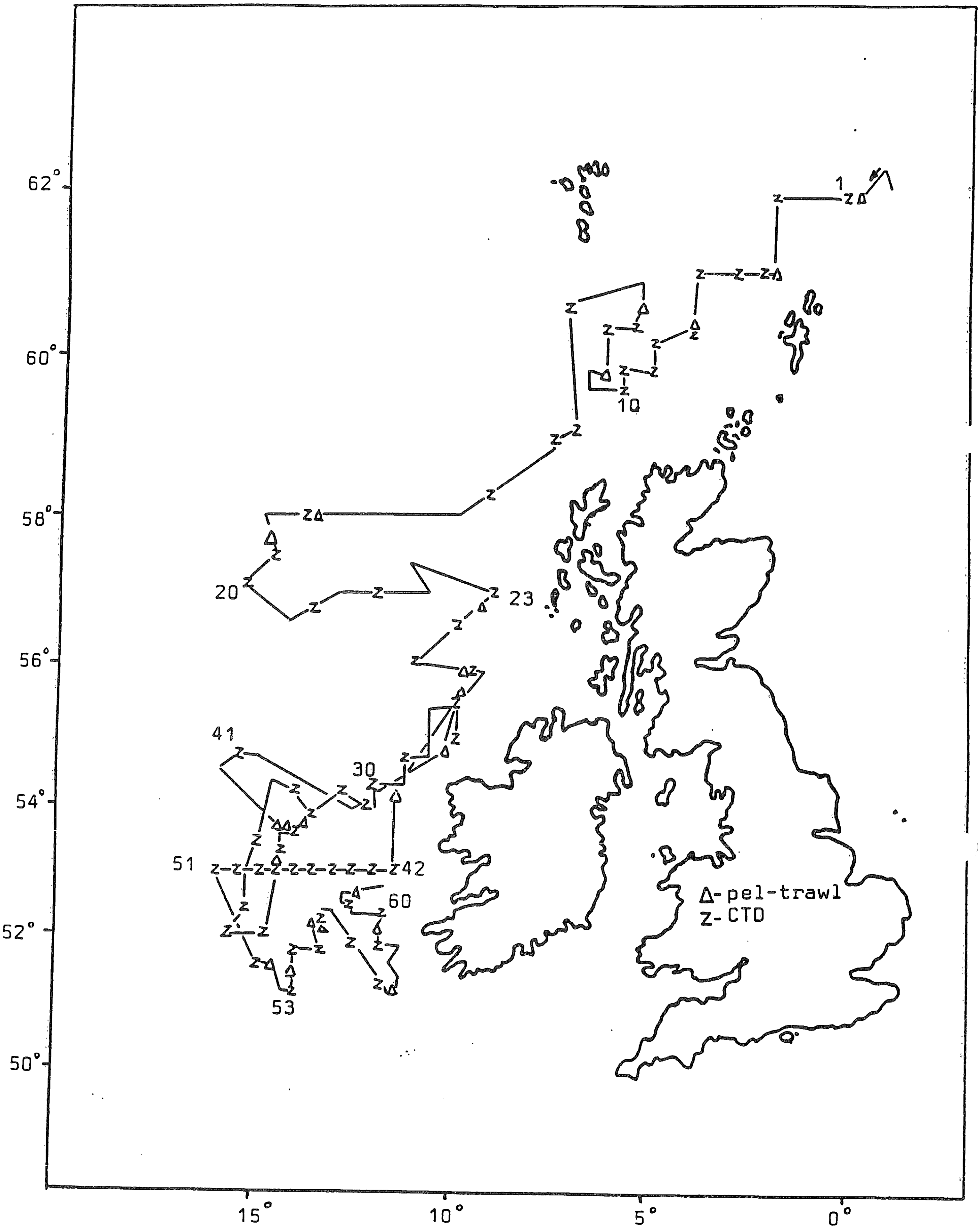


Figure 4.6.2 Cruise track and stations of R/V "Pinro" 17 March - 12 April 1992.

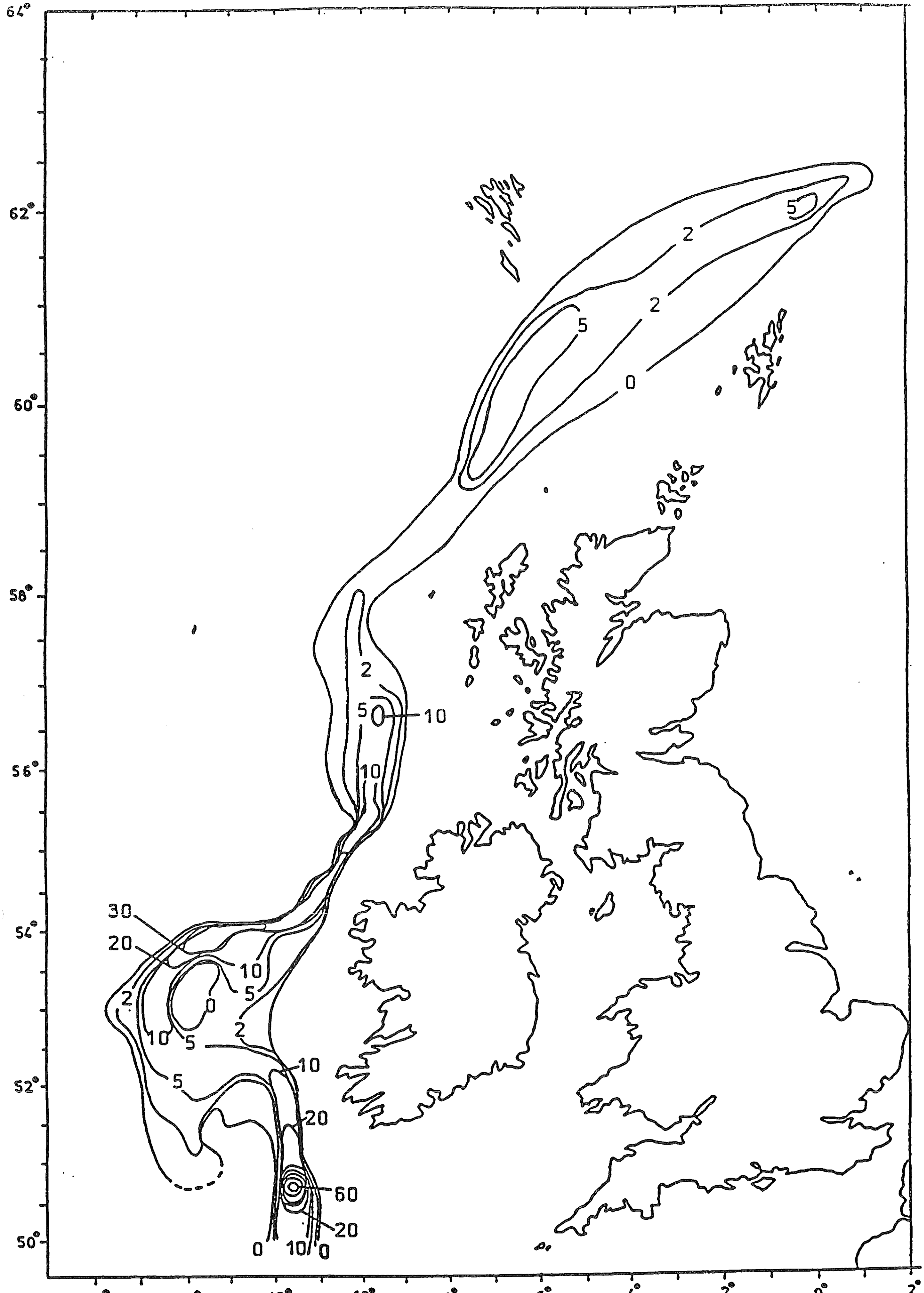


Figure 4.6.3 Density distribution of BLUE WHITING in spring 1992; Period I: 17-28 March. Combined recordings of R/V "Johan Hjort" and R/V "Pinro". Echo intensity in m^2 reflection per $(n.mile)^2 \times 1/100$.

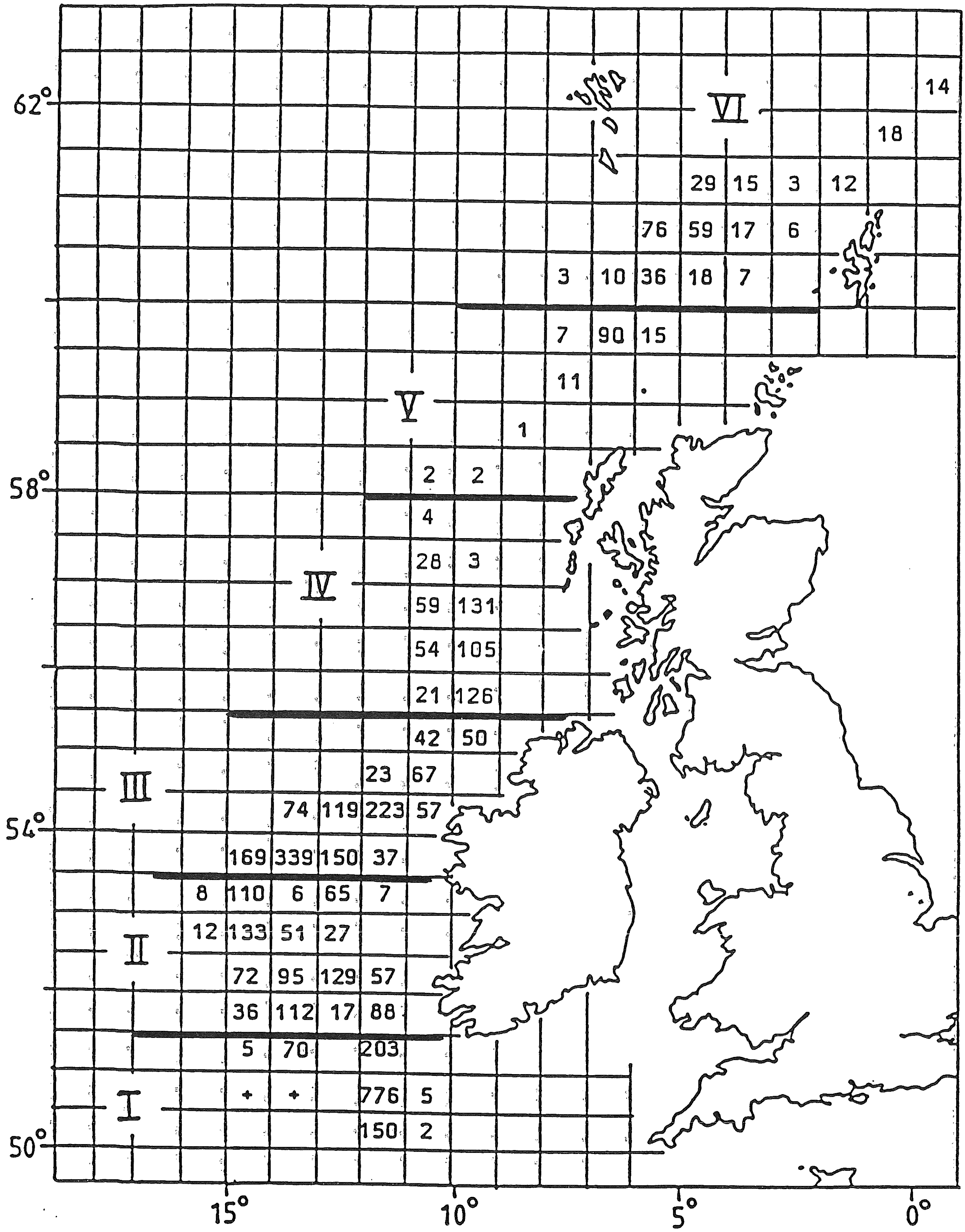


Figure 4.6.4 BLUE WHITING biomass ('000 tonnes) in spring 1992; Period I: 17-28 March. Rectangles and Sub-areas I-VI used in the assessments.

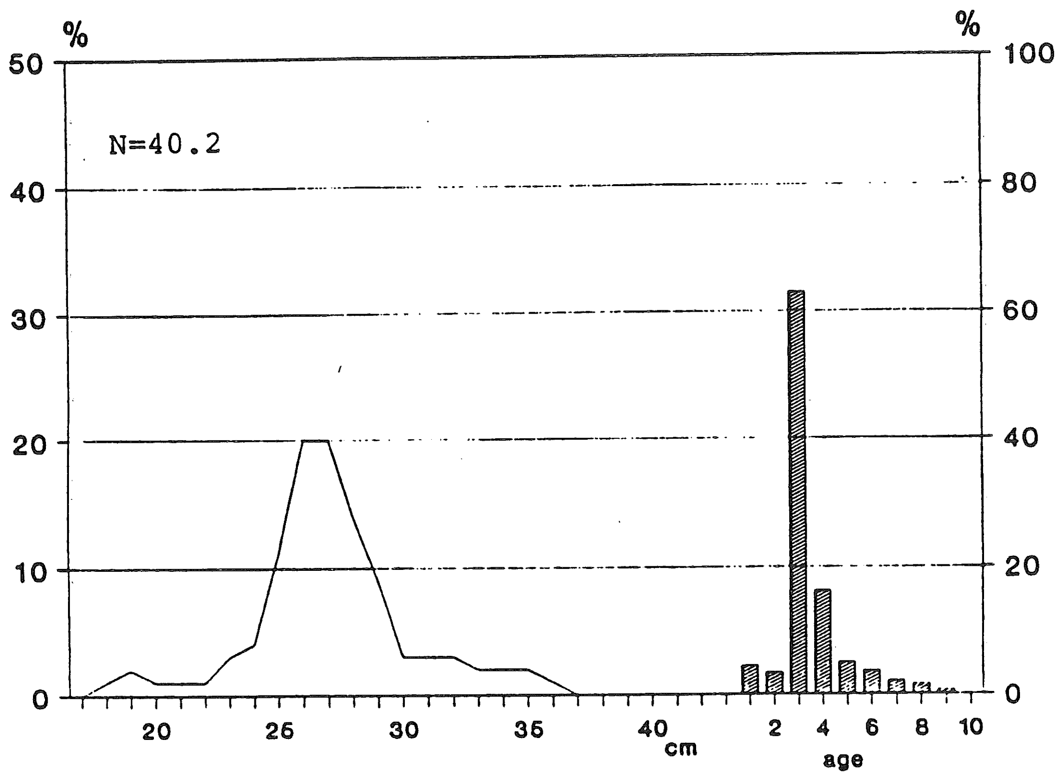


Figure 4.6.5 Total length and age distribution (N %) of BLUE WHITING in the area west of the British Isles, spring 1992; Period I: 17-28 March. N $\times$ 10^{-9}, weighted by abundance.

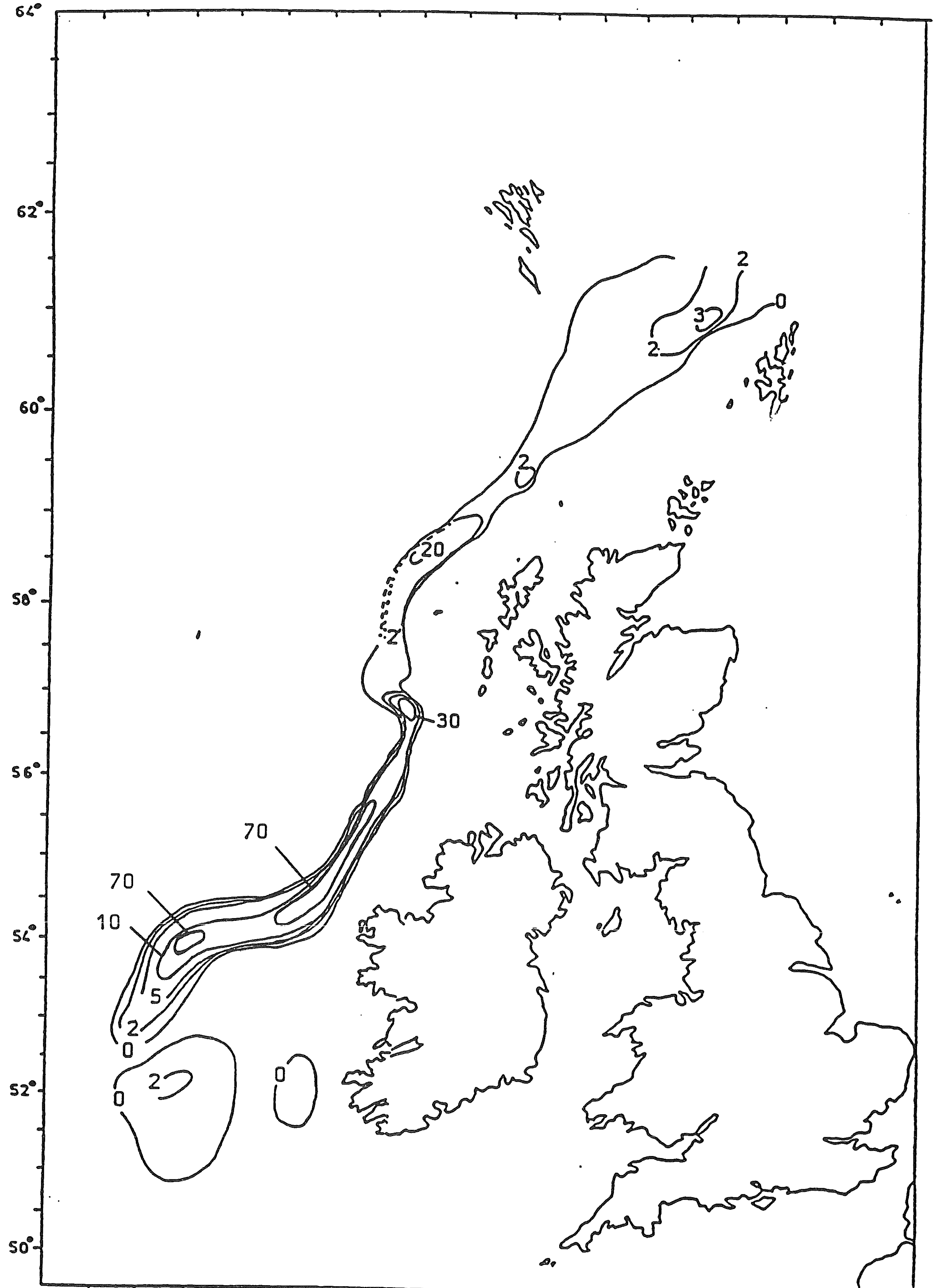


Figure 4.6.6 Density distribution of BLUE WHITING in spring 1992; Period II: 28 March - 12 April. Combined recordings of R/V "Johan Hjort" and R/V "Pinro". Echo intensity in m^2 reflection per $(n.mile)^2 \times 1/100$.

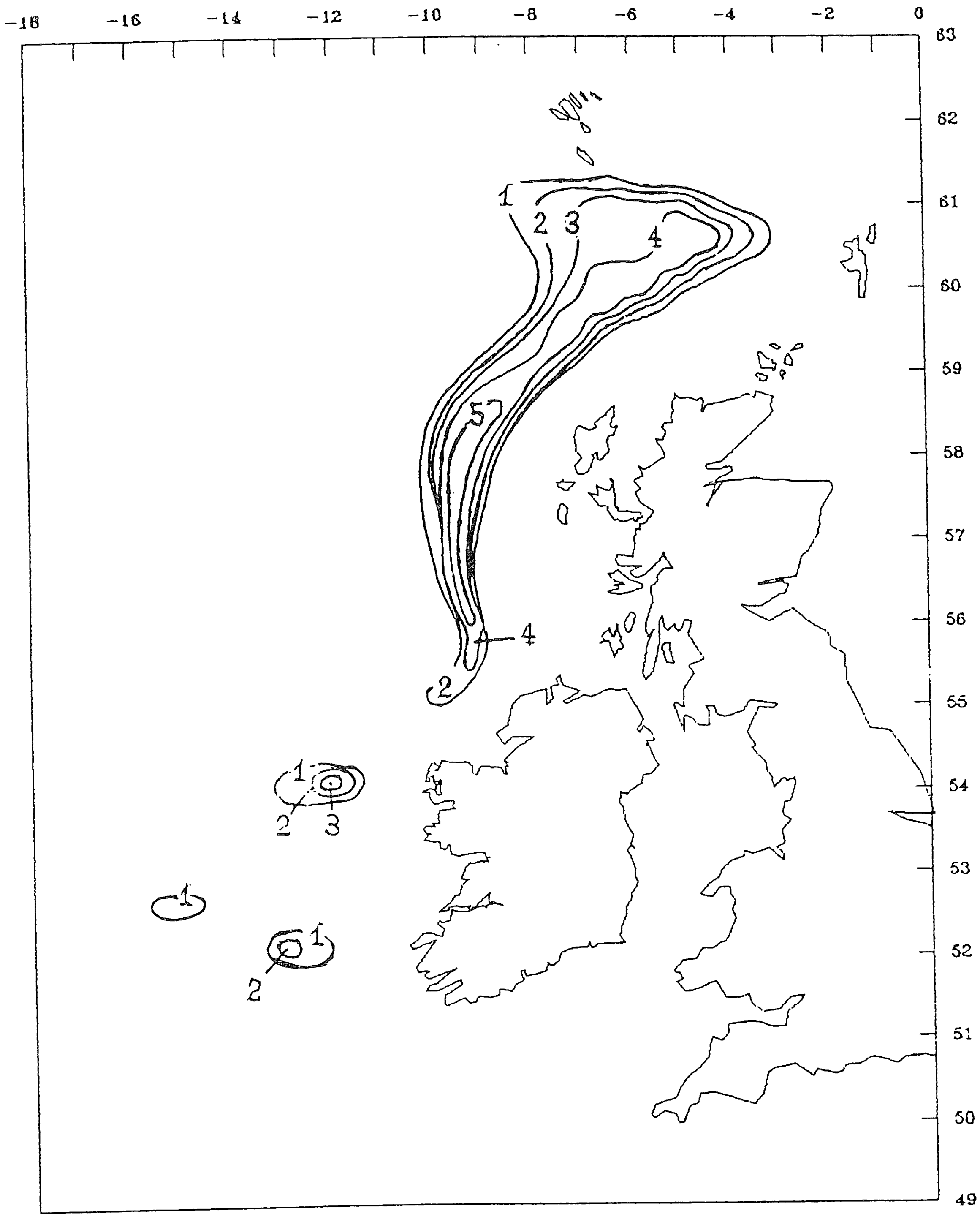


Figure 4.6.7 Density distribution of BLUE WHITING recorded by R/V "Pinro" 17 April - 2 May 1992. Density in tonnes/n.mile^2. 1) 0-10; 2) 11-50; 3) 51-250; 4) 251-1000; 5) >1000.

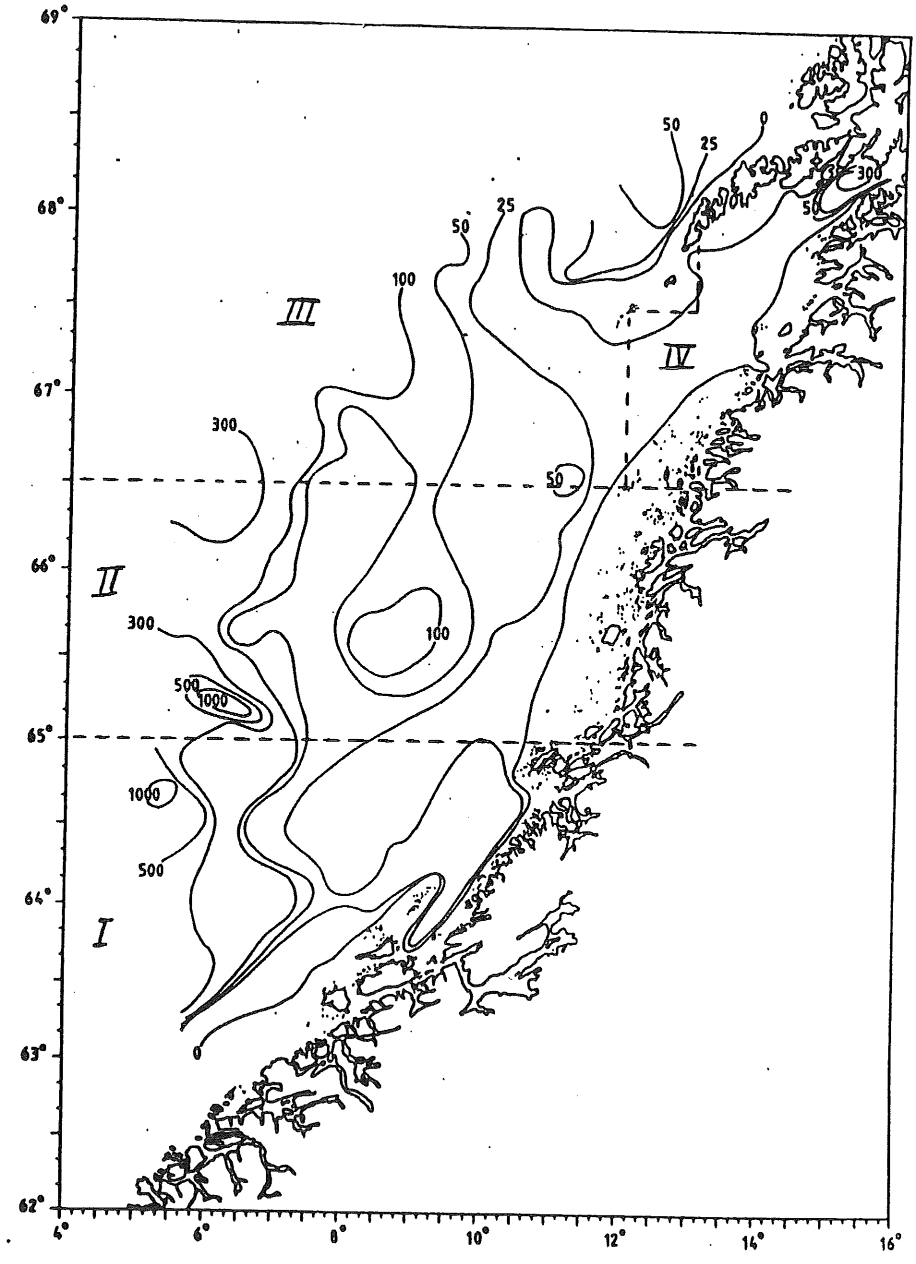


Figure 4.6.8 BLUE WHITING recordings in April/May 1992. Echo intensity in m reflection m/n.mile. The Sub-areas I-IV are marked by dotted lines.

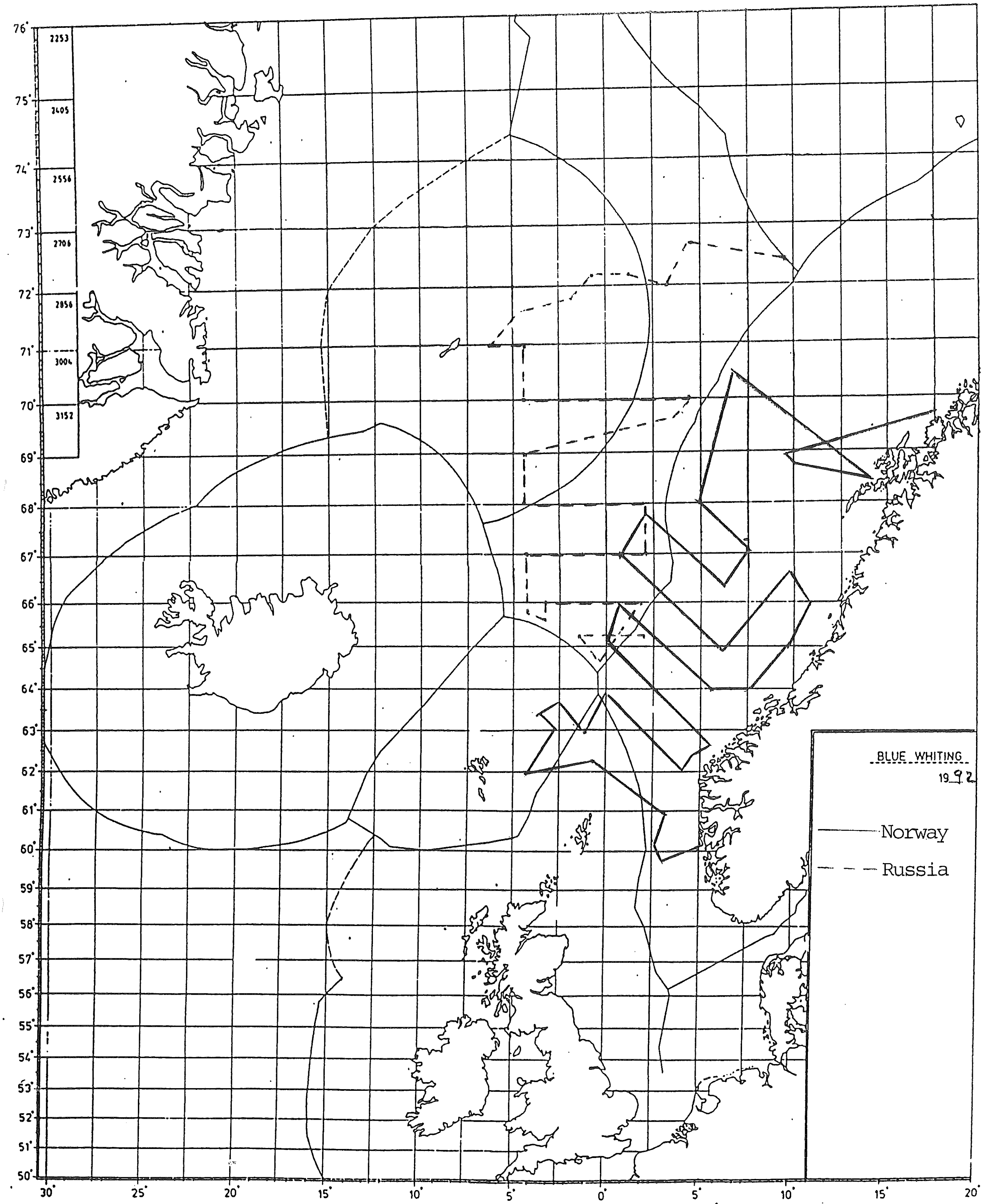


Figure 4.6.9 Cruise tracks from R/V "G.O. Sars" surveys during July-August 1992.

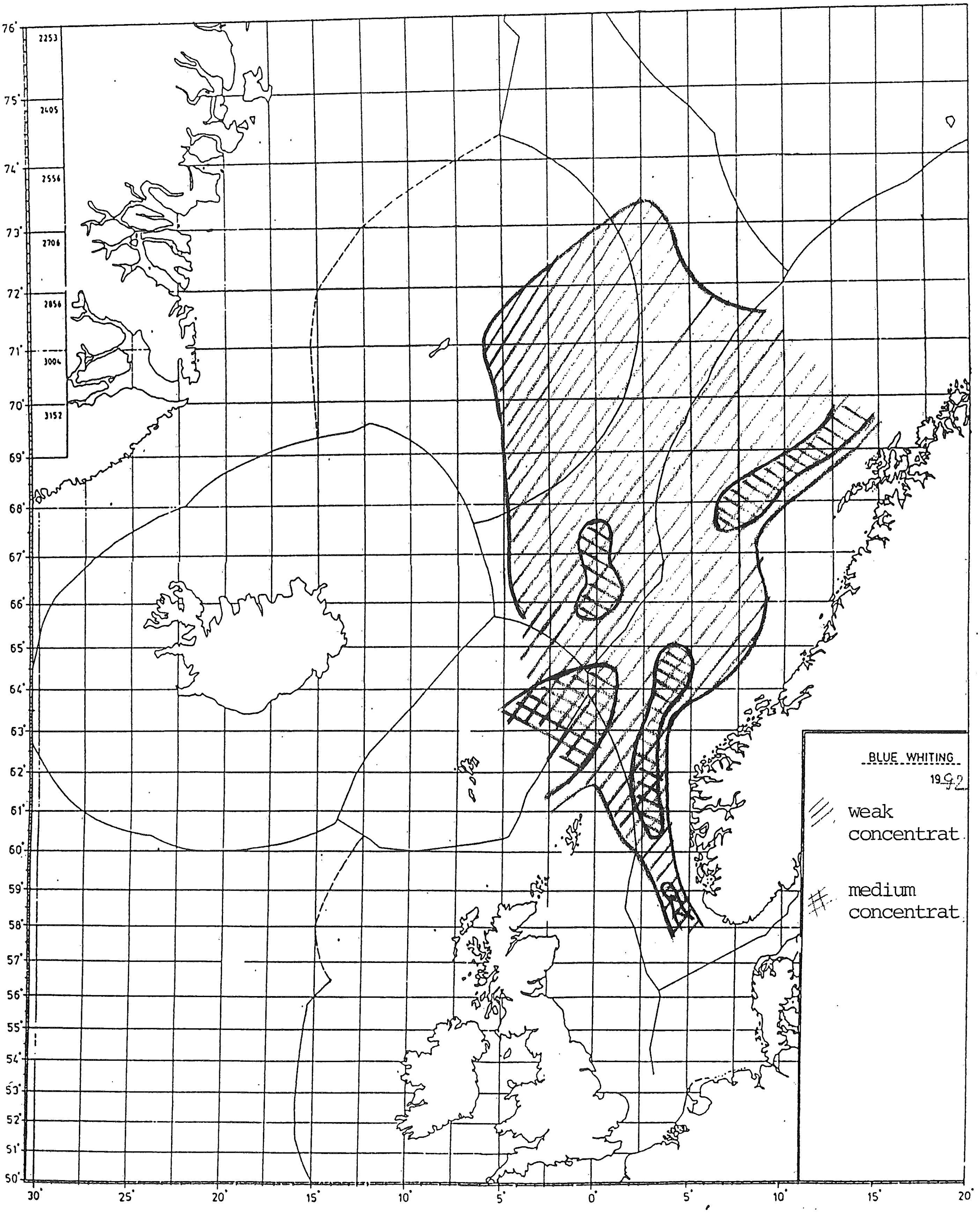


Figure 4.6.10 Area of BLUE WHITING distribution observed during R/V "G.O. Sars" survey, July-August 1992.

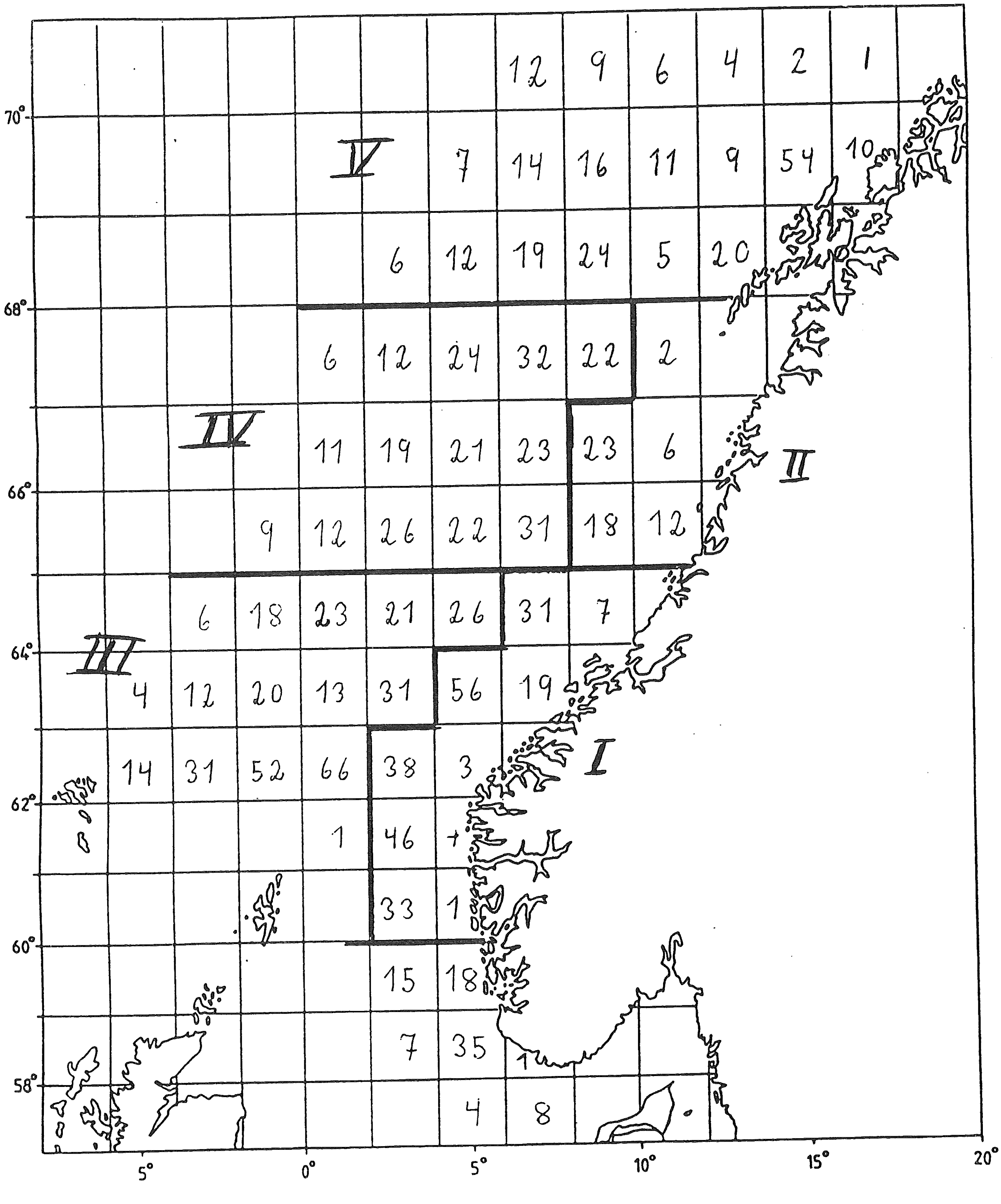


Figure 4.6.11 Biomass in 1000 tonnes of BLUE WHITING July/August 1992. Sub-areas I-V used in the assessment are marked.

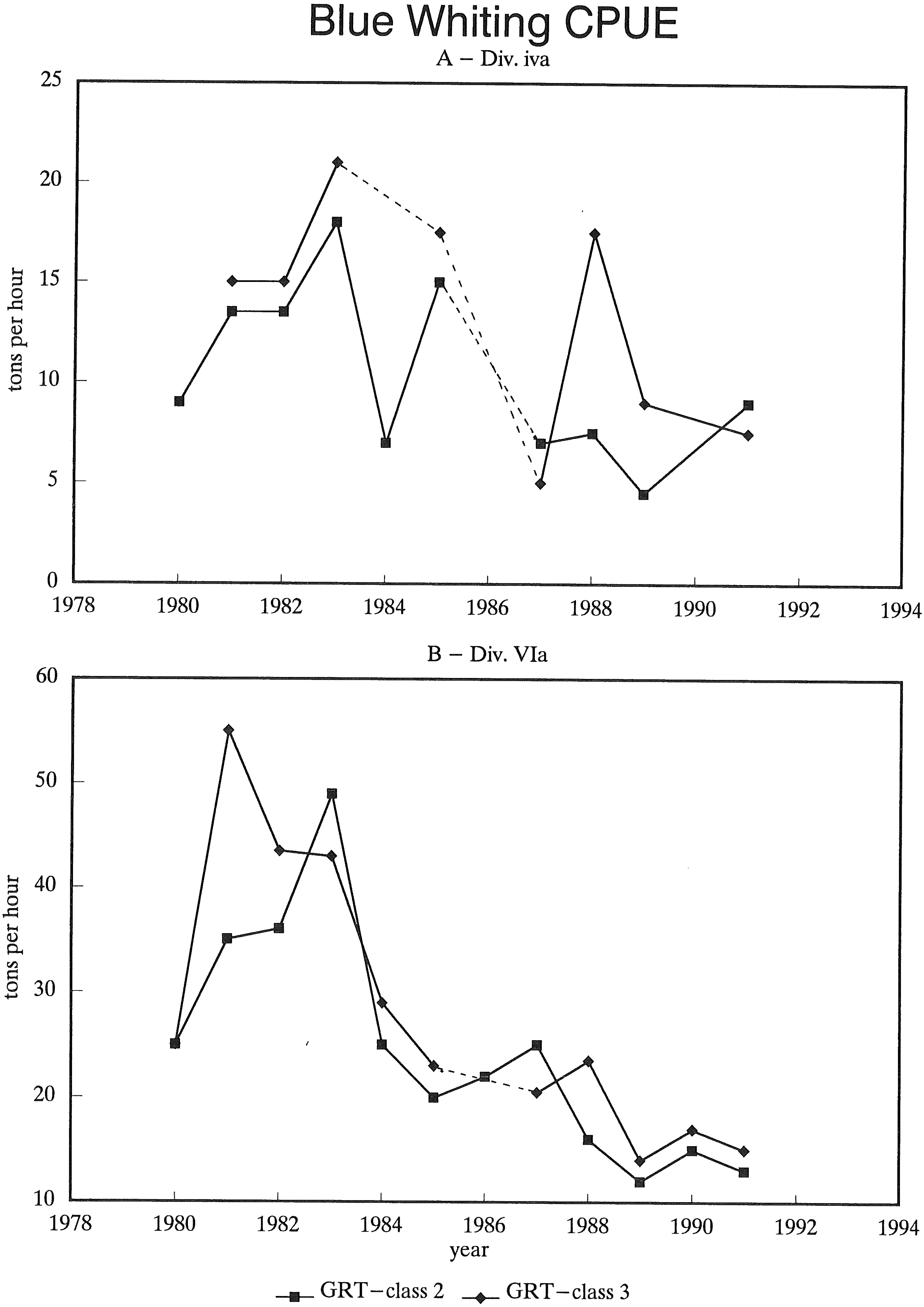


Figure 4.6.12 Trends in CPUE of Norwegian Blue Whiting fishery in Divisions IVa and VIa

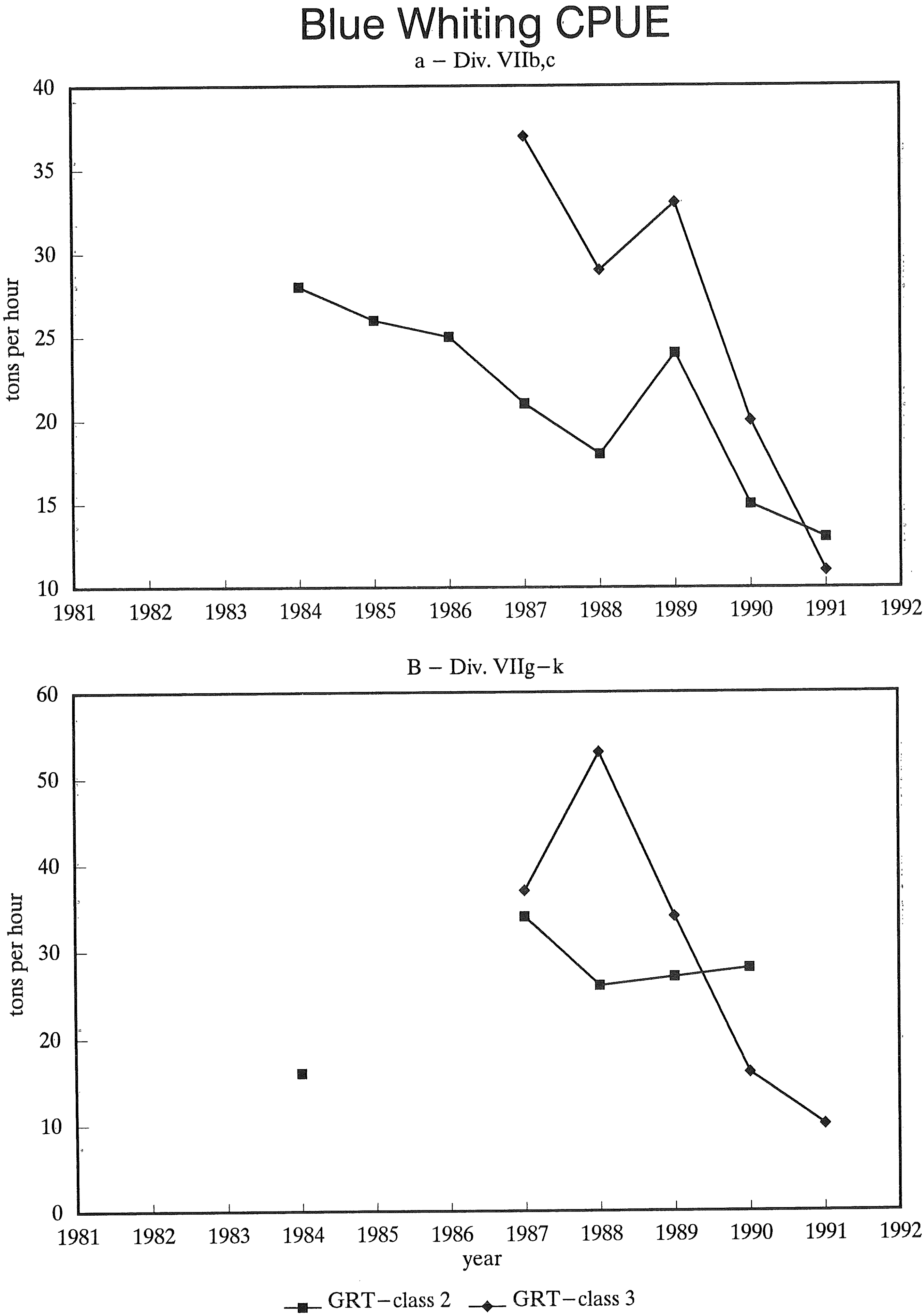


Figure 4.6.13 Trends in CPUE of Norwegian Blue Whiting fishery in the spawning area.

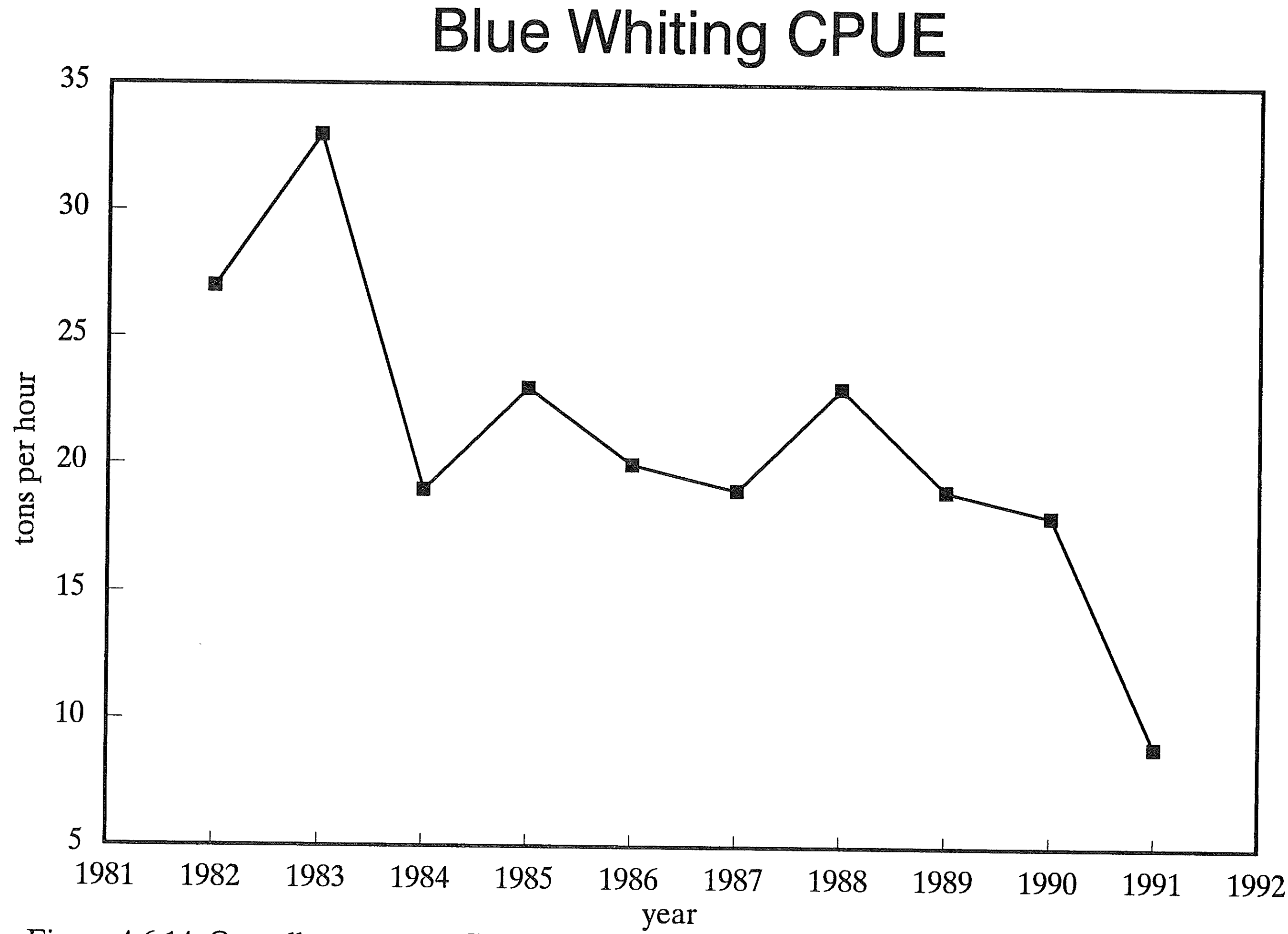


Figure 4.6.14. Overall aggregated CPUE for Norwegian fleet in Northern Blue whiting fishery.

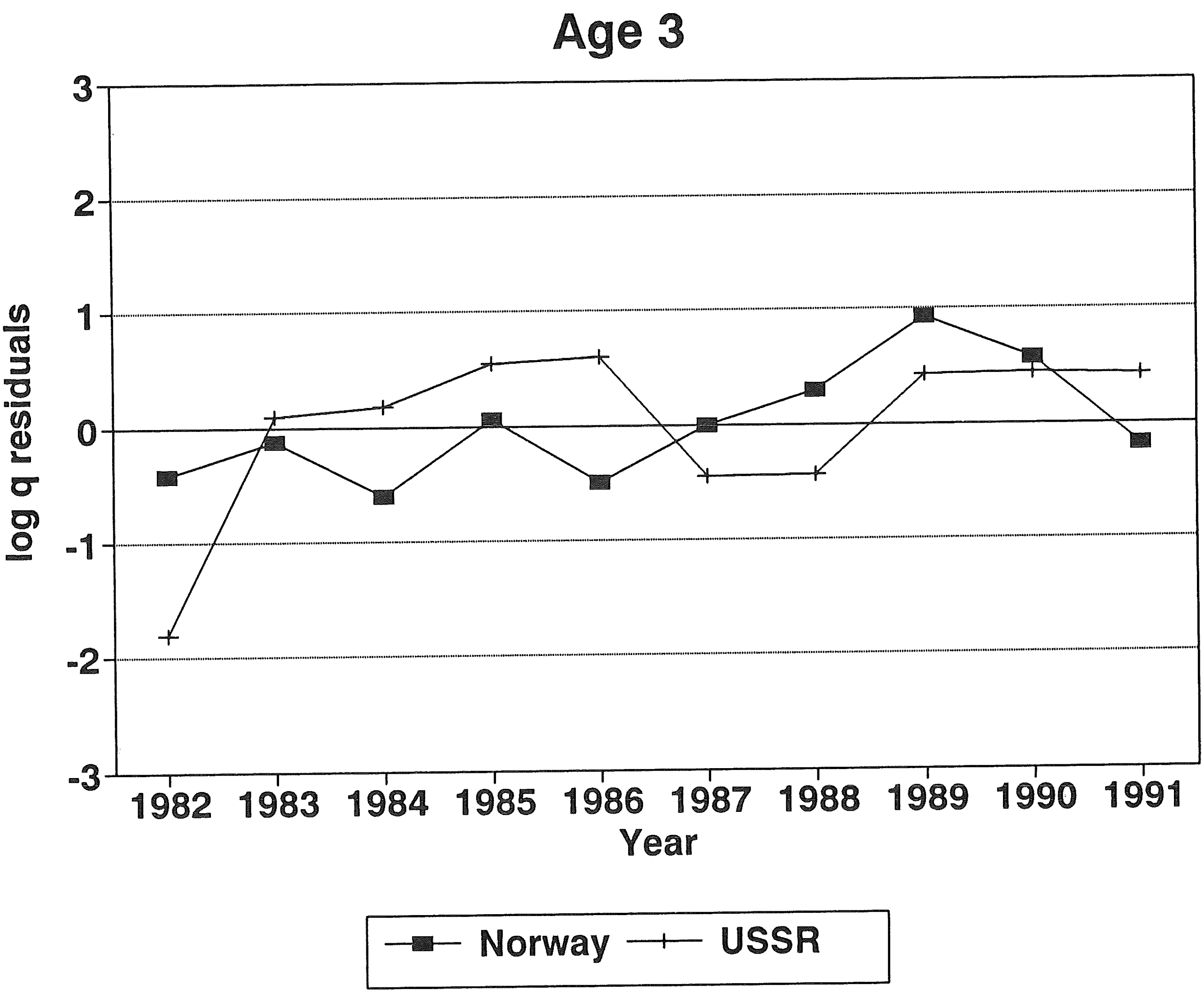


Figure 4.6.15A

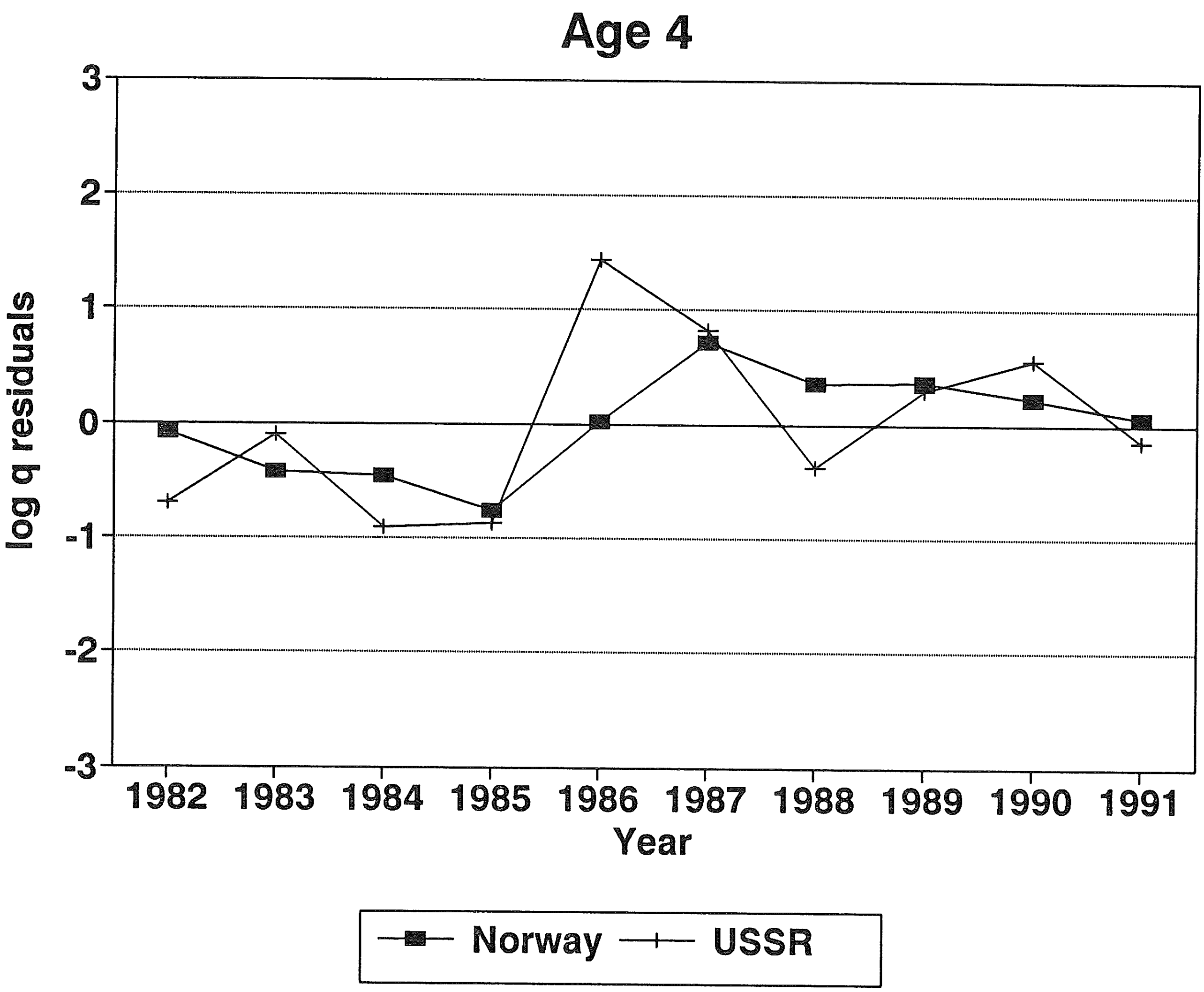


Figure 4.6.15B

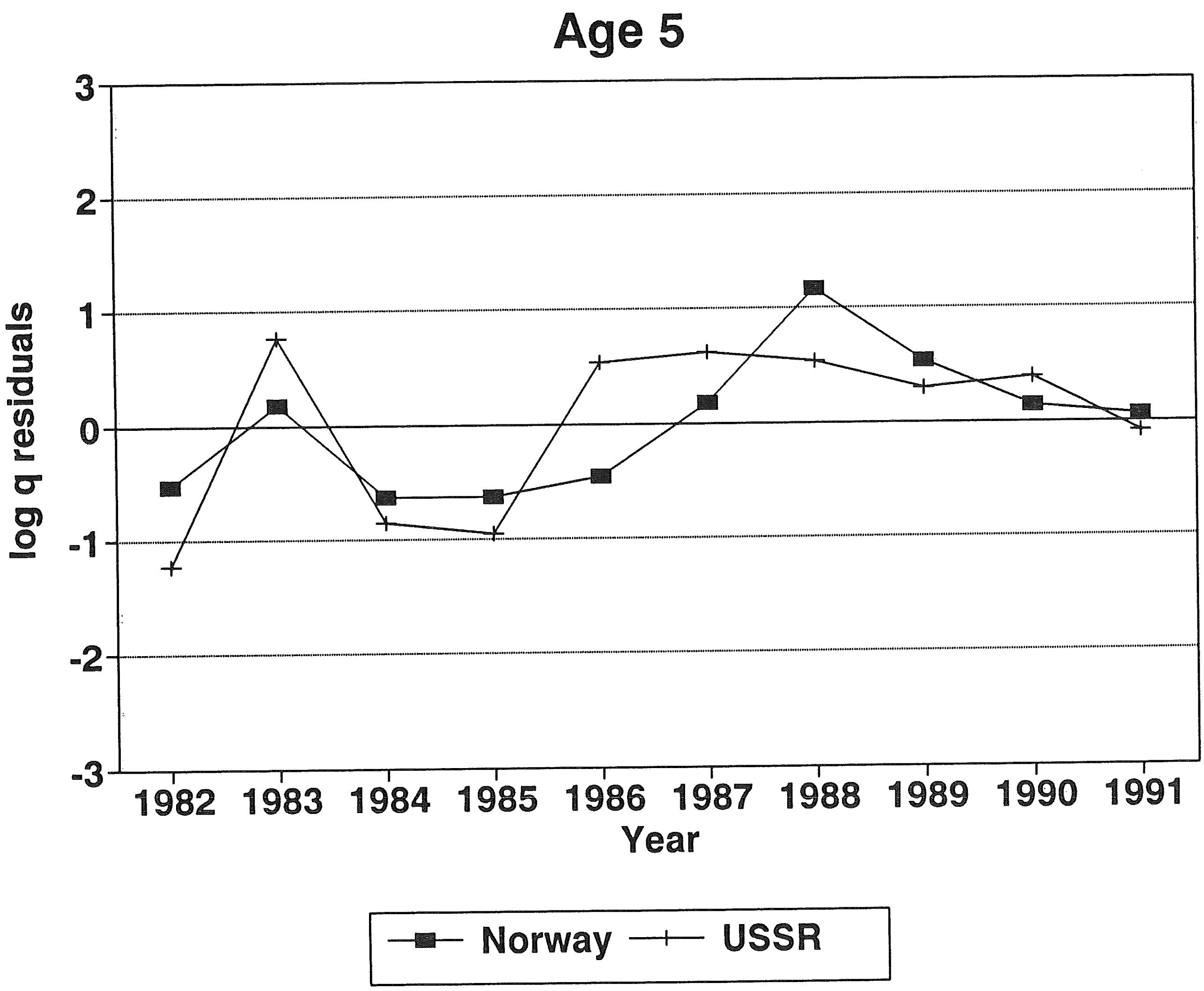


Figure 4.6.15C

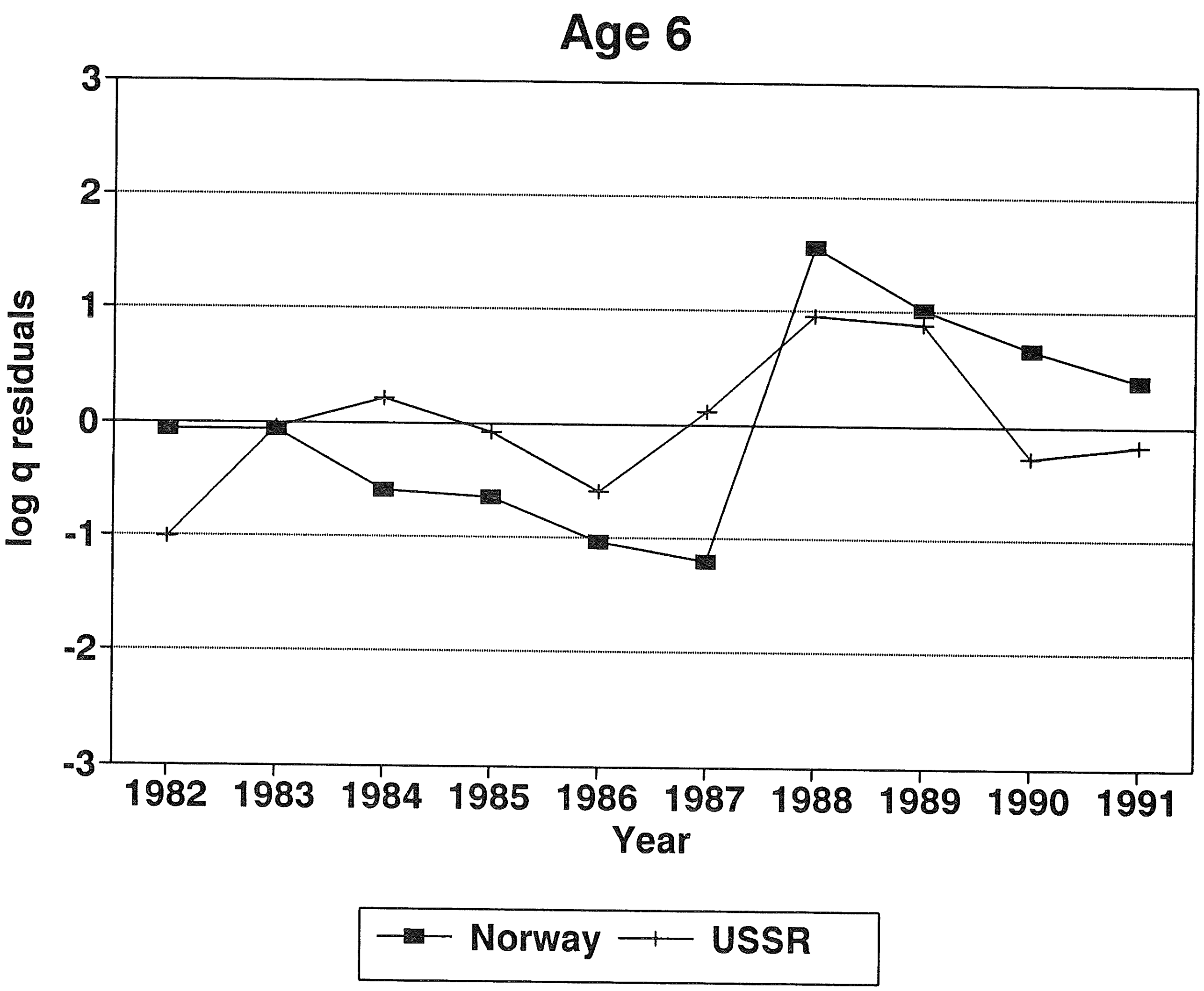


Figure 4.6.15D

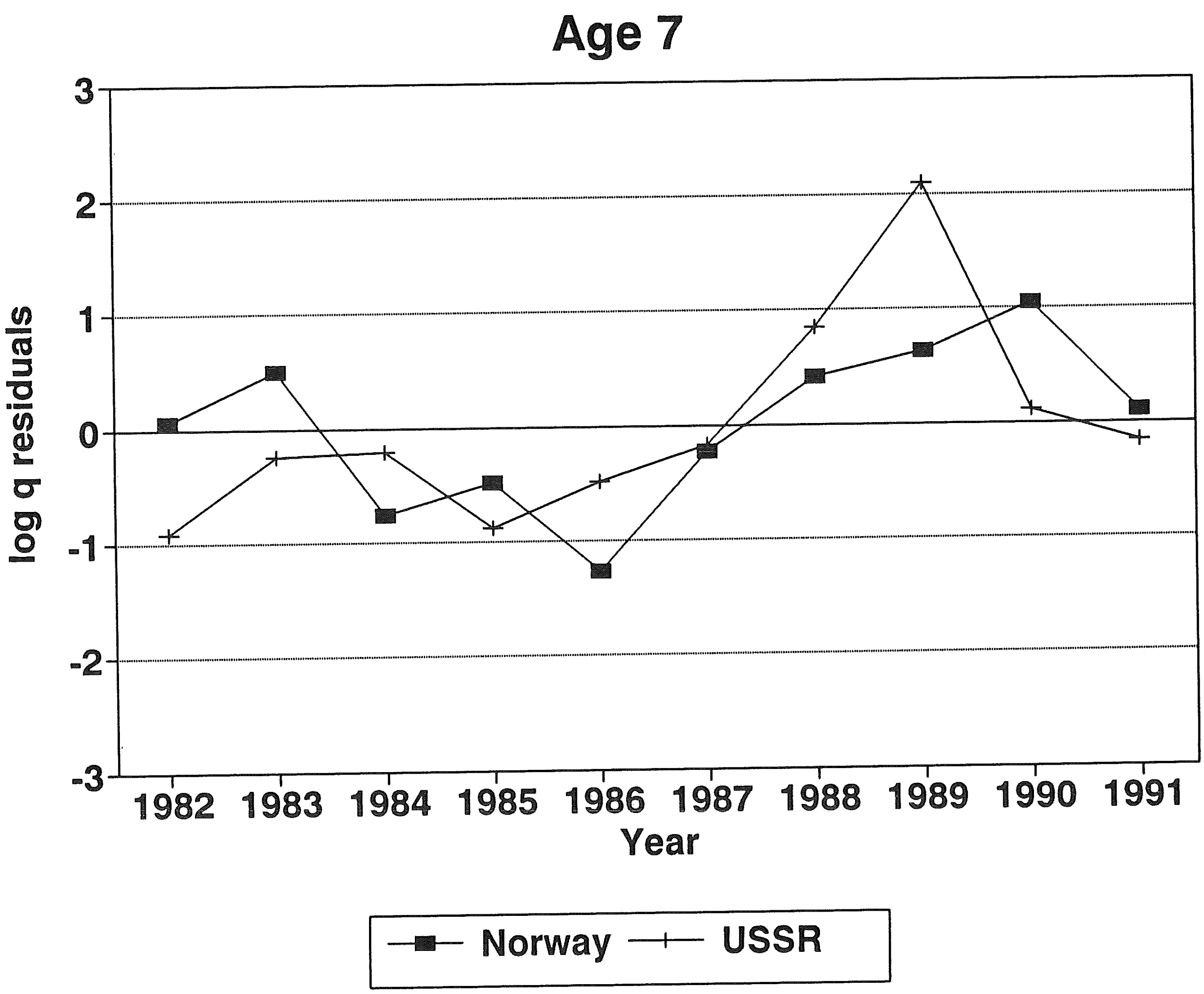


Figure 4.6.15E

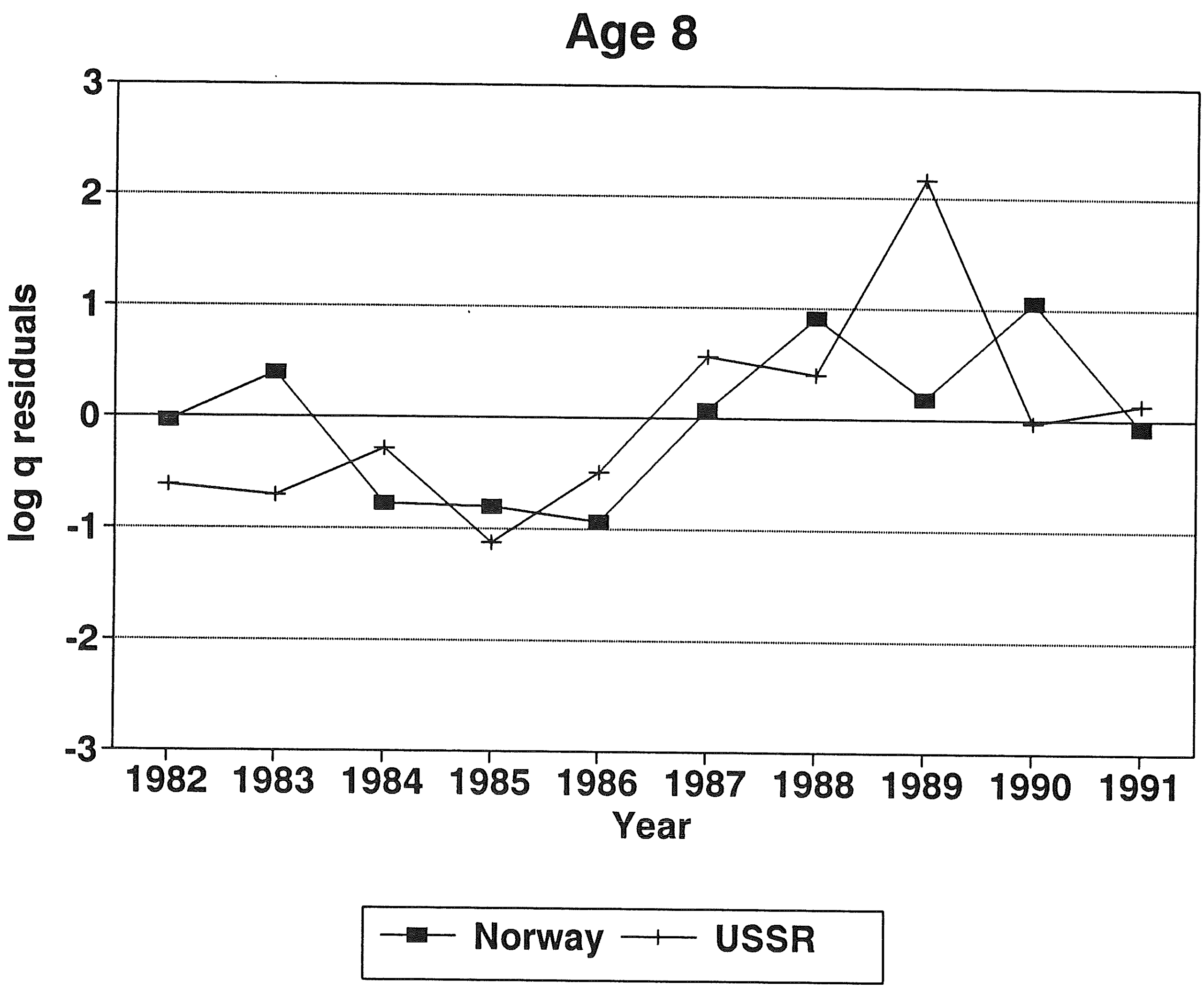


Figure 4.6.15F

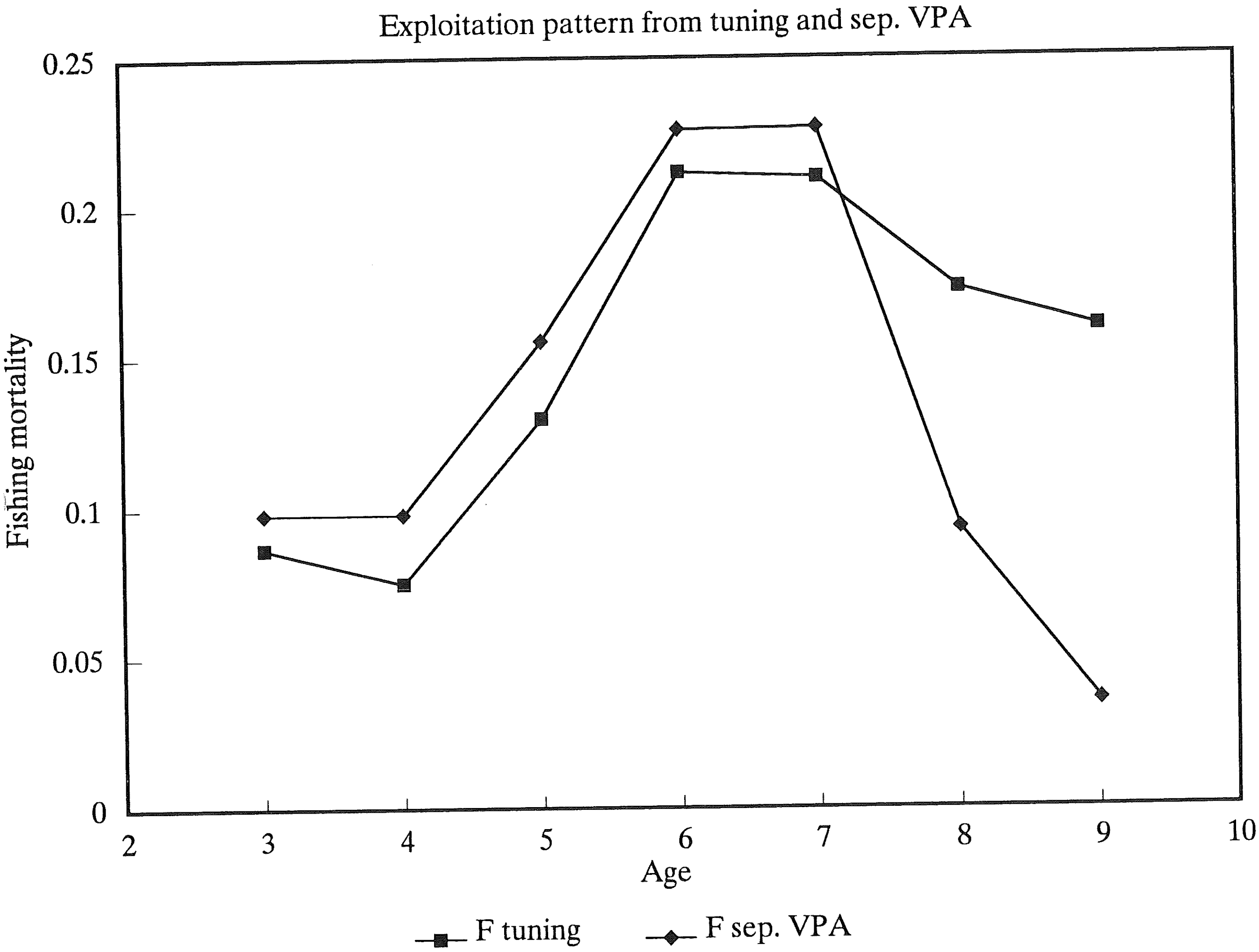
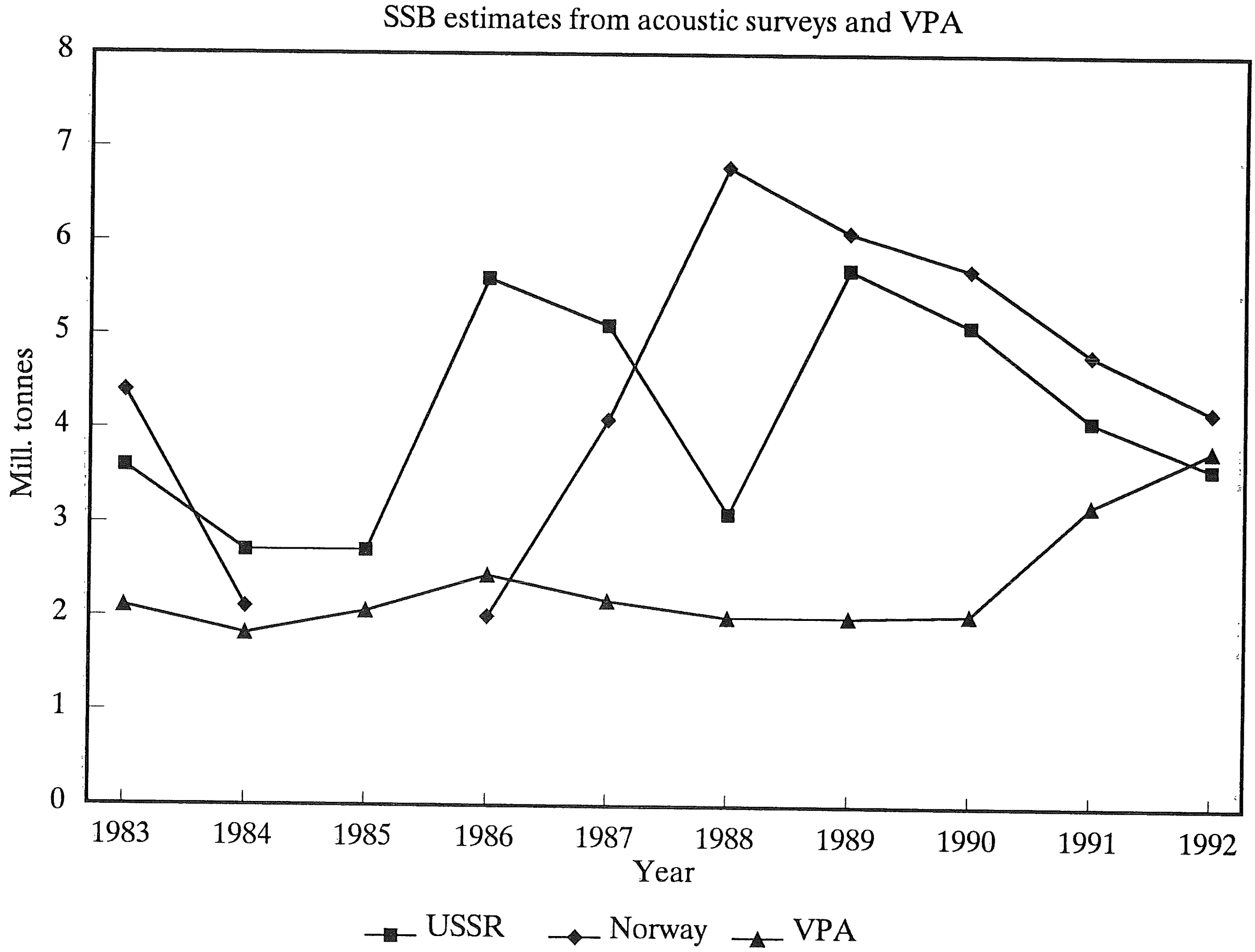

Exploitation pattern from tuning and sep. VPA
0.25
0.2
0.15
0.1
0.05
0
Fishing mortality
2
3
4
5
6
7
8
9
10
Age
F tuning
F sep. VPA

Figure 4.6.16

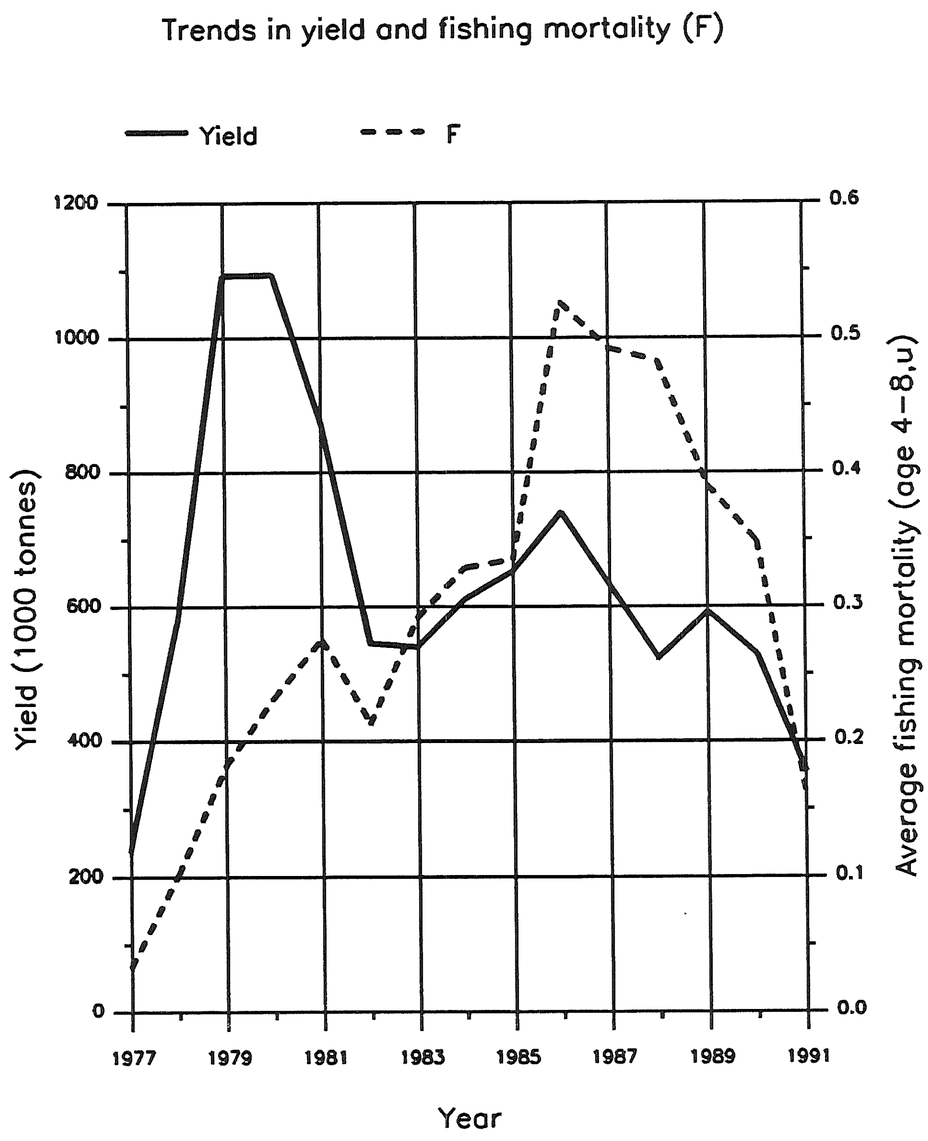


SSB estimates from acoustic surveys and VPA
Mill. tonnes
0
1
2
3
4
5
6
7
8
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
Year
USSR
Norway
VPA

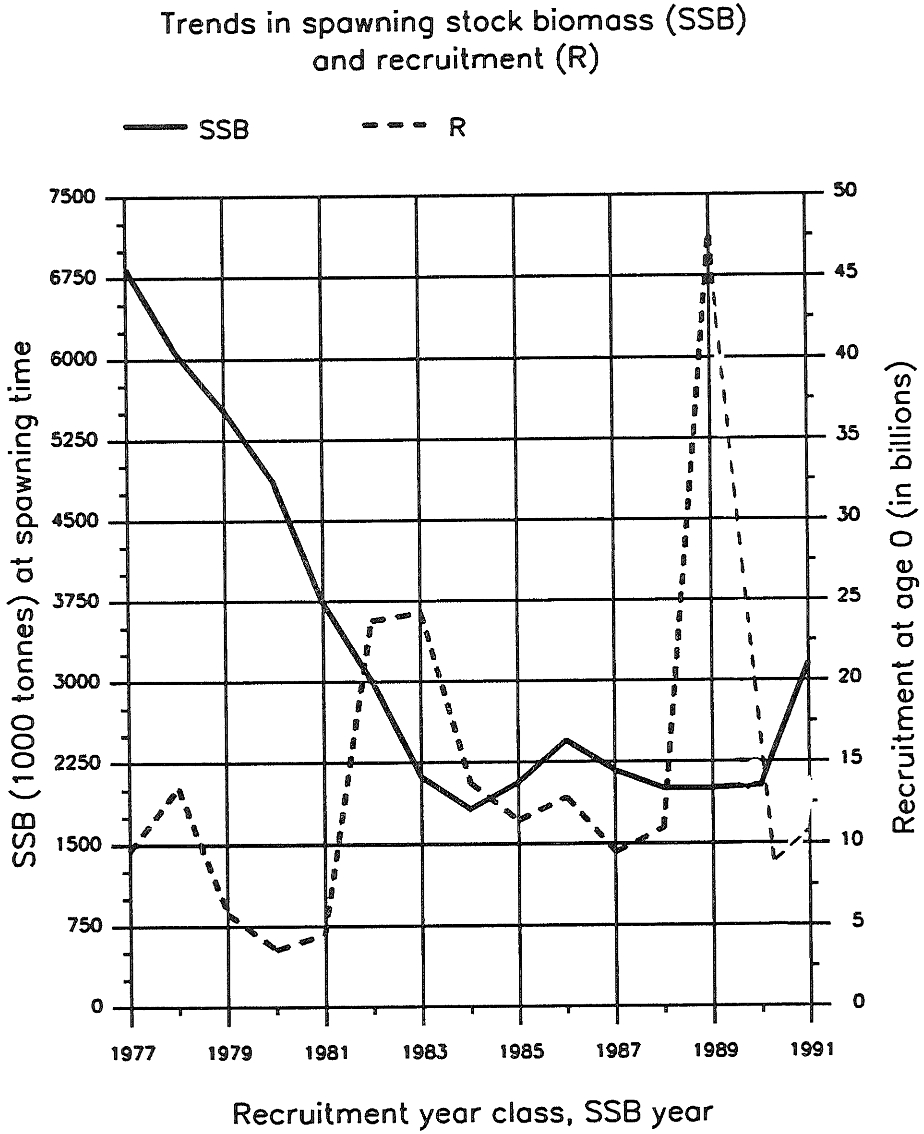
Figure 4.6.17

Figure 4.6.18A-B

FISH STOCK SUMMARY
STOCK: Blue Whiting in the Northern Area
11–10–1992



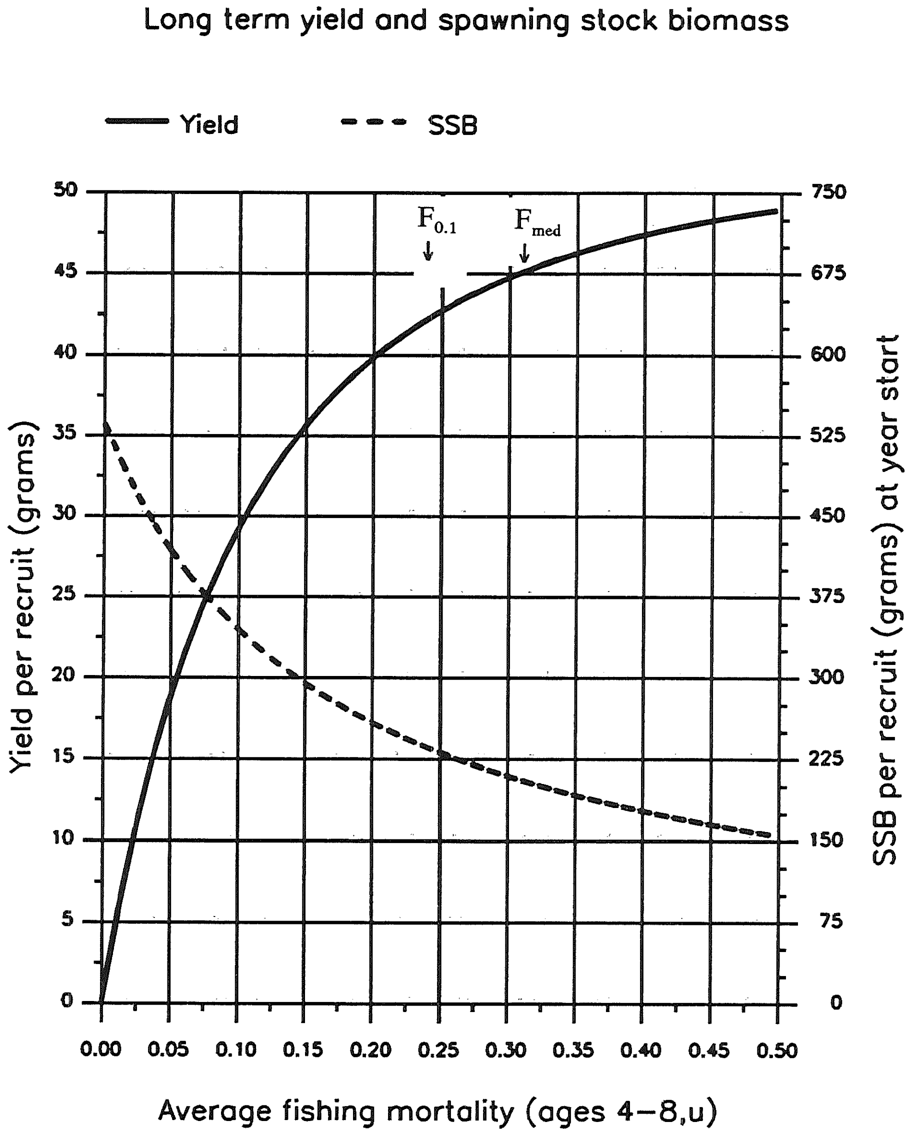
A



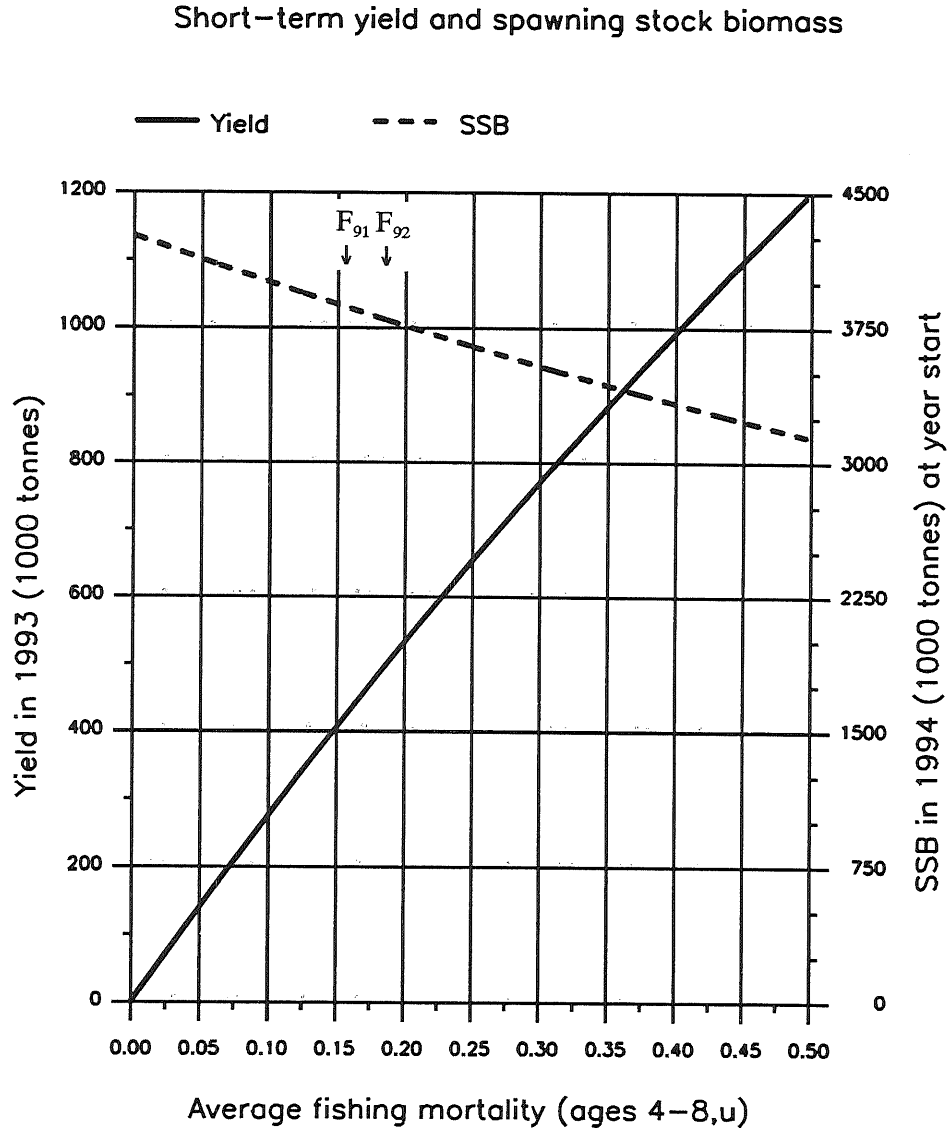
B

Figure 4.6.18C-D

FISH STOCK SUMMARY
STOCK: Blue Whiting in the Northern Area
12-10-1992



C



D

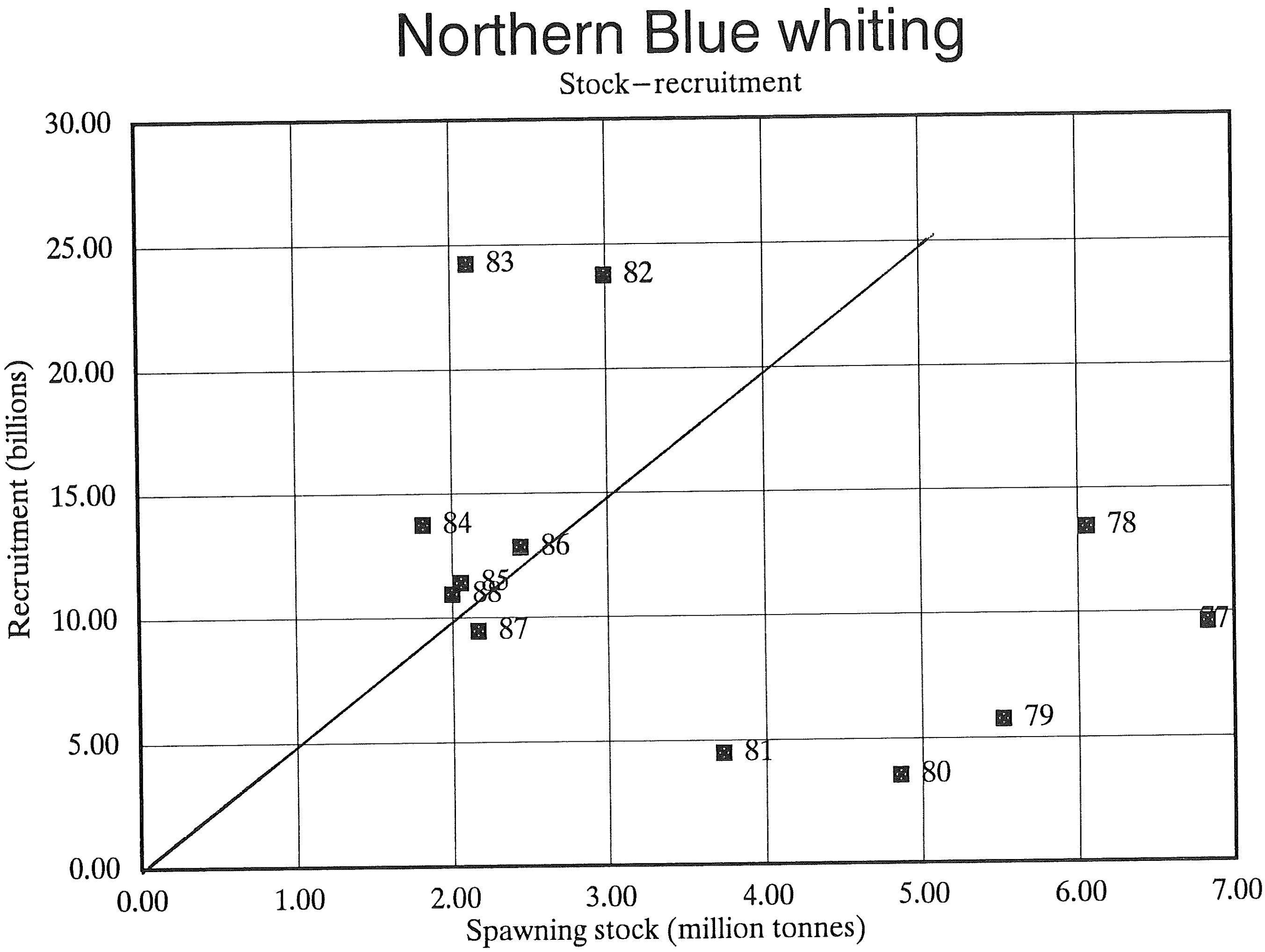

Northern Blue whiting
Stock–recruitment
Recruitment (billions)
Spawning stock (million tonnes)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
83
82
84
86
85
88
87
78
79
81
80

Figure 4.6.19

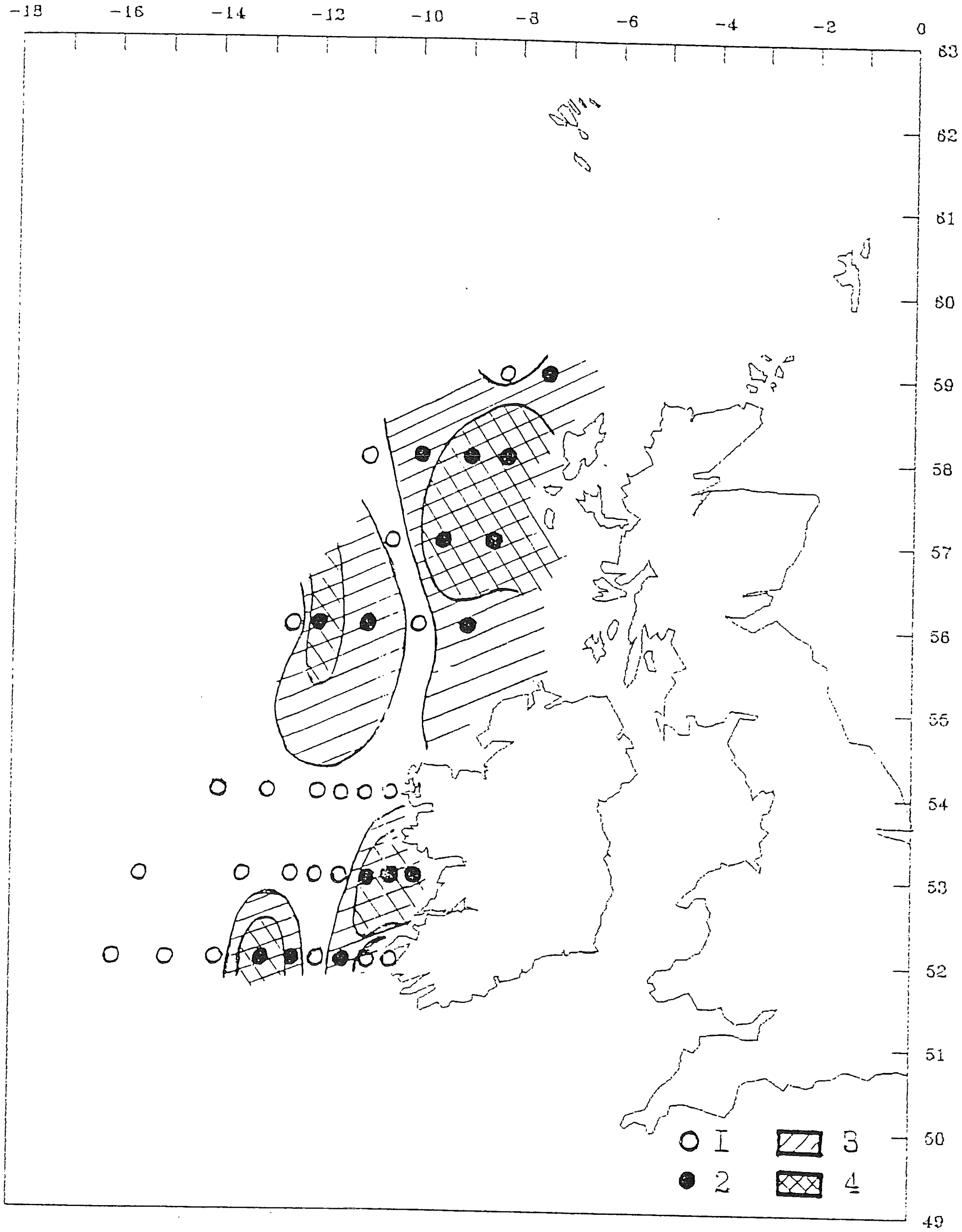


Figure 7.2.1 Distribution of BLUE WHITING larvae 17 April - 2 May 1992, R/V ""Pinro".
1) larvae absent; 2) larvae present; 3) 1-10 larvae/m^2; 4) >10 larvae/m^2.

APPENDIX 1

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 the selection pattern, was the same as for the standard prediction (Table 4.6.11).

For the recruitment in 1993-1996, two options were used:

1. The geometric mean of the recruitment in all the years 1977-1988. (10,279 $\times$ 10^9).

2. The geometric mean of the recruitment in all the years 1977-1988, excluding the rich year classes 1982-1983. (8,766 $\times$ 10^6).

The computations were done using a spreadsheet program.

Assuming a catch in 1992 of 440,000 tonnes, spawning stock biomass (SSB) and total stock biomass (TSB) at 1 January was computed for the years 1992-1996 with TAC constraints for 1993-1995 of 300, 400, 500, 600, 700 and 800 thousand tonnes.

The results are shown in Table A.1 and Figures A.1 and A.2.

Table A.1 Spawning stock biomass (SSB) and total stock biomass (TSB) assuming various levels of a constant TAC for the years 1993-1995.

A: Recruitment for 1993-1995: Average of 1977-1988 recruitments.

Year	SSB				
	300	400	500	600	700
1992	3,820	3,820	3,820	3,820	3,820
1993	3,857	3,857	3,857	3,857	3,857
1994	3,981	3,888	3,794	3,701	3,608
1995	3,950	3,768	3,587	3,406	3,226
1996	3,970	3,706	3,441	3,177	2,913
	TSB				
1992	5,439	5,439	5,439	5,439	5,439
1993	5,390	5,390	5,390	5,390	5,390
1994	5,170	5,066	4,963	4,260	4,757
1995	5,131	4,936	4,740	4,545	4,349
1996	5,085	4,809	4,532	4,255	3,977

B: Recruitment for 1993-1995: Average of 1977-1988 except 1982-1983 recruitments.

Year	SSB				
	300	400	500	600	700
1992	3,820	3,820	3,820	3,820	3,820
1993	3,857	3,857	3,857	3,857	3,857
1994	3,972	3,879	3,785	3,692	3,599
1995	3,905	3,724	3,543	3,362	3,181
1996	3,848	3,583	3,318	3,054	2,790
	TSB				
1992	5,439	5,439	5,439	5,439	5,439
1993	5,350	5,350	5,350	5,350	5,350
1994	5,086	4,983	4,880	4,777	4,673
1995	4,952	4,758	4,563	4,368	4,172
1996	4,810	4,535	4,259	3,982	3,705

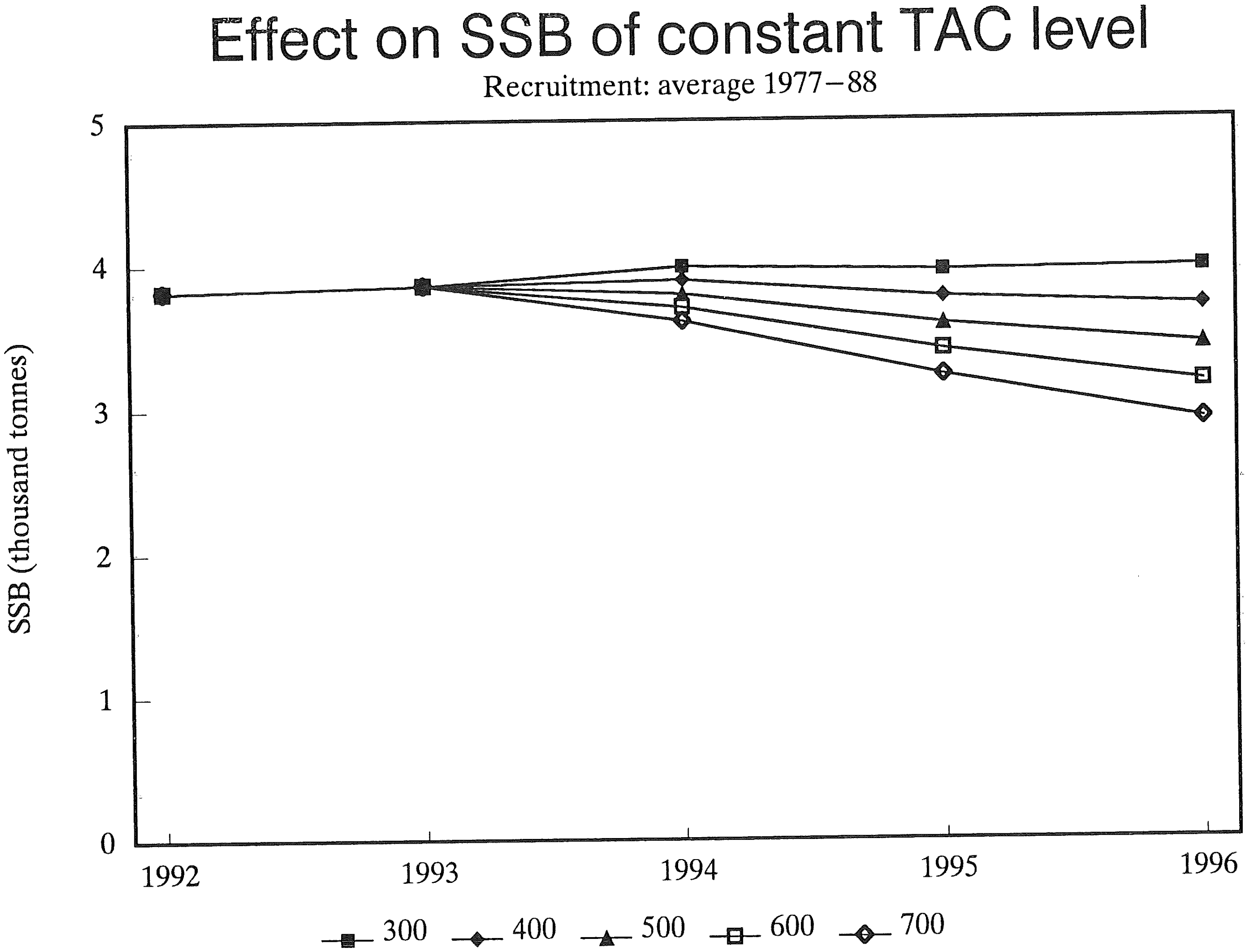


Figure A-1

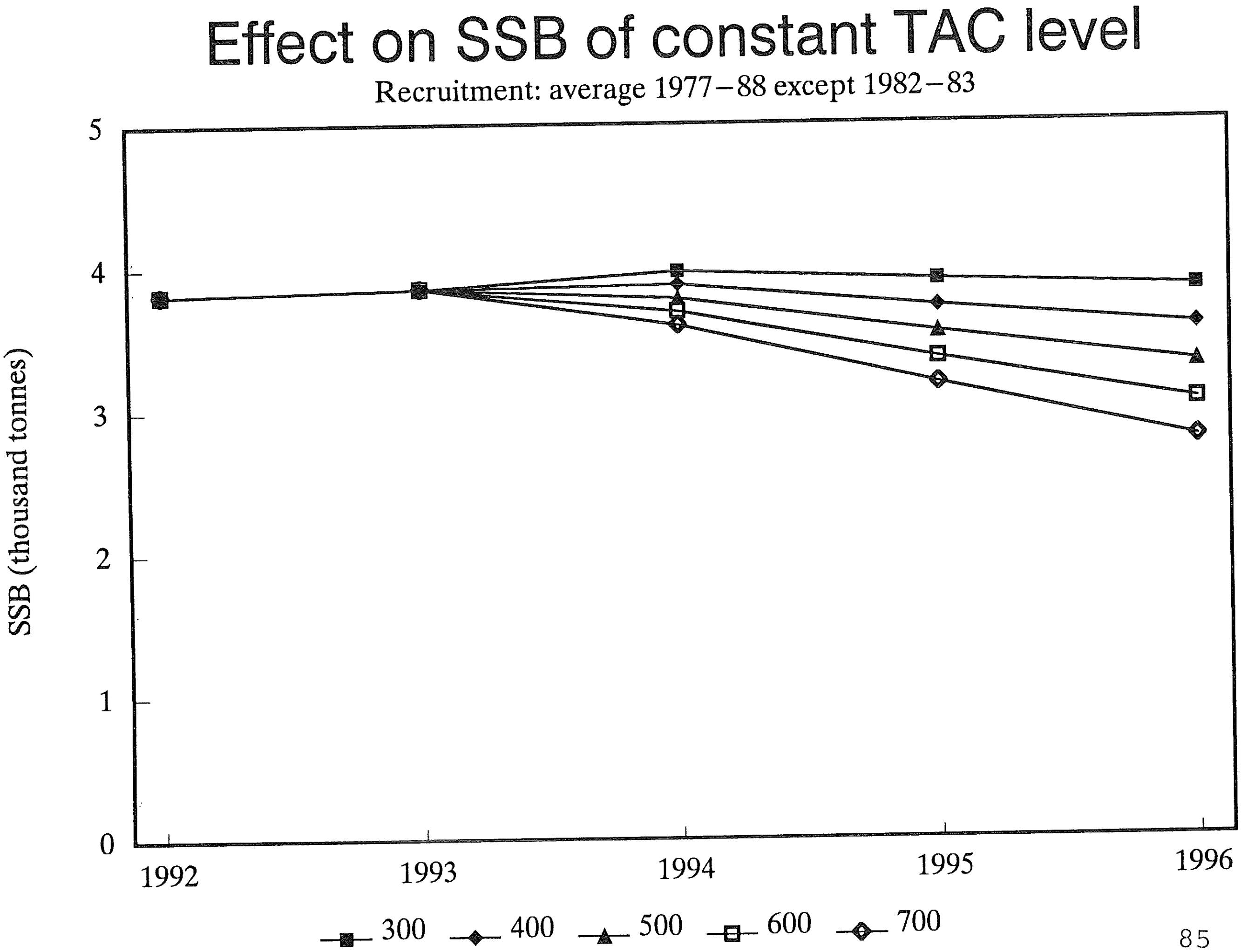


Figure A-2

APPENDIX 2

COMBINED ASSESSMENT

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 lower level, as shown in Figure B.1 and the following Tables B.1 - 4.

Blue whiting Northern Area
SSB

Blue whiting combined
SSB

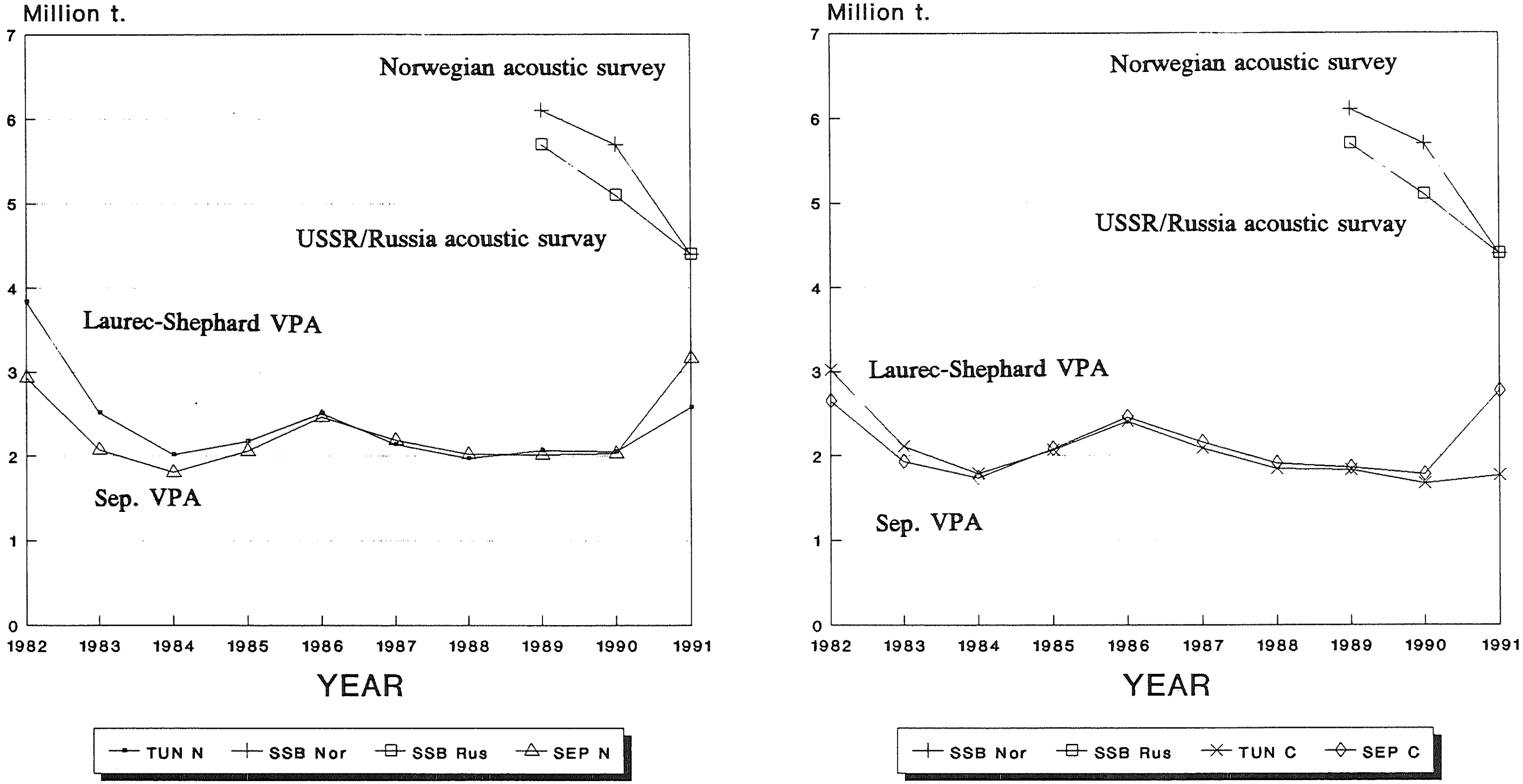


Figure B.1

Table B.1

VPA Version 3.0 (MSDOS)

At 17/09/1992 15:43

BLUE WHITING COMBINED STOCK,INDEX FILE,UNSEXED,PLUSGROUP

CPUE data from file tunbwco.dat

Disaggregated Qs
Log transformation
The final F is the (reciprocal variance-weighted) mean of the raised fleet F's.
No trend in Q (mean used)

Terminal Fs estimated using Laurec-Shepherd

Tuning converged after 15 iterations

Total of the absolute F residuals for all ages in the last year, between iterations 14 and 15 = .000

Regression weights
, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000

Oldest age F = 1.200*average of 5 younger ages.

Fishing mortalities

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	.173	.020	.044	.111	.008	.039	.006	.298	.018	.168
1	.037	.162	.139	.132	.083	.098	.063	.146	.431	.060
2	.120	.196	.247	.177	.114	.098	.115	.143	.170	.603
3	.130	.167	.238	.334	.242	.142	.144	.321	.193	.174
4	.198	.161	.240	.247	.560	.414	.191	.278	.301	.121
5	.132	.158	.239	.274	.582	.491	.561	.378	.298	.228
6	.217	.222	.371	.462	.481	.411	1.059	.690	.488	.233
7	.223	.366	.303	.381	.594	.549	.479	.734	.719	.239
8	.236	.396	.451	.338	.571	.925	.600	.590	1.330	.222
9	.241	.313	.385	.408	.669	.670	.694	.641	.753	.251

Log catchability residuals

Fleet : Norway Spawning Area

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
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	-.56	-.27	-.76	-.07	-.60	-.08	.19	1.14	.76	.26
4	-.07	-.52	-.55	-.86	-.08	.64	.29	.31	.55	.30
5	-.55	.17	-.70	-.69	-.52	.09	1.10	.49	.10	.49
6	-.03	-.03	-.59	-.68	-1.05	-1.20	1.50	1.00	.68	.40
7	.11	.53	-.74	-.51	-1.31	-.23	.41	.59	1.05	.10
8	-.02	.43	-.77	-.83	-.97	.02	.90	.19	1.13	-.08

Fleet : USSR Spawning Area/A

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
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	-1.94	-.04	.01	.42	.48	-.54	-.54	.64	.63	.88
4	-.70	-.19	-.99	-.97	1.33	.74	-.45	.23	.89	.10
5	-1.24	.76	-.93	-1.01	.48	.53	.47	.26	.35	.34
6	-.97	-.01	.21	-.11	-.60	.12	.91	.87	-.27	-.17
7	-.86	-.21	-.20	-.89	-.53	-.17	.84	2.05	.13	-.16
8	-.59	-.67	-.28	-1.14	-.53	.50	.39	2.17	.02	.13

Table B.1 (cont'd)

Fleet : CPUE Spanish Pair Tr

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0		-2.00	-1.01	-.10	-1.68	.48	-.16	-.01	1.30	3.18
1		-1.13	-.65	-.07	-1.21	.62	-.32	.49	1.28	.99
2		.49	-.18	-.52	-.56	-.44	-.02	.06	.30	.87
3		.70	1.00	-.16	-.40	-.79	.42	.36	-.65	-.49
4		.74	.80	.93	.15	-1.14	-.11	.39	-1.02	-.74
5		1.01	.19	.39	.44	-.56	-.77	.34	-.45	-.60
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									

Fleet : CPUE Aviles Trawlers

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0		-1.47	-1.58	.35	.67	-.14	1.24	.71	-.48	.70
1		-.92	-1.17	.21	.03	.19	.40	.52	.98	-.23
2		.61	-.32	-.06	-.17	-.14	.27	.01	.03	-.24
3		.36	.73	.07	-.59	-.25	.31	-.09	-.54	.00
4		.15	-.17	1.01	.01	-.46	-.21	.34	-.79	.14
5		.02	-1.24	.16	.74	.05	.09	.05	.11	.01
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									

Fleet : Bottom Trawl Survey

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0		-.52	.62	-.24	1.34	.02	.04	-.12	-.33	-.82
1		.47	1.11	.27	-1.86	2.09	-.58	-.76	.28	-1.02
2		2.12	1.73	.75	.51	-.90	-.28	-1.31	-1.21	-1.41
3		1.84	2.67	1.43	1.00	.95	-1.22	-.25	-2.96	-3.46
4		1.65	2.06	1.36	1.31	1.50	-1.62	-1.68	-1.96	-2.62
5		1.88	1.36	1.03	.54	2.15	-1.79	-.65	-3.12	-1.40
6	No data for this fleet at this age									
7	No data for this fleet at this age									
8	No data for this fleet at this age									

SUMMARY STATISTICS FOR AGE 0

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	No data for this fleet at this age							
2	No data for this fleet at this age							
3	-.95	1.664	.3852	.0070	.489E+00	.115E+00	-.954	.526
4	-4.72	1.055	.0089	.0834	.221E+00	.110E+00	-4.720	.334
5	-1.32	.678	.2675	.3808	-.850E-01	.828E-01	-1.319	.215

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.168	.540	.900	.900	2.778

SUMMARY STATISTICS FOR AGE 1

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	No data for this fleet at this age							
2	No data for this fleet at this age							
3	.46	.952	1.5864	.0222	.271E+00	.709E-01	.461	.301
4	-3.29	.720	.0371	.0752	.170E+00	.690E-01	-3.294	.228
5	-2.50	1.255	.0825	.1657	-.153E+00	.154E+00	-2.495	.397

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.060	.522	.501	.522	.921

SUMMARY STATISTICS FOR AGE 2

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	No data for this fleet at this age							
2	No data for this fleet at this age							
3	1.24	.515	3.4725	.2515	.781E-01	.606E-01	1.245	.163
4	-2.41	.302	.0897	.7632	-.295E-01	.379E-01	-2.411	.095
5	-3.71	1.414	.0244	2.4670	-.465E+00	.587E-01	-3.714	.447

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.603	.256	.383	.383	2.242

Table B.1 (cont'd)

SUMMARY STATISTICS FOR AGE 3

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.53	.639	1.7035	.1335	.154E+00	.455E-01	.533	.193
2	-6.50	.880	.0015	.0723	.177E+00	.754E-01	-6.503	.265
3	1.05	.674	2.8538	.2843	-.131E+00	.730E-01	1.049	.213
4	-2.26	.452	.1039	.1745	-.779E-01	.514E-01	-2.265	.143
5	-4.50	2.256	.0111	5.5041	-.727E+00	.108E+00	-4.503	.714

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.174	.301	.303	.303	1.010

SUMMARY STATISTICS FOR AGE 4

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.95	.531	2.5851	.0894	.117E+00	.423E-01	.950	.160
2	-6.22	.843	.0020	.1096	.132E+00	.815E-01	-6.218	.254
3	.70	.845	2.0038	.2529	-.212E+00	.760E-01	.695	.267
4	-2.35	.538	.0950	.1057	-.580E-01	.670E-01	-2.354	.170
5	-5.18	2.002	.0057	1.6617	-.635E+00	.105E+00	-5.176	.633

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.121	.315	.267	.315	.719

SUMMARY STATISTICS FOR AGE 5

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	1.06	.634	2.8945	.1399	.126E+00	.547E-01	1.063	.191
2	-6.06	.784	.0023	.1624	.132E+00	.738E-01	-6.063	.236
3	.19	.645	1.2140	.4159	-.162E+00	.583E-01	.194	.204
4	-2.49	.547	.0830	.2249	.526E-01	.688E-01	-2.489	.173
5	-5.96	1.925	.0026	.9272	-.537E+00	.149E+00	-5.956	.609

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.228	.314	.232	.314	.546

SUMMARY STATISTICS FOR AGE 6

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	1.03	.939	2.8037	.1569	.140E+00	.920E-01	1.031	.283
2	-5.86	.610	.0028	.2761	.754E-01	.624E-01	-5.861	.184
3	No data for this fleet at this age							
4	No data for this fleet at this age							
5	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.233	.511	.258	.511	.255

SUMMARY STATISTICS FOR AGE 7

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	1.01	.741	2.7430	.2160	.852E-01	.768E-01	1.009	.223
2	-5.77	.918	.0031	.2793	.155E+00	.863E-01	-5.773	.277
3	No data for this fleet at this age							
4	No data for this fleet at this age							
5	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.239	.577	.126	.577	.047

SUMMARY STATISTICS FOR AGE 8

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	1.05	.744	2.8467	.2403	.929E-01	.761E-01	1.046	.224
2	-5.60	.964	.0037	.1952	.177E+00	.872E-01	-5.602	.291
3	No data for this fleet at this age							
4	No data for this fleet at this age							
5	No data for this fleet at this age							

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.222	.589	.101	.589	.029

Table B.2

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

At 17/09/1992 15:44

Traditional vpa Terminal Fs estimated using Laurec-Shepherd

Table 8 Fishing mortality (F) at age

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	FBAR 89-91
AGE											
0,	.1727,	.0200,	.0445,	.1110,	.0076,	.0392,	.0059,	.2981,	.0175,	.1679,	.1612,
1,	.0374,	.1622,	.1386,	.1324,	.0828,	.0980,	.0627,	.1460,	.4305,	.0597,	.2121,
2,	.1204,	.1959,	.2475,	.1766,	.1145,	.0984,	.1145,	.1431,	.1696,	.6029,	.3052,
3,	.1301,	.1670,	.2382,	.3341,	.2416,	.1417,	.1439,	.3209,	.1932,	.1738,	.2293,
4,	.1981,	.1611,	.2402,	.2469,	.5599,	.4142,	.1914,	.2785,	.3008,	.1211,	.2335,
5,	.1325,	.1579,	.2389,	.2740,	.5820,	.4910,	.5613,	.3781,	.2981,	.2282,	.3015,
6,	.2167,	.2218,	.3709,	.4618,	.4806,	.4112,	1.0589,	.6904,	.4881,	.2334,	.4706,
7,	.2228,	.3662,	.3026,	.3809,	.5942,	.5495,	.4788,	.7340,	.7189,	.2391,	.5640,
8,	.2359,	.3958,	.4505,	.3376,	.5707,	.9247,	.5999,	.5900,	1.3305,	.2223,	.7143,
9,	.2415,	.3127,	.3848,	.4083,	.6690,	.6697,	.6937,	.6410,	.7527,	.2506,	.5481,
+gp,	.2415,	.3127,	.3848,	.4083,	.6690,	.6697,	.6937,	.6410,	.7527,	.2506,	
FBAR 4- 8,	.2012,	.2606,	.3206,	.3402,	.5575,	.5581,	.5781,	.5342,	.6273,	.2088,	
FBAR 0- 2,	.1102,	.1260,	.1435,	.1400,	.0683,	.0785,	.0610,	.1957,	.2059,	.2768,	

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

At 17/09/1992 15:44

Traditional vpa Terminal Fs estimated using Laurec-Shepherd

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

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	GMST 82-88	AMST 82-88
AGE													
0,	24362,	24286,	14794,	12303,	12166,	9791,	8611,	8301,	5269,	1125,	0,	14094,	15188,
1,	4444,	16782,	19489,	11586,	9015,	9885,	7708,	7008,	5045,	4239,	779,	10210,	11273,
2,	2661,	3505,	11683,	13892,	8309,	6794,	7337,	5927,	4959,	2685,	3269,	6732,	7740,
3,	2942,	1931,	2359,	7469,	9532,	6067,	5041,	5357,	4206,	3426,	1203,	4344,	5049,
4,	3353,	2115,	1338,	1522,	4378,	6129,	4311,	3574,	3182,	2838,	2358,	2887,	3307,
5,	2342,	2252,	1474,	862,	973,	2048,	3316,	2915,	2215,	1928,	2059,	1719,	1895,
6,	1557,	1680,	1575,	950,	536,	445,	1026,	1549,	1635,	1346,	1257,	994,	1110,
7,	1464,	1026,	1102,	890,	490,	272,	242,	291,	636,	822,	873,	647,	784,
8,	1422,	959,	583,	666,	498,	222,	128,	123,	115,	254,	530,	497,	640,
9,	1455,	920,	529,	304,	389,	230,	72,	58,	56,	25,	166,	391,	557,
+gp,	3448,	1365,	875,	847,	890,	436,	109,	88,	196,	64,	57,		
TOTAL,	49449,	56821,	55800,	51289,	47177,	42318,	37902,	35191,	27512,	18753,	12549,		

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

At 17/09/1992 15:44

Table 16 Summary (without SOP correction)

Table B.2 (cont'd)

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

At 17/09/1992 15:44

Table 16 Summary (without SOP correction)

Traditional vpa Terminal Fs estimated using Laurec-Shepherd

	RECRUITS,	TOTALBIO,	TOTSPBIO,	LANDINGS,	FBAR 4- 8,	FBAR 0- 2,
1982,	24362,	3929,	3022,	576219,	.2012,	.1102,
1983,	24286,	3570,	2110,	570022,	.2606,	.1260,
1984,	14794,	3421,	1784,	641776,	.3206,	.1435,
1985,	12303,	3446,	2064,	695593,	.3402,	.1400,
1986,	12166,	3743,	2407,	826987,	.5575,	.0683,
1987,	9791,	3334,	2082,	664407,	.5581,	.0785,
1988,	8611,	3018,	1836,	553307,	.5781,	.0610,
1989,	8301,	2785,	1804,	625403,	.5342,	.1957,
1990,	5269,	2391,	1621,	560509,	.6273,	.2059,
1991,	1125,	2323,	1662,	386494,	.2088,	.2768,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table B.3

Title : BLUE WHITING COMBINED STOCK,INDEX FILE,UNSEXED,PLUSGROUP

At 17/09/1992 16:01

Separable analysis
from 1982 to 1991 on ages 0 to 9
with Terminal F of .160 on age 5 and Terminal S of 1.500

Initial sum of squared residuals was 52.530 and
final sum of squared residuals is 22.232 after 36 iterations

Matrix of Residuals

Years,	1982/83,	1983/84,	1984/85,	1985/86,	1986/87,	1987/88,	1988/89,	1989/90,	1990/91,	,	,WTS
Ages											
0/ 1,	1.575,	-.554,	.093,	1.630,	-1.441,	.630,	-1.795,	.945,	-.857,	.227,	.158,
1/ 2,	-.992,	.280,	.204,	.698,	.162,	.189,	-.202,	.139,	-.303,	.173,	.421,
2/ 3,	.285,	.431,	.183,	.224,	.058,	-.120,	-.402,	-.109,	-.411,	.138,	.672,
3/ 4,	.245,	.083,	.231,	.075,	-.252,	-.171,	-.216,	.215,	-.096,	.114,	1.000,
4/ 5,	.626,	-.055,	.040,	-.417,	.511,	.027,	-.285,	-.066,	-.282,	.098,	.567,
5/ 6,	-.033,	-.382,	-.335,	-.090,	.763,	-.124,	.578,	-.064,	-.224,	.089,	.505,
6/ 7,	-.301,	-.219,	-.062,	-.023,	-.121,	-.199,	1.059,	.004,	-.053,	.084,	.492,
7/ 8,	-.249,	.109,	-.124,	-.156,	-.132,	.071,	.154,	-.210,	.620,	.084,	.738,
8/ 9,	-.252,	.063,	-.078,	-.688,	-.248,	.425,	.118,	-.456,	1.203,	.086,	.361,
,	.180,	.173,	.156,	.117,	.054,	-.011,	-.043,	-.040,	-.037,	1.092,	
WTS ,	1.000,	1.000,	1.000,	1.000,	1.000,	1.000,	1.000,	1.000,	1.000,		

Fishing Mortalities (F)

	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,
F-values	.1979,	.2484,	.3022,	.3001,	.3453,	.3322,	.3158,	.4053,	.3530,	.1600,

Selection-at-age (S)

	0,	1,	2,	3,	4,	5,	6,	7,	8,	9,
S-values	.0927,	.2962,	.4450,	.6406,	.8228,	1.0000,	1.4188,	1.4603,	1.6871,	1.5000,

Table B.4

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

At 17/09/1992 16:01

Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	FBAR 89-91
AGE											
0,	.1665,	.0193,	.0462,	.1193,	.0073,	.0436,	.0051,	.0711,	.0186,	.0148,	.0348,
1,	.0369,	.1554,	.1326,	.1379,	.0896,	.0940,	.0703,	.1255,	.0773,	.0636,	.0888,
2,	.1191,	.1927,	.2349,	.1678,	.1199,	.1074,	.1094,	.1626,	.1423,	.0702,	.1250,
3,	.1252,	.1650,	.2334,	.3117,	.2270,	.1493,	.1589,	.3031,	.2251,	.1416,	.2233,
4,	.1974,	.1541,	.2367,	.2406,	.5035,	.3803,	.2038,	.3152,	.2785,	.1451,	.2463,
5,	.1422,	.1573,	.2263,	.2689,	.5598,	.4133,	.4901,	.4112,	.3528,	.2067,	.3236,
6,	.2274,	.2414,	.3690,	.4280,	.4677,	.3862,	.7533,	.5437,	.5573,	.2926,	.4645,
7,	.2450,	.3906,	.3382,	.3780,	.5242,	.5252,	.4350,	.3721,	.4670,	.2905,	.3765,
8,	.2931,	.4515,	.4973,	.3948,	.5639,	.7203,	.5545,	.5038,	.3696,	.1193,	.3309,
9,	.2962,	.4206,	.4704,	.4769,	.8832,	.6550,	.4268,	.5567,	.5650,	.0358,	.3858,
+gp,	.2962,	.4206,	.4704,	.4769,	.8832,	.6550,	.4268,	.5567,	.5650,	.0358,	
FBAR 4- 8,	.2210,	.2790,	.3335,	.3421,	.5238,	.4851,	.4873,	.4292,	.4050,	.2109,	
FBAR 0- 2,	.1075,	.1225,	.1379,	.1417,	.0723,	.0817,	.0616,	.1197,	.0794,	.0496,	

Table B.4 (cont'd)

Traditional vpa Terminal populations from weighted Separable populations

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

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	GMST 82-88	AMST 82-88
AGE													
0,	25190,	25280,	14266,	11496,	12656,	8803,	9916,	31294,	4964,	11843,	0,	14182,	15372,
1,	4508,	17460,	20303,	11153,	8353,	10286,	6900,	8077,	23863,	3989,	9553,	10079,	11280,
2,	2687,	3557,	12238,	14558,	7955,	6253,	7666,	5266,	5833,	18084,	3065,	6766,	7845,
3,	3051,	1953,	2402,	7922,	10078,	5777,	4598,	5626,	3664,	4142,	13801,	4368,	5112,
4,	3364,	2204,	1356,	1557,	4749,	6575,	4074,	3211,	3402,	2395,	2944,	2960,	3411,
5,	2193,	2260,	1547,	876,	1002,	2350,	3680,	2721,	1919,	2108,	1696,	1787,	1987,
6,	1492,	1558,	1581,	1010,	548,	469,	1273,	1846,	1476,	1104,	1404,	1028,	1133,
7,	1345,	973,	1002,	895,	539,	281,	261,	491,	877,	692,	674,	645,	757,
8,	1176,	862,	539,	585,	502,	261,	136,	138,	277,	450,	424,	478,	580,
9,	1216,	718,	449,	268,	323,	234,	104,	64,	68,	157,	327,	363,	473,
+gp,	2882,	1066,	744,	748,	738,	443,	158,	97,	241,	407,	445,		
TOTAL,	49102,	57891,	56426,	51067,	47442,	41732,	38766,	58830,	46584,	45371,	34334,		

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

At 17/09/1992 16:01

Table 16 Summary (without SOP correction)

Traditional vpa Terminal populations from weighted Separable populations

	RECRUITS,	TOTALBIO,	TOTSPBIO,	LANDINGS,	FBAR 4- 8,	FBAR 0- 2,
1982,	25190,	3677,	2752,	576219,	.2210,	.1075,
1983,	25280,	3481,	1970,	570022,	.2790,	.1225,
1984,	14266,	3430,	1754,	641776,	.3335,	.1379,
1985,	11496,	3480,	2086,	695593,	.3421,	.1417,
1986,	12656,	3776,	2446,	826987,	.5238,	.0723,
1987,	8803,	3371,	2146,	664407,	.4851,	.0817,
1988,	9916,	3082,	1887,	553307,	.4873,	.0616,
1989,	31294,	3158,	1832,	625403,	.4292,	.1197,
1990,	4964,	3280,	1742,	560509,	.4050,	.0794,
1991,	11843,	5158,	2723,	386494,	.2109,	.0496,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		