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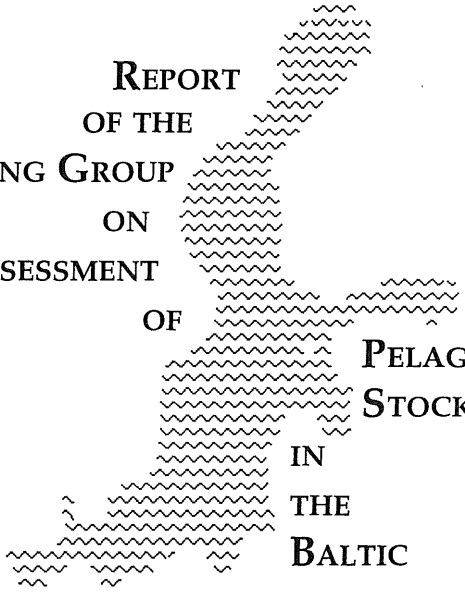

REPORT OF THE WORKING GROUP ON ASSESSMENT OF PELAGIC STOCKS IN THE BALTIC

Copenhagen 10-20 April 1989

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1 INTRODUCTION

1.1 Participants

The following members participated in the meeting held at ICES Headquarters from 10-20 April 1988:

O. Hagström (part-time)	Sweden
J. Horbowy	Poland
J. Netzel	Poland
T. Neudecker	Germany, Fed. Rep.
E. Ojaveer	USSR
L.E. Palmen	Sweden
R. Parmanne	Finland
O. Rechlin	German Dem.Rep.
F.Shvetsov	USSR
B. Sjöstrand (Chairman)	Sweden
H. Sparholt	Denmark
K.J. Stæhr (part-time)	Denmark
T. Jørgensen (part-time)	Norway

1.2 Terms of Reference

The Working Group on Assessment of Pelagic Stocks in the Baltic met with the following terms of reference (C.Res.1988/2:4:10):

a) consider the report of the Working Group on Multispecies Assessments of Baltic Fish;

b) compile fishing effort and catch-per-unit-effort data for possible use in assessments;

c) assess the status of and provide catch options for 1990 within safe biological limits for the herring and sprat stocks in the Baltic, including the combined stock of spring-spawning herring in Division IIIa and Sub-divisions 22-24;

d) provide quarterly catch-at-age and catch and stock mean weight-at-age data by sub-division for Baltic herring and sprat for 1988 as input to the multispecies VPA.

e) compile the following information on the stocks of herring and sprat in the Baltic Sea (including the Kattegat) for the years 1979-1988 for use by the Helsinki Commission in its Second Periodic Assessment of the Baltic:

i) a short review of the assessed status of each stock including trends in recruitment, yield, mortality, and stock size, and their significance;

ii) graphs showing the trends in the above parameters for 1) all available years and 2) the period 1979-1988;

iii) an explanation of the extent to which these stocks have reacted to environmental factors and to fishing activities, and what impact they have on zooplankton and benthos by predation.

2 GENERAL CONSIDERATIONS

2.1 Correction of the Finnish Fisheries Statistics

The Finnish catch statistics for herring and sprat have been reestimated for 1974-1987 (Tables 2.1.1 and 2.1.2). The correction is due to changes in the estimation procedures, which are now based on a more detailed survey of the number of active fishermen in the coastal fisheries. Hence, the correction of the herring catches affects mainly the trapnet and gillnet fishery, and trawlers less than 15 m. The catch figures of large trawlers (>15 m) are based on a complete census, and are unaffected by the change in the estimation procedure. The results of the new estimation method indicate that the total herring catch in recent years has previously been overestimated by 12%.

2.2 The International Hydroacoustic Survey 1988

The 1988 survey was performed in the same way as in previous years, i.e., with the same target strength regression and way of determining the area covered. An intercalibration between R/V "Argos" and R/V "Eisbär" gave a regression that was used to convert the acoustic signals from "Eisbär" to "Argos" units. All the acoustic data from both vessels could thus be used in the calculations of fish density.

The coverage of Sub-division 29S was incomplete and the stocks in that area are, therefore, underestimated.

The herring estimate indicates an increase of juveniles in the western part of the Baltic and an increase in the total biomass of about 25% for the total Baltic. The trend of decreasing mean weight at age has now been halted.

The sprat estimate indicates a strong 1988 year class in all sub-divisions in the Baltic. The total biomass has continued to decrease since 1983.

The results are given in Anon., 1989b

2.3 The USSR Hydroacoustic Survey 1988

Soviet autumn hydroacoustic surveys have been conducted since 1983 (Shevtsov et al., 1987). The latest hydroacoustic survey, which was conducted from 1 October up to the 30 October 1988, covered Sub-divisions 26 and 28 (Shvetsov et al., 1988). It included the economic zone of Poland and excluded the 12-mile zone of Sweden and Poland. The major tracks were passing through from east to west, starting from 20-30 m depth off the Soviet coast and terminated off the border of the 12-mile Swedish zone. Not less than 2 trawl hauls were normally accomplished in each ICES statistical rectangle.

The findings of the survey have revealed an exceptionally high abundance of young sprat in 1988, which was spread throughout the whole area under investigation. The abundance of the 1987 year class appeared to be the lowest on record. The abundance of 2-year-old and older fish was the highest for the period of 1983-1988. On the whole, the biomass of sprat (t>1) made up 304,000 t

and was 13% smaller than in 1987. The total stock of herring in Sub-divisions 26 and 28 was estimated to be 630.3 thousand t and was 30% higher than in 1987.

2.4 Multispecies Assessments

The report by the Working Group on Multispecies Assessment of Baltic Fish (Anon., 1989c) was presented to this Working Group. Since last year, the work has been concentrated on improving the data bases for the MSVPA programs. The catch-at-age and mean weight-at-age data by quarter are now worked up and implemented in both the western and the central Baltic MSVPA programs for the years 1980-1987. The data requested by the Multispecies Working Group on the distribution of cod by sub-divisions and quarters are now available from trawl surveys and from effort data from commercial fleets. These data are waiting for a critical examination with the purpose of using them in the compilation of the stomach data. Important inconsistencies in the analysis of the stomach data were discovered, and a meeting of an ICES ad hoc Study Group on Cod Stomach Data for the Baltic was held in Gdynia in January 1989 to sort out these problems.

The estimates presently used on cod consumption rates are very uncertain. The ICES Study Group on Stomach Evacuation Rates in Fish met in Lowestoft in April 1989 with the purpose of evaluating the evacuation experiments made so far. The results of these experiments will be thoroughly examined by various scientists and will be reported to the ICES Symposium on Multispecies Models Relevant to Management of Living Resources in October 1989 in The Hague.

The Baltic Multispecies Working Group felt that the estimates of natural mortality were not sufficiently reliable at present to replace the values used by the Baltic Pelagic Working Group.

The stomach data are at present undergoing a standardized analysis in the various national laboratories and are expected to be ready for international compilation by the end of July 1989. This compilation will be made by the Danish Institute of Fisheries and Marine Research, Charlottenlund, and will hopefully be implemented into the MSVPA programs before the meeting of the Working Group on Multispecies Assessment of Baltic Fish in Moscow in September 1989.

The quarterly catch-at-age and mean weight-at-age data for 1977-1979 are made available by the Baltic Pelagic and the Baltic Demersal Working Groups and will be implemented before the Moscow meeting.

3 HERRING

3.1 Catches

In 1987, the total catch of herring in the Baltic (Table 3.1.1) was 383,377 t (final figures) and in 1988 about 408,000 t according to preliminary data. A slight increase could be noted mainly in catches from Sub-divisions 25 and 26.

3.2 Herring in Sub-divisions 22, 23, and 24 and in Division IIIa

3.2.1 Introduction

As in previous years, assessments were made of both the combined Division IIIa and Sub-divisions 22 to 24 stock and the Sub-divisions 22 to 24 stock alone, although a combined assessment seems to be the more appropriate approach from a biological point of view, taking into consideration the migration pattern of spring spawners in the western Baltic. Both assessments were made on an annual basis.

In Division IIIa, the catch of 0- and 1-ringers, and to some extent 2-ringers, is generally a mixture of spring spawners and North Sea autumn spawners. In 1988, however, the total catch of 0-and 1-ringers was classified as North Sea autumn spawners. The bulk of 2-ringers of North Sea origin was caught in the first quarter. Classification of herring as spring or autumn spawners was based on a combined analysis of vertebral counts and length frequency distributions. Details are given in Anon. (1989a).

The assessment for the combined Division IIIa and Sub-divisions 22 to 24 stock was based on the catch-at-age data of spring spawners in the area, including transfers of spring spawners from the North Sea. Only catch figures for 2-ringers and older fish were used in the analysis.

3.2.2 Catch data

The reported catches in 1988 from Sub-divisions 22 and 24 (the Belt Sea and Western Baltic), Sub-division 23 (the Sound), and Division IIIa (Skagerrak-Kattegat) are given in the text table below.

Sub-divisions 22 and 24 (Belt Seas and Western Baltic) (tonnes):

Country	1977	1978	1979	1980	1981	1982
Denmark	11,048	12,383	9,695	7,221	5,806	26,256
German Dem.Rep.	37,237	40,678	46,749	58,178	54,501	49,832
Grmany,Fed.Rep.	6,946	6,849	6,672	9,323	8,300	8,142
Poland	14,649	6,335	10,276	13,605	13,366	14,869
Sweden	4,127	6,550	10,151	12,010	7,600	8,420
USSR	-	-	-	-	586	-
Total	74,007	72,795	83,543	100,337	90,159	107,519

Country	1983	1984	1985	1986	1987	1988[1]
Denmark	25,842	23,762	15,942	14,046	32,462	33,075
German Dem.Rep.	50,739	49,022	49,946	51,180	47,267	49,488
Germany,Fed.Rep.	8,300	7,085	7,888	8,550	5,806	5,188
Poland	16,868	14,250	16,721	12,344	7,997	6,590
Sweden	6,536	7,689	11,373	5,946	7,814	4,586
USSR	-	-	-	-	-	-
Total	108,103	101,808	101,870	92,066	101,346	98,927

Sub-division 23 (The Sound) (tonnes):

Country	1977	1978	1979	1980	1981	1982
Denmark	581	4,091	8,817	6,313	8,098	7,139
Sweden	511	1,000	1,860	2,400	2,000	2,460
Total	1,092	5,091	10,677	8,713	10,098	9,599

Country	1983	1984	1985	1986	1987	1988[1]
Denmark	4,583	6,935	6,849	1,490	754	102
Sweden	2,416	800	1,113	1,365	172	117
Total	6,999	7,735	7,962	2,855	926	219

Division IIIa (Kattegat-Skagerrak) (tonnes):

Country	1977	1978	1979	1980	1981	1982
Denmark	49,027	41,801	34,551	48,751	93,987	81,937
Germany,Fed.Rep.	32	28	181	-	199	43
Sweden	45,269	46,744	33,376	28,961	69,145	63,751
Others or unallocated	11,901	5,172	13,653	24,724	65,270	47,759
Total	106,229	93,745	81,761	102,436	228,601	193,490

Country	1983	1984	1985	1986	1987	1988[1]
Denmark	117,003	135,982	157,407	135,691	151,723	220,596
Germany, Fed.Rep.	40	40	-	11	-	-
Sweden	75,639	94,222	80,178	78,848	81,028	106,812
Others or unallocated	5,314	2,376	4,880	2,057	1,209	6,674
Total	197,996	232,620	244,465	216,607	233,960	334,082

[1] Preliminary.

In Sub-divisions 22 and 24, the catch for 1988 is 98,927 t, which is about the same as that taken in previous years.

The catch in 1988 in Sub-division 23 was only 219 t, compared to 926 t in 1987. It is not known to which extent the reduced catch is a result of lower abundance of herring or reduced effort.

The reported catch in Division IIIa for 1988 is 334,082 t, a considerable increase from last year's catch of 233,960 t. Danish catches were up by almost 70,000 t from 1987 and accounted for most of the increase in the total catch. Approximately 50% of the total catch in 1988 was 0- and 1-ringers of North Sea origin.

An estimated catch of 23,306 t of spring spawners from Division IIIa and Sub-divisions 22 to 24 was taken in the North Sea in 1988 (Table 3.1.1, Anon., 1989a). The total catches of 2-ringers and older spring-spawning herring in Division IIIa and Sub-divisions 22 to 24 (including the transfers from the North Sea) are

shown in the text table below. The catch increased by 86,000 t from 1987 and approximately 2/3 was taken in Division IIIa (including catches transferred from the North Sea).

Year	Jan-Jun	Jul-Dec	Total
1975	74,786	31,433	106,219
1976	58,593	26,974	85,567
1977	56,426	32,248	88,841
1978	84,678	39,510	124,196
1979	77,442	46,085	123,527
1980	87,487	55,173	142,660
1981	91,930	66,047	157,977
1982	82,233	68,442	150,675
1983	95,586	56,245	151,831
1984	104,931	86,361	191,292
1985	136,856	73,913	210,769
1986	116,299	47,588	163,887
1987	102.910	41,242	144,152
1988	120,951	108,617	230,223

Weights in t.

3.2.3 Catch in numbers at age

The half-yearly and total catches in numbers at age in Sub-divisions 22 to 24 are shown in Table 3.2.1. Age composition data were available from all countries fishing in the area, except Sweden. For the Swedish catches in Sub-divisions 22 and 24, numbers at age were estimated using the pooled samples from Denmark, the Federal Republic of Germany, the German Democratic Republic, and Poland. In Sub-division 23, the catch was distributed according to the age distribution of 2-ringers and older herring in the Division IIIa catch.

The catches in numbers at age of spring spawners in Division IIIa including transfers from the North Sea were given by the Herring Assessment Working Group for the Area South of 62°N (Anon., 1989a) and are presented in Table 3.2.2.

Total catches in numbers at age of spring spawners in Division IIIa (including transfers from the North Sea) and Sub-divisions 22 to 24 are given in Table 3.2.3.

3.2.4 Mean weights at age

Weighted average mean weights at age in the catch in Sub-divisions 22 to 24 and in the catch of spring spawners in Division IIIa (including transfers from the North Sea) are shown in Tables 3.2.1 and 3.2.2, respectively.

The weighted average mean weights at age in the total catch from this management area are given in Table 3.2.4. Mean weights at age in the catch were also used in the VPA as estimates for mean weights at age in the stock.

3.2.5 Herring in Sub-divisions 22 and 24 assessed as a unit stock

The natural mortality was chosen as 0.3, accounting for emigrations from the area into Division IIIa, following the procedure of previous assessments. Terminal F values for the oldest age groups were evaluated from a separable VPA. Taking into account that the concentration on younger age groups continued also in 1988 for a part of the fishery, age 4 was chosen as the reference age with a fishing mortality in the starting year somewhat reduced in comparison to previous years. As in 1988, the terminal S value was chosen to be 1.00 (Table 3.2.5.1).

An analysis of recruitment data from International Young Fish Surveys carried out in Division IIIa and of the German Democratic Republic young fish surveys in Sub-divisions 22 and 24 was then made, using the RCRTINX2 program (Table 3.2.5.2). The resulting prediction of the 1986, 1987, and 1988 year classes was used to calibrate the final VPA (Tables 3.2.5.5 and 3.2.5.6). The catch in number per year and mean weight at age in the catches are shown in Tables 3.2.5.3 and 3.2.5.4.

The data presented to the Working Group already show that the heavy fishing pressure on young herring which began in 1987 continued in the Western Baltic in 1988. The rather good recruitment in recent years may have been attracting an industrial fishery to this area (see also Table 3.2.5.6). The impact of this fishery on the stock if continued in a situation with a decreased recruitment might be considered as serious.

3.2.6 Herring in Division IIIa and Sub-divisions 22, 23, and 24 assessed as one unit stock

3.2.6.1 Fishery-independent stock estimates

As in last year, the International Young Fish Survey in February in Division IIIa provided an index of 2-group spring-spawning herring (IYFS-2). Like in previous years, the IYFS 1-group index was not available because it was impossible to separate it into autumn and spring spawners (Anon., 1989b). This year, also IYFS 3-group and 3+-group indices were available for the 1977-1986 year classes.

From the German Democratic Republic, young fish surveys in November-December, 0-group (GDRYFS-0), and 1-group (GDRYFS-1) indices were available from Sub-divisions 22 and 24. All young fish indices are shown in Table 3.2.6.1.

The acoustic surveys carried out each year since 1979 in Division IIIa in August-September have been shown to underestimate the amount of old herring (≥ 3-group) (Anon., 1986). The possibility that the acoustic estimates could be used as indices for each age group was investigated. Table 3.2.6.2 shows the correlation between the VPA estimates from this year's VPA and the acoustic estimates by age group. The correlation was only significant for 2-group herring which indicates that this acoustic estimate is of potential use in the tuning of the VPA in the future.

Three acoustic surveys were carried out during 1988 on this stock:

1) a Danish/Swedish survey in Division IIIa and the eastern part of the North Sea during August-September,

2) a Swedish survey in Sub-divisions 23 and 24 in October,

3) a Norwegian survey in Division IIIa in December.

The acoustic surveys of the stock seem to have improved considerably in 1987 and 1988 compared with previous years, because of improved coverage and improved quality of the trawl catch data.

The Danish/Swedish survey in Division IIIa in August-September covered for the second time the eastern part of the North Sea, where a significant part of the present herring stock is present during the summer. This was clearly demonstrated for age group 3 and older by vertebral count analysis (Anon., 1988b). Furthermore, the trawl stations in 1987 and 1988 were more properly placed geographically, with a reasonable amount of trawl hauls made in depth strata below 300 m where the old herring are mainly found. The underestimates of older herring in previous years were probably due to the fact that very few trawl hauls were done in this depth strata.

In 1987, Sub-division 22 was for the first time properly covered. This was done by the use of a small research vessel ("Solea") and mobile hydroacoustic equipment. In this way, it was possible to cover the shallow water areas. However, this survey was not repeated in 1988. The survey will be done again in 1989.

The Norwegian survey in December had mainly young herring as target species. Furthermore, the estimates from this survey were not directly comparable to the estimates from the other surveys because the herring had partly left the area and moved to the overwintering areas in Sub-divisions 22-24. Estimates from the various surveys are shown in Table 3.2.6.3.

3.2.6.2 VPA

The data available to tune the VPA were: 1) the IYFS 2-group index (February) for Division IIIa (Table 3.2.6.1), 2) the German Democratic Republic 0- and 1-group indices (December) for Sub-divisions 22 and 24, 3) an index of 2-group from the acoustic survey in Division IIIa (August-September) (Table 3.2.6.2), and 4) an acoustic estimate of absolute stock numbers based on two of the three acoustic surveys carried out in the area during 1988 (Table 3.2.6.3). The December survey in Division IIIa was not used in the combined acoustic estimate because of uncertainties about double counting when combining this survey with the other surveys.

It is, of course, difficult to make an *ad hoc* tuning of a VPA to both young fish indices for year-class strength and acoustic estimates of absolute stock numbers. The proper procedure to adopt would probably be to make a one-step estimation using stochastic integrated models as suggested by the Methods Working Group (Anon., 1987c). However, since a model for this stock using the data presented above has not been developed, the Working Group could do no better than try to do what it could imagine would be the outcome of such an integrated one-step model. The same procedure was adopted last year.

The following tuning procedure was used:

1) An SVPA was run with age 5 as age of unit selection, F_5= 0.9, S = 0.9, and M = 0.2. Age groups 2-8+ were included. An identical fishing pattern was assumed for each year from 1984-1988. F_5 = 0.9 was chosen because this was approximately the mean value for the preceding years. S = 0.9 was chosen for 1988 because this gave a dome-shaped selection pattern, which was assumed to be realistic, taking into account that a) old fish often reach and leave the spawning area at Rügen before the fishery starts, b) the fishery in Division IIIa is mainly exploiting the younger age groups. However, this F_2 = 0.7 must be regarded as rather uncertain. The results of the separable VPA are given in Table 3.2.6.4.

   The year-class strengths from this SVPA of 2-groups were used for regression analysis against the young fish indices.

2) The regression analysis was carried out using the program RCRTINX2. Predictions of year-class strength as 2-group at 1 January were obtained for the 1985-1988 year classes. The options used for the analysis are given in Table 3.2.6.5, together with the weighted average prediction of year-class strengths.

3) F = 0.7 for 2-group in 1988 was chosen in order to get the predicted year-class strength of the 1986 year class at 1 January 1988. Actually, the F_2 should have been much higher than 0.7 to exactly match the estimated year-class strength, but it was assumed unrealistic that the fishing mortality on this age group could be higher than 0.7. However, even with this high F_2 the year class 1986 becomes strong in the VPA and this corresponds to information given to the present Working Group that the catch of 3-groups in the Rügen herring fishery this spring has been very high.

4) The predicted year-class strength of the 1985 year class as 2-group at 1 January 1987 was different from that obtained from the above SVPA. In order to approach the predicted year-class strength, the fishing mortality on 3-group in 1988 should be increased to a very high level. As for the 2-groups, it was assumed unrealistic to have an F higher than 0.70.

5) Finally, the F values on the older age groups were chosen by using the separable pattern from the SVPA and using F_5 = 0.9 because the VPA stock number of age groups 4-8+ at 1 October then became identical to the acoustic estimate.

   The reliability of these Fs were supported by the fact that the acoustic estimates for 1987 and the VPA estimated for 1 October 1987 were very similar for ages 2-8+.

6) Terminal Fs for the oldest true age groups were taken from the SVPA using F_5 = 0.9 and S = 0.9.

The results of the VPA are given in Tables 3.2.6.6 and 3.2.6.7.

3.2.6.3 Yield per recruit

The input data are shown in Table 3.2.6.8. Yield per recruit calculations show that $F_{0.1}$ = 0.218 and F_{max} = 0.527. Thus, the 1988 fishing mortality was about 40% above Fmax.

3.2.6.4 Catch predictions

Recruitment figures for the 1987 and 1988 year classes were taken from the regression analysis above, and for the 1989 year class as the mean of the 1975-1984 year classes. The fishing mortality pattern was taken as the mean for 1981-1986. Fishing mortality in 1989 was assumed to be at the same level as in 1988. The low mean weights at age from the last 2-3 years were adopted for 1989-1991. The results of the catch predictions are given in Tables 3.2.6.9 and 3.2.6.10.

Assuming average F_{2-6} = 0.76 as in 1988, a decrease in the catch of 2-groups and older herring from 225,000 t in 1988 to 159,000 t in 1989 is predicted, and the spawning stock biomass will decrease from 220,000 t in 1989 to 198,000 t in 1990. Continuing this level of F in 1990 will lead to a further slight reduction in both yield in 1990 and SSB in 1991, to 155,000 t and 196,000 t, respectively.

Last year's prediction of an increase in the catches in 1988 was correct but the increase was much larger than predicted. However, as stated in last year's report, the estimate of the 1986 year class was probably conservative, and this year class is larger than predicted last year, constituting a large proportion of the total catch in 1988. The catch can be regarded as going back to normal levels except for the aspect of low mean weight at age which is expected to be unchanged in the coming two years. If the mean weights increase to the 1985 level, the expected catch will be greater by about 50,000 t in 1989 and 1990.

A likely catch of 0- and 1-ringers should be added to this predicted catch.

For 1988, this amounted to 22,749 t in Sub-divisions 22-24 and nil t in Division IIIa. Assuming the catch of 0- and 1-ringers in 1989 and 1990 will be the same as in 1988, the total catch will be about 180,000 t in both these years. Whether the catch of 0- and 1-groups will be as high in 1989 and 1990 as in 1988 is, however, doubtful and will probably depend on the size of the 1989 and 1990 year classes.

3.2.6.5 Separation of the catch projections

The separation of the catch projections into a Division IIIa component and a Western Baltic component was done by assuming the same separation of the fishing mortality between the two areas in 1989 and 1990 as in 1988. This was done by separating the total fishing mortality according to the catch in numbers in each area (Table 3.2.6.11).

The predicted catch in 1989 and 1990 by area is shown in Table 3.2.6.12. In 1989, it is about 86,000 t in Division IIIa and 84,000 t in Sub-divisions 22-24, and in 1990 82,000 t in Division IIIa and 79,000 t in the Western Baltic. To this should be added the catch of the 0- and 1-groups. Assuming that the catch of the

0-and 1-groups in 1989 and 1990 will be identical to the catch in 1988, the following predictions were made:

Area	1988[1]	1989	1990
Division IIIa	154,000	86,000	82,000
Western Baltic	99,000	110,000	102,000

[1] Actual catch.
Catch in tonnes.

3.2.6.6 Are the high F estimates in the Western Baltic herring stock reliable?

During the period 1974-1988, covered by the present VPA for the herring stock in Division IIIa and Sub-divisions 22-24, the mean $F_{(2-6)}$ has been very high, about 0.8. Other herring stocks which have suffered such high fishing mortality during a long period have all collapsed at some stage. Why does this not happen to the Western Baltic stock?

To be sure about the estimated F level from the VPA, catch curves were made for both the catch in the combined Division IIIa/Sub-divisions 22-24 stocks and for the separate catches in Sub-divisions 22+24 (Figure 3.2.6.1). These catch curves both show that Z is about 1.0, which means that F is about 0.8 if natural mortality is assumed to be 0.2. A small difference between the curve for the combined catch and the curve for Sub-divisions 22-24 catch alone was observed. For ages 1 to 3, the mortality was smaller in the separate catch data than in the combined ones. This can, however, be ascribed to the fact that herring recruit to the fishery in Sub-divisions 22-24 at a later stage than in Division IIIa.

These catch curves are not proof of a high mortality rate on older herring because it is implicitly assumed in the catch curve method that the herring are sampled representatively. This is not correct if the F on older herring is really lower than on, say, age 3-5, because then the reduction in catches by age observed in the catch curves is only a reflection of the decreased ability of the fishermen to catch these old herring. It could, therefore, very well be that F on older herring is less than we assume at present. An S = 0.5 is probably just as likely as S = 0.9 used now in the SVPA. If S = 0.5, the mean F would be reduced to about 0.5.

Other possibilities for explaining the high F could be that the catch of older herring taken in Sub-area IV is underestimated. Only a few years ago did we become aware of the migration of the Western Baltic herring into the North Sea, and if this has been going on for a long time we miss the North Sea catch of these herring in the assessment.

3.3 Herring in Sub-divisions 25,26 and 27 (Southern Central Baltic)

3.3.1 Catches

The total catch in 1988 was around 144,000 t, which is an increase of 18% from 1987.

3.3.2 Catch in numbers at age

For most of the catches, catch in numbers at age per quarter of the year and per sub-division was applied. About 14,000 t in Sub-division 25 was given only as catch per quarter and sub-division and was distributed on age groups according to the total of the appropriate quarters and sub-divisions (Table 3.3.1).

3.3.3 Mean weight at age

From quarterly national mean weight-at-age data, in some instances given per fleet and per spawning type, an average weighted by catches in numbers was calculated for each age group (Table 3.3.2).

The decrease in mean weight at age observed since 1984 seems to be halted in 1988, according to information from both catches and the 1988 International Acoustic Survey (Figures 3.3.1 a and b). The mean weights are still about 30% below the 1982-1983 level.

The SOP shows that nominal catches for the years 1972-1976 were around 75% of the sum of products (see Table 3.3.1).

3.3.4 VPA

As in previous assessments, natural mortality was assumed to be 0.2 for all age groups.

The estimates of stock numbers at age from the International Acoustic Surveys 1982-1987 were used as input CPUE values in the ad hoc tuning program (Table 3.3.3). Effort was put as 1.0 in all years. As the estimates are referring to the fourth quarter (October-November), they were used for the next calendar year, and consequently ages were shifted accordingly. The estimates of log catchabilities per age group, given in Figure 3.3.2, have standard errors around 0.3 and vary without a clear trend. The fishing mortalities resulting from the tuning process are given in Table 3.3.4. A separable VPA with age 3 as reference age, terminal S = 1.0, and terminal F = 0.4 (Table 3.3.5) resulted in the same mean $F_{(1-8)}$ as was obtained by the ad hoc tuning procedure. The fishing mortalities are given in Table 3.3.6 and stock size estimates in Table 3.3.7. Estimates of SSB 1972-1976 have been corrected for SOP discrepancies.

The level of exploitation has been around 0.2 during 1974-1984, increasing to 0.3 in 1985-1987 and is estimated as 0.38 in 1988. Spawning stock size has fluctuated between 450,000-600,000 t during 1972-1984 and thereafter decreased to below 300,000 t.

3.3.5 Recruitment

The VPA indicated that both the 1985, 1986, and 1987 year classes have been below the 1977-1986 average of 4,477 million. No information on recruitment was presented and, therefore, the average was applied for the 1988-1990 year classes.

3.3.6 Prediction

The 1988 exploitation level and pattern was applied on the 1989 stock. The mean weights for both the catch and the stock were taken as the 1987-1988 average. Input values for the prediction are given in Table 3.3.8, the catch options in Table 3.3.9 and in Figure 3.3.3. Detailed prediction for the status quo option is given in Table 3.3.10. The catch in 1989 is calculated to be 119,000 t and in 1990 118,000 t at the same level of F. Spawning stock biomass is predicted to decrease.

3.3.7 Separation of herring stocks in Sub-divisions 25-27

As in previous years, the Working Group separated the total catches in the area into the two main stocks present, i.e., the fast-growing, short-lived coastal herring spawning along the southern coast in Sub-divisions 25-27 (from Hanø Bay to Gdansk Bay) and the slow-growing, long-lived open-sea herring spawning along the coast in Sub-division 27.

It should be noted that the coastal herring includes autumn spawners which made up 4-8% of the total catch in Sub-division 25 in 1975-1982. In 1987, the proportion of autumn spawners in Polish catches in Sub-divisions 25 and 26 amounted to 8.7% and 2.0%, respectively. The corresponding figures for 1988 are 9% and 4%.

3.3.8 Separation procedure

As in previous years, the Polish (Sub-divisions 25-27) and USSR (Sub-divisions 26-27) catches presented as numbers at age, were separated on the basis of otolith types into coastal and open-sea components. The Polish catches in the Swedish zone (Sub-divisions 25, 26, and 27) were separated on the same basis. This method is still not adopted in the Swedish and Danish laboratories, and these countries presented catch as numbers at age for each quarter of the year. For catches in the Swedish zone (Sub-division 25), the German Democratic Republic and USSR submitted data on catches in numbers at age. Since the seasons and fishing grounds of the German Democratic Republic and USSR fishermen overlap those of the Polish fishermen, their catches in numbers at age were separated according to the stock ratio of the Polish catches in the Swedish zone.

All Swedish catches in Sub-division 25 in the first half year and 67% of the second half year catches were assumed to be open-sea herring, while 33% of the second half year catches were allotted to the coastal stock. The same rule was applied for the separation of Danish catches in Sub-division 25. Swedish and Finnish catches in Sub-division 27 were assumed to be open-sea herring.

3.3.9 Catch trends

In 1988, catches increased in the coastal herring stock by 13% and in the open-sea herring stock by 24% (Table 3.3.11). Part of this increase was due to the higher number of fish caught (12% for every stock), while some part can be attributed to the greater weight at age (especially for the open-sea stock, in the case of which mean weights were 17% higher on average than in 1987).

3.3.10 Mean weight at age

For both the coastal and open-sea herring stocks, data on mean weight at age were supplied by Poland (Sub-divisions 25-27) and the USSR (Sub-divisions 26-27).

It was assumed that the German Democratic Republic and USSR weights at age in Sub-division 25 were the same as those in the Polish catches in the Swedish fishery zone.

Sweden supplied the data on a quarterly basis for Sub-division 25 and 27, and Denmark similar data for Sub-division 25. Swedish and Danish data from the first half year from Sub-division 25 were assumed to represent only the coastal stock, while the data from the second half year were assumed to represent both stocks. Swedish weights from Sub-division 27 were used for the open-sea stock.

3.3.11 VPA

Natural mortality was assumed to be 0.3 for the coastal herring stock and 0.1 for the open-sea herring.

Two series of effort data were available for tuning:

1) CPUE of Polish state-owned 24 m cutters with pelagic pair-trawls for 1981-1988 (Table 3.3.12);

2) CPUE of Polish state-owned cutters (Table 3.3.13) estimated by GLM for 1984-1988.

In this model, type of cutter gear, month, year, and area effects are taken into account. The GLM model accounted for 75-80% of CPUE variation. As the data on the share of the coastal and open-sea herring in Polish catches in previous years were not available at the meeting, it was assumed that this share was approximately constant. Catches of the coastal and open-sea herring were divided by CPUE values to obtain rather rough effort indices.

The tuning procedure was based on CPUE of Polish 24-m cutter data, as the GLM estimate series was found to be too short. The separable VPA terminal numbers were used to estimate terminal Fs in a conventional VPA.

It was possible to tune the VPA, but the relationship between fishing mortality and fishing effort index was poor ($r = 0.2$ for coastal herring and $r = 0.53$ for open-sea herring) (Figure 3.3.4-3.3.5). It was noted that for 1985-1988, Polish CPUE data were probably overestimated due to the herring fishing season beginning later than in previous years and thus omitting less effi-

cient months. This effect was not taken into account in estimating effort indices.

The VPA is documented for the coastal stock in Tables 3.3.15 to 3.3.19, and in Figures 3.3.6A and B. The corresponding information for the open sea stock is given in Tables 3.3.22-3.3.26 and in Figures 3.3.7A and B.

3.3.12 Recruitment and catch prediction

Coastal herring

Correlation of recruitment data (Table 3.3.14) with VPA estimates is poor. The 1988 year class was assumed to be the mean of the 1975-1987 year classes, i.e., 4,173 million herring. The same assumption was applied for the 1989-1991 year classes. The 1988 mean weight-at-age data were used for the calculation of catch weight and biomasses. Input parameters for the projection are given in Table 3.3.20 and the results are shown in Table 3.3.21 and Figure 3.3.6D.

If the fishing mortality in 1989 and 1990 is at the same level as in 1988, the spawning stock biomass will remain at the level of about 230,000 t in these years. Catches in 1989 and 1990 are projected to be at a level of 69,000 t.

Open sea herring

The 1989-1991 year classes were set at the level of average (1980-1987) year-class abundance (1,820 million fish). Mean weights at age in 1988 were applied in the prediction as mean weights in catch and in stock. Input parameters for the projection are given in Table 3.3.27, and the results are shown in Table 3.3.28 and Figure 3.3.7D.

Unchanged level of fishing mortality in 1989 and 1990 would result in a catch of 61,000 t in 1990 and a spawning stock biomass remaining at the level of 260,000 t.

3.4 Herring in Sub-divisions 28 and 29S

3.4.1 Catches

In the open part of the sub-divisions, the catches in 1988 remained at the level of the previous year. In the Gulf of Riga they increased.

Open sea (Sub-divisions 28 and 29S) (tonnes):

Country	1976	1977	1978	1979	1980	1981
Finland	57	119	352	18	66	30
German Dem.Rep.	1,524	560	285	457	10	-
Poland	87	15	-	-	-	-
Sweden	1,800	3,046	3,570	5,014	7,332	6,290
USSR	36,704	28,890	35,380	35,593	32,793	28,804
Total	40,172	32,630	39,587	41,082	40,201	35,124

ctd.

Country	1982	1983	1984	1985	1986	1987	1988
Finland	168	44	11	8	451	2,436	2,289
German Dem.Rep.	-	-	-	-	-	-	82
Poland	-	-	-	-	-	24	-
Sweden	7,950	7,606	5,400	2,351	2,015	1,613	1,149
USSR	35,845	39,990	39,334	37,669	36,698	43,720	42,305
Total	43,963	47,640	44,745	40,028	38,164	47,793	46,095

Gulf of Riga (tonnes):

Category	1976	1977	1978	1979	1980	1981
Total catch	31,975	26,544	23,056	21,859	20,702	22,646
Gulf of Riga herring	27,422	24,186	16,728	17,142	14,998	16,769
Open-sea herring[1]	4,553	2,358	6,328	4,717	5,704	5,877

Category	1982	1983	1984	1985	1986	1987	1988
Total catch	17,431	20,318	19,679	20,187	18,180	17,676	19,779
Gulf of Riga herring	12,777	15,541	15,843	15,575	16,927	12,884	16,791
Open-sea herring[1]	4,654	4,777	3,836	4,612	1,253	4,792	2,988

[1] Included in the table of open-sea herring catches.
In the Gulf of Riga, herring are fished only by the USSR.

3.4.2 Catch in numbers by age

The USSR and Sweden presented catches in millions by age groups. Finnish (2,289 t) and the German Democratic Republic (82 t) catches were raised to the age composition of the combined USSR and Swedish catches in the open sea. The Gulf of Riga herring was assessed separately and accounted for directly by the USSR age composition from trapnet and trawl catches (Tables 3.4.1 and 3.4.2).

3.4.3 Mean weight at age

Weighted mean weight-at-age data from the USSR and Swedish catches (Table 3.4.4) were applied for the open sea herring. For the Gulf of Riga population, the corresponding information from the USSR trapnet and trawl fishery was used (Table 3.4.3). The SOP check showed that the nominal catches in 1988 constituted 92% of the calculated catches in the Gulf of Riga stock and 104% in the open sea stock.

As compared with the previous year, in 1988 in the Gulf of Riga herring weights at age were higher. They were generally also higher in the younger herring of the open sea stock but lower on 5-year-old and older herring.

3.4.4 VPA

Natural mortality in the open sea stock was taken equal to that in previous years (0.3). In the Gulf of Riga herring, the same natural mortality as in 1987 (0.2) was assumed.

Gulf of Riga herring

The level of input Fs for 1988 was estimated on the basis of the abundances estimates (millions) of 3-7-year-old Gulf herring from the acoustic surveys in November 1987 and 1988 (see text table below).

	Age				
Year	3	4	5	6	7
1987	1,062	844	158	46	-
1988	-	754	231	92	31

Based on summed abundances of 3- to 6-year-old herring in 1987 and 4- to 7-year-old herring in 1988, Z for age groups 4-7 in 1988 was estimated as 0.65 and F = 0.45. The input Fs for the age groups were estimated from the separable VPA (Table 3.4.5). Age group 4 was chosen as the reference age. The selection factor was taken as 1.0 to keep the dome-shaped exploitation pattern assumed in previous years. The resulting average unweighted F for the 4- to 7-year-old herring in 1988 (0.46) is considerably higher than $F_{0.1}$ (0.20) and slightly below F_{max} (0.50). The VPA results are given in Tables 3.4.6 and 3.4.7, and in Figure 3.4.1.

Open sea herring

The level of input Fs in the open sea stock was estimated by tuning of VPA using the acoustic survey data from both the international and the USSR surveys (Table 3.4.8). Fs were estimated from the separable VPA (F_3 = 0.20, S = 1.4) (Table 3.4.9). The average F for age groups 2-7 in 1988 is less than $F_{0.1}$ (0.33). The VPA results are presented in Tables 3.4.10 and 3.4.11 and in Figure 3.4.3.

This assessment gives stock estimates that are about 50% lower than those made by the Working Group 1984-1987. The difference is caused by the different ways of using the acoustic data for tuning. The Working Group has more confidence in this year's assessment.

3.4.5 Recruitment and catch prediction - Gulf of Riga herring

As in recent years, the abundance of 1-group and 2-group herring for the prediction was estimated on the basis of a regression of year-class abundance from the VPA on the average number of 0-group fish per haul with the experimental bottom trawl given in the text table below.

Category	Year						
	1975	1976	1977	1978	1979	1980	1981
Abundance of 0-group herring per haul	4,565	2,493	798	543	296	399	1,587
1-group (millions) from VPA	3,414	827	1,012	966	1,095	923	1,677
Category	1982	1983	1984	1985	1986	1987	1988
Abundance of 0-group herring per haul	768	1,694	806	454	3,316	656	1,601
1-group (millions) from VPA	1,398	2,246	1,075	680	-	-	-

The corresponding equation is $y = 719 + 0.51x$, $r = 0.82$. The analysis indicates the 1987 year class to be poor with 840 million age-2 herring at the beginning of 1989. The 1988 year class at age 1 is estimated to be of average size, i.e., 1,530 million herring. Natural mortality was estimated to be 0.2. The prediction was run with the smoothed 1988 exploitation pattern (Table 3.4.12). The 1990 year class at age 1 was assumed to be 1,230 million herring, the average over the period 1978-1986. Mean weights at age were used as mean of the 1987 and 1988 estimates (somewhat smoothed).

Input parameters for the projection are listed in Table 3.4.12, and the results of the short-term and medium-term projections are given in Table 3.4.13 and Figure 3.4.1. A detailed output based on a stable fishing mortality in 1989 and 1990 at the 1988 level is presented in Table 3.4.14.

Open sea herring

The abundance of the 1986 and 1987 year classes were estimated from a regression of VPA year-class abundances at age 1 in the period 1972-1985 versus the percentage of 1-group fish in annual catches (Figure 3.4.2). They were used as input values for the projection and correspond to 2.199 million fish at age 3 and 1.191 million fish at age 2 at the beginning of 1989. The abundance of the 1990 and 1991 year classes was set at the average of the 1979-1986 year classes, i.e., 3.194 million fish at age 1. The projection was run with the 1987-1988 average mean weights and the 1988 exploitation pattern. The parameters used for the projection are given in Table 3.4.15.

Continuation of the 1988 level of exploitation in 1989 and 1990 results in some decrease in both spawning stock biomass and catches due to the poor 1985 and 1987 year classes (Tables 3.4.16 and 3.4.17, Figure 3.4.3).

3.5 Herring in the Eastern Part of Sub-divisions 29N and 30E

3.5.1 Catch trends

A revision has taken place in the Finnish catch data in 1974-1987. In recent years, catches have been on a higher level than in the 1970s.

Country	1974	1975	1976	1977	1978	1979	1980
Finland	37,694	39,270	38,584	42,902	44,842	45,122	52,153
USSR	1,000[2]	1,000[2]	1,000[2]	1,000	1,000	1,000	1,000
Total	38,694	40,270	39,584	43,902	45,842	46,122	53,153

Country	1981	1982	1983	1984	1985	1986	1987	1988[1]
Finland	41,818	46,957	52,389	56,640	58,388	55,900	52,720	51,625
USSR	971	-	-	-	-	-	-	-
Total	42,818	46,957	52,389	56,640	58,388	55,900	52,720	51,625

[1] Preliminary. [2] Assumed amounts for 1974-1976.
Weight in t.

3.5.2 Catch in numbers at age

The age composition is based on the Finnish trapnet and trawl catches. The USSR landings were raised to the age distributions of the Finnish pelagic trawl catches (Table 3.5.1).

3.5.3 Mean weight at age

The mean weights are based on samples from the Finnish trapnet, trawl, and winter seine catches. In many age groups the mean weights have increased until 1983, and then decreased (Table 3.5.2). Mean weights at age in the stock are taken equal to the mean weights in the catch. Due to changes in weights, the mean weight at age of the actual year was used. In 1988, the nominal catch constituted 101% of the calculated one.

3.5.4 VPA

The natural mortality of M = 0.15 was used in the years 1974 and 1975, and that of M = 0.2 from 1976 onwards in all age groups.

The VPA was tuned using effort and catch-at-age data of Finnish trapnet, bottom trawl and pelagic trawl fishery in 1974-1988 (Table 3.5.3). In the tuning output (Table 3.5.4), the sigma values in older age groups were below 0.3 and the variance ratio usually below 0.9.

From the tuned VPA the terminal S (1.21) for separable VPA was taken (Table 3.5.5). The 0-group was omitted. Terminal F for age group 3 (0.164) was chosen in order to get the same mean F (0.182) in age groups 3-8 in the separable VPA as in the VPA tuning. Fishing mortalities and stock sizes calculated by separable VPA are given in Tables 3.5.6 and 3.5.7 and Figure 3.5.1.

3.5.5 Recruitment and catch prediction

The numbers of Copepoda adults (2.6 per cm^2 in 1988), C. nauplii (8.3), herring larvae $\leq$10 mm (40 per 10 m^2), 10-15 mm (15) , and $\geq$15 mm (2) in June, having a positive correlation with the year-class strength (Parmanne and Sjöblom, 1984, 1987), were treated as recruitment indices and combined using the RCRTINX2 program (Table 3.5.8). The 1988 year class was thus set at 29% above the average in 1974-1986. This seems realistic compared to the catch of 0-group in 1988 (Table 3.5.1). The parameters used in the projection are given in Table 3.5.9.

For the yield curve, mean weights at age in 1988 and average recruitment in 1974-1986 were used. The yield and stock biomass from different fishing mortalities in 1990 are given in Figure 3.5.1. The fishing mortality in 1988 (0.182) is at the level of $F_{0.1}$ (0.197). If F_{88} (slightly smoothed) is maintained in 1989 and 1990, a catch of 48,000 t is predicted for 1990 (Table 3.5.10). The slight decrease of the expected catch compared with actual catches is due to the weak 1987 year class.

A detailed projection for a stable fishing mortality in 1989 and 1990 at the same level as in 1988 is given in Table 3.5.11.

3.6 Herring in the Eastern Part of Sub-division 31

3.6.1 Catch trends

A revision has taken place in the catch data in 1974-1987. Catches increased in the 1970s and have been rather stable in the 1980s.

Country	1974	1975	1976	1977	1978	1979	1980	1981
Finland	5,737	4,802	7,763	6,580	9,068	6,275	8,899	7,206

Country	1982	1983	1984	1985	1986	1987	1988[1]
Finland	7,982	7,011	8,322	8,595	8,754	7,788	7,171

[1] Preliminary.
Weights in t.

3.6.2 Catch in numbers at age

All catches were given in numbers by age and year (Table 3.6.1).

3.6.3 Mean weight at age

The mean weights are based on samples from trapnet, bottom trawl, and pelagic trawl catches. Mean weight at age in the stock are taken equal to the mean weights in the catch. Average mean weights at age for the actual year were used (Table 3.6.2). In 1988, the nominal catch was 99% of the calculated catch.

3.6.4 VPA

The natural mortality of M = 0.15 was used for all years and age groups.

The VPA was tuned using effort and catch-at-age data of trapnet, bottom trawl, and pelagic trawl fishery in 1974-1988 (Table 3.6.3) The 0-group was omitted. In the tuning output (Table 3.6.4), in most age groups the sigma values were below 0.5 and the variance ratio below 0.9.

From the tuned VPA, the terminal S (1.25) for the separable VPA was taken (Table 3.6.5). Terminal F for age group 3 (0.115) was chosen in order to get the same mean F (0.128) in age groups 3-8 in the separable VPA as in the VPA tuning. Fishing mortalities and stock sizes calculated by separable VPA are given in Tables 3.6.6 and 3.6.7.

3.6.5 Recruitment and catch prediction

The numbers of Copepoda nauplii (5.0 per cm^2 in 1988), Cladocera (13.3), and Rotatoria (7.0) in August, other zooplankton in July (0.0), and total numbers of zooplankton in August (27.2), having a positive correlation with the year-class strength (Parmanne and Sjöblom, 1984, 1987), as recruitment indices were combined using the RCRTINX2 program (Table 3.6.8). The 1988 year class was thus set at 81% of the average.

For the yield curve, mean weights at age in 1988 and average recruitment in 1974-1986 were used. Table 3.6.9 shows the input parameters for the projection. The yield and stock biomass from different fishing mortalities in 1990 are given in Tables 3.6.10, 3.6.11, and in Figure 3.6.1. The fishing mortality in 1988 (0.128) is below $F_{0.1}$ (0.161). If the level of F in 1988 is maintained in 1989 and 1990, a catch of 8,700 t is predicted in 1990.

3.7 Herring in the Western Part of Sub-divisions 29N, 30, and 31

3.7.1 Catches

Both the Swedish and Finnish catches increased by almost 61% in these areas from 1987 to 1988. Most of the catches are taken in Sub-division 30.

Country	1977	1978	1979	1980	1981	1982
Finland	816	1,370	1,806	298	328	198
Sweden	5,640	5,660	6,800	7,302	7,910	7,311
Total	6,456	7,030	8,606	7,600	8,238	7,509

Country	1983	1984	1985	1986	1987	1988[1]
Finland	274	20	730	371	452	726
Sweden	9,486	6,813	3,612	3,331	2,536	4,087
Total	9,760	6,833	4,342	3,702	2,988	4,813

[1] Preliminary.
Weight in tonnes.

3.7.2 Catch in numbers and mean weight at age

The sampling intensity has previously been very low for this area but improved this year. Swedish catches for 1988 as numbers at age as well as the mean weights per quarter of the year and Finnish catches per quarter of the year are given in Table 3.7.1.

3.7.3 Stock assessment

The Working Group could not make an assessment due to the short data series available for this stock. The high mean age in the catches indicates that the exploitation level is low in these areas.

3.8 Herring in Sub-division 32 (Gulf of Finland)

3.8.1 Catches

The catches have declined since 1983 and in 1988, this tendency continued. There was a revision of Finnish catch data for 1974-1987.

Country	1974	1975	1976	1977	1978	1979	1980	1981
Finland	11,579	8,321	12,525	12,317	13,791	10,929	10,207	12,781
USSR	37,085	27,111	34,490	34,745	34,005	29,124	28,673	28,019
Total	48,664	35,432	47,015	47,062	47,796	40,053	38,880	40,800

Country	1982	1983	1984	1985	1986	1987	1988[1]
Finland	16,272	22,470	20,695	19,290	16,533	17,080	15,021
USSR	23,589	27,795	24,692	24,899	25,520	21,462	23,140
Total	39,861	50,265	45,387	44,189	42,053	38,542	38,161

[1] Preliminary.
Weights in t.

3.8.2 Catch in numbers at age

Both Finland and the USSR supplied catch in numbers data by age groups in 1988 (Table 3.8.1). Finland revised its data for 1974-1987.

3.8.3 Mean weight at age

From mean weights at age supplied by the USSR and Finland, an average weighted by catches in numbers was calculated (Table 3.8.2). The nominal catch was 99% of the calculated one in 1988. As compared with the previous year, in 1988 the mean weights decreased in most age groups.

Mean weights at age in the stock were taken equal to the mean mean weights in the catch.

3.8.4 VPA

As last year, the constant natural mortality rate (M = 0.2) for all age groups was used in 1988. The F level was estimated by tuning VPA against the yearly effort and catch values in five fisheries: Finnish trapnet, bottom trawl and pelagic trawl fisheries (1974-1988), Soviet trapnet fishery (1978-1988), and Soviet pelagic trawl fishery (1982-1988) (Table 3.8.3). Input Fs were estimated from a separable VPA. The version having the reference F_3 = 0.27 and the terminal S = 0.6 was accepted (Table 3.8.4).

The resulting average F in 1988 for the age groups 2-5 of 0.25 was somewhat higher than $F_{0.1}$ (0.21) but less than F_{max} (0.44). The VPA results are shown in Tables 3.8.5 and 3.8.6 and Figure 3.8.1.

3.8.5 Catch prediction

The abundance of the 1987 year class was estimated on the basis of the regression (y = 329 + 141x, r = 0.821) of the year-class abundance in VPA in 1970-1985 on the percentage of 1-group fish in the yearly catches. It was calculated to be 540 million at age 2 in 1989. Smoothed mean weights at age for 1987-1988 and the

1988 fishing mortality pattern were applied (Table 3.8.7). M was taken as 0.2 as in previous years. The 1988-1990 year classes were set at the average level for 1978-1986 (2910 million herring at age 1).

Owing to the good 1986 and average 1988 year classes, it is expected that the total herring biomass and SSB wil be rather high in 1989-1991. The short-term catch projections for the Gulf of Finland herring are presented in Tables 3.8.8 and in Figure 3.8.1. A detailed projection is given in Table 3.8.9.

3.9 Herring in the Baltic Proper, Sub-divisions 25-29 (Combined)

3.9.1 Introduction

The herring in this area has for a long period been divided into three assessment units: Sub-divisions 25-27, Sub-divisions 28 + 29S, and Sub-divisions 29N-30. The assessments in the two southern areas have been based on the stock estimates obtained from acoustic surveys and on effort/CPUE tuning in the northern unit.

It has been observed that the distribution of herring in relation to the borders between units varies from one year to the next.

The observed decrease in mean weights during the last five years seems partly to be due to migration of slow-growing herring from Sub-divisions 27, 28, and 29 southwards down to the fishing areas in Sub-divisions 25 and 26.

Acoustic surveys have always found large amounts of herring in Sub-divisions 28 and 29S during the fourth quarter, which has consequently increased stock size estimates in these areas considerably. It is, however, possible that part of these herring are emanating from Sub-division 29N and overwintering in the deeper parts of Sub-divisions 28 and 29S.

Based on this, the Working Group decided to also assess all herring in the Baltic Proper (Gulf of Riga excluded) as one unit.

3.9.2 Catches

The combined catches in the area have been remarkably stable during the period 1974-1988 included in the assessment files. It has varied between 207,000 and 267,000 t without any clear trend (Table 3.9.1).

3.9.3 Catch in numbers at age

Catch in numbers were summed for the three stocks (Table 3.9.1).

3.9.4 Mean weights

Data on mean weights at age were weighted together with by-catches in numbers.

The SOP was low in 1974-1976, but within $\pm$ 10% for the 1977-1988 period (Table 3.9.1).

3.9.5 Assessment

The natural mortality was taken as 0.2 for all years and age groups.

Stock estimates from the International Acoustic Surveys for the period 1982-1987 and from the USSR acoustic surveys in Sub-divisions 26 and 28 for 1985-1987 were used for tuning the VPA. Table 3.9.2 contains the input data, and it should be noted that the survey results are applied to the calendar year after the survey and that ages are shifted accordingly. Effort is taken as 1.0 for all years.

Log catchability estimates given in Table 3.9.3 are surrounded by low combined standard errors and low variance ratios.

The VPA results from the tuning procedure appear in Tables 3.9.4 and 3.9.5.

These results were compared to the outcome of separable VPAs with reference age 4 and S_t = 1.0. The version with F = 0.35 was chosen and is given in Tables 3.9.6 to 3.9.8.

The exploitation level seems to have been stable at about 0.20-0.25 for 1974-1984 and thereafter increased to 0.30-0.35. The $F_{0.1}$ level is calculated as 0.24. Spawning stock biomass, corrected for SOP deviations, has been around 1,100,000 t up to 1984 and then decreased slightly.

3.9.6 Recruitment and catch predictions

Year-class strengths are accepted as they are estimated in the VPA. The 1988 and 1989 year classes are assumed to be at the long-term average level of 8778 million individuals.

Input parameters for the projections are given in Table 3.9.9. Results of the projections are given in Table 3.9.10 and Figure 3.9.1. A detailed projection is shown in Table 3.9.11.

Status quo catches in 1989 and 1990 are calculated to be 186,000 and 181,000 t, respectively.

3.9.7 Combined assessment vs. separate assessment of herring stocks in Sub-divisions 25-29

A possible way of judging whether a combined assessment or separate assessments are most appropriate might be to compare the standard errors of logarithmic catchability estimates (SE) from the effort tuning program. If we really have several stocks fluctuating independently of each other, the SE (q) from the combined assessment should at least be as large as the (weighted) mean value of the SE (qs) from the separate assessments. If it is less than the mean, it indicates that a part of the variation in the qs in the separate assessments are caused by changed migration patterns from year to year. The following text table shows the SE (q) values obtained from tuning the VPA to the Swedish acoustic data.

Age	Comb. assess.	Sep. assess. 25-27	Sep. assess. 28-29S
2	0.380	0.496	0.297
3	0.190	0.399	0.146
4	0.202	0.246	0.207
5	0.241	0.256	0.287
6	0.301	0.314	0.261
7	0.256	0.307	0.468
8	0.407	0.313	0.858
Mean	0.282	0.333	0.361

Although SE(q) fluctuates somewhat from age group to age group, the mean of the SE(qs) for the combined assessment is smaller than the separate assessments. Thus, the combined assessment seems to be preferable.

4 SPRAT

4.1 Catches

Total catch of sprat in the Baltic amounted to 80,000 t in 1988 (Table 4.1). This is slightly less than the year before.

Most of the decrease is caused by a drop in the Polish catches (-10,000 t) in Sub-divisions 25 and 26.

4.2 Sprat in Sub-divisions 22, 24, and 25

4.2.1 Catch trends

Country	1977	1978	1979	1980	1981	1982
Denmark	7,167	10,815	5,549	4,738	8,359	6,787
German Dem.Rep.	2,214	1,090	924	114	78	1,022
Germany,Fed.Rep.	766	784	691	541	564	632
Poland	19,984	8,281	5,735	6,217	4,300	4,439
Sweden	173	569	1,336	1,185	747	1,460
USSR	6,000	360	135	-	2	3
Total	36,304	21,899	14,370	12,795	14,050	14,343

Country	1983	1984	1985	1986	1987	1988
Denmark	6,202	2,957	4,148	5,954	2,593	1,972
German Dem.Rep.	2,692	2,761	1,950	2,514	1,307	1,234
Germany,Fed.Rep.	619	663	879	473	1,125	330
Poland	2,786	1,639	5,460	12,057	15,488	10,932
Sweden	1,659	3,232	3,391	2,153	723	1,230
USSR	-	-	-	-	-	-
Total	13,958	11,252	15,828	23,151	21,236	15,698

Weights in t.

The total catch in 1988 decreased by 26.1% as compared with 1987 to about the catch level at the beginning of the 1980s. Major decreases appeared for the catches of the Federal Republic of Germany and Poland. The catch of Denmark decreased by the same relative amount as the total catch and the catch of Sweden increased. Danish and Swedish sprat catches were mainly taken as by-catch in the herring fishery.

4.2.2 Catch in numbers by age and year

The Federal Republic of Germany and Poland provided their total catches in numbers by age groups. The German Democratic Republic provided a proportion of the total catches, namely their catches for the period August-October in numbers by age groups. The remaining proportion of the total catch of this country was raised according to the age composition of the catches of Poland in the same sub-division at the same time. The same procedure was applied to the catches of Denmark. The Swedish catches were raised according to the age composition calculated for the other countries with catches in the assessment unit. Catch numbers are given in Table 4.2.1.

4.2.3 Mean weight at age

The countries providing catches in numbers also supplied mean weights at age in their landings. The age composition of catches calculated country by country on the basis of the catch in numbers by age groups provided was used to calculate weighted mean weights at age (Table 4.2.2).

The SOP of catches in numbers of age groups and the weighted mean weight per age group is in accordance with the nominal catch taken in the assessment unit in 1988.

The mean weights at age in the stock were estimated from weight-at-age data in the catches from the two quarters of the year.

4.2.4 VPA

As in previous assessments, the natural mortality was assumed to be M = 0.4 and constant for all ages and years. By using the tuning module, fishing mortalities for the years 1984-1988 for ages 0-7 have been calculated on the basis of acoustic surveys carried out in these years (Table 4.2.3). Each survey was given the same effort value, namely 1.00. The estimated amounts of sprat per age group were taken as CPUE. The resulting fishing mortality for age 3 was taken as starting fishing mortality in a separable VPA which was run on ages 1 to 5 (Tables 4.2.4). VPA output is shown in Tables 4.2.5 and 4.2.6 and Figures 4.2.1.A and 4.2.1.B.

4.2.5 Recruitment and catch prediction

An analysis of sprat data from young fish surveys carried out in Sub-divisions 22 and 24 by the German Democratic Republic on the basis of the RCRTINX2 program was done. As the data base available for the analysis only included the period 1983-1988, the method could only be applied with a minimum of 4 points used for regression. The resulting prediction of the 1987 and 1988 year classes as 1-group can be taken as a rather conservative one taking into account that the predicted values are respectively

below and slightly above the long-term average values (Table 4.2.7), and that the number of 0-group sprat was high in the catches in 1988 and also in the acoustic survey. From this recruitment prediction, the input values for ages 1 and 2 in 1989 have been calculated. The average recruitment at age 1 amounted to 4,186 millions for the period 1970-1986. This value was appplied in the projection (Table 4.2.8). Weights at age in the stock were the averages of the period 1970-1986. Assuming an exploitation pattern similar to the average situation in 1970-1986, the catch in 1989 could increase to 22,000 t with a fishing mortality at the level of 1988, resulting in a total stock and a spawning stock in 1990 at about the same level as in 1989 (Tables 4.2.9 and 4.2.10 and Figure 4.2.1.D). A continuation of this catch level in 1990 would again result in an unchanged total stock and spawning stock in 1991. This level of fishing mortality is below the biological reference points $F_{0.1}$ (0.480) and F_{med} (0.915).

4.3 Sprat in Sub-divisions 26 and 28

4.3.1 Catch trends

Country	1977	1978	1979	1980	1981	1982
German Dep.Rep.	14,725	12,619	3,057	15	-	-
Poland	18,758	16,411	6,660	6,518	4,591	9,770
Sweden	28	35	65	66	87	120
USSR	51,544	43,700	22,067	18,990	13,093	13,618
Total	85,055	72,765	31,849	25,529	17,770	23,508

Country	1983	1984	1985	1986	1987	1988[1]
Finland	-	-	-	-	21	11
Poland	4,302	7,615	13,023	11,596	16,515	11,304
Sweden	274	4,180	2,395	1,010	2,684	3,921
USSR	8,919	19,354	27,560	29,356	37,426	36,573
Total	13,495	31,149	42,978	41,962	56,646	51,809

[1] Preliminary.
Weights in tonnes.

The catch decreased in 1988 by 7,719 t in Sub-division 26 and increased by 2,822 t in Sub-division 28. Polish catches in 1988 as compared with 1987 decreased by 5,211 t and those of the USSR by 853 t. Swedish catch during this period increased by 1,237 t. The reduction of catches of Poland and the USSR was largely due to the termination of the sprat fishery in the autumn because of large by-catch of small fish of the 1988 year class. The young fish by-catch taken by Soviet fishermen in some fishing grounds even exceeded 50% of the total catch.

Polish CPUE of sprat in Sub-division 26 for the major part of the fleet (governmental fishery enterprises), and the calculated effort are shown in the text table below:

Category	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
CPUE (t)	3.73	4.77	4.09	4.13	3.46	6.07	5.12	6.31	4.63	4.43	4.80	4.08
Standardized effort[1]	5,024	3,439	1,629	1,579	1,328	1,610	840	1,206	2,812	2,620	3,440	2,772

[1] Days fished.

Fishing effort and catch per unit effort in the USSR sprat fishery are given in the following text table:

Year	Sub-division	Trawling hours	Catch per trawling hour (t)
1983	26	3,415	2.26
	28	1,238	0.97
Total		4,653	1.92
1984	26	9,826	1.03
	28	7,959	1.16
Total		17,785	1.09
1985	26	11,182	1.66
	28	7,789	1.16
Total		18,961	1.45
1986	26	8,466	1.18
	28	16,234	1.19
Total		24,700	1.19
1987	26	22,263	1.15
	28	10,948	1.08
Total		33,211	1.12
1988	26	21,095	1.10
	28	13,368	1.00
Total		34,463	1.06

Since USSR and Poland conduct sprat fishery by different types of vessels, their data on CPUE and effort values are incompatible. Sweden and Finland do not have statistical data on these indicators. For this reason to describe the fishery intensity in Sub-divisions 26 and 28, USSR catch per trawling hour data were taken as standard ones. On this basis, the value of fishing effort and CPUE using equation:

$$\text{Total Effort}^{26+28} = \text{Effort}^{26+28}_{USSR} + \frac{\text{Catch}_{Pol}}{\text{CPUE}^{26}_{USSR}} + \frac{\text{Catch}_{SW} + \text{Catch}_{Fin}}{\text{CPUE}^{28}_{USSR}}$$

$$\text{CPUE} = \frac{\text{Catch}^{26+28}_{total}}{\text{Total effort}}$$

The calculation results are represented in the following table:

Total effort and CPUE of sprat in Sub-divisions 26 and 28

Year	1983	1984	1985	1986	1987	1988
Effort (hours)	6,839	28,781	28,871	35,376	50,057	48,671
CPUE (t)	1.98	1.08	1.49	1.19	1.13	1.06

4.3.2 Catch in number

Poland and the USSR supplied catches in numbers by age. The catches taken by Sweden and Finland were raised by the age composition of the USSR (Table 4.3.1).

4.3.3 Mean weight at age

Mean weights used were supplied by Poland and the USSR. These mean weights at age were weighted by catches in numbers of these countries in Sub-divisions 26 and 28, and the resulting mean weights at age were used as the average weights in the catches. Weights at age in the catch and in the stock were taken as being equal for recent years (Tables 4.3.2 and 4.3.3). The SOP based on weighted mean weights at age in 1988 was in very good agreement with the nominal catch (100%) (Table 4.3.4).

4.3.4 VPA

This stock was assessed by two methods, both based on acoustic stock estimates. In one assessment (Assessment 1) the stock at age estimates were regarded as CPUE values and used as input to the standard tuning module. Data from both the international survey and the survey done by the USSR in Sub-divisions 26 and 28 were used.

The other assessment (Assessment 2) was solely based on the USSR data and they were treated in the same way as in last year's assessment: total mortality for the period 1 October 1987 - 1 October 1988 was obtained from the two stock estimates and split into fishing and natural mortality according to the catches in number.

4.3.5 VPA tuned by tuning model (Assessment 1)

A natural mortality level of 0.5 was applied for all years. Stock estimates from the two acoustic surveys were used as "CPUE" input (effort = 10 for all years) to the tuning module. Survey results from 1983-1987 (fourth quarter) were used for 1 January estimates for 1984-1988 (Table 4.3.5).

The log catchabilities (Table 4.3.6) are stable for most age groups, especially for the USSR data. The fishing mortality for 1988 was $F_{(2-6)} = 0.19$. This level of exploitation was also achieved from a separable VPA using reference age = 4, $S_{term} = 1.25$, and $F_{term} = 0.2$ (Table 4.3.7). The resulting fishing mortalities calculated from terminal populations are presented in Tables 4.3.8 and the accompanying stock sizes in Table 4.3.9.

Spawning stock biomass shows an increase from a very low level in 1981 of 24,000 t to around 300,000 t for 1985-88.

4.3.6 Recruitment and prediction

Year classes older than 1988 were taken from the VPA. The 1988 year class was estimated from the USSR 0-group data from a trawl survey in September to be $47,760 \times 10^6$ at age 1 from the regression shown in Figure 4.3.1. This corresponds to 2.2 times the 1979-1986 average. The prediction run with average recruitment for year class 1989 (Table 4.3.10) and with a continuation of the 1988 exploitation pattern gave a SQC of 45,000 t in 1989 and 51,000 t in 1990 (Table 4.3.11).

The 1988 year class makes up 5,000 t of the SQC in 1989 and 22,000 t in 1990 (Table 4.3.12). This year class is at present not estimated with any precision.

4.3.7 VPA tuned from the USSR acoustic surveys (Assessment 2)

F and M values for the 1980-1986 year classes in 1988 were derived from USSR acoustic survey data collected in September-October 1987 and 1988. For calculations the following equations were applied.

$$Z = \ln N_t^{87} - \ln N_t^{88}$$

$$F = Z \times \frac{C_t^{IX87} - IX88}{N_t^{87} - N_t^{88}}$$

$$M = Z - F$$

where N_t is the abundance of the sprat of year class t according to 1987 and 1988 survey data. Results of the calculations are presented in text table below:

Calculated Z, F, and M values for sprat in Sub-divisions 26 and 28 from USSR acoustic data in September-October 1987-1988.

	Year class							Total
	1986	1985	1984	1983	1982	1981	≥1980	
N^{87} millions	23,035	2,246	2,992	2,489	2,341	110	122	33,335
N^{88} millions	14,404	1,251	1,667	1,451	1,301	59	60	20,193
$N^{87}-N^{88}$ millions	8,631	995	1,325	1,038	1,040	51	62	13,142
C(IX87-IX88) millions	2,463	552	706	477	421	19	19	4,658
$Z=\ln\frac{N^{87}}{N^{88}}$	0.47	0.59	0.59	0.54	0.59	0.62	0.71	0.50
$F=Z\frac{C}{N^{87}-N^{88}}$	0.13	0.33	0.32	0.25	0.24	0.23	0.22	0.18
M = Z-F	0.34	0.26	0.27	0.29	0.35	0.39	0.49	0.32

The F and M values were applied in VPA for age groups 2-8+ (year classes 1986 - ≤1980) in 1988 (Tables 4.3.13-4.3.14). Natural mortality of 0- and 1-group sprat was set equal to the average M values for these age-groups in 1984-1987 (C.M.1988/Assess:18, Table 4.3.4). In the following text table, data on the USSR young sprat (t = 0) surveys that have been carried out yearly in September with pelagic commercial trawl and the Isaacs-Kidd trawl, are shown:

Year class	1980	1981	1982	1983	1984	1985	1986	1987	1988
Relative abundance of young sprat according to pelagic trawl survey. Index N_o	0.90	0.36	2.64	4.56	0.80	0.10	9.22	0.01	6.90
Mean weight of young sprat on pelagic trawl catches, w_1, g	3.5	2.9	3.2	2.9	2.3	1.1	2.5	2.6	3.2
Mean weight of young sprat in Isaacs-Kidd trawl, w_2, g	1.7	2.0	2.5	1.3	1.7	1.7	1.2	0.43	2.0

Based on 1-year-old sprat abundances of the 1980-1986 year classes from VPA (Table 4.3.15) and the data on young sprat surveys the following equation was derived for the estimation of 1-year-old numbers from the young sprat survey data:

$$N_2 = 21675.5 + 1461.8 \text{ (Index } N_o) \; W_1 + 16747.5 \; W_2 \quad (r = 0.939)$$

The estimate for the 1988 year class at the age of 1 year is 44 x 10^9 fishes. Taking that into account the terminal F for the 0-groups was chosen to get the 1988 year class abundance close to the calculated one. The 1987 survey showed that in pelagic trawl catches the 0-group was almost absent (the index N_o = 0.01). In the Isaacs-Kidd trawl catches the 0-group weight was very low (w_2 = 0.43 g) and these were in fact whitebait (large larvae). Therefore, the abundance of the year class was not calculated and it was taken equal to the weakest year class in the last 19 year period, the 1977 year class.

VPA results are presented in Tables 4.3.14 and 4.3.15 and Figures 4.3.3.A and 4.3.3.B.

Figure 4.3.2 shows the relationship between average F_{2-6} from VPA and the total effort for the period 1983-1988. The correlation coefficient between them is remarkably high (r = 0.95).

4.3.8 Recruitment and catch prediction

For the prediction, the 1989-1991 year classes were set at the average level for 1979-1986 (Table 4.3.15). The natural mortality level by age was taken as the average for 1984-1988. The fishing pattern for 1988 was applied (Table 4.3.14). Input data are given in Table 4.3.16. Long-term and short-term catch projections are given in Tables 4.3.17-4.3.19 and Figures 4.3.3.C and 4.3.3.D. Taking into account the TACs for sprat in 1989, it can be expected that the sprat catch in that year in Sub-divisions 26 and 28 will be about 60,000-65,000 t if fishing mortality in 1989 is at the level of 1988 (that is considerably less than $F_{0.1}$ = 0.508; Table 4.3.17). The corresponding status quo catch in these sub-divisions in 1990 is about 70,000 t (Table 4.3.18).

4.4 Sprat in Sub-divisions 27, 29 - 32

4.4.1 Catches

Country	1977	1978	1979	1980	1981	1982
Finland	7,212	6,373	7,125	6,311	5,850	4,550
German Dem.Rep.	302	1	37	12	-	-
Poland	22	-	-	-	-	-
Sweden	227	196	825	1,133	716	1,170
USSR	52,180	31,469	22,860	14,429	10,787	5,245
Total	59,943	38,039	30,847	19,885	17,353	10,965

Country	1983	1984	1985	1986	1987	1988[1]
Finland	3,355	2,415	2,923	3,246	2,796	2,985
German Dem.Rep.	-	-	-	-	-	-
Poland	-	-	-	-	-	-
Sweden	783	985	1,325	67	46	2,194
USSR	4,806	6,537	6 443	7,128	7,462	7,608
Total	8,944	9,937	10,691	10,441	10,204	12,787

[1] Preliminary.
Weights in t.

Swedish catches in 1988 as compared with 1987 increased by 2,148 t. Finnish and USSR catches practically remained on the 1987 level. The catches were mainly taken in the mixed herring-sprat fishery as herring by-catch.

4.4.2 Catch in numbers by age and year

The USSR and Finland presented catches in millions by age groups. The Swedish catch was raised to the age composition of the combined USSR and Finnish landings (Table 4.4.1).

4.4.3 Mean weight at age

Weighted mean weight-at-age data from the USSR and Finnish fisheries were applied for 1988 (Table 4.4.2). The nominal catch constituted 100% of the calculated one (Table 4.4.3). Weights at age in the catch and in the stock were taken as being equal.

4.4.4 VPA

A constant natural mortality rate (M = 0.3) was assumed for all age groups, as in the previous report. The input Fs for the oldest age groups for all years and for age groups 1 and older in 1988 were estimated using the separable VPA. For calculations the terminal F value 0.104 for the 2-year-old sprat was assumed, at which age sprat is fully recruited. Taking into account that from 1983 onwards directed fishing for sprat did not occur in that region and sprat was taken as by-catch in the herring fishery which has been comparatively stable, the terminal F value was selected close to the average for the period 1983-1987 (Table 4.4.4). Runs with six different terminal S values (0.5; 1.0;

1.5; 2.0; 2.5, and 3.0) were made. After a comparison of the results, the terminal S value of 1.5 was selected as probably best reflecting the observed exploitation pattern (Table 4.4.5). The terminal F for 0-group sprat in 1988 was taken to be equal to the mean for 1983-1987 (Table 4.4.4). The VPA results are shown in Tables 4.4.6 and 4.4.7, and in Figures 4.4.1.A and 4.4.1.B.

4.4.5 Recruitment and catch prediction

The average recruitment amounted to about 4.665 millions for 1979-1986 (Table 4.4.7). This value was applied for the projection. The weights at age in the stock and in the catch used for the projection were the averages of the period 1979-1988. For the prediction calculations, the 1988 F pattern was used (Table 4.4.8).

Owing to the good 1988 year class, it is expected that sprat catches and spawning stock in Sub-divisions 27, and 29-32 will increase. The long-term and short-term catch and stock projections are presented in Tables 4.4.9-4.4.11 and in Figures 4.4.1.C and 4.4.1.D.

4.5 Sprat in the Total Baltic (Sub-divisions 22-32)

The Working Group made, for the first time, an assessment for the total sprat in the Baltic. This was done partly in order to discover if migrations in the time between the acoustic surveys and fishing season had caused double counting. It is also possible that catches in the deeper parts of Sub-division 28 can contain older sprat coming from the Northern and Southern stocks; the so-called "pool of seniors" in the Gotland Deep area.

4.5.1 Catches

The catches have shown large fluctuations, a decrease from about 250,000 t in 1974 down to below 50,000 t in 1981-1983. Thereafter an increase to 80,000-90,000 t.

4.5.2 Catches in number at age

Catches in number were summed from the existing files covering the stocks in Sub-divisions 22-25, Sub-divisions 26 and 28, and Sub-divisions 27, 29-32 (Table 4.5.1).

4.5.3 Mean weight at age and maturity data

Mean weight in the catches were obtained by weighting the means from the three stocks by catches in numbers (Table 4.5.2). A maturity ogive was calculated as an average of the existing ogives.

4.5.4 VPA

Natural mortality was assumed to be constant over years and age groups. A value of M = 0.4 was used as a rough mean over the three stocks. Results from the International Acoustic Survey in Sub-divisions 24-29 in October and from the USSR Acoustic Surveys in Sub-divisions 26 and 28 in September were used for tuning the VPA. The values of estimated stock in number at age were treated as CPUE data and accompanied by an effort level of 1.0 for all years. Survey data from 1983-1987 were taken to represent the

stock at 1 January 1984-1988. Tuning data are shown in Table 4.5.3. Catchability estimates (logged) at age are given in Table 4.5.4. Sigma values for age groups 2-4 are around 0.2, and for age groups 5-6 about 0.6.

Results from the VPA based on the tuning are given in Tables 4.5.5 and 4.5.6. The stock sizes from this analysis are compared with the stock biomasses estimated by the surveys in Figure 4.5.1.

A separable VPA with a terminal selection value of 1.0, a terminal F of 0.2, and a reference age of 4 was performed (Table 4.5.7). Terminal populations were used for determining the fishing mortalities shown in Table 4.5.8; stock sizes are given in Table 4.5.9.

4.5.5 Recruitment and catch predicition

The relative sizes of the year classes are of course similar to that of the Sub-divisions 26 and 28 stock: year classes 1985 and 1987 below, and 1986, above average. The size of the 1988 year class was assumed to be 2.2 times the long-term (1974-1988) average, i.e., the same relation to the mean as in Sub-divisions 26 and 28 ($2.2 \times 25.9 = 57 \times 10^9$ fish; see Section 4.3.6). The prediction was made with the 1989 year class assumed as average, with a continuation of the 1988 exploitation pattern in 1989 and with mean weights taken as the 1984-1988 average (Tables 4.5.10 to 4.5.13). The status quo catches predicted are 72,000 t in 1989 and 89,000 t in 1990.

Under these assumptions, spawning stock biomass will increase from around 350,000 t at 1989 spawning time to about 450,000 t in 1991.

A comparison with the sum of single assessments concerning SQC for 1989-1990 is shown below:

	SQC ('000 t)	
Area	1989	1990
22-25[1]	22	21
26-28[1]	45	51
26-28[2]	65	67
27, 29-32	15	21
Sum	82-102	93-109
Total area	72	89

[1] Assessment 1.
[2] Assessment 2.

5 EFFORT AND CPUE

Effort and CPUE data from the herring fisheries have been revised, particularly the Polish and Finnish data for 1987 (Table 5.1). Data for 1988 are preliminary (Table 5.2). It is noted by the Working Group that the reporting of effort data is unreliable and that changes in fishing power (e.g., by more powerful engines or better acoustic equipment) are not taken into account.

A standardization of effort data should make them more useful for assessment purposes.

6 FUTURE WORK

Changes in length at age of the order 10-15% (Rechlin, 1984) and in weight at age of the order 30-40% (Anon., 1988a) have been observed for some herring stocks in the Baltic. Moreover, marked changes have also been reported for herring stocks in the North Sea and to the west of the British Isles in recent years (Anon., 1988b).

The Working Group, therefore, recommends that a review of growth changes be undertaken to consider:

1) indication of a dependency of growth rate on stock abundance (i.e., density dependence);

2) if a similar pattern in growth changes were observed in different stocks and in different geographical areas, thus indicating general environmental influence;

3) implications of growth changes to the management of the herring stocks.

The Working Group stressed the need for careful selection of data in order not to confuse real growth changes with apparent changes caused by a change in gear selectivity, changes in time of sampling between years or by not sampling the same stock across the years studied. Standardized growth rates should be used (Iles, 1967) and the analyses carried out for both young and fully recruited herring.

7 STOCK INFORMATION TO THE HELSINKI COMMISSION

Reviews of the stocks of herring and sprat stocks in the Baltic were made and handed over to the ICES Secretariat.

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Table 2.1.1 Finnish HERRING catches in the Baltic Sea by Sub-divisions in 1974-88 (tonnes). By-catch of sprat in directed herring fisheries excluded. Data for 1988 preliminary.

Subdiv.	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
27	0	0	5	45	148	0	5	0	0	0	0	0	89	344	81
28	0	0	0	0	0	1	2	0	5	0	0	0	116	2111	1840
29S	0	0	57	119	352	17	64	30	163	44	11	8	335	325	449
29N	20682	26308	19868	21188	23997	29469	33693	29736	31038	36559	33432	34883	32283	30557	31423
30	17597	13567	19315	22694	22215	17459	18758	12410	16117	16104	23228	24235	23988	22615	20928
31	5737	4802	7763	6580	9068	6275	8899	7206	7982	7011	8322	8595	8754	7788	7171
32	11579	8321	12525	12317	13791	10929	10207	12781	16272	22470	20695	19290	16533	17080	15021
Total	55595	52998	59471	62779	69571	64150	71628	62163	71577	82188	85688	87011	82098	80820	76913

Table 2.1.2 Finnish SPRAT catches in the Baltic Sea by Sub-divisions in 1974-88 (tonnes). By-catch of sprat in herring fisheries included. Data for 1988 preliminary.

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
Subdiv.															
27	0	0	0	1	7	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	21	11
29	2238	2577	415	2578	2633	3823	3775	3900	2964	2413	1713	1862	2178	1776	1975
30	18	6	0	101	162	38	234	8	16	0	33	3	5	4	3
31	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0
32	2624	3835	4694	4022	3250	3175	2182	2034	1557	962	654	1046	1052	1016	1007
Total	4880	6418	5109	6702	6052	7036	6191	5952	4537	3375	2400	2911	3235	2817	2996

Table 3.1.1 HERRING catches in the Baltic Sea by countries and sub-divisions, 1987 and 1988 (t). By-catch of sprat in directed herring fisheries excluded and by-catch of herring in sprat fisheries included.

Year and country	Total catch	Sub-divisions											
		22	23	24	25	26	27	28	29S	29N	30	31	32
1987													
Denmark	33,973	22,555	754	6,506	4,158	-	-	-	-	-	-	-	-
Finland	80,820	-	-	-	-	-	344	2,111	325	30,557	22,615	7,788	17,080
German Dem. Rep.	49,880	465	-	46,802	1,991	-	611	11	-	-	-	-	-
Germany, Fed. Rep.	5,806	5,178	-	628	+	-	-	-	-	-	-	-	-
Poland	63,490	-	-	7,997	39,732	15,393	344	24	-	-	-	-	-
Sweden	35,564	-	172	7,814	15,602	88	7,738	1,606	8	311	1,905	320	-
USSR	113,844	-	-	-	8,061	24,140	3,577	32,336	24,268	-	-	-	21,462
Total	383,377	28,198	926	69,747	69,544	39,621	12,614	36,068	24,601	30,868	24,520	8,108	38,542
1988[1]													
Denmark	43,971	23,987	102	9,088	10,794	-	-	-	-	-	-	-	-
Finland	76,913	-	-	-	-	-	81	1,840	449	31,423	20,928	7,171	15,021
German Dem. Rep	53,456	-	-	49,488	3,866	102	-	-	-	-	-	-	-
Germany, Fed. Rep.	5,188	4,937	-	251	-	-	-	-	-	-	-	-	-
Poland	63,746	-	-	6,590	36,777	20,379	-	-	-	-	-	-	-
Sweden	41,540	-	117	4,586	16,941	24	14,366	1,319	100	648	3,172	267	-
USSR	122,849	-	-	-	9,051	26,767	4,795	36,673	22,423	-	-	-	23,140
Total	407,663	28,924	219	70,003	77,429	47,272	19,242	39,832	22,972	32,071	24,100	7,438	38,161

[1] Preliminary data.

Table 3.2.1 HERRING. Catch at age (millions) and mean weight at age (g) by half year from Sub-divisions 22-24 in 1988.

Age	1st half year		2nd half year		Total	
	N	$\bar{w}$	N	$\bar{w}$	N	$\bar{w}$
0	-	-	789.5	11.03	789.5	11.03
1	658.3	13.76	153.8	32.38	812.1	17.29
2	311.4	25.00	51.3	54.47	362.7	29.17
3	325.1	83.01	24.8	93.86	349.9	83.78
4	122.8	110.31	15.1	93.04	137.8	108.43
5	104.2	126.98	10.8	102.67	115.0	124.69
6	27.6	152.34	4.6	102.19	32.2	145.20
7	6.5	160.31	3.4	143.50	9.9	154.52
8+	2.5	152.55	3.0	122.63	5.6	136.26
SOP(t)	76,242		22,655		98 897	

Table 3.2.2 HERRING. Catch at age (millions) and mean weight at age (g) of spring spawners in Division IIIa in 1988. Transfers from the North Sea are included. Source: Table 3.2.2 Anon., 1989a.

Age	1st half 1988[1]		2nd half 1988[1]		Total	
	N	$\bar{w}$	N	$\bar{w}$	N	$\bar{w}$
2	745	33	1330	55	2075	47
3	343	65	221	94	563	77
4	39	92	24	128	62	106
5	18	128	15	147	32	138
6	5	155	2	177	8	156
7	1	170	-	-	-	-
SOP (t)	53.767		99.650		154.072	

[1] Calculations based on quarterly values.

Table 3.2.3 SUM OF PRODUCTS CHECK

HERRING IN THE WESTERN BALTIC AND KATTEGAT
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: millions

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
2	438	301	585	488	931	1074	494	1005	572	850	1207	849
3	379	242	229	291	586	440	908	467	779	485	521	844
4	274	257	110	140	70	105	143	277	150	348	235	353
5	91	138	55	50	19	13	25	58	84	39	162	108
6	22	51	27	21	8	4	7	18	18	14	24	35
7	6	19	11	7	4	3	2	4	4	2	8	7
8+	3	2	4	4	5	1	2	4	3	3	2	6
TOTAL	1213	1010	1021	1001	1623	1640	1581	1833	1610	1741	2159	2202

	1986	1987	1988
2	468	988	2443
3	611	388	928
4	390	394	205
5	123	125	152
6	28	37	41
7	10	10	11
8+	3	4	6
TOTAL	1633	1945	3786

Table 3.2.4 SUM OF PRODUCTS CHECK

HERRING IN THE WESTERN BALTIC AND KATTEGAT
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: gram

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
2	76.300	59.080	59.570	61.240	58.430	61.720	63.190	64.010	63.310	60.390	63.370	62.860
3	111.000	94.190	93.380	96.320	94.050	92.290	96.620	96.320	100.610	97.030	106.680	108.410
4	137.200	127.190	126.650	126.710	126.580	126.500	126.630	127.190	127.500	128.400	131.890	136.390
5	172.900	146.850	146.620	148.090	146.350	147.070	145.980	146.830	149.420	147.070	147.590	153.730
6	209.000	167.950	166.890	168.720	169.140	169.140	170.380	168.170	172.030	167.900	172.410	173.030
7	236.200	190.620	190.440	191.090	190.840	191.390	189.290	190.870	190.870	192.440	204.490	200.140
8+	240.800	192.610	183.870	183.870	185.620	192.610	192.610	183.870	180.960	180.960	197.210	194.720

	1986	1987	1988
2	72.560	51.990	45.200
3	91.260	80.290	71.700
4	120.690	99.910	101.000
5	152.000	127.070	124.800
6	177.390	144.620	144.400
7	184.100	157.800	145.700
8+	199.780	166.420	135.800

Table 3.2.5.1 Separable VPA.

Title : HERRING IN FISHING AREAS 22 AND 24
At 16.13.48 24 APRIL 1989
from 70 to 88 on ages 0 to 7
with Terminal F of .400 on age 4 and Terminal S of 1.000

Initial sum of squared residuals was 175.287 and
final sum of squared residuals is 47.946 after 109 iterations

Matrix of Residuals

Years Ages	70/71	71/72	72/73	73/74	74/75	75/76	76/77	77/78
0/ 1	-1.115	-1.085	-.774	-1.486	-.977	-.443	-.350	-1.192
1/ 2	.121	1.157	1.736	.519	.968	.082	.672	.334
2/ 3	1.496	.563	-.487	-1.378	-.211	-.068	.469	-.442
3/ 4	1.191	-.225	-.414	-.756	.328	-.075	-.100	.385
4/ 5	.033	-.714	-.102	.489	.315	.197	-.194	.458
5/ 6	-1.038	-.314	.478	1.152	-.196	.090	-.327	-.027
6/ 7	-1.642	1.619	-.171	1.385	-.807	.003	.073	-.234
	.000	.000	.000	.000	.000	.000	.000	.000
WTS	.100	.100	.100	.100	.100	.100	.100	.100

Years Ages	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88		WTS
0/ 1	-.540	.817	.922	-1.003	-.598	.022	-.279	.400	-.119	.759	.000	.444
1/ 2	-.335	-.383	-.585	-1.125	-.485	-.016	-.381	-.021	-.227	.376	.000	.468
2/ 3	.241	-.120	.033	-.048	-.237	.552	.113	-.092	-.173	-.380	.000	.559
3/ 4	.143	.510	.719	.492	-.085	.353	-.137	-.184	-.108	-.134	.000	.714
4/ 5	.623	.348	-.002	.345	.189	-.063	-.242	-.174	.284	-.004	.000	1.000
5/ 6	-.285	-1.061	-.775	.218	.384	-.585	.586	.218	.155	-.203	.000	.570
6/ 7	-.717	-.533	-.532	.421	.661	-.396	.584	.155	-.095	-.200	.000	.420
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-3.072	
WTS	.100	.100	.100	.100	.100	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	70	71	72	73	74	75	76	77	78
F-values	.2696	.3319	.4439	.5512	.5253	.9701	.9921	1.2152	.9687

	79	80	81	82	83	84	85	86	87	88
F-values	.7255	.6412	.6669	.7655	.6373	.6914	.6953	.5716	.5495	.4000

Selection-at-age (S)

	0	1	2	3	4	5	6	7
S-values	.0538	.2535	.2587	.6559	1.0000	1.1835	1.0983	1.0000

Table 3.2.5.2
Analysis by RCRTINX2 of data from file RECBAL W BAL-herring as 0-group: Post 1977, 0.1 and 2-group data.

Data for 3 surveys over 12 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 2 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .00
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1982

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYSF2	7.2584	.000	.000	.0000	0	.0000	.00000	.00000	.00000
GDR 0	3.0773	.000	.000	.0000	0	.0000	.00000	.00000	.00000
GDR 1	1.0818	1.042	6.914	.4867	5	8.0411	.35192	.39449	.35843
MEAN						8.2274	.29486	.29486	.64157

Yearclass = 1983

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYSF2	7.5326	.395	5.584	.9453	5	8.5589	.07254	.09353	.85222
GDR 0	5.3149	.766	5.407	.2619	5	9.4803	.50631	.85444	.01021
GDR 1	1.3584	1.231	6.746	.3596	6	8.4182	.40927	.44843	.03708
MEAN						8.2588	.27238	.27238	.10050

Yearclass = 1984

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYSF2	7.3544	.361	5.783	.8812	6	8.4350	.09882	.11293	.74541
GDR 0	4.6298	.504	6.249	.2711	6	8.5818	.44138	.50240	.03766
GDR 1	1.2613	1.212	6.763	.3693	7	8.2915	.35953	.38601	.06380
MEAN						8.2749	.24917	.24917	.15312

Yearclass = 1985

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYSF2	7.9800	.380	5.609	.7168	7	8.6411	.15051	.19173	.47732
GDR 0	4.9273	.551	5.996	.2032	7	8.7098	.47422	.54766	.05850
GDR 1	1.3056	1.249	6.702	.3541	8	8.3323	.33910	.36234	.13365
MEAN						8.2615	.23040	.23040	.33053

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYSF2	8.9664	.378	5.566	.5067	8	8.9543	.21236	.31608	.25036
GDR 0	5.2101	.551	5.927	.1707	8	8.7984	.47444	.55336	.08168
GDR 1	2.0744	1.259	6.678	.3448	9	9.2887	.31515	.47644	.11019
MEAN						8.2580	.21177	.21177	.55776

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYSF2									
GDR 0	4.5535	.542	5.957	.3009	9	8.4265	.43207	.46025	.12621
GDR 1	1.3218	.869	7.144	.6127	10	8.2925	.22284	.23542	.48239
MEAN						8.3171	.26136	.26136	.39140

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter-cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYSF2									
GDR 0	4.7883	.545	5.936	.2990	10	8.5444	.40464	.43401	.24297
GDR 1									
MEAN						8.3255	.24588	.24588	.75703

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1981	.00	1.00	.00	.00	8.23 3757.00	.00
1982	8.16	3500.49	.24	.09	8.41 4496.00	.38
1983	8.53	5079.15	.09	.08	8.36 4287.00	.89
1984	8.41	4477.81	.10	.04	8.17 3542.00	.43
1985	8.48	4809.45	.13	.11	8.23 3764.00	.81
1986	8.59	5377.92	.16	.23	8.77 6441.00	1.42
1987	8.32	4101.21	.16	.03	8.37 4324.00	.18
1988	8.38	4353.14	.21	.09		.44

Table 3.2.5.3 VIRTUAL POPULATION ANALYSIS

HERRING IN FISHING AREAS 22 AND 24

CATCH IN NUMBERS UNIT: millions

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	14	23	19	25	31	91	256	89	60	204	84	40
1	176	175	299	165	340	466	438	1310	703	239	253	110
2	270	135	50	44	62	150	258	156	426	447	197	302
3	238	122	161	152	244	185	201	228	231	332	625	279
4	67	78	168	227	227	200	105	128	59	87	115	211
5	40	50	124	119	65	123	52	43	17	8	23	52
6	18	68	41	37	13	45	26	18	7	4	7	17
7	5	57	8	24	3	18	11	6	4	3	2	4
8+	2	19	3	4	2	2	4	4	5	1	1	4
TOTAL	829	726	872	797	987	1279	1349	1981	1512	1325	1305	1018

	1982	1983	1984	1985	1986	1987	1988
0	99	100	58	159	313	771	611
1	391	475	335	243	280	1090	861
2	245	334	334	312	131	221	364
3	496	361	292	416	404	220	363
4	124	290	182	218	280	311	142
5	70	35	144	97	94	97	119
6	15	12	22	25	21	28	34
7	4	2	7	4	6	8	10
8+	3	3	2	5	3	4	6
TOTAL	1447	1612	1376	1479	1532	2750	2510

Table 3.2.5.4 VIRTUAL POPULATION ANALYSIS

HERRING IN FISHING AREAS 22 AND 24

MEAN WEIGHT AT AGE OF THE STOCK UNIT: gram

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	9.000	9.000	9.000	9.000	9.000	9.000	9.000	9.000	9.000	9.000	13.400	13.400
1	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000	16.000	25.800	25.800
2	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	60.000	62.300	62.300
3	95.000	95.000	95.000	95.000	95.000	95.000	95.000	95.000	95.000	95.000	90.500	90.500
4	125.000	125.000	125.000	125.000	125.000	125.000	125.000	125.000	125.000	125.000	135.800	135.800
5	155.000	155.000	155.000	155.000	155.000	155.000	155.000	155.000	155.000	155.000	156.500	156.500
6	187.000	187.000	187.000	187.000	187.000	187.000	187.000	187.000	187.000	187.000	187.000	187.000
7	210.000	210.000	210.000	210.000	210.000	210.000	210.000	210.000	210.000	210.000	214.600	214.600
8+	223.000	223.000	223.000	223.000	223.000	223.000	223.000	223.000	223.000	223.000	236.700	226.200

	1982	1983	1984	1985	1986	1987	1988
0	12.000	12.000	12.000	12.000	1.000	5.500	11.000
1	29.000	29.000	29.000	14.000	13.000	12.800	16.900
2	59.000	59.000	50.000	40.000	28.500	33.700	29.100
3	88.000	88.000	88.000	85.000	56.500	81.700	83.800
4	115.000	115.000	115.000	124.000	92.500	101.200	108.500
5	142.000	142.000	140.000	146.000	137.500	132.900	124.800
6	167.000	167.000	160.000	165.000	188.500	162.500	142.200
7	191.000	191.000	191.000	196.000	200.000	176.200	143.700
8+	221.000	221.000	214.000	221.000	230.000	185.400	135.800

Table 3.2.5.5 VIRTUAL POPULATION A[illegible]YSIS

HERRING IN FISHING AREAS 22 AND 24

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = .30

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	.0064	.0109	.0137	.0142	.0158	.0451	.0610	.0199	.0278	.0502	.0298	.0118
1	.1078	.1134	.2128	.1753	.3009	.3853	.3530	.5609	.2396	.1649	.0898	.0550
2	.2530	.1249	.0479	.0480	.1017	.2342	.4325	.2292	.4033	.2642	.2215	.1638
3	.3881	.1932	.2407	.2224	.4602	.5588	.6413	1.0086	.7099	.7293	.8264	.6343
4	.2280	.2383	.4984	.7201	.6816	1.0119	.8477	1.4222	.9331	.7371	.6994	.8810
5	.2218	.3015	.8318	.9416	.5273	1.2233	.9420	1.3000	.8650	.3495	.4889	.9544
6	.1092	.8267	.4870	.7561	.2732	1.0262	1.1282	1.2478	.8222	.6286	.5890	.9626
7	.2688	.6582	.2370	.6938	.1517	.8162	.8948	1.1822	1.1730	1.1980	.8527	1.0296
8+	.2688	.6582	.2370	.6938	.1517	.8162	.8948	1.1822	1.1730	1.1980	.8527	1.0296
(1- 6)U	.2180	.2996	.3864	.4772	.3908	.7399	.7241	.9615	.6622	.4789	.4858	.6085

	1982	1983	1984	1985	1986	1987	1988
0	.0235	.0230	.0246	.0391	.0684	.2383	.1855
1	.1704	.1668	.1110	.1511	.0995	.4003	.5155
2	.1855	.2404	.1889	.1595	.1264	.1182	.2521
3	.4970	.5144	.3849	.4270	.3577	.3627	.3240
4	.7558	.7050	.6102	.6354	.6564	.5882	.4767
5	.9967	.5660	1.1373	.9173	.7249	.5705	.5340
6	.9378	.5112	1.0188	.6964	.5845	.5590	.4541
7	.7531	.3420	.6656	.5780	.3982	.5486	.4515
8+	.7531	.3420	.6656	.5780	.3982	.5486	.4515
(1- 6)U	.5905	.4506	.5752	.4978	.4249	.4331	.4261

Table 3.2.5.6 VIRTUAL POPULATION ANALYSIS

HERRING IN FISHING AREAS 22 AND 24

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .100
PROPORTION OF ANNUAL M BEFORE SPAWNING: .250

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	2559	2447	1618	2058	2293	2384	4996	5230	2517	4822	3306	3932
1	1988	1884	1793	1183	1503	1672	1688	3482	3798	1813	3398	2377
2	1390	1322	1246	1074	735	824	843	879	1472	2214	1139	2301
3	847	799	864	880	758	492	483	405	518	729	1260	676
4	377	426	488	503	522	355	208	188	109	189	260	408
5	230	222	248	220	181	196	95	66	34	32	67	96
6	202	136	122	80	63	79	43	28	13	11	17	30
7	24	134	44	55	28	36	21	10	6	4	4	7
8+	8	44	14	8	16	5	7	6	9	1	3	7
TOTAL NO	7625	7415	6439	6060	6100	6042	8384	10295	8476	9815	9453	9836
SPS NO	1801	1848	1808	1696	1438	1152	914	800	996	1460	1502	1763
TOT.BIOM	346159	358560	334896	310839	275389	242416	223171	236511	245504	306159	367378	397831
SPS BIOM	195756	210064	196151	182827	158943	126740	92026	75900	82964	118196	139579	158236

	1982	1983	1984	1985	1986	1987	1988	1989
0	4926	5084	2765	4789	5471	4185	4158	0
1	2879	3565	3681	1998	3412	3785	2443	2559
2	1667	1799	2235	2440	1273	2288	1879	1081
3	1447	1026	1048	1371	1541	831	1506	1082
4	266	652	454	528	663	799	428	807
5	125	92	239	183	207	255	329	197
6	27	34	39	57	54	74	107	143
7	9	8	15	10	21	22	32	50
8+	6	12	6	13	10	10	19	24
TOTAL NO	11353	12272	10481	11390	12653	12249	10900	
SPS NO	1956	2012	2173	2503	2315	2396	2512	
TOT.BIOM	424226	458763	439881	406044	279777	349000	377635	
SPS BIOM	168210	179978	182962	313	160813	185236	199766	

Table 3.2.6.1 Herring. Division IIIa and Sub-divisions 22- 24. Data for regression analysis of young fish indices against the combined VPA on 2-group at 1 January. (The values shown for the GDRYFS 0- and 1-group indices are exp of the log scale indices.)

	Spring spawners					
Year class	VPA 2-group (millions)	IYFS 2-group	GDRYFS 0-group	GDRYFS 1-group	IYFS 3-group	IYFS 3+-group
1977	3,066	-	-	2.61	147	162
1978	1,574	307	22.65	1.58	315	349
1979	3,159	1,318	98.49	5.99	183	196
1980	1,982	445	27.11	1.77	184	240
1981	2,586	946	57.97	2.03	344	445
1982	3,487	1,419	20.70	1.95	1,392	2,037
1983	2,834	1,867	202.35	2.89	1,737	1,897
1984	1,578	1,562	101.49	2.53	465	732
1985	3,491	2,921	137.00	2.69	5,219	7,084
1986	8,475	7,834	182.11	6.96	3,419	3,757
1987	-	0	93.69	2.75	-	-
1988	-	-	119.10	-	-	-

Table 3.2.6.2 HERRING in Division IIIa - Sub-divisions 22-24. The relation between acoustic estimates in Division IIIa, August/September in 1979-1987 and VPA estimates at 1 January the following year by age group.

Category	Year									
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Age 2										
VPA	1,548	845	1,685	1,109	1,355	1,773	1,558	872	1,971	4,746
Acoustic	1,067	434	1,260	989	1,160	2,069	1,132	1,473	958	1,512
	R^2 = 0.31 a = 817 b = 0.44 x = acoustic y = VPA N = 8									
Age 3										
VPA	271	460	276	684	475	643	699	729	367	882
Acoustic	93	473	44	221	413	756	73	317	665	761
	R^2 = 0.11 a = 455 b = 0.25									
Age 4										
VPA	60	94	131	93	250	79	213	225	246	136
Acoustic	13	84	22	31	122	126	11	77	310	87
	R^2 = 0.04 a = 124 b = 0.31									
Age 5+										
VPA	20	39	37	46	59	84	76	99	104	108
Acoustic	4	31	26	9	13	36	1	10	160	94
	R^2 = 0.00 a = 57 b = 0.04									

Table 3.2.6.3 HERRING in Division IIIa and Sub-divisions 22-24. The acoustic estimates of number at age (in millions) from the four acoustic surveys conducted in the area during 1987 and 1988.

1987

	1	2	3	4	5	6	
Age	Aug - Sep Div.IIIa and eastern part of North Sea (from Anon.1988b)	Dec Div.IIIa	Oct (Germany Fed.Rep.- DK) Sub-division 22	24	Oct (Sweden) Sub-division 23	24	Combination of 1 and 3 - 6[1]
0	-	10,192	418	1,517	346.6	2,077.1	2,562
1	-	3,619	592	838	272.3	1,137.9	1,852
2	958	312	163	652	166.7	294.6	1,761
3	665	7	45	324	22.2	87.4	938
4	310	5	-	4	9.8	45.9	345
5	114	-	-	-	1.1	8.5	124
6	43	-	-	-	1.1	0.9	45
7+	3	-	-	-	-	0.2	3
Tonnes	252,459	311,000	36,863	108,407	26,200	61,800	

[1] This combination is obtained by taking the mean of column 4 and 6 and adding columns 1, 3, and 5 to this mean.

1988

	1	2	3	4	5	6	
	Aug - Sep Div. IIIa and adjacent part of North Sea (from Anon.1989)	Dec Div. IIIa (from Anon.1989)	Oct (Germany Fed.Rep.- DK) Sub-division 22[2]	24	Oct (Sweden) Sub-division 23	24	Combination of 1, 3, 5, and 6[2]
0	-	2,257	598	No	5,084	2,723	8,355
1	-	2,803	426	survey	443	820	1,689
2	1,512	54	265		493	479	2,749
3	761	23	117		240	227	1,345
4	87	5	-		28	130	245
5	74	-	-		10	59	143
6	18	-	-		1	29	48
7+	22	-	-		-	19	21
Tonnes	217,997	234,000	-		119,000	113,300	

[2] 3 was constructed based on 1987 data. It was assumed that the relative distribution in 1988 between Sub-divisions 22 and 24 was the same as in 1987 by age.

Table 3.2.6.4

Title : HERRING IN THE WESTERN BALTIC AND KATTEGAT
At 11.15.58 17 APRIL 1989
from 74 to 88 on ages 2 to 7
With Terminal F of .900 on age 5 and Terminal S of .900

Initial sum of squared residuals was 21.790 and
Final sum of squared residuals is 8.667 after 85 iterations

Matrix of Residuals

Years	74/75	75/76	76/77	77/78
Ages				
2/ 3	.757	-.188	.635	-.788
3/ 4	.205	-.068	.016	.360
4/ 5	.082	.191	-.173	.370
5/ 6	-.320	-.073	-.322	-.179
6/ 7	-.651	-.045	.185	-.209
	.000	.000	.000	.000
WTS	.001	.001	.001	.001

Years	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88		WTS
Ages												
2/ 3	.113	-.082	.080	-.075	-.427	.497	.167	.021	-.042	-.147	.000	.444
3/ 4	.696	.549	.864	.418	-.134	.418	-.142	.127	-.109	.121	.000	.556
4/ 5	.163	.440	.152	-.004	-.050	.059	-.186	-.024	.176	.033	.000	1.000
5/ 6	-.327	-.695	-.727	-.367	.047	-.521	.250	-.054	-.076	-.117	.000	.650
6/ 7	-.777	-.516	-.392	.087	.569	-.349	.057	-.043	-.094	.081	.000	.498
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-.509	
WTS	.001	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	74	75	76	77	78
F-values	.9028	1.3920	1.2125	1.7066	1.4572

	79	80	81	82	83	84	85	86	87	88
F-values	1.0318	.9734	1.2911	1.2769	.8762	1.0592	1.1002	.9986	.9490	.9000

Selection-at-age (S)

	2	3	4	5	6	7
S-values	.3626	.5782	.8407	1.0000	.9259	.9000

Table 3.2.6.5
Analysis by RCRTINX2 of data from file RECBAL
WESTERN BALTIC AND DIV IIIA HERRING RECRUITMENT INDICES.

Data for 4 surveys over 12 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 1 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .00
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1985

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS 2	7.9800	.974	1.028	.2550	7	8.8032	.63230	.81843	.09983
GDR 0	4.9273	4.568	-10.850	.0067	7	11.6586	4.51783	5.25844	.00242
GDR 1	1.3056	2.641	4.495	.1593	8	7.9433	.81636	.87841	.08666
ACOUST	6.8659	1.421	-2.218	.2710	8	7.5358	.58790	.63377	.16648
MEAN						7.7920	.32208	.32208	.64461

Yearclass = 1986

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS 2	8.9664	.735	2.821	.3882	8	9.2126	.46795	.71273	.14718
GDR 0	5.2101	1.650	.886	.0549	8	9.4810	1.54641	1.82116	.02254
GDR 1	2.0744	2.973	4.108	.1524	9	10.2754	.84137	1.33077	.04222
ACOUST	7.3218	2.047	-6.535	.1546	9	8.4543	.83433	.92392	.08758
MEAN						7.8426	.32670	.32670	.70048

Yearclass = 1987

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS 2	.6931	.675	3.040	.7003	9	3.5076	.39319	1.15625	.08588
GDR 0	4.5506	1.336	2.185	.2160	9	8.2641	1.14522	1.22659	.07631
GDR 1	1.3218	1.768	5.590	.5780	10	7.9275	.48854	.51946	.42547
ACOUST									
MEAN						7.9981	.52766	.52766	.41235

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
IYFS 2									
GDR 0	4.7883	1.345	2.140	.2147	9	8.5807	1.16801	1.27370	.14877
GDR 1									
ACOUST									
MEAN						8.0009	.53248	.53248	.85123

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis		Ext.SE/ Int.SE
1985	7.87	2624.80	.26	.19	8.16	3492.00	.74
1986	8.24	3779.99	.27	.34	9.04	8476.00	1.24
1987	7.60	2003.68	.34	.73			2.14
1988	8.09	3252.53	.49	.21			.42

Table 3.2.6.6 VIRTUAL POPULATION ANALYSIS

HERRING IN THE WESTERN BALTIC AND KATTEGAT

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

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
2	.57	.45	.76	.41	.71	.48	.42	.43	.38	.45	.47	.39
3	.62	.72	.74	1.18	1.32	.90	1.01	.92	.70	.65	.54	.72
4	.80	1.22	.87	1.62	1.08	.94	.86	1.06	.89	.81	.77	.90
5	.73	1.37	.98	1.43	1.12	.59	.60	1.10	1.19	.61	1.21	1.05
6	.55	1.29	1.21	1.46	.98	.76	.76	1.28	1.42	.63	1.00	.98
7	.80	1.45	1.17	1.38	1.46	1.42	1.17	1.51	1.21	.56	.94	.96
8+	.80	1.45	1.17	1.38	1.46	1.42	1.17	1.51	1.21	.56	.94	.96
(2- 6)U	.65	1.01	.91	1.22	1.04	.73	.73	.96	.92	.63	.80	.81
(3- 6)U	.67	1.15	.95	1.42	1.13	.80	.81	1.09	1.05	.67	.88	.91

	1986	1987	1988	1981-86
2	.36	.37	.70	.41
3	.54	.59	.70	.68
4	.91	.81	.72	.89
5	.97	.86	.89	1.02
6	.90	.92	.80	1.03
7	.86	.92	.80	1.01
8+	.86	.92	.80	1.01
(2- 6)U	.73	.71	.76	
(3- 6)U	.83	.80	.78	

Table 3.2.6.7 VIRTUAL POPULATION ANALYSIS

HERRING IN THE WESTERN BALTIC AND KATTEGAT

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .100
PROPORTION OF ANNUAL M BEFORE SPAWNING: .250

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
2	1109	915	1193	1588	2003	3066	1574	3159	1984	2591	3506	2896
3	896	516	479	455	862	809	1548	845	1685	1111	1359	1789
4	542	395	206	188	115	188	271	460	276	684	476	647
5	192	200	96	71	31	32	60	94	131	93	250	180
6	57	76	42	30	14	8	14	27	26	33	41	61
7	12	27	17	10	6	4	3	6	6	5	14	12
8+	6	3	6	6	7	1	3	6	5	8	4	11
TOTAL NO	2814	2131	2039	2347	3037	4108	3473	4597	4112	4524	5650	5595
SPS NO	1466	1062	827	811	1030	1270	1569	1592	1841	1878	2193	2449
TOT.BIOM	307817	200637	167349	183348	221863	294768	295679	362610	356349	373583	477531	506884
SPS BIOM	184522	119850	84389	78121	90364	107819	152524	152211	185218	189133	228350	267709

	1986	1987	1988	1989
2	1681	3539	5293	0
3	1609	956	2011	2152
4	711	770	435	817
5	215	235	280	173
6	51	67	81	94
7	19	17	22	30
8+	6	7	12	12
TOTAL NO	4292	5591	8133	
SPS NO	2204	2184	2967	
TOT.BIOM	401023	381116	478744	
SPS BIOM	228932	183926	218180	

Table 3.2.6.8
List of input variables for the ICES prediction program.

HERRING IN DIVISIONS IIIA AND 22-24
The reference F is the mean F for the age group range from 2 to 6

The number of recruits per year is as follows:

Year	Recruitment
1989	2004.0
1990	3253.0
1991	2405.0

Proportion of F (fishing mortality) effective before spawning: .1000
Proportion of M (natural mortality) effective before spawning: .2500

Data are printed in the following units:

Number of fish:	millions
Weight by age group in the catch:	gram
Weight by age group in the stock:	gram
Stock biomass:	tonnes
Catch weight:	tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
2	2004.0	.38	.20	.20	45.200	45.200
3	2152.0	.64	.20	.75	71.700	71.700
4	817.0	.84	.20	.90	101.000	101.000
5	173.0	.96	.20	1.00	124.800	124.800
6	94.0	.97	.20	1.00	144.400	144.400
7	30.0	.95	.20	1.00	145.700	145.700
8+	12.0	.95	.20	1.00	135.800	135.800

Table 3.2.6.9

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

HERRING DIV.IIIA AND 22-24

Year 1989					Year 1990					Year 1991	
fac-tor	ref. F	stock biomass	sp.stock biomass	catch	fac-tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.76	369	220	159	.0	.00	371	213	0	533	370
					.1	.08		212	21	508	346
					.2	.15		210	40	485	324
					.4	.30		207	74	443	284
					.6	.45		204	105	407	250
					.8	.61		201	131	375	221
					1.0	.76		198	155	347	196
					1.2	.91		195	175	322	175
					1.4	1.06		192	193	300	156
					1.6	1.21		189	209	281	139
					1.8	1.36		186	224	263	125
					2.0	1.52		184	236	248	113

The data unit of the biomass and the catch is 1000 tonnes.
The spawning stock biomass is given for the time of spawning.
The spawning stock biomass for 1991 has been calculated with the same fishing mortality as for 1990.
The reference F is the mean F for the age group range from 2 to 6

Table 3.2.6.10

HERRING IN DIVISIONS IIIA AND 22-24

' Year 1989. F-factor 1.000 and reference F .7580 '

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	.3800	577.84	26118	2004.00	90580	400.80	18116	367.04	16590
3	.6400	931.78	66808	2152.00	154298	1614.00	115723	1440.10	103255
4	.8400	426.65	43091	817.00	82517	735.30	74265	643.09	64951
5	.9600	98.29	12266	173.00	21590	173.00	21590	149.50	18657
6	.9700	53.74	7760	94.00	13573	94.00	13573	81.15	11718
7	.9500	16.94	2467	30.00	4371	30.00	4371	25.95	3781
8+	.9500	6.77	919	12.00	1629	12.00	1629	10.38	1409
Total		2112.01	159432	5282.00	368560	3059.10	249269	2717.21	220363

' Year 1990. F-factor 1.000 and reference F .7580 '

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	.3800	937.98	42396	3253.00	147035	650.60	29407	595.79	26929
3	.6400	485.82	34833	1122.04	80450	841.53	60337	750.86	53836
4	.8400	485.15	49000	929.04	93833	836.14	84449	731.28	73858
5	.9600	164.07	20475	288.77	36038	288.77	36038	249.54	31143
6	.9700	31.01	4477	54.23	7831	54.23	7831	46.82	6760
7	.9500	16.47	2399	29.17	4250	29.17	4250	25.24	3676
8+	.9500	7.51	1019	13.30	1805	13.30	1805	11.50	1562
Total		2128.01	154602	5689.56	371245	2713.74	224121	2411.04	197768

' Year 1991. F-factor 1.000 and reference F .7580 '

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	.3800	693.46	31344	2405.00	108706	481.00	21741	440.48	19909
3	.6400	708.61	56543	1821.35	130590	1366.01	97943	1218.83	87390
4	.8400	252.96	25548	484.39	48923	435.96	44031	381.28	38509
5	.9600	186.57	23283	328.37	40981	328.37	40981	283.77	35414
6	.9700	51.76	7473	90.53	13071	90.53	13071	78.15	11284
7	.9500	9.50	1384	16.83	2452	16.83	2452	14.56	2121
8+	.9500	7.59	1030	13.45	1826	13.45	1826	11.63	1579
Total		1990.45	146609	5159.92	346552	2732.15	222047	2428.71	196210

Table 3.2.6.11 HERRING.Division IIIa - Sub-divisions 22-24. Separation of the 1988 fishing mortalities into the two areas, Division IIIa and Sub-divisions 22-24.

Age	Division IIIa	Sub-divisions 22-24	Total
2	0.60	0.10	0.70
3	0.43	0.27	0.70
4	0.22	0.50	0.72
5	0.19	0.70	0.89
6	0.16	0.64	0.80
7	-	0.80	0.80
8+	-	0.80	0.80

Table 3.2.6.12 HERRING.
Division IIIa and Sub-divisions 22-24. Predicted catch at age (in millions) in 1989 and 1990 in Division IIIa and Sub-divisions 22-24, respectively.

Age	1989		1990	
	Div. IIIa	Sub-Divs. 22-24	Div. IIIa	Sub-Divs. 22-24
2	495	83	804	134
3	572	359	298	187
4	130	296	148	337
5	21.0	77.3	35	129
6	10.7	43.0	6.2	24.8
7	-	16.9	-	16.5
8	-	6.8	-	7.5
SOP Tonnes	85,656[1]	84,014	82,219	79,374

[1] Due to rounding errors in the catch numbers and mean weights these tonnes do not correspond exactly to the figures given in the prediction table.

Table 3.3.1 SUM OF PRODUCTS CHECK

HERRING IN THE SOUTHERN CENTRAL BALTIC
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: millions

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	64	125	173	214	537	57	48	106	83	115	23	104
1	859	955	1959	1577	1085	963	640	206	466	815	235	215
2	221	379	687	477	621	529	905	744	376	564	1070	419
3	256	211	312	645	409	323	352	489	473	294	300	827
4	83	279	291	258	375	221	140	264	256	318	127	167
5	669	203	259	238	148	294	109	123	145	190	145	96
6	86	619	202	209	125	101	170	114	80	122	99	130
7	53	83	374	151	132	107	73	126	80	82	79	85
8	38	37	40	198	46	141	58	80	97	56	55	62
9	19	28	29	20	145	74	70	54	45	82	49	46
10+	11	20	32	21	6	94	47	60	102	141	113	96
TOTAL	2359	2938	4358	4007	3628	2905	2612	2368	2202	2780	2294	2247
A) SOP	154798	195316	249018	239125	204020	190004	164111	167684	154516	181442	160684	172983
B)NOMIN.	113455	149283	163809	179146	175350	189249	174007	194036	168216	164598	179624	174049
(B/A) %	73	76	66	75	86	100	106	116	109	91	112	101

0	76	23	44	7	23
1	221	418	324	178	382
2	348	440	474	358	500
3	428	486	494	571	403
4	474	416	404	431	482
5	105	326	297	274	333
6	76	96	127	175	179
7	73	73	57	78	98
8	56	70	48	35	42
9	40	51	28	16	16
10+	93	93	47	23	15
TOTAL	1989	2492	2342	2147	2473
A) SOP	144285	156993	137017	122994	140249
B)NOMIN.	146677	153803	138743	121779	143943
(B/A) %	102	98	101	99	103

Table 3.3.2 SUM OF PRODUCTS CHECK

HERRING IN THE SOUTHERN CENTRAL BALTIC
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: gram

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	13.000	13.000	13.000	13.000	13.000	13.000	13.000	13.000	13.000	13.000	15.500	10.400
1	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.000	33.400	34.700
2	52.000	52.000	52.000	52.000	52.000	52.000	52.000	52.000	52.000	52.000	55.800	58.000
3	78.000	78.000	78.000	78.000	78.000	78.000	78.000	78.000	78.000	78.000	78.500	81.200
4	93.000	93.000	93.000	93.000	93.000	93.000	93.000	93.000	93.000	93.000	96.600	96.000
5	97.000	97.000	97.000	97.000	97.000	97.000	97.000	97.000	97.000	97.000	98.000	105.000
6	101.000	101.000	101.000	101.000	101.000	101.000	101.000	101.000	101.000	101.000	103.600	107.000
7	102.000	102.000	102.000	102.000	102.000	102.000	102.000	102.000	102.000	102.000	107.300	107.000
8	106.000	106.000	106.000	106.000	106.000	106.000	106.000	106.000	106.000	106.000	104.000	107.000
9	112.000	112.000	112.000	112.000	112.000	112.000	112.000	112.000	112.000	112.000	112.400	115.000
10+	120.000	120.000	120.000	120.000	120.000	120.000	120.000	120.000	120.000	120.000	113.600	125.000

	1984	1985	1986	1987	1988
0	8.200	12.000	11.800	9.300	13.500
1	23.800	18.900	21.000	24.700	21.200
2	47.100	38.500	41.300	44.400	45.100
3	69.000	60.800	55.500	52.000	59.800
4	91.300	77.000	71.000	60.900	66.000
5	99.500	90.300	82.000	73.800	69.600
6	104.300	98.200	86.700	74.300	78.600
7	109.500	100.500	92.600	78.700	85.500
8	111.100	105.400	104.500	92.600	104.700
9	119.800	109.200	107.200	101.300	102.800
10+	128.100	120.000	117.000	103.600	115.000

Table 3.3.3

```
HERRING IN THE SOUTHERN CENTRAL BALTIC
INPUT FILE: TUNING

 Module run at 10.09.41  26 APRIL 1989
 DISAGGREGATED Qs
 LOG TRANSFORMATION
 NO explanatory variate (Mean used)
 Fleet  1 ,Internartional Acous, has terminal q estimated as the mean
 FLEETS COMBINED BY '' VARIANCE ''

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

    Age,     81,     84,     85,     86,     87,     88,

      1,   .056,   .052,   .106,   .148,   .056,   .010,
      2,   .139,   .121,   .139,   .165,   .242,   .218,
      3,   .366,   .206,   .246,   .229,   .312,   .470,
      4,   .259,   .400,   .316,   .333,   .314,   .473,
      5,   .218,   .256,   .541,   .391,   .395,   .438,
      6,   .327,   .269,   .396,   .405,   .423,   .489,
      7,   .266,   .308,   .449,   .430,   .473,   .443,
      8,   .286,   .280,   .548,   .600,   .523,   .503,
      9,   .271,   .303,   .448,   .432,   .427,   .469,

 Log catchability estimates

 Age  2
 Fleet,     83,     84,     85,     86,     87,     88
------,------,------,------,------,------,------
     1 ,   .12,  -.37,  -.57,  -.45,   .67,  -.12

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,   Slope  ,        ,Intrcpt
-------,--------,------,-------,-------,----------,----------,--------,------
     1 ,  -.12  ,  .496, .8849 , .2182,  .000E+00,  .000E+00,  -.122,   .187
      Fbar      SIGMA(int.)     SIGMA(ext.)     SIGMA(overall)  Variance ratio
      .218         .496            0.000           .496            0.000

 Age  3
 Fleet,     83,     84,     85,     86,     87,     88
------,------,------,------,------,------,------
     1 ,   .83,   .00,   .18,   .34,   .95,   .46

                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,   Slope  ,        ,Intrcpt
-------,--------,------,-------,-------,----------,----------,--------,------
     1 ,   .46  ,  .399,1.5855 , .4703,  .000E+00,  .000E+00,  .461,   .151
      Fbar      SIGMA(int.)     SIGMA(ext.)     SIGMA(overall)  Variance ratio
      .470         .399            0.000           .399            0.000
```

cont'd.

Table 3.3.3 cont'd.

Age 4

Fleet,	83,	84,	85,	86,	87,	88
1 ,	.92,	.94,	.73,	.51,	1.19,	.86

SUMMARY STATISTICS

Fleet ,	Pred. q	, SE(q),	Partial F	,Raised, F	SLOPE	SE Slope	,INTRCPT,	SE ,Intrcpt
1 ,	.86	, .246,	2.3573	, .4730,	.000E+00,	.000E+00,	.858,	.093

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.473	.246	0.000	.246	0.000

Age 5

Fleet,	83,	84,	85,	86,	87,	88
1 ,	.75,	1.13,	1.35,	.84,	1.28,	1.07

SUMMARY STATISTICS

Fleet ,	Pred. q	, SE(q),	Partial F	,Raised, F	SLOPE	SE Slope	,INTRCPT,	SE ,Intrcpt
1 ,	1.07	, .256,	2.9197	, .4380,	.000E+00,	.000E+00,	1.071,	.097

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.438	.256	0.000	.256	0.000

Age 6

Fleet,	83,	84,	85,	86,	87,	88
1 ,	.84,	1.10,	1.00,	.51,	1.39,	.97

SUMMARY STATISTICS

Fleet ,	Pred. q	, SE(q),	Partial F	,Raised, F	SLOPE	SE Slope	,INTRCPT,	SE ,Intrcpt
1 ,	.97	, .314,	2.6341	, .4891,	.000E+00,	.000E+00,	.969,	.119

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.489	.314	0.000	.314	0.000

Age 7

Fleet,	83,	84,	85,	86,	87,	88
1 ,	.80,	1.21,	.99,	.47,	1.23,	.94

SUMMARY STATISTICS

Fleet ,	Pred. q	, SE(q),	Partial F	,Raised, F	SLOPE	SE Slope	,INTRCPT,	SE ,Intrcpt
1 ,	.94	, .307,	2.5554	, .4431,	.000E+00,	.000E+00,	.938,	.116

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.443	.307	0.000	.307	0.000

Age 8

Fleet,	83,	84,	85,	86,	87,	88
1 ,	.59,	1.19,	1.04,	.72,	1.36,	.98

SUMMARY STATISTICS

Fleet ,	Pred. q	, SE(q),	Partial F	,Raised, F	SLOPE	SE Slope	,INTRCPT,	SE ,Intrcpt
1 ,	.98	, .313,	2.6626	, .5025,	.000E+00,	.000E+00,	.979,	.118

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.503	.313	0.000	.313	0.000

Table 3.3.4 VIRTUAL POPULATION ANALYSIS

HERRING IN THE SOUTHERN CENTRAL BALTIC

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

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	.20	.14	.41	.38	.26	.21	.16	.09	.17	.15	.06	.06
2	.07	.13	.14	.16	.25	.20	.31	.27	.23	.33	.29	.14
3	.07	.08	.14	.19	.20	.20	.20	.27	.28	.29	.29	.39
4	.04	.10	.16	.17	.16	.16	.12	.22	.22	.31	.19	.26
5	.14	.12	.12	.19	.14	.18	.11	.15	.18	.25	.23	.22
6	.19	.19	.16	.14	.14	.13	.16	.16	.14	.23	.20	.33
7	.15	.29	.17	.18	.12	.18	.14	.16	.16	.21	.23	.27
8	.16	.15	.22	.13	.08	.18	.14	.21	.18	.17	.21	.29
9	.14	.17	.17	.16	.13	.17	.13	.18	.18	.23	.21	.27
10+	.14	.17	.17	.16	.13	.17	.13	.18	.18	.23	.21	.27
(1- 8)U	.13	.15	.19	.19	.17	.18	.16	.19	.20	.24	.21	.24

	1984	1985	1986	1987	1988
1	.05	.11	.15	.06	.01
2	.12	.14	.17	.24	.22
3	.21	.25	.23	.31	.47
4	.40	.32	.33	.32	.47
5	.26	.53	.39	.40	.44
6	.27	.40	.40	.42	.49
7	.31	.45	.43	.47	.44
8	.28	.55	.60	.52	.50
9	.30	.45	.43	.43	.47
10+	.30	.45	.43	.43	.47
(1- 8)U	.24	.34	.34	.34	.38

Table 3.3.5 Separable VPA.

Title : HERRING IN THE SOUTHERN CENTRAL BALTIC
At 08.45.48 20 APRIL 1989
from 72 to 88 on ages 1 to 9
with Terminal F of .400 on age 3 and Terminal S of 1.000

Initial sum of squared residuals was 32.054 and
final sum of squared residuals is 18.524 after 103 iterations

Matrix of Residuals

Years	72/73	73/74	74/75	75/76	76/77	77/78
Ages						
1/ 2	1.528	.863	1.820	1.115	1.222	.281
2/ 3	.309	.266	.001	-.129	.703	.171
3/ 4	-.146	-.579	-.208	-.073	.337	.274
4/ 5	-1.004	-.235	-.248	-.110	-.083	.097
5/ 6	-.045	-.316	-.251	-.036	.038	-.085
6/ 7	-.068	.207	-.143	-.194	-.166	-.282
7/ 8	.296	.451	.223	.561	-.357	.047
8/ 9	.110	-.169	.162	-.464	-.920	-.025
	.000	.000	.000	.000	.000	.000
WTS	.010	.010	.010	.010	.010	.010

Years	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88		WTS
Ages												
1/ 2	.445	-.247	.379	-.028	-.023	-.070	.070	.211	.316	-.550	.000	.225
2/ 3	.760	.350	.357	.417	.358	-.072	-.047	-.273	-.267	-.144	.000	.470
3/ 4	.111	.219	.184	.296	.362	.177	-.014	-.322	-.291	-.208	.000	.539
4/ 5	-.103	.116	.031	.189	.006	.035	.278	-.225	-.093	-.175	.000	.523
5/ 6	-.293	-.066	-.099	.049	-.177	-.213	-.026	.371	.030	-.022	.000	.907
6/ 7	.086	-.112	-.267	-.150	-.113	.159	-.044	-.018	.010	.165	.000	1.000
7/ 8	-.272	-.181	.129	-.162	.007	.023	-.025	-.103	.027	.224	.000	.599
8/ 9	-.277	-.018	-.206	-.569	-.212	-.101	-.113	.268	.476	.268	.000	.433
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	5.709	
WTS	.010	.010	.010	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	72	73	74	75	76	77	78
F-values	.1641	.2187	.2498	.2526	.2006	.2192	.1781

	79	80	81	82	83	84	85	86	87	88
F-values	.2117	.1975	.2313	.1944	.2236	.2238	.3293	.3224	.3435	.4000

Selection-at-age (S)

	1	2	3	4	5	6	7	8	9
S-values	.3450	.7132	1.0000	1.0502	1.0537	1.0415	1.0578	1.1070	1.0000

Table 3.3.6 VIRTUAL POPULATION ANALYSIS

HERRING IN THE SOUTHERN CENTRAL BALTIC

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

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	.22	.14	.42	.37	.26	.20	.15	.09	.17	.14	.06	.06
2	.08	.14	.14	.17	.25	.19	.29	.26	.22	.31	.28	.14
3	.09	.10	.17	.19	.21	.20	.19	.26	.26	.27	.27	.35
4	.05	.14	.20	.20	.17	.17	.12	.21	.21	.28	.18	.24
5	.19	.18	.18	.25	.17	.19	.12	.15	.17	.23	.20	.20
6	.20	.26	.27	.22	.20	.17	.16	.17	.14	.21	.18	.27
7	.20	.31	.25	.33	.21	.26	.18	.17	.18	.20	.20	.24
8	.19	.21	.24	.21	.15	.36	.21	.30	.19	.18	.20	.24
9	.16	.21	.25	.18	.23	.40	.30	.32	.28	.24	.24	.27
10+	.16	.21	.25	.18	.23	.40	.30	.32	.28	.24	.24	.27
(1- 8)U	.15	.18	.23	.24	.20	.22	.18	.20	.19	.23	.20	.22

	1984	1985	1986	1987	1988	1977-86
1	.06	.11	.13	.08	.14	.12
2	.12	.15	.17	.22	.34	.21
3	.20	.24	.25	.32	.40	.25
4	.35	.31	.33	.37	.49	.24
5	.23	.44	.38	.39	.54	.23
6	.24	.35	.31	.40	.48	.22
7	.24	.37	.36	.32	.41	.24
8	.24	.38	.45	.39	.28	.28
9	.25	.36	.25	.27	.30	.29
10+	.25	.36	.25	.27	.30	.29
(1- 8)U	.21	.29	.30	.31	.38	

Table 3.3.7 VIRTUAL POPULATION ANALYSIS

HERRING IN THE SOUTHERN CENTRAL BALTIC

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .330
PROPORTION OF ANNUAL M BEFORE SPAWNING: .450

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	4778	7976	6310	5534	5283	5815	5099	2784	3327	6859	4670	4378
2	3192	3139	5670	3409	3115	3350	3894	3598	2093	2304	4881	3611
3	3231	2414	2229	4023	2362	1992	2266	2375	2277	1376	1379	3034
4	1778	2415	1786	1544	2713	1565	1341	1538	1504	1439	862	859
5	4301	1381	1726	1200	1032	1884	1082	972	1022	1002	892	591
6	518	2919	947	1180	769	712	1278	788	684	706	649	600
7	323	347	1833	594	777	517	492	893	542	488	468	442
8	242	217	209	1165	351	517	327	337	617	372	326	312
9	141	163	144	135	776	246	297	216	204	418	254	218
10+	76	119	162	144	31	312	200	236	464	717	586	451
TOTAL NO	18579	21089	21017	18927	17210	16911	16275	13736	12734	15680	14967	14497
SPS NO	9271	8590	7711	8506	7563	6594	6297	6253	6229	5495	4606	5397
TOT.BIOM	1293982	1358853	1350813	1269237	1157761	1094310	1048257	960367	903524	977818	953798	978687
SPS BIOM	846866	801542	722651	774261	705148	618905	585609	579578	583704	532878	447170	513092
SPS BIOM SOP corr.	618000	609000	477000	581000	606000							

	1984	1985	1986	1987	1988	1989	1977-86
1	4455	4503	2827	2510	3268	0	4472
2	3390	3448	3310	2022	1894	2331	3388
3	2579	2462	2426	2284	1334	1101	2217
4	1742	1726	1579	1542	1357	730	1415
5	553	1000	1039	929	876	679	1004
6	398	359	527	584	515	419	670
7	374	257	207	318	321	261	468
8	286	241	145	119	190	175	348
9	200	184	134	76	66	118	237
10+	467	335	230	107	63	78	400
TOTAL NO	14444	14515	12425	10491	9883		
SPS NO	5545	5406	5197	4851	3715		
TOT.BIOM	855714	737463	649358	531191	486768		
SPS BIOM	495087	426173	373849	308678	261713		

Table 3.3.8

List of input variables for the ICES prediction program.

HERRING IN THE CENTRAL SOUTHERN BALTIC (SUB-DIVISIONS 25-27)
The reference F is the mean F for the age group range from 1 to 8

The number of recruits per year is as follows:

Year	Recruitment
1989	4472.0
1990	4472.0
1991	4472.0

Proportion of F (fishing mortality) effective before spawning: .3300
Proportion of M (natural mortality) effective before spawning: .4500

Data are printed in the following units:

Number of fish:	millions
Weight by age group in the catch:	gram
Weight by age group in the stock:	gram
Stock biomass:	tonnes
Catch weight:	tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	4472.0	.12	.20	.00	22.300	22.300
2	2331.0	.34	.20	.00	43.600	43.600
3	1101.0	.40	.20	1.00	55.767	55.767
4	730.0	.49	.20	1.00	65.967	65.967
5	679.0	.54	.20	1.00	75.133	75.133
6	419.0	.48	.20	1.00	79.867	79.867
7	261.0	.41	.20	1.00	85.600	85.600
8	175.0	.28	.20	1.00	100.600	100.600
9	118.0	.30	.20	1.00	103.767	103.767
10+	78.0	.30	.20	1.00	111.867	111.867

Table 3.3.9

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

HERRING IN THE CENTRAL SOUTHERN BALTIC (SUB-DIVISIONS 25-27)

Year 1989					Year 1990					Year 1991	
fac-tor	ref. F	stock biomass	sp.stock biomass	catch	fac-tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.38	456	202	119	.0	.00	467	207	0	615	325
					.1	.04		204	14	600	308
					.2	.08		201	27	585	293
					.4	.15		195	53	556	263
					.6	.23		190	76	530	237
					.8	.31		185	98	506	213
					1.0	.38		180	118	483	192
					1.2	.46		175	137	462	173
					1.4	.54		170	155	442	156
					1.6	.61		165	171	423	141
					1.8	.69		161	187	406	127
					2.0	.76		156	201	390	114

The data unit of the biomass and the catch is 1000 tonnes.
The spawning stock biomass is given for the time of spawning.
The spawning stock biomass for 1991 has been calculated with the same fishing mortality as for 1990.
The reference F is the mean F for the age group range from 1 to 8

Table 3.3.10

HERRING IN THE CENTRAL SOUTHERN BALTIC (SUB-DIVISIONS 25-27)

' Year 1989. F-factor 1.000 and reference F .3825 '

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
1	.1200	459.25	10241	4472.0	99725	.00	0	.00	0
2	.3400	612.39	26700	2331.0	101631	.00	0	.00	0
3	.4000	331.17	18468	1101.0	61399	1101.00	61399	881.81	49175
4	.4900	258.39	17044	730.0	48155	730.00	48155	567.56	37440
5	.5400	259.08	19465	679.0	51015	679.00	51015	519.27	39014
6	.4800	145.93	11654	419.0	33464	419.00	33464	326.84	26103
7	.4100	80.11	6857	261.0	22341	261.00	22341	208.35	17834
8	.2800	38.92	3914	175.0	17605	175.00	17605	145.82	14669
9	.3000	27.86	2890	118.0	12244	118.00	12244	97.68	10135
10+	.3000	18.41	2059	78.0	8725	78.00	8725	64.57	7222
Total		2231.50	119297	10364.0	456308	3561.00	254951	2811.89	201597

' Year 1990. F-factor 1.000 and reference F .3825 '

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
1	.1200	459.25	10241	4472.0	99725	.00	0	.00	0
2	.3400	853.12	37196	3247.3	141583	.00	0	.00	0
3	.4000	408.59	22785	1358.4	75753	1358.39	75753	1087.95	60671
4	.4900	213.87	14108	604.2	39860	604.24	39860	469.78	30990
5	.5400	139.71	10496	366.2	27509	366.15	27509	280.02	21038
6	.4800	112.83	9011	324.0	25873	323.96	25873	252.70	20182
7	.4100	65.15	5577	212.3	18170	212.27	18170	169.45	14505
8	.2800	31.54	3172	141.8	14266	141.81	14266	118.17	11887
9	.3000	25.56	2652	108.3	11236	108.29	11236	89.64	9301
10+	.3000	28.07	3139	118.9	13298	118.88	13298	98.41	11008
Total		2337.69	118381	10953.3	467278	3233.99	225969	2566.12	179586

' Year 1991. F-factor 1.000 and reference F .3825 '

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
1	.1200	459.25	10241	4472.0	99725	.00	0	.00	0
2	.3400	853.12	37196	3247.3	141583	.00	0	.00	0
3	.4000	569.21	31743	1892.4	105532	1892.38	105532	1515.64	84522
4	.4900	263.87	17406	745.5	49178	745.50	49178	579.61	38235
5	.5400	115.64	8688	303.1	22770	303.07	22770	231.78	17414
6	.4800	60.84	4859	174.7	13952	174.70	13952	136.27	10883
7	.4100	50.37	4312	164.1	14048	164.12	14048	131.02	11214
8	.2800	25.65	2580	115.3	11603	115.34	11603	96.11	9668
9	.3000	20.72	2149	87.8	9105	87.75	9105	72.64	7537
10+	.3000	32.53	3638	137.8	15413	137.78	15413	114.06	12759
Total		2451.21	122816	11340.0	482914	3620.65	241605	2877.11	192235

Table 3.3.11 Catch (tonnes) of coastal and open-sea HERRING in Southern Baltic (Sub-divisions 25-27) in 1972-1988.

Year	Coastal	Open Sea	Compiled catch	Official catch
1972	56,865	50,523	107,388	118,272
1973	57,288	81,217	138,505	148,078
1974	81,292	77,324	158,618	159,197
1975	109,239	69,846	179,085	172,617
1976	93,635	82,471	176,106	174,388
1977	83,946	103,399	187,345	187,138
1978	88,853	88,510	177,363	174,007
1979	99,407	90,499	189,906	189,989
1980	103,218	71,794	175,012	174,662
1981	77,406	80,864	158,270	164,598
1982	97,748	68,394	166,142	179,624
1983	100,150	74,044	174,194	174,194
1984	79,456	67,222	146,678	146,678
1985	82,249	71,322	153,571	153,803
1986	76,871	61,872	138,743	138,743
1987	66,114	55,644	121,758	121,779
1988	74,995	68,948	143,943	-

Table 3.3.12 Cpue of HERRING of Polish state-owned 24 m cutters with pelagic pair trawl (t/day).

Year	Sub-Division 25	26
1981	2.76	2.62
1982	3.87	3.39
1983	3.99	2.87
1984	3.82	2.74
1985	4.01	2.64
1986	4.35	2.75
1987	2.65	2.66
1988	2.12	2.20

Table 3.3.13 Cpue of HERRING in the species directed fishery of Polish state-owned cutters estimated by the the GLM (t/day).

Year	Sub-Division 25	26
1984	3.29	2.19
1985	3.41	2.27
1986	2.70	1.80
1987	2.71	1.80
1988	2.68	1.78

Table 3.3.14 Mean CPUE of young HERRING (O-age group) caught in October-November 1983-88 by pelagic trawl type P 53/64 with 11 mm mesh size of cod end.

Fishing area	Year class 1983	1984	1985	1986	1987	1988
	(kg per hour of towing)					
Kolobzeg-Darlowo	95	21	183	310	7	35
Ustka-leba	49	44	617	328	16	7
Wladyslawowo	98	122	97	122	9	0
Gdansk Gulf	133	129	330	174	39	142

Table 3.3.15 VIRTUAL POPULATION ANALYSIS

HERRING IN THE COASTAL AREAS 25, 26 AND 27

CATCH IN NUMBERS UNIT: millions

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	352	320	52	20	73	123	49	36	86	71	21	39
1	782	651	703	304	96	421	388	173	80	166	229	250
2	393	543	440	786	522	369	387	783	306	213	219	342
3	318	247	216	261	491	384	203	233	644	272	272	259
4	121	129	71	83	187	180	164	72	113	316	240	207
5	66	27	42	32	59	91	71	55	42	48	193	137
6	25	7	8	27	23	26	31	26	32	22	38	37
7	10	8	6	7	11	13	14	16	14	10	15	8
8	2	3	4	5	4	4	6	9	6	8	7	9
9+	17	7	35	12	7	11	23	17	8	1	7	4
TOTAL	2086	1942	1575	1536	1474	1622	1337	1420	1331	1126	1241	1291

	1987	1988
0	7	29
1	158	223
2	291	388
3	382	291
4	191	230
5	92	82
6	33	49
7	7	10
8	3	5
9+	1	2
TOTAL	1165	1308

Table 3.3.16 VIRTUAL POPULATION ANALYSIS

HERRING IN THE COASTAL AREAS 25, 26 AND 27

MEAN WEIGHT AT AGE OF THE STOCK UNIT: gram

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	12.3	12.3	12.3	12.3	12.3	12.3	12.3	12.3	9.6	9.6	11.9	12.6
1	18.4	18.4	18.4	18.4	18.4	18.4	18.4	18.4	32.6	32.6	19.7	17.7
2	66.4	66.4	66.4	66.4	66.4	66.4	66.4	66.4	59.5	59.5	45.2	40.0
3	98.6	98.6	98.6	98.6	98.6	98.6	98.6	98.6	85.0	85.0	67.8	59.0
4	121.6	121.6	121.6	121.6	121.6	121.6	121.6	121.6	104.4	104.4	84.2	79.9
5	155.4	155.4	155.4	155.4	155.4	155.4	155.4	155.4	130.7	130.7	98.9	99.5
6	153.4	153.4	153.4	153.4	153.4	153.4	153.4	153.4	158.4	158.4	115.7	100.4
7	171.4	171.4	171.4	171.4	171.4	171.4	171.4	171.4	146.2	146.2	128.8	115.5
8	169.1	169.1	169.1	169.1	169.1	169.1	169.1	169.1	150.5	150.5	134.1	132.0
9+	183.3	183.3	183.3	183.3	183.3	183.3	183.3	183.3	157.7	157.7	155.8	122.9

	1987	1988
0	9.3	26.2
1	26.6	20.2
2	42.8	48.0
3	57.7	65.0
4	74.1	78.0
5	92.4	92.6
6	105.5	102.2
7	113.6	104.3
8	119.6	122.4
9+	122.5	131.1

Table 3.3.17

Title : HERRING IN THE COASTAL AREAS 25, 26 AND 27

from 79 to 88 on ages 0 to 8
with Terminal F of .390 on age 3 and Terminal S of .800

Initial sum of squared residuals was 78.692 and
final sum of squared residuals is 11.734 after 83 iterations

Matrix of Residuals

Years	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88		WTS
Ages											
0/ 1	-.108	.261	.151	.747	.850	.664	-.810	.028	-1.785	.000	.185
1/ 2	-.731	.484	-.276	-.012	-.446	.580	.264	.302	-.165	.000	.352
2/ 3	.168	.245	.214	.053	-.037	-.080	-.222	-.370	.028	.000	.765
3/ 4	.348	-.019	.257	.112	.094	-.171	-.259	-.433	.070	.000	.625
4/ 5	-.083	-.094	.157	-.221	.102	.060	-.111	-.079	.269	.000	1.000
5/ 6	-.121	-.074	-.057	-.348	-.245	-.339	.845	.414	-.076	.000	.400
6/ 7	-.374	-.547	-.471	-.287	.229	-.203	.686	.533	.433	.000	.330
7/ 8	.294	-.142	-.371	.332	-.175	-.026	-.103	.283	-.093	.000	.633
	.000	.000	.000	.000	.000	.000	.000	.000	.000	-.002	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	79	80	81	82	83	84	85	86	87	88
F-values	.5000	.5295	.4413	.3657	.3406	.3060	.3876	.4103	.3468	.3900

Selection-at-age (S)

	0	1	2	3	4	5	6	7	8
S-values	.0298	.2082	.6040	1.0000	1.1434	1.1760	1.0496	.8282	.8000

Table 3.3.18 VIRTUAL POPULATION ANALYSIS

HERRING IN THE COASTAL AREAS 25, 26 AND 27

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = .30

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	.087	.062	.014	.009	.025	.020	.014	.012	.029	.018	.007	.011
1	.343	.255	.208	.120	.060	.215	.089	.069	.037	.080	.081	.115
2	.408	.481	.307	.425	.347	.382	.352	.292	.187	.144	.161	.186
3	.569	.555	.404	.339	.590	.526	.424	.417	.470	.282	.310	.325
4	.734	.547	.344	.298	.493	.509	.512	.291	.413	.506	.488	.464
5	.750	.397	.387	.283	.408	.539	.438	.363	.311	.347	.777	.657
6	.601	.187	.215	.514	.382	.361	.401	.318	.424	.300	.593	.370
7	.634	.429	.231	.354	.488	.425	.368	.428	.304	.248	.372	.269
8	.400	.400	.400	.400	.400	.380	.400	.460	.300	.330	.310	.460
9+	.400	.400	.400	.400	.400	.380	.400	.460	.300	.330	.310	.460
(2- 7)U	.616	.433	.315	.369	.451	.457	.416	.352	.352	.305	.450	.378
(3- 6)U	.663	.422	.337	.359	.468	.484	.444	.347	.405	.359	.542	.454

	1987	1988	1975-87
0	.003	.008	.024
1	.065	.161	.134
2	.213	.250	.299
3	.367	.385	.429
4	.480	.445	.468
5	.442	.441	.469
6	.361	.510	.387
7	.130	.196	.360
8	.150	.131	.368
9+	.150	.131	.368
(2- 7)U	.332	.371	
(3- 6)U	.413	.445	

Table 3.3.19 VIRTUAL POPULATION ANALYSIS

HERRING IN THE COASTAL AREAS 25, 26 AND 27

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
0	4896	6196	4261	2600	3471	7221	4098	3493	3454	4666	3595	3963
1	3089	3326	4316	3112	1909	2508	5244	2994	2557	2485	3396	2645
2	1342	1624	1909	2598	2045	1333	1499	3553	2070	1826	1699	2320
3	836	661	743	1040	1258	1071	674	782	1965	1272	1171	1072
4	265	350	281	368	549	517	469	327	381	910	711	636
5	143	94	150	148	202	248	230	208	181	187	406	323
6	64	50	47	76	82	100	107	110	107	98	98	138
7	25	26	31	28	33	42	51	53	59	52	54	40
8	7	10	13	18	15	15	20	26	26	32	30	27
9+	59	24	121	42	25	40	81	52	35	2	32	13
TOTAL NO	10727	12361	11872	10030	9590	13094	12474	11598	10836	11531	11191	11178
SPS NO	2607	2677	3104	4058	4006	3232	2982	4755	4618	4197	4030	4338
TOT.BIOM	369179	385879	426238	459160	461280	462746	449240	523034	505288	490382	392866	359283
SPS BIOM	243198	237690	281736	352663	369877	318926	292387	401387	376469	353719	275753	253378

	1987	1988	1989	1975-87
0	2339	4183	0	4173
1	2903	1727	3074	3114
2	1746	2016	1089	1967
3	1427	1045	1163	1075
4	573	732	527	487
5	296	263	348	217
6	124	141	125	92
7	71	64	63	43
8	23	46	39	20
9+	9	14	39	41
TOTAL NO	9512	10232		
SPS NO	4095	4120		
TOT.BIOM	350866	419246		
SPS BIOM	244420	265091		

Table 3.3.20

List of input variables for the ICES prediction program.

HERRING IN SUB-DIVISIONS 25-27 COASTAL STOCK
The reference F is the mean F for the age group range from 2 to 7

The number of recruits per year is as follows:

Year	Recruitment
1989	4173.0
1990	4173.0
1991	4173.0

Data are printed in the following units:

Number of fish:	millions
Weight by age group in the catch:	gram
Weight by age group in the stock:	gram
Stock biomass:	tonnes
Catch weight:	tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
0	4173.0	.01	.30	.00	26.200	26.200
1	3074.0	.16	.30	.00	20.200	20.200
2	1089.0	.25	.30	.90	48.000	48.000
3	1163.0	.38	.30	1.00	65.000	65.000
4	527.0	.44	.30	1.00	78.000	78.000
5	348.0	.44	.30	1.00	92.600	92.600
6	125.0	.51	.30	1.00	102.200	102.200
7	63.0	.20	.30	1.00	104.300	104.300
8	39.0	.13	.30	1.00	122.400	122.400
9+	39.0	.13	.30	1.00	131.100	131.100

Table 3.3.21

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

HERRING IN SUB-DIVISIONS 25-27 COASTAL STOCK

Year 1989					Year 1990					Year 1991	
fac-tor	ref. F	stock biomass	sp.stock biomass	catch	fac-tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.37	402	225	69	.0	.00	408	228	0	496	314
					.1	.04			8	487	305
					.2	.07			15	479	297
					.4	.15			30	463	281
					.6	.22			43	447	266
					.8	.30			56	433	252
					1.0	.37			68	419	239
					1.2	.44			79	406	226
					1.4	.52			89	394	215
					1.6	.59			99	383	204
					1.8	.67			108	373	194
					2.0	.74			117	363	184

The data unit of the biomass and the catch is 1000 tonnes.
The spawning stock biomass is given for 1 January.
The reference F is the mean F for the age group range from 2 to 7

Table 3.3.22 VIRTUAL POPULATION ANALYSIS

HERRING IN THE OPEN SEA OF AREAS 25, 26 AND 27

CATCH IN NUMBERS UNIT: millions

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	0	0	11	0	8	6	4	4	3	4	2	18
1	14	0	177	40	50	74	55	30	28	22	74	135
2	0	48	253	85	54	108	94	153	35	291	211	113
3	83	67	122	305	134	128	106	95	93	151	56	182
4	34	283	196	137	278	159	87	116	91	133	48	54
5	794	200	216	184	137	328	101	65	118	134	85	54
6	70	611	197	193	133	119	171	78	66	115	70	97
7	20	90	334	156	135	128	71	120	64	65	55	71
8	31	32	30	186	50	164	38	70	105	57	45	56
9	14	25	25	22	141	89	70	47	40	75	41	41
10+	8	77	66	56	27	147	92	139	102	147	99	93
TOTAL	1069	1432	1626	1366	1147	1450	888	915	745	1193	786	916

	1984	1985	1986	1987	1988
0	1	1	2	1	9
1	72	185	41	20	86
2	146	186	105	66	87
3	155	177	196	188	141
4	151	152	181	239	262
5	56	109	170	180	232
6	53	60	93	142	133
7	61	62	44	70	85
8	49	64	46	33	36
9	36	47	24	16	15
10+	88	99	48	23	15
TOTAL	868	1143	950	977	1100

Table 3.3.23 VIRTUAL POPULATION ANALYSIS

HERRING IN THE OPEN SEA OF AREAS 25, 26 AND 27

MEAN WEIGHT AT AGE OF THE STOCK UNIT: gram

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	17.0
1	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	36.0
2	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0	54.0
3	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	71.0	68.0
4	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	86.0	79.0
5	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	88.0	85.0
6	94.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0	94.0	90.0
7	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	98.0
8	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	108.0	103.0
9	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	114.0	110.0
10+	119.7	119.7	119.7	119.7	119.7	119.7	119.7	119.7	119.7	119.7	119.7	125.3

	1984	1985	1986	1987	1988
0	12.9	.0	8.8	.0	16.4
1	33.9	18.2	29.9	23.9	31.0
2	44.7	32.0	38.3	39.0	48.6
3	58.4	50.0	45.9	42.3	55.3
4	78.9	66.0	59.0	49.6	57.6
5	84.6	73.0	61.6	63.1	64.9
6	91.9	88.0	72.1	66.7	75.0
7	105.2	94.5	86.9	73.2	82.0
8	107.8	101.2	99.7	85.5	102.9
9	115.7	105.2	105.4	91.5	103.3
10+	129.8	114.7	118.0	104.6	117.1

Table 3.3.24

Title : HERRING IN THE OPEN SEA OF AREAS 25, 26 AND 27

from 79 to 88 on ages 0 to 9
with Terminal F of .190 on age 4 and Terminal S of 1.000

Initial sum of squared residuals was 151.377 and
final sum of squared residuals is 27.309 after 118 iterations

Matrix of Residuals

Years / Ages	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88		WTS
0/ 1	1.226	1.220	-.298	-.756	1.606	-1.582	-.617	.581	-1.380	.000	.082
1/ 2	.668	-1.256	-1.849	.629	.658	.158	1.373	.330	-.711	.000	.093
2/ 3	.604	-1.087	1.348	.478	-.307	.185	.006	-.507	-.720	.000	.130
3/ 4	-.022	-.154	.672	.189	.022	.219	-.144	-.304	-.480	.000	.289
4/ 5	-.033	-.139	.011	.087	-.154	.566	-.195	-.062	-.081	.000	.424
5/ 6	-.132	.164	.112	-.028	-.202	.059	-.043	-.006	.077	.000	.830
6/ 7	-.059	.012	.066	-.051	.105	-.176	-.012	-.032	.147	.000	1.000
7/ 8	-.105	.147	-.285	-.035	.033	-.037	-.025	-.015	.322	.000	.583
8/ 9	.034	.095	-.600	-.196	-.174	-.224	.382	.520	.163	.000	.285
	.000	.000	.000	.000	.000	.000	.000	.000	.000	-.003	
WTS	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	79	80	81	82	83	84	85	86	87	88
F-values	.1146	.1168	.1583	.1082	.1389	.1298	.1780	.1819	.1894	.1900

Selection-at-age (S)

	0	1	2	3	4	5	6	7	8	9
S-values	.0104	.2539	.6663	.8795	1.0000	1.2157	1.3601	1.3414	1.3372	1.0000

Table 3.3.25 VIRTUAL POPULATION ANALYSIS

HERRING IN THE OPEN SEA OF AREAS 25, 26 AND 27

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = .10

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	.00	.00	.01	.00	.01	.00	.00	.00	.00	.00	.00	.01
1	.01	.00	.11	.03	.03	.05	.04	.03	.03	.01	.04	.07
2	.00	.03	.09	.06	.05	.08	.07	.12	.04	.38	.17	.07
3	.03	.04	.08	.13	.12	.14	.09	.09	.09	.23	.10	.19
4	.02	.14	.14	.12	.15	.18	.12	.12	.11	.17	.10	.12
5	.22	.11	.13	.17	.15	.23	.15	.11	.16	.20	.14	.13
6	.16	.24	.14	.15	.16	.16	.16	.14	.14	.21	.14	.21
7	.06	.28	.18	.14	.14	.21	.12	.15	.15	.19	.13	.18
8	.12	.12	.13	.13	.06	.22	.08	.15	.17	.18	.17	.17
9	.12	.12	.12	.12	.12	.12	.12	.12	.11	.16	.16	.20
10+	.12	.12	.12	.12	.12	.12	.12	.12	.11	.16	.16	.20
(2- 8)U	.09	.14	.13	.13	.12	.17	.11	.13	.12	.22	.13	.15
(3- 6)U	.11	.13	.13	.14	.14	.18	.13	.12	.13	.20	.12	.16

	1984	1985	1986	1987	1988	1980-87
0	.00	.00	.00	.00	.01	.00
1	.03	.09	.05	.03	.09	.04
2	.09	.09	.06	.09	.16	.12
3	.12	.13	.12	.14	.24	.14
4	.21	.15	.18	.18	.25	.15
5	.16	.21	.23	.24	.24	.18
6	.17	.23	.25	.28	.25	.20
7	.18	.27	.24	.26	.24	.20
8	.16	.25	.30	.25	.18	.21
9	.14	.21	.13	.14	.16	.16
10+	.14	.21	.13	.14	.16	.16
(2- 8)U	.16	.19	.20	.20	.22	
(3- 6)U	.17	.18	.19	.21	.25	

Table 3.3.26 VIRTUAL POPULATION ANALYSIS

HERRING IN THE OPEN SEA OF AREAS 25, 26 AND 27

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: tonnes

ALL VALUES ARE GIVEN FOR 1 JANUARY

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	3922	2033	1497	1894	1761	1741	1114	1223	1800	2114	2340	2878
1	2003	3549	1840	1345	1714	1585	1570	1004	1102	1627	1909	2115
2	1974	1799	3211	1496	1178	1503	1363	1368	880	971	1451	1657
3	2637	1786	1582	2664	1273	1015	1257	1145	1093	763	603	1113
4	2177	2307	1552	1316	2121	1025	797	1036	946	901	548	492
5	4188	1938	1818	1218	1060	1656	777	639	828	769	689	450
6	497	3036	1563	1440	927	829	1187	607	517	637	569	542
7	336	383	2167	1228	1120	713	637	912	475	405	467	448
8	289	286	262	1643	963	885	523	509	712	369	305	370
9	132	232	229	209	1311	824	646	437	395	545	280	233
10+	79	717	608	524	254	1366	858	1294	998	1076	686	530
TOTAL NO	18233	18065	16330	14978	13682	13142	10729	10173	9745	10177	9846	10830
SPS NO	10334	10684	9782	10243	9030	8312	6681	6578	5962	5465	4145	4179
TOT.BIOM	1118399	1216362	1158397	1089893	1000847	972584	780584	763062	684021	673652	580158	590369
SPS BIOM	878955	962467	896660	931724	849088	808093	634176	634468	569109	530448	397517	375789

	1984	1985	1986	1987	1988	1989	1980-87
0	2444	1072	778	1131	1705	0	1820
1	2588	2210	969	702	1023	1534	1653
2	1785	2273	1824	838	617	844	1460
3	1392	1476	1881	1551	695	475	1234
4	834	1112	1168	1516	1225	495	939
5	394	611	862	885	1145	860	686
6	356	303	450	618	630	815	499
7	398	272	217	318	425	444	375
8	338	302	187	155	222	303	342
9	282	260	213	125	109	167	292
10+	695	545	421	183	105	166	642
TOTAL NO	11506	10437	8968	8022	7899		
SPS NO	4689	4882	7039	7351	4554		
TOT.BIOM	613243	477514	455826	448	401334		
SPS BIOM	414265	364615	413018	304987	311694		

Table 3.3.27

List of input variables for the ICES prediction program.

HERRING IN SUB-DIVISIONS 25-27 OPEN SEA STOCK
The reference F is the mean F for the age group range from 2 to 8

The number of recruits per year is as follows:

Year	Recruitment
1989	1820.0
1990	1820.0
1991	1820.0

Data are printed in the following units:

Number of fish:	millions
Weight by age group in the catch:	gram
Weight by age group in the stock:	gram
Stock biomass:	tonnes
Catch weight:	tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
0	1820.0	.01	.10	.00	16.400	16.400
1	1534.0	.09	.10	.00	31.000	31.000
2	844.0	.16	.10	.00	48.600	48.600
3	475.0	.24	.10	1.00	55.300	55.300
4	495.0	.25	.10	1.00	57.600	57.600
5	860.0	.24	.10	1.00	64.900	64.900
6	815.0	.25	.10	1.00	75.000	75.000
7	444.0	.24	.10	1.00	82.000	82.000
8	303.0	.18	.10	1.00	102.900	102.900
9	167.0	.16	.10	1.00	103.300	103.300
10+	166.0	.16	.10	1.00	117.100	117.100

Table 3.3.28

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

HERRING IN SUB-DIVISIONS 25-27 OPEN SEA STOCK

Year 1989					Year 1990					Year 1991	
fac-tor	ref. F	stock biomass	sp.stock biomass	catch	fac-tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.22	394	276	63	.0	.00	399	257	0	473	321
					.1	.02			7	466	314
					.2	.04			13	459	308
					.4	.09			26	445	295
					.6	.13			38	432	283
					.8	.18			50	419	272
					1.0	.22			61	407	261
					1.2	.27			72	395	250
					1.4	.31			82	384	240
					1.6	.36			92	373	231
					1.8	.40			102	362	221
					2.0	.45			111	352	212

The data unit of the biomass and the catch is 1000 tonnes.
The spawning stock biomass is given for 1 January.
The reference F is the mean F for the age group range from 2 to 8

Table 3.4.1 SUM OF PRODUCTS CHECI

HERRING IN THE GULF OF RIGA
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: millions

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	77	4	2	0	4	32	10	1	8	15	19	11
1	546	795	105	87	303	112	426	70	112	77	101	63
2	383	628	770	294	303	563	237	885	97	177	126	173
3	410	131	154	578	299	288	364	141	404	104	100	112
4	149	114	54	60	326	157	160	110	39	343	55	83
5	49	36	35	17	38	161	59	35	36	22	133	51
6	45	13	13	17	9	15	81	16	9	19	11	72
7	2	15	7	2	13	2	4	16	3	7	9	7
8	1	0	5	1	3	2	4	1	5	3	2	3
9	2	0	1	1	1	2	2	0	0	2	1	0
10+	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1662	1737	1147	1057	1298	1335	1346	1274	714	769	555	575

	1982	1983	1984	1985	1986	1987	1988
0	1	3	2	4	1	1	1
1	80	50	44	23	9	70	6
2	96	225	152	284	107	49	198
3	117	138	255	204	247	110	113
4	69	78	96	122	111	205	112
5	43	39	57	32	67	75	145
6	30	23	33	24	20	32	39
7	25	16	15	8	8	5	28
8	2	9	10	4	4	1	4
9	1	1	2	2	2	1	2
10+	1	0	1	1	1	0	0
TOTAL	464	581	665	707	574	549	647

Table 3.4.2 SUM OF PRODUCTS CHECK

HERRING IN FISHING AREAS 28 AND 29S
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: millions

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	2	13	3	13	3	4	2	0	7	0	5	6
1	76	155	115	52	223	14	36	12	38	63	137	55
2	465	318	199	256	104	241	126	69	92	187	316	302
3	273	506	242	274	211	133	445	132	129	103	258	308
4	127	203	263	170	182	157	90	323	90	82	80	166
5	385	70	88	146	106	128	87	65	187	42	65	61
6	49	171	44	69	105	64	45	65	26	117	27	45
7	68	43	109	37	51	62	24	47	30	13	65	28
8	30	15	16	61	25	23	33	31	34	16	9	40
9	9	9	13	10	46	9	9	31	15	14	15	8
10+	8	6	12	13	12	22	15	14	32	18	25	15
TOTAL	1491	1508	1104	1101	1068	857	912	789	680	655	1000	1034

	1984	1985	1986	1987	1988
0	13	1	8	4	5
1	89	63	30	166	14
2	195	288	177	105	287
3	267	165	251	213	113
4	180	195	150	250	162
5	103	115	181	113	229
6	22	68	72	148	68
7	23	21	26	52	84
8	11	11	9	20	27
9	19	4	8	4	12
10+	16	15	6	9	10
TOTAL	938	946	918	1082	1010

Table 3.4.3 SUM OF PRODUCTS CHECK

HERRING IN THE GULF OF RIGA
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: gram

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
0	6.1	4.5	7.0	7.0	6.1	5.8	5.8	2.9	5.3	6.3	7.1	7.6
1	12.7	12.2	15.4	16.3	13.8	14.2	12.2	13.2	9.8	12.2	14.5	12.1
2	19.2	19.2	21.0	21.3	18.3	17.3	18.5	16.0	17.7	16.2	20.1	21.6
3	24.3	26.5	31.4	28.0	26.0	22.5	24.1	22.7	21.9	23.4	24.1	28.8
4	29.2	34.8	40.9	34.9	32.3	32.2	29.2	26.9	27.3	27.6	32.1	33.4
5	33.0	42.9	46.2	42.4	37.7	33.8	30.5	29.5	31.1	29.8	39.3	39.0
6	46.0	64.6	40.0	45.8	41.3	39.1	39.3	31.2	30.4	34.0	45.6	43.9
7	45.0	45.0	68.2	45.0	54.3	47.3	38.3	29.4	38.1	36.8	53.3	49.9
8	50.0	50.0	54.4	50.0	66.6	43.2	39.7	50.0	50.0	36.3	70.3	55.3
9	55.0	55.0	60.3	55.0	50.5	55.0	65.8	55.0	55.0	35.6	72.3	83.4
10+	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	90.0

	1982	1983	1984	1985	1986	1987	1988
0	5.4	5.7	5.4	6.0	6.0	6.0	6.6
1	14.1	13.8	10.0	12.9	12.6	10.1	11.7
2	21.4	19.3	15.0	17.2	19.8	15.4	18.6
3	28.7	27.6	21.5	20.8	25.6	19.7	21.0
4	35.7	37.9	28.1	27.8	31.4	26.3	27.3
5	37.2	41.6	34.3	35.8	40.2	30.3	36.8
6	45.1	50.9	39.1	48.7	46.2	37.9	43.4
7	50.3	61.0	49.1	53.1	63.9	43.1	58.6
8	62.4	93.6	51.2	59.1	65.3	40.6	61.1
9	84.5	57.3	73.4	75.8	77.7	140.3	100.1
10+	143.0	.0	84.9	85.0	85.0	.0	100.1

Table 3.4.4 SUM OF PRODUCTS CHECK

HERRING IN FISHING AREAS 28 AND 29S
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: gram

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
0	10.000	10.000	10.000	10.000	10.000	10.000	14.200	10.000	10.000	10.000	7.600	6.600
1	19.000	19.000	19.000	19.000	19.000	19.000	15.300	21.800	28.400	21.400	18.400	12.600
2	29.000	29.000	29.000	29.000	29.000	29.000	28.500	38.200	35.800	34.600	29.100	25.600
3	39.000	39.000	39.000	39.000	39.000	39.000	38.600	44.500	48.800	49.600	44.000	41.900
4	48.000	48.000	48.000	48.000	48.000	48.000	48.600	48.200	60.700	64.600	54.800	53.400
5	57.000	57.000	57.000	57.000	57.000	57.000	57.900	65.600	68.500	83.500	64.100	64.000
6	63.000	63.000	63.000	63.000	63.000	63.000	68.400	65.100	81.400	87.200	86.200	71.100
7	69.000	69.000	69.000	69.000	69.000	69.000	74.900	68.100	89.500	83.000	85.000	86.700
8	74.000	74.000	74.000	74.000	74.000	74.000	70.800	81.900	89.800	99.100	91.300	87.100
9	78.000	78.000	78.000	78.000	78.000	78.000	104.000	72.800	101.500	107.300	93.300	114.400
10+	80.000	80.000	80.000	80.000	80.000	80.000	87.500	90.600	103.600	108.500	98.700	115.800

	1984	1985	1986	1987	1988
0	7.900	6.500	4.800	4.500	8.000
1	16.500	15.300	20.500	15.700	17.300
2	29.800	21.000	25.100	27.000	26.500
3	41.600	35.600	32.000	36.100	42.300
4	57.700	46.200	42.300	43.400	45.300
5	71.000	56.300	54.500	56.800	48.100
6	82.400	67.000	70.400	63.400	58.800
7	84.700	74.200	78.400	69.200	65.500
8	95.400	92.100	93.800	88.700	78.200
9	101.400	77.500	100.600	79.700	89.900
10+	117.900	95.300	100.900	110.200	80.000

Table 3.4.5

BEARING IN THE GULF OF RIGA

From 70 to 88 on ages 1 to 9
with terminal F of .340 on age 4 and terminal S of 1.000

Initial sum of squared residuals was 100.000 and
final sum of squared residuals is 93.245 after 122 iterations

Matrix of Residuals

Years	70/71	71/72	72/73	73/74	74/75	75/76	76/77	77/78
Ages								
1/ 2	1.056	1.218	.213	.476	.863	.766	.473	.662
2/ 3	.766	1.152	.177	.316	.107	.480	.252	.566
3/ 4	.069	-.181	.067	.215	-.089	-.192	.077	.099
4/ 5	.156	.208	.023	.155	.131	-.131	.046	.348
5/ 6	-.490	-.551	-.549	.049	-.275	-.604	-.335	-.260
6/ 7	-1.220	-1.382	.048	-.811	-.265	.200	-.525	-.452
7/ 8	-.323	-1.034	-.048	-1.492	.053	-2.253	-.258	-1.608
8/ 9	-1.227	3.025	.553	-.697	-1.073	-1.520	1.541	-1.775
	.000	.000	.000	.000	.000	.000	.000	.000
WTS	.010	.010	.010	.010	.010	.010	.010	.010

Years	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88			WTS
Ages													
1/ 2	1.062	.665	.973	.751	.404	.473	-.585	-.213	-.339	.570		.000	1.000
2/ 3	.166	.460	.369	.325	-.150	.229	-.247	.249	.122	-.401		.000	1.000
3/ 4	-.267	-.148	-.199	-.272	.017	.100	.164	.128	-.233	-.151		.000	1.000
4/ 5	-.079	-.048	-.508	-.242	-.005	-.137	.339	-.054	-.191	.064		.000	1.000
5/ 6	-.112	-.321	-.026	-.412	-.003	-.322	.057	-.202	.140	.366		.000	1.000
6/ 7	-.755	-.604	-.613	-.209	-.264	-.347	.267	.099	.487	-.432		.000	1.000
7/ 8	-1.126	-.001	-.005	.083	-.024	-.437	.112	-.272	1.083	-.412		.000	.010
8/ 9	-.310	-.332	.298	-.260	.029	.843	.582	-.352	.241	-1.236		.000	.010
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-14.829		
WTS	.010	.010	.010	.010	.010	1.000	1.000	1.000	1.000	1.000			

Fishing Mortalities (F)

	70	71	72	73	74	75	76	77	78
F values	1.4193	1.1946	.9377	.7506	1.0209	1.1151	1.3004	1.0770	.6278

	79	80	81	82	83	84	85	86	87	88
F values	.6795	.5290	.5664	.4567	.4629	.5388	.4405	.3663	.3069	.3400

Selection-at age (S)

	1	2	3	4	5	6	7	8	9
S-values	.0642	.3797	.7764	1.0000	1.1757	1.4740	1.4720	1.2720	1.0000

Table 3.4.6 VIRTUAL POPULATION ANALYSIS

HERRING IN THE GULF OF RIGA

FISHING MORTALITY COEFFICIENT UNIT: Year-1 VARIABLE NATURAL MORTALITY COEFFICIENT

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	.392	.258	.088	.076	.188	.164	.144	.095	.127	.094	.110	.079
2	.863	1.013	.401	.352	.387	.590	.573	.466	.176	.299	.232	.292
3	.991	.782	.698	.561	.689	.736	.922	.765	.378	.287	.291	.352
4	1.109	.798	.833	.611	.679	.922	1.189	.757	.465	.638	.259	.447
5	.995	.852	.575	.654	.955	.815	1.085	.888	.565	.518	.590	.432
6	1.000	.770	.840	.593	.767	1.319	1.295	.929	.579	.682	.535	.805
7	.887	1.142	1.242	.331	1.195	.428	1.355	.954	.454	1.163	.817	1.005
8	1.002	.246	1.939	.764	.835	.647	3.222	.657	.953	1.100	.981	.834
9	1.379	1.589	2.904	1.544	2.369	2.817	2.863	1.667	1.905	1.945	1.719	.850
10+	1.379	1.589	2.904	1.544	2.369	2.817	2.863	1.667	1.905	1.945	1.719	.850
(4- 7)U	.998	.891	.872	.547	.899	.871	1.231	.882	.516	.750	.550	.672

	1982	1983	1984	1985	1986	1987	1988
1	.055	.041	.022	.024	.015	.027	.022
2	.178	.230	.174	.191	.147	.104	.099
3	.350	.443	.454	.373	.252	.222	.364
4	.405	.441	.664	.409	.356	.343	.370
5	.469	.449	.705	.481	.411	.436	.434
6	.516	.538	.893	.739	.623	.355	.422
7	.784	.596	.826	.573	.602	.315	.599
8	.722	.822	1.011	.524	.534	.136	.421
9	.815	.654	.339	.439	.508	.284	.358
10+	.815	.654	.339	.439	.508	.284	.358
(4- 7)U	.543	.506	.772	.550	.498	.362	.456

Table 3.4.7 VIRTUAL POPULATION ANALYSIS

HERRING IN THE GULF OF RIGA

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .200
PROPORTION OF ANNUAL M BEFORE SPAWNING: .300

	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	1803	3755	1347	1268	1893	796	3414	827	1012	966	1095	923
2	707	1048	2497	1062	1012	1349	581	2545	647	767	685	764
3	693	257	328	1439	642	591	644	282	1375	467	443	423
4	236	222	101	140	707	278	244	220	113	810	273	258
5	82	67	86	38	66	309	95	64	89	61	334	164
6	75	26	25	42	17	22	118	28	23	43	28	144
7	4	24	10	9	20	7	5	28	9	11	17	13
8	1	1	7	3	6	5	4	1	9	5	3	6
9	2	0	1	1	1	2	2	0	0	3	1	1
10+	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL NO	3603	5400	4401	4001	4362	3358	5107	3994	3277	3134	2879	2696
SPS NO	1367	1239	2502	2279	2020	2038	1309	2561	1957	1773	1495	1464
TOT.BIOM	66700	86171	93676	92567	88832	68819	83048	67582	58855	61508	64691	62259
SPS BIOM	33356	30814	59656	60002	51202	45785	31803	45786	42253	40608	40878	42176

	1982	1983	1984	1985	1986	1987	1988	1989
1	1677	1398	2246	1076	680	2899	304	0
2	664	1236	1045	1799	860	549	2310	244
3	444	433	765	719	1217	608	405	1713
4	232	244	217	398	405	774	399	230
5	128	120	122	91	216	233	450	225
6	83	63	60	49	46	117	123	239
7	50	39	28	20	19	20	67	66
8	4	18	17	10	9	9	12	30
9	2	1	6	5	5	4	6	7
10+	1	0	2	2	1	0	1	4
TOTAL NO	3285	3551	4508	4169	3460	5213	4078	
SPS NO	1347	1783	1894	2620	2403	2008	3242	
TOT.BIOM	70489	76621	70082	78714	82651	83054	93275	
SPS BIOM	39199	47500	39640	54925	64046	46684	77059	

TABLE 4.3.1 **Open sea.**

```
HERRING 28:29S TUNING DATA: International Acoustic Surveys
103
Intern.Acoustic
1983, 1988
1, 1
2, 8
1, 1731, 2429, 1014, 592, 572, 456, 284
1, 944, 2679, 1815, 850, 523, 398, 382
1, 655, 1476, 2320, 1665, 707, 406, 215
1, 4100, 3498, 1514, 1221, 500, 260, 197
1, 426, 2764, 3768, 1237, 940, 464, 79
1, 3257, 741, 7010, 2334, 771, 448, 99

USSR Surveys in 50 2B, 29S
1986, 1988
1, 1
2,8
1, 445, 2760, 891, 1090, 354, 166, 126
1, 12, 114, 103, 49, 124, 93, 82
1, 4164, 750, 1090, 1508, 488, 618, 226

FILE: 2 TUNING
--------------------------------------

Module Run at 14.38.08  19 APRIL 1989
DISAGGREGATED QS
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet  1 ,Intern.Acoustic      , has terminal q estimated as the mean
Fleet  2 ,USSR Surveys in 50 2, has terminal q estimated as the mean
FITFIS COMBINED BY '' VARIANCE ''

Regression weights
      , 1.000, 1.000, 1.000, 1.000, 1.000,
Oldest age F = 1.000*average of 4 younger ages, Fleets combined by variance of predictions
Fishing mortalities

   Age,    84,    85,    86,    87,    88,

     1,  .019,  .022,  .030,  .023,  .040,
     2,  .112,  .087,  .086,  .154,  .055,
     3,  .152,  .145,  .113,  .158,  .275,
     4,  .273,  .177,  .213,  .175,  .194,
     5,  .306,  .317,  .277,  .274,  .269,
     6,  .261,  .382,  .375,  .430,  .297,
     7,  .314,  .493,  .276,  .582,  .534,
     8,  .458,  .275,  .456,  .392,  .816,
     9,  .335,  .367,  .346,  .420,  .479.

Log catchability estimates

 Age  2
 Fleet,    84,    85,    86,    87,    88
------,------,------,------,------,------
     1 ,  -.61,   .07,  -.62,  -.47,  -.46
     2 ,      ,      , -1.52, -3.06,  -.22


                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,   Slope  ,        ,Intrcpt
-------,--------,------,-------,-------,----------,----------,--------,------
     1 ,  -.42  ,  .311, .6578 , .0579,  .000E+00,  .000E+00,  -.419,   .127
     2 , -1.60  , 1.642, .2020 , .0139,  .000E+00,  .000E+00, -1.600,   .821
      Fbar      SIGMA(int.)     SIGMA(ext.)     SIGMA(overall)  Variance ratio
      .055         .305            .261            .305             .729

 Age  3
 Fleet,    84,    85,    86,    87,    88
------,------,------,------,------,------
     1 ,  .41,   .82,   .45,   .72,   .59
     2 ,      ,      ,   .22, -2.47,   .61


                                SUMMARY STATISTICS
 Fleet , Pred.  , SE(q),Partial,Raised,   SLOPE   ,    SE     ,INTRCPT,  SE
       ,   q    ,      ,   F   ,   F   ,          ,   Slope  ,        ,Intrcpt
-------,--------,------,-------,-------,----------,----------,--------,------
     1 ,   .60  ,  .191,1.8188 , .2761,  .000E+00,  .000E+00,   .598,   .078
     2 ,  -.55  , 1.933, .5775 , .0866,  .000E+00,  .000E+00,  -.549,   .967
      Fbar      SIGMA(int.)     SIGMA(ext.)     SIGMA(overall)  Variance ratio
      .273         .190            .113            .190             .356
```

cont'd.

Table 3.4.8 cont'd

Age 4

Fleet	84	85	86	87	88
1	1.01	.74	.78	.97	.88
2			.23	-2.93	.26

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	.87	.131	2.3945	.1935	.000E+00	.000E+00	.873	.053
2	.71	1.920	.4911	.0732	.000E+00	.000E+00	-.711	.960

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.193	.131	.000E-01	.131	.255

Age 5

Fleet	84	85	86	87	88
1	.93	1.52	.83	1.10	1.01
2			.51	-2.13	.57

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	1.04	.355	2.8187	.2766	.000E+00	.000E+00	1.036	.145
2	-.35	1.778	.7064	.1073	.000E+00	.000E+00	-.348	.889

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.267	.348	.182	.348	.273

Age 6

Fleet	84	85	86	87	88
1	1.82	1.38	.96	1.01	1.22
2			.61	-1.02	.76

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	1.28	.382	3.5889	.3161	.000E+00	.000E+00	1.278	.156
2	.12	1.138	1.1256	.1566	.000E+00	.000E+00	.118	.569

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.294	.363	.212	.363	.342

Age 7

Fleet	84	85	86	87	88
1	1.69	2.24	1.02	1.09	1.04
2			.14	.04	1.37

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	1.41	.589	4.1145	.7733	.000E+00	.000E+00	1.415	.240
2	.51	.852	1.6731	.2279	.000E+00	.000E+00	.515	.426

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.521	.485	.571	.571	1.390

Age 8

Fleet	84	85	86	87	88
1	2.77	1.67	2.29	.45	1.08
2			1.94	.49	1.91

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	1.65	1.611	5.2223	1.4401	.000E+00	.000E+00	1.653	.413
2	1.41	.925	4.1107	.4966	.000E+00	.000E+00	1.414	.463

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.807	.683	.530	.683	.603

Table 3.4.9

Title : HERRING IN FISHING AREAS 28 AND 29S

from 72 to 88 on ages 1 to 9
with terminal F of .200 on age 3 and terminal S of 1.400

Initial sum of squared residuals was 63.134 and
final sum of squared residuals is 13.541 after 128 iterations

Matrix of Residuals

Years	72/73	73/74	74/75	75/76	76/77	77/78
Ages						
1/ 2	-.444	.637	.335	.395	.914	-1.235
2/ 3	-.200	.077	-.256	.716	.312	-.718
3/ 4	-.125	.168	.134	.151	-.050	.013
4/ 5	.092	.282	.317	.164	-.046	.177
5/ 6	.086	-.314	-.245	-.197	-.106	.420
6/ 7	-.563	-.292	-.264	-.187	-.059	.384
7/ 8	.622	.055	-.055	-.288	.032	-.121
8/ 9	.359	-.756	-.165	-.387	.307	.232
	.000	.000	.000	.000	.000	.000
WTS	.100	.100	.100	.100	.100	.100

Years	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88		WTS
Ages												
1/ 2	.588	-1.010	-.662	-.413	.370	-.415	-.149	.047	.002	.567	.000	.195
2/ 3	.146	-.635	-.225	-.171	.125	-.088	.144	.169	-.003	-.026	.000	.439
3/ 4	.247	.113	.071	.128	.268	.051	.022	-.142	-.081	.038	.000	1.000
4/ 5	.211	.228	.344	.079	.058	-.057	.110	-.202	.156	-.197	.000	.738
5/ 6	-.031	.395	-.169	.079	-.072	.269	-.123	-.006	-.135	.010	.000	.566
6/ 7	-.318	.272	.068	.266	-.459	-.040	-.477	.515	.019	.097	.000	.378
7/ 8	-.708	-.352	-.167	-.095	-.098	.051	.043	.231	-.207	-.001	.000	.431
8/ 9	-.387	.056	.126	-.380	-.509	-.136	.265	-.234	.352	-.096	.000	.355
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-3.094	
WTS	.100	.100	.100	.100	.100	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	72	73	74	75	76	77	78
F-values	.2964	.2617	.2052	.2044	.1941	.1653	.1392

	79	80	81	82	83	84	85	86	87	88
F-values	.1674	.1670	.1478	.1714	.1922	.1563	.1508	.1543	.1865	.2000

Selection-at-age (S)

	1	2	3	4	5	6	7	8	9
S-values	.1569	.6478	1.0000	1.2382	1.5294	1.5814	1.7197	1.5619	1.4000

Table 3.4.10 VIRTUAL POPULATION AN SIS

HERRING IN FISHING AREAS 28 AND 29S

FISHING MORTALITY COEFFICIENT UNIT: Year-1 VARIABLE NATURAL MORTALITY COEFFICIENT

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	.04	.07	.06	.04	.05	.01	.02	.01	.01	.02	.03	.02
2	.19	.21	.12	.17	.12	.07	.13	.06	.10	.10	.14	.10
3	.28	.32	.24	.23	.21	.22	.20	.21	.18	.18	.22	.22
4	.30	.34	.27	.26	.24	.23	.23	.24	.24	.18	.24	.24
5	.40	.27	.24	.23	.26	.26	.21	.30	.24	.19	.24	.31
6	.31	.31	.27	.31	.26	.25	.15	.26	.21	.26	.20	.29
7	.61	.48	.33	.37	.39	.25	.15	.25	.21	.17	.25	.37
8	.55	.26	.33	.31	.46	.30	.21	.32	.32	.19	.18	.27
9	.41	.31	.37	.36	.41	.29	.18	.34	.28	.23	.28	.30
10+	.41	.31	.37	.36	.41	.29	.18	.34	.28	.23	.28	.30
(2- 7)U	.34	.32	.24	.26	.24	.21	.18	.22	.20	.18	.21	.26

	1984	1985	1986	1987	1988
1	.02	.03	.02	.04	.03
2	.11	.10	.10	.12	.11
3	.14	.15	.13	.19	.20
4	.21	.15	.21	.21	.24
5	.26	.23	.23	.28	.35
6	.20	.31	.24	.34	.30
7	.26	.34	.21	.31	.38
8	.27	.22	.27	.27	.30
9	.22	.18	.25	.20	.28
10+	.22	.18	.25	.20	.28
(2- 7)U	.20	.21	.19	.24	.26

Table 3.4.11 VIRTUAL POPULATION ANALYSIS

HERRING IN FISHING AREAS 28 AND 29S

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .200
PROPORTION OF ANNUAL M BEFORE SPAWNING: .300

	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
1	2382	2619	2325	1323	4828	1514	1826	1457	3062	3893	5050	2922
2	3019	1882	2004	1799	1036	3751	1227	1322	1069	2236	2830	3624
3	1243	2053	1255	1461	1243	754	2854	801	920	714	1497	1827
4	545	772	1226	809	949	828	498	1735	480	572	441	889
5	1287	332	450	768	509	613	536	292	1010	279	353	258
6	204	708	208	289	498	322	387	323	161	589	171	207
7	163	123	426	131	174	313	206	248	184	97	337	104
8	76	73	63	251	74	97	201	132	144	111	60	194
9	28	36	46	37	151	38	59	121	71	77	68	37
10+	27	23	41	47	40	98	102	57	151	101	115	66
TOTAL NO	8974	8621	8044	6915	9502	8330	7894	6487	7253	8669	10923	10128
SPS NO	4593	4355	4201	4143	3618	4699	4513	3760	3159	3310	3950	4787
TOT.BIOM	314868	303511	289770	269329	308669	301598	299402	283324	333864	345947	354546	322651
SPS BIOM	199526	193345	190105	190637	174859	201892	211089	193666	195398	197662	190627	205470

	1984	1985	1986	1987	1988	1989
1	4737	2937	1491	4645	528	0
2	2117	3433	2122	1079	3299	379
3	2426	1402	2297	1421	710	2199
4	1091	1569	898	1487	871	430
5	517	655	996	537	889	507
6	140	295	387	583	302	464
7	115	85	161	225	307	166
8	53	65	45	97	123	156
9	110	30	39	25	55	68
10+	93	105	31	57	46	57
TOTAL NO	11399	10575	8466	10157	7129	
SPS NO	4771	5297	5070	4189	4492	
TOT.BIOM	390202	321705	296057	318380	264847	
SPS BIOM	236593	209446	212439	19[illegible]1	186435	

Table 3.4.12

List of input variables for the ICE[illegible]rediction program.

HERRING GULF OF RIGA
The reference F is the mean F for the age group range from 4 to 7

The number of recruits per year is as follows:

Year	Recruitment
1989	1530.0
1990	1230.0
1991	1230.0

Proportion of F (fishing mortality) effective before spawning: .2000
Proportion of M (natural mortality) effective before spawning: .3000

Data are printed in the following units:

Number of fish:	millions
Weight by age group in the catch:	gram
Weight by age group in the stock:	gram
Stock biomass:	tonnes
Catch weight:	tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	1530.0	.02	.20	.00	10.900	10.900
2	840.0	.10	.20	.93	17.000	17.000
3	1720.0	.36	.20	.98	20.400	20.400
4	230.0	.37	.20	.98	26.800	26.800
5	225.0	.42	.20	1.00	33.500	33.500
6	239.0	.42	.20	1.00	40.600	40.600
7	66.0	.60	.20	1.00	50.800	50.800
8	30.0	.42	.20	1.00	50.900	50.900
9	7.0	.36	.20	1.00	100.000	100.000
10+	4.0	.36	.20	1.00	100.000	100.000

Table 3.4.13

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

HERRING GULF OF RIGA

Year 1989					Year 1990					Year 1991	
fac-tor	ref. F	stock biomass	sp.stock biomass	catch	fac-tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.45	95	68	21	.0	.00	93	73	0	111	90
					.1	.05		72	2	108	87
					.2	.09		72	5	106	84
					.4	.18		71	9	101	79
					.6	.27		70	13	97	74
					.8	.36		69	16	93	69
					1.0	.45		68	20	89	65
					1.2	.54		67	23	85	61
					1.4	.63		66	26	82	58
					1.6	.72		66	28	79	54
					1.8	.81		65	31	76	51
					2.0	.90		64	33	74	49

The data unit of the biomass and the catch is 1000 tonnes.
The spawning stock biomass is given for the time of spawning.
The spawning stock biomass for 1991 has been calculated with the same fishing mortality as for 1990.
The reference F is the mean F for the age group range from 4 to 7

Table 3.4.14

HERRING GULF OF RIGA

' Year 1989, F-factor 1.000 and reference F .4525 '

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock at 1 January size	sp.stock at 1 January biomass	sp.stock at spawning time size	sp.stock at spawning time biomass
1	.0200	27.468	299.4	1530.00	16677.0	.00	.0	.00	.0
2	.1600	72.571	1233.7	840.00	14280.0	781.20	13280.4	721.14	12259.4
3	.3600	474.120	9672.1	1720.00	35088.0	1685.60	34386.2	1477.16	30134.1
4	.3700	64.866	1738.4	230.00	6164.0	225.40	6040.7	197.13	5283.2
5	.4200	70.426	2359.3	225.00	7537.5	225.00	7537.5	194.82	6526.6
6	.4200	74.808	3037.2	239.00	9703.4	239.00	9703.4	206.95	8402.1
7	.6000	27.258	1384.7	66.00	3352.8	66.00	3352.8	55.13	2800.5
8	.4200	9.390	478.0	30.00	1527.0	30.00	1527.0	25.98	1322.2
9	.3600	1.930	193.0	7.00	700.0	7.00	700.0	6.13	613.4
10+	.3600	1.103	110.3	4.00	400.0	4.00	400.0	3.51	350.5
Total		823.941	20506.0	4891.00	95429.7	3263.20	76928.1	2887.95	67691.9

' Year 1990, F-factor 1.000 and reference F .4525 '

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock at 1 January size	sp.stock at 1 January biomass	sp.stock at spawning time size	sp.stock at spawning time biomass
1	.0200	22.082	240.7	1230.00	13407.0	.00	.0	.00	.0
2	.1000	106.079	1803.3	1227.85	20873.5	1141.90	19412.4	1054.11	17919.9
3	.3600	171.534	3499.3	622.29	12694.7	609.84	12440.8	534.43	10902.4
4	.3700	277.086	7425.9	982.48	26330.5	962.83	25803.8	842.08	22567.8
5	.4200	40.713	1363.9	130.07	4357.4	130.07	4357.4	112.63	3773.0
6	.4200	37.885	1538.1	121.04	4914.1	121.04	4914.1	104.80	4255.1
7	.6000	53.099	2697.4	128.57	6531.3	128.57	6531.3	107.39	5455.4
8	.4200	9.282	477.5	29.66	1509.5	29.66	1509.5	25.68	1307.0
9	.3600	4.449	444.9	16.14	1613.8	16.14	1613.8	14.14	1414.3
10+	.3600	1.732	173.2	6.28	628.3	6.28	628.3	5.51	550.6
Total		723.942	19659.2	4494.37	92860.0	3146.33	77211.4	2800.77	68145.4

' Year 1991, F-factor 1.000 and reference F .4525 '

age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock at 1 January size	sp.stock at 1 January biomass	sp.stock at spawning time size	sp.stock at spawning time biomass
1	.0200	22.082	240.7	1230.00	13407.0	.00	.0	.00	.0
2	.1000	85.279	1449.7	987.10	16780.7	918.00	15606.0	847.42	14406.2
3	.3600	250.737	5115.0	909.62	18556.2	891.42	18185.1	781.19	15936.3
4	.3700	100.248	2686.7	355.46	9526.2	348.35	9335.7	304.66	8164.9
5	.4200	173.911	5826.0	555.62	18613.2	555.62	18613.2	481.10	16116.9
6	.4200	21.901	889.2	69.97	2840.8	69.97	2840.8	60.59	2459.8
7	.6000	26.891	1366.1	65.11	3307.7	65.11	3307.7	54.39	2762.8
8	.4200	18.052	920.4	57.77	2940.5	57.77	2940.5	50.02	2546.1
9	.3600	4.398	439.7	15.95	1595.3	15.95	1595.3	13.98	1398.0
10+	.3600	3.530	353.0	12.81	1280.7	12.81	1280.7	11.22	1122.4
Total		707.060	19286.6	4259.40	88848.2	2935.00	73705.0	2604.58	64913.5

Table 3.4.15

List of input variables for the ICES prediction program.

HERRING IN FISHING AREAS 28 AND 29S
The reference F is the mean F for the age group range from 2 to 7

The number of recruits per year is as follows:

Year	Recruitment
1989	3194.0
1990	3194.0
1991	3194.0

Proportion of F (fishing mortality) effective before spawning: .2000
Proportion of M (natural mortality) effective before spawning: .3000

Data are printed in the following units:

Number of fish:	millions
Weight by age group in the catch:	gram
Weight by age group in the stock:	gram
Stock biomass:	tonnes
Catch weight:	tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	3194.0	.03	.30	.00	16.500	16.500
2	1191.0	.11	.30	.60	26.750	26.750
3	2199.0	.20	.30	.85	39.200	39.200
4	430.0	.24	.30	.95	44.350	44.350
5	507.0	.35	.30	1.00	52.450	52.450
6	464.0	.30	.30	1.00	61.100	61.100
7	166.0	.38	.30	1.00	67.350	67.350
8	156.0	.30	.30	1.00	83.450	83.600
9	68.0	.28	.30	1.00	84.800	94.950
10+	57.0	.28	.30	1.00	95.100	95.000

Table 3.4.16

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

HERRING IN FISHING AREAS 28 AND 29S

Year 1989					Year 1990					Year 1991	
fac-tor	ref. F	stock biomass	sp.stock biomass	catch	fac-tor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.26	281	175	43	.0	.00	273	172	0	318	209
					.1	.03		171	4	313	204
					.2	.05		170	9	309	199
					.4	.11		168	17	300	190
					.6	.16		167	25	292	181
					.8	.21		165	32	284	173
					1.0	.26		163	39	277	165
					1.2	.32		162	46	270	158
					1.4	.37		160	52	263	151
					1.6	.42		159	58	257	145
					1.8	.47		157	64	251	139
					2.0	.53		156	70	245	133

The data unit of the biomass and the catch is 1000 tonnes.
The spawning stock biomass is given for the time of spawning.
The spawning stock biomass for 1991 has been calculated with the same fishing mortality as for 1990.
The reference F is the mean F for the age group range from 2 to 7

Table 3.4.17

Results

HERRING IN FISHING AREAS 28 AND 29S

' Year 1989. F-factor 1.000 and reference F .2633 '

						at 1 January		at spawning time	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0300	81.614	1346.6	3194.00	52701	.00	0	.00	0
2	.1100	207.476	2875.0	1191.00	31859	714.60	19115	638.88	17090
3	.2000	346.096	13566.9	2199.00	86200	1869.15	73270	1641.29	64338
4	.2400	79.741	3536.5	430.00	19070	408.50	18116	355.84	15781
5	.3500	130.482	6843.8	507.00	26592	507.00	26592	432.04	22660
6	.3000	104.676	6395.7	464.00	28350	464.00	28350	399.37	24401
7	.3800	45.769	3082.5	166.00	11180	166.00	11180	140.61	9470
8	.3000	35.193	2936.8	156.00	13041	156.00	13041	134.27	11225
9	.2800	14.447	1225.1	68.00	6456	68.00	6456	58.76	5579
10+	.2800	12.110	1151.7	57.00	5415	57.00	5415	49.26	4679
total		957.604	42960.7	8432.00	280867	4410.25	201539	3850.33	175226

' Year 1990. F-factor 1.000 and reference F .2633 '

						at 1 January		at spawning time	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0300	81.614	1346.6	3194.00	52701	.00	0	.00	0
2	.1100	207.213	5543.0	2296.24	61424	1377.75	36854	1231.77	32949
3	.2000	124.400	4876.5	790.41	30983	671.85	26336	589.95	23125
4	.2400	247.340	10969.5	1333.76	59152	1267.07	56194	1103.75	48951
5	.3500	64.490	3382.5	250.58	13143	250.58	13143	213.53	11199
6	.3000	59.710	3648.3	264.68	16171	264.68	16171	227.81	13919
7	.3800	70.210	4728.7	254.65	17150	254.65	17150	215.70	14527
8	.3000	18.972	1583.2	84.10	7030	84.10	7030	72.38	6051
9	.2800	18.190	1542.5	85.61	8129	85.61	8129	73.98	7024
10+	.2800	14.870	1414.1	69.99	6648	69.99	6648	60.48	5745
total		907.009	39034.8	8674.02	272535	4326.27	187659	3789.35	163494

' Year 1991. F-factor 1.000 and reference F .2633 '

						at 1 January		at spawning time	
age	absolute F	catch in numbers	catch in weight	stock size	stock biomass	sp.stock size	sp.stock biomass	sp.stock size	sp.stock biomass
1	.0300	81.614	1346.6	3194.00	52701	.00	0	.00	0
2	.1100	207.213	5543.0	2296.24	61424	1377.75	36854	1231.77	32949
3	.2000	239.843	9401.9	1523.90	59736	1295.32	50776	1137.41	44586
4	.2400	88.904	3942.9	479.41	21261	465.44	20198	396.73	17594
5	.3500	200.032	10491.7	777.25	40766	777.25	40766	662.33	34739
6	.3000	23.511	1303.1	130.82	7992	130.82	7992	112.59	6879
7	.3800	40.050	2697.3	145.26	9783	145.26	9783	123.04	8286
8	.3000	29.104	2428.7	129.01	10785	129.01	10785	111.04	9282
9	.2800	9.806	831.6	46.15	4382	46.15	4382	39.88	3787
10+	.2800	18.510	1790.3	87.12	8276	87.12	8276	75.29	7152
Total		944.588	40024.1	8809.17	277110	4444.10	189016	3890.08	165258

Table 3.5.1 SUM OF PRODUCTS CHECK

HERRING IN THE ARCHIPELAGO AND BOTHNIAN SEAS (BALTIC FISHING AREAS 29NE AND 30E)
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: millions

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	2	9	3	1	2	10	19	51	8	15	44	11
1	42	124	174	89	91	39	250	108	122	516	238	222
2	276	249	204	292	149	82	190	188	317	355	282	674
3	310	339	248	224	338	135	194	123	295	329	334	330
4	330	233	217	232	200	302	148	131	124	214	244	213
5	133	188	137	175	181	110	290	108	110	53	119	185
6	96	81	147	128	127	103	110	187	98	66	33	86
7	85	77	57	114	84	113	129	61	137	59	63	36
8	43	76	68	71	88	49	93	61	42	95	65	33
9	38	46	45	44	36	60	44	55	38	35	66	32
10	21	25	28	32	29	22	44	20	26	22	26	45
11+	18	31	42	35	44	33	32	44	44	38	46	36
TOTAL	1394	1476	1370	1437	1370	1057	1543	1138	1361	1798	1558	1903

	1986	1987	1988
0	22	1	18
1	72	176	37
2	716	127	357
3	638	468	132
4	273	403	339
5	144	183	288
6	91	100	130
7	39	66	70
8	15	22	35
9	18	12	13
10	19	15	9
11+	27	27	31
TOTAL	2072	1599	1456

Table 3.5.2 SUM OF PRODUCTS CHECK

HERRING IN THE ARCHIPELAGO AND BOTHNIAN SEAS (BALTIC FISHING AREAS 29NE AND 30E)
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: gram

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
0	7.0	5.0	5.0	6.2	4.3	5.3	5.5	5.6	5.1	6.5	6.2	5.6
1	9.9	12.6	12.6	11.3	11.5	10.2	11.1	14.1	10.9	9.0	12.7	12.4
2	16.9	18.3	19.6	18.0	18.5	22.6	19.6	19.1	21.9	21.1	21.1	18.7
3	24.2	24.5	24.7	24.7	25.1	28.6	27.3	26.6	26.8	32.8	32.1	27.8
4	30.4	29.1	29.1	29.7	32.2	33.8	34.0	35.1	36.4	38.4	41.3	37.0
5	34.5	34.1	33.4	34.6	35.9	41.1	38.5	42.3	43.6	47.1	46.1	43.9
6	41.5	38.1	37.7	39.6	42.6	42.3	43.0	46.7	46.3	58.0	57.6	47.8
7	41.8	40.1	40.0	42.3	49.7	50.6	48.0	51.1	49.0	58.3	66.6	57.8
8	44.6	46.7	45.5	47.1	53.1	61.3	55.7	60.0	57.6	66.8	68.6	66.6
9	48.4	50.3	49.0	51.4	60.7	63.4	67.1	71.6	65.5	76.7	68.0	70.4
10	53.4	56.1	56.6	55.1	65.6	70.1	70.6	77.2	82.2	81.4	75.6	70.5
11+	60.6	62.8	64.8	62.7	73.0	74.0	78.1	87.5	99.2	100.6	86.4	83.1

	1986	1987	1988
0	6.7	3.5	3.6
1	11.0	10.1	13.0
2	19.1	21.0	19.7
3	25.7	28.2	28.9
4	32.9	34.2	35.3
5	41.5	40.2	40.6
6	49.2	48.0	46.1
7	53.1	57.6	54.6
8	69.5	61.9	64.0
9	77.8	75.8	66.2
10	72.3	82.6	76.7
11+	72.5	89.4	81.8

TABLE 3.5.3 HERRING 29NE-30E.

103
Trapnet
1974, 1988
1,1
1, 10
1963,1.4,14.6,89.9,162.3,61.8,53.5,53.9,28.2,24.2,10.4
1592,1.9,28.2,88.1,73.6,78.8,36.0,34.6,35.0,18.0,13.8
1896,2.5,36.1,108.1,105.5,69.4,77.6,29.1,35.8,28.2,16.1
2227,2.8,51.0,86.3,122.8,80.3,52.4,67.0,34.3,23.9,16.5
2114,14.6,26.0,128.7,82.9,102.3,55.1,42.7,47.6,16.4,14.6
1987,8.2,17.8,41.6,144.7,58.6,68.5,39.0,19.8,23.8,7.8
1944,4.7,14.5,34.5,40.0,126.9,56.8,61.3,33.8,15.5,19.0
1848,3.2,33.1,22.7,38.7,35.1,67.1,28.8,18.4,14.1,7.8
1682,3.9,41.9,91.2,30.0,35.5,38.7,56.5,20.1,15.6,6.1
1544,0.4,31.2,52.6,63.1,15.9,17.1,21.6,31.6,10.9,7.6
1667,4.3,17.5,79.1,36.9,38.8,11.6,13.3,18.4,21.2,5.8
1523,3.5,33.2,58.9,76.7,26.7,31.3,10.1,11.6,10.3,17.0
1433,0.2,33.9,111.6,58.5,44.3,15.7,11.6,5.8,3.5,3.8
1142,0.7,13.3,72.1,107.8,48.3,36.0,17.4,8.4,3.7,5.8
1127,0,27.6,26.4,67.4,90.5,42.5,27.6,9.7,5.5,4.6
Bottom trawl
1974, 1988
1,1
1, 10
4233,16.5,169.6,153.5,110.6,43.4,28.8,18.5,10.6,11.2,7.4
4816,146.5,169.1,183.1,116.2,77.4,23.3,30.9,17.5,13.6,5.5
2843,117.2,109.5,85.5,75.6,36.0,28.0,14.5,13.0,8.3,6.6
3106,41.2,137.6,69.6,52.7,54.6,43.1,23.3,19.0,9.5,10.6
3076,78.3,107.3,142.3,62.5,42.9,35.4,15.1,14.3,6.8,3.1
2799,11.0,28.3,46.7,60.9,18.0,21.7,19.6,7.3,9.9,2.8
3451,120.3,103.1,94.1,49.8,64.2,18.9,19.0,11.6,8.1,2.5
2647,41.6,22.8,31.0,44.7,30.7,51.8,14.0,15.0,13.7,5.1
2736,37.9,46.6,49.3,18.7,19.7,19.4,26.1,7.9,4.6,8.8
2741,359.1,112.2,47.7,41.5,8.5,8.7,5.9,9.4,7.5,2.0
1943,51.8,42.6,46.4,33.0,14.9,9.4,11.1,6.3,13.5,3.8
1377,43.2,79.6,30.0,25.2,29.4,10.1,2.1,4.2,2.5,3.5
1531,0.5,89.8,53.4,26.2,15.5,13.1,4.8,3.5,2.6,3.3
2089,43.5,29.3,73.6,58.0,26.1,8.9,6.2,2.0,0.8,2.0
2062,16.3,70.2,17.5,48.5,36.6,16.1,10.3,2.8,1.2,1.4
Pelagic trawl
1974, 1988
1,1
1, 10
782,34.0,64.8,34.0,23.4,6.2,4.1,2.6,1.4,0.5,0.9
799,4.3,15.9,21.7,15.5,12.7,8.1,7.7,7.8,5.1,2.9
682,34.3,20.4,17.2,28.0,22.2,24.9,10.8,10.5,4.5,2.7
086,45.4,45.4,26.8,23.6,45.9,16.1,14.9,17.4,7.4,3.7
1437,31.9,30.5,60.3,39.1,37.3,35.4,17.3,17.4,13.0,6.5
2374,38.8,73.4,71.7,111.0,40.5,45.2,49.0,22.3,23.3,8.1
2879,38.9,31.4,32.5,37.6,68.9,31.0,42.0,44.1,18.6,19.3
2485,60.7,91.9,47.5,35.2,28.6,42.7,14.1,19.8,29.0,7.5
2858,67.1,131.3,61.0,32.5,26.5,31.7,49.5,14.8,23.5,15.0
3208,137.5,144.5,182.0,83.9,24.4,34.4,30.5,45.5,15.8,14.1
4767,189.4,170.3,153.5,148.7,55.5,16.4,25.5,38.2,31.6,19.6
3590,283.1,596.5,217.1,101.2,118.6,37.2,18.9,15.1,12.8,22.1
3909,60.3,507.3,402.3,166.9,85.2,66.2,24.1,8.0,12.6,17.7
5316,77.5,74.4,270.3,220.7,99.0,56.4,43.0,11.6,7.5,7.2
5247,18.7,231.8,73.3,196.8,161.9,75.8,40.0,27.3,7.7,5.1

Table 3.5.4 HERRING ZONE 30E

Module run at 13.07.31 14 APRIL 1989
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 ,Trapnet , has terminal q estimated as the mean
Fleet 2 ,Bottom trawl , has terminal q estimated as the mean
Fleet 3 ,Pelagic trawl , has terminal q estimated as the mean
FLEETS COMBINED BY '' VARIANCE ''

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

Age,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,
0,	.001,	.002,	.001,	.000,	.001,	.003,	.005,	.011,	.002,	.002,	.007,	.006,	.004,	.002,	.004,
1,	.013,	.045,	.035,	.036,	.045,	.027,	.098,	.096,	.034,	.123,	.035,	.044,	.052,	.043,	.090,
2,	.098,	.085,	.094,	.075,	.078,	.051,	.180,	.111,	.142,	.132,	.091,	.130,	.195,	.121,	.114,
3,	.186,	.158,	.126,	.142,	.116,	.094,	.166,	.171,	.255,	.215,	.177,	.146,	.175,	.188,	.177,
4,	.194,	.196,	.141,	.157,	.182,	.144,	.141,	.161,	.258,	.295,	.245,	.164,	.173,	.159,	.203,
5,	.175,	.153,	.165,	.161,	.190,	.144,	.201,	.145,	.196,	.169,	.266,	.296,	.159,	.168,	.163,
6,	.152,	.147,	.167,	.229,	.167,	.157,	.210,	.194,	.189,	.174,	.148,	.312,	.233,	.158,	.173,
7,	.178,	.164,	.141,	.189,	.230,	.221,	.301,	.171,	.212,	.166,	.249,	.240,	.230,	.264,	.158,
8,	.136,	.226,	.209,	.262,	.218,	.205,	.285,	.228,	.173,	.222,	.277,	.203,	.148,	.195,	.220,
9,	.195,	.198,	.198,	.203,	.206,	.227,	.284,	.274,	.217,	.212,	.238,	.211,	.158,	.171,	.168,
10,	.167,	.178,	.176,	.209,	.202,	.191,	.256,	.202,	.198,	.189,	.236,	.253,	.186,	.191,	.176,

Log catchability estimates

Age 0

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 , No data for this fleet at this age															
2 ,-15.97,-14.28,-15.65,-17.09,-18.72,-19.15,-12.88,-13.38,-16.52,-18.58,-14.24,-12.41,-19.10,-13.49,-13.89															
3 ,-13.27,-17.70,-13.73,-17.14,-13.87,-12.98,-13.73,-12.56,-13.88,-14.21,-13.53,-12.90,-13.55,-17.13,-15.22															

SUMMARY STATISTICS

Fleet , Pred. q ,	SE(q),	Partial, F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 , No data for this fleet at this age							
2 ,-15.69 ,	2.470,	.0003 ,	.0006,	.000E+00,	.000E+00,	-15.690,	.617
3 ,-14.36 ,	1.709,	.0030 ,	.0089,	.000E+00,	.000E+00,	-14.360,	.427

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.004	1.41	1.24	1.41	.783

Age 1

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 ,-15.32,-14.65,-15.15,-14.49,-12.60,-12.75,-13.77,-14.36,-14.24,-16.60,-14.79,-14.60,-16.12,-15.72,-16.25															
2 ,-13.62,-11.41, 11.71,-12.14,-11.29,-12.80,-11.10,-12.15,-12.45,-10.38,-12.46,-11.99,-15.27,-12.19,-10.84															
3 ,-11.21,-13.15,-11.51,-10.99,-11.43,-11.37,-12.05,-11.71,-11.93,-11.50,-12.06,-11.06,-11.41,-12.55,-11.64															

SUMMARY STATISTICS

Fleet , Pred. q ,	SE(q),	Partial, F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,-14.76 ,	1.206,	.0004 ,	.4007,	.000E+00,	.000E+00,	-14.761,	.302
2 ,-12.12 ,	1.232,	.0112 ,	.0252,	.000E+00,	.000E+00,	-12.120,	.308
3 ,-11.70 ,	.593,	.0433 ,	.0848,	.000E+00,	.000E+00,	-11.704,	.148

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.090	.488	.558	.558	1.304

Age 2

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 ,-12.85,-11.90,-11.64,-12.05,-11.96,-12.09,-11.86,-11.46,-11.40,-11.80,-12.59,-12.38,-11.95,-11.41,-11.75															
2 ,-11.16,-11.22,-10.94,-11.39,-10.92,-11.97,-10.47,-12.19,-11.78,-11.09,-11.86,-11.40,-11.05,-11.22,-11.42															
3 ,-10.43, 11.78,-11.19,-11.44,-11.41,-10.85,-11.48,-10.73,-10.79,-10.99,-11.37,-10.35,-10.25,-11.23,-11.16															

SUMMARY STATISTICS

Fleet , Pred. q ,	SE(q),	Partial, F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,-11.94 ,	.439,	.0074 ,	.0951,	.000E+00,	.000E+00,	-11.939,	.108
2 ,-11.34 ,	.470,	.0246 ,	.1247,	.000E+00,	.000E+00,	-11.338,	.118
3 ,-11.03 ,	.469,	.0349 ,	.1306,	.000E+00,	.000E+00,	-11.031,	.117

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.114	.263	.102	.263	.149

cont'd.

Table 3.5.4 cont'd.

Age 3

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1	-10.50,	-10.56,	-10.45,	-10.61,	-10.77,	-11.14,	-11.10,	-10.98,	-9.97,	-10.71,	-10.59,	-10.97,	-10.76,	-10.58,	-10.36
2	-10.74,	-10.94,	-11.09,	-11.16,	-11.05,	-11.37,	-10.67,	-11.03,	-11.07,	-11.38,	-11.28,	-11.55,	-11.56,	-11.16,	-11.38
3	-10.55,	-11.27,	-11.26,	-11.06,	-11.15,	-10.77,	-11.55,	-10.54,	-10.90,	-10.20,	-10.98,	-10.53,	-10.48,	-10.80,	-10.88

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-10.67	.315	.0262	.1303	.000E+00	.000E+00	-10.671	.079
2	-11.16	.273	.0293	.2203	.000E+00	.000E+00	-11.161	.068
3	-10.86	.375	.1006	.1805	.000E+00	.000E+00	-10.862	.094

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.177	.181	.161	.181	.796

Age 4

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1	-9.93,	-10.15,	-10.23,	-10.14,	-10.24,	-10.26,	-10.84,	-10.57,	-10.20,	-9.78,	-10.72,	-10.16,	-10.56,	-10.20,	-10.24
2	-11.08,	-10.80,	-10.97,	-11.32,	-10.90,	-11.47,	-11.20,	-10.79,	-11.16,	-10.77,	-10.98,	-11.17,	-11.43,	-11.42,	-11.17
3	-10.95,	-11.02,	-10.54,	-11.07,	-10.61,	-10.71,	-11.30,	-10.96,	-10.65,	-10.23,	-10.37,	-10.74,	-10.52,	-11.02,	-10.71

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-10.28	.291	.0386	.1944	.000E+00	.000E+00	-10.281	.073
2	-11.11	.245	.0369	.2161	.000E+00	.000E+00	-11.108	.061
3	-10.76	.300	.1117	.1924	.000E+00	.000E+00	-10.758	.075

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.203	.159	.388E-01	.159	.060

Age 5

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1	-10.09,	-10.12,	-10.03,	-10.32,	-9.89,	-10.16,	-10.00,	-10.58,	-10.18,	-10.33,	-9.86,	-10.48,	-10.28,	-10.15,	-10.00
2	-11.21,	-11.25,	-11.09,	-11.03,	-11.13,	-11.68,	-11.26,	-11.07,	-11.26,	-11.53,	-10.97,	-10.28,	-11.40,	-11.37,	-11.51
3	-11.47,	-11.26,	-10.15,	-10.16,	-10.51,	-10.71,	-11.01,	-11.08,	-11.01,	-10.63,	-10.55,	-9.85,	-10.63,	-10.97,	-10.95

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-10.17	.211	.0434	.1379	.000E+00	.000E+00	-10.165	.053
2	-11.20	.335	.0281	.2209	.000E+00	.000E+00	-11.204	.084
3	-10.73	.457	.1149	.2042	.000E+00	.000E+00	-10.729	.114

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.163	.166	.153	.166	.848

Age 6

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1	-10.06,	-10.11,	-9.98,	-10.08,	-10.28,	-9.85,	-9.80,	-10.19,	-10.02,	-10.44,	-10.36,	-9.50,	-10.48,	-9.91,	-9.90
2	-11.44,	-11.65,	-11.40,	-10.61,	-11.09,	-11.35,	-11.47,	-10.81,	-11.20,	-11.69,	-10.73,	-10.53,	-10.73,	-11.91,	-11.47
3	-11.70,	-10.91,	-10.09,	-10.54,	-10.33,	-10.45,	-10.79,	-10.94,	-10.75,	-10.48,	-11.07,	-10.18,	-10.05,	-11.00,	-10.86

SUMMARY STATISTICS

Fleet	Pred. q	SE(q)	Partial F	Raised F	SLOPE	SE Slope	INTRCPT	SE Intrcpt
1	-10.06	.272	.0480	.1467	.000E+00	.000E+00	-10.063	.068
2	-11.21	.447	.0281	.2261	.000E+00	.000E+00	-11.205	.112
3	-10.68	.453	.1212	.2075	.000E+00	.000E+00	-10.676	.113

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.173	.207	.138	.207	.444

Table 3.5.4

cont'd.

Age 7

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 ,	9.76,	-9.98,	-10.18,	-9.93,	-9.80,	10.17,	-9.52,	-10.03,	-9.67,	-10.14,	-10.36,	-10.02,	-9.96,	-9.71,	-9.80
2 ,	-11.60,	-11.20,	11.28,	-11.30,	-11.22,	-11.20,	-11.26,	-11.11,	-11.13,	-12.01,	-10.70,	-11.49,	-10.90,	-11.34,	-11.39
3 ,	-11.87,	-10.79,	-10.14,	-10.69,	-10.32,	-10.12,	-10.29,	-11.04,	-10.53,	-10.53,	-10.76,	-10.25,	-10.23,	-10.34,	-10.97

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	,INTRCPT,	SE ,Intrcpt
1 ,	-9.95 ,	.223,	.0540 ,	.1366,	.000E+00,	.000E+00,	-9.946,	.056
2 ,	-11.27 ,	.308,	.0262 ,	.1773,	.000E+00,	.000E+00,	-11.275,	.077
3 ,	-10.59 ,	.475,	.1319 ,	.2301,	.000E+00,	.000E+00,	-10.591,	.119

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.158	.169	.130	.169	.597

Age 8

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 ,	-10.00,	-9.63,	-9.76,	-9.77,	-9.80,	-10.09,	-9.84,	-10.20,	-9.93,	-9.95,	-9.96,	-9.98,	-10.12,	-9.64,	-9.83
2 ,	-11.75,	-11.43,	11.18,	-10.70,	-11.37,	-11.43,	-11.48,	-10.77,	-11.35,	-11.73,	-11.19,	-10.90,	-10.69,	-11.68,	-11.68
3 ,	-12.09,	-10.44,	-9.96,	-9.73,	-10.42,	-10.15,	-9.97,	-10.43,	-10.76,	-10.31,	-10.28,	-10.58,	-10.80,	-10.85,	-10.34

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	,INTRCPT,	SE ,Intrcpt
1 ,	-9.90 ,	.174,	.0566 ,	.2059,	.000E+00,	.000E+00,	-9.900,	.043
2 ,	-11.29 ,	.386,	.0258 ,	.3257,	.000E+00,	.000E+00,	-11.287,	.097
3 ,	10.47 ,	.566,	.1484 ,	.1919,	.000E+00,	.000E+00,	-10.473,	.142

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.220	.153	.120	.153	.618

Age 9

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 ,	-9.67,	-9.93,	-9.63,	-9.92,	-10.02,	-10.00,	-9.87,	-10.18,	-9.85,	-10.06,	-9.99,	-10.00,	-10.74,	-9.98,	-9.67
2 ,	-11.21,	-11.32,	11.26,	-11.17,	-11.28,	-11.22,	-11.09,	-10.57,	-11.56,	-11.01,	-10.60,	-11.32,	-11.10,	-12.12,	-11.79
3 ,	-12.63,	-10.50,	-10.45,	-10.37,	-9.87,	-10.20,	-10.08,	-9.76,	-9.97,	-10.42,	-10.64,	-10.64,	-10.46,	-10.81,	-10.87

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	,INTRCPT,	SE ,Intrcpt
1 ,	-9.97 ,	.272,	.0528 ,	.1239,	.000E+00,	.000E+00,	-9.968,	.068
2 ,	-11.24 ,	.405,	.0271 ,	.2908,	.000E+00,	.000E+00,	-11.241,	.101
3 ,	-10.51 ,	.694,	.1427 ,	.2391,	.000E+00,	.000E+00,	-10.512,	.174

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.168	.215	.278	.278	1.676

Table 3.5.5

Title : HERRING IN THE ARCHIPELAGO AND BOTHNIAN SEAS (BALTIC FISHING AREAS 29NE AND 30E)

from 74 to 88 on ages 1 to 10
with terminal F of .164 on age 3 and Terminal S of 1.210

Initial sum of squared residuals was 31.070 and
final sum of squared residuals is 9.625 after 104 iterations

Matrix of Residuals

Years	74/75	75/76	76/77	77/78								
Ages												
1/ 2	-1.099	.061	.247	.120								
2/ 3	.140	-.060	.045	-.147								
3/ 4	.078	.113	-.063	-.155								
4/ 5	.300	.147	.035	-.072								
5/ 6	.182	-.185	-.161	.044								
6/ 7	.088	.093	.191	.220								
7/ 8	.266	-.384	-.518	-.180								
8/ 9	-.415	.048	.164	.265								
9/10	.218	.149	.217	.136								
	.000	.000	.000	.000								
WTS	.001	.001	.001	.001								

Years	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88		WTS
Ages												
1/ 2	.640	-.571	.695	-.329	-.527	1.214	-.392	-.707	.001	-.115	.000	.198
2/ 3	.002	-.495	.194	-.343	-.143	.021	-.158	-.130	.352	-.083	.000	.591
3/ 4	-.252	.010	-.121	-.170	-.058	-.014	.173	-.272	.113	.002	.000	.888
4/ 5	.183	.088	-.255	-.041	.402	.216	-.056	-.122	-.002	-.037	.000	.690
5/ 6	.095	-.003	-.180	-.170	.020	.078	-.054	.142	-.086	-.080	.000	1.000
6/ 7	-.188	-.062	.148	.206	.191	-.205	-.311	.377	.037	.101	.000	.638
7/ 8	-.006	.127	.051	.012	-.198	-.595	.174	.236	.055	.131	.000	.464
8/ 9	-.129	.078	-.144	.158	.341	-.099	.294	.019	-.283	.069	.000	.556
9/10	.105	.415	.262	.591	.153	-.008	.098	.059	-.169	.019	.000	.664
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	-.679	
WTS	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	74	75	76	77	78
F-values	.1381	.1401	.1281	.1478	.1500

	79	80	81	82	83	84	85	86	87	88
F-values	.1370	.2062	.1706	.1987	.1884	.1901	.2005	.1744	.1673	.1640

Selection-at-age (S)

	1	2	3	4	5	6	7	8	9	10
S-values	.2989	.7309	1.0000	1.0748	1.1032	1.0803	1.2637	1.1735	1.1109	1.2100

Table 3.5.6 VIRTUAL POPULATION ANALYSIS

HERRING IN THE ARCHIPELAGO AND BOTHNIAN SEAS (BALTIC FISHING AREAS 29NE AND 30E)

FISHING MORTALITY COEFFICIENT UNIT: Year-1 VARIABLE NATURAL MORTALITY COEFFICIENT

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.014	.045	.034	.037	.046	.029	.104	.034	.038	.132	.037	.040
2	.094	.099	.094	.074	.079	.053	.190	.107	.131	.147	.098	.140
3	.170	.152	.131	.141	.114	.095	.171	.182	.242	.195	.201	.160
4	.179	.177	.134	.175	.181	.141	.144	.168	.279	.277	.216	.191
5	.162	.139	.146	.153	.201	.142	.196	.148	.206	.186	.245	.253
6	.140	.133	.150	.197	.157	.168	.208	.188	.195	.184	.165	.280
7	.154	.149	.127	.166	.192	.205	.329	.169	.204	.171	.268	.275
8	.126	.189	.186	.230	.186	.164	.259	.256	.171	.212	.289	.222
9	.173	.182	.159	.177	.175	.187	.215	.242	.252	.208	.224	.223
10	.167	.154	.158	.161	.172	.157	.202	.144	.169	.227	.230	.234
11+	.167	.154	.158	.161	.172	.157	.202	.144	.169	.227	.230	.234
(3- 8)U	.155	.157	.146	.177	.172	.153	.218	.185	.216	.204	.231	.230
(3- 8)W	.164	.155	.140	.166	.153	.141	.197	.178	.223	.210	.218	.197

	1986	1987	1988
1	.050	.046	.049
2	.173	.116	.124
3	.191	.163	.170
4	.192	.177	.171
5	.190	.191	.185
6	.190	.195	.201
7	.200	.205	.203
8	.175	.164	.161
9	.177	.210	.137
10	.198	.219	.226
11+	.198	.219	.226
(3- 8)U	.190	.183	.182
(3- 8)W	.191	.176	.180

Table 3.5.7 VIRTUAL POPULATION ANALYSIS

HERRING IN THE ARCHIPELAGO AND BOTHNIAN SEAS (BALTIC FISHING AREAS 29NF AND 30E)

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .150
PROPORTION OF ANNUAL M BEFORE SPAWNING: .330

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	3347	3049	5732	2742	2235	1516	2777	3600	3621	4668	7183	6303
2	3291	2842	2510	4536	2164	1747	1206	2049	2850	2855	3308	5666
3	2127	2578	2216	1871	3450	1637	1357	817	1508	2048	2017	2454
4	2161	1544	1905	1591	1330	2520	1219	936	558	969	1380	1351
5	955	1555	1114	1364	1093	968	1791	864	648	345	601	910
6	794	699	1164	788	959	732	645	1205	610	432	235	385
7	639	534	526	821	530	671	506	429	818	411	294	163
8	392	472	440	380	569	358	447	298	297	546	284	184
9	258	297	336	299	247	387	249	283	189	205	362	174
10	149	187	213	235	205	170	263	164	182	120	136	237
11+	127	231	312	255	304	246	190	360	311	207	246	189
TOTAL NO	14238	14047	16469	14882	13087	10893	10651	11006	11591	12747	16045	18016
SPS NO	7774	8159	8033	8012	8281	7308	6269	5361	5291	5262	5745	6647
TOT.BIOM	353129	363979	397475	381428	382483	365792	328993	341602	340702	339780	386588	439451
SPS BIOM	249351	267899	270909	263429	293772	290525	252313	237870	231717	217206	231761	249622

	1986	1987	1988	1989
1	1634	4298	844	0
2	4960	1273	3360	658
3	4031	3416	928	2429
4	1712	2726	2376	641
5	914	1156	1869	1640
6	579	619	782	1271
7	239	392	417	524
8	101	160	261	279
9	121	70	111	182
10	114	83	46	79
11+	166	150	166	139
TOTAL NO	14571	14343	11160	
SPS NO	8154	7756	6885	
TOT.BIOM	388398	393953	363765	
SPS BIOM	264883	285593	270169	

Table 3.5.8

Analysis by RCRTINX2 of data from file SURVEY
HERRING 29-NE-30-E AS 0-GROUP

Data for 5 surveys over 15 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 1 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
COADJN	1.2809	2.148	5.457	.2910	14	8.2081	1.11427	1.17325	.09678
CONAJN	2.2300	1.819	4.136	.3995	14	8.1924	.87517	.92168	.15682
LARSJN	3.7136	3.425	-3.389	.3771	14	9.3300	.91742	1.03691	.12391
LARMJN	2.7726	1.584	4.289	.4464	14	8.6804	.79490	.85532	.18210
LARBJN	1.0986	1.809	6.959	.3970	14	8.9462	.87974	.96225	.14388
MEAN						8.0156	.67030	.67030	.29651

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1988	8.48	4816.34	.36	.21		.56

Table 3.5.9

List of input variables for the ICL rediction program.

HERRING 29NE-30E
The reference F is the mean F for the age group range from 3 to 8

The number of recruits per year is as follows:

Year	Recruitment
1989	4816.0
1990	3719.0
1991	3719.0

Proportion of F (fishing mortality) effective before spawning: .1500
Proportion of M (natural mortality) effective before spawning: .3300

Data are printed in the following units:

Number of fish: millions
Weight by age group in the catch: gram
Weight by age group in the stock: gram
Stock biomass: tonnes
Catch weight: tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	4816.0	.05	.20	.00	13.000	13.000
2	658.0	.12	.20	.22	19.700	19.700
3	2429.0	.17	.20	.92	28.900	28.900
4	641.0	.17	.20	.97	35.300	35.300
5	1640.0	.19	.20	1.00	40.600	40.600
6	1271.0	.20	.20	1.00	46.100	46.100
7	524.0	.20	.20	1.00	54.600	54.600
8	279.0	.20	.20	1.00	64.000	64.000
9	182.0	.20	.20	1.00	66.200	66.200
10	79.0	.20	.20	1.00	76.700	76.700
11+	139.0	.20	.20	1.00	81.800	81.800

Table 3.5.10

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

HERRING 29NE-30E

Year 1989					Year 1990					Year 1991	
factor	ref. F	stock biomass	sp.stock biomass	catch	factor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.19	370	264	50	.0	.00	367	242	0	426	303
					.1	.02		241	5	421	297
					.2	.04		240	10	415	291
					.4	.08		239	20	404	280
					.6	.11		238	30	394	270
					.8	.15		236	39	384	260
					1.0	.19		235	48	374	250
					1.2	.23		234	57	364	240
					1.4	.26		233	65	355	231
					1.6	.30		231	74	346	222
					1.8	.34		230	82	338	214
					2.0	.38		229	89	329	206

The data unit of the biomass and the catch is 1000 tonnes.
The spawning stock biomass is given for the time of spawning.
The spawning stock biomass for 1991 has been calculated with the same fishing mortality as for 1990.
The reference F is the mean F for the age group range from 3 to 8

Table 3.5.11

HERRING 29NE-30E

Year 1989. F-factor 1.000 and reference F .1883

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
1	.0500	212.06	2769.8	4816.0	62608	.00	0	.00	0
2	.1200	67.57	1331.2	658.0	12962	144.76	2851	133.10	2622
3	.1700	345.15	9974.8	2429.0	70198	2234.68	64582	2039.28	58935
4	.1700	91.66	3215.2	641.0	22627	621.77	21948	567.40	20029
5	.1900	258.02	10475.7	1640.0	66584	1640.00	66584	1492.12	60579
6	.2000	209.51	9658.5	1271.0	58593	1271.00	58593	1154.66	53229
7	.2000	86.36	4716.1	524.0	28610	524.00	28610	476.04	25991
8	.2000	45.99	2943.4	279.0	17856	279.00	17856	253.46	16221
9	.2000	30.00	1986.1	182.0	12048	182.00	12048	165.34	10945
10	.2000	13.02	998.8	79.0	6059	79.00	6059	71.77	5504
11+	.2000	22.91	1874.3	139.0	11370	139.00	11370	126.28	10329
Total		1382.70	49943.9	12658.0	369517	7115.21	290503	6479.44	264388

Year 1990. F-factor 1.000 and reference F .1883

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
1	.0500	164.53	2138.9	3719.0	48347	.00	0	.00	0
2	.1200	385.18	7588.0	3750.7	73888	825.15	16255	758.67	14945
3	.1700	67.89	1962.1	477.8	13808	439.58	12703	401.15	11593
4	.1700	238.41	8415.7	1677.8	59226	1627.46	57449	1485.16	52426
5	.1900	69.66	2828.2	442.8	17976	442.76	17976	402.84	16355
6	.2000	183.03	8437.9	1110.4	51188	1110.37	51188	1008.73	46502
7	.2000	140.44	7668.0	852.0	46517	851.98	46517	773.99	42259
8	.2000	57.90	3705.6	351.2	22479	351.25	22479	319.10	20422
9	.2000	30.83	2040.8	187.0	12380	187.02	12380	169.90	11247
10	.2000	20.11	1542.5	122.0	9357	122.00	9357	110.83	8500
11+	.2000	24.09	1970.4	146.1	11953	146.13	11953	132.75	10859
Total		1382.06	48298.0	12836.8	367124	6103.70	258262	5563.12	235112

Year 1991. F-factor 1.000 and reference F .1883

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
1	.0500	164.53	2138.9	3719.0	48347	.00	0	.00	0
2	.1200	297.44	5859.5	2896.4	57058	637.20	12552	585.86	11541
3	.1700	387.01	11184.5	2723.6	78711	2505.68	72414	2286.59	66082
4	.1700	46.90	1655.5	330.0	11650	320.14	11300	292.14	10312
5	.1900	182.33	7402.7	1158.9	47051	1158.91	47051	1054.41	42808
6	.2000	49.41	2278.0	299.8	13819	299.77	13819	272.33	12554
7	.2000	122.69	6698.9	744.3	40639	744.31	40639	676.17	36919
8	.2000	94.14	6024.9	571.1	36550	571.10	36550	518.82	33204
9	.2000	38.81	2569.3	235.4	15586	235.45	15586	213.90	14159
10	.2000	20.66	1585.0	125.4	9615	125.36	9615	113.89	8735
11+	.2000	29.63	2423.5	179.7	14702	179.73	14702	163.28	13356
Total		1433.55	49820.7	12983.6	373731	6777.65	274232	6177.40	249675

Table 3.6.1 SUM OF PRODUCTS CHECK

HERRING IN THE BOTHNIAN BAY (FISHING AREA 31, EASTERN PART)
CATEGORY: TOTAL

CATCH IN NUMBERS UNIT: millions

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	9	2	13	2	2	5	61	12	6	27	36	4
2	23	39	20	97	7	6	49	80	14	11	137	76
3	17	31	40	25	131	7	6	22	107	19	20	117
4	27	11	42	26	18	77	13	4	20	67	10	16
5	23	17	19	22	28	12	82	10	5	10	51	11
6	25	14	23	15	22	21	14	45	15	11	7	31
7	28	13	26	21	11	15	23	15	29	10	6	5
8	10	11	21	12	26	11	16	14	7	15	1	3
9	3	2	10	7	6	12	9	8	10	4	13	3
10	3	2	3	2	7	3	6	4	3	3	2	7
11+	2	1	3	1	4	2	1	5	4	2	3	4
TOTAL	168	142	219	230	261	171	279	220	217	178	287	276

	1986	1987	1988
1	4	9	8
2	18	38	38
3	49	27	24
4	68	39	20
5	12	46	31
6	15	10	33
7	30	13	7
8	4	9	7
9	5	4	5
10	6	3	3
11+	13	5	4
TOTAL	224	203	178

Table 3.6.2 SUM OF PRODUCTS CHECK

HERRING IN THE BOTHNIAN BAY (FISHING AREA 31, EASTERN PART)
CATEGORY: TOTAL

MEAN WEIGHT AT AGE IN THE CATCH UNIT: gram

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	15.0	13.0	12.2	13.3	14.8	14.5	11.9	14.1	16.0	13.0	16.1	13.0
2	20.5	21.3	21.7	20.9	22.8	23.9	22.3	21.5	24.5	25.1	23.4	22.1
3	28.3	30.3	29.6	29.9	31.0	32.0	31.1	29.0	31.3	34.7	35.0	30.7
4	34.1	36.2	34.5	34.3	36.4	35.7	37.5	35.2	37.2	39.8	41.0	38.3
5	37.9	38.8	40.1	38.4	37.8	39.0	39.7	39.7	42.3	42.9	43.8	43.5
6	40.3	44.5	41.6	41.2	42.1	41.0	41.8	42.4	46.9	47.8	46.6	45.8
7	42.7	45.7	44.0	44.4	43.3	45.2	43.9	45.7	48.2	52.7	53.1	52.2
8	45.4	49.5	46.1	46.9	46.3	48.7	46.7	47.3	50.9	55.7	53.4	53.9
9	46.5	51.6	50.5	48.0	49.7	49.6	49.3	50.7	54.7	59.0	56.7	57.8
10	60.2	61.3	49.6	51.0	50.0	51.5	57.7	51.8	57.2	60.0	56.5	57.2
11+	50.0	63.0	57.7	56.3	63.1	50.7	55.6	57.3	60.6	63.6	61.8	62.9

	1986	1987	1988
1	12.3	14.3	9.2
2	18.7	23.8	23.7
3	29.4	32.4	35.2
4	36.7	38.9	41.4
5	41.4	44.2	45.7
6	45.3	48.9	50.5
7	49.0	53.5	54.6
8	50.7	56.7	60.7
9	59.2	59.4	59.5
10	58.0	61.3	61.9
11+	64.9	68.8	73.5

Table 3.6.3 HERRING 31E

```
Herring Botnbay VPA Tuning-module, FILE: TUNING-ALL
103
Trapnet
1974, 1988
1,1
1,10
529,  0.2,  8.9, 10.2, 14.1, 14.1, 14.9, 17.3,  6.2,  1.9,  1.5
554,  2.2, 15.4, 19.6,  4.1,  6.1,  3.9,  4.5,  3.7,  0.9,  0.7
695,  0.4,  9.8, 16.6, 17.3,  6.1,  9.3, 10.5,  9.2,  3.8,  1.4
484,  0.6, 16.7,  5.8,  9.6,  7.4,  3.5,  6.6,  3.9,  2.5,  0.8
424,  0.0,  2.1, 25.2,  2.7,  5.3,  4.9,  3.1,  6.2,  2.2,  1.3
556,  2.8,  0.6,  1.1, 12.3,  1.6,  2.2,  2.3,  1.1,  1.5,  0.3
424,  0.8,  8.4,  0.6,  0.8, 13.2,  1.8,  2.8,  1.9,  0.9,  1.8
370,  0.4, 16.6,  3.6,  0.5,  1.0,  8.5,  1.6,  1.5,  0.9,  0.5
272,  0.1,  4.8, 17.8,  3.2,  0.8,  2.4,  3.6,  0.9,  1.1,  0.7
233,  0.8,  2.3,  2.1,  6.8,  0.6,  0.3,  0.9,  1.5,  0.4,  0.6
232,  0.8, 17.3,  3.2,  1.7,  6.6,  0.9,  0.9,  0.3,  2.0,  0.4
203,  0.3,  7.0, 14.2,  3.4,  1.5,  4.4,  0.5,  0.7,  0.6,  1.8
292,  1.3,  2.3,  4.9,  7.9,  1.1,  1.0,  2.5,  0.6,  0.3,  0.4
263,  0.1,  2.8,  2.3,  3.7,  6.5,  1.0,  0.9,  1.0,  0.4,  0.4
242,  0.0,  6.1,  2.3,  1.4,  2.3,  3.3,  0.6,  0.6,  0.7,  0.2
Bottom trawl
1974, 1988
1,1
1,10
1022,  7.3,  8.8,  3.1,  3.5,  4.1,  3.6,  2.3,  1.0,  0.8,  0.3
2004,  3.2, 16.2, 10.5,  5.9,  7.1,  5.2,  4.1,  3.7,  0.6,  0.7
2232, 15.7,  5.2, 16.2, 15.2,  8.7,  8.0,  9.6,  6.5,  2.9,  1.6
2245,  3.4, 45.9,  7.7,  9.5,  8.0,  7.0, 10.1,  6.5,  2.6,  1.5
2821,  4.0,  3.7, 54.7, 11.8, 19.1, 15.5,  7.8, 17.6,  3.7,  3.5
6419,  5.0,  5.9,  6.2, 49.2, 10.4, 16.3, 10.2,  7.1,  8.3,  2.0
7510, 43.3, 39.1,  5.0,  9.7, 56.8, 13.5, 21.9, 11.8,  5.5,  2.9
6957, 14.4, 41.1, 11.8,  2.8,  9.5, 29.9, 10.7,  9.7,  4.9,  2.2
7196,  0.0,  4.6, 71.3, 13.0,  4.6, 11.9, 27.4,  6.1,  8.4,  2.3
5573, 20.7, 10.0, 16.7, 50.7,  8.7,  8.0,  6.7,  8.7,  2.0,  0.7
5071, 36.9, 62.6, 15.2,  6.9, 25.7,  3.3,  2.6,  1.2,  8.1,  0.5
3122,  1.4, 28.3, 55.7, 10.5, 11.2, 19.2,  4.2,  1.8,  0.7,  6.6
2663,  7.0, 10.0, 31.4, 39.8,  6.1,  8.5, 17.5,  1.8,  2.7,  3.6
2546, 12.7, 26.4, 19.6, 25.7, 25.6,  5.2,  6.9,  4.9,  2.5,  1.1
2345,  5.9, 26.2, 15.8, 11.7, 20.6, 19.3,  4.5,  3.8,  3.1,  2.0
Pelagic trawl
1974, 1988
1,1
1,10
  44,  3.5,  0.4,  0.0,  0.0,  0.0,  0.0,  0.0,  0.0,  0.0,  0.0
 108,  0.0,  0.0,  0.1,  0.0,  0.0,  0.0,  0.0,  0.0,  0.0,  0.0
 731,  2.2,  1.3,  1.1,  1.8,  1.4,  1.6,  0.7,  0.7,  0.3,  0.2
 705,  0.9, 11.9,  2.0,  2.5,  2.1,  1.8,  2.6,  1.7,  0.7,  0.4
1003,  1.0,  0.9, 13.9,  3.0,  4.9,  3.9,  2.0,  4.5,  0.9,  0.9
1056,  0.8,  0.9,  1.0,  7.9,  1.7,  2.6,  1.6,  1.1,  1.3,  0.3
1365, 20.8,  5.4,  1.4,  2.4,  2.4,  1.0,  0.3,  0.3,  0.0,  0.0
1139,  4.0, 31.4,  4.4,  0.1,  0.4,  1.7,  0.6,  0.4,  0.8,  0.9
 945,  5.1,  7.3,  6.5,  1.7,  0.3,  0.3,  0.1,  0.0,  0.0,  0.0
1128, 16.8,  1.8,  1.9,  5.7,  0.9,  0.8,  1.6,  2.3,  1.1,  0.7
1542, 21.2, 34.4,  2.3,  1.5, 10.1,  2.6,  1.0,  0.0,  1.1,  0.2
1177,  6.3, 28.9, 27.1,  3.3,  2.3,  5.6,  0.7,  0.9,  0.6,  1.7
1349,  0.0,  9.2, 18.1, 23.8,  4.4,  4.1,  7.2,  1.3,  1.2,  1.3
1249,  0.9,  5.3,  6.8, 10.4, 11.9,  3.0,  2.9,  1.9,  0.7,  1.3
1150,  0.0,  4.9,  5.6,  6.6,  7.9,  8.8,  1.6,  1.8,  1.3,  0.4
```

Table 3.6.4

HERRING 31E

Module run at 11.34.38 13 APRIL 1989
DISAGGREGATED Qs
LOG TRANSFORMATION
NO explanatory variate (Mean used)
Fleet 1 ,Trapnet , has terminal q estimated as the mean
Fleet 2 ,Bottom trawl , has terminal q estimated as the mean
Fleet 3 ,Pelagic trawl , has terminal q estimated as the mean
FLEETS COMBINED BY '' VARIANCE ''

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

Age,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88,
1,	.019,	.008,	.012,	.008,	.013,	.020,	.041,	.046,	.027,	.025,	.046,	.010,	.009,	.011,	.146,
2,	.071,	.109,	.095,	.118,	.033,	.044,	.248,	.140,	.067,	.063,	.160,	.124,	.056,	.099,	.061,
3,	.091,	.123,	.149,	.157,	.213,	.042,	.058,	.160,	.264,	.115,	.141,	.140,	.104,	.105,	.079,
4,	.119,	.079,	.126,	.131,	.151,	.178,	.092,	.046,	.196,	.247,	.077,	.154,	.152,	.107,	.099,
5,	.187,	.095,	.172,	.175,	.193,	.135,	.277,	.092,	.072,	.137,	.288,	.107,	.153,	.138,	.109,
6,	.211,	.153,	.177,	.186,	.245,	.201,	.216,	.228,	.182,	.204,	.130,	.269,	.196,	.173,	.132,
7,	.526,	.155,	.444,	.226,	.186,	.255,	.330,	.355,	.207,	.171,	.165,	.108,	.416,	.243,	.164,
8,	.436,	.367,	.386,	.377,	.467,	.283,	.437,	.332,	.251,	.150,	.026,	.097,	.129,	.209,	.185,
9,	.212,	.159,	.664,	.209,	.303,	.387,	.378,	.380,	.373,	.203,	.177,	.066,	.224,	.174,	.164,
10,	.315,	.186,	.369,	.234,	.279,	.252,	.327,	.277,	.217,	.173,	.157,	.129,	.223,	.187,	.151,

Log catchability estimates

Age 1

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 ,	-13.96,	-11.06,	-14.40,	-12.20,	-14.98,	-10.85,	-12.88,	-12.39,	-13.28,	-12.67,	-12.33,	-12.49,	-11.58,	-14.49,	-13.38
2 ,	-11.02,	-11.98,	-11.90,	-12.00,	-11.58,	-12.72,	-11.77,	-11.74,	-17.07,	-12.59,	-11.58,	-13.69,	-12.11,	-11.91,	-9.96
3 ,	-8.61,	-14.13,	-12.75,	-12.17,	-11.93,	-12.75,	-10.80,	-11.21,	-10.60,	-11.20,	-10.95,	-11.21,	-17.28,	-13.85,	-14.93

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-12.86 ,	1.271,	.0006 ,	.2446,	.000E+00,	.000E+00,	-12.863,	.318
2 ,	-12.24 ,	1.613,	.0113 ,	.0150,	.000E+00,	.000E+00,	-12.240,	.403
3 ,	-12.29 ,	2.178,	.0053 ,	2.0613,	.000E+00,	.000E+00,	-12.290,	.545

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.146	.907	1.22	1.22	1.817

Age 2

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 ,	-9.86,	-9.45,	-9.80,	-10.10,	-10.64,	-11.68,	-9.21,	-9.46,	-9.39,	-9.80,	-9.35,	-9.79,	-10.64,	-10.50,	-10.11
2 ,	-10.53,	-10.69,	-11.40,	-10.67,	-11.97,	-11.84,	-10.54,	-11.48,	-12.71,	-11.50,	-11.15,	-11.13,	-11.38,	-10.53,	-10.92
3 ,	-10.47,	-14.46,	-11.67,	-10.81,	-12.35,	-11.91,	-10.82,	-9.94,	-10.21,	-11.62,	-10.55,	-10.13,	-10.78,	-11.42,	-11.88

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-9.97 ,	.687,	.0113 ,	.0696,	.000E+00,	.000E+00,	-9.970,	.172
2 ,	-11.23 ,	.649,	.0313 ,	.0448,	.000E+00,	.000E+00,	-11.225,	.162
3 ,	11.27 ,	1.185,	.0147 ,	.1122,	.000E+00,	.000E+00,	-11.270,	.296

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.061	.438	.225	.438	.265

cont'd

Table 3.6.4 cont'd.

Age 3

Fleet,	73,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 ,	-9.15,	-8.87,	-9.13,	-9.49,	-9.24,	-11.37,	-11.21,	-9.96,	-9.73,	-9.82,	-9.21,	-9.09,	-10.25,	-10.30,	-10.38	
2 ,	-10.90,	-10.78,	-9.57,	-10.74,	-10.36,	-9.91,	-11.46,	-11.31,	-10.62,	-10.92,	-10.74,	-10.45,	-10.60,	-10.43,	-10.72	
3 ,	-12.00,	-12.51,	-12.09,	-10.93,	-10.70,	-12.11,	-11.53,	-10.48,	-10.90,	-11.50,	-11.44,	-10.20,	-10.47,	-10.78,	-11.05	

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-9.73 ,	.635,	.0144 ,	.1510,	.000E+00,	.000E+00,	-9.733,	.209
2 ,	-10.88 ,	.541,	.0440 ,	.0675,	.000E+00,	.000E+00,	-10.883,	.135
3 ,	-11.31 ,	.825,	.0141 ,	.0608,	.000E+00,	.000E+00,	-11.311,	.206

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.079	.398	.250	.398	.394

Age 4

Fleet,	73,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 ,	-9.03,	-9.88,	-8.90,	-9.22,	-9.81,	-9.88,	-11.20,	-11.05,	-9.04,	-9.13,	-9.78,	-8.72,	-9.72,	-10.17,	-10.46	
2 ,	-11.09,	-10.80,	-10.19,	-10.76,	-10.23,	-10.94,	-11.58,	-12.26,	-10.92,	-10.30,	-11.46,	-10.33,	-10.31,	-10.50,	-10.61	
3 ,	-13.11,	-13.56,	-11.21,	-10.94,	-10.57,	-10.97,	-11.27,	-13.78,	-10.92,	-10.89,	-11.80,	-10.51,	-10.14,	-10.69,	-10.47	

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-9.73 ,	.780,	.0143 ,	.2059,	.000E+00,	.000E+00,	-9.734,	.195
2 ,	-10.82 ,	.606,	.0469 ,	.0806,	.000E+00,	.000E+00,	-10.819,	.152
3 ,	-11.39 ,	1.197,	.0130 ,	.0396,	.000E+00,	.000E+00,	-11.389,	.299

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.099	.444	.395	.444	.791

Age 5

Fleet,	73,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 ,	-8.44,	-9.66,	-9.43,	-9.03,	-9.37,	-10.31,	-9.17,	-10.60,	-10.06,	-10.24,	-8.74,	-9.53,	-9.91,	-9.51,	-10.30	
2 ,	-10.33,	-10.80,	-10.24,	-10.49,	-9.98,	-10.89,	-10.58,	-11.29,	-11.59,	-10.74,	-10.47,	-10.25,	-10.41,	-10.41,	-10.38	
3 ,	-12.51,	-13.75,	-10.96,	-10.67,	-10.31,	-10.90,	-12.04,	-12.64,	-12.29,	-11.42,	-10.21,	-10.86,	-10.05,	-10.46,	-10.63	

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-9.62 ,	.643,	.0160 ,	.2155,	.000E+00,	.000E+00,	-9.622,	.161
2 ,	-10.59 ,	.431,	.0590 ,	.0885,	.000E+00,	.000E+00,	-10.590,	.108
3 ,	-11.31 ,	1.123,	.0140 ,	.0549,	.000E+00,	.000E+00,	-11.313,	.281

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.109	.341	.317	.341	.866

Age 6

Fleet,	73,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 ,	-8.33,	-9.45,	-9.18,	-9.30,	-8.96,	-10.17,	-9.60,	-9.07,	-9.13,	-10.60,	-9.55,	-8.58,	-10.00,	-9.59,	-9.82	
2 ,	-10.41,	-10.45,	-10.50,	-10.14,	-9.70,	-10.62,	-10.46,	-10.74,	-10.81,	-10.49,	-11.34,	-9.84,	-10.07,	-10.21,	-10.33	
3 ,	-12.45,	-13.09,	-10.99,	-10.34,	-10.04,	-10.65,	-11.36,	-11.80,	-12.46,	-11.20,	-10.38,	-10.10,	-10.12,	-10.05,	-10.40	

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-9.42 ,	.613,	.0196 ,	.1958,	.000E+00,	.000E+00,	-9.422,	.153
2 ,	-10.41 ,	.414,	.0709 ,	.1212,	.000E+00,	.000E+00,	-10.407,	.104
3 ,	-11.03 ,	1.037,	.0187 ,	.0700,	.000E+00,	.000E+00,	-11.029,	.259

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.131	.326	.210	.326	.415

Table 3.6.4 cont'd.

Age 7

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 ,	-7.39,	-9.24,	-8.25,	-8.81,	-8.95,	-9.58,	-9.25,	-9.15,	-9.25,	-9.63,	-9.16,	-9.74,	-9.03,	-9.63,	-9.70
2 ,	-10.06,	-10.61,	-9.51,	-9.92,	-9.92,	-10.54,	-10.07,	-10.19,	-10.49,	-10.80,	-11.19,	-10.34,	-9.29,	-9.87,	-9.95
3 ,	-11.66,	-13.02,	-11.01,	-10.12,	-10.25,	-10.59,	-12.65,	-11.26,	-14.08,	-10.64,	-10.95,	-11.16,	-9.50,	-10.02,	-10.27

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-9.12 ,	.641,	.0266 ,	.2921,	.000E+00,	.000E+00,	-9.117,	.160
2 ,	-10.18 ,	.509,	.0886 ,	.1299,	.000E+00,	.000E+00,	-10.184,	.127
3 ,	-11.14 ,	1.291,	.0166 ,	.0685,	.000E+00,	.000E+00,	-11.145,	.323

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.164	.381	.327	.381	.739

Age 8

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 ,	-7.53,	-8.37,	-8.33,	-8.32,	-8.26,	-9.86,	-9.02,	-9.26,	-8.96,	-9.64,	-10.48,	-9.00,	-9.65,	-9.37,	-9.59
2 ,	-10.02,	-9.66,	-9.85,	-9.34,	-9.11,	-10.46,	-10.06,	-10.32,	-10.33,	-11.06,	-12.17,	-10.79,	-10.76,	-10.05,	-10.01
3 ,	-10.78,	-11.96,	-10.96,	-9.52,	-9.44,	-10.52,	-12.03,	-11.70,	-14.02,	-10.79,	-15.08,	-10.51,	-10.41,	-10.28,	-10.05

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-9.04 ,	.796,	.0286 ,	.3195,	.000E+00,	.000E+00,	-9.043,	.199
2 ,	-10.27 ,	.770,	.0816 ,	.1439,	.000E+00,	.000E+00,	-10.266,	.193
3 ,	-11.20 ,	1.623,	.0157 ,	.0584,	.000E+00,	.000E+00,	-11.203,	.406

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.185	.524	.385	.524	.541

Age 9

Fleet,	74,	75,	76,	77,	78,	79,	80,	81,	82,	83,	84,	85,	86,	87,	88
1 ,	-8.40,	-9.05,	-7.92,	-8.87,	-8.26,	-9.37,	-9.33,	-9.07,	-8.76,	-9.24,	-9.03,	-9.45,	-9.90,	-9.65,	-9.30
2 ,	-9.93,	-10.74,	-9.36,	-10.32,	-9.64,	-10.10,	-10.39,	-10.30,	-10.00,	-10.81,	-10.72,	-12.03,	-9.92,	-10.09,	-10.09
3 ,	-10.47,	-11.22,	-10.51,	-10.47,	-10.02,	-10.15,	-14.31,	-10.31,	-14.01,	-9.81,	-11.53,	-11.21,	-10.05,	-10.65,	-10.24

SUMMARY STATISTICS

Fleet ,	Pred. q ,	SE(q),	Partial F ,	Raised, F ,	SLOPE ,	SE Slope ,	INTRCPT,	SE Intrcpt
1 ,	-9.04 ,	.551,	.0288 ,	.2136,	.000E+00,	.000E+00,	-9.038,	.138
2 ,	-10.30 ,	.646,	.0792 ,	.1329,	.000E+00,	.000E+00,	-10.296,	.161
3 ,	-11.00 ,	1.417,	.0193 ,	.0771,	.000E+00,	.000E+00,	-10.997,	.354

Fbar	SIGMA(int.)	SIGMA(ext.)	SIGMA(overall)	Variance ratio
.164	.402	.224	.402	.310

Table 3.6.5

Title : HERRING IN THE EUMANIAN BAY (FISHING AREA 31, EASTERN PART)

from 74 to 88 on ages 1 to 10
with terminal F of .115 on age 3 and terminal S of 1.250

Initial sum of squared residuals was 73.705 and
Final sum of squared residuals is 30.590 after 116 iterations

Matrix of Residuals

Years	74/75	75/76	76/77	77/78
Ages				
1/ 2	-.244	.028	-.662	.417
2/ 3	.556	.610	-.392	-.197
3/ 4	-.260	.406	-.122	.027
4/ 5	.012	-.064	.137	.179
5/ 6	.076	.122	.121	.071
6/ 7	.088	-.281	-.380	.132
7/ 8	-.245	-.785	-.400	-1.081
8/ 9	1.342	.826	1.027	.939
9/10	-.010	-.026	1.243	-.038
	.000	.000	.000	.000
WTS	.001	.001	.001	.001

Years	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86	86/87	87/88		WTS
Ages												
1/ 2	.383	-.300	1.086	1.410	.759	-.279	.759	.186	-.604	-.064	.000	.328
2/ 3	-.178	.324	.598	-.267	-.435	-.753	.134	.622	-.348	.346	.000	.443
3/ 4	.026	-.546	-.139	-.228	-.037	.076	-.175	.364	-.092	-.172	.000	1.000
4/ 5	.066	.118	-.163	-.442	.332	-.142	-.309	.291	.236	-.075	.000	.887
5/ 6	-.026	.041	.191	-.587	-1.090	-.060	.292	-.310	.046	.033	.000	.580
6/ 7	-.085	-.002	-.587	.162	-.063	.051	.142	-.061	-.098	-.033	.000	.966
7/ 8	-1.126	-.595	-.684	-.134	-.438	.979	-.150	-.663	.261	-.421	.000	.381
8/ 9	.760	.707	.629	.525	.580	.674	-.628	-.224	.174	.596	.000	.398
9/10	.236	.824	.334	.781	.813	.150	.365	-.973	.345	.109	.000	.389
	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	4.487	
WTS	.001	.001	.001	.001	.001	1.000	1.000	1.000	1.000	1.000		

Fishing Mortalities (F)

	74	75	76	77	78
F-values	.1358	.0992	.1836	.1535	.1681

	79	80	81	82	83	84	85	86	87	88
F-values	.1440	.2143	.1787	.1821	.1575	.1250	.1164	.1336	.1349	.1150

Selection-at-age (S)

	1	2	3	4	5	6	7	8	9	10
S-values	.1246	.7586	1.0000	.9958	1.0781	1.2567	1.3392	.7230	1.1189	1.2500

Table 3.6.6 VIRTUAL POPULATION ANALYSIS

HERRING IN THE BOTHNIAN BAY (FISHING AREA 31, EASTERN PART)

FISHING MORTALITY COEFFICIENT UNIT: Year-1 NATURAL MORTALITY COEFFICIENT = .15

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	.020	.008	.012	.010	.012	.020	.066	.044	.025	.023	.047	.013
2	.064	.111	.094	.113	.039	.041	.253	.111	.063	.060	.145	.125
3	.086	.108	.152	.155	.208	.050	.054	.164	.199	.108	.132	.168
4	.102	.074	.196	.134	.149	.172	.111	.042	.202	.174	.072	.143
5	.143	.081	.161	.146	.199	.132	.266	.113	.067	.142	.186	.099
6	.166	.112	.147	.171	.196	.208	.212	.216	.232	.186	.136	.156
7	.285	.118	.299	.180	.169	.193	.344	.345	.194	.231	.147	.113
8	.246	.159	.273	.217	.344	.250	.301	.352	.242	.139	.037	.085
9	.151	.077	.208	.134	.150	.251	.318	.227	.406	.194	.162	.094
10	.170	.125	.156	.053	.163	.107	.184	.221	.114	.194	.149	.117
11+	.170	.125	.156	.053	.163	.107	.184	.221	.114	.194	.149	.117
(3- 8)U	.171	.109	.204	.167	.211	.168	.215	.206	.189	.163	.118	.127
(3- 8)W	.145	.102	.188	.158	.207	.160	.217	.185	.192	.157	.139	.154

	1986	1987	1988
1	.012	.016	.014
2	.070	.134	.087
3	.105	.134	.111
4	.132	.108	.130
5	.141	.117	.110
6	.180	.157	.109
7	.206	.218	.146
8	.136	.087	.162
9	.193	.185	.061
10	.341	.157	.162
11+	.341	.157	.162
(3- 8)U	.150	.137	.128
(3- 8)W	.134	.122	.117

Table 3.6.7 VIRTUAL POPULATION ANALYSIS

HERRING IN THE BOTHNIAN BAY (FISHING AREA 31, EASTERN PART)

STOCK SIZE IN NUMBERS UNIT: millions

BIOMASS TOTALS UNIT: tonnes

ALL VALUES, EXCEPT THOSE REFERRING TO THE SPAWNING STOCK ARE GIVEN FOR 1 JANUARY; THE SPAWNING STOCK DATA REFLECT THE STOCK SITUATION AT SPAWNING TIME, WHEREBY THE FOLLOWING VALUES ARE USED: PROPORTION OF ANNUAL F BEFORE SPAWNING: .150
PROPORTION OF ANNUAL M BEFORE SPAWNING: .400

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
1	768	277	1013	226	176	278	403	501	249	1302	851	344
2	402	395	225	922	193	153	235	825	248	209	1096	690
3	217	325	304	185	747	159	124	157	636	200	169	816
4	294	171	251	225	137	523	130	101	114	448	155	120
5	186	228	137	178	169	101	379	100	83	80	324	124
6	172	139	181	100	132	120	76	256	77	67	60	232
7	120	125	107	135	73	94	84	53	173	53	48	45
8	47	78	96	68	97	53	66	51	32	123	36	36
9	26	32	57	63	47	59	35	42	31	22	92	30
10	21	19	25	40	47	35	40	22	29	18	16	67
11+	12	9	21	13	28	19	5	29	35	10	25	39
TOTAL NO	1966	1799	2559	2205	1846	1590	2197	1931	1707	2532	2871	2559
SPS NO	1114	1144	1132	1202	1371	1096	916	973	1151	984	1131	1468
TOT.BIOM	55758	56073	64242	62477	61215	52727	55462	54439	56808	66243	80706	78173
SPS BIOM	39253	42768	42280	41671	49696	41936	35886	34658	43604	41434	44307	54788

	1986	1987	1988	1989
1	386	569	590	0
2	292	328	482	501
3	531	235	247	380
4	594	412	177	190
5	95	448	318	134
6	97	71	343	245
7	171	70	52	265
8	35	119	48	39
9	28	26	94	35
10	23	20	19	76
11+	47	38	27	33
TOTAL NO	2299	2336	2397	
SPS NO	1526	1421	1392	
TOT.BIOM	72140	78701	79200	
SPS BIOM	56925	60086	61543	

Table 3.6.8

Analysis by RCRTINX2 of data from file SURVEY
HERRING 31-E AS 1-GROUP

Data for 5 surveys over 15 years
REGRESSION TYPE = C
TAPERED TIME WEIGHTING APPLIED
POWER = 1 OVER 20 YEARS
PRIOR WEIGHTING NOT APPLIED
FINAL ESTIMATES SHRUNK TOWARDS MEAN
ESTIMATES WITH S.E.'S GREATER THAN THAT OF MEAN INCLUDED
MINIMUM S.E. FOR ANY SURVEY TAKEN AS .20
MINIMUM OF 5 POINTS USED FOR REGRESSION

Yearclass = 1988

Survey/ Series	Index Value	Slope	Inter- cept	Rsquare	No. Pts	Predicted Value	Sigma	Standard Error	Weight
CONAAU	1.7918	2.268	1.845	.1779	14	5.9078	1.43349	1.50967	.08902
CLAAUG	2.6603	1.199	3.166	.2146	14	6.3557	1.27603	1.34343	.11241
ROTAUG	2.0794	1.653	2.984	.1563	14	6.4215	1.54936	1.63174	.07620
OTHJUL	.0000	3.058	4.701	.1113	14	4.7010	1.88443	2.04429	.04855
TOPLAU	3.3393	1.388	1.401	.2753	14	6.0356	1.08212	1.13855	.15650
MEAN						6.1551	.62622	.62622	.51733

Yearclass		Weighted Average Prediction	Internal Standard Error	External Standard Error	Virtual Population Analysis	Ext.SE/ Int.SE
1988	6.09	439.94	.45	.15		.34

Table 3.6.9

List of input variables for the ICES prediction program.

HERRING 31E
The reference F is the mean F for the age group range from 3 to 8

The number of recruits per year is as follows:

Year	Recruitment
1989	440.0
1990	540.0
1991	540.0

Proportion of F (fishing mortality) effective before spawning: .1500
Proportion of M (natural mortality) effective before spawning: .4000

Data are printed in the following units:

Number of fish:	millions
Weight by age group in the catch:	gram
Weight by age group in the stock:	gram
Stock biomass:	tonnes
Catch weight:	tonnes

age	stock size	fishing pattern	natural mortality	maturity ogive	weight in the catch	weight in the stock
1	440.0	.01	.15	.00	9.200	9.200
2	501.0	.09	.15	.39	23.700	23.700
3	380.0	.11	.15	.97	35.200	35.200
4	190.0	.11	.15	.99	41.400	41.400
5	134.0	.11	.15	1.00	45.700	45.700
6	245.0	.11	.15	1.00	50.500	50.500
7	265.0	.15	.15	1.00	54.600	54.600
8	39.0	.16	.15	1.00	60.700	60.700
9	35.0	.16	.15	1.00	59.500	59.500
10	76.0	.16	.15	1.00	61.900	61.900
11+	33.0	.16	.15	1.00	73.500	73.500

Table 3.6.10

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

HERRING 31E

Year 1989					Year 1990					Year 1991	
factor	ref. F	stock biomass	sp.stock biomass	catch	factor	ref. F	stock biomass	sp.stock biomass	catch	stock biomass	sp.stock biomass
1.0	.12	82	65	8	.0	.00	83	68	0	92	75
					.1	.01		68	1	91	74
					.2	.03		68	2	90	73
					.4	.05		68	4	89	71
					.6	.08		67	5	87	69
					.8	.10		67	7	85	68
					1.0	.12		67	9	83	66
					1.2	.15		66	10	82	64
					1.4	.18		66	12	80	62
					1.6	.20		66	13	78	61
					1.8	.22		66	15	77	59
					2.0	.25		65	16	75	57

The data unit of the biomass and the catch is 1000 tonnes.
The spawning stock biomass is given for the time of spawning.
The spawning stock biomass for 1991 has been calculated with the same fishing mortality as for 1990.
The reference F is the mean F for the age group range from 3 to 8

Table 3.6.11

HERRING SIE

* Year 1989, F-factor 1.000 and reference F .1250 *

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
1	.0100	4.050	37.41	440.00	4048.0	.00	.0	.00	.0
2	.0900	40.087	950.07	501.00	11877.7	196.39	4630.7	181.54	4302.6
3	.1100	86.808	1295.64	380.00	13376.0	368.60	12974.7	341.45	12019.2
4	.1100	18.404	761.92	190.00	7866.0	188.10	7787.3	174.25	7213.8
5	.1100	12.980	593.17	134.00	6123.8	134.00	6123.8	124.13	5672.8
6	.1100	23.731	1198.43	245.00	12372.5	245.00	12372.5	226.96	11461.3
7	.1500	34.342	1875.05	265.00	14469.0	265.00	14469.0	244.02	13323.2
8	.1600	5.365	325.68	39.00	2367.3	39.00	2367.3	35.86	2176.6
9	.1600	4.815	286.50	35.00	2082.5	35.00	2082.5	32.18	1914.7
10	.1600	10.456	647.21	76.00	4704.4	76.00	4704.4	69.88	4325.4
11+	.1600	4.540	333.69	33.00	2425.5	33.00	2425.5	30.34	2230.1
Total		195.594	8304.78	2338.00	81708.7	1579.09	69937.8	1460.60	64639.6

* Year 1990, F-factor 1.000 and reference F .1250 *

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
1	.0100	4.990	45.91	540.00	4968.0	.00	.0	.00	.0
2	.0900	30.001	711.02	374.94	8886.2	146.23	3465.6	135.87	3220.0
3	.1100	38.174	1343.71	394.10	13872.3	382.28	13456.2	354.12	12465.2
4	.1100	28.381	1174.96	293.00	12130.2	290.07	12008.9	268.71	11124.5
5	.1100	14.190	648.50	146.50	6695.0	146.50	6695.0	135.71	6202.0
6	.1100	10.008	505.40	103.32	5217.7	103.32	5217.7	95.71	4833.4
7	.1500	24.481	1336.65	188.91	10314.4	188.91	10314.4	173.95	9497.6
8	.1600	27.008	1639.41	196.32	11916.4	196.32	11916.4	180.50	10956.3
9	.1600	3.935	234.15	28.60	1702.0	28.60	1702.0	26.30	1564.8
10	.1600	3.532	218.61	25.67	1589.0	25.67	1589.0	23.60	1461.0
11+	.1600	10.999	808.40	79.95	5876.0	79.95	5876.0	73.50	5402.6
Total		195.698	8666.72	2371.31	83167.2	1587.84	72241.2	1467.97	66727.4

* Year 1991, F-factor 1.000 and reference F .1250 *

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
1	.0100	4.990	45.91	540.00	4968.0	.00	.0	.00	.0
2	.0900	36.819	872.62	460.16	10905.7	179.46	4253.2	166.74	3951.8
3	.1100	28.569	1005.62	294.94	10381.9	286.09	10070.5	265.02	9328.8
4	.1100	29.434	1218.56	303.37	12560.3	300.83	12454.5	278.68	11537.3
5	.1100	21.893	1008.05	225.92	10324.4	225.92	10324.4	209.28	9564.1
6	.1100	10.942	552.55	112.96	5704.4	112.96	5704.4	104.64	5284.3
7	.1500	10.324	563.69	79.67	4349.8	79.67	4349.8	73.36	4005.3
8	.1600	19.253	1168.67	139.95	8494.7	139.95	8494.7	128.67	7810.3
9	.1600	19.809	1178.65	143.99	8567.3	143.99	8567.3	132.39	7877.0
10	.1600	2.586	176.84	20.98	1298.7	20.98	1298.7	19.29	1194.0
11+	.1600	10.657	784.30	77.46	5693.6	77.46	5693.6	71.22	5234.9
Total		195.567	8568.29	2390.89	83768.9	1567.31	71211.1	1449.29	65787.8

Table 3.7.1 HERRING. Catch at age (thousands) and mean weight at age (g) by quarter in 1988 from the Swedish catches in the Western part of Sub-divisions 29N, 30 and 31 and the Swedish and Finnish catches in tonnes.

	1:st quarter		2:nd quarter		3:rd quarter		4:th quarter		Total	
AGE	N	W (g)	N	W (g)	N	W (g)	N	W (g)	N	W (g)
0										
1					120	24,8	190	25,0	310	24,9
2	14	27,5	300	26,1	1480	37,8	2350	37,7	4144	36,9
3	360	35,7	1750	31,8	710	42,3	560	42,3	3380	36,2
4	4230	40,6	5880	38,2	5300	46,5	5910	47,7	21320	43,4
5	6020	39,5	9660	42,2	6320	48,1	4850	50,1	26850	44,4
6	1630	47,1	5620	48,6	2870	52,6	1720	52,1	11840	49,9
7	300	59,4	1570	56,8	580	58,9	210	76,4	2660	59,1
8	120	53,8	1270	62,9	630	64,9	290	70,8	2310	63,9
9	590	60,5	1210	65,0	510	66,8	260	75,9	2570	65,4
10	890	60,2	2320	65,9	890	66,9	220	85,2	4320	65,9
11	480	61,6	1970	66,3	690	67,2	57	91,9	3197	66,3
12	360	66,3	510	87,8	210	88,7	25	87,8	1105	80,9
13	59	75,0	560	60,0	170	61,3	1	105,3	790	61,5
14	5	117,5	20	117,0	10	121,3	3	122,3	38	118,6
15	8	119,7	26	122,5	14	118,6	3	113,2	51	120,4
Total	15066	44,6	32666	48,5	20504	50,6	16649	48,9	84885	48,4
Tonnes	698		1576		1012		801		4087	
N*W (t)	672		1584		1037		815		4108	
SOP %	96		101		102		102		101	
Finnish Catch (t)	139		0		67		519		726	