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International Council for the
Exploration of the Sea

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REPORT OF THE BLUE WHITING ASSESSMENT WORKING GROUP

Bergen, 11 - 17 September 1991

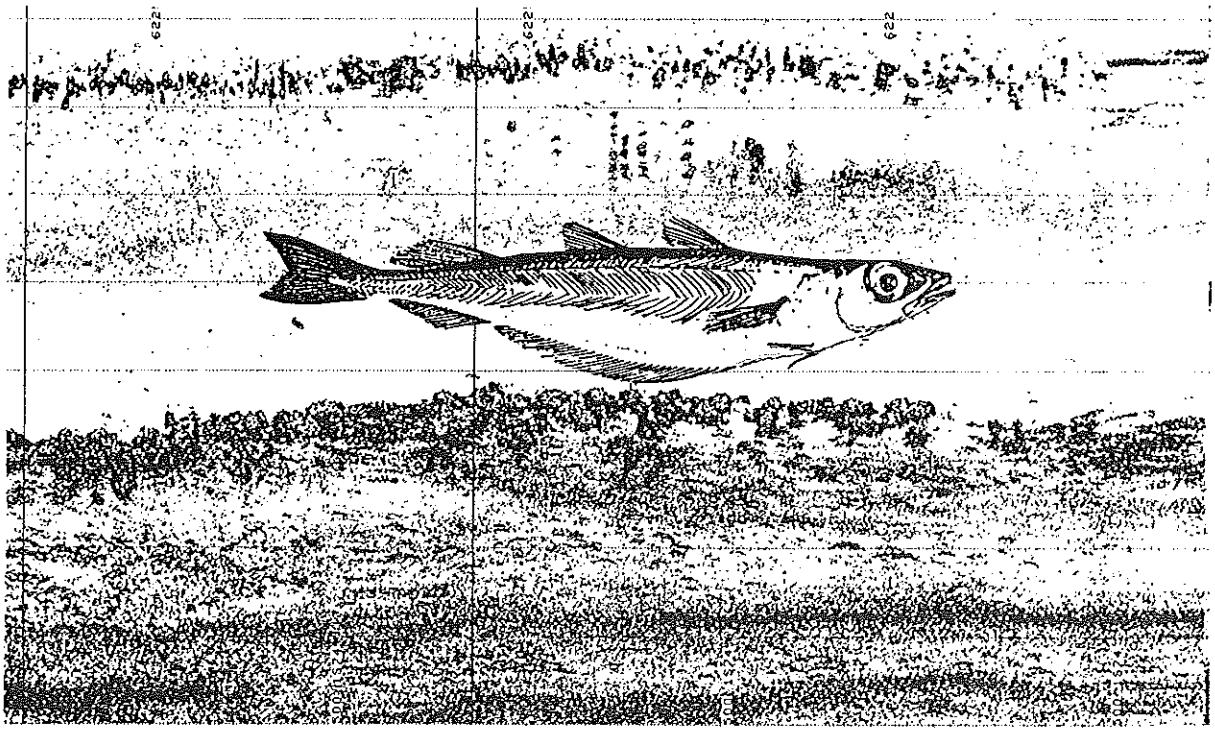

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TABLE OF CONTENTS

1 INTRODUCTION

1.1 Terms of Reference

The Blue Whiting Assessment Working Group (Chairman: Mr. T. Monstad) met at the Institute of Marine Research in Bergen from 11 to 17 of September 1991 (C. Res. 1990/2:5:20) to:

a) assess the status of and provide catch options for 1992 within safe biological limits for the northern and southern blue whiting stocks;

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

In addition there is a request from NEAFC for advice from ICES to provide additional information concerning the northern stock of blue whiting, to evaluate the development of the total stock biomass and spawning stock biomass over a three year period (1993-1995) assuming

- recruitment as estimated for the year class up to and including 1989,

- for the year classes 1990 and after average recruitment, excluding the recruitment for the year classes 1982, 1983, and 1989,

for each of the following scenarios:

- a TAC of 700,000 tonnes
- a TAC of 800,000 tonnes for each year of the three year period.1.2 Participants

1.2 Participation

Sergey BelikovUSSR
Vladimir BlinovUSSR
Pablo CarreraSpain
Ole GullaksenNorway
Jan Arge JacobsenFaroes
Manuel MeixideSpain
Terje Monstad (Chairman)Norway
Karl-Johan StährDenmark
Reidar ToresenNorway

In addition Anne-Liv Johnsen, Institute of Marine Research, Bergen gave secretarial help in preparation of the report.

2 STOCK IDENTITY AND STOCK SEPARATION

A decrease in the biomass of blue whiting feeding in the Norwegian Sea and a reduction of landings from this feeding area at the same time have been observed. In recent years, blue whiting have shown practically no mass migration north of 65°N, though in previous years they migrated to 72°N. When analysing this situation, Isaev and Seliverstov (1989) suggested that the northern stock consists of two populations, and according to their respective spawning areas, these were then named the Hebrides and the Porcupine stocks. In recent years, Soviet scientists have continued investigations of blue whiting on this subject (Isaev *et al.*, 1991). The current dynamics of stocks and catches have been analyzed, and proposals on future exploitation of stocks have also been made, using that approach. Norwegian scientists have continued genetic analysis of blue whiting (Monstad, pers. comm.).

An unknown part of the Northern blue whiting stock migrates westwards and southwards after spawning (Anon., 1990). In the southern area also the population structure of the stock is uncertain, and it is, therefore, extremely important to continue the observations concerning the centre of migration of the post-spawning blue whiting.

The Working Group recommends that discussion on population structure of blue whiting should take place in a special workshop.

3 OTOLITH EXCHANGE PROGRAM

According to recommendation in lst years report, another otolith exchange has been set up with otoliths selected from various areas.

In this new exchange exercise, the observed rings of the otoliths will be measured to make possible an analysis of the frequency distribution of the rings.

The set of otoliths has only been analyzed by a few of the concerned countries and the first results are to be presented at next year's Working Group meeting.

4 NORTHERN STOCK

4.1 Landings in 1990

Estimates of total landings in 1981-1990 from various fisheries by countries are given in Tables 4.2-4.4 and summarized in Table 4.1. Catches from 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 1990 were estimated as 528,793 t, which is 11% less than that in 1989. A small decrease of 2% in landings compared to 1989 is found in the landings

from the directed fishery in the spawning area, while the landings from the industrial mixed fishery decreased by 17%. The decline in the Norwegian Sea fishery continued with a decline of the catches of 94% compared to 1989; between 1988 and 1989 the decline in this fishery was 33%.

4.2 Landings in 1991

Preliminary data on the blue whiting catches from January to August 1991 were submitted by Working Group members, and these amounted to 281,000 t (Table 4.5).

4.3 Length composition of catches

Data on length composition of the 1990 catches of the Northern blue whiting by divisions were presented by USSR (Table 4.6.1), Norway (Table 4.6.2), the Netherlands (Tables 4.6.3 and 4.6.4), and the Faroes (Table 4.6.5).

Preliminary data for the length compositions in the catches in 1991 were presented by USSR (Table 4.6.6), Norway (Table 4.6.7) and the Netherlands (Table 4.6.8).

4.4 Age Compositions of Landings

For the directed fishery in 1990, age compositions were provided by the USSR, Norway and the Faroes. These countries accounted for 97 % of the landings.

The landings for the directed fishery of the GDR and UK (England & Wales) were raised to catch in numbers by age according to USSR data. For the landings from the directed fishery of the FRG, the Netherlands, and UK (Scotland), the age composition of the Norwegian landings in the same area and month was 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 and Skagerrak data were available for the Norwegian and Faroese landings. These accounted for 55 % of the total landings from this area. 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 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 were assumed to give the total age composition of the landing from the Northern stock (Table 4.9).

4.5 Weight at Age

Mean weight-at-age data for 1990 were presented by the USSR, the Faroes and Norway. Landings from other countries were assumed to have the same mean weight-at-age composition when fished in the same area and period as the sampled catches. Mean weights-at-age were calculated, weighted by the total landings in numbers in each fishery. The total catch landed in 1990 was compared to the sum of products of the total number landed and mean weights at age (SOP). The SOP discrepancy was found to be 0.03 %. 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 1991

4.6.1.1 Surveys in the spawning season

The second Norwegian-Soviet joint survey on blue whiting during the spawning season was carried out from 17 March to 16 April 1991, with a post-survey meeting in Bergen on 13-14 May 1991. The USSR coverage was from 17 March to 12 April and the Norwegian coverage from 18 March to 16 April (Monstad and Belikov, 1991).

A ship-to-ship calibration conducted on 24 March showed that the relationship between vessels could be treated as 1:1 (Hansen and Dorchekov, 1991).

Figures 4.1 and 4.2 show the survey routes and stations.

The survey started from the south with both vessels covering the Porcupine Bank and the adjacent area south and west of it. The northern edge of the shelf and the area beyond it towards the Faroe Islands were then criss-crossed, and the Soviet vessel in addition surveyed the southern part of the Rockall Bank.

Blue whiting was recorded over the Porcupine bank and along the shelf edge area from south of Ireland to north of the Faroes, in addition to parts of the Rockall Bank (Figure 4.3). The densest concentrations were found in the south, at latitudes 51°00'-53°00'N, and also rather dense concentrations were observed in the area north of the Porcupine bank along the continental slope. The blue whiting observations over the Rockall Bank were only of a weak character.

Separate estimates were made by each country, and the results were then combined on a rectangular and sub-area basis (Figure 4.4).

The blue whiting stock in the surveyed area was estimated to be 4.7 million tonnes, with 4.4 million tonnes

belonging to the spawning stock. The corresponding abundances were 38.6 x 10^9 and 35.2 x 10^9 individuals.

The total length and age distributions are shown in Figure 4.5. As expected from earlier observations since 1989 (Anon., 1991a), this survey confirmed that the 1989 year class was a strong one. In number it accounted for approximately 23% of the 1991 stock. The length distribution has two peaks, one at 23 cm for the 1989 year class and one at 30 cm for the 1986 and 1987 year classes.

During 18 April-4 May, a Soviet-Irish Ichthyoplankton survey was conducted in the area west and north-west of the British Isles (Belikov *et al.*, 1991). During this survey post-spawning migration of blue whiting was observed. The strongest blue whiting registrations were found between 53°00'N and 60°00'N along the coastal shelf in a narrow strip within the depth range of 500-1000 m. In addition, shoals of blue whiting were found at the eastern part of the Rockall Bank (Figure 4.6).

During 18-28 April the Norwegian R/V "Johan Hjort" surveyed the continental shelf between latitude 65° and 67°N, with one of the aims being to investigate the geographical distribution and abundance of blue whiting. (Monstad, 1991). The best concentrations were found at the shelf edge between approximately 62°30'-65°00'N (Figure 4.7).

The total biomass was estimated to be 526,000 tonnes, representing an abundance of 5.6 x 10^9 specimens.

The 1989 year class dominated in the samples, accounting for 58% by number, followed by the 1988 year class at 36% (Figure 4.8).

4.6.1.2 Survey in the feeding season

Only one country carried out an acoustic survey on blue whiting in the Norwegian Sea in 1991 (Jakobsen, 1991). From 16-28 August, the Faroes R/V "M. Heinason" conducted a survey from 62°-66°N and 00°-11°W (Figure 4.9). The distribution of echo intensity of blue whiting in the area is shown in Figure 4.10. Blue whiting was recorded throughout most of the surveyed area. Concentrations of blue whiting are always found on the shelf edge deeper than 300 m around the Faroes. Generally the highest concentrations were observed on the warmer side of the Polar front. The recordings were almost exclusively 2 year-old (1989 year class) blue whiting in the central and northeastern part of the area. Biomass in the surveyed area was estimated to be 282,000 tonnes. The overall age composition of the fish concentrations is shown in Figure 4.11. The 1989 year class constituted 85% in number in the western area and 69% in the eastern area.

During an oceanographic survey from 24 July - 7 August, the Norwegian R/V "Johan Hjort" observed some echo recordings of blue whiting in the area 63°00'- 65°30'N between 04°E - 09°W (Blindheim, J. pers. comm.).

4.6.1.3 Discussion

During the second Norwegian-Soviet joint survey the results of a ship-to-ship calibration of the acoustic instruments allowed a 1:1 relationship between the two vessels' acoustic data to be used. Thus, the data were combined unadjusted to provide a common result (Monstad and Belikov, 1991).

This result and estimates from previous years in the spawning area since 1988 are listed in the text table below (in millions of tonnes). The spawning biomass is given in brackets. Although for some years the USSR made estimates from 2 surveys, only the most appropriate ones are presented.

Year	USSR	Norway	Faroes	USSR+Nor.Comb.
1983	3.6(3.6)	4.7(4.4)		
1984	3.4(2.7)	2.8(2.1)	2.4(2.2)	
1985	2.8(2.7)		6.4(1.7)	
1986	6.4(5.6)	2.6(2.0)		
1987	5.4(5.1)	4.3(4.1)		
1988	3.7(3.1)	7.1(6.8)		
1989	6.3(5.7)	7.0(6.1)		
1990	5.4(5.1)	6.3(5.7)		
1991				4.7(4.4)

Compared to previous years, the blue whiting in the Porcupine area in 1991 showed a more easterly distribution. This may be due to changes in hydrographical conditions at depth, with warmer water than usual along the Irish coast (Boytsov *et al.*, 1991). As a result of this, the dense concentrations usually fished west of the Bank, were not observed this year. Observations during the spawning season have shown that the 1989 year class was a strong one. The spawning stock biomass was found to be 1 million tonnes less than that observed in 1990 (Anon., 1991a).

Only one national survey was carried out during the feeding season in the Norwegian Sea (Jacobsen, 1991). This survey was conducted inside of Faroese economic zone. The biomass in the surveyed area was estimated to be 282,000 tonnes. The 1989 year class totally dominated in the Faroese waters (68%). These findings confirm that the 1989 year class is rather strong.

4.6.2 Catch per unit effort

Data on catch per unit effort from the directed fisheries in 1990 were submitted by Norway, GDR, UK (Scot-

land) and USSR. The data presented were broken down by vessel tonnage class, area and month. GDR also submitted data for 1989.

Time series of catch per fishing hour in the Norwegian Sea, the Faroes area and the area west of the British Isles are given in Tables 4.11.1-4.11.3 and shown in Figures 4.12A-F.

Catch per hour for the USSR fleet in Division IIa was very high for the first quarter of 1990, whereas for the summer months and early autumn it was at the same level as the preceding years, and no particular trend in the CPUE could be noticed (Figure 4.12A).

In Division Vb, the decreasing trend seen since 1986 continued for the USSR CPUE during March-May, whereas during June-August a rapid increase has appeared since 1988. The whole USSR CPUE time series is, however, rather variable, forming oscillations with big amplitudes (Figure 4.12C). The GDR CPUE data have shown a steady decreasing trend since 1985.

A decreasing trend in the CPUE fishery during March-April in the spawning area (Division VIa) has continued since the early 1980s for Norwegian vessels of GRT classes 2 and 3, resulting in an overall decrease in the CPUE of up to 70% (Figure 4.12D).

In Divisions VIIb,c, a decreasing trend in CPUE for Norwegian vessels of both classes is evident, whereas the increasing trend in USSR CPUE has stabilized almost at the same level as in 1985 (Figure 4.12E).

In Table 4.11.3, the data for UK (Scotland) fisheries in Divisions VIa and VIIb,c are given, but no reference to GRT class of vessel having taken part in the fisheries was available.

Decreasing CPUE trends are noticed for larger Norwegian and USSR vessels in Divisions VIIg-k, whereas CPUE for Norwegian vessels of GRT class 2 reveal a small increase (Figure 4.12F). Thus, there is overall a decreasing CPUE trend in the fishery in Divisions VIIg-k during the last two or three years.

The GDR and USSR have for the first time reported catch per hour data for the fisheries in Sub-area XII for the years 1989 and 1990. These data confirm a more north-westerly distribution of blue whiting in the area in recent years.

In Table 4.11.4, the time series for the aggregated USSR CPUE show decreasing USSR catch rates in Division IIa, and increasing ones in Divisions Vb, VIIb,c and VIIg-k (Figure 4.13). A prolonged decreasing trend in USSR catch rates is seen for the fishery in Division IIa (Figure 4.13A). Aggregated USSR CPUE for Division Vb seems to vary around a stable level (Figure 4.13B).

Aggregated USSR CPUE reveals a steady increasing trend since 1987, which reached the highest value of the decade in 1990 (Figure 4.14).

According to the recommendations given by the Working Group in its previous Report (Anon., 1991a), the GDR, Norway and UK (Scotland) have reported catch per day data back to 1980 (Figures 4.15 and 4.16) as USSR did for the meeting in 1989 (Anon., 1990).

The most extensive GDR data on catch per day were used for comparison of catch rates expressed either by catch per hour or catch per day data for Divisions IIa and Vb (Figsures 4.15 and 4.16). The similar patterns of both indices can be seen for each GDR fishery. As was in the USSR catch-per-day data (Anon., 1990, Figure 4.10), the GDR CPUE showed a considerable rise in the period 1983-1986 in Division IIa (Figure 4.15). This could be explained by the state of the blue whiting stock in the Norwegian Sea, due to the appearance of the strong 1982 and 1983 year classes, which gave a notable increase in landings from the Norwegian Sea (Table 4.1).

Catch-per-day data for GDR vessels display a more oscillatory pattern for Division Vb (Figure 4.16) than for Division IIa. In Division Vb, GDR catch-per-hour data (Figure 4.12C) seems to be smoother revealing the decreasing trend, whereas those for the USSR fleet show less variation during March and May. Accordingly, GDR catch rates in Division Vb are unlikely to reflect changes in the stock size.

Figures 4.15 and 4.16 indicate that mean annual catch-per-day data are more representative of changes in the stock size than catch-per-hour data, as was stated in the Working Group Report of 1989 (Anon., 1990).

Catch-per-day data for the blue whiting directed fisheries were also submitted to the Working Group for the period 1980-1990 by Norway. The most representative time series for April in Division VIa and March in Division VIIbc are shown in Figure 4.17. Considerable variations in all data can be seen from the figure. At the same time a stable level of the fishery in Division VIIb,c is clearly noticed over the whole decade when data for GRT class II are considered. The fishing activity of larger vessels also confirms this conclusion.

Slightly higher variations of catch per day data can be seen in Figure 4.17 for fishery of class II vessels in Division VIa. Variations of the catch rates with the greatest amplitudes took place in the years 1983-1988, reflecting perhaps the somewhat uneven nature of spawners entering the spawning area when the strong

1982 and 1983 year classes were present in the spawning stock.

Catch-per-day data for UK (Scotland) vessels of all GRT classes in the fishery in Divisions VIa and VIIc in April in the years 1980-1990 are shown in Figure 4.18. The time series in 1986-1990 display a decreasing trend for the fishery in Division VIa and a very sharp rise in catch rate in Division VIIc.

It is evident to the Working Group that the gathering of both types of catch per unit data is still worthwhile.

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 3-10 years, and data from the years 1982-1990 were used. The tuning data used last year are described in Anon. (1991a) 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. No combined acoustic survey results from the Norwegian Sea have been available for the last two years (1989 and 1990) and, therefore, this fleet was left out of the tuning. An analysis of the three remaining fleets was run applying The Extended Survivors Analysis method (XSA). This is an extended version of the general procedure of survivors analysis first described by Doubleday (1981), and further developed by Shepherd and Sun (pers. comm.) and briefly described in Anon. (1988). The method may be used in the analysis of the consistency of the fleet data (Anon., 1991c) as the log standard deviations of the reciprocal catchability estimates of each age group are given in the output from the program. These indicate the quality and utility of the CPUE/survey data for each age group of each index series. The log unstandardised residuals of the estimates of the population number from each fleet (relative to VPA) are also given. As is pointed out by the Working Group on Methods of Fish Stock Assessment (Anon., 1991c), "values of the log standard deviation of the reciprocal catchability estimates less than 0.3 are good, between 0.3 and 0.5 moderate, above 0.5 poor, and above 1.0 useless (or even positively misleading)". The results from the analysis are presented in Table 4.12.1 and summarized in the text table below. Here the percentages of the log population residuals (LPR) of all the data in each quality group for each fleet are given.

	LPR			
Fleet	<0.3	0.3-0.5	0.5-1.0	>1.0
Norway	43.2	13.6	33.3	10.9
USSR	25.9	17.3	33.3	23.5
CPUE	6.8	6.6	13.1	73.5

From this table it is seen that the CPUE data are very bad, while the other two fleets perform better.

In addition, from the log standard deviations of the reciprocal catchabilities (Table 4.12.1) it is seen that all the USSR CPUE were "useless", while for the Norwegian and the USSR surveys, 4 and 5 values were "useless", respectively, while the corresponding "poor" ones were 2 and 4. The USSR acoustics performed no "moderate" or "good" data while the Norwegian fleet had 2 "moderate" and 1 "good" age groups in the fleet.

The Working Group found it difficult to make statistical tests on these results because there is too much of a trend in the residuals (the older the fish, the more inconsistency in the data). However, the Working Group discussed the results and agreed to leaving out the USSR CPUE fleet because it performs much worse than the two other fleets. The two remaining fleets, the Norwegian acoustic estimates on the spawning grounds, and the USSR acoustic estimates in the same area, also perform relatively poorly in the XSA analysis. The Norwegian data seems to give somewhat better consistency than the USSR data, but the difference between them is not striking.

The Working Group came to the conclusion that the reason for the inconsistency in the two acoustic-data fleets may be due to age-reading problems. The results of a number of VPA runs, Table 4.12.2, show a high sensitivity to different sets of fleets applied, reflecting this problem particularly for the older age groups. The Working Group, therefore, decided to reduce to the age range to 0-10+ as compared to 0-12+ as used last year in the final run.

The Working Group emphasizes that the Norwegian and Soviet acoustic survey data for the spawning area should have priority when choosing VPA options. The decreasing trend in SSB in recent years observed from these data ought to be reflected in the VPA output.

The Working Group, therefore, decided to use the two remaining fleets in the final tuning of the VPA (Table 4.12.3). As the age range in the tuning data started from age 3, the Fs for ages 0-2 had to be entered manually. Average Fs over the last 5 years of 0.015, 0.043

and 00.05, respectively, were used. These Fs are not included in the reference F for ages 0-2.

The results of the tuning are presented in Table 4.12.4, and it can be seen that the variance ratios are relatively low. A plot of the logarithmic catchabilities for each age group and fleet is given in Figures 4.19A-F. The fishing mortalities and stock size estimates obtained from tuning are given in Tables 4.12.5 and 4.12.6. The resulting mean $F_{(4-8)}$ level of 0.258 was accepted as a target for fitting the subsequent separable VPA.

4.6.3.2 Estimation of fishing mortalities using separable VPA

A separable VPA based on the tuning results was run with a terminal F of 0.265 at age 5 and a terminal S of 1.5. The resulting matrix of residuals was acceptable, although some high residuals were evident at the youngest ages (Table 4.12.7). The fishing mortalities obtained for 1990 gave an average value for ages 4-8 of 0.257 which is practically what was aimed for (Table 4.12.8.). The corresponding stock estimates are shown in Table 4.12.9. For comparison a plot of the exploitation pattern from the tuning and the separable VPA is given in Figure 4.20. Some discrepancies were observed for the older ages, which are believed to originate from the age-reading problems mentioned above.

4.6.3.3 Discussion of the stock size estimates from the VPA

The results of the VPA indicate a spawning stock at 1 January 1990 of 2.5 million tonnes (Table 4.12.9), which is a revision to the half of last year's estimate, when the SSB for 1990 was predicted to be 5.1 million tonnes. This reduction is substantial and needs some discussion. Firstly, the Working Group was not very happy with the high spawning stock estimate obtained in last year's tuning due to the great sensitivity of the tuning method (ref. Section 4.6.3.1 in Anon., 1991a), and in addition this year's tuning trials (Table 4.12.2) also show severe limitations in the method if the tuning data are noisy. Secondly, the introduction of the extended survivors analysis (XSA) gave new knowledge to the Working Group about the quality of the tuning data and was used as a guide to deciding which data sets to use. It is, therefore, assumed that the exclusion of the "bad" tuning data in the present analysis would yield more reliable and consistent tuning results and consequently stock size estimates.

The estimated total stock biomass in 1990 of 5.2 million tonnes (Table 4.12.9) is thought to be closer to the reality than the corresponding value of 7.5 million tonnes predicted last year.

The total stock biomass at 4.4 million tonnes estimated this year for 1989 is likewise thought to be much more realistic than last year's corresponding estimates of 13.3. million tonnes. This result, however, was last year considered to be unreliable because of the uncertainty in the strength of the 1988 and 1989 year classes (ref. Section 4.6.3.3 in Anon., 1990).

As can be seen from Table 4.12.9, average recruitment since the strong 1983 year class has been at 12.5 million; e.g., between 10.5 in 1988 and 14.5 in 1984, up to the last strong year class of 1989.

The text table below shows the ranges of the acoustic spawning stock estimates together with the VPA results from 1983-1991.

Estimates	1983	1984	1985	1986	1987	1988	1989	1990	1991
Survey min.	3.6	2.1	1.7	2.0	4.1	3.1	5.7	5.1	4.4[1]
Survey max.	4.4	2.7	2.7	5.6	5.1	6.8	6.1	5.7	4.4[1]
VPA	2.1	1.9	2.2	2.7	2.4	2.3	2.3	2.5	2.5

Biomass in million tonnes. [1]Combined surveys

The acoustic survey values of 1985 have been changed from those shown in last year's report when they were given as 4.1. That was a mean of the 1986 acoustic results, as the 1985 results were believed to be too low tuning the VPA.

Since 1988, there has been a downward trend in the acoustic results of the spawning stock size. The VPA results, however, show no such trend, but rather may be considered stable around a level of 2.4 million tonnes. The slight increase in 1990 and 1991 may be due to the influence of the strong 1989 year class. This is, however, not reflected in the same way in the acoustic results.

4.6.3.4 Yield per recruit

Yield per recruit and spawning stock biomass per recruit have been calculated using data in Table 4.12.10 and shown in Figure 4.21C. The exploitation pattern used was the smoothed fishing pattern (S-values) from separable VPA (Table 4.12.7) scaled so that the resulting average fishing mortality in the ages 4-8 was the same as in the F_{4-8} of 0.258 obtained from the tuning for 1990. The yield-per-recruit calculations gave an $F_{0.1}$ of 0.219 which is only slightly lower than the present fishing level.

4.6.4 Catch projection and management considerations

A projection of catches in 1991 (per 1. September) and a resulting spawning stock biomass in 1992 were made using data in Table 4.12.10. The stock size estimates at

the beginning of 1991 for age groups 3-10+ were taken from the VPA run (Table 4.12.9). The figure for age group 0 was set equal to the 1981-1988 average of 14.769 million. For the next age group the total fishing mortality for age group 0 in 1990 was applied to the average recruitment obtained, resulting in 11.960 million at age 1. For age group 2 (1989 year class) a different approach was used due to a prior knowledge of the strength of this year class, which is assumed to be rather strong. Hence an average recruitment from the strong 1982 and 1983 year classes was used as a starting value of 25.651 million at age 0 in 1989 for the calculation forward to 1991 as 2 year olds (Table 4.12.10).

A catch of 300,000 t assumed to be caught in 1991, corresponding to an average F_{4-8} of 0.16 will give a resulting SSB of 3.1 million tonnes in 1992 (Table 4.12.11).

The results of the catch projections are given in Figure 4.21D and Tables 4.12.11-4.12.13. A continuation of the assumed 1991 F level would result in a catch of 372 thousand tonnes in 1992, whereas a fishery at the 1990 F level would have resulted in a catch of 569 thousand tonnes (Table 4.12.13). Fishing at the $F_{0.1}$ level in 1992 would yield a catch of 491 thousand tonnes in 1992. A plot of recruitment *versus* spawning stock biomass from 1981 to 1988 is given in Figure 4.22. The estimated F_{med} was 0.25 and is shown in the figure together with F_{high} (0.81). Fishing at F_{med} in 1992 will result in a catch of 543 thousand tonnes. The most realistic fishing level, however, is considered to be *status quo*, i.e., F level for 1991 = 0.16, which will give a catch of 372,000 tonnes, for reasons described below. Firstly, the fleets have switched over to catch capelin (*Mallotus villosus* Mull.) in the Barents Sea during spring instead of blue whiting, this will reduce the effort on blue whiting in coming years. Secondly, it is likely that a part of the international fleet might shift effort from blue whiting to mackerel now when the mackerel are distributed rather far north in the Norwegian Sea (Anon., 1991d). This should be seen in the light of the low catch in 1991. The Working Group recommends, however, that the TAC could be set at a level of about 500 thousand tonnes in 1992 corresponding to a fishing mortality not exceeding the $F_{0.1}$ level.

5 SOUTHERN STOCK

5.1 Landings

Total landings from the Southern area are given in Table 5.1. The Spanish landings are similar to those in 1989. The Portuguese landings continued the declining trend seen in 1988 with a decrease of about 20% compared to 1989.

5.2 Length and age composition of catches

Table 5.2 summarizes the length compositions of blue whiting landings from Spanish and Portuguese fisheries in recent years. Length compositions and landings by quarters are presented in Tables 5.3, the annual length compositions by gear for both fisheries are shown in Table 5.4.

Catch-at-age data since 1981 are given in Table 5.5; these were calculated using the length compositions provided by both countries and age/length keys provided by Spain. As can be observed, most of the fishing was based on the first five age groups, mainly on the 1-, 2- and 3-year-olds.

Spanish landings represent 92% of the reported total landings in the Southern area. About 50% of the Spanish landings are taken by pair trawlers in a directed blue whiting fishery, without any significant discarding. The other 50% are fished as a by-catch in the bottom-trawl fishery where the discards have decreased in recent years, with the increase of the economic value of the fish, and are assumed to be negligible. The Portuguese landings are taken as a by-catch by bottom trawlers. The discards in this fishery are believed to be considerable, but quantitative data are not available.

5.3 Weight at age

Weight-at-age data from both fisheries, the Spanish and the Portuguese, are presented in Table 5.6. The SOP discrepancy is very small for 1990.

5.4 Stocks Estimates

5.4.1 Acoustic Survey in 1991

Systematic acoustic surveys have been carried out in Spanish Atlantic waters since 1983, but these surveys did not reach the outer limit of the possible distribution area of blue whiting. In 1991 with the new Simrad EK 500 Echosounder, the area covered was extended to the 1000 m isobath and further if blue whiting was present.

The survey was carried out from 15 March to 12 April during the spawning season (Meixide *et al.*, 1991). Figure 5.1 shows the cruise tracks and fishing stations. The degree of coverage for the whole area had a value of 12 (Aglen, 1989).

For the estimations, the target strength (TS) was calculated. The results were similar to those used in the assessment of the Northern stock. For that reason, values adopted in previous blue whiting assessments were used in the calculations (Anon., 1982; Monstad, 1986).

The estimated biomass was 171 thousand tonnes, corresponding to 4862 million fish. Figure 5.2 shows the echo intensity distribution (m^2/n.mile^2). Blue whiting was widely distributed along the shelf edge in deep water. Biomass estimates by ICES rectangle are shown in Figure 5.3. The highest abundance was recorded in the western part of Division VIIIc, where the continental shelf is wider. Results of abundance and biomass estimation by geographic zones and depth strata are shown in Table 5.7. The highest densities were observed in depth range from 200 to 500 m. Table 5.8 shows the length and age compositions for the whole area. The more abundant age- groups were age 1 (41%) and age 2 (36%). Ages 1 to 4 represent 97% in number and 94% in weight.

It is not clear if the external limit of the blue whiting distribution was reached because noise problems in the integrator when working at more than 1000 m depth make it difficult to interpret the echograms. Blue whiting was not caught at such depths during the cruise. Thus, it seems unlikely that concentrations of this species were distributed beyond the limit of the area surveyed.

5.4.2 Bottom trawl surveys

Bottom trawl surveys have been conducted off both the Galician and Portuguese coasts since 1980 and 1979 respectively, following a stratified random sampling design and covering depths down to 500 m (Tables 5.9 and 5.10) The biomass indices from the Spanish surveys split by age were included as input for the tuning in the ICES VPA program (Table 5.13).

Figure 5.4 shows the distribution pattern found in the Spanish bottom trawl survey carried out in fall 1990 (Sanchez and Pereiro, 1990). In Division VIIIc, the pattern was similar to that observed during the acoustic survey; in Division IXa it was somewhat different because there were not enough bottom trawl stations close to the continental shelf edge where the blue whiting is mainly distributed.

Figure 5.5 shows the length and age distribution for both surveys: fall 1990 and spring 1991.

5.4.3 Catch per unit effort

Information on CPUE data are given taking the fishing hours estimated for this fishery as effort unit. Table 5.10 and Fig.5.6a show the evolution from 1978 to 1990 of the landings, effort as days fishing and CPUE as Kg/day for both vessels of the main Galician ports and Portuguese bottom trawl fishery. Tables 5.11.1-5.11.2 and Figure 5.6b also represent the evolution of CPUE in the main Galician ports split in single trawlers and pair trawlers since 1983.

A new series of CPUE data since 1983 from bottom trawlers in Division VIIIc was presented to the Working Group (Villamor and Pereda, 1991) and are shown in Tables 5.12A and 5.12.B. In this case, effort was calculated as:

$$HP * \text{fishing days} * 10^{-2}$$

Table 5.12A shows the evolution on the number of fishing trips, effort, number of boats, horse power (HP) and the mean horse power by boat since 1983. Table 5.12B shows the evolution of blue whiting CPUE for the same years.

Contrary to the Index Abundance of both Spanish and Portuguese bottom trawl surveys, CPUE increased for all the fleets (Figure 5.6A,B).

About 50% of the total landings in the Southern area made by pair trawlers in a directed fishery, without any discarding; therefore, CPUE data from this fishery might give a more representative index of abundance. Discarding in the bottom-trawl fishery is also assumed to be negligible.

5.4.4 Virtual Population Analysis (VPA)

5.4.4.1 Tuning the VPA

The Laurec-Shepherd tuning method was applied to provide an estimate of the level of fishing mortality. The tuning data used last year are described in Anon. (1991a) and consisted in two fleets: the survey indices from the Spanish bottom-trawl survey and CPUE data from the Spanish pair-trawl fleet. This year, CPUE data from bottom trawlers in Division VIIIc were also available, as described in Section 5.4.3; these data were converted to age groups using Spanish age/length keys for each year (Table 5.13).

The Extended Survivors Analysis Method (XSA) was applied as described in Section 4.6.3.1. The results from this analysis are shown in Table 5.14 and summarized in the text table below in terms of percentages of the log population residuals (LPR).

Fleet	LPR			
	<0.3	0.3-0.5	0.5-1.0	>1.0
CPUE VIIIc	40.6	26.6	28.1	4.7
CPUE Pair T.	29.7	17.2	28.1	25.0
Bottom survey	17.9	3.6	26.8	51.8

From this table it appears that the Bottom fleet data are "very bad", while the other two fleets perform better.

After having discussed these results, using the same criteria as for Northern Stock, the Working Group decided to leave out the Spanish bottom trawl survey fleet. The results of the tuning log catchability for each age and fleet are presented in Table 5.15. Figure 5.7 presents the log catchability plots. The results of the VPA run based on the tuning are shown in Table 5.16. The mean fishing mortality was calculated for ages 1 to 4 and was estimated to have a value of 0.403 in 1990. Table 5.17 shows the stocks size estimates from this VPA.

5.4.4.2 Estimation of fishing mortality using separable VPA

A separable VPA based on the tuning results was run with a terminal F of 0.59 at age 4 and terminal S of 1.5, to reach the average F for ages 1 to 4 provided by the tuning. Figure 5.8 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 5.18). The fishing mortalities and stock sizes estimated in the VPA based on these results are shown in Tables 5.19 and 5.20 and Figures 5.9A and 5.9B.

5.4.4.3 Discussion of the stock size estimates from VPA

Th VPA results show that the spawning stock seems to be very stable, with the lowest level in 1984. The recruitment is in agreement with the one in last year's assessment from 1981 to 1988 except for 1986 and 1987 and in agreement with the values predicted last year for 1989, using the RCRTINX2 program.

5.4.4.4 Recruitment

Numbers at age 0 estimated by the final VPA were regressed against the 0-group indices from Spanish bottom trawl surveys carried out in September/October from 1981 to 1990. 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 5.21. For 1989, the predicted recruitment is at the same level as that provided by the final VPA, and so no changes were made. The predicted value for 1990 was used to calculate the surviving population at age 1 used in the prediction calculations.

5.4.4.5 Yield-per-recruit catch forecasts

Terminal populations from the final VPA (corrected for age 1 with the surviving populations of the predicted 1990 recruitment) and separable fishing mortalities were used for the catch forecast (Table 5.22). An arithmetic mean of the recruitment in the period 1981-1989 (1171 million) was assumed for the years 1991-1993. The yield-per-recruit calculations estimated $F_{0.1} = 0.12$ and $F_{max} = 0.84$. The fishing mortality in 1990 was 0.403.

The catch forecast assuming continued *status quo* fishing mortality predicts catches of 28,000 t in 1991 and 31,000 t in 1992. The SSB is predicted to increase to 42,000 t in 1991. The results of the projection are given in Figure 5.9D and Tables 5.23 and 5.24. At fishing mortality less than or equal to the *status quo* level, the SSB will continue to increase.

5.4.5 Safe biological limits and management considerations

F_{med} and F_{high} are shown in Figure 5.10; these were obtained by plotting spawning stock biomass against recruitment, both from the final VPA, for the period 1981-1989. No evidence of any stock/recruitment relationship could be observed, and the stock seems to be stable. With fishing at level of F_{med} in 1992, the SSB in 1993 remains at the level of 1991 (Table 5.23).

An acoustic survey was carried out in spring 1991 in ICES Divisions VIIIc and IXa. This acoustic assessment demonstrates that 80% of the blue whiting is distributed between 100 m and 500 m.

Stock separation is not based on strong biological arguments. Uncertainties in stock definition are of course a problem, but for both Southern and Northern stocks, the assessment could change if blue whiting in the Northern area consist of two populations or if the blue whiting in the Porcupine Bank area belongs to the Southern stock as has been suggested (Anon., 1989). The Working Group recommended that further investigations be undertaken before any new decision about it is made. In this situation to split the catches is problematic but the Working Group decided to include the directed fishery in Divisions VIIg-k since 1984 in the assessment of the Northern stock.

Landings used in the assessment of the Southern stock only included Divisions VIIIc and IXa because the available information provided by official statistics and Working Group members indicates that landings from Divisions VIId,e and VIIIa,b are negligible. Countries fishing in those areas should be requested to present data on landings and/or discards.

Spanish landings represent 75-90% of the reported total landings in the Southern area. About 50% of these landings are taken by pair trawlers in a directed blue whiting fishery, without any significant discarding. The other 50% is fished as a by-catch in the bottom trawler fishery where the discards have decreased during recent

years, with the increase in the economic value of the fish, and are assumed to be negligible.

The Portuguese landings (10 to 25% of the total reported landings) are taken as a by-catch by bottom trawlers. The discarding in this fishery is assumed to be considerable, but quantitative data are not available.

There has been a footnote in the Working Group reports since 1986 in the table of landings of the Spanish fishery in Divisions VIIg-k: "Significant quantities taken in Divisions VIIg-k not included in the table are discarded every year". This sentence was not based on data, and was probably included to show the lack of information on discards. Recent information collected by observers on the Spanish vessels shows that blue whiting discards are not important in this area. These discards do not affect the assessment of the Southern stock, because catches in this area have been alloated to the Northern stock since 1984. Hence the footnote is deleted in the present report.

As a conclusion we can say that the mainproblem to assess the so-called Southern stock seems to be the stock definition. It is not clear if there is a separate stock or if it is a nursery area that recruits to the Porcupine Bank spawning area. Investigations on larval drift could be useful because the scheme of surface current (Zilanov, 1984) shows that this northward drift is likely. Also, the lack of acoustic surveys covering the whole distribution area of the stock makes it difficult to assess this stock.

The predicted catch for 1990 given in last year's report (34,000 t) is, however, close to the Spanish and Portuguese landings (32,800 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 second Norwegian-Soviet acoustic survey conducted in 1991 confirmed that during spring time the distribution of the blue whiting spawning stock is mainly in the EC zone (Table 6.1). Only 18.2% of the blue whiting stock was observed within Norwegian, Faroese and International zones. During the summer period, only insignificant observations were made of the blue whiting distribution in the Norwegian Sea. It was, therefore, impossible to describe the distribution of the stock in the feeding areas in 1991.

Total catches of blue whiting in 1978-1990 divided into areas and beyond areas of national fisheries jurisdiction of NEAFC are presented in the Table 6.2.

7 DISTRIBUTION IN TIME AND SPACE OF THE BLUE WHITING STOCK

The observations carried out during 1991 have provided information concerning the distribution of the blue whiting in time and space which was not known previously or updated in last year's report (Anon., 1991a).

The Northern blue whiting stock has an extremely large distribution area, especially during the feeding season, and the investigations of population and age structure are consequently extremely costly due to expensive marine surveys. Those costs would be a considerable burden for any particular single country. Gaining essential new information would be possible if more effort in joint investigations is applied by all countries taking part in the fishery, with ICES in the coordinating role.

An update of results concerning distribution of blue whiting in the spawning and nursery areas is presented below.

7.1 Spawning area

The distribution of concentrations of blue whiting within the spawning areas is largely determined by the position of the Eastern Boundary Slope Current.

In this area two general water masses can be distinguished; low salinity Irish coastal water separated by a saline front from the oceanic waters further offshore. In 1988-1989, the distribution of blue whiting was further west than usual, but in 1990-1991 the main concentrations were located nearer the shelf (Monstad and Belikov 1990 and 1991). This difference in the distribution pattern may be due to changes in the hydrographical situation at depth, with warmer water than usual along the Irish coast.

The maturation of the blue whiting gonads was found to be retarded in 1991 compared to previous years, and the peak of spawning was observed to be 1-2 weeks later than last year (Monstad and Belikov, 1991).

7.2 Nursery area

In the period 18 April - 4 May 1991, a Soviet-Irish ichtyoplankton survey was conducted in the area west and northwest of the British Isles (Belikov *et al.*, 1991). The survey comprised 67 stations carried out between latitudes 51°00' and 60°00'N (Figure 7.1). Blue whiting larvae were present at 28 stations. The larval distribution is similar to that obtained from surveys conducted in the same area prior to 1991. The main concentrations of larvae were collected between latitudes 51°00'-54°00'N and 11°00'-13°00'W. Larvae were also taken from around the Porcupine Bank and from deep waters. The majority of the larvae (50.9%) were between

3.1-5.0 mm long with a mean length of 4.6 mm. Total numbers this year were almost twice that of 1990 but the area surveyed this year was approximately 30% larger, which is perhaps the reason for the scale of the difference.

The results of the international 0-group fish survey in the Barents Sea and adjacent waters in August-September 1991 have shown that 0-group of blue whiting were absent (Anon., 1991b).

8 RECOMMENDATIONS

1. The Working Group recommends the continuation of the joint Soviet-Norwegian survey aimed at assessing the blue whiting stock biomass in the spawning area during spring.

2. The Working Group Recommends the continuation of acoustic surveys in the Norwegian Sea in the feeding period on a national basis. In 1991 only one country conducted survey in this period. Due to the problems about defining the distribution of in particular the younger year classes during this period of the year, more effort should be put into this work.

3. The Working Group recommends observations of the state of water masses in the spawning and feeding areas for both the Northern and Southern stocks of blue whiting be carried out during the acoustic surveys. A detailed analysis of water dynamics in relation to the blue whiting distribution and migration behaviour is required. This could increase the general understanding of the stocks' biology, especially the spawning migrating pattern and stock separation problems.

4. To avoid serious biases in the data set for the stock analyses, it is strongly recommended that the countries participating in the fishery of blue whiting frequently sample the catch and provide biological data as well as catch data to the Working Group. This goes especially for the mixed industrial fishery, as a very high number of the youngest year classes are taken in this fishery.

5. 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 should be undertaken to investigate the total distribution area for the Southern stock.

6. The Working Group recommends a workshop dealing with problems concerning spatial distribution, stock units and otolith readings for blue whiting. The problems encountered last year in relation to the tuning of the VPA to data from acoustic surveys and CPUE data has brought the Working Group to the opinion that the following problems have to be looked more carefully into during a workshop:

   - the existence of a Hebridean and a Porcupine stock of blue whiting, the connection to the Southern stock and the possibility of assessing these stocks;

   - the possibility of assessing the Northern stock as a combination of the assessment of the stock in the feeding area and the stock in the spawning area;

   - the further consideration of age-reading problems.

   The workshop is proposed for one week and should take place at the end of 1992 at ICES Headquarters with Jan Arge Jacobsen, Faroes, as Chairman.

7. The Working Group recommends that all of the countries participating in fisheries in Divisions VIId,e and VIIIa,b provide information on landings and, where possible, discards of blue whiting.

8. The Working Group recommends that the members from countries involved in 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 can be used in further VPA tuning trials in a disaggregated form.

9 RE-ARRANGEMENT OF ICES WORKING GROUPS

Comments from the Blue Whiting Assessment Working Group:

In the proposal for the re-arrangement of assessment working groups, ACFM suggested that the Blue Whiting Assessment Working Group as a long-term objective should be integrated into a new Mackerel, Horse Mackerel, Sardine and Anchovy Working Group.

The Working Group discussed the proposal taking into account the biology, the fishery and the logistical problems of the various stocks. The number of participants and stocks in such a combined Working Group may make full plenary discussions difficult. It is important to ensure that all members of the group feel responsible for all of the assessments.

The Working Group finds that similarities between sardine and anchovy on the one hand and blue whiting on

the other is not obvious. Sardine and anchovy are short living species, and one is, therefore, dealing with other problems than for blue whiting. These problems could be solved better in a working group with other short living species.

Combining the mackerel, horse mackerel and blue whiting assessments into one Working Group could be a possibility, although some of the methods used in the assessment of mackerel and horse mackerel and of blue whiting are different. There is also little overlap in the fisheries.

The Working Group concludes that the best solution is to combine the proposed Herring Assessment Working Group with the existing Blue Whiting Assessment Working Group. It is found that the methods used in the assessments for these stocks are similar. The Group believes that this will allow the possibility of using the assessment methods of the Herring Assessment Working Group for the Area South of 62°N for the blue whiting stock also. If this combined group should become too large, two groups, one for Herring South of 62°N and one for the Atlanto-Scandian Herring and Blue Whiting could be considered.

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Table 4.1 Landings (tonnes) of BLUE WHITING from the main fisheries, 1981-1990, as estimated by the Working Group.

Area	1981	1982	1983	1984	1985
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	520 738	110 685	52 963	65 932[2]	90 742
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	288 316	316 566	361 537	421 865[2]	464 256[2]
Icelandic industrial fishery (Division Va)	-		7 000		-
Industrial mixed fishery (Division IVa-c, Vb, IIIa)	61 754	117 578	117 737	122 806	97 769
Subtotal northern fishery	870 808	544 829	539 237	610 603	652 776
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k	38 748	31 590	30 835	31 173[3]	42 820[3]
Total	909 556	576 419	570 072	645 776	695 596

Area	1986	1987	1988	1989	1990[1]
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	160 061	123 042	55 829	37 638	2 106
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIIc)	534 236[2]	445 884[2]	421 636	473 165	463 495
Icelandic industrial fishery (Division Va)	-	-	-	4 977	-
Industrial mixed fishery (Divisions IVa-c, Vb, IIIa	99 580	62 689	45 110	75 958	63 192
Subtotal northern fishery	793 904	631 615	522 575	591 738	528 793
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k)	33 082[3]	32 819[3]	30 838	33 712	32 817
Total	826 986	664 434	553 413	625 450	561 610

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, 1981-1990, as estimated by the Working Group.

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

Country	1986	1987	1988	1989	1990[1]
Denmark	-	-	-	-	-
Faroes	-	9,290	-	1,047	-
France	-	-	-	-	-
German Dem. Rep.	3,541	1,010	3	1,341	-
Germany, Fed. Rep.[2]	106	-	-	-	-
Greenland	10	-	-	-	-
Iceland	-	-	-	-	-
Norway	-	-	-	-	566
Poland	-	56	10	-	-
UK (Engl. & Wales)	-	-	-	-	-
USSR	156,404	112,686	55,816	35,250	1 540
Total	160,061	123,042	55,829	37,638	2 106

[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), 1981-1990, as estimated by the Working Group.

Country	1981	1982	1983	1984	1985
Denmark	11,361	23,164	28,680	26,445	21,104
Faroes	23,107	38,958	56,168	62,264	72,316
France	-	1,212	3,600	3,882	-
German Dem. Rep.	6,562	7,771	3,284	1,171	6,839
Germany, Fed. Rep.	935	701	825	994	626
Iceland	10,213	1,689	1,176	-	-
Ireland	-	-	-	-	668
Netherlands	222	200	150	1,000	1,801
Norway	166,168	169,700	185,646	211,773	234,137
Poland	2,279	-	-	-	-
Spain	-	-	318	-	-
UK (Engl. & Wales)	6,000	-	-	33	2
UK (Scotland)	2,611	-	-	-	-
USSR	58,858	73,171	81,690	114,303	126,772
Total	288,316	316,566	361,537	421,865	464,265

Country	1986	1987	1988	1989	1990[1]
Denmark	11,364	2,655	797	25	-
Faroes	80,564	70,625	79,339	70,711	43 405
France	-	-	-	2,190	-
German Dem. Rep.	2,750	3,584	4,663	3,225	230
Germany, Fed. Rep.	-	266	600	848	1 469
Iceland	-	-	-	-	-
Ireland	16,440	3,300	245	-	-
Netherlands	8,888	5,627	800	2,078	7 280
Norway	283,162[2]	191,012	208,416	258,386	281 036[2]
Poland	-	-	-	-	-
Spain	-	-	-	-	-
Sweden	-	-	-	-	-
UK (Engl. & Wales)	10	5	3	1,557	13
UK (Scotland)	3,472	3,310	5,068	6,463	5 993
USSR	127,613[3]	165,497	121,705	127,682	124 069
Total	534,263	445,884	421,636	473,165	463 495

[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, 1981-1990, as estimated by the Working Group.

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

Country	1986	1987	1988	1989	1990
Denmark	57,315	28,541	18,114	26,605	27,052
Faroes	5,678	7,051	492	3,325	5,281
France	-	-	-	-	-
German Dem. Rep.[2]	-	53	-	-	-
Germany, Fed. Rep.[2]	-	62	280	3	-
Ireland	-	-	-	-	-
Netherlands	1,114	-	-	-	20
Norway	26,941	24,969	24,898	42,956	29 336[3]
Poland[2]	-	-	-	-	-
Sweden[4]	8,532	2,013	1,226	3,062	1 503
UK (Engl. & Wales)[2]	-	-	-	7	-
UK (Scotland)	-	-	100	-	-
Total	99,580	62,689	45,110	75,958	63 192

[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 1991 based on information from Working Group members.

Country	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
USSR	IIa	-	-	77	-	-	1	28292	13634	42 489
	Vb	1698	174	1	11027	35679	4162	11338	15354	79 433
	VIb	-	-	308	500	-	-	-	-	808
	VIIb,c	-	-	120	-	-	-	-	-	120
	VIIg-k	-	1	3529	-	-	-	-	-	3 530
	VIII	-	-	236	-	-	-	-	-	236
	XII	-	225	7918	474	-	-	-	-	8 617
									Sum	135 433
Faroe Islands	IVa	34	166	-	-	-	-	39	-	239
	Vb	-	-	-	-	2731	336	-	-	3 067
	VIa	-	1709	-	-	-	-	-	-	1 709
	VIIc	-	53	-	-	-	-	-	-	53
	VIIk	-	-	-	-	552	102	-	-	654
									Sum	5 722
Denmark	IIIa	310	1008	1035	613	-	-	-	-	2 966
	IVa	22	-	-	-	-	-	-	-	22
	IVb	-	-	-	-	404	-	-	-	404
									Sum	3 392
Norway	IIa	-	-	-	-	100	-	-		100
	IVa	2005	166	903	2988	18652	8943	650		34 307
	Vb	-	-	-	-	495	-	-		495
	Va	-	-	1049	57929	4745	-	-		63 723
	VIIb,c	-	4263	28260	3913	-	-	-		36 436
	VIIg-k		782	532	-	-	-	-		1 314
									Sum	136 375
GSR	Vb									240
									Grand total	281 162

Table 4.6.1 Length distribution (%) of BLUE WHITING for the USSR directed fishery in 1990.

Length cm	DIVISIONS IIa	Vb_1	VIIbc	VIIg-k
17	0.3	1.1	-	-
18	1.5	1.5	-	1.0
19	3.9	3.4	0.3	0.7
20	4.0	10.5	1.0	0.3
21	6.4	11.6	1.3	1.5
22	2.7	12.2	2.3	2.0
23	2.8	11.3	4.0	2.8
24	2.1	4.5	4.0	6.3
25	1.5	1.9	3.0	7.0
26	2.2	4.1	4.3	7.7
27	6.7	9.8	6.7	4.5
28	7.9	4.9	12.0	7.8
29	11.6	3.4	13.5	8.8
30	12.6	3.4	13.3	13.1
31	12.5	4.1	11.0	8.8
32	7.3	1.1	7.7	6.8
33	6.1	2.6	4.3	6.5
34	4.7	3.0	4.3	5.2
35	2.1	1.1	3.3	3.2
36	0.6	1.9	0.7	3.3
37	0.1	1.1	1.0	1.5
38	0.1.	1.1	0.7	0.8
39	0.3	-	1.0	0.2
40	-	-	-	0.2
41	-	-	0.3	-
42	-	-	-	-
43	-	-	-	-
44	-	0.4	-	-
Number sp.N	673	266	300	600
Mean length	28.1	25.1	29.2	29.1

Table 4.6.2 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
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	16.1	14.1	13.9	8.1	7.4	7.7	7.6	15.5
30	16.3	12.5	11.4	12.3	7.1	15.1	14.1	21.0
31	9.2	11.9	10.6	12.2	8.7	16.2	12.0	11.9
32	5.1	9.3	11.3	21.0	14.4	13.8	13.2	7.0
33	2.6	5.0	6.5	8.9	13.0	9.0	13.8	5.7
34	2.8	2.4	3.8	6.9	9.2	6.4	5.8	6.8
35	1.0	1.5	2.5	3.2	7.3	2.8	2.4	4.0
36	0.2	0.3	2.7	1.2	2.6	1.4	3.3	2.0
37		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	
N	453	585	478	476	222	777	331	243

Table 4.6.3 Length distribution (%) of BLUE WHITING for the Netherlands fishery in 1990.

Length cm	VIIj-k Qua.1 %	IVa Qua.2 %	VIa Qua.2 %	VIIb,c Qua.2 %
18		0.5		
19	0.5	0.5	0.1	0.3
20	3.1	3.1		0.4
21	6.8	7.8	0.1	1.1
22	6.8	5.7	1.3	3.1
23	9.9	1.0	1.7	5.0
24	7.3	1.0	4.0	7.7
25	3.7	19.9	15.6	9.4
26	5.8	17.7	13.3	10.2
27	9.9	24.0	13.8	16.3
28	9.9	9.9	13.1	13.0
29	9.4	7.8	13.6	11.0
30	7.9	3.6	10.5	8.1
31	5.2	2.6	6.0	6.1
32	3.1	2.6	6.0	3.3
33	3.1	1.6	6.4	2.8
34	2.6	0.5	2.0	1.2
35	3.7		1.1	0.7
36	0.5		0.4	0.3
37	0.5		0.4	0.2
38			0.4	
39			0.4	
N	191	192	393	1243

Table 4.6.4 Length distribution (%) of BLUE WHITING from the Netherlands fishery, spring 1991

Length cm	VIIb,c Qua.1	VIIb,c Qua.2	VIIb,c Qua.2	VIIb,c Qua.2	VIa Qua.2
20				1	
21			2	1	
22		1	1	3	
23			4	5	
24		1		4	
25			1	6	
26			5	5	
27		4	17	25	
28	4	13	22	25	2
29	7	15	25	30	
30	24	26	26	19	2
31	12	22	15	16	5
32	19	14	14	12	1
33	17	28	8	11	11
34	16	10	8	5	9
35	9	8	5	5	6
36	6	2	2	5	16
37	3	2		1	15
38	2		3		7
39			1		2
40					1
41					1
N	119	147	159	179	78

Table 4.6.5 Length distribution (%) of BLUE WHITING from the Faroes fishery in 1990.

Length cm	May Vb %	June Vb %
18		0.45
19		0.91
20		0.45
21		
22		
23	0.58	0.45
24		0.91
25	1.16	1.36
26	6.36	9.09
27	15.61	16.36
28	15.03	17.27
29	12.72	17.73
30	10.98	14.09
31	10.98	5.91
32	4.62	7.73
33	5.20	3.18
34	6.94	2.27
35	4.05	0.91
36	4.05	0.45
37	1.16	
38		0.45
39	0.58	
N samples	173	220

Table 4.6.6 Preliminary length distribution (%) of BLUE WHITING from USSR (January-June) in 1991.

Length cm	DIVISIONS						
	IIa	IVa	Vb_1	VIa	VIb	VIIb,c	VIIg-k
19	-	-	-	0.3	1.0	1.0	-
20	-	-	-	0.8	10.0	3.0	2.3
21	4.0	-	-	2.3	9.0	5.0	4.9
22	28.0	-	2.0	3.4	25.0	2.0	2.3
23	44.0	3.0	1.0	7.1	29.0	2.0	2.3
24	18.0	20.0	13.0	19.7	14.0	2.5	2.0
25	4.0	36.0	33.0	15.0	7.0	3.5	4.1
26	-	26.0	31.0	9.4	3.0	2.0	2.6
27	2.0	5.0	9.0	4.3	-	5.5	4.4
28	-	4.0	3.0	3.4	-	9.5	8.1
29	-	-	5.0	5.1	1.0	12.0	12.5
30	-	1.0	2.0	0.4	1.0	16.5	16.6
31	-	2.0	1.0	5.1	-	10.5	11.0
32	-	-	-	4.0	-	7.5	11.6
33	-	-	-	4.0	-	7.0	5.2
34	-	1.0	-	3.4	-	3.5	4.4
35	-	-	-	2.0	-	1.5	2.3
36	-	-	-	0.3	-	3.0	1.7
37	-	1.0	-	0.6	-	-	0.6
38	-	1.0	-	0.6	-	1.0	-
39	-	-	-	0.3	-	0.5	0.3
40	-	-	-	0.6	-	0.5	0.3
41	-	-	-	-	-	0.5	-
42	-	-	-	-	-	-	0.3
Number sp.N	50	100	100	350	100	200	354
Mean length	22.9	25.7	25.8	27.0	22.7	29.0	29.2

Table 4.6.7A Preliminary length distribution (%) of blue whiting by month and division for the Norwegian mixed fishery 1991.

Length cm	Jan IIa	Jan IVa	Febr IVa	May IVa	Jun IVa	Aug IVa	Sept IVa
14							6.1
15							28.0
16							31.8
17							9.8
18							
19							
20							
21		2.7	4.2				
22	22.0	13.7	16.8		0.8		
23	46.0	49.3	37.9	11.0	8.7		
24	28.0	19.2	32.6	38.0	32.5		
25	4.0	11.0	8.5	37.0	35.7		2.4
26		2.7		14.0	17.5	30.0	3.7
27					3.2	12.0	6.1
28						22.0	7.3
29		1.4			0.8		1.2
30						22.0	
31					0.8	6.0	
32						8.0	2.4
33							
34							
35							1.2
N	50	73	95	100	126	50	82
$\bar{l}$	23.6	23.9	23.7	25.0	25.3	28.7	19.1

Table 4.6.7B Preliminary length distribution (%) of blue whiting by month and division for the Norwegian directed fishery in 1991.

Length cm	Jan IIa	May IIa	Apr IVa	May IVa	May Vb	Maroh VIa	April VIa	Febr VIIbc	Maroh VIIbc	April VIIbc
20										
21										
22										
23	71.9		1.4							
24	22.8		4.3							
25	3.5	12.6	17.1	16.1			2.2		0.1	0.8
26		16.8	20.0	16.9		1.8	1.3	4.0	0.1	1.3
27		15.1	10.0	12.1	5.3	8.0	6.2	8.0	5.2	2.5
28	1.8	2.5	1.4	3.2	7.9	7.1	7.3	6.0	9.6	14.6
29		8.4	8.6	8.9	5.3	11.5	12.4	6.0	12.4	13.8
30		8.4	11.4	7.3	18.4	17.7	12.3	16.0	17.3	17.1
31		14.3	12.9	12.1	21.1	19.5	16.4	12.0	19.3	22.1
32		16.8	4.3	16.1	15.8	8.8	19.2	12.0	8.3	7.8
33		0.8	2.9	3.2	2.6	10.6	11.3	8.0	9.7	10.6
34		1.7	5.7	1.6	13.2	8.0	7.9	8.0	7.1	4.6
35		2.5		2.4	10.5	7.1	3.3	12.0	5.5	4.8
36							0.3	4.0	5.4	
37								2.0		
38								2.0		
N	57	119	70	124	114	113	421	50	400	224
$\bar{l}$	23.9	29.3	28.6	29.2	31.8	35.5	32.3	32.0	31.6	22.1

Table 4.6.8 Preliminary length distribution (%) of blue whiting by quarter from the Netherlands fishery 1991.

Length cm	VIIb,c Qua.1	VIIb,c Qua.2	VIa Qua.2
20		0.2	
21		0.6	
22		1.0	
23		1.9	
24		1.0	
25		1.4	
26		2.1	
27		9.5	
28	3.4	12.4	2.6
29	5.9	14.4	0.0
30	20.2	14.6	2.6
31	10.1	10.9	6.4
32	16.0	8.2	1.3
33	14.3	9.7	14.1
34	13.4	4.7	11.5
35	7.6	3.7	7.7
36	5.0	1.9	20.5
37	2.5	0.6	19.2
38	1.7	0.6	9.0
39		0.2	2.6
40			1.3
41			1.3
N	119.0	485.0	78.0

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), 1981 - 1990.

Age	1981	1982	1983	1984	1985
0	-	1.2	2.5	63.6	871.4
1	4.0	1.7	290.4	417.6	127.4
2	40.1	48.6	239.1	1,394.1	1,341.6
3	322.8	123.1	164.1	277.9	1,588.1
4	225.3	371.0	194.1	211.9	199.3
5	501.5	212.6	411.4	259.2	161.0
6	539.0	251.0	284.4	420.2	303.7
7	448.5	250.7	274.0	253.1	248.7
8	618.3	259.3	283.5	190.3	167.2
9	573.2	278.7	219.9	151.6	91.7
10	718.3	259.8	152.6	113.8	87.8
11	343.6	158.5	71.5	57.7	73.1
12+	386.6	247.6	92.5	79.8	94.5
Total	4,721.2	2,464.1	2,680.0	3,890.9	5,355.3
Tonnes	809,054	427,341	416,730	481,872	554,640

Age	1986	1987	1988	1989	1990[1]
0	51.9	9.1	3.6	36.5	8.4
1	161.9	280.8	93.2	86.4	537.8
2	263.3	361.0	403.2	359.4	353.1
3	1,559.5	580.2	416.2	1,176.7	565.7
4	1,464.3	1,780.2	611.2	696.2	709.1
5	298.7	680.3	1,238.9	785.7	489.2
6	156.4	118.2	584.9	680.7	562.1
7	192.2	94.9	77.8	127.2	291.7
8	185.8	117.1	50.7	44.8	75.5
9	166.4	99.7	32.4	23.8	26.6
10	172.1	48.3	28.3	15.2	15.5
11	108.7	60.1	8.8	8.9	42.9
12+	105.7	86.6	11.8	12.9	33.4
Total	4,886.9	4,316.5	3,571.0	4,054.4	3,711.0
Tonnes	694,314	571,659	477,552	521,415	465,601

[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) 1981 - 1990.

Age	1981	1982	1983	1984	1985
0	-	3,450.1	336.3	446.4	184.3
1	65.1	45.3	1,844.2	1,650.8	891.4
2	81.4	41.3	90.0	587.7	365.0
3	191.9	80.9	38.4	49.7	173.8
4	58.4	112.8	47.7	12.8	37.4
5	20.1	29.2	55.6	12.6	13.4
6	16.7	21.6	12.2	10.4	13.9
7	17.8	14.8	12.8	6.1	5.8
8	15.7	12.0	2.6	2.2	5.6
9	4.4	5.2	5.8	2.7	1.8
10	4.9	1.8	4.2	2.6	3.0
11	3.6	-	9.6	0.9	1.4
12+	3.0	3.6	4.2	0.7	0.3
Total	483.0	3,816.6	2,463.6	2,785.5	1,697.0
Tonnes	61,754	117,578	124,737	122,806	97,769

Age	1986	1987	1988	1989	1990[1]
0	-	226.8	12.3	1,871.6	0.5
1	395.0	174.5	185.1	578.9	874.8
2	334.7	105.7	84.3	183.7	167.6
3	134.6	85.4	83.4	70.0	49.5
4	184.4	88.9	40.2	33.5	11.8
5	79.7	32.8	44.0	24.1	7.0
6	24.3	15.6	24.0	12.2	3.8
7	7.3	9.2	3.3	5.9	4.9
8	11.0	5.1	2.1	2.1	0.6
9	7.3	3.8	1.0	0.8	0.4
10	3.9	0.2	0.2	0.3	-
11	3.8	-	-	0.4	-
12+	3.5	-	-	0.3	-
Total	1,189.4	748.0	479.9	2,783.8	1,120.9
Tonnes	99,580	59,952	45,110	75,978	63,195

[1] Preliminary.

Table 4.9 SUM OF PRODUCTS CHECK

Blue Whiting in the Northern Area
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: millions

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	0	3451	339	510	1056	52	236	16	1908	9
1	69	45	2133	2068	1019	557	455	278	664	1413
2	122	90	328	1982	1707	598	467	488	541	521
3	515	204	202	328	1762	1694	666	500	1238	615
4	284	484	241	225	237	1649	1869	651	725	728
5	522	242	465	272	174	378	713	1293	804	496
6	556	273	295	431	318	181	134	609	688	566
7	466	266	285	259	254	200	104	81	132	297
8	634	271	285	192	173	197	122	53	47	76
9	578	284	225	154	93	174	103	33	25	27
10	723	262	156	116	91	176	48	28	14	16
11	347	159	81	59	74	113	60	9	9	43
12	234	136	49	50	52	67	42	9	11	33
13	75	42	26	15	21	26	21	2	1	0
14	50	46	12	8	12	8	11	1	1	0
15+	31	28	10	7	9	8	13	1	1	0
TOTAL	5206	6281	5132	6676	7052	6078	5064	4052	6809	4840

1983 avg.
1982 avg.

Table 4.10 SUM OF PRODUCTS CHECK

Blue Whiting in the Northern Area
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: kilogram

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	.027	.018	.018	.027	.014	.033	.020	.024	.014	.024
1	.063	.046	.046	.036	.038	.040	.056	.061	.065	.045
2	.092	.094	.094	.086	.080	.081	.092	.087	.089	.075
3	.118	.136	.136	.104	.102	.113	.109	.107	.106	.109
4	.135	.152	.152	.142	.129	.132	.125	.131	.130	.124
5	.145	.162	.162	.157	.164	.168	.148	.142	.150	.150
6	.155	.178	.178	.164	.178	.202	.178	.158	.159	.169
7	.170	.195	.195	.176	.200	.209	.209	.181	.174	.175
8	.178	.200	.200	.189	.208	.243	.221	.199	.206	.215
9	.187	.204	.204	.186	.218	.246	.222	.222	.224	.217
10	.199	.213	.213	.197	.225	.242	.251	.241	.225	.254
11	.208	.234	.234	.202	.233	.255	.249	.276	.222	.234
12	.228	.228	.228	.194	.233	.260	.252	.232	.246	.323
13	.234	.258	.258	.225	.243	.272	.274	.263	.295	.000
14	.249	.242	.242	.223	.251	.302	.242	.429	.390	.000
15+	.257	.258	.258	.242	.279	.305	.266	.229	.279	.000

Table 4.11.1. Catch per unit hour in the directed fisheries 1982-1990 (fishing gear - mid-water trawl). GRT-classes 1-5 are given at bottom of the table.

GRT class	Country	Time period	1982	1983	1984	1985	1986	1987	1988	1989	1990
Division IIa - t/hour											
3	USSR	Apr-Oct	-	0.87	-	1.86	1.63	2.47	-	2.29	1.50
3	German Dem.rep.	Jul-Sep	-	-	-	-	-	-	0.82	0.83	-
4	German Dem.Rep.	May-Jun	1.00	2.35	1.40	2.57	5.40	1.63	-	-	-
		Jul-Sep	1.21	1.10	2.57	2.29	2.30	0.80	-	1.34	-
		Oct-Dec	2.25	2.70	-	1.22	2.70	0.94	-	-	-
	USSR	Feb	-	-	-	-	3.58	2.21	0.73	-	-
		Mar-Apr	1.84	-	7.80	0.87	4.12	3.54	3.55	1.96	4.88
		May-Jun	1.35	1.73	3.06	2.48	3.08	2.34	2.57	-	1.94
		Jul-Sep	2.85	0.60	2.85	3.16	2.27	2.28	2.02	2.48	1.96
		Oct-Dec	2.99	-	-	-	1.42	1.90	2.12	-	-
5	USSR	Jan-Sep	-	-	-	-	5.43	2.51	-	-	-
Division IVa - t/hour											
1	Norway	Apr-May	17.39	16.51	8.68	-	2.18	-	18.40	-	-
2	Norway	Apr-May	13.75	18.31	7.01	15.70	-	7.91	7.64	5.03	-
		Nov	-	-	4.50[1]	-	-	-	-	-	-
3	Norway	Mar	-	-	-	-	-	7.93	-	-	-
		Apr-May	15.03	21.19	-	17.26	-	5.27	17.86	9.39	-
Division Vb - t/hour											
1	Norway	Jan	-	-	-	-	11.86	-	-	-	-
		Apr-May	4.88	-	12.40	16.19	13.43	-	10.47	-	-
		Nov-Dec	-	-	25.08	12.55	-	-	-	-	-
2	Norway	May	-	-	-	-	-	-	-	-	8.77
3	German Dem.Rep	Jan-Mar	-	-	-	-	-	1.47	-	-	-
		Dec	-	-	-	-	-	1.13	-	-	-
	Norway	Apr-May	-	-	-	24.85	-	13.96	16.47	6.37	15.55
		Jun	-	-	-	-	-	-	-	-	20.24
	USSR	Apr-Jun	-	0.38	-	7.05	-	-	-	3.91	2.91
		Jul-Dec	-	-	-	-	-	-	-	-	1.80
4	German Dem.Rep.	Jan-May	2.12	2.08	-	3.50	1.40	0.18	-	-	-
		Jun-Jul	-	-	-	3.58	2.50	1.86	1.52	0.89	-
		Aug	-	-	-	-	2.10	0.97	2.58	-	-
		Sep-Oct	-	-	-	-	-	0.64	-	1.28	-
		Nov-Dec	-	-	2.20	1.58	-	-	-	-	-
	USSR	Jan-Feb	5.16	3.05	1.74	3.71	3.12	2.37	2.15	-	3.91
		Mar-May	4.58	4.12	4.57	4.99	5.22	4.87	4.75	6.01	3.99
		Jun-Aug	3.03	3.16	4.29	5.33	5.41	5.45	2.36	3.51	3.87
		Sep-Dec	-	2.77	3.70	-	3.27	2.06	3.65	-	3.47
5	USSR	Feb-Oct	-	-	-	-	7.50	3.20	5.67	-	5.41

(cont'd.)

Table 4.11.1 (cont'd)

GRT class	Country	Time period	1982	1983	1984	1985	1986	1987	1988	1989	1990
						Division VIa - t/hour					
2	Norway	Jan-Feb	-	-	-	-	11.90	14.84	-	-	-
		Mar-Apr	36.30	49.04	25.21	20.05	21.50	24.78	15.94	12.33	13.29
		May	-	-	-	-	22.38	10.62	21.15	7.97	9.31
3	Norway	Feb	-	-	-	-	-	10.81	-	-	-
		Mar-Apr	42.38	42.83	28.78	22.29	-	20.53	23.36	14.41	15.25
		May	-	-	-	-	-	12.07	26.18	15.87	12.19
						Division VIb - t/hour					
2	Norway	Mar	-	-	-	-	-	-	-	-	9.68
3	German Dem.Rep.	Mar-Apr	-	-	-	-	-	-	-	3.11	-
4	USSR	Apr-Jun	-	-	-	-	4.80	4.42	5.60	6.11	3.07
						Divison VIIb,c - t/hour					
1	Norway	Mar	-	-	21.08	-	-	-	25.09	-	-
2	Norway	Jan	-	-	-	-	-	-	-	-	12.80
		Feb-Apr	-	-	27.74	26.83	25.35	21.74	18.29	25.26	14.66
3	Norway	Jan-Feb	-	-	-	-	-	-	-	30.00	22.40
		Mar	-	-	-	-	-	24.02	32.29	37.61	21.69
		Apr	-	-	-	-	-	38.35	29.55	34.26	22.29
		Nov	-	-	8.00[1]	32.08	-	-	-	-	-
	German Dem.Rep.	Mar	-	-	-	-	-	-	-	1.68	-
	USSR	Mar-Apr	-	-	-	-	-	-	-	-	2.35
4	USSR	Feb-Mar	-	-	4.72	6.21	3.83[2]	4.49[2]	5.61	6.64	6.32[2]
5	USSR	Feb-Mar	-	-	-	-	10.20	-	6.48	-	5.85
						Division VIIg-k - t/hour					
2	Norway	Jan	-	-	-	-	-	-	-	-	46.00
		Feb-Mar	-	-	14.58	-	-	35.54	25.93	26.45	25.74
3	Norway	Jan	-	-	-	-	-	-	-	-	12.65
		Feb-Mar	-	-	-	-	-	35.24	53.71	34.41	16.00
	German Dem.Rep.	Feb-Mar	-	-	-	-	-	-	-	3.76	-
	USSR	Feb-Apr	-	-	-	-	-	-	-	-	3.35
4	German Dem.Rep.	Feb-Mar	-	-	-	-	7.20	3.21	5.09	-	-

(cont'd)

Table 4.11.1 (cont'd.)

	USSR	Feb-Apr	-	-	3.85	12.30	6.96	4.96[3]	6.13	7.88	6.34
		Dec	-	-	-	-	-	-	-	-	1.85
5	USSR	Feb-Apr	-	-	-	-	-	-	-	-	7.12
					Division XII - t/hour						
3	German Dem.Rep.	Mar-Apr	-	-	-	-	-	-	-	2.25	-
4	USSR	Feb-Apr	-	-	-	-	-	-	-	-	3.74
5	USSR	Apr	-	-	-	-	-	-	-	-	4.88

[1] One trawl only.
[2] Refers to Feb-Apr.
[3] Refers to Mar-Apr.
GRT-class 1: 100 - 499.9.
GRT-class 2: 500 - 999.9.
GRT-class 3: 1.000 - 1.999.9.
GRT-class 4: 2.000 - 3.999.5.
GRT-class 5: 4.000 and more.

Table 4.11.2 USSR catch per hour for the BLUE WHITING directed fisheries in Division IIa for 2,000-3,999.9 GRT vessels using mid-water trawls, 1982-1990.

Month	1982	1983	1984	1985	1986	1987	1988	1989	1990
	Catch (tonnes)								
USSR									
January	8,003	-	-	-	1,069	-	8	-	-
February	-	-	-	-	3,622	2,423	126	-	-
March	375	-	-	-	463	1,483	631	-	-
April	618	-	1,782	62	529	9,182	176	220	39
May	46,089	15,188	6,131	3,289	455	5,104	2,034	-	-
June	27,617	7,919	16,564	25,031	27,967	31,833	24,678	-	31
July	6,820	1,172	11,842	33,177	47,485	34,022	10,818	1,127	126
August	-	-	15,609	20,969	32,608	23,594	1,142	562	837
September	2,921	-	492	5,311	9,269	6,256	407	-	17
October	1,121	-	-	-	1,812	2,944	-	-	-
November	379	-	-	-	966	-	143	-	-
December	-	-	-	-	268	-	139	-	-
All months	93,943	24,279	52,420	87,839	126,520	111,995	40,311	1,909	1,050
May - Oct	84,568	24,279	50,638	87,777	119,596	103,753	39,088	1,689	1,011
	Effort (hours)								
January	1,045	-	-	-	622	-	11	-	-
February	-	-	-	-	1,013	1,093	32	-	-
March	285	-	-	-	135	437	171	-	-
April	256	-	222	68	119	2,578	135	112	9
May	17,106	7,300	2,247	1,900	160	2,001	884	-	-
June	14,209	6,094	5,160	9,550	8,616	13,790	9,495	-	16
July	5,983	1,963	4,315	11,600	16,490	14,734	5,409	480	46
August	-	-	5,292	7,350	16,014	9,526	544	201	490
September	640	-	194	2,360	5,252	3,087	313	-	12
October	341	-	-	-	1,579	1,581	-	-	-
November	161	-	-	-	544	-	51	-	-
December	-	-	-	-	255	-	76	-	-
All months	40,026	15,357	17,430	32,828	50,799	48,827	17,121	793	572
May - Oct	38,279	15,357	17,208	32,760	48,111	44,719	16,645	681	564
	CPUE (tonnes/hour)								
January	7.66	-	-	-	1.72	-	0.72	-	-
February	-	-	-	-	3.58	2.22	3.94	-	-
March	1.32	-	-	-	3.43	3.40	3.69	-	-
April	2.41	-	8.01	0.91	4.44	3.57	1.30	1.96	4.88
May	2.69	2.08	2.73	1.56	2.84	2.55	2.30	-	-
June	1.94	1.30	3.21	2.62	3.25	2.31	2.60	-	1.94
July	1.14	0.60	2.74	2.86	2.88	2.31	2.00	2.35	2.74
August	-	-	2.95	2.84	2.04	2.50	2.09	2.80	1.71
September	4.56	-	2.54	2.25	1.77	2.03	1.30	-	1.42
October	3.29	-	-	-	1.15	1.86	-	-	-
November	2.35	-	-	-	1.78	-	2.80	-	-
December	-	-	-	-	1.05	-	1.83	-	-

(cont'd.)

Table 4.11.2 (cont'd.)

All months		2.35	1.58	3.01	2.68	2.49	2.29	2.28	2.41	2.5
May - Oct	(1)	2.21	1.58	2.94	2.68	2.49	2.32	2.35	2.48	1.8
	(2)	2.78	2.72	1.33	2.83	2.17	2.26	2.06	2.58	1.9

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

Table 4.11.3. UK (Scotland) catch (in tonnes) per hour for the BLUE WHITING industrial mixed fishery, 1989-1990.

Year	1989						1990					
Division	VIa			VIIc			VIa			VIIc		
Month	Catch t	Eff h	CPU t/h	Catch t	Eff h	CPU t/h	Catch t	Eff h	CPU t/h	Catch t	Eff h	CPU t/h
Apr	2,921	233	12.54	2,062	280	7.36	44	32	1.38	3,863	203	19.03
May	1,480	178	8.31	-	-	-	1,888	361	5.23	-	-	-
Jun	-	-	-	-	-		198	53	3.74	-	-	-

Table 4.11.4 Aggregated USSR CPUE weighted catch in tonnes per hour, in the Northern BLUE WHITING fishery, 1980-1990.

Division	Year										
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
IIa	3.75	3.07	2.90	2.36	3.00	2.68	2.98	2.21	2.50	2.19	1.83
Vb	5.55	5.71	4.52	3.44	4.39	4.99	5.54	3.97	4.46	4.18	4.82
VIb	-	-	-	-	3.92	6.74	4.94	2.91	5.60	4.43	3.07
VIIbmc	-	-	-	4.12	4.75	5.58	4.53	4.47	5.70	5.39	6.15
VIIg-k	-	-	-	-	4.05	10.48	10.48	-	-	6.32	6.50
XII	-	-	-	-	-	-	-	-	-	-	5.18
Overall ACPUE	3.87	3.39	3.57	3.13	3.88	4.30	4.13	3.12	3.76	4.16	5.21

Table 4.12.1. Extended Survivors Analysis

Data from:

BLUE-WHITING-NORTHERN CATCH IN NUMBERS
NORTHERN BLUE WHITING TUNING DATA.
Data for 3 surveys over 9 years

age range from 3 to 11
ages lower than 3 treated as recruits
catchability independent of age for ages >= 4
regression type = c
tapered time weighting applied
power = 3 over 20 years
prior weighting not applied
final estimates not shrunk towards mean
estimates with s.e.'s greater than that of mean
minimum s.e. for any survey taken as 0.30
minimum of 5 points used for regression

Log reciprocal catchability (LRC)
Log standard deviation (LSD)

Norway, Spawning Area, Acoustic

	Agegroup								
	3	4	5	6	7	8	9	10	11
LRC	0.10	-0.29	-0.29	-0.29	-0.29	-0.29	-0.29	-0.29	-0.29
LSD	0.39	0.24	0.39	0.66	0.95	1.27	1.50	1.75	1.92

USSR, Spawning Area, Acoustic

LRC	7.19	6.84	6.84	6.84	6.84	6.84	6.84	6.84	6.84
LSD	0.60	0.56	0.80	0.96	1.23	1.77	2.13	2.50	2.71

USSR, CPUE Div IIa, July

LRC	8.68	8.82	8.82	8.82	8.82	8.82	8.82	8.82	8.82
LSD	1.38	1.17	1.59	2.28	2.68	3.91	3.57	6.78	5.75

Log population residuals for each fleet (zeros - missing)

Norway, Spawning Area, Acoustic

(cont'd)

Table 4.12.1 (cont'd)

	Agegroup								
Year	3	4	5	6	7	8	9	10	11
82	-0.02	0.23	0.13	0.33	0.66	0.73	0.69	-0.57	0.07
83	0.24	-0.01	0.55	0.59	0.76	0.96	0.87	0.64	0.54
84	-0.28	-0.08	-0.12	-0.30	-0.18	-0.65	-0.45	-0.46	-1.49
85	-0.02	-0.43	-0.16	-0.23	-0.35	-0.24	-0.63	-0.45	-0.57
86	-0.82	-0.23	-0.13	-0.66	-0.97	-1.00	-1.09	-0.86	-1.01
87	-0.09	0.23	-0.23	-0.94	0.01	0.16	-1.37	-2.04	-0.43
88	0.21	0.22	0.49	0.61	0.48	0.98	0.73	-0.04	-0.01
89	0.62	0.23	0.38	-0.12	-1.06	0.05	0.26	-0.73	-0.74
90	0.13	-0.16	-0.02	0.27	-0.69	-1.39	0.02	0.25	0.81

USSR, Spawning Area, Acoustic

	3	4	5	6	7	8	9	10	11
82	-1.34	-0.43	-0.55	-0.37	0.04	0.64	0.66	0.87	-0.12
83	0.53	0.29	1.15	0.86	0.37	0.35	0.02	0.29	-0.90
84	0.56	-0.55	-0.34	0.74	0.72	0.33	1.12	1.01	0.57
85	0.53	-0.57	-0.48	0.59	-0.39	-0.06	0.05	0.52	-0.85
86	0.32	1.15	0.88	0.03	0.16	-0.07	0.58	0.77	1.50
87	-0.49	0.31	0.22	0.62	0.41	1.13	0.55	1.40	1.41
88	-0.47	-0.54	-0.14	0.26	1.27	0.95	0.69	-0.24	1.18
89	0.18	0.12	0.15	-0.01	0.75	2.51	2.85	2.37	0.50
90	0.06	0.15	0.23	-0.43	-1.26	-2.02	-0.58	-1.91	-1.06

USSR, CPUE, Div IIa, July

	3	4	5	6	7	8	9	10	11
82	-1.24	0.51	1.61	1.73	2.05	1.17	1.91	0.00	0.00
83	0.13	0.38	1.04	1.56	1.59	2.20	2.29	2.30	1.73
84	0.55	-0.72	0.19	-0.14	-0.71	0.34	0.27	1.05	0.00
85	1.36	0.50	-1.29	1.92	1.36	2.17	2.17	3.19	1.89
86	1.69	1.66	1.59	0.00	0.58	0.00	0.00	0.00	0.00
87	1.75	1.55	-0.24	0.00	0.00	0.00	1.78	0.00	0.00
88	-1.35	-1.10	-0.31	-0.25	-0.02	0.00	0.00	0.00	-0.21
89	-1.65	-1.01	-0.89	-1.02	-1.21	-0.95	-0.21	0.00	-1.13
90	-1.28	-1.61	-1.06	-1.29	-3.07	0.00	-0.51	0.00	0.00

Table 4.12.2 Various VPA-runs.

Year	Fleets: Acoustic survey spawning No. area	Age	From Tuning: F_{4-8}	From Tuning: SSB mill.t	From Separable VPA: F_{4-8}	From Separable VPA: SSB mill.t	From Separable VPA: TSB	Acoustic estimates SSB mill.t
1990	2 Norw.+USSR	0-12+	0.295	3.2	0.291	2.2	4.5	
1990	1 Norw.	0-12+	0.145	4.8	0.141	4.3	9.6	5.1 - 5.7
1990	2 Norw.+USSR	0-10+	0.258	3.5	0.257	2.5	5.2	
1990	1 Norw.	0-10+	0.153	4.5	0.156	3.7	7.8	
1989	2 Norw.+USSR	0-12+	0.06	9.9	0.061	11.3	44.0	
1989	1 Norw.	0-12+	0.203	5.4	0.200	3.3	8.4	5.7 - 6.1
1989	2 Norw.+USSR	0-10+	0.051	11.0	0.052	12.2	40.8	
1989	1 Norw.	0-10+	0.164	6.0	0.162	4.0	11.0	

Table 4.12.3

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BLUE WHITING - NEA
102
Norway, Spawning Area/Acoustic
82,90
1,1
3,11
1, 2431, 6676, 3335,3470,3656,3231,2239, 384,985
1, 2108, 2723, 6511,3735,3650,3153,2279,1182,531
1, 1514, 1616, 1719,1858,1128, 567, 440, 348, 80
1, 9150, 1336,  999, 985,1115, 639, 370, 256,183
1, 7183, 7340, 1159, 383, 251, 373, 151, 174, 73
1, 8050,22357, 4697, 282, 417, 385, 159,  27,111
1, 8799,12271,20285,7323, 723, 617, 326, 398,126
1,22270, 9973,10504,7803, 933, 293, 177,  46,148
1,12670,11228, 5587,6556,3273, 516, 183, 108, 81
USSR, Spawning Area/Acoustic
82,90
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
1, 9.74,12.14,5.74,2.58,1.47,0.22,0.08.0.00,0.00
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Table 4.12.4

2 Fleets, Norway and USSR spawning acoustic 1990, 10+.

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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
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,    82,    83,    84,    85,    86,    87,    88,    89,    90,

    0, .175, .014, .039, .085, .003, .012, .001, .045, .015,
    1, .013, .156, .111, .102, .059, .032, .018, .050, .043,
    2, .041, .119, .212, .126, .080, .064, .043, .043, .050,
    3, .082, .122, .168, .295, .178, .120, .091, .147, .063,
    4, .153, .132, .193, .176, .497, .304, .165, .184, .121,
    5, .109, .216, .215, .225, .466, .416, .357, .314, .185,
    6, .187, .187, .318, .419, .385, .298, .766, .327, .381,
    7, .181, .303, .249, .314, .509, .400, .296, .366, .229,
    8, .183, .301, .345, .262, .430, .680, .366, .280, .373,
    9, .163, .228, .264, .279, .457, .420, .390, .294, .258,

Log catchability estimates

 Age 3
 Fleet,    82,    83,    84,    85,    86,    87,    88,    89,    90
______,______,______,______,______,______,______,______,______,______
     1 ,  -.02,   .24,  -.26,   .43,  -.28,   .37,   .47,   .97,   .26
     2 , -8.43, -6.57, -6.51, -6.11, -6.23, -7.12, -7.30, -6.56, -6.91

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,  Slope   ,       ,Intrcpt
_______,________,______,_______,_______,__________,_________,_______,_______
     1 ,   .24  , .412,1.2738 , .0618,  .000E+00,  .000E+00,   .242,   .130
     2 , -6.86  , .745, .0010 , .0661,  .000E+00,  .000E+00, -6.862,   .236
      Fbar     SIGMA(int.)    SIGMA(ext.)   SIGMA(overall)  Variance ratio
      .063        .361          .283E-01       .361             .006

 Age 4
 Fleet,    82,    83,    84,    85,    86,    87,    88,    89,    90
______,______,______,______,______,______,______,______,______,______
     1 ,   .75,   .40,   .33,  -.01,   .79,  1.29,  1.13,   .93,   .62
     2 , -7.05, -6.44, -7.28, -7.28, -4.96, -5.77, -6.77, -6.32, -6.21

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,  Slope   ,       ,Intrcpt
_______,________,______,_______,_______,__________,_________,_______,_______
     1 ,   .69  , .431,1.9992 , .1296,  .000E+00,  .000E+00,   .693,   .136
     2 , -6.45  , .798, .0016 , .0946,  .000E+00,  .000E+00, -6.452,   .252
      Fbar     SIGMA(int.)    SIGMA(ext.)   SIGMA(overall)  Variance ratio
      .121        .379           .132          .379             .121

 Age 5
 Fleet,    82,    83,    84,    85,    86,    87,    88,    89,    90
______,______,______,______,______,______,______,______,______,______
     1 ,   .40,  1.11,   .31,   .26,   .36,  1.01,  1.72,  1.41,   .73
     2 , -7.42, -5.43, -7.05, -7.20, -5.77, -5.68, -6.04, -5.95, -6.15

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,  Slope   ,       ,Intrcpt
_______,________,______,_______,_______,__________,_________,_______,_______
     1 ,   .81  , .560,2.2523 , .2000,  .000E+00,  .000E+00,   .812,   .177
     2 , -6.30  , .767, .0018 , .1591,  .000E+00,  .000E+00, -6.297,   .243
      Fbar     SIGMA(int.)    SIGMA(ext.)   SIGMA(overall)  Variance ratio
      .185        .452           .109          .452             .058
```

cont'd.

Table 4.12.4 cont'd.

Age 6

Fleet	82	83	84	85	86	87	88	89	90
1	.87	.86	.32	.26	-.20	-.47	2.22	1.31	1.48
2	-6.96	-6.01	-5.78	-6.06	-6.65	-6.04	-5.26	-5.71	-6.36

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.74	.902	2.0937	.1808	.000E+00	.000E+00	.739	.285
2	-6.09	.538	.0023	.4967	.000E+00	.000E+00	-6.091	.170

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.381	.462	.445	.462	.926

Age 7

Fleet	82	83	84	85	86	87	88	89	90
1	.91	1.36	.08	.32	-.45	.47	.97	.95	.92
2	-6.84	-6.17	-6.16	-6.85	-6.45	-6.25	-5.37	-4.37	-6.78

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.62	.589	1.8524	.1681	.000E+00	.000E+00	.616	.186
2	-6.14	.854	.0022	.4366	.000E+00	.000E+00	-6.137	.270

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.229	.485	.446	.485	.846

Age 8

Fleet	82	83	84	85	86	87	88	89	90
1	.78	1.20	.02	-.03	-.21	.76	1.45	.56	.93
2	-6.44	-6.54	-6.14	-6.99	-6.42	-5.40	-5.71	-4.11	-6.83

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.61	.606	1.8348	.2702	.000E+00	.000E+00	.607	.192
2	-6.06	.937	.0023	.8030	.000E+00	.000E+00	-6.064	.296

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.373	.509	.497	.509	.953

Table 4.12.5 VIRTUAL POPULATION ANALYSIS from tuning

Blue Whiting in the Northern Area

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

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1981-88
0	.000	.175	.014	.039	.085	.003	.012	.001	.045	.015	.041
1	.025	.013	.156	.111	.102	.059	.032	.018	.050	.043	.064
2	.038	.041	.119	.212	.126	.080	.064	.043	.043	.050	.090
3	.117	.082	.122	.168	.295	.178	.120	.091	.147	.063	.147
4	.094	.153	.132	.193	.176	.497	.304	.165	.184	.121	.214
5	.237	.109	.216	.215	.225	.466	.416	.357	.314	.185	.280
6	.250	.187	.187	.318	.419	.385	.298	.766	.327	.381	.351
7	.212	.181	.303	.249	.314	.509	.400	.296	.366	.229	.308
8	.242	.183	.301	.345	.262	.430	.680	.366	.280	.373	.351
9	.208	.163	.228	.264	.279	.457	.420	.390	.294	.258	.301
10+	.208	.163	.228	.264	.279	.457	.420	.390	.294	.258	.301
(0- 2)U	.021	.076	.096	.121	.104	.047	.036	.021	.046	.036	
(4- 8)U	.207	.163	.228	.264	.279	.457	.420	.390	.294	.258	

Table 4.12.6 VIRTUAL POPULATION ANALYSIS from tuning

Blue Whiting in the Northern Area

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: thousand tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	4857	23696	26759	14750	14254	19646	21814	18481	47316	667	0
1	3092	3977	16292	21602	11616	10718	16037	17647	15116	37017	538
2	3616	2469	3215	11417	15822	8591	8272	12720	14197	11777	29032
3	5142	2851	1941	2337	7563	11415	6495	6351	9973	11135	9172
4	3475	3746	2150	1407	1618	4609	7820	4717	4749	7050	8562
5	2723	2589	2631	1543	949	1111	2296	4723	3275	3235	5116
6	2762	1760	1901	1736	1018	621	571	1240	2706	1959	2202
7	2687	1761	1196	1291	1034	548	346	347	472	1597	1096
8	3238	1781	1203	723	824	618	270	190	211	268	1040
9	3385	2081	1214	729	419	519	329	112	108	131	151
10+	8551	4922	1801	1207	1168	1187	623	170	159	445	364
TOTAL NO	43531	51633	60303	58741	56285	59583	64873	66696	98283	75281	
SPS NO	32692	22306	16564	17231	19783	21881	20766	21906	25354	30297	
TOT.BIOM	5950	4704	3994	3865	3956	4663	4584	4957	5690	5948	
SPS BIOM	5298	3896	2603	2129	2359	2830	2542	2554	2984	3451	

Table 4.12.7 Blue whiting, northern area.

from 81 to 90 on ages 0 to 9
with Terminal F of .246 on age 5 and Terminal S of 1.500

Initial sum of squared residuals was 75.685 and
final sum of squared residuals is 34.825 after 120 iterations

Matrix of Residuals

Years / Ages	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90		WTS
0/ 1	-2.796	2.103	-.489	.472	2.026	-1.051	.873	-2.429	1.292	.000	.05
1/ 2	-.169	-1.388	.360	.321	.883	.255	-.067	-.400	.205	.000	.16
2/ 3	-.330	-.132	.357	.317	.422	.036	.008	-.592	-.087	.000	.32
3/ 4	-.034	.224	-.053	.220	.172	-.268	-.205	-.332	.276	.000	.46
4/ 5	-.024	.333	-.179	.037	-.481	.546	.028	-.280	.020	.000	.34
5/ 6	.348	-.031	-.126	-.523	-.205	.588	-.328	.422	-.144	.000	.28
6/ 7	.144	-.165	-.375	-.147	-.008	-.211	-.294	1.018	.038	.000	.25
7/ 8	.117	-.031	.049	-.111	-.062	-.112	.041	.194	-.083	.000	1.00
8/ 9	.190	.040	.069	.006	-.525	-.169	.468	.202	-.282	.000	.36
	.000	.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	1.000		

Fishing Mortalities (F)

	81	82	83	84	85	86	87	88	89	90
F-values	.2205	.1974	.2956	.3287	.3127	.3734	.3405	.2848	.3090	.2460

Selection-at-age (S)

	0	1	2	3	4	5	6	7	8	9
S-values	.0437	.1861	.2933	.5227	.7373	1.0000	1.2761	1.2523	1.4847	1.5000

Table 4.12.8 VIRTUAL POPULATION ANALYSIS. From separable VPA.

Blue Whiting in the Northern Area

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

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1981-88
0	.000	.167	.014	.040	.102	.004	.024	.002	.032	.011	.044
1	.026	.013	.147	.112	.104	.072	.045	.035	.088	.030	.069
2	.038	.043	.127	.198	.128	.082	.079	.062	.088	.092	.095
3	.124	.082	.130	.181	.272	.180	.123	.114	.220	.137	.151
4	.113	.164	.132	.209	.192	.440	.308	.169	.240	.195	.216
5	.272	.132	.234	.216	.247	.529	.346	.363	.325	.257	.292
6	.316	.222	.236	.353	.420	.439	.361	.562	.335	.400	.364
7	.303	.244	.381	.336	.364	.512	.488	.386	.224	.236	.377
8	.355	.290	.449	.480	.394	.535	.687	.497	.406	.194	.461
9	.330	.265	.416	.468	.454	.888	.600	.398	.463	.433	.477
10+	.330	.265	.416	.468	.454	.888	.600	.398	.463	.433	.477
(0- 2)U	.021	.074	.096	.117	.111	.052	.049	.033	.069	.044	
(4- 8)U	.272	.211	.286	.319	.323	.491	.438	.395	.306	.257	

Table 4.12.9 From separable VPA.

Blue Whiting in the Northern Area

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: thousand tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	4573	24733	26569	14488	12000	14012	11174	10604	67214	929	0
1	2923	3744	17141	21447	11401	8873	11425	8935	8667	53308	752
2	3609	2331	3025	12111	15695	8416	6762	8943	7064	6497	42369
3	4875	2845	1827	2181	8131	11311	6351	5115	6882	5296	4849
4	2936	3527	2145	1314	1490	5073	7735	4599	3737	4520	3782
5	2410	2147	2452	1539	873	1006	2675	4653	3179	2407	3045
6	2255	1504	1540	1589	1015	558	486	1549	2649	1880	1525
7	1957	1346	986	996	914	546	295	277	723	1550	1032
8	2329	1183	864	551	582	520	268	148	154	474	1002
9	2257	1338	725	451	279	322	250	110	74	84	319
10+	5701	3164	1076	748	778	736	472	167	109	287	197
TOTAL NO	35823	47861	58348	57414	53159	51372	47891	45101	100453	77232	
SPS NO	25480	17792	14172	15921	19102	21039	19538	18648	18675	22219	
TOT.BIOM	4637	3821	3539	3631	3742	4226	3921	3777	4445	5189	
SPS BIOM	4010	3012	2131	1875	2183	2650	2413	2274	2321	2456	

Recrm 0	5.274	30.522	38.705	21.509	20.951	24.861	22.482	15.177	457.884
Tot B	5154	4438	4544	4908	5339	6548	6742	7058	7550
SSB	4459	3475	2688	2432	2977	3910	3999	4303	4818

Updated 1990

Table 4.12.10

List of input variables for the ICES prediction program.

Blue Whiting Northern Stock
The reference F is the mean F (non-weighted) for the age group range from 4 to 8

The number of recruits per year is as follows:

Year	Recruitment
1991	14769.0
1992	14769.0
1993	14769.0

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	14769.0	.01	.20	.00	.024	.024
1	11960.0	.04	.20	.10	.045	.045
2	16161.0	.07	.20	.37	.075	.075
3	4849.0	.12	.20	.81	.109	.109
4	3782.0	.17	.20	.85	.124	.124
5	3045.0	.22	.20	.91	.150	.150
6	1525.0	.29	.20	.94	.169	.169
7	1032.0	.28	.20	1.00	.175	.175
8	1002.0	.33	.20	1.00	.215	.215
9	319.0	.34	.20	1.00	.217	.217
10+	197.0	.34	.20	1.00	.254	.254

Table 4.12.11

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

BLUE WHITING NORTHERN STOCK

Year 1991					Year 1992					Year 1993	
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
.60	.160	4334	2504	300	.00	.000	4821	3135	0	5461	3731
					.10	.030			62	5395	3673
					.20	.050			123	5331	3615
					.40	.100			241	5207	3505
					.60	.150			355	5087	3398
					.80	.210			465	4972	3296
					1.00	.260			570	4861	3198
					1.20	.310			671	4755	3104
					1.40	.360			768	4652	3014
					1.60	.410			862	4554	2928
					1.80	.460			952	4458	2844
					2.00	.520			1039	4367	2764

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 4.12.12

```
*********************************************************
* Year 1991. F-factor     .601 and reference F     .1551 *
*---------------------------------------------------------*

* 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:	.0059:	78.64:	1.887:	14769.0:	354.46:	.0:	.00:
1:	.0251:	268.50:	12.082:	11960.0:	538.20:	1196.0:	53.82:
2:	.0396:	568.52:	42.639:	16161.0:	1212.07:	5979.6:	448.47:
3:	.0705:	299.61:	32.772:	4849.0:	530.39:	3927.7:	429.61:
4:	.0994:	325.00:	40.300:	3782.0:	468.97:	3214.7:	398.62:
5:	.1349:	348.95:	52.342:	3045.0:	456.75:	2770.9:	415.64:
6:	.1721:	219.19:	37.043:	1525.0:	257.72:	1433.5:	242.26:
7:	.1689:	145.75:	25.507:	1032.0:	180.60:	1032.0:	180.60:
8:	.2003:	165.37:	35.554:	1002.0:	215.43:	1002.0:	215.43:
9:	.2023:	53.13:	11.530:	319.0:	69.22:	319.0:	69.22:
10+:	.2023:	32.81:	8.335:	197.0:	50.04:	197.0:	50.04:
Total	:	2505.48:	299.991:	58641.0:	4333.85:	21072.4:	2503.72:

```
*********************************************************
* Year 1992. F-factor    1.000 and reference F     .2580 *
*********************************************************
```

						at 1 January:	
age:	absolute F:	catch in: numbers:	catch in: weight:	stock: size:	stock: biomass:	sp.stock: size:	sp.stock: biomass:
0:	.0098:	130.56:	3.133:	14769.0:	354.46:	.0:	.00:
1:	.0417:	445.29:	20.038:	12020.8:	540.94:	1202.1:	54.09:
2:	.0658:	551.79:	41.384:	9549.6:	716.22:	3533.3:	265.00:
3:	.1173:	1278.34:	139.826:	12718.3:	1391.14:	10301.8:	1126.82:
4:	.1654:	512.59:	63.561:	3699.7:	458.76:	3144.7:	389.95:
5:	.2243:	512.42:	76.862:	2803.3:	420.50:	2551.0:	382.66:
6:	.2863:	493.92:	83.472:	2178.5:	368.17:	2047.8:	346.08:
7:	.2809:	234.40:	41.020:	1051.1:	183.95:	1051.1:	183.95:
8:	.3331:	184.26:	39.615:	713.6:	153.43:	713.6:	153.43:
9:	.3365:	174.87:	37.947:	671.5:	145.71:	671.5:	145.71:
10+:	.3365:	89.87:	22.827:	345.1:	87.65:	345.1:	87.65:
Total	:	4608.29:	569.685:	60520.5:	4820.92:	25562.1:	3135.34:

```
*********************************************************
* Year 1993. F-factor    1.000 and reference F     .2580 *
*********************************************************
```

						at 1 January:	
age:	absolute F:	catch in: numbers:	catch in: weight:	stock: size:	stock: biomass:	sp.stock: size:	sp.stock: biomass:
0:	.0098:	130.56:	3.133:	14769.0:	354.46:	.0:	.00:
1:	.0417:	443.55:	19.960:	11973.9:	538.83:	1197.4:	53.88:
2:	.0658:	545.44:	40.908:	9439.8:	707.99:	3492.7:	261.96:
3:	.1173:	735.81:	80.484:	7320.6:	800.74:	5929.7:	648.60:
4:	.1654:	1283.01:	159.093:	9260.3:	1148.28:	7871.3:	976.04:
5:	.2243:	469.27:	70.390:	2567.3:	385.09:	2336.2:	350.43:
6:	.2863:	415.81:	70.272:	1834.0:	309.95:	1724.0:	291.35:
7:	.2809:	298.72:	52.276:	1339.6:	234.42:	1339.6:	234.42:
8:	.3331:	167.78:	36.073:	649.8:	139.71:	649.8:	139.71:
9:	.3365:	109.05:	23.664:	418.7:	90.87:	418.7:	90.87:
10+:	.3365:	154.82:	39.324:	594.5:	151.00:	594.5:	151.00:
Total	:	4753.83:	595.578:	60167.7:	4861.34:	25554.0:	3198.27:

Table 4.12.13

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

BLUE WHITING NORTHERN STOCK

Year 1991						Year 1992				Year 1993	
fac-tor	ref. F	stock biomass	sp.stock biomass	catch	Basis	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
.60	.160	4332	2502	300	F_{91}	.160	4816	3131	366	5072	3385
0	0	0	0	0	$F_{0.1}$	.220	0	0	491	4941	3269
0	0	0	0	0	F_{med}	.250	0	0	543	4886	3220
0	0	0	0	0	F_{90}	.260	0	0	569	4858	3196

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), 1981-1990 as estimated by the Working Group.

Country	1981	1982	1983	1984	1985
Germany, Fed.Rep.	-	-	50	-	-
Netherlands	633	200	-	-	-
Norway	-	-	-	-	-
Portugal	7,387	3,890	4,748	5,252	6,989
Spain	30,728	27,500	26,037	25,921	35,828
UK (England & Wales)	-	-	-	-	3
France	-	-	-	-	-
Total	38,748	31,590	30,835	31,173	42,820

Country	1986	1987	1988	1989	1990[1]
Germany, Fed.Rep.	-	-	-	-	-
Netherlands	-	-	-	-	450
Norway	-	4	-	-	-
Portugal	8,116	9,148	5,979	3,557	2,864
Spain	24,965	23,644	24,847	30,108	29,490
UK (England & Wales)	1	23	12	29	13
France	-	-	-	1	-
Total	33,082	32,819	30,838	33,695	32,817

[1] Preliminary.

Table 5.2 Catch in numbers (thousands) by length group in the Portuguese and Spanish blue whiting fisheries, 1983-1990.

Length (cm)	1983	1984	1985	1986	1987	1988	1989	1990
10	-	-	8	-	1	-	-	0
1	-	3	25	-	33	7	-	3
2	13	41	39	118	37	3	12	62
3	253	337	74	783	1,130	8	247	128
4	1,390	13,263	498	5,903	16,889	391	864	874
5	18,613	48,364	13,013	7,234	44,625	3,190	1,845	8,066
6	63,241	88,023	31,407	6,394	39,111	11,210	9,649	28,079
7	67,446	142,003	73,885	16,669	52,790	34,392	59,269	74,069
8	95,625	154,385	181,222	49,746	102,112	67,722	85,197	89,504
9	97,379	128,950	235,008	82,458	131,911	95,783	80,280	75,083
20	81,201	91,952	211,958	99,258	116,195	126,949	100,839	90,950
1	66,757	69,370	127,966	126,338	71,862	115,176	100,778	81,597
2	58,748	44,241	69,313	107,413	46,724	69,350	82,438	55,600
3	43,069	27,623	28,905	57,835	35,691	25,146	45,833	30,872
4	25,651	16,420	11,842	23,594	20,522	12,471	22,950	17,051
5	10,990	7,744	5,946	9,840	11,696	7,102	14,428	9,022
6	5,221	3,309	3,089	3,759	7,461	3,961	7,528	4,753
7	3,670	1,194	1,263	2,033	3,717	1,993	3,432	4,391
8	2,855	854	899	1,091	1,965	1,434	2,236	1,953
9	1,465	800	622	473	994	799	881	1,196
30	1,381	199	296	308	918	473	316	552
1	342	216	205	165	177	222	405	459
2	58	103	172	174	119	136	159	225
3	8	117	64	255	46	110	105	276
4	1	16	54	269	30	89	58	97
5	4	22	23	167	12	54	26	53
6	-	32	15	67	6	22	24	25
7	4	20	6	80	1	19	17	17
8	-	2	2	56	5	1	4	8
9	8	2	2	1	-	1	2	3
40	-	4	3	8	-	1	2	0
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	574,971
Landings (t)	30,785	31,173	42,817	33,083	32,792	30,732	33,665	31,716

Table 5.3 Catch in numbers (000) by length group and by quarters in the Portuguese and Spanish BLUE WHITING fisheries, 1990

	Quarter I			Quarter II		
Length	Spain	Portugal	Total	Spain	Portugal	Total
10	0	0	0	0	0	0
11	0	0	0	0	3	3
12	49	0	49	0	13	13
13	109	0	109	6	0	6
14	305	10	315	38	0	38
15	1,163	349	1,512	1,112	0	1,112
16	5,939	2,742	8,681	4,253	0	4,253
17	15,756	6,049	21,805	12,168	2,501	14,669
18	16,329	6,909	23,238	24,973	5,114	30,087
19	13,794	4,074	17,868	24,741	4,389	29,130
20	15,718	1,419	17,137	21,215	2,275	23,490
21	17,547	362	17,909	17,431	1,201	18,632
22	15,962	75	16,037	11,457	412	11,869
23	11,017	19	11,036	6,833	159	6,992
24	7,141	1	7,142	3,745	36	3,781
25	3,831	0	3,831	2,120	7	2,127
26	2,395	0	2,395	1,149	0	1,149
27	2,979	0	2,979	957	0	957
28	1,255	0	1,255	435	0	435
29	754	0	754	255	0	255
30	180	0	180	180	0	180
31	250	0	250	91	0	91
32	101	0	101	42	0	42
33	196	0	196	48	0	48
34	38	0	38	29	0	29
35	29	0	29	15	0	15
36	11	0	11	8	0	8
37	5	0	5	7	0	7
38	7	0	7	0	0	0
39	3	0	3	0	0	0
40	0	0	0	0	0	0
Total	132,863	22,008	154,871	133,308	16,111	149,419
Landing	8,252	790	9,042	7,503	603	8,106

(cont'd)

Table 5.3 (cont'd)

Length	Quarter I			Quarter II		
	Spain	Portugal	Total	Spain	Portugal	Total
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	13	0	13
14	0	7	0	514	0	514
15	1,116	94	1,210	4,232	0	4,232
16	2,586	322	2,908	11,752	484	12,236
17	7,081	1,138	8,219	26,035	3,341	29,376
18	9,045	2,595	11,640	21,176	3,365	24,541
19	10,145	3,351	13,496	12,105	2,484	14,589
20	24,526	2,537	27,063	21,097	2,163	23,260
21	22,692	1,880	24,572	19,233	1,251	20,484
22	13,563	846	14,409	12,584	701	13,285
23	7,183	140	7,323	5,228	293	5,521
24	3,366	55	3,421	2,583	125	2,708
25	1,683	13	1,696	1,326	42	1,368
26	706	1	707	485	17	502
27	280	0	280	168	7	175
28	167	0	167	96	0	96
29	122	0	122	63	2	65
30	120	0	120	72	0	72
31	80	0	80	38	0	38
32	57	0	57	25	0	25
33	22	0	22	10	0	10
34	29	0	29	1	0	1
35	7	0	7	1	0	1
36	6	0	6	1	0	1
37	4	0	4	1	0	1
38	0	0	0	1	0	1
39	0	0	0	0	0	0
40	0	0	0	0	0	0
Total	104,586	12,979	117,565	138,840	14,276	153,116
Landing	6,321	609	6,930	7,063	575	7,368

Table 5.4 Catch in numbers ('000) by length group and by gear in the Southern BLUE WHITING fisheries, 1990

	SPAIN			PORTUGAL	
Length	Bottom Trawl	Pair Trawl	Long line	Bottom Trawl	Total
10	0	0	0	0	0
11	0	0	0	3	3
12	49	0	0	13	62
13	125	0	3	0	128
14	846	6	6	17	874
15	4,953	2,663	7	443	8,066
16	16,482	8,028	20	3,549	28,079
17	34,946	26,075	19	13,029	74,069
18	31,439	40,053	33	17,981	89,504
19	24,360	36,368	57	14,298	75,083
20	30,514	51,952	89	8,394	90,950
21	32,030	44,771	102	4,694	81,597
22	25,163	28,223	179	2,034	55,600
23	17,542	12,569	168	611	30,872
24	10,128	6,560	147	216	17,051
25	6,874	1,912	175	62	9,022
26	3,475	1,121	139	18	4,753
27	3,702	548	135	7	4,391
28	1,693	175	85	0	1,953
29	1,017	106	71	2	1,196
30	421	84	48	0	552
31	405	22	33	0	459
32	160	44	21	0	225
33	242	13	21	0	276
34	71	6	19	0	97
35	29	1	22	0	53
36	17	0	8	0	25
37	12	0	5	0	17
38	2	0	6	0	8
39	0	0	3	0	3
40	0	0	0	0	0
Total	246,679	261,301	1,621	65,374	574,971
Landing	14,499	14,461	180	2,577	31,716

Table 5.5 SOP check.

Blue Whiting in the Southern Area
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: millions

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	48	61	98	74	118	32	105	30	41	74
1	189	103	150	223	286	93	383	147	200	198
2	226	184	239	349	337	218	111	233	175	182
3	166	122	68	127	171	168	62	114	93	57
4	50	64	45	35	66	68	28	32	61	25
5	26	22	34	13	14	15	13	10	27	24
6	3	3	9	14	3	6	3	9	15	11
7	0	0	2	3	2	1	1	3	6	2
8+	0	1	1	1	1	1	1	0	3	2
TOTAL	709	560	645	840	998	602	707	578	620	575

Table 5.6 SOP check.

Blue Whiting in the Southern Area
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: kilogram

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	.038	.032	.029	.022	.029	.026	.029	.035	.030	.035
1	.048	.045	.039	.029	.037	.042	.039	.039	.041	.045
2	.051	.061	.046	.035	.043	.052	.059	.053	.050	.055
3	.058	.069	.066	.050	.050	.063	.072	.055	.067	.069
4	.068	.077	.076	.066	.061	.073	.085	.067	.072	.087
5	.070	.085	.084	.077	.073	.090	.095	.101	.085	.094
6	.084	.103	.104	.081	.104	.097	.117	.090	.095	.108
7	.155	.156	.124	.094	.112	.156	.138	.117	.111	.144
8+	.200	.269	.145	.131	.139	.257	.161	.207	.155	.162

Table 5.7 Abundance in number (millions) and biomass (thousand tonnes) by depth strata and zone.

Depth Strata: A: 20 - 50 m
B: 50 - 100 m
C: 100 - 200 m
D: 200 - 500 m
E: 500 - 1000 m

	Depth Strata									
	B		C		D		E		Total	
Zones	Number	Biomass	Number	Biomass	Number	Biomass	Number	Biomass	Number	Biomass
Rias Baixas	5	0.2	44	1.9	278	13.1	125	5.8	452	21.0
Sisargas	0	0.0	76	3.0	456	18.3	345	14.3	577	35.6
A Marina	4	0.1	329	10.5	604	19.9	163	5.3	1101	35.7
Luarca	3	0.1	248	7.9	285	8.8	31	1.0	567	17.7
Llanes	11	0.4	471	15.7	592	19.9	93	3.1	1167	39.1
Cantabria	11	0.4	134	4.4	44	1.4	10	0.3	199	6.5
Euskadi	69	2.2	243	7.7	149	4.7	37	1.2	498	15.7
Total	103	3.3	1545	51.0	2408	86.0	804	31.0	4862	171.3

Table 5.8 Assessment of Blue Whiting in Spanish waters in Spring 1991.

Mean weight (ŵ): g
Mean length (l̆): cm

Numbers: Millions
Biomass: Thousand tonnes

Length	Age Groups						Total	
	I	II	III	IV	V	VI+	Number	Biomass
10	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0
15	34	0	0	0	0	0	34	0.7
16	418	42	0	0	0	0	460	11.1
17	887	333	0	0	0	0	1220	33.8
18	285	665	0	0	0	0	950	29.3
19	336	336	0	0	0	0	672	23.6
20	51	309	154	0	0	0	514	20.7
21	0	49	395	0	0	0	444	20
22	0	29	114	171	29	0	343	17
23	0	0	18	36	6	0	60	3.5
24	0	0	7	22	30	15	74	4.7
25	0	0	4	4	8	25	41	2.9
26	0	0	0	0	8	12	20	1.5
27	0	0	0	0	6	4	10	0.8
28	0	0	0	0	0	5	5	0.4
29	0	0	0	0	0	7	7	0.6
30	0	0	0	0	0	2	2	0.2
31	0	0	0	0	0	2	2	0.2
32	0	0	0	0	0	2	2	0.2
33	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0
Total	2011	1763	692	233	87	74	4860	171.3
%	41.38	36.28	14.24	4.79	1.79	1.52		
l̆	17.8	19	21.5	22.9	24.2	26.6	19.3	
Biomass	58.1	58.7	31.5	12.3	5.3	5.5	171.3	
ŵ	28.89	33.3	45.52	52.79	60.92	74.32	35.25	

Table 5.9. 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
1990	64.7	13.8	74.5	32.0	32.9	9.7	26.8	7.5	44.9	6.3	39.6	10.4	43.0	5.4

Table 5.10. 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	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
1989	June	-	-	39.4	14.3	312.5	128.5	76.1	26.0
	October	-	-	64.2	22.4	261.3	47.0	75.2	12.7

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

Table 5.11.1. Catch per unit effort

a) by Spanish vessels landing in the main Galician ports, 1978-1990.

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

b) by Portuguese bottom trawl fishery, 1978-1990.

Year	Landings (tonnes)	Effort (10^3 h)	CPUE (kg/h)
1978	2,389	228.4	10.5
1979	2,096	220.4	9.5
1980	6,051	211.4	28.6
1981	7,387	201.6	36.6
1982	3,890	225.4	17.3
1983	4,748	176.6	26.9
1984	5,252	154.0	34.1
1985	6,989	147.0	47.5
1986	8,116	155.4	52.2
1987	9,148	137.5	66.5
1988	5,934	127.6	46.5
1989	3,557	179,5	19,8
1990	2,577*	101,7	25,3

* Provisional data

Table 5.11.2. Catch per unit effort by Spanish single and pair trawlers landing in the main Galician ports, 1983-1990.

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

YEAR	F.TRIP	EFFORT	Nº BOATS	H.P.	H.P.
1983	2724	12568	20	9260	463
1984	2338	10815	19	8600	453
1985	2207	9856	16	7105	444
1986	2407	10845	15	6645	443
1987	1869	8309	15	6645	443
1988	2077	9047	15	6873	458
1989	1835	8063	14	6015	430
1990	2013	8492	14	5935	424

Table 5.12.A

Evolution of the number of fishing trips, effort (HP*fishing days * 10^{-2}), number of boats and horse power (HP) for the period 1983-1990.

QUARTER	I	II	III	IV	TOTAL	
YEAR	CPUE	CPUE	CPUE	CPUE	CPUE	CATCH (K)
1983	138.44	94.10	106.74	56.52	101.00	1268943
1984	155.13	74.20	74.64	51.06	81.86	885419
1985	285.96	83.66	100.22	65.22	162.54	1603305
1986	309.60	67.30	70.62	43.05	142.27	1542928
1987	230.29	49.38	56.19	99.86	140.39	1165897
1988	340.56	85.30	86.98	96.95	166.89	1508809
1989	310.65	37.42	49.72	126.15	151.44	1220295
1990	542.31	96.76	73.77	106.94	231.71	1968220

Table 5.12.B

Evolution of blue whiting CPUE (in K/(Σ HP*days* 10^{-2}))in Division VIIIc, for bacas of Avilés port.

Table 5.13

```
SOUTHERN BLUE WHITING TUNING DATA
103
cpue Spanish Pair Trawlers
83,90
1,1
0,7
1, 1140, 7196,16392, 9311,7476,6326,1718,360
1, 1839,13710,27286,14845,4836,1755,1750,338
1, 3680,14573,23823,14126,6256,1232, 217,126
1,  788, 3721,14131,14745,7113,1278, 505, 47
1, 5433,25328,13153, 6664,2938,1029, 166, 43
1, 2545, 7778,21473,18436,6391,1300, 781,223
1, 2488,15272,18486,17160,8374,3760,1003,771
1, 6703,21444,19407, 5194,1803,1357, 451, 77
Bottom Trawl Spanish Survey
83,90
1,1
0,7
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
1,  911, 410,  30,  2,  2, 0,0,0
cpue Aviles Trawlers
83,90
1,1
0,7
1, 44.6,208.4,479.1,240.3,196.0,160.9, 52.1, 14.4
1, 24.1,190.6,614.8,413.0, 86.9, 28.5, 33.4, 10.4
1,134.3,450.6,973.7,642.0,318.9, 67.0, 15.9, 11.5
1,191.7,299.7,541.9,445.3,292.9,117.9, 51.2, 18.1
1, 67.5,381.9,459.9,414.3,273.4,128.9, 41.3, 14.8
1,239.4,374.1,738.1,604.4,274.9,210.4,137.9, 60.9
1,118.2,370.2,452.5,398.3,378.7,192.5,127.3, 45.8
1,348.6,621.2,766.1,316.5,260.3,318.5,215.0,107.3
```

Table 5.14. Extended Survivors Analysis.

Data from:
BLUEWHITING-SOUTHERN STOCK, CATCH IN NUMBERS

SOUTHERN BLUE WHITING TUNING DATA

data for 3 surveys over 8 years

age range from 0 to 7
ages lower than 0 treated as recruits
catchability independent of age for ages >= 2
regression type = c
tapered time weighting applied
power = 3 over 20 years
prior weighting not applied
final estimates not shrunk towards mean
estimates with s.e.'s greater than that of mean
minimum s.e. for any survey taken as 0.30
minimum of 5 points used for regression

Log reciprocal catchability (LRC)
Log standard deviation (LSD)

Spanish Pair Trawlers, CPUE

	Agegroup							
	0	1	2	3	4	5	6	7
LRC	-0.62	-2.54	-3.58	-3.58	-3.58	-3.58	-3.58	-3.58
LSD	0.79	0.51	0.17	0.50	0.93	1.24	1.81	2.72

Spanish Survey, Bottom Trawl

LRC	-0.79	0.08	0.97	0.97	0.97	0.97	0.97	0.97
LSD	0.88	1.32	1.37	2.27	3.09	3.90	4.72	7.56

Aviles Trawlers, CPUE

LRC	2.50	0.99	-0.15	-0.15	-0.15	-0.15	-0.15	-0.15
LSD	0.80	0.43	0.18	0.44	0.76	0.98	1.12	1.19

Log population residuals for each fleet (zeros - missing)

Spanish Pair Trawlers, CPUE

	Agegroup							
	0	1	2	3	4	5	6	7
Year								
83	-0.89	-0.66	-0.07	0.54	1.16	1.10	0.68	-0.17
84	-0.22	0.01	0.17	0.53	0.54	0.50	0.56	-0.45
85	0.71	0.31	0.09	0.27	0.42	-0.24	-1.08	-1.53
86	-1.27	-0.87	-0.15	0.40	0.31	-0.53	-0.67	-2.28
87	1.11	0.66	-0.27	-0.32	-0.59	-1.10	-2.20	-2.80
88	0.08	-0.10	0.05	0.58	0.05	-1.05	-1.02	-1.63
89	-0.21	0.26	0.26	0.38	0.38	-0.06	-0.97	-0.69
90	0.58	0.31	-0.08	-0.46	-1.47	-0.92	-1.79	-3.21

(cont'd)

Table 5.14 (cont'd)

Spanish Survey, Bottom Trawl

	0	1	2	3	4	5	6	7
83	0.12	0.71	1.34	0.85	0.99	0.57	-0.13	0.67
84	0.94	1.54	1.87	1.39	0.65	0.23	-0.23	-0.92
85	0.12	0.47	1.17	1.06	-0.26	-1.06	0.00	0.00
86	1.27	-1.77	0.70	1.02	0.32	-1.92	-0.85	0.00
87	0.20	1.94	-1.03	0.53	0.83	0.10	-2.00	-1.25
88	-0.20	-0.57	-0.46	-1.90	-2.67	-3.60	-3.05	0.00
89	-0.79	-1.20	-1.35	-1.11	-2.85	-2.53	-2.53	0.00
90	-1.53	-0.92	-1.86	-3.65	-3.65	0.00	0.00	0.00

Aviles Trawlers, CPUE

	0	1	2	3	4	5	6	7
83	-1.01	-0.66	-0.18	0.31	0.94	0.85	0.61	0.04
84	-1.44	-0.74	-0.20	0.38	-0.05	-0.20	0.03	-0.50
85	0.52	0.37	0.33	0.60	0.87	0.28	-0.26	-0.50
86	0.43	0.14	0.02	0.33	0.54	0.51	0.47	0.20
87	-0.16	0.00	-0.19	0.33	0.47	0.25	-0.17	-0.44
88	0.83	0.40	0.11	0.59	0.33	0.55	0.67	0.50
89	-0.13	0.07	-0.03	0.04	0.71	0.39	0.40	-0.09
90	0.74	0.30	0.12	0.17	0.02	1.06	0.90	0.55

Table 5.15

```
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet  1 ,cpue Spanish Pair Tr, has terminal q estimated as the mean
Fleet  2 ,cpue Aviles Trawlers, 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,    83,    84,    85,    86,    87,    88,    89,    90,

    0,  .076,  .068,  .134,  .029,  .141,  .028,  .022,  .019,
    1,  .156,  .249,  .405,  .149,  .546,  .298,  .266,  .138,
    2,  .575,  .646,  .728,  .623,  .265,  .771,  .698,  .413,
    3,  .614,  .706,  .777, 1.041,  .356,  .477,  .833,  .508,
    4, 1.061,  .754, 1.035,  .849,  .478,  .316,  .507,  .561,
    5,  .905, 1.124,  .765,  .715,  .391,  .324,  .491,  .385,
    6,  .833, 1.293,  .865,  .883,  .341,  .491, 1.047,  .357,
    7,  .798,  .905,  .834,  .822,  .366,  .476,  .715,  .445,

Log catchability estimates

 Age  0
 Fleet,    83,    84,    85,    86,    87,    88,    89,    90
------,------,------,------,------,------,------,------,------
    1 ,  -.12,   .53,  1.43,  -.35,  1.98,   .88,   .27,   .57
    2 , -3.36, -3.80, -1.88, -1.76, -2.40, -1.48, -2.77, -2.39

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,   Slope  ,        ,Intrcpt
-------,--------,------,-------,------,----------,----------,--------,-------
     1 ,   .65  ,  .821,1.9155 , .0211,  .000E+00,  .000E+00,   .650,   .274
     2 , -2.48  ,  .849, .0836 , .0177,  .000E+00,  .000E+00, -2.482,   .283
      Fbar      SIGMA(int.)     SIGMA(ext.)     SIGMA(overall)  Variance ratio
      .019         .590           .877E-01         .590             .022


 Age  1
 Fleet,    83,    84,    85,    86,    87,    88,    89,    90
------,------,------,------,------,------,------,------,------
    1 ,  2.01,  2.73,  3.03,  1.78,  3.59,  2.76,  3.01,  2.70
    2 , -1.53, -1.55,  -.45,  -.74,  -.61,  -.28,  -.71,  -.84

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,   Slope  ,        ,Intrcpt
-------,--------,------,-------,------,----------,----------,--------,-------
     1 ,  2.70  ,  .609,****** , .1378,  .000E+00,  .000E+00,  2.701,   .203
     2 ,  -.84  ,  .496, .4336 , .1383,  .000E+00,  .000E+00,  -.837,   .165
      Fbar      SIGMA(int.)     SIGMA(ext.)     SIGMA(overall)  Variance ratio
      .138         .385           .179E-02         .385             .000

 Age  2
 Fleet,    83,    84,    85,    86,    87,    88,    89,    90
------,------,------,------,------,------,------,------,------
    1 ,  3.68,  3.96,  3.94,  3.70,  3.45,  4.26,  4.30,  3.78
    2 ,   .14,   .13,   .74,   .44,   .10,   .89,   .59,   .55

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,   Slope  ,        ,Intrcpt
-------,--------,------,-------,------,----------,----------,--------,-------
     1 ,  3.88  ,  .310,****** , .4544,  .000E+00,  .000E+00,  3.879,   .103
     2 ,   .45  ,  .319,1.5649 , .3724,  .000E+00,  .000E+00,   .448,   .106
      Fbar      SIGMA(int.)     SIGMA(ext.)     SIGMA(overall)  Variance ratio
      .413         .222           .995E-01         .222             .200

 Age  3
 Fleet,    83,    84,    85,    86,    87,    88,    89,    90
------,------,------,------,------,------,------,------,------
    1 ,  4.43,  4.41,  4.16,  4.52,  3.45,  4.35,  5.04,  3.84
    2 ,   .77,   .83,  1.07,  1.02,   .87,   .93,  1.27,  1.05

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,   Slope  ,        ,Intrcpt
-------,--------,------,-------,------,----------,----------,--------,-------
     1 ,  4.30  ,  .452,****** , .8016,  .000E+00,  .000E+00,  4.300,   .151
```

cont'd.

Table 5.15 cont'd.

Age 3

Fleet	83	84	85	86	87	88	89	90
1	4.43	4.41	4.16	4.52	3.65	4.35	5.04	3.84
2	.77	.83	1.07	1.02	.87	.93	1.27	1.05

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	4.30	.452	******	.8016	.000E+00	.000E+00	4.300	.151
2	.98	.171	2.6551	.4740	.000E+00	.000E+00	.976	.057

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.506	.160	.174	.174	1.184

Age 4

Fleet	83	84	85	86	87	88	89	90
1	5.17	4.65	4.59	4.48	3.91	4.15	4.25	3.70
2	1.53	.63	1.61	1.30	1.53	1.00	1.15	1.77

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	4.36	.491	******	1.0869	.000E+00	.000E+00	4.362	.164
2	1.31	.397	3.7222	.3575	.000E+00	.000E+00	1.314	.132

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.555	.309	.544	.544	3.096

Age 5

Fleet	83	84	85	86	87	88	89	90
1	5.13	5.01	4.24	4.10	3.40	3.70	4.21	3.08
2	1.45	.89	1.33	1.72	1.33	1.88	1.24	1.63

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	4.11	.760	******	1.0767	.000E+00	.000E+00	4.109	.253
2	1.43	.331	4.1913	.3158	.000E+00	.000E+00	1.433	.110

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.384	.303	.449	.449	2.191

Age 6

Fleet	83	84	85	86	87	88	89	90
1	5.09	5.10	4.14	4.36	2.81	3.76	4.28	2.72
2	1.60	1.14	1.52	2.07	1.42	2.03	2.21	1.98

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	4.03	.959	******	1.3257	.000E+00	.000E+00	4.033	.320
2	1.75	.401	5.7355	.2828	.000E+00	.000E+00	1.747	.134

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.356	.370	.550	.550	2.211

Table 5.16 VIRTUAL POPULATION ANALYSIS

BLUE WHITING, SOUTHERN AREA

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

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	.050	.047	.076	.068	.134	.029	.141	.028	.022	.019
1	.355	.144	.156	.249	.405	.149	.545	.298	.265	.138
2	.644	.698	.575	.646	.728	.622	.264	.769	.696	.413
3	.702	.896	.614	.706	.777	1.041	.355	.477	.828	.506
4	.692	.655	1.061	.754	1.035	.849	.478	.316	.506	.555
5	1.261	.772	.905	1.124	.765	.715	.391	.324	.490	.384
6	1.629	.488	.833	1.293	.865	.883	.341	.491	1.047	.356
7	.990	.709	.798	.905	.834	.822	.366	.476	.715	.445
8+	.990	.709	.798	.905	.834	.822	.366	.476	.715	.445
(1- 4)U	.598	.598	.601	.589	.736	.665	.411	.465	.574	.403

Table 5.17 VIRTUAL POPULATION ANALYSIS from tuning with two fleets.

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	1991
0	1079	1464	1468	1231	1036	1252	882	1183	2113	4242	0
1	694	840	1143	1113	941	741	996	627	941	1693	3407
2	520	399	596	801	711	514	523	473	381	591	1207
3	360	224	162	274	344	281	226	329	179	156	320
4	109	146	75	72	111	130	81	130	167	64	77
5	39	45	62	21	28	32	45	41	77	83	30
6	4	9	17	21	6	11	13	25	24	39	46
7	0	1	5	6	5	2	4	8	13	7	22
8+	0	2	2	1	2	2	4	1	5	7	7
TOTAL NO	2807	3129	3529	3541	3183	2965	2774	2816	3901	6881	
SPS NO	688	607	663	780	772	645	675	707	658	811	
TOT.BIOM	132	141	138	109	123	123	125	125	156	288	
SPS BIOM	39	39	36	33	37	38	44	41	41	51	

Table 5.18 BLUE WHITING - Southern area.

from 81 to 90 on ages 0 to 7
with Terminal F of .590 on age 4 and Terminal S of 1.500

Initial sum of squared residuals was 64.787 and
final sum of squared residuals is 14.619 after 55 iterations

Matrix of Residuals

Years / Ages	81/82	82/83	83/84	84/85	85/86	86/87	87/88	88/89	89/90		WT S
0/ 1	.123	.362	.440	-.142	1.278	-1.787	.825	-.382	-.716	.000	.282
1/ 2	-.016	-.499	-.530	-.184	.323	-.397	.806	.442	.055	.000	.556
2/ 3	-.401	.416	-.004	-.040	-.257	.066	-.593	.654	.158	.000	.654
3/ 4	-.258	.247	-.146	-.291	-.241	.394	-.067	.203	.159	.000	1.000
4/ 5	-.422	-.133	.386	-.041	.276	.213	.262	-.293	-.248	.000	.871
5/ 6	.855	.158	.053	.475	-.349	.088	-.295	-.776	-.209	.000	.530
6/ 7	.835	-.637	-.091	.497	-.379	.112	-.608	-.211	.482	.000	.490
	.000	.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	1.000		

Fishing Mortalities (F)

	81	82	83	84	85	86	87	88	89	90
F-values	.9138	.6989	.7821	.8993	1.0029	.9356	.5746	.5604	.8094	.5900

Selection-at-age (S)

	0	1	2	3	4	5	6	7
S-values	.0772	.3465	.8106	.9471	1.0000	1.0814	1.3071	1.5000

Table 5.19 VPA. From separable VPA based on tuning with two fleets.

BLUE WHITTING - SOUTHERN AREA.

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

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
0	.051	.048	.077	.073	.149	.028	.134	.032	.039	.046
1	.359	.146	.158	.251	.437	.167	.526	.279	.301	.264
2	.646	.711	.588	.660	.739	.709	.306	.719	.627	.496
3	.708	.902	.636	.736	.812	1.080	.442	.593	.719	.422
4	.714	.667	1.079	.811	1.147	.941	.517	.436	.745	.427
5	1.367	.825	.940	1.182	.897	.925	.475	.365	.838	.765
6	1.685	.591	.974	1.460	.993	1.343	.547	.677	1.358	.963
7	1.322	.786	1.207	1.386	1.220	1.171	.942	1.119	1.484	.821
8+	1.322	.786	1.207	1.386	1.220	1.171	.942	1.119	1.484	.821
(1- 4)U	.607	.606	.615	.614	.784	.724	.448	.507	.598	.402

Table 5.20 VPA. From separable VPA based on tuning with two fleets.

BLUE WHITTING - 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	1991
0	1065	1445	1457	1163	943	1285	926	1062	1194	(1827)	0
1	688	829	1148	1104	885	666	1023	664	842	940	(1429)
2	519	393	586	789	703	468	461	495	411	510	591
3	358	223	158	267	334	275	189	278	197	180	254
4	107	144	74	69	105	121	76	99	126	79	96
5	38	43	61	21	25	27	39	37	53	49	42
6	4	8	15	19	5	8	9	20	21	19	19
7	0	1	4	5	4	2	2	4	8	4	6
8+	0	2	1	1	2	2	2	1	3	4	3
TOTAL NO	2779	3088	3484	3437	3006	2854	2727	2660	2855	3612	
SPS NO	680	597	647	759	739	588	600	637	597	622	
TOT.BIOM	131	139	136	106	116	116	119	117	121	162	
SPS BIOM	38	39	35	31	35	35	38	36	36	40	

Table 5.21 Predicted values of recruitment.

```
  BLUE WHITING SOUTH : recruits as 0-group
        2        10         2     (No. of surveys, No. of years, VPA column)
     1981      1065      3465       69
     1982      1445      7196     1695
     1983      1457     13710     3455
     1984      1163     14573     6558
     1985       943      3721     2224
     1986      1285     25328    11229
     1987       926      7778     2389
     1988      1062     15272     2168
     1989      1194     21444     1554
     1990      1827       -11      911
     CPUE Spanish Pair Trawlers
     Bottom Trawl Spanish Survey


 Analysis by RCRTINX2 of data from file recruits
  BLUE WHITING SOUTH : recruits as 0-group

 Data for    2 surveys over   10 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 =   1989

 Survey/  Index     Slope   Inter-   Rsquare  No.   Predicted   Sigma    Standard   Weight
 Series   Value             cept              Pts    Value              Error
      C   9.9732    .534    2.158     .2197    8     7.4864    .36204    .41748    .14605
      B   7.3492    .466    3.463     .0669    8     6.8900    .71746    .76522    .04347

 MEAN                                                7.0481    .17722    .17722    .81048

 Yearclass =   1990

 Survey/  Index     Slope   Inter-   Rsquare  No.   Predicted   Sigma    Standard   Weight
 Series   Value             cept              Pts    Value              Error
      C
      B   6.8156    .490    3.296     .0622.   9     6.6343    .69137    .74762    .04685

 MEAN                                                7.0512    .16575    .16575    .95315


  Yearclass        Weighted      Internal      External      Virtual          Ext.SE/
                   Average       Standard      Standard      Population       Int.SE
                   Prediction    Error         Error         Analysis

  1989    7.11     1218.33         .16           .11       7.09 1195.00       .71
  1990    7.03     1131.93         .16           .09       7.51 1828.00       .54
```

Table 5.22

List of input variables for the ICES prediction program.

Blue Whiting in the Southern Area
The reference F is the mean F (non-weighted) for the age group range from 1 to 4

The number of recruits per year is as follows:

Year	Recruitment
1991	1171.0
1992	1171.0
1993	1171.0

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	1171.0	.04	.20	.00	.031	.031
1	885.0	.18	.20	.18	.040	.040
2	591.0	.42	.20	.48	.052	.052
3	254.0	.49	.20	.91	.063	.063
4	96.0	.52	.20	.98	.074	.074
5	42.0	.56	.20	1.00	.090	.090
6	19.0	.68	.20	1.00	.102	.102
7	6.0	.78	.20	1.00	.130	.130
8+	3.0	.78	.20	1.00	.180	.180

Table 5.23

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

Blue Whiting in the Southern Area

Year 1991						Year 1992				Year 1993	
factor	ref. F	stock biomass	sp.stock biomass	catch	Basis	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.40	133	42	28	$F_{0.1}$	.12	142	52	10	170	74
					F_{90}	.40		48	31	148	53
					F_{med}	.64		45	44	134	41
					F_{max}	.84		43	53	124	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 1993 has been calculated with the same fishing mortality as for 1992.
The reference F is the mean F (non-weighted) for the age group range from 1 to 4

Table 5.24

Results

17.10.55 17 OCTOBER 1991
Blue Whiting in the Southern Area

* Year 1991. F-factor 1.000 and reference F .4030 *

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	.0400	41.643	1.2909	1171.00	36.301	.000	.0000	.000	.0000
1	.1800	132.529	5.3011	885.00	35.400	159.300	6.3720	144.863	5.7945
2	.4210	185.343	9.6379	591.00	30.732	283.680	14.7514	242.887	12.6301
3	.4920	90.191	5.6820	254.00	16.002	231.140	14.5618	194.421	12.2485
4	.5190	35.532	2.6294	96.00	7.104	94.080	6.9619	78.602	5.8165
5	.5620	16.519	1.4867	42.00	3.780	42.000	3.7800	34.715	3.1243
6	.6790	8.583	.8755	19.00	1.938	19.000	1.9380	15.252	1.5557
7	.7790	2.981	.3875	6.00	.780	6.000	.7800	4.697	.6107
8+	.7790	1.490	.2683	3.00	.540	3.000	.5400	2.349	.4228
Total		514.812	27.5593	3067.00	132.577	838.200	49.6851	717.786	42.2031

* Year 1992. F-factor 1.000 and reference F .4030 *

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	.0400	41.643	1.2909	1171.00	36.301	.000	.0000	.000	.0000
1	.1800	137.941	5.5176	921.14	36.846	165.805	6.6322	150.779	6.0312
2	.4210	189.802	9.8697	605.22	31.471	290.504	15.1062	248.730	12.9340
3	.4920	112.777	7.1050	317.61	20.009	289.023	18.2084	243.108	15.3158
4	.5190	47.060	3.4825	127.15	9.409	124.603	9.2206	104.103	7.7036
5	.5620	18.397	1.6557	46.77	4.210	46.775	4.2097	38.662	3.4795
6	.6790	8.855	.9032	19.60	1.999	19.603	1.9995	15.736	1.6050
7	.7790	3.919	.5095	7.89	1.026	7.889	1.0255	6.176	.8029
8+	.7790	1.680	.3023	3.38	.609	3.381	.6086	2.647	.4765
Total		562.074	30.6365	3219.76	141.879	947.583	57.0109	809.940	48.3485

* Year 1993. F-factor 1.000 and reference F .4030 *

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	.0400	41.643	1.2909	1171.00	36.301	.00	.0000	.000	.0000
1	.1800	137.941	5.5176	921.14	36.846	165.81	6.6322	150.779	6.0312
2	.4210	197.553	10.2728	629.93	32.757	302.37	15.7231	258.888	13.4622
3	.4920	115.490	7.2759	325.25	20.491	295.98	18.6465	248.956	15.6842
4	.5190	58.845	4.3546	158.99	11.765	155.81	11.5297	130.173	9.6328
5	.5620	24.365	2.1929	61.95	5.576	61.95	5.5755	51.205	4.6084
6	.6790	9.862	1.0059	21.83	2.227	21.83	2.2268	17.524	1.7875
7	.7790	4.043	.5256	8.14	1.058	8.14	1.0581	6.372	.8284
8+	.7790	2.103	.3786	4.23	.762	4.23	.7621	3.315	.5967
Total		591.846	32.8148	3302.46	147.781	1016.11	62.1540	867.212	52.6313

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
1991	5.5	2.6	10.1	81.8	Norwegian and USSR

Table 6.2 Total catches of BLUE WHITING in 1978-1990 divided into areas within and beyond areas of national fisheries jurisdiction of NEAFC contracting parties. Percentage in ().

Year	Inter-national	Svalbard	Jan Mayen	Norway	Iceland	Greenland	Faroes	EEC	Total (t)	Total from off.data (t)	%
1978	136,504 (25.52)	-	-	67,391 (12.60)	26,444 (4.94)	6,580 (1.23)	195,361 (36.53)	102,523 (19.17)	534,803	574,812	93.0
1979	614,734 (56.18)	-	-	75,545 (6.90)	15,117 (1.38)	204 (0.02)	224,201 (20.49)	164,388 (15.02)	1,094,189	1,091,422	100.3
1980	567,693 (55.23)	-	-	152,095 (14.80)	4,562 (0.44)	8,757 (0.85)	164,342 (15.99)	130,417 (12.69)	1,027,866	1,092,620	94.1
1981	168,681 (19.76)	-	123,000 (14.41)	215,004 (25.18)	7,751 (0.91)	-	174,801 (20.48)	164,475 (19.27)	853,712	870,808	98.0
1982	22,993 (4.32)	-	-	130,435 (24.51)	5,797 (1.09)	-	125,072 (23.50)	247,884 (46.58)	532,181	544,919	97.7
1983	15,203 (2.93)	-	-	109,675 (21.15)	7,000 (1.35)	-	91,804 (17.70)	294,981 (56.87)	518,663	539,235	96.2
1984	18,407 (3.19)	-	-	150,603 (26.13)	105 (0.02)	-	124,905 (21.67)	282,418 (48.99)	576,438	586,504	98.3
1985	38,978 (6.07)	-	-	114,785 (17.88)	-	-	196,003 (30.52)	292,345 (45.53)	642,111	644,899	99.6
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
1990	88,509 (16.7)	-	-	39,160 (7.4)	-	-	115,308 (21.8)	285,893 (54.1)	528,803	528,803	100,0

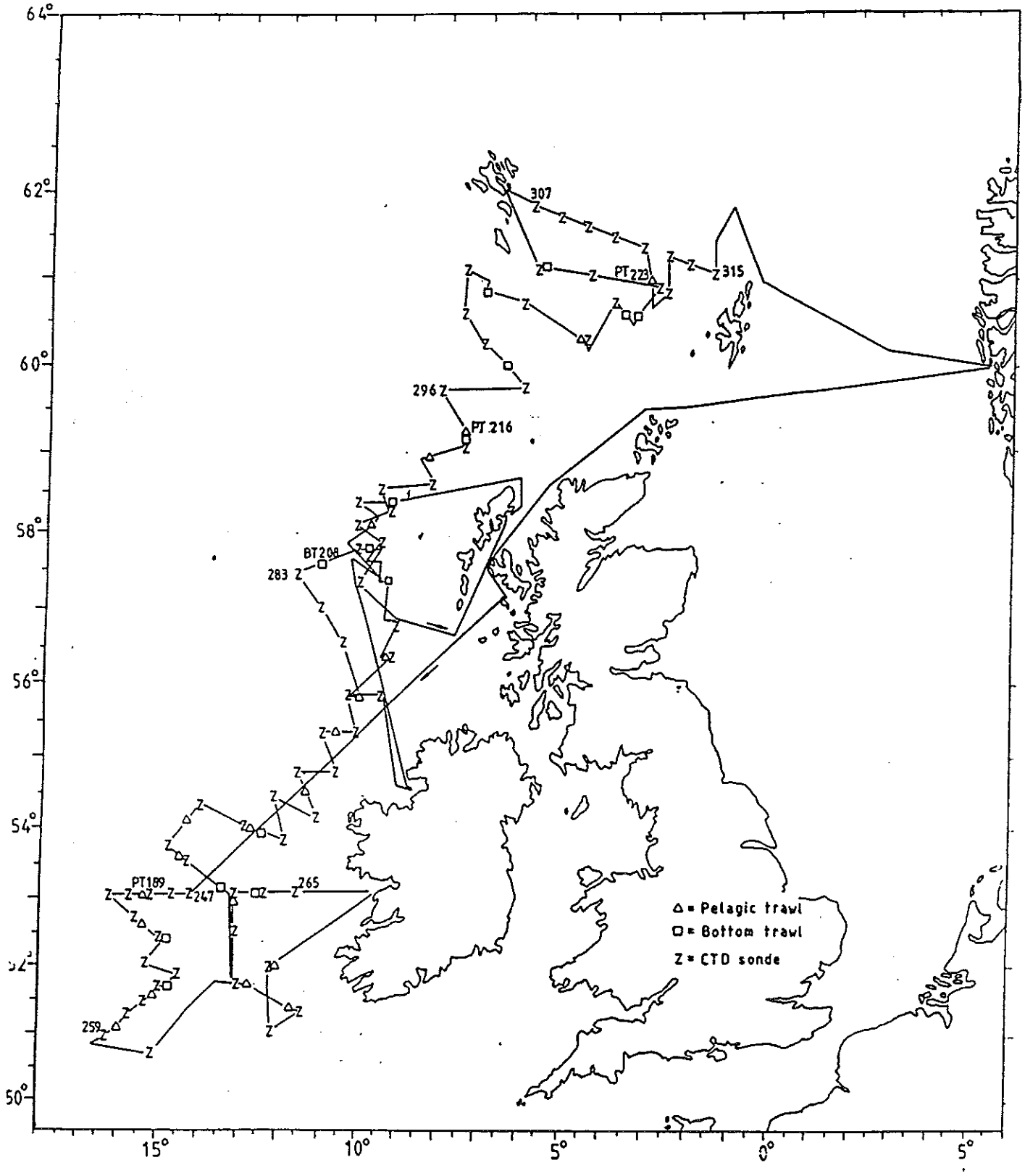


Figure 4.1 Cruise track and stations of R.V."Johan Hjort" 18 March-16 April 1991.

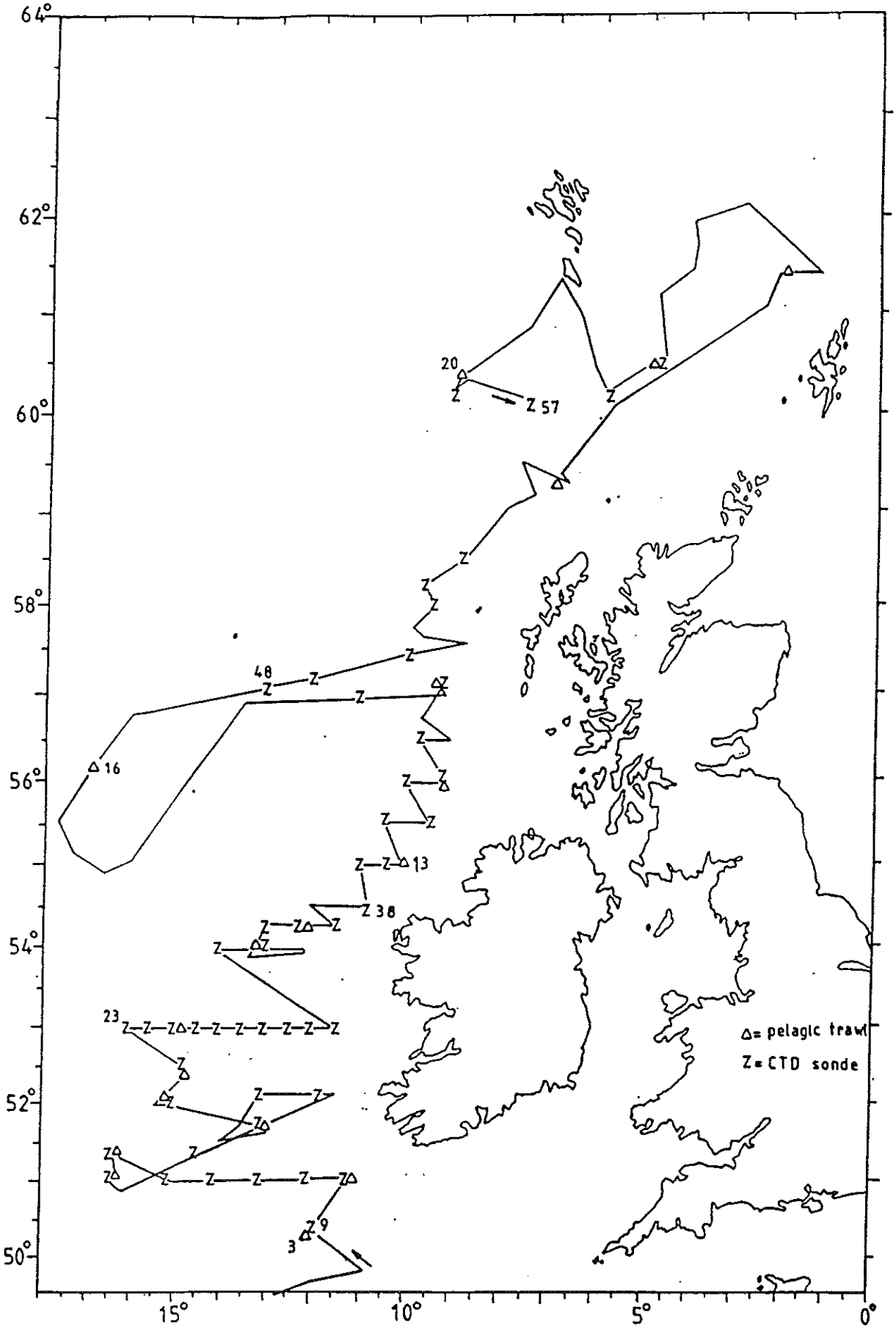


Figure 4.2 Cruise track and stations of R.V."Pinro" 17 March-12 April 1991.

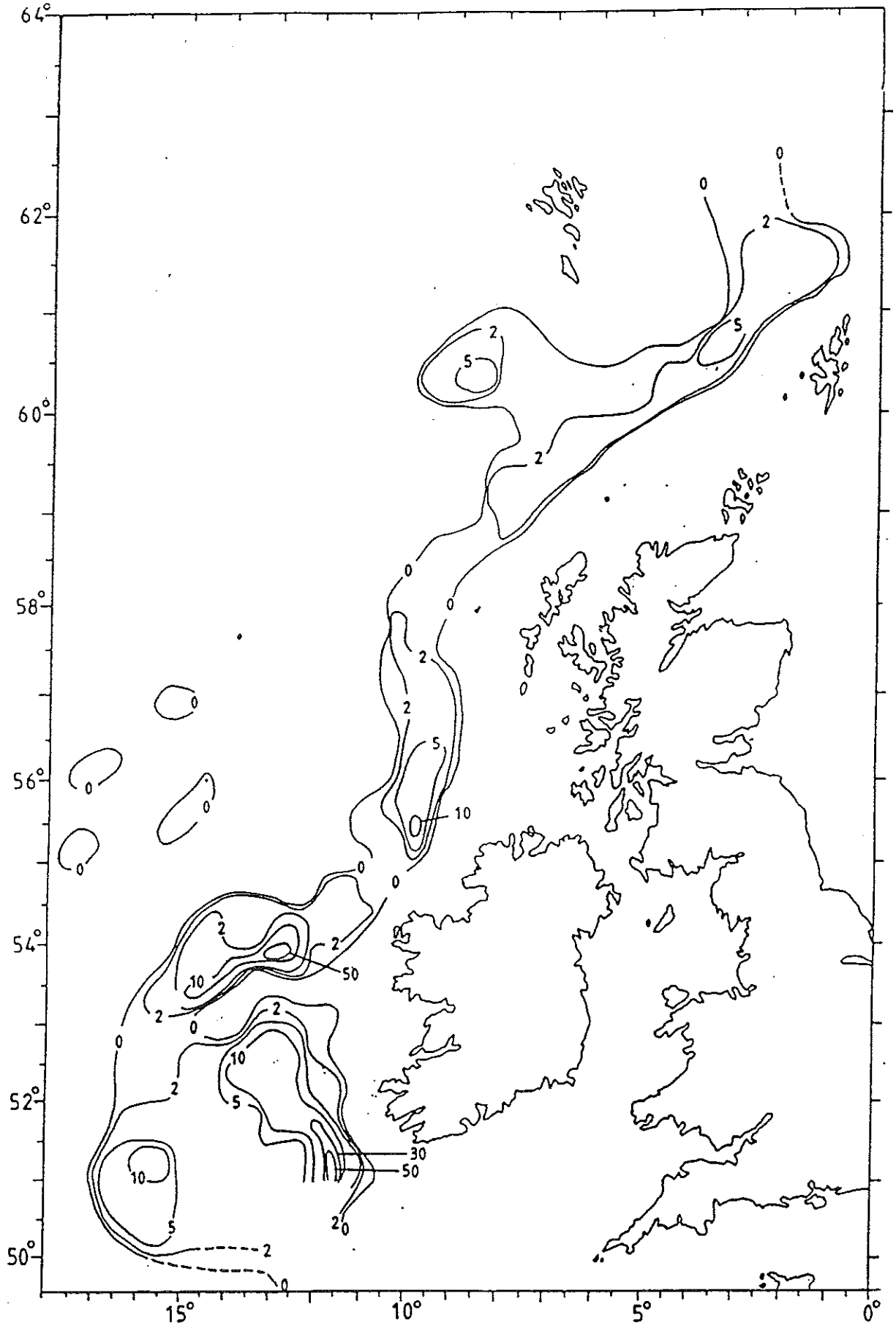


Figure 4.3 Density distribution of blue whiting, spring 1991. Combined recordings of R.V."Johan Hjort" and R.V."Pinro". Echo intensity in m^2 per square nautical mile x 1/100.

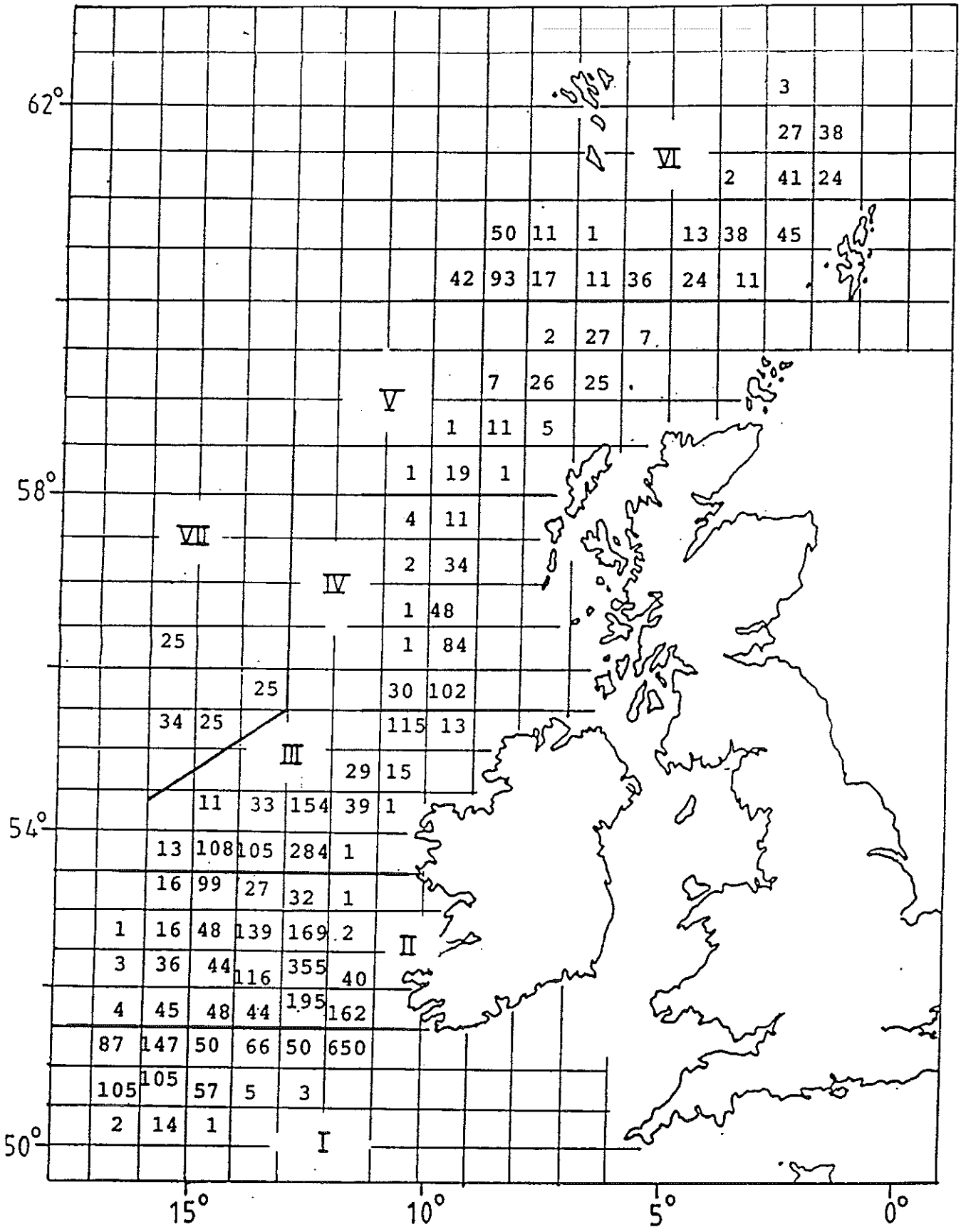


Figure 4.4 Estimated biomass ('000 tonnes) of blue whiting, spring 1991. Rectangles and subareras I-VII used in the assessment.

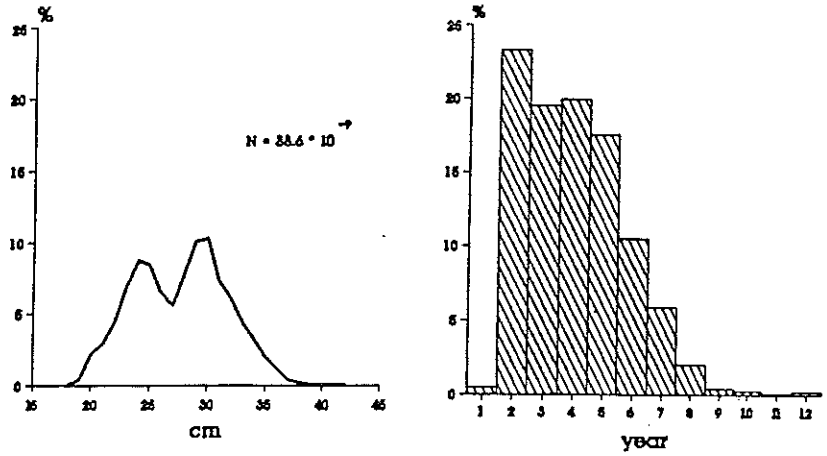


Figure 4.5

Total length- and age distribution (%) of blue whiting in the spawning area west of The British Isles, spring 1991. Numbers weighted by abundance.

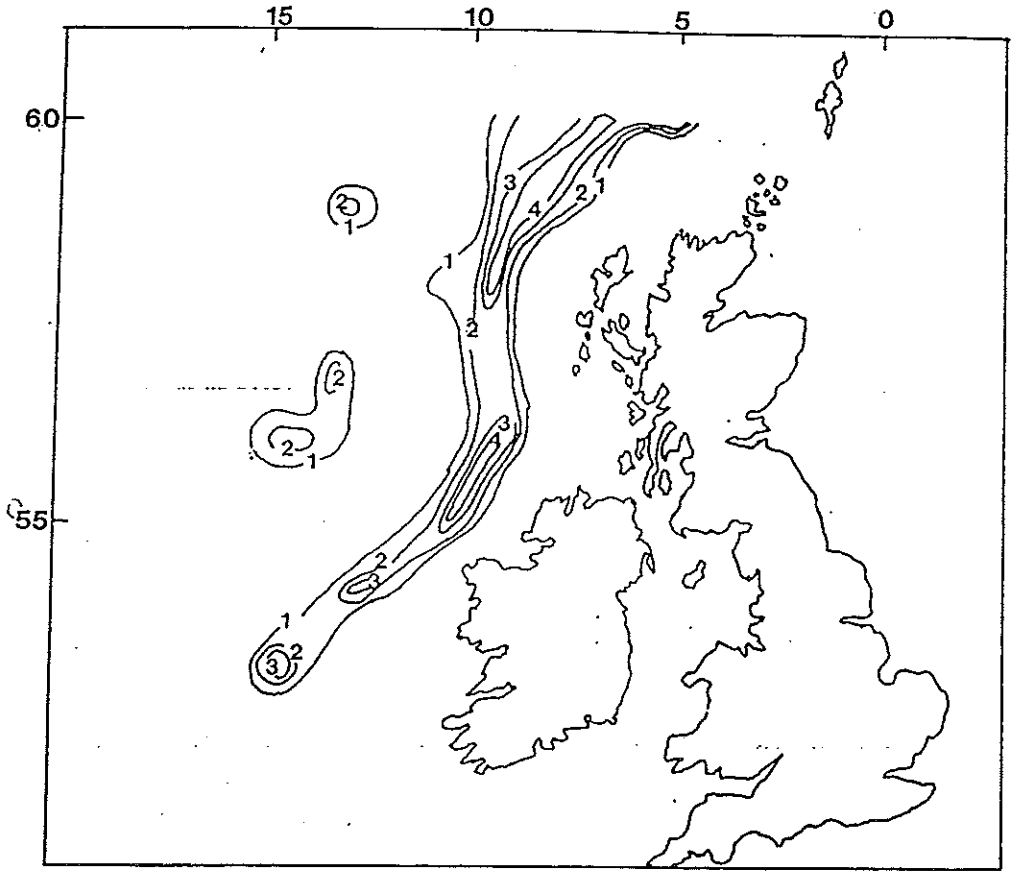


Figure 4.6

Density distribution of blue whiting recorded by R.V. Pinro 18 April - 4 May 1991. Density in tonnes/n.mile ^{2}
1) 0-10, 2) 11-50, 3) 51-250, 4) > 250

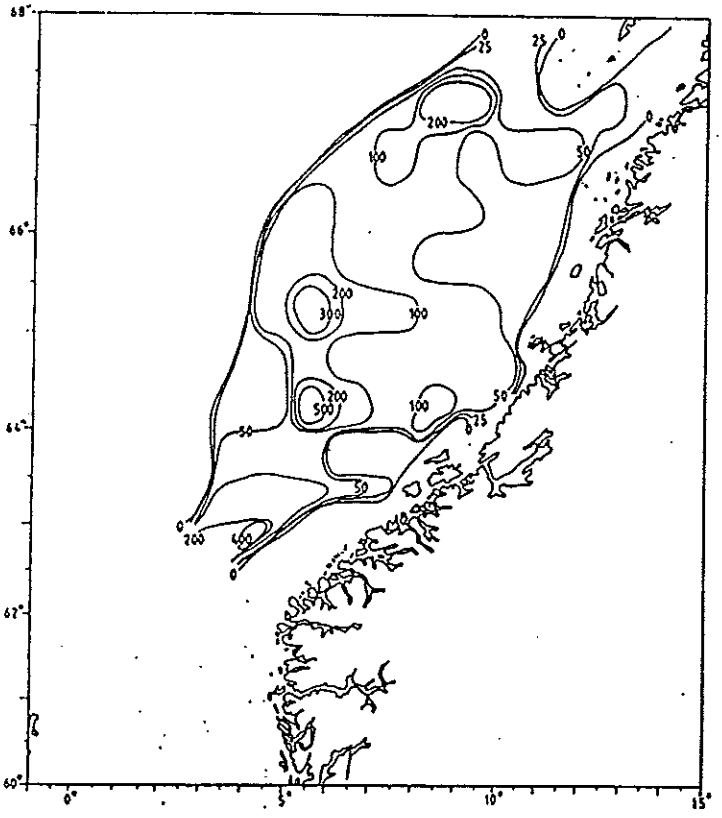


Figure 4.7 **Distribution and density of blue whiting, April 1991. Echo intensity in m^2/n.mile^2.**

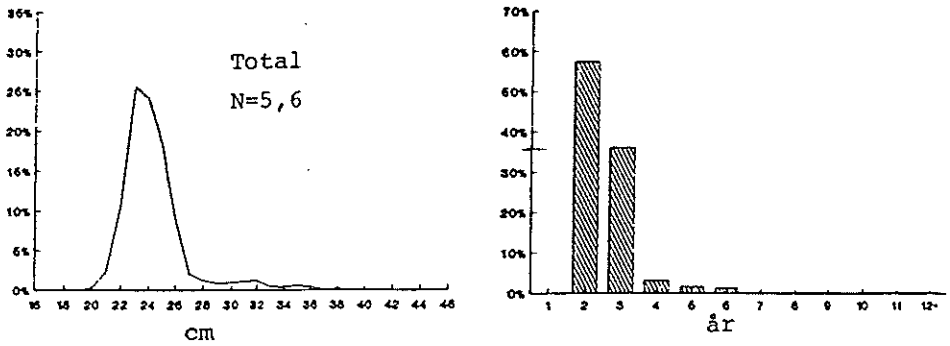


Figure 4.8 Total length and age composition of blue whiting along the Norwegian Coast between 62° and 67°N, April 1991, weighted by abundance. N x 10^{-9}.

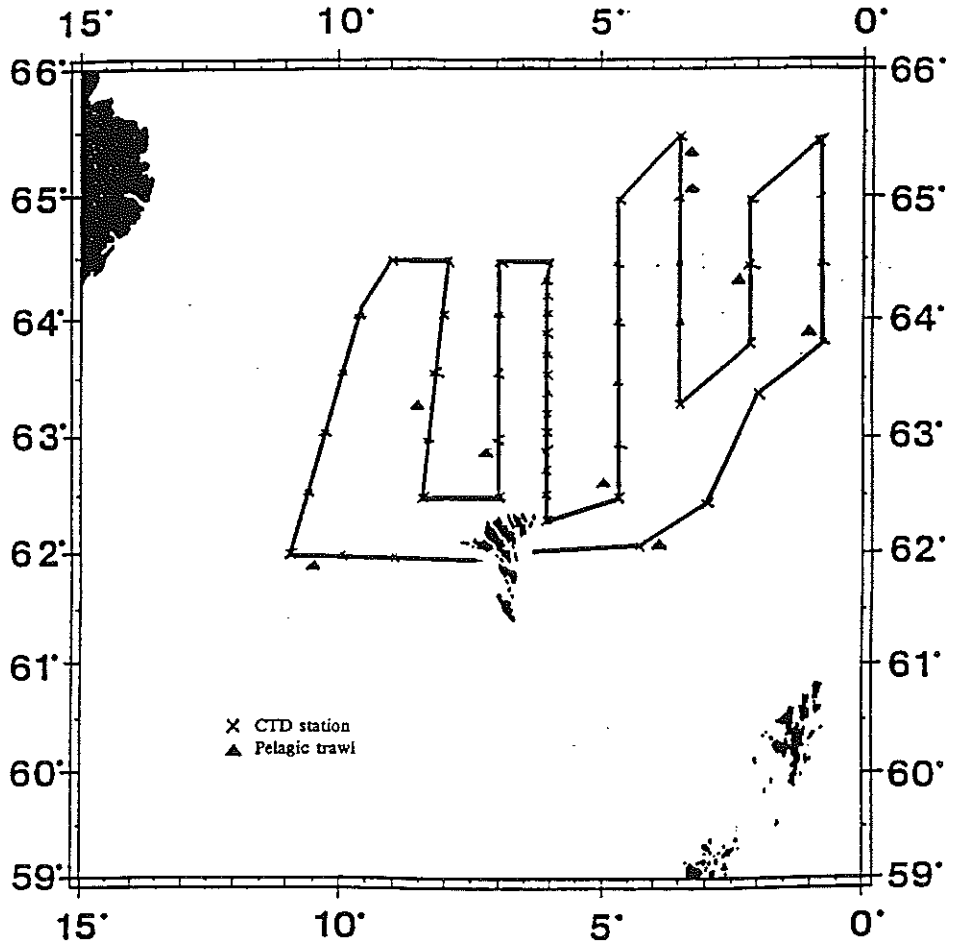


Figure 4.9 Cruise tracks with trawl stations and hydrographical stations. R/V *Magnus Heinason*, August 1991. Symbols: plus - CDT station, triangle - pelagic trawl.

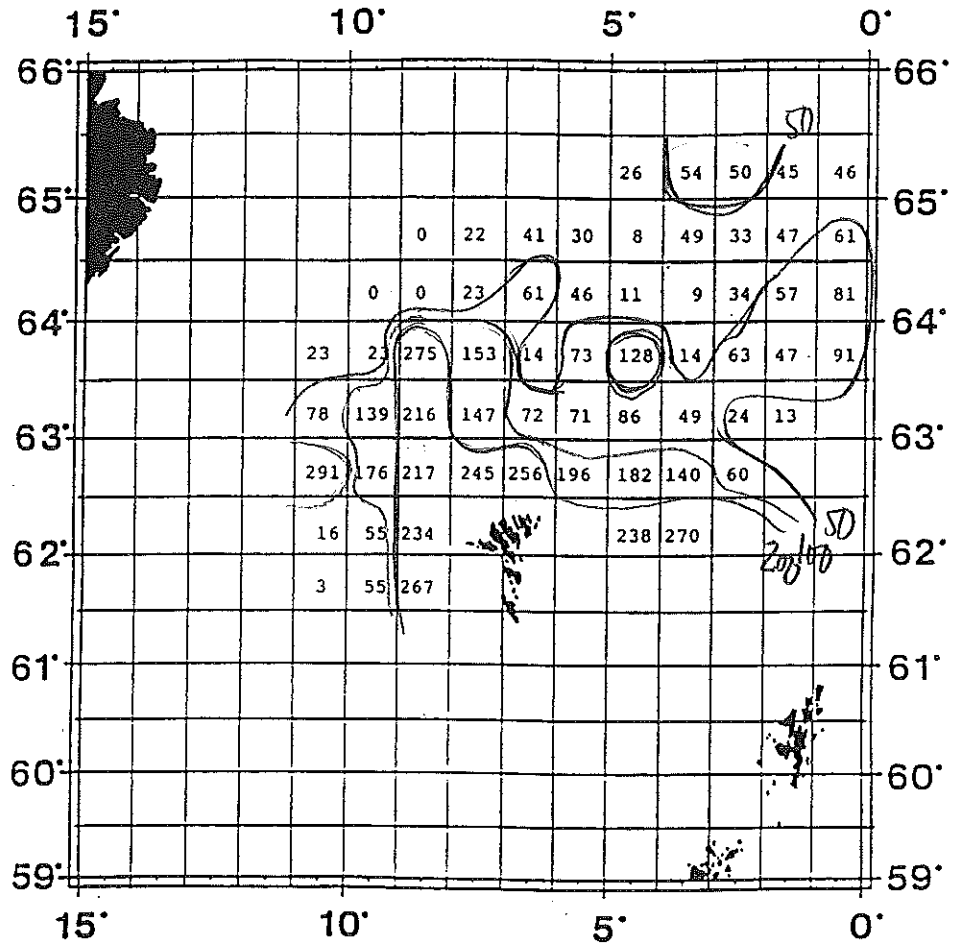


Figure 4.10 Mean integrator values (s_A) of blue whiting in each rectangle, August 1991. (units in m^2/nm^2).

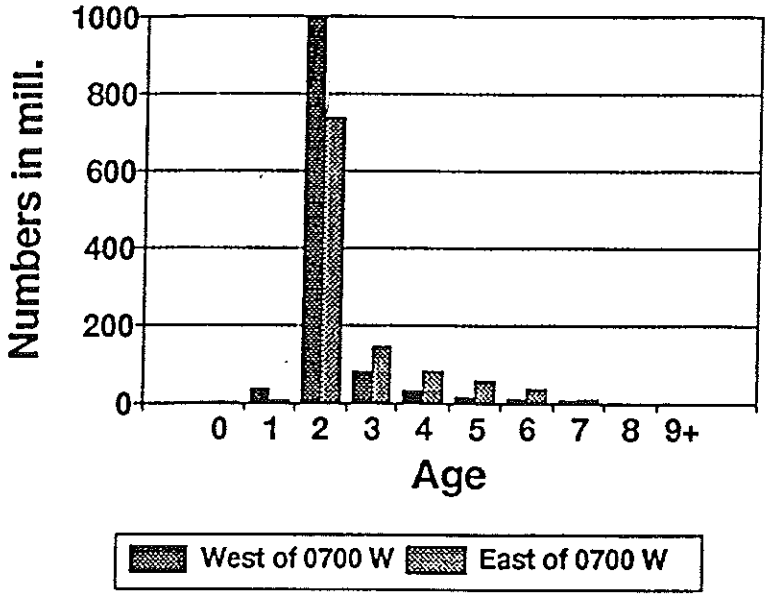


Figure 4.11 Age distribution of blue whiting in the north-western and the north-eastern part of the surveyed area, August 1991.

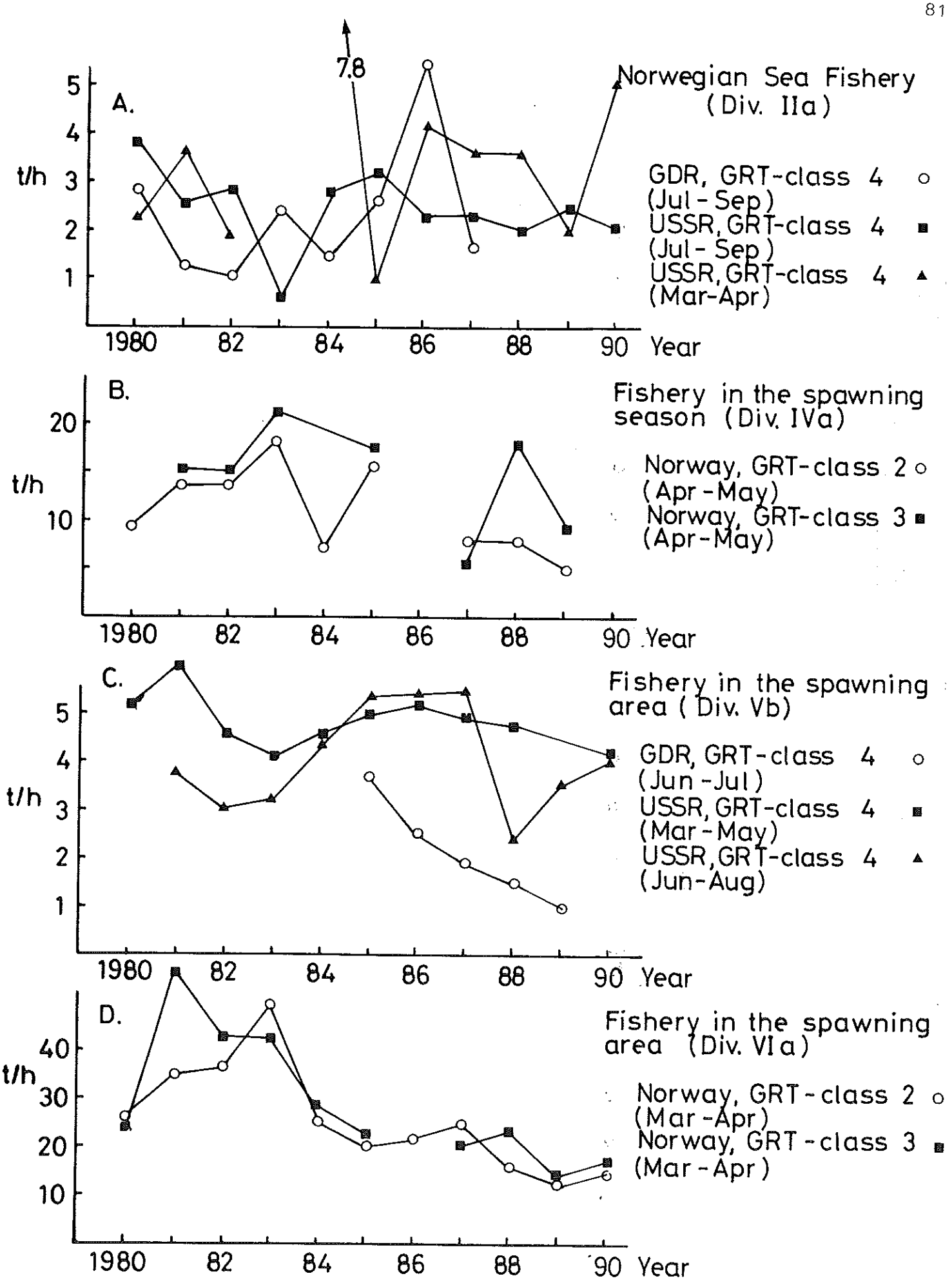


Figure 4.12A-D Trends in CPUE of the BLUE WHITING fishery in the Northern area.

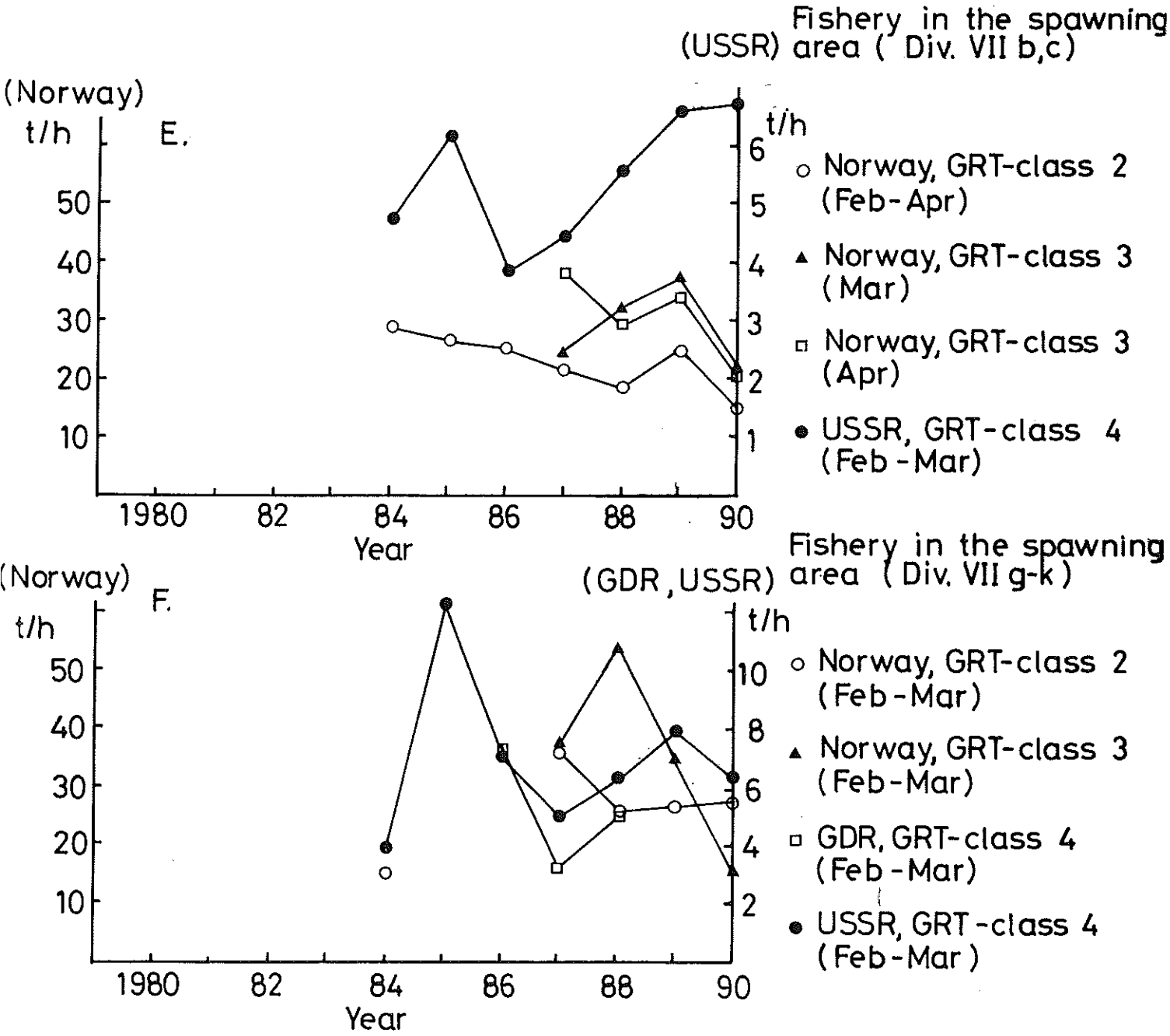


Figure 4.12E-F Trends in CPUE of the BLUE WHITING fishery in the Northern area.

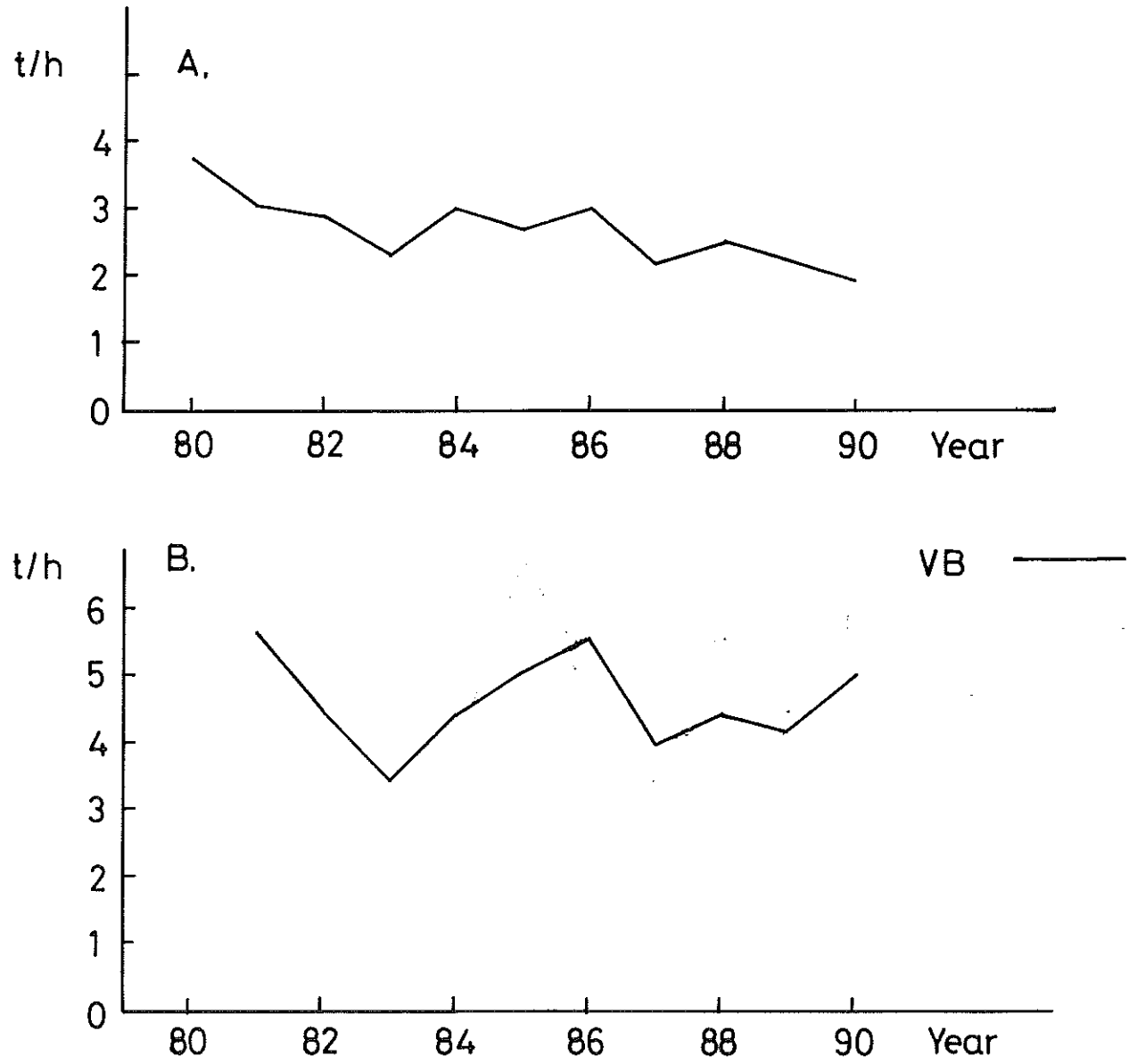


Figure 4.13 Aggregated USSR CPUE by Division
a) Division IIa
b) Divisions Vb

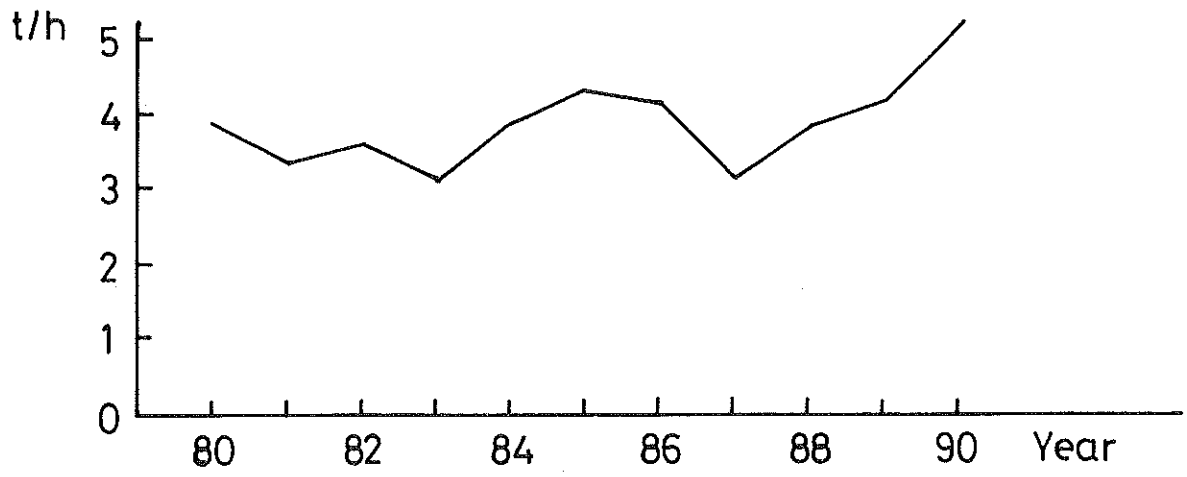


Figure 4.14 Overall aggregated USSR CPUE in Northern BLUE WHITING fishery.

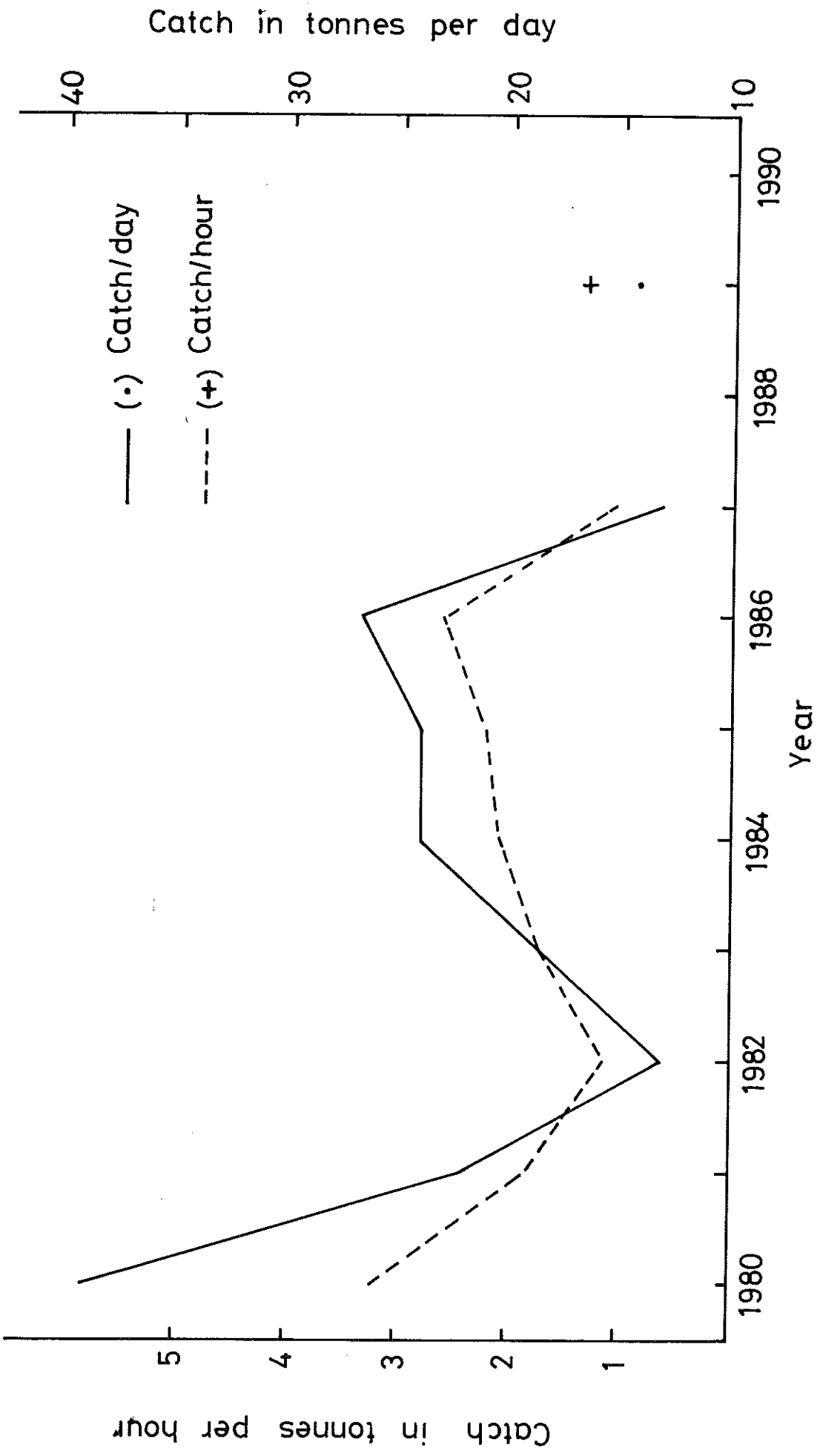


Figure 4.15 CPUE for the German GRT 2,000-3,999 t vessel class in Division IIa.

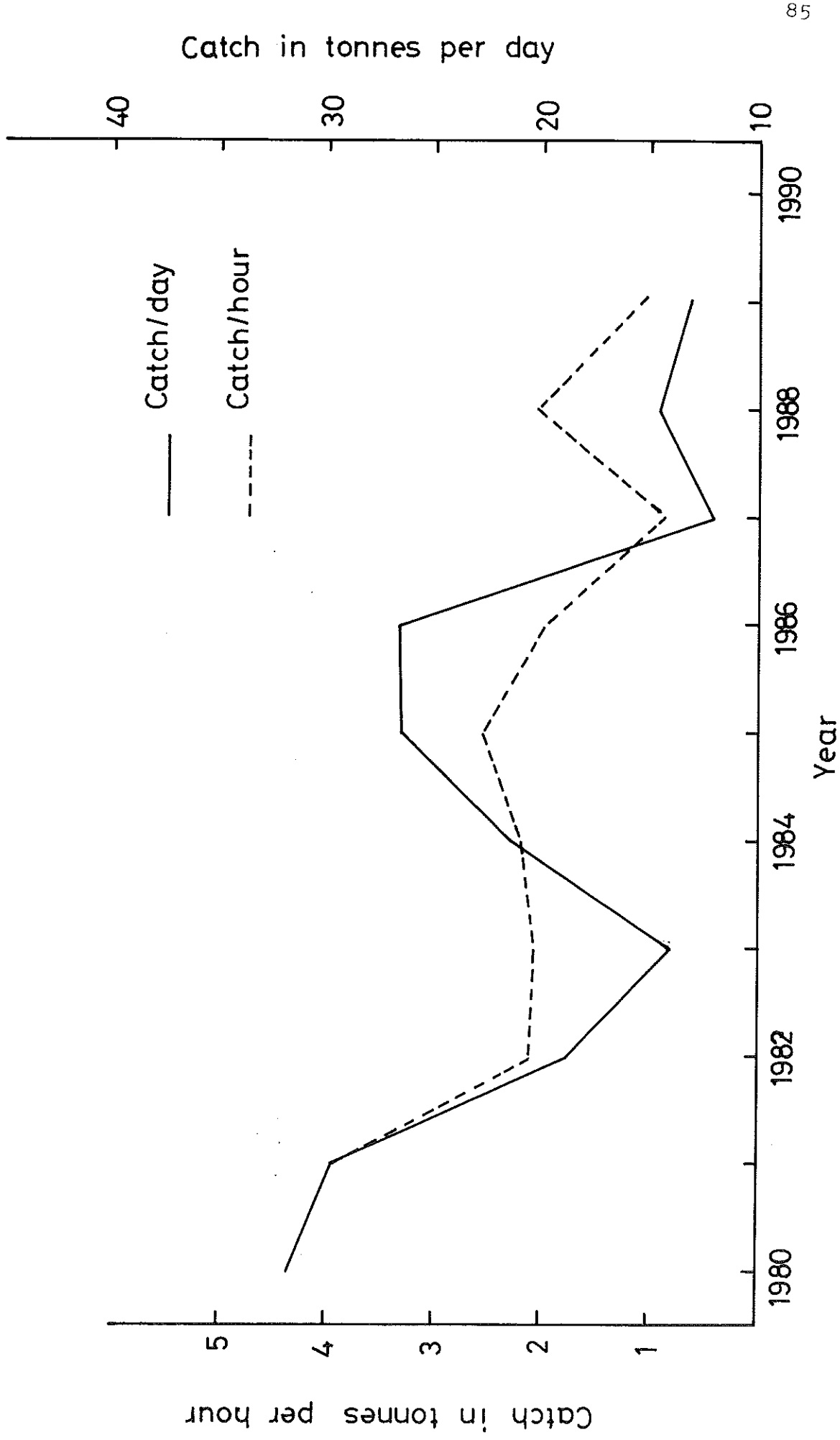


Figure 4.16 CPUE for the German GRT 2,000-3,999 t vessel class in Division Vb.

Figure 4.17 Catch per day for Norwegian vessels of GRT class II and III in Divisions VIa (April) and VIIb,c (March).

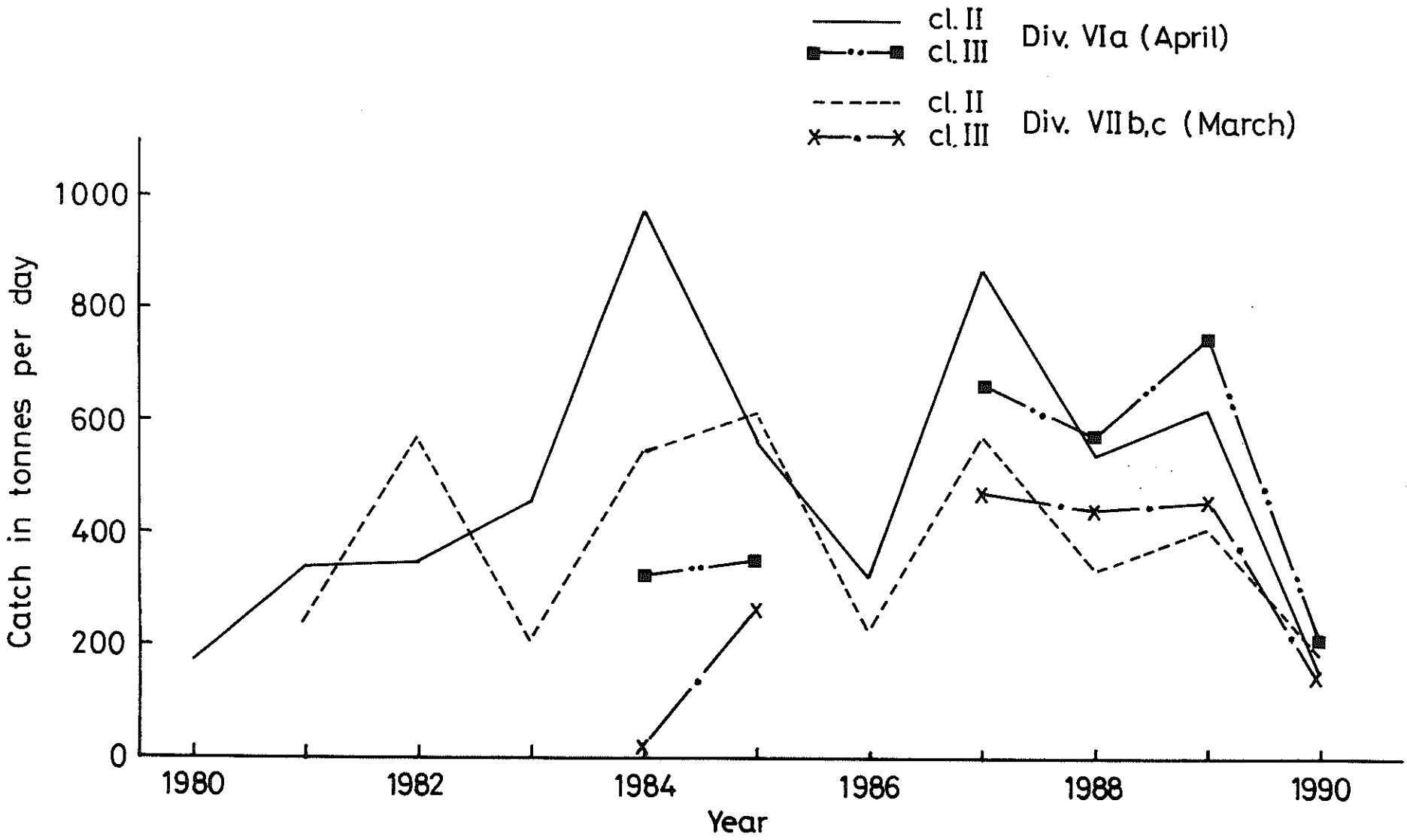


Figure 4.18 Catch per day in tonnes for UK (Scotland) vessels (all types) in the blue whiting industrial mixed fishery, 1980-1990.

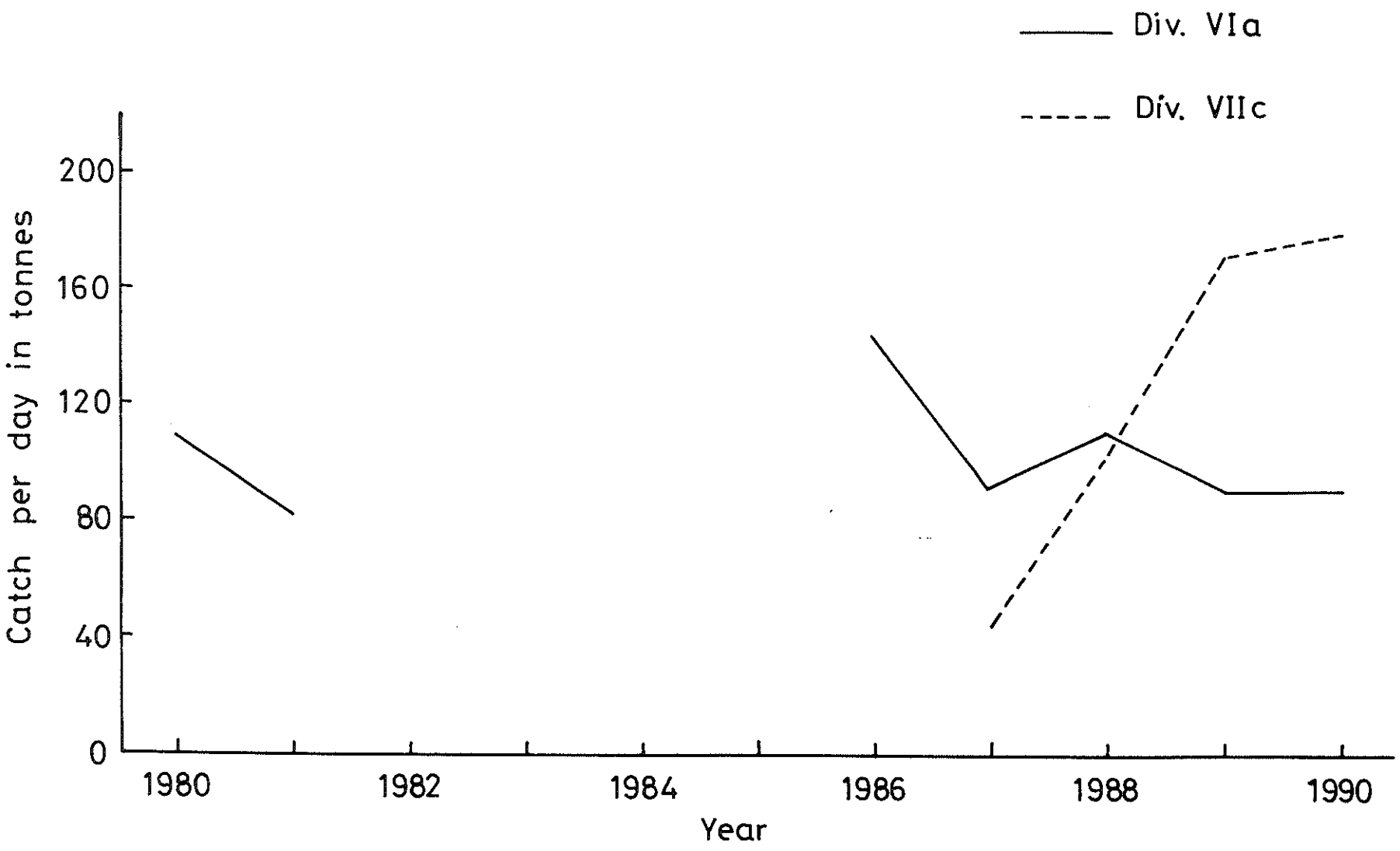


Figure 4.19a

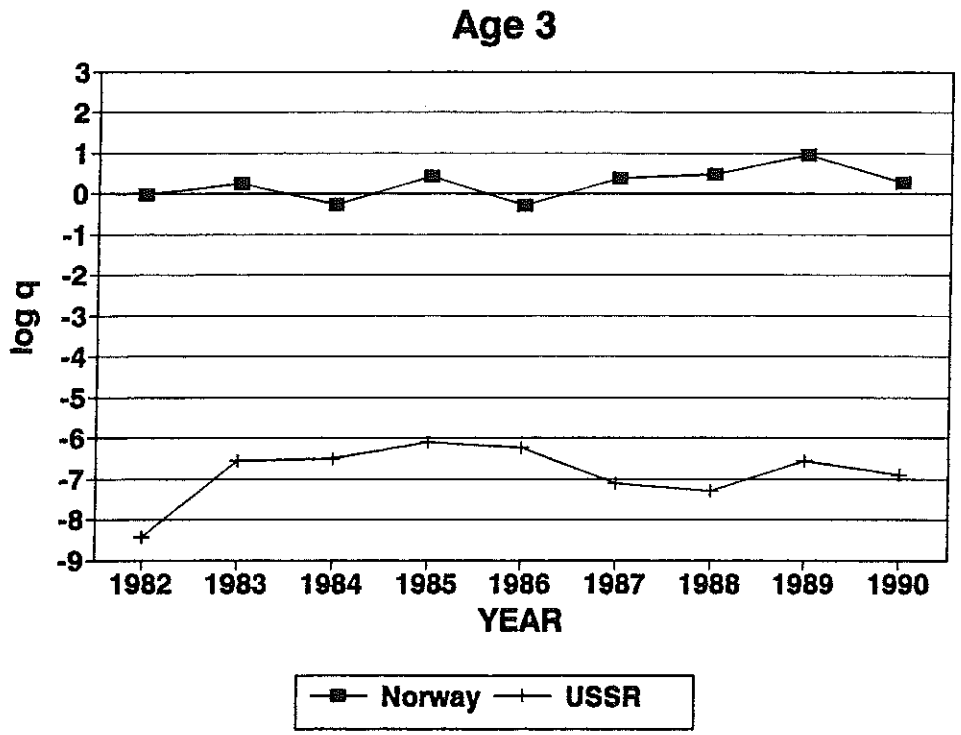


Figure 4.19b

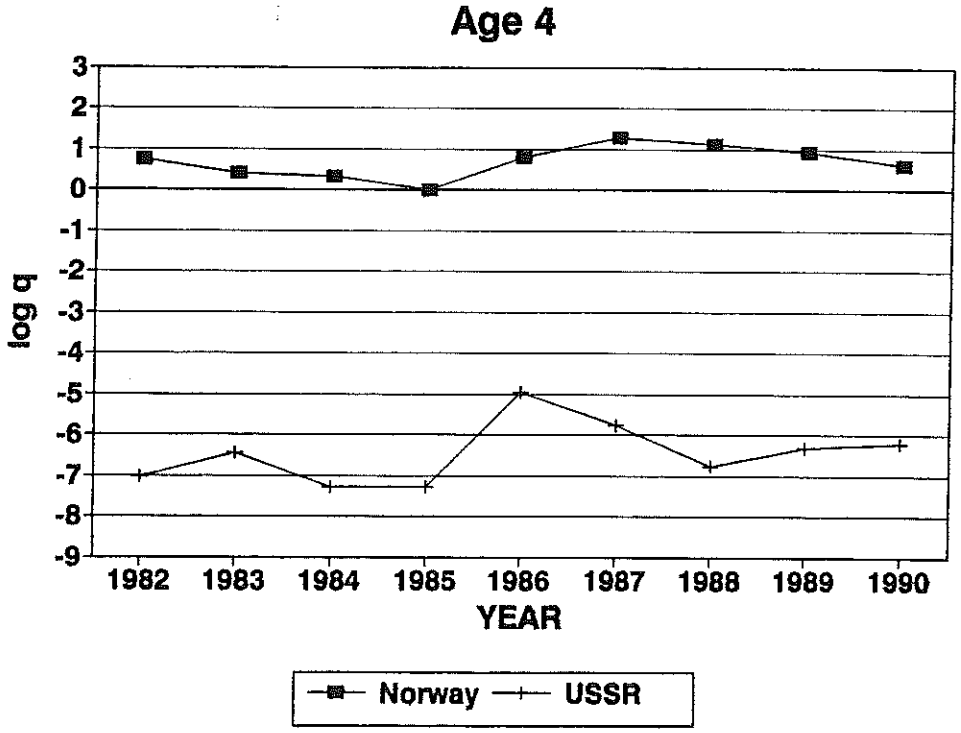


Figure 4.19c

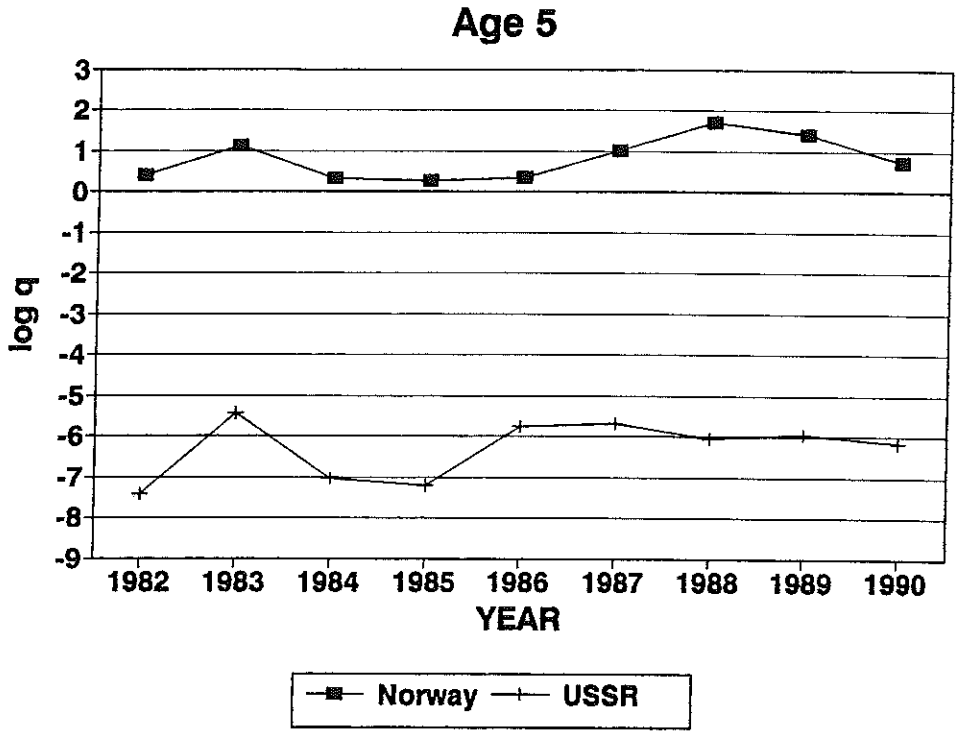


Figure 4.19d

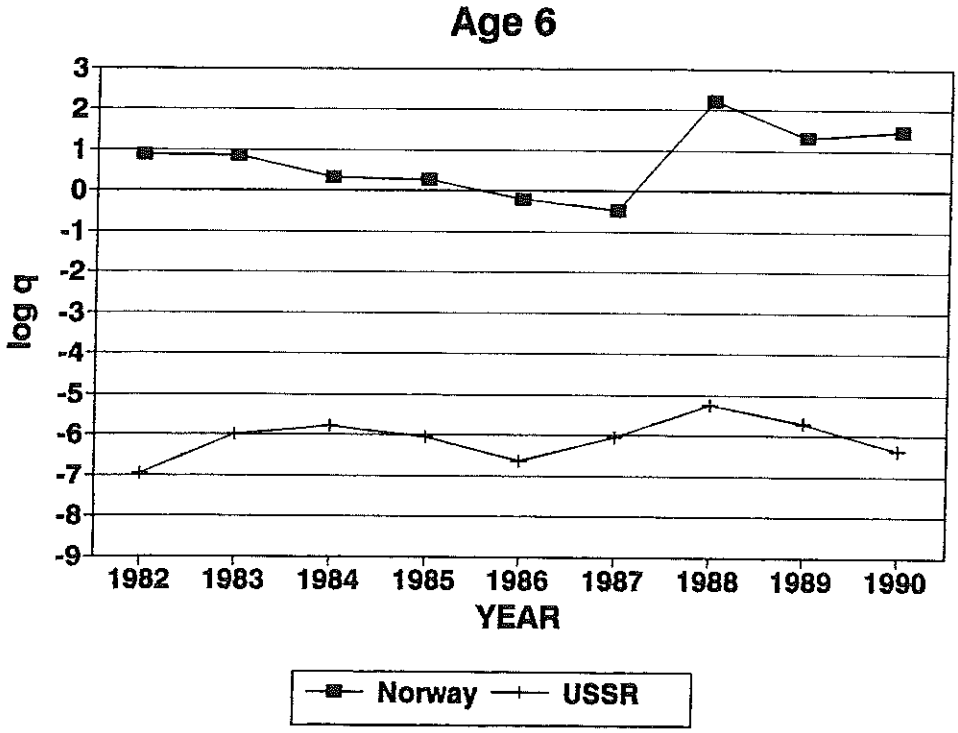


Figure 4.19e

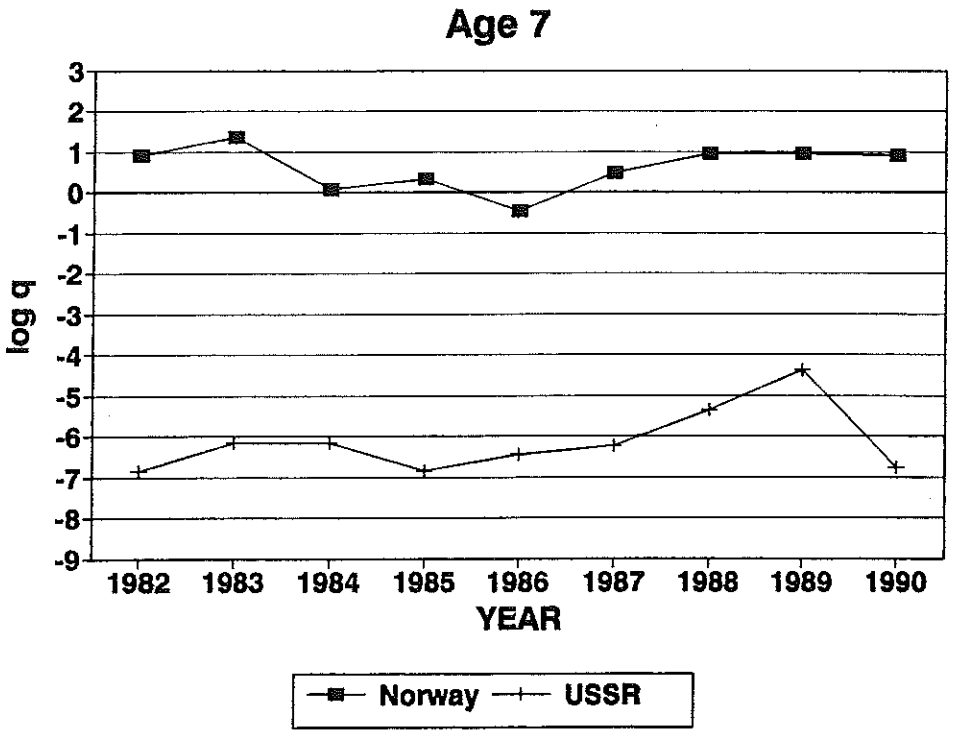


Figure 4.19f

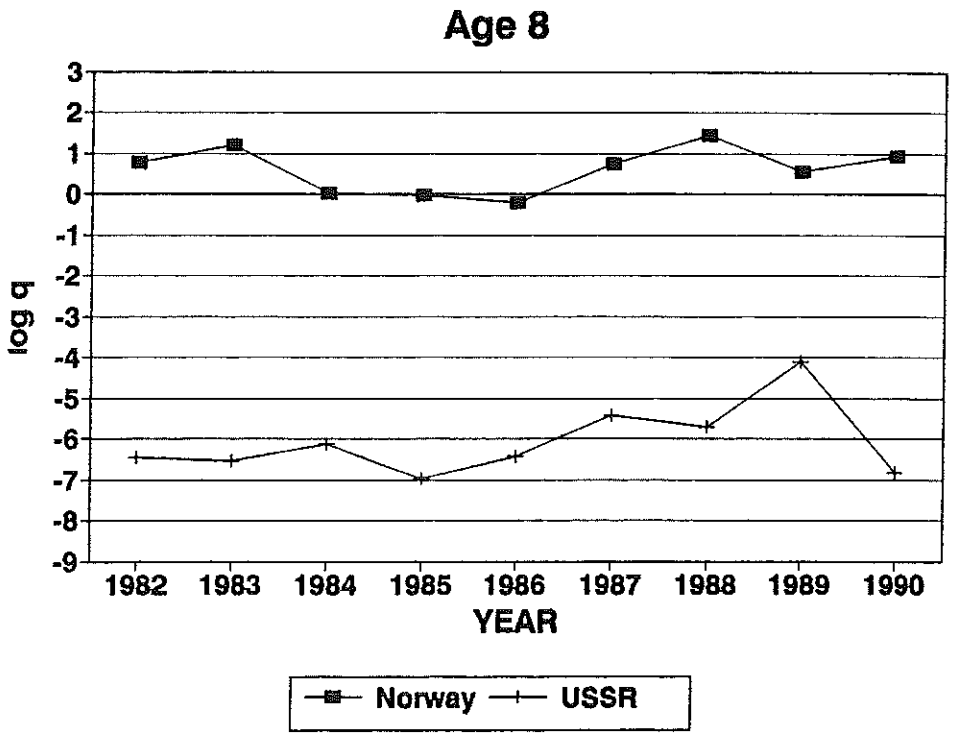


Figure 4.20

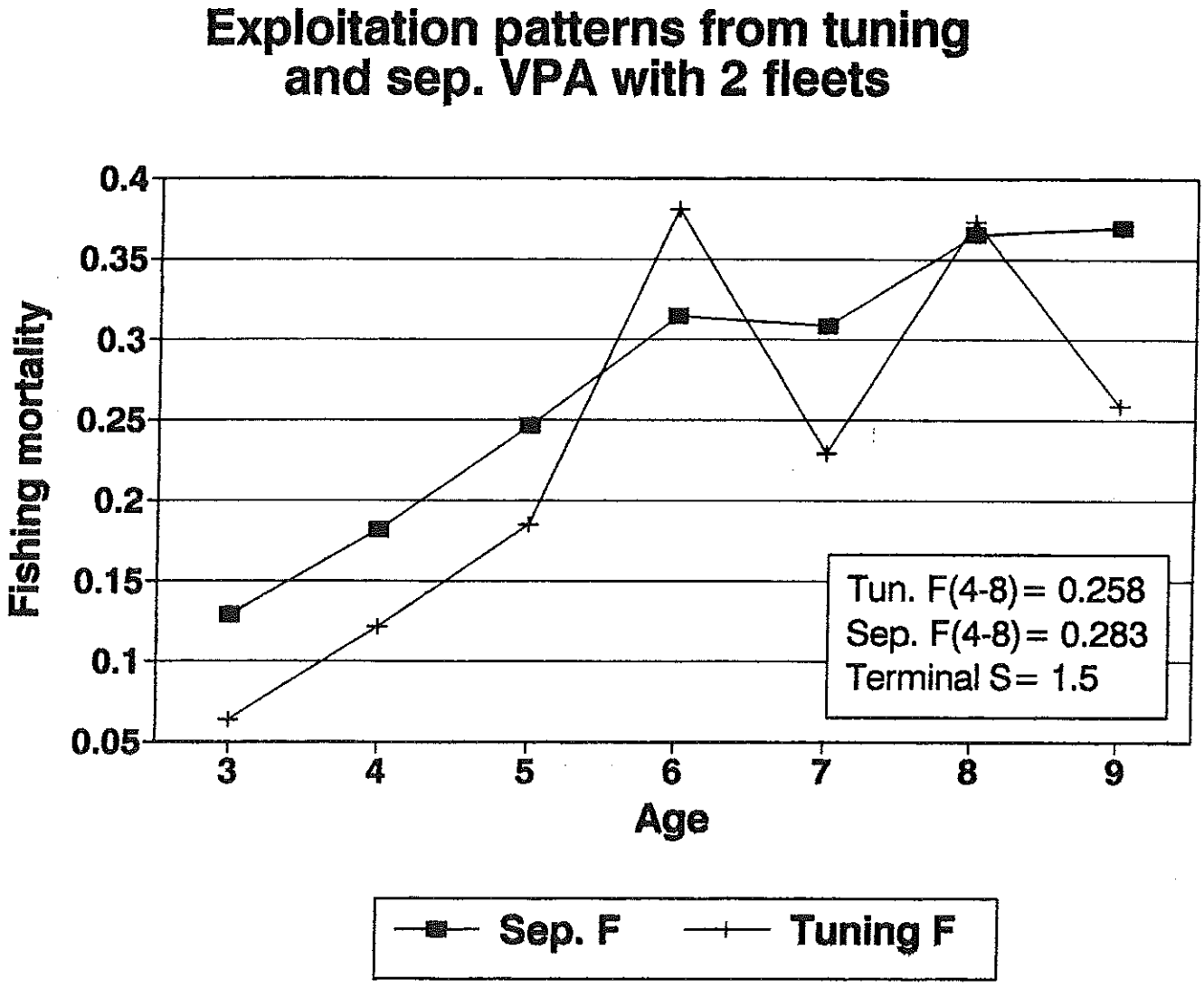
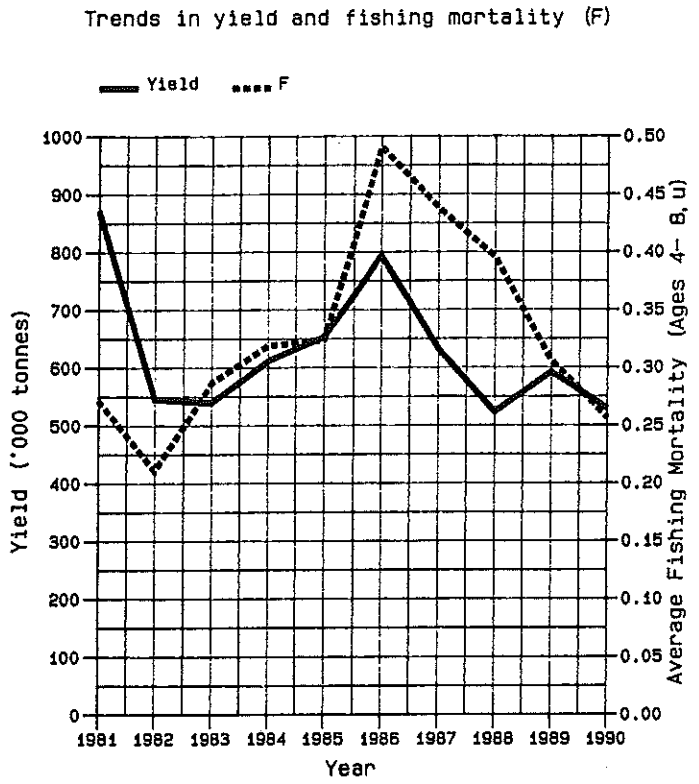
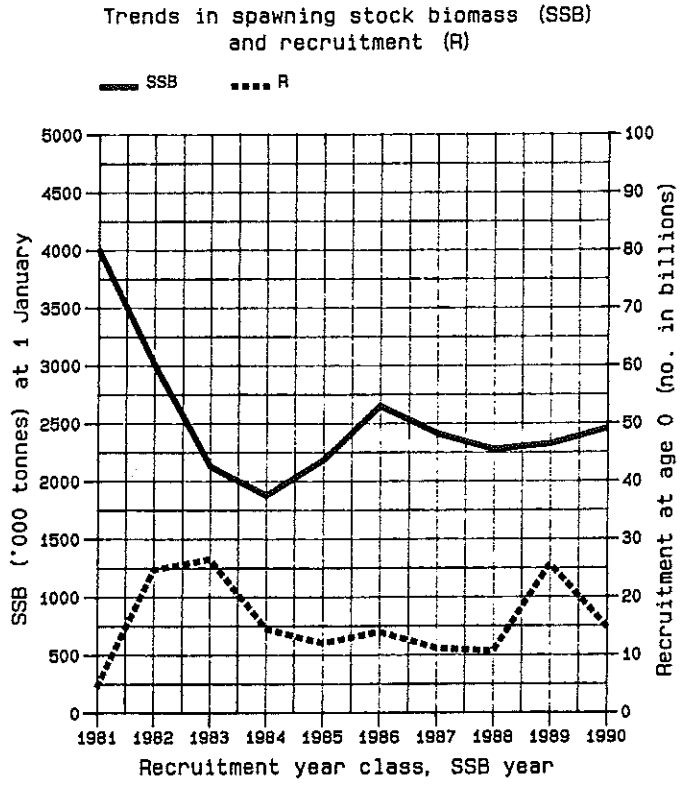

Exploitation patterns from tuning and sep. VPA with 2 fleets
Fishing mortality
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
3
4
5
6
7
8
9
Age
Tun. F(4-8)= 0.258
Sep. F(4-8)= 0.283
Terminal S= 1.5
Sep. F
Tuning F

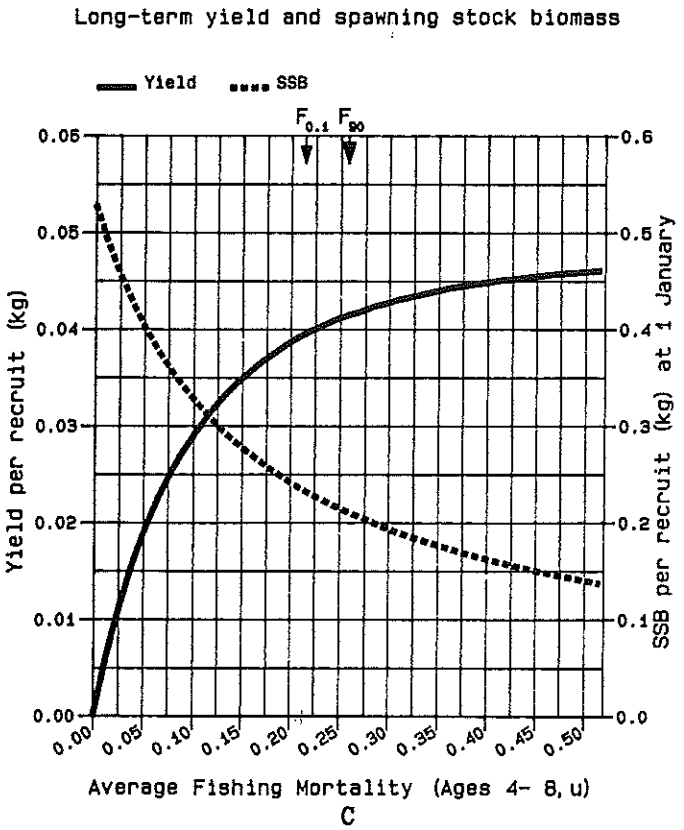
Figure 4.21

FISH STOCK SUMMARY
Blue Whiting in the Northern Area
16-10-1991





FISH STOCK SUMMARY
Blue Whiting Northern Stock
16-10-1991



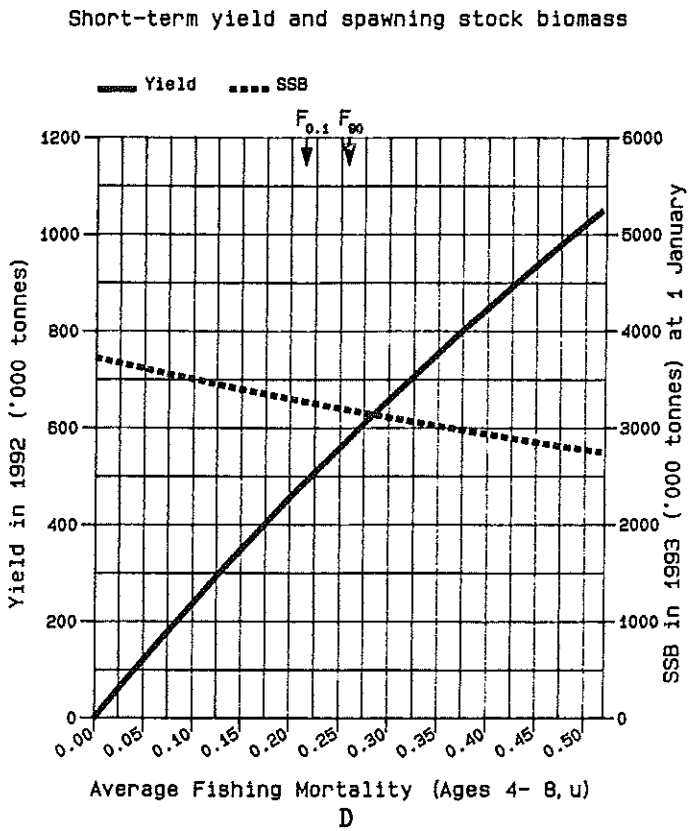
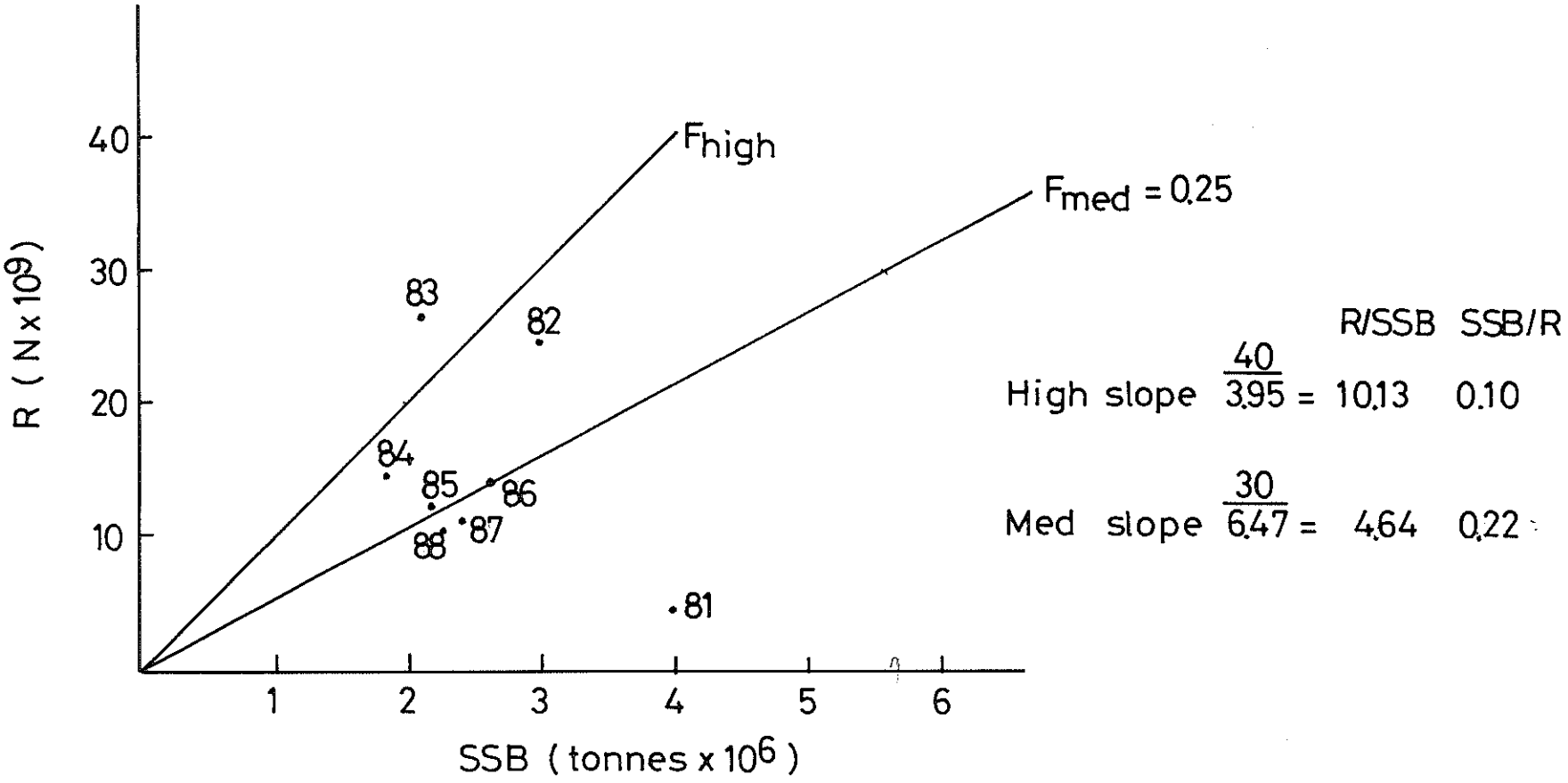
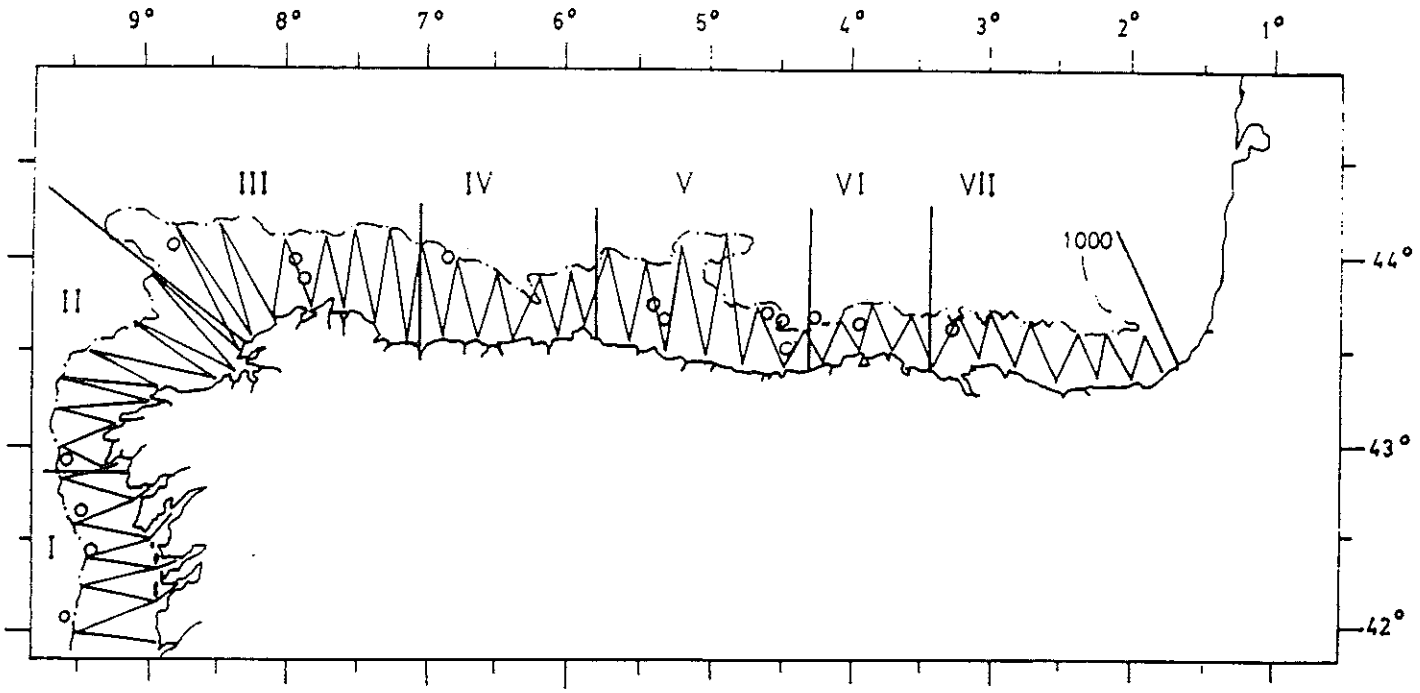


Figure 4.22 Stock-recruitment plot and estimation of F_{med} for the northern blue whiting stock.





° Pelagic trawl stations

ZONES:

I	RIAS BAIXAS
II	SISARGAS
III	A MARIÑA
IV	LUARCA
V	LLANES
VI	CANTABRIA
VII	EUSKADI

Figure 5.1 Cruise track and pelagic trawl stations.

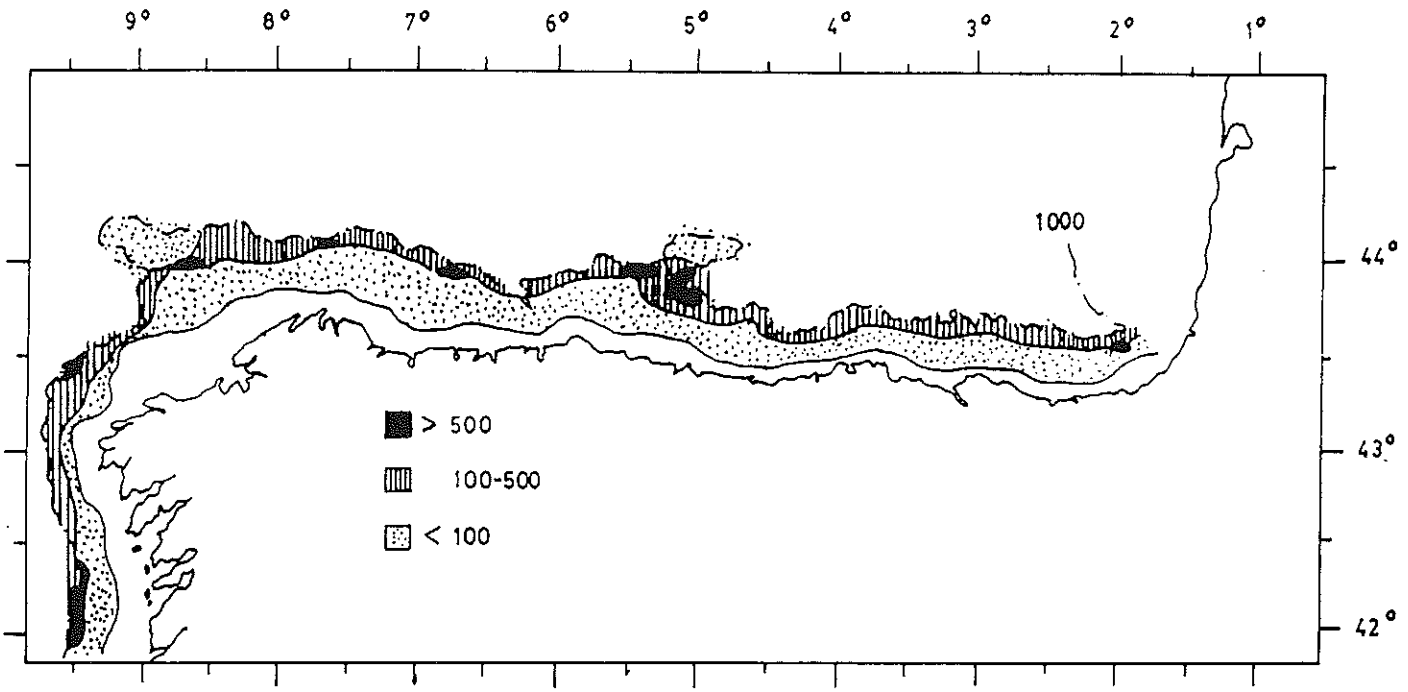


Figure 5.2 Density distribution of blue whiting. Echo intensity in m^2/n. $mile^2$.

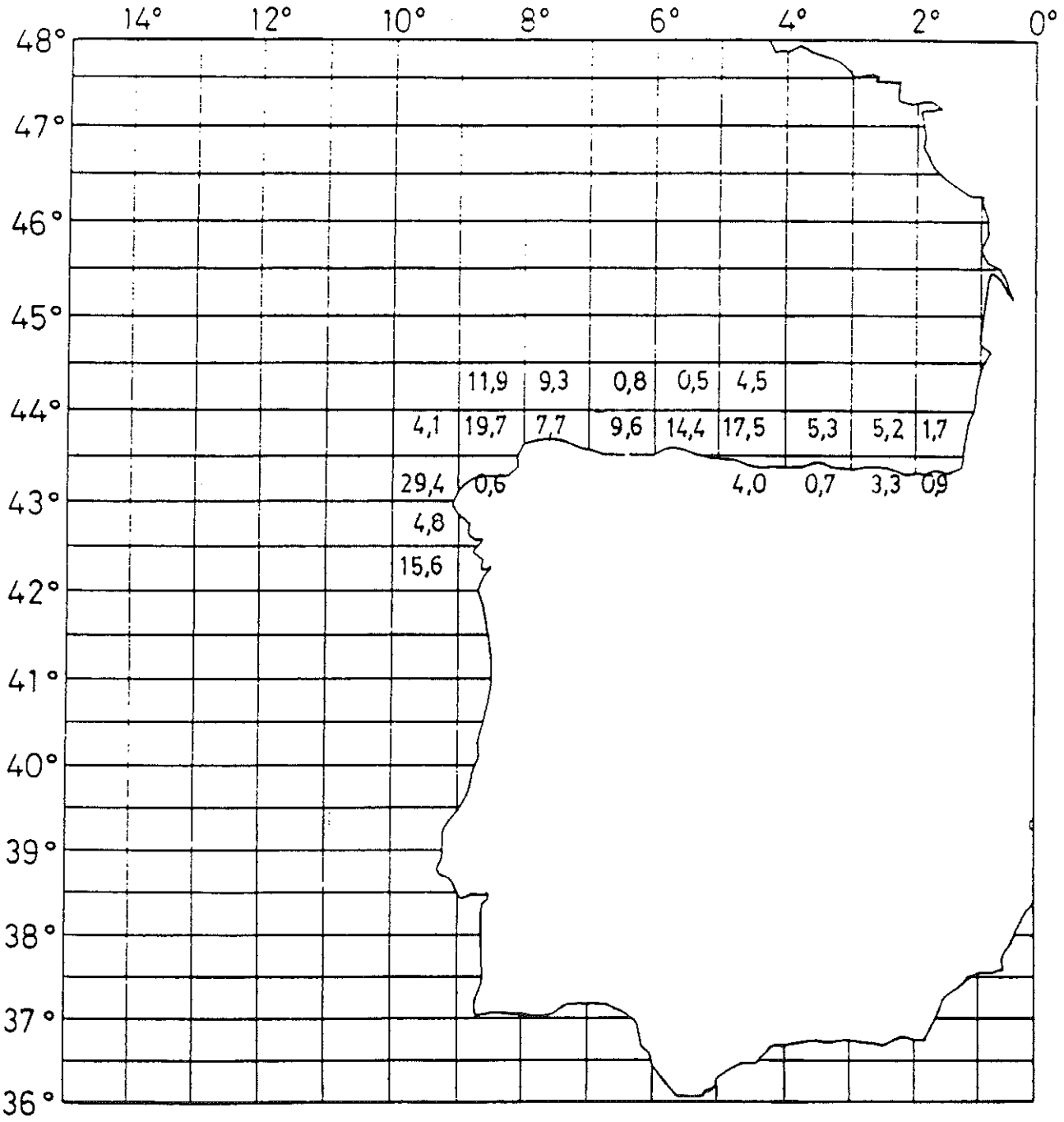


Figure 5.3 Estimated biomass (thousand tonnes) of blue whiting by ICES rectangle.

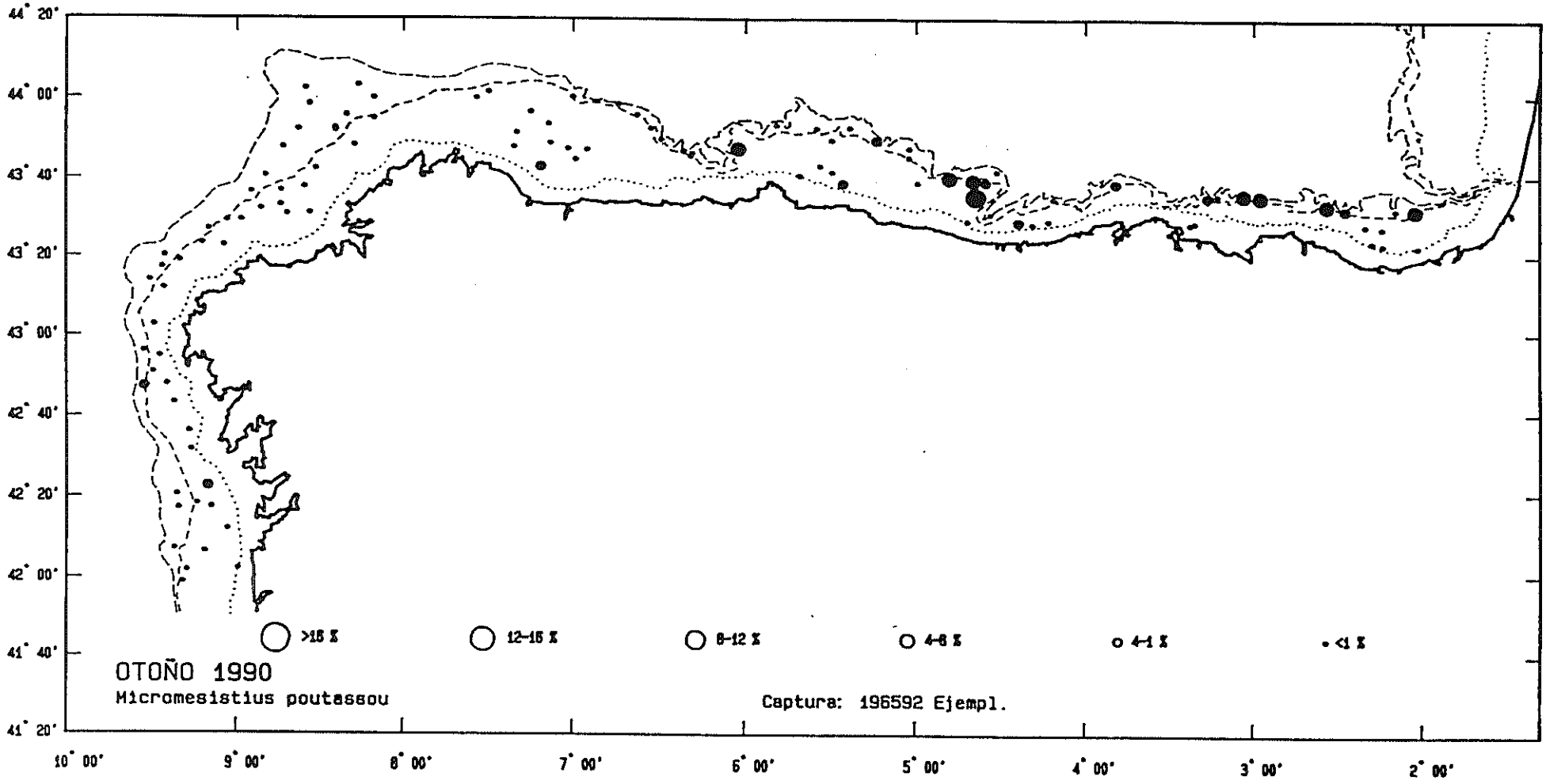
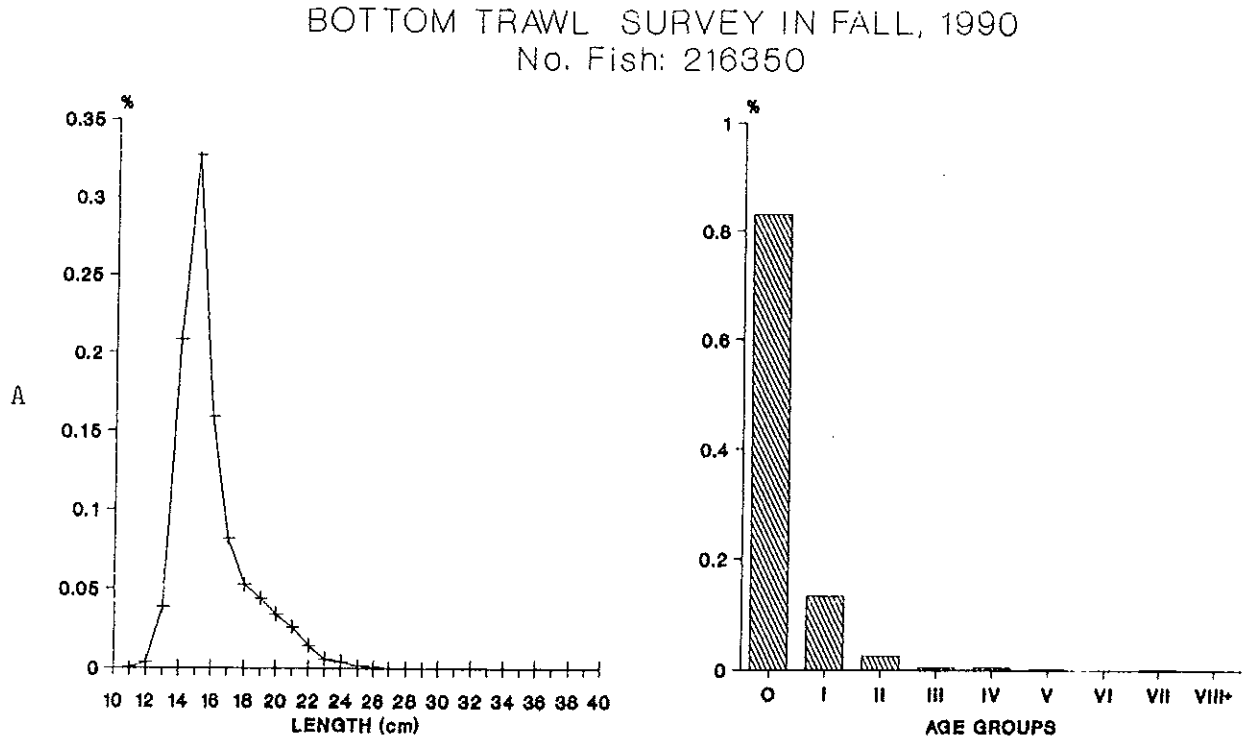
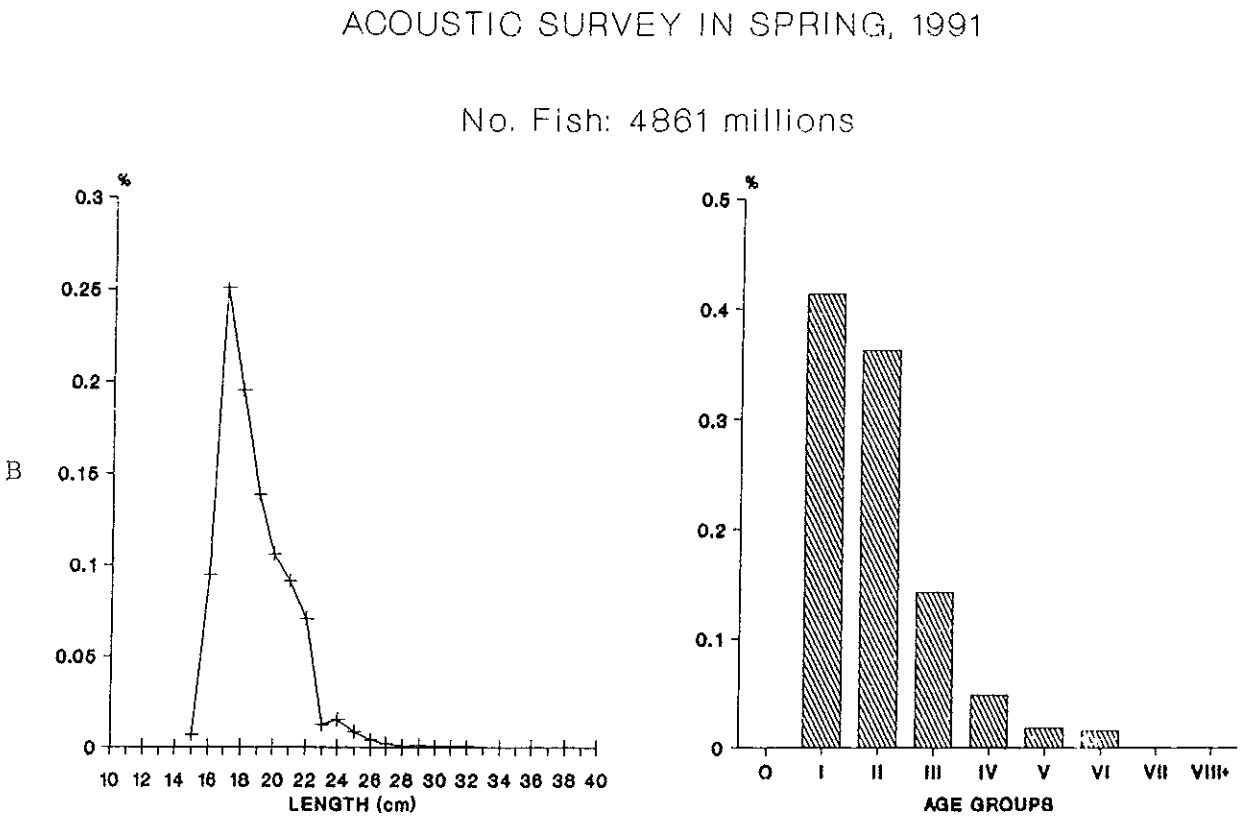


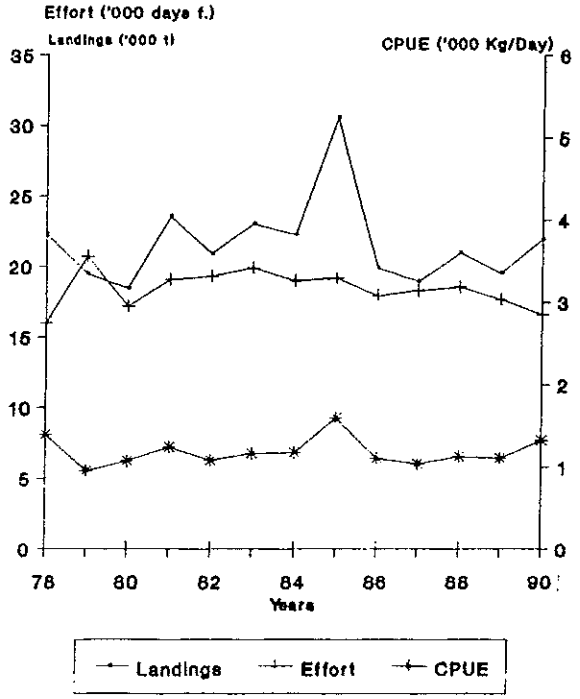
Figure 5.4 Distribution of blue whiting in the Spanish bottom trawl survey in 1990.

Figure 5.5


BOTTOM TRAWL SURVEY IN FALL, 1990
No. Fish: 216350
A
%
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
LENGTH (cm)
%
1
0.8
0.6
0.4
0.2
0
0 I II III IV V VI VII VIII+
AGE GROUPS


ACOUSTIC SURVEY IN SPRING, 1991
No. Fish: 4861 millions
B
%
0.3
0.25
0.2
0.15
0.1
0.05
0
10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
LENGTH (cm)
%
0.5
0.4
0.3
0.2
0.1
0
0 I II III IV V VI VII VIII+
AGE GROUPS

A



B

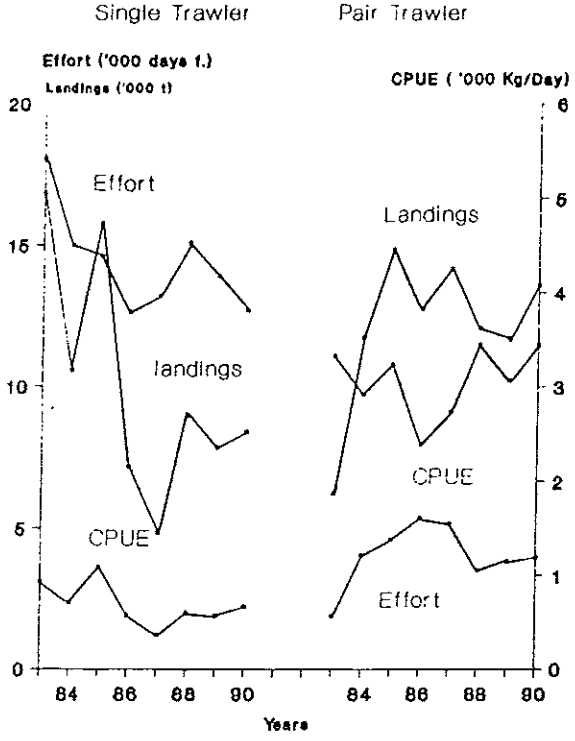
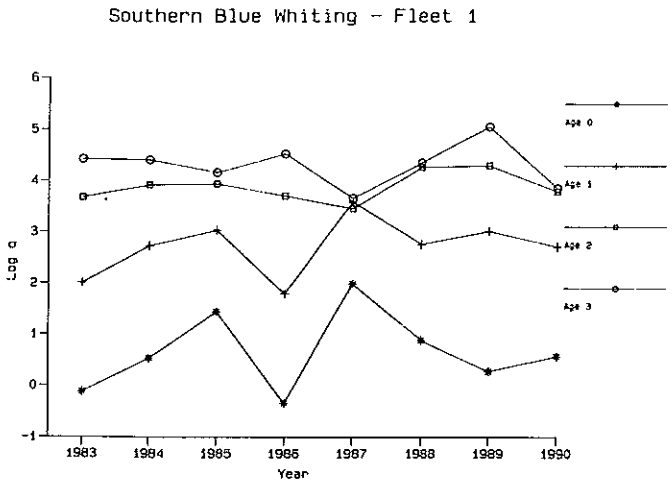
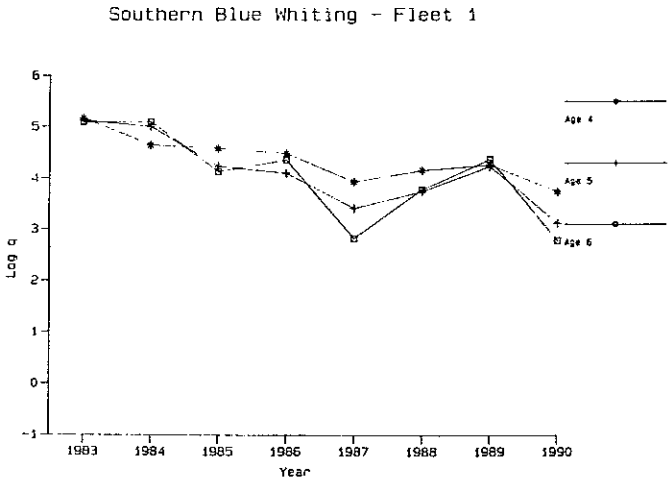


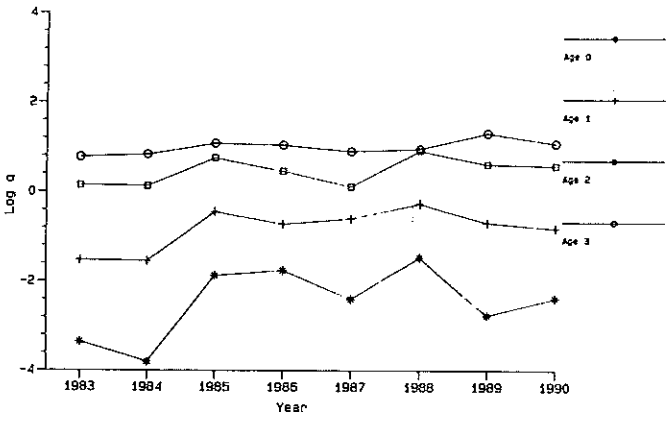
Fig. 5.6 Catch effort, and CPUE of Spanish trawlers for the Southern area.

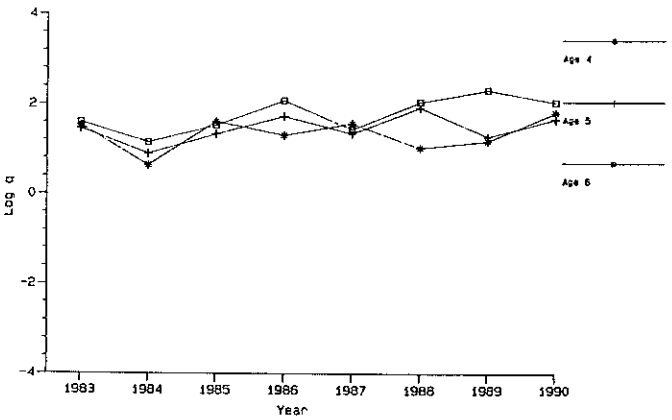
A) Total since 1978
B) Split into single and pair trawlers since 1983.

Figure 5.7 Southern blue whiting. Log catchability plots.









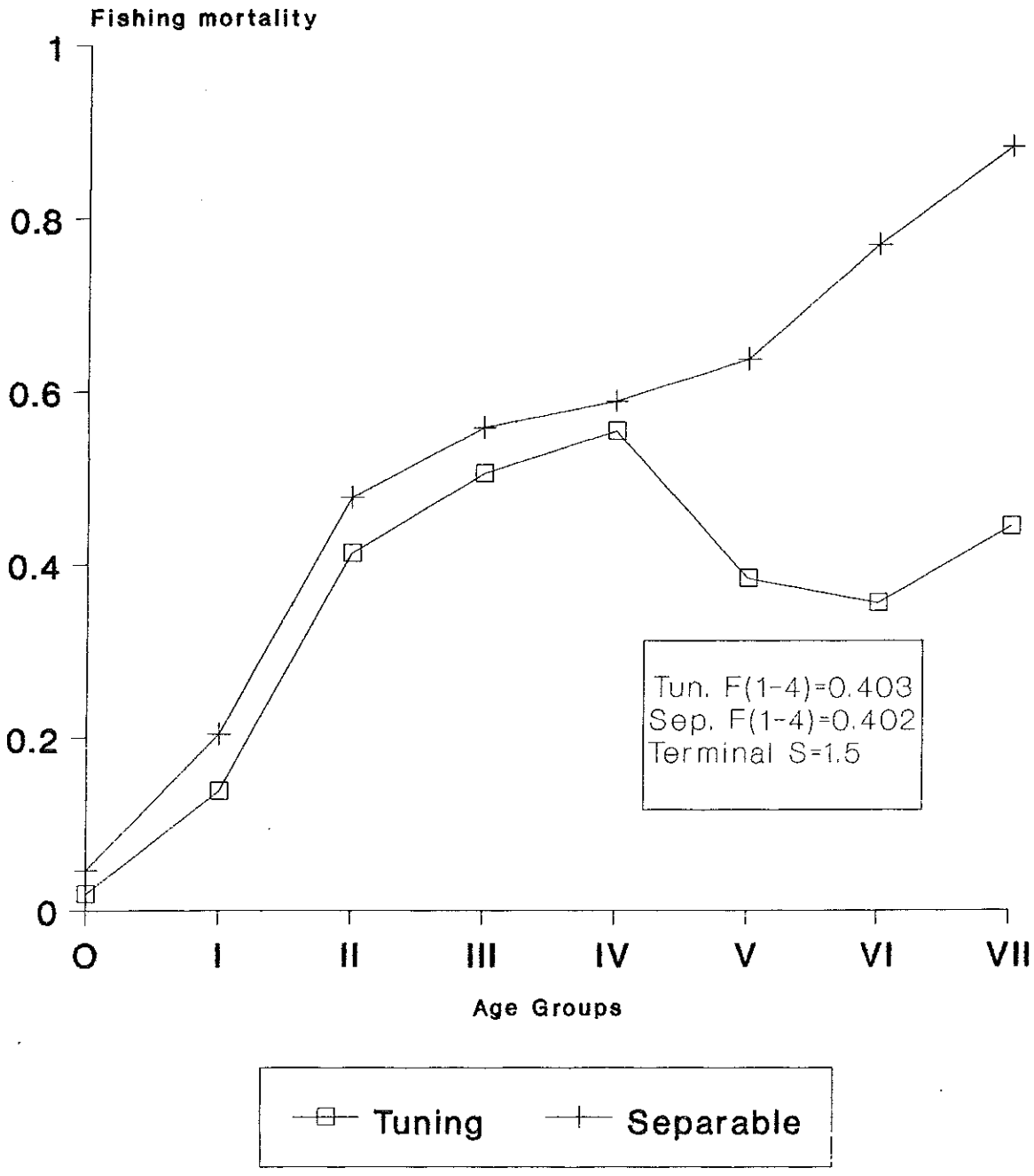
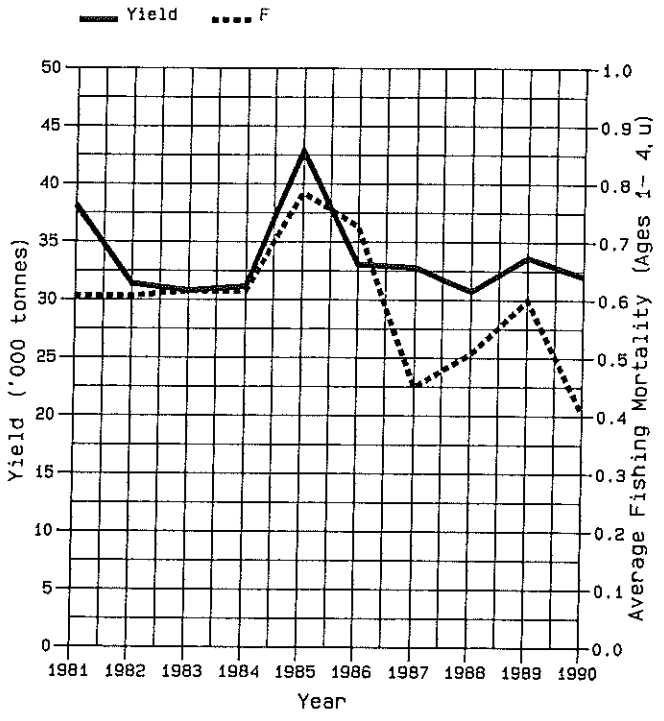


Figure 5.8 Exploitation patterns for the Southern stock.

Figure 5.9

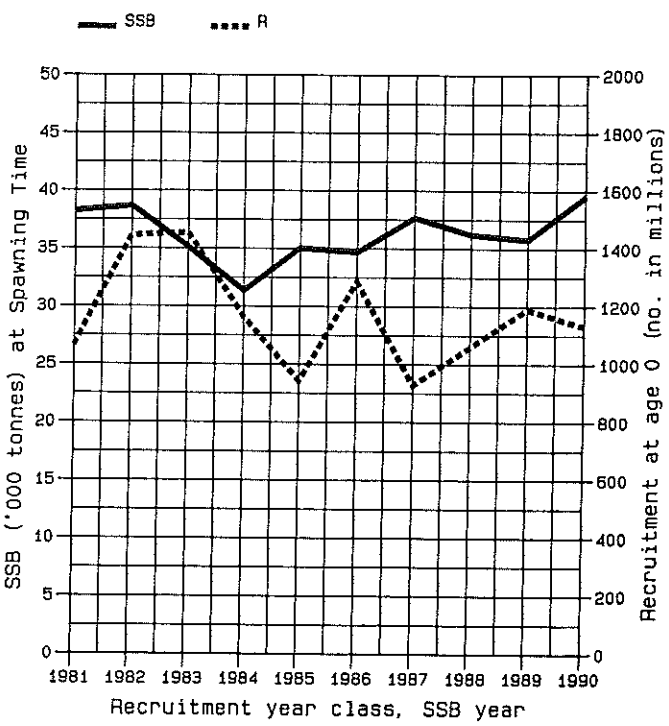
FISH STOCK SUMMARY
Blue Whiting in the Southern Area
15-10-1991

Trends in yield and fishing mortality (F)



A

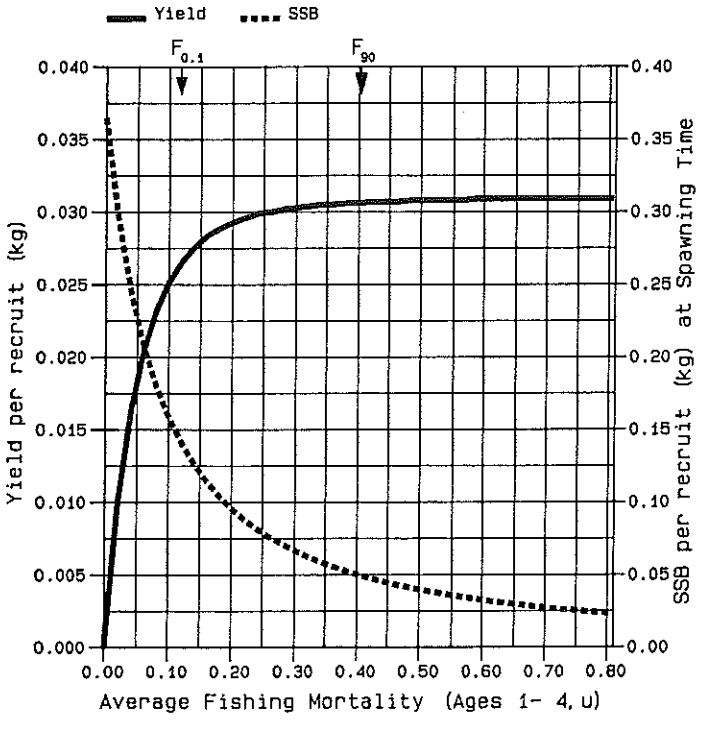
Trends in spawning stock biomass (SSB) and recruitment (R)



B

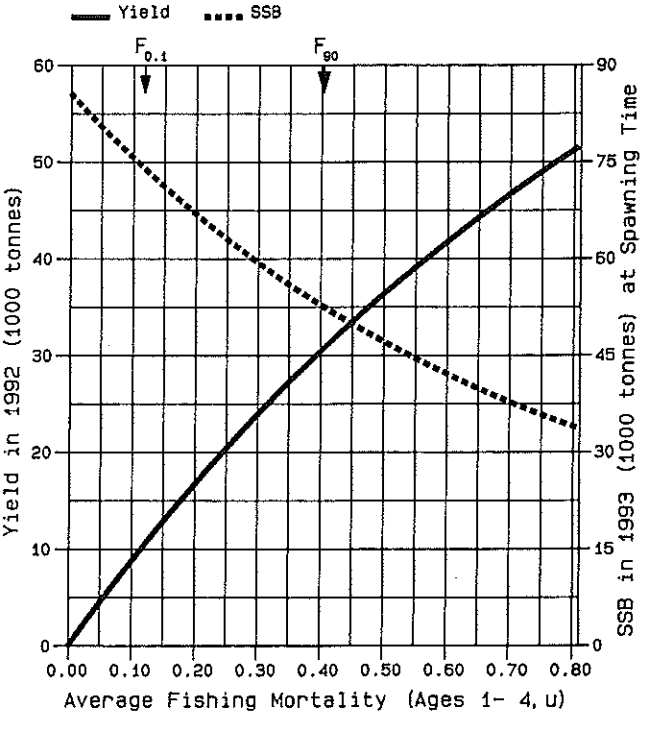
FISH STOCK SUMMARY
Blue Whiting in the Southern Area
18-10-1991

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

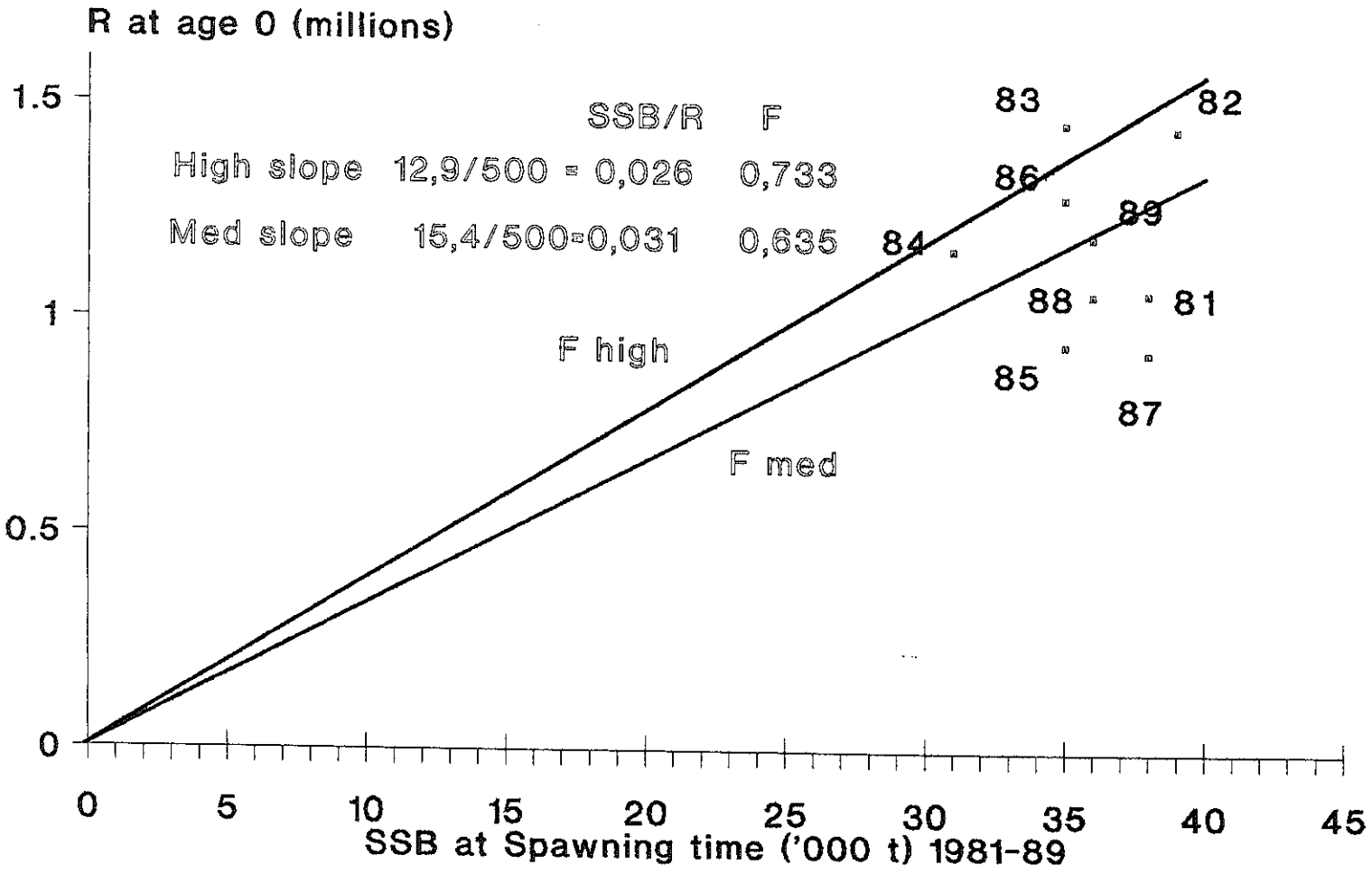


Figure 5.10 Stock recruitment plot and estimation of F_{med} and F_{high}.

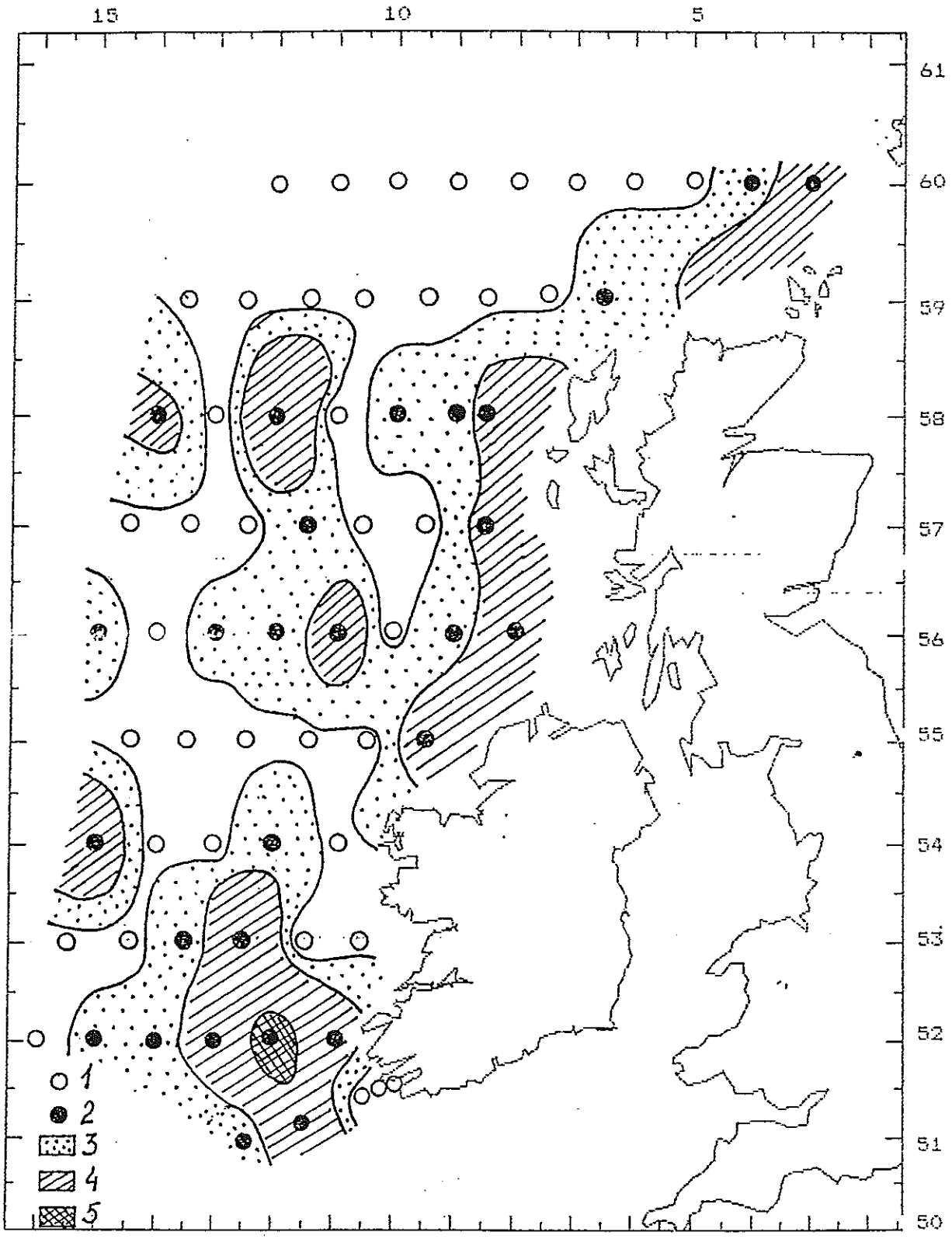


Figure 7.1 Distribution of blue whiting larvae 18 April - 4 May 1991
1) Larvae absent, 2) Larvae present, 3) 1-10 larvae /m²
4) 11-100 larvae/m² 5) > 100 larvae/m²

APPENDIX

NEAFC-request to ICES for medium-term prediction

The NEAFC request is quoted in Section 1.1.

Details of the calculation of stock sizes for ages 0-2 for use as input to the prediction at the beginning of 1991 were as follows:

Year	Nos age 0 from VPA (2 fleets)		
1981	4753	M=	0.2
1982	24733		
1983	26569	Z(0,90)=	0.211
1984	14488	Z(1,90)=	0.230
1985	12000	Z(0,89)=	0.232
1986	14012		
1987	11174		
1988	10604		
1989	25651	= Average of the strong 1982 and 1983 year classes.	

Average:	14769 from years 1981-1988, including two strong year classes.
Average:	25651 from years 1982-1983, i.e., two strong year classes.
NEAFC 1:	15978 from years 1981-1989, including three strong year classes.
NEAFC 2:	11142 from years 1981-1989, excluding three strong year classes.

The request from NEAFC was to run TAC-constrained predictions for 700,000 and 800,000 t with two options of recruitment. Due to the changes in the projected catch for 1991, however, the Working Group decided to run the two options (NEAFC 1 and NEAFC 2 described above) for the following TAC-constraints for each year from 1993-1995 (in thousand t): 300, 400, 500, 600, 700 and 800.

The inputs for these predictions are shown in Tables A.1 and A.2 for the recruitment assumptions NEAFC1 and NEAFC2 respectively.

The results in terms of spawning stock biomass (SSB) and total stock biomass (TSB) are summarised in Tables A.1 and A.2. SSBs are shown plotted in Figures A.1 and A.2.

The printouts are available in the Working Group files.

Table A.1

List of input variables for the ICES prediction program.

Northern Blue Whiting ** NEAFC Options **
The reference F is the mean F (non-weighted) for the age group range from 4 to 8

The number of recruits per year is as follows:

Year	Recruitment
1991	15978.0
1992	15978.0
1993	15978.0
1994	15978.0
1995	15978.0

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	15978.0	.01	.20	.00	.024	.024
1	12934.0	.04	.20	.10	.045	.045
2	16161.0	.07	.20	.37	.075	.075
3	4849.0	.12	.20	.81	.109	.109
4	3782.0	.17	.20	.85	.124	.124
5	3045.0	.22	.20	.91	.150	.150
6	1525.0	.29	.20	.94	.169	.169
7	1032.0	.28	.20	1.00	.175	.175
8	1002.0	.33	.20	1.00	.215	.215
9	319.0	.34	.20	1.00	.217	.217
10+	197.0	.34	.20	1.00	.254	.254

Table A.2

List of input variables for the ICES prediction program.

Northern Blue Whiting ** NEAFC Options **
The reference F is the mean F (non-weighted) for the age group range from 4 to 8

The number of recruits per year is as follows:

Year	Recruitment
1991	11142.0
1992	11142.0
1993	11142.0
1994	11142.0
1995	11142.0

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	11142.0	.01	.20	.00	.024	.024
1	9019.0	.04	.20	.10	.045	.045
2	16161.0	.07	.20	.37	.075	.075
3	4849.0	.12	.20	.81	.109	.109
4	3782.0	.17	.20	.85	.124	.124
5	3045.0	.22	.20	.91	.150	.150
6	1525.0	.29	.20	.94	.169	.169
7	1032.0	.28	.20	1.00	.175	.175
8	1002.0	.33	.20	1.00	.215	.215
9	319.0	.34	.20	1.00	.217	.217
10+	197.0	.34	.20	1.00	.254	.254

Table A.3 1981-1989 average recruitment including the strong 1982, 1983 and 1989 yearclasses.

Year	SSB					
	TAC 300	TAC 400	TAC 500	TAC 600	TAC 700	TAC 800
1991	2507	2507	2507	2507	2507	2507
1992	3158	3158	3158	3158	3158	3158
1993	3531	3438	3344	3251	3158	3066
1994	3938	3750	3562	3375	3188	3002
1995	4275	4000	3726	3451	3177	2902

Year	TSB					
	TAC 300	TAC 400	TAC 500	TAC 600	TAC 700	TAC 800
1991	4405	4405	4405	4405	4405	4405
1992	4948	4948	4948	4948	4948	4948
1993	5345	5239	5133	5028	4922	4816
1994	5765	5550	5343	5135	4928	4719
1995	6100	5804	5507	5208	4907	4604

Weights in '000 t

Table A.4 1981-1989 average recruitment excluding the strong 1982, 1983 and 1989 yearclasses.

Year	SSB					
	TAC 300	TAC 400	TAC 500	TAC 600	TAC 700	TAC 800
1991	2489	2489	2489	2489	2489	2489
1992	3049	3049	3049	3049	3049	3049
1993	3193	3099	3005	2912	2819	2726
1994	3373	3185	2998	2811	2624	2438
1995	3473	3200	2927	2655	2383	2112

Year	TSB					
	TAC 300	TAC 400	TAC 500	TAC 600	TAC 700	TAC 800
1991	4113	4113	4113	4113	4113	4113
1992	4416	4416	4416	4416	4416	4416
1993	4529	4425	4320	4217	4112	4008
1994	4675	4471	4267	4063	3858	3653
1995	4758	4468	4175	3882	3586	3288

Weights in '000 t.

Figure A.1

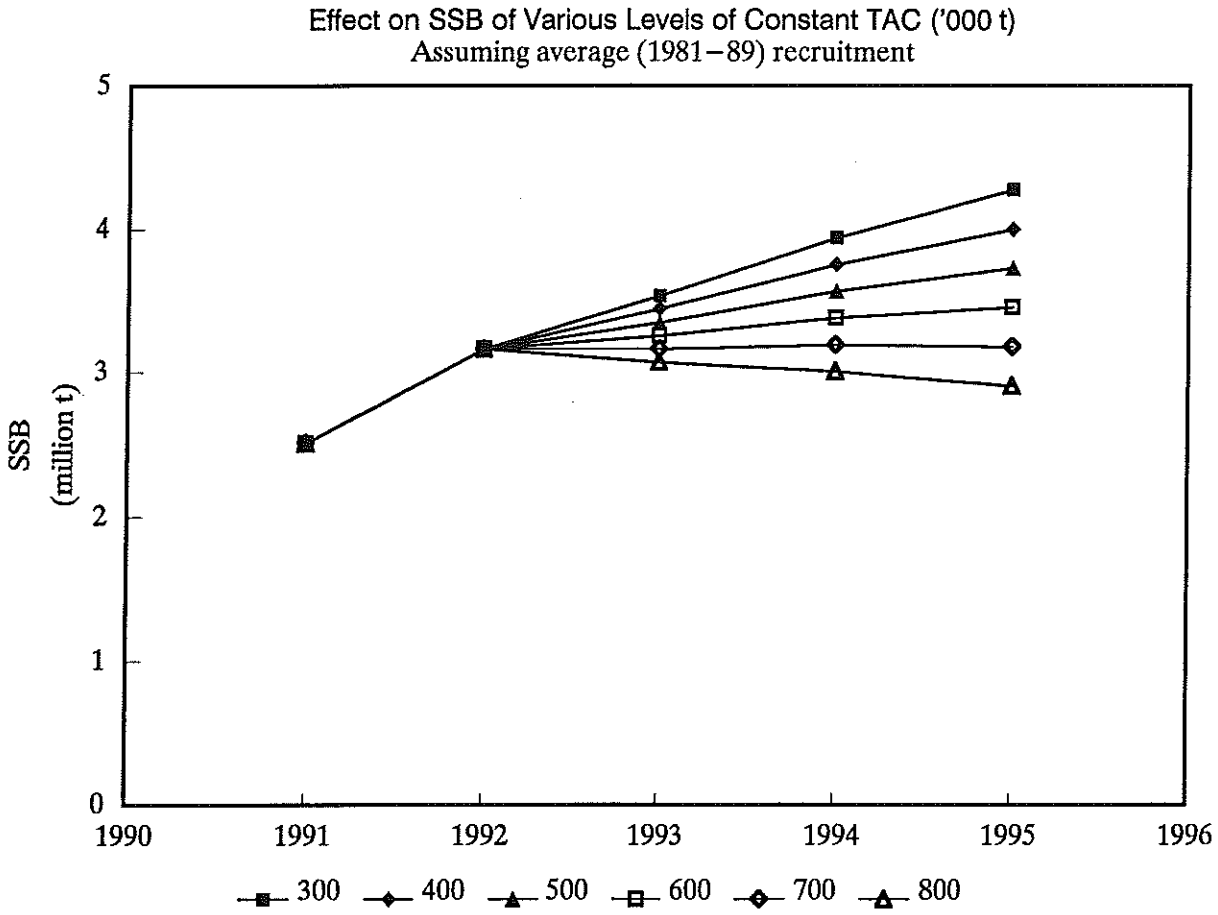


Figure A.2