International Council for the
Exploration of the Sea

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REPORT OF THE BLUE WHITING ASSESSMENT WORKING GROUP

Copenhagen, 12-18 September 1990

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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 12 to 18 September (C.Res. 1989/2:4:20) to:

a) assess the status of and provide catch options for 1991 within safe biological limits for the northern and the southern stocks;

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

1.2 Participants

P. Abaunza	Spain
S. Belikov	USSR
V.V. Blinov	USSR
O. Gullaksen	Norway
J.A. Jacobsen	Faroe Islands
M. Meixide	Spain
T. Monstad (Chairman)	Norway
A. Paciorkowski	Poland

2 STOCK IDENTITY AND STOCK SEPARATION

Isaev and Seliverstov (1989) suggest that the Northern stock consists of two populations, and according to the spawning areas these they named the Hebrides and the Porcupine stocks. This is thoroughly discussed in last year's Working Group report, with the conclusion that more research is needed on this matter before any decision about it is made (Anon., 1990a). Further investigations undertaken since last year include a separate trial VPA for the "Hebrides stock" made in the USSR (Isaev et al., 1990) and a pilot project for genetical analysis of blue whiting from various areas which has vbeen started in Norway (Mork, pers. comm.).

No other new information on stock identity and stock separation of the blue whiting stocks were reported to the Working Group in 1990.

In the Porcupine Bank area, which is considered a mixing area for the Northern and the Southern stocks together with some local populations, a minor part of the USSR-estimated biomass in spring 1990 was consigned to the Southern stock. This was based upon the presence (or absence) of a biological tag, the parasite Myxobolus aeglefini (Karasev, 1988).

The Norwegian-estimated biomass for the same period was, however, all consigned to the Northern stock.

The Working Group recommends that research in stock separation and stock identity is continued, and that the data are brought to the next meeting of the Working Group.

3 OTOLITH EXCHANGE PROGRAMME

It was recommended at the Blue Whiting Assessments Working Group meeting in 1987 (Anon., 1988) that an otolith exchange between the southern and northern areas should take place to test if the difference in the range of ages in the catch

between the Northern (ages 0-15) and Southern stocks (ages 0-8) may be due to ageing problems, because the length compositions are similar, as pointed out by ACFM. ACFM also commented that this could also explain the difference in the mean weights at age, that vary by a factor of almost two at some ages.

A sample of 115 otoliths from ICES Division IXa, covering a length range from 15 to 32 cm, was exchanged, and the results from six countries are available.

One of the otoliths from each fish was sectioned and the other preserved in aqeous solution. An analysis of the results was presented (Meixide, 1990)). In this paper it is shown that there are not differences between the mean age of the sample based on the age readings of three countries at a significant level of 5% using the Tukey test. Compared with this group, two countries are reading one year more, and one country is reading one year less (approximately). This means that there is a difference of two years between the two extreme age reading methods (Figure 3.1).

The percentage of agreement between the readers is low as shown in the text table below.

Sliced otoliths:

	GDR	Portugal	Faroes	Spain
Portugal	42.9	-	-	-
Faroes	17.3	12.2	-	-
Spain	36.7	51.0	15.3	-
Norway	11.2	9.2	0.0	23.5

Whole otoliths:

	Portugal	Spain
Spain	47.5	-
Norway	30.3	57.6

Only three countries aged the whole otoliths, and two of them (Spain and Portugal) read one year less, compared with the sectioned otoliths. Only Norway give the same ages for both sections on whole otoliths.

The difference in the range of ages between the northern (ages 0-15) and southern stocks (ages 0-8) could not be due to the difference in the age readings, because the difference between the two extreme age reading methods is only two years.

The difference in the mean weight at age between the northern and southern stocks can be partially explained by the difference in the age readings between Norway and Spain as is shown in Figure 3.2.

There seem to be two sources of variation in the age readings:

The identification of the first annual ring, which is the cause of the difference of 1 or 2 years. To solve this problem, an otolith workshop could be helpful, or it may be useful to continue the exchange and include otoliths from the northern area. Obviously this is the main problem and it produces systematic errors in the ageing.

The subjective interpretation of the edge, the false rings and the edge rings in old fish are other sources of variation. This problem is more difficult to solve, and only the experience of the readers gives the

criterion. New investigations are needed, e.g., an analysis of the frequency distri- bution of the rings to identify the true annual ones.

4 NORTHERN STOCK

4.1 Landings in 1989

Estimates of total landings in 1980-1989 from the various fisheries by countries are given in Tables 4.2-4.4 and summarized in Table 4.1. Catches from the directed fishery in Divisions VIIg-k as well as from Sub-area XII continued to be recorded as part of the northern stock.

The total landings from all Northern blue whiting fisheries in 1989 were estimated at 596,402 t, which is 12% more than that of 1988. The same increase of 12% is also reflected for the directed fishery in the spawning area, while the landings from the industrial mixed fishery increased by 41% compared to the landings in 1988. For the first time since 1983, catches from the Icelandic industrial fishery were landed. However, the decline in the Norwegian Sea fishery continued, and in 1989 the catch was 34% less than that of 1988.

As in the last few years, greater silver smelt was caught as by-catch in the directed fishery in Division VIa. A minor part, not being corrected for, is assumed by the Working Group to be less than 1%.

4.2 Landings in 1990

Preliminary data on the blue whiting catch from January to July 1990, submitted by the Working Group members, and by some countries amounted to 499,000 t (Table 4.5)

4.3 Length Composition of Catches (Tables 4.6.1-4.6.7)

Data on length composition of the 1989 catches of the Northern blue whiting by divisions were presented by the USSR, Norway, Faroes and the Netherlands. Length composition of catches varied over seasons and fishing areas.

Blue whiting in the length range 26-32 cm were taken by the USSR vessels in 1989. Some larger fish (29-33 cm) were taken in Sub-area XII.

The bulk of Norwegian catches in the traditional fishing areas consisted of blue whiting of 26-31 cm length, while in the areas of mixed fishery, fish in the length range 20-27 cm were frequently taken. Blue whiting of 13-16 cm in length dominated the catches of Norwegian vessels in the fourth quarter in Division IVa.

The length composition of catches from Dutch vessels ranged from 18 to 38 cm, and fish in the length range 22-31 cm dominated.

The Icelandic autumn fishery was based on fish of 12-19 cm in length (Sub-division Va2), which were exclusively 0-group fish (Sveinbjørnsson, 1990).

Length composition of catches of blue whiting taken by Faroese fishing vessels varied from 18 to 40 cm with fish of lengths 25-30 cm dominating.

Data on length composition of catches for the first half of 1990 were presented only by USSR and Norway (Tables 4.6.6-4.6.7).

4.4 Age Composition of Landings

For the directed fishery in 1989, age compositions were provided by the USSR and Norway. These countries accounted for 82% of the landings. The Faroese landings were raised to catch in numbers by age group according to the Norwegians data for the first half of the year, and according to the USSR data for the latter half of the year.

For other landings from the directed fishery, age compositions of Norwegian landings in the same area and month were used. The age composition of the catches in the directed fisheries is given in Table 4.7.

For the landings of blue whiting taken in the mixed industrial fisheries in the North Sea, data were available only for the Norwegian component. These accounted for 57% of the total landings. Landings of other countries were assumed to have the same age composition as the Norwegian landings in the same month and area. The age composition of the catches in the mixed industrial fisheries in the North Sea and adjacent waters, is given in Table 4.8. The catches in the Icelandic industrial fishery in 1989 consisted exclusively of 0-group fish.

The raised age composition combined for the directed fishery in the Norwegian Sea and in the spawning area and the industrial mixed fisheries in the North Sea and in the Icelandic area, were assumed to give the total age composition of landings (Table 4.9).

4.5 Weight at Age

Mean weight-at-age data for 1989 were presented by the USSR and Norway. Landings from other countries were assumed to have the same mean weight-at-age compositions 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 1989 was compared to the sum of products (SOP) of the total numbers landed and mean weights at age. The calculated SOP was found to be 4.3% lower than the nominal landings, and thus at an acceptable level of agreement. The mean weights at age used in the VPA runs are shown in Table 4.10.

4.6 Stock Estimates

4.6.1 Acoustic surveys in 1990

4.6.1.1 Surveys in the spawning season

The first USSR/Norwegian joint survey on blue whiting during the spawning season was carried out from 19 March to 20 April 1990, with a meeting afterwards of the cruise leaders in Tromsø, 23-25 May (Monstad and Belikov, 1990). The USSR coverage was from 19 March to 13 April and the Norwegian coverage from 29 March to 20 April.

Figures 4.1 and 4.2 show the survey routes and stations. One vessel from each country started from the south, in the area southwest of Ireland, and continued northwards along the shelf edge including the Porcupine Bank and the adjacent deep sea area. For the USSR R/V "PINRO" this also included the southern Rockall Bank area.

The distribution and density of the blue whiting recordings obtained from the Norwegian and USSR coverages are shown in Figures 4.3 and 4.4, respectively. Concentrations of blue whiting were mostly found over the continental slope, but also further off the shelf edge over deep sea water. For each vessel the highest concentrations were observed in the Porcupine Bank area.

An intercalibration between G.O. "Sars" and "PINRO" was carried out on 4 April, and the results are given in the Appendix of the cruise report (Monstad and Belikov, 1990).

Due to a time difference of approximately 10 days between the coverages by the two vessels surveying the area, it was decided not to combine the data for a common estimate. Separate estimates of the blue whiting stock size were made for the vessels, using only their own samples in the calculations. The results are given in the text table below:

Vessel	N x 10^{-9}		Mean values		Mill. tonnes		n.mile^2
	Spawn. stock	Total	W (g)	L (cm)	Spawn. stock	Total	Area of distribution
G.O. "Sars"	56.2	62.9	100.7	27.1	5.7	6.3	65.328
"PINRO"	35.3	39.2	139.0	28.6	5.1	5.4	55.500

Soviet scientists distinguished between the Northern and Southern stock components using presence (or absence) of a parasite-marker (Myxobolus aeglefini) (Karasev, 1988). On this basis, the part of the surveyed area with depths less than 300 m, between latitudes 50^0 and 53^0N, was excluded from the total estimate.

The time difference between the coverages during the spawning season resulted in different biological data due to changes in the proportions of fish at the various maturity stages and the corresponding weights. The concentrations had also shifted their location more to the north between the observation times, or had partly migrated to areas outside the surveyed ones, possibly in a westward direction. The two pictures of the observed distribution illustrate the pattern at different times during the spawning migration.

Another reason for not combining the results is the difference in the assessments. The Norwegian result of 5.7 million t for the spawning stock represents 56.2 x 10^9 individuals, while the USSR result of 5.1 million t represents a lesser number of 35.3 x 10^9 individuals.

The total biomass observed in each rectangle is shown in Figures 4.5 and 4.6 for the Norwegian and USSR coverages, respectively.

The difference in mean values of the length and the weight could be due to differences in sampling techniques between the two vessels, explained by the different mesh size in the inner net of the trawls. As mentioned above, this could also be explained by the different observation times as the biggest fish appear on the spawning ground before the smaller ones. The total mean length of 27.1 cm for the Norwegian coverage is 1.5 cm less than for the USSR coverage, while the corresponding Norwegian mean weight of 100.7 g is 38.3 g less than the USSR one.

The total distributions of length and age of blue whiting for the two vessels are shown in Figure 4.7. Norway sampled smaller fish than the USSR and hence obtained a different age composition with the 1988 year class as the most numerous. USSR found the 1986 year class to be the most abundant in the total

area.

The higher weight by length and by age observed by USSR may partly be due to more spawning products being included because of earlier observation time during the spawning season. Large fish mature earlier and hence spawn before smaller fish, and after spawning they leave the area. As mentioned above, the spent fish migrate either northwards or to other areas outside the surveyed one. In addition, differences in age determination from otolith readings may explain some of these differences.

After the spawning stock survey west of the British Isles, the R/V "G.O. Sars" carried out a survey along the Norwegian coast from 30 April to 3 May (Monstad, 1990b).

Blue whiting were recorded along the continental shelf from 62^0N to 68^0N and these consisted almost entirely of 1-group fish (Figure 4.8). The acoustic estimate of total biomass was 571,000 t, representing an abundance of 14.3 x 10^9 specimens of 1-year-olds and 0.4 x 10^9 specimens of 2+ year old fish. The age and length compositions are given in Figure 4.9.

4.6.1.2 Surveys in the feeding season

Four countries carried out acoustic surveys in the Norwegian Sea during July-September of 1990, which, among other objectives, were aimed at determining the blue whiting distribution and density. Working notes and information on the results were submitted to the Working Group. The cruise tracks are shown in Figure 4.10 and the blue whiting distribution area in Figure 4.11.

From 6-18 August the USSR R/V "PINRO" conducted an acoustic survey north and east of the Faroes and also in the open sea waters between 62^0-70^0N and 09^0W-07^0E. Only scattered recordings of blue whiting were observed. Biomass estimates were made and presented in a working paper by Ushakov and Belikov (1990). The 1989 year class was the most abundant, accounting for more than 28% of the catch in numbers. Length ranges 22-23 cm and 28-29 cm were predominant.

From 27 July to 13 August the Norwegian R/V "G.O. Sars" carried out an acoustic survey from $67^0$00' to $72^0$45'N between the Jan Mayen area (15^0W) and the coast of Norway (Monstad and Dommasnes, 1990). The aim of the survey was to search for and investigate herring concentrations. Blue whiting was found scattered over most of the area from east of Jan Mayen to the coast of Norway. The densest recordings were located in the southern part of the investigated area, i.e., at 67^0N and in the Vestfjorden area. The 1989 year class, 15-25 cm in size, dominated, especially near the coast where other year classes were virtually absent.

From 25 August to 10 September the Faroes R/V "M. Heinason" conducted an acoustic survey from 62^0 to 66^0N between 0^0-10^0W. Blue whiting was recorded in most of the area except in the northwestern part. The biomass in the surveyed area was estimated and presented in a working paper by Jacobsen (1990a). The 1989 year class dominated in the western area, comprising 65% of the recordings in the western area, while the 1985 and 1987 year classes were found to constitute 30% and 20%, respectively, of the recordings in the eastern area.

An Icelandic research vessel from 11-15 August carried out an acoustic survey in the area $62^0$30-$65^0$00'N between 20^0-10^0W. Dense concentrations of 1-group of blue whiting were found only off southeast of Iceland. The length range was 19-25 cm with a mean length of 22.07 cm (Sveinbjörnsson, 1990).

4.6.1.3 Discussion

During the first USSR/Norwegian joint survey to the west of the British Isles in spring 1990, the two abundance assessments of the spawning stock were significantly different, resulting in 56.2 x 10^9 and 35.3 x 10^9 individuals for Norway and USSR, respectively. The corresponding areas of blue whiting distribution observed were for Norway 65,328 and for USSR 55,500 square nautical miles, and this fact partly explains the difference.

The two estimates obtained are listed in the text table below (in million t), together with estimates from previous years in the spawning area since 1981. The spawning stock is given in brackets.

Year	Estimates					
	USSR1	USSR2	Norway	Faroes	Scotland	Combined
1981						6.1 (5.4)
1982					2.5	
1983		3.6 (3.5)	4.7 (4.4)			
1984	2.7 (2.4)	3.4 (2.7)	2.8 (2.1)			
1985		2.8 (2.7)		2.4 (2.2)		
1986	6.5 (5.6)		2.6 (2.0)	6.4 (1.7)		- (4.1)
1987	5.4 (5.1)	7.4 (6.9)	4.3 (4.1)			
1988	2.0 (1.9)	3.9 (3.1)	7.1 (6.8)			
1989	6.3 (5.7)		7.0 (6.1)			
1990	5.4 (5.1)		6.3 (5.7)			

The biomass estimates for 1990, however, showed a lesser difference than the abundance estimates, due to compensation of the difference in mean weights observed. The Norwegian result of 5.7 million t of the spawning stock and the USSR result of 5.1 million t give a difference of 0.6 million t in the biomass estimates.

The Norwegian estimate did not include the Rockall area, and hence may be regarded as an underestimate. On the contrary, however, no allowance was made for a component belonging to the Southern stock, as was done for the USSR estimate. The two survey estimates of the spawning stock in 1990 belong to two different observation times. They have both decreased compared to the corresponding estimates in 1989 of 6.1 and 5.7 million t for Norway and USSR, respectively (Anon., 1990a).

Norway sampled smaller fish than USSR and hence obtained different age composition, with the 1988 year class as the most numerous one. USSR found the 1986 year class to be the most abundant in the total area.

The four national surveys carried out during the feeding season in the Norwegian Sea obtained only weak recordings of blue whiting. The biomass estimates by USSR, the Faroes, and Iceland were all within limited areas, and hence represent only minor parts of the total stock. The surveys, however, gave valuable information about the immature part of the stock, and may provide first indices of the blue whiting recruitment as have been done in the past; the latest strong year class was observed as 0-group in 1989.

4.6.2 Catch per unit effort

Data on catch per unit of effort from the directed fisheries in 1989 were submitted by Norway and the USSR. It should be noted that the data from the German

Democratic Republic were not available for the present meeting of the Working Group. The data presented were broken down by vessel tonnage class, area and month.

Comparable time series of CPUE data for Divisions IIa, IVa, Vb, VIa,b, VIIb,c, VIIg-k, which could be indicative of stock abundance changes, are compiled in Tables 4.11 and 4.12.1 and Figures 4.12 and 4.13.

In Division IIa, the blue whiting fishery was predominantly conducted by the USSR fleet during the first three quarters of the year. Whereas the total landings and the total effort declined considerably compared to 1988, the catch per hour in 1989 did not show any clear trend.

Catch per unit effort of the Norwegian vessels (GRT classes 2 and 3) in the directed fishery conducted in Division IVa was substantially lower than in 1988, and approached the same level as in 1987.

In Division Vb, the USSR CPUE increased by about 30% compared to 1988, but was still about 35% below the 1985-1987 level. Likewise, the fishing season in 1989 was shortened encompassing only the period from March to August, compared to all months in the preceding years.

The data from the spawning fishery in Division VIa show a decline for both GRT classes (2 and 3) of Norwegian fishing vessels by 23-62% in different months. However, in Sub-division VIb USSR CPUE increased by 9% and this contributed to the higher catch from this Division.

A similar increasing trend in both Norwegian and USSR catch rates took place in Divisions VIIb,c within the range 16-38%. CPUE data from Divisions VIIg-k are variable, and this does not allow a definite conclusion to be drawn on the direction of the stock biomass changes.

In addition, newly-revised CPUE data for the USSR fishing vessels of different GRT classes (Blinov, 1990a) were available. Those data were averaged with weighting by catches over GRT classes and over Divisions where the USSR fleet has taken catches. Aggregated USSR CPUE data obtained by this method are given in Table 4.12.2 and shown in Figures 4.13 and 4.14.

Aggregated USSR CPUE data for Division IIa show a decreasing trend (Figure 4.13a). A more oscillating pattern of the CPUE data could be seen in Divisions VIa and VIb (Figure 4.13b).

The overall aggregated USSR CPUE data (Figure 4.14) display the effect of the strong year classes of 1982 and 1983. A further increase in CPUE took place after 1987 and this was due mainly to the shifting of the USSR fleet from Division IIa to Divisions Vb, VIb, VIIb,c and VIIg-k. For that reason it is unlikely that the overall index reflects the increase in stock biomass of Northern blue whiting in recent years.

4.6.3 Virtual Population Analysis (VPA)

4.6.3.1 Tuning the VPA to survey results

The Working Group decided to use the ad hoc tuning module of the ICES VPA program to tune the available survey indices and CPUE data to the catch-at-age data of blue whiting. The age range chosen for tuning was 3-11 years, and data from the years 1982-1989 were used. The tuning data used last year are described in Anon.(1990a) and consisted of four fleets: The Norwegian acoustic survey in the spawning area west of the British Isles, USSR acoustic spawning survey, combined acoustic surveys in the Norwegian Sea during the feeding season, and CPUE data

from the USSR commercial fishery in July in the Norwegian Sea. Unfortunately no combined acoustic survey results were available for 1989, therefore, only three fleets were used in the first tuning run (Table 4.13). As the age range in the tuning data started from age 3, the Fs for age groups 0-2 had to be entered manually, and the following Fs where chosen: 0.1, 0.05 and 0.05 for ages 0-2, respectively. The high F for the 0-group in 1989 was chosen to correspond to the F on 0-groups of the strong 1982 year class while the other two are an average of the last few years. These Fs are not included in the mean F computed and used in the further estimation.

The results of the tuning are presented in Tables 4.14 and 4.15, and the resulting VPA run based on the tuning is given in Tables 4.16 to 4.18. As can be seen from Table 4.15, the mean fishing mortality obtained for ages 4-8 was very low (F_{4-8} = 0.076), and the resulting SSB for 1989 amounted to 9.9 million tonnes (Table 4.18), a figure that the Working Group decided not to accept. However, it was decided to present the input tuning data and the resulting tables in order to point out the difficulties experienced when tuning the acoustic indices and the CPUE data to the catches. Several options were tried in the tuning, including allowing for trend in the USSR CPUE data and excluding the CPUE data, but the resulting mean Fs were even lower.

Therefore, the Working Group decided to again include the combined acoustic indices from the Norwegian Sea into the tuning data file and to estimate new indices by age group for 1989. This was done by extrapolating the estimates by age group obtained for 1988 one year ahead by applying the total mortalities for 1988 to the estimates. The new figures obtained are given as the last row in the third fleet in Table 4.19. The tuning results are listed in Table 4.20, and as can be seen the variance ratio for ages 3 and 7-10 was rather high, but the tuning was accepted. A plot of the logarithmic catchabilities for each age group and fleet is given in Figures 4.15a-h. The fishing mortalities and stock size estimates obtained from tuning are given in Tables 4.21 and 4.22. The mean $F_{(4-8)}$ level of 0.134 was accepted as an aim for the estimation of the fishing mortalities from a subsequent separable VPA run.

The Working Group noted the great sensitivity of the tuning method, as the addition of one more fleet resulted in a doubling of the estimated fishing mortality for 1989.

4.6.3.2 Estimation of fishing mortality using separable VPA

A separable VPA based on the tuning results was run with a terminal F of 0.13 at age 5 and terminal S of 1, and the resulting matrix of residuals was acceptable (Table 4.23). The fishing mortalities obtained for 1989 gave an average value for ages 4-8 of 0.134 as aimed for (Table 4.24). The corresponding stock estimates are shown in Table 4.25. For comparison, a plot of the exploitation patterns from tuning and separable VPA is given in Figure 4.16. Some discrepancies were observed for ages 7-9, which might correspond to some of the problems encountered during tuning.

4.6.3.3 Discussion of the stock size estimates from VPA

The results of the VPA indicate a spawning stock at 1 January 1989 of 4.8 million tonnes (Table 4.25), which is an increase of 500 thousand tonnes from 1988 due to the above average 1986 year class entering the SSB. The SSB decreased steadily from 1979 to 1984, but from 1985 onwards an increase is again observed as the strong 1982 and 1983 year classes entered the SSB. The total biomass also shows similar trends, although the estimate for 1989 is not reliable because of uncertainty about the strength of the 1988 and 1989 year classes. As can be seen from Table 4.25, the recruitment has been at an average level of 20 billion

since the strong year class in 1983, except for the 1988 year class which might be below average. As can be seen from Table 4.25, the recruitment had been at an average level of 20 billion since the strong year class of 1983, except for the 1988 year class which might be below average.

In the text table below the ranges of the acoustic spawning stock estimates together with the VPA results from 1983-1990 are shown.

Estimates	1983	1984	1985	1986	1987	1988	1989	1990
Survey min	3.5	2.1	4.1[1]	2.0	4.1	3.1	5.7	5.1
-"- max	4.4	2.7	4.1[1]	5.6	5.1	6.8	6.1	5.7
VPA	2.7	2.4	3.0	3.9	4.0	4.3	4.8	5.1

Biomass in million tonnes. [1]Combined surveys

The spawning stock estimates obtained from the VPA, with a few exceptions do reflect the acoustic survey results. In general, the VPA results tend to be on the lower side of the acoustic estimates. For 1990, the VPA and lower acoustic estimates are close.

4.6.3.4 Yield per recruit

Yield per recruit and spawning stock biomass per recruit have been calculated using data given in Table 4.26 and shown in Figure 4.17C. The exploitation pattern used was the smoothed fishing pattern (S-values) from separable VPA (Table 4.23) scaled so that the average for ages 4-8 was the same as the average F_{4-8} of 0.134 obtained from the tuning for 1989.

The yield per recruit calculations gave an $F_{0.1}$ of 0.26 which is approximately twice the level of present fishing mortality. No F_{max} is present.

The yield per recruit calculations of blue whiting are very sensitive to the exploitation pattern on the younger age groups (0-2) due to the high growth rate in the early years.

4.6.4 Catch Projections and Management Considerations

A projection of catches in 1990 and a resulting total and spawning stock biomass in 1991 were made using the data given in Table 4.26. The stock size estimates at the beginning of 1990 for age groups 3-12+ were taken from the VPA run (Table 4.25). The figure for age group 0 was set equal to the 1980-1987 average of 21,048 million. For the next age group the total fishing mortality for age group 0 in 1989 was applied to the average recruitment obtained, resulting in 17,215 million at age 1. For age group 3 (the 1988 year class) a different method was adopted due to the a priori knowledge of the strength of this year class, which is assumed to be below average. Hence an average recruitment from 1980-1987 excluding the two strong 1982 and 1983 year classes was used as a starting value of 16,527 million at age 0 for the calculation forward to 1990 (Table 4.26). The recruitment of the 1989 year class of 21 billion might be an underestimate (see Section 7) as the Faroese blue whiting survey northwest of the Faroes in 1989 resulted in an estimate of 15 billion at age 0 in a limited area (Jacobsen, 1990a). Also the Norwegian acoustic survey off the Norwegian coast in 1990 gave an estimate of 14 billion blue whiting at age 1 (Monstad, 1990b).

A catch of 630 thousand tonnes was assumed in 1990 corresponding to an average F_{4-8} of 0.16, with a resulting SSB in 1991 of 5.3 million tonnes (Table 4.27).

The results of the catch projections are given in Figure 4.17D and Tables 4.27-4.29. A continuation of the assumed 1990 F level would result in a catch of 667 thousand tonnes in 1991, whereas a fishery at the 1989 F level would have resulted in a catch of 100 thousand tonnes less (Table 4.29). The resulting spawning stock biomass in 1992 of 5.4 and 5.5 million tonnes, respectively, from the two options is rather similar.

Figure 4.18 gives the plot of recruitment versus spawning stock biomass from 1977 to 1988. The estimated F_{med} was 0.28 and is shown in the figure together with F_{high}. Fishing at F_{med} would result in a catch at the same level as in 1979/1980 of about 1 million tonnes.

Because the catch and SSB forecasts for 1991 and 1992 depend rather heavily on the uncertain recruitment estimates, the results of the prediction should be interpreted with caution.

The scarce recordings of blue whiting in the Norwegian Sea during feeding season, together with the decline in the landings from the area, are not easy to explain when compared to the rather high recordings in the spawning season and significant landings from the spawning area. There has possibly been a southward shift in the migration pattern of the stock over the last decade (Monstad 1990c), a possibility which was also commented on in last year's report (Anon., 1990a).

Nevertheless, the catch options listed in Table 4.29, of which the two options for the F levels of F_{89} and F_{90} are the most realistic, predict a nearly stable spawning stock biomass the next two years. Therefore, the Working Group recommends that the TAC should be set at a level of about 670,000 t in 1991 corresponding to a fishing mortality not exceeding the F_{90} level.

5 SOUTHERN STOCK

5.1 Landings

Total landings from the Southern area are given in Table 5.1. The Spanish landings in 1989 increased by about 21%. The Portuguese landings continue the declining trend seen in 1988 with a decrease of about 40% in 1989.

5.2 Landing Compositions by Length and by Age

Table 5.2 summarises the length compositions of blue whiting landings from Spanish and Portuguese fisheries in recent years. Length compositions by quarter are presented in Table 5.3.

Data on age composition since 1981 are given in Table 5.4, calculated with length compositions provided by both countries and age/length keys provided by Spain. As can be observed, most of the fishing was based on the first five age groups, mainly on the 1-, 2-, and 3-year-olds.

Quantitative data on discards are not available, but it is believed they are considerable.

5.3 Weight-at-age and SOP Check

Weight-at-age data from both fisheries, the Spanish and the Portuguese, are presented in Table 5.5. The total landings are compared to the sum of products (SOP) of the total numbers landed and the mean weight at age for the same year

in Table 5.4. The discrepancy is very small for 1989.

5.4 CPUE Data

Definition of a representative CPUE unit is difficult due to the lack of information on discards from the Spanish and the Portuguese fisheries. However, information on CPUE data is given.

In the case of Portugal, no directed fishery exists; blue whiting is captured almost exclusively as a by-catch by bottom trawlers. Fishing hours estimated for this fishery (Cardador, pers.comm. 1989) were adopted. Data from 1989 are not available.

For Spain, in addition to the single bottom trawl fishery there is a pair-trawl fishery that usually does not discard blue whiting. Therefore, CPUE from this fishery might give a more representative index of abundance. Data on catch per unit effort from both fisheries are presented combined in Table 5.6a and Figure 5.1.a and split by fleet in Table 5.7 and Figure 5.1b.

5.5 Maturity at Age

Maturity at age was assumed to be the same as used in last year's assessment (Table 5.16).

5.6 Surveys

5.6.1 Acoustic survey off the Cantabrian and Galician coast

Results from the acoustic survey aiming at the sardine stock in spring 1990 (April-May), showed that the spatial distribution of blue whiting was similar to that observed in previous surveys.

The blue whiting was mainly observed along the edge of the continental shelf in water deeper than 200 m. In the Cantabrian Sea, blue whiting was found in deep waters (about 700 m bottom depth) in scattered schools. The length composition of blue whiting catches (Figure 5.3) shows the predominance of young fish. The fact that the cruise tracks (Figure 5.2) did not cover the whole distribution area of the blue whiting, and the few representative samples taken, means that it is not possible to obtain biomass estimations. However, the Planning Group for Acoustic Surveys in ICES Sub-areas VIII and IX considered Spain should, with the new echosounder SIMRAD-EK500, be able to establish the offshore limit of the distribution area in water deeper than 500 m, and eventually estimate the abundance of this species (Anon., 1990c).

5.6.2 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 up to 500 m (Tables 5.8.1 and 5.8.2). The biomass indices from the Spanish surveys split by age were included as input in the tuning models of the ICES VPA program (Table 5.9).

Bottom trawl surveys using commercial trawlers were also conducted on 14 February, 20 March, and 31 March 1989; these were assumed to take place within the spawning season and were for the purpose of studying the batch fecundity of the blue whiting. The results were presented as a working paper by Perez and Meixide (1990). The presence of ovaries with hydrated and yolk oocytes, and old

post-ovulatory follicles at the same time, shows that there is a very short period between two partial spawnings for the blue whiting. A large proportion of ovaries were found showing alpha atresia, also present in hydrated oocytes, and these represent important findings for the calculation of the batch fecundity of this species.

5.7 Tuning of Virtual Population Analysis

The Laurec-Shepherd tuning method was applied to provide an estimate of the level of fishing mortality. It was decided to use CPUE data from the pair trawling fleet (Spanish fishery) due to the fact that discards are lower in these vessels. Survey indices from Spanish bottom trawl surveys were also used (Table 5.9).

Table 5.10 shows the log catchabilities by fleet, and there do not seem to be any cear trends in this period. The variance ratio is quite high for some ages, and SE(q) values are higher for the Spanish trawl survey. The resulting fishing mortalities are shown in Table 5.11.

5.8 Separable Virtual Population Analysis

Following the same procedure as last year, a terminal F of 0.53 on age 2 and a terminal S of 1.5 were used to reach the average F for ages 1 to 4 provided by the tuning. Figure 5.4 shows the resulting exploitation patterns from both the tuning run and the separable VPA. The resulting matrix of residuals did not contain high values except for the youngest ages (Table 5.12). The fishing mortalities and stock sizes estimated in the VPA based on these results are shown in Tables 5.13 and 5.14.

5.9 VPA Results

The VPA results show that the spawning stock seems to be very stable, with the lowest level in 1984. Since this year, it has been increasing, reaching in 1989 the highest level of the period. The recruitment is in agreement with the one in last year's assessment from 1981 to 1986, and in agreement with the values predicted last year for 1987 and 1988, using the RCRTINX2 program.

5.10 Recruitment

Numbers at age 0 estimated by final VPA were regressed against the 0-group indices from Spanish bottom trawl surveys carried out in September/October from 1981 to 1989. CPUE data at age 1 were taken as indices of recruitment of previous years, and the RCRTINX2 program was run.

The predicted values are shown in Table 5.15. For 1988, as the predicted recruitment is at the same level than the value provided by the final VPA, no changes were made. The predicted value for 1989 was used to calculate the surviving population at age 1 used in the prediction calculations.

5.11 Yield per Recruit and Catch Forecast

Terminal populations from the final VPA (corrected for age 1 with the surviving population of the predicted 1989 recruitment) and separable fishing mortalities were used for the catch forecast (Table 5.16). A geometric mean of the recruitment in the period 1981-1987 (1238 millions) was assumed for the years 1990-1992. The yield per recruit calculations give an $F_{0.1}$ = 0.15 and F_{max}= 0.88,

while the fishing mortality in 1989 was 0.45 (Figure 5.5c)

The catch forecast assuming continued status quo fishing mortality predicts catches of 34,000 t in 1990 and 35,000 t in 1991. The SSB is predictedd to increase to 50,000 t in 1990. The results of the projections are given in Figure 5.5D and Table 5.17, and results in detailed format are shown in Table 5.18. At fishing mortality levels less than the status quo level, the SSB will continue to increase.

5.12 Safe Biological Limits

F_{med} and F_{high} are shown in Figure 5.6; these were obtained by plotting spawning stock biomass against recruitment, both from the final VPA, for the period 1981-1988 (Figure 5.6) No evidence of any stock/recruitment relationship could be observed, and the stock seems to be stable. With fishing at the level of F_{med} and F_{high} in 1991, the SSB in 1992 remains at the level of the previous years (Table 5.17).

5.13 Management Considerations

There are uncertainties concerning stock identity, distribution of the spawning stock and its relationship to the Porcupine Bank population. However, the predicted catch in last year's report (34,000 t) is in agreement with the Spanish and Portuguese landings in 1989 (33,665 t). Despite the uncertainties, the assessment can serve as a basis for management in order to maintain this fishery based on young age groups at a controlled level.

6 ZONAL DISTRIBUTION

The joint Soviet-Norwegian survey conducted in 1990 continued to show that during the spring period the distribution of the blue whiting spawning stock is mainly in the EC zone (84.7%), and to a much lesser extent within the Norwegian and Faroese zones, as well as in international waters (Table 6.1). During the summer period the stock undertakes a feeding migration and is observed mainly in the national zones of Norway and the Faroes as well as in the open waters of the Norwegian Sea. Only an insignificant part of the stock is found in the EC zone at this time (Figure 4.11).

To update the information on partition of the blue whiting total catch into areas within and beyond the national fisheries jurisdiction zones, the 1989 catch was divided using the data brought to the meeting by the Working Group members, and official statistics reported to ICES. For some countries the landings were split according to statistics based on the current reporting of the fleet. Due to the lack of information from some of the countries involved in the fishery the Working Group had to make assumptions concerning the available statistics (Table 6.2).

7 DISTRIBUTION IN TIME AND SPACE OF THE BLUE WHITING STOCK

In the 1985 report of the Blue Whiting Assessment Working Group (Anon., 1986), available knowledge from various sources on the distribution of the blue whiting stock was summarized and presented in figures. The information was further updated in the 1989 report (Anon., 1990a). Additional knowledge and ideas on the subject are presented in this section, with the map illustrations of the distribution of the adult part of the stock and the main fishery areas revised in Figures 7.1a and 7.1b, respectively.

Spawning area

The main spawning areas of blue whiting are located along the continental slope west of the British Isles (Bailey, 1982; Zilanov, 1984; Belikov and Shevchenko, 1989). Spawning outside this area (i.e., in the Rockall Bank area, the southern parts of the Faroese shelf, and the Norwegian Shallow) plays a much less significant role in the reproduction of blue whiting.

Pre-spawning fish concentrations are distributed not only along the edge of the continental shelf, but also in water of depths of more than 1,500-2,000 m.

During the spawning season, fish usually concentrate in depths in the range of 350-600 m and virtually no vertical migration is made during the main spawning period (Belikov and Shevchenko, 1989).

Distribution of concentrations of blue whiting within the principal spawning areas is largely determined by the position of the Eastern Boundary Slope Current. In 1988-1989, the distribution was further west than usual but in 1990 concentrations were located nearer the shelf (Monstad and Belikov, 1990).

In 1989, an attempt was made to sub-divide the whole stock of Northern blue whiting into two stocks. Unfortunately, investigations aimed at making a clear population structure of the Northern blue whiting stock were conducted only in theoretical aspects (Isaev et al., 1990; Monstad, pers. comm.). It is likely that an unknown part of the Northern blue whiting stock migrates westwards and southwestwards after spawning. It is important to continue the investigations concerning the routes of migration of the post-spawning blue whiting.

Nursery area

The feeding grounds of young blue whiting (of ages up to 2 years) are known to cover the area around Faroes, the northern part of the North Sea, the area off the mid- and southern coast of Norway and the area off the southern coast of Iceland.

During a Norwegian acoustic survey from 2 to 25 November 1989 along the Norwegian continental shelf area, 0-group blue whiting were found, with the densest registrations off the coast of Norway at latitude 67^0N (Figure 7.2).

From 22 April to 5 May 1990, the R/V "PINRO" conducted an ichthyoplankton survey west of the British Isles (Belikov et al., 1990). The larval distribution is similar to that obtained in ichthyoplankton surveys in the same area prior to 1989. The largest concentrations of blue whiting larvae are found from 58^0N to 59^0N and from 8^0W to 10^0W in shallow inshore areas (Figure 7.3). As observed in previous years, no larvae were taken in samples from around the Porcupine Bank. The majority of larvae were between 4.1 and 5.5 mm with a mean length of 4.6 mm. In 1989, however, the corresponding ichthyoplankton survey was conducted at a later time and hence no blue whiting larvae were observed at all.

The results of the international 0-group fish survey in the Barents Sea and adjacent waters in August-September 1990 have shown that blue whiting were located within a limited area from the coast of Finnmark into the central part of the Barents Sea (Figure 7.4.) (Anon., 1990b). Only low numbers were caught, but they were more abundant than in the previous year (Figure 7.6) (Anon., 1989).

Observation on the 1989 Year-Class

a) As 0-group:

Considerable concentrations of 0-group blue whiting were recorded by research vessels from Norway, USSR, Faroes, and Iceland during summer-autumn 1989. During August in the Faroese waters, an abundance of 15 x 10^9 0-group individuals was recorded, representing 97% of the total estimate. The age composition is given in Figure 7.5 (Jacobsen, 1990a).

In August-September, 0-group blue whiting were also recorded in the Barents Sea during the international 0-group survey, but was found rather scattered off the mid-Finmark coast (Figure 7.6) (Anon., 1989).

In the latter half of October, blue whiting were recorded within a small area west of Iceland (position about 66^0 N, 28^0 W), estimated at 31,700 t or 0.9 x 10^9 individuals. The length range was 15-20 cm indicating that they were all belonging to the 0-groups (Sveinbjörnsson, 1990).

In November 1989, 0-group blue whiting were observed between 60^0 N and 68^0 N along the coast of Norway, as shown in Figure 7.2. The recordings were estimated at 96,200 t, representing 4.9 x 10^9 individuals (Monstad, 1990a).

b) As 1-group:

The survey along the Norwegian coast in April/May 1990 gave further indication of the strength of the 1989 year class (Figure 7.7). The abundance of 14.3 x 10^9 individuals is very different from the estimate of 3.7 x 10^9 obtained as 0-group in November 1989 within that same coastal area (Monstad, 1990b). Accordingly, the results of the various countries' summer surveys in 1990 support the indication that the 1989 year class is a strong one. It dominates nearly the whole of the observed distribution area in the Norwegian Sea. Thus, it is reasonable to assume that the 1989 year class of blue whiting is the most abundant within the period 1984-1990.

8 RECOMMENDATIONS

1) The Working Group stresses the importance of annual investigations of the Northern blue whiting stock. It is recommended that joint Soviet-Norwegian surveys aimed at assessing blue whiting stock biomass in the spawning area during spring be continued. The surveys must be conducted simultaneously by vessels of both countries so as to provide more consistent results.

2) The Working Group recommends the continuation of acoustic surveys in the Norwegian Sea on a national basis aimed at obtaining more information, particularly on the distribution of young blue whiting.

3) The Working Group stresses the importance of acquiring further knowledge about the population structure of the blue whiting stocks and recommends that further investigations be made on this in 1991.

4) The Working Group recommends that the present Working Group and the Working Group on Oceanic Hydrography cooperate (Coordinator: Mr J.A. Jacobsen) to clarify the current system dynamics and sea water mass structures in the area west and southwest of Ireland and their influence on the distribution of blue whiting.

5) Based on observations made in 1989 and 1990, the Working Group believes that the 1989 year class may be at a higher level than the average. As a result, the industrial mixed fishery will tend to be aimed at the high abundance of this resource, and hence a rather high number of small individuals will be caught. To avoid serious biases in the data set for the stock analysis, it is strongly recommended that the countries participating in this fishery frequently sample the catches and bring to the Working Group biological data as well as the catch data.

6) The Working Group recommends that the countries involved in the directed blue whiting fishery continue to provide their CPUE data both in terms of catch/day and catch/hour from 1990 onwards in order that those data may be used in further VPA tuning trials in a disaggregated form.

7) The results of surveys and investigations have provided some evidence of a separate Southern stock. In order to assess and manage the Southern stock, acoustic surveys are needed. The Working Group recommends that more surveys be undertaken to investigate the total distribution area for the Southern stock.

8) The Working Group recommended in last year's report a Workshop for ageing blue whiting otoliths. This was not approved by the Statutory Meeting. As the age-reading problems seem to be very important, as shown in the results of the Otolith Exchange, the Working Group recommends a new Otolith Exchange, including otoliths from the various areas. The countries involved in this exchange must provide measurements of all the observed rings, and indicate which of them should be considered annual rings, to make possible an analysis of the frequency distribution of the rings.

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Table 4.1 Landings (tonnes) of BLUE WHITING from the main fisheries, 1980-1989, as estimated by the Working Group.

Area	1980	1981	1982	1983	1984
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	766,798	520,738	110,685	52,963	65,932
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	250,693	288,316	316,566	361,537	421,865[2]
Icelandic industrial fishery (Division Va)	-	-	-	7,000	-
Industrial mixed fishery (Divisions IVa-c, Vb, IIIa)	75,129	61,754	117,578	117,737	122,806
Subtotal northern fishery	1,092,620	870,808	544,829	539,237	610,603
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k)	29,944	38,748	31,590	30,835	31,173[3]
Total	1,122,564	909,556	576,419	570,072	645,776

Area	1985	1986	1987	1988	1989[1]
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	90,742	160,061	123,042	55,829	37,638
Fishery in the spawning area (Divisions Vb, VIa, VIb, VIb and VIIb + VIIc)	464,265[2]	534,263[2]	445,884[2]	421,636	477,829
Icelandic industrial fishery (Division Va)	-	-	-	-	4,977
Industrial mixed fishery (Divisions IVa-c, Vb, IIIa)	97,769	99,580	62,689	45,110	75,958
Subtotal northern fishery	652,776	793,904	631,615	522,575	596,402
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k)	42,820[3]	33,082[3]	32,819[3]	30,838	33,695
Total	695,596	826,986	664,434	553,413	630,097

[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 4.2 Landings (tonnes) of BLUE WHITING from the Norwegian Sea (Sub-areas I and II, Divisions Va, XIVa and XIVb) fisheries, 1979-1988, as estimated by the Working Group.

Country	1980	1981	1982	1983	1984
Denmark	-	-	473	-	93
Faroes	-	11,131	-	11,316	-
France	-	5,093	2,067	2,890	-
German Dem. Rep.	14,234	15,607	3,042	5,553	8,193
Germany, Fed. Rep.[2]	8,919	17,385	890	2	35
Greenland	-	-	-	-	-
Iceland	4,562	4,808	-	-	105
Norway	902	187	-	5,061	689
Poland	11,307	2,434	443	-	-
UK (Engl. & Wales)	-	-	-	-	-
USSR	726,874	464,093	103,770	28,141	56,817
Total	766,798	520,738	110,685	52,961	65,932

Country	1985	1986	1987	1988	1989[1]
Denmark	-	-	-	-	-
Faroes	-	-	9,290	-	1,047[4]
France	-	-	-	-	-
German Dem. Rep.	1,689	3,541	1,010	3	1,341
Germany, Fed. Rep.[2]	75	106	-	-	-
Greenland	-	10	-	-	-
Iceland	-	-	-	-	-
Norway	-	-	-	-	-
Poland	-	-	56	10	-
UK (Engl. & Wales)	-	-	-	-	-
USSR	88,978	156,404	112,686	55,816	35,250
Total	90,742	160,061	123,042	55,829	37,638

[1] Preliminary.
[2] Including catches off East Greenland (Division XIVb) (698 t in 1978, 204 t in 1979, and 8,757 t in 1980).
[3] Including purse seine catches of 29,162 t of juvenile blue whiting.
[4] Catches taken in Division IVa.

Table 4.3 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), 1980-1989, as estimated by the Working Group.

Country	1980	1981	1982	1983	1984
Denmark	19,272	11,361	23,164	28,680	26,445
Faroes	37,488	23,107	38,958	56,168	62,264
France	-	-	1,212	3,600	3,882
German Dem. Rep.	181	6,562	7,771	3,284	1,171
Germany, Fed. Rep.	709	935	701	825	994
Iceland	5,375	10,213	1,689	1,176	-
Ireland	-	-	-	-	-
Netherlands	-	222	200	150	1,000
Norway	133,754	166,168	169,700	185,646	211,773
Poland	-	2,279	-	-	-
Spain	-	-	-	318	-
Sweden	3,185	-	-	-	-
UK (Engl. & Wales)	3,878	6,000	-	-	33
UK (Scotland)	6,819	2,611	-	-	-
USSR	40,032	58,858	73,171	81,690	114,303
Total	250,693	288,316	316,566	361,537	421,865

Country	1985	1986	1987	1988	1989[1]
Denmark	21,104	11,364	2,655	797	25
Faroes	72,316	80,564	70,625	79,339	70,711
France	-	-	-	-	2,190
German Dem. Rep.	6,839	2,750	3,584	4,663	3,225
Germany, Fed. Rep.	626	-	266	600	848
Iceland	-	-	-	-	-
Ireland	668	16,440	3,300	245	-
Netherlands	1,801	8,888[2]	5,627	800	2,078
Norway	234,137	283,162[2]	191,012	208,416	258,386
Poland	-	-	-	-	-
Spain	-	-	-	-	-
Sweden	-	-	-	-	-
UK (Engl. & Wales)	2	10	5	3	1,557
UK (Scotland)	-	3,472[3]	3,310	5,068	11,127
USSR	126,772	127,613[3]	165,497	121,705	127,682
Total	464,265	534,263	445,884	421,636	477,829

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

Table 4.4 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, 1980-1989, as estimated by the Working Group.

Country	1980	1981	1982	1983	1984
Denmark	49,947	35,066	34,463	38,290	48,939
Faroes	1,895	3,133	27,269	12,757	9,740
France	-	-	1,417	249	-
German Dem. Rep.[2]	-	-	-	-	-
Germany, Fed. Rep.[2]	252	-	93	-	566
Ireland	-	2,744	-	-	-
Netherlands	-	-	-	-	122
Norway	21,962[3]	18,627	47,856	62,591	58,038
Poland[2]	-	229	550	-	-
Spain	-	-	-	-	-
Sweden[4]	1,071	1,955	1,241	3,850	5,401
UK (Engl. & Wales)[2]	-	4,689	-	-	-
UK (Scotland)	2	-	-	-	-
USSR[2]	-	-	-	-	-
Total	75,129	61,754	117,578	117,737	122,806

Country	1985	1986	1987	1988	1989[1]
Denmark	35,843	57,315	28,541	18,114	26,605
Faroes	3,606	5,678	7,051	492	3,325
France	-	-	-	-	-
German Dem. Rep.[2]	-	-	53	-	-
Germany, Fed. Rep.[2]	52	-	62	280	3
Ireland	-	-	-	-	-
Netherlands	130	1,114	-	-	-
Norway	54,522	26,941	24,969	24,898	42,956
Poland[2]	-	-	-	-	-
Spain	-	-	-	-	-
Sweden[4]	3,616	8,532	2,013	1,226	3,062
UK (Engl. & Wales)[2]	-	-	-	-	7
UK (Scotland)	-	-	-	100	-
USSR[2]	-	-	-	-	-
Total	97,769	99,580	62,689	45,110	75,958

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

Table 4.5 Preliminary data on landings (t) of BLUE WHITING in 1990 based on information from Working Group members.

Country	Area	Jan	Feb	Mar	Apr	May	Jun	Jul		Total
Denmark	IVa	-	-	-	-	-	-	-		272
	IVb	-	-	-	-	-	-	-		307
									Sum	579
Faroe Islands	IVa	-	-	-	-	2,178	720	-		2,898
	Vb	-	216	230	64	3,884	1,030	-		5,424
	VIa	-	-	1,699	7,035	7,841	721	43		17,339
	VIIb,c	2,210	1,222	-	-	-	-	-		3,432
	VIIg-k	-	2,445	5,100	7,034	-	-	-		14,579
									Sum	43,672
Netherlands	Iva	-	-	-	-	-	-	-		2,268
	VIa	-	-	-	-	-	-	-		1,100
	VIIb,c	-	-	-	-	-	-	-		2,719
	VIIg-k	-	-	-	-	-	-	-		442
									Sum	6,529
Norway	IIa	-	-	-	-	577	86	102		165
	IVa	1,286	8	473	6,400	5,332	4,437	4,508		22,444
	IVb	173	-	466	59	-	-	-		698
	Vb	-	-	-	-	18,584	-	-		18,584
	VIa	-	-	-	77,295	26,576	-	-		103/871
	VIb	-	-	616	-	-	-	-		616
	VIIb,c	13,565	81,068	48,941	19,376	-	-	-		162,950
	VIIg,k	-	2,335	24,313	1,463	-	-	-		28,011
									Sum	337,939
UK (Scotland)	VIa	-	-	-	-	-	-	-		4,010
	VIIb,c	-	-	-	-	-	-	-		1,983
									Sum	5,993
USSR	IIa	-	-	10	99	-	34	122		265
	Vb	-	169	-	4,900	35,955	27,706	2,152		70,882
	VIb	-	-	-	504	-	-	-		504
	VIIb,c	-	-	578	215	-	-	-		793
	VIIg-k	-	2,119	14,661	1,877	-	-	-		18,657
	XII	-	1,348	9,961	1,620	-	-	-		12,929
									Sum	104,030
									Grand total	498,742

Table 4.6.1 Length distribution of BLUE WHITING in 1989, USSR, %.

Length (cm)	Divisions								
	II	IVa	Vb_1	Vb_2	VIa	VIb	VIIb,c	VIIg-k	XII
15	-	-	0.6	0.5	-	-	-	-	-
16	-	-	2.2	4.0	-	-	-	-	-
17	-	0.5	2.2	4.5	-	-	0.1	-	-
18	-	1.5	1.6	4.5	0.7	-	0.7	-	-
19	-	0.5	0.5	2.0	3.0	-	2.1	-	-
20	-	-	0.6	0.5	2.0	-	2.9	-	-
21	0.1	1.5	0.6	0.5	2.0	1.0	1.3	-	-
22	0.1	5.5	0.9	1.0	2.3	1.0	1.2	0.5	-
23	1.3	14.0	3.0	1.0	1.3	8.0	1.2	-	-
24	1.4	30.5	4.7	1.5	4.7	10.0	5.1	1.5	1.0
25	3.8	17.5	7.4	5.5	7.4	19.0	6.6	1.5	-
26	10.0	9.0	10.6	12.5	7.7	19.0	8.2	7.0	1.0
27	11.1	5.0	10.3	20.5	5.3	9.0	14.5	10.5	9.0
28	11.2	4.0	9.6	11.5	4.0	10.0	12.1	10.5	10.0
29	14.5	2.5	9.6	5.5	7.0	9.0	13.3	14.0	12.0
30	14.4	2.0	10.5	6.5	9.3	6.0	11.6	15.5	14.0
31	11.8	0.5	7.7	6.5	11.0	2.0	7.1	15.5	17.0
32	8.4	2.0	7.6	4.0	11.4	4.0	3.1	8.5	7.0
33	6.8	0.5	5.2	2.5	6.3	1.0	3.4	7.0	19.0
34	2.5	-	2.3	2.5	2.7	-	1.6	3.5	4.0
35	1.4	0.5	1.4	1.0	3.3	-	2.0	2.5	3.0
36	0.6	1.0	0.5	0.5	3.0	1.0	0.7	0.5	1.0
37	0.4	1.0	0.1	1.0	2.3	-	0.7	1.0	-
38	0.1	-	0.1	0.5	2.3	-	0.3	0.5	-
39	0.1	0.5	-	0.5	0.7	-	0.1	-	-
40	-	-	0.1	-	0.3	-	0.1	-	1.0
41	-	-	-	-	-	-	-	-	1.0
42	-	-	0.1	-	-	-	-	-	-
43	-	-	-	-	-	-	-	-	-
44	-	-	-	-	-	-	-	-	-
Number sp.N	2,100	200	1,100	200	300	100	900	200	100
Mean length	29.3	25.1	27.6	25.8	29.1	26.7	27.9	29.8	30.8

Table 4.6.2 BLUE WHITING.
Length distribution (%) by month and division from Norwegian Directed Fishery in 1989.

Length cm	Jan VIIb,c	Feb VIIb,c	Mar VIIb,c	Apr VIIb,c	Feb VIIg-k	Mar VIIg-k	Apr VIIg-k	Apr VIa	May VIa	May Vb	May IVa
15	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-
17	-	-	0.1	-	-	-	-	-	-	-	-
18	-	-	0.2	-	-	-	-	0.1	0.2	-	-
19	-	-	0.3	0.1	-	-	-	0.2	0.6	-	-
20	-	-	0.1	0.3	-	-	0.6	0.4	1.5	0.4	0.5
21	-	-	-	0.1	-	-	-	0.6	2.0	0.4	0.5
22	-	-	0.3	0.1	-	-	0.7	0.4	1.3	0.4	0.5
23	1.0	1.2	1.2	0.8	1.0	1.1	-	1.5	3.1	0.7	0.5
24	1.9	1.0	2.4	2.9	2.1	4.1	2.7	2.9	4.0	1.9	0.5
25	4.8	4.9	5.0	6.3	5.9	6.2	4.0	4.9	11.1	7.8	7.3
26	7.7	11.9	7.0	9.9	10.0	12.4	11.3	6.4	11.8	10.0	10.7
27	10.6	15.4	11.7	15.0	16.6	12.1	8.7	9.2	11.6	13.0	13.6
28	16.3	14.1	13.5	18.0	19.4	17.2	17.3	13.7	13.9	11.9	11.6
29	15.3	9.5	12.3	12.6	16.2	10.6	18.6	12.6	11.9	12.7	12.7
30	16.3	13.8	14.7	10.5	10.3	14.2	12.7	12.0	9.2	11.5	12.7
31	10.6	5.3	11.0	9.3	7.7	7.1	5.3	10.6	8.2	11.5	11.2
32	6.7	9.5	7.7	4.8	4.1	4.7	4.7	9.2	3.5	7.8	8.8
33	4.8	5.4	5.4	3.8	1.8	3.5	5.3	5.7	3.0	4.8	5.4
34	1.0	4.4	3.2	2.6	1.5	1.6	4.7	3.8	1.4	1.1	0.5
35	1.0	2.5	2.0	1.8	2.8	3.8	0.7	3.4	0.3	1.1	0.5
36	1.0	0.8	1.2	0.5	0.3	0.8	0.7	1.3	0.7	1.1	1.0
37	1.0	0.3	0.6	0.4	0.3	0.6	0.7	0.6	0.4	1.1	1.0
38	-	-	0.1	0.1	-	-	0.7	0.2	0.2	0.4	0.5
39	-	-	-	0.1	-	-	0.6	0.1	0.1	0.4	-
40	-	-	-	-	-	-	-	0.1	-	-	-
41	-	-	-	-	-	-	-	0.1	-	-	-
42	-	-	-	-	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-	-	-	-	-
44	-	-	-	-	-	-	-	-	-	-	-
45	-	-	-	-	-	-	-	-	-	-	-
N samples	104	590	1,199	735	390	634	150	1,733	958	269	205

Table 4.6.3 BLUE WHITING.
Length distribution (%) by month and division for the Norwegian mixed industrial fishery in 1989.

Length cm	IVa	IVa	IVa	IVa	IVa	Sep IVa South 08	Sep IVa North 28	4th Quarter IVa
08	-	-	-	-	-	-	9.3	3.8
09	-	-	-	-	-	-	21.3	10.4
10	-	-	-	-	-	-	23.1	3.4
11	-	-	-	-	-	-	3.7	2.1
12	-	-	-	-	-	1.8	12.0	3.6
13	-	-	-	-	-	4.4	20.4	16.8
14	-	-	-	-	-	11.3	9.3	26.1
15	-	-	-	-	-	2.9	0.9	20.9
16	0.4	-	-	-	-	1.6	-	10.4
17	-	-	-	-	-	0.5	-	1.7
18	1.1	0.9	-	-	-	-	-	-
19	3.2	1.8	-	-	-	-	-	-
20	14.2	21.7	-	-	-	-	-	-
21	13.1	27.9	8.8	3.2	1.3	0.5	-	-
22	6.4	17.1	9.7	8.2	6.4	3.5	-	-
23	3.9	9.0	7.1	16.9	21.8	10.7	-	0.2
24	8.9	1.8	7.1	18.5	23.5	12.9	-	0.2
25	11.6	7.2	11.5	10.7	9.7	10.3	-	-
26	5.3	8.1	22.1	13.2	10.2	7.2	-	-
27	3.6	4.5	17.7	11.9	10.2	8.3	-	-
28	6.0	-	6.2	7.1	5.7	5.7	-	0.2
29	7.5	-	4.4	3.2	3.6	5.7	-	0.2
30	3.9	-	1.8	2.0	2.8	4.8	-	-
31	1.8	-	2.7	2.0	1.9	2.6	-	-
32	2.1	-	0.9	1.0	0.8	2.0	-	-
33	2.5	-	-	0.2	0.2	1.0	-	-
34	0.4	-	-	0.5	0.6	0.4	-	-
35	0.4	-	-	1.2	1.1	0.8	-	-
36	0.4	-	-	-	-	0.4	-	-
37	0.4	-	-	0.2	0.2	0.4	-	-
38	0.4	-	-	-	-	0.1	-	-
39	0.4	-	-	-	-	0.1	-	-
40	0.4	-	-	-	-	-	-	-
41	-	-	-	-	-	0.1	-	-
N samples	281	111	113	402	472	768	108	470

Table 4.6.4 BLUE WHITING.
Length distribution (%) of commercial catches for the Netherlands in 1989.

Length cm	1. Quarter VIIk (%)	2. Quarter VIIj (%)
15	-	-
16	-	-
17	-	-
18	0.2	1.2
19	0.5	9.1
20	0.3	6.9
21	0.2	3.4
22	0.3	18.2
23	1.6	30.6
24	4.1	15.8
25	8.0	9.1
26	8.0	2.2
27	12.2	2.2
28	13.5	-
29	13.5	1.2
30	10.7	-
31	11.3	-
32	7.0	-
33	4.4	-
34	2.0	-
35	1.4	-
36	0.3	-
37	0.3	-
38	0.1	-
39	-	-
40	-	-
N samples	2,771	582

Table 4.6.5 BLUE WHITING.
Length distribution (%) by month and division from Faroese commercial catches in 1989.

Length cm	Apr VII	May VIa	May Vb	Jun Vb	May+Jun joint Vb	Aug IIa
10	-	-	-	-	-	1.3
11	-	-	-	-	-	7.9
12	-	-	-	-	-	18.3
13	-	-	-	-	-	18.5
14	-	-	-	-	-	18.8
15	-	-	-	-	-	9.7
16	-	-	-	-	-	5.4
17	-	-	-	-	-	1.3
18	-	-	0.1	-	0.1	0.4
19	-	-	0.4	-	0.3	-
20	-	1.3	1.2	-	1.0	-
21	-	1.0	4.3	-	3.4	-
22	0.4	-	2.6	0.5	2.1	0.3
23	2.2	1.0	4.4	-	3.5	0.7
24	1.8	5.0	8.3	0.5	6.7	1.0
25	3.3	7.0	13.6	5.8	12.0	1.9
26	6.6	11.6	17.3	11.5	16.3	2.4
27	12.1	13.6	10.8	13.2	11.2	1.8
28	16.8	13.6	9.7	14.3	10.8	2.8
29	17.6	14.3	6.9	13.7	8.2	2.7
30	11.0	8.3	6.9	15.8	8.7	1.0
31	7.0	8.0	6.5	15.8	8.4	0.9
32	8.1	7.0	3.0	6.3	3.6	1.6
33	5.1	4.7	2.7	1.1	2.4	0.6
34	3.3	3.0	1.3	0.5	1.2	0.6
35	0.7	-	-	-	-	0.1
36	0.7	-	-	-	-	-
37	1.8	0.3	-	-	0.1	-
38	1.1	0.3	-	-	-	0.1
39	-	-	-	-	-	-
40	0.4	-	-	-	-	-
N samples	273	301	744	190	934	670

Table 4.6.6 Length distribution (%) of BLUE WHITING in 1990 (January - June), USSR.

Length (cm)	Divisions						
	IIa	IVa	Vb_1	VIa	VIb	VIIb,c	VIIg-k
16	-	1.0	-	-	-	-	-
17	1.3	3.0	1.5	0.6	-	-	-
18	2.7	3.0	2.0	1.1	-	-	1.0
19	4.7	5.0	4.0	0.8	-	0.3	0.7
20	8.0	8.0	12.5	0.8	-	1.0	0.3
21	10.7	5.0	13.0	1.1	1.0	1.3	1.5
22	2.7	4.0	8.0	2.6	2.0	2.3	2.0
23	2.7	3.0	4.5	3.1	2.5	4.0	2.8
24	1.3	1.0	3.5	4.0	6.5	4.0	6.3
25	-	7.0	2.0	2.6	5.6	3.0	7.0
26	2.0	9.0	5.0	6.3	7.0	4.3	7.7
27	4.7	14.0	11.0	9.4	7.0	6.7	4.5
28	4.0	9.0	5.5	10.0	8.0	12.0	7.8
29	4.7	4.0	4.5	10.8	9.0	13.4	8.8
30	10.0	5.0	3.5	6.3	11.5	13.4	13.0
31	9.3	6.0	4.5	6.3	8.0	11.0	8.8
32	12.7	5.0	1.5	4.3	7.0	7.7	6.8
33	7.3	2.0	3.0	9.7	5.5	4.3	6.5
34	6.6	3.0	3.5	3.4	5.5	4.3	5.2
35	4.0	1.0	1.0	5.1	6.0	3.3	3.2
36	-	-	2.5	4.0	3.0	0.7	3.4
37	-	2.0	1.5	3.4	2.0	1.0	1.5
38	-	-	1.5	2.6	1.0	0.7	0.8
39	0.6	-	-	1.1	1.0	1.0	0.2
40	-	-	-	0.3	0.5	-	0.2
41	-	-	-	0.3	-	0.3	-
42	-	-	-	-	0.5	-	-
43	-	-	-	-	-	-	-
44	-	-	0.5	-	-	-	-
Number sp.N	150	100	200	351	200	300	600
Mean length	27.6	25.9	25.6	29.6	29.7	29.2	29.1

Table 4.6.7 BLUE WHITING.
Length distribution (%) by month and division for the Norwegian directed fishery in 1990.

Length cm	Jan VIIb,c	Feb VIIb,c	Mar VIIb,c	Mar VIIg-k	Apr VIIb,c	Apr VIa	May VIa	May Vb
10	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-
20	-	-	-	-	-	0.1	-	0.5
21	-	0.1	-	-	-	0.2	-	0.8
22	-	0.1	-	-	-	0.3	-	0.8
23	0.4	0.5	0.5	-	-	0.3	0.4	-
24	0.4	1.4	1.7	0.4	-	0.6	0.7	-
25	3.6	3.0	2.6	2.0	2.4	3.9	2.3	0.9
26	7.7	5.2	8.5	4.1	2.5	4.2	6.1	3.8
27	10.9	14.5	11.0	10.6	7.4	7.7	7.5	7.4
28	12.3	17.6	10.6	8.0	15.8	8.9	7.2	10.0
29	11.3	14.1	13.9	8.1	7.4	7.7	7.6	15.5
30	16.1	12.5	11.4	112.3	7.1	15.1	14.1	21.0
31	16.3	11.9	10.6	12.2	8.7	16.2	12.0	11.9
32	9.2	9.3	11.3	21.0	14.4	13.8	13.2	7.0
33	5.1	5.0	6.5	8.9	13.0	9.0	13.8	5.7
34	2.6	2.4	3.8	6.9	9.2	6.4	5.8	6.8
35	2.8	1.5	2.5	3.2	7.3	2.8	2.4	4.0
36	1.0	0.3	2.7	1.2	2.6	1.4	3.3	2.0
37	0.2	0.3	1.5	0.6	1.5	0.7	1.7	1.2
38	-	0.2	0.4	0.3	0.4	0.4	0.6	0.4
39	-	0.1	0.3	0.2	0.3	0.3	0.5	0.2
40	-	0.1	0.1	-	-	-	0.1	0.1
41	-	-	0.1	-	-	-	0.1	-
42	-	-	-	-	-	-	-	-
43	-	-	-	-	-	-	-	-
44	-	-	-	-	-	-	-	-
N	453	585	478	476	222	777	331	243

Table 4.7 BLUE WHITING.
Catch in number (millions) by age group in the directed fisheries (Sub-areas I and II, Divisions Va, XIVa + b, Vb, VIa + b, VIIb,c and VIIg,h,j,k), 1980 - 1989.

Age	1980	1981	1982	1983	1984
0	-	-	1.2	2.5	63.6
1	55.1	4.0	1.7	290.4	417.6
2	319.5	40.1	48.6	239.1	1,394.1
3	362.0	322.8	123.1	164.1	277.9
4	399.1	225.3	371.0	194.1	211.9
5	478.3	501.5	212.6	411.4	259.2
6	530.9	539.0	251.0	284.4	420.2
7	725.3	448.5	250.7	274.0	253.1
8	779.2	618.3	259.3	283.5	190.3
9	694.5	573.2	278.7	219.9	151.6
10	1,008.7	718.3	259.8	152.6	113.8
11	398.1	343.6	158.5	71.5	57.7
12	394.2	232.6	133.6	45.4	50.0
13	66.8	73.9	41.0	25.0	15.0
14	64.6	49.5	45.3	12.1	8.1
15+	4.7	30.6	28.0	10.0	6.7
Total	6,191.0	4,721.2	2,464.1	2,680.0	3,890.9
Tonnes	1,017,491	809,054	427,341	416,730	481,872

Age	1985	1986	1987	1988	1989[1]
0	871.4	51.9	9.1	3.6	36.5
1	127.4	161.9	280.8	93.2	86.4
2	1,341.6	263.3	361.0	403.2	359.4
3	1,588.1	1,559.5	580.2	416.2	1,176.7
4	199.3	1,464.3	1,780.2	611.2	696.2
5	161.0	298.7	680.3	1,238.9	785.7
6	303.7	156.4	118.2	584.9	680.7
7	248.7	192.2	94.9	77.8	127.2
8	167.2	185.8	117.1	50.7	44.8
9	91.7	166.4	99.7	32.4	23.8
10	87.8	172.1	48.3	28.3	15.2
11	73.1	108.7	60.1	8.8	8.9
12	51.4	65.6	41.6	8.9	10.7
13	21.1	25.2	21.1	2.0	0.9
14	12.5	6.8	10.9	0.3	1.1
15+	9.5	8.1	13.0	0.6	0.2
Total	5,355.3	4,886.9	4,316.5	3,571.0	4,054.4
Tonnes	554,640	694,314	571,659	477,552	521,415

[1] Preliminary.

Table 4.8 BLUE WHITING.
Catch in number (millions) by age group in the mixed industrial fisheries (Sub-area IV, Divisions IIIa, Vb, and Va) 1980 - 1989.

Age	1980	1981	1982	1983	1984
0	23.2	-	3,450.1	336.3	446.4
1	276.1	65.1	45.3	1,844.2	1,650.8
2	329.9	81.4	41.3	90.0	587.7
3	74.8	191.9	80.9	38.4	49.7
4	22.6	58.4	112.8	47.7	12.8
5	29.1	20.1	29.2	55.6	12.6
6	23.1	16.7	21.6	12.2	10.4
7	29.3	17.8	14.8	12.8	6.1
8	26.8	15.7	12.0	2.6	2.2
9	15.2	4.4	5.2	5.8	2.7
10	13.8	4.9	1.8	4.2	2.6
11	6.4	3.6	-	9.6	0.9
12	1.8	1.5	2.4	3.3	0.3
13	2.2	1.2	0.6	0.6	0.3
14	1.4	0.1	0.6	0.3	0.1
15+	0.4	0.2	-	-	-
Total	860.8	483.0	3,816.6	2,463.6	2,785.5
Tonnes	75,129	61,754	117,578	124,737	122,806

Age	1985	1986	1987	1988	1989[1]
0	184.3	-	226.8	12.3	1,871.6
1	891.4	395.0	174.5	185.1	578.9
2	365.0	334.7	105.7	84.3	183.7
3	173.8	134.6	85.4	83.4	70.0
4	37.4	184.4	88.9	40.2	33.5
5	13.4	79.7	32.8	44.0	24.1
6	13.9	24.3	15.6	24.0	12.2
7	5.8	7.3	9.2	3.3	5.9
8	5.6	11.0	5.1	2.1	2.1
9	1.8	7.3	3.8	1.0	0.8
10	3.0	3.9	0.2	0.2	0.3
11	1.4	3.8	-	-	0.4
12	0.3	1.4	-	-	0.3
13	-	1.0	-	-	-
14	-	1.1	-	-	-
15+	-	-	-	-	-
Total	1,697.0	1,189.4	748.0	479.9	2,783.8
Tonnes	97,769	99,580	59,952	45,110	75,978

[1] Preliminary.

Table 4.9 SUM OF PRODUCTS CHECK

BLUE WHITING, NORTHERN AREA
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: millions

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	Avg.
0	23	0	3451	339	510	1056	52	236	16	1908	'89
1	331	69	45	2133	2068	1019	557	455	278	665	88
2	649	122	90	328	1982	1707	598	467	488	543	87
3	437	515	204	202	328	1762	1694	666	500	1247	86
4	422	284	484	241	225	237	1649	1869	651	730	85
5	507	522	242	465	272	174	378	713	1293	810	84
6	554	556	273	295	431	318	181	134	609	693	83
7	755	466	266	285	259	254	200	104	81	133	82
8	806	634	271	285	192	173	197	122	53	47	
9	620	578	284	225	154	93	174	103	33	25	
10	1023	723	262	156	116	91	176	48	28	15	
11	405	347	159	81	59	74	113	60	9	9	
12	396	234	136	49	50	52	67	42	9	11	
13	69	75	42	26	15	21	26	21	2	1	
14	66	50	46	12	8	12	8	11	1	1	
15+	5	31	28	10	7	9	8	13	1	1	
TOTAL	7067	5206	6281	5132	6676	7052	6078	5064	4052	6839	

Table 4.10 SUM OF PRODUCTS CHECK

BLUE WHITING, NORTHERN AREA
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: kilogram

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	.027	.027	.018	.018	.027	.014	.033	.020	.024	.014
1	.036	.063	.046	.046	.036	.038	.040	.056	.061	.065
2	.079	.092	.094	.094	.086	.080	.081	.092	.087	.089
3	.107	.118	.136	.136	.104	.102	.113	.109	.107	.106
4	.122	.135	.152	.152	.142	.129	.132	.125	.131	.130
5	.135	.145	.162	.162	.157	.164	.168	.148	.142	.150
6	.149	.155	.178	.178	.164	.178	.202	.178	.158	.159
7	.165	.170	.195	.195	.176	.200	.209	.209	.181	.174
8	.176	.178	.200	.200	.189	.208	.243	.221	.199	.206
9	.186	.187	.204	.204	.186	.218	.246	.222	.222	.224
10	.199	.199	.213	.213	.197	.225	.242	.251	.241	.225
11	.202	.208	.234	.234	.202	.233	.255	.249	.276	.222
12	.207	.228	.228	.228	.194	.233	.260	.252	.232	.246
13	.207	.234	.258	.258	.225	.243	.272	.274	.263	.295
14	.207	.249	.242	.242	.223	.251	.302	.242	.429	.390
15+	.207	.257	.258	.258	.242	.279	.305	.266	.229	.279

Table 4.11 Catch per unit effort in the directed fisheries 1981-1989 (fishing gear - mid-water trawl). GRT-classes 1-5 are given at bottom of the table.

GRT class	Country	Time period	1981	1982	1983	1984	1985	1986	1987	1988	1989
Division IIa - t/hour											
3	USSR	Apr-Oct	-	-	0.87	-	1.86	1.63	2.47	-	2.29
4	German Dem.Rep.	May-Jun	1.21	1.00	2.35	1.40	2.57	5.40	1.63	-	-
		Jul-Sep	2.25	1.21	1.10	2.57	2.29	2.30	0.80	-	-
		Oct-Dec	1.04	2.25	2.70	-	1.22	2.70	0.94	-	-
	USSR	Feb	-	-	-	-	-	3.58	2.21	0.73	-
		Mar-Apr	3.57	1.84	-	7.80	0.87	4.12	3.54	3.55	1.96
		May-Jun	2.62	1.35	1.73	3.06	2.48	3.08	2.34	2.57	-
		Jul-Sep	2.54	2.85	0.60	2.85	3.16	2.27	2.28	2.02	2.48
		Oct-Dec	3.01	2.99	-	-	-	1.42	1.90	2.12	-
5	USSR	Jan-Sep	-	-	-	-	-	5.43	2.51	-	-
Division IVa - t/hour											
1	Norway	Apr-May	7.18	17.39	16.51	8.68	-	2.18	-	18.40	-
2	Norway	Apr-May	13.40	13.75	18.31	7.01	15.70	-	7.91	7.64	5.03
		Nov	-	-	-	4.50[1]	-	-	-	-	-
3	Norway	Mar	-	-	-	-	-	-	7.93	-	-
		Apr-May	15.36	15.03	21.19	-	17.26	-	5.27	17.86	9.39
Division Vb - t/hour											
1	Norway	Jan	-	-	-	-	-	11.86	-	-	-
		Apr-May	18.94	4.88	-	12.40	16.19	13.43	-	10.47	-
		Nov-Dec	-	-	-	25.08	12.55	-	-	-	-
3	German Dem.Rep	Jan-Mar	-	-	-	-	-	-	1.47	-	-
		Dec	-	-	-	-	-	-	1.13	-	-
	Norway	Apr-May	29.47	-	-	-	24.85	-	13.96	16.47	6.37
	USSR	Apr-Jun	-	-	0.38	-	7.05	-	-	-	3.91
4	German Dem.Rep.	Jan-May	3.88	2.12	2.08	-	3.50	1.40	0.18	-	-
		Jun-Jul	-	-	-	-	3.58	2.50	1.86	1.52	-
		Aug	-	-	-	-	-	2.10	0.97	2.58	-
		Sep-Dec	-	-	-	-	-	-	0.64	-	-
		Nov-Dec	-	-	-	2.20	1.58	-	-	-	-
	USSR	Jan-Feb	6.71	5.16	3.05	1.74	3.71	3.12	2.37	2.15	-
		Mar-May	5.97	4.58	4.12	4.57	4.99	5.22	4.87	4.75	6.01
		Jul-Aug	3.75	3.03	3.16	4.29	5.33	5.41	5.45	2.36	3.51
		Sep-Dec	2.72	-	2.77	3.70	-	3.27	2.06	3.65	-
5	USSR	Feb-Oct	-	-	-	-	-	7.50	3.20	5.67	-

cont'd)

Table 4.11 (cont'd)

GRT class	Country	Time period	1981	1982	1983	1984	1985	1986	1987	1988	1989
Division VIa - t/hour											
2	Norway	Jan-Feb	-	-	-	-	-	11.90	14.84	-	-
		Mar-Apr	34.96	36.30	49.04	25.21	20.05	21.50	24.78	15.94	12.33
		May	-	-	-	-	-	22.38	10.62	21.15	7.97
3	Norway	Feb	-	-	-	-	-	-	10.81	-	-
		Mar-Apr	57.13	42.38	42.83	28.78	22.29	-	20.53	23.36	14.41
		May	-	-	-	-	-	-	12.07	26.18	15.87
Division VIb - t/hour											
	USSR	Apr-Jun	-	-	-	-	-	4.80	4.42	5.60	6.11
Divison VIIb,c - t/hour											
1	Norway	Mar	-	-	-	21.08	-	-	-	25.09	-
2	Norway	Feb-Apr	-	-	-	27.74	26.83	25.35	21.74	18.29	25.26
3	Norway	Jan-Feb	-	-	-	-	-	-	-	-	30.00
		Mar	-	-	-	-	-	-	24.02	32.29	37.61
		Apr	-	-	-	-	-	-	38.35	29.55	34.26
		Nov	-	-	-	8.00[1]	32.08	-	-	-	-
4	USSR	Feb-Mar	-	-	-	4.72	6.21	3.83[2]	4.49[2]	5.61	6.64
5	USSR	Feb-Mar	-	-	-	-	-	10.20	-	6.48	-
Division VIIg-k - t/hour											
2	Norway	Feb-Mar	-	-	-	14.58	-	-	35.54	25.93	26.45
3	Norway	Feb-Mar	-	-	-	-	-	-	35.24	53.71	34.41
4	German Dem.Rep.	Feb-Mar	-	-	-	-	-	7.20	3.21	5.09	-
	USSR	Feb-Mar	-	-	-	3.85	12.30	6.96	4.96[3]	6.13	7.88

[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 4.12.1 USSR catch per unit effort for the BLUE WHITING directed fisheries in Division IIa for 2,000-3,999.9 GRT vessels using mid-water trawls, 1981-1989.

Month	1981	1982	1983	1984	1985	1986	1987	1988	1989
					Catch (tonnes)				
USSR									
January	-	8,003	-	-	-	1,069	-	8	-
February	-	-	-	-	-	3,622	2,423	126	-
March	3,886	375	-	-	-	463	1,483	631	-
April	45,645	618	-	1,782	62	529	9,182	176	220
May	88,754	46,089	15,188	6,131	3,289	455	5,104	2,034	-
June	78,727	27,617	7,919	16,564	25,031	27,967	31,833	24,678	-
July	87,582	6,820	1,172	11,842	33,177	47,485	34,022	10,818	1,127
August	63,889	-	-	15,609	20,969	32,608	23,594	1,142	562
September	37,960	2,921	-	492	5,311	9,269	6,256	407	-
October	11,560	1,121	-	-	-	1,812	2,944	-	-
November	4,778	379	-	-	-	966	-	143	-
December	10,704	-	-	-	-	268	-	139	-
All months	433,485	93,943	24,279	52,420	87,839	126,520	111,995	40,311	1,909
May - Oct	368,472	84,568	24,279	50,638	87,777	119,596	103,753	39,088	1,689
					Effort (hours)				
January	-	1,045	-	-	-	622	-	11	-
February	-	-	-	-	-	1,013	1,093	32	-
March	1,208	285	-	-	-	135	437	171	-
April	12,666	256	-	222	68	119	2,578	135	112
May	25,912	17,106	7,300	2,247	1,900	160	2,001	884	-
June	37,919	14,209	6,094	5,160	9,550	8,616	13,790	9,495	-
July	39,039	5,983	1,963	4,315	11,600	16,490	14,734	5,409	480
August	29,528	-	-	5,292	7,350	16,014	9,526	544	201
September	11,745	640	-	194	2,360	5,252	3,087	313	-
October	3,270	341	-	-	-	1,579	1,581	-	-
November	1,455	161	-	-	-	544	-	51	-
December	4,263	-	-	-	-	255	-	76	-
All months	167,005	40,026	15,357	17,430	32,828	50,799	48,827	17,121	793
May - Oct	147,413	38,279	15,357	17,208	32,760	48,111	44,719	16,645	681
					CPUE (tonnes/hour)				
January	-	7.66	-	-	-	1.72	-	0.72	-
February	-	-	-	-	-	3.58	2.22	3.94	-
March	3.22	1.32	-	-	-	3.43	3.40	3.69	-
April	3.60	2.41	-	8.01	0.91	4.44	3.57	1.30	1.96
May	3.42	2.69	2.08	2.73	1.56	2.84	2.55	2.30	-
June	2.08	1.94	1.30	3.21	2.62	3.25	2.31	2.60	-
July	2.24	1.14	0.60	2.74	2.86	2.88	2.31	2.00	2.35
August	2.16	-	-	2.95	2.84	2.04	2.50	2.09	2.80
September	3.23	4.56	-	2.54	2.25	1.77	2.03	1.30	-
October	3.53	3.29	-	-	-	1.15	1.86	-	-
November	3.28	2.35	-	-	-	1.78	-	2.80	-
December	2.51	-	-	-	-	1.05	-	1.83	-
All months	2.60	2.35	1.58	3.01	2.68	2.49	2.29	2.28	2.41
May - Oct (1)	2.50	2.21	1.58	2.94	2.68	2.49	2.32	2.35	2.48
(2)	3.67	2.78	2.72	1.33	2.83	2.17	2.26	2.06	2.58

(1) CPUE = total catch/total effort.
(2) CPUE = Σ(monthly CPUE)/no. of months.

Table 4.12.2 Aggregated USSR CPUE in Northern BLUE WHITING fishery.

Division	Year									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
IIa	3.75	3.07	2.90	2.36	3.00	2.68	2.98	2.21	2.50	2.19
Vb	5.55	5.71	4.52	3.44	4.39	4.99	5.54	3.97	4.46	4.18
VIb	-	-	-	-	3.92	6.74	4.94	2.91	5.60	4.43
VIIbmc	-	-	-	4.12	4.75	5.58	4.53	4.47	5.70	5.39
Viig-k	-	-	-	-	4.05	10.48	10.48	-	-	6.32
Overall ACPUE	3.87	3.39	3.57	3.13	3.88	4.30	4.13	3.12	3.76	4.16

Table 4.13 Tuning data, 3 fleets.

```
NORTHERN BLUE WHITING TUNING 1989.
103
Norway, Spawning Area/Acoustic
82,89
1,1
3,11
1, 2431, 6676, 3335,3470,3656,3231,2239, 384,985
1, 2108, 2723, 6511,3735,3650,3153,2279,1182,531
1, 1514, 1616, 1719,1858,1128, 567, 440, 348, 80
1, 9150, 1336,  999, 985,1115, 639, 370, 256,183
1, 7183, 7340, 1159, 383, 251, 373, 151, 174, 73
1, 8050,22357, 4697, 282, 417, 385, 159,  27,111
1, 8799,12271,20285,7323, 723, 617, 326, 398,126
1,22270, 9973,10504,7803, 933, 293, 177,  46,148
USSR, Spawning Area/Acoustic
82,89
1,1
3,11
1, 0.54, 2.75,1.34,1.38,1.57,2.35,1.73,1.29,0.65
1, 2.33, 2.93,9.39,3.88,1.97,1.37,0.78,0.66,0.10
1, 2.90, 0.80,1.10,4.20,2.20,1.20,1.70,1.20,0.50
1,13.22, 0.93,0.58,1.78,0.86,0.61,0.58,0.54,0.11
1,18.75,23.18,2.54,0.61,0.62,0.75,0.64,0.71,0.72
1, 4.48,19.17,5.86,1.07,0.50,0.81,0.86,0.67,0.56
1, 3.71, 4.55,8.61,4.13,1.27,0.48,0.25,0.26,0.33
1,11.91, 7.12,6.67,6.97,4.58,2.75,1.88,0.81,0.41
USSR cpue Div IIa, July
82,89
1,1
3,11
1,  .12, .85,1.42,1.35,1.37, .46, .66,   0,   0
1,  .31, .39,1.00, .92, .77, .96, .83, .54, .15
1,  .56, .08, .22, .20, .06, .14, .08, .14,   0
1, 5.84, .32, .03, .73, .57, .64, .57, .86, .19
1,14.64,4.41, .55,   0, .10,   0,   0,   0,   0
1, 8.49,7.95,0.44,   0,   0,   0, .34,   0,   0
1,  .31, .32, .87, .29, .04,   0,   0,   0, .01
1,  .38, .28, .28, .31, .08, .01, .01,   0, .01
```

Table 4.14 Tuning results, 3 fleets.

Module run at 00.08.12 18 SEPTEMBER 1990
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 ,Norway, Spawning Are, has terminal q estimated as the mean
Fleet 2 ,USSR, Spawning Area/, has terminal q estimated as the mean
Fleet 3 ,USSR cpue Div IIa, J, has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **

Regression weights
, 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. Fleets combined by variance of predictions
Fishing mortalities

Age,	82,	83,	84,	85,	86,	87,	88,	89,
0,	.115,	.009,	.021,	.052,	.001,	.014,	.001,	.100,
1,	.005,	.096,	.066,	.053,	.035,	.010,	.020,	.050,
2,	.022,	.047,	.122,	.071,	.040,	.037,	.014,	.050,
3,	.062,	.062,	.061,	.151,	.093,	.057,	.050,	.045,
4,	.143,	.096,	.091,	.057,	.207,	.141,	.072,	.096,
5,	.121,	.199,	.150,	.094,	.120,	.129,	.137,	.121,
6,	.126,	.212,	.287,	.261,	.134,	.057,	.156,	.101,
7,	.154,	.187,	.291,	.273,	.261,	.106,	.044,	.046,
8,	.221,	.247,	.186,	.322,	.352,	.251,	.072,	.033,
9,	.386,	.288,	.204,	.129,	.625,	.315,	.099,	.044,
10,	.476,	.380,	.236,	.179,	.381,	.348,	.131,	.060,
11,	.273,	.263,	.241,	.233,	.350,	.215,	.101,	.057,

Log catchability estimates

Age 3

Fleet,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	-.31,	-.44,	-1.28,	-.24,	-.93,	-.38,	-.12,	-.23
2 ,	-8.72,	-7.25,	-7.53,	-6.78,	-6.87,	-7.87,	-7.89,	-7.76
3 ,	-10.23,	-9.26,	-9.18,	-7.60,	-7.12,	-7.23,	-10.38,	-11.21

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-.49 ,	.424,	.6128 ,	.0343,	.000E+00,	.000E+00,	-.490,	.141
2 ,	-7.59 ,	.667,	.0005 ,	.0532,	.000E+00,	.000E+00,	-7.585,	.222
3 ,	-9.03 ,	1.652,	.0001 ,	.3950,	.000E+00,	.000E+00,	-9.025,	.551

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.043	.350	.366	.366	1.093

Age 4

Fleet,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	.68,	.08,	-.43,	-1.14,	-.08,	.53,	.31,	.27
2 ,	-7.11,	-6.75,	-8.04,	-8.41,	-5.84,	-6.54,	-7.59,	-6.97
3 ,	-8.29,	-8.77,	-10.34,	-9.48,	-7.50,	-7.42,	-10.25,	-10.21

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	.03 ,	.622,	1.0276 ,	.0752,	.000E+00,	.000E+00,	.027,	.207
2 ,	-7.16 ,	.884,	.0008 ,	.0799,	.000E+00,	.000E+00,	-7.157,	.295
3 ,	-9.03 ,	1.290,	.0001 ,	.3120,	.000E+00,	.000E+00,	-9.031,	.430

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.093	.473	.339	.473	.513

Age 5

Fleet,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	.51,	1.03,	-.06,	-.62,	-1.00,	-.16,	.77,	.45
2 ,	-7.31,	-5.52,	-7.41,	-8.07,	-7.12,	-6.85,	-7.00,	-6.91
3 ,	-7.25,	-7.76,	-9.02,	-11.03,	-8.65,	-9.43,	-9.29,	-10.09

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	.12 ,	.739,	1.1219 ,	.0865,	.000E+00,	.000E+00,	.115,	.246
2 ,	-7.02 ,	.766,	.0009 ,	.1082,	.000E+00,	.000E+00,	-7.023,	.255
3 ,	-9.06 ,	1.285,	.0001 ,	.3346,	.000E+00,	.000E+00,	-9.065,	.428

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.116	.491	.320	.491	.423

Table 4.14 (cont'd)

Age 6

Fleet,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	.47,	.99,	.21,	-.21,	-1.26,	-2.12,	.63,	.13
2 ,	-7.36,	-5.88,	-5.88,	-6.53,	-7.71,	-7.59,	-6.85,	-6.89
3 ,	-7.38,	-7.32,	-8.93,	-7.42,	-13.43,	-13.98,	-9.51,	-10.00

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-.15 ,	1.106,	.8642 ,	.0767,	.000E+00,	.000E+00,	-.146,	.369
2 ,	-6.85 ,	.769,	.0011 ,	.1054,	.000E+00,	.000E+00,	-6.849,	.256
3 ,	-9.75 ,	2.810,	.0001 ,	.1309,	.000E+00,	.000E+00,	-9.745,	.937

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.097	.616	.114	.616	.034

Age 7

Fleet,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	.75,	.88,	.24,	.18,	-1.12,	-.86,	-.93,	-1.13
2 ,	-7.00,	-6.65,	-6.00,	-6.99,	-7.12,	-7.58,	-7.27,	-6.45
3 ,	-7.14,	-7.59,	-9.60,	-7.40,	-8.94,	-13.11,	-10.73,	-10.49

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-.25 ,	.901,	.7803 ,	.1112,	.000E+00,	.000E+00,	-.248,	.300
2 ,	-6.88 ,	.529,	.0010 ,	.0298,	.000E+00,	.000E+00,	-6.883,	.176
3 ,	-9.38 ,	2.172,	.0001 ,	.1410,	.000E+00,	.000E+00,	-9.375,	.724

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.044	.447	.434	.447	.945

Age 8

Fleet,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	.97,	1.00,	-.60,	.17,	-.40,	-.23,	-.18,	-1.59
2 ,	-6.26,	-6.74,	-6.76,	-6.78,	-6.61,	-6.40,	-7.34,	-6.26
3 ,	-7.89,	-7.09,	-8.91,	-6.73,	-12.54,	-12.40,	-12.82,	-11.88

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-.11 ,	.899,	.8980 ,	.1440,	.000E+00,	.000E+00,	-.108,	.300
2 ,	-6.64 ,	.375,	.0013 ,	.0223,	.000E+00,	.000E+00,	-6.643,	.125
3 ,	-10.03 ,	2.790,	.0000 ,	.2067,	.000E+00,	.000E+00,	-10.032,	.930

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.030	.344	.495	.495	2.077

Age 9

Fleet,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	1.11,	1.07,	-.54,	-.67,	-.61,	-.72,	-.02,	-1.17
2 ,	-6.05,	-6.91,	-6.10,	-7.13,	-6.08,	-5.94,	-7.19,	-5.71
3 ,	-7.02,	-6.85,	-9.15,	-7.14,	-11.84,	-6.87,	-12.02,	-10.95

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-.19 ,	.904,	.8246 ,	.1165,	.000E+00,	.000E+00,	-.193,	.301
2 ,	-6.39 ,	.623,	.0017 ,	.0224,	.000E+00,	.000E+00,	-6.388,	.208
3 ,	-8.98 ,	2.458,	.0001 ,	.3147,	.000E+00,	.000E+00,	-8.980,	.819

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.042	.502	.612	.612	1.484

Age 10

Fleet,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	-.36,	1.06,	-.34,	-.69,	-.98,	-1.63,	.62,	-1.70
2 ,	-6.06,	-6.43,	-6.01,	-6.85,	-6.48,	-5.33,	-6.71,	-5.74
3 ,	-12.52,	-6.63,	-8.16,	-6.38,	-12.35,	-11.14,	-11.58,	-11.74

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-.50 ,	1.038,	.6054 ,	.1974,	.000E+00,	.000E+00,	-.502,	.346
2 ,	-6.20 ,	.544,	.0020 ,	.0376,	.000E+00,	.000E+00,	-6.200,	.181
3 ,	-10.06 ,	2.733,	.0000 ,	.3193,	.000E+00,	.000E+00,	-10.064,	.911

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.057	.475	.522	.522	1.208

Table 4.15 VIRTUAL POPULATION ANALYSIS - From tuning - with 3 fleets.

BLUE WHITING, NORTHERN AREA

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = .20

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1980-87
0	.004	.000	.113	.008	.020	.050	.001	.014	.001	.100	.026
1	.060	.013	.005	.094	.064	.051	.034	.010	.020	.050	.041
2	.102	.028	.021	.045	.119	.069	.038	.036	.013	.050	.057
3	.117	.110	.061	.060	.057	.148	.090	.055	.048	.043	.087
4	.098	.104	.143	.094	.087	.053	.200	.136	.069	.093	.115
5	.137	.170	.121	.199	.147	.090	.113	.125	.131	.116	.138
6	.193	.219	.126	.212	.287	.255	.128	.053	.149	.097	.184
7	.308	.246	.154	.187	.291	.273	.253	.101	.041	.044	.227
8	.382	.460	.221	.247	.186	.322	.352	.241	.068	.030	.301
9	.286	.521	.386	.288	.204	.129	.625	.315	.095	.042	.344
10	.601	.634	.476	.380	.236	.179	.381	.348	.131	.057	.404
11	.354	.419	.273	.263	.241	.233	.350	.215	.101	.057	.294
12+	.354	.419	.273	.263	.241	.233	.350	.215	.101	.057	.294
(0- 2)U	.055	.014	.046	.049	.068	.057	.024	.020	.012	.067	
(4- 8)U	.224	.240	.153	.188	.200	.199	.209	.131	.092	.076	

Table 4.16

Title : BLUE WHITING, NORTHERN AREA
At 00.36.25 18 SEPTEMBER 1990
from 80 to 89 on ages 0 to 11
with Terminal F of .076 on age 5 and Terminal S of 1.000 - Based on tuning with 3 fleets.

Initial sum of squared residuals was 77.846 and
final sum of squared residuals is 42.805 after 150 iterations

Matrix of Residuals

Years / Ages	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89		WTS
0/ 1	.533	-2.533	2.310	-.248	.754	2.402	-.934	.917	-2.394	.000	.061
1/ 2	1.269	-.236	-1.507	.282	.287	.946	.062	-.333	-.676	.000	.131
2/ 3	.756	-.228	-.075	.463	.471	.677	.040	-.061	-.670	.000	.232
3/ 4	.750	.152	.368	.153	.482	.538	-.141	-.143	-.273	.000	.311
4/ 5	-.148	.004	.328	-.113	.170	-.240	.559	-.010	-.311	.000	.389
5/ 6	-.364	.160	-.237	-.253	-.574	-.139	.431	-.524	.245	.000	.313
6/ 7	-.418	-.073	-.395	-.518	-.209	.050	-.374	-.494	.833	.000	.257
7/ 8	-.156	-.005	-.164	.009	-.070	.100	-.165	-.054	.124	.000	1.000
8/ 9	-.191	.064	-.094	.036	.060	-.348	-.203	.396	.156	.000	.491
9/10	-.686	.044	.309	.074	-.148	-.989	.427	.382	.183	.000	.223
10/11	.329	.541	.662	.162	-.452	-.790	-.017	.511	.283	.000	.226
	.000	.000	.000	.000	.000	.000	.000	.000	.000	1.866	
WTS	.010	.010	.010	.010	.010	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	80	81	82	83	84	85	86	87	88	89
F-values	.2605	.2649	.2107	.2633	.2515	.2139	.2499	.1718	.1008	.0760

Selection-at-age (S)

	0	1
S-values	.0155	.0958

	2	3	4	5	6	7	8	9	10	11
S-values	.1559	.3370	.6316	1.0000	1.2219	1.1046	1.3058	1.3100	1.3021	1.0000

Table 4.17 VIRTUAL POPULATION ANALYSIS From separable VPA, based on tuning with three fleets.

BLUE WHITING, NORTHERN AREA

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = .20

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	.005	.000	.121	.007	.017	.031	.001	.004	.000	.001
1	.063	.019	.009	.102	.055	.044	.020	.010	.006	.018
2	.100	.030	.031	.088	.130	.059	.033	.021	.014	.014
3	.108	.107	.064	.091	.118	.163	.077	.046	.029	.044
4	.100	.095	.139	.100	.138	.118	.225	.113	.058	.053
5	.135	.173	.109	.193	.157	.151	.278	.143	.107	.095
6	.192	.214	.129	.188	.275	.277	.232	.150	.175	.077
7	.285	.245	.150	.192	.251	.259	.281	.202	.127	.053
8	.331	.412	.220	.238	.192	.264	.327	.277	.151	.101
9	.246	.420	.328	.286	.196	.134	.463	.284	.112	.098
10	.400	.505	.341	.302	.234	.170	.400	.222	.116	.068
11	.260	.229	.195	.167	.178	.230	.328	.230	.059	.050
12+	.260	.229	.195	.167	.178	.230	.328	.230	.059	.050
(0- 2)U	.056	.016	.054	.066	.067	.045	.018	.012	.007	.011
(4- 8)U	.208	.228	.149	.182	.203	.214	.269	.177	.124	.076

Table 4.18 VIRTUAL POPULATION ANALYSIS From separable VPA, based on tuning with three fleets.

BLUE WHITING, NORTHERN AREA

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: thousand tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	4935	6490	33466	52066	32620	38351	59701	66170	49316	1784750	0
1	5938	4020	5314	24289	42322	26247	30445	48832	53962	40362	1459506
2	7517	4562	3229	4310	17962	32784	20569	24424	39569	43929	32445
3	4709	5569	3625	2562	3233	12920	25301	16301	19575	31956	35476
4	4877	3461	4095	2784	1916	2351	8990	19186	12745	15575	25038
5	4434	3613	2578	2917	2062	1366	1711	5877	14023	9847	12093
6	3489	3173	2488	1892	1969	1443	961	1061	4169	10315	7332
7	3341	2358	2097	1791	1284	1225	896	624	748	2865	7820
8	3142	2057	1511	1478	1210	818	774	553	417	539	2225
9	3117	1848	1115	993	953	818	514	457	343	294	399
10	3397	1995	994	658	611	642	586	265	281	251	218
11	1941	1864	986	579	398	396	444	322	174	205	192
12+	2572	2095	1564	694	540	502	428	466	251	319	409
TOTAL NO	53408	43103	63062	97012	107081	119861	151320	184538	195574	1941209	
SPS NO	37677	29144	22150	19988	24947	34218	44892	52464	65620	82544	
TOT.BIOM	6442	5395	4864	5322	6142	7206	10249	12157	14801	40905	
SPS BIOM	5660	4576	3761	3066	2895	3788	5375	6170	7619	9916	

Table 4.19 Tuning data.

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NORTHERN BLUE WHITING TUNING 1989.
104
Norway, Spawning Area/Acoustic
82,89
1,1
3,11
1, 2431, 6676, 3335,3470,3656,3231,2239, 384,985
1, 2108, 2723, 6511,3735,3650,3153,2279,1182,531
1, 1514, 1616, 1719,1858,1128, 567, 440, 348, 80
1, 9150, 1336,  999, 985,1115, 639, 370, 256,183
1, 7183, 7340, 1159, 383, 251, 373, 151, 174, 73
1, 8050,22357, 4697, 282, 417, 385, 159,  27,111
1, 8799,12271,20285,7323, 723, 617, 326, 398,126
1,22270, 9973,10504,7803, 933, 293, 177,  46,148
USSR, Spawning Area/Acoustic
82,89
1,1
3,11
1, 0.54, 2.75,1.34,1.38,1.57,2.35,1.73,1.29,0.65
1, 2.33, 2.93,9.39,3.88,1.97,1.37,0.78,0.66,0.10
1, 2.90, 0.80,1.10,4.20,2.20,1.20,1.70,1.20,0.50
1,13.22, 0.93,0.58,1.78,0.86,0.61,0.58,0.54,0.11
1,18.75,23.18,2.54,0.61,0.62,0.75,0.64,0.71,0.72
1, 4.48,19.17,5.86,1.07,0.50,0.81,0.86,0.67,0.56
1, 3.71, 4.55,8.61,4.13,1.27,0.48,0.25,0.26,0.33
1,11.91, 7.12,6.67,6.97,4.58,2.75,1.88,0.81,0.41
Norwegian Sea Acoustic
82,89
1,1
3,11
1, 1254,4778,3652,3172,2339,1692,887,425,263
1,  456, 779,1425, 594, 487, 450,346,222,105
1,  826, 393, 534, 544, 325,  56, 53, 61, 24
1,12525, 682, 418, 203, 245, 127,381,153, 59
1, 7201,6924,1863, 962, 348, 317,147,207, 54
1, 4894,5173,1383, 542, 219, 167, 99,103, 30
1, 2838,2587,3423, 903, 120,  91, 17, 55,  0
1, 3785,2166,1897,2436, 649   81, 59, 12   8
USSR cpue Div IIa, July (vsl. 2-4000 GRT)
82,89
1,1
3,11
1,  .12, .85,1.42,1.35,1.37, .46, .66,   0,   0
1,  .31, .39,1.00, .92, .77, .96, .83, .54, .15
1,  .56, .08, .22, .20, .06, .14, .08, .14,   0
1, 5.84, .32, .03, .73, .57, .64, .57, .86, .19
1,14.64,4.41, .55,   0, .10,   0,   0,   0,   0
1, 8.49,7.95,0.44,   0,   0,   0, .34,   0,   0
1,  .31, .32, .87, .29, .04,   0,   0,   0, .01
1,  .38, .28, .28, .31, .08, .01, .01,   0, .01
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Table 4.20 Tuning results. Tuning with four fleets.

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Module run at 23.48.25  17 SEPTEMBER 1990
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet  1 ,Norway, Spawning Are, has terminal q estimated as the mean
Fleet  2 ,USSR, Spawning Area/, has terminal q estimated as the mean
Fleet  3 ,Norwegian Sea Acoust, has terminal q estimated as the mean
Fleet  4 ,USSR cpue Div IIa,    has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **

Regression weights
     , 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. Fleets combined by variance of predictions
Fishing mortalities

  Age,    82,    83,    84,    85,    86,    87,    88,    89,

    0, .139, .011, .029, .069, .001, .014, .001, .100,
    1, .010, .120, .083, .073, .047, .016, .020, .050,
    2, .030, .092, .155, .091, .056, .050, .021, .050,
    3, .081, .087, .125, .202, .123, .082, .070, .070,
    4, .162, .129, .132, .125, .294, .194, .107, .138,
    5, .132, .230, .210, .143, .298, .200, .200, .188,
    6, .153, .235, .346, .405, .217, .163, .262, .156,
    7, .180, .236, .334, .353, .482, .187, .141, .083,
    8, .252, .299, .247, .391, .511, .617, .137, .113,
    9, .427, .342, .262, .181, .874, .554, .333, .088,
   10, .533, .442, .298, .244, .610, .639, .283, .248,
   11, .309, .311, .297, .315, .539, .432, .231, .138,

Log catchability estimates

 Age  3
 Fleet,    82,    83,    84,    85,    86,    87,    88,    89
-------,------,------,------,------,------,------,------,------
    1 , -.04, -.09, -.55,  .05, -.65, -.01,  .21,  .22
    2 , -8.45, -6.90, -6.81, -6.49, -6.60, -7.51, -7.56, -7.32
    3 , -.70, -1.63, -1.16,  .36, -.65, -.51, -.92, -1.56
    4 , -9.96, -8.92, -8.46, -7.31, -6.85, -6.87,-10.04,-10.76

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,   Slope  ,       ,Intrcpt
-------,--------,------,-------,-------,----------,----------,-------,------
    1  ,  -.11  , .344, .8959 , .0502,  .000E+00,  .000E+00,  -.110,   .115
    2  , -7.21  , .684, .0007 , .0777,  .000E+00,  .000E+00, -7.206,   .228
    3  ,  -.85  , .676, .4294 , .1415,  .000E+00,  .000E+00,  -.845,   .225
    4  , -8.65  ,1.626, .0002 , .5774,  .000E+00,  .000E+00, -8.645,   .542
     Fbar      SIGMA(int.)     SIGMA(ext.)    SIGMA(overall)  Variance ratio
     .069         .275            .307           .307            1.243

 Age  4
 Fleet,    82,    83,    84,    85,    86,    87,    88,    89
-------,------,------,------,------,------,------,------,------
    1 ,  .80,  .38, -.05, -.35,  .27,  .84,  .70,  .64
    2 , -6.99, -6.46, -7.66, -7.62, -5.49, -6.22, -7.20, -6.61
    3 ,  .47, -.88, -1.47, -1.03,  .21, -.62, -.86, -.89
    4 , -8.17, -8.47, -9.97, -8.69, -7.15, -7.10, -9.85, -9.84

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,   Slope  ,       ,Intrcpt
-------,--------,------,-------,-------,----------,----------,-------,------
    1  ,  .40   , .456,1.4962 , .1095,  .000E+00,  .000E+00,  .403,   .152
    2  , -6.78  , .784, .0011 , .1163,  .000E+00,  .000E+00, -6.781,   .261
    3  ,  -.63  , .688, .5316 , .1792,  .000E+00,  .000E+00,  -.632,   .229
    4  , -8.66  ,1.238, .0002 , .4543,  .000E+00,  .000E+00, -8.655,   .413
     Fbar      SIGMA(int.)     SIGMA(ext.)    SIGMA(overall)  Variance ratio
     .137         .330            .223           .330            .458

 Age  5
 Fleet,    82,    83,    84,    85,    86,    87,    88,    89
-------,------,------,------,------,------,------,------,------
    1 ,  .60, 1.17,  .28, -.20, -.09,  .27, 1.14,  .89
    2 , -7.22, -5.37, -7.07, -7.65, -6.21, -6.41, -6.62, -6.47
    3 ,  .69, -.35, -.89, -1.07,  .38, -.95, -.64, -.82
    4 , -7.16, -7.61, -8.68,-10.61, -7.74, -9.00, -8.91, -9.64

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,   Slope  ,       ,Intrcpt
-------,--------,------,-------,-------,----------,----------,-------,------
    1  ,  .51   , .560,1.6638 , .1283,  .000E+00,  .000E+00,  .509,   .187
    2  , -6.63  , .740, .0013 , .1605,  .000E+00,  .000E+00, -6.629,   .247
    3  ,  -.45  , .694, .6348 , .2711,  .000E+00,  .000E+00,  -.454,   .231
    4  , -8.67  ,1.211, .0002 , .4963,  .000E+00,  .000E+00, -8.671,   .404
     Fbar      SIGMA(int.)     SIGMA(ext.)    SIGMA(overall)  Variance ratio
     .186         .359            .248           .359            .477
```

Table 4.20 (cont'd)

Age 6

Fleet	82	83	84	85	86	87	88	89
1	.66	1.09	.40	.23	-.78	-1.07	1.15	.57
2	-7.17	-5.78	-5.69	-6.09	-7.22	-6.64	-6.33	-6.45
3	.57	-.75	-.83	-1.35	.14	-.41	-.95	-.60
4	-7.19	-7.22	-8.74	-6.98	-12.94	-12.92	-8.99	-9.57

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.28	.859	1.3245	.1176	.000E+00	.000E+00	.281	.286
2	-6.42	.608	.0016	.1616	.000E+00	.000E+00	-6.422	.203
3	-.52	.656	.5937	.1689	.000E+00	.000E+00	-.521	.219
4	-9.32	2.568	.0001	.2007	.000E+00	.000E+00	-9.318	.856

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.154	.391	.830E-01	.391	.045

Age 7

Fleet	82	83	84	85	86	87	88	89
1	.91	1.11	.38	.44	-.50	-.29	.23	-.54
2	-6.84	-6.42	-5.86	-6.73	-6.51	-7.01	-6.12	-5.85
3	.46	-.91	-.87	-1.08	-.18	-.93	-1.57	-.90
4	-6.98	-7.36	-9.47	-7.14	-8.33	-12.54	-9.58	-9.90

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.22	.657	1.2411	.1769	.000E+00	.000E+00	.216	.219
2	-6.42	.467	.0016	.0474	.000E+00	.000E+00	-6.418	.156
3	-.75	.656	.4742	.0972	.000E+00	.000E+00	-.746	.219
4	-8.91	1.984	.0001	.2243	.000E+00	.000E+00	-8.911	.661

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.081	.325	.329	.329	1.025

Age 8

Fleet	82	83	84	85	86	87	88	89
1	1.10	1.20	-.32	.37	-.03	.67	.47	-.35
2	-6.13	-6.54	-6.47	-6.59	-6.24	-5.50	-6.69	-5.02
3	.45	-.75	-2.63	-1.25	-.20	-.17	-1.45	-1.63
4	-7.76	-6.90	-8.62	-6.54	-12.17	-11.50	-12.17	-10.63

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.39	.629	1.4731	.2363	.000E+00	.000E+00	.387	.210
2	-6.15	.629	.0021	.0365	.000E+00	.000E+00	-6.148	.210
3	-.95	1.047	.3856	.2238	.000E+00	.000E+00	-.953	.349
4	-9.54	2.500	.0001	.3390	.000E+00	.000E+00	-9.537	.833

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.110	.404	.532	.532	1.736

Age 9

Fleet	82	83	84	85	86	87	88	89
1	1.21	1.24	-.29	-.33	-.28	-.16	1.19	-.47
2	-5.95	-6.74	-5.85	-6.78	-5.74	-5.38	-5.98	-5.01
3	.29	-.64	-2.41	-.30	-.30	-.63	-1.76	-1.57
4	-6.92	-6.67	-8.90	-6.80	-11.51	-6.30	-10.81	-10.25

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.27	.839	1.3054	.1844	.000E+00	.000E+00	.267	.280
2	-5.93	.643	.0027	.0354	.000E+00	.000E+00	-5.929	.214
3	-.91	.959	.4006	.1697	.000E+00	.000E+00	-.915	.320
4	-8.52	2.237	.0002	.4983	.000E+00	.000E+00	-8.521	.746

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.086	.442	.500	.500	1.283

Age 10

Fleet	82	83	84	85	86	87	88	89
1	-.25	1.21	-.11	-.38	-.51	-1.02	1.39	-.27
2	-5.94	-6.28	-5.78	-6.54	-6.01	-4.72	-5.94	-4.31
3	-.14	-.46	-1.85	-.89	-.33	.32	-.59	-1.62
4	-12.41	-6.48	-7.93	-6.07	-11.88	-10.53	-10.81	-10.32

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.01	.896	1.0080	.3287	.000E+00	.000E+00	.008	.299
2	-5.69	.817	.0034	.0625	.000E+00	.000E+00	-5.691	.272
3	-.70	.777	.4982	.6228	.000E+00	.000E+00	-.697	.259
4	-9.55	2.562	.0001	.5317	.000E+00	.000E+00	-9.554	.854

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.244	.469	.570	.570	1.479

Table 4.21 VIRTUAL POPULATION ANALYSIS - From tuning with four fleets.

BLUE WHITING, NORTHERN AREA

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = .20

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1980-87
0	.005	.000	.138	.011	.028	.068	.001	.014	.001	.100	.033
1	.078	.018	.010	.119	.083	.073	.047	.016	.020	.050	.055
2	.112	.037	.030	.091	.154	.091	.056	.050	.021	.050	.078
3	.126	.122	.080	.086	.123	.199	.122	.081	.069	.069	.118
4	.113	.112	.162	.129	.131	.123	.290	.192	.106	.137	.157
5	.153	.200	.132	.230	.210	.141	.292	.196	.198	.186	.194
6	.209	.249	.153	.235	.346	.403	.214	.159	.256	.154	.246
7	.322	.273	.180	.236	.334	.353	.480	.184	.137	.081	.295
8	.398	.491	.252	.299	.247	.391	.511	.612	.134	.110	.400
9	.301	.558	.427	.342	.262	.181	.874	.554	.329	.086	.437
10	.631	.686	.533	.442	.298	.244	.610	.639	.283	.244	.510
11	.373	.455	.309	.311	.297	.315	.539	.432	.231	.138	.379
12+	.373	.455	.309	.311	.297	.315	.539	.432	.231	.138	.379
(0- 2)U	.065	.018	.059	.073	.088	.077	.035	.027	.014	.067	
(4- 8)U	.239	.265	.176	.226	.253	.282	.357	.269	.166	.134	

Table 4.22 VIRTUAL POPULATION ANALYSIS - From tuning with four fleets.

BLUE WHITING, NORTHERN AREA

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: thousand tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1980-87
0	5169	6288	29447	35494	20121	17645	39222	18945	18377	22085	0	21542
1	4868	4211	5148	20998	28754	16013	13494	32066	15298	15032	16361	15694
2	6732	3687	3386	4175	15269	21676	12191	10545	25842	12274	11707	9708
3	4077	4927	2908	2691	3122	10715	16207	9441	8212	20717	9559	6761
4	4329	2944	3569	2197	2021	2260	7187	11742	7129	6272	15837	4531
5	3944	3164	2154	2486	1582	1452	1637	4402	7931	5250	4477	2603
6	3230	2772	2121	1546	1617	1050	1032	1000	2962	5329	3569	1796
7	3011	2146	1769	1491	1000	937	574	682	698	1877	3739	1451
8	2688	1788	1338	1209	964	586	539	291	465	499	1417	1175
9	2620	1478	895	851	734	617	325	265	129	333	366	973
10	2386	1588	692	478	495	462	421	111	125	76	250	829
11	1426	1040	655	333	252	301	297	187	48	77	49	561
12+	1890	1168	1039	398	341	382	286	272	69	120	140	722
TOTAL NO	46371	37200	55122	74348	76272	74097	93412	89949	87285	89940		
SPS NO	31966	23924	18428	16913	20487	25816	29998	31490	35338	40924		
TOT.BIOM	5436	4431	4082	4352	4726	5106	6668	6880	7336	7592		
SPS BIOM	4732	3671	3069	2535	2398	2935	3738	3788	4202	5054		

Table 4.23 Separable VPA based on tuning with four fleets.

Title : BLUE WHITING, NORTHERN AREA
At 23.56.45 17 SEPTEMBER 1990
from 80 to 89 on ages 0 to 11
with Terminal F of .130 on age 5 and Terminal S of 1.000

Initial sum of squared residuals was 79.499 and
final sum of squared residuals is 41.064 after 134 iterations

Matrix of Residuals

Years	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89		WTS
Ages											
0/ 1	.387	-2.665	2.188	-.358	.659	2.328	-.974	.876	-2.443	-.001	.059
1/ 2	1.207	-.285	-1.547	.251	.272	.948	.096	-.298	-.646	-.001	.129
2/ 3	.559	-.414	-.252	.292	.313	.533	-.075	-.173	-.785	-.001	.233
3/ 4	.510	-.082	.144	-.069	.269	.336	-.324	-.326	-.459	.000	.318
4/ 5	-.188	-.033	.297	-.142	.142	-.262	.549	-.028	-.336	.000	.374
5/ 6	-.221	.303	-.095	-.109	-.433	-.003	.576	-.390	.370	.000	.306
6/ 7	-.234	.115	-.213	-.337	-.031	.220	-.198	-.324	1.001	.000	.253
7/ 8	-.104	.049	-.113	.054	-.029	.131	-.132	-.018	.162	.000	1.000
8/ 9	-.161	.094	-.066	.055	.072	-.346	-.205	.396	.160	.000	.481
9/10	-.626	.106	.367	.124	-.104	-.957	.457	.413	.219	.000	.218
10/11	.200	.412	.537	.030	-.588	-.927	-.161	.360	.136	.000	.220
	.000	.000	.000	.000	.000	.000	.000	.000	.000	-.005	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	80	81	82	83	84	85	86	87	88	89
F-values	.2033	.2128	.1763	.2325	.2374	.2192	.2853	.2259	.1519	.1300

Selection-at-age (S)

	0	1
S-values	.0354	.1854

	2	3	4	5	6	7	8	9	10	11
S-values	.2798	.4903	.7006	1.0000	1.2996	1.3263	1.5826	1.5631	1.5768	1.0000

Table 4.24 VIRTUAL POPULATION ANALYSIS. From Separable VPA based on tuning with four fleets.

BLUE WHITING, NORTHERN AREA

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = .20

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1980-87
0	.006	.000	.133	.010	.026	.057	.002	.012	.001	.005	.031
1	.073	.023	.012	.114	.075	.068	.039	.025	.017	.061	.054
2	.108	.035	.038	.109	.147	.082	.052	.041	.034	.042	.076
3	.118	.117	.075	.112	.152	.188	.110	.075	.057	.113	.118
4	.115	.105	.153	.120	.176	.156	.269	.170	.097	.109	.158
5	.157	.204	.122	.216	.192	.201	.397	.179	.170	.168	.208
6	.212	.257	.156	.215	.317	.359	.331	.238	.228	.129	.261
7	.283	.278	.187	.243	.297	.313	.403	.322	.221	.071	.291
8	.320	.408	.258	.314	.256	.331	.428	.462	.270	.193	.347
9	.232	.401	.323	.354	.280	.190	.654	.417	.217	.197	.356
10	.354	.464	.318	.295	.311	.265	.652	.375	.189	.144	.379
11	.203	.194	.173	.153	.173	.334	.612	.484	.111	.085	.291
12+	.203	.194	.173	.153	.173	.334	.612	.484	.111	.085	.291
(0- 2)U	.062	.019	.061	.077	.083	.069	.031	.026	.017	.036	
(4- 8)U	.217	.250	.175	.221	.248	.272	.366	.274	.197	.134	

Table 4.25 VIRTUAL POPULATION ANALYSIS. From Separable VPA based on tuning with four fleets.

BLUE WHITING, NORTHERN AREA

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: thousand tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1980-87
0	4083	5274	30522	38705	21509	20951	24861	22482	15177	457884	0	21048
1	5154	3322	4318	21879	31383	17150	16200	20308	18194	12411	373160	14964
2	7004	3921	2657	3495	15990	23828	13121	12761	16216	14645	9561	10347
3	4313	5148	3100	2094	2565	11305	17969	10203	10026	12836	11500	7087
4	4263	3137	3751	2354	1533	1805	7669	13184	7753	7757	9385	4712
5	3854	3110	2313	2635	1710	1052	1264	4796	9111	5760	5693	2592
6	3188	2698	2076	1675	1739	1155	705	696	3285	6295	3987	1742
7	3363	2112	1709	1454	1106	1036	660	414	449	2141	4529	1482
8	3229	2075	1310	1160	934	673	620	361	246	295	1633	1295
9	3286	1919	1130	828	694	592	395	331	186	154	199	1147
10	3761	2132	1053	670	476	429	401	168	179	123	103	1136
11	2420	2161	1098	627	408	286	270	171	95	121	87	930
12+	3207	2429	1742	751	554	363	260	248	137	188	233	1194
TOTAL NO	51124	39439	56778	78327	80601	80626	84397	86124	81052	520610		
SPS NO	37338	27793	20155	17416	20740	26645	31968	32936	35200	37831		
TOT.BIOM	6461	5154	4438	4544	4908	5339	6548	6742	7058	(13323)	7.55	
SPS BIOM	5760	4459	3475	2688	2432	2977	3910	3999	4303	4818		

Table 4.26

List of input variables for the ICES prediction program.

BLUE WHITING NORTHERN STOCK
The reference F is the mean F for the age group range from 4 to 8

The number of recruits per year is as follows:

Year	Recruitment
1990	21048.0
1991	21048.0
1992	21048.0

Data are printed in the following units:

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

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
0	21048.0	.00	.20	.00	.014	.014
1	17215.0	.02	.20	.10	.065	.065
2	10412.0	.03	.20	.37	.089	.089
3	11500.0	.06	.20	.81	.106	.106
4	9385.0	.08	.20	.85	.130	.130
5	5693.0	.11	.20	.91	.150	.150
6	3987.0	.15	.20	.94	.159	.159
7	4529.0	.15	.20	1.00	.174	.174
8	1633.0	.18	.20	1.00	.206	.206
9	199.0	.18	.20	1.00	.224	.224
10	103.0	.18	.20	1.00	.225	.225
11	87.0	.11	.20	1.00	.222	.222
12+	233.0	.11	.20	1.00	.246	.246

Table 4.27

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

BLUE WHITING NORTHERN STOCK

Year 1990					Year 1991					Year 1992	
fac-tor	ref. F	stock biomass	sp.stock biomass	catch	fac-tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.2	.16	7536	5121	630	.0	.00	7788	5250	0	8603	6004
					.1	.01			59	8543	5949
					.2	.03			118	8483	5894
					.4	.05			233	8366	5786
					.6	.08			345	8252	5681
					.8	.11			455	8140	5579
					1.0	.13			562	8030	5479
					1.2	.16			667	7924	5382
					1.4	.19			769	7819	5286
					1.6	.21			870	7717	5194
					1.8	.24			968	7617	5103
					2.0	.27			1063	7520	5014

The data unit of the biomass and the catch is 1000 tonnes.
The spawning stock biomass is given for 1 January.
The reference F is the mean F for the age group range from 4 to 8

Table 4.28
BLUE WHITING NORTHERN STOCK

```
**********************************************************
* Year 1990. F-factor   1.221 and reference F    .1632 *
*--------------------------------------------------------*
* Run depending on a TAC value                           *
**********************************************************
```

						at 1 January	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass
0	.0049	92.99	1.302	21048.0	294.67	.0	.00
1	.0257	395.31	25.695	17215.0	1118.97	1721.5	111.90
2	.0391	361.99	32.217	10412.0	926.67	3852.4	342.87
3	.0684	689.92	73.131	11500.0	1219.00	9315.0	987.39
4	.0965	783.71	101.883	9385.0	1220.05	7977.2	1037.04
5	.1380	666.77	100.015	5693.0	853.95	5180.6	777.09
6	.1796	595.71	94.719	3987.0	633.93	3747.8	595.90
7	.1832	689.32	119.942	4529.0	788.05	4529.0	788.05
8	.2186	291.74	60.097	1633.0	336.40	1633.0	336.40
9	.2162	35.19	7.883	199.0	44.58	199.0	44.58
10	.2186	18.40	4.140	103.0	23.17	103.0	23.17
11	.1380	10.19	2.262	87.0	19.31	87.0	19.31
12+	.1380	27.29	6.713	233.0	57.32	233.0	57.32
Total		4658.53	630.000	86024.0	7536.08	38578.6	5121.02

```
**********************************************************
* Year 1991. F-factor   1.000 and reference F    .1336 *
**********************************************************
```

						at 1 January	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass
0	.0040	76.16	1.066	21048.0	294.67	.0	.00
1	.0210	323.10	21.002	17148.7	1114.66	1714.9	111.47
2	.0320	392.33	34.918	13737.5	1222.64	5082.9	452.38
3	.0560	405.03	42.933	8197.8	868.97	6640.3	703.87
4	.0790	606.15	78.800	8792.9	1143.08	7474.0	971.61
5	.1130	676.94	101.541	6977.0	1046.55	6349.0	952.36
6	.1470	504.29	80.182	4060.1	645.56	3816.5	606.82
7	.1500	345.23	60.070	2727.8	474.63	2727.8	474.63
8	.1790	459.96	94.752	3087.2	635.97	3087.2	635.97
9	.1770	158.43	35.489	1074.4	240.67	1074.4	240.67
10	.1790	19.55	4.400	131.2	29.53	131.2	29.53
11	.1130	6.58	1.460	67.8	15.04	67.8	15.04
12+	.1130	22.14	5.447	228.2	56.14	228.2	56.14
Total		3995.90	562.059	87278.6	7788.11	38394.1	5250.49

```
**********************************************************
* Year 1992. F-factor   1.000 and reference F    .1336 *
**********************************************************
```

						at 1 January	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass
0	.0040	76.16	1.066	21048.0	294.67	.0	.00
1	.0210	323.39	21.020	17163.9	1115.65	1716.4	111.57
2	.0320	392.64	34.945	13748.4	1223.60	5086.9	452.73
3	.0560	538.19	57.048	10893.1	1154.67	8823.4	935.28
4	.0790	437.49	56.874	6346.3	825.02	5394.4	701.27
5	.1130	645.43	96.814	6652.2	997.83	6053.5	908.02
6	.1470	633.69	100.757	5101.9	811.20	4795.8	762.53
7	.1500	363.20	63.196	2869.7	499.33	2869.7	499.33
8	.1790	286.39	58.996	1922.2	395.98	1922.2	395.98
9	.1770	311.64	69.807	2113.4	473.39	2113.4	473.39
10	.1790	109.80	24.704	737.0	165.81	737.0	165.81
11	.1130	8.72	1.935	89.8	19.95	89.8	19.95
12+	.1130	21.00	5.166	216.4	53.24	216.4	53.24
Total		4147.73	592.329	88902.2	8030.34	39818.8	5479.10

Table 4.29

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

BLUE WHITING NORTHERN STOCK

Year 1990					Year 1991					Year 1992	
factor	ref. F	stock biomass	sp.stock biomass	catch	factor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.2	.16	7536	5121	630	1.0	F_{89} 13	7788	5250	562	8030	5479
					1.2	F_{90} 16			667	7924	5382
					2.0	$F_{0.1}$ 26			1040	7544	5036
					2.1	F_{med} 28			1111	7472	4971

The data unit of the biomass and the catch is 1000 tonnes.
The spawning stock biomass is given for 1 January.
The reference F is the mean F for the age group range from 4 to 8

Table 5.1 Landings (tonnes) of BLUE WHITING from the Southern areas (Sub-areas VIII and IX and Divisions VIIg-k and VIId,e; from 1984, the Divisions VIIg-k are not included), 1980-1989 as estimated by the Working Group.

Country	1980	1981	1982	1983	1984
Germany, Fed.Rep.	-	-	-	50	-
Ireland	-	-	-	-	-
Netherlands	31	633	200	-	-
Norway	-	-	-	-	-
Poland	-	-	-	-	-
Portugal	6,051	7,387	3,890	4,748	5,252
Spain[2]	23,862	30,728	27,500	26,037	25,921
UK (Scotland)	-	-	-	-	-
USSR	-	-	-	-	-
Total	29,944	38,748	31,590	30,835	31,173

Country	1985	1986	1987	1988	1989[1]
Germany, Fed.Rep.	-	-	-	-	-
Ireland	-	-	-	-	-
Netherlands	-	-	-	-	-
Norway	-	-	4	-	-
Poland	-	-	-	-	-
Portugal	6,989	8,116	9,148	5,979	3,557
Spain[2]	35,828	24,965	23,644	24,847	30,108
UK (England & Wales)	3	1	23	12	29
USSR	-	-	-	-	-
France	-	-	-	-	1
Total	42,820	33,082	32,819	30,838	33,695

[1] Preliminary.
[2] Significant quantities taken in Divisions VIIg-k not included in the table are discarded every year.

Table 5.2 Catch in numbers (thousands) by length group in the Portuguese and Spanish blue whiting fisheries, 1983-1989.

Length (cm)	1983	1984	1985	1986	1987	1988	1989
10	-	-	8	-	1	-	-
1	-	3	25	-	33	7	-
2	13	41	39	118	37	3	12
3	253	337	74	783	1,130	8	247
4	1,390	13,263	498	5,903	16,889	391	864
5	18,613	48,364	13,013	7,234	44,625	3,190	1,845
6	63,241	88,023	31,407	6,394	39,111	11,210	9,649
7	67,446	142,003	73,885	16,669	52,790	34,392	59,269
8	95,625	154,385	181,222	49,746	102,112	67,722	85,197
9	97,379	128,950	235,008	82,458	131,911	95,783	80,280
20	81,201	91,952	211,958	99,258	116,195	126,949	100,839
1	66,757	69,370	127,966	126,338	71,862	115,176	100,778
2	58,748	44,241	69,313	107,413	46,724	69,350	82,438
3	43,069	27,623	28,905	57,835	35,691	25,146	45,833
4	25,651	16,420	11,842	23,594	20,522	12,471	22,950
5	10,990	7,744	5,946	9,840	11,696	7,102	14,428
6	5,221	3,309	3,089	3,759	7,461	3,961	7,528
7	3,670	1,194	1,263	2,033	3,717	1,993	3,432
8	2,855	854	899	1,091	1,965	1,434	2,236
9	1,465	800	622	473	994	799	881
30	1,381	199	296	308	918	473	316
1	342	216	205	165	177	222	405
2	58	103	172	174	119	136	159
3	8	117	64	255	46	110	105
4	1	16	54	269	30	89	58
5	4	22	23	167	12	54	26
6	-	32	15	67	6	22	24
7	4	20	6	80	1	19	17
8	-	2	2	56	5	1	4
9	8	2	2	1	-	1	2
40	-	4	3	8	-	1	2
1	-	-	3	-	-	-	-
2	-	-	1	-	-	-	-
3	-	2	1	-	-	-	-
4	-	-	-	-	-	-	-
5	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	-	-	1	-	-	-	-
9	-	-	-	-	-	-	-
50	-	-	-	-	-	-	-
Total N	645,393	839,611	997,830	602,489	707,780	578,215	619,824
Landings (t)	30,785	31,173	42,817	33,083	32,792	30,732	33,665

Table 5.3 Catch in numbers by length group and by quarters in the Portuguese and Spanish BLUE WHITING fisheries, 1989.

Length	Spain	Portugal			VIIIc+IXa
	Quarter 1	Jan	Feb	Mar	Quarter 1
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	2	0	0	0	2
15	10	6	589	2	607
16	966	150	2,947	241	4,304
17	11,014	4,454	17,132	385	32,985
18	13,993	7,532	9,770	197	31,492
19	5,613	3,084	2,333	23	11,053
20	6,498	571	830	102	8,021
21	11,311	302	23	173	11,809
22	15,530	198	7	132	15,867
23	11,541	211	5	64	11,821
24	7,702	254	5	117	8,078
25	4,431	106	0	60	4,597
26	3,217	81	0	18	3,316
27	1,947	0	0	30	1,977
28	1,507	0	0	12	1,519
29	504	0	0	10	514
30	72	0	0	6	78
31	295	0	0	0	295
32	32	0	0	6	38
33	43	0	0	6	49
34	22	0	0	0	22
35	10	0	0	0	10
36	18	0	0	0	18
37	8	0	0	0	8
38	3	0	0	0	3
39	1	0	0	0	1
40	1	0	0	0	1
Total	96,291	16,949	33,661	1,584	148,485

(cont'd)

Table 5.3 (cont'd)

Length	Spain	Portugal			VIIIc+IXa
	Quarter 2	Apr	May	Jun	Quarter 2
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	7	0	0	0	7
15	13	0	12	0	25
16	633	27	0	142	802
17	6,932	1,278	3	2,412	10,625
18	16,302	6,811	3,280	3,953	30,246
19	20,760	7,733	7,030	2,160	37,685
20	27,458	4,677	5,555	1,258	38,948
21	21,368	1,969	1,296	1,063	25,696
22	19,372	492	516	246	20,626
23	8,792	115	199	506	9,612
24	4,516	50	19	147	4,732
25	2,796	21	13	3	2,833
26	2,190	8	0	0	2,198
27	729	3	0	0	732
28	379	0	0	0	379
29	179	3	0	0	182
30	132	3	0	0	135
31	65	0	0	0	65
32	77	0	0	0	77
33	43	0	0	0	43
34	25	0	0	0	25
35	8	0	0	0	8
36	1	0	0	0	1
37	1	0	0	0	1
38	0	0	0	0	0
39	0	0	0	0	0
40	0	0	0	0	0
Total	132,778	23,192	17,923	11,790	185,683

(cont'd)

Table 5.3 (cont'd)

Length	Spain	Portugal			VIIIc+IXa
	Quarter 3	Jul	Aug	Sep	Quarter 3
10	0	0	0	0	0
11	0	0	0	0	0
12	12	0	0	0	12
13	246	0	0	0	246
14	515	0	0	0	515
15	574	61	0	0	635
16	1,198	0	0	394	1,592
17	989	1,108	0	2,231	4,328
18	1,099	1,460	11,650	3,826	8,035
19	5,870	2,528	3,629	1,217	13,244
20	24,843	2,832	3,445	478	31,598
21	34,133	1,334	766	260	36,493
22	24,372	270	287	104	25,033
23	12,634	277	0	89	13,000
24	3,653	18	0	80	3,751
25	2,800	64	0	56	2,920
26	1,012	2	0	37	1,051
27	400	1	0	23	424
28	98	1	0	0	99
29	102	1	0	0	103
30	50	2	0	0	52
31	27	2	0	0	29
32	22	0	0	0	22
33	7	0	0	0	7
34	7	0	0	0	7
35	4	0	0	0	4
36	4	0	0	0	4
37	8	0	0	0	8
38	1	0	0	0	1
39	1	0	0	0	1
40	1	0	0	0	1
Total	114,682	9,961	9,777	8,795	143,215

(cont'd)

Table 5.3 (cont'd)

Length	Spain	Portugal			VIIIc+IXa
	Quarter 4	Oct	Nov	Dec	Quarter 4
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	1	0	0	0	1
14	340	0	0	0	340
15	452	0	126	0	578
16	2,574	0	377	0	2,951
17	7,449	48	2,638	1,196	11,131
18	8,268	434	3,775	2,947	15,424
19	12,471	1,157	1,501	3,169	18,298
20	19,590	1,199	399	1,084	22,272
21	24,604	1,475	284	417	26,780
22	19,587	1,044	142	139	20,912
23	10,849	379	172	0	11,400
24	5,725	473	191	0	6,389
25	3,824	189	65	0	4,078
26	821	142	0	0	963
27	267	0	32	0	299
28	239	0	0	0	239
29	82	0	0	0	82
30	43	0	8	0	51
31	16	0	0	0	16
32	22	0	0	0	22
33	6	0	0	0	6
34	4	0	0	0	4
35	4	0	0	0	4
36	1	0	0	0	1
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	117,239	6,540	9,710	8,952	142,441

Table 5.4 SUM OF PRODUCTS CHECK

BLUE WHITING, SOUTHERN AREA
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: millions

	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	48	61	98	74	118	32	105	30	41
1	189	103	150	223	286	93	383	147	200
2	226	184	239	349	337	218	111	233	175
3	166	122	68	127	171	168	62	114	93
4	50	64	45	35	66	68	28	32	61
5	26	22	34	13	14	15	13	10	27
6	3	3	9	14	3	6	3	9	15
7	0	0	2	3	2	1	1	3	6
8+	0	1	1	1	1	1	1	0	3
TOTAL	709	560	645	840	998	602	707	578	620
A) SOP	38	34	32	31	43	34	33	30	34
B)NOMIN.	38115	31390	30785	31173	42817	33070	32792	30732	33666
(B/A) %	101304	93310	96753	99375	99948	97320	98467	103178	100412

Table 5.5 SUM OF PRODUCTS CHECK

BLUE WHITING, SOUTHERN AREA
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: kilogram

	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	.038	.032	.029	.022	.029	.026	.029	.035	.030
1	.048	.045	.039	.029	.037	.042	.039	.039	.041
2	.051	.061	.046	.035	.043	.052	.059	.053	.050
3	.058	.069	.066	.050	.050	.063	.072	.055	.067
4	.068	.077	.076	.066	.061	.073	.085	.067	.072
5	.070	.085	.084	.077	.073	.090	.095	.101	.085
6	.084	.103	.104	.081	.104	.097	.117	.090	.095
7	.155	.156	.124	.094	.112	.156	.138	.117	.111
8+	.200	.269	.145	.131	.139	.257	.161	.207	.155

Table 5.6 Catch per unit effort

a) by Spanish vessels landing in the main Galician ports, 1978-1989.

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

b) by Portuguese bottom trawl fishery, 1978-1988.

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

Table 5.7 Catch per unit effort by Spanish single and pair trawlers landing in the main Galician ports, 1983-1989.

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
		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

Table 5.8.1 Stratified mean catch (kg/h) and standard deviation of BLUE WHITING in bottom trawl surveys by Spain in Galician waters. All the surveys in September-October except the 1986 survey which was in April.

	Division IXa				Division VIIIc				Divisions VIIIc + IXa				Total	
Strata →	<200		>200		<200		>200		<200		>200		<500	
Year	y	s_y	y	s_y	y	s_y	y	s_y	y	s_y	y	s_y	y	s_y
1980	80.0	64.4	-	-	120.7	114.9	-	-	101.4	19.3	-	-	-	-
1981	20.2	19.0	53.9	41.4	70.8	75.0	59.0	27.3	46.8	12.2	57.6	16.2	-	-
1982	82.1	61.5	-	-	118.5	70.8	-	-	101.2	12.9	-	-	-	-
1983	224.3	224.5	40.5	10.7	275.6	192.9	144.0	143.6	251.2	38.7	116.2	37.2	189.1	24.2
1984	180.2	49.3	23.1	21.6	125.0	19.6	93.9	74.4	151.2	25.6	74.9	15.9	131.2	15.5
1985	295.5	153.8	212.8	241.6	129.9	23.3	126.3	160.4	208.6	74.1	149.5	41.9	163.6	39.7
1986	213.7	85.2	78.9	60.7	98.6	16.0	41.4	41.6	153.3	41.4	51.4	11.7	101.5	21.9
1987	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1988	461.9	88.9	-	-	78.6	32.8	-	-	212.5	36.2	114.6	29.6	155.3	25.7

Table 5.8.2 Stratified mean catch and standard error for BLUE WHITINGin groundfish surveys by Portugal (Cardador, 1986).

Year	Month	20-100 m		100-200 m		200-500 m		20-500 m	
		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] [3]	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[3]	October	2.4	1.2	357.0	144.4	650.2	111.0	276.2	63.2
1987[3]	October	4.0	0.0	256.8	63.5	811.0	267.4	267.4	58.9

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

Table 5.9

```
SOUTHERN BLUE WHITING TUNING DATA
102
cpue Spanish Pair Trawlers
81,89
1,1
0,7
1, 2224,13174,17326,13325,3500,1715, 146,  1
1,  798, 3465,12070, 8731,5070,1658, 175, 10
1, 1140, 7196,16392, 9311,7476,6326,1718,360
1, 1839,13710,27286,14845,4836,1755,1750,338
1, 3680,14573,23823,14126,6256,1232, 217,126
1,  788, 3721,14131,14745,7113,1278, 505, 47
1, 5433,25328,13153, 6664,2938,1029, 166, 43
1, 2545, 7778,21473,18436,6391,1300, 781,223
1, 2488,15272,18486,17160,8374,3760,1003,771
Bottom Trawl Spanish Survey
81,89
1,1
0,7
1,   69, 568,  63, 66, 14, 2,0,0
1, 1695, 195,  99, 47, 45,11,0,0
1, 3455,1856, 590,113, 52,32,7,8
1, 6558,4126,1293,304, 48,12,7,2
1, 2224,1064, 600,267, 27, 5,0,0
1,11229, 101; 290,231, 64, 3,4,0
1, 2386,5673,  58,147,116,33,2,2
1, 2168, 314, 116, 14,  4, 1,1,0
1, 1554, 229,  33, 36,  3, 3,2,0
```

Table 5.10

Module run at 15.47.35 15 SEPTEMBER 1990
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 ,cpue Spanish Pair Tr, has terminal q estimated as the mean
Fleet 2 ,Bottom Trawl Spanish, has terminal q estimated as the mean
FLEETS COMBINED BY ** VARIANCE **

Regression weights
, 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. Fleets combined by variance of predictions
Fishing mortalities

Age,	81,	82,	83,	84,	85,	86,	87,	88,	89,
0,	.050,	.047,	.076,	.071,	.148,	.024,	.109,	.025,	.033,
1,	.355,	.144,	.155,	.248,	.425,	.166,	.437,	.219,	.232,
2,	.644,	.698,	.574,	.642,	.724,	.677,	.303,	.522,	.437,
3,	.702,	.896,	.615,	.704,	.769,	1.027,	.408,	.586,	.407,
4,	.692,	.655,	1.062,	.757,	1.027,	.831,	.465,	.385,	.727,
5,	1.261,	.772,	.905,	1.125,	.770,	.701,	.376,	.311,	.672,
6,	1.624,	.488,	.833,	1.292,	.867,	.897,	.330,	.462,	.966,
7,	.984,	.702,	.798,	.904,	.831,	.826,	.376,	.453,	.642,

Log catchability estimates

Age 0

Fleet,	81,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	.84,	-.49,	-.12,	.57,	1.53,	-.52,	1.73,	.76,	.68
2 ,	-2.63,	.26,	.99,	1.84,	1.02,	2.14,	.90,	.60,	.21

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	.55 ,	.847,	1.7396 ,	.0288,	.000E+00,	.000E+00,	.554,	.268
2 ,	.59 ,	1.444,	1.8106 ,	.0480,	.000E+00,	.000E+00,	.594,	.457

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.033	.730	.223	.730	.093

Age 1

Fleet,	81,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	3.21,	1.58,	2.01,	2.72,	3.08,	1.89,	3.36,	2.45,	2.88
2 ,	.06,	-1.30,	.65,	1.52,	.46,	-1.71,	1.87,	-.76,	-1.32

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	2.58 ,	.664,	****** ,	.1718,	.000E+00,	.000E+00,	2.575,	.210
2 ,	-.06 ,	1.363,	.9431 ,	.8224,	.000E+00,	.000E+00,	-.059,	.431

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.232	.597	.617	.617	1.067

Age 2

Fleet,	81,	82,	83,	84,	85,	86,	87,	88,	89
1 ,	3.90,	3.83,	3.68,	3.92,	3.94,	3.78,	3.59,	3.87,	3.83
2 ,	-1.72,	-.98,	.35,	.87,	.25,	-.11,	-1.84,	-1.35,	-2.50

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	3.81 ,	.123,	****** ,	.4297,	.000E+00,	.000E+00,	3.814,	.039
2 ,	-.78 ,	1.226,	.4588 ,	2.4373,	.000E+00,	.000E+00,	-.779,	.388

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.437	.122	.172	.172	1.983

Table 5.10 (cont'd)

Age 3

Fleet	81	82	83	84	85	86	87	88	89
1	4.03	4.16	4.43	4.41	4.15	4.50	3.79	4.55	4.32
2	-1.28	-1.06	.02	.52	.19	.35	-.03	-2.63	-1.85

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	4.26	.263	******	.3833	.000E+00	.000E+00	4.261	.083
2	-.64	1.167	.5265	1.3573	.000E+00	.000E+00	-.641	.369

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.407	.256	.271	.271	1.117

Age 4

Fleet	81	82	83	84	85	86	87	88	89
1	3.88	3.94	5.17	4.65	4.58	4.46	3.88	4.34	4.61
2	-1.64	-.78	.20	.04	-.87	-.25	.65	-3.03	-3.32

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	4.39	.454	******	.5843	.000E+00	.000E+00	4.391	.144
2	-1.00	1.482	.3677	7.4274	.000E+00	.000E+00	-1.001	.469

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.727	.434	.712	.712	2.689

Age 5

Fleet	81	82	83	84	85	86	87	88	89
1	4.42	4.06	5.13	5.01	4.24	4.08	3.36	3.66	4.52
2	-2.33	-.96	-.16	.02	-1.26	-1.97	-.08	-3.51	-2.61

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	4.28	.605	******	.5249	.000E+00	.000E+00	4.277	.191
2	-1.43	1.324	.2398	2.1898	.000E+00	.000E+00	-1.428	.419

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.672	.551	.540	.551	.963

Age 6

Fleet	81	82	83	84	85	86	87	88	89
1	4.37	3.28	5.09	5.10	4.14	4.38	2.78	3.70	4.20
2	-2.22	-3.49	-.41	-.42	-2.85	-.46	-1.64	-2.96	-2.02

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	4.12	.808	******	.8916	.000E+00	.000E+00	4.115	.256
2	-1.83	1.245	.1602	1.1696	.000E+00	.000E+00	-1.831	.394

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.966	.678	.124	.678	.033

Table 5.11 VIRTUAL POPULATION ANALYSIS - From tuning.

BLUE WHITING, SOUTHERN AREA

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = .20

	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	.050	.047	.076	.071	.148	.024	.109	.025	.033
1	.355	.144	.155	.248	.425	.166	.437	.219	.232
2	.644	.698	.574	.642	.724	.677	.303	.522	.437
3	.702	.896	.615	.704	.769	1.027	.408	.586	.407
4	.692	.655	1.062	.757	1.027	.831	.465	.385	.727
5	1.261	.772	.905	1.125	.770	.701	.376	.311	.672
6	1.624	.488	.833	1.292	.867	.897	.330	.462	.966
7	.984	.702	.798	.904	.831	.826	.376	.453	.642
8+	.984	.702	.798	.904	.831	.826	.376	.453	.642
(1- 4)U	.598	.598	.601	.588	.736	.675	.403	.428	.451

Table 5.12 - Separable VPA.

Title : BLUE WHITING, SOUTHERN AREA
At 21.01.54 18 SEPTEMBER 1990
from 81 to 89 on ages 0 to 7
with Terminal F of .530 on age 2 and Terminal S of 1.500

Initial sum of squared residuals was 55.102 and
final sum of squared residuals is 13.648 after 69 iterations

Matrix of Residuals

Years	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89		WTS
Ages										
0/ 1	.048	.296	.364	-.224	1.182	-1.886	.725	-.505	.000	.293
1/ 2	-.003	-.479	-.520	-.177	.325	-.394	.808	.439	.000	.562
2/ 3	-.381	.442	.011	-.026	-.244	.090	-.571	.679	.000	.657
3/ 4	-.242	.271	-.135	-.281	-.231	.421	-.039	.236	.000	1.000
4/ 5	-.460	-.160	.346	-.082	.235	.185	.240	-.304	.000	.926
5/ 6	.820	.131	.020	.448	-.374	.062	-.325	-.782	.000	.543
6/ 7	.890	-.586	-.035	.573	-.294	.174	-.578	-.143	.000	.517
	.000	.000	.000	.000	.000	.000	.000	.000	.000	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	81	82	83	84	85	86	87	88	89
F-values	.7272	.5548	.6253	.7158	.7881	.7127	.4232	.3966	.5300

Selection-at-age (S)

	0	1	2	3	4	5	6	7
S-values	.1019	.4248	1.0000	1.1818	1.2712	1.3229	1.4604	1.5000

Table 5.13 VIRTUAL POPULATION ANALYSIS - From separable VPA.

BLUE WHITING, SOUTHERN AREA

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = .20

	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	.051	.047	.076	.072	.146	.025	.101	.029	.054
1	.358	.146	.157	.248	.434	.164	.453	.199	.270
2	.644	.708	.585	.654	.725	.701	.299	.554	.384
3	.704	.897	.631	.728	.798	1.030	.434	.573	.447
4	.704	.659	1.064	.798	1.118	.902	.468	.423	.697
5	1.314	.801	.916	1.133	.864	.864	.438	.314	.793
6	1.535	.537	.906	1.343	.883	1.200	.478	.588	.981
7	1.066	.600	.968	1.118	.929	.863	.696	.840	1.031
8+	1.066	.600	.968	1.118	.929	.863	.696	.840	1.031
(1- 4)U	.603	.602	.609	.607	.769	.699	.413	.437	.449

Table 5.14 (VIRTUAL POPULATION ANALYSIS) From separable VPA.

BLUE WHITING, SOUTHERN AREA

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: thousand tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .250
PROPORTION OF ANNUAL M BEFORE SPAWNING: .250

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	1069	1452	1471	1168	957	1441	1212	1167	(864)	0
1	689	832	1134	1116	890	677	1150	897	928	(670)
2	520	395	589	794	713	472	470	599	602	581
3	359	224	159	268	338	283	192	285	282	336
4	108	145	75	69	106	125	83	102	132	148
5	38	44	62	21	26	28	41	42	55	54
6	4	8	16	20	6	9	10	22	25	20
7	0	1	4	5	4	2	2	5	10	8
8+	0	2	1	1	2	2	2	1	4	4
TOTAL NO	2788	3103	3511	3463	3041	3038	3162	3121	2902	
SPS NO	684	601	653	768	751	605	639	743	792	
TOT.BIOM	132	140	137	107	118	122	134	137	131	
SPS BIOM	38	39	36	32	36	36	40	42	47	

Bracketed figures not used for prediction.

Table 5.15 Southern Blue Whiting. RCRTINX2 analysis.

```
BLUE WHITING SOUTH RECRUITMENT INDEX 1989
   2,    9,     2
1981, 1069,    69,  3465
1982, 1452,  1695,  7196
1983, 1471,  3455, 13710
1984, 1168,  6558, 14573
1985,  957,  2224,  3721
1986, 1441, 11229, 25328
1987, 1212,  2386,  6333
1988, 1167,  2168, 15272
1989,  864,  1554,   -11
SPANISH BTTOM TRAWL SURVEY
CPUE AT AGE 1
```

Analysis by RCRTINX2 of data from file recruit-89
BLUE WHITING SOUTH RECRUITMENT INDEX 1989

Data for 2 surveys over 9 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 3 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
SPANIS	7.6820	.243	5.258	.1864	7	7.1252	.38681	.41413	.08829
CPUE A	9.6338	.313	4.287	.5213	7	7.3065	.17739	.19855	.37853
MEAN						7.1223	.16852	.16852	.53318

Yearclass = 1989

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
SPANIS	7.3492	.251	5.182	.1810	8	7.0294	.36231	.38642	.14190
CPUE A									
MEAN						7.1146	.15714	.15714	.85810

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis		Ext.SE/ Int.SE
1988	7.19	1329.10	.12	.06	7.06	1168.00	.51
1989	7.10	1214.98	.15	.03	6.76	865.00	.20

Table 5.16

List of input variables for the ICES prediction program.

BLUE WHITING SOUTHERN STOCK.
The reference F is the mean F for the age group range from 1 to 4

The number of recruits per year is as follows:

Year	Recruitment
1990	1238.0
1991	1238.0
1992	1238.0

Proportion of F (fishing mortality) effective before spawning: .2500
Proportion of M (natural mortality) effective before spawning: .2500

Data are printed in the following units:

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

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
0	1238.0	.05	.20	.00	.030	.030
1	943.0	.20	.20	.18	.041	.041
2	581.0	.46	.20	.48	.050	.050
3	336.0	.55	.20	.91	.067	.067
4	148.0	.59	.20	.98	.072	.072
5	54.0	.61	.20	1.00	.085	.085
6	20.0	.68	.20	1.00	.095	.095
7	8.0	.70	.20	1.00	.111	.111
8+	4.0	.70	.20	1.00	.155	.155

Table 5.17

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

SOUTHERN BLUE WHITING

Year 1990						Year 1991					Year 1992	
fac-tor	ref. F	stock biomass	sp.stock biomass	catch		fac-tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.45	146	50	34	$F_{0.1}$	.3	.14	149	56	12	177	77
					F_{90}	1.0	.45		52	35	152	53
					F_{med}	1.5	.67		48	48	138	41
					F_{high}	1.7	.77		47	53	133	38
					F_{max}	2.0	.90		45	59	127	33

The data unit of the biomass and the catch is 1000 tonnes.
The spawning stock biomass is given for the time of spawning.
The spawning stock biomass for 1992 has been calculated with the same fishing mortality as for 1991.
The reference F is the mean F for the age group range from 1 to 4

Table 5.18
Results

21.14.28 18 SEPTEMBER 1990
BLUE WHITING SOUTHERN STOCK.

****
* Year 1990. F-factor 1.000 and reference F .4500 *
****

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January: sp.stock size	at 1 January: sp.stock biomass	at spawning time: sp.stock size	at spawning time: sp.stock biomass
0	.0500	54.769	1.6431	1238.00	37.140	.000	.0000	.000	.0000
1	.2000	155.444	6.3732	943.00	38.663	169.740	6.9593	153.587	6.2971
2	.4600	195.646	9.7823	581.00	29.050	278.880	13.9440	236.461	11.8230
3	.5500	130.009	8.7106	336.00	22.512	305.760	20.4859	253.484	16.9834
4	.5900	60.367	4.3465	148.00	10.656	145.040	10.4429	119.046	8.5713
5	.6100	22.576	1.9189	54.00	4.590	54.000	4.5900	44.101	3.7486
6	.6800	9.044	.8592	20.00	1.900	20.000	1.9000	16.050	1.5248
7	.7000	3.692	.4099	8.00	.888	8.000	.8880	6.388	.7091
8+	.7000	1.846	.2862	4.00	.620	4.000	.6200	3.194	.4951
Total		633.394	34.3298	3332.00	146.019	985.420	59.8301	832.311	50.1524

****
* Year 1991. F-factor 1.000 and reference F .4500 *
****

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January: sp.stock size	at 1 January: sp.stock biomass	at spawning time: sp.stock size	at spawning time: sp.stock biomass
0	.0500	54.769	1.6431	1238.00	37.140	.00	.0000	.000	.0000
1	.2000	158.931	6.5162	964.16	39.530	173.55	7.1155	157.033	6.4383
2	.4600	212.857	10.6429	632.11	31.606	303.41	15.1707	257.263	12.8631
3	.5500	116.192	7.7849	300.29	20.119	273.26	18.3087	226.544	15.1785
4	.5900	64.738	4.6611	158.72	11.427	155.54	11.1989	127.665	9.1919
5	.6100	28.081	2.3869	67.17	5.709	67.17	5.7094	54.856	4.6628
6	.6800	10.863	1.0320	24.02	2.282	24.02	2.2821	19.278	1.8314
7	.7000	3.829	.4250	8.30	.921	8.30	.9208	6.624	.7353
8+	.7000	2.252	.3490	4.88	.756	4.88	.7562	3.896	.6039
Total		652.513	35.4411	3397.64	149.491	1010.13	61.4623	853.159	51.5051

****
* Year 1992. F-factor 1.000 and reference F .4500 *
****

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January: sp.stock size	at 1 January: sp.stock biomass	at spawning time: sp.stock size	at spawning time: sp.stock biomass
0	.0500	54.769	1.6431	1238.00	37.140	.00	.0000	.000	.0000
1	.2000	158.931	6.5162	964.16	39.530	173.55	7.1155	157.033	6.4383
2	.4600	217.633	10.8816	646.29	32.315	310.22	15.5110	263.034	13.1517
3	.5500	126.413	8.4697	326.71	21.889	297.30	19.9194	246.474	16.5137
4	.5900	57.858	4.1658	141.85	10.213	139.01	10.0087	114.097	8.2150
5	.6100	30.114	2.5597	72.03	6.123	72.03	6.1227	58.828	5.0003
6	.6800	13.512	1.2837	29.88	2.839	29.88	2.8387	23.980	2.2781
7	.7000	4.599	.5105	9.96	1.106	9.96	1.1060	7.956	.8832
8+	.7000	2.472	.3832	5.36	.830	5.36	.8302	4.277	.6630
Total		666.302	36.4134	3434.24	151.985	1037.32	63.4522	875.678	53.1433

Table 6.1 Acoustic estimates 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

Table 6.2 Total catches of BLUE WHITING in 1978-1989 divided into areas within and beyond areas of 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 (25.52)	-	-	67,391 (12.60)	26,444 (4.94)	6,580 (1.23)	195,361 (36.53)	102,523 (19.17)	534,803	574,812	93.0
1979	614,734 (56.18)	-	-	75,545 (6.90)	15,117 (1.38)	204 (0.02)	224,201 (20.49)	164,388 (15.02)	1,094,189	1,091,422	100.3
1980	567,693 (55.23)	-	-	152,095 (14.80)	4,562 (0.44)	8,757 (0.85)	164,342 (15.99)	130,417 (12.69)	1,027,866	1,092,620	94.1
1981	168,681 (19.76)	-	123,000 (14.41)	215,004 (25.18)	7,751 (0.91)	-	174,801 (20.48)	164,475 (19.27)	853,712	870,808	98.0
1982	22,993 (4.32)	-	-	130,435 (24.51)	5,797 (1.09)	-	125,072 (23.50)	247,884 (46.58)	532,181	544,919	97.7
1983	15,203 (2.93)	-	-	109,675 (21.15)	7,000 (1.35)	-	91,804 (17.70)	294,981 (56.87)	518,663	539,235	96.2
1984	18,407 (3.19)	-	-	150,603 (26.13)	105 (0.02)	-	124,905 (21.67)	282,418 (48.99)	576,438	586,504	98.3
1985	38,978 (6.07)	-	-	114,785 (17.88)	-	-	196,003 (30.52)	292,345 (45.53)	642,111	644,899	99.6
1986	20,665 (2.74)	-	-	187,768 (24.87)	-	116 (0.02)	171,074 (22.66)	375,257 (49.71)	754,880	757,370	99.7
1987	103,535 (17.76)	-	-	109,201 (18.74)	-	-	135,980 (23.31)	234,249 (40.19)	582,830	631,610	92.3
1988	65,172 (13.2)	-	-	38,449 (7.8)	-	-	157,368 (31.8)	234,344 (47.3)	495,333	522,575	94.8
1989	137,093 (23.0)	-	-	68,817 (11.5)	4,977 (0.8)	-	101,177 (17.0)	284,338 (47.7)	596,402	596,402	100,0

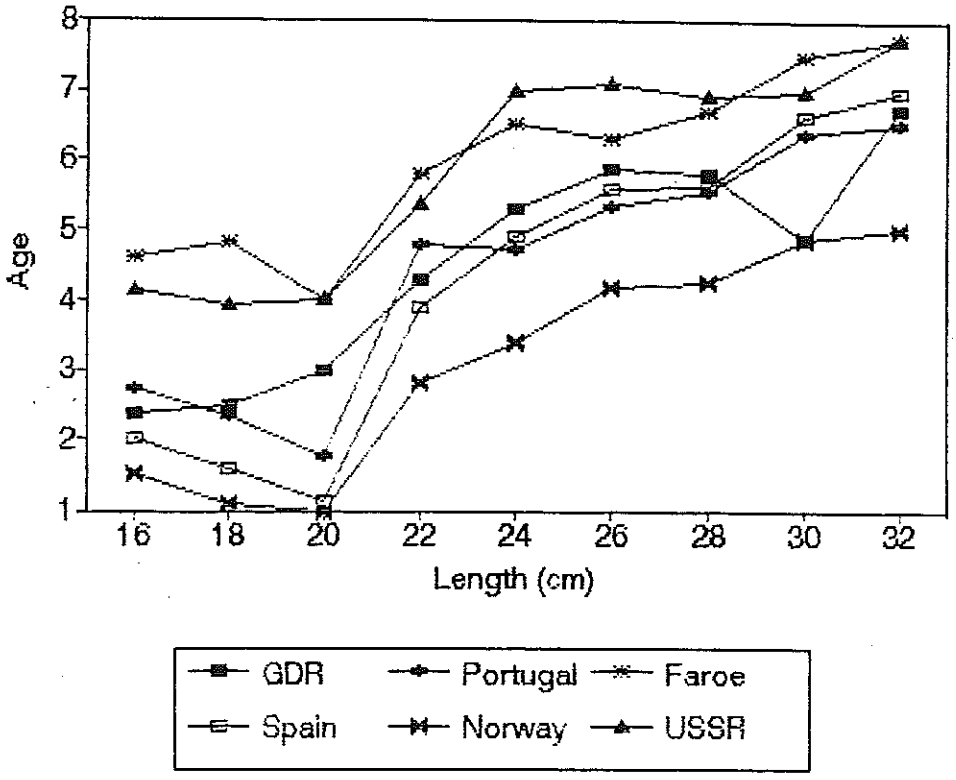
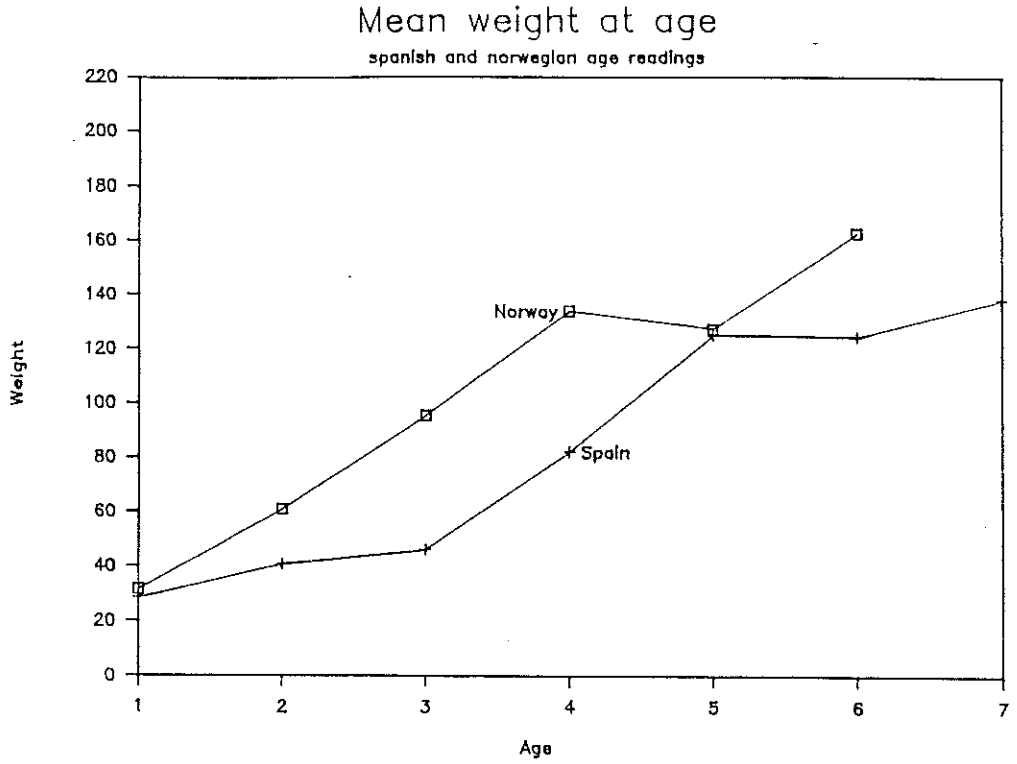


Figure 3.1 Mean age at length in sectioned otoliths.



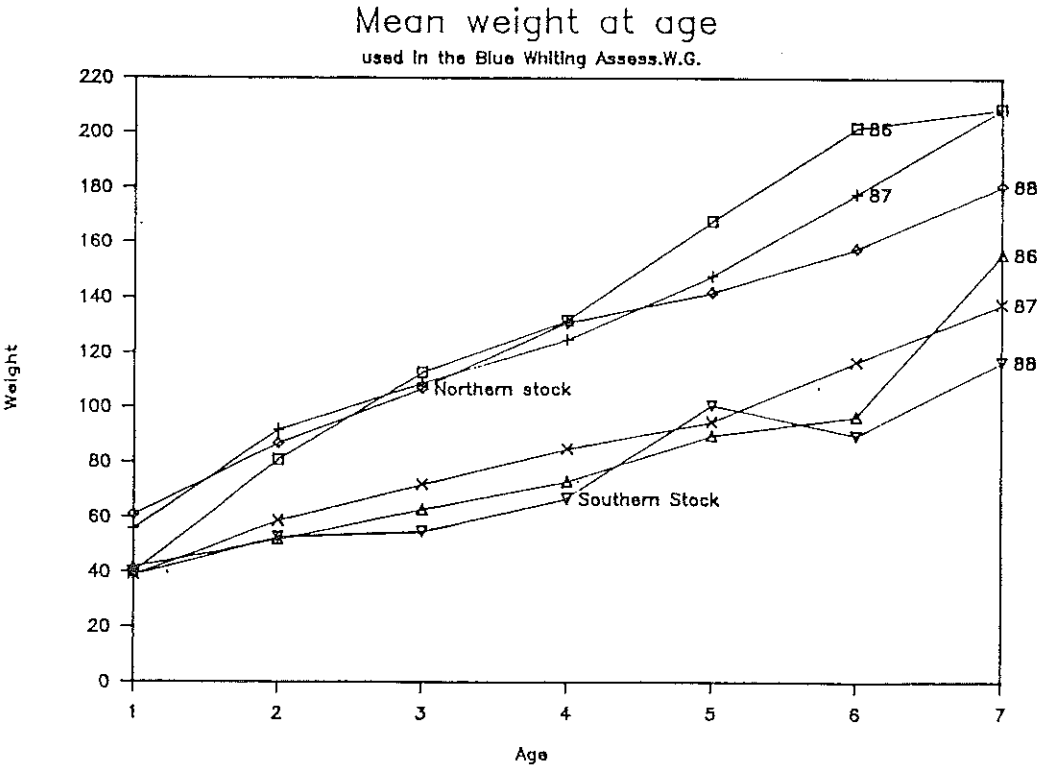


Figure 3.2 Mean weight at age used in the assessment of the Northern and Southern BLUE WHITING, and mean weight at age in the Spanish and Norwegian age readings of the sample exchanged.

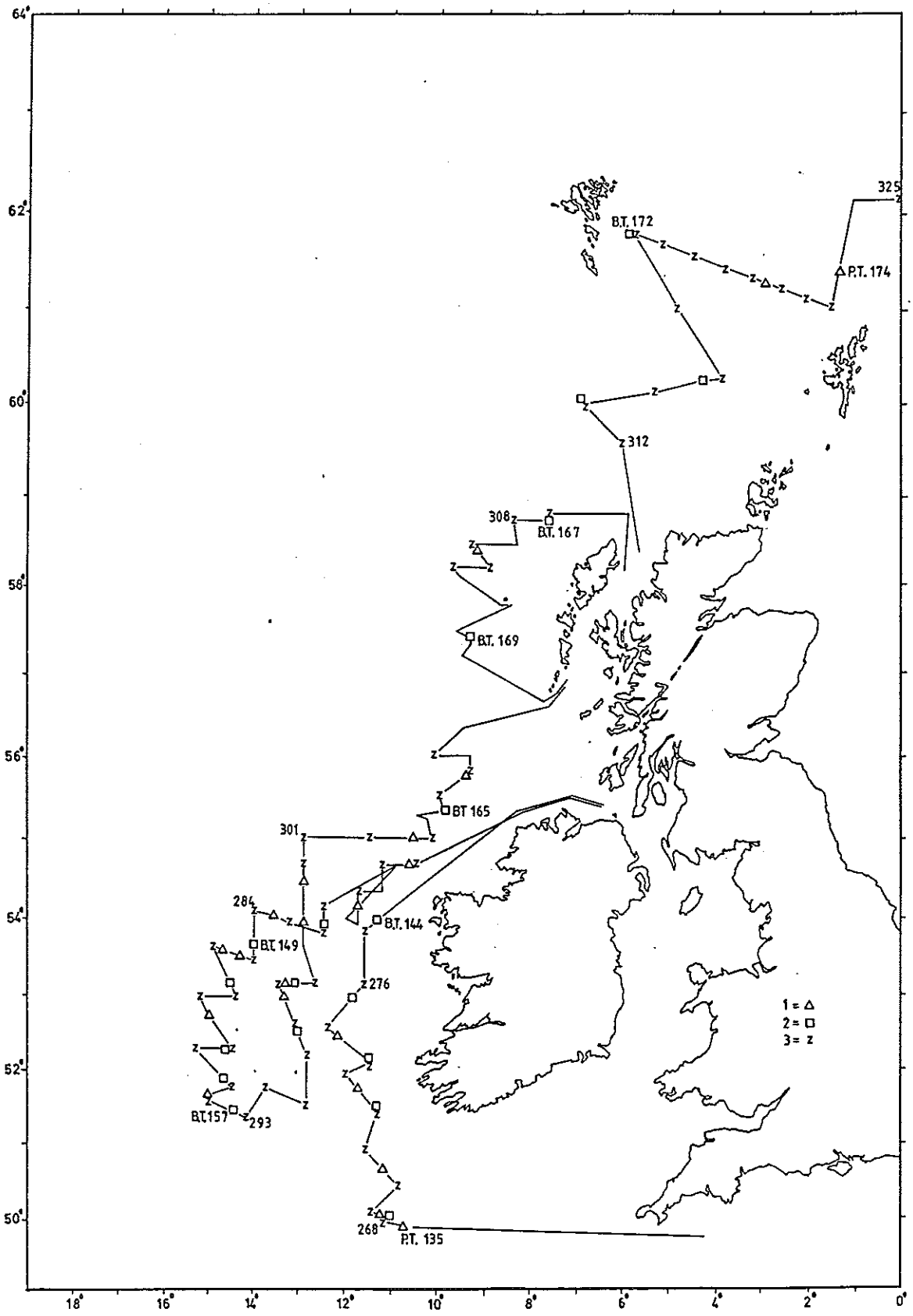


Fig. 4.1. Survey route and stations of "G.O. Sars" 29 March-20 April 1990. 1) Pelagic trawl, 2) Bottom trawl, 3) CTD-sonde.

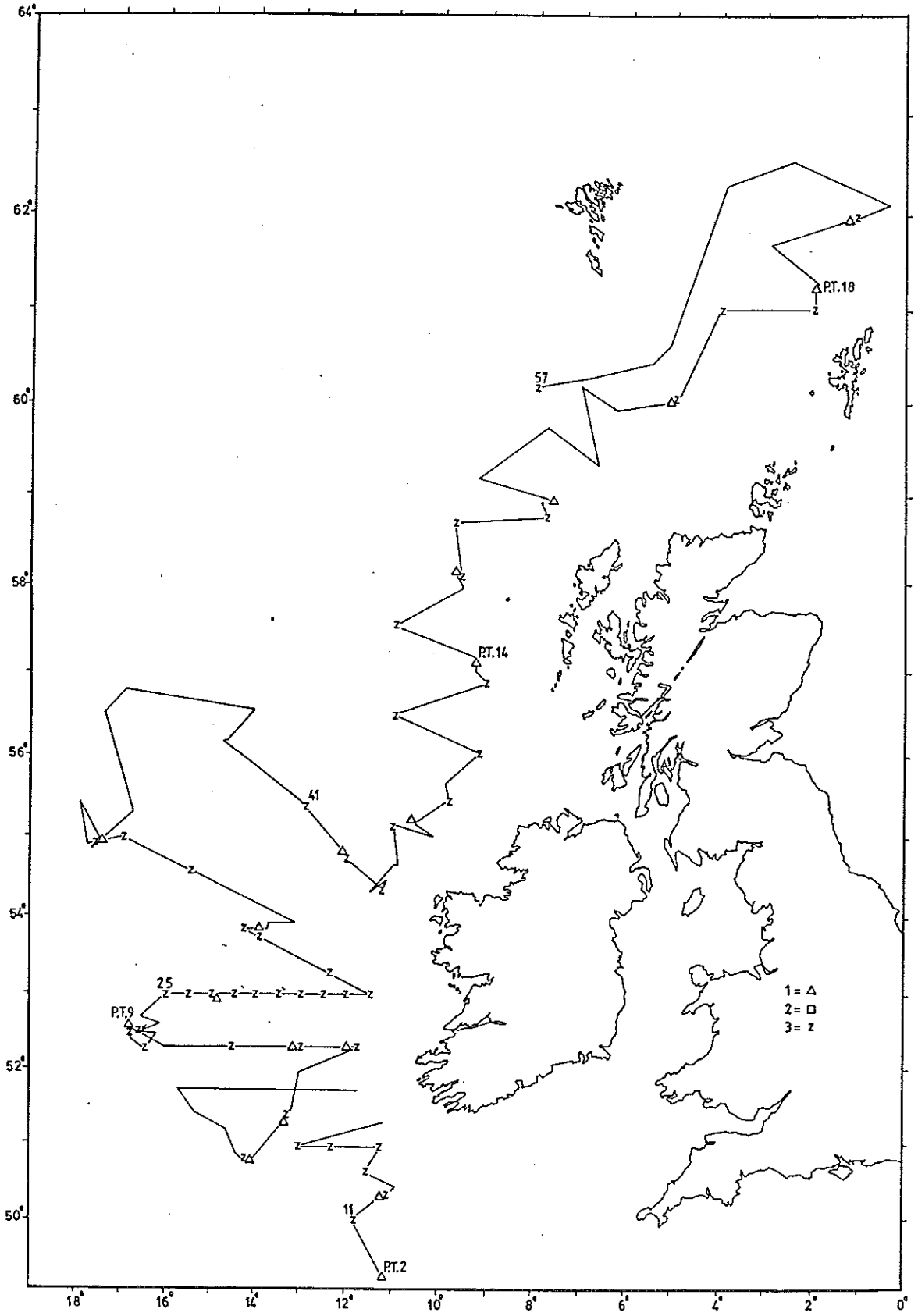


Fig. 4.2. Survey route and stations of "Pinro" 19 March-13 April 1990
1) Pelagic trawl, 2) Bottom trawl, 3) Hydrological station.

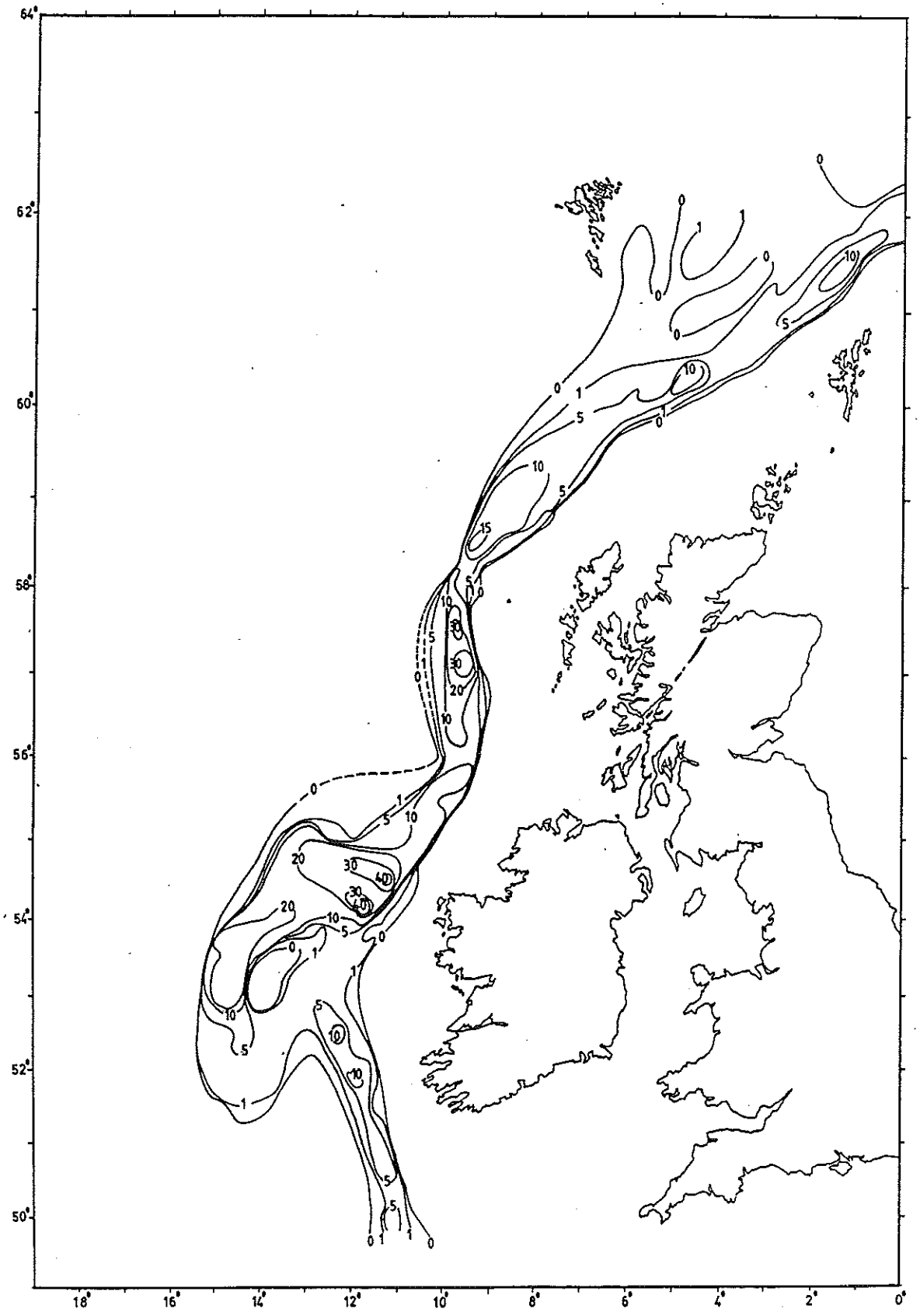


Fig. 4.3. Density distribution of blue whiting recorded by "G.O. Sars" 29/3-20/4 1990. Echo intensity in $m^2/n.mile^2$.

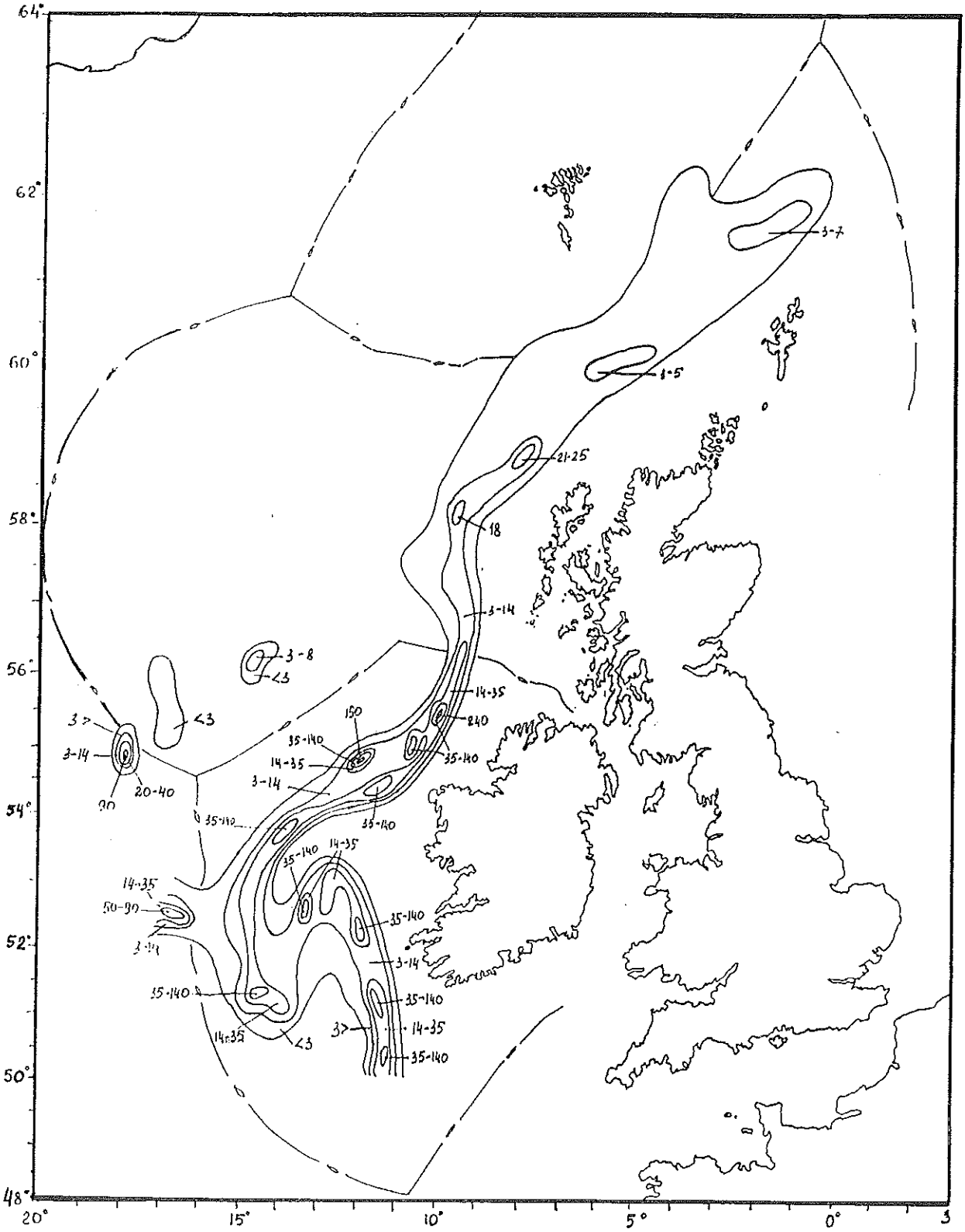


Fig. 4.4. Density distribution of blue whiting recorded by "Pinro" 19/3-13/4 1990. Echo intensity in $m^2/n.mile^2$.

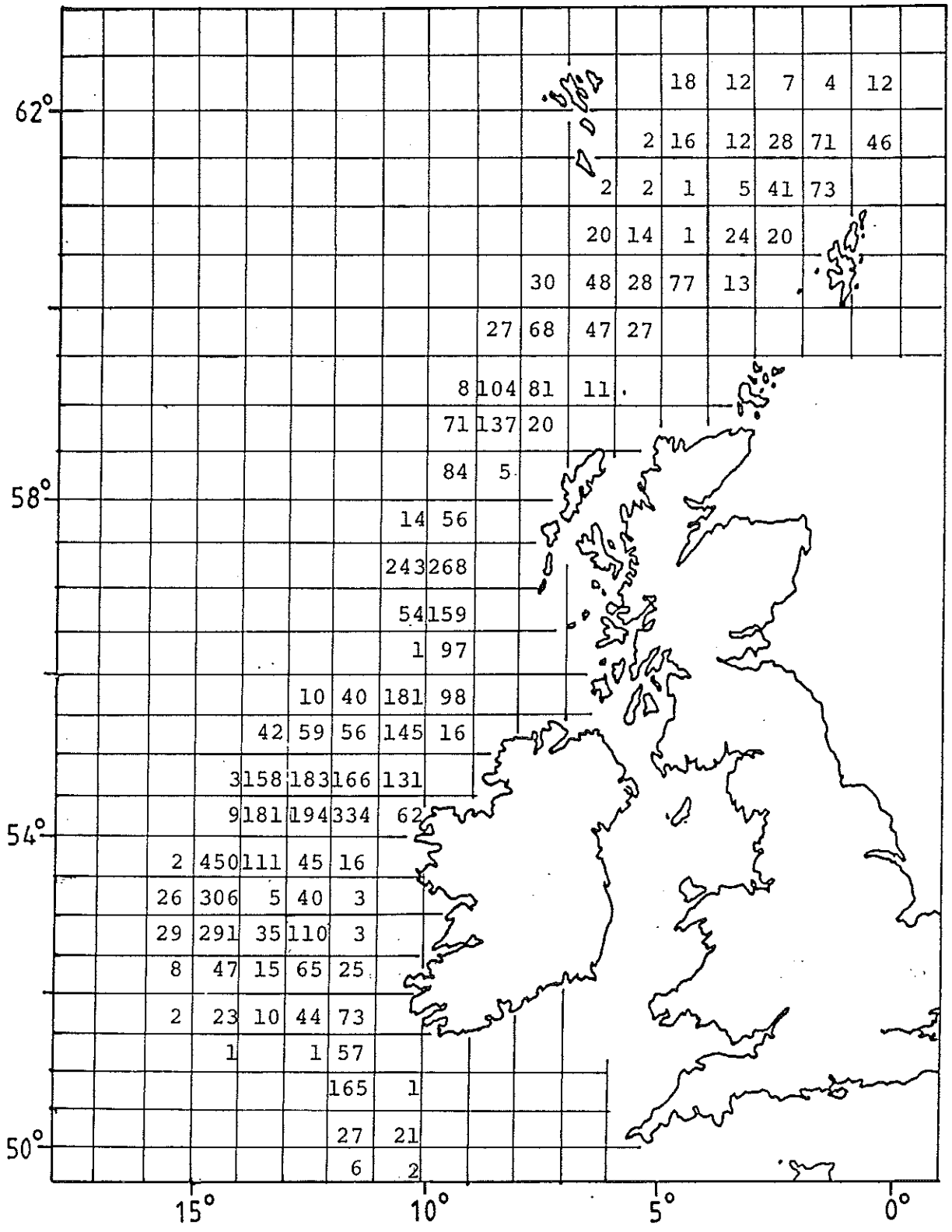


Fig. 4.5. Estimated biomass (thousand tonnes) of blue whiting recorded by "G.O. Sars", spring 1990.

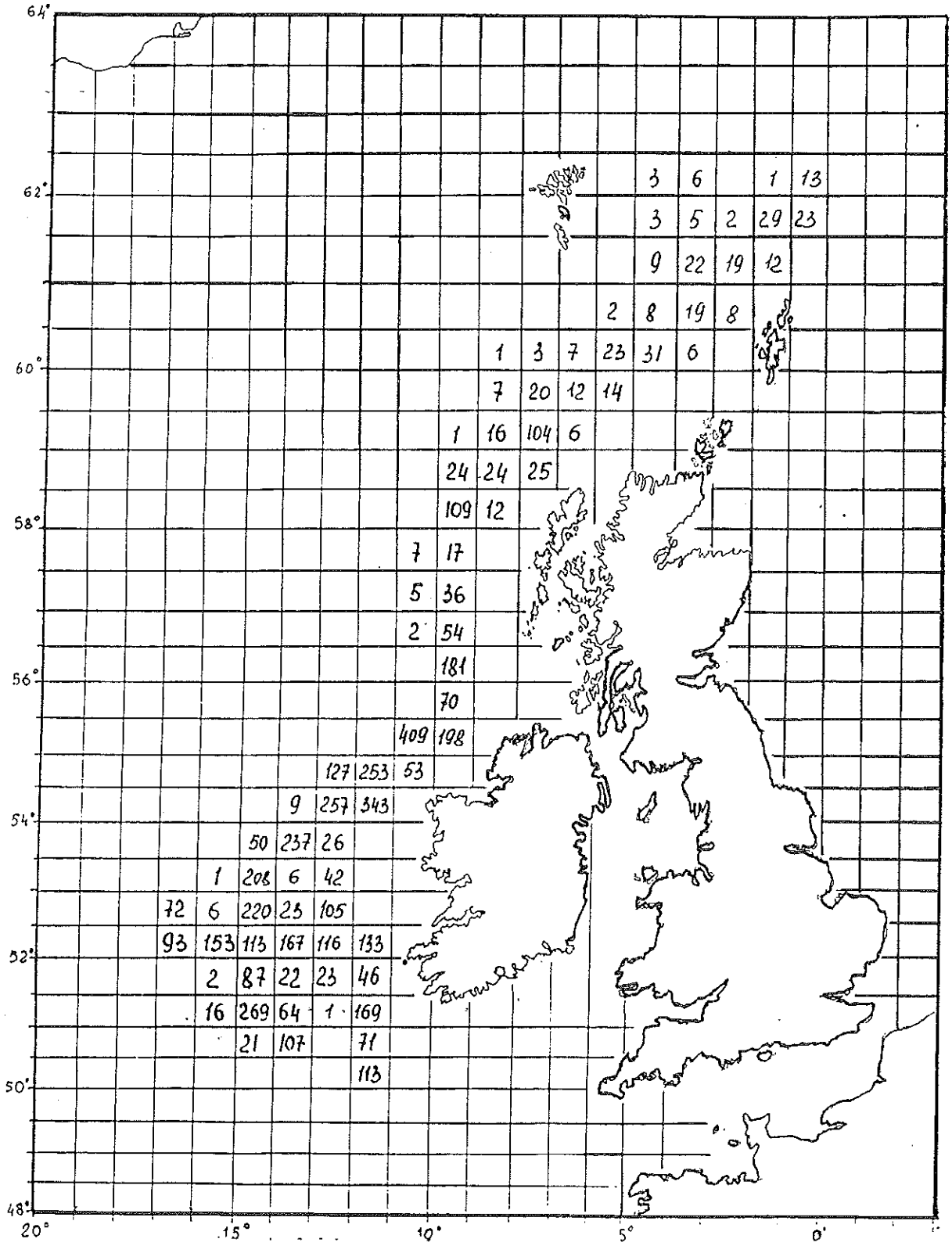


Fig. 4.6. Estimated biomass (thousand tonnes) of blue whiting recorded by "Pinro", spring 1990.

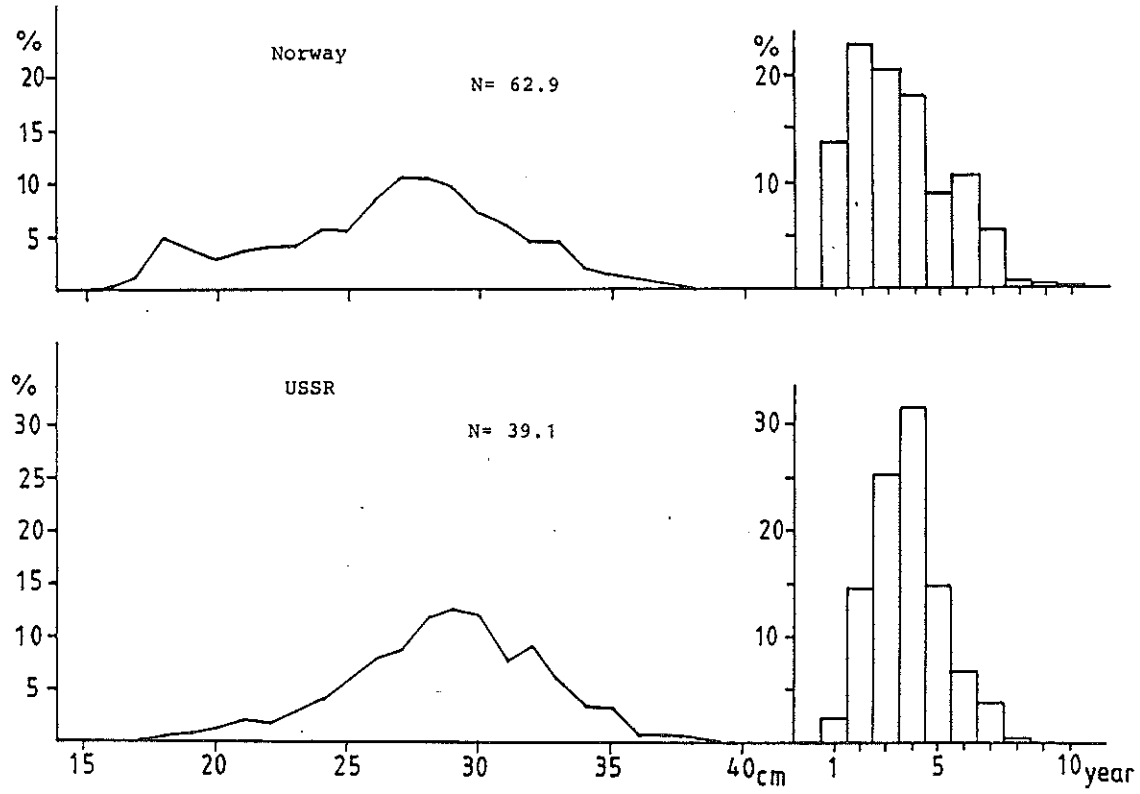


Fig. 4.7. Total length and age distribution (%) of blue whiting in the spawning area west of the British Isles, spring 1990, observed by "G.O. Sars", upper part and by "Pinro", lower part. Numbers weighted by abundance: N x 10^{-9}.

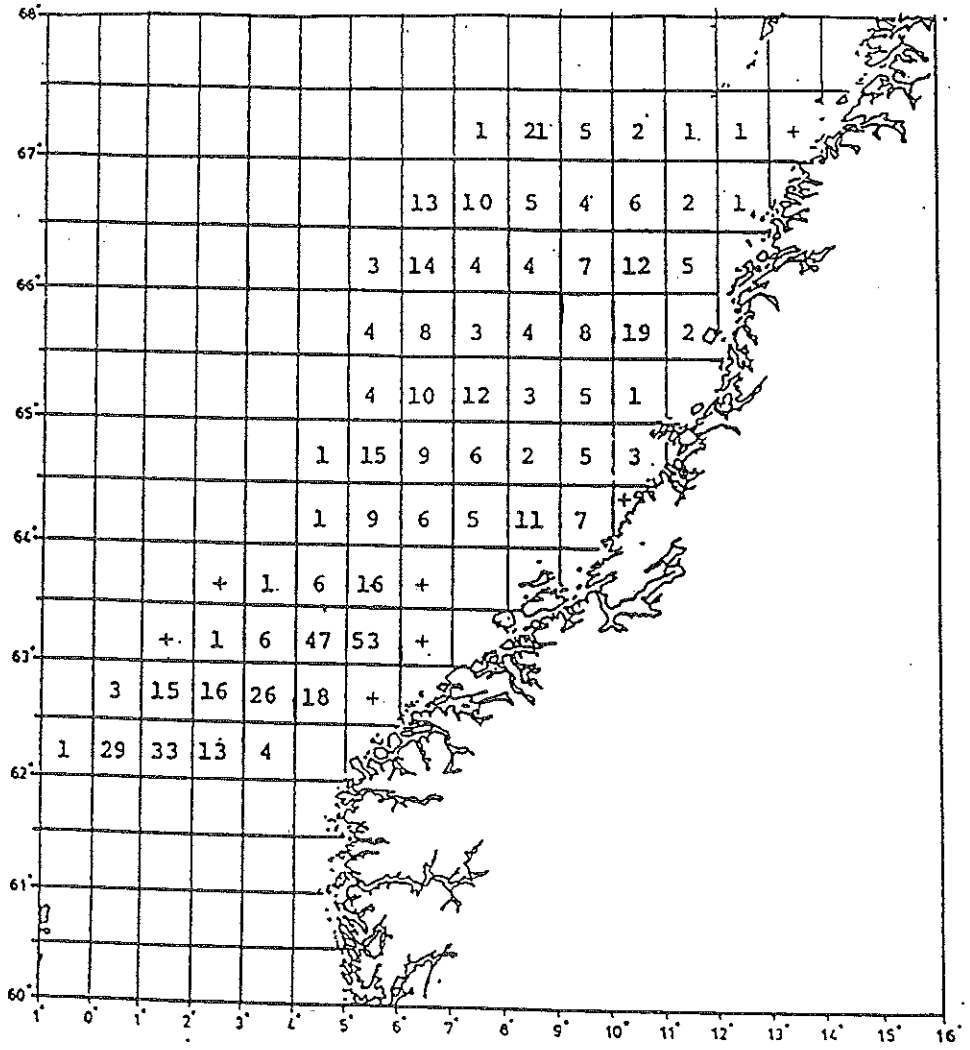


Fig. 4.8. Biomass (1000 tonnes) of blue whiting total, April/May 1990.

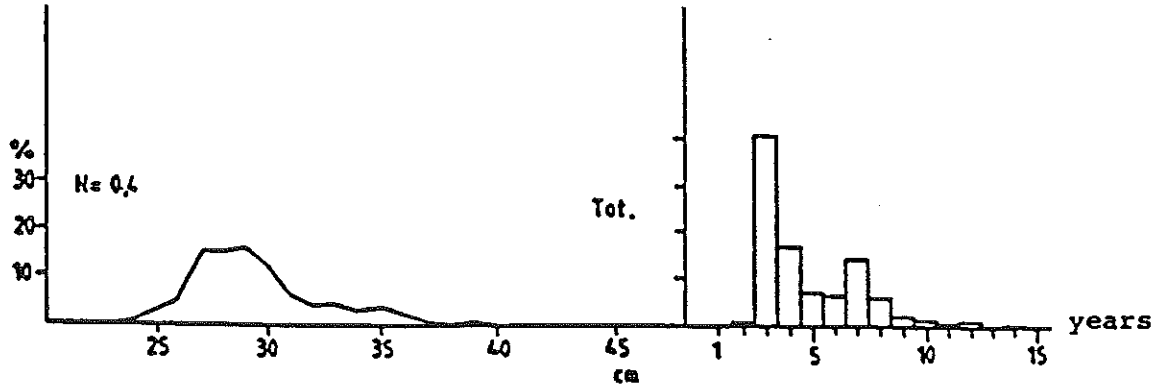


Fig. 4.9.a. Length- and age distribution of blue whiting 2+ years
N x 10 .

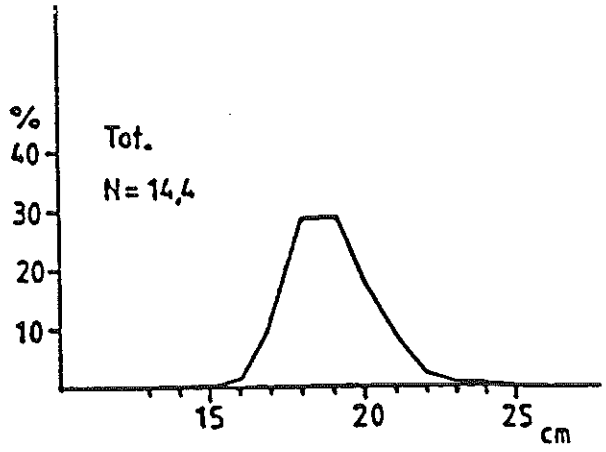


Fig. 4.9.b. Length distribution of blue whiting 1 year old
April/May 1990. N x 10^{-9}.

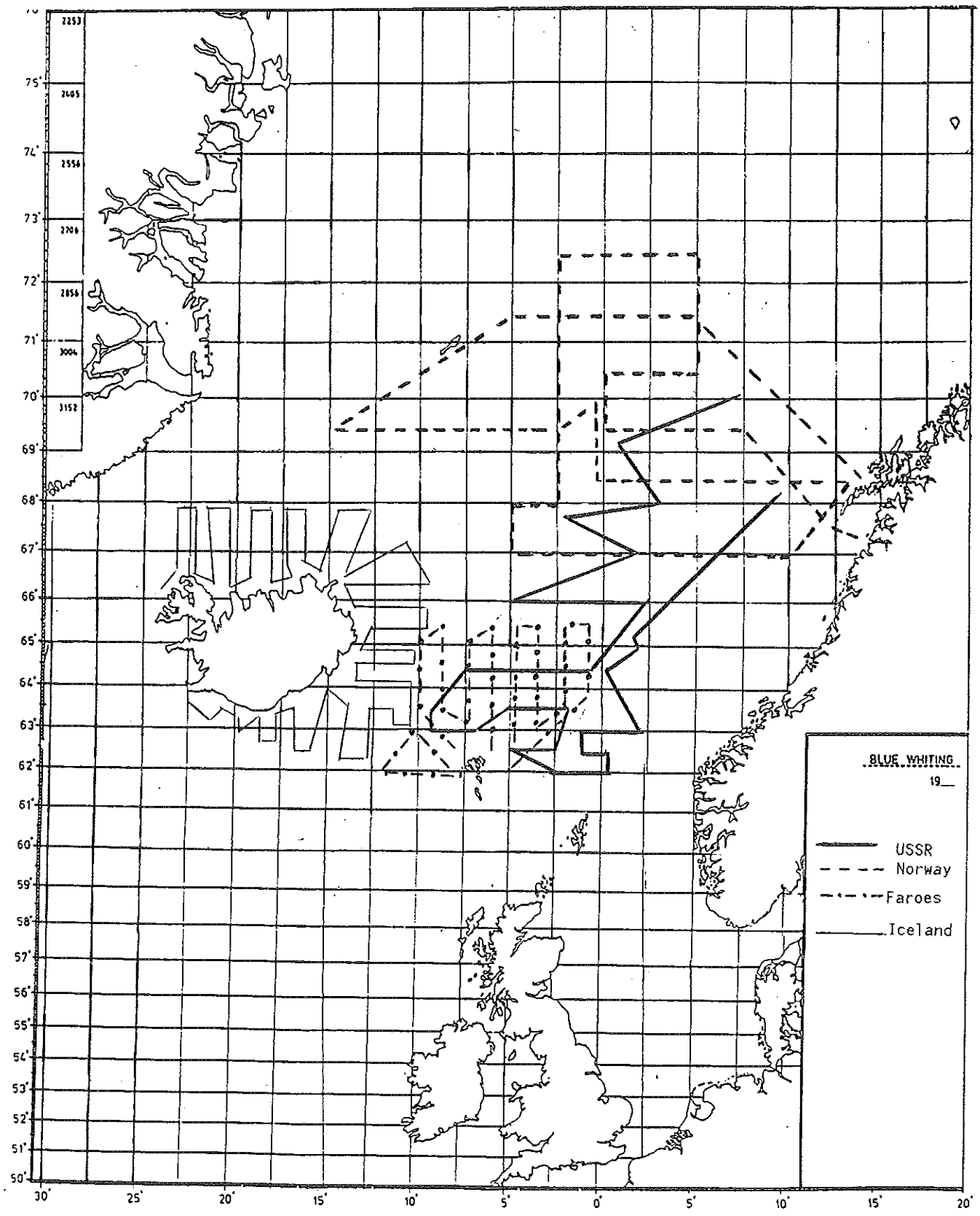


Fig. 4.10. Cruise tracks from surveys during July/September 1990.

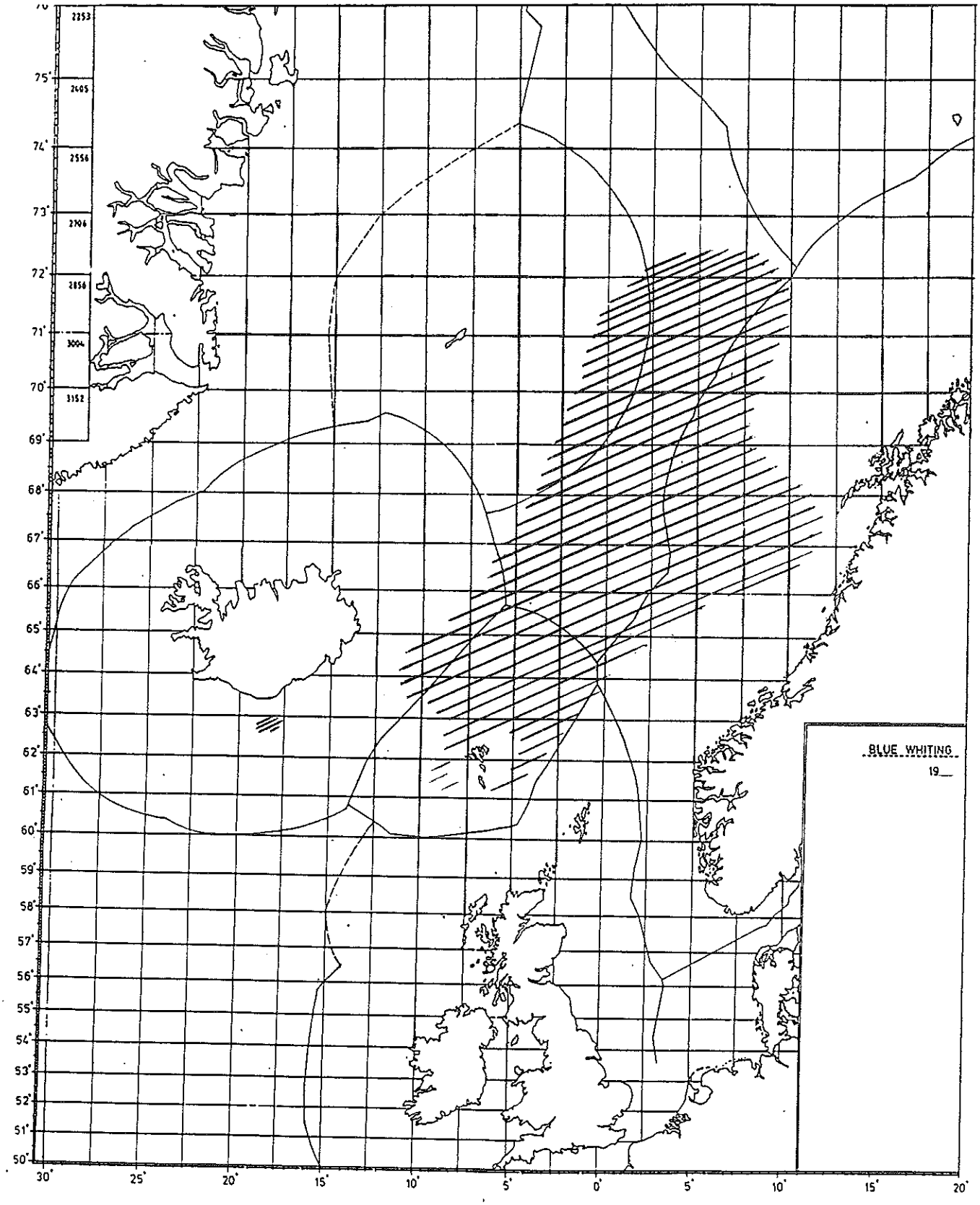


Fig. 4.11. Area of blue whiting distribution observed during July/August 1990. With boundaries of national jurisdiction used.

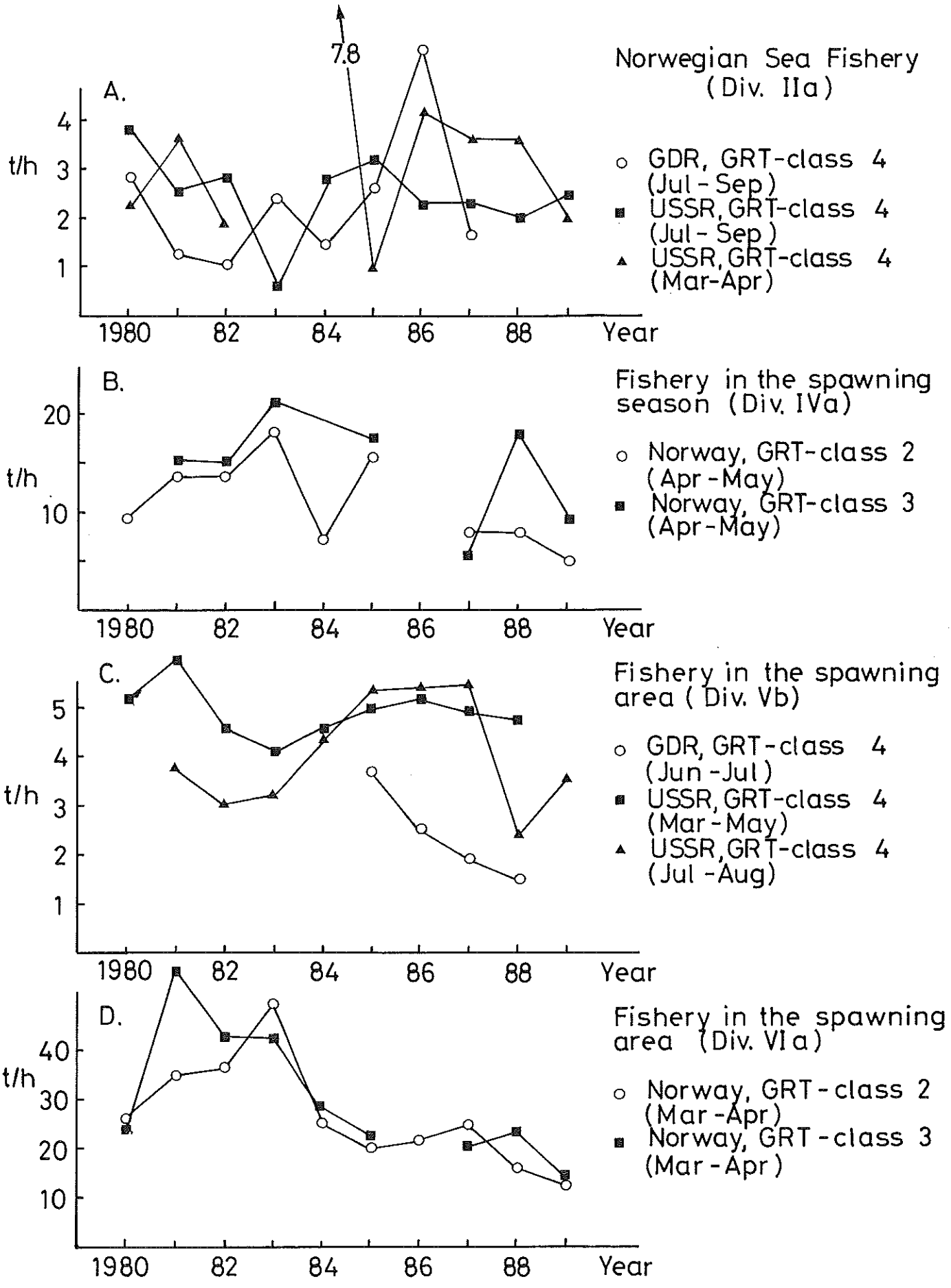


Figure 4.12A-D Trends in CPUE of the BLUE WHITING fishery in the Northern area.

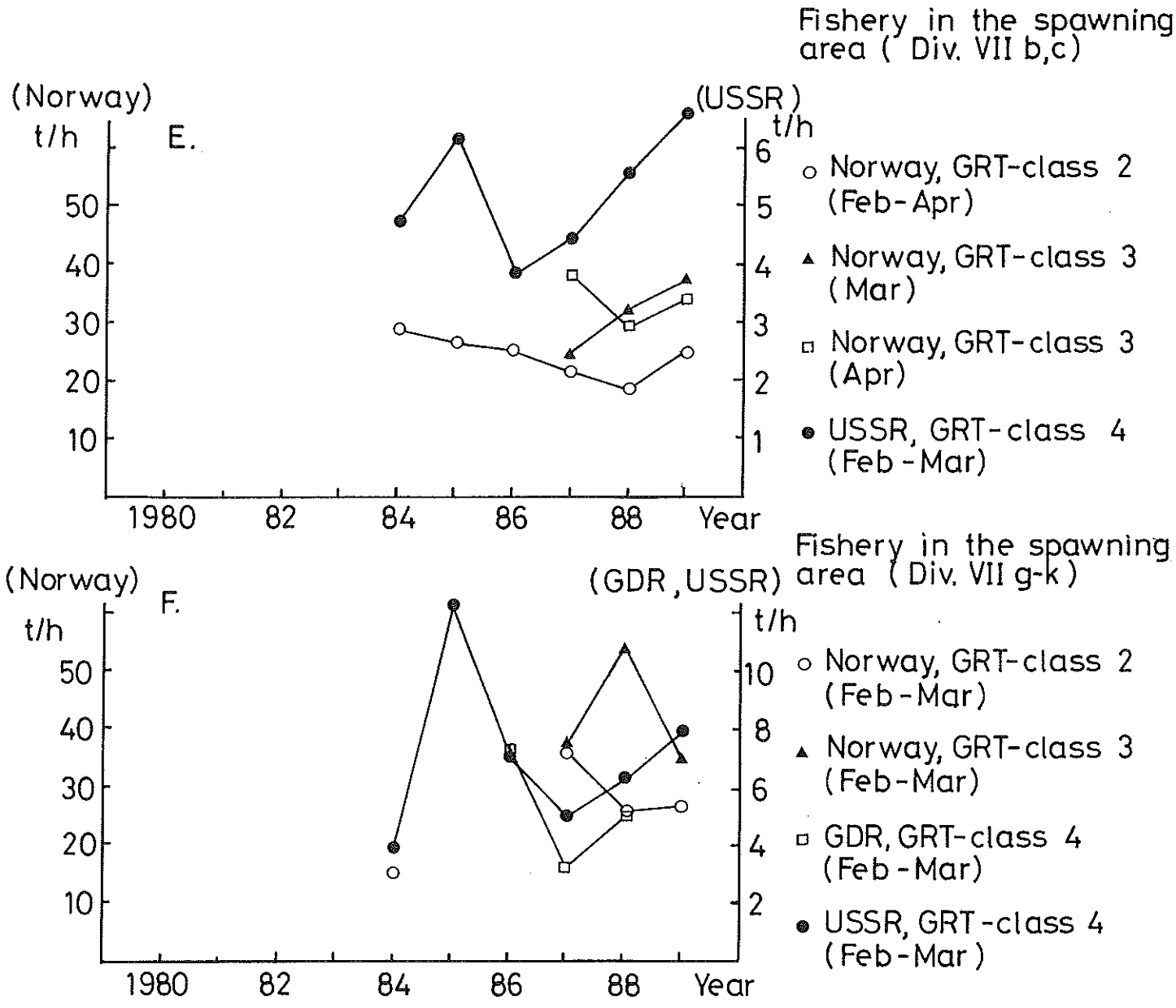


Figure 4.12E-F Trends in CPUE of the BLUE WHITING fishery in the Northern area.

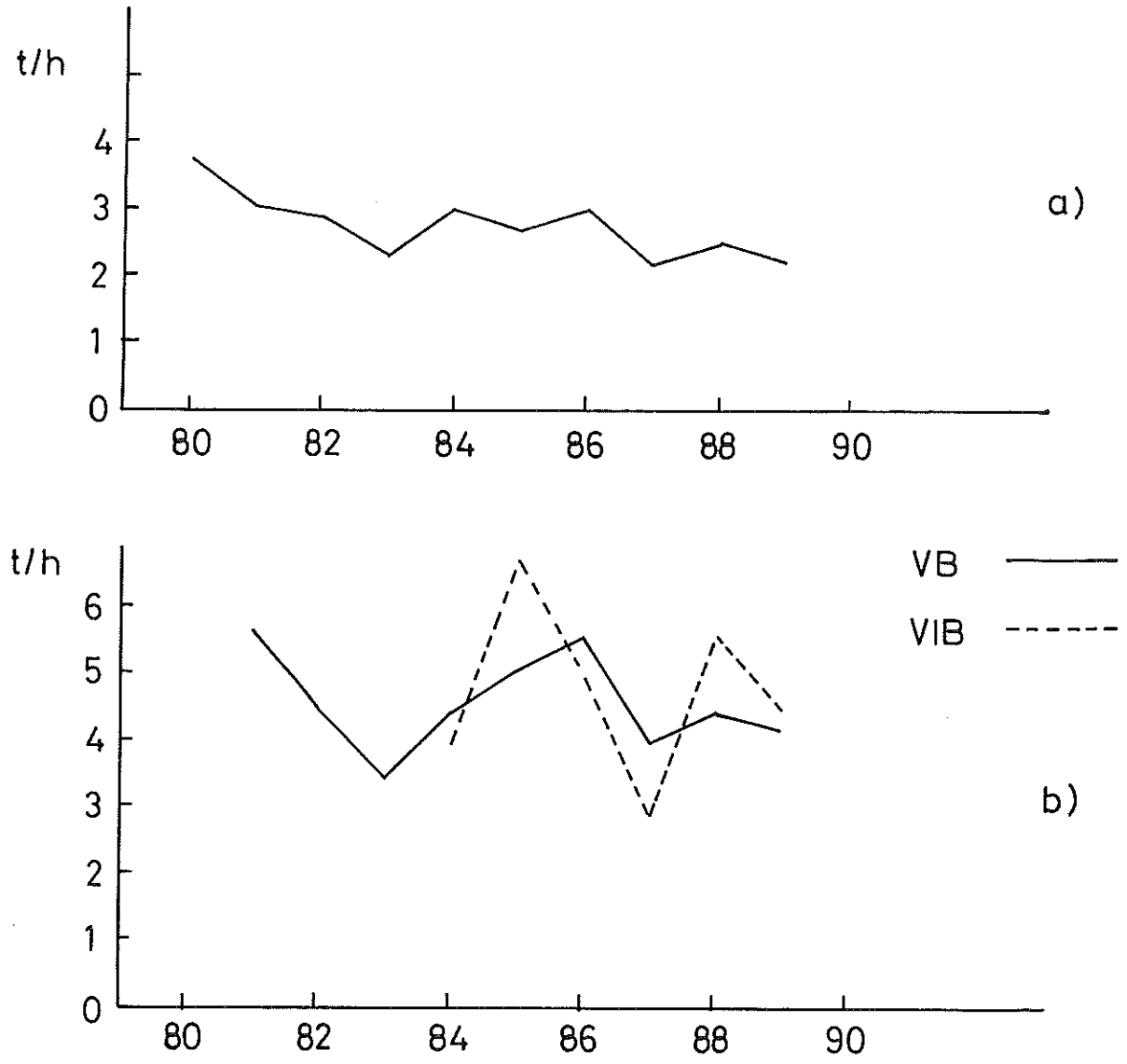


Figure 4.13 Aggregated USSR CPUE by Division
a) Division IIa
b) Divisions Vb, VIb.

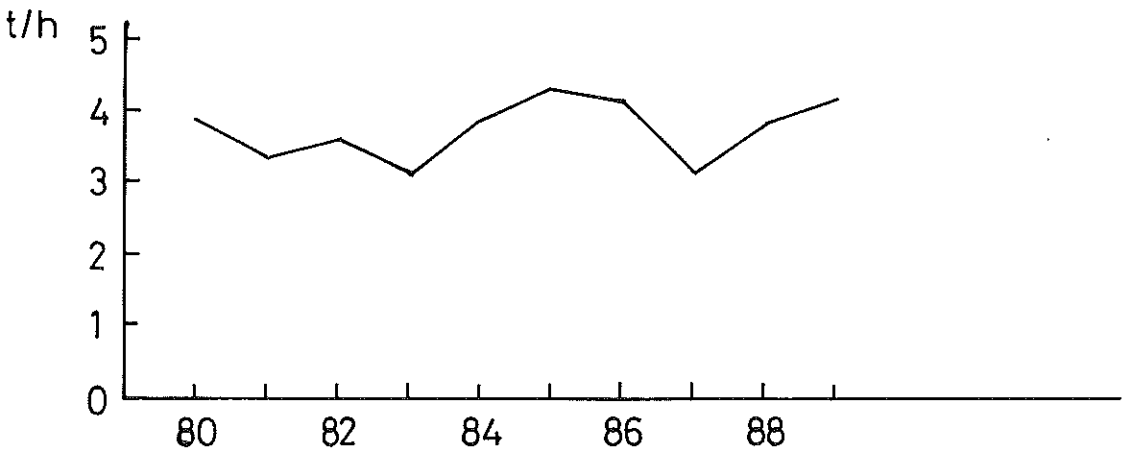


Figure 4.14 Overall aggregated USSR CPUE in Northern BLUE WHITING fishery.

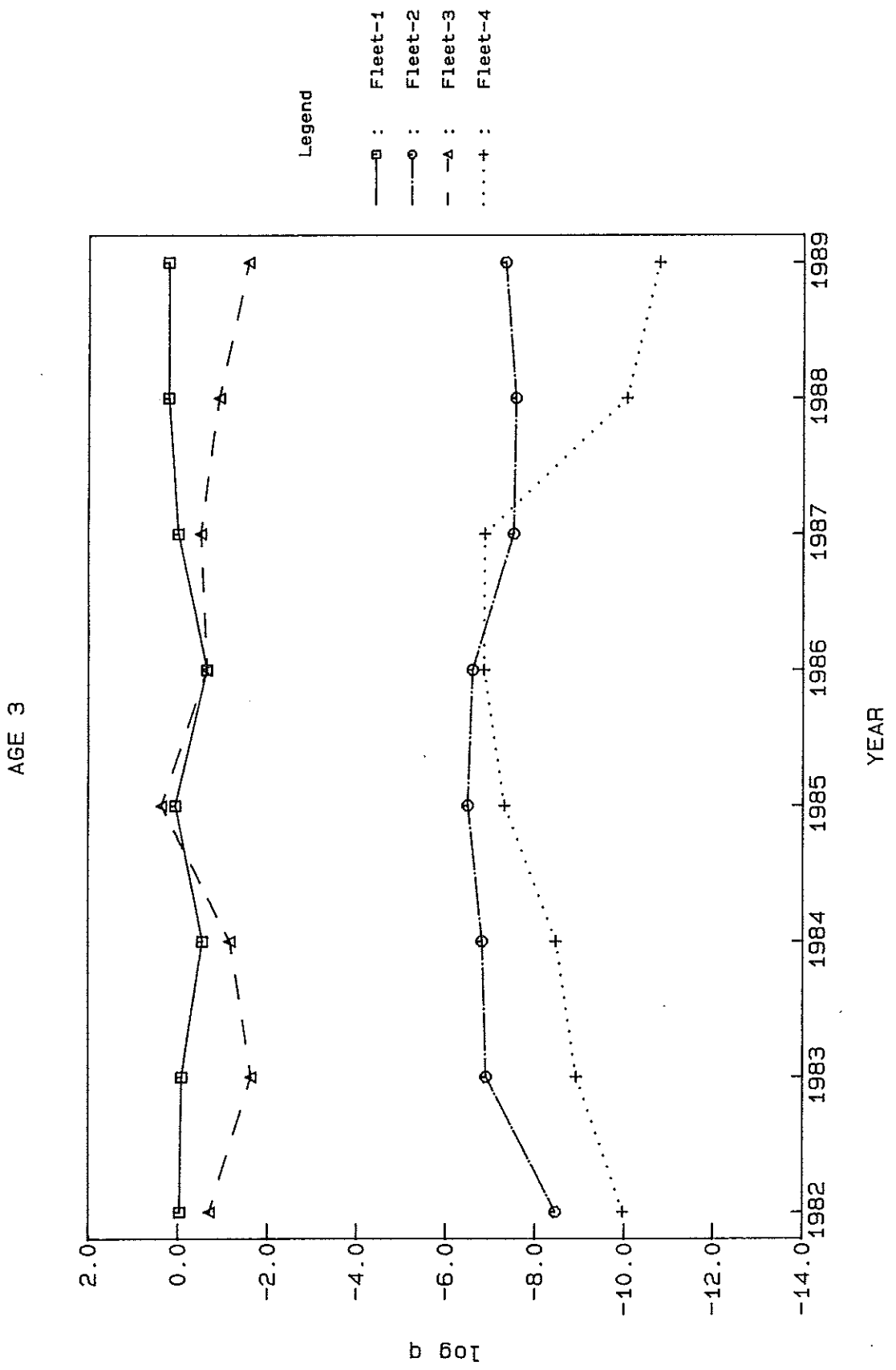
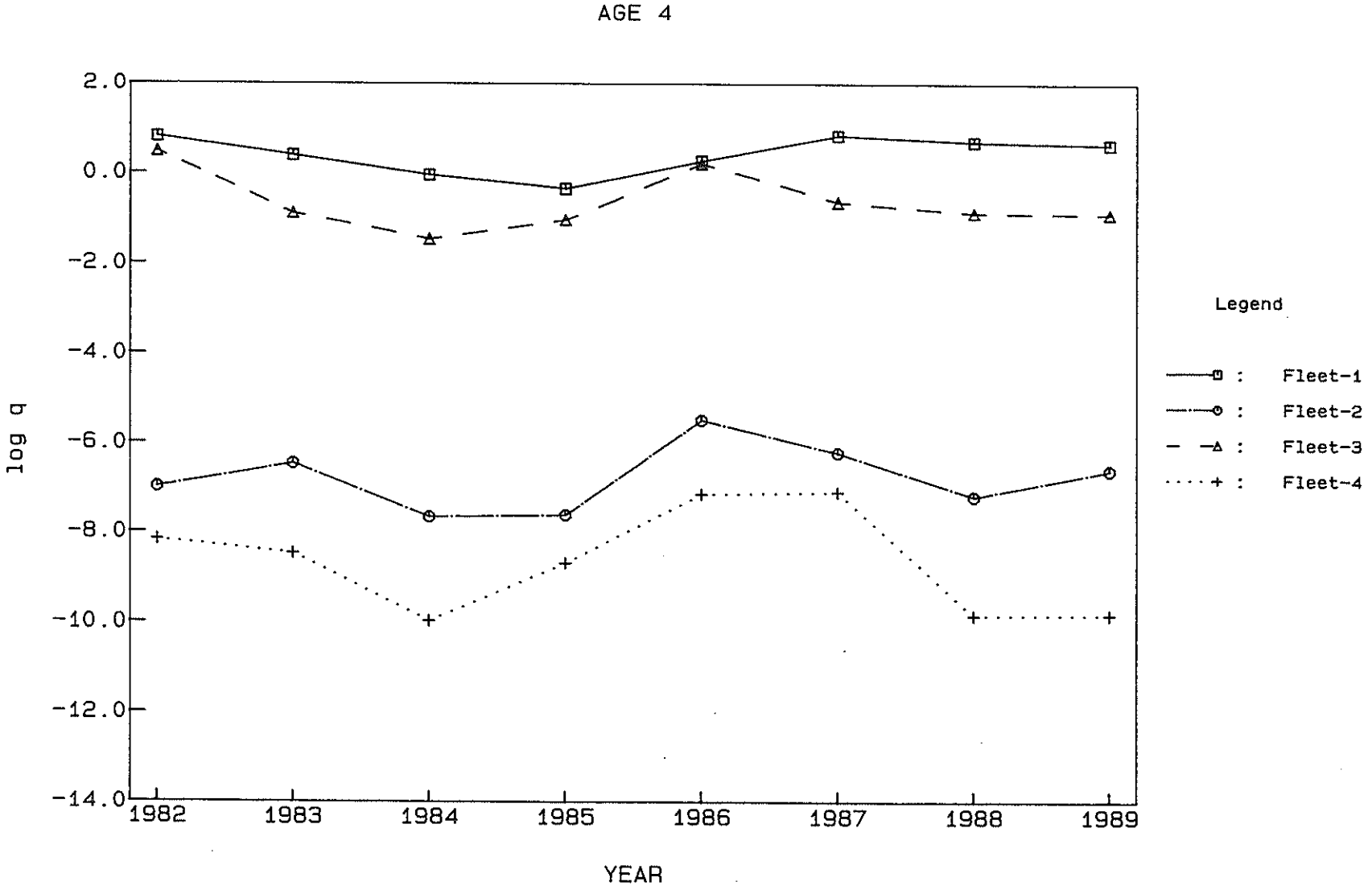

AGE 3
log q
YEAR
Legend
Fleet-1
Fleet-2
Fleet-3
Fleet-4
2.0
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
-14.0
1982
1983
1984
1985
1986
1987
1988
1989

Figure 4.15a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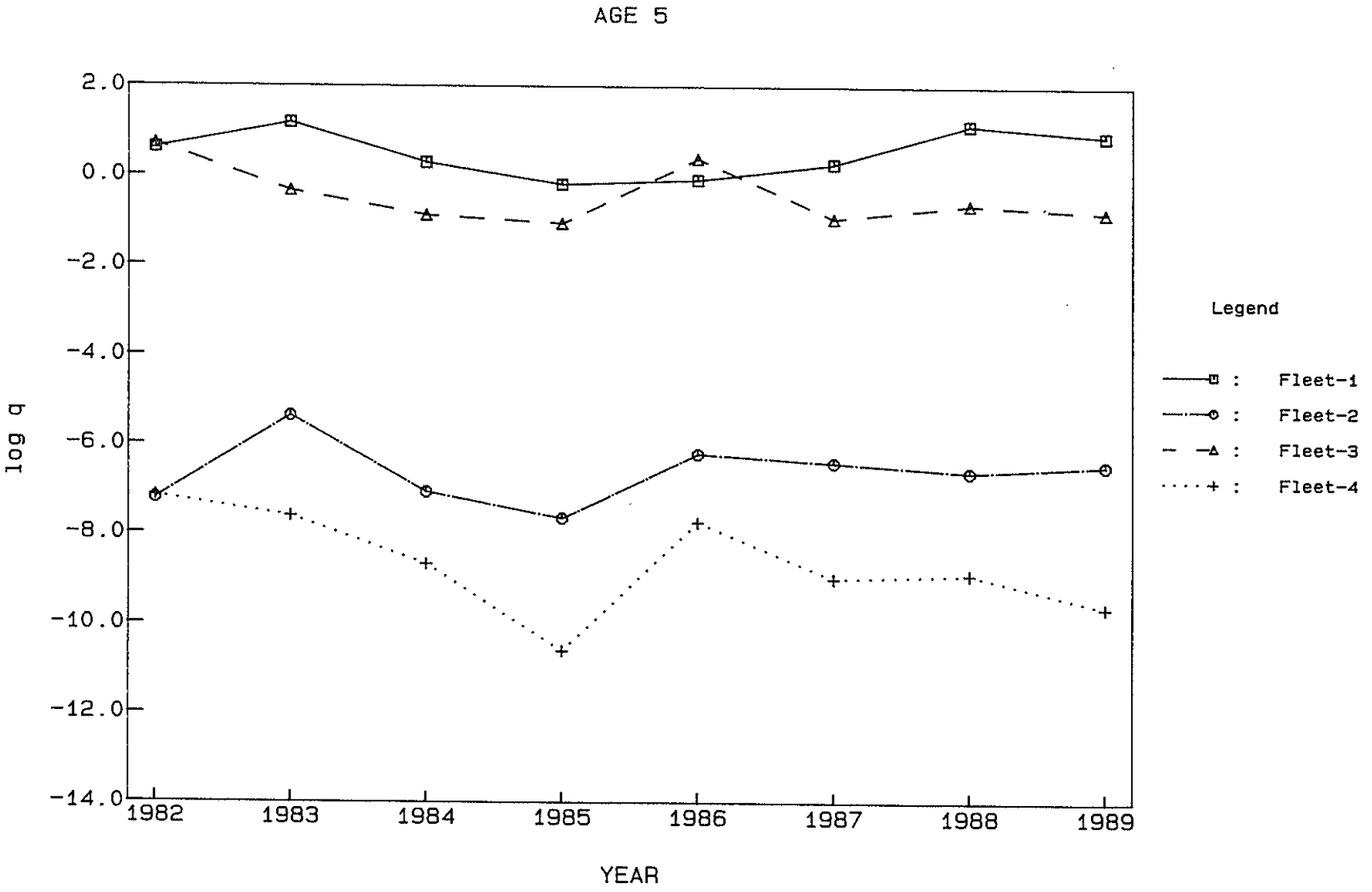
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
-14.0
log q
1982
1983
1984
1985
1986
1987
1988
1989
YEAR
Legend
Fleet-1
Fleet-2
Fleet-3
Fleet-4

Figure 4.15b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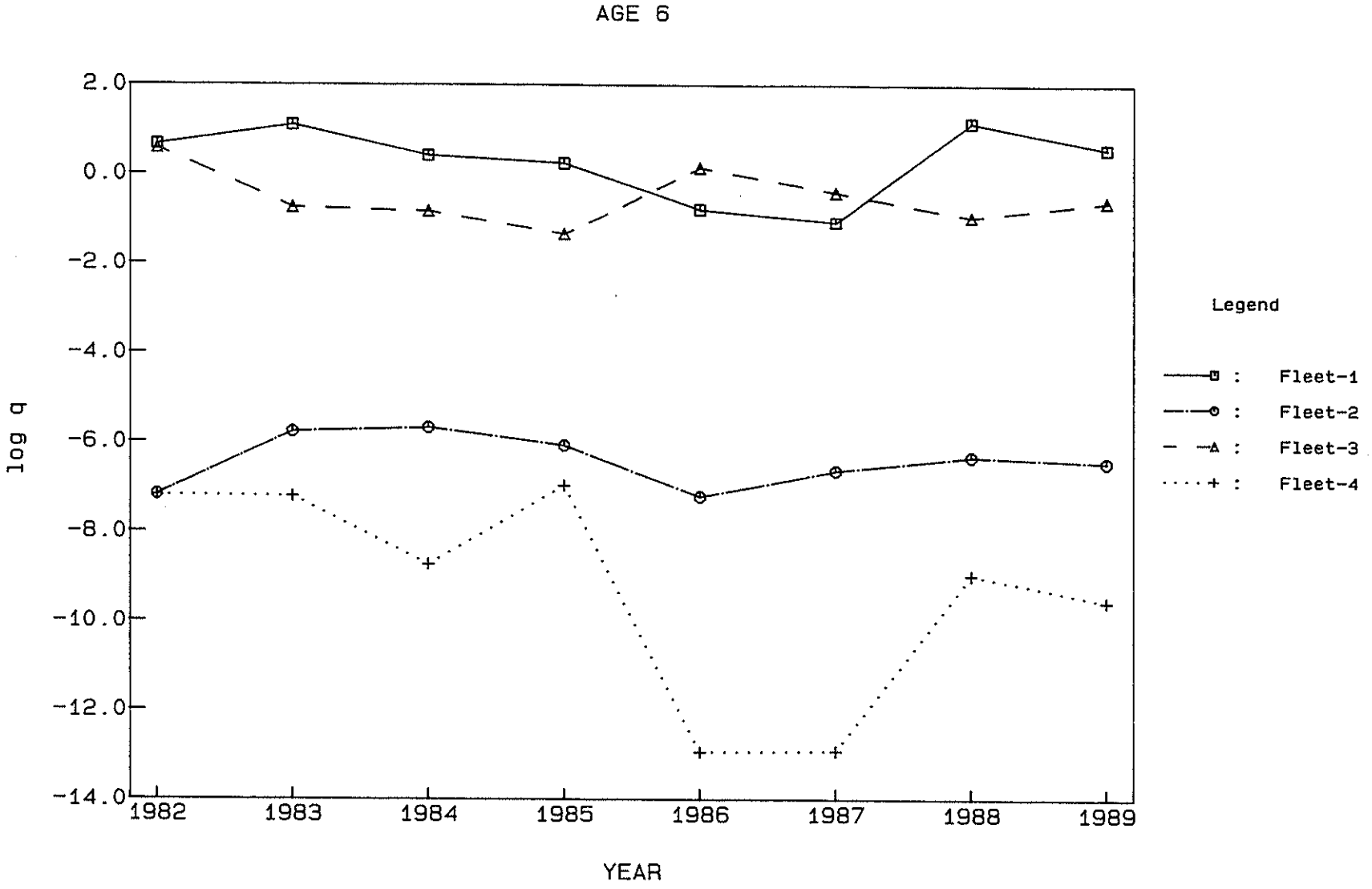
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
-14.0
log q
1982
1983
1984
1985
1986
1987
1988
1989
YEAR
Legend
Fleet-1
Fleet-2
Fleet-3
Fleet-4

Figure 4.15c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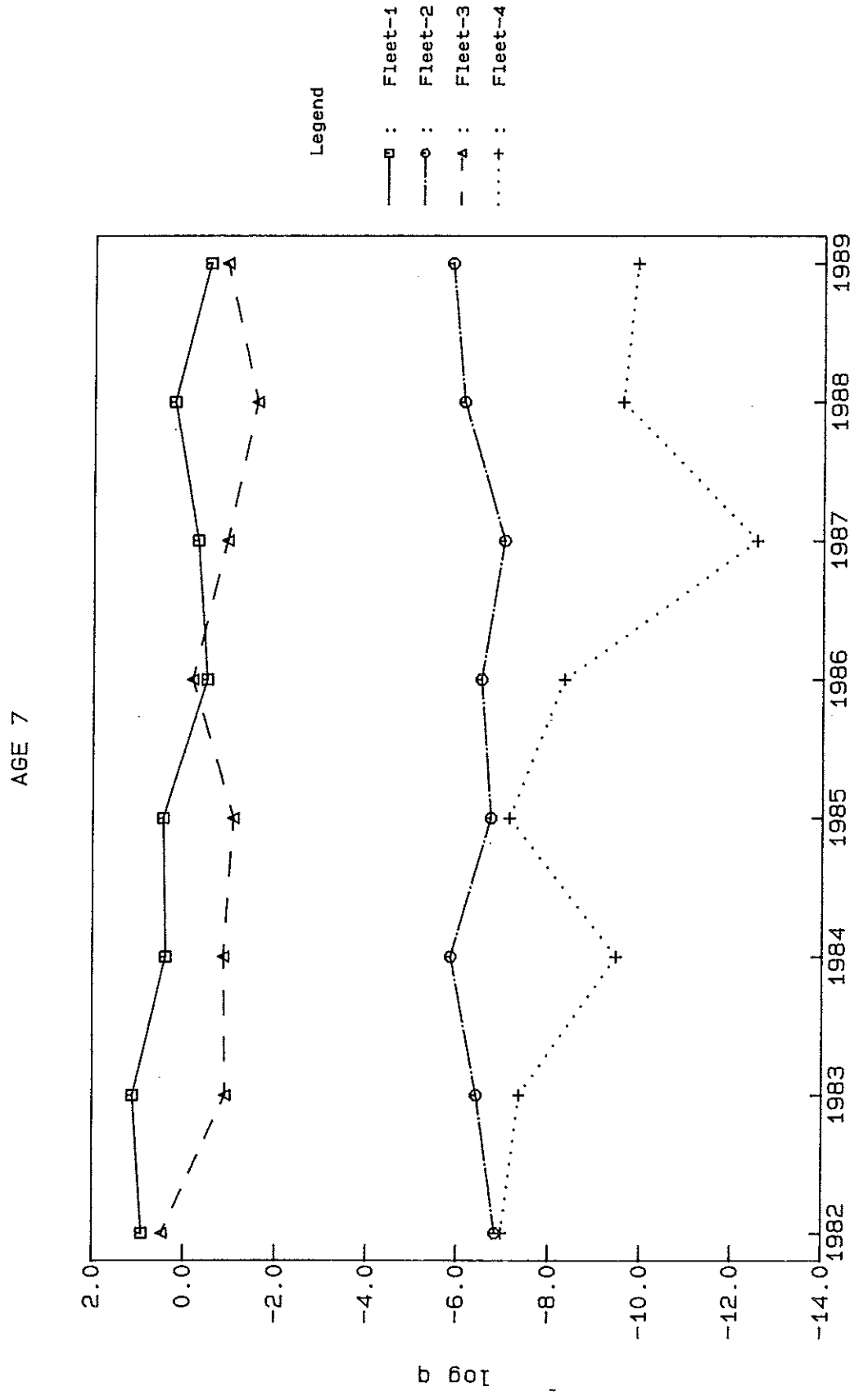
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
-14.0
log q
1982
1983
1984
1985
1986
1987
1988
1989
YEAR
Legend
Fleet-1
Fleet-2
Fleet-3
Fleet-4

Figure 4.15d


AGE 7
log q
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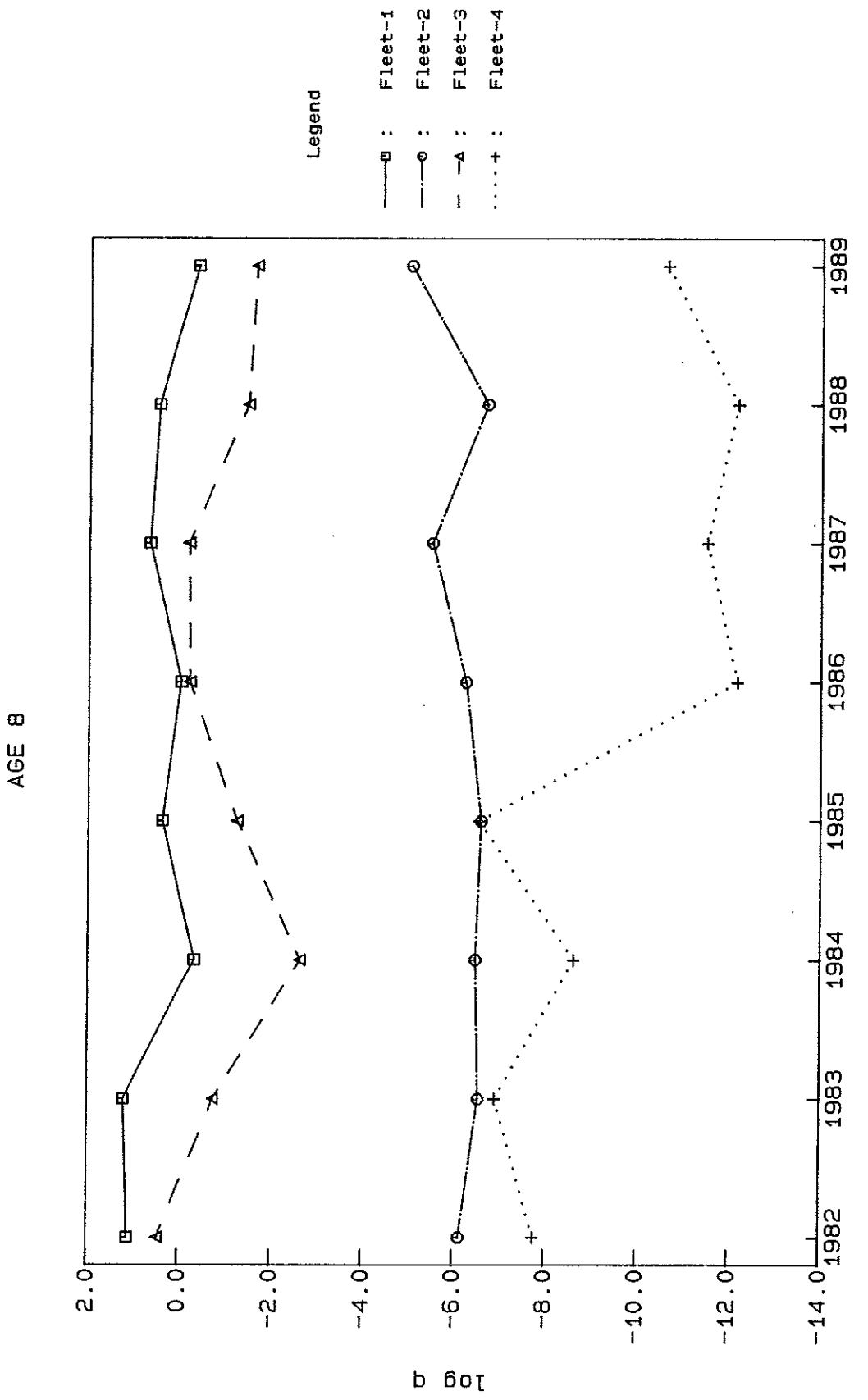
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
-14.0
1982
1983
1984
1985
1986
1987
1988
1989
YEAR
Legend
Fleet-1
Fleet-2
Fleet-3
Fleet-4

Figure 4.15e


Legend
Fleet-1
Fleet-2
Fleet-3
Fleet-4
AGE 8
log q
YEAR
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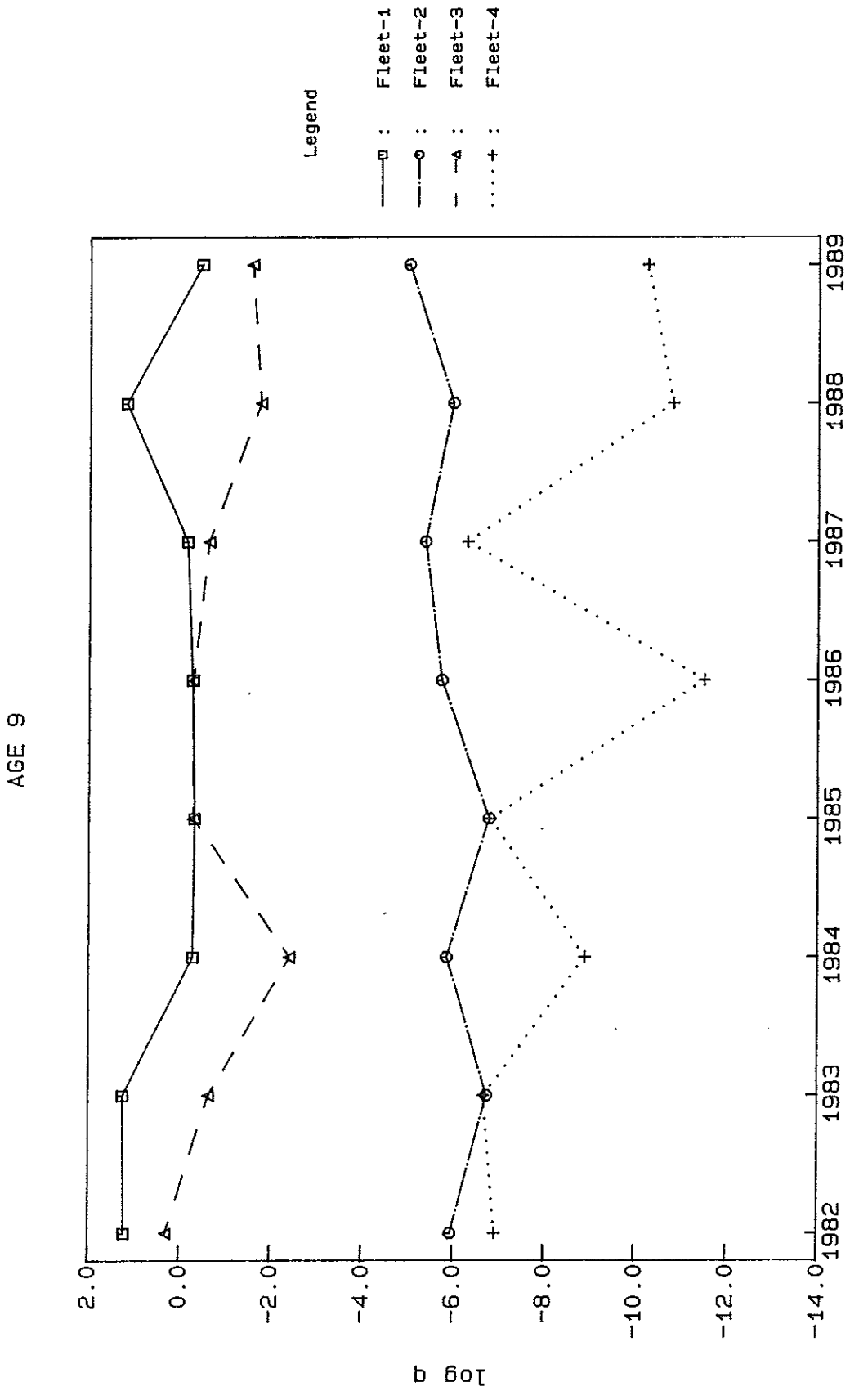
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
-14.0
1982
1983
1984
1985
1986
1987
1988
1989

Figure 4.15f


AGE 9
log q
YEAR
Legend
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Fleet-2
Fleet-3
Fleet-4
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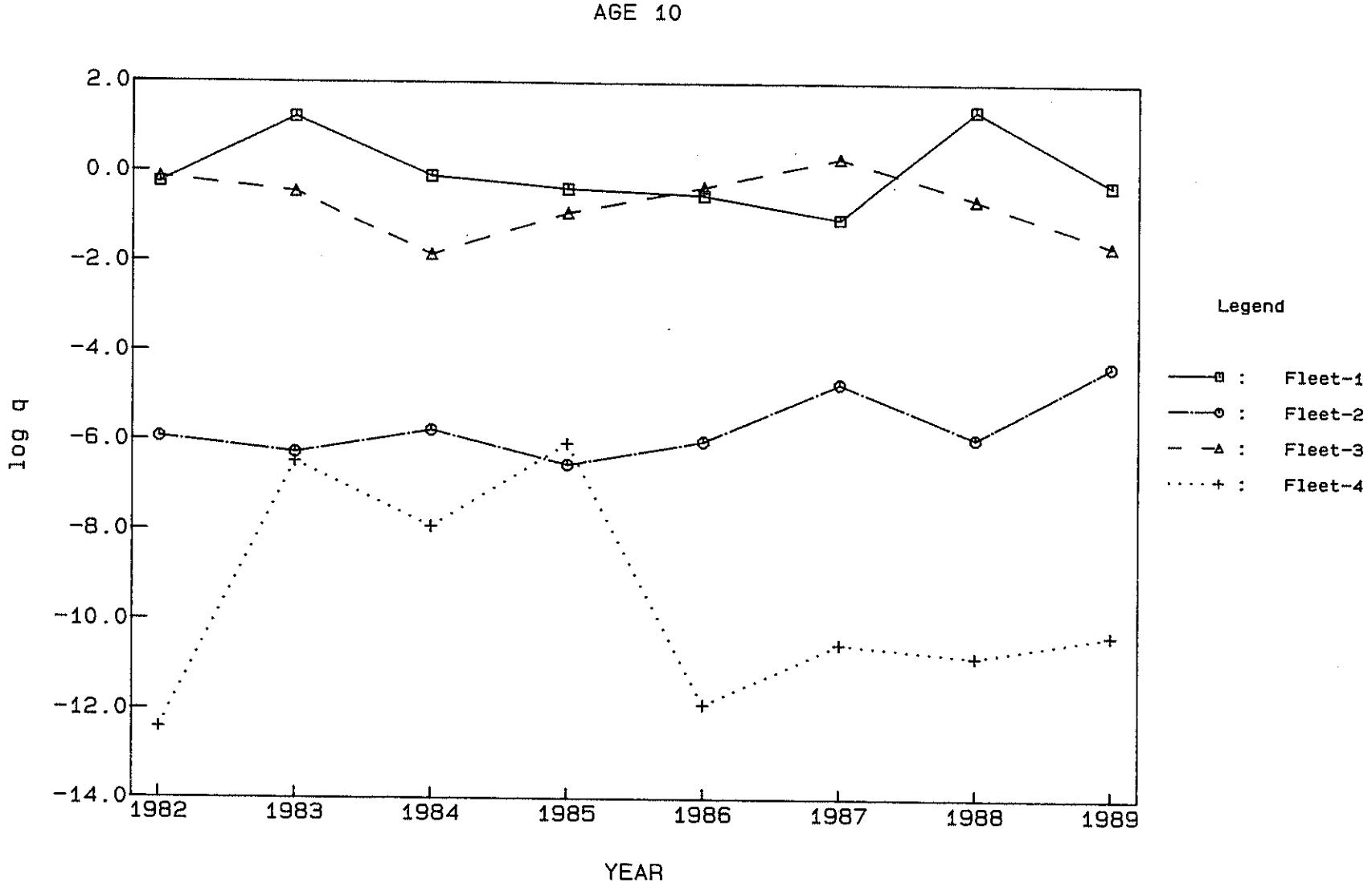
0.0
-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
-14.0
1982
1983
1984
1985
1986
1987
1988
1989

Figure 4.15g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-2.0
-4.0
-6.0
-8.0
-10.0
-12.0
-14.0
log q
1982
1983
1984
1985
1986
1987
1988
1989
YEAR
Legend
Fleet-1
Fleet-2
Fleet-3
Fleet-4

Figure 4.15h

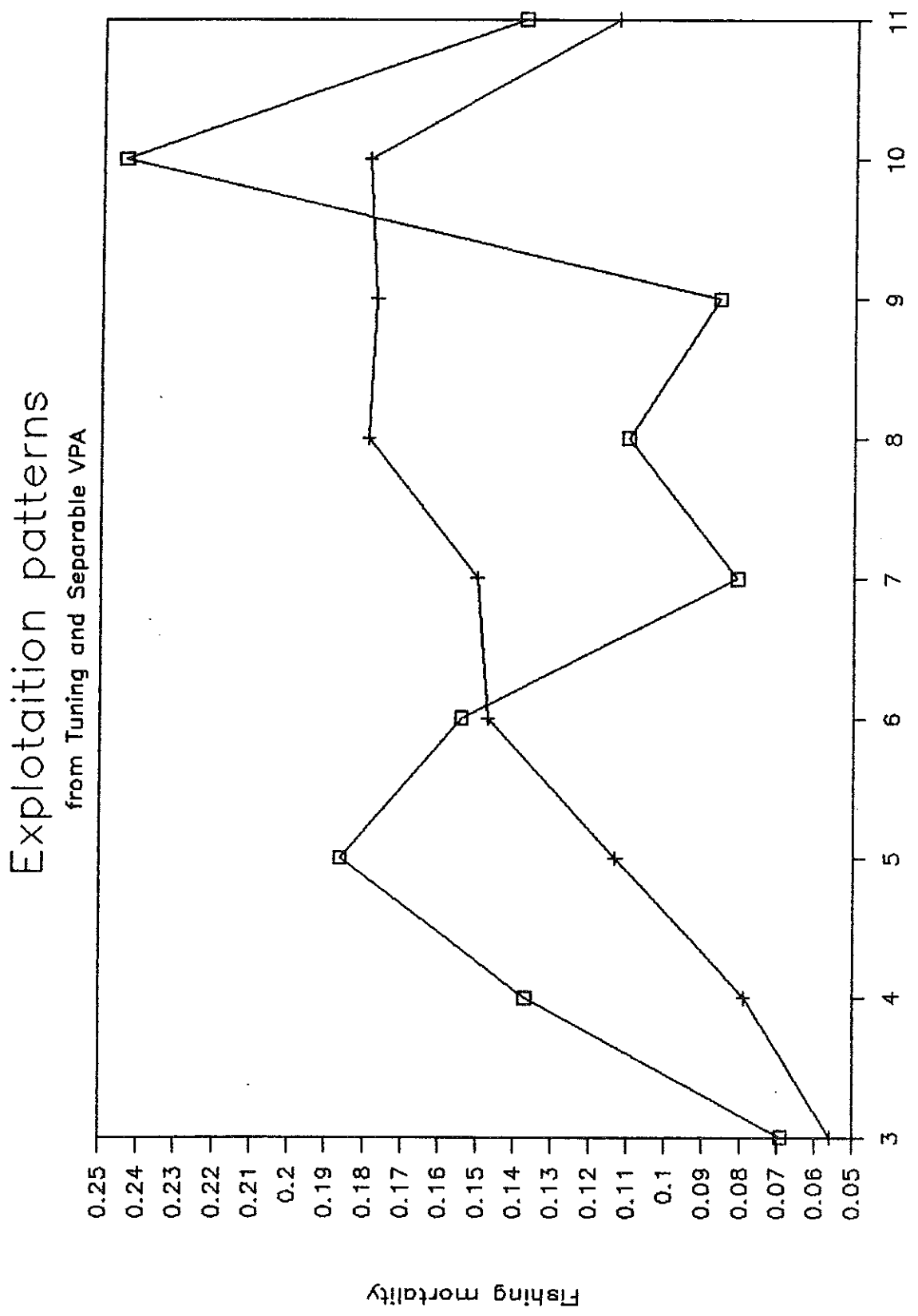
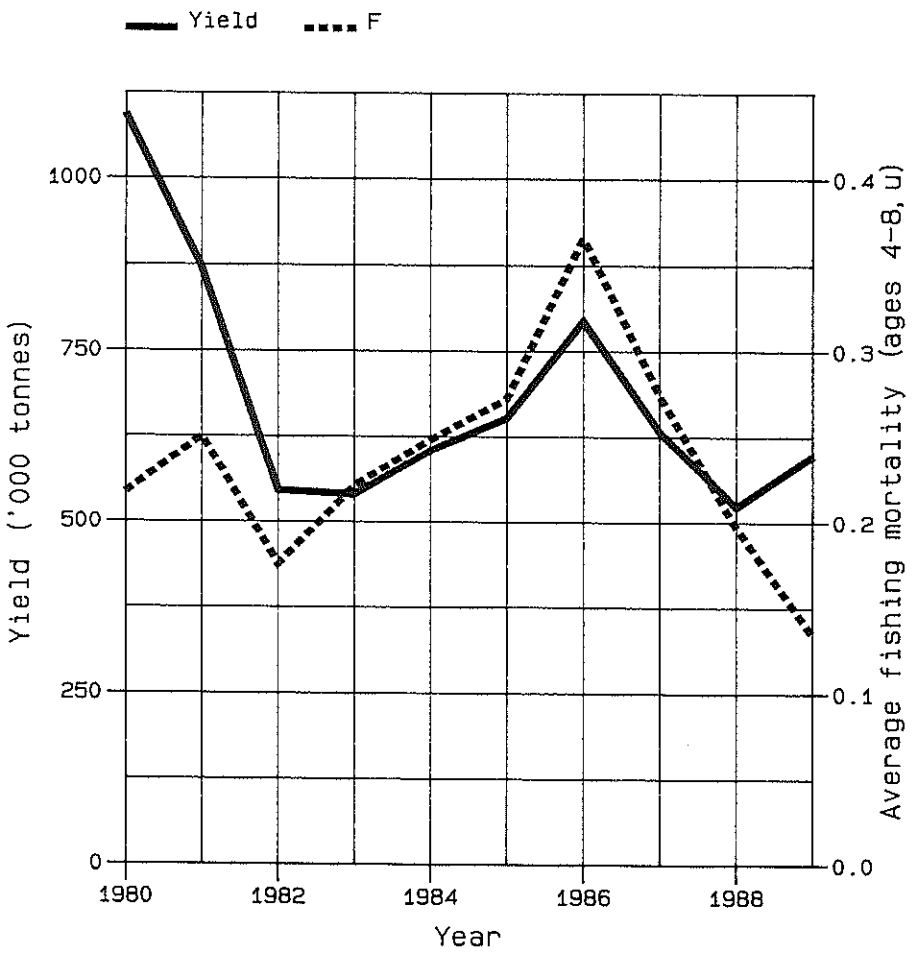


Figure 4.16 Northern BLUE WHITING.

Figure 4.17

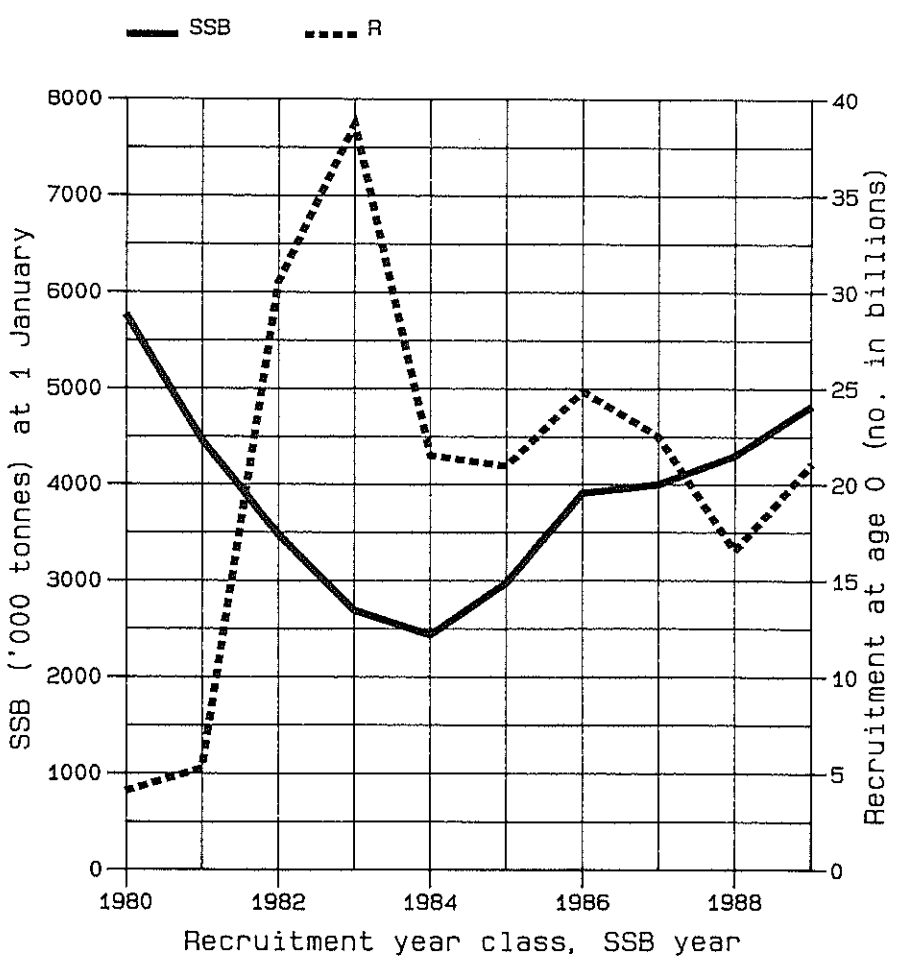
FISH STOCK SUMMARY
STOCK: Blue Whiting – Northern Area
27-09-1990

Trends in yield and fishing mortality (F)



A

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



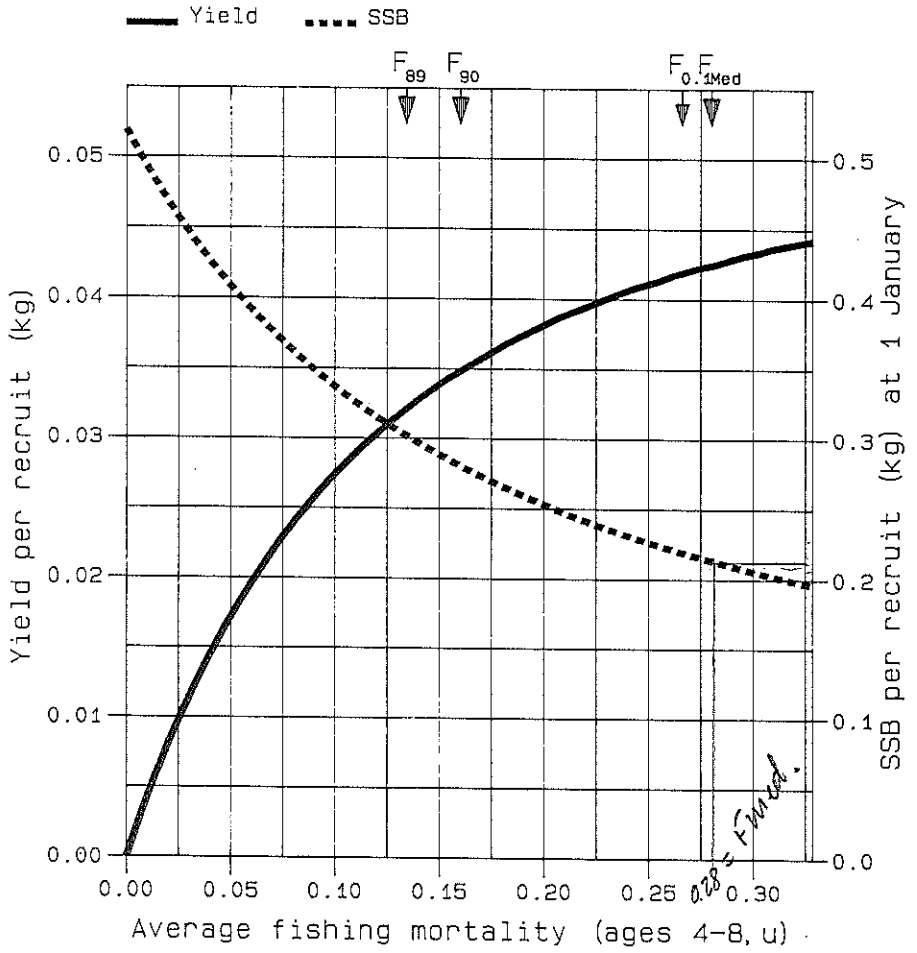
B

(cont'd)

Figure 4.17 (cont'd)

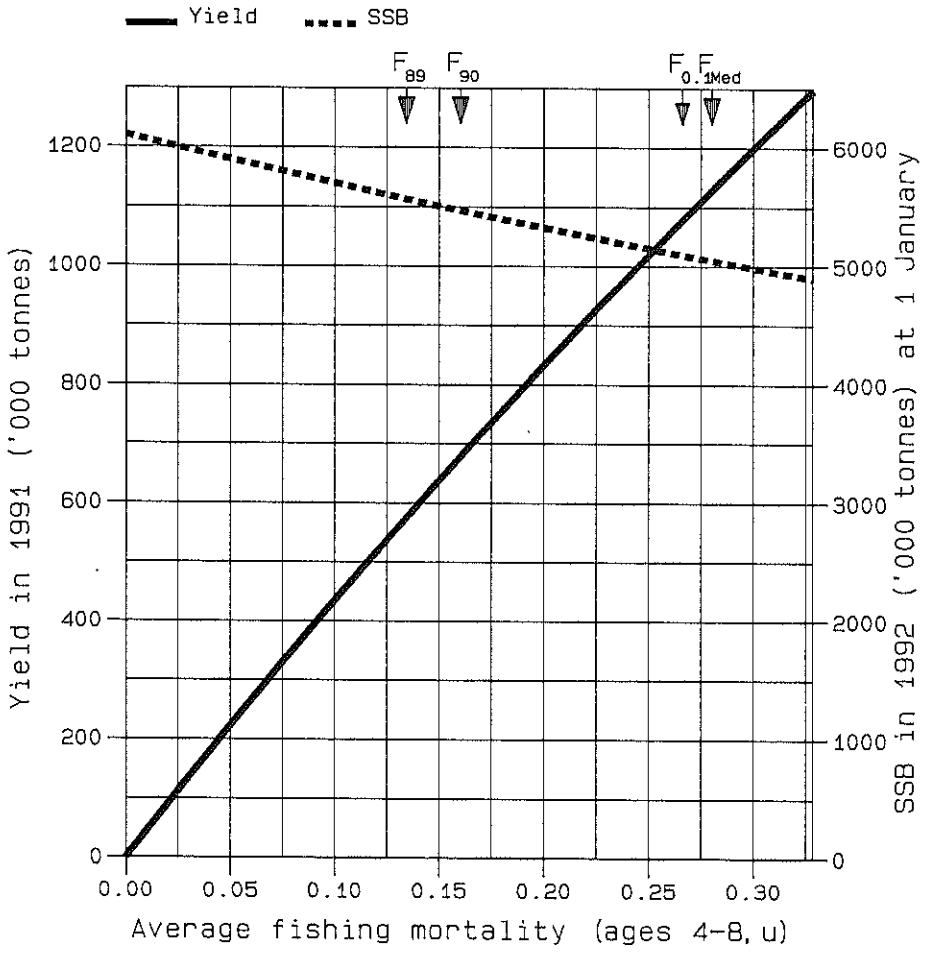
FISH STOCK SUMMARY
STOCK: Blue Whiting – Northern Area
21-09-1990

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

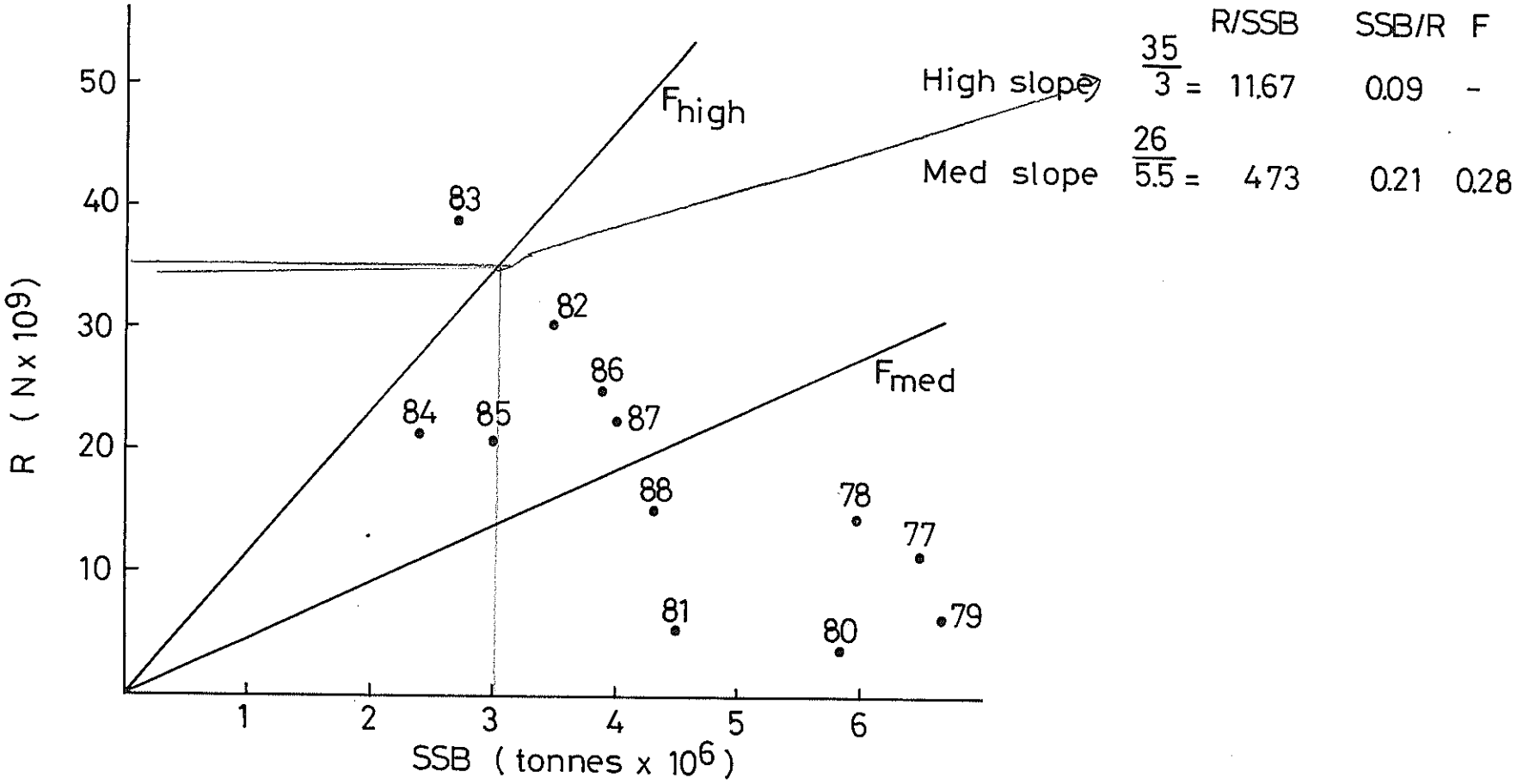
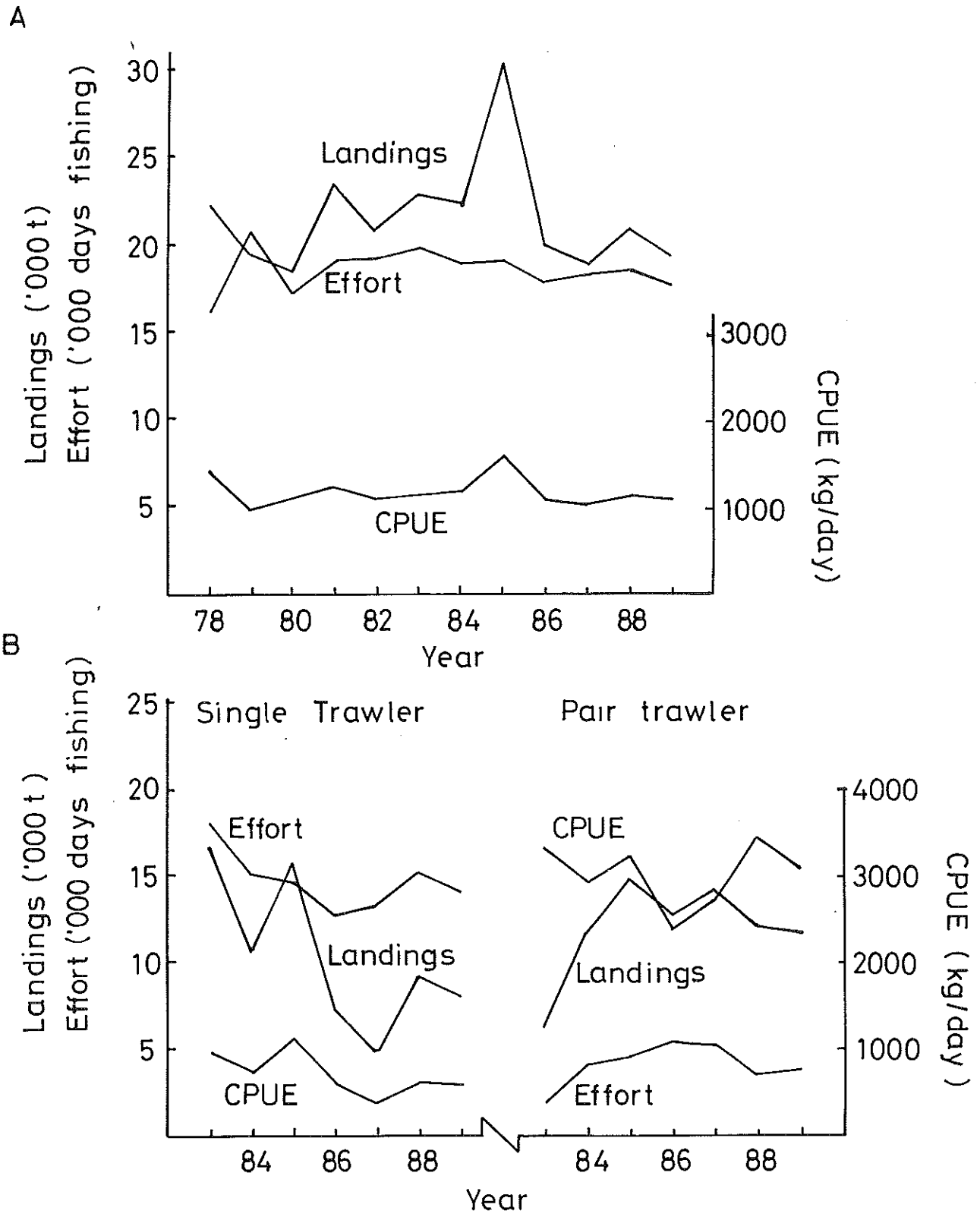


Figure 4.18 Stock-recruitment plot and estimation of F_{med} for the Northern BLUE WHITING stock.

Figure 5.1 Catch effort, and CPUE of Spanish trawlers for the Southern area.
A: Total in the period 1978-1989
B: Split into single and pair trawlers in the period 1983-1989.



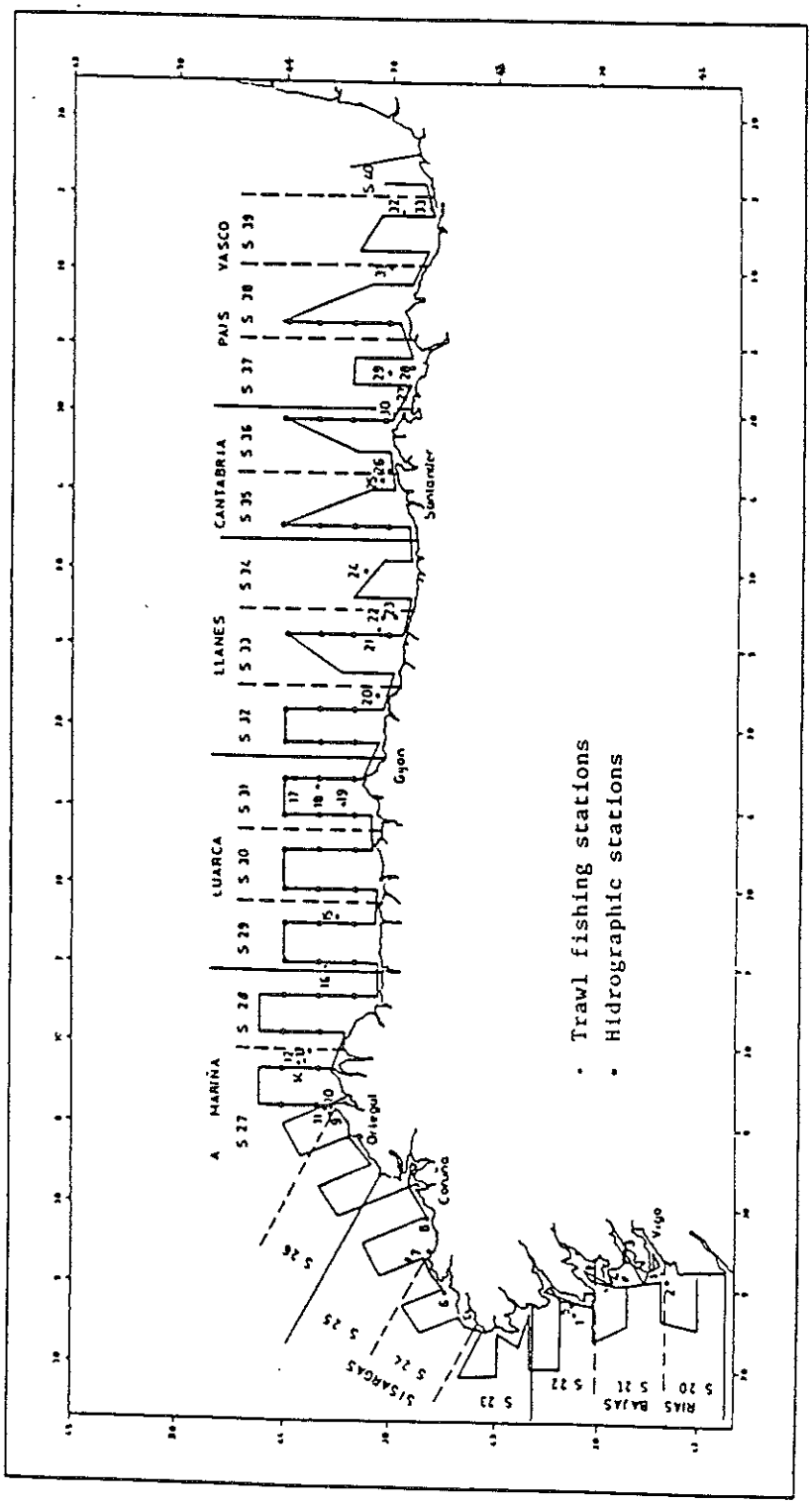


Fig 5.2 - "SARACUS-0490". Survey track and pelagic trawl stations.

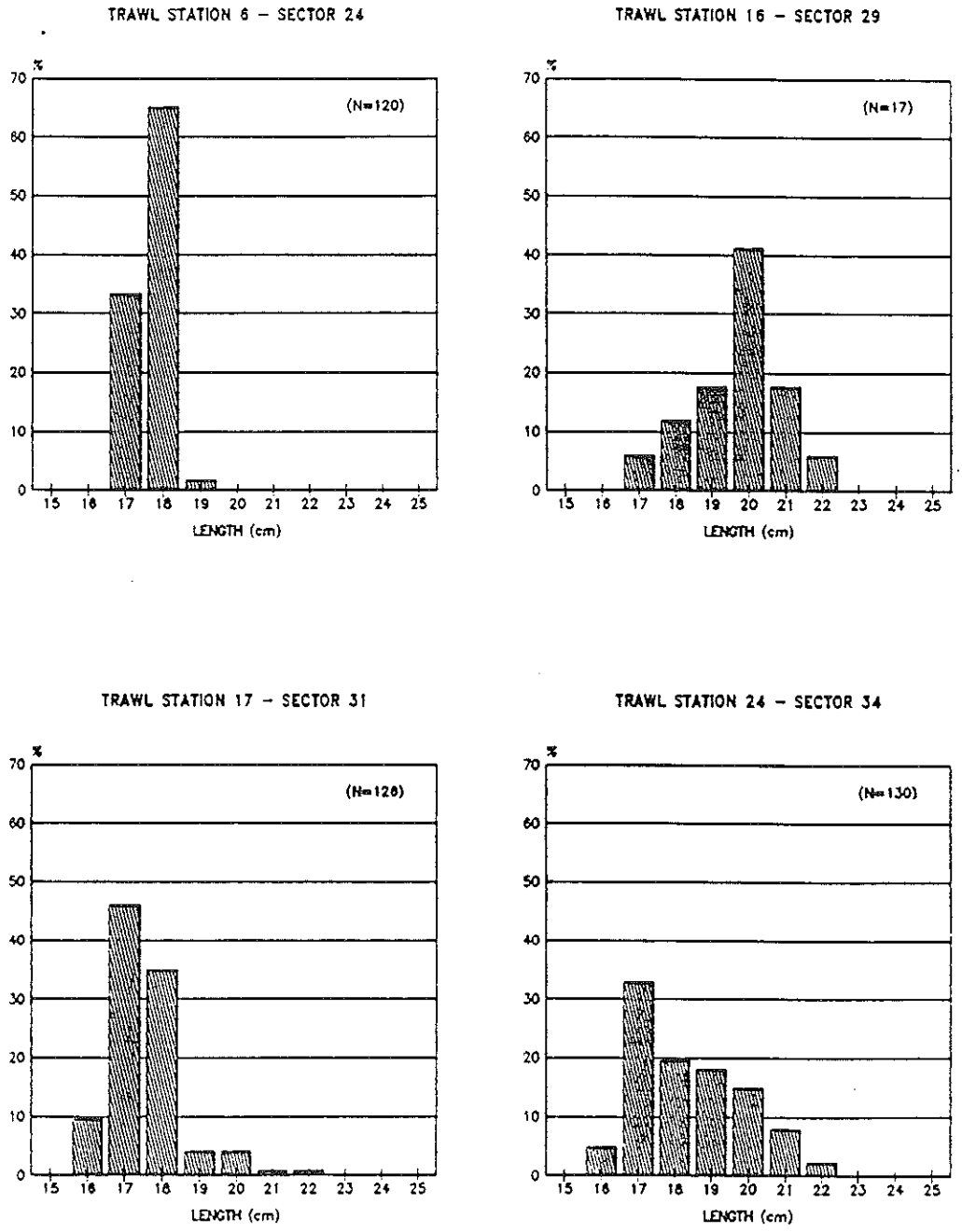


Fig 5.3 "SARACUS-0490". Length distributions of blue-whiting samples.

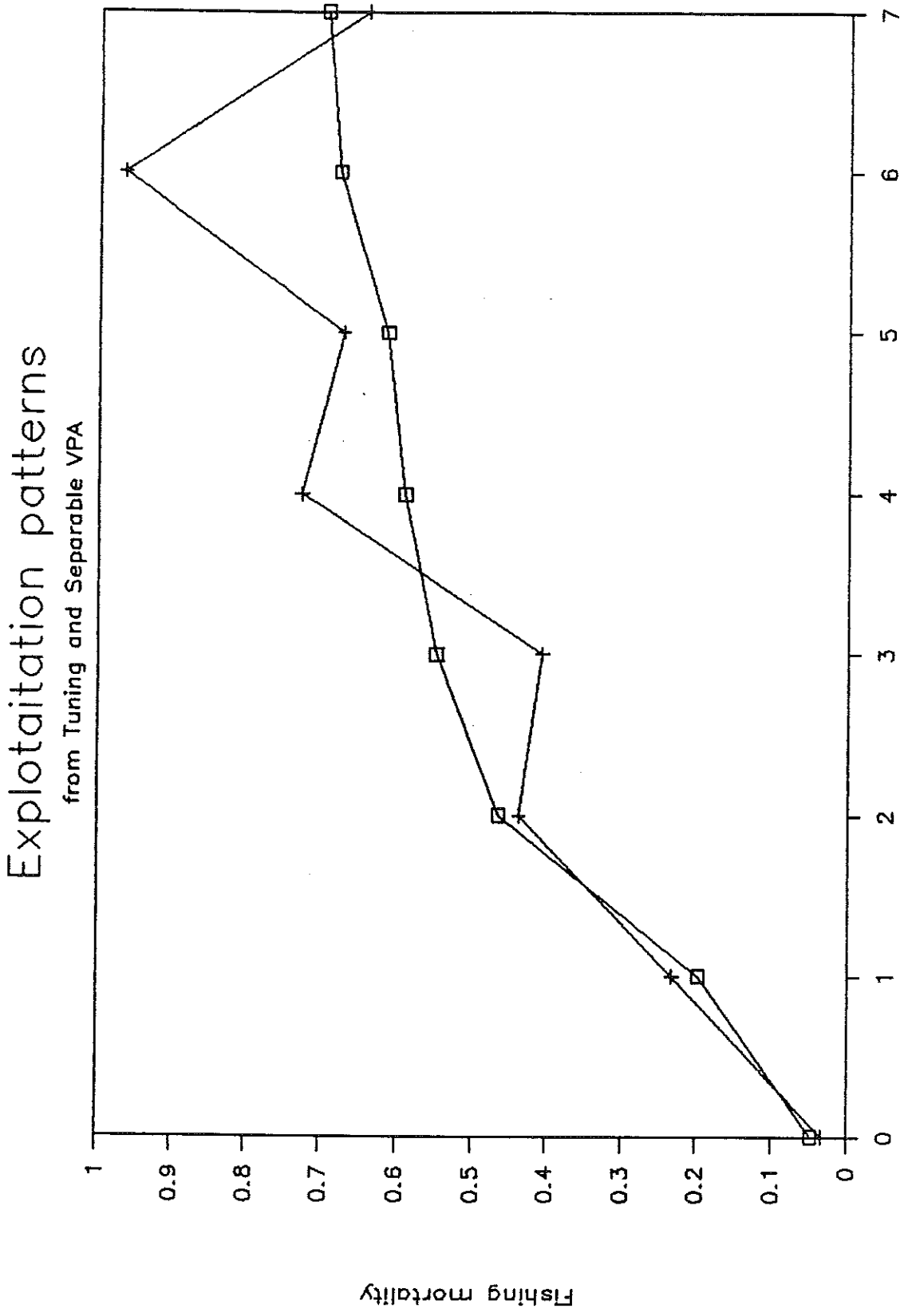
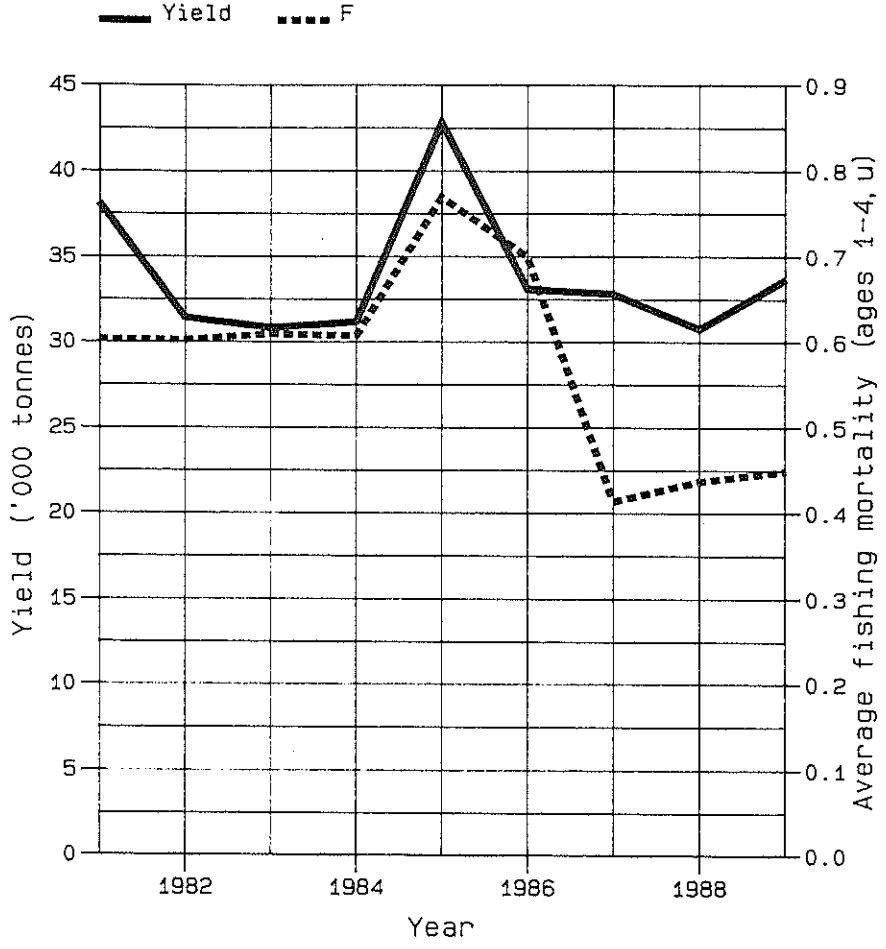


Figure 5.4 Exploitation patterns from the tuning and separable VPA for Southern BLUE WHITING.

Figure 5.5

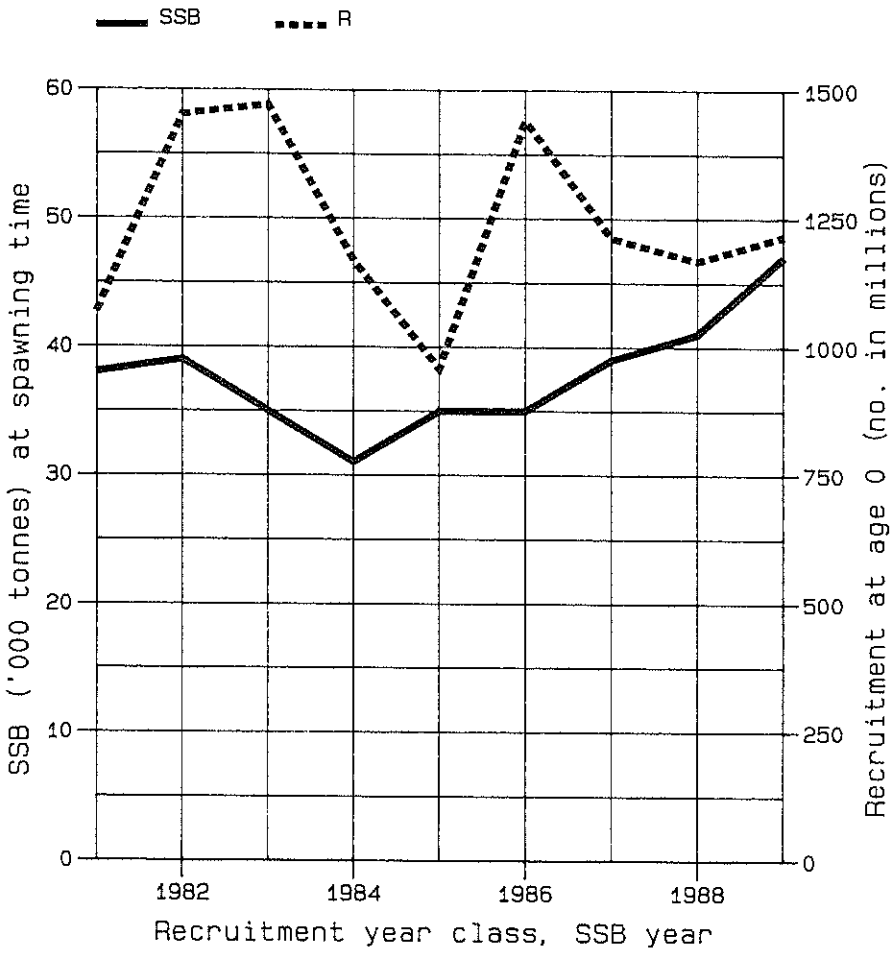
FISH STOCK SUMMARY
STOCK: Blue Whiting – Southern Area
27-09-1990

Trends in yield and fishing mortality (F)



A

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



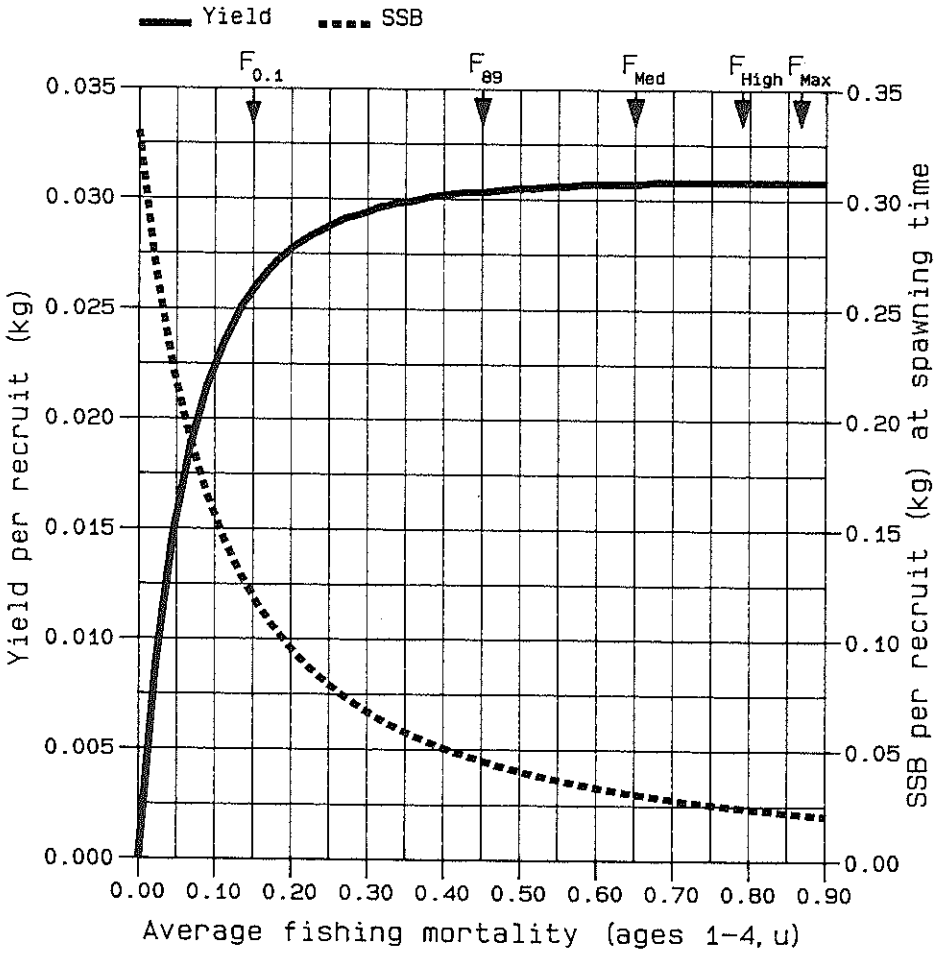
B

(cont'd)

Figure 5.5 (cont'd)

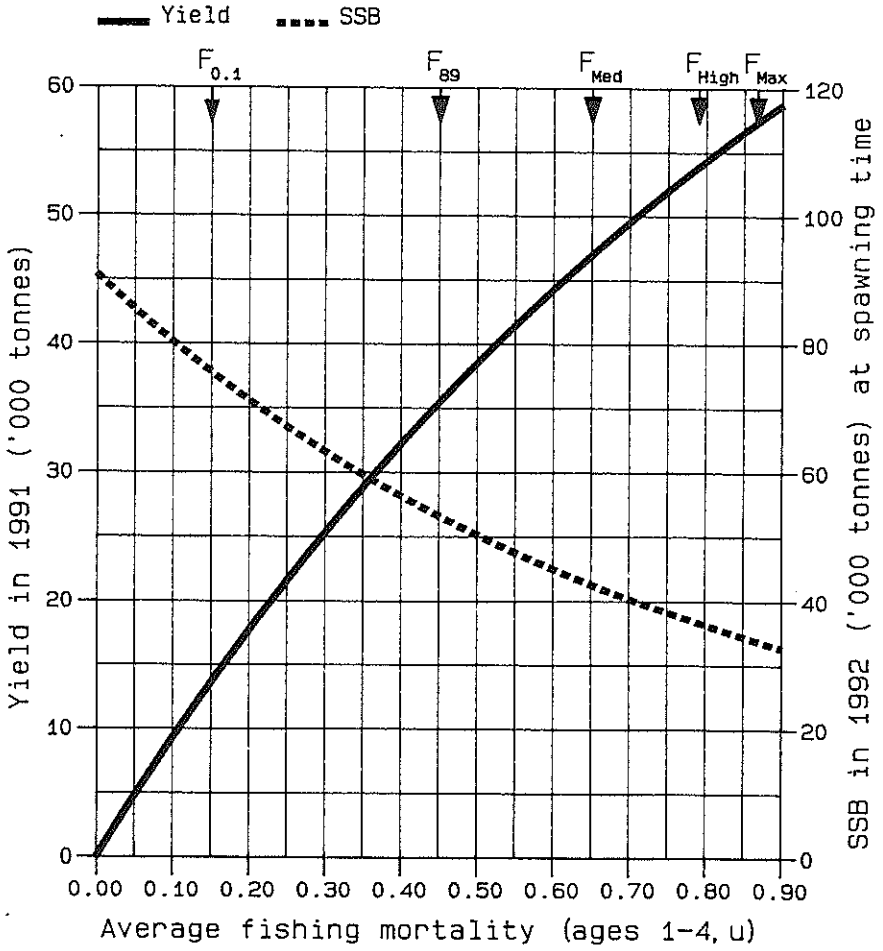
FISH STOCK SUMMARY
STOCK: Blue Whiting – Southern Area
27–09–1990

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

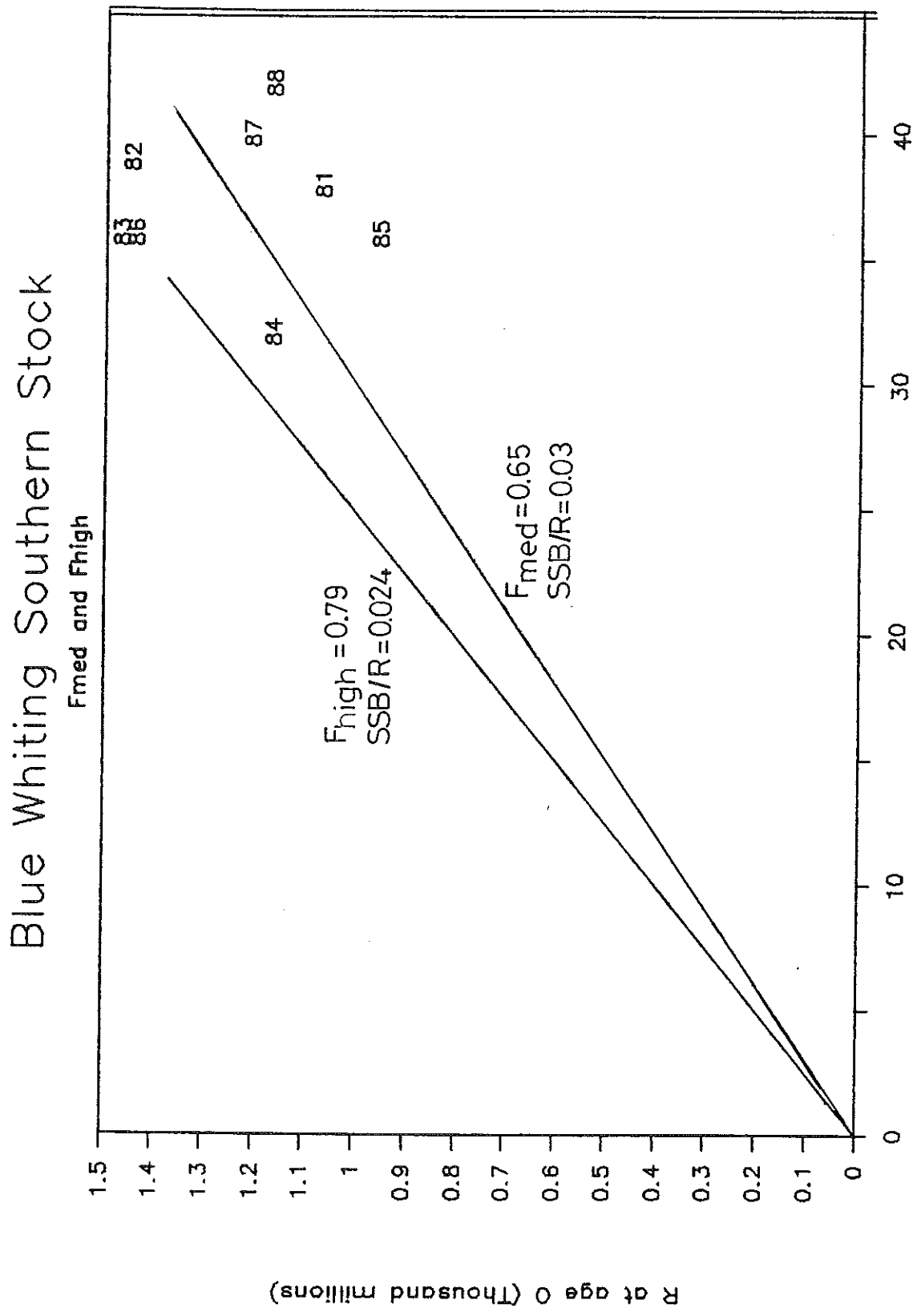

Blue Whiting Southern Stock
Fmed and Fhigh
R at age 0 (Thousand millions)
SSB at spawning time ('000 t) 1981–88
F_{high} =0.79
SSB/R=0.024
F_{med}=0.65
SSB/R=0.03
82
83
86
84
85
81
87
88
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
0
10
20
30
40

Fig 5.6

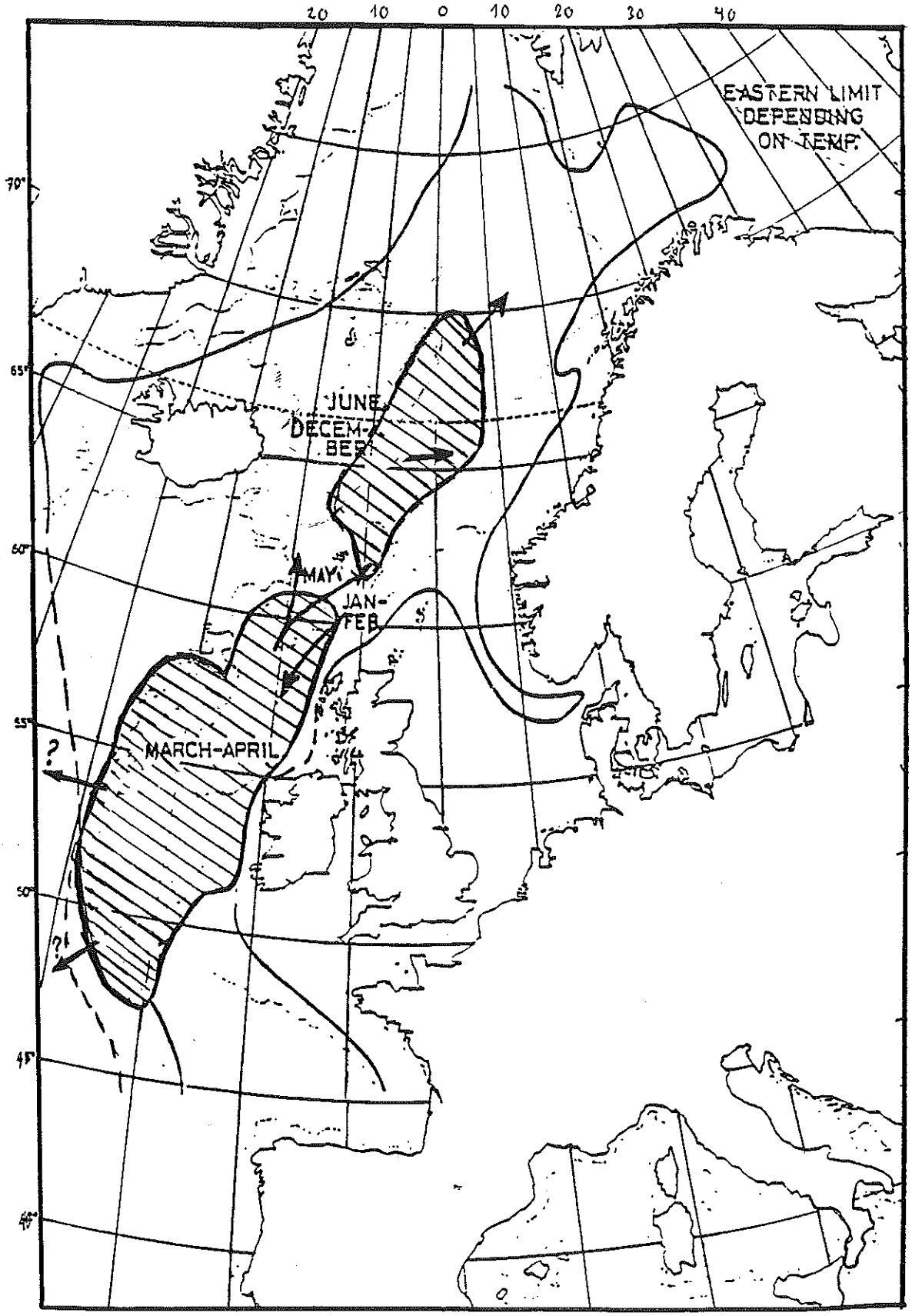


Fig. 7.1.a. Blue whiting adult distribution and migration.

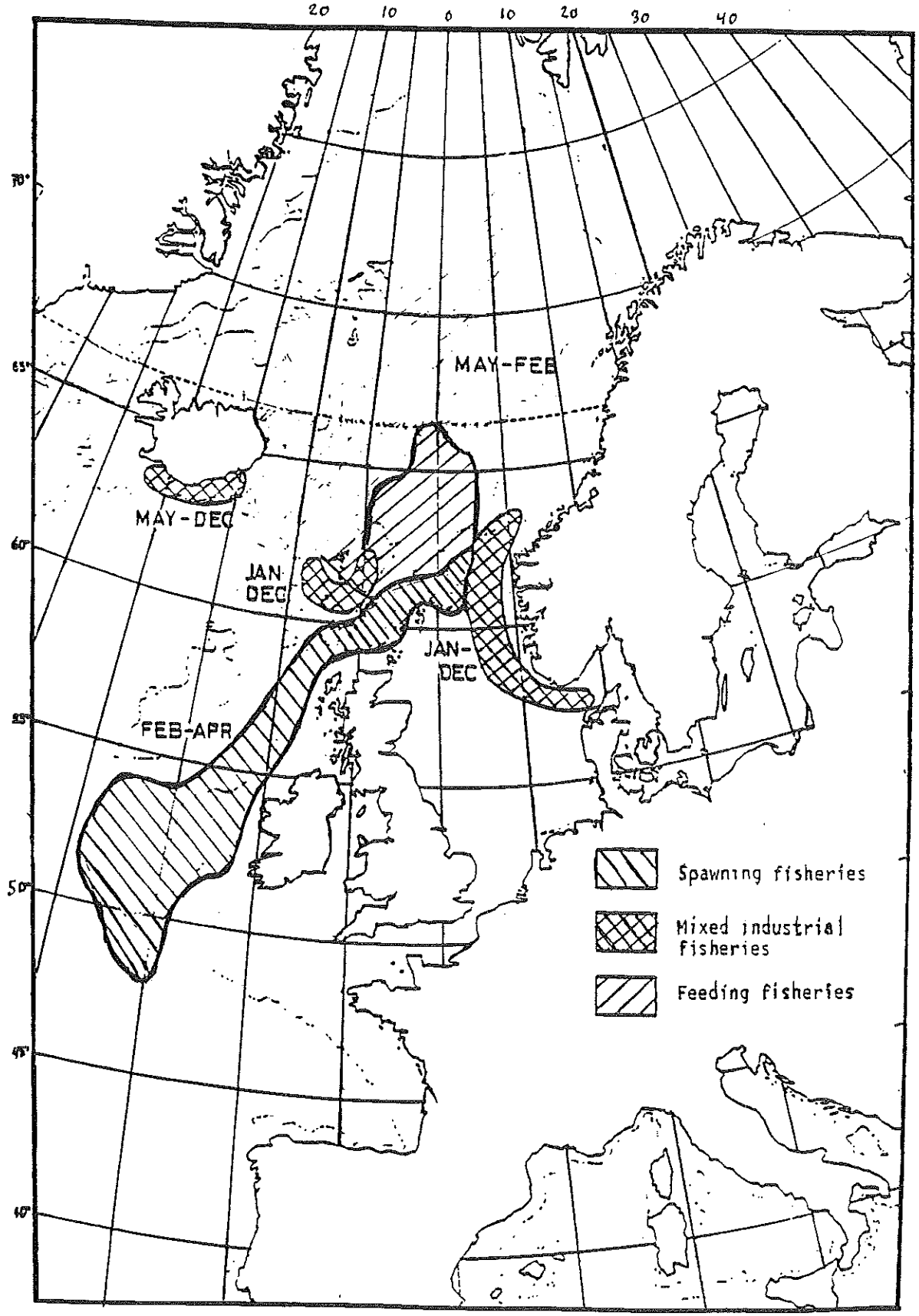


Fig.7.1.b. Fishing area for the various fisheries on the blue whiting northern stock.

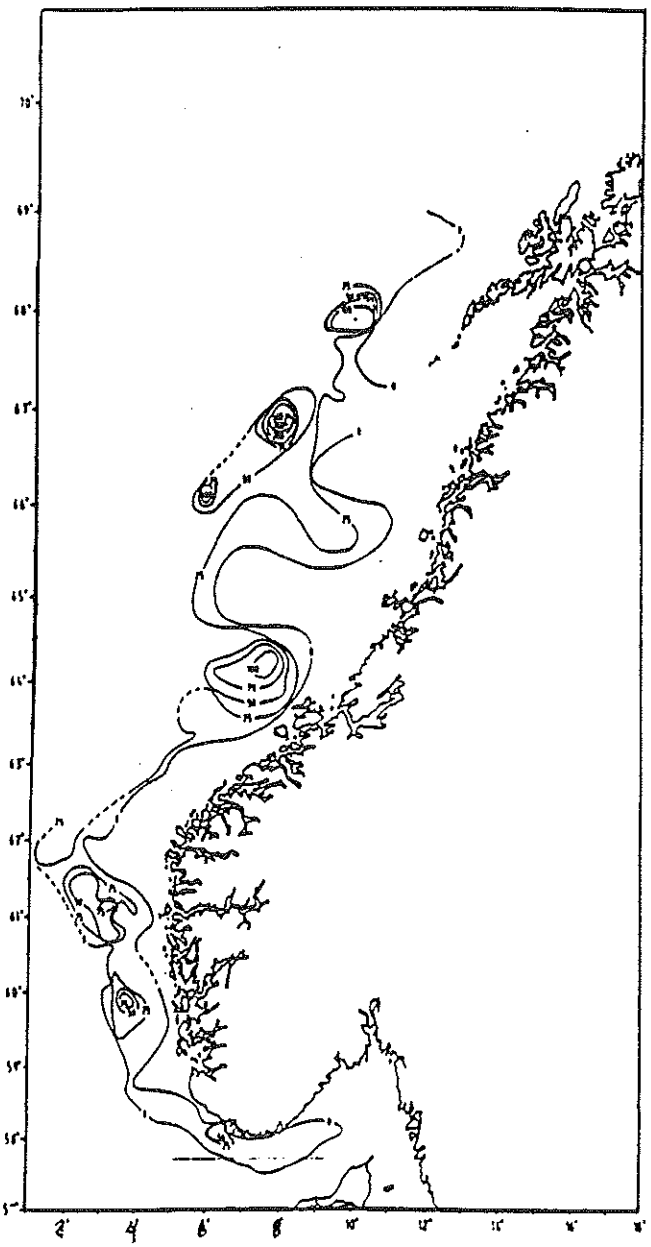


Fig. 7.2. Distribution and density of 0-group blue whiting, November 1989. Echo intensity in $m^2/n.mile^2$.

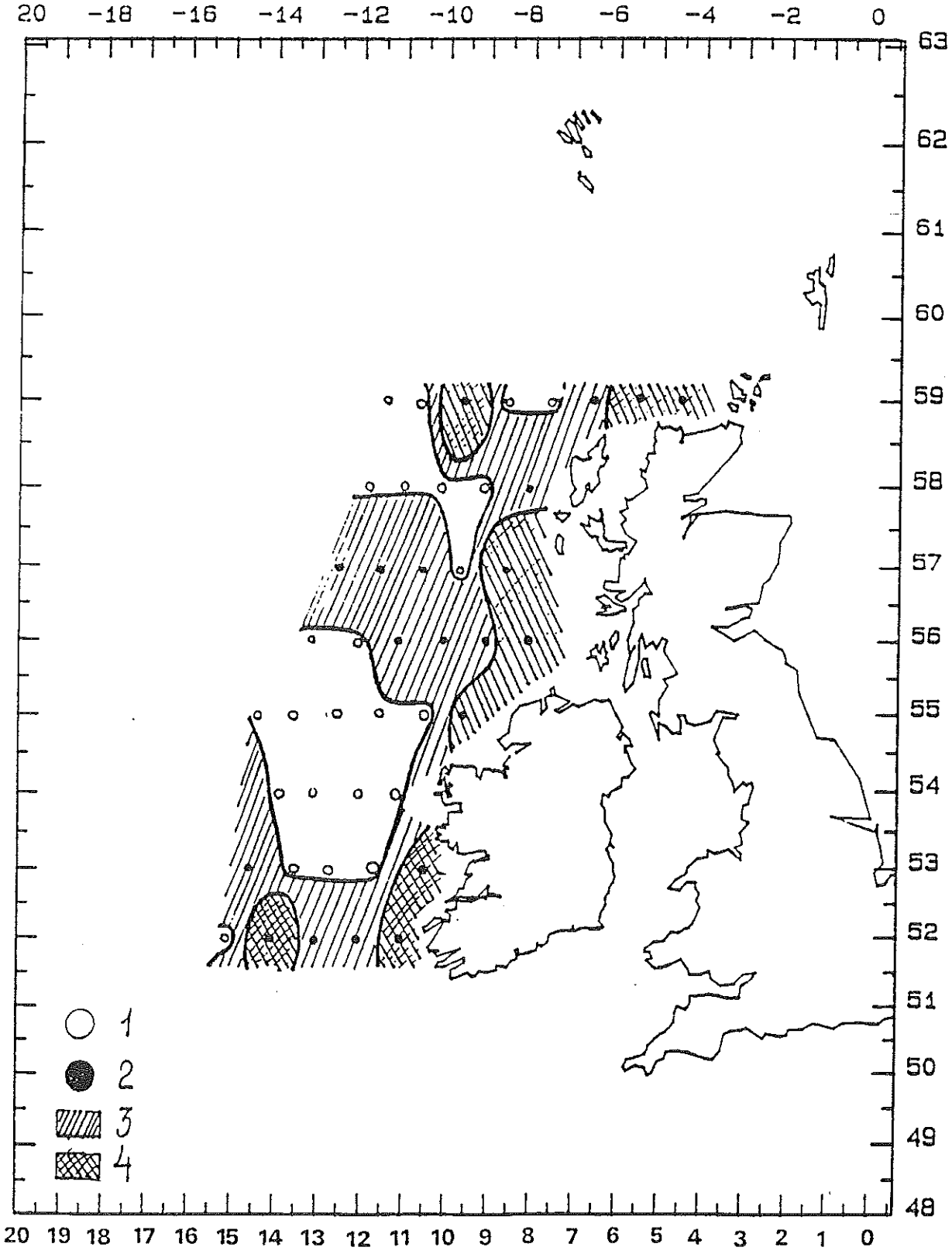


Fig. 7.3. Position of ichthyoplankton stations and distribution of larval blue whiting, 22/4-5/5 1990. R/V "Pinro" USSR. 1: larvae absent; 2: larvae present; 3: 1-10 larvae/m 4: 11-100 larvae/m . (Belikov et al.,1990)

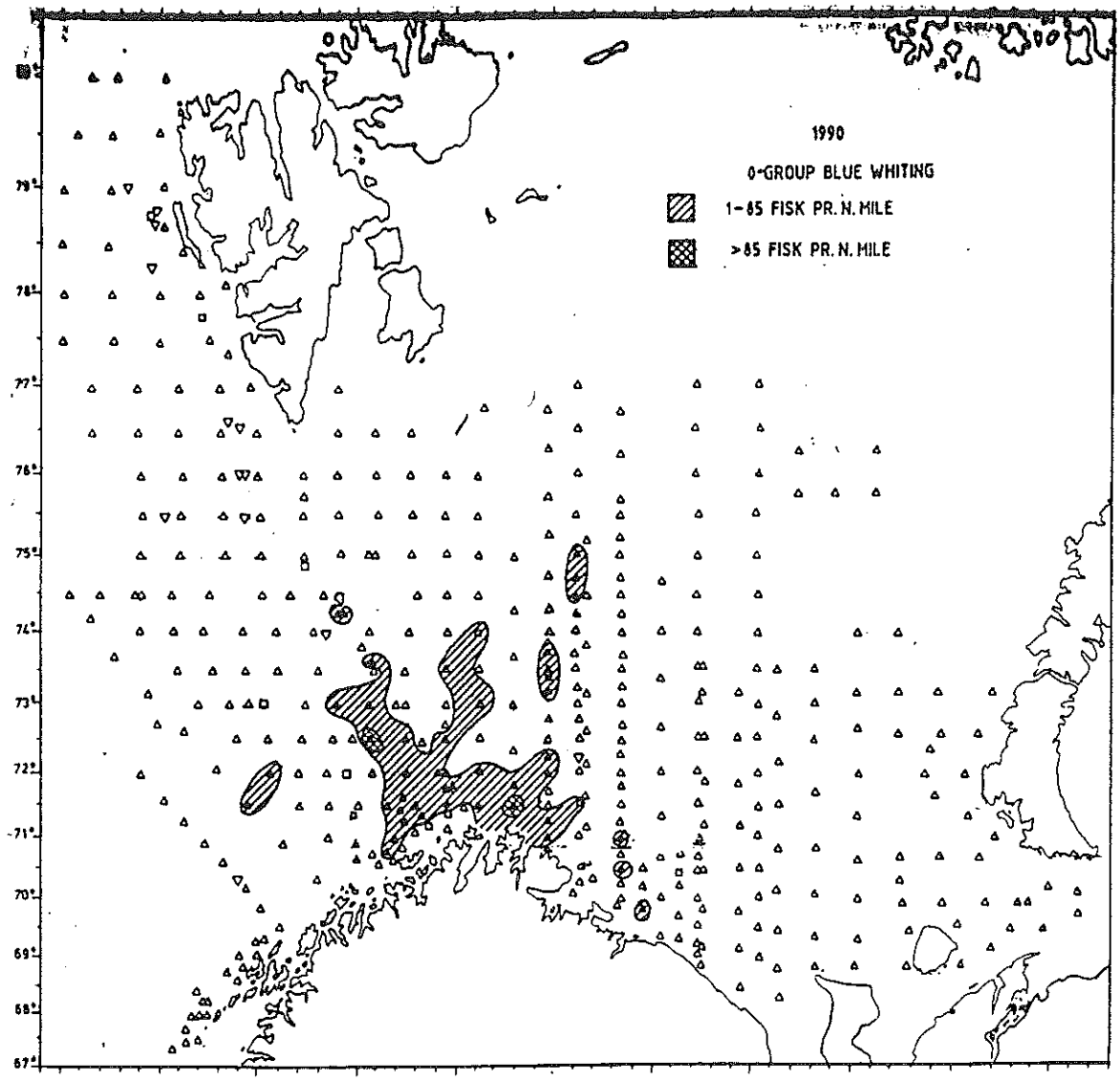


Fig. 7.4. 0-group blue whiting distribution in the Barents Sea (Anon. 1990).

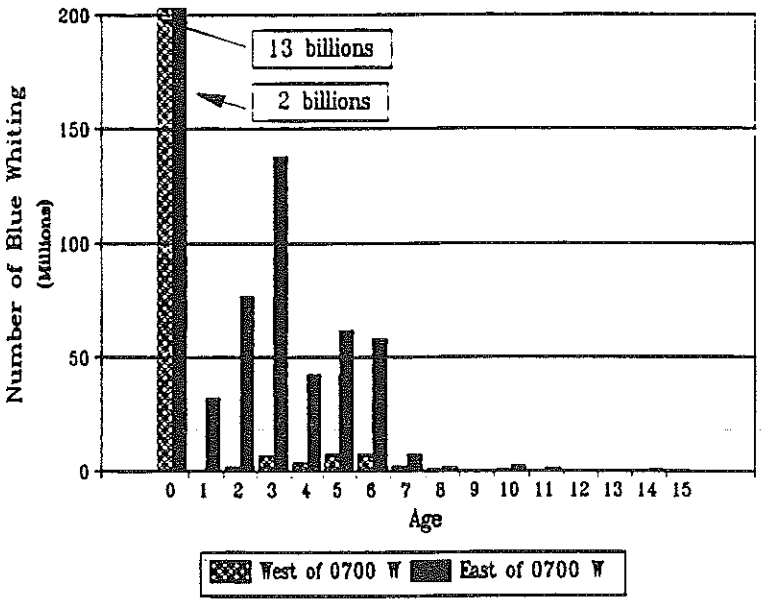


Fig. 7.5. Total age distribution of blue whiting in the north-western and north-eastern part of the surveyed area 1989. (Jacobsen, 1990)

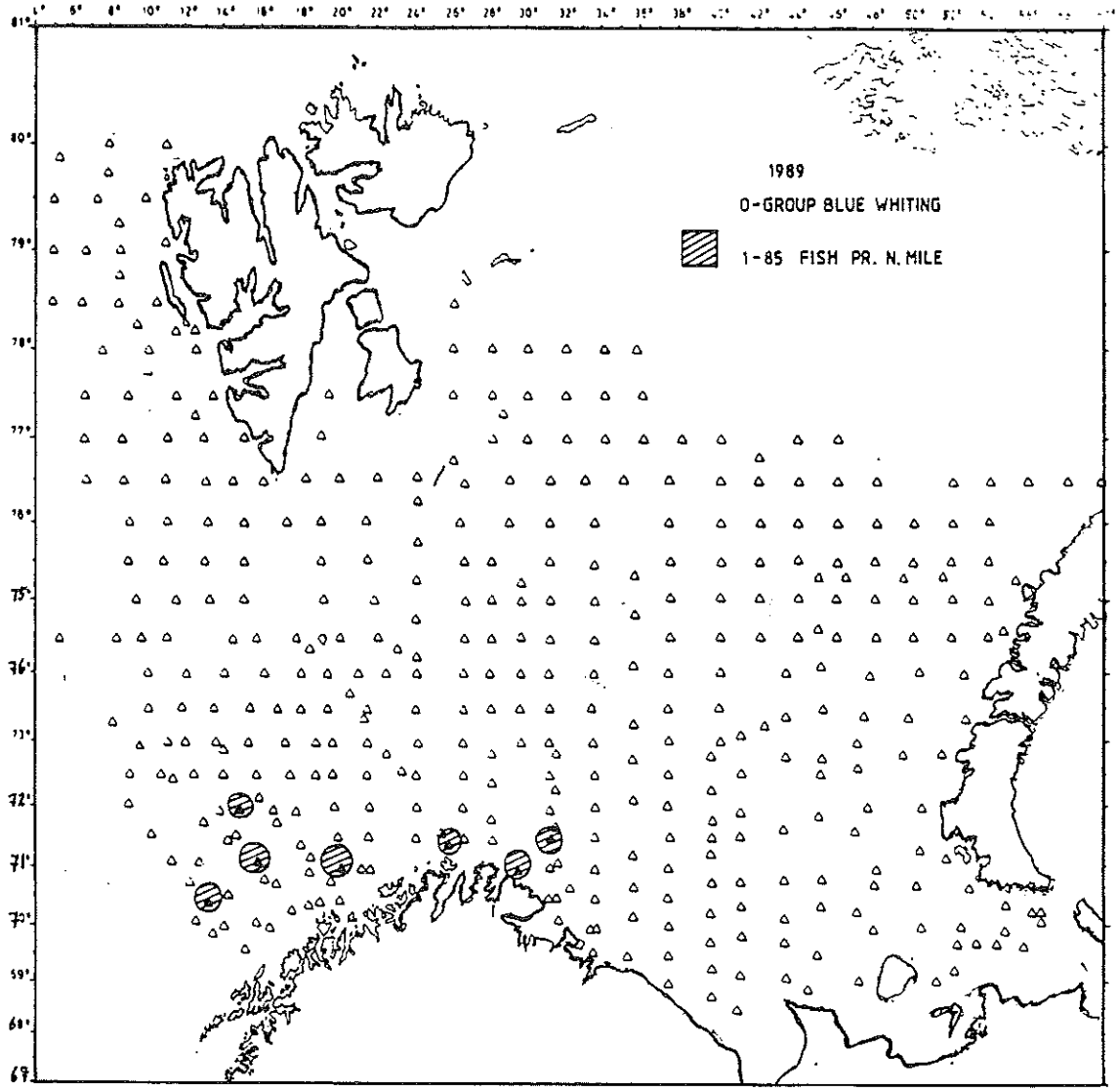


Fig. 7.6. Distribution of 0-group blue whiting, 1989.