This report not to be quoted without prior reference to the Council*

International Council for the
Exploration of the Sea

C.M.1990/Assess:3

REPORT OF THE BLUE WHITING ASSESSMENT WORKING GROUP

Copenhagen, 13-19 September 1989

This document is a report of a Working Group of the International Council for the Exploration of the Sea and does not necessarily represent the views of the Council. Therefore, it should not be quoted without consultation with the General Secretary.

*General Secretary
ICES
Palægade 2-4
DK-1261 Copenhagen K
DENMARK

TABLE OF CONTENTS

---ooOoo---

1 INTRODUCTION

1.1 Terms of Reference

The Blue Whiting Assessment Working Group (Chairman: Mr T. Monstad) met at ICES Headquarters from 13 to 19 September 1989 (C.Res.1988/2:4:22) to:

a) assess the status of and provide catch options for 1990 within safe biological limits for the northern and southern blue whiting stock;

b) update the information on the zonal distribution of the stock and the fisheries on the northern blue whiting stock;

c) reevaluate the basis for separate northern and southern stock.

In addition to this, the Working Group was asked by the Chairman of the ACFM to give information for NEAFC on the stock distribution by national zones at other times of the year than the summer period. Furthermore to include in the report any new information in quantitative terms on spatial and temporal distribution of the northern stock.

1.2 Participants

S. Belikov	USSR
L. Danke	German Democratic Republic
O. Gullaksen	Norway
J.A. Jakobsen	Faroe Islands
M. Meixide	Spain
T. Monstad (Chairman)	Norway
A. Paciorkowski	Poland
S. Sveinbjornsson	Iceland
M.E. Vasconcelos	Portugal

2 STOCK IDENTITY AND STOCK SEPARATION

Material from the Fourth Soviet-Norwegian Symposium in June 1989 on Herring and Blue Whiting in the North-East Atlantic was used at the present Working Group meeting (Bakanev, 1989; Belikov *et al*., 1989b,c; Karasev, 1989; Monstad, 1989a,b; Shevchenko *et al*., 1989).

The blue whiting in the North-east Atlantic is suggested by many authors to consist of several populations (Anon., 1980, 1981, 1982). The Working Group has assumed, for assessment purposes, two main compononents, i.e., a northern and a southern stock.

The northern stock is known to feed in the Norwegian Sea and spawn west of the British Isles along the slope south to the Porcupine Bank. Nursery areas are in the North Sea with an extension northwards along the Norwegian coast and in the southern part of the Norwegian Sea in Faroese and Icelandic waters (Anon., 1986).

The southern stock is known to have its nursery area on the Continental Shelf off Spain and Portugal where some spawning also takes place. The main spawning of this stock could be along the slope further north towards the Porcupine Bank, and on the bank. The main feeding area, however, is not yet fully known. It could be in the area west and southwest of the Porcupine Bank, where blue whiting have in some years been observed over-wintering (Zilanov, 1984).

The Porcupine Bank area has been considered as a transition area between the two main stocks but may also be inhabited by local populations from the Celtic Sea area.

The basis for separating the blue whiting in the North-East Atlantic into two stocks was reevaluated (as asked in the Terms of Reference). The conclusion was that there is no justification at present to change the assessment units. However, the Working Group is aware of the fact that some of the parameters like the length at maturity (L_{50}) are very sensitive to extrinsic factors, and tend to characterize the environment occupied by the stock as well as the stock itself (Anon., 1983).

Based on biological samples during the acoustic spawning surveys, the USSR in 1986 assigned a part of the biomass in the Porcupine Bank area to the southern stock, and Norway did the same in 1987 (Anon., 1987, 1988). In 1988, however, neither of the two countries was able to do a similar separation in that area (Anon., 1989). Using the method of parasitological indicators, Karasov (1988, 1989) also suggested that the blue whiting at the Porcupine Bank belonged to the northern stock.

The results of a USSR acoustic survey in spring 1989 to the west and northwest of the British Isles, however, suggested that the northern stock of blue whiting consists of two populations. According to the areas where they spawn, these were named the Porcupine and Hebrides stocks (Isaev and Seliverstov, 1989).

The most important index characterizing reproductive capacity of the stock is the population fecundity (PF). Having analysed the conditions of the habitat, PF and stock size of the same year classes, Belikov et al., 1989 concluded that under average survival conditions, for strong year classes to be produced the PF should correspond to a spawning stock of 3.5 million t. A critical level of the PF at which only under extremely favourable survival conditions a strong year class may be expected is 2.0 million t. At lower stock sizes, production of a strong year class is impossible.

The minimum allowable PF was calculated for a single northern stock of blue whiting; that is why under intensive exploitation - if this stock actually consists of two relatively independent entities - one of these can be underexploited, whereas the other can be depleted. If the state of the Porcupine population is not depleted, the Hebrides population is most probably in a critical state due to overexploitation of this stock.

The suggestion by Isaev and Seliverstov to have the northern stock divided in two may well be extended to suggest that the

Porcupine population might also be included in the southern stock. If it is so, the majority of the blue whiting spawning in the Porcupine area belongs to the southern stock, while up to present it has been considered as part of the northern stock.

The Working Group would like to have this matter further discussed in ICES fora and recommends that further investigations be undertaken before any new decision about it is made.

3 OTOLITH EXCHANGE PROGRAMME

An attempt to solve the problem of ageing by finding objective criteria of age determination other than otolith ring counting was initiated during the preceding Working Group meeting (Anon., 1988), and undertaken by T. Linkowski. He tried to fit the multiple regression to the age data as dependent variable against fish length, fish weight, otolith length, otolith height, and otolith weight as independent variables. The resulting correlation coefficients were high, ranging for males from 0.82(R) (all age groups) to 0.93 (age groups 0-7), but the standard error of the estimated age was 1.8 and 0.6 years, respectively. Confidence limits for the model parameters did not allow the prediction of age for older age groups with the required precision (T. Linkowski, pers. comm.). It is expected that more detailed results of the analysis will be presented to the Working Group in 1990.

It was recommended at the last meeting of the Blue Whiting Assessment Working Group to have an otolith exchange between the southern and the northern areas. A set of 115 whole otoliths and corresponding sections was exchanged, as well as photographs of the two series. Results are only available from 3 countries, and the consequent analysis was presented (Meixide, 1989). The regressions made between the age readings are expected to have a slope of 1 and an intercept of 0, if a systematic difference does not exist. The results of the regressions were:

	Slope	Intercept
Whole otoliths		
Norway-Spain	1.05	0.03
Norway-Portugal	0.81	1.32
Spain-Portugal	0.80	1.03
Sections		
Norway-Spain	1.27	0.24
Norway-Portugal	1.07	1.10
Spain-Portugal	0.82	0.96
Sections - Whole otolith		
Norway	0.96	0.06
Spain	0.80	0.14
Portugal	0.70	0.75

Figure 3.1a presents the mean length at age based on the readings of the otolith sections. Figure 3.1b shows the same plot but adding one year to the Norwegian data. That excercise proved that there was systematically a difference of one year in the readings.

4 NORTHERN STOCK

4.1 Landings in 1988

Estimates of total landings in 1979-1988 from the various fisheries by countries are given in Tables 4.2-4.4 and summarized in Table 4.1.

The catch from directed fishery in Divisions VIIg-k was continued to be recorded as a part of the northern stock.

The total landings from all northern blue whiting fisheries in 1988 were estimated at 522,575 t. This catch was about 17% less than that of 1987. It should be noted that the most remarkable decline of 55% appeared in the Norwegian Sea fishery. The landings from the directed fishery in the spawning area decreased by only 5,5% and from the mixed industrial fishery by 28%.

Since the last landings from the Icelandic mixed industrial trawl fisheries in Division Va were recorded in 1983, the Working Group decided that this table should not be included in the report.

As in the last few years, greater silver smelt was caught in Division VIa as by-catch in the directed fishery. An amount of 11,000 t was recorded and is corrected for in the Norwegian catch statistics.

4.2 Landings in 1989

Preliminary data on the blue whiting catch from January to July 1989, submitted by Working Group members and by some countries, amounted to 396,431 t (Table 4.6)..

4.3 Length Composition of Catches

Three countries, USSR, Norway, and the Faroes provided length distributions of commercial catches from the main fisheries in 1988. They were dominated by fish ranging from 26 to 31 cm. Differences between length distributions from the various divisions can be attributed to different time periods during which the fish were taken along their migration routes (Tables 4.6a-e).

For 1988, Norway provided the length compositions from the mixed industrial fishery in Division IVa. The Faroes gave the length composition of by-catches in Division Vb.

For 1989, the length compositions of the catches from the period January-July were submitted by USSR (Table 4.6f).

4.4 Age Composition of Landings

For the directed fisheries in 1988, age compositions were provided by the Faroes, The German Democratic Republic, Norway, and the USSR. These data accounted for 98% of the landings from the directed fisheries. The German Democratic Republic landings from Division Vb were raised to catch in number by age group by the USSR data from the same area and month.

For other landings from the directed fisheries in the spawning area, age compositions of Norwegian landings in the same area and month were used, and catches taken elsewhere were assumed to have the same relative age composition as the total sampled part. 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 (Divisions IVa and IIIa), data were available from Norwegian catches only. These accounted for 55% of the total landings. Landings from other countries in these areas were assumed to have the same age composition as the Norwegian landings in the same months (Table 4.8). By-catches taken by Faroese vessels in Division Vb were raised to catch in number by age group from Faroese samples and are included in Table 4.7. The raised age compositions for the directed fisheries were assumed to give the total age composition of landings (Table 4.9).

4.5 Weight at Age

Mean-weight-at-age data for 1987 were presented by the Faroes, the German Democratic Republic, Norway, and USSR. Landings from other countries were assumed to have the same mean weight-at-age compositions when fished in the same area and period as the sampled catches. Mean weights at age were calculated, weighted by the total landings in numbers in each fishery. The total catch landed in 1988 was compared to the sum of products (SOP) of the total numbers landed in 1988 and mean weight at age. The calculated SOP is virtually the same (within 1%) as the nominal landings. The mean weight at age used in the VPA runs is shown in Table 4.10.

4.6 Stock Estimates

4.6.1 Acoustic surveys in 1989

4.6.1.1 Surveys in the spawning season

During the spawning season of 1989, USSR, Norway, and the Faroes carried out acoustic surveys in the area west of the British Isles and south of the Faroes to assess the size of the blue whiting spawning stock (Isaev and Belikov, 1989; Monstad, 1989).

The Faroes conducted an acoustic survey in April south of the Faroes inside the Faroese fisheries jurisdiction. Only very scarce recordings of mature fish were made.

The USSR survey took place from 25 March-22 April and was conducted northwards from SW of Ireland in the south to the Faroe/ Shetland area in the north, i.e., between 50°N and 62°N (Figure 4.1). The biomass of blue whiting was estimated at 6.3 million t (or 50.9 x 10^9 individuals) of which 5.7 million t (or 42.5 x 10^9 individuals) were estimated to belong to the spawning stock based on the maturity ogive obtained from the cruise samples.

The densest concentrations of blue whiting were found in the southern part of the survey area gradually decreasing further north. The spawning concentrations west of the British Isles were found to have a more westerly distribution than before, and because the survey took place rather late some post-spawning fish might have left the spawning area, resulting in an underestimate of the spawning stock.

The Norwegian survey was conducted from 3 - 24 April and covered approximately the same area as the USSR survey (Figures 4.2. and 4.3). The total blue whiting biomass was estimated at 7.0 million t (or 67.4 x 10^9 individuals) of which 6.1 million t (representing 58.3 x 10^9) individuals belonged to the spawning stock.

The densest concentrations, as in the USSR survey, were found in the southern part of the survey area and also at the edge southwest of St. Kilda. The distribution was similar to that of 1988 when for the first time noteable recordings of blue whiting were observed far off the edge, i.e., in the area towards the Rockall Bank. Most of the blue whiting found that far west were spent or running.

The length and age compositions are given in Figure 4.4 for both surveys. The 1986 year class was found to predominate in both the Norwegian and the USSR surveys constituting 32% and 23% respectively of the total number of fish. The main age group has thus shifted from 5 to 3 year olds from 1988 to 1989.

4.6.1.2 <u>Surveys in the feeding season</u>

Four countries carried out acoustic surveys in the Norwegian Sea during the summer of 1989, which, among other objectives, were aimed at determining the blue whiting distribution and abundance. Working notes and information on the results were submitted to the Working Group. The cruise tracks are shown in Figure 4.5. and the area of distribution in Figure 4.6.

From 25 July to 2 August and from 9 to 14 August, a Norwegian research vessel operated in the Norwegian Sea while on its way to and from the capelin grounds in the Jan Mayen area.

Only scattered and very scattered recordings of blue whiting were observed and only few specimens were collected by pelagic trawling. Figure 4.7 shows the length and age composition of the combined trawl catches. The 1986 year class dominated with more than 30% in numbers, whereas the previously strong year class of 1983 only contributed less than 10% of the numbers.

From 27 July to 17 August, the USSR conducted an acoustic survey around and north of the Faroes between 60^0-69^0N and $6^0$30'E-10^0W. Only scattered recordings of blue whiting were observed with a correspondingly low biomass estimate of 600,000 t. The 1983 year class was the most abundant, accounting for more than 22% of the catch in numbers.

The Faroes conducted an acoustic survey north of the Faroes from 7 August - 5 September from 62^0-66^0N between 1^0-13^0W. In most of the surveyed area, except the northwestern part, scattered recordings were made. West of 6^0N, the recordings were almost entirely O-group blue whiting, 10-17 cm long, with a mean length of 12 cm. East of 6^0W, larger fish of 23-24 cm predominated in the catches but in the southeastern part the older fish were mixed with O-group fish (Figure 4.8).

An Icelandic research vessel during a scouting survey for Atlanto-Scandian herring in the Norwegian Sea in the first half of June surveyed an area from 69^0-$64^0$30'N between approximately 5^0-$7^0$30'W. No blue whiting was recorded. Similarly, during their annual O-group fish survey in East Greenland and Icelandic waters in August, which covered the area from 63^0-68^0N and from 10^0W to the East Greenland coast, no blue whiting recordings were identified.

In addition to this, a Norwegian research vessel in the North Sea in July observed blue whiting of length range 27-28 cm in the Norwegian trench area between 61^0 and $57^0$30'N (Aglen, pers. comm.).

4.6.1.3 Discussion

In the period during the acoustic surveys to the west of the British Isles in spring 1989, the weather conditions were excellent enabling the vessels to obtain recordings without acoustic disturbances. The stock was distributed along the Continental Shelf west of the British Isles and it also had a more westerly and southerly distribution compared to the period before 1988.

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

Year	Estimates
1981	6.1(5.4)
1982	2.5
1983	4.7(4.4), 3.6(3.5)
1984	2.7(2.4), 3.4(2.7), 2.8(2.1), 2.4(2.2)
1985	6.4(1.7), 2.8(2.7)
1986	6.4(5.6), 2.6(2.0)
1987	5.4(5.1), 7.4(6.9), 4.8(4.5)
1988	2.0(1.9), 3.9(3.1), 7.1(6.8)
1989	6.3(5.7), 7.0(6.1)

At the time of the USSR survey, some fish had already spawned and migrated from the slope to the west. These fish were not included in the estimate and, therefore, the result (6.3 million t) might be considered an underestimate.

The Norwegian survey covered more or less the same area at the same time as the USSR survey. The total biomass of 7.0 million t was similar to the biomass estimate obtained in 1988 but the spawning stock biomass was somewhat lower in 1989 than in 1988 due to lower mean weight in the stock.

The two countries' age compositions differ in that the dominant year class, although the same (the 1986 year class) for both surveys was found in greater numbers in the Norwegian catches than in the USSR ones (33% and 23%, respectively). Also in the Norwegian catches, the 1988 year class contributed more than 12% of the total number of fish while it contributed less than 1% to the USSR catches. The previously very strong year class of 1983 was found to have diminished quite drastically in the stock and the main age group has shifted from 5 to 3 year olds since 1988.

The five national surveys carried out during the feeding season in the Norwegian Sea obtained only weak recordings of blue whiting and only the USSR one provided any biomass estimates. The USSR survey did not cover the whole of the distribution area of the blue whiting in the Norwegian Sea and the resulting biomass estimate should, therefore, be considered an underestimate.

The length and age composition of blue whiting in the Norwegian Sea, however, differs between the USSR and the Norwegian observations. The 1986 year class dominated in the Norwegian samples (30% in numbers) as in the spawning area, whereas the 1983 year class was still found to be the dominant year class in the USSR samples.

4.6.2 Catch per unit effort

Data on catch per unit effort from the directed fisheries in 1988 were submitted by the German Democratic Republic, Norway, and the USSR. These countries presented their data broken down by vessel tonnage class, area, and month.

Comparable time series of CPUE data for Divisions IIa, IVa, Vb, VIab, VIIbc, and VIIg-k which could be indicative of stock abundance changes are compiled in Tables 4.11 and 4.12 and Figure 4.9.

In Division IIa, the blue whiting fishery was continued only by the USSR fleet during the whole year. Whereas the total landings and the effort by this country again substantially declined, the catch per hour in 1988 did not show distinct decrease.

In Division Vb, the German Democratic Republic fleet operated only in the second half of the year. There is a constant decline of CPUE since 1985 from 3.58 t/hour to 1.52 t/hour. The USSR CPUE shows a similar declining trend in the January-February period and a sharp decrease by about 50% from 1987 to 1988 during the July/August period.

The data from the spawning fishery, (Divisions VIa,b, VIIb,c and VIIg-k) are variable and do not allow clear conclusions to be drawn as to the stock biomass changes. In some cases, the CPUE declined (Norway, Divisions VIa and VIIb, March/April), whereas in others an increase was observed (USSR, Divisions VIIb,c, February/March).

The Working Group discussed the question of validity of CPUE-data as stock biomass indices. Comparison of catch/hour data (Table 4.12) with catch/day data (Bakanev, 1989) shows until 1985 quite similar trends from 1980. During the period 1986-1988 the catch per hour remains more or less stable, while catch per day after an increase in 1986 declines rapidly in 1987 and 1988 (Figure 4.10.)

The origin of the differences might result from extended time of scouting for suitable concentrations, due to the more scattered distribution.

Due to the uncertanty of the real trend of the biomass changes the Working Group decided to provide catch/day data to allow more detailed analysis of this problem.

4.6.3 <u>Virtual population analysis (VPA)</u>

4.6.3.1 <u>Tuning the VPA to survey results</u>

The Working Group decided to use the tuning module of the ICES VPA program to obtain initial VPA results. The age range chosen for tuning was 3-14 years, and data from 1982-1988 were used. There were four different fleets consisting of USSR and Norwegian acoustic surveys in the spawning area west of the British Isles, combined acoustic surveys in the Norwegian Sea during the feeding season, and CPUE data from USSR commercial fishery in July in the Norwegian Sea.

The data set of the USSR acoustic surveys covered the entire period, while from the Norwegian surveys, data were available for all years except 1982 and 1985. For these two years the data were assumed to be the average of the two neighbouring years. The USSR

CPUE data for July were not available for 1982 and 1987, and for those years, data from August for the USSR and German Democratic Republic trawlers combined were used.

Although the CPUE data, e.g., catch/hour, do not show the same downward trend as the corresponding catch/day data from 1987 onwards (see Section 4.6.2). It was decided to include these data in the tuning. In this way data were included from both the spawning area and the feeding area, and hence this should give better representation of the whole stock.

The results of the tuning are presented in Table 4.14 and in Figure 4.11, the range of the data was limited to cover only the age groups 3-11, even if data vere available up to age 15. The reason is that the resulting Fs for the oldest age groups were very high and variable, also the variance estimates were bad. The resulting VPA run based on the tuning is given in Tables 4.15 and 4.16, the F_{4-8} level of 0.163 was then accepted as an aim for the estimation of the fishing mortalities from a separable VPA run.

4.6.3.2 Estimation of fishing mortality using separable VPA

The initial runs of the separable VPA, including the age groups 0-15+, gave very high residuals for the oldest age groups and for age group 0 in some years. Because of uncertanity in the ageing of the oldest groups it was decided to lower the plus group to 12.

By using the age groups 0-12+, with a terminal F of 0.123 on age 5 and a terminal S of 1.5, the resulting matrix of residuals was acceptable (Table 4.17). The fishing mortalities obtained for 1988 gave an average value of 0.16 for the 4-8 olds, as aimed for (Table 4.18), and the corresponding stock estimates are shown in Table 4.19.

4.6.3.3 Discussion of the stock size estimates

The results of the VPA indicate a spawning stock at 1 January 1988 of 4.4 million t, which is at the same level as 1987 and a sligth decrease from 1986. In the text table below the ranges of the acoustic spawning stock estimates together with the VPA results from 1983-1989 are shown.

	1983	1984	1985	1986	1987	1988	1989
Survey minimum	3.5	2.1	4.1	2.0	4.1	3.1	5.7
maximum	4.4	2.7	"	5.6	5.1	6.8	6.1
VPA	2.6	2.6	3.4	4.5	4.4	4.4	4.5

Biomass in millions of tonnes.

With few exceptions, the spawning stock estimates obtanied from VPA do reflect the acoustic survey results from previous years, but in 1989 the acoustic estimates were higher. The Working Group had confidence in the VPA estimates, and decided to use the figures for prediction of future catch levels.

4.6.3.4 VPA results (Tables 4.18 and 4.19)

The VPA results show that the total biomass has decreased steadily from 1979 to 1982. From 1983 onwards, an increase is again observed, which was an effect of the strong incoming 1982 and 1983 year classes. The spawning stock biomass shows a similar picture, however, the start of the increasing trend began two years later when the strong year classes started to contribute (Figure 4.12B). At the beginning of 1989, the total stock biomass and the spawning stock biomwss were at a level of 6.1 and 4.5 million t respectively.

4.6.3.5 Yield per recruit

Yield per recruit and spawning stock per recruit have been calculated using the data given in Table 4.20 and are shown in Figure 4.12C. The exploitation pattern was obtanied in two steps: First, the smoothed separable fishing mortalities were used as input for an initial prediction with a TAC constraint of 500,000 t (the expected catch in 1989). This gave a reference F of 0.14 for ages 4-8 with a factor of 0.876. Secondly, the exploitation pattern was scaled so that the mean F at ages 4-8 corresponded to the 1989 level. The yield-per-recruit calculations gave a $F_{0.1}$ of 0.22 which is higher than the present level.

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

4.7 Catch Projection and Management Consideration

A projection of catches in 1989 and a resulting total and spawning stock biomass in 1990 were made using the stock size estimate at the beginning of 1989 and the parameters given in Table 4.20. In the projection, a recruitment equal to the 1979-1986 average, excluding the strong year classes of 1982 and 1983 of 11,400 million at age 0, was used for the 1987-1991 year classes. Although a Faroes survey during summer season obtained better recordings of 0-group blue whiting than the last 2-3 years, the average was still used to obtain a recruitment level for the 1989 year class.

It was assumed that the catch in 1989 would be about 500,000 t corresponding to F = 0.14 for ages 4-8 years. The results of the catch projections are given in Figure 4.12D and Tables 4.21 and 4.23.

A continuation of the assumed 1989 F level would result in a catch of 529,000 t, whereas a fishery at the 1988 F level would have resulted in a catch of 70,000 t more.

In Figure 4.13 is given the plot of recruitment versus spawning stock biomass from 1977, when the blue whiting fishery was at full exploitation, to 1986. The estimated F_{med} became 0.13 and is shown in the figure together with F_{high} and F_{low}. Fishing at the F_{med} level would result in a catch of 492,000 t in 1990.

The sparce recordings of blue whiting in the Norwegian sea during feeding season, together with the decline in the landings from the area, could either be caused by a change of the migration pattern or a decrease in the stock size. The increase, however, in the biomass recorded in the spawning area during spring may also reflect a change in the migration pattern, i.e., of a southern component, or a noteable increase of the stock size. The suggestion to separate the northern stock in two main components may help resolve this question in the future.

Except for the 1986 year class, which must be considered above average, there has been no strong year class produced since 1982 and 1983. These two year classes, however, have almost disappeared from the stock, and the 1986 year class has been their successor as the dominant one. This has at least been observed for the spawning stock in 1989, and also to a certain degree in the Norwegian Sea stock in the feeding season. The shift of the main age group from 5-year olds in 1988 to 3-year olds in 1989 may well be a signal of approching a critical level for the stock. The TAC should be held at a low level and it is suggested that it should not exceed the F_{med} level of about 500,000 t in 1990.

5 SOUTHERN STOCK

5.1 Landings

Total landings from the southern area are given in Table 5.1. The Spanish landings had an increase of about 5%, attaining the same level as in 1986. The Portuguese landings, which had been increasing since 1985, decreased in 1988 by about 34%.

5.2 Landings Compositions by Length and by Age

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

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

Qualitative data on discards are not available, but it is assumed they are considerable. Consequently, data on the real catch composition are not provided.

5.3 Weight-at-age and SOP Check

Weight-at-age data from both fisheries, the Spanish and the Portuguese, are presented in Table 5.5. The total landings from 1988 was compared to the sum of products (SOP) of the total numbers landed in the same year, and to the mean weight at age. The SOP calculated was within about 3% of nominal landings (Table 5.4).

5.4 CPUE Data

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

In the case of Portugal, no directed fishery exists; blue whiting is caught almost exclusively by bottom trawlers, and so, fishing hours estimated for this fishery (Cardador, pers. comm., 1989) were adopted (Table 5.6b).

In Spain, apart from the single bottom trawl fishery there is a pair-trawl fishery that usually does not discard blue whiting. So, CPUE from this fishery gives a more correct index of abundance. Data on catch per unit effort from both fisheries are presented all together in Table 5.6a and split by fleet in Table 5.7.

5.5 Maturity at Age

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

5.6 Tuning of Virtual Population Analysis

The tuning method was applied to provide a preliminary estimate of terminal F values. It was decided to use CPUE data from the pair-trawling fleet (Spanish fishery) due to the fact that discards are almost non-existant for these vessels. Catch data from Spanish surveys were also included (Tables 5.8. and 5.9). No survey was done in 1987, so the average of the years 1986 and 1988, for the same year classes was assumed.

The output of the tuning is shown in Table 5.10 and it can be observed that the variance ratio is not high for most ages. The log catchabilities of the tuning results have been plotted and are presented in Figure 5.1.

5.7 Separable Virtual Population Analysis

Mean fishing mortality for ages 1 to 4 obtained through the VPA tuning (Table 5.11) was 0.49. This fishing mortality level was used as terminal F, at age 2, to run a separable VPA with terminal S of 1.5. The matrix of residuals is shown in Table 5.12. It can be observed that the residuals are not high, and the selection pattern derived is similar to that from the tuning analysis (Figure 5.2).

5.8 VPA Results

Tables 5.13 and 5.14 and Figures 5.3A and B show the final fishing mortalities and stock size estimates based on the separable VPA results. In 1988, the spawning stock biomass attained the same level as in 1982 (39,000 t) and the lowest level was in 1984 (31,000 t).

5.9 Recruitment VPA Calibration

Numbers at age 0 estimated by final VPA were regressed against the 0-group indices from Spanish bottom trawl surveys carried out in September/October from 1981 to 1988. CPUE data at age 1 were taken as indices of recruitment of previous years. The recommended program for this was run. Table 5.15 shows predicted values for 1987 and 1988 year classes. These new calculated values were used to obtain numbers for the 1987-1988 year classes in 1989 for the input of the prediction and the yield per recruit calculations.

5.10 Yield-per-Recruit and Catch Forecast

Terminal populations from the final VPA (corrected for ages 1 and 2) and separable fishing mortalities were used for the catch forecast (Table 5.16). An average recruitment at 1,100 millions at age 0 from 1984-1988 was assumed for the years 1989-1991.

Results of the yield per recruit are shown in Figure 5.3C. In Tables 5.17 and 5.19, two options of catch forecast are presented. In option 1, a level of catch similar to that of 1986-1988 was fixed for 1989 assuming status quo F. Even with a fishing mortality in 1990 at the level of F_{high} the spawning stock stays at the level of 33,000 t. Detailed results for this option are shown in Table 5.18. In option 2, a catch at the level of TAC established by the European Community was fixed for 1989. In this case, with a fishing mortality in 1990 at the level of F_{high}, the spawning stock will reach the lowest level of the last years.

5.11 Biological Safe Limits

F_{med} and F_{high} are shown in Figure 5.4; these were obtained by plotting spawning stock biomass against recruitment for the period 1981-1987. No evidence of any stock/recruitment relationship could be observed (Figure 5.4). The level of SSB has varied little in the period.

5.12 Management Considerations

Uncertanties concerning stock identity, distribution of the spawning stock and the fact that the southern fishery is mainly based on the first five age groups, indicate the need to maintain the juvenile fishery at a controlled level.

Acoustic surveys in the southern area are needed to investigate distribution and stock size. A coordinated Spanish-Portuguese acoustic survey in March/April 1988 was carried out for pelagic species, covering all the Atlantic-Iberian coast with the exception of the southern coast of Spain. In the Portuguese area the blue whiting distribution was not fully observed because the survey only covered the sardine distribution area. Also, spatial distribution off the Spanish coast is only known down to the 500 meters isobath, as can be seen in Figure 5.5. Thus, part of the distribution area is still not known (ICES, Doc. C.M.1989/ H:G).

6 ZONAL DISTRIBUTION

The four hydroacoustic surveys which took place in the Norwegian Sea during the summer of 1989 and the one in the North Sea, have not resulted in any reliable estimate of the total stock size. The surveys' cruise tracks and the overall geographical distribution of blue whiting are shown in Figures 4.5 and 4.6, respectively. Acoustic survey data collected during the summer period of 1989 suggested that only an insignificant part of the total stock might migrate to the feeding area. This is also supported by survey results from a few recent years as well as by the decreasing trend in the landings, especially from the Norwegian and the Faroes zones (Table 4.1).

Spawning blue whiting aggregate in the area west of the British Isles to spawn in March-April. Since 1980, acoustic surveys have been carried out in that area in order to estimate the biomass of the spawning stock. The results of the various surveys were not very consistent in the beginning, but the agreement be-tween the surveys has been improving considerably in later years. In the spring surveys, however, the biomass estimates are not divided into national zones. The Working Group has attempted to do this from distribution maps presented in the Working Group reports from 1981 to 1989 (Table 6.1).

This could not, however, be done for all surveys as the surveys were carried out at different times and did not cover the same areas. The results obtained are only estimates and should be interpreted with caution.

Since 1986, surveys in the Norwegian Sea during the feeding period have only been conducted on a national basis. No reliable biomass estimates for the whole stock in that area have been obtained, and the Working Group feels unable to provide any reliable quantitative distribution within national economic zones from the results.

The total landings of blue whiting from 1978 to 1988 are updated and divided into national fisheries zones in Table 6.2. The table was derived from data brought to the meeting by the Working Group members, and official statistics reported to ICES. For some countries the landings were split according to a statistic based on the current reporting of the fleet. For other countries, the most appropriate assumptions were made from the statistics.

The fishery zone of Jan Mayen was not declared until 1981, and an unknown part of the catches allocated to international waters in the years prior to 1981 was actually taken in the Jan Mayen zone.

7 DISTRIBUTION IN TIME AND SPACE OF THE BLUE WHITING STOCK

In the 1985 report of the Blue Whiting Assessment Working Group (Anon., 1986), available knowledge from various sources on the spatial and temporal distribution of the blue whiting stock at different stages of its life was summarized. The general conclusions together with any new information and ideas on this subject are presented in this section.

Spawning area

The main spawning areas of the blue whiting extend from west of Ireland northwards along the continental slope west of the British Isles and along the slope of the Rockall Bank. The distribution pattern of the blue whiting spawning stock has been gradually changing in recent years. The spawning has been observed further offshore and the centre of gravity of the spawning aggregations has progressively been shifting southwards to the area of the Porcupine Bank (Monstad,a,b, 1989, Isaev and Belikov, 1989).

Furthermore, there is some evidence suggesting that the northern stock of blue whiting may be separated (morphometrically, biologically and geographically) into two distinct populations, one with the main spawning area north of latitude 56^0N, and the other with the main spawning area south of 56^0N (see Section 2). If this is so, the observed shifting of the centre of gravity of the spawning towards the Porcupine Bank area may be a reflection of changing population dynamics of the two spawning populations. Nevertheless, it can be concluded that the main bulk of the northern blue whiting stock spawns in March-April to the west of the British Isles inside the fisheries jurisdiction of the EC.

Nursery area

No additional information is available on the planktonic drift of blue whiting eggs and larvae to that given in the report of the Working Group in 1986 (Anon., 1986). In that same report the present knowledge on the distribution of the juveniles was summarized. The only conclusive additional information to that is from a Faroese survey conducted around and north of the Faroes and in the Faroe-Iceland Ridge area in August-September 1989. Noteable recordings of O-group blue whiting (10-17 cm long) were made, especially on the ridge between the Faroes and Iceland.

Postspawning and prespawning distribution

Since 1986, when the international acoustic surveys coordinated by ICES ceased, surveys in the Norwegian Sea have been conducted on a national basis and the results have been brought to the Working Group meetings for discussion. This has been done ever since, but the Working Group feels that no reliable estimate on the total stock size or its quantitative distribution in the area could be given from the results. The overall geographic distribution in the Norwegian Sea in summer 1989, however, is presented in Figure 4.6.

It is clear, however, that considerable changes have taken place in the migration pattern of the blue whiting into the Norwegian Sea in recent years (Shevenko, Isaev and Belikov, 1989; Monstad 1989). In 1978-1981, the feeding migrations covered a large area, including the northern and northwestern areas. From 1982 and onwards, the feeding area has contracted markedly and the blue whiting has virtually stopped migrating north of 65^0-66^0N in any great numbers.

The reason for the changed migration pattern of the feeding stock is thought to be caused by large fluctuations in the stock size and the age composition of the stock, resulting from the fisheries and changes in the recruitment.

8 RECOMMENDATIONS

1) The Working Group considers it very important that the northern blue whiting stock is monitored each year. The surveys of the spawning stock during the spring have proved to be very valuable and the Working Group recommends that they be continued.

2) Because of the evidence of some changes in the stock distribution and in the light of new results of stock separation, the Working Group stresses the importance of surveys and recommends that surveys be done to investigate the distribution in the southern and southwestern area.

3) Taking into account new suggestions on the northern stock separation, the Working Group recommends that further investigations be undertaken to have this important question clarified.

4) The Working Group recommends, that the countries involved in directed blue whiting fishery provide their historical CPUE data for the next meeting in terms of catch/day from 1980 onwards, and as catch/day as well as catch/hour in 1990.

5) Although it is difficult at present to indicate the precision of the stock estimates obtained by the acoustic surveys in the Norwegian Sea, the results from the 1981-1988 surveys have given appreciable information, especially about the younger year classes. The Working Group, therefore, recommends that the acoustic surveys during the summer/autumn season of 1990 should be carried out on a national basis, and the results brought to the Working Group.

6) The Working Group recommends that further investigations should be carried out on selectivity with the mesh sizes still in use, and other mesh sizes both in the mixed industrial and in the directed fishery.

7) It is recommended that for future analysis of stock size, the age range 0-12+ years should be used. Historical data should be compiled in accordance with this for future meetings.

8) A workshop for ageing Blue whiting otoliths is recommended to be held in 1990 in Spain. The Working Group proposes Mr M. Meixide as coordinator.

9 REFERENCES

Anon. 1980. Report of the Blue Whiting Assessment Working Group, Bergen, 5 - 10 May 1980. ICES, Doc. C.M.1980/H:5.

Anon. 1981. Report of the Blue Whiting Assessment Working Group, Copenhagen, 6 - 12 May 1981. ICES, Doc. C.M.1980/H:12.

Anon. 1983. Report of the Blue Whiting Assessment Working Group, Copenhagen, 15 - 21 September 1982. ICES, Doc. C.M.1980/ Assess:3.

Anon. 1984. Report of the Blue Whiting Assessment Working Group, Copenhagen, 15 - 22 September 1983. ICES, Doc. C.M.1980/ Assess:2.

Anon. 1987. Report of the Blue Whiting Assessment Working Group, Copenhagen, 24 - 30 September 1986. ICES, Doc. C.M.1980/ Assess:4.

Anon. 1988. Report of the Blue Whiting Assessment Working Group, Copenhagen, 16 - 22 September 1987. ICES, Doc.C.M.1980/ Assess:6.

Anon. 1989. Report of the Blue Whiting Assessment Working Group Meeting. ICES, Doc. C.M.1980/Assess:5.

Anon. 1989. Report of the Planning Group for Acoustic Surveys in ICES Sub-areas VIII and IX, Vigo, 5-7 April 1989. ICES, Doc. C.M.1989/H:6.

Bakanev, V.S. 1989. Dynamics of Blue Whiting abundance in the Norwegian Sea. Contribution to the Fourth Soviet-Norwegian Symposium in Bergen 1989 "Biology and Fishery of Blue Whiting in the Northeast Atlantic and Norwegian Spring-Spawning Herring".

Belikov, S.V. 1989a. Survey during summer 1989. Working note to the meeting of the Blue Whiting Assessment Working Group, Copenhagen, 13-19 September 1989.

Belikov, S.V., Ermolcher, V.A., Isaev, N.A., and Shleinik, V.N. 1989b. Soviet acoustic investigations in 1980-1989. "Biology and fishery of Blue Whiting in the Northeastern Atlantic and Atlanto-Scandian Herring". IV Soviet-Norwegian Symposium, Bergen, 12-16 June 1989.

Belikov, S.V., Tereshenko, E.S., and Isaev, N.A. 1989c. Population fecundity and year-class strength of Blue Whiting in the Northeast Atlantic. Contribution to the Fourth Soviet-Norwegian Symposium in Bergen 1989 "Biology and fishery of the Blue Whiting in the Northeast Atlantic and the Norwegian spring-spawning herring".

Domasnes, A. and Monstad, T. 1989. Survey in the Norwegian Sea July/August 1989. Working note to the Meeting of the Blue Whiting Assessment Working Group, Copenhagen, 13-19 September 1989.

Isaev, N.A. and Belikov, T. 1989. Results of Soviet Blue Whiting investigations in the Northeast Atlantic in spring 1989. Working paper to the Blue Whiting Assessment Working Group, Copenhagen, 13-19 September 1989.

Isaev, N.A. and Seliverstov, A.S. 1989. Population structure of the Hebrido-Norwegian stock of Blue Whiting. ICES, Doc. C.M.1989/H:9.

Jacobsen, J.A. 1989. Blue Whiting Survey, Summer 1989. Working note to the meeting of the Blue Whiting Assessment Working Group, Copenhagen, 13-19 September 1989.

Karasev, A.B. 1988. Myxosporidian Myxobolus aeglefin (Chidospoza: Myxospozea) - Blue Whiting biological tag from the Celtic Sea and adjacent waters. ICES, Doc. C.M.1988/H:27.

Karasev, A.B. 1989. Ecological and geographic analysis of the Northeast Atlantic Blue Whiting parasite fauna. Contribution to the Fourth Soviet-Norwegian Symposium in Bergen 1989 "Biology and fishery of the Blue Whiting in the Northeast Atlantic and the Norwegian spring-spawning herring".

Meixide, M. 1989. First results of the otolith exchange. Working paper to the Blue Whiting Assessment Working Group, Copenhagen, 13-19 September 1989.

Monstad, T. 1989a. Distribution and growth of Blue Whiting in the Northeast Atlantic. "Biology and fishery of Blue Whiting in the Northeastern Atlantic and Atlanto-Scandian herring". IV Soviet-Norwegian Symposium, Bergen, 12-16 June 1989.

Monstad, T. 1989b. Some aspects of mortality condition factors and liver state with Anisakis-infection in Blue Whiting in the Northeast Atlantic. "Biology and fishery of Blue Whiting in the Northeastern Atlantic and Atlanto-Scandian herring". IV Soviet-Norwegian Symposium, Bergen, 12-16 June 1989.

Monstad, T. 1989c. Norwegian Blue Whiting Survey in April 1989. Working paper to the Blue Whiting Assessment Working Group, Copenhagen, 13-19 September 1989.

Shevchenko, A.V., Isaev, N.A., and Belikov, S.V. 1989. Some pecularities of the Blue Whiting migrations in the Northeast Atlantic in 1978-1988 in relation to stock composition and hydrographic conditions. Contribution to the Fourth Soviet-Norwegian Symposium in Bergen 1989 "Biology and fishery of the Blue Whiting in the Northeast Atlantic and the Norwegian spring-spawning herring".

Sveinbjörnson, S. 1989. Relevant Icelandic Surveys in 1989. Working note to the Meeting of the Blue Whiting Assessment Working Group, Copenhagen, 13-19 September 1989.

Zilanov, V.K. 1984. Blue Whiting of the North-East Atlantic, Moscow, Pischeraya Promishlenost (in Russian).

Table 4.1 Landings (tonnes) of BLUE WHITING from the main fisheries, 1979-1988, as estimated by the Working Group.

Area	1979	1980	1981	1982	1983
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	741,042	766,798	520,738	110,685	52,963
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	284,547	250,693	288,316	316,566	361,537
Icelandic industrial fishery (Division Va)	2,500	-	-	-	7,000
Industrial mixed fishery (Divisions IVa-c, Vb, IIIa)	63,333	75,129	61,754	117,578	117,737
Subtotal northern fishery	1,091,422	1,092,620	870,808	544,829	539,237
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k)	27,176	29,944	38,748	31,590	30,835
Total	1,118,598	1,122,564	909,556	576,419	570,072

Area	1984	1985	1986	1987	1988[1]
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	65,932	90,742	160,061	123,042	55,829
Fishery in the spawning area (Divisions Vb, VIa, VIb, VIb and VIIb + VIIc)	421,865[2]	464,265[2]	534,263[2]	445,884[2]	421,636
Icelandic industrial fishery (Division Va)	-	-	-	-	-
Industrial mixed fishery (Divisions IVa-c, Vb, IIIa)	122,806	97,769	99,580	62,689	45,110
Subtotal northern fishery	610,603	652,776	793,904	631,615	522,575
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k)	31,173[3]	42,817[3]	33,081[3]	32,796[3]	30,838
Total	645,776	695,593	826,985	664,411	553,413

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

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

Country	1979	1980	1981	1982	1983
Denmark	-	-	-	473	-
Faroes	762	-	11,131	-	11,316
France	-	-	5,093	2,067	2,890
German Dem. Rep.	22,502	14,234	15,607	3,042	5,553
Germany, Fed. Rep.[2]	1,157	8,919	17,385	890	2
Greenland	-	-	-	-	-
Iceland	12,428	4,562	4,808	-	-
Norway	33,588[3]	902	187	-	5,061
Poland	4,346	11,307	2,434	443	-
UK (Engl. & Wales)	-	-	-	-	-
USSR	666,259	726,874	464,093	103,770	28,141
Total	741,042	766,798	520,738	110,685	52,961

Country	1984	1985	1986	1987	1988[1]
Denmark	93	-	-	-	-
Faroes	-	-	-	9,290	-
France	-	-	-	-	-
German Dem. Rep.	8,193	1,689	3,541	1,010	3
Germany, Fed. Rep.[2]	35	75	106	-	-
Greenland	-	-	10	-	-
Iceland	105	-	-	-	-
Norway	689	-	-	-	-
Poland	-	-	-	56	10
UK (Engl. & Wales)	-	-	-	-	-
USSR	56,817	88,978	156,404	112,686	55,816
Total	65,932	90,742	160,061	123,042	55,829

[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.

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), 1979-1988, as estimated by the Working Group.

Country	1979	1980	1981	1982	1983
Denmark	21,200	19,272	11,361	23,164	28,680
Faroes	35,780	37,488	23,107	38,958	56,168
France	-	-	-	1,212	3,600
German Dem. Rep.	172	181	6,562	7,771	3,284
Germany, Fed. Rep.	3,304	709	935	701	825
Iceland	4,864	5,375	10,213	1,689	1,176
Ireland	-	-	-	-	-
Netherlands	154	-	222	200	150
Norway	186,737	133,754	166,168	169,700	185,646
Poland	4,643	-	2,279	-	-
Spain	-	-	-	-	318
Sweden	-	3,185	-	-	-
UK (Engl. & Wales)	4,136	3,878	6,000	-	-
UK (Scotland)	1,466	6,819	2,611	-	-
USSR	22,091	40,032	58,858	73,171	81,690
Total	284,547	250,693	288,316	316,566	361,537

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

[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, 1979-1988, as estimated by the Working Group.

Country	1979	1980	1981	1982	1983
Denmark	28,932	49,947	35,066	34,463	38,290
Faroes	1,489	1,895	3,133	27,269	12,757
France	-	-	-	1,417	249
German Dem. Rep.[2]	49	-	-	-	-
Germany, Fed. Rep.[2]	13	252	-	93	-
Ireland	-	-	2,744	-	-
Netherlands	-	-	18,627	47,856	62,591
Norway	30,930	21,962[3]	-	-	-
Poland[2]	-	-	229	550	-
Spain	-	-	-	-	-
Sweden[4]	1,249	1,071	1,955	1,241	3,850
UK (Engl. & Wales)[2]	-	-	-	4,689	-
UK (Scotland)	37	2	-	-	-
USSR[2]	634	-	-	-	-
Total	63,333	75,129	61,754	117,578	117,737

Country	1984	1985	1986	1987	1988[1]
Denmark	48,939	35,843	57,315	28,541	18,114
Faroes	9,740	3,606	5,678	7,051	492
France	-	-	-	-	-
German Dem. Rep.[2]	-	-	-	53	-
Germany, Fed. Rep.[2]	566	52	-	62	280
Ireland	-	-	-	-	-
Norway	58,038	54,522	26,941	24,969	24,898
Netherlands	122	130	1,114	-	-
Poland[2]	-	-	-	-	-
Spain	-	-	-	-	-
Sweden[4]	5,401	3,616	8,532	2,013	1,226
UK (Engl. & Wales)[2]	-	-	-	-	-
UK (Scotland)	-	-	-	-	100
USSR[2]	-	-	-	-	-
Total	122,806	97,769	99,580	62,689	45,110

[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 1989 based on information from Working Group members.

Country	Area	Jan	Feb	Mar	Apr	May	Jun	Jul		Total
Faroe Islands	Vb	-	-	14	622	2,256	586	-		3,478
	VIIb,c	3,594	5,301	12,763	20,751	13,496	-	-		55,905
									Sum	59,383
German Dem.Rep.	Vb	-	-	-	-	-	113	607		720
	VIb	-	-	63	62	-	-	-		125
	VIIb,c	-	-	143	-	-	-	-		143
	VIIg-k	-	20	1,725	-	-	-	-		1,7[illegible]
	XII	-	-	27	88	-	-	-		115
										2,848
Netherlands	VIIg-k								Sum	800[1]
Norway	IVa	1	159	583	5,524	9,674	3,423	2,328		21,692
	Vb	-	-	-	-	1,731	-	-		1,731
	VIa	-	-	-	-	25,450	44	-		25,494
	VIIb,c	4,448	13,696	55,760	31,991	-	-	-		105,895
	VIIg,k	-	24,706	13,846	1,509	-	-	-		40,061
									Sum	194,873
UK (Scotland)	VIa	-	-	-	2,921	740	-	-		3,661
	VIIc	-	-	-	2,062	-	-	-		2,062
									Sum	5,723
USSR	IIa	-	-	-	-	-	9,474	13,977		23,451
	Vb	1,519	984	106	12,612	35,658	16,352	3,076		70,307
	VIb	-	-	-	465	-	-	-		465
	VIIb,c	-	11	16,544	109	1	-	-		16,665
	VIIg-k	-	483	470	-	-	-	-		953
	XII	3,740	16,051	1,172	-	-	-	-		20,963
									Sum	132,804
									Grand total	396,431

[1] Monthly distribution not available.

Table 4.6a Length distribution of BLUE WHITING in 1988, USSR, %.

Length cm	Divisions II	Vb_1	VIb	VIIb,c	VIIg-k
15	-	0.1	-	-	-
16	-	0.1	-	-	-
17	0.1	0.5	-	-	-
18	0.1	0.9	-	-	0.1
19	0.1	0.3	-	-	1.3
20	0.2	0.3	-	-	2.6
21	0.7	0.5	1.0	0.8	6.9
22	1.3	1.4	4.5	3.5	6.5
23	1.9	3.3	5.0	6.5	4.2
24	2.9	6.9	6.5	6.3	2.1
25	5.3	9.9	5.5	5.0	2.4
26	7.8	6.9	7.5	6.3	2.4
27	10.0	9.0	14.0	5.0	6.9
28	11.5	10.7	18.5	12.8	13.6
29	15.6	11.4	12.5	11.5	13.2
30	15.8	12.6	11.0	13.8	12.0
31	11.0	8.3	8.0	7.8	8.8
32	6.6	7.0	4.0	6.8	6.8
33	3.9	3.2	1.5	4.0	3.0
34	2.2	2.3	0.5	4.5	1.6
35	1.6	1.9	-	2.3	2.4
36	0.5	1.1	-	0.7	1.4
37	0.5	0.8	-	0.5	1.0
38	0.1	0.4	-	1.0	0.6
39	0.1	0.2	-	0.5	0.1
40	0.1	-	-	0.2	0.1
41	0.1	-	-	0.2	-
Number sp.N	1,943	1,196	200	399	949
Mean length	28.9	28.3	27.5	28.7	27.9

Table 4.6b BLUE WHITING.
Length distribution (%) by month and Division from the Norwegian directed fishery in 1988.

Length cm	Feb VIIgk	Mar VIIgk	Mar VIIbc	Apr VIIbc	Apr Vb	May Vb	Apr VIa	May VIa	May IVa
21	-	0.3	-	0.1	-	0.1	0.1	-	0.7
22	0.6	0.8	0.2	0.4	-	0.2	0.3	-	1.1
23	1.7	1.5	0.3	1.3	-	0.3	0.6	0.2	3.5
24	1.4	1.8	1.6	0.9	-	2.8	0.5	5.4	6.7
25	6.6	4.9	4.6	3.0	-	4.2	2.2	9.0	4.9
26	12.5	8.3	8.3	7.9	-	5.0	3.9	13.2	10.7
27	18.8	12.9	13.4	11.4	3.7	10.0	7.7	14.0	11.1
28	17.8	15.4	18.9	15.0	3.7	14.4	13.2	12.3	12.4
29	8.9	14.2	14.3	12.2	9.3	12.3	12.2	12.2	14.9
30	11.1	14.7	12.7	15.6	13.0	16.8	15.4	12.2	12.1
31	8.1	10.9	10.1	12.2	18.5	12.0	14.1	9.9	8.7
32	4.1	5.4	5.8	8.6	22.2	9.5	10.4	6.6	5.4
33	3.8	3.9	4.8	5.3	16.7	6.0	6.9	4.7	2.2
34	1.7	1.9	2.4	2.7	5.6	2.2	4.6	-	3.3
35	1.0	1.4	1.6	2.0	3.7	1.4	3.7	0.2	1.4
36	1.0	1.0	0.4	0.7	3.0	2.0	3.0	-	0.4
37	0.9	0.6	0.4	0.6	0.7	0.8	0.8	-	-
38	-	-	0.2	0.2	-	-	0.4	-	-

Table 4.6c BLUE WHITING.
Length distribution (%) by month for the Norwegian mixed industrial fishery in Division IVa in 1988.

Length cm	Feb	Apr	May	Jun	Aug	Sep
15	5.3	-	-	-	-	-
16	15.8	-	-	-	-	-
17	13.3	-	1.3	0.2	-	-
18	5.3	1.9	6.6	0.7	0.6	-
19	-	4.5	19.8	2.1	1.5	-
20	2.6	2.5	39.5	4.0	3.0	-
21	-	1.9	18.4	1.9	1.5	2.2
22	-	0.7	5.3	0.5	0.6	4.3
23	-	3.8	3.9	8.6	16.8	28.0
24	-	12.7	2.6	6.4	9.9	14.0
25	2.6	20.1	-	12.9	9.0	11.8
26	5.3	17.7	-	11.2	8.1	6.5
27	-	11.4	1.3	12.4	11.8	11.8
28	-	7.6	1.3	13.9	12.9	9.7
29	2.6	1.9	-	7.9	10.5	5.4
30	15.8	5.7	-	8.3	6.3	-
31	7.9	3.8	-	2.4	3.6	3.2
32	2.6	3.8	-	3.3	2.4	2.2
33	7.9	-	-	1.0	0.9	1.1
34	2.6	-	-	1.9	0.3	-
35	2.6	0.6	-	0.2	-	-
36	2.6	-	-	0.2	0.3	-
37	2.6	-	-	-	-	-
38	-	-	-	-	-	-
39	-	-	-	-	-	-
40	2.6	-	-	-	-	-

Table 4.6d BLUE WHITING.
Length distribution (%) by month in Division Vb from the Faroese directed fishery in 1988.

Length cm	Jan-Feb	Mar-Apr	May	Oct-Nov	Dec
16	0.8	0.6		-	-
17	2.9	1.3		-	-
18	3.0	5.8	0.5	-	-
19	2.7	7.7	1.0	-	0.2
20	1.2	6.3	0.6	-	-
21	1.8	4.5	1.1	0.2	-
22	5.3	5.5	1.5	0.8	0.6
23	11.9	10.3	2.9	4.3	1.2
24	13.3	11.2	3.9	2.9	4.3
25	6.5	11.2	4.6	5.7	5.5
26	5.6	9.0	8.6	11.4	7.3
27	5.5	4.3	15.4	16.0	13.4
28	8.8	4.8	17.8	17.8	17.1
29	10.7	4.8	14.1	14.7	18.3
30	7.5	4.8	9.8	8.6	13.6
31	4.7	3.7	7.5	8.0	7.3
32	2.8	1.7	4.7	4.3	5.3
33	1.5	0.9	2.6	2.2	3.0
34	1.3	0.5	1.4	1.0	1.2
35	0.8	0.4	0.9	0.8	1.0
36	0.2	0.4	0.7	1.2	0.4
37	0.5	0.1	0.2	1.0	-
38	0.4	-	0.1	-	-
39	0.1	-	-	-	0.2
40		0.1	-	-	-
Mean length	25.8	24.3	28.0	28.2	28.5
N	915	1529	870	511	492

Table 4.6e BLUE WHITING.
Length distribution (%) by month in Division Vb caught as by-catch in Faroese mixed industrial fisheries in 1988.

Length cm	Jan-Feb	Oct
14	7.7	-
15	19.2	14.3
16	57.7	35.7
17	15.4	21.4
18	-	21.4
19	-	-
Mean length	15.8	16.7
N	26	14

Table 4.6f Length distribution (%) of BLUE WHITING in 1989, USSR.

Length cm	Divisions IIa	Vb_1	Vb_2	VIb	VIIb,c	VIIg-k	XII
16	-	0.5	-	-	-	-	-
17	-	1.0	-	-	0.1	-	-
18	-	1.0	1.0	-	0.9	-	-
19	-	0.2	1.0	-	2.7	-	-
20	-	1.0	-	-	3.7	-	-
21	-	1.8	1.0	1.0	1.6	-	-
22	-	2.5	1.0	1.0	1.4	0.5	-
23	-	7.5	3.0	8.0	1.1	-	-
24	6.0	10.3	6.0	10.0	4.3	1.5	1.0
25	7.0	14.5	13.0	19.0	5.6	1.5	-
26	16.0	16.7	25.0	19.0	7.7	7.0	1.0
27	12.0	8.8	14.0	9.0	14.3	10.5	9.0
28	10.0	10.5	7.0	10.0	11.3	10.5	10.0
29	12.0	5.8	7.0	6.0	13.0	14.0	12.0
30	13.0	4.2	7.0	2.0	12.0	15.5	14.0
31	5.0	4.2	6.0	4.0	7.6	15.5	17.0
32	4.0	3.8	-	1.0	3.6	8.5	7.0
33	5.0	2.3	1.0	-	3.0	7.0	19.0
34	3.0	0.5	2.0	-	1.6	3.5	4.0
35	5.0	1.8	1.0	1.0	2.2	2.5	3.0
36	1.0	0.5	2.0	-	0.9	0.5	1.0
37	-	0.2	1.0	-	0.9	1.0	-
38	-	0.2	1.0	-	0.3	0.5	-
39	1.0	-	-	-	0.1	-	-
40	-	-	-	-	0.1	-	1.0
41	-	-	-	-	-	-	1.0
Number sp.N	100	400	100	100	700	200	100
Mean length	28.8	26.6	24.3	26.7	27.9	29.8	30.8

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), 1979 - 1988.

Age	1979	1980	1981	1982	1983
0	-	-	-	1.2	2.5
1	-	55.1	4.0	1.7	290.4
2	69.9	319.5	40.1	48.6	239.1
3	165.0	362.0	322.8	123.1	164.1
4	457.5	399.1	225.3	371.0	194.1
5	468.3	478.3	501.5	212.6	411.4
6	569.0	530.9	539.0	251.0	284.4
7	743.2	725.3	448.5	250.7	274.0
8	904.8	779.2	618.3	259.3	283.5
9	826.4	694.5	573.2	278.7	219.9
10	797.0	1,008.7	718.3	259.8	152.6
11	473.2	398.1	343.6	158.5	71.5
12	359.2	394.2	232.6	133.6	45.4
13	142.7	66.8	73.9	41.0	25.0
14	69.3	64.6	49.5	45.3	12.1
15+	39.0	4.7	30.6	28.0	10.0
Total	6,405.4	6,191.0	4,721.2	2,464.1	2,680.0
Tonnes	1,025,599	1,017,491	809,054	427,341	416,730

Age	1984	1985	1986	1987	1988[1]
0	63.6	871.4	51.9	9.1	3.6
1	417.6	127.4	161.9	280.8	93.2
2	1,394.1	1,341.6	263.3	361.0	403.2
3	277.9	1,588.1	1,559.5	580.2	416.2
4	211.9	199.3	1,464.3	1,780.2	611.2
5	259.2	161.0	298.7	680.3	1,238.9
6	420.2	303.7	156.4	118.2	584.9
7	253.1	248.7	192.2	94.9	77.8
8	190.3	167.2	185.8	117.1	50.7
9	151.6	91.7	166.4	99.7	32.4
10	113.8	87.8	172.1	48.3	28.3
11	57.7	73.1	108.7	60.1	8.8
12	50.0	51.4	65.6	41.6	8.9
13	15.0	21.1	25.2	21.1	2.0
14	8.1	12.5	6.8	10.9	0.3
15+	6.7	9.5	8.1	13.0	0.6
Total	3,890.9	5,355.3	4,886.9	4,316.5	3,571.0
Tonnes	481,872	554,640	694,314	571,659	477,552

[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) 1979 - 1988.

Age	1979	1980	1981	1982	1983
0	2.4	23.2	-	3,450.1	336.3
1	1,849.0	276.1	65.1	45.3	1,844.2
2	78.8	329.9	81.4	41.3	90.0
3	32.3	74.8	191.9	80.9	38.4
4	22.3	22.6	58.4	112.8	47.7
5	18.2	29.1	20.1	29.2	55.6
6	20.8	23.1	16.7	21.6	12.2
7	10.8	29.3	17.8	14.8	12.8
8	8.8	26.8	15.7	12.0	2.6
9	14.0	15.2	4.4	5.2	5.8
10	6.2	13.8	4.9	1.8	4.2
11	1.0	6.4	3.6	-	9.6
12	4.4	1.8	1.5	2.4	3.3
13	-	2.2	1.2	0.6	0.6
14	-	1.4	0.1	0.6	0.3
15+	-	0.4	0.2	-	-
Total	2,069.0	860.8	483.0	3,816.6	2,463.6
Tonnes	94,995	75,129	61,754	117,578	124,737

Age	1984	1985	1986	1987	1988[1]
0	446.4	184.3	-	226.8	12.3
1	1,650.8	891.4	395.0	174.5	185.1
2	587.7	365.0	334.7	105.7	84.3
3	49.7	173.8	134.6	85.4	83.4
4	12.8	37.4	184.4	88.9	40.2
5	12.6	13.4	79.7	32.8	44.0
6	10.4	13.9	24.3	15.6	24.0
7	6.1	5.8	7.3	9.2	3.3
8	2.2	5.6	11.0	5.1	2.1
9	2.7	1.8	7.3	3.8	1.0
10	2.6	3.0	3.9	0.2	0.2
11	0.9	1.4	3.8	-	-
12	0.3	0.3	1.4	-	-
13	0.3	-	1.0	-	-
14	0.1	-	1.1	-	-
15+	-	-	-	-	-
Total	2,785.5	1,697.0	1,189.4	748.0	479.9
Tonnes	122,806	97,769	99,580	59,952	45,110

[1] Preliminary.

Table 4.9

BLUE WHITING, NORTHERN AREA
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: millions

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
0	2	23	0	3451	339	510	1056	52	236	16
1	1919	331	69	45	2133	2068	1019	557	455	278
2	244	649	122	90	328	1982	1707	598	467	488
3	353	437	515	204	202	328	1762	1694	666	500
4	480	422	284	484	241	225	237	1649	1869	651
5	487	507	522	242	465	272	174	378	713	1293
6	590	554	556	273	295	431	318	181	134	609
7	754	755	466	266	285	259	254	200	104	81
8	914	806	634	271	285	192	173	197	122	53
9	840	620	578	284	225	154	93	174	103	33
10	803	1023	723	262	156	116	91	176	48	28
11	474	405	347	159	81	59	74	113	60	9
12	364	396	234	136	49	50	52	67	42	9
13	143	69	75	42	26	15	21	26	21	2
14	69	66	50	46	12	8	12	8	11	1
15+	39	5	31	28	10	7	9	8	13	1
TOTAL	8474	7067	5206	6281	5132	6676	7052	6078	5064	4052

Table 4.10

BLUE WHITING, NORTHERN AREA
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: kilogram

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
0	.032	.027	.027	.018	.018	.027	.014	.033	.020	.024
1	.030	.036	.063	.046	.046	.036	.038	.040	.056	.061
2	.084	.079	.092	.094	.094	.086	.080	.081	.092	.087
3	.105	.107	.118	.136	.136	.104	.102	.113	.109	.107
4	.109	.122	.135	.152	.152	.142	.129	.132	.125	.131
5	.129	.135	.145	.162	.162	.157	.164	.168	.148	.142
6	.147	.149	.155	.178	.178	.164	.178	.202	.178	.158
7	.160	.165	.170	.195	.195	.176	.200	.209	.209	.181
8	.170	.176	.178	.200	.200	.189	.208	.243	.221	.199
9	.177	.186	.187	.204	.204	.186	.218	.246	.222	.222
10	.188	.199	.199	.213	.213	.197	.225	.242	.251	.241
11	.193	.202	.208	.234	.234	.202	.233	.255	.249	.276
12	.199	.207	.228	.228	.228	.194	.233	.260	.252	.232
13	.200	.207	.234	.258	.258	.225	.243	.272	.274	.263
14	.200	.207	.249	.242	.242	.223	.251	.302	.242	.429
15+	.200	.207	.257	.258	.258	.242	.279	.305	.266	.229

Table 4.11 Catch per unit effort in the directed fisheries 1980-1987 (fishing gear - mid-water trawl). GRT-classes 1-5 are given at bottom of the table.

GRT class	Country	Time period	1980	1981	1982	1983	1984	1985	1986	1987	1988
					Division IIa - t/hour						
4	Norway	Nov	-	-	-	-	8.00[1]	-	-	-	-
3	USSR	Apr-Oct	-	-	-	0.87	-	1.86	1.63	2.47	-
4	German Dem.Rep.	May-Jun	2.79	1.21	1.00	2.35	1.40	2.57	5.40	1.63	-
		Jul-Sep	3.11	2.25	1.21	1.10	2.57	2.29	2.30	0.80	-
		Oct-Dec	3.51	1.04	2.25	2.70	-	1.22	2.70	0.94	-
	USSR	Feb	6.35	-	-	-	-	-	3.58	2.21	0.73
		Mar-Apr	2.38	3.57	1.84	-	7.80	0.87	4.12	3.54	3.55
		May-Jun	3.30	2.62	1.35	1.73	3.06	2.48	3.08	2.34	2.57
		Jul-Sep	3.82	2.54	2.85	0.60	2.85	3.16	2.27	2.28	2.02
		Oct-Dec	3.14	3.01	2.99	-	-	-	1.42	1.90	2.12
5	USSR	Jan-Sep	-	-	-	-	-	-	5.43	2.51	-
					Division IVa - t/hour						
1	Norway	Apr-May	-	7.18	17.39	16.51	8.68	-	2.18	-	18.40
2	Norway	Apr-May	9.29	13.40	13.75	18.31	7.01	15.70	-	7.91	7.64
		Nov	-	-	-	-	4.50[1]	-	-	-	-
3	Norway	Mar	-	-	-	-	-	-	-	7.93	-
		Apr-May	-	15.36	15.03	21.19	-	17.26	-	5.27	17.86
					Division Vb - t/hour						
1	Faroes	May	6.20	9.60	-	-	-	-	-	-	-
	Norway	Jan	-	-	-	-	-	-	11.86	-	-
		Apr-May	18.14	18.94	4.88	-	12.40	16.19	13.43	-	10.47
		Nov-Dec	-	-	-	-	25.08	12.55	-	-	-
3	German Dem.Rep	Jan-Mar	-	-	-	-	-	-	-	1.47	-
		Dec	-	-	-	-	-	-	-	1.13	-
	Norway	Apr-May	13.57	29.47	-	-	-	24.85	-	13.96	16.47
	USSR	Apr-Jun	-	-	-	0.38	-	7.05	-	-	-
4	German Dem.Rep.	Jan-May	-	3.88	2.12	2.08	-	3.50	1.40	0.18	-
		Jun-Jul	-	-	-	-	-	3.58	2.50	1.86	1.52
		Aug	-	-	-	-	-	-	2.10	0.97	2.58
		Sep-Dec	-	-	-	-	-	-	-	0.64	-
		Nov-Dec	-	-	-	-	2.20	1.58	-	-	-
	USSR	Jan-Feb	6.83	6.71	5.16	3.05	1.74	3.71	3.12	2.37	2.15
		Mar-May	5.23	5.97	4.58	4.12	4.57	4.99	5.22	4.87	4.75
		Jul-Aug	-	3.75	3.03	3.16	4.29	5.33	5.41	5.45	2.36
		Sep-Dec	-	2.72	-	2.77	3.70	-	3.27	2.06	3.65
5	USSR	Feb-Oct	-	-	-	-	-	-	7.50	3.20	5.67

(cont'd)

Table 4.11 (cont'd)

GRT class	Country	Time period	1980	1981	1982	1983	1984	1985	1986	1987	1988
							Division VIa - t/hour				
1	Norway	Feb	-	-	-	-	31.35	-	-	-	-
2	Faroes	Apr	16.40	-	-	-	-	-	-	-	-
	Norway	Jan-Feb	-	-	-	-	-	-	11.90	14.84	-
		Mar-Apr	26.56	34.96	36.30	49.04	25.21	20.05	21.50	24.78	15.94
		May	-	-	-	-	-	-	22.38	10.62	21.15
3	Norway	Feb	-	-	-	-	-	-	-	10.81	-
		Mar-Apr	23.92	57.13	42.38	42.83	28.78	22.29	-	20.53	23.36
		May	-	-	-	-	-	-	-	12.07	26.18
4	USSR	Mar	-	-	-	-	3.92	-	-	-	-
							Division VIb - t/hour				
4	German Dem.Rep.	Mar-Apr	-	-	-	-	-	-	-	2.49	-
	USSR	Apr-Jun	-	-	-	-	-	-	4.80	4.42	5.60
							Divison VIIb,c - t/hour				
1	Norway	Mar	-	-	-	-	21.08	-	-	-	25.09
2	Norway	Mar-Apr	-	-	-	-	27.74	26.83	25.35	21.74	18.29
3	Norway	Mar	-	-	-	-	-	-	-	24.02	32.29
		Apr	-	-	-	-	-	-	-	38.35	29.55
		Nov	-	-	-	-	8.00[1]	32.08	-	-	-
4	USSR	Feb-Mar	-	-	-	-	4.72	6.21	3.83[2]	4.49[2]	5.61
5	USSR	Feb-Mar	-	-	-	-	-	-	10.20	-	6.48
							Division VIIg-k - t/hour				
2	Norway	Mar	-	-	-	-	14.58	-	-	35.54	25.93
3	Norway	Mar	-	-	-	-	-	-	-	35.24	53.71
4	German Dem.Rep.	Feb-Mar	-	-	-	-	-	-	7.20	3.21	5.09
	USSR	Feb-Mar	-	-	-	-	3.85	12.30	6.96	4.96[3]	6.13

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

Table 4.12 Catch per unit effort in the BLUE WHITING directed fisheries in Division IIa for 2,000 - 3,999.9 GRT, using mid-water trawls, 1980-1988.

Month	1980	1981	1982	1983	1984	1985	1986	1987	1988
	Catch (tonnes)								
German Dem.Rep.									
January	-	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-	-	-
May	546	159	289	613	351	-	-	-	-
June	3,025	2,566	1,148	2,524	1,876	393	150	432	-
July	3,523	5,951	1,226	1,026	3,947	642	-	111	-
August	2,871	4,130	-	764	1,779	-	1,441	70	-
September	605	1,481	113	-	240	490	1,335	139	-
October	1,128	55	266	-	-	111	403	258	-
November	1,380	-	-	494	-	-	412	-	-
December	754	-	-	132	-	-	-	-	-
All months	13,832	14,310	3,042	5,553	8,193	1,636	3,741	1,010	-
May - Oct	11,698	14,310	3,042	4,917	8,193	1,636	3,179	1,010	-
	Effort (hours)								
January	-	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-	-	-
May	279	210	152	393	219	-	-	-	-
June	999	2,046	1,280	945	1,371	153	28	265	-
July	902	2,596	1,045	831	1,596	247	-	163	-
August	965	2,079	-	801	598	-	563	60	-
September	248	627	54	-	128	247	546	175	-
October	-	53	118	-	-	91	192	274	-
November	-	-	-	-	-	-	115	-	-
December	-	-	-	-	-	-	-	-	-
All months	4,322	7,611	2,649	3,202	3,912	738	1,444	937	-
May - Oct	3,817	7,611	2,649	2,970	3,912	738	1,301	937	-
	CPUE (tonnes/hour)								
January	-	-	-	-	-	-	-	-	-
February	-	-	-	-	-	-	-	-	-
March	-	-	-	-	-	-	-	-	-
April	-	-	-	-	-	-	-	-	-
May	1.96	0.76	1.90	1.56	1.60	-	-	-	-
June	3.03	1.25	0.90	2.67	1.37	2.57	5.36	1.63	-
July	3.91	2.29	1.17	1.24	2.47	2.60	-	0.68	-
August	2.98	1.99	-	0.95	2.97	-	2.56	1.17	-
September	2.44	2.36	2.09	-	1.88	1.98	2.45	0.79	-
October	-	1.04	2.25	-	-	1.22	2.10	0.94	-
November	-	-	-	-	-	-	3.58	-	-
December	-	-	-	-	-	-	-	-	-
All months	3.20	1.88	1.15	1.73	2.09	2.22	2.59	1.08	-
May - Oct	3.06	1.88	1.15	1.66	2.09	2.22	2.51	1.08	-
	2.83	1.62	1.66	1.61	2.06	2.09	3.12	1.04	-

(cont'd)

Table 4.12 (cont'd)

Month	1980	1981	1982	1983	1984	1985	1986	1987	1988
	Catch (tonnes)								
USSR									
January	2,927	-	8,003	-	-	-	1,069	-	8
February	2,153	-	-	-	-	-	3,622	2,423	126
March	16,811	3,886	375	-	-	-	463	1,483	631
April	36,284	45,645	618	-	1,782	62	529	9,182	176
May	125,988	88,754	46,089	15,188	6,131	3,289	455	5,104	2,034
June	114,117	78,727	27,617	7,919	16,564	25,031	27,967	31,833	24,678
July	121,463	87,582	6,820	1,172	11,842	33,177	47,485	34,022	10,818
August	114,505	63,889	-	-	15,609	20,969	32,608	23,594	1,142
September	79,504	37,960	2,921	-	492	5,311	9,269	6,256	407
October	50,954	11,560	1,121	-	-	-	1,812	2,944	-
November	17,543	4,778	379	-	-	-	966	-	143
December	1,292	10,704	-	-	-	-	268	-	139
All months	683,541	433,485	93,943	24,279	52,420	87,839	126,520	111,995	40,311
May - Oct	606,531	368,472	84,568	24,279	50,638	87,777	119,596	103,753	39,088

Month	1980	1981	1982	1983	1984	1985	1986	1987	1988
	Effort (hours)								
January	-	-	1,045	-	-	-	622	-	11
February	339	-	-	-	-	-	1,013	1,093	32
March	6,151	1,208	285	-	-	-	135	437	171
April	16,119	12,666	256	-	222	68	119	2,578	135
May	25,244	25,912	17,106	7,300	2,247	1,900	160	2,001	884
June	47,634	37,919	14,209	6,094	5,160	9,550	8,616	13,790	9,495
July	42,319	39,039	5,983	1,963	4,315	11,600	16,490	14,734	5,409
August	28,293	29,528	-	-	5,292	7,350	16,014	9,526	544
September	17,499	11,745	640	-	194	2,360	5,252	3,087	313
October	16,072	3,270	341	-	-	-	1,579	1,581	-
November	5,710	1,455	161	-	-	-	544	-	51
December	413	4,263	-	-	-	-	255	-	76
All months	206,372	167,005	40,026	15,357	17,430	32,828	50,799	48,827	17,121
May - Oct	177,061	147,413	38,279	15,357	17,208	32,760	48,111	44,719	16,645

Month	1980	1981	1982	1983	1984	1985	1986	1987	1988
	CPUE (tonnes/hour)								
January	-	-	7.66	-	-	-	1.72	-	0.72
February	6.35	-	-	-	-	-	3.58	2.22	3.94
March	2.73	3.22	1.32	-	-	-	3.43	3.40	3.69
April	2.25	3.60	2.41	-	8.01	0.91	4.44	3.57	1.30
May	4.99	3.42	2.69	2.08	2.73	1.56	2.84	2.55	2.30
June	2.39	2.08	1.94	1.30	3.21	2.62	3.25	2.31	2.60
July	2.87	2.24	1.14	0.60	2.74	2.86	2.88	2.31	2.00
August	4.05	2.16	-	-	2.95	2.84	2.04	2.50	2.09
September	4.54	3.23	4.56	-	2.54	2.25	1.77	2.03	1.30
October	3.17	3.53	3.29	-	-	-	1.15	1.86	-
November	3.07	3.28	2.35	-	-	-	1.78	-	2.80
December	3.13	2.51	-	-	-	-	1.05	-	1.83
All months	3.31	2.60	2.35	1.58	3.01	2.68	2.49	2.29	2.28
May - Oct (1)	3.43	2.50	2.21	1.58	2.94	2.68	2.49	2.32	2.35
(2)	3.14	3.67	2.78	2.72	1.33	2.83	2.17	2.26	2.06

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

Table 4.13

```
NORTHERN BLUE WHITING TUNING-3-11. 1988
104
Norway,Spawning Area/Acoustic
82,88
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
USSR,Spawning Area/Acoustic
82,88
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
Norwegian Sea Acoustic
82,88
1,1
3,11
1, 1254,4778,3652,3172,2339,1692,887,425,263
1,  456, 779,1425, 594, 487, 450,346,222,105
1,  826, 393, 534, 544, 325,  56, 53, 61, 24
1,12525, 682, 418, 203, 245, 127,381,153, 59
1, 7201,6924,1863, 962, 348, 317,143,207, 54
1, 4894,5173,1383, 542, 219, 167, 99,103, 30
1, 2838,2587,3423, 903, 120,  91, 17, 55,  0
USSR cpue Div IIa, July
82,88
1,1
3,11
1,  .12, .85,1.42,1.35,1.37,.46,.66,  0,  0
1,  .31, .39,1.00, .92, .77,.96,.83,.54,.15
1,  .56, .08, .22, .20, .06,.14,.08,.14,  0
1, 5.84, .32, .03, .73, .57,.64,.57,.86,.19
1,14.64,4.41, .55,   0, .10,  0,  0,  0,  0
1, 8.49,7.95,0.44,   0,   0,  0,.34,  0,  0
1,  .31, .32,. 87, .29, .04,  0,  0,  0,.01
```

Table 4.14 Tuning results.

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

Regression weights
, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,
Oldest age F = 1.000*average of 3 younger ages. Fleets combined by variance of predictions
Fishing mortalities

Age	82	83	84	85	86	87	88
0	.129	.009	.030	.067	.005	.058	.040
1	.010	.110	.071	.076	.045	.050	.090
2	.035	.090	.141	.078	.059	.049	.070
3	.081	.102	.122	.180	.103	.086	.068
4	.157	.129	.158	.121	.255	.158	.113
5	.133	.223	.211	.176	.289	.167	.156
6	.162	.237	.331	.407	.280	.157	.210
7	.194	.254	.338	.332	.487	.258	.134
8	.246	.329	.271	.397	.465	.628	.202
9	.418	.332	.298	.204	.903	.474	.343
10	.589	.428	.285	.288	.730	.684	.226
11	.418	.363	.284	.296	.699	.596	.257

Log catchability estimates

Age 3

Fleet	82	83	84	85	86	87	88
1	-.04	.06	-.58	-.07	-.83	.03	.17
2	-8.45	-6.74	-6.83	-6.61	-6.78	-7.46	-7.60
3	-.70	-1.47	-1.18	.25	-.83	-.46	-.96
4	-9.95	-8.76	-8.48	-7.42	-7.03	-6.82	-10.08

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-.18	.401	.8380	.0476	.000E+00	.000E+00	-.177	.142
2	-7.21	.711	.0007	.0996	.000E+00	.000E+00	-7.210	.251
3	-.76	.590	.4657	.0821	.000E+00	.000E+00	-.764	.208
4	-8.36	1.427	.0002	.3763	.000E+00	.000E+00	-8.363	.505

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.068	.294	.275	.294	.873

Age 4

Fleet	82	83	84	85	86	87	88
1	.77	.38	.13	-.38	.13	.63	.75
2	-7.02	-6.45	-7.48	-7.65	-5.63	-6.43	-7.15
3	.44	-.87	-1.29	-1.05	.07	-.83	-.80
4	-8.20	-8.47	-9.79	-8.72	-7.29	-7.31	-9.80

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.35	.448	1.4124	.0749	.000E+00	.000E+00	.345	.159
2	-6.83	.753	.0011	.1546	.000E+00	.000E+00	-6.830	.266
3	-.62	.671	.5384	.1355	.000E+00	.000E+00	-.619	.237
4	-8.51	1.102	.0002	.4100	.000E+00	.000E+00	-8.509	.389

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.113	.320	.289	.320	.818

(cont'd)

Table 4.14 (cont'd)

Age 5

Fleet	82	83	84	85	86	87	88
1	.61	1.14	.29	.01	-.12	.09	.89
2	-7.21	-5.41	-7.07	-7.44	-6.24	-6.59	-6.87
3	.70	-.38	-.88	-.86	.35	-1.13	-.89
4	-7.16	-7.64	-8.68	-10.40	-7.77	-9.18	-14.14

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.42	.508	1.5151	.0966	.000E+00	.000E+00	.415	.180
2	-6.69	.739	.0012	.1866	.000E+00	.000E+00	-6.690	.261
3	-.44	.752	.6433	.2430	.000E+00	.000E+00	-.441	.266
4	-9.28	2.571	.0001	******	.000E+00	.000E+00	-9.282	.909

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.156	.362	.461	.461	1.622

Age 6

Fleet	82	83	84	85	86	87	88
1	.72	1.10	.35	.23	-.52	-1.11	.92
2	-7.11	-5.77	-5.74	-6.08	-6.96	-6.68	-6.56
3	.63	-.74	-.87	-1.35	.40	-.45	-1.17
4	-7.13	-7.21	-8.78	-6.98	-11.59	-11.86	-3.51

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.24	.856	1.2760	.1061	.000E+00	.000E+00	.244	.303
2	-6.41	.595	.0016	.2416	.000E+00	.000E+00	-6.414	.210
3	-.51	.811	.6023	.4062	.000E+00	.000E+00	-.507	.287
4	-8.15	3.113	.0003	.0020	.000E+00	.000E+00	-8.151	1.100

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.210	.415	.453	.453	1.193

Age 7

Fleet	82	83	84	85	86	87	88
1	.98	1.18	.39	.38	-.49	.03	.18
2	-6.77	-6.35	-5.85	-6.79	-6.50	-6.69	-6.16
3	.54	-.84	-.86	-1.14	-.17	-.61	-1.62
4	-6.91	-7.29	-9.45	-7.20	-8.32	-11.12	-7.64

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.38	.605	1.4593	.1635	.000E+00	.000E+00	.378	.214
2	-6.44	.373	.0016	.1013	.000E+00	.000E+00	-6.445	.132
3	-.67	.742	.5118	.3455	.000E+00	.000E+00	-.670	.262
4	-8.28	1.626	.0003	.0712	.000E+00	.000E+00	-8.275	.575

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.134	.287	.260	.287	.817

Age 8

Fleet	82	83	84	85	86	87	88
1	1.08	1.29	-.22	.38	-.13	.68	.86
2	-6.15	-6.45	-6.38	-6.57	-6.34	-5.48	-6.30
3	.43	-.65	-2.54	-1.23	-.29	-.15	-1.06
4	-7.78	-6.80	-8.53	-6.52	-11.17	-10.38	-8.79

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.56	.621	1.7560	.1508	.000E+00	.000E+00	.563	.219
2	-6.24	.383	.0020	.2156	.000E+00	.000E+00	-6.239	.136
3	-.79	1.022	.4561	.2656	.000E+00	.000E+00	-.785	.361
4	-8.57	1.852	.0002	.2519	.000E+00	.000E+00	-8.568	.655

(cont'd)

Table 4.14 (cont'd)

Age 9

Fleet	82	83	84	85	86	87	88
1	1.19	1.21	-.16	-.21	-.24	-.31	1.22
2	-5.97	-6.77	-5.72	-6.67	-5.71	-5.53	-5.95
3	.27	-.67	-2.28	-.18	-.30	-.79	-1.73
4	-6.94	-6.71	-8.77	-6.69	-10.38	-6.46	-9.68

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.39	.824	1.4700	.1488	.000E+00	.000E+00	.385	.291
2	-6.05	.518	.0024	.3126	.000E+00	.000E+00	-6.046	.183
3	-.81	.961	.4440	.8619	.000E+00	.000E+00	-.812	.340
4	-7.95	1.744	.0004	1.9473	.000E+00	.000E+00	-7.946	.617

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.343	.389	.387	.389	.990

Age 10

Fleet	82	83	84	85	86	87	88
1	-.15	1.18	-.16	-.21	-.33	-.95	1.17
2	-5.84	-6.31	-5.83	-6.37	-5.83	-4.65	-6.17
3	-.04	-.50	-1.90	-.72	-.15	.38	-.81
4	-11.21	-6.51	-7.98	-5.91	-10.60	-9.37	-9.94

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.08	.852	1.0817	.0761	.000E+00	.000E+00	.079	.301
2	-5.86	.621	.0029	.3080	.000E+00	.000E+00	-5.857	.220
3	-.53	.782	.5858	.2982	.000E+00	.000E+00	-.535	.276
4	-8.79	2.180	.0002	.7124	.000E+00	.000E+00	-8.787	.771

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.226	.415	.362	.415	.761

Table 4.15 From Tuning Analysis.

BLUE WHITING, NORTHERN AREA

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

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1979-86
0	.00	.01	.00	.13	.01	.03	.07	.00	.06	.04	.03
1	.22	.08	.02	.01	.11	.07	.08	.05	.05	.09	.08
2	.05	.11	.04	.03	.09	.14	.08	.06	.05	.07	.08
3	.07	.13	.12	.08	.10	.12	.18	.10	.09	.07	.11
4	.11	.12	.11	.16	.13	.16	.12	.25	.16	.11	.15
5	.13	.16	.21	.13	.22	.21	.18	.29	.17	.16	.19
6	.16	.21	.26	.16	.24	.33	.41	.28	.16	.21	.26
7	.23	.32	.27	.19	.25	.34	.33	.49	.26	.13	.30
8	.29	.41	.49	.25	.33	.27	.40	.46	.63	.20	.36
9	.31	.33	.59	.42	.33	.30	.20	.90	.47	.34	.42
10	.50	.76	.82	.59	.43	.28	.29	.73	.68	.23	.55
11	.37	.50	.64	.42	.36	.28	.30	.70	.60	.26	.45
12+	.37	.50	.64	.42	.36	.28	.30	.70	.60	.26	.45
(0- 2)U	.09	.06	.02	.06	.07	.08	.07	.04	.05	.07	
(4- 8)U	.18	.24	.27	.18	.23	.26	.29	.36	.27	.16	

Table 4.16 From Tuning Analysis.

BLUE WHITING, NORTHERN AREA

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: thousand tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1979-86
0	5922	4443	6337	31377	40754	19223	18064	12537	4606	450	0	17332
1	10501	4846	3617	5188	22578	33060	15278	13837	10218	3558	354	13613
2	5222	6871	3669	2899	4207	16562	25201	11589	10826	7955	2663	9528
3	5470	4055	5040	2894	2292	3149	11774	19093	8949	8442	6073	6721
4	5135	4160	2926	3662	2185	1695	2282	8053	14104	6726	6461	3762
5	4534	3771	3026	2140	2562	1572	1185	1655	5110	9864	4920	2556
6	4354	3273	2631	2007	1534	1679	1042	813	1015	3541	6911	2167
7	4020	3034	2181	1654	1398	990	988	568	503	710	2351	1854
8	3935	2613	1806	1367	1115	888	578	580	286	318	509	1610
9	3483	2400	1416	910	875	657	555	318	299	125	213	1327
10	2250	2096	1408	642	491	514	399	370	106	152	73	1021
11	1698	1122	804	509	292	262	317	245	146	44	99	656
12+	2201	1487	904	807	349	355	402	236	212	63	68	843
TOTAL NO	58723	44172	35764	56056	80632	80606	78065	69896	56379	41949		
SPS NO	39123	30434	22963	17691	16575	21062	27625	32570	31420	29571		
TOT.BIOM	6419	5134	4215	3951	4426	4911	5421	6120	5687	4947		
SPS BIOM	5568	4445	3486	2930	2458	2401	3074	4013	3923	3842		

Table 4.17 BLUE WHITING, NORTHERN AREA.

from 79 to 88 on ages 0 to 11
with Terminal F of .123 on age 5 and Terminal S of 1.500

Initial sum of squared residuals was 105.661 and
final sum of squared residuals is 52.889 after 131 iterations

Matrix of Residuals

Years	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88		WTS
Ages											
0/ 1	-2.961	.626	-3.759	2.443	-.117	.884	2.501	-.744	1.126	-.001	.034
1/ 2	1.312	.971	-.534	-1.765	.018	.020	.648	-.149	-.522	-.001	.080
2/ 3	-.079	.478	-.506	-.316	.215	.218	.391	-.161	-.240	-.001	.217
3/ 4	.102	.446	-.158	.097	-.129	.191	.214	-.388	-.375	-.001	.261
4/ 5	.180	-.248	-.107	.255	-.197	.070	-.375	.494	-.072	-.001	.268
5/ 6	.058	-.181	.331	-.037	-.061	-.403	-.011	.632	-.329	-.001	.230
6/ 7	-.215	-.082	.257	-.046	-.179	.111	.321	-.025	-.142	-.001	.387
7/ 8	-.027	-.080	.065	-.071	.079	-.018	.103	-.091	.039	-.001	1.000
8/ 9	.194	-.164	.082	-.051	.051	.053	-.403	-.191	.429	-.001	.306
9/10	-.298	-.560	.166	.450	.186	-.056	-.949	.539	.522	-.001	.142
10/11	.120	.206	.411	.565	.030	-.604	-.985	-.150	.406	-.001	.145
	.000	.000	.000	.000	.000	.000	.000	.000	.000	-.007	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	79	80	81	82	83	84	85	86	87	88
F-values	.1331	.1784	.1866	.1526	.2044	.2095	.1907	.2322	.1816	.1230

Selection-at-age (S)

	0	1
S-values	.0432	.2895

	2	3	4	5	6	7	8	9	10	11
S-values	.3485	.5655	.7559	1.0000	1.3178	1.5474	1.9187	1.9366	2.1906	1.5000

Table 4.18 From Separable VPA.

BLUE WHITING, NORTHERN AREA

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

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1979-86
0	.00	.01	.00	.11	.01	.03	.07	.00	.02	.01	.03
1	.22	.07	.02	.01	.09	.07	.07	.05	.04	.02	.07
2	.05	.11	.03	.04	.10	.11	.07	.06	.05	.06	.07
3	.07	.12	.11	.07	.11	.14	.14	.10	.08	.07	.11
4	.11	.12	.11	.15	.12	.17	.15	.18	.14	.11	.14
5	.13	.16	.21	.12	.21	.19	.19	.36	.11	.14	.20
6	.15	.22	.26	.16	.22	.31	.34	.31	.21	.13	.25
7	.20	.30	.29	.19	.25	.30	.30	.38	.30	.19	.28
8	.24	.35	.45	.28	.33	.27	.34	.40	.42	.24	.33
9	.22	.26	.45	.37	.39	.30	.20	.68	.38	.19	.36
10	.31	.46	.55	.38	.35	.36	.29	.70	.40	.17	.42
11	.20	.25	.28	.22	.19	.22	.41	.70	.55	.12	.31
12+	.20	.25	.28	.22	.19	.22	.41	.70	.55	.12	.31
(0- 2)U	.09	.06	.02	.05	.07	.07	.07	.04	.04	.03	
(4- 8)U	.17	.23	.26	.18	.22	.25	.26	.33	.24	.16	

Table 4.19 From Separable VPA.

BLUE WHITING, NORTHERN AREA

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: thousand tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1979-86
0	6448	4208	5557	37546	43307	19622	18023	15013	16347	3327	0	18716
1	10782	5277	3424	4549	27628	35151	15605	13803	12244	13171	2709	14527
2	5499	7101	4022	2741	3684	20696	26913	11857	10798	9614	10532	10314
3	5511	4282	5228	3183	2163	2720	15157	20494	9168	8420	7431	7342
4	5129	4194	3112	3816	2422	1589	1932	10822	15252	6905	6442	4127
5	4286	3767	3053	2292	2688	1765	1098	1368	7375	10803	5067	2540
6	4544	3070	2627	2030	1659	1782	1200	742	781	5395	7679	2207
7	4513	3189	2015	1651	1416	1092	1072	697	445	518	3868	1956
8	4628	3017	1932	1231	1112	903	662	649	391	271	352	1767
9	4655	2967	1746	1014	764	655	567	386	355	211	174	1594
10	3305	3055	1872	911	575	423	398	380	161	198	143	1365
11	2884	1984	1585	885	511	331	242	244	154	89	137	1083
12+	3738	2630	1781	1405	612	448	308	235	224	128	157	1395
TOTAL NO	65923	48740	37953	63253	88541	87179	83177	76691	73695	59049		
SPS NO	45369	34665	25856	19331	17726	22959	30814	36101	34785	33880		
TOT.BIOM	7605	5962	4772	4385	4826	5375	5881	6746	6536	6208		
SPS BIOM	6715	5249	4054	3279	2636	2582	3378	4465	4383	4382		

Table 4.20

List of input variables for the ICES prediction program.

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

The number of recruits per year is as follows:

Year	Recruitment
1989	11400.0
1990	11400.0
1991	11400.0

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	11400.0	.00	.20	.00	.022	.022
1	9241.0	.03	.20	.10	.058	.058
2	7269.0	.04	.20	.37	.089	.089
3	7431.0	.07	.20	.81	.108	.108
4	6442.0	.09	.20	.85	.128	.128
5	5067.0	.12	.20	.91	.145	.145
6	7679.0	.16	.20	.94	.168	.168
7	3868.0	.19	.20	1.00	.195	.195
8	352.0	.24	.20	1.00	.210	.210
9	174.0	.24	.20	1.00	.222	.222
10	143.0	.27	.20	1.00	.246	.246
11	137.0	.18	.20	1.00	.263	.263
12+	157.0	.18	.20	1.00	.242	.242

Table 4.21

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

BLUE WHITING - NORTHERN STOCK.

Year 1989					Year 1990					Year 1991	
factor	ref. F	stock biomass	sp.stock biomass	catch	factor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
.9	.14	6070	4503	500	.0	.00	5918	4436	0	6230	4744
					.1	.02			64	6164	4682
					.2	.03			127	6100	4622
					.4	.06			251	5975	4505
					.6	.10			370	5853	4391
					.8	.13			486	5736	4281
					1.0	.16			599	5621	4174
					1.2	.19			708	5511	4070
					1.4	.22			814	5403	3970
					1.6	.26			917	5299	3873
					1.8	.29			1017	5198	3779
					2.0	.32			1114	5099	3688

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 4.22 BLUE WHITING - NORTHERN STOCK.

Year 1989. F-factor .875 and reference F .1399

Run depending on a TAC value

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
0	.0044	45.12	.993	11400.0	250.80	.0	.00
1	.0306	252.82	14.790	9241.0	540.60	924.1	54.06
2	.0376	243.51	21.794	7269.0	650.58	2689.5	240.71
3	.0604	395.12	42.673	7431.0	802.55	6019.1	650.06
4	.0805	452.34	57.899	6442.0	824.58	5475.7	700.89
5	.1068	465.95	67.563	5067.0	734.71	4611.0	668.59
6	.1409	916.96	154.049	7679.0	1290.07	7218.3	1212.67
7	.1654	535.99	104.519	3868.0	754.26	3868.0	754.26
8	.2057	59.52	12.498	352.0	73.92	352.0	73.92
9	.2074	29.65	6.581	174.0	38.63	174.0	38.63
10	.2346	27.21	6.693	143.0	35.18	143.0	35.18
11	.1602	18.43	4.837	137.0	35.96	137.0	35.96
12+	.1602	21.12	5.110	157.0	37.99	157.0	37.99
Total		3463.73	500.000	59360.0	6069.83	31768.7	4502.93

Year 1990. F-factor 1.000 and reference F .1598

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
0	.0050	51.54	1.134	11400.0	250.80	.0	.00
1	.0350	289.86	16.957	9292.8	543.63	929.3	54.36
2	.0430	280.11	25.070	7337.6	656.72	2714.9	242.99
3	.0690	346.75	37.449	5731.5	619.00	4642.5	501.39
4	.0920	456.96	58.491	5727.4	733.11	4868.3	623.14
5	.1220	507.58	73.599	4866.2	705.60	4428.2	642.09
6	.1610	503.86	84.648	3728.3	626.36	3504.6	588.78
7	.1890	855.01	166.727	5460.7	1064.83	5460.7	1064.83
8	.2350	511.46	107.406	2684.0	563.64	2684.0	563.64
9	.2370	45.05	10.000	234.6	52.08	234.6	52.08
10	.2680	24.78	6.095	115.8	28.48	115.8	28.48
11	.1830	14.08	3.695	92.6	24.31	92.6	24.31
12+	.1830	31.18	7.545	205.1	49.63	205.1	49.63
Total		3918.20	598.817	56876.6	5918.19	29880.7	4435.73

Year 1991. F-factor 1.000 and reference F .1598

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
0	.0050	51.54	1.134	11400.0	250.80	.0	.00
1	.0350	289.68	16.946	9287.0	543.29	928.7	54.33
2	.0430	280.45	25.100	7346.6	657.52	2718.2	243.28
3	.0690	348.15	37.600	5754.7	621.51	4661.3	503.42
4	.0920	349.44	44.728	4379.7	560.60	3722.8	476.51
5	.1220	446.13	64.688	4277.1	620.17	3892.1	564.36
6	.1610	476.58	80.066	3526.5	592.46	3314.9	556.91
7	.1890	406.88	79.341	2598.6	506.72	2598.6	506.72
8	.2350	705.23	148.099	3700.9	777.18	3700.9	777.18
9	.2370	333.56	74.050	1737.3	385.67	1737.3	385.67
10	.2680	32.44	7.979	151.6	37.28	151.6	37.28
11	.1830	11.02	2.893	72.5	19.03	72.5	19.03
12+	.1830	30.86	7.467	203.0	49.12	203.0	49.12
Total		3761.94	590.092	54435.3	5621.36	27701.8	4173.82

Table 4.23

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

BLUE WHITING - NORTHERN STOCK.

Year 1989					Year 1990					Year 1991	
factor	ref. F	stock biomass	sp.stock biomass	catch	factor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
.9	.14	6070	4503	500	.8	F_{med} .13	5918	4436	492	5730	4275
					.9	F(89) .14			529	5692	4240
					1.0	F(88) .16			599	5621	4174
					1.4	$F_{0.1}$ .22			813	5404	3971

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 and since 1984, the Divisions VIIg-k are not included), 1979-1988, as estimated by the Working Group.

Country	1979	1980	1981	1982	1983
Germany, Fed.Rep.	-	-	-	-	50
Ireland	1	-	-	-	-
Netherlands	-	31	633	200	-
Norway	-	-	-	-	-
Poland	-	-	-	-	-
Portugal	2,096	6,051	7,387	3,890	4,748
Spain[2]	25,016	23,862	30,728	27,500	26,037
UK (Scotland)	63	-	-	-	-
USSR	-	-	-	-	-
Total	27,176	29,944	38,748	31,590	30,835

Country	1984	1985	1986	1987	1988[1]
Germany, Fed.Rep.	-	-	-	-	-
Ireland	-	-	-	-	-
Netherlands	-	-	-	-	-
Norway	-	-	-	4	-
Poland	-	-	-	-	-
Portugal	5,252	6,989	8,116	9,148	5,979
Spain[2]	25,921	35,828	24,965	23,644	24,847
UK (Scotland)	-	-	-	-	12
USSR	-	-	-	-	-
Total	31,173	42,817	33,081	32,796	30,838

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

Table 5.2 Catch in numbers (thousands) by length group in the Portuguese and Spanish blue whiting fisheries, 1983-1988.

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

Table 5.3 Catch in numbers by length group and by quarters in the Portuguese and Spanish BLUE WHITING fisheries, 1989. Blue Whiting South. Length composition by quarter.

Length (cm)	Spain	Portugal			VIIIc+IXa
	Quarter 1	Jan	Feb	Mar	Quarter 1
10	-	-	-	-	-
11	-	-	-	-	-
12	-	-	-	-	-
13	-	-	-	-	-
14	-	3	-	375	378
15	-	259	588	2,249	3,096
16	128	1,134	2,462	4,022	7,746
17	2,345	2,297	5,271	4,689	14,602
18	17,810	3,110	5,188	4,712	30,820
19	30,915	1,942	2,435	4,215	39,507
20	24,199	749	782	2,179	27,909
21	12,200	817	241	529	13,787
22	6,106	64	227	210	6,607
23	4,443	57	134	71	4,705
24	3,680	29	47	65	3,821
25	3,712	22	29	32	3,795
26	2,229	6	7	5	2,247
27	1,158	4	0	0	1,162
28	470	-	0	3	473
29	406	-	0	-	406
30	59	-	0	-	59
31	37	-	7	-	44
32	41	-	-	-	41
33	8	-	-	-	8
34	7	-	-	-	7
35	6	-	-	-	6
36	0	-	-	-	-
37	0	-	-	-	-
38	0	-	-	-	-
39	0	-	-	-	-
40	0	-	-	-	-
Total	110,559	9,893	17,418	23,356	161,226

(cont'd)

Table 5.3 (cont'd)

Length (cm)	Spain	Portugal			VIIIc+IXa
	Quarter 2	Apr	May	Jun	Quarter 2
10	0	-	7	-	7
11	0	-	0	-	0
12	0	-	8	-	8
13	0	-	1	-	1
14	0	-	0	-	0
15	2	-	7	604	613
16	9	53	114	2,618	2,794
17	30	804	1,647	6,174	8,655
18	2,145	3,935	5,385	4,520	15,985
19	22,151	7,637	5,173	1,970	36,931
20	47,006	3,452	1,479	2,843	54,780
21	31,557	465	329	985	33,336
22	11,438	250	154	312	12,154
23	1,616	190	23	31	1,860
24	660	68	12	1	741
25	334	14	0	0	348
26	286	7	-	-	293
27	330	-	-	-	330
28	545	-	-	-	545
29	201	-	-	-	201
30	246	-	-	-	246
31	131	-	-	-	131
32	40	-	-	-	40
33	53	-	-	-	53
34	16	-	-	-	16
35	45	-	-	-	45
36	22	-	-	-	22
37	19	-	-	-	19
38	1	-	-	-	1
39	1	-	-	-	1
40	1	-	-	-	1
	118,885	16,875	14,339	20,058	170,157

Table 5.4 Catch in numbers (millions) by age group in the Portuguese and Spanish blue whiting fisheries, 1981-1988.

Age	1981	1982	1983	1984	1985	1986	1987	1988
0	48.0	61.1	98.0	73.9	118.3	32.4	105.3	30.0
1	189.1	102.5	149.7	223.2	285.9	93.2	382.6	147.3
2	226.2	183.5	238.5	349.0	337.2	218.2	110.6	232.9
3	166.4	121.8	68.2	127.4	170.5	167.6	61.6	113.9
4	50.0	64.3	45.1	35.0	65.9	68.1	28.2	32.0
5	25.9	22.1	34.0	13.2	13.6	15.1	13.4	10.4
6	3.0	3.2	8.8	13.8	3.0	5.7	3.4	8.9
7	0.2	0.3	2.3	3.3	2.4	1.0	1.0	2.6
8+	0.2	1.0	0.8	0.8	1.1	1.0	1.0	0.4
Total	709	559.9	645.4	839.6	997.8	602.5	707.1	578.2
Nominal (t)	38,115	31,390	30,785	31,173	42,817	33,083	32,792	30,732
SOP	37,624	33,660	31,805	31,370	42,839	33,981	32,792	28,758

Table 5.5

BLUE WHITING, SOUTHERN AREA
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: kilogram

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

Table 5.6 Catch per unit effort

a) by Spanish vessels landing in the main Galician ports, 1978-1988.

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

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

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

Table 5.7 Catch per unit effort by Spanish single and pair trawlers landing in the main Galician ports, 1983-1988.

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
		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

Table 5.8a 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	$\bar{y}$	$s_{\bar{y}}$	$\bar{y}$	$s_{\bar{y}}$	$\bar{y}$	$s_{\bar{y}}$	$\bar{y}$	$s_{\bar{y}}$	$\bar{y}$	$s_{\bar{y}}$	$\bar{y}$	$s_{\bar{y}}$	$\bar{y}$	$s_{\bar{y}}$
1980	80.0	64.4	-	-	120.7	114.9	-	-	101.4	19.3	-	-	-	-
1981	20.2	19.0	53.9	41.4	70.8	75.0	59.0	27.3	46.8	12.2	57.6	16.2	-	-
1982	82.1	61.5	-	-	118.5	70.8	-	-	101.2	12.9	-	-	-	-
1983	224.3	224.5	40.5	10.7	275.6	192.9	144.0	143.6	251.2	38.7	116.2	37.2	189.1	24.2
1984	180.2	49.3	23.1	21.6	125.0	19.6	93.9	74.4	151.2	25.6	74.9	15.9	131.2	15.5
1985	295.5	153.8	212.8	241.6	129.9	23.3	126.3	160.4	208.6	74.1	149.5	41.9	163.6	39.7
1986	213.7	85.2	78.9	60.7	98.6	16.0	41.4	41.6	153.3	41.4	51.4	11.7	101.5	21.9
1987	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1988	461.9	88.9	-	-	78.6	32.8	-	-	212.5	36.2	114.6	29.6	155.3	25.7

Table 5.8b Stratified mean catch and standard error for BLUE WHITING in groundfish surveys by Portugal (Cardador, 1986).

Year	Month	20-100 m		100-200 m		200-500 m		20-500 m	
		$\bar{y}$	$s_{\bar{y}}$	$\bar{y}$	$s_{\bar{y}}$	$\bar{y}$	$s_{\bar{y}}$	$\bar{y}$	$s_{\bar{y}}$
1979	June	0.2	0.2	32.8	22.7	86.3	34.6	31.2	11.5
	October/November	5.1	4.9	17.2	7.6	102.9	47.9	27.8	9.3
1980	March	-	-	178.0	173.0	4.7	0.7	71.7	68.5
	May/June	0.9	2.7	4.0	1.5	45.4	18.2	10.7	3.5
	October	3.6	2.7	9.9	4.4	586.7	305.9	117.3	58.3
1981	March	-	-	23.5	17.4	185.5	112.7	44.2	22.2
	June	-	-	4.2	1.6	177.5	24.5	33.8	4.5
1982	April/May	-	-	3.2	2.6	136.4	39.3	26.0	7.2
	September	0.6	0.5	85.1	42.3	271.4	122.6	85.7	28.7
1983[1]	March	0.7	0.6	14.0	9.5	259.2	96.1	54.3	18.3
	June	-	-	22.6	8.4	177.2	46.9	42.2	9.3
1985[1,3]	June	0.1	0.1	194.4	145.9	404.8	161.5	159.0	67.9
	October	3.5	3.1	126.2	80.3	360.6	46.9	123.6	34.4
1986	June	4.1	1.1	59.2	18.5	196.3	30.9	64.8	9.8
1986[3]	October	2.4	1.2	357.0	144.4	650.2	111.0	276.2	63.2
1987[3]	October	4.0	0.0	256.8	63.5	811.0	267.4	267.4	58.9

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

Table 5.9

```
SOUTHERN BLUE WHITING TUNING DATA
102
cpue Spanish Pair Trawlers
81,88
1,1
0,7
1, 2224,13174,17326,13325,3500,1715, 146,  1
1,  798, 3465,12070, 8731,5070,1658, 175, 10
1, 1140, 7196,16392, 9311,7476,6326,1718,360
1, 1839,13710,27286,14845,4836,1755,1750,338
1, 3680,14573,23823,14126,6256,1232, 217,126
1,  788, 3721,14131,14745,7113,1278, 505, 47
1, 5433,25328,13153, 6664,2938,1029, 166, 43
1, 2545, 7778,21473,18436,6391,1300, 781,223
Bottom Trawl Spanish Survey
81,88
1,1
0,7
1,   69, 568,  63, 66, 14, 2,0,0
1, 1695, 195,  99, 47, 45,11,0,0
1, 3455,1856, 590,113, 52,32,7,8
1, 6558,4126,1293,304, 48,12,7,2
1, 2224,1064, 600,267, 27, 5,0,0
1,11229, 101, 290,231, 64, 3,4,0
1, 2386,5673,  58,147,116,33,2,2
1, 2168, 314, 116, 14,  4, 1,1,0
```

Table 5.10

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

Regression weights
, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000, 1.000,
Oldest age F = 1.000*average of 5 younger ages. Fleets combined by variance of predictions
Fishing mortalities

Age	81	82	83	84	85	86	87	88
0	.051	.048	.080	.076	.139	.024	.141	.022
1	.357	.145	.160	.263	.465	.155	.433	.299
2	.645	.704	.583	.672	.797	.795	.278	.515
3	.703	.900	.625	.723	.845	1.321	.546	.512
4	.694	.658	1.073	.783	1.097	1.038	.842	.617
5	1.264	.776	.913	1.160	.829	.824	.582	.903
6	1.627	.491	.844	1.329	.941	1.072	.437	1.012
7	.987	.706	.808	.933	.902	1.010	.537	.712

Log catchability estimates

Age 0

Fleet	81	82	83	84	85	86	87	88
1	.85	-.46	-.07	.64	1.46	-.53	1.99	.64
2	-2.62	.29	1.04	1.91	.96	2.13	1.16	.48

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.56	.947	1.7592	.0207	.000E+00	.000E+00	.565	.316
2	.67	1.560	1.9516	.0270	.000E+00	.000E+00	.669	.520

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.022	.809	.117	.809	.021

Age 1

Fleet	81	82	83	84	85	86	87	88
1	3.21	1.59	2.04	2.78	3.17	1.82	3.36	2.76
2	.07	-1.29	.68	1.58	.55	-1.78	1.86	-.45

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	2.59	.724	******	.2527	.000E+00	.000E+00	2.591	.241
2	.15	1.364	1.1651	.5466	.000E+00	.000E+00	.153	.455

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.299	.639	.319	.639	.249

Age 2

Fleet	81	82	83	84	85	86	87	88
1	3.90	3.84	3.69	3.96	4.03	3.94	3.50	3.86
2	-1.72	-.97	.37	.91	.35	.06	-1.93	-1.36

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	3.84	.182	******	.5044	.000E+00	.000E+00	3.840	.061
2	-.54	1.151	.5850	1.1745	.000E+00	.000E+00	-.536	.384

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.515	.180	.130	.180	.526

(cont'd)

Table 5.10 (cont'd)

Age 3

Fleet	81	82	83	84	85	86	87	88
1	4.03	4.17	4.45	4.43	4.25	4.76	4.08	4.42
2	-1.28	-1.06	.04	.55	.28	.60	.26	-2.76

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	4.32	.253	******	.4657	.000E+00	.000E+00	4.322	.084
2	-.42	1.254	.6559	5.3360	.000E+00	.000E+00	-.422	.418

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.512	.248	.473	.473	3.637

Age 4

Fleet	81	82	83	84	85	86	87	88
1	3.88	3.95	5.18	4.68	4.65	4.69	4.47	4.81
2	-1.64	-.78	.21	.07	-.80	-.03	1.24	-2.56

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	4.54	.461	******	.4689	.000E+00	.000E+00	4.540	.154
2	-.53	1.255	.5860	4.6884	.000E+00	.000E+00	-.534	.418

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.617	.433	.745	.745	2.964

Age 5

Fleet	81	82	83	84	85	86	87	88
1	4.43	4.06	5.14	5.04	4.32	4.24	3.80	4.73
2	-2.33	-.95	-.15	.05	-1.19	-1.81	.36	-2.44

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	4.47	.494	******	.6985	.000E+00	.000E+00	4.469	.165
2	-1.06	1.147	.3474	3.6133	.000E+00	.000E+00	-1.057	.382

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.903	.454	.597	.597	1.731

Age 6

Fleet	81	82	83	84	85	86	87	88
1	4.37	3.29	5.11	5.13	4.22	4.55	3.06	4.49
2	-2.22	-3.48	-.40	-.39	-2.77	-.28	-1.36	-2.17

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	4.28	.801	******	.8207	.000E+00	.000E+00	4.277	.267
2	-1.64	1.287	.1949	1.7344	.000E+00	.000E+00	-1.635	.429

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
1.012	.680	.336	.680	.244

Table 5.11 From Tuning Analysis.

BLUE WHITING, SOUTHERN AREA

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

	1981	1982	1983	1984	1985	1986	1987	1988	1981-88
0	.051	.048	.080	.076	.139	.024	.141	.022	.073
1	.357	.145	.160	.263	.465	.155	.433	.299	.285
2	.645	.704	.583	.672	.797	.795	.278	.515	.624
3	.704	.900	.625	.723	.845	1.321	.546	.512	.772
4	.694	.658	1.073	.783	1.097	1.038	.842	.617	.850
5	1.264	.776	.913	1.160	.829	.824	.582	.903	.906
6	1.627	.491	.844	1.329	.941	1.072	.437	1.012	.969
7	.987	.706	.808	.933	.902	1.010	.537	.712	.824
8+	.987	.706	.808	.933	.902	1.010	.537	.712	.824
(1- 4)U	.600	.602	.610	.610	.801	.827	.525	.486	

Table 5.12 BLUE WHITING, SOUTHERN AREA.

from 81 to 88 on ages 0 to 7
with Terminal F of .490 on age 2 and Terminal S of 1.500

Initial sum of squared residuals was 45.577 and
final sum of squared residuals is 11.891 after 59 iterations

Matrix of Residuals

Years / Ages	81/82	82/83	83/84	84/85	85/86	86/87	87/88		WTS
0/ 1	-.039	.172	.266	-.320	1.136	-1.950	.736	.000	.266
1/ 2	.054	-.460	-.471	-.125	.416	-.335	.921	.000	.510
2/ 3	-.279	.499	.100	.065	-.117	.175	-.443	.000	.842
3/ 4	-.201	.272	-.105	-.256	-.174	.437	.029	.000	1.000
4/ 5	-.497	-.231	.302	-.136	.208	.117	.236	.000	.889
5/ 6	.713	-.005	-.087	.334	-.465	-.084	-.406	.000	.638
6/ 7	.879	-.638	-.049	.559	-.281	.119	-.589	.000	.462
	.000	.000	.000	.000	.000	.000	.000	.000	
WTS	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
F-values	.6859	.5329	.5879	.6756	.7483	.7230	.4534	.4900

Selection-at-age (S)

	0	1	2	3	4	5	6	7
S-values	.1119	.4176	1.0000	1.2651	1.4341	1.5051	1.5337	1.5000

Table 5.13 From Separable VPA.

BLUE WHITING, SOUTHERN AREA

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

	1981	1982	1983	1984	1985	1986	1987	1988	1981-88
0	.05	.05	.08	.08	.16	.02	.08	.05	.07
1	.36	.15	.16	.26	.47	.18	.41	.16	.27
2	.64	.71	.59	.67	.77	.80	.34	.46	.62
3	.70	.90	.63	.73	.84	1.20	.55	.72	.79
4	.70	.66	1.07	.80	1.14	1.03	.66	.62	.84
5	1.31	.80	.92	1.14	.88	.92	.57	.55	.89
6	1.50	.54	.91	1.35	.91	1.27	.54	.96	1.00
7	1.01	.56	.96	1.13	.94	.92	.81	1.07	.93
8+	1.01	.56	.96	1.13	.94	.92	.81	1.07	.93
(1- 4)U	.60	.60	.61	.62	.81	.80	.49	.49	

Table 5.14 From Separable VPA.

BLUE WHITING, SOUTHERN AREA

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: thousand tonnes

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

	1981	1982	1983	1984	1985	1986	1987	1988	1989
0	1066	1431	1428	1108	877	1572	(1490)	(620)	0
1	689	829	1116	1080	841	611	1258	(1125)	(481)
2	520	394	587	779	684	432	416	687	(788)
3	359	223	159	267	326	259	159	242	353
4	108	145	75	69	105	115	64	75	96
5	38	44	62	21	25	27	34	27	33
6	4	8	16	20	5	9	9	16	13
7	0	1	4	5	4	2	2	4	5
8+	0	3	1	1	2	2	2	1	1
TOTAL NO	2784	3078	3447	3351	2869	3029	3434	2796	
SPS NO	684	601	648	752	716	540	578	737	
TOT.BIOM	131	139	135	104	112	118	139	125	
SPS BIOM	38	39	35	31	34	32	35	39	

Bracketed figures revised to predicted values.

Table 5.15

Analysis by RCRTINX2 of data from file RECRUIT-88
BLUE WHITING SOUTH RECRUITMENT INDEX 1988

Data for 2 surveys over 8 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 = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
SPANIS	7.7778	.388	4.205	.1007	6	7.2218	.75326	.81622	.04011
CPUE A	8.7537	.377	3.686	.5528	6	6.9819	.22665	.24880	.43169
MEAN						7.1092	.22492	.22492	.52820

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
SPANIS	7.6820	.415	4.007	.1011	7	7.1948	.71772	.76880	.07513
CPUE A									
MEAN						7.1382	.21913	.21913	.92487

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis		Ext.SE/ Int.SE
1987	7.06	1163.03	.16	.05	7.31	1491.00	.30
1988	7.14	1264.51	.21	.01	6.43	621.00	.07

Table 5.16

List of input variables for the ICES prediction program.

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

The number of recruits per year is as follows:

Year	Recruitment
1989	1100.0
1990	1100.0
1991	1100.0

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	1100.0	.05	.20	.00	.035	.035
1	984.0	.20	.20	.18	.039	.039
2	613.0	.49	.20	.48	.053	.053
3	353.0	.62	.20	.91	.055	.055
4	96.0	.70	.20	.98	.067	.067
5	33.0	.74	.20	1.00	.101	.101
6	13.0	.75	.20	1.00	.090	.090
7	5.0	.74	.20	1.00	.117	.117
8+	1.0	.74	.20	1.00	.207	.207

Table 5.17 Option 1.

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

BLUE WHITING SOUTERN STOCK

Year 1989					Year 1990					Year 1991	
factor	ref. F	stock biomass	sp.stock biomass	catch	factor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.50	141	43	33	$F_{0.1}$ .3	.13	140	50	10	164	70
					F_{88} 1.0	.50		45	35	139	45
					F_{med} 1.3	.68		43	43	129	38
					F_{high} 1.6	.80		42	49	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 1991 has been calculated with the same fishing mortality as for 1990.
The reference F is the mean F for the age group range from 1 to 4

Table 5.18 OPTION 1.

BLUE WHITING SOUTERN STOCK

* Year 1989. F-factor 1.000 and reference F .5025 *

						at 1 January		at spawning time	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
0	.0500	48.664	1.7032	1100.00	38.500	.000	.0000	.000	.0000
1	.2000	162.203	6.3259	984.00	38.376	177.120	6.9077	160.265	6.2503
2	.4900	216.973	11.4996	613.00	32.489	294.240	15.5947	247.620	13.1239
3	.6200	149.350	8.2143	353.00	19.415	321.230	17.6676	261.689	14.3929
4	.7000	44.309	2.9687	96.00	6.432	94.080	6.3034	75.124	5.0333
5	.7400	15.831	1.5989	33.00	3.333	33.000	3.3330	26.089	2.6350
6	.7500	6.294	.5665	13.00	1.170	13.000	1.1700	10.252	.9227
7	.7400	2.399	.2806	5.00	.585	5.000	.5850	3.953	.4625
8+	.7400	.480	.0993	1.00	.207	1.000	.2070	.791	.1636
Total		646.502	33.2570	3198.00	140.507	938.670	51.7684	785.782	42.9842

* Year 1990. F-factor 1.000 and reference F .5025 *

						at 1 January		at spawning time	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
0	.0500	48.664	1.7032	1100.00	38.500	.000	.0000	.000	.0000
1	.2000	141.215	5.5074	856.68	33.411	154.203	6.0139	139.528	5.4416
2	.4900	233.466	12.3737	659.59	34.959	316.606	16.7801	266.442	14.1214
3	.6200	130.085	7.1547	307.47	16.911	279.794	15.3887	227.934	12.5363
4	.7000	71.759	4.8079	155.47	10.417	152.363	10.2083	121.664	8.1515
5	.7400	18.724	1.8911	39.03	3.942	39.031	3.9421	30.857	3.1165
6	.7500	6.241	.5617	12.89	1.160	12.891	1.1602	10.166	.9149
7	.7400	2.412	.2822	5.03	.588	5.028	.5882	3.975	.4650
8+	.7400	1.124	.2327	2.34	.485	2.344	.4852	1.853	.3836
Total		653.691	34.5146	3138.51	140.372	962.258	54.5667	802.418	45.1309

* Year 1991. F-factor 1.000 and reference F .5025 *

						at 1 January		at spawning time	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
0	.0500	48.664	1.7032	1100.00	38.500	.000	.0000	.000	.0000
1	.2000	141.215	5.5074	856.68	33.411	154.203	6.0139	139.528	5.4416
2	.4900	203.258	10.7727	574.25	30.435	275.640	14.6089	231.967	12.2943
3	.6200	139.973	7.6985	330.84	18.196	301.062	16.5584	245.259	13.4893
4	.7000	62.503	4.1877	135.42	9.073	132.709	8.8915	105.971	7.1000
5	.7400	30.323	3.0626	63.21	6.384	63.210	6.3842	49.972	5.0472
6	.7500	7.382	.6643	15.25	1.372	15.246	1.3722	12.023	1.0821
7	.7400	2.392	.2798	4.99	.583	4.985	.5833	3.941	.4611
8+	.7400	1.381	.2859	2.88	.596	2.879	.5961	2.276	.4712
Total		637.091	34.1623	3083.51	138.551	949.935	55.0085	790.939	45.3868

Table 5.19 Option 2.

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

BLUE WHITING SOUTERN STOCK

Year 1989					Year 1990					Year 1991	
factor	ref. F	stock biomass	sp.stock biomass	catch	factor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.7	.88	141	39	TAC 50	$F_{0.1}$ .3	.13	123	38	8	149	57
					F_{88} 1.0	.50		34	27	129	38
					F_{med} 1.3	.68		33	34	121	32
					F_{high} 1.6	.80		31	39	117	28

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 1991 has been calculated with the same fishing mortality as for 1990.
The reference F is the mean F for the age group range from 1 to 4

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

Table 6.2 Total catches of BLUE WHITING in 1978-1988 divided into areas within and beyond areas of national fisheries jurisdiction of NEAFC contracting parties. Percentage in ( ).

Year	International	Svalbard	Jan Mayen	Norway	Iceland	Greenland	Faroes	EEC	Total (t)	Total from off.data (t)	%
1978	136,504 (25.52)	-	-	67,391 (12.60)	26,444 (4.94)	6,580 (1.23)	195,361 (36.53)	102,523 (19.17)	534,803	574,812	93.0
1979	614,734 (56.18)	-	-	75,545 (6.90)	15,117 (1.38)	204 (0.02)	224,201 (20.49)	164,388 (15.02)	1,094,189	1,091,422	100.3
1980	567,693 (55.23)	-	-	152,095 (14.80)	4,562 (0.44)	8,757 (0.85)	164,342 (15.99)	130,417 (12.69)	1,027,866	1,092,620	94.1
1981	168,681 (19.76)	-	123,000 (14.41)	215,004 (25.18)	7,751 (0.91)	-	174,801 (20.48)	164,475 (19.27)	853,712	870,808	98.0
1982	22,993 (4.32)	-	-	130,435 (24.51)	5,797 (1.09)		125,072 (23.50)	247,884 (46.58)	532,181	544,919	97.7
1983	15,203 (2.93)	-	-	109,675 (21.15)	7,000 (1.35)	-	91,804 (17.70)	294,981 (56.87)	518,663	539,235	96.2
1984	18,407 (3.19)	-	-	150,603 (26.13)	105 (0.02)	-	124,905 (21.67)	282,418 (48.99)	576,438	586,504	98.3
1985	38,978 (6.07)	-	-	114,785 (17.88)	-	-	196,003 (30.52)	292,345 (45.53)	642,111	644,899	99.6
1986	20,665 (2.74)	-	-	187,768 (24.87)	-	116 (0.02)	171,074 (22.66)	375,257 (49.71)	754,880	757,370	99.7
1987	103,535 (17.76)	-	-	109,201 (18.74)	-	-	135,980 (23.31)	234,249 (40.19)	582,830	631,610	92.3
1988	65,172 (13.2)	-	-	38,449 (7.8)	-	-	157,368 (31.8)	234,344 (47.3)	495,333	522,575	94.8

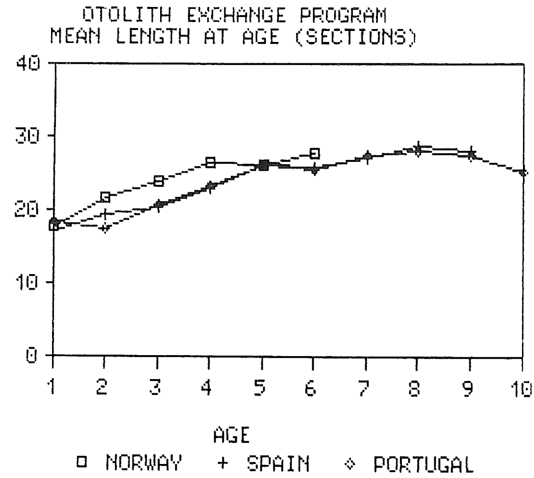


Figure 3.1a Results from otoliths exchange program. Raw data.

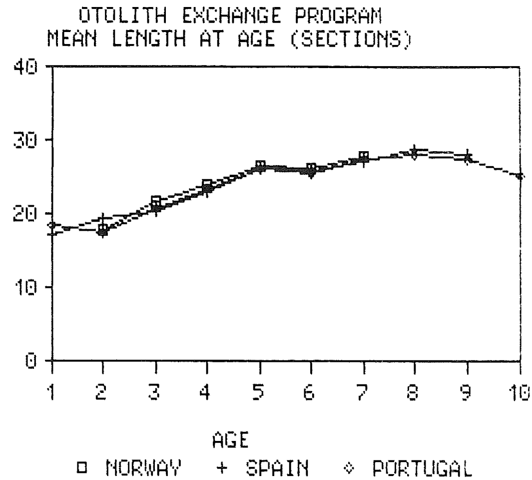


Figure 3.1b Results from otoliths exchange program. Norwegian readings plus 1 year.

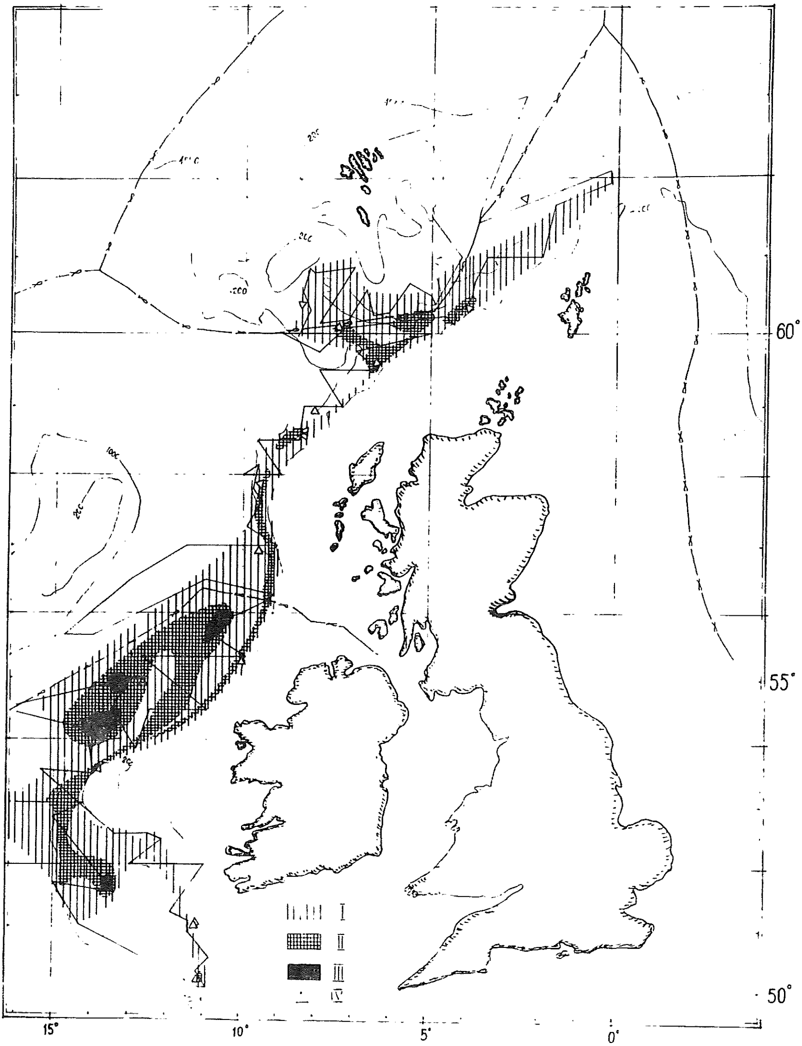


Figure 4.1 Distribution of BLUE WHITING biomass in the period from 25 March to 22 April 1989 (USSR Survey):

1. <150 t/sq. mile;
2. 151-500 t/sq. mile;
3. >500 t/sq. mile;
4. trawlings.

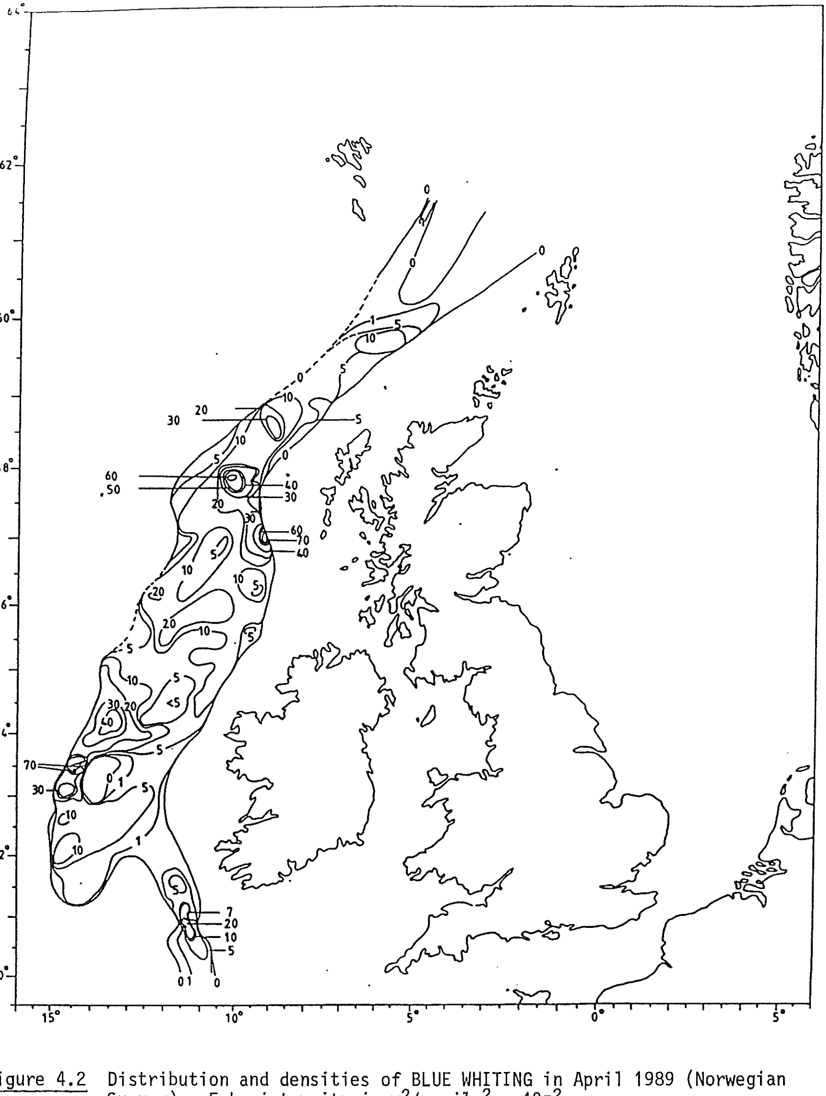


Figure 4.2 Distribution and densities of BLUE WHITING in April 1989 (Norwegian Survey). Echo intensity in $m^2/n.mile^2 \times 10^{-2}$.

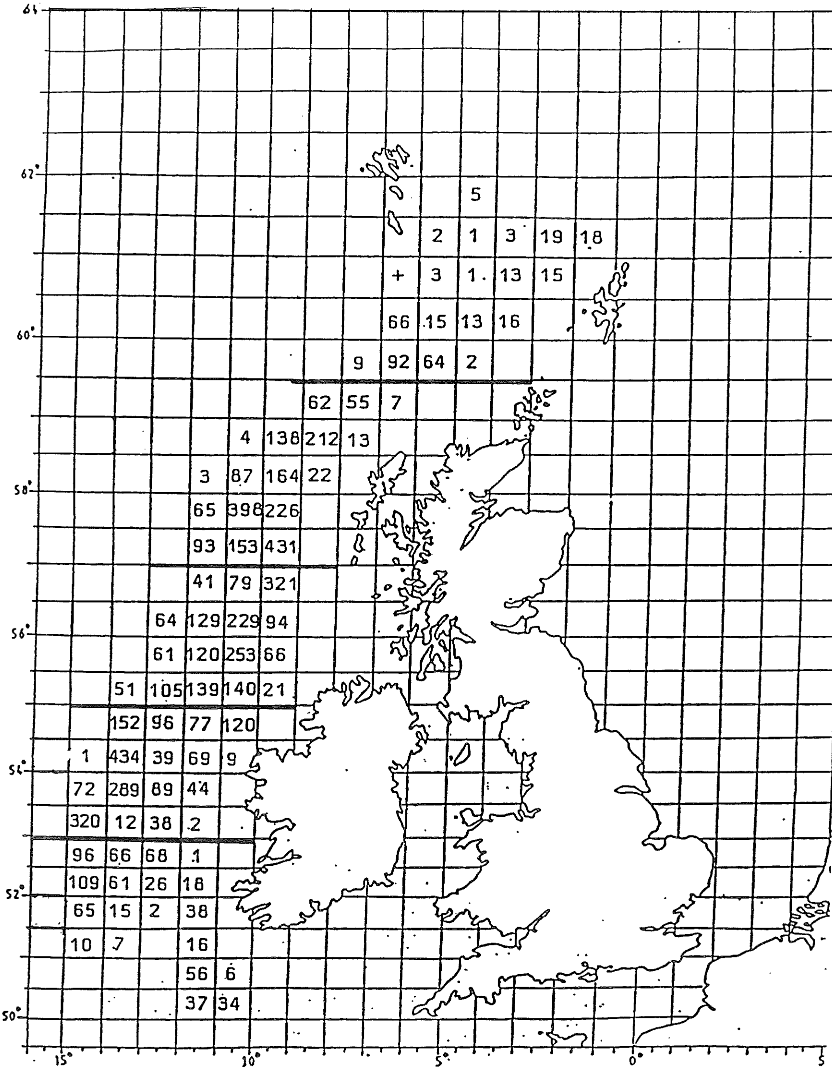


Figure 4.3 Biomass of BLUE WHITING (1,000 t) by rectangles in April 1989.

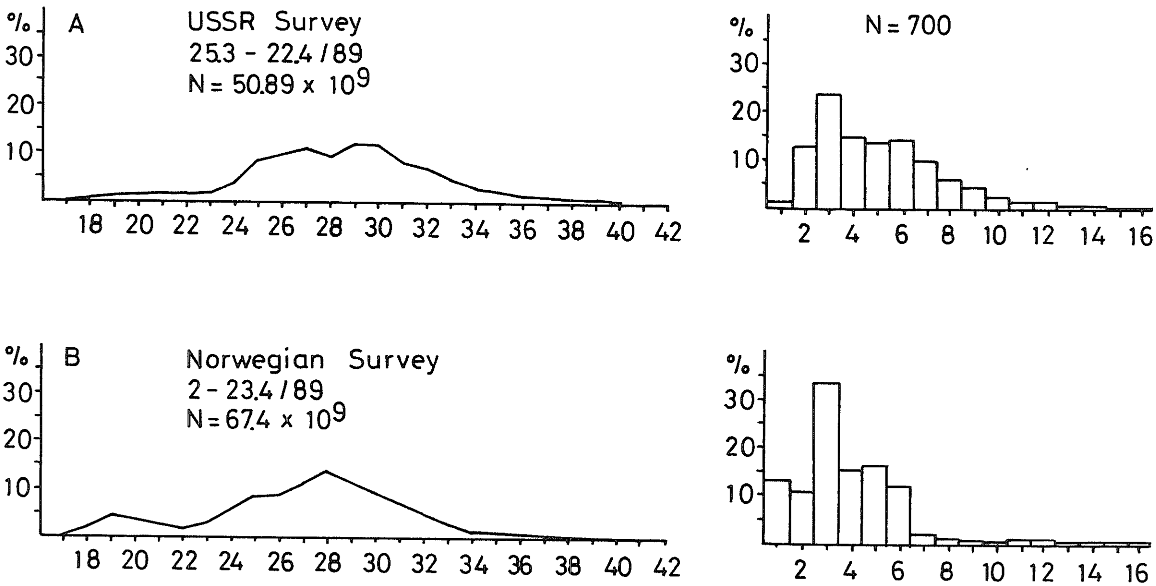


Figure 4.4 Total length and age composition (%) of BLUE WHITING from the area west of the British Isles during spring of 1989.

The length distribution and the age distribution of Norway are weighted by abundance N.
The USSR age distributions are based on number of aged fish.

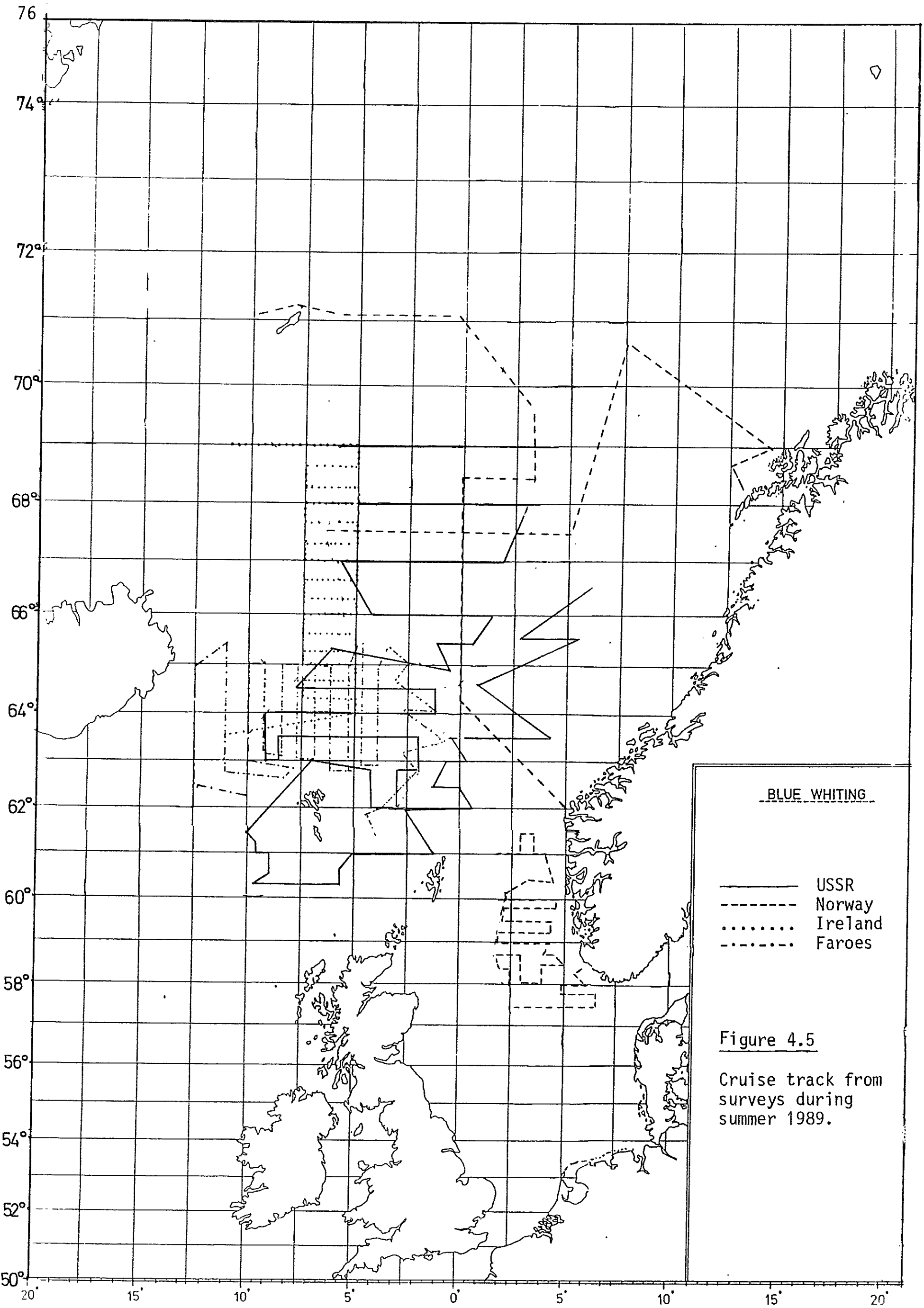


Figure 4.5

Cruise track from surveys during summer 1989.

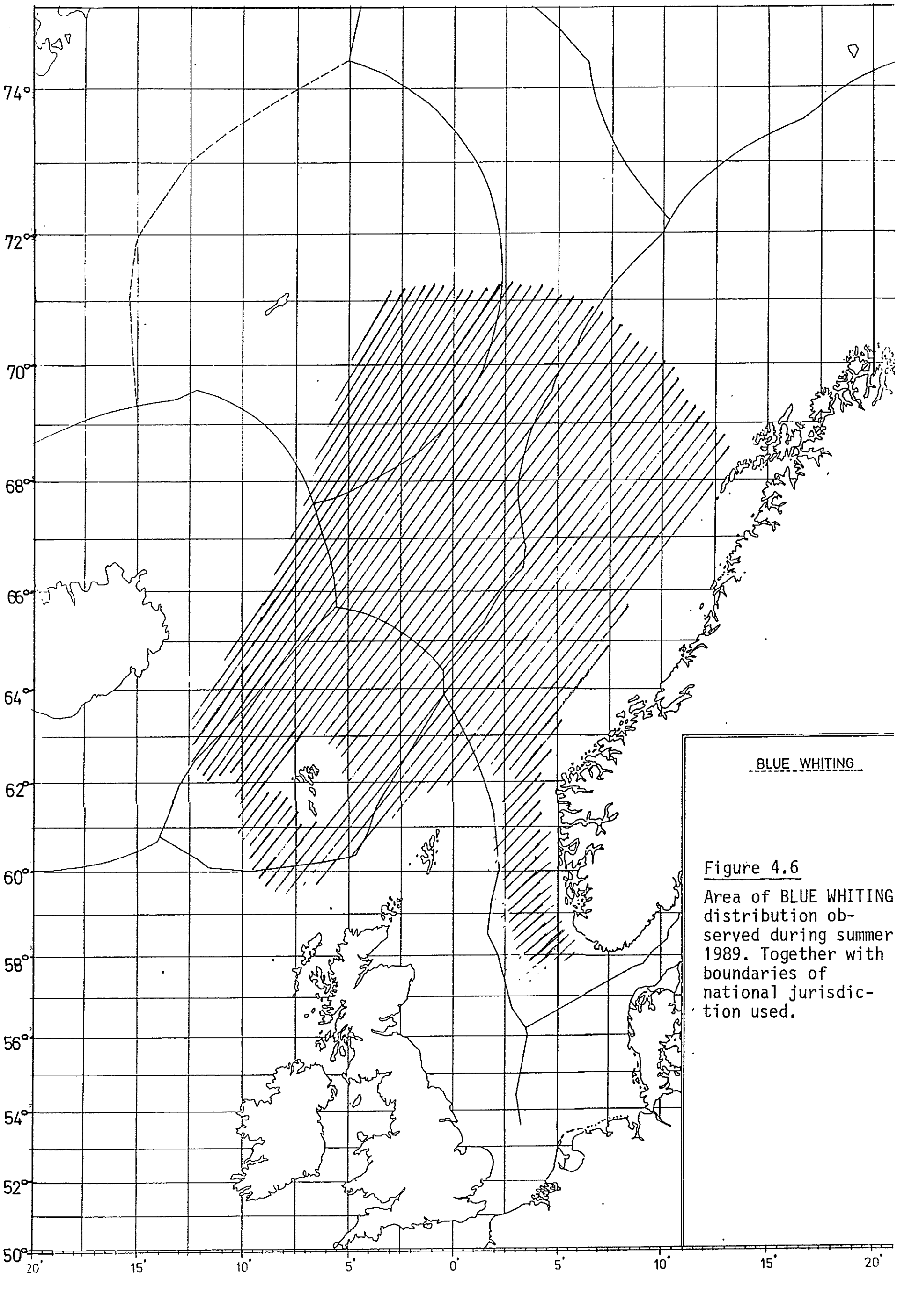


Figure 4.6

Area of BLUE WHITING distribution observed during summer 1989. Together with boundaries of national jurisdiction used.

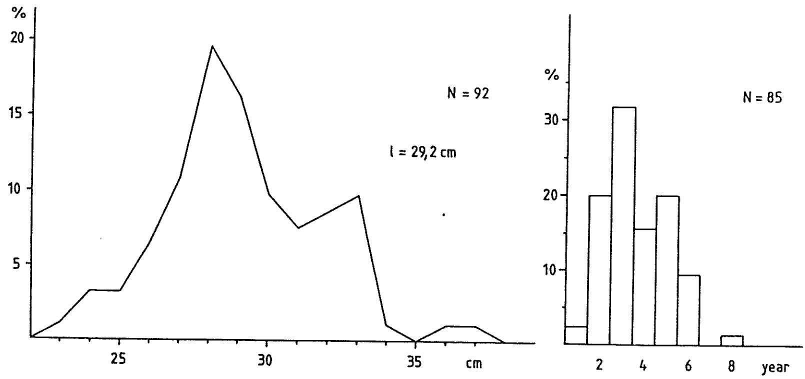


Figure 4.7 Length and age compositions of BLUE WHITING from 13 stations of "G.O. Sars" July/August 1989, in the Norwegian Sea.

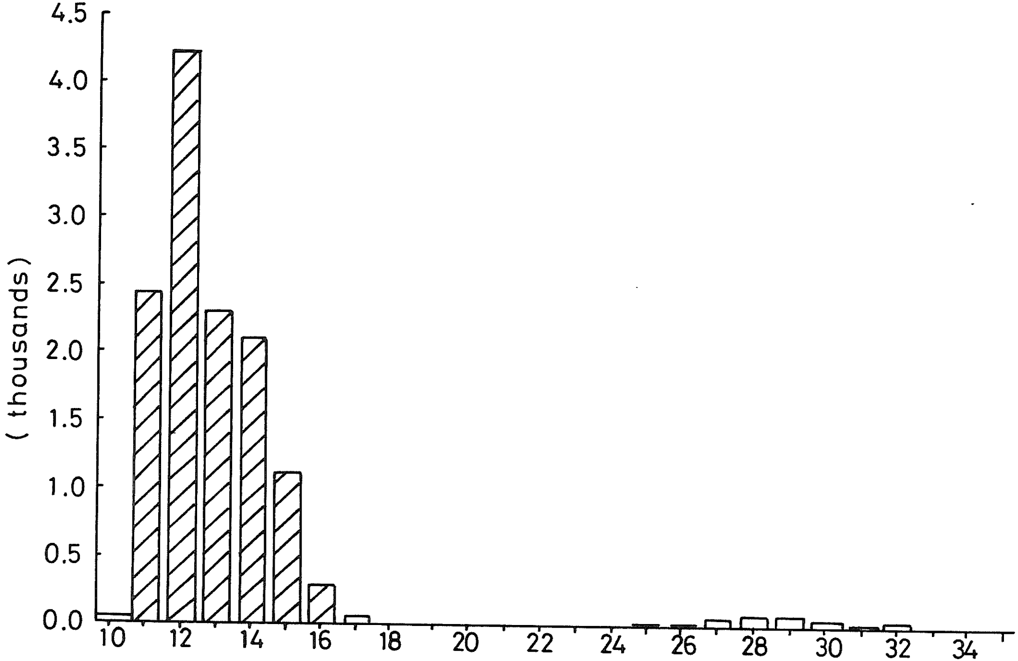
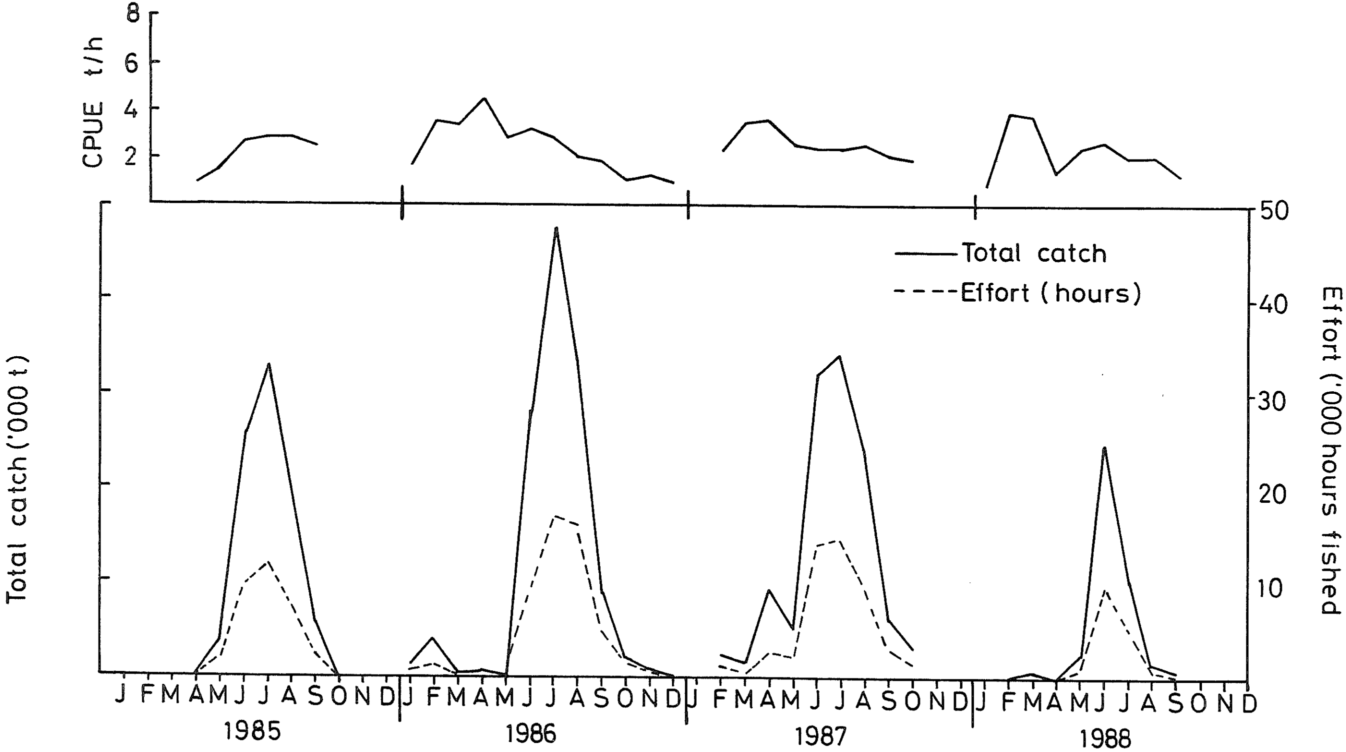


Figure 4.8 Length composition from the Faroes BLUE WHITING survey, 1989.

Figure 4.9 Catch, effort and CPUE by month for the USSR - GRT 2,000 - 3,999 t vessel class in Division IIa.



1989

Figure 4.10 CPUE for the USSR - GRT 2,000 - 3,999 t vessel class in Division IIa.

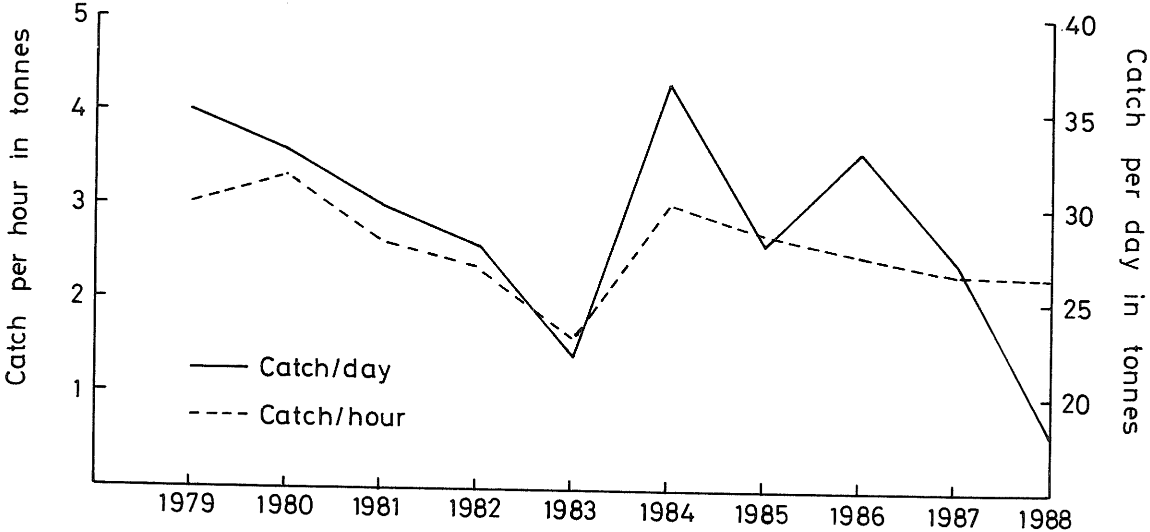
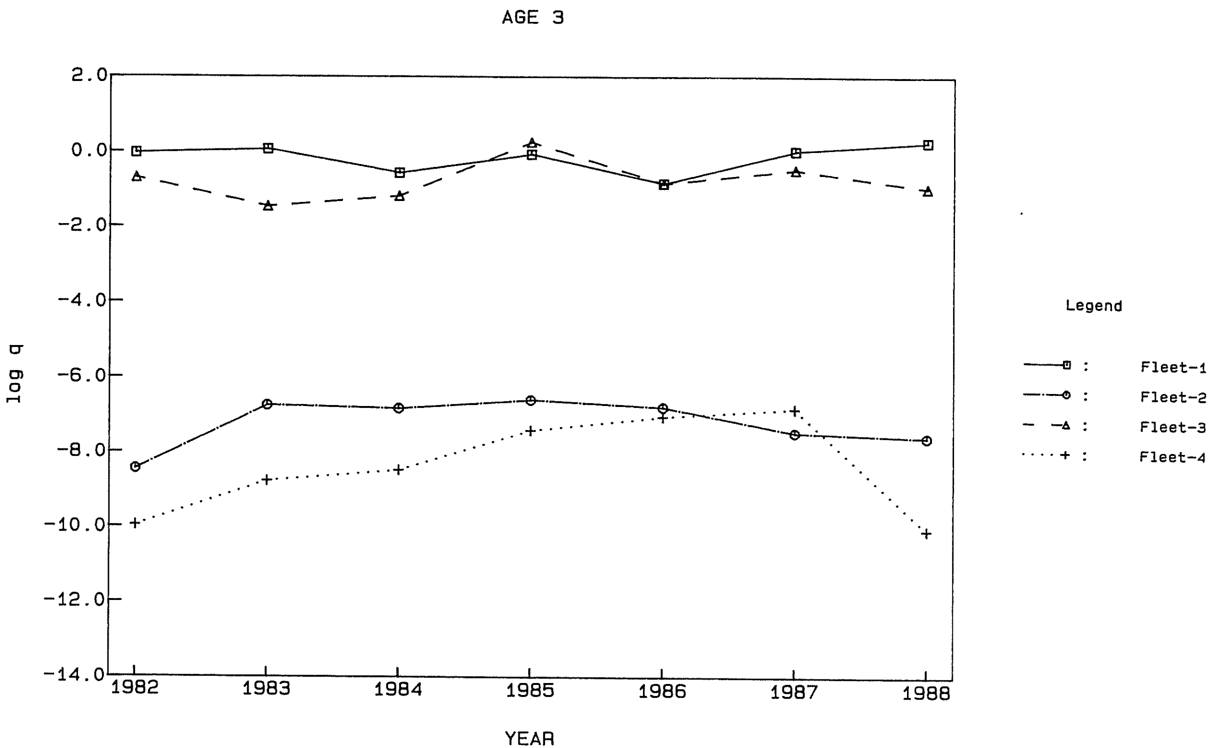
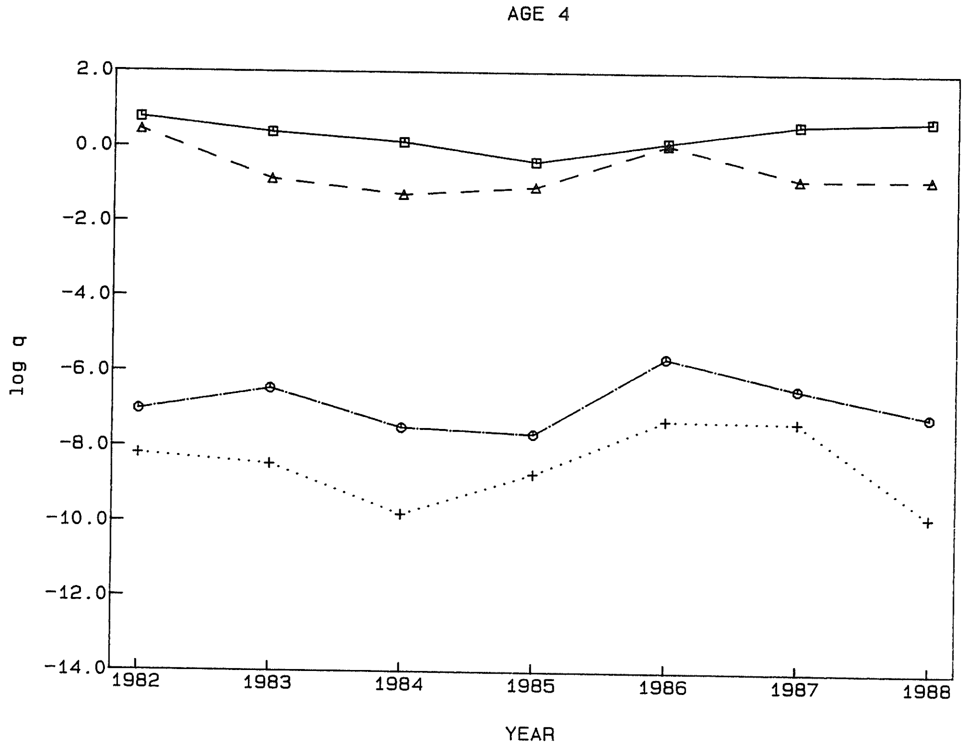


Figure 4.11



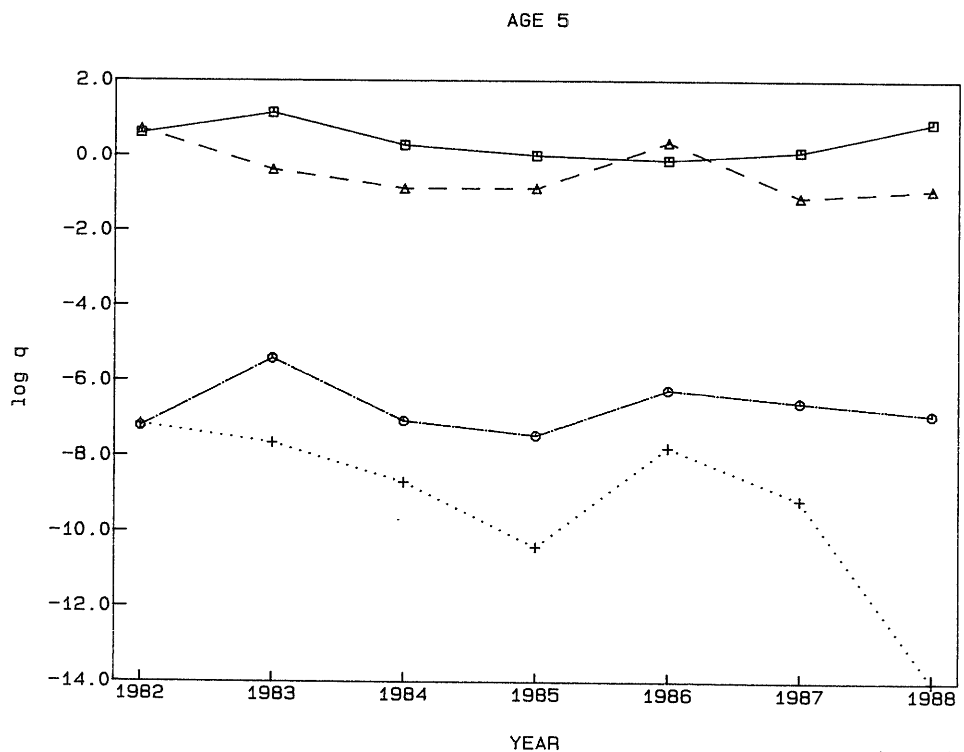
(cont'd)

Figure 4.11 (cont'd)



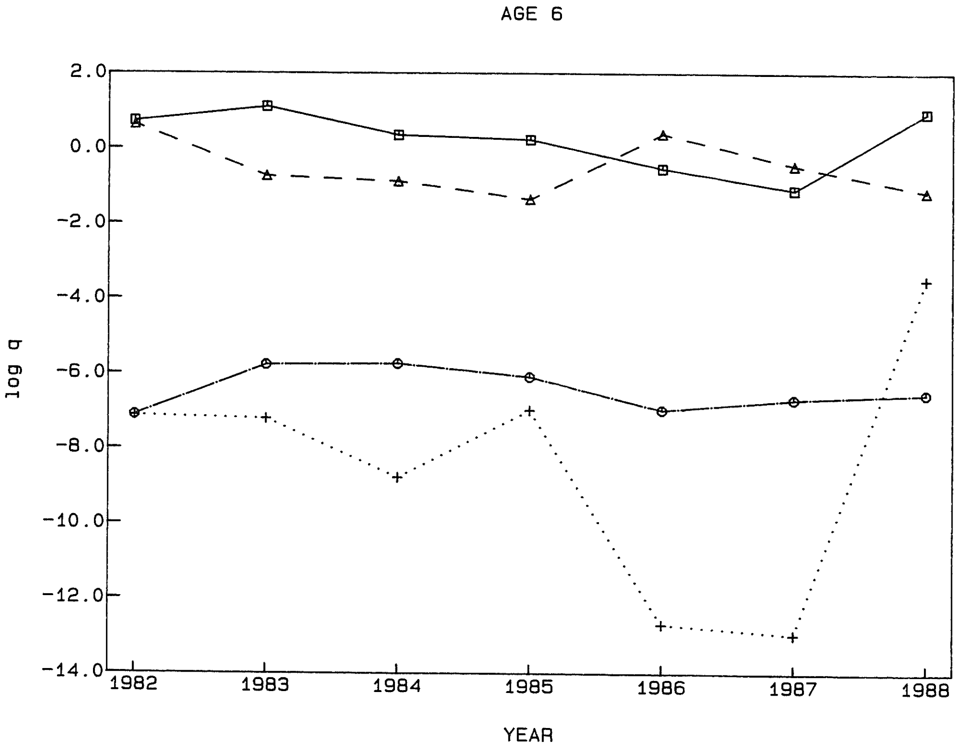
(cont'd)

Figure 4.11 (cont'd)



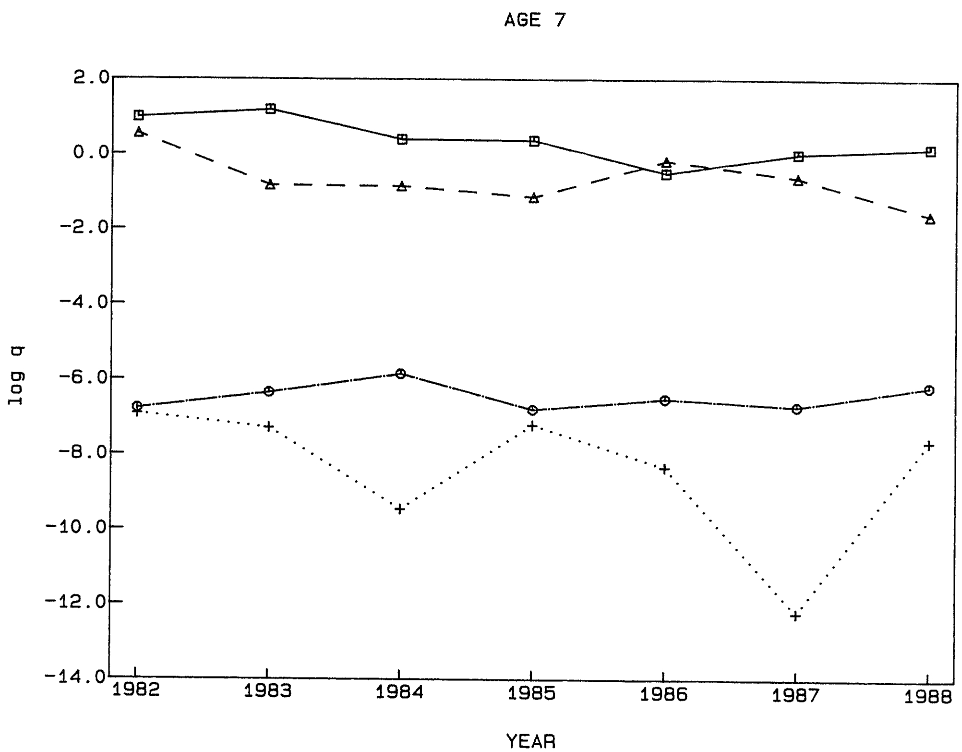
(cont'd)

Figure 4.11 (cont'd)



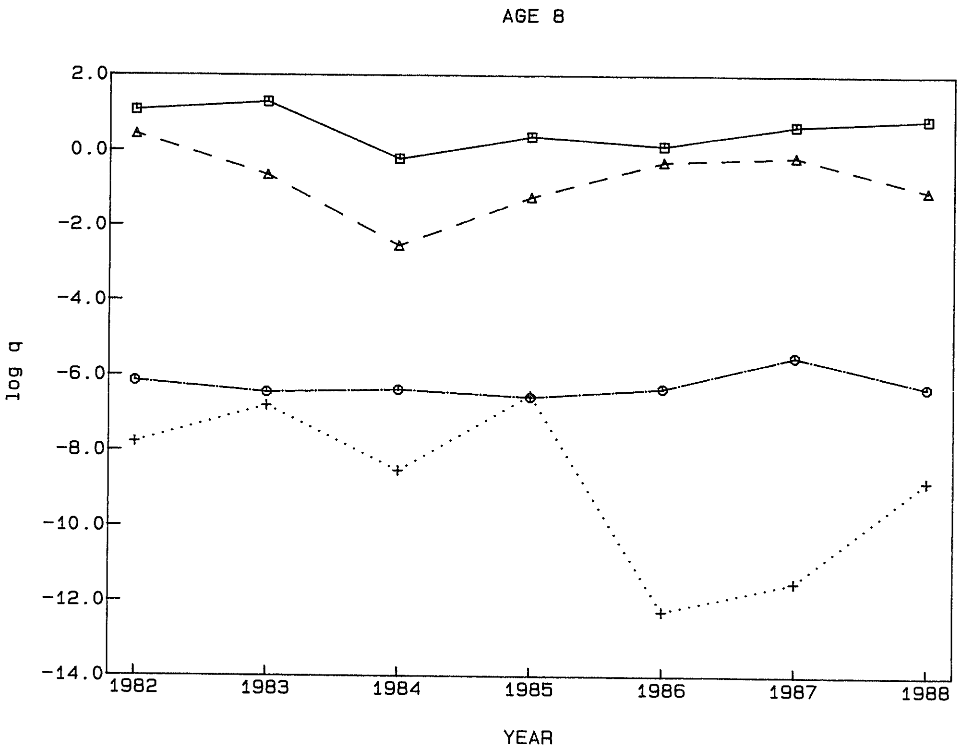
(cont'd)

Figure 4.11 (cont'd)



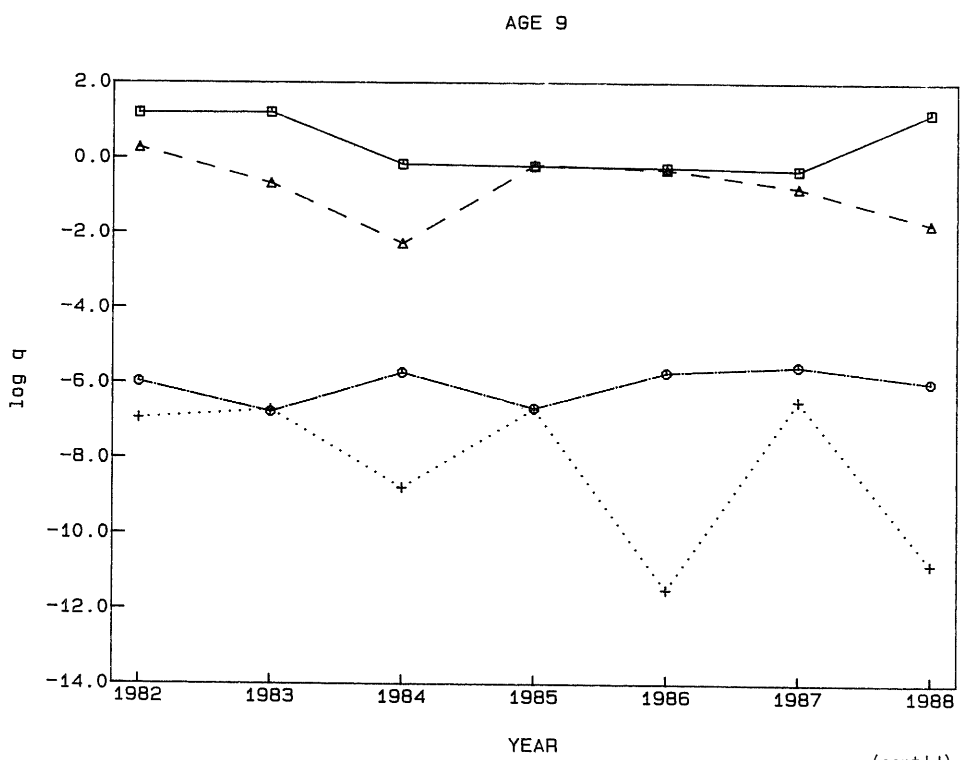
(cont'd)

Figure 4.11 (cont'd)



(cont'd)

Figure 4.11 (cont'd)



(cont'd)

Figure 4.11 (cont'd)

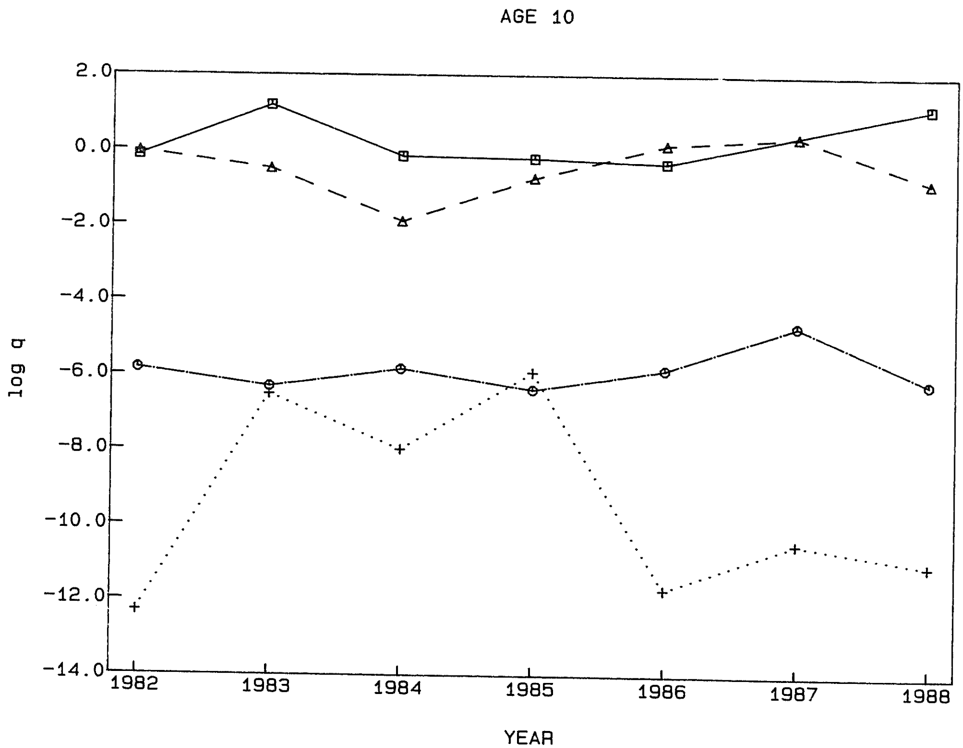
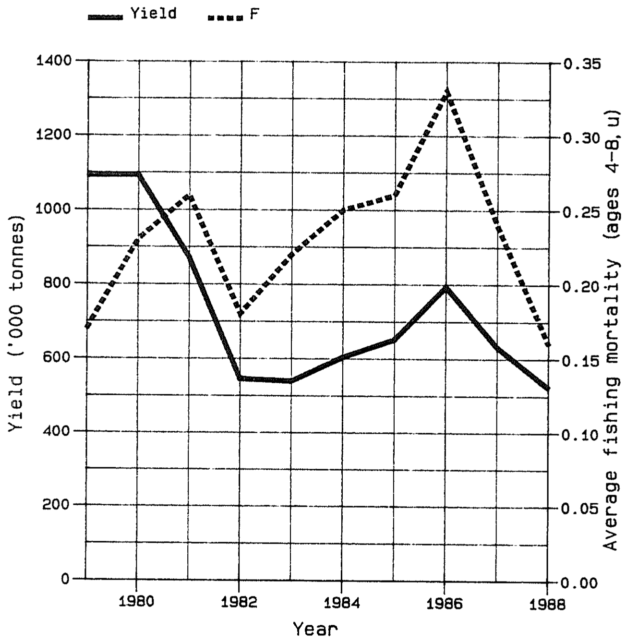


Figure 4.12

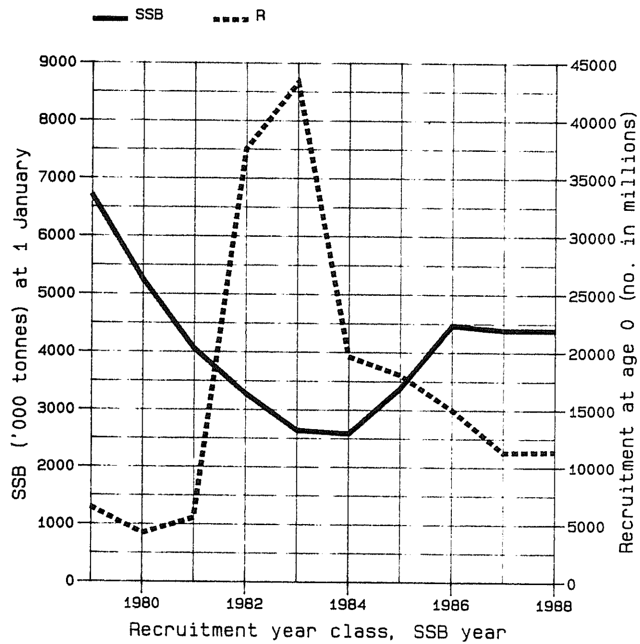
FISH STOCK SUMMARY
STOCK: Blue Whiting - Northern Area
29-09-1989

Trends in yield and fishing mortality (F)



A

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



B

(cont'd)

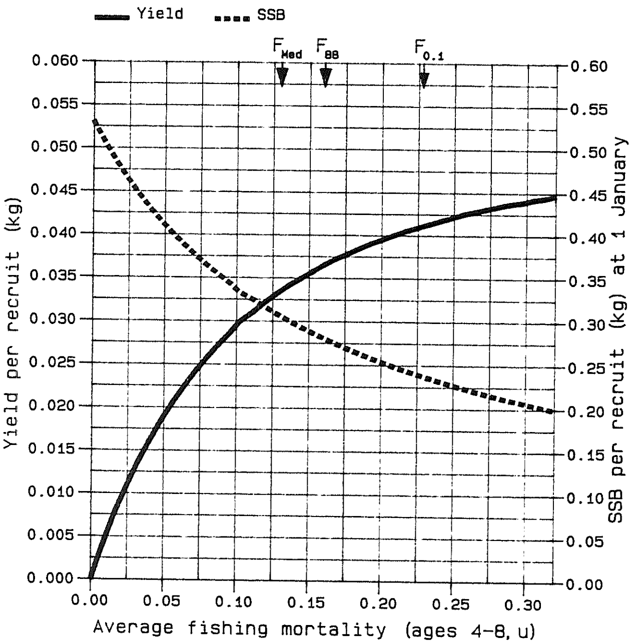
Figure 4.12 (cont'd)

FISH STOCK SUMMARY

STOCK: Blue Whiting - Northern Area

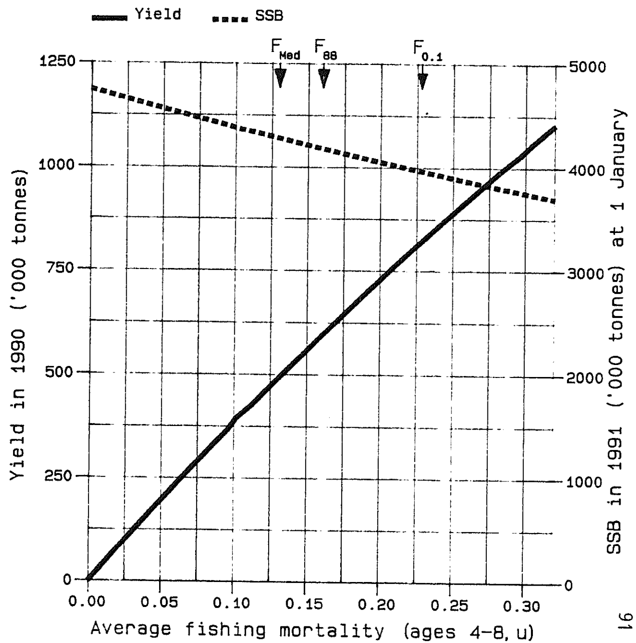
29-09-1989

Long-term yield and spawning stock biomass



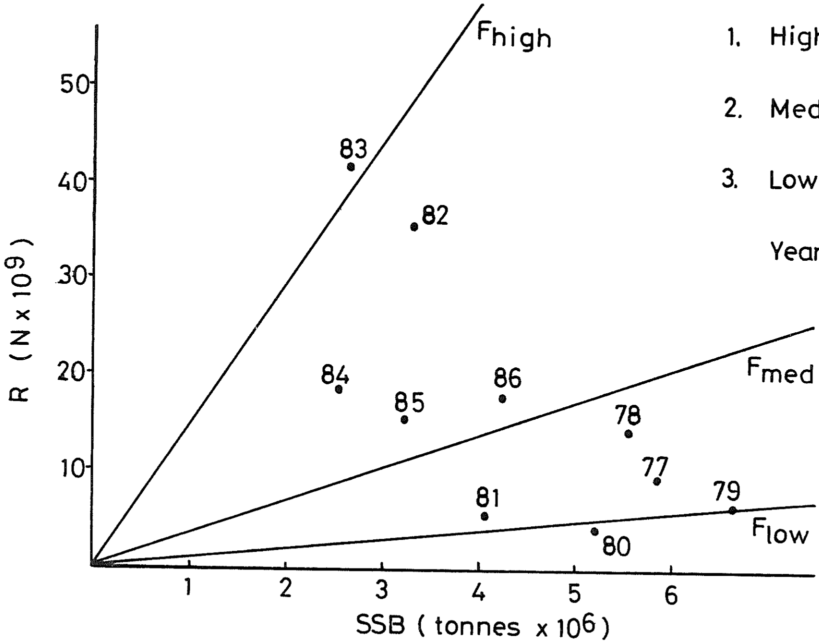
C

Short-term yield and spawning stock biomass



D

Figure 4.13 F_{med}, F_{high}, and F_{low} for the northern BLUE WHITING stock 1977-1986.



			R/SSB	SSB/R	F
1.	High slope	$\frac{15000}{1000}$ =	15.00	0.07	–
2.	Med. slope	$\frac{10100}{3000}$ =	3.37	0.30	0.13
3.	Low slope	$\frac{7000}{6000}$ =	1.17	0.86	–

Years included: 1977-1986 (N=10)

Figure 5.1(a) Log catchability by fleet.

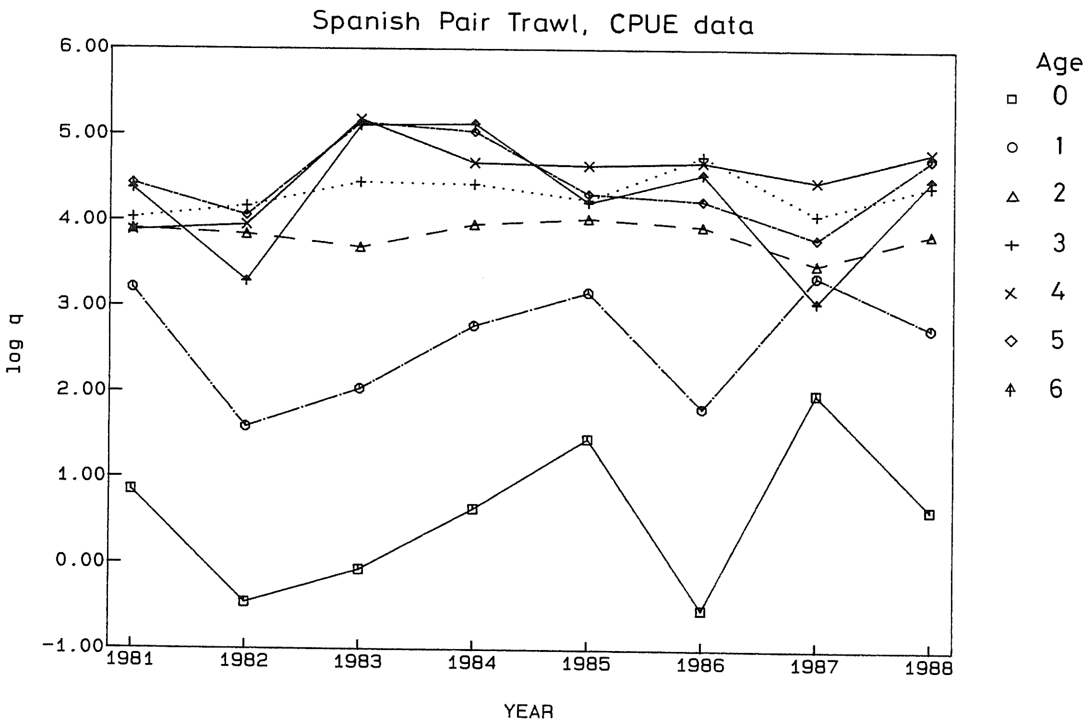


Figure 5.1(b) Log catchability by fleet.

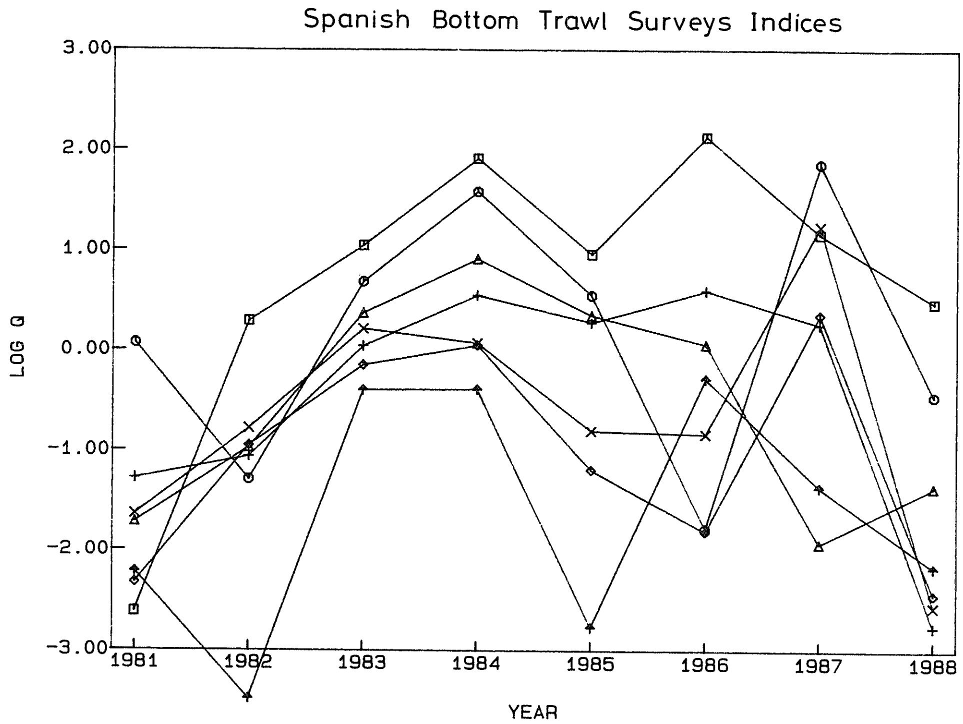


Figure 5.2

Exploitation patterns

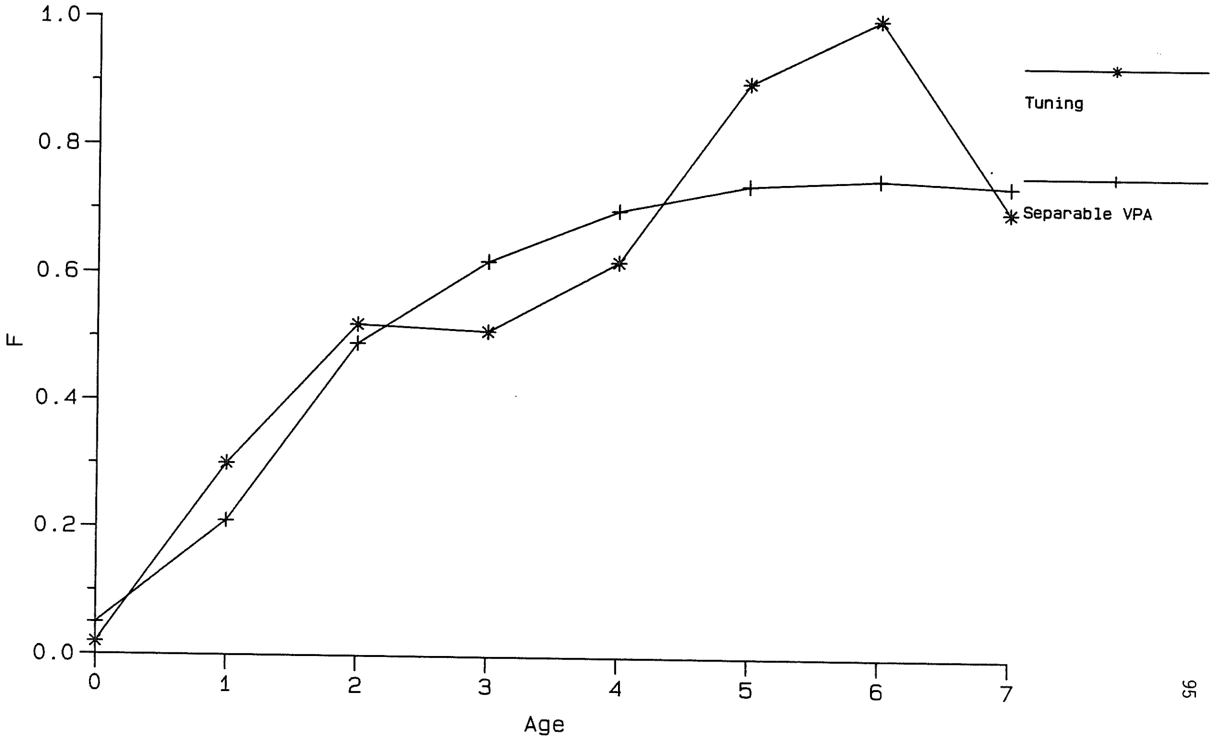
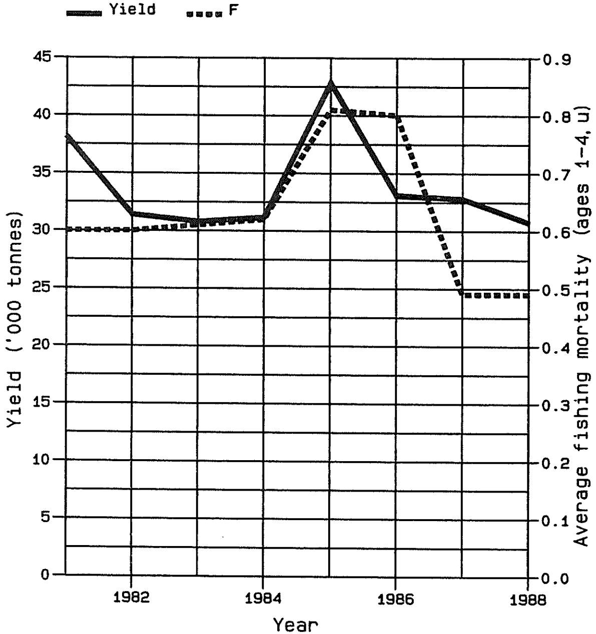


Figure 5.3

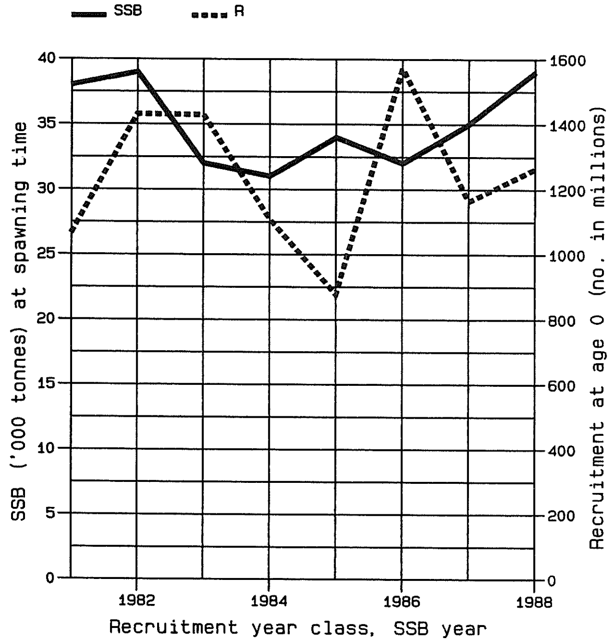
FISH STOCK SUMMARY
STOCK: Blue Whiting - Southern Area
29-09-1989

Trends in yield and fishing mortality (F)



A

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



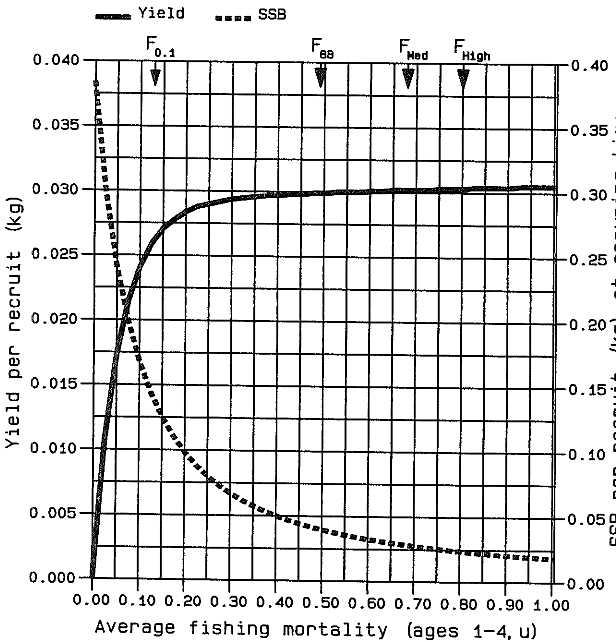
B

(cont'd)

Figure 5.3 (cont'd)

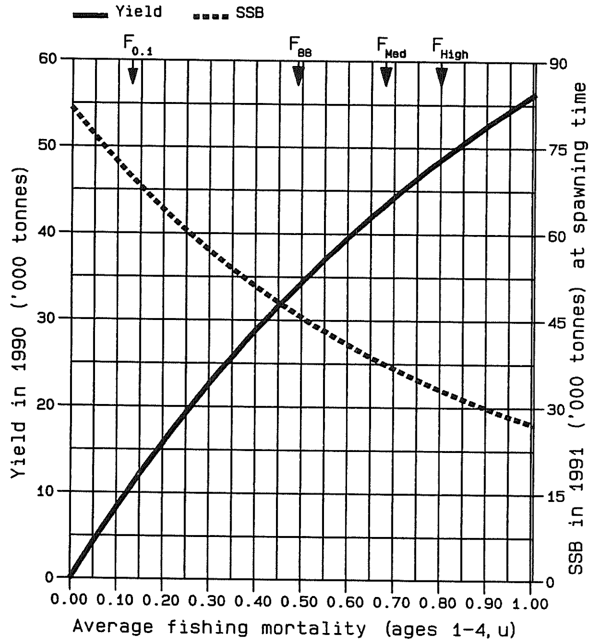
FISH STOCK SUMMARY
STOCK: Blue Whiting - Southern Area
29-09-1989

Long-term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

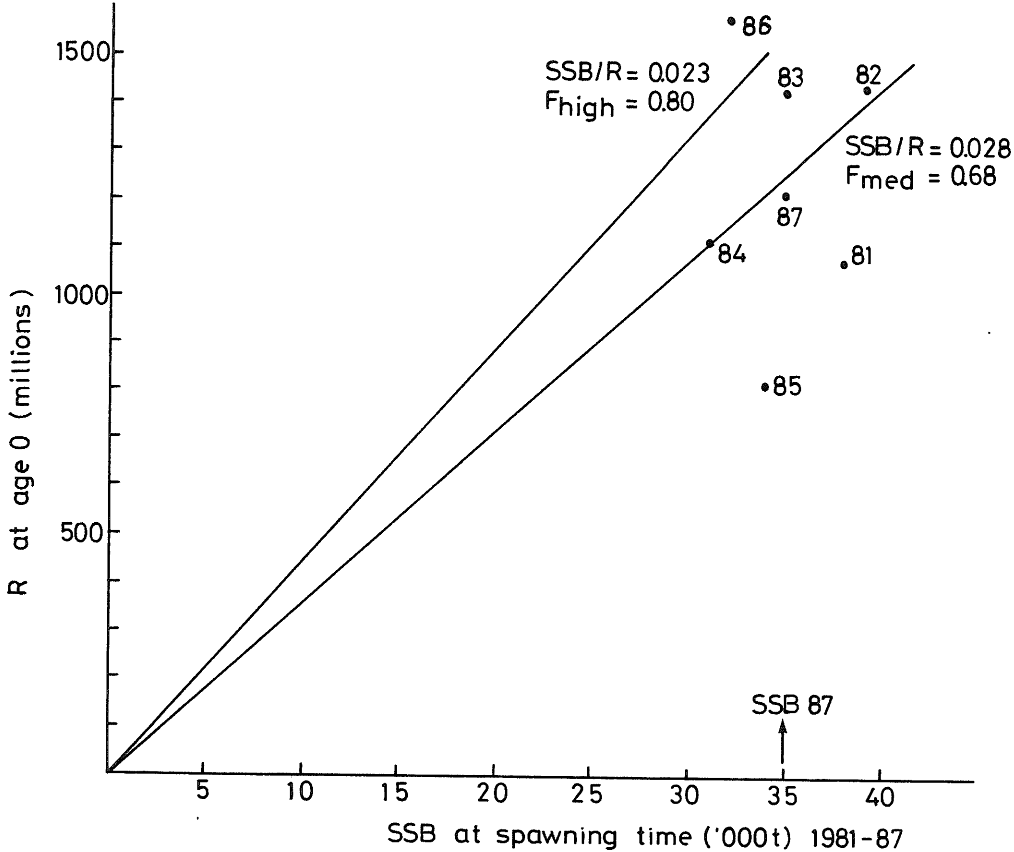


Figure 5.4 F_{med} and F_{high} of the southern BLUE WHITING stock.

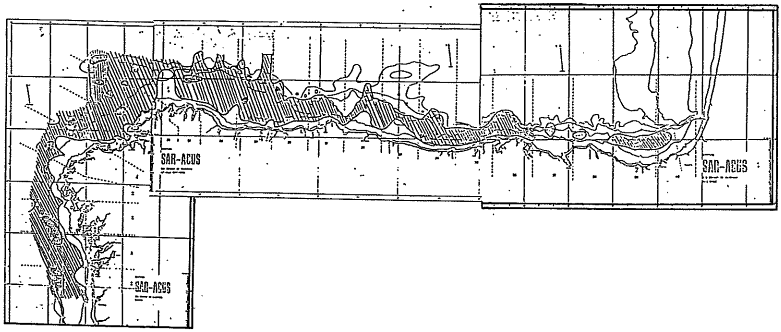


Figure 5.5 "SARACUS-88" (Spain). Distribution of BLUE WHITING at the shelf off northern Spain. (Reference: ICES, Doc. C.M.1989/H:6).