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REPORT OF THE ATLANTO-SCANDIAN HERRING, CAPELIN AND BLUE WHITING ASSESSMENT WORKING GROUP

Institute of Marine Research, Bergen, Norway

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International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

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1. INTRODUCTION

1.1 Terms of Reference

The Atlanto-Scandian Herring, Capelin and Blue Whiting Assessment Working Group (Chairman Mr I. Røttingen, Norway) met at the Institute of Marine Research, Bergen, Norway from 12-18 October 1995 to (C. Res. 1994/2:6:2):

a) assess the status of and provide catch options for 1996 and 1997 for the Norwegian spring-spawning and Icelandic summer-spawning herring stocks;

b) provide any new information on the present spatial and temporal distribution of Norwegian spring-spawning herring;

c) assess the status of capelin in Sub-areas V and XIV and provide catch options for the winter 1995/1996 and summer/autumn 1996 seasons;

d) assess the status of and provide catch options for capelin in Sub-areas I and II (excluding Division IIa west of 5°W) for the winter 1995/1996 and summer/autumn 1996 seasons;

e) consider further possibilities for the incorporation of biological interaction into the assessments of capelin, herring and cod stocks;

f) assess the status and provide catch options for 1996 and 1997 for the blue whiting stock;

g) update the information on the spatial and temporal distribution of the stock and of the fisheries on blue whiting;

h) for those stocks and/or fisheries where data permit, provide the information required to give advice or guidance on

   i) medium-term management objectives (in terms of spawning stock biomass and mortality rates and options)
   ii) the appropriateness of control on catch (or landings) and fishing effort,
   iii) the potential for multispecies and multi-annual catch options.

In addition, the following relevant paragraphs of the NEAFC request for advice from ICES was passed on to the present working group by the chairman of ACFM:

1) provide quantitative information on the present spatial and temporal distribution of the Norwegian spring spawning herring stock;

2) assess the impact of the *Ichtyophonus hoferi* disease on stocks of herring (and other pelagic fish);

3) for blue whiting, evaluate the development of the total stock biomass and spawning stock biomass over a three-year period (1996-1998) if at all possible.

1.2 Participants

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J.A. Jacobsen	Faroe Islands
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A. Krysov	Russia
M. Meixide	Spain
T. Monstad	Norway
I. Røttingen (Chairman)	Norway
T. Sigurdsson	Iceland
G. Stefánsson	Iceland
S. Tjelmeland	Norway

2. ICELANDIC SUMMER SPAWNING HERRING

2.1 The fishery

The catches of summer spawning herring from 1975-1994 are given in Table 2.1.1. These include an estimate of 2,009 t of discards for the 1994/1995 season. The fishery took place off the southeast coast and 57% of the catches were used for reduction while 43% were used for human consumption. Major part of the catches was taken by purse seiners but 1 trawler participated in the fishery. Until 1990 the herring fishery took place during the last three months of each calendar year but in 1990-1994 the autumn fishery continued in January and early February the following year. Therefore all references to the years 1990-1994 refer to the season starting in October of that year.

Year	Landings	Catches	TACs	Rec TAC
1984	50.3	50.3	50.0	50.0
1985	49.1	49.1	50.0	50.0
1986	65.5	65.5	65.0	65.0
1987	73.0	73.0	72.9	70.0
1988	92.8	92.8	90.0	100.0
1989	97.3	101.0	90.0	90.0
1990/1991	101.6	105.1	100.0	90.0
1991/1992	98.5	109.5	110.0	79.0
1992/1993	106.7	108.5	120.0	86.0
1993/1994	101.5	102.7	111.0	90.0
1994/1995	132.0	134.0	137.0	120.0

2.2 Catch in numbers and weight at age

The catches in number at age for the Icelandic summer spawners for the period 1975-1994 are given in Table 2.1.1. As usual the age is given in rings where the age in years equals the number of rings +1. In the first years after the fishery was reopened in 1975 the 1971 year class was most abundant. During the period 1979-1982 the 1974 and 1975 year classes predominated in the catches. During the period 1983-1986 the fishery was dominated by the strong 1979 year class. In 1987 and 1988 the fishery was on the other hand based on a number of year classes ranging from 3-10 ringed herring. In the period 1989-1991 the 1983 year class predominated in the catch. The 1988 year class was also well represented in the 1991 catches and predominated during the 1992 season. In 1993 the age distribution was dominated by the strong 1989 year class although the 1988 year class was also well represented. In 1994/1995 the catches were distributed on 4 year classes, 1988-1991. The catch in numbers of 2-ringers has never been higher and yielded some 25% of the total numbers. The weight at age for each year are given in Table 2.2.1 and the proportion mature at age is given in Table 2.2.2. The most striking feature of these parameters in this stock is that despite an inter-annual variation, the weights at age as well as other biological parameters of this herring stock have remained relatively stable over a wide range of stock size and fluctuations in environmental conditions in Icelandic waters.

2.3 Acoustic surveys

The Icelandic summer spawning herring stock has been monitored by acoustic surveys annually since 1973. These surveys have been carried out in November-December or January, usually after the fishery has been closed. During a survey which took place in November - December 1994 no acoustic estimate was obtained, neither for the adults nor the juveniles. Therefore results of the January 1994 survey have been used as a basis for the present assessment (Table 2.3.1). As in last year's report, the TS value of TS = 20 log L-72 dB was used to calculate the stock estimates. In addition the estimate from a previous survey carried out in December 1992 was used for the 1991 year class (3 ringers in 1995). In the absence of any estimates of the 1992 and 1993 year classes they were assumed to be of average abundance (600 million as 1-ringers).

2.4 Stock Assessment

The result of the acoustic surveys together with the catch in number at age were used to calculate initial mortalities for the 1994/1995 season. Results are given in Table 2.4.1 as F^1. In this analysis 5-ringers and older have been grouped for estimating the fishing mortality on the oldest herring, whereas the fishing mortality for the younger age groups is calculated for each year class.

As in previous years the estimation procedure from Halldórsson *et al.* (1986) was used to estimate the stock size in the final year, based on all available acoustic data for the older part of the stock (5+ ringers on 1 January each year). The procedure minimizes the sum of squares of log-transformed rather than untransformed data since there is increased variability in later years coinciding with the increase in stock size.

A series of VPAs were run using varying terminal F's on 5+ ringers. For each terminal F a sum of squares (SSE(F)) of differences between the 5+ from the VPA and acoustic estimates is computed. A plot of these values is shown in Figure 2.4.1. From this series of VPAs it is clear that the best (giving the minimum value of SSE) one to one relation between the acoustic estimates and virtual population analysis is obtained with an input F of about 0.32. The confidence intervals for the fitted terminal F values (0.20, 0.62) are obtained as described by Halldórsson *et al.* (1986) and Stefánsson (1987) by using the tabled F-distribution to set bounds on the SSE and finding the terminal F values corresponding to these bounds (Figure 2.4.1).

Using the catch data given in Table 2.1.1 and the fitted values of fishing mortalities given in Table 2.4.1, a final VPA was run using a natural mortality rate of 0.1 on all age groups and proportion of natural mortality before spawning as 0.5. Fishing mortality at age and stock in numbers at age with spawning stock biomass on 1 July are given in Tables 2.4.2 and 2.4.3, respectively, and the standard plots are shown in Figure 2.4.2. The resulting stock trend from VPA is plotted along the acoustic estimate in Figure 2.4.3 and the correspondence with acoustic estimates is shown in Figure 2.4.4.

According to the current assessment the spawning stock biomass was about 530,000 t in July 1994 as compared to the projected spawning stock from last year's assessment of 570,000 t. This difference is partly due to lower mean weights by ages than expected and higher catches.

2.5 Catch and Stock Projections

The input data for the projections are given in Table 2.5.1. As in previous years a regression of weight increase has been used to predict the weight at age for 2-8 ringers (using as input weight at age for 1-7 ringers the year before). Data for the regression included, as starting years, the period 1986-1994. For 1 ringers and 9+ ringers, a simple average of mean weights at age for the period 1986-1994 was used for the prediction. Weights at age for 2-8 ringers in the catch are thus obtained by using the relation:

$$W_{y+1} - W_y = -0.223 \times W_y + 88.99 \text{ (g)}$$

Where W_y and W_{y+1} are the mean weight of the same year class in the year y and y+1, respectively.

During the 1995/96 fishing season the age distribution will be dominated by the 1988 - 1991 year classes (5-7 ringers). The exploitation pattern used for the stock and catch predictions takes this into account. This is somewhat different from the average exploitation pattern based on the fishery during 1986-1990 as shown in Table 2.4.1.

As in previous assessment and in agreement with the increased level of recruitment during the 1980s and early 1990s, an assumed value of 600 million of 1-ringers in 1994 and 1995 has been used. The estimate of 2- ringers in 1994 is derived from the acoustic estimate of 1 ringers in 1993 (the 1991 year class).

Output of the prediction assuming catches corresponding to a fishing mortality rate of F = 0.22 is given in Table 2.5.2, and projections of spawning stock biomass and catches ('000 t) for a range of values of F are given in Table 2.5.3.

Yield per recruit calculations are shown in Figure 2.5.1 using the input values in Table 2.5.4.

2.6 Management Considerations

A TAC of 110,000 tonnes has been set for the current 1995/96 season. This corresponds to a fishing mortality of $F_{4\text{-}14w} = 0.22$. Fishing at the fishing mortality rate of $F_{0.1} = 0.22$ during the 1996/97 season would result in a catch of about 115,000 tonnes. The working group points out that managing this stock at an exploitation rate at or near $F_{0.1}$ has been successful in the past. Fishing at higher fishing mortality rates than $F_{0.1}$ would give a correspondingly higher short-term yield but would reduce the stock sharply when the effect of the strong year classes presently in the stock has dwindled.

2.7 Medium-term prediction

Medium term prediction was carried out for the Icelandic summer spawning herring.

Input data for 1995 was based on the current assessment and short-term projections (sections 2.4 and 2.5). For future years, the same values were used for the selection pattern at age, weights at age and proportion mature at age as in 1995.

A stock-recruitment function of the Ricker form was used to generate recruitment in future years, starting with the 1995 year class which appears as 1-ringers in 1997. This stock-recruitment function was estimated based on available data since 1974. Although data is available for earlier years (Anon. 1995a), this was not used in light of the results in Jakobsson *et al.* (1993), which indicate that different recruitment functions were applicable in earlier years.

The resulting fitted recruitment function is given along with the input data in Fig. 2.7.1. The parameter estimates are given by a=3.576 and K=601.1. These estimates are quite uncertain due to the variability in historical recruitment. This uncertainty can be estimated if estimation is based on the usual linear transformation of the Ricker function. The resulting table of standard errors and correlation is given by:

	ln a	-1/K
ln a	0.38	-0.92
-1/K	-0.92	0.00

The CV of recruitment around the fitted curve is about 65% and this is used for generating future recruits with lognormal variation.

For the projections, a lognormal standard error (s.e.) of 0.2 was used for the stock size of 5+-ringed herring. This is in accordance with Fig. 2.4.1, which indicates that the confidence interval for the terminal fishing mortality may correspond roughly to a (s.e.) of 20%. Since the estimate of fishing mortality is based on assuming a constant selection pattern on the older fish, errors in this estimate will be in the same direction for all age groups. Thus, a single lognormal error on stock size is generated for all 5+-ringed age groups in the year 1995.

Since there is some more knowledge on the 1-ringed herring in 1995 than there is on future recruitment (e.g. this year class has not appeared in huge quantities in the fishery or surveys), the CV on this year class is set to 0.4. The CV for 2-4 ringers is set so that the CV decreases linearly from 0.4 on 1-ringers to 0.2 on 5+-ringers.

Since this stock has been managed at levels corresponding fairly closely to fishing at $F_{0.1}$, the approach taken is to simulate using an approximation to this strategy. In recent years $F_{0.1}$ has consistently been estimated at about 0.22, so this strategy is basically a fixed-F harvesting strategy. A simple catch control law corresponding to fishing at $F_{0.1}$ was implemented by generating future true stock sizes and perturbing the stock numbers by a CV of 20% to obtain a simulation of the estimated stock. The catch was then set based on the fixed F strategy. This procedure is an approximation to using a quota based on a fishing mortality estimated with an error which is the inverse of the error in the stock estimate.

The true stock was projected forward in time using a fishing mortality which was perturbed to accommodate the fact that the set catches did not correspond to the true catches at $F_{0.1}$.

The resulting output is given in Fig. 2.7.2. It is seen that there is very little probability of the harvesting strategy

reducing the stock to low level. There is some probability within this model of the stock increasing to very high levels. This is due to the handling of uncertainty in the parameters of the Ricker curve and variation around the curve and is a consequence of the fact that the present state of the stock is close to or above the historical upper bound.

2.8 Comments on the assessment

The XSA method was also attempted for this stock. The resulting VPA summary tables from the usual method and XSA are given in Tables 2.8.1-2. SSB in July 1994 from XSA is given as 553 thousand tonnes, compared to 529 thousand tonnes from section 2.4. There are relatively minor differences between the SSB and recruitment from the two methods. Retrospective plots of the SSB for both methods are shown in Figure 2.8.1. Although both methods show similar retrospective plots, the method described in section 2.4 gives less disagreement between runs made in different years, at least for the latest years. Therefore the method used in earlier assessments has been adhered to.

3. NORWEGIAN SPRING SPAWNING HERRING

3.1 The Fisheries

3.1.1 1994

An initial TAC for 1994 was set at 450,000 tonnes. This was divided into 375,000 tonnes (Norway) and 75,000 tonnes (Russia).

The Faroes

The Faroese herring fishery took place in June in international waters in the Norwegian Sea. A total of 2,911 t were taken, the mean weight of the herring in the catches was 371 g.

Iceland

The Icelandic herring fishery took place in June mainly in international waters in the Norwegian Sea. A total of 21,146 t were taken, the mean weight of the herring in the catches was 391 g.

Norway

The Norwegian fishery started in the beginning of January in the wintering areas of Northern Norway, and 107,433 t were taken in this area in January and beginning of February. The herring then migrated to the spawning areas. On the spawning areas the fishery took place at Møre from the beginning of February to the beginning of March. 74,321 t were taken in this fishery. In the latter part of March and in April there was a fishery on spent herring (32,517 t) at the start of the feeding migration. In the period May-July there was only a minor fishery on herring. 6,321 t of herring were caught in this period, including 2,648 t in international waters and the Jan Mayen zone in the Norwegian Sea. In autumn the adult herring returned to the wintering areas in Northern Norway, and in the period August - December 160,265 t were caught, according to the nominal catch statistics. The mean weight of the herring in the catches varied from 360 g in the prespawning fishery in winter at Møre to 180 g in the coastal summer fishery. Of the total Norwegian catch of 380,767 t, 70% was used for human consumption and 30% for industrial purposes.

Russia

The Russian herring fishery took place in February to April on the Norwegian coastal banks. A total of 74,400 t were taken, mean weight in the catches was 319 g.

The total catch of Norwegian spring spawning herring in 1994 amounted to 479,228 tonnes.

3.1.2 1995

The following TACs were set independently: For the fisheries of Norway and Russia: 650,000 tonnes. For the fisheries of the Faroes and Iceland: 250,000 tonnes.

The Faroes

The Faroese fishery started in the beginning of May. The first catches were taken in the area north of the Faroes, but later in May the fishery shifted to the north and northeast to the northern border of the Faroese EEZ. The total catch of herring in Faroese waters was about 50,000 t. In addition some Faroese catches were taken in international waters in the Norwegian Sea. The total landings of Faroese catches in 1995 amounted to 57,000 t.

Iceland

The Icelandic fishery started in the last days of April, but only small catches were taken in that month. In May the Icelandic catch was about 139,000 t, of which about 3/4 were taken within the Faroese EEZ and the remainder in international waters. In June some 38,000 t were caught, mostly in international waters but also in the Icelandic EEZ. The total Icelandic catch amounted to 170,611 tonnes.

Norway

The structure of the winter and spring fisheries was the same in 1995 as in to 1994. By 1 May, Norway had caught approximately 310,000 t . In May-June approximately 4,900 t and 2,400 t were caught by Norwegian vessels in international waters and in the Jan

Mayen EEZ, respectively. By 1 October 1995 the total Norwegian catch was approximately 410,000 t.

Russia

The Russian catch in the spawning area in February to April amounted to 92,000 t. In addition, 8,000 t of herring were taken in the Lofoten area in September.

Other nations

Other nations have, as a preliminary figure, reported a catch of 37,017 t of Norwegian spring spawning herring, mainly from international waters.

The total catch of Norwegian spring spawning herring is expected to be 914,000 tonnes in 1995.

3.2 Catch statistics

The total annual catches of Norwegian spring spawning herring for the period 1972-1995 (1995 preliminary) are presented in Tables 3.2.1 and 3.2.2. For 1994 there has not been added any amount for discards, private fishery, etc.

3.3 The adult stock

3.3.1 Acoustic surveys on the spawning stock

In 1995 this survey also included areas of both spawning and spawning migration. Fig 3.3.1 shows the distribution of the herring in the period 15.2 - 31.3 1995.

The acoustic abundance estimates were converted to biomass using TS=20 log L - 71.9 and in the text table below the number per year class (in millions) is presented:

Year class	Total estimate
1992	1792
1991	7621
1990	3807
1989	2151
1988	322
1987	20
1986	1
1985	124
1984	63
1983	2573
Total	18474

3.3.2 Acoustic surveys in the wintering areas

The wintering area was acoustically surveyed in December 1994 and January 1995 (Foote and Røttingen 1995). The following estimates (in million individuals) were obtained, corrected for acoustic extinction and applying a target strength/length relationship of TS=20 log L-71.9:

Year class	Estimate Dec. 1994	Estimate Jan. 1995
1992	16	47
1991	3708	3781
1990	4124	4013
1989	2593	2445
1988	1096	1215
1987	34	42
1986	25	24
1985	196	267
1984	29	29
1983	3239	4326
Total	15209	16189

3.3.3 Acoustic estimates in the feeding areas

In summer 1995 the herring was distributed over wide areas in the Norwegian Sea. At times the herring was distributed in the upper water masses and could not be estimated by traditional echo integrator technique. However, late in the feeding season, in July-August when the return migration to the wintering areas had begun, the herring was distributed in deeper layers and could thus be estimated by the integrator technique. The areas of distribution in July -August 1995 are given in Figs 3.3.2 and 3.3.3. The text table below gives an estimate of the stock (in million individuals) based on the combination of these surveys (TS=20 log L-71.9 is applied):

Year class	Estimate
1994	199
1993	167
1992	13144
1991	17228
1990	3309
1989	1356
1988	228
1987	1
1986	1
1985	4
1984	71
1983	1427
1982	10
Total	37143

3.3.4 Tagging experiments

The Norwegian tagging experiment on herring, which was initiated in 1975, has been continued, and recoveries from commercial catches have been screened

for tags using tag detectors installed at sea food processing factories. 11.900 tonnes of herring were screened for tags in 1995, and 92 tagged fish were recovered, out of which 64 tags originated from releases in 1987 to 1992. Tags have also been reported from other Norwegian factories, mainly fish meal plants, which use herring entrails from the herring filleting industry in the production. These tags originate from an unknown catch, and have not been used in the assessment. Table 3.3.1 show the number of recoveries and corresponding releases used in the assessment. Due to the expected high F-value on the year classes older than the 1983-year class in 1985-1988, the WG based the assessment on the releases of herring from the year classes 1983-1988. The tagged herring are not aged individually but samples of the age distribution of the catches from which the tagging is done are available. These samples were used for calculating the number of tagged herring from the year classes 1983-1988 last year. However, the lengths of tagged herring were recorded when released, and in the present estimate the number of releases and corresponding recoveries are determined according to the length of the tagged fish when released. This new procedure has to some extent changed the estimated number of releases compared to the data given in the 1994 report.

The total number of screened herring in 1995 is 37.0 million individuals, the number screened of the year classes 1983-1988 is 13.8 million individuals, and 66 % is from the 1983 year class.

From the catch of herring in the Norwegian Sea this summer, Iceland has reported 630 herring tags retained on magnets in Icelandic fish meal plants. A magnet efficiency test carried out at one of the plants gave a magnet efficiency of 47.5 %. The herring used in the test experiment was however in very poor condition, which may have caused error in the efficiency estimate. The Icelandic sample was therefore not used in the assessment.

3.3.5 Mortality estimates

The mortality Z was estimated by the method previously used (Anon., 1995a; Hamre 1990). The plots of ln K against year of release of the sample in Table 3.3.1 are shown in Figure 3.3.4. In order to avoid error of non-random mixing, the estimate of mortality was based on the tag releases in 1987-1992 only, which mainly consists of the year classes 1983-1988 (as in last year report). This grouping gives a fit of the points to a straight line with a slope corresponding to a total mortality Z of 0.277. This is almost the same total mortality estimate as obtained last year (Z=0.269).

3.3.6 Abundance estimate from tagging

Applying the calculated average mortality rate Z of 0.277 for the period 1987 to 1992, the VPA-estimated mortality for 1993 and 1994 (Z=0.30 and 0.38 respectively) and a tagging mortality of 40 % (as in last years report) the number of survivals by release in 1995 was calculated and the results are shown in the right hand column of Table 3.3.1. According to this estimate, 22509 tagged herring from the releases 1987-1992 did survive in 1995, and 64 tagged herring were recovered in a screened catch of 13.8 million individuals of the year classes 1983-1988. This gives a stock estimate of 4.85 billion individuals. The 1983 year class accounts for 66 % of the estimate or $3.2 \cdot 10^9$ individuals.

3.3.7 Natural mortality

Last year the Atlanto-Scandian Herring and Capelin Working Group decided, on the basis of the results from the tagging experiment, to apply an M of 0.23 for the adult stock. Tagging experiments carried out around 1980 indicated an M of 0.13 in this stock. It was argued that the disease *Ichthyophonus hoferi* may have contributed to the apparent increase in natural mortality. However, the prevalence of *Ichthyophonus* has now decreased considerably (Section 3.8). In year classes 1988 and younger the prevalence seems to have been low since 1991, therefore the working group decided to change the M value in the VPA from 0.23 to 0.13 for the period 1991-1994 for the year classes 1988 and younger. For the year classes 1987 and older the M value given in last years report (M=0.23) is unchanged. It is pointed out that this value is very uncertain, and thus the absolute values from the VPA of these year classes (and spawning stock) should be interpreted with great caution.

In the prognosis an M of 0.13 is used for 3 years and older herring.

3.4 Recruitment

3.4.1 Stock estimates of immature herring

The nursery area of the Norwegian spring spawning herring are Norwegian fjord and coastal areas and the southern part of the Barents Sea. Since 1988, when the 1983 year class spawned for the first time, the latter area has increased in importance as a nursery area for the herring. The main part of the data on immature herring are obtained from three different investigation series:

1) Acoustic estimates of 0-group herring in fjord and coastal areas of Norway (Table 3.4.1).

2) 0-group trawl survey in the Barents Sea in August-September (Table 3.4.2).

3) Acoustic estimates of immature herring in the Barents Sea (Table 3.4.3).

In last year's report it was stated that there was some uncertainties with the estimates of immature herring

from the Barents Sea due to a possible mixing with other herring stocks (Cheshko-Petschorskaya stock of herring). The Working Group recommended that research should be made on this subject, and in 1995 a joint Norwegian-Russian project has been in operation on this matter (herring sampled during the abundance surveys have been sampled for both genetics and vertebrae number). The estimates for 1995 consist of only Norwegian spring spawning herring.

3.4.2 Natural mortality of immature herring

Barros (1995) has shown that natural mortality of juvenile Norwegian spring spawning herring in the Barents Sea is highly variable and strongly age dependent, but the precision of the data allows only estimation of two mortality patterns, "high and low". He has also shown that this mortality is associated with the ratio between the abundance of the capelin stock and that of juvenile cod.

Given the present state of the system (high cod abundance and low capelin abundance), it is therefore quite plausible that both the 1994 and 1995 year classes will suffer a high mortality rate. The derived mortalities for ages 1 and 2 are 1.56 and 0.54 respectively.

3.4.3 Assessment of immature and recruiting year classes

1991 year class

In 1995 members of this year class were distributed over wide areas in the Norwegian Sea. An estimate on the basis of the surveys in July -August 1995 (Figs 3.3.2 and 3.3.3) gave an estimate of 17.2 billion individuals (text table in section 3.3.3). This is regarded as the most reliable total estimate of this year class. Raised by a natural mortality of 0.13 for 8 months gives 18.8 billion individuals. In addition some of this year class was fished in 1995. The number of this year class fished is only known for the Faroese and Icelandic fishery. In the Icelandic fishery 1 % of the catches consisted of this year class, in the Faroes the percentage was 7 %.

Assuming an average of 3 % in all the fisheries up to 1 August 1995 and a total catch of 680,000 t, gives approximately 20,400 tonnes fished of this year class. With an average weight of 190 g (as in the Faroese and Icelandic fishery) this indicates that approximately 107 million individuals of this year class is caught in the fishery. The total estimate for this year class at 1 January 1995 is thus set to 18.9 billion.

1992 year class

Individuals of this year class probably began emigrating from the Barents Sea in 1994. During the summer 1995 the year class was distributed over wide areas in the eastern part of the Norwegian Sea from 64°N and northwards, and in parts of the Barents Sea.

There have been several acoustic estimates of this year class in 1995. A Russian survey in the Barents Sea in February gave 35,000 million individuals, and a joint Russian/Norwegian survey in the Barents Sea in May gave 8,000 million. A Norwegian survey in the Barents Sea in June also gave 8,000 million. Two Norwegian surveys in the Norwegian Sea in July and August, respectively, gave 13,100 million when combined. A new Norwegian survey in the eastern part of the Norwegian Sea in September gave 8,900 million.

The results from the surveys are given in the text table below. Earlier estimates used by the 1994 Atlanto-Scandian Herring and Capelin Working Group have also been included in the table. In order to allow comparison of the numbers, the last column contains the numbers by 1 January, if the estimates from the surveys are reduced by natural mortality (M1 = 1.56 for age 1, M2 = 0.54 for age 2, and M3 = 0.13 for age 3).

Time	Area	Acoustic estimate (billion individuals)	Number by 1 January 1995 (billion individuals)
May 1993	Barents Sea	102.6	24.1
May 1994	Barents Sea	59.2	43.2
February 1995	Barents Sea	35.0	35.8
May 1995	Barents Sea	8.0	8.4
June 1995	Barents Sea	8.0	8.5
July/August 1995	Norwegian Sea	13.1	14.3
September 1995	Norwegian Sea (eastern part)	8.9	9.7

The estimates from May and June 1995 cover only part of the year class, and are therefore too low.

The estimates from July/August 1995 and September 1995 both are from a highly dynamic situation when the herring was migrating out of the Barents Sea, and it is likely that the herring measured in July/August had migrated further south and out of the area when the new estimate was made in September. Although the surveys in July/August and September probably did not cover the entire distribution area, and the sum of the two estimates may thus to a certain degree be an underestimate, it is felt that this sum (22 billion individuals) is the best estimate of this year class. Raised by natural mortality for 8 months the estimate for 1 January 1995 is 24.0 billion.

This estimate is in accordance with the prognosis of this year class as 3 year olds made in 1993 (24.6 billion), but is only 55% of the number in the prognosis made last year. In this context, it should be noted that there are considerable difficulties in monitoring the large migratory movements of this year class from the Barents Sea to the Norwegian Sea. In retrospect, it can

be seen that, according to the acoustic estimates, the strong 1983 year class from 2 years old to 3 years old (Table 3.4.3) show an even stronger relative reduction in year class strength compared to the 1992 year class.

1993 year class

There have been several acoustic estimates of the Barents Sea component of this year class, but the results are conflicting. The joint Russian/Norwegian survey in May 1994 gave 6,600 million individuals. The Russian survey in February 1995 gave 36,700 million, and the joint Russian/Norwegian survey in May 1995 gave 7,700 million. The Norwegian survey in June 1995 gave 3,200 million, and the joint survey in September 1995 gave 400 million.

The results from the surveys are shown in the text table below, together with the corresponding numbers by 1 January 1996 if the numbers calculated from the different surveys are reduced by a natural mortality of 1.56 from age 1 to 2 and 0.54 from age 2 to 3.

Time	Area	Acoustic estimate (billion individuals)	Number by 1 January 1996 (billion individuals)
May 1994	Barents Sea	6.6	1.5
February 1995	Barents Sea	36.7	23.4
May 1995	Barents Sea	7.7	5.6
June 1995	Barents Sea	3.2	2.4
September 1995	Barents Sea	0.4	0.4

In last years report it was stated that the May 1994 estimate was probably an underestimate due to concentrations of small herring in Russian territorial waters which were not covered by the survey. In May 1995 no herring were reported from these waters.

Although the results from the 1995 surveys seem to be contradictory and indicate serious methodological problems, the working group decided to use the May 1995 survey as a basis for the estimate of the 1993 year class on 1 January 1995. The May survey is a joint Norwegian/Russian long time investigation series and the main task is to survey the immature herring stock. The remaining surveys in 1995 were designed primarily for other tasks. The May estimate is reduced by a mortality of 0.54 for 7 months. This gives an estimate of 5,6 million herring as 3 years old.

1994 year class

This year class had been estimated as 1 year old herring by using the estimate at 500 million at 1 May (Table 3.4.3) and reducing it by a natural mortality of 1.56 for 7 months and a further natural mortality of 0.54 for one year. In addition the estimate for the fjord areas from December 1994 (Table 3.4.1) is reduced correspondingly and added to the estimate. This gives a total of 845 million individuals of the 1994 year class as 1 year old herring.

3.4.4 Maturity development of the 1991 and 1992 year classes

1991 year class

In July - August 1995 approximately 55 % of this year class were classified as immature fish and will probably not spawn in 1996.

1992 year class

In August 1995 only a few per cent of this year class was classified as maturing. Taking into account that there also were a considerable number of this year class remaining in the Barents Sea, the total maturity coefficient of this year class is set to 1%.

The following proportion mature at age is applied for 1996:

Age	Proportion mature
3	0
4	0.01
5	0.45
6-13+	1.00

3.5 VPA and Catch and Stock Prognosis

3.5.1 Tuning the VPA

Data from the acoustic surveys in the wintering areas in December and January and on the spawning grounds in February-March were available for tuning the VPA, in addition to stock estimates from tagging. It was decided to use these acoustic estimates only for age 5 and older fish, because younger age groups are not completely covered by these surveys. The survey data, catch data and natural mortalities used are given in Table 3.5.1.

During the assessments in 1993 and 1994, the abundance estimates of the 1983 year class from surveys and from the tagging experiments were combined by first estimating a catchability (or availability) coefficient q_s for each survey s , which is used to scale each survey to the VPA. Popes approximation is used in the VPA. The sum of squares of the deviations between the scaled survey estimates and the corresponding VPA estimates are then computed, and the population number in the final year is then varied in order to obtain the best possible fit.

Mathematically, this can be expressed as follows:

y: year index
s: survey index
N_y: Stock number in year y

$A_{y,s}$: Survey index in year y from survey s
n_s: number of years for which we have an index from survey s
t: last year for which catch data exist

We then minimize $S_{y,s}$ $(N_y - A_{y,s}q_s)^2$, where $q_s = S_y N_y/S_y A_{y,s}$ when $n_s > 1$, and $q_s = 1$ when $n_s = 1$. This is done by varying N_{t+1}, and using Popes approximation to calculate the population number backwards in time.

However, this approach seemed to give too much weight to the series of acoustic estimates on the spawning areas, because of the high stock number in 1988-1991. Even a small relative deviation from these stock numbers will cause a high sum of squares for the acoustic estimates in 1988-1991. Also, the way the catchability is computed gives most weight to the surveys with the highest absolute values. This causes most of the survey estimates in 1994 and 1995 to be higher than the VPA estimate, as seen from Figure 3.5.1.

Thus, it was decided to also try to minimize the sum of squares of the deviations between the logarithm of the scaled survey estimates and the corresponding VPA estimates, i.e. to minimize $S_{y,s}$ $(\ln N_y - \ln (A_{y,s}q_s))^2$, where $q_s = \exp((S_y \ln(N_y/A_{y,s})/n_s)$ when $n_s > 1$, and $q_s = 1$ when $n_s = 1$. The result of this minimization is shown in Figure 3.5.2. From this figure it is seen that the new method gives a better fit to the survey data in the last years, and thus it was decided to adopt this new method. It should be noted that the catchability for the tagging estimate was fixed to 1, and not computed. If the catchability of the tagging estimate was estimated in the same way as the other estimates, a minimum could not always be found.

The text table below shows that the new method, as well as the new data, increase the estimate (millions) of the size of the 1983 year class at January 1, 1995.

Last year in analysis/method	Old	New
1994	2.040	2.814
1995	1.806	3.500

We then extended the new method to include also the 1988 and 1989 year classes, assuming the catchability to be constant for all year classes. It was decided to exclude the year classes 1982 and earlier and 1984-1987 from this analysis, as they are very weak. The result of this tuning is given in Table 3.5.1. Figures 3.5.3-3.5.5 show the VPA compared to the survey data adjusted by the estimated catchabilities for the 1983, 1988 and 1989 year classes respectively.

The 1984-1987 and 1990 year classes were estimated by averaging the December 1994 and January 1995 estimates of these year classes, scaled with the catchabilities for these surveys estimated from the tuning. The estimates of all the year classes 1983-1990 at January 1, 1995, are summed up in the text table below.

Year class	Estimate January 1, 1995 (million individuals)
1983	3457
1984	35
1985	277
1986	30
1987	46
1988	1203
1989	3595
1990	4924

3.5.2 VPA input and output

The input data to the VPA are given in Tables 3.5.2-3.5.6. The terminal Fs for the different year classes in the last year were found by tuning the catch at age data given in Table 3.5.2 to the stock numbers at age given in the text table above. This year the VPA was run for age groups 3-13+. The terminal Fs at oldest age were adjusted somewhat from the values used last year, when the VPA was run for age groups 3-12+, to give reasonable values for fishing mortalities and stock sizes. The VPA program used sets the fishing mortality on the plus group equal to the fishing mortality on the oldest true age group in such a way that the stock number of the plus group in one year may become larger than the sum of the numbers in the oldest true age group and the plus group the year before. Thus, it is difficult to avoid inconsistencies.

In previous years, $F_{5\text{-}10,u}$ has been used as the reference F. In 1994, this reference F will not include the fishing mortality on the 1983 year class. Also, with the very large variability in year-class strength observed in this stock, an unweighted F does not always give a good indication of the development in F. However, we have continued to use $F_{5\text{-}10,u}$.

The results of the VPA are given in Tables 3.5.7-3.5.11.

3.5.3 Input data for the catch and stock prognosis

These data are given in Table 3.5.12. For the adult herring VPA stock numbers at 1 January 1995 have been used (Table 3.5.8). The abundance of the 1991-1994 year classes is calculated as described in Section 3.4.3.

The weight at age in the stock for 1995 is calculated from biological samples in December 1994 and January 1995. No trend in weight at age in the catch has been detected in recent years and therefore the weight at age in the catch in 1995 has been set equal to the 1991-1994 average. As the stock size is expected to increase towards the level from the 1950s and 1960s in the coming years, a slower growth may be anticipated. The weights at age in the catch data from the 1950s are not comparable to the present values due to a different structure in the fisheries (a larger portion was then taken as spent herring). The Working Group therefore chose the 1960s as a reference period for weight at age in the stock and catch at higher stock sizes. The change in weight at age is made gradual by setting the weight at age in the stock and in the catch in 1997 and later equal to the 1960 - 1969 average, and setting the 1996 values equal to the average of the 1995 and 1997 values. The maturity at age in 1996 is given in Section 3.4.4. For the years 1997 and later the average maturity at age in the period 1960-1968 was used.

For the prognosis the same flat-topped exploitation pattern as last year was chosen, assuming full recruitment to the fishery at age 5. A natural mortality of M=0.13 was applied for all age groups.

3.5.4 Results of the prognosis

The expected catch in 1995 (914,000 t) indicates that the fishing mortality ($F_{5\text{-}10,u}$) decreased from 0.23 in 1994 to 0.18 in 1995. This decrease is, however, an artifact caused by the high fishing mortality on age 10 in 1994, in reality there has been an increase. The effects of different levels of F on the catch in 1996 and on the stock and SSB in 1997 are presented in Table 3.5.13.

The assessment shows that the spawning stock biomass will increase from 3.9 million tonnes in 1995 to 4.8 million tonnes in 1996. In 1997, the spawning stock biomass will increase to above 5.5 million t at all levels of fishing mortality in 1996 listed in Table 3.5.13. The total stock biomass (3+) will increase from 8.4 million t in 1995 to 10.7 million tonnes in 1996. This increase is due to the strong 1991 and 1992 year classes.

3.6 Risk analysis and management considerations

3.6.1 Risk analysis

A risk analysis on the spawning stock biomass was performed using the program @RISK with 300 iterations. The time range for the runs was 1 January 1996 to 1 January 2005.

3.6.1.1 Input data

The same data as for the short-term prognosis was used.

3.6.1.2 Modelling of uncertainty

Stock data

The uncertainty connected to the initial values of the 1983, 1988 and 1989 year classes were modelled by performing the tuning procedure 30 times, each time drawing each measured value from a normal distribution with standard deviation equal to the standard deviation of the differences between the time series and the tuning vpa series. Data from other year classes were neglected and the 1989 year class was calculated from the two other year classes by keeping the sum equal to the sum in each time series. The final standard deviations for the 1983 and 1988 year classes were 0.08 and 0.167 billion, respectively.

For the younger year classes a coefficient of variation of 0.25 was assumed.

Maturity ogive

A normal distribution with standard deviation of 0.1 was assumed for the 4 year old fish. The drawn value was kept through each simulation run.

Natural mortality

A standard deviation of 0.05 was assumed. The drawn value was kept throughout each simulation run.

Recruitment

All recruitment refers to 3 year old fish. Two different approaches were used:

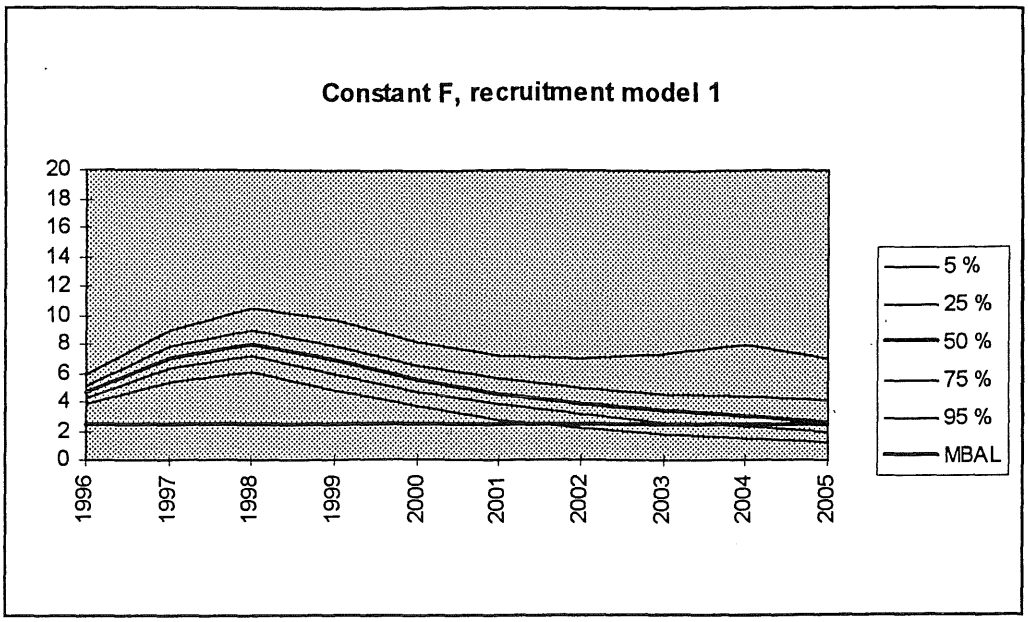
A Beverton-Holt recruitment function was fitted to the data assuming a log-normal error. Two different cases were applied: Retaining all data (recruitment model 2) and deleting the exceptionally large year classes 1950, 1959 and 1983 year classes (recruitment model 1). The rationale behind the latter approach is that the time series shows that there always has been a period of up to 10 years between years of good recruitment. 1992 was a year of good recruitment, so it is unlikely that another year of good recruitment will occur within the time series used for the simulations.

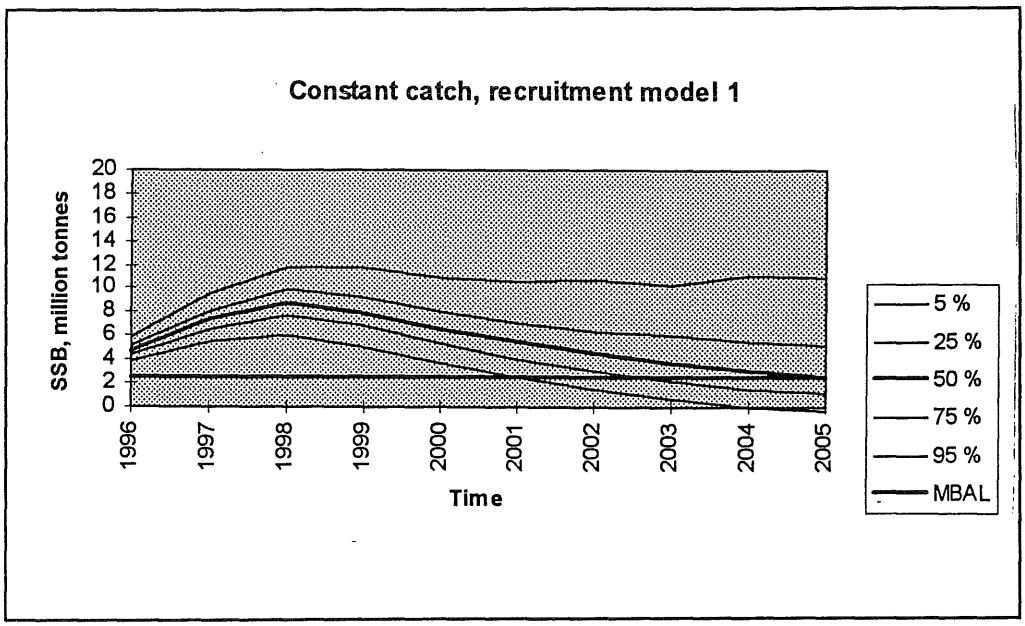
Also, the method used last year was run. The historical halfvalues in a Beverton-Holt model were calculated assuming a maximum recruitment of 1.5 times the maximum observed recruitment and were drawn with equal probability during the simulations (recruitment model 4). In this case the effect of autocorrelation in recruitment was taken into account by drawing halfvalues from the same number of years after a good year class (1950, 1959, 1983) as the time from the year in question to 1992 (recruitment model 3).

3.6.1.3 Results

The simulation results are compared to a spawning stock level of 2.5 million tonnes, in the text figures below called MBAL.

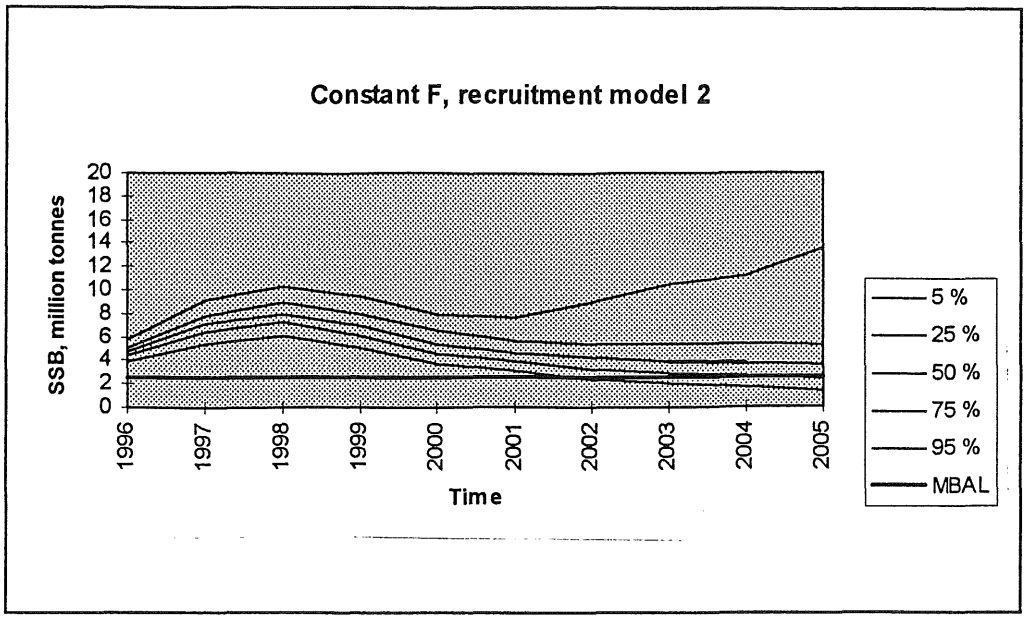
The figures below show the simulation results for recruitment model 1 using an F-value of fully recruited herring of 0.166, yielding a mean of the yearly mean catch of 1.02 million tonnes as compared to using a constant catch of 1.02 million tonnes.

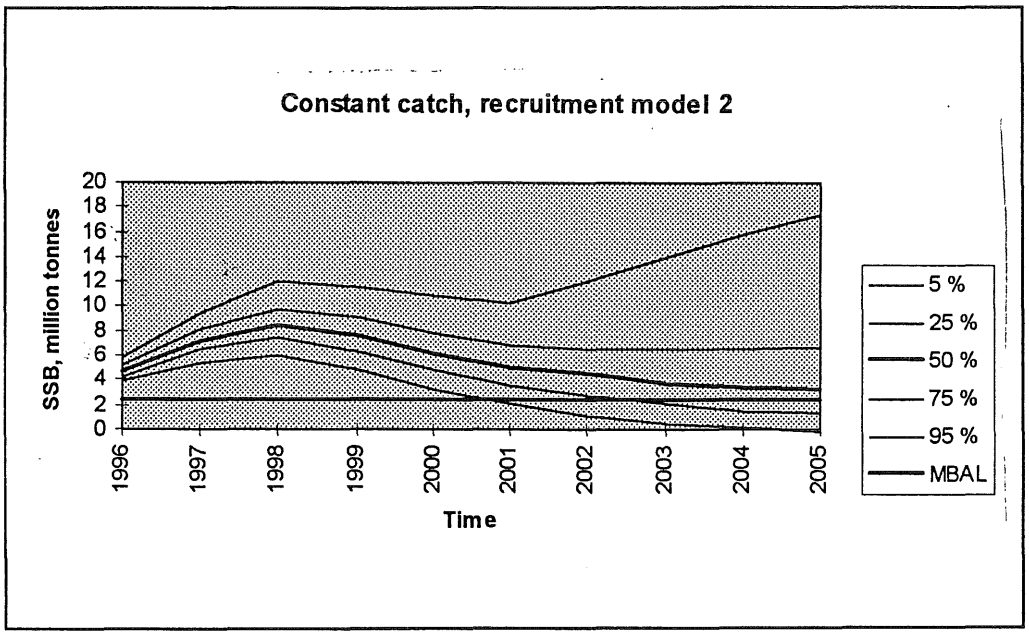




In both cases the median increases until 1998 and decreases afterwards. The median is about 2.5 million tonnes in 2005 in both cases, but the constant catch option exhibits higher variability.

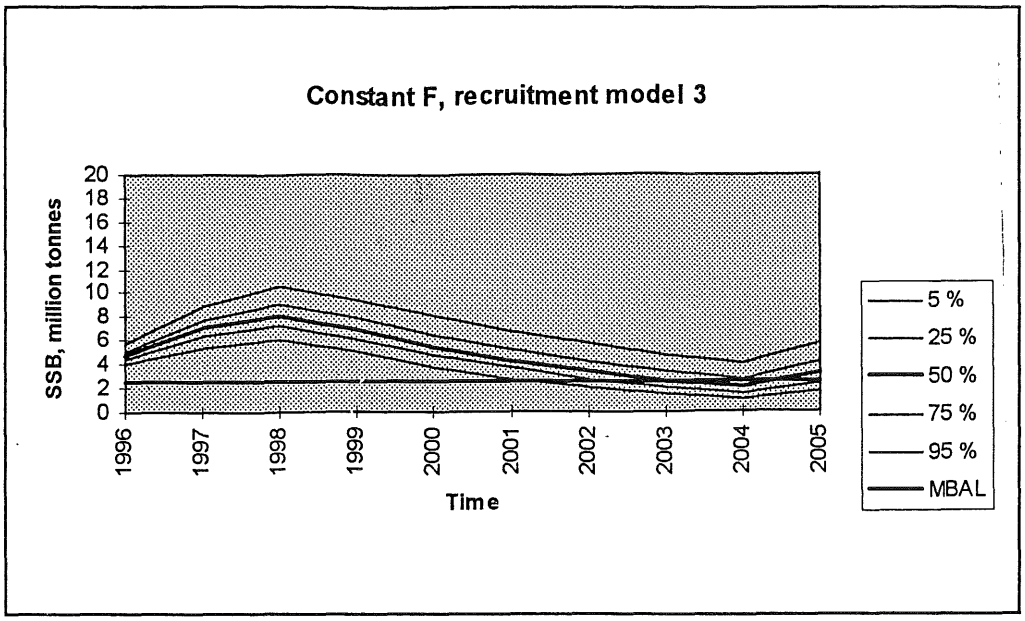
The figures below show the simulation results for recruitment model 2 using an F-value of fully recruited herring of 0.166, yielding a mean of the yearly mean catch of 1.13 million tonnes as compared to using a constant catch of 1.13 million tonnes.

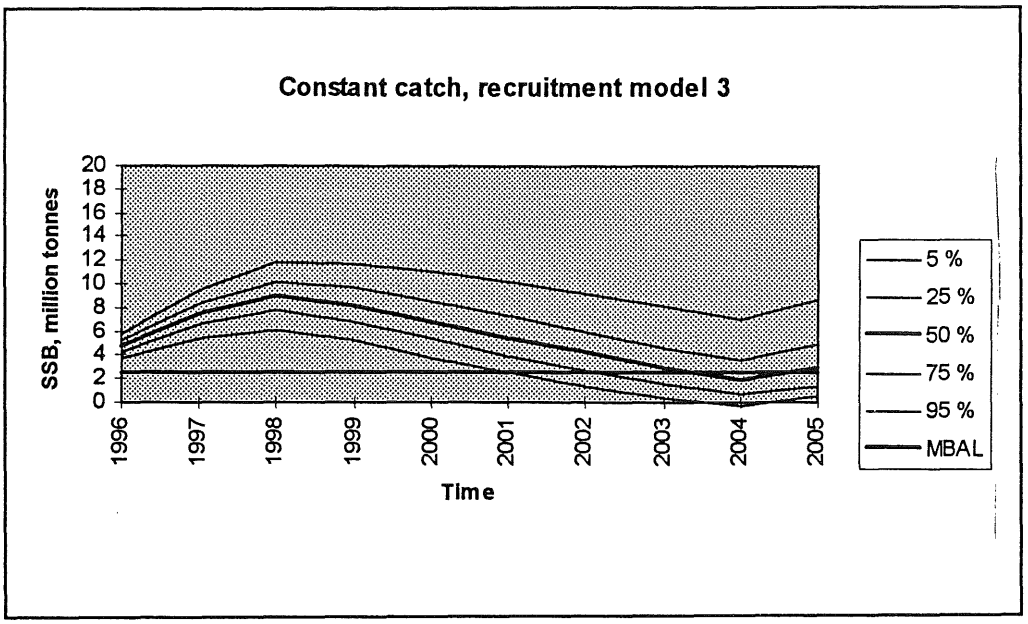




For recruitment model 2 the medians in 2005 are above 2.5 million tonnes in both cases, the median for the constant F option being somewhat larger than the median for the constant catch option. Also in this case the constant catch option shows the larger variability.

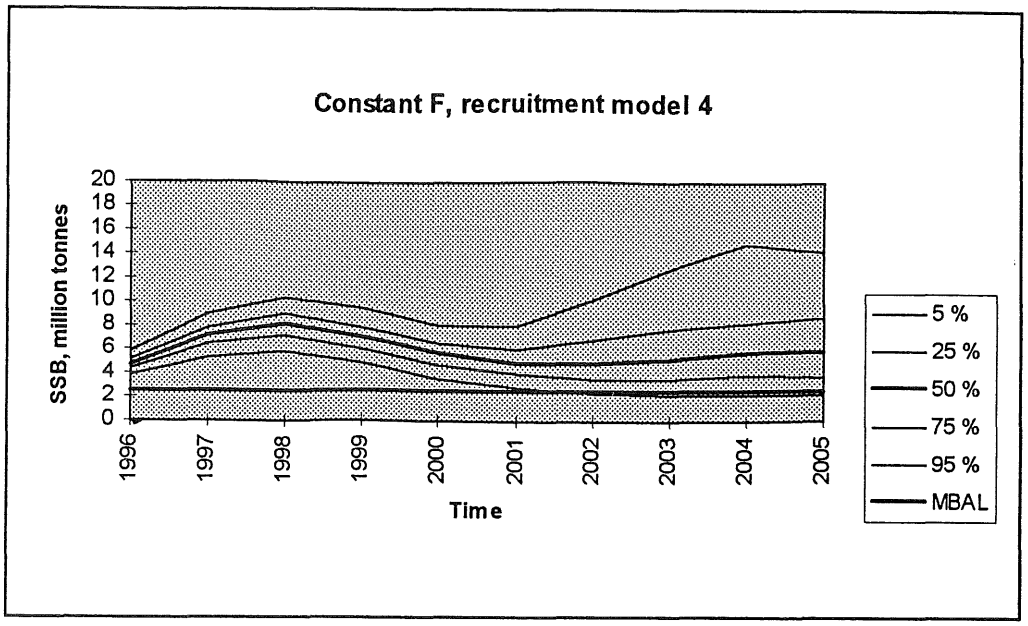
The figures below show the simulation results for recruitment model 3 using an F-value of fully recruited herring of 0.166, yielding a mean of the yearly mean catch of 0.97 million tonnes as compared to using a constant catch of 0.97 million tonnes.

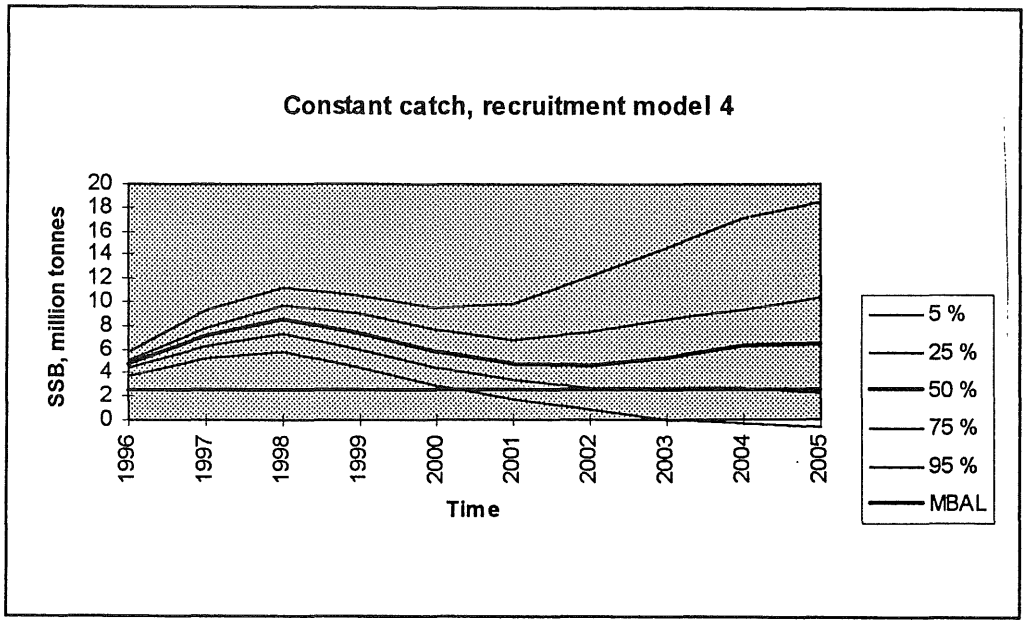




The medians are in both cases a little higher in 2005 than for recruitment models 1 and 2. The same difference between the constant catch option and the constant F option found for recruitment models 1 and 2 applies also here.

The figures below show the simulation results for recruitment model 4 using an F-value of fully recruited herring of 0.166, yielding a mean of the yearly mean catch of 1.25 million tonnes as compared to using a constant catch of 1.25 million tonnes.





The median is about the same in 2005 in both cases, but also here the constant catch option exhibits the larger variability. However, recruitment model 4 is the most optimistic one giving a median spawning stock of more than 5 million tonnes in 2005 as compared to about 3.5 million tonnes for recruitment model 2.5 - 3.0 million tonnes for the more pessimistic recruitment models 1 and 3.

The most striking difference between the two alternative approaches to modelling recruitment is that the recruitment models 1 and 2 give a consistently negative trend for the median spawning stock from 1998 whereas in the models 3 and 4 the median spawning stock have a slight increase from year 2002. The difference between the approaches is however not large, and both approaches gives the same differences between the constant F and constant catch options.

The reason why the constant catch option seems to give smaller probabilities of maintaining the spawning stock above 2.5 million tonnes throughout 2005 comes probably from the stock decline after year 1998, which is evident in all models. A constant F option will tend to be more conservative in a declining stock situation.

3.6.2 Management considerations

The immatures and adults of this stock form a central part of the ecosystem in the Barents and Norwegian Seas, respectively. The herring has an important role as a transformer of the production of zooplankton biomass and energy to a form which is available to organisms at a higher level of the food chain. Thus a large stock of herring, both immature and adults, will utilize larger quantities of plankton (and over wider areas) and be able to support larger fish stocks in the higher food chain levels, than a small stock of herring will do. Seen from this ecosystem point of view the spawning stock should be maintained at a level above 2.5 million t. In the 1950s and beginning of the 1960s the spawning stock was in the order of 5-10 million t (Table 3.5.11). Further, the MSY level of this stock has been estimated to be about 6 million t, and the Working Group has earlier indicated this as a preferable level in a long time perspective.

The prospects for recruitment to the spawning stock are discussed in the present and last years report. The spawning stock is expected to increase strongly in the coming years due to the recruitment of the strong 1991 and 1992 year classes. However, the year classes 1993 - 95 seem to be weak. Due to these extreme dynamics in the recruitment situation in the coming years, the choice of a harvesting strategy for 1996 (and for the coming years) should **not** be made on the basis of the short-term prediction table (Table 3.5.13). Rather, the choice should be made on the basis of the medium-term development of this stock and keeping in mind the important role this stock has in the Barents and Norwegian Sea ecosystems.

In the above section on risk analysis the Working Group has put forward possible developments of the spawning stock of Norwegian spring-spawning herring using two different harvesting strategies, i.e., a constant TAC strategy and a constant F strategy presented with the use of four different recruitment models.

An advantage of using a constant TAC is to keep the spawning stock at a relatively higher level over a longer time period, an advantage of using a constant F strategy will be a more cautious harvesting at lower levels of the spawning stock. A combination of these two harvesting strategies should be considered in the management of this stock. Harvesting according to $F_{0.1}$ but taking no more than MSY needs particular consideration.

3.7 Information on the Spatial and Temporal Distribution of Norwegian spring spawning herring

3.7.1 Recorded distribution and migration in 1995

A) Winter 1995

Adult herring: The entire spawning stock was, before the spawning migration commenced in the beginning of January, located in the wintering areas in Ofotfjorden and Tysfjorden in Northern Norway. The spawning took place along the Norwegian coast. In 1995 the spawning grounds were located on the coastal banks from 62°N to 70°N. Very little spawning took place on the historical spawning grounds south of 62°N.

Immature herring: In winter 1995 the immature stock was distributed in the south and southeastern parts of the Barents Sea. (Fig 3.7.1).

B) Spring and summer 1995

Adult herring: After spawning the adult stock started their feeding migration to the Norwegian Sea. In spring and summer 1995 a joint investigation series in the Norwegian Sea by research vessels from the Faroes, Iceland, Norway and Russia was coordinated according to an agreed procedure. Thus the migration in the Norwegian Sea could be monitored month by month. A general picture of the migration pattern for the adult herring is given in Fig. 3.7.2.

Immature herring: In spring and summer a large amount of the immature herring recorded in the previous years in the Barents sea (mainly 1992 year class) emigrated from that area.

C) Autumn 1995

Adult herring: Adult herring were reported off Vesterålen in the latter part of August, and have later entered Vestfjorden. The first herring schools were reported from Tysfjord around October 1. This indicates that the wintering areas which have been utilized since 1987/1988 will be in use in the wintering season 1995/1996 by the older part of the population.

Immature herring: During the joint Norwegian/Russian surveys in the Barents Sea in August/September very little immature herring were recorded. Further, the 1995 year class is the weakest on record since 1987 (Table 3.4.2).

3.7.2 Quantitative information on present spatial and temporal distribution of the Norwegian spring spawning herring stock

In September 1995 scientists from Faroes, Iceland, Norway and Russia met in Reykjavik in order to estimate zonal distribution of Norwegian spring spawning herring by the use of a "biomass x time" model (Hamre 1993). The 1983 year class was chosen as representative for the present period and used as an input year class in the model. The following present zonal attachment was estimated:

Zone	%
Faroes	1.3
Iceland	0.1
Norway	87.3
Jan Mayen	1.0
Russia	6.2
Int. Norw. Sea	3.1
Svalbard	0.9
Int. Bar. Sea	0.1
EU	0.0

3.8 *Ichtyophonus hoferi* disease in the Norwegian spring spawning herring stock

This disease was first observed in herring in the North-East Atlantic in the summer of 1991. In a working paper presented by D. Skagen (Trends in Prevalence of *Ichtyophonus* disease in Norwegian spring spawning herring in the Ofoten area in 1992) to the present Working Group meeting show that the prevalences in this stock are declining (Fig 3.8.1). As in the North Sea herring, the disease appears to be mainly associated with certain year classes. Within each year class, the prevalence declines with time. For the North sea herring , it was shown that a decline like this could be explained by assuming that a fraction of the year class was infected at an early stage in life, giving that part of the year class a higher mortality throughout the following years. The declining prevalence could thus be explained as due to exhaustion of an infected subpopulation. This argument can also be applied to the Norwegian spring spawning herring.

The overall prevalence in the most recent samples is now in the order of 1.2 %. This, together with the clearly declining trend in the prevalence in the oldest year classes, indicates that the disease in the Norwegian spring spawning herring, as in the North Sea herring, is fading away. A prevalence of 1.2 % corresponds to an additional natural mortality of 0.05 and 0.025 with a disease duration of 3 and 6 months respectively.

As discussed in last years report, there has been some uncertainties about the estimation of the prevalence of the *Ichtyophonus* disease in the stock of Norwegian spring spawning herring (Anon. 1995a). Some methods seem to give prevalences in the order of 100 % (Karaseva *et al.* 1995) In a working paper (Hodneland et al.) presented to the Working Group the different methods to estimate the prevalence of the *Ichtyophonus* disease are critically examined. On the basis of the evaluation of the methods given in this working paper, the Working Group concluded that the method applied to investigate the development of the prevalence of the *Ichthyophonus* (working document by D. Skagen) should be continued.

3.9 Comments to the assessment and the predictions

The assessment has changed considerably since last year. The size of the 1983 year class at present has been increased by about 50%, while the size of the 1992 year class as 3-year-olds has been decreased by 40%. Also, the natural mortality in the predictions has been reduced from 0.23 to 0.13. Altogether, this increases both the current stock size and the projections for stock size and catches considerably. It is also worth noting that according to this assessment, the spawning stock biomass has been above 2.5 million tonnes from 1988 onwards.

4. BARENTS SEA CAPELIN

4.1 Regulation of the Barents Sea Capelin Fishery

Since 1979, the Barents Sea capelin fishery has been regulated by a bilateral fishery management agreement between USSR (now Russia) and Norway. A TAC has been set separately for the winter fishery and for the autumn fishery. The fishery was closed from 1 May to 15 August until 1984. During the period 1984 to 1986, the fishery was closed from 1 May to 1 September. From the autumn of 1986 to the winter of 1991, no fishery took place. The fishery was re-opened in the winter season 1991, on a recovered stock. From the autumn 1993 the fishery was again closed. A minimum landing size of 11 cm has been in force for several years.

4.2 Catch Statistics

The international catch by country and season in the years 1965-1995 is given in Table 4.2.1. Following the recommendation from ACFM, there was no fishing for Barents Sea capelin during 1995.

4.3 Stock Size Estimates

4.3.1 Larval and 0-group surveys

Norwegian larval surveys based on Gulf III plankton samples have been conducted in June each year since 1981. The calculated numbers by year (which should be regarded as indices only) are shown in Table 4.3.1. The index this year is 0. A few larvae only were caught during the larval survey. However, during the joint Norwegian-Russian acoustic survey during September, some few larvae were caught in a Gulf III sampler, showing that some spawning must have taken place during summer in the eastern areas. During the international 0-group survey in the Barents Sea in August 1994 very small amounts of 0-group capelin were detected. An area based index (Table 4.3.1) of 43 shows that the year class 1995 is at the same low level as the year classes 1992-1994. These findings confirm

the present collapse of the stock. The amount of young herring in the Barents Sea is now seen to decrease. As noted previously (Anon. 1995a) this may increase the chances for a high survival rate of capelin larvae next year.

4.3.2 Acoustic stock estimates in 1995

The 1995 acoustic survey was carried out jointly by two Russian and two Norwegian vessels in the period 13 September to 1 October. The geographical distribution of capelin is shown in Figure 4.3.1. Table 4.3.2 gives the estimate as numbers by age and length, and the biomass at age. The results are summarized in the text table below (the estimates of the same age groups measured in 1994 are shown on a shaded background).

Year class		Age	Number (10^9)		Mean weight (g)		Biomass (10^3 t)	
1994	1993	1	7.1	19.7	6.7	4.4	47.4	86.8
1993	1992	2	8.1	3.4	13.8	11.2	112.4	38.5
1992	1991	3	1.5	4.3	16.8	16.5	25.7	71.0
1991	1990	4	0.4	0.2	22.6	18.4	7.9	3.1
Total stock in								
1995	1994	1-4	17.2	27.7	11.3	7.2	193.6	199.3
Based on TS value: 19.1 log L - 74.0, corresponding to $= 5.0 \times 10^{-7} \times L^{1.91}$								

In comparing the acoustic estimate by year class obtained this year to the estimate obtained last year, one should bear in mind that the relative error is probably large when the capelin abundance is low, both because of fewer trawl stations with large capelin catches (incomplete age sampling) and because the echogram scrutinizing becomes more uncertain.

The total stock is estimated at about 195 000 tonnes, the lowest abundance on record, apart from those in 1986 and 1987. About 60 % (120,000 tonnes) of this stock is maturing.

The 1994 year class (1-group) consists, according to this estimate, of 7 billion individuals. The mean weight is estimated at 6.7 g, which is the highest on record. Consequently, the biomass of the 1994 year class is about 47 thousand tonnes.

The estimated number of fish in the 1993 year class (2-group) is 8.1 billion, as opposed to 3.4 billion in the 1992 year class measured last year. The mean weight at this age is 13.8 g (11.2 g in 1994), and consequently the biomass of the two years old fish is about 112,000 tonnes. The mean weight is the highest recorded apart from that found in 1990.

The 1992 year class is estimated at 1.5 billion individuals with mean weight 16.8 g, giving a biomass of about 26,000 tonnes. The mean weight is at the same level as the preceding year classes. The 1991 year class (now 4 years old) is estimated at 0.4 billion individuals. With a mean weight of 22.6 g this age group makes up only
8,000 tonnes. Only negligible amounts were found of 5 years old capelin.

The text table below shows the number of fish in the various year classes, and their mortality from age 1 to 2.

Year: Year class:	85-86 1984	86-87 1985	87-88 1986	88-89 1987	89-90 1988	90-91 1989	91-92 1990	92-93 1991	93-94 1992	94-95 1993
Age 1, Nos (10^9)	35.1	7.5	37.3	20.0	177.9	700.0	392.0	351.3	2.2	19.8
Age 2, Nos (10^9)	3.4	1.5	28.8	17.8	177.5	574.4	196.3	53.4	3.4	8.1
Total mortality (%)	90	80	33	12	.2	18	50	85	-	59

As there has been practically no fishing on these age groups, the figures for total mortality constitute natural mortality only. In spite of the uncertainties, illustrated by the low value for the 1988 year class and the negative mortality for the 1992 year class, these values probably reflect quite well the trend in predation on capelin. As can be seen from the table, the mortality was high up to 1985-1987, but then a substantial decrease occurred in 1987–1990, probably caused by diminished predation pressure from cod. From 1990 the mortality increased again, back at the level measured before 1986. The negative mortality last year is due to measurement error, and consequently it is difficult to interpret the value obtained this year. The increase since 1990 is consistent with an increasing stock of cod now preying on the capelin. Estimates of stock in number and weight for the period 1973-1995 are shown in Table 4.3.3.

Historical stock developmentAn overview of the development of the Barents Sea capelin stock in the period 1986-1995 is given in Tables 4.3.4-4.3.13. The methods and assumptions used for constructing the tables were explained in Appendix A to Anon. (1995a).

In that report, also the complete time series back to 1973 can be found. It should be noted that several of the assumptions and parameter values used in constructing these tables are provisional and future research may alter some of the tables considerably. For instance, M-values for immature capelin will be calculated using new estimates of the length at maturity and M-values for mature capelin will be calculated taking the predation by cod into account. However, for giving a crude overview of the development of the Barents Sea capelin stock the tables may be adequate.

Estimates of stock in number by age group and total biomass for the period are shown in Table 4.3.4. Catch in number by age group and total biomass is shown for the spring season and the autumn season in Tables 4.3.5 and 4.3.6. Fishing mortality coefficients by age group for the autumn season and natural mortality coefficients by age group for immature capelin are shown in Tables 4.3.7 and 4.3.8. Stock size at 1 January in numbers by age group and total biomass and the mean weight by age group at 1 January are shown in Tables 4.3.9 and 4.3.10. Proportion of mature stock by age group at 1 January and spawning stock biomass at 1 April are shown in Tables 4.3.11 and 4.3.12. Table 4.3.13 gives an aggregated summary.

4.4 Management Considerations

In managing the Barents Sea fishery one of the main goals has been to allow a minimum target spawning stock biomass to spawn. In the period 1979-1982, this was set at 500,000 t and later at 400,000 t based on an analysis by Hamre and Tjelmeland (1982). The present maturing component of 120,000 t, which will be reduced by predation by cod until spawning, is far below this and other conceivable levels of the target spawning stock. Therefore, there is no room for any fishery in 1996. The 1993, 1994 and 1995 year classes are very poor, and consequently any fishery for capelin in the Barents Sea cannot be expected before at least 1999.

5. CAPELIN IN THE ICELAND-EAST GREENLAND-JAN MAYEN AREA

5.1 The Fishery and Catch Regulations

The fishery depends for the most part upon maturing capelin, *i.e.* that part of each year class which spawns at age 3 as well as those fish at age 4 which did not spawn earlier. The size of the immature components is difficult to assess before their recruitment to the adult stock at ages 2 and 3. This is especially true of the 3-group immatures.

The fishery of the Iceland-East Greenland-Jan Mayen capelin has, therefore, been regulated by preliminary catch quotas set prior to each fishing season (July-March) based on the results of surveys of the abundance of immature 1- (and 2-) group capelin. Final catch quotas for each season have then been set in accordance with the results of acoustic surveys of abundance of the maturing fishable stock, carried out in autumn (October-November) and/or winter (January/February) in that season. A summary of the above procedure and its results is given in Table 5.1.1.

Over the years, there has generally been no fishery permitted in the period April-June and the season opened in July/August or later, depending on the state of the stock. Due to very low stock abundance there was a fishing ban lasting from December 1981 to November 1983. In addition, areas with high abundance of juvenile 1- and 2-group capelin (in the shelf region off NW-, N- and NE-Iceland) have usually been closed to the summer and autumn fishery.

The total annual catch of capelin in the Iceland-East Greenland-Jan Mayen area since 1964 is given by weight, season and fleet in Table 5.1.2. The total international catch in numbers during the summer/autumn 1978-1994 and winter 1979-1995 seasons is given by age groups and years in Tables 5.1.3 and 5.1.4 respectively.

5.2 Historic Stock Abundance

The annual abundance by number and weight at age for mature and immature capelin in the Iceland-East Greenland-Jan Mayen area has been calculated with reference to 1 August (before the fishing season) and 1 January in the following year for the 1978/79 - 1994/95 seasons. The results are given in Tables 5.2.1 and 5.2.2 (1 August and 1 January, respectively. Table 5.2.2 also gives the remaining spawning stock by number and biomass in March/April 1979-1995.

The above calculations of stock abundance are based on the "best" acoustic estimates of the abundance of maturing capelin. These are obtained in autumn and/or winter, the "best" in each case being defined as that estimate on which the final decision on TAC was based. Taking account of the catch in number and a monthly natural mortality rate of M = 0.035 (Anon. 1991a) the abundance estimates of each age group are then projected to the appropriate point in time. Since the acoustic estimates of the abundance of the juvenile part of the stock are unrealistically low and no information is available on natural mortality rates among such capelin, the abundance of juvenile capelin by number was also back-calculated using the same natural mortality rate as in the case of the adult stock.

The observed annual mean weight by age is used for obtaining the stock biomass on 1 January. With the exception of juvenile capelin, the historic average growth pattern was used for estimating stock biomass of the other components on 1 August, from mean weights observed in the autumn of the same year or in January of

the following year. The remaining spawning stock biomass is calculated from mean weights in January of the same year. It is known that some weight increase takes place in February and March. Therefore, the remaining spawning stock biomass is underestimated by a small margin.

5.3 Method of Stock Prognosis

The precautionary TAC should be set at such a level as to open the fishery before the October survey, yet keep it closed when it is likely that fishing will reduce the residual spawning stock below 400,000 t. Thus the prognosis procedure needs to predict the fishable stock in the beginning of the season in order to predict the effects of fishing. In order to account for the highly variable year class strength, the procedure needs to predict separately the two major components of the mature stock (ages 2 and 3) in the fall. These predictions need to be done in spring.

Available data usually include acoustic survey estimates of the different age groups in August, October and January. August survey results, used for a number of years in order to predict 2-group recruits, have proven unreliable. This has become apparent by comparing these predictions to later assessments of the same stock components. On the other hand, it has been found that autumn (October/November) acoustic estimates of 1- and 2-group abundance are more reliable predictors of fishable stock abundance one year ahead in time. A prediction model was, therefore, developed using the autumn survey data (Anon., 1993a). A summary of the method reads as follows (for denotations see Table 5.3.1 and Fig. 5.3.1):

The maturing part of the 2-group in fall (N_2^{mat}) is a part of the survivors of the 1-group in the previous fall (N_1), which is measured in October. A regression of the back-calculated maturing 2-group abundance against the autumn acoustic estimates of 1-group abundance is used for predicting the abundance of maturing 2-group capelin.

The maturing part of the 3-group in fall corresponds to the surviving part of the year class which did not mature and spawn in the year before. Unfortunately, the surveys of the immature 2-group (N_2^{imm}) in the year before are gross underestimates and will, therefore, not be used. Similarly, the January survey of this year class only estimates the part which will spawn and thus is no indication of what will appear in fall of next year. It is found, however, that maturity at age 2 is inversely related to year class size (N_2^{tot}). Hence the total abundance of the 2-group in autumn is an indication of what will appear as 3-group in the following season. A regression relating the back-calculated total abundance of year classes at age 2 to their abundance at age 3 (N_2^{tot} and N_3^{tot}) is used for predicting the abundance of 3-group capelin.

The data sets comprising all comparisons of numbers by age and maturity, relevant to the prediction model, are given in Table 5.3.1. The mean weight of maturing 2- and 3-group capelin in autumn 1981-1994 (year classes 1978-1992) is given in Table 5.3.2. The above regressions are updated as new data become available. A test of their performance is given in Table 5.3.3.

5.4 Stock Prognosis and Assessments for the 1994/1995 Season

Calculations of expected TAC for the 1994/1995 season, using the prediction method described in section 5.3 and year classes 1980-1990, indicated a total catch of 1,430,000 t, with the usual prerequisite of a monthly natural mortality rate of 0.035 and a remaining spawning stock of 400,000 t, if the catch were spread evenly over the period August 1994-March 1995.

Although the model has predicted roughly the same TAC or slightly lower than finally recommended from acoustic assessments of fishable stock abundance in late autumn and/or winter, the series includes the notable exception of the 1989/1990 season. In this case the prediction proved to be optimistic by about one third. In view of this, as well as the short time series it was recommended that a precautionary TAC should not exceed 2/3 of the total TAC predicted for the season, *i.e.* 950,000 t. This advice was accepted by all parties concerned. In addition, areas north of Iceland were closed to the fishery in order to protect the juvenile part of the stock from coming into contact with the summer fishery.

The autumn survey was carried out in the period 25 October - 16 November 1994. Because of ice, the westernmost part of the channel between Iceland and Greenland as well as the Greenland plateau could not be reached. However, no capelin were recorded near the ice border. Weather conditions were quite variable and surveying had to be halted on occasions to wait out storms. The capelin were almost always recorded in scattering layers and in most areas the recordings consisted of a mixture of mature and immature fish.

According to the autumn 1994 survey the estimated fishable/spawning stock was 33.8 * 10^9 fish on 1 November 1994. At that time the observed mean weight in the fishable stock was 16.8 g and the stock biomass, therefore, about 570,000 t. Details of this stock estimate are given in Table 5.4.1.

With the usual prerequisite of a monthly natural mortality rate of 0.035, a remaining spawning stock of 400,000 t and an estimated weight increase of 2.6 g, the autumn abundance estimate indicated a TAC of 165,000 t in the period November 1994-March 1995, if the catch were spread evenly over the period. Counting the catch taken in July-October 1994, this corresponded to a total TAC of about 485,000 t for all of the 1994/95 season.

Clearly, the autumn 1994 assessment indicated a much smaller fishable stock than had been projected and was even well below the precautionary TAC set prior to the opening of the fishery. Due to the continued scattered distribution of the capelin, practically no fishery could be conducted in November and December 1994. A new survey of stock abundance was, therefore, not scheduled until January 1995.

The winter 1995 survey of the spawning/fishable stock abundance stretched over the period 2 January - 16 February. This was both because of difficult weather conditions, especially in January, but also and no less due to the extreme dispersal of the capelin until the spawners began to aggregate near the shelf edge east and southeast of Iceland.

According to the winter 1995 survey, the estimated fishable/spawning stock was 42.1 * 10^9 fish on 15 February 1995. At that time the observed mean weight in the fishable stock was 20.8 g and the stock biomass, therefore, about 875,000 t. Details of this stock estimate are given in Table 5.4.2.

The winter 1995 survey was carried out under extremely difficult conditions which necessitated adjustments for effects by aeration and migration. In view of previous experience of evaluating such estimates it is likely that the 1995 spawning and fishable stock of capelin has been underestimated to some, but unquantifiable, extent.

In retrospect, it is clear that the autumn 1994 survey did not register but part of the older year class in the fishable/spawning stock and missed the largest individuals of the younger year class. Similarly, part of the smaller adult individuals seem to be missing in the winter 1995 estimate. The result of an attempt to reconcile these differences is given in Table 5.4.3, where a discounted autumn 1994 estimate of the adult numbers of fish in the <15 cm categories have been substituted for those recorded during the winter 1995 survey. This combined estimate indicates a spawning stock biomass of about 925,000 t on 15 February.

Counting the catch already taken, the autumn/winter 1994/95 abundance estimates correspond to a TAC of about 850,000 t for all of the 1994/95 season, or 532,000 t for the 1995 winter fishery. Due to the fact that only 40,000 t of capelin had been taken by 15 February there was practically no possibility of the catch exceeding the above limit in the short time remaining of the winter 1995 season (6-7 weeks). A formal advice on TAC during the winter 1995 season was, therefore, never issued.

5.5 The Fishery in the 1994/1995 Season

The summer capelin fishery was opened on 1 July 1994. In the first half of July the fleet was mainly fishing with relatively high catch rates off the eastern north coast of Iceland at about latitude 68°N. The fishery gradually moved to the west and was in the latter half of July conducted off the western north coast of Iceland, but with reduced catch rates. By August, the fishery had shifted to the area between the Vestfir_ir peninsula and Greenland, south of Scoresby Sound, where the fleet finally lost contact with the fishable stock.

In spite of intensive search, hardly any fishable concentrations were located during the remainder of the 1994 summer/autumn season. Thus, 218,000 t were taken in July, 89,000 t in August and only 17,000 t during the period September-December. Thus, the total capelin catch in the 1994 summer/autumn season amounted to just under 324,000 tonnes.

Because of extremely difficult weather conditions and scattered distribution of the capelin east of Iceland, practically no catches could be taken until in the second week of February 1995, when the first spawners migrated into and concentrated in the shallower waters off the southeast coast of Iceland. From about mid-February until 20 March the fishery was quite intensive and only hampered by spells of bad weather and the capacity of the shore-based reduction plants. Towards the end of March, good catches became more sporadic until the end of the season in early April. With the exception of the Greenlandic vessel "Ammassat", which landed only 440 tonnes, the winter 1995 capelin fishery was exclusively Icelandic.

A total of 863,900 t were landed by Icelandic, Norwegian, Greenlandic and Faroese vessels in the 1994/1995 season (Table 5.1.2). About 400,000 t were left and spawned in the spring of 1995 (cf. Tables 5.1.1 and 5.2.2).

The total international catch in numbers by age groups is given for the summer autumn 1994 and the winter 1995 seasons in Tables 5.1.3 and 5.1.4. The length distribution of the catch is given by age groups in Tables 5.5.1 and 5.5.2.

5.6 Stock Abundance and TAC in the 1995/1996 Season

The main component of the fishable stock in the 1995/1996 season will be the maturing part of the 1993 year class and that part of the 1992 year class which did not mature and spawn at age 3 in the spring of 1995.

The October 1994 survey gave an estimate of 119.0 billion capelin belonging to the 1993 year class. The winter 1995 assessment gave a total of 33.4 billion mature capelin, belonging to the 1992 year class (Table 5.4.2). Counting the catch and assuming a monthly natural mortality rate of 0.035 this estimate corresponds to 59.8 billion maturing capelin of the 1992 year class when back-calculated to 1 August 1994 (Table 5.3.1).

As stated in section 5.4, the October 1994 survey underestimated the larger individuals of the 1992 year class (size >15 cm). Using the winter 1995 survey estimate of the abundance of these size categories and the October 1994 estimate of the smaller fish (<15 cm), the back-calculated total estimate of the 1992 year class on 1 August 1994 is 71.4 billion capelin, when account has been taken of fishing and natural mortalities (Table 5.3.1).

After updating the appropriate regressions in the light of new information, the prediction model, described in section 5.3 gives:

a) for the 1993 year class; $N_2^{mat} = 0.66\ N_1 + 14.4$; $R^2 = 0.73$, $P<0.01$.

b) for the 1992 year class; $N_3^{tot} = 0.39\ N_2^{tot} - 12.8$; $R^2 = 0.67$, $P<0.01$.

The resulting predictions of the abundance by number of maturing capelin at ages 2 and 3 on 1 August 1995 are 92.5 and 14.9 billion fish, respectively.

The fishable stock biomass, obtained by multiplying the estimated stock in number by the average mean weight of maturing capelin in autumn, was then projected forward to spawning time in March 1996 with the usual prerequisites of a monthly mortality rate of M = 0.035 and a remaining spawning stock of 400,000 t. This gave a predicted TAC of 1,202,000 t if spread evenly over the time August 1995 - March 1996 (Table 5.3.3).

The limitations of this model and its historic performance (see Table 5.3.3 and section 5.3 above) indicate that a precautionary TAC should not exceed 2/3 of the total TAC predicted for the whole season. According to this criterion the precautionary TAC for the 1995/96 capelin fishery should be set at 800,000 t. Decisions on the final TAC for the 1995/96 season should, as in earlier years, be based on the results of surveys carried out in October-November 1995 and/or January 1996.

The stock prognosis just described was submitted to the May 1995 meeting of ACFM. The resolution of that meeting concurred with the above advice of a precautionary TAC of 800,000 t for the 1995/96 season, the final decision to be made when the stock had been surveyed in autumn 1995/winter 1996. This advice was subsequently accepted by all parties concerned and a TAC of 800,000 t set for the first part of the season.

The autumn 1995 stock assessment survey is scheduled to begin on 25 October. Therefore, no further information is as yet available on the actual state of the present fishable stock of capelin in the Iceland-East Greenland-Jan Mayen area.

5.7 The 1995 Summer and Autumn Fishery

The season opened on 1 July with the Icelandic fishing fleet taking good catches, especially near the shelf edge north of the Vestfir_ir peninsula. However, it soon became apparent that the catch consisted of slow growing 2-group capelin, especially in the westernmost part of the fishing area. Therefore, this area was temporarily closed to the fishery around mid-July.

On 10 July a Norwegian fishery began in deep water areas the ENE of Langanes with catches consisting mainly of large capelin of the 1993 and 1992 year classes. However, it seems that there was not much capelin in this area and the fishery soon shifted to near the shelf edge north of Melrakkaslétta (around 16°W).

Extensive sampling of the catch around mid-July by Icelandic fishery inspectors revealed that a large part by number of the catch in the north Icelandic area consisted of capelin <13.5 cm. The fish were full of copepods and were expected to increase rapidly in weight in the next few weeks. The area within the Icelandic EEZ, south of 68°10'N to the west of 18°W, and south of 67°40'N to the east of 18°W was, therefore, closed as of 19 July 1995. At the time there was much ice in the Denmark Strait, as well as east of Greenland farther to the north, and no fishable capelin concentrations could be found outside of the closed area.

When the fishing ban was lifted on 9 August, the Icelandic fishing fleet searched for capelin in the previously closed area as well as in most of the usual summer distribution area of the fishable stock. No fishable concentrations were located.

In the summer of 1995, Icelandic, Norwegian, Greenlandic and Faroese vessels caught about 82,000, 28,000, 1,000 and 200 tonnes, respectively. All of the catch was taken in July.

5.8 Stock Abundance and TAC in the 1996/97 Season

The main components of the fishable stock in the 1996/97 season will be the 1994 and 1993 year classes. As yet the only available information on the abundance of the 1994 year class is the 0-group and 1-group indices, obtained in August 1994 and 1995, respectively. An abundance estimate of the 1993 year class as 1-group was obtained in October/November 1994.

The 1994 0-group capelin index is one of the highest indices recorded in the past (Table 5.8.1). Further, the August 1995 0-group survey yielded an estimate of 189 billion 1-group capelin of the 1994 year class. This is the second highest August estimate of 1-group capelin on record (Table 5.8.2). The autumn 1994 survey results indicated a strong 1993 year class, but as stated in section 5.6 no new information on the abundance and

maturing ratio of this year class has yet been obtained in 1995.

Although the above information thus indicates good recruitment to the fishable stock of 1996/97, experience has shown that such type of data are erroneous predictors of stock abundance one and a half to two years ahead in time.

Information necessary for predicting year class abundance in the 1996/1997 season, using the method described in section 5.2, will not become available until after both the autumn 1995 and winter 1996 surveys have been completed. Therefore, even a preliminary advice on a precautionary TAC for the 1996/1997 season, must be postponed, at least until late November 1995.

5.9 Closed Areas During the Summer-Autumn Season

In the years 1989-1992 very few capelin seem to have migrated to feed in the central and northern parts of the Iceland-East Greenland-Jan Mayen area. Instead, most of the adult stock apparently stayed in or near the shelf area north of Iceland to feed there together with the immatures. Although on a smaller scale, this is also true for other years since as a rule only part of the fishable stock migrates to feed at high latitudes in summer.

When conducted over the north Icelandic shelf and in the area of the Iceland-Greenland Ridge, a summer fishery, and in part the autumn fishery also, is usually dependent upon mixed concentrations of mature and immature capelin. Such fishery inevitably results in repeated escape of 1-group capelin and the smallest 2-group fish, which are generally not retained by the mesh used in capelin seines. While there are no measurements of mortalities caused by escape, it is likely that fishing for prolonged periods on such mixed concentrations can cause mass mortality of 1-group capelin that goes unnoticed (Anon., 1993a). This was indeed the situation in July of 1995, when the closed area west of 18°W only reached 67°45'N while fishing was allowed east of that longitude without constraints.

A closure of an area south of 68°N from west of 18°W and south of 67°30' from east of 18°W, within the Icelandic EEZ, would effectively force the initial fishing operations in July and August to take place in deep water areas and to concentrate on fast growing fish with maximum fat content. This area should, therefore, be closed to the fishery during those months.

The October-November surveys will resolve the actual size distribution of capelin within the waters of the north Icelandic shelf and allow the establishment of further area closures, if necessary, on a real time basis.

5.10 Comments on the Assessment

The Working Group noted that alternative methods for computing the precautionary TAC should be considered. In particular, an approach which directly uses the relationship between abundance and the proportion mature should be investigated.

6. BLUE WHITING

6.1 Stock identity and stock separation

Preliminary results of investigations conducted by Russian and Norwegian scientists (Mazhirina, 1993; Belikov 1993; Mork and Gievær 1993) in 1991-1993 indicate that several populations could appear in the spawning area. There were, however, no indications of genetic substructure among the blue whiting from west of the British Isles to Gibraltar.

In 1995 genetic investigations of population structure of blue whiting were continued by Norwegian scientists. It was found that the southern boundary of the separate stock off Northern Norway was located north of Lofoten Isles, and in addition two local populations were identified, i.e. one in a fjord in North-Norway and one in a fjord in West-Norway (Giæver and Mork, 1995).

ACFM also agreed at its November 1993 meeting that the two stocks should be combined for assessment purposes, but that the catch predictions could still be done by area.

The Working Group, ACFM and NEAFC adhere to the idea of a single blue whiting stock. However, it is considered necessary to continue the study of this species' population structure.

6.2 Fishery in 1994 and 1995

Estimates of total landings of blue whiting by countries in 1994 from various fisheries by countries are given in Tables 6.2.2-5 and summarised in Table 6.2.1. The total landings from all blue whiting fisheries in 1994 were 455,739 t which is 4 % less than in 1993.

The majority of the blue whiting catches have been taken in the spawning area. The landings in 1994 from the directed fishery increased by 3 % and the industrial mixed fishery decreased by 54 % respectively compared to 1993.

Preliminary data on the blue whiting catches from January-August 1995 were submitted by Working Group members and the total preliminary catch amounted to 380,000 t (Table 6.2.6). Scaling this to the preliminary catch within the same period of 1994, the expected total catch of 1995 will be 470,000 t.

Landings from the southern area, i.e. from Spain and Portugal were 29,473 t in 1994 which is 9 % less than in 1993 (Table 6.2.1).

6.3 Biological characteristics

6.3.1 Length Composition of Catches

Data on length composition of the 1994 catches of the blue whiting stock by ICES-division were presented by Norway, Faroes, Portugal and Spain (Table 6.3.1-4). Length composition of the catches varied over seasons and areas.

Length composition of catches of blue whiting taken by Faroese vessels in 1994 varied in the directed fishery from 20-40 cm, in mixed fishery from 14-26 cm. The Norwegian directed fishery in 1994 was based on blue whiting with length 23-40 cm and the mixed fishery 19-39 cm. Blue whiting in the length range 12-39 cm was taken by the Spanish and Portuguese vessels in 1994.

Data on length composition of the catches in 1995 were presented by Norway, Faroes and Russia (Table 6.3.5-8). The bulk of the Norwegian catches in the directed fishery consisted of fish from 22-42 cm and in the mixed industrial fishery from 13-34 cm. The length compositions from the Russian vessels ranged from 16-44 cm, with fish of length 31-33 cm dominating. Length compositions of blue whiting catches taken by Faroese vessels in 1995 varied from 22-40 cm.

6.3.2 Age Composition of Catches

For the directed fishery in 1994 age compositions were provided by Norway and Faroes. These countries accounted for 62 % of the landings. The landings for the directed fishery of Russia, Latvia and Estonia in area Vb and Russia in area IIa and VIa were allocated to catch in numbers by use of Faroese age compositions in the same areas, and the rest of the landings for the directed fishery were allocated to catch in numbers by use of Norwegian age compositions in the same areas (Table 6.3.9).

For landings of blue whiting taken in the mixed industrial fisheries, age compositions were provided by Norway and The Faroes representing 21 % of the landings (Table 6.3.10).

For the landings in the Southern area catch-at-age data for Portugal and Spain were calculated using the age length keys provided by Spain (Table 6.3.11).

The combined age composition for the directed fishery in the spawning area and in the Norwegian Sea, as well as the total mixed industrial fishery, together with the age composition for the landings in the southern area, were assumed to give the total age composition of the total landings from the blue whiting stock (Table 6.3.12).

6.3.3 Weight at Age

Data on mean weight at age for 1994 were presented by Norway, Faroes and Spain. Landings from other countries were assumed to have the same mean weight at age composition when fished in the same area and period as the sampled catches. Table 6.3.13 shows the mean weight-at-age from 1981-94 as used in the VPA run. The weight in the stock was assumed to be the same as in the catch.

6.3.4 Maturity at Age

Table 6.3.14 shows the maturity-at-age from 1981-94 as used in the VPA run.

6.4 Stock estimates

6.4.1 Acoustic surveys

6.4.1.1 Surveys in the spawning season

In 1995 during the period 22 March-24 April, Norway and Russia carried out surveys in the shelf edge area to the west of the British Isles for recording of the distribution, and for assessment of the blue whiting spawning stock size (Monstad *et al.* 1995a). It was the fifth joint survey by research vessels from IMR, Bergen and PINRO, Murmansk. The Norwegian survey was also part of the SEFOS-project (EC, AIR) and hence a numbers of plankton stations were also worked for studies of the blue whiting eggs and larvae. Both vessels operated echo sounders of 38 kHz (EK-500), and a ship-to-ship calibration performed resulted in a 1:1 relationship of the vessels' acoustic instruments.

Separate estimates were made by both vessels and combined on subarea basis. The area was surveyed from the south (48°30'N) and northwards to the Faroe/Shetland area (62°00'N), including the Porcupine bank (Figs.6.4 1 and 6.4.2). Blue whiting was recorded along the whole continental slope, with the densest concentrations recorded the 5-6 April near the edge of the northern part of the Porcupine bank. One week later these concentrations had moved approximately 150 nautical miles northwards (Figs.6.4.3 and 6.4.4).

The combined result of the acoustic assessment was a biomass of 6.1 mill. tonnes belonging to the spawning stock, and 0.8 mill. tonnes of immature blue whiting. These represent 45.5×10^9 and 21.9×10^9 individuals respectively.

By numbers one year old blue whiting dominated, especially in the Faroe/Shetland area. Totally, this 1994 year class made up almost 30 % of the stock recorded. Among the adults the 1992 year class was the most numerous one (Fig.6.4.5).

6.4.1.2 Surveys in the feeding season

During the international investigations on herring and environment in the Norwegian Sea (Anon., 1995a), blue whiting was recorded by Russia, Norway and Faroes over a rather wide area in June/July and July/August (Figs.6.4.6 and 6.4.7). From the Faroes area the distribution in May/June stretched northwards to 71°N between the Norwegian coast and 5°W, while in July/August it was observed northwards to 74°N and westwards to 7°W. The recordings were mostly of very scattered nature, but some higher concentrations were, however, in both periods found between 62° and 68°N from the Norwegian coast to 1°E.

Norway, with the R.V."Johan Hjort" from 7/7-2/8 assessed the biomass to 1.8 mill. tonnes (Monstad *et al.*, 1995b), while Russia, with R.V."Prof. Marty" from 6/6-12/7 assessed it to 2.5 mill. tonnes (Krysov, 1995).

The weighted total length and age composition of blue whiting obtained by the Norwegian, Russian and Faroese vessels are shown on Fig.6.4.8. Totally the 1994 year class dominated and contributed with 45 % in numbers to the stock recorded.

6.4.1.3 Discussion

In the text table below the total biomass estimates (in million tonnes) in the spawning area since 1983 are given. The corresponding spawning stock size are given in brackets.

Year	Russia	Norway	Faroes	Russia + Norway combined
1983	3.6 (3.6)	4.7 (4.4)	-	-
1984	3.4 (2.7)	2.8 (2.1)	2.4 (2.2)	-
1985	2.8 (2.7)	-	6.4 (1.7)	-
1986	6.4 (5.6)	2.6 (2.0)	-	-
1987	5.4 (5.1)	4.3 (4.1)	-	-
1988	3.7 (3.1)	7.1 (6.8)	-	-
1989	6.3 (5.7)	7.0 (6.1)	-	-
1990	5.4 (5.1)	6.3 (5.7)	-	-
1991	4.6 (4.2)	5.1 (4.8)	-	4.7 (4.4)
1992	3.6 (3.3)	4.3 (4.2)	-	4.6 (4.3)*
1993	3.8 (3.7)	5.2 (5.0)	-	5.1 (4.9)
1994	-	4.1 (4.1)	-	-
1995	6.8 (6.0)	6.7 (6.1)	-	6.9 (6.1)

* with calibration factor: 1.38

The variability between survey estimates in the early years of the period listed above has been discussed in previous Blue Whiting Working Groups. As also mentioned in previous reports the main factors will be the difference in acoustic equipment, weather conditions during the surveys, size of the area surveyed and timing of the survey with respect to spawning progression.

From 1988/89 up to 1992 there has been a downward trend in the spawning stock estimates. In 1993 the stock increased slightly due to the notable arrival to the spawning stock of the rich 1989 year class, but in 1994 it was again estimated to be lower, i.e. at the same level as in 1992. Generally the spawning stock acoustic estimates are considered under-estimates, due to the continuous long lasting pre- and post-spawning migration throughout the season. The 1994 estimate of 4.1 mill. tonnes, however, has to be considered as a more serious underestimate than average because of the extremely bad weather conditions during that year's survey. The weather conditions in 1995 were however, very favourable and hence the best possible coverage of the spawning stock within the survey period was obtained. The result of 6.1 mill. tonnes for the spawning stock can therefore be regarded a more precise estimate than the results for many years. The significant increase in the stock size in 1995 of approximately 1 and 2 mill. tonnes from 1993 and 1994 respectively, are partly due to differences in recording conditions, but also to the increased recruitment to the spawning stock.

The 1994 year class made up almost 30% of the stock recorded during spring 1995, which is the highest contribution recorded for one year olds during similar surveys in the area. This year class dominated in the Faroes-Shetland area. Among the adults, however, the 1992 year class was the most numerous one, but the 1989 year class, which has predominated in the spawning stock since 1991, still contributed significantly.

During the post-spawning and feeding period of 1995 the surveys in the Norwegian Sea covered altogether rather large areas of the main blue whiting stock's assumed feeding area. One should therefore expect to observe a greater part of the stock, but this was not experienced in earlier years nor in 1995. Except for a few localities, only weak recordings of blue whiting were obtained. That led to the conclusion that either a greater part of the stock remains outside the surveyed area, or that the fish behave in ways that make them difficult to observe, e.g. scattered over vast areas at great depths (Anon. 1985).

In summer 1994 the blue whiting stock in the Norwegian Sea was not assessed. In summer 1993 the biomass was estimated to be 1.7 mill t, but within the area from Skagerrak to 74°N in the Norwegian Sea. Within the same area, covered both these years, the difference was approximately 0.3 mill tonnes more in 1995 than estimated in 1993. The spawning stock to the west of the British Isles was, however, estimated to be 6.1 mill tonnes in March/April 1995, which demonstrates that only a part of the total stock was measured during its feeding season in the Norwegian Sea.

As observed during the joint survey west of the British Isles in 1995, one year old blue whiting dominated also in the feeding area, i.e. in the central and eastern part of

the Norwegian Sea, where it contributed with 45 % in numbers.

The German ichthyoplankton investigations carried out during spring 1994 in the area west of the British Isles, indicated that the 1994 year class was a rich one (Hillgruber *et al.*, 1995).

6.4.2 Bottom trawl surveys in the Southern area

Bottom-trawl surveys have been conducted off both the Galician (NW Spain) and Portuguese coast since 1980 and 1979 respectively, following a stratified random sampling design and covering depths down to 500 m. Since 1983, the area covered in the Spanish survey was extended to completely cover the Spanish waters in Division VIIIc. Stratified mean catch and standard error in Spanish bottom trawl surveys (in weight and in number by haul) since 1985 are shown in Table 6.4.1.

6.4.3 Catch per unit effort

Data on CPUE from the fisheries in the Northern area were submitted only by Norway. Those data, which were from the directed fishery in 1994, were broken down by vessel tonnage class, area, and month. The data were combined and added to the time series of overall aggregated CPUE values across areas in the Norwegian blue whiting directed fisheries, and presented in Fig.6.4.9. There was a decline from 33 t/h in 1983 to 10 t/h in 1991, then an increase to approximately the same level of 25,28 and 27 t/h for 1992, 1993 and 1994 respectively.

Data on CPUE of 1994 from two fleets were submitted by Spain (Galician single and pair trawl), and shown in Fig. 6.4.10. While the CPUE varied throughout the 1980s for both fleets, it has been more stable in the 1990s. From 1993 to 1994, however, the single trawlers' CPUE was reduced slightly and the pair trawlers' increased slightly.

6.4.4 Virtual Population Analysis (VPA)

The blue whiting in the North Atlantic is treated as one combined stock in the present analysis.

6.4.4.1 Tuning the VPA to survey results

Big discrepancies are observed between SSB estimates from acoustic and VPA based on XSA, not only in the level, but also in the trend (Fig.6.4.11a). In the last few years, when the surveys are supposed to be more accurate, and the Norwegian and the Russian surveys are more in agreement, there are still conflicting trends between the surveys and the SSB from the VPA. This problem was analysed and it was found that when plotting the spawning stock in numbers obtained in the surveys and in the VPA, the trends are less conflicting (Fig.6.4.11b). The only explanation to the conflicting trends in the spawning stock estimates in weight and in number must be found in the mean weights at age used for the survey and in the VPA. As a consequence, the weight at age matrices for 1991 onwards will be revised. The remaining difference could be explained by the use of a different maturity ogive each year in the acoustics, and a constant in VPA up to 1992.

Altogether 5 tuning series were used by the Working Group in 1994 to tune the VPA. Two series from the spawning area west of the British isles (Norwegian acoustic and Russian acoustic surveys, previously used in the tuning of the Northern stock), two from Spain (CPUE from pairtrawlers and bottom trawl survey) ,one series from the acoustic surveys in the Norwegian Sea during the feeding season in the summer. Especially the inclusion of the acoustic surveys in the Norwegian Sea with estimates of recruits (age range 0-11) from 1980 to 1993, seem to improve the tuning, especially for the younger ages. In addition, a new tuning series was provided by Portugal, obtained in the bottom trawl surveys, and was also used in the assessment (Table 6.4.2).

Earlier tests (Anon. 1994b) had indicated that variations on XSA options did not improve the reliability of the results. For this reason only a standard XSA run is presented in Tables 6.4.2-6.

It is seen in this tables that standard errors of the catchabilities are very high and t-tests of the slope of regressions are in many cases quite high. In light of this and the various problems described in earlier sections, it was concluded that available input data is not sufficient to support a full-fledged XSA-based stock assessment.

6.4.4.2 Alternative Tuning Method

An alternative method (YC method) to estimate a year class based on survey results and catches is described in section 3.5.1.

The 1989 year class is used in this analysis, because it is strong and it might give a better approximation to the survey results, and furthermore it is still in the fishery. Two other choices, the strong 1982 and 1983 year classes, might be used, but as they are practically no longer present in the fishery , they add very little to the estimate of the present stock in 1995 in this method. Therefore they were not used. The age ranges used for the 1989 year class were from age 3-6, i.e. the years 1992-95.

The Norwegian and the Russian acoustic surveys in the spawning area in the spring, and a Norwegian acoustic survey in the Norwegian Sea in the summer were used in this method. The large errors and variances associated with the Norwegian Sea survey from the method lead to the exclusion of this survey in the analysis.

Results from the estimation of the terminal number in the stock of the 1989 year class in 1995 are shown in Table 6.4.7 in the column labelled "YC estimate". The acoustic estimates from the Norwegian and the Russian surveys are also shown, and for comparison the XSA estimates of the 1989 year class (unweighted and weighted) are also given. The unweighted XSA is just an ordinary XSA (Section 6.4.4.1) where the tuning series (fleets) are weighted due to the inverse variance in the data, while in the weighted XSA the fleets are manually weighted according to the catch proportions in the area where the surveys have been conducted. The weights given to the fleets were as follows:

Norwegian spawning area acoustics:	0.40
Russian spawning area acoustics:	0.40
CPUE Spanish pair trawlers:	0.04
Spanish bottom trawl survey:	0.03
Norwegian Sea acoustic survey:	0.10
Portuguese bottom trawl survey:	0.03
Total:	1.00

This downweighting of the Spanish, Portuguese and the Norwegian Sea acoustic surveys do not reflect the Working Group's confidence in any particular survey.

It should be noted that the estimated catchability (availability) factor q_s for the Russian survey was nearly 2 and nearly 3.5 for the Norwegian survey as compared to the numbers back-calculated from the catches (Table 6.4.7), indicating that the surveys and especially the Norwegian survey give consistently higher stock estimates compared to VPA as noted earlier.

In Figure 6.4.12 the "YC estimate" is shown as a solid line for the years 1992-1995, and the other year class estimates are also indicated by points. There appears to be relatively good fit of the acoustic surveys to the YC estimate (line) for all but the first year, where the Norwegian estimate seems to be too low. It is worth noting the very good agreement between the YC estimate and the ordinary unweighted XSA, while the weighted XSA estimate is consistently higher by approximately 2 billion fish but with exactly the same trend. The good agreement in trend between the YC method and the XSA methods are not unexpected, since both methods are based on the same principles of minimising the SS between the survey estimates and the VPA stock estimates of the different year classes simultaneously.

6.4.4.3 Conclusion

The Working Group concluded that the available data are not of sufficient quality to support an analytical stock assessment at this time. It was noted, however, that several data problems have been explicitly identified and some of these would work to the effect of reconciling the data series.

6.5 Spatial, temporal and zonal distribution

The available knowledge from various sources on the distribution and the main fishing areas of blue whiting in the northern area were summarized and presented in the previous Working Group Reports (Anon., 1985, 1991b and 1995c).

During 1995 rather interesting new information were obtained about distribution of eggs and larvae west of the British Isles. Icthyoplankton observations were made by R.V. "Johan Hjort" (Monstad *et al.*, 1995). Blue whiting eggs were numerous in the sampling area except to the north of Scotland where spawning had not yet commenced (Fig. 6.5.1). Larvae of blue whiting were taken mostly at the same stations as the eggs, but with relatively higher concentrations around Porcupine, indicating that spawning had taken place for a longer period of time in that area, than to the west of Scotland (Fig.6.5.2).

Under-sampling of larvae was probably of less significance than for the eggs. The blue whiting larvae ranged from 2.0-7.5 mm in length with a mean of 3.75 mm. Larvae larger than 4.5 mm predominated over and to the south of the Porcupine Bank, indicating that spawning had been in progress for at least a few weeks in those areas.

During spring, most of the blue whiting recordings were made within the EU-zone, i.e. in British and Irish waters. Most of the blue whiting concentrations in the feeding season in the Norwegian Sea were observed in the Norwegian and The Faroese zones (Fig. 6.4.7), however, this might not be the true picture of the total stock situation. The WG, concludes every year that the percentage distribution of concentrations obtained within various zones strongly depends upon the geographical size and location of the survey area.

Total catch of blue whiting in 1978-1994 divided into areas within and beyond national fisheries jurisdiction of NEAFC area are presented in Table 6.5.1, as provided by the Working Group members. The catches of nations not attending the WG meeting have been subjectively allocated to the probable appropriate zones. This is a complicated and hazardous undertaking, as the data available to the WG are insufficient for the task. Consequently, the WG has only limited confidence in the final table.

6.6 Biological uncertainties

In the Blue Whiting Assessment Working Group Report of 1994 (Anon., 1994b) three main sources were identified as problems for the assessment of the blue whiting stock; age determination, stock identity and acoustic estimates.

Age determination: Several otolith exchanges and workshops have been carried out since 1979 to solve discrepancies between countries. The workshop in November 1992, however showed that there is no difference in the structure of otoliths from the Southern and the Northern areas (Anon. 1993b). Further exchange programmes and workshops were recommended, to identify the causes of difference age readings between various countries on a regular basis, and especially between Norway and Russia.

In October/November 1994 another otolith reading workshop was held in Bergen, between otolith readers from Russia and Norway, with the main purpose to compare their different interpretation and traditions of age reading. The aim was also to start a process of gradually arriving at a common method for future age reading of blue whiting otoliths (Seliverstova *et al.*,1994).

There were disagreements both between the readers from the two different institutes (12-22 %) and between individual readers from each country (12-13 %). The greatest disagreement in the age evaluation occurred from otoliths of age 3-5 years old and older, i.e. when false rings were present. Great difficulty also occurred when reading otoliths taken around mid-summer, due to the determination of the last ring.

Stock identity
The study of genetic population structure has so far not given indications on genetic substructure among blue whiting from west of the British Isles to Gibraltar (Mork and Giæver, 1993). Since 1994 the blue whiting in the North-East Atlantic therefore has been assessed as one stock. However, the blue whiting population question is far from solved, and further genetic studies to clarify the picture continue.

Acoustic estimates
The discrepancies between different acoustic estimates are caused by several factors. Among these the influence of the biological conditions and fish behaviour on target strength values are major, as is the effect of timing and direction of stock migration during the survey area, as well as the hydrological situation, trawl sampling differences and, as mentioned above, the age reading errors. The extremely large area to be covered has also to be considered as an important source of error.

7. ECOLOGICAL CONSIDERATIONS

In the terms of reference item (e) the Working Group is asked to consider how biological interactions can be incorporated into the assessments of capelin, herring and cod stocks. In this chapter we provide relevant new information on this subject.

7.1 Barents Sea/Norwegian Sea

7.1.1 Oceanography

The recruitment of herring and cod is positively influenced by high temperatures (Sætersdal and Loeng, 1987). The temperature in the Barents Sea in 1995 is above the long-term average, according to several Norwegian and Russian surveys. However, the temperature itself is only a proxy for several important underlying parameters. Such parameters can be the degree of drift into optimal nursery areas, turbulence and feeding conditions (Sundby 1995). More research is needed to clarify the full impact of these parameters on recruitment variability.

7.1.2 Plankton

The plankton abundance in the Barents Sea in 1995 is described in a working document by Hassel and Johannesen. Figure 7.1 gives the plankton abundance by area and year for the period 1986-1995. From 1991 to 1994 the plankton abundance increased in all areas. In the north-eastern part of the Barents Sea, the abundance increased from 1994 to 1995, while a reduction was observed in the remaining areas.

7.1.3 Predation by cod

Data on the predation by cod on various prey species, including capelin and herring , are compiled and discussed in a working document by Bogstad and Mehl. The annual consumption of various prey stocks by cod in the period 1984-1994 is given in the text table below.

Consumption by cod of various prey species 1984-1994, in thousand tonnes.

Year	Krill	Amphipods	Shrimp	Capelin	Herring	Cod	Haddock	Polar cod	Redfish	Others	Total
1984	120	28	442	735	77	23	53	15	369	520	2382
1985	49	156	155	1630	187	32	47	3	226	1138	3623
1986	111	1232	140	833	136	82	109	140	315	663	3761
1987	71	1107	191	221	32	24	4	202	313	703	2868
1988	334	1299	137	325	8	9	3	91	235	476	2917
1989	274	895	141	641	3	9	11	37	250	922	3183
1990	85	155	214	1788	8	21	18	7	277	2087	4660
1991	93	80	308	3250	9	31	23	13	360	1853	5920
1992	285	155	429	3107	389	127	165	138	242	1718	6755
1993	499	280	365	3690	198	361	90	341	122	1250	7196
1994	819	809	629	1094	175	311	51	803	118	1007	5816

The table shows that the cod's consumption of capelin decreased by 2.6 million tonnes from 1993 to 1994, showing the same trend as the acoustic abundance estimates in the autumn 1993 and 1994 (796 and 199 thousand tonnes, respectively). The same phenomenon was also observed in 1986, when the capelin stock also was low. We also see that the annual consumption of shrimp by cod increased by about 50 % from the 1992-1993 level to 1994. The consumption of cod by cod (cannibalism) increased dramatically from 1992 to 1993-1994. The fraction of cod in the diet is, however, not higher than the few stomach content data from the 1950s (Bogstad *et al.* 1994) indicate. The amount of redfish consumed dropped from a previously stable level of about 250-350,000 tonnes in 1984-1992 to about 120,000 tonnes in 1994. The amount of amphipods consumed increased considerably in 1994, but has not yet reached the level observed during the previous capelin stock collapse in 1986-1989, when the cod switched from capelin to amphipods as prey. The amount of herring consumed is not very high, and was reduced by about 50% from 1992 to 1993-1994. The rapid increase in the consumption of polar cod in 1992-1994 should also be noted.

7.1.4 Marine mammals

Cod is the most important predator on fish stocks in the Barents Sea, but predation by marine mammals (especially harp seal and minke whale) may also have a significant impact on the fish stocks in the Barents Sea. The food consumption by harp seals and minke whales in the Barents Sea has been estimated by Nordøy *et al.* (1995a,b). They calculated that minke whales consumed 450,000 tonnes of herring and 355,000 tonnes of capelin in the Barents Sea and Norwegian Sea in 1992, while harp seals consumed about 200,000 tonnes of herring and 250,000 tonnes of capelin in the Barents Sea in 1993. These estimates are based on a small number of stomach samples, and are more uncertain than the estimates of the consumption by cod. Also, the knowledge about year-to-year variability in the consumption by marine mammals is scarce.

The impact of harp seal and minke whale on the cod, capelin and herring stocks was studied by Bogstad *et al.* (1995) using the Multspec model. Simulations were carried out over a 20-year period for various assumptions about the diet composition for minke whales.

7.1.5 Consumption of herring

It is very important to relate the herring mortality rates calculated by Barros (1995) to mortality rates calculated from stomach content data and gastric evacuation rate models. It should be investigated whether the amount of herring consumed by cod, minke whale and harp seal according to the consumption calculations is compatible with the biomass removed by natural mortality, and reasons for discrepancy should be investigated.

7.2 Icelandic waters

An earlier multispecies model described in Stefánsson *et al.* (1994) included cod, capelin and shrimp in an aggregated model. Two major extensions to this may be important, *i.e.* including marine mammals in light of the indications in Sigurjónsson and Víkingsson (1995) and differentiating areas and seasons as indicated in Anon. (1994a). The past few years have seen the development and adoption of a formal harvesting strategy for cod in addition to the *de facto* $F_{0.1}$ harvesting strategy for herring, the 400 thousand tonnes target SSB strategy for capelin and a *de facto* biomass-based strategy for shrimp. This development makes modelling easier than earlier since there is no need to model a large variety of harvesting strategies for all species but rather to focus on the development of biological models.

The above models have been extended by including marine mammals in an aggregated model as described in Stefánsson *et al.* (1995). The analysis indicates that the marine mammals are potentially quite important factors in the development of the cod and capelin stocks and catches. Furthermore, the uncertainty in predictions

is increased due to the uncertainty in consumption by marine mammals and cod.

The models are currently being extended in the direction of including spatial and seasonal effects as described in Pálsson and Stefánsson (1995). The preliminary results seem to indicate that it is feasible to combine a wide variety of data sources to estimate parameters describing migration, consumption and inflicted natural mortality, growth and harvest.

7.3 Multispecies modelling at other meetings

This year, the Multispecies Assessment Working Group (Anon., 1996) reviewed three multispecies models for boreal ecosystems:

1) The Norwegian multispecies model Multspec, which include the species cod, capelin, herring, minke whale and harp seal.

2) The Icelandic multispecies model Bormicon, containing the species cod and capelin.

3) The Russian MSVPA model for the Barents Sea, containing the species cod, herring, capelin and shrimp.

The meeting focused on cod-capelin interactions. All models were able to reproduce the main features observed in the ecosystems (fluctuations in stock size and in individual growth of cod).

7.4 Conclusions

The Working Group noted that the multispecies models may potentially resolve some important questions regarding e.g. natural mortality of herring and capelin. It is recommended that the work described above be continued and advances reported to the next meeting of the group.

In particular it is of considerable interest to estimate the consumption of herring by e.g. killer whales in Icelandic waters in relation to natural mortality of herring. It is recommended that attempts be made to evaluate the possible effects of predation on the natural mortality of herring and advances reported to the next meeting of the group.

The Working Group also noted that it is important to continue the development of multispecies models for boreal systems in order to obtain a better understanding of both fish-fish and marine mammals-fish interactions that are of relevance to the stocks assessed by this Working Group.

8. RECOMMENDATIONS

1) The Working Group considers it very important that the blue whiting stock is monitored each year. It therefore recommends the continuation of the joint Norwegian-Russian acoustic survey aimed at assessing the stock biomass in the spawning area during spring, and also, the continuation of surveys in the Norwegian Sea in the feeding season on a national basis.

2) Based on observations made in 1994 and 1995, the WG believes that the 1994 and 1995 year classes of Blue Whiting are strong. As a result, the industrial mixed fishery will tend to be aimed at the high abundance of this resource, and hence a rather high number of small individuals will be caught. To avoid serious biases in the data set for the stock analysis, it is strongly recommended that the countries participating in this fishery frequently sample the catches and bring to the WG biological data as well as the catch data.

3) Annual workshops for blue whiting otolith reading should continue. This is for comparison of the various countries different methods and further discussion to gradually arrive at a common method for future age reading. The WG therefore recommends that a Workshop for reading of blue whiting otoliths should be held in Vigo, Spain in February 1996, with Manuel Meixide as coordinator.

9. SAMPLING SUMMARY

9.1 Icelandic summer spawning herring

Investigation	No of samples	Length measurements	Aged individuals
Fishery (1994-1995)	26	2558	2558

9.2 Norwegian spring spawning herring

Investigation	No of samples	Length measurements	Aged individuals
Norwegian fishery (1994)	21	11700	2045
Mean weight in stock 1 Jan 1995	47		4195
Acoustic wintering area 1994 -95	22	2185	1980
Acoustic spawning area 1995	2	2400	200

Catches adequately sampled. Very difficult to obtain satisfactory knowledge of age distribution of wintering and spawning population due to present extreme dynamic recruitment situation.

9.3 Barents Sea capelin

Investigation	No of samples	Length measurements	Aged individuals
Acoustic survey 1995	95	4619	2710

No fishing have been taking place, and therefore no samples from catches. Adequate number of samples in acoustic survey.

9.4 Capelin in the Iceland-East Greenland-Jan Mayen area

Adequate sampling.

9.5 Blue Whiting

Investigation	No of samples	Length measurements	Aged individuals
Fishery	96	4617	780
Survey British Isles	11	749	669
Survey Norwegian Sea	39	1146	682
Southern fishery	368	32348	1209
Southern surveys	126	not available	1208

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Table 2.1.1 Icelandic summer spawners. Catch in numbers (millions) and total catch in weight, '000 tonnes. Age in years is number of rings +1.

Rings/year	1975	1976	1977	1978	1979	1980	1981
1	1.518	0.614	0.705	2.634	0.929	3.147	2.283
2	2.049	9.848	18.853	22.551	15.098	14.347	4.629
3	31.975	3.908	24.152	50.995	47.561	20.761	16.771
4	6.493	34.144	10.404	13.846	69.735	60.728	12.126
5	7.905	7.009	46.357	8.738	16.451	65.329	36.871
6	0.863	5.481	6.735	39.492	8.003	11.541	41.917
7	0.442	1.045	5.421	7.253	26.04	9.285	7.299
8	0.345	0.438	1.395	6.354	3.05	19.442	4.863
9	0.114	0.296	0.524	1.616	1.869	1.796	13.416
10	0.004	0.134	0.362	0.926	0.494	1.464	1.032
11	0.001	0.092	0.027	0.4	0.439	0.698	0.884
12	0.001	0.001	0.128	0.017	0.032	0.001	0.76
13	0.001	0.001	0.001	0.025	0.054	0.11	0.101
14	0.001	0.001	0.001	0.051	0.006	0.079	0.062
Catch in wt	13.28	17.168	28.924	37.333	45.072	53.269	39.544

Rings/year	1982	1983	1984	1985	1986	1987	1988
1	0.454	1.47	0.421	0.111	0.1	0.029	0.869
2	19.187	22.422	18.011	12.8	8.161	3.144	4.702
3	28.109	151.198	32.237	24.521	33.893	44.59	40.855
4	38.28	30.181	141.324	21.535	23.421	60.285	98.222
5	16.623	21.525	17.039	84.733	20.654	20.622	68.533
6	38.308	8.637	7.111	11.836	77.526	19.751	22.691
7	43.77	14.017	3.915	5.708	18.228	46.24	19.899
8	6.813	13.666	4.112	2.323	10.971	15.232	31.83
9	6.633	3.715	4.516	4.339	8.583	13.963	12.207
10	10.457	2.373	1.828	4.03	9.662	10.179	10.132
11	2.354	3.424	0.202	2.758	7.174	13.216	7.293
12	0.594	0.552	0.255	0.97	3.677	6.224	7.2
13	0.075	0.1	0.26	0.477	2.914	4.723	4.752
14	0.211	0.003	0.003	0.578	1.786	2.28	1.935
Catch in wt	56.528	58.665	50.293	49.092	65.413	75.439	91.76

Rings/year	1989	1990	1991	1992	1993	1994
1	3.963	11.061	35.872	11.82	0.87	6.225
2	22.568	14.413	92.766	78.547	35.581	110.079
3	26.578	57.293	51.052	129.508	170.207	99.377
4	77.618	34.509	87.614	43.109	87.415	150.31
5	188.155	78.187	33.439	55.215	25.161	90.824
6	43	152.955	54.845	41.283	28.819	23.926
7	8.095	32.417	109.428	35.663	18.317	20.809
8	5.881	8.754	9.252	44.072	24.282	19.164
9	7.273	4.453	3.796	9.101	14.327	17.973
10	4.767	4.307	2.634	2.224	3.641	16.222
11	3.44	2.529	1.826	0.573	0.879	2.955
12	1.406	1.232	0.516	0.3	0.3	1.433
13	0.842	1.024	0.262	0.2	0.2	0.345
14	0.347	0.613	0.298	0.1	0.1	0.345
Catch in wt	100.733	105.593	109.499	106.825	102.802	134.003

Table 2.2.1 Icelandic summer spawners. Weight at age in grammes. Age in years is number of rings +1.

Rings/year	1975	1976	1977	1978	1979	1980	1981
1	110	103	84	73	75	69	61
2	179	189	157	128	145	115	141
3	241	243	217	196	182	202	190
4	291	281	261	247	231	232	246
5	319	305	285	295	285	269	269
6	339	335	313	314	316	317	298
7	365	351	326	339	334	352	330
8	364	355	347	359	350	360	356
9	407	395	364	360	367	380	368
10	389	363	362	376	368	383	405
11	430	396	358	380	371	393	382
12	416	396	355	425	350	390	400
13	416	396	400	425	350	390	400
14	416	396	420	425	450	390	400

Rings/year	1982	1983	1984	1985	1986	1987	1988
1	65	59	49	53	60	60	75
2	141	132	131	146	140	168	157
3	186	180	189	219	200	200	221
4	217	218	217	266	252	240	239
5	274	260	245	285	282	278	271
6	293	309	277	315	298	304	298
7	323	329	315	335	320	325	319
8	354	356	322	365	334	339	334
9	385	370	351	388	373	356	354
10	389	407	334	400	380	378	352
11	400	437	362	453	394	400	371
12	394	459	446	469	408	404	390
13	390	430	417	433	405	424	408
14	420	472	392	447	439	430	437

Rings/year	1989	1990	1991	1992	1993	1994	1995
1	63	75	74	63	74	67	72
2	130	119	139	144	150	135	141
3	206	198	188	190	212	204	194
4	246	244	228	232	245	249	248
5	261	273	267	276	288	269	283
6	290	286	292	317	330	302	298
7	331	309	303	334	358	336	323
8	338	329	325	346	373	368	350
9	352	351	343	364	387	379	361
10	369	369	348	392	401	398	378
11	389	387	369	444	425	387	406
12	380	422	388	399	387	421	399
13	434	408	404	419	414	402	411
14	409	436	396	428	420	390	420

Table 2.2.2 Icelandic summer spawners. Proportion mature at age. Age in years is number of rings +1. Based on samples taken in September - December by purse seine.

Rings/year	1975	1976	1977	1978	1979	1980	1981
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.27	0.13	0.02	0.04	0.07	0.05	0.03
3	0.97	0.90	0.87	0.78	0.65	0.92	0.65
4	1.00	1.00	1.00	1.00	0.98	1.00	0.99
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Rings/year	1982	1983	1984	1985	1986	1987	1988
1	0.02	0.00	0.00	0.00	0.00	0.00	0.00
2	0.05	0.00	0.01	0.00	0.03	0.01	0.05
3	0.85	0.64	0.82	0.90	0.89	0.87	0.90
4	1.00	1.00	1.00	1.00	1.00	1.00	1.00
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Rings/year	1989	1990	1991	1992	1993	1994	1995
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.06	0.00	0.01	0.02	0.05	0.05	0.04
3	0.93	0.78	0.72	0.93	1.00	1.00	0.98
4	1.00	1.00	1.00	1.00	1.00	0.99	1.00
5	1.00	1.00	1.00	1.00	1.00	1.00	1.00
6	1.00	1.00	1.00	1.00	1.00	1.00	1.00
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	1.00	1.00	1.00	1.00	1.00	1.00	1.00
9	1.00	1.00	1.00	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	1.00
11	1.00	1.00	1.00	1.00	1.00	1.00	1.00
12	1.00	1.00	1.00	1.00	1.00	1.00	1.00
13	1.00	1.00	1.00	1.00	1.00	1.00	1.00
14	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 2.3.1 Acoustic estimates (in millions) of the Icelandic summer spawning herring, 1974-1995.

Rings	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95
1	-	-	-	-	-	-	-	625	3	-	-	-	201	-	392	285	5	478	410	1418	-	-
2	154	5	136	-	212	158	19	361	17	-	171	28	652	-	126	725	178	805	745	254	332	-
3	-	137	20	-	424	334	177	462	75	-	310	67	208	-	352	181	593	227	850	858	533	-
4	-	19	133	-	46	215	360	85	159	-	724	56	110	-	836	249	177	304	353	687	860	-
5	-	21	17	-	19	49	253	170	42	-	80	360	86	-	287	381	302	137	273	160	443	-
6	-	2	10	-	139	20	51	182	123	-	39	65	425	-	53	171	538	176	94	99	55	-
7	-	2	3	-	18	111	41	33	162	-	15	32	67	-	37	42	185	387	81	87	69	-
8	-	-	3	-	18	30	93	29	24	-	27	16	41	-	76	23	-	40	210	44	43	-
9	-	-	-	-	10	30	10	58	8	-	26	17	17	-	25	30	-	10	32	92	86	-
10	-	-	-	-	-	20	-	10	46	-	10	18	27	-	21	16	-	2	11	39	55	-
11	-	-	-	-	-	-	-	-	10	-	5	9	26	-	14	10	18	-	-	-	2	-
12	-	-	-	-	-	-	-	-	-	-	12	7	16	-	17	9	-	-	17	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	4	6	-	8	5	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	5	6	-	6	3	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	5	1	-	3	2	-	-	-	-	-	-
5+	-	25	33	-	204	260	448	482	415	-	214	538	718	-	547	692	1043	752	718	521	753	-

Table 2.4.1 Stock abundance and catches by age groups (millions) and fishing mortality rate for the Icelandic summer spawners. F^1 is the F calculated from the acoustic surveys. Estimates for the 1-4 ringers in 1994. F_{p94} is the exploitation pattern in 1995 (used in the prognosis) and $F_{p\,av}$ is the average exploitation pattern for 1986-1990.

Rings in 1994	Year class	Acoustic estimate Jan.94	Catch 1994/95	F'	F94	$F_{p\,94}$	$F_{p\,av}$
1	1992	600	6.23	0.010	0.011	0.032	0.009
2	1991	1283	110.08	0.100	0.102	0.317	0.045
3	1990	533	99.38	0.220	0.212	0.66	0.174
4	1989	860	150.31	0.200	0.212	0.66	0.342
5+		752	193.65	0.320	0.322	1	1.000

Table 2.4.2 Icelandic summer spawners. Fishing mortality at age (M=0.1). Age in years is number of rings +1.

Rings/year	1975	1976	1977	1978	1979	1980	1981
1	0.008	0.001	0.002	0.014	0.004	0.013	0.003
2	0.018	0.060	0.040	0.062	0.095	0.070	0.022
3	0.104	0.040	0.183	0.131	0.161	0.165	0.098
4	0.110	0.139	0.126	0.136	0.238	0.284	0.123
5	0.237	0.149	0.253	0.133	0.212	0.326	0.249
6	0.097	0.230	0.187	0.316	0.156	0.202	0.319
7	0.104	0.147	0.331	0.281	0.316	0.243	0.170
8	0.175	0.128	0.266	0.708	0.164	0.366	0.174
9	0.140	0.200	0.199	0.492	0.409	0.123	0.412
10	0.012	0.218	0.354	0.561	0.242	0.573	0.087
11	0.005	0.368	0.056	0.729	0.502	0.558	0.725
12	0.165	0.006	1.137	0.041	0.100	0.002	2.183
13	0.145	0.220	0.007	0.614	0.157	0.510	0.203
14	0.105	0.189	0.317	0.468	0.256	0.322	0.534
W.Av 4-14	0.150	0.148	0.220	0.244	0.239	0.294	0.246
Ave 4-14	0.118	0.181	0.294	0.407	0.250	0.319	0.471
Ave 4-9	0.144	0.166	0.227	0.344	0.249	0.257	0.241

Rings/year	1982	1983	1984	1985	1986	1987	1988
1	0.002	0.007	0.001	0.000	0.000	0.000	0.002
2	0.026	0.115	0.098	0.032	0.008	0.006	0.014
3	0.159	0.257	0.216	0.168	0.101	0.047	0.084
4	0.300	0.229	0.360	0.196	0.214	0.234	0.125
5	0.221	0.246	0.175	0.339	0.261	0.264	0.401
6	0.391	0.153	0.107	0.159	0.523	0.378	0.458
7	0.567	0.215	0.087	0.106	0.346	0.603	0.712
8	0.212	0.306	0.081	0.061	0.271	0.480	0.988
9	0.337	0.154	0.141	0.104	0.297	0.574	0.787
10	0.577	0.172	0.095	0.161	0.313	0.602	0.965
11	0.260	0.332	0.018	0.182	0.420	0.807	1.052
12	1.542	0.080	0.033	0.101	0.347	0.693	1.363
13	1.966	1.157	0.044	0.072	0.431	0.880	1.810
14	0.731	0.321	0.076	0.118	0.369	0.627	1.017
W.Av 4-14	0.367	0.224	0.255	0.226	0.356	0.387	0.289
Ave 4-14	0.646	0.306	0.111	0.145	0.345	0.558	0.880
Ave 4-9	0.338	0.217	0.159	0.161	0.319	0.422	0.579

Rings/year	1989	1990	1991	1992	1993	1994	1987-1990
1	0.012	0.013	0.026	0.017	0.001	0.011	0.007
2	0.053	0.052	0.125	0.066	0.060	0.102	0.031
3	0.092	0.167	0.232	0.231	0.179	0.212	0.097
4	0.203	0.148	0.366	0.279	0.215	0.212	0.178
5	0.331	0.288	0.188	0.368	0.233	0.322	0.321
6	0.419	0.433	0.299	0.331	0.296	0.322	0.422
7	0.261	0.568	0.559	0.289	0.214	0.322	0.536
8	0.415	0.439	0.277	0.406	0.290	0.322	0.581
9	0.557	0.563	0.307	0.426	0.199	0.322	0.620
10	0.727	0.668	0.681	0.265	0.268	0.322	0.740
11	0.942	0.983	0.589	0.268	0.142	0.322	0.946
12	0.509	0.966	0.475	0.158	0.196	0.322	0.883
13	0.476	0.762	0.485	0.303	0.135	0.322	0.982
14	0.538	0.673	0.459	0.306	0.217	0.322	0.714
W.Av 4-14	0.306	0.345	0.365	0.334	0.233	0.264	0.360
Ave 4-14	0.489	0.590	0.426	0.309	0.219	0.312	0.629
Ave 4-9	0.364	0.407	0.333	0.350	0.241	0.304	0.443

Table 2.4.3 Icelandic summer spawners. VPA stock size in numbers (millions) and SSB in '000 tonnes. Age in years is number of rings +1.

Rings/year	1975	1976	1977	1978	1979	1980	1981
1	198.438	553.915	435.896	195.376	247.829	253.564	878.952
2	119.278	178.111	500.620	393.745	174.280	223.361	226.442
3	338.583	105.979	151.802	435.059	334.844	143.351	188.472
4	65.434	275.986	92.179	114.427	345.223	257.818	109.996
5	39.249	53.039	217.294	73.525	90.387	246.196	175.677
6	9.777	28.013	41.336	152.631	58.229	66.171	160.818
7	4.687	8.027	20.145	31.008	100.655	45.088	48.919
8	2.258	3.821	6.270	13.088	21.177	66.381	31.987
9	0.914	1.715	3.041	4.350	5.836	16.266	41.634
10	0.350	0.719	1.271	2.254	2.406	3.510	13.012
11	0.196	0.313	0.523	0.807	1.163	1.708	1.790
12	0.007	0.177	0.196	0.448	0.352	0.637	0.885
13	0.008	0.005	0.159	0.057	0.389	0.288	0.575
14	0.010	0.006	0.004	0.143	0.028	0.301	0.157
SSB	116.932	129.346	132.972	175.61	198.278	212.579	185.989

Rings/year	1982	1983	1984	1985	1986	1987	1988
1	239.068	225.877	467.943	1251.130	654.882	394.148	504.979
2	793.138	215.886	202.985	423.012	1131.964	592.467	356.612
3	200.493	699.421	174.043	166.557	370.590	1016.484	533.097
4	154.603	154.722	489.406	126.884	127.424	303.124	877.371
5	88.010	103.584	111.356	308.859	94.366	93.068	217.068
6	123.973	63.858	73.302	84.581	199.126	65.790	64.647
7	105.764	75.869	49.580	59.571	65.293	106.781	40.808
8	37.334	54.276	55.345	41.142	48.479	41.797	52.872
9	24.326	27.314	36.150	46.171	35.019	33.458	23.394
10	24.960	15.722	21.187	28.421	37.655	23.545	17.060
11	10.793	12.689	11.972	17.434	21.889	24.909	11.674
12	0.784	7.533	8.235	10.641	13.157	13.009	10.055
13	0.090	0.152	6.291	7.209	8.707	8.418	5.887
14	0.425	0.011	0.043	5.445	6.069	5.117	3.159
SSB	193.037	219.423	232.725	251.101	260.146	368.43	430.915

Rings/year	1989	1990	1991	1992	1993	1994	1995
1	336.933	925.049	1459.401	719.198	1316.192	600.000	600.000
2	456.098	301.102	826.503	1286.420	639.520	1190.112	536.984
3	318.206	391.246	258.750	659.738	1089.357	544.847	972.280
4	443.547	262.673	299.613	185.678	474.051	824.093	398.674
5	700.583	327.660	204.904	188.048	127.114	345.970	603.003
6	131.465	455.500	222.314	153.660	117.812	91.140	226.919
7	37.001	78.211	267.241	149.139	99.892	79.266	59.778
8	18.115	25.800	40.089	138.242	101.119	73.000	51.990
9	17.819	10.819	15.051	27.497	83.323	68.463	47.880
10	9.636	9.240	5.575	10.019	16.258	61.793	44.905
11	5.879	4.214	4.288	2.554	6.955	11.256	40.530
12	3.688	2.074	1.427	2.152	1.767	5.459	7.383
13	2.327	2.006	0.714	0.803	1.662	1.314	3.580
14	0.872	1.308	0.847	0.398	0.537	1.314	0.862
SSB	407.148	368.98	312.25	359.401	516.884	528.976	

Table 2.5.1 Icelandic summer spawners. Short-term prediction. Input data.

Rings	N_{95}	Selp	p_{mat}	w	M
1	600.0	0.034	0.000	72	0.1
2	537.0	0.250	0.041	141	0.1
3	972.3	0.600	0.976	194	0.1
4	398.7	1.000	0.998	248	0.1
5	603.0	1.000	1.000	283	0.1
6	226.9	1.000	1.000	298	0.1
7	59.8	1.000	1.000	323	0.1
8	52.0	1.000	1.000	350	0.1
9	47.9	1.000	1.000	361	0.1
10	44.9	1.000	1.000	378	0.1
11	40.5	1.000	1.000	406	0.1
12	7.4	1.000	1.000	399	0.1
13	3.6	1.000	1.000	411	0.1
14	0.9	1.000	1.000	420	0.1

$F_{mort\ 95}$	0.220
F_{fin}	0.264
F_{factor}	1.000
F_{mort}	0.264

Rings	N_{95}	N_{96}	N_{97}	C_{95}	C_{96}	C_{97}
1	600	600	600	4.3	5.1	5.1
2	537	539	543	27.4	32.8	33.0
3	972	460	482	114.5	64.2	67.3
4	399	771	322	75.1	170.6	71.2
5	603	289	536	113.5	64.1	118.6
6	227	438	201	42.7	96.9	44.5
7	60	165	304	11.3	36.5	67.3
8	52	43	115	9.8	9.6	25.3
9	48	38	30	9.0	8.4	6.7
10	45	35	26	8.5	7.7	5.8
11	41	33	24	7.6	7.2	5.3
12	7	29	23	1.4	6.5	5.0
13	4	5	20	0.7	1.2	4.5
14	1	3	4	0.2	0.6	0.8
SSB	**587**	**587**	**545 Y**	**107**	**134**	**124**
B	**737**	**735**	**692**			

Table 2.5.2 Icelandic summer spawning herring. Single option prediction results.

Year	F Factor	Reference F	Catch in numbers	Catch in weight	Stock biomass	Sp. stock biomass
1995	0.83	0.22	426	107	737	587
1996	0.83	0.22	432	113	735	587
1997	0.83	0.22	406	110	717	569
1998	0.83	0.22	387	106	695	549
1999	0.83	0.22	371	102	674	529
					1. January	Sp. time
			Millions	Thousand tonnes	Thousand tonnes	Thousand tonnes

Table 2.5.3 Icelandic summer spawners. Prediction with management option table.

Year: 1995					Year: 1996					Year: 1997	
F Factor	Reference F	Stock biomass	Sp. stock biomass	Catch in weight	F Factor	Reference F	Stock biomass	Sp.stock biomass	Catch in weight	Stock biomass	Sp.stock biomass
0.83	0.22	737	587	107	0.00	0.000	735	587	0	837	683
					0.05	0.013		587	8	829	676
					0.10	0.026		587	15	821	668
					0.15	0.040		587	22	814	661
					0.20	0.053		587	29	806	654
					0.25	0.066		587	37	798	647
					0.30	0.079		587	44	791	639
					0.35	0.092		587	51	783	632
					0.40	0.106		587	58	776	625
					0.45	0.119		587	64	769	619
					0.50	0.132		587	71	762	612
					0.55	0.145		587	78	755	605
					0.60	0.158		587	84	748	599
					0.65	0.172		587	91	741	592
					0.70	0.185		587	97	734	586
					0.75	0.198		587	104	727	579
					0.80	0.211		587	110	720	573
					0.85	0.224		587	116	714	567
					0.90	0.238		587	122	707	561
					0.95	0.251		587	128	701	555
					1.00	0.264		587	134	695	549

Table 2.5.4 Icelandic summer spawning herring. Input data for long-term (yield per recruit and spawning stock per recruit) prediction.

Rings =years+1	Selection pattern	Proportion mature	Weight at age	Natural mortality
1	0.034	0.000	72	0.1
2	0.250	0.041	141	0.1
3	0.600	0.976	194	0.1
4	1.000	0.998	248	0.1
5	1.000	1.000	283	0.1
6	1.000	1.000	298	0.1
7	1.000	1.000	323	0.1
8	1.000	1.000	350	0.1
9	1.000	1.000	361	0.1
10	1.000	1.000	378	0.1
11	1.000	1.000	406	0.1
12	1.000	1.000	399	0.1
13	1.000	1.000	411	0.1
14	1.000	1.000	420	0.1

Table 2.8.1 Icelandic summer spawning herring. Summary table from classical ADAPT-type assessment.

Year	Recruits Rings 1	Total biomas	Total sp.biomas	Landings	Yield/SSB	Fbar w 4-14
1977	437	257	139	28.9	0.208	0.22
1978	196	266	184	37.3	0.203	0.25
1979	249	273	208	45.1	0.217	0.24
1980	255	268	223	53.3	0.239	0.30
1981	882	293	195	39.5	0.203	0.25
1982	240	330	203	56.5	0.279	0.37
1983	226	318	231	58.7	0.254	0.22
1984	469	301	245	50.3	0.205	0.26
1985	1255	397	264	49.1	0.186	0.23
1986	656	476	274	65.4	0.239	0.36
1987	395	537	388	75.4	0.194	0.39
1988	506	558	455	91.8	0.202	0.29
1989	337	511	429	100.7	0.235	0.31
1990	926	512	389	105.6	0.272	0.35
1991	1459	564	329	109.5	0.333	0.37
1992	719	614	378	106.8	0.282	0.33
1993	1315	733	544	102.9	0.189	0.23
1994	600	749	554	134.0	0.242	0.26

Table 2.8.2 Icelandic summer spawners. XSA results. Summary (without SOP correction).

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS AGE 1	TOTALBIO	TOTSBIO	LANDINGS	YIELD/SSB	FBAR 3-11
1977	436462	257299	131445	28924	0.22	0.2219
1978	195669	265831	175103	37333	0.2132	0.3889
1979	248405	273676	198199	45072	0.2274	0.311
1980	253926	267930	212687	53269	0.2505	0.3037
1981	879940	292908	186011	39544	0.2126	0.2469
1982	238403	330402	193043	56528	0.2928	0.3568
1983	221095	317420	219409	58665	0.2674	0.2391
1984	457826	298622	232404	50293	0.2164	0.1405
1985	1217465	392929	251291	49092	0.1954	0.1614
1986	608432	465777	258754	65413	0.2528	0.3025
1987	349082	518479	361950	75439	0.2084	0.4499
1988	506863	532878	415431	91760	0.2209	0.6385
1989	342611	484618	383230	100733	0.2629	0.4641
1990	1106601	498925	344232	105593	0.3067	0.5269
1991	1450143	560895	288584	109499	0.3794	0.4613
1992	841372	622440	359878	106825	0.2968	0.3737
1993	1314579	754124	523140	102802	0.1965	0.2696
1994	539511	772340	553343	134003	0.2422	0.3687
Arith. Mean	622688	439305	293785	72822	0.2479	0.3459
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)		

Table 3.2.1 Catches of Norwegian spring-spawning herring (tonnes) since 1972

Year	A	B[1]	C	D	Total	Total catch as used by the Working Group
1972	-	9,895	3,266[2]	-	13,161	13,161
1973	139	6,602	276	-	7,017	7,017
1974	906	6,093	620	-	7,619	7,619
1975	53	3,372	288	-	3,713	13,713
1976	-	247	189	-	436	10,436
1977	374	11,834	498	-	12,706	22,706
1978	484	9,151	189	-	9,824	19,824
1979	691	1,866	307	-	2,864	12,864
1980	878	7,634	65	-	8,577	18,577
1981	844	7,814	78	-	8,736	13,736
1982	983	10,447	225	-	11,655	16,655
1983	3,857	13,290	907	-	18,054	23,054
1984	18,730	29,463	339	-	48,532	53,532
1985	29,363	37,187	197	4,300	71,047	169,872[3]
1986	71,122[4]	55,507	156	-	126,785	225,256[3]
1987	62,910	49,798	181	-	112,899	127,306[3]
1988	78,592	46,582	127	-	125,301	135,301
1989	52,003	41,770	57	-	93,830	103,830
1990	48,633	29,770	8	-	78,411	86,411
1991	48,353	31,280	50	-	79,683	84,683
1992	43,688	55,737	23	-	99,448	104,448
1993	117,195	110,212	50	-	227,457	232,457
1994	288,581	190,643	4	-	479,228	479,228

A = catches of adult herring in winter
B = mixed herring fishery in autumn
C = by-catches of 0- and 1-group herring in the sprat fishery
D = USSR-Norway by-catch in the capelin fishery (2-group)

[1] Includes also by-catches of adult herring in other fisheries
[2] In 1972, there was also a directed herring 0-group fishery
[3] Includes mortality caused by fishing operations in addition to unreported catches
[4] Includes 26,000 t of immature herring (1983 year-class) fished by USSR in the Barents Sea

Table 3.2.2 Total catch of Norwegian spring-spawning herring (tonnes) since 1972

Year	Norway	USSR/Russia	Denmark	Faroes	Iceland	Netherlands	Total
1972	13,161	-	-	-	-	-	13,161
1973	7,017	-	-	-	-	-	7,017
1974	7,619	-	-	-	-	-	7,619
1975	13,713	-	-	-	-	-	13,713
1976	10,436	-	-	-	-	-	10,436
1977	22,706	-	-	-	-	-	22,706
1978	19,824	-	-	-	-	-	19,824
1979	12,864	-	-	-	-	-	12,864
1980	18,577	-	-	-	-	-	18,577
1981	13,736	-	-	-	-	-	13,736
1982	16,655	-	-	-	-	-	16,655
1983	23,054	-	-	-	-	-	23,054
1984	53,532	-	-	-	-	-	53,532
1985	167,272	2,600	-	-	-	-	169,872
1986	199,256	26,000	-	-	-	-	225,256
1987	108,417	18,889	-	-	-	-	127,306
1988	115,076	20,225	-	-	-	-	135,301
1989	88,707	15,123	-	-	-	-	103,830
1990	74,604	11,807	-	-	-	-	86,411
1991	73,683	11,000	-	-	-	-	84,683
1992	91,111	13,337	-	-	-	-	104,448
1993	199,812	32,645	-	-	-	-	232,457
1994	380,771	74,400	-	2,911	21,146	-	479,228
1995[1]	410,000[2]	100,000	30,131[3]	57,000	170,611	6,886	-

[1] Preliminary, [2] Per 1 October 1995, [3] Preliminary, provided by WG members

Table 3.3.1 Norwegian spring spawning herring. Recoveries of tags in 1995 by year of release.

Year of release	r	m	k	Ln(k)	m_{95}
1987	5	36510	18.26	2.90	2105
1988	12	46996	9.79	2.28	3574
1989	8	37600	11.75	2.46	3773
1990	16	29596	4.62	1.53	3918
1991	7	18292	6.53	1.88	3195
1992	16	25800	4.03	1.39	5944
Sum	64	194794			22509

r = Number recovered in the screened catch
m = Number released
k = m/r · 400
m_{95} = Calculated number of survivals in 1995

Table 3.4.1 Norwegian spring-spawners. Acoustic abundance (TS = 20 logL - 71.9) of 0-group herring in Norwegian coastal waters in 1975-1994 (numbers in millions).

Year	Area				Total
	South of 62°N	62°N-65°N	65°N-68°N	North of 68°30'	
1975		164	346	28	538
1976		208	1,305	375	1,888
1977		35	153	19	207
1978		151	256	196	603
1979		455	1,130	144	1,729
1980		6	2	109	117
1981		132	1	1	134
1982		32	286	1,151	1,469
1983		162	2,276	4,432	6,866
1984		2	234	465	701
1985		221	177	104	502
1986		5	72	127	204
1987		327	26	57	410
1988		14	552	708	1,274
1989		575	263	2,052	2,890
1990		75	146	788	1,009
1991		80	299	2,428	2,807
1992		73	1,993	621	2,891
1993	290	109	140	288	827
1994	157	443	323	6,168	7,091

Table 3.4.2 Abundance indices for 0-group herring in the Barents Sea, 1973-1995

Year	Log index	Year	Log index
1973	0.05	1984	0.34
1974	0.01	1985	0.23
1975	0.00	1986	0.00
1976	0.00	1987	0.00
1977	0.01	1988	0.30
1978	0.02	1989	0.58
1979	0.09	1990	0.31
1980	0.00	1991	1.19
1981	0.00	1992	1.05
1982	0.00	1993	0.75
1983	1.77	1994	0.28
		1995	0.16

Table 3.4.3 Acoustic estimates of immature herring in the Barents Sea

Year	Period	Year class											
		1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
1983	Jan/Feb												
	Mar/Apr												
	May/June												
	July/Aug												
	Sept/Oct												
	Nov/Dec	17900											
1984	Jan/Feb												
	Mar/Apr												
	May/June	21400											
	July/Aug												
	Sept/Oct												
	Nov/Dec		3800										
1985	Jan/Feb												
	Mar/Apr												
	May/June	19900											
	July/Aug												
	Sept/Oct			20800									
	Nov/Dec			2700									
1986	Jan/Feb	8100											
	Mar/Apr												
	May/June	3000											
	July/Aug												
	Sept/Oct												
	Nov/Dec												
1987		No estimates obtained											
1988	Jan/Feb												
	Mar/Apr												
	May/June												
	July/Aug												
	Sept/Oct												
	Nov/Dec						4900						
1989	Jan/Feb												
	Mar/Apr												
	May/June												
	July/Aug												
	Sept/Oct												
	Nov/Dec												
1990	Jan/Feb												
	Mar/Apr												
	May/June							4400					
	July/Aug												
	Sept/Oct						221	4748					
	Nov/Dec												
1991	Jan/Feb												
	Mar/Apr												
	May/June							5200	24300				
	July/Aug												
	Sept/Oct												
	Nov/Dec												
1992	Jan/Feb												
	Mar/Apr												
	May/June							5731	14027	32614			
	July/Aug												
	Sept/Oct										300000		
	Nov/Dec												
1993	Jan/Feb												
	Mar/Apr												
	May/June								1470	25790	102670		
	July/Aug												
	Sept/Oct											100000	
	Nov/Dec												
1994	Jan/Feb												
	Mar/Apr												
	May/June								1700	18000	59200	6600	
	July/Aug												
	Sept/Oct												
	Nov/Dec												
1995	Jan/Feb												
	Mar/Apr												
	May/June									1100	8000	7700	500
	July/Aug												
	Sept/Oct												
	Nov/Dec												

Table 3.5.1

Catches and stock				1983 yearcl.		Surveys				
	C-no	N	F	M	Z	Tag	AcDec	AcJan	AcSpawn	WG 94
88	0,550	17,899	0,033	0,13	0,16				6,81	12,61
89	0,324	15,201	0,023	0,13	0,15				5,40	10,56
90	0,226	13,044	0,019	0,13	0,15				4,49	8,97
91	0,219	11,242	0,022	0,23	0,25				4,15	7,66
92	0,226	8,737	0,029	0,23	0,26			4,69		5,89
93	0,410	6,741	0,071	0,23	0,30	5,50	3,77	5,70		4,48
94	0,570	4,990	0,137	0,23	0,37		4,44	3,68	1,82	3,20
95		3,457				3,20	3,24	4,33	2,573	
Catches and stock				1988 yearcl						
	C-no	**N**	**F**	**M**	**Z**					
91	0,008	2,447	0,003	0,13	0,13					2,43
92	0,033	2,141	0,017	0,13	0,15					1,92
93	0,087	1,849	0,052	0,13	0,18		1,32	2,05		1,50
94	0,162	1,542	0,119	0,13	0,25		1,27	1,50	0,476	1,11
95		1,203					1,10	1,22	0,322	
Catches and stock				1989 yearcl						
	C-no	**N**	**F**	**M**	**Z**					
92	0,013	6,042	0,002	0,13	0,13					5,24
93	0,107	5,293	0,022	0,13	0,15					4,16
94	0,425	4,548	0,105	0,13	0,24		3,29	4,85	1,375	3,21
95		3,595					2,59	2,45	2,151	
						q	1,00	0,78	0,88	0,38	1
						SSE	0,05	0,21	0,59	0,89	
						1,73					

Table 3.5.2

Run title : Herring Spring-Spawn file 0: VPA for the years 1975-1994

At 18/10/1995 14:16

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	3268,	23248,	22103,	3019,	6352,	6407,	4166,	13817,	3183,	4483,
4,	132,	5436,	23595,	12164,	1866,	5814,	4591,	7892,	21191,	5388,
5,	910,	1,	336,	20315,	6865,	2278,	8596,	4507,	9521,	61543,
6,	30667,	1,	1,	870,	11216,	8165,	2200,	6258,	6181,	18202,
7,	5,	13086,	419,	1,	326,	15838,	4512,	1960,	6823,	12638,
8,	2,	1,	10766,	620,	1,	441,	8280,	5075,	1293,	15608,
9,	1,	1,	1,	5027,	1,	8,	345,	6047,	4598,	7215,
10,	1,	1,	1,	1,	2534,	1,	103,	121,	7329,	16338,
11,	1,	1,	1,	1,	1,	2688,	114,	37,	143,	6478,
12,	1,	1,	1,	1,	1,	1,	964,	37,	40,	1,
+gp,	4,	4,	4,	4,	4,	4,	4,	124,	1007,	1655,
TOTALNUM,	34992,	41781,	57228,	42023,	29167,	41645,	33875,	45875,	61309,	149549,
TONSLAND,	13713,	10436,	22706,	19824,	12864,	18577,	13736,	16655,	23054,	53532,
SOPCOF %,	107,	105,	108,	104,	109,	101,	118,	102,	110,	101,

Table 1 Catch numbers at age Numbers*10**-3

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
3,	21500,	539785,	19776,	62923,	2890,	18633,	8438,	12586,	28408,	58530,
4,	15500,	17594,	501393,	25059,	3623,	2658,	2780,	33100,	106866,	188652,
5,	16500,	14500,	18672,	550367,	5650,	11875,	1410,	4980,	87269,	425414,
6,	130000,	15500,	3502,	9452,	324290,	10854,	14698,	1193,	8625,	161767,
7,	59000,	105000,	7058,	3679,	3469,	226280,	8867,	11981,	3648,	14601,
8,	55000,	75000,	28000,	5964,	800,	1289,	218851,	5748,	29603,	7655,
9,	63000,	42000,	12000,	14583,	679,	1519,	2499,	225677,	18631,	33623,
10,	10000,	77000,	9500,	8872,	3297,	2036,	461,	2483,	410110,	31875,
11,	31000,	19469,	4500,	2818,	1375,	2415,	87,	639,	1,	569883,
12,	50000,	66000,	7834,	3356,	679,	646,	690,	247,	1,	2825,
+gp,	2641,	82471,	13954,	4790,	581,	1244,	900,	1239,	4,	2622,
TOTALNUM,	454141,	1054319,	626189,	691863,	347333,	279449,	259681,	299873,	693166,	1497447,
TONSLAND,	169872,	225256,	127306,	135301,	103830,	86411,	84683,	104448,	232457,	479228,
SOPCOF %,	103,	100,	103,	101,	105,	102,	101,	100,	100,	100,

Table 3.5.3

Run title : Herring Spring-Spawn file 0: VPA for the years 1975-1994

At 18/10/1995 14:16

Table 2 Catch weights at age (kg)

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	.2410,	.1890,	.3160,	.2740,	.2930,	.2660,	.1960,	.2560,	.2170,	.2180,
4,	.3180,	.2500,	.3500,	.4240,	.3590,	.3990,	.2910,	.3120,	.2650,	.2620,
5,	.3580,	.2800,	.3980,	.4540,	.4160,	.4490,	.3410,	.3780,	.3370,	.3250,
6,	.3810,	.2980,	.4390,	.4950,	.4360,	.4600,	.3680,	.4150,	.3780,	.3460,
7,	.4130,	.3230,	.4950,	.5240,	.4820,	.4850,	.3800,	.4350,	.4100,	.3810,
8,	.4290,	.3360,	.5110,	.5960,	.4820,	.4720,	.3970,	.4490,	.4260,	.4000,
9,	.4840,	.3790,	.5580,	.6130,	.5390,	.6180,	.4360,	.4480,	.4350,	.4130,
10,	.5060,	.3960,	.5830,	.6500,	.5530,	.6450,	.4500,	.5060,	.4440,	.4050,
11,	.3840,	.3000,	.5370,	.5900,	.5180,	.6080,	.4920,	.4930,	.4680,	.4260,
12,	.4660,	.3640,	.5370,	.5900,	.5180,	.5940,	.4810,	.4990,	.4610,	.4150,
+gp,	.4660,	.3640,	.5370,	.5900,	.5180,	.5940,	.4810,	.4990,	.4610,	.4150,
SOPCOFAC,	1.0675,	1.0453,	1.0766,	1.0382,	1.0865,	1.0132,	1.1828,	1.0218,	1.0976,	1.0141,

Table 2 Catch weights at age (kg)

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
3,	.2140,	.0550,	.1240,	.1240,	.1880,	.2300,	.2080,	.1910,	.1530,	.1940,
4,	.2770,	.2490,	.1730,	.1540,	.2640,	.2390,	.2500,	.2330,	.2430,	.2390,
5,	.2950,	.2940,	.2530,	.1940,	.2600,	.2660,	.2880,	.3040,	.2820,	.2800,
6,	.3380,	.3120,	.2320,	.2410,	.2820,	.3050,	.3120,	.3370,	.3200,	.3170,
7,	.3600,	.3520,	.3120,	.2650,	.3060,	.3080,	.3160,	.3650,	.3300,	.3280,
8,	.3810,	.3740,	.3280,	.3040,	.3090,	.3760,	.3300,	.3610,	.3650,	.3560,
9,	.3970,	.3980,	.3490,	.3050,	.3910,	.4070,	.3440,	.3710,	.3730,	.3720,
10,	.4090,	.4020,	.3530,	.3170,	.4220,	.4120,	.3720,	.4030,	.3790,	.3900,
11,	.4170,	.4010,	.3700,	.3080,	.3640,	.4240,	.3540,	.3650,	.3800,	.3790,
12,	.4350,	.4100,	.3850,	.3340,	.4290,	.4280,	.3980,	.3940,	.3850,	.3990,
+gp,	.4350,	.4100,	.3850,	.3340,	.4290,	.4280,	.3980,	.4040,	.3975,	.4062,
SOPCOFAC,	1.0306,	1.0032,	1.0291,	1.0071,	1.0549,	1.0183,	1.0062,	1.0039,	1.0016,	1.0037,

Table 3.5.4

Run title : Herring Spring-Spawn file 0: VPA for the years 1975-1994

At 18/10/1995 14:16

Table 3 Stock weights at age (kg)

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	.1810,	.1810,	.1810,	.1800,	.1780,	.1750,	.1700,	.1700,	.1550,	.1400,
4,	.2590,	.2590,	.2590,	.2940,	.2320,	.2830,	.2240,	.2040,	.2490,	.2040,
5,	.3420,	.3420,	.3430,	.3260,	.3590,	.3470,	.3360,	.3030,	.3040,	.2950,
6,	.3840,	.3840,	.3840,	.3710,	.3850,	.4020,	.3780,	.3550,	.3680,	.3380,
7,	.4090,	.4090,	.4090,	.4090,	.4200,	.4210,	.3870,	.3830,	.4040,	.3760,
8,	.4440,	.4440,	.4440,	.4610,	.4440,	.4650,	.4080,	.3950,	.4240,	.3950,
9,	.4610,	.4610,	.4610,	.4760,	.5050,	.4650,	.3970,	.4130,	.4370,	.4070,
10,	.5200,	.5200,	.5200,	.5200,	.5200,	.5200,	.5200,	.4530,	.4360,	.4130,
11,	.5430,	.5430,	.5430,	.5430,	.5510,	.5340,	.5430,	.4680,	.4930,	.4220,
12,	.4820,	.4820,	.4820,	.5000,	.5000,	.5000,	.5120,	.5060,	.4950,	.4370,
+gp,	.4820,	.4820,	.4820,	.5000,	.5000,	.5000,	.5120,	.5060,	.4950,	.4370,

Table 3 Stock weights at age (kg)

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
3,	.1480,	.0540,	.0900,	.0980,	.1540,	.2190,	.1470,	.1280,	.0810,	.0750,
4,	.2340,	.2060,	.1430,	.1350,	.1750,	.1980,	.2100,	.2240,	.2010,	.1510,
5,	.2650,	.2650,	.2410,	.1970,	.2090,	.2580,	.2440,	.2960,	.2650,	.2540,
6,	.3120,	.2890,	.2790,	.2770,	.2520,	.2880,	.3000,	.3270,	.3230,	.3180,
7,	.3460,	.3390,	.2990,	.3150,	.3050,	.3090,	.3240,	.3550,	.3540,	.3710,
8,	.3700,	.3680,	.3160,	.3390,	.3670,	.4280,	.3360,	.3450,	.3580,	.3470,
9,	.3950,	.3910,	.3420,	.3430,	.3770,	.3700,	.3430,	.3670,	.3810,	.4120,
10,	.3970,	.3820,	.3430,	.3590,	.3590,	.4030,	.3820,	.3410,	.3690,	.3820,
11,	.4280,	.3880,	.3620,	.3650,	.3950,	.3870,	.3660,	.3610,	.3960,	.4070,
12,	.4280,	.3950,	.3760,	.3760,	.3960,	.4400,	.4250,	.4300,	.3930,	.4100,
+gp,	.4280,	.3950,	.3760,	.3760,	.3960,	.4400,	.4250,	.4700,	.3943,	.4100,

Table 3.5.5

Run title : Herring Spring-Spawn file 0: VPA for the years 1975-1994

At 18/10/1995 14:16

Table 4 Natural Mortality (M) at age

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,
4,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,
5,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,
6,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,
7,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,
8,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,
9,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,
10,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,
11,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,
12,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,
+gp,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,

Table 4 Natural Mortality (M) at age

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
3,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,
4,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.2300,	.1300,	.1300,	.1300,
5,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.2300,	.2300,	.1300,	.1300,
6,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.2300,	.2300,	.2300,	.1300,
7,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.2300,	.2300,	.2300,	.2300,
8,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.2300,	.2300,	.2300,	.2300,
9,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.2300,	.2300,	.2300,	.2300,
10,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.2300,	.2300,	.2300,	.2300,
11,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.2300,	.2300,	.2300,	.2300,
12,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.2300,	.2300,	.2300,	.2300,
+gp,	.1300,	.1300,	.1300,	.1300,	.1300,	.1300,	.2300,	.2300,	.2300,	.2300,

Table 3.5.6

Run title : Herring Spring-Spawn file 0: VPA for the years 1975-1994

At 18/10/1995 14:16

Table 5 Proportion mature at age

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	.5000,	.5000,	.7300,	.1300,	.1000,	.2500,	.3000,	.1000,	.1000,	.1000,
4,	1.0000,	.9000,	.8900,	.9000,	.6200,	.5000,	.5000,	.4800,	.5000,	.5000,
5,	1.0000,	1.0000,	1.0000,	1.0000,	.9500,	.9700,	.9000,	.7000,	.6900,	.9000,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.7100,	.9500,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
3,	.1000,	.1000,	.1000,	.1000,	.1000,	.4000,	.1000,	.1000,	.0100,	.0100,
4,	.5000,	.2000,	.3000,	.3000,	.3000,	.8000,	.7000,	.2000,	.3000,	.3000,
5,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,	1.0000,	.8000,	.8000,	.8000,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 3.5.7

Run title : Herring Spring-Spawn file 0: VPA for the years 1975-1994

At 18/10/1995 14:16

Traditional vpa using screen input for terminal F

Table 8 Fishing mortality (F) at age

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	.2639,	.0260,	.0425,	.0134,	.0138,	.0209,	.0109,	.0218,	.0288,	.0722,
4,	.0401,	.8405,	.0309,	.0276,	.0096,	.0146,	.0174,	.0239,	.0393,	.0580,
5,	.0798,	.0004,	.0981,	.0312,	.0182,	.0134,	.0251,	.0198,	.0338,	.1421,
6,	.2327,	.0001,	.0004,	.3613,	.0202,	.0251,	.0150,	.0213,	.0318,	.0777,
7,	.0878,	.1363,	.0509,	.0005,	.2058,	.0333,	.0161,	.0155,	.0270,	.0782,
8,	.0418,	.0211,	.1471,	.0920,	.0005,	.4326,	.0204,	.0211,	.0118,	.0741,
9,	.0452,	.0246,	.0246,	.0881,	.0002,	.0048,	.6559,	.0173,	.0222,	.0782,
10,	.0541,	.0541,	.0288,	.0288,	.0543,	.0002,	.0727,	.4636,	.0243,	.0952,
11,	.0653,	.0653,	.0653,	.0339,	.0339,	.0698,	.0266,	.0314,	1.5376,	.0251,
12,	.0800,	.0800,	.0800,	.0800,	.0400,	.0400,	.0300,	.0100,	.0400,	.0300,
+gp,	.0800,	.0800,	.0800,	.0800,	.0400,	.0400,	.0300,	.0100,	.0400,	.0300,
FBAR 5-10,	.0902,	.0394,	.0583,	.1003,	.0499,	.0849,	.1342,	.0931,	.0252,	.0909,

Table 8 Fishing mortality (F) at age

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	FBAR 92-94
AGE											
3,	.1821,	.0239,	.0506,	.0510,	.0225,	.0960,	.0037,	.0022,	.0046,	.0029,	.0032,
4,	.3480,	.2059,	.0259,	.0778,	.0034,	.0242,	.0181,	.0166,	.0218,	.0352,	.0245,
5,	.2332,	.5840,	.3229,	.0333,	.0210,	.0129,	.0156,	.0421,	.0516,	.1050,	.0662,
6,	.4560,	.3295,	.2471,	.2483,	.0230,	.0475,	.0194,	.0169,	.0984,	.1185,	.0779,
7,	.3528,	.7546,	.2264,	.4076,	.1255,	.0187,	.0487,	.0203,	.0679,	.2480,	.1121,
8,	.5126,	.9380,	.4207,	.2803,	.1335,	.0583,	.0220,	.0415,	.0660,	.2045,	.1040,
9,	.4339,	.8681,	.3356,	.3716,	.0430,	.3683,	.1495,	.0293,	.1894,	.1025,	.1071,
10,	.1372,	1.3816,	.4426,	.4088,	.1235,	.1622,	.1763,	.2248,	.0705,	.5900,	.2951,
11,	.2428,	.3934,	.2242,	.2090,	.0937,	.1162,	.0090,	.4078,	.0001,	.1364,	.1814,
12,	.2520,	1.0800,	.2500,	.2400,	.0660,	.0540,	.0430,	.0330,	.0010,	.6000,	.2113,
+gp,	.2520,	1.0800,	.2500,	.2400,	.0660,	.0540,	.0430,	.0330,	.0010,	.6000,	
FBAR 5-10,	.3543,	.8093,	.3326,	.2917,	.0783,	.1113,	.0719,	.0625,	.0906,	.2281,	

Table 3.5.8

Run title : Herring Spring-Spawn file 0: VPA for the years 1975-1994

At 18/10/1995 14:16

Traditional vpa using screen input for terminal F

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

YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	1498,	96665,	56583,	24133,	49406,	32959,	41050,	68183,	11935,	6859,
4,	358,	1011,	82704,	47617,	20908,	42788,	28341,	35656,	58578,	10182,
5,	1264,	302,	383,	70414,	40673,	18185,	37028,	24457,	30571,	49453,
6,	15715,	1025,	265,	305,	59928,	35072,	15755,	31709,	21053,	25953,
7,	6,	10935,	900,	232,	186,	51573,	30033,	13628,	27258,	17908,
8,	5,	5,	8378,	751,	204,	133,	43803,	25949,	11783,	23296,
9,	2,	4,	4,	6350,	602,	179,	76,	37688,	22311,	10226,
10,	2,	2,	4,	4,	5106,	528,	156,	35,	32528,	19160,
11,	2,	2,	2,	3,	3,	4246,	464,	128,	19,	27876,
12,	1,	1,	1,	1,	3,	3,	3477,	397,	109,	4,
+gp,	6,	6,	6,	6,	11,	11,	14,	1329,	2738,	5970,
TOTAL,	18860,	109957,	149231,	149816,	177031,	185678,	200198,	239158,	218882,	196887,

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

YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	GMST 55-92
AGE												
3,	13746,	2438784,	42754,	134994,	13825,	21692,	244696,	603934,	665179,	2155360,	0,	41362,
4,	5603,	10061,	2090952,	35691,	112649,	11869,	17305,	214077,	529133,	581430,	1887131,	27404,
5,	8436,	3474,	7190,	1789118,	28996,	98577,	10173,	13502,	184881,	454625,	492893,	18341,
6,	37671,	5867,	1701,	4571,	1519498,	24932,	85448,	7958,	10285,	154176,	359413,	12311,
7,	21086,	20965,	3705,	1167,	3131,	1303905,	20877,	66585,	6217,	7406,	120252,	8053,
8,	14543,	13012,	8656,	2594,	682,	2425,	1123768,	15799,	51839,	4615,	4592,	4945,
9,	18996,	7648,	4472,	4991,	1721,	524,	2009,	873415,	12042,	38558,	2989,	2830,
10,	8304,	10808,	2819,	2807,	3022,	1448,	318,	1375,	673898,	7917,	27651,	1572,
11,	15296,	6357,	2384,	1590,	1638,	2345,	1081,	212,	872,	499008,	3487,	1096,
12,	23872,	10536,	3767,	1673,	1133,	1310,	1834,	851,	112,	693,	345925,	758,
+gp,	1261,	13166,	6709,	2388,	969,	2522,	2392,	4270,	448,	643,	583,	
TOTAL,	168814,	2540677,	2175110,	1981585,	1687264,	1471550,	1509902,	1801978,	2134906,	3904431,	3244916,	

Table 3.5.9

Run title : Herring Spring-Spawn file 0: VPA for the years 1975-1994

At 18/10/1995 14:16

Traditional vpa using screen input for terminal F

Table 12 Stock biomass at age (start of year) Tonnes*10**-1										
YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	271,	17496,	10242,	4344,	8794,	5768,	6979,	11591,	1850,	960,
4,	93,	262,	21420,	13999,	4851,	12109,	6348,	7274,	14586,	2077,
5,	432,	103,	131,	22955,	14602,	6310,	12441,	7410,	9293,	14589,
6,	6035,	394,	102,	113,	23072,	14099,	5955,	11257,	7748,	8772,
7,	3,	4472,	368,	95,	78,	21712,	11623,	5220,	11012,	6734,
8,	2,	2,	3720,	346,	91,	62,	17872,	10250,	4996,	9202,
9,	1,	2,	2,	3023,	304,	83,	30,	15565,	9750,	4162,
10,	1,	1,	2,	2,	2655,	275,	81,	16,	14182,	7913,
11,	1,	1,	1,	2,	2,	2268,	252,	60,	9,	11764,
12,	1,	1,	1,	1,	1,	1,	1780,	201,	54,	2,
+gp,	3,	3,	3,	3,	5,	5,	7,	672,	1355,	2609,
TOTALBIO,	6842,	22737,	35991,	44883,	54456,	62693,	63369,	69515,	74835,	68783,

Table 12 Stock biomass at age (start of year) Tonnes*10**-1										
YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
3,	2034,	131694,	3848,	13229,	2129,	4751,	35970,	77304,	53879,	161652,
4,	1311,	2072,	299006,	4818,	19714,	2350,	3634,	47953,	106356,	87796,
5,	2236,	921,	1733,	352456,	6060,	25433,	2482,	3997,	48993,	115475,
6,	11753,	1696,	475,	1266,	382914,	7180,	25635,	2602,	3322,	49028,
7,	7296,	7107,	1108,	368,	955,	402907,	6764,	23638,	2201,	2748,
8,	5381,	4788,	2735,	879,	250,	1038,	377586,	5451,	18558,	1601,
9,	7503,	2990,	1529,	1712,	649,	194,	689,	320543,	4588,	15886,
10,	3297,	4129,	967,	1008,	1085,	584,	122,	469,	248668,	3024,
11,	6547,	2466,	863,	580,	647,	908,	396,	77,	345,	203096,
12,	10217,	4162,	1416,	629,	449,	576,	779,	366,	44,	284,
+gp,	540,	5200,	2523,	898,	384,	1110,	1016,	2007,	177,	264,
TOTALBIO,	58115,	167226,	316203,	377844,	415235,	447030,	455074,	484405,	487132,	640854,

Table 3.5.10

Run title : Herring Spring-Spawn file 0: VPA for the years 1975-1994

At 18/10/1995 14:16

Traditional vpa using screen input for terminal F

Table 13 Spawning stock biomass at age (spawning time) Tonnes YEAR,	1975,	1976,	1977,	1978,	1979,	1980,	1981,	1982,	1983,	1984,
AGE										
3,	1304,	86128,	73485,	5567,	8669,	14204,	20643,	11416,	1821,	941,
4,	911,	2138,	187599,	124024,	29658,	59676,	31278,	34381,	71705,	10192,
5,	4235,	1019,	1284,	225877,	136677,	60337,	110249,	51101,	63084,	127773,
6,	58197,	3886,	1004,	1077,	227285,	138821,	58696,	110878,	54125,	81622,
7,	25,	43549,	3616,	939,	757,	213605,	114540,	51442,	108406,	65948,
8,	23,	22,	36183,	3387,	894,	586,	176050,	100962,	49258,	90162,
9,	11,	20,	20,	29576,	2999,	822,	279,	153377,	96024,	40762,
10,	10,	10,	19,	19,	26066,	2711,	797,	148,	139649,	77370,
11,	9,	9,	9,	17,	17,	22227,	2479,	588,	80,	115828,
12,	7,	7,	7,	7,	13,	13,	17521,	1978,	529,	16,
+gp,	26,	26,	26,	27,	53,	53,	73,	6630,	13322,	25674,
TOTSPBIO,	64757,	136813,	303251,	390516,	433089,	513055,	532604,	522903,	598004,	636286,

Table 13 Spawning stock biomass at age (spawning time) Tonnes YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
3,	1972,	129683,	3779,	12992,	2097,	18578,	35493,	76288,	5316,	15952,
4,	6250,	4008,	883143,	14158,	58357,	18513,	24814,	94510,	314262,	259073,
5,	19403,	7715,	14905,	3120713,	53723,	225648,	24220,	31114,	384893,	902342,
6,	110843,	16194,	4571,	12193,	3770989,	63487,	250030,	25387,	32148,	478245,
7,	69519,	65054,	10691,	3483,	9310,	3572646,	65782,	230532,	21361,	26195,
8,	50459,	43033,	25887,	8441,	2436,	10187,	3681887,	53048,	180171,	15334,
9,	70920,	27063,	14599,	16280,	6378,	1843,	6634,	3123376,	43997,	153664,
10,	32099,	35496,	9131,	9550,	10578,	5667,	1167,	4479,	2413079,	27862,
11,	63073,	23407,	8329,	5610,	6327,	8856,	3863,	718,	3376,	1957895,
12,	98341,	36876,	13634,	6062,	4399,	5658,	7583,	3565,	430,	2615,
+gp,	5194,	46078,	24286,	8652,	3764,	10895,	9891,	19547,	1726,	2427,
TOTSPBIO,	528072,	434606,	1012956,	3218134,	3928359,	3941977,	4111366,	3662565,	3400757,	3841602,

Table 3.5.11

Run title : Herring Spring-Spawn file 0: VPA for the years 1955-1994

At 18/10/1995 14:16

Table 16 Summary (without SOP correction)

Traditional vpa using screen input for terminal F

	RECRUITS, Age 3	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 5-10,
1950,	9975288,	17242108,	13686284,	933000,	.0682,	.0718,
1951,	5416803,	14265558,	10937858,	1278400,	.1169,	.0686,
1952,	3811720,	11760410,	8900434,	1254800,	.1410,	.0969,
1953,	49068732,	15340126,	8424798,	1090600,	.1295,	.0871,
1954,	7306779,	15400232,	6029080,	1644500,	.2728,	.1208,
1955,	3127013,	12098966,	7089802,	1359800,	.1918,	.1059,
1956,	3076476,	10626511,	8238536,	1659400,	.2014,	.1382,
1957,	534805,	8565191,	7370488,	1319500,	.1790,	.1070,
1958,	492960,	6685968,	6052443,	986600,	.1630,	.0905,
1959,	168616,	5464491,	5101597,	1111100,	.2178,	.1230,
1960,	252731,	4390022,	4127924,	1101800,	.2669,	.1252,
1961,	240822,	3052330,	2908017,	830100,	.2855,	.0858,
1962,	21374782,	4454078,	2184182,	848600,	.3885,	.0925,
1963,	7278655,	5955756,	2161766,	984500,	.4554,	.1043,
1964,	2134689,	6158594,	2755220,	1281800,	.4652,	.1787,
1965,	198728,	4458641,	2954187,	1547700,	.5239,	.2905,
1966,	8271656,	3722680,	2604253,	1955000,	.7507,	.9064,
1967,	3801753,	2723090,	1210225,	1677200,	1.3859,	1.2632,
1968,	107701,	827094,	260861,	712200,	2.7302,	1.7514,
1969,	228187,	130045,	112993,	67800,	.6000,	.4805,
1970,	15952,	74735,	62176,	62300,	1.0020,	.9044,
1971,	7491,	39119,	35376,	21100,	.5964,	1.3087,
1972,	334196,	58985,	6836,	13161,	1.9254,	1.8134,
1973,	19236,	73306,	63211,	7017,	.1110,	1.2146,
1974,	4180,	74955,	72285,	7619,	.1054,	.5545,
1975,	14984,	68423,	64757,	13713,	.2118,	.0902,
1976,	966647,	227369,	136813,	10436,	.0763,	.0394,
1977,	565833,	359915,	303251,	22706,	.0749,	.0583,
1978,	241331,	448826,	390516,	19824,	.0508,	.1003,
1979,	494057,	544555,	433089,	12864,	.0297,	.0499,
1980,	329592,	626926,	513055,	18577,	.0362,	.0849,
1981,	410505,	633691,	532604,	13736,	.0258,	.1342,
1982,	681831,	695153,	522903,	16655,	.0319,	.0931,
1983,	119347,	748354,	598004,	23054,	.0386,	.0252,
1984,	68586,	687830,	636286,	53532,	.0841,	.0909,
1985,	137455,	581147,	528072,	169872,	.3217,	.3543,
1986,	24387836,	1672264,	434606,	225256,	.5183,	.8093,
1987,	427537,	3162030,	1012956,	127306,	.1257,	.3326,
1988,	1349943,	3778440,	3218134,	135301,	.0420,	.2917,
1989,	138248,	4152348,	3928359,	103830,	.0264,	.0783,
1990,	216921,	4470296,	3941977,	86411,	.0219,	.1113,
1991,	2446964,	4550735,	4111366,	84683,	.0206,	.0719,
1992,	6039342,	4844055,	3662565,	104448,	.0285,	.0625,
1993,	6651788,	4871321,	3400757,	232457,	.0684,	.0906,
1994,	21553600,	6408541,	3841602,	479228,	.1247,	.2281,
Arith. Mean ,	4322052,	4381671,	3012500,	571322,	.3385,	.3400,
Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Note : Figures for 1950-1954 taken from last year's report. Means adjusted accordingly.

Table 3.5.12

	Input data to the prediction:						
	Weight in catch (g)				Fishing pattern all years		
Age	1995	1996	1997-		age	pattern	
3	187	138	89		3	0,0055	
4	241	203	165		4	0,055	
5	289	267	246		5	0,228	
6	322	314	306		6	0,228	
7	335	336	337		7	0,228	
8	353	349	344		8	0,228	
9	365	366	367		9	0,228	
10	386	387	388		10	0,228	
11	370	384	398		11	0,228	
12	394	400	405		12	0,228	
13+	399	402	405		13+	0,228	
	Weight in stock (g)				Stock size in 1995		
3	66	83	100		age	number (1000)	
4	138	160	182		3	24000000	
5	230	229	227		4	18871310	
6	296	283	270		5	4928930	
7	346	318	289		6	3594130	
8	388	353	318		7	1202520	
9	363	345	327		8	45920	
10	409	380	350		9	29890	
11	414	384	354		10	276510	
12	422	391	359		11	34870	
13+	410	386	361		12	3459250	
	Maturity ogive				13+	5830	
3	0	0	0,02				
4	0,01	0,01	0,14				
5	0,8	0,45	0,39		Recruitment 1996		5600000
6	1	1	0,83		Recruitment 1997-		845000
7	1	1	1		Proportion of M and F before		
8	1	1	1		spawning equal to 0.1 in all years		
9	1	1	1				
10	1	1	1				
11	1	1	1				
12	1	1	1				
13+	1	1	1				

Table 3.5.13

		Management option table									
Year		1995			1996					1997	
F factor	Ref F	Stock B	SSB	Catch	F factor	Ref F	Stock B	SSB	Catch	Stock B	SSB
0,8071	0,1840	8420219	3907025	914000	0,0000	0,0000	10700189	4852040	0	11710032	7568574
					0,1000	0,0228		4841047	184640	11538985	7416019
					0,2000	0,0456		4830080	365583	11371392	7266952
					0,3000	0,0684		4819137	542908	11207177	7121290
					0,4000	0,0912		4808219	716694	11046266	6978953
					0,5000	0,1140		4797326	887019	10888586	6839860
					0,6000	0,1368		4786457	1053957	10734067	6703936
					0,7000	0,1596		4775614	1217582	10582640	6571104
					0,8000	0,1824		4764795	1377965	10434237	6441292
					0,9000	0,2052		4754000	1535178	10288792	6314428
					1,0000	0,2280		4743230	1689288	10146241	6190442
					1,1000	0,2508		4732485	1840364	10006520	6069266
					1,2000	0,2736		4721764	1988470	9869567	5950833
					1,3000	0,2964		4711068	2133672	9735323	5835079
					1,4000	0,3192		4700396	2276031	9603727	5721939
					1,5000	0,3420		4689748	2415609	9474723	5611352

Table 4.2.1 Barents Sea CAPELIN. International catch ('000 t) as used by the Working Group

Year	Winter				Summer-Autumn			Total
	Norway	Russia	Others	Total	Norway	Russia	Total	
1965	217	7	0	224	0	0	0	224
1966	380	9	0	389	0	0	0	389
1967	403	6	0	409	0	0	0	409
1968	460	15	0	475	62	0	62	537
1969	436	1	0	437	243	0	243	680
1970	955	8	0	963	346	5	351	1314
1971	1300	14	0	1314	71	7	78	1392
1972	1208	24	0	1232	347	13	360	1592
1973	1078	34	0	1111	213	12	225	1336
1974	749	63	0	812	237	99	336	1149
1975	559	301	43	903	407	131	538	1440
1976	1252	228	0	1480	739	368	1107	2587
1977	1441	317	2	1760	722	504	1227	2987
1978	784	429	25	1237	360	318	678	1915
1979	539	342	5	886	570	326	896	1783
1980	539	253	9	801	459	388	847	1648
1981	784	429	28	1240	454	292	746	1986
1982	568	260	5	833	591	336	927	1760
1983	751	373	36	1161	758	439	1197	2358
1984	330	257	42	629	481	368	849	1478
1985	340	234	17	590	113	164	278	868
1986	72	51	0	123	0	0	0	123
1987	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0
1991	528	159	20	707	31	195	226	933
1992	620	247	24	891	73	159	232	1123
1993	402	170	14	586	0	0	0	586
1994	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0

Table 4.3.1 Barents Sea CAPELIN. Larval abundance (unit:10^{12}) in June, and 0-group index in August

Year	Larval abundance	0-group index
1981	9.7	570
1982	9.9	393
1983	9.9	589
1984	8.2	320
1985	8.6	110
1986	-	125
1987	0.3	55
1988	0.3	187
1989	7.3	1300
1990	13.0	324
1991	3.0	241
1992	7.3	26
1993	3.3	43
1994	0.1	58
1995	0.0	43

Table 4.3.2 Barents Sea CAPELIN. Acoustic estimate, September-October 1995

Year class	1994	1993	1992	1991	Total number (10^9)	Biomass (10^3 t.)	Mean weight (g)
Age (years)	1	2	3	4			
Length (cm)							
7.5 - 8.0	0.03				0.03	0.1	2.0
8.0 - 8.5	0.04				0.04	0.1	2.0
8.5 - 9.0	0.02	+			0.02	0.0	2.1
9.0 - 9.5	0.13	+			0.13	0.4	3.0
9.5 - 10.0	0.32				0.32	1.1	3.3
10.0 - 10.5	0.74	+			0.74	3.0	4.1
10.5 - 11.0	1.12	0.14			1.26	6.1	4.8
11.0 - 11.5	1.27	0.31			1.57	8.8	5.6
11.5 - 12.0	0.78	0.33			1.10	7.4	6.7
12.0 - 12.5	0.76	0.53	0.01		1.30	9.9	7.6
12.5 - 13.0	0.76	0.60	0.02		1.38	12.1	8.8
13.0 - 13.5	0.56	0.68	0.06		1.30	12.9	10.0
13.5 - 14.0	0.34	0.80	0.04		1.18	13.3	11.3
14.0 - 14.5	0.19	1.02	0.23		1.44	18.7	13.0
14.5 - 15.0	0.07	0.96	0.25	+	1.29	18.9	14.7
15.0 - 15.5		0.87	0.38	0.02	1.27	21.0	16.5
15.5 - 16.0		0.68	0.26	0.05	1.00	18.3	18.5
16.0 - 16.5		0.52	0.17	0.05	0.74	15.3	20.7
16.5 - 17.0		0.45	0.06	0.10	0.61	14.1	23.2
17.0 - 17.5		0.17	0.05	0.06	0.28	7.3	26.1
17.5 - 18.0		0.07	0.02	0.07	0.15	4.2	28.0
18.0 - 18.5		0.02			0.02	0.5	28.5
Number (10^9)	7.13	8.14	1.53	0.35	17.16		
Biomass (10^3 tonnes)	47.4	112.4	25.7	7.9		193.6	
Mean length (cm)	11.64	14.26	15.21	16.68	13.31		
Mean weight (g)	6.7	13.8	16.8	22.6			11.3

Based on TS value: 19.1 log L - 74.0, corresponding to $\bar{\sigma} = 5.0 \cdot 10^{-7} \cdot L^{1.91}$

Table 4.3.3 Barents Sea CAPELIN. Stock size in numbers by age, total stock biomass and biomass of the maturing component. Both stock in numbers (unit:10^9) and stock and maturing stock biomass (unit:10^3 tonnes) are at 1 October

Year	Stock in numbers (10^9)						Stock in weight ('000 t)	
	Age 1	Age 2	Age 3	Age 4	Age 5	Total	Total	Mature
1973	770	379	42	18	0	1209	5810	1385
1974	540	564	179	4	0	1287	6624	946
1975	380	361	304	88	1	1134	8735	2964
1976	265	241	167	78	13	764	6792	2701
1977	625	181	102	42	7	957	5461	2749
1978	515	371	100	14	1	1000	5888	2013
1979	360	334	112	5	0	811	5562	1203
1980	335	197	154	33	0	719	6969	3866
1981	600	195	48	14	0	857	4287	1547
1982	496	146	57	2	0	701	3750	1577
1983	515	200	38	0	0	754	4230	1328
1984	145	184	48	3	0	380	2864	1139
1985	35	47	21	1	0	104	822	275
1986	7	3	3	0	0	14	115	63
1987	37	2	0	0	0	39	100	17
1988	20	29	0	0	0	49	427	196
1989	178	19	1	0	0	198	872	181
1990	700	177	17	0	0	894	5834	2623
1991	392	574	33	1	0	1000	7096	2115
1992	351	196	129	1	0	678	5150	2229
1993	2	53	17	2	0	75	796	329
1994	20	3	4	0	0	28	199	95
1995	7	8	2	0	0	17	193	119

Table 4.3.4 Barents Sea CAPELIN: Estimated stock size in numbers (unit:10^9) by age group and total, and biomass ('000 t) of total stock, by August 1.

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	11.1	48.8	20.9	181.4	700.1	405.0	395.2	3.1	27.0	8.3
2	5.0	2.2	30.1	18.9	177.5	596.1	223.9	73.1	4.7	9.4
3	4.3	0.1	0.3	1.5	16.6	34.1	147.6	23.7	5.9	1.8
4	0.2	0.0	0.0	0.0	0.2	1.3	1.5	3.3	0.2	0.4
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sum	20.6	51.2	51.2	201.8	894.4	1036.5	768.2	103.1	37.9	19.9
Biomass	106	73	188	478	2931	4623	3654	704	164	128.9

Table 4.3.5 Barents Sea CAPELIN. Catch in numbers (unit:10^9) by age group and total landings ('000 t) in the spring season

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.5	0.0	0.0
3	1.9	0.0	0.0	0.0	0.0	24.1	23.8	4.8	0.0	0.0
4	4.5	0.0	0.0	0.0	0.0	8.3	17.2	26.9	0.0	0.0
5	0.8	0.0	0.0	0.0	0.0	2.8	2.1	1.4	0.0	0.0
Sum	7.2	0.0	0.0	0.0	0.0	35.6	43.5	33.6	0.0	0.0
Landings	83	16	0	0	0	0	76	61	33	0

Table 4.3.6 Barents Sea CAPELIN. Catch in numbers (unit:10^9) by age group and total landings ('000 t) in the autumn season

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	0.0	0.0	0.0	0.0	0.0	2.2	0.9	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	9.3	5.8	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	3.1	7.9	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.9	0.8	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Sum	0.0	0.0	0.0	0.0	0.0	15.5	15.3	0.0	0.0	0.0
Landings	0	0	0	0	0	226	232	0	0	0

Table 4.3.7 Barents Sea CAPELIN. Fishing mortality coefficients by age group and weighted average for age groups 2-4 in the autumn fishing season

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.10	0.06	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	1.19	0.85	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	N/A	N/A	0.00	0.00	0.00
Avr (2-4)	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.00	0.00	0.00

Table 4.3.8 Barents Sea CAPELIN. Natural mortality coefficients (per month) for immature fish (M_{imm}), used for the whole year, and for mature fish (per season) (M_{mat}) used January to March

	1986		1987		1988		1989		1990	
Age	M_{imm}	M_{mat}	M_{imm}	M_{mat}	M_{imm}	M_{mat}	M_{imm}	M_{mat}	M_{imm}	M_{mat}
1	0.195	0.585	0.134	0.402	0.022	0.066	0.010	0.030	0.000	0.000
2	0.195	0.585	0.134	0.402	0.022	0.066	0.010	0.030	0.000	0.000
3	0.195	0.585	0.134	0.402	0.022	0.066	0.010	0.030	0.000	0.000
4	0.195	0.585	0.134	0.402	0.022	0.066	0.010	0.030	0.000	0.000
5	0.195	0.585	0.134	0.402	0.022	0.066	0.010	0.030	0.000	0.000
Avr	0.195	0.585	0.134	0.402	0.022	0.066	0.010	0.030	0.000	0.000

Table 4.3.8 (Continued)

	1991		1992		1993		1994		1995	
Age	M_{imm}	M_{mat}	M_{imm}	M_{mat}	M_{imm}	M_{mat}	M_{imm}	M_{mat}	M_{imm}	M_{mat}
1	0.016	0.048	0.058	0.174	0.157	0.471	0.157	0.471	0.075	0.224
2	0.016	0.048	0.058	0.174	0.157	0.471	0.157	0.471	0.075	0.224
3	0.016	0.048	0.058	0.174	0.157	0.471	0.157	0.471	0.075	0.224
4	0.016	0.048	0.058	0.174	0.157	0.471	0.157	0.471	0.075	0.224
5	0.016	0.048	0.058	0.174	0.157	0.471	0.157	0.471	0.075	0.224
Avr	0.016	0.048	0.058	0.174	0.157	0.471	0.157	0.471	0.075	0.224

Table 4.3.9 Barents Sea CAPELIN. Estimated stock size in numbers (unit:10^9) by age group and total, and biomass ('000 t) of total stock, by 1 January.

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	43.3	124.7	24.4	194.5	700.6	453.0	593.1	9.2	81.2	13.9
2	26.0	4.2	25.0	18.7	172.5	699.8	371.8	294.9	1.4	12.3
3	32.8	1.9	1.1	26.9	18.0	177.4	541.4	162.6	33.3	2.1
4	12.1	1.6	0.1	0.2	1.4	16.6	28.5	103.7	10.8	2.7
5	0.2	0.1	0.0	0.0	0.0	0.1	0.4	0.5	1.5	0.1
Sum	114.4	132.5	50.6	240.4	892.6	1346.9	1535.0	570.9	128.2	31.2
Biomass	669	174	108	706	1997	7090	8134	4645	690	174

Table 4.3.10 Barents Sea CAPELIN. Mean weight (g) by age group and weighted average for the whole stock by 1 January.

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	1.70	0.83	1.39	1.37	1.52	1.49	1.42	1.38	1.76	2.66
2	4.70	4.67	2.29	3.83	3.76	4.19	4.09	3.91	3.78	4.84
3	9.07	12.81	13.48	13.52	13.65	16.85	9.52	9.47	9.94	12.32
4	14.26	15.74	15.71	18.92	25.09	29.82	21.21	18.55	16.63	18.15
5	17.22	17.60	36.66	0.00	25.14	21.56	33.06	32.45	20.58	20.24
Avr	5.85	1.32	2.13	2.94	2.24	5.26	5.30	8.14	5.38	5.58

Table 4.3.11 Barents Sea CAPELIN. Estimated proportion of maturing stock by 1 January.

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
3	0.10	0.46	0.65	0.41	0.48	0.65	0.15	0.12	0.11	0.43
4	0.53	0.85	0.82	0.72	1.00	1.00	0.89	0.74	0.71	0.87
5	0.93	1.00	0.01	1.00	0.77	1.00	0.96	0.00	0.92	0.88
Avr	0.09	0.02	0.02	0.05	0.01	0.10	0.07	0.17	0.10	0.11

Table 4.3.12 Barents Sea CAPELIN. Estimated spawning stock biomass ('000 t) by 1 April.

Age	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.56	16.59	0.00	0.00	0.00	1.04
3	5.30	10.61	12.37	194.96	155.75	1600.00	938.73	131.55	37.44	12.65
4	7.43	19.15	1.12	3.42	29.99	176.93	133.60	531.89	104.89	40.86
5	0.00	1.39	0.00	0.00	0.24	0.00	0.00	0.00	22.30	1.95
Sum	13	31	13	198	187	1794	1072	663	165	57

Table 4.3.13 Barents Sea CAPELIN. Stock summary table. Recruitment (number of 1 year old fish (unit:10^9)) and stock biomass ('000 t) given at 1 August , spawning stock ('000 t) at time of spawning (1 April next year). Landings ('000 t) are the sum of the total landings in the season starting in the autumn of the year indicated and those in the following spring season.

Year	Recruit-ment	Total stock biomass	Landings	Spawning stock biomass
1973	1175	4480	1037	389
1974	762	5576	1239	95
1975	510	6639	2018	1147
1976	447	5740	2867	919
1977	789	4598	2464	475
1978	857	4406	1565	579
1979	553	4375	1697	21
1980	592	5607	2087	1654
1981	487	3348	1579	505
1982	574	2686	2088	25
1983	613	3019	1826	150
1984	174	2310	1439	102
1985	43	746	401	13
1986	11	106	0	31
1987	49	73	0	13
1988	21	188	0	198
1989	181	478	0	187
1990	700	2931	707	1794
1991	405	4623	1117	1072
1992	395	3654	817	663
1993	3	704	0	165
1994	27	164	0	57
1995	8	129	0	74

Table 5.1.1 Preliminary TACs for the summer/autumn fishery, recommended TACs for the whole season, landings and remaining spawning stock in the 1983/84-1993/94 seasons.

Season	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	94/95
Prelim. TAC	300	700	1100	500	900	900	600	0	500	900	950
Rec. TAC	920	1280	1290	1115	1065	-	250	740	900	1250	850
Landings	897	1311	1333	1116	1036	808	314	677	788	1179	842
Spawn. stock	460	460	420	440	445	115	330	475	499	460	420

Table 5.1.2. The international capelin catch 1964 - 1994 (thousand tonnes)

	Winter season				Summer- and autumn season					Total
Year	Iceland	Norway	Faroes	total	Iceland	Norway	Faroes	Others	total	
1964	8.6	-	-	8.6	-	-	-	-	-	8.6
1965	49.7	-	-	49.7	-	-	-	-	-	49.7
1966	124.5	-	-	124.5	-	-	-	-	-	124.5
1967	97.2	-	-	97.2	-	-	-	-	-	97.2
1968	78.1	-	-	78.1	-	-	-	-	-	78.1
1969	170.6	-	-	170.6	-	-	-	-	-	170.6
1970	190.8	-	-	190.8	-	-	-	-	-	190.8
1971	182.9	-	-	182.9	-	-	-	-	-	182.9
1972	276.5	-	-	276.5		-	-	-	-	276.5
1973	440.9	-	-	440.9	-	-	-	-	-	440.9
1974	461.9	-	-	461.9	-	-	-	-	-	461.9
1975	457.1	-	-	457.1	3.1	-	-	-	3.1	460.2
1976	338.7	-	-	338.7	114.4	-	-	-	114.4	453.1
1977	549.2	-	24.3	573.5	259.7	-	-	-	259.7	833.2
1978	468.4	-	36.2	504.6	497.5	154.1	3.4	-	655.0	1,159.6
1979	521.7	-	18.2	539.9	442.0	124.0	22.0	-	588.0	1,127.9
1980	392.1	-	-	392.1	367.4	118.7	24.2	17.3	527.6	919.7
1981	156.0	-	-	156.0	484.6	91.4	16.2	20.8	613.0	769.0
1982	13.2	-	-	13.2	-	-	-	-	-	13.2
1983	-	-	-	-	133.4	-	-	-	133.4	133.4
1984	439.6	-	-	439.6	425.2	104.6	10.2	8.5	548.5	988.1
1985	348.5	-	-	348.5	644.8	193.0	65.9	16.0	919.7	1,268.2
1986	341.8	50.0	-	391.8	552.5	149.7	65.4	5.3	772.9	1,164.7
1987	500.6	59.9	-	560.5	311.3	82.1	65.2	-	458.6	1,019.1
1988	600.6	56.6	-	657.2	311.4	11.5	48.5	-	371.4	1,028.6
1989	609.1	56.0	-	665.1	53.9	52.7	14.4	-	121.0	786,1
1990	612.0	62.5	12.3	686,8	83.7	21.9	5.6	-	111.2	798.0
1991	202.4	-	-	202.4	56.0	-	-	-	56.0	258.4
1992	573.5	47.6	-	621.1	213.4	65.3	18.9	*0.5	298.1	919.2
1993	489.1	-	*0.5	489.6	450.0	127.5	23.9	*10.2	611.6	1,101.2
1994	550.3	15.0	*1.8	567.1	210.7	99.0	12.3	*2.1	324.1	891.2
1995	539.8	-	*0.4							540.2

* Greenlandic vessel

Table 5.1.3 The total international catch of capelin in the Iceland-Greenland-Jan Mayen area by age groups in numbers (billions) and the total catch by numbers and weight (thous. tonnes) the autum season (August-December) 1978 - 1994.

	Year								
Age	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	-	0.6	4.9	0.6	-	0.6	0.5	0.8	+
2	21.4	29.4	17.2	27.9	-	7.2	9.8	25.6	10.0
3	12.2	6.1	5.4	2.0	-	0.8	7.8	15.4	23.3
4	-	-	-	+	-	-	0.1	0.2	0.5
Total number	33.6	36.1	27.5	30.5	-	8.6	18.2	42.0	33.8
Total weight	655.0	588.0	527.6	613.0	-	133.4	548.5	919.7	772.9

	Year							
Age	1987	1988	1989	1990	1991	1992	1993	1994
1	+	0.3	1.7	0.8	0.3	1.7	0.2	0.6
2	27.7	13.6	6.0	5.9	2.7	14.0	24.9	15.0
3	6.7	5.4	1.5	1.0	0.4	2.1	5.4	2.8
4	+	+	+	+	+	+	0.2	+
Total number	34.4	19.3	9.2	7.7	3.4	17.8	30.7	18.4
Total weight	458.6	371.4	121.0	111.2	56.0	298.1	611.6	324.1

Table 5.1.4 The total international catch of capelin in the Iceland-Greenland-Jan Mayen area by age groups in numbers (billions) and the total catch by numbers and weight (thous. tonnes) the winter season (January-March) 1979 - 1995

	Year								
Age	1979	1980	1981	1982	1983	1984	1985	1986	1987
2	1.0	1.3	1.7	-	-	2.1	0.4	0.1	+
3	20.8	17.6	7.1	0.8	-	18.1	9.1	9.8	6.9
4	4.8	3.5	1.9	0.1	-	3.4	5.4	6.9	15.5
5	0.1	-	-	-	-	-	-	0.2	-
Total number	26.7	22.4	10.7	0.9	-	23.6	14.5	17.0	22.4
Total weight	539.9	392.1	156.0	13.2	-	439.6	348.5	391.8	560.5

	Year							
Age	1988	1989	1990	1991	1992	1993	1994	1995
2	+	0.1	1.4	0.5	2.7	0.2	0.6	1.3
3	23.4	22.9	24.8	7.4	29.4	20.1	22.7	17.6
4	7.2	7.8	9.6	1.5	2.8	2.5	3.9	5.9
5	0.3	+	0.1	+	+	+	+	+
Total number	30.9	30.8	35.9	9.4	34.9	22.8	27.2	24.8
Total weight	657.2	665.1	686.8	202.4	621.1	489.6	567.1	539.8

Table 5.2.1 The calculated number (billions) of capelin on 1 August 1978 - 1994 by age and maturity groups. The total number (billions) and weight (thous. tonnes) of the immature and maturing (fishable) stock components are also given.

	Year								
Age/maturity	1978	1979	1980	1981	1982	1983	1984	1985	1986
1 juvenile	163.9	60.3	65.9	49.1	147.3	125.1	252.1	99.1	157.1
2 immature	15.3	16.4	4.2	3.7	15.0	42.5	40.9	100.0	29.4
2 mature	81.9	91.3	35.4	39.7	17.1	53.7	40.7	64.6	35.6
3 mature	29.1	10.1	10.8	2.8	2.3	9.8	27.9	27.0	65.8
4 mature	0.4	0.3	+	+	+	0.1	0.4	0.4	0.7
Number immat.	179.2	76.7	70.1	52.8	162.3	167.6	293.0	199.1	176.5
Number mature	111.4	101.7	46.2	42.5	19.4	63.6	69.0	92.0	102.1
Weight immat	790	337	298	228	650	882	1343	1358	812
Weight mature	2147	1482	932	743	307	985	1270	1417	2116

	Year								
Age/maturity	1987	1988	1989	1990	1991	1992	1993	1994	1995
1 juvenile	143.5	80.8	64.2	117.8	132.9	148.4	*125.4	*171.2	
2 immature	37.2	24.0	10.3	10.1	9.7	16.6	20.1	**22.7	
2 mature	65.4	70.3	42.8	31.9	67.7	70.7	77.4	59.7	**92.5
3 mature	20.1	24.5	15.8	6.8	6.7	6.4	10.9	13.2	**14.9
4 mature	0.1	0.4	+	+	+	+	0.2	-	
Number immat.	180.7	104.8	74.5	127.9	142.6	165.0	45.7	*193.9	
Number mature	85.6	95.2	58.6	38.7	74.4	77.1	88.5	72.9	
Weight immat	832	469	307	562	764	707	*621	*756	
Weight mature	1540	1528	1072	680	1146	1237	1490	1101	

* Preliminary
** Predicted

Table 5.2.2 The calculated number (billions) of capelin on 1 January 1979 - 1995 by age and maturity groups. The total number (billions) and weight (thous. tonnes) of the immature and maturing (fishable) stock components and the remaining spawning stock by number and weight are also given.

	Year								
Age/maturity	1979	1980	1981	1982	1983	1984	1985	1986	1987
2 juvenile	137.6	50.6	55.3	41.2	123.7	105.0	211.6	83.2	131.9
3 immature	12.8	13.8	3.5	3.0	12.6	35.7	34.3	83.9	25.6
3 mature	51.8	53.4	16.3	8.0	14.3	39.8	25.2	34.5	22.1
4 mature	14.8	3.6	4.9	0.5	2.0	7.6	15.6	10.5	37.0
5 mature	0.3	0.2	+	+	+	0.1	0.3	0.2	0.2
Number immat.	150.9	64.4	58.8	44.2	136.3	140.7	245.9	167.1	157.5
Number mature	65.6	57.2	21.2	8.5	16.3	47.5	41.1	45.2	59.1
Weight immat.	1028	502	527	292	685	984	1467	1414	1003.0
Weight mature	1358	980	471	171	315	966	913	1059	1355
Number sp.st.	29.0	17.5	7.7	6.8	13.5	21.6	20.7	19.6	18.3
Weight sp. st	600	300	170	140	260	440	460	460	420

	Year							
Age/maturity	1988	1989	1990	1991	1992	1993	1994	1995
2 juvenile	120.5	67.8	53.9	98.9	111.6	124.6	*104.8	**143.7
3 immature	31.2	20.1	8.6	8.6	8.1	13.9	16.9	**19.1
3 mature	34.1	48.8	31.2	22.3	54.8	46.5	50.5	35.1
4 mature	11.7	16.0	12.1	4.5	5.3	3.5	4.6	8.7
5 mature	+	0.3	+	+	+	+	+	+
Number immat.	151.3	87.9	62.5	107.5	119.7	138.5	121.7	**162.8
Number mature	45.8	64.8	43.3	26.8	60.1	50.0	55.1	43.8
Weight immat.	1083	434	291	501	487	622	573	**696
Weight mature	993	1298	904	544	1106	1017	1063	914
Number sp.st.	18.5	22.0	5.5	16.3	25.8	23.6	24.8	19.2
Weight sp. st.	400	440	115	330	475	499	460	420

* Preliminary

** Predicted

Table 5.3.1 The data used in the comparisons between abundance of age groups (numbers) when predicting fishable stock abundance for calculations of preliminary TACs.

	Age 1	Age 2	Age 2	Age 2	Age 3
	Acoustics	Back-calc.	Acoustics	Back-calc.	Back-calc.
		Mature	Immature	Total	Mature
Year-class	N_1	N_2^{mat}	N_2^{imm}	N_2^{tot}	N_3^{tot}
1980	23.7	17.1	1.7	32.1	9.8
1981	68.0	53.7	8.2	96.2	27.9
1982	44.1	40.7	4.6	81.6	27.0
1983	73.8	64.6	12.6	164.6	65.8
1984	33.8	35.6	1.4	65.0	20.1
1985	58.6	65.4	5.4	102.6	24.5
1986	70.2	70.3	6.7	94.3	15.8
1987	43.9	42.8	1.8	53.1	6.8
1988	29.2	31.9	1.3	42.0	6.7
1989	*39.2	67.7	5.2	77.4	6.4
1990	60.0	70.7	2.3	87.3	10.9
1991	104.6	86.9	10.8	107.0	13.2
1992	100.4	59.8	6.9	**71.4	
1993	119.0				

* Invalid due to ice conditions.
** Calculated from total abundance recorded in autumn/winter 1994/95, catches and natural mortality.

Table 5.3.2 Mean weight (g) in autumn of mature capelin of the 1978-1992 year classes

Year class	Age 2	Age 3
1978		24.0
1979	19.2	24.1
1980	16.5	22.5
1981	16.1	25.7
1982	15.8	23.8
1983	15.5	24.1
1984	18.1	25.8
1985	17.9	23.4
1986	15.5	25.5
1987	18.0	25.5
1988	18.1	25.4
1989	16.3	22.6
1990	16.5	23.3
1991	16.2	23.6
1992	16.0	
Average	16.8	24.3

Table 5.3.3 Predictions of fishable stock abundance and TACs for the 1982/83 - 1995/96 seasons. The last column gives contemporary advice on TACs for comparison.

Age 2 and age 3 = Numbers in age groups at the beginning of season.
Fish.st. = calculated weight of maturing capelin in thous. tonnes (ref. 1 August).
TAC calc = predicted TAC and TAC adv = advised TAC.

Mean weight of maturing 2 and 3 group capelin in October/November 1981-1991 is 17.0 and 24.3 g respectively.
Numbers are billions; weights in thous. tonnes.

Season	Year classes	Age 2	Age 3	Fish.st.	TAC calc	TAC adv
1982/83	80 - 79	26.6	4.1	549	17	0
1983/84	81 - 80	63.0	0.0	1065	465	573
1984/85	82 - 81	43.4	26.3	1373	733	897
1985/86	83 - 82	67.8	20.2	1637	963	1311
1986/87	84 - 83	34.9	55.0	1926	1215	1333
1987/88	85 - 84	55.3	13.7	1268	642	1115
1988/89	86 - 85	64.8	29.0	1800	1105	1036
1989/90	87 - 86	43.2	25.5	1350	713	550
1990/91	88 - 87	31.1	8.2	724	170	265
1991/92	89 - 88	39.4	3.7	755	197	740
1992/93	90 - 89	56.4	18.3	1398	755	*900
1993/94	91 - 90	93.1	22.6	2123	1385	1250
1994/95	92 - 91	89.6	27.0	2170	1427	850
1995/96	93 - 92	92.5	14.9	1916		1202

* In January 1993 80,000 t were added to the 820,000 t recommended after the October 1992 survey due to an unexpectedly large increase in mean weights.

Table 5.4.1 Acoustic estimate of capelin in the Iceland-East Greenland-Jan Mayen area in October-November 1994.

	Age/Year Class							
Total length (cm)	1 1993	2 1992	3 1991	4+ 1990	Number maturing (10^9)	Total number (10^9)	Biomass (10^3 t)	Mean weight (g)
7.0 - 7.4	+	-	-	-	-	+	+	1.0
7.5 - 7.9	0.9	-	-	-	-	0.9	1.0	1.1
8.0 - 8.4	5.6	-	-	-	-	5.6	11.1	2.0
8.5 - 8.9	9.5	-	-	-	-	9.5	18.9	2.0
9.0 - 9.4	17.7	-	-	-	-	17.7	40.6	2.3
9.5 - 9.9	24.7	-	-	-	-	24.7	74.0	3.0
10.0 - 10.4	27.4	-	-	-	-	27.4	96.0	3.5
10.5 - 10.9	18.5	0.1	-	-	-	18.6	74.4	4.0
11.0 - 11.4	9.2	0.2	-	-	-	9.4	44.0	4.7
11.5 - 11.9	3.4	0.3	-	-	-	3.7	20.5	5.5
12.0 - 12.4	0.9	1.1	-	-	-	2.1	13.3	6.4
12.5 - 12.9	0.7	2.2	-	-	-	2.8	21.9	7.8
13.0 - 13.4	0.3	3.0	-	-	-	3.3	30.4	9.2
13.5 - 13.9	0.1	5.0	-	-	5.2	5.2	55.2	10.7
14.0 - 14.4	0.1	5.4	0.1	-	5.6	5.5	67.8	12.2
14.5 - 14.9	+	4.1	0.1	-	4.2	4.2	58.3	14.0
15.0 - 15.4	0.1	3.9	0.4	-	4.3	4.3	68.2	15.9
15.5 - 15.9	-	4.1	0.6	-	4.7	4.7	85.6	18.1
16.0 - 16.4	-	3.7	0.8	-	4.5	4.5	91.3	20.2
16.5 - 16.9	-	1.9	0.8	-	2.7	2.7	61.7	23.2
17.0 - 17.4	-	0.8	0.7	-	1.5	1.5	40.9	26.6
17.5 - 17.9	-	0.2	0.6	-	0.8	0.8	24.9	29.8
18.0 - 18.4	-	0.1	0.3	-	0.4	0.4	11.3	32.2
18.5 - 18.9	-	+	0.1	-	0.1	0.1	3.6	38.2
19.0 - 19.4	-	+	+	-	+	+	0.2	43.0
19.5 - 19.9	-	-	-	-	-	-	-	-
Number (10^9)	119.0	36.1	4.4	-	33.8	159.4	-	-
Biomass (10^3 t)	394.5	518.0	102.5	-	568.8	1015.0	-	-
Mean length (cm)	10.0	14.7	16.7	-	15.3	11.2	-	-
Mean weight (g)	3.3	14.3	23.6	-	16.8	6.4	-	-

Table 5.4.2 Acoustic estimate of capelin in the Iceland-East Greenland-Jan Mayen area in January/February 1995.

	Age/Year Class							
Total length (cm)	2 1993	3 1992	4 1991	5+ 1990	Number maturing (10^9)	Total number (10^9)	Biomass (10^3 t)	Mean weight (g)
8.5 - 8.9	+	-	-	-	-	+	+	2.0
9.0 - 9.4	+	-	-	-	-	+	+	2.0
9.5 - 9.9	0.1	-	-	-	-	0.1	0.2	2.0
10.0 - 10.4	0.2	-	-	-	-	0.2	0.5	3.0
10.5 - 10.9	0.2	+	-	-	-	0.2	0.8	4.7
11.0 - 11.4	0.1	-	-	-	-	0.1	0.5	4.8
11.5 - 11.9	0.2	+	-	-	-	0.2	0.9	4.7
12.0 - 12.4	0.1	0.2	-	-	-	0.3	1.4	6.4
12.5 - 12.9	0.1	0.3	-	-	-	0.4	2.5	7.3
13.0 - 13.4	0.1	0.5	-	-	-	0.6	5.0	8.7
13.5 - 13.9	0.1	2.2	+	-	2.3	2.3	24.2	10.4
14.0 - 14.4	0.2	2.9	0.1	-	3.2	3.2	37.4	11.8
14.5 - 14.9	0.3	3.6	0.2	-	4.1	4.1	56.0	13.7
15.0 - 15.4	0.3	3.9	0.3	-	4.5	4.5	69.2	15.5
15.5 - 15.9	0.4	4.3	0.9	-	5.7	5.7	99.9	17.7
16.0 - 16.4	0.2	4.4	0.7	-	5.3	5.3	108.8	20.5
16.5 - 16.9	0.1	3.7	0.9	-	4.7	4.7	108.6	23.0
17.0 - 17.4	0.1	2.8	1.1	-	3.9	3.9	99.2	25.6
17.5 - 17.9	-	2.4	1.1	-	3.5	3.5	101.1	28.8
18.0 - 18.4	-	1.4	1.2	-	2.5	2.5	80.6	31.9
18.5 - 18.9	-	0.7	1.0	-	1.7	1.7	58.1	35.1
19.0 - 19.4	-	0.2	0.5	-	0.7	0.7	27.3	38.2
19.5 - 19.9	-	+	0.1	-	0.1	0.1	3.7	40.3
Number (10^9)	2.7	33.4	7.9	-	42.1	44.0	-	-
Biomass (10^3 t)	33.2	642.6	210.2	-	873.9	886.0	-	-
Mean length (cm)	13.9	15.6	17.1	-	15.9	15.8	-	-
Mean weight (g)	12.5	19.2	26.6	-	20.8	20.1	-	-

Table 5.4.3 A corrected acoustic estimate of capelin in the Iceland-East Greenland-Jan Mayen area in January/February 1995 (see text).

	Age/Year Class							
Total length (cm)	2 1993	3 1992	4 1991	5+ 1990	Number maturing (10^9)	Total number (10^9)	Biomass (10^3 t)	Mean weight (g)
8.5 - 8.9	+	-	-	-	-	+	+	2.0
9.0 - 9.4	+	-	-	-	-	+	+	2.0
9.5 - 9.9	0.1	-	-	-	-	0.1	0.2	2.0
10.0 - 10.4	0.1	-	-	-	-	0.1	0.3	3.0
10.5 - 10.9	0.2	0.1	-	-	-	0.3	1.4	4.7
11.0 - 11.4	0.1	0.2	-	-	-	0.3	1.4	4.8
11.5 - 11.9	0.2	0.3	-	-	-	0.5	2.4	4.7
12.0 - 12.4	0.1	1.0	-	-	-	0.2	1.3	6.4
12.5 - 12.9	0.1	1.9	-	-	-	2.0	14.6	7.3
13.0 - 13.4	0.1	2.7	-	-	-	2.8	24.4	8.7
13.5 - 13.9	0.1	4.5	+	-	4.6	4.6	47.8	10.4
14.0 - 14.4	0.2	4.9	0.1	-	5.2	5.2	61.4	11.8
14.5 - 14.9	0.3	3.7	0.2	-	4.2	4.2	57.5	13.7
15.0 - 15.4	0.3	3.9	0.3	-	4.5	4.5	69.2	15.5
15.5 - 15.9	0.4	4.3	0.9	-	5.7	5.7	99.9	17.7
16.0 - 16.4	0.2	4.4	0.7	-	5.3	5.3	108.8	20.5
16.5 - 16.9	0.1	3.7	0.8	-	4.7	4.7	108.6	23.0
17.0 - 17.4	0.1	2.7	1.0	-	3.9	3.9	99.2	25.6
17.5 - 17.9	-	2.4	1.1	-	3.5	3.5	101.1	28.8
18.0 - 18.4	-	1.4	1.2	-	2.5	2.5	80.6	31.9
18.5 - 18.9	-	0.7	1.0	-	1.7	1.7	58.1	35.1
19.0 - 19.4	-	0.2	0.5	-	0.7	0.7	27.3	38.2
19.5 - 19.9	-	+	0.1	-	0.1	0.1	3.7	40.3
Number (10^9)	2.7	43.1	7.9	-	46.6	52.9	-	-
Biomass (10^3 t)	33.2	730.6	210.2	-	925.0	974.0	-	-
Mean length (cm)	14.1	15.3	17.1	-	16.0	15.6	-	-
Mean weight (g)	12.4	17.0	26.6	-	19.9	18.4	-	-

Table 5.5.1 The total international catch in numbers (millions) of capelin in the Iceland-east Greenland-Jan Mayen area in the summer/autumn season of 1994 by age and length, and the catch in weight ('000 t) by age groups.

Total length (cm)	Age 1	Age 2	Age 3	Age 4	Total	%
11 - 12	-	-	-	-	-	-
12 - 13	400	375	-	-	775	4.2
13 - 14	200	2085	-	-	2285	12.4
14 - 15	-	3960	81	-	4041	21.9
15 - 16	-	4575	1000	-	5575	30.1
16 - 17	-	3255	879	-	4134	22.4
17 - 18	-	765	759	-	1524	8.2
18 - 19	-	75	81	-	156	0.8
Total	600	15090	2800	-	18490	
%	3.2	81.6	15.2	-		100.0
Weight ('000 t)	6.0	250.5	67.6	-	324.1	

Table 5.5.2 The total international catch in numbers (millions) of capelin in the Iceland-east Greenland-Jan Mayen area in the winter season of 1995 by age and length, and the catch in weight ('000 t) by age groups.

Total length (cm)	Age 2	Age 3	Age 4	Age 5	Total	%
11 - 12	-	-	-	-	-	-
12 - 13	34	202	-	-	236	1.0
13 - 14	138	689	-	-	827	3.3
14 - 15	397	2134	67	-	2598	10.5
15 - 16	447	3914	465	-	4826	19.5
16 - 17	241	5655	1254	-	7150	28.8
17 - 18	43	3410	2025	-	5478	22.1
18 - 19	-	1411	1697	-	3108	12.4
19 - 20	-	202	358	-	560	2.3
20 - 21	-	-	28		28	0.1
Total	1300	17617	5894	-	24811	
%	5.2	71.0	23.8	-		100.0
Weight ('000 t)	12.8	370.4	157.0	-	540.2	

Table 5.8.1 Abundance indices of 0-group capelin 1970-1995 and their division by areas.

	Northwestern				Iceland
Year class	Irminger Sea	West	North	East	Total
1970	1	8	2	-	11
1971	+	7	12	+	19
1972	+	37	52	+	89
1973	14	39	46	17	116
1974	26	44	57	7	134
1975	3	37	46	3	89
1976	2	5	10	15	32
1978	+	2	29	+	31
1979	4	19	25	1	49
1980	3	18	19	1	41
1981	10	13	6	-	29
1982	+	8	5	+	13
1983	+	3	18	1	22
1984	+	2	17	9	28
1985	1	8	19	3	31
1986	+	16	17	4	37
1987	1	6	6	1	14
1988	3	22	26	1	52
1989	-	16	7	-	23
1990	+	7	12	2	21
1991	8	2	43	1	54
1992	3	11	20	+	35
1993	2	21	13	15	51
1994	3	9	69	10	94
1995	+	6	10	8	24

Table 5.8.2 Estimated numbers, mean length and weight of 1-group capelin in during the August surveys of 1982-1995.

Year class	Number in 10^{-9}	Length (cm)	Weight (g)
1981	119	10.0	3.4
1982	155	10.4	4.2
1983	286	9.7	3.6
1984	31	10.2	3.8
1985	71	9.5	3.3
1986	101	9.1	3.0
1987	147	8.8	2.6
1988	111	10.1	3.4
1989	36	10.4	4.0
1990	50	10.7	5.1
1991	87	9.7	3.4
1992	33	9.4	3.0
1993	85	9.0	2.8
1994	189	9.8	3.2

Table 6.2.1 Landings (tonnes) of BLUE WHITING from the main fisheries, 1985-1994, as estimated by the Working Group.

Area	1985	1986	1987	1988	1989
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	90,742	160,061	123,042	55,829	37,638
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	464,265 [2]	534,263 [2]	445,884 [2]	421,636	473,165
Icelandic industrial fishery (Division Va)	-	-	-	-	4,977
Industrial mixed fishery (Divisions IVa-c, Vb, IIIa)	97,769	99,580	62,689	45,110	75,958
Sub-total northern fishery	652,776	793,904	631,615	522,575	591,738
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k)	42,820 [3]	33,082 [3]	32,819 [3]	30,838	33,695
Total	695,596	826,986	664,434	553,413	625,433

Area	1990	1991	1992	1993	1994
Norwegian Sea fishery (Sub-areas I + II and Divisions Va, XIVa + XIVb)	2,106	78,703	62,312	43,240	22,252
Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb + VIIc)	463,495	218,946	317,237	345,770	378,704
Icelandic industrial fishery (Division Va)	-	-	-	-	
Industrial mixed fishery (Divisions IVa-c, Vb, IIIa)	63,192	39,872	66,174	55,215	24,888
Sub-total northern fishery	528,793	337,521	445,723	444,225	425,844
Southern fishery (Sub-areas VIII + IX, Divisions VIId,e + VIIg-k)	32,817	32,003	28,722	32,256	29,473
Total	561,610	369,524	474,445	476,481	455,317

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

Table 6.2.2 Landings (tonnes) of BLUE WHITING from the directed fishery in the Norwegian Sea (Sub-areas I and II, Divisions Va, XIVa and XIVb) fisheries, 1985-1994, as estimated by the Working Group.

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

Country	1990	1991	1992	1993[1]	1994
Faroes	-	-	-	-	-
France	-	-	-	-	-
Germany	-	-	-	-	2
Greenland	-	-	-	-	-
Iceland	-	-	-	-	-
Norway	566	100	912	240	-
Poland	-	-	-	-	22,250[3]
UK (Engl. & Wales)	-	-	-	-	-
USSR/Russia[1]	1,540	78,603	61,400	43,000	-
Total	2,106	78,703	62,312	43,240	22,252

[1]From 1991.
[2]Includes Division Vb

Table 6.2.3 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), 1985-1994, as estimated by the Working Group.

Country	1985	1986	1987	1988	1989
Denmark	21,104	11,364	2,655	797	25
Faroes	72,316	80,564	70,625	79,339	70,711
France	-	-	-	-	2,190
German Dem.Rep.	6,839	2,750	3,584	4,663	3,225
Germany, Fed.Rep.	626	-	266	600	848
Ireland	668	16,440	3,300	245	-
Netherlands	1,801	8,888	5,627	800	2,078
Norway	234,137	283,162[2]	191,012	208,416	258,386
UK (Engl. & Wales)	2	10	5	3	1,557
UK (Scotland)	-	3,472	3,310	5,068	6,463
USSR	126,772	127,613	165,497	121,705	127,682
Total	464,265	534,263	445,884	421,636	473,165

Country	1990	1991	1992	1993[1]	1994
Denmark	-	-	3,167	-	770
Faroes	43,405	10,208[2]	12,731[2]	14,984	22,548
France	-	-	-	1,195	-
German Dem.Rep.	230	-			-
Germany, Fed.Rep.	1,469	349	1,307[4]	91[4]	-
Ireland	-	-	-	-	3
Netherlands	7,280	17,359	11,034	18,436	21,076
Norway	281,036[2]	114,866[2]	148,733[2]	198,916	226,235
UK (Engl. & Wales)	13	-	356	2	1,418
UK (Scotland)	5,993	3,541	6,493	2,030	3,047
USSR/Russia[3]	124,069	72,623	115,600	96,000	94,531
Japan	-	-	918	1,742	2,574
Estonia	-	-	6,156	10,328	4,342
Latvia	-	-	10,742	2,046	2,160
Total	463,495	218,946	317,237	345,770	378,704

[1]Including directed fishery also in Division IVa.
[2]From 1991.

Table 6.2.4 Landings (tonnes) of BLUE WHITING from mixed industrial fisheries and caught as by-catch in ordinary fisheries in Divisions IIIa, IVa,

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Denmark	35,843	57,315	28,541	18,144	26,605	27,052	15,538	31,389	41,053	19,686
Faroes	3,606	5,678	7,051	492	3,325	5,281	355	705	1,522	1,794
German Dem. Rep.[1]	-	-	53	-	-	-	-			
Germany, Fed. Rep.[1]	52	-	62	280	3	-	-	25[3]	9[2]	- -
Netherlands	130	1,114	-	-	-	20	-	2	46	-
Norway	54,522	26,941	24,969	24,898	42,956	29,336[2]	22,644	31,977	12,333	3,408
Sweden	3,616	8,532	2,013	1,229	3,062	1,503	1,000	2,058	[4]	[4]
UK (Eng & Wal)[1]	-	-	-	-	7	-	-	17	-	-
UK (Scotland)	-	-	-	100	-	-	335	1	252	-
Total	97,769	99,580	62,689	45,110	75,958	63,192	39,872	66,174	55,215	24,888

[1] Including directed fishery also in Division Iva
[2] Including mixed industrial fishery in the Norwegian Sea
[3] Germany
[4] Unprecise estimates. Reported catch of 37,265 t in 1993 and 28,653 t in 1994 not used in the VPA-RUN

Table 6.2.5 Landings (tonnes) of BLUE WHITING from the Southern areas (Sub-areas VIII and IX and Divisions VIIg-k and VIId, E; from 1984, the Divisions VIIg-k are not included) 1985-1994 as estimated by the Working Group.

Country	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Netherlands	-	-	-	-	-	450	10	-	-	-
Norway	-	-	4	-	-	-	-	-	-	-
Portugal	6,989	8,116	9,148	5,979	3,557	2,864	2,813	4,928	1,236	1,350
Spain	35,828	24,965	23,644	24,847	30,108	29,490	29,180	23,794	31,020	28,118
UK (Eng. &Wal.)	3	1	23	12	29	13	-	-	-	5
France	-	-	-	-	1	-	-	-	-	-
Total	42,820	33,082	32,819	30,838	33,695	32,817	32,003	28,722	32,256	29,473

Table 6.2.6 Preliminary data on landings (t) of BLUE WHITING in 1995.

Country	Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Total
Russia	IIa	-	61	325	190	1.585	11.831	564	1.765	16.321
	IVa	-	-	-	-	2.123	1.027	171	1	3.322
	Vb	7.853	3.441	448	8.791	22.701	305	266	299	44.104
	VIa	599	92	20	2.195	2.454	-	-	-	5.360
	VIIb,c	-	-	1.300	434	-	-	-	-	1.734
	VIIg-k	-	-	2.550	-	-	-	-	-	2.550
Sum		8.452	3.594	4.643	11.610	28.863	13.163	1.001	2.065	73.391
Faroe Islands	IVa	-	-	29	389	1.900	-	201	164	2.683
	VIa	-	-	-	10.000	2.522	38	-	-	12.560
	VIIb,c,g-k	-	-	-	9.320	-	-	-	-	9.320
Sum		0	0	29	19.709	4.422	38	201	164	24.563
Norway	IVa	-	-	-	-	24.555	-	-	-	24.555
	Vb	-	-	-	-	6.003	-	-	-	6.003
	VIa	-	-	-	71.459	32.203	-	-	-	103.662
	VIb	-	-	-	-	-	-	-	-	0
	VIIb,c	1.749	17.431	63.223	37.723	-	-	-	-	120.126
	VIIg-k	-	-	524	-	-	-	-	-	524
Sum		1.749	17.431	63.747	109.182	62.761	0	0	0	254.870
Estonia	Vb	11	728	81	2.503	3.710	645	76	-	7.754
France	Vb	-	-	-	-	720	-	-	-	720
Spain	VIII + IXa	1.307	2.196	2.485	2.084	3.134	2.799	1.863	1.663	17.531
Grand total		11.519	23.949	70.985	145.088	103.610	16.645	3.141	3.892	378.829

Table 6.3.1. Length distribution of blue whiting from Norwegian industrial fishery 1994.

	IVa Jan	IVa April	IVa May	IVa June	IVa July	IVa Aug	IVa Sept	IVa Oct	IVa Nov	IVa Dec
18										
19	2	12		1						
20	5	42	10	14						
21	1	42	35	57	2					
22	4	34	34	141	12	10				
23	2	18	15	88	6	23				
24		4	4	17	2	22		3		
25	1	9	1	23	2	16		6	2	
26	1	8	1	24	2	10	1	6		
27		5		25	4	12	2	2		
28	1	6		30	4	22		4		
29	1	10		21	1	16	1	1		
30		4		17	1	21	8	4		1
31		5		12		16	3	4	2	
32		3		14		7	5	3	1	1
33	1	1		1		6		2	5	
34		2		2		5	2	6	2	
35		3		3		2		2	6	
36		2		1		1				1
37		1					4		2	
38		1					1		1	
39									1	
N tot	19	212	100	491	36	189	27	43	22	3
N samp	1	7	2	17	3	14	4	5	3	1

Table 6.3.2. Length distribution of blue whiting from Norwegian directed fishery 1994

	VIIbc January	VIIbc February	VIIg-k March	VIb March	VIIbc March	VIa April	VIa May	Vb May
23		3						
24		7		2		1		
25		7		1	2	3		
26		22	3		4	3		1
27	1	31	4		24	15	4	6
28	8	71	4	1	66	53	14	16
29	9	89	13	11	110	89	26	38
30	15	120	24	21	140	176	44	63
31	23	112	20	14	155	174	46	37
32	25	109	16	16	129	131	23	44
33	37	64	6	9	61	99	15	15
34	29	56	9	3	50	89	18	9
35	21	32	10	3	51	70	18	4
36	15	23	4	1	37	37	6	6
37	6	19	3	2	28	12	2	
38	13	4	2		8	12	3	
39	3	1	1		4	1		1
40		1	1		1	1		
N tot	205	771	120	84	870	966	219	240
N samp	2	8	1	1	9	13	3	2

Table 6.3.3. Blue whiting length distributions in 1994 from the Faroese commercial catches.

	Directed			Mixed industrial	
Length (cm)	Mar-Apr VII, IVa	May IVa, Vb	Aug IIa	Jan-Feb Vb	Sep-Nov Vb
10					
11					
12					
13					
14					6
15				1	25
16				5	62
17				19	100
18				12	106
19				10	60
20		1		4	15
21	1	2		1	4
22	1	2		1	30
23	4	1		2	53
24	5	1			43
25	5	2			11
26	3	2			1
27	29	14	1		
28	39	28	8		
29	54	37	24		
30	53	36	36		
31	62	51	28		
32	60	34	23		1
33	28	17	12		
34	22	15	7		1
35	18	6	2		
36	6	6			
37	3	1			
38		2			
39	2	3			
40		1			
Sum	395	262	141	55	518
N sample	8	4	2	6	11

Table 6.3.4. Length composition of commercial blue whiting catches of Portugal and Spain in 1994.

A

PORTUGAL					
	Quarter				
Length	1	2	3	4	Total
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	0	0
13	0	0	0	0	0
14	0	0	0	0	0
15	0	314	631	86	1031
16	0	479	893	2079	3451
17	144	378	1409	2506	4437
18	342	374	1800	2089	4605
19	437	429	876	803	2545
20	596	536	53	10	1195
21	878	878	391	10	2157
22	841	901	413	141	2296
23	740	349	230	328	1647
24	549	154	36	260	999
25	539	67	44	125	775
26	263	32	20	53	368
27	278	16	6	28	328
28	206	4	0	12	222
29	184	1	0	8	193
30	134	0	0	2	136
31	26	0	0	0	26
32	0	0	0	0	0
33	1	0	0	0	1
34	12	0	0	0	12
35	0	0	0	0	0
36	0	0	0	0	0
37	0	0	0	0	0
38	0	0	0	0	0
39	0	0	0	0	0
40	0	0	0	0	0
TOTAL	6170	4912	6802	8540	26424
Landings (t	406	268	279	397	1350
N samples	12	15	9	13	49
Fish sampl	1017	1285	691	982	3975

B

SPAIN					
	Quarter				
Length	1	2	3	4	Total
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	0	15	15
13	0	0	0	47	47
14	0	0	0	242	242
15	0	0	0	516	516
16	0	0	46	1091	1137
17	5	0	210	1068	1284
18	170	16	210	735	1131
19	1563	256	65	244	2127
20	6256	1929	303	734	9222
21	16223	11900	2396	2754	33273
22	19391	28476	13030	9641	70539
23	19663	22272	20394	12057	74385
24	14888	12939	21844	12370	62041
25	8257	5634	12603	7003	33497
26	5004	2867	4764	3868	16504
27	2016	2070	1765	1243	7095
28	1404	1242	703	610	3959
29	653	540	128	117	1438
30	343	388	87	87	906
31	303	71	39	28	441
32	161	82	22	44	310
33	80	50	30	15	175
34	73	22	9	1	105
35	54	8	6	13	81
36	32	6	4	0	42
37	14	4	1	1	19
38	25	2	1	0	28
39	1	1	0	0	1
40	0	0	0	0	0
TOTAL	96578	90775	78663	54544	320559
Landings (t	8189	7630	7190	5111	28118
N samples	69	71	90	89	319
Fish sampl	6182	6131	7689	8371	28373

C

	SPAIN			PORTUGAL	
Length	Bottom trawl	Pair trawl	Long line	Bottom trawl	Total
10	0	0	0	0	0
11	0	0	0	0	0
12	15	0	0	0	15
13	47	0	0	0	47
14	242	0	0	0	242
15	516	0	0	1031	1547
16	920	217	0	3451	4588
17	828	456	0	4437	5721
18	605	526	0	4605	5736
19	925	1202	0	2545	4672
20	3589	5632	1	1195	10417
21	8815	24449	9	2157	35430
22	13226	57273	40	2296	72835
23	14101	60227	57	1647	76032
24	12948	49032	61	999	63040
25	7577	25846	73	775	34272
26	3777	12654	72	368	16872
27	2277	4762	56	328	7423
28	1305	2616	38	222	4181
29	647	774	17	193	1631
30	357	532	17	136	1042
31	271	162	8	26	467
32	199	106	6	0	310
33	128	42	5	1	176
34	86	14	4	12	117
35	65	14	3	0	81
36	27	12	3	0	42
37	15	3	2	0	19
38	24	2	1	0	28
39	0	0	1	0	1
40	0	0	0	0	0
TOTAL	73534	246552	474	26424	346984
Landings (t	6743	21317	58	1350	29468
N samples	188	106	25	49	368
Fish sampl	15228	11680	1465	3975	32348

Table 6.3.5. Length distribution of blue whiting. Norwegian mix industrial fisheries 1995.

	IVa February	IVa April	IVa May	IVa September
13				61
14				178
15				586
16				253
17		10		71
18		8	1	34
19		38	12	15
20		67	23	2
21		46	59	
22		39	67	
23		18	30	
24		12	10	
25	1	11	28	
26	1	16	27	
27		4	34	
28		5	9	
29	1	4	3	
30			3	
31			1	
32				
33				
34			1	
N tot	3	278	308	1200
N samp	1	10	5	12

Table 6.3.6. Length distribution of blue whiting. Norwegian directed fisheries 1995.

	VIIbc Jan	VIIbc Feb	VIIbc March	VIIbc April	VIa April	VIa May	IVa May	Vb May
22					2			
23			1		2		1	
24			2	1	3		4	
25		6	16		4	9	6	
26	1	2	15	5	8	9	7	2
27	1	7	17	20	13	13	13	2
28	5	15	21	32	23	19	19	4
29	9	23	67	45	42	38	23	12
30	26	37	95	75	62	47	29	21
31	14	47	88	55	50	33	34	19
32	17	50	61	49	40	26	34	11
33	16	60	43	32	27	16	18	9
34	19	36	40	19	20	15	13	15
35	4	20	23	17	16	6	12	15
36	4	13	16	7	11	2	6	7
37		16	7	4	15	4	4	2
38	1	3	1	3	5	2	4	1
39	1	2	2		3			
40	1	4			1			
41		1						
42	1							
N tot	120	342	516	364	347	239	227	120
N samp	1	3	7	3	3	2	3	1

Table 6.3.7. Blue whiting length distribution in 1995 (per July) from the Faroese commercial catches.

	Directed		
Length (cm)	Mar VII	Apr VII, VIa	May IVa
20			
21			
22		1	1
23		1	1
24	11	5	1
25	26	14	3
26	14	11	9
27	18	16	4
28	42	33	10
29	61	55	20
30	73	80	31
31	76	75	35
32	43	76	35
33	36	49	32
34	22	19	21
35	16	26	11
36	8	15	13
37	4	4	4
38	6	8	2
39	2	1	2
40		2	1
Sum	458	491	236
N sample	2	4	2

Table 6.3.8. Length distribution of blue whiting. Russian directed fisheries 1995.

	VIIg-k March	VIIbc March	VIIbc April	VIa April	Vb1 June	IVa April	IIa June
16	3						
17	9	1	2	1		1	
18	24	1	5			2	
19	15	2	13	1		1	
20	9	2	11	1		3	
21	5	1	5	1		1	3
22	1			6	1	3	2
23	2	1		2	1	1	6
24	1		1	6		3	6
25	11	1	1	28	1	16	
26	14	1	1	31	2	16	3
27	23	2	2	34	2	21	9
28	26	6	2	25	4	11	2
29	35	8	4	30	1	4	1
30	25	10	7	31	3	1	1
31	25	8	7	40	12	1	1
32	17	15	2	37	4	3	6
33	12	7	6	41	9	1	1
34	7	10	3	31	6	3	4
35	8	6	6	14	3	2	1
36	4	6	8	9	1	2	2
37	5	5	3	11			1
38	2	5	7	5			
39	3	1	1	8		3	
40	1	1	2	5			1
41				1		1	
42							
43	1		1				
44				1			
N tot	288	100	100	400	50	100	50

Table 6.3.9 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), 1985-1994.

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
0	871.4	51.9	9.1	3.6	36.5	8.4	63.6	-	-	-
1	127.4	161.9	280.8	93.2	86.4	537.8	33.4	82.4	36.8	43.6
2	1,341.6	263.3	361.0	403.2	359.4	353.1	533.2	52.2	130.1	31.2
3	1,588.1	1,559.5	580.2	416.2	1,176.7	565.7	384.4	1,508.5	334.5	190.0
4	199.3	1,464.3	1,780.2	611.2	696.2	709.1	243.9	510.4	1,348.2	361.9
5	161.0	298.7	680.3	1,238.9	785.7	489.2	329.9	200.1	375.7	1,242.4
6	303.7	156.4	118.2	584.9	680.7	562.1	235.3	138.8	196.1	294.2
7	248.7	192.2	94.9	77.8	127.2	291.7	149.9	92.0	107.9	201.3
8	167.2	185.8	117.1	50.7	44.8	75.5	39.9	86.7	59.8	102.5
9	91.7	166.4	99.7	32.4	23.8	26.6	4.3	84.6	37.9	88.3
10+	255.4	386.5	195.0	48.9	37.0	91.8	14.0	14.5	13.6	32.1
Total	5,355.3	4,886.9	4,316.5	3,571.0	4,054.4	3,711.0	2,031.8	2,707.2	2,640.5	2,587.5
Tonnes	554,640	694,314	571,659	477,552	521,415	465,601	297,649	379,549	389,010	401,378

Table 6.3.10 BLUE WHITING. Catch in number (millions) by age group in the mixed industrial fisheries (Sub-area IV, Divisions IIIa, Vb, and Va) 1985 - 1994.

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
0	184.3	-	226.8	12.3	1,871.6	0.5	24.9	-	132.2	94.8
1	891.4	395.0	174.5	185.1	578.9	874.8	8.4	159.8	166.9	33.1
2	365.0	334.7	105.7	84.3	183.7	167.6	397.9	63.9	38.8	20.7
3	173.8	134.6	85.4	83.4	70.0	49.5	42.3	167.1	90.8	17.5
4	37.4	184.4	88.9	40.2	33.5	11.8	11.4	75.1	97.3	36.7
5	13.4	79.7	32.8	44.0	24.1	7.0	11.3	25.2	15.0	6.1
6	13.9	24.3	15.6	24.0	12.2	3.8	11.2	16.7	6.7	3.0
7	5.8	7.3	9.2	3.3	5.9	4.9	6.2	6.7	8.3	1.2
8	5.6	11.0	5.1	2.1	2.1	0.6	3.4	2.7	-	0.6
9	1.8	7.3	3.8	1.0	0.8	0.4	0.7	0.9	-	0.1
10+	4.7	11.2	0.2	0.2	1.0	-	0.2	0.6	-	-
Total	1,697.0	1,189.4	748.0	479.9	2,783.8	1,120.9	517.9	518.7	556.1	213.8
Tonnes	97,769	99,580	59,952	45.110	75,978	63,195	39,872	66,174	55,215	24,888

Table 6.3.11 BLUE WHITING. Catch in number (millions) by age group in the Southern area (Divisions VIIIc and IXa) 1985-1994.

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
0	118	32	105	30	41	74	70	19	25	13
1	286	93	383	147	200	198	181	139	41	12
2	337	218	111	233	175	182	182	205	146	56
3	171	168	62	114	93	57	70	95	181	149
4	66	68	28	32	61	25	39	43	62	72
5	14	15	13	10	27	24	17	12	12	27
6	3	6	3	9	15	11	8	6	7	9
7	3	1	1	3	6	2	3	2	2	5
8+	1	1	1	0	3	2	3	1	1	4
Total	999	602	707	578	621	575	573	522	478	347
Tonnes	42,820	33,082	32,819	30,838	33,695	32,817	32,003	28,722	32,256	29,468

Table 6.3.12 Blue whiting combined. Catch in number at age 1981-94.

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

At 18/10/1995 13:57

	Catch numbers at age				Numbers*10**-6
YEAR,	1981,	1982,	1983,	1984,	
AGE					
0,	48,	3512,	437,	584,	
1,	258,	148,	2283,	2291,	
2,	348,	274,	567,	2331,	
3,	681,	326,	270,	455,	
4,	334,	548,	286,	260,	
5,	548,	264,	299,	285,	
6,	559,	276,	304,	445,	
7,	466,	266,	287,	262,	
8,	634,	272,	286,	193,	
9,	578,	284,	225,	154,	
+gp,	1460,	673,	334,	255,	
0 TOTALNUM,	5914,	6843,	5578,	7515,	
TONSLAND,	909556,	576419,	570072,	641776,	
SOPCOF %,	98736,	94246,	101531,	101943,	

	Catch numbers at age									Numbers*10**-6
YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
0,	1174,	84,	341,	46,	1949,	83,	158,	19,	157,	83,
1,	1305,	650,	838,	425,	865,	1611,	223,	381,	244,	110,
2,	2044,	816,	578,	721,	718,	703,	1113,	321,	315,	109,
3,	1933,	1862,	728,	614,	1340,	672,	497,	1771,	606,	358,
4,	303,	1717,	1897,	683,	791,	753,	294,	628,	1508,	469,
5,	188,	393,	726,	1303,	837,	520,	358,	237,	403,	1279,
6,	321,	187,	137,	618,	708,	577,	255,	161,	209,	307,
7,	257,	201,	105,	84,	139,	299,	159,	101,	118,	207,
8,	174,	198,	123,	53,	50,	78,	46,	90,	60,	104,
9,	93,	174,	103,	33,	25,	27,	5,	85,	38,	90,
+gp,	259,	398,	195,	50,	38,	95,	13,	15,	14,	33,
0 TOTALNUM,	8051,	6680,	5771,	4630,	7460,	5418,	3121,	3809,	3672,	3149,
TONSLAND,	695596,	826986,	664434,	553413,	625433,	561610,	369524,	474445,	477513,	455739,
SOPCOF %,	99931,	97507,	100295,	100040,	95191,	99891,	83374,	84757,	99856,	100352,

Table 6.3.13 Blue whiting combined stock. Mean weight at age in the catch and in the stock 1981-94.

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

At 18/10/1995 13:57

		Catch weights at age (kg)			
	YEAR,	1981,	1982,	1983,	1984,
	AGE				
	0,	.0380,	.0180,	.0200,	.0260,
	1,	.0520,	.0450,	.0460,	.0350,
	2,	.0650,	.0720,	.0740,	.0780,
	3,	.1030,	.1110,	.1180,	.0890,
	4,	.1250,	.1430,	.1400,	.1320,
	5,	.1410,	.1560,	.1530,	.1530,
	6,	.1550,	.1770,	.1760,	.1610,
	7,	.1700,	.1950,	.1950,	.1750,
	8,	.1780,	.2000,	.2000,	.1890,
	9,	.1870,	.2040,	.2040,	.1860,
	+gp,	.2105,	.2277,	.2262,	.2013,
0	SOPCOFAC,	*******,	*******,	*******,	*******,

		Catch weights at age (kg)									
	YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
	AGE										
	0,	.0160,	.0300,	.0230,	.0310,	.0140,	.0340,	.0360,	.0240,	.0350,	.0580,
	1,	.0380,	.0400,	.0480,	.0530,	.0590,	.0450,	.0540,	.0780,	.0660,	.0670,
	2,	.0740,	.0730,	.0860,	.0760,	.0790,	.0700,	.1510,	.0740,	.0820,	.0940,
	3,	.0970,	.1080,	.1060,	.0970,	.1030,	.1060,	.1130,	.1420,	.1140,	.0990,
	4,	.1140,	.1300,	.1240,	.1280,	.1260,	.1230,	.1440,	.1620,	.1400,	.1250,
	5,	.1570,	.1650,	.1470,	.1420,	.1480,	.1470,	.1770,	.1900,	.1530,	.1480,
	6,	.1770,	.1990,	.1770,	.1570,	.1580,	.1680,	.1940,	.2080,	.1790,	.1820,
	7,	.1990,	.2090,	.2080,	.1790,	.1710,	.1750,	.2070,	.2230,	.2040,	.2010,
	8,	.2080,	.2430,	.2210,	.1990,	.2030,	.2140,	.2270,	.2400,	.2410,	.2170,
	9,	.2180,	.2460,	.2220,	.2220,	.2240,	.2170,	.2500,	.3070,	.2280,	.2360,
	+gp,	.2334,	.2532,	.2536,	.2501,	.2380,	.2694,	.1140,	.2592,	.3074,	.2140,
0	SOPCOFAC,	*******,	*******,	*******,	*******,	*******,	*******,	*******,	*******,	*******,	*******,
1											

Table 6.3.14 Blue whiting combined stock. Maturity at age 1981-94.

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

At 18/10/1995 13:57

	Proportion mature at age			
YEAR,	1981,	1982,	1983,	1984,
AGE				
0,	.0000,	.0000,	.0000,	.0000,
1,	.1100,	.1100,	.1100,	.1100,
2,	.4000,	.4000,	.4000,	.4000,
3,	.8200,	.8200,	.8200,	.8200,
4,	.8600,	.8600,	.8600,	.8600,
5,	.9100,	.9100,	.9100,	.9100,
6,	.9400,	.9400,	.9400,	.9400,
7,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,

	Proportion mature at age									
YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,
AGE										
0,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
1,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1300,	.1100,	.1100,
2,	.4000,	.4000,	.4000,	.4000,	.4000,	.4000,	.4000,	.4400,	.4200,	.4200,
3,	.8200,	.8200,	.8200,	.8200,	.8200,	.8200,	.8200,	.9600,	.9500,	.9500,
4,	.8600,	.8600,	.8600,	.8600,	.8600,	.8600,	.8600,	.9900,	.9900,	.9900,
5,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	.9100,	1.0000,	1.0000,	1.0000,
6,	.9400,	.9400,	.9400,	.9400,	.9400,	.9400,	.9400,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 6.4.1 Stratified mean catch (Kg/haul and Number/haul) and standard error of BLUE WHITING in bottom trawl surveys in Spanish waters. All surveys in September except the 1986 survey which was in April.

Kg/haul	30-100 m		101-200 m		201-500 m		TOTAL 30-500 m	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1985	9.50	5.87	119.75	45.99	68.18	13.79	92.83	28.24
1986	9.74	7.13	45.41	12.37	29.54	8.70	36.93	7.95
1987	-	-	-	-	-	-	-	-
1988	2.90	2.59	154.12	38.69	183.07	141.94	144.87	45.89
1989	14.17	12.03	76.92	17.08	18.79	6.23	53.60	10.62
1990	6.25	3.29	52.54	9.00	18.80	4.99	37.88	5.66
1991	64.59	34.65	126.41	26.06	46.07	18.99	27.05	17.16
1992	6.37	2.59	44.12	6.64	29.50	6.16	34.60	4.23
1993	1.06	0.63	14.07	3.73	51.08	22.02	22.59	6.44
1994	8.04	5.28	37.18	8.45	25.42	5.27	29.70	5.19

Numb/haul	30-100 m		101-200 m		201-500 m		TOTAL 30-500 m	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1985	267	181.71	3669	1578.86	1377	262.98	2644	963.20
1986	368	237.56	2486	1006.67	752	238.87	1763	616.40
1987	-	-	-	-	-	-	-	-
1988	83	71.74	6112	1847.36	7276	6339.88	5746	2087.74
1989	629	537.29	3197	876.75	566	213.11	2173	539.98
1990	220	115.48	2219	426.46	578	185.43	1535	264.74
1991	2922	1645.73	5563	1184.69	1789	847.33	4214	780.88
1992	124	50.81	1412	233.99	845	199.12	1069	146.87
1993	14	8.61	257	69.61	894	427.77	401	124.53
1994	346	234.12	2002	456.50	997	245.91	1487	689.00

Table 6.4.2 Tuning data input.

```
BLUE WHITING-COMBINED
     106
Norway Spawning Area/Acoustic
      80       94
       1        1     0.17     0.25
       2       11
       1     3300   3663   4026   5577  5115  4719  3036  1485   627  693
       1     2368   7511   3219   3626  4551  4625  3626  2590  1776 1332
       0        0      0      0      0     0     0     0     0     0    0
       1      297   2108   2723   6511  3735  3650  3153  2279  1182  531
       1    11130   1514   1616   1719  1858  1128   567   440   348   80
       0        0      0      0      0     0     0     0     0     0    0
       1      954   7183   7340   1159   383   251   373   151   174   73
       1     4042   8050  22357   4697   282   417   385   159    27  111
       1     6960   8799  12271  20285  7323   723   617   326   398  126
       1     6745  22270   9973  10504  7803   933   293   177    46  148
       1    14169  12670  11228   5587  6556  3273   516   183   108   81
       1    11147   6340   8497   7407  4558  2019   545    96    16   33
       1     1232  26123   4719   1574  1386   810   616   257    19    0
       1     4489   3321  26771   2643  1270   557   426   108    22   12
       1     1603   2950   4476  11354  1742  1687   908   770   207    0
USSR Spawning Area/Acoustic
      82       93
       1        1     0.17     0.25
       3       11
       1    540    2750    1340    1380    1570    2350    1730    1290    650
       1   2330    2930    9390    3880    1970    1370     780     660    100
       1   2900     800    1100    4200    2200    1200    1700    1200    500
       1  13220     930     580    1780     860     610     580     540    110
       1  18750   23180    2540     610     620     750     640     710    720
       1   4480   19170    5860    1070     500     810     860     670    560
       1   3710    4550    8610    4130    1270     480     250     260    330
       1  11910    7120    6670    6970    4580    2750    1880     810    410
       1   9740   12140    5740    2580    1470     220      80      10     10
       1  10300    5350    5130    2630    1770     870     300     220      0
       1  20010    6700    1350     440     390     170       0       0      0
       1   4728   12337    5304    2249    1316     621     386     150      0
CPUE Spanish Pair Trawlers
      83       94
       1        1        0        1
       0        6
       1     1140     7196    16392     9311     7476    6326    1718
       1     1839    13710    27286    14845     4836    1755    1750
       1     3680    14573    23823    14126     6256    1232     217
       1      788     3721    14131    14745     7113    1278     505
       1     5433    25328    13153     6664     2938    1029     166
       1     2545     7778    21473    18436     6391    1300     781
       1     2488    15272    18486    17160     8374    3760    1003
       1     6703    21444    19407     5194     1803    1357     451
       1     8745    15924    15370     4989     2329    1045     440
       1       36    10007    24235     9671     4316    1194     462
       1     1793     4036    13991    22493     7979    1354     658
       1      168      543     6066    15917     7474    2990    1055
Spanish Survey (Bottom trawl)
      85       94
       1        1     0.67     0.75
       0        7
       1   1748.4    508.3    266.4    104.0    11.4     3.5     1.0     0.5
       1   1572.8     26.7     67.5     63.2    28.7     2.0     2.6     0.2
       0        0        0        0        0       0       0       0       0
       1   4979.6    368.7    344.9     37.3     7.2     3.0     5.0     0.3
       1   1923.3    163.0     51.2     28.6     3.8     2.8     0.7     0.2
       1   1525.0     74.9     46.1     10.7    10.4     2.4     0.1     0.5
       1   4003.2     95.2     49.6     24.5    17.9     5.1     1.5     0.8
       1    299.8    428.2    233.3     77.0    20.4     6.9     2.3     0.9
       1    115.7    107.5    150.8     19.4     5.5     1.6     0.2     0.2
       1   1415.4     30.9      4.8     16.0    13.5     5.1     0.9     0.3
Norwegian Sea acoustic - Blue Whiting
      80       93
       1        1      0.6     0.75
       0       11
 1  0.001   1400  10192   4536  4704  7056  8232  6944  5432  2688  1792  1848
 1  0.001    182    728   4542  3874  2678  2834  2964  2756  2054  1300  1092
 1   3680    184    460   1242  4715  3611  3128  2323  1679   874   414   253
 1.  8280  22356    396    468   756  1404   576   468   432   324   216   108
 1   1862  30380  13916    833   392   539   539   343    49    49    49    49
 1   2256   5969  23876  12502   658   423   188   235   141   376   141    47
 1   5040   2324   2380   7224  6944  1876   952   336   308   140   196    56
 1   3192   8204   4032   5180  5572  1204   224   168    56    84    28    28
 1   8760   4992   2880   2640  3480   912   120    96    24    48 0.001 0.001
```

Table 6.4.2 (cont.)

```
  1  20430   1172   1125    812   379   410   212    22    32     0     8     1
  0      0      0      0      0     0     0     0     0     0     0     0     0
  0      0      0      0      0     0     0     0     0     0     0     0     0
  1  0.001    792   1134   6939   766   247   172    90    11    18     1     3
  1  0.001    830    125   1070  6392  1222   489   248    58    88    71 0.001
1       719       1467        306        129         18          6
Portuguese survey (Bottom trawl)
       85       94
        1        1        0.75   0.83
        0        5
        1      719        1467        306        129         18          6
        0        0           0          0          0          0          0
        1     4757        1190        366        110         26         19
        1     4018         158        218         27          3          4
        1      835         690        318        143         45         41
        1     1935         519        270        262        271         87
        1     1445         144        154        169        124         55
        1      109         164        120        200        147         59
        1       43         134        431        127         59         23
        1     2677        1595         12         34         59         31
```

Table 6.4.3 Blue whiting combined. XSA diagnostics.

```
CPUE data from file TUNBW94.DAT

Catch data for  14 years. 1981 to 1994. Ages  0 to  10.

     Fleet,           First, Last, First, Last, Alpha,  Beta
                ,    year, year,  age ,  age
Norway Spawning Area,  1981, 1994,   2,     9,   .170,   .250
USSR Spawning Area/A,  1982, 1994,   3,     9,   .170,   .250
CPUE Spanish Pair Tr,  1983, 1994,   0,     6,   .000,  1.000
Spanish Survey (Bott,  1985, 1994,   0,     7,   .670,   .750
Norwegian Sea acoust,  1981, 1994,   0,     9,   .600,   .750
Portuguese survey (B,  1985, 1994,   0,     5,   .750,   .830


Time series weights :

     Tapered time weighting applied
     Power =    3 over  20 years


Catchability analysis :

     Catchability dependent on stock size for ages <    2

        Regression type = C
        Minimum of   5 points used for regression
        Survivor estimates shrunk to the population mean for ages <  2


     Catchability independent of age for ages >=    7


Terminal population estimation :

     Survivor estimates shrunk towards the mean F
     of the final   5 years or the   5 oldest ages.

     S.E. of the mean to which the estimates  are shrunk =    .500

     Minimum standard error for population
     estimates derived from each fleet =    .300

     Prior weighting not applied


Tuning had not converged after   30 iterations


Total absolute residual between iterations
29 and  30 =     .00062

Final year F values
Age          ,      0,      1,      2,      3,      4,      5,      6,      7,      8,      9
Iteration 29,  .0248,  .0821,  .1034,  .1506,  .2313,  .4932,  .3738,  .4326,  .4376,  .5047
Iteration 30,  .0248,  .0821,  .1034,  .1506,  .2312,  .4932,  .3738,  .4325,  .4374,  .5046

1


Regression weights
      ,  .751,  .820,  .877,  .921,  .954,  .976,  .990,  .997, 1.000, 1.000


Fishing mortalities
   Age,  1985,  1986,  1987,  1988,  1989,  1990,  1991,  1992,  1993,  1994

     0,  .124,  .009,  .046,  .005,  .097,  .012,  .028,  .010,  .088,  .025
     1,  .146,  .094,  .112,  .075,  .128,  .108,  .040,  .087,  .166,  .082
     2,  .170,  .127,  .113,  .133,  .175,  .146,  .102,  .075,  .096,  .103
     3,  .330,  .232,  .160,  .168,  .390,  .246,  .146,  .233,  .198,  .151
```

Table 6.4.3 (cont.)

```
4,  .238,  .553,  .392,  .222,  .340,  .397,  .162,  .278,  .319,  .231
5,  .251,  .553,  .480,  .515,  .466,  .394,  .333,  .190,  .289,  .493
6,  .445,  .426,  .378, 1.024,  .593,  .692,  .341,  .244,  .255,  .374
7,  .366,  .560,  .453,  .421,  .674,  .541,  .409,  .219,  .285,  .432
8,  .343,  .537,  .824,  .436,  .479, 1.075,  .145,  .430,  .196,  .437
9,  .355,  .693,  .601,  .544,  .379,  .520,  .164,  .433,  .325,  .505
```

1
XSA population numbers (Thousands)

	AGE									
YEAR ,	0,	1,	2,	3,	4,	5,	6,	7,	8,	9,
1985 ,	1.11E+04,	1.06E+04,	1.44E+04,	7.59E+03,	1.58E+03,	9.35E+02,	9.87E+02,	9.27E+02,	6.62E+02,	3.44E+02,
1986 ,	1.08E+04,	8.03E+03,	7.54E+03,	9.95E+03,	4.47E+03,	1.02E+03,	5.96E+02,	5.18E+02,	5.27E+02,	3.85E+02,
1987 ,	8.33E+03,	8.74E+03,	5.99E+03,	5.43E+03,	6.46E+03,	2.10E+03,	4.81E+02,	3.18E+02,	2.42E+02,	2.52E+02,
1988 ,	9.75E+03,	6.51E+03,	6.40E+03,	4.38E+03,	3.79E+03,	3.58E+03,	1.07E+03,	2.70E+02,	1.66E+02,	8.69E+01,
1989 ,	2.33E+04,	7.94E+03,	4.95E+03,	4.58E+03,	3.03E+03,	2.48E+03,	1.75E+03,	3.13E+02,	1.45E+02,	8.77E+01,
1990 ,	7.73E+03,	1.73E+04,	5.72E+03,	3.40E+03,	2.54E+03,	1.76E+03,	1.28E+03,	7.91E+02,	1.31E+02,	7.36E+01,
1991 ,	6.37E+03,	6.25E+03,	1.27E+04,	4.04E+03,	2.18E+03,	1.40E+03,	9.74E+02,	5.23E+02,	3.77E+02,	3.66E+01,
1992 ,	2.18E+03,	5.07E+03,	4.92E+03,	9.41E+03,	2.86E+03,	1.52E+03,	8.21E+02,	5.67E+02,	2.85E+02,	2.67E+02,
1993 ,	2.06E+03,	1.77E+03,	3.81E+03,	3.74E+03,	6.10E+03,	1.77E+03,	1.03E+03,	5.27E+02,	3.73E+02,	1.52E+02,
1994 ,	3.74E+03,	1.54E+03,	1.23E+03,	2.83E+03,	2.51E+03,	3.63E+03,	1.09E+03,	6.52E+02,	3.24E+02,	2.51E+02,

Estimated population abundance at 1st Jan 1995

, 0.00E+00, 2.99E+03, 1.16E+03, 9.06E+02, 1.99E+03, 1.63E+03, 1.82E+03, 6.13E+02, 3.46E+02, 1.72E+02,

Taper weighted geometric mean of the VPA populations:

, 7.65E+03, 6.42E+03, 5.41E+03, 4.45E+03, 3.04E+03, 1.91E+03, 1.08E+03, 6.04E+02, 3.63E+02, 2.17E+02,

Standard error of the weighted Log(VPA populations) :

, .8217, .8009, .6697, .4730, .4502, .4191, .4139, .5615, .7899, 1.1292,

1

Log catchability residuals.

Fleet : Norway Spawning Area

Age ,	1981,	1982,	1983,	1984
0 ,	No data for this fleet at this age			
1 ,	No data for this fleet at this age			
2 ,	-.20,	99.99,	-2.13,	.31
3 ,	-.06,	99.99,	-.45,	-.94
4 ,	-.95,	99.99,	-.72,	-.80
5 ,	-.57,	99.99,	.11,	-.79
6 ,	-.17,	99.99,	.02,	-.62
7 ,	-.08,	99.99,	.54,	-.65
8 ,	-.42,	99.99,	.47,	-.76
9 ,	-.81,	99.99,	.06,	-.93

Age ,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
0 ,	No data for this fleet at this age									
1 ,	No data for this fleet at this age									
2 ,	99.99,	-1.72,	-.05,	.43,	.67,	1.26,	.21,	-1.05,	.51,	.61
3 ,	99.99,	-.79,	-.09,	.22,	1.15,	.85,	-.03,	.56,	-.59,	-.44
4 ,	99.99,	-.36,	.35,	.25,	.29,	.59,	.42,	-.42,	.57,	-.35
5 ,	99.99,	-.72,	-.05,	.89,	.58,	.28,	.78,	-.88,	-.50,	.29
6 ,	99.99,	-1.18,	-1.29,	1.31,	.79,	.95,	.78,	-.26,	-.56,	-.28
7 ,	99.99,	-1.35,	-.37,	.33,	.49,	.79,	.70,	-.34,	-.62,	.30
8 ,	99.99,	-.97,	-.10,	.67,	.06,	.86,	-.34,	.12,	-.57,	.38
9 ,	99.99,	-1.53,	-1.07,	.70,	.04,	.28,	.26,	-.69,	-1.01,	.49

Mean log catchability and standard error of ages with catchability
independent of year class strength and constant w.r.t. time

Table 6.4.3 (cont.)

Age ,	2,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	-.2802,	.5539,	1.0165,	1.0003,	.8721,	.7816,	.7816,	.7816,
S.E(Log q),	.9941,	.6687,	.5292,	.6433,	.8738,	.6676,	.5812,	.8149,

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	1.16,	-.254,	-1.05,	.23,	12,	1.22,	-.28,
3,	.78,	.574,	1.40,	.46,	12,	.54,	.55,
4,	.65,	1.400,	2.13,	.67,	12,	.33,	1.02,
5,	.53,	1.832,	3.04,	.65,	12,	.30,	1.00,
6,	.49,	1.739,	3.16,	.58,	12,	.38,	.87,
7,	1.02,	-.045,	-.92,	.39,	12,	.72,	.78,
8,	1.73,	-1.812,	-5.53,	.43,	12,	.90,	.76,
9,	1.52,	-1.639,	-3.46,	.55,	12,	1.05,	.48,

1

Fleet : USSR Spawning Area/A

Age ,	1981,	1982,	1983,	1984
0 ,	No data for this fleet at this age			
1 ,	No data for this fleet at this age			
2 ,	No data for this fleet at this age			
3 ,	99.99,	-2.12,	-.27,	-.21
4 ,	99.99,	-.90,	-.38,	-1.25
5 ,	99.99,	-1.28,	.68,	-1.03
6 ,	99.99,	-.88,	.13,	.27
7 ,	99.99,	-.78,	-.19,	-.09
8 ,	99.99,	-.44,	-.47,	-.12
9 ,	99.99,	-.80,	-1.13,	.31

Age ,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
0 ,	No data for this fleet at this age									
1 ,	No data for this fleet at this age									
2 ,	No data for this fleet at this age									
3 ,	.19,	.25,	-.59,	-.56,	.61,	.67,	.54,	.37,	-.15,	99.99
4 ,	-1.20,	1.05,	.45,	-.49,	.21,	.93,	.22,	.19,	.06,	99.99
5 ,	-1.17,	.28,	.38,	.24,	.34,	.51,	.62,	-.83,	.41,	99.99
6 ,	-.07,	-.64,	.12,	.82,	.75,	.10,	.31,	-1.33,	.08,	99.99
7 ,	-.85,	-.55,	-.30,	.79,	1.97,	-.12,	.46,	-1.18,	.13,	99.99
8 ,	-.86,	-.38,	.53,	.31,	2.19,	-.10,	.02,	-1.27,	-.30,	99.99
9 ,	-.25,	-.19,	.50,	.32,	2.30,	-.66,	1.29,	99.99,	.15,	99.99

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age ,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	.4709,	.7568,	.7918,	.7953,	.8908,	.8908,	.8908,
S.E(Log q),	.6790,	.7349,	.7162,	.6497,	.8871,	.9149,	1.0370,

Regression statistics :

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
3,	.71,	.847,	2.09,	.52,	12,	.49,	.47,

Table 6.4.3 (cont.)

```
  4,     .57,    1.604,      3.03,     .63,     12,     .39,     .76,
  5,     .63,     .940,      2.28,     .44,     12,     .45,     .79,
  6,     .64,    1.061,      1.98,     .52,     12,     .41,     .80,
  7,   20.63,   -1.917,    ******,     .00,     12,   16.07,     .89,
  8,    2.78,   -1.692,    -12.74,     .10,     12,    2.31,     .86,
  9,    2.03,   -1.890,     -7.74,     .33,     11,    1.75,    1.17,
1
```

Fleet : CPUE Spanish Pair Tr

Age	1981	1982	1983	1984
0	99.99	99.99	-1.48	-.39
1	99.99	99.99	-1.04	-.58
2	99.99	99.99	.47	-.18
3	99.99	99.99	.56	.88
4	99.99	99.99	.68	.69
5	99.99	99.99	1.03	.21
6	99.99	99.99	.47	.59
7	No data for this fleet at this age			
8	No data for this fleet at this age			
9	No data for this fleet at this age			

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
0	.53	-1.01	1.17	.25	-.61	1.43	1.90	-2.44	1.50	-1.46
1	.13	-.98	.86	-.04	.46	.01	.70	.46	.65	-1.26
2	-.55	-.44	-.29	.14	.27	.16	-.90	.50	.21	.51
3	-.26	-.53	-.75	.48	.47	-.50	-.76	-.90	.85	.76
4	.85	.09	-1.24	-.01	.54	-.79	-.49	-.09	-.21	.57
5	.35	.43	-.54	-.82	.58	-.12	-.18	-.19	-.18	-.01
6	-.97	.38	-.55	.48	.06	-.38	-.29	-.12	.02	.49
7	No data for this fleet at this age									
8	No data for this fleet at this age									
9	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age	2	3	4	5	6
Mean Log q	1.2314	1.1336	.7316	.1439	-.2445
S.E(Log q)	.4669	.7112	.6468	.4813	.4731

Regression statistics :

Ages with q dependent on year class strength

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Log q
0	.98	.028	1.62	.24	12	1.53	-1.50
1	1.00	.004	-.34	.56	12	.78	.36

Ages with q independent of year class strength and constant w.r.t. time.

Age	Slope	t-value	Intercept	RSquare	No Pts	Reg s.e	Mean Q
2	2.19	-3.786	-12.99	.54	12	.66	1.23
3	23.38	-2.521	******	.00	12	13.31	1.13
4	4.65	-2.022	-32.62	.03	12	2.61	.73
5	1.49	-.901	-3.92	.28	12	.73	.14
6	.71	1.022	2.18	.59	12	.34	-.24

1

Fleet : Spanish Survey (Bott

Age	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994

Table 6.4.3 (cont.)

```
    0 ,  -.19,  -.33, 99.99,   .81,  -.86,  -.02,  1.05,  -.22,  -.96,   .65
    1 ,  3.42, -4.73, 99.99,  2.86,   .46, -2.55, -1.00,  3.56,   .86, -2.69
    2 ,   .31,  -.44, 99.99,  1.36,  -.26,  -.53, -1.29,  1.19,  1.02, -1.29
    3 ,   .84,   .00, 99.99,   .25,   .09,  -.69,  -.11,   .25,  -.23,  -.18
    4 ,   .64,   .75, 99.99,  -.70, -1.03,   .19,   .72,   .66, -1.38,   .35
    5 ,   .65,   .22, 99.99,  -.66,  -.40,  -.26,   .68,   .80,  -.75,  -.16
    6 ,   .11,  1.56, 99.99,  2.06,  -.71, -2.27,   .46,   .99, -1.67,  -.14
    7 ,  -.32,  -.52, 99.99,   .44,   .07,  -.04,   .75,   .65,  -.73,  -.43
    8 , No data for this fleet at this age
    9 , No data for this fleet at this age
```

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

```
   Age ,        2,        3,        4,        5,        6,        7
Mean Log q,  -4.0421,  -4.7503,  -5.2657,  -5.9184,  -6.5511,  -6.8025,
S.E(Log q),   1.0415,    .4055,    .8415,    .5986,   1.4423,    .5431,
```

Regression statistics :

Ages with q dependent on year class strength

```
Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e, Mean Log q

 0,     .90,     .294,      2.22,     .56,      9,     .78,   -1.47,
 1,    2.83,   -1.279,     -5.61,     .07,      9,    3.13,   -3.58,
```

Ages with q independent of year class strength and constant w.r.t. time.

```
Age, Slope , t-value , Intercept, RSquare, No Pts, Reg s.e,  Mean Q

 2,     .86,     .299,      4.70,     .40,      9,     .95,   -4.04,
 3,     .65,    1.943,      6.07,     .83,      9,     .22,   -4.75,
 4,   -2.88,   -2.063,     15.93,     .04,      9,    2.02,   -5.27,
 5,    5.05,   -2.115,      -.58,     .04,      9,    2.50,   -5.92,
 6,    -.56,   -1.707,      7.16,     .16,      9,     .72,   -6.55,
 7,    1.80,    -.847,      7.23,     .15,      9,     .99,   -6.80,
```

1

Fleet : Norwegian Sea acoust

```
 Age  ,  1981,  1982,  1983,  1984
    0 , -1.12,  -.50,  -.42,  -.02
    1 ,  -.92, -1.14,   .37,   .36
    2 ,  -.48,  -.56,  -.91,  1.49
    3 ,   .54,  -.29,  -.85,  -.40
    4 ,   .66,   .84,  -.55,  -.75
    5 ,   .75,  1.07,   .15,  -.34
    6 ,  1.08,  1.55,  -.16,  -.10
    7 ,  1.13,  1.37,   .20,  -.15
    8 ,   .99,   .98,   .20, -1.47
    9 ,   .62,   .27,  -.23, -1.42
```

```
 Age  ,  1985,  1986,  1987,  1988,  1989,  1990,  1991,  1992,  1993,  1994
    0 ,   .22,   .35,   .55,   .53,  -.22, 99.99, 99.99,  -.18,  -.11, 99.99
    1 ,   .07,  -.22,   .43,   .43,  -.59, 99.99, 99.99,  -.38,   .73, 99.99
    2 ,  1.79,   .10,   .85,   .46,  -.19, 99.99, 99.99,  -.25, -2.18, 99.99
    3 ,  1.24,   .35,   .58,   .12,  -.95, 99.99, 99.99,   .37,  -.60, 99.99
    4 ,  -.32,  1.21,   .51,   .46, -1.45, 99.99, 99.99,  -.73,   .66, 99.99
    5 ,  -.08,  1.52,   .31,  -.48,  -.94, 99.99, 99.99, -1.14,   .36, 99.99
    6 ,  -.60,  1.52,   .25,  -.73,  -.95, 99.99, 99.99,  -.64,   .19, 99.99
    7 ,  -.32,   .76,   .48,   .06, -1.39, 99.99, 99.99,  -.88,   .25, 99.99
    8 ,  -.51,   .64,  -.10,  -.83,  -.38, 99.99, 99.99, -2.15,  -.92, 99.99
    9 ,  1.14,   .27,   .12,   .58, 99.99, 99.99, 99.99, -1.60,   .49, 99.99
```

Table 6.4.3 (cont.)

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age ,	2,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	-1.0338,	-.3807,	-.2610,	-.4078,	-.6272,	-.6751,	-.6751,	-.6751,
S.E(Log q),	1.1780,	.6957,	.8795,	.8475,	.8702,	.8086,	1.1050,	.9373,

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
0,	.14,	4.578,	8.44,	.81,	11,	.48,	-4.67,
1,	.58,	1.299,	4.19,	.59,	11,	.62,	-.79,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	.32,	3.990,	6.19,	.84,	11,	.22,	-1.03,
3,	.52,	2.341,	4.27,	.79,	11,	.29,	-.38,
4,	.48,	1.997,	4.34,	.70,	11,	.36,	-.26,
5,	2.26,	-.726,	-8.53,	.05,	11,	1.98,	-.41,
6,	1.47,	-.455,	-2.32,	.13,	11,	1.35,	-.63,
7,	.66,	1.150,	2.60,	.64,	11,	.52,	-.68,
8,	.64,	1.429,	2.92,	.71,	11,	.58,	-1.17,
9,	1.11,	-.255,	.11,	.48,	10,	1.13,	-.69,

1

Fleet : Portuguese survey (B

Age ,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
0 ,	-.69,	99.99,	1.03,	.72,	-1.33,	.38,	.35,	-.62,	-1.25,	1.37
1 ,	7.00,	99.99,	5.82,	-5.89,	2.80,	.25,	-6.56,	-5.37,	-5.13,	9.13
2 ,	-.40,	99.99,	.62,	.05,	.71,	.38,	-1.01,	-.33,	1.22,	-1.22
3 ,	-.24,	99.99,	-.20,	-1.38,	.42,	1.21,	.52,	-.09,	.35,	-.73
4 ,	-.36,	99.99,	-1.28,	-3.04,	-.01,	2.00,	1.19,	1.18,	-.46,	.36
5 ,	-.83,	99.99,	-.31,	-2.37,	.28,	1.32,	1.05,	.92,	-.10,	-.35
6 ,	No data for this fleet at this age									
7 ,	No data for this fleet at this age									
8 ,	No data for this fleet at this age									
9 ,	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age ,	2,	3,	4,	5
Mean Log q,	-3.1630,	-3.4184,	-3.7690,	-3.8631,
S.E(Log q),	.8340,	.7626,	1.5125,	1.1352,

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
0,	.79,	.433,	3.25,	.39,	9,	1.08,	-1.76,
1,	5.86,	-1.611,	-28.05,	.02,	9,	6.66,	-2.37,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q

Table 6.4.3 (cont.)

```
  2,     .93,     .167,      3.55,     .46,      9,     .83,   -3.16,
  3,    1.31,    -.308,      1.85,     .13,      9,    1.07,   -3.42,
  4,   -1.56,   -1.425,     14.76,     .05,      9,    2.22,   -3.77,
  5,   -3.88,   -1.377,     22.08,     .01,      9,    4.16,   -3.86,
1

Terminal year survivor and F summaries :

Age  0   Catchability dependent on age and year class strength

Year class = 1994

Fleet,                  Estimated,    Int,       Ext,     Var,    N, Scaled,  Estimated
    ,                   Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
Norway Spawning Area,         1,   .000,       .000,    .00,   0,  .000,     .000
USSR Spawning Area/A,         1,   .000,       .000,    .00,   0,  .000,     .000
CPUE Spanish Pair Tr,       694,  1.719,       .000,    .00,   1,  .041,     .000
Spanish Survey (Bott,      5705,   .826,       .000,    .00,   1,  .178,     .000
Norwegian Sea acoust,         1,   .000,       .000,    .00,   0,  .000,     .000
Portuguese survey (B,     11737,  1.172,       .000,    .00,   1,  .088,     .000

  P shrinkage mean  ,        6418,    .80,,,,                          .194,     .012

  F shrinkage mean  ,        1560,    .50,,,,                          .498,     .047

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,    ,   Ratio,
      2991,       .35,      .49,    5,  1.407,   .025


Age  1   Catchability dependent on age and year class strength

Year class = 1993

Fleet,                  Estimated,    Int,       Ext,     Var,    N, Scaled,  Estimated
    ,                   Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
Norway Spawning Area,         1,   .000,       .000,    .00,   0,  .000,     .000
USSR Spawning Area/A,         1,   .000,       .000,    .00,   0,  .000,     .000
CPUE Spanish Pair Tr,       703,   .864,      1.228,   1.42,   2,  .105,     .133
Spanish Survey (Bott,       391,   .955,       .455,    .48,   2,  .081,     .227
Norwegian Sea acoust,      1042,   .567,       .000,    .00,   1,  .229,     .091
Portuguese survey (B,       470,  1.330,      1.844,   1.39,   2,  .042,     .192

  P shrinkage mean  ,        5409,    .67,,,,                          .194,     .018

  F shrinkage mean  ,         888,    .50,,,,                          .349,     .106

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,    ,   Ratio,
      1163,       .29,      .38,    9,  1.335,   .082


1
Age  2   Catchability constant w.r.t. time and dependent on age

Year class = 1992

Fleet,                  Estimated,    Int,       Ext,     Var,    N, Scaled,  Estimated
    ,                   Survivors,    s.e,       s.e,   Ratio,    , Weights,    F
Norway Spawning Area,      1669,  1.042,       .000,    .00,   1,  .048,     .057
USSR Spawning Area/A,         1,   .000,       .000,    .00,   0,  .000,     .000
CPUE Spanish Pair Tr,      1387,   .413,       .414,   1.00,   3,  .293,     .069
Spanish Survey (Bott,       485,   .681,       .425,    .62,   3,  .102,     .185
Norwegian Sea acoust,      1108,   .435,       .447,   1.03,   2,  .232,     .085
Portuguese survey (B,       307,   .720,       .326,    .45,   3,  .095,     .278

  F shrinkage mean  ,         780,    .50,,,,                          .230,     .119

Weighted prediction :

Survivors,        Int,      Ext,    N,    Var,     F
at end of year,   s.e,      s.e,    ,   Ratio,
```

Table 6.4.3 (cont.)

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age ,	2,	3,	4,	5,	6,	7,	8,	9
Mean Log q,	-1.0338,	-.3807,	-.2610,	-.4078,	-.6272,	-.6751,	-.6751,	-.6751,
S.E(Log q),	1.1780,	.6957,	.8795,	.8475,	.8702,	.8086,	1.1050,	.9373,

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
0,	.14,	4.578,	8.44,	.81,	11,	.48,	-4.67,
1,	.58,	1.299,	4.19,	.59,	11,	.62,	-.79,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q
2,	.32,	3.990,	6.19,	.84,	11,	.22,	-1.03,
3,	.52,	2.341,	4.27,	.79,	11,	.29,	-.38,
4,	.48,	1.997,	4.34,	.70,	11,	.36,	-.26,
5,	2.26,	-.726,	-8.53,	.05,	11,	1.98,	-.41,
6,	1.47,	-.455,	-2.32,	.13,	11,	1.35,	-.63,
7,	.66,	1.150,	2.60,	.64,	11,	.52,	-.68,
8,	.64,	1.429,	2.92,	.71,	11,	.58,	-1.17,
9,	1.11,	-.255,	.11,	.48,	10,	1.13,	-.69,

1

Fleet : Portuguese survey (B

Age ,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994
0 ,	-.69,	99.99,	1.03,	.72,	-1.33,	.38,	.35,	-.62,	-1.25,	1.37
1 ,	7.00,	99.99,	5.82,	-5.89,	2.80,	.25,	-6.56,	-5.37,	-5.13,	9.13
2 ,	-.40,	99.99,	.62,	.05,	.71,	.38,	-1.01,	-.33,	1.22,	-1.22
3 ,	-.24,	99.99,	-.20,	-1.38,	.42,	1.21,	.52,	-.09,	.35,	-.73
4 ,	-.36,	99.99,	-1.28,	-3.04,	-.01,	2.00,	1.19,	1.18,	-.46,	.36
5 ,	-.83,	99.99,	-.31,	-2.37,	.28,	1.32,	1.05,	.92,	-.10,	-.35
6 ,	No data for this fleet at this age									
7 ,	No data for this fleet at this age									
8 ,	No data for this fleet at this age									
9 ,	No data for this fleet at this age									

Mean log catchability and standard error of ages with catchability independent of year class strength and constant w.r.t. time

Age ,	2,	3,	4,	5
Mean Log q,	-3.1630,	-3.4184,	-3.7690,	-3.8631,
S.E(Log q),	.8340,	.7626,	1.5125,	1.1352,

Regression statistics :

Ages with q dependent on year class strength

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Log q
0,	.79,	.433,	3.25,	.39,	9,	1.08,	-1.76,
1,	5.86,	-1.611,	-28.05,	.02,	9,	6.66,	-2.37,

Ages with q independent of year class strength and constant w.r.t. time.

Age,	Slope ,	t-value ,	Intercept,	RSquare,	No Pts,	Reg s.e,	Mean Q

906, .22, .19, 13, .859, .103

Age 3 Catchability constant w.r.t. time and dependent on age

Year class = 1991

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
Norway Spawning Area,	1693,	.582,	.430,	.74,	2,	.104,	.175
USSR Spawning Area/A,	1,	.000,	.000,	.00,	0,	.000,	.000
CPUE Spanish Pair Tr,	3171,	.358,	.214,	.60,	4,	.258,	.097
Spanish Survey (Bott,	2334,	.363,	.355,	.98,	4,	.264,	.130
Norwegian Sea acoust,	876,	.598,	.776,	1.30,	2,	.086,	.315
Portuguese survey (B,	2274,	.529,	.549,	1.04,	4,	.120,	.133
F shrinkage mean ,	1173,	.50,,,,				.168,	.244

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1994,	.19,	.18,	17,	.943,	.151

1

Age 4 Catchability constant w.r.t. time and dependent on age

Year class = 1990

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
Norway Spawning Area,	983,	.404,	.163,	.40,	3,	.170,	.359
USSR Spawning Area/A,	1401,	.712,	.000,	.00,	1,	.049,	.265
CPUE Spanish Pair Tr,	3081,	.319,	.097,	.30,	5,	.247,	.129
Spanish Survey (Bott,	1648,	.334,	.211,	.63,	5,	.225,	.229
Norwegian Sea acoust,	974,	.634,	.152,	.24,	2,	.061,	.362
Portuguese survey (B,	1835,	.505,	.267,	.53,	5,	.096,	.208
F shrinkage mean ,	1209,	.50,,,,				.153,	.301

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1631,	.17,	.11,	22,	.679,	.231

Age 5 Catchability constant w.r.t. time and dependent on age

Year class = 1989

Fleet,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N,	Scaled, Weights,	Estimated F
Norway Spawning Area,	2818,	.354,	.085,	.24,	4,	.161,	.344
USSR Spawning Area/A,	2238,	.527,	.159,	.30,	2,	.061,	.417
CPUE Spanish Pair Tr,	1278,	.282,	.179,	.64,	6,	.248,	.645
Spanish Survey (Bott,	1390,	.308,	.275,	.89,	6,	.197,	.606
Norwegian Sea acoust,	2178,	.402,	.262,	.65,	3,	.088,	.426
Portuguese survey (B,	1057,	.484,	.197,	.41,	6,	.074,	.739
F shrinkage mean ,	2896,	.50,,,,				.170,	.336

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
1815,	.15,	.10,	28,	.695,	.493

1

Age 6 Catchability constant w.r.t. time and dependent on age

Year class = 1988

Fleet,	Estimated,	Int,	Ext,	Var,	N,	Scaled,	Estimated

Table 6.4.3 (cont.)

,	Survivors,	s.e,	s.e,	Ratio,	,	Weights,	F
Norway Spawning Area,	480,	.335,	.210,	.63,	5,	.155,	.456
USSR Spawning Area/A,	898,	.437,	.094,	.21,	3,	.083,	.269
CPUE Spanish Pair Tr,	682,	.251,	.152,	.61,	7,	.295,	.342
Spanish Survey (Bott,	518,	.304,	.203,	.67,	7,	.165,	.429
Norwegian Sea acoust,	625,	.370,	.317,	.86,	4,	.094,	.368
Portuguese survey (B,	949,	.483,	.171,	.35,	6,	.058,	.257
F shrinkage mean ,	520,	.50,,,,				.149,	.428

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
613,	.14,	.08,	33,	.555,	.374

Age 7 Catchability constant w.r.t. time and dependent on age

Year class = 1987

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
Norway Spawning Area,	372,	.310,	.267,	.86,	6,	.176,	.407
USSR Spawning Area/A,	343,	.374,	.297,	.80,	4,	.109,	.436
CPUE Spanish Pair Tr,	315,	.249,	.112,	.45,	7,	.232,	.466
Spanish Survey (Bott,	283,	.292,	.280,	.96,	7,	.198,	.509
Norwegian Sea acoust,	356,	.371,	.322,	.87,	5,	.089,	.423
Portuguese survey (B,	932,	.490,	.188,	.38,	6,	.047,	.183
F shrinkage mean ,	350,	.50,,,,				.149,	.428

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
346,	.14,	.09,	36,	.686,	.432

1
Age 8 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1986

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
Norway Spawning Area,	215,	.308,	.218,	.71,	7,	.227,	.363
USSR Spawning Area/A,	152,	.374,	.451,	1.21,	5,	.116,	.482
CPUE Spanish Pair Tr,	152,	.269,	.136,	.50,	7,	.183,	.482
Spanish Survey (Bott,	158,	.311,	.264,	.85,	7,	.163,	.467
Norwegian Sea acoust,	162,	.403,	.231,	.57,	6,	.091,	.459
Portuguese survey (B,	363,	.557,	.331,	.59,	5,	.028,	.230
F shrinkage mean ,	157,	.50,,,,				.193,	.468

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N, ,	Var, Ratio,	F
172,	.15,	.09,	38,	.616,	.437

Age 9 Catchability constant w.r.t. time and age (fixed at the value for age) 7

Year class = 1985

Fleet, ,	Estimated, Survivors,	Int, s.e,	Ext, s.e,	Var, Ratio,	N, ,	Scaled, Weights,	Estimated F
Norway Spawning Area,	122,	.298,	.179,	.60,	8,	.240,	.512
USSR Spawning Area/A,	104,	.364,	.265,	.73,	6,	.127,	.578
CPUE Spanish Pair Tr,	108,	.265,	.138,	.52,	7,	.155,	.560
Spanish Survey (Bott,	159,	.319,	.218,	.68,	7,	.142,	.413
Norwegian Sea acoust,	72,	.402,	.240,	.60,	7,	.093,	.758
Portuguese survey (B,	120,	.508,	.545,	1.07,	5,	.027,	.517
F shrinkage mean ,	167,	.50,,,,				.216,	.396

Table 6.4.3 (cont.)

Weighted prediction :

Survivors, at end of year,	Int, s.e,	Ext, s.e,	N,	Var, Ratio,	F
124,	.16,	.09,	41,	.548,	.505

1
1

Table 6.4.4 Blue whiting combined. F-at-age 1981-94.

At 18/10/1995 14:00

Terminal Fs derived using XSA (With F shrinkage)

Table 8 Fishing mortality (F) at age YEAR,	1981,	1982,	1983,	1984,
AGE				
0,	.0095,	.1714,	.0194,	.0484,
1,	.0801,	.0365,	.1607,	.1343,
2,	.0993,	.1145,	.1911,	.2451,
3,	.1651,	.1273,	.1578,	.2311,
4,	.1214,	.1941,	.1571,	.2244,
5,	.2646,	.1331,	.1541,	.2321,
6,	.2843,	.2062,	.2235,	.3606,
7,	.2303,	.2121,	.3437,	.3060,
8,	.2884,	.2041,	.3714,	.4108,
9,	.2467,	.2020,	.2598,	.3507,
+gp,	.2467,	.2020,	.2598,	.3507,
0 FBAR 3- 7,	.2131,	.1746,	.2072,	.2708,

Table 8 Fishing mortality (F) at age YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	FBAR 92-94
AGE											
0,	.1242,	.0087,	.0463,	.0052,	.0970,	.0119,	.0278,	.0097,	.0881,	.0248,	.0409,
1,	.1455,	.0937,	.1120,	.0748,	.1283,	.1085,	.0402,	.0867,	.1655,	.0821,	.1114,
2,	.1704,	.1274,	.1128,	.1331,	.1748,	.1461,	.1017,	.0749,	.0959,	.1034,	.0914,
3,	.3304,	.2316,	.1603,	.1684,	.3902,	.2464,	.1460,	.2332,	.1975,	.1506,	.1938,
4,	.2376,	.5529,	.3920,	.2221,	.3404,	.3969,	.1617,	.2778,	.3191,	.2312,	.2761,
5,	.2513,	.5532,	.4802,	.5153,	.4657,	.3940,	.3325,	.1897,	.2891,	.4932,	.3240,
6,	.4452,	.4262,	.3777,	1.0239,	.5930,	.6920,	.3414,	.2442,	.2548,	.3738,	.2909,
7,	.3657,	.5603,	.4533,	.4211,	.6735,	.5405,	.4092,	.2192,	.2845,	.4325,	.3121,
8,	.3431,	.5370,	.8242,	.4364,	.4791,	1.0752,	.1447,	.4301,	.1958,	.4374,	.3544,
9,	.3553,	.6929,	.6009,	.5438,	.3786,	.5198,	.1639,	.4329,	.3245,	.5046,	.4207,
+gp,	.3553,	.6929,	.6009,	.5438,	.3786,	.5198,	.1639,	.4329,	.3245,	.5046,	
0 FBAR 3- 7,	.3260,	.4648,	.3727,	.4701,	.4926,	.4539,	.2781,	.2328,	.2690,	.3363,	
1											

Table 6.4.5 Blue whiting combined. Stock size from XSA 1981-94.

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

At 18/10/1995 14:00

Terminal Fs derived using XSA (With F shrinkage)

Table 10 Stock number at age (start of year)	Numbers*10**-3			
YEAR,	1981,	1982,	1983,	1984,
AGE				
0,	5628,	24642,	25082,	13652,
1,	3705,	4564,	16997,	20140,
2,	4067,	2800,	3603,	11850,
3,	4945,	3015,	2044,	2437,
4,	3228,	3432,	2174,	1430,
5,	2605,	2341,	2314,	1521,
6,	2497,	1637,	1677,	1624,
7,	2504,	1538,	1090,	1098,
8,	2797,	1628,	1019,	633,
9,	2922,	1716,	1087,	575,
+gp,	7337,	4047,	1604,	946,
0 TOTAL,	42235,	51361,	58693,	55907,

Table 10 Stock number at age (start of year)	Numbers*10**-3												
YEAR,	1985,	1986,	1987,	1988,	1989,	1990,	1991,	1992,	1993,	1994,	1995,	GMST 81-92	AMST 81-92
AGE													
0,	11107,	10765,	8332,	9746,	23308,	7730,	6366,	2180,	2057,	3744,	0,	10119,	12378,
1,	10649,	8032,	8738,	6513,	7937,	17320,	6253,	5069,	1768,	1542,	2991,	8397,	9660,
2,	14417,	7538,	5988,	6396,	4948,	5716,	12722,	4918,	3806,	1226,	1163,	6254,	7080,
3,	7593,	9954,	5433,	4379,	4584,	3401,	4044,	9409,	3736,	2831,	906,	4552,	5103,
4,	1583,	4468,	6465,	3789,	3030,	2540,	2177,	2861,	6101,	2511,	1994,	2849,	3098,
5,	935,	1022,	2104,	3576,	2485,	1765,	1399,	1516,	1774,	3631,	1631,	1833,	1965,
6,	987,	596,	481,	1066,	1749,	1277,	974,	821,	1027,	1088,	1815,	1161,	1282,
7,	927,	518,	318,	270,	313,	791,	523,	567,	527,	652,	613,	701,	872,
8,	662,	527,	242,	166,	145,	131,	377,	285,	373,	324,	346,	457,	718,
9,	344,	385,	252,	87,	88,	74,	37,	267,	152,	251,	172,	302,	653,
+gp,	950,	868,	472,	130,	132,	256,	95,	47,	55,	91,	169,		
0 TOTAL,	50155,	44671,	38825,	36118,	48719,	41001,	34968,	27941,	21376,	17891,	11801,		
1													

Table 6.4.6 Blue whiting combined. Stock summary table 1981-94.

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

At 18/10/1995 14:00

Table 16 Summary (without SOP correction)

Terminal Fs derived using XSA (With F shrinkage)

	RECRUITS, Age 0	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 3- 7,
1981,	5628,	5353,	4604,	909556,	197.5490,	.2131,
1982,	24642,	4228,	3302,	576419,	174.5908,	.1746,
1983,	25082,	3746,	2253,	570072,	253.0382,	.2072,
1984,	13652,	3493,	1854,	641776,	346.1191,	.2708,
1985,	11107,	3507,	2147,	695596,	323.9475,	.3260,
1986,	10765,	3688,	2452,	826986,	337.2672,	.4648,
1987,	8332,	3193,	2071,	664434,	320.8947,	.3727,
1988,	9746,	2852,	1751,	553413,	316.1425,	.4701,
1989,	23308,	2818,	1652,	625433,	378.6161,	.4926,
1990,	7730,	2841,	1499,	561610,	374.5533,	.4539,
1991,	6366,	3909,	2067,	369524,	178.7967,	.2781,
1992,	2180,	3359,	2701,	474445,	175.6646,	.2328,
1993,	2057,	2485,	2098,	477513,	227.5733,	.2690,
1994,	3744,	2045,	1652,	455739,	275.8455,	.3363,
Arith. Mean ,	11024,	3394,	2293,	600180,	277.1856,	.3259,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		
1						

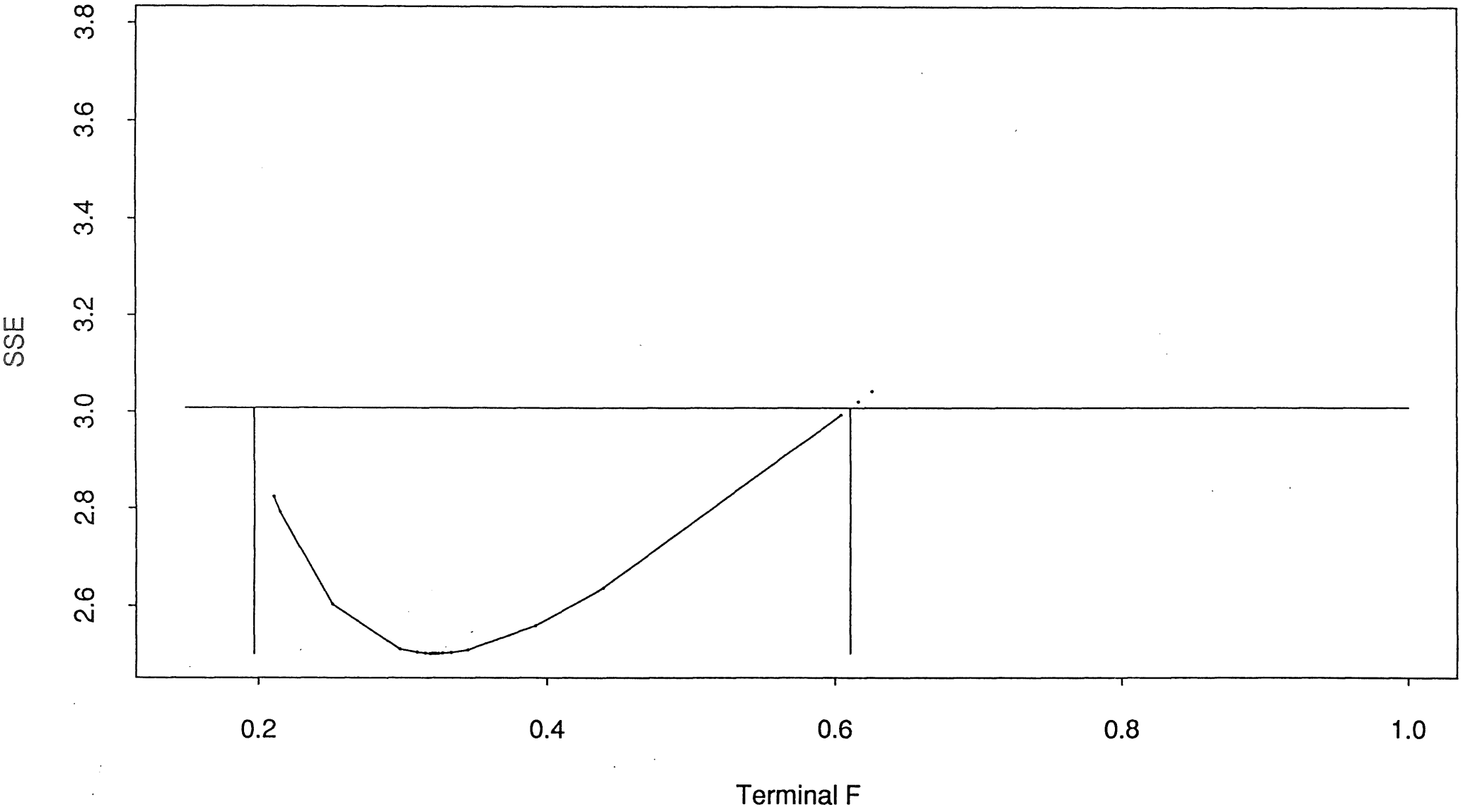
Table 6.4.7 Blue whiting combined. Estimates of the 1989 year class.

	Catches and stock					Surveys		Surveys adjusted		Year class estimates			Squared sum	
Year	C-no	N	F	M	Z	Ru_Sp	No_Sp	Russia Sp	Norway Sp	YC method	XSA	XSA wt.	Ru_Sp	No_Sp
1991	1,113	13,365	0,10	0,2	0,30					13,365	12,722	15,459		
1992	1,771	9,935	0,22	0,2	0,42	20,010	26,123	11,700	7,512	9,935	9,409	11,649	0,027	0,078
1993	1,568	6,532	0,31	0,2	0,51	12,337	26,771	7,214	7,698	6,532	6,101	7,935	0,010	0,027
1994	1,327	3,929	0,47	0,2	0,67		11,354		3,265	3,929	3,631	5,132		0,034
1995		2,016				2,651	9,467	1,550	2,722	2,016	1,815	3,045	0,069	0,090
	All surv.	0,78				q	1,71	3,48					0,106	0,230
	Sp. surv	0,34				SS	0,11	0,23						

Table 6.5.1 Total catches of BLUE WHITING in 1978-1994 divided into areas within and beyong areas of national fisheries juridiction of NEAFC contracting parties, as estimated by the Working Group members.

Year	International	Jan Mayen	Norway	Iceland	Greenland	Faores	EU	Total (t)
1978	136,504	-	67,391	26,444	6.580	195,361	136,421	568,701
	(24 %)		(12 %)	(5 %)	(1 %)	(34 %)	(24 %)	
1979	614,734	-	75,545	15,117	204	224,202	191,564	1,121,365
	(55 %)		(7 %)	(1 %)	(0 %)	(20 %)	(17 %)	
1980	567,693	-	152,095	4,562	8,757	164,342	160,361	1,057,810
	(54 %)		(14 %)	(0 %)	(1 %)	(16 %)	(15 %)	
1981	168,681	123,000	215,004	7,751	-	174,801	203,223	892,460
	(19 %)	(14 %)	(24 %)	(1 %)		(20 %)	(23 %)	
1982	22,993	-	130,435	5,797	-	125,072	279,474	563,771
	(4 %)		(23 %)	(1 %)		(22 %)	(50 %)	
1983	15,203	-	109,675	7,000	-	91,804	325,816	549,498
	(3 %)		(20 %)	(1 %)		(17 %)	(59 %)	
1984	18,407	-	150,603	105	-	124,905	313,591	607,611
	(3 %)		(25 %)	(0 %)		(21 %)	(52 %)	
1985	38,978	-	114,785	-	-	196,003	335,162	684,928
	(6 %)		(17 %)			(29 %)	(49 %)	
1986	20,665	-	187,768	-	116	171,074	408,338	787,961
	(3 %)		(24 %)		(0 %)	(22 %)	(52 %)	
1987	103,535	-	109,201	-	-	135,980	267,045	615,761
	(17 %)		(18 %)			(22 %)	(43 %)	
1988	65,172	-	38,449	-	-	157,368	265,182	526,171
	(12 %)		(7 %)			(30 %)	(50 %)	
1989	137,093	-	68,817	4,977	-	101,177	318,033	630,097
	(22 %)		(11 %)	(1 %)		(16 %)	(50 %)	
1990	88, 509	-	39,160	-	-	115,308	318,710	561,687
	(16 %)		(7 %)			(21 %)	(57 %)	
1991	51,950	-	72,309	-	-	99,268	197,522	421,049
	(12 %)		(17 %)			(24 %)	(47 %)	
1992	47,786	-	66,333	-	-	135,294	253,754	503,167
	(9 %)		(13 %)			(27 %)	(50 %)	
1993	69,213	-	47,917	-	-	112,773	249,094	478,997
	(14 %)		(10 %)			(24 %)	(52 %)	
1994	68,926	-	36,933	-	-	133,678	218,303	457,840
	(15 %)		(8 %)			(29 %)	(48 %)	

Figure 2.4.1. Icelandic summer spawners. Sum of squares used for fitting VPA to acoustic data, as a function of terminal fishing mortality.



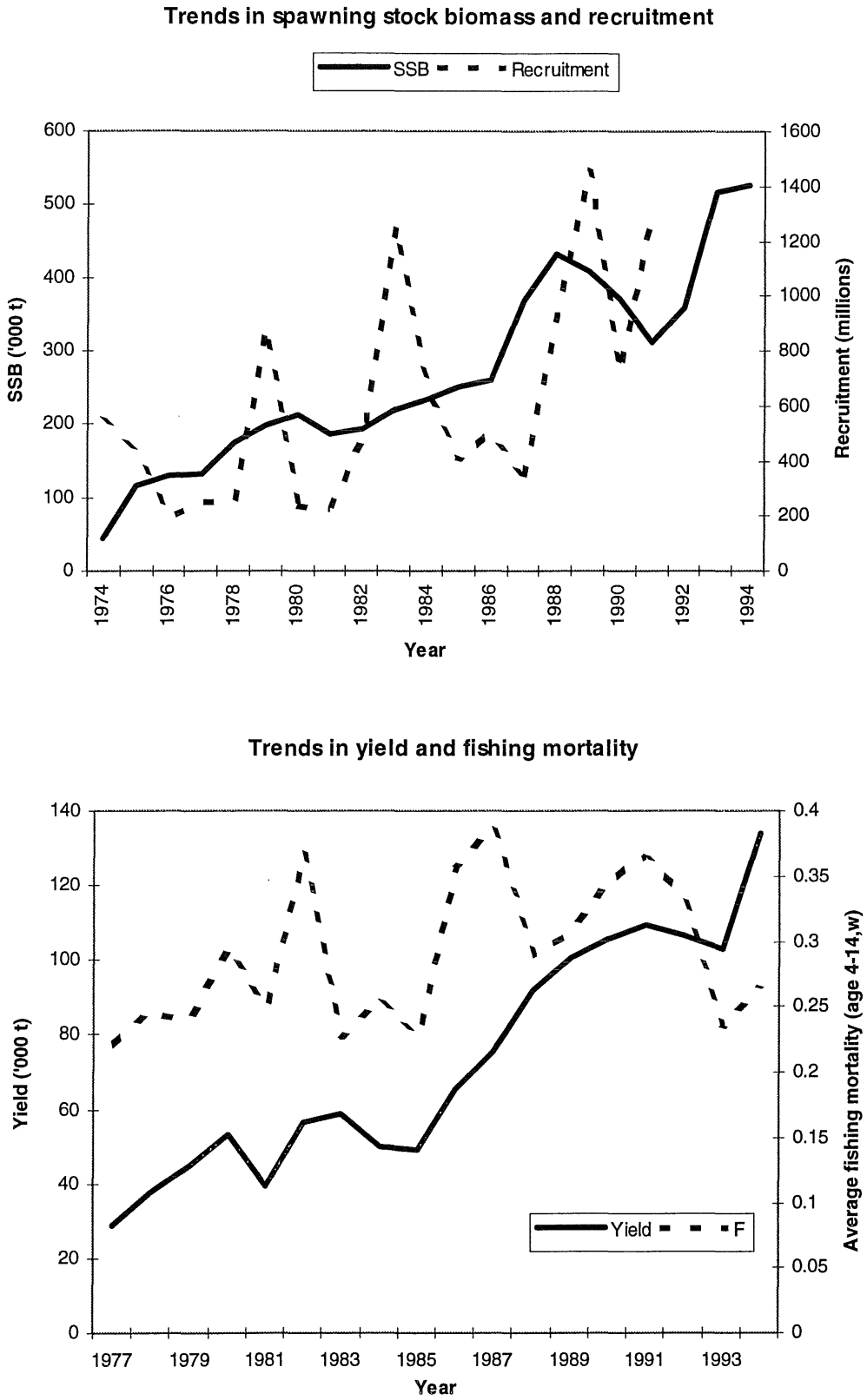
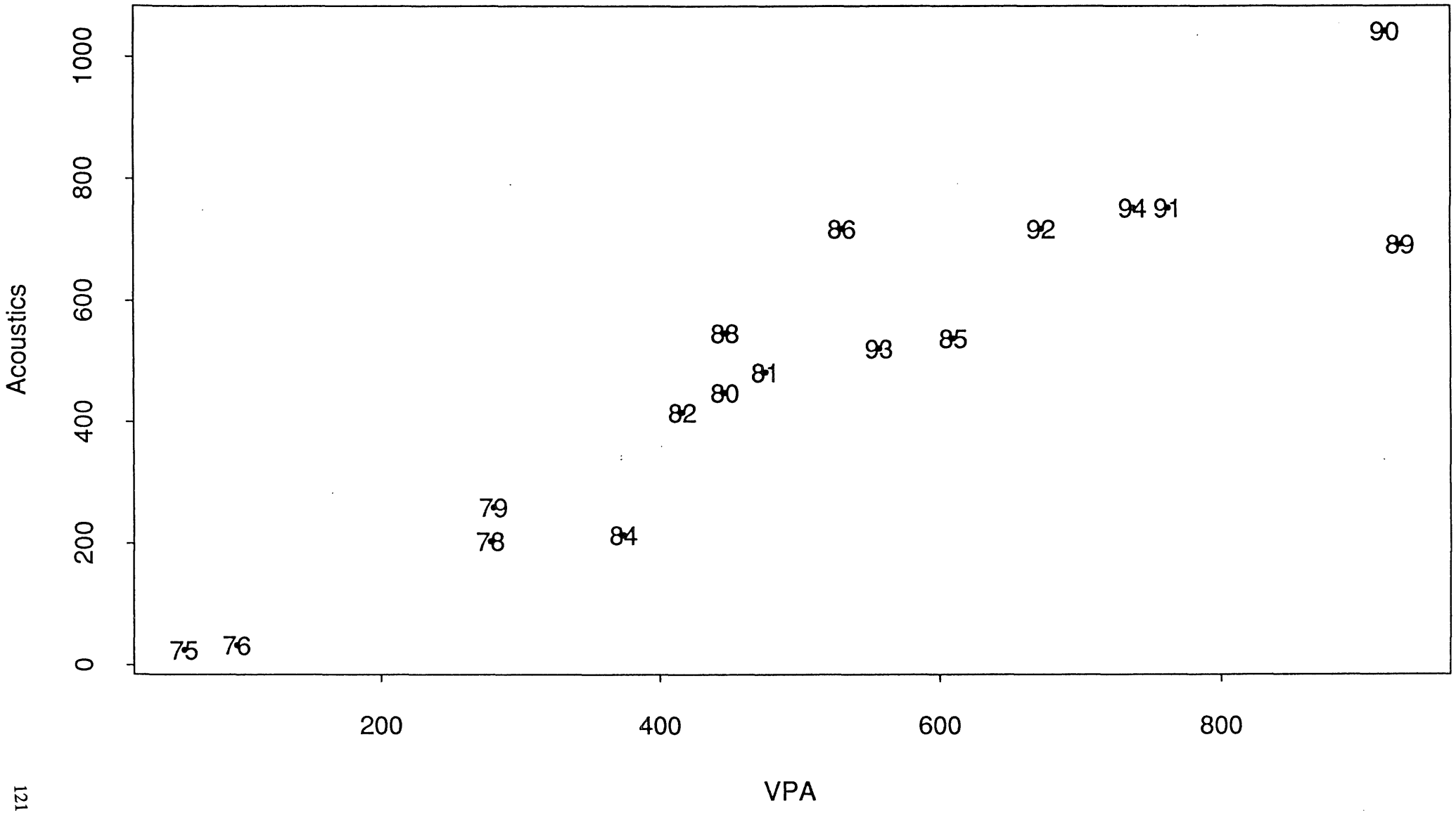


Figure 2.4.2. Icelandic summer spawners. Fish stock summary.

Figure 2.4.3. Icelandic summer spawners. Trens in acoustics and VPA stock numbers.

Figure 2.4.4 Icelandic summer spawners. Acoustic estimates *vs* VPA stock numbers.



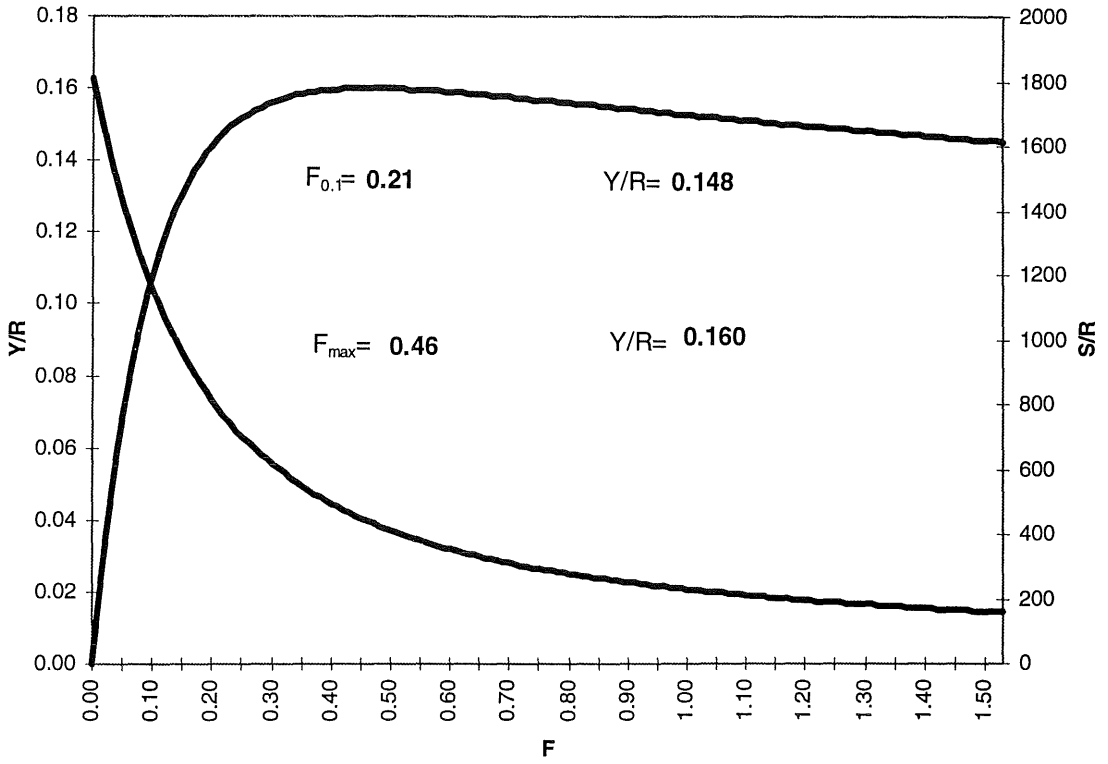


Figure 2.5.1. Icelandic summer spawners. Yield per recruit and spawning stock per recruit.

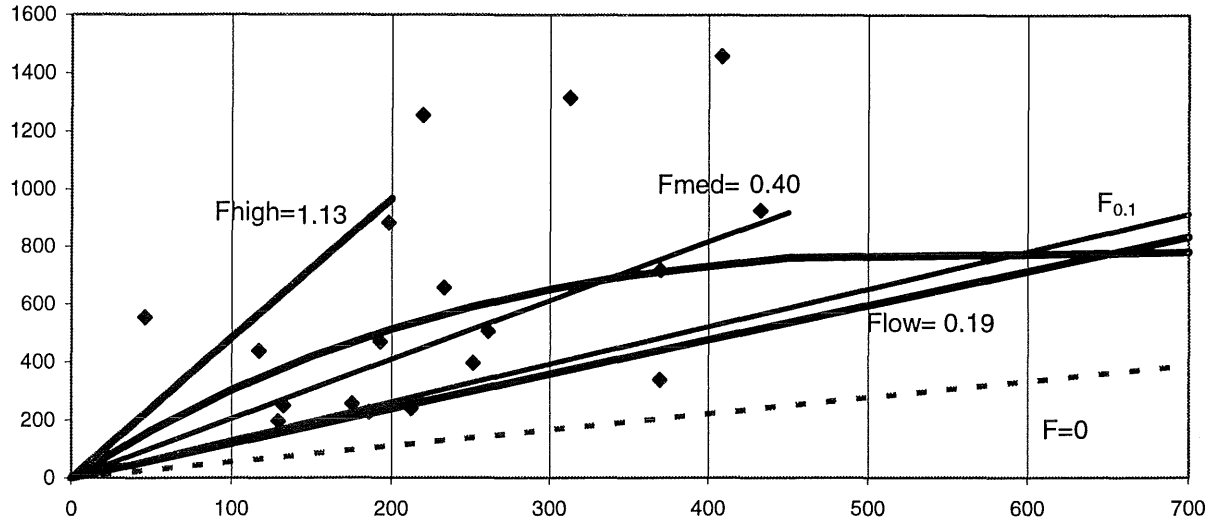


Figure 2.7.1. Icelandic summer spawners. Stock and recruitment along with fitted Ricker stock-recruitment curve and replacement lines.

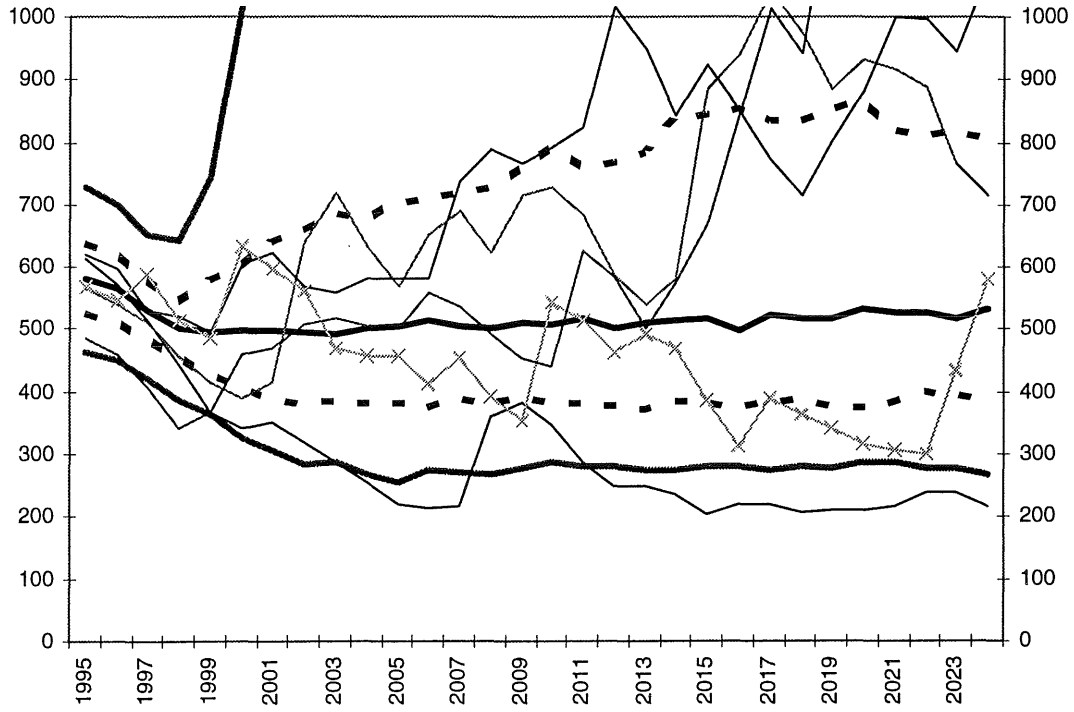
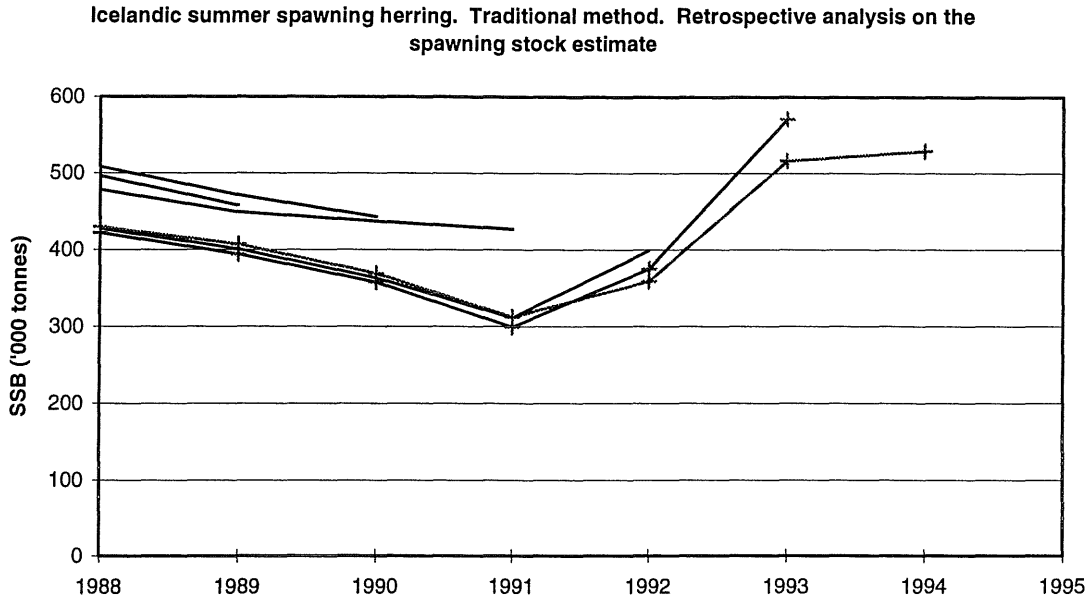


Figure 2.7.2. Icelandic summer spawners. Results from medium-term computer games. Thin lines denote sample trajectories. Thick lines denote 5%, 25%, 50%, 75% and 95% percentiles.



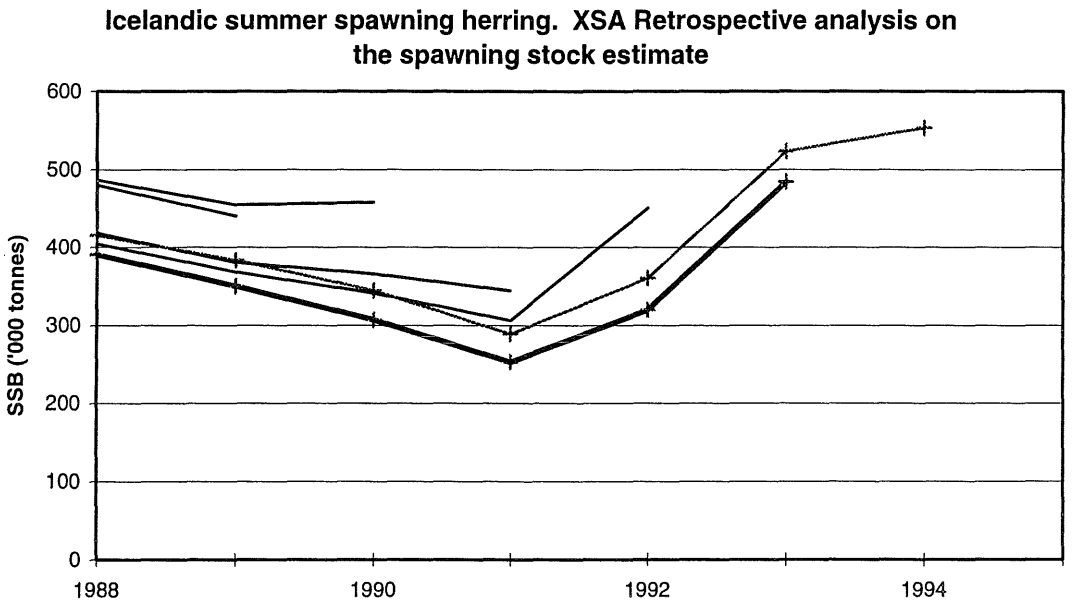


Figure 2.8.1 Icelandic summer spawners. Retrospective plots of spawning stock biomass trends from XSA and traditional stock estimates.

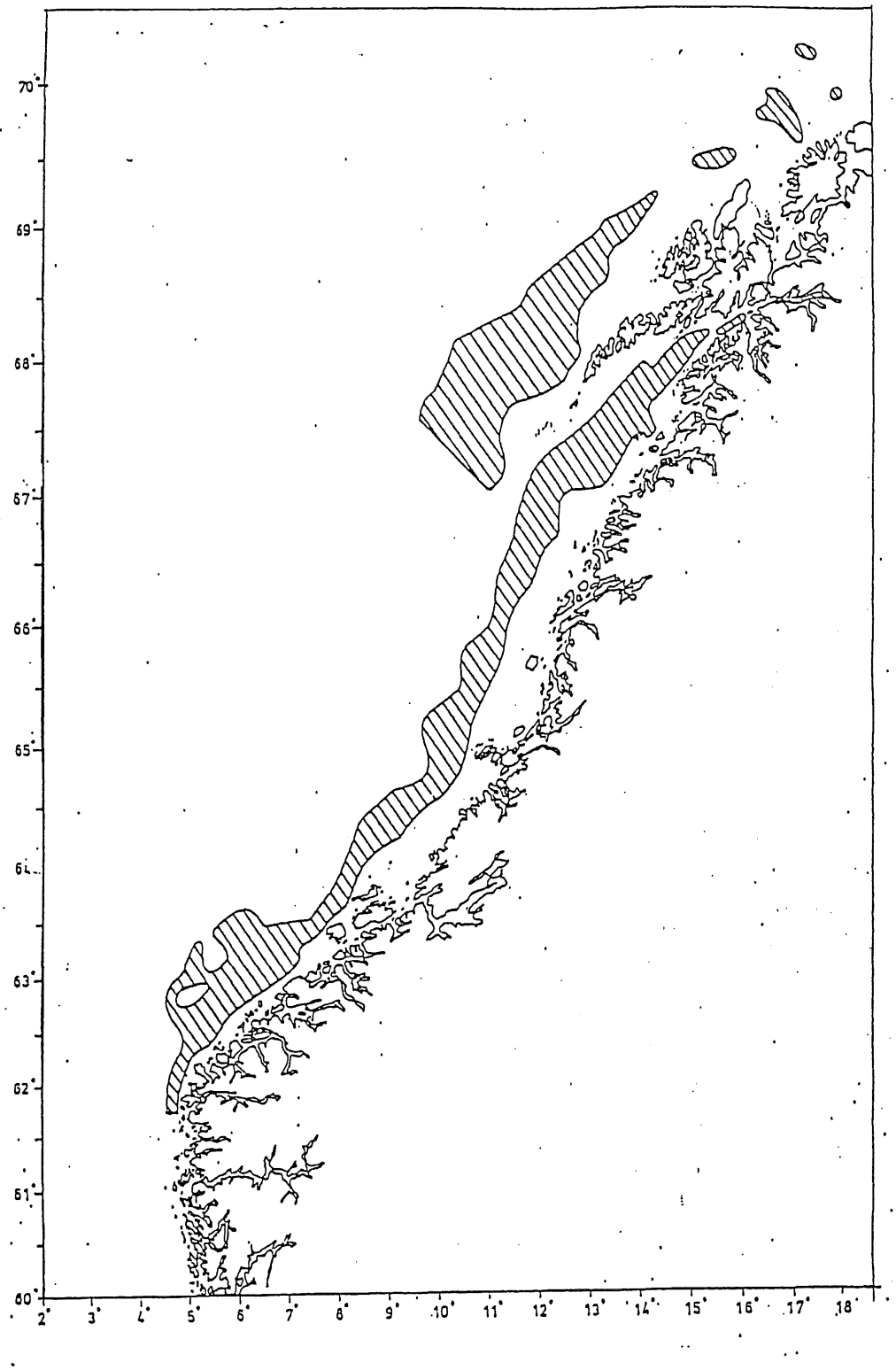


Figure 3.3.1. Distribution of adult herring 15.2 - 31.3 1995.

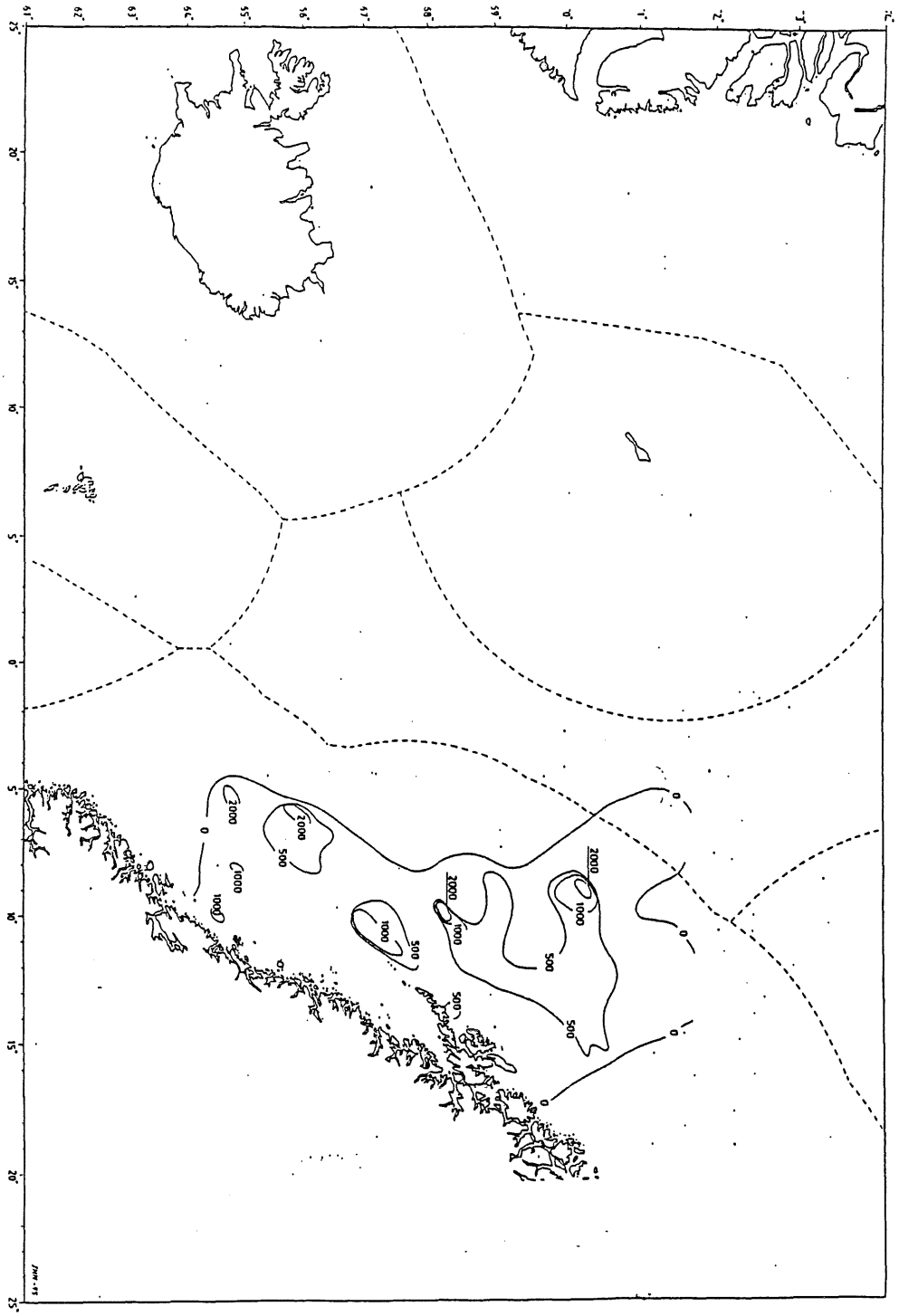


Figure 3.3.2. Distribution of Norwegian spring spawning herring 7.7 - 2.8 1995.

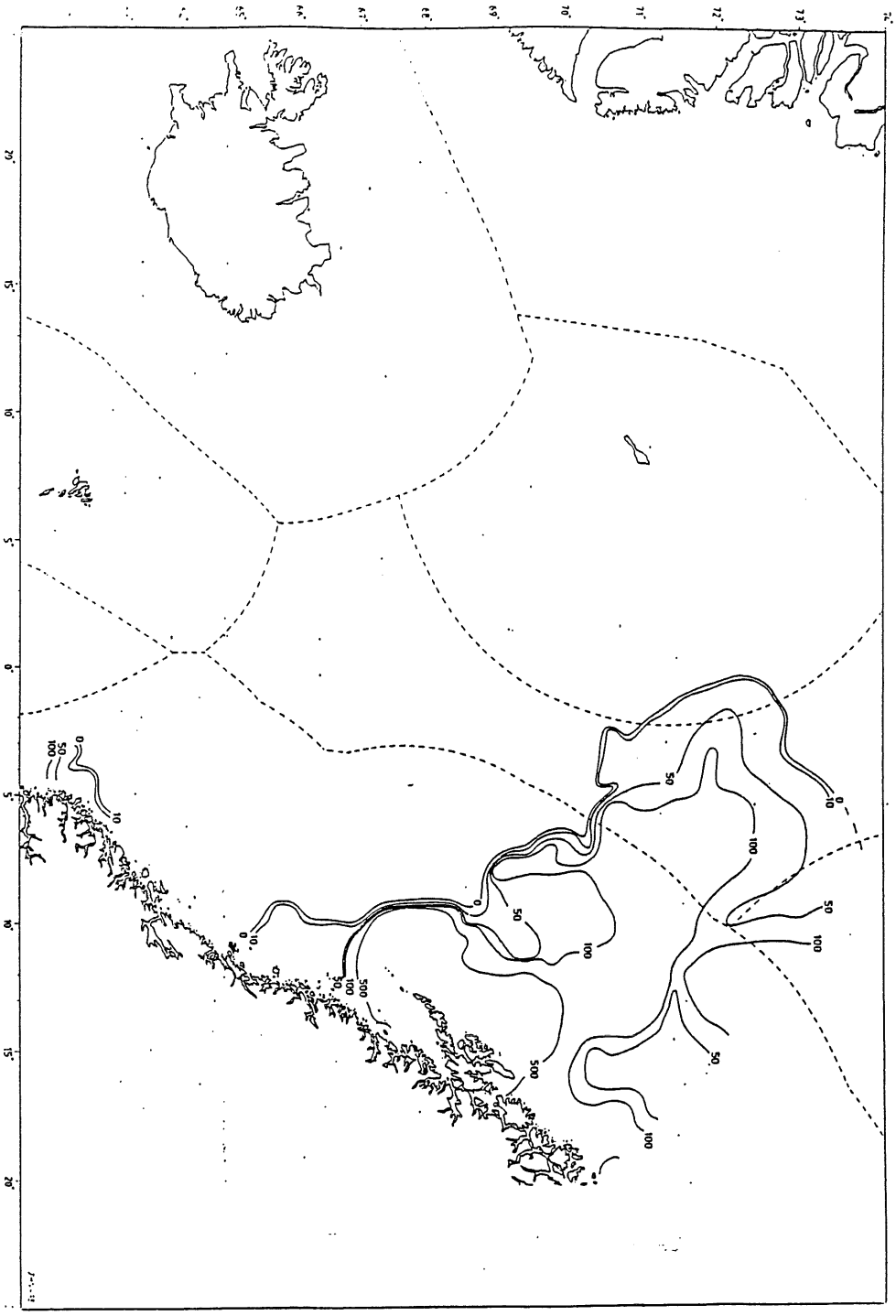


Figure 3.3.3. Distribution of Norwegian spring spawning herring 29.7 - 15.8 1995.

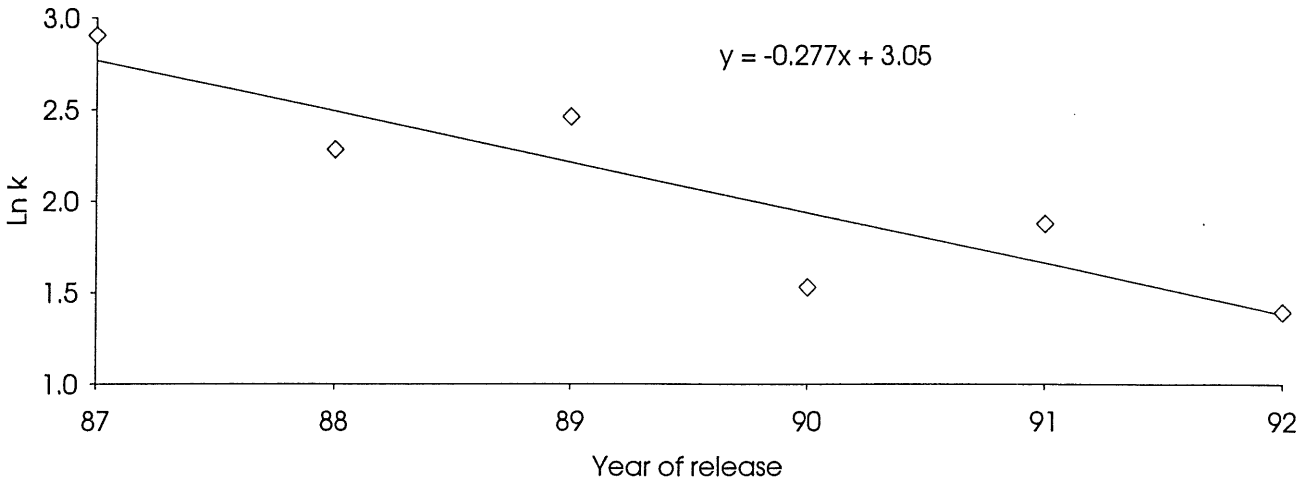


Figure 3.3.4. Norwegian spring spawning herring. Plots of In k (see text) against year of release.

Figure 3.5.1

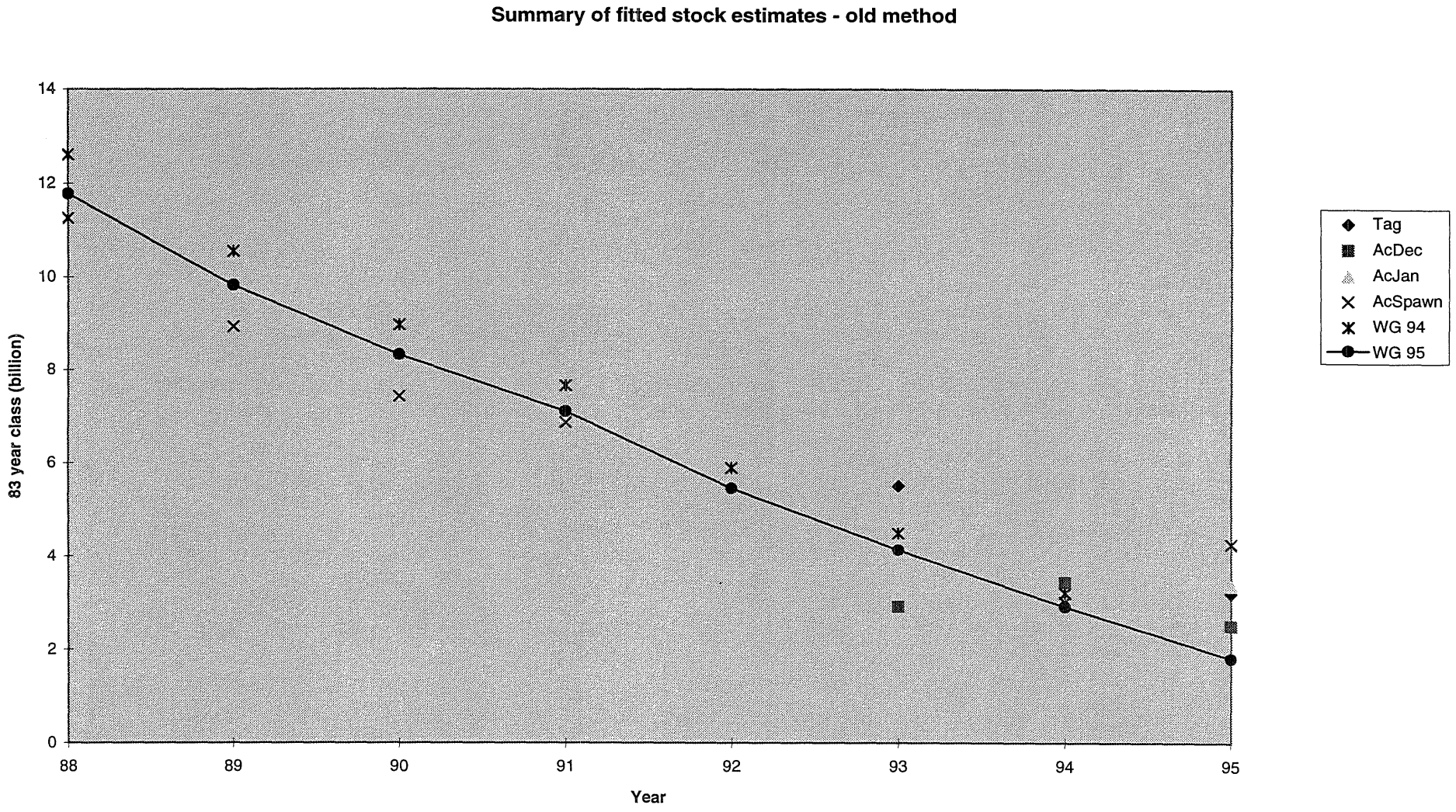

Summary of fitted stock estimates - old method
83 year class (billion)
0
2
4
6
8
10
12
14
88
89
90
91
92
93
94
95
Year
Tag
AcDec
AcJan
AcSpawn
WG 94
WG 95

Figure 3.5.2

BJARTE Chart 13

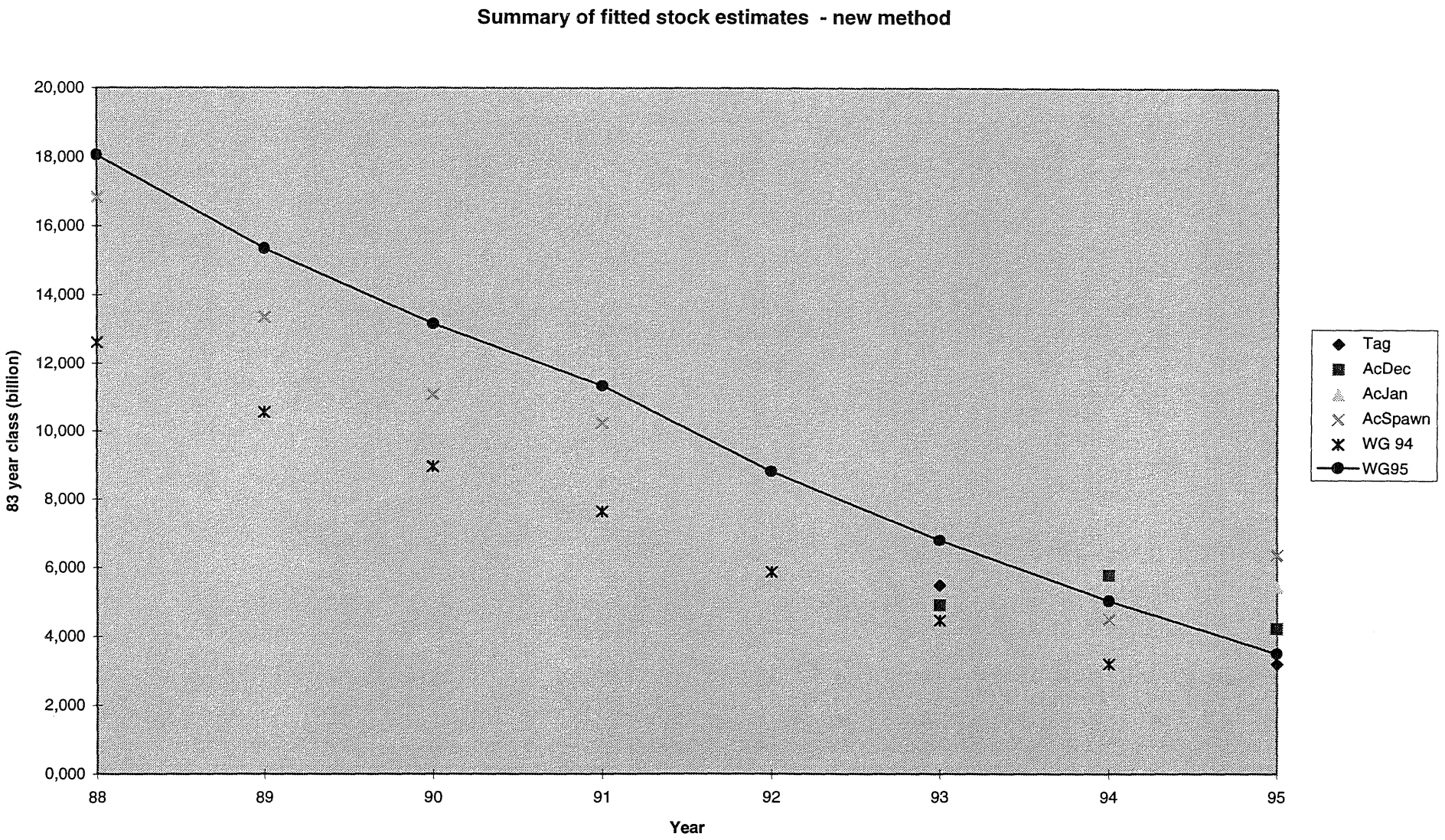


Figure 3.5.3 BJARTE Chart 11

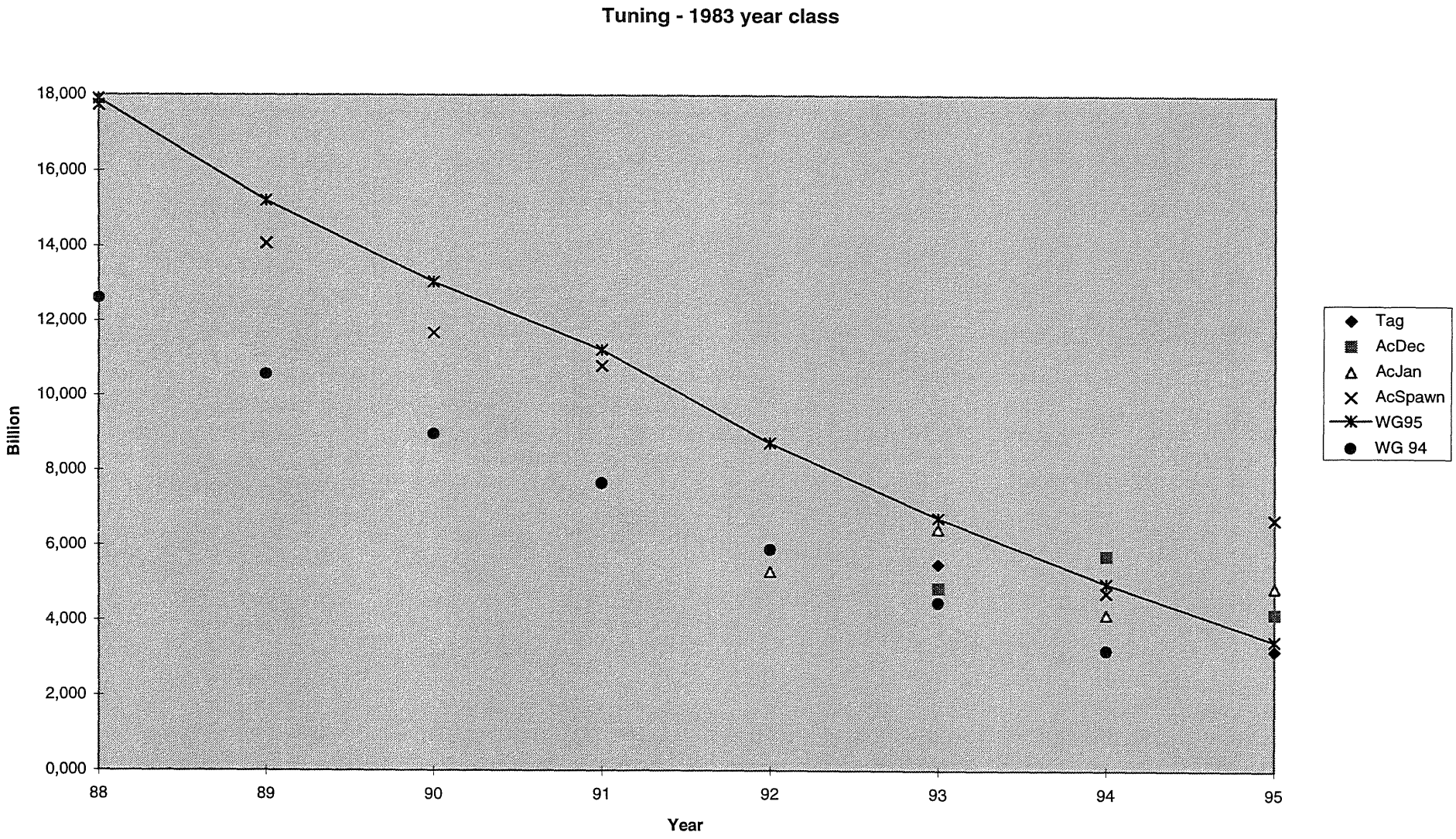


Figure 3.5.4

BJARTE Chart 12

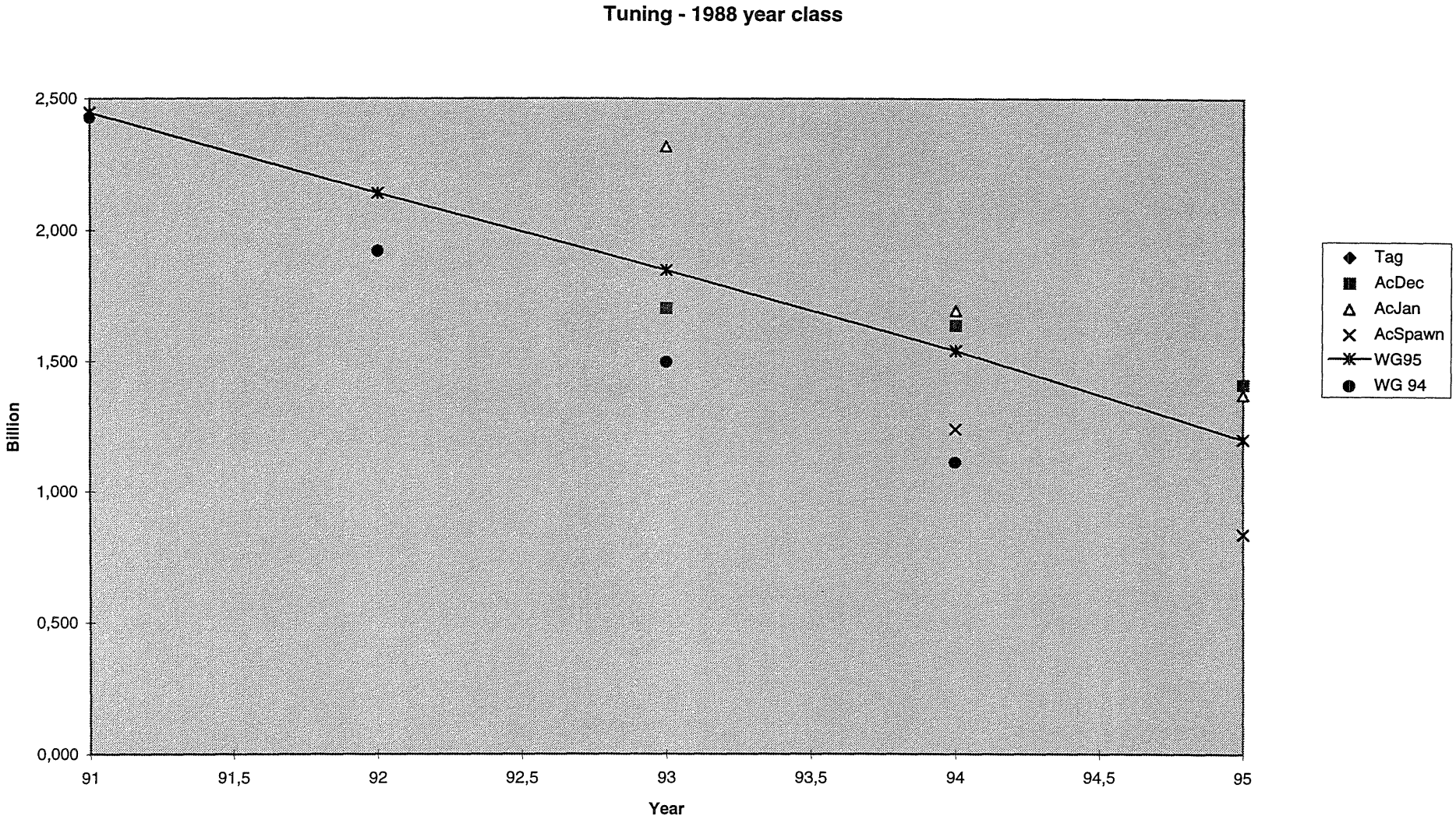
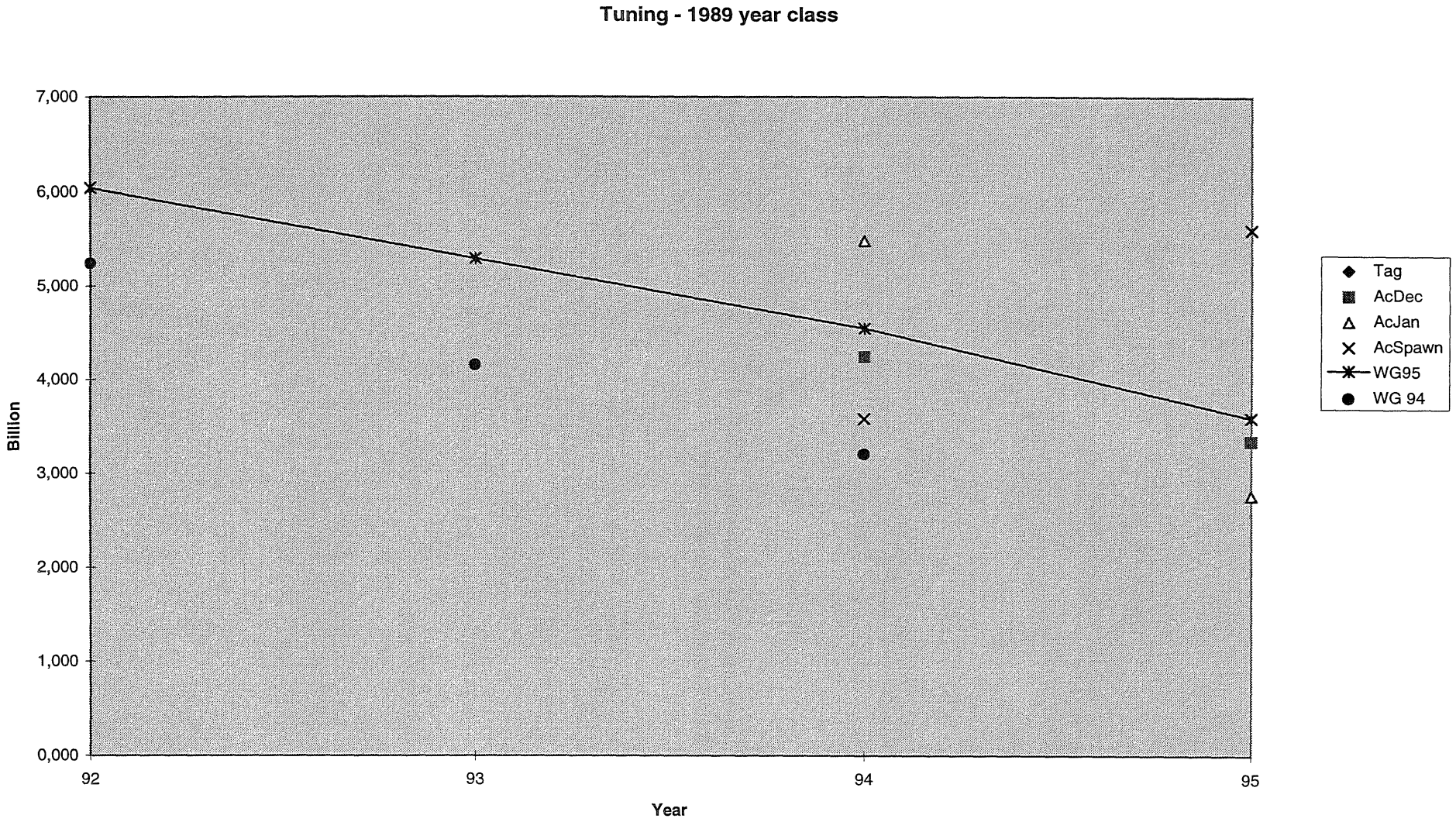


Figure 3.5.5

BJARTE Chart 13



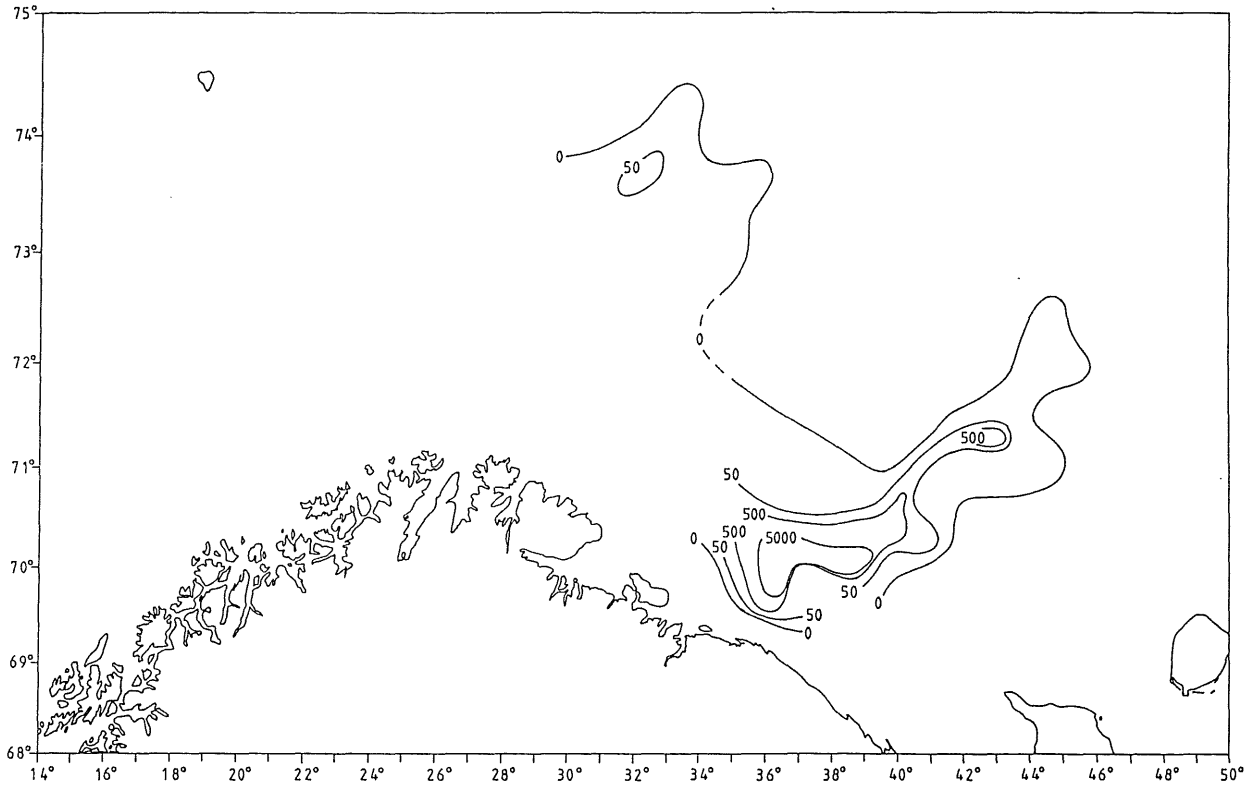


Figure 3.7.1. Distribution of immature Norwegian spring spawning herring in the Barents Sea in winter 1995.

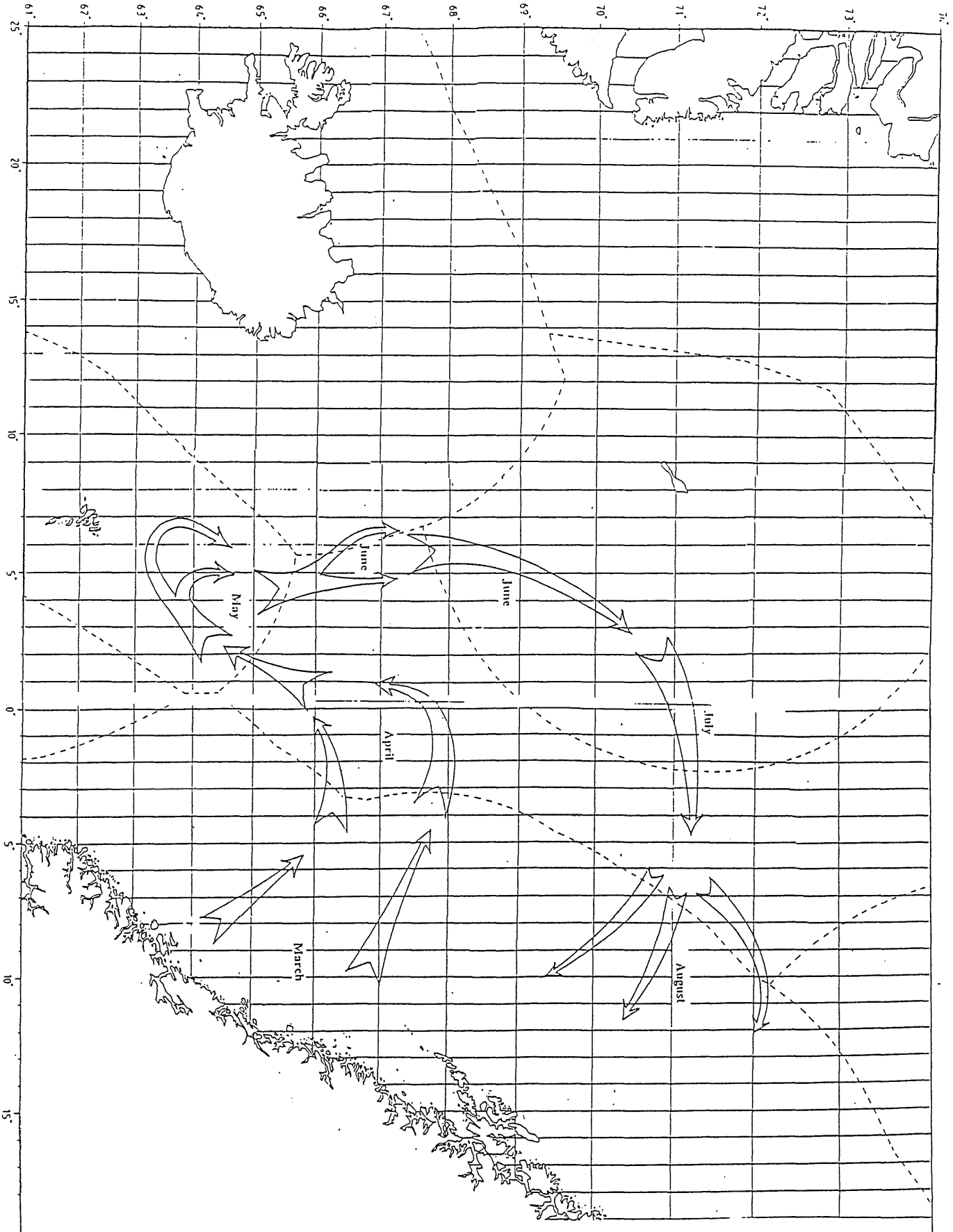


Figure 3.7.2. A schematic presentation of the general migration pattern of adult Norwegian spring spawning herring from spring until in the autumn of 1995.

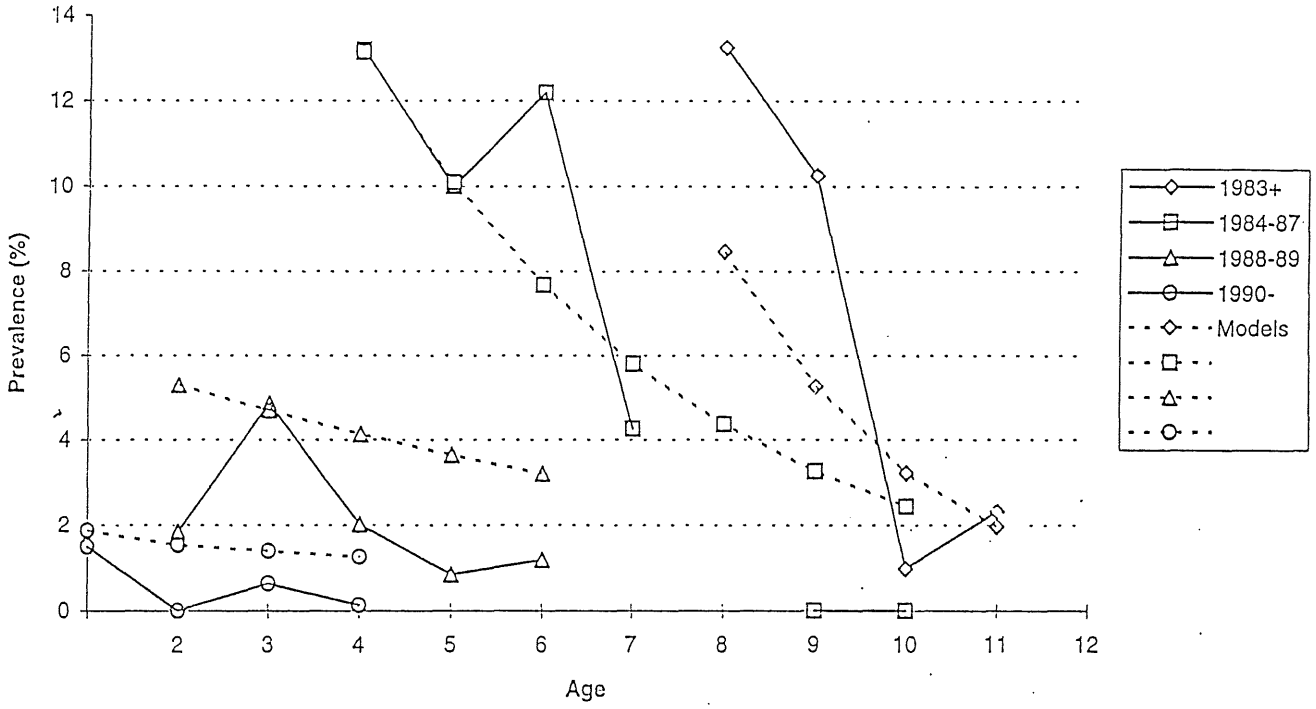


Figure 3.8.1. Ichthyophonus disease in Norwegian spring spawning herring. Prevalence at age by year classes.

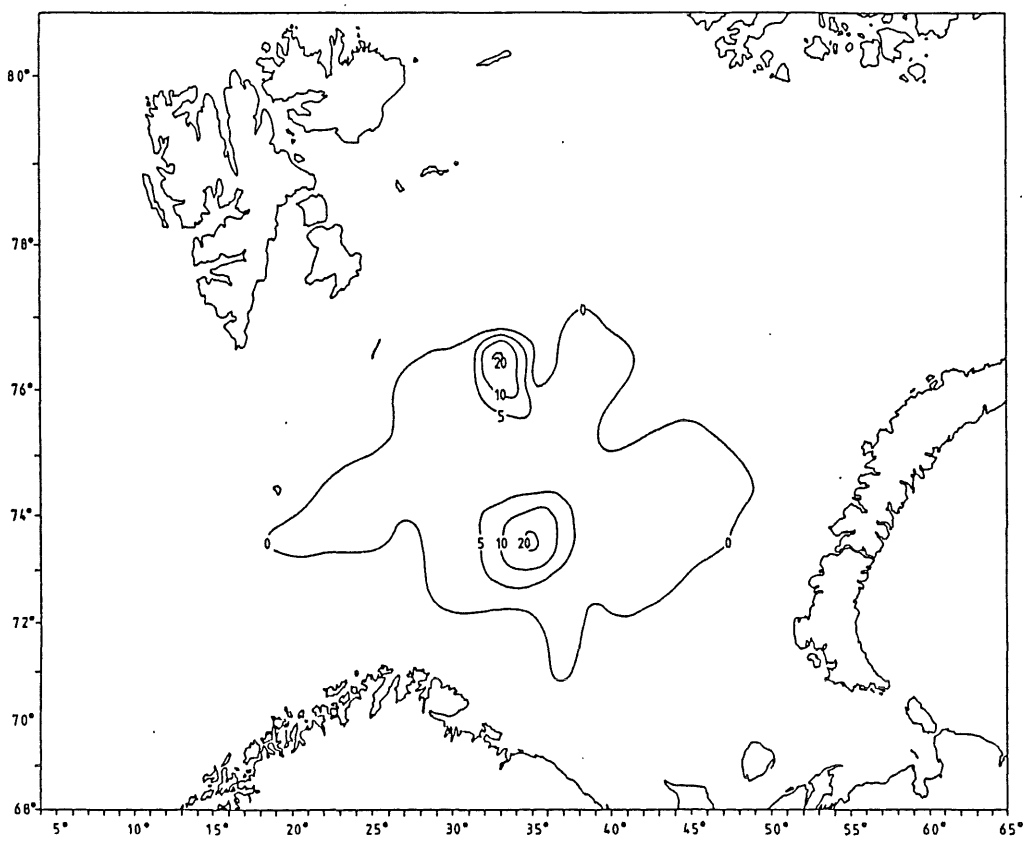


Figure 4.3.1. Estimated total density distribution of capelin (tonnes/square nautical mile) autumn 1995.

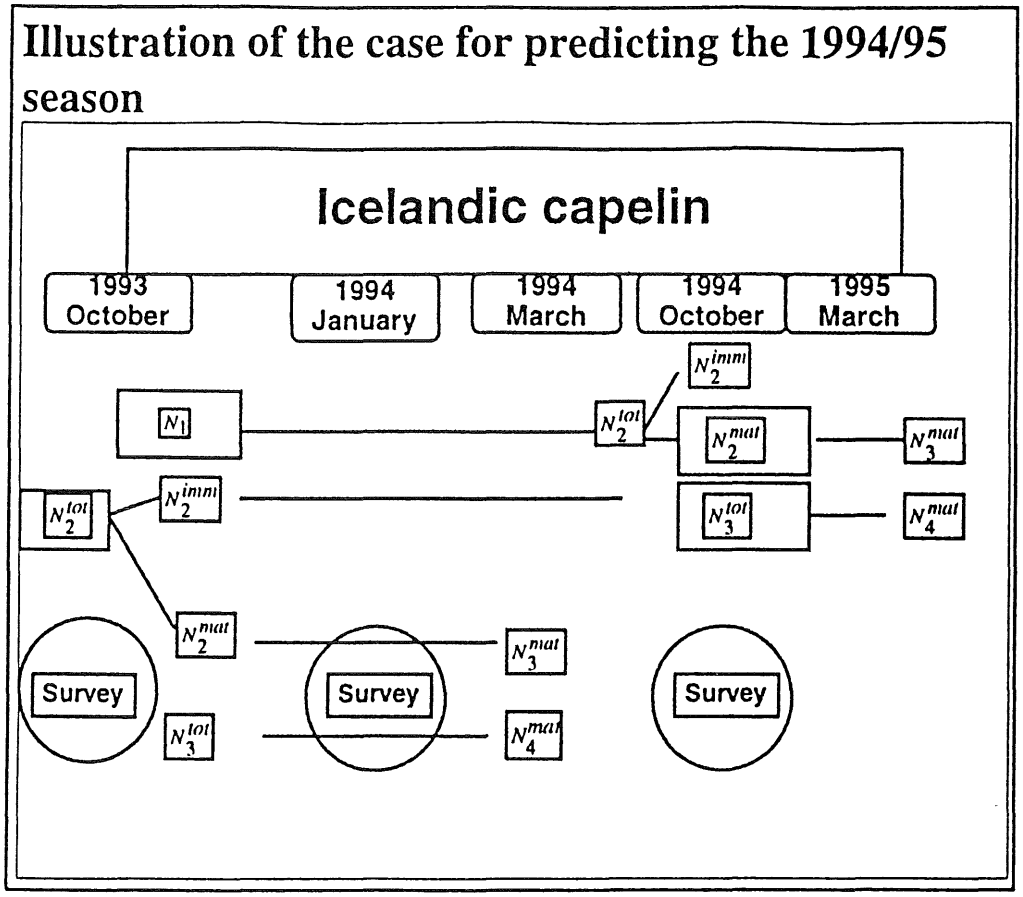


Figure 5.3.1. Capelin in the Iceland - East Greenland - Jan Mayen area. Summary of method of stock prediction.

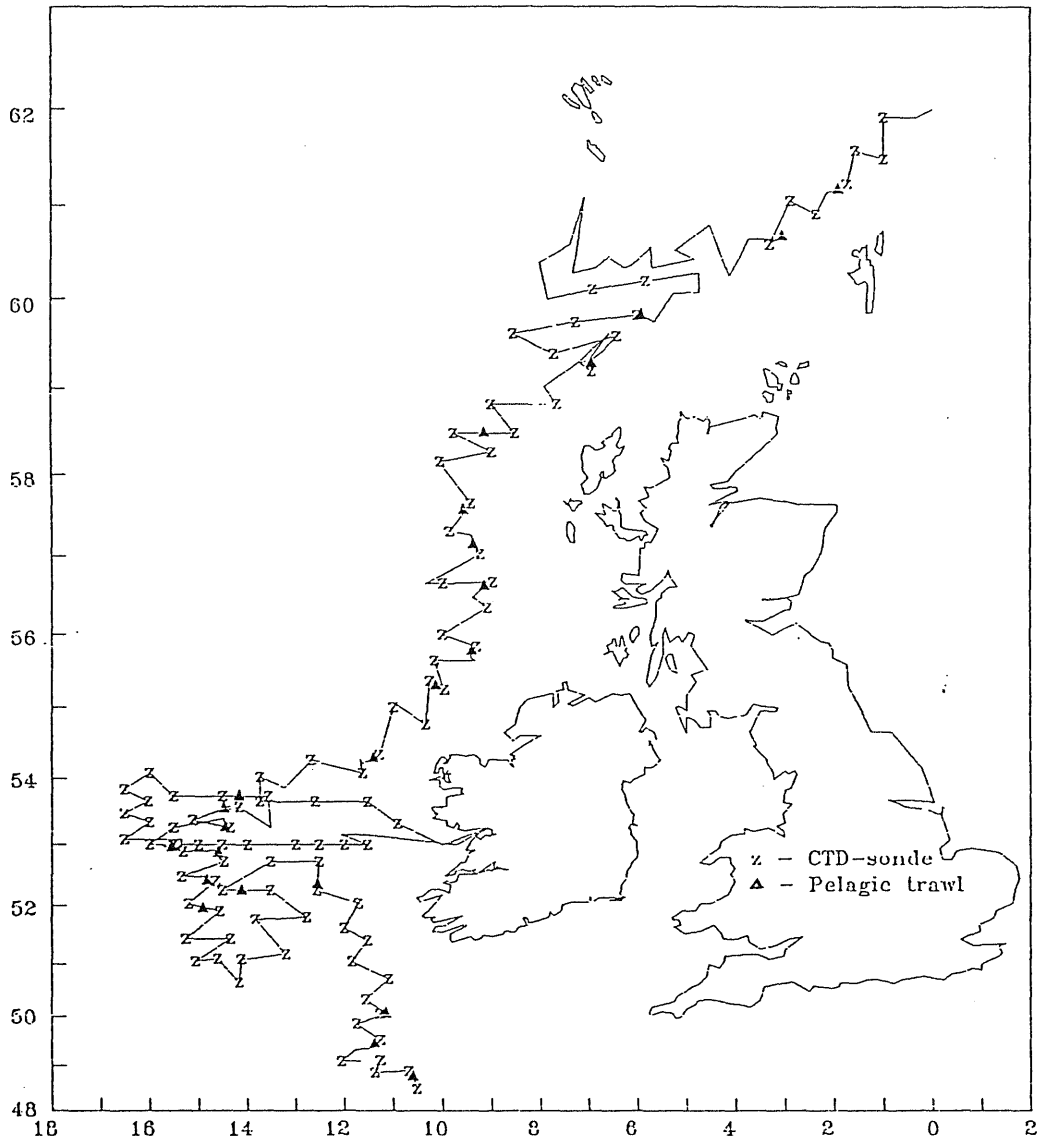


Fig.6.4.1. Cruise tracks and stations of R.V. "Fridtjof Nansen", 22 March-23 April 1995.

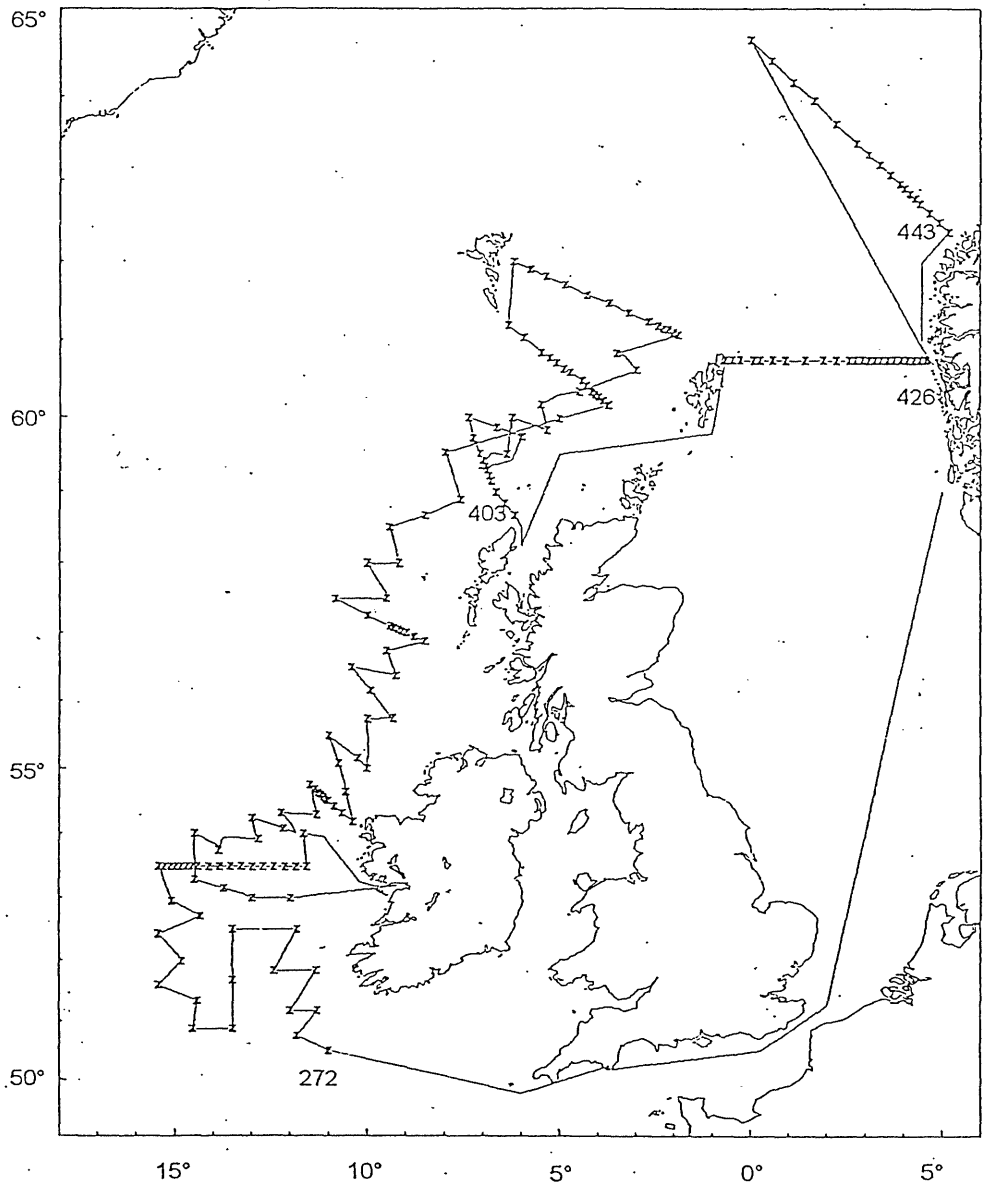


Fig.6.4.2. Cruise tracks and CTD- stations of R.V. "Johan Hjort", 22 March-24 April 1995.

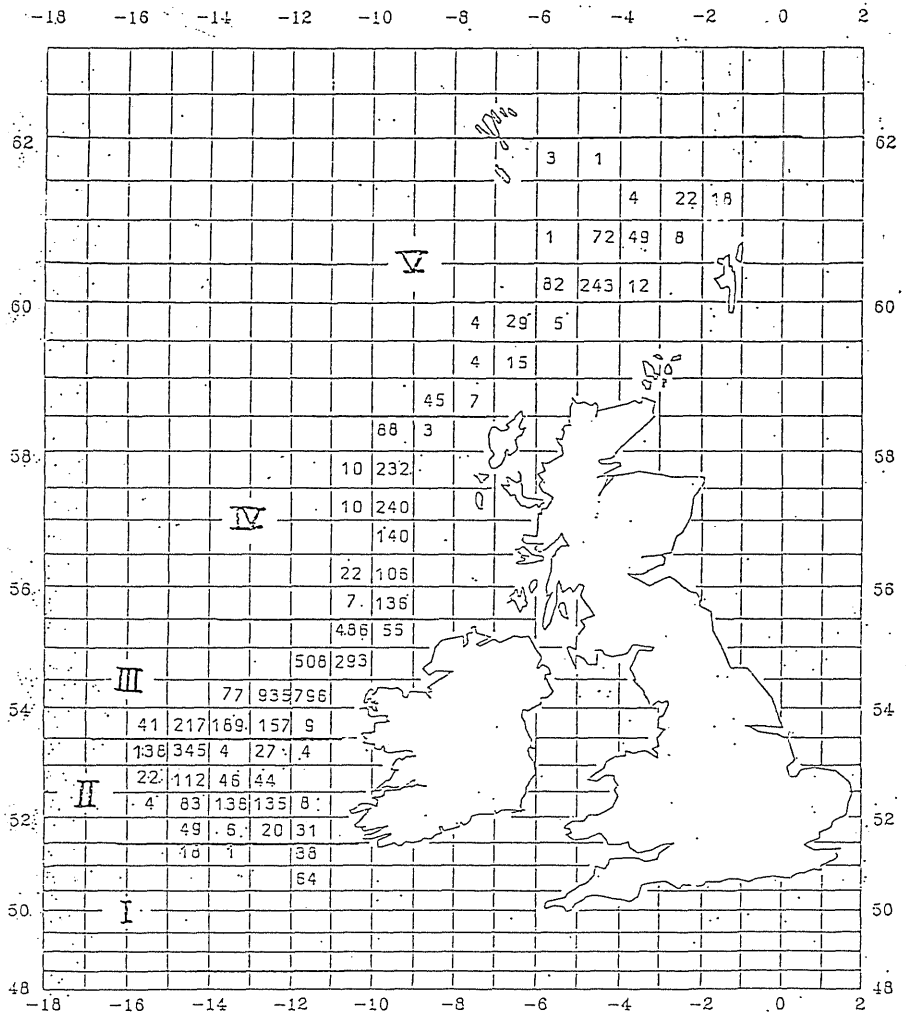


Fig. 6.4.3. Blue whiting biomass (in thousand tonnes) obtained by Norway, March/April 1995. Markings of subareas I-V used in the assessment.

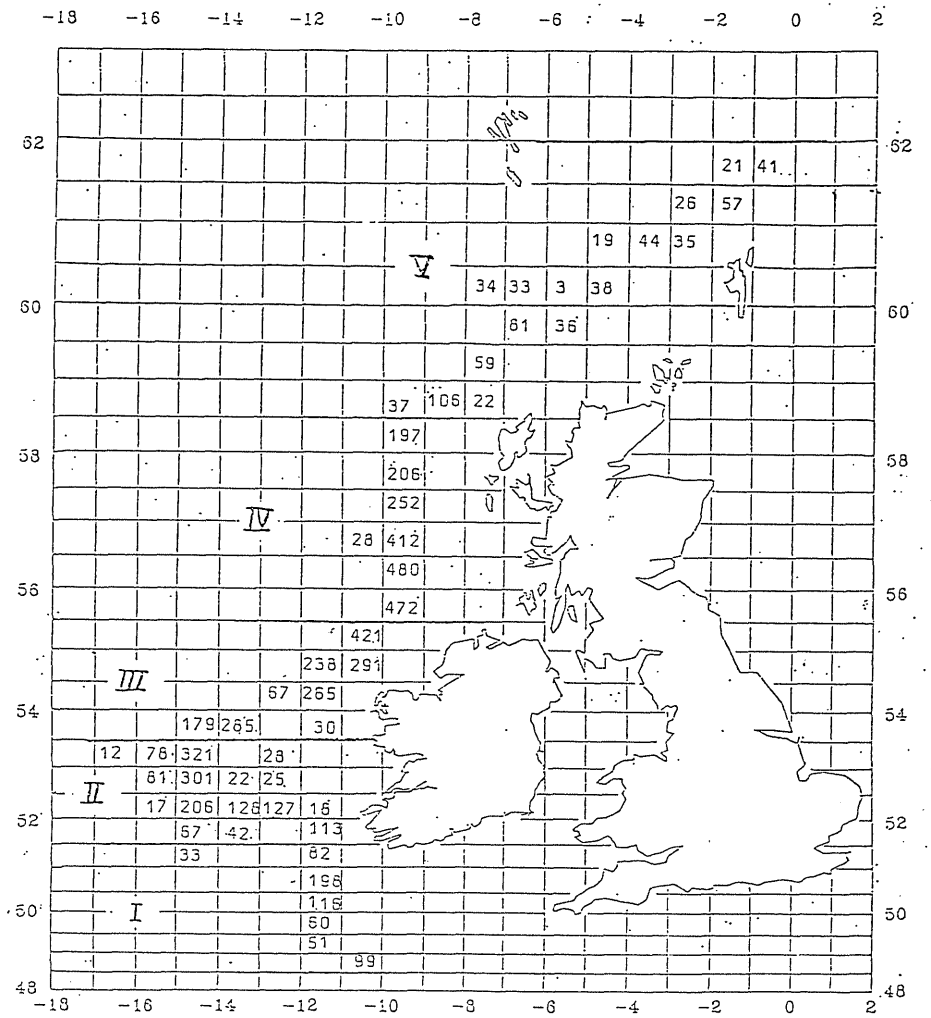


Fig. 6.4.4. Blue whiting biomass (in thousand tonnes) obtained by Russia, March/April 1995. Markings of subareas I-V used in the assessment.

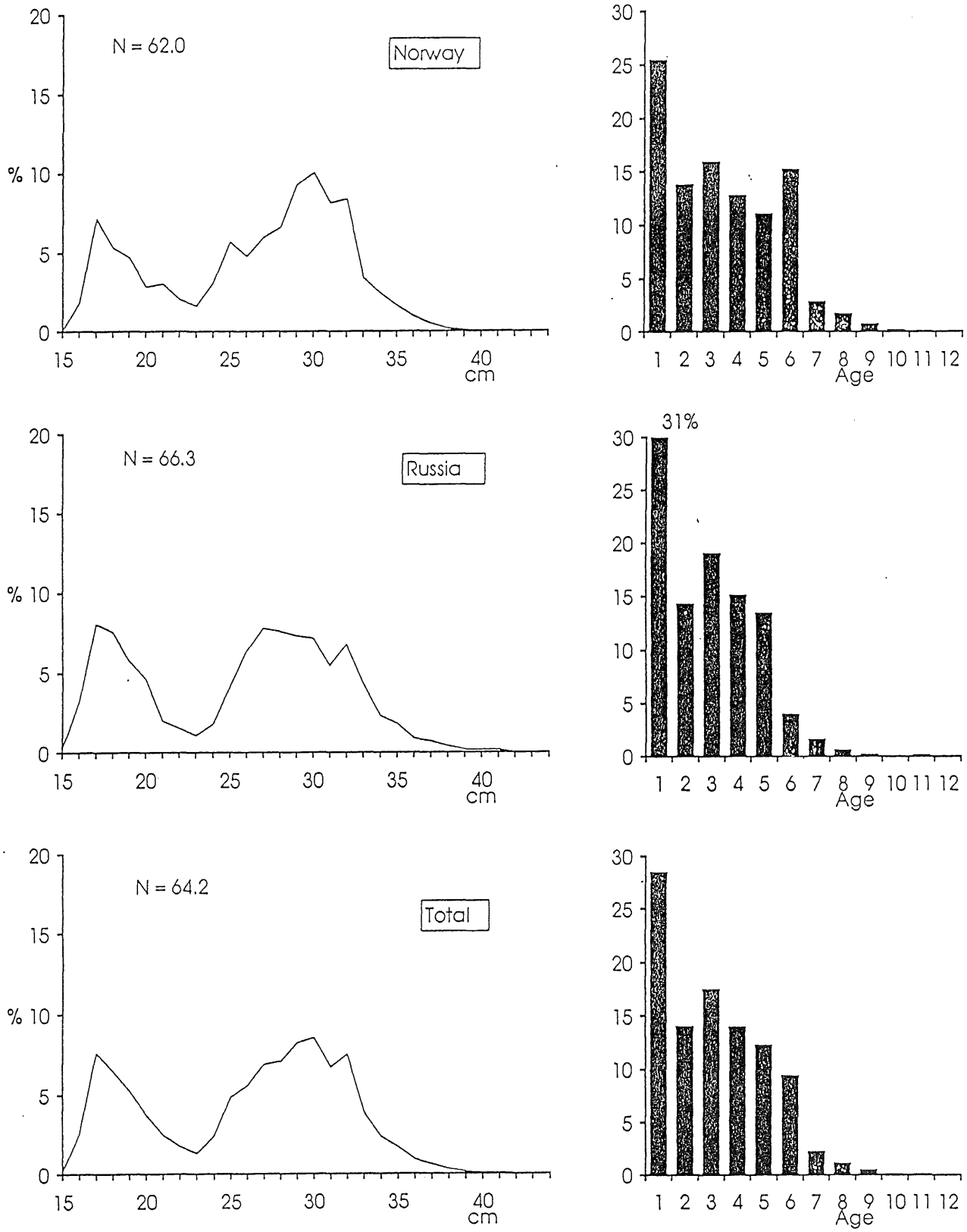


Fig. 6.4.5. Total length and age compositions (N%) of blue whiting to the west of the British Isles, spring 1995, obtained by Norway and Russia respectively and their combined results. N x 10^{-9}, weighted by abundance.

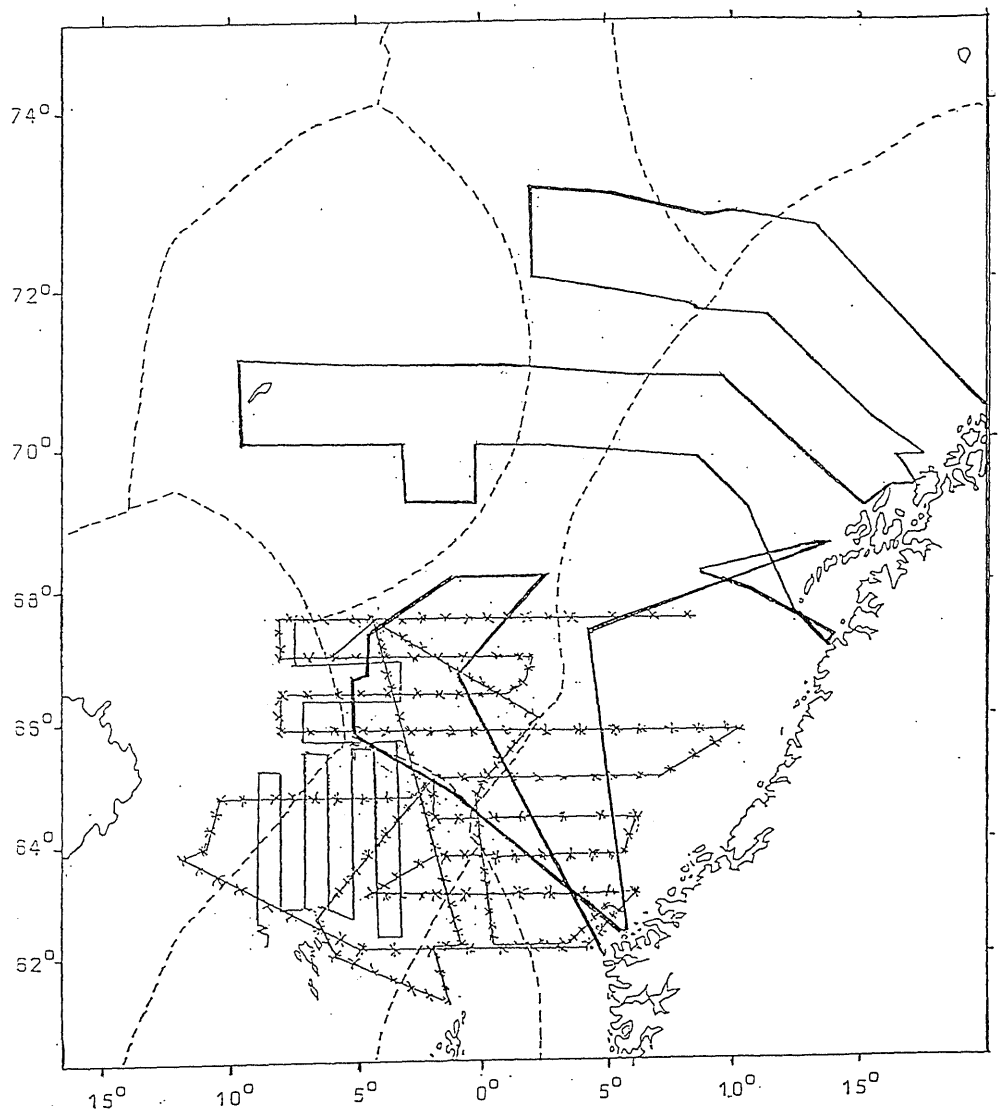


Figure 6.4.6.a.

Cruise tracks June/July 1995.

—— "M. Heinason", ×–×–× "Prof. Marty" —— "G.O.Sars"

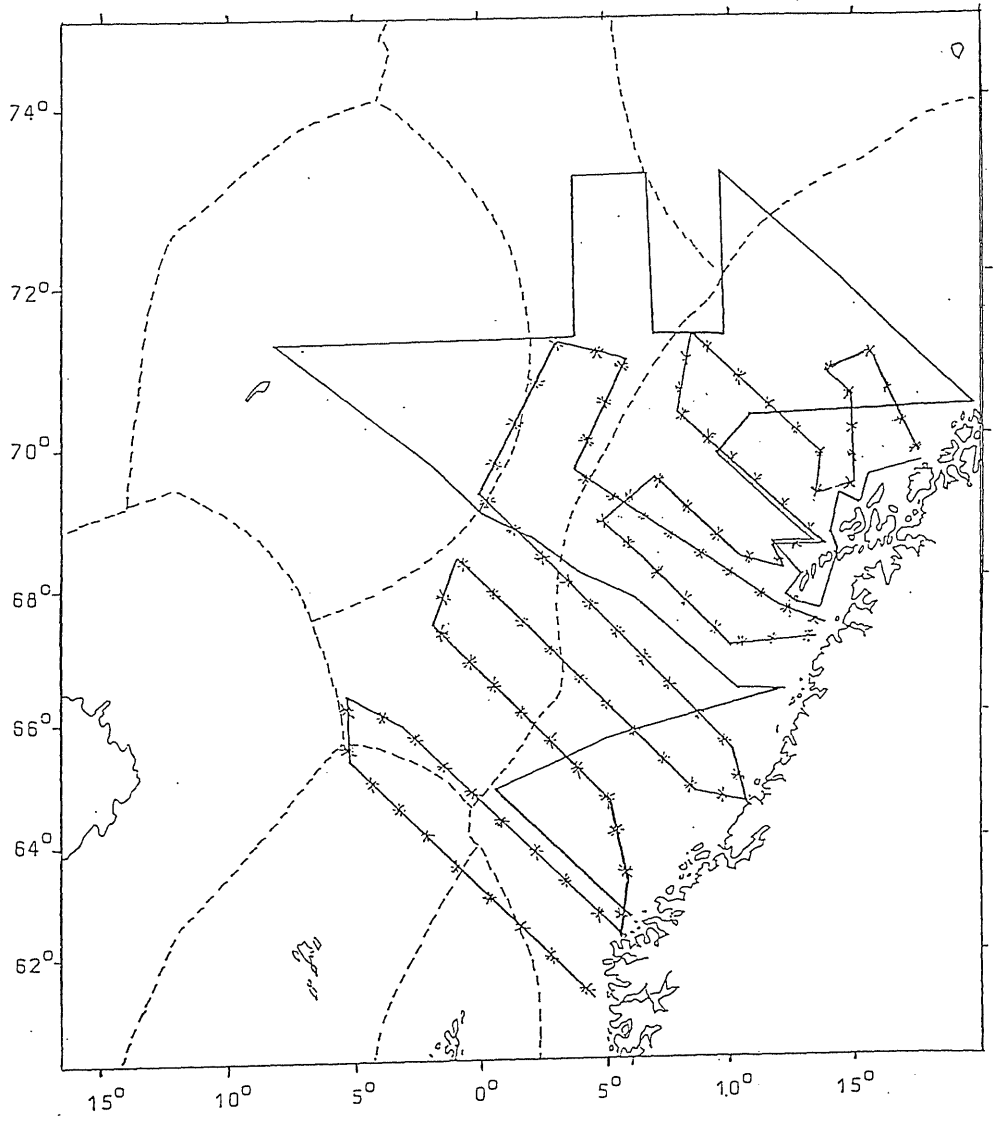


Figure 6.4.6.b.

Cruise tracks July/August 1995

×–×–× "Johan Hjort", —— "G.O. Sars"

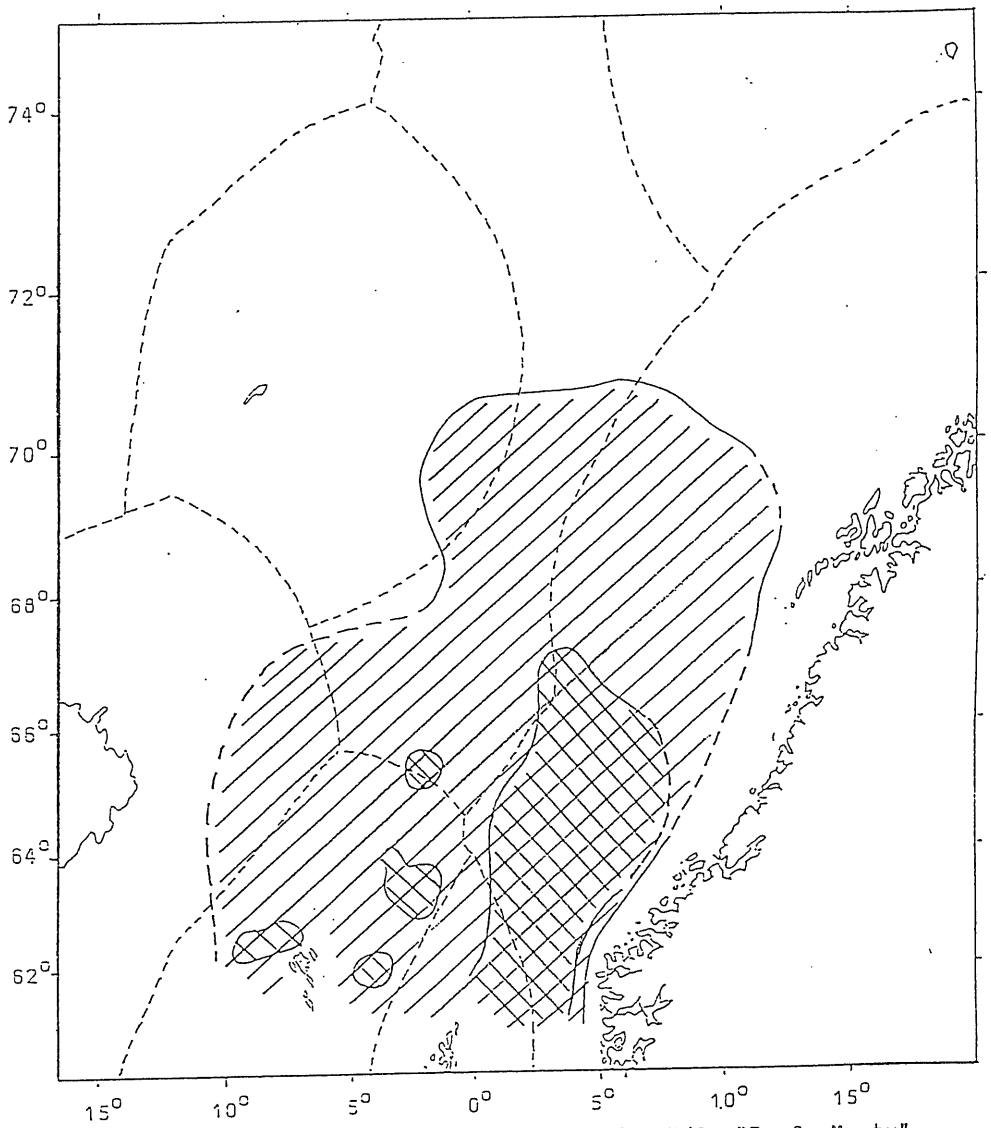


Fig. 6.4.7a. June/July 1995. "G.O.Sars" 26/5-27/6, "Prof. Marty" 6/6-12/7, "M. Heinason" 3/6-21/6. Blue whiting.

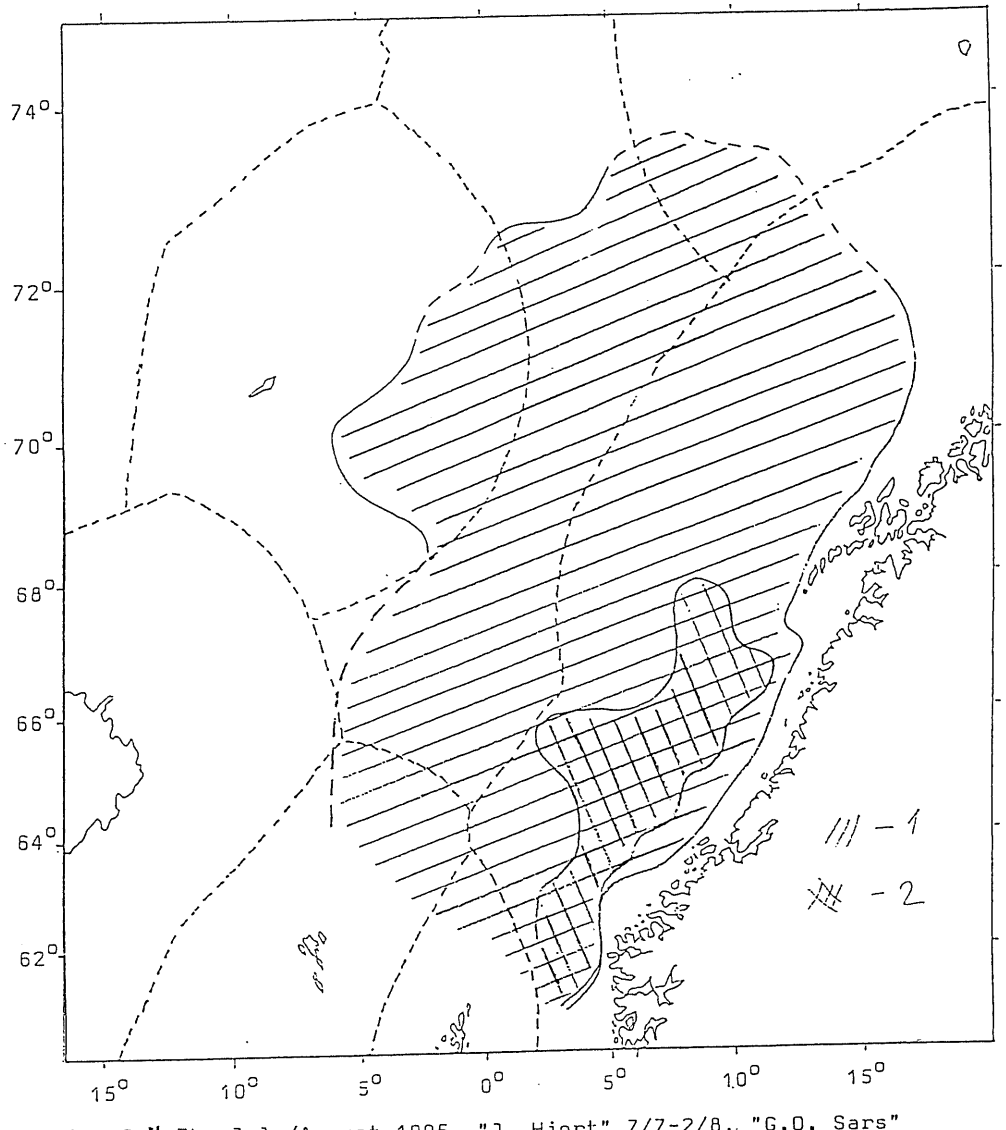
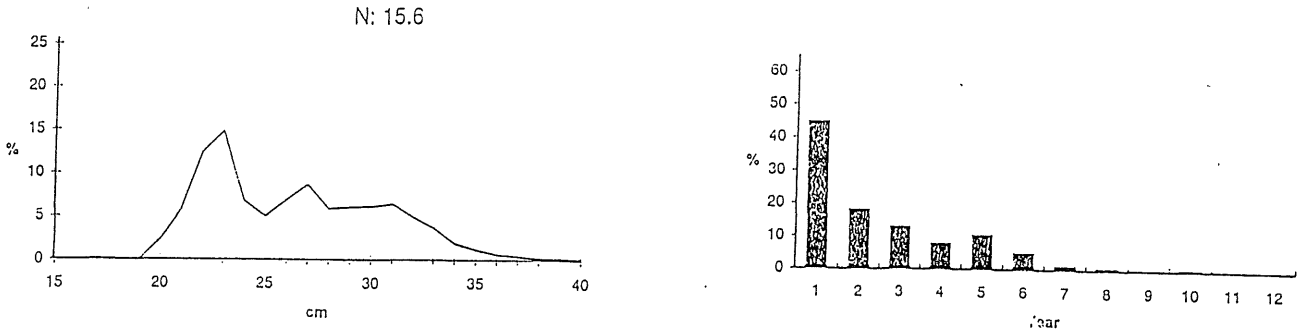
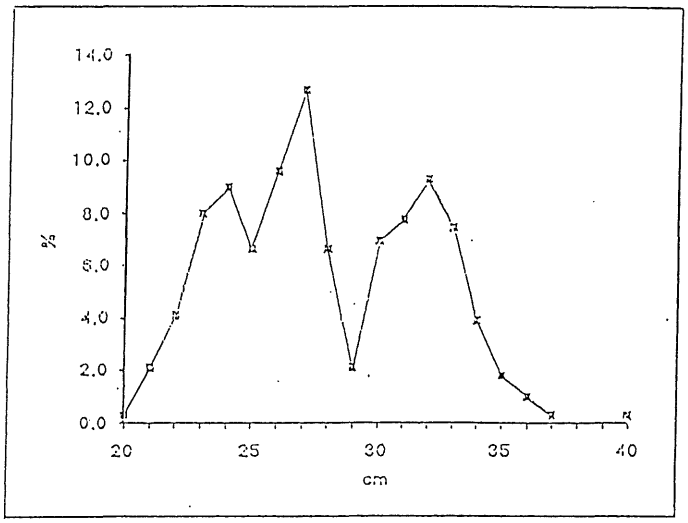


Fig. 6.4.7b. July/August 1995. "J. Hjort" 7/7-2/8, "G.O. Sars" 29/7-15/8. Blue whiting.

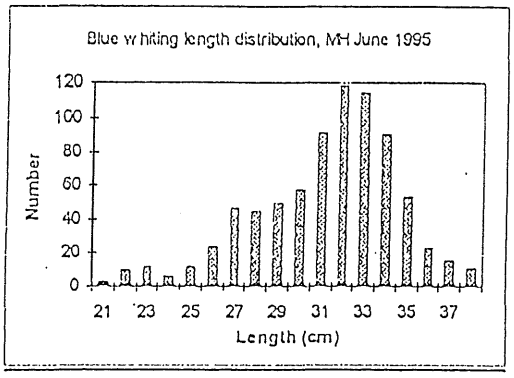
A



B



C



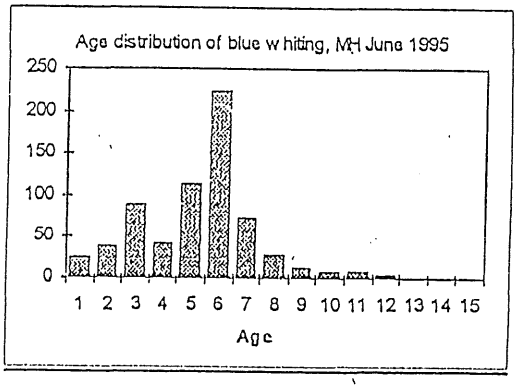


Figure 6.4.8. Length and age distribution of blue whiting in the Norwegian Sea feeding area 1995. A) Norway, B) Russia, C) Faroe Islands.

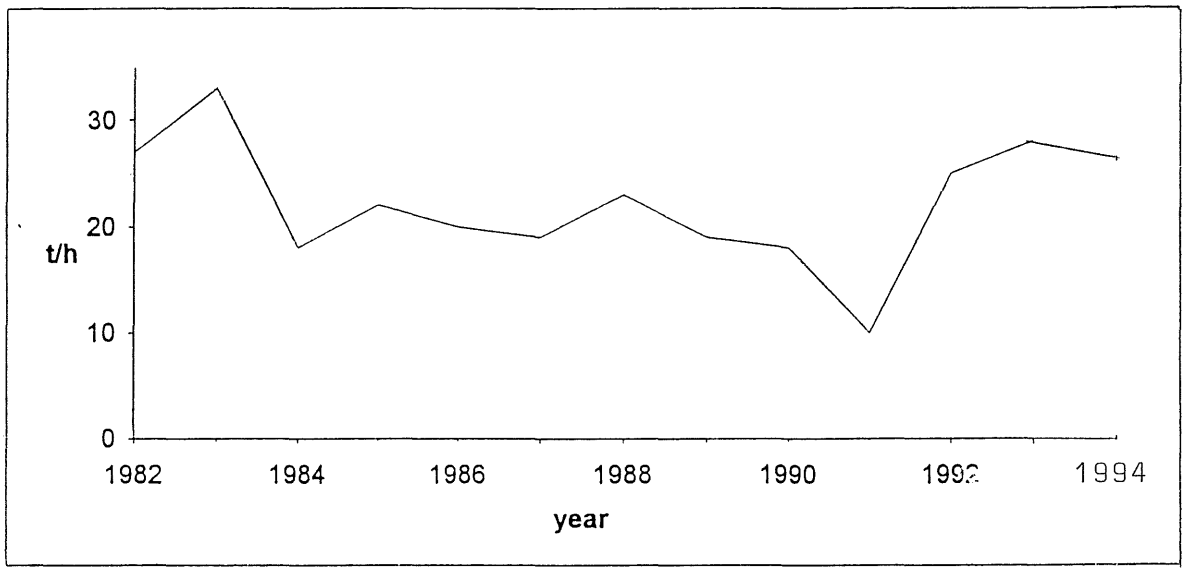


Figure 6.4.9. Blue Whiting. Overall aggregated CPUE from the Norwegian directed fishery 1982-1993 (tonnes/h).

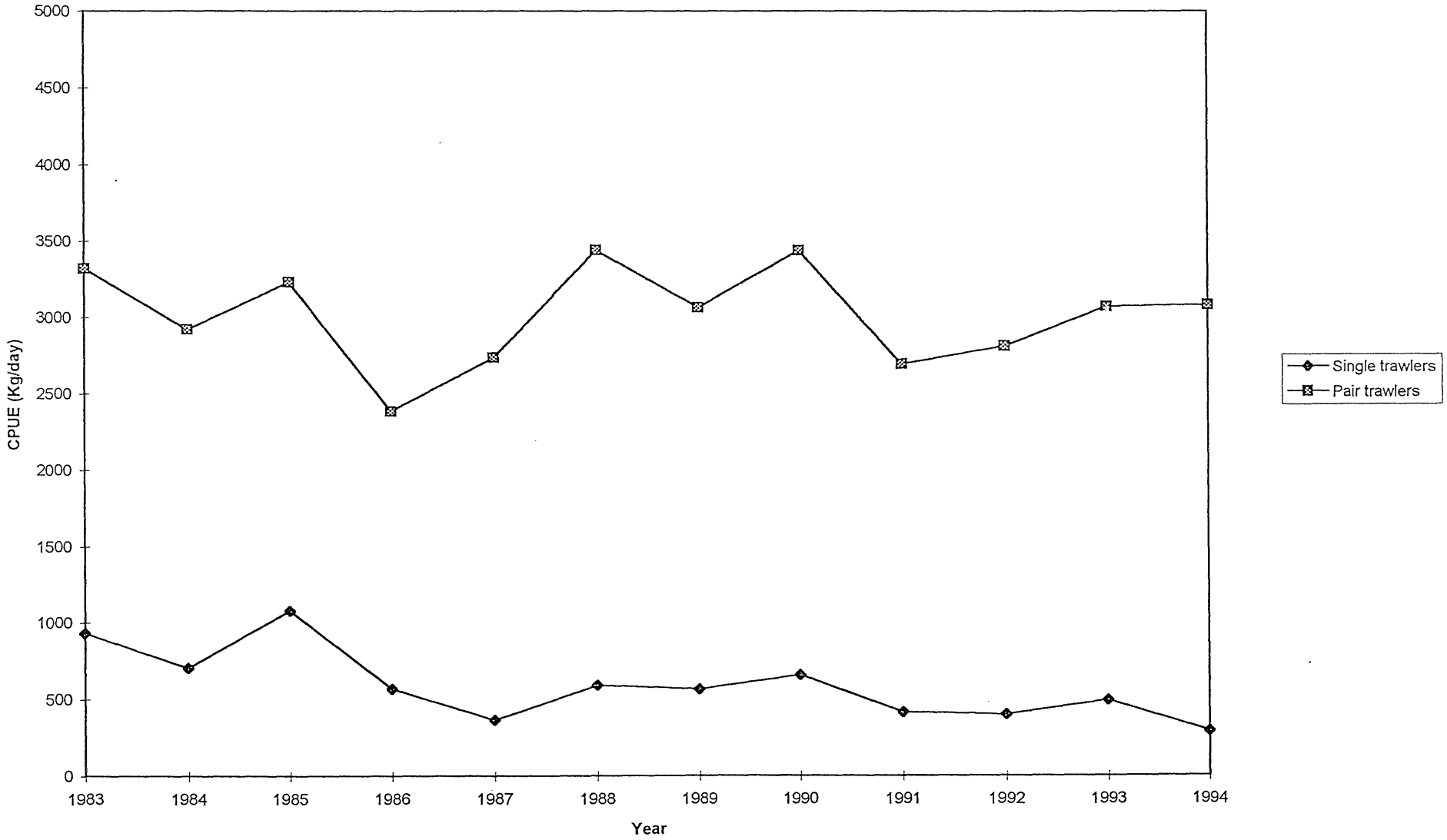


Fig. 6.4.10. Blue whiting CPUE from Galician single and pair trawlers in the southern fishery (Div. VIIc and IXa).

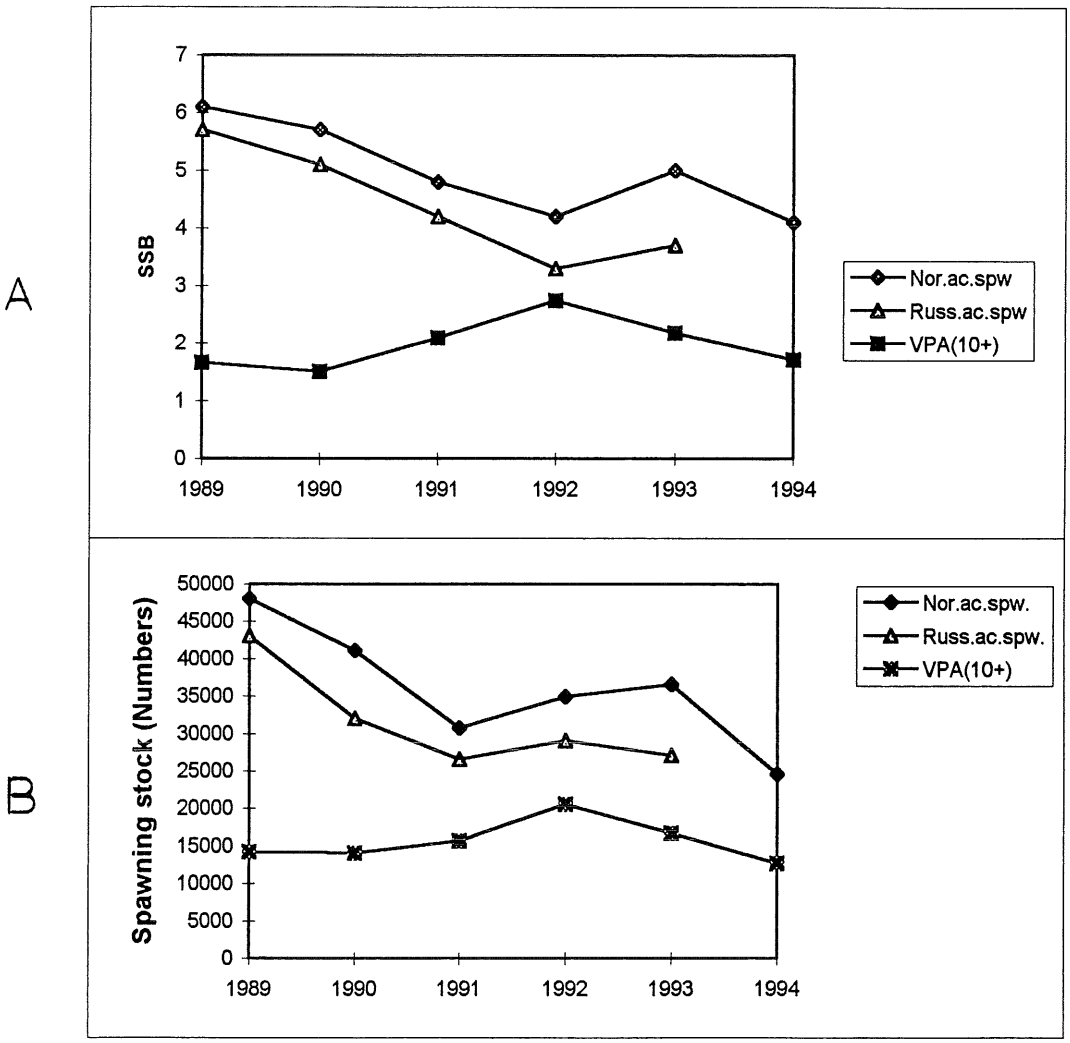


Figure 6.4.11. Blue whiting spawning stock estimates from acoustic surveys and VPA, in biomass and in numbers.

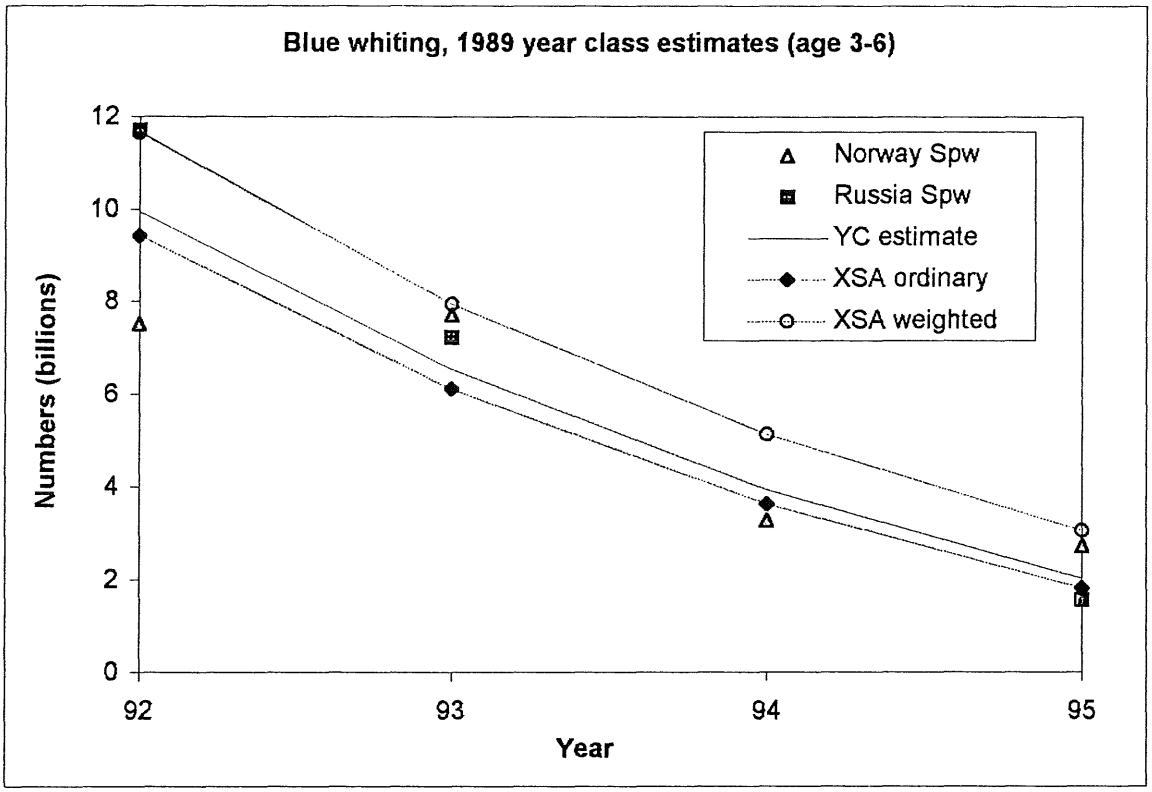


Figure 6.4.12 Blue whiting combined. Different estimates in numbers of the 1989 year class since 1992.

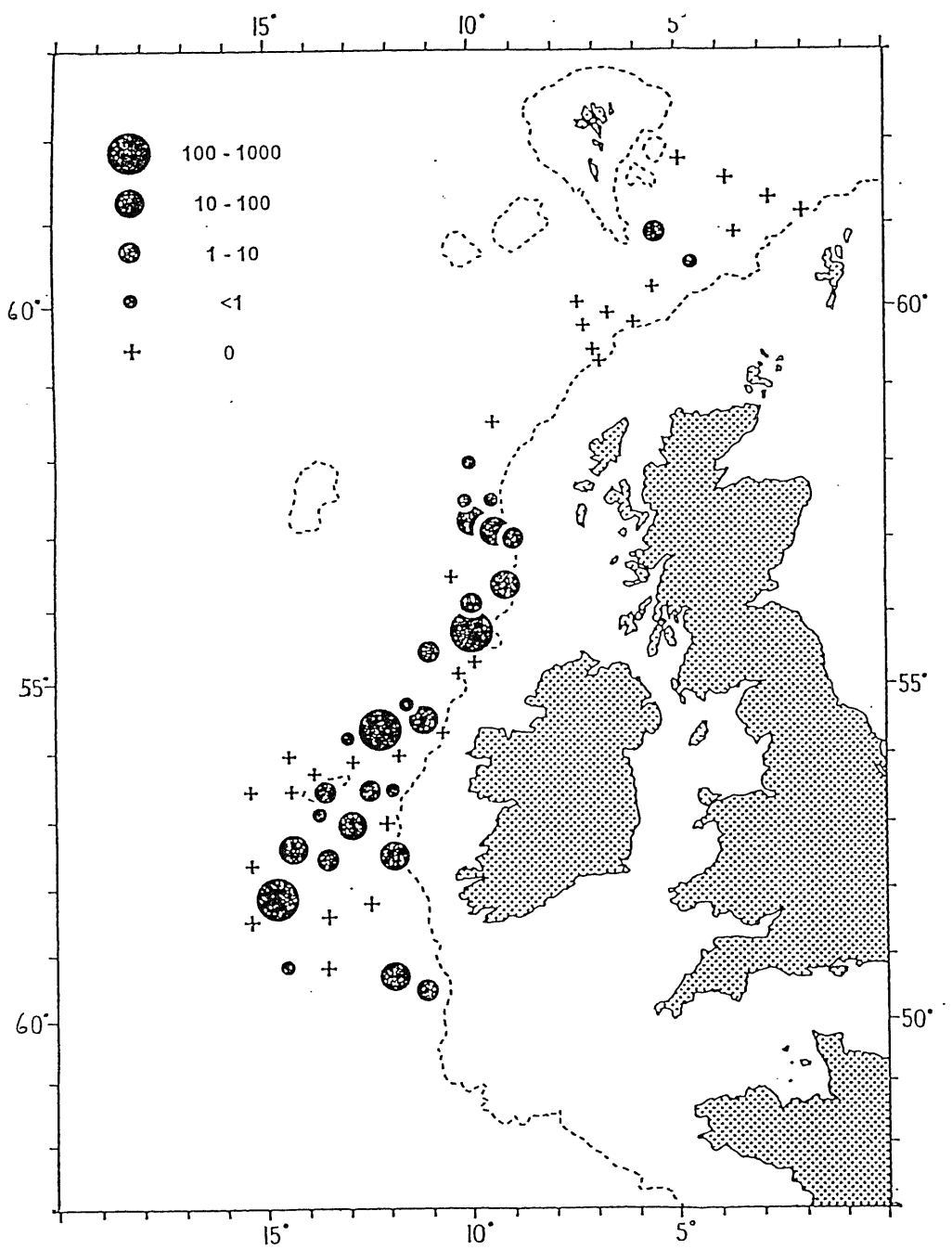


Fig. 6.5.1. Distribution of blue whiting eggs, nm^{-2}, R.V."Johan Hjort" 27 March-17 April 1995.

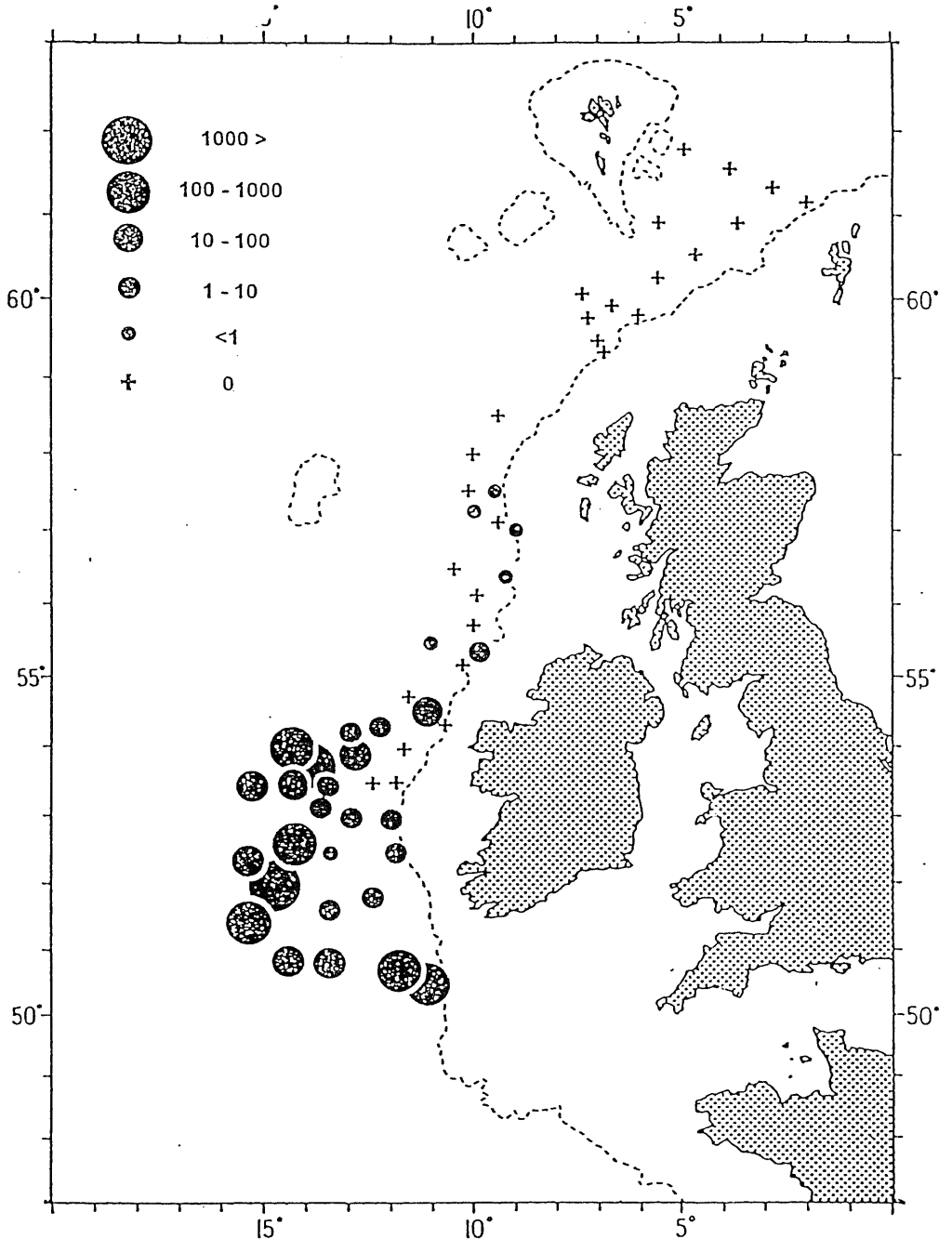


Fig. 6.5.2. Distribution of blue whiting larvae, nm^{-2}, R.V."Johan Hjort" 27 March-17 April 1995.

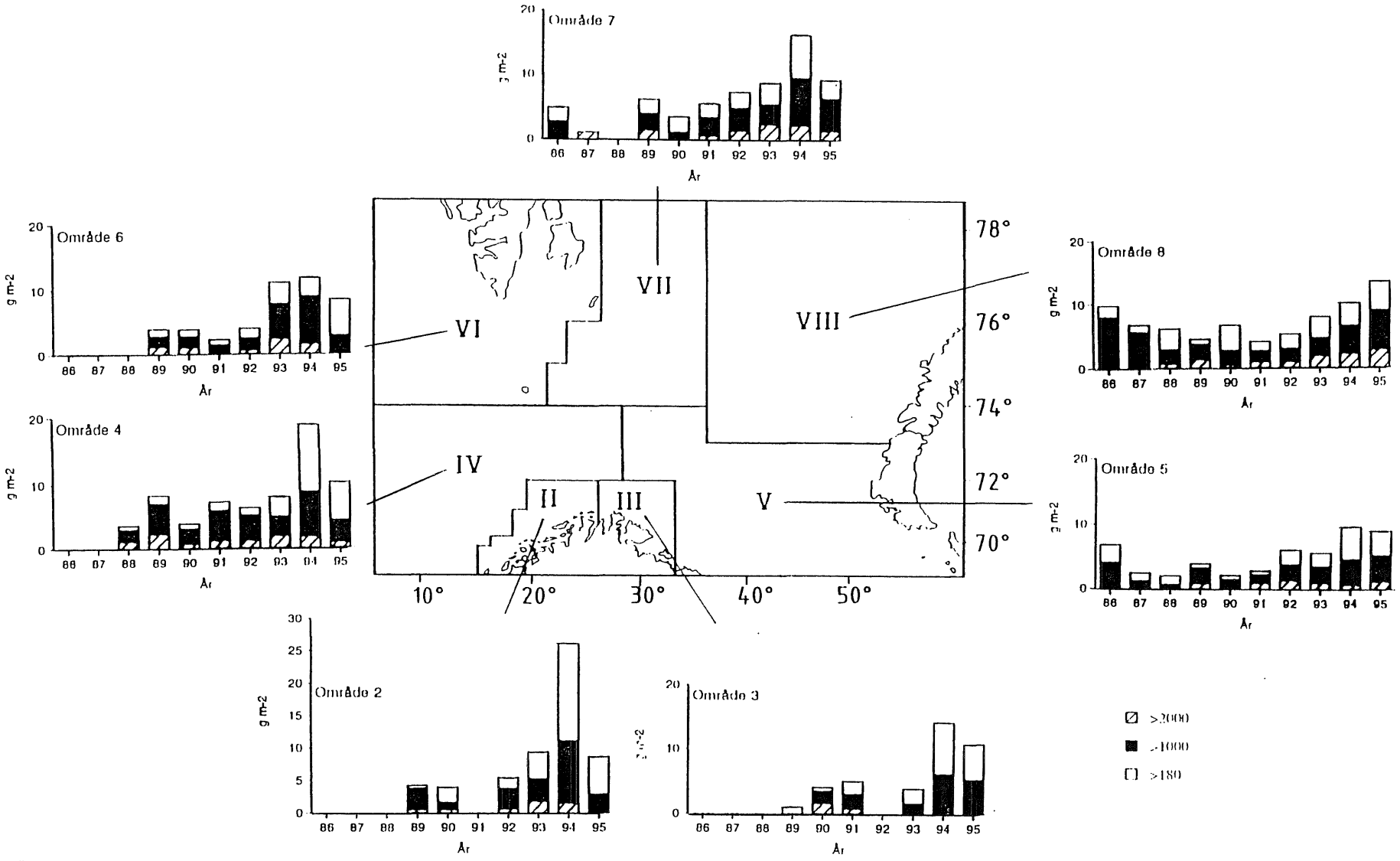


Fig. 7.1. Mean values of size-fractioned biomass of plankton in seven subareas of the Barents Sea in 1986–1995