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REPORT OF THE BLUE WHITING ASSESSMENT WORKING GROUP

Copenhagen, 15-22 September 1983

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

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1. INTRODUCTION

1.1 Terms of Reference

The Blue Whiting Assessment Working Group met at ICES headquarters, Copenhagen, 15-22 September 1983. The terms of reference were set by the Council's resolution, passed at its 70th Statutory Meeting (C.Res. 1982/2:5:13):

'It was decided, that:

the Blue Whiting Assessment Working Group (Chairman: Mr H í Jákupsstovu) should meet at ICES Headquarters from 15 to 22 September 1983 to:

(i) assess catch options inside safe biological limits for the blue whiting stock in 1984,

(ii) review which data are available in the Working Group files for evaluating density dependence in the parameters of the models used in fish stock assessment,

(iii) specify deficiencies in data required for assessments.'

1.2 Participants

V Babajan	USSR
H Becker	The Netherlands
S Ehrich	Federal Republic of Germany
H í Jakupsstovu (Chairman)	Faroe Islands
T Monstad	Norway
R Robles	Spain
R Schöne	Federal Republic of Germany
V Shleinik	USSR
B Vaske	German Democratic Republic

2. LANDINGS

2.1 Landings in 1982

Total landings by countries in the various blue whiting fisheries are presented in Tables 2.2 - 2.6 and summarised in Table 2.1.

There was a significant decrease in the total landings of blue whiting in 1982 compared to 1981, the major part of which is accounted for by a reduction in the USSR landings from the Norwegian Sea. All countries, however, fishing for blue whiting in the Norwegian Sea had lower catches in 1982 compared to 1981.

The landings from the spawning and post-spawning fishery increased, and so did the landings of blue whiting from the mixed industrial fisheries in the North Sea. The very strong 1982 year class dominated the landings from the mixed industrial fisheries in the latter half of 1982.

2.2 Landings in 1983

Preliminary information on landings of blue whiting have been submitted by some countries reporting on Data Form 5. Data up to and including August 1983 are presented in Table 2.7.

3. STOCK IDENTITY AND STOCK SEPARATION

The investigations on maturity curves, starting in 1982 in the area between 42° and 61°N (Ehrich and Robles, 1982) were continued in 1983, limited to the area between the Porcupine Bank and the Faroe Islands. No investigations on stock identification were done in the area south of the Porcupine Bank in 1982.

Investigations by B Bussmann (pers.comm.), using the method of electrophoretic determination of protein loci in the crystalline lens, indicate a possible existence of more than one population in the northern North Atlantic. The results are not yet published and, therefore, a discussion on these investigations should be postponed.

Population parameters like the size at maturity (L_{50}) are very sensistive to extrinsic factors. They tend to characterize the environment occupied by a stock as well as the stock itself (Ihssen et al., 1981). Nevertheless, the different sizes at maturity in the areas to the west of the British Isles and Ireland could suggest the existence of several populations in these areas (Table 3.1) (Ehrich and Schöne, 1983).

The occurrence of blue whiting on the Banks of the Rockall Trough area over the whole year could be another indication of the existence of different populations (Bailey, 1982, Ehrich, 1983(a & b)).

NORTHERN AREA
(Chapter 4-7)

4. CATCH COMPOSITION

4.1 Age Determination

In June 1983 a Workshop on age determination of blue whiting was held in Tórshavn (Anon., 1983a). The great difficulty encountered in reading blue whiting otoliths was once more demonstrated. During the meeting a number of problems were identified and dicussed in front of a video-monitoring equipment. Based on this, a number of recommendations were made with the aim of standardising the age determination and reporting. The Blue Whiting Assessment Working Group, to whom the report of the Workshop was presented, endorsed the recommendations.

A bilateral comparison on age determination was made by USSR and Norway when a Norwegian sample of 100 blue whiting otoliths were brought to PINRO, Murmansk in November 1982. The results were reported to the Working Group in a working paper by Seliverstova. All the otoliths in the sample, which were determined to different age by the different readers, were studied again and discussed. After this, a better agreement was reached.

The Working Group members agreed in further comparison of age determination, and new samples of blue whiting otoliths will therefore be circulated (see section 11.6).

4.2 Age Composition of Landings

Age composition of landings were revised for 1976-81 and new data were made available for 1982.

No attempt was made to standardize the age readings brought to the Working Group meeting, and the catch in number by age group (Tables 4.1 - 4.3) are as provided by the Working Group members.

For the directed fisheries in 1982, age composition data were provided by the USSR, Norway, German Democratic Republic and the Faroe Islands. These countries together accounted for 93% of the landings in the directed fisheries. Landings by other countries were assumed to have the same relative age composition as those mentioned (Table 4.1).

For landings of blue whiting taken in the mixed industrial fisheries, age compositions were available from Norwegian catches only. These accounted for 45% of the total industrial landings. Other countries' landings were assumed to have the same relative age composition as those of Norway (Table 4.2).

The raised age composition for the directed fisheries and the mixed industrial fisheries were summed to give the total age composition of the Northern area (Table 4.3).

5. WEIGHT AT AGE

Mean weights at age were presented by Norway, USSR and the German Democratic Republic for different areas by months.

Mean weights for the spawning fishery, Norwegian Sea fishery and the mixed industrial fishery were calculated weighted by the monthly catches. An overall mean was calculated weighted by the total landings in weight from each country. The total catch landed in 1982 was compared against the sums of products (SOPs) of total numbers landed in 1982 and mean weight at age. As the calculated SOPs were 15% higher than the nominal landings the mean weights at age calculated for 1981 were used in the VPA runs resulting in a SOP within 3% of the nominal landings. In Table 5.1 the mean weights of age used in the VPA runs are presented.

6. STOCK SIZE ESTIMATES

6.1 Acoustic Surveys in 1983

6.1.1 Surveys during the spawning season

During the spawning season of 1983 two independent surveys of the blue whiting spawning stock were conducted in the areas west of the British Isles by Norway and USSR, respectively.

In the Norwegian survey (Midttun, 1983) the blue whiting concentrations were found in a very narrow but dense layer along the shelf edge from Porcupine Bank to west of Shetland. Applying the method described in Anon. (1982) the stock surveyed was estimated to be 4.7 million tonnes equivalent to 30.1×10^9 specimens; of this, 4.4 million tonnes were fish 26 cm and larger. During the survey the concentrations moved generally northwards, and as the survey route was in the same direction some overestimation might have been introduced (Midttun, loc.cit.). In Figure 6.1 the estimate divided on areas is presented.

The results of the USSR survey that took place in the period mid-April to mid-May in the area from south of Porcupine Bank to the Faroes were presented to the Working Group by V Shleinik. Based on in situ TS measurements during the survey (Table 6.1) the spawning stock was estimated to 3.6 million tonnes. In Figure 6.2 the estimate divided on areas is presented. The USSR survey route was also from south to north and thus introducing an overestimation. An underestimation, however, might also have been introduced by the survey taking place after the peak spawning, when some of the fish had migrated from the area.

6.1.2 Surveys in the Norwegian Sea and adjacent areas

In August 1983, the second ICES-coordinated acoustic assessment survey was carried out. The plans for the survey were made during a meeting in March (Anon., 1983b) and the report was finalised during a meeting prior to the 1983 Working Group meeting (Anon., 1983c).

Five countries participated in the joint survey with altogether 8 research vessels. The area covered in 1983 was somewhat larger compared to 1982 extending also into the Norwegian Deeps and to the south and east of the Faroes (Figure 6.3).

Using the same assessment methods as in 1982 (Anon., 1982) the total stock was estimated to 2.8 million tonnes equivalent to 36.5 x 10^9 specimens.

In Figure 6.4 the total biomass estimate divided into areas is presented, and in Figure 6.5 in relative integrator units. Juvenile fish dominated the stock and especially the 1982 year class was numerous. From the length distribution in the trawl samples the total biomass could be divided into lenght groups (Figure 6.6) and based on this on age groups giving 0.2 million tonnes of the 1983 year class, 1.5 million tonnes of the 1982 year class and 1.1 million tonnes of the older year classes, i.e., 27 cm and larger.

In addition to the joint survey the Federal Republic of Germany research vessel "Walther Herwig" in August 1983 made a scouting and trawl survey to the areas north and east of the Faroes around Iceland and especially the Dohrn Bank off East Greenland (Figure 6.7). The length distribution of the blue whiting found at Dohrn Bank was dominated by fish in the length group 14 - 18 cm (Figure 6.8). No concentration of adult fish was recorded at the Dohrn Bank.

6.1.3 Discussion on the acoustic surveys

In the text table below the biomass estimates obtained at the spawning area and in the Norwegian Sea 1981-83 are given in million tonnes, together with the estimates of the spawning and adult stocks in brackets.

	1981	1982	1983
Spawning area	6.1(5.4)	2.5	4.7(4.4) 3.6(3.6)
Norwegian Sea	4.9	4.6(4.1)	2.8(1.1)

The methods used for these estimates and the conversion factors applied are well described in the 1982 Working Group Report (Anon., 1983d) and in Appendix II of Anon. (1982).

In 1982 the entire spawning area was not surveyed, and the estimate was therefore considered an underestimate. The area covered during the spawning survey in 1981 extended into the southeastern parts of the Norwegian Sea, and 12% of the biomass observed were immature fish and the estimate of the spawning stock 5.4 million tonnes. In the Norwegian estimate from the spawning area in 1983 0.3 million tonnes were immature fish yielding a spawning stock estimate of 4.4 million tonnes.

During all the August surveys the major part of the Norwegian Sea was fairly well covered. In 1981, the area west and north of Bear Island was surveyed thoroughly, whereas in 1982 and 1983 this area was only partly surveyed. In 1982 and 1983 the waters around Iceland were included. In 1982 but not in 1983 the Dohrn Bank and the sea south of Iceland were also included. The Dohrn Bank, however, was surveyed in 1983 by "Walther Herwig". In 1983 the survey was extended to include the Norwegian Deep and the areas south and west of the Faroes. In the areas not covered in 1983 only minor quantities of blue whiting had been found during surveys in previous years.

In August 1981 only small concentrations of juvenile blue whiting were recorded and almost all the biomass estimates consisted of adult fish. In 1982 0-group blue whiting were recorded along the Norwegian Shelf and south-east of Iceland. The total estimate was not divided then into an estimate of the adult stock and the juvenile stock. The length distribution by area given in Anon. (1982) indicates, however, that the biomass of juveniles recorded in that year was less than 0.5 million tonnes. This would imply a spawning stock biomass in August 1982 in the order of 4 million tonnes. In 1983 the biomass estimated in August was 0.2 million tonnes 0-group blue whiting, 1.5 million tonnes 1-group and 1.1 million tonnes adult fish ($\geq$ 27 cm).

Taking into account the area covered the estimates from the August surveys in 1981 and 1982 are not inconsistent with the spawning stock estimated the same years. The spawning stock estimates obtained during the spawning season in 1983, 3.6 and 4.4 million tonnes, however, are very inconsistent with the estimate obtained from the adult stock ($\geq$27 cm) during the August survey in 1983, 1.1 million tonnes, and it is very hard to account for this discrepancy of at least 2.5 million tonnes.

In the previous Working Group reports it has been pointed to the various difficulties encountered when surveying the spawning stock during the spawning period, the main points being:

(a) The rapid migration during the spawning period creates two major difficulties. It is hard to time the survey to a time when most of the stock is in the area, and it is almost impossible to have the survey as synoptic as is needed considering the large area which has to be covered. Due to the migration it is always a hazard that major concentrations are recorded more than once or missed.

(b) While intergrating very dense recordings in narrow bands and shoals the methods applied in averaging in the calculations of the total biomass are influential on the final results.

Since 1972 yearly estimates of the blue whiting spawning stock have been obtained. Looking in retrospect at these estimates (Anon., 1980) it is difficult to find a clear picture, and it was for this reason that the Working Group recommended that the Norwegian Sea surveys were undertaken.

In the period between August 1982 and August 1983 a total amount of approximately 300 000 tonnes of adult blue whiting has been removed from the stock by the international fishery. Accepting the figures obtained during the two August surveys (in 1982 and 1983), however, implies either a very high natural mortality in the intervening period or that significant quantities of adult blue whiting are in areas not surveyed in 1983.

After the survey in August 1983 Norwegian and USSR vessels surveyed the Barents Sea for 0-group fish (Anon., 1983e). During this survey 0-group blue whiting were for the first time in 19 years recorded in significant numbers in the Barents Sea. The length range of the 0-group blue whiting found (2.5 - 10 cm) was lower than that found in the Norwegian Sea. This might indicate that spawning has taken place north of the main spawning areas west of the British Isles and also at a later date. Some blue whiting were recorded during this survey but not in any significant quantities.

The USSR research vessel "Lensk" in late July and first half of August in a redfish survey to the west of Bear Island had catch rates of blue whiting in pelagic trawls of up to 1 t/hour. The same area was surveyed during the August survey without any high concentrations being recorded.

Judged from the geographical distribution of the fishery after spawning in 1983, the blue whiting spawning stock migrated northwards into the Norwegian Sea and dispersed there. Whether they have migrated southwards again at a later stage is impossible to tell, but seems fairly unlikely from previous experience. The "Walther Herwig" during a bottom trawl survey in May to the areas west of the British Isles between Porcupine Bank and the Wyville Thomson Ridge found no significant pelagic concentrations of blue whiting.

As reported to the Working Group, USSR scouting vessels found concentrations of pre-spawning and spawning blue whiting in late March and early April 1983 southwards from Rockall Bank to 20°W, but this was before the spawning area surveys, and cannot help in this context.

During the survey to East Greenland in August, the "Walther Herwig" during a tow at very great depths with pelagic trawl caught a few baskets of large blue whiting, without any echo traces between 0 and 1 000 m.

In the report of the 1983 August survey the following sources of error are mentioned which might have introduced a negative bias to the estimates of adult fish.

1) Blue whiting is a fast swimming fish and a bias might have been introduced by the trawls catching relatively better the younger fish. Due to the very numerous 1982 year class, the adult stock might thus have been underestimated.

2) Some small concentrations of adult fish heavily mixed with juveniles were found in the area between the Faroes and Iceland which were not recorded by the research vessels. These concentrations were, however, too small to substantiate a fishery.

3) The very low concentrations of adult fish found over the larger areas in the Norwegian Sea might occasionally have been below the intergrator threshold values.

4) An underestimate might also have been introduced by blue whiting distributed very close to the bottom along the Norwegian Shelf edge not having been recorded.

On the other hand, the commercial fleet from USSR, the German Democratic Republic and the Faroes fishing blue whiting in the Norwegian Sea for human consumption was not able to find any suitable concentrations of adult fish in August. A new fishery in the southeastern Norwegian Sea, which developed in July-August 1983, was solely based on the strong 1982 year class.

Following the discussion above the Working Group finds it very difficult from the acoustic surveys to draw any final conclusions on the size of the adult stock of blue whiting at present, other than it is probably somewhere in between the estimates obtained during the spawning surveys and the August survey.

6.2 Virtual Population Analysis (VPA)

Several trial VPA runs were made by the Working Group based on various assumptions on the stock biomass in 1983. However, because of the discrepancies observed between the estimates from the acoustic surveys conducted during 1983, it was not possible to derive a single reliable value for the terminal fishing mortality for 1982 in the VPA. For illustration purposes it was therefore decided to produce a VPA based on the following assumptions:

(i) The stock biomass of the 1982 year class in August 1983 should be at 1.5 million tonnes as estimated from the August survey in the Norwegian Sea.

(ii) The stock biomass of the adult stock, e.g., age groups 2 and older, was taken at a level of 3 million tonnes in August 1983, which is somewhat below the value estimated from the spring surveys in the spawning area.

(iii) The catches taken during the first half of the year 1983 were assumed to be 290 000 tonnes for the adult and 70 000 tonnes for juveniles.

Based on these assumptions, and taking into account a natural mortality of M = 0.2, the stock size at the beginning of 1983 was estimated. The terminal F in 1982 was chosen so that the predicted stock size from the VPA at the beginning of 1983 corresponds with the assumed one. According to this the F on the 0-group in 1982 was at a level of F = 0.10, whereas for the older age groups an F of 0.12 was calculated. In the absence of reliable information on the exploitation pattern, the same F was applied for age groups 1 and older, which appears not to be far from the calculated F-array for the previous years.

According to the VPA results, the total stock biomass increased from 5 million tonnes in 1970 to about 10 million tonnes in 1974 and remained fairly stable at this level up to 1978. From 1978 onwards it decreased steadily to about 5.5 million tonnes in 1982. Furthermore, the calculated total biomasses for 1981 and 1982 are in accordance with the estimates obtained from the August surveys in the same years.

According to the VPA the recruitment has decreased more or less steadily from 1972 up to 1981. The 1982 year class is obviously a strong one, and its size was estimated to be about 36×10^9 (as 0-group), which is close to the average strength of the 1970-73 year class. The VPA results are given in Tables 6.2 - 6.4 and also shown in Figure 6.9.

6.3 Catch per Unit of Effort

Catch and effort data for 1982 were presented by 3 countries, i.e., the German Democratic Republic, Norway and USSR. These countries presented their data broken down by vessel tonnage, area and month.

Comparable time series of cpue data for Divisions IIa, Vb, VIa and IVa, which may be indicative of changes in stock abundance, are compiled in Table 6.5.

The German Democratic Republic catch rates (GRT-class 2 000 - 3 999.9 tonnes) for the period July-September decreased from 1981 to 1982 by 28% in the Norwegian Sea (Division IIa). The USSR catch rates averaged for the same period increased in this area from 2.54 to 2.85 t/h, or by 12%. But taking into account that Soviet catches for the same period in 1982 were significantly smaller compared with previous years, the data on cpue of the Soviet fleet could hardly be considered representative. USSR catch rates averaged over the whole year 1982 decreased by 10% compared with 1981 (Table 6.6).

A tendency to a reduction in catch rates was observed in Division Vb for the German Democratic Republic and USSR vessels, and in Division VIa for Norwegian vessels (GRT-class 1 000 - 1 999.9 tonnes). At the same time catch rates for smaller Norwegian vessels (GRT-class 100 - 499.9 and 500 - 999.9 tonnes) became higher compared with the previous year.

The decrease noted in the catch rates can be explained either by a reduction of adult stock biomass or by changes in the distribution pattern of the fish caused by hydrographic conditions (Schevchenko and Isaev, 1983).

6.4 Bottom Trawl Survey on Rockall Bank

During 4 January to 4 February 1983, 76 hauls were made by the RV "Walther Herwig" on the plateau and at the slope of the Rockall Bank in depths down to 700 m. Using the swept area (catchability factor = 1) method, the stock size was estimated to be approximately 77 000 tonnes (Ehrich, 1983b).

The relative mean density (t/nm^2), the trawable biomass and the confidence limits per depth range are listed in Table 6.7. Figure 6.10 shows the sex-separated length distribution of the total catch.

During the survey the blue whiting concentrations were found very near the bottom. When using midwater trawls close to the bottom (4-6 m), however, blue whiting were also caught implying that the estimate could be an underestimate.

Similar surveys in August to the shelfedge and the Oceanic Banks west of the British Isles could lead to estimates of the residual population of the blue whiting stocks north of the Porcupine Bank which do not migrate to the feeding areas further north.

7. MANAGEMENT CONSIDERATIONS

(a) The acoustic surveys for 1983 gave conflicting evidence on the size of the spawning stock. As the highest of these estimates might be an overestimate, it could be concluded, however, that the spawning stock has not increased from 1982 to 1983 and possibly has decreased.

(b) Catch per unit of effort data from the USSR and German Democratic Republic fleets indicate clearly a decrease in the availability of blue whiting in the Norwegian Sea in 1982 compared to 1980 and 1981. Some of the decrease could possibly be explained by changes in the hydrographic conditions in the Norwegian Sea, but as the trend is found throughout the year a reduction in abundance seems likely.

(c) It was not possible for the Working Group to make an analytical assessment with an acceptable reliability. All VPA runs made, however, either calibrated to a high spawning stock level (4.4 million tonnes), an intermediate (3.0 million tonnes) or a low one (1.1 million tonnes), indicating a steady decrease in the stock from 1978 til 1982.

There is thus some evidence that the size of the stock is lower than at any time during the last ten years. Using a higher M in the VPA would result in a steeper decline in the stock size and would also result in a higher discrepancy than is likely between the VPA estimates of the spawning stock in past years and the acoustic estimates in the same years.

The 1983 August survey indicates the 1982 year class to be strong, and, compared with the VPA results, of the same order of magnitude as the year classes 1970-73.

As no reliable analytical assessments could be made the Working Group did not attempt to make any predictions or to calculate Y/R curves.

All evidence points to a steady decline in the recruitment in past years apart from the 1982 year class. As this year class is already heavily fished the Working Group would advocate caution in the future exploitation of the stock.

8. SOUTHERN AREA

8.1 Landings

Total landings by countries are presented in Table 2.6. A decrease of 14% from 1981 to 1982 was registered. Portuguese landings decreased by 47%, and those of Spain also decreased slightly (10%), while landings from the Netherlands in Divisions VIId-e, VIIg-k increased from 633 tonnes in 1981 up to 2 406 tonnes in 1982. Portugal took all their catches in Division IXa, and Spain caught about 7 000 tonnes in Division IXa and approximately 20 000 tonnes in Division VIIIc.

8.2 Catch Composition

8.2.1 Age determination

During the Workshop carried out in June 1983 on otolith reading it was felt that, in general, otoliths from fish of the southern area seem to be easier to interpret than corresponding otoliths from fish to the north. One also had the impression during the Workshop that the growth rate of blue whiting in the southern area is less than that in the northern area, and this seems to be confirmed in the age/length key presented by Spain (Table 8.1).

8.2.2 Age composition of the landings

Table 8.1 provides the age composition of the landings based on Spanish data which represent 81% of the total. The Portuguese landings were assumed to have the same age compositions. The landings from the Netherlands (7% of the total) were not included, because they were taken in other areas further north, and no sampling data were available from them.

8.3 Weight at Age

Table 8.1 also presents mean weights at age for Spanish and Portuguese landings. The calculated SOPs were within 7% of the nominal landings. The data show that mean weights at age up to 7 years are also less than in the north, but from 8 years upwards they seem to be greater than the overall weighted mean of the northern area and more similar to the North Sea mixed industrial fishery. However, the results obtained from the oldest fish (7 - 15 years) were based on a very limited number of otoliths.

8.4 Catch per Unit Effort

Table 8.2 presents the series of data available from Spain and Portugal since 1977. Portuguese data are presented in kg per hour fishing and in tonnes per vessel, whereas revised Spanish cpue are presented in kg per day fishing, but only for the three main ports of Galicia, which each year account for approximately 75% of the total Spanish landings.

Effort seems to be more or less stable, while the cpue declines slightly in the Spanish fleet and by 50% in the Portuguese fleet. In the case of Spain, one possible explanation, other than a decline in the abundance, can be found in the enforcement of two closed areas between January-March and October-December and a stop of the fleet in some ports during October.

8.5 Groundfish Surveys in Portuguese Waters

During 1982 two stratified random groundfish surveys in the Portuguese continental waters were carried out following the series initiated in 1979 and where blue whiting is one of the species under study.

A paper by Cardador (1983) describes the results obtained which indicate greater abundance of blue whiting in deep waters (200 - 500 m) in relation to shallow waters. From a statistical analysis of the data it was possible to conclude that in June 1981 the abundance of blue whiting was larger than in June 1980. Minimum biomass estimated by the swept area method gave the highest value in the October 1980 survey with a value of 46 000 tonnes (variation coefficient = .50) and the lowest value in the May-June 1980 survey, with an estimate of 4 200 tonnes (variation coefficient = .33).

8.6 Assessment

No attempt was made to assess the stock of the blue whiting in the southern area.

9. DATA DEFICIENCIES

9.1 Catch reporting is in general adequate. Discarding of small and juvenile blue whiting is known from the southern area as well as from the fisheries using blue whiting for human consumption, only in the northern area. This may become of more importance, because of the good recruitment in nearly all northern areas. There are no estimates of the amount of blue whiting discarded, or perhaps landed unreported, in Divisions VIIg-k and VIIIa,b, where blue whiting is known from surveys to be one of the most abundant species of fish.

9.2 It is still difficult to use the Virtual Population Analysis for assessing the northern blue whiting stock. Reliable estimates of natural mortality, terminal F as well as standardized age determinations are urgently needed. In addition, also the biological data base (weight at age, maturation ogive, etc.) should be improved.

9.3 Some of the deficiencies are related to major biological problems (e.g., age determination, stock separation, extent of stock distribution), which, in the case of blue whiting, have not yet received adequate attention.

9.4 Biological sampling is also adequate for a large part of the catch, although there are important exceptions. Approximately 55% of the landings in the mixed industrial fishery are apparently completely unsampled. This is an important deficiency, because landings of the youngest three or four classes have formed the only available information on recruitment.

The results of the August surveys 1981-83 have indicated that abundance indices of the one-year olds can possibly be obtained from such surveys.

10. DENSITY DEPENDENCE

Regarding Item (ii) of the terms of reference (C.Res.1982/2:5:13), the meaning of it is understood to be:

> To review which data on blue whiting are available in the files of the Working Group's member countries for evaluating density dependence in the parameters of the methods and the models to be used in fish stock assessments.

USSR and Norway, which together account for the majority of the blue whiting landings, started their regular investigation on the species in 1965 and 1970, respectively. Since then both nations have yearly collected biological samples in the northeastern Atlantic. Norway has mainly sampled the spawning stock, while USSR has sampled both from the spawning and the feeding areas. Other nations engaged in the fishery also collect samples, but at a comparatively smaller scale.

During this period the abundance of the blue whiting stock in the northern areas has apparently fluctuated considerably. The material has, however, not been analysed in this context.

11. FUTURE RESEARCH RECOMMENDATIONS

11.1 The results of cruises and investigations in the last two years have shown that there is clear evidence of the existence of a separate southern blue whiting stock. In order to provide data for a better management, larger data series on age determination would be needed. Acoustic estimates are also required during summer-time, when the annual recruits are in mid-waters.

11.2 Further investigations on stock separation have to be done in the entire distribution area. More investigations on meristic, morphometric and biochemical characters, growth rates, maturation length data and gonad studies, as well as parasite infestation rates and other diseases, have to be encouraged.

11.3 All the information on the occurrence of 0- and 1-group blue whiting should be reported very carefully, and special searching should be carried out during future research cruises.

11.4 The Working Group considers it very important to continue the supervision of the northern blue whiting stock. The surveys 1981-83 have given valuable information about the abundance as well as changes in the distribution of the stock in relation to hydrographic parameters.

Although it is difficult at present to indicate the precision of the stock estimates obtained during these surveys, they are the only means by which both the adult and the recruiting year classes can be monitored at the same time, and while there are indications of a declining stock, these should be continued at least.

It is therefore recommended that a similar coordinated acoustic assessment survey should be carried out in August 1984. In connection with this, meetings of members from participating countries should be arranged before and after the survey.

11.5 In addition to this, the surveying of the spawning stock during spring time has demonstrated to be very valuable as well, and should consequently be continued. If more than one vessel undertakes this, the surveys should preferably be coordinated. In order to facilitate this survey, plans should be circulated as soon as possible to Rudiger Schöne, whose responsibility it would be to investigage whether any coordination is possible.

11.6 Taking into account that some countries fishing the major part of the annual blue whiting landings were not present at the Workshop held in the Faroe Islands in June 1983, it seems appropriate to set up another international otolith exchange programme which can serve also as a control of the theoretical improvements and agreements reached during the Workshop. The Working Group appointed V Shleinik as coordinator for this programme.

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Table 2.1 Landings (tonnes) of Blue Whiting from the main fisheries 1972-1982

Area	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982*
Norwegian Sea Fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	625	878	146	6 746	3 336	56 999	235 226	741 074	766 858	520 738	111 001
Spawning Fishery (Divisions Vb, VIa, VIb and VIIb,c)	15 426	15 027	15 207	30 335	81 362	136 787	229 228	284 547	250 693	288 316	322 772
Icelandic Industrial Fishery (Division Va)	12	2 833	4 230	1 294	8 220	5 838	9 484	2 500	-	-	-
Industrial Mixed Fishery (Divisions IVa-c, IIIa)	27 959	56 826	62 197	41 955	36 024	38 389	99 874	63 333	75 129	61 754	106 560
Southern Fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k)	33 503	27 452	25 733	31 715	35 035	30 723	33 898	27 176	29 944	38 749	33 796
Total	77 525	103 016	107 513	112 045	163 977	268 736	607 710	1 118 630	1 122 624	909 557	574 129

*Preliminary

Table 2.2 Landings (tonnes) of Blue Whiting from the Norwegian Sea (Sub-areas I and II, Divisions Va, XIVa, and XIVb) fisheries 1972-1982

Country	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982[1)]
Denmark	-	-	-	-	-	-	-	-	-	-	443
Faroes	-	-	-	-	-	593	2 810	762	-	11 131	-
France	-	-	-	-	-	-	-	-	-	5 093	2 410
German Democratic Republic	3	-	-	-	90	2 031	7 301	22 502	14 234	15 607	3 042
Germany, Fed. Rep. of[2)]	-	3	2	35	33	6 777	8 421	1 157	8 319	17 385	890
Iceland	622	60	119	3	569	4 768	17 756	12 428	4 562	4 808	-
Norway	-	-	20	31	737	-	-	33 588[3)]	902	187	-
Poland	-	-	-	-	95	1 536	5 083	4 346	11 307	2 434	446
UK (England and Wales)	-	-	-	-	60	165	11	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-		-	-	-
USSR	-	815	5	6 677	1 752	41 129	194 844	666 259	726 874	464 093	103 770
Total	625	878	146	6 746	3 336	56 999	235 226	741 074	766 858	520 738	111 001

1) Preliminary.

2) Including catches off East Greenland (Division XIVb).
(327 tonnes in 1977, 896 tonnes in 1978, 204 tonnes in 1979 and 8 784 tonnes in 1980). (ICES 8 757 tonnes).

3) Including purse-seine catches of 29 162 tonnes of juvenile Blue Whiting.

Table 2.3 Landings (tonnes) of the Blue Whiting from the Spawning Fishery (Divisions Vb, VIa,b and VIIb,c) 1972-1982

Country	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982*
Denmark	-	-	-	-	-	18 745	23 498	21 200	19 272	11 361	23 164
Faroes	-	1 155	1 527	-	12 826	29 096	39 491	35 780	37 488	23 107	38 958
France	-	-	-	-	-	-	-	-	-	-	723
German Democratic Republic	-	-	-	-	4 971	1 094	1 714	172	181	6 562	7 771
Germany, Fed. Rep. of	-	-	2 655	-	85	3 260	6 363	3 304	709	935	710
Iceland	-	319	-	-	-	5 172	7 537	4 864	5 375	10 213	1 689
Ireland	-	-	-	-	160	-	-	-	-	-	-
Netherlands	-	-	-	-	-	-	1 172	154	-	222	6 796
Norway	651	2 445	3 247	7 301	24 853	38 214	116 815	186 737	133 754	166 168[1]	169 790[2]
Poland	-	-	116	4 704	10 950	3 996	2 469	4 643	-	2 279	-
Spain	6 955	6 571	6 484	8 153	5 910	183	14	-	-	-	-
Sweden	-	-	-	-	-	6 391	6 260	-	3 185	-	-
UK (England and Wales)	-	-	-	455	341	1 475	5 287	4 136	3 878	6 000	-
UK (Scotland)	-	-	-	279	1 488	3 001	1 599	1 466	6 819	2 611	-
USSR	7 820	4 537	1 178	9 443	19 778	26 160	17 009	22 091	40 032	58 858	73 171
Total	15 426	15 027	15 207	30 335	81 362	136 787	229 228	284 547	250 693	288 316	322 772

[1] Including 28 466 tonnes from directed fisheries in Division IVa. *Preliminary.

[2] Including 35 001 tonnes from directed fisheries in Division IVa.

Table 2.4. Landings (tonnes) of Blue Whiting from the Icelandic mixed industrial trawl fisheries Division Va 1972-1980.

Country	1972	1973	1974	1975	1976	1977	1978	1979	1980
Iceland	12	2 833	4 230	1 294	8 220	5 838	9 484	2 500	-

Table 2.5 Landings (tonnes) of Blue Whiting from the Mixed Industrial Fisheries and caught as by-catch in ordinary fisheries in the North Sea (Divisions IVa-c and IIIa), 1972-1982

Country	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982[1]
Denmark	-	-	-	-	-	16 071	54 804	28 932	49 947	35 066	24 117
Faroes	-	3 714	2 610	428	1 254	-	1 177	1 489	1 895	3 133	27 269
France	-	-	-	-	-	-	-	-	-	-	727
German Democratic Republic[2]	-	-	-	-	-	-	988	49	-	-	-
Germany, Fed. Rep. of[2]	-	-	-	-	-	76	1 514	13	252	-	111
Ireland	-	-	-	-	-	-	-	-	-	2 744	-
Norway	27 609	50 835	59 151	40 210	34 600	20 737	39 989	30 930	21 962[3]	18 627	47 856
Poland[2]	-	-	55	-	45	838	601	-	-	229	550
Spain	350	350	318	195	47	-	-	-	-	-	-
Sweden[4]	-	-	-	-	-	639	648	1 249	1 071	1 955	1 241
UK (England and Wales)[2]	-	-	-	-	-	3	+	-	-	-	4 689
UK (Scotland)	-	-	-	414	58	25	153	37	2	-	-
USSR[2]	-	1 927	63	708	20	-	-	634	-	-	-
Total	27 959	56 826	62 197	41 955	36 024	38 389	99 874	63 333	75 129	61 754	106 560

[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 2.6 Landings (tonnes) of Blue Whiting from the Southern Areas (Sub-areas VIII and IX and Divisions VIIg-k and VIId,e) 1972-1982

Country	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982[1]
German Democratic Republic	-	-	-	-	-	-	-	-	-	-	-
Germany, Fed. Rep. of	-	-	-	-	-	-	25	-	-	-	-
Ireland	-	-	-	-	-	-	-	1	-	-	-
Netherlands	-	-	-	-	-	-	7	-	31	633	2 406
Poland	-	-	170	-	385	169	53	-	-	-	-
Portugal	-	-	-	-	-	1 557	2 381	2 096	6 051	7 388	3 890
Spain[2]	28 090	26 741	24 627	30 790	29 470	25 259	31 428	25 016	23 862	30 728	27 500
UK (England and Wales)	-	-	-	-	-	+	-	-	-	-	-
UK (Scotland)	-	-	-	-	-	-	-	63	-	-	-
USSR	5 413	711	936	925	5 180	3 738	4	-	-	-	-
Total	33 503	27 452	25 733	31 715	35 035	30 723	33 898	27 176	29 944	38 749	33 796

[1] Preliminary.

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

Table 2.7. Preliminary returns on ICES data Form 5 for 1983.

Country	Area	Jan.	Feb.	March	April	May	June	July	Aug.	Total
Faroes[1]	Vb									16 274
	IV+VI									27 534
Germany Fed. Rep.	IV	-	-	-	-	50	-	2	-	52
	VI	-	-	-	-	-	265	202	39	506
	XII	-	-	-	-	-	138	-	-	138
Norway	IVa	-	-		1 304	16 806	-	-	-	18 110
	VI	-	-	7 829	111 747	14 724	-	-	-	134 300
	VIIc	-	-	19 974	2 909	-	-	-	-	22 883
USSR	IIa	-	10	23	277	19 116	8 994	1 478	-	29 898
	Vb	75	410	9	1 881	12 856	10 422	6 707	-	32 360

[1]Figures from national fisheries statistics.

Table 3.1. Size at maturity (L_{50}) per sex and area in cm. Data of 1982 from Ehrich and Robles, 1982.

Date	Porcupine Bank		Rockall Bank		Northern Banks		Hebrides Shelf		Faroe+Shetland Shelves	
	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀	♂♂	♀♀
February-March 1982	-	23.5	21.8	22.7	-	28.2	-	-	-	-
January 1983	-	-	23.5	25.0	-	-	-	-	-	-
March 1983	-	23.5	21.0	25.3	25.5	27.9	-	29.3	27.8	31.9

Table 4.1. Catch in number (millions) by age group in the adult fisheries (Sub-areas I and II, Divisions Va, XIVa and XIVb, Vb, VIa and VIb, and VIIb,c, 1970-1982

Age	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
0		16.5	0.7	3.0		2.0							1.2
1	0.4	11.3	0.4	6.0	0.6	2.3	4.8			67.9	55.1	4.0	1.7
2	14.6	17.5	5.8	4.6	6.0	5.3	13.9	45.2	64.1	160.2	319.5	40.1	49.3
3	20.3	54.8	13.5	8.2	5.0	30.3	25.6	89.8	69.6	311.6	362.0	322.8	125.0
4	24.5	75.1	22.0	12.0	16.4	28.2	58.0	169.2	348.6	444.2	397.1	225.3	376.6
5	28.5	87.8	28.5	15.7	22.1	26.6	28.0	189.9	440.4	454.7	478.4	501.5	215.8
6	17.5	73.6	27.9	15.0	17.6	36.2	55.6	158.4	487.0	552.5	531.0	539.0	254.8
7	11.9	59.0	21.3	20.0	15.7	34.8	73.4	141.3	532.2	721.6	725.4	448.5	254.5
8	7.3	36.8	19.2	9.0	16.0	28.5	61.2	181.5	478.1	878.5	779.3	618.3	263.2
9	4.7	19.8	6.0	12.8	3.9	29.2	69.3	123.3	367.8	802.4	604.6	573.2	282.9
10	1.7	12.7	2.7	11.0	4.7	14.6	77.6	135.5	310.1	773.9	1 008.8	718.3	263.7
11	0.4	4.7	1.3	8.9	4.0	13.7	32.1	113.1	158.7	459.5	398.1	343.6	160.9
12		1.9	0.4	5.7	3.0	11.8	39.0	57.8	122.8	348.8	394.2	232.6	135.6
13		0.5		2.7	1.7	7.7	20.0	18.7	50.8	138.6	66.8	73.9	41.6
14				1.1	0.8	4.9	10.5	13.9	20.7	67.3	64.6	49.5	46.0
15+				1.0	1.1	3.7	6.7	7.1	16.2	37.9	4.7	30.6	28.4
Total	131.8	472.0	149.7	136.7	118.6	279.8	576.2	1 444.7	3 467.1	6 219.6	6 189.6	4 721.2	2 501.2
Tonnes	15 162	63 721	21 844	21 517	16 730	39 183	89 990	199 004	468 215	995 838	1 017 630	809 054	433 773

Table 4.2. Catch in number (millions) by age group in the mixed industrial fisheries (Sub-area IV, Divisions IIIa and Va), 1972-1982

Age	1972	1973	1974	1975	1976	1977	1978	1979[1]	1980	1981	1982*
0	1 066.4	1 748.0	376.9	788.0	127.6	413.6	895.8	2.3	22.8		3 126.7
1	98.7	336.2	476.9	214.7	757.8	450.8	965.8	1 811.1	271.2	65.1	39.2
2	48.2	44.7	48.4	70.9	98.3	107.4	157.6	77.2	324.1	81.4	37.4
3	5.7	20.7	12.9	27.4	36.8	32.6	84.0	31.6	73.5	191.9	73.3
4+[2]	1.7	11.5	7.5	13.6	22.3	30.7	69.3	21.8	22.2	58.4	102.2
5								17.8	28.6	20.1	26.5
6								20.4	22.7	16.7	19.6
7								10.6	28.8	17.8	13.4
8								8.6	26.3	15.7	10.9
9								13.7	14.9	4.4	4.7
10								6.1	13.6	4.9	1.6
11								1.0	6.3	3.6	
12								4.3	1.8	1.5	2.2
13									2.2	1.2	0.5
14									1.4	0.1	0.5
15+									0.4	0.2	
Total	1 220.7	2 161.1	922.6	1 115.4	1 042.8	1 035.1	2 172.5	2 026.5	860.8	483.0	3 458.7
Tonnes	27 621	57 382	65 991	41 986	44 074	42 646	102 454	93 050	73 804	61 754	106 560

*Preliminary

[1] Includes purse-seine catches of 29 162 tonnes of juvenile blue whiting taken in the southern Norwegian Sea (see Table 2.2)

[2] 1972-1978

Table 4.3.

BLUE WHITING, NORTHERN AREA

CATCH IN NUMBERS UNIT: MILLIONS

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
0	1751	377	791	128	414	896	2	23	0	3128
1	342	478	217	763	451	967	1380	326	69	41
2	49	54	76	112	153	220	241	660	122	87
3	29	18	58	62	122	151	345	433	515	198
4	24	24	42	38	200	420	477	424	264	479
5	16	22	27	29	190	442	480	506	522	242
6	15	16	30	50	156	488	572	550	556	274
7	20	16	35	73	142	531	729	747	466	268
8	9	16	29	61	183	478	879	804	654	274
9	13	4	29	69	124	367	815	616	578	288
10	11	5	15	76	135	307	775	1022	725	265
11	9	4	14	32	113	159	459	404	347	161
12	6	3	12	39	56	119	350	395	234	138
13	3	2	8	20	18	51	136	69	75	42
14	1	1	5	10	14	20	66	66	50	47
15+	1	1	4	7	6	0	37	5	31	28
TOTAL	2298	1041	1595	1619	2479	5616	8245	7050	5206	5960

SUM OF PRODUCTS CHECK
BLUE WHITING, NORTHERN AREA
CATEGORY: TOTAL

Table 5.1. Mean weights at age used in the VPA runs.

MEAN WEIGHT AT AGE IN THE CATCH UNIT: KILOGRAM

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.027	0.027
1	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.036	0.063
2	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.079	0.092
3	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.107	0.118
4	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.109	0.122	0.135
5	0.129	0.129	0.129	0.129	0.129	0.129	0.129	0.129	0.129	0.129	0.135	0.145
6	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.147	0.149	0.155
7	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.160	0.165	0.170
8	0.170	0.170	0.170	0.170	0.170	0.170	0.170	0.170	0.170	0.170	0.176	0.178
9	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.177	0.186	0.187
10	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.188	0.199	0.199
11	0.193	0.193	0.193	0.193	0.193	0.193	0.193	0.193	0.193	0.193	0.202	0.208
12	0.199	0.199	0.199	0.199	0.199	0.199	0.199	0.199	0.199	0.199	0.207	0.228
13	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.207	0.234
14	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.207	0.249
15+	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.207	0.257

	1982
0	0.027
1	0.063
2	0.092
3	0.118
4	0.135
5	0.145
6	0.155
7	0.170
8	0.178
9	0.187
10	0.199
11	0.208
12	0.228
13	0.234
14	0.249
15+	0.257

Table 6.1. In situ TS measurements made on Blue Whiting during the USSR spawning stock survey in 1983 (V Shleinik, personal communication).

Fish length, cm	25.1	29.0	31.4
TS, db	-44.0	-41.3	-40.3
TS, db/kg	-31.1	-32.6	-32.3

Table 6.2.

BLUE WHITING, NORTHERN AREA

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = 0.20

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1978-82
0	0.07	0.02	0.05	0.01	0.05	0.06	0.00	0.02	0.00	0.10	0.04
1	0.01	0.02	0.01	0.06	0.05	0.14	0.14	0.11	0.07	0.12	0.13
2	0.00	0.00	0.00	0.01	0.02	0.03	0.05	0.09	0.06	0.12	0.07
3	0.00	0.00	0.00	0.00	0.01	0.02	0.06	0.12	0.09	0.12	0.08
4	0.00	0.00	0.00	0.01	0.02	0.05	0.08	0.10	0.10	0.12	0.09
5	0.00	0.00	0.00	0.00	0.02	0.05	0.08	0.11	0.16	0.12	0.11
6	0.00	0.00	0.01	0.01	0.02	0.06	0.08	0.12	0.18	0.12	0.11
7	0.01	0.01	0.01	0.01	0.02	0.08	0.11	0.15	0.15	0.12	0.12
8	0.01	0.01	0.01	0.02	0.05	0.08	0.16	0.17	0.19	0.12	0.15
9	0.03	0.00	0.02	0.04	0.04	0.12	0.19	0.19	0.18	0.12	0.16
10	0.05	0.01	0.01	0.06	0.09	0.13	0.41	0.37	0.35	0.12	0.28
11	0.04	0.02	0.05	0.04	0.11	0.14	0.29	0.39	0.21	0.12	0.23
12	0.04	0.02	0.06	0.19	0.09	0.16	0.55	0.44	0.41	0.12	0.33
13	0.13	0.01	0.06	0.19	0.13	0.11	0.27	0.19	0.14	0.12	0.16
14	0.05	0.05	0.05	0.10	0.20	0.20	0.20	0.20	0.20	0.12	0.18
15+	0.05	0.05	0.05	0.10	0.20	0.20	0.20	0.20	0.20	0.12	0.18
(1-11)U	0.01	0.01	0.01	0.02	0.04	0.08	0.16	0.18	0.16	0.12	

Tables 6.3 + 6.4.

BLUE WHITING, NORTHERN AREA

STOCK SIZE IN NUMBERS UNIT: MILLIONS

BIOMASS TOTALS UNIT: THOUSAND TONNES

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	30486	20912	17752	13262	10123	16012	4154	1382	488	36206	********
1	27648	23379	16781	13520	10743	7915	12301	3400	1111	399	20622
2	21554	22327	18710	13543	10627	8389	5609	8378	2489	847	290
3	19540	17602	16251	15250	10987	8562	6069	4374	6264	1928	615
4	10179	15972	14395	14874	12429	8785	6674	5149	3191	4664	1400
5	6059	8305	13955	11748	12105	9956	6895	5198	3653	2357	5387
6	4112	6576	6780	10665	9593	9739	7785	5212	3799	2668	1711
7	3000	3353	5308	5516	6661	7711	7534	5658	3772	2610	1937
8	1763	2438	2731	4364	4452	6979	5834	5511	4123	2668	1895
9	495	1435	1982	2210	3518	3480	5263	3935	3788	2804	1937
10	206	394	1172	1596	1747	2763	2516	3591	2708	2580	2036
11	247	208	516	946	1237	1308	1990	1366	2023	1568	1674
12	174	195	167	248	746	911	928	1216	756	1344	1138
13	25	136	157	120	168	560	638	446	642	409	976
14	25	14	111	121	85	121	413	400	303	458	297
15+	23	25	83	77	56	0	224	50	168	273	550
TOTAL NO	127573	123273	117793	108369	97276	93337	75649	55498	39477	63783	
SPS NO	16180	23085	31224	37619	42367	43574	40042	32814	25954	19738	
TOT.BIO	9453	10267	10866	10895	10561	10170	8836	7496	6119	5567	
SPS BIO	2657	3432	4740	5696	6513	6848	6465	5580	4634	3624	

Table 6.5. Catch per unit effort in the Blue Whiting fisheries, 1976-82
(fishing gear: mid-water trawl)

Division	GRT-class	Country	Time period	Years							Units
				1976	1977	1978	1979	1980	1981	1982	
IIa	2 000 - 3 999.9	German Dem.Rep.	July-Sept.	- [1]	-	1.99 [2]	2.19	3.11	2.25	1.63	c/hour
		Poland	July-Aug.	-	-	14.0	17.8	24.0	19.7	-	c/day
		USSR	July-Sept.	-	-	-	3.04	3.82	2.54	2.85	c/hour
	1 000 - 1 999.9	USSR	July-Sept.	-	2.31	2.70	-	-	-	-	c/hour
Vb	2 000 - 3 999.9	German Dem.Rep.	June-July	-	1.38	1.77	2.20	-	3.88 [3]	2.12 [3]	c/hour
		Poland	May-June	27.0	36.7	17.2	43.6 [4]	-	-	-	c/day
		USSR	March-May	-	-	-	5.83	5.23	5.97	4.58	c/hour
	1 000 - 1 999.9	Norway	April-May	-	-	-	-	13.57	29.47	-	c/hour
		USSR	June-July	-	2.98	4.62	-	-	-	-	c/hour
	500 - 999.9	Faroes	May	-	17.6	13.6	10.6	6.2	9.6		c/hour
		Iceland	May	-	55.6	57.5	33.8	43.3	79.2	-	c/day
		Norway	April-May	-	-	21.35	20.29	18.14	18.94	4.88	c/hour
VIa	1 000 - 1 999.9	Norway	March-April	-	-	-	-	23.92	57.13	42.38	c/hour
	500 - 999.9	Faroes	April	-	17.4	19.8	21.4	16.4	-	-	c/hour
		Norway	March-April	-	-	24.93	30.27	26.56	34.96	36.30	c/hour
	100 - 499.9	Norway	March-April	-	-	-	24.93	13.53	23.59	31.00	c/hour
IVa	1 000 - 1 999.9	Norway	April-May	-	-	-	-	-	15.36	15.03	c/hour
	500 - 999.9	Norway	April-May	-	-	-	13.98	9.29	13.40	13.75	c/hour
	100 - 499.9	Norway	April-May	-	-	-	-	-	7.18	17.39	c/hour

[1] Hyphen means no fishing.

[2] Refers to June-July period.

[3] Refers to January-May period.

[4] Refers to April-May period.

Table 6.6. Catch per unit effort in the Blue Whiting fisheries in Sub-division IIa for 2 000 - 3 999.9 GRT, using mid-water trawls, 1978-1982

Month	Catch					Effort					C.P.U.E.				
	1978	1979	1980	1981	1982	1978	1979	1980	1981	1982	1978	1979	1980	1981	1982
	(tonnes)					(hours)					(tonnes/hour)				
German Dem.Rep.															
January															
February															
March															
April															
May		407	546	159	289		127	279	210	152		3.20	1.96	0.76	1.90
June	848	2 548	3 025	2 566	1 148	247	893	999	2 046	1 280	3.43	2.85	3.03	1.25	0.90
July	55	2 317	3 523	5 951	1 226	100	792	902	2 596	1 045	0.55	2.93	3.91	2.29	1.17
August		64	2 871	4 130			39	965	2 079			1.64	2.98	1.99	
September		862	605	1 481	113		430	248	627	54		2.00	2.44	2.47	2.09
October			1 128	55	266			424	53	118			2.66	1.04	2.25
November			1 380					275					5.02		
December			754					230					3.28		
All months	903	6 198	13 832	14 310	3 082	347	2 281	4 322	7 611	2 649	2.60	2.71	3.20	1.88	1.15
July[1]- Sep [2]	-	3 243	6 999	11 562	1 339	-	1 261	2 115	5 302	1 099	-	2.57 2.19	3.31 3.11	2.18 2.25	1.22 1.63
Poland	(tonnes)				*)	(days)				*)	(tonnes/hour)				*)
January															
February															
March															
April															
May		948					21					45.1			
June		2 216	200	210			80	25	13			27.7	8.0	16.1	
July	129	896	1 405	369		13	59	62	30		9.9	15.2	22.7	12.3	
August	2 269	264	3 269	569		126	13	130	21		18.0	20.3	25.2	27.1	
September	1 393		3 123			113		128			12.3		24.4		
October	554		1 757	526		34		93	43		16.3		18.9	12.2	
November			1 383	178				72	10				19.2	17.8	
December															
All months	4 763	4 324	11 137	1 852		303	173	510	117		15.7	25.0	21.8	15.8	
July[1]- Aug. [2]	2 398	1 160	4 674	938		139	72	192	51		17.3 14.0	16.1 17.8	24.3 24.0	18.4 19.7	
U.S.S.R.	(tonnes)					(hours)					(tonnes/hour)				
January		8 992	2 927		8 003					1 045					7.66
February		4 959	2 153				1 833	339				2.70	6.35		
March		5 520	16 811	3 886	375		1 538	6 151	1 208	285		3.59	2.73	3.22	1.32
April		3 382	36 284	45 645	618		1 933	16 119	12 666	256		1.74	2.25	3.60	2.41
May		51 409	125 988	88 754	46 089		15 336	25 244	25 912	17 100		3.35	4.99	3.42	2.69
June		110 918	114 117	78 727	27 617		38 069	47 634	37 919	14 209		2.91	2.39	2.08	1.94
July		124 618	121 463	87 582	6 820		42 166	42 319	39 039	5 963		2.95	2.87	2.24	1.14
August		142 962	114 505	63 889			47 395	28 293	29 528			3.01	4.05	2.16	
September		106 606	79 504	37 960	2 921		33 755	17 499	11 745	640		3.16	4.54	3.23	4.56
October		57 562	50 954	11 560	1 121		16 574	16 072	3 270	341		3.47	3.17	3.53	3.29
November		16 317	17 543	4 778	379		6 841	5 710	1 455	161		2.39	3.07	3.28	2.35
December		5 830	1 292	10 704			2 867	413	4 263			2.03	3.13	2.51	
All months		639 129	683 541	433 485	93 943		210 936	206 372	167 005	40 026		3.03	3.31	2.60	2.35
July[1]- Sep. [2]		314 186	315 472	189 431	9 741		123 316	86 111	80 312	6 623		3.03 3.04	3.58 3.82	2.36 2.54	1.47 2.85

[1] CPUE = Total catch/total effort

[2] CPUE = ΣMonthly CPUE/Nb of months

*) No data available

Table 6.7. Relative mean density ($\bar{D}$), trawlable biomass (TB) and confidence limits (CL) per depth range. Confidence level = 80%. Survey on Rockall Bank.

Depth range (m)	$\bar{D}$ (t/nm^2)	TB (t)	CL (± %)
100 - 200	0.1	265	70
200 - 300	3.1	8 741	68
300 - 400	16.6	32 601	46
400 - 500	7.4	20 237	64
500 - 600	5.9	12 722	89
600 - 700	1.6	2 556	88
		77 122	

Table 8.1. BLUE WHITING - Southern Area

Age	1982		
	Numbers (millions)	Mean lengths (cm)	Mean weights (g)
0	61.1	17.3	32
1	102.5	19.5	45
2	183.5	21.7	61
3	121.8	22.5	69
4	64.3	23.4	77
5	22.1	24.2	85
6	3.2	25.8	103
7	0.3	29.8	156
8	0.2	33.3	216
9	0.3	35.0	250
10	0.4	37.2	299
11	0.01	38.5	331
12	0.03	37.5	306
13	0.01	38.5	331
14	0.04	36.5	283
15	0.03	37.5	306
Total	559.9		
Nominal (tonnes)	31 390		33 660
Weighted Mean			60 g

Table 8.2. Data of landings, effort and catch per unit effort of the Portuguese and Spanish fleets in Divisions VIIIc and IXa of the Southern Area

Year	Landings (tonnes)			Effort			CPUE		
	Spain	Portugal		Spain[1]	Portugal		Spain[1]	Portugal	
	Main Galician Ports	Total	Total	days fishing	hrs fishing	No.of vessels	kg/dag	kg/hr	tonnes/vessel
1977	18 449	1 557	26 816	15 515	374 000	116	1 189	4.2	13.4
1978	22 286	2 381	33 809	16 059	270 000	109	1 388	8.8	21.8
1979	19 507	2 096	27 112	20 748	294 000	117	953	7.1	17.9
1980	18 478	6 051	29 913	17 229	313 000	119	1 072	19.3	50.8
1981	23 577	7 388	38 116	19 112	260 000	114	1 234	28.4	64.8
1982	20 940	3 890[2]	31 390	19 320	273 000[2]	115	1 084	14.2[2]	33.8[2]

[1] Only for the three main ports of Galicia (Coruña, Riveira and Muros)

[2] Preliminary

Figure 6.1. Abundance (in '000 tonnes) of BLUE WHITING recorded during the Norwegian survey April 1983. (Compiled from Midttun, 1983)

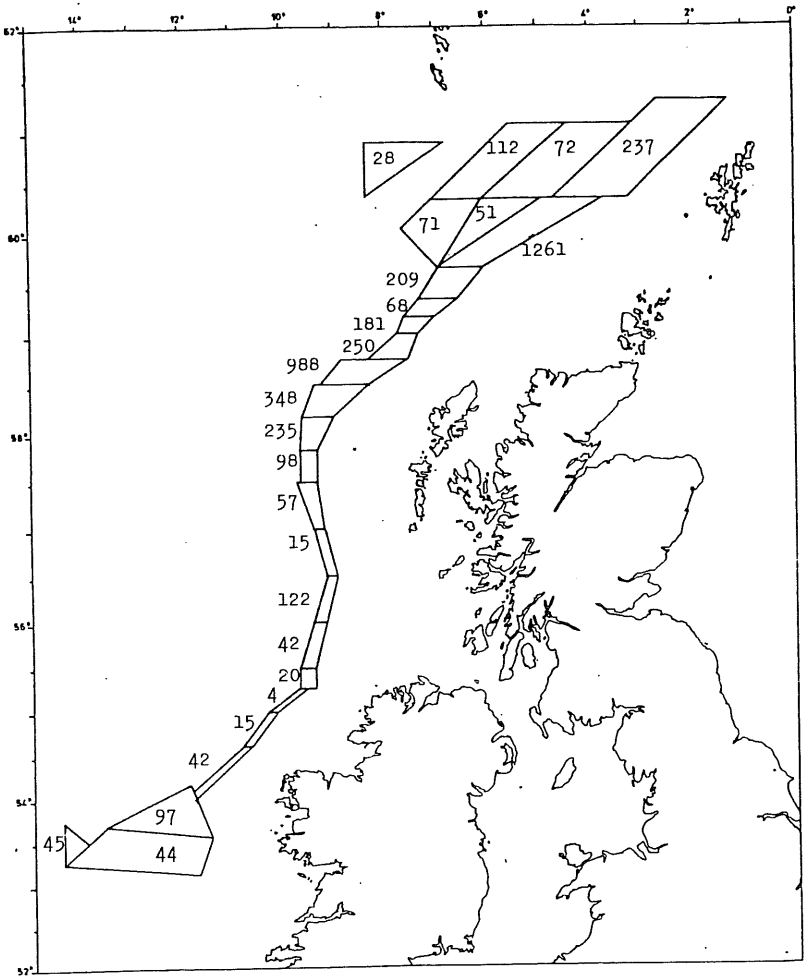


Figure 6.2 Abundance (in '000 tonnes) of BLUE WHITING recorded during the U.S.S.R. survey in April/ May 1983.

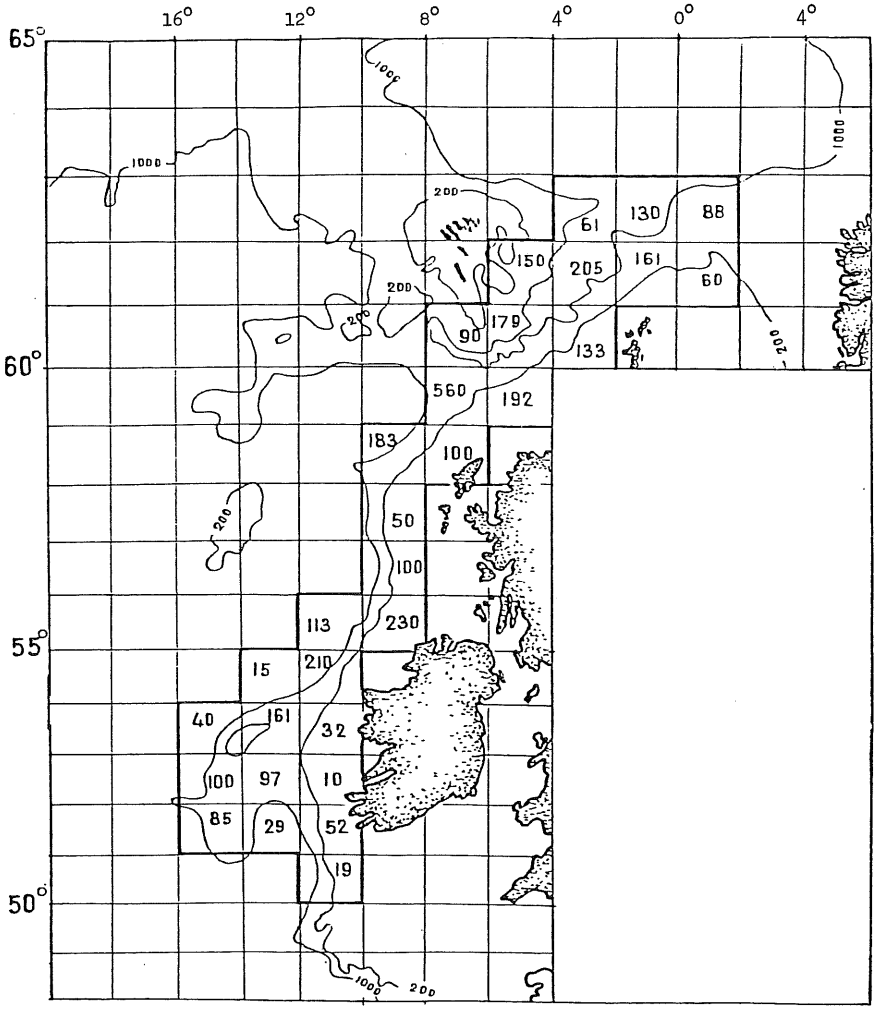
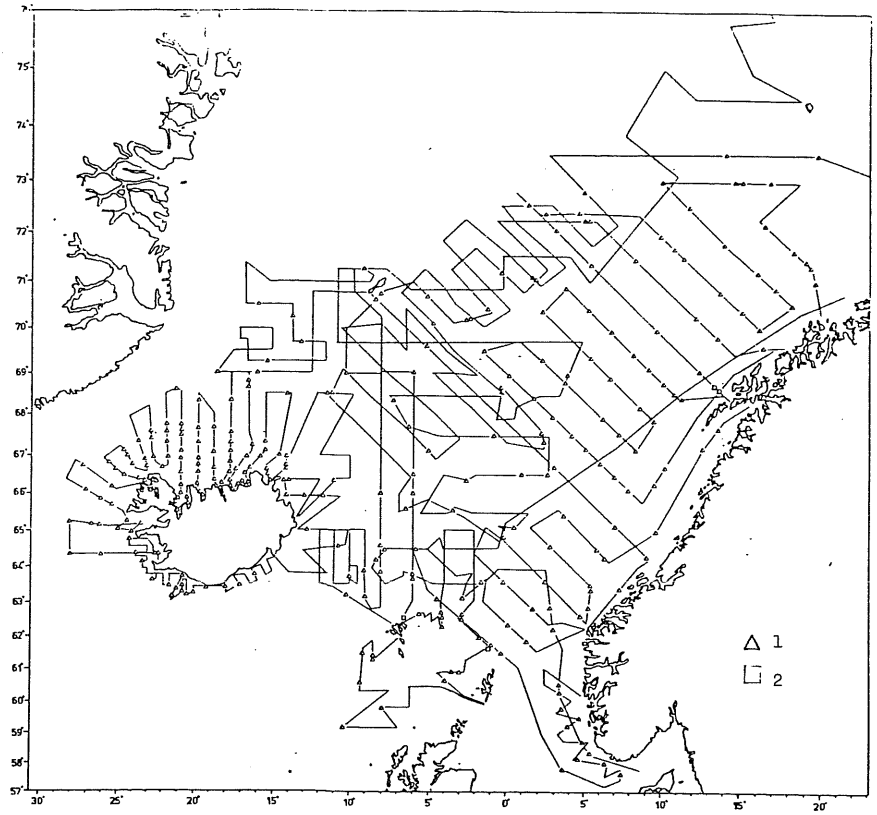


Figure 6.3 Cruise tracks and trawl stations of the ICES coordinated acoustic assessment survey in the Norwegian Sea and adjacent waters. August 1983.



1) Pelagic trawl

2) Bottom trawl

Figure 6.4 Estimated BLUE WHITING biomass (in '000 tonnes), August 1983.

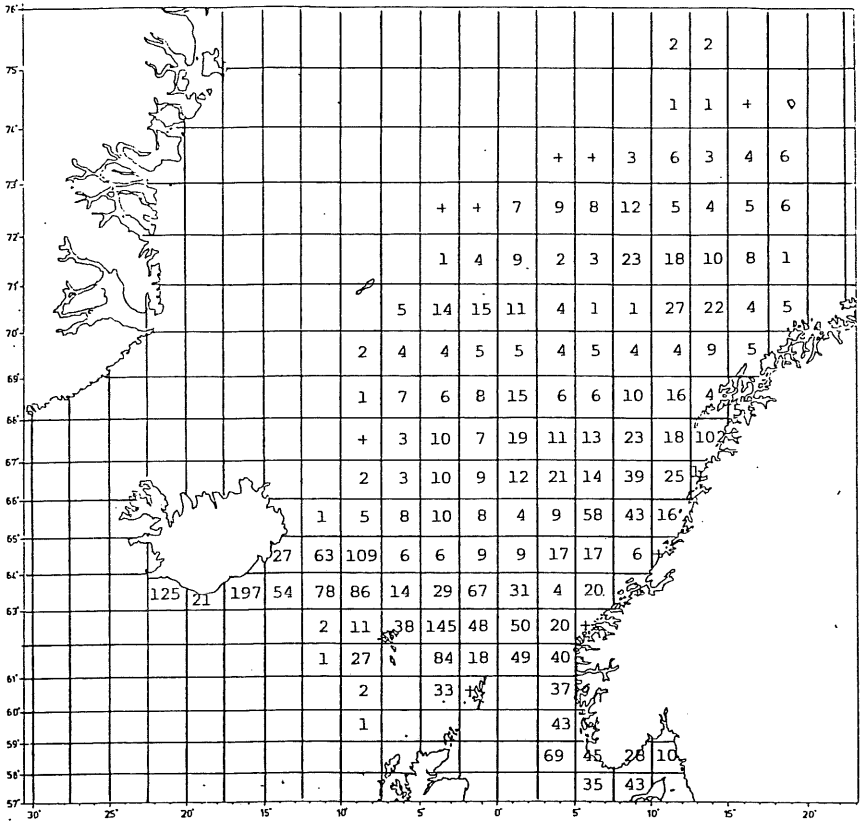


Figure 6.5 Distribution and relative densities of BLUE WHITING. August 1983. Echo intensity in m^2reflection/(n.mile)^2.

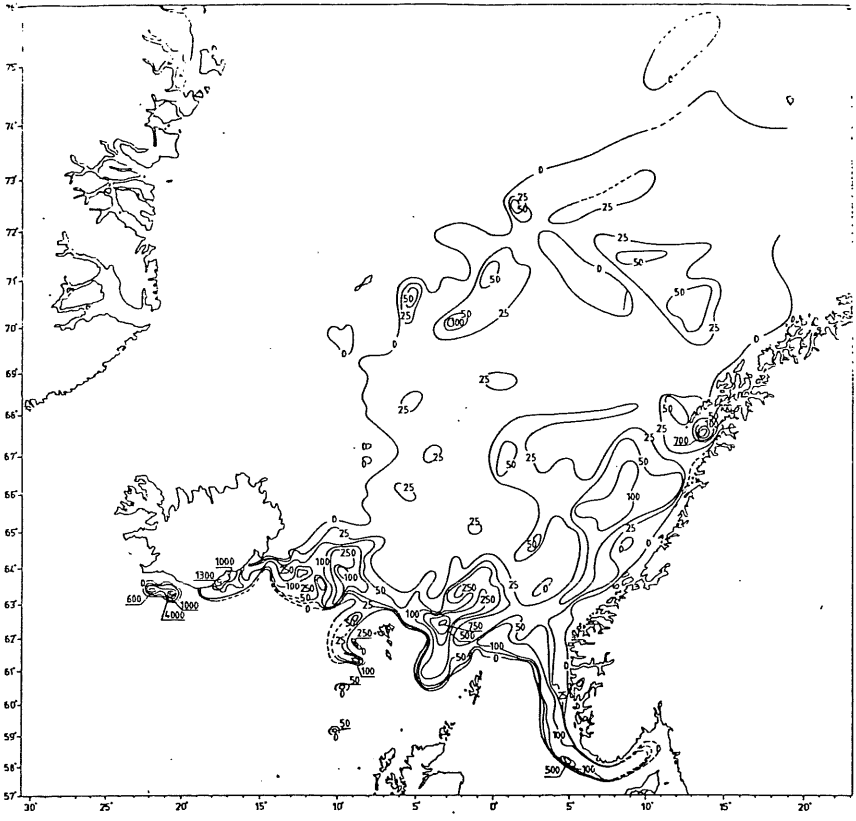


Figure 6.6 Total length distribution of BLUE WHITING, August 1983. N = 36.5×10^9.

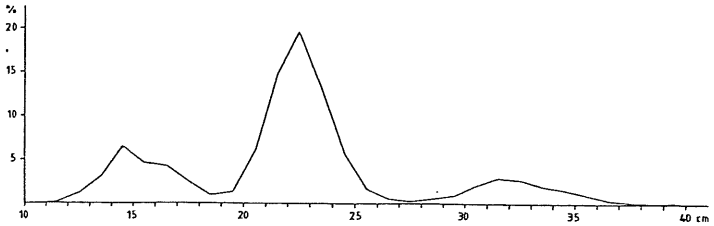


Figure 6.7 Cruise track and fishing stations R.V."Walther Herwig" from 21 July - 23 August 1983.

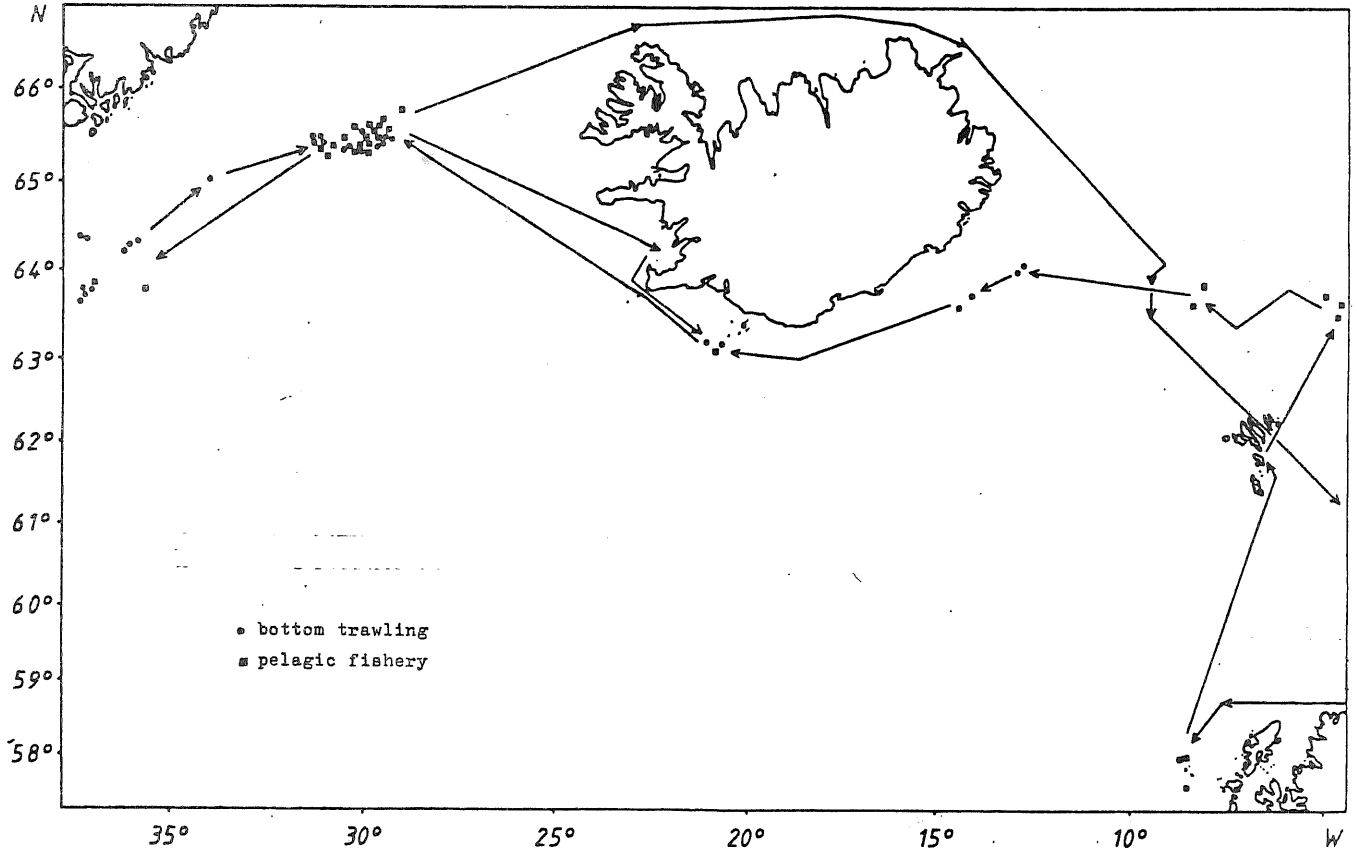


Figure 6.8 Length distribution of BLUE WHITING in the Dohrnbank/East Greenland area from catches of R.V."Walther Herwig" in 1983.

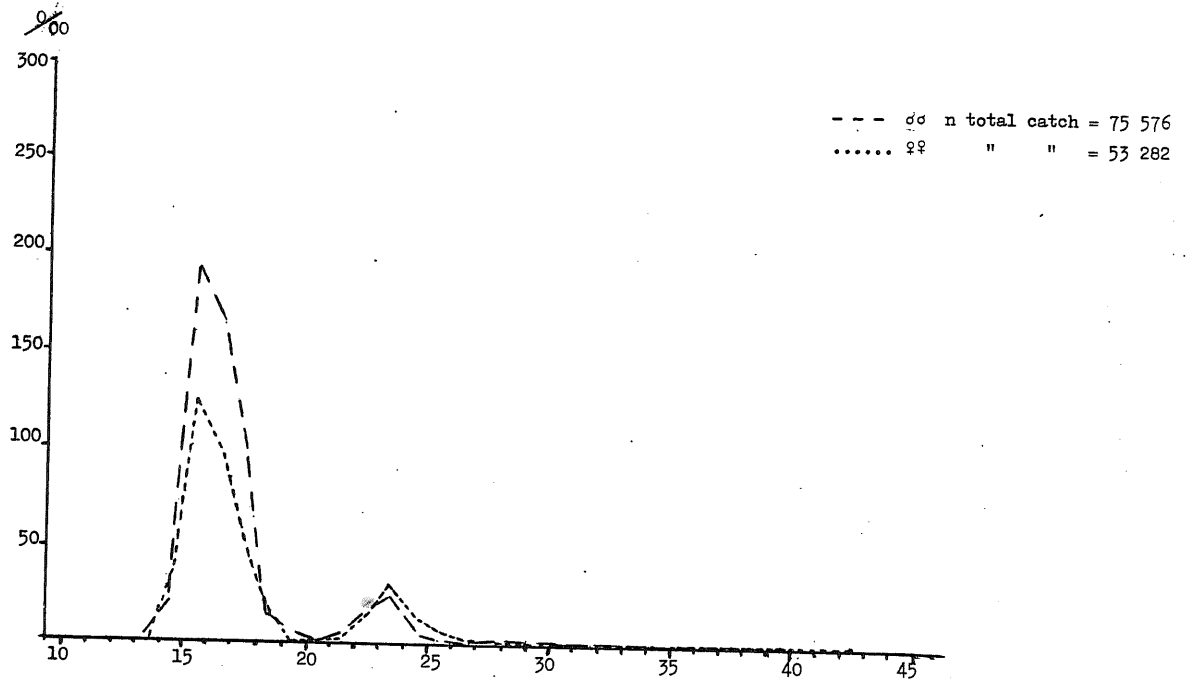


Figure 6.9 BLUE WHITING, Northern area

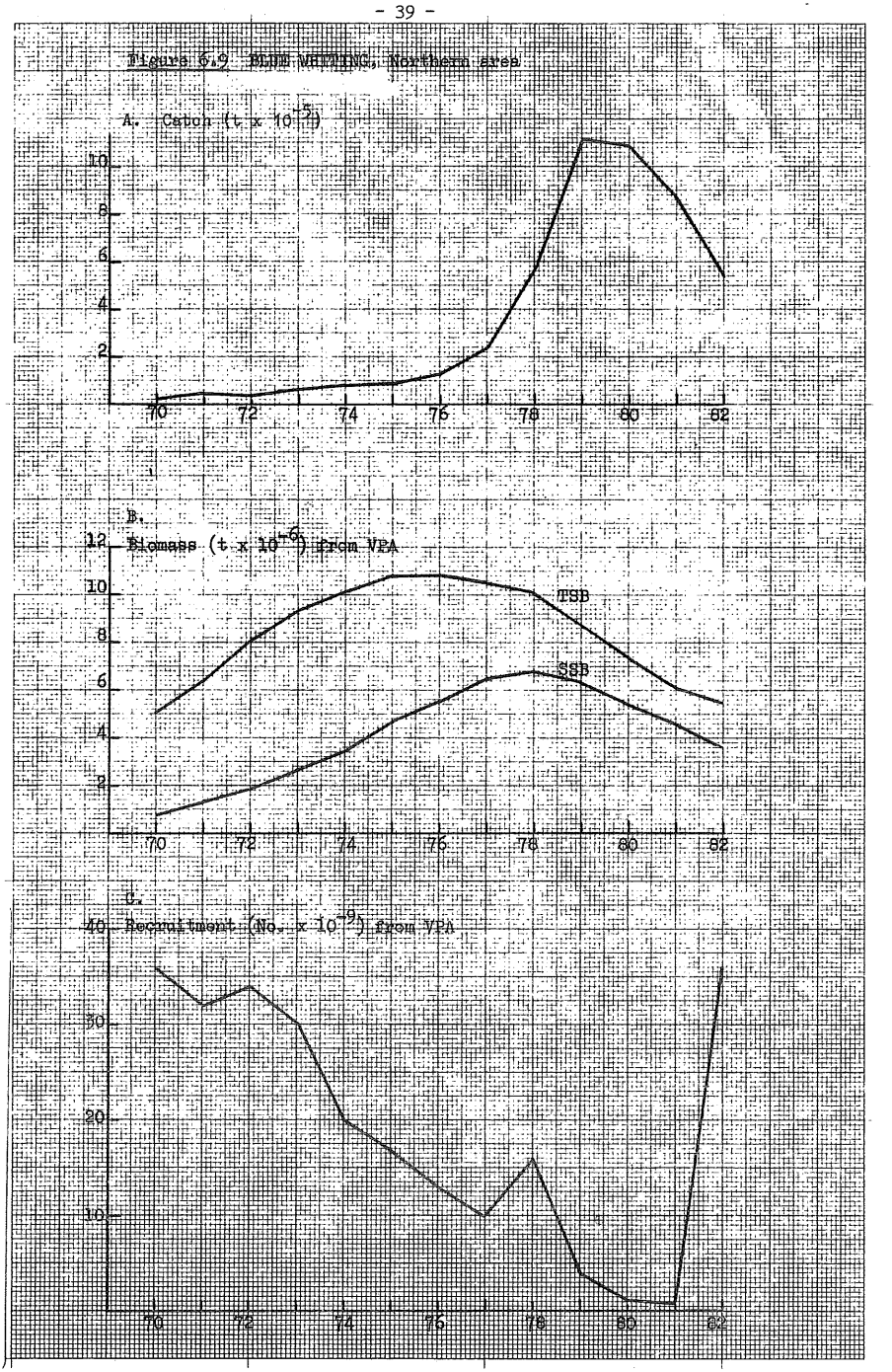


Figure 6.10 Rockall Bank. Sex separated length distribution of the total catch in January 1983.