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International Council for the
Exploration of the Sea

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REPORT OF THE HERRING ASSESSMENT WORKING GROUP FOR THE AREA SOUTH OF 62°N

Copenhagen, 31 March - 10 April 1992

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

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1 INTRODUCTION

1.1 Participants

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1.2 Terms of Reference

The Working Group met at ICES Headquarters from 31 March - 10 April 1992 with the following terms of reference (C.Res.1991/2:7:7):

a) assess the status of and provide catch options for 1993 and, where appropriate, 1994 within safe biological limits for the North Sea autumn-spawning herring stock in Division IIIa, Sub-area IV, and Division VIId (separately, if possible, for Divisions IVc and VIId) and the herring stocks in Division VIa and Sub-area VII;

b) provide data to the Working Group on the Assessment of Pelagic Stocks in the Baltic on stock composition of herring catches in Division IIIa and adjacent areas of Sub-area IV in 1991;

c) provide the data requested by the Multispecies Assessment Working Group;

d) prepare for the transfer of its work to area-based Working Groups, advise how this might be best achieved, and consider what difficulties might arise and how these could be overcome.

A number of additional requests was passed to the Working Group by the Chairman of ACFM before the start of the meeting:

e) to provide advice on the biological justification for a SSB of 2.2 million tonnes as a management objective for the North Sea herring;

f) to make an evaluation of the structure (including catch composition) and implications of the mixed clupeoid fishery in Division IIIa, with particular reference to its impact on the yield from the North Sea herring stock.

1.3 Workshop on Methods of Forecasting Herring Catches in Division IIIa and the North Sea

A Workshop was held in Lysekil from 10 - 13 March 1992 and the draft report was available to the Working Group (C.M.1992/H:5).

In 1991, the Working Group had not been able to allocate predicted catches of North Sea autumn spawners to the North Sea and Division IIIa management areas and ACFM had adopted an *ad hoc* method based on the distribution of catches by age group in recent years. The Workshop considered this to be an inappropriate procedure for long-term use because of changes in fishing pattern in the two areas. As an alternative the Workshop explored the possibility of predicting the actual stock of North Sea autumn spawners in Division IIIa at the beginning of the year, thereby making a choice of options available to managers.This is discussed further in Section 2.8.2.

The Workshop also revised the catch data for Division IIIa for 1989 and 1990. For 1990, however, they concluded that the level of sampling of major sections of the catch was grossly inadequate. To enable assessments involving Division IIIa data to continue, the Workshop made the best use of the few data available but stressed that this new analysis can in no way make up for the lack of samples. They further state that: "... the reliability of assessments using these data is thus permanently impaired".

A further section of the report evaluates the methods of stock separation with particular reference to Division IIIa and the eastern North Sea. A number of promising methods are discussed, notably morphometric analysis and the analysis of daily growth ring patterns in the otolith nucleus but the Workshop concluded that further research is needed before these methods can be put into operational use.

The present Working Group endorsed the conclusions of the Workshop.

1.4 Evaluation of the Working Group on Pathology and Diseases of Marine Organisms (WGPDMO) concerning the Impact of Fungus on Affected Herring Stocks

In the summer of 1991, the parasitic fungus *Ichthyophonus* spp. was shown to occur in herring stocks in parts of the North Sea, Norwegian Sea and in the southwestern Baltic. Available data from June 1991 - February 1992 suggest occurrence of the disease in the following stocks: the North Sea autumn-spawners, Division IIIa-southwestern Baltic spring spawner and the Norwegian spring spawner.

Two areas with high levels of infection can be identified north of 60°N between Shetland and Norway and in Kattegat-southwestern Baltic. Uninfected areas are recognized in the Baltic proper, west of the British Isles, Faroe Islands and Iceland. New information provided by the this Working Group indicated a very low prevalence (< 1%) in commercial catches in the southern North Sea and the Channel area during the 1991/1992 fishing season.

The disease is assumed to be lethal for herring but lack of precise information of prevalence in the infected stocks as well as lack of knowledge of its temporal dynamics prevented the WGPDMO to estimate the mortality caused by the infection.

Based on data from infection on a plaice stock, different levels of additional mortality were calculated by the WGPDMO. This approach was considered justified as available information suggests that the disease is lethal for both species.

With a survival time of 100 days, annual mortality rates ranged from about 20% to 55% with a prevalence of 5-15%. The mortality rates were about half with 200 days' survival.

The WGPDMO reports that studies are currently in progress to determine more accurate prevalence levels and mortality rates. It is recommended that a special meeting be arranged involving stock assessment and disease specialists. The recommendation is endorsed by this Group. It is recommended that this meeting should be held prior to the ACFM meeting in November in order to have the opportunity, if needed, to revise the stock estimate and prognosis before 1993.

1.5 Evaluation of the Draft Report of the Study Group on Age Units in Herring

A draft report was presented by the Study Group on Age Units in Herring. This report described the problems that were related to the use of rings instead of years when defining the age of herring.

The convention of defining herring age rings instead of years was introduced in various ICES working groups around 1970. The main argument to do so was the uncertainty about the racial identity of the herring in some areas. A herring with one winter ring is classified as 2-years-old if it is an autumn spawner, and one-year-old if it is a spring spawner. Recording the age of the herring in rings instead of in years allowed scientists to postpone the decision on year of birth until a later date when they might have obtained more information on the racial identity of the herring.

The use of winter rings in ICES working groups has introduced a certain amount of confusion and errors. In specifying the age of the herring, people always have to state explicitly whether they are talking about rings or years, and whether the herring are autumn- or spring spawners. These details tend to get lost in working group reports, which can make these reports confusing for outsiders, and even for herring experts themselves. As the age of all other fish species (and of herring in other parts of the world) is expressed in years, one could question the justification of treating West-European herring in a special way. Especially with the present trend towards multispecies assessment and integration of ICES working groups, there might be a case for a uniform system of age definition throughout all ICES working groups.

However, the change from rings to years would create a number of practical problems. Data files in national laboratories and at ICES would have to be adapted, which would involve extra costs and manpower. People that had not been aware of the change might be confused when comparing new data with data form old working group reports. Finally, in some areas (notably Division IIIa), the distinction between spring- and autumn spawners is still hard to make, and scientists preferred to continue using rings instead of years.

The Working Group discussed at length the various consequences of a change from rings to years. The majority of the Group felt that the advantages of such a change did not outweigh the disadvantages, and it was decided to stick to the present system for the time being.

It was agreed that in the introduction of each working group report, there should be a statement that the ages used throughout the report were based on rings and not on years. The use of the names of 0-group, 1-group, etc. should be discouraged, as this could give rise to further confusion.

2 NORTH SEA HERRING

2.1 The Fishery

2.1.1 ACFM advice applicable for 1991

The 1990 ACFM meeting recommended for the total North Sea and Divisions VIId a TAC of 327,000 t to 372,000 t in 1991, depending on the level of the catches in 1990.

The agreed TACs adopted by the management bodies in December 1990 were: Divisions IVa,b: 342,000 t; Divisions IVc and VIId: 30,000 t. In May 1991, ACFM provided a new advice for the total TAC of 503,000 t, including a TAC of 50,000 to 60,000 t for Divisions IVc and VIId.

The agreed TACs were revised in July 1991 and were set at 370,000 t for Divisions IVa,b and 50,000 t for Divisions IVc and VIId.

It was additionally recommended that existing regulations designed to protect juvenile North Sea herring (sprat box closures, 20 cm minimum landing size, by-catch regulations) should be maintained and enforced more rigidly, that spawning area closures in Division IVb should be maintained and that the TAC for mixed clupeoids in Division IIIa should be reduced to zero.

2.1.2 Catches in 1991

Total landings for 1991 are shown in Table 2.1.1 for the total North Sea, and for each division in Tables 2.1.2-2.1.5.

The catch in 1991, at 566,000 t is very close to the one of 1990, and lower than in the years 1987-1989 (674,000 t on average). However, the 1991 catch still represents a 147,000 t overshot of the total TAC.

As in previous years, Norwegian catches of Norwegian spring spawners in the North Sea were removed.

Like in recent years, catches of autumn-spawning herring have been reported by the Faroese fleet in Division Vb. These catches amounted to 5,334 t in 1990 and 16,000 t in 1991. Based on length-at-age data, these fish look very similar to North Sea herring. However, it is not quite clear whether they belong to the North Sea stock or to the Division VIa North stock. So, as in previous years, these catches were not included in the North Sea assessment.

The Netherlands catches included an additional estimate for discards. Discards are recorded separately (Tables 2.1.1-2.1.5). The total amount of North Sea herring discarded at sea is probably underestimated. However, a Danish experiment presented at the meeting, and other information collected since the previous meeting show that the current level of discards might not exceed 15% of the landings.

In Divisions IVc and VIId, the estimated catch of 60,685 t remains at the same level as in 1990. This catch still constitutes an overshot of the revised TAC for that area (50,000 t). It includes an estimated discard of 2,262 t and a catch of 252 t of spring spawners (in the Thames area fishery). The total catch of spring spawners in that area is likely to be higher as French trawlers catch some hundred tonnes of stages IV-VI fish in Division VIId, and Dutch trawlers some in Division IVc. However, a correct estimate of those catches would require a sampling effort disproportionate to their level and impact in the assessment.

2.2 Catch Composition

2.2.1 Catch in number and weights at age

Quarterly and annual catches in numbers and mean weights at age were compiled for each Division and for the total North Sea. Table 2.2.1 provides a breakdown of numbers caught by age group for each division on a quarterly and annual basis. Table 2.2.2 presents a comparison of total North Sea catches in numbers at age over the years 1971-1991.

The numbers of 0-, 1- and 2-ringer North Sea autumn spawners caught in Division IIIa were estimated for 1990 and 1991. [The 1990 estimate was not available at the 1991 meeting (see Sections 1.3 and 3.2.3)]. Therefore, Table 2.2.3 was updated and the assessment includes Division IIIa catches of North Sea autumn spawners.

The total catch in number in the North Sea in 1991 of 5.5 billions was 8% higher than in 1990. The mean for the year 1987, 1988 and 1989 was 7.9 billions against 5.3 billions, as an average for the two last years (Table 2.2.2).

The contribution to the catch in numbers of young herring was much higher than in 1990. The number of 0-ringers is close to the average figure for the years 1987-1988, but the number of 1-ringers is the lowest since 1985, probably due to the weakness of the 1989 year class. 0- and 1-ringers account together for 52% of the catch in number.

The 1985 year class has become less dominant in the catches. However, the catch in number of 5-ringers was the highest recorded since 1970 (Table 2.2.2), and it accounted for 9% of the total catch in number compared to an average of 4% for the years 1987-1990.

The bulk of the juvenile fish was caught in Division IVb in the quarters 3 and 4. Among adult fish, the highest proportion of 2-ringers was also taken in Division IVb (Table 2.2.4).

The SOP by age and division for each quarter is given in Table 2.2.5.

Because of improved sampling of industrial catches, separate age compositions have now been calculated for the human consumption fishery and the small-mesh industrial fishery. The results of this are presented in Table 2.2.6.

2.2.2 Quality of catch and biological data

Table 2.2.7 shows a breakdown of the sampling schemes of landings by divisions. As in 1990, there are some gaps in the biological data; however, some improvements have been achieved, and the problem of access to the landed fish seems to have been reduced. Nevertheless, the sampling of some countries in some quarters has still been very low.

In order to estimate the age composition of the total catch, the numbers at age of the unsampled landings were calculated from the sampling by countries assumed to have similar fleets. The data of some countries have been used to estimate the age composition of unsampled landings of a similar order of magnitude than their own landings.The bias so introduced in the catch-at-age data is not thought to be very serious, however, some enhancement is still required and some international coordination might allow a better allocation of sampling effort. The Working Group still requests all countries whose annual landings are not negligible, to schedule sampling of commercial landings in the current year.

In some countries independent estimates of catches are made by fisheries scientists and these figures have been used in this report; however, in other countries no independent estimates are available and official landing figures are used.

2.2.3 Treatment of spring-spawning herring in the North Sea

Norwegian spring spawners are taken close to the Norwegian coast under a separate TAC. These catches are not included in the catch tables. Coastal spring spawners in the southern North Sea are caught in small quantities most years. These catches are given in Tables 2.1.1 and 2.1.5. With the exception of 1990, these catches are included in the assessment of North Sea autumn spawners.

Baltic and Division IIIa spring spawners are taken in the deeper parts of the eastern North Sea during their summer feeding migration during summer. These catches are included in Table 2.1.1. The table specifies the estimated amount of Division IIIa/Baltic spring spawners which are transferred from the North Sea assessment to the assessment in the Baltic. The methods for separating these fish from North Sea autumn spawners are described in former reports from this Working Group and in *Anon.* (1992).

The 1991 Working Group estimated the fraction of spring spawners fsp $(56.50-\bar{v})/0.7$, where $\bar{v}$ is the mean vertebral count of the (mixed) sample. The method requires that the two components have mean counts close to 56.50 and 55.80, respectively, in all samples. The method is quite sensitive to within-stock variations (like between year classes) of mean vertebral counts, and severe reservations against the method were expressed during the 1991 Working Group meeting.

Several meristic samples from the 1991 summer acoustic survey were split by using this simple formulae, by modal length analysis and by splitting the vertebral count distribution. The latter methods are reviewed by Anon., (1992). The results are shown in Table 2.2.8. As the various meristic samples were available to the Working Group in different formats, applying the simple formulae was the only way of making use of all the samples. As Table 2.2.8 shows, there is a reasonable agreement between the methods, and the simple procedure was accepted.

Figures 2.2.1-2.2.3 show mean vertebral counts by age group and by rectangle during May, June and July 1991. The transfer area defined from meristic samples in previous years is indicated. The presence of spring spawners in the south eastern part of the transfer area is evident from the low vertebral counts. None of the samples indicated any spring spawners among the 0- and 1-ringers in any month.

In July, spring spawners seem to occur somewhat north of the transfer area. When comparing the distribution of catches during these months (Figures 2.10.5-2.10.7), it seems reasonable to apply the same transfer area for all months. The meristic sampling in August and September was too scarce to verify the presence of spring spawners in the most important rectangles of the transfer area. In previous years the sampling has indicated that these spring spawners leave the North Sea during late September.

All meristic samples within the transfer area each month were combined. The resulting proportion of spring spawners and the monthly catches in the transfer area are as follows:

	Proportion (%)				No. of	Catch in
Month	2-ring	3-ring	4-ring	5+ring	rectangles sampled	transfer area (t)
May	38	24	46	70	4	4,858
Jun	14	52	67	62	7	5,190
Jul	24	75	82	67	12	2,883
Aug	57	96	99	100	1	1,286
Sep	-	-	-	-	0	2,385
Q2	26	38	57	66	11	10,048
Q3	34	81	87	77	13	6,554

The table above also shows average proportions by quarter (weighted by monthly catch).

The quarterly age distributions in Sub-division IVa East as applied to the catches in the part of the transfer area belonging to that Sub-division (4,731 t in quarter 2 and 2,563 t in quarter 3). Number of spring spawners by age were obtained by applying the estimated proportion by age.

The quarterly age distributions for the total Division IVb, were not considered representative for the southern part of the transfer area. In this case, research vessel samples from late June were used for the catches in quarter 2 (4,317 t) and research vessel samples from late July for catches in quarter 3 (3,991 t).

The resulting catch in number of spring spawners by age is shown in Table 3.1.1. The total amount of spring spawners transferred is 7,894 t.

2.3 Recruitment

2.3.1 Relationship between IYFS indices and VPA

In last year's report mention was made of the possible application of the General Linear Model (GLM) analysis to the IYFS data. Whereas this approach was further pursued this year (Section 2.3.8), some problems remained, and it was decided for this year to base the recruitment predictions on the traditional regressions.

The traditional regression of VPA estimates of 1-ringers on IYFS indices of the same year classes was updated (Table 2.3.1), using the 12 most recent years for which reliable VPA estimates were available (1977-1988). Year classes prior to 1977 have been disregarded because of possible time trends in efficiency of the survey gear. The scatter plot and fitted regression line are shown in Figure 2.3.1. For prediction purposes, the equation is forced through the origin:

$$y = 0.0064x$$

where x is the IYFS index (no./hour in the standard area) and y is the VPA estimate of 1-ringers in billions.

Indices for 2-ringers from the IYFS have not been used so far in predicting recruitment. The reason for this is the strong variation in catchability of 2-ringers during the surveys, as demonstrated in the 1989 report of this Working Group (*Anon.*, 1989a).

The use of IYFS indices for 3-ringers and older to estimate the spawning stock size is discussed in Section 2.7.

2.3.2 Relationship between MIK indices and VPA

In 1992, most countries in the IYFS deployed the recommended Methot Isaacs-Kidd (MIK) trawl instead of the traditional IKMT. The MIK has a fixed opening and a sampling efficiency close to 100% (P. Munk, pers. comm.). This sampling gear thus allows an absolute estimate of abundance to be made. The results of the MIK sampling are converted into a total abundance of herring larvae, expressed in billions, for North Sea and Division IIIa combined.

Comparative fishing experiments with MIK and IKMT indicated that the IKMT catch rates, given in numbers/min., are approximately equivalent to numbers/cubic meter x 300. This factor has been used to convert the historic series of IKMT indices into absolute abundance estimates. The new series for various sub-areas of the North Sea and Division IIIa is shown in Table 2.3.2, and the combined series for the whole survey area is compared with VPA estimates of 0-ringers in Table 2.3.3.

A new regression was calculated for the new series of abundance estimates, covering year classes 1976-1988. The scatterplot and regression line are shown in Figure 2.3.2. The slope is different from 1, probably due to underestimation of 0-ringer mortality in the VPA calculations. For predictive purposes, the regression line is forced through the origin:

$$y = 0.422 x$$

The scatter of points around the regression line is rather wide, and the predicted values have wide confidence limits.

2.3.3 Recruitment forecast for the 1989 year class

The final IYFS for this year class as 1-ringers was 2433. In last year's report a preliminary index of 2485 was used. The predicted VPA estimate of 1-ringers based on the final index is 15.57 billion (compared to a provisional estimate of 16.1 billion used last year).

The acoustic survey in July 1991 also provided an estimate of 1-ringer abundance in the North Sea and in Division IIIa. However, this survey was aimed at adult herring, and most of the distribution area of 1-ringers was poorly sampled. It was decided, therefore, not to use the acoustic estimate of 1-ringers in 1991 for prediction purposes.

2.3.4 Recruitment forecast for the 1990 year class

The preliminary index of 1-ringers in the standard area during the 1992 IYFS is 2339. This index is based on length data from all participating countries, and age/length keys from 4 countries. Using the new regression, this year class is estimated at 14.97 billion.

The previous estimate for this year class, based on the IKMT index in 1991, was 21.0 billion as 0-ringers.

Using the new estimate for 1-ringers in February 1992, and applying to this the catches of 0-ringers in 1991 (2.3066 billion), the revised estimate for this year class as 0-ringers is 44.52 billion. Fishing mortality on this age group in 1991 is estimated at 0.09.

2.3.5 Recruitment for the 1991 year class

The MIK index for this year class (200.7) is the second highest in the revised historical series (Table 2.3.2). Using the new regression, the size of the year class as 0-ringers in the VPA is estimated at 84.70 billion. As the MIK index is near the limit of the range of values used in the regression, the confidence limits on the predicted value are very wide and the estimate should be regarded as uncertain.

2.3.6 Trends in recruitment

The distribution as 0-ringers of the three most recent year classes is shown in Figure 2.3.3.

The time series of 1-ringer recruitment from 1970 to the present is shown in Figure 2.3.4.

2.3.7 Projection of recruitment in the North Sea and Division IIIa

To provide a means of estimating the number of 1-ringers in the North Sea and Division IIIa, respectively, the IYFS data for each of these two areas have been treated in the same way. The mean number in each rectangle sampled was multiplied by the proportion of sea area in that rectangle and the values for all sampled rectangles summed. This value was then raised to the total sea area (including unsampled rectangles). The comparable estimates are given for 1983-1992 in Table 2.3.4. These show that the proportion of the total population of 1-ringers in Division IIIa increased during the 1980s and that it has now decreased to a lower level (25% in 1992). In Section 2.8, the proportions have been applied to the VPA estimates of 1-ringers to obtain estimates of the number of 1-ring autumn spawners in the two management areas.

It should be noted that IYFS catches of 1-ringers in Division IIIa contain a proportion of Baltic spring spawners. The proportion was estimated by previous Working Groups to be 28% in 1983 and 46% in 1984, but the stock separation procedure proved to be unreliable for 1-ringers over the years 1985-1989. In 1990, the whole 1-ringer index was allocated to autumn spawners. However, mean vertebral counts in 1991 indicated that the IYFS index in Division IIIa included an increased proportion of spring spawners compared with 1990. For 1992, the split is unreliable and it has been assumed that the 1-ringers are autumn spawners (Section 3.4.2). The proportion of 1-ringers in Division IIIa in Table 2.3.4 must, therefore, be considered as overestimates for some years. In recent years it is likely that most were autumn spawners, however.

2.3.8 GLM-analysis of IYFS data

At last year's meeting, the use of the GLM-analysis on herring catches from IYFS was discussed and described in the 1991 Working Group report. The regression of GLM-indices to VPA differed from the regressions where the standard index was used, and their predictions of the 1987-1989 year classes were very different.

Last year's analysis indicated that the major cause of the discrepancy between the two indices was the log-transformation of the data for use in the GLM-analysis. Analysis of the distribution of sizes of the catch has shown that a log-transformation of data is appropriate. This aspect has been investigated further at the present meeting.

A comparison is made between an index based on the standard method (mean of catches within rectangles and the mean of these) with data untransformed and log-transformed. This is done for the standard area and for the total area sampled (Table 2.3.5).

These four indices, and the GLM-index, are then used in regressions to the VPA, either linear or on a log-log scale (Figure 2.3.5 and Table 2.3.6). From the results it is obvious that the log-transformation of catch data has significant influence on regressions and predictions. Except for the "untransformed" standard index, a log-log regression resulted in higher R-squares. The predictions, when using log-transformed data, were in general lower than with the untransformed data, but it is not clear to what extent this is due to a bias introduced by the transformation. The Working Group recommends that this should be investigated by the Workshop on the Analysis of Trawl Survey Data.

2.4 Acoustic Surveys

2.4.1 Northern and central North Sea (Divisions IVa,b) and Division IIIa summer survey

The 1991 acoustic survey of the North Sea and Division VIa was carried out by vessels from Norway, the Netherlands and Scotland over the period 13 June - 1 August (Simmonds *et al.*, Working Paper, 1992). In addition, a survey of Division IIIa was carried out by Denmark from 23 July to 11 August. This survey extended into the eastern North Sea. However, since it was carried out rather later than the other surveys, only the results for Division IIIa was used by the Working Group (see Section 3.3).

The coverage of the survey in 1991 was reasonably complete and no especial difficulties were experienced in allocating the echointegral to species. An area of the North Sea covered by more than one vessel gave estimates of herring biomass differing by only 7% between vessels for the total overlap area, and 17% and 23% for two different halves of the overlap area.

The results of the survey are given in Table 2.4.1 for autumn spawners and in Table 2.4.2 for Baltic/Division IIIa spring spawning, respectively. The total estimate of 1.87 million t for Divisions IVa and IVb combined compare with an estimate of 2.17 million t in 1990 (Table 2.4.3).

The proportion of 2- and 3-ringers mature on the 1991 surveys were 79% and 98%, respectively, which is rather close to the proportions in 1990. The average survey date in the main area of distribution was about 15 July.

To make the spawning stock estimate from the acoustic survey comparable to the estimate from the VPA, the catches of mature autumn spawners taken between the average survey date (15 July) and the date when 67% of the annual fishing mortality is reached should be deducted. In the VPA run it is assumed that 67% of the annual fishing mortality is reached prior to spawning. According to Figure 2.10.13, the 67% catch date is about 15 September and 35% of the annual catch is taken between 15 July and 15 September. The catch taken in this period is 194,174 t, from which an estimated catch of 4,720 t of spring spawners (Section 2.2.3, text table) is deducted, giving a total catch of 189,454 t. The adult part of this catch in the third quarter is 69.3% by weight (Table 2.2.5) or about 131,000 t. Applying this value to the acoustic figure, the spawning stock estimate is reduced to 1,743,000 t.

2.4.2 Acoustic winter survey in Division IVb (east of 3°E) and Division IIIa

During 23 November - 6 December FRV "G.O. Sars" covered these areas. Table 2.4.4 shows estimates of herring and sprat by age group and area. The very low estimates in Skagerrak are likely to be an underestimate due to the lack of trawl samples along the Danish coast. Based on the trawl catch composition, herring and sprat represented 75% of the echo integrator values of fish in Division IVb, 2% in the Skagerrak and 68% in the Kattegat. The sprat estimates are somewhat higher than during previous years.

Estimates of 0- and 1-ringed herring are compared to earlier years in the text table below. The 0-ringer estimate in Division IVb is the highest in the time series, while that in Division IIIa is the second lowest. The 1-ringer estimate in Division IIIa is very low.

Survey year	Division IVb (E of 2°E)		Division IIIa		Total	
	0-ringers	1-ringers	0-ringers	1-ringers	0-ringers	1-ringers
1985	3,723	153	5,814	574	9,537	727
1986	4,098	2,431	6,513	489	10,611	2,920
1987	3,792	1,986	10,192	3,619	13,984	5,605
1988	1,495	297	2,527	2,803	3,752	3,100
1989	984	554	(224)	(375)	1,208	929
1990	3,949	568	463	686	4,412	1,254
1991	6,405	715	287	65	6,692	780

2.5 Herring Larvae Surveys

2.5.1 Herring larvae surveys in 1991/92

The results of the herring larvae surveys were presented in a working document (Hopkins, Working Document, 1992). The Netherlands, Scotland and Germany participated in the surveys in 1991/1992. The decrease in effort continued, as illustrated in the text table below:

Year	Number of samples
1986/1987	2,040
1987/1988	1,978
1988/1989	1,886
1989/1990	1,672
1990/1991	1,005
1991/1992	931

Of the 931 samples taken in 1991/92, 738 were taken in the North Sea areas.

2.5.2 Larvae production estimates

The sampling periods recommended in *Anon.*(1990) for the calculation of larvae production estimates (LPE) are compared with the available samples below:

Area	Recommended period	Available samples	(n)
Buchan	15/09 - 07/10	18/09 - 23/09	(58)
Orkney/ Shetland	10/09 - 30/09	12/09 - 23/09	(115)
		10/09 - 12/09	(62)
		16/09 - 25/09	(76)
Central North Sea	01/10 - 20/10	01/10 - 15/10	(101)
		09/12 - 19/12	(130)
Southern North Sea	01/01 - 15/01	04/01 - 15/01	(196)

This distribution of sampling effort is considered adequate to calculate estimates of larval production for all areas. However, the problem remains that larval production is implicitly assumed to be zero in hatching periods for which there are no back-calculated estimates. Gaps in temporal coverage of can, therefore, lead to an underestimation of larval production. Further work is needed on methods of estimation for unsampled production periods.

The LPEs were calculated as described in *Anon.*(1987). Z/K values were estimated for each area based on the slope of the log mean abundance of larvae against length over the range 8 - 16 mm (or 10 - 16 mm in the case of the southern North Sea). These were used to calculate the mean Z/K over the years 1980-1991 in order to calculate the LPEs (Table 2.5.1). Growth rates were assumed to be 0.35 mm per day in all areas.

The LPE values for each area are shown in Table 2.5.2. In Table 2.5.3, the LPEs are expressed in units of spawning stock biomass by dividing by estimated fecundity. These are the index values used in all subsequent calculations.

2.5.3 Larvae abundance indices

The requirements for the calculation of the LAI for each area are compared to the available data below. The reduced index refers to the index suggested in *Anon.* (1990) which could be calculated over core areas and time periods.

Area	Time period required for: Full index	Reduced index	Samples available		Adequate?
Buchan	01-15/09	01-15/09	No samples		No
	16-30/09	16-30/09	18-23/09	58	Only 6 days
Orkney/ Shetland	01-16/09	01-16/09	12-15/09	56	Only 4
	16-30/09	16-30/09	16-23/09	59	days
Central North Sea	01-15/09	01-15/09	10-12/09	62	Only 3 days
	16-30/09	16-30/09	16,17, 23-25/09	76	Only 5 days
	01-15/10		01-10/10	101	Yes
	16-31/10		No samples		No
Southern North Sea	16-31/12	16-31/12	09-19/12	130	Yes
	01-15/01	01-15/01	04-15/01	196	Yes
	16-31/01		No samples		No

From the above table it is clear that LAIs cannot be calculated for most of the North Sea areas. An index was, however, calculated for the southern North Sea, with the larval abundance during the period 16 - 31/1 estimated as the mean contribution of that time period to the index values for the years 1985 -1989 (20%).

The updated series of LAIs for the North Sea areas are shown in Table 2.5.4

2.6 Mean Weight and Maturity at Age

2.6.1 Mean weight at age in the catch and stock

The mean weights at age (weighted by numbers caught) of fish in the catches in 1991 are presented by divisions and quarters in Table 2.6.1.

The observation made in last year's report that the declining trend in mean weight observed in Division IVa and IVb during 1986-1989 has stopped, can now be confirmed this year (Table 2.6.2). In Divisions IVa, IVb and IVc + VIId the mean weight of 2-and 3-ringers are the highest since 1985. In Divisions IVc and VIId this applies also to 4- and 5-ringers. The mean weights in the stock obtained from the summer acoustic survey show a similar pattern.

Table 2.6.3 provides a convenient comparison of the changes in the third quarter mean weights at age in the catch from Divisions IVa and IVb for the years 1986-1991. In this quarter, most fish will be at or approaching their peak weights just prior to spawning. The mean weights in the stock obtained from the summer acoustic survey show a more marked increase than the weights in the catches. The increase seems to apply to all age groups.

2.6.2 Maturity ogive

The percentage of 2- and 3-ringers likely to mature in 1991 was estimated from the acoustic survey made by the research vessels in July 1991.

The proportions likely to have spawned in 1991 (maturity stage 3 and above) compared to the three previous years were as follows:

	1988	1989	1990	1991
2-ring	65.6%	78.7%	72.6%	63.8%
3-ring	87,7%	93.9%	97.0%	97.1%
older	100.0%	100.0%	100.0%	100.0%

2.7 State of the Stocks

2.7.1 Total North Sea

2.7.1.1 Description of assessment method

Table 2.7.1 shows time series of spawning stock indices from larvae surveys, acoustic surveys and IYFS. Earlier Working Groups have considered the IYFS index for 2-ringers and older for the total area to be a useful index of spawning stock, under the assumption that it was based on data from the North Sea only. It is, however, evident that the figures used are also based on the sampling in Division IIIa, which means that variable proportions of spring spawners have been contributing. New figures were presented for the North Sea area only. 2-ringed North Sea autumn spawners have in some years been abundant in Division IIIa (Table 3.4.1), while older North Sea herring rarely occur in Division IIIa during the IYFS.

The best IYFS index for the spawning stock of North Sea herring is therefore considered to be the index for 3-ringers and older in the North Sea, in the beginning of the year after spawning. This index for the spawning stock in the years 1981-1991 (survey year 1982-1992) is presented. Both the larvae production estimate (LPE) and the IYFS indicate a considerable reduction (40-50%) of the spawning stock in 1991 compared to the two previous years, while the acoustic estimate is at the same level as the two previous years.

The apparent discrepancy between the 1991 indices was discussed. No major difference in survey methods or survey conditions compared to earlier years seem to give reasons to reject any of the indices. Some doubts were expressed due to the reduced effort in the larvae surveys.

A VPA was tuned by the method described in the 1991 Working Group report. By use of the program "RCT3" each series of indices was regressed with the VPA estimates of spawning stock for the converged year (log-log regression). The regression for the acoustic estimates was replaced by a log-log regression with slope fixed to 1. Predictions of spawning stock in the unconverted years were calculated from these regressions by making a weighted average. The weighting factor was $1/SE^2$, where SE is the estimated standard error of the individual predictions.

On the basis of some trial VPAs the spawning stock estimates were considered reasonably converged for 1988 and earlier years; increasing the relative fishing mortality in 1991 by a factor of 2 caused a 20% decrease in estimated stock.

The output from "RCT3" is shown in Table 2.7.2. Concerning the slope of the regressions the pattern described in the 1991 Working Group report is repeated; the LPE and acoustic estimates causes slopes well above 1 and the IYFS gets a slope somewhat below 1. This implies a curve linear relationship between the non-logged indices and the VPA. A linear relationship was used between acoustic estimates and VPA and, therefore, the slope was fixed to 1 for the log-log regression as in last year's assessment.

Increasing egg mortality at increasing stock size would result in a curved relationship in the direction observed for the LPE and that regression was thus accepted.

Possible reasons for a non-linearity between IYFS and VPA were discussed. Increasing trawl efficiency during a period of increasing stock size was mentioned, but the point was not strongly supported. Anyhow, it was considered reasonable to allow for non-linear relationships as long as no strong reasons for a strict linear relationship was evident.

Table 2.7.2 contains the regression parameters, predicted values with standard errors and the weighting factors obtained when applying the acoustic regression with fixed slope. Predictions from IYFS have a relatively low standard error. Those values therefore get about 50% of the weighting when making the average predictions.

For all years in the VPA an annual natural mortality of 1.0 for 0- and 1-ringers, 0.3 for 2-ringers, 0.2 for 3-ringers and 0.1 for older fish was applied. These values are smoothed values from the most recent multispecies assessment. A number of separable VPAs were made with different fishing mortalities in 1991. The selection pattern based on the years 1986-1991 and fishing mortality of oldest true age group by year is shown in Table 2.7.7. All other input values are shown in Tables 2.7.3 - 2.7.6. The 1991 values for weights at age in the stock and proportions of maturity are derived from the summer acoustic surveys.

The VPA with 0.42 as reference fishing mortality for 1991 was the one giving the minimum sum of squared residuals relative to average predicted values. This VPA was therefore considered as the best fit to the survey data. The outputs of this VPA are shown in Tables 2.7.8 to 2.7.10. Table 2.7.8 shows an average fishing mortality in 1991 of 0.39 for 2-6 ringed fish. This is close to the value for 1990.

2.7.1.2 Estimates of total stock size in recent years.

The VPA estimate of present stock size has to be considered rather uncertain. It is based on survey indices with fairly large variance. There are partly conflicting trends in the different series of indices as well. The observed fungus disease brings additional uncertainties to the natural mortality applied for 1991 relative to earlier years. The effects on the 1991 VPA estimate caused by any increased mortality might have been incorporated in the assessment since survey data from as late as February 1992 is used. In that case the stock size in 1990 and 1989 could have been underestimated by the present VPA.

It seems noteworthy that for all the three latest years the VPA estimates are 30-40% below the acoustic estimates, which is at the likely lower confidence limit of the acoustic surveys. This cannot be resolved from available information but could be due to error in both the survey and VPA estimates.

In spite of these uncertainties the present VPA estimate of the spawning stock in 1991 is quite close to the prediction from last year's assessment even when taking into account the overshooting of the agreed quotas. The present stock estimates for 1989 and 1990 are 13% down relative to last year's assessment.

2.7.2 Southern North Sea (Divisions IVc and VIId) stock

Estimates of stock abundance are available only from herring larvae surveys. Because of the increased sampling intensity in this area in 1991/1992, both the larval abundance index (LAI) and the larval production estimate (LPE) can be calculated.

The LAI in 1991/1992 is considerably higher than the corresponding values for the seasons up till 1989/1990 (no value is available for 1990/1991). It should be noted, however, that the figure for 1991/1992 is largely driven by one large haul in December 1991 (Hopkins, Working Document 1992). The high LAI for 1991/1992, therefore, must have wide confidence limits, and it cannot be considered as a strong evidence for an increase in stock size.

The LPE for 1991/92 should be considered more accurate, as it depends equally on the survey results for December and January. The LPE value for this season is at the same level of the preceding three seasons. In earlier years, the LPE shows more variation from year to year. Considering the time series from 1981 onward, there is no increasing trend over time.

The catch-at-age table (Table 2.7.11) shows an increasing proportion of old fish in the catch. This could indicate an increase in stock size or reduced recruitment.

The monthly distribution of commercial catches (Figures 2.10.11 and 2.10.12) show that catches during the spawning season (November/December) are largely confined to a single statistical rectangle. This confirms earlier reports about the limited spatial (and temporal) extent of the spawning.

2.7.3 Historical review of assessment quality

From the Working Group reports since 1972, average fishing mortalities, recruitment and spawning stock estimates are tabulated in Tables 2.7.12-2.7.14. The tables are similar to the ACFM quality diagrams. For practical purposes, columns and rows are interchanged. When reading the tables, the following comments are useful:

Date of assessment	Comments
1972	The first VPA for total North Sea for the years 1947-1971 M =0.1.
1972-1975	No estimates of SSB, only numbers by age and total biomass.
1976	Predicts SSB for the years 1976-1980 assuming zero catches of adults, *status quo* F on juveniles and recruitment estimate from R/SSB relationship.
1977	Predicts SSB for 1977-1979 assuming no adult catch since early 1977, and reduced F on juveniles.
1978	No new VPA, prognosis based on previous VPA and International Young Herring Survey estimates of recruitment, assuming no directed herring fishery.
1979	No new VPA.
1980	An "extension" of age the 1977 VPA given with reservations.
1981	No new VPA.
1982	VPA presented for total North Sea and southern North Sea. Doubts about catch figures.
1983	VPA for each sub-division and total North Sea.
1984	M =1.0 for 0-ring, 0.8 for 1-ring, 0.1 for older. VPA for each sub-division and total North Sea. SSB at time of spawning for total North Sea calculated as sum of the divisions.
1987	M = 1.0 for 0- and 1-ring, 0.3 for 2-ring, 0.2 for 3-ring, 0.1 for older. Prognosis only for Divisions IVa+b, 150,000 t added in Table 2.7.14.
1990	F-old created by separable VPA. (Most previous assessments have been based on F-old from "file").
1991	Catches of North Sea autumn spawners in Division IIIa included.

2.8 Projection of Catch and Stock of North Sea Autumn Spawners by Area and Fleet

The starting point for the prediction is the stock of the North Sea autumn spawners in the North Sea and Division IIIa combined at 1 January 1992. For 3-ringers and older the VPA estimate (Table 2.7.9) is used. For 2-ringers of 1 January 1992 the estimate is based on the IYFS 1-ringer estimate (15.57 billion) one year earlier, taking into account the catch in 1991 of 2,067 million. The starting value for 1-ringers is the 1992 IYFS estimate (14.97 billion) and for 0-ringers the MIK-estimate from the 1992 survey (84.7 billion). The recruitment section (2.3) describes how these year classes (1989, 1990 and 1991) are estimated. 0-ringers at 1 January 1993 are set to 68 billion (1982-1989 average).

For the total stock mean weights at age, maturity at age, natural mortalities and proportions of F and M before spawning are all taken from the VPA input for the year 1991 (Section 2.7). The fishing pattern for the total stock is taken from the separable output (Table 2.7.7).

Catch predictions for 1992 and 1993 were made for five different fleets:

a) other fisheries in the North Sea;
b) small-mesh fisheries in the North Sea;
c) human consumption landings in Division IIIa;
d) mixed clupeoid landings in Division IIIa;
e) other industrial landings in Division IIIa.

Mean weights at age in the 1991 catches by the same fleets were applied for the predictions.

The proportion of each year class in Division IIIa is likely to vary between years for each of the age groups 0, 1 and 2 (winter rings). For the 1-ringers this is reflected in the IYFS results presented in Table 2.3.4. For this reason, it was assumed that the most realistic predictions would be obtained if the proportion (or abundance) in each area could be estimated for each age group at the beginning of each prediction year.

3-ringers and older were assumed to be exclusively in the North Sea. The Workshop on Methods of Forecasting Herring Catches in Division IIIa and the North Sea (*Anon.*, 1992) suggests a procedure for estimating the abundance of 1-ringers in Division IIIa. The proportion of 1-ringers in Division IIIa estimated during the IYFS (Table 2.3.4) is applied to the VPA estimate of the total year class (Table 2.7.9) giving a time series of 1-ringer abundance in Division IIIa. This is regressed with survey indices thought to be related to it. Table 2.8.1 shows the time series and the regression results. All these survey indices are fairly well correlated to the abundance. However, only the MIK index predicts abundance of 1-ringers in Division IIIa more than one year ahead. The 1992 MIK index was, therefore, used to estimate the 1-ringer abundance in Division IIIa on 1 January 1993. The result is 12.7 billion. At 1 January 1992 the IYFS proportion observed in Division IIIa (25%) was directly applied to the total estimate of the year class (14.97 billion)) giving 3.75 billion.

The fishing mortalities by age calculated by fleet for the 1991 catches formed the bases for a *status quo* prediction ($F = F_{91}$) for 1992. For age groups 1 and 2 (winter rings), adjustments between the North Sea and Division IIIa fleets were made to fit the (expected) change in distribution of 1- and 2-ringers relative to 1991.

Another option with TAC constraints on "other fisheries in the North Sea" (A) and *status quo* on the remaining fleets (B,C,D,E) was considered realistic. This is because most catches from them are not counted against the TAC in the North Sea. The first option (Table 2.8.2), however, shows a catch by "fleet A" quite close to the TAC for the North Sea (430,000 t, including 10,000 t of spring spawners) and thus covers both cases.

A *status quo* option for 1993 was made in the same manner as the one for 1992. In addition, one option with 20% increase and one with 20% decrease in fishing mortality caused by "other fisheries in the North Sea (A) were made keeping *status quo* fishing mortality for remaining fleets (B,C,D,E). Similar options ($\pm$ 20%) for the small-mesh fleet in the North Sea were made, keeping *status quo* for remaining fleets. A final option was made based on no mixed clupeoid fishery in Division IIIa keeping *status quo* on remaining fleets.

The option of $F_{2\text{-}6} = 0.30$ for the "other fisheries in the North Sea" keeping *status quo* on remaining fleets was planned. This would, however, be close to the option of 20% reduction in " the "A" fleet.

The various options are presented in Tables 2.8.2-2.8.8. The consequences for the spawning stock in 1994 is not shown for any of the options. One reason for this is the uncertainties regarding the assessment of the present stock size (Section 2.7.1.2). New information on stock size (acoustic estimate in 1992) and likely increases in mortality due to the fungus disease will be presented at a meeting planned for the early autumn 1992. For this reason, the predictions given in this report should be considered preliminary, and a new prediction may be needed for 1993. Tables 2.7.12-2.7.14 show that for different reasons 3-year-ahead predictions from earlier assessments have not been particularly realistic.

All options presented for 1992 and 1993 show fairly stable spawning biomass, while the catches vary considerably between years and between options for the fleets exploiting the younger age groups. This because the 1991 year class is estimated to be above average thus contributing strongly as 1-ringers in Division IIIa fisheries in 1993.

In predicting the stock of 1-ringers in Division IIIa using the method described above, it must be stressed that the relationship between VPA estimates of 0-group and the MIK index has wide confidence limits. The estimate of the total size of the year class is thus very uncertain. In addition, moreover, the same index is used to predict the quantity of the year class that will be in Division IIIa (and, by subtraction, the quantity in the North Sea). Any imprecision in the predicted values from the regressions will have a major effect on the reliability of the estimates of the stock in the North Sea and Division IIIa.

2.9 Management Considerations

2.9.1 TAC advice for the total North Sea stock

The TAC advice depends on the management objectives set by fisheries managers. Until now, this objective has been to increase the spawning stock size to a level of 1.5-2.2 million t. The Working Group in recent years has advised that this objective could be achieved by fixing F on 2-ringers and older at 0.30, and by reducing the exploitation of 0- and 1-ringers. The subject of management objectives is further discussed in Section 2.9.5.

The latest assessment of the stock shows that F in recent years has exceeded the level of 0.30 (Section 2.7). This is largely due to the constant overshooting of TACs.

The TAC advice provided by ACFM in recent years was composed of a component of adult catch, taken mainly in the directed herring fisheries, and a component of juvenile catch, taken mainly in the industrial small-mesh fishery. However, the total TAC advice has been applied in practice to the directed herring fishery. The actual catches of adult herring, therefore, were always higher than the projections on which the TAC advice was based.

Most of the juvenile catches taken in the industrial fisheries were not counted against national quotas. This has resulted in total catches (adults and juveniles) that were considerably above the internationally agreed TACs.

In this year's report, separate projections have been made for the catches in the directed herring fishery and for the by-catch of herring in the industrial small-meshed fishery. It is advised that these fisheries are managed separately, and that the TAC for the directed fishery is only based on the projected catches for that fishery.

The industrial fisheries should be managed under a different set of regulations. Under the assumption of a *status quo* F, the projected catch of herring in this small-mesh fishery, including mixed clupeoid fishery in 1993 is 304,000 t in the North Sea and Division IIIa. Section 2.8 describes how this catch is expected to be distributed between the North Sea and Division IIIa. It should be emphasised that this prediction is very uncertain in view of the wide confidence limits on the predicted strength of the 1991 year class. It is also uncertain whether the 2-ringed herring in 1993 will be distributed in the same way between North Sea and Division IIIa as they were as 1-ringers in 1992.

As shown in Section 2.9.3, the exploitation of juvenile herring by the small-mesh industrial fishery, including mixed clupeoid fishery, reduces the potential yield from the herring stock up to 10%. The reduction in adult catch (≥ 2-ringers) is about 30%. Spawning stock biomass is reduced by about 30%. These yield calculations are, however, based on the fishing pattern and mean weights at age in the catches in 1991 which are very different from those in previous years (see Section 3.2.7). As a result, the relative changes in yield are different from those given in *Anon.*(1989) and can only be considered as uncertain estimates.

2.9.2 Management advice for the southern North Sea (Divisions IVc, VIId)

The population spawning in the southern North Sea is part of the total North Sea stock, and the catches taken in this area are part of the total North Sea TAC. The southern North Sea population has historically shown to be rather susceptible to high fishing pressure, presumably due to the suitability of its spawning grounds to bottom trawling. Whereas the population was very large up till the early 1950s, it was reduced to a very low level in subsequent years, and became nearly extinct in the 1970s. During the period of closure (1977-1981), the population rapidly increased to a level of about 200,000 t, and it has apparently stayed at that level since the reopening of the fishery.

The population is exploited in summer in the central and northern North Sea, and in autumn and winter on its spawning grounds in the southern North Sea and English Channel. Management regulations in recent years have allowed only a certain part of the total North Sea TAC to be taken in Divisions IVc, VIId in order to provide the southern North Sea population some protection during its period of spawning. Contrary to the situation in the central North Sea, the spawning grounds in the southern North Sea are not closed for fishing during the spawning period.

In 1989 and 1990, the TAC advice for the southern North Sea (30,000 t) was based on a policy to increase the size of this population above the present level. Such an increase would buffer the population against short-term reductions in recruitment, and it might result in an extension of its spawning grounds and season. It should be noted that this population spawns at the southernmost border of the herring distribution area. The population is, therefore, expected to be rather sensitive to environmental variation. An extension of spawning grounds and season would make recruitment less susceptible to chance occurrence of adverse hydrographic conditions.

In 1991, the TAC was increased to 50,000 t, following ACFM's conclusion that catches in this order of magnitude had kept the stock at a stable level throughout the 1980s.

The level of the TAC in future years depends on the management choice whether the present stock level is satisfactory, or whether one should try to further rebuild this population. The first option would allow a continuation of the present catch level of 50,000 t, but it contains a risk of future reductions in catch due to falling recruitment. To allow for some growth in the stock, a reduction of catches below 50,000 t would be required.

2.9.3 Management of the juvenile fishery

2.9.3.1 Improving the exploitation pattern in the North Sea

Juvenile North Sea herring of the 0- and 1-ringer groups are caught in both the North Sea and Division IIIa. Details of the fisheries are discussed in Sections 2.2.1 and 3.3.2. The harvesting of these age groups are known to reduce the potential stock yield. In an attempt to estimate the percent reduction of total yield resulting from exploitation of these fish, we employed a standard yield per recruit model with input parameters for these age groups by quarter. Four scenarios of preventing the catch of juveniles were evaluated as follows:

1) For both the North Sea and Division IIIa;
2) Division IIIa;
3) The North Sea;
4) Mixed clupeoid fishery in Division IIIa.

For each scenario, except 4), the result of removing fishing mortality on 0-ringers and 1-ringers were evaluated. In scenario 4) it was not considered reasonable to separate the 0-, 1- or 2-ringers because of the nature of the fishery. Fishing mortality on all three groups were removed and the input parameter adjusted accordingly.

2.9.3.2 Input parameters

All input parameters were estimated from the 1991 assessment data with the exception of natural mortality rates for 0- and 1-ringers. These natural mortalities by quarters were scaled to 1991 values using the mean 1980-1985 quarterly results of the 1989 MSVPA key run (*Anon.*, 1989b). Values for M for age groups 2-9 were the same as those used in the 1991 SSVPA. Input parameters for each simulation are presented in Tables 2.9.1 and 2.9.2.

The weights at age used in the catch were:

- Weight at age by quarters in the total North Sea (Table 2.6.1).
- Weight at age by quarter and by "fleet" in the Kattegat and Skagerrak.

The weight in the catch for the total stock (North Sea and Division IIIa) is the mean weighted by number caught in the North Sea, Kattegat and Skagerrak. For each simulation the weight in the catch was recomputed in order to take into account the catch assumed to be taken by area (Table 2.9.2).

The weights in the stock are those from the July 1991 acoustic survey in the North Sea which were used in the assessment and prediction. As these weights in the stock are used for the calculation of the spawning biomass, the weights of the Division IIIa juveniles can be ignored. The fishing pattern is derived from the separable VPA used in the prediction.

In order to obtain a fishing mortality coefficient by quarter and by area, the SVPA values were split according to catch by area and quarter. The split by area gives exact fishing mortality by area, but the split by quarter gives a biased estimate. Unbiased ones would have to be computed through a quarterly VPA. However, the error is expected to be very low and has, therefore, been ignored.

2.9.3.3 Yield per recruit prediction

The net increase for each simulation is presented in the following text table:

Preventing catch of juveniles in:	Age	Relative Increase	
		Net Yield	SS Biomass
North Sea + Division IIIa	0	1.4%	6.7%
	1	9.3%	42.9%
Division IIIa	0	0.0%	2.0%
	0,1	3.5%	14.6%
North Sea	0	4.0%	4.7%
	0,1	7.9%	24.8%
Mixed Clupeoids Division IIIa	0,1,2	1.4%	9.8%

The net gain in catch and SSB ranged from 0 to 9.3% and from 2.0 to 42.9%, respectively, according to the age group and approach taken.

2.9.4 Additional conservation measure

No new information was available on the spawning area in the central North Sea, and the Working Group considers that it would be appropriate to continue the closure in that area to protect the spawning stocks.

2.9.5 Biological justification for a target spawning stock biomass of 2.2 million t for North Sea herring

In response to a request from the EC the Working Group considered the background of the figure of 2.2 million t, which has been used as a management objective for North Sea herring SSB in recent years.

The figure of 2.2 million t first appeared in the Agreed Record of Conclusions of Fisheries Consultations between the European Economic Community and Norway in Brussels, 26-28 November 1986. This document states that: "The Parties agreed that the target level for the spawning stock biomass should be about 2.2 million tonnes. The Parties will manage the North Sea herring stock in a way designed to reach this objective". The record does not specify how the figure of 2.2 million t was arrived at.

The target SSB of 2.2 million t does not correspond to a specific biological reference point. It is merely an indication of what the average stock level might be under a regime of low fishing mortality (0.30) and average recruitment (see below). A target stock in this order of magnitude would buffer the TAC against short-term reductions in recruitment.

However, the idea of a buffer stock is to let the stock change in order to keep the TAC relatively stable. If one tries to maintain the stock at a specific target level of 2.2 million t, the TAC will fluctuate considerably (reflecting all fluctuations in recruitment). It may be more practical, therefore, to use a specific fishing mortality as management objective, rather than a specific stock biomass, as long as the spawning stock does not approach the minimum biologically acceptable level.

In 1987, the Working Group discussed the pros and cons of various management strategies, such as aiming for a specific SSB, fixing the TAC at a certain level, or stabilizing fishing mortality (*Anon.*, 1987). From the discussion presented by this Group, and also from studies made by other authors (Skagen, 1991; Corten, 1990), the following conclusions can be drawn regarding the choice of management objectives:

a) Management objectives should be set by managers and not by scientists.

b) The choice of management objectives necessarily contains an arbitrary element. None of the "biological reference points"can be used as an ideal management objective. Moreover, the biological reference points will vary over time.

c) A management policy of fixing F at a relatively low level is probably the best method of securing stability in TACs, maximizing yield over a longer period, and avoiding the risk of the SSB dropping below the minimum level of 800,000 t required for average recruitment.

d) The exact choice of target F depends not only on considerations of stock/recruitment and stability of TACs, but also on aspects like density dependant growth, market demand for specific size categories, multispecies effects, and ecosystem effects.

e) Management objectives, once defined, should be adhered to over a longer period. It will take several years before the full results of a certain management strategy become apparent. If management objectives are changed too frequently, it will not be possible to evaluate the results of a certain management regime.

In recent years, the Working Group has interpreted the stated management objective of 2.2 million t SSB for North Sea herring as an approximate long-term goal. They have suggested to fix F at a level of 0.30, which would eventually result in an average SSB above 2 million t (Skagen, 1991). The precise level of SSB in future years will depend on the exploitation level for juvenile herring, and also on the strength of new year classes.

It is expected that SSB (and TACs) will continue to fluctuate under a regime of constant F. In order to illustrate the possible long-term effects of such a management policy, the results of a simple simulation of catch and SSB are shown in Figure 2.9.1. In this simulation the F on 1-ringers and older has been fixed at 0.30. Recruitment is allowed to vary according to the cyclic pattern observed in the period 1980-1989 (Figure 2.3.4). Under these conditions, the TAC would vary between 500,000 - 800,000 t, whereas SSB would show fluctuations between 1.2 and 2.2 million t. A comparison with historic data (Figure 2.9.2) shows that fluctuations within this range were indeed common during the period when fishing mortality was relatively stable within the range 0.20 - 0.40 (in 1952 - 1964).

It should be noted that the results presented in Figure 2.9.1 are merely meant as an example. If managers want to know the full implications of various management strategies, more elaborate risk analyses (such as presented by Skagen (1991) are required.

2.10 Requests from the Multispecies Working Group

2.10.1 Quarterly data base (numbers and mean-weights-at-age)

The Multispecies Assessment Working Group has requested annual provision of quarterly catch-at-age data, together with quarterly weights at age in the catch and in the stock at spawning time for North Sea herring. The data for 1991 are provided in Table 2.10.1.

Weight-at-age data for the stock at spawning time are best provided by samples taken during the July acoustic surveys which cover Divisions IVa and IVb, and these are shown in the bottom line of Table 2.10.1.

A comparable breakdown of catches of spring spawners taken in the North Sea and transferred to Division IIIa is shown in Table 3.1.1.

2.10.2 Geographical distribution of the catches in the North Sea in 1991

Data on the geographical distribution of catches in the North Sea (Sub-areas IV and Division VIId) in 1991 were available from Denmark, the Netherlands, Norway, Sweden and the UK (Scotland and England). The data represent 87% of the total catch, and include both juveniles and adults. Figures 2.10.1 - 2.10.12 show the catch by ICES rectangles for each month. The total catches by month were also available for France and Germany. Therefore, the cumulative catch by month for the total North Sea, shown in Figure 2.10.13, includes 99% of the catch in the North Sea.

3 DIVISION IIIA HERRING

3.1 Stock Composition

3.1.1 Baltic and Division IIIa spring spawners in the North Sea

Details on the separation of the catches of spring spawners in the North Sea are given in Section 2.2.3.

The transferred spring-spawning herring totalled about 7,900 t in 1991. Catch in numbers and mean weight at age are given in Table 3.1.1

3.1.2 Stock composition in Division IIIa

The herring fishery in Division IIIa traditionally exploits local spring spawners and 0- to 2-ring autumn-spawning herring from the North Sea. The catches of herring in the area were allocated to their respective spawning stocks using a combination of modal length analysis and vertebral counts. The methods and problems are described in *Anon.*(1992).

The analysis was carried out on the catch-at-age data for 1990 and 1991. Annotated with these allocations are type of fishery (see Section 3.2.2). The results are summarized in the text tables below:

1990	Quar-	0-ringers		1-ringers		2-ringers	
Area	ter	AS	SS	AS	SS	AS	SS
Skagerrak	1	1.0	0.0	1.0	0.0	1.0	0.0
	2	1.0	0.0	1.0	0.0	1.0	0.0
	3	1.0	0.0	1.0	0.0	0.0 ind. .22 con.	1.0 ind. .78 con.
	4	1.0	0.0	1.0	0.0	0.0 ind. .17 con.	1.0 ind. .83 con.
Kattegat	1	1.0	0.0	1.0	0.0	0.0	1.0
	2	1.0	0.0	1.0	0.0	0.0	1.0
	3	1.0	0.0	.54	.46	0.0	1.0
	4	1.0	0.0	.36	.64	0.0	1.0

Proportions by stock of catches taken in Division IIIa in 1990. SS = Spring spawning herring. AS = Autumn spawning herring. Ind. = Landings for industrial purposes. Con. = Landings for human consumption.

As pointed out in last year's report (*Anon.*, 1991) the biological sampling of the catches taken in Division IIIa in 1990 was at a very low level. As a consequence the number of herring measured for vertebral count was low and the estimated stock proportions are considered to be uncertain. The separation is based mainly on data from the Swedish catches taken in the 32-mm fishery. This procedure could add to the uncertainties as the proposition of stocks in 32-mm fishery could differ from the proportions in the small-mesh fishery.

1991	Quar-	0-ringers		1-ringers		2-ringers	
Area	ter	AS	SS	AS	SS	AS	SS
Skager-rak	1	1.0	0.0	1.0	0.0	1.0	0.0
	2	1.0	0.0	1.0	0.0	1.0	0.0
	3	1.0	0.0	1.0	0.0	.30	.70
	4	1.0	0.0	1.0	0.0	.71	.29
Katte-gat	1	1.0	0.0	1.0	0.0	0.0 ind. .31 con.	1.0 ind. .69 con.
	2	1.0	0.0	1.0	0.0	.03 ind. .49 con.	.97 ind. .51 con.
	3	1.0	0.0	1.0	0.0	0.0 ind. .07 con.	1.0 ind. .93 con.
	4	.66 ind. 1.0 con.	.34 ind. 0.0 con.	0.0 ind. .46 con.	1.0 ind. .64 con.	0.0	1.0

Above is given the proportions by stock of catches taken in Division IIIa in 1991. SS = Spring spawning herring. AS = Autumn spawning herring. Ind. = Landings for industrial purposes. Con. = Landings for human consumption.

3.2 The Fishery

3.2.1 ACFM advice and management applicable to 1991 and 1992

1991

In 1990 ACFM recommended a TAC of 178,000 t in Sub-divisions 22-24 and Division IIIa (87,000 t in Sub-divisions 22-24 and 91,000 t in Division IIIa) and zero catch in the mixed clupeoid fishery (sprat TAC). At its May 1991 meeting ACFM predicted the likely catch of North Sea autumn spawners in Division IIIa to be 80,000 t in 1991, and indicated that it would be appropriate to add it to the TAC for spring spawners.

The agreed TAC for herring in Division IIIa was 124,000 t. A further TAC of 50,000 t was set for the mixed clupeoid fishery.

1992

In 1991 ACFM did not recommend any TAC for 1992 but preferred a fishing mortality for the spring-spawning herring in Division IIIa and Sub-divisions 22-24 below the expected level in 1990. ACFM indicated that this could be achieved with a catch of about 180,000 t in 1992 of which 90,000 t could be taken in Division IIIa, 10,000 t in the North Sea and 80,000 t in Sub-divisions 22-24. The TAC for the mixed clupeoid fishery was recommended to be reduced to zero.

To calculate an area TAC for herring in Division IIIa, ACFM found it appropriate to add to the TAC of spring spawners an allowance for the quantity of 1-ringed and older North Sea autumn spawners expected to be taken in Division IIIa. This amount was estimated to be 41,000 t for 1992.

The agreed TAC for herring in Division IIIa was 124,000 t. A further TAC of 50,000 t was set for the mixed clupeoid fishery.

3.2.2 Landings

The landings from the fishery in Division IIIa by countries are shown in Table 3.2.1. As shown in the table, the landings amount a total of 188,000 t, which are 12,000 t lower than the landings in 1990. The landings from Skagerrak in 1990 and 1991 were 123,000 t and 121,000 t, respectively. The landings in the Kattegat have decreased over the last four years from 126,000 t in 1988 to 66,000 t in 1991.
The fishery in Division IIIa is carried out by Denmark, Norway and Sweden. The catches of herring are mainly taken in the following types of fishery.

- The directed fishery for herring is carried out by purse seiners and trawlers. The trawlers are using 32 mm mesh size. Because of a mixed occurrence of young and adult herring in the area, the landing for human consumption, where the legal landing size is 18 cm, contains varying amounts of unavoidable by-catch of young immature herring. These are mainly landed for reduction.

- The "mixed fishery" is carried out by Denmark, Norway and Sweden under a special "Sprat TAC". In the years before 1991, the Danish fishery was carried out using a mesh size less than 32 mm. On 1 January 1991, Denmark set the legal minimum mesh size to 32 mm. The Swedish fishery including purse seiners fishing for sprat and trawlers with a mesh size under 32 mm is counted against this quota. The Norwegian fishery is a purse seine fishery for sprat landed to the canning industry.

- By-catch in other fisheries: Catches of herring occur in the Norway pout and sandeel fishery, but in relation to the total landings, these landings are small.

It is not possible to allocate the landings to the above mentioned types of fisheries as the landings for reduction, except for the catches taken in the Danish mixed clupeoid fishery, cannot be separated by fishery. In the text table below the landings by categories are shown for 1990 and 1991. The landings in the HC column are those taken in purse seine and 32 mm trawl fisheries and used for human consumptions purposes. Danish landings under the mixed clupeoid TAC are listed under the column MIXED. The last column L.f.I.P (Landings for industrial purposes) are landings of herring taken in 32 mm human consumption trawl fishery and used for reduction plus herring taken as by-catch in small-mesh fisheries. The Swedish landings counted against the mixed TAC could not be separated from other landings used for industrial purposes.

For the years 1990 and 1991 it has also been possible to split the landings from the different landings categories in autumn and spring spawners.

Year	Autumn spawners			Spring spawners		
	HC	Mixed	L.f.I.P.	HC	Mixed	L.f.I.P.
1990	21,891	12,681	43,685	61,638	8,053	53,647
1991	26,117	13,142	37,934	68,370	4,995	40,393

The landings of spring spawners in Division IIIa in 1991 of about 114,000 t (Tables 3.2.3-3.2.4) were at the same level as in 1990. 68,000 t were landed for human consumption and 46,000 t for reduction, of which only about 5,000 t were caught in the "mixed fishery" (Table 3.2.5-3.2.6).

The landings of autumn spawners in Division IIIa in 1991 were 77,000 t of which about 26,000 t was landed for human consumption and 51,000 t for reduction. Approximately 13,000 t was taken in the "mixed fishery".

The estimated landings overshot the TAC (174,000 t) by about 15,000 t. The catch of herring in the "mixed clupeoid" fishery 18,000 t, excluding a minor catch which could not be separated from the catch in the directed 32 mm trawl fishery), comprises about 40% of the agreed TAC of 50,000 t. Both in 1990 and in 1991 the species composition in this fishery shows that the catches consist of a large number of species, Norway pout, whiting and herring dominating the catches. The low proportion of herring in the catches may partly be due to the relative low abundance of juvenile herring in Division IIIa in 1990 and 1991.

3.2.3 Catch in numbers and mean weight at age

The total landings in numbers and mean weight at age for the year 1991 are given in Table 3.2.2. The landings in numbers at age by fishery and split in spring/autumn spawners by area (Skagerrak and Kattegat) are shown in Tables 3.2.3 - 3.2.6.

The revised landings in numbers and mean weight at age for 1990 are shown in Table 3.2.7.

The landings of spring spawners caught in Division IIIa and the North Sea and autumn spawners in Division IIIa are given in number and mean weight at age by stock for the period 1987 to 1991 in Tables 3.2.8 and 3.2.9. A revision of the 1989 and 1990 data was made by the Workshop on Methods of Forecasting Herring Catches in Division IIIa and the North Sea (*Anon.*, 1992). The revised figures are included in Tables 3.2.8 and 3.2.9.

3.2.4 Quality of catch and biological sampling data

The number of fish aged by country, area and quarter are shown in Table 3.2.10. The sampling in 1991 was generally at a higher level than the very poor sampling in 1990. At this Working Group meeting the 1991 landings were given by fishery.

The landings statistics for herring to the human consumption market were of good quality. There is still a large uncertainty about the landings for reduction purposes taken in the 32 mm fishery for human consumption. A major part of the Swedish Skagerrak landings for industrial purposes are not adequately sampled in 1991 as was the case in 1990. These landings in 1991 amounted to about 31,000 t (Table 3.2.10). This is serious for the assessment of the autumn-spawner stock and particularly for the spring-spawner stock for which the catches in Division IIIa are dominating. The number of samples from the Danish "mixed fishery" was at a fairly good level in 1991.

Discards occur in Division IIIa, but it only amounts at the most to 10% of the total human consumption landing (Kirkegaard, Working Document 1992). There are no discard data included in the landings statistics (see Section 8).

The Working Group strongly recommends adequate sampling in all fisheries in Division IIIa where herring are caught.

3.3 Acoustic Survey

The acoustic survey of the spring-spawning herring in the summer of 1991 covered the distribution area in the North Sea in July and Division IIIa in August (see Section 2.4.1).

The combined result of spring-spawning herring by age, derived as the sum of spring spawners found in the July survey in the North Sea and the August estimate of the same stock in Division IIIa, is shown in Table 3.3.1.

The estimated number of 2-ringers and older is about 5,200 millions, an increase of more than 100% compared to the number found during the 1990 survey. The highest concentrations were found in the eastern part of the Skagerrak indicating a relatively eastern distribution in 1991.

The possibility that some herring could have been double-counted as a result of migration in the two-week period between the two surveys cannot be ruled out. The number of spring spawners found in the North Sea was, however, only 954 millions and even if all these fish had been counted twice it cannot explain the dramatic increase in number observed from 1990 to 1991.

3.4 Recruitment

3.4.1 General remarks on the 1992 survey

The 1992 survey was carried out in February as in previous years and a total of 44 hauls were made. All standard stations were sampled and the weather situation was good. The water temperature in 1992 was much above the long-term mean.

3.4.2 Abundance of 1-ringed herring

The final index of 1-ringed herring in 1992 was 5,057 which is about 40% higher than in 1991 but much lower than the mean (Table 3.4.1). The length frequency distribution was bimodal. A modal length frequency analysis was used to separate the observed cohorts but the mean vertebral counts showed values from 56.3 to 56.5. All 1-ringed herring were, therefore, assigned to North Sea autumn spawners.

3.4.3 Abundance of 2-ringed herring

The total index of 2-ring herring in 1992 was 1,934 which is well below the mean value since 1980. The 2-ring index has normally been dominated by the spring spawners. It has generally been possible to verify the separation with vertebral counts. The results of a modal length analysis of the 1992 data presented as mean length, vertebral counts and proportion of the separated components are shown in the text table below:

	Stratum (m)	Mean length	Mean VS	Proportion
1	10-34	20.0	55.98	0.36
		22.2	56.30	0.25
		24.6	56.40	0.39
2	34-44	20.3	55.78	1.00
3	45-65	20.2	55.90	0.95
		22.5	56.30	0.05
4	>65	22.3	56.48	1.00

Cohorts with VS in the range 55.7-55.9 are similar to VS of adult spring-spawning herring and the autumn spawner component is identified by VS values of 56.3-56.5. The separation was accepted and the corresponding indices are shown in Table 3.4.1. The trend in indices by stock indicates a shift in dominance since 1989 with increasing proportion of autumn spawners.

3.5 State of the Stock and Management Considerations

3.5.1 General remarks

The assessment of the Division IIIa and Sub-divisions 22 - 24 herring is performed by the Working Group on the Assessment of Pelagic Stocks in the Baltic.

3.5.2 Management of the juvenile fisheries

The juvenile fisheries in Division IIIa mainly exploit the North Sea autumn spawners. For the first time the species and age composition of the majority of the catches taken under the "mixed quota" concept was made available to the Working Group. In 1990 and 1991, about 50% of the catches of 0-ring and 20% of the catches of 1-ring herring were generated in this fishery. The majority of the remaining catch of juveniles was caught as by-catch in the 32 mm mesh consumption fishery and as by-catch in the small-mesh fishery for Norway pout and sandeel. The management of the juvenile fisheries is discussed in Section 2.9.3.

4 CELTIC SEA AND DIVISION VIIJ HERRING

4.1 Introduction

The herring fisheries to the south of Ireland in the Celtic Sea and Division VIIj are considered to exploit the same stock. For purposes of stock assessment and management, these areas have been combined since 1982. The areas for which the assessment is now made, together with the area for which the TAC is set by the EC, are shown in Figure 4.1.1. It should be noted, however, that, although the management unit covers all of Divisions VIIg, h, j and k and the southern part of Division VIIa, the major portion of the catch (over 95%) has, in fact, come from the inshore waters along the Irish coast in this area.

4.2 The Fishery in 1991-1992

4.2.1 Advice and management applicable to 1991 and 1992

The TAC recommended by ACFM for 1991 for this area was originally 15,000 t. However, this figure was revised by ACFM during the year and subsequently increased by the EC to 21,000 t. The TAC recommended by ACFM for 1992 was 27,000 t, while the figure agreed by the EC was 21,000 t.The preliminary reported landing figure for 1991 was about 21,300 t, while the figure for the 1991/1992 season (1 April - 31 March) was about 23,300 t. The catches and landing figures are shown in Tables 4.2.1 and 4.2.2.

The major portion of the catches (over 95%) from this area has in recent years been taken by Ireland. The fishery is managed on a seasonal basis which usually lasts from mid-October until March. During 1991/1992, the fishery was partly opened on 6 October and was closed in mid-March. Only the western part of the area, i.e., Division VIIj, was opened at the beginning of the season as the result of an experimental fishery carried out in Division VIIa (south) had indicated that the herring in that area at the beginning of October were not suitable for the roe market. The opening of the season in that area was, therefore, delayed until the end of the month.

The total Irish quota was again divided into weekly quotas in order to ensure a continuation of the fishery over the entire spawning season. The weekly quota was further sub-divided into boat quotas/night. The number of boats participating in the fishery was about the same as in the previous season although the number of the large tank (R.S.W.) boats decreased from eight to two. All boats participating in the fishery are regulated by licence which restrict landings to specific ports and during specific periods. As has been pointed out in the previous report of the Working Group, considerable effort has been spent in recent years on the management of this fishery. Although it is still difficult to monitor catches, particularly illegal catches taken out of season, the management authorities are confident that the accuracy of the reported catches has improved considerably in recent seasons.

The system whereby selected spawning grounds are closed in rotation, and which was first introduced in 1988, was continued during the 1991/1992 season. The spawning grounds closed to fishing were those situated in Division VIIj, the closure lasting from 1-15 November.

4.2.2 Description of the fishery in recent years

In response to a request by ACFM (cf. Minutes of ACFM Meeting, May 1991), the following brief description of the fishery is given.

The catches by the Dutch fleet, which in recent years have been very small, are taken by pelagic freezer trawlers which fish during summer on the offshore feeding shoals.

The Irish fleet exploit the spawning shoals which move inshore to spawn during the months October to February. The pattern of fishing has remained remarkably constant for at least 20 years. The fleet is mainly composed of small dry hold boats from 60'-80' length which use paired midwater trawls. There is a small number of tank (R.S.W.) boats, about 90' long which also use midwater trawls. Most of the spawning grounds are situated within a few hours' steaming from the adjacent port so that most vessels make daily or nightly trips. The fleet is highly efficient and fishing now takes place by day and by night. In recent years, the stated management policy for the fishery is designed to cater for the Japanese roe market. Markets for herring other than those suitable for the roe fishery are extremely limited while the roe market itself in 1991/1992 was restricted.

Attempts have been made in recent years to reduce the amounts of herring discarded at sea by the introduction of a number of means, e.g., experimental fishing prior to opening of the season and closed periods. These measures are believed to have a certain degree of success. In addition, skippers have become more skilful in identifying areas where unsuitable herring are concentrated and claim to be able to identify different types of herring echo-traces, e.g., "hard" herring or "ripe" herring on their echo-sounders.

4.2.3 The fishery in 1991/1992

Initial catches during October 1991 were taken from the northern part of Division VIIj and also from the southern part of Division VIIb. The fishery continued in this area until the closed period was introduced in November. An experimental fishery was carried out in the southern part of Division VIIa (south) during late September and early October. Substantial quantities of herring were located in this area and spawned in early October. Shoals were located on the spawning grounds in Division VIIg during late October and the main catches were taken from this area and from Division VIIa (south) during the November-February period. Small catches were made in Division VIIj during January-March.

The catches taken in the fishery by statistical rectangle and quarter are shown in Figure 4.2.1a-d.

4.2.4 Catch data

The estimated catches from the combined areas by year and by season (1 April - 31 March) are given in Tables 4.2.1 and 4.2.2, respectively. The reported landings, including estimates of discards and unallocated catches taken during 1991/1992, was 25,100 t compared with 18,600 t during 1990-1991.

There has been considerable concern about the possibility of under-reporting of the landings from this fishery. This concern arose because of difficulties in interpreting the trends in spawning stock biomasses, estimated by VPAs during the 1983-1990 period. The 1991 Working Group, therefore, calculated the theoretical catches which could have been taken from the fishery during 1983-1990, using the roe production figures and a roe yield of 6.5%. The recalculated catches indicated that the original catches from the roe fishery could have been underestimated by as much as 50%. The appropriate catches from 1982-1991 were, therefore, raised accordingly. ACFM was concerned at such a major revision of catch data but considered that as the stock was in a healthy state and that, if the revised figures were correct, then the fishery should be stabilized at the catch level of recent years. On this basis, a TAC of 27,000 t for 1992 was recommended.

The Working Group has now been informed that the roe production figures used in the revision of the catches were inappropriate. This is because the figures included considerable quantities of roe obtained from other fisheries around Ireland and the UK. Therefore, the Working Group had to revert to the catch figures presented at the 1990 meeting. As pointed out in the section on management of the fishery, the management authorities are confident that the accuracy of the catch statistics has improved considerably in recent years.

Discards. The problem of discards in this fishery has been discussed at length both in the 1990 and 1991 reports of the Working Group. There are, however, still no estimates of discards for the roe fishery. It is felt that the problem is reducing as fishermen become more skilled in identifying shoals which are suitable for the Japanese market. It was, therefore, decided to continue to assume a level of discarding in the roe fishery of 10% which is the same as that agreed for the previous year. This figure does not seem unrealistic compared with discard figures from other fisheries mentioned in this report.

4.2.5 Quality of catch and biological data

The sampling programme carried out on this fishery throughout the season is very intensive and adequate biological data are available. The sampling data are shown in Table 4.2.3. The quarterly length distribution of the catches from the Irish fleet are shown in Table 4.2.4.

4.2.6 Catches in numbers at age

The total catches in numbers at age, including discards, are shown in Table 4.2.5. The percentage age distribution of catches in recent seasons is shown in Table 4.2.6. These catches include discards mainly taken during the roe fishery and which have been assumed to be 20% of the landings during 1983/1984 - 1989/1990 and 10% during 1990/1991 and 1991/1992.

The catches in numbers at age for 1991/1992 are mainly based on samples obtained from the Irish fishery. One sample, obtained from the Dutch fishery, has been used to convert both the German and Dutch catches to numbers at age. The age distribution is dominated by 2-winter-ring fish, i.e., incoming year class of 1988/1989. 5-winter-ring fish (i.e., the 1985/1986 year class) are also well represented (18%). This year class is particularly well represented in the fishery in Division VIIj. The age distribution of the catches shows a gradual increase of older fish in recent years. There has been a noticeable decrease in the number of 1-winter-ring fish taken in the catches which first became apparent in 1986/1987.

4.3 Mean Weights at Age

The major portion of the catch from this fishery is taken from the spawning fishery. Therefore, the mean weights of the catches have been taken as the mean weight of the stock at spawning time (1 October). The mean weight (g) of all samples are shown below compared with those for recent seasons.

Season	1	2	3	4	5	6	7	8
1986/1987	119	155	172	187	215	248	236	284
1987/1988	96	138	186	192	204	231	255	267
1988/1989	97	132	168	203	209	215	237	257
1989/1990	106	129	151	169	184	199	210	221
1990/1991	99	137	153	167	188	208	209	229
1991/1992	92	128	168	182	190	206	229	237

4.4 Stock Assessment

4.4.1 Larval surveys

No larval surveys were carried out on the stock in the area during the 1991/1992 season.

4.4.2 Acoustic surveys

Acoustic surveys have been carried out on the stock for the last three seasons. The spawning stock biomass estimated by the 1989/1990 survey was only 18,000 t, but this estimate was considered to be unrealistically low *Anon.* (1990). The SSB estimated by the 1990/1991 surveys was 90,000 t. This estimate was not accepted by the Working Group as an absolute level of stock size but was considered as an indication that the stock was in a healthy state and possibly a minimum estimate. The results of the 1991 surveys, again carried out by the R/V "Lough Foyle", were presented in a Working Document by Reid and Simmonds (Mar. Lab., Aberdeen) and discussed in a Working Document (Molloy, 1992a). The biomass of adult herring estimated for both surveys was about 100,000 t, and, allowing for catches taken, a total spawning stock at about 110,000 t was calculated. Because of the intensive nature of the grid system the precision of the stock estimates, although not calculated, is likely to be high.

It was felt however, that the first of the surveys, designed to estimate the size of the autumn-spawning component, had in fact been carried out after the major portion of this component had completed spawning and migrated out of the area. This first survey included a substantial number of herring which appeared by their maturity stages and vertebral counts to be winter/spring spawners and, therefore, may possibly have been double counted during the second survey. The biomass of those herring which may have been double counted was, therefore, removed and a revised spawning stock of about 77,000 t was calculated. The removal of these herring which may have been double counted may result in an under-estimate of the spawning stock.

The Working Group considered that this was a minimum spawning stock estimate and did not include the major portion of the autumn component. It has been indicated by the 1990/1991 surveys that the autumn and winter spawning components were at about equal size. This was also the position during the mid-eighties after the stocks had recovered. It is therefore likely that the acoustic surveys, if they had been carried out at the correct time, would have indicated an SSB equal to, if not greater than, that of 90,000 t suggested by the 1990/1991 surveys.

4.5 Result from Tagging Experiments

The results of a tagging experiment carried out during 1991 were presented in a Working Document (Molloy, 1992b). Approximately 10,000 herring were tagged on the west coast of the Isle of Man. Over 160 fish have been recaptured to date. Approximately 32% of the recovered tags were taken in the main Celtic Sea fishery during the December-February period. Tagged herring first became apparent in the catches during December and became more numerous as the season progressed, suggesting a gradual influx of herring from the Irish Sea. The biological data of those herring recovered from the Celtic Sea indicated that over 95% were 2-winter-ring fish in stage VI maturity stage, i.e., probably first-time spawners. The maturity stages indicate that these herring belong to a winter-spawning component. As there is no evidence of any significant winter spawning of herring in the northern Irish Sea, it is most likely that these fish must originally have been born in the Celtic Sea and transported into the Irish Sea as larvae.

The implication of these results for stock assessment warrant further investigation because it is clear that catches of young herring taken west of the Isle of Man will have an effect on the mortality of 2-winter-ring herring in the Celtic Sea. The results should also be considered in relation to the acoustic estimates of 1- and 2- winter ring herring in the Celtic Sea.

4.6 State of the Stock

Recent meetings in the working group have been unable to produce estimates the size of the stock in this area because of difficulties in interpreting the larval surveys, doubts about the catch data, lack of recruitment indices, and the absence of a series of acoustic surveys. The 1991 Working Group did not carry out an analytical assessment of the stock because of the poor data. It did, however, conclude that, on the basis of the age distribution of the catches in recent years, the results of the 1990/1991 acoustic surveys and the recent larval surveys, the stock was in a healthy condition. The acoustic survey carried out during 1990/1991 gave an estimate of the spawning stock of about 90,000 t.

The present Working Group is again faced with extreme difficulties in carrying out an assessment of the stock. The available information can be summarized as follows.

1. The acoustic surveys carried out during 1991/1992 gave a <u>minimum</u> spawning stock estimate of about 77,000 t. This estimate does not include a large proportion of the autumn-spawning component.

2. The average age composition of the catches has continued to improve in recent years and shows a greater survival of older fish.

3. The fishing effort of the fleet in the area has remained very constant in recent years and has probably decreased slightly in 1991/1992 because of the absence of a number of the larger tank vessels, and the closure of the fishery on a number of occasions.

4. Reports and observations from fishermen again suggest a high stock level in the area.

The available information, therefore, suggests that the current stock size is at least as high as that indicated by the acoustic surveys of 1990/1991 and may be around <u>90,000 t</u>.

4.7 Management Considerations

The stock in this area can be defined according to the ACFM criterion as a stock whose state of exploitation cannot be precisely assessed. No stock size or recruitment estimates are available on which to make forecasts although the spawning stock is considered to be in a healthy state and around 90,000 t. The Working Group is unable to calculate any advised catch levels because of the uncertainty about the stock size. However, it appears desirable that the catch level should be stabilized until more precise information is available. A precautionary

TAC in line with that recommended by ACFM in 1991, but based on the revised catches is therefore suggested. The average catches during the last 5 years was about 22,700 t and this may be an appropriate level.

The Working Group considers that it is extremely important to continue to carry out acoustic surveys in this area, particularly in view of the history of the stock and the fluctuations that appear to have taken place. It is also important to obtain more information about stock distribution in view of the results suggested by the tagging experiment.

4.8 Evaluation of the Effects on Stock Size of Closures of Spawning Areas

The 1991 Working Group described the operation of the rotating box closure system of the spawning beds throughout the area. ACFM questioned the benefits that might arise from this measure and whether it was possible to evaluate them in terms of increases in spawning stock sizes.

The spawning box closure system was first introduced during the 1988/1989 season and continued for three seasons. The system was again introduced following a review by the Working Group and the area defined as Box A was closed from 1-15 November during the 1991/1992 season. Box B is scheduled to be closed from 1-15 November during the 1992/1993 season, while Box C is due to be closed during the 1993/1994 season.

Although some illegal fishing has taken place within the closed area during closed periods, fishermen have generally respected the regulations and consider them as a necessary method of conservation. They associate the closed box system with the increase which they claim has taken place in recent years in stock size in this area.

The Working Group was unable to quantify the effects that these measures may have had on the stock size in the area. This might have been possible if the whole area had been closed for fishing for a season and some estimates of likely decreases in fishing mortality could have been estimated. However, under the present system this does not appear possible because the effort previously exerted on a closed area may be changed to an alternate area.

The original aim of the spawning box closure system was to ensure that a portion of the total stock would be able to spawn each year without being subjected to fishing. The Working Group considers that the measures should be retained until after the 1993/1994 season.

A larval survey, planned to take place during November in Box A, did not take place because of bad weather. However, the results of the commercial sampling did suggest that spawning would have taken place in the area during the closed period. The maturity distribution of samples obtained from catches taken from Division VIIg during October and November 1991 would suggest that the closure dates (1-15 November 1992) are appropriate for that area.

5 WEST OF SCOTLAND HERRING

5.1 Division VIa (North)

5.1.1 ACFM advice applicable to 1991 and 1992

The ACFM recommended TAC for 1991 was 57,000 t and the agreed TAC was 62,000 t, corresponding to a fishing mortality of 0.25. No long term gains in yield can be expected from higher levels of F. On the assumption that the agreed TAC would be taken in 1991, ACFM recommended a TAC in 1992 of 62,000 tonnes.

5.1.2 The fishery

The catches reported for each country are given in Table 5.1.1. The total catch in 1991 was 50,606 t compared with the TAC of 62,000 tonnes. This is the fourth year in succession where the TAC was not reached, but there is no evidence that this reflects any difficulties encountered by the fleets in reaching their quotas.

The estimates of discards shown in Table 5.1.1 are derived from only one fleet. Discarding is thought to occur in the other fleets but no estimates are available.

The distribution of the catches per quarter for the Dutch, Irish and United Kingdom fleets are shown in Figure 4.2.1a-d.

In addition to the catches shown in Table 5.1.1, the Faroese fishery in Area V caught approximately 6700 t of herring in 1990 and approximately 16000 t in 1991. The stock identity of these fish is unknown, but they may belong to the VIa(north) stock.

5.1.3 Catch in numbers at age

Age composition data for 1991 were available from Scotland and the Netherlands. In previous years only the Dutch data were used to convert unsampled catches to numbers at age, because the Scottish figures include catches from the Minch fishery which is not exploited by other fleets. However, this year Dutch data were available only for quarter 3, so unallocated catches and catches by Ireland, Germany, France, Norway, England & Wales and the Faroe Islands were converted to numbers at age using the combined Dutch and Scottish data, covering quarters 1, 3 and 4. For unsampled catches during quarter 2, the combined catches at age for quarters 1 and 3 were used to estimate numbers at age. The catches by quarter and the percentages for which age composition data were available are shown in the text table below.

Quarter	Catch ('000 t)	% sampled
1	3,152	98.5
2	2,087	0.0
3	33,139	79.0
4	12,229	51.9

The sampling effort used to derive the catch in numbers is summarised in Table 5.1.2. The estimated catch in numbers at age for the years 1970-1991 are given in Table 5.1.3.

5.1.4 Larvae surveys

A total of 193 samples were taken in Division VIa(N) in 1991 compared with 367 samples in 1990. This is largely the result of poor weather during the survey period, although the overall effort invested in the larvae surveys continues to decrease (see Section 2.5).

The sampling period recommended in Anon.(1990) for the calculation of the LPE in this area is compared with the available samples below:

Recommended period	Available samples	n
	06 - 14/09	100
15/09 - 07/10	15 - 17/09	24
	13 - 19/10	69

The requirements for the calculation of the LAI compared to the available data are as follows:

Time periods required for		Available samples	n
Full index	Reduced index		
01 - 30/09	01 - 30/09	06 - 17/09	124
01 - 31/10		13 - 19/10	69

Last year, sampling is considered insufficient to calculate a reliable LPE and only the LAI was used to tune the assessment. Both the LPE and LAI estimates have deteriorated in quality this year. The acoustic survey estimate for this area also needs to be treated with caution (see Section 5.1.5). In the absence of more reliable information, it was decided to use both the LPE and LAI for the assessment this year, including the LPE estimate from the 1990/91 survey.

The updated series of indices are shown in Table 5.1.4.

5.1.5 Acoustic survey

Acoustic surveys were carried out in Division VIa(N) during November in 1985-1987, during December in 1988 and during January in 1990. These surveys were often severely disrupted by poor weather, and only the result of the 1987 survey was considered reliable. However, the 1991 Working Group found that the results of its assessment were inconsistent with the biomass estimated from the 1987 survey, and speculated that one reason might be a migration of adult herring between VIa(N) and the North Sea. In 1991 the survey period was changed to July, both to avoid disruption by poor weather and to allow concurrent estimates of stock size in the North Sea and VIa(N).

The acoustic survey was carried out by FRV "Clupea" from 13 - 26 July and covered the area between 56°N and 60°N and between 04°W and 10°W. Echotraces were allocated to the categories "definitely herring", "probably herring" and "other fish species", but fishing operations were unsuccessful in providing samples to confirm these. In the absence of trawl samples, herring biomass was calculated using length composition and weight relationships obtained from the trawl samples taken by FRV "Scotia" south west of Orkney in the same month during the acoustic survey of the North Sea (Simmonds *et al.*, Working Document 1992).

Clearly the biomass estimates must be treated with caution. First, the allocations of echotraces to species were not verified. Secondly, the length distributions in VIa(N) may have differed from those in Orkney/Shetland, generating errors in the estimates of mean target strength. Length - weight relationships may also have differed between the areas, though this is unlikely to be a major source of error. Estimates of age composition would be even more tentative. They are used only to subtract the estimated biomass of 1-ringers and immature 2-ringers in order to estimate the spawning stock biomass (SSB).

The total biomass estimate from the "Clupea" survey is 475,000 tonnes, of which 80% were in the "definitely herring" category and 20% in the "probably herring" category. Combining the results with the FRV "Scotia" survey in the area of overlap, the total biomass estimate in Division VIa(N) is 517,000 tonnes and the SSB estimate is 446,000 tonnes.

The series of survey estimates of biomass are given in the following table:

Year	Month	Estimated SSB (t)
1985	November	225,000
1986	November	297,000
1987	November	364,000
1988	December	326,000
1990	January	No estimate
1991	July	446,000

These are estimates of biomass at the time of the survey. The November surveys can be considered estimates of SSB at spawning time, but for the July survey an adjustment must be made. This was done by assuming an annual natural mortality rate of 0.1 over the period 1 August - 1 October and subtracting the catch over the same period, assumed to be two thirds of the catch in the third quarter. For simplicity the catch was assumed to have been taken in the middle of the period 1 August - 1 October. The final acoustic estimate of SSB at spawning time in 1991 is 417,000 tonnes.

5.1.6 Recruitment

For the reasons stated in Section 5.1.5, the acoustic survey results cannot be used to provide estimates of recruitment. As was the case for last year's assessment, the only information available on recruitment is the index based on the mean catch rate of 2-ringers in statistical rectangles 46E4-E6, 47E4-E6, 44E3-E4 and 45E3-E4 during the bottom trawl survey carried out by Scotland in March each year.

The series of indices and the number of hauls used in their calculation are shown in Table 5.1.5. Figure 5.1.1 shows the relationship between the natural logarithm of the indices and the corresponding VPA estimates of 2-ringer abundance for the years 1981 - 1990. This relationship is poor and can be used only to provide an indication of very good recruitment.

5.1.7 Mean weight at age

Weight at age data from the 1991 fishery were available from Scotland and the Netherlands and are shown in Table 5.1.6. The mean weights at age in the stock, also shown in Table 5.1.6., are those used in previous years.

5.1.8 Description of the assessment method

Last year, the tuning procedure used the relation between VPA estimates of SSB and the two series of larvae indices to predict SSB for the most recent 3 years using the RCRTINX2 program.

This procedure was repeated this year. The series of LPEs and LAIs from 1973 to 1987 were regressed with estimates of SSB from last year's assessment using the RCT3 program, and the LPEs and LAIs for 1988 - 1991 were used to predict weighted average predictions of SSB from 1988 - 1991.

Individual plots of LAI and LPE against SSB are shown in Figures 5.1.2 and 5.1.3. The fitted lines are based on the regressions calculated by RCT3. The outlying LPE point for 1986 is likely to be because the long term mean Z/K value was not appropriate for that year, the rate of transport of larvae from Division VIa(north) to the North Sea being very variable. This point was included in the analysis, but does not seem to unduly affect the regression over the range of values more commonly observed.

The series of acoustic survey estimates were not included in the RCT3 analysis because the estimates are too recent to establish any relationship with the converged part of the VPA. In any case the LPE and LAI indices are not independent, so that the larvae surveys would be implicitly given extra weight if included with the acoustic series. Instead, the acoustic survey estimates of SSB in 1987 and 1991 were used directly. The other acoustic surveys were considered to have been too disrupted by poor weather to provide useful estimates and were rejected. A disadvantage of this approach is that the acoustic estimates are treated as absolute estimates of SSB without any verification by comparison with a converged VPA.

The input F chosen for 1991 was the one which minimised the sum of squared residuals between the survey estimates of SSB and those derived from the VPA for 1987 - 1991. Two methods were compared. The first method was identical to that used for last year's assessment and used only the estimates of SSB from the larvae surveys, with the residuals weighted by the squared standard errors of the predicted SSBs from RCT3. The second method used the SSB estimates from both the larvae surveys and acoustic surveys. However, the standard errors of the acoustic survey estimates of SSB are unknown, so the unweighted residuals were used to calculate the sum of squares.

As stated in Section 5.1.2, catches by the Faroese fishery in area V were significant in 1990 and 1991. Since these may be fish belonging to the VIa(north) stock, the above tuning procedures were carried out using catch in number data both including and excluding these catches.

5.1.9 Results of the assessment

Separable VPAs were run to examine the catch data with all years prior to 1986 downweighted to 0.001. With a reference age of 3, SVPAs were run with terminal S values of 0.8, 1.0 and 1.2. Each case produced a dip in the exploitation pattern at age 7. From an examination of the residuals from the SVPA (Table 5.1.7) this seems to be due to the anomalous catches of the 1978 year class (as 7 ringers) in 1986 and (as 8 ringers) in 1987, and of the 1979 year class in 1987 and 1988 (Table 5.1.3). This may indicate a problem in ageing the fish, particularly as similar anomalies are evident in some of the earlier years. The SVPA with a terminal S of 1 was accepted.

The results of the RCT3 analysis are given in Table 5.1.8. As would be expected from an examination of Figures 5.1.2 and 5.1.3, the LAI is given much more weight for all the estimates of SSB. The SSB estimates used in the tuning procedure are summarised in the text table below:

Year	1991 VPA	Pred. SSB	SE	Acoust.SSB
1987	219	-	-	364
1988	354	323	.49	-
1989	350	292	.43	-
1990	361	285	.43	-
1991	-	284	.39	417

Separable VPAs were run over a range of terminal fishing mortalities. In each case the fishing mortalities based on the terminal populations were used to run a series of VPAs. The weighted sum of squared residuals between the SSBs estimated by the VPA and those predicted using RCT3 was minimised at F=0.25. The unweighted sum of squares using the SSB estimates from both RCT3 and the acoustic surveys was minimised at F = 0.20. The behaviour of both types of sum over the range of fishing mortalities 0.17 - 0.30 is shown in Figure 5.1.4.

Including the Faroese catches in area V in 1990 and 1991, the residuals were minimised at F = 0.34 using only the larvae surveys and at F = 0.27 using both the larvae and acoustic surveys.

The trends in SSB using the fishing mortalities in 1991 estimated by each of the tuning methods on each set of catch data are shown in figure 5.1.5. The effect of including or excluding the acoustic survey estimates of SSB in 1987 and 1991 on the VPA estimates of SSB in the most recent years is much greater than the effect of including or excluding the Faroese catches in 1990 and 1991.

Although all the tuning options suggest that stock size may be decreasing, this is simply a consequence of using the same tuning information and should not therefore be taken as evidence of a reliable result. The larvae indices are thought to be of poor quality because of the very large reduction in sampling effort, and the acoustic survey estimate in 1991 is thought to be unreliable because of the failure of trawling operations during the cruise. The identity of the Faroese catches seems to be of relatively minor importance.

Detailed results of the assessment are given in Tables 5.1.9 - 5.1.11 and in Figures 5.1.6A and B. These are arbitrarily based on a terminal F of 0.20 and catches which exclude the Faroese catches in area V.

5.1.10 Projection

The parameters used in the projections are given in Table 5.1.12. From the yield per recruit calculations $F_{0.1}$ was estimated at 0.15. From the plot of stock and recruitment (Figure 5.1.7), F_{med} was estimated at 0.38.

In view of the uncertainties in the assessment, projections have been made only for 1993, assuming status quo fishing mortalities (F_{sq})over a range of possible stock sizes in 1991. The status quo fishing mortalities were defined as the mean fishing mortality of 3- to 6-ringers ($F_{3\text{-}6}$) over the years 1989 -1991. Recruitment was assumed to be the geometric mean of 2-ringer abundance over the years 1980 - 1989. As in previous years 1-ringers were excluded from the projection. This is because 1-ringers are partly exploited in the North Sea, so the catches do not reflect year class strength.

Assuming that the agreed TAC of 62,000 t would be taken in 1992, the catches in 1993 corresponding to the status quo fishing mortalities are summarised in the text table below.

1991			1992			1993		
Terminal F	SSB	$F_{3\text{-}6}$	SSB	$F_{3\text{-}6}$	Catch	F_{sq}	SSB	Catch
0.20	295	.201	328	.225	62	.200	322	54
0.25	234	.260	269	.270	62	.241	266	54
0.27	284	.279	314	.232	62	.229	307	58
0.34	222	.352	253	.288	62	.277	249	57

Note that the VPA runs with F in 1991 of 0.27 and 0.34 were carried out using the catch in number raised by the Faroese landings in Area V, but the assumed catches in 1992 do not include any estimate of catches in Area V.

Regardless of the tuning procedure adopted, the catches corresponding to the status quo fishing mortalities are within the range 54 - 58 thousand tonnes. However, this assumes average recruitment for the years 1991 - 1993 even though there is some evidence from the bottom trawl index, albeit rather weak, that recruitment in 1991 may be below average (Section 5.1.6).

A detailed output assuming the TAC will be taken in 1992 and F_{sq} in 1993 is shown in Table 5.1.13.

5.1.11 Management considerations

The assessment carried out by the Working Group in 1991 suggested that the stock size was increasing. This year's assessment suggests that the stock size is decreasing. This reflects the deterioration in the quality of the fishery independent information used to tune the assessment. Despite these limitations, the available evidence suggests that the stock is not in any immediate danger if current catch levels are maintained.

5.1.12 Research and data requirements

Although there is no immediate cause for concern, the substantial revisions to the estimates of stock size, and even to trends in stock size, in successive assessments emphasise the need for improved fishery independent information. The larvae surveys have performed well when sampling effort was adequate and they should be continued. Despite the problems encountered during the acoustic survey in VIa(north) in 1991, the acoustic surveys in July can potentially provide valuable estimates of biomass in VIa(north) at the same time as in the North Sea, as well as providing an estimate of recruitment as 2-ringers.

5.2 Clyde Herring

5.2.1 Advice and management applicable to 1991 and 1992

The herring exploited in the Firth of Clyde consist of a mixture of stocks: the indigenous spring-spawning stock which spawns on two known spawning grounds in March-April; immigrant autumn-spawning herring from adjacent areas (Divisions VIaS+ VIIb,c; Division VIIa; Division VIa N) which do not spawn in the Clyde. During certain parts of the year, the spring and autumn-spawning stocks cannot be reliably distinguished on the available biological criteria and the assessment and management of Clyde herring is therefore based on the spring and autumn-spawning stocks combined. The TAC given by ACFM thus relates to the combined stocks. ACFM recommended a TAC of 2,900 t for 1991 and this was adopted by the management body. Directed fisheries for herring were closed from 1 January-15 April with an allowance of 200 t within the closure period.

For 1992 ACFM gave a range of options from 1,600-2,700 t and indicated a preference for a TAC of 1,600 t based on *status quo* fishing mortality. The management body adopted a TAC of 2,300 t and extended the closure period up to 30 April in line with advice from ACFM. Once again, there was an allowance of 200 t within the closure period.

As an additional measure under national legislation, the spawning grounds at Ballantrae Bank were closed to all forms of active fishing (including scallop dredging) from 1 February-30 April to prevent disturbance to pre-spawning and spawning shoals and to protect the spawn beds themselves.

5.2.2 The fishery in 1991

Landings in 1991 decreased to their lowest recorded level (Table 5.2.1). The total landings are estimated to be 731 t. There were no reports of discarding in 1991. Of the total landings, 474 t were taken by pair trawlers in a directed herring fishery from July-December, and 239 t as by-catch in demersal trawl fisheries in all months except May and June.

Monthly samples were taken mostly from the demersal trawl by-catches (Table 5.2.2). Assuming that there was no discarding in 1991, the catches in number at age of spring- and autumn-spawners combined over the period 1970-1991 are given in Table 5.2.3. Five ring herring were the most abundant age group in the landings, making up 46%. The contribution of this year class, however, was 69% in 1989 and 65% in 1990. Estimated numbers in each 1/2 cm length group are given for 1988-1991 in Table 5.2.4.

The number of days absence from port by pair trawlers is given in Table 5.2.5. An index of total effort directed at herring was obtained by raising the days absence by pair trawlers by the ratio of total to pair trawl landings. Effort decreased to its lowest recorded level in 1991.

5.2.3 Weight at age and stock composition

Weights at age in the catch are given in Table 5.2.6. They were unusually low for all age groups in 1991 and this may have been partly due to a low condition factor.

The mean weights at age in the stock given in last year's report were assumed to be the same as the weights in the catch. In this report the stock mean weights at age refer only to the indigenous spring-spawning stock at spawning time (March). However, the weights in the catch in March 1991 are not appropriate because the samples contained a proportion of fish at maturity stage VIII (i.e. recovering spents). The mean weights in the stock given in Table 5.2.6 are those for February, in which month the samples contained almost entirely fish at stages IV, V and VI. For comparison, mean weights are also given for a research vessel sample taken on the spawning grounds in March 1991. However, this sample contained very small numbers of age groups other than 5-ringers, so the mean weights of other age groups in this sample are very poorly estimated.

Monthly maturity data for 1991 are given in Table 5.2.7. Using the race/maturity key given in Table 5.2.8, the percentages of spring spawners in the catches in each month are given in Table 5.2.9. While spring spawners predominated in January and February, the percentages are much less certain for the rest of the year, largely because of the uncertainties about the racial identity of some maturity stages in some months. Overall, however, the analysis indicates that spring spawners predominated in most months, with spring spawners constituting somewhere between 54.5 and 93.0% over all months combined.

Further quantitative information on the racial composition of the landings can be obtained from the monthly age compositions (Table 5.2.9). In February, when fish at maturity stages IV-VI (i.e. spring spawners) made up 95% of the catch in number, 5-ringers made up 93% of the catch of 3-ringers and older. Research vessel samples taken on the spawning grounds in March, moreover, contained 90.5-95.5% of this age group (Gibb, working document). Over the period March-December this age group contributed 53% to the catches in number. This implies that the mean percentage of spring spawners in the catches was considerably less than in February. The percentage of spring spawners cannot be reliably calculated using age data alone, however, because the origin of the autumn spawners in the Clyde is not known. The age composition in the Clyde catches in 1991 is compared with that in adjacent stocks in Table 5.2.10. From this it is clear that 5-ringers (the 1985 year class of autumn spawners) were also predominant in Divisions VIa S and VIIb,c and prominent in Divisions VIa N and VIIa. The decrease in percentage of 5-ringers in the Clyde catches could thus be due to a wide range of alternative possibilities.

To provide a very rough estimate of the number of spring spawners caught in 1991 it has been assumed that the decrease in percentage contribution of 5-ringers between February and the rest of the year is entirely due to dilution by a stock with equal number of each age group. By comparison with the contribution of this year class in February, the mean proportion of spring spawners in the catches is estimated to be $0.53/0.93 = 0.58$. For the reasons given above, this may be an overestimate of the true proportions. However, the maturity data suggest that the proportion of spring spawners cannot have been very much less than 55%.

5.2.4 Surveys

No further acoustic surveys of Clyde herring were carried out in 1991.

Grab surveys of the two known spawning grounds (Ballantrae Bank and Brown Head (South Arran)) were carried out over the period 8-26 April 1991. From the development stages of eggs sampled spawning was estimated to have started around 3 April at Ballantrae Bank and around 10 April at Brown Head. Length and age compositions of herring sampled in both areas are given in Table 5.2.11. As in 1990, the 1986 year class predominated in both areas and there was no evidence of any significant recruitment to the spawning population since that of the 1986 year class.

From the areas covered by the egg mats and the mean number of eggs per m^2, the estimated numbers of eggs spawned in each area were:

362 (+/-14) x 10^9 at Ballantrae Bank
490 (+/-32) x 10^9 at Brown Head

Total = 852 x 10^9 in both areas combined.

Using length-weighted fecundities obtained in September-December 1989 and a weight/length relationship obtained in March 1991, and assuming a 1:1 sex ratio, the spawning biomass in 1991 is estimated to have been: 2984 t at Ballantrae Bank, 3976 t at Brown Head and 6,960 t for both areas combined. This compares with an estimate of 6,730 t in 1990. Estimated numbers at age in 1990 and 1991 are given in Table 5.2.12. The total number of spawners in 1991 is estimated to have been 32.3 million, which compares with 39.9 million in 1990.

Since the egg survey estimates take no account of egg predation and since spawning in other parts of the Clyde, and at other times of the spring, cannot be ruled out, these estimates are likely to be conservative. However, from the historic distribution of spawning in the Clyde, it is not thought likely that there is major spawning other than at Ballantrae Bank and Brown Head. The presence of stage VI fish in commercial samples in February and March (Table 5.2.7) indicates that some spawning occurred prior to the egg survey, but the amount of this appears to be small in relation to spawning in April when the egg surveys were carried out.

5.2.5 Stock assessment

The egg survey estimates have been used to provide a stock size in number for the spring-spawning stock at 1 April 1991 (Table 5.2.13). Accurate estimates of the catch in number of this stock are not available. However, assuming that the catch in number of spring spawners was 58% of the total catch in numbers (see Section 5.2.3), the catch in number at age can be estimated very approximately by allocating the total by the age composition in the spawning area at spawning time. Using values of M of 0.15 for age 3 and 0.075 for older herring and catches for the period April-December, fishing mortalities and the numbers at age surviving at 1 January 1992 are given in Table 5.2.13. In confirmation of the predicted age composition in 1992 a single sample taken on the spawning grounds in March 1992 contained predominantly fish around 28-29 cm. The age composition of this sample is not yet available, but from the length composition it clearly contained a negligible proportion of recruiting 3-ringers. The number of 3-ringers in 1992 has therefore been assumed to be the same as in 1991, i.e. 250 thousand.

On the basis of this assessment, the spawning stock is estimated to be about 6,000 t at 1 January 1992, and the fishing mortality to be about 0.064 in 1991.

5.2.6 Stock and catch projections

The estimated stock size of spring spawners at 1 January 1992 is given in Table 5.2.14. These estimates are very uncertain, and there is no firm basis on which to predict the catches of this stock in 1992. The Working Group has therefore made no catch prediction for 1993. However, the stock is at present composed almost entirely of the 1986 year class and there appears to have been no significant recruitment in 1992. Stock projections have therefore been carried out to indicate the expected decrease in spawning stock at different levels of fishing mortality. These are given in the text table below:

Year	$F=0$	$F=F_{1991}=0.064$	$F=0.15\approx F_{1990}$[1]
	SSB	SSB	SSB
1992	5,800	5,800	5,800
1993	5,850	5,490	5,040
1994	5,360	4,720	3,980
1995	4,900	4,060	3,150

[1]1991 ACFM report gives 0.16.

This shows the predicted changes in catch and spawning stock size if recruitment continues at its recent low level. In all scenarios, including a total ban on fishing, the stock is expected to decrease, the rate depending on the level of fishing mortality.

Prediction of the catch of autumn spawners in the Clyde in 1992 is problematic. These fish belong to a mixture of stocks from other areas, autumn spawning in the Clyde is negligible and the level of immigration probably varies considerably from year to year.

In the last few years, the percentage contribution of autumn spawners in the total catch in number has been very approximately estimated by previous working groups to be:

1988	ca 50%	
1989	27%	
1990	25-40%	
1991	7-45%	(42% assumed).

5.2.7 Management considerations

In the historic past the herring stocks in the Clyde were much larger and supported an annual catch averaging 8,000 t from 1955-1974. The prospects for a recovery to these levels are not known. However, recent recruitment to the spring-spawning stock has been at a very low level and good year classes have been both infrequent and unpredictable. Studies on the spawning grounds have shown that survival of eggs has been low as a result of disturbance of the spawn and substrate by storms (Morrison *et al.*, 1990) and, in one case, as a result of mass mortality caused by settlement of floc from decaying diatom blooms on the spawn beds (Morrison *et al.*, 1991). It thus appears that the timing of spawning may be critical to egg survival. However, if an improvement in the conditions for egg and larval survival occurs, then the chances of recovery based on better recruitment may depend on the spawning by the surviving members of the 1986 year class.If the recent poor recruitment continues, then it is clear that the stock will decline, and that the rate of decline will depend on the fishing mortality.

In recent years the fishery has been dependent on a mixture of both spring and autumn spawners. There is no basis on which to estimate the catch of autumn spawners in 1993.

In addition to controls on catch, some protection of the spring spawning stock can be achieved by restricting directed herring fishing in the Clyde during the period 1 January-30 April when spring spawners assemble for spawning. Closure of the spawning grounds themselves to all active forms of fishing also provides protection to the beds of spawn and to the spawning shoals.

5.2.8 Future research requirements

If the management of the Clyde herring fishery is to be put on a firmer basis it is necessary to have:

1. Fishery independent surveys of the spring-spawning stock and if possible the total exploitable stock each year. The egg surveys in the last two years have given fairly precise estimates of the population spawning on the two main spawning grounds, and it would seem appropriate to maintain these.

2. Research into stock separation of herring in the catches. This would make it possible to assess and predict the spring- and autumn-spawning components independently. In this connection, examination of the

daily growth ring structure of the otoliths may be worth investigating as pointed out in the Report of the Workshop on Methods Forecasting herring catches in Division IIIa and the North Sea (*Anon.*, 1992).

6 HERRING IN DIVISIONS VIA (SOUTH) AND VIIb,c

6.1 The Fishery

6.1.1 Advice and management applicable in 1991

The TAC set for this area for 1991 was 27,500 t which was the same as for 1990. The total catch estimated to have been taken in 1991 was about 37,600 t which was 6,400 t (14%) less than in 1990. This total catch was, as it has been every year since 1982, considerably higher than the recommended level. In general, the agreed TACs for this fishery in recent years have been in close agreement with the recommended figures.

The main catches attributable to any nation was again taken by Ireland. The catches taken by the Irish fleet were regulated by weekly boat quotas and no fishing was permitted from mid-June to 1 August. Over 11,000 t were placed in the "unallocated" category and, as in recent years, considerable quantities of herring (estimated to be over 8,400 t) were believed to have been taken in Division VIa (South) but were reported as having been taken in Division VIa (North). These catches have been included in the catches in numbers at age for Division VIa (south) and Division VIIb,c.

6.1.2 Catch data

The catches taken by each country fishing in this area from 1982-1990 are shown in Table 6.1.1, together with the preliminary figures for 1991. It has not been found necessary to make any revision to the 1990 catch data. Estimates of herring caught but discarded at sea have been included for 1991 but are only available for the Dutch Fleet. The quantities of herring discarded by the Irish Fleet are not known but are believed to be small.

The location and distribution of the main fisheries, both by the Irish and Dutch fleets, were similar to those of recent years. The landings from the "roe" fishery which was developed in 1990 by the Irish Fleet were not as substantial during 1991 as in the previous year - mainly because of a poor demand on the Japanese market. The fishery for spawning (stage VI) herring, however, extended well into December and it appeared that spawning may have been spread out over a longer period than usual. The distribution of the Irish and Netherlands catches per quarter together with the unallocated catches are shown in Figure 4.2.1a-d. The composition and fishing pattern of the Irish fleet has remained very stable in recent years and the fishery in general has been considerably restricted by lack of markets.

6.1.3 Catches in numbers at age

The catches in numbers at age for this fishery since 1970 are shown in Table 6.1.2. No revisions have been made to the 1990 data. The catches in numbers at age have been based mainly on samples from the Irish fishery throughout the year, together with a small number of samples from the Dutch fishery during the third quarter. The age compositions of both the Irish and Dutch catches were dominated by the 1985 year class, which constituted over 44% of the total number caught. This year class has been well represented in all areas throughout the year and is also a feature of the catches from Divisions VIa (North) and Division VIIj. The 1986 year class (5.5%) appears to have been a comparatively weak one, but the 1987 and 1988 year classes both appear to be well represented. In general, the age composition of the catches would appear to represent a stock which is in a healthy state.

6.1.4 Quality of catch and biological data

Although there are considerable quantities of unallocated and misreported catches, there appears to be reasonable confidence in the overall estimate for the total landing figure. The total amounts of discards is not known but is not believed to be significant. The level of biological sampling from the area appears to be satisfactory, although no samples were obtained from the Irish catches taken during December 1991 when over 6,000 t were landed. The number of samples and biological data are shown in Table 6.1.3 and the length distributions of the catches taken by the Irish fleet per quarter are shown in Table 6.1.4.

6.2 Mean Weights at Age

The mean weights (g) at age in the catches are based on a combination of Irish and Dutch data and are shown below compared with those for 1989 and 1990:

Year	Age							
	1	2	3	4	5	6	7	8
1988	-	88	133	153	166	171	183	191
1989	80	130	141	164	174	183	192	193
1990	94	138	148	160	176	189	194	208
1991	89	134	145	157	167	185	199	207

There appears to have been little change in the mean weights in recent years and the 1991 values have been used to update the VPA data set.

The mean weights for the stock at spawning time are based on Irish samples taken from the fishery for spawning fish during September to November. As has previously been pointed out (*Anon.*, 1991), the mean weights at spawning time calculated for 1989 had shown a sudden decrease of approximately 20% on the values for the previous year. The values obtained for 1991, which are shown below together with those from 1988 - 1990 are very consistent with those obtained for 1989 and 1990. There does not yet appear to be any satisfactory explanation for the sudden decrease which occurred between 1988 and 1989.

Year	Age							
	2	3	4	5	6	7	8	>8
1988	164	206	233	252	271	280	296	317
1989	157	168	182	200	217	227	238	245
1990	152	170	180	200	217	225	233	255
1991	149	174	190	195	206	226	236	249

6.3 Larval Surveys

No larval surveys have been carried out in this area since 1989.

6.4 Young Fish Surveys

Young fish surveys were carried out in Divisions VIa(S) and VIIb from 1981-1988. No surveys were carried out during 1989, but the series was resumed in 1990 and continued in 1991. The original surveys, which were designed to obtain an index of recruitment for herring and mackerel, have been extended to provide an index for abundance for demersal fish. The results from the surveys have been very difficult to analyze, mainly because they have been carried out by a number of commercial vessels using a variety of gears. The 1991 survey was, however, carried out by the R/V "Lough Foyle" using a rock hopper trawl with a small mesh cod-end liner. 27 stations were fished before bad weather brought a premature end to the survey.

A comparison of the results based on the average catches from a small number of standard herring stations is shown in Table 6.5.1. The results have been compared with the number of recruits from VPAs but do not appear to give any indication for recruitment patterns - although the strong 1985 year class did show up as high numbers of 1-winter-ring fish in 1987.

Nevertheless, it is felt that these surveys should be continued because it is now likely that future surveys will be carried out using the R/V "Lough Foyle" and with standardized gear.

6.5 Results from Tagging Experiments

The results of the tagging experiment have been presented in a Working Document (Molloy, 1992b). Even though some further recoveries may yet be made the majority of the tags recovered to-date were from the extreme south of Division VIa and extreme north of Division VIIb. A small number of tags were recovered from the southern part of Division VIIb while a further small number were recovered from the northern part of Division VIIj. The results so far would, therefore, indicate some movement of fish in a southerly direction and a certain degree of mixture between herring from Divisions VIa (south), VIIb and VIIj. However, it is not yet possible to decide to what extent this mixing should be taken into consideration when the assessments of the relevant populations are made.

6.6 Stock Assessment

In the absence of any fishery-independent data, recent working groups have been unable to carry out any analytical assessment of this stock. The 1991 Working Group did, however, carry out a VPA in order to study historical trends during the period in which convergence had occurred. The VPA was also used to obtain some indication of F for different levels of catches. It was suggested that the F level during the last period when it could be estimated with any confidence (i.e., the 1985-1986 period) was around 0.2. At that time the SSB appeared to be around 177,000 t. The Working Group was unable to determine with any degree of confidence how the stock had developed since then, although it was assumed that the SSB level in 1991 may have been around the average level of that between 1980-1986, i.e., around 133,000 t.

The present Working Group has no additional data on which to make any further assessment of the stock. A VPA was carried out to update the historical data but has not been included in the report. Apart from the age distribution of the catches, which indicate that the stock is in a healthy state, there is no other information to indicate how the stock has developed in recent years.

6.7 Management Considerations

In 1991 ACFM did not consider that there were sufficient data available on which to make an assessment on this stock. Predictions were, therefore, not carried out. Instead, ACFM recommended that the catch levels for 1992 should be stabilized at the average level of catches taken during 1988 and 1989, i.e., about 29,000 t. It was decided that the high catches taken during 1990 (43,000 t) should not be included because this high catch had been the result of a rapid development of a "roe" fishery.

The present Working Group is faced with the same situation as that of last year and is, therefore, unable to carry out any meaningful assessment. However, the available biological information (e.g., age compositions) would suggest that the stock is in a healthy condition and reports from fishermen indicate substantial concentrations in the area in recent years.

According to the categories defined by ACFM in November 1991, the stock could be classified as 3B, i.e., one in which the state of exploitation cannot be precisely assessed. It is, therefore, difficult to formulate any management advice based on the state of the stock. A VPA carried out to obtain some information on the historical development of the stock suggested that the spawning stock from 1981-1987 averaged around 132,000 t. The development of the stock since then is not known but presumably it increased in 1988 because of the recruitment of the very strong 1985 year class.

The Working Group has previously drawn attention to the high catching power of the fleet in this area and also the potential for a roe fishery if market conditions improve. In these conditions and in the absence of adequate biological data on current stock size and recruitment, the Working Group would suggest that the TAC should be stabilized at the level recommended by ACFM in 1991, i.e., 29,000 t.

6.8 Future Research Requirements

The Working Group would again express their concern about the lack of data on the stock in this area. It is imperative, if assessments are required, that adequate fishery-independent surveys on the adult stock and on recruitment strengths are available.

7 IRISH SEA HERRING (DIVISION VIIA, NORTH)

7.1 The Fishery

7.1.1 Advice and management applicable to 1991

The 1990 assessment, based on analysis of data up to 1989, indicated that the SSB of the combined Manx and Mourne stocks would show a small decrease in 1991 if catches were held at approximately 7,000 t. ACFM recommended a TAC of 5,600 t to reduce fishing mortality by 20 percent, and the EC subsequently adopted a TAC of 6,000 t for the 1991 fishing season. This was partitioned as 1,560 t to the Republic of Ireland and 4,400 t to the UK. The quotas were partitioned as follows: Anglo-North Irish Fish Producers Organisation (ANIFPO) 828 t; Northern Ireland Fish Producers Organisation (NIFPO) 2,316 t; Scottish Fishermen's Organisation (SFO) 190 t; Fish Producers' Organisation (FPO) 420 t. In addition 237 t were allocated to the non-sectoral industry and 449 t to the Mourne skiff (gill net) fishery. Of the non-sectoral allocation 201 t appears to have been transferred to FPO. The spawning closures were retained for this year.

The UK fishery opened in the third week of June. The closed area to the east of the Isle of Man (encompassing the Douglas Bank spawning ground) closed on the 21st September until the end of the year. The Mourne shore fishery (skiff fishery) opened on 2nd September and closed on 15th October. Fishing from the Republic of Ireland was regulated on a weekly vessel quota basis within the period of the second week in August to the end of September.

7.1.2 The fishery in 1991

The catches reported from each country fishing for herring in Division VIIa (North) from 1980-1991 are given in Table 7.1.1. The reported landings make no allowance for under-reporting, discards or slippage. The total catch of 4,398 t in 1991 was below the TAC of 6,000 t agreed by the EC for Division VIIa (North), because the Republic of Ireland took only 5% of their quota. The reason was given as a lack of fish in the area at the beginning of August resulting in vessels moving elsewhere. The vessels did not return later in the year when herring were apparently more available. The extent of discarding throughout this fishery is still unknown.

The fishery remained open through December but the non-sector fishery was closed in September. The majority of landings in 1991 were in the third quarter (81%) which is the normal pattern for this fishery. Approximately 16% of the landings were in the fourth quarter, a lower figure than in the previous year. In 1991 approximately 9% of the landings were to offshore vessels. The catch taken prior to spawning was 3,671 t in 1991 compared with 4,645 t in 1990. The distribution of catches by quarter of the UK, Northern Irish and Republic of Ireland fleets are shown in Figure 4.2.1a-d.

7.1.3 Quality of catch and biological data

One incidence of over-reporting was recognised in 1991 and corrected at source. Under-reporting is suspected to have been high in some years, and there are still no estimates of quantities of herring discarded. There is good biological sampling of landings from this fishery (Table 7.1.2), and in 1991 there was one sample per 32 t landed and one fish aged per 7,000 fish landed. The absence of samples from 1st quarter landings, 2nd quarter landings into Northern Ireland and landings to offshore vessels in quarters 3 and 4 will have had relatively little effect on the accuracy of the estimated length- and age-compositions of the overall landings.

7.1.4 Catches in numbers at age

Catches in numbers at age are given in Table 7.1.3 for the years 1972 to 1991. In 1991 the dominant groups were the 2,3 and 5 ringers (year classes produced in the autumns of 1988, 1987 and 1985). The above-average 1985 year class was still prominent in the catches. The catch in numbers at length is given in Table 7.1.4 for the years 1988 to 1991. The modal length was at 26 cm which is consistent with the presence of the strong 1985 year class. Over the period 1988 to 1991 large herring of 30 cm and greater have become more poorly represented in the catches, possibly as a consequence of the presence of the strong 1985 year class or of an overall decline in growth rate.

7.2 Mean Length, Weight, and Maturity at age

Mean lengths at age were calculated for the third quarter using the data from Northern Ireland and are given in Table 7.2.1 for the years 1985 to 1991. In general, mean length at age have remained fairly stable except for 5-ring and older herring, for which there has been a decline in mean length since 1985.

Mean weight at age in the stock is given in Table 7.2.2 for the years 1976-83 and 1984 to 1991. The mean weight at age is lower in 1991 than any previous year for all age classes above 1-ringers. There is a general trend of decreasing weight at age. Mean weight at age for the years 1989 and 1990 were modified in the WEST (weight at age in the stock) files to represent estimates from commercial catch data in the third quarter rather than estimates from research surveys, in order to maintain consistency with previous data. It is recognised that the mean weights of 1-ringers in the stock computed from commercial data may not reflect the true mean weight of this group.

The maturity ogive, expressed as a proportion of the sampled population at stage 3+ appears to have remained stable over the last few years and the 1991 ogive is similar to the one used previously. Therefore, the ogive used in 1989 and 1990 was adopted again (0.08 for 1-ringers, 0.85 for 2-ringers and 1.00 for 3+-ringers).

7.3 Research Surveys

7.3.1 Acoustic surveys

The acoustic survey of the spawning stock of Manx herring in September, which provided SSB estimates of 18,000 t in September 1989 and 27,000 t in 1990, could not be carried out in 1991 because of a change-over of research vessels at Port Erin Marine Laboratory. An attempt to survey the spawning grounds of the Mourne stock in October 1991 (Armstrong, 1992a, Working Document) resulted in a failure to detect any adult herring. An area of known herring concentration could not be surveyed because of the presence of a fleet of gillnetters over the fish.

An acoustic survey of the mixed stocks of herring in the northern Irish Sea was carried out from 26 July to 8 August 1991 on board R.V. "Lough Foyle" (Armstrong, 1992a, Working Document). An initial, exploratory, survey of this nature had been carried out in August 1990. A towed 38 kHz transducer was employed, and acoustic data were processed by means of the HADAS echo-integration software (Lindem Associates). The survey grid and the distribution of detected herring are shown in Figure 7.3.1. Although insufficient time was available to survey the region east of the Isle of Man, it was expected that the majority of the Manx stock would be present to the west and south of the Isle of Man, as known within the fishery and observed during the 1990 survey. A total of 16 trawl hauls provided data for estimation of species compositions, length- and age-frequencies, and target strengths.

The total biomass of herring was estimated to be 17,800 t, of which 10,300 t comprised potential spawners according to the maturity ogive adopted by the Working Group. The estimate for the total stock occurring in the inshore strata along the Irish Coast was 6,900 t, whilst the estimate for the Manx coast was 10,300 t. The bulk of the estimate for the Irish Coast was attributable to herring-like targets for which the species composition could not be verified.

These estimates of total biomass of herring are within the range of approximately 10,000 - 30,000 t (depending on assumptions regarding target identification) estimated during the August 1990 survey. Errors in allocation of species compositions during the 1991 survey will have been greatest off the Irish Coast where sprats were abundant. The total biomass of sprats was estimated to be 66,000 t. A negative bias of unknown magnitude will be present in the estimate for herring because of incomplete coverage of the range of the Manx and Mourne stocks, and because of the tendency for some herring to migrate into the acoustic dead-zone close to the seabed. Groundfish surveys conducted in June and September 1991 showed herring to be more widespread than shown in Figure 7.3.1, indicating a strong likelihood of non-detection of herring in some areas during the acoustic survey. Hence, the acoustic estimates are not expected to be comparable in an absolute sense with the VPA estimates.

7.3.2 Tagging studies

Approximately 10,000 herring were tagged off the west coast of the Isle of Man in 1991 (Molloy, 1992b, Working Document), as described in Section 4 of this report

(Celtic Sea and Division VIIj herring). Thirty percent of the tag returns comprised spawning 2-ring fish taken in the Celtic Sea fishery in the following December - February, supporting earlier suggestions that Division VIIa (North) is one of the nursery areas for Celtic Sea juvenile herring. The migration out of Division VIIa (North) appeared to take place in the fourth quarter of 1991, after the main period of the Division VIIa fishery. The results of VPA on numbers-at-age in the herring landings in Division VIIa (see Section 7.4) indicate that 1-ring and 2-ring herring experience 7% and 85% of the full rate of fishing mortality, respectively. Hence, the possibility that the Division VIIa fishery could inflict a significant fishing mortality on Celtic Sea 2-ringers warrants further investigation and possibly a re-evaluation of the basis for treating these stocks independently.

7.4 Stock Assessment

7.4.1 Estimation of fishing mortality and trends in abundance

The only data available for inclusion in an analytical assessment of Division VIIa (North) herring are from annual catches at age of the commercial fleet. No time-series of abundance indices were available to the Working Group for tuning the recent-year Fs, and the acoustic estimates of biomass that have been made are few in number and contain biases of unknown magnitude.

Data on the monthly proportion of landings of the Northern Ireland *Nephrops* trawl fleet that contained herring during the years 1982 to 1990 showed low values in 1982 and 1983 followed by a period of stable but larger values (Armstrong, 1992b, Working Document). This may reflect an increase in the spatial and temporal distribution of herring following the increase in abundance of adult fish in 1984 shown in *Anon.* (1991). The 70 mm diamond mesh employed by Northern Ireland *Nephrops* vessels would retain mostly adult herring. A very high proportion of landings in 1990 contained herring, although the average quantity of herring in each landing during the months July to December was a factor of ten lower than the mean for the years 1984 to 1989. These data, together with anecdotal information from the herring fleet of an increase in abundance of herring in recent years, indicate that the biomass of adult herring has either been comparatively stable, or has increased, since the mid-1980s.

The effect of choice of terminal fishing mortality on the estimated recent trend in abundance of Division VIIa (North) herring was explored by running a series of conventional VPAs, as carried out by the 1991 Working Group. Terminal fishing mortalities ($F_{(2-6)}$) for the different age-classes in the most recent year (1991) were obtained from initial runs of separable VPA. Values of input $F_{(2-6)}$ of 0.1, 0.15, 0.20 and 0.30 were tried. As at the previous Working Group, natural mortality was assumed to be 1.0 on 1-ringers, 0.3 on 2-ringers, 0.2 on 3-ringers and 0.1 on all older ages.

7.4.2 Exploitation pattern

The age class containing 3-ring herring was chosen as reference age for the exploitation pattern generated by separable VPA, and unweighted mean Fs were computed for age classes 2 - 6. This procedure differed from the one adopted by the 1991 Working Group, who chose 2-ring herring as reference age and averaged F over age classes 2 - 7. The output of separable VPA at a terminal F of 0.15 is shown in Table 7.4.1. Setting terminal selectivities at 1.0 generated a flat-topped selectivity curve for the most recent six years of data, with no anomalous values for any age classes. Although there was some tendency for a temporal trend in positive residuals associated with catches of the strong 1985 year class, the results of the separable VPA runs were accepted for initiation of conventional VPA.

7.4.3 Results of VPA

Trends in fishing mortality, landings, SSB and recruitment are shown in Figure 7.4.1 . The output for terminal $F_{(2-6)}$ of 0.15 is given in Tables 7.4.2 to 7.4.4. This run is illustrated as it is the most compatible with the output presented by the 1991 Working Group (*Anon.*, 1991), who anticipated that the mean F would be 0.21 in 1991 if the TAC of 6,000 t was taken in full. The predicted mean F for 1991 would have been closer to 0.15 for the catch that was eventually taken in that year.

Terminal $F_{(2-6)}$ values of 0.15 and 0.2 gave stable or slightly increasing estimates of SSB over the 1984 - 1991 period, whereas a terminal $F_{(2-6)}$ of 0.10 gave estimates of SSB increasing substantially over time (Figure 7.4.2). A terminal $F_{(2-6)}$ of 0.3 showed a downward trend in SSB that, together with very low absolute values of SSB, seems less plausible in view of the data from the commercial *Nephrops* fishery and from the acoustic surveys of the Manx spawning stock in 1989 and 1990. Recruitment in 1987 of 1-ring fish spawned in the autumn of 1985 was the strongest since 1977, whilst the recruitment in 1988 was the weakest in the time series commencing 1972.

7.5 Recruitment

There continue to be no independent time series of recruitment indices for this stock. Catch rates in groundfish surveys carried out by the Republic of Ireland and UK could not be obtained in time for evaluation at the meeting. Values of recruitment for use in stock predictions were computed as the geometric mean of VPA estimates for the years 1984 to 1990.

7.6 Stock and Catch projections

Evaluation of the most appropriate of the VPA results shown in Figure 7.4.2 can be guided only very loosely by the crude index of abundance obtained from the incidence of herring landings by Northern Irish *Nephrops* trawlers, and by the general levels of biomass estimated from the small number of acoustic surveys of the Manx spawning stock that have been carried out. Until suitable time series of abundance indices are available for this stock to allow objective estimation of current levels of fishing mortality, the Working Group is unable to provide any advice on TAC levels other than that based on *status quo* fishing mortalities (F_{sq}). The sensitivity of F_{sq} catch predictions to the choice of terminal $F_{(2-6)}$ in the VPA was examined as described below.

Stock and catch projections were run for a range of terminal F values using the stock numbers at 1 January 1992 calculated from the appropriate VPAs and the smoothed selectivity patterns generated from the initial separable VPA runs (Table 7.6.1). Recruitment in each case was assumed to be the geometric mean (GM) numbers of 1-ring fish over the period 1984 - 1990. The very imprecise VPA estimates of numbers of 1-ringers at 1 January 1991 were discarded in favour of the GM estimates to improve the stability of the stock predictions. It was assumed that the catch in 1992 would be the agreed TAC of 7,000 t. The value of F_{sq} for 1993 was taken as the mean of the $F_{(2-6)}$ estimates for 1989 and 1990. The value of $F_{(2-6)}$ for 1991 was considered inappropriate for inclusion in the mean because of the unusual withdrawal of the Republic of Ireland fleet from the herring fishery in that year.

The input data for the stock predictions are given in Table 7.6.1. An example of the predictions by age class is given in Table 7.6.2 for the option using VPA estimates from the run with terminal $F_{(2-6)}$ = 0.15.

The results of the various options are summarized in the text table below.

	1992			1993		
F_t (1991)	F	SSB	Catch	F_{sq}	SSB	Catch
0.10	0.144	42.3	7.0	0.148	43.2	7.4
0.15	0.220	26.8	7.0	0.205	27.2	6.6
0.20	0.300	19.1	7.0	0.253	19.4	5.9
0.30	0.466	11.4	7.0	0.333	11.8	4.9

(Weight in '000 t, SSB at spawning time, F's = means for 2-6 ring fish)

The results show the expected result that the F_{sq} catches are much less sensitive to choice of terminal fishing mortality in the VPA than are the SSB estimates. In each case, a very slight increase in SSB is predicted for 1993. The 1993 catches for the options 1.2*F_{sq} and 0.8*F_{sq} (not shown in text table) are predicted to be 6,900 t and 4,800 t respectively for estimates of stock from VPA with terminal $F_{(2-6)}$ of 0.20. For most of the options examined, the fishing mortality in 1992 is expected to be greater than the mean value for 1989 and 1990 adopted as F_{sq}, if the TAC of 7,000 t is taken in full. In these cases a slight increase in the F_{sq} catch in 1993 would be expected if the fishing mortality in 1992 is also *status quo*.

For completeness, SSB vs numbers of 1-ringers are given in Figure 7.4.3 for a terminal F of 0.15. The F_{low} (0.26), F_{med} (0.37) were estimated from this graph. The yield-per-recruit calculations estimated $F_{0.1}$ as 0.165.

7.7 Management Considerations

7.7.1 Recommended catch levels

The 1991 Working Group explored 1992 TAC options on the basis of predictions from VPAs that had been calibrated against the results of acoustic surveys of the Manx spawning stock. An F_{sq} TAC of 6,600 t was estimated and was subsequently recommended by ACFM. The EC adopted a TAC of 7,000 t for 1992. This has been allocated as 1,820 t to the Republic of Ireland and 5,180 t to the UK. Spawning closures were retained for 1992.

Although the trend in biomass of herring in Division VIIa (North) is very poorly estimated, the information available to the 1992 Working Group has indicated that the stock is unlikely to have declined under recent levels of catch. The *status quo* catch for 1993 (i.e., the predicted catch if $F_{(2-6)}$ in 1993 is maintained at the average level recorded in 1989 and 1990) is in the range 6,000 t to 7,000 t. For the prediction based on VPA with terminal $F_{(2-6)}$ of 0.20, a catch of 7,000 t in 1993 would correspond to 1.2*F_{sq}. This would result in a very slight reduction in SSB in 1993, whereas the F_{sq} catches resulted in a slight increase in SSB in all cases examined. These predictions are based on an assumption of average recruitment in 1991, 1992 and 1993. It is emphasized that it is not possible to accurately assess the value of current fishing mortality relative to the standard reference F_s.

7.7.2 Spawning area closures

Due to a continued uncertainty about the size of this stock and the fact that a large portion of the stock aggregates in one small area for spawning (at least on the

Douglas Bank for the Manx stock), the spawning area closures should be maintained in 1993.

7.8 Research and Data Requirements

The Working Group expressed some concerns over the lack of samples taken from the landings to the offshore vessels and hopes this will be rectified. It continues to firmly support the acoustic surveys on the whole Division VIIa area, Douglas Bank spawning aggregations and the Mourne spawning aggregations. Recruitment indices are still needed for this area, and the Working Group encouraged the collation of existing data from groundfish surveys that have been carried out by Republic of Ireland and UK research vessels in Division VIIa (North). It was recommended that further investigations of the mixing of Celtic Sea and Division VIIa (North) juveniles in the northern Irish Sea be carried out, and encouragement was given to repeat the valuable tagging studies carried out in 1991 by the Working Group representative from the Republic of Ireland.

The Working Group encourages the establishment of an otolith exchange programme in 1992 to evaluate the precision of ageing by the three main laboratories collecting data in this area.

8 REPORT ON DISCARDS IN THE NORTH SEA AND SKAGERRAK FISHERY

As pointed out in last year report (*Anon.*, 1991) only a few countries collect discard data on a routine basis, and except for one country, discards are not included in the catch figures.

Compared to last year, new information on discards was available for the Danish purse seine and pelagic trawl fisheries for herring in 1991 in the North Sea and Skagerrak. The information was collected as part of an EC founded programme to investigate discards in pelagic fisheries.

The results indicate very large variations in discards between fishing trips with a mean level of 10 to 15% of the total catch of herring in weight. Four main reasons for discards were identified:

1. waste of fish in connection with loading operations;
2. the catch exceeds the individual boat quota or the carrying capacity of the vessel;
3. the length composition of the catch is unwanted (undersized fish or economical not optimal size composition) or the quality of the fish is too poor;
4. all or some of the fish caught escapes because the net is damaged.

The results were supported by Dutch investigations carried out under the same programme.

The above-mentioned investigations indicate that discards of herring in 1991 in most fisheries were at a relatively low level with exception of the row fishery. The abundance of juveniles were, however, relatively low in 1991 compared to the situation in the second half of the 1980s, and the discards of undersized herring may have been lower than in years of high abundance of juveniles.

The study on discards in the Danish and Dutch fisheries in the North Sea and Skagerrak may not be considered as representative for all fisheries and the Working Group stresses the importance of studies of discards in all fisheries for herring.

Except for one country, for which discards have been included in the catch figures for several years the Working Group decided not to include new estimates of discards for other countries in the assessment. The reason for this decision was that the information indicates that discard is at a relatively low level and including discards for single years will affect the relationship between survey indices and VPA.

9 TRANSFER OF HERRING ASSESSMENTS TO AREA-BASED WORKING GROUPS

9.1 General Comments

Traditionally herring stocks have been assessed separately or together with other pelagic species as sprat but normally not together with demersal stocks. The main reasons for this separation beside pure historical motives, have been limited technical interactions, different methods applied in the assessments, and that pelagic species show large migration patterns compared to demersal species.

The fleets exploiting herring stocks are mainly purse seiners and pelagic trawlers. By-catches of other species than pelagic species are small or negligible. The boats operates in a very selective manor and target at specific pelagic species in different well-defined seasons. When changing target species the majority turn to other pelagic species as mackerel, horse mackerel, blue whiting. Characteristic for a major part of the pelagic fleet is also an extended operation area depending on season and target species such as North Sea, west of the British Isles to the Norwegian Sea. Exception from this general strategy occurs in some areas and in some fleets. These exceptions will be discussed in relation to each stock.

Pelagic species generally undertake large seasonal migration over extensive areas. Merging pelagic species with the suggested area-based assessment units will create problems with stocks and fleets moving between areas. The present boundary between areas-based Working Groups is not optimum for the pelagic species and this has to be considered more in detail to minimise boundary problems.

Although similar assessment methods are used for both pelagic and demersal species there are also characteristic differences. While CPUE data from the fisheries are commonly used in tuning procedure for demersal species, these data series cannot be used when assessing pelagic species. In assessment of pelagic species fishery, independent data such as larvae abundance, larvae production estimates and acoustic estimates are used for tuning purpose. Evaluation of the fishery independent data and technical discussion of methods are generally important parts of the assessment work in pelagic assessment working groups. These discussion may not be of common interest in area-based working groups,which could lead to fragmentation into sub-groups. Synergistic effects are not guarantied by mixing different assessment techniques into one large working group.

Biological interactions between pelagic and demersal species are well documented and the need to consider these interactions in both short- and long-term are important.

The consequences of transfer to area-based assessments groups are considered by stock in the following sections.

9.2 The North Sea Stock

Description of fishing fleets

Herring fisheries in the North Sea are conducted mainly by vessels specialised in pelagic fisheries. These include the purse seiners from Norway, Scotland and Denmark, and the freezer trawlers from the Netherlands, Germany and the UK. These vessels fish for pelagic species such as herring, mackerel and horse mackerel throughout the year. Their operations are not restricted to the North Sea, but may extend to the west of Scotland and Ireland, and into the Celtic Sea.

A minor fraction of the herring catch in the North Sea is taken by pair trawlers. These vessels may switch to roundfish or flatfish at other times of the year.

A certain amount of juvenile herring is taken by industrial trawlers as a by-catch in the sprat fishery.

Description of herring migrations

There are several connections between herring in the North Sea and in adjacent regions. Some of the North Sea herring spawn outside the North Sea in Division VIId (English Channel). Juvenile North Sea herring grow up in Division IIIa and then re-enter the North Sea as 1- or 2-ringers. Adult herring from the North Sea stock migrates north towards the Faroe Islands. Spring-spawning herring from the Baltic and Division IIIa enter the North Sea as adult herring on their annual feeding migration along the edge of the Norwegian Trench. Larvae from the herring stock in Division VIa drift into the North Sea, metamorphose into juveniles, and return to Division VIa after one or two years.

Possibilities to transfer herring assessment to other working groups

There is very little that the herring fisheries in the North Sea have in common with the demersal fisheries in that region. A transfer of the herring assessment to the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak would not offer much benefits in terms of fleet interactions or multispecies aspects. Disconnecting assessment of North Sea herring from the assessment of herring stocks in Divisions IIIa and VIa would fragmentize the information on fishing operations by the same fleet, and migrations by the same herring stocks.

9.3 Division IIIa SW Baltic Stock

The spring spawning herring in Division IIIa-SW Baltic is known to undertake seasonal migration between this area and the North Sea. A review of the general distribution and migration pattern are given in the 1991 report of this Working Group (*Anon.*, 1991).

In the North Sea area the stock is exploited in directed herring fishery mainly by the purse seiner fleet and in Division IIIa by pelagic pair trawlers and, to a lesser extent, by purse seines. A minor part of the catches are at present generated in the small-mesh mixed fishery, which also exploit demersal species. About half of the fishing mortality is generated in the North Sea and Division IIIa. A more detailed description of the different fisheries that take herring in Division IIIa are given in the report of the Workshop on Methods of Forecasting Herring Catches in Division IIIa and the North Sea (*Anon.*, 1992).The other half of the fishing mortality is generated by the pelagic trawler fleet in the southwestern Baltic, i.e Sub-divisions 22-24. By-catches in this fishery are mainly sprat.

While the purse seine fleet is fishing for pelagic species all through the year the trawler fleets changes between herring, demersal species as cod and shellfish as

Nephrops or shrimp. The cod fishery in the Baltic have been an important alternative fishery for the pelagic trawler fleets during the past decade.

With the present arrangement of working groups the stocks in Division IIIa are divided between the North Sea area working group and the Baltic working groups. There are no common biological border line for all stocks. At present, this Working Group prepares data and the assessment is carried out by the Working Group on the Assessment of Pelagic Stocks in the Baltic. If the assessment of the herring stock should be transferred to an area working group, the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak seems to be the most logical choice. Any border line in Division IIIa or between this area and southwestern Baltic will cut through the distribution area of this herring stock. The most logical border for this stock seems to be in the Baltic at Bornholm.

The main disadvantage is the size and the large number of stocks to be assessed by the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak.

An alternative solution could be to create a Division IIIa-Southwestern Baltic area group. The disadvantage is disconnecting the assessment from the North Sea area. If there are strong reasons to change the present arrangement, it is recommended that the herring stock in this area should be included in the Working Group on the Assessment of Demersal Stocks in the North Sea and Skagerrak.

9.4 Implications for Herring Stocks in Sub-area VII and Division VIIa(S)

The herring fisheries in this area are assessed and managed in three units:

Divisions VIIa South, VIIg-k, i.e., Celtic Sea and Division VIIj.

Divisions VIa South and VIIb-c, i.e., West and Northwest Ireland.

Division VIIa North (Irish Sea), i.e., Manx and Mourne stocks.

9.4.1 Biological interactions between stocks between each unit

Divisions VIIa (South), VIIg-k

The stock in the Celtic Sea and Division VIIj is also composed of different spawning components - mainly autumn and winter components which spawn inshore along the Irish coast, but which migrate during spring and summer to deeper water south and southwest of Ireland, e.g. Labadie and Jones Banks. The larvae originating from the spawning grounds in the eastern Celtic Sea, i.e. Division VIIa (South), appear to be transported into the Irish Sea (Division VIIa (North)) where they remain for two years before returning to the Celtic Sea as potential recruits. The main spawning grounds off the southwestern Irish coast are situated along or very near the boundary between Division VIIj and Division VIIb and there has always been difficulties in allocating catches from this area to the appropriate management unit. Herrings tagged in the northern part of Division VIIb have also been recovered from Division VIIj indicating some biological links between the two units.

Division VIa (South), VIIb-c

The stock in Division VIa (South), which is mainly composed of an autumn spawning component, was separated from that in Division VIa (North) during the early 1980s for assessment and management purposes. The separation was justified at that time on the basis of biological data and on the location of the fisheries. Nevertheless, there are similarities between the stocks from both units. In addition, herring tagged in the Clyde have also been recovered in some years from catches taken off the northwest coast of Ireland. Larval surveys carried out in this area would suggest that larvae are transported along the Irish coast in a north-easterly direction toward the Scottish coast.

Division VIIa (North)

The stock in the Irish Sea (Division VIIa (North)) is also composed of two spawning components - the Manx and the Mourne - which are exploited together in a mixed fishery prior to spawning but which have separate and discrete spawning areas. Recent tagging experiments have shown that potential recruits to the Celtic Sea stock are present in this area during summer and there is, therefore, a biological link between the stocks in Division VIIa (North) and the stock in the Celtic Sea.

Conclusion

There appears to be considerable biological interaction between the stocks in this area. This would suggest that it would be advisable to transfer all the stocks rather than one or two to an area-based working group, if it is considered necessary.

9.4.2 Technical Interactions: Fleets

The pelagic fisheries throughout Division VIa and Sub-area VII are in general exploited by the same fleets. The greatest portion of the herring catches in recent years have been taken by the Irish and Northern Irish fleets. Smaller catches are taken by Dutch, German, French, Scottish and Isle of Man vessels. The Dutch fleet is composed of large pelagic freezer trawlers which fish mainly for mackerel and horse mackerel and whose herring catch can now be considered as a by-catch.

The Irish and Northern Irish herring fleets may be broadly classified into five main types. Many of these vessels exploit the same fisheries and compete with each other.

Large factory ships. These ships (two large and one small) are pelagic trawlers. Although they concentrate mainly on mackerel throughout Sub-areas IV, VI and VII, they also fish herring in Divisions VIa (South) and VII b during summer and early autumn.

Large RSW trawlers and purse-seiners. These vessels which number about 14, again mainly exploit mackerel and horse mackerel over a large area. However, they also catch substantial quantities of herring during summer and early autumn throughout Divisions VIa (South) and VIIb.

Small RSW trawlers. These vessels, approximately 30, use pair mid-water trawls and concentrate on herring throughout the year. They exploit all the stocks and rapidly switch their effort from one area to another.

Dry hold boats. These vessels, approximately 80-90, only fish herring in Sub-area VII. They also use mid-water trawls and their fishing activities are confined to the main autumn and winter fisheries. During the remainder of the year they fish *Nephrops* and various inshore and offshore fisheries and also take part in the demersal fisheries. This fleet does not include those Northern Irish boats which use twin-rigged nets for demersal fish throughout the year. These vessels also occasionally fish sprat in the Celtic Sea.

Small boat drift netters. These boats are now confined to the drift net fishery operating on the Mourne spawning grounds off the east North Irish coast (in the Irish Sea).

In general, there appears to be considerable interaction between the various fleets operating in the different areas.

By-catch. As the target species for most of these pelagic trawlers are mainly mackerel, horse mackerel or herring, there is little by-catch of other species.

9.5 Division VIa (North)

9.5.1 Biological considerations

The herring in Division VIa (North) is assessed as a single autumn spawning stock. Spawning occurs to the northwest of Scotland and in particular to the west of the Hebrides. A significant proportion of the larvae are thought to be transported to nursery areas in the North Sea, returning as juveniles and adults. The return migration can extend over several years, so that a component of the stock is subject to fishing mortality in the North Sea. However, it is generally assumed that the return migration is sufficiently complete as 2-ringers and that this component of F can be ignored. There may be further movements of adults between Division Va (North) and the North Sea, and between Division VIa (North) and Division VIa (South), but again no attempt is made to estimate the extent to which the catches are of mixed stocks. The relation between herring in Division VIa (North) and herring in Sub-area V is unknown.

The natural mortality estimates for the stock in Division VIa (North) are based on the results of the multispecies VPA in the North Sea. In the absence of more appropriate estimates this is reasonable, but it would be preferable to have estimates of the predation mortalities in Division VIa (North) itself. In this respect, any attempt by the Working Group on the Assessment of Northern Shelf Demersal Stocks to adopt a multispecies approach would be relevant for this stock.

9.5.2 Technical interactions

This stock is mainly exploited by Scotland and the Netherlands. The bulk of the Scottish catch is taken by pair trawlers and purse seiners which also fish for mackerel. The same vessels also fish other areas including the North Sea. The Dutch fleet comprises large freezer trawlers, again exploiting both herring and mackerel over a wide geographical area. There is relatively little technical interaction between the exploitation of the pelagic and demersal stocks.

9.5.3 Clyde herring

The herring exploited in the Clyde consist of more than one stock. The total spring-spawning stock spawns in the Clyde and its total distribution at that time of year is not certain. According to tag returns, autumn-spawners migrate into the Clyde from all the adjacent stocks, including Divisions VIIa, VIa (South) + VIIb,c, and VIa (North). To maintain coherence it is appropriate for this stock to be assessed by the working group that assess these other stocks.

The directed herring fishery is carried out by pair-trawlers which switch, according to market demand, between demersal trawling for roundfish and *Nephrops* and herring. Whatever the ultimate destination of the assessment of this stock, the data on effort and fleet structure should be made available to the Working Group on the Assessment of Northern Shelf Demersal Stocks. However, the assessment of the indigenous stock is a self-contained problem and there is no reason for merging with an area-bound group for assessment and prediction purposes.

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Table 2.1.1 HERRING. Catch in tonnes, 1980-1991, North Sea, Sub-area IV,and Division VIId by country. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1980	1981	1982	1983	1984	1985
Belgium	-	-	9,700	5,969	5,080	3,482
Denmark	4,431	21,146	67,851	10,467	38,777	129,305
Faroe Islands	-	-	-	-	-	-
France	5,527	15,099	15,310	16,353	20,320	14,400
Germany, Fed.Rep.	147	2,300	349	1,837	11,609	8,930
Netherlands	509	7,700	22,300	40,045	44,308	79,335
Norway[4]	2,165	-	-	32,512	98,706	159,947
Sweden	-	-	-	284	886	2,442
UK (England)	77	303	3,703	111	1,689	5,564
UK (Scotland)	610	45	1,780	17,260	31,393	55,795
UK (N.Ireland)	-	-	-	-	-	-
Unallocated landings	47,528	94,309	114,252	181,116	64,487	74,220
Total landings	60,994	140,902	235,245	305,954	317,255	533,420
Discards[3]	-	-	-	-	-	-
Total catch	60,994	140,902	235,245	305,954	317,255	533,420
Catches of spring spawners (included above)						
IIIa type	-	-	-	-	6,958	17,386
Coastal type	-	-	-	-	520	905

Country	1986	1987	1988	1989	1990	1991[1]
Belgium	414	39	4	434	180	163
Denmark	121,631	138,596	263,006	210,315[2]	159,280[2]	194,358[2]
Faroe Islands	623	2,228	810	1,916	633	334
France	9,729	7,266	8,384	29,085	23,480	24,625
Germany, Fed.Rep.	3,934	5,552	13,824	38,707	43,191	41,791
Netherlands	85,998	91,478	82,267	84,178	69,828	75,135
Norway[4]	223,058	241,765	222,719	221,891[2]	157,850[2]	124,991[2]
Sweden	1,872	1,725	1,819	4,774	3,754	5,866
UK (England)	1,404	873	8,097	7,980	8,333	11,548
UK (Scotland)	77,459	76,413	64,108	68,106	56,812	57,572
UK (N.Ireland)	-	-	-	-	-	92
Unallocated landings	21,089	58,972	33,411	26,749[2]	21,081	24,435
Total landings	547,211	624,907	698,449	694,135[2]	544,422	560,910
Discards[3]	-	-	-	4,000	8,660	4,617
Total catch	547,211	624,907	698,449	698,135	553,082	565,527
Catches of spring spawners (included above)						
IIIa type	19,654	14,207	23,306	19,869	8,357	7,894
Coastal type	490	250	250	2,283	1,136	252[5]

[1]Preliminary.
[2]Working Group estimates.
[3]Any discards prior to 1989 estimates were included in unallocated landings.
[4]Catches of Norwegian spring spawners removed (taken under a separate TAC).
[5]Landings from the Thames estuary area.

Table 2.1.2 HERRING, catch in tonnes in Division IVa West. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1982	1983	1984	1985	1986
Denmark	3,155	4,282	26,786	77,788	48,590
Faroe Islands	-	-	-	-	275
France	1,970	680	1,408	2,075	462
Germany, Fed.Rep.	-	1,542	12,092	4,790	2,510
Netherlands	-	15,745	19,143	49,965	42,900
Norway	-	16,971	21,305	10,507	63,848
Sweden	-	213	-[1]	-[1]	-[1]
UK (England)	-	-	-	-	-
UK (Scotland)	1,706	16,136	24,634	52,100	71,285
Unallocated landings	300	3,955	24,030	4,249	-
Total Landings	7,179	61,738	129,398	197,225	229,870
Total catch	7,179	61,738	129,298	201,474	229,870

Country	1987	1988	1989	1990	1991[3]
Denmark	50,184	25,268	29,298	9,037	5,980
Faroe Islands	102	810	1,916	633	334
France	285	266	-[1]	2,581	3,393
Germany, Fed.Rep.	3,250	9,308	26,528	20,422	20,608
Netherlands	44,358	32,639	24,600	29,729	29,563
Norway	55,311	30,657	41,768	24,239	37,674
Sweden	768	1,197	742	-	1,130
UK (N.Ireland)	-	-	-	-	92
UK (England)	4,820	4,820	5,104	3,337	4,873
UK (Scotland)	66,774	48,791	58,455	46,431	42,745
Unallocated landings	16,092	-	3,173	4,621	5,492
Total Landings	221,032	153,751	191,584	141,030	151,884
Discards[2]	-	-	900	750	883
Total catch	237,124	153,751	192,484	141,780	152,767

[1]Included in Division IVb.
[2]Any discards prior to 1989 were included in unallocated.
[3]Preliminary.

Table 2.1.3 HERRING, catch in tonnes in Division IVa East. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1982	1983	1984	1985	1986
Denmark	491	-	126	-	4,540
Faroe Islands	-	-	-	-	-
France	-	-	-	-	-
Netherlands	-	-	-	-	-
Norway[1]	-	-	51,581	109,975	118,408
Sweden	-	-	-	-	-
UK (Scotland)	-	257	74	-	-
Unallocated landings	-	431	-	-	-
Total landings	491	688	51,781	109,975	122,348
Total catch	491	688	51,781	109,975	122,948

Country	1987	1988	1989	1990	1991[3]
Denmark	7,101	47,183	44,269	44,364	48,875
Faroe Islands	2,126	-	-	-	-
France	159	45	-	892	-
Netherlands	-	200	-	-	-
Norway[1]	145,843	153,496	168,365	121,405	77,465
Sweden	957	622	612	2,482	114
UK (Scotland)	-	-	-	-	173
Germany, Fed.Rep.	-	-	-	5,604	[4]
Unallocated landings	-	-	-	-	-
Total landings	156,186	201,546	213,246	174,747	126,627
Discards[2]	-	-	-	-	-
Total catch	156,186	201,546	213,246	174,747	126,627

[1]Catches of Norwegian spring spawners herring removed (taken under a separate TAC).
[2]Any discards prior to 1989 would have been included in unallocated.
[3]Preliminary.
[4]Included in IVa West.

Table 2.1.4 HERRING, catch in tonnes in Division IVb. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1982	1983	1984	1985	1986
Denmark	64,205	6,050	13,808	51,517	67,966
France	561	705	2,299	1,037	605
Faroe Islands	-	-	-	-	348
Germany, Fed.Rep.	118	-	2	4,139	1,424
Netherlands[4]	219	300	4,600	-[3]	21,101
Norway	-	14,156	25,820	39,465	40,682
Sweden	-	71	884	2,442[2]	1,872[2]
UK (England)	3,128	40	1,956	5,214	1,101[1]
UK (Scotland)	74	867	2,477	2,894	6,057
Unallocated landings	90,262	159,124	41,294	47,799	1,594
Total landings	158,567	181,313	93,140	154,507	142,750
Total catch	158,567	181,313	93,140	154,507	142,750

Country	1987	1988	1989	1990	1991[6]
Denmark	81,280	190,555	136,239	105,614	138,555
France	387	617	14,415[5]	10,289	4,120
Faroe Islands	-	-	-	-	-
Germany, Fed.Rep.	2,302	4,516	11,880	17,165	20,479
Netherlands[4]	31,371	37,192	47,388	28,402	26,266
Norway	40,111	38,566	11,758	12,207	9,852
Sweden	-	-	3,420	1,276	4,622
UK (England)	329	2,011	957	3,200	2,715
UK (Scotland)	9,639	15,317	9,651	10,381	14,587
Unallocated landings	20,829	1,969	-23,947[7]	-15,616[7]	3,180
Total landings	186,248	290,743	211,711	172,914	224,376
Discards[4]	-	-	1,900	2,560	1,072
Total catch	186,248	290,743	213,611	175,474	225,448

[1]Includes catches misreported from Division IVc.
[2]Includes Division IVa catches.
[3]Included in Division IVa.
[4]Any discards prior to 1989 were included in unallocated.
[5]Includes catch in Division IVa.
[6]Preliminary.
[7]Negative unallocated catches due to misreporting from other areas.

Table 2.1.5 HERRING, catch in tonnes in Divisions IVc and VIId. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1982	1983	1984	1985	1986
Belgium	9,700	5,969	5,080	3,482	414
Denmark	-	135	53	-	535
France	12,799	14,968	16,613	11,288	8,662
Germany, Fed.Rep.	183	295	-	-	-
Netherlands	22,081	24,000	21,922	32,370	21,997
Norway	-	1,385	-	-	-
UK (England)	602	71	571	350	303
UK (Scotland)	-	-	-	799	117
Unallocated landings	23,307	17,606	1,788	21,595	19,495
Total landings	-	-	-	69,884	51,523
Discards[1]	-	-	-	-	-
Total catch	68,652	64,430	46,027	69,884	51,523
Coastal spring spawners included above	-	-	-	905	496

Country	1987	1988	1989	1990[2]	1991[2]
Belgium	39	4	434	180	163
Denmark	31	-	509	265	948
France	6,435	7,456	14,670	9,718	17,112
Germany, Fed.Rep.	-	-	299	-	704
Netherlands	15,749	12,236	12,240	11,697	19,306
Norway	-	-	-	-	-
UK (England)	544	1,266	1,919	1,796	3,960
UK (Scotland)	-	-	-	-	67
Unallocated landings	22,051	31,442	47,523	32,076	15,763
Total landings	44,849	52,404	77,594	55,732	58,023
Discards[1]	-	-	1,200	5,350	2,662
Total catch	44,849	52,404	78,794	61,082	60,685
Coastal spring spawners included above	250	250	2,283	1,136	252

[1]Any discards prior to 1989 would have been included in unallocated.
[2]Preliminary.

Table 2.2.1 North Sea Herring, Millions caught by age group (winter ring), year class, division and quarter

Catches in: 1991

Division	Quarter	0 1990	1 1989	2 1988	3 1987	4 1986	5 1985	6 1984	7 1983	8 1982	9 1981	Total	0 + 1 ring
	I	0.0	0.1	8.9	2.3	2.0	2.4	0.8	0.4	0.6	0.3	17.7	0.1
	II	0.0	1.4	34.7	31.1	45.8	52.9	15.1	2.7	3.0	2.8	189.3	1.4
(West of 2E)	III	0.0	0.1	74.5	100.8	121.8	113.8	38.1	8.3	7.0	3.5	467.9	0.1
	IV	0.0	0.0	5.8	11.3	27.1	14.4	5.2	1.1	0.7	0.3	65.8	0.0
	Total	0.0	1.5	123.9	145.5	196.6	183.5	59.2	12.5	11.2	6.9	740.8	1.5
	I	0.0	0.1	46.0	70.7	102.3	86.2	24.2	7.9	3.1	0.7	341.2	0.1
	II	0.0	2.6	41.4	26.6	27.7	16.5	6.7	0.7	0.5	0.1	122.8	2.6
(East of 2E)	III	11.9	1.2	8.1	7.3	8.2	9.2	2.4	1.0	0.3	0.1	49.8	13.1
	IV	40.5	14.8	75.2	54.1	56.2	50.9	26.4	6.4	2.3	1.6	328.4	55.2
	Total	52.3	18.7	170.8	158.7	194.4	162.9	59.8	16.1	6.2	2.4	842.2	71.0
	I	0.0	20.5	43.2	1.9	1.3	0.9	0.2	0.1	0.0	0.0	68.2	20.5
	II	0.0	187.9	141.7	33.5	13.5	10.3	9.8	0.1	1.2	0.3	398.3	187.9
IVb	III	1128.6	625.0	171.3	63.8	65.9	69.0	32.6	5.0	2.7	2.6	2166.6	1753.7
	IV	409.7	371.3	41.3	29.5	18.0	17.3	6.5	1.5	0.2	0.3	895.6	781.1
	Total	1538.4	1204.8	397.5	128.8	98.7	97.5	49.1	6.6	4.1	3.2	3528.7	2743.2
	I	0.0	3.8	12.1	15.7	8.5	7.4	5.1	1.0	0.1	0.0	53.8	3.8
	II	0.0	2.6	1.5	0.8	0.6	0.5	0.3	0.2	0.1	0.0	6.5	2.6
IVc + VIId	III	0.0	0.9	1.5	5.6	1.3	0.8	1.0	0.3	0.1	0.0	11.5	0.9
	IV	3.6	12.2	63.9	98.5	49.0	41.3	27.1	2.0	3.1	0.0	300.8	15.8
	Total	3.6	19.5	79.1	120.6	59.3	50.1	33.5	3.6	3.4	0.0	372.7	23.1
	I	0.0	24.5	110.2	90.6	114.0	97.0	30.3	9.4	3.8	1.0	480.9	24.5
Total	II	0.0	194.4	219.3	92.0	87.5	80.1	31.9	3.7	4.8	3.2	717.0	194.4
North	III	1140.5	627.2	255.5	177.5	197.2	192.9	74.1	14.7	10.1	6.2	2695.8	1767.7
Sea	IV	453.8	398.3	186.3	193.4	150.2	123.9	65.2	11.0	6.3	2.2	1590.6	852.1
	Total	1594.3	1244.4	771.4	553.5	548.9	493.9	201.6	38.8	25.0	12.6	5484.3	2838.7

Spring spawners transferred to Division IIIa and North Sea autumn spawners caught in IIIa are not included.

Table 2.2.2 Millions of HERRING caught annually per age group (winter rings) in the North Sea, 1970-1990.

Year	Winter ring										Total
	0	1	2	3	4	5	6	7	8	>8	
1970	898.1	1,196.2	2,002.8	883.6	125.2	50.3	61.0	7.9	12.0	12.2	5,294.3
1971	684.0	4,378.5	1,146.8	662.5	208.3	26.9	30.5	26.8	-	12.4	7,176.7
1972	750.4	3,340.6	1,440.5	343.8	130.6	32.9	5.0	0.2	1.1	0.4	6,045.5
1973	289.4	2,368.0	1,344.2	659.2	150.2	59.3	30.6	3.7	1.4	0.6	4,906.6
1974	996.1	846.1	772.6	362.0	126.0	56.1	22.3	5.0	2.0	1.1	3,189.3
1975	263.8	2,460.5	541.7	259.6	140.5	57.2	16.1	9.1	3.4	1.4	3,753.3
1976	238.2	126.6	901.5	117.3	52.0	34.5	6.1	4.4	1.0	0.4	1,482.0
1977	256.8	144.3	44.7	186.4	10.8	7.0	4.1	1.5	0.7	+	656.3
1978	130.0	168.6	4.9	5.7	5.0	0.3	0.2	0.2	0.2	0.3	315.4
1979	542.0	159.2	34.1	10.0	10.1	2.1	0.2	0.8	0.6	0.1	759.2
1980	791.7	161.2	108.1	91.8	32.1	21.8	2.3	1.4	0.4	0.2	1,211.0
1981	7,888.7	447.0	264.3	56.9	39.5	28.5	22.7	18.7	5.5	1.1	8,772.9
1982	9,556.7	840.4	268.4	230.1	33.7	14.4	6.8	7.8	3.6	1.1	10,963.0
1983	10,029.9	1,146.6	544.8	216.4	105.1	26.2	22.8	12.8	11.4	12.2	12,128.2
1984	2,189.4	561.1	986.5	417.1	189.9	77.8	21.7	24.2	10.6	17.8	4,496.1
1985	1,292.9	1,620.2	1,223.2	1,187.6	367.6	124.1	43.5	20.0	13.2	15.9	5,908.3
1986	704.0	1,763.2	1,155.1	827.1	458.3	127.7	61.1	20.2	13.4	14.6	5,144.7
1987	1,797.5	3,522.4	2,005.4	687.2	481.6	248.9	75.7	23.9	7.9	8.1	8,859.7
1988	1,292.9	1,970.8	1,955.5	1,185.1	398.1	260.6	128.6	37.9	15.1	8.4	7,252.8
1989	1,955.8	1,899.5	927.7	1,383.6	828.1	218.3	129.4	63.3	20.7	8.7	7,435.1
1990	853.9	1,477.4	592.8	763.3	849.1	375.9	80.1	54.4	28.4	11.8	5,087.1
1991	1594.3	1244.4	771.2	553.1	548.5	493.5	201.4	38.8	25.0	12.6	5482.7

Table 2.2.3 Transfers of juvenile autumn spawners from Division IIIa (used in assessment). Numbers (millions) per age group (winter rings).

Year	O-ring	1-ring	2-ring
1980	471	84	26
1981	1,631	425	20
1982	2,400	276	31
1983	3,267	1,302	29
1984	4,472	1,177	119
1985	2,886	1,608	93
1986	2,960	2,960	91
1987	6,238	3,153	117
1988	1,830	5,792	292
1989	1,028	1,171	655
1990	392	1,378	284
1991	712	823	330

Table 2.2.4 Percentage age composition of North Sea HERRING (2-ringers and olders) in the catch.
Catches in : 1991

Division	age in W. Rings Quarter	2 1988	3 1987	Older >=1986	Total (millions)
	I	50.6	13.0	36.4	17.6
IVa West	II	18.5	16.5	65.0	188.0
	III	15.9	21.6	62.5	467.8
	IV	8.8	17.1	74.1	65.8
	Total	16.8	19.7	63.6	739.3
	I	13.5	20.7	65.8	341.1
IVa East	II	34.5	22.1	43.4	120.2
	III	22.2	19.8	58.0	36.7
	IV	27.5	19.8	52.7	273.2
	Total	22.1	20.6	57.3	771.2
	I	90.6	4.1	5.3	47.6
IVb	II	67.3	15.9	16.7	210.4
	III	41.5	15.5	43.1	413.0
	IV	36.1	25.8	38.1	114.5
	Total	50.6	16.4	33.0	785.5
	I	24.3	31.4	44.3	50.0
IVc + VIId	II	38.3	19.2	42.5	3.9
	III	14.2	52.4	33.4	10.6
	IV	22.4	34.6	43.0	285.0
	Total	22.6	34.5	42.9	349.6
	I	24.1	18.4	57.4	406.4
IVa + IVb	II	42.0	17.6	40.4	518.6
	III	27.7	18.7	53.6	917.5
	IV	27.0	20.9	52.1	453.5
	Total	30.1	18.9	51.0	2296.0
	I	24.1	19.9	56.0	456.4
Total	II	42.0	17.6	40.4	522.5
North	III	27.5	19.1	53.3	928.1
Sea	IV	25.2	26.2	48.6	738.5
	Total	29.2	20.9	49.9	2645.6

Spring spawners transferred to Division IIIa and North Sea autumn spawners are not included

Table 2.2.5 Catches (SOP, t) of North Sea Herring by Quarter and Division.

Catches in: 1991

Quarter	Division	0 1990	1 1989	2 1988	3 1987	4 1986	5 1985	6 1984	7 1983	8 1982	9 1981	SOP Total
	IVaW	0	2	839	255	255	365	132	71	113	75	2106
1	IVaE	0	5	4549	8228	13493	12437	3805	1394	622	123	44654
	IVB	0	653	2073	203	162	130	35	11	7	2	3274
	IVC	0	129	598	1433	902	913	687	137	17	0	4815
	Total	0	788	8058	10119	14811	13845	4659	1613	758	199	54850
	IVaW	0	119	5422	5604	9380	11975	3618	701	863	801	38482
2	IVaE	0	241	6417	4639	5156	3303	1329	146	128	17	21377
	IVB	0	5491	10394	4211	1996	1605	1605	20	227	68	25619
	IVC	0	65	77	84	73	76	47	36	12	3	474
	Total	0	5916	22309	14539	16605	16959	6599	903	1231	888	85951
	IVaW	0	4	12070	18955	26008	26302	9595	2312	2099	1072	98417
3	IVaE	204	116	1189	1078	1269	1631	498	231	88	28	6333
	IVB	18735	45600	28409	12417	13766	16029	7940	1421	782	696	145797
	IVC	0	70	143	644	197	143	177	62	19	4	1459
	Total	18939	45790	41812	33095	41241	44105	18210	4026	2988	1800	252005
	IVaW	0	1	901	1904	4942	2848	1077	250	153	67	12143
4	IVaE	668	1257	11717	9269	10189	9820	5458	1495	540	380	50793
	IVB	7194	17396	6560	5396	3455	3722	1458	379	35	73	45667
	IVC	65	937	8943	17694	9771	8867	6201	464	765	0	53708
	Total	7926	19592	28121	34263	28358	25256	14194	2588	1493	520	162310
Total North Sea,	1991	26865	72086	100300	92016	101015	100165	43661	9130	6470	3407	0 555116

Spring spawners transferred to Division IIIa and North Sea autumn spawners caught in IIIa are not included.

Table 2.2.6 Catch in numbers (millions) and mean weight (g), by fleets in the total North Sea 1991.

1. QUARTER	TOTAL		HUMAN CONSUMPTION		SMALL MESHED FISHERY	
	N	W	N	W	N	W
0						
1	24.3	32.2			24.3	32.2
2	110.2	73.0	46.9	96.7	63.3	55.5
3	90.6	112.0	75.1	111.5	15.5	114.3
4	114.0	130.0	92.7	129.9	21.3	130.6
5	97.0	143.0	79.2	143.1	17.8	142.7
6	30.3	154.0	25.8	153.9	4.5	154.6
7	9.4	171.0	8.0	170.0	1.4	176.6
8	3.8	200.0	3.1	201.9	0.7	192.1
9+	1.0	194.0	0.6	202.0	0.4	180.4
TOTAL	480.6	114.2	331.3	127.8	149.3	84.1
LAND./SOP		54893.9		42341.3		12552.6
2. QUARTER	N	W	N	W	N	W
0						
1	194.4	30.0	54.4	42.1	140.0	25.3
2	219.3	102.0	105.7	153.5	113.6	54.1
3	92.0	158.0	63.8	199.7	28.2	63.7
4	87.5	190.0	83.9	192.1	3.6	140.7
5	80.0	212.0	77.2	213.2	2.8	179.3
6	31.9	207.0	30.4	207.8	1.6	191.6
7	3.7	246.0	3.1	255.9	0.6	195.0
8	4.8	257.0	4.7	257.6	0.1	216.4
9+	3.2	277.0	3.2	277.7	0.0	229.0
TOTAL	716.8	119.9	426.4	171.3	290.4	44.5
LAND./SOP		85955.1		73031.9		12923.2
3. QUARTER	N	W	N	W	N	W
0	1140.0	16.6			1140.0	16.6
1	627.2	73.0	17.8	73.3	609.4	73.0
2	255.3	164.0	173.6	168.3	81.7	154.9
3	177.0	186.0	167.5	187.7	9.5	156.2
4	196.7	209.0	188.9	211.8	7.8	140.8
5	192.5	229.0	188.9	229.8	3.6	189.0
6	74.0	246.0	69.4	249.3	4.6	195.0
7	14.6	275.0	14.4	275.5	0.2	227.8
8	10.1	295.0	10.1	295.0	0.0	291.0
9+	6.1	293.0	6.1	293.1	0.0	241.0
TOTAL	2693.5	93.4	836.7	204.9	1856.8	43.2
LAND./SOP		251686.4		171413.5		80272.9
4. QUARTER	N	W	N	W	N	W
0	454.0	17.5			454.0	17.5
1	398.3	49.0	24.6	86.5	373.7	46.5
2	186.3	151.0	180.2	151.3	6.1	140.7
3	193.4	177.0	189.3	177.7	4.2	146.2
4	150.2	189.0	145.6	190.2	4.6	151.3
5	123.9	204.0	121.4	204.7	2.5	168.2
6	65.2	218.0	64.3	218.1	0.9	212.3
7	11.0	235.0	10.8	235.0	0.2	233.8
8	6.3	237.0	6.2	237.0	0.1	233.0
9+	2.2	239.0	2.2	239.1	0.0	229.4
TOTAL	1590.8	102.0	744.5	180.1	846.3	33.3
LAND./SOP		162291.0		134123.3		28167.7
TOTAL YEAR	N	W	N	W	N	W
0	1594.0	16.9			1594.0	16.9
1	1244.2	57.8	96.9	59.1	1147.3	57.7
2	771.1	130.2	506.4	152.5	264.7	87.5
3	553.0	166.1	495.7	173.9	57.3	98.6
4	548.4	184.1	511.1	187.6	37.3	136.3
5	493.4	203.1	466.7	205.8	26.7	155.2
6	201.4	216.9	189.8	219.2	11.6	180.2
7	38.7	235.6	36.3	238.6	2.4	189.5
8	25.0	258.6	24.1	260.8	0.9	200.4
9+	12.5	271.5	12.0	274.6	0.5	189.7
TOTAL	5481.7	101.2	2339.0	180.0	3142.8	42.6
LAND./SOP		554826.3		420910.0		133916.3

Table 2.2.7 North Sea Herring sampling intensity of commercial catches.

DIVISION IVa

Country	Total Landings ('000 t)	No of Samples	No of Age-readings	No of fish measured	Estimates of discards	Catches to which the age compositions were applied ('000 t)
Denmark	54855	28	3280	3280	no	54224
Faroe Islands	334	-	-	-	-	-
France	3393	-	-	-	-	-
Germany	20608	-	-	-	-	-
Netherlands	35495	28	700	7000	yes	62345
Norway	115139	160	2300	8800	no	121055
Sweden	1244				-	
UK (Scotland)	42919	53	n/a	8302	no	45477
UK (England)	4873	-	-	-	-	-
Catches split by survey samples						208

DIVISION IVb

Country	Total Landings ('000 t)	No of Samples	No of Age-readings	No of fish measured	Estimates of discards	Catches to which the age compositions were applied ('000 t)
Denmark	138549	35	2760	2760	no	143372 (1)
France	4120	-	-	-	-	-
Germany	20479				-	16097
Netherlands	29923	37	925	3700	yes	69199
Norway	9852	7	560	560	no	9852
Sweden	4622				-	
UK (Scotland)	14588	16	n/a	2900	no	17097
UK (England)	2715	-	-	-	-	-
Catches split by survey samples						0

(1) : including IVc+VIId catches

DIVISIONS IVc+VIId

Country	Total Landings ('000 t)	No of Samples	No of Age-readings	No of fish measured	Estimates of discards	Catches to which the age compositions were applied ('000 t)
Belgium	163	-	-	-	-	-
Denmark	948	-	-	-	-	-
France	18212	18	1378	3776	no	22402
Germany	704	-	-	-	-	-
Netherlands	36631	19	475	1900	yes	37335
UK (Scotland)	67	-	-	-	-	-
UK (England)	3960	-	-	-	-	-
Catches split by survey samples						0

Table 2.2.8 Proportion of Division IIIa/Baltic spring spawners estimated by modal length analysis, by the formulae: $(56.5-\bar{v})/0.7$ and by analysis of vertebral count distributions. $\bar{v}$ is mean vertebral count of mixed samples.

				Proportion of spring spawners %		
Time	Area (rectangle)	Winter rings	$\bar{v}$	Modal length analysis	Formulae	Analysis of vert. count distribution
July	45F3	2	56.66	0	0	0
July	45F3	5+	56.49	0	0	0
July	49F4	4	56.15	63	50	60
July	45F4	5+	56.19	61	44	61
July	45F4	2	56.25	35	35	35
July	45F4	3	55.90	69	86	100
July	45F4	4	55.87	100	90	100
July	45F4	5+	56.02	10	69	71
July	43F6	2	56.21	25	41	40
Q1	Skagerrak	1	56.24	16	37	-
Q4	Skagerrak	2	56.22	29	40	-
Q1	Kattegat	2	56.28	69	31	-
Q2	Kattegat	2	56.05	51	64	-
Q2	Kattegat	2	55.89	97	87	-
Q3	Kattegat	2	55.89	93	87	-
Q4	Kattegat	1	55.98	90	74	-

Table 2.3.1 Recruitment index for 1-ringed herring from International Young Fish Surveys. Indices given are means of all rectangle means in 1-ringer standard area.

Year class	IYFS 1-ringer index	VPA estimate of 1-ringers (billions)
1974	452	0.81
1975	342	0.81
1976	575	1.43
1977	139	1.65
1978	535	3.59
1979	551	5.42
1980	1,293	8.56
1981	1,797	16.98
1982	2,663	15.34
1983	3,416	15.82
1984	3,667	27.59
1985	5,717	33.52
1986	4,192	27.83
1987	3,468	15.29
1988	2,146	17.68
1989	2,433	11.94
1990	2,339[1]	-

[1]Preliminary

Table 2.3.2 Density and abundance estimates of 0-ringers caught in February during the IYFS. Values given for year classes by areas are density estimates in numbers per square meter. Total abundance is found by multiplying density by area and summing up.

AREA	North west	North east	Cent. west	Cent. east	South west	South east	Div. IIIA	South Bight	O-ringers abundance
Area $m^2 \times 10^9$	83	34	86	102	37	93	31	31	no. in billions
Year class									
1976	0.054	0.014	0.122	0.005	0.008	0.002	0.002	0.016	17.1
1977	0.024	0.024	0.050	0.015	0.056	0.013	0.006	0.034	13.1
1978	0.176	0.031	0.061	0.020	0.010	0.005	0.074	0.000	52.1
1979	0.061	0.195	0.262	0.408	0.226	0.143	0.099	0.053	101.1
1980	0.052	0.001	0.145	0.115	0.089	0.339	0.248	0.187	76.7
1981	0.197	0.000	0.289	0.199	0.215	0.645	0.109	0.036	133.9
1982	0.025	0.011	0.068	0.248	0.290	0.309	0.470	0.140	91.8
1983	0.019	0.007	0.114	0.268	0.271	0.473	0.339	0.377	115.0
1984	0.083	0.019	0.303	0.259	0.996	0.718	0.277	0.298	181.3
1985	0.116	0.057	0.421	0.344	0.464	0.777	0.085	0.084	177.4
1986	0.317	0.029	0.730	0.557	0.830	0.933	0.048	0.244	270.9
1987	0.078	0.031	0.417	0.314	0.159	0.618	0.483	0.495	168.9
1988	0.036	0.020	0.095	0.096	0.151	0.411	0.181	0.016	71.4
1989	0.083	0.030	0.040	0.094	0.013	0.035	0.041	0.000	25.9
1990	0.075	0.053	0.202	0.158	0.121	0.198	0.086	0.196	69.9
1991	0.255	0.390	0.431	0.539	0.500	0.369	0.298	0.395	200.7

Table 2.3.3 MIK index and VPA estimates of 0-ringers for North Sea and Division IIIa combined. MIK index represents absolute estimates of abundance of herring larvae in billions.

Year class	MIK-index	VPA 0-ringers (billions)
1976	17.1	4.29
1977	13.1	4.69
1978	52.1	10.62
1979	101.1	16.70
1980	76.7	37.75
1981	133.9	64.55
1982	91.8	62.07
1983	115.0	53.36
1984	181.3	81.56
1985	177.4	96.89
1986	270.9	88.22
1987	168.9	46.46
1988	71.4	52.76
1989	25.9	-
1990	69.9	-
1991	200.7	-

Note: MIK-indices for year classes 1990-1991 are based on catches by the MIK-Gear; others are converted from earlier IKMT indices (see text).

Table 2.3.4 Calculated abundance of 1-ringed HERRING in North Sea 1983-1992 based on IYFS results.

Year	North Sea	Division IIIa	Sum	Prop. in Div. IIIa
1983	132075	64282	196357	0.33
1984	156197	85436	242633	0.35
1985	231535	124225	355760	0.35
1986	219136	234623	453759	0.52
1987	388807	224115	612922	0.37
1988	247205	545006	792211	0.69
1989	223244	113088	336332	0.34
1990	130396	36807	167203	0.22
1991	154454	27186	181640	0.15
1992	144114	46812	190926	0.25

Table 2.3.5 VPA-estimate and indices of 1-ringer abundance based on IYFS

Year class	VPA estimate millions	Standard area	Standard area log-transf.	Total area	Total area log-tranf.	GLM 5230-5830 log-tranf.
1980	8630	1308	79.2	853	37.5	1.33
1981	17140	1777	310.4	1834	125.7	1.52
1982	15168	2456	204.1	2018	109.4	1.09
1983	16100	3195	209.9	2938	115.2	1.27
1984	29000	3546	390.3	4007	145.9	1.76
1985	35900	6223	796.7	4895	298.4	3.39
1986	27930	4227	250.6	6906	113.5	1.22
1987	12750	3422	170.1	3272	110.2	1.19
1988	9930	2248	82.0	1494	52.2	0.59
1989	-	2464	149.0	1831	57.5	1.00

Table 2.3.6 Regression to VPA and prediction by indices.

		Standard area	Standard area log trans.	Total area	Total area log trans	GLM 5230-5830 log trans.
Log-Log regression	intercept	-3.9	-0.53	-2.3	-0.56	2.65
	slope	0.84	0.63	0.65	0.73	0.85
	R-square	0.66	0.86	0.74	0.78	0.74
Linear regression	intercept	1.86	8.71	6.62	5.89	5.50
	slope	0.005	0.03	0.004	0.11	9.65
	R-square	0.74	0.77	0.65	0.72	0.71
Prediction log-log r.	1988 Y.c.	13236	9452	11600	10249	9039
	1989 Y.c.	14297	13770	13240	10990	14154

Table 2.4.1 Estimated numbers of autumn-spawning herring by age, maturity, and area. Acoustic surveys 13 June to 12 August 1991.

AGE	NUMBERS (MILLIONS)						BIOMASS ('000 TONNES)					
RINGS	VIa	IVa	IVb	SKAGER	KATTEGAT	TOTAL	VIa	IVa	IVb	SKAGER	KATTEGAT	TOTAL
0			1237	60	934	2231			5	+	5	10
1	449	341	1990	539	312	3631	42	30	122	51	29	274
2 IMMATURE	217	347	163	515		1242	27	43	20	67		157
2 MATURE	770	1232	577			2579	134	209	96			439
3 IMMATURE	12	28	4			44	2	4	1			7
3 MATURE	583	1359	200			2142	119	272	40			431
4	441	2054	48			2543	98	462	10			570
5	290	1928	56			2274	70	456	12			538
6	74	697	51			822	20	183	12			215
7	11	240	22			273	3	67	5			75
8	0	79	33			112	0	25	8			33
9+	9	56	0			65	2	18	0			20
TOTAL IMMATURE	678	716	3394	1114	1246	7148	71	77	147	118	34	447
TOTAL SPAWNERS	2178	7644	987	0	0	10809	446	1691	183	0	0	2320
TOTAL	2856	8360	4382	1114	1246	17958	517	1768	330	118	34	2767

AGE	MEAN WEIGHT (GRAM)				
RINGS	VIa	IVa	IVb	SKAGER	KATTEGAT
0			4	6.0	14
1	93	89	61	94.0	55
2 IMMATURE	126	123	121	131.0	
2 MATURE	174	169	167		
3 IMMATURE	132	129	128		
3 MATURE	204	200	198		
4	222	225	206		
5	241	237	217		
6	271	262	233		
7	294	277	248		
8	345	322	240		
9+	252	317	261		
TOTAL IMMATURE					
TOTAL SPAWNERS					
TOTAL	181	211	111	106	24

Table 2.4.2 Estimated numbers of autumn-spawning herring (IIIa/Baltic) by age, maturity, and area. Acoustic surveys 13 June to 12 August 1991.

AGE	NUMBERS (MILLIONS)				BIOMASS ('000 TONNES)			
RINGS	IV	SKAGER.	KATTEGAT	TOTAL	IV	SKAGER.	KATTEGAT	TOTAL
0								
1								
2	119	795	950	1864	12	83	82	177
3	360	925	642	1927	45	109	67	221
4	322	342	202	866	44	45	27	116
5	105	150	95	350	15	21	15	51
6	35	24	29	88	7	5	7	19
7	11	29	32	72	2	5	6	13
8	2	8		10	0	2		2
9+								
TOTAL	954	2273	1950	5177	125	270	204	599

AGE	MEAN WEIGHT (GRAM)		
RINGS	IV	SKAGER.	KATTEGAT
0			
1			
2	103	105	86
3	124	118	104
4	138	133	134
5	143	143	156
6	193	191	237
7	209	164	188
8	164	205	
9+			
TOTAL	131	119	105

Table 2.4.3 Estimates of North Sea autumn spawners (millions) at age from acoustic surveys, 1984-1991. For 1984-1986 the estimates are the sum of those from the Division IVa summer survey, the Division IVb autumn survey, and the Divisions IVc, VIId winter survey. The 1987 to 1990 estimates are from the summer survey in Divisions IVa,b, and IIIa excluding estimates of Division IIIa/Baltic spring spawners.

Age (rings)	Numbers (millions)							
	Year							
	1984	1985	1986	1987	1988	1989	1990	1991
1	551	726	1,639	13,736	6,431	6,333	6,249	3,182
2	3,194	2,789	3,206	4,303	4,202	3,726	2,971	2,834
3	1,005	1,433	1,637	955	1,732	3,751	3,530	1,501
4	394	323	833	657	528	1,612	3,370	2,102
5	158	113	135	368	349	488	1,349	1,984
6	44	41	36	77	174	281	395	748
7	52	17	24	38	43	120	211	262
8	39	23	6	11	23	44	134	112
9+	41	19	8	20	14	22	43	56
Z(2+/3+)		0.92	0.57	1.02	0.81	0.11	0.11	0.56
SSB('000 t)	807	697	942	817	897	1,637	2,174	1,874

SSB defined as all fish >maturity stage III.

Table 2.4.4 Herring and sprat estimates from winter acoustic survey. Number in millions, biomass in '000 t.

Herring	w-rings	IVb,east	Skagerrak	Kattegat
	0	6405	0	287
	1	715	3	62
	2	14	0	13
	3	7	2	8
	4+	7	6	14
	Biomass	151.2	1.4	14.1
Sprat	Age			
	0	7825	83	1528
	1	798	0	166
	2	52	0	2
	Biomass	41.2	0.6	15.0

Table 2.5.1 ICES International herring larvae surveys. Estimated mortality rates rates (z/k) per mm for the standard areas over the years 1980-1991. Estimates marked with an asterix (*) are based on regression over the larval length range 10-16 mm. Estimates marked with a double asterix (**) are based on the length range 11-16 mm. Other estimates are based on the length range 8-16 mm.

Year	Orkney-Shetland	Div. VIa (N) + Ork./Shet.	Buchan	Central North Sea	Divs.IVc + VIId
1980	-	0.29*	-	-	0.33**
1981	0.29	0.34	-	-	-
1982	0.25*	0.26*	-	0.40	0.80**
1983	0.27*	0.26*	0.43	0.34	-
1984	0.20	0.24	0.42	-	0.54**
1985	0.25*	0.29*	-	0.33*	0.56**
1986	0.28*	0.22*	0.27*	-	0.48**
1987	0.37*	0.36	0.37*	0.35*	0.64**
1988	0.53*	0.56	0.38	0.31	0.71**
1989	0.39*	0.41	0.22	0.46	-
1990	0.36	-	0.40*	0.38	1.07*
1991	0.39	-	0.29	0.39	0.90*
Mean	0.33	-	0.35	0.37	0.67
91z/k	0.37		0.36	0.37	0.64
90z/k	0.31		0.35	0.37	0.58

91z/k: Mortality rates used in the 1991 HAWG Report (*Anon.*, 1991).
90z/k: Mortality rates used in the 1990 HAWG Report (*Anon.*, 1990).

Table 2.5.2 Larvae production estimates (LPE x 10^{11} larvae) calculated using area-specific natural mortality rates (z/k). Division IVa is the sum of Orkney-Shetland and Buchan LPEs. Division VIa + Orkney/Shetland is combined LPEs for Orkney-Shetland and Division VIa(N).

Year	Ork/Shet	Buchan	IVa	VIa(N)+Ork/Sh	Central North Sea	IVc+VIId
1972	174	-	174	-	23	20
1973	95	-	95	229	80	10
1974	78	-	78	153	45	2
1975	54	-	54	147	46	1
1976	20	-	20	55	10	1
1977	-	-	-	151	67	-
1978	102	-	102	198	73	3
1979	299	-	299	517	57	11
1980	332	-	332	586	103	127
1981	225	-	225	457	187	406
1982	336	92	428	554	76	190
1983	282	277	559	396	64	258
1984	213	433	646	391	523	178
1985	314	477	791	575	633	206
1986	218	831	1,049	789	451	359
1987	359	200	559	597	331	175
1988	413	727	1,140	803	568	231
1989	730	703	1,433	1,422	313	275
1990	890	887	1,777	-	335	266
1991	359	437	796	-	270	257

Table 2.5.3 The LPE index of SSB ('000 tonnes) estimated from larvae production estimates (LPE * 10^{11} larvae), and Fec, i.e., number of eggs (* 10^5) per kg SSB. SSB is the index of spawning stock biomass estimated as the ratio between LPE and Fecundity. Fecundities marked with an asterix are estimated as the average of the three closest years where an estimate was available.

Year	IVa (incl. Buchan)			IVb			IVa+IVb	IVc+VIId			North Sea
	LPE	Fec.	SSB	LPE	Fec.	SSB	SSB	LPE	Fec.	SSB	SSB
1972	174	1.56*	112	23	1.79*	13	124	20	0.94	21	146
1973	95	1.56*	61	80	1.79*	45	106	10	0.93	11	116
1974	78	1.56*	50	45	1.79*	25	75	2	0.87	2	77
1975	54	1.59	34	46	1.79*	26	60	1	1.01	1	61
1976	20	1.52	13	10	1.79*	6	19	1	0.74	1	20
1977	-	1.57	0	67	1.79*	37	-	2	1.02	2	-
1978	102	1.57	65	73	1.79*	41	106	3	1.18	3	108
1979	299	1.64	182	57	1.79*	32	214	11	1.07	10	224
1980	332	1.69	196	103	1.79*	58	254	127	1.14	111	365
1981	225	1.51	149	187	1.79*	104	253	406	1.06	383	636
1982	428	1.60	268	76	1.83*	42	309	190	1.11	171	480
1983	559	1.53	365	64	1.82*	35	401	258	1.10	235	635
1984	646	1.67	387	523	1.67	313	700	178	1.04	171	871
1985	791	1.60*	494	633	1.88	337	831	206	1.08	191	1,022
1986	1,049	1.60*	656	451	1.76*	256	912	359	1.08*	332	1,244
1987	559	1.60*	349	331	1.76*	188	537	175	1.08*	162	699
1988	1,140	1.60*	713	568	1.76*	323	1,035	231	1.08*	214	1,249
1989	1,433	1.60*	896	313	1.76*	176	1,074	230	1.08*	255	1,328
1990	1,777	1.60*	1,111	335	1.76*	190	1,301	266	1.08*	246	1,547
1991	796	1.60*	498	270	1.76*	153	651	257	1.08*	238	889

Table 2.5.4 Larvae abundance indices (LAI) by area and for the total North Sea.

Year	Ork-Shet.	Buchan	Central North Sea	IVc+VIId	North Sea
1972	5,779	7	112	171	6,405
1973	2,387	10	734	133	5,466
1974	1,284	379	635	25	4,228
1975	439	441	59	25	1,141
1976	655	1	76	18	978
1977	1,321	228	174	23	2,268
1978	3,705	363	462	111	6,027
1979	5,649	200	188	403	7,004
1980	3,982	18	214	1,193	6,049
1981	3,939	20	3,364	4,855	22,270
1982	3,795	1,002	338	3,709	9,858
1983	3,346	4,483	661	2,354	12,827
1984	3,538	4,296	1,055	2,267	14,321
1985	10,487	4,351	3,802	4,065	34,111
1986	5,500	3,780	2,027	4,780	22,168
1987	9,596	3,308	1,970	3,317	24,101
1988	16,502	12,319	2,946	3,907	44,512
1989	17,424	6,940	2,205	7,861	41,045
1990[1]	-	-	-	-	-
1991[1]	-	-	-	-	-

[1]No LAI could be calculated for 1990 or 1991.

Table 2.6.1. North Sea Herring,
Mean weight (g) at age (w.r.) and year class weighted by numbers caught.

Catches in: 1991

Division	Quarter	0	1	2	3	4	5	6	7	8	9
		1990	1989	1988	1987	1986	1985	1984	1983	1982	1981
	I		45	94	111	130	153	172	182	196	215
	II		87	156	180	205	227	239	264	288	287
(W of 2 E)	III		53	162	188	214	231	252	277	300	310
	IV		130	156	169	183	197	208	221	232	220
	Total		84	155	184	206	226	244	266	287	292
	I		47	99	116	132	144	157	176	202	183
	II		93	155	174	186	201	198	212	236	269
(E of 2 E)	III	17	95	146	148	155	177	204	220	305	250
	IV	17	85	156	171	181	193	207	233	231	239
	Total	17	87	140	146	155	167	185	203	221	225
	I		32	48	105	124	141	158	176	211	177
	II		29	73	126	148	156	164	187	194	201
IVb	III	17	73	166	195	209	232	244	286	285	272
	IV	18	47	159	183	192	216	224	256	226	258
	Total	17	57	119	173	196	220	225	277	257	263
	I		34	49	91	106	123	134	132	159	
	II		25	51	111	133	147	161	158	163	163
IVc + VIId	III		79	95	116	150	172	184	201	186	160
	IV	18	77	140	180	199	215	229	232	243	
	Total	18	62	123	165	184	200	212	196	237	161
IVa	Total	17	87	146	164	181	198	214	231	263	275
	I		32	76	116	132	144	157	176	201	194
IVa + IVb	II		30	102	158	190	212	207	251	259	278
	III	17	73	164	189	210	229	246	276	296	293
	IV	17	48	157	175	184	198	210	235	231	239
	Total	17	58	131	167	184	203	217	239	262	272
	I		32	73	112	130	143	154	171	200	194
Total	II		30	102	158	190	212	207	246	257	277
North	III	17	73	164	186	209	229	246	275	295	293
Sea	IV	17	49	151	177	189	204	218	235	237	239
	Total	17	58	130	166	184	203	217	235	259	271

Spring spawners transferred to Division IIIa and North Sea Autumn spawners caught in division IIIa are not included

Table 2.6.2. Comparison between mean weights (g) at age (w.r.) in catch of North Sea Herring (adult) from earlier years and 1985-1991

Division		Year	2	3	4	5	6	7	8	9+
			age in winter rings							
IVa		1985	137	170	199	216	235	263	270	293
		1986	123	158	183	209	222	246	253	263
		1987	118	157	186	214	237	260	278	304
		1988	126	150	176	200	218	237	260	263
		1989	129	157	175	210	233	246	268	256
		1990	123	154	177	194	229	234	251	295
		1991	146	164	181	198	214	231	263	275
IVb		1985	123	177	202	216	223	250	267	291
		1986	120	157	191	219	232	220	207	237
		1987	70	131	179	215	233	225	273	244
		1988	98	136	175	195	208	244	228	205
		1989	93	162	199	225	280	276	273	333
		1990	102	145	194	219	250	272	259	277
		1991	119	173	196	220	225	277	257	263
IVa+	Pre-	1985	126	176	211	243	256	267	271	271
IVb		1985	133	171	200	216	233	261	270	293
		1986	122	158	184	210	223	245	253	263
		1987	99	152	186	214	237	259	278	304
		1988	112	147	176	199	217	238	257	263
		1989	116	158	179	212	237	250	269	259
		1990	113	152	181	198	232	238	252	290
		1991	131	167	184	203	217	239	262	272
IVc+	pre-	1985	117	141	170	192	221	224	216	208
VIId		1985	113	124	148	170	168	212	207	193
		1986	108	139	164	185	208	174	202	232
		1987	105	128	148	164	198	211	197	234
		1988	103	132	156	178	197	185	165	
		1989	110	127	151	182	198	201	198	179
		1990	118	131	152	171	195	216	208	231
		1991	123	165	184	200	212	196	237	161
Total	pre-	1985	125	166	204	228	253	266	271	270
North		1985	128	164	194	211	220	258	270	292
Sea		1986	121	153	182	207	221	238	252	262
		1987	99	149	180	211	234	258	278	295
		1988	111	145	174	197	216	237	253	263
		1989	115	153	173	208	231	247	265	259
		1990	114	149	177	193	229	236	250	287
		1991	130	166	184	203	217	235	259	271

Spring spawners transferred to Division IIIa and North sea autumn spawners caught in IIIa are not included

Table 2.6.3 HERRING mean weight at age in the third quarter in Divisions IVa and IVb.

Age (WR.)	Mean weights (g) at age in the catch							
	Third quarter (Divisions IVa and IVb)						July Acoustic Survey	
	1986	1987	1988	1989	1990	1991	1990	1991
1	78	54	58	42	58	73	64	65
2	146	134	124	126	128	164	128	158
3	190	182	178	179	180	189	186	198
4	214	219	217	207	208	210	207	224
5	248	248	239	244	228	229	232	236
6	282	265	261	274	256	246	257	260
7	288	286	283	288	267	276	282	275
8	327	310	283	296	272	296	278	298
9+	364	342	296	350	295	293	318	317

Table 2.7.1 Time series of relative estimates of spawning stock, and the spawning stock for the converged part of the VPA ('000 t).

Year	SSB VPA	SSB LPE	SSB Acoustic	LAI	IYFS 3+ Total North Sea
1972	289	146	-	6,405	-
1973	233	116	-	5,466	-
1974	161	77	-	4,228	-
1975	79	61	-	1,141	-
1976	75	20	-	978	-
1977	41	-	-	2,268	-
1978	52	108	-	6,027	-
1979	100	224	-	7,004	-
1980	126	365	-	6,049	-
1981	191	636	305	22,270	41.8
1982	276	480	402	9,858	73.4
1983	428	635	440	12,827	93.4
1984	726	871	807	14,321	247.8
1985	764	1,022	697	34,111	300.6
1986	818	1,244	942	22,168	182.6
1987	935	699	667[1]	24,101	508.6
1988	1123	1,249	801[2]	44,512	374.0
1989	-	1,328	1,490[3]	40,707	566.4
1990	-	1,547	2,009[4]	-	554.3
1991	-	849	1,743[5]	-	281.3

[1]Reduced by 150,000 t (catches of spawners beteen time of the survey (15 July) and 1 November).
[2]Reduced by 94,000 t (catches of spawners between time of the survey (15 July) and 1 September).
[3]Reduced by 147,000 t (catches of spawners between time of the survey and 1 September).
[4]Reduced by 165,000 t (catches of spawners between time of the survey (13 July) and 27 September).
[5]Reduced by 131,000 t (catches of autumn spawners between time of the survey (15 July) and 15 September).

Table 2.7.2

Analysis by RCT3 ver3.1 of data from file :

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PRediction of SSB from LPE, Acoustics, IYFS 3+, Total North Sea.

Data for 3 surveys over 14 years : 1978 - 1991

Regression type = C
Tapered time weighting not applied
Survey weighting not applied
Final estimates not shrunk towards mean
Estimates with S.E.'S greater than that of mean
\+ included
Minimum S.E. for any survey taken as .20
Minimum of 5 points used for regression

Forecast/Hindcast variance correction used.

Year = 1989

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights	Net weights
	I-----------Regression----------				I	-----------Prediction---------			I	
LPE SS	1.47	-3.45	.43	.860	11	7.19	7.11	.531	.168	.139
ACOUST	1.69	-4.45	.27	.867	8	7.31	7.90	.421	.268	.000
IYFS 3	.76	2.42	.21	.911	8	6.34	7.25	.290	.564	.465
Acoust	1.00	-0.04				7.31	7.22	.314		.396
					VPA Mean =		5.84	1.022	.000	

Year = 1990

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights	
	I-----------Regression----------				I	-----------Prediction---------			I	
LPE SS	1.47	-3.45	.43	.860	11	7.34	7.34	.542	.173	.133
ACOUST	1.69	-4.45	.27	.867	8	7.61	8.40	.481	.220	.000
IYFS 3	.76	2.42	.21	.911	8	6.32	7.23	.289	.608	.469
Acoust	1.00	-0.04				7.61	7.57	.314		.397
					VPA Mean =		5.84	1.022	.000	

Year = 1991

Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights	
	I-----------Regression----------				I	-----------Prediction---------			I	
LPE SS	1.47	-3.45	.43	.860	11	6.79	6.52	.511	.166	.136
ACOUST	1.69	-4.45	.27	.867	8	7.43	8.11	.445	.220	.000
IYFS 3	.76	2.42	.21	.911	8	5.64	6.72	.266	.614	.503
Acoust	1.00	-0.04				7.43	7.42	.314		.361
					VPA Mean =		5.84	1.022	.000	

Year	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1989	1636	7.40	.22	.22	.98		
1990	1822	7.51	.23	.34	2.24		
1991	1085	6.99	.21	.42	4.09		

Net weighted average predictions

1989 1,392
1990 1,603
1991 1,038

Table 2.7.3

Run title : Herring in the North Sea Area (Fishing Areas IV and IIIA) (r At 7/04/1992 19:36
Traditional vpa Terminal populations from weighted Separable populations

Catch numbers at age Numbers*10**-4

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE												
0	89810	68400	75040	28940	99610	26380	23820	25680	13000	54200	126270	951970
1	119620	437850	334060	236800	84610	246050	12660	14430	16860	15920	24510	87200
2	200280	114680	144050	134420	77260	54170	90150	4470	490	3410	13400	28430
3	88360	66250	34380	65920	36200	25960	11730	18640	570	1000	9180	5690
4	12520	20830	13060	15020	12600	14050	5200	1080	500	1010	3220	3950
5	5030	2690	3290	5930	5610	5720	3450	700	30	210	2170	2850
6	6100	3050	500	3060	2230	1610	610	410	20	20	230	2270
7	790	2680	20	370	500	910	440	150	20	80	140	1870
8	1200	10	110	140	200	340	100	70	20	60	40	550
+gp	1220	1240	40	60	110	140	40	0	30	10	10	110
TOTALNUM	524930	717680	604550	490660	318930	375330	148200	65630	31540	75920	179170	1084890
TONSLAND	563100	520100	497500	484000	275100	312800	174800	46000	11000	25100	61000	140972
SOPCOF %	104	93	109	104	103	107	105	83	82	99	79	80

Catch numbers at age Numbers*10**-4

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE										
0	1195670	1329690	666190	417890	366400	803550	312290	298400	124600	230660
1	111640	244860	173720	322820	472320	667530	776280	307100	285500	206710
2	29940	57380	109500	131620	124610	212370	224750	158300	87700	110160
3	23010	21640	42170	117340	82710	68710	118510	138358	76330	55350
4	3370	10510	19250	36570	45830	48150	39810	82812	84910	54890
5	1440	2620	7750	12360	12770	24880	26060	21834	37590	49390
6	680	2280	2160	4330	6110	7570	12860	12940	8010	20160
7	780	1280	2410	2000	2020	2370	3790	6327	5440	3880
8	360	1100	1060	1300	1340	790	1510	2073	2840	2500
+gp	110	1210	1780	1600	1460	800	840	866	1180	1260
TOTALNUM	1367000	1672570	1025990	1047830	1115570	1836720	1516700	1029009	714100	734960
TONSLAND	235925	305954	312436	519474	527995	612087	675143	679080	543589	558646
SOPCOF %	88	73	72	82	70	76	65	83	82	85

Table 2.7.4

Run title : Herring in the North Sea Area (Fishing Areas IV and IIIA) (r
Traditional vpa Terminal populations from weighted Separable populations

Catch weights at age (kg)

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE												
0	.0150	.0150	.0150	.0150	.0150	.0150	.0150	.0150	.0150	.0150	.0150	.0070
1	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0490
2	.1260	.1260	.1260	.1260	.1260	.1260	.1260	.1260	.1260	.1260	.1260	.1180
3	.1760	.1760	.1760	.1760	.1760	.1760	.1760	.1760	.1760	.1760	.1760	.1420
4	.2110	.2110	.2110	.2110	.2110	.2110	.2110	.2110	.2110	.2110	.2110	.1890
5	.2430	.2430	.2430	.2430	.2430	.2430	.2430	.2430	.2430	.2430	.2430	.2110
6	.2510	.2510	.2510	.2510	.2510	.2510	.2510	.2510	.2510	.2510	.2510	.2220
7	.2670	.2670	.2670	.2670	.2670	.2670	.2670	.2670	.2670	.2670	.2670	.2670
8	.2710	.2710	.2710	.2710	.2710	.2710	.2710	.2710	.2710	.2710	.2710	.2710
+gp	.2710	.2710	.2710	.2710	.2710	.2710	.2710	.2710	.2710	.2710	.2710	.2710
SOPCOFAC	1.0356	.9305	1.0873	1.0444	1.0331	1.0703	1.0494	.8348	.8229	.9944	.7882	.7996

Catch weights at age (kg)

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE										
0	.0100	.0100	.0100	.0090	.0060	.0110	.0110	.0170	.0190	.0170
1	.0590	.0590	.0590	.0360	.0670	.0350	.0550	.0430	.0550	.0580
2	.1180	.1180	.1180	.1280	.1210	.0990	.1110	.1150	.1140	.1300
3	.1490	.1490	.1490	.1640	.1530	.1500	.1450	.1530	.1490	.1660
4	.1790	.1790	.1790	.1940	.1820	.1800	.1740	.1730	.1770	.1840
5	.2170	.2170	.2170	.2110	.2080	.2110	.1970	.2080	.1930	.2030
6	.2380	.2380	.2380	.2200	.2210	.2340	.2160	.2310	.2290	.2170
7	.2650	.2650	.2650	.2580	.2380	.2580	.2370	.2470	.2360	.2350
8	.2740	.2740	.2740	.2700	.2520	.2770	.2530	.2650	.2500	.2590
+gp	.2750	.2750	.2750	.2920	.2620	.2990	.2630	.2590	.2870	.2710
SOPCOFAC	.8765	.7336	.7236	.8185	.7028	.7623	.6454	.8297	.8250	.8487

Table 2.7.5

Run title : Herring in the North Sea Area (Fishing Areas IV and IIIA) (r At 7/04/1992 19:36
Traditional vpa Terminal populations from weighted Separable populations

Table 3 Stock weights at age (kg)

YEAR AGE	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	.0150	.0150	.0150	.0150	.0150	.0150	.0150	.0150	.0150	.0150	.0150	.0150
1	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500	.0500
2	.1550	.1550	.1550	.1550	.1550	.1550	.1550	.1550	.1550	.1550	.1550	.1550
3	.1870	.1870	.1870	.1870	.1870	.1870	.1870	.1870	.1870	.1870	.1870	.1870
4	.2230	.2230	.2230	.2230	.2230	.2230	.2230	.2230	.2230	.2230	.2230	.2230
5	.2390	.2390	.2390	.2390	.2390	.2390	.2390	.2390	.2390	.2390	.2390	.2390
6	.2760	.2760	.2760	.2760	.2760	.2760	.2760	.2760	.2760	.2760	.2760	.2760
7	.2990	.2990	.2990	.2990	.2990	.2990	.2990	.2990	.2990	.2990	.2990	.2990
8	.3060	.3060	.3060	.3060	.3060	.3060	.3060	.3060	.3060	.3060	.3060	.3060
+gp	.3120	.3120	.3120	.3120	.3120	.3120	.3120	.3120	.3120	.3120	.3120	.3120

Run title : Herring in the North Sea Area (Fishing Areas IV and IIIA) (r At 7/04/1992 19:36
Traditional vpa Terminal populations from weighted Separable populations

Table 3 Stock weights at age (kg)

YEAR AGE	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	.0150	.0150	.0150	.0090	.0060	.0060	.0070	.0120	.0160	.0170
1	.0500	.0500	.0500	.0640	.0780	.0490	.0430	.0510	.0640	.0650
2	.1550	.1550	.1550	.1410	.1460	.1330	.1220	.1400	.1450	.1580
3	.1870	.1870	.1870	.1930	.1900	.1830	.1630	.1780	.1860	.1980
4	.2230	.2230	.2230	.2280	.2240	.2200	.2150	.2110	.2080	.2240
5	.2390	.2390	.2390	.2480	.2480	.2470	.2390	.2540	.2320	.2360
6	.2760	.2760	.2760	.2580	.2810	.2630	.2700	.2830	.2570	.2600
7	.2990	.2990	.2990	.3000	.2870	.2850	.2770	.2880	.2820	.2750
8	.3060	.3060	.3060	.3180	.3280	.3100	.2970	.3160	.2780	.2980
+gp	.3120	.3120	.3120	.3160	.3640	.3420	.3100	.3620	.3180	.3170

Table 2.7.6

Run title : Herring in the North Sea Area (Fishing Areas IV and IIIA) (r At 7/04/1992 19:36
Traditional vpa Terminal populations from weighted Separable populations

Table 5 Proportion mature at age

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE												
0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	1.0000	1.0000	.8200	.8200	.8200	.8200	.8200	.8200	.8200	.8200	.8200	.8200
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	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	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	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	1.0000	1.0000

Run title : Herring in the North Sea Area (Fishing Areas IV and IIIA) (r At 7/04/1992 19:36
Traditional vpa Terminal populations from weighted Separable populations

Table 5 Proportion mature at age

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE										
0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
1	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
2	.8200	.8200	.8200	.7000	.7500	.6300	.6600	.7900	.7300	.6400
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	.9000	.9400	.9700	.9700
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	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
+gp	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 2.7.7

Title : Herring in the North Sea Area (Fishing Areas IV and IIIA) (r   At 8/04/1992 10:34

Separable analysis
from 1970 to 1991 on ages 0 to 8
with Terminal F of .365 on age 4 and Terminal S of 1.050

Initial sum of squared residuals was 235.419 and
final sum of squared residuals is 101.889 after 114 iterations

Matrix of Residuals

Years / Ages	1970/71	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
0/ 1	-1.423	-2.095	-.566	-.998	-.492	.661	.196	-1.529	.290	2.008	1.104
1/ 2	-1.367	-1.004	.090	-.339	-.690	-.833	-1.047	-.161	.890	.174	-.700
2/ 3	.247	-.327	.505	.412	.489	.245	.058	-.873	-.854	-.431	.860
3/ 4	.602	.147	.613	.795	.345	.279	.842	.789	-.543	-.461	.966
4/ 5	.421	.088	.365	-.132	-.079	-.275	.106	.487	.771	-.191	.083
5/ 6	-.725	-.185	-.436	-.240	.273	.419	.089	.355	.260	.431	-.148
6/ 7	-.485	3.060	-.283	.508	-.153	-.611	-.736	-.293	-1.618	-1.504	-2.278
7/ 8	3.158	1.330	-2.452	-.595	-.572	.418	-.177	-1.194	-1.270	1.195	-1.484
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
WTS	.001										
WTS	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001	

Years / Ages	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91		WTS
0/ 1	1.968	2.116	2.465	1.239	.008	-.312	.279	.220	.075	-.266	.000	.197
1/ 2	-.449	-.080	-.069	-.537	-.292	-.263	-.023	.442	-.051	-.099	.000	.468
2/ 3	-.733	.140	-.005	-.327	-.214	.095	.035	-.099	-.005	-.025	.000	.549
3/ 4	-.292	.732	-.073	-.010	.366	.147	.104	-.115	-.122	-.020	.000	.553
4/ 5	.015	.044	-.053	.113	.286	.033	-.013	-.056	.004	.031	.000	1.000
5/ 6	.370	-.728	-.229	.182	-.137	-.128	-.041	-.029	.148	.050	.000	.729
6/ 7	-.084	-.984	-.561	-.404	-.165	.213	-.093	-.105	-.075	.066	.000	.243
7/ 8	.569	-.629	-.248	.208	-.450	.279	-.259	-.136	-.068	.187	.000	.214
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-4.352	
WTS	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	1970	1971
F-values	1.1259	1.2970

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
F-values	.6618	1.0466	1.0266	1.6282	1.7181	1.3201	.1385	.1501	.3548	.5587

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
F-values	.3406	.4208	.4816	.6276	.5536	.5701	.5617	.5255	.3984	.3650

Selection-at-age (S)

	0	1	2	3	4	5	6	7	8
S-values	.1586	.6884	.6911	.7943	1.0000	1.0753	1.1104	1.0504	1.0500

Table 2.7.8

Herring in the North Sea Area (Fishing Areas IV and IIIA) (r At 8/04/1992 10:58
Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR	1970	1971
AGE		
0	.0351	.0340
1	.2681	.6024
2	.9728	.8831
3	1.2664	1.2145
4	1.3354	1.2248
5	.8704	1.0981
6	1.0335	2.5147
7	3.2714	2.0612
8	1.1628	.4488
+gp	1.1628	.4488
FBAR 2- 6	1.0957	1.3870

Table 8 Fishing mortality (F) at age

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE										
0	.0583	.0467	.0751	.1715	.1567	.0987	.0447	.0836	.1260	.4839
1	.5789	.6738	.4582	.6897	.2770	.3225	.2028	.1633	.1131	.2861
2	.8129	1.0249	1.0280	1.3597	1.3486	.2585	.0267	.0962	.3543	.3236
3	.8024	1.3373	.9801	1.5011	1.6696	1.4514	.0499	.0737	.4280	.2657
4	.7991	.9909	1.0022	1.4073	1.7198	.6377	.1102	.1114	.3371	.3127
5	.5478	.9501	1.1973	1.9586	1.8005	1.1545	.0279	.0556	.3277	.4969
6	.5317	1.3665	1.0743	1.3182	1.2775	1.0998	.0717	.0211	.0717	.5929
7	.0876	.8498	.7552	1.9921	1.7374	1.2159	.1153	.3972	.1798	1.0862
8	.3783	1.2098	1.5868	1.8379	1.4773	1.7336	.4338	.5172	.3142	1.8585
+gp	.3783	1.2098	1.5868	1.8379	1.4773	1.7336	.4338	.5172	.3142	1.8585
FBAR 2- 6	.6988	1.1339	1.0564	1.5090	1.5632	.9204	.0573	.0716	.3037	.3984

: Herring in the North Sea Area (Fishing Areas IV and IIIA) (r At 8/04/1992 10:58
Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE										
0	.3357	.3977	.2157	.0839	.0614	.1535	.1113	.0930	.0587	.0682
1	.2263	.2530	.1940	.3756	.3067	.3650	.5484	.3687	.2870	.3105
2	.2613	.3044	.3003	.3923	.4414	.3944	.3584	.3665	.2997	.3000
3	.5072	.3258	.4106	.6566	.4928	.5020	.4279	.4187	.3226	.3345
4	.2360	.4349	.5093	.7188	.5523	.5671	.5816	.5712	.4658	.3844
5	.1603	.2596	.5860	.6363	.5219	.5837	.6093	.6500	.4890	.4801
6	.1865	.3620	.3147	.6765	.6651	.5953	.6028	.6171	.4648	.4682
7	.3680	.5537	.7095	.4747	.6901	.5200	.5982	.5975	.5058	.3812
8	.5438	1.1673	1.1208	.9536	.5967	.5622	.6533	.6823	.5206	.4074
+gp	.5438	1.1673	1.1208	.9536	.5967	.5622	.6533	.6823	.5206	.4074
FBAR 2- 6	.2703	.3374	.4242	.6161	.5347	.5285	.5160	.5247	.4084	.3935

Table 2.7.9

Herring in the North Sea Area (Fishing Areas IV and IIIA) (r At 8/04/1992 10:58
Traditional vpa Terminal populations from weighted Separable populations

Table(10 Stock number at age (start of year) Numbers*10**-5

YEAR	1970	1971
AGE		
0	410609	322800
1	78722	145842
2	36398	22149
3	13300	10194
4	1766	3069
5	903	420
6	987	342
7	84	318
8	182	3
+gp	185	359
TOTAL	543136	505496

Table(10 Stock number at age (start of year) Numbers*10**-5

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE										
0	208636	99956	216609	26114	25649	42882	46882	106203	167027	377543
1	114781	72406	35094	73924	8093	8067	14293	16493	35937	54173
2	29374	23668	13579	8165	13644	2257	2150	4293	5153	11807
3	6785	9653	6292	3599	1553	2624	1291	1551	2889	2679
4	2478	2490	2075	1933	657	239	503	1006	1179	1542
5	816	1008	836	689	428	106	115	408	814	762
6	127	427	353	229	88	64	30	101	349	531
7	25	67	99	109	55	22	19	26	89	294
8	37	21	26	42	13	9	6	16	16	67
+gp	13	9	14	17	5	0	9	3	4	13
TOTAL	363072	209705	274977	114821	50186	56271	65298	130098	213457	449410

: Herring in the North Sea Area (Fishing Areas IV and IIIA) (r At 8/04/1992 10:58
Traditional vpa Terminal populations from weighted Separable populations

Table(10 Stock number at age (start of year) Numbers*10**-5

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE											
0	645537	620730	533622	815588	968895	882151	464632	527579	344330	550692	0
1	85610	169767	153421	158214	275885	335217	278343	152919	176851	119454	189239
2	14971	25116	48494	46489	39980	74682	85605	59170	38909	48828	32215
3	6329	8540	13723	26606	23263	19049	37292	44317	30383	21360	26797
4	1681	3120	5048	7452	11297	11635	9440	19903	23871	18017	12516
5	1020	1202	1828	2745	3286	5884	5971	4775	10172	13557	11100
6	419	786	839	920	1314	1764	2970	2938	2256	5644	7590
7	265	315	495	554	423	612	880	1471	1434	1282	3198
8	90	166	164	221	312	192	329	438	732	783	792
+gp	27	183	275	271	340	195	183	183	304	394	709
TOTAL	755950	829925	757909	1059061	1324996	1331381	885647	813692	629243	780013	284155

Table 2.7.10

Herring in the North Sea Area (Fishing Areas IV and IIIA) (r   At 8/04/1992 10:59
Traditional vpa Terminal populations from weighted Separable populations

Table 13 Spawning stock biomass at age (spawning time) Tonnes

YEAR	1970	1971
AGE		
0	0	0
1	0	0
2	240475	155393
3	93112	73891
4	15053	28173
5	11265	4502
6	12741	1638
7	263	2232
8	2386	61
+gp	2473	7755
TOTSPBIO	377769	273646

Table 13 Spawning stock biomass at age (spawning time) Tonnes

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE										
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0
2	177129	123821	70892	34133	57464	19730	21951	41843	42250	98818
3	64819	64441	53359	21527	8298	16229	20421	24136	35466	36664
4	30249	26735	22110	15702	4326	3257	9748	19463	19622	26073
5	12635	11923	8382	4147	2864	1097	2512	8782	14607	12204
6	2293	4411	4433	2439	965	791	747	2564	8587	9208
7	660	1067	1661	802	483	275	499	548	2213	3971
8	812	264	258	350	143	79	127	315	360	556
+gp	301	115	145	147	58	0	195	53	92	113
TOTSPBIO	288899	232777	161239	79246	74602	41458	56199	97704	123197	187607

Herring in the North Sea Area (Fishing Areas IV and IIIA) (r   At 8/04/1992 10:59
Traditional vpa Terminal populations from weighted Separable populations

Table 13 Spawning stock biomass at age (spawning time) Tonnes

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE										
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0
2	130634	212921	412246	288544	266398	392951	443433	418711	275579	330304
3	73687	112279	170459	289262	277862	217795	359200	489885	386250	286757
4	29936	48625	74838	98166	163467	163720	128554	267843	339877	291744
5	20483	22568	27586	41564	53726	91931	88730	73378	159037	216912
6	9553	15928	17531	14114	22122	29123	50078	51420	39704	100283
7	5800	6076	8613	11308	7157	11506	15274	26546	26950	25542
8	1785	2176	2212	3462	6413	3822	5899	8193	13431	16599
+gp	556	2441	3787	4234	7754	4270	3425	3919	6383	8899
TOTSPBIO	272433	423014	717271	750654	804900	915117	1094593	1339895	1247212	1277039

Table 2.7.11 Herring in the southern North Sea (fishing areas IVc and VIId).

Catch numbers at age   Numbers*10**-3

YEAR	1964	1965	1966	1967	1968	1969	1970	1971
AGE								
1	21300	400	3600	3600	6000	5500	4200	21800
2	22300	25500	54800	42400	22900	161800	81600	130800
3	78500	60500	9900	15400	19900	8800	83800	41700
4	700	32600	1200	4900	9700	5300	5400	31100
5	5900	2100	3100	2200	1500	1900	1600	700
6	10	2400	10	100	3000	400	1000	300
7	10	500	10	10	600	400	100	600
8	10	10	10	10	10	10	400	10
+gp	10	30	10	10	10	20	100	300
TOTALNUM	128740	124040	72640	68630	63620	184130	178200	227310
TONSLAND	56572	21777	11623	11446	9610	24322	27086	23451
SOPCOF %	316	114	123	124	104	104	113	93

Catch numbers at age   Numbers*10**-3

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE										
1	4800	2200	3900	24100	22200	900	400	400	23400	7300
2	135100	43300	24100	127200	94400	6400	2800	21600	99100	222600
3	29300	115100	20300	39600	41800	3000	4000	9000	83800	40400
4	9300	55000	8400	5300	3500	700	1200	5600	30200	19300
5	5000	7400	1200	1800	500	200	10	600	18400	6700
6	10	1900	100	10	300	10	10	100	1700	3300
7	10	500	200	10	10	10	10	10	500	600
8	10	100	10	10	10	10	10	10	10	10
+gp	10	10	10	10	10	10	10	10	10	10
TOTALNUM	183540	225510	58220	198040	162730	11240	8450	37330	257120	300220
TONSLAND	23004	30163	7383	25527	17526	1446	1591	6552	43086	41883
SOPCOF %	101	90	99	101	101	101	105	101	99	103

Catch numbers at age
Numbers*10**-3

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE										
1	20900	25100	13700	13100	10800	19700	4400	12600	10858	19500
2	201200	251700	172600	314100	107600	161400	112000	106100	139347	79100
3	221400	105100	116600	169000	193700	77400	212800	205400	95411	120600
4	26500	64500	33000	44100	45700	80500	45300	182000	109117	59300
5	6800	11100	22600	12300	13500	13800	32500	31500	59573	50100
6	2200	3000	2000	8400	9200	6500	5800	19500	7931	33500
7	1500	500	500	1400	1900	200	800	3400	4717	3600
8	500	500	30	100	100	100	500	1200	1307	3400
+gp	100	100	400	200	400	600	0	40	581	0
TOTALNUM	481100	461600	361430	562700	382900	360200	414100	561740	428842	369100
TONSLAND	68652	64430	45643	68979	51290	44598	52404	78794	61082	60685
SOPCOF %	109	103	99	102	100	100	97	103	102	101

Table 2.7.12 Assessment quality diagram, herring total North Sea. Average FISHING MORTALITY for 2-ringers and older. Unweighted average except for the period 1982-1985.

	Date of assessment																					
Year	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	Year
1969	.89	.88	.90	.90	.89	.91	.91				.90	.91			1.06	1.03	1.09	1.03				1969
1970	1.05	1.05	1.13	1.14	1.13	1.15	1.15				1.14	1.15		1.15	1.31	1.10	1.13	1.10	1.10	1.10	1.10	1970
1971	1.00	?	1.09	1.12	1.11	1.12	1.12				1.12	1.12		1.12	1.39	1.36	1.48	1.36	1.41	1.37	1.39	1971
1972		.70	?	.89	.86	.88	.88				.87	.87		.88	.71	.69	.65	.69	.70	.69	.70	1972
1973			.70	?	1.12	1.17	1.17				1.14	1.14		1.18	1.14	1.11	1.13	1.11	1.14	1.13	1.13	1973
1974				1.00	.94	1.03	1.03				1.02	1.02	1.04	1.08	1.07	1.04	1.04	1.04	1.06	1.05	1.06	1974
1975					.90	1.27	1.27				1.18	1.09	1.30	1.42	1.45	1.41	1.46	1.41	1.52	1.45	1.51	1975
1976						.80	.80				.83	.99	1.28	1.43	1.31	1.27	1.26	1.27	1.59	1.36	1.56	1976
1977							.18				.24	.36	.61	.79	.69	.67	.79	.67	.97	.73	.92	1977
1978									.02		.01	.02	.03	.04	.05	.05	.05	.05	.06	.05	.06	1978
1979									.02		.03	.05	.08	.08	.06	.06	.05	.06	.07	.06	.07	1979
1980											.15	.20	.29	.32	.25	.24	.23	.24	.29	.27	.30	1980
1981											.15	.20	.28	.32	.30	.30	.30	.30	.39	.33	.40	1981
1982												.19	.25	.29	.23	.24	.25	.24	.26	.25	.27	1982
1983													.25	.29	.28	.31	.33	.32	.32	.33	.34	1983
1984														.32	.33	.38	.45	.41	.41	.42	.42	1984
1985															.39	.54	.67	.61	.58	.60	.62	1985
1986																.45	.55	.53	.49	.51	.53	1986
1987																	.55	.55	.49	.49	.52	1987
1988																		.58	.47	.46	.52	1988
1989																			.47	.44	.52	1989
1990																				.33	.41	1990
1991																					.39	1991
1992																						1992
1993																						1993
1994																						1994

Table 2.7.13 Assessment quality diagram, herring total North Sea. RECRUITMENT as 2-ringers (billions).
Figures below the indicated "diagonal" are prognosis.

	Date of assessment																					
Year	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	Year
1969	3.40	3.40	3.38	3.35	3.39	3.36	3.36				3.36	3.36			3.36	3.94	3.94	3.94				1969
1970	3.32	3.32	3.16	3.15	3.19	3.15	3.15				3.15	3.15		3.15	3.15	3.64	3.64	3.64	3.64	3.64	3.64	1970
1971	3.33	?	1.93	1.90	1.92	1.90	1.90				1.90	1.90		1.90	1.90	2.22	2.22	2.22	2.22	2.22	2.21	1971
1972	5.40	?	?	2.49	2.58	2.52	2.52				2.53	2.53		2.52	2.52	2.94	2.94	2.94	2.94	2.94	2.94	1972
1973		3.10	?	?	2.13	2.08	2.08				2.11	2.11		2.06	2.06	2.38	2.38	2.38	2.37	2.38	2.37	1973
1974			2.20	?	1.31	1.22	1.22				1.20	1.20	1.19	1.18	1.18	1.36	1.36	1.36	1.36	1.36	1.36	1974
1975				1.22	?	.78	.78				.84	.91	.77	.76	.76	.86	.86	.86	.82	.84	.82	1975
1976						?	?				1.64	1.39	1.26	1.22	1.22	1.38	1.38	1.38	1.36	1.38	1.36	1976
1977							.54				.49	.29	.24	.23	.23	.29	.29	.29	.23	.27	.23	1977
1978							.63		.63		.43	.25	.21	.21	.21	.26	.26	.26	.22	.25	.22	1978
1979									1.26		.62	.49	.37	.37	.37	.46	.46	.46	.44	.45	.43	1979
1980									.24		.46	.47	.39	.36	.40	.50	.50	.50	.49	.52	.52	1980
1981											1.53	1.50	1.15	1.02	.99	1.19	1.16	1.16	1.17	1.18	1.18	1981
1982												1.70	1.41	1.31	1.30	1.54	1.46	1.46	1.49	1.51	1.50	1982
1983													2.57	2.31	2.46	2.53	2.50	2.48	2.52	2.54	2.51	1983
1984													4.10	3.95	5.11	4.96	4.76	4.71	4.77	4.91	4.85	1984
1985														5.30	4.81	4.66	4.59	4.54	4.63	4.77	4.65	1985
1986															6.03	4.49	3.72	3.84	4.07	4.10	4.00	1986
1987																5.43	6.70	6.12	7.34	7.98	7.47	1987
1988																	8.00	6.09	7.68	9.43	8.56	1988
1989																		6.18	4.56	5.95	5.92	1989
1990																			3.95	3.04	3.89	1990
1991																				3.20	4.88	1991
1992																					4.45	1992
1993																						1993
1994																						1994

Table 2.7.14 Assessment quality diagram, herring total North Sea. SPAWNING STOCK. Figures given with decimal point are number in billions, the remaining table is biomass in thousand tonnes. Figures below the indicated "diagonal" are prognosis.

	Date of assessment																					
Year	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	Year
1969	4.69	4.71	4.63	4.62	4.67	4.61	4.61				359				409	436	434	434				1969
1970	5.07	5.12	4.87	4.85	4.90	4.81	4.81				318			361	361	382	381	381	378	378	378	1970
1971	4.92	?	3.37	3.30	3.36	3.29	3.29				219			251	251	267	266	266	265	268	274	1971
1972	7.28	?	?	3.47	3.60	3.49	3.49				269	263		310	274	291	290	290	327	289	289	1972
1973		4.91	?	?	3.52	3.40	3.40				228	225		250	225	237	236	236	260	235	233	1973
1974			4.04	?	2.35	2.18	2.18				166	173	164	173	159	165	165	165	176	163	161	1974
1975				1.97	146	1.48	1.48				107	111	96	93	85	88	88	88	86	83	79	1975
1976					249	155			155		160	129	98	93	80	85	85	85	87	80	75	1976
1977					351	185	180		180		172	114	72	59	54	58	58	58	45	52	41	1977
1978					494	289	275		271		231	150	99	80	75	79	79	79	61	71	56	1978
1979					696	400	435		442		311	174	131	129	120	123	123	123	109	114	98	1979
1980					930				508		345	197	153	149	146	148	148	148	133	140	123	1980
1981											482	313	237	234	214	218	214	214	212	205	188	1981
1982												433	344	338	308	306	293	293	278	289	272	1982
1983													563	555	521	471	452	451	434	446	423	1983
1984													797	837	968	782	741	733	732	743	717	1984
1985													1162	1180	1196	839	770	757	777	780	751	1985
1986														1800	1314	941	805	801	847	844	805	1986
1987														2000	1680	1060	862	821	964	991	915	1987
1988															1790	1540	1171	822	1102	1242	1095	1988
1989																1700	1466	961	1256	1549	1340	1989
1990																	1559	1178	1262	1411	1247	1990
1991																		1212	1282	1320	1277	1991
1992																			1080	1374		1992
1993																				1237		1993
1994																						1994

Table 2.8.1 Proportion and abundance of each year class as 1-ringers in Division IIIa and survey indices related to that abundance.

Year class (aut. sp.)	Proportion in IIIa (1 ringers)	No. of 1-ringers IIIa (millions)	MIK index N.S. + IIIa	Acoustic estimates 0-ringers August IIIa	Acoustic estimates 0-ringers November IIIa
1981	0.33	5,602	133.9	3,394	-
1982	0.35	5,369	91.8	783	-
1983	0.35	5,537	115.0	552	-
1984	0.52	14,346	181.3	3,583	5,814
1985	0.37	12,403	177.4	8,187	6,513
1986	0.69	19,206	270.9	11,548	10,192
1987	0.34	5,199	168.9	3,706	2,527
1988	0.22	3,890	71.4	1,058	224
1989	0.15	1,792	25.9	77	463
1990	0.25	-	69,9	994	287
1991	-	-	200.7	-	-

Regressions: No of 1-ringers in Division IIIa (millions) =

$72.1 \cdot MIK - 1759$	$r^2 = 0.786$	or $61.8 \cdot MIK$
$1.3 \cdot ACO_A + 3397$	$r^2 = 0.728$	or $1.8 \cdot ACO_A$
$1.7 \cdot ACO_N + 2116$	$r^2 = 0.943$	or $2.0 \cdot ACO_N$

Proportion in IIIa =

$2.02 \cdot 10^{-3} \cdot MIK + 0.09$	$r^2 = 0.835$	or $2.55 \cdot 10\text{-}3 . MIK$
$3.2 \cdot 10^{-5} \cdot ACO_A + 0.025$	$r^2 = 0.553$	or $6.6 \cdot 10\text{-}5 . ACO_A$
$4.7 \cdot 10^{-5} \cdot ACO_N + 0.178$	$r^2 = 0.846$	or $7.2 \cdot 10\text{-}5 . ACO_N$

Table 2.8.2. Predicted catch and biomass of North Sea autumn spawning herring in 1992. Status quo F for 3+ and 0-ringer and catch of 1- and 2-ringers estimated based on relative abundance and unchanged effort.

AGE	STOCK SIZE	ABSOLUTE F	YIELD NS OTHER	YIELD NS SM. M.	YIELD NS TOTAL	YIELD 3A HC	YIELD 3A MIXED	YIELD 3A IND. L.	YIELD 3A TOTAL	YIELD TOTAL AS	SP STOCK NUMBER	SP STOCK BIOMASS
0	84700	0.07	0	40370	40370	110	11704	13739	25553	65923	0	0
1	14970	0.28	1369	56575	57944	19054	6646	28614	54313	112257	0	0
2	4550	0.29	79114	23441	102555	9564	471	6310	16345	118901	2239	353755
3	2680	0.33	108774	6877	115650	0	0	0	0	115650	1817	359762
4	1252	0.42	71856	3913	75768	0	0	0	0	75768	883	197786
5	1110	0.45	75574	2993	78567	0	0	0	0	78567	766	180865
6	759	0.47	56353	2438	58791	0	0	0	0	58791	519	134905
7	320	0.44	24809	1038	25847	0	0	0	0	25847	222	61187
8	79	0.44	6687	270	6957	0	0	0	0	6957	55	16370
9	71	0.44	6333	230	6563	0	0	0	0	6563	49	15650
TOTAL	110491		430869	138144	569013	28728	18820	48663	96212	665225	6551	1320279

AGE	STOCK SIZE	ABSOLUTE F	CATCH NS OTHER	CATCH NS SM. M.	CATCH NS TOTAL	CATCH 3A HC	CATCH 3A MIXED	CATCH 3A IND. L.	CATCH 3A TOTAL	CATCH TOTAL AS	SP STOCK NUMBER	SP STOCK BIOMASS
0	84700	0.07	0	2375	2375	3	509	509	1021	3395	0	0
1	14970	0.28	81	975	1056	224	277	818	1319	2375	0	0
2	4550	0.29	517	266	783	99	12	99	209	993	2239	353755
3	2680	0.33	625	69	695	0	0	0	0	695	1817	359762
4	1252	0.42	382	29	411	0	0	0	0	411	883	197786
5	1110	0.45	367	19	386	0	0	0	0	386	766	180865
6	759	0.47	257	14	271	0	0	0	0	271	519	134905
7	320	0.44	104	5	109	0	0	0	0	109	222	61187
8	79	0.44	26	1	27	0	0	0	0	27	55	16370
9	71	0.44	23	1	24	0	0	0	0	24	49	15650
TOTAL	110491		2382	3756	6137	326	798	1425	2549	8686	6551	1320279

AGE	STOCK SIZE	ABSOLUTE F	F NS OTHER	F NS SM. M.	F 3A HC	F 3A MIXED	F 3A IND. L.	SP STOCK NUMBER	SP STOCK BIOMASS
0	84700	0.07	0.00	0.05	0.00	0.01	0.01	0	0
1	14970	0.28	0.01	0.12	0.03	0.03	0.10	0	0
2	4550	0.29	0.15	0.08	0.03	0.00	0.03	2239	353755
3	2680	0.33	0.30	0.03	0.00	0.00	0.00	1817	359762
4	1252	0.42	0.39	0.03	0.00	0.00	0.00	883	197786
5	1110	0.45	0.43	0.02	0.00	0.00	0.00	766	180865
6	759	0.47	0.44	0.02	0.00	0.00	0.00	519	134905
7	320	0.44	0.42	0.02	0.00	0.00	0.00	222	61187
8	79	0.44	0.42	0.02	0.00	0.00	0.00	55	16370
9	71	0.44	0.42	0.02	0.00	0.00	0.00	49	15650
TOTAL	110491							6551	1320279

Yield = Catch in t. Catch = Catch in number (mill.).
NS SM. M. = Small meshed fisheries in the North Sea
NS OTHER = Other fisheries in the North Sea
3A HC = Human consumption landings in Division IIIa
3A MIXED = Mixed clupeoid landings in Division IIIa
3A IND. L. = Other industrial landings in Division IIIa

Table 2.8.3. Predicted catch and biomass of North Sea autumn spawning herring in 1993. Status quo F for 3+ and 0-ringer and catch of 1- and 2-ringers estimated based on relative abundance and unchanged effort.

AGE	STOCK SIZE	ABSOLUTE F	YIELD NS OTHER	YIELD NS SM. M.	YIELD NS TOTAL	YIELD 3A HC	YIELD 3A MIXED	YIELD 3A IND. L.	YIELD 3A TOTAL	YIELD TOTAL AS	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.07	0	33813	33813	92	9803	11508	21403	55216	0	0
1	29194	0.38	7196	84526	91722	63146	22025	94829	180000	271722	0	0
2	4156	0.32	65936	19537	85472	15250	751	10062	26063	111535	2005	316813
3	2526	0.33	102479	6479	108958	0	0	0	0	108958	1712	339052
4	1570	0.38	83644	4554	88199	0	0	0	0	88199	1135	254249
5	743	0.48	53000	2099	55099	0	0	0	0	55099	504	118950
6	639	0.47	47451	2053	49504	0	0	0	0	49504	436	113460
7	430	0.38	29557	1237	30794	0	0	0	0	30794	312	85705
8	186	0.41	14738	594	15333	0	0	0	0	15333	132	39461
9	87	0.41	7280	265	7545	0	0	0	0	7545	62	19678
TOTAL	107532		411282	155156	566438	78488	32579	116398	227465	793904	6299	1287369

AGE	STOCK SIZE	ABSOLUTE F	CATCH NS OTHER	CATCH NS SM. M.	CATCH NS TOTAL	CATCH 3A HC	CATCH 3A MIXED	CATCH 3A IND. L.	CATCH 3A TOTAL	CATCH TOTAL AS	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.07	0	1989	1989	3	426	426	855	2844	0	0
1	29194	0.38	122	1457	1579	743	918	2709	4370	5949	0	0
2	4156	0.32	431	222	653	157	19	157	334	987	2005	316813
3	2526	0.33	589	65	654	0	0	0	0	654	1712	339052
4	1570	0.38	445	33	478	0	0	0	0	478	1135	254249
5	743	0.48	257	14	271	0	0	0	0	271	504	118950
6	639	0.47	217	11	228	0	0	0	0	228	436	113460
7	430	0.38	124	7	130	0	0	0	0	130	312	85705
8	186	0.41	56	3	59	0	0	0	0	59	132	39461
9	87	0.41	26	1	28	0	0	0	0	28	62	19678
TOTAL	107532		2267	3803	6070	903	1363	3293	5559	11629	6299	1287369

AGE	STOCK SIZE	ABSOLUTE F	F NS OTHER	F NS SM. M.	F 3A HC	F 3A MIXED	F 3A IND. L.	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.07	0.00	0.05	0.00	0.01	0.01	0	0
1	29194	0.38	0.01	0.09	0.05	0.06	0.17	0	0
2	4156	0.32	0.14	0.07	0.05	0.01	0.05	2005	316813
3	2526	0.33	0.30	0.03	0.00	0.00	0.00	1712	339052
4	1570	0.38	0.36	0.03	0.00	0.00	0.00	1135	254249
5	743	0.48	0.46	0.02	0.00	0.00	0.00	504	118950
6	639	0.47	0.44	0.02	0.00	0.00	0.00	436	113460
7	430	0.38	0.36	0.02	0.00	0.00	0.00	312	85705
8	186	0.41	0.39	0.02	0.00	0.00	0.00	132	39461
9	87	0.41	0.39	0.02	0.00	0.00	0.00	62	19678
TOTAL	107532							6299	1287369

Yield = Catch in t. Catch = Catch in number (mill.).
NS SM. M. = Small meshed fisheries in the North Sea
NS OTHER = Other fisheries in the North Sea
3A HC = Human consumption landings in Division IIIa
3A MIXED = Mixed clupeoid landings in Division IIIa
3A IND. L. = Other industrial landings in Division IIIa

Table 2.8.4. Predicted catch and biomass of North Sea autumn spawning herring in 1993. 20% decrease in "NS OTHER" F. Status quo F for 3+ and 0-ringer. in other fisheries. Catch of 1- and 2-ringers in IIIa estimated based on relative abundance and unchanged effort.

AGE	STOCK SIZE	ABSOLUTE F	YIELD NS OTHER	YIELD NS SM. M.	YIELD NS TOTAL	YIELD 3A HC	YIELD 3A MIXED	YIELD 3A IND. L.	YIELD 3A TOTAL	YIELD TOTAL AS	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.07	0	33813	33813	92	9803	11508	21403	55216	0	0
1	29194	0.37	7106	83464	90570	63178	22036	94877	180091	270661	0	0
2	4156	0.29	53435	19791	73226	15314	754	10104	26173	99399	2044	322973
3	2526	0.27	84277	6660	90936	0	0	0	0	90936	1783	353009
4	1570	0.31	69166	4708	73874	0	0	0	0	73874	1191	266725
5	743	0.39	44200	2188	46388	0	0	0	0	46388	536	126447
6	639	0.38	39534	2138	41672	0	0	0	0	41672	463	120428
7	430	0.31	24452	1279	25731	0	0	0	0	25731	327	89967
8	186	0.33	12219	616	12835	0	0	0	0	12835	139	41561
9	87	0.33	6035	274	6310	0	0	0	0	6310	65	20726
TOTAL	107532		340424	154931	495355	78585	32593	116489	227666	723021	6549	1341836

AGE	STOCK SIZE	ABSOLUTE F	CATCH NS OTHER	CATCH NS SM. M.	CATCH NS TOTAL	CATCH 3A HC	CATCH 3A MIXED	CATCH 3A IND. L.	CATCH 3A TOTAL	CATCH TOTAL AS	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.07	0	1989	1989	3	426	426	855	2844	0	0
1	29194	0.37	120	1439	1559	743	918	2711	4372	5932	0	0
2	4156	0.29	349	225	574	158	19	158	335	909	2044	322973
3	2526	0.27	484	67	552	0	0	0	0	552	1783	353009
4	1570	0.31	368	35	403	0	0	0	0	403	1191	266725
5	743	0.39	215	14	229	0	0	0	0	229	536	126447
6	639	0.38	181	12	192	0	0	0	0	192	463	120428
7	430	0.31	102	7	109	0	0	0	0	109	327	89967
8	186	0.33	47	3	50	0	0	0	0	50	139	41561
9	87	0.33	22	1	23	0	0	0	0	23	65	20726
TOTAL	107532		1888	3792	5680	904	1364	3295	5562	11242	6549	1341836

AGE	STOCK SIZE	ABSOLUTE F	F NS OTHER	F NS SM. M.	F 3A HC	F 3A MIXED	F 3A IND. L.	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.07	0.00	0.05	0.00	0.01	0.01	0	0
1	29194	0.37	0.01	0.09	0.05	0.06	0.17	0	0
2	4156	0.29	0.11	0.07	0.05	0.01	0.05	2044	322973
3	2526	0.27	0.24	0.03	0.00	0.00	0.00	1783	353009
4	1570	0.31	0.29	0.03	0.00	0.00	0.00	1191	266725
5	743	0.39	0.36	0.02	0.00	0.00	0.00	536	126447
6	639	0.38	0.36	0.02	0.00	0.00	0.00	463	120428
7	430	0.31	0.29	0.02	0.00	0.00	0.00	327	89967
8	186	0.33	0.31	0.02	0.00	0.00	0.00	139	41561
9	87	0.33	0.31	0.02	0.00	0.00	0.00	65	20726
TOTAL	107532							6549	1341836

Yield = Catch in t. Catch = Catch in number (mill.).
NS SM. M. = Small meshed fisheries in the North Sea
NS OTHER = Other fisheries in the North Sea
3A HC = Human consumption landings in Division IIIa
3A MIXED = Mixed clupeoid landings in Division IIIa
3A IND. L. = Other industrial landings in Division IIIa

Table 2.8.5. Predicted catch and biomass of North Sea autumn spawning herring in 1993. 20% increase in "NS OTHER" F. Status quo F for 3+ and 0-ringer. in other fisheries. Catch of 1- and 2-ringers in IIIa estimated based on relative abundance and unchanged effort.

AGE	STOCK SIZE	ABSOLUTE F	YIELD NS OTHER	YIELD NS SM. M.	YIELD NS TOTAL	YIELD 3A HC	YIELD 3A MIXED	YIELD 3A IND. L.	YIELD 3A TOTAL	YIELD TOTAL AS	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.07	0	33813	33813	92	9803	11508	21403	55216	0	0
1	29194	0.37	7106	83464	90570	63178	22036	94877	180091	270661	0	0
2	4156	0.35	78079	19279	97358	15311	754	10102	26166	123524	1966	310577
3	2526	0.39	119665	6304	125969	0	0	0	0	125969	1645	325647
4	1570	0.46	97148	4408	101556	0	0	0	0	101556	1082	242357
5	743	0.57	61053	2015	63067	0	0	0	0	63067	474	111898
6	639	0.56	54710	1972	56682	0	0	0	0	56682	411	106895
7	430	0.45	34313	1196	35510	0	0	0	0	35510	297	81646
8	186	0.48	17074	574	17648	0	0	0	0	17648	126	37466
9	87	0.48	8434	256	8689	0	0	0	0	8689	59	18684
TOTAL	107532		477581	153281	630863	78581	32593	116486	227660	858523	6059	1235169

AGE	STOCK SIZE	ABSOLUTE F	CATCH NS OTHER	CATCH NS SM. M.	CATCH NS TOTAL	CATCH 3A HC	CATCH 3A MIXED	CATCH 3A IND. L.	CATCH 3A TOTAL	CATCH TOTAL AS	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.07	0	1989	1989	3	426	426	855	2844	0	0
1	29194	0.37	120	1439	1559	743	918	2711	4372	5932	0	0
2	4156	0.35	510	219	729	158	19	158	335	1064	1966	310577
3	2526	0.39	688	64	751	0	0	0	0	751	1645	325647
4	1570	0.46	517	32	549	0	0	0	0	549	1082	242357
5	743	0.57	296	13	309	0	0	0	0	309	474	111898
6	639	0.56	250	11	261	0	0	0	0	261	411	106895
7	430	0.45	144	6	150	0	0	0	0	150	297	81646
8	186	0.48	65	3	68	0	0	0	0	68	126	37466
9	87	0.48	31	1	32	0	0	0	0	32	59	18684
TOTAL	107532		2621	3778	6399	904	1364	3295	5562	11961	6059	1235169

AGE	STOCK SIZE	ABSOLUTE F	F NS OTHER	F NS SM. M.	F 3A HC	F 3A MIXED	F 3A IND. L.	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.07	0.00	0.05	0.00	0.01	0.01	0	0
1	29194	0.37	0.01	0.09	0.05	0.06	0.17	0	0
2	4156	0.35	0.17	0.07	0.05	0.01	0.05	1966	310577
3	2526	0.39	0.36	0.03	0.00	0.00	0.00	1645	325647
4	1570	0.46	0.43	0.03	0.00	0.00	0.00	1082	242357
5	743	0.57	0.55	0.02	0.00	0.00	0.00	474	111898
6	639	0.56	0.53	0.02	0.00	0.00	0.00	411	106895
7	430	0.45	0.43	0.02	0.00	0.00	0.00	297	81646
8	186	0.48	0.46	0.02	0.00	0.00	0.00	126	37466
9	87	0.48	0.46	0.02	0.00	0.00	0.00	59	18684
TOTAL	107532							6059	1235169

Yield = Catch in t. Catch = Catch in number (mill.).
NS SM. M. = Small meshed fisheries in the North Sea
NS OTHER = Other fisheries in the North Sea
3A HC = Human consumption landings in Division IIIa
3A MIXED = Mixed clupeoid landings in Division IIIa
3A IND. L. = Other industrial landings in Division IIIa

Table 2.8.6. Predicted catch and biomass of North Sea autumn spawning herring in 1993. 20% increase in "NS SM. M." F. Status quo F for 3+ and 0-ringer. in other fisheries. Catch of 1- and 2-ringers in IIIa estimated based on relative abundance and unchanged effort.

AGE	STOCK SIZE	ABSOLUTE F	YIELD NS OTHER	YIELD NS SM. M.	YIELD NS TOTAL	YIELD 3A HC	YIELD 3A MIXED	YIELD 3A IND. L.	YIELD 3A TOTAL	YIELD TOTAL AS	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.08	0	40417	40417	92	9765	11463	21319	61736	0	0
1	29194	0.39	7051	99378	106429	63139	22022	94817	179978	286407	0	0
2	4156	0.33	65473	23279	88752	15341	755	10122	26217	114969	1984	313493
3	2526	0.34	102168	7751	109918	0	0	0	0	109918	1705	337536
4	1570	0.39	83438	5452	88890	0	0	0	0	88890	1131	253334
5	743	0.48	52885	2513	55399	0	0	0	0	55399	502	118568
6	639	0.47	47350	2458	49808	0	0	0	0	49808	435	113104
7	430	0.39	29505	1481	30986	0	0	0	0	30986	311	85487
8	186	0.41	14711	712	15423	0	0	0	0	15423	132	39353
9	87	0.41	7266	317	7583	0	0	0	0	7583	62	19625
TOTAL	107532		409847	183758	593605	78571	32542	116402	227515	821120	6262	1280500

AGE	STOCK SIZE	ABSOLUTE F	CATCH NS OTHER	CATCH NS SM. M.	CATCH NS TOTAL	CATCH 3A HC	CATCH 3A MIXED	CATCH 3A IND. L.	CATCH 3A TOTAL	CATCH TOTAL AS	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.08	0	2377	2377	3	425	425	852	3229	0	0
1	29194	0.39	120	1713	1833	743	918	2709	4369	6202	0	0
2	4156	0.33	428	265	692	158	19	158	336	1028	1984	313493
3	2526	0.34	587	78	665	0	0	0	0	665	1705	337536
4	1570	0.39	444	40	484	0	0	0	0	484	1131	253334
5	743	0.48	257	16	273	0	0	0	0	273	502	118568
6	639	0.47	216	14	230	0	0	0	0	230	435	113104
7	430	0.39	123	8	131	0	0	0	0	131	311	85487
8	186	0.41	56	4	60	0	0	0	0	60	132	39353
9	87	0.41	26	2	28	0	0	0	0	28	62	19625
TOTAL	107532		2258	4517	6774	904	1362	3292	5557	12331	6262	1280500

AGE	STOCK SIZE	ABSOLUTE F	F NS OTHER	F NS SM. M.	F 3A HC	F 3A MIXED	F 3A IND. L.	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.08	0.00	0.06	0.00	0.01	0.01	0	0
1	29194	0.39	0.01	0.11	0.05	0.06	0.17	0	0
2	4156	0.33	0.14	0.09	0.05	0.01	0.05	1984	313493
3	2526	0.34	0.30	0.04	0.00	0.00	0.00	1705	337536
4	1570	0.39	0.36	0.03	0.00	0.00	0.00	1131	253334
5	743	0.48	0.46	0.03	0.00	0.00	0.00	502	118568
6	639	0.47	0.44	0.03	0.00	0.00	0.00	435	113104
7	430	0.39	0.36	0.02	0.00	0.00	0.00	311	85487
8	186	0.41	0.39	0.02	0.00	0.00	0.00	132	39353
9	87	0.41	0.39	0.02	0.00	0.00	0.00	62	19625
TOTAL	107532							6262	1280500

Yield = Catch in t. Catch = Catch in number (mill.).
NS SM. M. = Small meshed fisheries in the North Sea
NS OTHER = Other fisheries in the North Sea
3A HC = Human consumption landings in Division IIIa
3A MIXED = Mixed clupeoid landings in Division IIIa
3A IND. L. = Other industrial landings in Division IIIa

Table 2.8.7. Predicted catch and biomass of North Sea autumn spawning herring in 1993. 20% decrease in "NS SM. M." F. Status quo F for 3+ and 0-ringer. in other fisheries. Catch of 1- and 2-ringers in IIIa estimated based on relative abundance and unchanged effort.

AGE	STOCK SIZE	ABSOLUTE F	YIELD NS OTHER	YIELD NS SM. M.	YIELD NS TOTAL	YIELD 3A HC	YIELD 3A MIXED	YIELD 3A IND. L.	YIELD 3A TOTAL	YIELD TOTAL AS	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.06	0	27157	27157	92	9842	11553	21487	48645	0	0
1	29194	0.35	7163	67305	74468	63152	22027	94837	180016	254484	0	0
2	4156	0.30	66367	15731	82099	15323	754	10110	26188	108286	2025	319908
3	2526	0.33	102793	5199	107991	0	0	0	0	107991	1720	340575
4	1570	0.38	83852	3653	87504	0	0	0	0	87504	1139	255168
5	743	0.48	53115	1683	54798	0	0	0	0	54798	506	119334
6	639	0.46	47552	1646	49197	0	0	0	0	49197	438	113816
7	430	0.38	29609	991	30600	0	0	0	0	30600	312	85924
8	186	0.40	14766	476	15242	0	0	0	0	15242	133	39568
9	87	0.40	7293	212	7506	0	0	0	0	7506	62	19732
TOTAL	107532		412509	124053	536562	78568	32623	116501	227691	764254	6335	1294026

AGE	STOCK SIZE	ABSOLUTE F	CATCH NS OTHER	CATCH NS SM. M.	CATCH NS TOTAL	CATCH 3A HC	CATCH 3A MIXED	CATCH 3A IND. L.	CATCH 3A TOTAL	CATCH TOTAL AS	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.06	0	1597	1597	3	428	428	858	2456	0	0
1	29194	0.35	121	1160	1282	743	918	2710	4370	5652	0	0
2	4156	0.30	434	179	613	158	19	158	335	948	2025	319908
3	2526	0.33	591	53	643	0	0	0	0	643	1720	340575
4	1570	0.38	446	27	473	0	0	0	0	473	1139	255168
5	743	0.48	258	11	269	0	0	0	0	269	506	119334
6	639	0.46	217	9	226	0	0	0	0	226	438	113816
7	430	0.38	124	5	129	0	0	0	0	129	312	85924
8	186	0.40	57	2	59	0	0	0	0	59	133	39568
9	87	0.40	27	1	28	0	0	0	0	28	62	19732
TOTAL	107532		2274	3045	5319	904	1365	3296	5564	10883	6335	1294026

AGE	STOCK SIZE	ABSOLUTE F	F NS OTHER	F NS SM. M.	F 3A HC	F 3A MIXED	F 3A IND. L.	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.06	0.00	0.04	0.00	0.01	0.01	0	0
1	29194	0.35	0.01	0.07	0.05	0.06	0.17	0	0
2	4156	0.30	0.14	0.06	0.05	0.01	0.05	2025	319908
3	2526	0.33	0.30	0.03	0.00	0.00	0.00	1720	340575
4	1570	0.38	0.36	0.02	0.00	0.00	0.00	1139	255168
5	743	0.48	0.46	0.02	0.00	0.00	0.00	506	119334
6	639	0.46	0.44	0.02	0.00	0.00	0.00	438	113816
7	430	0.38	0.36	0.02	0.00	0.00	0.00	312	85924
8	186	0.40	0.39	0.02	0.00	0.00	0.00	133	39568
9	87	0.40	0.39	0.02	0.00	0.00	0.00	62	19732
TOTAL	107532							6335	1294026

Yield = Catch in t. Catch = Catch in number (mill.).
NS SM. M. = Small meshed fisheries in the North Sea
NS OTHER = Other fisheries in the North Sea
3A HC = Human consumption landings in Division IIIa
3A MIXED = Mixed clupeoid landings in Division IIIa
3A IND. L. = Other industrial landings in Division IIIa

Table 2.8.8. Predicted catch and biomass of North Sea autumn spawning herring in 1993. Status quo F for 0- and 3+-ringers in "NS OTHER", "3A MIXED" closed and catch of 1- and 2-ringers in The North Sea estimated based on relative abundance and unchanged effort.

AGE	STOCK SIZE	ABSOLUTE F	YIELD NS OTHER	YIELD NS SM. M.	YIELD NS TOTAL	YIELD 3A HC	YIELD 3A MIXED	YIELD 3A IND. L.	YIELD 3A TOTAL	YIELD TOTAL AS	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.06	0	33956	33956	92	0	11556	11649	45605	0	0
1	29194	0.31	2073	84508	86582	64119	0	96289	160408	246990	0	0
2	4156	0.31	66180	19609	85788	15291	0	10089	25380	111169	2013	318089
3	2526	0.33	102479	6479	108958	0	0	0	0	108958	1712	339052
4	1570	0.38	83644	4554	88199	0	0	0	0	88199	1135	254249
5	743	0.48	53000	2099	55099	0	0	0	0	55099	504	118950
6	639	0.47	47451	2053	49504	0	0	0	0	49504	436	113460
7	430	0.38	29557	1237	30794	0	0	0	0	30794	312	85705
8	186	0.41	14738	594	15333	0	0	0	0	15333	132	39461
9	87	0.41	7280	265	7545	0	0	0	0	7545	62	19678
TOTAL	107532		406402	155354	561756	79503	0	117935	197438	759194	6307	1288645

AGE	STOCK SIZE	ABSOLUTE F	CATCH NS OTHER	CATCH NS SM. M.	CATCH NS TOTAL	CATCH 3A HC	CATCH 3A MIXED	CATCH 3A IND. L.	CATCH 3A TOTAL	CATCH TOTAL AS	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.06	0	1997	1997	3	0	428	431	2428	0	0
1	29194	0.31	122	1457	1579	754	0	2751	3505	5084	0	0
2	4156	0.31	433	223	655	158	0	158	315	971	2013	318089
3	2526	0.33	589	65	654	0	0	0	0	654	1712	339052
4	1570	0.38	445	33	478	0	0	0	0	478	1135	254249
5	743	0.48	257	14	271	0	0	0	0	271	504	118950
6	639	0.47	217	11	228	0	0	0	0	228	436	113460
7	430	0.38	124	7	130	0	0	0	0	130	312	85705
8	186	0.41	56	3	59	0	0	0	0	59	132	39461
9	87	0.41	26	1	28	0	0	0	0	28	62	19678
TOTAL	107532		2269	3812	6081	915	0	3337	4251	10332	6307	1288645

AGE	STOCK SIZE	ABSOLUTE F	F NS OTHER	F NS SM. M.	F 3A HC	F 3A MIXED	F 3A IND. L.	SP STOCK NUMBER	SP STOCK BIOMASS
0	68000	0.06	0.00	0.05	0.00	0.00	0.01	0	0
1	29194	0.31	0.01	0.09	0.05	0.00	0.17	0	0
2	4156	0.31	0.14	0.07	0.05	0.00	0.05	2013	318089
3	2526	0.33	0.30	0.03	0.00	0.00	0.00	1712	339052
4	1570	0.38	0.36	0.03	0.00	0.00	0.00	1135	254249
5	743	0.48	0.46	0.02	0.00	0.00	0.00	504	118950
6	639	0.47	0.44	0.02	0.00	0.00	0.00	436	113460
7	430	0.38	0.36	0.02	0.00	0.00	0.00	312	85705
8	186	0.41	0.39	0.02	0.00	0.00	0.00	132	39461
9	87	0.41	0.39	0.02	0.00	0.00	0.00	62	19678
TOTAL	107532							6307	1288645

Yield = Catch in t. Catch = Catch in number (mill.).
NS SM. M. = Small meshed fisheries in the North Sea
NS OTHER = Other fisheries in the North Sea
3A HC = Human consumption landings in Division IIIa
3A MIXED = Mixed clupeoid landings in Division IIIa
3A IND. L. = Other industrial landings in Division IIIa

Table 2.9.1 Yield per recruit input parameters (North Sea + Div. IIIa)

Age (w.r.) Quarter	fishing pattern	natural mortality	Maturity ogive	Prop. of F and M before spawning	Weight in the catch	weight in the stock
0 qua.3	0.0396	0.2106	0	0	17.9	17
0 qua.4	0.0255	0.3759	0	0	22	17
1 qua.1	0.0356	0.3409	0	0	25.8	27
1 qua.2	0.0771	0.1212	0	0	30	31
1 qua.3	0.1159	0.4652	0	0	71.7	73
1 qua.4	0.0614	0.0932	0	0	52.3	48
2	0.2911	0.3	0.638	0.67	114.3	158
3	0.3346	0.2	0.971	0.67	166	198
4	0.4215	0.1	1	0.67	184	224
5	0.4529	0.1	1	0.67	203	236
6	0.4677	0.1	1	0.67	217	260
7	0.4424	0.1	1	0.67	235	275
8	0.4423	0.1	1	0.67	259	298
9+	0.4423	0.1	1	0.67	271	317

Table 2.9.2. Catch at age and fishing pattern used when removing the catch of juveniles

SCENARIO	1		2		3		4	
AGE (w. r.)	Fishing Pattern	Weight in catch	Fishing Pattern	Weight in catch	Fishing Pattern	Weight in catch	Fishing Pattern	Weight in catch
0 qua.3	0	0	0.0322	17	0.0074	22	0.0325	17.1
0 qua.4	0	0	0.0128	17	0.0127	27.1	0.0226	21.5
1 qua.1	0	0	0.0034	27	0.032	25.7	0.0152	30.5
1 qua.2	0	0	0.0273	31	0.05	29.4	0.0738	30.2
1 qua.3	0	0	0.088	73	0.0279	67.5	0.1153	71.8
1 qua.4	0	0	0.0559	48	0.056	95.1	0.0612	52.2
2	0.2911	114.3					0.2857	115.8

Example : in scenario 2 (preventing the catch of juveniles in IIIa),the fishing mortality and the weight at age of 0 ringers in quarter 3 are set to .0322 and 17g when catch of 0 ringers are prevented in IIIa

Table 2.10.1 HERRING Total North Sea, 1991.
Numbers (millions) and weights (g) at age (winter rings) and year class of herring caught in each quarter. Spring spawners transferred to Division IIIa, and North Sea autumn spawners caught in Division III are not included.

Catches in: 1991 Total North Sea

Quarter		0 1990	1 1989	2 1988	3 1987	4 1986	5 1985	6 1984	7 1983	8 1982	9 1981	Total no	SOP ('000t)
I	No	0.0	24.5	110.2	90.6	114.0	97.0	30.3	9.4	3.8	1.0	480.9	54.8
	W		32	73	112	130	143	154	171	200	194		
II	No	0.0	194.4	219.3	92.0	87.5	80.1	31.9	3.7	4.8	3.2	717.0	86.0
	W		30	102	158	190	212	207	246	257	277		
III	No	1140.5	627.2	255.5	177.5	197.2	192.9	74.1	14.7	10.1	6.2	2695.8	252.0
	W	17	73	164	186	209	229	246	275	295	293		
IV	No	453.8	398.3	186.3	193.4	150.2	123.9	65.2	11.0	6.3	2.2	1590.6	162.3
	W	17	49	151	177	189	204	218	235	237	239		
Total	No	1594.3	1244.4	771.4	553.5	548.9	493.9	201.6	38.8	25.0	12.6	5484.3	555.1
Year	W	17	58	130	166	184	203	217	235	259	271		
Stock weights (1)			65	158	198	224	236	260	275	298	317		

(1) These stock weights derive from acoustic survey samples taken in july from divisions IVa,b and used in the 1992 SSVPA

For the 2 and 3 ringers the stock weights are combined of the ones of immature and mature fish displayed above

Age (W.R.) :	2	2	3	3
Mature/Immature :	I	M	I	M
Mean weight :	122	168	129	200

Table 3.1.1 Transfer of Division IIIa spring spawners taken in the North Sea catches in 1987-1991. Catch in numbers ('000) and mean weight (g) at age with SOPs in tonnes.

		Quarters 2 and 3 Divisions IVa (e) and IVb								
Rings		2	3	4	5	6	7	8	9+	Total
Year										
1987	No	35,500	35,000	25,000	8,900	2,800	700	100	100	108,100
	$\bar{w}$	94	124	147	177	195	216	278	283	
	SOP									14,207
1988	No	44,561	108,915	19,532	8,168	2,203	391	-	-	183,770
	$\bar{w}$	94	131	154	171	176	212	-	-	
	SOP	4,206	14,221	3,015	1,393	399	83	-	-	23,306
1989	No	27,313	52,687	38,325	11,615	8,651	3,811	1,700	224	144,326
	$\bar{w}$	91	120	164	180	178	191	202	209	
	SOP	2,488	6,337	6,298	2,090	1,537	729	344	47	19,869
1990	No	12,431	14,703	21,812	3,573	2,986	2,088	746	352	58,691
	$\bar{w}$	103	113	134	166	161	184	190	236	
	SOP	1,079	1,668	2,932	1,588	482	384	142	83	8,358
1991	No	6,650	15,074	18,007	9,145	3,050	821	289	-	52,747
	$\bar{w}$	115	136	148	168	205	216	221	-	
	SOP	762	2,054	2,670	1,541	626	177	64	-	7,894

Table 3.2.1 HERRING in Division IIIa. Landings in tonnes, 1984-1991. (Data provided by Working Group members 1991.)

Country	1984	1985	1986	1987	1988	1989	1990	1991[1]
				Skagerrak				
Denmark	64,621	88,192	94,014	105,017	144,421	47,393	62,349	58,658
Faroe Islands	891	455	520	-	-	-	-	-
Germany, Fed.Rep.	-	-	11	-	-	-	-	-
Norway (Open sea)	-	2,752	677	-	2,982	242	4,056	6,546
Norway (Fjords)	1,494	1,673	860	1,209	2,692	1,363	1,542	1,581
Sweden	59,195	40,349	42,996	51,184	57,159	47,900	56,503	54,679
Total	126,201	133,421	139,078	157,410	207,254	96,898	124,450	121,464
				Kattegat				
Denmark	71,359	69,235	37,419	46,603	76,175	57,130	32,224	29,653
Sweden	35,027	39,829	35,852	29,844	49,653	37,869	45,228	36,732
Total	106,386	109,064	73,271	76,447	125,828	94,999	77,512	66,385
Div. IIIa total	232,587	242,485	212,349	233,931	333,082	191,897	201,962	187,849

[1]Preliminary.

Table 3.2.2 HERRING Division IIIa, 1991.

Numbers (millions) at age (winter rings) and landings in tonnes.

Quarter		0	1	2	3	4	5	6	7	8+	Total Landings
1	Skagerrak		69.6	78.0	14.0	7.3	4.6	1.2	0.4	0.2	9676
	Kattegat		159.4	247.1	93.1	12.2	8.1	0.8			25072
	Div. IIIa	0	229.0	325.1	107.1	19.5	12.7	2.0	0.4	0.2	34748
2	Skagerrak		331.9	130.1	111.1	54.2	23.6	7.2	2.8	1.4	40149
	Kattegat		23.4	54.1	55.6	17.7	10.3	1.5	0.4	0.3	18292
	Div. IIIa	0	355.3	184.2	166.7	71.9	33.9	8.7	3.2	1.7	58441
3	Skagerrak	45.2	134.6	83.4	94.2	43.9	36.4	6.0	2.0	0.3	48333
	Kattegat	217.5	64.1	29.3	21.9	6.1	5.0	0.5	0.5	0.4	15739
	Div. IIIa	262.7	198.7	112.7	116.1	50.0	41.4	6.5	2.5	0.7	64072
4	Skagerrak	322.1	24.3	24.8	24.2	11.6	9.0	1.5	0.7	0.4	22506
	Kattegat	192.3	58.4	28.9	18.0	3.7	2.6	0.4	0.1		15282
	Div. IIIa	514.4	82.7	53.7	42.2	15.3	11.6	1.9	0.8	0.4	37738
Total Year	Skagerrak	367.3	560.4	316.4	243.5	117.0	73.6	15.9	5.9	2.3	121464
	Kattegat	409.8	305.3	359.3	188.6	39.7	26.0	3.2	1.0	0.7	66385
	Div. IIIa	777.1	865.7	675.7	432.1	156.7	99.6	19.1	6.9	3.0	187849

Mean weight at age by quarter.

Quarter		0	1	2	3	4	5	6	7	8+
1	Skagerrak		25.9	64.2	96.1	130.0	139.2	145.3	143.0	169.0
	Kattegat		25.5	40.0	74.7	89.7	95.9	100.1		
	Div. IIIa	0.0	25.6	52.6	77.5	107.0	111.6	130.4	143.0	169.9
2	Skagerrak		29.2	90.5	93.3	133.9	120.6	147.0	152.0	182.1
	Kattegat		32.4	59.3	67.5	81.3	92.9	107.4	107.5	114.2
	Div. IIIa	0.6	29.4	70.0	84.7	121.0	116.4	140.2	140.4	170.1
3	Skagerrak	22.7	73.6	127.3	130.0	150.9	170.0	179.4	191.0	190.1
	Kattegat	21.9	65.9	80.3	100.5	150.7	156.4	200.3	265.2	207.0
	Div. IIIa	22.0	71.1	115.1	132.7	150.9	176.2	181.5	206.5	199.7
4	Skagerrak	24.5	109.6	132.6	150.0	164.2	180.4	217.5	236.6	207.0
	Kattegat	33.7	63.6	70.6	97.0	113.4	132.3	130.6	210.0	
	Div. IIIa	27.9	77.1	104.2	132.3	151.4	169.6	200.9	233.2	206.0
Total Year	Skagerrak	24.3	42.0	96.4	117.5	143.7	159.0	165.7	174.9	200.2
	Kattegat	27.4	41.0	55.4	70.5	97.5	110.0	126.9	196.0	167.2
	Div. IIIa	25.9	42.5	74.6	100.5	132.0	146.0	159.2	178.1	192.5

Table 3.2.3 Skagerrak 1991. Spring spawning herring. Catch in numbers (millions) and mean weight (g) at age.

	TOTAL		LANDINGS FOR HUMAN CONSUMPT.		MIXED CLUPEOID		LANDINGS FOR INDUST. PURPOSES	
1. QUARTER	N	W	N	W	N	W	N	W
2								
3	14.0	96.1	12.6	98.6			1.3	72.3
4	7.3	138.0	6.9	136.9	0.4	158.0		
5	4.6	139.2	4.6	139.2				
6	1.2	145.3	1.2	145.3				
7	0.4	143.0	0.4	143.0				
8								
9+	0.2	169.0	0.2	169.0				
TOTAL	27.7	117.6	25.9		0.4	158.0	1.3	72.3
LAND./SOP		3252.4		3090.7		64.8		96.9
2. QUARTER	N	W	N	W	N	W	N	W
2								
3	111.1	93.3	49.0	116.0	0.9	92.2	61.3	75.2
4	54.2	113.9	29.5	129.2	0.3	104.7	24.4	95.5
5	23.6	126.6	16.7	135.1	0.1	112.5	6.9	106.0
6	7.3	146.8	6.2	152.9			1.1	112.5
7	2.8	152.0	2.8	152.0				
8	0.4	168.8	0.4	168.8				
9+	1.0	187.4	1.0	187.4				
TOTAL	200.4	106.2	105.5		1.2	96.0	93.7	83.2
LAND./SOP		21270.0		13356.7		112.3		7801.0
3. QUARTER	N	W	N	W	N	W	N	W
2	68.0	125.1	42.4	128.0	0.6	112.0	25.0	120.5
3	94.2	138.8	57.3	128.4	3.0	120.5	33.9	158.1
4	43.9	150.9	24.0	131.4	2.4	141.3	17.6	178.7
5	36.4	178.9	11.2	153.9	0.4	168.0	24.9	190.3
6	6.0	179.4	4.4	155.1			1.6	244.0
7	2.0	191.8	0.8	146.3			1.1	224.5
8	0.3	190.1	0.3	190.1				
9+								
TOTAL	250.7	144.5	140.3		6.3	130.1	104.1	162.3
LAND./SOP		36224.8		18499.8		822.5		16902.5
4. QUARTER	N	W	N	W	N	W	N	W
2	10.0	95.4	4.3	0.0	0.4	167.1	5.3	168.6
3	24.2	158.0	18.2	152.4	0.2	175.1	5.7	175.2
4	11.6	166.2	11.6	166.2				
5	9.0	180.4	9.0	180.4				
6	1.5	217.5	1.5	217.5				
7	0.7	236.6	0.7	236.6				
8	0.4	287.0	0.4	287.0				
9+								
TOTAL	57.4	155.7	45.8		0.6	170.0	11.0	172.0
LAND./SOP		8936.2		6943.7		108.8		1883.7
TOTAL YEAR	N	W	N	W	N	W	N	W
2	78.0	121.3	46.7	116.1	1.0	133.9	30.3	128.9
3	243.5	117.5	137.2	124.4	4.1	117.7	102.2	108.2
4	117.0	134.5	72.0	136.6	3.0	140.3	42.0	130.3
5	73.7	159.8	41.5	150.4	0.4	161.2	31.8	172.0
6	16.0	165.7	13.3	160.4			2.7	191.2
7	5.8	175.3	4.7	163.3			1.1	224.5
8	1.0	216.5	1.0	216.5				
9+	1.1	184.8	1.1	184.8				
TOTAL	536.2	130.0	317.5	131.9	8.5	129.8	210.2	127.0
LAND./SOP		69683.3		41890.9		1108.3		26684.1

Table 3.2.4 Kattegat 1991. Spring spawning herring. Catch in numbers (millions) and mean weight (g) at age.

	TOTAL		LANDINGS FOR HUMAN CONSUMPT.		MIXED CLUPEOID		LANDINGS FOR INDUST. PURPOSES	
1. QUARTER	N	W	N	W	N	W	N	W
0	0.0							
1	0.0							
2	163.1	59.8	73.0	70.7	26.7	45.2	63.5	53.4
3	93.1	74.7	57.2	82.4	8.6	74.7	27.2	58.6
4	12.2	89.7	9.5	94.9	0.0	0.0	2.7	71.7
5	8.1	95.9	7.2	96.7	0.2	139.0	0.7	79.2
6	0.8	108.1	0.8	108.1				
7	0.0							
8	0.0							
9+	0.0							
TOTAL	277.3	67.3	147.7		35.4	52.8	94.2	55.6
LAND./SOP		18664.3		11554.7		1867.9		5241.8
2. QUARTER	N	W	N	W	N	W	N	W
0								
1								
2	47.2	57.6	5.2	76.5	14.1	53.6	27.9	56.2
3	55.6	67.5	18.4	78.0	4.2	61.8	33.0	62.3
4	17.7	81.3	9.2	87.9	1.3	85.1	7.2	72.0
5	10.3	92.9	8.1	95.0	0.5	118.4	1.8	77.3
6	1.5	107.4	1.5	107.4				
7	0.4	107.5	0.3	111.0			0.1	97.8
8	0.3	114.2	0.3	114.2				
9+								
TOTAL	133.0	68.5	43.0	84.6	20.1	58.9	69.9	61.3
LAND./SOP		9105.9		3639.9		1181.8		4284.3
3. QUARTER	N	W	N	W	N	W	N	W
0								
1								
2	28.2	80.3	16.9	83.6			11.4	75.3
3	21.9	106.5	17.4	112.4	1.1	100.0	3.4	79.1
4	6.1	150.7	5.4	159.2			0.7	85.9
5	5.0	156.4	4.9	157.5			0.1	104.5
6	0.5	206.3	0.5	206.3				
7	0.5	265.2	0.5	265.2				
8	0.4	207.0	0.4	207.0				
9+								
TOTAL	62.8	105.9	46.0	115.9	1.1	100.0	15.6	76.8
LAND./SOP		6644.9		5334.5		110.0		1200.4
4. QUARTER	N	W	N	W	N	W	N	W
0	64.8	33.7			21.8	28.9	43.0	36.1
1	43.0	60.5	18.6	73.3	1.1	49.0	23.3	50.8
2	28.8	79.6	25.1	82.2	0.3	142.1	3.5	55.5
3	18.0	97.8	17.2	99.4	0.0	158.0	0.7	55.5
4	3.7	113.4	3.5	116.8			0.2	57.6
5	2.6	132.3	2.6	132.3				
6	0.4	138.6	0.4	138.6				
7	0.1	210.0	0.1	210.0				
8								
9+								
TOTAL	161.3	59.9	67.4	88.3	23.2	31.4	70.7	42.2
LAND./SOP		9659.9		5950.0		727.6		2982.3
TOTAL YEAR	N	W	N	W	N	W	N	W
0	64.8	33.7			21.8	28.9	43.0	36.1
1	43.0	60.5	18.6	73.3	1.1	49.0	23.3	50.8
2	267.4	63.7	120.0	75.2	41.1	48.8	106.3	56.6
3	188.5	78.5	110.3	89.0	13.9	73.1	64.4	61.6
4	39.7	97.5	27.6	107.9	1.3	85.1	10.8	72.6
5	26.0	110.0	22.8	113.3	0.6	123.6	2.6	78.9
6	3.3	127.6	3.3	127.6				
7	1.0	197.1	0.9	209.5			0.1	97.8
8	0.7	168.9	0.7	168.9				
9+								
TOTAL	634.3	69.5	304.1	87.1	79.8	48.7	250.5	54.7
LAND./SOP		44075.1		26479.0		3887.2		13708.8

Table 3.2.5 Skagerrak 1991. Autumn spawning herring. Catch in numbers (millions) and mean weight (g) at age

	TOTAL		LANDINGS FOR HUMAN CONSUMPT.		MIXED CLUPEOID		LANDINGS FOR INDUST. PURPOSES	
1. QUARTER	N	W	N	W	N	W	N	W
0	0.0	0.0						
1	69.6	26.1	0.7	69.0	49.5	23.2	19.4	32.1
2	70.0	67.0	35.3	85.6	18.3	35.5	16.4	62.0
TOTAL	139.5	46.6	36.0	85.3	67.7	26.5	35.8	
LAND./SOP		6505.9		3070.8		1796.2		1638.9
2. QUARTER	N	W	N	W	N	W	N	W
0	0.0	0.0						
1	331.9	29.2	15.2	73.2	6.9	27.1	309.8	27.1
2	138.1	79.3	48.9	101.8	1.9	66.9	87.2	66.9
TOTAL	470.0	43.9	64.1	95.0	8.8	35.8	397.1	
LAND./SOP		20640.7		6092.4		315.3		14233.0
3. QUARTER	N	W	N	W	N	W	N	W
0	45.2	22.7			33.8	20.4	11.4	29.5
1	134.6	68.2	67.3	85.9	0.7	51.0	66.6	50.5
2	15.4	126.9	15.4	126.9				
TOTAL	195.2	62.3	82.6	93.5	34.6	21.1	78.0	
LAND./SOP		12156.9		7729.2		728.1		3699.6
4. QUARTER	N	W	N	W	N	W	N	W
0	322.1	24.5	0.2	114.7	61.7	24.8	260.1	24.4
1	24.3	109.6	12.1	130.0	1.6	60.6	10.6	93.5
2	14.8	167.3	10.9	166.4			3.9	170.0
TOTAL	361.1	36.1	23.3	146.9	63.3	25.7	274.5	
LAND./SOP		13043.8		3423.7		1626.4		7993.8
TOTAL YEAR	N	W	N	W	N	W	N	W
0	367.3	24.3	0.2	114.7	95.6	23.2	271.5	24.6
1	560.4	41.7	95.3	89.4	58.7	25.0	406.4	32.9
2	238.2	84.2	110.5	106.5	20.2	38.5	107.5	69.9
TOTAL	1165.9	44.9	206.1	98.6	174.4	25.6	785.4	35.1
LAND./SOP		52347.3		20316.1		4465.9		27565.3

Table 3.2.6 Kattegat 1991. Autumn spawning herring. Catch in numbers (millions) and mean weight (g) at age.

	TOTAL		LANDINGS FOR HUMAN CONSUMPT.		MIXED CLUPEOID		LANDINGS FOR INDUST. PURPOSES	
1. QUARTER	N	W	N	W	N	W	N	W
0								
1	159.4	25.5	3.6	44.1	95.7	21.9	60.1	30.1
2	84.0	60.1	32.7	70.7			51.3	53.4
TOTAL	243.4	37.5	36.3	68.1	95.7	21.9	111.4	40.8
LAND./SOP		9115.8		2472.3		2096.3		4547.2
2. QUARTER	N	W	N	W	N	W	N	W
0								
1	23.4	32.4	1.1	58.5	16.7	24.8	5.7	49.7
2	6.9	70.6	5.0	76.5	0.4	53.6	1.5	56.2
TOTAL	30.3	41.1	6.0	73.3	17.1	25.5	7.2	51.0
LAND./SOP		1245.0		441.5		436.5		367.0
3. QUARTER	N	W	N	W	N	W	N	W
0	217.5	21.9			216.3	21.9	1.2	19.8
1	64.1	65.9	20.3	80.0	3.5	51.3	40.2	60.1
2	1.1	79.7	1.1	79.7				
TOTAL	282.7	32.1	21.4	80.0	219.8	22.4	41.4	58.9
LAND./SOP		9074.8		1714.5		4918.6		2441.8
4. QUARTER	N	W	N	W	N	W	N	W
0	127.5	33.7	1.7	36.0	42.4	28.9	83.5	36.1
1	15.4	72.1	15.4	72.1				
2								
TOTAL	142.9	37.9	17.1	68.6	42.4	28.9	83.5	36.1
LAND./SOP		5410.6		1172.5		1224.8		3013.3
TOTAL YEAR	N	W	N	W	N	W	N	W
0	345.0	26.3	1.7	36.0	258.7	23.0	84.7	35.9
1	262.3	38.7	40.4	73.2	115.9	23.2	106.0	42.5
2	92.0	61.2	38.8	71.7	0.4	53.6	52.8	53.5
TOTAL	699.4	35.5	80.9	71.7	375.0	23.1	243.5	42.6
LAND./SOP		24846.2		5800.7		8676.1		10369.3

Table 3.2.7 HERRING Division IIIa, 1990.

Numbers (millions) at age (winter rings) and landings in tonnes.

Quarter		0	1	2	3	4	5	6	7	8+	Total Landings
1	Skagerrak		162.4	166.9	25.5	11.0	3.4	0.9	0.7	0.3	16139
	Kattegat		231.6	284.2	32.9	15.9	5.6	0.8	0.4	0.2	21695
	Div. IIIa	0	394.0	451.1	58.4	26.9	9.0	1.7	1.1	0.5	37834
2	Skagerrak		660.5	125.0	17.8	16.7	2.0	0.5	0.4	0.2	23708
	Kattegat	5.1	46.2	98.6	16.2	16.3	2.8	0.5	0.6	0.0	7949
	Div. IIIa	5.1	706.7	223.6	34.0	33.0	4.8	1.0	1.0	0.2	31657
3	Skagerrak	0.0	125.3	302.6	74.9	75.1	36.6	2.3	14.2	0.1	63249
	Kattegat	2.1	74.2	112.9	32.6	17.7	2.5	0.8	0.4	0.1	16846
	Div. IIIa	2.1	199.5	415.5	107.5	92.8	39.1	3.1	14.6	0.2	80095
4	Skagerrak	310.2	19.8	77.1	22.6	5.0	4.1	0.8	0.1	0	19811
	Kattegat	80.5	245.2	110.2	22.7	12.7	1.5	0.4	0.2	0.2	31023
	Div. IIIa	390.7	265.0	187.3	45.3	17.7	5.6	1.2	0.3	0.2	50834
Total Year	Skagerrak	310.2	968.0	671.6	140.8	107.8	46.1	4.5	15.4	0.6	122907
	Kattegat	87.7	597.2	605.9	104.4	62.6	12.4	2.5	1.6	0.5	77513
	Div. IIIa	397.9	1565.2	1277.5	245.2	170.4	58.5	7.0	17.0	1.1	200420

Mean weight at age by quarter.

Quarter		0	1	2	3	4	5	6	7	8+
1	Skagerrak		28.8	52.5	75.9	90.0	96.4	151.9	170.3	188.2
	Kattegat		21.8	43.3	69.3	83.1	102.4	123.8	124.1	161.7
	Div. IIIa	0.0	24.7	46.7	72.2	85.9	100.1	138.7	153.5	177.6
2	Skagerrak		20.8	51.6	83.7	100.6	96.4	151.9	170.3	188.2
	Kattegat	5.5	28.7	39.5	64.4	79.5	88.1	92.0	91.0	0.0
	Div. IIIa	5.5	21.3	46.3	74.5	90.2	91.6	121.9	122.7	188.1
3	Skagerrak	0.0	82.6	87.0	109.2	145.4	127.1	201.4	161.1	233.7
	Kattegat	24.6	51.9	69.5	86.8	95.1	117.9	122.6	132.3	173.3
	Div. IIIa	24.6	71.2	82.2	102.4	135.8	126.5	181.1	160.3	203.4
4	Skagerrak	30.5	45.0	87.3	98.3	101.0	112.3	152.7	200.0	0.0
	Kattegat	33.0	65.6	80.2	88.1	101.3	99.8	128.5	201.9	91.7
	Div. IIIa	31.0	64.1	83.1	93.2	101.2	108.9	144.6	201.2	91.7
Total Year	Skagerrak	30.5	30.6	71.9	98.2	130.7	122.2	177.3	162.0	195.8
	Kattegat	31.2	44.1	54.3	78.1	89.2	102.0	117.8	123.5	136.0
	Div. IIIa	30.7	35.8	63.5	89.6	115.5	117.9	156.1	158.4	168.6

Table 3.2.8 Total catch in numbers (mill) and mean weight (g), SOP (tonnes) of spring spawners in Div. IIIa and the North Sea in the years 1987 – 1991.

Rings / Year		0	1	2	3	4	5	6	7	8+	Total
1987	No			767.00	168.10	82.90	27.70	9.30	1.20	0.20	1056.40
	Mean w.			57.0	85.0	105.6	145.3	154.6	201.2	280.4	
	SOP			43705.0	14290.4	8756.5	4023.8	1437.6	241.4	56.1	72511
1988	No			2075.00	563.00	62.00	8.00	2.00	0.50	0.50	2711
	Mean w.			47.3	77.0	138.3	156.0	166.0	149.0	209.0	
	SOP			98147.5	43351.0	8574.6	1248.0	332.0	74.5	104.5	151832
1989	No			497.69	503.66	115.23	29.96	13.68	5.35	2.34	1167.91
	Mean w.			56.5	79.9	125.5	151.6	167.3	189.2	204.8	
	SOP			28119.5	40242.4	14461.4	4541.9	2288.7	1012.2	479.2	91145
1990	No		140.90	1006.23	259.90	192.21	62.07	9.99	19.09	2.20	1692.59
	Mean w.		56.6	65.0	84.6	102.4	111.1	109.3	141.0	84.3	
	SOP		7974.9	65445.2	21980.2	19673.4	6898.2	1092.4	2692.4	185.5	125942
1991	No	64.80	43.00	352.05	447.07	174.71	108.85	22.35	7.62	3.09	1223.54
	Mean w.	33.7	60.5	77.4	101.7	127.5	148.6	165.4	182.5	194.9	
	SOP	2183.8	2601.5	27259.5	45458.0	22272.7	16174.5	3697.5	1391.0	602.1	121640.6

There may be minor corrections in data from 1987 and 1988.

Table 3.2.9 HERRING Division IIIa, 1987 – 1991.
Transfers of juvenile autumn spawners from Div. IIIa to the North Sea
Numbers (mill), mean weight (g) per age group (wr). SOP in tonnes

YEAR	0-WR		1-WR		2-WR		TOTAL SOP
	Numbers	Mean w.	Numbers	Mean w.	Numbers	Mean w.	
1987	6238.0	8.0	3153.0	33.0	117.0	63.0	161324
1988	1830.0	12.0	5792.0	28.0	292.0	57.0	200780
1989	1028.2	16.2	1170.5	33.4	654.8	53.3	90652
1990	397.9	31.0	1424.3	34.1	283.7	55.4	76621
1991	712.3	25.3	822.7	40.7	330.2	77.8	77195

There are minor corrections for the years previous to 1991.

Table 3.2.10 HERRING in Division IIIa. Samples of commercial catches by quarter and area for 1991 available to the Working Group.

Country	Quarter	Landings for consumption		Landings for industrial purposes	
		Catch (t)	No. aged	Catch (t)	No. aged
		Skagerrak			
Denmark	1	1,651	-	3,072	168
	2	11,864	491	10,622	376
	3	13,594	190	5,787	330
	4	6,374	228	5,694	999
Total		33,483	909	26,175	1,873
Sweden	1	3,405	536	516	209
	2	5,667	0	9,073	0
	3	9,984	534	16,061	123
	4	4,055	620	5,918	0
Total		23,111	1,690	31,568	332
Norway	1	1,032	196	0	
	2	2,923	192[1]	0	
	3	3,707	559[1]	0	
	4	465	100	0	
Total		8,127	1,047	0	
		Kattegat			
Denmark	1	4,437	143	5,322	413
	2	1,377	-	2,103	250
	3	5,108	114	5,072	185
	4	4,125	420	2,109	1,235
Total		15,047	677	14,606	2,083
Sweden	1	9,626	664	5,687	553
	2	2,694	1,018	4,118	456
	3	1,948	642	3,611	325
	4	3,215	799	5,833	374
Total		17,483	3,123	19,249	1,708

[1]Research vessel samples.

Table 3.3.1 Total estimate in numbers (millions) and mean weight (g) at age of spring-spawning herring in Division IIIa and the eastern part the Sub-area IV in 1987-1991 (from acoustic surveys).

Age rings	1987 N	1987 W	1988 N	1988 W	1989 N	1989 W	1990 N	1990 W	1991 N	1991 W
0							31	18		
1							135	50		
2	958		1512	65	1105	78	1352	85	1864	95
3	665		761	118	714	117	521	108	1927	114
4	310		87	160	317	171	320	130	866	134
5	114		74	166	81	198	76	144	350	146
6	43		18	181	54	211	23	157	88	216
7	3		1	241	16	215	9	164	72	181
8+			1	175	4	226	3	181	10	200
Total no.	2093		2454		2291		2470		5177	
Biomass (t)	252459		217997		255500		236000		597942	

Table 3.4.1 Recruitment indices for 1- and 2-ringed herring from the International Young Fish Survey in Division IIIa. Indices are given for autumn and spring spawners based on modal length analysis and vertebral counts. The indices are weighted by the areas of four depth strata.

Year	Index: Total 1-ring	Total 2-ring	Spring spawners 1-ring	Spring spawners 2-ring	Autumn spawners 1-ring	Autumn spawners 2-ring
1980	2,311	387	1,607	307	704	80
1981	3,246	1,393	996	1,318	2,250	75
1982	2,560	549	1,408	445	1,152	104
1983	5,419	1,063	1,522	946	3,897	117
1984	6,035	1,947	2,793	1,419	3,242	528
1985	7,994	2,473	-[1]	1,867	-[1]	606
1986	21,489	2,738	-[1]	1,562	-[1]	1,175
1987	11,733	3,671	-[1]	2,921	-[1]	949
1988	67,753	10,095	-[1]	7,834	-[1]	2,161
1989	17,451	4,976	-[1]	0	-[1]	4,976
1990	3,544	3,876	0	3,192	3,544	684
1991	3,588	3,749	-[1]	480	-[1]	3,269
1992	5,057	1,934	0	771	5,057	1,163

[1]Separation not valid.

Table 4.2.1 Celtic Sea and Division VIIj HERRING landings by calendar year (t), 1977-1991. (Data provided by Working Group members.)

Year	France	Germany	Ireland	Netherlands	U.K.	Unallocated	Discards	Total
1977	100	100	5,500	1,500	-	-	+	7,200
1978	+	200	6,200	1,000	-	900	+	8,300
1979	600	+	7,000	900	-	3,700	+	12,200
1980	+	+	8,800	400	-	-	+	9,200
1981	100	-	15,600	1,200	-	-	+	16,900
1982	+	-	9,500	-	-	-	-	9,500
1983	500	-	10,000	1,500	-	10,200	4,000	26,200
1984	700	-	7,000	900	-	11,100	3,600	23,300
1985	600	-	11,000	-	-	4,600	3,100	19,300
1986	-	-	13,300	+	-	6,100	3,900	23,300
1987	800	-	15,500	1,500	-	5,300	4,200	27,300
1988	-	-	16,800	-	-	-	2,400	19,200
1989	+	-	16,000	1,900	-	1,300	3,500	22,700
1990	+	-	15,800[1]	1,000	200	700	2,500	20,200
1991[1]	+	100	19,400[1]	1,800	-	400	1,900	23,600

[1]Provisional.

Table 4.2.2 Celtic Sea and Division VIIj HERRING landings (t) by season (1 April - 31 March). (Data provided by Working Group members).

Year	France	Germany	Ireland	Netherlands	U.K.	Unallocated	Discards	Total
1977/1978	100	100	6,300	1,400	-	-	+	7,900
1978/1979	+	200	8,200	1,000	-	-	+	9,400
1979/1980	600	+	7,900	900	-	900	+	10,300
1980/1981	+	+	8,000	300	-	3,800	+	-
1981/1982	100	-	15,800	1,200	-	-	+	17,100
1982/1983	+	-	13,000	-	-	-	+	13,000
1983/1984	500	-	10,000	1,500	-	9,200	3,800	25,000
1984/1985	700	-	7,000	900	-	14,000	4,200	26,800
1985/1986	600	-	12,000	-	-	4,500	3,300	20,400
1986/1987	-	-	14,700	+	-	6,100	4,200	25,000
1987/1988	800	-	15,500	1,500	-	4,400	4,000	26,200
1988/1989	-	-	17,000	-	-	-	3,400	20,400
1989/1990	+	-	15,000	1,900	-	2,600	3,600	23,100
1990/1991	+	-	15,000	1,000	200	700	1,700	18,600
1991/1992[1]	+	100	21,400	1,800	-	-300	2,100	25,100

[1]Provisional.

Table 4.2.3 Celtic Sea, Division VIIj (1991 - 1992). Sampling intensity of commercial catches.

Country	Catch (t)	No. of samples	No. of age readings	No. of fish measured	Estimates of discards
Ireland	19,400	117	2,388	16,245	No
Netherlands	1,770	1	25	100	Yes

Table 4.2.4 Celtic Sea/Division VIIj.Length distribution of Irish catches/quarter (thousands).

Length	Q3 (1991)	Q4 (1991)	Q1 (1992)
14.0	-	-	-
14.5	-	7	-
15.0	-	-	-
15.5	-	-	-
16.0	-	-	-
16.5	-	29	-
17.0	-	7	-
17.5	-	15	-
18.0	-	15	-
18.5	-	-	-
19.0	-	7	-
19.5	-	-	-
20.0	-	7	25
20.5	3	15	38
21.0	2	22	89
21.5	10	37	266
22.0	30	44	393
22.5	38	110	520
23.0	43	468	1,674
23.5	49	1,023	3,614
24.0	83	1,842	6,074
24.5	106	3,041	7,064
25.0	168	3,860	5,770
25.5	226	5,226	5,314
26.0	267	6,575	6,074
26.5	403	8,626	5,656
27.0	429	10,373	7,025
27.5	463	10,066	6,036
28.0	330	7,586	4,591
28.5	163	4,379	2,638
29.0	78	2,259	1,065
29.5	66	1,396	457
30.0	54	870	203
30.5	28	402	76
31.0	14	234	25
31.5	-	44	-
32.0	2	7	-
32.5	-	7	-
33.0	-	-	-
Total	3,054	68,595	64,688

Table 4.2.5. 16:14 Sunday, May 10, 1992

Herring South and South West of Ireland (Fishing Areas VIIg-j)

Catch in Numbers (Thousands)

(CANUM)

Year	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6	Age 7	Age 8	Age 9
1970	1319	37260	50087	26481	18763	7853	6351	2175	3367
1971	12658	23313	37563	41904	18759	10443	4276	4942	2239
1972	8422	137690	17855	15842	14531	4645	3012	2374	1020
1973	23547	38133	55805	7012	9651	5323	3352	2332	1209
1974	5507	42808	17184	22530	4225	3737	2978	903	827
1975	12768	15429	17783	7333	9006	3520	1644	1136	1194
1976	13317	11113	7286	7011	2872	4785	1980	1243	1769
1977	8159	12516	8610	5280	1585	1898	1043	383	470
1978	2800	13385	11948	5583	1580	1476	540	858	482
1979	11335	13913	12399	8636	2889	1316	1283	551	635
1980	7162	30093	11726	6585	2812	2204	1184	1262	565
1981	39361	21285	21861	5505	4438	3436	795	313	866
1982	15339	42725	8728	4817	1497	1891	1670	335	596
1983	13540	102871	26993	3225	1862	327	372	932	308
1984	19517	92892	41121	16043	2450	1085	376	231	180
1985	17916	57054	36258	16032	2306	228	85	173	132
1986	4159	56747	42881	32930	8790	1127	98	29	12
1987	5976	67000	43075	23014	14323	2716	1175	296	464
1988	2307	82027	30962	9398	5963	3047	869	297	86
1989	8260	42413	68399	19601	8205	3837	2589	767	682
1990	2702	41756	24634	35258	8116	3808	1671	695	462
1991	1861	62306	37753	16590	27904	4786	2569	945	589

Table 4.2.6 Celtic Sea, Divison VIIj. Percentage age distributions 1977/1978 - 1991/1992.

Winter rings	Season														
	1977-1978	1978-1979	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984	1984-1985	1985-1986	1986-1987	1987-1988	1988-1989	1989-1990	1990-1991	1991-1992
1	20.4	7.3	21.4	11.3	40.2	19.8	9.0	11.2	13.8	2.8	3.8	1.7	5.3	2.2	1.2
2	31.3	34.6	26.3	47.3	21.8	55.1	68.4	53.4	43.8	38.7	42.4	60.8	27.4	35.1	40.1
3	21.5	30.9	23.4	18.4	22.3	11.2	17.9	23.6	27.9	29.2	27.3	22.9	44.2	20.7	24.3
4	13.2	14.5	16.3	10.4	5.6	6.2	2.1	9.2	12.3	22.4	14.6	7.0	12.7	23.6	10.7
5	4.0	4.1	5.5	4.4	4.5	1.9	1.2	1.4	1.8	6.0	9.1	4.4	5.3	6.8	18.0
6	4.8	3.8	2.5	3.5	3.5	2.4	0.2	0.6	0.2	0.8	1.7	2.3	2.5	3.2	3.1
7	2.6	1.4	2.4	1.9	0.8	2.2	0.2	0.2	+	+	0.7	0.6	1.7	1.4	1.6
8	1.0	2.2	1.0	2.0	0.3	0.4	0.2	0.1	0.1	+	0.2	0.2	0.5	0.6	0.6
9+	1.2	1.2	1.2	0.9	0.9	0.8	0.2	0.1	0.1	+	0.3	0.1	0.4	0.4	0.4

Table 5.1.1 Nominal catch (t), Division VIa (North) HERRING, 1982-1991, as reported to the Working Group.

Country	1982	1983	1984	1985	1986
Denmark	-	-	96	-	-
Faroes	74	834	954	104	400
France	2,069	1,313	-	20	18
Germany,Fed.Rep	8,453	6,283	5,564	5,937	2,188
Ireland	-	-	-	-	6,000
Netherlands	11,317	20,200	7,729	5,500	5,160[2]
Norway	13,018	7,336	6,669	4,690	4,799
UK (England)	90	-	-	-	-
UK (Scotland)	38,381	31,616	37,554	28,065	25,294
Unallocated	18,958	-4,059	16,588	502	37,840[2]
Discards	-	-	-	-	-
Total	92,360	63,523	75,154	43,814	81,699

Country	1987	1988	1989	1990	1991[1]
Denmark	-	-	-	-	-
Faroes	-	-	-	326	482
France	136	44	1,342	1,287	1,168
Germany,Fed.Rep	1,711	1,860	4,290	7,096	6,450
Ireland	6,800	6,740	8,000	10,000	8,000
Netherlands	5,212[2]	6,131	5,860	7,693	7,979
Norwaylands	4,300	456	-	1,607	3,318
UK (England)	-	1,892	1,977	2,376	2,998
UK (Scotland)	26,810	25,002	27,897	35,877	29,630
Unallocated	18,038[2]	5,229[2]	2,123	2,397	-10,597
Discards	-	-	1,550	1,300	1,180
Total	63,007	47,354	53,039	69,959	50,606

[1]Preliminary.
[2]Including discards.

Table 5.1.2 HERRING in Division VIa (North), 1991. Sampling intensity of commercial catches.

Country	Catch in tonnes	No. of samples	No. of age readings	No. of fish measured	Estimate of discards
Faroes	482	0	0	0	No
France	1,168	0	0	0	No
Germany	6,450	0	0	0	No
Ireland	8,000	0	0	0	No
Netherlands	7,979	0	0	0	Yes
Norway	3,318	0	0	0	No
UK (England)	2,996	0	0	0	No
UK (Scotland)	29,630	0	0	12,035	No

Table 5.1.3

Run title : Herring in the Northern part of VIa (run name: HERRING VIA(N

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

YEAR	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE												
1	238738	169947	801663	51170	309016	172879	69053	34836	22525	392	12867	36740
2	205454	372615	804097	235627	124944	202087	319604	47739	46284	225	1335	77961
3	359711	560348	219502	808267	151025	89066	101548	95834	20587	122	452	105600
4	139718	357745	63069	131484	519178	63701	35502	22117	40692	31	246	61341
5	53320	113391	85920	63071	82466	188202	25195	10083	6879	21	62	21473
6	203462	54571	37341	54642	49683	30601	76289	12211	3833	12	43	12623
7	29141	181592	13377	18242	34629	12297	10918	20992	2100	7	40	11583
8	32860	18042	100938	6506	22470	13121	3914	2758	6278	2	3	1309
+gp	30651	36395	20465	32223	21042	13698	12014	1486	1544	0	1	1326
TOTALNUM	1293055	1864646	2146372	1401232	1314453	785652	654037	248056	150722	812	15049	329956
TONSLAND	165930	207167	164756	208270	177458	111922	93642	41341	22176	60	306	51420
SOPCOF %	83	70	61	95	89	97	100	109	100	63	21	103

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

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE										
1	13304	81923	2961	45663	38943	27645	2273	9690	22374	46052
2	250010	77810	253291	77063	178714	93679	158832	57305	75241	40086
3	72179	92743	66857	166112	99264	64575	55529	170687	63832	44635
4	93544	29262	46963	19269	137077	45488	37815	29497	116270	50070
5	58452	42535	20057	17027	21723	71188	26292	28228	41512	66459
6	23580	27318	15250	7422	20759	11973	37993	11830	20826	24005
7	11516	14709	12478	7731	2973	10378	4327	23400	15463	13441
8	13814	8437	5940	3720	16177	4982	2956	2529	33585	12228
+gp	4027	8484	2629	2450	2273	8498	3140	5463	8644	7901
TOTALNUM	540426	383221	426426	346457	517903	338406	329157	338629	397747	304877
TONSLAND	92361	63523	75154	43814	82280	63007	47354	53039	69959	50606
SOPCOF %	97	97	105	99	92	103	94	98	99	94

Table 5.1.4 HERRING in Division VIa (North). Larvae abundance indices (numbers in billions), larvae mortality rates (Z/K), fecundity estimate (10^5 eggs/g).

Year	LAI	Z/K	LPE		
			Larvae	Fecundity	SSB
1973	2,442	0.74	318	(1.39)	229
1974	1,186	0.42	238	(1.39)	171
1975	878	0.46	157	1.46	108
1976	189	-	60	1.23	49
1977	787	-	223	1.49	150
1978	332	-	132	1.37	109
1979	1,071	-	118	1.49	79
1980	1,436	0.39	287	2.04	141
1981	2,154	0.34	448	2.12	211
1982	1,890	0.39	267	1.95	137
1983	668	-	112	1.88	60
1984	2,133	0.57	253	1.75	145
1985	2,710	0.37	418	(1.86)	225
1986	3,037	0.24	907	(1.86)	488
1987	4,119	0.53	423	(1.86)	227
1988	5,947	0.47	781	(1.86)	420
1989	4,320	0.40	752	(1.86)	404
1990	6,525	0.64	426	(1.86)	229
1991	4,430	0.60	632	(1.86)	340

Table 5.1.5 HERRING in Division VIa (North). Scottish bottom trawl survey indices of 2-ringed herring catch rates.

Trawl survey year	Year class	Number of GOV hauls	2-ringer index (millions)	ln (2-ringer index)
1981	1978	9	1,237	7.12
1982	1979	10	2,361	7.77
1983	1980	12	11	2.40
1984	1981	12	12,456	9.43
1985	1982	17	98	4.58
1986	1983	12	359	5.88
1987	1984	15	40	3.69
1988	1985	19	15,770	9.67
1989	1986	15	1,435	7.27
1990	1987	16	46	3.83
1991	1988	18	1,242	7.12
1992	1989	14	38	3.64

Table 5.1.6 HERRING in Division VIa (North). Mean weights at age (g).

Age (rings)	Weight in the stock	Weight in the catch							
		1982-1984	1985	1986	1987	1988	1989	1990	1991
1	90	90	69	113	73	80	82	79	84
2	164	140	103	145	143	112	142	129	118
3	208	175	134	173	183	157	145	173	160
4	233	205	161	196	211	177	191	182	203
5	246	231	182	215	220	203	190	209	211
6	252	253	199	230	238	194	213	224	229
7	258	270	213	242	241	240	216	228	236
8	269	284	223	251	253	213	204	237	261
9	292	295	231	258	256	228	243	247	271

Table 5.1.7

Title : Herring in the Northern part of VIa (run name: HERRING VIA(N At 5/04/1992 10:47

Separable analysis
from 1970 to 1991 on ages 1 to 8
with Terminal F of .200 on age 3 and Terminal S of 1.000

Initial sum of squared residuals was 558.450 and
final sum of squared residuals is 72.000 after 97 iterations

Matrix of Residuals

Years	1970/71
Ages	
1/ 2	1.801
2/ 3	-.950
3/ 4	-.092
4/ 5	.267
5/ 6	-.168
6/ 7	.102
7/ 8	.674
	.000
WTS	.001

Years	1971/72	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
Ages										
1/ 2	-.387	3.029	1.070	1.945	.961	1.670	1.022	.269	1.358	4.297
2/ 3	-.653	-.415	.132	-.563	-.170	.038	-.202	-.599	-.070	.292
3/ 4	.809	-.057	-.037	-.238	-.139	.145	-.377	-.212	-.195	-.366
4/ 5	.230	-.404	.145	.081	.034	.055	.110	1.050	-.014	.236
5/ 6	-.328	-.172	-.289	-.166	-.210	-.716	-.327	-.431	-.272	-.824
6/ 7	.128	.226	.078	.419	.102	.039	.627	-.353	-.683	-1.018
7/ 8	-.447	.456	-.378	.214	.431	.357	.312	.569	1.619	1.316
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
WTS	.001	.001	.001	.001	.001	.001	.001	.001	.001	.001

Years	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91		WTS
Ages												
1/ 2	.240	-.231	.442	-1.925	.754	.657	-.281	-1.520	.064	1.064	.000	.190
2/ 3	.109	.327	-.439	-.368	-.211	.438	-.088	-.410	-.038	.102	.000	.735
3/ 4	.010	.077	-.065	.304	.097	.053	-.217	.159	.321	-.316	.000	.958
4/ 5	.100	.133	-.196	.250	-.049	.101	-.031	-.009	-.236	.173	.000	.954
5/ 6	-.258	-.124	.222	-.006	-.349	-.191	-.185	.266	.184	-.070	.000	1.000
6/ 7	.043	-.284	.101	-.210	.868	.017	.307	.048	-.292	-.080	.000	.641
7/ 8	-.001	-.208	.462	.566	-.553	-.951	.790	.343	-.147	-.040	.000	.435
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	15.406	
WTS	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	1970	1971
F-values	.4210	.8348

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
F-values	.5085	.5977	.9277	.9402	1.0443	.8180	.5888	.0012	.0024	.3149

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
F-values	.5058	.4264	.3628	.2312	.3344	.2634	.1880	.1689	.2333	.2000

Selection-at-age (S)

	1	2	3	4	5	6	7	8
S-values	.0633	.8316	1.0000	.9631	1.0484	.9025	.8383	1.0000

Table 5.1.8

Analysis by RCT3 ver3.1 of data from file :

rct3.dat

Herring in VIa(north)

Data for 2 surveys over 19 years : 1973 - 1991

Regression type = C
Tapered time weighting not applied
Survey weighting not applied

Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .00
Minimum of 5 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1988

	I-----------Regression----------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
LAI	.83	-.89	.47	.586	15	8.69	6.29	.573	.389
LPE	1.50	-2.42	.71	.379	15	6.04	6.62	.876	.167
					VPA Mean =		5.02	.537	.444

Yearclass = 1989

	I-----------Regression----------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
LAI	.83	-.89	.47	.586	15	8.37	6.02	.554	.405
LPE	1.50	-2.42	.71	.379	15	6.00	6.57	.870	.164
					VPA Mean =		5.02	.537	.431

Yearclass = 1990

	I-----------Regression----------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
LAI	.83	-.89	.47	.586	15	8.78	6.37	.579	.373
LPE	1.50	-2.42	.71	.379	15	5.44	5.72	.807	.192
					VPA Mean =		5.02	.537	.435

Yearclass = 1991

	I-----------Regression----------I				I-----------Prediction---------I				
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
LAI	.83	-.89	.47	.586	15	8.40	6.05	.555	.400
LPE	1.50	-2.42	.71	.379	15	5.83	6.31	.846	.172
					VPA Mean =		5.02	.537	.428

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1988	323	5.78	.36	.49	1.87		
1989	292	5.68	.35	.43	1.47		
1990	285	5.65	.35	.43	1.46		
1991	284	5.65	.35	.39	1.25		

Table 5.1.9

Run title : Herring in the Northern part of VIa (run name: HERRING VIA(N At 5/04/1992
Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR	1970	1971
AGE		
1	.1054	.0269
2	.1801	.4224
3	.4146	1.1477
4	.4503	.9018
5	.4227	.7115
6	.3644	.8985
7	.5253	.5673
8	.4203	.6393
+gp	.4202	.6393
FBAR 3- 6	.4130	.9149
FBARS	.2602	.4818
FBARS	.2602	.4818

Table 8 Fishing mortality (F) at age

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE										
1	.5016	.0769	.3298	.1389	.1981	.0837	.0344	.0004	.0211	.0311
2	.2952	.4971	.4877	.7190	.7848	.3617	.2624	.0007	.0026	.2955
3	.5095	.5852	.7571	.8565	1.1393	.6237	.2782	.0010	.0018	.3050
4	.3370	.6246	.9056	.8178	.9996	.7870	.5622	.0006	.0024	.3350
5	.4941	.5835	.9159	.8923	.8058	.7764	.5314	.0004	.0012	.2640
6	.4750	.5955	1.1604	.9535	1.0350	1.0844	.6802	.0014	.0010	.3291
7	.5037	.3982	.8416	.9175	.9905	.8051	.4683	.0020	.0050	.3437
8	.6326	.4341	1.0856	.8052	.7538	.6422	.5272	.0006	.0009	.2006
+gp	.6326	.4341	1.0856	.8052	.7538	.6422	.5272	.0006	.0009	.2006
FBAR 3- 6	.4539	.5972	.9347	.8800	.9949	.8179	.5130	.0008	.0016	.3083
FBARS	.3204	.3328	.5924	.5433	.5840	.4665	.3119	.0006	.0015	.1809
FBARS	.3204	.3328	.5924	.5433	.5840	.4665	.3119	.0006	.0015	.1809

Run title : Herring in the Northern part of VIa (run name: HERRING VIA(N At 5/04/1992
Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE										
1	.0213	.0331	.0029	.0387	.0372	.0113	.0024	.0120	.0324	.0127
2	.5491	.2869	.2311	.1648	.3643	.1997	.1391	.1297	.2044	.1247
3	.5259	.4331	.4575	.2481	.3516	.2299	.1850	.2311	.2211	.1905
4	.4587	.3977	.3865	.2177	.3157	.2555	.1942	.1345	.2312	.2564
5	.5420	.3464	.4616	.2099	.3605	.2397	.2058	.1945	.2532	.1796
6	.4559	.4649	.1794	.2748	.3772	.3072	.1742	.1207	.1925	.2036
7	.4982	.5076	.3553	.1167	.1510	.2921	.1553	.1388	.2048	.1642
8	.7736	.7378	.3503	.1518	.3366	.3586	.1131	.1149	.2690	.2214
+gp	.7736	.7378	.3503	.1518	.3366	.3586	.1131	.1149	.2690	.2214
FBAR 3- 6	.4956	.4105	.3712	.2376	.3512	.2581	.1898	.1702	.2245	.2075
FBARS	.3642	.3163	.2220	.1242	.2069	.1804	.1023	.0942	.1476	.1263
FBARS	.3642	.3163	.2220	.1242	.2069	.1804	.1023	.0942	.1476	.1263

Table 5.1.10

Run title : Herring in the Northern part of VIa (run name: HERRING VIA(N At 5/04/1992
Traditional vpa Terminal populations from weighted Separable populations

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

YEAR	1970	1971
AGE		
1	374202	1009483
2	143674	123886
3	116127	88898
4	40344	62806
5	16196	23269
6	69797	9602
7	7461	43868
8	10029	3993
+gp	9355	8054
TOTAL	787184	1373858

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

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE										
1	308753	108681	169416	208437	59800	68165	105005	162309	97213	189456
2	361498	68779	37022	44816	66732	18045	23063	37322	59688	35015
3	60159	199358	30995	16841	16176	22554	9311	13142	27629	44103
4	23098	29592	90909	11903	5855	4239	9897	5772	10749	22580
5	23064	14920	14338	33258	4754	1950	1746	5104	5220	9703
6	10336	12733	7532	5191	12329	1922	812	929	4617	4717
7	3538	5816	6351	2136	1810	3963	588	372	839	4173
8	22508	1934	3534	2477	772	608	1603	333	336	755
+gp	4563	9581	3309	2586	2370	328	394	0	112	765
TOTAL	817518	451394	363408	327646	170599	121773	152419	225283	206403	311269

Run title : Herring in the Northern part of VIa (run name: HERRING VIA(N At 5/04/1992
Traditional vpa Terminal populations from weighted Separable populations

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

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE											
1	99575	397001	159392	189721	168143	387762	148127	128919	110772	578573	0
2	67564	35858	141293	58465	67145	59597	141042	54361	46863	39452	210167
3	19304	28904	19940	83078	36731	34556	36157	90914	35373	28298	25800
4	26618	9341	15347	10332	53075	21158	22481	24602	59075	23216	19149
5	14615	15224	5679	9435	7520	35024	14829	16752	19460	42419	16256
6	6742	7691	9742	3239	6921	4745	24936	10922	12478	13669	32072
7	3071	3867	4372	7367	2226	4295	3158	18956	8759	9314	10090
8	2678	1689	2106	2773	5932	1732	2902	2446	14930	6458	7151
+gp	781	1698	932	1826	833	2955	3082	5284	3843	4173	7708
TOTAL	240947	501274	358804	366236	348526	551823	396714	353157	311552	745570	328394

Table 5.1.11

Run title : Herring in the Northern part of VIa (run name: HERRING VIA(N At 5/04/1992

Table 16 Summary (without SOP correction)
Traditional vpa Terminal populations from weighted Separable populations

	RECRUITS	TOTALBIO	EXPLTBIO	TOTSPBIO	LANDINGS	FBAR 3- 6	FBARS	FBARS
1970	3742016	1197225	484331	603745	165930	.4130		
1971	10094825	1671829	323148	413848	207167	.9149		
1972	3087528	1215468	592516	622981	164756	.4539		
1973	1086806	811201	367491	430881	208270	.5972		
1974	1694162	579289	214518	221155	177458	.9347		
1975	2084372	438478	130936	128464	111922	.8800		
1976	598003	266981	93973	101381	93642	.9949		
1977	681646	170188	46269	63473	41341	.8179		
1978	1050045	188076	43434	63456	22176	.5130		
1979	1623094	264823	112994	102163	60	.0008		
1980	972133	295764	909055	179549	306	.0016		
1981	1894564	423071	161769	182352	51420	.3083		
1982	995747	372944	192814	175754	92361	.4956		
1983	3970014	574304	159034	147725	63523	.4105		
1984	1593924	510595	192183	259320	75154	.3712		
1985	1897212	526678	185464	270123	43814	.2376		
1986	1681429	521585	253870	261799	82280	.3512		
1987	3877622	690383	237441	258682	63007	.2581		
1988	1481267	616481	264005	376917	47354	.1898		
1989	1289195	591253	317812	375804	53039	.1702		
1990	1107717	541065	314642	342736	69959	.2245		
1991	5785727	890751	259862	295180	50606	.2075		
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)	(Tonnes)			

Table 5.1.12 List of input variables for prediction.

Herring in Division VIa(north)

List of input variables:

Reference F is the mean f (unweighted) for the age group range from 3 to 6.

The number of recruits per year is as follows for each VPA terminal F option.

Geometric mean recruitment (1980-1989) for VPA terminal Fs:

Year	F=0.20	F=0.25	F=0.27	F=0.34
1992	646,890	613,620	653,400	620,340
1993	646,890	613,620	653,400	620,340

Proportion of F (fishing mortality) effective before spawning: .67
Proportion of M (natural mortality) effective before spawning: .67

Data are printed in the following units:

Number of Fish:	Thousands
Weight by age group in the catch:	Kilogram
Weight by age group in the stock:	Kilogram
Stock biomass:	tonnes
Catch in weight:	tonnes

				All gears		
age	stock size	natural[1] mortality	maturity[2] ogive	fishing pattern	weight in[3] the catch	weight in[4] the stock
2	646890	.30	1.00	.83	.118	.164
3	282980	.20	1.00	1.00	.160	.208
4	232160	.10	1.00	.96	.203	.233
5	424190	.10	1.00	1.05	.211	.246
6	136690	.10	1.00	.90	.229	.252
7	93140	.10	1.00	.84	.236	.258
8	64580	.10	1.00	1.00	.261	.269
9	41730	.10	1.00	1.00	.271	.292

[1] Year 1991 from file NATMOR
[2] Year 1991 from file MORPROP
[3] Year 1991 from file WECA
[4] Year 1991 from file WEST

Table 5.1.12 (cont.)

Stock size and fishing pattern for each VPA terminal F option. Stock sizes in thousands of fish on 1st January 1992.

	F=0.20		F=0.25		F=0.27		F=0.34	
Age	Stock size	fish ing patt ern	Stock size	fish ing patt ern	Stock size	Fish ing patt ern	Stock size	Fish ing patt ern
2	646,890	0.83	613,620	0.83	653,400	0.83	620,340	0.83
3	404,110	1.00	369,250	1.00	386,700	1.00	346,380	1.00
4	188,740	0.96	147,500	0.96	177,690	0.96	135,580	0.96
5	172,430	1.05	136,820	1.05	166,100	1.05	129,330	1.05
6	309,590	0.90	239,870	0.90	288,690	0.90	217,850	0.90
7	102,790	0.84	80,790	0.84	98,110	0.84	75,570	0.84
8	70,970	1.00	55,740	1.00	67,570	1.00	52,000	1.00
9+	78,360	1.00	61,720	1.00	74,540	1.00	57,440	1.00

Table 5.1.13

Herring in VIa(north)

* Species: Herring Year 1991. F-factor .2000 and ref. F .1955 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January sp.stock size	at 1 January sp.stock biomass	at spawning time sp.stock size	at spawning time sp.stock biomass
2	.1701	87813.9	10362.04	646890.	106090.0	646890.0	106090.0	472092.9	77423.2
3	.2050	47701.2	7632.19	282980.	58859.8	282980.0	58859.8	215729.7	44871.8
4	.1968	39532.7	8025.13	232160.	54093.3	232160.0	54093.3	190294.1	44338.5
5	.2152	78315.0	16524.46	424190.	104350.7	424190.0	104350.7	343423.4	84482.1
6	.1845	21949.2	5026.36	136690.	34445.9	136690.0	34445.9	112967.5	28467.8
7	.1722	14041.1	3313.70	93140.	24030.1	93140.0	24030.1	77612.6	20024.0
8	.2050	11410.5	2978.14	64580.	17372.0	64580.0	17372.0	52644.1	14161.3
9+	.2050	7373.2	1998.13	41730.	12185.2	41730.0	12185.2	34017.3	9933.1
Total		308136.7	55860.14	1922360.	411427.0	1922360.0	411427.0	1498782.0	323701.9

* Species: Herring Year 1992. F-factor .2300 and ref. F .2248 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January sp.stock size	at 1 January sp.stock biomass	at spawning time sp.stock size	at spawning time sp.stock biomass
2	.1909	97586.7	11515.23	646890.	106090.0	646890.0	106090.0	465575.0	76354.3
3	.2300	74633.7	11941.40	399245.	83043.0	399245.4	83043.0	299308.9	62256.3
4	.2208	35119.7	7129.30	185931.	43321.9	185931.1	43321.9	149970.8	34943.2
5	.2415	34794.0	7341.54	170073.	41837.9	170072.8	41837.9	135290.2	33281.4
6	.2070	54302.4	12435.26	304655.	76773.2	304655.5	76773.2	248015.6	62499.9
7	.1932	16990.7	4009.80	101465.	26178.0	101465.2	26178.0	83368.6	21509.1
8	.2300	13724.2	3582.02	70057.	18845.2	70056.6	18845.2	56159.9	15107.0
9+	.2300	15123.0	4098.33	77197.	22541.5	77196.9	22541.5	61883.9	18070.1
Total		342274.5	62052.88	1955514.	418630.8	1955514.0	418630.8	1499573.0	324021.3

* Species: Herring Year 1993. F-factor .2000 and ref. F .1955 *

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January sp.stock size	at 1 January sp.stock biomass	at spawning time sp.stock size	at spawning time sp.stock biomass
2	.1660	85836.2	10128.67	646890.	106090.0	646890.0	106090.0	473407.4	77638.8
3	.2000	64193.1	10270.90	389427.	81000.8	389426.9	81000.8	297875.7	61958.1
4	.1920	42388.0	8604.77	254570.	59314.8	254570.1	59314.8	209335.1	48775.1
5	.2100	23896.4	5042.15	132340.	32555.7	132340.3	32555.7	107519.9	26449.9
6	.1800	18582.0	4255.28	118360.	29826.6	118359.5	29826.6	98113.7	24724.7
7	.1680	32439.6	7655.75	220122.	56791.5	220121.9	56791.5	183942.2	47457.1
8	.2000	12858.8	3356.13	74419.	20018.8	74419.3	20018.8	60868.5	16373.6
9+	.2000	17929.8	4858.98	103768.	30300.2	103767.8	30300.2	84873.0	24782.9
Total		298124.0	54172.64	1939896.	415898.4	1939896.0	415898.4	1515936.0	328160.2

Table 5.2.1 Catches (t) of HERRING from the Firth of Clyde (spring and autumn-spawners combined).

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Reported landings:										
UK (Scotland)	2,506	2,530	2,991	3,001	3,395	2,895	1,568	2,135	2,184	713
UK (N.Ireland + Isle of Man)	-	273	247	22	-	-	-	-	-	-
Additional landings[1]	262	293	224	433	576	278	110	208	75	18
Discards	1,253	1,265	2,308[3]	1,344[3]	679[3]	439[4]	245[4]	-[2]	-[2]	-[2]
Catch used by Working Group	4,021	4,361	5,770	4,800	4,650	3,612	1,923	2,343	2,259	731

[1]Calculated from estimates of weight per box and, in some years, estimated by-catch in sprat fishery.
[2]Reported to be at a low level; assumed to be zero.
[3]Based on sampling.
[4]Estimated assuming same discarding rate as in 1986.

Table 5.2.2 Sampling levels of Clyde HERRING 1988-1991.

Year	Reported landings (t)	No. of samples	No. of fish measured	No. of fish aged	Estimates of discards
1988	1,568	41	5,955	2,574	Based on
1989	2,135	45	8,368	4,152	local reports
1990	2,184	37	5,926	3,803	" "
1991	713	29	4,312	2,992	" "

Table 5.2.3 Clyde HERRING (spring and autumn spawners combined).

IN NUMBERS UNIT: thousands

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	5008	2207	1351	9139	5308	12694	6194	1041	14123	507	333	312
2	7551	6503	8983	5258	8841	1876	10480	7524	1796	4859	5633	2372
3	10338	1976	3181	4548	2817	2483	913	6976	2259	807	1592	2785
4	8745	4355	1684	1811	2559	1024	1049	1062	2724	930	567	1622
5	2306	3432	3007	918	1140	1072	526	1112	634	888	341	1158
6	741	1090	1114	1525	494	451	638	574	606	341	204	433
7	760	501	656	659	700	175	261	489	330	289	125	486
8	753	352	282	307	253	356	138	251	298	156	48	487
9	227	225	177	132	87	130	178	146	174	119	56	74
10+	117	181	132	114	59	67	100	192	236	154	68	18
TOTAL	36546	20822	20567	24411	22258	20328	20477	19367	23188	9050	8967	9667

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	220	314	4156	1639	678	508	0	845	716	42
2	11311	10109	11829	2951	4574	1376	1062	1523	1004	615
3	4079	5232	5774	4420	4431	3669	1724	9293	839	472
4	2440	1747	3406	4592	4622	4379	2506	876	7533	703
5	1028	963	1509	2806	2679	3408	2014	452	576	1908
6	663	555	587	2654	1847	1983	1319	252	359	169
7	145	415	489	917	644	1427	510	146	329	92
8	222	189	375	681	287	680	234	29	119	113
9	63	85	74	457	251	308	66	16	49	22
10+	53	38	80	240	79	175	16	5	16	9
TOTAL	20224	19647	28278	21357	20092	17913	9451	13437	11523	4145

Table 5.2.4 Clyde HERRING. Numbers ('000) landed in half cm length groups.

Length (cm)	1988	1989	1990	1991
13.0		3		
13.5		3		
14.0		3		
14.5				
15.0		3		
15.5				
16.0				
16.5				
17.0		7		
17.5				
18.0				
18.5				
19.0		2		
19.5				1
20.0	+	5	3	1
20.5			1	2
21.0		12	4	+
21.5	+	13	5	7
22.0	+	61	46	14
22.5	2	78	92	10
23.0	3	169	54	34
23.5	10	186	94	25
24.0	31	235	127	51
24.5	59	304	138	85
25.0	99	422	230	143
25.5	185	883	204	149
26.0	172	1,494	443	243
26.5	171	2,128	632	294
27.0	229	2,196	1,164	437
27.5	376	1,529	1,761	393
28.0	620	815	2,064	601
28.5	348	484	1,878	636
29.0	977	421	1,120	495
29.5	923	315	530	226
30.0	889	158	382	148
30.5	697	112	194	50
31.0	514	80	148	42
31.5	305	72	115	21
32.0	146	20	51	20
32.5	102	22	26	3
33.0	43	2	12	3
33.5	6	1	14	10
34.0	7	+	4	
34.5	+	+	4	
35.0	+			
35.5	2			

+Less than 500.

Table 5.2.5 Number of days absent from port by pair trawlers in the Firth of Clyde, 1974-1991, and estimated total effort in pair trawl units.

Year	Days absent (pair trawl)	Raised to total landings
1974	3,376	3,376
1975	3,209	3,209
1976	3,016	3,016
1977	4,186	4,186
1978	4,379	4,379
1979	2,933	2,933
1980	1,982	1,982
1981	1,529	1,529
1982	1,755	1,755
1983	1,644	1,644
1984	1,401	1,401
1985	1,688	1,688
1986	1,375	1,375
1987	850	998
1988	540	626
1989	582	639
1990	388	429
1991	169	254

Table 5.2.6 CLYDE HERRING. Mean weight at age (kg) in the catch and stock.

Age (rings)	Mean weight in catch (spring and autumn-spawners combined)								Mean weight in stock (spring spawners only)	
	1970-1981	1982-1985	1986	1987	1988	1989	1990	1991	Feb[1] 1991	Mar[2] 1991
2	.225	.149	.166	.149	.156	.149	.170	.143	-	-
3	.270	.187	.199	.194	.194	.174	.186	.163	.171	.173
4	.290	.228	.224	.203	.207	.203	.202	.188	.195	.218
5	.310	.253	.253	.217	.211	.221	.216	.192	.210	.215
6	.328	.272	.265	.225	.222	.227	.237	.198	.210	.245
7	.340	.307	.297	.236	.230	.235	.234	.210	.234	-
8	.345	.291	.298	.247	.225	.237	.234	.222	-	-
9	.350	.300	.298	.255	.244	.219	.257	.200	-	-
10+	.350	.300	.321	.258	.230	.254	.272	.203	-	-

[1]Based on commercial samples of herring mostly at stages IV, V and VI.
[2]Based on one sample taken on the spawning grounds.

Table 5.2.7 Estimated percentages of herring (2-ringers and older at each maturity stage in each month of 1991.

Month	Maturity stages				
	Immature I-II	Developing III	Developing IV-V	Spawning/spent VI-VII	Recovering spents VIII
Jan	5.7	2.2	75.2	0	16.8
Feb	0	0.4	66.5	28.5	4.6
Mar	4.3	0.3	42.7	7.2	45.5
Apr	24.8	0.4	1.6	7.7	65.6
May	2.8	0	0.6	3.1	93.6
Jun	2.3	2.6	0.3	7.2	87.7
Jul	10.2	44.8	12.3	0	32.8
Aug	2.2	26.7	34.7	0.5	35.8
Sept	0.6	41.8	44.2	0	13.3
Oct	0.5	23.2	63.1	0	13.2
Nov	12.5	9.1	53.9	0	24.4
Dec	1.5	3.8	63.5	0	31.2

Table 5.2.8 Race/maturity key used in estimating percentage of spring- and autumn-spawners in the catch

	MATURITY STAGE							
	I	II	III	IV	V	VI	VII	VIII
January	?	?	S	S	S	S	?	A
February	?	?	?	S	S	S	S	A
March	?	?	?	S	S	S	S	?
April	?	?	?	?	S	S	S	?
July	?	?	?	?	A	A	?	?
August	?	?	?	?	A	A	A	S
September	?	?	S	?	A	A	A	S
October	?	?	S	S	A	A	A	?
November	?	?	S	S	A	A	A	?
December	?	?	S	S	S	A	A	A

Table 5.2.9 Monthly percentage of spring-spawners and estimated numbers (thousands) and percentages of 5-ringers in catches of 3-ringers and older in 1991.

Month	Estimated number		% of 5-ringers	% of spring-spawners based on maturity data
	5-ringers	3-ringers & older		
January	17.4	20.2	85.8	81.6 - 82.1
February	86.9	94.0	92.5	95.3
March	35.4	50.7	69.9	51.1 - 100
April	48.5	125.7	38.5	9.8 - 100
July	259.7	570.9	45.5	0.0 - 100
August	116.8	301.9	38.7	35.8 - 97.6
September	346.7	581.3	59.6	56.0 - 82.7
October	589.6	1027.3	57.4	81.2 - 97.0
November	217.7	398.7	54.6	68.5 - 99.7
December	142.4	230.9	61.6	66.7 - 67.1

Table 5.2.10 Percentage age compositions (3-ringers and older) in landings from Clyde (spring and autumn spawners combined) and adjacent areas in 1991.

Age in rings	Clyde		VIa N	VIIa	VIa S + VIIb,c
	Jan-Feb.	Mar.-Dec.			
3	2.3	13.9	20.4	38.2	14.1
4	4.2	20.7	22.9	16.0	6.4
5	91.3	53.4	30.4	28.7	52.2
6	1.4	5.0	11.0	8.4	9.3
7	0.7	2.7	6.1	4.1	7.7
≥8	0.1	4.3	9.2	4.6	9.9

Table 5.2.11 Length and age compositions of herring sampled on the spawning grounds in the Clyde, March 1991.

		% Frequency		
Length (cm)		Brown Head	Ballantrae Bank	
25.0		0.5		
25.5		0.5	0.5	
26.0				
26.5			0.5	
27.0			2.5	
27.5		5.0	6.5	
28.0		12.0	19.9	
28.5		16.0	21.9	
29.0		36.5	21.4	
29.5		16.5	12.4	
30.0		9.5	11.0	
30.5		1.0	0.5	
31.0		1.5	1.5	
31.5		1.0	0.5	
32.0			0.5	
32.5			0.5	
Age (rings)	Year class			Combined
2	1989		0.5	0.2
3	1988	1.0	0.5	0.8
4	1987	2.5	5.5	4.0
5	1986	95.5	90.6	93.0
6	1985	1.0	2.5	1.8
7	1984		0.5	0.2

Table 5.2.12 Estimated numbers at age (thousands) in the spawning population in the Clyde in 1991, with 1990 for comparison.

	1991						
	Age (rings) & Year Class						Total
	2	3	4	5	6	7	
	1989	1988	1987	1986	1985	1984	
Brown Head	-	184	461	17,645	185	-	18,475
Ballantrae Bank	69	69	759	12,560	344	69	13,870
Combined	69	253	1,220	30,205	529	69	32,345

	1990						
	Age (rings) & Year Class						Total
	2	3	4	5	6	7	
	1988	1987	1986	1985	1984	1983	
Combined	-	362	38,860	428	120	-	39,824

Table 5.2.13 Calculation of fishing mortality in 1991 and stock in number of spring spawners at 1 January 1992 from egg survey and catches in numbers at age (thousands).

Age (rings)	No at 1.4.91	Catch Apr-Dec 1991[1]	M	F	No at 1.1.92
3	253	15	0.15	0.066	(250)
4	1,220	73	0.075	0.064	204
5	30,205	1,815	0.075	0.064	1,062
6	529	32	0.075	0.064	26,285
=/>7	69	4	0.075	0.064	520

[1]58% of total catch in number assumed to be spring spawners allocated to age in proportion to numbers in stock.

Table 5.2.14 Input for prediction of Clyde spring spawning herring.

Age (rings)	No at 1.1.92 (thousands)	M	F pattern	Maturity Ogive	W_c[1]	W_s[2]
3	250	0.2	1	1	.174	.171
4	204	0.1	1	1	.198	.195
5	1,062	0.1	1	1	.210	.210
6	26,285	0.1	1	1	.221	.210
=/>7	520	0.1	1	1	.229	.234

[1]Weight in catch = mean over 1989-1991.
[2]W_s weight in stock is from samples from the spawning grounds in February 1991.
Recruitment in 1993 and 1994: 250 assumed.

Table 6.1.1 Estimated HERRING catches in tonnes in Divisions VIa (South) and VIIb,c, 1982-1991.

Country	1982	1983	1984	1985	1986
France	353	19	-	-	-
Germany, Fed.Rep.	265	-	-	-	-
Ireland	16,856	15,000	10,000	13,900	15,540
Netherlands	1,735	5,000	6,400	1,270	1,550
UK (N.Ireland)	-	-	-	-	-
UK (England + Wales)	-	-	-	-	-
UK Scotland	-	-	-	-	-
Unallocated	-	13,000	11,000	-	11,785
Total landings	19,209	33,019	27,400	23,374	28,785
Discards	-	-	-	-	-
Total catch	19,209	33,019	27,400	23,374	28,785

Country	1987	1988	1989	1990	1991[1]
France	-	-	-	+	-
Germany, Fed.Rep.	-	-	-	-	-
Ireland	15,000	15,000	18,200	25,000	22,500
Netherlands	1,550	300	2,900	2,533	600
UK (N.Ireland)	5	-	-	80	-
UK (England + Wales)	51	-	-	-	-
UK (Scotland)	-	-	+	-	+
Unallocated	31,994	13,800	7,100	13,826	11,200
Total landings	48,600	29,100	28,200	41,439	34,300
Discards	-	-	1,000	2,530	3,400
Total catch	48,600	29,100	29,200	43,969	37,700

[1]Provisional

Table 6.1.2 Herring West of Ireland & Porcupine Bank & lower part of VIa (Fishing Areas VIIb,c & of VIa).

CATCH IN NUMBERS UNIT: thousands

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	135	883	1001	6423	3374	7360	16613	4485	10170	5919	2856	1620
2	35114	6177	28786	40390	29406	41308	29011	44512	40320	50071	40058	22265
3	26007	7038	20534	47389	41116	25117	37512	13396	27079	19161	64946	41794
4	13243	10856	6191	16863	44579	29192	26544	17176	13308	19969	25140	31460
5	3895	8826	11145	7432	17857	23718	25317	12209	10685	9349	22126	12812
6	40181	3938	10057	12383	8882	10703	15000	9924	5356	8422	7748	12746
7	2982	40553	4243	9191	10901	5909	5208	5534	4270	5443	6946	3461
8	1667	2286	47182	1969	10272	9378	3596	1360	3638	4423	4344	2735
9+	1911	2160	4305	50980	30549	32029	15703	4150	3324	4090	5334	5220
TOTAL	125135	82717	133444	193020	196936	184714	174504	112746	118150	126847	179498	134113
NOM	20306	15044	23474	36719	36589	38764	32767	20567	19715	22608	30124	24922
SOP%	90	87	90	102	98	112	105	108	102	107	96	103

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
1	748	1517	2794	9606	918	12149	0	2241	878	675
2	18136	43688	81481	15143	27110	44160	29135	6919	24977	34437
3	17004	49534	28660	67355	24818	80213	46300	78842	19500	27810
4	28220	25316	17854	12756	66383	41504	41008	26149	151978	12420
5	18280	31782	7190	11241	14644	99222	23381	21481	24362	100444
6	8121	18320	12836	7638	7988	15226	45692	15008	20164	17921
7	4089	6695	5974	9185	5696	12639	6946	24917	16314	14865
8	3249	3329	2008	7587	5422	6082	2482	4213	8184	11311
9+	2875	4251	4020	2168	2127	10187	1964	3036	1130	7660
TOTAL	100722	184432	162817	142679	155106	321382	196908	182806	267487	227543
	19209	32988	27450	23343	28785	48600	29100	29210	43969	37700
	103	100	97	98	100	95	100	100	100	100

Table 6.1.3 Sampling intensity of commercial catches.

Country	Catch (t)	No. of samples	No. of age readings	No. of fish measured	Estimates of discards
Ireland	22,000	45	1,958	9,464	No
Netherlands	600	4	100	400	Yes

Table 6.1.4 Divisions VIa(S) and VIIb.
Length distributions of Irish catches (pelagic trawlers) per quarter (10^3).

Length	1st quarter	2 quarter	3 quarter	4 quarter
16.0	13			
16.5	25			
17.0	13			
17.5	25			
18.0	25			
18.5	-			
19.0	13			
19.5	-			
20.0	63		17	
20.5	241	33	17	34
21.0	266	33	76	-
21.5	431	263	110	34
22.0	494	493	202	-
22.5	507	362	185	135
23.0	481	117	194	270
23.5	456	920	211	641
24.0	785	920	514	2429
24.5	1495	1150	801	4251
25.0	1695	920	666	5701
25.5	2597	2366	514	5634
26.0	4383	3516	430	6275
26.5	10084	4502	531	8029
27.0	10793	6047	565	12651
27.5	8259	4009	590	17609
28.0	4788	2498	480	15113
28.5	3230	1479	219	10222
29.0	2736	1052	236	5735
29.5	1812	657	118	4419
30.0	1064	230	126	2496
30.5	583	66	101	1451
31.0	279	66	67	405
31.5	89	-	8	236
32.0	13	-	8	67
32.5	13	33	-	
33.0			8	
33.5			8	
34.0				
Total	57753	32372	7004	103666

Table 6.1.5 Irish young fish surveys. Catch of herring per hour.

Year	0-w.r.	1-w.r	No. of stations	Type of trawl
1981	628	455	10	3 briddle butterfly trawl
1982	1,599	861	10	1 whitefish bottom trawl
1983	238	661	10	and sprat bag
1984	2,398	64	10	"
1985	7	77	10	Pelagic trawl and sprat bag
1986	24	0	6	Whitefish bottom trawl and sprat bag
1987	1,065	3,661	8	Star trawl and sprat bag
1988	4,432	45	13	Star trawl and rock hopper
1989			No survey	
1990	17	4	8	Rock hopper and sprat bag
1991	61	3	6	Rock hopper and sprat bag

Table 7.1.1 HERRING. Total catches (t) in North Irish Sea (Division VIIa, North), 1980-1991 as reported to the Working Group.

Country	1980	1981	1982	1983	1984	1985
France	1	-	-	48	-	-
Ireland	1,340	283	300	860	1,084	1,000
Netherlands	-	-	-	-	-	-
UK	9,272	4,094	3,375	3,025	2,982	4,077
Unallocated	-	-	1,180	-	-	4,110
Total	10,613	4,377	4,855	3,933	4,066	9,187

Country	1986	1987	1988	1989	1990	1991
France	-	-	-	-	-	
Ireland	1,640	1,200	2,579	1,430	1,699	
Netherlands	-	-	-	-	-	
UK	4,376	3,290	7,593	3,532	4,613	
Unallocated	1,424	1,333	-	-	-	
Total	7,440	5,823	10,172	4,962	6,312	

Table 7.1.2 HERRING.
Sampling intensity of commercial landings for Division VIIa (North) in 1991.

Quarter	Country	Landings (t)	No. samples	No. fish measured	No. fish aged	Estimation of discards
Q1	Ireland	0	-	-	-	-
	UK (N.Ireland)	2[2]	0	0	0	No
	UK (Isle of Man)	0	-	-	-	-
	UK (Scotland)	0	-	-	-	-
	UK (Offshore)	0	-	-	-	-
Q2	Ireland	0	-	-	-	-
	UK (N.Ireland)	7[2]	0	0	0	No
	UK (Isle of Man)	98	5	1,597	246	No
	UK (Scotland)	+	0	0	0	No
	UK (Offshore)[1]	0	-	-	-	-
Q3	Ireland	80	5	1,255	247	No
	UK (N.Ireland)	2,859	98	15,729	2,434	No
	UK (Isle of Man)	531	23	6,683	1,146	No
	UK (Scotland)	+	0	0	0	No
	UK (Offshore)[1]	96[2]	0	0	0	No
Q4	Ireland	0	-	-	-	-
	Uk (N.Ireland)	430	7	995	50	No
	UK (Isle of Man)	0	-	-	-	-
	UK (Scotland)	0	-	-	-	-
	UK (Offshore)[1]	295[3]	0	0	0	No

[1]UK offshore denotes landings to offshore vessels + < 1t.
[2]Mean weight at age data for Q3 (N. Ireland) applied to these catches.
[3]Mean weight-at-age data for Q4 (N. Ireland) applied to these catches.
+ = landings < 1t.

Table 7.1.3 HERRING in the North Irish Sea (Manx plus Mourne herring, Division VIIa (North)).

Run title : Herring in the North Irish Sea (Manx plus Mourne herring) (r At 5/04/1992 16:12
Traditional vpa Terminal populations from weighted Separable populations

Catch numbers at age Numbers*10**-3

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE										
1	40640	42150	43250	33330	34740	30280	15540	11770	5840	5050
2	46660	32740	109550	48240	56160	39040	36950	38270	25760	15790
3	26950	38240	39750	39410	20780	22690	13410	23490	19510	3200
4	13180	11490	24510	10840	15220	6750	6780	4250	8520	2790
5	13750	6920	10650	7870	4580	4520	1740	2200	1980	2300
6	6760	5070	4990	4210	2810	1460	1340	1050	910	330
7	2660	2590	5150	2090	2420	910	670	400	360	290
+gp	1670	2600	1630	1640	1270	1120	350	290	230	240
TOTALNUM	152270	141800	239480	147630	137980	106770	76780	81720	63110	29990
TONSLAND	27350	22600	38640	24500	21250	15410	11080	12338	10613	4377
SOPCOF %	112	101	100	103	99	95	92	93	97	91

Catch numbers at age Numbers*10**-3

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE										
1	5100	1305	1168	2429	4491	2225	2607	1156	2313	1999
2	16030	12162	8424	10050	15266	12981	21250	6385	12835	9754
3	5670	5598	7237	17336	7462	6146	13343	12039	5726	6743
4	2150	2820	3841	13287	8550	2998	7159	4708	9697	2833
5	330	445	2221	7206	4528	4180	4610	1876	3598	5068
6	1110	484	380	2651	3198	2777	5084	1255	1661	1493
7	140	255	229	667	1464	2328	3232	1559	1042	719
+gp	380	59	479	724	877	1671	4213	1956	1615	815
TOTALNUM	30910	23128	23979	54350	45836	35306	61498	30934	38487	29424
TONSLAND	4855	3933	4066	9187	7440	5823	10172	4949	6312	4398
SOPCOF %	98	98	96	102	98	104	105	100	101	100

Table 7.1.4 HERRING in Division VIIa (North). Catch at length for 1988-1990. Numbers of fish in thousands.

Length (cm)	1988	1989	1990
14	1		
	1		
15	1		
	10		
16	13		6
	16		6
17	29		50
	44	24	7
18	46	44	224
	85	43	165
19	247	116	656
	306	214	318
20	385	226	791
	265	244	472
21	482	320	735
	530	401	447
22	763	453	935
	1,205	497	581
23	2,101	612	2,400
	3,573	814	1,908
24	5,046	1,183	3,474
	5,447	1,656	2,818
25	5,276	2,206	4,803
	4,634	2,720	3,688
26	4,082	3,555	4,845
	4,570	3,293	3,015
27	4,689	2,847	3,014
	4,124	2,018	1,134
28	3,406	1,947	993
	2,916	1,586	582
29	2,659	1,268	302
	1,740	997	144
30	1,335	801	146
	685	557	57
31	563	238	54
	144	128	31
32	80	57	29
	7	7	
33	2	5	
	1	6	
34		0	
		5	

Table 7.2.1 HERRING in Division VIIa (North).

Year	Lengths at age (cm)							
	Age (rings)							
	1	2	3	4	5	6	7	8
1985	22.1	24.3	26.1	27.6	28.3	28.6	29.5	30.1
1986	19.7	24.3	25.8	26.9	28.0	28.8	28.8	29.8
1987	20.0	24.1	26.3	27.3	28.0	29.2	29.4	30.1
1988	20.2	23.5	25.7	26.3	27.2	27.7	28.7	29.6
1989	20.9	23.8	25.8	26.8	27.8	28.2	28.0	29.5
1990	20.1	24.2	25.6	26.2	27.7	28.3	28.3	29.0
1991	20.5	23.8	25.4	26.1	26.8	27.3	27.7	28.7

Table 7.2.2 HERRING in Division VIIa (North).

Year	Weights at age (g)							
	Age (rings)							
	1	2	3	4	5	6	7	8
1976-1983	74	155	195	219	232	251	258	278
1984	76	142	187	213	221	243	240	273
1985	87	125	157	186	202	209	222	258
1986	68	143	167	188	215	229	239	254
1987	58	130	160	175	194	210	218	229
1988	70	124	160	170	180	198	212	232
1989	81	128	155	174	184	195	205	218
1990	77	135	163	175	188	196	207	217
1991	70	121	153	167	180	189	195	214

Table 7.4.1 HERRING in the North Irish Sea (Manx plus Mourne herring, Division VIIa (North)).

At 6/04/1992 12:44

Separable analysis
from 1972 to 1991 on ages 1 to 7
with Terminal F of .150 on age 3 and Terminal S of 1.000

Initial sum of squared residuals was 129.351 and
final sum of squared residuals is 20.140 after 128 iterations

Matrix of Residuals

Years	1972/73	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80	1980/81
Ages									
1/ 2	1.672	1.108	1.260	1.052	1.274	1.142	.613	.764	-.161
2/ 3	-.592	-.368	-.048	.012	-.173	-.029	-.411	-.179	.511
3/ 4	-.084	.130	.040	-.057	-.150	-.078	.111	-.017	.186
4/ 5	-.254	-.200	-.083	-.107	-.020	.109	.127	-.228	-.411
5/ 6	.094	.050	-.291	.062	-.090	-.031	-.494	-.109	.068
6/ 7	.103	-.251	-.300	-.368	-.056	-.418	.257	.126	-.527
	.000	.000	.000	.000	.000	.000	.000	.000	.000
WTS	.001	.001	.001	.001	.001	.001	.001	.001	.001

Years	1981/82	1982/83	1983/84	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91		WTS
Ages												
1/ 2	.149	.360	-.204	.441	-.313	.334	.017	.193	-.472	-.081	.000	.262
2/ 3	.188	.218	.172	-.146	-.281	.237	.205	-.438	.024	-.027	.000	.585
3/ 4	-.561	-.242	-.065	-.127	.013	.132	-.021	-.078	.034	-.066	.000	1.000
4/ 5	1.212	.670	-.168	-.114	.419	-.029	-.263	.255	.122	-.086	.000	.431
5/ 6	-.202	-1.298	-.260	.330	.146	-.266	-.037	.207	-.036	.134	.000	.469
6/ 7	-.027	.601	.375	-.014	-.027	-.392	.049	.135	.072	.136	.000	.564
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	5.524	
WTS	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
F-values	.6688	.5690	1.0442	.9424	1.0941	1.0466	.9074	.9415	1.0486	.4681

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
F-values	.3085	.1784	.1568	.3807	.3123	.2163	.3829	.1943	.2312	.1500

Selection-at-age (S)

	1	2	3	4	5	6	7
S-values	.0650	.8287	1.0000	1.0092	1.0007	.9787	1.0000

Table 7.4.2 HERRING in the North Irish Sea (Manx plus Mourne herring, Division VIIa (North)).

Fishing mortality (F) at age

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE										
1	.1669	.1043	.2141	.1527	.2294	.1573	.1029	.1416	.0608	.0363
2	.3625	.3459	.8244	.7529	.7959	.8560	.5332	.7453	1.0577	.4084
3	.5357	.6164	1.0230	.9062	.9784	1.0061	.9209	.8573	1.2889	.3659
4	.5513	.4359	1.0125	.8456	1.0982	1.0003	.9373	.8253	.8593	.5876
5	.6530	.5565	.8163	.9732	.9679	1.0675	.6754	.8154	1.0759	.5230
6	.6898	.4715	.8959	.8017	1.0477	.8571	.9824	1.0262	.8576	.4429
7	.6660	.5466	1.1172	1.1083	1.4997	1.0855	1.1592	.8031	1.1327	.6519
+gp	.6660	.5466	1.1172	1.1083	1.4997	1.0855	1.1592	.8031	1.1327	.6519
FBAR 2- 6	.5584	.4853	.9144	.8559	.9776	.9574	.8099	.8539	1.0279	.4656

Fishing mortality (F) at age

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
AGE										
1	.0340	.0083	.0130	.0229	.0331	.0108	.0296	.0083	.0142	.0097
2	.2648	.1787	.1133	.2520	.3395	.2142	.2288	.1581	.2013	.1279
3	.2671	.1471	.1626	.3806	.3203	.2361	.3792	.2080	.2203	.1638
4	.4249	.1956	.1354	.4727	.3102	.1949	.4478	.2109	.2446	.1533
5	.1109	.1294	.2082	.3568	.2587	.2190	.4540	.1791	.2210	.1746
6	.4568	.2106	.1397	.3638	.2364	.2234	.3984	.1903	.2130	.1205
7	.3032	.1594	.1308	.3431	.3119	.2414	.3879	.1817	.2135	.1207
+gp	.3032	.1594	.1308	.3431	.3119	.2414	.3879	.1817	.2135	.1207
FBAR 2- 6	.3049	.1723	.1519	.3652	.2930	.2175	.3816	.1893	.2200	.1480

Table 7.4.3 HERRING in the North Irish Sea (Manx plus Mourne herring, Division VIIa (North)). Traditional VPA terminal populations from weighted separable population.

Stock number at age (start of year) Numbers*10**-3

YEAR	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
AGE										
1	412653	667683	348898	367806	263083	324905	249393	139421	155876	223359
2	176045	128475	221305	103618	116151	76940	102129	82778	44519	53961
3	71062	90766	67343	71890	36156	38823	24217	44390	29104	11453
4	32530	34050	40119	19822	23782	11128	11622	7895	15420	6566
5	29972	16959	19924	13188	7700	7176	3703	4119	3130	5909
6	14175	14116	8796	7970	4509	2647	2233	1705	1649	966
7	5717	6435	7971	3249	3235	1431	1016	756	553	633
+gp	3589	6460	2523	2550	1697	1761	531	548	353	524
TOTAL	745744	964944	716879	590092	456314	464811	394844	281613	250604	303370

Stock number at age (start of year) Numbers*10**-3

YEAR	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
AGE											
1	240845	248816	142920	169301	217806	328591	140963	222211	258554	325744	0
2	79239	85642	90775	51898	60871	77519	119588	50344	81075	93772	118672
3	26572	45046	53063	60045	29883	32114	46356	70475	31842	49111	61131
4	6503	16656	31836	36924	33599	17761	20763	25975	46862	20916	34134
5	3302	3847	12394	25159	20826	22293	13225	12005	19035	33201	16236
6	3169	2674	3059	9107	15933	14548	16204	7600	9081	13809	25230
7	561	1816	1960	2407	5727	11382	10528	9844	5685	6641	11076
+gp	1523	420	4100	2612	3431	8170	13724	12351	8811	7527	11363
TOTAL	361714	404918	340107	357452	388076	512378	381350	410804	460946	550721	277841

Table 7.4.4 HERRING in the North Irish Sea (Manx plus Mourne herring, Division VIIa (North)).

Summary (with SOP correction)
Traditional vpa Terminal populations from weighted Separable populations

	RECRUITS	TOTALBIO	EXPLTBIO	TOTSPBIO	LANDINGS	SOPCOFAC	FBAR 2- 6	FBAR 2- 6
1972	412653	102808	48975	36251	27350	1.1200	.5584	
1973	667683	106183	46572	31572	22600	1.0073	.4853	
1974	348898	91238	42256	23477	38640	.9958	.9144	
1975	367806	70016	28624	16687	24500	1.0260	.8559	
1976	263083	53561	21737	12210	21250	.9927	.9776	
1977	324905	46894	16096	8837	15410	.9538	.9574	
1978	249393	40099	13681	10036	11080	.9243	.8099	
1979	139421	32783	14449	9058	12338	.9296	.8539	
1980	155876	28006	10325	5541	10613	.9701	1.0279	
1981	223359	27718	9402	7100	4377	.9092	.4656	
1982	240845	38207	15924	12949	4855	.9837	.3049	
1983	248816	45518	22831	19229	3933	.9838	.1723	
1984	142920	43811	26776	24326	4066	.9623	.1519	
1985	169301	46627	25158	19889	9187	1.0202	.3652	
1986	217806	44137	25391	19677	7440	.9767	.2930	
1987	328591	50990	26769	22021	5823	1.0382	.2175	
1988	140963	49077	26653	23538	10172	1.0521	.3816	
1989	222211	48454	26148	22424	4949	1.0034	.1893	
1990	258554	53378	28687	23460	6312	1.0130	.2200	
1991	325744	56680	29716	25466	4398	1.0006	.1480	
Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)	(Tonnes)			

Table 7.6.1 List of input variables for prediction.

Herring in the North Irish Sea (VIIa)

List of input variables:

Reference F is the mean f (unweighted) for the age group range from 2 to 6.

The number of recruits per year is as follows for each VPA terminal F option.

Geometric mean recruitment (1984-1990) for VPA terminal Fs:

Year	F=0.10	F=0.15	F=0.20	F=0.30
1992	251,876	202,628	176,900	149,934
1993	251,876	202,628	176,900	149,934

Proportion of F (fishing mortality) effective before spawning: .9000
Proportion of M (natural mortality) effective before spawning: .7500

Data are printed in the following units:

Number of Fish:	Thousands
Weight by age group in the catch:	Kilogram
Weight by age group in the stock:	Kilogram
Stock biomass:	tonnes
Catch in weight:	tonnes

				All gears		
age	stock size	natural[1] mortality	maturity[2] ogive	fishing pattern	weight in[3] the catch	weight in[4] the stock
1	202630.0	1.00	.08	.07	.076	.071
2	73381.0	.30	.85	.83	.129	.128
3	61131.0	.20	1.00	1.00	.159	.158
4	34134.0	.10	1.00	1.01	.173	.172
5	16236.0	.10	1.00	1.00	.185	.185
6	25230.0	.10	1.00	.98	.198	.198
7	11076.0	.10	1.00	1.00	.208	.207
8	11363.0	.10	1.00	1.00	.223	.222

[1] Year 1991 from file NATMOR
[2] Year 1991 from file MORPROP
[3] Mean for years 1987-1991 from file WECA
[4] Mean for years 1987-1991 from file WEST

Table 7.6.1 (cont.)

Stock size and fishing pattern for each VPA terminal F option. Stock sizes in thousands of fish on 1st January 1992.

	F=0.10		F=0.15		F=0.20		F=0.30	
Age Ring	Stock size	fishing pattern	Stock size	fishing pattern	Stock size	Fishing pattern	Stock size	Fishing pattern
1	251,876	0.06	202,628	0.07	176,900	0.07	149,934	0.07
2	91,495	0.83	73,381	0.83	63,917	0.83	53,995	0.84
3	93,940	1.00	61,131	1.00	44,860	1.00	28,722	1.00
4	52,600	1.01	34,134	1.01	24933	1.01	15,774	1.01
5	24,984	1.00	16,236	1.00	11,859	1.00	7,487	1.00
6	38,932	0.98	25,230	0.98	18,385	0.98	11,564	0.98
7	17,065	1.00	11,076	1.00	8,084	1.00	5,101	1.00
8+	17,499	1.00	11,363	1.00	8,297	1.00	5,241	1.00

Numbers of 2-ring fish obtained by replacing VPA estimate of 1-ring fish in 1991 with a geometric mean value.

Table 7.6.2 Results of prediction based on VPA with terminal F = 0.15.

Herring in the North Irish Sea (VIIa)

Species: Herring   Year 1992. All gears   F-factor .2282 and ref. F .2200

age	All gears: absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January: sp.stock size	sp.stock biomass	at spawning time: sp.stock size	sp.stock biomass
1	.0160	2032.4	154.47	202628.	14386.6	16210.2	1150.9	7547.9	535.9
2	.1894	10990.8	1417.81	73381.	9392.8	62373.9	7983.9	42000.5	5376.1
3	.2282	11347.7	1804.28	61131.	9658.7	61131.0	9658.7	42847.1	6769.8
4	.2305	6699.4	1159.00	34134.	5871.0	34134.0	5871.0	25735.2	4426.5
5	.2282	3158.5	584.31	16236.	3003.7	16236.0	3003.7	12266.2	2269.3
6	.2236	4820.3	954.42	25230.	4995.5	25230.0	4995.5	19139.6	3789.6
7	.2282	2154.7	448.17	11076.	2292.7	11076.0	2292.7	8367.9	1732.2
8+	.2282	2210.5	492.94	11363.	2522.6	11363.0	2522.6	8584.7	1905.8
Total		43414.3	7015.40	435179.	52123.6	237754.1	37479.0	166489.2	26805.1

Species: Herring   Year 1993. All gears   F-factor .2124 and ref. F .2048

age	All gears: absolute F	catch in numbers	catch in weight	stock size	stock biomass	at 1 January: sp.stock size	sp.stock biomass	at spawning time: sp.stock size	sp.stock biomass
1	.0149	1892.6	143.84	202628.	14386.6	16210.2	1150.9	7555.4	536.4
2	.1763	10289.0	1327.28	73361.	9390.3	62357.2	7981.7	42487.8	5438.4
3	.2124	7829.1	1244.83	44982.	7107.1	44981.8	7107.1	31979.6	5052.8
4	.2145	7332.7	1268.55	39838.	6852.1	39837.9	6852.1	30470.1	5240.9
5	.2124	4474.5	827.78	24528.	4537.7	24527.9	4537.7	18796.1	3477.3
6	.2082	2094.7	414.76	11693.	2315.3	11693.5	2315.3	8995.2	1781.1
7	.2124	3330.0	692.64	18254.	3778.6	18254.2	3778.6	13988.5	2895.6
8+	.2124	2948.2	657.44	16161.	3587.7	16161.0	3587.7	12384.4	2749.3
Total		40190.8	6577.12	431446.	51955.4	234023.8	37311.2	166657.3	27171.8

Figure 2.3.1 Relation between IYFS 1-ringer index and estimates of 1-ringers from VPA. Regression based on year classes 1977-1988.

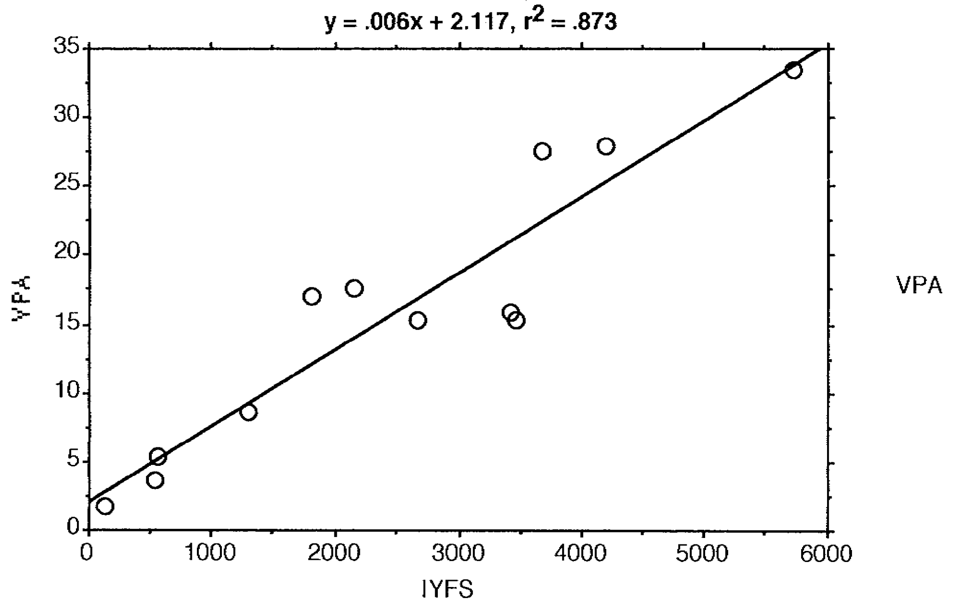


Figure 2.3.2 Relation between MIK 0-ringer index and estimates of 0-ringers from VPA. Regression based on year classes 1976-1988.

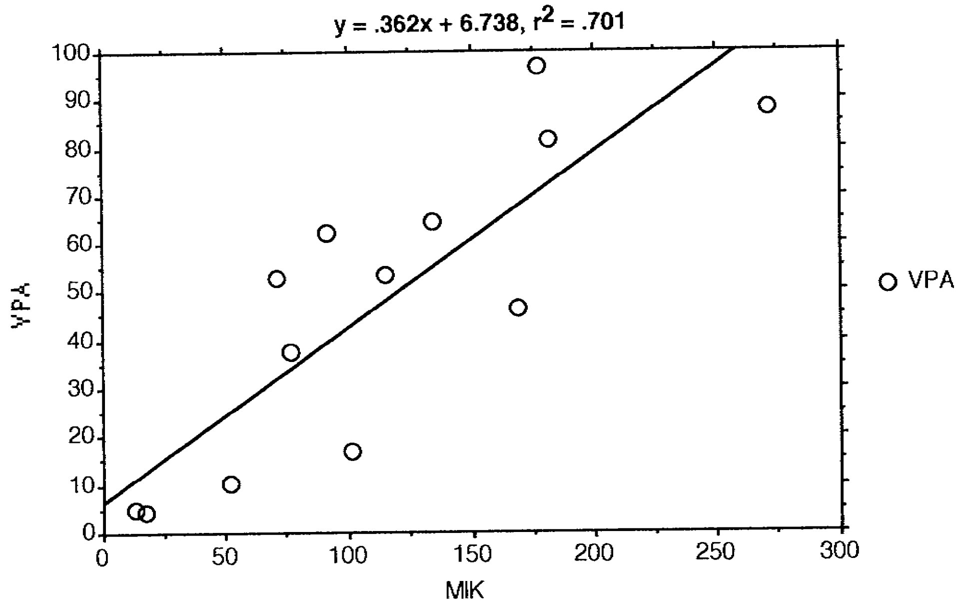


Figure 2.3.3 Distribution of 0-ringers, year classes 1989-1991. Density of 0-ringers within statistical rectangles, estimated from catches with either IKMT or MIK during the IYFS in February. Area of filled circles represents densities in no. m^{-2}, the area of circles that extends to the borders of a statistical rectangle represents 1.8 m^{-2}.

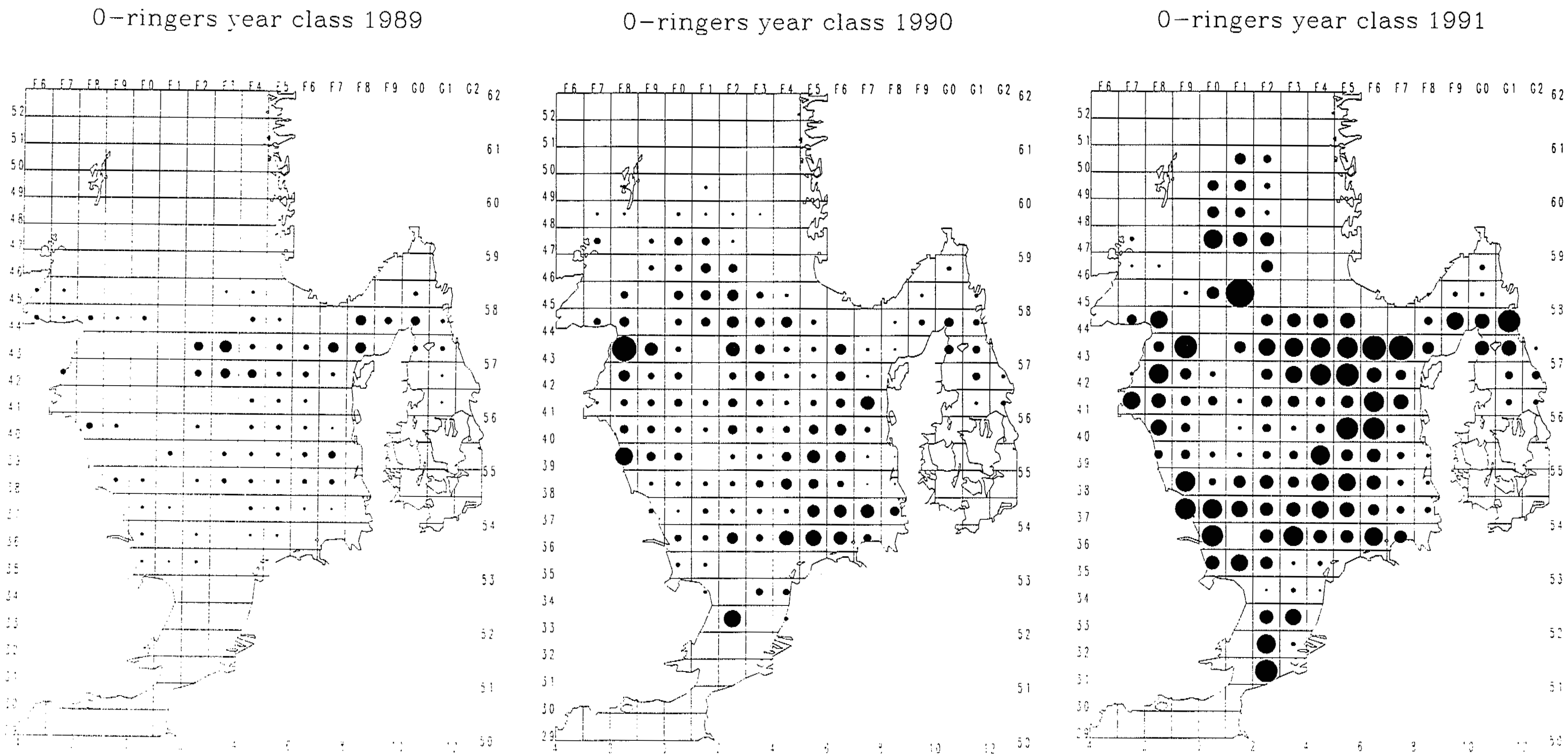


Figure 2.3.4 Trends in recruitment of 1-ringed North Sea autumn spawners

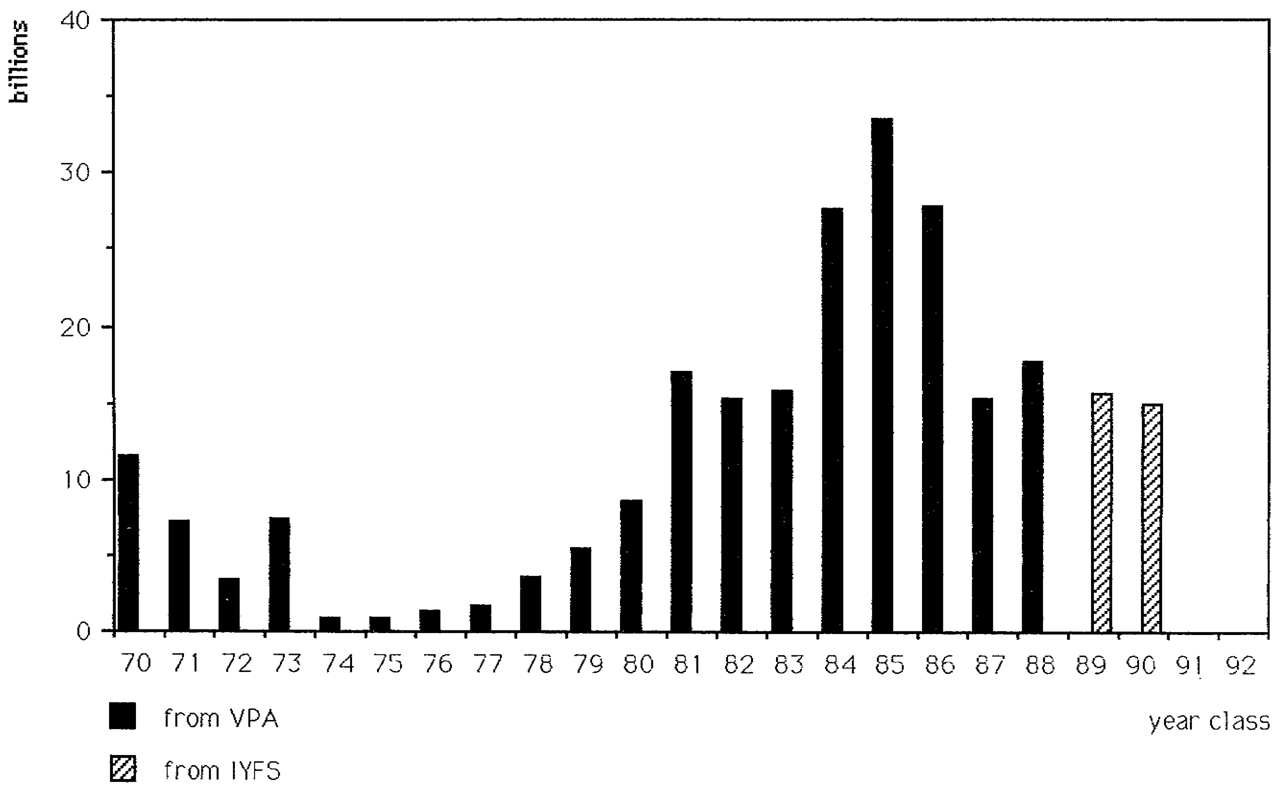


Figure 2.3.5 The logarithm of the VPA estimate of 1-ringers, regressed against the logarithm of either. 1) the standard index based on untransformed data, 2) the "standard" index based on log-transformed catch data, or 3) the GLM-index which also uses log-transformed catch data.

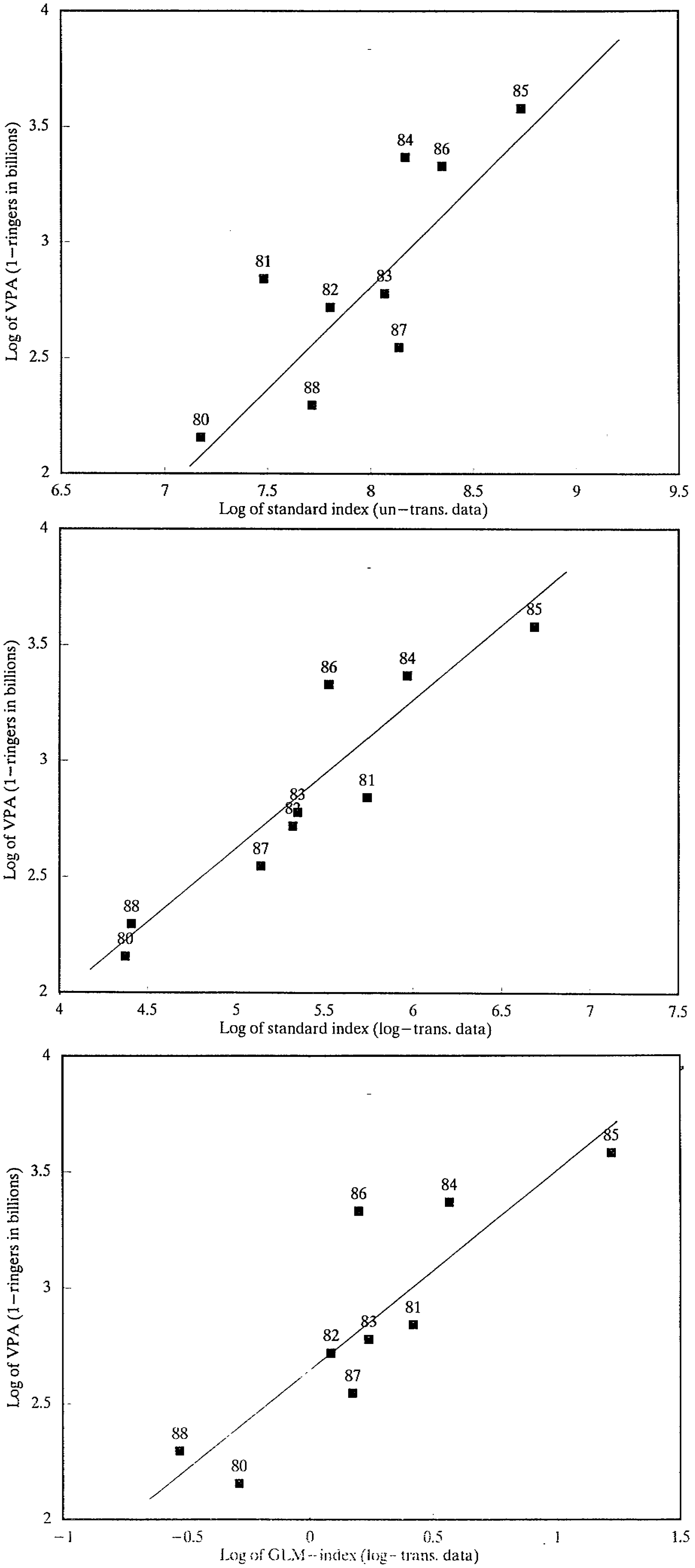
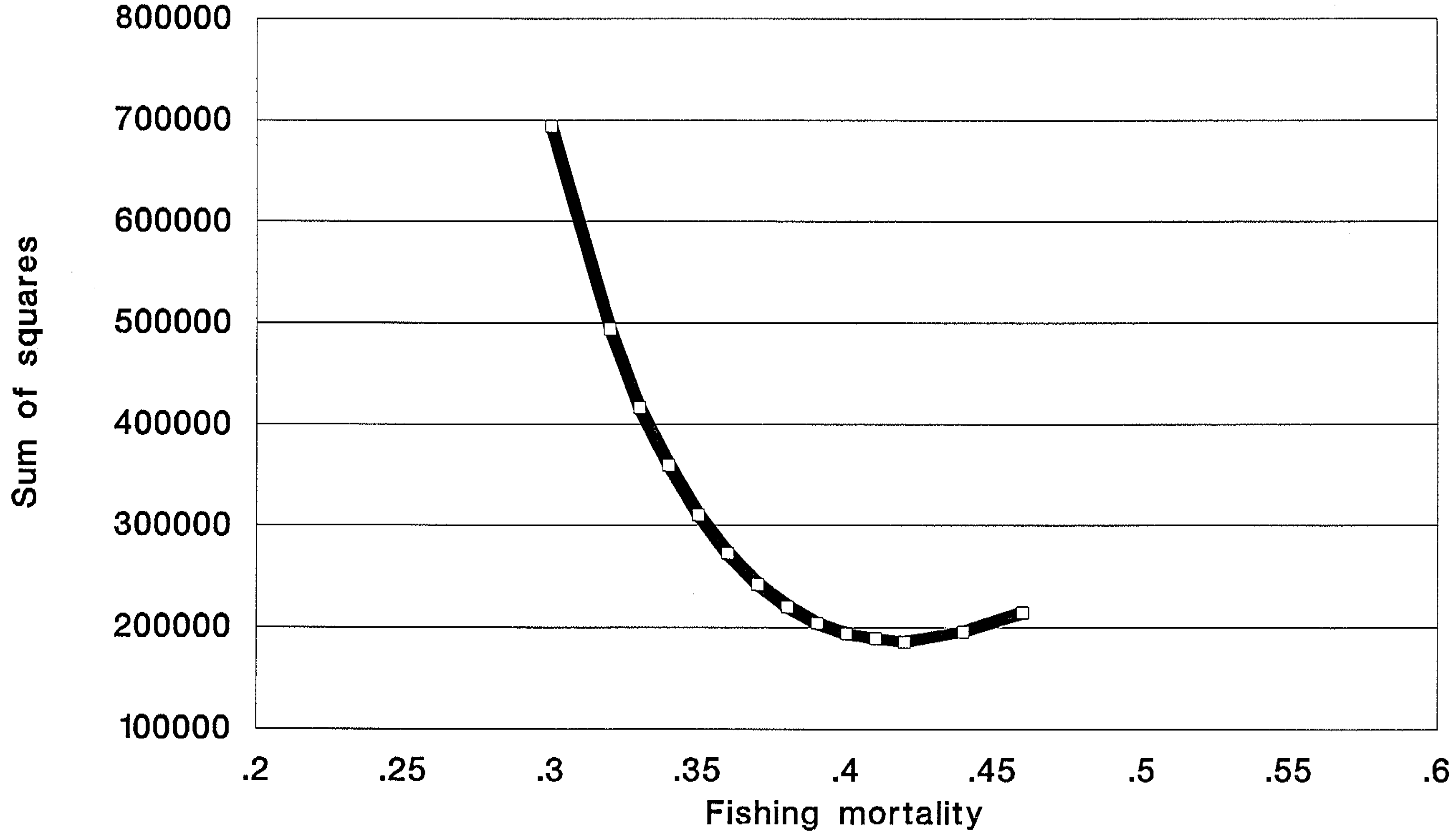


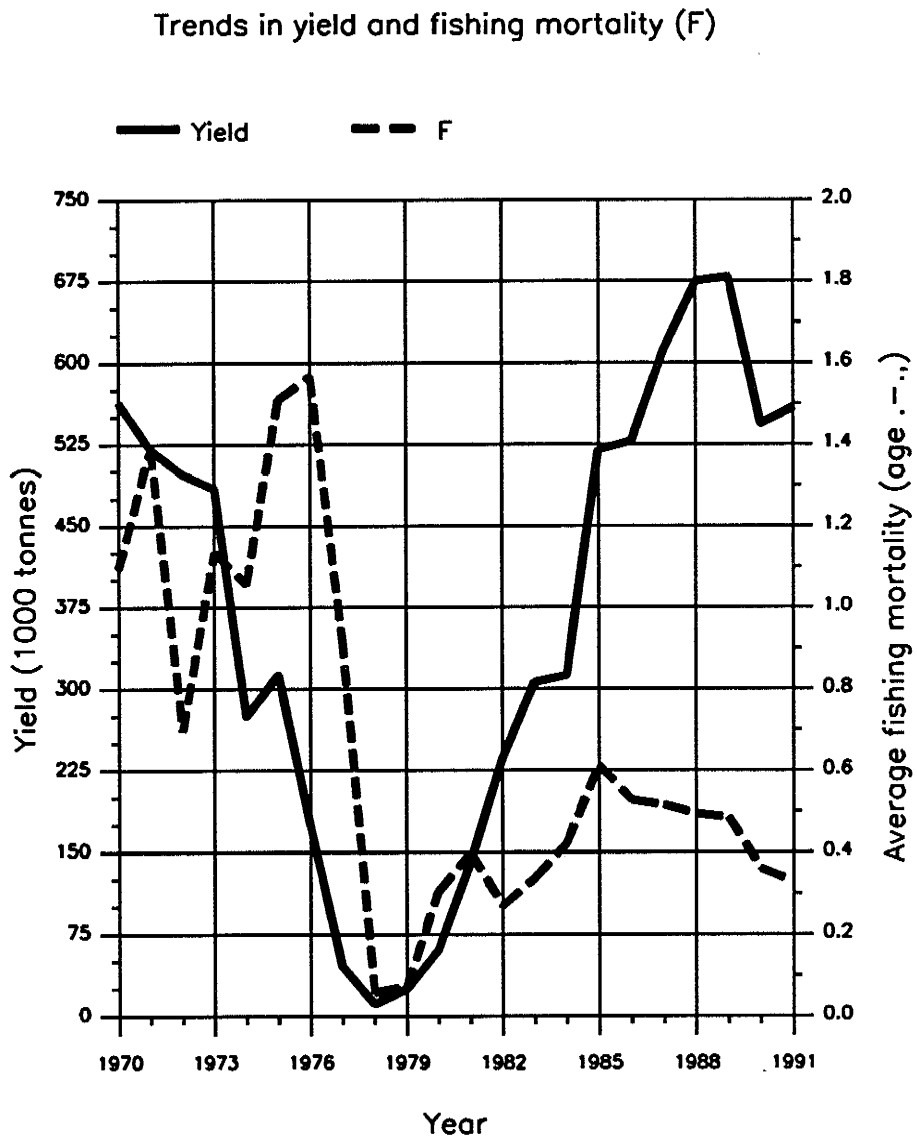
Figure 2.7.1



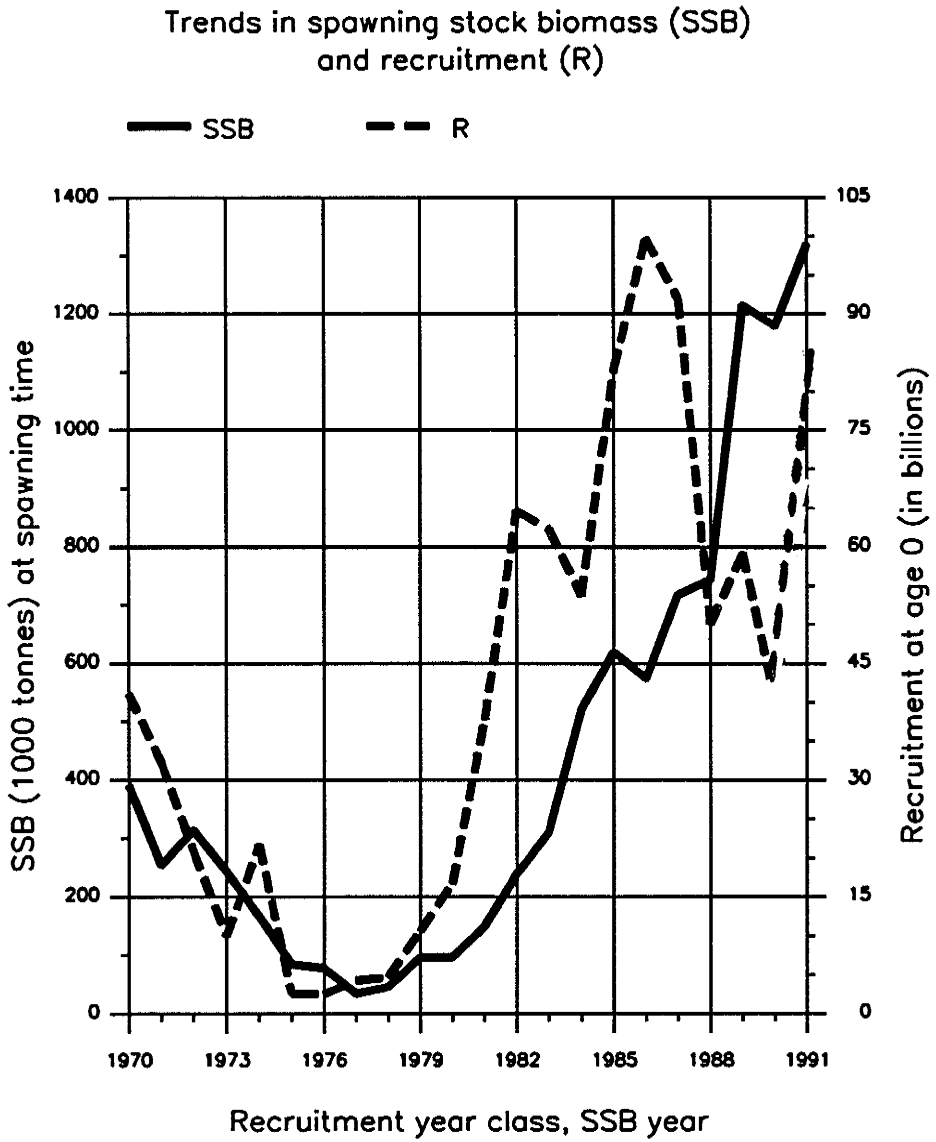
Sum of squares
800000
700000
600000
500000
400000
300000
200000
100000
.2
.25
.3
.35
.4
.45
.5
.55
.6
Fishing mortality

Figure 2.7.8

FISH STOCK SUMMARY
STOCK: Herring in the North Sea Area (Fishing Areas IV and IIIA)
7–4–1992



A



B

Figure 2.9.1 Simulated catches and SSB under a regime of constant F=0.30 on 1-ringers and older. Recruitment for 1980-1989 used as input for the periods 1991-2000 and 2001-2010.

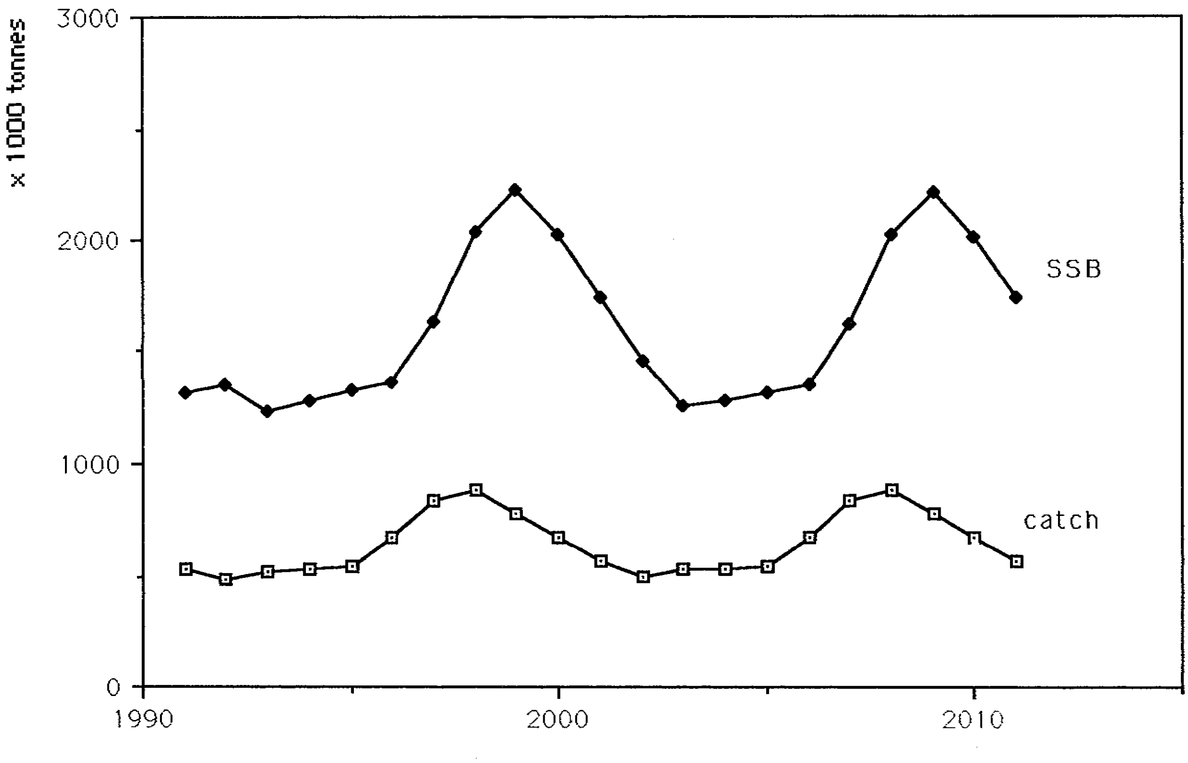


Figure 2.9.2 North Sea herring. Yield and F by year from Anon. (1990).

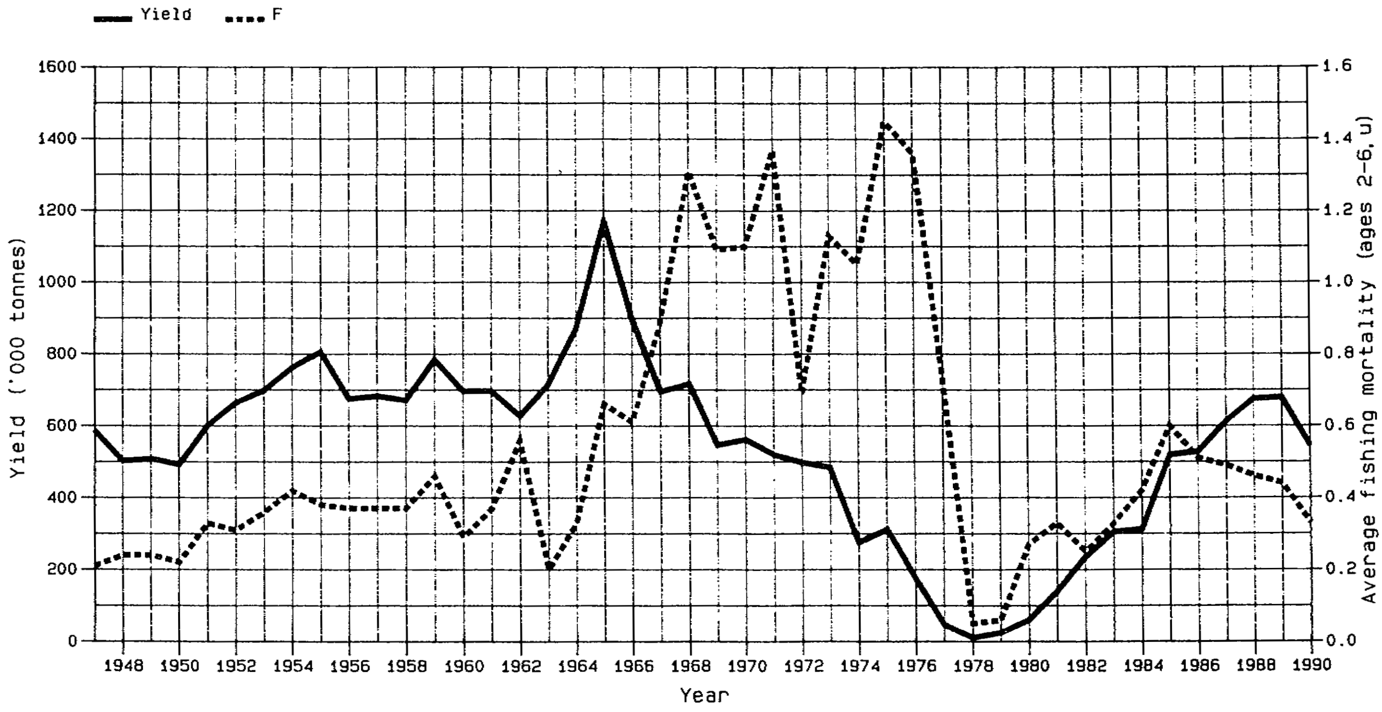
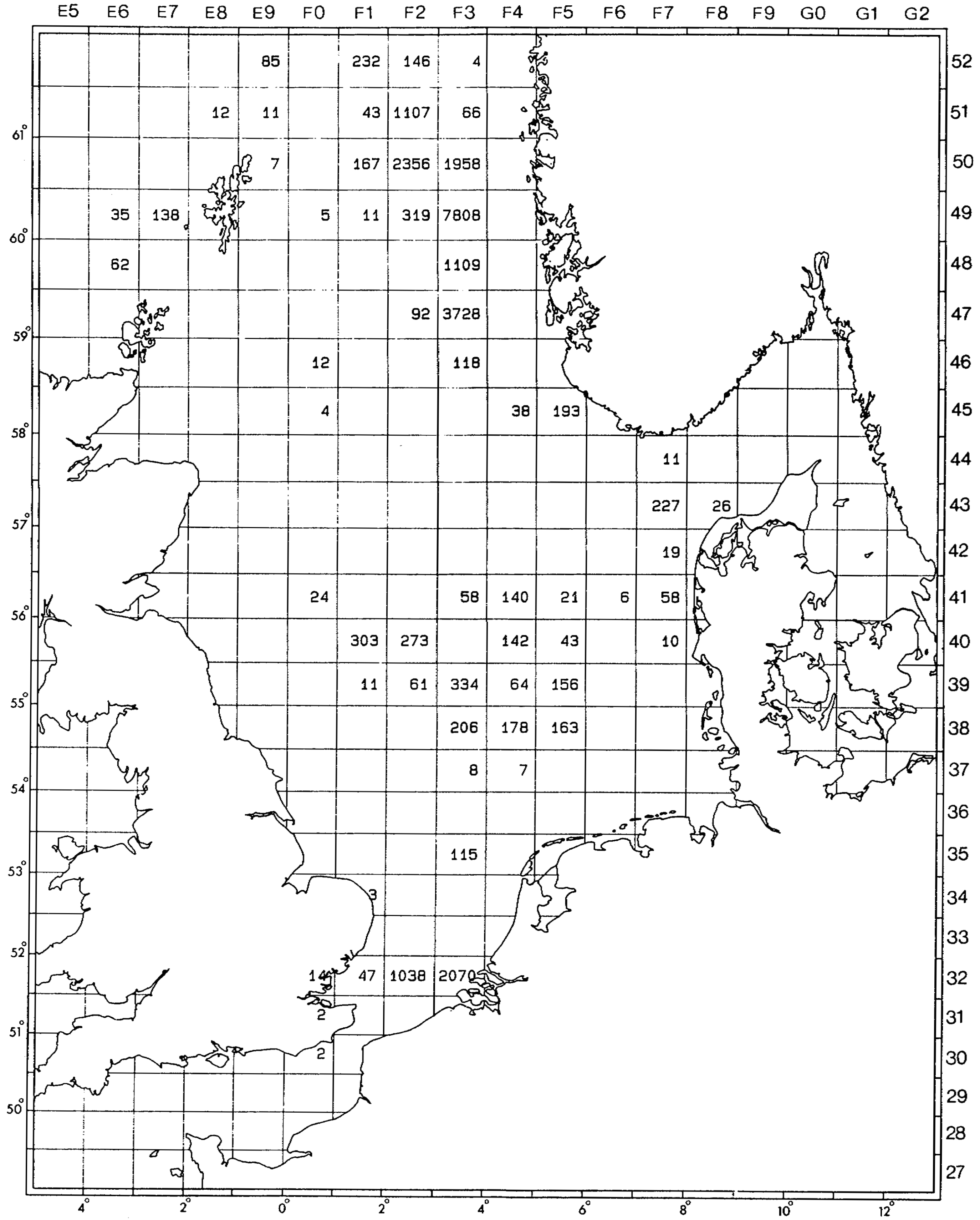
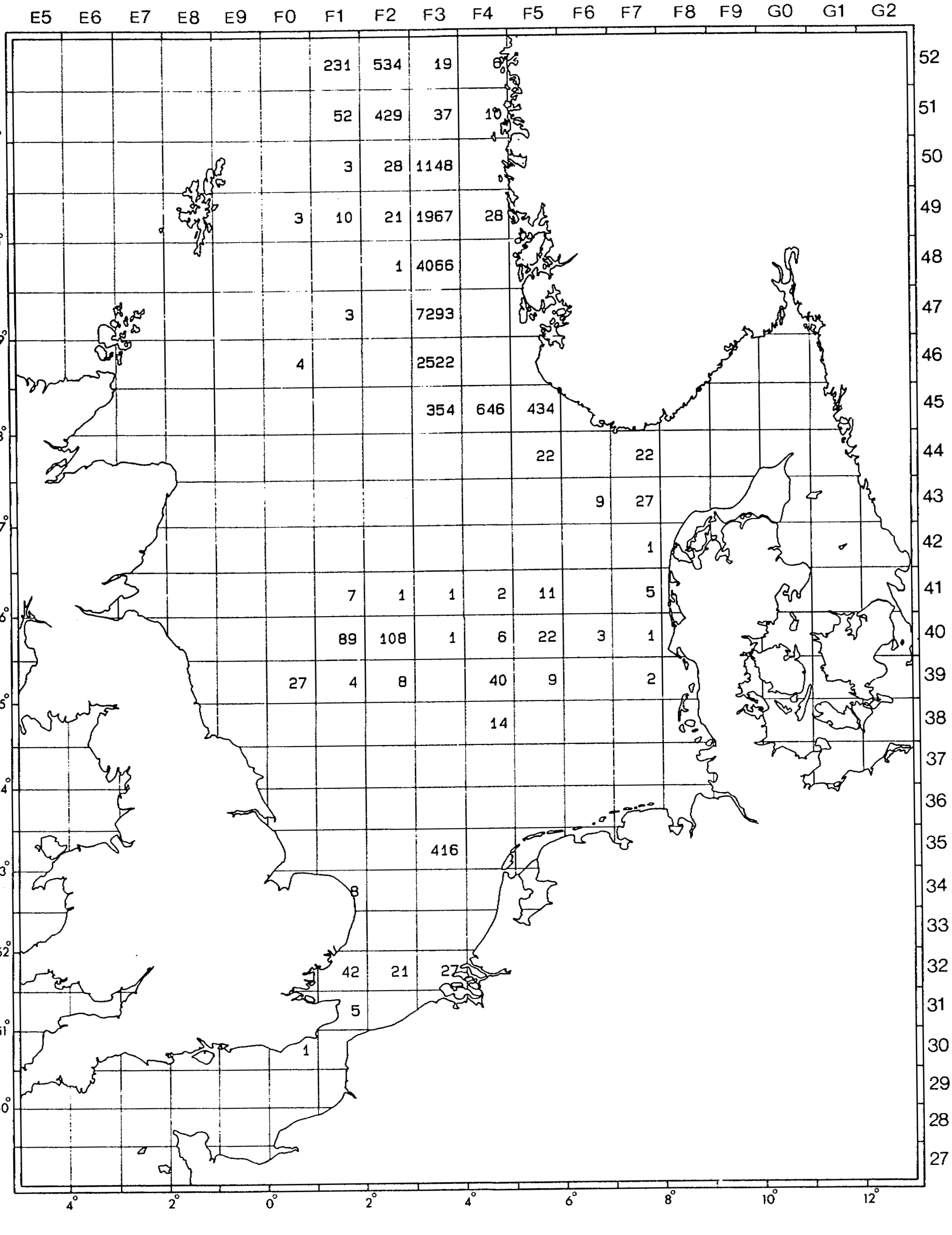


Figure 2.10.1 North Sea catches.



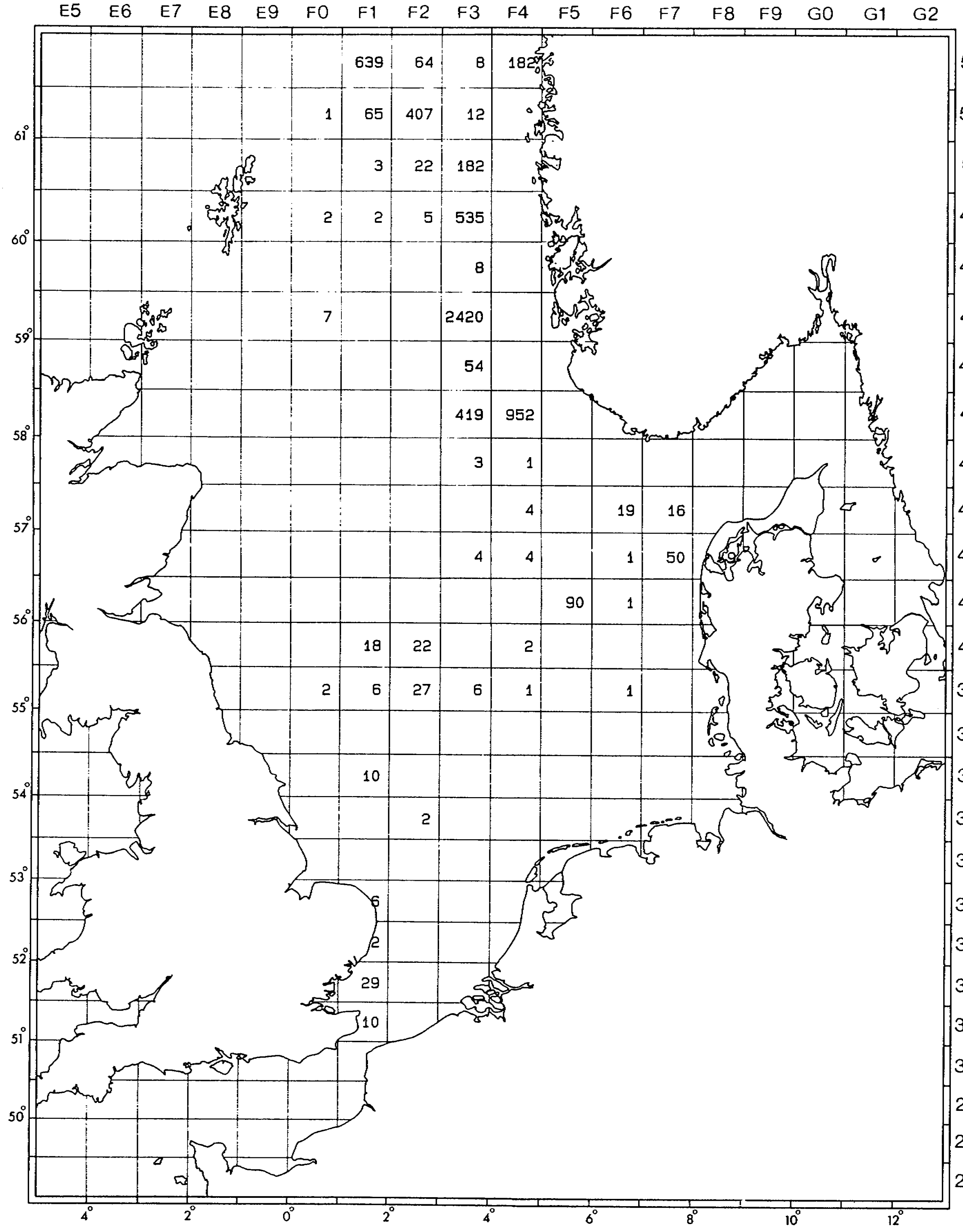
January 1991 - 25 706 tonnes.

Figure 2.10.2 North Sea catches.



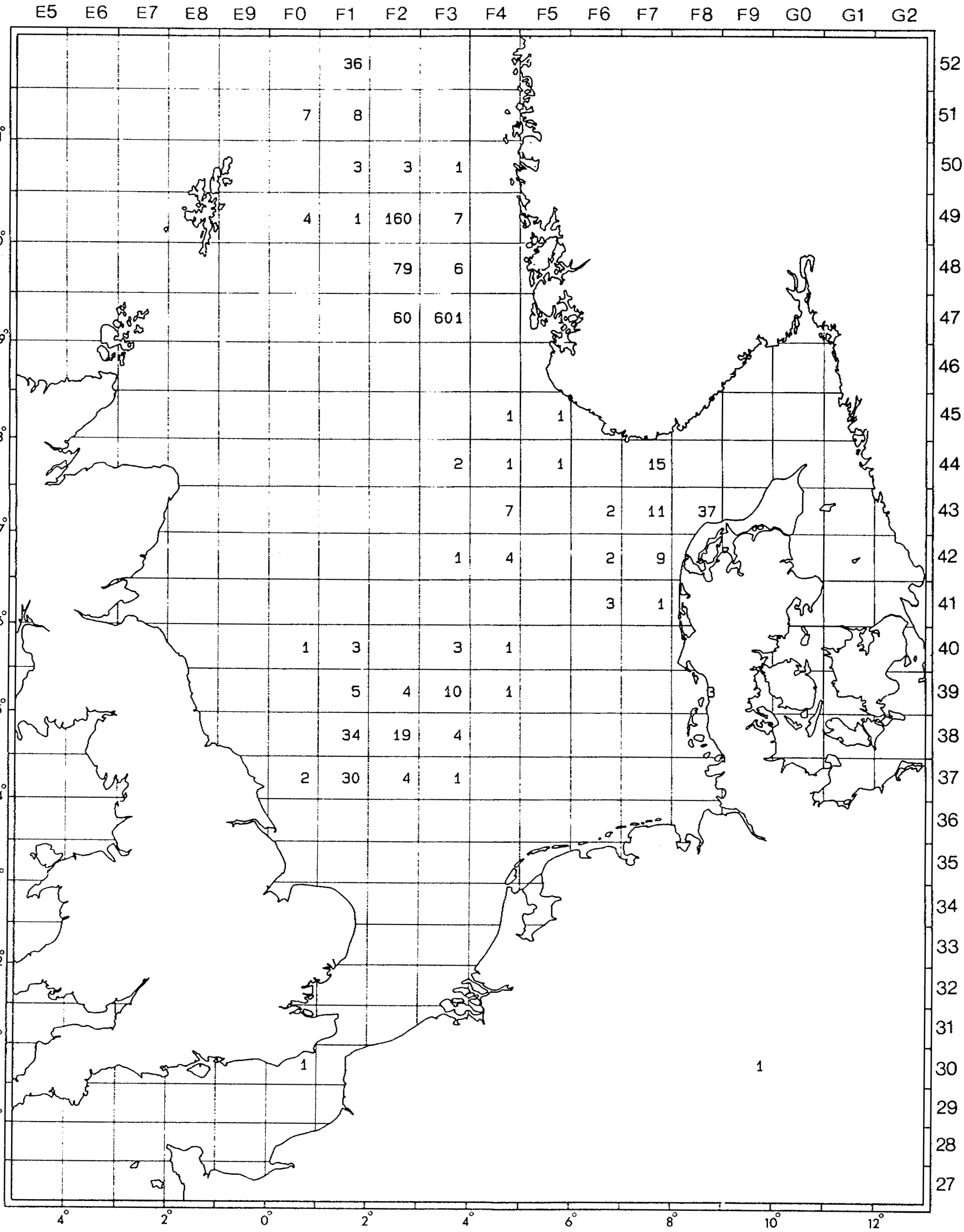
February 1991 - 20 811 tonnes.

Figure 2.10.3 North Sea catches.



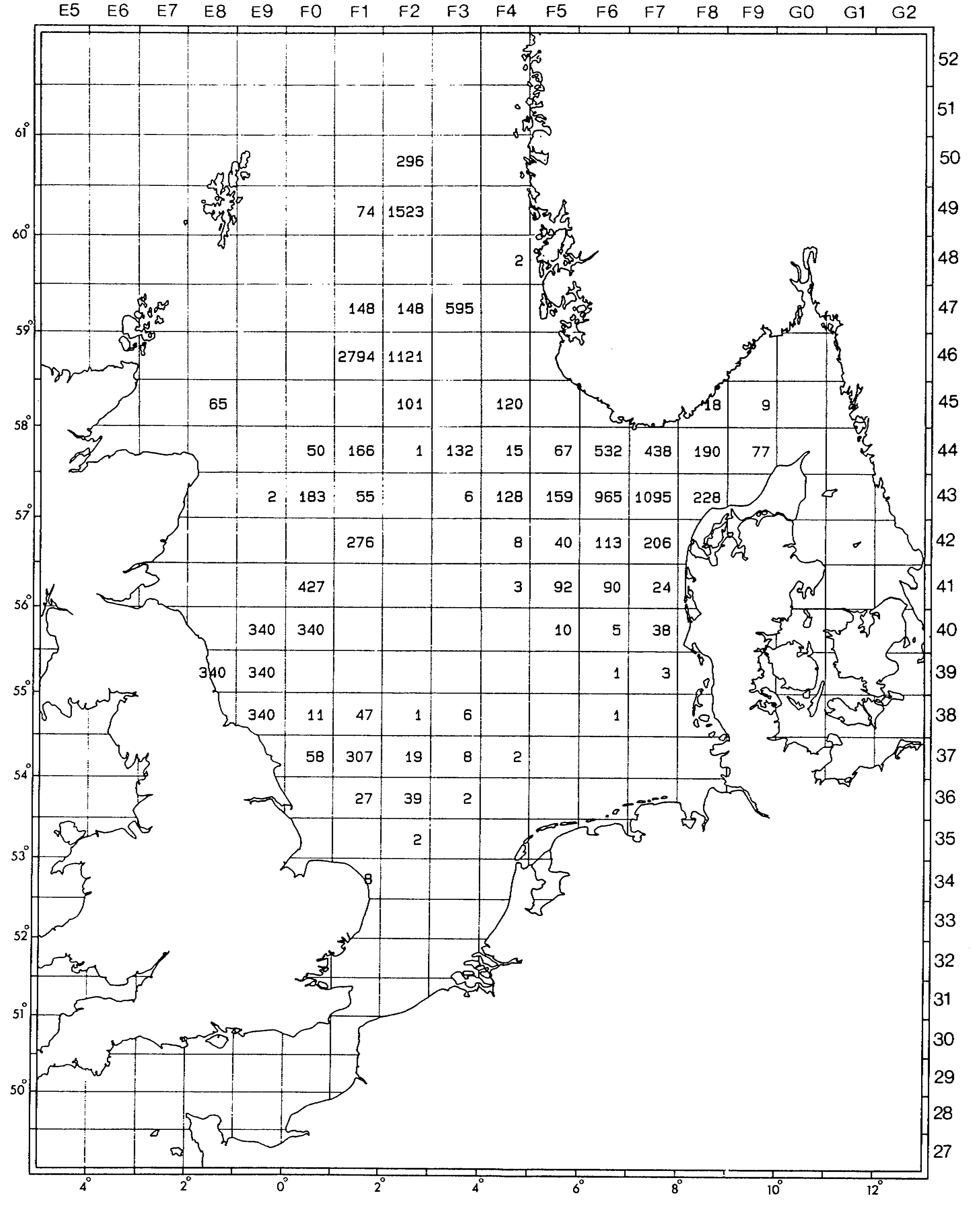
March 1991 - 6 335 tonnes.

Figure 2.10.4 North Sea catches.



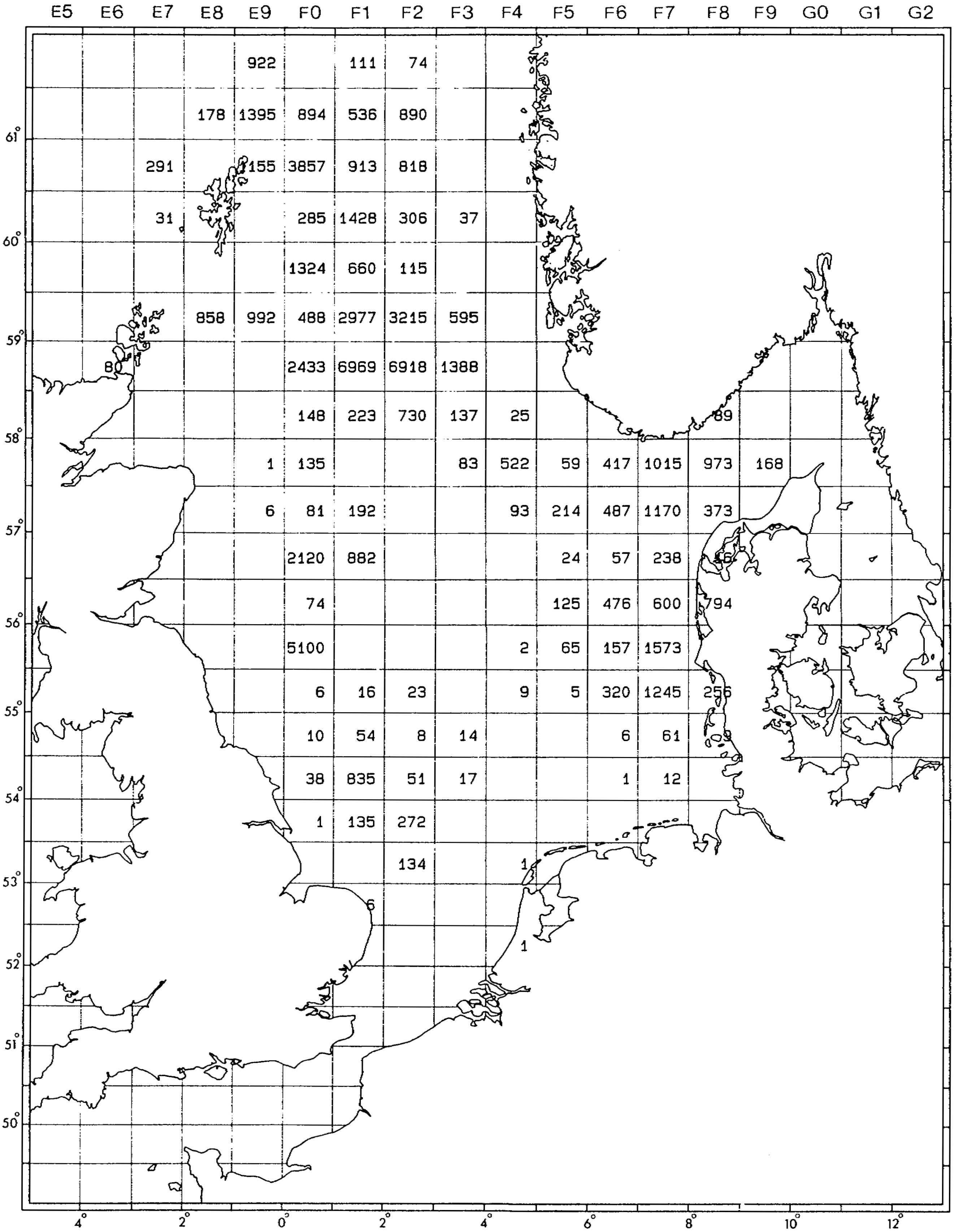
April 1991 - 1 202 tonnes.

Figure 2.10.5 North Sea catches.



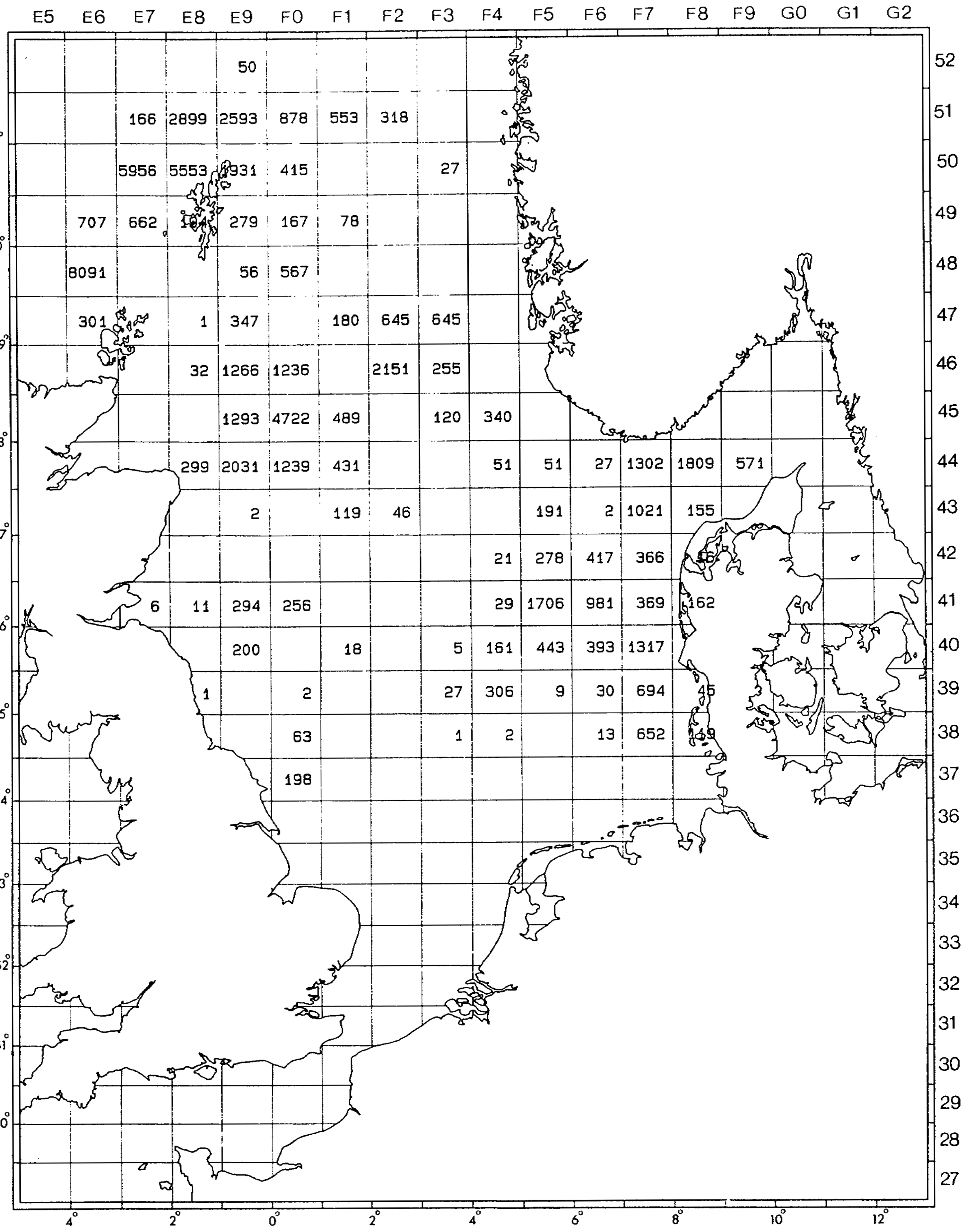
May 1991 - 14 991 tonnes.

Figure 2.10.6 North Sea catches.



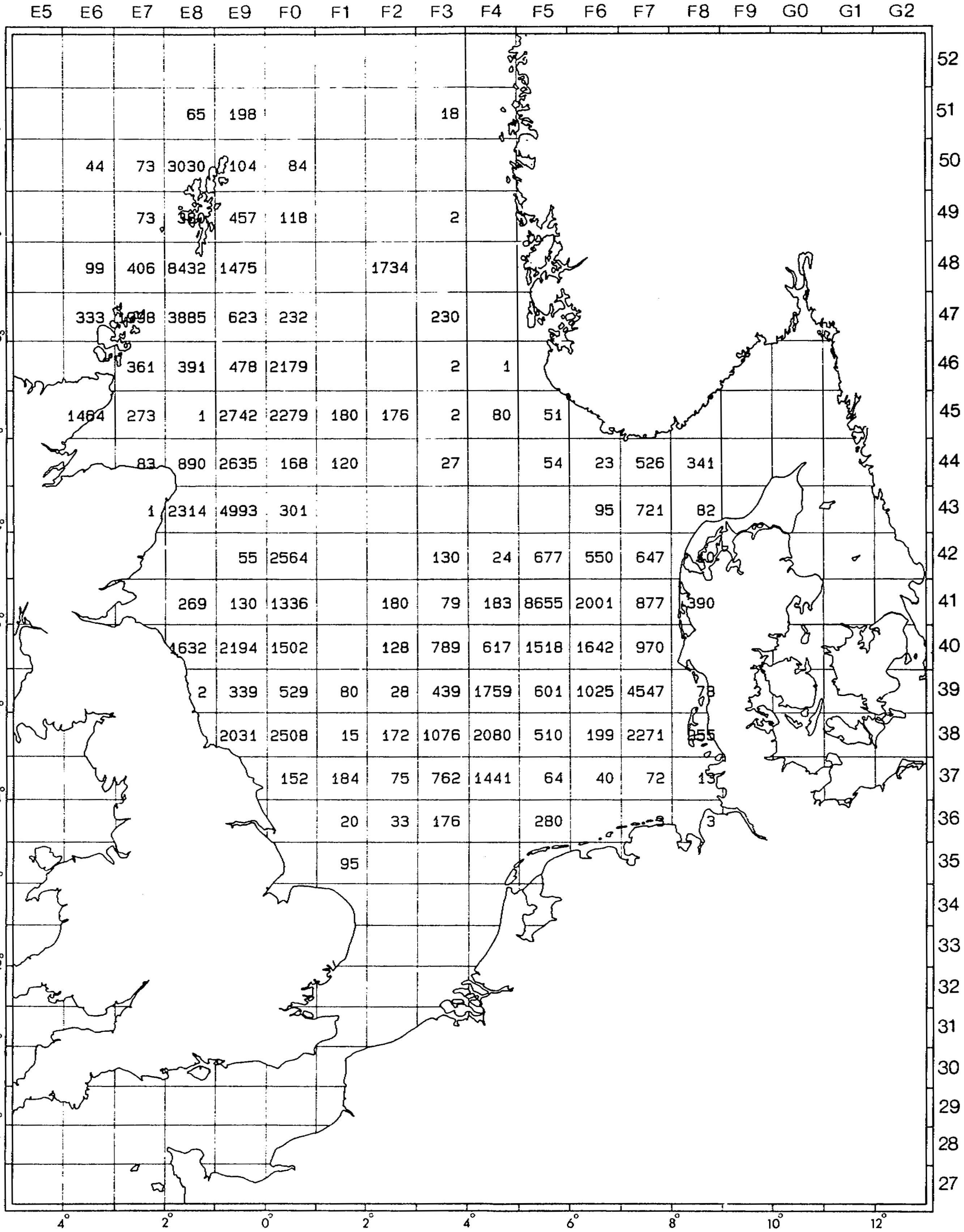
June 1991 - 66 323 tonnes.

Figure 2.10.7 North Sea catches.



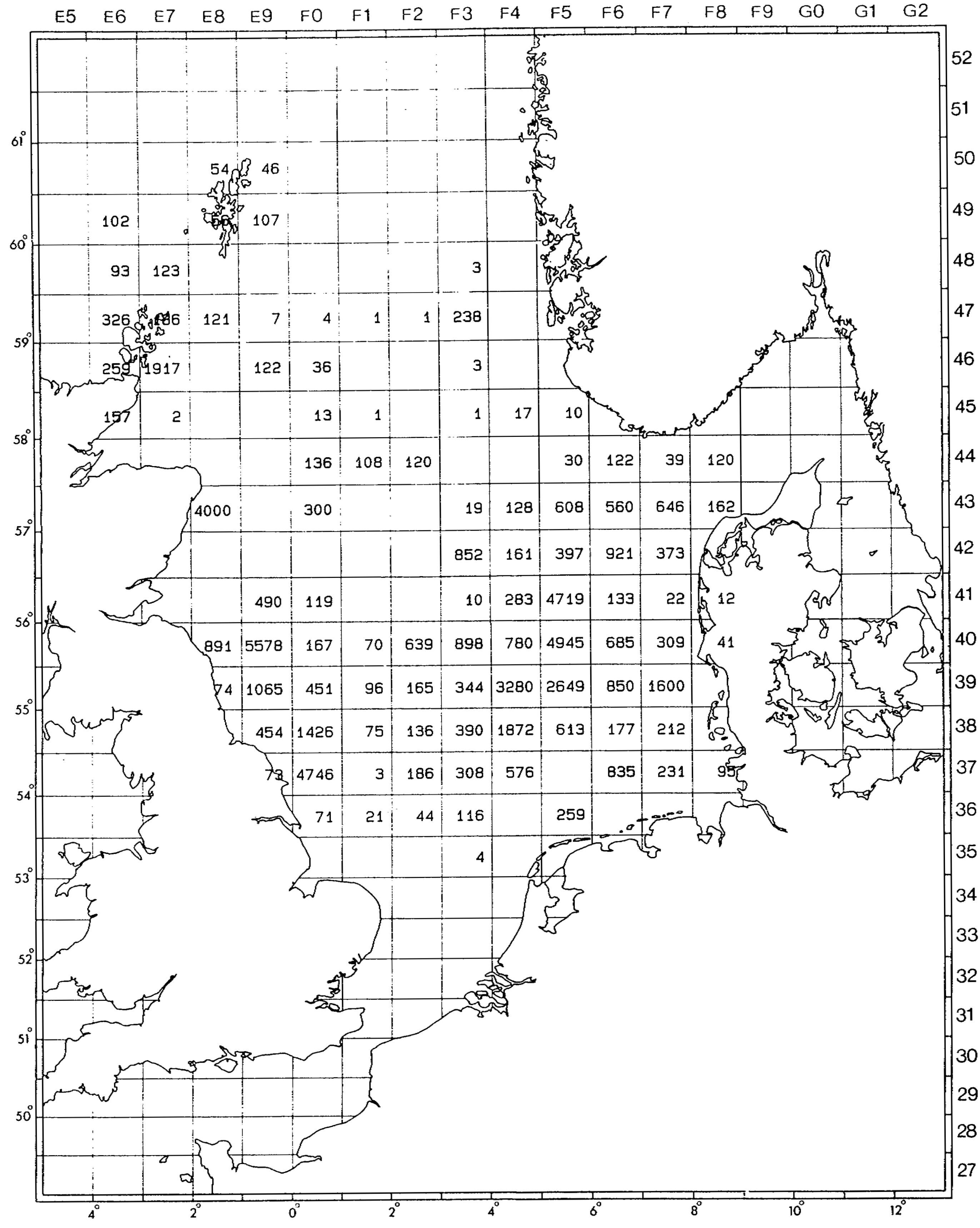
July 1991 - 65 121 tonnes.

Figure 2.10.8 North Sea catches.



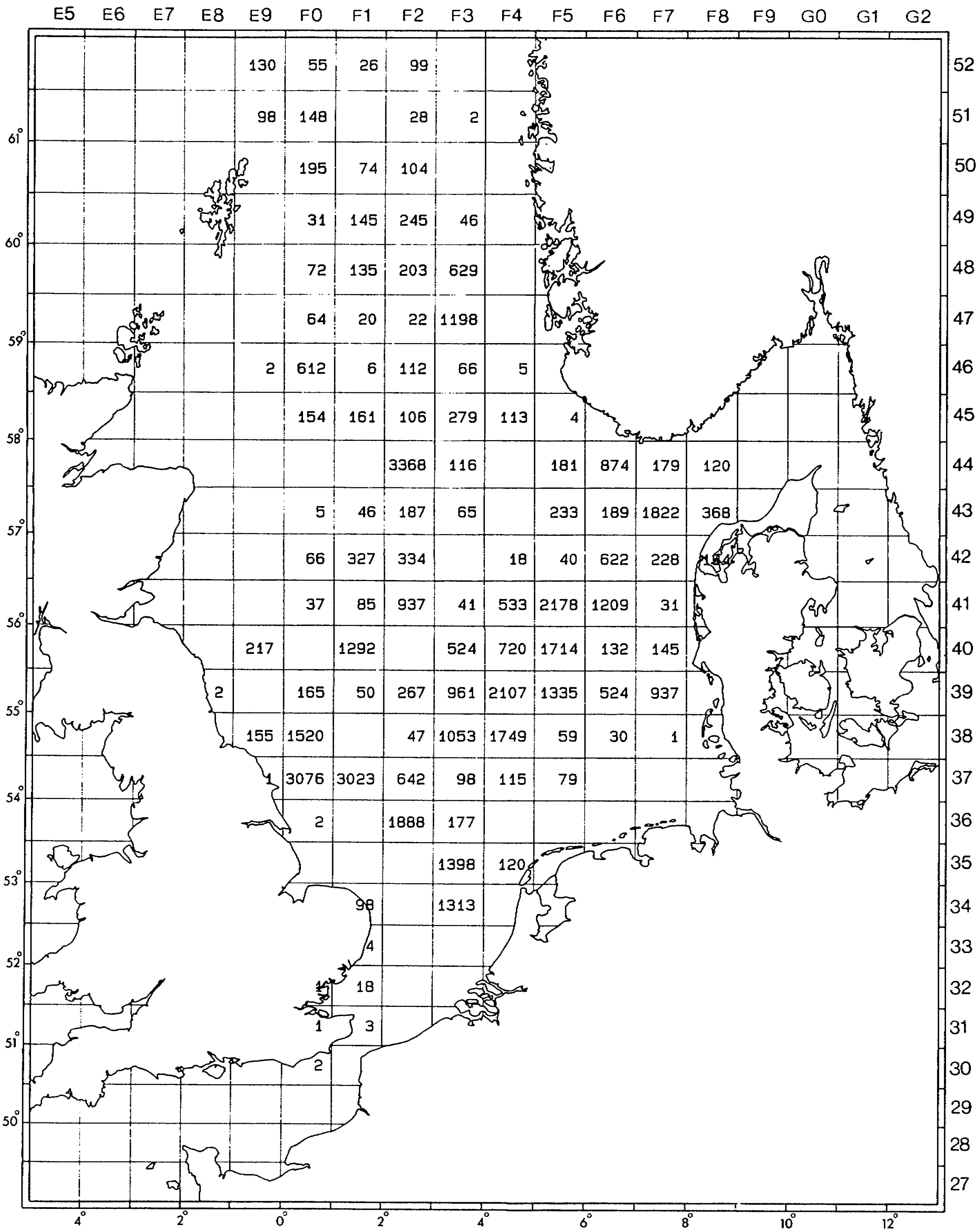
August 1991 - 101 833 tonnes.

Figure 2.10.9 North Sea catches.



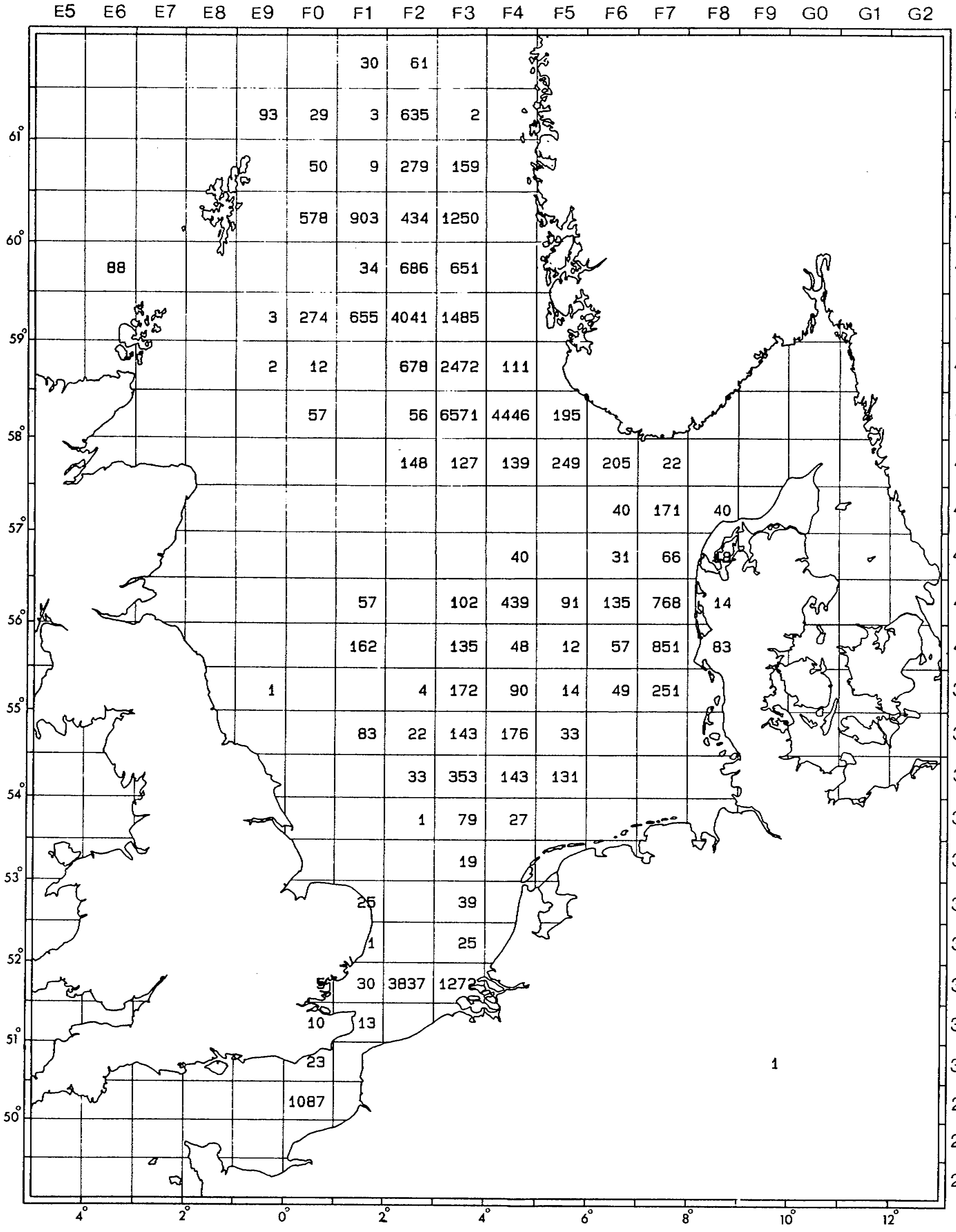
September 1991 - 58 096 tonnes.

Figure 2.10.10 North Sea catches.



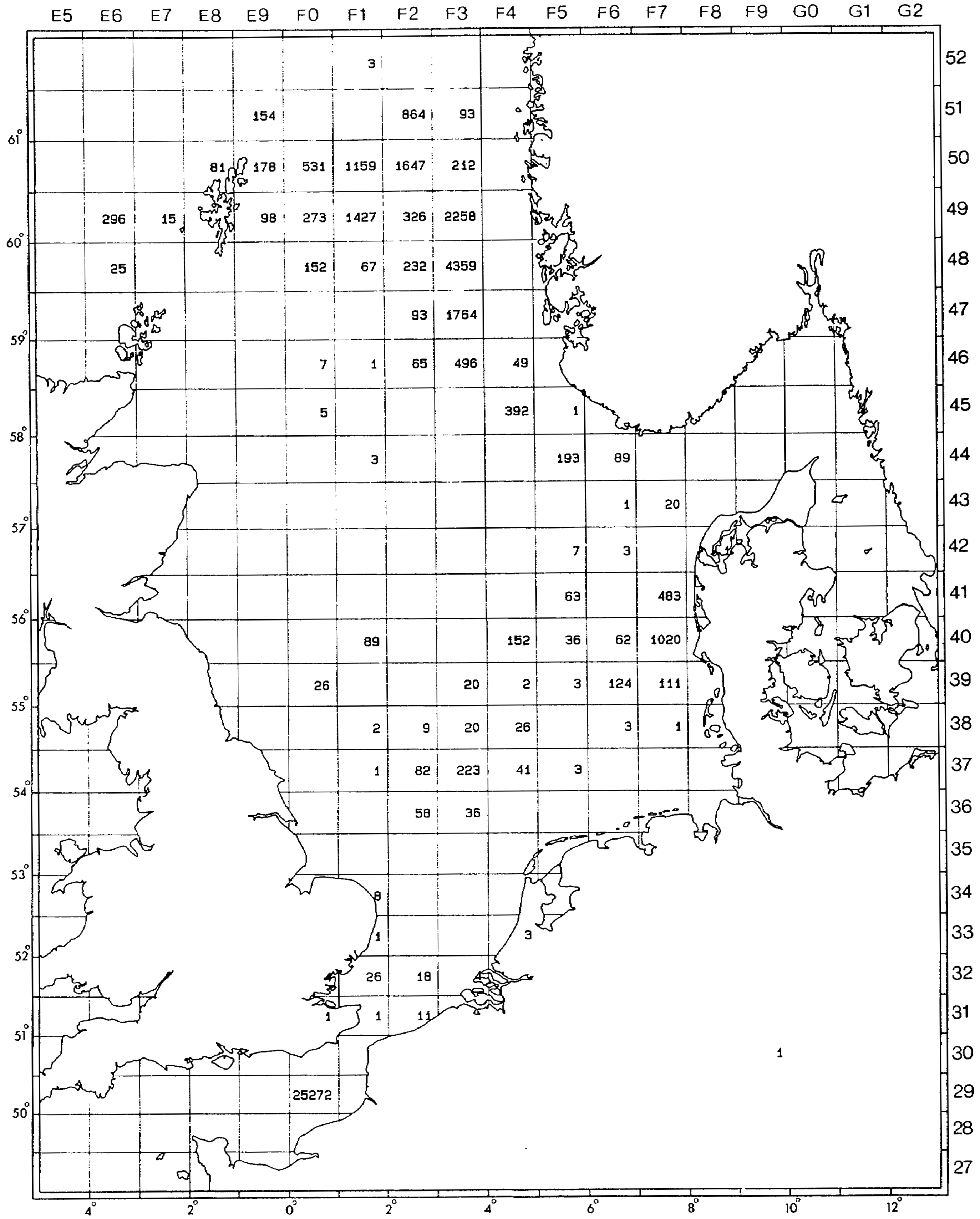
October 1991 - 47 727 tonnes.

Figure 2.10.11 North Sea catches.



November 1991 - 39 474 tonnes.

Figure 2.10.12 North Sea catches.



December 1991 - 45 686 tonnes.

FIGURE 2.10.13 NORTH SEA HERRING

Cumulative catch by month

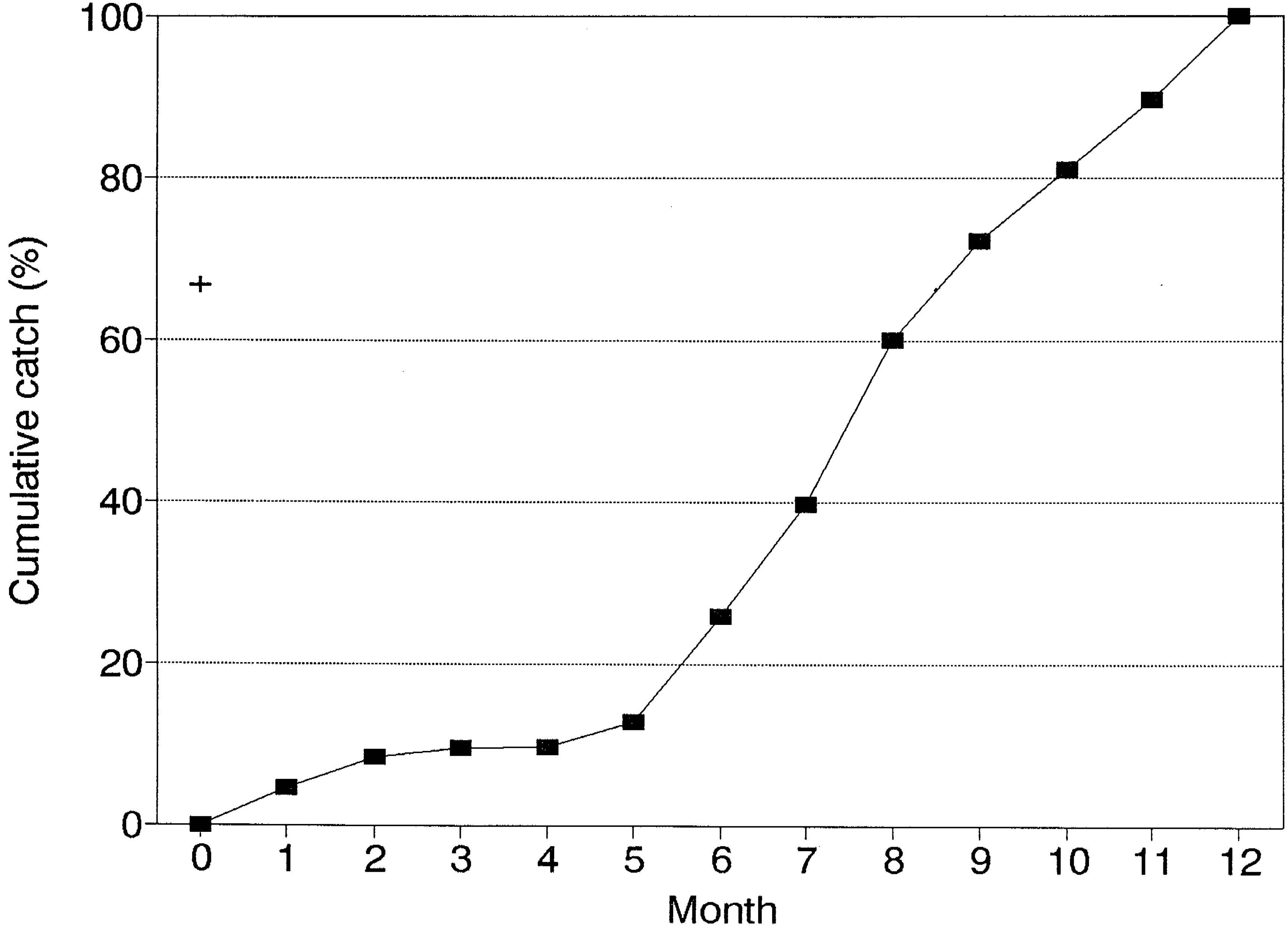
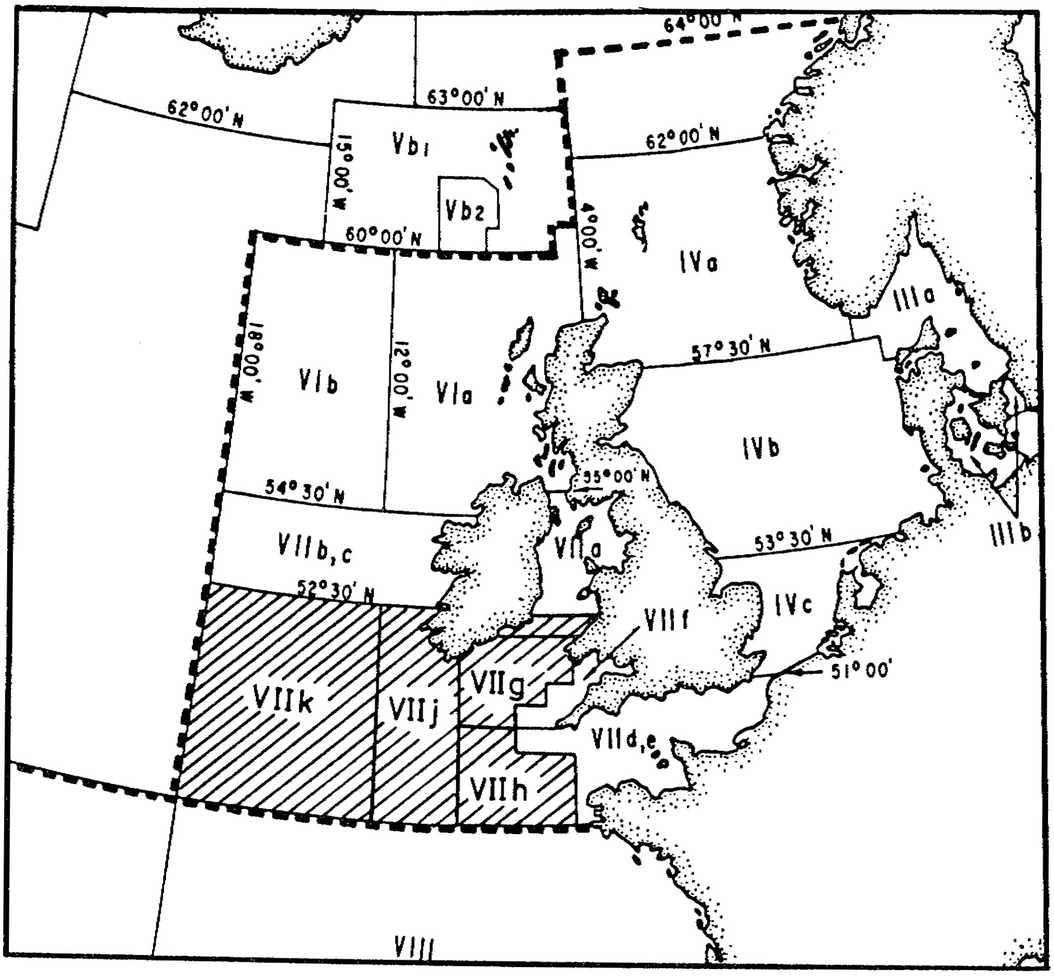


Figure 4.1.1 The assessment covers the area Divisions VIIj and VIIg and that part of Division VIIa below 52°30. TAC is set by EC for Divisions VIIg-k and that section of Division VIIa below 52°30.



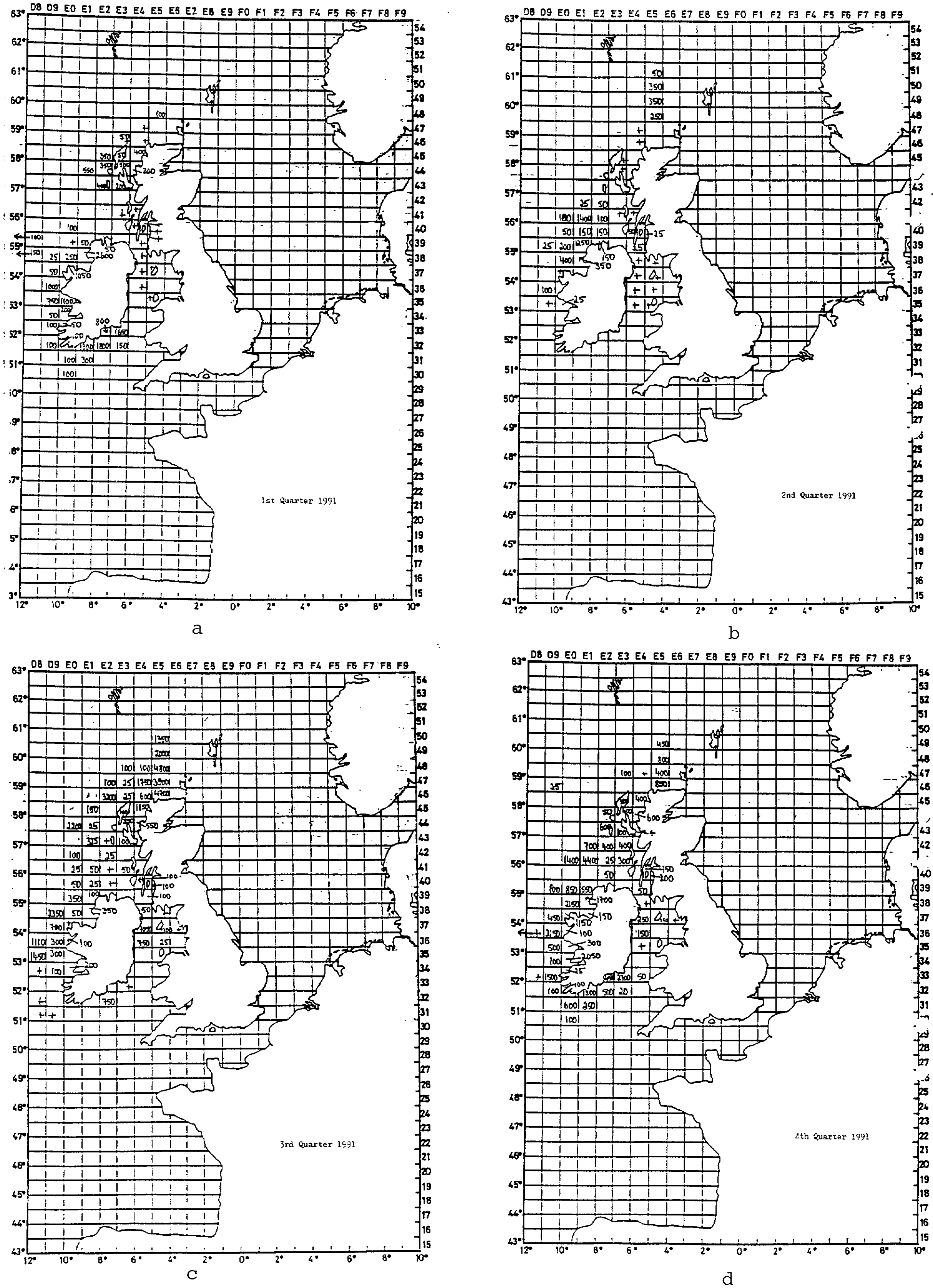


Figure 4.2.1a-d Reported distribution of catches by quarter for 1991 based on data from Ireland, the Netherlands, Norway, and the UK.

Figure 5.1.1 The natural logarithms of the mean-catch rate of 2-ringers in statistical rectangles 46E4-E6, 47E4-E6, 44E3-E4 during the March bottom-trawl survey, plotted against VPA estimates of 2-ringer abundance. Years refer to year classes.

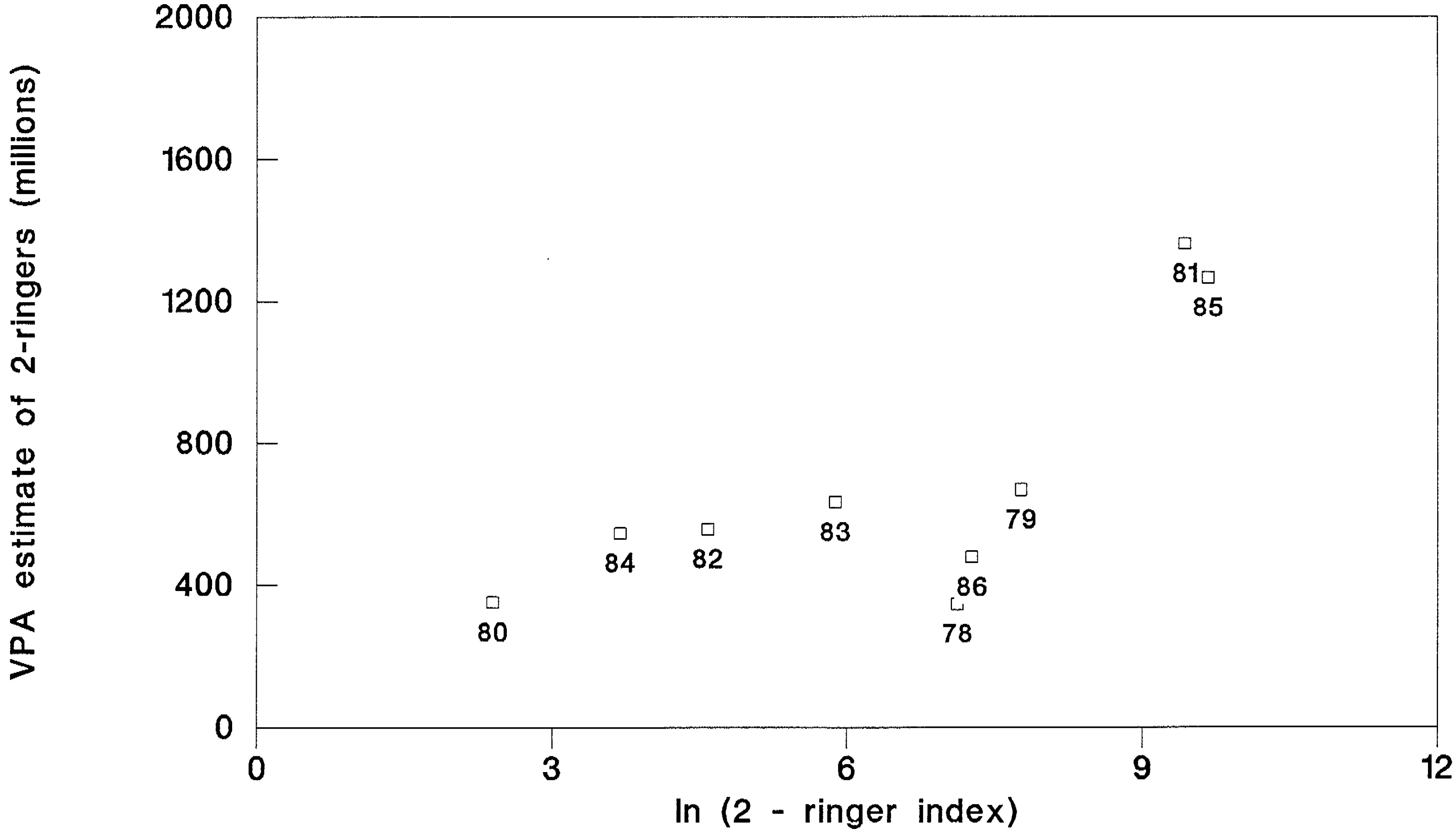


Figure 5.1.2 The relation between LAI and SSB from 1973-1987. The line is based on the regression fitted by RCT3.

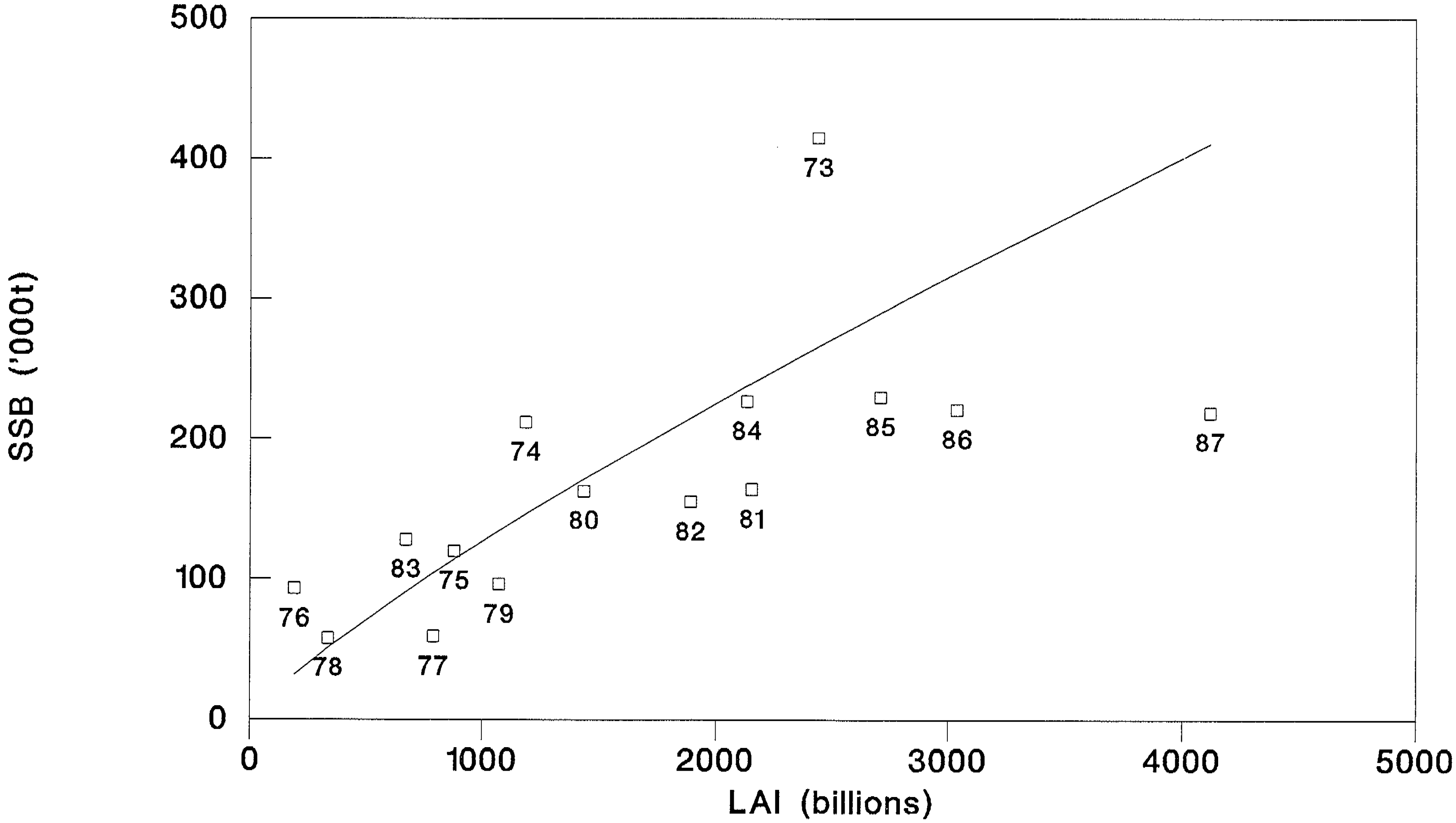


Figure 5.1.3 The relation between LPE and SSB from 1973-1987. The line is based on the regression fitted by RCT3.

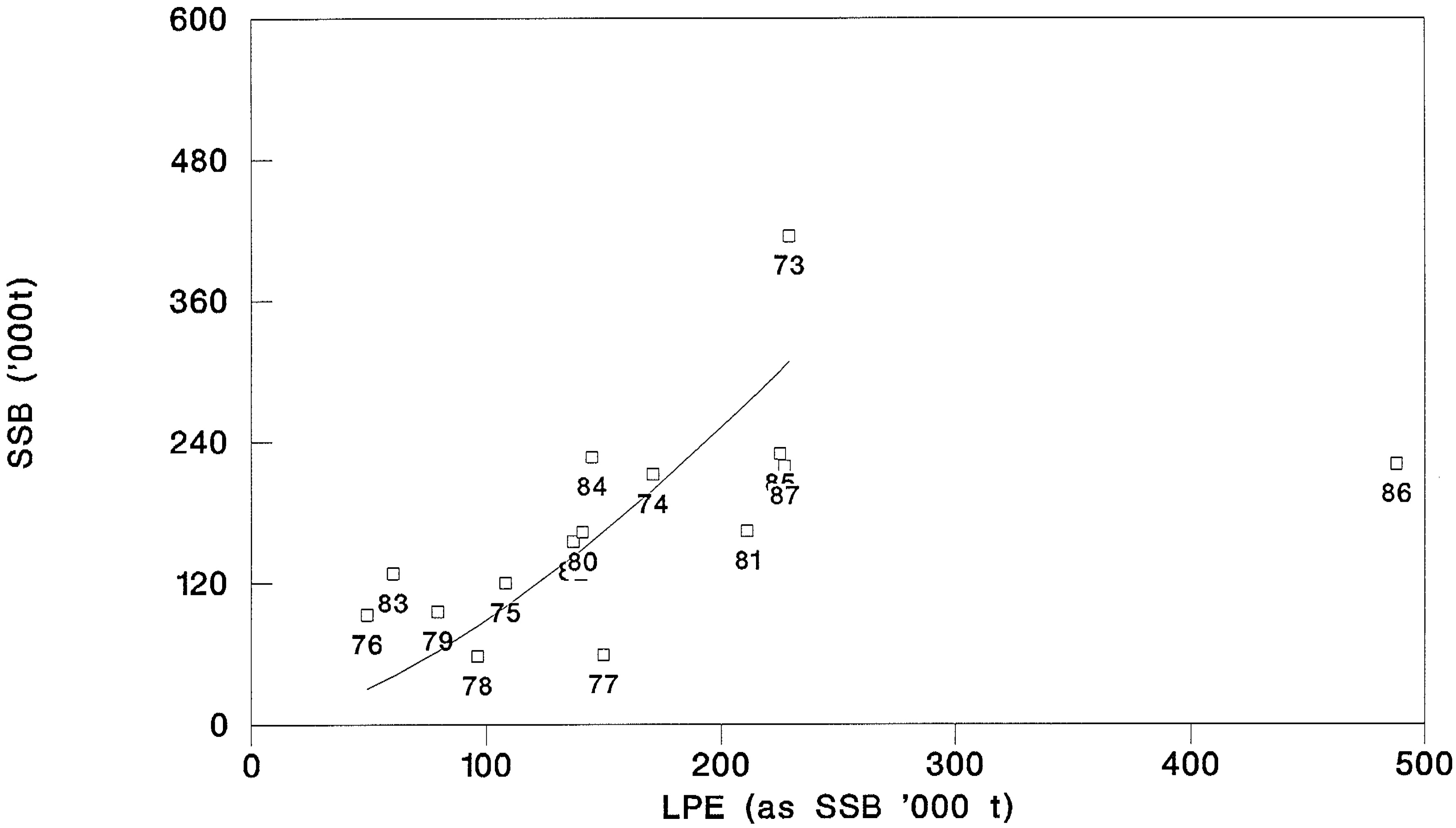


Figure 5.1.4 Sum of squared residuals between VPA estimates of SSB and fishery-independent estimates of SSB at a range of terminal F values.

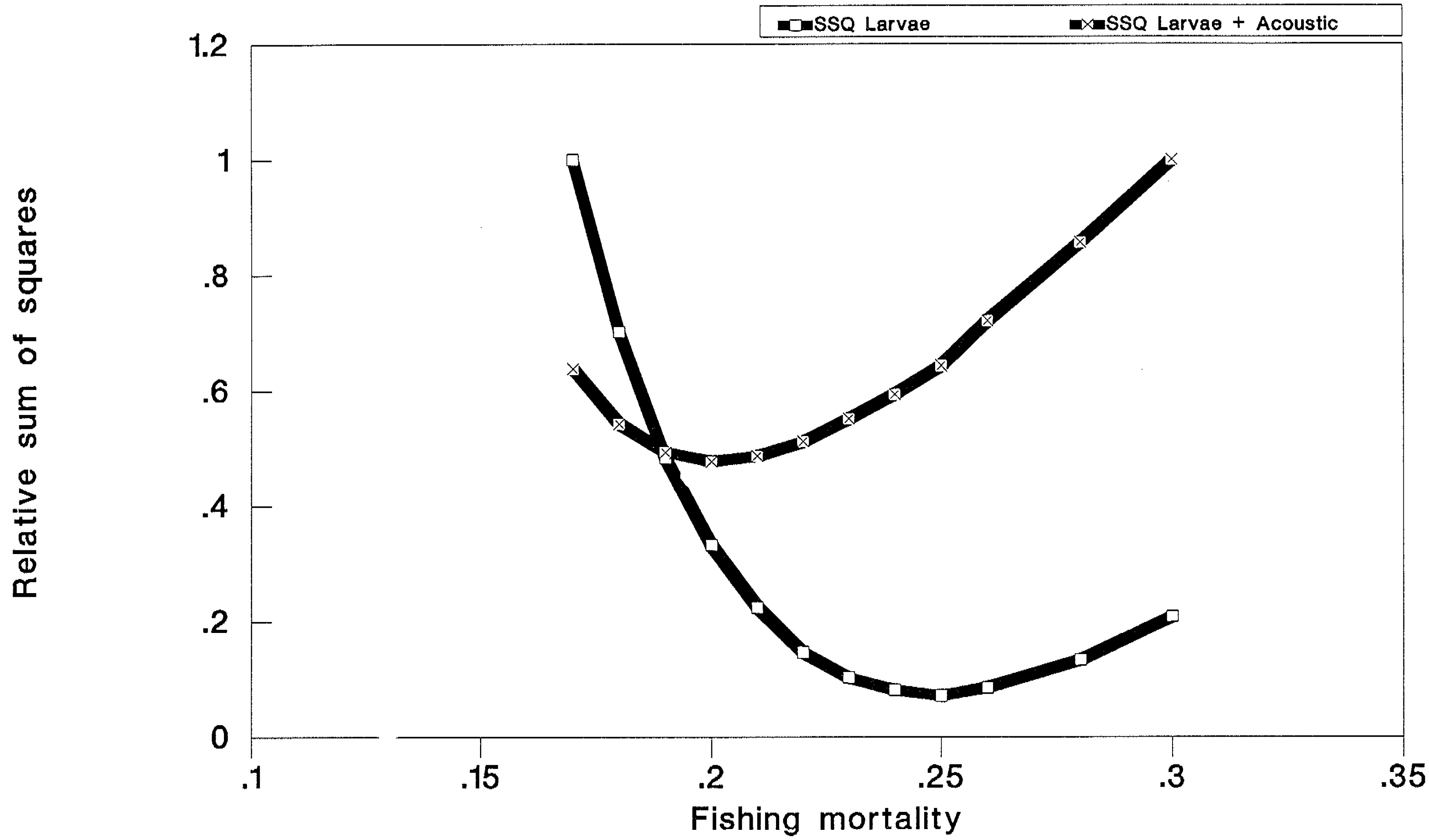


Figure 5.1.5 Trend in SSB estimated by VPA.
A = Terminal F of 0.2 excluding Faroese catches
B = Terminal F of 0.25 excluding Faroese catches
C = Terminal F of 0.27 including Faroese catches
D = Terminal F of 0.34 including Faroese catches.

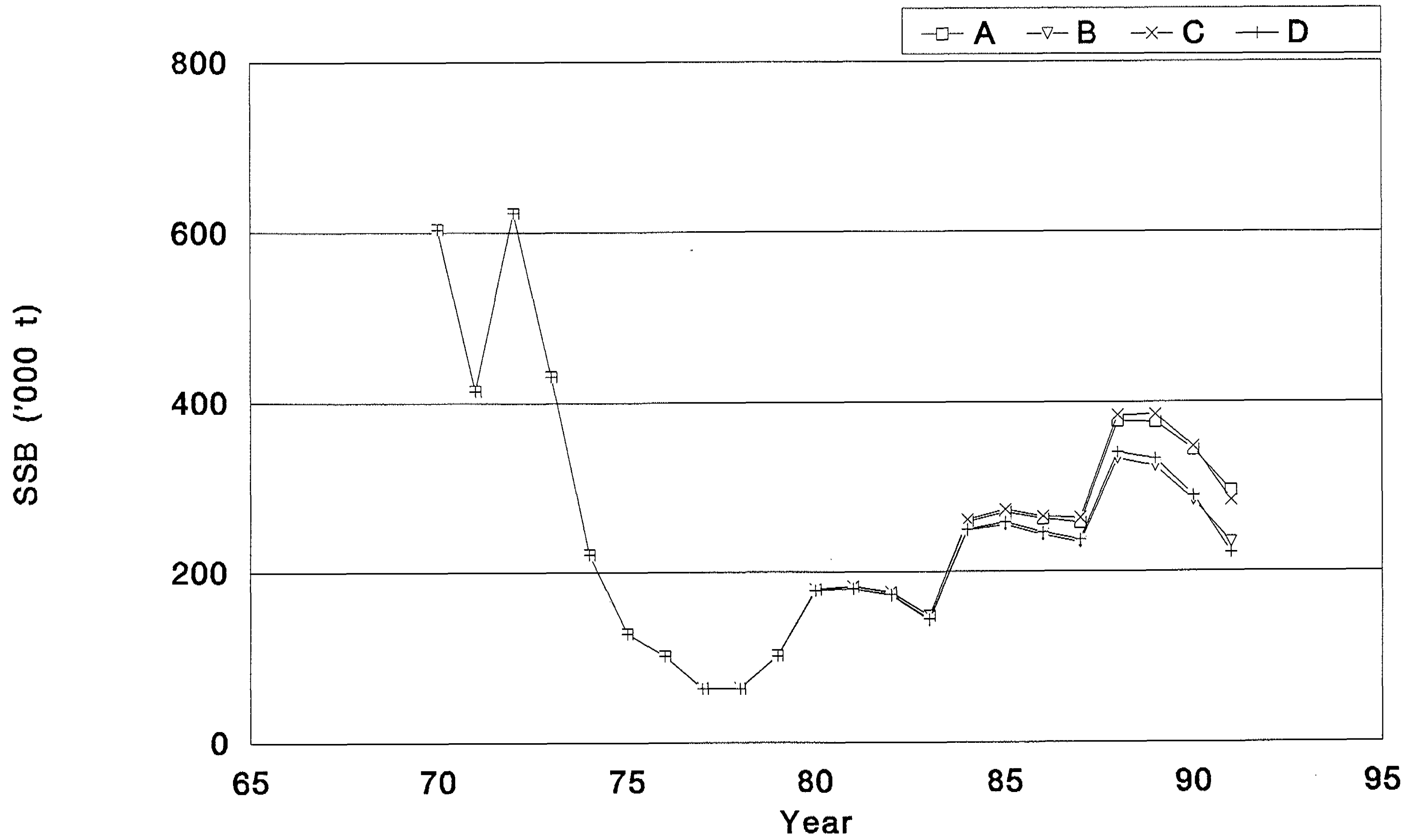
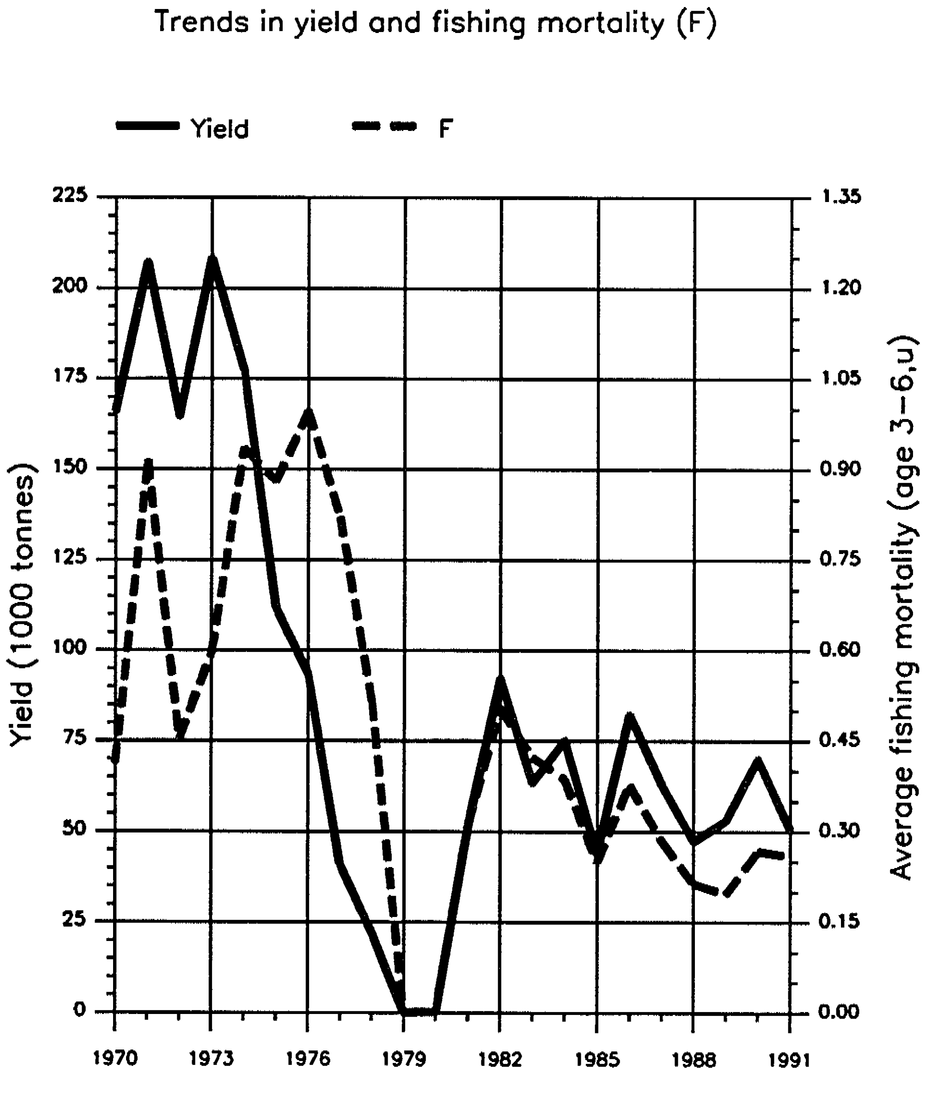
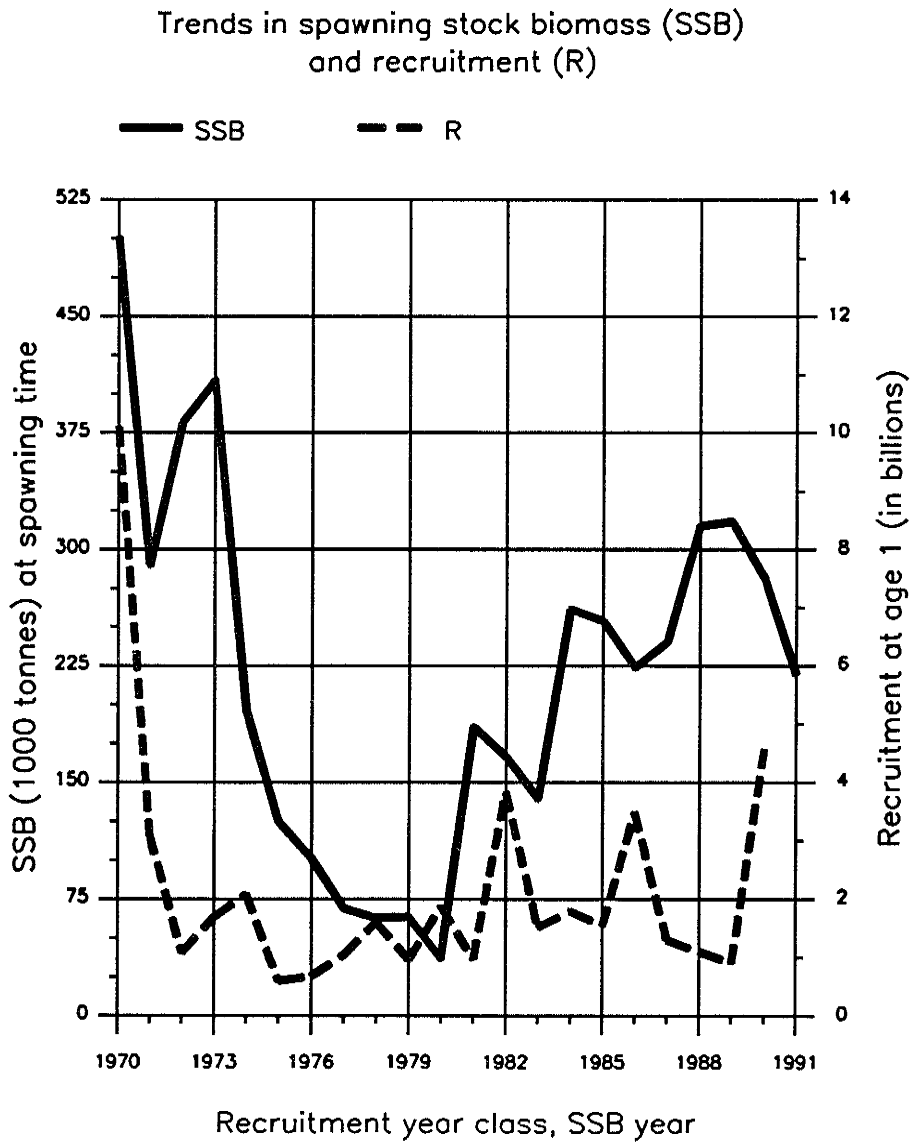


Figure 5.1.6

FISH STOCK SUMMARY
STOCK: Herring in the Northern part of VIa
3—4—1992

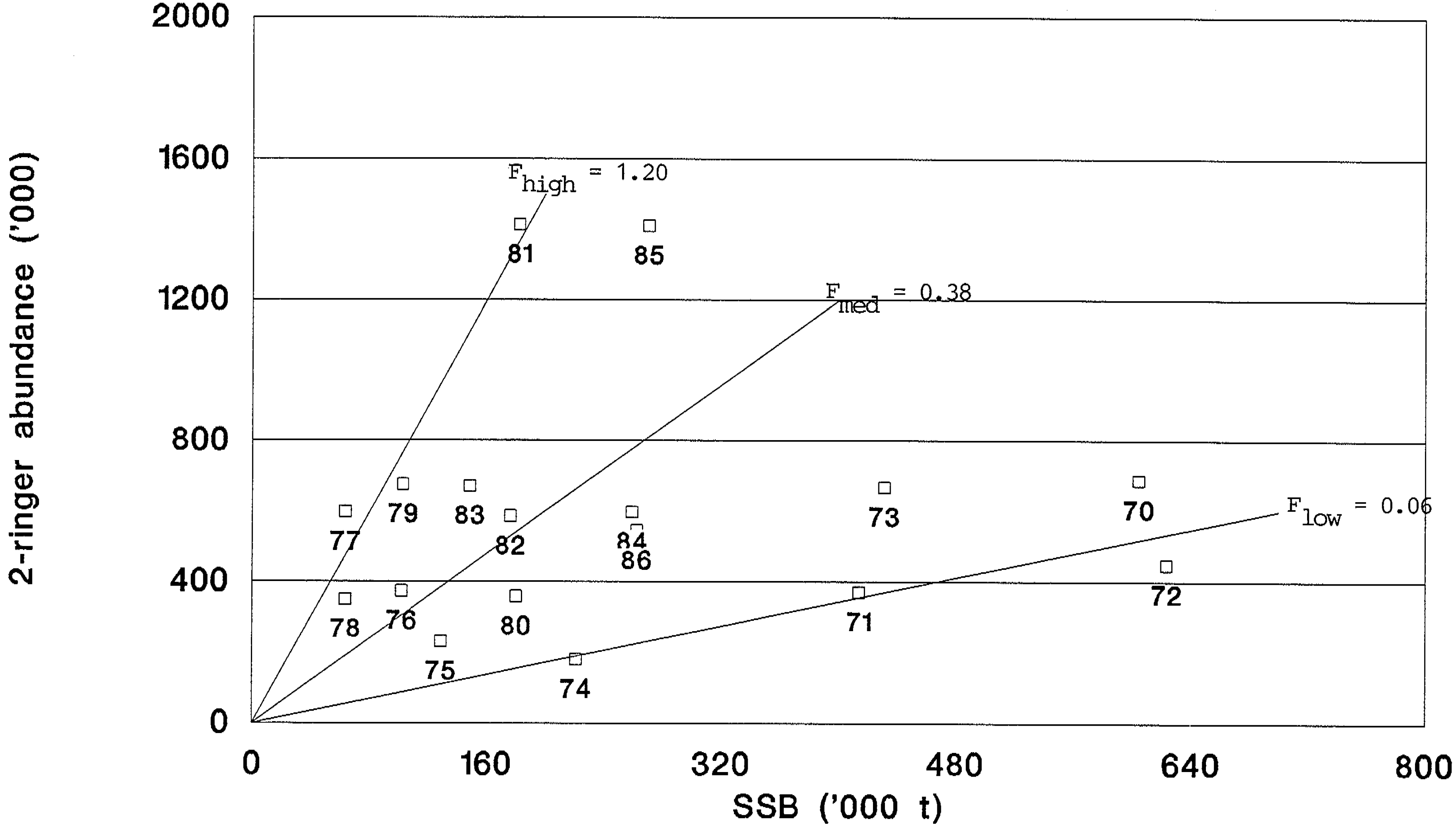


A



B

Figure 5.1.7



2-ringer abundance ('000)
2000
1600
1200
800
400
0
0
160
320
480
640
800
SSB ('000 t)
F_{high} = 1.20
F_{med} = 0.38
F_{low} = 0.06
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86

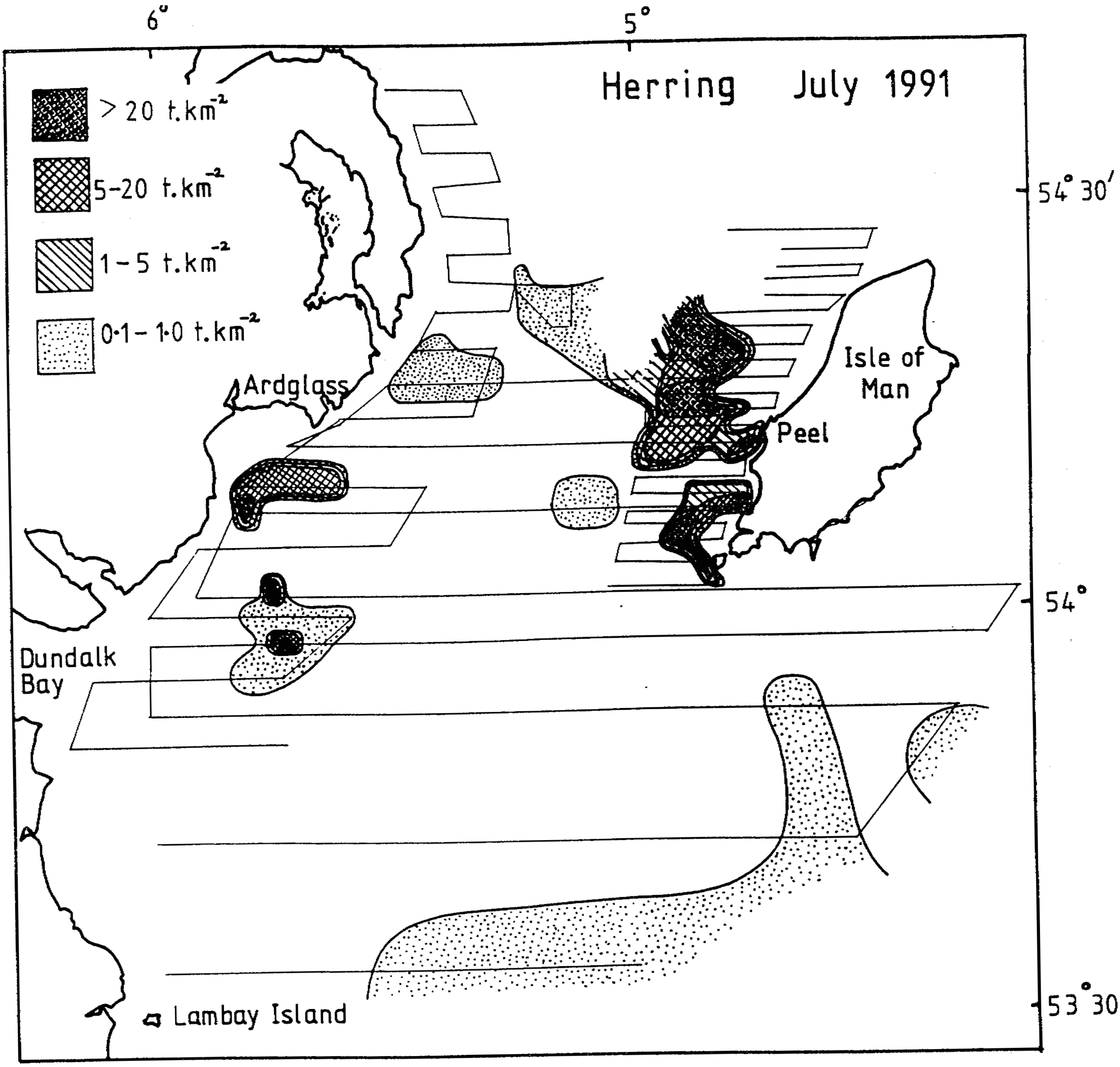
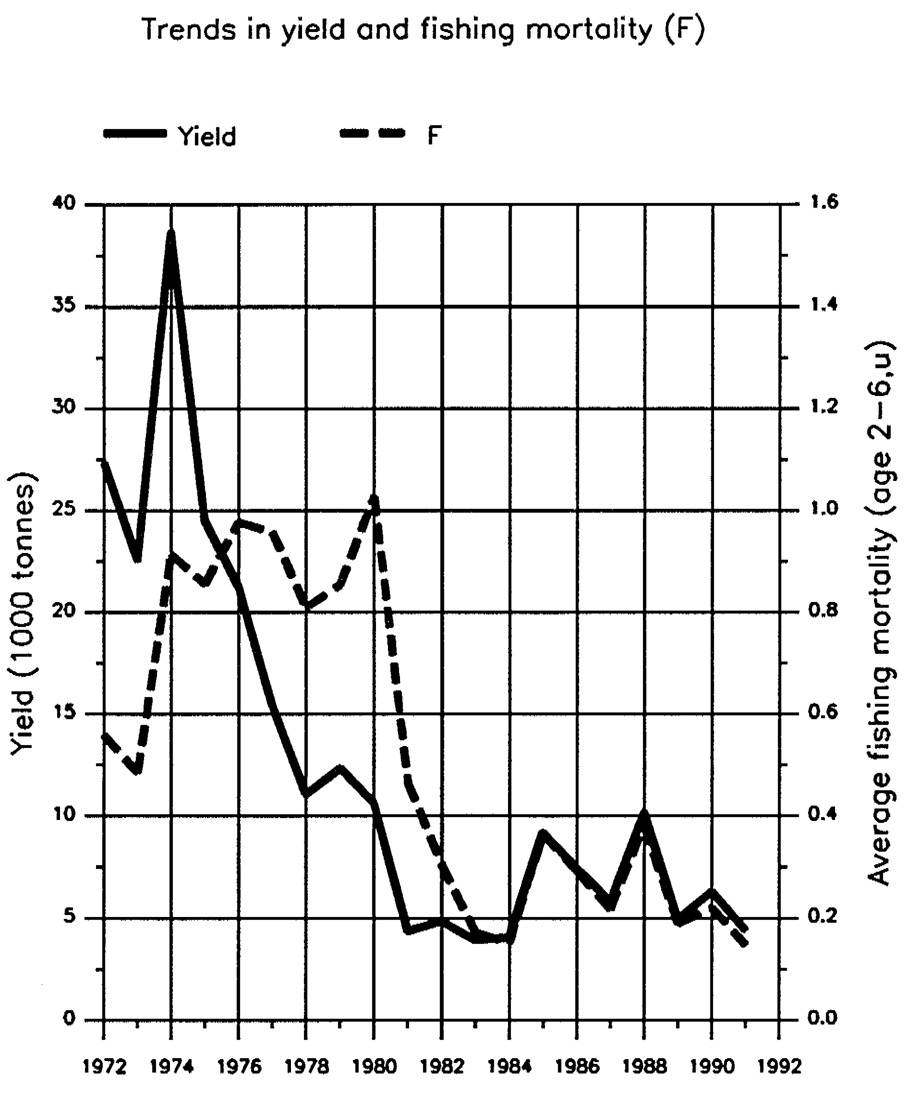


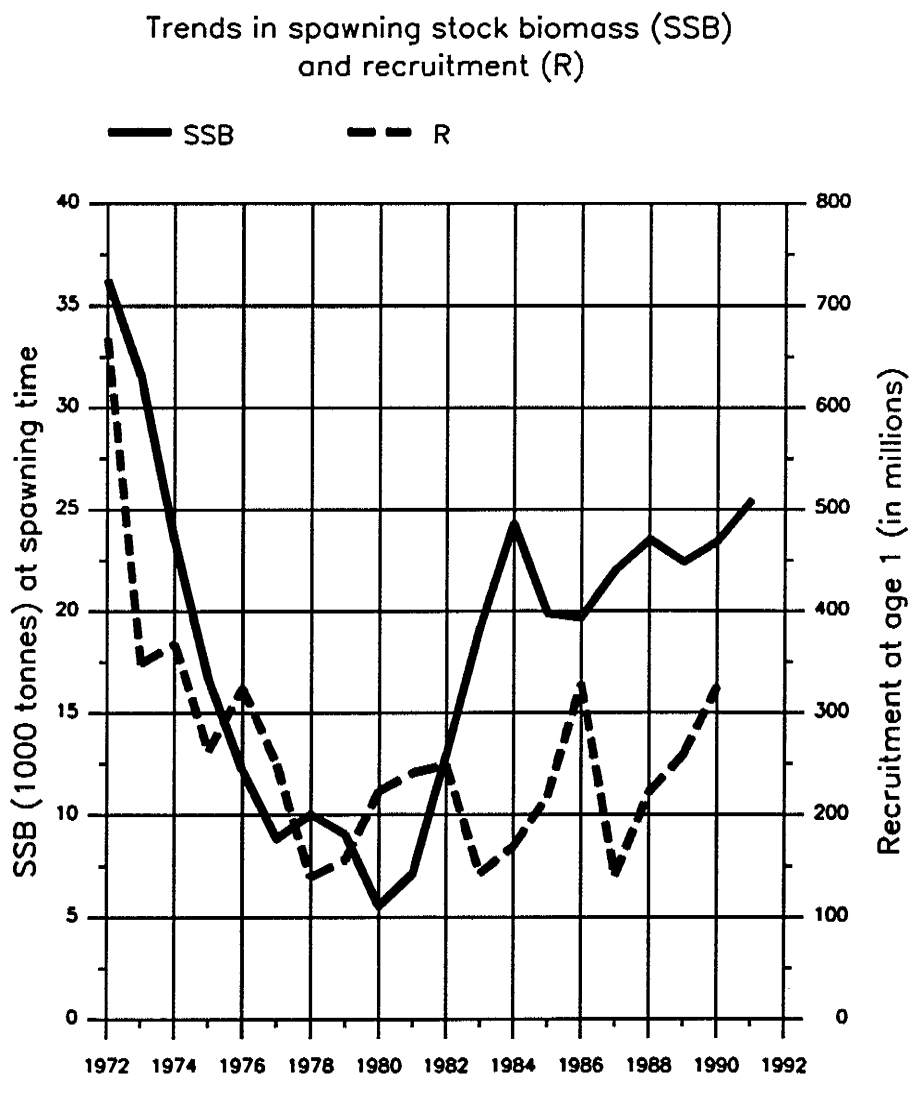
Figure 7.3.1 Density distribution of herring in Division VIIa (North) during the July 1991 acoustic survey.

Figure 7.4.1

FISH STOCK SUMMARY
STOCK: Herring in the North Irish Sea (Manx plus Mourne herring)
5–4–1992



A

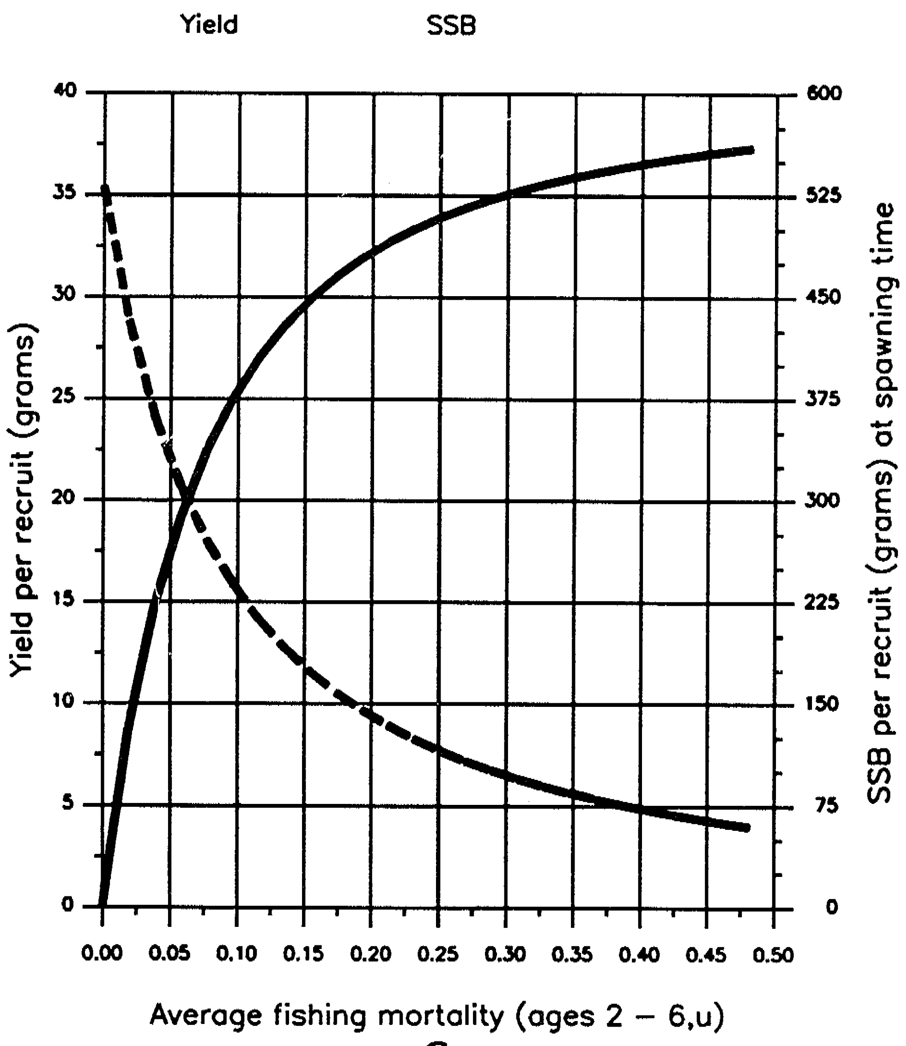


B

Figure 7.4.1 (cont'd)

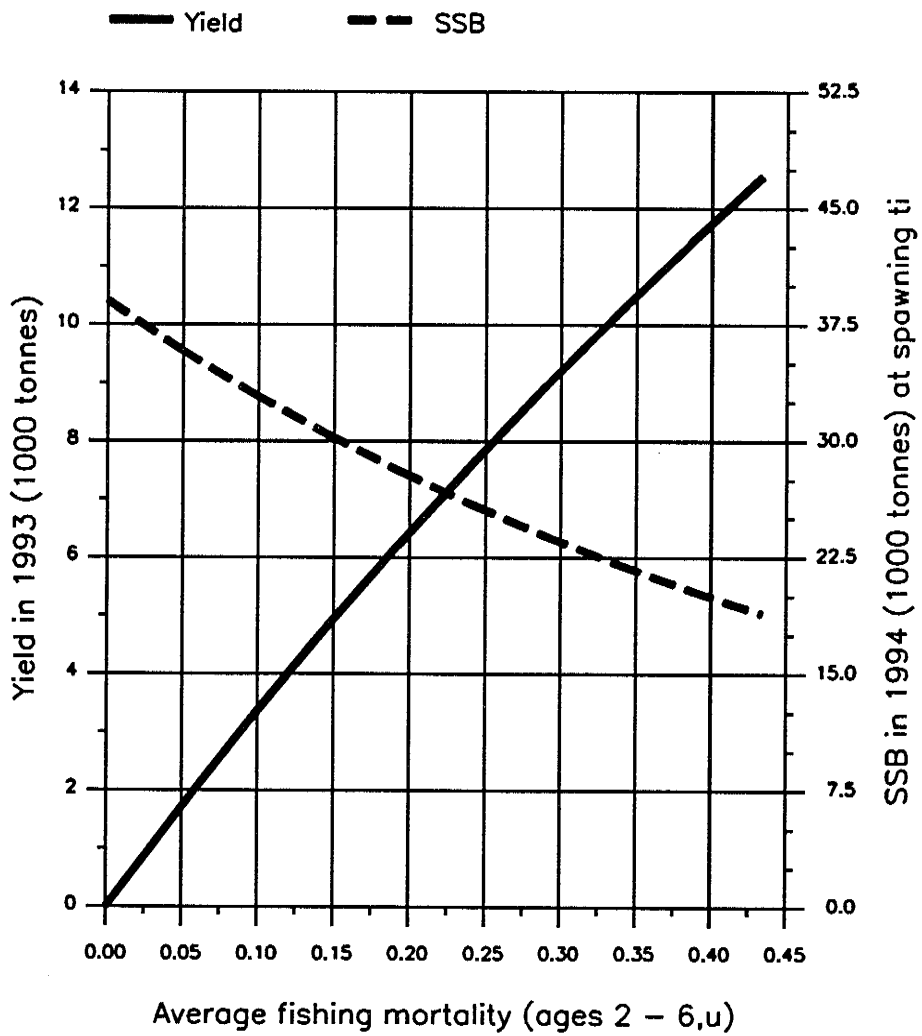
FISH STOCK SUMMARY
STOCK: Herring in the North Irish Sea (Manx plus Mourne herring)
5-4-1992

Long term yield and spawning stock biomass



C

Short-term yield and spawning stock biomass



D

Figure 7.4.2 Spawning stock biomass from VPA with a number of terminal Fs.

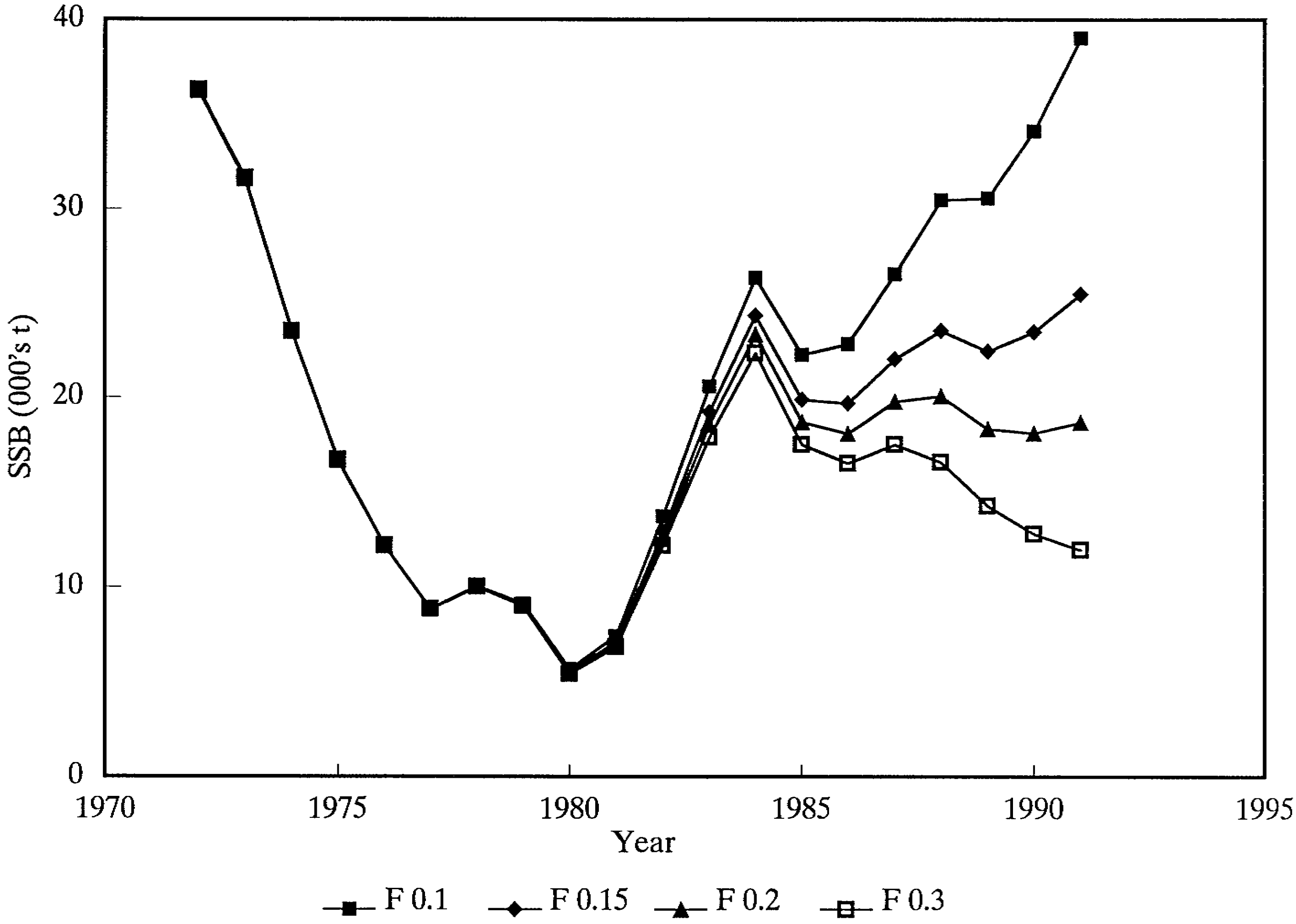


Figure 7.4.3 North Irish Sea HERRING (Division VIIa (N).