ICES HAWG Report 2005

ICES Advisory Committee on Fishery Management
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Report of the Herring Assessment Working Group for the Area South of 62°N (HAWG)

8 – 17 March 2005

ICES Headquarters

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer

International Council for the Exploration of the Sea
Conseil International pour l'Exploration de la Mer
H.C. Andersens Boulevard 44-46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

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Executive Summary

The ICES herring assessment working group (HAWG) met for 10 days in March 2005 to assess the state of 7 herring stocks and 3 sprat stocks. HAWG was able to carry out age-based assessments on 3 of the herring stocks: North Sea autumn spawners, western Baltic spring spawners and autumn spawning herring to the west of Scotland. Exploratory assessments were carried out on herring in the Irish Sea and to the north / north west of Ireland. Problems were encountered in assessing herring in the Celtic Sea but broad trends in the population could still be determined. No assessment of Clyde herring was carried out due to lack of survey data and the poor quality of catch data. The dynamics of sprat in the North Sea and ICES area IIIa were examined and broadly described, but no investigation of sprat in the English Channel could be carried out as no suitable catch and survey data were available. The assessments of the autumn spawners in the North Sea, herring to west of Scotland, the western Baltic spring spawners were consistent with those presented last year, resulting in little changes in the perception of the stocks. Although another successive weaker than average year class will recruit to the North Sea autumn spawners in 2005, thus reducing the potential productivity of that stock in the short term.

The working group also commented on the quality and availability of data, the problems with estimating the amounts of discarded fish, the relevance of ecosystem changes to the stocks considered by the group and recent meetings and reports of relevance to HAWG. It also made nine recommendations about issues that affect the group.

The Stock Annexes of the Quality Control Handbook have been drafted and are attached to the HAWG report. In many cases these are incomplete as there is a large amount of information needed for each and they take a considerable amount of time to compile. For stocks without an accepted assessment, general elements (stock definitions, fisheries and ecosystem aspects) are presented.

Contents

1 Introduction

1.1 Participants

John Boyd	Ireland
Massimiliano Cardinale	Sweden
Maurice Clarke	Ireland
Lotte Worsøe Clausen	Denmark
Jørgen Dalskov	Denmark
Mark Dickey-Collas (Chair)	The Netherlands
Tomas Gröhsler	Germany
Olvin van Keeken	The Netherlands
Stephen Keltz	UK/Scotland
Henrik Mosegaard	Denmark
Peter Munk	Denmark
Beatriz Roel	UK/England & Wales
Norbert Rohlf	Germany
John Simmonds	UK/Scotland
Dankert Skagen	Norway
Else Torstensen	Norway
Jens Ulleweit	Germany
Christopher Zimmermann	Germany

Contact details for each participant are given in Appendix 1.

1.2 Terms of Reference

2ACFM03 The **Herring Assessment Working Group for the Area South of 62°N** [HAWG] (Chair: Mark Dickey-Collas) will meet at *ICES Headquarters* from 8-17 March 2005 to:

a. assess the status of and provide management options (by fleet where possible) for 2006 for:
   i. the North Sea autumn-spawning herring stock in Division IIIa, Sub-area IV, and Division VIId (separately, if possible, for Divisions IVc and VIId);
   ii. the herring stocks in Division VIa and Sub-area VII;
   iii. the stock of spring-spawning herring in Division IIIa and Sub-divisions 22–24 (Western Baltic);
b. forecasts for North Sea autumn-spawning herring should be provided by fleet and according to the management plan agreed between the EU and Norway;
c. catch options for Div. IIIa shall be given by fleets taking into account that North Sea herring and Western Baltic herring are taken together in this Division;
d. assess the status of the sprat stocks in Subarea IV and Divisions IIIa and VIId,e;
e. for the stocks mentioned in a) and d) perform the tasks described in C.Res. 2ACFM01.

HAWG will report by 18 March 2005 for the attention of ACFM.

There were no additional requests from ACFM.

1.3 Working Group's response to ad hoc requests

1.3.1 Request by SGBYSAL

HAWG– as all other ICES groups dealing with pelagic stocks in the Northeast-Atlantic – was asked to contribute to the Study Group on Bycatches of Salmon in Pelagic Fisheries (SGBY-SAL). SGBYSAL requested weekly catch information for fisheries potentially bycatching salmon postsmolts and adults, for a specified period of the year, and as far back as possible. As stated earlier, HAWG is not in the position to deliver data directly from its data holdings, because it is only collated quarterly and never as weekly catch data. However, HAWG encouraged national laboratories collecting data on herring fisheries in its area to contribute data to SGBYSAL at the required level of disaggregation.

Among nations participating in the herring fishery south of 62°N, Norway, Denmark, Ireland, England/UK, Germany, the Faroese and Scotland/UK delivered data to the SGBYSAL meeting in February 2005, for periods varying from 2-15 years, but almost all covered 2000- 2003. Only The Netherlands and France felt unable to prepare the data as requested. However, data appeared to be sufficient to study the possible overlap in time and space of salmon and pelagic fisheries in the North East Atlantic. Also, the group started to identify fisheries that represent the greatest risk to the salmon. In general, fisheries catching fish at or close to the surface appeared to be most risky for salmon, but since purse seines are covering only limited areas, they represent lesser risk than trawls which cover large areas. Hence, trawl fisheries for mackerel performed close to the surface pose the greatest danger for intercepting salmon. Herring trawling represents lesser risk for the youngest stages of salmon, but there are anecdotal reports (ICES, WGNAS, 2003) of occasional large number of salmon being taken in herring catches. An overlap between herring fisheries and known postsmolt distribution was identified in the area west of Scotland and in the Faroes -Shetland area, predominantly in week 23-24 and possibly before, but there is little data on potsmolt prior to week 23, and the fisheries are rather small at the time of the postsmolt passage. SGBYSAL recommends that data on postsmolt bycatch should be collected from onboard observers, and that the nations which haven't delivered data to SGBYSAL do so as soon as possible.

1.4 Reviews of groups or work important for the WG

1.4.1 The Planning Group for Herring Surveys [PGHERS]

PGHERS met in Bergen, Norway, from 24–28 January 2005 (Chair: B. Couperus, Netherlands) to:

a. combine the 2004 survey data to provide indices of abundance for the population within the area;
b. coordinate the timing, area and effort allocation, and methodologies for acoustic and larvae surveys for herring and sprat in the North Sea, Divisions VIa and IIIa and Western Baltic in 2005;
c. review and update the PGHERS manual for acoustic surveys to address standardization of all sampling tools and survey gears;
d. review the results of an exchange exercise on herring maturity staging, and comment on the implications of the conclusions of the sprat age reading exchange and Workshop for the Acoustic Surveys;
e. evaluate the results of the investigations of survey overlaps between vessels in the North Sea acoustic survey;
f. to conduct an Echogram Scrutiny Workshop aiming at further harmonisation of scrutiny procedures.

Review of larvae surveys in 2004/2005. At the time of writing the report two of the seven surveys in the North Sea remained to be carried out in January 2005. There were subsequently completed successfully and the results were made ready for this Herring Assessment Working Group (HAWG) meeting. These are reported in Section 2.3.2

Co-ordination of larvae surveys for 2005/2006. In the 2005/2006 period, the Netherlands and Germany will undertake 6 larvae surveys in the North Sea from 1 September 2004 to 31 January 2005. The Baltic Sea Fisheries Institute will continue with the larvae survey in the Greifswalder Bodden area in 2005.

North Sea acoustic surveys in 2005. Six acoustic surveys were carried out during late June and July 2004 covering the North Sea and west of Scotland. The provisional total combined estimate of North Sea spawning stock biomass (SSB) is 2.6 million t, a decrease from 3.1 million t in 2003. The survey again shows two well-above average year classes of herring (1998 and 2000). Growth of the 2000 year class seems still to be slower than average. The west of Scotland SSB estimate is 400,000 t (739,000 t in 2003). The surveys were reported individually in Annex 2 of the PGHERS report. The survey results are presented in section 2.3.1.

Western Baltic acoustic survey in 2004. A joint German-Danish acoustic survey was carried out with RV “Solea” from 29 September to 18 October in the Western Baltic. The estimate of Western Baltic spring spawning herring SSB is 192,100 t, an increase since 2003 (106,000 t). A full survey report was given in Annex 3 of the PGHERS report. The results of the survey are given in section 3.3.

Survey overlap between FRV “Scotia”, FRV “G.O. Sars”. During the 2004 surveys two areas were selected for overlap, involving FRV Scotia and FV Enterprise in one area and “Johan Hjort”, “Walther Herwig III” and “Dana” in another area. No significant differences have been found. However, this is not just confirmation of similar performance, but also illustrates the difficulty of obtaining sufficient precision to establish significant differences.

Manuals for acoustic and herring larvae surveys. The manual for herring acoustic surveys in ICES Divisions III, IV, and VIA has been reviewed and updated according to TOR (c) The new version 3.2 is provided in Annex 4 of the PGHERS report. There was no need for an update of the IHLS manual.

Exchange exercise on herring maturity staging. A selection of digital images was prepared from a collection of Dutch, Irish, Norwegian and Scottish pictures, and distributed digitally to all the participating laboratories. This is further discussed in section 1.4.11

Status and future of the HERSUR database. The upload of data at least for one year has been done with the exception of Norwegian data and Dutch ALKs.

It is currently intended that a higher-level database holding national aggregated data with survey results is to be set up by DIFRES, this will be based on the consistency-checked data available from previous North Sea acoustic surveys, kept at Aberdeen. This database would then used to further develop an automated system for delivering the outputs needed for the combined survey report and HAWG removing the need for the current MS Excel data system.

Sprat. Data on sprat were only available from RV “Walther Herwig III”, RV “Tridens” and RV “Dana”. Other vessels caught no sprat. The total sprat biomass estimated was 360,000 t in the North Sea (up from 270,000 t in 2003) and 15,000 t in the Kattegat (up from 13,000 t in 2003).

Co-ordination of acoustic surveys in 2005. Six acoustic surveys will be carried out in the North Sea and west of Scotland in 2005 between 28 June and 27 July. Small changes to the design are proposed and “Tridens” and “Walther Herwig” will cover the area between 52º and 57º together with interlaced transects. A survey of the western Baltic and southern part of Kattegat, will be carried out by a German research vessel from 4 to 24 October.

Scrutiny workshop. A scrutiny workshop was held on 25 and 26 January. Five teams scrutinized six data sets (3 BI500 sets and 3 echoview sets) of which one BI500 set was later excluded, because time and position data were lost in the post logging process. Preliminary results show reasonable agreement between the teams. The data will be analysed and presented in a paper before the next PGHERS meeting.

1.4.2 The Annual Meeting of Assessment Working Group Chairs [AMAWGC]

The working group read the report from AMAWGC 2005 and noted that many of the chapters were pertinent to HAWG. Specifically the request to give advice relevant to the new ACFM sheets, the comments and advice on management strategies, the information and comments provided by WGRED (Working Group for Regional Ecosystem Description) and the approach advised by AMAWGC on how to handle misreported and unallocated catches.

HAWG agrees with the need for management strategies to be consistent with the knowledge base available for each stock, and considered the idea of thinking “out-side the box” very relevant to many of the stock assessed by the group (see 1.4.10 on SGMAS). Comments on the WGRED are given in section 1.8.

1.4.3 Study Group on Regional Scale Ecology of Small Pelagics [SGRESP]

HAWG acknowledges the important contribution being made by SGRESP to improving the understanding of pelagic fish dynamics within an ecosystem context. Members of HAWG made 4 contributions to SGRESP:

i. North Sea herring (see WD3)
ii. North Sea sprat.
iii. Celtic Sea herring
iv. VIa S VIIbc herring

These contributions covered the migrations, spawning and feeding of herring and sprat and a description of the recent population dynamics and the long-term trends in the fish stocks.

1.4.4 HERGEN [EU project]

HERGEN: Conservation of diversity in an exploited species: spatio - temporal variation in the genetics of herring (Clupea harengus) in the North Sea and adjacent areas. EU-project under the Quality of Life and Management of Living Resources programme, 5.1.2. Sustainable fisheries and aquaculture - Scientific basis of fisheries management (QLRT - 2000 – 01370).

1.4.4.1 Estimation of genetic differentiation among spawning aggre gations

Microsatellite DNA based analyses were carried out examining the spatial genetic structure of Atlantic herring in the West of Scotland, North Sea, Kattegat, Skagerrak and Western Baltic. The results obtained will be reported in two scientific publications. The first study (reported in Mariani et al.) concerns structure within the North Sea and the English Channel. This study shows similarities within herring in the North Sea but with underlying genetic substructure. Overall, a signal of isolation by distance is detected, signifying that gene flow is higher among neighbouring spawning components than between geographically distant spawning components.

The second study (reported in Bekkevold et al.) compares genetic differentiation among ten spawning components sampled along a transect from the eastern North Sea to the western Baltic (Rügen). The study indicates low differentiation among three spawning components within the Skagerrak. Spawning components from the Limfjord, the Kattegat, the Kolding Fjord and the Lillebælt (all in the inner Danish waters) generally exhibit significant differentiation. Levels of differentiation between Skagerrak samples and samples from the inner Danish waters are relatively high (and highly significant) in all pair-wise comparisons, indicating a strong reproductive barrier between Skagerrak populations and populations spawning south of Skagerrak. Samples from Rügen exhibit significant differentiation from Kattegat samples and from most of the samples from 'neighbouring' Danish spawning components. Herring components within the Kattegat/Western Baltic area are thus indicated to exhibit much higher levels of differentiation, compared to components within the North Sea. The generality of the pattern indicating that early spawning Rügen herring are reproductively isolated from fish spawning later in the same location remains unknown. A strong signal of isolation by distance is observed across the analysed samples, which represent the entire transition zone between the highly saline and stable North Sea and the brackish and temperature variable Baltic Sea. When environmental differences among spawning sites are taken into consideration in a test of the relationship between genetic differentiation, geographic distance and differences in environmental parameters on spawning sites, salinity differences yield a higher explanatory power than geographic isolation per se. The implication is that population components experiencing different salinity conditions on spawning sites, also exhibit genetic differentiation, and suggests a role for local adaptation to spawning at low salinity in the Baltic.

1.4.4.2 Determination of composition of mixed feeding aggregations using genetic Mixed Stock Analysis

Genetic mixed stock analysis was performed on random samples from mixed feeding aggregations from Shetland and across Skagerrak for two consecutive years in order to quantify the proportions of fish from the various regional spawning components that contribute to mixed aggregations found on common feeding grounds in areas targeted by major fisheries in the North Sea and the Skagerrak/ Kattegat. The analysis was based on microsatellite DNA genotype frequency information obtained for individuals from the mixed stocks and from the spawning samples. Contributions from each of the four regional areas could be estimated with good precision

v. North Sea (including Norwegian Spring spawning components)/English Channel
vi. Skagerrak
vii. Kattegat/inner Danish waters (a "Kattegat-Western Baltic" group)
viii. Rügen

Simulation analyses indicated that presence-absence of components from Rügen and Kattegat/inner Danish waters can be determined.

Mixed-stocks in summer in Skagerrak

Analyses operating with three baseline regions generated stock estimates for spatially separated Skagerrak samples showing that individual samples were made up of varying proportions of individuals of North Sea/Skagerrak/Western Baltic origin, and that individual stock composition estimates were highly correlated with the age distributions of the sampled fish. Samples mostly containing juveniles mainly originated from the North Sea, whereas samples consisting mainly of adults contained high proportions of spring spawners of Kattegat-Western Baltic origin. An overall estimate based on genetic information pooled across spatial samples showed that in summer stocks were made up of near equal proportions of North Sea autumn spawners and spawning components from the Kattegat-Western Baltic components, whereas local Skagerrak spawning fish exhibited low abundance or were absent. This pattern was consistent across two years.

Mixed-stocks sampled in winter from coastal Skagerrak

Samples taken in winter in more coastal areas of northern IIIa exhibited a very different stock composition pattern. Here, adult spring spawners of local origin made up an estimated 40-65% of the stocks (estimates varied among samples and years). Whereas most of the remaining individuals were juvenile North Sea autumn spawners, the analysis also identified low but significant contributions from both juvenile and adult spring spawners from the Kattegat-Western Baltic group.

Mixed-stocks in winter from coastal Skagerrak: analyses by spawning type

Analyses where individuals were discriminated based on their spawning type (from otolith microstructure) showed good correspondence between spawning type and expected geographical origin.

Mixed-stocks in summer around Shetland

Mixed stock estimates from samples from Shetland, taken in July 2002 and 2003 showed very high contributions for herring of North Sea origin (composition estimates were both close to 100%), and there was no evidence for contributions from spawning components from Skagerrak, inner Danish waters or Rügen. The resolution of the genetic markers used in this study did not allow for estimates of contributions from individual spawning populations within the North Sea.

1.4.5 WESTHER [EU project]

WESTHER: A multidisciplinary approach to the identification of herring (*Clupea harengus* L.) stock components west of the British Isles using biological tags and genetic markers. Q5RS-2002-01056 (2003-2005).

WESTHER's overall goal is to describe the population structure of herring stocks distributed from the south-west of Ireland and the Celtic Sea to the northwest of Scotland. To achieve its goal WESTHER has four research objectives: (i) estimation of genetic and phenotypic differentiation between spawning aggregations; (ii) determination of stock origins and life history of juveniles; (iii) determination of composition of feeding aggregations and (iv) improved guidelines for the conservation and management of biodiversity and stock preservation. The Project started officially on January 1st, 2003.

Altogether 2004 was a more productive year than 2003. Most of the sampling was successful. Four "mixed" adult aggregations were sampled, one more than originally intended and all of the major spawning areas were successfully sampled, giving a wider coverage than in 2003.

Five of the eight analytical workpackages produced enough data to enable initial analyses of spawning population differentiation, and the relation of juveniles and non-spawning aggregations to spawners in some cases. The research using parasites as biological tags enables the different life-stages to be linked; the other workpackages allow determination of the most important indicators of differentiation between spawners. These indicators will then inform mixed stock analyses of non-spawning adults and juveniles. The use of a number of different methods results in a broader analysis of different facets of population structure than a single method would allow.

To date, the research on using parasites as biological tags has yielded the most results, with more working hypotheses produced than from other workpackages. Results include a new host record for herring, and linkage of different life-stages of herring in different areas. For example, fish that spawn in winter off the north coast of Ireland have been linked to juveniles on Stanton Bank to the north of the area, and to mixtures of adults in the local sea area off the north of Ireland (VIa(S)). In contrast, autumn spawners off the north-west coast of Scotland do not appear to be recruited from coastal nurseries either to the south of the spawning grounds, or from the Scottish east coast.

However, Scottish spring spawners caught slightly further south appear to be recruited entirely from Scottish coastal nursery grounds.

Sampling will be completed by the end of March 2005. WESTHER agreed that all samples taken in the first twelve months will be analysed by the end of March.

1.4.6 Linking Herring 2008 [ICES/GLOBEC sponsored symposium]

ICES and Globec are sponsoring a symposium in 2008 in Galway on herring as a key component of some ecosystems called "Linking Herring". The symposium is also supported by The Marine Institute Norway, The Netherlands Institute for Fisheries Research and The Marine Institute Ireland. The symposium will act as a forum to bring together existing knowledge on herring, to highlight new issues and to pin point inadequacies in our understanding of the role of herring in the dynamics of temperate seas. The symposium will be highly applied in nature, specifically requesting contributions that increase our understanding of ecological role of herring, the variability of production and the impact of source of change on this major pelagic species. Members of HAWG and others with interests in herring will be invited to contribute to the symposium. At present the scientific and managing committees have not been appointed.

The recent success of ICES symposia on the interaction of key ecological species (e.g. capelin and salmon) show that such symposia, can be highly productive and advance the ICES mission towards goals 1 to 4 of its strategy. Bearing these successes in mind, a symposium on the role and interactions of herring would be very pertinent for ICES. Herring are a key high biomass fish in many temperate seas within the ICES area. They are both predator and prey. Herring has a very long association with ICES, with its study and management being at the heart and initiation of the organisation. The last ICES symposium on herring was in 1978. It is aimed to produce a synopsis that integrates the findings of the symposium, which will be of use to scientists and managers.

The Theme Sessions will include:

i. *Herring in the middle*- the trophic and ecological interactions and impacts of herring
ii. *Managing Change*- management and exploitation of herring in a dynamic environment, within the context of long term change
iii. *Variable Production*- particularly the role of reproduction, recruitment and life history strategies.
iv. *Population Integrity*- the integrity of stocks and the drivers of migration
v. *Counting herring*- qualitative and quantitative estimation of herring and its application.

1.4.7 Sprat age reading exchange and Workshop

An age reading workshop was organised by Norway in December 2004 (ICES, 2003). Prior to the meeting an otolith exchange was organised to detect the problems in age reading. The exchange indicated that an improvement in the precision level of age reading was required. Younger fish were more difficult to be interpreted. This indicates that a reduction in the age reading bias is required.

Based on the results of the exchange it appeared to be possible to achieve reliable age readings for North Sea/Skagerrak sprat in future, if it can be proven that sprat always produces an opaque growth zone in the year it is born and that by age reading the otoliths of sprat, the fish can be assigned to a certain year class.

After discussion of the results, the WS re-read a sub-sample of the otoliths. Most readers still demonstrated difficulties in determining annual ring of age group 1 (highest CV). The CV is lowest for age group 2 and increases again for age group 3. This indicates that readers are uncertain in determining the first annual and again become uncertain at the time the annual growth increment becomes narrow at age 3.

It was recommended that:

- age-validation should be performed in order to confirm the validity of the ageing method used (confirm the periodicity of deposition of the translucent ring, microstructures), to investigate the time of deposition of the translucent ring for each age-class and to determine the spawning time
- measure L1 in sprat otoliths from the various areas to establish the position of the first annual translucent zone (the range in the area)
- not to consider fish length in age estimation, at least not for the first reading
- to have a next exchange in 2007, followed by a WS if necessary

1.4.8 Planning Group on Commercial Catch, Discards and Biological Sampling [PGCCDBS]

The ICES Planning Group on Commercial Catch, Discards and Biological Sampling [PGCCDBS] met in Oostende, 1-4 March to:

a. review the recommendations of the EU regional Data Collection Coordination Meetings and address the future of the PG in light of the role and involvement of non-EU countries,
b. propose sampling methodology for fleet/fishery based data collection;
c. review existing information and propose sampling strategies for recreational fisheries;
d. review national descriptions of small scale fleets by country and evaluate the strategies used by different countries to obtain basic information for management purposes;
e. review the possibilities of using shared ALKs;
f. review the reports from the age-reading exchanges and workshop and identify on a regional basis the candidate stocks and species requiring improved ageing;

The meeting was attended by 39 participants from 18 countries and representatives from the EU Commission, DG FISH.

ToR a): During September 2004 and in January 2005 Regional Coordination Meetings (RCM's) organised by the EU Commission were held (see sec. 1.4.9). Non-EU countries were invited to participate in these data collection planning group meetings. The PGCCDBS expressed its support for having the RCM's, though the PG found it was very important to maintain the PG coordination between the different regions as well ensure same data quality in e.g. age readings, sampling methodology. Furthermore, the PG recommended that the PG could be the forum for discussing mythological and technical issues and how these could be implemented.

ToR b): This issue created intensive discussion on fleet/fisheries/metier definitions despite the guidelines given by ICES (ICES, SGDFF 2003, 2004). At a workshop for fisheries economists organised by the EU Commission other fleet/fisheries/metier definitions were set. A number of national fishery/fleet based data collection programmes were presented to the PG. The general conclusion was that closer cooperation and coordination of data collection are needed as many more cells (quarter, fleet, fishery, area) have to be sampled. Without this cooperation there is a risk of having too many empty cells.

The EU Commission has decided that within the frame of the data collection programme an EU coordinated workshop on fleet/fisheries/metier data collection will be held in Nantes, France in May 2005.

ToR c): In some countries data collection programmes for recreational fisheries have been carried out. The EU data collection regulation prescribes that data collection programmes have to be conducted for tuna fish and salmon. From 2006 and onward, information on the recreational fishery on cod should be collected.

Information on how this challenge in collecting information from the recreational fishery has been dealt with in the U.S.A was presented to the PG. This information and experience can be very useful for the European countries and the approaches used in the U.S.A. could be used as an inspiration. There is no doubt, that data collection will be resource intensive.

ToR d): Most participants presented their present data collection on the small scale fishery. In all countries data collection is very dependent on the EU control regulation (ECC Reg. 850/1998) and other national regulation. Still, uncertainty on how to define “small scale fishery” exists. Therefore, the PG decided to recommend to the EU Commission that the planned workshop on small scale fisheries should be postponed to the autumn of 2005. At that time the findings from workshop fisheries/metier definitions should be agreed and available. An EU coordinated workshop on small scale fisheries data collection will be held in Kavala, Greece in the September/October 2005.

ToR e): Analysis on comparison of ALK‘s have been carried out for a number of species. On the background of present information the PG recommended further analysis to be carried out. A software developed for the purpose of analysing ALK’s was distributed. PG participants were encouraged to carry out analyses on their national data as well as data store in international databases.

ToR f): During 2004 four age reading workshops have been held; sprat, hake, anglerfish and megrim. The agreement between readers for hake and anglerfish is low and therefore uncertainty on input data, such as estimated catch in numbers, for stock assessment purposes may be uncertain. In 2005 four age reading workshop on herring, whiting, sardine and blue whiting will be held.

The PG also reviewed the remarks on the assessment input data for the 2004 assessment WG’s. All Assessment WG reports were scanned for data quality and data requirement remarks and for each stock a data sheet has been filled in. An annex with these data sheets is attached to the PGCCDBS 2004 report. The data sheets for the HAWG 2005 are given as table (1.5.3 to 1.5.10)

1.4.9 EU regional meetings on data.

The EU Commission decided in 2004 within fisheries data collection to form a counterpart to the Regional Advisory Committee’s. These Regional Coordination Meeting’s (RCM’s) were established for the Baltic, the North Sea, the Western Areas and Atlantic and for the Mediterranean.

The members of the RCM’s are the National Correspondent, one biologist and one economist from each country. The idea of establishing the RCM’s was to have a forum where coordination of the fisheries data collection could be discussed and agreements could be made. It should not be a forum where detailed technical issues should be discussed but a forum where agreements on who is doing what and also potential financial issues agreed.

The RCM reports can be found as Annexes to the ICES, PGCCDBS 2005 report.

1.4.10 Study Group on Management Strategies [SGMAS]

A brief overview of the work done by the Study Group on Management Strategies, which met in Jan-Feb. 2005, was presented to the group. It was noted that the report from the SGMAS gives an overview of terminology and concepts, of types of stocks and fisheries, checklists for evaluation of management strategies and standards for simulation of management strategeies in general and harvest control rules in particular. Examples of previously agreed management strategies and how they were developed are given in the report from the SGMAS, including the North Sea herring and the Blackwater herring.

Of particular interest to the group is the management of stocks where annual updated assessments cannot be provided or are considered unreliable, but where there still is a good deal information on the biology and dynamics of the stocks. This problem, which the SGMAS plans to deal with more extensively at its next meeting, applies to most of the herring stocks west of the British Isles. Hence, the development by the SGMAS in this field will hopefully be useful for the HAWG, and current work by the HAWG on management of these stocks will be of particular interest to the SGMAS.

1.4.11 Exchange of maturity photos.

Doubts and difficulties in the maturity staging of herring have been discussed in PGHERS since the end of the 1990s and different measures have been discussed to improve the confidence in the classification. In 2004 PGHERS (ICES, 2004b) agreed that an exchange of digital images should be carried out before the start of the acoustic surveys at the end of June.

A selection of 72 digital images was prepared from a collection of Dutch, Irish, Norwegian and Scottish pictures, and distributed digitally to all the laboratories participating in the summer acoustic surveys. The exchange series covered a whole spectrum of maturity stages. In the acoustic survey for the North Sea herring, scientists use either an 8-point or a 4-point scale for maturity classification (ICES 2004b) and in this exercise were asked to use the scale they normally use.

The main purpose of the exchange was to:

i. study the usefulness of digital photos as a tool for classification of maturity stages
ii. analyse the agreement of maturity classifications between the participants.

Three analyses were made, based on a) classification according to the 8-point scale, b) classification according to the 4-point scale (and those from the 8-point scale merged into 4-point scale) and c) all merged into immature and mature. A spreadsheet for a standardised analysis of the age reading comparisons, (www.efan.no) was used for the analysis. The overall results from the three sets were as shown in the following text table:

Mat-scale	% agreement	% CV	N readers
8-point	65.4	23.7	13
4-point	86.3	18.1	14
2-point	92.1	16.4	14

Improvements in the precision were noted going from an 8-point classification to a 2-point classification, as reported from the surveys. However, the overall CV was still high (16.4%) and it is recommended that the national laboratories put some effort into improving the confidence in maturity classifications of herring. An exchange exercise should be carried out every three years, beginning in 2007.

1.5 Commercial catch data collation, sampling, and terminology

1.5.1 Commercial catch and sampling: data collation and handling

Input spreadsheet and initial data processing. Since 1999 (catch data 1998), the working group members have used a spreadsheet to provide all necessary landing and sampling data. The current version used for reporting the 2004 catch data was v1.6.4. All but one nation provided commercial catch data on these spreadsheets, which were then further processed with the SALLOCL-application (Patterson et al., 1997). This program gives the needed standard outputs on sampling status and biological parameters. It also clearly documents any decisions made by the species co-ordinators for filling in missing data and raising the catch information of one nation/quarter/area with information from another data set. This allows recalculation of data in the future (as done by SG REDNOSE in 2003, ICES 2003/ACFM:10, and as will have to be done when the new ICES InterCatch database is released, see below), choosing the same (subjective) decisions made today. Ideally, all data for the various areas should be provided on the standard spreadsheet and processed similarly, resulting in a single output file for all stocks covered by this working group. Data submission in 2005 went smoother than ever before, all but one nation used the spreadsheets and data were almost error-free. However, some institutes delivered their data very late.

More information on data handling transparency, data archiving and the current methods compiling fisheries assessment data are given in the stock annex 2. To facilitate a long-term data storage, the group stores all relevant catch and sampling data in a separate “archive” folder on the ICES network, which is updated annually. This collection is supposed to be kept confidential as it will contain data on misreporting and unallocated catches, and will be available for WG members on request. Table 1.5.1 gives an overview over data available at present, and the source of the data. Members are encouraged to use the latest-version input spreadsheets if it is needed to re-enter catch data. Figure 1.5.1 shows the separation of areas as used for the long-term storage of data.

Future developments: The ICES InterCatch database. In this section of the report, since 1999, the WG has stated that the handling of catch data is considered as a priority issue for quality control, as the quality of the input data from commercial sampling has proven to be crucial for the quality of the whole assessment procedure. ICES has been asked repeatedly to develop a database application for the proper handling and storage of fisheries catch (-at-age) data. This is also regarded to be a prerequisite for the use of fisheries data for multifleet/multispecies advice. Following generous funding by Norway in 2002, ICES has recently started to develop such a database, called “InterCatch”. Draft user specifications are now available, and it is expected that a first version for testing by all WGs or stock coordinators is released at the Annual Science Conference 2005. The thoroughly tested system is planned to be up and running at the start of the WG season 2006, with HAWG being the first WG to use it. All WGs were asked to contribute, namely by delivering fleet and stock definitions, specifications for WG specific inputs (data types needed for specific assessments – with dimensions, level of disaggregation, limits for initial validity checks, stock extraction rules etc.). The WG discussed issues related to the database development briefly at this year’s meeting. Information requested by the ICES data centre is given in Table 1.5.2. (based on WD 7). HAWG welcomes ICES’ initiative and again offers any possible support in the future. The group reiterated that the database should provide an opportunity to clearly track changes of “official” landings made by WG members to compensate misreported or unallocated landings or discards. This would, however, require means to keep some of the national disaggregated data confidential in order to protect their sources. Further, a transparent and effective handling of information obtained from market sampling in foreign ports should be possible. As the application should be usable by all WGs and all stock coordinators, platform independency is regarded to be a crucial issue for the acceptance of the new system. In this respect, the WG expresses concern that the development outlined at present heavily relies on software of a single commercial vendor. If the new system is not platform independent, the WG will not be able to test the software after initial release, and to use it for data collation at the 2006 meeting. The WG therefore encourages the ICES data centre to assure that access to InterCatch is platform-independent, if not using open source software.

1.5.2 Sampling

Quality of sampling for the whole area. The working group again produced a map indicating the level of catch sampling by area for all herring stocks covered by HAWG (Figure 1.5.2). The map indicates that the sampling level (in terms of fraction of catch sampled and number of age readings per 1000 t catch) is very different for the various areas. Further details of the sampling quality can be found by stock in the respective sections (Sec. 2.2.4 for North Sea herring, 3.2.6 for Western Baltic Spring Spawners, 4.2.3 for Celtic Sea and VIIj herring, 5.2. for VIa(N) herring, 6.2.2 for VIa(S) and VIIb,c herring, 7.2.2 for Irish Sea herring).

The EU sampling regime. HAWG has recommended for years that sampling of commercial catches should be improved for most of the stocks. The EU directive for the collection of fisheries data was implemented in 2002 for all EU member states (Commission Regulation 1639/2001). The provisions in the “data directive” define specific sampling levels. As most of the nations participating in the fisheries on herring assessed here have to obey this data directive, the definitions applicable for herring and the area covered by HAWG are given below:

Area	**sampling level per 1000 t catch**		
Baltic area (IIIa (S) and IIIb-c)	*1 sample of which*	*100 fish measured and*	*50 aged*
Skagerrak (IIIa (N))	*1 sample*	*100 fish measured*	*100 aged*
North Sea (IV and VId):	*1 sample*	*50 fish measured*	*25 aged*
NE Atlantic and Western Channel ICES sub-areas II, V, VI, VII (excluding d) VIII, IX, X, XII, XIV	*1 sample*	*50 fish measured*	*25 aged*

There are some exemptions to the above mentioned sampling rules if e.g. landings of a specific EU member states are less than 5 % of the total EU-quota for that particular species.

The process of setting up bilateral agreements for sampling landings into foreign ports has started and is beginning to yield results. However, more of these agreements have to be negotiated, especially between EU and non-EU countries, to reach a sufficient sampling coverage of these landings.

HAWG reviewed the quality of the overall sampling of herring and sprat for the whole area. There is concern that the present sampling regime may lead to a deterioration of sampling quality, because it does not assure an appropriate sampling of different metiers (each combination of fleet/nation/area and quarter). Given the diversity of the fleets harvesting most stocks assessed by HAWG, an appropriate spread of sampling effort over the different métiers is more important to the quality of catch at age data than a sufficient overall sampling level. The EU data directive appears to not assure this. The WG therefore recommends that all metiers with substantial catch should be sampled (including by-catches in the industrial fisheries), that catches landed abroad should be sampled and information on these samples should be made available to the national laboratories.

Comments to sampling quality of the different herring and sprat stocks are given in Tables 1.5.3 to 1.5.10. Most of the issues raised her have also been addressed by the Planning Group on Commercial Catch, Discard and Biological Sampling (see Section 1.4.8.).

1.5.3 Terminology

The WG noted that the use of “age”, “winter rings” and “rings” still causes confusion outside the group (and sometimes even among WG members). The WG tries to avoid this by consequently using “rings” or “ringers” instead of “age” throughout the report. It should be observed that, for autumn spawning stocks, there is a difference of one year between “age” and “rings”. Further elaboration on the rationale behind this can be found in the stock annex 2.

1.6 Methods Used

The main assessment tools used by this WG is ICA (Patterson, 1998, Needle 2000) which is a separable model over a recent number of years and a conventional VPA over the earlier part of the time-series. This model appears to behave well on the stocks considered by this WG. However, for some stocks additional methods need to be used, e.g. for herring caught in Divisions VIaS and VIIbc where no reliable tuning data are available. For North Sea sprat ageing is considered to be problematic therefore an exploratory assessment is carried out using Catch Survey Analysis (CSA, Mesnil 2003). Both XSA (Darby & Flatman, 1994; Shepherd, 1999) and SURBA (ICES CM2003/D:03; Needle 2004) were used for data exploration and for comparisons with ICA.

Short term predictions for the North Sea used MFSP that was developed three years ago in the HAWG (Skagen; WD to HAWG 2003). Other short term predictions were carried out using the MFDP v.1a software.

1.7 Discarding by Pelagic fishing Vessels

In many fisheries, fish, invertebrates and other animals are caught as bycatch and returned to the sea, a practice known as discarding. Most animals do not survive this procedure. Reasons for discarding are various and usually have economic drivers:

- Fish smaller than the minimum landing size
- Quota for this specific species has already taken
- Fish of undesired quality (high-grading)
- By-caught species of no commercial value

Theoretically, the use of modern fish finding technology used to find schools of fish should result in low by-catch. However, if species mixing occurs in pelagic schools (most notable of herring and mackerel), non-target species might be discarded. Releasing unwanted catch from the net (slipping) or pumping unsorted catch overboard also results in discarding.

Discarding of herring in the pelagic fisheries was considered not to be a large problem, with discards below 5%, estimated by onboard observer programmes. In the area considered by HAWG, only two nations reported discards from their fleets in 2004. For those nations, discard figures were raised to national landings (based on the spatial and temporal distribution of the fleet), and used in the assessment of North Sea autumn spawning herring (UK/Scotland and Germany, see Section 2.3) and VIaN (UK/Scotland, see Section 5.1.3). All other nations did not report notable amounts of discards of herring in the pelagic fisheries, either because they did not occur, catches were not sampled for discards or difficulties with raising procedures. No discard estimates for the total international catch were calculated.

The inclusion of discarded catch is considered to reduce bias of the assessment and thus give more realistic values of fishing mortality and biomass. However, they might also increase the noise in the assessment because the sampling level for discards is usually lower than that for landings (Table 1.7.1, 1.7.2). This is, as for sampling of landings, caused by the large number of different metiers in the pelagic fishery and the difficult to predict behaviour of the fisheries (in terms of target species and spatial and temporal distribution). Raising discard estimates to the national landings might result in a higher bias than an area based estimate of discards from the total international fleet, if sampling is insufficient. HAWG therefore recommends that the development of methods for estimating discards be based on a fleet based method, rather than on a national basis.

1.8 Ecosystem considerations, sprat and herring- response to WGRED and SGRESP.

HAWG welcomes the moves within ICES to attempt to reconcile the single species advice within an ecosystem context. It is important when considering ecosystem advice that the quality and robustness of the science is supportable and the advice is able to withstand the rigors of scientific and stakeholder scrutiny. Measures and objectives must be testable and based on high quality science that is defensible to the non-scientific community.

1.8.1 Ecosystem Areas

HAWG considers it productive to break up problems into tractable components and acknowledges that ecosystems from different regions vary from each other. However, the setting of rigid boundaries between neighbouring seas worries HAWG.

With regard to the WGRED descriptions of eco-regions, it is obvious that the demarcation of boundaries between regions is problematic and must be based on certain criteria that may be contentious, e.g. boundaries of the North Sea. Some limits of the WGRED eco-regions contradict well established definitions, e.g. the separation between North Sea and Baltic. The criteria used for the selection of these regions are not transparent to HAWG.

Even if the suggested eco-regions may fit for some demersal stocks, many pelagic ones migrate among areas. In addition currents have an impact on fish distribution, especially for early life stages, and supporting exchange between areas. Thus the classified eco-regions should not necessarily be considered as suitable areas for pelagic management purposes.

1.8.2 North Sea

HAWG notes the comments from WGRED about the decline in sandeel, Norway pout and the copepod *Calanus finmarchicus* abundance in the North Sea. It also acknowledges that the plankton community in the North Sea has shifted to a dominance of more “southerly” species, as shown by CPR data (Beaugrand et al., 2002, Reid et al., 2003). Both Calanus and juvenile sand eels are common prey of herring and recent evidence from the Baltic has shown that juvenile herring positively select *Pseudocalanus* and *Temora* and avoid eating *Acartia* (Casini et al., 2004). *Acartia* is associated with summer blooms and warmer temperatures as shown by Gowen et al (1998).

The individual fish from the strong 2000 year class of herring have been smaller in size and are less mature at age. This suggests that either more slower-growing fish have survived in that year class or that the ecosystem has failed to provide enough food to allow the full potential growth for that cohort i.e. that food has been limiting for that cohort. This cohort grew well up to 1 wr of age.

In terms of the impact of a high biomass of herring on the North Sea ecosystem, some studies are ongoing, but more resources are required to obtain new estimates of stomach contents and feeding by sprat and herring. With low sandeel and *Calanus* abundances, the herring may well be having a stronger impact than in the previous last 2 decades. However a high biomass of herring may also be providing an alternative prey source to piscivores such as horse mackerel and Minke whales (Olsen & Holst, 2001) reducing the pressure on sandeel. These last three sentences are very speculative and if the quantitative trophic-complexities of the system are to considered a priority by ICES, more resources need to be spent on understanding the trophic interactions in the North Sea and developing spatial and temporal models of trophic dynamics in the system.

The production of herring has increased since the collapse caused by overfishing in the 1970s (Figure 1.8.1) and is dominated by the growth in 1wr fish. The methods used to determine these productions are described in WD 21, and based on that of Dutil & Brander (2003). Surplus production has been of the order of 700 k tonnes for the last 25 years and the recent positive net production has lead to an increase in available herring biomass in the system.

Little analysis is currently taking place into the relative roles of sprat and herring as 'sinks of biomass", predators and prey within the southern North Sea. The interactions of the two species have been shown to be very dynamic in the neighbouring Baltic Sea (Mollmann & Koster, 2002). With the decline in sandeel and other planktivorous fish, HAWG would support further studies into the interaction and associations (or not) of herring, sprat, anchovy and pilchard (sardine).

Kattegat and Skagerrak is also considered an important area for herring by HAWG, it supports both local spawning populations and is the major nursery ground for North Sea herring. The impact of the higher saline inflows through this area into the Baltic Sea in recent years on the resident herring populations is at present unknown. Studies presented to HAWG in 2005 about the HERGEN project suggest that salinity may play a role in the genetic integrity of local spawning components.

Most herring fisheries deploy gear that is deployed clear of the seabed. The impact of gravel extraction on the conservation and productivity of herring is still unclear, and there are virtually no studies to provide evidence at present (CM2003/ACFM:17). The limited evidence available at present records no incidences of cetacean mortality due to pelagic trawling (0 catches observed out of 218 pelagic hauls by commercial trawlers from 1999-2004). There are also very few other by-catches of fish, beyond the targeted fisheries of herring, mackerel, horse mackerel and blue whiting.

1.8.3 Celtic Seas

WGRED did not look at the Celtic Seas in great detail, although SGRESP has considered the region. Across the region information on the comparative dynamics of sprat and herring, particularly in the areas used by juveniles, may prove useful to HAWG. Information on the variability in hydrography, and its influence on larval drift may also be of benefit. In the region, there is no evidence to support the likelihood of wide scale catching of cetaceans by vessels targeting herring. As in the North Sea, there is a severe paucity of data on herring feeding and stomach contents.

Within the Celtic Sea itself, HAWG would like information on the trends in planktonic productivity and recent changes in temperature and related hydrography that may help explain the changes seen in Celtic Sea herring. It should be noted that Celtic Sea herring is the second most southerly population of herring exploited in Europe and thus it may be more effected by sea warming.

Similar requests are made for the continental shelf west of Scotland and the Irish Sea. HAWG would like information on planktonic productivity of the region and any evidence for shifts that coincide with the years of higher herring productivity in the 1970s, particularly in the context of increased yield of recruits per spawner.

Factors that may interest SGRESP and WGRED, include the recent change in the maturity at age ogive in Irish Sea herring. In certain years, the proportion mature 1wr fish (almost 2 years old) can be higher than 30%, and in 2004 100% of 2wr fish were mature.

Despite recent evidence from WESTHER and HERGEN that there is little genetic differentiation between the stocks, their phenotypic characteristics and population dynamics are different. A comparison of the relative trends in surplus production indicates that after the collapses due to overfishing in the 1970s, the Celtic Sea shows a very different pattern compared to both the west of Scotland and the Irish Sea stock (Figure 1.8.2, methods in WD21). The Celtic Sea stock appears to have been more dynamic in terms of surplus production (biomass available to fish) than the stocks further to the north.

1.9 Stock overview

At HAWG, a total of eight herring stocks and three sprat stocks are considered in the area south of 62°N. Analytical assessment could be carried out for four of these eleven stocks. Results of the assessments are presented in the subsequent sections of the report and are summarized below and in Figures 1.9.1 - 1.9.3.

North Sea autumn spawning herring is the largest stock assessed by this WG. It has experienced very low spawning stock biomass levels in the late 1970s when the fishery was closed for a number of years. This stock began to recover until the mid-1990s, when it appeared to decrease again rapidly. A management scheme was adopted to halt this decline. Following a period of good recruitment co-occurring with the new management measures, SSB and the proportion of older fish in the stock increased. This gave the opportunity to increase TACs and catch. In recent years, F on the adults has been just below F_{pa} and fishing mortality on the juveniles has been low. Projections demonstrate that stock-size is likely to be decline due to weak incoming year classes.

Western Baltic Spring Spawners (WBSS) is the only spring spawning stock assessed within this WG. It is distributed in the eastern part of the North Sea, the Skagerrak, the Kattegat and the Sub-Divisions 22, 23 and 24. Within the northern area, they mix with North Sea Autumn Spawners. The WBSS herring stock is slowly recovering from the lowest observed SSB level in 1998. Yield and fishing mortality on the adults are considered to have been reduced in the last years.

Celtic Sea herring: The herring fisheries to the south of Ireland in the Celtic Sea and in Division VIIj have been considered to exploit the same stock. For the purpose of stock assessment and management, these areas have been combined since 1982. The fishery in the eastern part of the Celtic Sea was closed in the early eighties due to poor recruitment. Stock assessments have become unstable in the recent past due to fluctuations in recruitment, for which there is no independent measure. In 2005 no final assessment could be produced. SSB and F cannot be precisely estimated. Indications from recruitment in the catch suggests that recruitment in 2003 (year-class 2001) may be the lowest in the series.

West of Scotland herring is currently lightly exploited and with two good year classes the stock is at a relatively high level compared to last 30 years. Earlier data indicate the possibility of larger stock in the 1960s. The stock experienced a heavy fishery in the mid-70s following closure of the North Sea fishery. The fishery was closed before the stock collapsed. It was opened again along with the North Sea. In the mid 1990s there was substantial area misreporting of catch into this area and sampling of catch deteriorated. Recently the area misreporting has reduced to a very low level and information on catch has improved, but in 2004 misreporting increased again. Instability in the assessment has reduced considerably and the assessment shows a relatively stable SSB and a low F over the last 4 years. Recruitment of the 2001 year-class is well below average.

Herring in VIa south and VIIbc are considered to consist of a mixture of autumn- and winter/spring-spawning fish. The winter/spring-spawning component is distributed in the northern part of the area. The main decline in the overall stock since 1998 appears to have taken place on the autumn-spawning component, and this is particularly evident on the traditional spawning grounds in VIIb. The current levels of SSB and F are not precisely known, as there is no tuned assessment available for this stock. The results of the non-tuned assessment suggest that the SSB may have stabilised at a low level.

Irish Sea autumn spawning herring comprises of two spawning groups (Manx and Mourne). This stock complex experienced a very low biomass level in the late 1970s with an increase in the mid-1980s after the introduction of quotas. The stock then declined from the late 1980s to its present level. During this time period the contribution of the Mourne spawning component has declined. In the past decade there have been problems in assessing the stock. F appears to be at historic low levels in recent years.

North Sea Sprat is the only sprat stock on which an assessment is carried out within this WG. Sprat is a short-lived species. The recruits account for a large proportion of the stock, and the fishery in a given year is very dependent on that year's incoming year class. The size of the stock has been variable with a large biomass in the early 90's followed by a sharp decline. The sprat stock now shows signs of being in good condition.

The main **assessment tools** used by this WG is ICA (Patterson, 1998, Needle 2000) which is a separable model over a recent number of years and a conventional VPA over the earlier part of the time-series. This model appears to behave well on the stocks considered by this WG. However, for some stocks additional methods need to be used, e.g. for herring caught in Divisions VIaS and VIIbc where no reliable tuning data are available.

ACFM in May 2004 has accepted the assessment of North Sea autumn-spawning herring, West of Scotland herring and Baltic spring-spawning herring as full analytical assessments. The other assessments were only considered to be indicative of stock trends.

1.10 HAWG approach to the western stocks

The WG did not have time at this year's meeting to carry out a full evaluation of the western herring stocks (VIa (N), VIa (S), Irish Sea and Celtic Sea), as was suggested by ACFM. The current situation for these stocks is believed to be the following:

Only VIa (N) herring has a separate agreed assessment.

Currently fisheries in the four stock areas are rather distinct.

Stock development for Celtic Sea, Irish Sea is distinct but with mixing juveniles.

Demographically Celtic Sea, VIa (S) and VIa (N) herring have been believed to recruit independently. VIa (N) and VIa (S) were split into two stocks in 1982 based on demographics through a discriminant analysis of catch data.

Historically Irish Sea and VIa (N) appear to have similar historic stock productivity.

Currently there is an EU funded project evaluating the differences among the Western Stocks with a variety of methods, including genetics, life history traits and biological markers (WESTHER). This project is now in the data evaluation phase and will finish in December 2005. A full evaluation of all the data might not be available before by HAWG in 2006.

A combination of the catch data to provide a historic VPA would be relatively straightforward but would provide little benefit over combination of the individual VPAs.

The main benefits for combination of some or all of the area is where either fisheries overlap, as for juveniles in the southern Irish Sea for Celtic and Irish Sea herring, or where stock separation is less distinct for adults in areas VIa (N), Irish Sea and Clyde.

The current main problem for a combined area assessment is the lack of a single source of a comprehensive survey to act as a tuning index.

The WG considers that it would be best to await the results from WESTHER before considering what should be done. If combination of two or more stocks or areas in considered useful, this may require coordination of a suitable survey.

1.11 Recommendations

- HAWG recommends that the new ICES InterCatch database should provide an opportunity to clearly track changes or allocations of "official" landings made by WG members and to compensate for misreported or unallocated landings or discards. This would, however, require means to keep some of the national disaggregated data confidential in order to protect their sources. Further, a transparent and effective handling of information obtained from market sampling in foreign ports should be possible. The WG also encourages the ICES data centre to assure that access to InterCatch is platform-independent, if not using open source software. Action: C. Zimmermann. (from Sec 1.5)
- HAWG recommends that all metiers with substantial catch should be sampled (including by-catches in the small meshed fishery).
- HAWG recommends that similar arrangements, as the obligation implemented by the EU Member States on sampling of landings outside the flag country, to be implemented between all countries. Furthermore, agreements on when and how the sampling country provides sampled data to the flag country should be made in order to make data available for the HAWG
- HAWG recommends that the development of methods for estimating discards be based on a fleet based method, rather than on a national basis. The inclusion of discarded catch is considered to give more realistic values of fishing mortality and biomass. Action: PGCCDBS. (from Sec 1.7).
- To ensure the continuity of the North Sea herring larvae surveys they should be considered for priority 1 EU funding. This survey is providing value for money that is equivalent to the other sources of information used to assess North Sea herring. It should therefore be given the same priority of funding as the other surveys and market sampling data collection schemes.
- HAWG recommends that the existing surveys of herring in the southern North Sea and English Channel be maintained, and that the micro-increment analysis of otoliths (to determine spawning type) is carried out on samples collected during the annual acoustic survey.
- HAWG recommends that the possibility of separating the juveniles caught in the Irish Sea acoustic and ground fish surveys into autumn and winter spawning components based on otolith microstructure and/or length composition is investigated.
- The annual series of IBTS indices on North Sea herring 1-5+ ringers used by the HAWG is an accumulation of the indices retrieved during each years HAWG. While there might have been additions and corrections to data after these retrievals, and while there might be some differences between retrieval procedures throughout the series, HAWG recommends that updated, standardized retrievals are available to the WG at the 2006 meeting.
- HAWG recommends the following timetable for benchmark assessments:

  2006 North Sea herring autumn spawners
  2007 Western Baltic spring spawners
  2008 Celtic Sea herring, VIa North herring
- HAWG notes the third year of weak recruitment in North Sea herring, and that series of poor recruitments have occurred in the past with major implications for the management of the North Sea herring stock. HAWG therefore recommends that studies be initiated into whether the tendency of periodicity in the level of recruitment of autumn spawned herring is linked to changes in the hydrography and/or the biology in the North Sea.

Table 1.5.1: Available disaggregated data for the HAWG per March 2005
X: Multiple spreadsheets (usually xls); W: WG-data national input spreadsheets (xls);
D: Disfad inputs and Alloc-outputs (ascii/txt)

Stock	Catchyear	Format X	W	D	Comments
Baltic Sea: IIIa and SD 22-24					
her_3a22	1991-2000	X			raw data, provided by Jørgen Dalskov, Mar. 2001, splitting revised
	1998	X			provided by Jørgen Dalskov, Mar. 2001, splitting revised
	1999	X			provided by Jørgen Dalskov, Mar. 2001, splitting revised, catch data revised
	2000	X			provided by Jørgen Dalskov, Mar. 2001
	2001	X			provided by Jørgen Dalskov, Mar. 2002
	2002	X			provided by Jørgen Dalskov, Mar. 2003
	2003	X			provided by Jørgen Dalskov, Mar. 2004
	2004	X			provided by Lotte Worsøe Clausen, Mar. 2005
Celtic Sea and VIIj					
her_irls	1999	X			provided by Ciarán Kelly, Mar. 2000
	2000	X			provided by Ciarán Kelly, Mar. 2001
	2001			D	provided by Ciarán Kelly, Mar. 2002
	2002			D	provided by Ciarán Kelly, Mar. 2003
	2003			D	provided by Maurice Clarke, Mar. 2004
	2004			D	provided by Maurice Clarke, Mar. 2005
Clyde					
her_clyd	1999	X			provided by Mark Dickey-Collas, Mar. 2000
	2000-2003				included in VIaN
Irish Sea					
her_nirs	1988-2003	X			updated by SG HICS, March 2004
	1998	X			provided by Mark Dickey-Collas, Mar. 2000
	1999	X			provided by Mark Dickey-Collas, Mar. 2000
	2000	X	W		provided by Mark Dickey-Collas, Mar. 2001
	2001	X			provided by Mark Dickey-Collas, Mar. 2002
	2002	X			provided by Richard Nash, Mar. 2003
	2003	X			provided by Richard Nash, Mar. 2004
	2004	X			provided by Beatriz Roel, Mar. 2005
North Sea					
her_47d3, her_nsea	1991	X			provided by Yves Verin, Feb. 2001
	1992	X			provided by Yves Verin, Feb. 2001
	1993	X			provided by Yves Verin, Feb. 2001
	1994	X			provided by Yves Verin, Feb. 2001
	1995	X	W	D	provided by Yves Verin, Feb. 2001, updated by SG Rednose, Oct 2003
	1996	(X)	W	D	provided by Yves Verin, Feb. 2001, updated by SG Rednose, Oct 2003
	1997	(X)	W	D	provided by Yves Verin, Feb. 2001, updated by SG Rednose, Oct 2003
	1998	(X)	W	D	provided by Yves Verin, Mar. 2000, updated by SG Rednose, Oct 2003
	1999		W	D	provided by Christopher Zimmermann, Mar. 2000, updated by SG Rednose, Oct 2003
	2000		W	D	provided by Christopher Zimmermann, Mar. 2001, updated by SG Rednose, Oct 2003
	2001		W	D	provided by Christopher Zimmermann, Mar. 2002
	2002		W	D	provided by Christopher Zimmermann, Mar. 2003
	2003		W	D	provided by Christopher Zimmermann, Mar. 2004
	2004		W	D	provided by Christopher Zimmermann, Mar. 2005
West of Scotland (VIa(N))					
her_vian	1957-1972	x			provided by John Simmonds, Mar. 2004
	1997	X			provided by Ken Patterson, Mar. 2002
	1998	X			provided by Ken Patterson, Mar. 2002
	1999		W	D	provided by Paul Fernandes, Mar. 2000, W included in North Sea
	2000		W	D	provided by Emma Hatfield, Mar. 2001, W included in North Sea
	2001		W	D	provided by Emma Hatfield, Mar. 2002, W included in North Sea
	2002		W	D	provided by Emma Hatfield, Mar. 2003, W included in North Sea
	2003		W	D	provided by Emma Hatfield, Mar. 2004, W included in North Sea
	2004		W	D	provided by John Simmonds, Mar. 2005, W included in North Sea
West of Ireland					
her_irlw	1999	X	(W)		provided by Ciaran Kelly, Mar. 2000
	2000	X	(W)		provided by Ciaran Kelly, Mar. 2001
	2001			D	provided by Ciaran Kelly, Mar. 2002
	2002			D	provided by Ciaran Kelly, Mar. 2003
	2003			D	provided by Maurice Clarke, Mar. 2004
	2004			D	provided by Maurice Clarke, Mar. 2005
Sprat in IIIa					
spr_kask	1999	X	(W)		provided by Else Torstensen, Mar. 2000
	2000	X	(W)		provided by Else Torstensen, Mar. 2001
	2001	X	(W)		provided by Lotte Askgaard Worsøe, Mar. 2002
	2002	X	(W)		provided by Lotte Worsøe Clausen, Mar. 2003
	2003	X	(W)		provided by Lotte Worsøe Clausen, Mar. 2004
	2004	X	(W)		provided by Lotte Worsøe Clausen, Mar. 2005
Sprat in the North Sea					
spr_nsea	1999	X	(W)		provided by Else Torstensen, Mar. 2000
	2000	X	(W)		provided by Else Torstensen, Mar. 2001
	2001	X	(W)		provided by Lotte Askgaard Worsøe, Mar. 2002
	2002	X	(W)		provided by Lotte Worsøe Clausen, Mar. 2003
	2003	X	(W)		provided by Lotte Worsøe Clausen, Mar. 2004
	2004	X	(W)		provided by Lotte Worsøe Clausen, Mar. 2005
Sprat in VIId & e					
spr_ech	1999	X	(W)		provided by Else Torstensen, Mar. 2000
	2000	X	(W)		provided by Else Torstensen, Mar. 2001
	2001	X	(W)		provided by Lotte Askgaard Worsøe, Mar. 2002
	2002	X	(W)		provided by Lotte Worsøe Clausen, Mar. 2003
	2003	X	(W)		provided by Lotte Worsøe Clausen, Mar. 2004
	2004	X	(W)		provided by Lotte Worsøe Clausen, Mar. 2005
National Data					
Germany: Western Baltic	1991-2000	X			provided by Tomas Gröhsler, Mar. 2001 (with sampling)
Germany: North Sea	1995-1998		W		provided by Christopher Zimmermann, Mar 2001 (without sampling)
Norway: Sprat	1995-1998		W		provided by Else Torstensen, Mar 2001 (without sampling)
Sweden	1990-2000		W		provided by Johan Modin, Mar 2001 (without sampling)
UK/England & Wales	1985-2000	X			database output provided by Marinelle Basson, Mar. 2001 (without sampling)
UK/Scotland	1990-1998		W		provided by Sandy Robb/Emma Hatfield, Mar. 2002

Table 1.5.2 HAWG initial definitions for the new ICES InterCatch database. Note that definitions of fleets and fisheries are currently under development; the list provided here is not final.

1. General

Definitions should apply for all WGs and are therefore predefined (species, catchyear, date of submission/resubmission, nation, contact details, national fleet descriptions, sampling level, catch,...) and general consistency checking should apply

2. WG/Species specific input			**3. WG/Species specific validity check:**		
WGs should choose entry fields relevant for them from an exhaustive option list (to assure interWG operability)			***initial range for acceptance***		
Information type			**value min**	**value max**	**integ/text**
WG		**HAWG**			na
species		**herring (*Clupea harengus*)**			"herring"
area covered	lat min	na			na
	lat max	62			
	lon min	-18			
	lon max	13			
temporal res.	res 1	month?	1	12	
	res 2	quarter	1	4	
spatial resol.	res 1	ICES statistical rectangle (for CATON only)	20D2?	52G4?	
	res 2	HAWG (sub)-divisions (further defs with link to rectangles required): 22, 23, 24, IIIaN, IIIaS, IVaE, IVaW, IVb, IVb, VIaN, VIaS, VIIaN, VIIaS, VIIb, VIIc, VIId, VIIe, VIIf, VIIg, VIIh, VIIj, VIIk, VIIIa also: IVa, IIIa, 22-24, IVcVIId, Blackwater, Norwegian fjords and shelf, Clyde			one of those listed *check that sums rect-areas and month-quarter match!*
data required					
catch	unit 1	t	0.1	400000	if in t
	unit 2	kg	100	400000000	if in kg
disaggregation type 1		fleet			
fleet types	directed	all; freezer trawlers; trawlers and RSW trawlers; RSW purse seiners; drift netters; set nets/traps (static gear); others; unknown			one of those listed
	bycatch	human consumption *(if that doesn't duplicate info given elsewhere)*; industrial (by target spec?)			
disaggregation type 2		age			
data type 1		age	1	9	
	age unit	wr (winter rings); years			"wr"; "years" invalid, pls resubmit in wr
	age min	0			
	age max	8			
	+group	12			
data type 2		numbers	0		
	numbers unit	thousands (1000); millions (1000000)			
data type 3		mean mass			
	mass unit	kg; g	0.004	0.050	at age 0 *if in kg*
			0.008	0.180	at age 1
			0.030	0.200	at age 2
			0.050	0.240	at age 3
			0.070	0.260	at age 4
			0.090	0.300	at age 5
			0.090	0.300	at age 6
			0.100	0.350	at age 7
			0.100	0.350	at age 8
			0.100	0.400	at age 9
data type 4		mean total length			
	length unit	cm; 1/2 cm; mm	8.0	15.0	at age 0 *if in cm*
			10.0	30.0	at age 1
			12.0	32.0	at age 2
		info on how this is derived?	17.0	33.0	at age 3
		E.g. from 1/2 cm increment middles?	18.0	35.0	at age 4
			19.0	36.0	at age 5
			19.0	37.0	at age 6

			20.0	37.0	at age 7
			21.0	37.0	at age 8
			21.0	38.0	at age 9
derived data					
data 1		SoP (Sum of Products)			
	unit	%	75	125	
	procedure	=sumprod(canum age=0*mean mass age =0; ...;canum age=9+*mean mass age=9+)			

Table 1.5.2 cont'd HAWG initial definitions for the new ICES InterCatch database.

4. Stock specific splitting rules

a. for the splitting of WBSS and NSAS caught in the North Sea (basis: Norwegian samples-vertebrae counts):

i. for Q2 and Q3, calculate catch taken in the "transfer area" (43F3,F4,F5,F6,F7;44F3,F4,F5,F6; 45F3,F4,F5,F6;46F3,F4,F5;47F3,F4,F5)
ii. split catch for Q2: xx% of canum age=1 wr is WBSS, xx% of canum age=2 wr is WBSS, xx% of canum age=3 wr is WBSS, xx% of canum age=4-9+ wr is WBSS
iii. split catch for Q3: xx% of canum age=1 wr is WBSS, xx% of canum age=2 wr is WBSS, xx% of canum age=3 wr is WBSS, xx% of canum age=4-9+ wr is WBSS
iv. apply quarterly catch in number fraction for WBSS to catch in Q2 and Q3 in the transfer area

b. for the splitting of WBSS and NSAS caught in IIIa (basis: Danish and Swedish samples - otolith microstructures):

i. for Q1-4 calculate catch taken in subdiv. IIIaN (Skagerrak)
ii. split catch for Q1 IIIaN: xx% of canum age=1 wr is NSAS, xx% of canum age=2 wr is NSAS, xx% of canum age=3 wr is NSAS, xx% of canum age=4 wr is NSAS, xx% of canum age=5 wr is NSAS, xx% of canum age=6 wr is NSAS, xx% of canum age=7 wr is NSAS, xx% of canum age=8+ wr is NSAS
iii. split catch for Q2 IIIaN: xx% of canum age=1 wr is NSAS, xx% of canum age=2 wr is NSAS, xx% of canum age=3 wr is NSAS, xx% of canum age=4 wr is NSAS, xx% of canum age=5 wr is NSAS, xx% of canum age=6 wr is NSAS, xx% of canum age=7 wr is NSAS, xx% of canum age=8+ wr is NSAS
iv. split catch for Q3 IIIaN: xx% of canum age=0 wr is NSAS, xx% of canum age=1 wr is NSAS, xx% of canum age=2 wr is NSAS, xx% of canum age=3 wr is NSAS, xx% of canum age=4 wr is NSAS, xx% of canum age=5 wr is NSAS, xx% of canum age=6 wr is NSAS, xx% of canum age=7 wr is NSAS, xx% of canum age=8+ wr is NSAS
iv. split catch for Q4 IIIaN: xx% of canum age=0 wr is NSAS, xx% of canum age=1 wr is NSAS, xx% of canum age=2 wr is NSAS, xx% of canum age=3 wr is NSAS, xx% of canum age=4 wr is NSAS, xx% of canum age=5 wr is NSAS, xx% of canum age=6 wr is NSAS, xx% of canum age=7 wr is NSAS, xx% of canum age=8+ wr is NSAS
vi. apply quarterly catch in number fraction for NSAS to catch in Q1-4 in subdiv. IIIaN
vii. for Q1-4 calculate catch taken in subdiv. IIIaS (Kattegatt)
viii. split catch for Q1 IIIaS: xx% of canum age=1 wr is NSAS, xx% of canum age=2 wr is NSAS, xx% of canum age=3 wr is NSAS, xx% of canum age=4 wr is NSAS, xx% of canum age=5 wr is NSAS, xx% of canum age=6 wr is NSAS, xx% of canum age=7 wr is NSAS, xx% of canum age=8+ wr is NSAS
ix. split catch for Q2 IIIaS: xx% of canum age=1 wr is NSAS, xx% of canum age=2 wr is NSAS, xx% of canum age=3 wr is NSAS, xx% of canum age=4 wr is NSAS, xx% of canum age=5 wr is NSAS, xx% of canum age=6 wr is NSAS, xx% of canum age=7 wr is NSAS, xx% of canum age=8+ wr is NSAS
x. split catch for Q3 IIIaS: xx% of canum age=0 wr is NSAS, xx% of canum age=1 wr is NSAS, xx% of canum age=2 wr is NSAS, xx% of canum age=3 wr is NSAS, xx% of canum age=4 wr is NSAS, xx% of canum age=5 wr is NSAS, xx% of canum age=6 wr is NSAS, xx% of canum age=7 wr is NSAS, xx% of canum age=8+ wr is NSAS
xi. split catch for Q4 IIIaS: xx% of canum age=0 wr is NSAS, xx% of canum age=1 wr is NSAS, xx% of canum age=2 wr is NSAS, xx% of canum age=3 wr is NSAS, xx% of canum age=4 wr is NSAS, xx% of canum age=5 wr is NSAS, xx% of canum age=6 wr is NSAS, xx% of canum age=7 wr is NSAS, xx% of canum age=8+ wr is NSAS
xii. apply quarterly catch in number fraction for NSAS to catch in Q1-4 in subdiv. IIIaS

5. Stock extraction rules

stock 1 NSAS North Sea Autumn Spawning herring
div IIIa
plus subdiv IVaE Q1-4 minus WBSS resulting from splitting rule 4a above
plus subdiv. IVaW Q1-4 plus div. IVb Q1-4 plus div. IVc Q1-4 plus div. VIId Q1-4
stock 2 WBSS Western Baltic Spring Spawning herring
subdiv. 22, 23, 24 Q1-4
plus div. IIIa minus NSAS resulting from splitting rule 4b above
stock 3 SCOW Herring in VIa North
subdiv. VIaN Q1-4 (minus CLYDE Q1-4)
stock 4 IRLW Herring in VIa South, VIIb,c
subdiv. VIaS Q1-4 plus div. VIIb Q1-4 plus div. VIIc Q1-4
stock 5 IRLS Herring in the Celtic Sea and VIIk
subdiv. VIIaS plus div. VIIg Q1-4 plus div. VIIh Q1-4 plus div. VIIj Q1-4 plus div. VIIk Q1-4
stock 6 NIRS Herring in the Irish Sea
subdiv. VIIaN Q1-4
stock 7 NSSH Norwegian Spring Spawning Herring and local fjord-type herring
Norwegian fjords and shelf Q1-4
stock 8 CLYDE Clyde herring
Clyde Q1-4
stock 9 Blackwater herring (thames estuary)
Blackwater Q1-4
stock 10 OTHER
div. VIIe Q1-4 plus div. VIIf Q1-f plus div. VIIIc Q1-4

Table 1.5.3 HAWG comments to the sampling of North Sea Autumn Spawning Herring in 2004

<table>
<tr><td>Stock:</td><td>North Sea Autumn Spawning Herring</td></tr>
<tr><td>WG name:</td><td>Herring Assessment Working Group for the Area South of 62^0N</td></tr>
<tr><td colspan="2">WG data aggregation level:</td></tr>
<tr><td>Temporal and segmentation:</td><td>Spatial:</td></tr>
<tr><td>By quarter and fishery/métier</td><td>By ICES Div. or sub-Div.: IVaE, IVaW, IVb, IVc and VIId, catch by rectangle</td></tr>
<tr><td colspan="2">DCR data aggregation level:</td></tr>
<tr><td>Temporal and segmentation:</td><td>Spatial:</td></tr>
<tr><td>By quarter and fishing technique</td><td>By ICES Division</td></tr>
<tr><td colspan="2">WG comments to the data quality:</td></tr>
<tr><td colspan="2">The working group has evaluated the spatial coverage of the level of catch sampling by area for all herring stocks covered by HAWG. It was indicated that the sampling level (in terms of fraction of catch sampled and number of age readings per 1000 t catch) is different for the various areas
Given the diversity of the fleets harvesting North Sea Autumn Spawning herring, an appropriate spread of sampling effort over the different fisheries/métiers is important to ensure the quality of the catch at age data The EU data directive (Commission Regulation 1639/2001) does not warrant this. The WG therefore recommends that all fisheries/métiers with substantial catch should be sampled (including by-catches in the industrial fisheries) and that catches landed in foreign ports should be sampled and information on these samples be made available to the national laboratories of the vessel's flag state.
Most of the issues raised her have also been addressed by the Planning Group on Commercial Catch, Discard and Biological Sampling at its meeting in 2004.</td></tr>
<tr><td colspan="2">WG comments to data requirements:</td></tr>
<tr><td colspan="2">As the advice on exploitation of the marine fish and shellfish stocks gradually changes from single species advice to multispecies/mixed fisheries advice, it is necessary to obtain catch-at-age information by fishery/metier. To facilitate this, HAWG has defined the fisheries that exploit the herring stocks which are assessed by the WG
It is recommended to the regional fisheries data collection coordination and co-operation groups and to the national laboratories to take the WG suggestions for the definition of fisheries into account when setting up sampling schemes for 2005.
It should be noted that this fishery/metier definition is on a lower level of aggregation than defined in the EU data directive. In order to be able to derive multi-fisheries advice it will be necessary to harmonise the data directive accordingly.</td></tr>
<tr><td>Completed by:</td><td>Jørgen Dalskov</td></tr>
</table>

Table 1.5.4 HAWG comments to the sampling of Herring in Division IIIa and the Western Baltic area.

<table>
<tr><td>Stock:</td><td colspan="2">Herring in Division IIIa and the Western Baltic area</td></tr>
<tr><td>WG name:</td><td colspan="2">Herring Assessment Working Group for the Area South of 62^{0}N</td></tr>
<tr><td colspan="3">WG data aggregation level:</td></tr>
<tr><td colspan="2">Temporal and segmentation:</td><td>Spatial:</td></tr>
<tr><td colspan="2">By quarter and fishery/métier</td><td>By ICES Sub-division: IIIaN and IIIaS</td></tr>
<tr><td colspan="3">DCR data aggregation level:</td></tr>
<tr><td colspan="2">Temporal and segmentation:</td><td>Spatial:</td></tr>
<tr><td colspan="2">By quarter and fishing technique</td><td>By ICES Division</td></tr>
<tr><td colspan="3">WG comments to the data quality:</td></tr>
<tr><td colspan="3">Given the diversity of the fleets harvesting this stock the HAWG recommends that an appropriate spread of sampling effort over the different fisheries/métiers is important to the quality ensure the estimates of catch at age data The EU data directive (Commission Regulation 1639/2001) appears not ensure this. The WG therefore recommends that all fisheries/métiers with substantial catch should be sampled (including by-catches in the industrial fisheries) and that catches landed abroad should be sampled and information on these samples should be made available to the national laboratories.</td></tr>
<tr><td colspan="3">WG comments to data requirements:</td></tr>
<tr><td colspan="3">As the advice on exploitation of the marine fish and shell fish stocks gradually changes from single species advice to multi fisheries advice, it is necessary to have data by fishery/metier. As a first step the HAWG has defined the fisheries that exploit the herring stocks which are assessed by the WG
The regional fisheries data collection coordination and co-operation groups as well as the national laboratories are recommended to take the WG suggestion for fishery definition into account when setting up sampling schemes for 2006.
It should be noticed that this fishery/metier definition is on a lower level of aggregation than prescribed in the EU data directive. In order to be able to give multi fisheries advice it is necessary to harmonize the data directive accordingly.</td></tr>
<tr><td>Completed by:</td><td colspan="2">Jørgen Dalskov</td></tr>
</table>

Table 1.5.5 HAWG comments to the sampling of Herring in Division VIa North

<table>
<tr><td>Stock:</td><td colspan="2">Herring in Division VIa (North)</td></tr>
<tr><td>WG name:</td><td colspan="2">Herring Assessment Working Group for the Area South of 62^0N</td></tr>
<tr><td colspan="3">WG data aggregation level:</td></tr>
<tr><td colspan="2">Temporal and segmentation:</td><td>Spatial:</td></tr>
<tr><td colspan="2">By quarter and fishery/métier</td><td>By ICES Sub-division</td></tr>
<tr><td colspan="3">DCR data aggregation level:</td></tr>
<tr><td colspan="2">Temporal and segmentation:</td><td>Spatial:</td></tr>
<tr><td colspan="2">By quarter and fishing technique</td><td>By ICES Division: VIa (North)</td></tr>
<tr><td colspan="3">WG comments to the data quality:</td></tr>
<tr><td colspan="3">The number of samples used to allocate an age-distribution for the VIa (N) catches has steadily decreased from 52 in 2002, 37 in 2003 down to 10 in 2004. This is due to two problems;
iii. The difficulty of targeting sampling on vessels that fish in this area because these vessels fish in other herring areas and there may be no prior knowledge of the fishing intentions of the vessel before departure from port.
iv. The area misreporting recorded of catch taken in other in other areas and reported as VIa (N) can result in successfully collected samples being subsequently reallocated correctly to their true area thus loosing numbers of samples from the sampling program.
In the past concern has been raised over the quality of sampling of commercial catch. It was suggested in the 2001 ACFM technical minutes that an analysis of catch by quarter and country might shed some light on the variability in the catch information. In practice the fishery is often dominated by a single quarter catch, and a single country dominates sampling. Thus such an analysis is impossible. Although sampling is relatively poor the analysis indicated that sampling for age information was not the major source of variability in the assessment at that stage.</td></tr>
<tr><td colspan="3">WG comments to data requirements:</td></tr>
<tr><td colspan="3">As the advice on exploitation of the marine fish and shell fish stocks gradually changes from single species advice to multi fisheries advice, it is necessary to have data by fishery/metier. As a first step the HAWG has defined the fisheries that exploit the herring stocks which are assessed by the WG
The regional fisheries data collection coordination and co-operation groups as well as the national laboratories are recommended to take the WG suggestion for fishery definition into account when setting up sampling schemes for 2006.
It should be noted the mixing of species in this fishery is not perceived as a problem in VIa (N) and is not a consideration.</td></tr>
<tr><td colspan="3">PGCCDBS comments to improvement of the data collection:</td></tr>
<tr><td colspan="3">Closer cooperation in sampling between England, Germany, Netherlands and France (freezer trawler fleet) and an increase in sampling from Scotland.</td></tr>
<tr><td>Completed by:</td><td colspan="2">Stephen Keltz</td></tr>
</table>

Table 1.5.6 **HAWG comments to the sampling of Herring in Division VIa South and VIIbc.**

<table>
<tr><td>Stock:</td><td colspan="2">Herring in Division VIa (South) and VIIb,c</td></tr>
<tr><td>WG name:</td><td colspan="2">Herring Assessment Working Group for the Area South of 62^{0}N</td></tr>
<tr><td colspan="3">WG data aggregation level:</td></tr>
<tr><td colspan="2">Temporal and segmentation:</td><td>Spatial:</td></tr>
<tr><td colspan="2">By quarter and fishery/métier</td><td>By ICES Sub-division: Via (South), VIIb,c</td></tr>
<tr><td colspan="3">DCR data aggregation level:</td></tr>
<tr><td colspan="2">Temporal and segmentation:</td><td>Spatial:</td></tr>
<tr><td colspan="2">By quarter and fishing technique</td><td>By ICES Division</td></tr>
<tr><td colspan="3">WG comments to the data quality:</td></tr>
<tr><td colspan="3">The management of the Irish fishery in recent years has tightened considerably and the accuracy of reported catches in recent years is believed to have improved. The level of sampling is quite high relative to three years ago. There is a need, however, to achieve a better coverage of VIIb, especially in the first quarter. Also, better coverage of large RSW trawlers that target this stock spasmodically is required.</td></tr>
<tr><td colspan="3">WG comments to data requirements:</td></tr>
<tr><td colspan="3">IT is vitally important that historic and current catch data for herring in industrial fisheries in this area be made available. This may account for considerable unknown mortality.</td></tr>
<tr><td colspan="3">PGCCDBS comments to improvement of the data collection:</td></tr>
<tr><td colspan="3">The DCR has to be changed so it has the same segmentation as required by the ICES Assessment Working Group.</td></tr>
<tr><td>Completed by:</td><td colspan="2">Maurice Clarke</td></tr>
</table>

Table 1.5.7 HAWG comments to the sampling of Herring in Division VIIa North.

<table>
<tr><td>Stock:</td><td colspan="2">Herring in Division VIIa (North)</td></tr>
<tr><td>WG name:</td><td colspan="2">Herring Assessment Working Group for the Area South of 62^0N</td></tr>
<tr><td colspan="3">WG data aggregation level:</td></tr>
<tr><td colspan="2">Temporal and segmentation:</td><td>Spatial:</td></tr>
<tr><td colspan="2">By quarter and fishery/métier</td><td>By ICES Sub-division: VIIa</td></tr>
<tr><td colspan="3">DCR data aggregation level:</td></tr>
<tr><td colspan="2">Temporal and segmentation:</td><td>Spatial:</td></tr>
<tr><td colspan="2">By quarter and fishing technique</td><td>By ICES Division</td></tr>
<tr><td colspan="3">WG comments to the data quality:</td></tr>
<tr><td colspan="3">There was a suggestion that the landings data for herring in Division VIIa(N) were un-reliable between 1998 and 2001. A re-examination of these data by the institute where most of the landings occur, resulted in the conclusion that the landings data for this time period are no more un-reliable than landings data in any adjacent management area. There are still no estimates of discarding or slippage of herring in the Irish Sea fisheries that target herring. Biological sampling of this fishery remains high (approximately 1 sample per 270 t landed, however, there is a suggestion that there may need to be some revisions for the 2003 data. All sampling was undertaken by Northern Ireland.</td></tr>
<tr><td colspan="3">WG comments to data requirements:</td></tr>
<tr><td colspan="3">As the advice on exploitation of the marine fish and shell fish stocks gradually changes from single species advice to multi fisheries advice, it is necessary to have data by fishery/metier. As a first step the HAWG has defined the fisheries that exploit the herring stocks which are assessed by the WG
The regional fisheries data collection coordination and co-operation groups as well as the national laboratories are recommended to take the WG suggestion for fishery definition into account when setting up sampling schemes for 2005.
It should be noticed that this fishery/metier definition is on a lower level of aggregation than prescribed in the EU data directive. In order to be able to give multi fisheries advice it is necessary to harmonize the data directive accordingly.</td></tr>
<tr><td colspan="3">PGCCDBS comments to improvement of the data collection:</td></tr>
<tr><td colspan="3">The DCR has to be changes so it has the same segmentation as required by the ICES Assessment Working Group.</td></tr>
<tr><td>Completed by:</td><td colspan="2">Jørgen Dalskov</td></tr>
</table>

Table 1.5.8 HAWG comments to the sampling of Herring in the Celtic Sea

Stock:	Herring in the Celtic Sea
WG name:	Herring Assessment Working Group for the Area South of 62^0N
WG data aggregation level:	
Temporal and segmentation:	**Spatial:**
By quarter and fishery/métier	By ICES Sub-division: VIIaS, VIIg and VIIj.
DCR data aggregation level:	
Temporal and segmentation:	**Spatial:**
By quarter and fishing technique	By ICES Division
WG comments to the data quality:	
Data quality are very good, with high level of sampling. This is achieved by collaboration with fishermen and processors. The fact that the assessment is conducted during the period when the fishery is still open and sampling continues right up to the time of the group means that it is difficult to turn Q1 in year samples into data in sufficient time.	
WG comments to data requirements:	
It is essential to get historic and current evaluations of the level of freezer trawler effort, mainly French, especially in VIIj.	
PGCCDBS comments to improvement of the data collection:	
The DCR has to be changed so it has the same segmentation as required by the ICES Assessment Working Group.	
Completed by:	Maurice Clarke

Table 1.5.9 HAWG comments to the sampling of sprat in the North Sea

<table>
<tr><td>Stock:</td><td colspan="2">Sprat in the North Sea</td></tr>
<tr><td>WG name:</td><td colspan="2">Herring Assessment Working Group for the Area South of 62^{0}N</td></tr>
<tr><td colspan="3">WG data aggregation level:</td></tr>
<tr><td colspan="2">Temporal and segmentation:</td><td>Spatial:</td></tr>
<tr><td colspan="2">By quarter and fishery/métier</td><td>By ICES Division:</td></tr>
<tr><td colspan="3">DCR data aggregation level:</td></tr>
<tr><td colspan="2">Temporal and segmentation:</td><td>Spatial:</td></tr>
<tr><td colspan="2">By quarter and fishing technique</td><td>By ICES rectangle</td></tr>
<tr><td colspan="3">WG comments to the data quality:</td></tr>
<tr><td colspan="3">The sampling level in 2004 was lower than in previous years. In Denmark the provisions in the EU regulation 1639/2001 have been implemented. This provision requires 1 sample per 2000 tonnes landed. This sampling level is lower than the guidelines (1 sample per 1000 tonnes) previously used by the HAWG, but as the fishery was carried out in a limited area, the recommended sampling level can be regarded as adequate.
The recommended sampling levels for species composition were achieved.</td></tr>
<tr><td colspan="3">WG comments to data requirements:</td></tr>
<tr><td colspan="3">As the advice on exploitation of the marine fish and shell fish stocks gradually changes from single species advice to multi fisheries advice, it is necessary to have data by fishery/metier. As a first step the HAWG has defined the fisheries that exploit the herring stocks which are assessed by the WG
The regional fisheries data collection coordination and co-operation groups as well as the national laboratories are recommended to take the WG suggestion for fishery definition into account when setting up sampling schemes for 2006.
It should be noticed that this fishery/metier definition is on a lower level of aggregation than prescribed in the EU data directive. In order to be able to give multi fisheries advice it is necessary to harmonize the data directive accordingly.</td></tr>
<tr><td colspan="3">PGCCDBS comments to improvement of the data collection:</td></tr>
<tr><td colspan="3">The DCR has to be changed so it has the same segmentation as required by the ICES Assessment Working Group.</td></tr>
<tr><td>Completed by:</td><td colspan="2">Lotte Worsøe Clausen</td></tr>
</table>

Table 1.5.10 HAWG comments to the sampling of sprat in Division IIIa

Stock:	Sprat in Division IIIa
WG name:	Herring Assessment Working Group for the Area South of 62^0N
WG data aggregation level:	
Temporal and segmentation:	**Spatial:**
By quarter and fishery/métier	By ICES Sub-division: IIIaN and IIIaS
DCR data aggregation level:	
Temporal and segmentation:	**Spatial:**
By quarter and fishing technique	By ICES Division
WG comments to the data quality:	
The sampling level in 2004 was lower than in previous years. In Denmark the provisions in the EU regulation 1639/2001 have been implemented. This provision requires 1 sample per 2000 tonnes landed. This sampling level is lower than the guidelines (1 sample per 1000 tonnes) previously used by the HAWG, but as the fishery was carried out in a limited area, the recommended sampling level can be regarded as adequate. The recommended sampling levels for species composition were achieved.	
WG comments to data requirements:	
As the advice on exploitation of the marine fish and shell fish stocks gradually changes from single species advice to multi fisheries advice, it is necessary to have data by fishery/metier. As a first step the HAWG has defined the fisheries that exploit the herring stocks which are assessed by the WG The regional fisheries data collection coordination and co-operation groups as well as the national laboratories are recommended to take the WG suggestion for fishery definition into account when setting up sampling schemes for 2006. It should be noticed that this fishery/metier definition is on a lower level of aggregation than prescribed in the EU data directive. In order to be able to give multi fisheries advice it is necessary to harmonize the data directive accordingly.	
PGCCDBS comments to improvement of the data collection:	
The DCR has to be changed so it has the same segmentation as required by the ICES Assessment Working Group.	
Completed by:	Lotte Worsøe Clausen

Table 1.7.1 Sampling of the pelagic fleet by country, quarter and area for the North Sea (area IV) and area VIId. No. trip = number of trips. Total hauls = total number of hauls sampled. Herring hauls = total number of hauls sampled with herring catches (landings and/or discards) on a discard observer trip.

Country	Quarter	Area	No. trips	Total hauls	Herring hauls
Germany	1	IVa	2	8	1
Denmark*	1	IVa	8	8	4
Scotland	1	IVa	2	2	0
Denmark	2	IVa	17	17	0
Germany	3	IVa	1	26	26
Netherlands	3	IVa	1	31	31
Denmark	3	IVa	3	3	1
Scotland	3	IVa	9	18	18
Scotland	4	IVa	11	28	8
England*	1	IVb	5	52	35
Denmark	1	IVb	8	8	4
England	2	IVb	6	29	26
Denmark	2	IVb	12	12	0
Germany	3	IVb	1	24	24
Netherlands	3	IVb	1	35	35
Denmark	3	IVb	8	8	0
Scotland	3	IVb	2	4	4
England	1	IVc	1	6	5
Netherlands	4	IVc	1	3	3
Germany	4	VIId	2	44	42
Netherlands	4	VIId	1	46	19
	Total		**76**	**412**	**266**

*** Denmark does not sample pelagic vessels for discards. All observations in the table are from demersal and lobster fisheries with herring catches. Industrial fisheries are not included.**

*** All English samples in the table are taken from several different pelagic and demersal fisheries.**

Table 1.7.2 **Sampling of the pelagic fleet by country, quarter and area for the remaining areas covered by the national sampling programmes within HAWG. No. trip = number of trips. Total hauls = total number of hauls sampled. Herring hauls = total number of hauls sampled with herring catches (landings and/or discards) on a discard observer trip.**

Country	Quarter	Area	No. trips	Total hauls	Herring hauls
Faroes	-	-	-	0	0
Ireland	-	-	-	0	0
Sweden*	-	-	-	0	0
Denmark*	1	IIIa	21	21	11
Denmark	2	IIIa	16	16	4
Denmark	3	IIIa	19	19	6
Denmark	4	IIIa	6	6	1
Germany	1	VIa	2	21	0
Netherlands	1	VIa	2	31	0
Scotland	1	VIa	3	8	1
Netherlands	2	VIa	1	21	0
Scotland	3	VIa	1	2	2
Germany	2	VIIb	1	20	0
Netherlands	1	VIIb	1	22	0
Scotland	1	VIIb	1	4	0
Netherlands	1	VIIc	1	1	0
Germany	4	VIIe	1	5	0
Netherlands	4	VIIe	2	13	0
Germany	4	VIIh	1	24	0
Netherlands	4	VIIh	1	10	0
Germany	1	VIIj	2	15	0
	Total		**82**	**259**	**25**

*** Sweden is not required to sample discarding due to prior evidence that the discarding of herring catches are negligible by their fleet.**

*** Denmark does not sample pelagic vessels for discards. All observations in the table are from demersal and lobster fisheries with herring catches. Industrial fisheries are not included.**

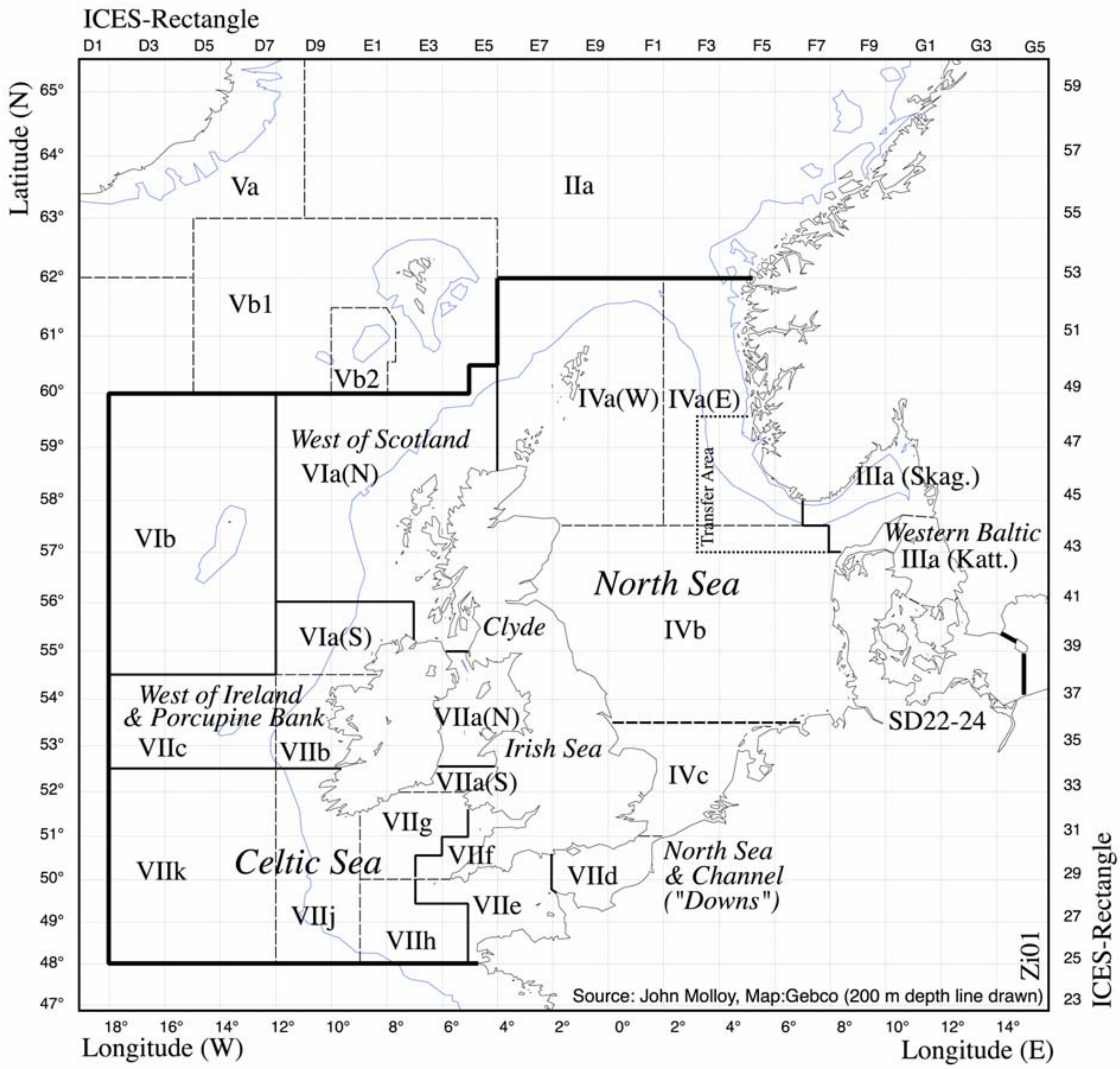


Figure 1.5.1 ICES areas as used for the assessment of herring stocks south of 62°N. Area names in italics indicate the separation used for long term storage of comer cial catch and sampling data. "Transfer area" refers to the transfer of Western Baltic Spring Spawners caught in the North Sea to the Baltic Assessment.

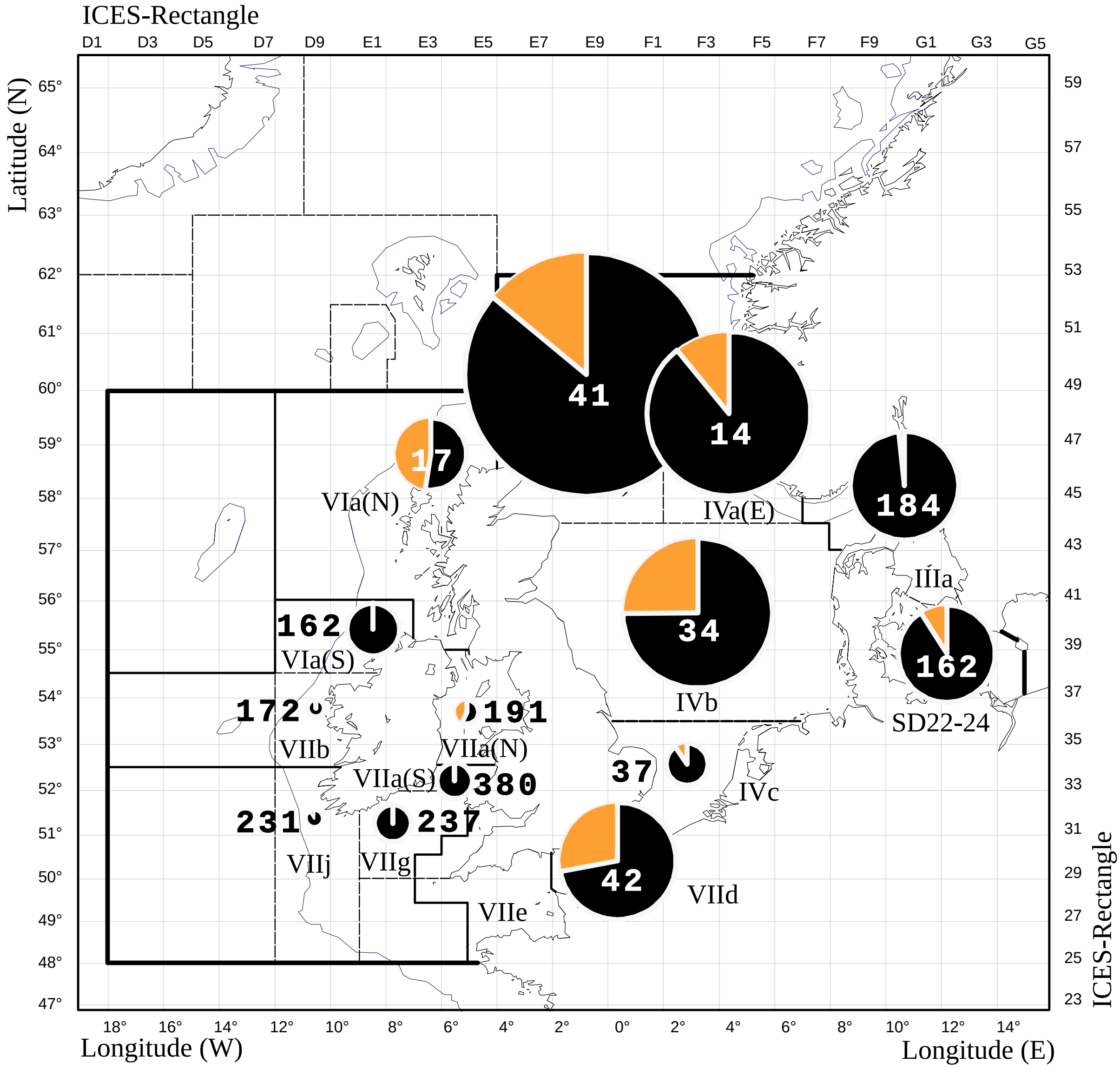
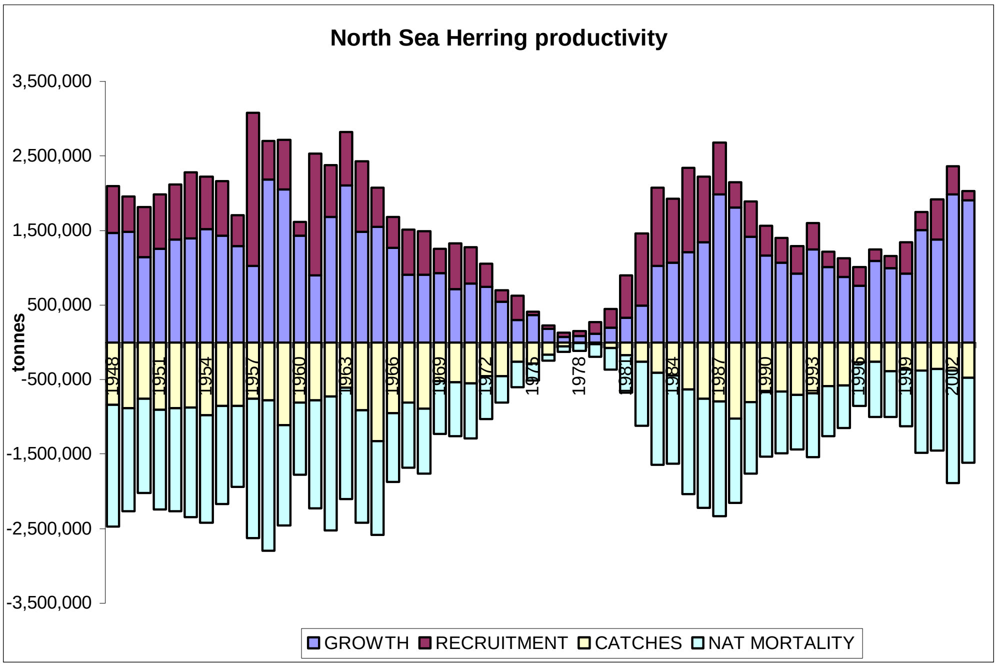


Figure 1.5.2 Herring south of 62°N: Sampling level per ICES areas for the whole year and all fleets in 2004. Circle diameter is proportional to working group catch; share of sampled catch (black) is indicated. Numbers give the numbers of age readings per 1000 t catch. For the allocation of areas to stocks, see Fig. 1.5.1



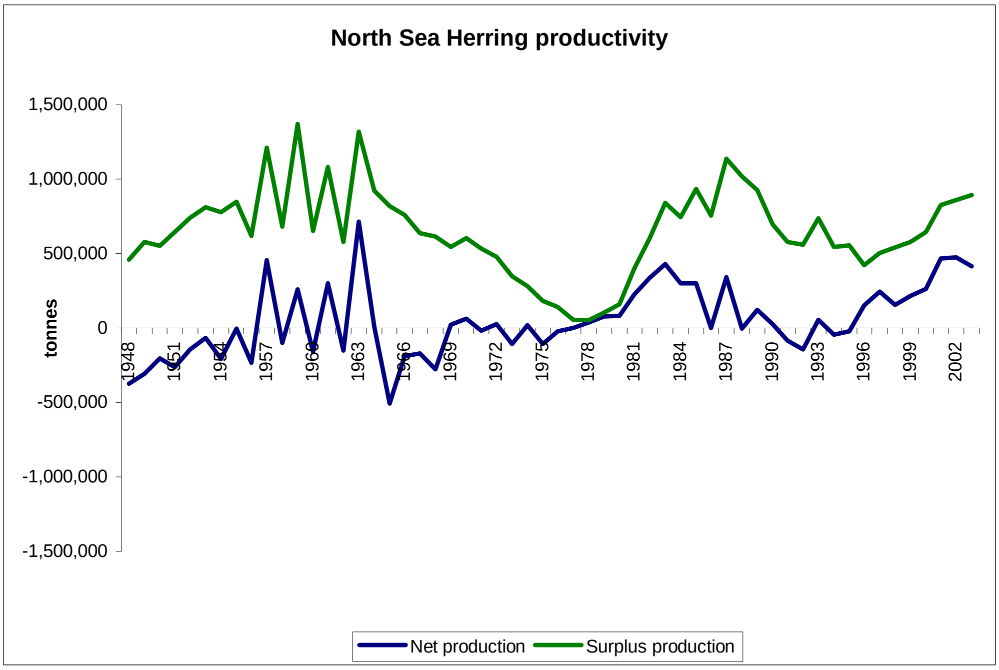
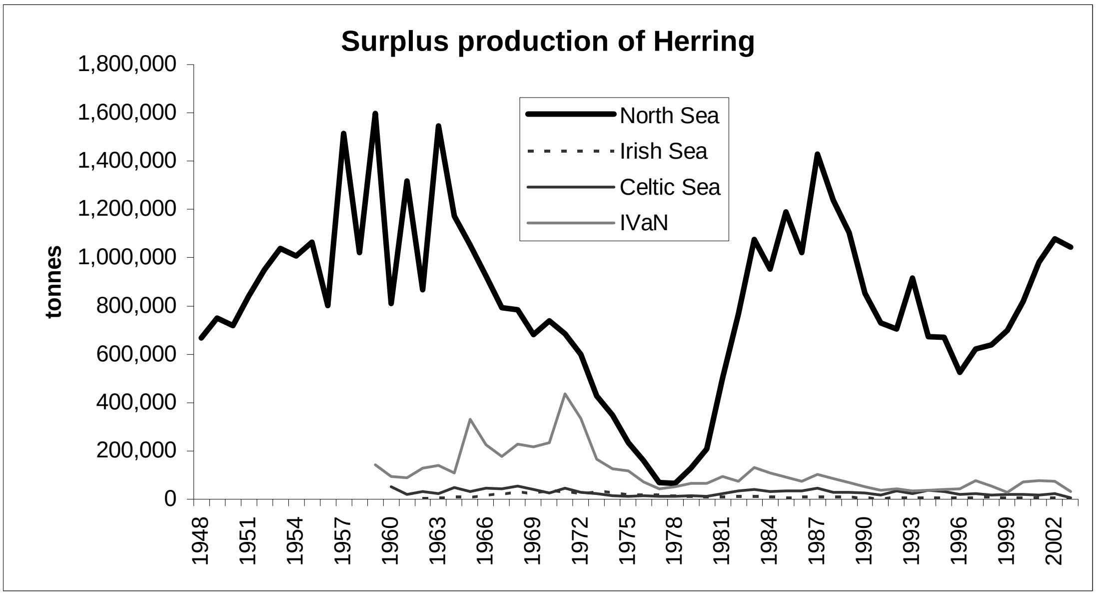


Figure 1.8.1 North Sea Autumn spawners. Productivity of North Sea herring from 1947 to 2003. Net production is the sum of the biomass estimates in the top panel, whereas surplus is the production without fishing.



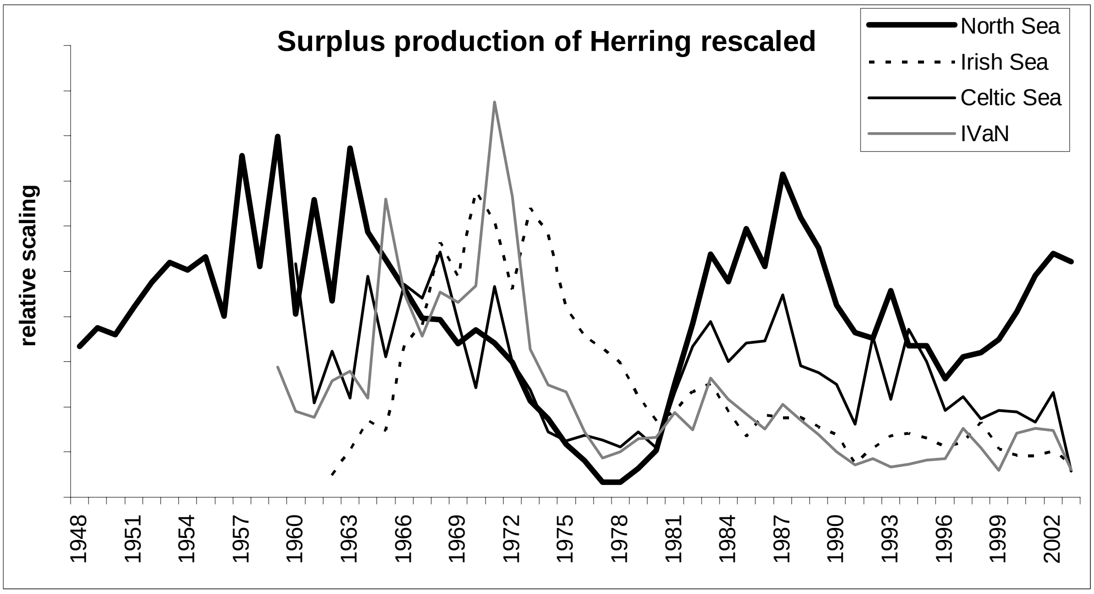


Figure 1.8.2 **North Sea Autumn spawners. Comparison of surplus of North Sea, IVaN, Celtic Sea and Irish Sea herring in biomass and with a relative scaling to compare the dynamics.**

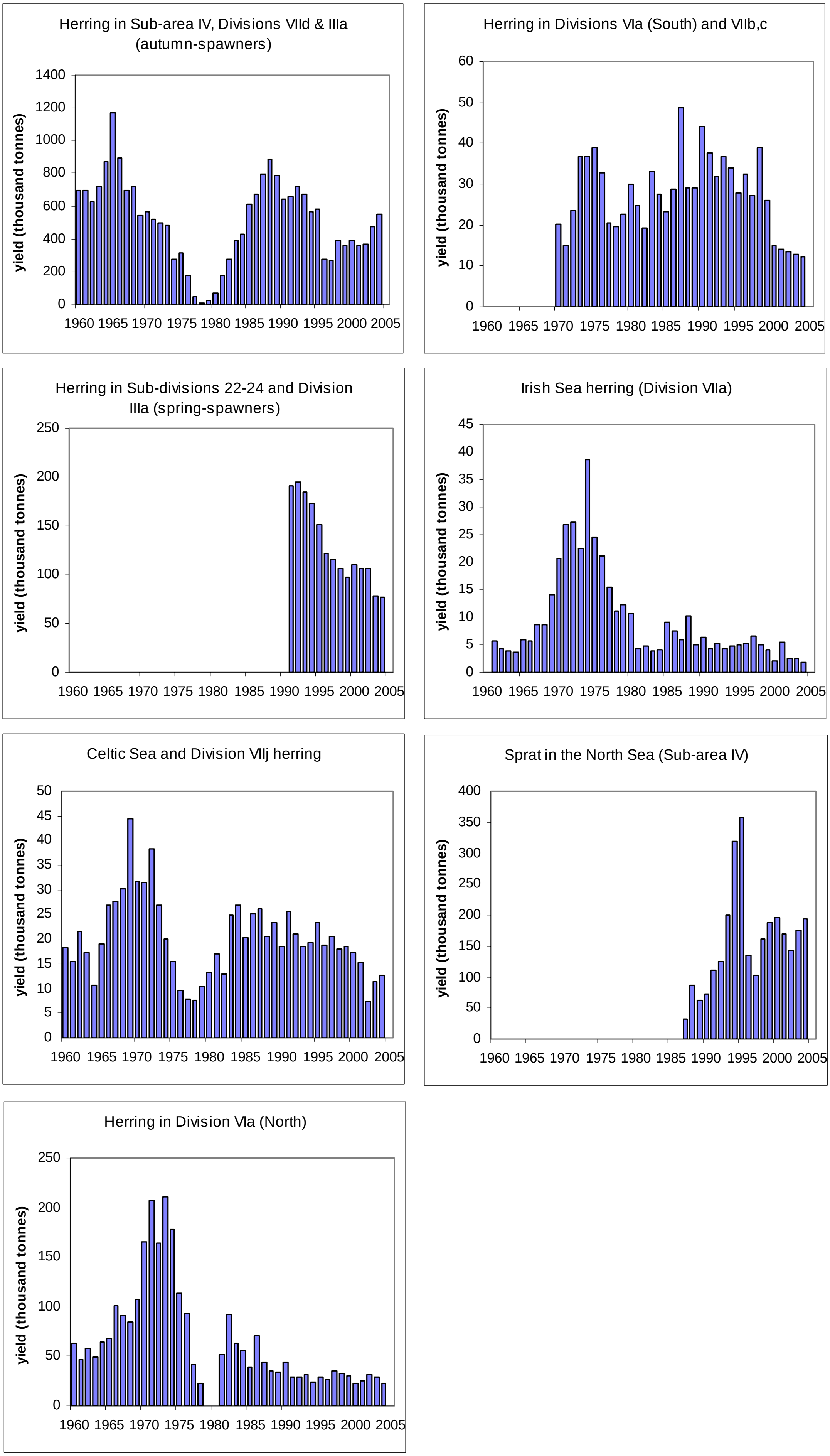


Figure 1.9.1 WG estimates of catch (yield) of the stocks presented in HAWG 2005.

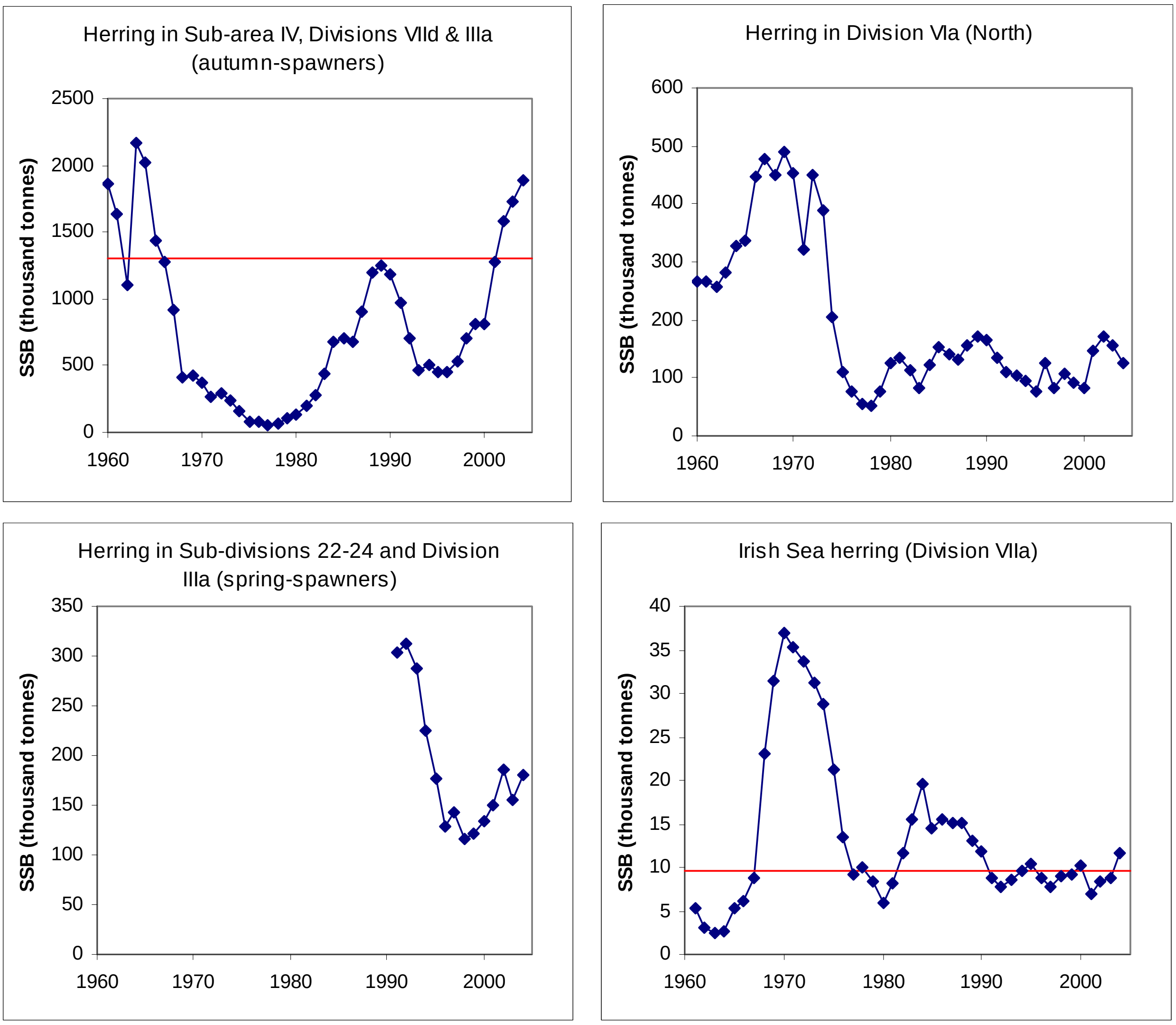


Figure 1.9.2 Spawning stock biomass estimates of the 4 stocks for which analytical assessments were presented in HAWG 2005. The B_{pa} level (if defined) is indicated in the graphs.

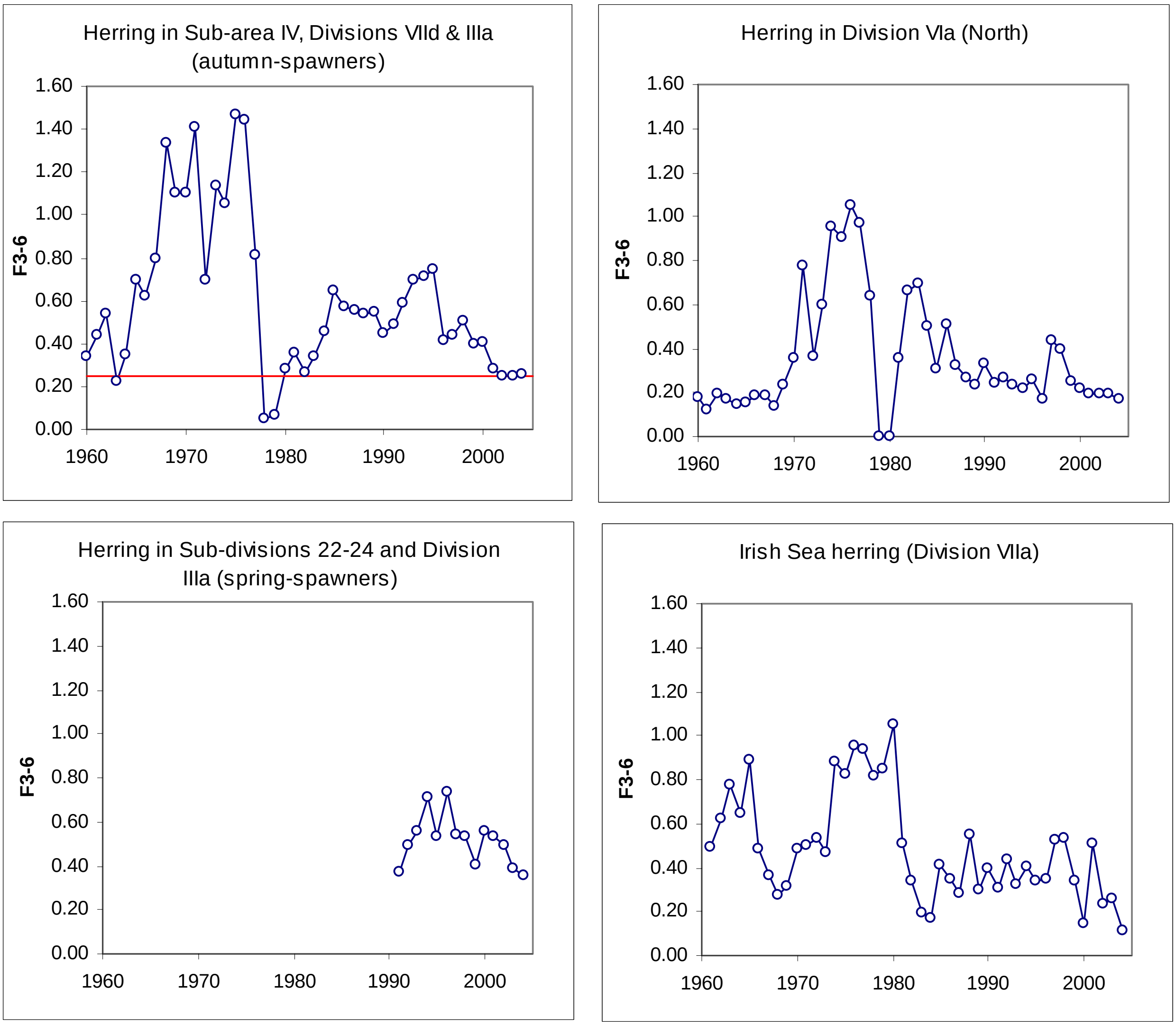


Figure 1.9.3 **Estimates of mean F of the 4 stocks for which analytical assessments were presented in HAWG 2005. The F_{pa} level (if defined) is indicated in the graphs.**

2 North Sea Herring

2.1 The Fishery

2.1.1 ACFM advice and management applicable to 2003 and 2004

According to the management scheme agreed between the EU and Norway, adopted in December 1997 and last amended in November 2004, efforts should be made to maintain the SSB of North Sea Autumn Spawning herring above 800,000 tonnes. An SSB reference point of 1.3 million has been set (=$\mathbf{B}_{pa}$) above which the TACs will be based on an F= 0.25 for adult herring and F= 0.12 for juveniles. If the SSB falls below 1.3 million tonnes, the fishing mortality will have to be linearly reduced. A TAC deviation of more than 15% between two subsequent years should be avoided, however, the TAC might be reduced by more than 15% if the parties consider this appropriate.

Since 2002, the SSB is considered to have been above $\mathbf{B}_{pa}$. From then on, ACFM gave fleet-wise catch option tables for fishing mortalities within the constraints of the EU-Norway management scheme. The advice for a sub-TAC on catches in IVc and VIId for 2004 was that it should not increase faster than the TAC for the North Sea as a whole. ACFM thought that a share of 11% on the total North Sea TAC (average share 1989-2002) would be an appropriate guide to distributing the harvesting of Downs herring.

It was expected that fishing at the recommended level would lead to a further increase in the SSB in the short term, mainly due to large recruiting year classes entering the fishery. ACFM noted, however, that catches would have to be reduced from 2006 on to account for the weak year classes seen since 2001.

The final TAC adopted by the management bodies for 2004 was 460,000 t for Area IV and Division VIId, whereof not more than 66,098 t should be caught in Division IVc and VIId. For 2005, the TAC was raised to 535,000 t (by 16%) and the sub-TAC set for Division IVc and VIId was raised to 74,293 t (by 12%, representing a share of almost 14% on the total TAC). Catches of herring in the Thames estuary are not included in the TAC. The by-catch ceiling set for fleet B in the North Sea was 38,000 t for 2004 and was increased by 32% to 50,000 t for 2005. As North Sea autumn spawners are also caught in Division IIIa, regulations for the fleets operating in this area have to be taken into account for the management of the stock (see Section 3). For a definition of the different fleets harvesting North Sea herring see the stock annex and Section 2.7.2.

Following the apparent recovery of the North Sea Autumn Spawning herring, some regulatory measures have been amended in 2004: The total Norwegian quota and half of the EU quota for Division IIIa could be taken in the North Sea. UK/Scotland relaxed its licensing scheme which was put in place in 1997 to reduce misreporting between the North Sea and VIaN. The minimal amount of target species in the EU industrial fisheries in IIIa has been reduced to 50% (for sprat, blue whiting and Norway pout). It is at present unclear whether all of these amendments will be kept for 2005; for Division IIIa, Norway can only take half of its quota in the North Sea, and there is no flexibility for EU vessels.

2.1.2 Catches in 2004

Total landings and estimated catches are given in the Table 2.1.1 for the North Sea and for each Division in Tables 2.1.2 to 2.1.5. Total working group catches per statistical rectangle and quarter are shown in Figures 2.1.1 a-d, the total for the year in Figure 2.1.1e. Each nation provided most of their catch data (either official landings or working group catch) by statistical rectangle.

The catch figures in Tables 2.1.1 – 2.1.5 are mostly provided by WG members and may or may not reflect national catch statistics. These figures can therefore **not** be used for legal purposes. For corrections applied to and inconsistencies in previous year's data see Section 2.2.3. Denmark and Norway provided information on by-catches of herring in the industrial fishery. These are taken in the small-meshed fishery (B-fleet) under a EU quota by Denmark and are included in the A-fleet figures for Norway. Catch estimates of herring taken as by-catch by other small-mesh fisheries in the North Sea may be an underestimate. The total catch in 2004 as used by the Working Group amounted to 550,100 t. Following the raising of the TAC for herring caught in the North Sea by 15%, the total catch increased by more than 22% compared to last year. By area, catches increased in Division IVa (East) by about 43%, in IVa (West) by 20%, in IVb by 26%, and by only 1% in the southern North Sea (Division IVc and VIId), while the sub-TAC for the latter area was raised by 11%.

Landings of herring taken as by-catch in the Danish small-meshed fishery in the North Sea were much lower than the by-catch ceiling set for Denmark (38,000 t), and have increased by 11% to 13,586 t as compared to last year (Table 2.1.6). In 2004, the Danish sprat fishery was carried out mainly in the second half of the year with by-catches of herring of about 5% (10,100 t). Herring by-catches in the Danish Norway pout fishery were estimated to be less than 8% (700 t), less than 0.9 % in the sandeel fishery (2,400 t) and 3 % in other industrial fisheries (700 t). In the Norwegian industrial fishery, herring by-catch has increased from 3,809 t last year to 4,984 t, mostly due to a relatively high bycatch in the Norway pout and blue whiting fishery in the first quarter. The quarterly distribution of herring by-catches in the Norwegian industrial fishery and its relative share on the total industrial landings are given in the text table below. These figures are counted against the human consumption quota.

Quarter 1	Quarter 2	Quarter 3	Quarter 4	Total
3,502 t	423 t	626 t	434 t	4,984 t
27.9 %	0.6 %	1.5 %	2.4 %	3.5 %

Misreporting of landings taken in the North Sea but reported from other areas such IIa and IIIa, and again from VIaN have significantly increased in 2004. However, while the Norwegian catch officially reported for IIIa is believed to have been taken in the North Sea since 1995, there have been real Norwegian catches in IIIa this year. The estimates of the total amount of misreported (including within-area misreporting) and unallocated catches have increased to about 66,000 t (roughly 12% of the total catch in the North Sea).

Based on WG estimates of total catch, TACs for the human consumption fishery in Subarea IV and Division VIId have been significantly exceeded for several years. This appears to have continued in 2004, when the over catch of TAC was almost doubled to 77,000 t compared to 2003. In the past, the largest relative discrepancies between officially reported landings and WG catch occurred in Division IVc and VIId, where TACs were exceeded by almost 100% between 1996 and 2001 (when the sub-TAC was set to 25,000 t). This has apparently changed in 2004, when the over catch of TAC in the southern North Sea and the Eastern Channel was reduced to only 4%. The majority of excess catch is now taken in IVa and IVb.

The total North Sea TAC excess for the years 1995 to 2004 is shown in the table below (adapted from Table 2.1.6). Since the introduction of yearly by-catch ceilings in 1996, these ceilings have never been exceeded.

Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
TAC HC (‘000 t)	440	156	159	254	265	265	265	265	400	460
“Official” landings HC (‘000 t)[1]	443	170	162	253	275	267	275	282	414	484
Working Group catch HC (‘000 t)	449	196	226	324	318	328	303	331	438	537
Excess of landings over TAC HC (‘000 t)	9	40	67	70	53	63	38	66	38	77
By-catch ceiling (‘000 t) [3]		44	24	22	30	36	36	36	52	38
Reported by-catches (‘000 t) [4]	67	38	13	14	15	18	20	22	12	14
Working Group catch North Sea (‘000 t)	516	233	238	338	333	346	323	353	450	550

HC = human consumption fishery

[1] *“Official” landings might be provided by WG members; they do not in all cases correspond to official catches and cannot be used for management purposes. Norwegian by-catches included in this figure.*

[2] *figure altered in 2000 on the basis of a re-evaluation of misreported catches from VIa North.*

[3] *by-catch ceiling for EU industrial fleets only, Norwegian by-catches included in the HC figure.*

[4] *provided by Denmark only.*

2.2 Biological composition of the catch

Biological information (numbers, weight, length, catch (SOP) at age and relative age composition) on the catch as obtained by sampling of commercial catches is given for the whole year and per quarter in Tables 2.2.1 to 2.2.5. Where available, data are displayed separately for herring caught in the North Sea (including a minor amount of Western Baltic Spring-spawners taken in IVa East), IVa East (total; Western Baltic Spring spawners [WBSS] only – see Section 2.2.2; North Sea Autumn-spawners only), IVa West, IVb, VIId/IVc as well as for North Sea Autumn-spawners (NSAS) caught in Division IIIa, and the total NSAS stock, including catches in Division IIIa.

Biological information on the NSAS caught in Division IIIa was obtained using splitting procedures described in Sec. 3.2 and in the stock annex 2. The total catches of NSAS (SOP figures), mean weights and numbers-at-age by fleet are given in Table 2.2.6. Data on catch numbers-at-age and SOP catches are shown for the period 1995-2004 in Tables 2.2.7 (herring caught in the North Sea), 2.2.8 (WBSS taken in the North Sea, see below), 2.2.9 (NSAS caught in Division IIIa) and 2.2.10 (total numbers of NSAS). Mean weights-at-age are given for 1995-2004 separately for the different Divisions where NSAS are caught (Tab. 2.2.11). Note that SOP catch estimates may deviate in some instances slightly from the working group catch used for the assessment, this year most notably for area IVaW where the SOP catch estimate is 3,400 t higher than WG catch. As no information was available to decide whether numbers or weight was incorrect, SOP figures were not scaled to arrive at 100%.

2.2.1 Catch in numbers-at-age

North Sea catches in numbers-at-age over the years 1990-2004 are given in Table 2.2.7. The total number of herring taken in the North Sea and the total number of NSAS have increased by 18% (to 3.9 billion fish) and by 6% (to 4.3 billion fish), respectively, as compared to last year. 0- and 1-ringers contributed 21% of the total catch in numbers of NSAS in 2004. Fig. 2.2.1. shows the relative proportions of the total catch numbers for different periods (1960-2004, 1980-2004 for the total area, and 2004 for different Divisions). Note that almost 70% of the catch in the southern North Sea consists of the 2000 year class, while catches in the North (IVa) are dominated by the strong 1998 year class. During winter, the 2000 year class appears to be almost absent from some areas in IVaW.

The following table summarises the total catch in tonnes of North Sea autumn spawners. To arrive at the total catch of NSAS, splitting of the catch into NSAS and Western Baltic Spring Spawners has to be done in Divisions IIIa and IVaE. NSAS from IIIa are then added, and

WBSS from the North Sea subtracted from the total NSAS catch figure. The final total catch used for the assessment of NSAS in 2004 was 567,000 tonnes:

AREA	ALLOCATED	UNALLOCATED	DISCARDS	TOTAL
IVa West	218,427	28,631	15,794	262,852
IVa East	119,329	-	-	119,329
IVb	89,898	8,300	1,265	99,463
IVc/VIId	56,506	11,967	-	68,473
	Total catch in the North Sea			550,117
	Autumn Spawners caught in Division IIIa (SOP)			24,214
	Baltic Spring Spawners caught in the North Sea (SOP)			-7,079
	Other Spring Spawners			-62
	Total Catch NSAS used for the assessment			**567,190**

"Other spring spawners" are 62 t of Blackwater herring caught under a separate quota and included in the catch figure for England & Wales, while this year no spring spawners were reported from the commercial catch taken in the Western North Sea.

2.2.2 Spring-spawning herring in the North Sea

Norwegian Spring-spawners and local fjord-type herring are taken in Division IVa (East) close to the Norwegian coast under a separate TAC. These catches are not included in the Norwegian North Sea catch figures given in Tables 2.1.1 to 2.1.6, but are listed separately in the respective catch tables. The amount of these catches varied significantly between less than 500 t in 2004 and 55,000 t in 1997. Coastal Spring Spawners in the southern North Sea (e.g. Thames estuary) are caught in small quantities (usually less than 100 t) regulated by a local TAC. The Netherlands reported increasing catches of Spring Spawners in the Western Part of the North Sea in recent years, which were included in the national catch figures and subtracted from the total catch used for the assessment of NSAS. This year no spring spawners were reported from routine sampling of commercial catch taken in the west.

Western Baltic and Division IIIa Spring-spawners (WBSS) are taken in the eastern North Sea during the summer feeding migration. These catches are included in Table 2.1.1 and listed as IIIa type. Table 2.2.8 specifies the estimated catch numbers of WBSS caught in the North Sea, which are transferred from the North Sea assessment to the assessment of Division IIIa/Western Baltic in 1991-2004.

The method of separating these fish, using vertebral counts as described in former reports of this Working Group (ICES 1991/ACFM:15) is given in Sec. 3 and in stock annex 2. For herring 2-ringers, 3-ringers, and 4+-ringers caught in the 2^{nd} quarter, mean vertebral counts in the transfer area (see Fig. 1.5.1) were used. Samples from the Norwegian catches that have been taken in May and June 2004 were used for the second quarter (Figure 2.2.2). For 1-ringers in the 2^{nd} quarter it was assumed that all fish were autumn spawners. For the 3^{rd} quarter no Norwegian or Danish samples were available for landings from the transfer area, and instead the proportions from samples taken during the Danish acoustic survey in this area (based on otolith examinations) were applied to the age distributions. The resulting proportion of spring spawners and the quarterly catches of these in the transfer area in 2004 are as follows:

QUARTER	1-RINGERS (%)	2-RINGERS (%)	3-RINGERS (%)	4+-RINGERS (%)	CATCH IN THE TRANSFER AREA (T)	CATCH OF WBSS IN THE NORTH SEA (T)
Q 2	0%	28%	21%	3%	33,654	4,533
Q 3	23%	33%	82%	95%	3,099	2,546
total					36,753	7,079

The quarterly age distribution in Subdivision IVa East was applied to the catches of the second and third quarters in the whole area. The numbers of Spring-spawners by age were obtained by applying the estimated proportion by age.

2.2.3 Data revisions

A number of data revisions have been applied to the assessment input data set at last year's WG meeting, specifically following the work of the Study Group on the Revision of Data for North Sea Herring (SG Rednose, ICES 2003/ACFM:10) which reworked catch and catch-at-age data for 1995-2001. Further, the splitting between NSAS and WBSS in Division IIIa had been revised last year, based on new information of the distribution of Norwegian catches in Divisions IIIa and IVa(E) for the same period. Splitting data is still not completely reworked for the earlier period and NSAS assessment data could therefore not be updated for 1991 to 1995.

No data revisions were made this year.

2.2.4 Quality of catch and biological data, discards

As in previous years, some nations provided information on misreported and unallocated catches of herring in the North Sea and adjacent areas. Catches made in Division IVa were mainly misreported to Division VIa, IIIa and IIa, but misreporting also occurred from IIIa to IVa, within Area IV, and from Division VIId to IVb. The **Working Group catch**, which includes estimates of discards and misreported or unallocated catches (see Section 1.5), was estimated to exceed the official catch by about 14%. An analysis conducted in 2002 (ICES 2002/ACFM:12) indicated that this figure could be much higher if the mean rate of misreporting and unallocated catch for nations reporting this would be applied to the whole North Sea catch. This corroborates suggestions of the Study Group for Herring Assessment Procedures (ICES 2001/ACFM:22), that a important uncertainty of the total catch figure exists since the reopening of the fishery in 1980.

Discards. Prior to 1998, there was little available information available on herring discards in the pelagic fisheries in the North Sea. Observer sampling programs since 1999 suggested that discarding in these fisheries were less than 5%.. In 2002 for the first time, onboard sampling by two nations observed increased discards of herring in the mackerel fishery in the 3rd and 4th quarter in Division IVa (W). At this time, the quotas for herring were already taken and herring occurred in mixed schools with mackerel. The discard figure finally used for the assessment was 17,000 t. If the same raising scheme would have been used for all fleets involved, discards would have been as high as 50,000 t. However, the behaviour of other than the sampled fleets is uncertain. For 2003, the herring TAC has been increased by 50%, and at the same time the mackerel TAC has been reduced by more than 5%. Sampling of the same fleets in 2003 showed a reduced level of discarding, as was anticipated. Discards again occurred mainly in the mackerel fishery in the 1st and 4th quarter, and to less extent as slippage in the directed herring fishery in the 3rd quarter. The discard figure used in the assessment for 2003 was 4125 t, based on the raised figure for one sampled fleet. In 2004, herring quotas were again increased and mackerel quotas markedly decreased. In spite of this, reported discarding was back to the 2002 level. Three pelagic fleets have been sampled for discards (see Section 1.7); the majority of discards were again reported from the mackerel fishery in IVa in the 4th quarter (11,000 t), smaller amounts were due to slipping/technical failures in the same area in the 3rd quarter. In one fleet, substantial discards occurred in the 3rd quarter in IVa and IVb, when there were clear indications for highgrading: smaller fish was consistently discarded from most of the hauls. If this behaviour would have been raised to the total catch of the fleets believed to be operating in the same way, discards due to highgrading could have been in the order of 19,000 t (WD 6). However, onboard sampling of other vessels in a similar fleet obtained no highgrading (see Section 1.7), which points to the uncertainty of any such raising.

The final figure for discards in 2004 as used in the assessment was 17,059 t, based on the raised discards for two fleets. As discards are likely to occur in all nation's fisheries, this figure is certainly an underestimate. With a higher market value and the availability of bigger fish, and at the same time the strong 2000 year class with comparatively slow growth entering the fishery, there is concern that smaller herring is increasingly discarded earlier in the year when fish could have been landed legally.

In general, **sampling of commercial landings** for age, length and weight has again improved as compared to last year (Table 2.2.12). The European Union implemented a new sampling regime in 2002, obliging member states to meet specified overall sampling levels. This year, 94% of the catch was sampled (2003: 85%), and the number of age readings has again been increased by 28%. It should be observed that "sampled catch" in Table 2.2.12 refers to the proportion of the reported catch to which sampling was applied. This figure is limited to 100% but might in fact exceed the official landings due to sampling of discards, unallocated and misreported catches.

However, more important than a sufficient overall sampling level is an appropriate spread of sampling effort over the different metiers (each combination of fleet/nation/area and quarter). Of 100 different *reported* metiers, only 39 were sampled in 2004 (39%; 2003: 40%). Some of them, however, yielded very little catch. The recommended sampling level of more than 1 sample per 1,000 t catch has been met only for 29 metiers (2003: 34). For age readings (recommended level >25 ageings per 1000 t catch) this is only slightly worse: only 26 metiers appear to be sampled sufficiently (2003: 29). The catch of France, UK/England and Wales, Sweden, Northern Ireland and the Faroe Islands from the North Sea (combined share 13% of the total North Sea catch) has not been sampled. Information on catches landed abroad was again not available or could not be used. While it is known that by-catches of herring in other than the directed human consumption fisheries occur, most countries have not implemented a sampling scheme for monitoring these fisheries.

In this respect, there is still a need to improve the quality of the catch data for the North Sea herring. It appears that in some instances the new EU data collection directive could lead to a deterioration of sampling quality, because it does not assure an appropriate sampling of different metiers. This introduces uncertainties in the biological composition of the catches, which affects the quality of the assessment. The WG therefore recommends that all metiers with substantial catch should be sampled (including by-catches in the industrial fisheries), that catches landed abroad should be sampled and information on these samples should be made available to the national laboratories (see Section 1.5).

2.3 Fishery Independent Information

2.3.1 Acoustic Surveys in VIa(N) and the North Sea in July 2004

Six surveys were carried out during late June and July 2004 covering most of the continental shelf north of 51° 30'N in the North Sea and 56°N to the west of Scotland to a northern limit of 62°N. The eastern edge of the survey area is bounded by the Norwegian, Danish, Swedish, German and Dutch coasts, and to the west by the shelf edge at approximately 200 m depth. The individual surveys and the survey methods are given in the report of the Planning Group for Herring surveys (ICES 2005/G:04). The vessels, areas and dates of cruises are given below and in Figure 2.3.1.1:

VESSEL	PERIOD	AREA
FV Enterprise	6 July – 25 July	56°- 60°N, 3° - 7° W
R.V Johan Hjort	8 – 30 July	57°- 61° N, 2° - 6° E
Scotia	1 - 22 July	58 15°- 62° N, 4° W - 2° E
Tridens	28 June – 23 July	54°30 – 58° 15’ N, west of 3° E
Walther Herwig III	28 June – 19 July	51° 30’ - 57° N, east England / 3° E / 6° E
Dana	29 June – 12 July	North of 57°NS & 56° N, Kattegat east of 6° E

The data has been combined to provide an overall estimate. Estimates of numbers-at-age, maturity ogive and mean weights-at-age are calculated as weighted means of individual survey estimates by ICES statistical rectangle. The weighting applied is proportional to the survey track for each vessel that has covered each statistical rectangle. The data have been combined and the estimate of the stock surveyed is shown in Tables 2.3.1.1-3 by ICES subarea for North Sea autumn spawning herring.

Combined Acoustic Survey Results:

The estimate of North Sea autumn spawning herring SSB is 2.6 million tonnes which is 14,000 millions herring (Table 2.3.1.4). This data series is used as a relative index in the assessment of North Sea herring because the absolute abundance cannot be used directly due to uncertainties in target strength. The North Sea survey is reasonably consistent with previous years but shows a small decline, giving a total adult mortality of about 0.5 over the last 3 years, which is slightly higher than the estimates from the assessment. The North Sea herring SSB estimated from the survey rose from 2.6 million tonnes in 2001 (Table 2.3.1.5) to 2.9 million tonnes in 2002 and again to 3.0 million tonnes in 2003 and has now been seen to fall to 2.6 million. As observed last year the growth of the 2000 year class seems to be slower than for previously observed year classes. The herring are now 1.4 cm smaller, and 33g lighter than the similarly abundant 1998 year class at the same age (3-rings). Last year only 43% of this year class were mature at 2-ring compared to 77% and 86% for 1998 and 1999 year classes. This year at 3-ring only 65% are mature compared to 97% and 93% for 1998 and 1999 year classes. If this year class had grown and matured as previous years, to 95% mature, and 177g the spawning stock biomass would have been 21% higher at 3.1 million tonnes, but if the 2003 estimate were treated in the same manner (i.e. use average growth and maturity) it would give an SSB of 3.8 million tonnes, still suggesting a decline in the last year. The survey shows again the two exceptional year classes of herring (the 1998 and 2000 year classes) in the North Sea, which is consistent with the observation of exceptionally large year classes observed in the MIK and IBTS surveys (ICES 2001/ACFM:12). The 2004 estimate of the 2000 year class suggests that it may be higher than the 1998 year class at 1.1 times at age 3-ring.

The numbers and biomass of adult autumn spawning herring can be seen in Figures 2.3.1.2, the numbers at 1, 2 and 3+ rings in Figure 2.3.1.3. The spatial distribution of mean weight at 1 and 2 ring, and fraction mature at 2 and 3 ring are given in Figure 2.3.1.4. These show a considerable spatial trend which is observed each year, with larger more mature fish found in the North and smaller less mature fish found in the south and particularly the eastern north Sea. The relative spatial distributions of adult and juvenile autumn spawning herring can be seen in Figures 2.3.1.5 and 2.3.1.6 respectively. The mean weights-at-age and the fraction mature are used in the assessment, the influence of the precision of this data were discussed in detail in section 2.10 last year.

2.3.2 Larvae surveys

In 2004/05 The Netherlands and Germany participated in six surveys and managed to cover six out of ten areas. The survey effort is comparable to previous years. The areas and time periods (including numbers of samples, vessel-days in sampling and area coverage) are given in Table 2.3.2.1 and Table 2.3.2.2. The spatial extent of the surveys is shown in Figures 2.3.2.1 – 2.3.2.6. The historical background of the larvae surveys and the methods used for abundance calculation are described in the handbook for quality control. A more detailed description is available in the manual for the international herring larvae surveys in the North Sea (ICES 2004/G:05).

Each surveys in 2004 resulted in high abundance estimates. In the Orkney/Shetlands area a large spatial extension of newly hatched larvae and high larvae aggregations were observed eastwards the Orkneys as in previous years (Figure 2.3.2.1). The overall abundance in this area varies greatly between years. In 2004 the estimates are average in recent time-series.

In the Buchan area (Figure 2.3.2.2) larval distribution was spread out compared to last year. The LAI increased substantially during the last three years.

The LAI for the Central North Sea (Figure 2.3.2.3) has reduced compared to last sampling period, but the 2003 estimate was influenced by large catches at single stations. The CNS still yields a high abundance estimate. The LAIs in the CNS continuously rise over the last seven years.

Abundance estimates from the three surveys in the Southern North Sea resulted in a high index which is almost comparable to last year. Spawning starts in the second half of December in a restricted area in VIId and then spread out into VIc during January (Figure 2.3.2.4-6). As usual, an area from the French coastline to the middle of the Channel contributed most to the abundance index in the Southern North Sea.

As a general pattern, herring seem to have recolonized the sampled spawning grounds in a broader range. An overview of the historic trends for a collection of sampling areas and periods is given in Figure 2.3.2.7.

The model for the Multiplicative Larval Abundance Index (MLAI) was fitted to abundances of larvae less than 10 mm in length (11 mm for SNS) (Table 2.3.2.3). The analysis of variance and the parameter estimates are given in Table 2.3.2.4. The updated MLAI time-series is shown in Table 2.3.2.5. The estimated trend in spawning stock biomass from this model fit is plotted in Figure 2.3.2.8 versus the SSB values obtained from the ICA runs of the Herring Assessment Working Group (ICES 2004/ACFM:18).

The result of the survey in the 1st period in the SNS is influenced by a large catch at one single station. Almost 12,000 larvae per m² were caught which contribute roughly 70% to the total catch. As a general rule, additional stations should be inserted in areas with high larval concentrations to enable average calculation. Unfortunately this wasn't done here. However, there are some routines in the MLAI calculation to make it robust against patchiness effect. Exclusion of the high catch leads to a difference less than 3% on the MLAI estimate. With respect to the general noise in survey data this impact can be neglected. Thus no data were excluded from the MLAI calculation. Both the LAI per unit as well as the MLAI from the larvae surveys in period 2004/2005 indicate that the SSB has slightly increased when compared to last years WG estimate.

2.3.3 International Bottom Trawl Survey (IBTS)

The International Bottom Trawl Survey (IBTS) started out as a young herring fish survey in 1966 with the objective of obtaining annual recruitment indices (abundance of 1-ringers in 1st quarter) for the combined North Sea herring stocks. It has been carried out every year since, and presently the survey provides recruitment indices not only for herring, but also for round-fish species as well. Examinations of the catch of adult herring during the 1st quarter IBTS have shown that this catch also indicates abundances of 2-5+ herring. Also during IBTS 1st quarter, herring larvae are sampled during the night by small, fine-meshed nets. From 1977 to 1991 the gear was a small mid-water trawl (IKMT), but due to poor catchability of this gear, the standard gear was changed to a 2 metre ring net (MIK), used since the 1991 sampling. The total abundance of herring larvae in the survey area is used as an estimate of 0-ringer abundance of the stock. Hence, a series of herring abundance indices (0-5+ ringers) are available from the IBTS programme.

2.3.3.1 Indices of 2-5+ ringer herring abundances

Fishing gear and survey practices were standardised from 1983, and herring abundance estimates of 2-5+ ringers from 1983 onwards has shown the most consistent results in assessments of these age groups. This series is subsequently used in North Sea herring assessment. Note that the abundances in Division IIIa are not included in the 2-5+ ringer indices. Table 2.3.3.1 shows the time-series of abundance estimates of 2-5+ ringers from the 1st quarter IBTS for the period 1983-2005, when Table 2.3.3.2 contains area-disaggregated information on the IBTS indices for year 2005.

2.3.3.1 Index of 1-ringer recruitment

The 1-ringer index of recruitment is based on trawl catches in the entire survey area. Indices are available for year classes 1977 to 2003 (Table 2.3.3.3). This years estimate of the 2003 year class strength (1033) indicates a very low recruitment, among the lowest on record.

Figure 2.3.3.1 illustrates the spatial distribution of 1-ringers as estimated by the trawling in February 2003, 2004 and 2005. In 2005 the main concentrations of 1-ringers were found in the south-eastern part of the North Sea. The mean length of the 1-ringers in this area is relatively small, between 10 and 14 cm (Figure 2.3.3.2.).

The Downs herring hatch later than the other autumn spawned herring and generally appears as a smaller sized group during the 1st quarter IBTS. A recruitment index of smaller sized 1-ringers is calculated based on abundance estimates of herring <13 cm (see discussion of procedures in earlier reports (ICES CM 2000/ ACFM:12, and ICES CM 2001/ ACFM:12).

Table 2.3.3.3 includes abundance estimates of 1-ringer herring smaller than 13 cm, based on a standard retrieval of the IBTS database, i.e. the standard index is in this case calculated for herring <13 cm only. Indices for these small 1-ringers are given either for the total area or the area excluding division IIIa, and their relative proportions are also shown. In the time-series, the proportion of 1-ringers smaller than 13 cm (of total catches) is in the order of 20%, and the contribution from division IIIa to the overall abundance of <13 cm herring varies markedly during the period. (Table 2.3.3.3)

About 35% of this years group of 1-ringers is smaller than 13 cm. These are almost exclusively found in the North Sea area (Table 2.3.3.3)

2.3.3.2 The MIK index of 0-ringer recruitment

This years 0-ringer index is based on 544 depth-integrated hauls with a 2 metre ring-net (the MIK). Index values are calculated as described in the WG report of 1996 (ICES 1996/ACFM:10). The series of estimates is shown in Table 2.3.3.4, the new index value of 0-ringer abundance of the 2004 year class is estimated at 61.3.

This estimate indicates a very low recruitment, of the same size as estimated for the last two year classes, 2002 and 2003. The 0-ringers were distributed westerly and southerly in the North Sea with highest concentrations in the south-western areas. However, compared to the preceding two year classes, which is also shown in Figure 2.3.3.3, the 0-ringers of this year class are distributed in a wider area of the North Sea. This is also apparent from Figure 2.3.3.4, which illustrates the changes in absolute and relative abundance of 0-ringers in the western part of the North Sea. The relative abundance is given as the number of 0-ringers in the area west of 2°E relative to the total number of 0-ringers in the given year class. Since the year class 1982, when the relative abundance was 25%, a general increase has been seen for the western part. In the last decade, the 0-ringer abundance in this area has dominated, during the preceding two years the relative abundance was in the order of 85%, while in 2005 the relative abundance declined to ca. 55%.

2.4 Mean weights-at-age and maturity-at-age

2.4.1 Mean weights-at-age

The mean weights-at-age of fish in the catches in 2004 (weighted by the numbers caught) are presented by ICES Division and by quarter in Table 2.2.11.

Table 2.4.1.1 shows the historic mean weights-at-age (wr) in the North Sea stock during the 3rd quarter in Divisions IV and IIIa for the period 1995 to 2004. These values were obtained from the acoustic survey. The data for 2004 are taken from Table 2.3.1.4. In this quarter most fish are approaching their peak weights just prior to spawning. The spatial distribution of mean weight for 1 and 2-ringers are given in Figure 2.3.1.4. The spatial variability of mean weight is considerable. For comparison the mean weights-in-the-catch from the last ten years are also shown in Table 2.4.1.1 (from Section 2.2.1 for the 2004 values). For 4-ringers and older the mean weights in both the catch and the acoustic survey are generally either close to the long-term mean or in the case of the acoustic survey a little lower. These estimates are typical for this time series. For 3-ring herring both the catch and the acoustic survey show mean weights that are the lowest for the last 10 years supporting the view that the exceptional 2000 year class is growing slowly. Maturity of this yearclass is also found to be lower than usual (see next section). The influence of this low mean weight on the assessment of the state of the stock is discussed in section 2.10, Quality of the assessment. The weight of two ring herring is low but not unusually so. The weight of 1-ring herring is rather variable, particularly in the catch, which this year shows a low value.

2.4.2 Maturity Ogive

The percentages of North Sea autumn-spawning herring (at age) that spawned in 2004 were estimated from the July acoustic survey (Table 2.4.2.1). The values were determined from samples of herring from the research vessel catches examined for maturity stage, and raised by the local abundance. All herring at maturity stage between 3 and 6 inclusive (using an 8-stage scale) in June or July were assumed to spawn in the autumn. The method and justification for the use of values derived from a single years data was described fully in ICES (1996/ACFM:10). The values for 2- & 3-ringers taken from the acoustic survey results (Table 2.3.1.4.) For 2-ringers the proportion mature at 70% was typical for this age group. For 3 ring herring the fraction mature was much lower than last year, and is almost the lowest in the time-series, although a very slightly lower value has been observed in 1993. This yearclass was seen to be slow growing and with low proportion mature last year at 2 ring. As last year the data were examined carefully for errors and it was concluded that the 2000 year class has developed slowly since July 2002. Fraction mature, mean weight and mean length-at-age and by year are shown in Figure 2.4.2.1. This year class, possibly the largest in recent years and the first large one competing with an already large herring stock biomass, has grown more slowly than earlier year classes. The influence on the assessment of the low fraction mature at 2-ring is discussed in Section 2.10, Quality of the assessment.

2.5 Recruitment

Information on the development in North Sea herring recruitment is available from the two IBTS indices, the 1-ringer and the 0-ringer index. Further, the ICA assessment provides estimates of the recruitment of herring in which information from the catch and from all fishery independent indices is incorporated.

2.5.1 Relationship between the MIK 0-ringer and the IBTS 1-ringer indices

The 0-ringer MIK index predicts the year class strength one year before the information is available from the IBTS 1-ringer estimates. The relationship between year class estimates from the two indices is illustrated in Figure 2.5.1 and described by the fitted linear regression. Last years prediction of a very small 2003 year class was confirmed by this year's IBTS 1-ringer index of the year class. The good correlation between the indices is also evident when comparing the respective trends in indices during the period (Figure 2.5.2).

2.5.2 Trends in recruitment from the assessment

Recruitment is estimated in the ICA-assessment, and in Figure 2.5.3 the trends in 1-ringer recruitment based on 2005 assessment is illustrated. The recruitment declined during the sixties and the seventies, followed by a marked increase in the early eighties. After the strong 1985 year class recruitment declined again until the strong year classes 1998-2001. However, the 1-ringer recruitments of the recent 2002 and 2003 year classes are very low, and the 0-ringer recruitment based on the MIK index indicates that this will be followed by another low year class 2004. The present ICA estimates of 1-ringer recruitment are 7.2 and 7.0 no10^9 for year classes 2002 and 2003 respectively, while the estimates for 0-ringers are 20.3, 19.6 and 22.3 no 10^9 for year classes 2002, 2003 and 2004 respectively.

2.6 Assessment of North Sea herring

2.6.1 Data exploration and preliminary results

North Sea herring is on the AFCM observation list, but was also classed as an update assessment in 2005 by ACFM. With this in mind limited exploration was carried out into the fit of the assessment. The full choice of assessment model, catch and survey weightings and the length of separable period where not explored in detail in 2005. It is proposed to carry out a benchmark assessment for North Sea herring in 2006.

2.6.1.1 Selection of weighting of indices in the assessment of North Sea herring

The usual assessment tool for the assessment of North Sea herring is ICA. The settings were the same as last year. Acoustic, Bottom trawl (IBTS), MIK and Larvae (MLAI) surveys are available for the assessment of North Sea autumn spawning herring. The surveys and the years for which they are available are given in Table 2.6.1.1.

In 2002 the HAWG moved from arbitrary index weighting as used for the previous 6 years (1996-2001) to a more objective method. This new method was developed from the work of the ACFM study group SGEHAP (ICES CM 2001/ACFM:22) which had one of its objectives to try to rationalise the survey index weighting in the assessment. The analysis is described in the 2003 report (ICES 2003/ ACFM:17). The weighting values are given in Table 2.6.1.2. The weightings applied account for sampling error of the surveys. The WG in 2002 selected index weighting which both minimised the variability in the assessment output but also reduced the retrospective revision of management parameters (F, SSB and recruitment). However, they could not find a method that minimised the revision of all of these parameters but selected the one that performed best for two out of three. This was done by down-weighting the influence of catch of 0wr and 1wr in the assessment (Table 2.6.1.2).

The WG in 2003 made an extensive review covering both inverse variance and structural errors, and it considered that the inverse variance method provided the better method. This process meant that the weighting of surveys and catch is fixed as the sensitivity of the assessment to these weighting values has been greatly studied in recent years. The weights express the WG view that the young herring are best estimated with MIK and IBTS surveys, the older herring are best evaluated through the acoustic survey and the SSB should be estimated through the MLAI.

2.6.1.2 Period of separable constraint

Changes in the regulations in 1996 have affected the various components of the fishery differently. Recent meetings of this WG split the separable period into two different periods: 1992-1996 and 1997 onwards. In the WG 2001 it was considered that the number of years after the change in selection was long enough to use only a single separable period of four years. During 2002-2004 a separable period of five years was used. The WG in 2002 found that year on year adaptation of the separable period did not improve the performance of the assessment model and that a fixed selection period gave more stable assessments, even with changing management. Last years WG explored a 4, 5 and 6 year separable period. No important differences in the model fit or outputs were detected. The estimation of F at reference age (4wr) was not significantly different and differences in mean $F_{2\text{-}6}$ and SSB where found negligible. So the 5 year separable period was maintained in the current assessment.

2.6.1.3 Model fit and residuals

The influence of the catch and the surveys was explored on the estimation of reference F and the model fit. ICA was run using all catch and survey data with the same procedure as last year (SPALY). The patterns in catch and survey residuals (Figure 2.6.1.1, upper panels) are similar to the assessments in 2003 and 2004 but greater in magnitude. In the assessments in 2003 and 2004, positive residuals in the catch of 2+wr fish against negative residuals in the acoustic survey and IBTS were detected. Using the same procedure as last year, the catch residuals in this year's assessment showed positive residuals for older ages in recent years, while at 2wr in the terminal year there is a large negative residual. Different trends in the residual patterns between catch and surveys indicate conflicting signals in the information.

To explore the contribution of the catch and the survey data to the specific patterns in the residuals, runs with modification to the data were explored:

i. Setting the weights for the catch in the separable period to 10% of the original values for the separable period to explore the influence of the catch data on the model.
ii. Setting the weights for the catch of 1wr and 2wr in 2004 at 0.01 to explore the influence of the large negative residual for 2wr in the terminal year
iii. Using the acoustic survey as the only tuning fleet,
iv. Using the IBTS as the only tuning fleet,
v. Using the MIK survey as the only tuning fleet,
vi. Using the MLAI as the only tuning fleet to explore the influence of the survey data on the model

Setting the weights for the catch in the separable period to 10% of the original values reduces the negative residuals in the survey data in recent years slightly (Figure 2.6.1.1, middle panels). Setting the weights for the catch of 1wr and 2wr in 2004 at 0.01 does hardly change the patterns in the group of negative residuals in the survey data in recent years (Figure 2.6.1.1, lower panels).

Using each individual survey as the only tuning fleet did not resolve the pattern of negative survey residuals in recent years for the acoustic and the IBTS survey (Figure 2.6.1.2). The MIK and MLAI survey showed random distributions in the residuals with no apparent trend.

Depending on the data source explored, the reference F (4wr) varied between 0.20 and 0.40 (Figure 2.6.1.3a). The runs with down weighted catch (i and ii) and using only the IBTS as tuning fleet gave similar perceptions of fishing mortality on the reference age (4wr) of the separable model with estimates within the 90% confidence intervals of the run with last years settings. The acoustic survey gave slightly higher estimates of F, while the MIK and the MLAI gave slightly lower estimates. The MIK and the MLAI gave higher estimated of SSB associated with the lower reference F (Figure 2.6.1.3b). The MIK is not expected to have great power, since it is a recruitment index with information on only the 0wr.

2.6.1.4 Exploring other assessment models

The performance of ICA is explored against XSA and SURBA (ICES CM2003/D:03; Needle 2004), which is a survey-only based assessment model. ICA has been used for the assessment of North Sea herring during the last decade. Concern at WGMG was raised about the instability in the selection patterns at older ages impacting on the earlier part of the time-series (ICES CM2003/D:03). The WG in 2003 and 2004 explored the performance of ICA against another regularly used assessment model, XSA. The approach used was to choose XSA settings that reflect as many of the assumptions of the ICA model of North Sea herring.

The model settings for XSA in this years assessment are given in Table 2.6.1.3 and the summary of the results in Table 2.6.1.4. The XSA assessment is consistent with the ICA assessment (Figure 2.6.1.4) for the recruitment and $F_{2\text{-}6}$ and SSB in historic period. Only during the last 3 years does XSA show higher estimates of mean $F_{2\text{-}6}$ and lower estimates of SSB. Higher estimate of F and lower estimate of SSB in the terminal year by XSA might be influenced by the exclusion of the MLAI in the XSA (which cannot use biomass indices) and the effect of the weak shrinkage during a period of declining F, maybe responsible for part of the increase.

A new version of SURBA that could assess North Sea herring was developed immediately prior to the HAWG in 2005. This version could combine multiple surveys, with weighting factors and incorporated the use of a biomass tuning fleet. Its use should be viewed as exploratory and its results as preliminary as no major testing of the model or sensitivity analysis of the model settings has taken place as yet. The SURBA run had a higher mean $F_{2\text{-}6}$ and lower SSB in the terminal year than ICA and XSA, and showed more between year variability in F in recent years than the other models.

2.6.1.5 Conclusions of exploration of the assessment

The formulation of the assessment was recently supported by an external and independent review of the North Sea herring assessment carried out for the North Sea Commission Fisheries Partnership, where the consistency, precision and quality of the assessment were judged as credible and fully acceptable as a tool for management advice. However patterns in the residuals seen in previous years and current assessment indicate that catch and survey indices show different signals. Closer investigation of the model suggested a slight underestimation of F and an overestimation of SSB in current assessment (see section 2.10), and this should be monitored closely. Therefore WG strongly suggests a benchmark assessment of North Sea herring next year. Exploratory runs of ICA and XSA however showed similar trends in the development of mean $F_{2\text{-}6}$, SSB and recruitment and are within the precision levels of the ICA model. As exploration provides no simple solution to the apparent conflicts between catch and survey data, it was concluded that this years assessment method is maintained as last year, with comparable settings, tuning indices and weightings.

2.6.2 The stock assessment

2.6.2.1 The model used

The assessment of the stock was carried out by fitting the integrated catch-at-age model (ICA) including a separable constraint over a five-year period as explained above (Patterson, 1998, Needle 2000). The input data are shown in Table 2.6.2.1.

2.6.2.2 Results

The ICA output is presented in Tables 2.6.2.2 and 2.6.2.3, with model fit and parameter estimates in Table 2.6.2.4 and Figures 2.6.2.1 - 2.6.2.19. Uncertainty analysis of the final assessment is presented in Figure 2.6.2.20, although this only reflects the uncertainty in fitting the model and does not include uncertainty in the model specification. Estimates in 2004 of mean $F_{2\text{-}6}$ vary in a similar way to last year, between 0.21 and 0.31 (25 and 75 percentile respectively), and for SSB between 1.73 and 2.14 million tonnes (Figure 2.6.2.20). There appears to be a relatively good agreement between the point estimates of the final assessment and the median values of the ICA bootstrap realisations. The estimation of mean $F_{2\text{-}6}$ varies less than the SSB (Figure 2.6.2.21). Long-term trends in yield, fishing mortality, spawning stock biomass and recruitment are given in Figure 2.6.2.22.

The spawning stock at spawning time in 2004 is estimated at approximately 1.89 million tonnes. The abundance of 0wr fish in 2005 (2004 year class) is low for the third consecutive year. A low recruitment was also observed in the two previous years for the 2002 and 2003 year classes. The strong 1998 and 2000 year classes are still evident in the population, with the 2000 year class at 3wr in 2004 being the highest since 1964 and the 1998 year class at 5wr being the highest since 1962. Mean fishing mortality on 2-6wr herring in 2004 is estimated at around 0.25, and on 0-1wr herring at 0.05. The value of F for 2003 in this years assessment is in close agreement with last year’s assessment, which was 0.24.

2.7 Short term projection by fleets.

2.7.1 Method

The program used (MFSP) was developed three years ago in the HAWG. The version used this year was the same as at last years meeting (Skagen 2003). The standard tool that currently is available for short term predictions (the MFDP program) has some limitations with regard to management options that can be covered. In particular, when varying the fishing mortality for one fleet, the fishing mortalities for the other fleets are assumed constant at status quo F. For the North Sea herring, managers have agreed to constrain the total outtake at levels of fishing mortalities for ages 0-1 and 2-6, and need options to show the trade-off between fleets within those limits. The MFSP program was developed to cover these needs.

2.7.2 Input data

Fleet Definitions

The current fleet definitions are:

North Sea

Fleet A: Directed herring fisheries with purse seiners and trawlers. By-catches in industrial fisheries by Norway are included.

Fleet B: Herring taken as by-catch under EU regulations.

Division IIIa

Fleet C: Directed herring fisheries with purse seiners and trawlers

Fleet D: By-catches of herring caught in the small-mesh fisheries

The fleet definitions are the same as last year.

Input Data for Short Term Projections

All the input data for the short term projections are shown in Table 2.7.1, which is the input file for the predictions.

Stock Numbers: For the start of 2005 the total stock number was taken from ICA (ica.n – file)

For 2006 and 2007, the recruitment was set to 49 960 million which is the geometric mean of the recruitments of the year classes 1981 – 2001.

Fishing Mortalities: Selection by fleet at age was calculated by splitting the total fishing mortality in 2004 for each age proportional to the catches by fleets at that age. These fishing mortalities were used for all years in the prediction.

Maturity at age: For all the year classes except the 2000 year class, the average maturity at age for 2001 to 2004, calculated without the 2000 year class, was used (Table 2.6.2.2). For the 2000 year class, which so far has matured more slowly than usual, the maturity was predicted by fitting a logistic function to the maturities at age observed so far. That gave a fraction mature of 0.91 as 4-ringers in 2005 and 0.98 as 5-ringers in 2006. For 2007, this year class was assumed to be fully mature.

Mean Weights at age in the stock: A similar procedure as for maturities was followed for mean weights at age in the stock. Again a 4 year average of the annual weights, excluding the 2000 year class was used for all year classes except the 2000 year class. The weights at age for the 2000 year class were obtained by fitting a von Bertalanffy function. The weights used for this purpose were the raw annual weights, while smoothed weights are used in the assessment.

Mean weights in the catch by fleet: The mean weights by fleet for the years 2002 – 2004, excluding the 2000 year class was used for all year classes except the 2000 year class. For the 2000 year class, the procedure outlined for weights in the stock was followed, assuming von Bertalanffy growth. Separate values for t_0 were estimated for each fleet. The W_{inf} and k were estimated assuming they were equal for all fleets.

Natural Mortality: Unchanged from last year, equal to those assumed in the assessment.

Proportion of M and F before spawning: Unchanged from last year at 0.67.

2.7.3 Prediction for 2005 and management option tables for 2006

Assumptions and Predictions for 2005

In 2004, the TAC for the A-fleet was overfished by approximately 15%, while the B- and C-fleets caught less than half their TAC. Catches in 2005 may be predicted with some confidence. The retrospective error has been low in recent years. It therefore seems most reasonable to use assumed catches to account for the removal in 2005. It is assumed that the TAC of 535 000 tonnes of the A-fleet will be taken, and that the bycatch by the B-fleet will increase somewhat in 2005, because it is expected to target sprat to a larger extent than in recent years due to shortage of sandeel, and closure of the fishery for Norway pout..

The alternative option assuming $F_{status\ quo}$ is also presented. The partial fishing mortalities at $F_{status\ quo}$ appear in tables 2.7.1. It should be noted, however, that $F_{status\ quo}$ gives far lower catch by the A-fleet than the agreed TAC, and also lower catch by the B-fleet than can be expected.

Management Option Tables for 2006

The EU-Norway agreement on management of North Sea herring was updated in 2004. The revised rule specifies fishing mortalities for juveniles (F_{0-1}) and for adults (F_{2-6}) not to be exceeded, at 0.12 and 0.25 respectively, for the situation where the SSB is above 1.3 million tonnes. In addition, it now has a rule specifying reduced fishing mortalities when the SSB is below 1.3 million tonnes. Moreover, the current agreement has a constraint on year-to-year change of 15% in TAC, but allows for a stronger reduction in TAC if necessary.

With four fleets there are innumerable combinations of fleetwise fishing mortalities and catches that satisfy the agreed rules. The predictions presented are in accordance with the agreed arrangement.

Since the North Sea autumn spawning (NSAS) stock was rebuilt, the advise has been that the primary limiting factor for the fishery in IIIa should be the concern for the Western Baltic spring spawning (WBSS) stock. Using that as a guideline, and in order to reduce the number of possible options, a range of fixed catches were assumed for the fleets C and D derived from the likely recommended outtake of WBSS. The procedure for obtaining these catch limitations are described in detail in Section 3.10. In brief, the historical fractional distribution of the WBSS catches on IIIa and the other areas is used to translate the total recommended TAC for WBSS into outtake of WBSS in IIIa. Then, the mix of WBSS and NSAS in the IIIa catches is used to derive the outtake of NSAS in IIIa. Assuming a total catch of WBSS of 95 000 tonnes (see Section 3.7) led to a catch of 16 600 tonnes of NSAS herring for the C-fleet and 11100 tonnes of NSAS herring for the D-fleet by this procedure.

It has become increasingly clear that in previous years, large parts of the catches reported for IIIa were actually taken in the North Sea. For 2004, Norway was allowed to transfer all of its quota in IIIa to IV, while the EC could transfer 50% of its quota. For 2005, Norway could again transfer its quota in IIIa to IV, while the EC could not. Furthermore, the last 3 year classes of NSAS have been weak, implying relatively small amounts of NSAS in IIIa. Therefore, it seems likely that the current fleet behaviour, with relatively small catches of NSAS in IIIa will be continued in the coming years.

In each set of predictions, a range of fixed catches were assumed for fleets C and D (8300, 12450 and 16600t for fleet C and 5500, 7750 and 11100t for fleet D). For each combination of these, the catches by the fleets A and B were adjusted to give an F_{0-1} at either 0.05, which is close to the F status quo, or the agreed value of 0.12, and to an F_{2-6} at 0.25. In addition, because these predictions lead to a reduction of catches by the A-fleet of slightly more than 15% compared to the 2005 TAC, a similar set of predictions were done with a fixed catch by the A-fleet at 85% of the 2005 TAC, i.e. 455 000 tonnes.

The text tables below is an overview of the options.

Predictions with $F_{status\ quo}$ for 2005

Status quo F-values by fleet:

A: F2-6 = 0.240, B: F0-1 = 0.036, C: F0-1 = 0.003, D: F0-1 = 0.010

ASSUMPTION FOR 2005	F_{0-1} 2006	F_{2-6} 2006	FLEET A	FLEET B	CATCH FLEET C 2006	CATCH FLEET D 2006
F status quo	0.05	0.25	Derived F and catch	Derived F and catch	8300 – 16 600 t	5 500 – 11 100 t
F status quo	0.12	0.25	Derived F and catch	Derived F and catch	8300 – 16 600 t	5 500 – 11 100 t
F status quo	Approx 0.05	Derived	Assumed catch 455 000 t	Derived F and catch	8300 – 16 600 t	5 500 – 11 100 t
F status quo	Approx 0.12	Derived	Assumed catch 455 000 t	Derived F and catch	8300 – 16 600 t	5 500 – 11 100 t

Predictions with catch constraint for 2005

Catch constraints by fleet: A: 535, B: 25, C: 20, D: 15

ASSUMPTION FOR 2005	F_{0-1} 2006	F_{2-6} 2006	FLEET A	FLEET B	CATCH FLEET C 2006	CATCH FLEET D 2006
Catch con-straint	0.12	0.25	Derived F and catch	Derived F and catch	8300 – 16 600 t	5 500 – 11 100 t
Catch con-straint	0.05	0.25	Derived F and catch	Derived F and catch	8300 – 16 600 t	5 500 – 11 100 t
Catch con-straint	Approx 0.05	Derived	Assumed catch 455 000 t	Derived F and catch	8300 – 16 600 t	5 500 – 11 100 t
Catch con-straint	Approx 0.12	Derived	Assumed catch 455 000 t	Derived F and catch	8300 – 16 600 t	5 500 – 11 100 t

All predictions are for North Sea autumn spawning herring only.

The results are presented in Table 2.7.2. In addition, runs were made screening over narrow intervals of catch options for all fleets, as requested in the Memorandum of Understanding between ICES and its client commissions. The results file is too extensive to be included in the report, but is available on the WG directory.

2.7.4 Comments on the short-term projections

Making fleetwise predictions for 4 fleets that are more or less independent remains problematic, in particular when it comes to presenting results in a way that allows managers to overview the range of possible trade-offs between fleets.

It is also worth noticing that the realised F_{2-6} in the past have exceeded that intended when setting the TACs for many years. If managers wish to avoid exceeding the agreed limits, options with lower F-values may be preferable.

All scenarios presented indicate a decrease in spawning biomass and in yield. This is mainly caused by the weak 2002, 2003 and 2004 year classes taking over from the strong 1998 and

2000 year classes. The catches by the A fleet are estimated close to the lower bound implicit in the constraint on TAC reduction agreed by EU and Norway at $F_{2-6} = 0.25$, while the catches by the B, C and D fleets is a trade-off between these fleets, the sum of which will be approximately 70 – 80 000 tonnes with an $F_{0-1} = 0.12$.

The predictions presented here account for the delayed maturation of the large 2000 year class. To what extent the increased stock size will lead to slower growth and maturation in the future remains to be seen. There are some indications that this was the case when the stock was large prior to 1960 (ICES 1998/ACFM:14), but there are no indications of reduced growth of the 2001 and 2002 year classes.

The estimated impact of the juvenile fishery depends on the assumed value for natural mortality. It has not been investigated to what extent changes in natural mortality would affect the current advise, or if indeed such changes are taking place.

2.8 Medium term predictions and HCR simulations

Medium term predictions were performed to explore the robustness of the newly agreed harvest control rule (HCR), in light of the present situation where several recent year classes have been well below average. HCRs for North Sea herring were extensively evaluated in June 2004 (Anon 2004. EU Norway ad hoc Scientific Working Group on Multi-annual Management Plans for Stocks shared by EU and Norway). The initial stock numbers are taken from the most recent assessments. Because all year classes after the 2000 year class now appear to be weak, the initial data reflect this exceptional situation to a larger extent than in the predictions made in June (Figure 2.8.1).

The software used was STPR3, the same as used at the evaluation of HCRs for North Sea herring in June 2004. This is a program for performing 10 years stochastic simulations of the stock and fishery, applying some HCRs. A description can be found i.a. the SGMAS report (ICES 2005, ICES CM 2005 /ACFM:09).

2.8.1 Input data:

The program was run with 2 fleets, Fleet 1 corresponds to the A-fleet and Fleet 2 corresponds to fleets B, C and D combined.

Stock numbers in the initial year 2005 and their variance-covariance matrix were taken from the current ICA output (ica.n and ica.vc)

The stock-recruitment function was the same as used in June 2004. It assumed recruitment of 49342 millions independent of SSB at SSB larger than 547 thousand tonnes, and a linear reduction of the recruitment at lower SSB. The recruitment was drawn from a log-normal distribution with $\sigma = 0.572$. A comparison of the ensuing model recruitments with historical recruitments (except those generated by a SSB below 547 000 tonnes) is given in Figure 2.8.2.

For weights and maturities historical data were used, by drawing years randomly and using data from that year.

Fleetwise selection at age were equal to those used in the short term prediction (Table 2.7.1)

For the intermediate year, fleetwise fishing mortalities at Fstatus quo (Fleet 1: 0.24, Fleet 2: 0.049) were assumed.

2.8.2 Harvest rule:

The harvest rule agreed by Norway and EU from 2004 was simulated:

At SSB > 1.3 million tonnes: F0-1 = 0.12 and F2-6 = 0.25

At SSB < 1.3 million tonnes and SSB > 800 000 tonnes:

F0-1 = 0.12 – (0.08*(1300 000 – SSB)/500 000)

F2-6 = 0.25 – (0.15*(1300 000 – SSB)/500 000)

For SSB < 800 000 tonnes: F0-1 = 0.04 and F2-6 = 0.10

In addition, there is a constraint of 15% on the year-to-year change in TAC. A larger reduction can be implemented, but was not simulated, as the criteria for deviating from the 15% rule are not precisely known.

The agreement does not state the year which the SSB refers to. The SSB considered by STPR3 is the SSB in the quota year.

2.8.3 Simulation options:

Three HCR scenarios were studied:

1. The rule as agreed by Norway and the EU (Figure 2.8.a)
2. The rule as agreed by Norway and the EU, but with a F0-1 of 0.05 instead of 0.12 (Figure 2.8.b)
3. The rule as agreed by Norway and the EU but without the lower bound on year to year change in TAC (Figure 2.8.c)

Simulations were made where the HCR was applied to precise estimates of the stock, and were implemented precisely as decided. Furthermore, deviations were simulated by using random multiplies as follows:

i. No deviation, but CV = 0.1 on both assessment and implementation error.
ii. Assessment error: mean 1.1, CV: 0.1; Implementation error: mean 1.1, CV: 0.1
iii. Assessment error: mean 1.2, CV: 0.1; Implementation error: mean 1.2, CV: 0.1

The results are shown in Figures 2.8.3 a-c as probability that the 'true' SSB (i.e. in the operating model) is below 800 000 tonnes and 1300 000 tonnes. Furthermore, percentiles by year are shown for SSB and realised fishing mortalities for each of the fleets.

2.8.4 Results

The results are shown in Figures 2.8.3 a-c. In all cases, the SSB goes down at least until 2008, which is to be expected when 3 poor year classes enter the stock in succession. In the ideal world, where both assessment and implementation are unbiased, the stock seems to recover, and the risk for the SSB falling below 1.3 million tonnes is relatively small. However, even moderate bias in assessment or implementation, leading to a larger removal than corresponding to the intended fishing mortality, carries a considerable risk of bringing the stock out of control, with an escalating fishing mortality and a deteriorating spawning stock. Not only is there a risk of bringing the stock below reference levels, the agreed rule does not seem to be sufficient to rebuild the stock if it cannot be strictly adhered to.

Having a lower fishing mortality on the juveniles, as it has been in the recent years, will reduce the risk of falling below reference levels, and enable rebuilding, even with a moderate bias in assessment and implementation. If the bias is more severe (20% on both assessment and implementation), this modification of the harvest rule cannot prevent the stock from getting out of control.

Applying a larger reduction in TAC than 15% whenever needed, as the agreed rule allows for, is helpful in the sense that it prevents the fishing mortality from coming out of control.

The present situation, with 3 poor year classes in succession, is exceptional in the sense that it is unlikely to occur when drawing recruitments randomly in a simulation routine. The performance of the present harvest rule is a best marginal in this situation, since it may easily break down if assessment and/or implementation are sufficiently biased. As noted in Section 2.10, the present assessment may possibly be an overestimate, and the TACs in the consumption fishery have regularly been overfished.

Allowance for efficient reduction of the TACs at an early stage increases the robustness of the regime. In particular, too great a constraint on reduction of the outtake when the stock is declining may lead into a vicious circle, which is clearly demonstrated in some of the examples here. The simulations also show the beneficial effect of reducing the fishing mortality on juveniles. The effect of a lower fishing mortality on adults was not explored in this study. An additional problem is that the effect of the juvenile fishery is dependent on the assumed natural mortality, which is high. Exploring the validity of these high natural mortalities, which are derived from the MSVPA, and the impact of the assumed natural mortality on the performance of the harvest rule ought to be explored, but was outside reach of this WG.

2.9 Precautionary reference points

In 2003, SGPRP (ICES 2003 ACFM:04) suggested to reduce B_{lim} from the current 800 000 tonnes to about 560 000 tonnes, based on the results of the segmented regression analysis of the stock and recruitment data. Fitting an “Ockham Razor” stock-recruit function with non-linear minimisation of the SSQ of log residuals (section 2.8) suggests a break point at 537 000 tonnes. Although it is apparent that the recruitment historically has been at about the same level when the SSB was somewhat below 800 000 tonnes as above, HAWG decided not to propose any revision of the reference points at present for the following reasons:

- There is some doubt as to the validity of the calculation procedure used by the SGPRP
- HAWG would prefer to consider all reference points together, rather than revising just B_{lim}.

Moreover, the harvest control rule in place for this stock worked well in the recent past, and apart from B_{lim}, the current reference points are derived from this HCR. The target F in the HCR was adopted by ACFM as F_{pa}, while the trigger point at which F should be reduced below the target is adopted as B_{pa}. Future revisions of the reference points should not trigger alterations in this HCR (see section 2.8).

2.10 Quality of the Assessment

2.10.1 Sensitivity of the assessment to sampling variability in the input data

The influence of sampling variability in the input data on the output of the assessment has been explored through the bootstrap analysis, documented in SGEHAP report (ICES 2003). This was reported in detail in the 2003 Working Group report. All the analyses carried out by this method are conditional on the total catch in tonnes, the Working Group choice of fixed natural mortality and the choice of assessment method ICA (Patterson 1998, and Needle 2000) with predefined inverse variance weighting of the data. The model formulation and index weighting are described in Section 2.6.1. The study showed that estimates of terminal SSB and $F_{2\text{-}6}$ are the most sensitive to the precision of the Acoustic survey, which is the most precise survey for adults. The IBTS, MIK and MLAI surveys form a second group with precision influencing the results to a lesser extent. The variability due to sampling for estimates of catch in numbers at age, the weights-at-age in the stock and the fraction mature form a third group of factors, and these have the least influence. SSB does vary a little due to sampling errors in mean weights and maturity but F is almost independent of these parameters. The results show that the estimates of TAC were almost equal dependent on Acoustic survey IBTS and MIK, with some influence from catch at age and MLAI but almost no influence from maturity or mean weights in the stock.

2.10.2 Weighing of indices and catch in the assessment

The tuning index weighting in the ICA assessment was considered in detail (Simmonds, 2003) and the resulting weights are given in Table 2.6.1.2 The relatively high weights on catch (3.17 & 2.65 for 2wr and 3wr herring respectively) do not make the assessment overly dependent on measurement variability in the catch. The effect of down weighting the catch can be seen in Figure 2.6.1.3, confirming that these weights have little influence on the estimate of terminal F or SSB, increased weights do provide some stability rather than determining the terminal values.

The adaptive weighting from the XSA assessment (presented in section 2.6) are given in Table 2.10.1. The weighting of indices in the current assessment can be compared to weighting in the XSA assessment. XSA weighting is adaptive changing weighting within the model. The weighting values are taken directly from the model output tables. It is difficult to compare these values directly. But the general structure of weighting among the surveys is similar. The highest weights go to the MIK for the 2003 yearclass (0wr). Weighting is shared almost equally between IBTS and the acoustic survey for 2002 yearclass (1wr) with increasing weight to the acoustic survey and declining weight to the IBTS as the year classes get older.

2.10.3 Sensitivity to measured maturity

The fraction of the 2000 yearclass that spawned for the first time in 2003, estimated from the 2003 and 2004 acoustic survey, was 43% of the yearclass in 2003 and 65% in 2004. This is close to the lowest fraction mature in the recent history of the stock (1984-2002) and compares with values at age 2wr of 77% and 86% in 2001 and 2002 and 97% and 93% at age 3wr in 2002 and 2003 respectively. The source of the data is discussed in section 2.4.2. The weight at age for the 2000 yearclass has also been well below average since 2003 (see table 2.4.1). The data support the view that there is a significant decrease in fraction mature, which is probably due to slow growth of this very large yearclass. The implications for the assessment is that the SSB is estimated as lower than would otherwise be the case. The effect was evaluated by comparing of growth and maturity data from the acoustic survey in previous years. This shows that had all the 2-ring herring both grown and matured at a rate equal to the average of the previous 3 years (95% mature) this would have resulted in an increase in SSB of 21% or 2.29 Mt.

2.10.4 Use of tuning indices in the 2005 assessment

In this year's surveys, the IBTS and MLAI surveys display a substantial upward trend in SSB, in contrast to the Acoustic index that shows a small decline. In single fleet tuning of the ICA assessment these translate into Acoustic Index: 2% decline, IBTS: 9% increase and MLAI: 14% increase in SSB from 2003 to 2004. The MIK can also be used to tune the assessment but as this only provides a recruitment index the results are not that informative as a tuning index for the older parts of the population. ICA provides a variance/covariance method to bootstrap parameters estimated in the assessment. The scatter plot from 100 bootstrap estimates (Figure 2.10.3) are shown together with the locations of the individual assessments using indices on their own. The spread of terminal F and SSB is consistent among indices and with the combined assessment. The Acoustic survey suggests a lower SSB and higher F, the MLAI the highest SSB and lowest F. From it can be seen that although there is a difference in perception of SSB when using each index separately they individually lie within the spread of the bootstrap evaluation of precision indicating that they individually lie within the confidence intervals for the assessment.

2.10.5 Comparison with the 2004 assessment and projection

The 2005 assessment is in good agreement with last years assessment see table below.

ASSESSMENT YEAR	SSB IN 2003	F2-6 IN 2003	SSB IN 2004	F IN 2004
2004	**1.74 M t**	**0.24**	**Projected 2.01 Mt**	**Projected 0.25**
2003	**1.73 M t**	**0.25**	**Assessed 1.89 Mt**	**Assessed 0.25**

These values are in relatively good agreement, F is consistent and SSB projected for 2004 was only a 6% overestimate of the current assessment. Last year's projection accounted for the reduced fraction mature of the 2000 year class so the projected and assessed SSB should be comparable within the context of the precision of the assessment..

2.10.6 Uncertainty in the 2005 assessment

The current estimate of SSB is dominated by the highly abundant 3-ringers in 2004. Figure 2.10.1 provides a scatter plot of F against SSB for this assessment, the spread of SSB is slightly wider than in 2004 suggesting a less precise assessment than last year.

As noted in Section 2.6.1 there was some clustering of negative residuals in both the acoustic and IBTS survey data. Figure 2.10.2 shows the residuals averaged over ages and over 3 years, to highlight the trends. The acoustic survey residuals at older ages have a clear downwards trend since about 1996, indicating that increasingly less fish is found in the survey, compared to that indicated by the ICA model. There is no similar trend at the youngest ages. A similar analysis of trends in the IBTS survey are less clear because the survey is noisy, and this survey does not cover the older ages well but over a longer time period there is a shift in exploitation between survey and assessment. The same information is only available for 5 years for catch, so trends are not that meaningful.

The mortality signal as inferred from the log survey index ratios (Figure 2.10.3) show no trends in the surveys. The log catch ratio shows a downward trend for the older ages. If it can be assumed that survey catchability is constant over time, the surveys indicate a rather stable mortality. The declining trend in log catch ratios would then most likely be caused by a relative increase in exploitation a older age, i.e. a twisting of the selection at age. It is a twisted selection at age that thus emerges as the most plausible cause of the discrepancy between trends in catch and survey residuals. The impact of such twisting on the assessment is not straightforward, as it is influenced both by the relative strengths of the conflicting signals, and of secondary effects when attempting to improve the fit. The fit to the relatively high catches at old age in recent years could be improved by

1. raising those cohorts in the modelled population.
2. increasing the fishing mortality in 2004 or
3. increasing the selection at old age.

Increasing these cohorts is contradicted by the survey data. Increasing the fishing mortality would give a better fit to the survey data, but is contradicted by the low catches at young age. The selection at age is a compromise between the requirements in the beginning and the end of the separable period.

To elucidate the effect of the twisting of selection at age, some alternative assessments were made for comparison and have already been presented in the data exploration. An XSA which does not fit a fixed selection pattern gave a less marked rise in SSB in recent years and a higher F. A less marked rise in SSB was also seen in a run with SURBA, which uses only the survey data. Though SURBA is rather noisy, especially in the last years and XSA might be expected to lift the F through the action of shrinkage. Both these indicate that within an ICA assessment the effect of a twisting in selection with the low catches at young age in 2004 lead to a low estimate of terminal F and a high estimate of the recent SSB. Finally, runs of ICA with down-weighting of the all catches and just with ages 1-2 in 2004 also indicated that these data had some effect on the SSB estimate in recent years (Figure 2.6.1.3).

The effect of down-weighting on young ages in the catch on the final estimate of terminal F, and on the estimate of stock abundance, in the recent years, and the finding that most alternative procedures give lower estimates for the SSB in the final year, suggest that the present update assessment may have a higher probability of overestimating the stock and underestimating the fishing mortality.

The formulation of the assessment was recently supported by an external and independent review of the North Sea herring assessment carried out for the North Sea Commission Fisheries Partnership, where the consistency, precision and quality of the assessment were judged as credible and fully acceptable as a tool for management advice. All these changes discussed here are well within the precision of the assessment, and there is no way to determine conclusively whether the residuals are caused by year effects in the surveys, or changes in fishing pattern, though the latter is thought more probable as the TAC has recently increased giving opportunity for changes in fishing behaviour.

Experience from earlier years (2003 HAWG report) suggest that tinkering with the selection pattern and down-weighting individual observations in catch while looking plausible in an assessment year were found to be less stable than continuing with a fixed separable period. Nevertheless, further exploration of what would be an appropriate method for assessing the stock should be undertaken, but is outside the scope of an update assessment, requiring preparation before a HAWG, preferably within the framework of a benchmark assessment in 2006 and HAWG recommend that this should be required.

However, in this context it is important to remember that the conclusions that; the stock has increased markedly in recent years, that the fishing mortality is at a moderate level, and that recruitment has been low since 2001, are robust across models and assumptions.

2.10.7 Comparison with earlier assessments

An historic retrospective of assessments by sequential working groups is presented in Figure 2.10.4. Values for retrospective bias and standard error (Jónsson and Hjörleifsson 2000) are presented in the figures. The magnitude of the revision seems to be different in different periods, it is less in the last four years (2000-2003) than for the years 1998 and 1999, and then improves again in 1996 and 1997. It is thought this period of the assessment has been made more difficult due to the difficulties in modelling the change in the fishery from 1996 and 1997, following the changes in management At the time the model was adapted annually to cope with this but retrospectives from today indicate that the current fixed assessment would have been better than the attempts to model the changes. This perception that tinkering did not help is one reason for suggesting that it is better to follow the current assessment model for one more year and to review the whole procedure as a bench mark assessment in 2006.

Cohort retrospectives are shown in Figure 2.10.5. The 2000 year class (93,000 million) is thought to be third highest in the history of the stock since 1960, at 97% above geometric mean recruitment (1983-2002), and larger than the 1998 year class (71,000 million) which has provided the recent large rise in the SSB. Both these cohorts have been estimated with little change from year to year. Estimates of incoming year classes (2001-2003) are still variable in particular the 2001 year class (3-ring herring in 2005) which has been estimated by the MIK at 0-ring, IBTS at 3,2&1 and Acoustic index at 2&1-ring is particularly variable; these estimates are not all in good agreement but do confirm the yearclass is small. The current estimate of 42,000 million is 12% below geometric mean and reduced from last. The 2002 year class (2-ring in 2005) is estimated by the MIK and the IBTS and acoustic surveys which are in relatively good agreement and is thought to be low at about 42% of geometric mean recruitment (this was estimated at 40% and 43% of geometric mean recruitment in 2003 and 2004 respectively). The 2003 yearclass is estimated by MIKand IBTS and is even lower at 40% of geometric mean recruitment. The 2004 year class (not shown in Figure 2.10.5) is only estimated by the MIK and is also a low yearclass at 47% of geometric mean.

The retrospective selection patterns show a marked change in 2001 (Figure 2.6.2.24), this is probably due to separable period moving back through time of the change in the catching behaviour and management of the fishery in 1996. The fitted selection in 2004 suggests lower exploitation of juveniles than in earlier periods.

2.10.8 Predictions

The short-term prediction method was substantially modified in 2002. Following the review by SGEHAP (ICES 2001/ACFM:22), which recommended that a simple multi-fleet method would be preferable, the complex split-factor method used for a number of years prior to 2002 has not been used since. The multi-fleet, multi-option, deterministic short-term prediction programme (MFSP) was accepted by ACFM and was developed further last year. It is intended to continue to use this programme in the future. Last year’s short-term prediction suggested that the North Sea autumn-spawning herring stock SSB in 2005 would be around 2.01 Mt. This compares reasonably well with this year’s estimate of the 2005 SSB which is 1.89 Mt, a reduction of 6%. Both projection and estimate take low maturation into account. This demonstrates that the current prediction procedure for stock numbers is working reasonably well. The Working Group has included prediction of low maturation into projections for 2006 and expects to monitor growth and maturation of North Sea herring carefully in the future and when deemed necessary will include these changes in predictions in the future.

Simmonds, E. J. (2003). "Weighting of acoustic- and trawl-survey indices for the assessment of North Sea herring." ICES J. Mar. Sci. **60**: 463-471.

2.11 Herring in Division IVc and VIId (Downs Herring)

Over many years the working group has attempted to assess the contribution of winter spawning Downs herring to the overall population of North Sea herring. There is a separate TAC for herring in Divisions IVc and VIId as part of the total North Sea TAC. The TAC for IVc and VIId in 2005 was increased from 66,098 tonnes to 74,293 tonnes, the highest TAC in the last 20 years and since the recovery of the stock (Table 2.11.1, Figure 2.11.1). This was a 11% increase on the TAC from 2004 and represent 1.75 times of the long term mean TAC for Downs, and 14% of the total TAC for North Sea Autumn spawning herring.

ACFM has been concerned that the TAC should not be raised faster than the whole TAC for North Sea herring, and suggested in 2004 that the TAC for IVc and VIId should be approximately 11% of the total TAC for North Sea Autumn spawning herring. ACFM also noted with concern the wide scale and historic tendency to over fish the TAC in IVc and VIId.

The strong 2000 year class dominated recent catches in IVc and VIId, making up 55% and 69% of the catch by number in 2003 and 2004 respectively. As has been noted previously these fish are smaller than average for their age and also have a lower proportion mature than average. In 2004 the amount of overfishing appears to have reduced to 3% of the TAC, which is well within the error of catch-estimation.

Historically the Downs herring has been thought as highly sensitive to overexploitation (Burd, 1985; Cushing 1968; 1992). It is less fecund and expresses different growth dynamics and recruitment patterns to the more northern spawning components. Further more the targeted fishery in quarters 4 and 1, operates on aggregations of spawning herring. The Downs herring mixes with other components of North Sea herring in the summer whilst feeding. Hence, it has been impossible to determine the complete catch of the Downs herring as the catch of the summer fishery contains different components.

The proportion of the autumn and winter spawning components in North Sea herring has been traditionally monitored through the abundance of different sized fish in the IBTS. 1 wr fish from Downs spawning sites (winter) are thought to be smaller than those from the more northern, autumn spawning sites (<13 cm and >13 cm respectively). Both the total abundance of smaller 1wr fish and the proportion that is smaller have increased in recent years (Figure 2.11.2). These data suggest that 30% of the strong 2000 year class came from Downs production, and that approximately 70% of the weaker 2002 year class originates from Downs production.

Further evidence on the role of Downs herring became available in 2003 and 2004. Two projects used microstructure of the otoliths to determine spawner type. In July 2003, 17% of the fish in a sample caught to the immediate east of Shetland were winter spawners. In 2004, over 20 samples from the landings of the Dutch fleet were sampled in May to July. These samples came from the central and northern North Sea and contained both autumn and winter spawners (see WD 1). The majority of fish in the majority of samples were winter spawners (Fig. 2.11.3). When these values were raised to total Dutch catch in quarters 2 and 3, winter spawners accounted for 59% of the catch and autumn spawners for 39%. Hence the Dutch fleet which is the major exploiter of the Downs herring in December and January was also relying on Downs fish during their summer fishery in 2004. The size of these fish suggests that they were mostly from the 2000 year class, although no annual ageing of the fish was carried out.

2000 and 2002 year classes- It is apparent that the Downs component can, and did in 2004, make a sizable contribution to the total fishery on the North Sea herring stock (at least 93 k tonnes from identifiable sources). This contribution was mostly by the 2000 year class. In the future, there is a suggestion that the proportionate contribution may be larger for the 2002 yearclass (Figure 2.11.2).

2003 and 2004 year classes- It appears probable that the recruitment for the 2003 and 2004 year classes of Downs herring is poor (Figure 2.11.4), based on the MIK index for the southern North Sea, and the concordance between the estimates from the MIK survey and the IBTS 1wr estimates (<13cm). This is despite the high larval abundances for these years (but the larval estimates have high variance). Hence it is probable that the productivity of the Downs component will reduce over the next few years, as the 2000 and 2002 year classes are fished out.

The Downs herring has returned to its pre-collapse state of being a major component of the stock but is currently dominated by one year class. Hence the management of the fishery on the spawning aggregations of Downs herring should more cautious. More evidence about the dynamics and catches of Downs herring is required. Hence, HAWG recommends that the existing surveys of herring in the southern North Sea and English Channel be maintained and that the microincrement analysis of otoliths (to determine spawning type) is expanded to other fleets in the North Sea and also carried out on samples collected during the annual acoustic survey.

The IVc and VIId TAC is specific to the conservation of the spawning aggregation of Downs herring. Downs herring is caught in large numbers in other areas during the rest of the year. The TAC is the highest in 20 years and low recruitment to the component is probable in the next few years. Thus, HAWG recommends as a preliminary measure that the IVc-VIId TAC should be reduced now to 11% of the total North Sea TAC (as recommended by ACFM) as a matter of urgency, and that research effort into the dynamics of this component be increased.

2.12 Management Considerations

Based on the most recent estimates of SSB and fishing mortality, the North Sea autumn spawning herring stock is considered to have full reproductive capacity and to be harvested sustainably. SSB in 2004 was estimated at 1.89 million t and is expected to increase to decrease to 1.82 million tonnes in 2005, which is above the $\mathbf{B}_{pa}$ of 1.3 million t. SSB has now peaked since the rise from the low stock size in the mid-1990s, in response to reduced catches, strong recruitment and management measures that reduced exploitation both on juveniles and adults. The stock is managed according to the EU-Norway Management agreement which was updated on 26 November 2004, the relevant parts of the text are included here for reference:-

1. *Every effort shall be made to maintain a level of Spawning Stock Biomass (SSB) greater than the 800,000 tonnes (Blim).*
2. *Where the SSB is estimated to be above 1.3 million tonnes the Parties agree to set quotas for the directed fishery and for by-catches in other fisheries , reflecting a fishing mortality rate of no more than 0.25 for 2 ringers and older and no more than 0.12 for 0-1 ringers.*
3. *Where the SSB is estimated to be below 1.3 million tonnes but above 800,000 tonnes, the Parties agree to set quotas for the direct fishery and for by-catches in other fisheries, reflecting a fishing mortality rate equal to:*
4. *0.25 – (0.15*(1,300,000-SSB)/500,000) for 2 ringers and older, and*
5. *0.12 – (0.08*(1,300,000-SSB)/500,000) for 0-1 ringers.*
6. *Where the SSB is estimated to be below 800,000 tonnes the Parties agree to set quotas for the directed fishery and for by-catches in other fisheries, reflecting a fishing mortality rate of less than 0.1 for 2 ringers and older and less than 0.04 for 0-1ringers.*
7. *Where the rules in paragraphs 2 and 3 would lead to a TAC which deviates by more than 15% from the TAC of the preceding year the Parties shall fix a TAC that is no more than 15% greater or 15% less than the TAC of the preceding year.*
8. *Not withstanding paragraph 5 the Parties may, where considered appropriate, reduce the TAC by more than 15% compared to theTAC of the preceding year.*
9. *By-catches of herring may only be landed in ports where adequate sampling schemes to effectively monitor the landings have been set up. All catches landed shall be deducted from the respective quotas set, and the fisheries shall be stopped immediately in the event that the quotas are exhausted*
10. *The allocation of TAC for the directed fishery for herring shall be 29% to Norway and 71% to the Community. The by-catch quota for herring shall be allocated to the Community*
11. *A review of this arrangement shall take place no later than 31 December 2007 .*
12. *This arrangement enters in to force on 1 January 2005.*

Landings of adult herring in recent years have consistently exceeded the agreed TAC, mainly due to unallocated catches and catches misreported into and out of the North Sea (see section 2.1).

The 1998 year class and the 2000 year classes appear to be very strong in all the surveys and in the catches. They will comprise 26% and 13% of SSB in 2005 respectively. In the past large year classes have tended to have a lower maturation rate than the long-term average. These signals have not been detected for the 1998 year class as the proportion mature appears to be above average. However, the 2000 year class has been seen to exhibit a reduced growth and maturation in 2003 and 2004. As this is expected to continue in 2004, the reduction has been taken into account for the short-term projections.

The ICES advice for 2006 is based on the projected SSB in 2006 being above 1.3 million t. SSB in 2006 depends on the fisheries in 2004 and that part in 2005 that takes place before spawning. About 2/3 of the total mortality is expected to be realised before spawning each year. The increase in SSB projected for 2005 depends on the incoming 2002 year class surveys suggest that this is one of the lowest observed in the last 23 years. Generally, the surveys provide more reliable indications of year class strength than the catches of juveniles do. The 2003 yearclass is also estimated as low and initial estimates of the 2004 year class is that it is also low and only slightly above the 2002 and 2003 year classes. It is anticipated that with three small year classes in a row the stock will now decline for a number of years.

The HCR that conforms to the management agreement given above has been tested with medium term simulation and the results are given in Section 2.8. The present situation, with 3 poor year classes in succession, is exceptional. The performance of the present harvest rule is at best marginal in this situation, since it may easily break down if assessment and/or implementation are sufficiently biased. As noted in Section 2.10, the present assessment may possibly be an overestimate, and the TACs in the consumption fishery have regularly been overfished. For this situation we need a HCR that is robust to errors in the assessment and implementation error, the current one is not thought to be sufficiently robust. As the stock is set to reduce more rapidly than expected, managers should be particularly cautious and ensure that reduction in TAC are sufficient to maintain F at the agreed level of F=0.25. In this context it would be advisable for managers to explicitly include implementation failure into the TAC, such as area misreporting, if they cannot ensure compliance.

Due to the current unusual circumstances of a clearly identified sequence of three poor recruiting year-classes of North Sea herring it is particularly important that management action should address the imminent decline of this stock with sufficient determination to ensure the safety of the spawning stock in the next few years.

Discards were so far considered to be relatively unproblematic in the North Sea herring fishery (less than 5% of the total catch, based on observer sampling programs). In 2002 for the first time, onboard sampling observed substantial discards of herring in the mackerel fishery in the 3rd and 4th quarter in Div. IVa(W). The discard figure used for the assessment was 17,000 t. For 2003, discarding was estimated at 4,100 t but for 2004 the estimate had risen again to 17,000 t. These estimates come from rather limited reports from discard programmes and may not include the full extent of discarding.

This stock complex also includes Downs herring (herring in Divisions IVc and VIId), which has shown independent trends in exploitation rate and recruitment, but cannot be assessed separately. This year the Working Group concludes that the current state of the component is unknown. The WG's understanding of the component's dynamics is unlikely to improve until further examination of catch and the existing time series of surveys takes place. Both, alternative assessment methods have to be explored, and a greater knowledge the ecology of Downs herring is needed. The Downs fishery is concentrated on the spawning aggregations in a restricted area, which makes this stock component particularly vulnerable to excessive fishing pressure. The EU splits its share of the total North Sea herring TAC (Subarea IV and Division VIId) into TACs for Divisions IVa+IVb and for Divisions IVc+VIId. In response to ICES advice in May 1996, the IVc+VIId TAC was reduced by 50% in line with reductions for the whole North Sea. The TAC for Downs herring was reduced to 25 000 t and remained there until 2001. The catches for this component have significantly exceeded the sub-TACs in all years since 1989. The sub-TAC was increased in 2002 (to 42,673 t) following the advice of ICES in 2001. Subsequently the TACs for 2003 to 2005, were increased first to 59,542 t, then to 66,098 t and finally to 74,293 t against the advice of ICES. The 2004 ACFM advice was *"that it should not increase faster than the TAC for the North Sea as a whole. [A] share of 11% on the total North Sea TAC (average share 1989-2002) would be an appropriate guide to distributing the harvesting among Downs herring"*

The IVc and VIId TAC is specific to the conservation of the spawning aggregation of Downs herring. Downs herring is caught in large numbers in other areas during the rest of the year. The TAC is the highest in 20 years and low recruitment to the component is probable in the next few years. Thus, HAWG recommends as a preliminary measure that the IVc-VIId TAC should be reduced now to 11% of the total North Sea TAC (as recommended by ACFM) as a matter of urgency, and that research effort into the dynamics of this component be increased.

Since the North Sea autumn spawning (NSAS) stock was rebuilt, the advise has been that the primary limiting factor for the fishery in IIIa should be the concern for the Western Baltic spring spawning (WBSS) stock. This affects advices for the C and D fleets operating in IIIa. This issue is dealt with in detail in the discussion of short term predictions in Section 2.7. and Section 3.10. Following the procedure set out in section 3.10 and assuming a total catch of WBSS of 95 000 tonnes (see Section 3.7) leads to a catch of 16 600 tonnes of NSAS herring for the C-fleet and 11 100 tonnes of NSAS herring for the D-fleet. For other catch options for WBSS herring options this procedure (Section 3.10) needs to be followed once the option for catch of WBSS herring has been finalised.

It has become increasingly clear that in previous years, large parts of the catches reported for IIIa were actually taken in the North Sea. For 2004, Norway was allowed to transfer all of its quota in IIIa to IV, while the EC could transfer 50% of its quota. For 2005, Norway could again transfer 50% of its quota in IIIa to IV, while the EC now cannot (See Section 3.10). Furthermore, the last 3 year classes of NSAS have been weak, implying relatively smaller amounts of NSAS in IIIa. Therefore, it seems likely that the current fleet behaviour, with relatively small catches of NSAS in IIIa, will continue in the coming year.

Table 2.1.1: HERRING caught in the North Sea (Sub-area IV and Division VIId).
Catch in tonnes by country, 1995–2004. These figures do not in all cases correspond to the official statistics and cannot be used for legal purposes.

Country	1995 [9]	1996 [9]	1997 [9]	1998 [9]	1999 [9]
Belgium	-	-	1	-	2
Denmark	153361	66733	38324	58924	61268
Faroe Islands	2018	815	1156	1246	1977
France	29503	12500	14525	20784	26962
Germany, Fed.Rep	43299	14215	13380	22259	26764
Netherlands	82286	42792	35985	49933	54467
Norway [4]	131026	43739	41606	70981	74071
Sweden	5147	2458	2253	3221	3241
USSR/Russia	-	-	1619	452	-
UK (England)	14899	6880	3470	7635	11434
UK (Scotland)	47944	17212	22582	31313	29911
UK (N.Ireland)	-	-	-	1015	-
Unallocated landings	6599 [12]	26069 [12]	63403 [,12]	70329 [12]	43327 [12]
Misreporting from VIaN		-	-		
Total landings	516082	233413	238304	338092	333424
Discards	-	-	-		
Total catch	**516082**	**233413**	**238304**	**338092**	**333424**
Estimates of the parts of the catches which have been allocated to spring spawning stocks					
IIIa type (WBSS)	10315	855	979	7833	4732
Thames estuary [5]	203	168	202	88	88
Norw. Spring Spawners [13]	9501	30274	54728	29220	32106

Country	2000 [9]	2001 [9]	2002	2003	2004 [1]
Belgium	-	-	23	5	8
Denmark [7]	64123	67096	70825	78606	99037
Faroe Islands	915	1082	1413	627	402
France	20952	24880 [14]	25422	31544	34521
Germany	26687	29779	27213	43953	41858
Netherlands	54341	51293	55257	81108	96162
Norway [4]	72072	75886 [1]	74974 [1]	112481 [1]	137638
Sweden	3046	3695	3418	4781	5692
Russia	-	-	-	-	-
UK (England)	11179	14582	13757	18639	20855
UK (Scotland)	30033	26719	30926	40292	45331
UK (N.Ireland)	996	1018	944	2010	2656
Unallocated landings	61673 [12]	27362 [12]	31552 [12]	31875 [12]	48898 [12]
Misreporting from VIaN					
Total landings	346017	323392 [14]	335724	445921	533058
Discards			17093	4125	17059
Total catch	**346017**	**323392** [14]	**352817**	**450046**	**550117**
Estimates of the parts of the catches which have been allocated to spring spawning stocks					
IIIa type (WBSS)	6649	6449	6652	2821	7079
Thames estuary [5]	76	107	60	84	62
Others [11]	378	1097	0	308	0
Norw. Spring Spawners [13]	25678	7108	4069	979	452

1 Preliminary.
4 Catches of Norwegian spring spawners removed (taken under a separate TAC).
5 Landings from the Thames estuary area are included in the North Sea catch figure for UK (England).
7 Including any bycatches in the industrial fishery
9 Figures verified and altered if needed in 2003 by SG Rednose (ICES 2003/ACFM:10)
10 Figure altered in 2001
11 Caught in the whole North Sea, partly included in the catch figure for The Netherlands
12 may include misreported catch from VIaN and discards
13 These catches (including some local fjord-type Spring Spawners) are taken by Norway under a separate quota so of 62°N and are not included in the Norwegian North Sea catch figure for this area.
14 Figure altered in 2004

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

Country	1995 [#]	1996 [#]	1997 [#]	1998 [#]	1999 [11]
Denmark	17748	3183	2657	4634	15359
Faroe Islands	2018	815	1156	1246	1977
France	10427	3177	362	4758	6369
Germany	17095	2167	4576	7753	11206
Netherlands	27205	7714	6072	10917	21552
Norway	56124	22187	16869	27290	31395
Sweden	1007	769	1617	315	859
Russia	-	-	1619	452	-
UK (England)	3315	2391	49	4306	7999
UK (Scotland)	43204	12763	17121	29462	28537
UK (N. Ireland)	-	-	-	1015	-
Unallocated landings	-2556 [8]	12681 [8]	40662 [5,8]	56058 [8]	25469 [8]
Misreporting from VIa North					
Total Landings	175587	67847	92760	148206	150722
Discards					
Total catch	**175587**	**67847**	**92760**	**148206**	**150722**

Country	2000 [#]	2001 [#]	2002	2003	2004 [1]
Denmark [7]	25530	17770	26422	48358	48128
Faroe Islands	205	192	-	95	-
France	3210	8164	10522	11237	10941
Germany	5811	17753	15189	25796	17559
Netherlands	15117	17503 [10]	18289	25045	43876
Norway	33164	11653 [1]	10836 [1]	34443	36119
Sweden	1479	1418	2397	2647	2178
Russia	-	-	-	-	-
UK (England)	8859	12283	10142	12030	13480
UK (Scotland)	29055	25105	30014	39970	43490
UK (N. Ireland)	996	1018	944	2010	2656
Unallocated landings	44334 [8]	24725 [8]	14201 [8]	14115 [8]	28631 [8]
Misreporting from VIa North					
Total Landings	167760	137584	138956	215746	247058
Discards			17093	4125	15794
Total catch	**167760**	**137584**	**156049**	**219871**	**262852**

1 Preliminary.
4 Including IVa East.
5 Negative unallocated catches due to misreporting from other areas.
6 Altered in 2000 on the basis of a Bayesian assessment on misreporting into VIa (North)
7 Including any bycatches in the industrial fishery
8 May include misreported catch from VIaN and discards
9 Figure altered in 2001
10 Including 1057 t of local spring spawners
11 Figures verified and altered if needed in 2003 by SG Rednose (ICES 2003/ACFM:10)

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

Country	**1995** 7	**1996** 7	**1997** 7	**1998** 7	**1999** 7
Denmark 5	45257	19166	22862	25750	18259
Faroe Islands	-	-	-	-	-
France	4	-	3	-	115
Germany	-	-	-	-	-
Netherlands	167	-	756	301	-
Norway 2	62224	18256	20975	43646	39977
Sweden	2211	1119	422	1189	772
Unallocated landings	-132 4	-	-756 4	-292 4	-
Total landings	109731	38541	44262	70594	59123
Discards	-	-	-	-	-
Total catch	**109731**	**38541**	**44262**	**70594**	**59123**
Norw. Spring Spawners 6	9501	30274	54728	29220	32106

Country	**2000** 7	**2001** 7	**2002**	**2003** 1	**2004** 1
Denmark 5	11300	18466	17846	7401	16278
Faroe Islands	710	890	1365	359	-
France	-	-	-	-	-
Germany	29	-	81	54	888
Netherlands	38	-	-	-	-
Norway 2	38655	56904 1	63482 1	62306	100443
Sweden	1177	517	568	1529	1720
Unallocated landings	338	o	5961	11991	0
Total landings	52247	76777	89303	83640	119329
Discards	-	-	-	-	-
Total catch	**52247**	**76777**	**89303**	**83640**	**119329**
Norw. Spring Spawners 6	25678	7108	4069	979	452

1 Preliminary
2 Catches of Norwegian spring spawners herring removed (taken under a separate TAC).
3 Included in IVa West.
4 Negative unallocated catches due to misreporting into other areas.
5 Including any bycatches in the industrial fishery
6 These catches (including some local fjord-type Spring Spawners) are taken by Norway under a separate quota south of 62°N and are not included in the Norwegian North Sea catch figure for this area.
7 Figures verified and altered if needed in 2003 by SG Rednose (ICES 2003/ACFM:10)

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

Country	1995 [6]	1996 [6]	1997 [6]	1998 [6]	1999 [6]
Belgium	-	-	-	-	1
Denmark [4]	87917	43749	11558	26667	26211
Faroe Islands	-	-	-	-	-
France	7639	2373	6069	8945	7634
Germany	21209	11051	7455	13590	13529
Netherlands	31025	21053	14976	27468	22343
Norway	12678	3296	3762	45	2699
Sweden	1929	570	214	1717	1610
UK (England)	9688	2757	2033	1767	1641
UK (Scotland)	4700	4449	5461	1851	1374
Unallocated landings	-12552 [3]	-17313 [5]	-3744 [5]	-12138 [5]	-3794 [5]
Total landings	164233	71985	47784	69912	73248
Discards [2]	-				
Total catch	**164233**	**71985**	**47784**	**69912**	**73248**

Country	2000 [6]	2001 [6]	2002	2003 [1]	2004 [1]
Belgium	-	-	-	-	-
Denmark [4]	26825	30277	26387	22574	33857
Faroe Islands	-	-	48	173	402
France	10863	7796 [14]	4214	7918	10592
Germany	18818	8340	7577	12116	13823
Netherlands	26839	24160	13154	19115	23649
Norway	253	7329 [1]	656 [1]	15732	1076
Sweden	390	1760	453	605	1794
UK (England)	669	814	317	2632	2864
UK (Scotland)	978	1614	289	322	1841
Unallocated landings	-9820 [5]	-22885 [5]	4052	-2401	8300
Total landings	75815	59205	57147	78786	98198
Discards [2]					1265
Total catch	**75815**	**59205** [14]	**57147**	**78786**	**99463**

1 Preliminary
2 Discards partly included in unallocated
3 Negative unallocated catches due to misreporting from other areas.
4 Including any bycatches in the industrial fishery
5 May include discards. Negative unallocated due to misreporting into other areas.
6 Figures verified and altered if needed in 2003 by SG Rednose (ICES 2003/ACFM:10)
14 Figure altered in 2004

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

Country	**1995** 9	**1996** 9	**1997** 9	**1998** 9	**1999** 9
Belgium	-	-	1	-	1
Denmark	2439	635	1247	1873	1439
France	11433	6950	8091	7081	12844
Germany	4996	997	1349	916	2029
Netherlands	23889	14024	14181	11247	10572
UK (England)	1895	1733	1388	1562	1794
UK (Scotland)	40	-	-	-	-
Unallocated landings	21840 4	30702 4	27241 4	26701 4	21652 4
Total landings	66532	55041	53498	49380	50331
Discards 3					
Total catch	**66532**	**55041**	**53498**	**49380**	**50331**
Coastal spring spawners included above 2	203	168	143	88	88

Country	**2000** 9	**2001** 9	**2002**	**2003** 1	**2004** 1
Belgium	1	-	23	5	8
Denmark	468	583	170	273	774
France	6879	8750	10686	12389	12988
Germany	2029	3686	4366	5987	9588
Netherlands	12348	9630	23814	36948	28637
UK (England)	1651	1485	3298	3977	4511
UK (Scotland)	-	-	623	-	-
Unallocated landings	26822 4	25522 4	7338	8170	11967
Total landings	50198	49656	50318	67749	68473
Discards 3			-	-	-
Total catch	**50198**	**49656**	**50318**	**67749**	**68473**
Coastal spring spawners included above 2	76	147 11	60	84	62

1 Preliminary
2 Landings from the Thames estuary area are included in the North Sea catch figure for UK (England).
3 Discards partly included in unallocated
4 May include misreported catch and discards.
9 Figures verified and altered if needed in 2003 by SG Rednose (ICES 2003/ACFM:10)
10 Figure altered in 2002 (was 7851 t higher before)
11 Thames/Blackwater herring landings: 107 t, others included in the catch figure for The Netherlands
14 Figure altered in 2004

Table 2.1.6 ("The Wonderful Table"): HERRING in Sub-area IV, Division VIId and Division IIIa. Figures in thousand tonnes.

Year	1989	1990	1991	1992	1993	1994	1995 #	1996 #	1997 #	1998 #	1999 #	2000 #	2001 #	2002	2003	2004	2005
Sub-Area IV and Division VIId: TAC (IV and VIId)																	
Recommended Divisions IVa, b [1]	484	373, 332	363 [6]	352	290 [7]	296 [7]	389 [11]	156	159	254	265	265	- #	- #	- #	- #	[22]
Recommended Divisions IVc, VIId	30	30	50-60 [6]	54	50	50	50	- [14]	- [14]	- [14]	- [14]	- [14]	- [14]	- [14]	- [14]	- [14]	[14]
Expected catch of spring spawners				10	8												
Agreed Divisions IVa,b [2]	484	385	370 [6]	380	380	390	390	263;131 [13]	134	229	240	240	240	223	340.5	393.9	460.7
Agreed Div. IVc, VIId	30	30	50 [6]	50	50	50	50	50; 25 [13]	25	25	25	25	25	42.7	59.5	66.1	74.3
Bycatch ceiling in the small mesh fishery									24	22	30	36	36	36	52.0	38.0	50.0
CATCH (IV and VIId)																	
National landings Divisions IVa,b [3]	639	499	495	481	463	421	465	183	149	245	261	261	272	261	354.5	427.7	
Unallocated landings Divisions IVa,b	-2	14	30	14	-1	6	-15	-5	36	44	22	35	2	24	23.7	36.9	
Discard/slipping Divisions IVa,b [4]	3	4	2	3	1	1	-	-	-	-	-	-	-	17	4.1	17.1	
Total catch Divisions IVa,b [5]	638	516	527	498	463	428	450	178	185	289	283	296	273	303	382.3	481.6	
National landings Divisions IVc, VIId [3]	30	24	42	37	32 [21]	42	45	24	26	23	29	23	24	43	59.5	56.5	
Unallocated landings Divisions IVc,VIId	48	32	16	35	43	30	22	31	27	27	22	27	26	7	8.2	12.0	
Discard/slipping Divisions IVc, VIId [4]	1	5	3	2	2	2	-	-	-	-	-	-	-	0	-	-	
Total catch Divisions IVc, VIId	79	61	61	74	77 [21]	74	67	55	53	49	50	50	50	50	67.7	68.5	
Total catch IV and VIId as used by ACFM [5]	**717**	**578**	**588**	**572**	**540** [21]	**498**	**516**	**233**	**238**	**338**	**333**	**346**	**323**	**353**	**450.0**	**550.1**	
CATCH BY FLEET/STOCK (IV and VIId) [10]																	
North Sea autumn spawners directed fisheries (Fleet A)	N.a.	N.a.	446	441	438	447	439	195	225	316	313	322	296	323	434.9	529.5	
North Sea autumn spawners industrial (Fleet B)	N.a.	N.a.	134	124	101	38	67	38	13	14	15	18	20	22	12.3	13.6	
North Sea autumn spawners in IV and VIId total	**696**	**569**	**580**	**564**	**539**	**485**	**506**	**233**	**237**	**330**	**329**	**339**	**317**	**346**	**447.2**	**543.0**	
Baltic-IIIa-type spring spawners in IV	20	8	8	8	9	13	10	1	1	8	5	7	6	7	2.8	7.1	
Coastal-type spring spawners	2.3	1.1	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	1.2	0.1	0.1	0.1	
Norw. Spring Spawners caught under a separate quota in	N.a.	4	5	5	9	6	10	30	55	29	32	26	7	4	1.0	0.5	
Division IIIa: TAC (IIIa)																	
Predicted catch of autumn spawners			96	153	102	77	98	48	35	58	43	53	- #	- #	- #	- #	- [22]
Recommended spring spawners	84	67	91	90	93–113	- [9]	- [12]	- [12]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- [15]	- #	- [22]
Recommended mixed clupeoids	80	60	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-
Agreed herring TAC	138	120	104.5	124	165	148	140	120	80	80	80	80	80	80	80.0	70.0	96.0
Agreed mixed clupeoid TAC	80	65	50	50	45	43	43	43									
Bycatch ceiling in the small mesh fishery									20	17	19	21	21	21	21.0	21.0	24.2
CATCH (IIIa)																	
National landings	192	202	188	227	214	168	157	115	83	120	86	108	90	79	76.0	61.1	
Catch as used by ACFM	162	195	191	227	214	168	140	105	74	108	79	99	82	73	68.1	52.7	
CATCH BY FLEET/STOCK (IIIa) [10]																	
Autumn spawners human consumption (Fleet C)	N.a.	N.a.	26	47	44	42	38	24	21	59	28 [17]	36	34	17	24.1	13.4	
Autumn spawners mixed clupeoid (Fleet D) [19]	N.a.	N.a.	13	23	25	12	6	9	4	6	8 [17]	13	12	9	8.4	10.8	
Autumn spawners other industrial landings (Fleet E)	N.a.	N.a.	38	82	63	32	29	8	2								
Autumn spawners in IIIa total	**91**	**77** [8]	**77**	**152**	**132**	**86**	**73**	**43**	**27**	**61**	**34** [17]	**49**	**46**	**26**	**32.5**	**24.2**	
Spring spawners human consumption (Fleet C)	N.a.	N.a.	68	53	68	59	44	58	43	40	40 [17]	45	33	38	31.6	16.8	
Spring spawners mixed clupeoid (Fleet D) [19]	N.a.	N.a.	5	2	1	1	2	4	3	3	3 [17]	5	3	9	4.0	11.2	
Spring spawners other industrial landings (Fleet E)	N.a.	N.a.	40	20	12	24	21	2	1								
Spring spawners in IIIa total	**71**	**118**	**113**	**75**	**81**	**84**	**67**	**64**	**47**	**43**	**43** #	**50**	**36**	**47**	**35.6**	**28.0**	
North Sea autumn spawners Total as used by ACFM	**787**	**646**	**657**	**716**	**671**	**571**	**579**	**275**	**264**	**392**	**363**	**388**	**363**	**372**	**479.7**	**567.2**	

[1] Includes catches in directed fishery and catches of 1-ringers in small mesh fishery up to 1992. [2] IVa,b and EC zone of IIa. [3] Provided by Working Group members. [4] Incomplete, only some countries providing discard information. Discards might also be included in un. [5] Includes spring spawners not included in assessment. [6] Revised during 1991. [7] Based on F=0.3 in directed fishery only; TAC advised for IVc, VIId subtracted. [8] Estimated. [9] 130-180 for spring spawners in all areas. [10] Based on sum-of-products (number x mean weight at age). [11] Status quo F catch for fleet A. [12] The catch should not exceed recent catch levels. [13] During the middle of 1996 revised to 50% of its original agreed TAC. [14] Included in IVa,b. [15] Managed in accordance with autumn spawners. [17] Figure altered in 2001 and again in 2004. [18] Data for 1995-2001 were verified and amended where necessary by SG REDNOSE in 2003. [19] Fleet D and E are merged from 1999 onwards. [20] These catches (including local fjord-type Spring Spawners) are taken by Norway under a separate quota south of 62°N and are not included in the Norwegian North Sea catch figure for this area. [21] figure altered in 2003 to account for earlier summarizing errors. [22] See catch option tables for different fleets.Shaded cells for the catch by fleet in Division IIIa indicate persisting inconsistencies which have to be resolved intersessionally.

Table 2.2.1: North Sea Autumn Spawning Herring (NSAS), and Western Baltic Spring Spawners (WBSS) caught in the North Sea 2004. Catch in numbers (millions) at age (CANUM), by quarter and division

WR	IIIa NSAS	IVa(E) all	IVa(E) WBBS	IVa(E) NSAS only	IVa(W)	IVb	IVc	VIId	IVa & IVb NSAS	IVc & VIId	Total NSAS	Herring caught in the North Sea
Quarters: 1-4												
0	88.4	0.0	0.0	0.0	0.0	619.3	7.9	0.0	619.3	7.9	715.6	627.2
1	70.9	0.0	0.0	0.0	0.1	133.2	2.5	0.0	133.3	2.5	206.7	135.8
2	179.9	98.3	15.1	83.2	66.1	80.8	5.7	23.1	230.0	28.8	438.8	274.0
3	20.7	230.3	27.9	202.4	484.6	250.0	47.1	321.3	937.0	368.4	1326.1	1333.3
4	6.0	102.5	3.5	99.0	288.2	81.7	6.0	38.5	469.0	44.5	519.5	517.0
5	9.7	179.0	4.1	174.9	395.2	86.0	7.1	53.3	656.1	60.4	726.2	720.6
6	1.8	66.3	1.0	65.3	61.0	17.4	2.8	22.8	143.8	25.6	171.1	170.3
7	2.0	25.7	0.5	25.2	53.1	11.8	0.0	9.1	90.1	9.1	101.2	99.7
8	0.9	15.4	0.1	15.3	38.8	9.6	0.6	6.0	63.6	6.6	71.1	70.4
9+	0.0	15.5	0.0	15.5	5.9	0.5	0.0	0.1	21.9	0.1	22.0	22.0
Sum	380.4	733.2	52.3	680.9	1393.0	1290.3	79.7	474.2	3364.2	553.8	4298.4	3970.3
Quarter: 1												
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	9.4	0.0	0.0	0.0	0.0	0.8	2.0	0.0	0.8	2.0	12.2	2.8
2	111.6	7.9	0.0	7.9	0.5	1.2	3.3	0.0	9.6	3.3	124.5	12.9
3	6.0	45.2	0.0	45.2	41.9	5.7	19.2	42.8	92.8	62.0	160.9	154.9
4	3.1	22.5	0.0	22.5	35.6	4.8	2.9	9.3	63.0	12.2	78.3	75.2
5	7.6	38.1	0.0	38.1	37.9	5.1	4.4	7.9	81.1	12.3	100.9	93.3
6	1.2	13.7	0.0	13.7	3.6	0.5	1.7	5.1	17.8	6.9	25.9	24.7
7	1.8	8.8	0.0	8.8	4.7	0.6	0.0	2.3	14.2	2.3	18.3	16.5
8	0.8	1.8	0.0	1.8	1.2	0.1	0.3	2.3	3.2	2.6	6.6	5.8
9+	0.0	0.4	0.0	0.4	0.1	0.0	0.0	0.0	0.5	0.0	0.5	0.5
Sum	141.6	138.6	0.0	138.6	125.6	18.8	33.8	69.9	283.0	103.7	528.2	386.6
Quarter: 2												
0	0.0	0.0	0.0	0.0	0.0	13.6	0.1	0.0	13.6	0.1	13.7	13.7
1	1.3	0.0	0.0	0.0	0.0	29.9	0.2	0.0	29.9	0.2	31.4	30.1
2	45.2	85.4	14.5	70.9	20.6	9.7	0.0	0.0	101.1	0.0	146.3	115.6
3	1.6	142.3	17.8	124.6	80.1	23.9	0.1	1.4	228.6	1.5	231.7	247.9
4	0.1	43.4	0.7	42.7	21.3	3.6	0.0	0.6	67.6	0.6	68.3	68.9
5	0.2	69.6	1.1	68.4	27.6	3.5	0.0	0.5	99.5	0.5	100.2	101.2
6	0.1	27.0	0.4	26.6	5.4	1.7	0.0	0.2	33.7	0.2	34.0	34.3
7	0.0	7.4	0.1	7.3	3.2	0.2	0.0	0.1	10.7	0.1	10.8	10.9
8	0.0	5.1	0.1	5.0	1.9	0.1	0.0	0.1	7.0	0.1	7.1	7.2
9+	0.0	2.5	0.0	2.5	0.1	0.0	0.0	0.0	2.7	0.0	2.7	2.7
Sum	48.4	382.8	34.8	348.0	160.3	86.2	0.4	2.8	594.4	3.2	646.1	632.4
			0.0									
Quarter: 3			0.0									
0	41.0	0.0	0.0	0.0	0.0	237.9	2.9	0.0	237.9	2.9	281.8	240.8
1	41.0	0.0	0.0	0.0	0.0	37.2	0.0	0.0	37.2	0.0	78.2	37.2
2	17.6	2.9	0.6	2.3	33.6	62.9	0.0	0.0	98.7	0.0	116.4	99.3
3	10.0	18.8	10.1	8.7	286.9	185.3	0.0	0.3	480.8	0.3	491.1	491.2
4	2.6	4.7	2.8	1.9	171.8	69.0	0.0	0.1	242.6	0.1	245.3	245.6
5	1.8	4.8	3.0	1.8	250.3	70.4	0.0	0.1	322.5	0.1	324.4	325.6
6	0.5	0.9	0.6	0.3	43.4	14.4	0.0	0.0	58.1	0.0	58.7	58.7
7	0.2	0.5	0.3	0.2	33.9	10.3	0.0	0.0	44.3	0.0	44.5	44.7
8	0.0	0.0	0.0	0.0	28.9	8.8	0.0	0.0	37.7	0.0	37.8	37.8
9+	0.0	0.0	0.0	0.0	4.6	0.4	0.0	0.0	5.1	0.0	5.1	5.1
Sum	114.7	32.6	17.5	15.1	853.4	696.5	2.9	0.5	1565.0	3.5	1683.2	1586.0
Quarter: 4												
0	47.4	0.0	0.0	0.0	0.0	367.8	4.9	0.0	367.8	4.9	420.1	372.6
1	19.1	0.0	0.0	0.0	0.1	65.3	0.3	0.0	65.4	0.3	84.9	65.8
2	5.5	2.1	0.0	2.1	11.5	7.1	2.4	23.1	20.7	25.4	51.6	46.1
3	3.1	24.0	0.0	24.0	75.7	35.1	27.8	276.8	134.8	304.6	442.5	439.3
4	0.3	32.0	0.0	32.0	59.4	4.4	3.1	28.4	95.7	31.5	127.5	127.2
5	0.2	66.6	0.0	66.6	79.4	7.0	2.7	44.7	153.1	47.5	200.7	200.5
6	0.0	24.8	0.0	24.8	8.5	0.8	1.0	17.5	34.1	18.5	52.6	52.5
7	0.0	8.9	0.0	8.9	11.3	0.8	0.0	6.7	21.0	6.7	27.7	27.7
8	0.0	8.4	0.0	8.4	6.8	0.6	0.3	3.6	15.7	3.9	19.7	19.7
9+	0.0	12.6	0.0	12.6	1.0	0.0	0.0	0.1	13.6	0.1	13.8	13.8
Sum	75.7	179.3	0.0	179.3	253.7	488.8	42.5	401.0	921.8	443.5	1441.0	1365.3

Table 2.2.2: North Sea Autumn Spawning Herring (NSAS), and Western Baltic Spring Spawners (WBSS) caught in the North Sea 2004. Mean weight at age (kg) in the catch (WECA), by quarter and division

WR	IIIa NSAS	IVa(E) all	IVa(E) WBSS	IVa(E) NSAS only	IVa(W)	IVb	IVc	VIId	IVa & IVb all	IVc & VIId	Total NSAS	Herring caught in the North Sea
Quarters: 1-4												
0	**0.022**	**0.000**	**0.000**	**0.000**	**0.000**	**0.013**	**0.012**	**0.000**	**0.013**	**-**	**0.014**	**0.013**
1	**0.055**	**0.000**	**0.000**	**0.000**	**0.105**	**0.026**	**0.036**	**0.000**	**0.026**	**0.036**	**0.036**	**0.026**
2	**0.070**	**0.119**	**0.121**	**0.119**	**0.131**	**0.118**	**0.065**	**0.108**	**0.122**	**0.099**	**0.099**	**0.120**
3	**0.121**	**0.133**	**0.133**	**0.133**	**0.155**	**0.143**	**0.108**	**0.114**	**0.147**	**0.113**	**0.137**	**0.137**
4	**0.141**	**0.171**	**0.164**	**0.171**	**0.193**	**0.186**	**0.129**	**0.136**	**0.187**	**0.135**	**0.182**	**0.182**
5	**0.152**	**0.185**	**0.166**	**0.186**	**0.220**	**0.214**	**0.132**	**0.166**	**0.210**	**0.162**	**0.205**	**0.206**
6	**0.170**	**0.212**	**0.175**	**0.213**	**0.242**	**0.234**	**0.145**	**0.189**	**0.227**	**0.184**	**0.220**	**0.221**
7	**0.187**	**0.192**	**0.184**	**0.192**	**0.251**	**0.239**	**0.135**	**0.191**	**0.233**	**0.191**	**0.228**	**0.229**
8	**0.178**	**0.218**	**0.208**	**0.218**	**0.246**	**0.297**	**0.186**	**0.186**	**0.247**	**0.186**	**0.241**	**0.241**
9+	**0.000**	**0.252**	**0.000**	**0.252**	**0.299**	**0.308**	**0.000**	**0.224**	**0.266**	**0.224**	**0.265**	**0.265**
Quarter: 1												
0	0.000	0.000		0.000	0.000	0.000	0.000	0.000	-	-	0.000	**0.000**
1	0.017	0.000		0.000	0.000	0.029	0.029	0.000	0.029	0.029	0.020	**0.029**
2	0.062	0.080		0.080	0.136	0.035	0.035	0.000	0.077	0.035	0.062	**0.066**
3	0.093	0.106		0.106	0.112	0.112	0.084	0.076	0.109	0.078	0.097	**0.097**
4	0.132	0.140		0.140	0.133	0.133	0.107	0.106	0.136	0.106	0.131	**0.131**
5	0.147	0.144		0.144	0.144	0.144	0.111	0.118	0.144	0.116	0.141	**0.140**
6	0.167	0.158		0.158	0.161	0.161	0.118	0.160	0.159	0.149	0.157	**0.156**
7	0.187	0.170		0.170	0.171	0.171	0.000	0.143	0.170	0.143	0.168	**0.166**
8	0.177	0.182		0.182	0.187	0.188	0.125	0.173	0.184	0.168	0.177	**0.177**
9+	0.000	0.182		0.182	0.191	0.000	0.000	0.000	0.184	-	0.184	**0.184**
Quarter: 2												
0	0.000	0.000	0.000	0.000	0.000	0.008	0.008	0.000	-	-	0.008	**0.008**
1	0.019	0.000	0.000	0.000	0.079	0.017	0.017	0.000	0.017	0.017	0.017	**0.017**
2	0.075	0.121	0.121	0.121	0.112	0.096	0.052	0.000	0.117	0.052	0.104	**0.117**
3	0.112	0.133	0.133	0.133	0.134	0.113	0.071	0.073	0.131	0.073	0.131	**0.131**
4	0.126	0.164	0.164	0.164	0.195	0.138	0.095	0.097	0.172	0.097	0.171	**0.171**
5	0.140	0.166	0.166	0.166	0.216	0.166	0.098	0.099	0.180	0.099	0.179	**0.179**
6	0.157	0.175	0.175	0.175	0.216	0.159	0.123	0.128	0.181	0.128	0.180	**0.180**
7	0.173	0.184	0.184	0.184	0.273	0.223	0.135	0.135	0.211	0.135	0.211	**0.211**
8	0.172	0.214	0.207	0.214	0.303	0.241	0.133	0.133	0.238	0.133	0.237	**0.237**
9+	0.000	0.193	0.000	0.193	0.351	0.299	0.000	0.000	0.201	-	0.201	**0.201**
Quarter: 3												
0	0.017	0.000	0.000	0.000	0.000	0.011	0.010	0.000	0.011	-	0.012	**0.011**
1	0.061	0.000	0.000	0.000	0.000	0.028	0.000	0.000	0.028	-	0.045	**0.028**
2	0.099	0.134	0.121	0.138	0.141	0.124	0.000	0.000	0.130	-	0.125	**0.130**
3	0.133	0.138	0.133	0.145	0.166	0.152	0.073	0.073	0.159	0.073	0.159	**0.159**
4	0.151	0.152	0.164	0.133	0.209	0.191	0.097	0.097	0.203	0.097	0.203	**0.203**
5	0.172	0.163	0.166	0.159	0.239	0.224	0.099	0.099	0.234	0.099	0.234	**0.234**
6	0.182	0.174	0.175	0.173	0.254	0.245	0.128	0.128	0.250	0.128	0.251	**0.250**
7	0.188	0.162	0.184	0.121	0.272	0.243	0.135	0.135	0.264	0.135	0.264	**0.264**
8	0.232	0.221	0.214	0.235	0.250	0.300	0.133	0.133	0.262	0.133	0.262	**0.262**
9+	0.000	0.351	0.000	0.351	0.298	0.308	0.000	0.000	0.299	-	0.299	**0.299**
Quarter: 4												
0	0.027	0.000		0.000	0.000	0.015	0.013	0.000	0.015	0.013	0.016	**0.015**
1	0.064	0.000		0.000	0.107	0.029	0.088	0.000	0.029	0.088	0.037	**0.030**
2	0.104	0.181		0.181	0.136	0.113	0.106	0.108	0.133	0.107	0.117	**0.119**
3	0.139	0.183		0.183	0.158	0.123	0.124	0.120	0.153	0.121	0.131	**0.131**
4	0.152	0.206		0.206	0.180	0.191	0.151	0.146	0.189	0.147	0.179	**0.179**
5	0.170	0.231		0.231	0.197	0.195	0.166	0.176	0.211	0.175	0.203	**0.203**
6	0.135	0.284		0.284	0.230	0.240	0.191	0.198	0.269	0.198	0.244	**0.244**
7	0.000	0.223		0.223	0.216	0.249	0.000	0.209	0.220	0.209	0.217	**0.217**
8	0.000	0.228		0.228	0.226	0.279	0.237	0.196	0.229	0.199	0.223	**0.223**
9+	0.000	0.266		0.266	0.307	0.309	0.000	0.224	0.269	0.224	0.269	**0.269**

Table 2.2.3: North Sea Autumn Spawning Herring (NSAS), and Western Baltic Spring Spawners (WBSS) caught in the North Sea 2004. Mean length at age (cm) in the catch, by quarter and division.

WR	IIIa NSAS	IVa(E) all	IVa(E) WBSS	IVa(W)	IVb	IVc	VIId	IVa & IVb all	IVc & VIId	Herring caught in the North Sea
Quarters: 1-4										
0	n.d.	0.0	n.d.	0.0	13.4	13.3	0.0	13.4	13.3	13.4
1	n.d.	0.0	n.d.	24.2	16.0	18.1	0.0	16.0	18.1	16.1
2	n.d.	23.7	n.d.	24.8	24.2	20.4	23.4	24.2	22.8	24.1
3	n.d.	25.2	n.d.	26.1	25.7	24.1	24.0	25.8	24.0	25.3
4	n.d.	27.4	n.d.	28.0	27.9	25.4	25.5	27.9	25.5	27.7
5	n.d.	28.0	n.d.	29.2	29.1	26.1	26.7	28.8	26.6	28.7
6	n.d.	29.0	n.d.	29.8	29.8	26.8	28.0	29.4	27.8	29.2
7	n.d.	29.2	n.d.	30.5	30.1	27.8	28.4	30.1	28.4	29.9
8	n.d.	30.0	n.d.	30.5	31.7	28.8	28.3	30.5	28.4	30.3
9+	n.d.	31.4	n.d.	31.9	32.0	0.0	29.2	31.6	29.2	31.5
Quarter: 1										
0	n.d.	0.0	n.d.	0.0	0.0	0.0	0.0	-	-	0.0
1	n.d.	0.0	n.d.	0.0	17.5	17.5	0.0	17.5	17.5	17.5
2	n.d.	22.7	n.d.	27.5	18.1	18.1	0.0	22.4	18.1	21.3
3	n.d.	25.1	n.d.	25.8	25.8	23.2	22.4	25.5	22.6	24.3
4	n.d.	27.4	n.d.	27.3	27.3	25.0	24.6	27.3	24.7	26.9
5	n.d.	27.6	n.d.	28.0	28.0	25.6	25.6	27.8	25.6	27.5
6	n.d.	28.0	n.d.	29.3	29.3	26.2	27.5	28.3	27.2	28.0
7	n.d.	29.3	n.d.	29.9	29.9	0.0	28.2	29.5	28.2	29.3
8	n.d.	29.8	n.d.	30.8	30.9	26.8	29.2	30.2	28.9	29.6
9+	n.d.	28.2	n.d.	30.9	0.0	0.0	0.0	28.7	-	28.7
Quarter: 2										
0	n.d.	0.0	n.d.	0.0	11.8	11.8	0.0	11.8	11.8	11.8
1	n.d.	0.0	n.d.	20.8	14.1	14.1	0.0	14.1	14.1	14.1
2	n.d.	23.7	n.d.	23.5	22.8	20.1	0.0	23.6	20.1	23.6
3	n.d.	24.8	n.d.	24.7	24.2	22.5	22.4	24.7	22.4	24.7
4	n.d.	26.2	n.d.	27.2	25.9	24.7	24.6	26.5	24.6	26.5
5	n.d.	26.6	n.d.	28.0	27.1	25.2	25.2	27.0	25.2	27.0
6	n.d.	27.3	n.d.	28.3	27.5	27.4	27.4	27.5	27.4	27.5
7	n.d.	27.8	n.d.	29.6	28.9	27.8	27.8	28.3	27.8	28.3
8	n.d.	28.6	n.d.	30.9	29.1	27.8	27.8	29.2	27.8	29.2
9+	n.d.	28.2	n.d.	31.3	30.3	0.0	0.0	28.4	-	28.4
Quarter: 3										
0	n.d.	0.0	n.d.	0.0	12.5	12.4	0.0	12.5	12.4	12.5
1	n.d.	0.0	n.d.	0.0	16.7	0.0	0.0	16.7	-	16.7
2	n.d.	24.8	n.d.	25.1	24.6	0.0	0.0	24.8	-	24.8
3	n.d.	24.9	n.d.	26.3	26.1	22.4	22.4	26.1	22.4	26.1
4	n.d.	25.7	n.d.	28.1	28.1	24.6	24.6	28.0	24.6	28.0
5	n.d.	26.3	n.d.	29.4	29.3	25.2	25.2	29.3	25.2	29.3
6	n.d.	27.2	n.d.	29.9	30.0	27.4	27.4	29.9	27.4	29.9
7	n.d.	27.4	n.d.	30.7	30.2	27.8	27.8	30.6	27.8	30.6
8	n.d.	29.4	n.d.	30.3	31.8	27.8	27.8	30.7	27.8	30.7
9+	n.d.	31.3	n.d.	31.7	32.1	0.0	0.0	31.7	-	31.7
Quarter: 4										
0	n.d.	0.0	n.d.	0.0	14.1	13.9	0.0	14.1	13.9	14.1
1	n.d.	0.0	n.d.	24.5	16.5	23.3	0.0	16.5	23.3	16.6
2	n.d.	27.6	n.d.	26.1	24.2	23.5	23.4	25.6	23.4	24.4
3	n.d.	28.2	n.d.	27.3	24.8	24.7	24.2	26.8	24.3	25.1
4	n.d.	29.3	n.d.	28.5	28.0	25.8	25.8	28.7	25.8	28.0
5	n.d.	30.0	n.d.	29.3	28.2	26.8	26.9	29.5	26.9	28.9
6	n.d.	31.5	n.d.	30.4	29.8	27.8	28.1	31.2	28.1	30.1
7	n.d.	30.4	n.d.	30.4	30.3	0.0	28.5	30.4	28.5	29.9
8	n.d.	31.0	n.d.	30.9	31.1	30.5	27.7	30.9	28.0	30.3
9+	n.d.	32.2	n.d.	33.0	32.1	0.0	29.2	32.3	29.2	32.2

Table 2.2.4: North Sea Autumn Spawning Herring (NSAS), and Western Baltic Spring Spawners (WBSS) caught in the North Sea 2004. Catches (tonnes) at age (SOP figures), by quarter and division.

WR	IIIa NSAS	IVa(E) all	IVa(E) WBSS	IVa(E) NSAS only	IVa(W)	IVb	IVc	VIId	IVa & IVb NSAS	IVc & VIId	Total NSAS	Herring caught in the North Sea
Quarters: 1-4												
0	2.0	0.0	0.0	0.0	0.0	8.2	0.1	0.0	8.2	0.1	10.3	8.3
1	3.9	0.0	0.0	0.0	0.0	3.4	0.1	0.0	3.5	0.1	7.5	3.6
2	12.6	11.7	1.8	9.9	8.7	9.5	0.4	2.5	28.1	2.9	43.6	32.8
3	2.5	30.7	3.7	27.0	74.9	35.8	5.1	36.7	137.7	41.7	181.9	183.1
4	0.9	17.6	0.6	17.0	55.6	15.2	0.8	5.2	87.7	6.0	94.6	94.3
5	1.5	33.1	0.7	32.5	86.8	18.4	0.9	8.9	137.7	9.8	149.0	148.2
6	0.3	14.1	0.2	13.9	14.7	4.1	0.4	4.3	32.7	4.7	37.7	37.6
7	0.4	4.9	0.1	4.8	13.3	2.8	0.0	1.7	21.0	1.7	23.1	22.8
8	0.2	3.4	0.0	3.3	9.6	2.8	0.1	1.1	15.7	1.2	17.1	17.0
9+	0.0	3.9	0.0	3.9	1.8	0.2	0.0	0.0	5.8	0.0	5.8	5.8
Sum	24.2	119.3	7.1	112.3	265.3	100.5	7.8	60.4	478.1	68.3	570.6	553.5
Quarter: 1												
0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.2	0.1
2	6.9	0.6	0.0	0.6	0.1	0.0	0.1	0.0	0.7	0.1	7.8	0.9
3	0.6	4.8	0.0	4.8	4.7	0.6	1.6	3.3	10.1	4.9	15.5	15.0
4	0.4	3.2	0.0	3.2	4.7	0.6	0.3	1.0	8.5	1.3	10.2	9.8
5	1.1	5.5	0.0	5.5	5.5	0.7	0.5	0.9	11.7	1.4	14.2	13.1
6	0.2	2.2	0.0	2.2	0.6	0.1	0.2	0.8	2.8	1.0	4.1	3.9
7	0.3	1.5	0.0	1.5	0.8	0.1	0.0	0.3	2.4	0.3	3.1	2.7
8	0.1	0.3	0.0	0.3	0.2	0.0	0.0	0.4	0.6	0.4	1.2	1.0
9+	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1
Sum	9.8	18.1	0.0	18.1	16.6	2.3	2.8	6.7	37.0	9.6	56.4	46.6
Quarter: 2												
0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.1
1	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.5	0.0	0.5	0.5
2	3.4	10.3	1.7	8.5	2.3	0.9	0.0	0.0	11.8	0.0	15.2	13.5
3	0.2	18.9	2.4	16.5	10.8	2.7	0.0	0.1	30.0	0.1	30.3	32.5
4	0.0	7.1	0.1	7.0	4.2	0.5	0.0	0.1	11.6	0.1	11.7	11.8
5	0.0	11.5	0.2	11.4	6.0	0.6	0.0	0.1	17.9	0.1	18.0	18.1
6	0.0	4.7	0.1	4.6	1.2	0.3	0.0	0.0	6.1	0.0	6.1	6.2
7	0.0	1.4	0.0	1.3	0.9	0.0	0.0	0.0	2.3	0.0	2.3	2.3
8	0.0	1.1	0.0	1.1	0.6	0.0	0.0	0.0	1.7	0.0	1.7	1.7
9+	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.5
Sum	3.6	55.5	4.5	51.0	25.9	5.7	0.0	0.3	82.5	0.3	86.4	87.3
Quarter: 3												
0	0.7	0.0	0.0	0.0	0.0	2.6	0.0	0.0	2.6	0.0	3.3	2.6
1	2.5	0.0	0.0	0.0	0.0	1.0	0.0	0.0	1.0	0.0	3.5	1.0
2	1.7	0.4	0.1	0.3	4.7	7.8	0.0	0.0	12.8	0.0	14.6	12.9
3	1.3	2.6	1.3	1.3	47.5	28.1	0.0	0.0	76.9	0.0	78.3	78.3
4	0.4	0.7	0.5	0.2	36.0	13.2	0.0	0.0	49.4	0.0	49.8	49.9
5	0.3	0.8	0.5	0.3	59.7	15.8	0.0	0.0	75.7	0.0	76.1	76.2
6	0.1	0.2	0.1	0.1	11.0	3.5	0.0	0.0	14.6	0.0	14.7	14.7
7	0.0	0.1	0.1	0.0	9.2	2.5	0.0	0.0	11.7	0.0	11.8	11.8
8	0.0	0.0	0.0	0.0	7.2	2.6	0.0	0.0	9.9	0.0	9.9	9.9
9+	0.0	0.0	0.0	0.0	1.4	0.1	0.0	0.0	1.5	0.0	1.5	1.5
Sum	7.1	4.7	2.5	2.2	176.8	77.3	0.0	0.0	256.3	0.1	263.4	258.9
Quarter: 4												
0	1.3	0.0	0.0	0.0	0.0	5.5	0.1	0.0	5.5	0.1	6.9	5.6
1	1.2	0.0	0.0	0.0	0.0	1.9	0.0	0.0	1.9	0.0	3.2	1.9
2	0.6	0.4	0.0	0.4	1.6	0.8	0.3	2.5	2.7	2.7	6.0	5.5
3	0.4	4.4	0.0	4.4	11.9	4.3	3.4	33.3	20.7	36.7	57.8	57.4
4	0.0	6.6	0.0	6.6	10.7	0.8	0.5	4.2	18.1	4.6	22.8	22.7
5	0.0	15.4	0.0	15.4	15.6	1.4	0.5	7.9	32.4	8.3	40.7	40.7
6	0.0	7.0	0.0	7.0	2.0	0.2	0.2	3.5	9.2	3.7	12.8	12.8
7	0.0	2.0	0.0	2.0	2.4	0.2	0.0	1.4	4.6	1.4	6.0	6.0
8	0.0	1.9	0.0	1.9	1.5	0.2	0.1	0.7	3.6	0.8	4.4	4.4
9+	0.0	3.3	0.0	3.3	0.3	0.0	0.0	0.0	3.7	0.0	3.7	3.7
Sum	3.6	41.0	0.0	41.0	46.1	15.3	5.0	53.4	102.3	58.4	164.3	160.7

Table 2.2.5: North Sea Autumn Spawning Herring (NSAS), and Western Baltic Spring Spawners (WBSS) caught in the North Sea 2004. Percentage age composition (based on numbers, 3+ group summarised), by quarter and division.

WR	IIIa NSAS	IVa(E) all	IVa(E) WBSS	IVa(E) NSAS only	IVa(W)	IVb	IVc	VIId	IVa & IVb NSAS	IVc & VIId	Total NSAS	Herring caught in the North Sea
Quarters: 1-4												
0	23.2%	0.0%	0.0%	0.0%	0.0%	48.0%	9.9%	0.0%	18.4%	1.4%	16.6%	15.8%
1	18.6%	0.0%	0.0%	0.0%	0.0%	10.3%	3.1%	0.0%	4.0%	0.4%	4.8%	3.4%
2	47.3%	13.4%	29.0%	12.2%	4.7%	6.3%	7.2%	4.9%	6.8%	5.2%	10.2%	6.9%
3	5.4%	31.4%	53.4%	29.7%	34.8%	19.4%	59.1%	67.8%	27.9%	66.5%	30.9%	33.6%
4	1.6%	14.0%	6.7%	14.5%	20.7%	6.3%	7.5%	8.1%	13.9%	8.0%	12.1%	13.0%
5	2.6%	24.4%	7.9%	25.7%	28.4%	6.7%	8.9%	11.2%	19.5%	10.9%	16.9%	18.1%
6	0.5%	9.0%	1.9%	9.6%	4.4%	1.3%	3.5%	4.8%	4.3%	4.6%	4.0%	4.3%
7	0.5%	3.5%	0.9%	3.7%	3.8%	0.9%	0.0%	1.9%	2.7%	1.6%	2.4%	2.5%
8	0.2%	2.1%	0.3%	2.2%	2.8%	0.7%	0.8%	1.3%	1.9%	1.2%	1.7%	1.8%
9+	0.0%	2.1%	0.0%	2.3%	0.4%	0.0%	0.0%	0.0%	0.7%	0.0%	0.5%	0.6%
Sum 3+	10.8%	86.6%	71.0%	87.8%	95.2%	35.4%	79.8%	95.1%	70.8%	92.9%	68.3%	73.9%
Quarter: 1												
0	0.0%	0.0%	-	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1	6.7%	0.0%	-	0.0%	0.0%	4.2%	5.9%	0.0%	0.3%	1.9%	2.3%	0.7%
2	78.8%	5.7%	-	5.7%	0.4%	6.2%	9.8%	0.0%	3.4%	3.2%	23.6%	3.3%
3	4.2%	32.6%	-	32.6%	33.4%	30.4%	56.8%	61.3%	32.8%	59.8%	30.5%	40.1%
4	2.2%	16.3%	-	16.3%	28.4%	25.7%	8.6%	13.3%	22.3%	11.8%	14.8%	19.5%
5	5.4%	27.5%	-	27.5%	30.2%	26.9%	12.9%	11.3%	28.6%	11.8%	19.1%	24.1%
6	0.9%	9.9%	-	9.9%	2.9%	2.6%	5.2%	7.3%	6.3%	6.6%	4.9%	6.4%
7	1.3%	6.4%	-	6.4%	3.7%	3.3%	0.0%	3.3%	5.0%	2.2%	3.5%	4.3%
8	0.6%	1.3%	-	1.3%	0.9%	0.6%	0.9%	3.3%	1.1%	2.5%	1.3%	1.5%
9+	0.0%	0.3%	-	0.3%	0.1%	0.0%	0.0%	0.0%	0.2%	0.0%	0.1%	0.1%
Sum 3+	14.5%	94.3%	-	94.3%	99.6%	89.5%	84.3%	100.0%	96.3%	94.9%	74.1%	95.9%
Quarter: 2												
0	0.0%	0.0%	0.0%	0.0%	0.0%	15.8%	20.0%	0.0%	2.3%	2.4%	2.1%	2.2%
1	2.7%	0.0%	0.0%	0.0%	0.0%	34.7%	43.8%	0.0%	5.0%	5.2%	4.9%	4.8%
2	93.3%	22.3%	41.7%	20.4%	12.8%	11.2%	2.8%	0.0%	17.0%	0.3%	22.6%	18.3%
3	3.4%	37.2%	51.1%	35.8%	50.0%	27.8%	18.7%	50.0%	38.5%	46.2%	35.9%	39.2%
4	0.2%	11.3%	2.0%	12.3%	13.3%	4.1%	7.0%	22.0%	11.4%	20.2%	10.6%	10.9%
5	0.3%	18.2%	3.2%	19.7%	17.2%	4.1%	5.0%	18.0%	16.7%	16.4%	15.5%	16.0%
6	0.1%	7.1%	1.2%	7.6%	3.4%	2.0%	1.8%	6.0%	5.7%	5.5%	5.3%	5.4%
7	0.0%	1.9%	0.3%	2.1%	2.0%	0.2%	0.5%	2.0%	1.8%	1.8%	1.7%	1.7%
8	0.0%	1.3%	0.4%	1.4%	1.2%	0.1%	0.5%	2.0%	1.2%	1.8%	1.1%	1.1%
9+	0.0%	0.7%	0.0%	0.7%	0.1%	0.0%	0.0%	0.0%	0.4%	0.0%	0.4%	0.4%
Sum 3+	4.0%	77.7%	58.3%	79.6%	87.2%	38.3%	33.5%	100.0%	75.7%	92.0%	70.4%	74.8%
Quarter: 3												
0	35.7%	0.0%	0.0%	0.0%	0.0%	34.2%	99.6%	0.0%	15.2%	84.2%	16.7%	15.2%
1	35.8%	0.0%	0.0%	0.0%	0.0%	5.3%	0.0%	0.0%	2.4%	0.0%	4.6%	2.3%
2	15.4%	8.9%	3.6%	15.0%	3.9%	9.0%	0.0%	0.0%	6.3%	0.0%	6.9%	6.3%
3	8.7%	57.8%	57.9%	57.6%	33.6%	26.6%	0.2%	50.0%	30.7%	7.9%	29.2%	31.0%
4	2.2%	14.4%	16.1%	12.4%	20.1%	9.9%	0.1%	22.0%	15.5%	3.5%	14.6%	15.5%
5	1.6%	14.6%	17.1%	11.8%	29.3%	10.1%	0.1%	18.0%	20.6%	2.8%	19.3%	20.5%
6	0.5%	2.7%	3.2%	2.0%	5.1%	2.1%	0.0%	6.0%	3.7%	0.9%	3.5%	3.7%
7	0.1%	1.6%	1.9%	1.2%	4.0%	1.5%	0.0%	2.0%	2.8%	0.3%	2.6%	2.8%
8	0.0%	0.1%	0.1%	0.1%	3.4%	1.3%	0.0%	2.0%	2.4%	0.3%	2.2%	2.4%
9+	0.0%	0.0%	0.0%	0.0%	0.5%	0.1%	0.0%	0.0%	0.3%	0.0%	0.3%	0.3%
Sum 3+	13.1%	91.1%	96.4%	85.0%	96.1%	51.5%	0.4%	100.0%	76.1%	15.8%	71.7%	76.2%
Quarter: 4												
0	62.7%	0.0%	-	0.0%	0.0%	75.2%	11.4%	0.0%	39.9%	1.1%	29.2%	27.3%
1	25.2%	0.0%	-	0.0%	0.1%	13.4%	0.8%	0.0%	7.1%	0.1%	5.9%	4.8%
2	7.3%	1.2%	-	1.2%	4.5%	1.4%	5.6%	5.8%	2.2%	5.7%	3.6%	3.4%
3	4.1%	13.4%	-	13.4%	29.8%	7.2%	65.4%	69.0%	14.6%	68.7%	30.7%	32.2%
4	0.3%	17.8%	-	17.8%	23.4%	0.9%	7.2%	7.1%	10.4%	7.1%	8.8%	9.3%
5	0.3%	37.2%	-	37.2%	31.3%	1.4%	6.4%	11.2%	16.6%	10.7%	13.9%	14.7%
6	0.1%	13.8%	-	13.8%	3.4%	0.2%	2.4%	4.4%	3.7%	4.2%	3.6%	3.8%
7	0.0%	4.9%	-	4.9%	4.5%	0.2%	0.0%	1.7%	2.3%	1.5%	1.9%	2.0%
8	0.0%	4.7%	-	4.7%	2.7%	0.1%	0.8%	0.9%	1.7%	0.9%	1.4%	1.4%
9+	0.0%	7.0%	-	7.0%	0.4%	0.0%	0.0%	0.0%	1.5%	0.0%	1.0%	1.0%
Sum 3+	4.8%	98.8%	-	98.8%	95.4%	9.9%	82.2%	94.2%	50.8%	93.1%	61.4%	64.5%

Table 2.2.6 Total catch of Herring in the North Sea and Div. IIIa: North Sea Autumn Spawners (NSAS)
Catch in numbers (millions) and mean weight (kg) at age by fleet, and SOP catches ('000 t).
SOP catch might deviate from reported catch as used for the assessment.

2001	Fleet A		Fleet B		Fleet C		Fleet D		TOTAL	
Total		Mean		Mean		Mean		Mean		**Mean**
Winter rings	Numbers	Weight	Numbers	Weight	Numbers	Weight	Numbers	Weight	**Numbers**	**Weight**
0			1,024.9	0.015	16.1	0.025	791.7	0.008	**1,832.7**	**0.012**
1	35.6	0.104	47.0	0.029	344.0	0.066	219.7	0.023	**646.3**	**0.051**
2	682.4	0.126	21.9	0.050	140.9	0.076	9.1	0.058	**854.4**	**0.116**
3	469.2	0.149	8.6	0.096	16.6	0.108	0.5	0.099	**494.9**	**0.147**
4	258.2	0.175	10.7	0.126	1.4	0.130	0.0	0.133	**270.2**	**0.173**
5	293.0	0.194	1.1	0.121	0.3	0.147	0.0	0.149	**294.4**	**0.194**
6	70.2	0.216	4.8	0.122	0.5	0.221	0.0	0.155	**75.5**	**0.210**
7	39.7	0.229	0.5	0.154	0.0	0.179	0.0	0.166	**40.3**	**0.228**
8	38.6	0.218	0.1	0.251	0.0	0.211	0.0	0.184	**38.6**	**0.218**
9+	2.4	0.285							**2.4**	**0.285**
TOTAL	1,889.3		1,119.6		519.8		1,021.0		**4,549.7**	
SOP catch		**295.3**		**20.4**		**36.1**		**12.3**		**364.0**

2002	Fleet A		Fleet B		Fleet C		Fleet D		TOTAL	
Total		Mean		Mean		Mean		Mean		**Mean**
Winter rings	Numbers	Weight	Numbers	Weight	Numbers	Weight	Numbers	Weight	**Numbers**	**Weight**
0			318.8	0.013	10.2	0.015	468.3	0.012	**797.3**	**0.013**
1	77.5	0.082	412.9	0.025	201.0	0.054	161.6	0.018	**852.9**	**0.036**
2	427.2	0.129	77.8	0.050	51.5	0.101	5.2	0.096	**561.7**	**0.115**
3	874.3	0.153	23.5	0.114	5.1	0.120	0.5	0.136	**903.4**	**0.151**
4	281.5	0.169	1.7	0.169	0.7	0.143	0.1	0.143	**283.9**	**0.169**
5	131.4	0.199	1.6	0.180	0.2	0.161	0.0	0.170	**133.2**	**0.198**
6	159.7	0.215	1.4	0.193	0.1	0.179	0.0	0.180	**161.2**	**0.214**
7	46.0	0.228	0.2	0.228	0.0	0.177	0.0	0.000	**46.3**	**0.227**
8	33.2	0.250	0.2	0.244	0.0	0.221	0.0	0.179	**33.4**	**0.250**
9+	7.2	0.253							**7.2**	**0.253**
TOTAL	2,037.9		838.1		268.8		635.7		**3,780.5**	
SOP catch		**323.4**		**22.1**		**17.1**		**9.1**		**371.7**

Figures for A fleet include 4457 t unsampled bycatch in the industrial fishery

2003	Fleet A		Fleet B		Fleet C		Fleet D		TOTAL	
Total		Mean		Mean		Mean		Mean		**Mean**
Winter rings	Numbers	Weight	Numbers	Weight	Numbers	Weight	Numbers	Weight	**Numbers**	**Weight**
0	1.7	0.038	345.8	0.013	1.9	0.013	19.7	0.021	**369.1**	**0.014**
1	59.2	0.078	112.8	0.030	167.5	0.054	277.5	0.021	**617.0**	**0.037**
2	952.9	0.115	69.2	0.048	142.1	0.073	40.2	0.048	**1,204.5**	**0.104**
3	502.0	0.158	1.9	0.123	12.4	0.124	0.7	0.099	**516.9**	**0.157**
4	799.1	0.174	4.4	0.133	16.0	0.151	0.2	0.128	**819.7**	**0.173**
5	240.5	0.185	0.4	0.162	1.8	0.163	0.0	0.174	**242.7**	**0.184**
6	104.7	0.204	0.4	0.173	1.1	0.193	0.1	0.152	**106.2**	**0.204**
7	118.8	0.221	0.5	0.178	1.2	0.214	0.0	0.244	**120.5**	**0.221**
8	36.8	0.232	0.1	0.178	0.2	0.187	0.0	0.180	**37.1**	**0.232**
9+	8.3	0.253							**8.3**	**0.253**
TOTAL	2,824.0		535.5		344.1		338.4		**4,041.9**	
SOP catch		**434.8**		**12.3**		**24.1**		**8.4**		**479.6**

Figures for A fleet include 3809 t unsampled bycatch in the industrial fishery

2004	Fleet A		Fleet B		Fleet C		Fleet D		TOTAL	
Total		Mean		Mean		Mean		Mean		**Mean**
Winter rings	Numbers	Weight	Numbers	Weight	Numbers	Weight	Numbers	Weight	**Numbers**	**Weight**
0			627.2	0.013	13.2	0.024	75.2	0.022	**715.6**	**0.014**
1	2.7	0.073	133.0	0.025	18.8	0.060	52.1	0.054	**206.7**	**0.036**
2	252.9	0.121	5.9	0.039	114.2	0.069	65.7	0.073	**438.8**	**0.099**
3	1298.6	0.138	6.8	0.096	12.0	0.120	8.7	0.121	**1,326.1**	**0.137**
4	510.6	0.183	2.9	0.137	4.4	0.138	1.6	0.147	**519.5**	**0.182**
5	714.6	0.206	1.9	0.175	8.7	0.149	1.0	0.171	**726.2**	**0.205**
6	168.6	0.221	0.8	0.168	1.6	0.169	0.2	0.185	**171.1**	**0.220**
7	99.1	0.229	0.2	0.217	1.9	0.187	0.1	0.183	**101.2**	**0.228**
8	69.7	0.241	0.5	0.232	0.8	0.178	0.0	0.213	**71.1**	**0.241**
9+	22.0	0.265							**22.0**	**0.265**
TOTAL	3,139.0		779.1		175.7		204.7		**4,298.4**	
SOP catch		**532.8**		**13.6**		**13.4**		**10.8**		**570.6**

Figures for A fleet include 4984 t unsampled bycatch in the industrial fishery

Table 2.2.7: Catch at age (numbers in millions) of herring caught in the North Sea, 1991-2004.
SG Rednose's revisions for 1995-2001 are included (see Sect. 2.2.3).

Year/rings	0	1	2	3	4	5	6	7	8	9+	Total
1991	1658	1301	801	568	563	507	207	40	26	13	5684
1992	7874	705	995	424	344	351	370	149	39	24	11274
1993	7254	1385	792	614	315	222	230	191	88	42	11133
1994	3834	497	1438	504	355	117	98	78	71	46	7038
1995	6294	484	1319	818	244	122	57	43	69	29	9480
1996	1795	645	488	516	170	57	22	9	17	4	3723
1997	364	174	565	428	285	109	31	12	19	6	1993
1998	208	254	1084	525	267	179	89	14	17	4	2642
1999	968	73	487	1034	289	134	70	28	10	2	3096
2000	873	194	516	453	636	212	82	36	15	3	3019
2001	1025	58	678	473	279	319	92	39	18	2	2982
2002	319	490	513	913	294	136	164	47	34	7	2917
2003	347	172	1022	507	809	244	106	121	37	8	3375
2004	627	136	274	1333	517	721	170	100	70	22	3970

Table 2.2.8: Catch at age (numbers in millions) of Baltic Spring spawning Herring taken in the North Sea, and transfered to the assessment of the spring spawning stock in IIIa, 1991-2004.

Year/rings	0	1	2	3	4	5	6	7	8	9+	Total
1991			6.7	15.1	18.0	9.1	3.1	0.8	0.3		53.0
1992			0.3	9.9	11.1	8.4	8.6	2.5	0.7	0.6	42.1
1993			4.2	10.8	12.3	8.4	5.9	4.7	1.7	1.0	49.0
1994			8.8	28.2	16.3	11.0	8.6	3.4	3.2	0.7	80.2
1995			22.4	11.0	14.9	4.0	2.9	1.9	0.7	0.0	57.8
1996			0.0	2.8	0.8	0.4	0.1	0.1	0.3	0.0	4.5
1997			2.2	1.3	1.5	0.4	0.2	0.1	0.2	0.0	5.9
1998		5.1	9.5	12.0	10.1	6.0	3.0	0.4	0.9	0.0	47.0
1999			3.3	14.3	5.6	3.6	1.4	0.6	0.4	0.0	29.3
2000			8.2	9.8	10.2	5.7	2.5	0.6	0.7	0.1	37.6
2001			11.3	10.2	6.1	7.2	2.7	1.6	0.4	0.0	39.9
2002			7.6	14.8	10.6	3.3	2.9	1.0	0.5	0.1	40.8
2003			0.0	3.1	6.0	3.5	1.2	1.3	0.5	0.1	15.7
2004			15.1	27.9	3.5	4.1	1.0	0.5	0.1	0.0	52.3

Table 2.2.9: Catch at age (numbers in millions) of North Sea Autumn Spawners taken in IIIa, and transfered to the assessment of NSAS, 1991 - 2004. Figures for 1991-1999 were altered in 2001 and 2002, but for 1991-1995 not used n the assessment. SG Rednose's revisions and the revision of 2002 splitting are included (see Sect. 2.2.3).

Year/rings	0	1	2	3	4	5	6	7	8+	Total
1991	677	748	298	52	8	5	1	0	0	1791
1992	2298	1409	220	22	10	7	3	1	0	3971
1993	2795	2033	238	27	8	4	3	2	1	5109
1994	482	1087	201	27	6	3	2	0	0	1807
1995	1145	1181	147	10	3	1	1	0	0	2487
1996	516	961	154	13	3	1	1	0	0	1649
1997	68	305	125	20	1	1	0	0	0	521
1998	51	729	145	25	19	3	3	1	0	977
1999	598	231	133	39	10	5	1	1	0	1017
2000	232	978	115	20	21	7	3	1	0	1377
2001	808	557	140	15	1	0	0	0	0	1521
2002	411	345	48	5	1	0	0	0	0	811
2003	22	445	182	13	16	2	1	1	0	682
2004	88	71	180	21	6	10	2	2	1	380

Table 2.2.10: Catch at age (numbers in millions) of the total North Sea Autumn Spawning stock 1991 - 2004. Figures for 1991-1999 were altered in 2001 and 2002, but for 1991-1995 not used in the assessment.
SG Rednose's revisions and the revision of 2002 splitting are included (see Sect. 2.2.3).

Year/rings	0	1	2	3	4	5	6	7	8	9+	Total
1991	2405	2198	1157	500	537	493	203	39	25	13	7570
1992	10390	2470	1342	445	376	368	383	156	40	23	15994
1993	10280	4160	1305	577	295	210	221	184	86	41	17358
1994	4437	1890	1839	449	332	103	88	74	68	45	9325
1995	7438	1665	1444	817	232	119	55	41	69	29	11909
1996	2311	1606	642	526	172	58	23	9	17	4	5368
1997	431	480	688	447	285	109	31	12	19	6	2507
1998	260	978	1220	538	276	176	89	15	17	4	3572
1999	1566	304	616	1059	294	136	69	28	10	2	4084
2000	1105	1172	623	463	647	213	82	36	15	2	4358
2001	1833	614	806	477	274	312	89	37	17	2	4463
2002	730	835	553	903	284	133	161	46	33	7	3687
2003	369	617	1204	517	820	243	106	120	37	8	4042
2004	716	207	439	1326	520	726	171	101	71	22	4298

Table 2.2.11: Comparison of mean weights (kg) at age (rings) in the catch of adult herring in the North Sea (by Div.) and North Sea Autumn Spawners caught in Div IIIa in 1995-2004.
SG Rednose's revisions for 1995-2001 are included.

		Age (Rings)							
Div.	**Year**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9+**
IIIa*	1995	0.084	0.135	0.159	0.203	0.203	0.239	0.244	-
	1996	0.078	0.110	0.160	0.182	0.215	0.215	0.244	-
	1997	0.066	0.122	0.155	0.176	0.175	0.179	0.185	-
	1998	0.078	0.118	0.163	0.180	0.197	0.179	0.226	-
	1999	0.084	0.113	0.141	0.161	0.181	0.206	0.199	-
	2000	0.076	0.103	0.162	0.190	0.184	0.186	0.177	-
	2001	0.073	0.105	0.128	0.133	0.224	0.170	0.192	-
	2002	0.104	0.126	0.144	0.164	0.180	0.180	0.218	-
	2003	0.067	0.123	0.150	0.163	0.191	0.214	0.187	-
	2004	0.070	0.121	0.141	0.152	0.170	0.187	0.178	
IVa(E)	1995	0.134	0.158	0.193	0.215	0.233	0.227	0.245	0.242
	1996	0.131	0.141	0.168	0.196	0.217	0.218	0.242	0.300
	1997	0.122	0.149	0.174	0.204	0.228	0.229	0.221	0.313
	1998	0.114	0.148	0.171	0.199	0.219	0.237	0.269	0.233
	1999	0.125	0.143	0.162	0.191	0.207	0.226	0.232	0.272
	2000	0.130	0.154	0.172	0.195	0.202	0.218	0.261	0.256
	2001	0.121	0.148	0.165	0.177	0.197	0.220	0.262	0.238
	2002	0.130	0.154	0.167	0.189	0.198	0.212	0.229	0.238
	2003	0.122	0.154	0.162	0.177	0.189	0.203	0.213	0.218
	2004	0.119	0.133	0.171	0.185	0.212	0.192	0.218	0.252
IVa(W)	1995	0.144	0.186	0.218	0.221	0.267	0.268	0.307	0.286
	1996	0.131	0.167	0.215	0.218	0.237	0.275	0.301	0.278
	1997	0.127	0.166	0.218	0.248	0.246	0.262	0.294	0.289
	1998	0.130	0.170	0.205	0.244	0.263	0.270	0.308	0.314
	1999	0.129	0.162	0.192	0.227	0.250	0.261	0.272	0.309
	2000	0.127	0.159	0.187	0.214	0.237	0.271	0.293	0.265
	2001	0.138	0.168	0.193	0.222	0.235	0.266	0.285	0.296
	2002	0.144	0.161	0.191	0.211	0.230	0.242	0.261	0.263
	2003	0.130	0.167	0.184	0.202	0.224	0.237	0.259	0.276
	2004	0.131	0.155	0.193	0.220	0.242	0.251	0.246	0.299
IVb	1995	0.136	0.176	0.201	0.214	0.257	0.267	0.271	0.296
	1996	0.111	0.184	0.209	0.230	0.249	0.297	0.282	0.287
	1997	0.124	0.170	0.210	0.230	0.259	0.263	0.286	0.286
	1998	0.117	0.162	0.203	0.216	0.243	0.218	0.311	0.307
	1999	0.118	0.148	0.154	0.207	0.226	0.209	0.287	0.345
	2000	0.118	0.173	0.194	0.224	0.229	0.251	0.240	0.268
	2001	0.105	0.150	0.176	0.188	0.199	0.206	0.244	0.275
	2002	0.086	0.149	0.161	0.206	0.214	0.189	0.270	0.241
	2003	0.098	0.161	0.178	0.195	0.214	0.214	0.222	0.281
	2004	0.118	0.143	0.186	0.214	0.234	0.239	0.297	0.308
IVa & IVb	1995	0.139	0.174	0.206	0.218	0.256	0.255	0.286	0.276
	1996	0.124	0.162	0.199	0.215	0.236	0.267	0.282	0.288
	1997	0.125	0.161	0.202	0.233	0.245	0.254	0.264	0.291
	1998	0.123	0.162	0.194	0.224	0.243	0.253	0.293	0.283
	1999	0.124	0.155	0.179	0.213	0.236	0.250	0.264	0.301
	2000	0.125	0.162	0.185	0.210	0.227	0.258	0.275	0.263
	2001	0.129	0.156	0.180	0.202	0.217	0.242	0.275	0.285
	2002	0.119	0.157	0.177	0.203	0.219	0.228	0.253	0.253
	2003	0.113	0.163	0.178	0.190	0.210	0.225	0.239	0.255
	2004	0.122	0.147	0.187	0.210	0.227	0.233	0.247	0.266
IVc & VIId	1995	0.117	0.140	0.169	0.190	0.207	0.212	0.209	0.245
	1996	0.121	0.143	0.159	0.185	0.194	0.203	0.155	-
	1997	0.101	0.133	0.156	0.168	0.166	0.190	0.163	-
	1998	0.096	0.114	0.146	0.149	0.184	0.000	0.176	-
	1999	0.116	0.139	0.159	0.189	0.198	0.217	-	-
	2000	0.106	0.133	0.150	0.180	0.194	0.203	-	-
	2001	0.113	0.138	0.171	0.167	0.171	0.168	0.180	-
	2002	0.108	0.123	0.153	0.170	0.187	0.219	0.208	-
	2003	0.103	0.127	0.144	0.168	0.176	0.188	0.200	0.227
	2004	0.099	0.113	0.135	0.162	0.184	0.191	0.186	0.224
Total North Sea Catch	1995	0.135	0.169	0.199	0.207	0.244	0.248	0.283	0.276
	1996	0.123	0.157	0.189	0.205	0.212	0.262	0.280	0.288
	1997	0.118	0.149	0.195	0.227	0.227	0.235	0.245	0.291
	1998	0.119	0.146	0.185	0.219	0.239	0.253	0.288	0.283
	1999	0.123	0.152	0.172	0.208	0.233	0.246	0.264	0.301
	2000	0.122	0.159	0.180	0.202	0.217	0.247	0.275	0.263
	2001	0.127	0.150	0.178	0.197	0.212	0.236	0.267	0.285
	2002	0.118	0.152	0.168	0.198	0.214	0.227	0.250	0.253
	2003	0.111	0.157	0.174	0.185	0.204	0.221	0.232	0.254
	2004	0.120	0.137	0.182	0.206	0.221	0.229	0.241	0.265

*Figures for 1991-1999 altered in 2002 but the1991-1995 updated figures were still not included in the assessment.

Table 2.2.12: Sampling of commercial landings of Herring in the North Sea (Div. IV and VIId) in 2004 by quarter. Sampled catch means the proportion of the reported catch to which sampling was applied. It is limited to 100% but might exceed the official landings due to sampling of discards, unallocated and misreported catches. It is not possible to judge the quality of the sampling by this figure alone. Note that only one nation sampled their herring by-catches in the industrial fishery (Denmark, fleet B) for age. Metiers are each **reported** combination of nation/fleet/area/quarter.

Country (fleet)	Quarter	No of metiers	Metiers sampled	Sampled Catch %	Official Catch	No. of samples	No. fish aged	No. fish measured	>1 sample per 1 kt catch
Belgium	4	1	0	0%	8	0	0	0	n
total		**1**	**0**	**0%**	**8**	**0**	**0**	**0**	**n**
Denmark (A)	1	3	2	93%	30966	18	445	2512	n
	2	3	2	48%	4128	5	123	699	y
	3	3	2	100%	22926	21	540	2730	n
	4	3	3	100%	27431	23	703	2988	n
total		**12**	**9**	**95%**	**85451**	**67**	**1811**	**8929**	**n**
Denmark (B)	1	4	1	25%	219	3	2	4	y
	2	3	1	99%	1073	37	234	268	y
	3	4	2	88%	3903	10	286	291	y
	4	4	2	96%	8390	19	193	359	y
total		**15**	**6**	**93%**	**13586**	**69**	**715**	**922**	**y**
England & Wales	1	2	0	0%	146	0	0	0	n
	2	3	0	0%	1111	0	0	0	n
	3	4	0	0%	15248	0	0	0	n
	4	2	0	0%	4350	0	0	0	n
total		**11**	**0**	**0%**	**20855**	**0**	**0**	**0**	**n**
Faroe Isl	2	1	0	0%	285	0	0	0	n
	3	1	0	0%	117	0	0	0	n
total		**2**	**0**	**0%**	**401**	**0**	**0**	**0**	**n**
France	1	3	0	0%	971	0	0	0	n
	2	3	0	0%	1932	0	0	0	n
	3	3	0	0%	19674	0	0	0	n
	4	2	0	0%	11944	0	0	0	n
total		**11**	**0**	**0%**	**34521**	**0**	**0**	**0**	**n**
Germany	1	1	1	3%	67	1	139	139	y
	2	2	0	0%	4985	0	0	0	n
	3	2	2	100%	26695	53	2376	23426	y
	4	3	1	95%	10111	41	600	17329	y
total		**8**	**4**	**96%**	**41858**	**95**	**3115**	**40894**	**y**
Netherlands	1	4	2	100%	5405	10	250	2599	y
	2	3	3	100%	6790	33	825	5925	y
	3	3	2	100%	56986	98	2450	10899	y
	4	4	2	100%	26981	15	1822	1042	n
total		**14**	**9**	**100%**	**96163**	**156**	**5347**	**20465**	**y**
Northern Ireland	3	1	0	0%	2643	0	0	0	n
	4	1	0	0%	13	0	0	0	n
total		**2**	**0**	**0%**	**2656**	**0**	**0**	**0**	**n**
Norway	1	1	0	0%	5658	0	0	0	n
	2	3	2	99%	59467	20	1878	1900	n
	3	3	1	81%	25265	2	200	200	n
	4	2	2	100%	47248	8	436	442	n
total		**9**	**5**	**92%**	**137638**	**30**	**2514**	**2542**	**n**
Scotland	2	1	1	100%	1913	7	219	1718	y
	3	3	3	100%	41839	88	4519	16554	y
	4	2	2	100%	1579	7	403	1287	y
total		**6**	**6**	**100%**	**45331**	**102**	**5141**	**19559**	**y**
Sweden	2	3	0	0%	2628	0	0	0	n
	3	3	0	0%	2750	0	0	0	n
	4	3	0	0%	314	0	0	0	n
total		**9**	**0**	**0%**	**5692**	**0**	**0**	**0**	**n**
grand total		**100**	**39**	**94%**	**484159**	**519**	**18643**	**93311**	**y**
Period total	**1**	18	6	86%	43433	32	836	5254	n
Period total	**2**	25	9	87%	84312	102	3279	10510	y
Period total	**3**	30	12	96%	218046	272	10371	54100	y
Period total	**4**	27	12	99%	138368	113	4157	23447	n
Total for stock 2004		**100**	**39**	**94%**	**484159**	**519**	**18643**	**93311**	**y**
Human Cons. only		85	33	95%	470574	450	17928	92389	n
Total for stock 2002		91	41	100%	304170	351	10932	53637	n
Total for stock 2003		108	46	90%	414045	533	14568	95347	y
Human Cons. only 2003		93	40	90%	401759	465	14142	94603	y

Table 2.3.1.1 North Sea herring numbers (millions) at ring and maturity by ICES Subarea from July acoustic survey 2004

ICES A	IIIA	IVA	IVB	IVC
0	45.4	0.0	10437.7	212.1
1i	431.2	65.8	4682.0	0.0
1m	3.5	0.4	0.8	0.0
2i	193.7	286.3	550.3	0.0
2m	141.5	1076.0	1168.2	0.0
3i	31.4	1127.5	2069.9	0.0
3m	20.3	4415.3	1527.4	0.0
4	4.8	1956.9	205.5	0.0
5	1.5	2469.4	119.8	0.0
6	0.0	301.8	15.3	0.0
7	0.0	304.3	23.2	0.0
8	0.0	338.6	3.5	0.0
9+	0.0	180.1	5.5	0.0
Immature	701.8	1479.6	17740.0	212.1
Mature	171.6	11042.8	3069.1	0.0
Total	873.4	12522.4	20809.1	212.1

Table 2.3.1.2 North Sea herring biomass (thousands of tonnes) at ring and maturity by ICES subarea from July acoustic survey 2004

ICES A	IIIA	IVA	IVB	IVC
0	0.33	0.00	79.54	1.6
1i	24.37	3.34	151.63	0.0
1m	0.20	0.02	0.03	0.0
2i	17.84	32.33	51.62	0.0
2m	13.03	143.10	139.04	0.0
3i	3.19	127.44	214.42	0.0
3m	2.07	738.63	193.52	0.0
4	0.71	416.38	28.26	0.0
5	0.22	578.62	18.83	0.0
6	0.00	77.73	2.62	0.0
7	0.00	81.14	4.51	0.0
8	0.00	94.73	0.57	0.0
9+	0.00	49.06	0.99	0.0
Immature	45.74	163.11	497.21	1.6
Mature	16.23	2179.42	388.36	0.0
Total	61.97	2342.53	885.57	1.6

Table 2.3.1.3 North Sea herring mean weight (g) at ring and maturity by ICES Subarea from July acoustic survey 2004

ICES A	IIIA	IVA	IVB	IVC
0	7.18		7.62	7.62
1i	56.52	50.72	32.38	
1m	56.52	44.01	42.97	
2i	92.12	112.91	93.81	
2m	92.12	133.00	119.02	
3i	101.68	113.04	103.59	
3m	101.68	167.29	126.70	
4	146.67	212.77	137.50	
5	147.59	234.32	157.19	
6		257.51	170.97	
7		266.63	194.23	
8		279.79	165.83	
9+		272.38	179.73	

Table 2.3.1.4 North Sea autumn-spawning herring in the area surveyed in the acoustic surveys July 2004 Total numbers (millions) and biomass (thousands of tonnes) with mean weights (g) and fraction mature by ring.

NORTH SEA	NUMBERS	BIOMASS	MATURITY	MEAN WEIGHT	MEAN LENGTH
Ring	(millions)	Tonnes $*10^3$	(fraction)	(g)	(cm)
0	10695.3	81.5	0.00	7.6	10.1
1	5183.7	179.6	0.00	34.6	16.3
2	3415.9	397.0	0.70	116.2	24.0
3	9191.8	1279.3	0.65	139.2	25.0
4	2167.3	445.3	1.00	205.5	27.6
5	2590.7	597.7	1.00	230.7	28.5
6	317.1	80.3	1.00	253.3	29.2
7	327.6	85.7	1.00	261.5	29.6
8	342.1	95.3	1.00	278.6	30.1
9+	185.6	50.1	1.00	269.6	29.9
Immature	20133.5	707.7			
Mature	14283.6	2584.0			
Total	34417.1	3291.7			

Table 2.3.1.5 North Sea autumn spawners, estimates of (millions) at age from acoustic surveys, and SSB (thousands of tonnes) 1984-2004. For 1984-1986 the estimates are the sum of those from the Division IVa summer survey, the Division IVb autumn survey, and the Divisions IVc, VIId winter survey. The 1987 to 2000 estimates are from the summer survey in Divisions IVa,b, and IIIa excluding estimates of Division IIIa/Baltic spring spawners. For 1999 & 2000 the Kattegat was excluded from the results because it was not surveyed. The 1996 to 1999 surveys have been revised due to changes in methods for calculating mean weight and proportion adult. The earlier surveys were revised in March 2002 following recent reorganisation of archive, removal of a 9% calibration error on Scottish survey 1999-2000. In 2003 the area was extended to include part of area IVc and provide better coverage for sprat, the increase in biomass due to this change in area was negligible at 0.05%.

AGE (RINGS)	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	551	726	1,639	13,736	6,431	6,333	6,249	3,182	6,351	10,399	3,646	4,202	6,198	9,416	4,449	5,087	24,735	6,837	23,055	9,829	5,183
2	3,194	2,789	3,206	4,303	4,202	3,726	2,971	2,834	4,179	3,710	3,280	3,799	4,557	6,363	5,747	3,078	2,922	12,290	4,875	18,949	3,415
3	1,005	1,433	1,637	955	1,732	3,751	3,530	1,501	1,633	1,855	957	2,056	2,824	3,287	2,520	4,725	2,156	3,083	8,220	3,081	9,191
4	394	323	833	657	528	1,612	3,370	2,102	1,397	909	429	656	1,087	1,696	1,625	1,116	3,139	1,462	1,390	4,189	2,167
5	158	113	135	368	349	488	1,349	1,984	1,510	795	363	272	311	692.1	982.4	506.4	1,006	1,676	794.6	675.1	2,590
6	44	41	36	77	174	281	395	748	1,311	788	321	175	98.7	259.2	445.2	313.6	482.5	449.6	1,031	494.8	317.1
7	52	17	24	38	43	120	211	262	474	546	238	135	82.8	78.6	170.3	138.6	266.4	169.6	244.4	568.3	327.6
8	39	23	6	11	23	44	134	112	155	178	220	110	132.9	78.3	45.2	54.3	120.4	97.7	121.0	145.5	342.1
9+	41	19	8	20	14	22	43	56	163	116	132	84	206	158.3	121.4	87.2	97.2	58.9	149.5	177.7	185.6
Total	5,478	5,484	7,542	20,165	13,496	16,377	18,262	12,781	17,173	19,326	13,003	11,220	18,786	22,028	16,104	15,107	34,928	26,124	39,881	38,110	23,722
$Z_{2+/3+}$	.	0.92	0.57	1.02	0.81	0.11	0.11	0.57	0.37	0.74	1.21	0.53	0.43	0.40	0.76	0.52	0.32	0.38	0.47	0.59	0.62
Smooth $Z_{2+/3+}$	.	.	0.73	0.76	0.91	0.30	0.11	0.25	0.46	0.52	0.94	0.80	0.48	0.41	0.55	0.63	0.41	0.35	0.42	0.53	0.60
SSB (‘000 t)	807	697	942	817	897	1,637	2,174	1,874	1,545	1,216	1,035	1,082	1446.2	1,780	1,792	1,534	1,833	2,622	2,948	2,999	2,584

Table 2.3.2.1: North Sea autumn spawners. Fortnightly time periods sampled and survey effort in 2004/2005.

NL – Netherlands, FRG – Federal Republic of Germany

AREA	TIME PERIOD	SAMPLES AVAILABLE	VESSEL DAYS	NATION	COVERAGE
Orkney/Shetland	01-15 Sep.	None			
	16-30 Sep.	74	9	FRG	4/5
Buchan	01-15 Sep.	None			
	16-30 Sep.	78	5	NL	Total
Central North	01-15 Sep.	None			
Sea	16-30 Sep.	64	4	NL	Partial
	01-15 Oct.	None			
Southern North	16-31 Dec.	76	4	NL	Total
Sea	01-15 Jan.	100	7	FRG	Total
	16-31 Jan.	91	4	NL	Total

Table 2.3.2.2: North Sea autumn spawners. Number of samples taken and sampling effort for the herring larvae surveys in Orkney/Shetland, Buchan, Central North Sea and Southern North Sea by year

YEAR	SAMPLES	VESSEL-DAYS (SAMPLING)
1988/89	1355	98
1989/90	1300	96
1990/91	634	49
1991/92	738	51
1992/93	498	31
1993/94	491	34
1994/95	450	33
1995/96	421	26
1996/97	469	32
1997/98	456	29
1998/99	531	37
1999/00	645	38
2000/01	696	53
2001/02	534	32
2002/03	533	35
2003/04	568	35
2004/05	483	33

Table 2.3.2.3: North Sea autumn spawners. Estimated abundances of herring larvae <10 mm long, by standard sampling area and time periods. The number of larvae are expressed as mean number per ICES rectangle * 10^9

	Orkney/Shetland		Buchan		Central North Sea			Southern North Sea		
Period	1-15 Sep.	16-30 Sep.	1-15 Sep.	16-30 Sep.	1-15 Sep.	16-30 Sep.	1-15 Oct.	16-31 Dec.	1-15 Jan.	16-31 Jan.
1972	1133	4583	30		165	88	134	2	46	
1973	2029	822	3	4	492	830	1213			1
1974	758	421	101	284	81		1184		10	
1975	371	50	312			90	77	1	2	
1976	545	81		1	64	108			3	
1977	1133	221	124	32	520	262	89	1		
1978	3047	50		162	1406	81	269	33	3	
1979	2882	2362	197	10	662	131	507		111	89
1980	3534	720	21	1	317	188	9	247	129	40
1981	3667	277	3	12	903	235	119	1456		70
1982	2353	1116	340	257	86	64	1077	710	275	54
1983	2579	812	3647	768	1459	281	63	71	243	58
1984	1795	1912	2327	1853	688	2404	824	523	185	39
1985	5632	3432	2521	1812	130	13039	1794	1851	407	38
1986	3529	1842	3278	341	1611	6112	188	780	123	18
1987	7409	1848	2551	670	799	4927	1992	934	297	146
1988	7538	8832	6812	5248	5533	3808	1960	1679	162	112
1989	11477	5725	5879	692	1442	5010	2364	1514	2120	512
1990		10144	4590	2045	19955	1239	975	2552	1204	
1991	1021	2397		2032	4823	2110	1249	4400	873	
1992	189	4917		822	10	165	163	176	1616	
1993		66		174		685	85	1358	1103	
1994	26	1179				1464	44	537	595	
1995		8688					43	74	230	164
1996		809		184		564		337	675	691
1997		3611		23				9374	918	355
1998		8528		1490	205	66		1522	953	170
1999		4064		185		134	181	804	1260	344
2000		3352	28	83		376		7346	338	106
2001		11918		164		1604		971	5531	909
2002		6669		1038			3291	2008	260	925
2003		3199		2263		12018	3277	12048	3109	1116
2004		7055		3884		5545		7055	2052	4175

Table 2.3.2.4: North Sea autumn spawners. Parameter estimates obtained on fitting the MLAI model to the estimates of larval abundance by area and time-period. Model fitted to abundances of larvae < 10 mm in length (11 mm for the Southern North Sea).

a) Analysis of variance of the model fit

	DF	Sum of Squares	Mean Square	F Value	P
Model	42	165.0	3.929	8.52	<0.0001
Error	229	105.5	0.461		
C Total	271	270.5			

b) Estimates of parameters

Reference Mean

Estimate	Standard Error	
6.8399	0.5518	Reference: 1972, Orkney/Shetland 09/01 – 09/15

Year Effects

Year	Estimate	Standard Error	Year	Estimate	Standard Error
1973	0.35675	0.6860	1989	2.66978	0.6067
1974	-0.14521	0.7351	1990	2.92334	0.6295
1975	-1.21976	0.7470	1991	2.27588	0.6820
1976	-1.32184	0.7331	1992	1.52072	0.7210
1977	-0.42103	0.7027	1993	1.19106	0.6977
1978	-0.22688	0.7133	1994	0.81107	0.7355
1979	0.47189	0.6866	1995	0.93736	0.7250
1980	0.09285	0.6836	1996	1.61863	0.7636
1981	0.48777	0.6804	1997	1.84735	0.7162
1982	0.84278	0.6176	1998	2.13801	0.6732
1983	1.09615	0.6333	1999	1.94986	0.6769
1984	1.68831	0.6148	2000	1.53414	0.6921
1985	2.11018	0.5930	2001	2.66664	0.7047
1986	1.45386	0.6127	2002	2.49819	0.6840
1987	2.01258	0.6046	2003	3.41659	0.6963
1988	2.69993	0.5929	2004	3.56465	0.7381

Sampling Unit Effects

Sampling Unit	Estimate	Standard Error
Or/Shet 16-30 Sep	-0.7162	0.3239
Buchan 01-15 Sep	-1.8218	0.4177
Buchan 16-30 Sep	-2.5264	0.3551
CNS 01-15 Sep	-1.6544	0.4043
CNS 16-30 Sep	-1.4771	0.3568
CNS 01-15 Oct	-2.0808	0.3813
CNS 16-31 Oct	-4.1669	0.5259
SNS 12-31 Dec	-1.8195	0.3831
SNS 01-15 Jan	-2.5491	0.3324
SNS 16-31 Jan	-3.6190	0.3713

Table 2.3.2.5: North Sea autumn spawners. Time-series of the Multiplicative Larval Abundance Index (MLAI). The original MLAI is given in the second column. $MLAI_{plus}$ is the sum of the MLAI and the value of the reference area (Orkney/Shetlands, 1st-15th September 1972). This estimate is then unlogged (eMLAI) and divided by 100 ($MLAI_{assess}$). The $MLAI_{assess}$ describes the time-series that is used in the assessment.

Reference Value: 6.83992

Year	MLAI	$MLAI_{plus}$	eMLAI	$MLAI_{assess}$
1973	0.35675	7.1967	1,334.98	13.35
1974	-0.14521	6.6947	808.12	8.08
1975	-1.21976	5.6202	275.93	2.76
1976	-1.32184	5.5181	249.16	2.49
1977	-0.42103	6.4189	613.32	6.13
1978	-0.22688	6.6130	744.74	7.45
1979	0.47189	7.3118	1,497.89	14.98
1980	0.09285	6.9328	1,025.33	10.25
1981	0.48777	7.3277	1,521.86	15.22
1982	0.84278	7.6827	2,170.47	21.71
1983	1.09615	7.9361	2,796.36	27.96
1984	1.68831	8.5282	5,055.52	50.55
1985	2.11018	8.9501	7,708.69	77.09
1986	1.45386	8.2938	3,998.91	39.99
1987	2.01258	8.8525	6,991.83	69.92
1988	2.69993	9.5398	13,902.81	139.03
1989	2.66978	9.5097	13,489.96	134.90
1990	2.92334	9.7633	17,383.22	173.83
1991	2.27588	9.1158	9,097.93	90.98
1992	1.52072	8.3606	4,275.43	42.75
1993	1.19106	8.0310	3,074.76	30.75
1994	0.81107	7.6510	2,102.72	21.03
1995	0.93736	7.7773	2,385.78	23.86
1996	1.61863	8.4585	4,715.20	47.15
1997	1.84735	8.6873	5,927.00	59.27
1998	2.13801	8.9779	7,926.24	79.26
1999	1.94986	8.7898	6,566.78	65.67
2000	1.53414	8.3741	4,333.18	43.33
2001	2.66664	9.5066	13,447.72	134.48
2002	2.49819	9.3381	11,362.89	113.63
2003	3.41659	10.2565	28,466.90	284.67
2004	3.56465	10.4046	33,010.15	330.10

Table 2.3.3.1. North Sea herring. Indices of 2-5+ ringers from the 1st quarter IBTS

YEAR OF SAMPLING	2-RINGER	3-RINGER	4-RINGER	5+ RINGER
1983	137.4	46.4	15.3	28.5
1984	169.9	67.0	30.0	10.8
1985	748.1	301.5	47.6	31.2
1986	820.1	288.9	84.1	28.5
1987	946.3	124.0	63.2	53.6
1988	4725.8	915.0	65.4	28.0
1989	933.9	401.2	111.8	10.5
1990	482.1	312.9	292.7	77.1
1991	821.0	288.4	258.7	174.3
1992	410.1	195.1	68.5	109.4
1993	840.8	225.1	46.9	68.6
1994	1176.5	214.4	68.4	43.0
1995	1263.1	251.0	33.2	6.2
1996	209.0	46.6	13.5	9.1
1997	526.6	204.1	42.8	24.3
1998	799.7	96.4	22.0	20.7
1999	456.8	547.8	109	40.3
2000	232.2	169.3	65.5	9.7
2001	1228.1	337.0	106.8	79.0
2002	666.2	323.9	22.8	19.2
2003	1597.7	452.7	354.8	51.5
2004	456.0	759.9	110.9	141.1
2005*	190.2	325.7	402.2	140.3

*** Norwegian survey data not included**

Table 2.3.3.2. North Sea herring. Estimates of mean number per hour per statistical rectangle from 1st quarter IBTS 2005. Means for age groups in "Roundfish areas" (*) and in all areas. In the index 2-5+ for all areas, the findings in RF8 and RF9 are not included.

AREA	TOTAL	MEAN PER STATISTICAL RECTANGLE				
		Age group (wr)				
		1	2	3	4	5+
All areas		1033	190.2	325.7	402.2	140.3
RF1	4062.5	4.6	187.6	1302.9	1850.7	716.8
RF2	413.3	57.2	124.6	151.2	69	11.4
RF3	2225.7	1768.7	379.4	60.5	12.8	4.2
RF4	48.3	24.8	15.3	6.5	1.5	0.2
RF5	359.4	323.4	20.7	12	3.3	0
RF6	3048.8	2985.7	59.1	3.2	0.8	0
RF7	1683.9	854.2	736.7	64	24.5	4.5
RF8	4991.1	2959.6	1839.4	176.8	13.2	2.2
RF9	7204.3	2801.9	3971.1	326.4	46.9	58

(*) "Roundfish areas" are shown in the IBTS Manual (Add. ICES CM 2002/D:03)

Table 2.3.3.3. North Sea herring. Indices of 1-ringers from the IBTS 1st Quarter. Estimation of the small sized component (possibly Downs herring) in different areas. " North Sea" = total area of sampling minus IIIa.

YEAR CLASS	YEAR OF SAMPLING	ALL 1-RINGERS IN TOTAL AREA (NO/HOUR)	SMALL<13CM 1-RINGERS IN TOTAL AREA (NO/HOUR)	PROPORTION OF SMALL IN TOTAL AREA VS. ALL SIZES	SMALL<13CM 1-RINGERS IN NORTH SEA (NO/HOUR)	PROPORTION OF SMALL IN NORTH SEA VS. ALL SIZES	PROPORTION OF SMALL IN IIIA VS SMALL IN TOTAL AREA
1977	1979	156	11.07	0.07	11.87	0.08	0
1978	1980	342	112.85	0.33	112.47	0.33	0.07
1979	1981	518	57.57	0.11	48.34	0.09	0.22
1980	1982	799	175.36	0.22	184.03	0.23	0.02
1981	1983	1231	188.6	0.15	180.2	0.15	0.11
1982	1984	1469	330.25	0.23	278.5	0.19	0.21
1983	1985	2082	295.46	0.14	276.2	0.13	0.13
1984	1986	2593	585.93	0.23	372.45	0.15	0.41
1985	1987	3734	640.27	0.17	526.85	0.14	0.23
1986	1988	4470	2365.73	0.52	697.49	0.15	0.72
1987	1989	2187	548.79	0.24	488.36	0.21	0.17
1988	1990	1025	69.01	0.07	60.07	0.06	0.19
1989	1991	1180	299.97	0.26	305.38	0.26	0.05
1990	1992	1204	120.9	0.10	125.44	0.11	0.03
1991	1993	2989	754.89	0.26	163.09	0.06	0.8
1992	1994	1644	266.99	0.16	224.91	0.13	0.21
1993	1995	1215	386.34	0.33	379.98	0.32	0.08
1994	1996	1728	537.1	0.31	408.92	0.24	0.29
1995	1997	3993	1179.9	0.29	932.95	0.23	0.26
1996	1998	2067	1168.12	0.57	1231.57	0.60	0.02
1997	1999	715	141.15	0.20	138.77	0.19	0.08
1998	2000	3639	1062.18	0.29	936.11	0.26	0.18
1999	2001	2696	322.57	0.12	302.19	0.11	0.06
2000	2002	3948	1510.9	0.38	1427.64	0.36	0.12
2001	2003	2926	708.4	0.24	201.6	0.07	0.73
2002	2004	980	649.0	0.66	691.5	0.71	0.004
2003	2005	**1033**	346.6	0.34	363.9	0.35	0.02

Table 2.3.3.4 North Sea herring. Density and abundance estimates of 0-ringers caught in February during the IBTS. Values given for year classes by areas are density estimates in numbers per square metre. Total abundance is found by multiplying density by area and summing up.

AREA	NORTH WEST	NORTH EAST	CENTRAL WEST	CENTRAL EAST	SOUTH WEST	SOUTH EAST	DIV. IIIA	SOUTH' BIGHT	0-RINGER ABUNDANCE
Area m^2 x 10^9	83	34	86	102	37	93	31	31	no. in 10^9
Year class									
1976	0.054	0.014	0.122	0.005	0.008	0.002	0.002	0.016	17.1
1977	0.024	0.024	0.05	0.015	0.056	0.013	0.006	0.034	13.1
1978	0.176	0.031	0.061	0.02	0.01	0.005	0.074	0	52.1
1979	0.061	0.195	0.262	0.408	0.226	0.143	0.099	0.053	101.1
1980	0.052	0.001	0.145	0.115	0.089	0.339	0.248	0.187	76.7
1981	0.197	0	0.289	0.199	0.215	0.645	0.109	0.036	133.9
1982	0.025	0.011	0.068	0.248	0.29	0.309	0.47	0.14	91.8
1983	0.019	0.007	0.114	0.268	0.271	0.473	0.339	0.377	115
1984	0.083	0.019	0.303	0.259	0.996	0.718	0.277	0.298	181.3
1985	0.116	0.057	0.421	0.344	0.464	0.777	0.085	0.084	177.4
1986	0.317	0.029	0.73	0.557	0.83	0.933	0.048	0.244	270.9
1987	0.078	0.031	0.417	0.314	0.159	0.618	0.483	0.495	168.9
1988	0.036	0.02	0.095	0.096	0.151	0.411	0.181	0.016	71.4
1989	0.083	0.03	0.04	0.094	0.013	0.035	0.041	0	25.9
1990	0.075	0.053	0.202	0.158	0.121	0.198	0.086	0.196	69.9
1991	0.255	0.39	0.431	0.539	0.5	0.369	0.298	0.395	200.7
1992	0.168	0.039	0.672	0.444	0.734	0.268	0.345	0.285	190.1
1993	0.358	0.212	0.26	0.187	0.12	0.119	0.223	0.028	101.7
1994	0.148	0.024	0.417	0.381	0.332	0.148	0.252	0.169	126.9
1995	0.26	0.086	0.699	0.092	0.266	0.018	0.001	0.02	106.2
1996	0.003	0.004	0.935	0.135	0.436	0.379	0.039	0.032	148.1
1997	0.042	0.021	0.338	0.064	0.178	0.035	0.023	0.083	53.1
1998	0.1	0.056	1.15	0.592	0.998	0.265	0.28	0.127	244.0
1999	0.045	0.011	0.799	0.2	0.514	0.22	0.107	0.026	137.1
2000	0.284	0.011	1.052	0.197	1.156	0.376	0.063	0.006	214.8
2001	0.08	0.019	0.566	0.473	0.567	0.247	0.209	0.226	161.8
2002	0.141	0.04	0.287	0.028	0.121	0.045	0.003	0.157	54.4
2003	0.045	0.005	0.284	0.074	0.106	0.021	0.022	0.154	47.3
2004	0.017	0.010	0.189	0.089	0.268	0.187	0.027	0.198	**61.3**

Table 2.4.1.1: North Sea Herring: Mean weight-at-age (wr) in the third quarter, in Divisions IVa, IVb and IIIa

	MEAN WEIGHTS-AT-AGE (G)																			
Ring	Third quarter mean weights in catch (Divisions IVa, IVb and IIIa)										July acoustic Survey									
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	63	75	43	54	62	54	69	50	65	45	58	45	45	52	52	46	50	45	46	35
2	149.7	135.1	129	131	128	123	136	140	119	125	132	119	120	109	118	118	127	138	104	116
3	192.5	186.3	175	172	163	172	167	177	177	159	180	196	168	198	171	180	162	172	185	139
4	221	224.3	220	209	193	201	199	200	198	203	200	253	233	238	207	218	204	194	209	206
5	232.4	229.3	247	237	228	228	218	224	210	234	195	262	256	275	236	232	228	224	214	231
6	272	252.6	255	263	252	241	237	244	236	250	228	299	245	307	267	261	237	247	243	253
7	275.8	291.6	278	269	263	266	262	252	247	264	257	306	265	289	272	295	255	261	281	262
8	317	300.3	295	313	275	286	288	281	272	262	302	325	269	308	230	300	286	280	290	279
9+	306	302.3	295	298	306	271	298	298	282	299	324	335	329	363	260	280	294	249	307	270

Weights-at-age in the catch for 1995 to 2001 were revised by SG Rednose for details of the revision see last years report (ICES ACFM).

Table 2.4.2.1 North Sea herring. Maturity at 2-, 3- and 4+ring for Autumn Spawning herring in the North Sea. The values are derived from the acoustic survey for 1988 to 2003.

Year \ Ring	2	3	>3
1988	65.6	87.7	100
1989	78.7	93.9	100
1990	72.6	97.0	100
1991	63.8	98.0	100
1992	51.3	100	100
1993	47.1	62.9	100
1994	72.1	85.8	100
1995	72.6	95.4	100
1996	60.5	97.5	100
1997	64.0	94.2	100
1998	64.0	89.0	100
1999	81.0	91.0	100
2000	66.0	96.0	100
2001	77.0	92.0	100
2002	86.0	97.0	100
2003	43.0	93.0	100
2004	69.8	64.9	100

Table 2.6.1.1. North Sea herring. Years of duration of survey and years used in the assessment.

Survey	Age range	Years survey has been running	Years used in assessment
MLAI (Larvae survey)	SSB	1972-2004	1973-2004
IBTS 1st Quarter (Trawl survey)	1wr	1971-2005	1979-2005
	2-5wr	1971-2005	1983-2005
IBTS 3rd Quarter (Trawl survey)		1991-2004	------------
Acoustic (+trawl)	1wr	1995-2004	1997-2004
	2-9+wr	1984-2004	1989-2004
MIK net	0wr	1977-2005	1977-2005

Table 2.6.1.2. North Sea herring. The weights used in the ICA assessment from 2002 onwards.

	Weights for the catch	Weights for the surveys			
Rings		**MLAI**	**Acoustic**	**IBTS 1-5**	**MIK**
0	0.10				2.05
1	0.10		0.74	0.67	
2	3.17		0.75	0.24	
3	2.65		0.64	0.06	
4	1.94		0.27	0.03	
5	1.31		0.14	0.03	
6	0.97		0.13		
7	0.75		0.12		
8	0.55		0.07		
9	0.54		0.07		
SSB		0.645			
St/R rel*	0.1				

*** St/R rel= stock recruitment relationship weight**

Table 2.6.1.3. North Sea herring. Model settings for XSA with low F shrinkage (2.0). Age = rings.

```
Extended Survivors Analysis

Autumn spawning herring in IV

CPUE           data           from           file           fleet.txt

Catch data for 45 years. 1960 to 2004. Ages 0 to 9.

Fleet                    First    Last   First Last   Alpha   Beta
                          year    year    age  age
Acoustic survey 1-9+      1989    2004      1    8     0.54   0.56
IBTS: 1-5+ wr             1979    2004      1    5     0.08   0.17
MIK 0-wr                  1977    2004      0    0     0.08   0.17

Time series weights :
Tapered time weighting not applied

 Catchability analysis :
      Catchability dependent on stock size for ages < 2

      Regression type = C
      Minimum of   5 points used for regression

      Survivor estimates shrunk to the population mean for ages < 2

      Catchability independent of age for ages >= 4

 Terminal population estimation :

      Survivor estimates shrunk towards the mean F
      of the final 5 years or the 1 oldest ages.
      S.E. of the mean to which the estimates are shrunk = 2.000
      Minimum standard error for population
      estimates derived from each fleet = .300
      Prior weighting not applied


Tuning converged after 26 iterations
```

Table 2.6.1.4. North Sea herring. EXPLORATORY stock summary results (without SOP corrections) from XSA model with low shrinkage (=2.0). Model settings given in Table 2.6.1.3.

	RECRUITS	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	FBAR 2-6
	Thousand	**Tonnes**	**Tonnes**	**Tonnes**		
1960	12273704	4327089	2393348	696200	0.2909	0.2762
1961	110197272	4866185	2106771	696700	0.3307	0.3581
1962	47010516	4791819	1455864	627800	0.4312	0.4205
1963	49157192	5069881	2563308	716000	0.2793	0.2097
1964	64470780	5167142	2323578	871200	0.3749	0.3333
1965	35926536	4625353	1662521	1168800	0.703	0.6998
1966	28993228	3490561	1402660	895500	0.6384	0.6192
1967	41629420	2872802	926397	695500	0.7508	0.7988
1968	40167484	2597103	421236	717800	1.704	1.3428
1969	22310824	1957817	430411	546700	1.2702	1.0966
1970	43509836	1992514	382267	563100	1.4731	1.085
1971	34222836	1936743	273383	520100	1.9025	1.3562
1972	22272876	1625482	299801	497500	1.6594	0.6768
1973	10724407	1213914	246425	484000	1.9641	1.0941
1974	23510572	970775	176427	275100	1.5593	0.975
1975	3265412	739404	97707	312800	3.2014	1.2011
1976	3078300	401181	99933	174800	1.7492	1.0094
1977	4669138	250819	72697	46000	0.6328	0.4591
1978	5689090	284389	97610	11000	0.1127	0.0297
1979	10823767	438871	136590	25100	0.1838	0.0515
1980	17347406	694614	173005	70764	0.409	0.2286
1981	39553592	1242439	239602	174879	0.7299	0.2789
1982	67412280	1944144	325268	275079	0.8457	0.2305
1983	64453152	2846300	481329	387202	0.8044	0.2965
1984	55763052	2984385	730973	428631	0.5864	0.4092
1985	83229400	3591344	748046	613780	0.8205	0.623
1986	101449952	3610537	736342	671488	0.9119	0.5447
1987	90352320	4068564	928263	792058	0.8533	0.5373
1988	44369548	3704570	1235278	887686	0.7186	0.5099
1989	40605524	3414190	1291028	787899	0.6103	0.5202
1990	36709524	3072573	1237655	645229	0.5213	0.424
1991	35239728	2801715	1026378	658008	0.6411	0.4797
1992	65520112	2534139	743556	716799	0.964	0.5615
1993	52542952	2630602	506667	671397	1.3251	0.6744
1994	34426408	2115792	562350	568234	1.0105	0.6828
1995	42287472	1879896	493379	579371	1.1743	0.7398
1996	49890292	1638710	483790	275098	0.5686	0.3924
1997	26523964	1925121	557792	264313	0.4739	0.3893
1998	23699908	1989402	722228	391628	0.5422	0.4624
1999	65715436	2198909	822214	363163	0.4417	0.3909
2000	35861976	2664460	772959	388157	0.5022	0.4233
2001	87389920	2952850	1158083	363343	0.3137	0.3385
2002	38644356	3671107	1378171	370941	0.2692	0.2768
2003	23296650	3528195	1497644	472587	0.3156	0.3236
2004	19534400	3224443	1586498	551873	0.3479	0.4292
Mean	**41238278**	**2589974**	**844609**	**509140**	**0.8425**	**0.5613**

Table 2.6.2.1 North Sea herring. Final model fit ICA log. Note age=ringer.

```
Enter the name of the index file --> index.txt  canum.txt   weca.txt
Stock weights in 2005 used for the year 2004                west.txt
Natural mortality in 2005 used for the year 2004            natmor.txt
Maturity ogive in 2005 used for the year 2004               matprop.txt
Name of age-structured index file (Enter if none) : -->     fleet.txt
Name of the SSB index file (Enter if none) -->              ssb.txt
No of years for separable constraint ?      -->    5
Reference age for separable constraint ?    -->    4
Constant selection pattern model (Y/N) ?    -->    y
S to be fixed on last age ?                 -->    1.000000000000000
First age for calculation of reference F ?  -->    2
Last age for calculation of reference F ?   -->    6
Use default weighting (Y/N) ?               -->    n
Enter relative weights at age
 Weight for age 0-->    0.100000000000000
 Weight for age 1-->    0.100000000000000
 Weight for age 2-->    3.170000000000000
 Weight for age 3-->    2.650000000000000
 Weight for age 4-->    1.940000000000000
 Weight for age 5-->    1.310000000000000
 Weight for age 6-->    0.970000000000000
 Weight for age 7-->    0.750000000000000
 Weight for age 8-->    0.550000000000000
 Weight for age 9-->    0.540000000000000
Enter relative weights by year
 Weight for year 2000-->    1.000000000000000
 Weight for year 2001-->    1.000000000000000
 Weight for year 2002-->    1.000000000000000
 Weight for year 2003-->    1.000000000000000
 Weight for year 2004-->    1.000000000000000
Enter new weights for specified years and ages if needed
 Enter year, age, new weight or -1,-1,-1 to end.  -1 -1   -1.000000000000000
 Is the last age of Acoustic survey 1-9+ wr a plus-group (Y/N) ?   -->y
 Is the last age of IBTS: 1-5+ wr a plus-group (Y/N) ?             -->y
 Is the last age of MIK 0-wr a plus-group (Y/N) ?                  -->n
You must choose a catchability model for each index.
Models:   A  Absolute:  Index = Abundance . e
          L  Linear:    Index = Q. Abundance . e
          P  Power:     Index = Q. Abundance^ K .e
where Q and K are parameters to be estimated, e is a lognormally-distributed
error.

 Model for MLAI is to be A/L/P ?                       -->p
 Model for Acoustic survey 1-9+ wr is to be A/L/P ?  -->L
 Model for IBTS: 1-5+ wr  is to be A/L/P ?           -->L
 Model for MIK 0-wr  is to be A/L/P ?                -->L
 Fit a stock-recruit relationship (Y/N) ?            -->y
Enter the time lag in years between spawning and the stock size of fish aged 0
years on 1 January. This will probably be 0 unless the stock is an autumn-
spawning herring     in which case it will probably be 1 years.
 Enter the lag in years (rounded up)        --> 1
 Enter lowest feasible F                    --> 2.0000000000000000E-02
 Enter highest feasible F                   --> 2.000000000000000
Mapping the F-dimension of the SSQ surface

    F                  SSQ
+--------+------------------
    0.02       141.5561944283
    0.12        38.6656231742
    0.23        23.5986122213
    0.33        21.2487817508
    0.44        22.3399750659
    0.54        24.5195160787
    0.65        27.0670093550
    0.75        29.7356108731
    0.85        32.4381283334
    0.96        35.1497251510
    1.06        37.8760500321
    1.17        40.6457829604
    1.27        43.5226880980
```

Table 2.6.2.1 North Sea herring. Continued.

```
    1.37        46.0852332241
    1.48        48.4972844913
    1.58        50.8175456190
    1.69        53.0456581553
    1.79        55.2885546824
    1.90        57.3920469174
    2.00        59.1476874491
Lowest SSQ is for F =     0.333
-----------------------------------------------------------------
No of years for separable analysis :         5
Age range in the analysis :                  0  . . . 9
Year range in the analysis :                 1960  . . . 2004
Number of indices of SSB :                   1
Number of age-structured indices :           3
Stock-recruit relationship to be fitted.
Parameters to estimate : 45
Number of observations : 405

Conventional single selection vector model to be fitted.

-----------------------------------------------------------------
 Survey weighting to be Manual (recommended) or Iterative (M/I) ?-->M
 Enter weight for   MLAI-->                                 0.650000000000000
 Enter weight for Acoustic survey 1-9+ wr  at age 1-->      0.740000000000000
 Enter weight for Acoustic survey 1-9+ wr  at age 2-->      0.750000000000000
 Enter weight for Acoustic survey 1-9+ wr  at age 3-->      0.640000000000000
 Enter weight for Acoustic survey 1-9+ wr  at age 4-->      0.270000000000000
 Enter weight for Acoustic survey 1-9+ wr  at age 5-->      0.140000000000000
 Enter weight for Acoustic survey 1-9+ wr  at age 6-->      0.130000000000000
 Enter weight for Acoustic survey 1-9+ wr  at age 7-->      0.120000000000000
 Enter   weight   for   Acoustic   survey   1-9+   wr      at   age   8-->
       7.0000000000000007E-02
 Enter   weight   for   Acoustic   survey   1-9+   wr      at   age   9-->
       7.0000000000000007E-02
 Enter weight for IBTS: 1-5+ wr  at age 1-->                0.670000000000000
 Enter weight for IBTS: 1-5+ wr  at age 2-->                0.240000000000000
 Enter weight for IBTS: 1-5+ wr  at age 3-->
       5.9999999999999998E-02
 Enter weight for IBTS: 1-5+ wr  at age 4-->
       2.9999999999999999E-02
 Enter weight for IBTS: 1-5+ wr  at age 5-->
       2.9999999999999999E-02
 Enter weight for MIK 0-wr  at age 0-->                     2.050000000000000
 Enter weight for stock-recruit model-->                    0.100000000000000
Enter estimates of the extent to which errorsnin the age-structured indices are
correlated across ages. This can be in the range 0 (independence) to 1 (corre-
lated errors).
  Enter value for Acoustic survey 1-9+ wr-->
       0.0000000000000000E+000
  Enter value for IBTS: 1-5+ wr-->
       0.0000000000000000E+000
  Enter value for MIK 0-wr-->
       0.0000000000000000E+000
Do you want to shrink the final fishing mortality (Y/N) ?-->N
Seeking solution. Please wait.
SSB index weights     0.650
Aged index weights
Acoustic survey 1-9+ wr
 Age   :      1     2     3     4     5     6     7     8     9
 Wts :    0.740 0.750 0.640 0.270 0.140 0.130 0.120 0.070 0.070
IBTS: 1-5+ wr
 Age   :      1     2     3     4     5
 Wts :    0.670 0.240 0.060 0.030 0.030
MIK 0-wr
 Age   :      0
 Wts :    2.050
 Stock-recruit weight 0.100
F in 2004  at age 4  is 0.297469  in iteration 1
Detailed, Normal or Summary output (D/N/S)          -->D
Output page width in characters (e.g. 80..132) ?    --> 80
Estimate historical assessment uncertainty ?        -->n
Succesful exit from ICA
```

Table 2.6.2.2 North Sea herring. Final model fit ICA output. Note age=ringer

Catch in Number x 10 ^ 6

AGE	1960	1961	1962	1963	1964	1965	1966	1967
0	195.	1269.	142.	443.	497.	157.	375.	645.
1	2393.	336.	2147.	1262.	2972.	3209.	1383.	1674.
2	1142.	1889.	270.	2961.	1548.	2218.	2570.	1172.
3	1967.	480.	797.	177.	2243.	1325.	741.	1365.
4	166.	1456.	335.	158.	148.	2039.	450.	372.
5	168.	124.	1082.	81.	149.	145.	890.	298.
6	113.	158.	127.	230.	95.	152.	45.	393.
7	126.	61.	145.	22.	256.	118.	65.	68.
8	129.	56.	86.	42.	26.	413.	96.	82.
9	142.	88.	87.	51.	58.	78.	236.	173.

AGE	1968	1969	1970	1971	1972	1973	1974	1975
0	839.	112.	898.	684.	750.	289.	996.	264.
1	2425.	2503.	1196.	4379.	3341.	2368.	846.	2461.
2	1795.	1883.	2003.	1147.	1441.	1344.	773.	542.
3	1494.	296.	884.	663.	344.	659.	362.	260.
4	621.	133.	125.	208.	131.	150.	126.	141.
5	157.	191.	50.	27.	33.	59.	56.	57.
6	145.	50.	61.	31.	5.	31.	22.	16.
7	163.	43.	8.	27.	0.	4.	5.	9.
8	14.	27.	12.	0.	1.	1.	2.	3.
9	92.	25.	12.	12.	0.	1.	1.	1.

AGE	1976	1977	1978	1979	1980	1981	1982	1983
0	238.	257.	130.	542.	1263.	9520.	11957.	13297.
1	127.	144.	169.	159.	245.	872.	1116.	2449.
2	902.	45.	5.	34.	134.	284.	299.	574.
3	117.	186.	6.	10.	92.	57.	230.	216.
4	52.	11.	5.	10.	32.	40.	34.	105.
5	35.	7.	0.	2.	22.	29.	14.	26.
6	6.	4.	0.	0.	2.	23.	7.	23.
7	4.	2.	0.	1.	1.	19.	8.	13.
8	1.	1.	0.	1.	0.	6.	4.	11.
9	0.	0.	0.	0.	0.	1.	1.	12.

AGE	1984	1985	1986	1987	1988	1989	1990	1991
0	6973.	4211.	3725.	8229.	3165.	3058.	1303.	2387.
1	1818.	3253.	4801.	6836.	7867.	3146.	3020.	2139.
2	1146.	1326.	1267.	2137.	2233.	1594.	899.	1133.
3	441.	1182.	841.	668.	1091.	1364.	779.	557.
4	202.	369.	466.	467.	384.	809.	861.	549.
5	81.	125.	130.	246.	256.	212.	388.	501.
6	23.	44.	62.	75.	128.	124.	80.	205.
7	25.	20.	21.	24.	38.	61.	54.	39.
8	11.	13.	14.	8.	15.	20.	29.	26.
9	19.	16.	15.	8.	9.	9.	12.	13.

AGE	1992	1993	1994	1995	1996	1997	1998	1999
0	10331.	10265.	4499.	7438.	2311.	431.	260.	1566.
1	2303.	3827.	1785.	1665.	1606.	480.	978.	304.
2	1285.	1176.	1783.	1444.	642.	688.	1220.	616.
3	443.	609.	489.	817.	526.	447.	538.	1059.
4	362.	306.	348.	232.	172.	285.	276.	294.
5	361.	216.	109.	119.	58.	109.	176.	136.
6	376.	226.	92.	55.	23.	31.	89.	69.
7	152.	188.	76.	41.	9.	12.	15.	28.
8	39.	87.	70.	69.	17.	19.	17.	10.
9	23.	42.	47.	29.	4.	6.	4.	2.

Table 2.6.2.2 North Sea herring. Continued.

Catch in Number x 10 ^ 6

AGE	2000	2001	2002	2003	2004
0	1105.	1833.	730.	369.	716.
1	1172.	614.	835.	617.	207.
2	623.	806.	553.	1204.	439.
3	463.	477.	903.	517.	1326.
4	647.	274.	284.	820.	520.
5	213.	312.	133.	243.	726.
6	82.	89.	161.	106.	171.
7	36.	37.	46.	120.	101.
8	15.	17.	33.	37.	71.
9	2.	2.	7.	8.	22.

Predicted Catch in Number x 10 ^ 6

AGE	2000	2001	2002	2003	2004
0	1409.9	2245.3	864.9	425.2	420.1
1	1562.3	635.7	1259.3	570.4	284.1
2	539.8	955.7	490.2	1144.7	524.8
3	456.9	416.0	948.5	575.8	1359.2
4	659.5	260.9	315.4	857.9	525.8
5	213.8	295.3	158.4	229.9	630.8
6	94.3	84.2	158.5	102.3	149.7
7	40.5	40.4	49.1	111.0	72.2
8	15.4	15.7	21.3	31.1	70.9

Weights at age in the catches (Kg)

AGE	1960	1961	1962	1963	1964	1965	1966	1967
0	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500
1	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000
2	0.12600	0.12600	0.12600	0.12600	0.12600	0.12600	0.12600	0.12600
3	0.17600	0.17600	0.17600	0.17600	0.17600	0.17600	0.17600	0.17600
4	0.21100	0.21100	0.21100	0.21100	0.21100	0.21100	0.21100	0.21100
5	0.24300	0.24300	0.24300	0.24300	0.24300	0.24300	0.24300	0.24300
6	0.25100	0.25100	0.25100	0.25100	0.25100	0.25100	0.25100	0.25100
7	0.26700	0.26700	0.26700	0.26700	0.26700	0.26700	0.26700	0.26700
8	0.27100	0.27100	0.27100	0.27100	0.27100	0.27100	0.27100	0.27100
9	0.27100	0.27100	0.27100	0.27100	0.27100	0.27100	0.27100	0.27100

AGE	1968	1969	1970	1971	1972	1973	1974	1975
0	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500
1	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000
2	0.12600	0.12600	0.12600	0.12600	0.12600	0.12600	0.12600	0.12600
3	0.17600	0.17600	0.17600	0.17600	0.17600	0.17600	0.17600	0.17600
4	0.21100	0.21100	0.21100	0.21100	0.21100	0.21100	0.21100	0.21100
5	0.24300	0.24300	0.24300	0.24300	0.24300	0.24300	0.24300	0.24300
6	0.25100	0.25100	0.25100	0.25100	0.25100	0.25100	0.25100	0.25100
7	0.26700	0.26700	0.26700	0.26700	0.26700	0.26700	0.26700	0.26700
8	0.27100	0.27100	0.27100	0.27100	0.27100	0.27100	0.27100	0.27100
9	0.27100	0.27100	0.27100	0.27100	0.27100	0.27100	0.27100	0.27100

AGE	1976	1977	1978	1979	1980	1981	1982	1983
0	0.01500	0.01500	0.01500	0.01500	0.01500	0.00700	0.01000	0.01000
1	0.05000	0.05000	0.05000	0.05000	0.05000	0.04900	0.05900	0.05900
2	0.12600	0.12600	0.12600	0.12600	0.12600	0.11800	0.11800	0.11800
3	0.17600	0.17600	0.17600	0.17600	0.17600	0.14200	0.14900	0.14900
4	0.21100	0.21100	0.21100	0.21100	0.21100	0.18900	0.17900	0.17900
5	0.24300	0.24300	0.24300	0.24300	0.24300	0.21100	0.21700	0.21700
6	0.25100	0.25100	0.25100	0.25100	0.25100	0.22200	0.23800	0.23800
7	0.26700	0.26700	0.26700	0.26700	0.26700	0.26700	0.26500	0.26500
8	0.27100	0.27100	0.27100	0.27100	0.27100	0.27100	0.27400	0.27400
9	0.27100	0.27100	0.27100	0.27100	0.27100	0.27100	0.27500	0.27500

Table 2.6.2.2 North Sea herring. Continued.

Weights at age in the catches (Kg)

AGE	1984	1985	1986	1987	1988	1989	1990	1991
0	0.01000	0.00900	0.00600	0.01100	0.01100	0.01700	0.01900	0.01700
1	0.05900	0.03600	0.06700	0.03500	0.05500	0.04300	0.05500	0.05800
2	0.11800	0.12800	0.12100	0.09900	0.11100	0.11500	0.11400	0.13000
3	0.14900	0.16400	0.15300	0.15000	0.14500	0.15300	0.14900	0.16600
4	0.17900	0.19400	0.18200	0.18000	0.17400	0.17300	0.17700	0.18400
5	0.21700	0.21100	0.20800	0.21100	0.19700	0.20800	0.19300	0.20300
6	0.23800	0.22000	0.22100	0.23400	0.21600	0.23100	0.22900	0.21700
7	0.26500	0.25800	0.23800	0.25800	0.23700	0.24700	0.23600	0.23500
8	0.27400	0.27000	0.25200	0.27700	0.25300	0.26500	0.25000	0.25900
9	0.27500	0.29200	0.26200	0.29900	0.26300	0.25900	0.28700	0.27100

AGE	1992	1993	1994	1995	1996	1997	1998	1999
0	0.01000	0.01000	0.00600	0.00900	0.01500	0.01500	0.02100	0.00900
1	0.05300	0.03300	0.05600	0.04200	0.01800	0.04400	0.05100	0.04500
2	0.10200	0.11500	0.13000	0.13000	0.11200	0.10800	0.11400	0.11500
3	0.17500	0.14500	0.15900	0.16900	0.15600	0.14800	0.14500	0.15100
4	0.18900	0.18900	0.18100	0.19800	0.18800	0.19500	0.18300	0.17100
5	0.20700	0.20400	0.21400	0.20700	0.20400	0.22700	0.21900	0.20700
6	0.22300	0.22800	0.24000	0.24300	0.21200	0.22600	0.23800	0.23300
7	0.23700	0.24400	0.25500	0.24700	0.26100	0.23500	0.24700	0.24500
8	0.24900	0.25600	0.27300	0.28300	0.28000	0.24400	0.28900	0.26100
9	0.28700	0.31000	0.28100	0.27600	0.28800	0.29100	0.28300	0.30100

AGE	2000	2001	2002	2003	2004
0	0.01500	0.01200	0.01200	0.01400	0.01400
1	0.03300	0.04800	0.03700	0.03700	0.03600
2	0.11300	0.11700	0.11600	0.10400	0.09900
3	0.15700	0.14900	0.15100	0.15700	0.13700
4	0.17900	0.17700	0.16900	0.17300	0.18200
5	0.20100	0.19700	0.19800	0.18400	0.20500
6	0.21600	0.21200	0.21400	0.20400	0.22000
7	0.24600	0.23700	0.22800	0.22100	0.22800
8	0.27500	0.26700	0.25000	0.23200	0.24100
9	0.26200	0.28600	0.25300	0.25300	0.26500

Weights at age in the stock (Kg)

AGE	1960	1961	1962	1963	1964	1965	1966	1967
0	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500
1	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000
2	0.15500	0.15500	0.15500	0.15500	0.15500	0.15500	0.15500	0.15500
3	0.18700	0.18700	0.18700	0.18700	0.18700	0.18700	0.18700	0.18700
4	0.22300	0.22300	0.22300	0.22300	0.22300	0.22300	0.22300	0.22300
5	0.23900	0.23900	0.23900	0.23900	0.23900	0.23900	0.23900	0.23900
6	0.27600	0.27600	0.27600	0.27600	0.27600	0.27600	0.27600	0.27600
7	0.29900	0.29900	0.29900	0.29900	0.29900	0.29900	0.29900	0.29900
8	0.30600	0.30600	0.30600	0.30600	0.30600	0.30600	0.30600	0.30600
9	0.31200	0.31200	0.31200	0.31200	0.31200	0.31200	0.31200	0.31200

AGE	1968	1969	1970	1971	1972	1973	1974	1975
0	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500
1	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000
2	0.15500	0.15500	0.15500	0.15500	0.15500	0.15500	0.15500	0.15500
3	0.18700	0.18700	0.18700	0.18700	0.18700	0.18700	0.18700	0.18700
4	0.22300	0.22300	0.22300	0.22300	0.22300	0.22300	0.22300	0.22300
5	0.23900	0.23900	0.23900	0.23900	0.23900	0.23900	0.23900	0.23900
6	0.27600	0.27600	0.27600	0.27600	0.27600	0.27600	0.27600	0.27600
7	0.29900	0.29900	0.29900	0.29900	0.29900	0.29900	0.29900	0.29900
8	0.30600	0.30600	0.30600	0.30600	0.30600	0.30600	0.30600	0.30600
9	0.31200	0.31200	0.31200	0.31200	0.31200	0.31200	0.31200	0.31200

Table 2.6.2.2 North Sea herring. Continued.

Weights at age in the stock (Kg)

AGE	1976	1977	1978	1979	1980	1981	1982	1983
0	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01500	0.01700
1	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05000	0.05700
2	0.15500	0.15500	0.15500	0.15500	0.15500	0.15500	0.15500	0.15000
3	0.18700	0.18700	0.18700	0.18700	0.18700	0.18700	0.18700	0.19000
4	0.22300	0.22300	0.22300	0.22300	0.22300	0.22300	0.22300	0.23000
5	0.23900	0.23900	0.23900	0.23900	0.23900	0.23900	0.23900	0.24300
6	0.27600	0.27600	0.27600	0.27600	0.27600	0.27600	0.27600	0.28200
7	0.29900	0.29900	0.29900	0.29900	0.29900	0.29900	0.29900	0.31100
8	0.30600	0.30600	0.30600	0.30600	0.30600	0.30600	0.30600	0.33800
9	0.31200	0.31200	0.31200	0.31200	0.31200	0.31200	0.31200	0.34700

AGE	1984	1985	1986	1987	1988	1989	1990	1991
0	0.01600	0.01400	0.00900	0.00800	0.00800	0.01200	0.01100	0.01000
1	0.05600	0.06100	0.05000	0.04800	0.04400	0.05200	0.05900	0.06400
2	0.13800	0.13000	0.12200	0.12300	0.12200	0.12600	0.13900	0.13700
3	0.18700	0.18300	0.17000	0.16600	0.16500	0.17400	0.18400	0.19400
4	0.23200	0.23200	0.21200	0.20800	0.20500	0.21200	0.21200	0.21400
5	0.24700	0.25200	0.23000	0.22900	0.22800	0.24400	0.23900	0.23400
6	0.27500	0.27300	0.24200	0.24800	0.25200	0.27000	0.26500	0.25300
7	0.32100	0.31500	0.27500	0.25900	0.26100	0.28400	0.28000	0.27100
8	0.34100	0.33200	0.26800	0.26300	0.27700	0.29800	0.30000	0.29100
9	0.36500	0.39200	0.34300	0.32500	0.31500	0.33100	0.32800	0.31200

AGE	1992	1993	1994	1995	1996	1997	1998	1999
0	0.00600	0.00700	0.00600	0.00600	0.00500	0.00600	0.00600	0.00600
1	0.06100	0.06000	0.05700	0.05400	0.04900	0.04700	0.05100	0.05100
2	0.13400	0.12700	0.13000	0.13000	0.12300	0.11600	0.11600	0.11600
3	0.18400	0.19200	0.18600	0.19900	0.18300	0.18700	0.17900	0.18400
4	0.21300	0.21400	0.21100	0.22800	0.23000	0.24100	0.22600	0.22100
5	0.23500	0.24000	0.22400	0.23400	0.23700	0.26400	0.25600	0.24800
6	0.26200	0.27500	0.26800	0.27400	0.25700	0.28400	0.27300	0.27900
7	0.27300	0.29100	0.29300	0.30100	0.28000	0.28700	0.27600	0.28600
8	0.30200	0.30900	0.31800	0.32400	0.30300	0.30100	0.27000	0.28100
9	0.32000	0.33800	0.34600	0.34400	0.33400	0.34200	0.31800	0.30300

AGE	2000	2001	2002	2003	2004
0	0.00600	0.00600	0.00700	0.00700	0.00700
1	0.05100	0.04700	0.04700	0.04200	0.04100
2	0.12200	0.12800	0.12300	0.11900	0.11000
3	0.17200	0.17200	0.17300	0.16500	0.16200
4	0.21000	0.20500	0.20200	0.20300	0.20700
5	0.23300	0.22800	0.22200	0.22300	0.22300
6	0.25500	0.24800	0.24200	0.24800	0.24800
7	0.27500	0.27000	0.26600	0.26800	0.27100
8	0.27400	0.28900	0.28500	0.28300	0.28500
9	0.28000	0.27500	0.28300	0.27500	0.28900

Natural Mortality (per year)

AGE	1960	1961	1962	1963	1964	1965	1966	1967
0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
3	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
5	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
6	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
7	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
8	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
9	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000

Table 2.6.2.2 North Sea herring. Continued.

Natural Mortality (per year)

AGE	1968	1969	1970	1971	1972	1973	1974	1975
0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
3	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
5	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
6	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
7	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
8	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
9	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000

AGE	1976	1977	1978	1979	1980	1981	1982	1983
0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
3	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
5	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
6	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
7	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
8	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
9	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000

AGE	1984	1985	1986	1987	1988	1989	1990	1991
0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
3	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
5	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
6	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
7	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
8	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
9	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000

AGE	1992	1993	1994	1995	1996	1997	1998	1999
0	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
3	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
5	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
6	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
7	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
8	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
9	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000

AGE	2000	2001	2002	2003	2004
0	1.0000	1.0000	1.0000	1.0000	1.0000
1	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.3000	0.3000	0.3000	0.3000	0.3000
3	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.1000	0.1000	0.1000	0.1000	0.1000
5	0.1000	0.1000	0.1000	0.1000	0.1000
6	0.1000	0.1000	0.1000	0.1000	0.1000
7	0.1000	0.1000	0.1000	0.1000	0.1000
8	0.1000	0.1000	0.1000	0.1000	0.1000
9	0.1000	0.1000	0.1000	0.1000	0.1000

Table 2.6.2.2 North Sea herring. Continued.

Proportion of fish spawning

AGE	1960	1961	1962	1963	1964	1965	1966	1967
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1968	1969	1970	1971	1972	1973	1974	1975
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	1.0000	1.0000	1.0000	1.0000	0.8200	0.8200	0.8200	0.8200
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1976	1977	1978	1979	1980	1981	1982	1983
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.8200	0.8200	0.8200	0.8200	0.8200	0.8200	0.8200	0.8200
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1984	1985	1986	1987	1988	1989	1990	1991
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.8200	0.7000	0.7500	0.8000	0.8500	0.8200	0.9100	0.8600
3	1.0000	1.0000	1.0000	1.0000	0.9300	0.9400	0.9700	0.9900
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1992	1993	1994	1995	1996	1997	1998	1999
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.5000	0.4700	0.7300	0.6700	0.6100	0.6400	0.6400	0.6900
3	0.9900	0.6100	0.9300	0.9500	0.9800	0.9400	0.8900	0.9100
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 2.6.2.2 North Sea herring. Continued.

Proportion of fish spawning

AGE	2000	2001	2002	2003	2004
0	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.6700	0.7700	0.8700	0.4300	0.7000
3	0.9600	0.9200	0.9700	0.9300	0.6500
4	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000

INDICES OF SPAWNING BIOMASS
MLAI

	1973	1974	1975	1976	1977	1978	1979	1980
1	13.30	8.10	2.70	2.50	6.10	7.40	15.00	10.30
	1981	1982	1983	1984	1985	1986	1987	1988
1	15.30	21.70	28.00	50.80	77.40	40.10	69.90	139.30
	1989	1990	1991	1992	1993	1994	1995	1996
1	134.80	172.70	90.80	42.50	30.70	20.80	23.80	47.50
	1997	1998	1999	2000	2001	2002	2003	2004
1	59.30	79.60	66.20	43.60	134.70	113.70	286.50	330.10

AGE-STRUCTURED INDICES
Acoustic survey 1-9+ wr x 10 ^ 3

AGE	1989	1990	1991	1992	1993	1994	1995	1996
1	999990.	999990.	999990.	999990.	999990.	999990.	999990.	999990.
2	4090.	3306.	2634.	3734.	2984.	3185.	3849.	4497.
3	3903.	3521.	1700.	1378.	1637.	839.	2041.	2824.
4	1633.	3414.	1959.	1147.	902.	399.	672.	1087.
5	492.	1366.	1849.	1134.	741.	381.	299.	311.
6	283.	392.	644.	1246.	777.	321.	203.	99.
7	120.	210.	228.	395.	551.	326.	138.	83.
8	44.	133.	94.	114.	180.	219.	119.	133.
9	22.	43.	51.	104.	116.	131.	93.	206.
AGE	1997	1998	1999	2000	2001	2002	2003	2004
1	9361.	4449.	5087.	24736.	6837.	23055.	9829.	5184.
2	5960.	5747.	3078.	2923.	12290.	4875.	18949.	3416.
3	2935.	2520.	4725.	2156.	3083.	8220.	3081.	9192.
4	1441.	1625.	1116.	3140.	1462.	1390.	4189.	2167.
5	601.	982.	506.	1007.	1676.	795.	675.	2591.
6	215.	445.	314.	483.	450.	1031.	495.	317.
7	46.	170.	139.	266.	170.	244.	568.	328.
8	78.	45.	54.	120.	98.	121.	146.	342.
9	159.	121.	87.	97.	59.	149.	178.	186.

Table 2.6.2.2 North Sea herring. Continued.

IBTS: 1-5+ wr

AGE	1979	1980	1981	1982	1983	1984	1985	1986
1	156.3	342.8	517.7	799.3	1230.7	1468.9	2082.4	2593.0
2	*******	*******	*******	*******	137.4	169.9	748.1	820.1
3	*******	*******	*******	*******	46.4	67.0	301.5	288.9
4	*******	*******	*******	*******	15.3	30.0	47.6	84.1
5	*******	*******	*******	*******	28.5	10.8	31.2	28.5

AGE	1987	1988	1989	1990	1991	1992	1993	1994
1	3733.8	4469.6	2187.0	1024.6	1180.3	1204.0	2988.5	1644.3
2	946.3	4725.8	933.9	482.1	821.0	410.1	840.8	1176.5
3	124.0	915.0	401.2	312.9	288.4	195.1	225.1	214.4
4	63.2	65.4	111.8	292.7	258.7	68.5	46.9	68.4
5	53.6	28.0	10.5	77.1	174.3	109.4	68.6	43.0

AGE	1995	1996	1997	1998	1999	2000	2001	2002
1	1215.4	1728.3	3992.7	2067.1	714.8	3693.7	2508.8	4071.1
2	1263.1	209.0	526.6	799.7	456.8	217.9	1117.2	654.4
3	251.0	46.6	204.1	96.4	547.8	159.3	317.4	306.3
4	33.2	13.5	42.8	22.0	109.0	61.5	98.0	21.9
5	6.2	9.1	24.3	20.7	40.3	8.6	66.2	19.9

AGE	2003	2004	2005
1	2999.9	979.5	1033.1
2	1547.9	456.0	190.2
3	475.2	759.0	325.6
4	345.9	110.9	402.1
5	43.9	141.1	140.3

MIK 0-wr

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	17.10	13.10	52.10	101.10	76.70	133.90	91.80	115.00

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	181.30	177.40	270.90	168.90	71.40	25.90	69.90	200.70

AGE	1993	1994	1995	1996	1997	1998	1999	2000
0	190.10	101.70	127.00	106.50	148.10	53.10	244.00	137.10

AGE	2001	2002	2003	2004	2005
0	214.80	161.80	54.40	47.30	61.00

Fishing Mortality (per year)

AGE	1960	1961	1962	1963	1964	1965	1966	1967
0	0.0257	0.0186	0.0049	0.0148	0.0126	0.0071	0.0215	0.0256
1	0.2560	0.1294	0.0897	0.1241	0.3084	0.2461	0.1852	0.2981
2	0.4381	0.6176	0.2503	0.2976	0.3890	0.7753	0.5921	0.4222
3	0.3303	0.3548	0.6279	0.2756	0.4124	0.7389	0.7082	0.8046
4	0.3396	0.4121	0.4257	0.2275	0.3706	0.7769	0.5718	0.9244
5	0.2700	0.4062	0.5419	0.1524	0.3086	0.6608	0.8352	0.8277
6	0.3187	0.3889	0.8318	0.1855	0.2413	0.5220	0.3912	1.0116
7	0.6292	0.2558	0.6572	0.2933	0.2891	0.4661	0.3908	1.5417
8	0.5948	0.5642	0.6007	0.3539	0.5822	0.9015	0.7586	1.0839
9	0.5948	0.5642	0.6007	0.3539	0.5822	0.9015	0.7586	1.0839

Table 2.6.2.2 North Sea herring. Continued.

Fishing Mortality (per year)

AGE	1968	1969	1970	1971	1972	1973	1974	1975
0	0.0348	0.0082	0.0351	0.0340	0.0583	0.0462	0.0749	0.1581
1	0.3003	0.3291	0.2681	0.6022	0.5782	0.6740	0.4519	0.6883
2	1.3273	0.7844	0.9729	0.8826	0.8121	1.0222	1.0288	1.3136
3	1.8722	0.9127	1.2671	1.2148	0.8014	1.3338	0.9732	1.5054
4	1.0716	0.8744	1.3316	1.2269	0.7998	0.9879	0.9940	1.3739
5	1.2340	1.0545	0.8762	1.0879	0.5500	0.9519	1.1863	1.8853
6	1.1751	1.9010	1.0812	2.6288	0.5211	1.3813	1.0799	1.2768
7	1.6107	1.3013	4.1258	2.7371	0.0998	0.8164	0.7781	2.0456
8	1.7033	1.3621	1.7587	1.9827	1.0865	1.6187	1.3891	2.0887
9	1.7033	1.3621	1.7587	1.9827	1.0865	1.6187	1.3891	2.0887

AGE	1976	1977	1978	1979	1980	1981	1982	1983
0	0.1472	0.0978	0.0456	0.0837	0.1258	0.4822	0.3345	0.3998
1	0.2507	0.2984	0.2006	0.1671	0.1133	0.2856	0.2252	0.2518
2	1.3405	0.2269	0.0243	0.0950	0.3650	0.3244	0.2608	0.3024
3	1.4448	1.4176	0.0429	0.0668	0.4209	0.2768	0.5091	0.3250
4	1.7448	0.4369	0.1051	0.0947	0.2992	0.3054	0.2488	0.4376
5	1.6064	1.2229	0.0170	0.0528	0.2686	0.4168	0.1556	0.2779
6	1.0863	0.7483	0.0795	0.0127	0.0679	0.4396	0.1469	0.3482
7	1.5116	0.7655	0.0623	0.4534	0.1043	0.9849	0.2357	0.3984
8	1.7129	0.9779	0.1867	0.2391	0.3815	0.6447	0.4439	0.5333
9	1.7129	0.9779	0.1867	0.2391	0.3815	0.6447	0.4439	0.5333

AGE	1984	1985	1986	1987	1988	1989	1990	1991
0	0.2265	0.0853	0.0620	0.1615	0.1248	0.1305	0.0589	0.1180
1	0.2053	0.3831	0.3160	0.3726	0.5806	0.4312	0.4536	0.3086
2	0.3147	0.4048	0.4600	0.4067	0.3561	0.3990	0.3775	0.5760
3	0.4302	0.6720	0.5235	0.5067	0.4015	0.4108	0.3705	0.4557
4	0.5384	0.7395	0.5833	0.5910	0.5843	0.5575	0.4687	0.4596
5	0.6301	0.6666	0.5566	0.6193	0.6683	0.6615	0.5027	0.4856
6	0.3641	0.7363	0.7383	0.6413	0.6806	0.7094	0.4991	0.4821
7	0.7078	0.5675	0.8325	0.6220	0.7034	0.7195	0.6972	0.4318
8	0.6314	0.8931	0.8374	0.8217	0.9448	0.8630	0.7970	0.7426
9	0.6314	0.8931	0.8374	0.8217	0.9448	0.8630	0.7970	0.7426

AGE	1992	1993	1994	1995	1996	1997	1998	1999
0	0.2970	0.3773	0.2336	0.3258	0.0757	0.0257	0.0153	0.0354
1	0.3878	0.4227	0.2471	0.3054	0.2579	0.0455	0.1729	0.0502
2	0.5738	0.6704	0.6853	0.6039	0.3265	0.2931	0.2676	0.2723
3	0.5009	0.6431	0.7201	0.8715	0.4959	0.4249	0.4198	0.4193
4	0.5751	0.7403	0.9188	0.8774	0.4224	0.5216	0.4812	0.4048
5	0.5501	0.7168	0.5675	0.8395	0.4892	0.4595	0.6284	0.4087
6	0.7271	0.7083	0.6798	0.5568	0.3250	0.4782	0.7420	0.4803
7	0.7079	0.8931	0.4873	0.6643	0.1495	0.2523	0.3991	0.4839
8	0.8992	1.0503	0.9006	0.9776	0.5677	0.4465	0.5946	0.4493
9	0.8992	1.0503	0.9006	0.9776	0.5677	0.4465	0.5946	0.4493

AGE	2000	2001	2002	2003	2004
0	0.0550	0.0386	0.0332	0.0336	0.0344
1	0.1021	0.0716	0.0617	0.0623	0.0638
2	0.2006	0.1408	0.1213	0.1225	0.1254
3	0.3549	0.2491	0.2146	0.2167	0.2219
4	0.4758	0.3340	0.2877	0.2905	0.2975
5	0.5118	0.3593	0.3094	0.3125	0.3200
6	0.4903	0.3441	0.2964	0.2994	0.3065
7	0.5085	0.3569	0.3074	0.3105	0.3179
8	0.4758	0.3340	0.2877	0.2905	0.2975
9	0.4758	0.3340	0.2877	0.2905	0.2975

Table 2.6.2.2 North Sea herring. Continued.

Population Abundance (1 January) x 10 ^ 9

AGE	1960	1961	1962	1963	1964	1965	1966	1967
0	12.09	108.85	46.27	47.66	62.79	34.89	27.86	40.26
1	16.41	4.33	39.31	16.94	17.27	22.81	12.75	10.03
2	3.69	4.67	1.40	13.22	5.51	4.67	6.56	3.90
3	7.67	1.76	1.87	0.81	7.27	2.76	1.59	2.69
4	0.60	4.51	1.01	0.82	0.50	3.94	1.08	0.64
5	0.74	0.39	2.71	0.60	0.59	0.31	1.64	0.55
6	0.43	0.51	0.23	1.42	0.46	0.39	0.15	0.64
7	0.28	0.29	0.31	0.09	1.07	0.33	0.21	0.09
8	0.30	0.14	0.20	0.15	0.06	0.73	0.19	0.13
9	0.33	0.21	0.20	0.18	0.14	0.14	0.46	0.27

AGE	1968	1969	1970	1971	1972	1973	1974	1975
0	38.70	21.58	41.07	32.31	20.86	10.10	21.69	2.82
1	14.43	13.75	7.87	14.59	11.49	7.24	3.55	7.40
2	2.74	3.93	3.64	2.22	2.94	2.37	1.36	0.83
3	1.89	0.54	1.33	1.02	0.68	0.97	0.63	0.36
4	0.98	0.24	0.18	0.31	0.25	0.25	0.21	0.20
5	0.23	0.31	0.09	0.04	0.08	0.10	0.08	0.07
6	0.22	0.06	0.10	0.03	0.01	0.04	0.04	0.02
7	0.21	0.06	0.01	0.03	0.00	0.01	0.01	0.01
8	0.02	0.04	0.02	0.00	0.00	0.00	0.00	0.00
9	0.12	0.04	0.02	0.01	0.00	0.00	0.00	0.00

AGE	1976	1977	1978	1979	1980	1981	1982	1983
0	2.72	4.33	4.59	10.60	16.72	37.86	64.75	61.79
1	0.89	0.86	1.44	1.61	3.59	5.42	8.60	17.05
2	1.37	0.25	0.24	0.43	0.50	1.18	1.50	2.53
3	0.17	0.27	0.15	0.17	0.29	0.26	0.63	0.86
4	0.07	0.03	0.05	0.12	0.13	0.16	0.16	0.31
5	0.04	0.01	0.02	0.04	0.10	0.09	0.10	0.11
6	0.01	0.01	0.00	0.02	0.04	0.07	0.05	0.08
7	0.01	0.00	0.00	0.00	0.01	0.03	0.04	0.04
8	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.03
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03

AGE	1984	1985	1986	1987	1988	1989	1990	1991
0	53.44	80.89	97.56	86.15	42.25	39.12	35.84	33.60
1	15.24	15.67	27.32	33.73	26.97	13.72	12.63	12.43
2	4.88	4.57	3.93	7.33	8.55	5.55	3.28	2.95
3	1.38	2.64	2.26	1.84	3.61	4.44	2.76	1.67
4	0.51	0.74	1.10	1.09	0.91	1.98	2.41	1.56
5	0.18	0.27	0.32	0.56	0.55	0.46	1.03	1.36
6	0.08	0.09	0.12	0.16	0.27	0.25	0.21	0.56
7	0.05	0.05	0.04	0.05	0.08	0.12	0.11	0.12
8	0.02	0.02	0.03	0.01	0.03	0.04	0.05	0.05
9	0.04	0.03	0.03	0.02	0.01	0.02	0.02	0.03

AGE	1992	1993	1994	1995	1996	1997	1998	1999
0	62.09	50.12	33.52	41.22	49.84	26.79	26.98	71.14
1	10.98	16.97	12.64	9.76	10.95	17.00	9.61	9.77
2	3.36	2.74	4.09	3.63	2.65	3.11	5.98	2.97
3	1.23	1.40	1.04	1.53	1.47	1.41	1.72	3.39
4	0.86	0.61	0.60	0.41	0.52	0.73	0.76	0.93
5	0.89	0.44	0.26	0.22	0.16	0.31	0.39	0.42
6	0.76	0.47	0.19	0.14	0.09	0.09	0.18	0.19
7	0.31	0.33	0.21	0.09	0.07	0.06	0.05	0.08
8	0.07	0.14	0.12	0.12	0.04	0.05	0.04	0.03
9	0.04	0.07	0.08	0.05	0.01	0.02	0.01	0.01

Table 2.6.2.2 North Sea herring. Continued.

Population Abundance (1 January) x 10 ^ 9

AGE	2000	2001	2002	2003	2004	2005
0	41.53	93.58	41.76	20.33	19.62	22.35
1	25.26	14.46	33.12	14.86	7.23	6.97
2	3.42	8.39	4.95	11.46	5.14	2.50
3	1.68	2.07	5.40	3.25	7.51	3.36
4	1.82	0.96	1.32	3.57	2.14	4.92
5	0.56	1.03	0.62	0.90	2.41	1.44
6	0.25	0.30	0.65	0.41	0.59	1.59
7	0.11	0.14	0.19	0.44	0.28	0.40
8	0.04	0.06	0.09	0.13	0.29	0.18
9	0.01	0.01	0.03	0.03	0.09	0.25

Weighting factors for the catches in number

AGE	2000	2001	2002	2003	2004
0	0.1000	0.1000	0.1000	0.1000	0.1000
1	0.1000	0.1000	0.1000	0.1000	0.1000
2	3.1700	3.1700	3.1700	3.1700	3.1700
3	2.6500	2.6500	2.6500	2.6500	2.6500
4	1.9400	1.9400	1.9400	1.9400	1.9400
5	1.3100	1.3100	1.3100	1.3100	1.3100
6	0.9700	0.9700	0.9700	0.9700	0.9700
7	0.7500	0.7500	0.7500	0.7500	0.7500
8	0.5500	0.5500	0.5500	0.5500	0.5500

Predicted SSB Index Values
MLAI

	1973	1974	1975	1976	1977	1978	1979	1980
1	17.33	11.42	5.22	4.95	2.81	4.00	7.10	8.94

	1981	1982	1983	1984	1985	1986	1987	1988
1	14.14	21.17	35.01	58.60	60.58	58.58	80.79	111.47

	1989	1990	1991	1992	1993	1994	1995	1996
1	117.27	110.30	88.69	60.64	38.40	41.91	37.20	36.54

	1997	1998	1999	2000	2001	2002	2003	2004
1	44.78	61.43	72.18	71.69	120.40	154.01	170.53	188.71

Predicted Age-Structured Index Values
Acoustic survey 1-9+ wr Predicted x 10 ^ 3

AGE	1989	1990	1991	1992	1993	1994	1995	1996
1	999990.	999990.	999990.	999990.	999990.	999990.	999990.	999990.
2	5807.	3471.	2802.	3191.	2470.	3656.	3395.	2881.
3	5705.	3628.	2090.	1505.	1586.	1127.	1524.	1805.
4	2579.	3293.	2143.	1115.	718.	644.	452.	734.
5	599.	1466.	1967.	1240.	559.	363.	258.	224.
6	338.	318.	845.	998.	618.	262.	195.	140.
7	163.	151.	181.	415.	396.	309.	121.	126.
8	49.	80.	76.	95.	177.	169.	152.	68.
9	60.	89.	105.	152.	228.	304.	174.	42.

Table 2.6.2.2 North Sea herring. Continued.

Acoustic survey 1-9+ wr Predicted x 10 ^ 3

AGE	1997	1998	1999	2000	2001	2002	2003	2004
1	10634.	5603.	6099.	15319.	8917.	20538.	9211.	4480.
2	3450.	6719.	3334.	3990.	10118.	6035.	13953.	6246.
3	1805.	2200.	4336.	2225.	2913.	7736.	4650.	10713.
4	974.	1028.	1310.	2484.	1418.	1998.	5380.	3218.
5	454.	525.	637.	794.	1585.	991.	1424.	3813.
6	130.	231.	286.	381.	491.	1079.	689.	984.
7	95.	76.	114.	157.	226.	320.	717.	455.
8	96.	64.	52.	74.	109.	172.	248.	553.
9	79.	39.	28.	32.	44.	157.	179.	465.

IBTS: 1-5+ wr Predicted

AGE	1979	1980	1981	1982	1983	1984	1985	1986
1	202.8	453.6	671.4	1072.6	2119.1	1905.4	1916.7	3369.2
2	*******	*******	*******	*******	361.8	697.3	645.7	552.1
3	*******	*******	*******	*******	93.1	148.4	274.5	239.3
4	*******	*******	*******	*******	20.3	32.7	46.4	70.8
5	*******	*******	*******	*******	10.6	13.3	15.8	18.6

AGE	1987	1988	1989	1990	1991	1992	1993	1994
1	4130.2	3217.1	1667.7	1530.9	1534.0	1342.2	2064.9	1572.4
2	1036.1	1216.4	785.6	465.3	408.7	465.0	375.0	558.6
3	195.4	389.2	477.1	298.3	178.1	130.8	146.4	107.5
4	70.2	58.2	127.6	156.9	101.7	55.6	38.4	37.1
5	28.1	32.6	30.7	50.6	75.4	72.2	49.4	30.3

AGE	1995	1996	1997	1998	1999	2000	2001	2002
1	1205.5	1359.6	2168.1	1205.9	1245.8	3199.3	1838.4	4216.2
2	501.1	377.9	446.2	859.6	427.4	496.1	1226.4	725.5
3	155.1	156.5	151.9	184.7	363.9	181.7	227.5	595.2
4	25.6	34.3	47.5	49.2	60.7	118.7	63.8	88.1
5	20.8	13.0	18.7	23.3	26.0	34.4	55.5	57.7

AGE	2003	2004	2005
1	1891.3	920.4	887.6
2	1678.2	752.1	365.6
3	358.1	826.8	369.6
4	237.6	142.5	327.6
5	69.5	133.2	140.3

MIK 0-wr Predicted

AGE	1977	1978	1979	1980	1981	1982	1983	1984
0	11.72	12.52	28.75	45.12	97.71	170.21	161.11	142.38

AGE	1985	1986	1987	1988	1989	1990	1991	1992
0	219.36	265.34	231.42	114.02	105.49	97.50	90.73	163.97

AGE	1993	1994	1995	1996	1997	1998	1999	2000
0	131.03	89.24	108.46	135.32	73.20	73.80	194.12	113.04

AGE	2001	2002	2003	2004	2005
0	255.25	113.98	55.49	53.55	61.00

Table 2.6.2.2 North Sea herring. Continued.

Fitted Selection Pattern

AGE	1960	1961	1962	1963	1964	1965	1966	1967
0	0.0758	0.0451	0.0114	0.0650	0.0340	0.0092	0.0375	0.0277
1	0.7539	0.3140	0.2106	0.5453	0.8323	0.3168	0.3240	0.3224
2	1.2902	1.4987	0.5879	1.3079	1.0497	0.9980	1.0354	0.4567
3	0.9728	0.8608	1.4748	1.2116	1.1130	0.9510	1.2386	0.8704
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	0.7951	0.9856	1.2728	0.6701	0.8329	0.8505	1.4606	0.8953
6	0.9386	0.9437	1.9539	0.8152	0.6510	0.6719	0.6842	1.0943
7	1.8529	0.6208	1.5436	1.2895	0.7802	0.6000	0.6834	1.6677
8	1.7516	1.3692	1.4110	1.5555	1.5710	1.1603	1.3267	1.1725
9	1.7516	1.3692	1.4110	1.5555	1.5710	1.1603	1.3267	1.1725

AGE	1968	1969	1970	1971	1972	1973	1974	1975
0	0.0325	0.0094	0.0264	0.0277	0.0729	0.0468	0.0754	0.1150
1	0.2802	0.3764	0.2013	0.4908	0.7230	0.6823	0.4547	0.5009
2	1.2386	0.8971	0.7306	0.7194	1.0155	1.0347	1.0351	0.9561
3	1.7471	1.0438	0.9515	0.9902	1.0021	1.3502	0.9791	1.0957
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.1515	1.2060	0.6580	0.8868	0.6877	0.9636	1.1935	1.3722
6	1.0966	2.1740	0.8120	2.1427	0.6516	1.3983	1.0864	0.9293
7	1.5031	1.4882	3.0983	2.2310	0.1247	0.8264	0.7828	1.4889
8	1.5895	1.5577	1.3207	1.6160	1.3585	1.6385	1.3975	1.5202
9	1.5895	1.5577	1.3207	1.6160	1.3585	1.6385	1.3975	1.5202

AGE	1976	1977	1978	1979	1980	1981	1982	1983
0	0.0844	0.2238	0.4342	0.8841	0.4205	1.5790	1.3447	0.9137
1	0.1437	0.6830	1.9093	1.7640	0.3786	0.9354	0.9052	0.5754
2	0.7683	0.5194	0.2316	1.0029	1.2199	1.0625	1.0485	0.6910
3	0.8281	3.2446	0.4084	0.7058	1.4069	0.9063	2.0468	0.7426
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	0.9207	2.7990	0.1620	0.5576	0.8977	1.3649	0.6253	0.6350
6	0.6226	1.7128	0.7564	0.1344	0.2269	1.4397	0.5907	0.7956
7	0.8664	1.7520	0.5927	4.7867	0.3486	3.2253	0.9477	0.9103
8	0.9818	2.2383	1.7766	2.5249	1.2749	2.1112	1.7844	1.2186
9	0.9818	2.2383	1.7766	2.5249	1.2749	2.1112	1.7844	1.2186

AGE	1984	1985	1986	1987	1988	1989	1990	1991
0	0.4206	0.1154	0.1062	0.2732	0.2135	0.2341	0.1257	0.2568
1	0.3814	0.5181	0.5417	0.6304	0.9937	0.7735	0.9676	0.6715
2	0.5845	0.5473	0.7886	0.6882	0.6094	0.7157	0.8054	1.2534
3	0.7991	0.9088	0.8974	0.8573	0.6872	0.7369	0.7905	0.9917
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.1704	0.9014	0.9542	1.0478	1.1438	1.1864	1.0725	1.0566
6	0.6762	0.9957	1.2656	1.0850	1.1649	1.2724	1.0647	1.0492
7	1.3146	0.7674	1.4271	1.0523	1.2039	1.2905	1.4874	0.9397
8	1.1727	1.2076	1.4355	1.3902	1.6170	1.5480	1.7002	1.6159
9	1.1727	1.2076	1.4355	1.3902	1.6170	1.5480	1.7002	1.6159

AGE	1992	1993	1994	1995	1996	1997	1998	1999
0	0.5165	0.5096	0.2542	0.3714	0.1792	0.0493	0.0318	0.0873
1	0.6744	0.5710	0.2689	0.3481	0.6106	0.0872	0.3593	0.1239
2	0.9978	0.9055	0.7459	0.6883	0.7729	0.5620	0.5561	0.6726
3	0.8710	0.8687	0.7837	0.9933	1.1740	0.8146	0.8723	1.0358
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	0.9566	0.9682	0.6176	0.9569	1.1581	0.8810	1.3059	1.0096
6	1.2645	0.9567	0.7398	0.6346	0.7695	0.9169	1.5421	1.1866
7	1.2311	1.2064	0.5303	0.7571	0.3539	0.4838	0.8294	1.1954
8	1.5637	1.4186	0.9802	1.1143	1.3439	0.8561	1.2356	1.1100
9	1.5637	1.4186	0.9802	1.1143	1.3439	0.8561	1.2356	1.1100

Table 2.6.2.2 North Sea herring. Continued.

Fitted Selection Pattern

AGE	2000	2001	2002	2003	2004
0	0.1155	0.1155	0.1155	0.1155	0.1155
1	0.2145	0.2145	0.2145	0.2145	0.2145
2	0.4217	0.4217	0.4217	0.4217	0.4217
3	0.7459	0.7459	0.7459	0.7459	0.7459
4	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0757	1.0757	1.0757	1.0757	1.0757
6	1.0305	1.0305	1.0305	1.0305	1.0305
7	1.0688	1.0688	1.0688	1.0688	1.0688
8	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000

Table 2.6.2.3 North Sea herring. STOCK SUMMARY

Year	Recruits Age 0 thousands	Total Biomass tonnes	Spawning Biomass tonnes	Landings tonnes	Yield /SSB ratio	Mean F Ages 2- 6	SoP (%)
1960	12085810	3719372	1857636	696200	0.3748	0.3393	84
1961	108849690	4337975	1638004	696700	0.4253	0.4359	88
1962	46274910	4380653	1098707	627800	0.5714	0.5355	85
1963	47657580	4608645	2170065	716000	0.3299	0.2277	116
1964	62785190	4781336	2016341	871200	0.4321	0.3444	93
1965	34894780	4329881	1435223	1168800	0.8144	0.6948	86
1966	27857860	3308238	1272584	895500	0.7037	0.6197	93
1967	40255750	2815821	921114	695500	0.7551	0.7981	85
1968	38698280	2520431	411855	717800	1.7428	1.3361	79
1969	21581660	1905094	423845	546700	1.2899	1.1054	103
1970	41073920	1921901	374645	563100	1.503	1.1058	103
1971	32308480	1849426	266003	520100	1.9552	1.4082	93
1972	20858500	1549469	288287	497500	1.7257	0.6969	108
1973	10103560	1155965	233375	484000	2.0739	1.1354	104
1974	21692510	911887	161982	275100	1.6983	1.0524	103
1975	2817930	680136	81631	312800	3.8319	1.471	107
1976	2719920	358337	77825	174800	2.2461	1.4446	104
1977	4327240	210145	47382	46000	0.9708	0.8105	83
1978	4594140	224568	64639	11000	0.1702	0.0538	82
1979	10601180	381732	106834	25100	0.2349	0.0644	99
1980	16722120	630113	130653	70764	0.5416	0.2843	91
1981	37863520	1158335	195260	174879	0.8956	0.3526	99
1982	64750020	1842851	278173	275079	0.9889	0.2642	102
1983	61792670	2718303	432253	387202	0.8958	0.3382	92
1984	53437890	2863777	678858	428631	0.6314	0.4555	94
1985	80888510	3460951	698919	613780	0.8782	0.6438	95
1986	97558410	3470798	678666	671488	0.9894	0.5724	87
1987	86152360	3933785	899455	792058	0.8806	0.553	98
1988	42252210	3575609	1192507	887686	0.7444	0.5382	85
1989	39120340	3305404	1246773	787899	0.632	0.5477	96
1990	35835440	2970957	1181607	645229	0.5461	0.4437	95
1991	33595240	2708659	976042	658008	0.6742	0.4918	98
1992	62085590	2430859	699494	716799	1.0247	0.5854	100
1993	50115230	2512905	468745	671397	1.4323	0.6958	97
1994	33522870	2013351	506049	568234	1.1229	0.7143	95
1995	41215390	1813999	455908	579371	1.2708	0.7498	99
1996	49838780	1594778	448794	275098	0.613	0.4118	100
1997	26792470	1906381	536286	264313	0.4929	0.4355	99
1998	26976620	1999789	707455	391628	0.5536	0.5078	99
1999	71136210	2287797	814895	363163	0.4457	0.3971	100
2000	41527050	2863959	809971	388157	0.4792	0.4067	99
2001	93576800	3235185	1275881	363343	0.2848	0.2855	100
2002	41756580	4040405	1583035	370941	0.2343	0.2459	100
2003	20331850	3855722	1730894	472587	0.273	0.2483	98
2004	19622580	3527930	1891500	567252	0.2999	0.2543	99

No of years for separable analysis : 5
Age range in the analysis : 0 . . . 9
Year range in the analysis : 1960 . . . 2004
Number of indices of SSB : 1
Number of age-structured indices : 3
Stock-recruit relationship to be fitted.
Parameters to estimate : 45
Number of observations : 405
Conventional single selection vector model to be fitted.

Table 2.6.2.4 North Sea herring. Model fit parameters, residuals and diagnostics.

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PARAMETER ESTIMATES
  Parm.         Maximum                                                    Mean of
   No.          Likelh.   CV    Lower     Upper      -s.e.      +s.e.     Param.
                Estimate  (%)  95% CL    95% CL                           Distrib.
 Separable model : F by year
    1   2000     0.4758  12    0.3749    0.6038    0.4213    0.5373    0.4793
    2   2001     0.3340  12    0.2604    0.4284    0.2941    0.3792    0.3367
    3   2002     0.2877  13    0.2229    0.3713    0.2525    0.3277    0.2901
    4   2003     0.2905  13    0.2241    0.3765    0.2545    0.3316    0.2931
    5   2004     0.2975  13    0.2270    0.3899    0.2591    0.3415    0.3003
 Separable Model: Selection (S) by age
    6      0     0.1155  38    0.0541    0.2465    0.0785    0.1700    0.1245
    7      1     0.2145  37    0.1027    0.4480    0.1473    0.3123    0.2302
    8      2     0.4217  11    0.3340    0.5325    0.3744    0.4750    0.4247
    9      3     0.7459  11    0.5938    0.9370    0.6640    0.8380    0.7510
           4     1.0000     Fixed : Reference Age
   10      5     1.0757  13    0.8317    1.3913    0.9434    1.2266    1.0850
   11      6     1.0305  14    0.7718    1.3759    0.8892    1.1943    1.0418
   12      7     1.0688  17    0.7630    1.4970    0.8999    1.2692    1.0847
           8     1.0000     Fixed : Last true age
 Separable model: Populations in year 2004
   13      0   19622581  15   14351221  26830168  16727695  23018455  19874142
   14      1    7232868  13    5508301   9497373   6294439   8311207   7303049
   15      2    5136194  11    4119680   6403529   4589603   5747881   5168811
   16      3    7508143  10    6164669   9144401   6789651   8302666   7546223
   17      4    2141999  10    1759138   2608188   1937256   2368382   2152837
   18      5    2413943  11    1936182   3009593   2157045   2701437   2429273
   19      6     594261  12     461272    765591    522209    676253    599245
   20      7     277915  16     203076    380335    236807    326159    281498
   21      8     289026  19     196334    425478    237275    352063    294706
Separable model: Populations at age
   22   2000      42603  35      21441     84652     30013     60476     45299
   23   2001      57922  26      34315     97769     44345     75655     60025
   24   2002      89354  23      56728    140743     70867    112664     91787
   25   2003     129256  20      85851    194605    104902    159263    132103
 Recruitment in year 2005
   26   2004   22351052  18   15403444  32432328  18484517  27026378  22757892
 SSB Index catchabilities
   MLAI
 Power model fitted. Slopes (Q) and exponents (K) at age
   27    1  Q  3.131      17 2.371     4.652     2.797     3.944     3.371
   28    1  K  .1296E-04  17 .1996E-04 .3915E-04 .2354E-04 .3320E-04 .3046E-04
 Age-structured index catchabilities
                                        Acoustic survey 1-9+ wr
 Linear model fitted. Slopes at age :
   29    1  Q  1.112      11 .9953     1.564     1.112     1.400     1.256
   30    2  Q  1.537       7 1.424     1.942     1.537     1.800     1.668
   31    3  Q  1.800       8 1.658     2.317     1.800     2.135     1.967
   32    4  Q  1.870      13 1.650     2.748     1.870     2.425     2.148
   33    5  Q  1.990      18 1.674     3.394     1.990     2.854     2.422
   34    6  Q  2.071      18 1.729     3.616     2.071     3.018     2.545
   35    7  Q  2.062      19 1.705     3.704     2.062     3.063     2.563
   36    8  Q  2.380      25 1.858     5.107     2.380     3.987     3.184
   37    9  Q  6.436      25 5.041     13.66     6.436     10.70     8.573
                                        IBTS: 1-5+ wr
 Linear model fitted. Slopes at age :
   38    1  Q  .1454E-03   6 .1367E-03 .1757E-03 .1454E-03 .1652E-03 .1553E-03
   39    2  Q  .1544E-03  11 .1384E-03 .2167E-03 .1544E-03 .1942E-03 .1743E-03
   40    3  Q  .1161E-03  22 .9331E-04 .2277E-03 .1161E-03 .1830E-03 .1496E-03
   41    4  Q  .6993E-04  32 .5135E-04 .1812E-03 .6993E-04 .1330E-03 .1016E-03
   42    5  Q  .3828E-04  32 .2810E-04 .9930E-04 .3828E-04 .7290E-04 .5564E-04
```

Table 2.6.2.4 North Sea herring. Continued.

```
                                        MIK 0-wr
Linear model fitted. Slopes at age :
   43   0  Q  .3106E-05   3 .2998E-05 .3464E-05 .3106E-05 .3343E-05 .3225E-05
 Parameters of the stock-recruit relationship
   44   1  a  .6859E+08  32 .5035E+08 .1779E+09 .6859E+08 .1306E+09 .9968E+08
   45   1  b  .5039E+06  61 .2801E+06 .3079E+07 .5039E+06 .1712E+07 .1120E+07
```

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals

Age	2000	2001	2002	2003	2004
0	-0.2436	-0.2030	-0.1692	-0.1417	0.5326
1	-0.2877	-0.0341	-0.4106	0.0785	-0.3184
2	0.1432	-0.1698	0.1206	0.0509	-0.1791
3	0.0137	0.1379	-0.0490	-0.1079	-0.0246
4	-0.0195	0.0491	-0.1050	-0.0455	-0.0120
5	-0.0016	0.0546	-0.1735	0.0542	0.1410
6	-0.1338	0.0592	0.0168	0.0375	0.1340
7	-0.1271	-0.0756	-0.0582	0.0825	0.3378
8	-0.0524	0.0927	0.4481	0.1762	0.0022

SPAWNING BIOMASS INDEX RESIDUALS

MLAI

	1973	1974	1975	1976	1977	1978	1979	1980
1	-0.2644	-0.3436	-0.6602	-0.6826	0.7757	0.6144	0.7476	0.1420

	1981	1982	1983	1984	1985	1986	1987	1988
1	0.0791	0.0247	-0.2234	-0.1429	0.2450	-0.3791	-0.1448	0.2229

	1989	1990	1991	1992	1993	1994	1995	1996
1	0.1393	0.4483	0.0235	-0.3554	-0.2238	-0.7005	-0.4467	0.2623

	1997	1998	1999	2000	2001	2002	2003	2004
1	0.2809	0.2592	-0.0865	-0.4972	0.1122	-0.3035	0.5188	0.5592

AGE-STRUCTURED INDEX RESIDUALS

Acoustic survey 1-9+ wr

Age	1989	1990	1991	1992	1993	1994	1995	1996
1	*******	*******	*******	*******	*******	*******	*******	*******
2	-0.351	-0.049	-0.062	0.157	0.189	-0.138	0.126	0.445
3	-0.380	-0.030	-0.206	-0.088	0.031	-0.295	0.292	0.447
4	-0.457	0.036	-0.090	0.028	0.228	-0.479	0.396	0.393
5	-0.197	-0.071	-0.062	-0.090	0.282	0.049	0.146	0.327
6	-0.176	0.208	-0.271	0.222	0.229	0.202	0.041	-0.343
7	-0.307	0.333	0.233	-0.049	0.329	0.052	0.134	-0.416
8	-0.114	0.514	0.208	0.185	0.018	0.260	-0.242	0.664
9	-0.995	-0.726	-0.721	-0.381	-0.678	-0.842	-0.626	1.578

Age	1997	1998	1999	2000	2001	2002	2003	2004
1	-0.128	-0.231	-0.181	0.479	-0.266	0.116	0.065	0.146
2	0.547	-0.156	-0.080	-0.311	0.195	-0.213	0.306	-0.603
3	0.486	0.136	0.086	-0.031	0.057	0.061	-0.412	-0.153
4	0.391	0.458	-0.161	0.234	0.030	-0.363	-0.250	-0.395
5	0.281	0.626	-0.230	0.238	0.056	-0.221	-0.746	-0.387
6	0.501	0.655	0.092	0.237	-0.088	-0.045	-0.331	-1.133
7	-0.720	0.806	0.196	0.527	-0.286	-0.270	-0.232	-0.329
8	-0.209	-0.345	0.042	0.485	-0.102	-0.351	-0.534	-0.480
9	0.701	1.138	1.124	1.111	0.290	-0.047	-0.010	-0.917

Table 2.6.2.4 North Sea herring. Continued.

IBTS: 1-5+ wr

Age	1979	1980	1981	1982	1983	1984	1985	1986
1	-0.261	-0.280	-0.260	-0.294	-0.543	-0.260	0.083	-0.262
2	*******	*******	*******	*******	-0.968	-1.412	0.147	0.396
3	*******	*******	*******	*******	-0.696	-0.795	0.094	0.188
4	*******	*******	*******	*******	-0.283	-0.086	0.026	0.172
5	*******	*******	*******	*******	0.988	-0.205	0.682	0.428

Age	1987	1988	1989	1990	1991	1992	1993	1994
1	-0.101	0.329	0.271	-0.402	-0.262	-0.109	0.370	0.045
2	-0.091	1.357	0.173	0.035	0.698	-0.126	0.807	0.745
3	-0.455	0.855	-0.173	0.048	0.482	0.400	0.430	0.690
4	-0.105	0.116	-0.132	0.624	0.934	0.209	0.200	0.611
5	0.644	-0.151	-1.074	0.421	0.838	0.415	0.328	0.349

Age	1995	1996	1997	1998	1999	2000	2001	2002
1	0.008	0.240	0.611	0.539	-0.556	0.144	0.311	-0.035
2	0.925	-0.592	0.166	-0.072	0.066	-0.823	-0.093	-0.103
3	0.482	-1.212	0.296	-0.650	0.409	-0.131	0.333	-0.664
4	0.259	-0.931	-0.103	-0.806	0.585	-0.657	0.429	-1.392
5	-1.209	-0.359	0.260	-0.119	0.440	-1.386	0.175	-1.065

Age	2003	2004	2005
1	0.461	0.062	0.152
2	-0.081	-0.500	-0.653
3	0.283	-0.086	-0.127
4	0.376	-0.251	0.205
5	-0.460	0.058	0.000

MIK 0-wr

Age	1977	1978	1979	1980	1981	1982	1983	1984
0	0.378	0.045	0.594	0.807	-0.242	-0.240	-0.562	-0.214

Age	1985	1986	1987	1988	1989	1990	1991	1992
0	-0.191	-0.403	0.158	0.393	-0.390	-1.326	-0.261	0.202

Age	1993	1994	1995	1996	1997	1998	1999	2000
0	0.372	0.131	0.158	-0.239	0.705	-0.329	0.229	0.193

Age	2001	2002	2003	2004	2005
0	-0.173	0.350	-0.020	-0.124	0.000

PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES AT AGE)

Separable model fitted from 2000 to 2004

Variance	0.0434
Skewness test stat.	0.6642
Kurtosis test statistic	0.2486
Partial chi-square	0.0711
Significance in fit	0.0000
Degrees of freedom	20

PARAMETERS OF DISTRIBUTIONS OF THE SSB INDICES

DISTRIBUTION STATISTICS FOR MLAI

Power catchability relationship assumed

Last age is a plus-group

Variance	0.1136
Skewness test stat.	0.2556
Kurtosis test statistic	-0.9526
Partial chi-square	1.5539

Table 2.6.2.4 North Sea herring. Continued.

```
Significance in fit                   0.0000
Number of observations                    32
Degrees of freedom                        30
Weight in the analysis                0.6500
PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES
------------------------------------------------------------
DISTRIBUTION STATISTICS FOR Acoustic survey 1-9+ wr
Linear catchability relationship assumed
Age                            1         2         3         4         5         6         7         8         9
Variance                  0.0467    0.0695    0.0440    0.0289    0.0150    0.0222    0.0189    0.0092    0.0534
Skewness test stat.       0.8451   -0.0388    0.4336   -0.1021   -0.5271   -1.7480    0.3573    0.4806    0.8174
Kurtosis test statisti   -0.2501   -0.4140   -0.4479   -1.1125    0.1922    1.4204   -0.4368   -0.7794   -1.0155
Partial chi-square        0.0202    0.0678    0.0449    0.0310    0.0165    0.0254    0.0241    0.0118    0.0724
Significance in fit       0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
Number of observations         8        16        16        16        16        16        16        16        16
Degrees of freedom             7        15        15        15        15        15        15        15        15
Weight in the analysis    0.7400    0.7500    0.6400    0.2700    0.1400    0.1300    0.1200    0.0700    0.0700
DISTRIBUTION STATISTICS FOR IBTS: 1-5+ wr
Linear catchability relationship assumed
Age                            1         2         3         4         5
Variance                  0.0696    0.1017    0.0170    0.0090    0.0132
Skewness test stat.       0.2592   -0.0834   -1.0912   -1.4848   -1.3925
Kurtosis test statisti   -0.9661   -0.1390   -0.5088    0.3364   -0.4258
Partial chi-square        0.2475    0.3513    0.0719    0.0470    0.0882
Significance in fit       0.0000    0.0000    0.0000    0.0000    0.0000
Number of observations        27        23        23        23        23
Degrees of freedom            26        22        22        22        22
Weight in the analysis    0.6700    0.2400    0.0600    0.0300    0.0300
DISTRIBUTION STATISTICS FOR MIK 0-wr
Linear catchability relationship assumed
Age                            0
Variance                  0.3752
Skewness test stat.      -1.4485
Kurtosis test statisti    1.7401
Partial chi-square        2.4312
Significance in fit       0.0000
Number of observations        29
Degrees of freedom            28
Weight in the analysis    2.0500
ANALYSIS OF VARIANCE
Unweighted Statistics
Variance
                                       SSQ     Data    Parameters d.f. Variance
Total for model                    87.6869      405            45  360   0.2436
Catches at age                      1.4277       45            25   20   0.0714
SSB Indices
  MLAI                              5.2433       32             2   30   0.1748
Aged Indices
Acoustic survey 1-9+ wr            24.4120      136             9  127   0.1922
IBTS: 1-5+ wr                      34.5788      119             5  114   0.3033
MIK 0-wr                            5.1241       29             1   28   0.1830
Stock-recruit model                16.9009       44             2   42   0.4024
Weighted Statistics
Variance
                                       SSQ     Data    Parameters d.f. Variance
Total for model                    28.3107      405            45  360   0.0786
Catches at age                      0.8688       45            25   20   0.0434
SSB Indices
  MLAI                              2.2153       32             2   30   0.0738
Aged Indices
Acoustic survey 1-9+ wr             1.7376      136             9  127   0.0137
IBTS: 1-5+ wr                       1.7857      119             5  114   0.0157
MIK 0-wr                           21.5342       29             1   28   0.7691
Stock-recruit model                 0.1690       44             2   42   0.0040
```

Table 2.7.1.North Sea herring. Input data for short term prediction

```
North sea herring 2005
2005
0 9
4
F ref. age for each fleet
1 2 6
2 0 1
3 0 1
4 0 1
Two age ranges for overall F
0 1
2 6
Init numbers
0 22351
1  6975
2  2496
3  3356
4  4924
5  1440
6  1586
7   396
8   183
9   265
recruitments
49960
49960
selection by age and fleet
0 0.00000 0.03012 0.00064 0.00361
1 0.00085 0.04108 0.00580 0.01608
2 0.07233 0.00168 0.03266 0.01879
3 0.21732 0.00113 0.00201 0.00145
4 0.29239 0.00166 0.00254 0.00092
5 0.31491 0.00082 0.00384 0.00045
6 0.30195 0.00135 0.00288 0.00040
7 0.31121 0.00060 0.00583 0.00034
8 0.29182 0.00207 0.00355 0.00007
9 0.29751 0       0       0
natmor at age
0 1.0
1 1.0
2 0.3
3 0.2
4 0.1
5 0.1
6 0.1
7 0.1
8 0.1
9 0.1
```

Table 2.7.1 cont. North Sea herring. Input data for short term prediction

```
weca2005
0   0.0     0.0132  0.0175  0.0185
1   0.0759  0.0274  0.0569  0.0376
2   0.1254  0.0442  0.0850  0.0842
3   0.1551  0.1184  0.1222  0.1177
4   0.1353  0.0977  0.1197  0.1006
5   0.1964  0.1721  0.1578  0.1718
6   0.2133  0.1779  0.1799  0.1723
7   0.2258  0.2076  0.1929  0.1422
8   0.2413  0.2177  0.1954  0.1906
9   0.2573  0.000   0.000   0.000
weca 2006
0   0.0     0.0132  0.0175  0.0185
1   0.0759  0.0274  0.0569  0.0376
2   0.1254  0.0442  0.0850  0.0842
3   0.1551  0.1184  0.1222  0.1177
4   0.1750  0.1462  0.1439  0.1395
5   0.1697  0.1321  0.1541  0.1350
6   0.2133  0.1779  0.1799  0.1723
7   0.2258  0.2076  0.1929  0.1422
8   0.2413  0.2177  0.1954  0.1906
9   0.2573  0.000   0.000   0.000
west 2005
0 0.0067
1 0.0437
2 0.127
3 0.173
4 0.164
5 0.224
6 0.245
7 0.265
8 0.284
9 0.284
west 2006
0 0.0067
1 0.0437
2 0.127
3 0.173
4 0.203
5 0.187
6 0.245
7 0.265
8 0.284
9 0.284
west 2007
0 0.0067
1 0.0437
2 0.127
3 0.173
4 0.203
5 0.224
6 0.205
7 0.265
8 0.284
9 0.284
```

Table 2.7.1 cont. North Sea herring. Input data for short term prediction

```
maturity 2005
0 0
1 0
2 0.78
3 0.94
4 0.91
5 1
6 1
7 1
8 1
9 1
maturity 2006
0 0
1 0
2 0.78
3 0.94
4 1
5 0.98
6 1
7 1
8 1
9 1
maturity 2007
0 0
1 0
2 0.78
3 0.94
4 1
5 1
6 1
7 1
8 1
9 1
Proportion of F and M before spawning
0.67 0.67
```

Table 2.7.2. Catch options for North Sea herring

Assuming F status quo in 2005

	Options	F-values Fleet A	Fleet B	Fleet C	Fleet D	F 0-1	F 2-6	Catches Fleet A	Fleet B	Fleet C	Fleet D	SSB 2005	2006	2007
For 2005	F status quo	0.240	0.036	0.003	0.010	0.049	0.254	479	12.1	11.0	7.8	1876		
For 2006														
	F 0-1 = 0.05, F 2-6 = 0.25													
		0.239	0.041	0.002	0.006	0.050	0.250	452	22.4	8.3	5.5		1720	1595
		0.238	0.038	0.002	0.009	0.050	0.250	450	20.8	8.3	8.2		1721	1596
		0.237	0.035	0.002	0.012	0.050	0.250	448	19.1	8.3	11.0		1721	1597
		0.236	0.040	0.003	0.006	0.050	0.250	447	21.8	12.4	5.5		1721	1597
		0.235	0.037	0.003	0.009	0.050	0.250	444	20.1	12.5	8.2		1722	1598
		0.234	0.034	0.003	0.012	0.050	0.250	442	18.5	12.4	11.0		1723	1599
		0.233	0.039	0.005	0.006	0.050	0.250	441	21.2	16.6	5.5		1723	1599
		0.232	0.036	0.005	0.009	0.050	0.250	439	19.5	16.6	8.2		1723	1600
		0.231	0.033	0.005	0.012	0.050	0.250	437	17.8	16.6	11.0		1724	1601
	F 0-1 = 0.12, F 2-6 = 0.25													
		0.237	0.111	0.002	0.006	0.120	0.250	447	59.0	8.3	5.5		1720	1580
		0.235	0.108	0.002	0.009	0.120	0.250	445	57.3	8.3	8.3		1721	1581
		0.234	0.105	0.002	0.012	0.120	0.250	443	55.7	8.3	11.0		1722	1582
		0.234	0.110	0.003	0.006	0.120	0.250	442	58.4	12.5	5.5		1722	1582
		0.232	0.107	0.003	0.009	0.120	0.250	440	56.7	12.4	8.2		1723	1583
		0.231	0.104	0.003	0.012	0.120	0.250	437	55.1	12.5	11.0		1724	1585
		0.230	0.109	0.005	0.006	0.120	0.250	436	57.8	16.6	5.5		1723	1585
		0.229	0.106	0.005	0.009	0.120	0.250	434	56.1	16.6	8.2		1724	1586
		0.228	0.103	0.005	0.012	0.120	0.250	432	54.5	16.6	11.0		1725	1587
	TAC A-fleet 455, F0-1 approx. 0.05													
		0.241	0.040	0.002	0.006	0.049	0.252	455	21.8	8.3	5.5		1717	1591
		0.241	0.035	0.002	0.009	0.047	0.253	455	19.1	8.3	8.2		1717	1589
		0.241	0.035	0.002	0.012	0.050	0.254	455	19.0	8.3	11.0		1716	1585
		0.241	0.040	0.003	0.006	0.050	0.255	455	21.8	12.4	5.5		1714	1583
		0.241	0.035	0.003	0.009	0.048	0.256	455	19.1	12.5	8.2		1714	1582
		0.241	0.035	0.003	0.012	0.051	0.258	455	19.0	12.4	11.0		1713	1578
		0.242	0.040	0.005	0.006	0.051	0.258	455	21.7	16.6	5.5		1712	1576
		0.242	0.035	0.005	0.009	0.049	0.260	455	19.0	16.6	8.3		1711	1574
		0.242	0.035	0.005	0.012	0.052	0.261	455	19.0	16.6	11.0		1710	1571
	TAC A-fleet 455, F0-1 approx. 0.12													
		0.241	0.110	0.002	0.006	0.119	0.255	455	58.4	8.3	5.5		1714	1568
		0.242	0.110	0.002	0.009	0.122	0.256	455	58.3	8.3	8.3		1713	1564
		0.242	0.105	0.002	0.012	0.120	0.257	455	55.7	8.3	11.0		1713	1563
		0.242	0.110	0.003	0.006	0.120	0.258	455	58.3	12.4	5.5		1711	1561
		0.242	0.105	0.003	0.009	0.118	0.259	455	55.7	12.5	8.3		1710	1559
		0.242	0.105	0.003	0.012	0.121	0.261	455	55.7	12.5	11.0		1710	1555
		0.242	0.110	0.005	0.006	0.121	0.261	455	58.3	16.6	5.5		1708	1553
		0.242	0.105	0.005	0.009	0.119	0.263	455	55.7	16.6	8.2		1708	1552
		0.242	0.100	0.005	0.012	0.118	0.264	455	53.1	16.6	11.0		1707	1550

Table 2.7.2. cont.

Assuming catch constraints in 2005

		F-values						Catches				SSB		
	Options	**Fleet A**	**Fleet B**	**Fleet C**	**Fleet D**	**F 0-1**	**F 2-6**	**Fleet A**	**Fleet B**	**Fleet C**	**Fleet D**	**2005**	**2006**	**2007**
For 2005	Catch constraints	0.274	0.075	0.006	0.019	0.101	0.302	**535**	**25**	**20**	**15**	1820		
For 2006														
	F 0-1 = 0.05, F 2-6 = 0.25													
		0.239	0.041	0.002	0.006	**0.050**	**0.250**	431	21.9	8.3	5.5		1639	1521
		0.238	0.038	0.002	0.010	**0.050**	**0.250**	429	20.2	8.3	8.2		1640	1522
		0.236	0.035	0.002	0.013	**0.050**	**0.250**	427	18.5	8.3	11.0		1641	1523
		0.236	0.040	0.004	0.006	**0.050**	**0.250**	425	21.3	12.5	5.5		1641	1523
		0.234	0.036	0.004	0.010	**0.050**	**0.250**	423	19.6	12.5	8.3		1641	1524
		0.233	0.033	0.004	0.013	**0.050**	**0.250**	421	17.9	12.5	11.0		1642	1525
		0.232	0.038	0.005	0.006	**0.050**	**0.250**	420	20.6	16.6	5.5		1642	1525
		0.231	0.035	0.005	0.010	**0.050**	**0.250**	418	18.9	16.6	8.3		1643	1526
		0.230	0.032	0.005	0.013	**0.050**	**0.250**	415	17.2	16.6	11.0		1644	1528
	F 0-1 = 0.12, F 2-6 = 0.25													
		0.236	0.111	0.002	0.006	**0.120**	**0.250**	426	57.9	8.3	5.5		1640	1507
		0.235	0.108	0.002	0.010	**0.120**	**0.250**	424	56.3	8.3	8.3		1641	1508
		0.234	0.104	0.002	0.013	**0.120**	**0.250**	422	54.6	8.3	11.0		1642	1509
		0.233	0.110	0.004	0.006	**0.120**	**0.250**	421	57.3	12.4	5.5		1641	1509
		0.232	0.106	0.004	0.010	**0.120**	**0.250**	418	55.6	12.4	8.2		1642	1510
		0.230	0.103	0.004	0.013	**0.120**	**0.250**	416	53.9	12.4	11.0		1643	1511
		0.230	0.108	0.005	0.006	**0.120**	**0.250**	415	56.7	16.6	5.5		1643	1511
		0.228	0.105	0.005	0.010	**0.120**	**0.250**	413	55.0	16.6	8.2		1644	1512
		0.227	0.102	0.005	0.013	**0.120**	**0.250**	411	53.3	16.6	11.0		1645	1514
	TAC A-fleet 455, F0-1 approx. 0.05													
		0.255	0.040	0.002	0.006	**0.049**	0.266	**455**	21.4	8.3	5.5		1620	1482
		0.255	0.040	0.002	0.010	**0.052**	0.267	**455**	21.4	8.3	8.2		1619	1479
		0.255	0.035	0.002	0.013	**0.051**	0.268	**455**	18.8	8.3	11		1618	1476
		0.255	0.040	0.004	0.006	**0.050**	0.269	**455**	21.4	12.4	5.5		1617	1475
		0.255	0.035	0.004	0.010	**0.049**	0.271	**455**	18.8	12.4	8.3		1616	1473
		0.255	0.035	0.004	0.013	**0.052**	0.272	**455**	18.8	12.4	11.0		1615	1469
		0.255	0.035	0.005	0.006	**0.047**	0.273	**455**	18.8	16.6	5.5		1614	1469
		0.255	0.035	0.005	0.010	**0.050**	0.274	**455**	18.8	16.6	8.2		1613	1466
		0.255	0.035	0.005	0.013	**0.053**	0.276	**455**	18.7	16.6	11.0		1612	1462
	TAC A-fleet 455, F0-1 approx. 0.12													
		0.255	0.110	0.002	0.006	**0.119**	0.269	**455**	57.5	8.3	5.5		1617	1460
		0.255	0.105	0.002	0.010	**0.118**	0.270	**455**	54.9	8.3	8.2		1616	1458
		0.255	0.105	0.002	0.013	**0.121**	0.271	**455**	54.9	8.3	11		1615	1455
		0.255	0.110	0.004	0.006	**0.121**	0.272	**455**	57.5	12.4	5.5		1614	1453
		0.255	0.105	0.004	0.010	**0.119**	0.274	**455**	54.9	12.5	8.3		1613	1451
		0.255	0.105	0.004	0.013	**0.122**	0.275	**455**	54.9	12.5	11.0		1612	1447
		0.255	0.105	0.005	0.006	**0.117**	0.276	**455**	55.0	16.6	5.5		1611	1447
		0.256	0.105	0.005	0.010	**0.120**	0.277	**455**	54.9	16.6	8.2		1610	1444
		0.256	0.105	0.005	0.013	**0.123**	0.279	**455**	54.9	16.6	11.0		1609	1441

Table 2.10.1 North Sea herring, Parameter weighting from XSA assessment. The details of the assessment are given in Section 2.6.1 and reported in Tables 2.6.1.3 and 2.6.1.4.

YEAR CLASS = 2003		AGE 0					
Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Acoustic survey 2-9+	1	0	0	0	0	0	0
IBTS: 1-5+ wr	1	0	0	0	0	0	0
MIK 0-wr	6585893	0.522	0	0	1	0.687	0
P shrinkage mean	10851310	0.85				0.264	0.02
F shrinkage mean	6509072	2				0.048	0.034
Year class = 2002		Age 1					
Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Acoustic survey 2-9+	5600174	0.3	0	0	1	0.403	0.065
IBTS: 1-5+ wr	7793348	0.3	0	0	1	0.403	0.047
MIK 0-wr	8391669	0.52	0	0	1	0.131	0.044
P shrinkage mean	2944680	0.86				0.052	0.12
F shrinkage mean	3712851	2				0.01	0.096
Year class = 2001		Age 2					
Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Acoustic survey 2-9+	8386317	0.212	0.152	0.71	2	0.566	0.116
IBTS: 1-5+ wr	6666246	0.272	0.008	0.03	2	0.339	0.144
MIK 0-wr	7712182	0.526	0	0	1	0.087	0.125
F shrinkage mean	4045943	2				0.007	0.227
Year class = 2000		Age 3					
Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Acoustic survey 2-9+	1554921	0.174	0.067	0.39	3	0.636	0.262
IBTS: 1-5+ wr	2566799	0.248	0.11	0.44	3	0.297	0.167
MIK 0-wr	2733759	0.518	0	0	1	0.061	0.157
F shrinkage mean	1037631	2				0.007	0.371
Year class = 1999		Age 4					
Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Acoustic survey 2-9+	2560210	0.152	0.14	0.92	4	0.671	0.265
IBTS: 1-5+ wr	2548143	0.228	0.191	0.84	4	0.28	0.266
MIK 0-wr	4051415	0.529	0	0	1	0.043	0.175
F shrinkage mean	1414586	2				0.006	0.437
Age 5 Catchability constant w.r.t. time and age (fixed at the value for age) 4							
Year class = 1998		Age 5					
Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Acoustic survey 2-9+	270278	0.148	0.075	0.51	5	0.722	0.613
IBTS: 1-5+ wr	202744	0.237	0.265	1.12	5	0.24	0.755
MIK 0-wr	192716	0.523	0	0	1	0.026	0.782
F shrinkage mean	409396	2				0.011	0.444
Year class = 1997		Age 6					
Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Acoustic survey 2-9+	223078	0.14	0.034	0.24	6	0.799	0.371
IBTS: 1-5+ wr	268361	0.24	0.237	0.99	5	0.175	0.317
MIK 0-wr	531667	0.519	0	0	1	0.018	0.173
F shrinkage mean	190130	2				0.008	0.423
Year class = 1996		Age 7					
Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Acoustic survey 2-9+	270100	0.138	0.048	0.35	7	0.855	0.35
IBTS: 1-5+ wr	289697	0.239	0.222	0.93	5	0.123	0.33
MIK 0-wr	221769	0.516	0	0	1	0.013	0.413
F shrinkage mean	315143	2				0.009	0.307
Year class = 1995		Age 8					
Fleet	Estimated Survivors	Int s.e	Ext s.e	Var Ratio	N	Scaled Weights	Estimated F
Acoustic survey 2-9+	65210	0.144	0.064	0.45	7	0.911	0.43
IBTS: 1-5+ wr	51674	0.247	0.393	1.59	5	0.073	0.517
MIK 0-wr	77523	0.518	0	0	1	0.005	0.373
F shrinkage mean	83812	2				0.011	0.349

Herring in Division IVc and VIId (Downs Herring).

Table 2.11.1 Downs herring (IVc+VIId). TAC and ACFM catch from 1986 to 2004. Weights in 1000 tonnes.

	TAC			CATCH		
	IVa+IVb	IVc+VIId	Total	IVa+IVb	IVc+VIId	Total
1986	500	70	570	493	51	544
1987	560	40	600	577	45	622
1988	500	30	530	646	52	698
1989	484	30	514	638	79	717
1990	385	30	415	516	61	577
1991	370	50	420	527	61	588
1992	380	50	430	498	74	572
1993	380	50	430	463	77	540
1994	390	50	440	428	74	502
1995	264	50	440	503	63	566
1996	86	25	156	216	50	266
1997	88	25	159	183	51	234
1998	156	25	254	281	48	329
1999	164	25	265	282	54	336
2000	164	25	265	285	44	329
2001	164	25	265	278	45	323
2002	146	43	265	303	50	353
2003	340	60	400	382	66	450
2004	394	66	460	482	69	550
2005	461	74	535			

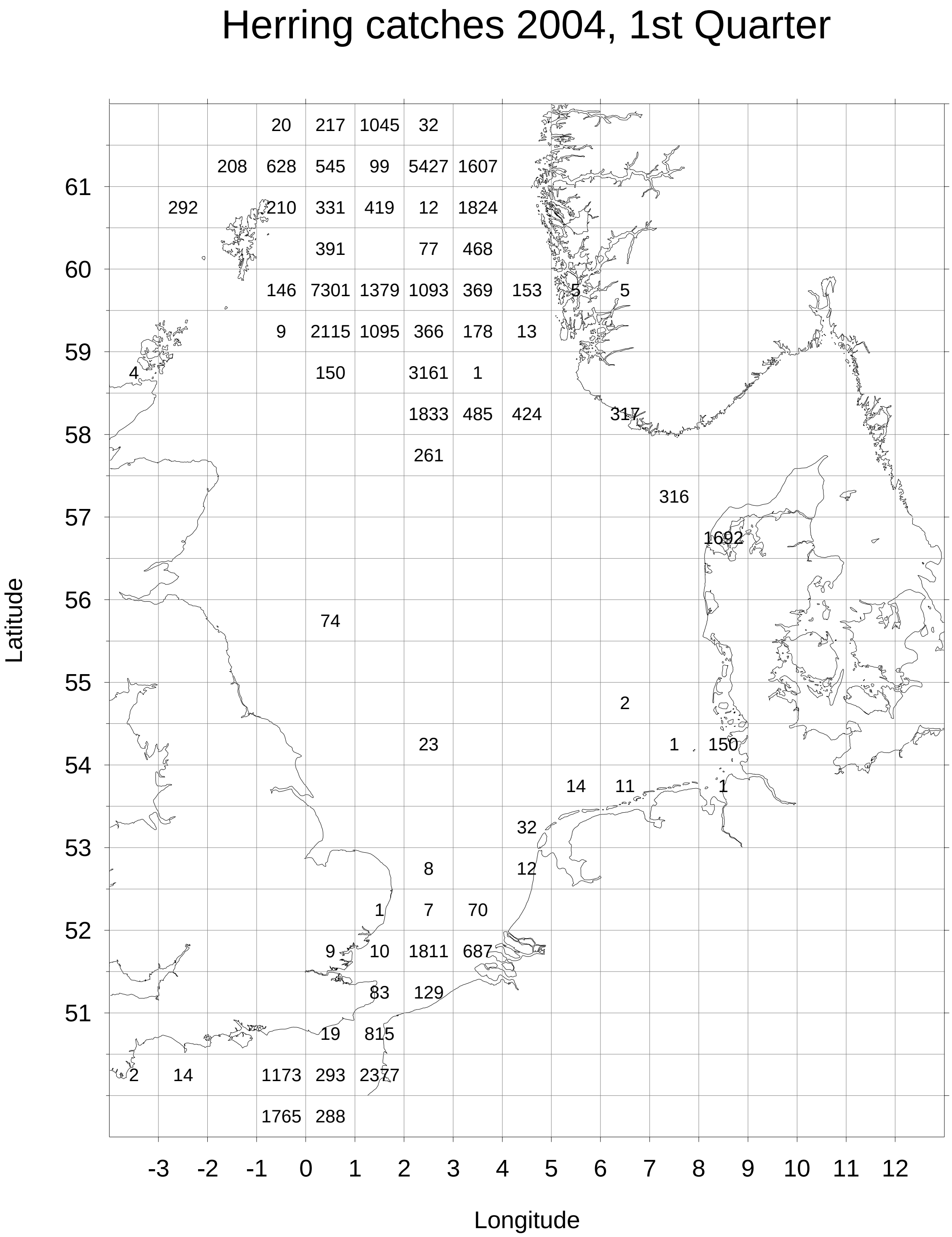


Figure 2.1.1 Herring catches in the North Sea (in tonnes) in 2004 by statistical rectangle. Working group estimates (if available). a.: 1st quarter

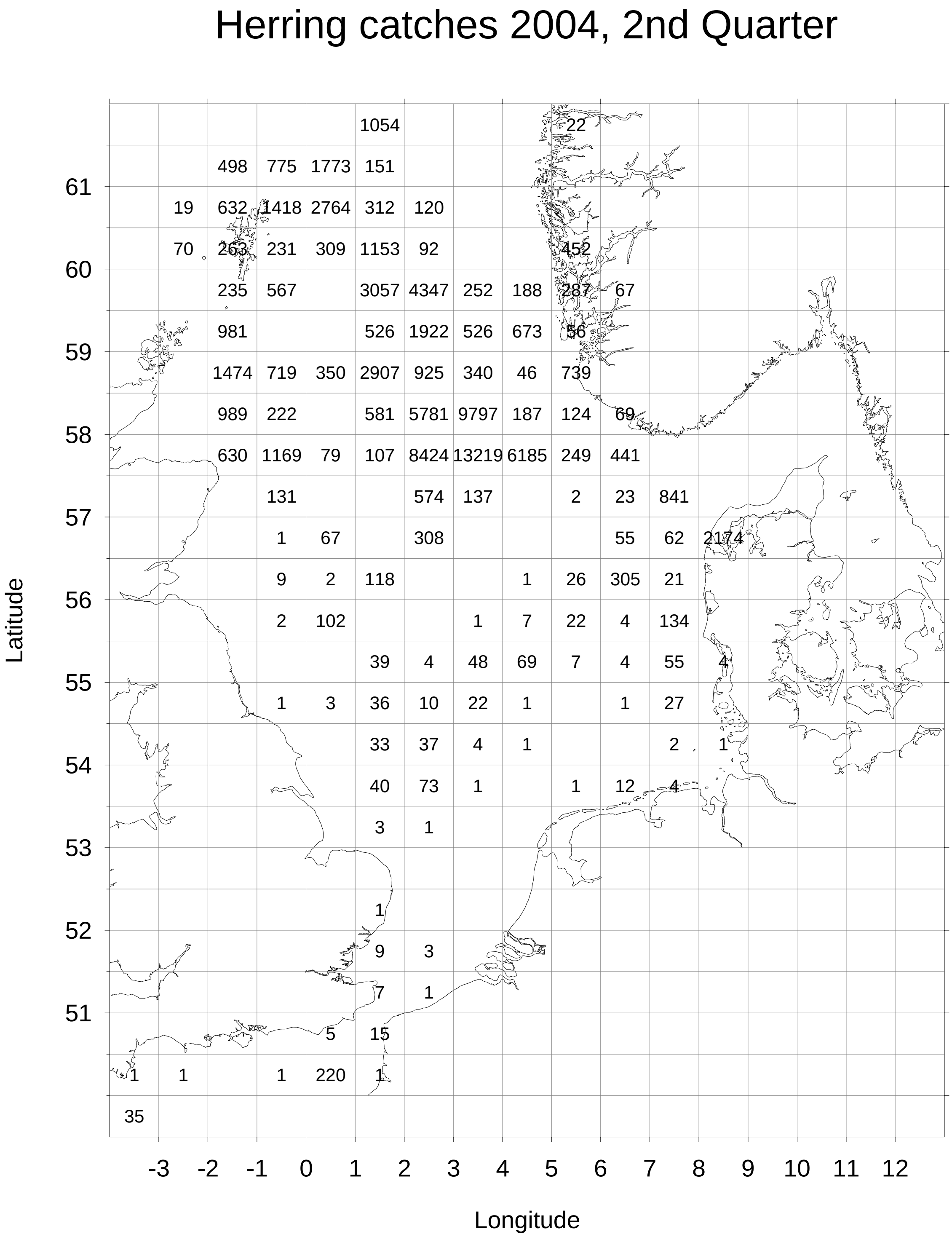


Figure 2.1.1 **Herring catches in the North Sea (in tonnes) in 2004 by statistical rectangle. Working group estimates (if available). b.: 2nd quarter**

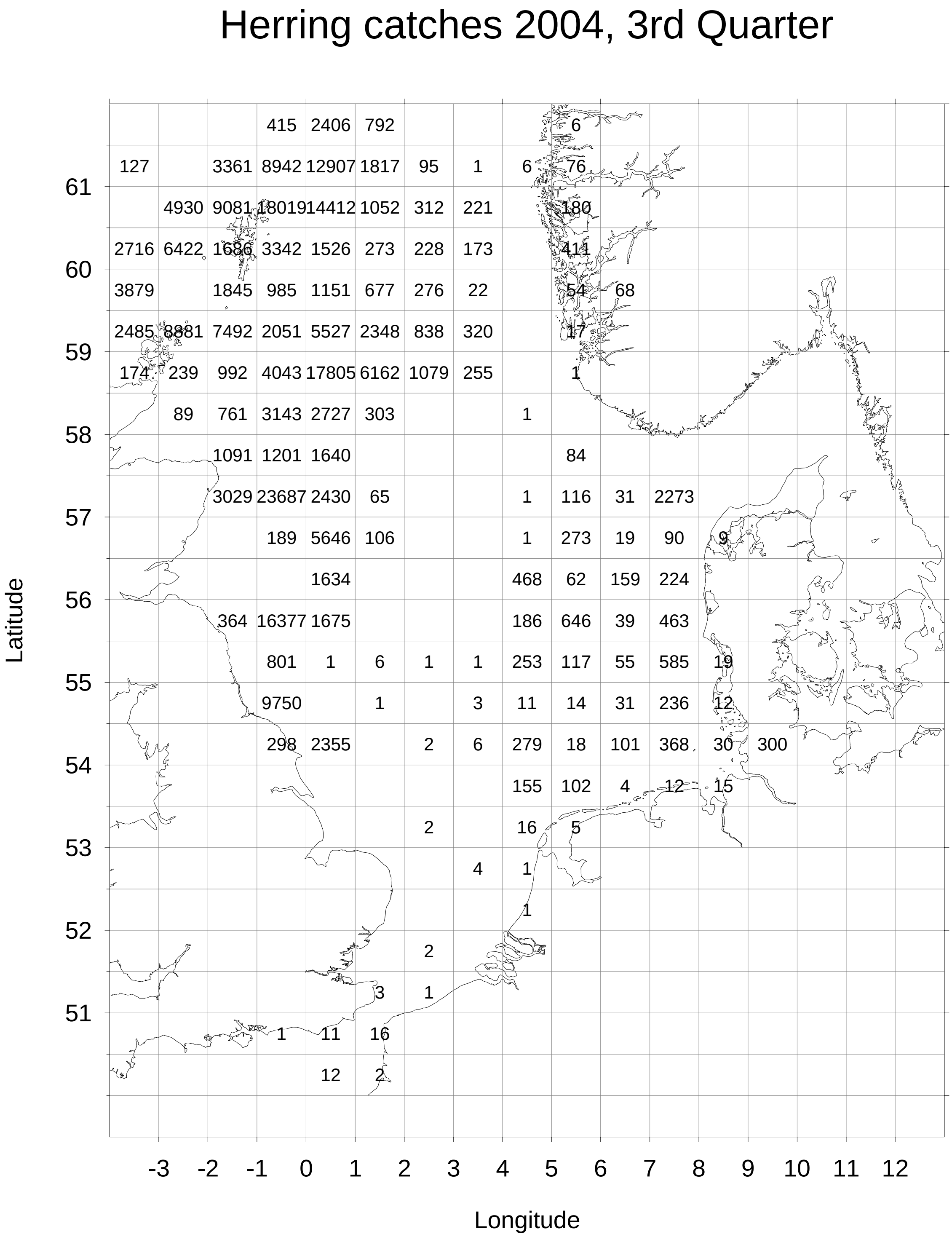


Figure 2.1.1 **Herring catches in the North Sea (in tonnes) in 2004 by statistical rectangle. Working group estimates (if available). c.: 3rd quarter**

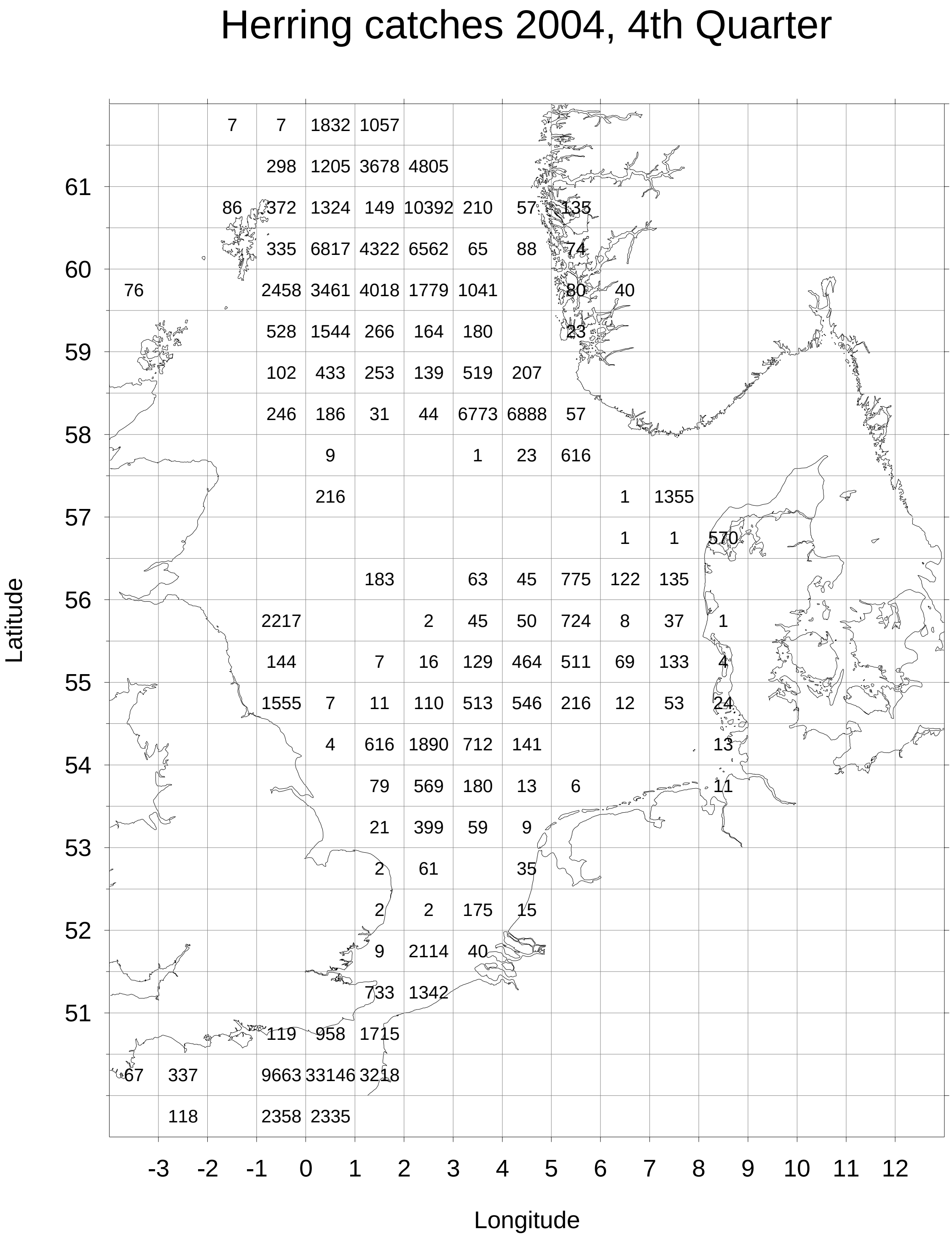


Figure 2.1.1 **Herring catches in the North Sea (in tonnes) in 2004 by statistical rectangle. Working group estimates (if available). d.: 4th quarter**

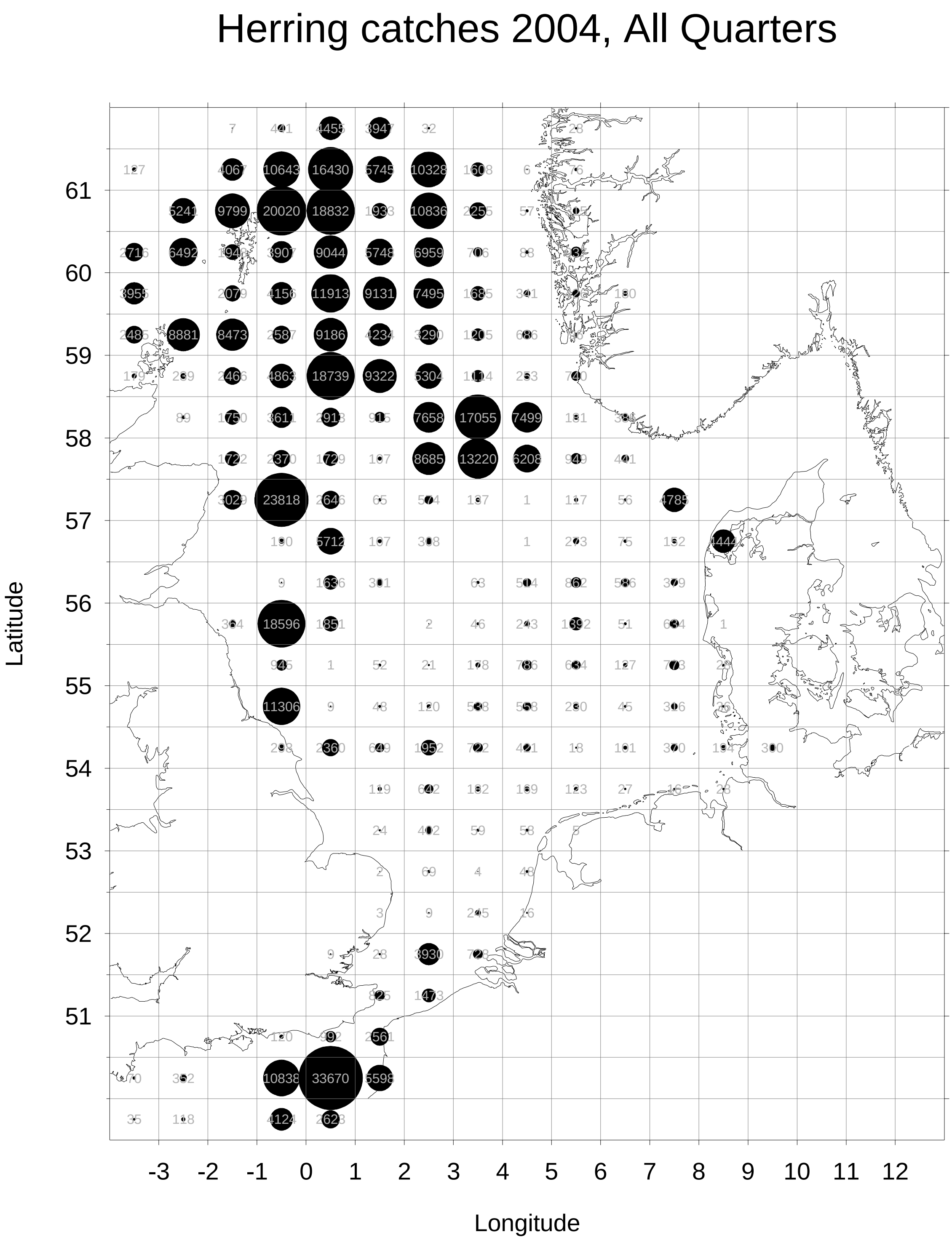


Figure 2.1.1 Herring catches in the North Sea (in tonnes) in 2004 by statistical rectangle. Working group estimates (if available). e.: all quarters

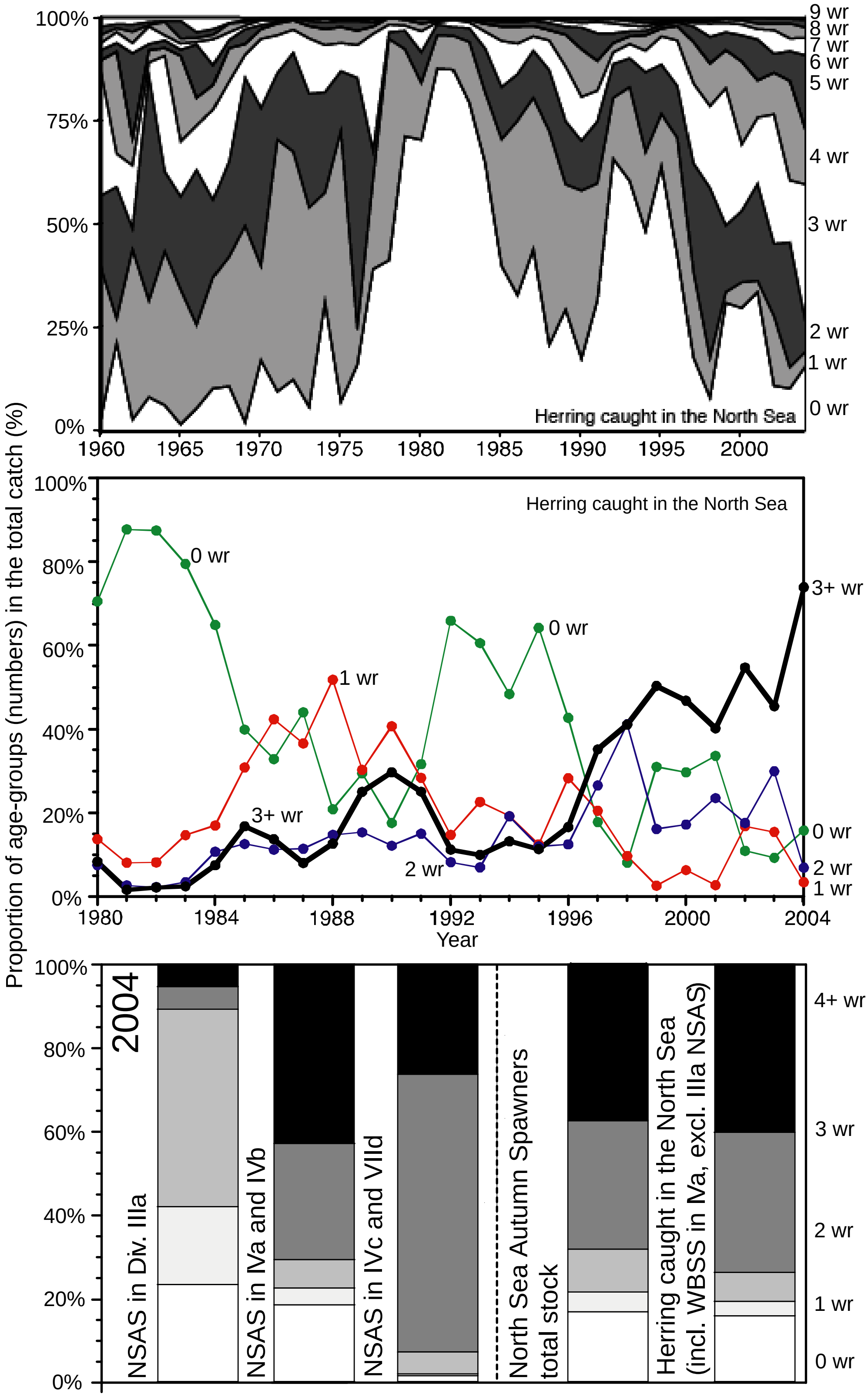


Figure 2.2.1: Proportions of age groups (numbers) in the total catch of herring in the North Sea (upper, 1960-2004, and middle panel, 1980-2004), and in the total catch of North Sea Autumn Spawners in 2004 (lower panel).

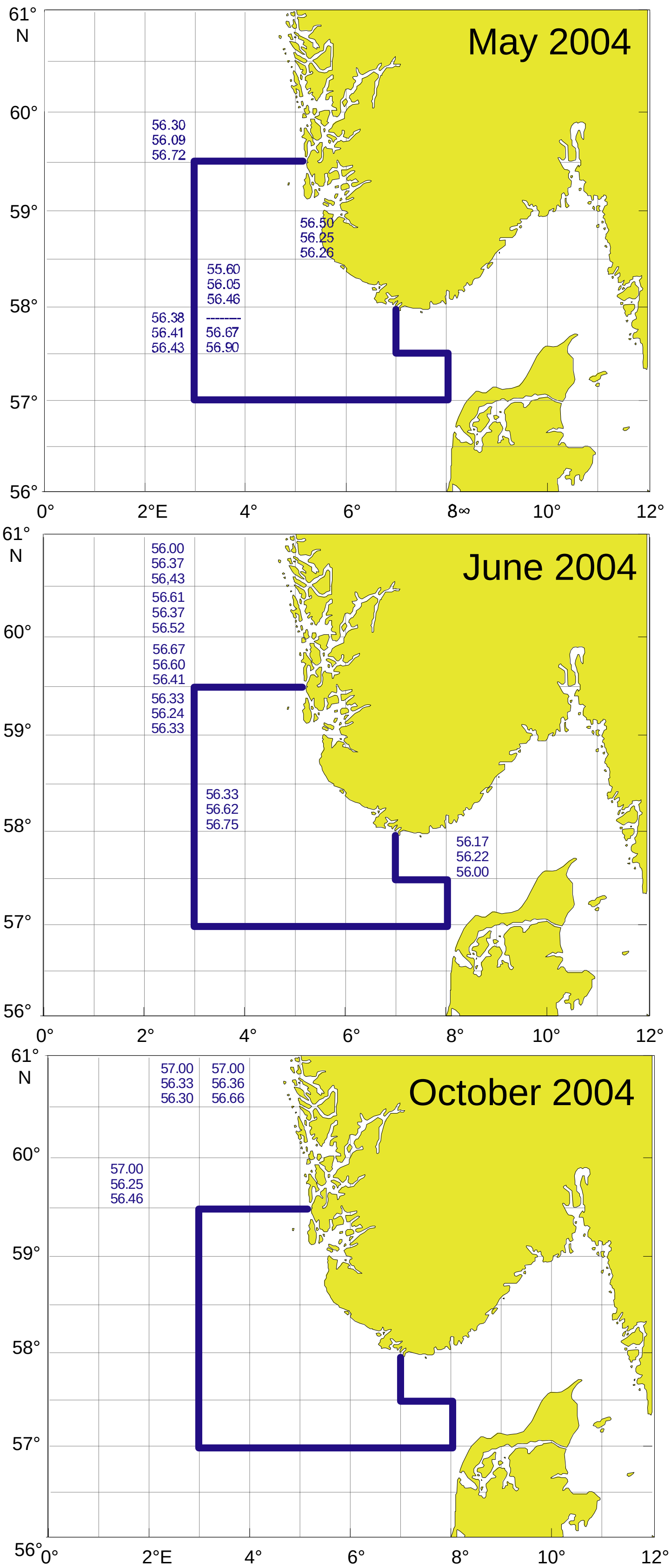


Figure 2.2.2 Mean vertebrae counts of 2 (upper number), 3 (middle) and 4+ herring (lower) in the North Sea and Div. IIIa as obtained by Norwegian sampling in the 2nd and 4th quarter 2004. The transfer area (Western Baltic Spring Spawners transferred to the assessment of IIIa herring) is indicated.

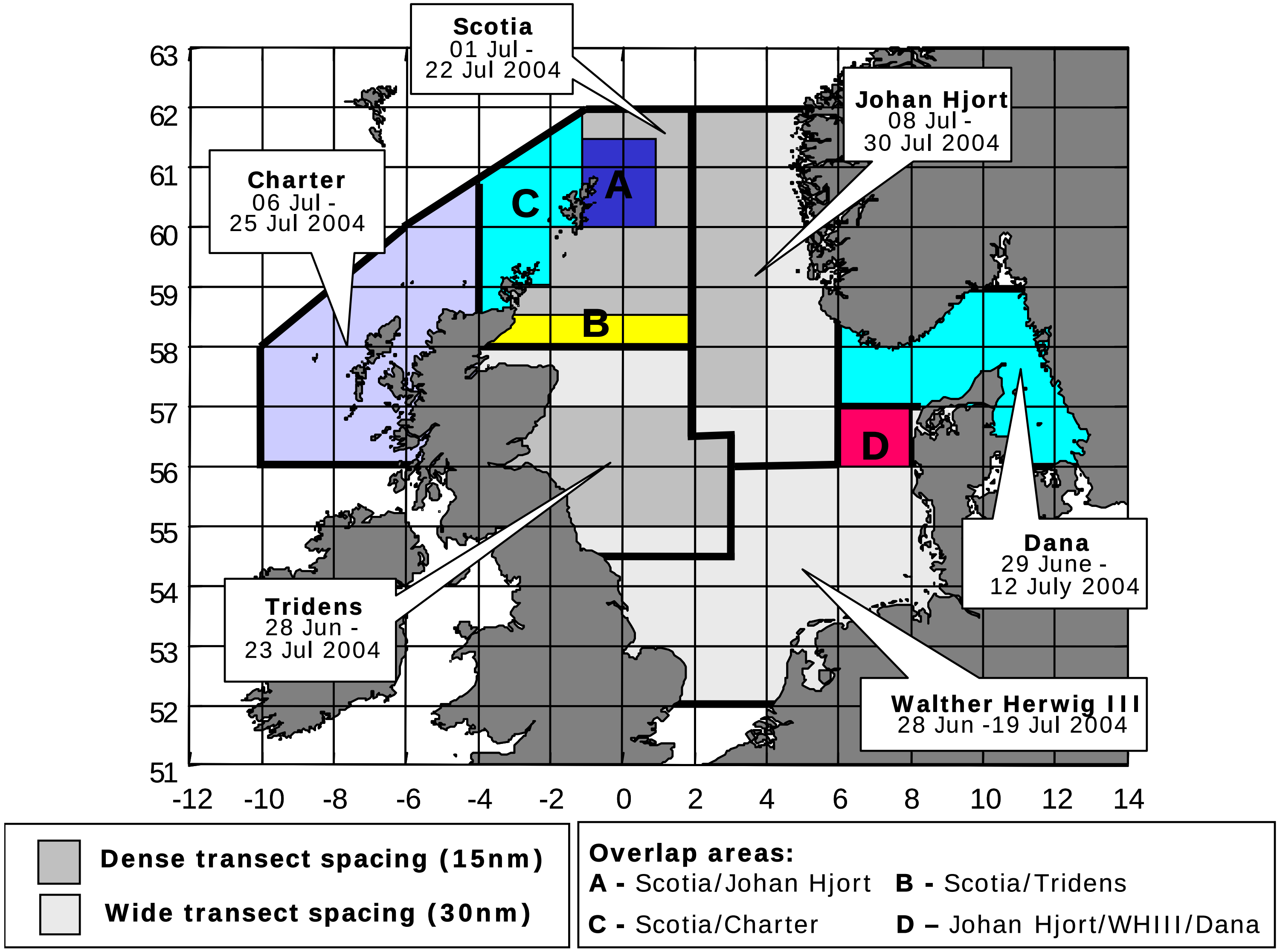


Figure 2.3.1.1 **Herring in the North Sea. Herring survey area layouts and dates for all participating vessels in the 2004 acoustic survey of the North Sea and adjacent areas. Shaded areas indicate areas of overlap**

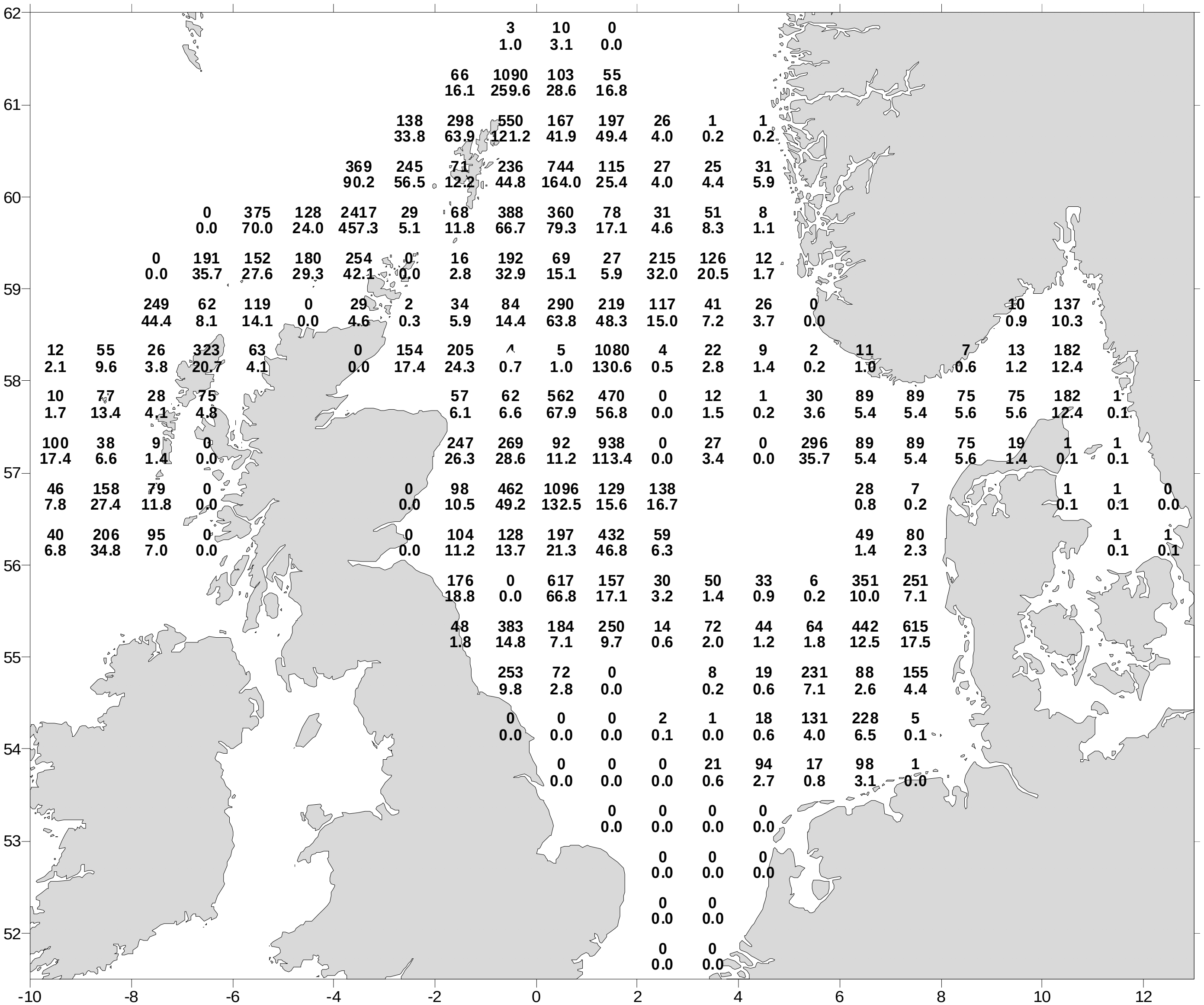


Figure 2.3.1.2 **Herring in the North Sea. Autumn spawning herring abundance from combined acoustic survey July 2004. Numbers (millions) (upper figure), and biomass (thousands of tonnes) (lower figure)**

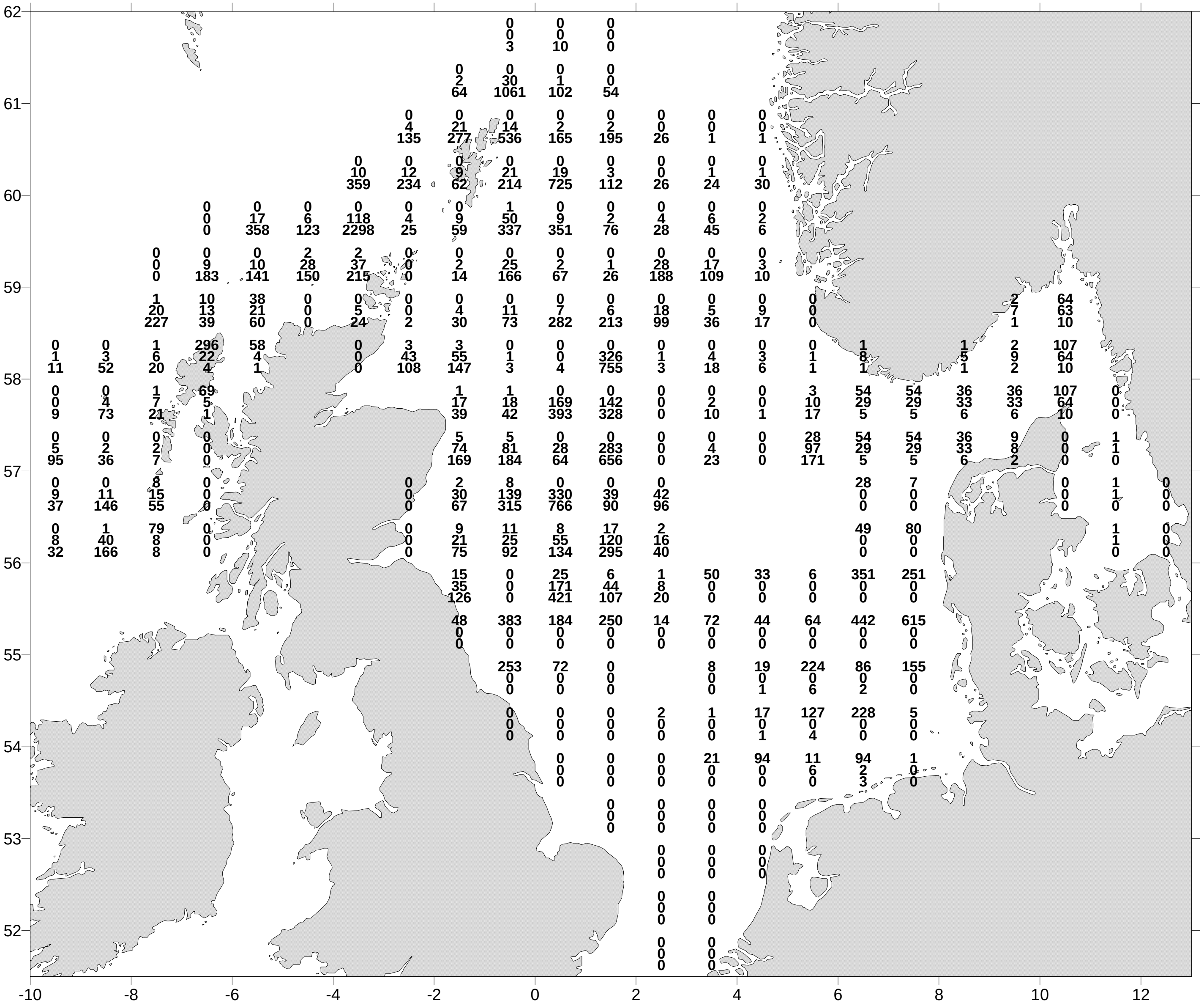


Figure 2.3.1.3 Herring in the North Sea. Autumn spawning herring numbers (millions) from combined acoustic survey July 2004. 1-ring (upper figure), 2-ring (centre figure), 3+ (lower figure)

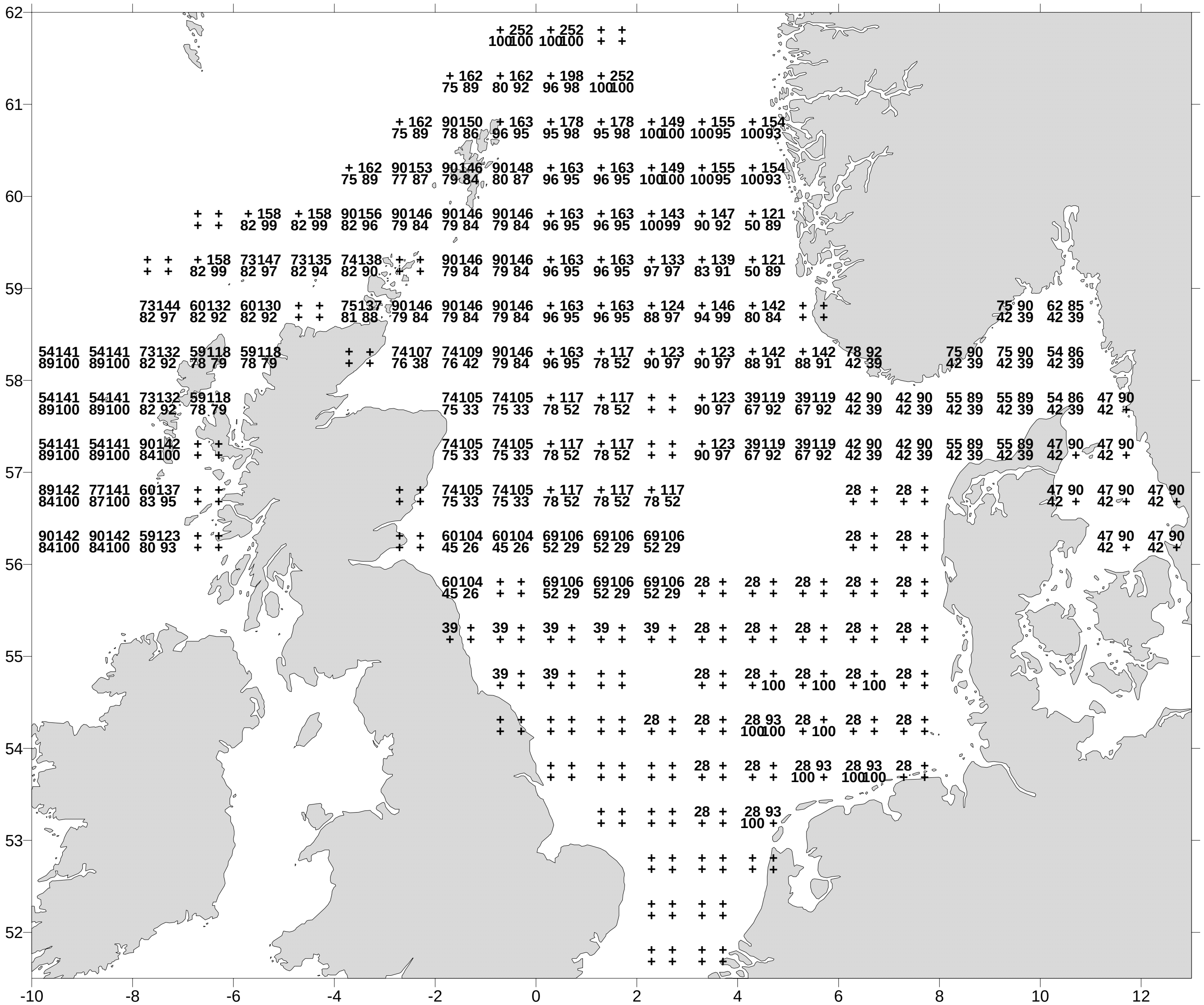


Figure 2.3.1.4 Herring in the North Sea. Mean weight & maturity of Autumn spawning herring from combined acoustic survey June – July 2004. Four values per ICES rectangle, percentage mature (lower),2 ring (left), 3 ring (right), mean weights gram (upper),1 ring (left) ,2 ring (right) ,0 indicates measured percentage mature, + indicates surveyed with zero abundance blank indicates an unsurveyed rectangle

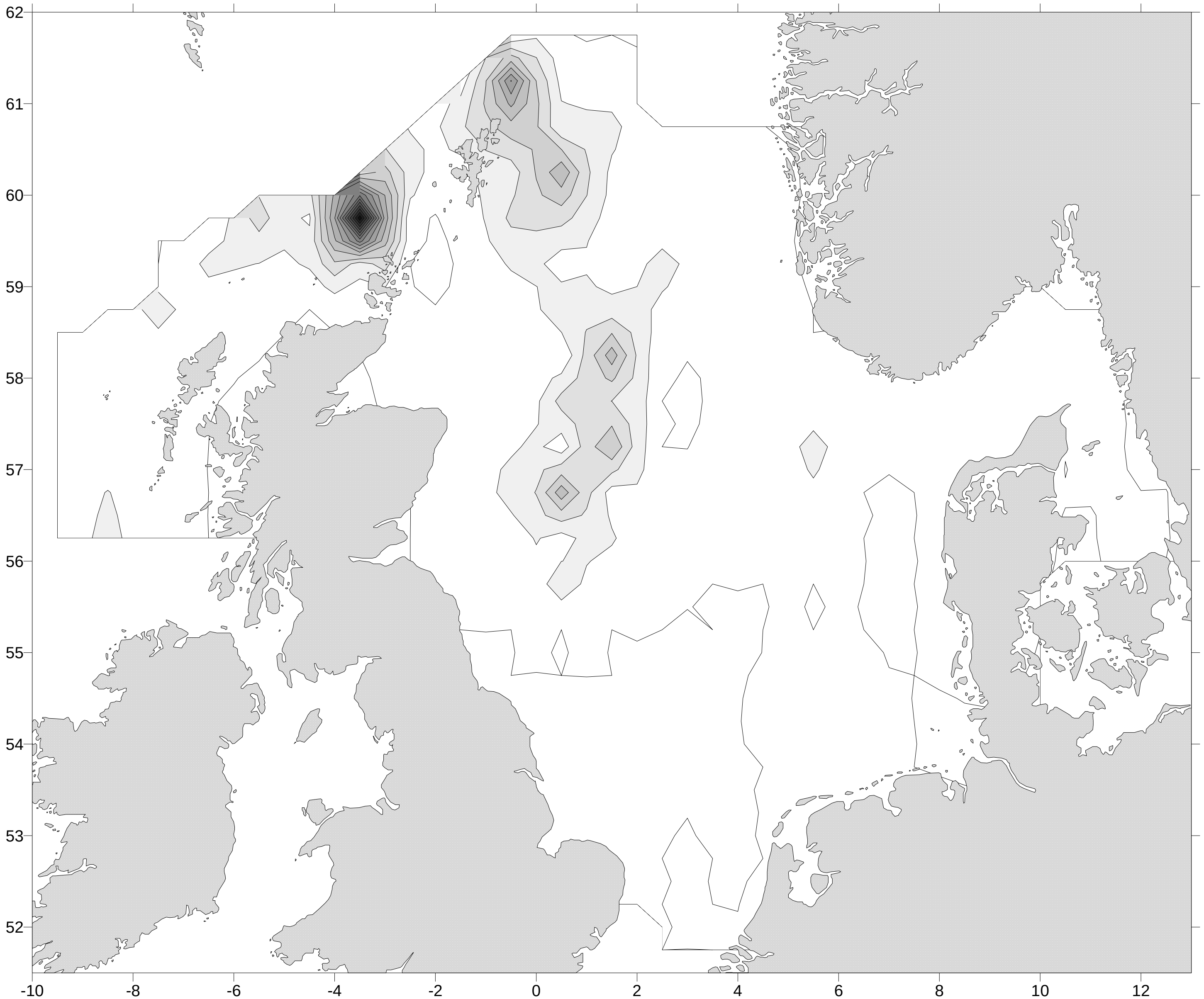


Figure 2.3.1.5 Herring in the North Sea. Abundance of mature autumn-spawning herring from combined acoustic survey July 2004. Numbers of herring, (dark areas indicate higher density).

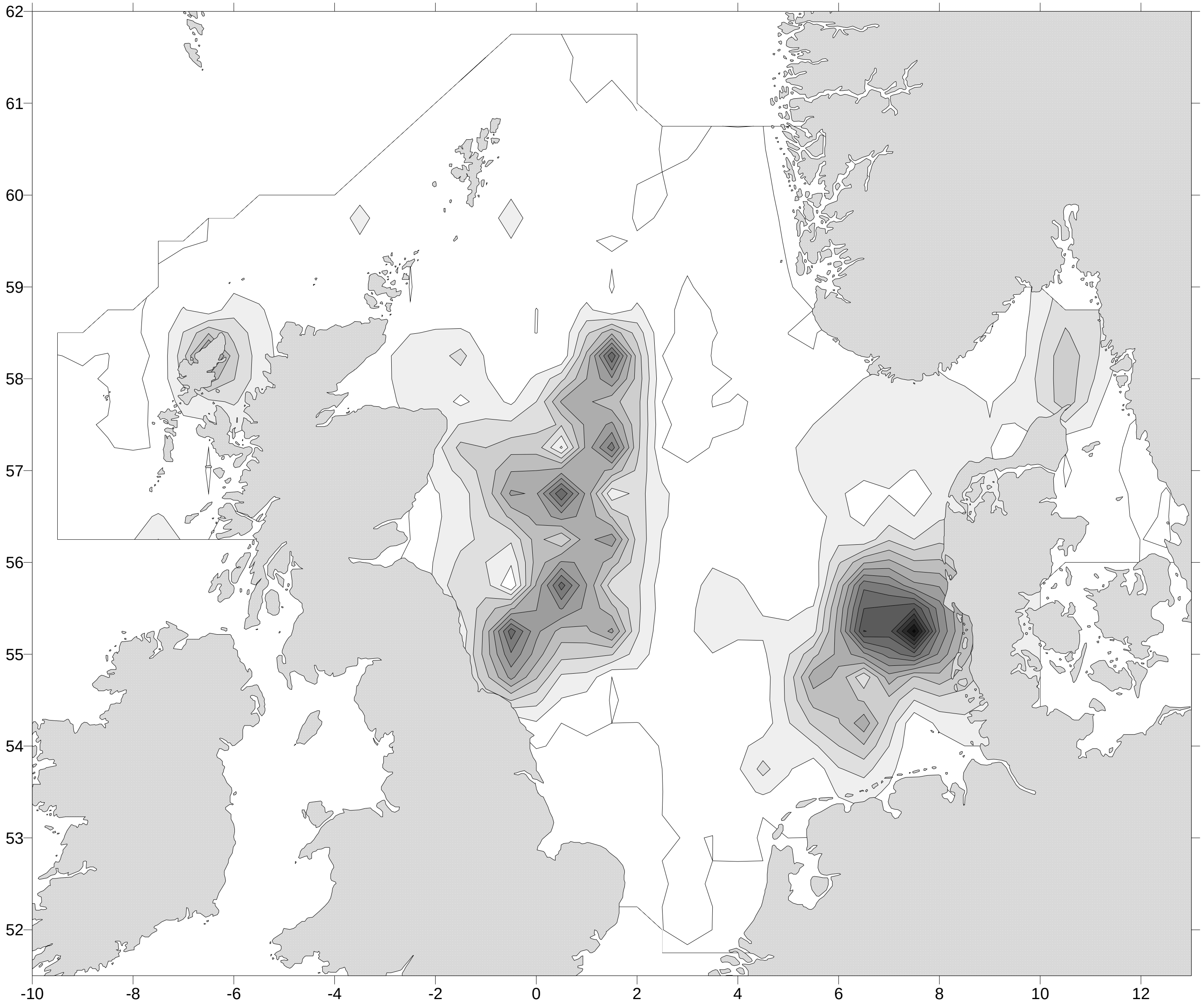


Figure 2.3.1.6 **Herring in the North Sea. Abundance of immature autumn spawning herring from combined acoustic survey July 2004. Numbers of herring.(dark areas indicate higher density)**

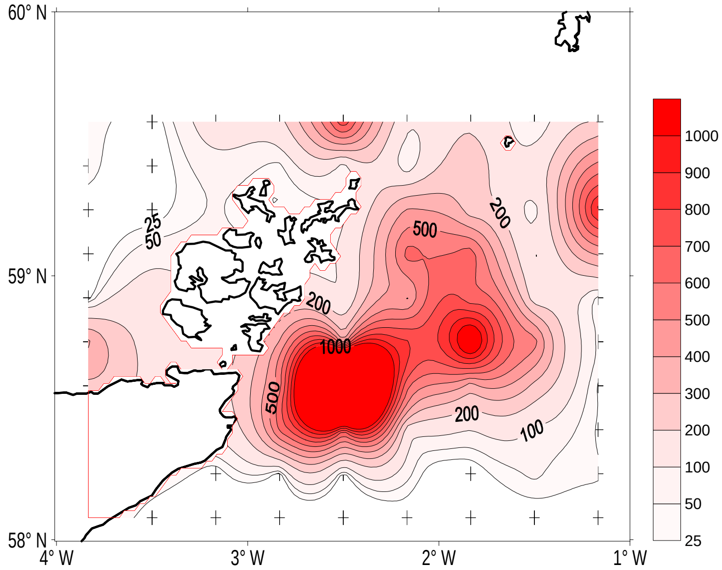


Figure 2.3.2.1: North Sea autumn spawners. Orkney/Shetlands 16–30 September 2004. Abundance of larvae < 10 mm (n/m²)

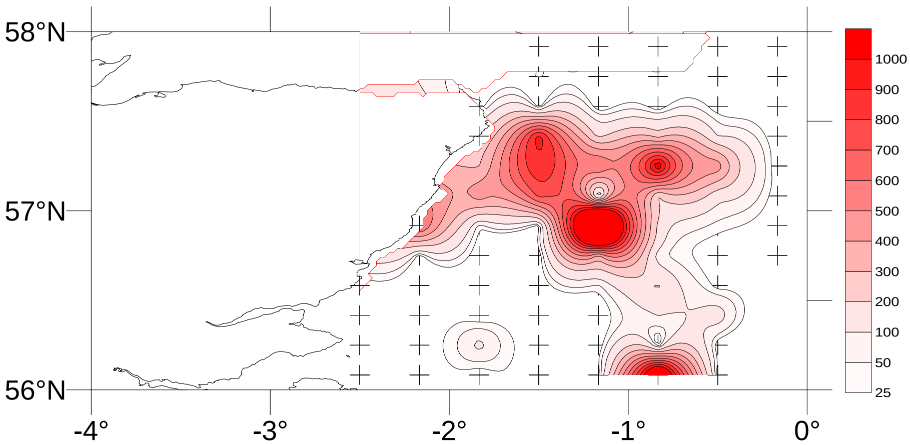


Figure 2.3.2.2: North Sea autumn spawners. Buchan 16–30 September 2004. Abundance of larvae < 10 mm (n/m²)

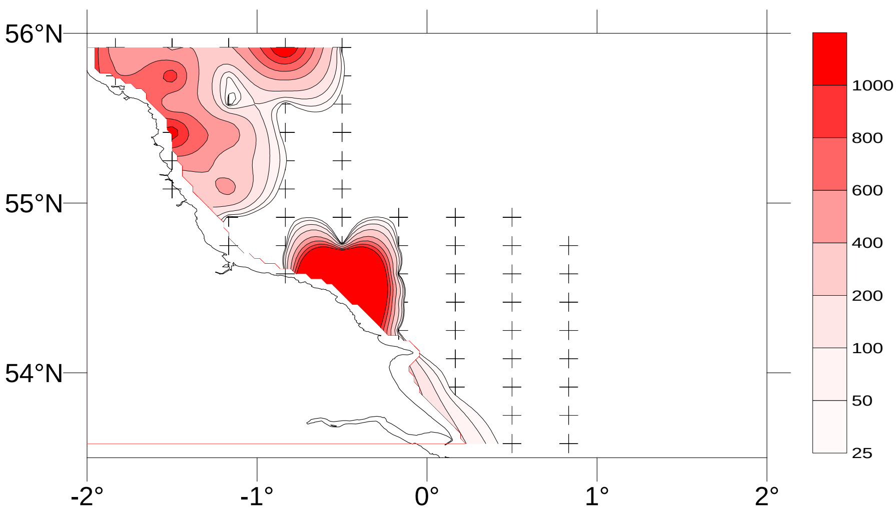


Figure 2.3.2.3: North Sea autumn spawners. Central North Sea 16–30 September 2004. Abundance of larvae < 10 mm (n/m²)

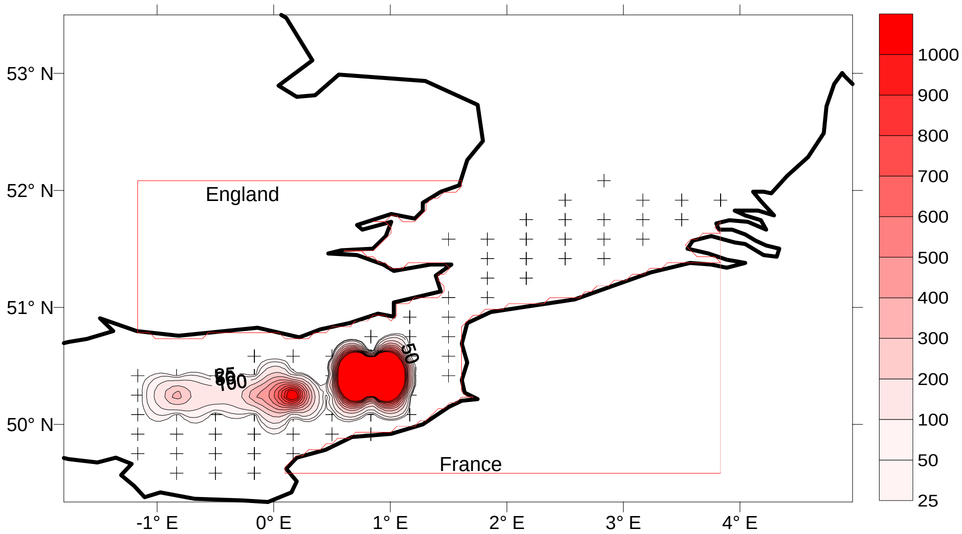


Figure 2.3.2.4: North Sea autumn spawners. Southern North Sea 16–31 December 2004. Abundance of larvae < 11 mm (n/m²)

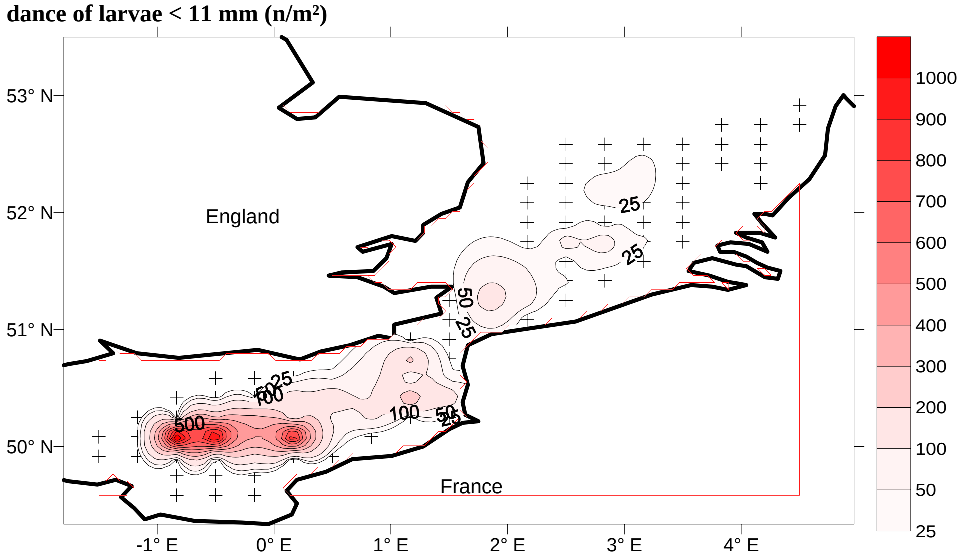


Figure 2.3.2.5: North Sea autumn spawners. Southern North Sea 1–15 January 2005. Abundance of larvae < 11 mm (n/m²)

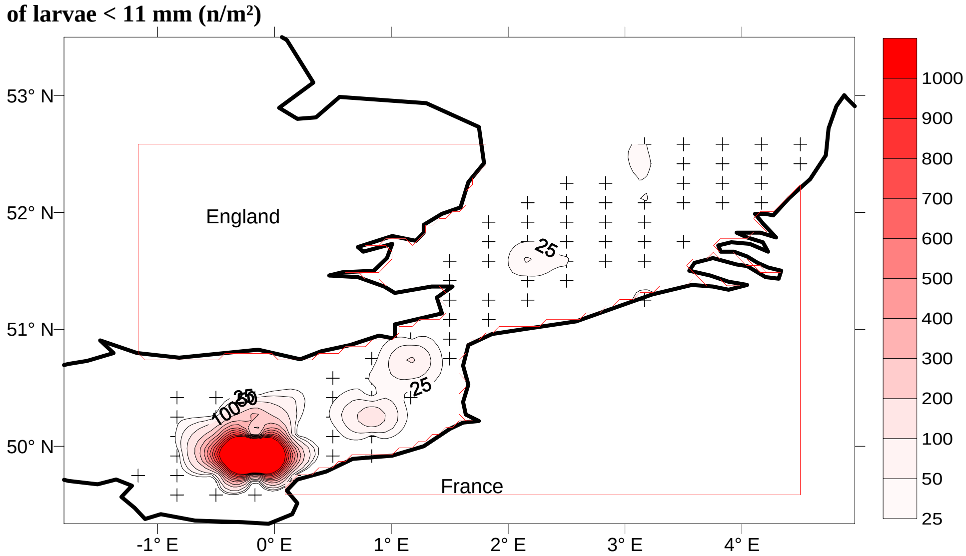


Figure 2.3.2.6: North Sea autumn spawners. Southern North Sea 16–31 January 2005. Abundance of larvae < 11 mm (n/m²)

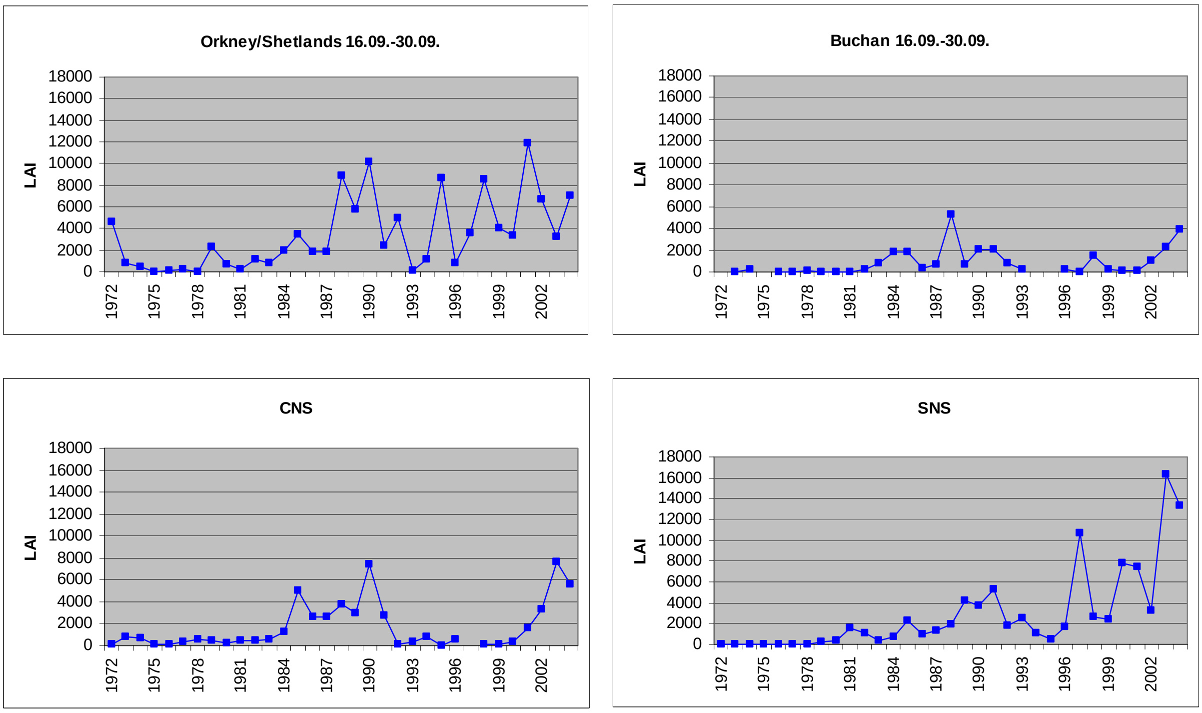


Figure 2.3.2.7: North Sea autumn spawners. Larval Abundance Index time-series for a collection of areas and sampling periods (Orkney/Shetlands 2nd half of September top left panel, Buchan 2nd half of September top right, Central North Sea lower left, Southern North Sea lower right. CNS is given as the mean of three surveys and SNS as the sum of three).

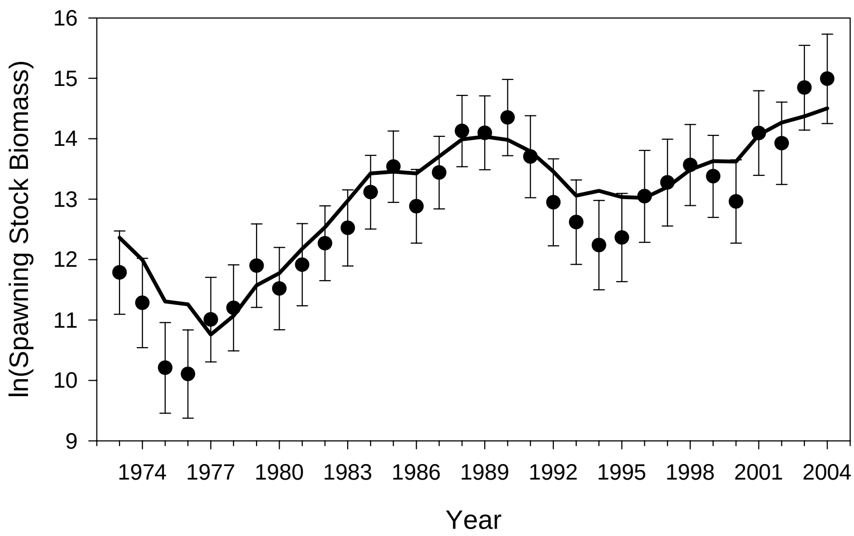


Figure 2.3.2.8: North Sea autumn spawners. Comparison of spawning stock size estimates from the Herring Assessment Working Group (ICES, 2004; bold line) and the year effects fitted to the larval abundances in the multiplicative model (symbols with error bars). The MLAI estimates have been rescaled to the mean of the WG estimates. Error bars indicate +/- one standard error of larval survey abundance estimates.

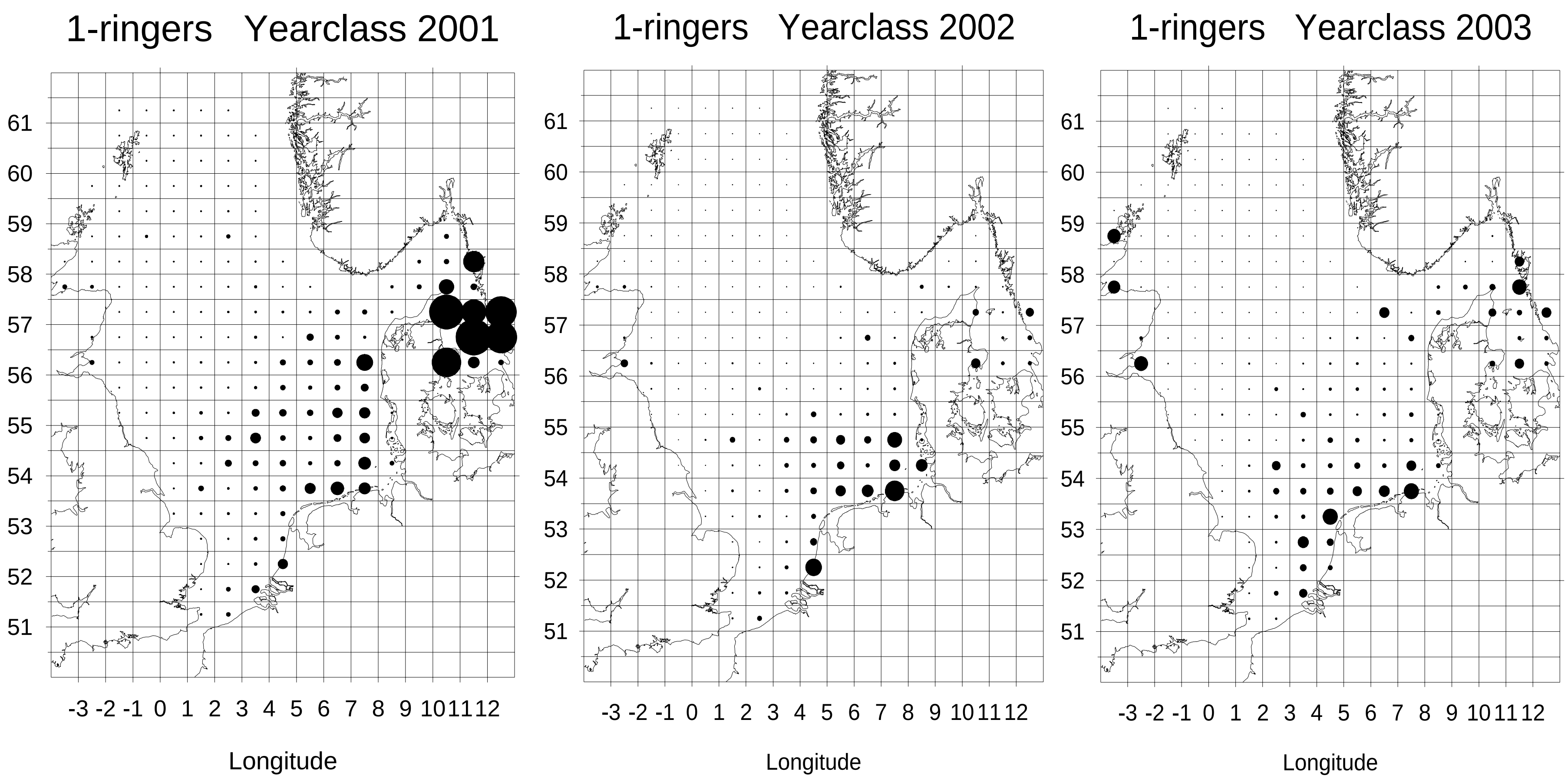


Figure 2.3.3.1. North Sea herring. Distribution of 1-ringer herring, year classes 2001-2003. Abundance estimates of 1-ringers within each statistical rectangle are based on GOV catches during IBTS in February 2003-2005. Areas of filled circles illustrate numbers per hour, the area of a circle extending to the border of a rectangle represents 45000 h^{-1}.

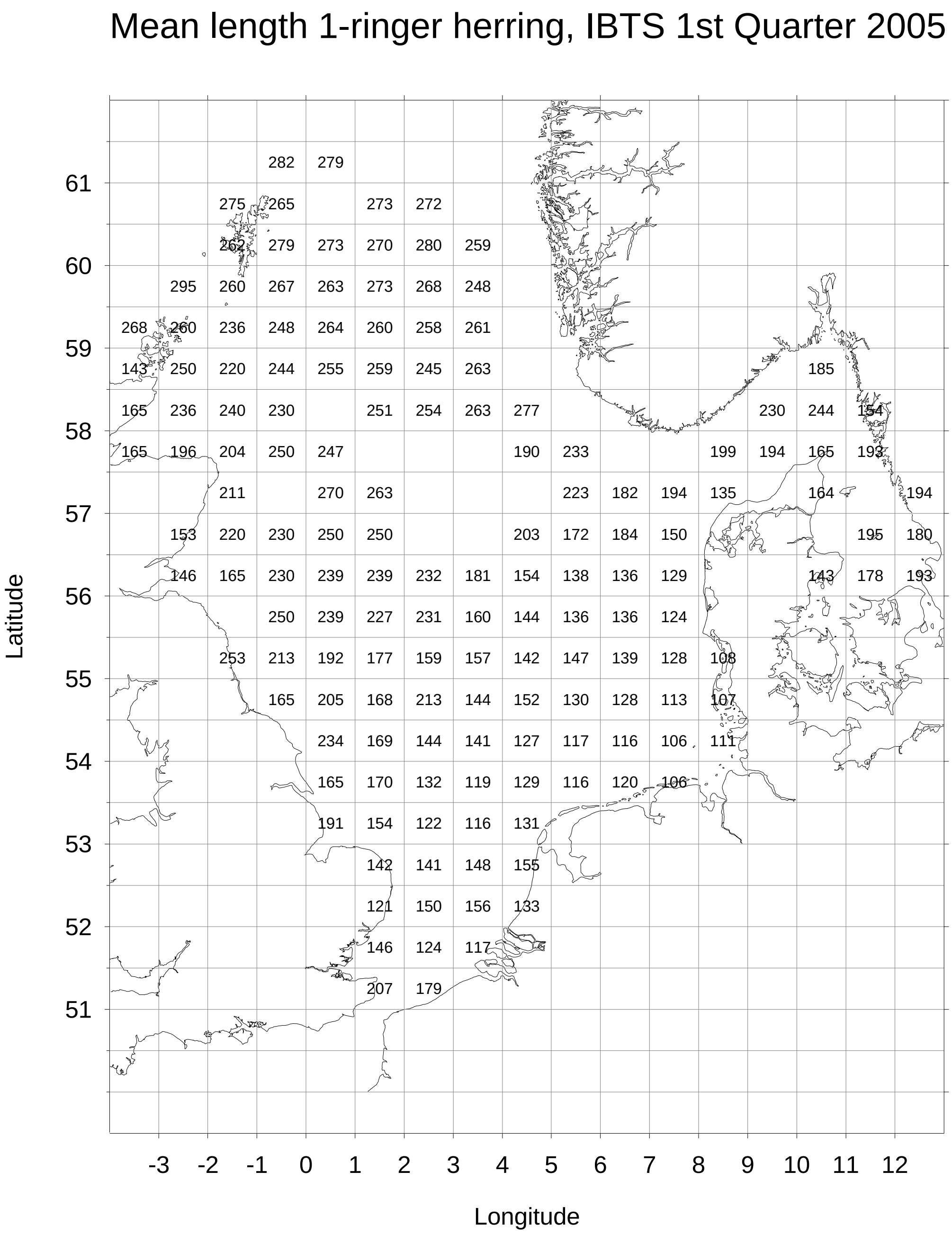


Figure 2.3.3.2. North Sea herring. Mean length (mm) of 1-ringer herring caught during IBTS 1st Quarter

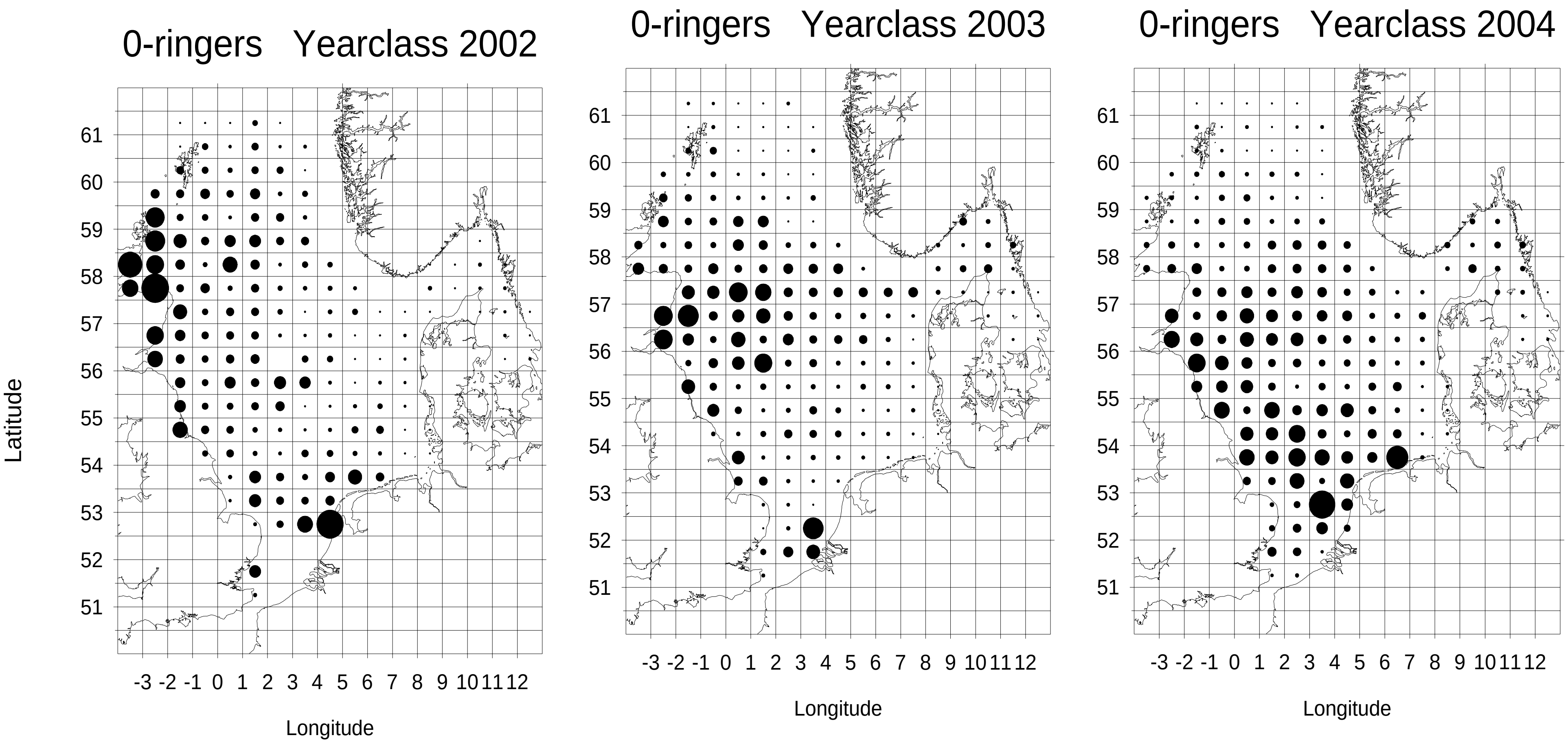


Figure 2.3.3.3. North Sea herring. Distribution of 0-ringer herring, year classes 2002-2004. Abundance estimates of 0-ringers within each statistical rectangle are based on MIK catches during IBTS in February 2003-2005. Areas of filled circles illustrate densities in no m^{-2}, the area of a circle extending to the border of a rectangle represents 1 m^{-2}

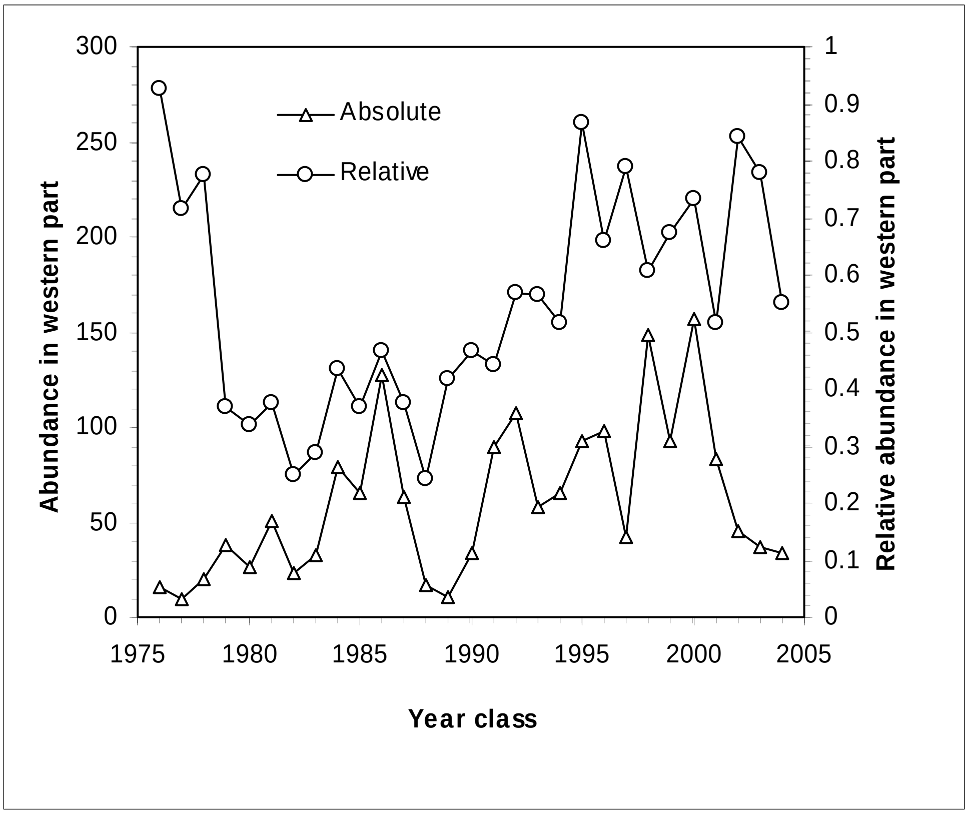


Figure 2.3.3.4 North Sea herring. Absolute (no * 10^9) and relative abundance of 0-ringers in the area west of 2°E in the North Sea. Abundances estimated by MIK sampling during IBTS, the relative abundance in the western part is estimated as the number of 0-ringers west of 2°E relative to total number of 0-ringers.

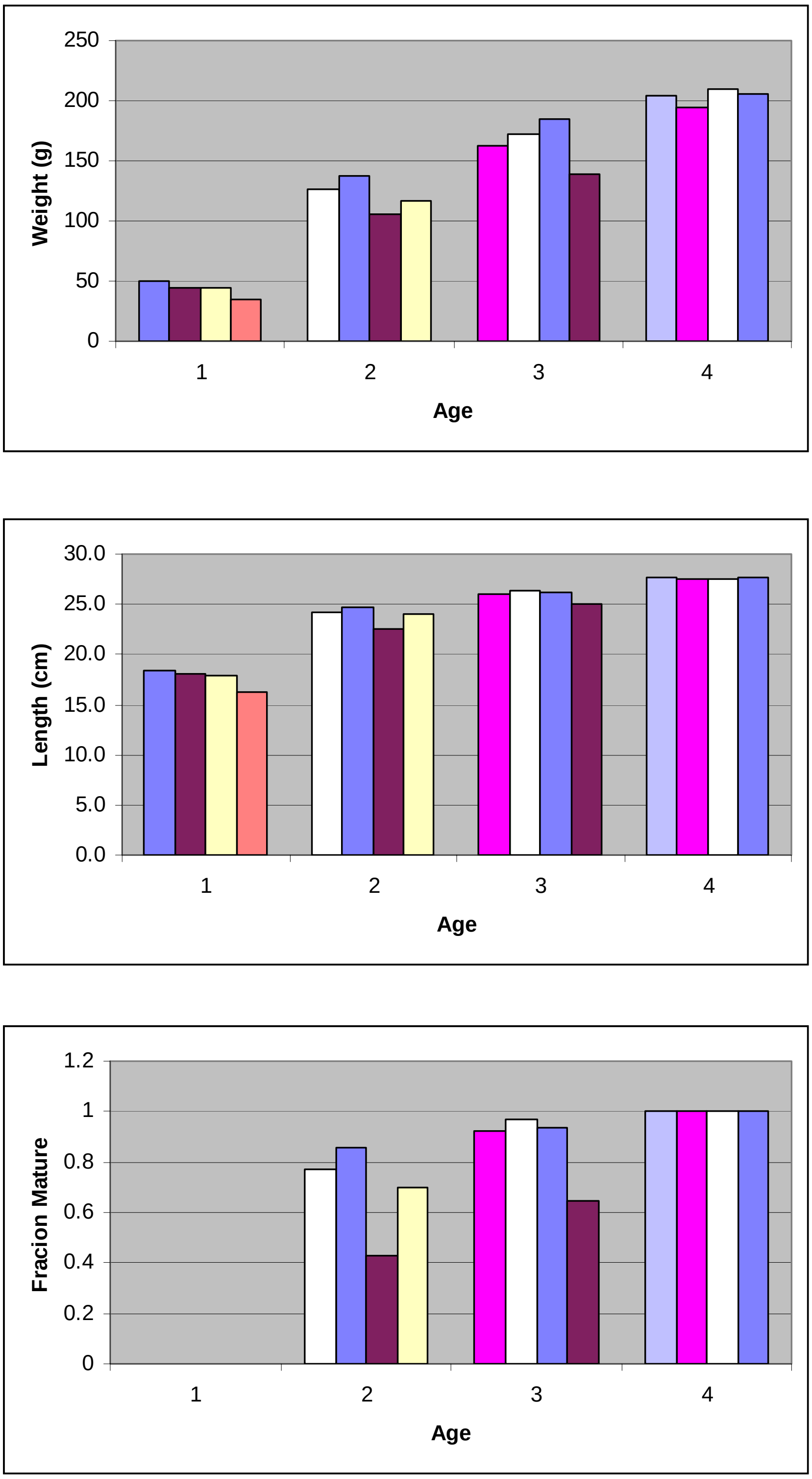


Figure 2.4.2.1. North Sea herring. Growth and maturation of North Sea herring by age (colours indicate year classes) and year from 2001 to 2004. Note the low growth of the 2000 year class (darkest bar) at 2 and 3 ring and low fraction mature at 2 and 3 ring. Note age= winter ring.

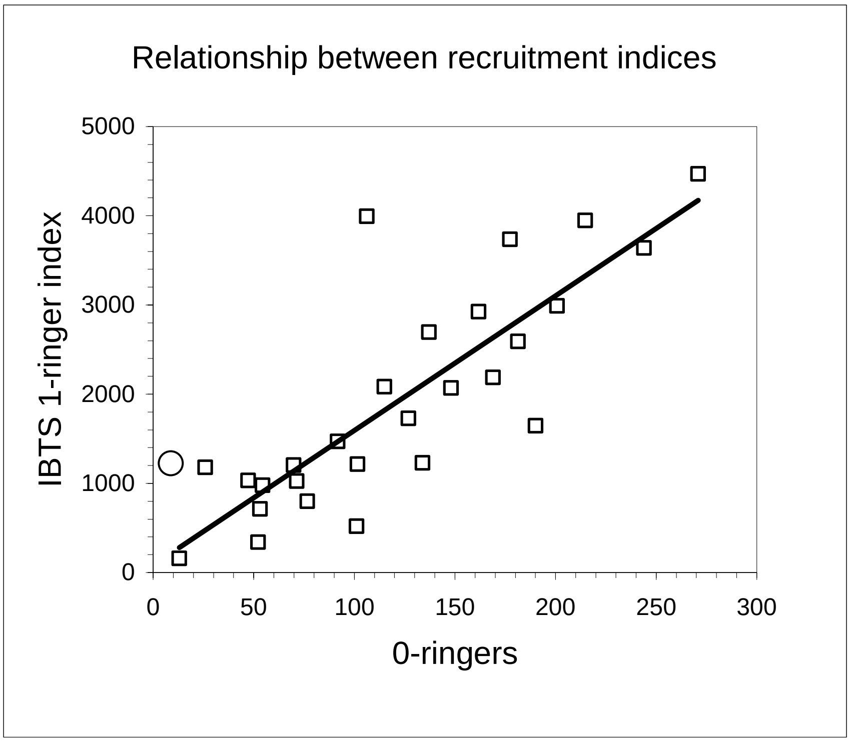


Figure 2.5.1 North Sea herring. Relationship between indices of 0-ringers and 1-ringers for year classes 1977 to 2003. The 2003 relation is indicated by a circle.

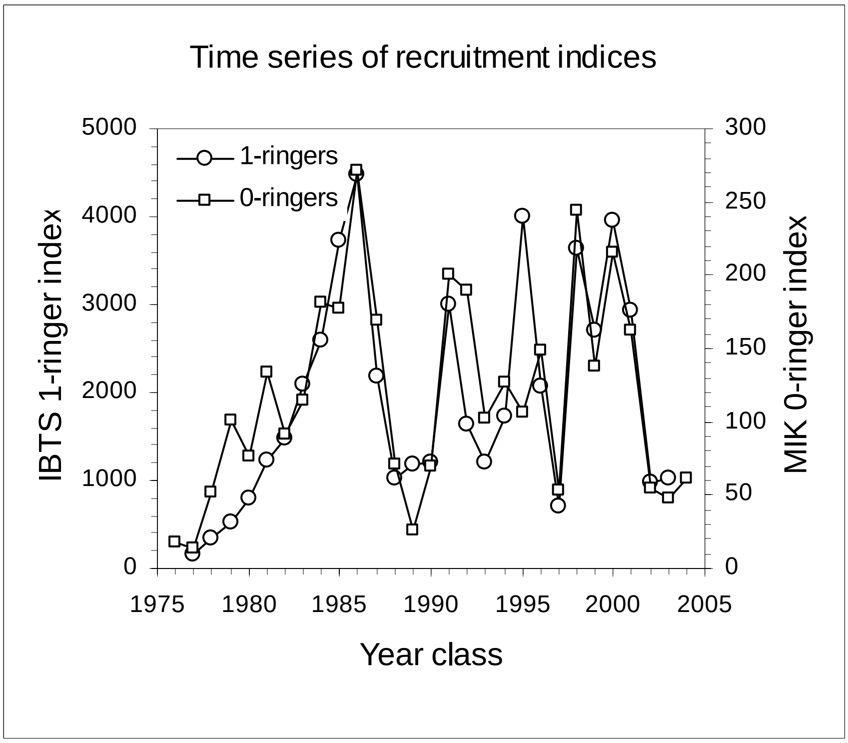


Figure 2.5.2 North Sea herring. Time series of 0-ringer and 1-ringer indices. Year classes 1976 to 2004 for 0-ringers, year classes 1977-2003 for 1-ringers.

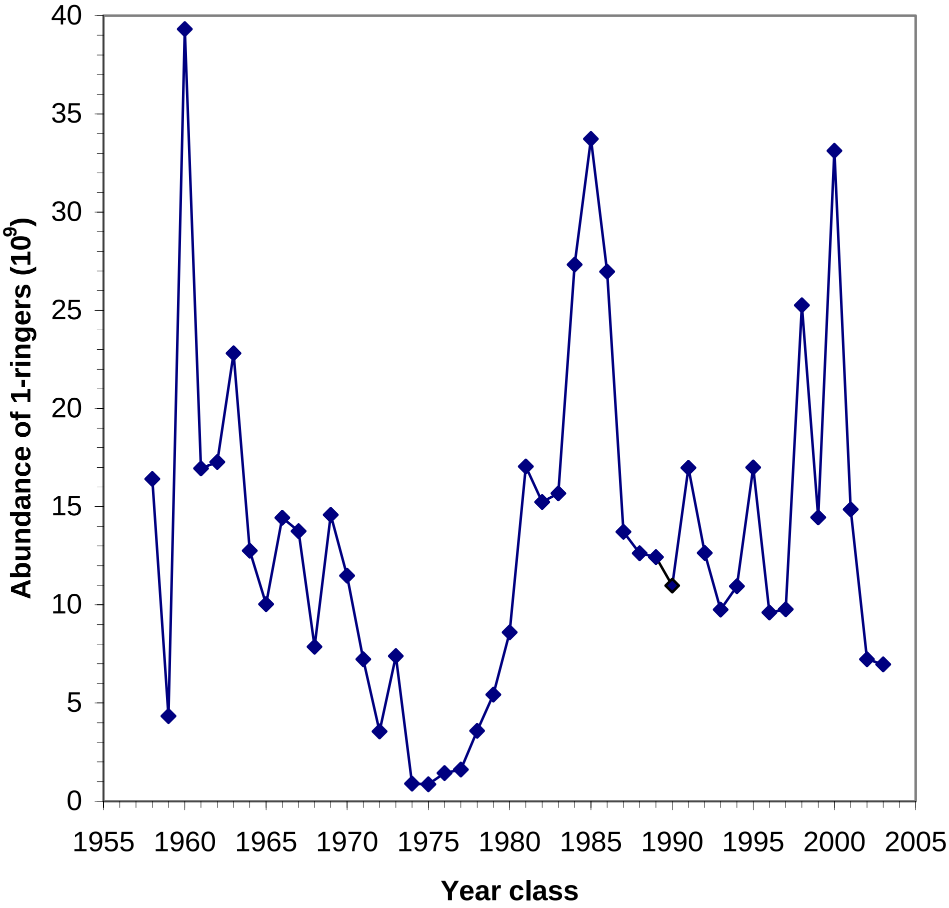


Figure 2.5.3. North Sea herring. Trend in recruitment of 1-ringers from year class 1958 to 2003. Data from the 2005 ICA assessment of the North Sea autumn spawned herring.

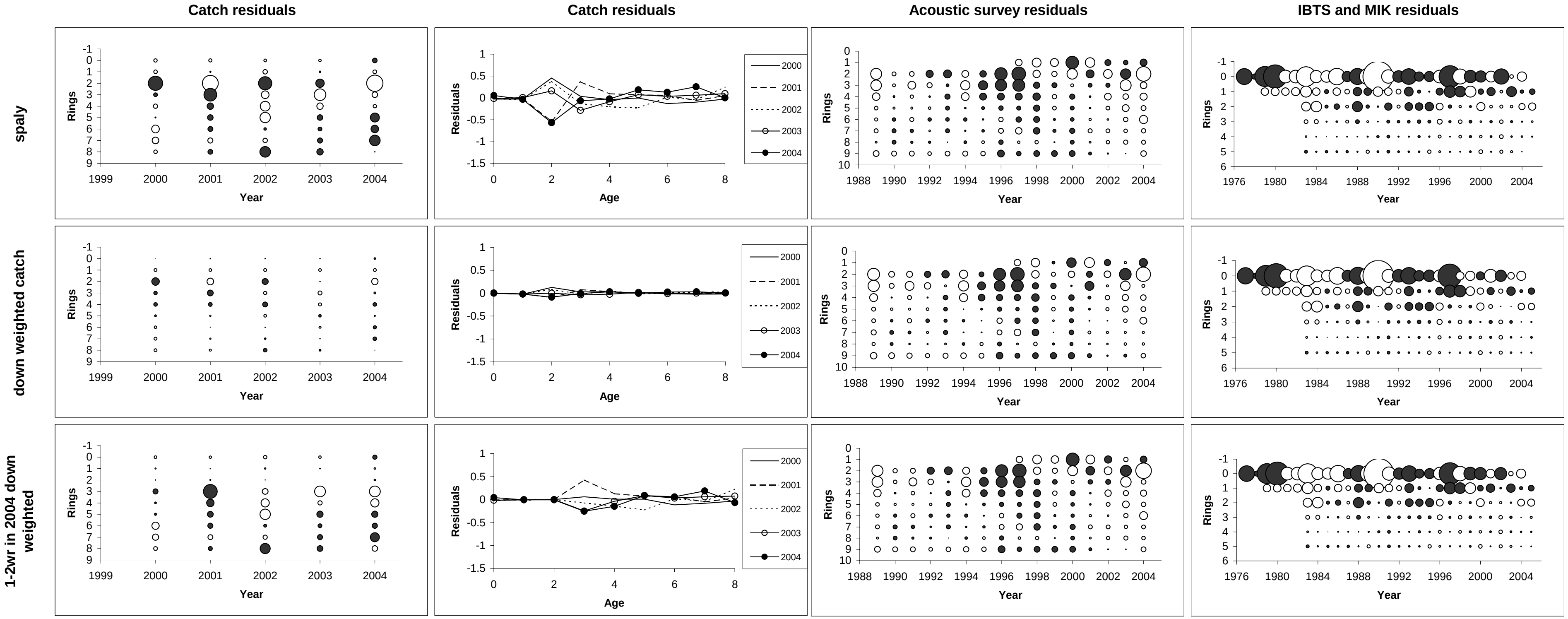


Figure 2.6.1.1. North Sea herring. Weighted residuals for assessment using same procedure as last year (upper panels), with the weights for the catch set in the separable period to 10% of the original values (middle panels), and with the weights for the catch for the 1wr and 2wr in 2004 set at 0.01 (lower panels).

Panels on left side: bubble plot of catch residuals at age for the separable period. Dark bubbles represent residual values greater than 0, white bubbles less then 0.

Panels on middle left side: catch residuals plotted against age for the separable period. Panels on middle right side: bubble plot of acoustic survey residuals at age. Dark bubbles represent values greater than 0, white bubbles less then 0.

Panels on right side: bubble plot of IBTS and MIK residuals at age. Dark bubbles represent values greater than 0, white bubbles less then 0.

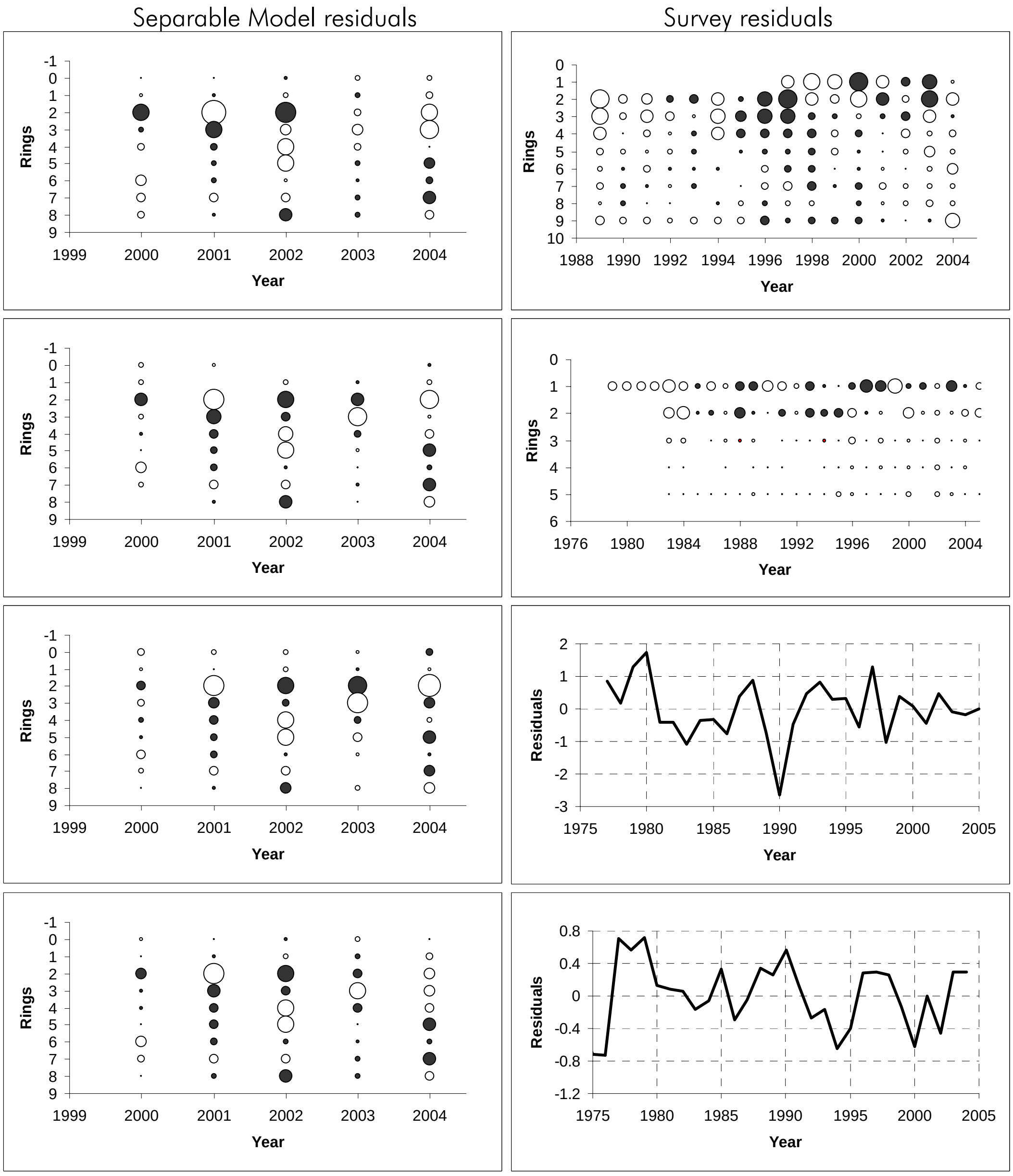
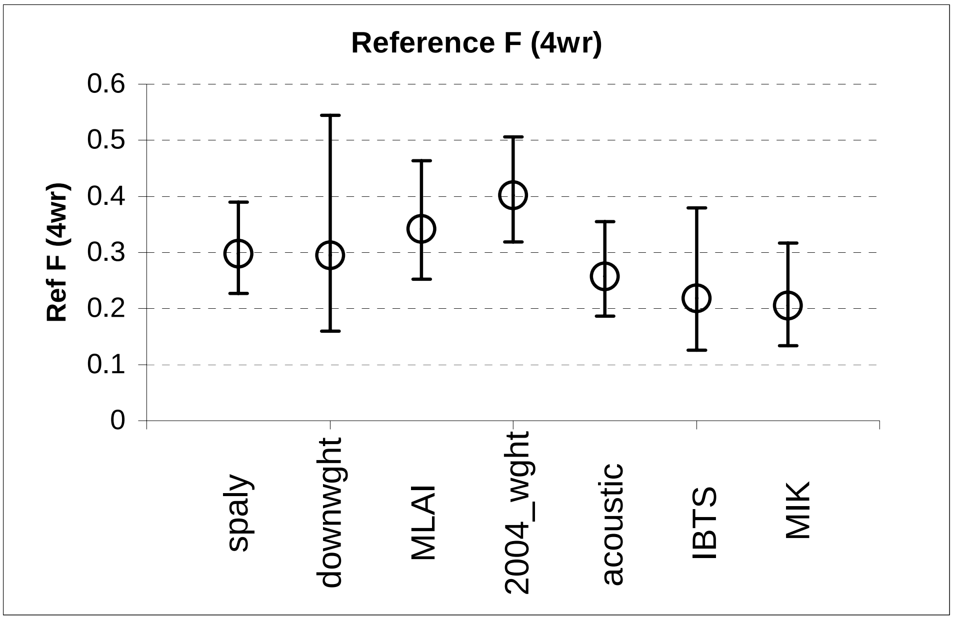


Figure 2.6.1.2. North Sea herring. Individual tuning fleets. Weighted residuals for assessments using each individual survey as the only tuning fleet: acoustic survey (1-9+ wr), IBTS (1-5+ wr), MIK (0 wr) and MLAI (SSB).

Panels on left side: bubble plot of catch residuals at age for the separable period. Dark bubbles represent residual values greater than 0, white bubbles less then 0.

Panels on right side: bubble plot of tuning fleet residuals at age.



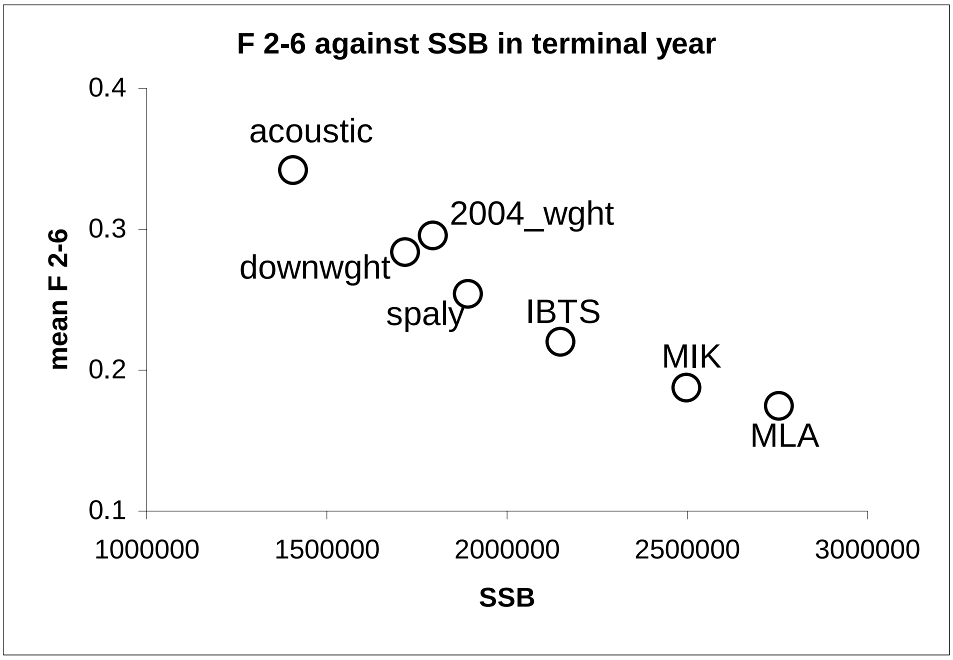


Figure 2.6.1.3. North Sea herring. Comparison of mean reference F at 4wr (panel a) and the relation between mean F and SSB (panel b) for:

- Total catch and all indices using the same procedure as last year (spaly)
- Setting the weights for the catch in the separable period to 10% of the original values (downwght)
- Setting the weights for the catch of 1wr and 2wr in 2004 at 0.01 (2004_wght)
- Each individual fleet as the only tuning indices (Acoustic 1-9+wr, IBTS 1-5+wr, MIK 0wr and MLAI SSB index)

The model settings were used in the same manner as in last year's final assessment. Error bars in the top figure show 90% confidence limits.

a

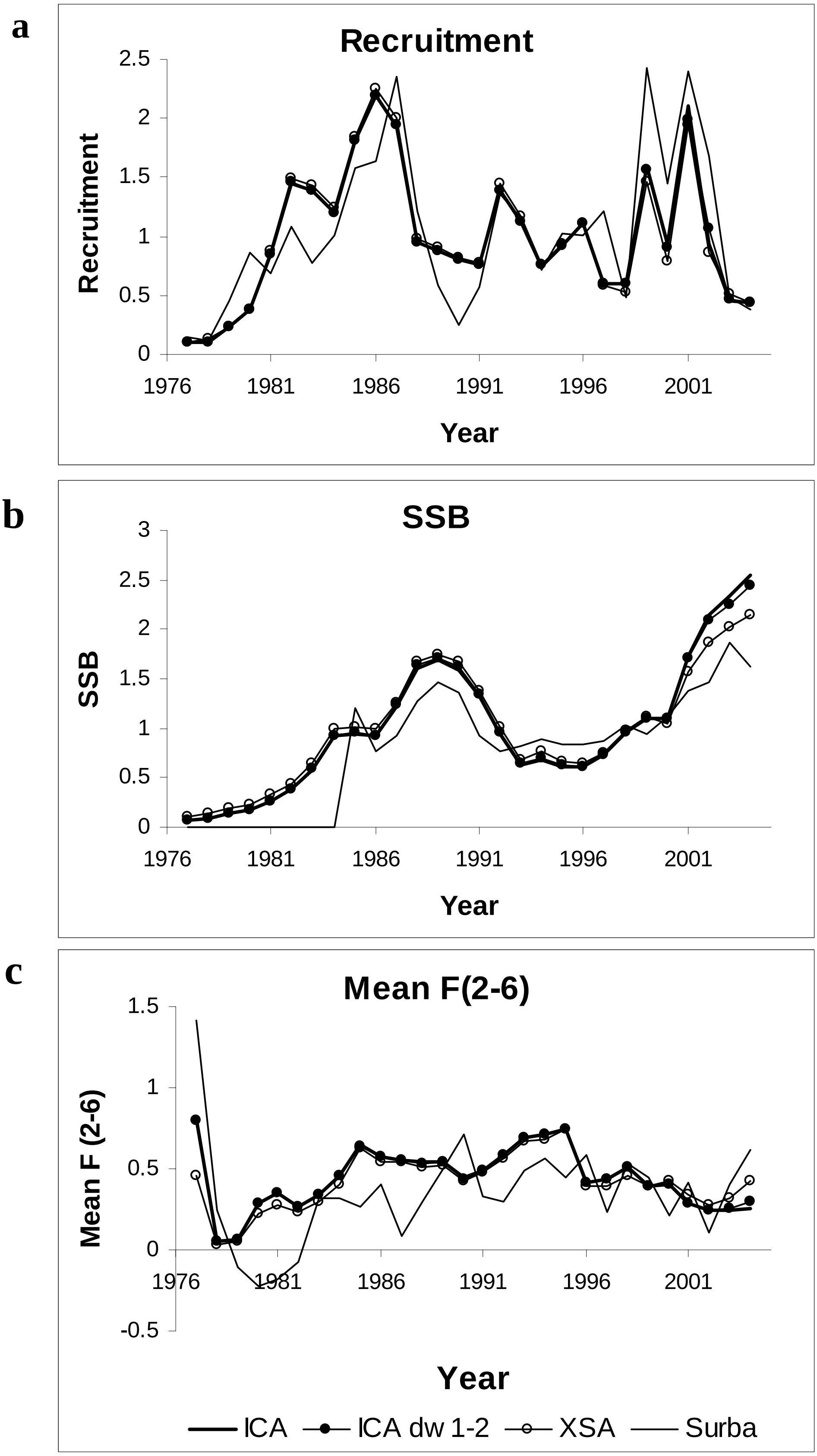


Figure 2.6.1.4. North Sea herring. Comparison of results of ICA (using same procedure as last year and setting the weights for the catch of 1wr and 2wr in 2004 at 0.01) with XSA (low shrinkage of 2.0) and SURBA. Due to the nature os SUBA the SSB scales are relative to 1 which is the series mean.

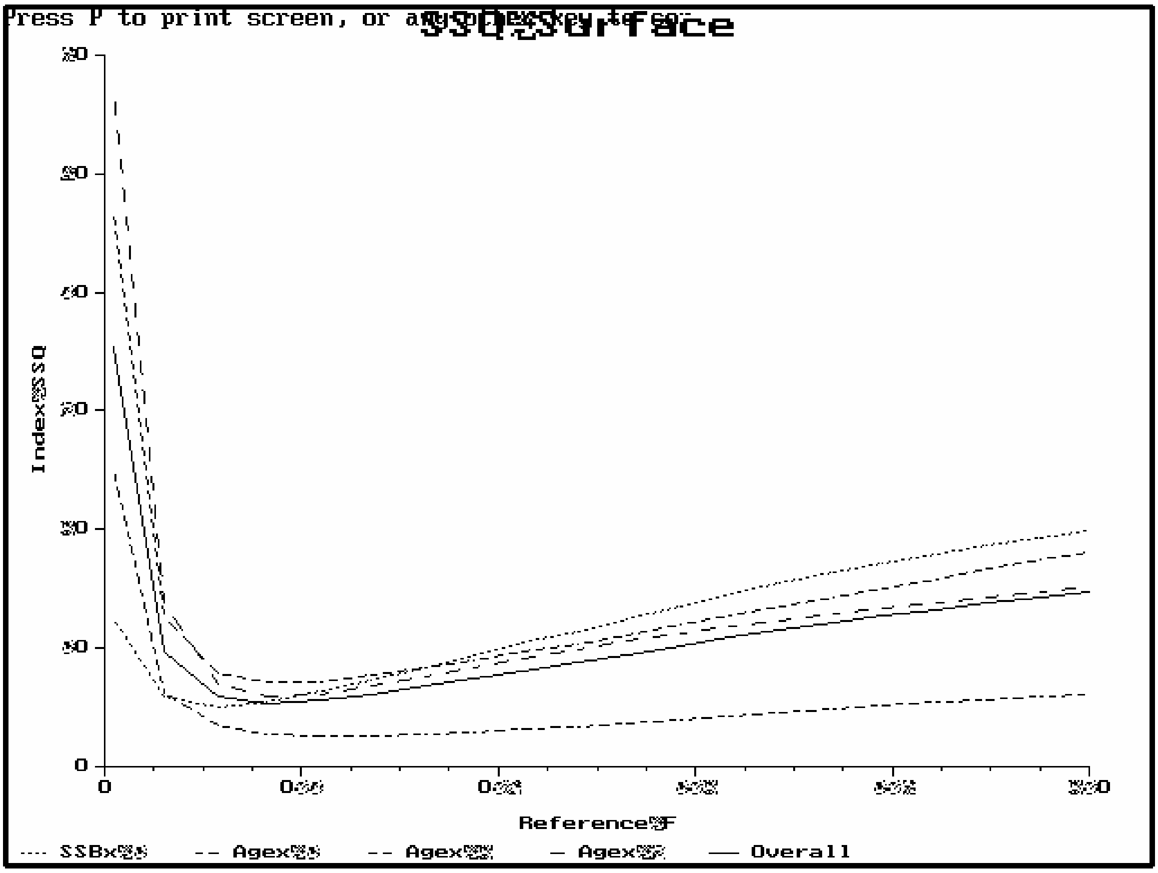


Figure 2.6.2.1. North Sea herring. SSQ surface for the deterministic calculation of the 5-year separable period.

SSBx1 – MLAI larvae survey,

Agex1- age disaggregated acoustic estimates

Agex2 – age disaggregated IBTS estimates

Agex3 – age disaggregated MIK net estimates

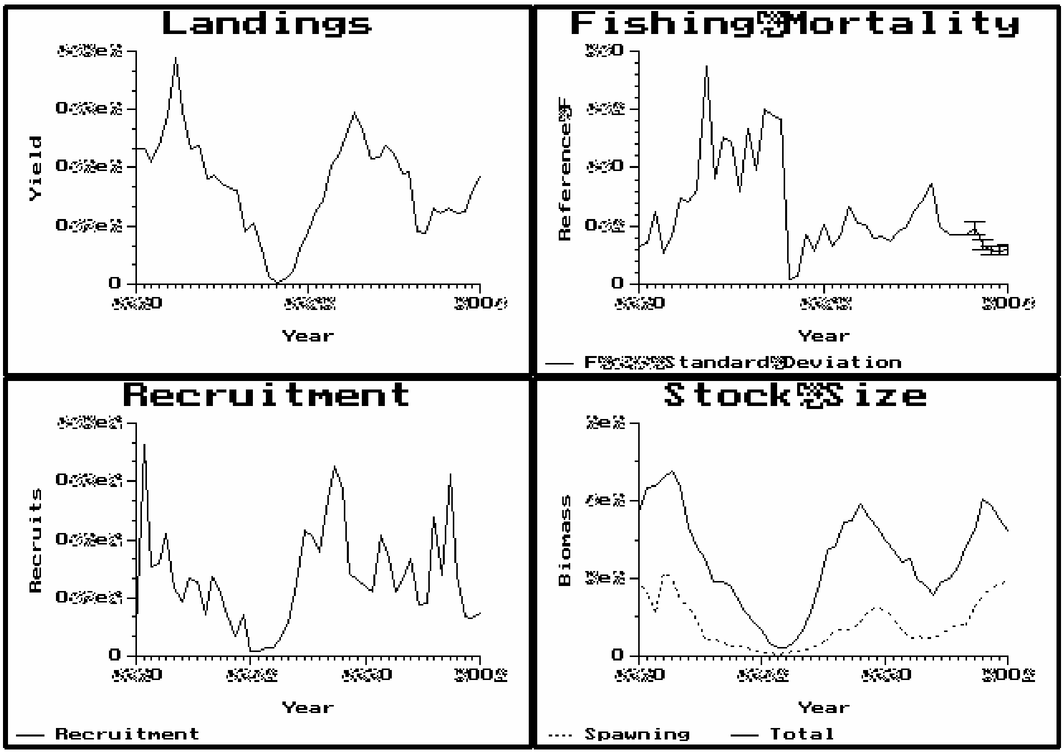


Figure 2.6.2.2. North Sea herring. Illustration of stock trends from deterministic calculation (5-year separable period). Summary of estimates of landings, fishing mortality at 4-ring, recruitment at 0-ring, stock size on 1 January and spawning stock at spawning time (solid line=total biomass, dotted line=SSB).

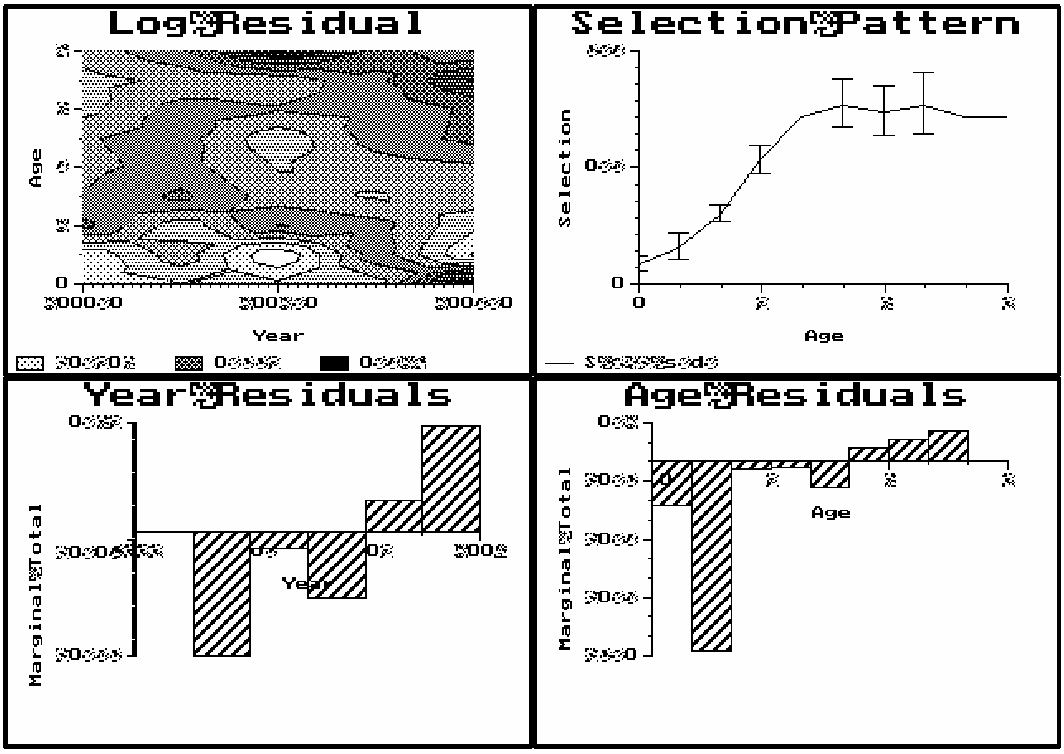


Figure 2.6.2.3. North Sea herring. Illustration of selection patterns diagnostics, from deterministic calculation (5-year separable period). Top left, a contour plot of selection pattern residuals. Top right, estimated selection (relative to 4-ringers) +/- standard deviation. Bottom, marginal totals of residuals by year and ring (with weights applied).

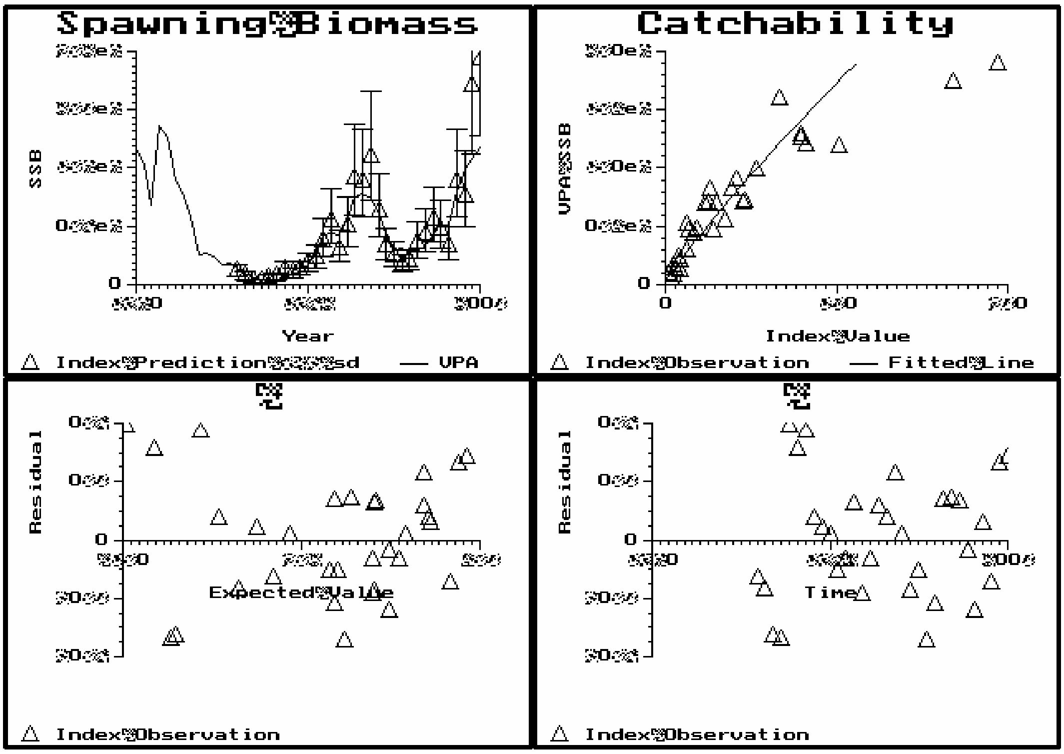


Figure 2.6.2.4. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the predicted SSB against the SSB MLAI survey. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

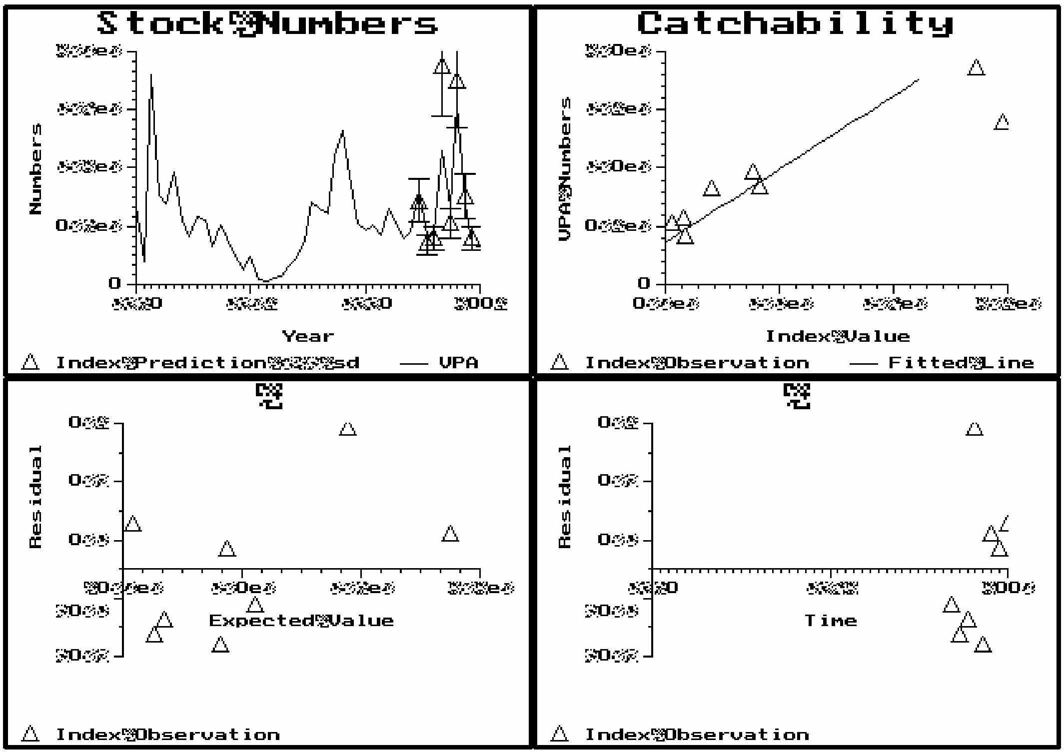


Figure 2.6.2.5. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 1-ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 1-ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

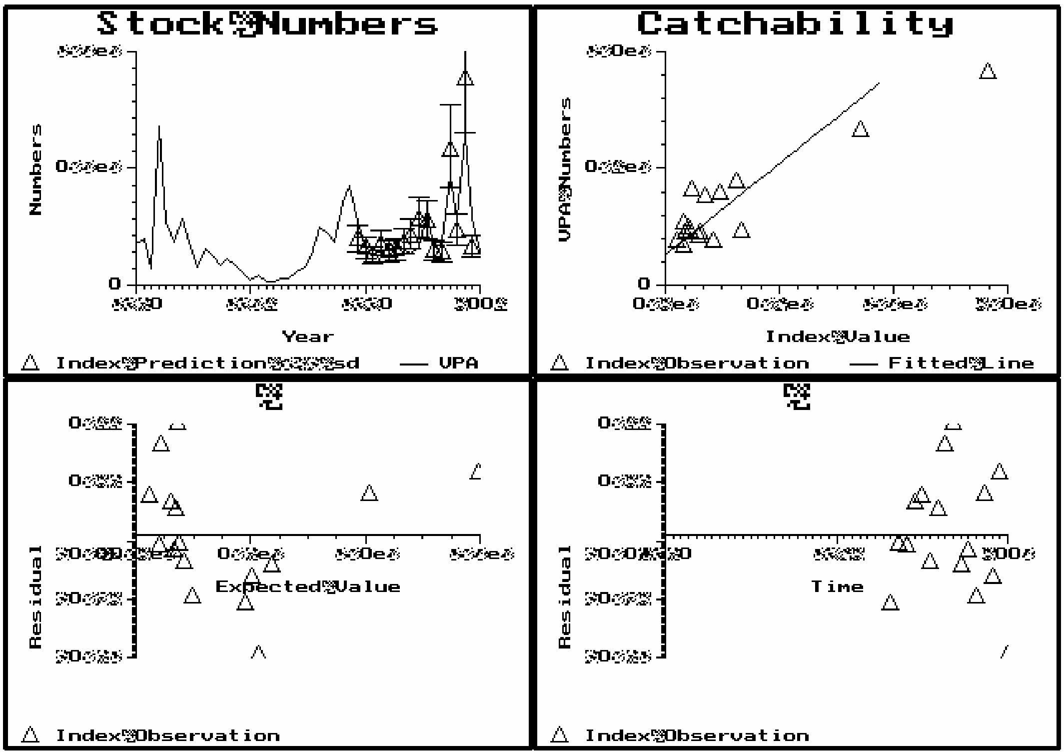


Figure 2.6.2.6. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 2-ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 2-ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

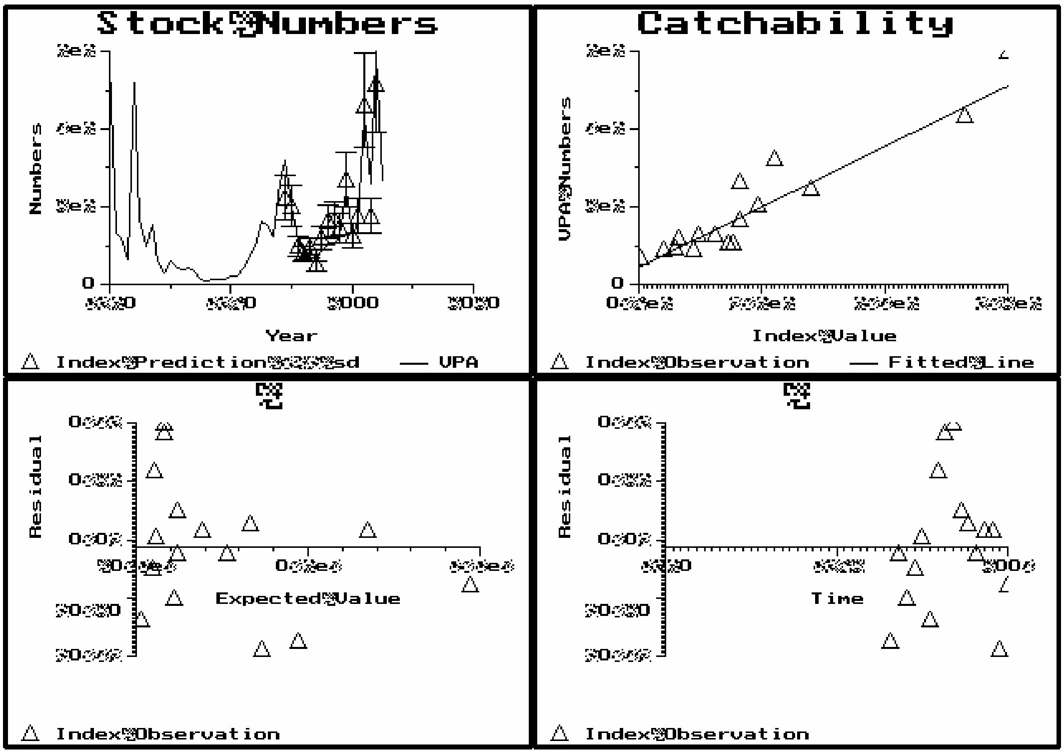


Figure 2.6.2.7. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 3-ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 3-ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

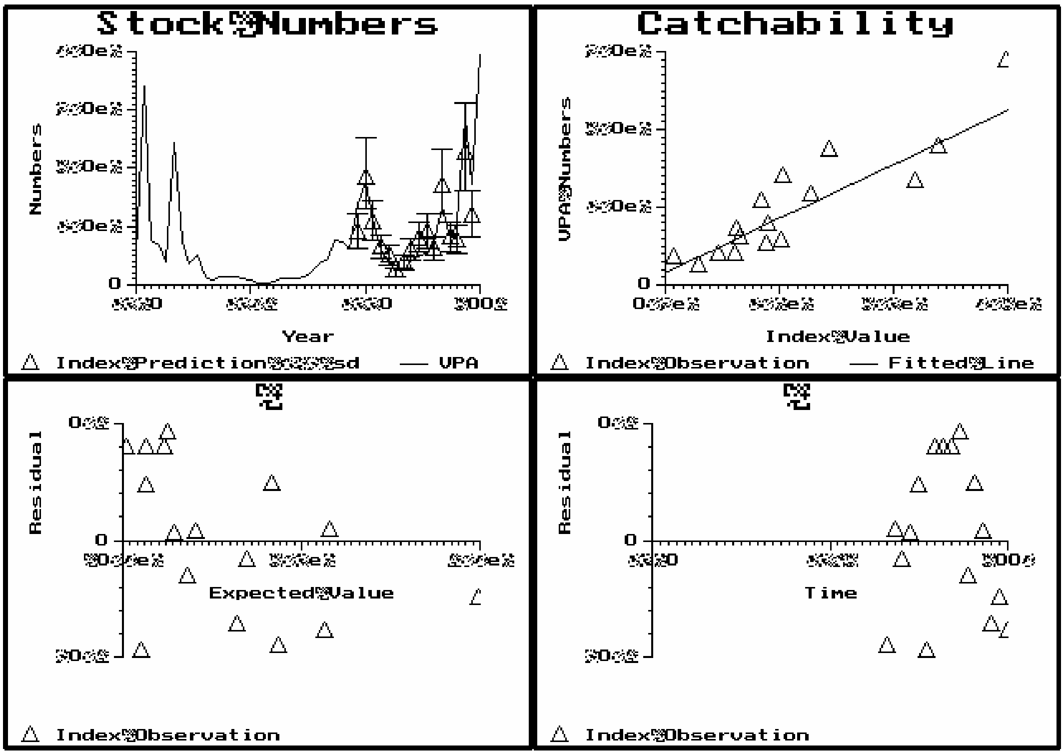


Figure 2.6.2.8. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 4 ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 4 ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

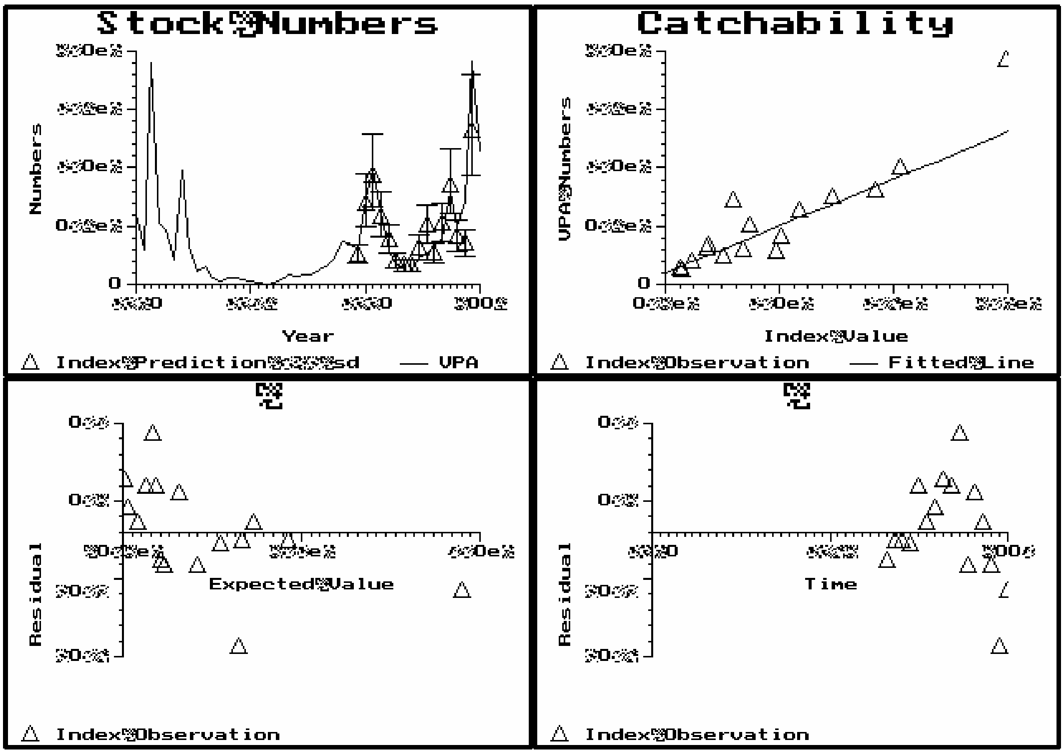


Figure 2.6.2.9. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 5 ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 5 ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

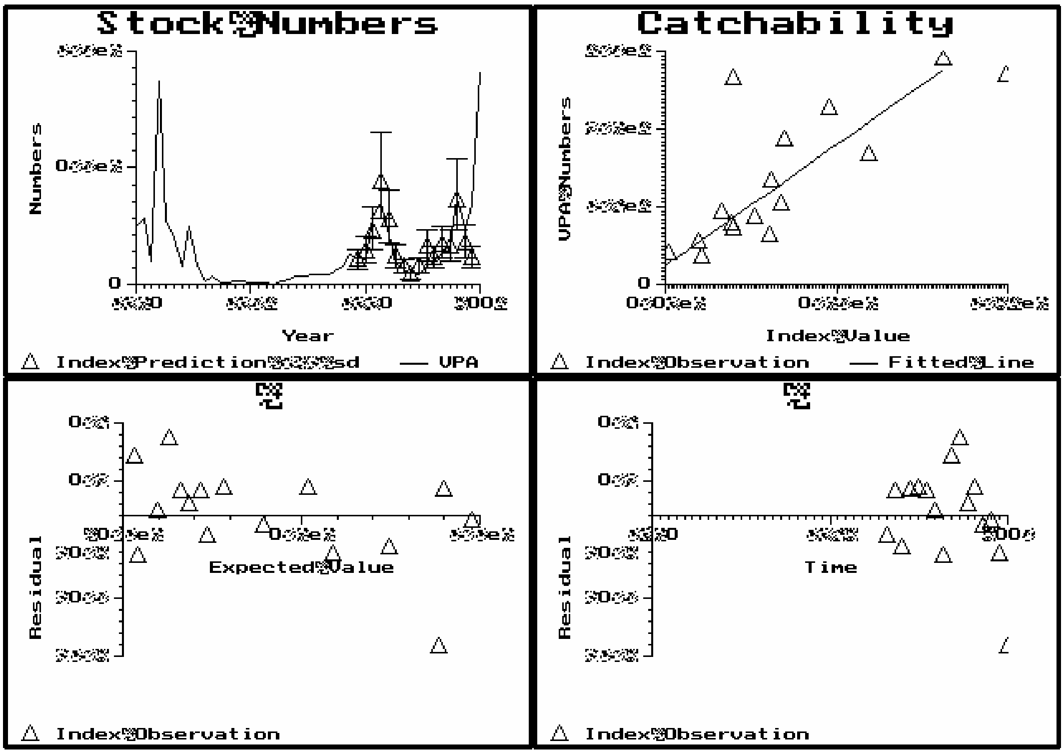


Figure 2.6.2.10. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 6 ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 6 ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

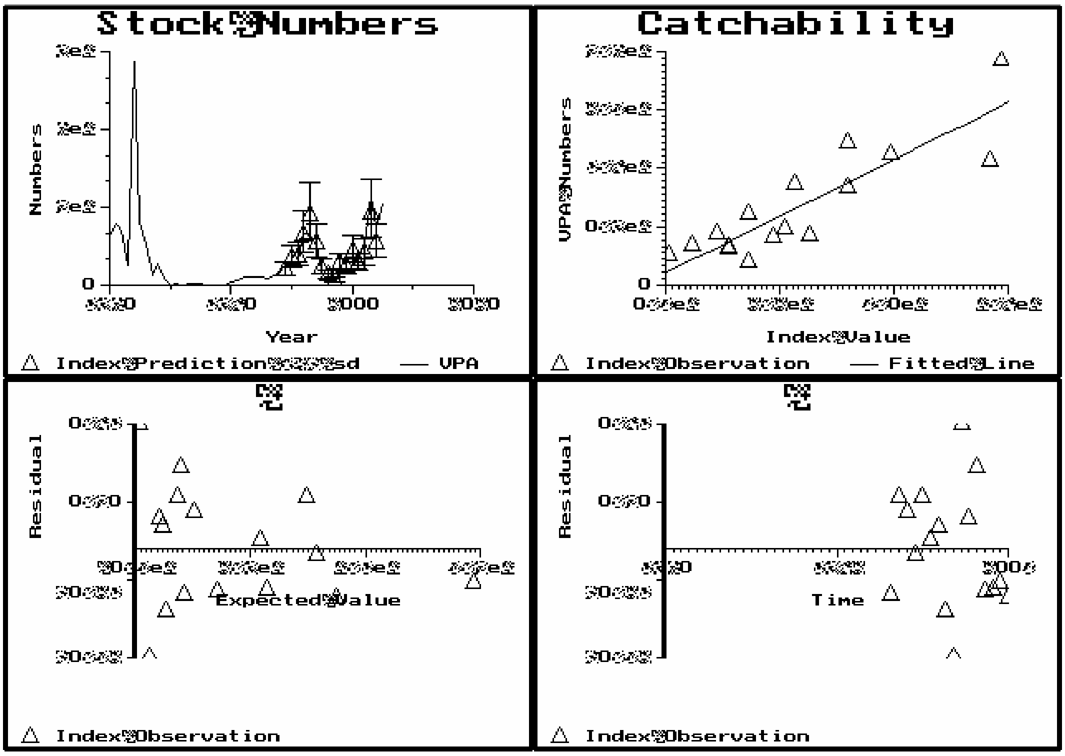


Figure 2.6.2.11. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 7 ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 7 ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

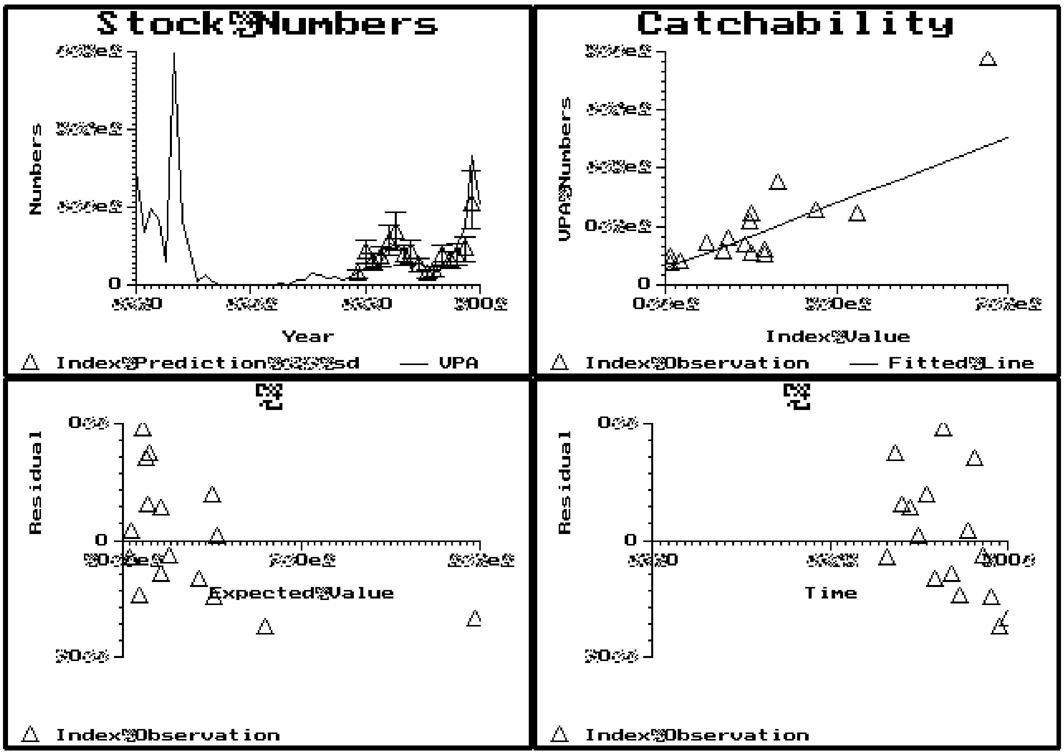


Figure 2.6.2.12. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 8 ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 8 ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

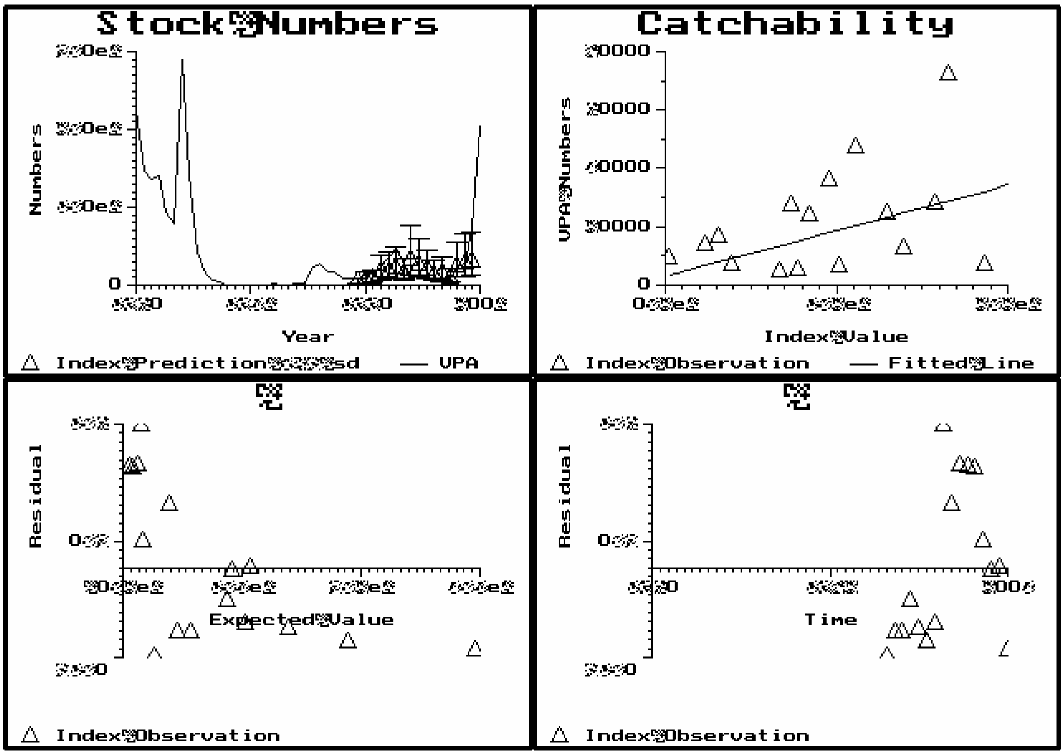


Figure 2.6.2.13. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 9 ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 9 ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

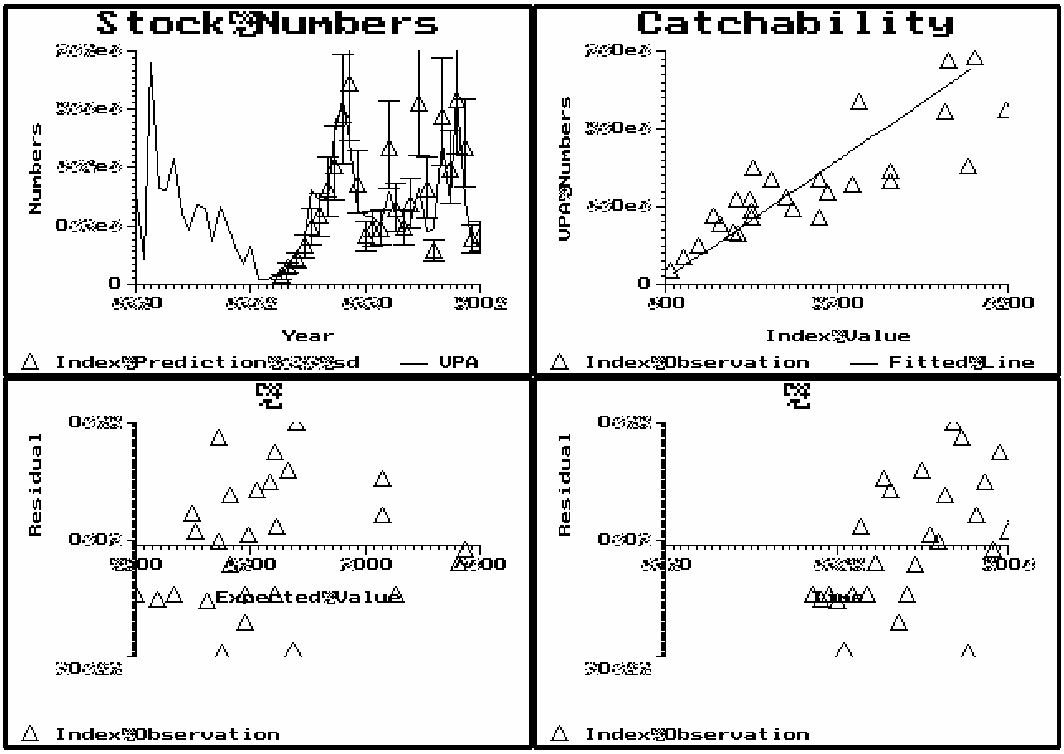


Figure 2.6.2.14. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 1 ring index against the IBTS surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 1 ringers in IBTS. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

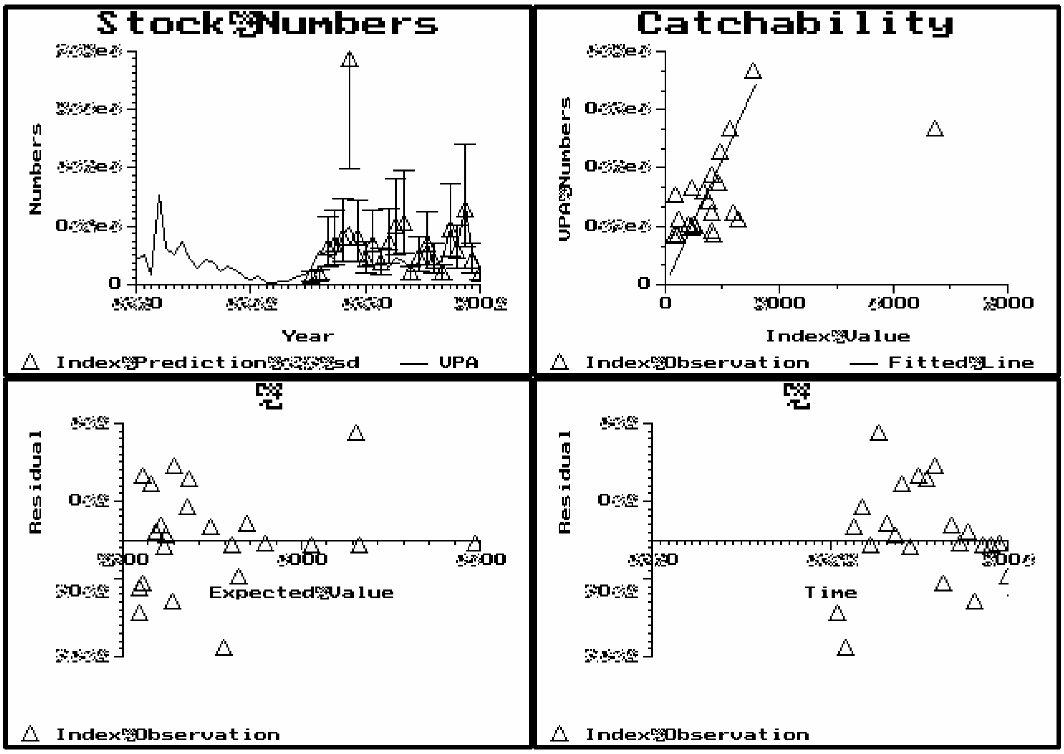


Figure 2.6.2.15. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 2 ring index against the IBTS surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 21 ringers in IBTS. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

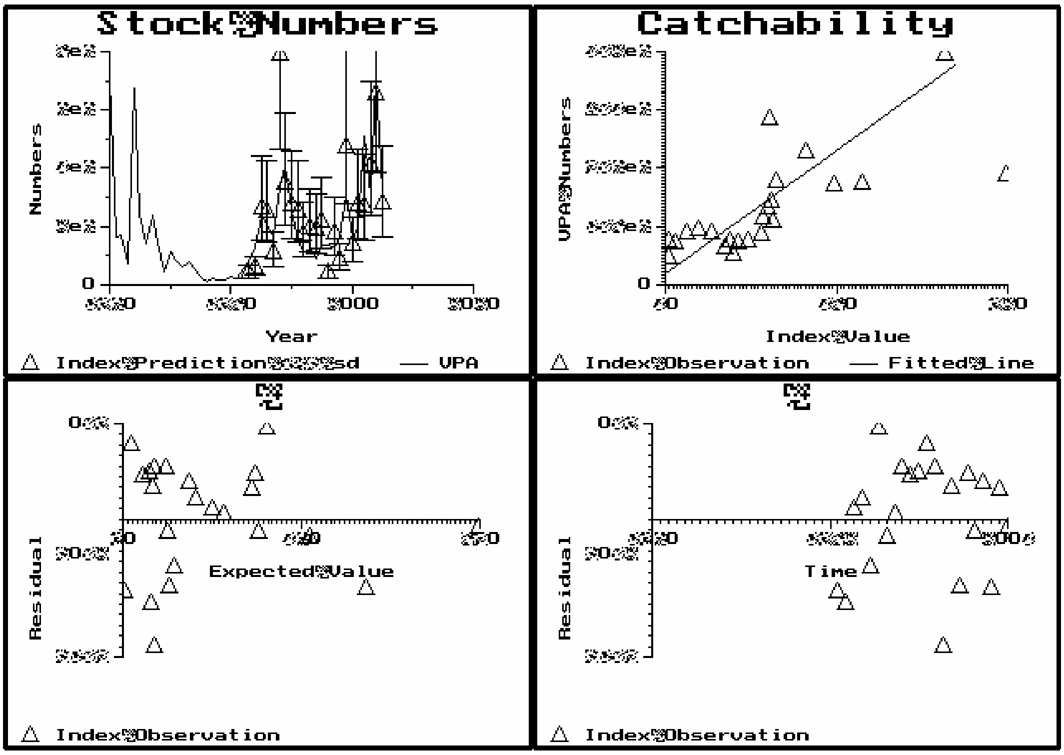


Figure 2.6.2.16. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 3 ring index against the IBTS surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 3 ringers in IBTS. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

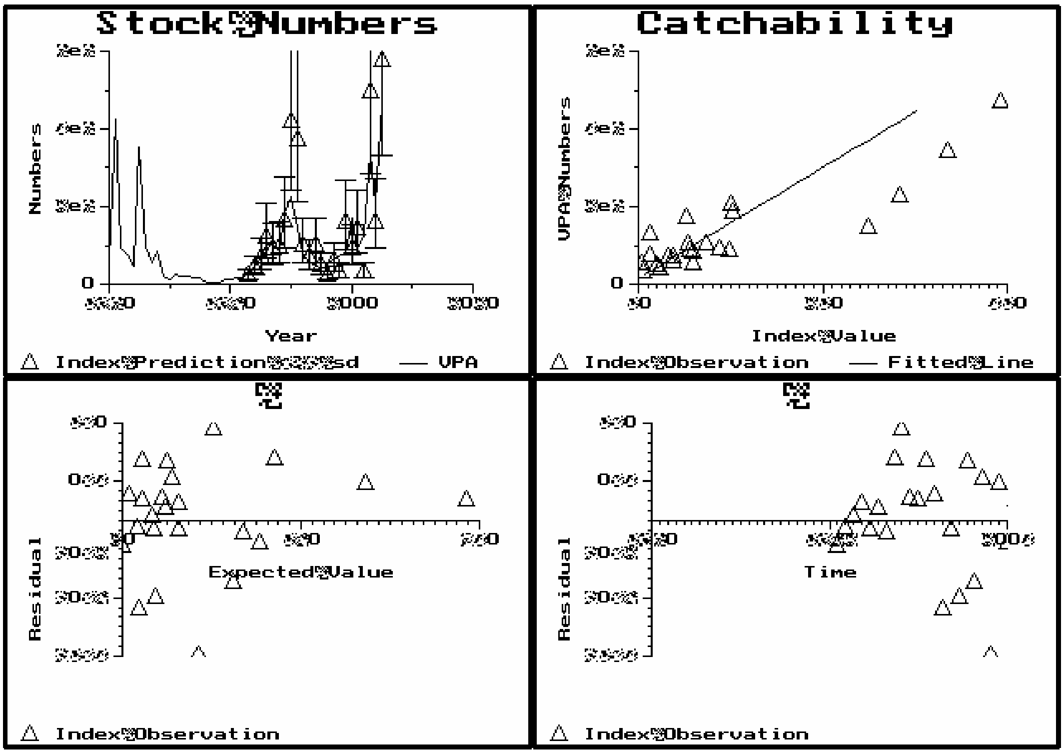


Figure 2.6.2.17. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 4 ring index against the IBTS surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 4 ringers in IBTS. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

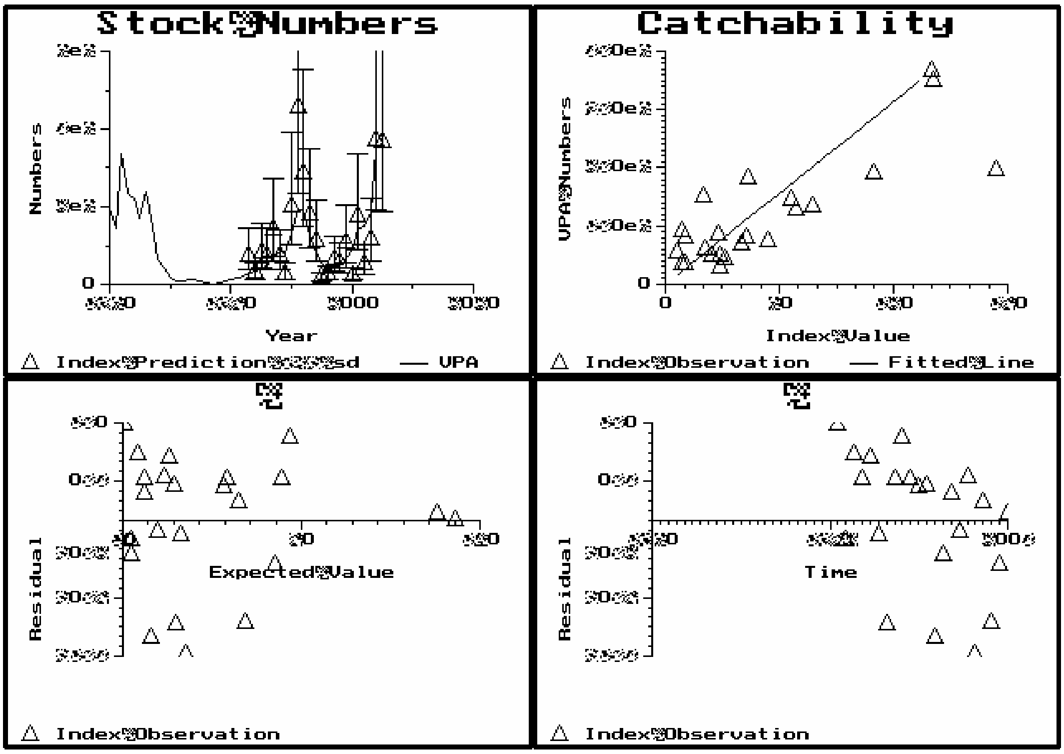


Figure 2.6.2.18. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 5 ring index against the IBTS surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 5 ringers in IBTS. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

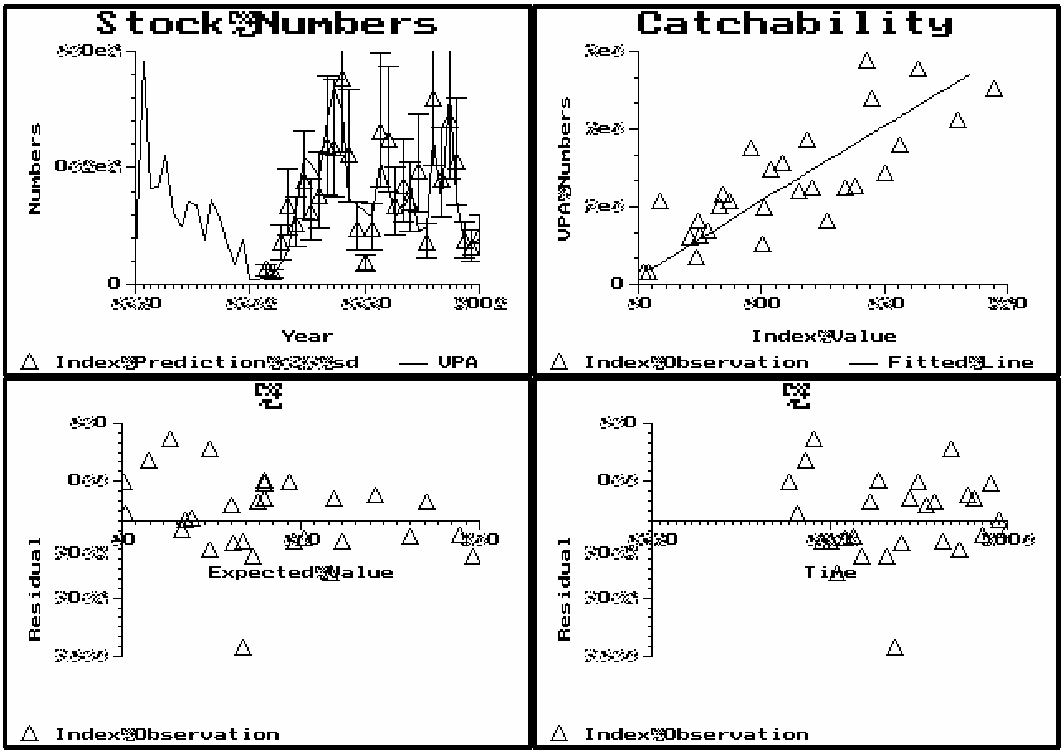


Figure 2.6.2.19. North Sea herring. Illustration of residuals from deterministic calculation (5-year separable period). Diagnostics of the fit of the 0 ring index against the MIK surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 0 ringers in MIK. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

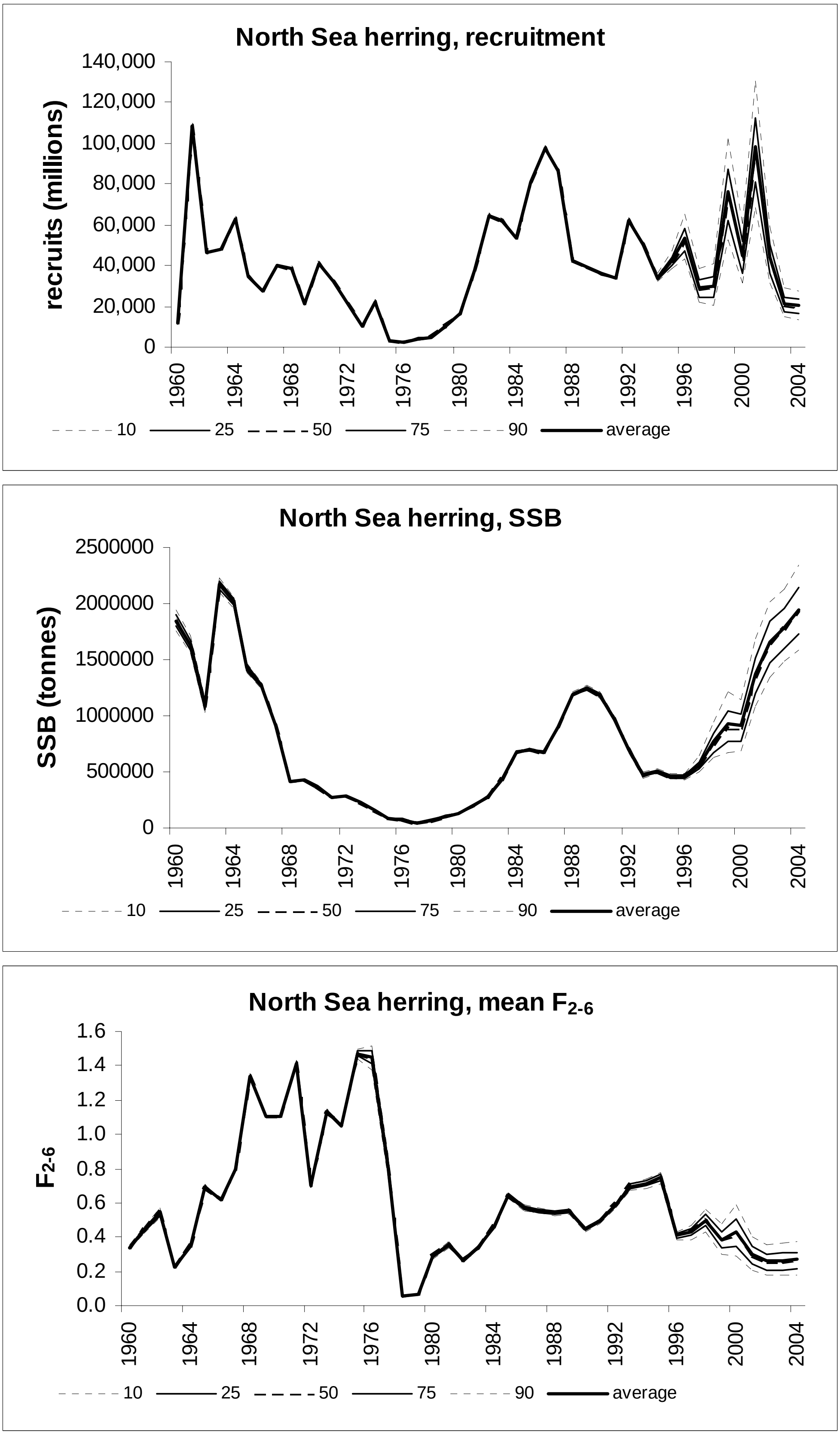


Figure 2.6.2.20. North Sea herring. Historic uncertainty in the final model fit (ICA assssment): recruitment, SSB and mean F2-6. Percentiles 10, 25, 50, 75 and 90%.

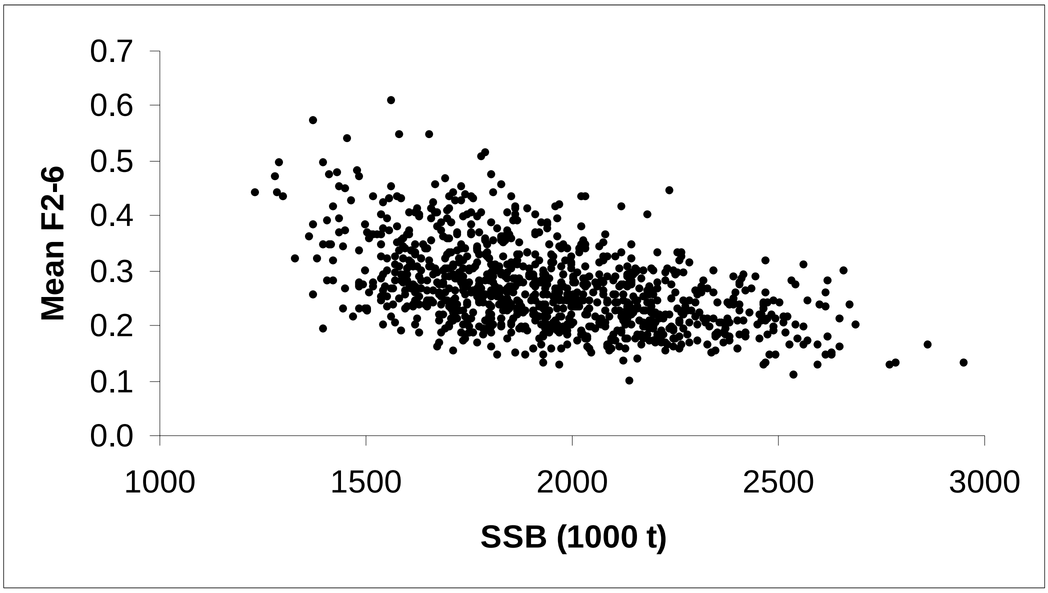


Figure 2.6.2.21. North Sea herring. Uncertainty in the final model fit (ICA assssment): mean F2-6 against SSB. See figure 2.10.1

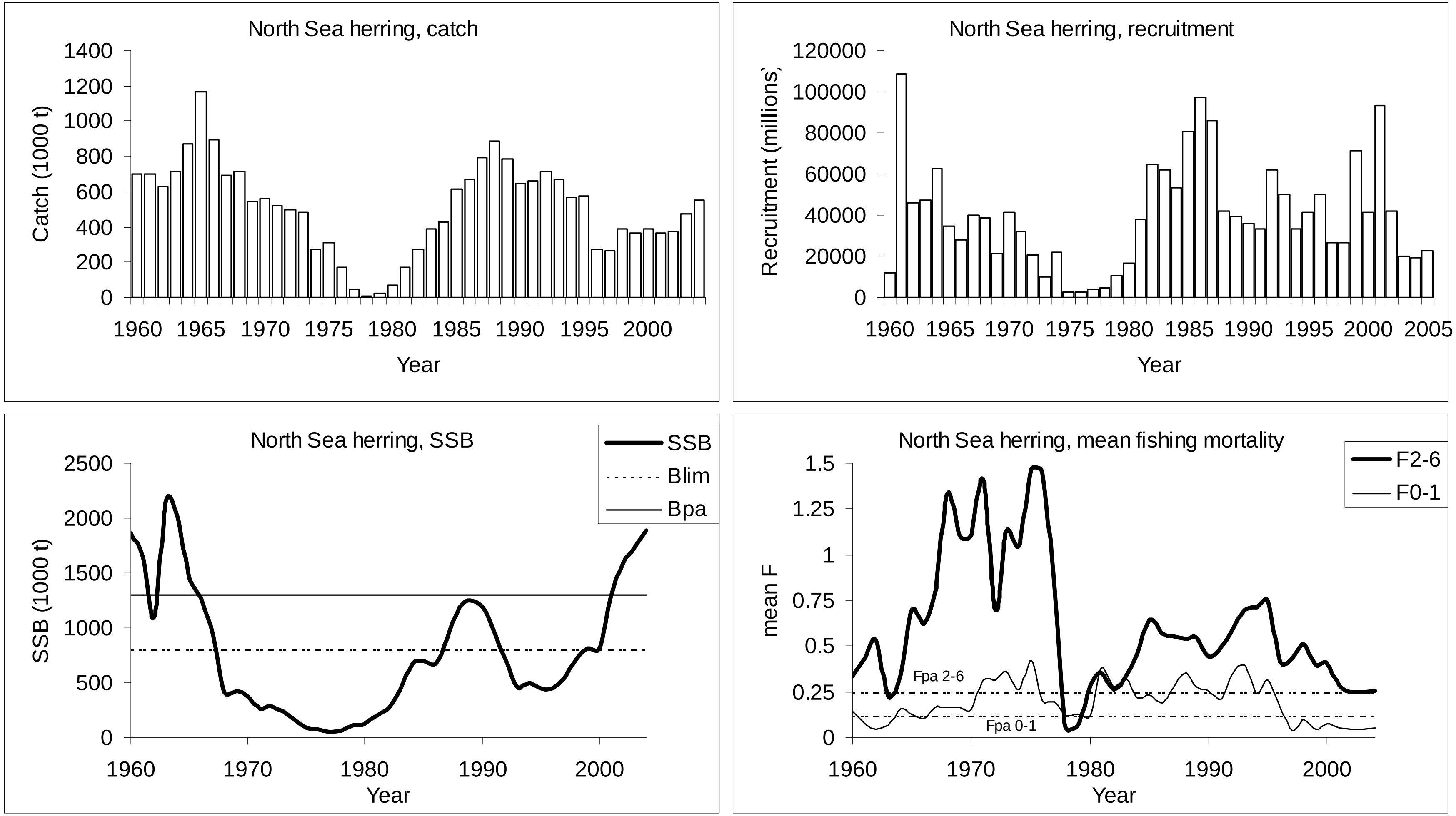


Figure 2.6.2.22. North Sea herring. Stock summary. Yield, recruitment at 0 wr, SSB and mean $F_{2\text{-}6}$ from current assessment.

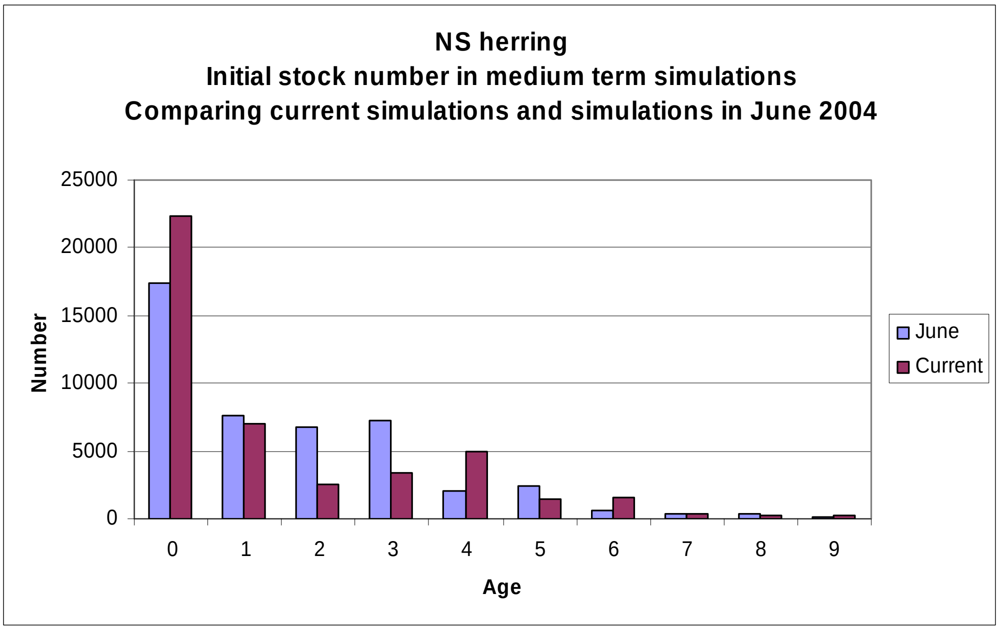


Figure 2.8.1
Comparison of the initial stock numbers used for evaluating harves control rules for the North sea herring in June 2004, and the numbers used in the current medium term predictions.

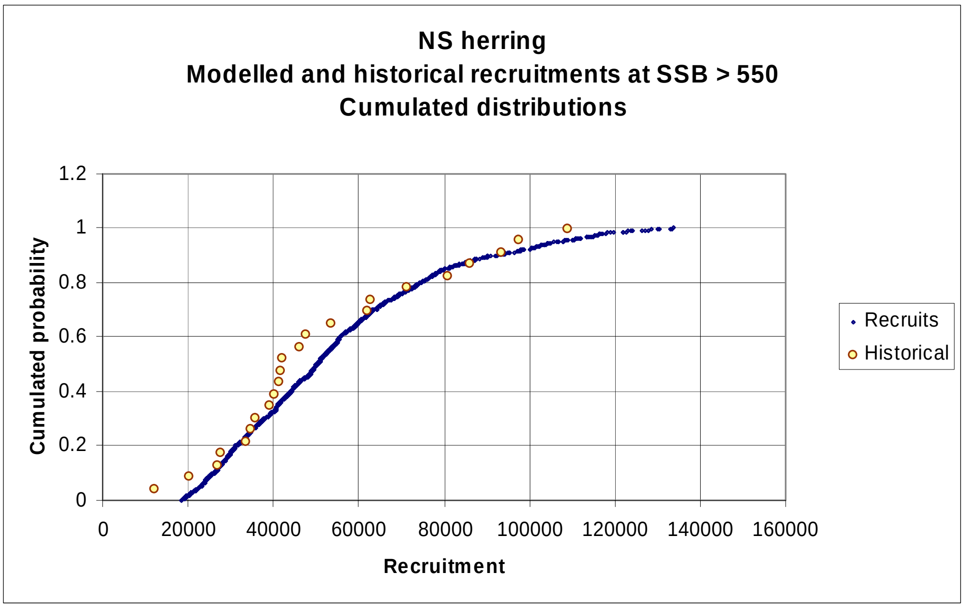
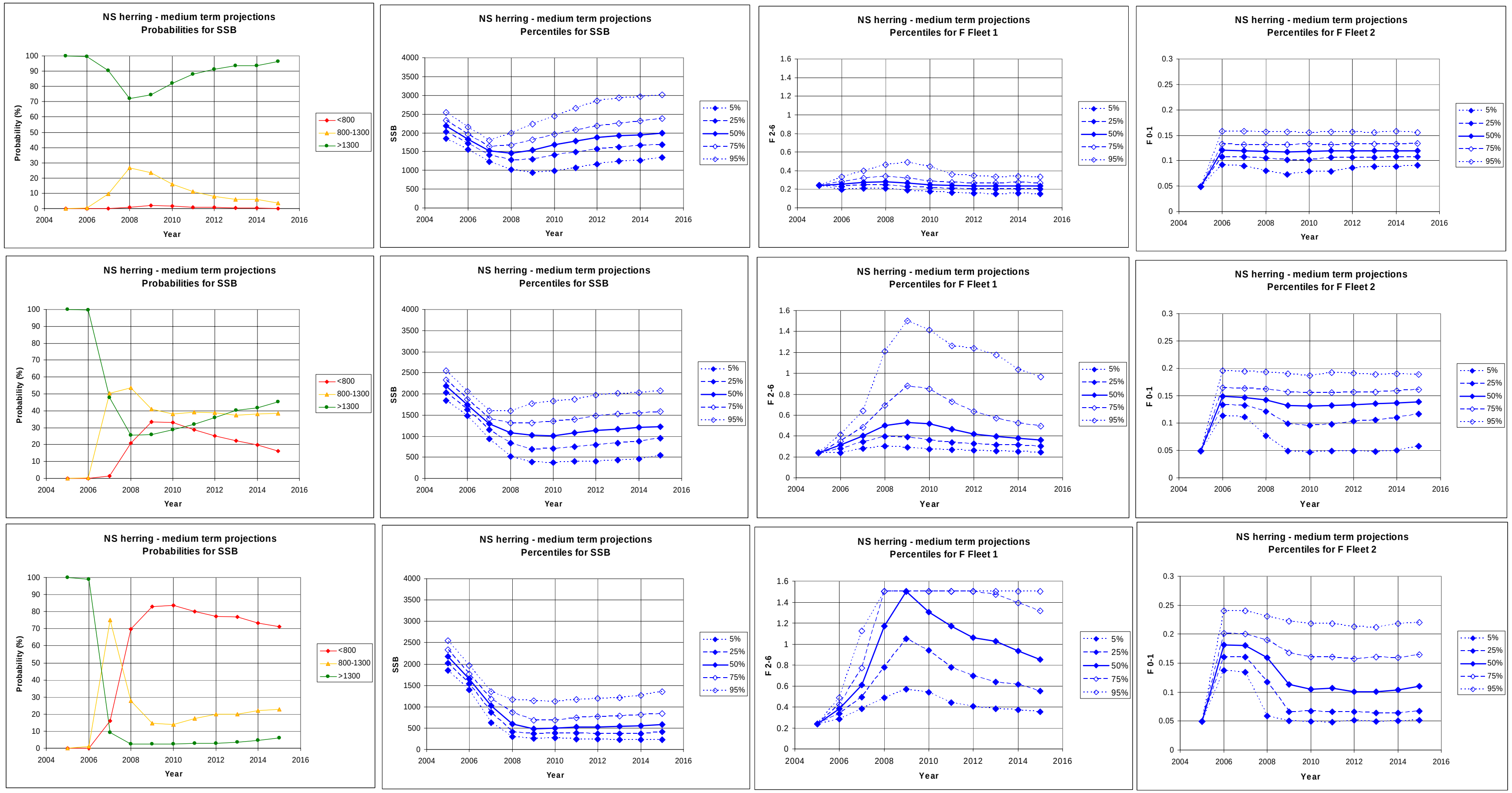


Figure 2.8.2
Comparison of recruitments generated by STPR and historical recrutiemtn values, at SSB > 550 000 tonnes.

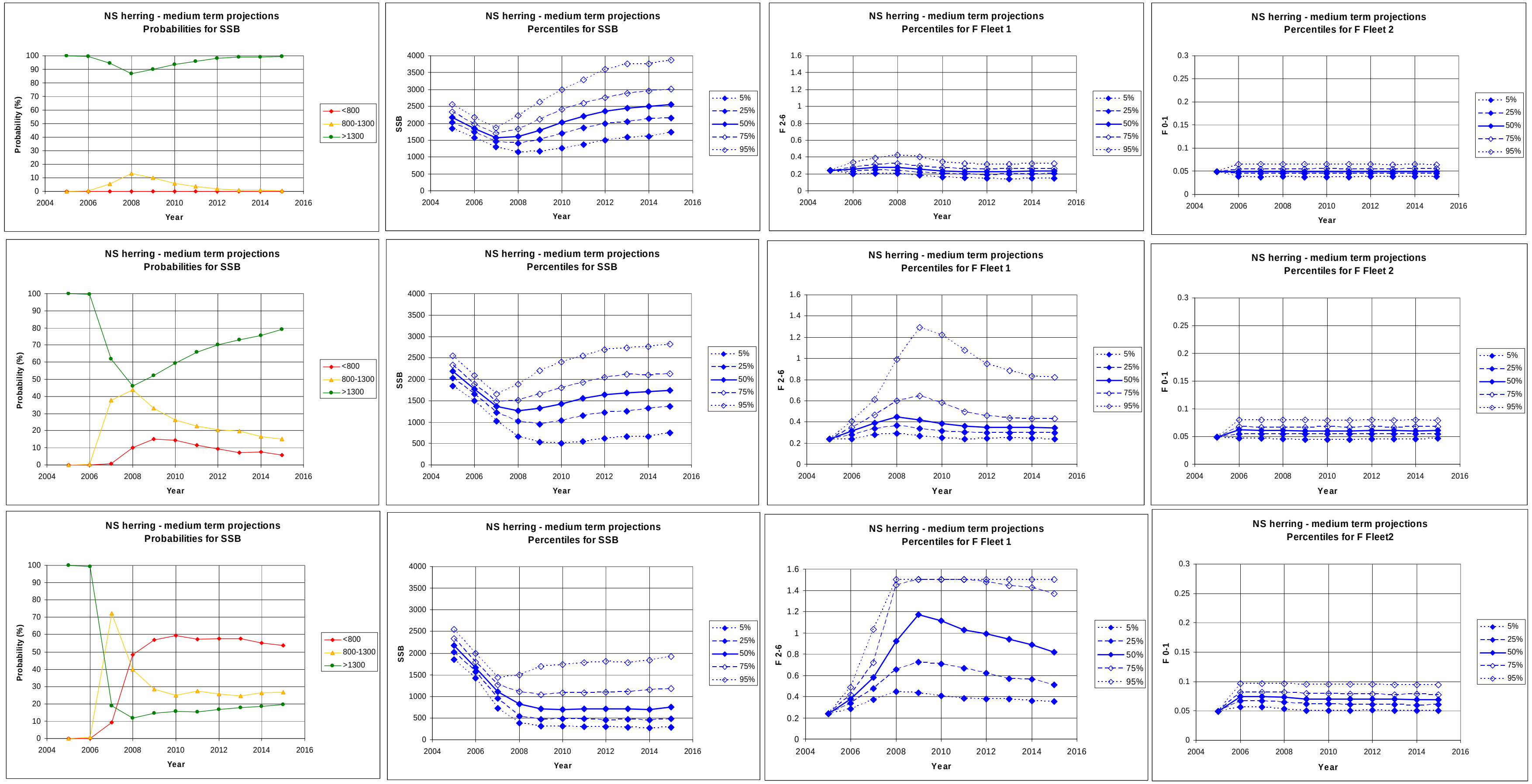


No deviation

10% bias
on both assessment
and implementation

20% bias
on both assessment
and implementation

Figure 2.8.3 a.
Results of medium term predictions for North Sea herring
Harvest rle applied as agreed, with different levels of assessment and implementation bias as indicated

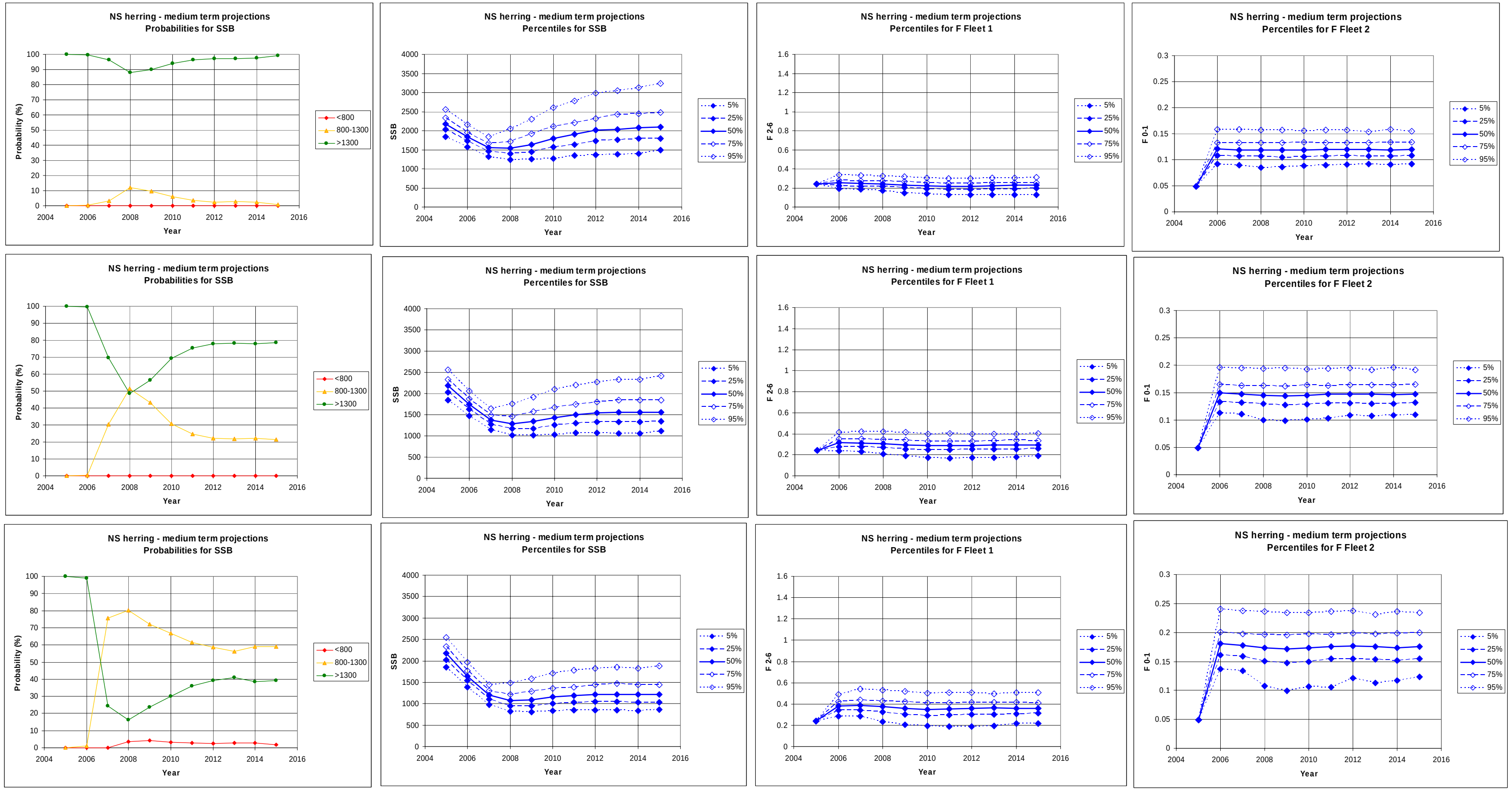


No deviation

10% bias
on both assessme
and implementati

20% bias
on both assessme
and implementati

Figure 2.8.3 b.
Results of medium term predictions for North Sea herring
Harvest rule applied as agreed, except for a lower F for fleet 2
Different levels of assessment and implementation bias as indicated



No deviation

10% bias
on both assessment
and implementation

20% bias
on both assessment
and implementation

Figure 2.8.3 c.
Results of medium term predictions for North Sea herring
Harvest rule applied as agreed, except for no constraint on reduction of TAC.
Different levels of assessment and implementation bias as indicated

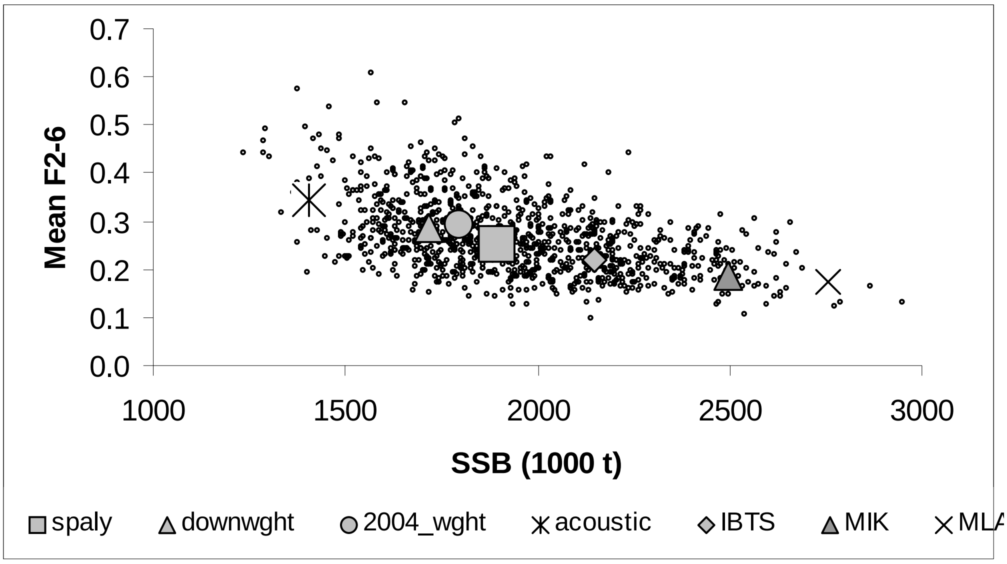


Figure 2.10.1 North Sea herring, Scatter plot from bootstrap of variance covariance matrix from ICA assessment and the point values from the runs used in data exploration (see section 2.6.1)

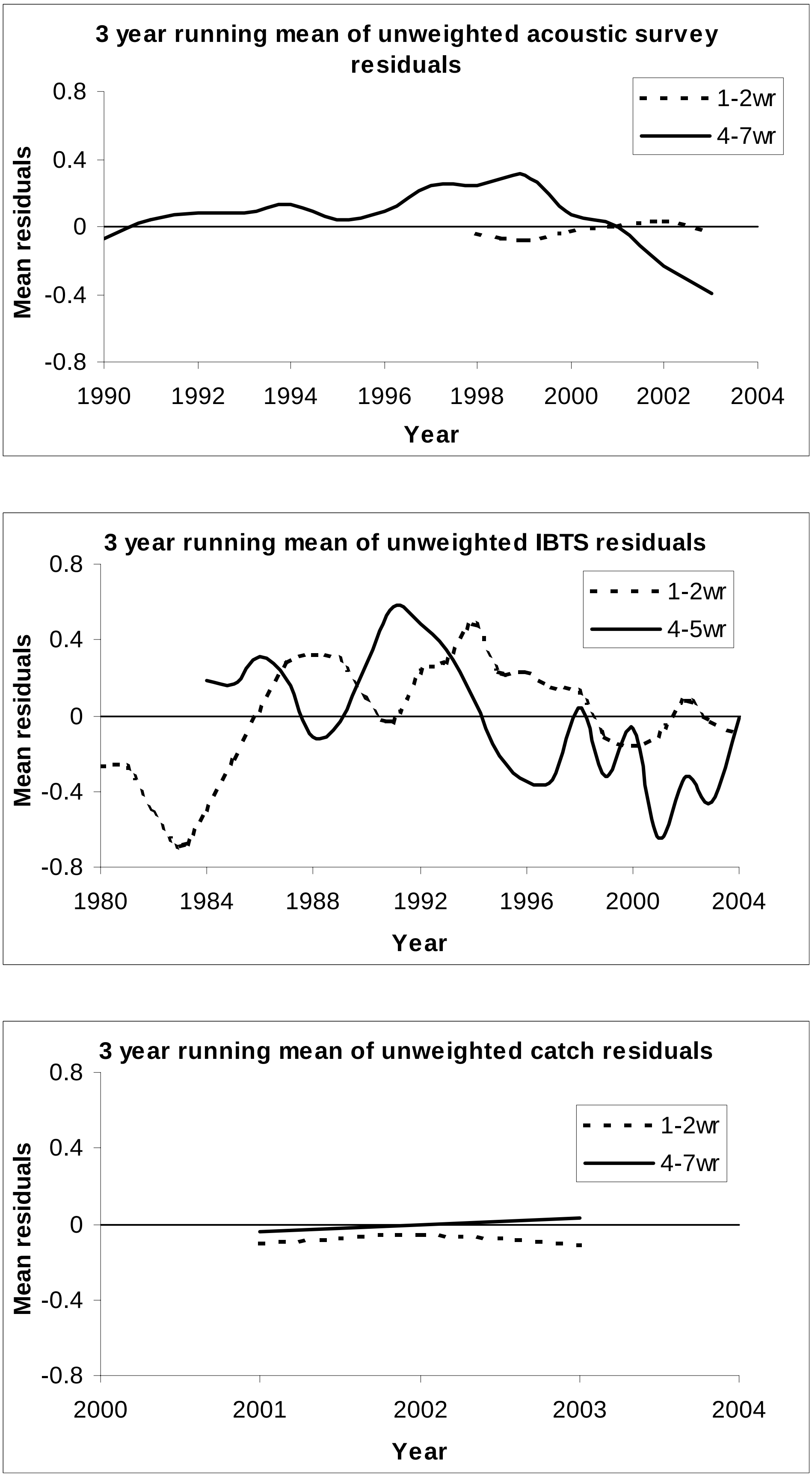
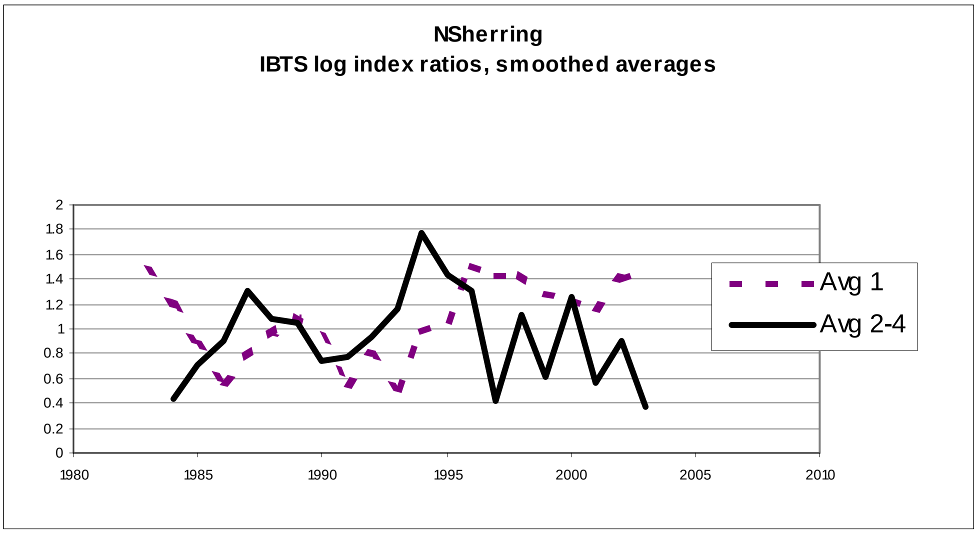
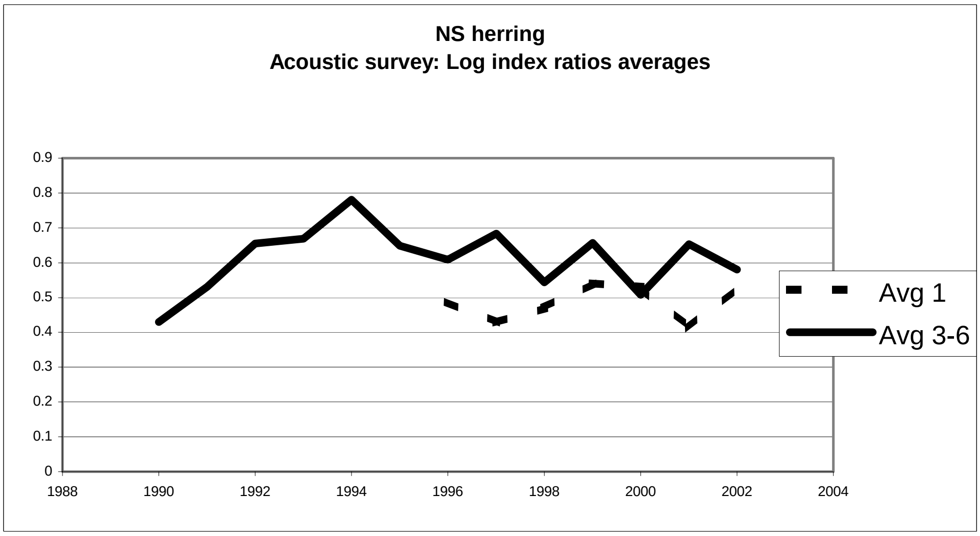


Figure 2.10.2 North Sea herring, trends in residuals at age in the ICA model. Averages over 3 years for ages 1 & 2wr and 4-7wr





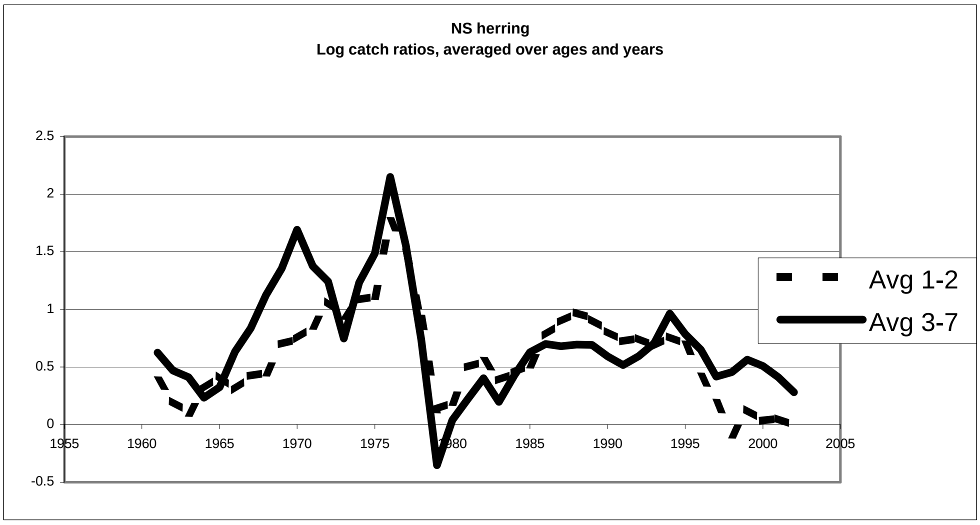
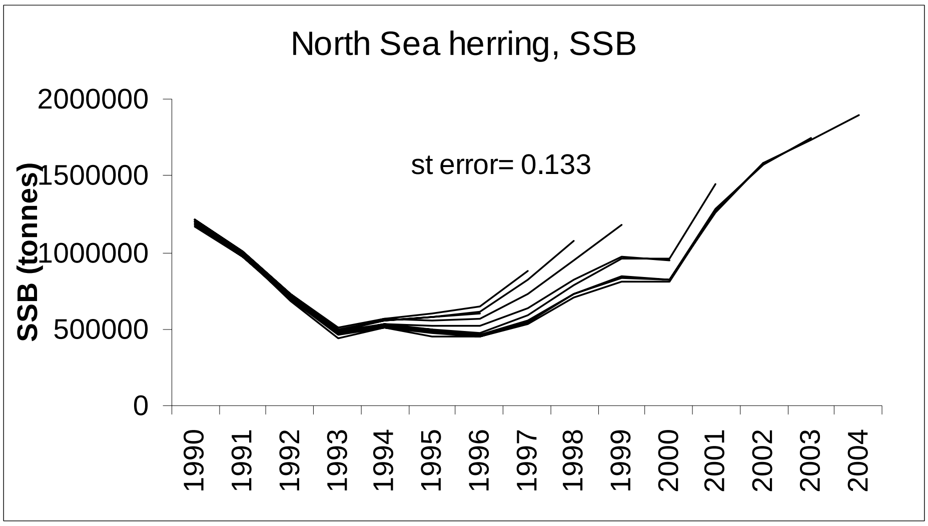
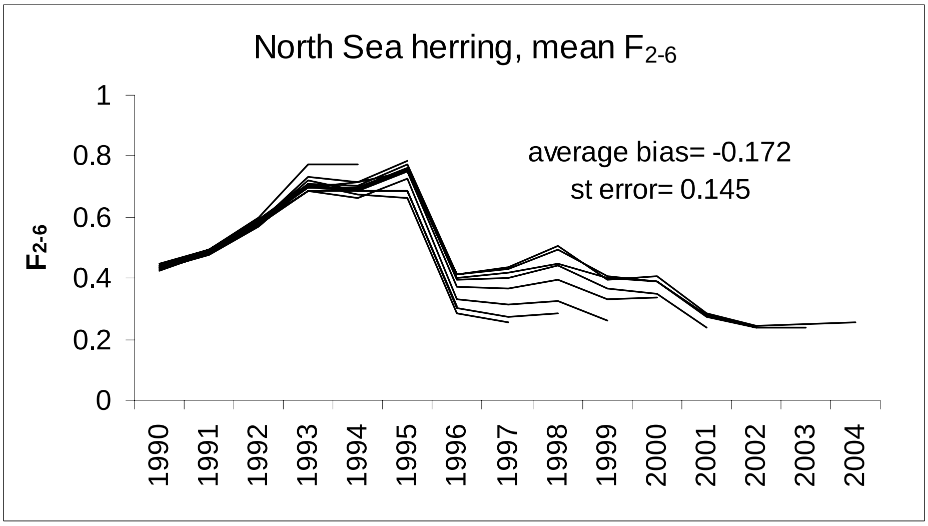


Figure 2.10.3 North Sea herring, log index ratios (IBTS and Acoustic surveys) and log catch ratios for ages 1-2 and 3-7 to illustrate the presence of different trends in mortality in the different data sources.





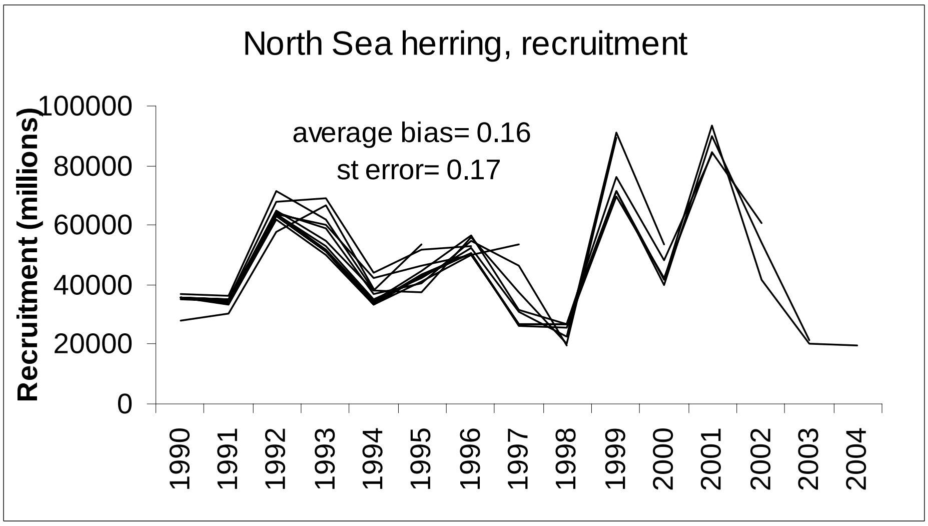


Figure 2.10.4. North Sea herring. Analytical retrospective analysis of final model fit (ICA) from 2004 to 1994. Showing recent consistency of estimation of SSB and F since 2000 with a period of poor estimation 1997 to 1999, following management change, with the estimates of 1994 and 1995 similar to current estimates.

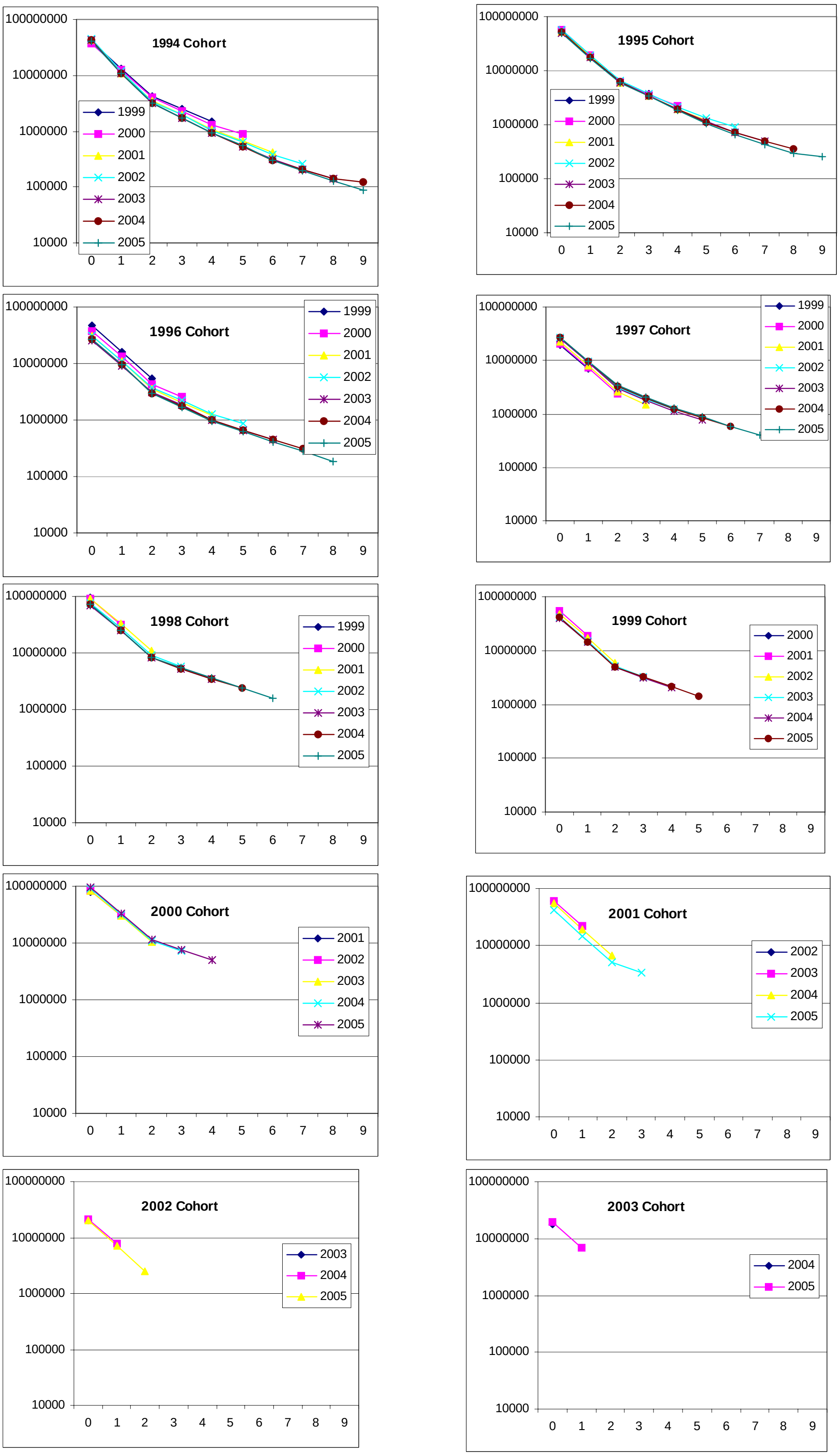


Figure 2.10.5 North Sea herring cohort retrospectives for 1995 to 2003 yearclasses from assessments in 1999 to 2005

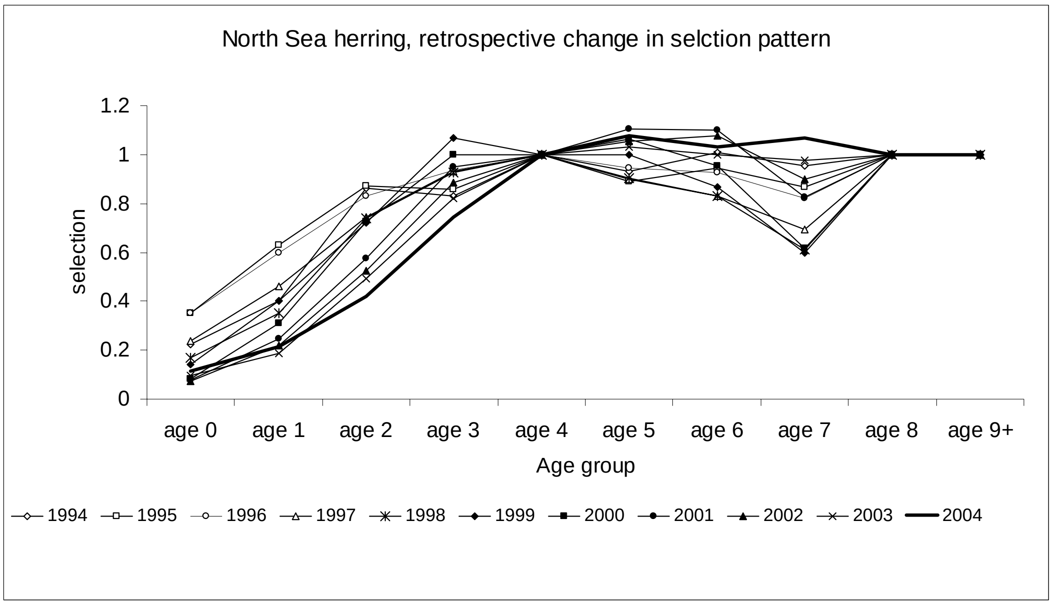


Figure 2.10.6. North Sea herring. Analytical retrospective analysis of selection pattern of final model fit (ICA) from 2004 to 1994.

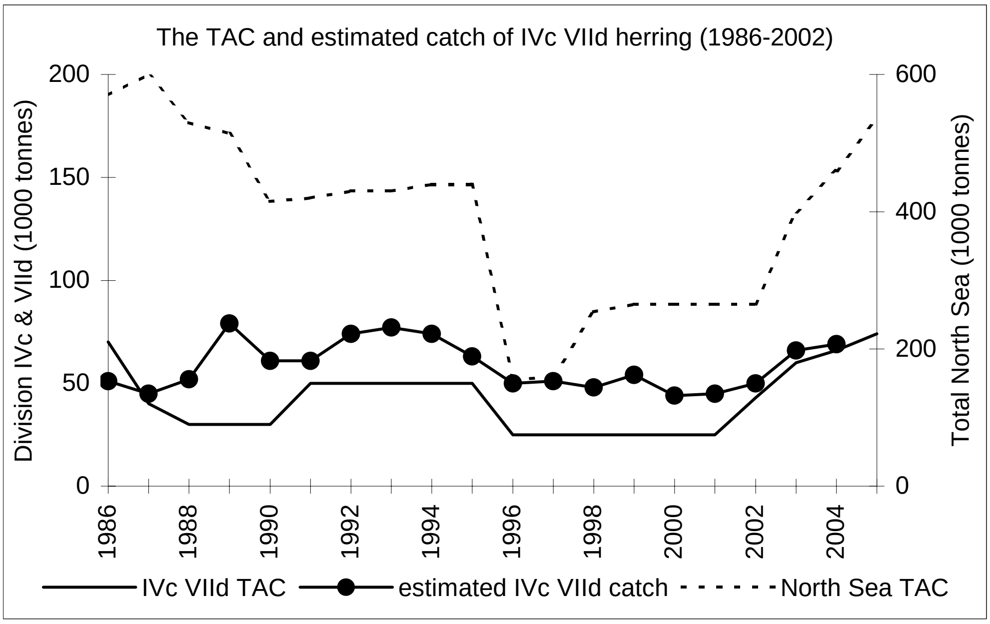


Figure 2.11.1. N orth Sea herring. TAC and catch of Downs herring and TAC for the whole north Sea stock (on another axis).

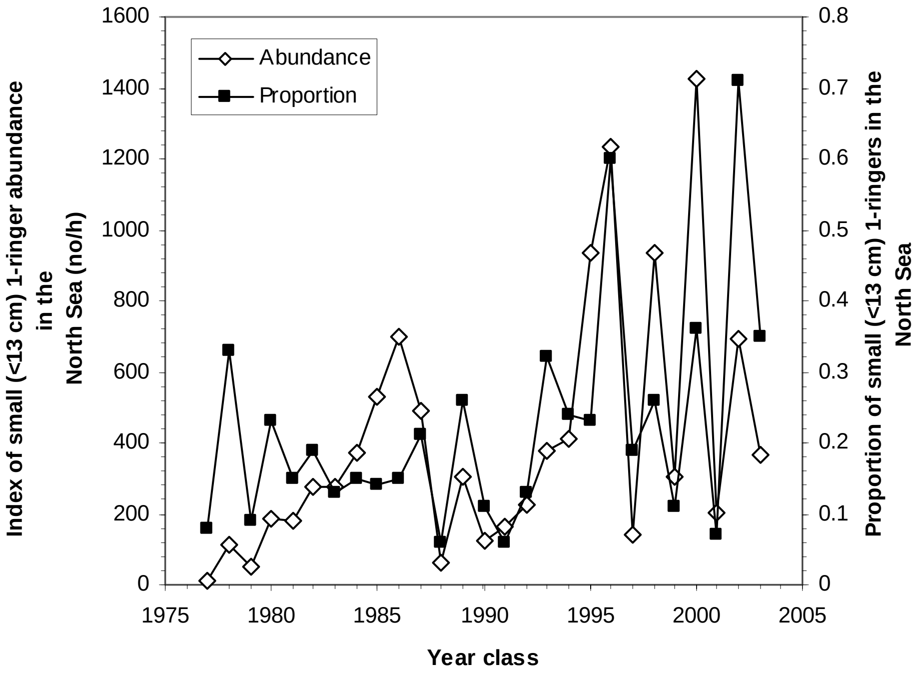
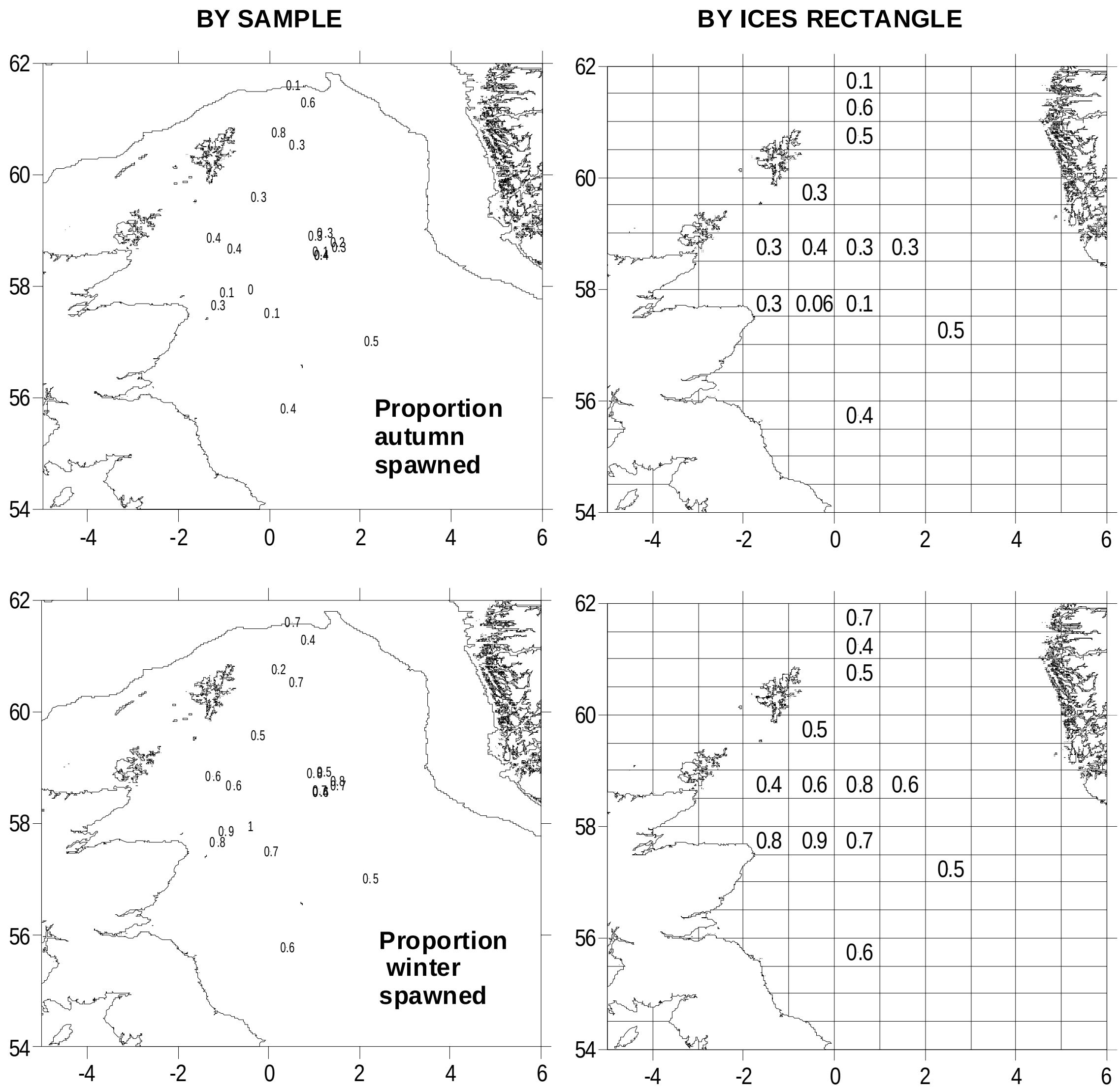


Figure 2.11.2 Downs Herring. Index (numbers per hour) of small (<13 cm) 1-ringers in the North Sea area, and proportion of small 1-ringers versus all sizes in the North Sea area. From Table 2.3.3.3



Note: the standard deviation between 6 samples within 1 ICES rectangle is 0.15.

Figure 2.11.3. North Sea herring. Proportion of herring by spawner origin within the sampled Dutch catch of North Sea herring in May to July 2004.

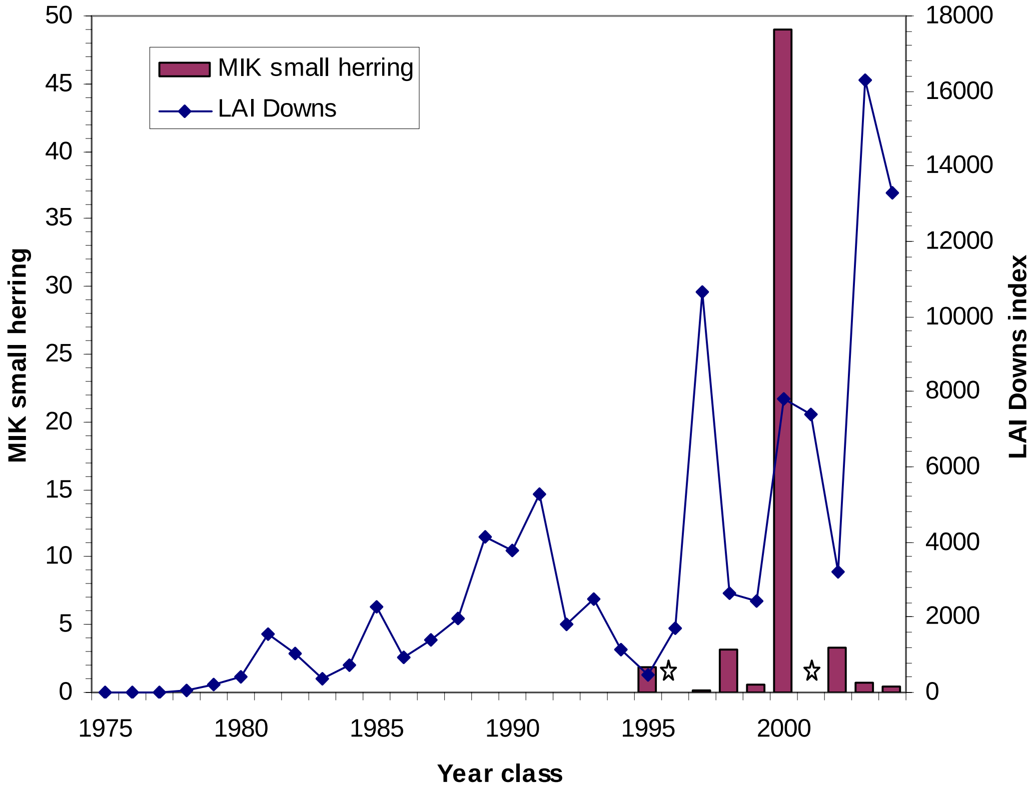


Figure 2.11.4 Downs herring. Larval Abundance Index (LAI) in the Channel area (line), calculated as mean of surveys per year class 1975-2004, and preliminary MIK survey results in the Channel (bars) (early spring 1995-2004). Stars denote no data.

3 Herring in Division IIIa and Subdivisions 22–24

3.1 The Fishery

3.1.1 ACFM advice and management applicable to 2004 and 2005

At the ACFM (May) meeting in 2004, it was stated that the status of the stock is unknown relative to safe biological limits, because reference points have not been determined. Although the assessment is uncertain SSB has been slightly increasing over the last four years. Fishing mortality is uncertain, but estimates for 2003 are 0.38 for adults and 0.12 for juveniles (0- and 1- ringers), which is slightly greater than $\mathbf{F}_{max}$.

ACFM recommended that since the current fishing mortality has lead to a stable or increased SSB, the fishing mortality should not be allowed to increase. This would correspond to catches in 2005 less than 92,000 t. According to the recent geographic distribution of catches, approximately half of the total catches should be taken from Subdivisions 22-24.

The EU and Norway agreement on a herring TACs set for 2005 was 96,000 t in Division IIIa for the human consumption fleet and a by-catch ceiling of 24,150 t to be taken in the small mesh fishery.

In previous years the International Baltic Sea Fishery Commission (IBSFC) set no special TAC for sub-division 22-24. In 2005, a TAC was set for the first time on the Western Baltic area the stock component. The TAC for 2005 was set at 46,000 t.

3.1.2 Catches in 2004

Herring caught in Division IIIa are a mixture of North Sea autumn spawners (NSAS) and Western Baltic spring spawning herring (WBSS). This Section gives the landings of both North Sea autumn spawners and Western Baltic spring spawners, but the stock assessment applies only to the spring spawners.

Landings from 1985 to 2004 are given in Table 3.1.1. In 2004 the total landings decreased to 94,200 t in Division IIIa and Subdivisions 22–24 compared with 2003 where the landings were 109,500 t, resulting in a landing figure for 2004 at the lowest level for the whole time-series. In 2004, 20,500 t were taken in the Kattegat, about 31,700 t from the Skagerrak and 42,000 t from Subdivisions 22–24. These landings represent a decrease of 15,200 t compared to 2003 and 34,700 t compared to 2002. The Danish national management regime for herring and sprat fishery in Subdivision 22 was changed in 2002. It should be noted that the total landings for fishery in Skagerrak have been updated for 1995-2001 because of Norwegian misreporting of landings taken in the North Sea and reported to Skagerrak. This was also delt with in 2002 and 2003 but was not thought to occur in 2004.

The German landings in 2004 were at the same level as in 2003. Since 2001 the fishery behaviour changed in the German fleet. In former years the dominant part of herring was caught in the passive gears, gillnets and trapnets. The share of herring, which was caught by trawlers in the area off the Rügen Island coast up to the Arcona Sea (Subdivision 24), increased from 26% in 2001 to 52% in 2004. This change was caused by new requirements for a new fish factory on Rügen Island. This factory expects to process 50,000 t per year and started during autumn 2003.

In 2004 the landing data are calculated by fleet according to the fleet definitions used when setting TACs.

The fleet definitions used since 1998 are:

- **Fleet C**: directed fishery for herring in which trawlers (with 32 mm minimum mesh size) and purse seiners participate.
- **Fleet D**: All fisheries in which trawlers (with mesh sizes less than 32 mm) and small purse seiners, fishing for sprat along the Swedish coast and in the Swedish fjords, participate. For most of the landings taken by this fleet, herring is landed as by-catch. Danish and Swedish by-catches of herring from the sprat fishery and the Norway pout and blue-whiting fisheries are listed under fleet D.
- **Fleet F**: Landings from Subdivisions 22–24. Most of the catches are taken in a directed fishery for herring and some as by-catch in a directed sprat fishery.

In table 3.1.2 the landings are given for 2001 to 2004 in thousands of tonnes by fleet and quarter.

3.2 Biological composition of the catch

The level of sampling of the landings for human consumption and the industrial landings was generally acceptable in the Skagerrak and Kattegat and Subdivisions 22-24. Where sampling was missing in areas and quarters on national landings, sampling from either other nations or adjacent areas and quarters were used to estimate catch in numbers and mean weight-at-age (see Table 3.2.17).

Table 3.2.2 and Table 3.2.3 show the total catch (autumn and spring spawners) in numbers and mean weight-at-age for herring by quarter and fleet landed from Skagerrak and Kattegat, respectively. The total numbers and mean weights-at-age for herring landed from the Kattegat, Skagerrak and Subdivisions 22 - 24 by fleets are shown in Table 3.2.10.

Based on the proportions of spring- and autumn spawners (see Section 3.2.1 and Section 3.2.2) in the landings, number and mean weights by age and spawning stock are calculated. The total numbers and mean weight of the NSAS landed from Kattegat and Skagerrak by quarter and fleet is shown in Table 3.2.4 and 3.2.6. The total numbers and mean weight of the WBSS landed from Kattegat and Skagerrak by quarter and fleet are shown in Table 3.2.5 and 3.2.7.

The total numbers and mean weight of the NSAS by quarter and fleet landed from Division IIIa are shown in Table 3.2.8 and the WBSS in Table 3.2.9.

The total catch in numbers of WBSS in Division IIIa and the North Sea are shown in Tables 3.2.11 and 3.2.12 (see also Tables 2.2.1 – 2.2.5). The landings (SOP) of the WBSS taken in Division IIIa and the North Sea in 2004 were estimated to be about 35,078 t (Table 3.2.15) compared to about 37,075 t in 2003 and 53,544 t in 2002. This slight decrease in landings (SOP) was mainly due to a decrease in the estimated number of 1 group spring spawners in Skagerrak and Kattegat. The landings (SOP) of NSAS in Division IIIa amounted to 24,214 t compared to 32,498 t in 2003 and 26,205 t in 2002 (Table 3.2.13). The total catch in number and mean weight-at-age of WBSS in the North Sea, Division IIIa and in Subdivisions 22–24 for 1991–2004 are given in Tables 3.2.14 and 3.2.15.

3.2.1 Quality of Catch Data and Biological Sampling Data

Misreporting of fishing area still occurs. There is uncertainty about where the Danish landings for human consumption, reported from Division IIIa were actually taken. There is a high probability that these catches have been taken in the North Sea. Therefore, these catches have been transferred to the North Sea. The Norwegian landings reported as having been taken in Skagerrak for the period 1995 to 2003 may have been caught in the North Sea and have been transferred to the North Sea. However, due to changes in the Norwegian management the catches reported from Skagerrak in 2004 are reliable. Some landings, reported as taken in this triangle, (an area in the southern Kattegat, which is a part of the Baltic area: Gilleleje, DK - Kullen, S - Helsingborg, S - Helsingør, DK), may have been taken outside this area. These landings are listed under Kattegat.

No estimates of discards were available to the Working Group. The amount of discards for 2004 is regarded as being insignificant.

Sampling for species composition in the small-meshed fishery has been carried out as in previous years. Sampling in this section only refers to sampling for length, weight and age information.

Table 3.2.16 show the number of fish aged by country, area, fishery and quarter. The total landings from Division IIIa and Subdivisions 22-24 were 94,200 t from which 352 samples were taken, 34,581 fish were measured and 18,611aged. For comparison, for 2003 where 109,500 t were landed from which 292 samples were taken, 30,500 fish measured and 14,800 fish aged.

Although the overall sampling more than meets the recommended level of one sample per 1000 t landed per quarter, there is an unequal coverage of some areas and times of the year.

There is an unknown effect of variability in the stock composition in Division IIIa due to uncertainty of the splitting factor between the NSAS and the WBSS. There is at present no information about the relevance of local herring stocks in relation to the fisheries (i.e. the Kattegat autumn spawners and the Skagerrak winter or spring spawners) and their possible influence on the stock assessment. Recent evidence from genetic differentiation among spawning aggregations in the Skagerrak suggests a potential high representation of these local spawning stocks (see section 1.4.4).

3.2.2 Stock composition in the catch

Catches of herring in the Kattegat, the Skagerrak and the Eastern part of the North Sea are taken from a mixture of two main spawning stocks mainly 1+ ringers of the Western Baltic spring spawners and 0-2-ringers from the North Sea autumn spawners, including winter-spawning Downs herring (see stock annex). As in recent years the WG uses the analysis of individual otolith microstructure for determination of spawning type in age-class stratified random sub-samples of herring in Division IIIa (see stock annex).

For the present year the otolith-based method has been exclusively applied for the Division IIIa split. For Subdivisions 22, 23 and 24 it was assumed that all individuals caught belong to the WBSS stock, even when otolith microstructure indicate occurrence of autumn spawners in the surveys or in samples of landings (see stock annex).

Sampling levels in 2004 were high enough to allow the split to be applied to their respective spatial and temporal origin without reallocating between the landings and the surveys or between areas or quarters. Sampling of individual older age classes is generally scarce and analyses were pooled in combined age groups to achieve at least 12 individual otolith microstructure estimates per age group (Table 3.2.1).

3.2.2.1 Spring-spawning herring in the North Sea

Catches from the transfer area within Subdivision IVa East and Division IVb are usually split by analyses of Norwegian samples (see Figure 2.2.2). Norwegian samples were only available for herring caught in the 2nd quarter. For 1-ringers it was assumed that all fish were autumn spawners. For 2-ringers, 3-ringers, and 4+-ringers, mean vertebral counts in the transfer area were used (see stock annex). For the 3rd quarter no Norwegian samples were available for landings from the transfer area and instead the otolith-based proportions from the Danish acoustic survey from the same area were applied to the age distributions. The quarterly age distribution and mean weight-at-age in Subdivision IVa East was applied to the catches of the second and third quarters in the transfer area. The numbers of spring spawners by age were obtained by applying the estimated proportion by age. For the actual split and catch in the transfer area see Section 2.2.2.

3.2.2.2 Autumn spawners in Division IIIa

For commercial landings in 2003 the split of the Swedish and Danish landings was conducted using the proportion by age in the combined samples of Swedish and Danish microstructure analyses. The estimation of the proportion spring and autumn spawners in the landings from Division IIIa was performed on the basis of totally 3489 (2674 Danish and 815 Swedish) otolith microstructure analyses in 2004. Data were disaggregated by area (Kattegat and Skagerrak), age group and quarter (1–4). The proportions and the analysed numbers are presented in Table 3.2.1. In the acoustic survey in quarter 2 and 3 in Division IIIa and VIa East, 1163 otoliths were analysed and applied for the split of this survey, 389 otoliths from the survey in the VIa East area were further used to split catches taken in the 3rd quarter in the transfer area (see section 3.2.2.1). In the 2004 Division IIIa IBTS survey in the 3rd quarter 226 otoliths were analysed and in the 2005 Division IIIa IBTS survey in the 1st quarter 192 otoliths were analysed.

3.2.2.3 Autumn spawners in the fishery in Subdivisions 22 to 24

All herring found in subdivisions 22-24 are treated as Western Baltic spring spawners independent of spawning type from otolith micro-structure analysis (see stock annex).

3.2.2.4 Accuracy and precision in stock identification

To test both precision and accuracy otolith microstructure analyses were compared among the three Danish readers on material from spawning populations sampled under the EU project HERGEN (QLRT – 2000 – 01370). Assuming that herring spawn during the same season in which they were hatched themselves, a high accuracy would imply a high correspondence between estimated spawning type and sampling season for the spawning populations (herring stage 6 maturity). Spawning season was initially estimated as either autumn, winter, or spring, but for the comparison autumn and winter were pooled into one group. Precision was estimated both as within reader repeatability and among reader correspondence. 168 otoliths were available in the analysis representing 63 spring and 105 autumn/winter spawners. Otoliths considered as unreadable by one or both readers were disregarded for that comparison, between 4 and 8 otoliths were dismissed in each comparison.

	SPRING	AUTUMN/WINTER		SPRING	AUTUMN/WINTER
Reader1 vs season	97%	100%	Reader1 vs Reader2	77%	89%
Reader2 vs season	80%	86%	Reader1 vs Reader3	100%	99%
Reader3 vs season	95%	100%	Reader3 vs Reader2	77%	92%

Reader 2 had an internal agreement between two reading of the same 50 otoliths of 81% and 93% on autumn/winter and spring spawners respectively, whereas reader 3 had 97% and 100% agreement on autumn/winter and spring spawners respectively. A generally high agreement was found between readers 1 and 3, whereas both among and within reader variability indicated some uncertainty with regards to readings by reader 2. A closer analysis of the results from this reader pointed at misinterpretations of winter spawners assigned as spring spawners. The problem is being corrected and is not considered to influence splitting results to a high degree since readers 1 and 3 performed by far the most readings in the routine analyses for 2004.

Danish, Swedish and German otolith microstructure analyses are regularly double checked by the same Danish expert reader for consistency in interpretation. The overall impression is a good agreement among readers implying a potential high accuracy in the splits.

Results presented to the WG on mixed stock analysis exploiting genetic variation in herring from Division IIIa in 2002 and 2003, show excellent agreement between assignments based on micro satellites and otolith microstructure (Bekkevold pers. commun. HERGEN QLRT - 2000 – 01370; see also section 1.4.4) indicating good accuracy of the split between North Sea on the one hand and local stocks plus Western Baltic herring on the other hand. The possibility of combining genetics and otolith analyses for a higher resolution of the Skagerrak, Kattegat and Western Baltic stocks is presently being explored.

3.3 Fishery-Independent Information

3.3.1 International Bottom Trawl Survey in Division IIIa

The survey indices were split into spring and autumn spawning components by microstructure analysis of otoliths (section 3.2.2) except for 2001 3rd quarter and 2002 1st quarter when vertebrae counting methods were used. The estimates of the abundance by age of the spring spawning component in the Kattegat are presented in Table 3.3.1 and Table 3.3.2. The mean value for 1-ringers in 2005 1st quarter is the third lowest observed in the time-series and follows the lowest values in 2004.

3.3.2 Summer acoustic survey in Division IIIa

The acoustic survey from 30 June to 10 July 2004 covered the area in the Skagerrak and the Kattegat. Details of the survey are given in the 'Report of the Planning Group for Herring Surveys' (ICES 2005/G:04). The estimated spawning biomass (3+) of Western Baltic spring spawning herring in 2004 was about 179,000 tonnes, showing an increase compared to the previous year but well below the level of the beginning of the 1990´s. The results from this survey are summarised in Table 3.3.3.

3.3.3 Autumn acoustic survey in western Baltic and the southern part of Division IIIa (Kattegat)

A joint German-Danish acoustic survey was carried out with R/V "SOLEA" between 29 September and 18 October 2004 in the Western Baltic covering Subdivisions 21, 22, 23 and 24. A full survey report is given in the Report of the Planning Group for Herring Surveys (ICES 2005/G:04). The results for 2004 are presented in Table 3.3.4. The herring stock was estimated to be about 172,000 tonnes in Subdivisions 22-24 (Table 3.3.4). This is comparable to the last year estimate.

3.3.4 Larvae surveys

The estimated numbers of larvae for the period 1977 to 2004 are summarised in Table 3.3.5. The 2004 estimate of the larvae index (see stock annex) is smaller than the previous year's estimate but above the low values estimated during the beginning and middle of the 1990´s.

3.4 Mean weights and Maturity at age in the Stock

Mean weights at age in the catch in the 1st quarter were used as stock weights (Table 3.2.11). The maturity ogive was assumed constant between years. The same maturity ogive was used as in the HAWG 2004:

W-RINGS	0	1	2	3	4	5	6	7	8+
Maturity	0.00	0.00	0.20	0.75	0.90	1.00	1.00	1.00	1.00

3.5 Recruitment estimates

Indices of 0-ringer abundance of the Western Baltic spring spawning herring in Sub-divisions 22-24 for 2004 were available from the larval surveys during the spawning season on the main spawning area (Table 3.3.5) and from the Acoustic survey (September/October). Log transformed indices were compared by year class in Figure 3.5.1. Historical high recruitment of the 1998 and 1999 year-classes were supported by 0-ringer and 1-ringer indices in the acoustic survey in Sub-divisions 22–24 (Table 3.3.4). The larval index and the 0-ringer from the acoustic survey showed very similar trends in the last 5 years.

3.6 Stock Assessment

3.6.1 Input data

Catch in numbers at age from 1991 to 2004 were available for Sub-division IVa (East), Division IIIa and Subdivisions 22-24 (Table 3.6.1) and as proportion at age (Figure 3.6.1). Catches were updated for 2004. Years before 1991 have been excluded due to lack of reliable data for splitting spawning type and to a large change in fishing pattern caused by changes in the German fishing fleets.

Mean weights at age in the landings are found in Table 3.6.2 and in Figure 3.6.2. The proportions of F and M before spawning was assumed constant between years. F-prop was set to be 0.1 and M-prop 0.25 for all age groups. Natural mortality was assumed constant at age and equal to 0.3, 0.5, and 0.2 for 0- ringers, 1- ringers, and 2+ ringers respectively (Table 3.6.4). The estimates of predation mortality were derived as a mean for the years 1977–1995 from the Baltic MSVPA (ICES 1997/J:2).

Available survey indices were:

FLT1: Hydroacoustic survey in Division IIIa and Subdivision IVa East, July 1991–2004, 0–8+ ringers

FLT2: Hydroacoustic survey in Subdivisions 22, 23 and 24, Oct. 1991–2004, 0–8+ ringers

FLT3: IBTS in Division IIIa, Quarter 1, 1991-2005, 1-5 ringers

FLT4: IBTS in Division IIIa, Quarter 3, 1991-2004, 1–5 ringers

FLT5: Larvae survey in Subdivision 24 (Greifswalder Bodden), March-June 1977-2004

All are age-structured indices with FLT5 used as an index of recruiting 0-ringers. None of the indices covered the total spatial distribution of the WBSS stock and the indices covered the following quarters and areas:

SURVEY AREA	QUARTER 1	QUARTER 2	QUARTER 3	QUARTER 4
Division IIIa	FLT3		FLT1 and FLT4	
Sub-divisions 22-24	FLT5	FLT5		FLT2

Subsets of these data series representing selected age groups were constructed to give a better representation of the stock (see section 3.6.3).

3.6.2 ICA settings

The following settings were used in 2005, similar to 2004:

- The period for the separable constraint: 5 years (2000-2004).
- The weighing factor to all indices (lambda = 1).

- A linear catchability model for indices 1,2,3, and 4, and both linear and power model for index 5.
- The reference F set at age 4 and the selection=1 for the oldest age.
- The catch data were down-weighted to 0.1 for 0-ringer herring.

3.6.3 Exploration by individual survey indices

Exploratory runs of catch data with single indices were performed using the general ICA-setting mentioned earlier (Section 3.6.2). A summary of the results from these runs is presented in Figures 3.6.3 and 3.6.4.

The runs with the larval survey index only including all years and using a linear model did not exhibit a realistic F value, whereas the power model was more in line with other individual indices. However, the recent history of exploratory runs for the larval survey has shown large variation in estimated F and it may still be too early to judge their robustness for use in the final assessment.

The IBTS in Kattegat Q1 (FLT3) indicate a very high F of 0.8, whereas the hydroacoustic survey indices in Division IIIa (FLT1a and FLT1b), the Acoustic survey in Subdivisions 22-24 (FLT2a and FLT2b) and the IBTS in Kattegat Q3 (FLT4) suggest more intermediate Fs of 0.6, 0.3 and 0.2 respectively. On the other extreme the larval survey in Subdivision 24 (FLT5a and FLT5b) give indications of quite low fishing mortality depending on the chosen model, power- (F~0.1) and linear catchability (F~0.03).

The larvae survey FLT5 (N30) predicts strong and weak year classes very well but does not reflect the actual magnitude of year class strength. This results in a strong correlation, but large residuals when fitted in the ICA model to the catch data. A longer time-series may help resolve these issues, particularly if intermediate N30 values appear in the time-series. Although the larval survey does not add information to the current specification of the ICA model, it appears to function well as an indicator of recruitment. Trends in log transformed values of recruitment indices (larval index total time-series, 0-ringer Acoustic in SD 22-24 and 1-ringer Acoustic in SD 22-24) show good concordance in the recent seven years (Figure 3.5.1). In the North Sea, the long MIK time-series (on post larvae) works well as an indicator of 0 ring year class strength in the ICA model. The larvae N30 is an abundance index of post-larvae in some ways similar to the MIK index, so potentially maybe of use in the future. The N30 index provides extremely valuable information on the general biology and year class development of the WBSS herring population.

The tuning fleet choice and the settings for the final ICA run for the 2005 assessment were the same as in the last two years assessments with fleets FLT1b, FLT2b, and FLT4. The biological reasoning behind the choice of indices with restricted numbers of age classes is that there is only a partial migration of age 0-1 ringers to the Division IIIa in the summer and that ages older than 5-ringers are poor represented in the Subdivision 22-24 acoustic surveys and in the IBTS.

3.6.4 Final Assessment

This assessment conforms to an update assessment of WBSS herring, input data (years 1991-2004, Ages 0-8+ ringers) are given in the following tables:

- Catch in number (Table 3.6.1)
- Weight in catch (Table 3.6.2)
- Weight in stock (Table 3.6.3)
- Natural mortality (Table 3.6.4)
- Maturity (see text table in section 3.4)

The following surveys were included (Tables 3.6.5a-c):

- FLT 1b: DK Hydroacoustic survey in Division IIIa+ SD IVaE, July 1991–2004, excl. 1999, 2–8+ ringers
- FLT 2b: GER Hydroacoustic survey in Subdivisions 22, 23 and 24, Oct 1991–2004, 0–5 ringers
- FLT 4: IBTS in Kattegat, Quarter 3, 1991-2004, 1–5 ringers

The final model settings are shown in Table 3.6.6. The output data are given in Tables 3.6.7-3.6.16. The estimated SSB for 2004 is about 180,000 tonnes with a mean fishing mortality (ages 3-6) of 0.36 (Table 3.6.9). The model diagnostics show a rather well defined minimum SSQ response-curve for all age-indices except age-index 1 (Acoustic Survey in Division IIIa+IVaE) that is somewhat flat (Figure 3.6.5). The minimum SSQ for the Acoustic Survey in SD 22-24 (age-index 2) finds an intermediate compromise between the high F of age-index 1 (Acoustic Survey in Division IIIa+IVaE) and the low F of age-index 3 (IBTS Kattegat Q3). The stock summary is shown in Figure 3.6.6 and Table 3.6.9.

The marginal totals of residuals between the catch and the separable model are overall small, with almost no residuals for younger ages and slightly larger residuals at older ages 4-7 as well as a reasonably trend-free separable period (2000-2004). Year effects repeat the somewhat large positive and negative values for 2001 and 2003 respectively (see Figure 3.6.7), but as already noted in last years assessment most of the year effects are again caused by 0-ringers that are down-weighted in the analysis but still appears with full weight in the residual plots of the ICA diagnostics. For values see Table 3.6.12.

The diagnostics for the three surveys repeat the trend of low acoustic and high IBTS residuals for 2003 seen in last years assessment, whereas values for 2004 are much closer to model predictions although they reflect the same type of balance between acoustic and IBTS surveys. The Acoustic Survey in Division IIIa+IVaE and the Acoustic Survey in SD 22-24 showed in general negative residuals for 2004 except for 2 ringers in both surveys (Figure 3.6.11). This was balanced by similar sized but positive residuals for all ages in the IBTS Kattegat Q3 survey.

The catch-at-age unweighted variance component is of the same magnitude as the individual acoustic survey variance components and smaller than the IBTS survey component (Table 3.6.16) , however in the unweighted statistics down-weighting of the 0-ringers is not accounted for, and this age contribute quite some variation with a C.V. of 50% compared to about 15% for the 2+ groups (Table 3.6.10). After a decrease from a period of high fishing mortality in the mid 1990s, the $F_{3\text{-}6}$ values in the recent 5 years are estimated to have decreased from 0.56 to 0.36. The SSB shows a slight increasing trend over the recent years after a marked decline in the mid 1990s.

The fit of the surveys to the population number by age class is similar between the Division IIIa acoustic survey (Figures 3.6.8a-g) and Subdivisions 22-24 acoustic survey (Figures 3.6.9a-f) (FLT1b and FLT2b respectively). Both surveys exhibit the best fit for intermediate ages 3-5 ringers, and neither survey has an annual trend in residuals although Subdivisions 22-24 acoustic survey has lower catchability values than the Division IIIa survey (Table 3.6.11). On the other hand, the Kattegat Q3 IBTS-index (FLT4) shows quite poor fit of catchabilities for the age classes 1-3 ringers but improving for the two oldest ages 4 and 5 ringers in the index (Figures 3.6.10a-e). The reason for the poorer performance of the Kattegat Q3 IBTS survey may be an increased redistribution of immature age-classes into the Kattegat area in the recent two or three years.

Overall trends in the age structured data for the ICA model

Exploring the cohort dynamics by log catch and log survey indices gives an indication of overall mortality and catchability in successive cohorts from year classes 1991-2000 (Figures 3.6.8a-d). Slopes of log catches do not indicate any increasing trend in mortality (Figure 3.6.12a). Slopes from the Division IIIa acoustic survey and from the Subdivision 22-24 acoustic survey are relatively stable (Figure 3.6.12b and Figure 3.6.12c), whereas for IBTS in Kattegat it shows fluctuation with initially increasing negative values followed by decreasing negative slopes from the 1994 cohort (Figure 3.6.12d).

Generally however, the trends may be interpreted as an overall stable to decreasing fishing mortality from 1994. The signal from the catches is relatively stable whereas the survey indices are more scattered and somewhat conflicting, but together provide a compromise in line with the catch information.

3.7 Short-term Projection

The assessment was used to provide a yield-per-recruit plot for WBSS herring in Division IIIa and Subdivisions 22-24 (Figure 3.7.1). The values for $\mathbf{F}_{0.1}$ and $\mathbf{F}_{max}$ are 0.21 and 0.43, respectively.

Short-term predictions were carried out using MFDP v.1a software. ICA estimates of population numbers and fishing mortalities were used except for the numbers of 0-ringers in 2004-2007, where the geometric mean of the recruitment over the period 1993–2002 was taken, and for the numbers of 1-ringers in 2005, where the geometric mean over the period 1994-2003 was used. Mean weights-at-age in the catch and in the stock were taken as a mean for the years 2002–2004. A *status quo* fishing mortality for 2005 onwards was assumed, with values rescaled to the last year estimate. Input data for catch predictions are presented in Table 3.7.1.

Short-term predictions were carried out assuming a *status quo* fishing mortality for 2005 onwards. The single option table is available for 2005 to 2007 (Table 3.7.2).

SCENARIO	2005	2006	2007
1) *status quo* F	$F_{2005}= F_{2004} = 0.36$ *Status quo* F Catch = 91,900 t	$F_{2005}= F_{2004} = 0.36$ *Status quo* F Catch = 95,400 t	$F_{2005}= F_{2004} = 0.36$ *Status quo* F Catch = 101,500 t

The results of the short-term predictions are given in Tables 3.7.2 – 3.7.4. Table 3.7.2 shows single option predictions for 2005-2007 and Table 3.7.3 multiple options for 2006 at *status quo* fishing mortality in 2005. The catches for 2006 and 2007 at *status quo* fishing mortality were predicted to be 95,400 t and 101,500 t, respectively, which is an overall increase in relation to the current catch level of 76,800 t. The SSB is predicted to increase to 220,000 t in 2006 and to 233,000 t in 2007.

Based on *Status quo* F and $F_{0.1}$ (0.36 and 0.21 respectively) the predictions of SSB_{2006} (233,000 t and 266,000 t respectively) are well both above the lowest observed in the time series from 1991-2004 (SSB_{1998} 116,000 t).

3.8 Reference Points

Reference points have neither been defined nor proposed for this stock. The time series is short with revised catch data and reliable splitting factors for only 14 years, the estimated SSB has not been below 116,000 t since 1991 and there is no obvious stock-recruitment relationship.

3.9 Quality of the Assessment

This year's assessment is an update of last year's assessment. Therefore, the assessment has not been explored beyond examining the standard diagnostics.

Three data series are now used in addition to the catch numbers at age. None of these surveys cover the whole distribution area of the stock, but each of them cover areas where it is likely that certain ages are well represented at survey time. The acoustic survey in Division IIIa+IVaE covers fish age 2 and older while the two others largely cover the younger part of the population. Hence, these surveys can be regarded as complementary. All surveys are noisy, with strong year effects. The acoustic survey in Division IIIa+IVaE indicates a higher mortality than the others, but its contribution to the total sum of squares does not have a distinct minimum.

The retrospective errors are small, except in the recruitment. Apparently, the strength of a year class is not firmly estimated before the year class has been followed for 2-3 years. The selection at age in the fishery changes in retrospective runs. This probably reflects a stronger exploitation of younger herring prior to 1999, which in the present assessment is reflected in the VPA part. The selection at age in this year's assessment is virtually equal to that in last year's assessment, and the catch residuals are small. Hence, the separable assumption does not seem to be violated.

Altogether, the current procedure for assessing the stock has given consistent results with respect to fishing mortality and spawning biomass for several years. Compared to last year's assessment, the change in the estimate is +1% for the fishing mortality in 2003 and –2% for the SSB in 2003.

For prediction purposes better indicators of recruitment would be useful. At present, geometric mean recruitment has to be assumed for age 1 in the intermediate year and for later year classes. The larval survey index has been considered previously as a candidate recruitment indicator, but including it in the assessment as another tuning series was not successful. It does identify most strong and weak year classes, however. Using it as a semi-quantitative support for the assumptions about recruitment in the predictions may be considered as an alternative. This would need further exploration with this purpose in mind. It is suggested to search for procedures that give a better predictive power of the recruitment by reducing the impact of outliers, and also to examine the raw data for area subsets that may reflect the year class strength better.

The predictions are made for the Western Baltic Spring Spawning (WBSS) stock, while management is by areas. In Division IIIa, the fishery exploits both WBSS and North sea autumn spawning herring. The Working Group has attempted to outline the consequences for both stocks in fishery in Division IIIa (Section 3.10). This requires insight in both how the catches of WBSS is distributed on areas, and in the proportions of the catches in Division IIIa from each stock. Both these relations change over time, and are influenced both by managers decisions and the abundance of the respective stocks in the area. So far, the only basis has been historical data of catches in biomass by area and species (cfr. Table 2.1.6). A better basis could be achieved by considering catches at age, and through further investigations of how management decisions influence the fishery. This would require inter-sessional work.

The text table below gives an overview of the assumptions made in the 2004 and 2005 assessments and a comparison of the main results.

CATEGORY	PARAMETER	ASSESSMENT 2004	ASSESSMENT 2005	DIFF. (+/-) %
ICA input	No. of years for separable constraints	5	5	No
	Reference age for separable constraint	4	4	No
	Selection to be fixed on last age	1	1	No
	Weighting factor to all indices	1	1	No
	Catch down-weighted to 0.1 for 0-ringer	Yes	Yes	No
	Tuning data	Acoustic Surv. Div. IIIa 2-8+ ringers	Acoustic Surv. Div. IIIa 2-8+ ringers	No
		Acoustic Surv. SDs 22-24 0-5 ringers	Acoustic Surv. SDs 22-24 0-5 ringers	No
		IBTS Surv. Quarter 3 1-5 ringers	IBTS Surv. Quarter 3 1-5 ringers	No
ICA results	SSB 2003 F(3-6) 2003	157,600 t 0.385	154,970 t 0.389	-2% +1%

3.10 Management Considerations

Catch options for mixed stocks in Division IIIa based on short term predictions for WBSS

During last year's HAWG management considerations for the Western Baltic spring spawning stock (WBSS) was elaborated taking into account the mixed stock nature of the catches in Division IIIa. Before 2004 the main constraint on the fishery in Division IIIa was the concern for the North Sea autumn spawning herring (NSAS). This situation has changed since the NSAS herring at least at present is in a good state. Hence, quotas in Division IIIa, which include both stocks, may have to be constrained by the need to restrict the exploitation of WBSS, which are taken together with NSAS in this area.

It should, however, be noted that the scope for exploitation is continuously changing due to different population dynamics of the two stocks. In this perspective the WBSS 2003 year-class is indicated to be well above average whereas the three most recent year-classes of NSAS, 2002, 2003, and 2004 appear to be low.

The current fleet definitions are:

North Sea

Fleet A: Directed herring fisheries with purse seiners and trawlers. By-catches in industrial fisheries by Norway are included.
Fleet B: Herring taken as by-catch under EU regulations.

Division IIIa

Fleet C: Directed herring fisheries with purse seiners and trawlers
Fleet D: By-catches of herring caught in the small-mesh fisheries

The WBSS are exploited by other fleets as well, in Subdivision 22-24.

Quotas in Division IIIa

The quota for the C-fleet and the by-catch ceiling for the D-fleet are set for both stocks together. Therefore the implication of the quotas for the outtake of WBSS has to be considered. Furthermore the implication for the outtake of NSAS has to be taken into account when setting fleet wise quotas for that stock (see section 2.7).

In ***2004 the agreed TAC*** for the directed fishery in Division IIIa (C-fleet) was 70,000 t. 500 t for the Faeroes, 60,200 t for the EU of which 50% could be taken in the North Sea, and 9,300 t for Norway of which 100% could be taken in the North Sea. With the regulations allowing these quota transfers from Division IIIa to the North Sea, the incentive to misreport might have decreased. Thus catches in 2004 reported from Division IIIa may in fact be real.

For ***2005 the agreed TAC*** for the directed fishery in Division IIIa (C-fleet) is 96,000 t. This TAC is divided into quotas, 500 t for the Faeroes, 82,700 t for the EU of which all has to be taken in Divisiion IIIa, and 12,800 t for Norway of which 50% can be taken in the North Sea. A by-catch ceiling for Division IIIa herring in the small meshed fishery (fleet-D) is set at 24,150 t for the EU fleet.

It may also be noted that a variable, but relatively small amount (up to about 8,000 t) of WBSS herring is taken in the fishery in Subarea IV (see sec. 2.2.2 and figure 2.2.2 for information about WBSS taken in Divisions IVa and IVb East). This component is accounted for in both the assessments on NSAS and WBSS. The situation is further complicated by misreporting by areas. In recent years, the HAWG in its calculations has assumed that a substantial part of the catch reported as taken in Division IIIa in fleet C actually has been taken in Subarea IV. These catches have been allocated to the North Sea stock and accounted under the A-fleet.

Data used for catch options in 2006

There is no firm basis for predicting the fraction of NSAS in the catches by the C-fleet in future years. It will to some extent depend on the abundance of each stock in the area, which for NSAS is related to the strength of incoming year classes (0-2 ringers), and for the WBSS the late juvenile and adult age classes (2+ ringers), but also to where and when the fishery is conducted.

Hence, to compute the catch of WBSS and NSAS by fleet in Division IIIa corresponding to a given total catch option for WBSS, the first step will be to estimate the amount corresponding to the C- and D- fleets.

However, the proportions of the two stocks as well as the distribution pattern of the fishery in the Eastern North Sea and the Division IIIa is dynamically changing year by year. This is influenced by year-class strength of the two stocks and their relative geographical distributions as well as fleet behaviour reacting on herring availability and management decisions. Directed intersessional work is needed to make further progress regarding catch predictions by stock for the different fleets.

Therefore the information used for catch options in 2006 is based on the 2004 share of the total catch for the involved fleets and the proportions caught of each stock.

The text table below shows the 2004 share of the total catch in t of WBSS by fleet.

WBSS	FLEET C (IIIA)	FLEET D (IIIA)	SD 22-24 + FLEET A (IV)	TOTAL
2004	16,825 (22%)	11,175 (15%)	48,815 (64%)	76,815

Next, this share is translated to total catch of herring of both stocks (NSAS and WBSS) for each fleet by accounting for the fraction of WBSS in the catches by these fleets.

The text table below shows the proportion WBSS in the catches by fleet in Division IIIa as well as for the fleets in SD 22-24.

WBSS	FLEET C	FLEET D	SD22-24 *+ FLEET A (IV)**
2004	0.56	0.51	1

*** Only WBSS caught in Subarea IV are accounted for in the calculations**

From this, it also follows the amount of WBSS by each fleet corresponding to a certain catch option for the total catch of the WBSS stock. The algorithm can be outlined as follows:

- Start with a total catch of WBSS
- Allocate this WBSS catch to fleets based on the 2004 share to get the WBSS catch by the C- and D- fleets.
- Translate these fleetwise WBSS catches to catches of both stocks together by the C- and D- fleets, using 2004 data for the proportion of each stock in the C- and D- fleet catches, and further, derive the corresponding catches of NSAS by these fleets.

ICES catch predictions versus management TAC

ICES gives advice on catch options for each stock separately, whereas herring is managed by area (see the following text diagram).

		TAC		BY-CATCH CEILING		TAC		BY-CATCH CEILING		TAC	
		Div. IV		Div. IV		Div. IIIa		Div. IIIa		Sub-div. 22-24	
		Fleet A		Fleet B		Fleet C		Fleet D		All fleets	
ICES Advice		NSAS		NSAS		NSAS		NSAS			
		WBSS		*WBSS*		WBSS		WBSS		WBSS	**ICES Advice**

The way it was done in 2004. In response to a special EU request the HAWG2004 calculated the effect of TAC shares for Division IIIa for 2005. ICES in 2004 advised that catches for the **total** Western Baltic Spring Spawners (WBSS) in Division IIIa, IVa East, and SD 22-24 should not exceed 92,000 t. With the average (2001-2003) share of the WBSS catch taken by the C- and D-fleets of 44% and an amount of WBSS corresponding to its proportion of catches in the C-fleet of 0.58 and D-fleet 0.35 this would lead to a total TAC of 79,400 t in Division IIIa. However, the agreed TAC for 2005 in Division IIIa in the directed fishery (C-fleet) was set to 96,000 t, plus the by-catch ceiling (D-fleet) was set to 24,150, giving a total TAC of 120,150 t.

The HAWG 2005 procedure. Catch options based on presently set TACs in Division IIIa along with different shares expected to be taken in SD22-24 and in Subarea IV are compared with catch options derived from the HAWG2005 short-term predictions for the Western Baltic spring spawners in Division IIIa and SD 22-24.

Catches following present TAC for Division IIIa. Short-term predictions indicate a catch in 2006 of 95,000 t with F_{sq}. However, if a total TAC for 2006 in Division IIIa was to be set at 120,150 t for both stocks combined, as it presently is for 2005, then with the present proportions of WBSS and NSAS in the C- and D-fleet and different shares taken in SD22-24 and Subarea IV, this could lead to scenarios 1-3 in the following text table.

All three scenarios greatly overshoot the predicted catches with amounts depending on the rule of calculating the catch taken in SD 22-24 and Subarea IV:

1. using the fixed TAC of 46,000 t in SD 22-24 set by the IBSFC + 7000 t taken in Subarea IV
2. using equal shares of WBSS taken in Division IIIa and in SD 22-24 and Subarea IV
3. using the 2004 share (64%) of WBSS catches taken in SD 22-24 and Subarea IV

***Catches following* F_{sq}.** To reach total WBSS catches of 95,000 t in 2006, TACs should be lower than 120,150 t for Division IIIa, with values depending on the expected share of the catch taken in SD 22-24. Scenarios 4-6 in the table below have the same share of SD22-24 catches as 1-3, but Division IIIa TACs are calculated so that they all lead to total catches of 95,000 t. The scenarios are shown as the lower three rows in the text table below (rounded to nearest 100 t).

CATCH OPTIONS IN DIV.IIIA WITH DIFFERENT PROPORTIONS TAKEN IN SD 22-24 AND SUBAREA IV	TAC DIVIIIA NSAS+WBSS	CATCHES NSAS+WBSS		CATCHES WBSS		CATCHES WBSS	CATCHESTOTAL WBSS	CATCHES NSAS	CATCHES NSAS + WBSS
Catch in SD 22-24 and Subarea IV	Fleets C+D	Fleet C	Fleet D	Fleet C	Fleet D	Fleets C+D	All fleets	Fleets C+D	total
(1) Fixed TAC set by IBSFC =46,000+7,000 [d]	120,200[b]	69,600	50,500	38,700	25,700	64,400	117,400	55,700	173,200
(2) 50:50 share with DivIIIa =64,400	120,200[b]	69,600	50,500	38,700	25,700	64,400	128,900	55,700	184,600
(3) 2004 proportion of total WBSS catch =112,300	120,200[b]	69,600	50,500	38,700	25,700	64,400	176,800	55,700	232,500
(4) Fixed TAC set by IBSFC =46,000+7,000 [d]	78,300 [c]	45,400	32,900	25,200	16,800	42,000	95,000 [a]	36,300	131,300
(5) 50:50 share with DivIIIa =47,500	88,600 [c]	51,300	37,200	28,500	19,000	47,500	95,000 [a]	41,100	136,100
(6) 2004 proportion of total WBSS catch =60,400	64,600 [c]	37,400	27,100	20,800	13,800	34,600	95,000[a]	29,900	124,900

[a] Derived from short term predictions

[b] Total TAC for DivIIIa as in 2005

[c] Backcalculated from short-term predictions of WBSS catch of 2006 (95,000 t)

[d] when a fixed TAC in SD22-24 is used a fixed amount of 7,000t in Subarea IV is assumed

The bottom shaded row in the above text table (scenario 6), shows the combined TAC for the C- and D-fleets that should be set to remain at predicted total WBSS catches for 2006 at 95,000 t, assuming the present share of the total WBSS herring taken outside Divisiion IIIa (i.e. 64% of WBSS taken in SD 22-24 and IVa East in 2004).

Exploring a range of total WBSS catches

Considering the present high level of the NSAS stock, catch options were explored for the two stocks in Division IIIa at total catches set for the WBSS stock. The settings for scenario 6 above (64% of WBSS taken in SD 22-24 and Subarea IV in 2004), were expanded with different total catches of the WBSS stock. Further the 2004 compositions of NSAS and WBSS in each of the C and D fleets were employed (in Division IIIa).

The text table below gives examples of catch options for the C- and D- fleets at different TACs for the entire WBSS stock between 60,000 and 100,000 t (values rounded to the nearest 100 t). The shaded row in table below corresponds to scenario 6 in table above.

MANAGEMENT CONSIDERATIONS FOR DIVIIIA BASED ON SHORT TERM PREDICTIONS (2006)						
Western Baltic Spring Spawners			North Sea Autumn Spawners		Both Stocks together	
All fleets total catches	Fleet C (22% of TAC)	Fleet D (15% of TAC)	Fleet C (WBSS/56%)	Fleet D (WBSS/51%)	Fleet C	Fleet D
60,000	13,100	8,700	10,500	8,400	23,600	17,100
65,000	14,200	9,500	11,400	9,100	25,600	18,600
70,000	15,300	10,200	12,200	9,800	27,500	20,000
75,000	16,400	10,900	13,100	10,500	29,500	21,400
80,000	17,500	11,600	14,000	11,200	31,500	22,800
85,000	18,600	12,400	14,900	11,900	33,500	24,300
90,000	19,700	13,100	15,700	12,600	35,400	25,700
95,000	20,800	13,800	16,600	13,300	37,400	27,100
100,000	21,900	14,500	17,500	14,000	39,400	28,500

For a TAC on catch of NSAS and total catch by the fleets in Division IIIa to be compatible with the advise for WBSS, the numbers derived as above, based on the largest advisable catch of WBSS, are upper bounds on the advisable catches of NSAS by the C- and D- fleets. Thus the resulting catch options were also used as constraints for short term predictions for the NSAS herring (section 2.7).

Consequences of continuing the present transfer of quota from C-fleet to A-fleet

The working group has treated this problem as effectively a partial transfer between fleets, but also to some extent a transfer between stocks, since the C-fleet exploits both North Sea autumn spawners (NSAS) and Western Baltic spring spawners (WBSS).

To calculate possible effects of the present quota transfer, the proportions of the two stocks for the last year, 2004, were used. The text table below shows the percentage of WBSS 2004 catches in two stocks in Division IIIa.

WBSS	FLEET C	FLEET D
2004	0.56	0.51

Thus, one t of C-fleet total quota can be assumed to represent 0.56 t of catch of WBSS. A transfer of one t from the C-fleet to the A-fleet would then imply that the catch of WBSS by the C-fleet is reduced by this amount, while the catch by the A-fleet is increased by a little less than one t, since part of the A-fleet catches are taken in the Eastern part of Subarea IV where they are a mix of NSAS and WBSS herring. Further complications are the previously mentioned misreporting by areas.

The effect of a transfer of 50% of Norwegian catches amounting to 6,400 t and will at the most equal a reduction in outtake of 3,600 t in the exploitation of WBSS, since part of the catches will anyway be taken in the transfer area where WBSS are taken in the 2nd and 3rd quarter. The changes in F and SSB for WBSS will thus be marginal.

Conclusions

a. The presently set TAC for Division IIIa of 96,000 t in the C-fleet is too high for a sustainable fishery, with the present share taken in SD22-24 and Subarea IV.
b. A TAC of 37,400 t for the C-fleet is in accordance with F_{sq} predictions of 95,000 t WBSS total, under assumptions of retained catch share among areas and retained proportions among stocks. For the SD 22-24 estimated catches will be 51,600 t, and the WBSS taken in Subarea IV will amount to 8,800 t.

c. Low recruitment of the three most recent NSAS year classes together with an increase in the WBSS stock, is expected to lead to changes in stock composition as well as area distribution and thereby affect near future catch options. Especially consequences for the D-fleet catch options should be closely followed.

Table 3.1.1 **HERRING in Division IIIa and Sub. Division 22-24. 1985 - 2004**
Landings in thousands of tonnes.

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
Skagerrak										
Denmark	88.2	94.0	105.0	144.4	47.4	62.3	58.7	64.7	87.8	44.9
Faroe Islands	0.5	0.5								
Norway	4.5	1.6	1.2	5.7	1.6	5.6	8.1	13.9	24.2	17.7
Sweden	40.3	43.0	51.2	57.2	47.9	56.5	54.7	88.0	56.4	66.4
Total	133.5	139.1	157.4	207.3	96.9	124.4	121.5	166.6	168.4	129.0
Kattegat										
Denmark	69.2	37.4	46.6	76.2	57.1	32.2	29.7	33.5	28.7	23.6
Sweden	39.8	35.9	29.8	49.7	37.9	45.2	36.7	26.4	16.7	15.4
Total	109.0	73.3	76.4	125.9	95.0	77.4	66.4	59.9	45.4	39.0
Sub. Div. 22+24										
Denmark	15.9	14.0	32.5	33.1	21.7	13.6	25.2	26.9	38.0	39.5
Germany	54.6	60.0	53.1	54.7	56.4	45.5	15.8	15.6	11.1	11.4
Poland	16.7	12.3	8.0	6.6	8.5	9.7	5.6	15.5	11.8	6.3
Sweden	11.4	5.9	7.8	4.6	6.3	8.1	19.3	22.3	16.2	7.4
Total	98.6	92.2	101.4	99.0	92.9	76.9	65.9	80.3	77.1	64.6
Sub. Div. 23										
Denmark	6.8	1.5	0.8	0.1	1.5	1.1	1.7	2.9	3.3	1.5
Sweden	1.1	1.4	0.2	0.1	0.1	0.1	2.3	1.7	0.7	0.3
Total	7.9	2.9	1.0	0.2	1.6	1.2	4.0	4.6	4.0	1.8
Grand Total	349.0	307.5	336.2	432.4	286.4	279.9	257.8	311.4	294.9	234.4

Year	1995	1996	1997	1998 [2]	1999 [2]	2000	2001 [3]	2002	2003	2004 [1]
Skagerrak										
Denmark	43.7	28.7	14.3	10.3	10.1	16.0	16.2	26.0	15.5	8.0
Faroe Islands										
Germany									0.7	0.5
Norway										1.4
Sweden	48.5	32.7	32.9	46.9	36.4	45.8	30.8	26.4	25.8	21.8
Misreporting										
Total	95.2	64.4	50.2	60.2	46.5	61.8	47.0	43.4	43.9	31.7
Kattegat										
Denmark	16.9	17.2	8.8	23.7	17.9	18.9	18.8	22.5	14.0	10.9
Sweden	30.8	27.0	18.0	29.9	14.6	17.3	16.2	7.2	10.2	9.6
Total	47.7	44.2	26.8	53.6	32.5	36.2	35.0	29.7	24.2	20.5
Sub. Div. 22+24										
Denmark	36.8	34.4	30.5	30.1	32.5	32.6	28.3	11.0	6.1	7.1
Germany	13.4	7.3	12.8	9.0	9.8	9.3	11.4	22.4	18.8	18.0
Poland	7.3	6.0	6.9	6.5	5.3	6.6	9.3	7.0	4.4	5.5
Sweden	15.8	9.0	14.5	4.3	2.6	4.8	13.9	10.7	9.6	9.9
Total	73.3	56.7	64.7	49.9	50.2	53.3	62.9	51.1	38.9	40.5
Sub. Div. 23										
Denmark	0.9	0.7	2.2	0.4	0.5	0.9	0.6	0.4	2.3	1.2
Sweden	0.2	0.3	0.1	0.3	0.1	0.1	0.2	1.0	0.2	0.3
Total	1.1	1.0	2.3	0.7	0.6	1.0	0.8	1.4	2.6	1.5
Grand Total	217.3	166.3	144.0	164.4	129.8	152.3	145.7	125.6	109.6	94.2

[1] Preliminary data.
[2] Data for 1998 and 1999 revised in 2003
[3] German data revised in 2004

Table 3.1.2 HERRING in Division IIIa and Sub. Division 22-24. 2001 - 2004
Landings (SOP) in thousands of tonnes by fleet and quarter.

Year	Quarter	Div. IIIa		SD 22-24	Div. IIIa + SD 22-24
		Fleet C	Fleet D	Fleet F	Total
2001	1	19.6	3.8	20.8	44.2
	2	11.1	1.9	20.7	33.7
	3	24.7	7.9	7.5	40.1
	4	11.1	1.7	14.8	27.6
	Total	66.5	15.3	63.8	145.6
2002	1	11.4	6.2	19.6	37.2
	2	6.3	2.1	18.3	26.7
	3	23.2	7	1.5	31.7
	4	14.2	2.5	13.3	30.0
	Total	55.1	17.8	52.7	125.6
2003	1	10.9	7	20.3	38.2
	2	7.9	1.3	12.9	22.1
	3	21.9	0.9	1.5	24.3
	4	15	3.3	5.6	23.9
	Total	55.7	12.5	40.3	108.5
2004	1	13.5	2.8	20.4	36.7
	2	2.8	3.3	10.4	16.5
	3	8.2	10.8	2.4	21.4
	4	5.9	5.0	8.6	19.4
	Total	30.3	22.0	41.7	93.9

Table 3.2.1 HERRING in Division IIIa and Sub. Division 22-24. Proportion of North Sea autumn spawners and Western Baltic spring spawners given as % in Skagerrak and Kattegat by age and quarter.

Year: 2004

		Skagerrak				Kattegat			
Quarter	**W-rings**	North Sea autumn SP	W-Baltic Spring SP	**n**	**source**	North Sea autumn SP	W-Baltic Spring SP	**n**	**source**
	1	13.19%	86.81%	182		11.92%	88.08%	604	
	2	93.50%	6.50%	123		64.03%	35.97%	253	
	3	42.67%	57.33%	75		10.91%	89.09%	110	
	4	65.79%	34.21%	38		0.00%	100.00%	19	
	5	95.12%	4.88%	41		*0.00%*	*100.00%*		
	6	*84.21%*	*15.79%*			*0.00%*	*100.00%*		
	7	*84.21%*	*15.79%*			*0.00%*	*100.00%*		
1	8+	*84.21%*	*15.79%*	*19*	(6-8+)	*0.00%*	*100.00%*	13	(5-8+)
	1	64.52%	35.48%	31		11.11%	88.89%	18	
	2	90.91%	9.09%	77		69.54%	30.46%	197	
	3	14.29%	85.71%	49		23.44%	76.56%	64	
	4	7.14%	92.86%	14		0.00%	100.00%	9	
	5	2.22%	97.78%	45		21.43%	78.57%	14	
	6	*5.56%*	*94.44%*			*0.00%*	*100.00%*		
	7	*5.56%*	*94.44%*			*0.00%*	*100.00%*		
2	8+	*5.56%*	*94.44%*	18	(6-8+)	*0.00%*	*100.00%*	15	(4-8+)
	0	66.67%	33.33%	6		100.00%	0.00%	8	Acoust
	1	60.24%	39.76%	83		18.00%	82.00%	50	
	2	56.63%	43.37%	166		14.29%	85.71%	49	
	3	32.75%	67.25%	345		*4.17%*	*95.83%*		
	4	27.36%	72.64%	106		*4.17%*	*95.83%*		
	5	24.71%	75.29%	85		*4.17%*	*95.83%*		
	6	*25.00%*	*75.00%*			*4.17%*	*95.83%*		Acoust
	7	*25.00%*	*75.00%*			*4.17%*	*95.83%*		age5&6
3	8+	*25.00%*	*75.00%*	40	(6-8+)	*4.17%*	*95.83%*	24	(3-8+)
	0	65.47%	34.53%	278		72.34%	27.66%	47	
	1	29.87%	70.13%	77		15.00%	85.00%	120	
	2	60.27%	39.73%	73		6.73%	93.27%	104	
	3	40.19%	59.81%	107		3.03%	96.97%	33	
	4	*34.78%*	*65.22%*			*0.00%*	*100.00%*		
	5	*34.78%*	*65.22%*			*0.00%*	*100.00%*		
	6	*34.78%*	*65.22%*			*0.00%*	*100.00%*		
	7	*34.78%*	*65.22%*			*0.00%*	*100.00%*		
4	8+	*34.78%*	*65.22%*	*23*	(4-8+)	*0.00%*	*100.00%*	*15*	(4-8+)

Proportions as % are calculated using combined otolith microstructure data from Danish and Swedish catches in 2004.

Age-classes with few analyses were joined into plus-groups with more than 11 individuals and indicated by numbers in italics. In the source column the constructed plus groups are indicated.

In the source column the constructed plus groups are indicated. For 0-ringers in Q3 the proportion from the Acoustic survey in Kattegat was used.

Table 3.2.2 HERRING in Division IIIa and Sub. Division 22-24. Landings in numbers (mill.), mean weight (g.) and SOP (t) by age, quarter and fleet.

Division: Skagerrak Year: 2004 Country: All

		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
1	1	1.66	29	3.50	15	5.17	20
	2	51.52	67	5.47	67	56.99	67
	3	6.47	99	1.23	106	7.70	101
	4	4.67	131	0.06	140	4.73	132
	5	7.95	147	0.01	135	7.97	147
	6	1.42	167	0.02	174	1.44	167
	7	2.12	187			2.12	187
	8+	0.99	177			0.99	177
	Total	76.82		10.29		87.11	
	SOP		6,711		566		7,277
		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
2	1			0.87	25	0.87	25
	2	5.02	116	33.37	73	38.39	79
	3	4.46	131	3.28	96	7.73	116
	4	0.63	134	0.63	117	1.26	126
	5	1.17	160	1.74	123	2.91	138
	6	0.61	161	0.37	150	0.98	157
	7	0.01	213	0.08	166	0.10	173
	8+			0.13	172	0.13	172
	Total	11.90		40.47		52.37	
	SOP		1,538		3,155		4,693
		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
3	0			10.25	25	10.25	25
	1	2.77	77	47.91	64	50.68	65
	2	4.59	111	22.96	99	27.55	101
	3	10.95	136	18.92	132	29.87	133
	4	3.91	154	5.32	149	9.23	151
	5	3.31	170	3.83	174	7.15	172
	6	1.30	178	0.74	190	2.05	183
	7	0.27	194	0.41	184	0.68	188
	8+	0.05	222	0.04	245	0.09	232
	Total	27.17		110.38		137.54	
	SOP		3,674		9,796		13,470
		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
4	0	16.99	22	26.38	33	43.37	29
	1	11.46	68	31.28	67	42.74	68
	2	3.58	114	4.53	101	8.11	107
	3	5.50	143	2.09	131	7.59	140
	4	0.58	160	0.17	127	0.75	152
	5	0.48	169	0.08	173	0.56	170
	6	0.11	135			0.11	135
	7						
	8+						
	Total	38.70		64.52		103.22	
	SOP		2,540		3,738		6,278
		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
Total	0	16.99	22	36.62	31	53.61	28
	1	15.90	65	83.56	63	99.45	63
	2	64.72	76	66.32	84	131.04	80
	3	27.37	128	25.52	126	52.89	127
	4	9.79	142	6.18	145	15.97	144
	5	12.91	155	5.67	158	18.58	156
	6	3.45	169	1.13	177	4.58	171
	7	2.41	187	0.49	181	2.90	186
	8+	1.05	179	0.17	188	1.22	181
	Total	154.59		225.66		380.25	
	SOP		14,463		17,255		31,718

**Table 3.2.3 HERRING in Division IIIa and Sub. Division 22-24.
Landings in numbers (mill.), mean weight (g.) and SOP (t) by age, quarter and fleet.**

Division: Kattegat Year: 2004 Country: ALL

Quarter	W-rings	Fleet C Numbers	Fleet C Mean W.	Fleet D Numbers	Fleet D Mean W.	Total Numbers	Total Mean W.
1	1	2.04	33	71.47	16	73.51	16
	2	70.52	62	20.55	45	91.07	58
	3	19.25	98	5.64	38	24.88	84
	4	2.45	119	0.03	134	2.48	119
	5	1.04	114	0.01	99	1.05	114
	6	0.08	182	0.01	182	0.09	182
	7						
	8+						
	Total	95.38		97.71		193.09	
	SOP		6,742		2,279		9,021

Quarter	W-rings	Fleet C Numbers	Fleet C Mean W.	Fleet D Numbers	Fleet D Mean W.	Total Numbers	Total Mean W.
2	1	0.22	43	6.64	13	6.86	14
	2	12.91	64	1.84	36	14.76	61
	3	2.24	103			2.24	103
	4	0.28	113			0.28	113
	5	0.41	142			0.41	142
	6	0.16	167			0.16	167
	7	0.11	173			0.11	173
	8+	0.09	158			0.09	158
	Total	16.44		8.49		24.92	
	SOP		1,224		152		1,376

Quarter	W-rings	Fleet C Numbers	Fleet C Mean W.	Fleet D Numbers	Fleet D Mean W.	Total Numbers	Total Mean W.
3	0	0.29	22	33.87	16	34.17	16
	1	44.72	57	13.58	28	58.30	50
	2	14.31	83			14.31	83
	3	3.44	114	0.63	120	4.07	115
	4	1.01	152	0.19	150	1.20	151
	5	1.27	157	0.10	157	1.37	157
	6	0.29	158			0.29	158
	7	0.00	186			0.00	186
	8+						
	Total	65.34		48.37		113.71	
	SOP		4,510		1,028		5,539

Quarter	W-rings	Fleet C Numbers	Fleet C Mean W.	Fleet D Numbers	Fleet D Mean W.	Total Numbers	Total Mean W.
4	0	2.50	36	23.81	24	26.31	25
	1	34.35	57	7.74	66	42.08	58
	2	8.04	86	1.61	87	9.65	86
	3	2.37	116	0.33	67	2.71	110
	4	0.83	151			0.83	151
	5	1.07	153			1.07	153
	6	0.21	158			0.21	158
	7	0.00	186			0.00	186
	8+						
	Total	49.37		33.49		82.87	
	SOP		3,324		1,237		4,560

Quarter	W-rings	Fleet C Numbers	Fleet C Mean W.	Fleet D Numbers	Fleet D Mean W.	Total Numbers	Total Mean W.
Total	0	2.79	35	57.69	19	60.48	20
	1	81.33	56	99.43	21	180.76	37
	2	105.79	67	24.00	47	129.78	63
	3	27.31	102	6.60	47	33.90	91
	4	4.57	131	0.22	147	4.79	132
	5	3.79	142	0.11	150	3.90	142
	6	0.75	162	0.01	182	0.76	163
	7	0.12	174			0.12	174
	8+	0.09	158			0.09	158
	Total	226.53		188.05		414.58	
	SOP		15,800		4,695		20,495

Table 3.2.4 HERRING in Division IIIa and Sub. Division 22-24.
Landings in numbers (mill.), mean weight (g.) and SOP (t) by age, quarter and fleet. ***North Sea Autumn spawners***
Division: Kattegat Year: 2004 Country: All

		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
1	1	0.24	33	8.52	16	8.76	16
	2	45.16	62	13.16	45	58.31	58
	3	2.10	98	0.61	38	2.71	84
	4						
	5						
	6						
	7						
	8+						
	Total	47.50		22.29		69.79	
	SOP		3,013		749		3,762
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
2	1	0.02	43	0.74	13	0.76	14
	2	8.98	64	1.28	36	10.26	61
	3	0.53	103			0.53	103
	4						
	5	0.09	142			0.09	142
	6						
	7						
	8+						
	Total	9.62		2.02		11.64	
	SOP		646		55		702
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
3	0	0.29	22	33.87	16	34.17	16
	1	8.05	57	2.44	28	10.49	50
	2	2.04	83			2.04	83
	3	0.14	114	0.03	120	0.17	115
	4	0.04	152	0.01	150	0.05	151
	5	0.05	157	0.00	157	0.06	157
	6	0.01	158			0.01	158
	7	0.00	186			0.00	186
	8+						
	Total	10.64		36.35		46.99	
	SOP		664		603		1,267
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
4	0	1.81	36	17.23	24	19.04	25
	1	5.15	57	1.16	66	6.31	58
	2	0.54	86	0.11	87	0.65	86
	3	0.07	116	0.01	67	0.08	110
	4						
	5						
	6						
	7						
	8+						
	Total	7.57		18.51		26.08	
	SOP		412		495		907
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
Total	0	2.10	34	51.10	18	53.20	19
	1	13.47	56	12.86	23	26.33	40
	2	56.72	63	14.55	44	71.27	59
	3	2.84	100	0.65	41	3.49	89
	4	0.04	152	0.01	150	0.05	151
	5	0.14	147	0.00	157	0.15	148
	6	0.01	158			0.01	158
	7	0.00	186			0.00	186
	8+						
	Total	75.33		79.17		154.50	
	SOP		4,736		1,902		6,638

Table 3.2.5 HERRING in Division IIIa and Sub. Division 22-24.
Landings in numbers (mill.), mean weight (g.) and SOP (t) by age, quarter and fleet. ***Western Baltic Spring spawners***
Division: Kattegat Year: 2004 Country: All

		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
1	1	1.80	33	62.95	16	64.75	16
	2	25.36	62	7.39	45	32.76	58
	3	17.15	98	5.02	38	22.17	84
	4	2.45	119	0.03	134	2.48	119
	5	1.04	114	0.01	99	1.05	114
	6	0.08	182	0.01	182	0.09	182
	7						
	8+						
	Total	47.88		75.41		123.30	
	SOP		3,729		1,530		5,258
		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
2	1	0.19	43	5.91	13	6.10	14
	2	3.93	64	0.56	36	4.49	61
	3	1.72	103			1.72	103
	4	0.28	113			0.28	113
	5	0.33	142			0.33	142
	6	0.16	167			0.16	167
	7	0.11	173			0.11	173
	8+	0.09	158			0.09	158
	Total	6.82		6.47		13.29	
	SOP		577		97		674
		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
3	0						
	1	36.67	57	11.13	28	47.80	50
	2	12.27	83			12.27	83
	3	3.30	114	0.60	120	3.90	115
	4	0.97	152	0.19	150	1.15	151
	5	1.22	157	0.09	157	1.31	157
	6	0.28	158			0.28	158
	7	0.00	186			0.00	186
	8+						
	Total	54.70		12.01		66.71	
	SOP		3,847		425		4,272
		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
4	0	0.69	36	6.59	24	7.28	25
	1	29.19	57	6.58	66	35.77	58
	2	7.50	86	1.50	87	9.00	86
	3	2.30	116	0.32	67	2.63	110
	4	0.83	151			0.83	151
	5	1.07	153			1.07	153
	6	0.21	158			0.21	158
	7	0.00	186			0.00	186
	8+						
	Total	41.80		14.99		56.79	
	SOP		2,912		742		3,653
		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
Total	0	0.69	36	6.59	24	7.28	25
	1	67.86	56	86.57	21	154.43	36
	2	49.06	71	9.45	51	58.51	68
	3	24.47	102	5.95	48	30.41	91
	4	4.52	131	0.22	147	4.74	132
	5	3.65	142	0.11	150	3.76	142
	6	0.74	163	0.01	182	0.74	163
	7	0.12	174			0.12	174
	8+	0.09	158			0.09	158
	Total	151.20		108.88		260.08	
	SOP		11,064		2,793		13,857

Table 3.2.6 HERRING in Division IIIa and Sub. Division 22-24.
Landings in numbers (mill.), mean weight (g.) and SOP (t) by age, quarter and fleet. ***North Sea Autumn spawners***
Division: Skagerrak Year: 2004 Country: All

Quarter	W-rings	Fleet C Numbers	Fleet C Mean W.	Fleet D Numbers	Fleet D Mean W.	Total Numbers	Total Mean W.
1	1	0.22	29	0.46	15	0.68	20
	2	48.17	67	5.11	67	53.28	67
	3	2.76	99	0.52	106	3.29	101
	4	3.07	131	0.04	140	3.11	132
	5	7.57	147	0.01	135	7.58	147
	6	1.20	167	0.02	174	1.21	167
	7	1.79	187			1.79	187
	8+	0.84	177			0.84	177
	Total	65.61		6.17		71.78	
	SOP		5,682		417		6,099
2	1			0.56	25	0.56	25
	2	4.57	116	30.33	73	34.90	79
	3	0.64	131	0.47	96	1.10	116
	4	0.04	134	0.05	117	0.09	126
	5	0.03	160	0.04	123	0.06	138
	6	0.03	161	0.02	150	0.05	157
	7	0.00	213	0.00	166	0.01	173
	8+			0.01	172	0.01	172
	Total	5.31		31.48		36.78	
	SOP		630		2,290		2,920
3	0			6.83	25	6.83	25
	1	1.67	77	28.86	64	30.53	65
	2	2.60	111	13.00	99	15.60	101
	3	3.59	136	6.20	132	9.78	133
	4	1.07	154	1.45	149	2.52	151
	5	0.82	170	0.95	174	1.77	172
	6	0.33	178	0.19	190	0.51	183
	7	0.07	194	0.10	184	0.17	188
	8+	0.01	222	0.01	245	0.02	232
	Total	10.15		57.59		67.74	
	SOP		1,283		4,574		5,856
4	0	11.12	22	17.27	33	28.39	29
	1	3.42	68	9.34	67	12.77	68
	2	2.16	114	2.73	101	4.89	107
	3	2.21	143	0.84	131	3.05	140
	4	0.20	160	0.06	127	0.26	152
	5	0.17	169	0.03	173	0.19	170
	6	0.04	135			0.04	135
	7						
	8+						
	Total	19.32		30.27		49.59	
	SOP		1,108		1,593		2,701
Total	0	11.12	22	24.10	31	35.22	28
	1	5.31	69	39.23	64	44.54	65
	2	57.49	74	51.18	81	108.67	77
	3	9.19	126	8.03	128	17.22	127
	4	4.39	138	1.60	147	5.99	141
	5	8.58	149	1.03	171	9.60	152
	6	1.60	169	0.22	185	1.82	171
	7	1.86	187	0.11	183	1.96	187
	8+	0.85	178	0.02	213	0.87	178
	Total	100.39		125.50		225.89	
	SOP		8,702		8,874		17,576

Table 3.2.7 HERRING in Division IIIa and Sub. Division 22-24.
Landings in numbers (mill.), mean weight (g.) and SOP (t) by age,
quarter and fleet. ***Wesern Baltic Spring spawners***
Division: Skagerrak Year: 2004 Country: All

		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
1	1	1.44	29	3.04	15	4.48	20
	2	3.35	67	0.36	67	3.71	67
	3	3.71	99	0.71	106	4.42	101
	4	1.60	131	0.02	140	1.62	132
	5	0.39	147	0.00	135	0.39	147
	6	0.22	167	0.00	174	0.23	167
	7	0.34	187			0.34	187
	8+	0.16	177			0.16	177
	Total	11.21		4.12		15.33	
	SOP		1,029		149		1,178
		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
2	1			0.31	25	0.31	25
	2	0.46	116	3.03	73	3.49	79
	3	3.82	131	2.81	96	6.63	116
	4	0.58	134	0.59	117	1.17	126
	5	1.14	160	1.70	123	2.84	138
	6	0.57	161	0.35	150	0.92	157
	7	0.01	213	0.08	166	0.09	173
	8+			0.13	172	0.13	172
	Total	6.59		8.99		15.59	
	SOP		908		865		1,773
		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
3	0			3.42	25	3.42	25
	1	1.10	77	19.05	64	20.15	65
	2	1.99	111	9.96	99	11.95	101
	3	7.36	136	12.72	132	20.09	133
	4	2.84	154	3.86	149	6.70	151
	5	2.50	170	2.89	174	5.38	172
	6	0.98	178	0.56	190	1.54	183
	7	0.20	194	0.31	184	0.51	188
	8+	0.04	222	0.03	245	0.07	232
	Total	17.02		52.79		69.80	
	SOP		2,391		5,222		7,614
		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
4	0	5.87	22	9.11	33	14.98	29
	1	8.04	68	21.94	67	29.97	68
	2	1.42	114	1.80	101	3.22	107
	3	3.29	143	1.25	131	4.54	140
	4	0.38	160	0.11	127	0.49	152
	5	0.31	169	0.05	173	0.36	170
	6	0.07	135			0.07	135
	7						
	8+						
	Total	19.38		34.26		53.63	
	SOP		1,432		2,146		3,577
		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
Total	0	5.87	22	12.52	31	18.39	28
	1	10.58	63	44.33	62	54.92	62
	2	7.22	91	15.15	94	22.37	93
	3	18.18	129	17.49	125	35.67	127
	4	5.40	146	4.58	145	9.98	145
	5	4.34	165	4.64	155	8.98	160
	6	1.85	170	0.91	175	2.76	171
	7	0.55	190	0.39	180	0.94	186
	8+	0.20	186	0.16	185	0.35	186
	Total	54.19		100.16		154.35	
	SOP		5,761		8,381		14,142

Table 3.2.8 HERRING in Division IIIa and Sub. Division 22-24.
Landings in numbers (mill.), mean weight (g.) and SOP (t) by age, quarter and fleet. ***North Sea Autumn spawners***

Division: IIIa Year: 2004 Country: All

		Fleet C		Fleet D		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
1	1	0.46	31	8.98	16	9.44	17
	2	93.32	64	18.27	51	111.59	62
	3	4.86	99	1.14	69	6.00	93
	4	3.07	131	0.04	140	3.11	132
	5	7.57	147	0.01	135	7.58	147
	6	1.20	167	0.02	174	1.21	167
	7	1.79	187			1.79	187
	8+	0.84	177			0.84	177
	Total	113.11		28.46		141.57	
	SOP		8,695		1,166		9,861
		Fleet C		**Fleet D**		**Total**	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
2	1	0.02	43	1.30	18	1.32	19
	2	13.55	82	31.61	72	45.16	75
	3	1.16	118	0.47	96	1.63	112
	4	0.04	134	0.05	117	0.09	126
	5	0.11	146	0.04	123	0.15	140
	6	0.03	161	0.02	150	0.05	157
	7	0.00	213	0.00	166	0.01	173
	8+			0.01	172	0.01	172
	Total	14.93		33.50		48.42	
	SOP		1,276		2,346		3,622
		Fleet C		**Fleet D**		**Total**	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
3	0	0.29	22	40.70	17	41.00	17
	1	9.72	60	31.31	61	41.02	61
	2	4.64	99	13.00	99	17.65	99
	3	3.73	135	6.22	131	9.95	133
	4	1.11	154	1.46	149	2.57	151
	5	0.87	169	0.95	174	1.82	172
	6	0.34	178	0.19	190	0.52	182
	7	0.07	194	0.10	184	0.17	188
	8+	0.01	222	0.01	245	0.02	232
	Total	20.79		93.94		114.73	
	SOP		1,946		5,177		7,123
		Fleet C		**Fleet D**		**Total**	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
4	0	12.93	24	34.49	28	47.43	27
	1	8.58	61	10.50	67	19.08	64
	2	2.70	109	2.84	100	5.54	104
	3	2.28	142	0.85	130	3.13	139
	4	0.20	160	0.06	127	0.26	152
	5	0.17	169	0.03	173	0.19	170
	6	0.04	135			0.04	135
	7						
	8+						
	Total	26.89		48.77		75.67	
	SOP		1,520		2,087		3,608
		Fleet C		**Fleet D**		**Total**	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
Total	0	13.22	24	75.20	22	88.42	23
	1	18.78	60	52.09	54	70.87	55
	2	114.22	69	65.72	73	179.94	70
	3	12.03	120	8.68	121	20.72	121
	4	4.43	138	1.60	147	6.04	141
	5	8.72	149	1.03	171	9.75	152
	6	1.61	169	0.22	185	1.83	171
	7	1.86	187	0.11	183	1.96	187
	8+	0.85	178	0.02	213	0.87	178
	Total	175.72		204.67		380.39	
	SOP		13,438		10,776		24,214

Table 3.2.9 HERRING in Division IIIa and Sub. Division 22-24.
Landings in numbers (mill.), mean weight (g.) and SOP (t) by age, quarter and fleet. ***Western Baltic Spring spawners***
Division: IIIa Year: 2004 Country: All

Quarter	W-rings	Fleet C Numbers	Fleet C Mean W.	Fleet D Numbers	Fleet D Mean W.	Total Numbers	Total Mean W.
1	1	3.24	31	65.99	16	69.24	17
	2	28.72	63	7.75	46	36.46	59
	3	20.86	98	5.73	46	26.58	87
	4	4.05	124	0.05	136	4.10	124
	5	1.43	123	0.01	101	1.44	123
	6	0.30	171	0.01	180	0.31	171
	7	0.34	187			0.34	187
	8+	0.16	177			0.16	177
	Total	59.09		79.54		138.63	
	SOP		4,758		1,678		6,436
2	1	0.19	43	6.21	14	6.41	14
	2	4.39	70	3.59	67	7.98	69
	3	5.54	122	2.81	96	8.35	113
	4	0.86	127	0.59	117	1.45	123
	5	1.47	156	1.70	123	3.17	138
	6	0.74	162	0.35	150	1.09	158
	7	0.13	178	0.08	166	0.20	173
	8+	0.09	158	0.13	172	0.22	166
	Total	13.41		15.46		28.87	
	SOP		1,486		961		2,447
3	0			3.42	25	3.42	25
	1	37.77	57	30.18	51	67.95	54
	2	14.26	87	9.96	99	24.22	92
	3	10.66	129	13.32	131	23.98	130
	4	3.81	154	4.05	149	7.85	151
	5	3.71	166	2.98	173	6.69	169
	6	1.26	174	0.56	190	1.82	179
	7	0.21	193	0.31	184	0.51	188
	8+	0.04	222	0.03	245	0.07	232
	Total	71.72		64.80		136.52	
	SOP		6,238		5,647		11,886
4	0	6.56	24	15.70	29	22.25	27
	1	37.23	59	28.51	67	65.75	63
	2	8.92	90	3.30	94	12.22	91
	3	5.59	132	1.57	118	7.16	129
	4	1.21	154	0.11	127	1.32	152
	5	1.38	156	0.05	173	1.43	157
	6	0.29	152			0.29	152
	7	0.00	186			0.00	186
	8+						
	Total	61.18		49.24		110.42	
	SOP		4,343		2,888		7,231
Total	0	6.56	24	19.11	28	25.67	27
	1	78.44	57	130.90	35	209.34	43
	2	56.29	74	24.60	77	80.88	75
	3	42.65	113	23.43	105	66.08	110
	4	9.93	139	4.79	145	14.72	141
	5	7.99	155	4.75	155	12.73	155
	6	2.59	168	0.92	175	3.50	170
	7	0.67	187	0.39	180	1.06	184
	8+	0.29	177	0.16	185	0.45	180
	Total	205.39		209.04		414.44	
	SOP		16,825		11,175		27,999

Table 3.2.10 HERRING in Division IIIa and Sub. Division 22-24. Landings in numbers (mill.), mean weight (g.) and SOP (t) by age and quarter.

Division: 22-24 Year: 2004 Country: ALL

		Sub-division 22		Sub-division 23		Sub-division 24		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
1	1	110.21	10	0.43	62	39.53	15	150.17	11
	2	13.84	32	0.61	92	45.45	38	59.90	37
	3	1.38	60	0.80	135	25.11	74	27.30	76
	4	0.50	65	0.06	159	30.34	108	30.90	107
	5			0.47	151	36.63	145	37.10	145
	6			0.04	142	19.97	163	20.02	163
	7			0.07	170	7.51	194	7.59	194
	8+					4.43	209	4.43	209
	Total	125.94		2.49		208.98		337.41	
	SOP		1,669		290		18,400		20,359
		Sub-division 22		Sub-division 23		Sub-division 24		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
2	1	60.94	8	0.01	71	9.99	15	70.94	9
	2			1.13	61	9.11	42	10.24	44
	3			0.07	79	11.01	70	11.09	70
	4			0.01	111	21.18	93	21.19	93
	5					23.24	114	23.24	114
	6					19.58	142	19.58	142
	7					4.46	130	4.46	130
	8+			0.01	173	5.31	110	5.31	110
	Total	60.94		1.23		103.88		166.05	
	SOP		498		78		9,870		10,446
		Sub-division 22		Sub-division 23		Sub-division 24		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
3	0	0.00	11	0.06	22	0.09	33	0.15	29
	1	0.11	23	3.75	54	3.84	38	7.70	45
	2	0.00	51	1.52	84	7.52	47	9.04	53
	3	0.00	74	0.46	115	7.42	63	7.88	66
	4			0.19	152	6.86	63	7.06	65
	5			0.24	157	4.44	72	4.68	77
	6			0.06	158	1.33	78	1.39	81
	7			0.00	186	0.32	102	0.32	102
	8+					0.55	81	0.55	81
	Total	0.12		6.27		32.38		38.77	
	SOP		3		460		1,900		2,363
		Sub-division 22		Sub-division 23		Sub-division 24		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
4	0	207.58	3	0.09	22	10.07	9	217.74	4
	1			5.82	54	13.79	39	19.61	43
	2			2.36	84	20.25	72	22.61	73
	3			0.71	115	23.81	86	24.52	87
	4			0.30	152	15.51	92	15.82	93
	5			0.38	157	8.99	99	9.37	102
	6			0.09	158	3.38	153	3.47	154
	7			0.00	186	0.99	137	0.99	137
	8+					0.13	168	0.13	168
	Total	207.58		9.75		96.93		314.25	
	SOP		712		715		7,142		8,569
		Sub-division 22		Sub-division 23		Sub-division 24		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
t	0	207.58	3	0.14	22	10.16	9	217.88	4
	1	171.26	9	10.01	54	67.14	21	248.41	14
	2	13.84	32	5.61	80	82.34	48	101.79	47
	3	1.38	60	2.04	121	67.36	77	70.79	78
	4	0.50	65	0.57	151	73.90	96	74.97	96
	5			1.10	154	73.30	125	74.40	125
	6			0.19	154	44.26	150	44.45	150
	7			0.07	171	13.29	166	13.36	166
	8+			0.01	173	10.42	151	10.42	151
	Total	394.58		19.74		442.17		856.48	
	SOP		2,881		1,543		37,312		41,736

Table 3.2.11 HERRING in Division IIIa and Sub. Division 22-24.
Landings in numbers (mill.), mean weight (g.) and SOP (t)
by age and quarter from. Western Baltic Spring Spawners
(values from the North Sea, see Table 2.2.1-2.2.5)
Division: IV + IIIa + 22-24 Year: 2004

		Division IV		Division IIIa		Sub-division 22-24		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
1	1			69.24	17	150.17	11	219.41	13
	2			36.46	59	59.90	37	96.36	46
	3			26.58	87	27.30	76	53.88	81
	4			4.10	124	30.90	107	35.00	109
	5			1.44	123	37.10	145	38.55	144
	6			0.31	171	20.02	163	20.33	163
	7			0.34	187	7.59	194	7.92	193
	8+			0.16	177	4.43	209	4.59	208
	Total	0.00		138.63		337.41		476.04	
	SOP		0		6,436		20,359		26,795

		Division IV		Division IIIa		Sub-division 22-24		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
2	1			6.41	14	70.94	9	77.34	10
	2	14.50	121	7.98	69	10.24	44	32.73	84
	3	17.77	133	8.35	113	11.09	70	37.20	110
	4	0.70	164	1.45	123	21.19	93	23.34	97
	5	1.12	166	3.17	138	23.24	114	27.53	119
	6	0.43	175	1.09	158	19.58	142	21.10	144
	7	0.12	184	0.20	173	4.46	130	4.79	133
	8+	0.12	207	0.22	166	5.31	110	5.66	114
	Total	34.77		28.87		166.05		229.69	
	SOP		4,533		2,447		10,446		17,426

		Division IV		Division IIIa		Sub-division 22-24		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
3	0			3.42	25	0.15	29		
	1			67.95	54	7.70	45	75.65	53
	2	0.63	120.60	24.22	92	9.04	53	33.90	82
	3	10.13	133	23.98	130	7.88	66	41.99	119
	4	2.82	164	7.85	151	7.06	65	17.73	119
	5	2.99	166	6.69	169	4.68	77	14.36	138
	6	0.57	175	1.82	179	1.39	81	3.77	142
	7	0.34	184	0.51	188	0.32	102	1.17	163
	8+	0.02	214	0.07	232	0.55	81	0.64	102
	Total	17.50		136.52		38.77		189.23	
	SOP		2,546		11,886		2,363		16,705

		Division IV		Division IIIa		Sub-division 22-24		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
4	0			22.25	27	217.74	4	239.99	6
	1			65.75	63	19.61	43	85.35	58
	2			12.22	91	22.61	73	34.83	80
	3			7.16	129	24.52	87	31.68	97
	4			1.32	152	15.82	93	17.13	98
	5			1.43	157	9.37	102	10.81	109
	6			0.29	152	3.47	154	3.76	153
	7			0.00	186	0.99	137	1.00	137
	8+					0.13	168	0.13	168
	Total	0.00		110.42		314.25		424.67	
	SOP		0		7,231		8,569		15,799

		Division IV		Division IIIa		Sub-division 22-24		Total	
Quarter	W-rings	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.	Numbers	Mean W.
Total	0			25.67	27	217.88	4	243.55	6
	1			209.34	43	248.41	14	457.75	28
	2	15.14	121	80.88	75	101.79	47	197.81	64
	3	27.90	133	66.08	110	70.79	78	164.77	100
	4	3.52	164	14.72	141	74.97	96	93.21	106
	5	4.11	166	12.73	155	74.40	125	91.24	131
	6	1.00	175	3.50	170	44.45	150	48.96	152
	7	0.46	184	1.06	184	13.36	166	14.88	168
	8+	0.15	208	0.45	180	10.42	151	11.01	153
	Total	52.27		414.44		856.48		1,323.19	
	SOP		7,079		27,999		41,736		76,815

Table 3.2.12 HERRING in Division IIIa and the North Sea
Total catch in numbers (mill) and mean weight (g), SOP (tonnes) of *Western Baltic Spring spawners* in Division IIIa and the North Sea in the years 1991-2004.

Year	W-rings	0	1	2	3	4	5	6	7	8+	Total
1991	Numbers	100.00	157.43	382.91	394.77	166.97	112.35	21.86	7.33	3.15	1,346.77
	Mean W.	33.0	48.6	69.5	99.9	135.7	146.2	166.9	179.7	193.2	
	SOP	3,300	7,656	26,614	39,455	22,657	16,430	3,648	1,318	609	121,687
1992	Numbers	109.08	246.00	321.85	174.02	154.47	78.33	55.83	17.91	8.53	1,166.03
	Mean W.	13.9	44.1	87.0	112.9	136.2	166.3	183.5	194.4	203.6	
	SOP	1,516	10,841	27,986	19,653	21,035	13,030	10,243	3,481	1,737	109,523
1993	Numbers	161.25	371.50	315.82	219.05	94.08	59.43	40.97	21.71	8.22	1,292.03
	Mean W.	15.1	25.9	81.4	127.5	150.1	171.1	195.9	209.1	239.0	
	SOP	2,435	9,612	25,696	27,936	14,120	10,167	8,027	4,541	1,966	104,498
1994	Numbers	60.62	153.11	261.14	221.64	130.97	77.30	44.40	14.39	8.62	972.19
	Mean W.	20.2	42.6	94.8	122.7	150.3	168.7	194.7	209.9	220.2	
	SOP	1,225	6,524	24,767	27,206	19,686	13,043	8,642	3,022	1,898	106,013
1995	Numbers	50.31	302.51	204.19	97.93	90.86	30.55	21.28	12.01	7.24	816.86
	Mean W.	17.9	41.5	97.8	138.0	163.1	198.5	207.0	228.8	234.3	
	SOP	902	12,551	19,970	13,517	14,823	6,065	4,404	2,747	1,696	76,674
1996	Numbers	166.23	228.05	317.74	75.60	40.41	30.63	12.58	6.73	5.63	883.60
	Mean W.	10.5	27.6	90.1	134.9	164.9	186.6	204.1	208.5	220.2	
	SOP	1,748	6,296	28,618	10,197	6,665	5,714	2,568	1,402	1,241	64,449
1997	Numbers	25.97	73.43	158.71	180.06	30.15	14.15	4.77	1.75	2.31	491.31
	Mean W.	19.2	49.7	76.7	127.2	154.4	175.8	184.4	192.0	208.0	
	SOP	498	3,648	12,176	22,913	4,656	2,489	879	337	480	48,075
1998	Numbers	36.26	175.14	315.15	94.53	54.72	11.19	8.72	2.19	2.09	699.98
	Mean W.	27.8	51.3	71.5	108.8	142.6	171.7	194.4	184.2	230.0	
	SOP	1,009	8,980	22,542	10,287	7,804	1,922	1,695	403	481	55,121
1999	Numbers	41.34	190.29	155.67	122.26	43.16	22.21	4.42	3.02	2.40	584.77
	Mean W.	11.5	51.0	83.6	114.9	121.2	145.2	169.6	123.8	152.3	
	SOP	477	9,698	13,012	14,048	5,232	3,225	749	373	366	47,179
2000	Numbers	114.83	318.22	302.10	99.88	50.85	18.76	8.21	1.35	1.40	915.60
	Mean W.	22.6	31.9	67.4	107.7	140.2	170.0	157.0	185.0	210.1	
	SOP	2,601	10,145	20,357	10,756	7,131	3,189	1,288	249	294	56,010
2001	Numbers	121.68	36.63	208.10	111.08	32.06	19.67	9.84	4.17	2.42	545.65
	Mean W.	9.0	51.2	76.2	108.9	145.3	171.4	188.2	187.2	203.3	
	SOP	1,096	1,875	15,863	12,093	4,657	3,371	1,852	780	492	42,079
2002	Numbers	69.63	577.69	168.26	134.60	53.09	12.05	7.48	2.43	2.02	1,027.26
	Mean W.	10.2	20.4	78.2	117.7	143.8	169.8	191.9	198.2	215.5	
	SOP	709	11,795	13,162	15,848	7,632	2,046	1,435	481	435	53,544
2003	Numbers	52.11	63.02	182.53	65.45	64.37	21.47	6.26	4.35	1.81	461.38
	Mean W.	13.0	37.4	76.5	113.3	132.7	142.2	153.5	169.9	162.2	
	SOP	678	2,355	13,957	7,416	8,540	3,053	961	740	294	37,994
2004	Numbers	243.55	457.75	197.81	164.77	93.21	91.24	48.96	14.88	11.01	1,323.19
	Mean W.	6.2	27.5	64.2	100.2	106.0	131.4	152.3	167.7	152.9	
	SOP	1,506	12,608	12,698	16,505	9,877	11,988	7,455	2,494	1,685	76,815

Data for 1995 to 2001 was revised in 2003.

Table 3.2.13 HERRING in Division IIIa and Sub. Division 22-24.
Transfers of North Sea autumn spawners from Div. IIIa to the North Sea
Numbers (mill) and mean weight, SOP in (tonnes) 1991-2004.

Year	W-Rings	0	1	2	3	4	5	6	7	8+	Total
1991	Number	677.1	748.3	298.3	52.4	7.7	5.1	1.1	0.4	0.1	1,790.6
	Mean W.	25.6	40.5	72.9	97.2	135.8	149.7	155.7	159.8	176.8	
	SOP	17,314	30,336	21,744	5,098	1,049	771	178	59	26	76,575
1992	Number	2,298.4	1,408.8	220.3	22.1	10.4	6.6	2.9	1.0	0.4	3,970.9
	Mean W.	12.3	51.8	84.2	131.4	162.0	173.4	185.3	198.4	201.2	
	SOP	28,159	72,985	18,557	2,907	1,683	1,143	533	200	84	126,251
1993	Number	2,795.4	2,032.5	237.6	26.5	7.7	3.6	2.7	2.2	0.7	5,109.0
	Mean W.	12.5	28.6	79.7	141.4	132.3	233.4	238.5	180.6	203.1	
	SOP	34,903	58,107	18,939	3,749	1,016	850	647	390	133	118,734
1994	Number	481.6	1,086.5	201.4	26.9	6.0	2.9	1.6	0.4	0.2	1,807.5
	Mean W.	16.0	42.9	83.4	110.7	138.3	158.6	184.6	199.1	213.9	
	SOP	7,723	46,630	16,790	2,980	831	460	287	75	37	75,811
1995	Number	1,144.5	1,189.2	161.5	13.3	3.5	1.1	0.6	0.4	0.3	2,514.4
	Mean W.	11.2	39.1	88.3	145.7	165.5	204.5	212.2	236.4	244.3	
	SOP	12,837	46,555	14,267	1,940	573	225	133	86	65	76,680
1996	Number	516.1	961.1	161.4	17.0	3.4	1.6	0.7	0.4	0.3	1,661.9
	Mean W.	11.0	23.4	80.2	126.6	165.0	186.5	216.1	216.3	239.1	
	SOP	5,697	22,448	12,947	2,151	565	307	145	77	66	44,403
1997	Number	67.6	305.3	131.7	21.2	1.7	0.8	0.2	0.1	0.1	528.7
	Mean W.	19.3	47.7	68.5	124.4	171.5	184.7	188.7	188.7	192.4	
	SOP	1,304	14,571	9,025	2,643	285	146	40	16	25	28,057
1998	Number	51.3	745.1	161.5	26.6	19.2	3.0	3.1	1.2	0.5	1,011.6
	Mean W.	27.4	56.4	79.8	117.8	162.9	179.7	197.2	178.9	226.3	
	SOP	1,409	41,994	12,896	3,137	3,136	547	608	211	108	64,045
1999	Number	598.8	303.0	148.6	47.2	13.4	6.2	1.2	0.5	0.5	1,119.4
	Mean W.	10.4	50.5	87.7	113.7	137.4	156.5	188.1	187.3	198.8	
	SOP	6,255	15,297	13,037	5,369	1,841	974	230	90	92	43,186
2000	Number	235.3	984.3	116.0	21.9	22.9	7.5	3.3	0.6	0.1	1,391.8
	Mean W.	21.3	28.5	76.1	108.8	163.1	190.3	183.9	189.4	200.2	
	SOP	5,005	28,012	8,825	2,377	3,731	1,436	601	114	13	50,115
2001	Number	807.8	563.6	150.0	17.2	1.4	0.3	0.5	0.0	0.0	1,540.8
	Mean W.	8.7	49.4	75.3	108.2	130.1	147.1	219.1	175.8	198.1	
	SOP	7,029	27,849	11,300	1,856	177	43	109	8	5	48,376
2002	Number	478.5	362.6	56.7	5.6	0.7	0.2	0.1	0.0	0.0	904.5
	Mean W.	12.2	38.0	100.6	121.5	142.7	160.9	178.7	177.4	218.6	
	SOP	5,859	13,790	5,705	684	106	26	21	8	5	26,205
2003	Number	21.6	445.0	182.3	13.0	16.2	1.8	1.1	1.2	0.2	682.4
	Mean W.	20.5	33.7	67.0	123.2	150.3	163.5	190.2	214.6	186.8	
	SOP	442	14,992	12,219	1,606	2,436	293	213	264	33	32,498
2004	Number	88.4	70.9	179.9	20.7	6.0	9.7	1.8	2.0	0.9	380.4
	Mean W.	22.5	55.3	70.2	120.6	140.9	151.7	170.6	186.6	178.5	
	SOP	1,993	3,921	12,638	2,498	851	1,479	312	367	154	24,214

Corrections for the years 1991-1998 was made in WG2001, but are NOT included in the North Sea assessment.

Table 3.2.14 **HERRING in Division IIIa and Sub. Division 22-24.**
Total catch in numbers (mill) of *Western Baltic Spring Spawners* in Division IIIa and the North Sea + in Sub-Divisions 22-24 in the years 1991-2004

	W-rings	0	1	2	3	4	5	6	7	8+	Total
Year	Area										
1991	Div. IV+Div. IIIa	100.0	157.4	382.9	394.8	167.0	112.4	21.9	7.3	3.2	1246.8
	Sub-div. 22-24	19.0	668.5	158.3	169.7	112.8	65.1	24.6	5.9	1.8	1206.8
1992	Div. IV+Div. IIIa	109.1	246.0	321.9	174.0	154.5	78.3	55.8	17.9	8.5	1056.9
	Sub-div. 22-24	36.0	210.7	280.8	190.8	179.5	104.9	84.0	34.8	14.0	1099.5
1993	Div. IV+Div. IIIa	161.3	371.5	315.8	219.0	94.1	59.4	41.0	21.7	8.2	1130.8
	Sub-div. 22-24	44.9	159.2	180.1	196.1	166.9	151.1	61.8	42.2	16.3	973.7
1994	Div. IV+Div. IIIa	60.6	153.1	261.1	221.6	131.0	77.3	44.4	14.4	8.6	911.6
	Sub-div. 22-24	202.6	96.3	103.8	161.0	136.1	90.8	74.0	35.1	24.5	721.6
1995	Div. IV+Div. IIIa	50.3	302.5	204.2	97.9	90.9	30.6	21.3	12.0	7.2	816.9
	Sub-div. 22-24	491.0	1,358.2	233.9	128.9	104.0	53.6	38.8	20.9	13.2	1951.5
1996	Div. IV+Div. IIIa	166.2	228.1	317.7	75.6	40.4	30.6	12.6	6.7	5.6	883.6
	Sub-div. 22-24	4.9	410.8	82.8	124.1	103.7	99.5	52.7	24.0	19.5	917.1
1997	Div. IV+Div. IIIa	26.0	73.4	158.7	180.1	30.2	14.2	4.8	1.8	2.3	491.3
	Sub-div. 22-24	350.8	595.2	130.6	96.9	45.1	29.0	35.1	19.5	21.8	973.2
1998	Div. IV+Div. IIIa	36.3	175.1	315.1	94.5	54.7	11.2	8.7	2.2	2.1	700.0
	Sub-div. 22-24	513.5	447.9	115.8	88.3	92.0	34.1	15.0	13.2	12.0	818.4
1999	Div. IV+Div. IIIa	41.34	190.29	155.67	122.26	43.16	22.21	4.42	3.02	2.40	584.8
	Sub-div. 22-24	528.3	425.8	178.7	123.9	47.1	33.7	11.1	6.5	3.7	830.5
2000	Div. IV+Div. IIIa	114.8	318.2	302.1	99.9	50.8	18.8	8.2	1.3	1.4	915.6
	Sub-div. 22-24	37.7	616.3	194.3	86.7	77.8	53.0	30.1	12.4	9.3	1079.9
2001	Div. IV+Div. IIIa	121.7	36.6	208.1	111.1	32.1	19.7	9.8	4.2	2.4	545.6
	Sub-div. 22-24	634.6	486.5	280.7	146.8	76.0	48.7	29.3	14.1	4.3	1721.0
2002	Div. IV+Div. IIIa	69.6	577.7	168.3	134.6	53.1	12.0	7.5	2.4	2.0	1027.3
	Sub-div. 22-24	80.6	81.4	113.6	186.7	119.2	45.1	31.1	11.4	6.3	675.4
2003	Div. IV+Div. IIIa	52.1	63.0	182.5	64.0	62.2	20.3	5.9	3.8	1.6	455.5
	Sub-div. 22-24	1.4	63.9	82.3	95.8	125.1	82.2	22.9	13.1	7.0	493.6
2004	Div. IV+Div. IIIa	25.7	209.3	96.0	94.0	18.2	16.8	4.5	1.5	0.6	466.7
	Sub-div. 22-24	217.9	248.4	101.8	70.8	75.0	74.4	44.5	13.4	10.4	856.5

Data for 1995-2001 for the North Sea and Div. IIIa was revised in 2003.

Table 3.2.15 **HERRING in Division IIIa and Sub. Division 22-24.**
Mean weight (g) and SOP (tons) of *Western Baltic Spring Spawners* in Division IIIa + the North Sea and in Sub-Divisions 22-24 in the years 1991 - 2003

	W-rings	0	1	2	3	4	5	6	7	8+	SOP
Year	Area										
1991	Div. IV+Div. IIIa	33.0	48.6	69.5	99.9	135.7	146.2	166.9	179.7	193.2	121,687
	Sub-div. 22-24	11.5	31.5	60.4	83.2	105.2	126.6	145.6	160.0	163.7	69,886
1992	Div. IV+Div. IIIa	13.9	44.1	87.0	112.9	136.2	166.3	183.5	194.4	203.6	109,523
	Sub-div. 22-24	19.1	23.3	44.8	77.4	99.2	123.3	152.9	166.2	184.2	84,888
1993	Div. IV+Div. IIIa	15.1	25.9	81.4	127.5	150.1	171.1	195.9	209.1	239.0	104,498
	Sub-div. 22-24	16.2	24.5	44.5	73.6	94.1	122.4	149.4	168.5	178.7	80,512
1994	Div. IV+Div. IIIa	20.2	42.6	94.8	122.7	150.3	168.7	194.7	209.9	220.2	106,013
	Sub-div. 22-24	12.9	28.2	54.2	76.4	95.0	117.7	133.6	154.3	173.9	66,425
1995	Div. IV+Div. IIIa	17.9	41.5	97.8	138.0	163.1	198.5	207.0	228.8	234.3	76,674
	Sub-div. 22-24	9.3	16.3	42.8	68.3	88.9	125.4	150.4	193.3	207.4	74,157
1996	Div. IV+Div. IIIa	10.5	27.6	90.1	134.9	164.9	186.6	204.1	208.5	220.2	64,449
	Sub-div. 22-24	12.1	22.9	45.8	74.0	92.1	116.3	120.8	139.0	182.5	56,817
1997	Div. IV+Div. IIIa	19.2	49.7	76.7	127.2	154.4	175.8	184.4	192.0	208.0	48,075
	Sub-div. 22-24	30.4	24.7	58.4	101.0	120.7	155.2	181.3	197.1	208.8	67,513
1998	Div. IV+Div. IIIa	27.8	51.3	71.5	108.8	142.6	171.7	194.4	184.2	230.0	55,121
	Sub-div. 22-24	13.3	26.3	52.2	78.6	103.0	125.2	150.0	162.1	179.5	51,911
1999	Div. IV+Div. IIIa	11.5	51.0	83.6	114.9	121.2	145.2	169.6	123.8	152.3	47,179
	Sub-div. 22-24	11.1	26.9	50.4	81.6	112.0	148.4	151.4	167.8	161.0	50,060
2000	Div. IV+Div. IIIa	22.6	31.9	67.4	107.7	140.2	170.0	157.0	185.0	210.1	56,010
	Sub-div. 22-24	16.5	22.2	42.8	80.4	123.5	133.2	143.4	155.4	151.4	53,904
2001	Div. IV+Div. IIIa	9.0	51.2	76.2	108.9	145.3	171.4	188.2	187.2	203.3	42,079
	Sub-div. 22-24	12.9	22.3	46.8	69.0	93.5	150.8	145.1	146.3	153.1	63,724
2002	Div. IV+Div. IIIa	10.2	20.4	78.2	117.7	143.8	169.8	191.9	198.2	215.5	53,544
	Sub-div. 22-24	10.8	27.3	57.8	81.7	108.8	132.1	186.6	177.8	157.7	52,647
2003	Div. IV+Div. IIIa	13.0	37.4	76.5	112.7	132.1	140.8	151.9	167.4	158.2	37,075
	Sub-div. 22-24	22.4	25.8	46.4	75.3	95.2	117.2	125.9	157.1	162.6	40,315
2004	Div. IV+Div. IIIa	27.1	43.2	81.9	117.1	145.4	157.4	170.7	184.4	187.1	35,078
	Sub-div. 22-24	3.7	14.3	47.4	77.7	96.4	125.5	150.4	165.8	151.0	41,736

Data for 1995-2001 for the North Sea and Div. IIIa was revised in 2003.

Table 3.2.16 HERRING in Division IIIa and Sub. Division 22-24. Samples of commercial landings by quarter and area for 2004 available to the Working Group.

	Country	Quarter	Landings in '000 tons	Numbers of samples	Numbers of fish meas.	Numbers of fish aged
Skagerrak	**Denmark**	**1**	2.4	7	439	368
		2	0.6	19	77	64
		3	3.8	21	1,896	1,280
		4	1.2	13	523	483
	Total		8.0	60	2,935	2,195
	Germany	**1**	-			
		2	-		No data available	
		3	0.5			
		4	-			
	Total		0.5	0	0	0
	Norway	**1**	0.6			
		2	0.6		No data available	
		3	0.1			
		4	0.1			
	Total		1.4	0	0	0
	Sweden	**1**	4.3	16	897	896
		2	3.4	15	664	664
		3	9.1	19	969	967
		4	4.9	14	757	755
	Total		21.8	64	3,287	3,282
Kattegat	**Denmark**	**1**	4.3	15	1,630	1,158
		2	0.4	3	209	183
		3	3.4	12	556	282
		4	2.8	14	1,181	700
	Total		10.9	44	3,576	2,323
	Sweden	**1**	4.7	14	900	899
		2	1.0	3	259	259
		3	2.1	2	300	300
		4	1.7	7	350	349
	Total		9.6	26	1,809	1,807
Sub-Division 22	**Denmark**	**1**	0.2	13	560	356
		2	0.1	1	42	42
		3	0.0	6	153	151
		4	0.0	1	7	7
	Total		0.3	21	762	556
	Germany	**1**	1.5			
		2	0.4		No data available	
		3	0.0			
		4	0.7			
	Total		2.5	0	0	0
Sub-Division 23	**Denmark**	**1**	0.3		No data available	
		2	0.1		No data available	
		3	0.3		No data available	
		4	0.5	1	125	51
	Total		1.2	1	125	51
	Sweden	**1**	0.0			
		2	0.0		No data available	
		3	0.1			
		4	0.2			
	Total		0.3	0	0	0
Sub-Division 24	**Denmark**	**1**	2.9	2	146	98
		2	1.1	2	152	95
		3	0.2		No data available	
		4	2.6	4	161	102
	Total		6.8	8	459	295
	Germany	**1**	9.3	20	5,675	1,517
		2	4.8	12	4,197	900
		3	0.0			
		4	1.3	7	2,244	562
	Total		15.5	39	12,116	2,979
	Poland	**1**	0.5	2	329	101
		2	3.0	5	969	271
		3	1.3	1	218	71
		4	0.7	3	658	180
	Total		5.5	11	2174	623
	Sweden	**1**	5.6	22	2,466	1,348
		2	1.0	12	964	666
		3	0.5	2	96	95
		4	2.5	3	143	141
	Total		9.5	39	3,669	2,250

Table 3.2.17 HERRING in Division IIIa and Sub. Division 22-24. Samples of landings by quarter and area used to to estimate catch in numbers and mean weight by age for 2004

	Country	Quarter	Fleet	Sampling
Skagerrak	**Denmark**	**1**	**C**	Danish sampling in Q1
		2	**C**	Danish sampling in Q2 in area IVaE
		3	**C**	Danish sampling in Q3
		4	**C**	Danish sampling in Q4
	Germany	**1**	**C**	No landings
		2	**C**	No landings
		3	**C**	Danish sampling in Q3
		4	**C**	No landings
	Norway	**1**	**C**	Danish sampling in Q1
		2	**C**	Danish sampling in Q2
		3	**C**	Norwegian sampling in Q3
		4	**C**	Danish sampling in Q4
	Sweden	**1**	**C**	Swedish sampling in Q1
		2	**C**	Danish sampling in Q2
		3	**C**	Danish sampling in Q3
		4	**C**	Swedish sampling in Q4
	Denmark	**1**	**D**	Danish sampling in Q1
		2	**D**	Danish sampling in Q2
		3	**D**	Danish sampling in Q3
		4	**D**	Danish sampling in Q4
	Sweden	**1**	**D**	Swedish sampling in Q1
		2	**D**	Swedish sampling in Q2
		3	**D**	Swedish sampling in Q3
		4	**D**	Swedish sampling in Q4
Kattegat	**Denmark**	**1**	**C**	Danish sampling in Q1
		2	**C**	Danish sampling in Q2
		3	**C**	Danish sampling in Q4
		4	**C**	Danish sampling in Q4
	Sweden	**1**	**C**	Swedish sampling in Q1
		2	**C**	Swedish sampling in Q2
		3	**C**	Swedish sampling in Q3
		4	**C**	Swedish sampling in Q4
	Denmark	**1**	**D**	Danish sampling in Q1
		2	**D**	Danish sampling in Q2
		3	**D**	Danish sampling in Q3
		4	**D**	Danish sampling in Q4
	Sweden	**1**	**D**	Swedish sampling in Q1
		2	**D**	Swedish sampling in Q2
		3	**D**	Swedish sampling in Q3
		4	**D**	Danish sampling in Q4

Fleet C= Human consumption, Fleet D= Industrial landings.

Table 3.2.17 continued.HERRING in Division IIIa and Sub. Division 22-24. Samples of landings by quarter and area used to to estimate catch in numbers and mean weight by age for 2004

	Country	Quarter	Fleet	Sampling
Sub-Division 22	**Denmark**	**1**	**F**	Danish sampling in Q1
		2	**F**	Danish sampling in Q2
		3	**F**	Danish sampling in Q3
		4	**F**	Danish sampling in Q4
	Germany	**1**	**F**	Danish sampling in Q1
		2	**F**	Danish sampling in Q2
		3	**F**	Danish sampling in Q3
		4	**F**	Danish sampling in Q4
Sub-Division 23	**Denmark**	**1**	**F**	Danish sampling in Q1
		2	**F**	Danish sampling in Q2 in Kattegat
		3	**F**	Danish sampling in Q3 in Kattegat
		4	**F**	Danish sampling in Q4 in Kattegat
	Sweden	**1**	**F**	Danish sampling in Q1
		2	**F**	No landings
		3	**F**	Danish sampling in Q3 in Kattegat
		4	**F**	Danish sampling in Q4 in Kattegat
Sub-Division 24	**Denmark**	**1**	**F**	Danish sampling in Q1
		2	**F**	Danish sampling in Q2
		3	**F**	Danish sampling in Q4
		4	**F**	Danish sampling in Q4
	Germany	**1**	**F**	German sampling in Q1
		2	**F**	German sampling in Q2
		3	**F**	No landings
		4	**F**	German sampling in Q4
	Poland	**1**	**F**	Polish sampling in Q1
		2	**F**	Polish sampling in Q2
		3	**F**	Polish sampling in Q3
		4	**F**	Polish sampling in Q4
	Sweden	**1**	**F**	Swedish sampling in Q1
		2	**F**	Swedish sampling in Q2
		3	**F**	Swedish sampling in Q3
		4	**F**	Swedish sampling in Q4

Fleet C= Human consumption, Fleet D= Industrial landings, Fleet F= All landings from sub.div.22-24.

Table 3.3.1 WESTERN BALTIC HERRING.
International Bottom Trawl Survey in the Kattegat in quarter 1.
Mean catch of spring-spawning herring at age in number per hour.

Year	Winter rings				
	1	2	3	4	5
1990	416	681	65	43	11
1991	190	206	144	25	20
1992	588	82	33	21	13
1993	3140	554	81	35	50
1994	1380	256	112	22	31
1995	781	132	30	42	24
1996	1312	1405	160	42	22
1997	3267	229	119	15	18
1998	407	853	165	74	8
1999	309	66	43	21	14
2000	1933	219	28	10	7
2001*	-	-	-	-	-
2002	2335	178	222	23	7
2003	1364	1495	41	10	0
2004	147	144	37	6	2
2005	286	257	26	12	5

* = no data available

Table 3.3.2 WESTERN BALTIC HERRING.
International Bottom Trawl Survey in the Kattegat in quarter 3.
Mean catch of spring-spawning herring at age in number per hour.

Year	Winter rings				
	1	2	3	4	5
1991	141	83	101	41	24
1992	372	108	70	63	25
1993	404	159	42	36	25
1994	265	229	154	49	36
1995	687	192	113	99	29
1996	631	322	31	17	11
1997	52	122	33	8	13
1998	118	86	22	27	5
1999	292	116	71	34	14
2000*	-	-	-	-	-
2001	313	190	72	18	2
2002	1568	169	100	16	6
2003	969	550	170	53	29
2004	1225	215	144	30	23

* = no survey was carried out in 2000

Table 3.3.3 WESTERN BALTIC HERRING. Acoustic surveys on the Spring Spawning Herring in the North Sea/Division IIIa in 1991-2004 (July).

Year	1991	1992*	1993*	1994*	1995*	1996*	1997	1998	1999**	2000	2001	2002	2003	2004
Numbers in millions														
W-rings														
0		3,853	372	964										
1		277	103	5	2,199	1,091	128	138	1,367	1,509	66	3,346	1,833	1,669
2	1,864	2,092	2,768	413	1,887	1,005	715	1,682	1,143	1,891	641	1,577	1,110	930
3	1,927	1,799	1,274	935	1,022	247	787	901	523	674	452	1,393	395	726
4	866	1,593	598	501	1,270	141	166	282	135	364	153	524	323	307
5	350	556	434	239	255	119	67	111	28	186	96	88	103	184
6	88	197	154	186	174	37	69	51	3	56	38	40	25	72
7	72	122	63	62	39	20	80	31	2	7	23	18	12	22
8+	10	20	13	34	21	13	77	53	1	10	12	17	5	18
Total	**5,177**	**#####**	**5,779**	**3,339**	**6,867**	**2,673**	**2,088**	**3,248**	**3,201**	**4,696**	**1,481**	**7,002**	**3,807**	**3,926**
3+ group	**3,313**	**4,287**	**2,536**	**1,957**	**2,781**	**577**	**1,245**	**1,428**	**691**	**1,295**	**774**	**2,079**	**864**	**1,328**
Biomass ('000 tonnnes)														
W-rings														
0		34.3	1	8.7										
1		26.8	7	0.4	77.4	52.9	4.7	7.1	74.8	61.4	3.5	137.2	79.0	63.9
2	177.1	169.0	139	33.2	108.9	87.0	52.2	136.1	101.6	138.1	55.8	107.2	91.5	75.6
3	219.7	206.3	112	114.7	102.6	27.6	81.0	84.8	59.5	68.8	51.2	126.9	41.4	89.4
4	116.0	204.7	69	76.7	145.5	17.9	21.5	35.2	14.7	45.3	21.5	55.9	41.7	41.5
5	51.1	83.3	65	41.8	33.9	17.8	9.8	13.1	3.4	25.1	17.9	12.8	13.9	29.3
6	19.0	36.6	26	38.1	27.4	5.8	9.8	6.9	0.5	10.0	6.9	7.4	4.2	11.7
7	13.0	24.4	16	13.1	6.7	3.3	14.9	4.8	0.3	1.4	4.7	3.5	2.0	4.1
8+	2.0	5.0	2	7.8	3.8	2.7	13.6	9.0	0.1	1.3	2.7	3.1	0.9	3.2
Total	597.9	756.1	436.5	325.8	506.2	215.1	207.5	297.0	254.9	351.4	164.2	454.0	274.5	318.8
3+ group	420.9	560.3	291.0	292.3	319.9	75.2	150.6	153.7	78.5	151.9	104.9	209.6	104.0	179.3
Mean weight (g)														
W-rings														
0		8.9	4.0	9.0										
1		96.8	66.3	80.0	35.2	48.5	36.9	51.9	54.7	40.7	54.0	41.0	43.1	38.3
2	95	80.8	50.1	80.3	57.7	86.6	73.0	80.9	88.9	73.1	87.0	68.0	82.5	81.3
3	114	114.7	87.9	122.7	100.4	111.9	103.0	94.1	113.8	102.2	113.2	91.1	104.9	123.2
4	134	128.5	116.2	153.0	114.6	126.8	129.6	124.7	109.1	124.4	140.5	106.6	128.8	135.2
5	146	149.8	149.9	175.1	132.9	149.4	145.0	118.7	120.0	135.4	185.2	145.8	134.2	159.4
6	216	185.7	169.6	205.0	157.2	157.3	143.1	135.8	179.9	179.2	182.6	186.5	165.4	162.9
7	181	199.7	256.9	212.0	172.9	166.8	185.6	156.4	179.9	208.8	206.3	198.7	167.2	191.6
8+	200	252.0	164.2	230.3	183.1	212.9	178.0	168.0	181.7	135.2	226.9	183.4	170.3	178.0
Total	115.6	123.9	75.8	100.2	73.7	80.5	99.4	91.4	78.5	74.8	110.9	64.8	72.1	81.2

* revised in 1997

**the survey only covered the Skagerrak area by Norway. Additional estimates for the Kattegat area were added (see ICES 2000/ACFM:10, Table 3.5.8)

Table 3.3.4 WESTERN BALTIC HERRING. Acoustic survey on the Spring Spawning Herring in Sub-divisions 22-24 in 1991-2004 (September/October).

Year	1991[3]	1992[3]	1993[1]	1994[1]	1995[1]	1996[1]	1997[1]	1998[1]	1999[1]	2000	2001[2]	2002	2003	2004
	Numbers in millions													
W-rings														
0	5,577	3,467	768	4,383	4,001	1,418	2,608	2,179	4,821	1,021	1,831	3,984	3,701	2,401
1	2,507	2,179	345	412	1,163	1,084	1,389	451	1,145	1,208	1,314	611	781	912
2	880	1,015	354	823	307	541	492	557	246	477	1,761	372	200	590
3	852	465	485	540	332	413	343	364	187	348	1,013	566	230	352
4	259	233	381	433	342	282	151	232	129	206	357	337	276	166
5	102	71	122	182	247	283	112	99	44	81	92	61	103	145
6	49	32	52	56	124	110	92	51	8	39	55	23	41	81
7	6	8	28	22	40	44	32	23	1	5	5	3	9	23
8+	27	9	13	2	27	18	46	9	2	4	0	13	11	12
Total	10,259	7,480	2,547	6,854	6,583	4,193	5,265	3,966	6,582	3,389	6,428	5,970	5,353	4,682
3+ group	1,295	818	1,080	1,235	1,112	1,151	775	778	370	682	1,522	1,002	671	780
	Biomass ('000 tonnnes)													
W-rings														
0	62.0	48.9	11.1	49.3	41.1	12.3	25.6	20.4	54.2	12.8	21.4	33.9	31.5	20.5
1	97.8	77.8	12.3	14.3	39.6	32.9	49.4	18.2	42.3	47.5	59.1	23.9	24.7	34.2
2	60.0	57.5	15.7	38.1	19.8	26.8	29.2	41.4	18.8	29.7	118.7	27.1	14.9	34.9
3	76.9	39.5	29.7	39.2	28.5	29.2	31.9	32.9	22.0	29.0	93.4	56.1	23.3	28.4
4	29.4	28.5	23.5	41.3	39.1	20.0	21.0	27.5	13.1	24.1	34.2	39.8	36.3	18.9
5	13.5	10.6	12.3	22.9	26.7	33.9	16.0	11.2	5.6	9.2	11.6	8.6	15.6	17.8
6	6.4	5.1	6.7	11.5	14.7	14.7	13.2	6.1	0.8	5.6	7.6	3.3	6.2	12.6
7	0.8	1.6	2.2	4.9	8.8	5.7	5.1	3.7	0.2	1.1	0.9	0.5	1.5	3.5
8+	3.6	2.1	1.8	0.6	6.6	2.7	10.2	2.2	0.4	0.7	0.0	1.9	1.8	2.1
Total	350.3	271.6	115.3	222.1	224.8	178.4	201.6	163.5	157.4	159.7	346.9	195.2	155.8	172.8
3+ group	130.5	87.4	76.2	120.4	124.4	106.3	97.4	83.5	42.1	69.6	147.7	110.3	84.6	83.2
	Mean weight (g)													
W-rings														
0	11.1	14.1	14.4	11.2	10.3	8.7	9.8	9.4	11.2	12.6	11.7	8.5	8.5	8.6
1	39.0	35.7	35.7	34.7	34.0	30.4	35.6	40.3	37.0	39.3	45.0	39.1	31.7	37.5
2	68.2	56.7	44.3	46.3	64.5	49.6	59.4	74.3	76.4	62.2	67.4	72.8	74.5	59.1
3	90.2	84.9	61.3	72.6	85.9	70.7	93.1	90.4	117.6	83.3	92.2	99.2	101.2	80.7
4	113.5	122.3	61.6	95.5	114.5	71.1	139.2	118.3	101.8	117.1	95.7	118.2	131.2	113.6
5	132.2	148.7	100.9	125.9	108.0	119.7	142.3	114.0	127.5	114.1	126.0	142.6	151.0	122.6
6	130.4	161.0	129.6	204.0	118.1	133.5	143.4	120.5	107.2	143.0	137.0	142.8	150.9	154.6
7	133.0	205.7	80.2	222.6	222.0	128.5	161.6	158.1	232.7	202.9	175.7	205.5	155.7	151.1
8+	132.5	224.4	137.5	269.6	241.1	154.7	222.2	232.9	219.1	180.9	-	143.5	165.6	169.0
Total	34.1	36.3	45.3	32.4	34.2	42.5	38.3	41.2	23.9	47.1	54.0	32.7	29.1	36.9

[1] revised in 2001 due to new presented area of strata in the 'Manual for the Baltic International Acoustic Survey'. ICES CM 2000/H:2 Ref.: D: Annex 3 (Table 2.2)

[2] incl. estimates for Sub-division 23, which was covered by RV ARGOS (Sweden) in November 2001

[3] revised in 2003 due to revised Sa values

Table 3.3.5 WESTERN BALTIC HERRING. Estimation of the herring 0-Group (TL >=30 mm) Greifswalder Bodden and adjacent waters (March/April to June).

	YEAR	NUMBER IN MILLIONS
	1977	2000[1]
	1978	100[1]
	1979	2200[1]
	1980	360[1]
	1981	200[1]
	1982	180[1]
	1983	1760[1]
	1984	290[1]
	1985	1670[1]
	1986	1500[1]
	1987	1370[1]
	1988	1223[2]
	1989	63[2]
	1990	57[2]
	1991	236[3]
	1992	18[4]
	1993	199[4]
	1994	788[4]
	1995	171[4]
	1996	31[4]
	1997	54[4]
	1998	2553[4]
	1999	1945[4]
	2000	151[4]
	2001	421[4]
	2002	2051[4]
	2003	2005[5]
	2004	860[5]

[1] Brielmann 1989

[2] Klenz 1999 Inf.Fischwirtsch. Fischereiforsch. 46(2), 1999: 15-17

[3] Müller & Klenz 1994

[4] Klenz 2002 Inf.Fischwirtsch. Fischereiforsch. 49(4), 2002: 143-144

[5] unpublished

Table 3.6.1 WESTERN BALTIC HERRING. Input to ICA.

Catch in number (millions)

AGE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
0	119.0	145.1	206.1	263.2	541.3	171.1	376.8	549.8	569.6	152.6	756.3	150.3	53.5	243.6
1	826.0	456.7	530.7	249.4	1660.7	638.9	668.6	623.1	616.1	934.5	523.2	659.1	126.9	457.8
2	541.2	602.6	495.9	365.0	438.1	400.6	289.3	430.9	334.3	496.4	488.8	281.8	264.9	197.8
3	564.4	364.9	415.1	382.6	226.8	199.7	276.9	182.9	246.2	186.6	257.8	321.3	161.3	164.8
4	279.8	334.0	260.9	267.0	194.9	144.2	75.3	146.7	90.3	128.6	108.1	172.3	189.4	93.2
5	177.5	183.2	210.5	168.1	84.1	130.1	43.1	45.3	55.9	71.7	68.4	57.2	103.6	91.2
6	46.5	139.8	102.8	118.4	60.1	65.3	39.9	23.8	15.5	38.3	39.1	38.5	29.1	49.0
7	13.2	52.7	63.9	49.5	32.9	30.7	21.2	15.4	9.5	13.8	18.3	13.8	17.5	14.9
8	4.9	22.6	24.5	33.1	20.5	25.1	24.1	14.1	6.1	10.7	6.7	8.3	8.8	11.0

Table 3.6.2 WESTERN BALTIC HERRING. Input to ICA.

Mean weight in catch (kg)

AGE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
0	0.02957	0.01519	0.01535	0.01458	0.01010	0.01056	0.02962	0.01426	0.01112	0.02113	0.01229	0.01053	0.01325	0.00618
1	0.03476	0.03447	0.02545	0.03704	0.02092	0.02458	0.02748	0.03333	0.03433	0.02550	0.02432	0.02127	0.03152	0.02754
2	0.06685	0.06732	0.06797	0.08328	0.06843	0.08090	0.06845	0.06634	0.06583	0.05775	0.05931	0.06998	0.06711	0.06419
3	0.09490	0.09435	0.10204	0.10323	0.09841	0.09702	0.11807	0.09423	0.09814	0.09501	0.08618	0.09678	0.09075	0.10017
4	0.12342	0.11630	0.11428	0.12213	0.12349	0.11254	0.13420	0.11779	0.11642	0.13013	0.10886	0.11956	0.10792	0.10596
5	0.13901	0.14169	0.13615	0.14115	0.15196	0.13283	0.16198	0.13673	0.14713	0.14280	0.15673	0.14003	0.12234	0.13139
6	0.15560	0.16511	0.16795	0.15648	0.17041	0.13687	0.18170	0.16628	0.15660	0.14633	0.15597	0.18763	0.13188	0.15228
7	0.17091	0.17576	0.18228	0.17046	0.20626	0.15425	0.19671	0.16523	0.15382	0.15829	0.15560	0.18141	0.16029	0.16768
8	0.18256	0.19152	0.19890	0.18596	0.21696	0.19100	0.20872	0.18701	0.15756	0.15908	0.17132	0.17170	0.16252	0.15295

Table 3.6.3 WESTERN BALTIC HERRING. Input to ICA .

Mean weight in stock (kg)

AGE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
0	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010	0.00010
1	0.03085	0.02029	0.01563	0.01855	0.01305	0.01815	0.01310	0.02209	0.02106	0.01398	0.01686	0.01645	0.01444	0.01306
2	0.05277	0.04513	0.04020	0.05288	0.04590	0.05456	0.05147	0.05578	0.05668	0.04313	0.05088	0.06368	0.04447	0.04561
3	0.07873	0.08176	0.09671	0.08357	0.07081	0.09051	0.10633	0.08293	0.08705	0.08370	0.07829	0.09046	0.07926	0.08106
4	0.10412	0.10751	0.10793	0.10767	0.13269	0.11703	0.13334	0.11280	0.10813	0.12504	0.11594	0.12388	0.10509	0.10925
5	0.12447	0.13127	0.14087	0.13921	0.16745	0.11974	0.16618	0.13378	0.14801	0.14365	0.16904	0.17365	0.12681	0.14399
6	0.14492	0.15934	0.16715	0.15656	0.18923	0.15383	0.19429	0.16779	0.16015	0.16287	0.17627	0.19830	0.15061	0.16285
7	0.15943	0.17102	0.18273	0.17676	0.20970	0.14667	0.20895	0.16832	0.14394	0.16503	0.16808	0.19801	0.17287	0.19321
8	0.16398	0.18693	0.18906	0.20275	0.23377	0.12803	0.22635	0.18432	0.15043	0.18311	0.18052	0.20363	0.18471	0.20750

Table 3.6.4 WESTERN BALTIC HERRING. Input to ICA .

Natural mortality

AGE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
0	0.30000	0.30000	0.30000	0.30000	0.30000	0.30000	0.30000	0.30000	0.30000	0.30000	0.30000	0.30000	0.30000	0.30000
1	0.50000	0.50000	0.50000	0.50000	0.50000	0.50000	0.50000	0.50000	0.50000	0.50000	0.50000	0.50000	0.50000	0.50000
2	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000
3	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000
4	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000
5	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000
6	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000
7	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000
8	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000

Table 3.6.5 a WESTERN BALTIC HERRING. Input to ICA.

AGE - STRUCTURED INDICES.

Fleet 1b: Acoustic Survey in Div. IIIa+IVaE, Ages 2-8+

(Catch: Number in millions)

AGE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
2	1864.0	2092.0	2768.0	413.0	1887.0	1005.0	715.0	1682.0	*******	1891.1	641.2	1576.6	1110.0	929.6
3	1927.0	1799.0	1274.0	935.0	1022.0	247.0	787.0	901.0	*******	673.6	452.3	1392.8	394.6	726.0
4	866.0	1593.0	598.0	501.0	1270.0	141.0	166.0	282.0	*******	363.9	153.1	524.3	323.4	306.9
5	350.0	556.0	434.0	239.0	255.0	119.0	67.0	111.0	*******	185.7	96.4	87.5	103.4	183.7
6	88.0	197.0	154.0	186.0	174.0	37.0	69.0	51.0	*******	55.6	37.6	39.5	25.2	72.1
7	72.0	122.0	63.0	62.0	39.0	20.0	80.0	31.0	*******	6.9	23.0	17.8	12.0	21.5
8	10.0	20.0	13.0	34.0	21.0	13.0	77.0	53.0	*******	9.6	11.9	17.1	5.4	18.0

Table 3.6.5 b WESTERN BALTIC HERRING. Input to ICA.

AGE - STRUCTURED INDICES.

Fleet 2b: Acoustic Survey in SD 22-24, Ages 0-5

(Catch: Number in millions)

AGE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
0	5577.0	3467.0	768.0	4383.0	4001.0	1418.0	2608.0	2179.0	4821.0	1021.0	1831.0	3984.0	3701.0	2401.0
1	2507.0	2179.0	345.0	412.0	1163.0	1084.0	1389.0	451.0	1145.0	1208.0	1314.0	611.0	781.0	912.0
2	880.0	1015.0	354.0	823.0	307.0	541.0	492.0	557.0	246.0	477.0	1761.0	372.0	200.0	590.0
3	852.0	465.0	485.0	540.0	332.0	413.0	343.0	364.0	187.0	348.0	1013.0	566.0	230.0	352.0
4	259.0	233.0	381.0	433.0	342.0	282.0	151.0	232.0	129.0	206.0	357.0	337.0	276.0	166.0
5	102.0	71.0	121.0	182.0	247.0	283.0	112.0	99.0	44.0	81.0	92.0	61.0	103.0	145.0

Table 3.6.5 c WESTERN BALTIC HERRING. Input to ICA.

AGE - STRUCTURED INDICES.

Fleet 4: IBTS in Kattegat, Quarter 3, Ages 1-5

(Catch: Number per hour)

AGE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	141.2	371.5	404.0	264.5	687.3	631.3	52.4	117.5	292.0	*******	313.0	1567.8	968.8	1225.2
2	83.2	107.6	158.7	229.4	191.5	321.8	122.2	85.8	116.3	*******	190.0	169.0	550.2	215.0
3	100.9	69.9	41.9	154.2	113.2	30.8	33.2	22.4	71.2	*******	72.0	100.2	170.2	143.6
4	41.2	63.0	36.0	49.0	99.1	17.5	8.4	27.3	33.6	*******	18.0	15.5	52.7	30.0
5	23.8	24.7	25.1	35.7	29.4	11.3	13.2	5.0	14.3	*******	2.0	5.8	29.4	23.0

Table 3.6.6 WESTERN BALTIC HERRING:

Input parameters for ICA FINAL Run

```
                         Integrated Catch at Age Analysis
                         --------------------------------

                                 Version 1.4 w

                                 K.R.Patterson
                          Fisheries Research Services
                               Marine Laboratory
                                   Aberdeen

                                 24 August 1999

 Type * to change language
 Enter the name of the index file -->index.dat
canum.low
weca.low
 Stock weights in 2005  used for the year 2004
west.low
 Natural mortality in 2005  used for the year 2004
natmor.low
 Maturity ogive in 2005  used for the year 2004
matprop.low
 Name of age-structured index file (Enter if none) : -->DAGAIYFD.dat
 Name of the SSB index file (Enter if none) -->
No indices of spawning biomass to be used.
 No of years for separable constraint ?--> 5
 Reference age for separable constraint ?--> 4
 Constant selection pattern model (Y/N) ?-->y
 S to be fixed on last age ?-->    1.000000000000000
 First age for calculation of reference F ?--> 3
 Last age for calculation of reference F ?--> 6
 Use default weighting (Y/N) ?-->n
Enter relative weights at age
 Weight for age 0-->    0.100000000000000
 Weight for age 1-->    1.000000000000000
 Weight for age 2-->    1.000000000000000
 Weight for age 3-->    1.000000000000000
 Weight for age 4-->    1.000000000000000
 Weight for age 5-->    1.000000000000000
 Weight for age 6-->    1.000000000000000
 Weight for age 7-->    1.000000000000000
 Weight for age 8-->    1.000000000000000
Enter relative weights by year
 Weight for year 2000-->    1.000000000000000
 Weight for year 2001-->    1.000000000000000
 Weight for year 2002-->    1.000000000000000
 Weight for year 2003-->    1.000000000000000
 Weight for year 2004-->    1.000000000000000
Enter new weights for specified years and ages if needed
 Enter year, age, new weight or -1,-1,-1 to end.  -1 -1   -1.000000000000000
 Is the last age of Acoustic  Survey in  Div IIIa⅖ Ages a plus-group (Y/-->y
 Is the last age of Acoustic Survey in Sub div 22-24 Ages 0- a plus-group (Y--
>n
 Is the last age of IYFS Katt Quart3 Age groups 1-5 (Mean Ca a plus-group (Y--
>n
You must choose a catchability model for each index.

Models:   A  Absolute:  Index = Abundance . e
          L  Linear:    Index = Q. Abundance . e
          P  Power:     Index = Q. Abundance^ K .e

   where Q and K are parameters to be estimated, and
   e is a lognormally-distributed error.

 Model for Acoustic  Survey in  Div IIIa⅖ Ages  is to be A/L/P ?-->L
 Model for Acoustic Survey in Sub div 22-24 Ages 0-  is to be A/L/P ?-->L
 Model for IYFS Katt Quart3 Age groups 1-5 (Mean Ca  is to be A/L/P ?-->L
 Fit a stock-recruit relationship (Y/N) ?-->n
 Enter lowest feasible F-->   5.0000000000000003E-02
 Enter highest feasible F-->    1.000000000000000
```

Table 3.6.6 continued

```
Mapping the F-dimension of the SSQ surface
    F                  SSQ
+-------+------------------
    0.05        39.1316811741
    0.10        22.7464496099
    0.15        17.5312656009
    0.20        15.4990404439
    0.25        14.6649580018
    0.30        14.3796445701
    0.35        14.3870015864
    0.40        14.5693775687
    0.45        14.8653629889
    0.50        15.2395035785
    0.55        15.6696450328
    0.60        16.1412158398
    0.65        16.6443224260
    0.70        17.1721389345
    0.75        17.7199762963
    0.80        18.2847681521
    0.85        18.8646193280
    0.90        19.4586382697
    0.95        20.0667856091
    1.00        20.6898146604
Lowest SSQ is for F =     0.326
-----------------------------------------------------------------
No of years for separable analysis : 5
Age range in the analysis : 0  . . . 8
Year range in the analysis : 1991  . . . 2004
Number of indices of SSB : 0
Number of age-structured indices : 3
Parameters to estimate : 41
Number of observations : 280
Conventional single selection vector model to be fitted.
-----------------------------------------------------------------
 Survey weighting to be Manual (recommended) or Iterative (M/I) ?-->M
 Enter weight for Acoustic  Survey in  Div IIIa⅖ Ages  at age 2-->    1.000000000000000
 Enter weight for Acoustic  Survey in  Div IIIa⅖ Ages  at age 3-->    1.000000000000000
 Enter weight for Acoustic  Survey in  Div IIIa⅖ Ages  at age 4-->    1.000000000000000
 Enter weight for Acoustic  Survey in  Div IIIa⅖ Ages  at age 5-->    1.000000000000000
 Enter weight for Acoustic  Survey in  Div IIIa⅖ Ages  at age 6-->    1.000000000000000
 Enter weight for Acoustic  Survey in  Div IIIa⅖ Ages  at age 7-->    1.000000000000000
 Enter weight for Acoustic  Survey in  Div IIIa⅖ Ages  at age 8-->    1.000000000000000
 Enter weight for Acoustic Survey in Sub div 22-24 Ages 0-  at age 0-->    1.000000000000000
 Enter weight for Acoustic Survey in Sub div 22-24 Ages 0-  at age 1-->    1.000000000000000
 Enter weight for Acoustic Survey in Sub div 22-24 Ages 0-  at age 2-->    1.000000000000000
 Enter weight for Acoustic Survey in Sub div 22-24 Ages 0-  at age 3-->    1.000000000000000
 Enter weight for Acoustic Survey in Sub div 22-24 Ages 0-  at age 4-->    1.000000000000000
 Enter weight for Acoustic Survey in Sub div 22-24 Ages 0-  at age 5-->    1.000000000000000
 Enter weight for IYFS Katt Quart3 Age groups 1-5 (Mean Ca  at age 1-->    1.000000000000000
 Enter weight for IYFS Katt Quart3 Age groups 1-5 (Mean Ca  at age 2-->    1.000000000000000
 Enter weight for IYFS Katt Quart3 Age groups 1-5 (Mean Ca  at age 3-->    1.000000000000000
 Enter weight for IYFS Katt Quart3 Age groups 1-5 (Mean Ca  at age 4-->    1.000000000000000
 Enter weight for IYFS Katt Quart3 Age groups 1-5 (Mean Ca  at age 5-->    1.000000000000000
Enter estimates of the extent to which errors in the age-structured indices are correlated
across ages. This can be in the range 0 (independence) to 1 (correlated errors).
  Enter value for Acoustic  Survey in  Div IIIa⅖ Ages-->    1.000000000000000
  Enter value for Acoustic Survey in Sub div 22-24 Ages 0--->    1.000000000000000
  Enter value for IYFS Katt Quart3 Age groups 1-5 (Mean Ca-->    1.000000000000000
 Do you want to shrink the final fishing mortality (Y/N) ?-->N
Aged index weights
Acoustic  Survey in  Div IIIa⅖ Ages
 Age   :       2     3     4     5     6     7     8
 Wts :     0.143 0.143 0.143 0.143 0.143 0.143 0.143
Acoustic Survey in Sub div 22-24 Ages 0-
 Age   :       0     1     2     3     4     5
 Wts :     0.167 0.167 0.167 0.167 0.167 0.167
IYFS Katt Quart3 Age groups 1-5 (Mean Ca
 Age   :       1     2     3     4     5
 Wts :     0.200 0.200 0.200 0.200 0.200
F in 2004  at age 4  is 0.383541  in iteration 1
 Detailed, Normal or Summary output (D/N/S)-->D
 Output page width in characters (e.g. 80..132) ?--> 132
 Estimate historical assessment uncertainty ?-->n
Succesful exit from ICA
```

Table. 3.6.7 WESTERN BALTIC HERRING. Output from ICA Final Run

FISHING MORTALITY (per year)

AGE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
0	0.02802	0.04730	0.08107	0.05082	0.16791	0.04623	0.11618	0.12305	0.11223	0.06639	0.06292	0.05851	0.04624	0.04245
1	0.26073	0.17512	0.30056	0.16337	0.64501	0.37998	0.31565	0.35436	0.24327	0.26371	0.24991	0.23242	0.18366	0.16859
2	0.32218	0.37474	0.35372	0.42622	0.58876	0.38444	0.36039	0.42233	0.39942	0.37139	0.35195	0.32732	0.25865	0.23743
3	0.42450	0.37501	0.48097	0.50895	0.51550	0.59111	0.50262	0.40748	0.45657	0.40632	0.38506	0.35811	0.28298	0.25976
4	0.40678	0.48103	0.50521	0.66138	0.53202	0.73754	0.46508	0.54851	0.36167	0.59994	0.56854	0.52875	0.41782	0.38354
5	0.38622	0.51214	0.64298	0.72460	0.44936	0.84352	0.51079	0.57032	0.41696	0.57163	0.54171	0.50379	0.39810	0.36544
6	0.25820	0.60154	0.61162	0.95903	0.62583	0.76550	0.68845	0.59423	0.38820	0.65879	0.62431	0.58061	0.45881	0.42117
7	0.46461	0.52063	0.61706	0.68448	0.79220	0.77970	0.61175	0.62971	0.50426	0.59994	0.56854	0.52875	0.41782	0.38354
8	0.46461	0.52063	0.61706	0.68448	0.79220	0.77970	0.61175	0.62971	0.50426	0.59994	0.56854	0.52875	0.41782	0.38354

Table. 3.6.8 WESTERN BALTIC HERRING. Output from ICA Final Run

POPULATION ABUNDANCE (millions)- 1 January

AGE	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
0	4979.1	3631.2	3057.3	6141.0	4036.7	4380.0	3964.8	5479.6	6192.9	3460.9	4607.1	2736.5	5311.2	4808.1	3659.7
1	4524.2	3586.6	2565.8	2088.5	4324.0	2528.2	3098.2	2615.1	3589.4	4100.8	2399.2	3204.9	1912.0	3756.8	3413.9
2	2156.6	2114.3	1825.9	1152.2	1075.8	1376.0	1048.7	1370.5	1112.9	1707.0	1910.7	1133.4	1540.7	965.1	1925.1
3	1787.7	1279.3	1190.0	1049.6	616.0	488.9	767.0	598.8	735.5	611.1	964.0	1100.2	668.9	974.0	623.2
4	917.4	957.4	719.9	602.3	516.6	301.2	221.6	379.9	326.2	381.5	333.3	537.0	629.7	412.7	615.0
5	607.3	500.1	484.5	355.6	254.5	248.4	117.9	114.0	179.7	186.0	171.4	154.5	259.1	339.5	230.2
6	224.4	337.9	245.3	208.6	141.1	133.0	87.5	57.9	52.8	97.0	86.0	81.6	76.4	142.5	192.8
7	39.0	141.9	151.6	109.0	65.4	61.8	50.6	36.0	26.2	29.3	41.1	37.7	37.4	39.6	76.6
8	14.5	60.8	58.2	72.8	40.7	50.5	57.6	33.0	16.8	25.9	16.9	22.2	28.3	37.9	43.2

Table. 3.6.9 WESTERN BALTIC HERRING. Output from ICA Final Run

STOCK SUMMARY

Year	Recruits Age 0 thousands	Total Biomass tonnes	Spawning Biomass tonnes	Landings tonnes	Yield /SSB ratio	Mean F Ages 3- 6	SoP (%)
1991	4979060	606861	302863	191573	0.6325	0.3689	99
1992	3631200	531218	313084	194411	0.6210	0.4924	100
1993	3057310	454564	287160	185010	0.6443	0.5602	100
1994	6141020	369033	224788	172438	0.7671	0.7135	99
1995	4036680	310930	177088	150831	0.8517	0.5307	100
1996	4380020	266621	129220	121266	0.9384	0.7344	100
1997	3964840	266282	143328	115588	0.8065	0.5417	100
1998	5479590	264372	115933	107032	0.9232	0.5301	99
1999	6192940	279930	121986	97240	0.7971	0.4058	100
2000	3460880	282230	133636	109914	0.8225	0.5592	100
2001	4607080	306316	149508	105803	0.7077	0.5299	99
2002	2736450	346229	185430	106191	0.5727	0.4928	99
2003	5311160	271910	154966	78309	0.5053	0.3894	99
2004	4808130	305186	180386	76815	0.4258	0.3575	100

Table. 3.6.10 WESTERN BALTIC HERRING. Output from ICA Final Run

PARAMETER ESTIMATES

Parm. No.		Maximum Likelh. Estimate	CV (%)	Lower 95% CL	Upper 95% CL	-s.e.	+s.e.	Mean of Param. Distrib.
Separable model : F by year								
1	2000	0.5999	12	0.4682	0.7688	0.5286	0.6809	0.6048
2	2001	0.5685	12	0.4427	0.7302	0.5004	0.6460	0.5732
3	2002	0.5287	13	0.4083	0.6848	0.4634	0.6033	0.5334
4	2003	0.4178	14	0.3155	0.5534	0.3620	0.4822	0.4221
5	2004	0.3835	16	0.2795	0.5264	0.3263	0.4508	0.3886
Separable Model: Selection (S) by age								
6	0	0.1107	37	0.0535	0.2290	0.0764	0.1604	0.1186
7	1	0.4396	15	0.3237	0.5969	0.3760	0.5138	0.4449
8	2	0.6190	14	0.4621	0.8292	0.5333	0.7186	0.6260
9	3	0.6773	14	0.5063	0.9060	0.5839	0.7857	0.6848
	4	1.0000		Fixed : Reference Age				
10	5	0.9528	13	0.7346	1.2358	0.8344	1.0880	0.9612
11	6	1.0981	12	0.8561	1.4084	0.9671	1.2468	1.1070
	7	1.0000		Fixed : Last true age				
Separable model: Populations in year 2004								
12	0	4808131	50	1784711	12953426	2899881	7972094	5463796
13	1	3756815	22	2414213	5846070	2998045	4707622	3853654
14	2	965112	16	693514	1343074	815365	1142361	978928
15	3	973954	14	732226	1295484	842030	1126548	984325
16	4	412683	13	318855	534120	361794	470729	416272
17	5	339455	13	262319	439273	297621	387169	342403
18	6	142474	14	107040	189638	123133	164854	143999
19	7	39558	17	28323	55248	33358	46909	40136
Separable model: Populations at age								
20	2000	29293	24	18189	47175	22970	37355	30171
21	2001	41082	19	28000	60276	33783	49957	41875
22	2002	37704	17	26709	53226	31623	44956	38292
23	2003	37402	17	26550	52691	31402	44549	37978

Table. 3.6.11 WESTERN BALTIC HERRING. Output from ICA Final Run

AGE-STRUCTURED INDEX OF CATCHABILITIES

Acoustic Survey in Div IIIa+IVaE WR 2-8+

Linear model fitted. Slopes at age :

24	2	Q	1.249	18	1.049	2.137	1.249	1.795	1.522
25	3	Q	1.407	18	1.183	2.406	1.407	2.022	1.715
26	4	Q	1.331	18	1.119	2.277	1.331	1.913	1.623
27	5	Q	1.085	18	.9105	1.860	1.085	1.561	1.323
28	6	Q	.9359	18	.7840	1.615	.9359	1.353	1.145
29	7	Q	.9647	18	.8054	1.683	.9647	1.405	1.185
30	8	Q	.8168	18	.6841	1.411	.8168	1.182	.9994

Acoustic Survey in Sub div 22-24 WR 0-5

Linear model fitted. Slopes at age :

31	0	Q	.8069	16	.6875	1.322	.8069	1.126	.9667
32	1	Q	.5801	16	.4960	.9398	.5801	.8036	.6919
33	2	Q	.5818	16	.4979	.9405	.5818	.8049	.6934
34	3	Q	.8052	16	.6892	1.301	.8052	1.113	.9593
35	4	Q	.9527	16	.8153	1.540	.9527	1.318	1.135
36	5	Q	.7923	16	.6774	1.284	.7923	1.098	.9452

IYFS Katt Quart3 WR 1-5

Linear model fitted. Slopes at age :

37	1	Q	.2025E-03	15	.1745E-03	.3201E-03	.2025E-03	.2759E-03	.2392E-03
38	2	Q	.1736E-03	15	.1498E-03	.2737E-03	.1736E-03	.2362E-03	.2049E-03
39	3	Q	.1211E-03	15	.1045E-03	.1907E-03	.1211E-03	.1646E-03	.1428E-03
40	4	Q	.1009E-03	15	.8703E-04	.1589E-03	.1009E-03	.1371E-03	.1190E-03
41	5	Q	.9007E-04	15	.7767E-04	.1422E-03	.9007E-04	.1226E-03	.1063E-03

Table. 3.6.12 WESTERN BALTIC HERRING. Output from ICA Final Run

RESIDUALS ABOUT THE MODEL FIT Separable Model Residuals

(log(Observed Catch)-log(Expected Catch))

Age	2000	2001	2002	2003	2004
0	-0.232	1.135	0.110	-1.356	0.343
1	0.212	0.215	0.222	-0.696	-0.009
2	0.028	-0.056	-0.023	-0.188	0.064
3	0.002	-0.086	0.062	0.071	-0.208
4	-0.203	-0.201	-0.157	-0.035	-0.252
5	-0.032	0.042	0.022	0.289	-0.038
6	-0.114	0.067	0.158	0.125	0.091
7	0.130	0.116	-0.023	0.403	0.258

Table. 3.6.13 WESTERN BALTIC HERRING. Output from ICA Final Run

AGED INDEX RESIDUALS: LOG(OBSERVED INDEX) - LOG(EXPECTED INDEX)

Acoustic Survey in Div IIIa+IVaE WR 2-8+

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
2	-0.042	0.126	0.540	-0.857	0.833	-0.171	-0.255	0.371	*******	0.237	-0.969	0.437	-0.264	0.014
3	0.124	0.359	0.152	-0.014	0.612	-0.530	0.123	0.447	*******	0.135	-0.733	0.243	-0.568	-0.348
4	0.035	0.649	-0.031	0.068	1.071	-0.459	-0.160	-0.116	*******	0.167	-0.584	0.145	-0.566	-0.218
5	-0.266	0.470	0.336	0.099	0.327	-0.165	-0.202	0.374	*******	0.399	-0.193	-0.210	-0.626	-0.342
6	-0.584	0.028	0.108	0.676	0.792	-0.609	0.384	0.435	*******	0.047	-0.246	-0.172	-0.632	-0.227
7	1.064	0.335	-0.332	0.025	0.139	-0.479	1.001	0.405	*******	-0.910	-0.064	-0.259	-0.715	-0.209
8	0.244	-0.460	-0.786	-0.007	0.160	-0.543	1.000	1.195	*******	-0.290	0.335	0.398	-1.068	-0.178

Acoustic Survey in Sub div 22-24 WR 0-5

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
0	0.590	0.446	-0.862	0.158	0.580	-0.636	0.129	-0.369	0.294	-0.713	-0.418	0.877	0.130	-0.206
1	0.563	0.586	-0.821	-0.548	0.147	0.402	0.395	-0.529	-0.003	-0.067	0.542	-0.527	0.196	-0.336
2	0.063	0.268	-0.656	0.706	-0.081	0.076	0.233	0.139	-0.488	-0.276	0.902	-0.151	-1.133	0.399
3	-0.025	-0.335	-0.136	0.119	0.171	0.681	-0.026	0.205	-0.628	0.139	0.734	-0.001	-0.464	-0.433
4	-0.731	-0.820	-0.024	0.407	0.222	0.733	0.197	0.154	-0.430	0.072	0.732	0.165	-0.282	-0.395
5	-1.082	-1.150	-0.480	0.303	0.722	1.198	0.750	0.708	-0.681	0.019	0.204	-0.134	-0.211	-0.165

IYFS Katt Quart3 WR 1-5

Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	-1.394	-0.248	0.249	-0.055	0.474	0.760	-1.973	-0.971	-0.447	*******	0.029	1.340	1.345	0.894
2	-1.178	-0.868	-0.346	0.528	0.518	0.663	-0.049	-0.631	-0.133	*******	-0.212	0.177	1.008	0.523
3	-0.373	-0.436	-0.809	0.637	0.864	-0.159	-0.590	-0.797	0.186	*******	-0.117	0.064	1.045	0.485
4	-0.430	-0.002	-0.260	0.323	1.100	0.035	-0.568	0.130	0.373	*******	-0.144	-0.793	0.200	0.037
5	-0.464	-0.156	-0.025	0.685	0.653	-0.033	0.661	-0.246	0.262	*******	-1.580	-0.430	0.605	0.069

Table. 3.6.14 WESTERN BALTIC HERRING. Output from ICA Final Run

PARAMETERS OF THE DISTRIBUTION OF Ln CATCHES AT AGE

```
PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES AT AGE)
 -----------------------------------------------------

 Separable model fitted from 2000  to 2004
 Variance                              0.0967
Skewness test stat.                   -2.1194
Kurtosis test statistic                2.6569
Partial chi-square                     0.1411
Significance in fit                    0.0000
Degrees of freedom                         17
```

Table. 3.6.15 WESTERN BALTIC HERRING. Output from ICA Final Run. PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES

DISTRIBUTION STATISTICS FOR **Acoustic Survey in Div IIIa+IVaE WR 2-8+**

Linear catchability relationship assumed

Age	2	3	4	5	6	7	8
Variance	0.0384	0.0249	0.0307	0.0176	0.0320	0.0503	0.0615
Skewness test stat.	-0.6371	-0.6644	1.2987	-0.1178	0.2865	0.6252	0.3785
Kurtosis test statisti	-0.3171	-0.7096	0.3176	-0.9126	-0.7770	-0.4150	-0.4478
Partial chi-square	0.0330	0.0222	0.0284	0.0174	0.0344	0.0595	0.0748
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	13	13	13	13	13	13	13
Degrees of freedom	12	12	12	12	12	12	12
Weight in the analysis	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429

DISTRIBUTION STATISTICS FOR **Acoustic Survey in Sub div 22-24 WR 0-5**

Linear catchability relationship assumed

Age	0	1	2	3	4	5
Variance	0.0488	0.0382	0.0472	0.0261	0.0386	0.0824
Skewness test stat.	-0.1498	-0.4160	-0.5615	0.5127	-0.2463	-0.1123
Kurtosis test statisti	-0.8900	-1.0038	-0.0538	-0.3361	-0.6275	-0.6627
Partial chi-square	0.0435	0.0362	0.0463	0.0265	0.0401	0.0914
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	14	14	14	14	14	14
Degrees of freedom	13	13	13	13	13	13
Weight in the analysis	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667

DISTRIBUTION STATISTICS FOR **IYFS Katt Quart3 WR 1-5**

Linear catchability relationship assumed

Age	1	2	3	4	5
Variance	0.2052	0.0838	0.0754	0.0456	0.0793
Skewness test stat.	-0.6518	-0.3961	0.4328	0.7570	-1.5427
Kurtosis test statisti	-0.4791	-0.6514	-0.8149	0.3909	0.7745
Partial chi-square	0.4148	0.1900	0.2168	0.1607	0.3982
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	13	13	13	13	13
Degrees of freedom	12	12	12	12	12
Weight in the analysis	0.2000	0.2000	0.2000	0.2000	0.2000

Table. 3.6.16 WESTERN BALTIC HERRING. Output from ICA Final Run

ANALYSIS OF VARIANCE TABLE

Unweighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	77.3951	280	41	239	0.3238
Catches at age	4.6240	40	23	17	0.2720
Aged Indices					
Acoustic Survey in Div IIIa+IVaE WR 2-8+	21.4555	91	7	84	0.2554
Acoustic Survey in Sub div 22-24 WR 0-5	21.9533	84	6	78	0.2815
IYFS Katt Quart3 WR 1-5	29.3623	65	5	60	0.4894

Weighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	3.8666	280	41	239	0.0162
Catches at age	1.6444	40	23	17	0.0967
Aged Indices					
Acoustic Survey in Div IIIa+IVaE WR 2-8+	0.4379	91	7	84	0.0052
Acoustic Survey in Sub div 22-24 WR 0-5	0.6098	84	6	78	0.0078
IYFS Katt Quart3 WR 1-5	1.1745	65	5	60	0.0196

Table 3.7.1 WESTERN BALTIC HERRING. Input table for short term predictions

MFDP version 1a
Run: WBSS05
Time and date: 18:57 11/03/2005
Fbar age range: 3-6

2005

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	4255743	0.3	0.00	0.1	0.25	0.000	0.042	0.010
1	2885618	0.5	0.00	0.1	0.25	0.015	0.169	0.027
2	1925100	0.2	0.20	0.1	0.25	0.051	0.237	0.067
3	623200	0.2	0.75	0.1	0.25	0.084	0.260	0.096
4	615000	0.2	0.90	0.1	0.25	0.113	0.384	0.111
5	230200	0.2	1.00	0.1	0.25	0.148	0.365	0.131
6	192800	0.2	1.00	0.1	0.25	0.171	0.421	0.157
7	76600	0.2	1.00	0.1	0.25	0.188	0.384	0.170
8	43200	0.2	1.00	0.1	0.25	0.199	0.384	0.162

2006

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	4255743	0.3	0.00	0.1	0.25	0.000	0.042	0.010
1		0.5	0.00	0.1	0.25	0.015	0.169	0.027
2		0.2	0.20	0.1	0.25	0.051	0.237	0.067
3		0.2	0.75	0.1	0.25	0.084	0.260	0.096
4		0.2	0.90	0.1	0.25	0.113	0.384	0.111
5		0.2	1.00	0.1	0.25	0.148	0.365	0.131
6		0.2	1.00	0.1	0.25	0.171	0.421	0.157
7		0.2	1.00	0.1	0.25	0.188	0.384	0.170
8		0.2	1.00	0.1	0.25	0.199	0.384	0.162

2007

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
0	4255743	0.3	0.00	0.1	0.25	0.000	0.042	0.010
1		0.5	0.00	0.1	0.25	0.015	0.169	0.027
2		0.2	0.20	0.1	0.25	0.051	0.237	0.067
3		0.2	0.75	0.1	0.25	0.084	0.260	0.096
4		0.2	0.90	0.1	0.25	0.113	0.384	0.111
5		0.2	1.00	0.1	0.25	0.148	0.365	0.131
6		0.2	1.00	0.1	0.25	0.171	0.421	0.157
7		0.2	1.00	0.1	0.25	0.188	0.384	0.170
8		0.2	1.00	0.1	0.25	0.199	0.384	0.162

Input units are thousands and kg - output in tonnes

N =	Stock size (thousands)
M =	Natural mortality
MAT =	Maturity ogive
PF =	Proportion of F before spawning
PM =	Proportion of M before spawning
SWT =	Weight in stock (kg)
Sel =	Exploit. Pattern
CWT =	Weight in catch (kg)

N_{2005} Age 1:	Geometric Mean from ICA of age 1 (Table 3.6.8) for the years 1994-2003
N_{2005} Age 2-8+:	Output from ICA (Table 3.6.8)
$N_{2005/2006/2007}$ Age 0:	Geometric Mean from ICA of age 0 (Table 3.6.8) for the years 1993-2002
Natural Mortality (M):	Average for 2002-2004
Weight in the Catch/Stock (CWt/SWt):	Average for 2002-2004
Expoitation pattern (Sel):	Average for 2002-2004 rescaled to the last year

Table 3.7.2 WESTERN BALTIC HERRING.
Short term prediction single option table, status quo F.

MFDP version 1a
Run: WBSS05
Time and date: 18:57 11/03/2005
Fbar age range: 3-6

Year:	2005	F multiplier: 1		Fbar:	0.3575				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0.0424	152956	1528	4255743	426	0	0	0	0
1	0.1686	354773	9500	2885618	42274	0	0	0	0
2	0.2374	370220	24839	1925100	98668	385020	19734	357649	18331
3	0.2598	129774	12445	623200	52095	467400	39072	433204	36213
4	0.3835	178697	19862	615000	69335	553500	62402	506694	57125
5	0.3654	64255	8434	230200	34104	230200	34104	211115	31277
6	0.4212	60483	9512	192800	32889	192800	32889	175833	29995
7	0.3835	22257	3779	76600	14403	76600	14403	70122	13185
8	0.3835	12552	2038	43200	8581	43200	8581	39547	7856
Total		1345968	91936	10847461	352776	1948720	211184	1794165	193981

Year:	2006	F multiplier: 1		Fbar:	0.3575				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0.0424	152956	1528	4255743	426	0	0	0	0
1	0.1686	371506	9948	3021713	44268	0	0	0	0
2	0.2374	284367	19079	1478677	75787	295735	15157	274712	14080
3	0.2598	258845	24823	1243025	103909	932269	77931	864062	72230
4	0.3835	114340	12708	393509	44364	354158	39928	324209	36551
5	0.3654	95774	12571	343120	50833	343120	50833	314674	46619
6	0.4212	41027	6452	130779	22309	130779	22309	119270	20346
7	0.3835	30101	5111	103595	19479	103595	19479	94834	17832
8	0.3835	19421	3154	66839	13277	66839	13277	61187	12154
Total		1368336	95373	11036999	374652	2226495	238915	2052948	219812

Year:	2007	F multiplier: 1		Fbar:	0.3575				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
0	0.0424	152956	1528	4255743	426	0	0	0	0
1	0.1686	371506	9948	3021713	44268	0	0	0	0
2	0.2374	297779	19979	1548415	79361	309683	15872	287668	14744
3	0.2598	198820	19067	954772	79813	716079	59859	663689	55480
4	0.3835	228060	25348	784887	88488	706398	79639	646663	72905
5	0.3654	61281	8043	219546	32526	219546	32526	201345	29829
6	0.4212	61152	9617	194930	33252	194930	33252	177776	30326
7	0.3835	20418	3467	70270	13213	70270	13213	64328	12096
8	0.3835	27629	4487	95088	18889	95088	18889	87047	17291
Total		1419601	101483	11145364	390236	2311995	253251	2128516	232671

Input units are thousands and kg - output in tonnes

Table 3.7.3 **WESTERN BALTIC HERRING.**
Short-term prediction multiple option table, Status quo F.

MFDP version 1a
Run: WBSS05
Western Baltic Herring (combined sex; plus group)
Time and date: 18:57 11/03/2005
Fbar age range: 3-6

2005				
Biomass	**SSB**	**FMult**	**FBar**	**Landings**
352776	193981	1.0000	0.3575	91936

2006					2007	
Biomass	**SSB**	**FMult**	**FBar**	**Landings**	**Biomass**	**SSB**
374652	227263	0.0000	0.0000	0	499989	324801
	226506	0.1000	0.0357	10801	487518	314061
	225752	0.2000	0.0715	21298	475407	303694
	225001	0.3000	0.1072	31499	463646	293687
	224252	0.4000	0.1430	41414	452224	284026
	223505	0.5000	0.1787	51052	441130	274700
	222762	0.6000	0.2145	60421	430354	265695
	222020	0.7000	0.2502	69530	419886	257001
	221282	0.8000	0.2860	78387	409716	248606
	220546	0.9000	0.3217	86999	399836	240499
	219812	1.0000	0.3575	95373	390236	232671
	219081	1.1000	0.3932	103518	380907	225111
	218352	1.2000	0.4290	111440	371841	217809
	217626	1.3000	0.4647	119146	363031	210756
	216903	1.4000	0.5005	126642	354468	203944
	216182	1.5000	0.5362	133934	346144	197364
	215463	1.6000	0.5720	141030	338053	191007
	214747	1.7000	0.6077	147934	330187	184865
	214034	1.8000	0.6435	154653	322540	178932
	213323	1.9000	0.6792	161192	315104	173199
	212614	2.0000	0.7150	167557	307873	167659

Input units are thousands and kg - output in tonnes

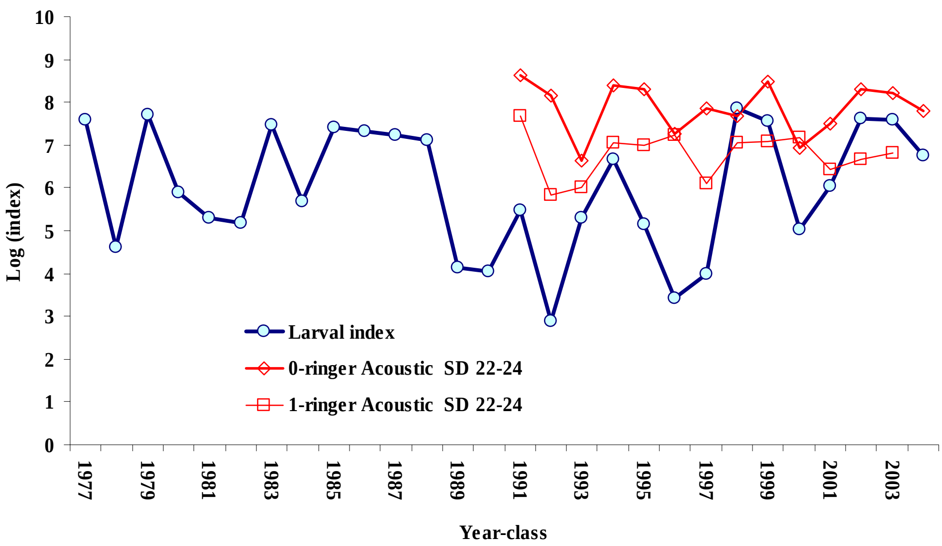


Figure 3.5.1 **WESTERN BALTIC HERRING. Recruitment indices (natural log) adjusted to year-class, versus time.**

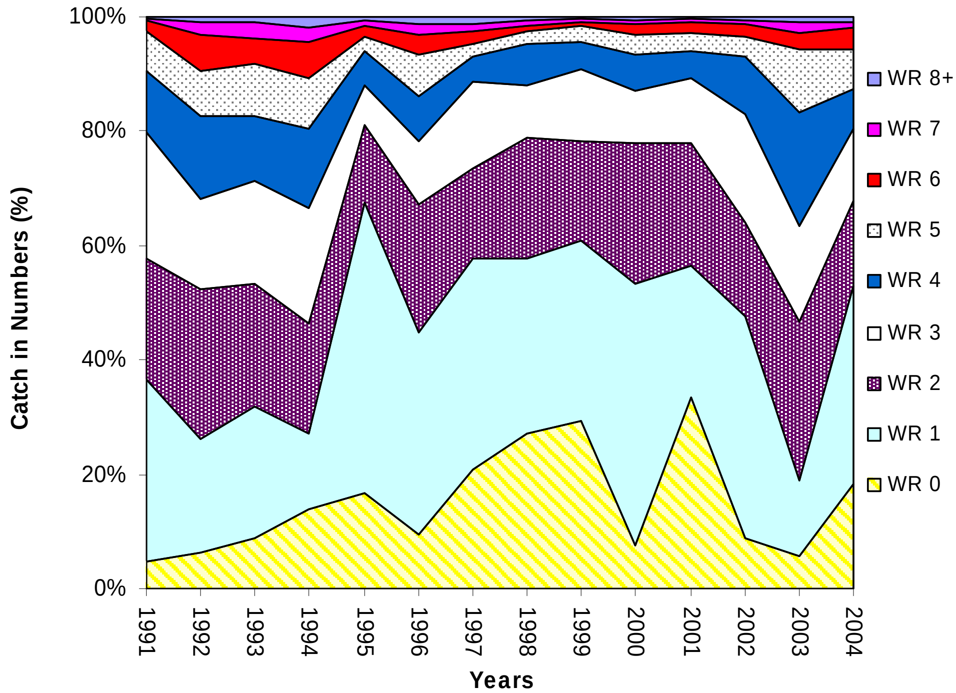


Figure 3.6.1 WESTERN BALTIC HERRING.
Proportions of age groups (numbers) in the total catch.

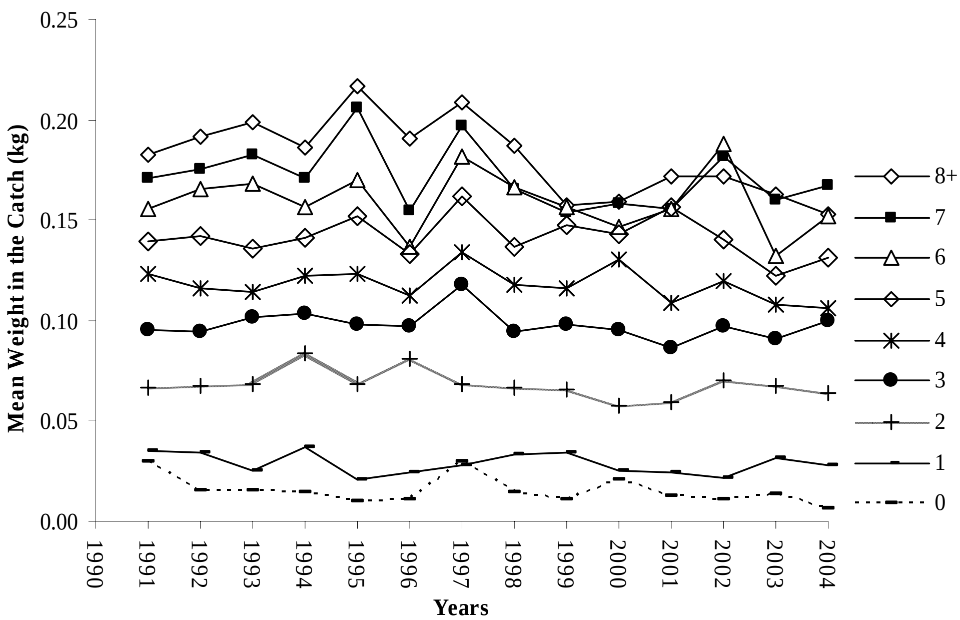
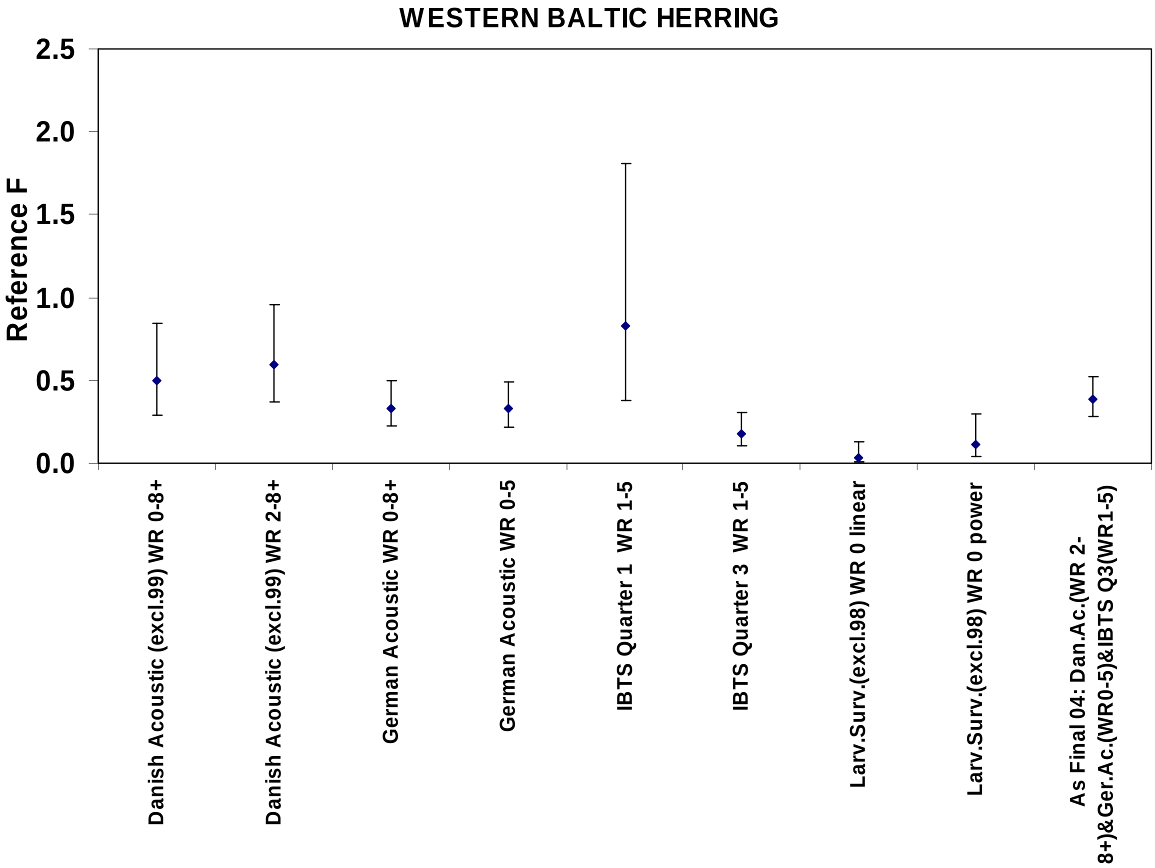


Figure 3.6.2 WESTERN BALTIC HERRING.
Mean weight in the catch (kg).



Fleet No.	Survey	Area	Quarter	WR	Mean F 2004	Lower 95% CL	Upper 95% CL	SSB (t) 2004
1a	Danish Acoustic (excl.99) WR 0-8+	Div. IIIa incl. Katt.	3	0-8+	0.495	0.291	0.840	143,904
1b	Danish Acoustic (excl.99) WR 2-8+	Div. IIIa incl. Katt.	3	2-8+	0.594	0.371	0.953	119,349
2a	German Acoustic WR 0-8+	SD 22, 23, 24	4	0-8+	0.334	0.225	0.495	184,002
2b	German Acoustic WR 0-5	SD 22, 23, 24	4	0-5	0.328	0.219	0.493	181,864
3	IBTS Quarter 1 WR 1-5	Kattegat	1	1-5	0.827	0.377	1.812	89,670
4	IBTS Quarter 3 WR 1-5	Kattegat	3	1-5	0.180	0.107	0.303	351,345
5a	Larv.Surv.(excl.98) WR 0 linear	SD 24	1-2	0	0.031	0.007	0.130	1,789,987
5b	Larv.Surv.(excl.98) WR 0 power	SD 24	1-2	0	0.112	0.043	0.294	498,181
1b+2b+4	As Final 04: Dan.Ac.(WR 2-8+)&Ger.Ac.(WR0-5)&IBTS Q3(WR1-5)	SD 24	1-2	0-8+	0.384	0.280	0.526	180,386

Figure 3.6.3 WESTERN BALTIC HERRING. Estimates of mean F and SSB by ICA runs by individual fleets and catch at age data for 1991-2004.

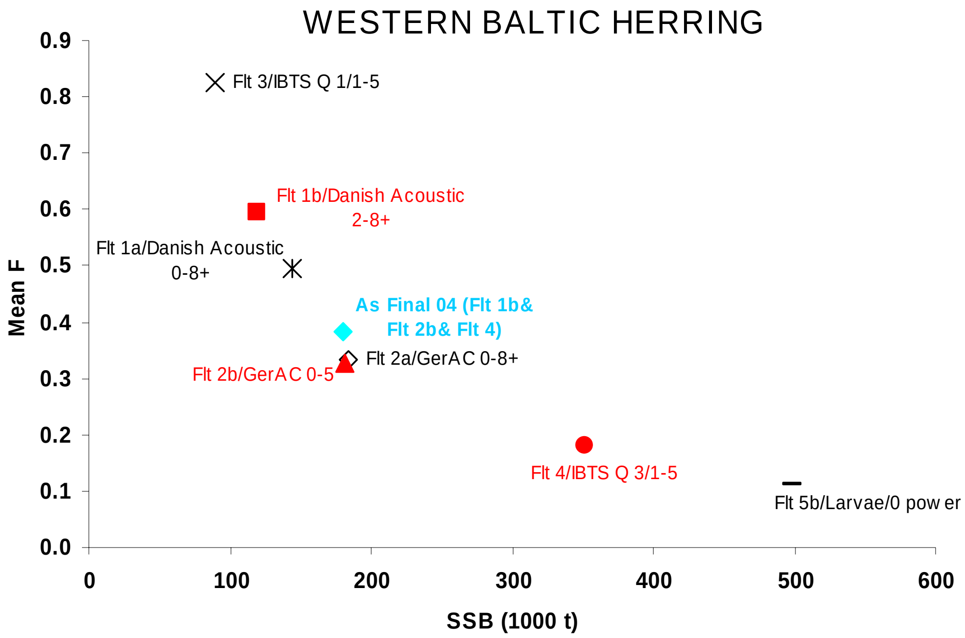


Figure 3.6.4 **WESTERN BALTIC HERRING.**
Estimates of mean F and SSB in terminal year by ICA runs by individual fleets and catch at age data for 1991-2004.

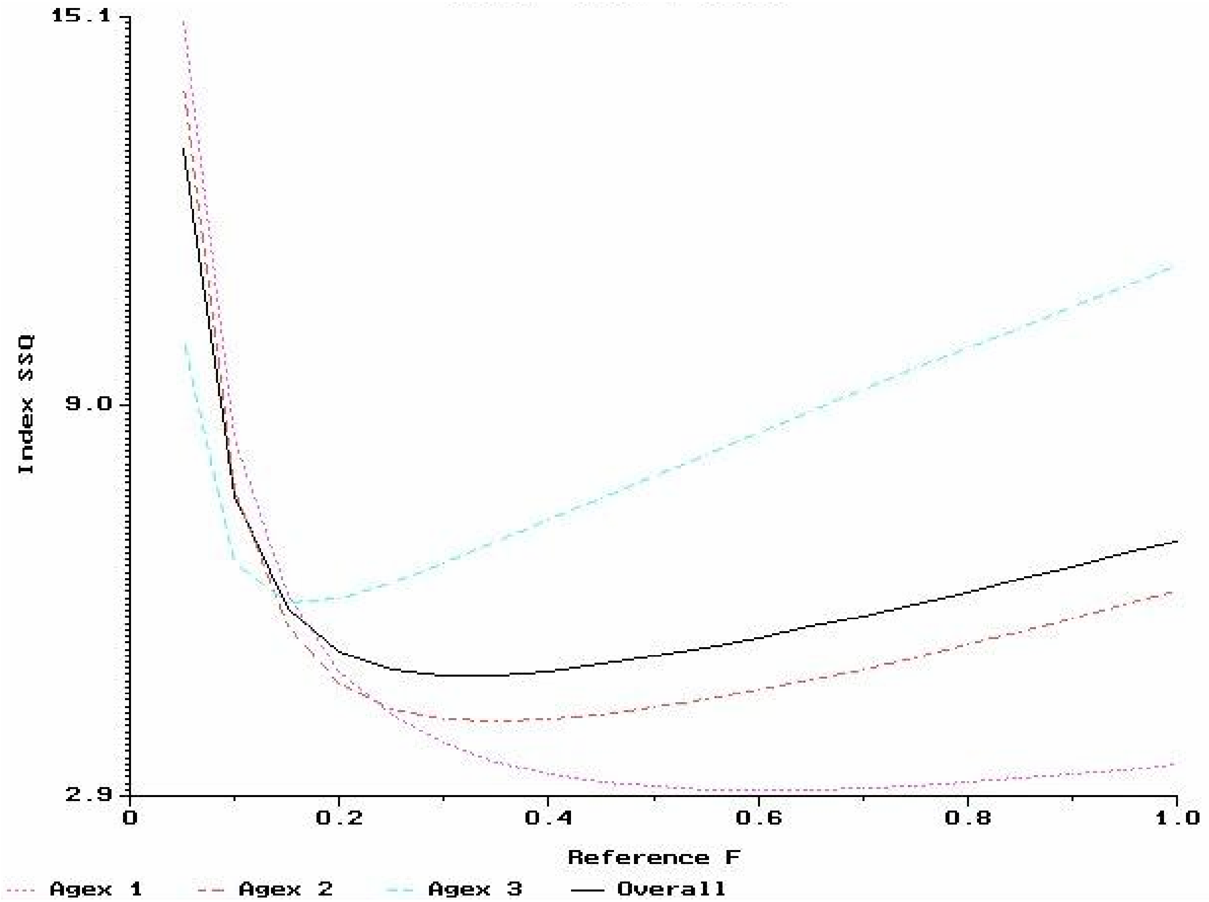


Figure 3.6.5 WESTERN BALTIC HERRING. Output from ICA Final run 2005.

Index sum of squares of deviations between model and observations

(survey index) as a function of the reference F in 2004.

Agex 1: Fleet 1b/Danish Acoustic in Division IIIa+IVaE, ages 0-8+

Agex 2: Fleet 2b/German Acoustic in SD 22-24, ages 0-5

Agex 3: Fleet 4/IBTS Quarter 3, ages 1-5

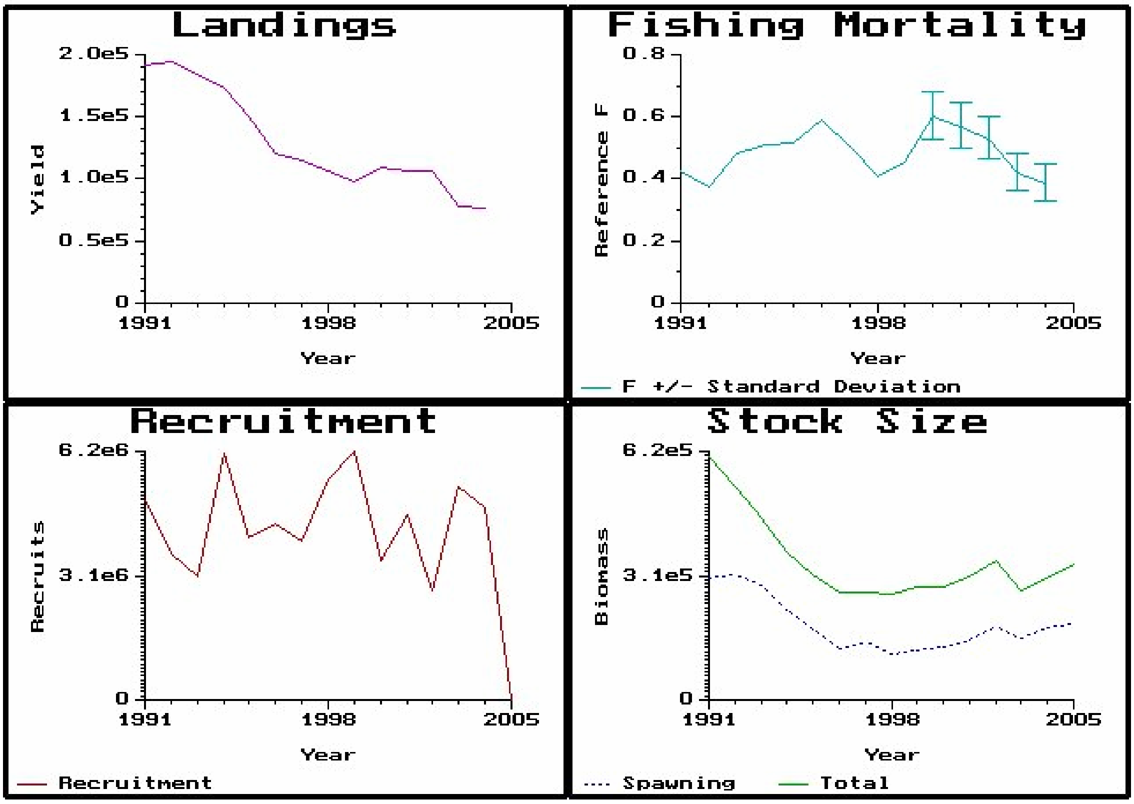


Figure 3.6.6 **WESTERN BALTIC HERRING. Output from ICA Final Run 2005. Stock summary.**

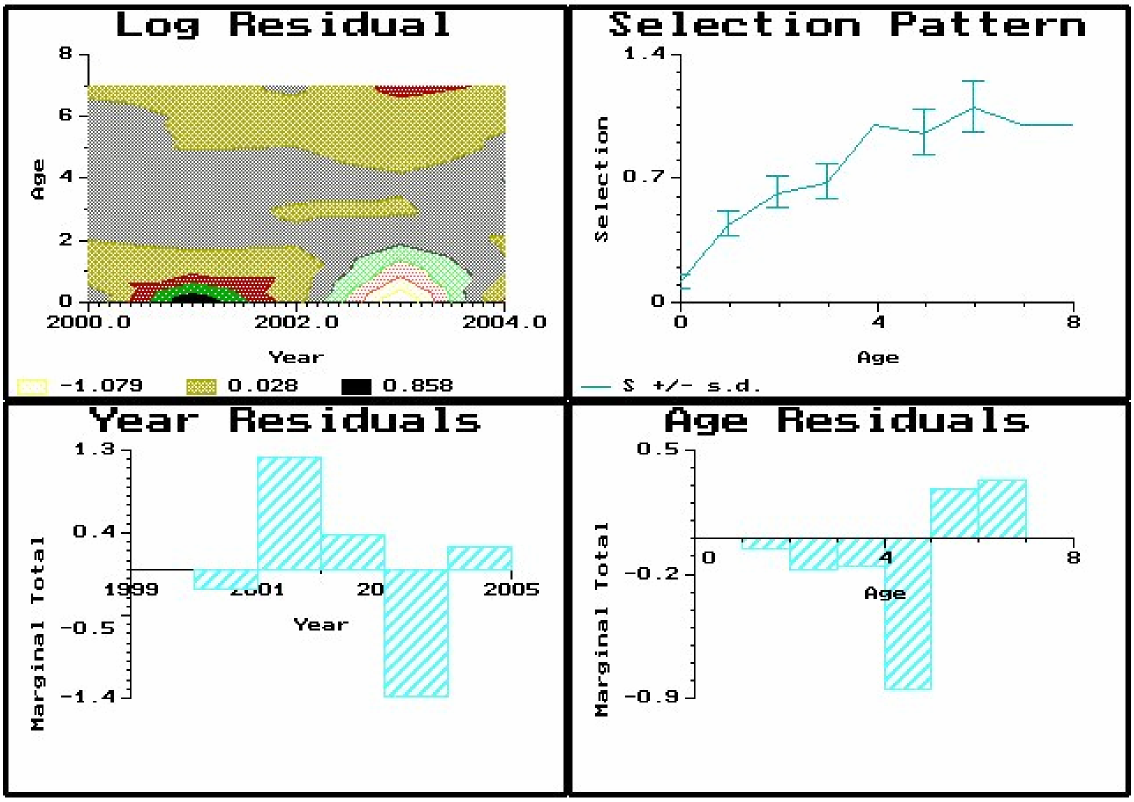


Figure 3.6.7 **WESTERN BALTIC HERRING. Output from ICA Final Run 2005.**
Separable Model Diagnostics.
Age 0 is still included in the log residual and year residuals although age 0 was downweighted (0.1) in the catch.

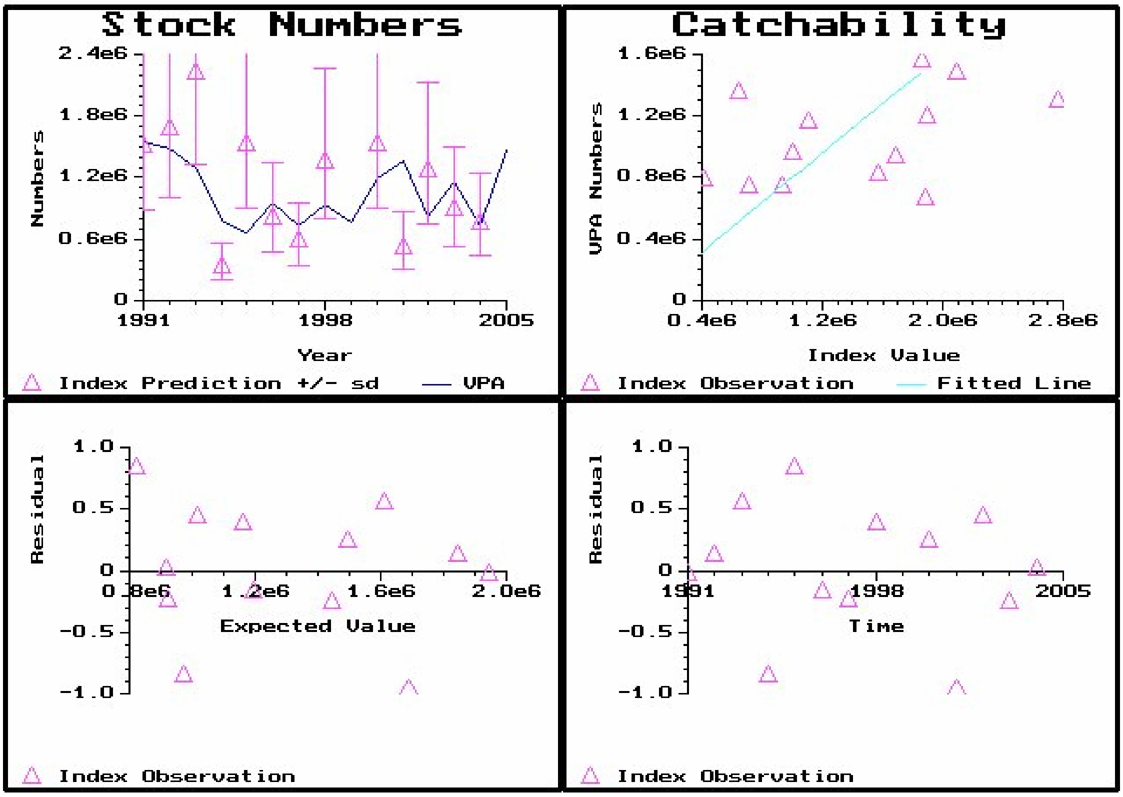


Figure 3.6.8a Western Baltic Herring. Output from ICA Final Run:
Tuning Diagnostics.
Acoustic Survey, Division IIIa+IVaE, July, Age group 2

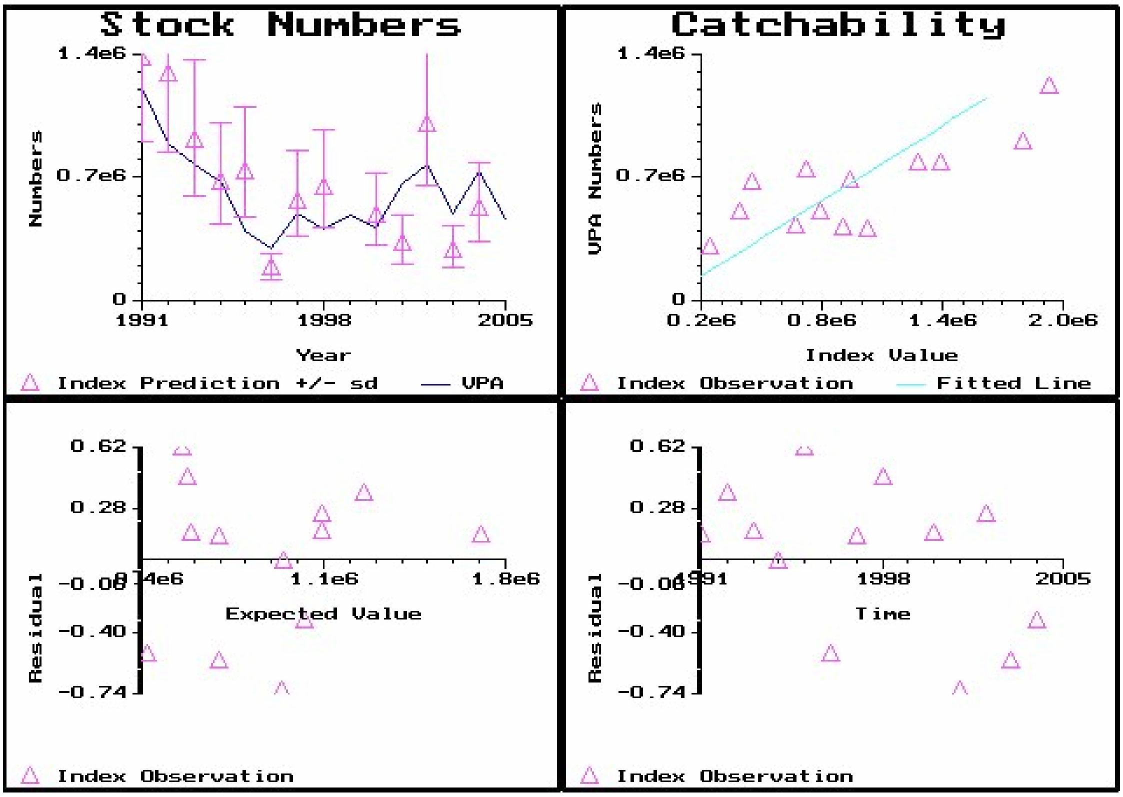


Figure 3.6.8b Western Baltic Herring. Output from ICA FinaL Run:
Tuning Diagnostics.
Acoustic Survey, Division IIIa+IVaE, July, Age group 3

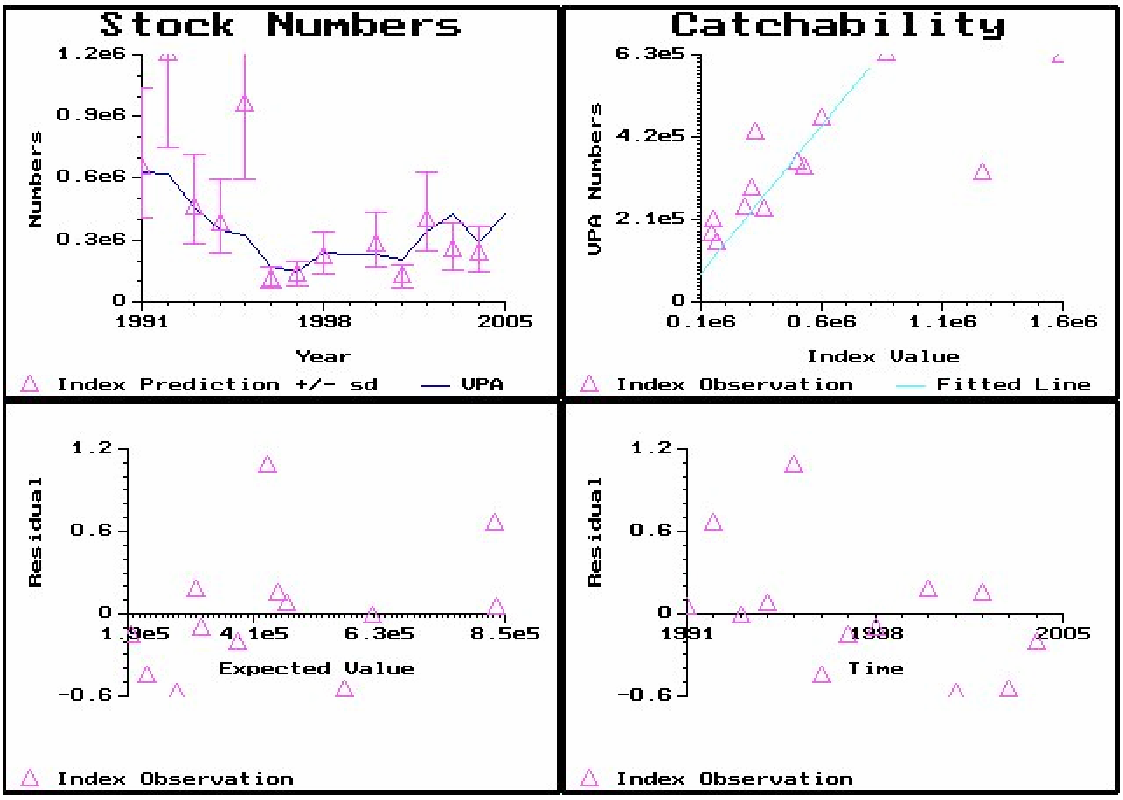


Figure 3.6.8c **Western Baltic Herring. Output from ICA Final Run:**
Tuning Diagnostics.
Acoustic Survey, Division IIIa+IvaE, July, Age group 4

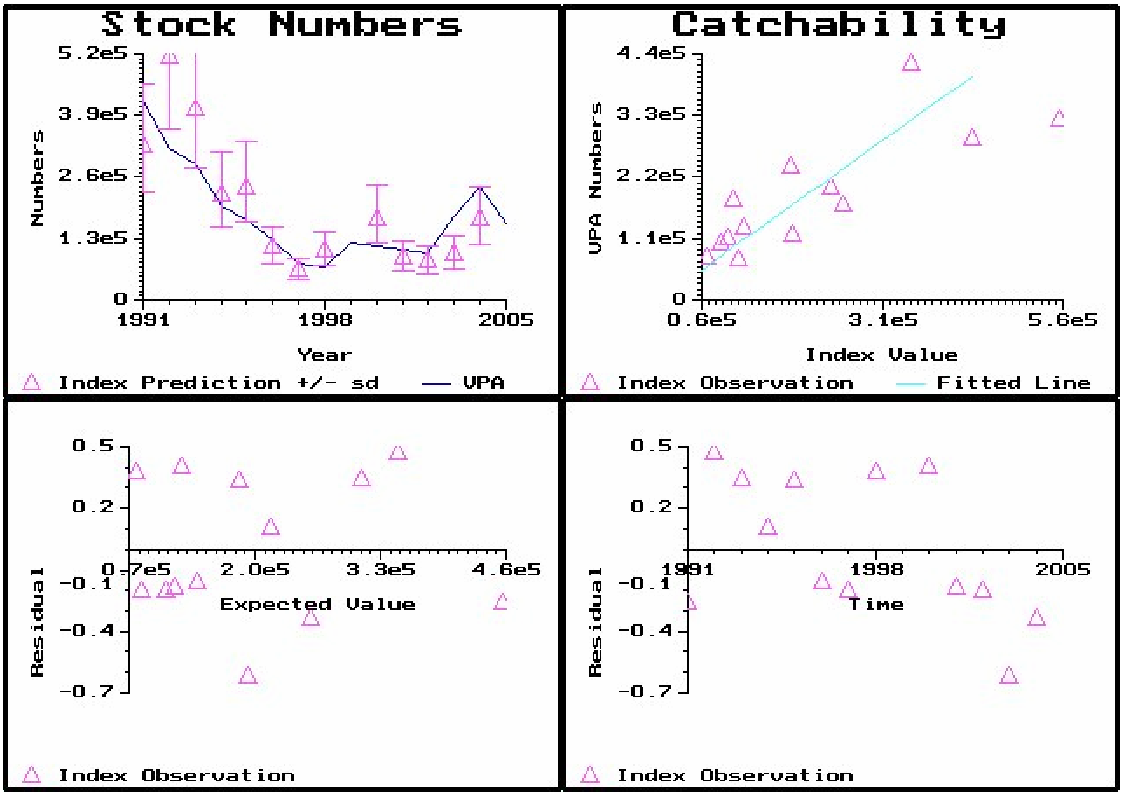


Figure 3.6.8d **Western Baltic Herring. Output from ICA Final Run:**
Tuning Diagnostics.
Acoustic Survey, Division IIIa+IvaE, July, Age group 5

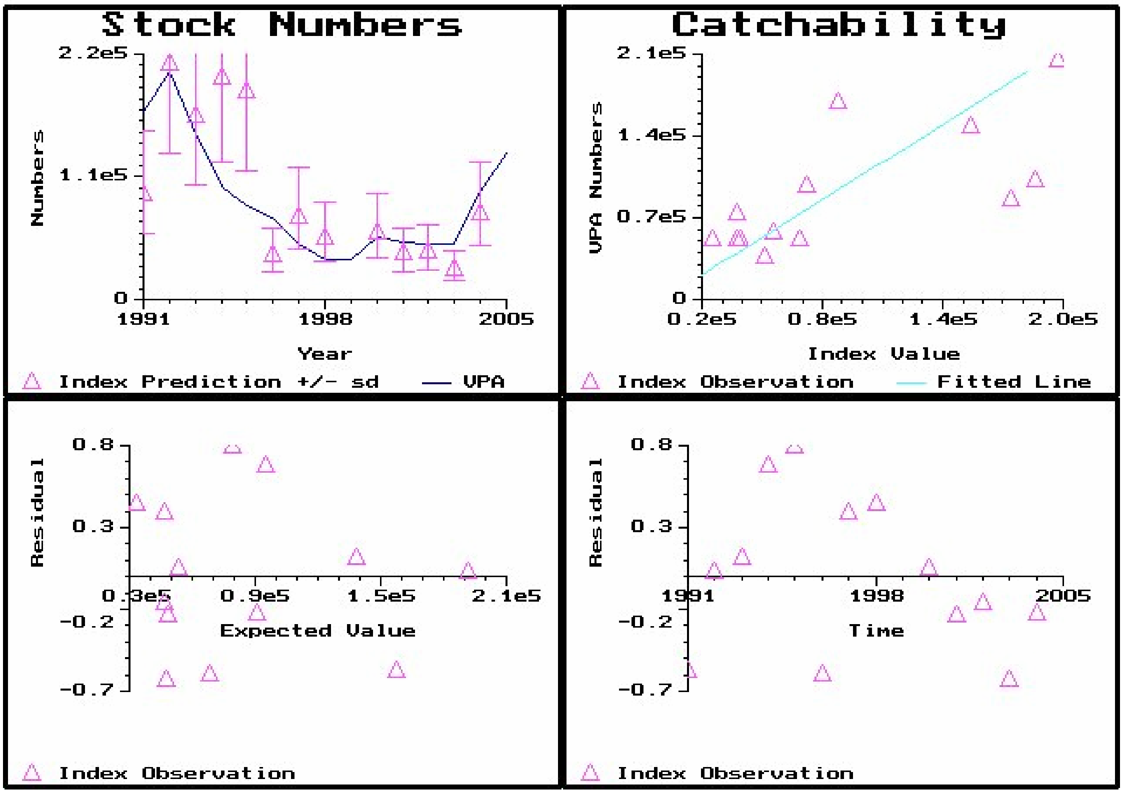


Figure 3.6.8e Western Baltic Herring. Output from ICA Final Run: Tuning Diagnostics. Acoustic Survey, Division IIIa+IVaE, July, Age group 6

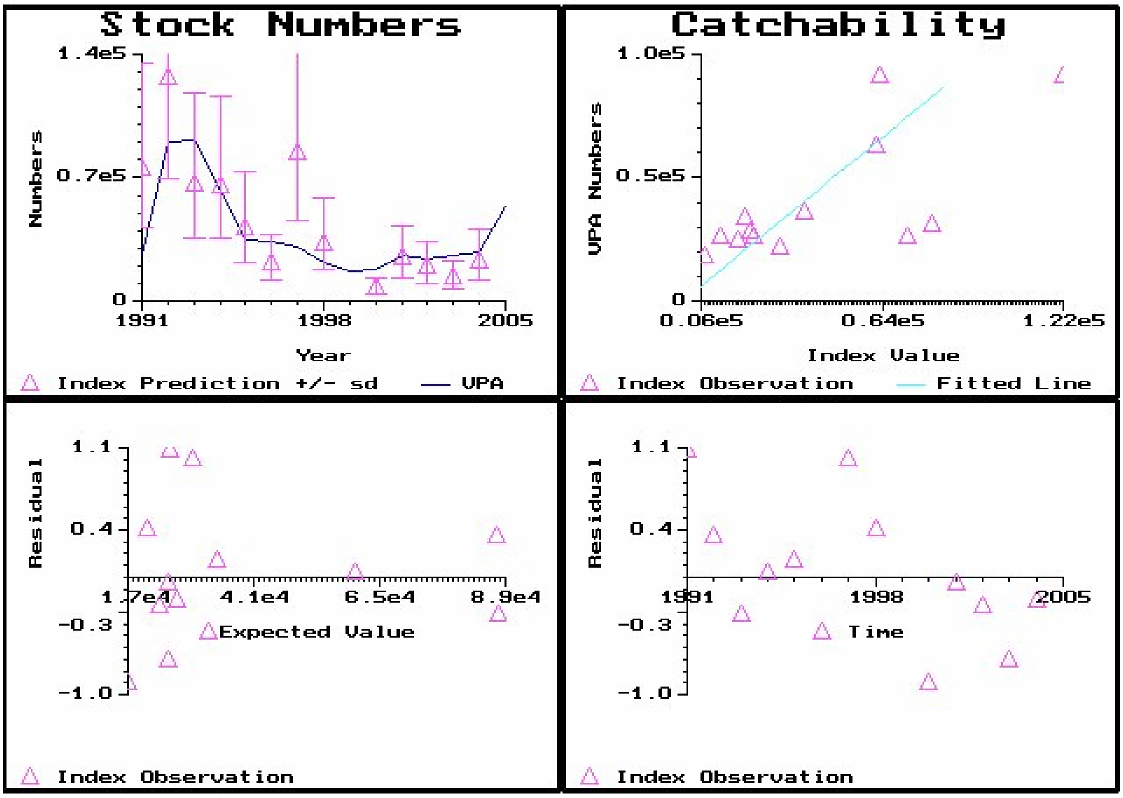


Figure 3.6.8f Western Baltic Herring. Output from ICA Final Run: Tuning Diagnostics. Acoustic Survey, Division IIIa+IVaE, July, Age group 7

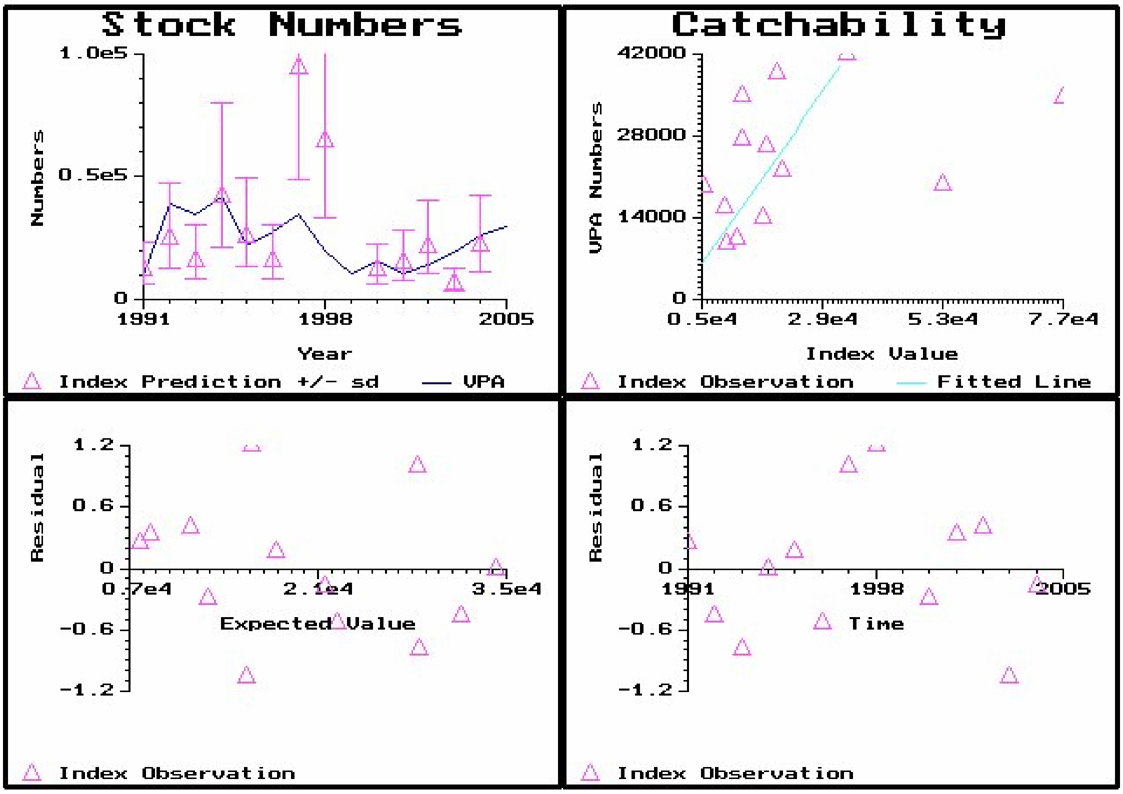


Figure 3.6.8g Western Baltic Herring. Output from ICA Final Run: Tuning Diagnostics. Acoustic Survey, Division IIIa+IVaE July, Age group 8+

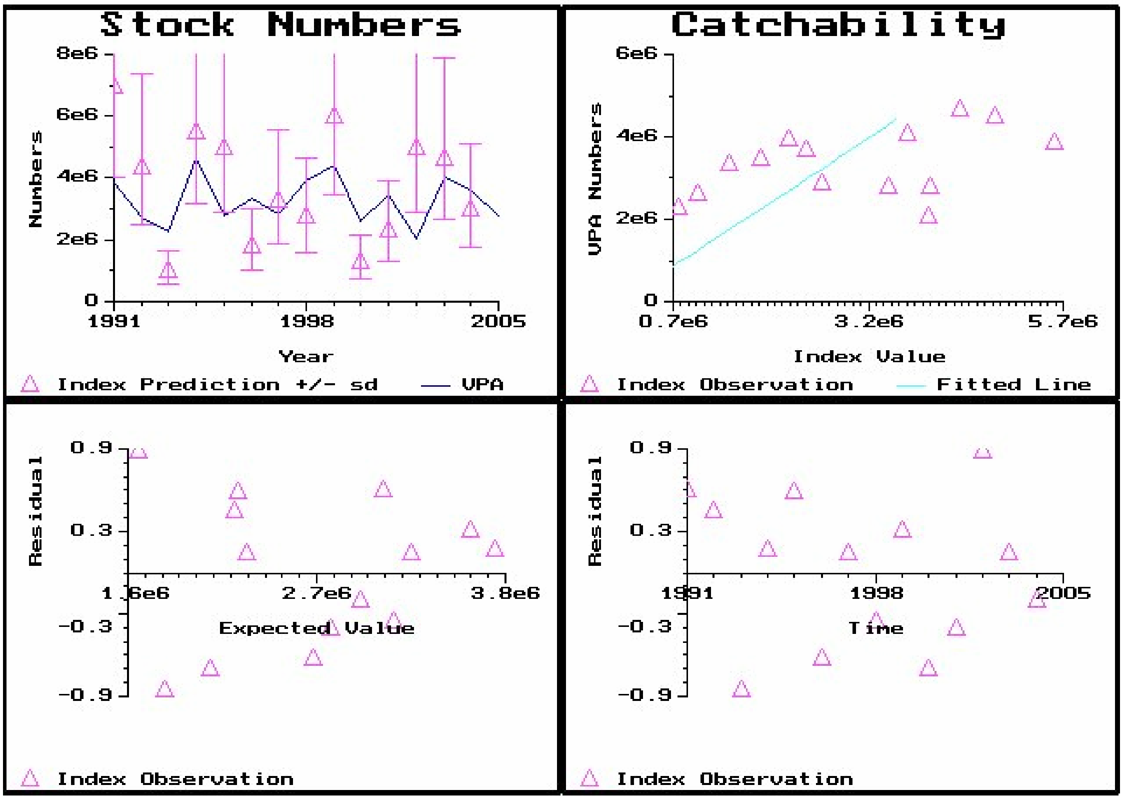


Figure 3.6.9a Western Baltic Herring. Output from ICA Final Run: Tuning Diagnostics. Acoustic Survey, SD 22-24, Sep./Oct., Age group 0

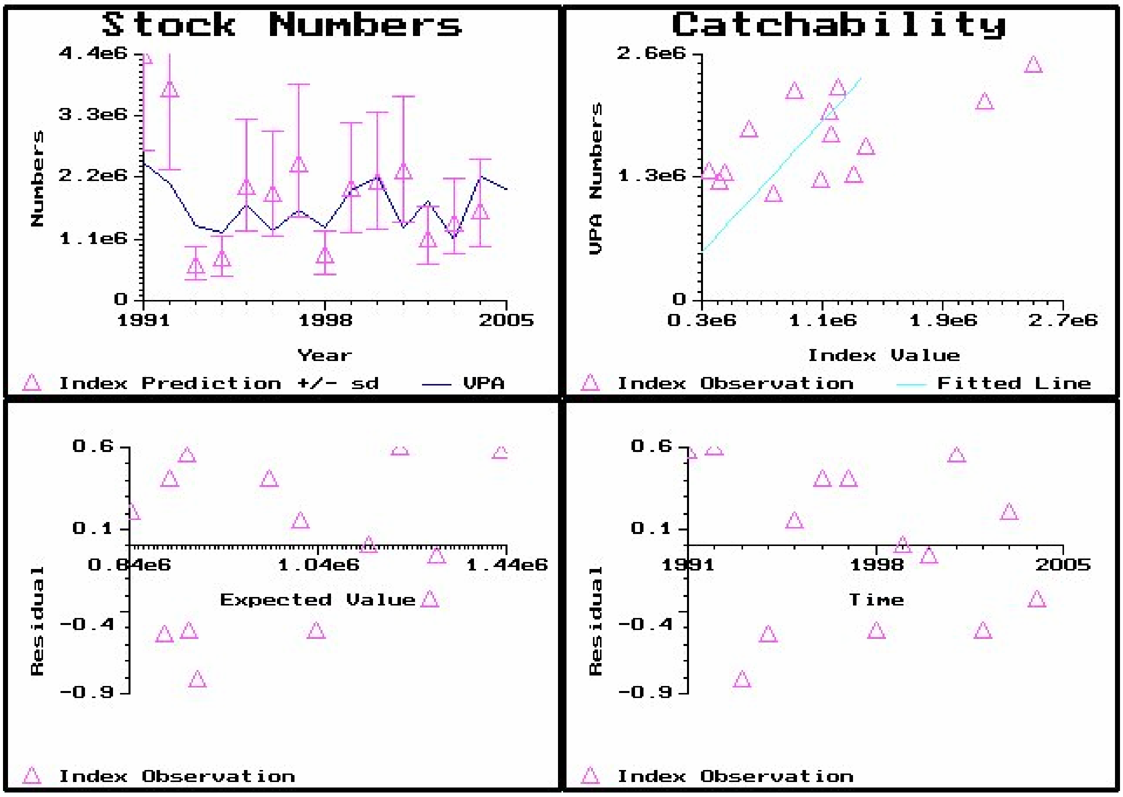


Figure 3.6.9b Western Baltic Herring. Output from ICA Final Run: Tuning Diagnostics. Acoustic Survey, SD 22-24, Sep./Oct., Age group 1

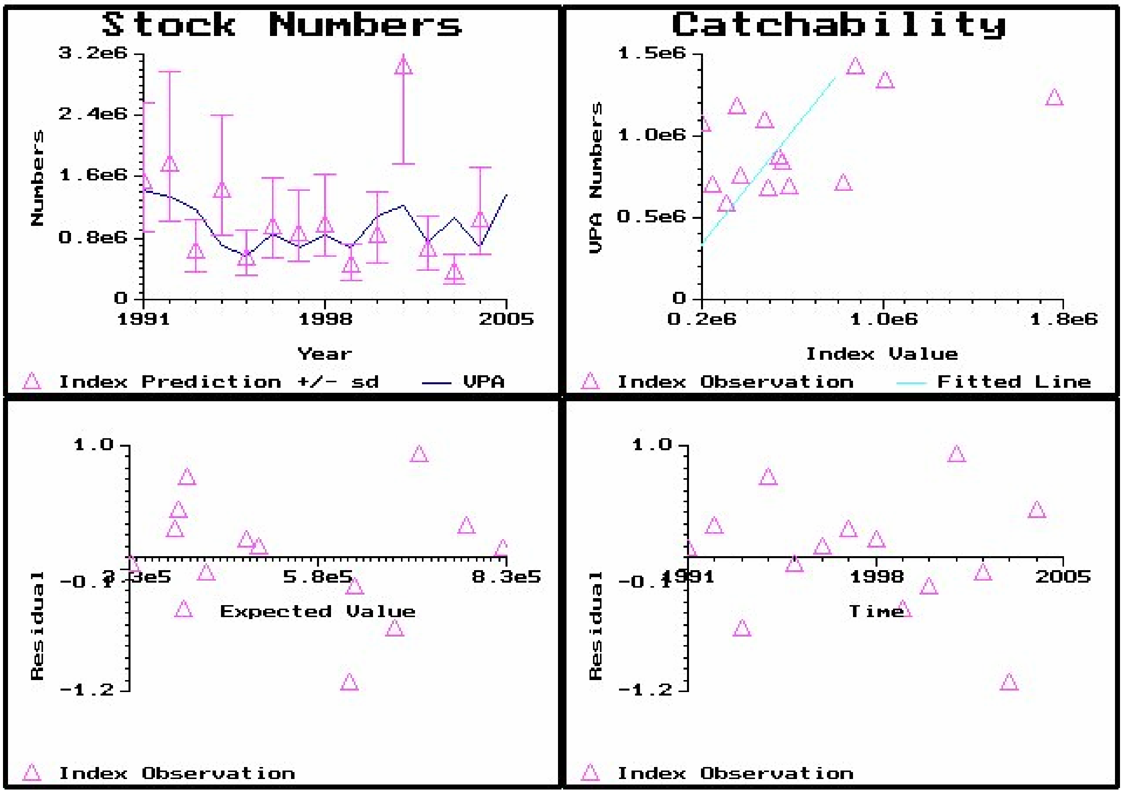


Figure 3.6.9c Western Baltic Herring. Output from ICA Final Run: Tuning Diagnostics. Acoustic Survey, SD 22-24, Sep./Oct., Age group 2

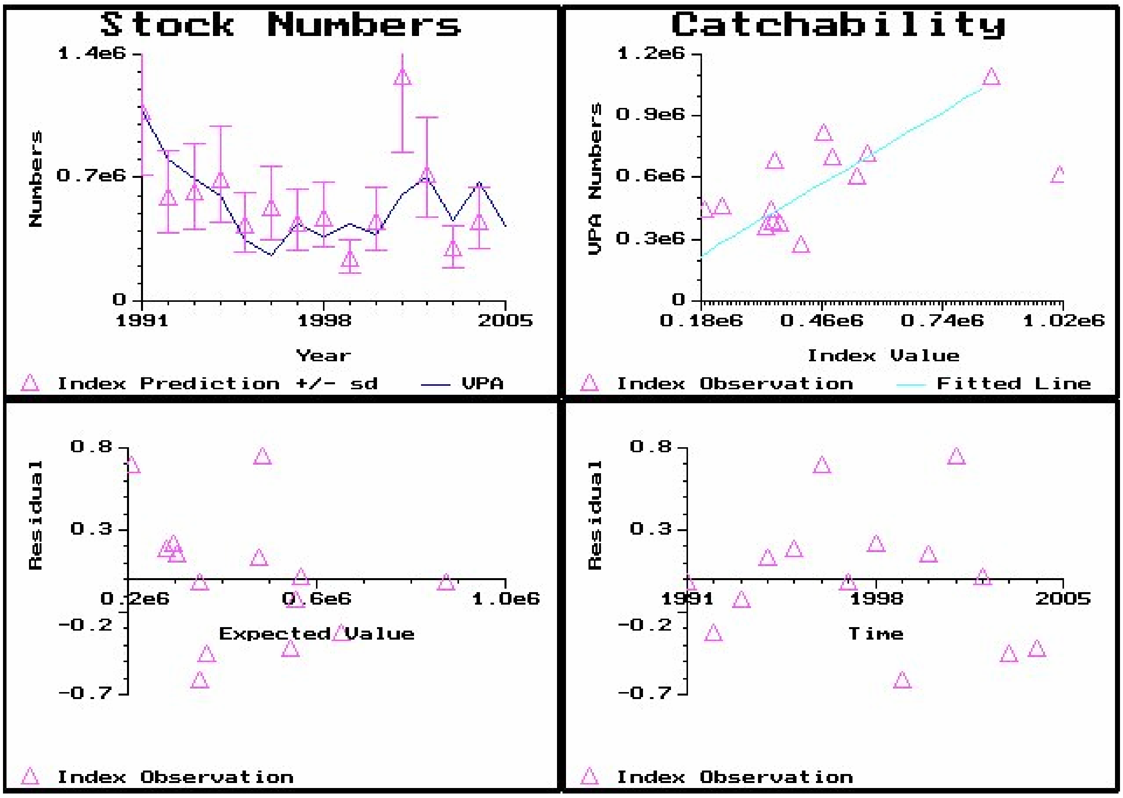


Figure 3.6.9d Western Baltic Herring. Output from ICA Final Run: Tuning Diagnostics. Acoustic Survey, SD 22-24, Sep./Oct., Age group 3

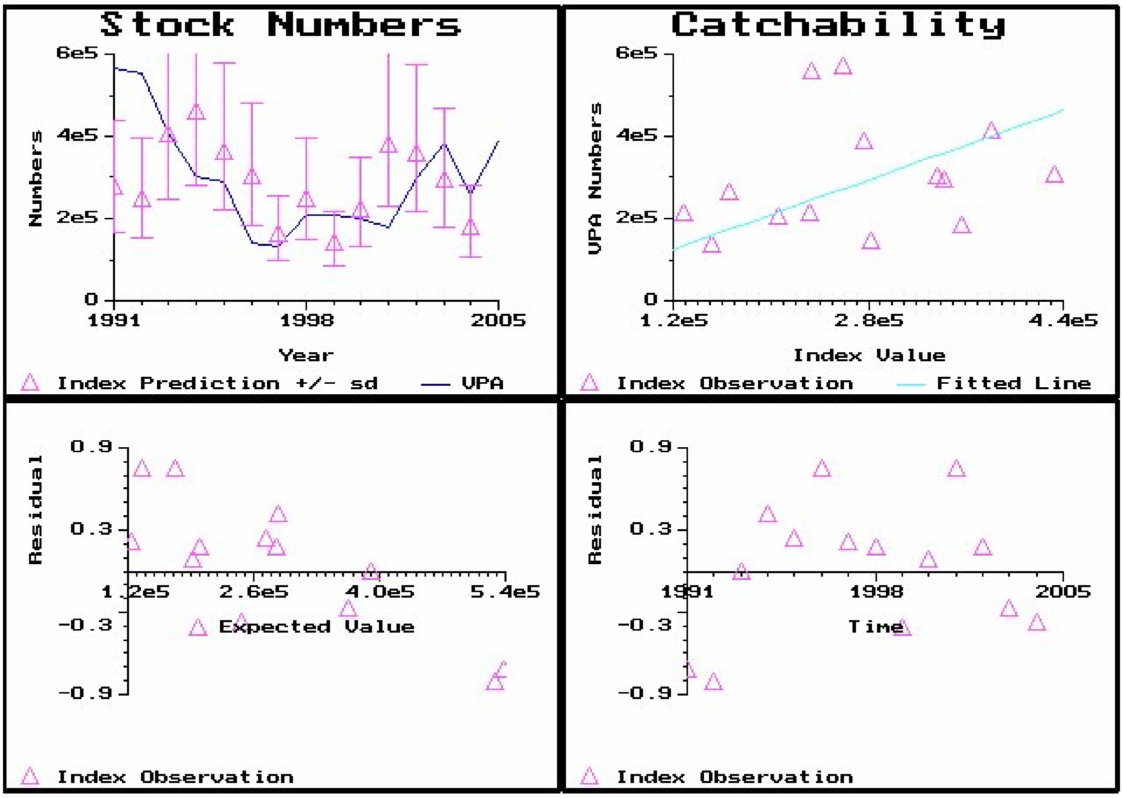


Figure 3.6.9e **Western Baltic Herring. Output from ICA Final Run: Tuning Diagnostics. Acoustic Survey, SD 22-24, Sep./Oct., Age group 4**

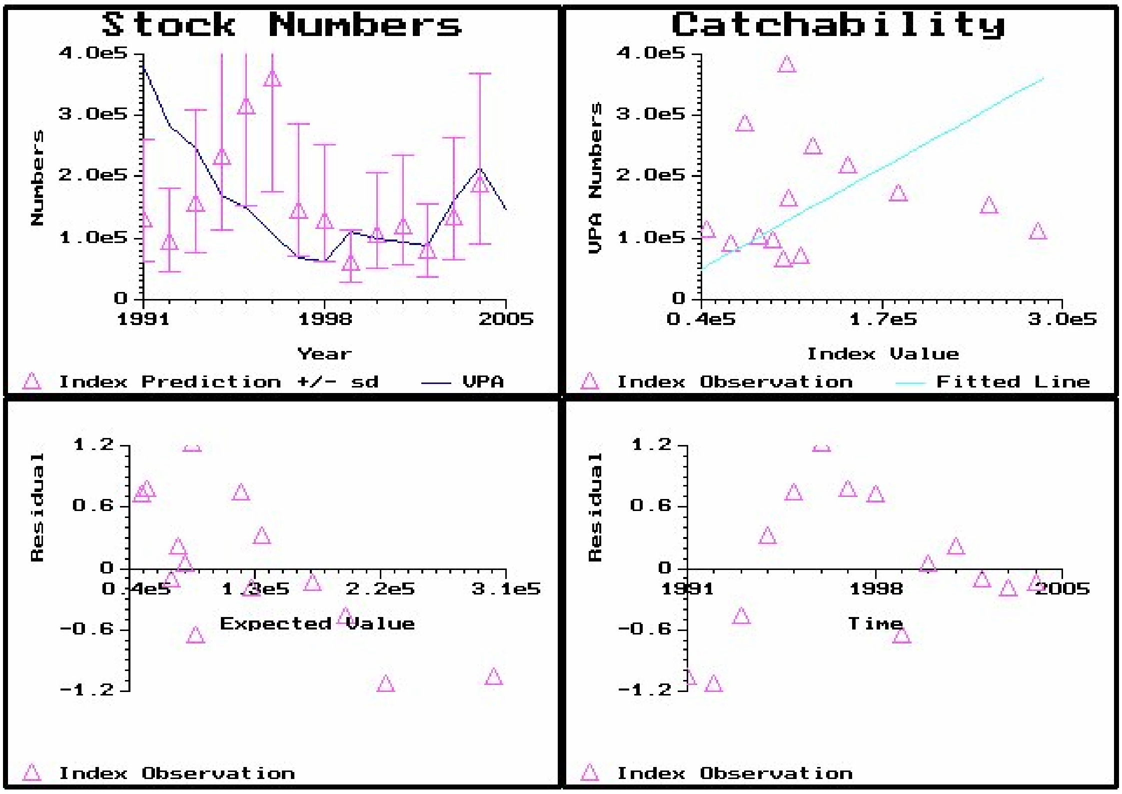


Figure 3.6.9f **Western Baltic Herring. Output from ICA Final Run: Tuning Diagnostics. Acoustic Survey, SD 22-24, Sep./Oct., Age group 5**

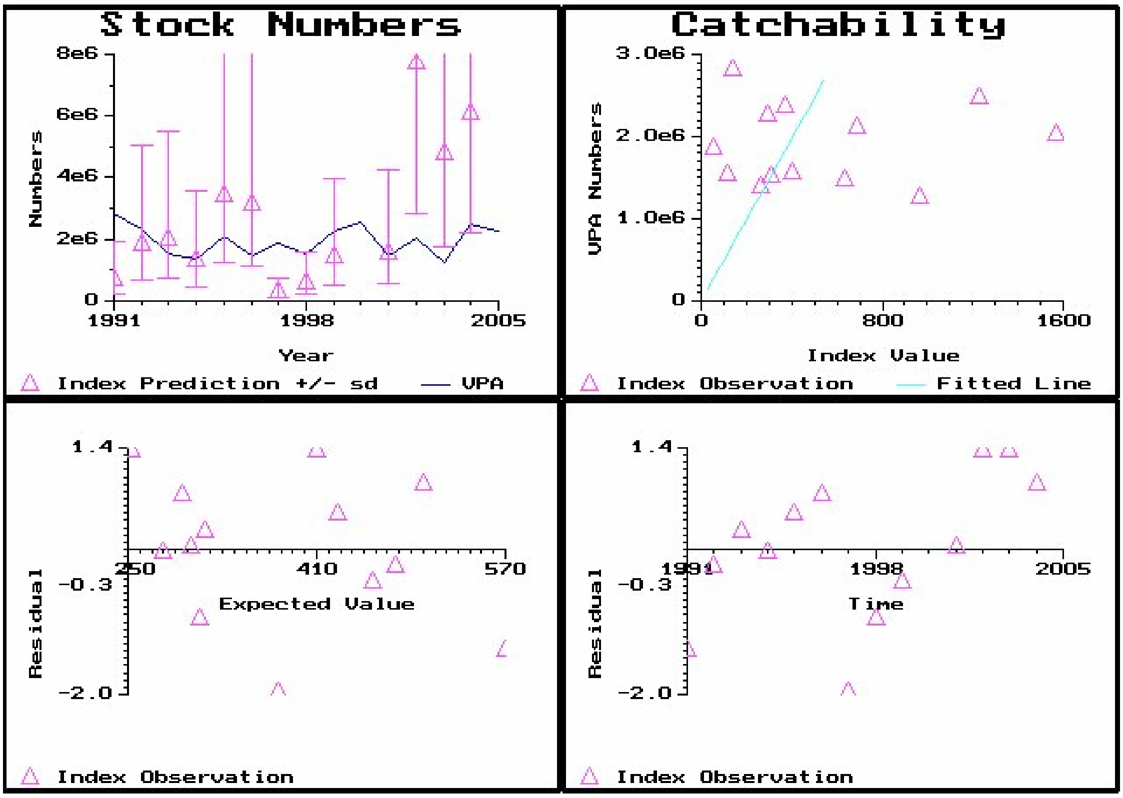


Figure 3.6.10a Western Baltic Herring. Output from ICA Final Run: Tuning Diagnostics. IBTS, Kattegat, Quarter 3, Age group 1

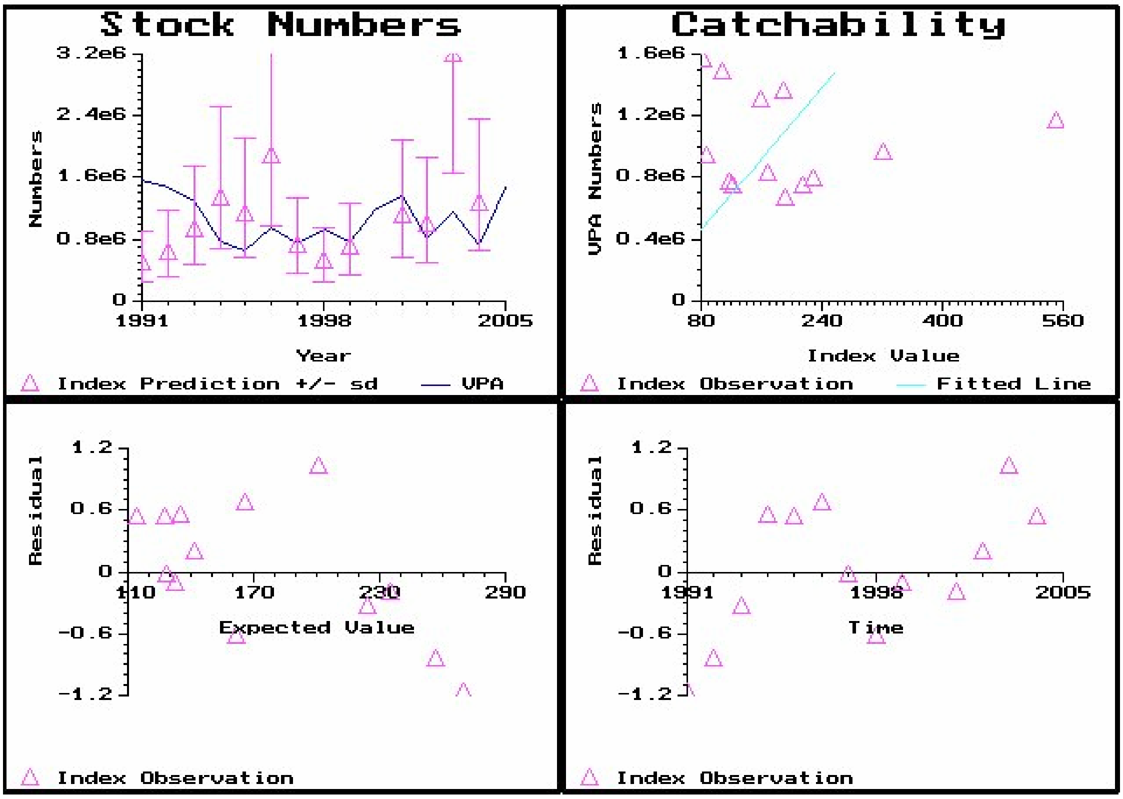


Figure 3.6.10b Western Baltic Herring. Output from ICA FinaL Run: Tuning Diagnostics. IBTS, Kattegat, Quarter 3, Age group 2

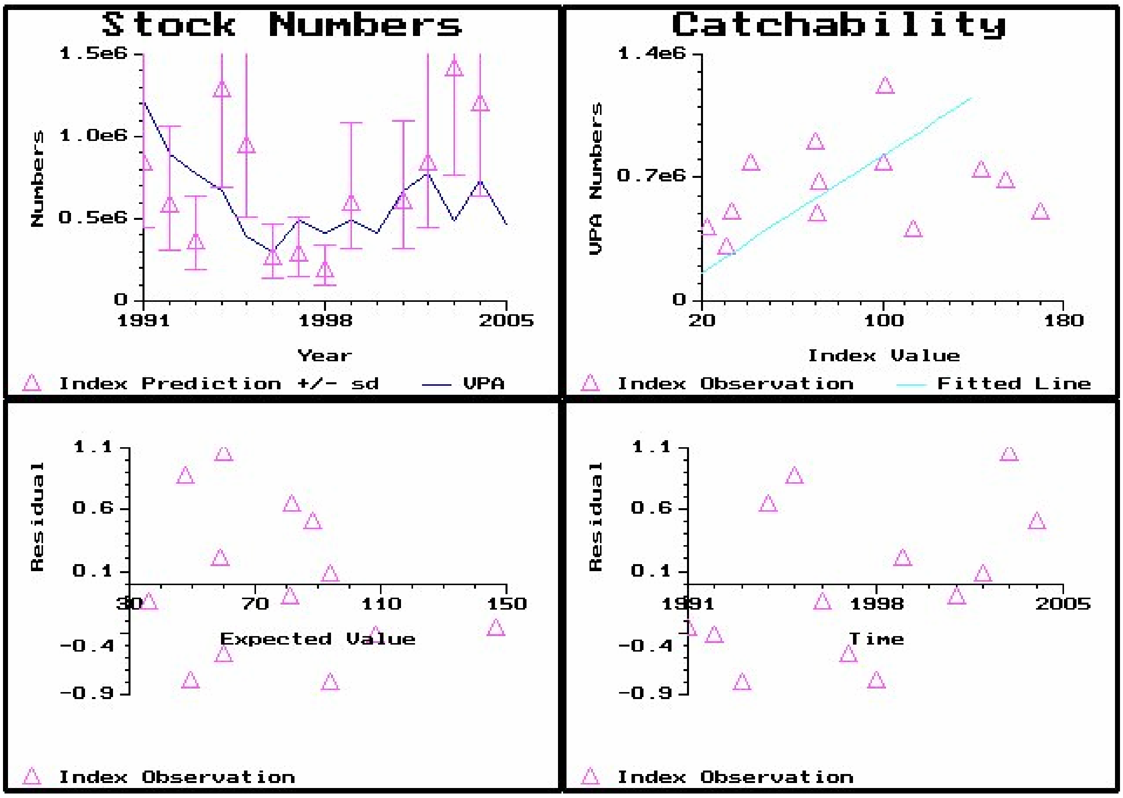


Figure 3.6.10c Western Baltic Herring. Output from ICA Final Run:
Tuning Diagnostics.
IBTS, Kattegat, Quarter 3, Age group 3

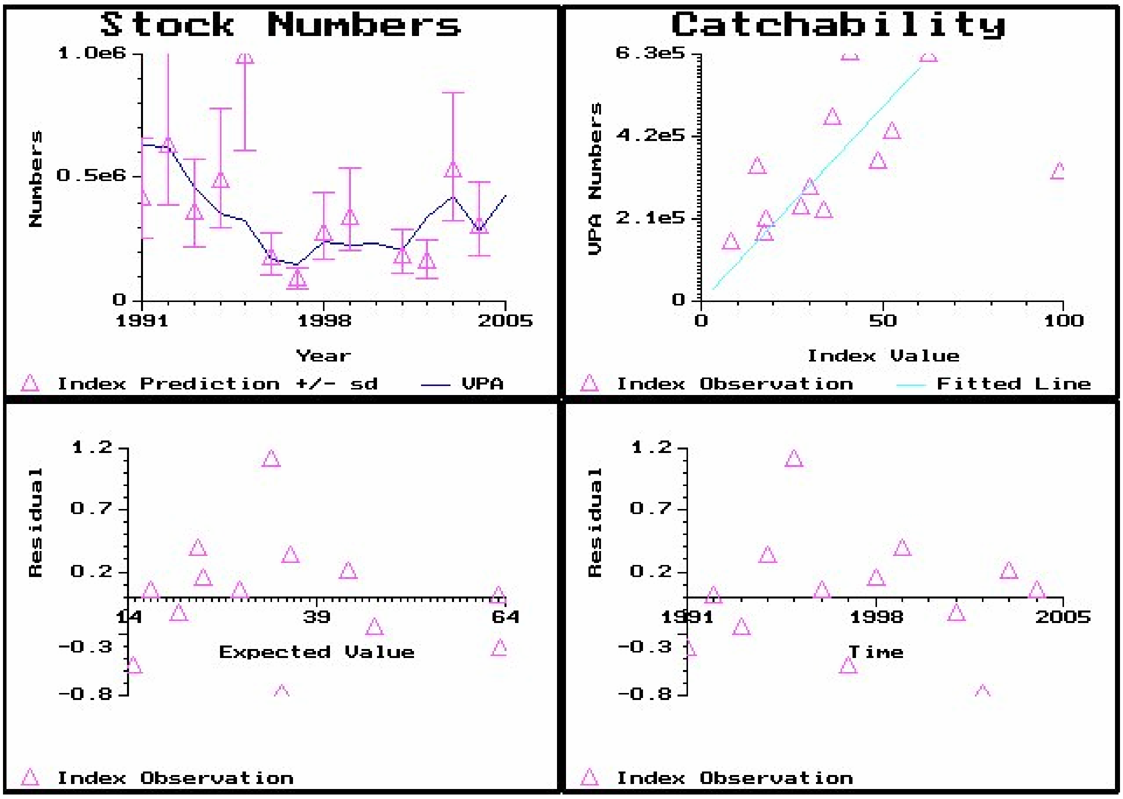


Figure 3.6.10d Western Baltic Herring. Output from ICA Final Run:
Tuning Diagnostics.
IBTS, Kattegat, Quarter 3, Age group 4

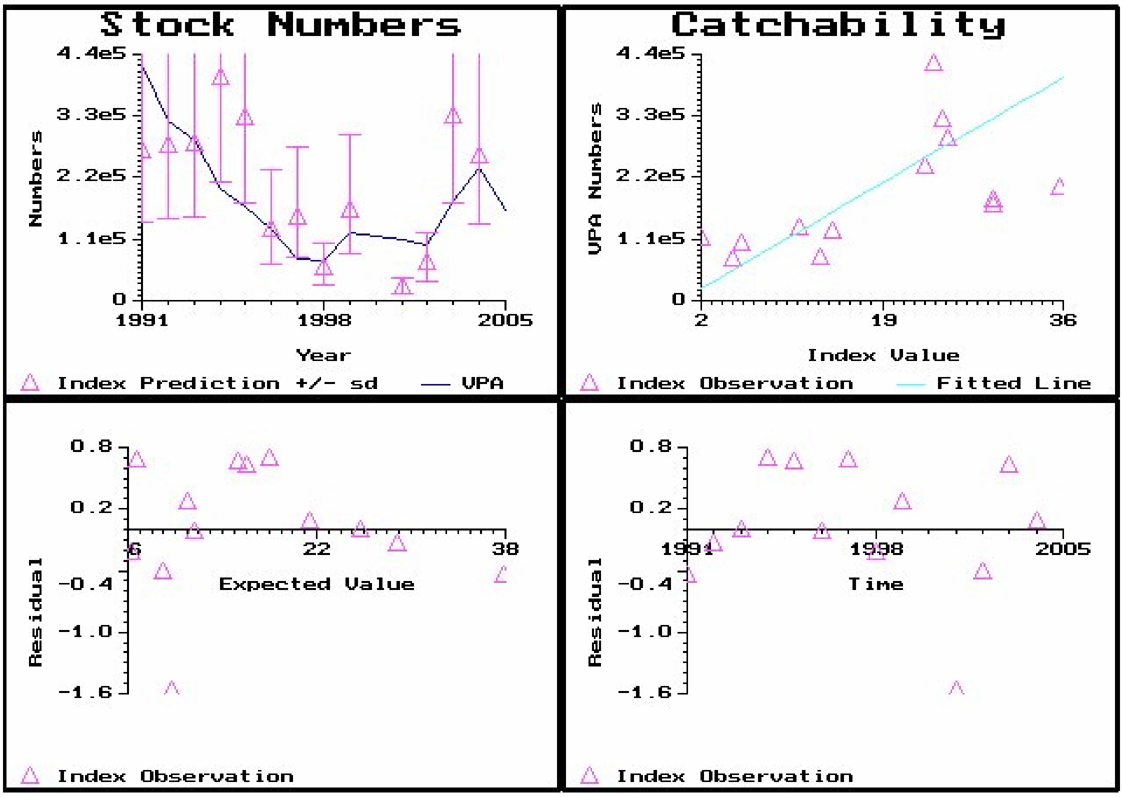


Figure 3.6.10e Western Baltic Herring. Output from ICA Final Run:
Tuning Diagnostics.
IBTS, Kattegat, Quarter 3, Age group 5

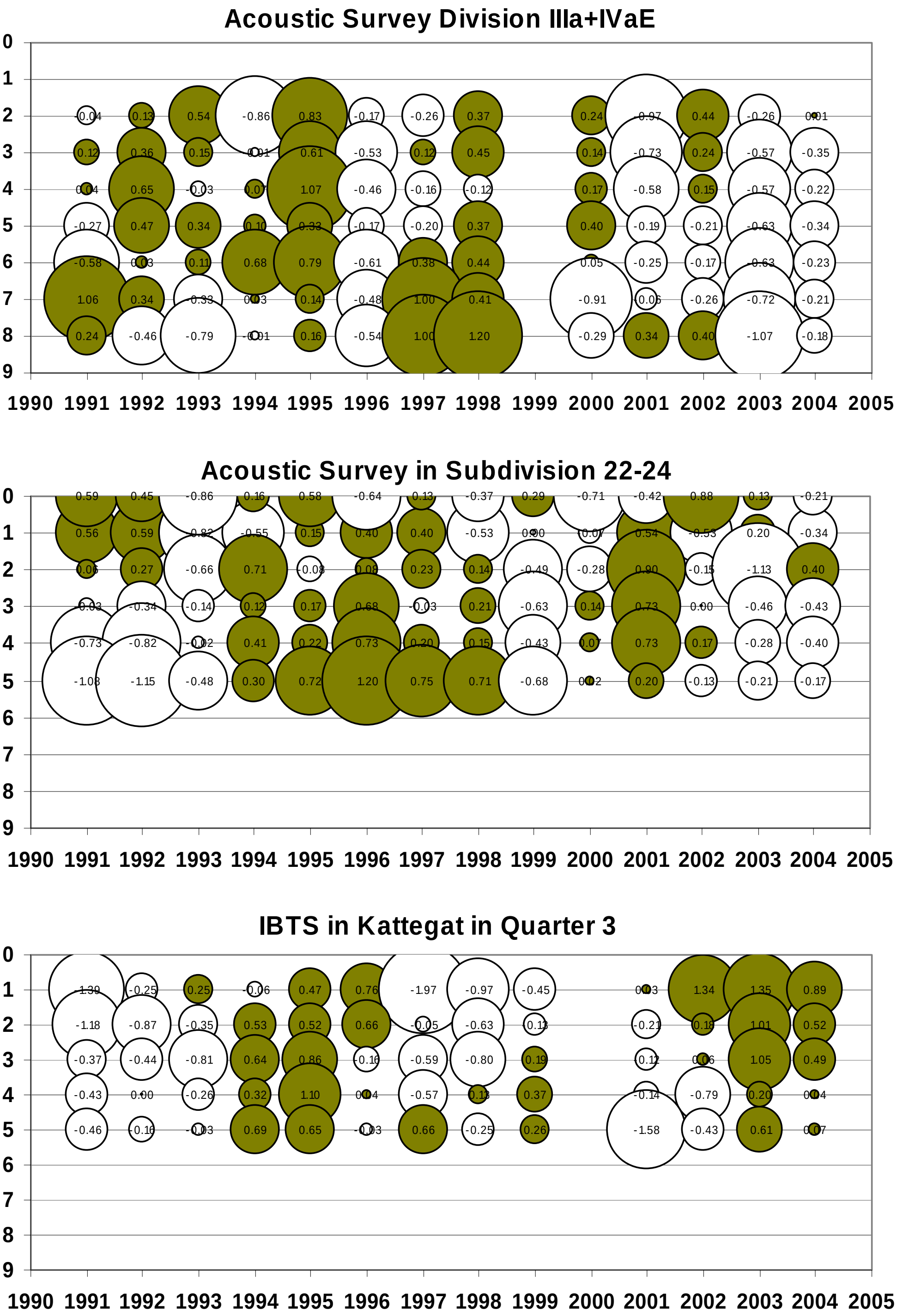


Figure 3.6.11 **WESTERN BALTIC HERRING. ICA Final Run 2005. Log catchability residuals plots.**

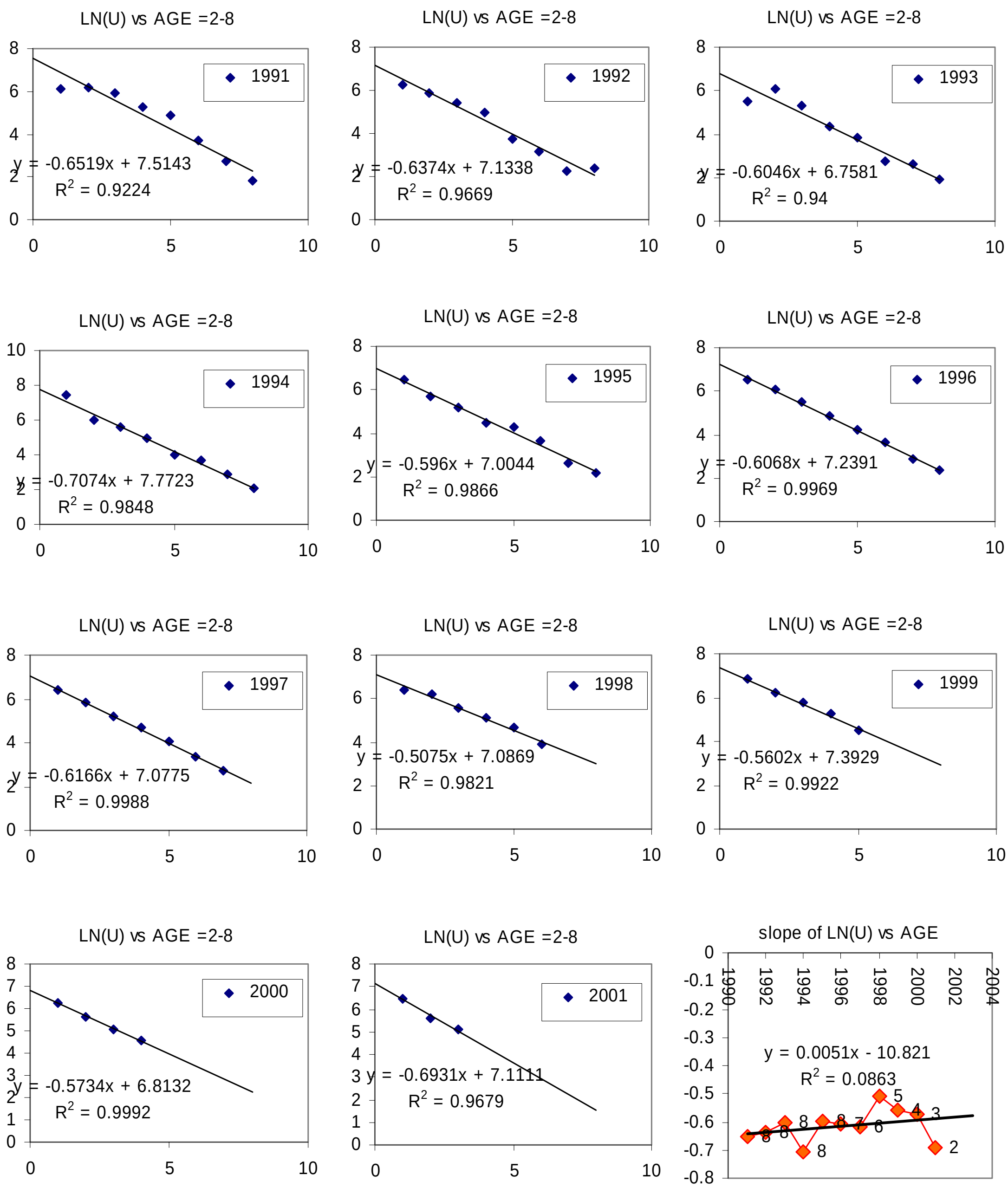


Figure 3.6.12a **WESTERN BALTIC HERRING. Log catch vs age for succescessive cohorts and their resulting slope estimates. <u>Catch in number (ages 1-8)</u>.**

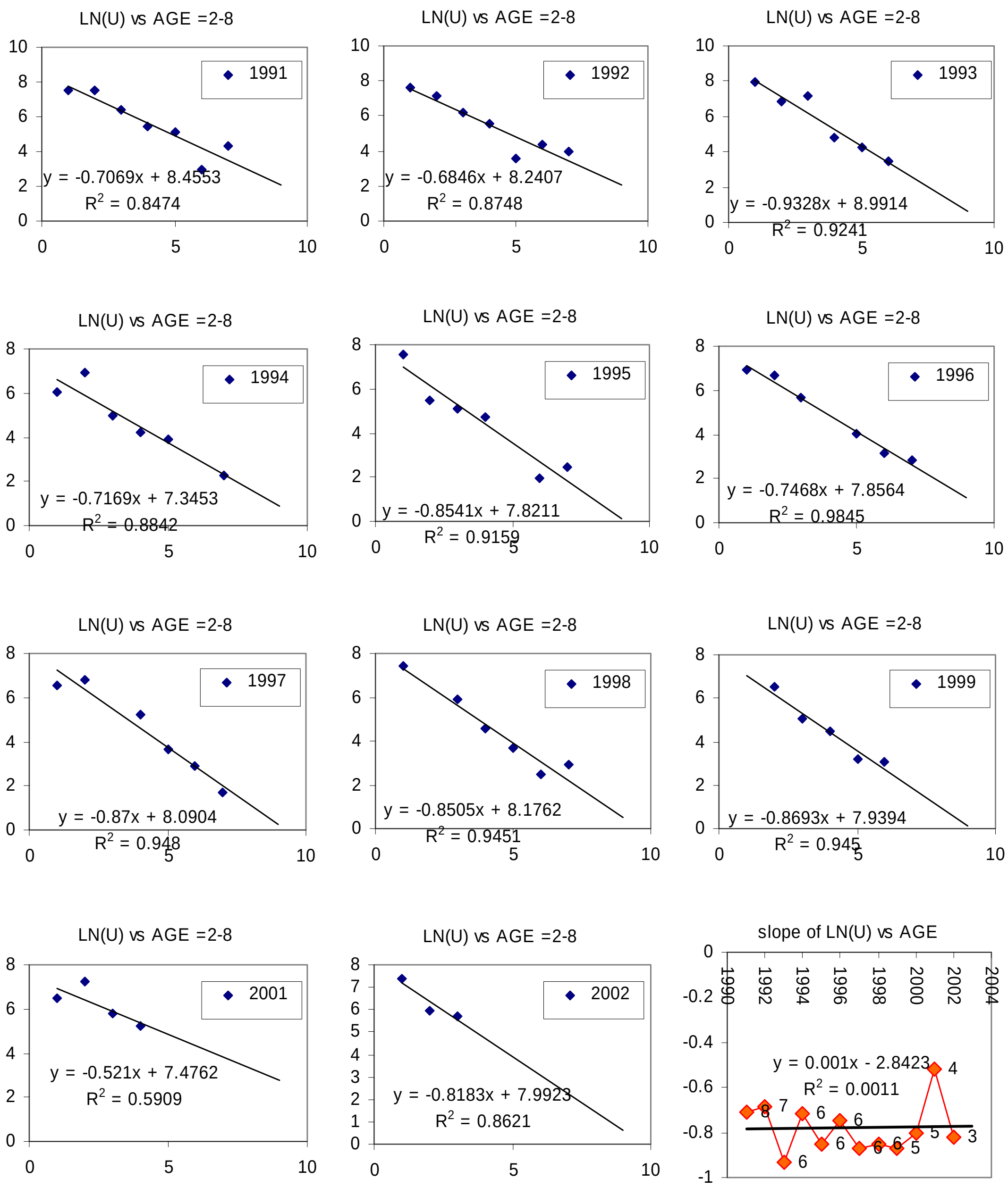


Figure 3.6.12b WESTERN BALTIC HERRING. Log catch vs age for successcessive cohorts and their resulting slope estimates. Acoustic Survey in Div. IIIa+IVaE (ages 2-8+).

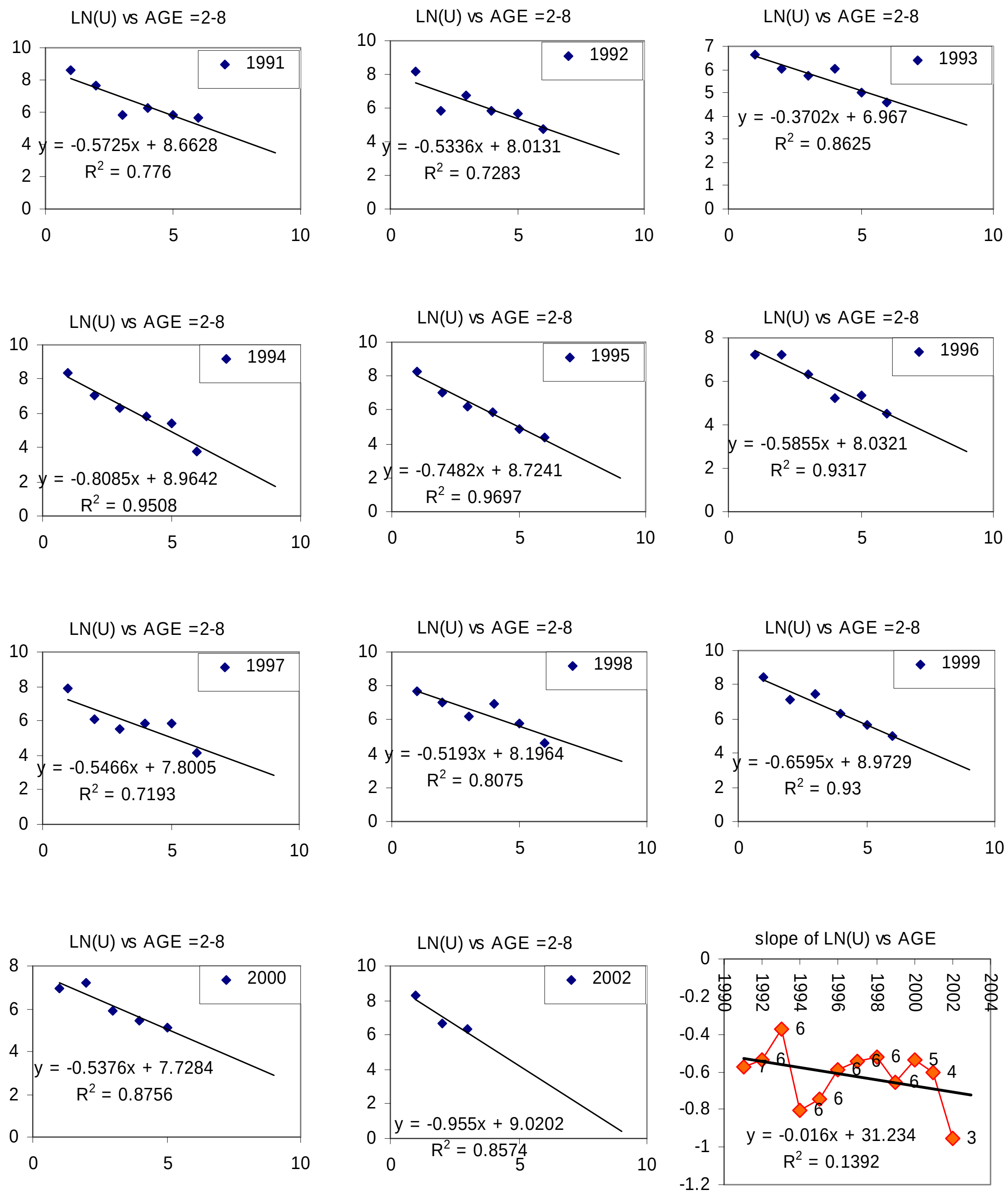


Figure 3.6.12c **WESTERN BALTIC HERRING. Log catch vs age for succescessive cohorts and their resulting slope estimates. Acoustic Survey in Subdiv. 22-24 (ages 0-5).**

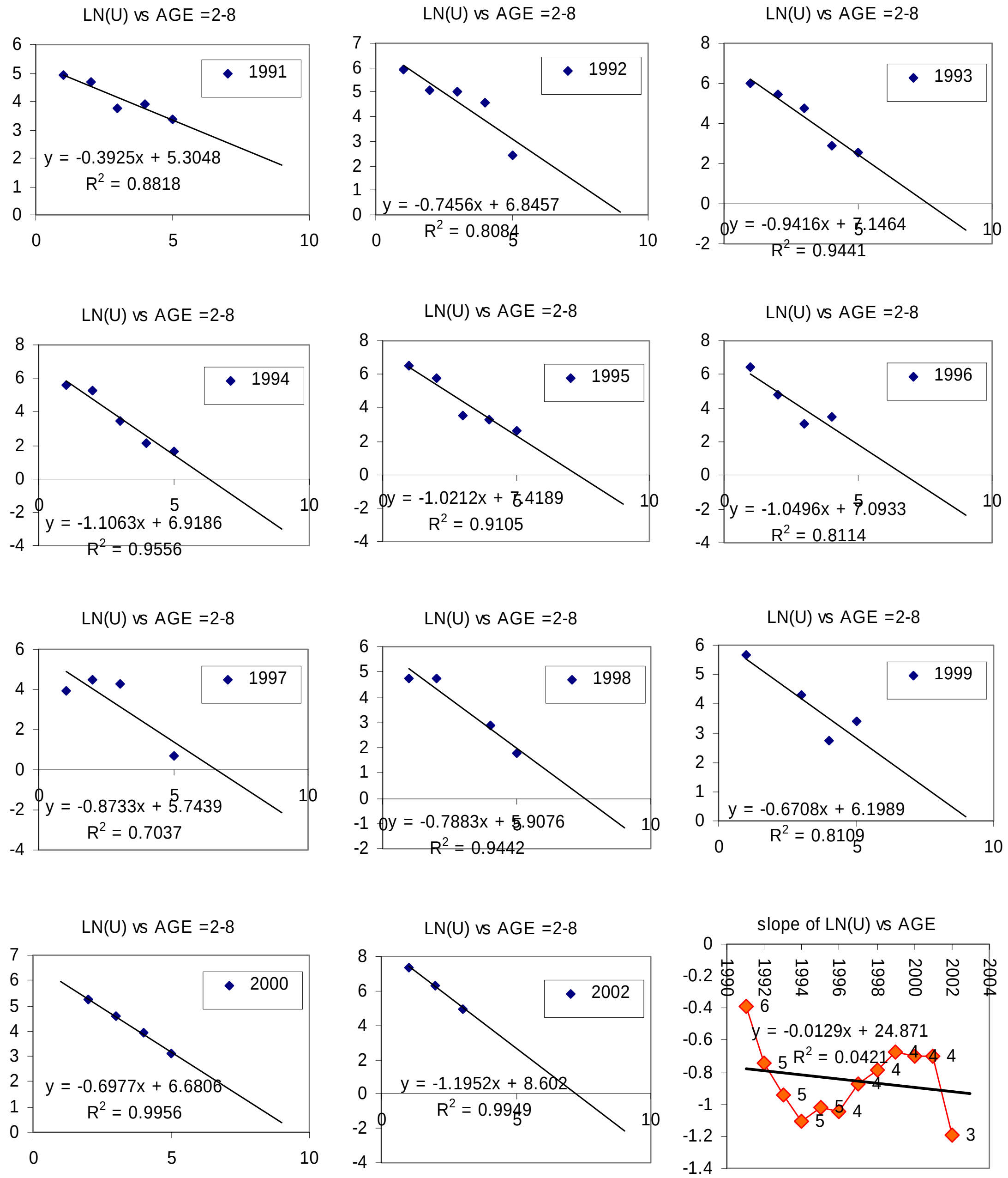
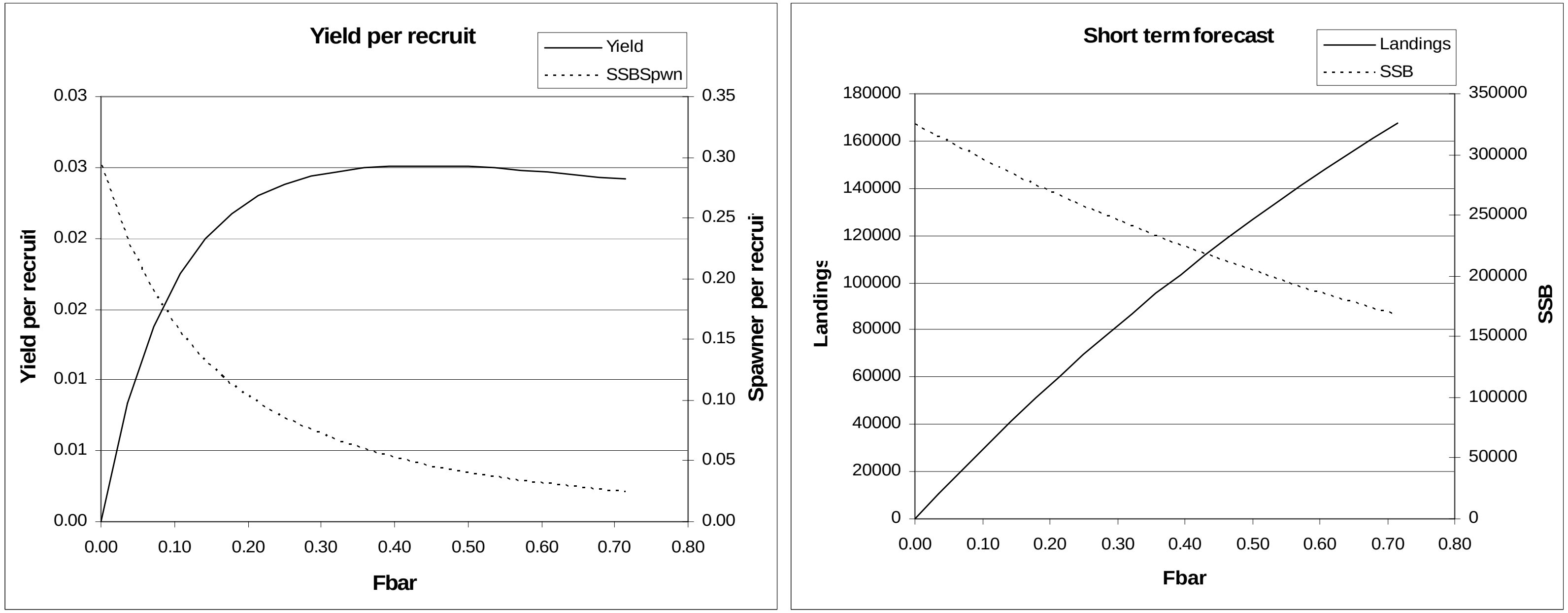


Figure 3.6.12d **WESTERN BALTIC HERRING. Log catch vs age for successescive cohorts and their resulting slope estimates. IBTS in Kattegat Quarter 3 (ages 1-5).**



MFYPR version 2a
Run: WBSS05
Time and date: 19:00 11/03/2005

Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.3575
FMax	1.2128	0.4336
F0.1	0.5917	0.2115
F35%SPR	0.5638	0.2015

Weights in kilograms

MFDP version 1a
Run: WBSS05
Western Baltic Herring (combined sex; plus group)
Time and date: 18:57 11/03/2005
Fbar age range: 3-6

Input units are thousands and kg - output in tonnes

Figure 3.7.1 **WESTERN BALTIC HERRING. Long and short term yield and SSB, derived by MFYPR v2a**

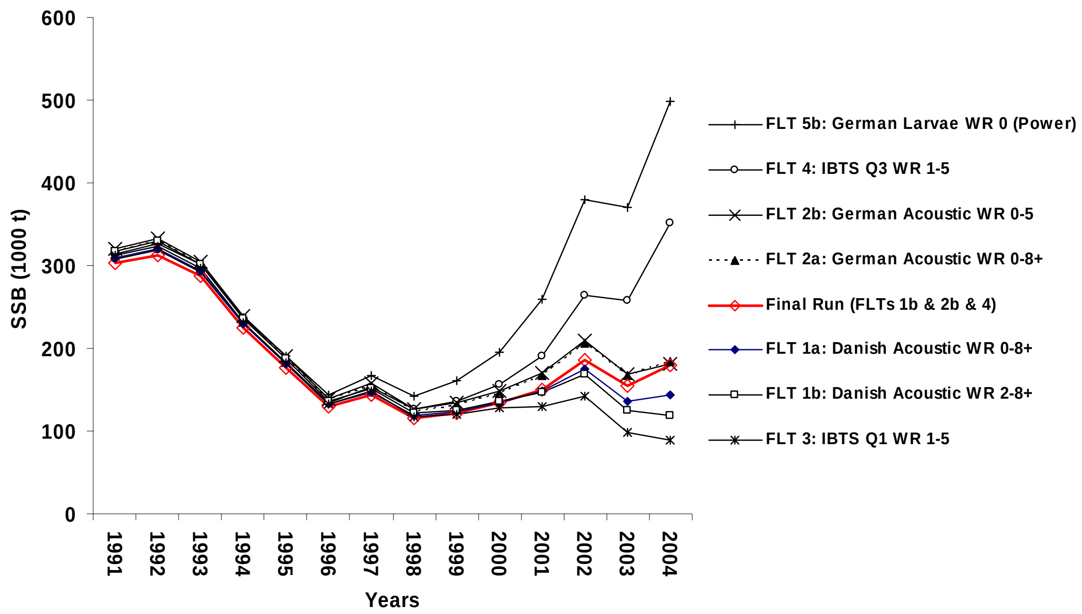


Figure 3.9.1.1 WESTERN BALTIC HERRING. SSB estimates from ICA model with separate indices and with indices combined (Final Run 2005).

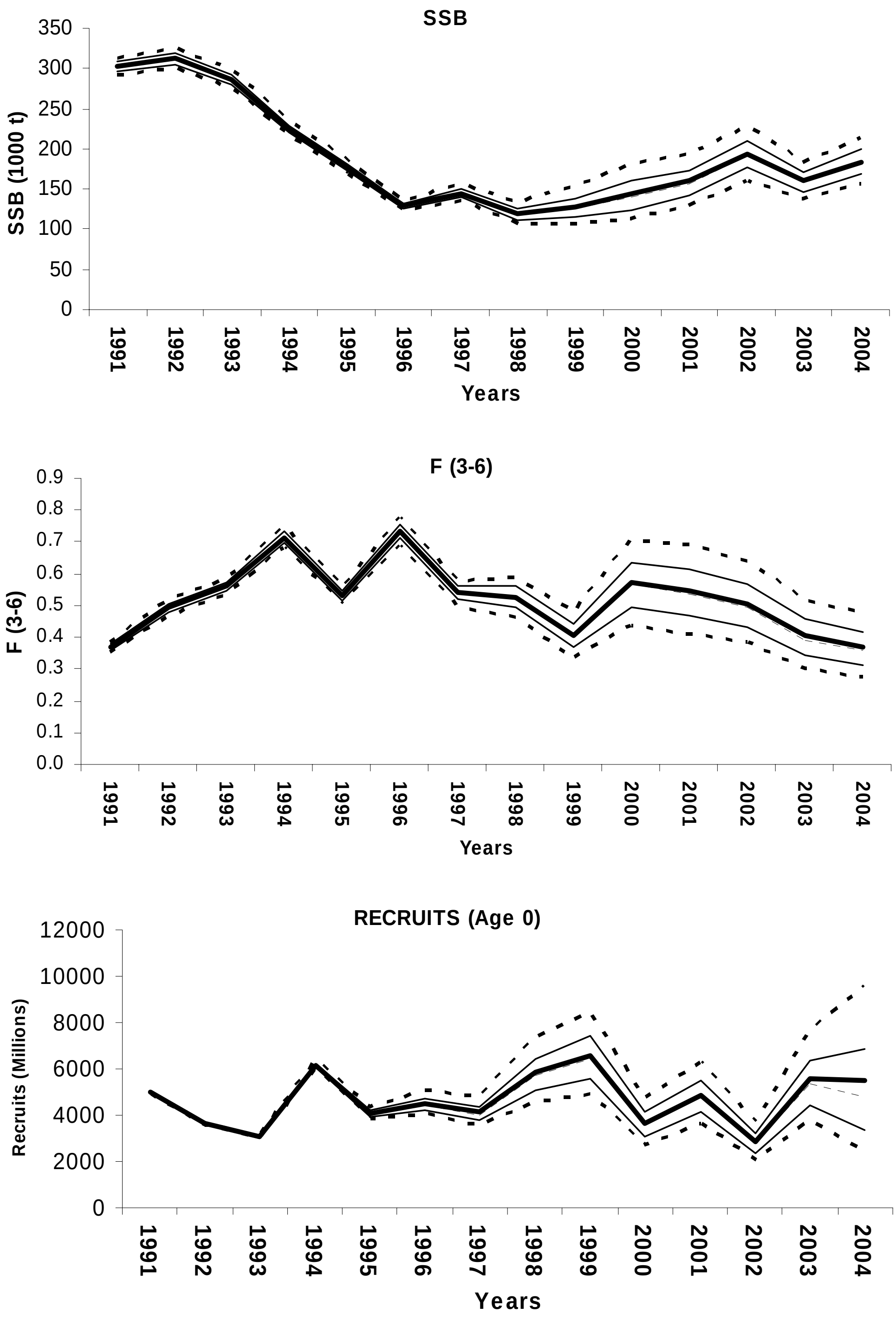


Figure 3.9.1.2 **WESTERN BALTIC HERRING.**
Historic uncertainty in the Final model fit (ICA assessment).
Percentiles 10, 25, 50, 75 and 90 %.

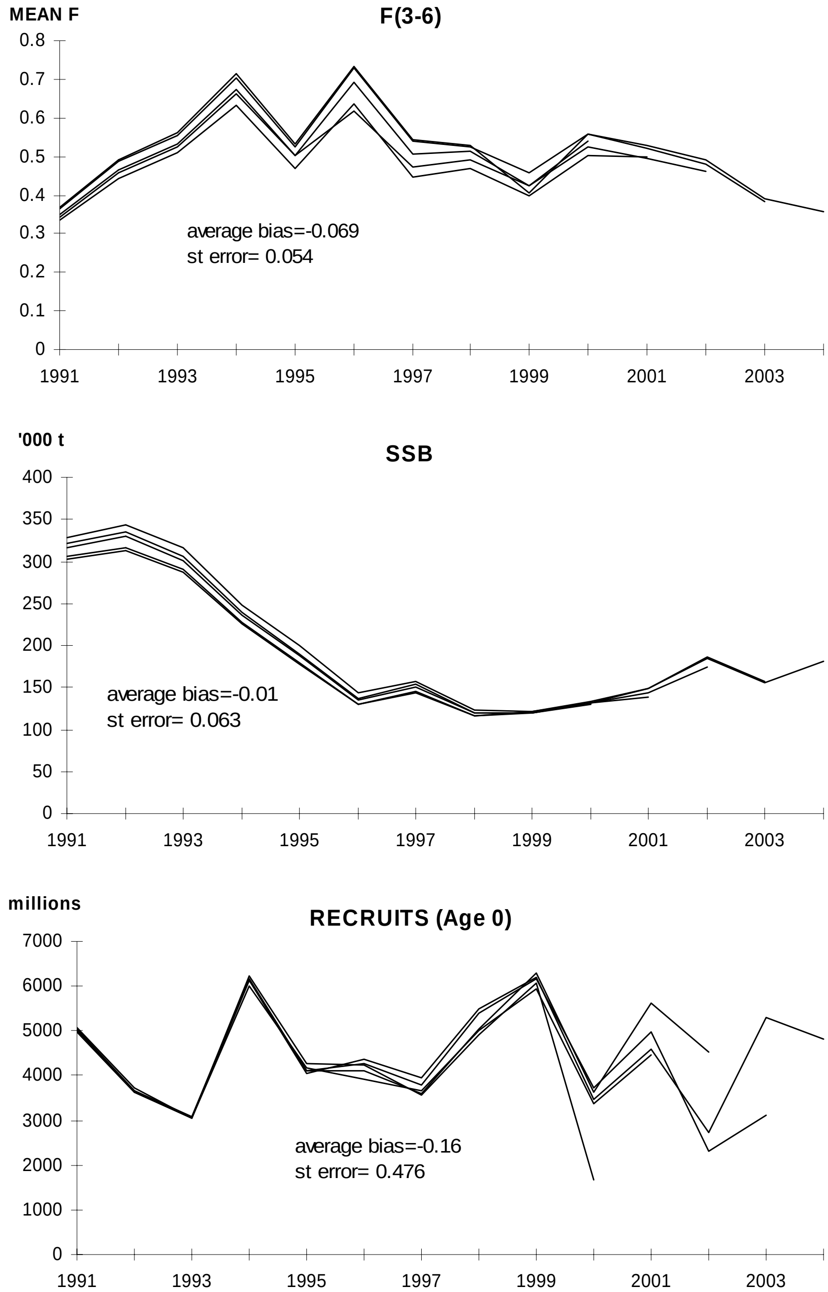


Figure 3.9.2.1 WESTERN BALTIC HERRING: Restrospective Analysis (ICA)

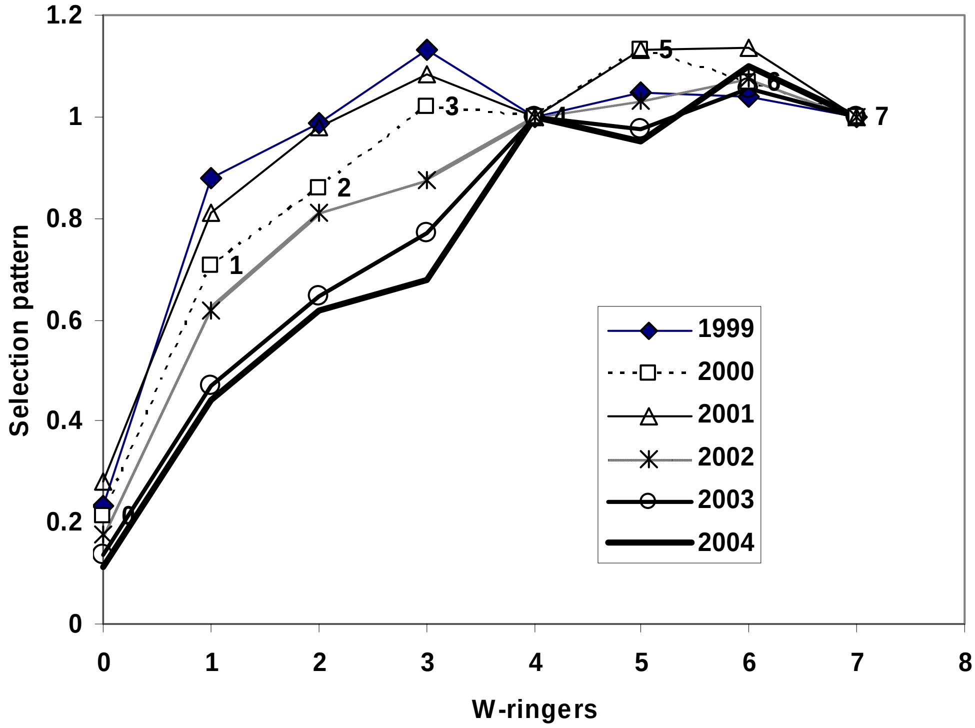


Figure 3.9.2.2 **WESTERN BALTIC HERRING. Restrospective selection pattern.**

4 CELTIC SEA AND DIVISION VIIj HERRING

Introduction

The herring fisheries to the south of Ireland in the Celtic Sea and in Division VIIj exploit autumn and winter spawning components. For the purpose of stock assessment and management, these areas have been combined since 1982. The management unit covers all of Divisions VIIg,h,j and k and the southern part of Division VIIa (Figure 1.5.1). In the recent seasons, Ireland has been almost the only country to exploit the stock.

4.1 The Fishery in 2004-2005

4.1.1 Advice and management applicable to 2004 - 2005

The TAC in 2004, was 13,000 t. In 2004, ICES considered the status of this stock to be uncertain. ACFM advised that catch restrictions in 2005 should be 60% of the average catches in 1997 –2000 corresponding to catches of less than 11,000 t. This was expected to allow SSB to increase. B_{pa} is set at 44,000 t and B_{lim} at 26,000 t. F reference points are not defined for this stock. The TAC is set by calendar year, whilst the assessment of the stock is conducted on a seasonal basis (1st April to 31st March).

The fishing season runs from the 1st April 2003 to the 31st March 2004, though the fishery was traditionally only opened on the 1st October. In the current and previous seasons, the fishery was allowed to remain open throughout. This was to allow vessels to target fish outside the spawning seasons when the fish are of better quality and marketability. The spawning box closures implemented under EU legislation continued. Box A was closed in the 2003-2004 season and Box B was closed in November 2004 (Fig 4.1.1.1). In 2005, Box C will be closed. In addition to these, Box A was voluntarily closed in the recent seasons, being finally re-opened in December 2003. This initiative was put in place by the Irish Southwest Pelagic Management Committee to afford extra protection to first time spawners. Areas mentioned in the text are shown in Figure 4.1.1.2.

The Irish Southwest Pelagic Management Committee was established to manage the Irish fishery for this herring stock. This committee, therefore, has responsibility for management of the entire fishery for this stock at present. The committee has the following objectives:

- To build the stock to a level whereby it can sustain annual catches of around 20,000 t.
- In the event of the stock falling below the level at which these catches can be sustained the Committee will take appropriate rebuilding measures.
- To introduce measures to prevent landings of small and juvenile herring including closed areas, and or appropriate time closures.
- To ensure that all landings of herring should contain at least 50% of individual fish above 23 cm.
- To maintain and if necessary expand, the spawning box closures in time and area.
- To ensure that adequate scientific resources are available to assess the state of the stock.
- To participate in the collection of data and to play an active part in the stock assessment procedure.

Ireland has 86.4% of the quota with, France and the Netherlands having most of the remainder. The Irish quota in 2004 was 11,236 t. This is managed by allocating individual quotas to vessels on a weekly basis. Participation in the fishery is restricted to licensed vessels. The licensing requirements have been changed. Previously, vessels had to participate in the fishery each year to maintain their licence. Now this requirement has been lifted. This has been one of the contributing factors to the reduction in number of vessels participating in the fishery in recent seasons. Fishing is restricted to the period Monday to Friday each week, and vessels must apply a week in advance before they are allowed to fish in the following week.

4.1.2 The fishery in 2004/2005

In recent years, this fishery has been prosecuted entirely by Ireland. The landings in this fishery since 1958 are shown in Figure 4.1.2.1. The fishing season is the same as the assessment period, 1st April to the 31st March the following year. The fishery closed in the last week of January in 2005.

Fishing in 2004 began in the first week of August on offshore marks around the Kinsale Gas Field and the Labadie Bank. Traditionally these offshore fish have been of a superior size and condition to those caught on the inshore roe fisheries. Between August and the start of the traditional roe fishery in October, approximately 3,900 t were landed. Fish were described as being easily located and more available than in the previous two years of this fishery. Participation in the offshore third quarter fishery was limited to those vessels with refrigerated seawater tanks (RSW).

In November fishing switched to the inshore roe and fillet fishery off the Waterford Coast. Fishing was described by fishermen as the best in many years in terms of the early arrival of the fish on the grounds, the size of the fish, and enhanced availability with the result that the annual quota was exhausted by the first week in December. Large aggregations of distinctly smaller fish were reported from the inner harbour and these encouraged the entry of small local dry hold boats to the fishery. In the roe fisheries most of the quota is caught in the first part of the week suggesting that the dense spawning aggregations scatter with the application of effort and re-aggregate as fishing intensity dies down later in the week.

Fishing resumed in January 2005 with the allocation of a quota of 4,000 t which was exhausted by the end of the month. In the latter half of January fishermen reported that the size of fish decreased in VIIa south with the result that the larger RSW component of the fleet, comprising eight vessels moved their effort to the Cork coast at Ballycotton in VIIg where fish of a good size were found to be consistently available. Fishermen report that good catches in this ground maintaining their fishery through the two year box closure brought in by the South West Pelagic Management Committee in 2000 to rest the fishing grounds in VIIa south. In recent years a pot fishery for shrimp has developed in this area and this has curtailed to some extent access to this ground.

Throughout the season occasional catches were made other coastal grounds, mainly in sheltered areas in response to bad weather. The most important of these in the 2004/2005 season were Kinsale and Courtmacsherry harbours in VIIg where approximately 600 t were caught in the third and fourth quarters. A consistent theme in discussion of Irish herring fisheries with fishermen is that the different fishing grounds are characterized by distinctive “stocks” of fish. With respect to Kinsale and Courtmacsherry these components are described as harbour herring, i.e. herrings of small size and inferior condition.

One traditional ground that did not fish well in the 2004/2005 season was the area outside Cork Harbour at the Daunt Rock. Fish were registered here during the acoustic survey but not caught.

Landings from VIIj, traditionally concentrated between Valentia Island and Loop Head, declined in the assessment period and this was attributed to the enhanced availability of fish in VIIg and VIIa south and further north in VII B where increased availability of fish was also reported. VIIj lies between these grounds and the home ports of the RSW component of the

Celtic sea herring fleet and the landings that were reported are described by fishermen as incidental catches made on the way, or returning from the main fishing grounds.

Total landings for the assessment period were about 12,700t. Figure 4.1.1.2. shows the division of catches by statistical rectangle and quarter for the period. As in previous years markets for fillets were adversely affected by the North Sea and Atlanto-Scandian herring fisheries, that have flooded markets in recent years. Landings with roe of suitable quality returned the most value to fishermen.

4.1.3 The catches in 2004/2005

The estimated national catches from 1988–2004 for the combined areas by year and by season (1 April–31 March) are given in Table 4.1.3.1 and Table 4.1.3.2 respectively. The total catches for the fishery over the longer period from 1958 to 2004 are shown in Figure 4.1.3.1 The catch, taken during the 2004/2005 season was about 12,700 t having increased from around 11,000 t during the previous season.

Discards

There are no estimates of discards for this fishery. Anecdotal reports from fishermen suggest that discarding is not a feature of this fishery at present.

4.2 Biological Composition of the Catch

4.2.1 Catches in numbers-at-age

Catch numbers at age are available for the period 1958/1959 to 2004/2005. These data include discards, when estimates were available (until 1997). In 2004/2005, 10% of the catch was composed of 2 ringers compared with 41% in 2003/2004. In 2004/2005, 3-ringers comprise 50% of the catch with 4 and 5 ringers comprising 24% and 9% respectively. This represents a considerable shift towards older fish in the catches from the previous season with little indication of any follow through from younger fish (Table 4.2.1.1). In all 85% of the catch were 3 ringers or older. In 2003/2004 the slightly increased proportion of older fish was explained at least in part by the summer fishery that caught large fish in VIIg and VIIj. The further proportional increase of older fish in 2004/2005 is thought to be due to the steep decline in 2 ringers in the catches. Only in VIIj quarter 4 and to a lesser extent VIIg quarter 4, was the proportion of 2-ringers above 25%. In all other metiers the proportion does not exceed 10% of the catch (Figure 4.2.1.1 and Table 4.2.1.1).

In 2001, VIIa south was voluntarily closed and reopened in early December 2003. Since reopening, catches from this area have been dominated by the 2000/2001 year class. In the current season, 85% of the catches were 3-ring fish or older. This may indicate that the box closure of VIIa south in 2001 was successful as a conservation measure. The 2000/2001 year class dominates the catches in the entire fishery. However the weakness of following year classes is a cause for concern and is the salient feature of the catches for 2004/2005. In 2003/2004 landings from the offshore third quarter fishery were distinguished by the elevated numbers of larger and older fish relative to the inshore roe and fillet fisheries.

In in 2004/2005, 2-ringers were the dominant year class in VIIj, in contrast to the rest of the assessment area. A difference in mean weight at age was also found for herring in this area, in contrast to VIIa south and VIIg indicating that this area may be more similar to VIIb than to the Celtic Sea (Table 4.2.1.2). These differences were noted previously, and it was recommended that the western part of VIIj be removed from this assessment area and combined with VIaS and VIIbc.

4.2.2 Movements of juvenile fish

A recent study on herring otolith microstructure has elucidated several points with respect to the natal origin of juvenile herring in the Irish and Celtic Seas (Brophy and Danilowicz, 2002). The results show that fish spawned in the eastern Celtic Sea are present as larvae in the Irish Sea, where fish of local origin are also found. The fish of Celtic Sea origin then return to that area as 1- and 2-ringers.

Brophy and Danilowicz, (2002) found Celtic Sea herring to have different growth rates depending on whether they resided in nursery areas in the Celtic Sea, the western or eastern Irish Sea. The variability in growth rate patterns occurred mainly in the larval phase and could be attributed to the different temperature regimes of the Celtic and the Irish Seas, suggesting that larval drift into the Irish Sea could be a factor in Celtic Sea recruitment variability. Larval dispersal can further influence maturity at age. In the Celtic Sea faster growing individuals mature in their second year (1 w. ring) while slower growing ones spawn for the first time in their third year (2 w. winter ring). Pre-recruitment dispersal such as into the Irish Sea and subsequent decrease in growth rates could thus determine whether juveniles are recruited to the adult population in the second or third year (Brophy and Danilowicz, 2003).

4.2.3 Quality of catch and biological data

Since 1997 there has been a major increase in the monitoring of landings from this fishery and the management measures were again tightly enforced throughout the season. As a result the accuracy of the landing figures are thought to be considerably better for this period.

Biological sampling of the catches throughout the region were guided by daily appraisals of the fishery supplied by members of the Irish Southwest Pelagic Management Committee, including fisheries officers, fishermen, skippers and processors (Table 4.2.3.1). Due to the close proximity of the working group to the end of the fishing season, in the first quarter of 2005 it was not possible to process samples in time for the assessment for VIIg. Under the DCR the sampling of this stock is relatively good.

4.3 Fishery Independent Information

4.3.1 Acoustic Surveys

Acoustic surveys of this stock have been carried out since 1990, with the exception of 1997. Up until 1996, two acoustic surveys were carried out. In 1997 there was no research vessel available to do the survey. Since 1998, usually only one winter survey was conducted (Table 4.3.1.1). The survey conducted in 2004/2005, was conducted on the Celtic Explorer, for the first time. The abundance estimates produced are presented in Table 4.3.1.2).

The acoustic survey of the 2004/2005 season was carried out in November and December of 2004 (O’Donnell et al. WD, 2005). This single survey was aimed at pre-spawners as they move inshore to spawn. The survey track was begun at the northern boundary of VIIj, and moved south and then eastwards, ending in VIIaS (Figure 4.3.1.1a). The only substantial echo traces of herring were encountered in the bays and inlets of VIIj (Figure 4.3.1.1b). Offshore in VIIg, herring were encountered in a mix with sprat. An acoustic trace registered at the Daunt Rock outside Cork Harbour was not fished but was allocated to herring. In the Baginbun Bay area (eastern VIIaS) herring were encountered close inshore. The survey design of parallel transects, did not allow for the inclusion of these echo traces in the overall survey estimate, because they were located on the inshore inter transect. It was concluded from this information that the survey underestimated the stock size in these areas in 2004/2005.

The commercial fishery was closed in early December, so it is not possible to compare the sparcity of herring echo traces in the main fishing zone (eastern VIIg and in VIIaS) to the experience of fishermen. However, when the fishery was reopened in January 2005, about 4,000 t of herring were caught in these areas. In the previous season (2003/3004), the geographical positioning of the Sa values obtained along the southwest and south coasts closely matched that of the pattern of fleet activity.

The age compositions of the survey abundance estimate and the commercial catch numbers at age were dissimilar in the 2004/2005 season. In the commercial fishery all metiers displayed a dominance of 3- and 4-ringers, with the exception of VIIj in the 4th quarter (Figure 4.2.1.1). The acoustic abundance estimate was dominated by 2- and 3-ringers, closely mirroring the VIIj fourth quarter fishery only (Figure 4.3.1.2).

The age structured index of biomass and catch numbers from acoustic surveys in this area, is shown in Table 4.3.1.2. The overall biomass estimate (13,000 t) is considerably lower than in the previous season (89,000 t). This is certainly an underestimate of the stock size in the area at this time, and is not a good indicator of abundance in the 2004/2005 season. However, the results of the survey are not inconsistent with the low abundance of 2-ringers in the commercial catches.

The working group estimated the biomass of the herring aggregations in Baginbun Bay, that were not included in the survey estimate. This was accomplished by Kriging the abundance estimate obtained on the inshore intertransects in this area, using the Surfer package. Using the target strength, length weight relationship and same settings as used in the production of the survey estimate, an estimate of 1,500 t was obtained. This suggests that the survey did miss some fish that were present in the area at the time. However, the abundance of these fish was not of sufficient quantity to merit their addition in the survey estimate.

4.3.2 Other surveys

An investigation of the utility of the Irish segment of the western IBTS survey was made (Johnston and Clarke, WD 2005). Gear changes were thought to have accounted for the higher catches in the 2004 survey. Ageing of herring on this survey only began in 2003. It is considered that this survey will be very useful as a recruit index in three years or so, when a time series is achieved. In the meantime the following survey data should be made available to the group as a matter of urgency:

- DARD Groundfish Survey of the Irish Sea, Northern Ireland
- CEFAS Celtic Sea Groundfish Survey, UK, England and Wales.
- EVHOE Groundfish Survey of the Celtic Sea, France.

4.4 Mean weights and maturity-at-age

The mean weights in the catch for this stock over time are presented in Figure 4.4.1. There has been an overall downward trend in mean weights at age since the mid-1980's. The values for 2003/2004 among the lowest in the series. This trend in mean weights at age is similar to those seen in the Irish Sea and to a lesser extent, the North Sea.

For the past two seasons substantial catches were taken outside the spawning season. The spawning season is considered to begin on the 1st October and progresses through to mid February, in a generally west to east direction. For 2003/2004, the mean weights in the stock were calculated from samples taken in VIIg, VIIj and VIIaS from October 2003 to February 2004. Summer samples, and samples from Waterford Harbour were not used in these calculations.

While the maturity-at-age for this stock (Figure 4.4.2) has been assumed to be constant throughout the whole time period (50% of 1 ring fish are assumed to be mature at age 1 and

100% mature at 2 ring), in comparison with other stocks it may not be stable and should now be updated.

4.5 Recruitment

At present there are no recruitment estimates for this stock that can be used for predictive purposes. The 2003 recruitment was estimated as weak in the 2004 assessments, and appears to be the weakest in the series. There is little information in the assessment on the strength of recruitment in 2004, because these 1-ringers are poorly represented in the catches.

In this stock a proportion of juvenile fish are present in the Irish Sea and do not recruit to the Celtic Sea and Division VIIj until they are mature. Therefore neither the numbers of 1-ringers in the stock as estimated from the acoustic surveys nor the numbers in the catches give a reliable indication of year class strength. The relationship between the numbers of 1-ringers taken per hour in the Northern Irish ground fish surveys in the Irish Sea and the numbers of 1- ringers estimated by ICA for the Celtic Sea and Division VIIj was examined in a working document presented to the 1999 WG (Armstrong et al., 1999) and the results suggest that these surveys may become a useful indicator of recruitment to the Celtic Sea and Division VIIj when a longer time-series is established.

4.6 Stock Assessment

4.6.1 Preliminary data exploration

Recent WG's have used the results of the acoustic surveys in the ICA programme but stated that the results should be taken as minimum estimates. In 1998 the WG decided to use the age-disaggregated data but only over the 2 to 5-ringers as a relative index in the ICA programme, and this has been continued. As in the 2004 assessment, this year's assessments used a different proportion of F before spawning (=0.551 in 2004 and 2005) and the different procedure for estimating stock weights (see 4.4.4).

Catch numbers at age from 1958 to 2004 are presented in Figure 4.6.1.1. These numbers were mean standardised and show a pattern of truncation of older ages in the catches during the mid-1970's to the early 1980's. This coincided with impaired recruitment and high fishing mortality, leading to stock collapse. Some stronger year classes restored the stock in the early 1980's. In recent seasons there is evidence of lack of older fish and recent year classes seem to have lower survivorship. The dominance of 3 and 4 ringers in the past two seasons is also apparent.

Catch curves of each individual year class since 1958/1959 are presented in Figure 4.6.1.2. The declining limb of these catch curves can be considered as an indication of total mortality on those year classes, assuming constant catchability. There is a trend towards higher total mortalities for the year classes in the 1970's and 1990's, and lower rates during the 1960's and 1980's. These trends are more apparent with reference to Figure 4.6.1.3, which shows catch curves for several year classes combined.

Log catch ratios ($\ln C_{a,y}/ C_{a+1,y+1}$) are presented in Figure 4.6.1.4 and smoothed by 4 year running average in Figure 4.6.1.5. Data for 1-ringers are noisy, because these ages are not fully selected in the fishery. The data for older fish are noisy, particular in later years, reflecting their relative weakness in the catches in recent years. There is a marked trend in log catch ratios. Since 1998/1999 the values have displayed an increasing trend. This may reflect increased mortality. It may also indicate a change in fishing pattern, as landings have decreased over this period.

Catch curves of individual year classes based on the abundance estimates from the acoustic survey are presented in Figure 4.6.1.6 and for several year classes combined in Figure 4.6.1.7.

There is evidence from these data that total mortality has increased on year classes since 1997. Catchability is likely to have changed in the survey series since 1996, the last year that uniform design was used (Tabe 4.3.1.1). The mortality signal produced by the acoustic survey is greater for the recent year classes, than the signal from the commercial data. This may indicate that catch data are poorly underestimated in some years, or that catchability is different in each series. This may also be explained by different catchabilities of the older ages in the fishery, over the time period. It most likely also reflects the discarding of fish in the past. There is less information in the most recent years in these data, because they refer to year classes.

The changes in this fishery in recent seasons have been documented in last year's report. The working group considered that the inability of the assessment model to track changes in the exploitation pattern and the inconsistencies between the survey and the fishery could not be overcome. The working group considers that this stock cannot be assessed using the ICA model as has been done in the past. A particular problem in 2004/2005 has been the acoustic survey. It is considered to underestimate the stock abundance, because of fish being located further inshore than the vessel could cover and because aggregations with strongly contagious distributions were located in these area.

Due to the problems outlined above, it was decided to explore the ICA model using the same procedure as last year, with the 2004/2005 catch and survey data included. Two scenarios were explored:

- 2005a Same procedure as last year with updated catch and survey data
- 2005b Same procedure as last year with updated catch, but not survey data.

The results of the ICA run using the same procedure as last year, with the new catch and survey data are presented in Figures 4.6.1.8 to 4.6.1.12 and Table 4.6.1. The results of the ICA run using the same procedure as last year, with the new catch but excluding the 2004 survey data are presented in Figures 4.6.1.13 to 4.6.1.21 and Table 4.6.2. Comparisons of these two exploratory assessments, along with last year's estimates are presented in Figure 4.6.1.20. A table is given below showing the options used in the assessment since 1998.

Working Group	**Age structured acoustic Index (ages 2-5 rings)**	**Shrinkage**	**Separable period**
1998	1990-1996	No	1992-1997
1999	1990-1996, 1998	No	1993-1998
2000	1990-1996, 1998	Yes (5yr)	1994-1999
2001	1990-1996, 1998, 2000	No	1995-2000
2002	1990-1996, 1998, 2000-2001	No	1996-2001
2003	1990-1996, 1998-2002	No	1998-2003
2004	1990-1996, 1998-2003	No	1997-2003
2005a	1990-1996 and 1998-2004	No	1998-2004
2005b	1990-1996 and 1998-2003	No	1998-2004

Following the procedure of HAWG in 2003, recruitment in the final year was replaced with geometric mean 1958-2001. The estimates from both exploratory runs are very different with regard to SSB and F. A clear result of both runs is that recruitment in 2003 was at a historically low level. The current observations of this recruitment are considered more reliable than those obtained in 2004.

Exploratory run 2005a displayed very imprecise fit, with poor minimisation (Figure 4.6.1.8). There were high year residuals in recent years and string negative trends in age redisuals for 4-ringers and older. Catchabilities were reasonably estimated. However, the estimate of F in the final year was condidered to be unfeasibly high (Figure 4.6.1.20).

Exploratory run 2005b displayed more precise model fit with a better resolution of the minimisation routine. Ther residuals were lower, though they still displayed a trend. F in the final year was lower than in 2003. Overall the model was more stable, but the working group did not consider it acceptable either (Figure 4.6.1.20).

Due to the incoming 1-ringers being 50% mature, SSB in 2004 was recalculated as:

$$\Sigma\ N_{2004} * \text{Stock weight at age}_{2004} * \text{Proportion mature at age}_{2004}$$

SSB has declined since the mid 1990's, in both runs. This downward trend accompanies a decline in the mean weights in the catch (Figure 4.4.1). Including the 2004 acoustic survey produces an estimate of SSB that is declining and below B_{lim}. Excluding the 2004 acoustic survey produces an SSB estimate that is fluctuating around B_{pa}. Uncertainty in the estimates of SSB are presented in Figure 4.6.1.21 (note logarithmic scale). There was huge uncertainty in the estimate of SSB in the late 1990s' especially the 1998 and 1999 estimates. It is clear that the uncertainty has reduced somewhat in recent years, and this may reflect the improved reporting of catches that has taken place in this period, or a strong year effect in the survey.

Including the 2004 acoustic survey produces an unfeasibly high value for mean fishing mortality in 2004, a much higher estimate than in any previous assessment. Excluding the 2004 survey estimates mean F in the range of time series. Very high estimates of F are sometimes a feature of this assessment, when recruitment has been weak. The weak representation of recruits in the modelled population is manifested as an increase in F. This can be considered an artefact of the ICA model formulation as applied to this stock.

The results of these exploratory runs display the sensitivity of the model to the inclusion of the 2004 acoustic survey. The working group felt that both model formulations resulted in poor model fit and unacceptable residual patterns. Consequently, neither was accepted as an assessment of stock status. Instead it was thought necessary to highlight the important information that is known about the stock. There is a lack of older fish in the catches and modelled populations. Fishing mortality has declined since the late 1990's, concomitant with decreased landings. SSB has declined in this period and though there have been some relatively strong year classes, recruitment in this period has been below average strength.

There is a marked absence of 2-ringers in catches, highlighting a recruitment failure of the 2001/2002 year class. There is no evidence from the acoustic survey to contradict this finding. Therefore this pattern in recruitment should be considered relevant. The poor performance of the acoustic survey has been well described. Whether it is excluded, the main signal is the same, that recruitment in 2003 has been very weak. In a fishery that is based on only a few age classes, this is a cause for concern.

4.6.2 Results of the assessment

No final assessment was presented in 2005. The analyses presented in Section 4.6.1, above, are useful as an indicator of trends in the stock development. However, they are not useful for determining SSB or F in the final year.

4.6.3 Comments on the assessment

No final assessment was conducted in 2005.

4.7 Short-term projection

In the absence of an agreed assessment, it was not considered informative to conduct any short term predictions. This is a departure from the routine procedure. However, the changes in the exploitation of the stock have meant that no assessment is informative enough to form the basis of deterministic short-term predictions.

4.8 Medium term projections

Though no final assessment was conducted by the working group in 2005, some exploratory medium term projections were carried out. In particular it was considered relevant to evaluate the current management objective, of building the stock to a level that could produce yields of 20,000 t per year. Simulations were carried out to evaluate the risk of the stock falling below Precautionary Approach reference points, at various levels of TAC. This was accomplished using the FSSSPS, as described in the ICES Study Group on Management Strategies, 2005. This procedure can be considered as a simple hindcast, projecting forward from 2001. The results of these simulations should be treated with caution as the software has not been fully tested as yet. The simulations are based on the trial assessment presented in Table 4.6.1.2, using 2001 as the start point and projecting forward to the end of 2007. The working group landings estimates were set as the yields in the intermediate years. The stock characteristics are such that there is great variation in the system, particularly in recruitment. Recruitment was modelled using a Ricker curve with stochasticity added, based on the CV's from the normal distribution. The input data are described in the text table below. This projection is a preliminary approach to this issue and further development will be conducted in the coming months.

Recruitment	Geometric mean 1958 to 2001
Stock recruit relationship	Ricker with stochasticity from normal distribution
Catch weights	1-9+ ringers, 2001
Stock weights	1-9+ ringers, 2001
Catches	WG estimates up to 2004/2005
M	1-9+ ringers, 2001
F	1-9+ ringers, 2001
Prop. F before spawning	0.2

Figure 4.8.1 shows a projection of the level of SSB at the end of 2007 under a variety of TAC's. The simulation suggests that the system is very noisy, with large 95% confidence limits. The results suggest that even with low TAC's, there is a risk that the stock will collapse. A large proportion of the catch is made up of the incoming year class. If recruitment fails, there is a high probability of stock collapse, under a constant TAC, even if set at a low level. This effect is highlighted in Figure 4.8.2, which shows the probability of the stock being below Precautionary reference points at the end of 2007. Even with zero catch there is a 25% probability of being below B_{pa} (=44,000 t) at end of 2007. These simulations though preliminary in nature, do highlight the danger in having a fixed TAC over a long period. It would seem appropriate to develop a Harvest Control Rule that would limit fishing when recruitment is weak, or at low SSB levels. The sensitivity of such a harvest control rule needs to be evaluated, by way of simulations.

The working group also conducted preliminary evaluations of the stated management objective of changing the exploitation pattern of the fishery. In recent seasons, the management committee and Irish authorities allocated a portion of the quota for fishing in the summer. This change in the selection pattern has adversely effected the assessment. Managers considered that catching the quota in summer would result in lower fishing mortality, because less fish per tonne would be caught. Preliminary yield per recruit analyses were conducted, based on the 2005 exploratory assessment. Further work on this subject will be conducted intersessionally, and presented by the HAWG to ACFM at its May meeting.

4.9 Quality of assessment

The landings in this fishery have been monitored rigorously and management measures tightly enforced, resulting in considerably better accuracy in landings figures. Allied to this there is a comprehensive sampling programme of the landings that has been enhanced through co-operation with the industry. Sampling in this stock continues to be very high for some years and is described in Section 4.2.3. A difficulty arose in processing sufficient samples for VIIg in the first quarter of 2005. This is because this working group takes place in close proximity to the end of the fishery season.

Fishery independent data are provided by the autumn acoustic survey, of which the principle index is the age dis-aggregated numbers. These data are noisy, and therefore the index only uses the mid range of the year cases. There are no estimates of recruitment. In 2004, the survey was considered to be an underestimate of the stock abundance, because fish were distributed inshore, and could not be included in the survey. It is considered by HAWG that alternatives to the current winter survey be explored. This may include conducting the acoustic survey during the feeding period, when fish are more homogeneously distributed offshore.

In 2005, two exploratory assessments were produced, both following the same procedure as last year. The only difference being the inclusion of the 2004/2005 acoustic survey. No final assessment was accepted by the working group, and therefore no short term predictions were carried out.

The group considers that the survey series as currently used in tuning is problematic. In particular, the earlier surveys before 1996 are not comparable with most of those since 1998. This is because in the earlier period, two surveys were conduced each season (Table 4.3.1.1), whilst since 2001, only one pre-spawners survey was conducted. It may be useful to explore the use of only those surveys since 2001 in tuning, in next year’s assessment.

The present exploratory assessments is essentially an update on the previous year’s assessment, with or without the 2004 acoustic estimate. In recent years, the assessment has become unstable due to problems with acoustic survey numbers at age data and an apparent change in the recruitment levels between 1996 and 1998, which was not detected by the assessments in those years. The uncertainty in the assessment around the mid to late 1990s (partially due to differences in the trends in the acoustic survey and catch data) is reflected in the historical uncertainties (see Figure 4.6.2.23). The group suggests that efforts be made to describe the reasons for this great uncertainty in the assessment over that period.

4.10 Biological reference points

Biological reference points were discussed in detail in the 2000 WG report (ICES 2000/ACFM:10) and in the report of the previous years (ICES 1999/ACFM:12, ICES 1998/ACFM:14). A summary of this discussion was presented in the 2003 HAWG report. $\mathbf{B}_{pa}$ is currently at 44,000t and $\mathbf{B}_{lim}$ at 26,000 t for this stock $\mathbf{F}_{pa}$ and $\mathbf{F}_{lim}$ are not defined. The SGPRP (ICES 2003 ACFM :15) has reviewed the methodology for the calculation of biological reference points, and applying a segmented regression to the stock and recruit data from the 2002 HAWG assessment gave a breakpoint at 61,306 t. This change point appears to be very high with respect to the historical exploitation of the stock. Given that there is a cluster of observations just above this value the sensitivity of the method to these data needs to be further investigated. The HAWG decided that the first priority for this stock should be to achieve a stable assessment and that once this was done the reference points would be reinvestigated (see section 1.4.2). There is still considerable instability in the assessment, so there is no basis for a revision of reference points at this point.

4.11 Management considerations

The current management of this fishery has been described above. The working group encourages the initiatives of the Irish South West Pelagic Management Committee. The group considers that efforts continue and be intensified. In particular, efforts to maintain the good quality of fishery dependent data should continue. A stock that is subject to such variations requires good quality data. The state of the stock is still uncertain, there is no strong evidence that it is recovering, and there is evidence of the weakness of an incoming year class.

No final assessment was conducted in 2005, because of the uncertainties in the basic data. Trial assessments were used to track the trends in the stock development, but give less information on current status. Nevertheless the weakness of the 2001/2002 year class is a cause for concern. This is because the fishery is based on few year classes, and a failure of an incoming cohort could quickly lead to stock decline.

The current assessment procedure is no longer applicable to this stock. Consequently, the cycle of conducting annual VPA assessments, conducting short term predictions and producing annual TAC advice is flawed. The fishery is recruitment driven, and as such has more in common with sardine and anchovy stocks than to any other herring stock in Europe. The distinguishing properties of the fish in this stock include their early age at maturity, the few year classes present and the fluctuations in recruitment.

The working group considers that this stock should be managed using a harvest control rule, that allows managers to react quickly to the fluctuations in the stock. This rule needs to be developed in consultation with stakeholders and scientists. However such a rule should be developed rapidly. Preliminary medium term projections were conducted for this stock in 2005. These projections highlight the danger in having a fixed TAC, that is unreactive to the stock dynamics. This analysis was used by the working group to evaluate the current management plan, though this evaluation was preliminary.

<u>Box Closure</u>

It is difficult to evaluate the effects of closing this box between 2001 and December 2003. However the strongest year class to enter the fishery in recent years was that of 2000/2001. This cohort was strongly dominant in catches from this box, once it was opened in 2003 and dominated catches throughout the Celtic Sea (though not VIIj) in 2004/2005. The box closure must have reduced F on this cohort. The subsequent 2001/2002 year class is estimated to be very weak. This cohort should be fully selected by now. Each recruiting year class is of great importance to the stock composition. Therefore every effort should be made to protect incoming cohorts.

<u>Ability of the stock to produce annual catches of 20,000 t.</u>

It is clear that at present the stock cannot sustain catches at this level. The preliminary simulations conducted by the HAWG suggest that this stock is not suited to having annual TAC's set at a constant level, without a string rule to reduce catches when necessary.

<u>Prevent landings of small and juvenile fish</u>

It would appear that catching the quota during the summer would result in lower fishing mortality, with fewer fish per tonne of landings. However in order to evaluate if the summer fishing strategy is beneficial to the stock it is necessary to consider the effect of removing biomass before spawning, as well as the trade off between growth and mortality. The yield per recruit analyses conducted by the HAWG are preliminary in nature, and further work is required.

The present state of this stock is uncertain. However all available information points to the weakness of the incoming 2001/2002-year class. This fishery is dominated by recruitment;

therefore the failure of an incoming cohort is a cause for concern. ICES advice in the past two years has been for catches not greater than 11,000 t (= 60% of catches in the period 1997-2000). The failure of the incoming year class indicates that advised catches for 2006 should be lower than 11,000 t. The working group notes that the TAC in the past two years has been set at a higher level than that advised by ICES. HAWG considers that this TAC should not be in excess of ICES advice.

Table 4.1.3.1 Celtic Sea and Division VIIh, j and k herring landings by calendar year (t), 1988–2004. (Data provided by Working Group members.) These figures may not in all cases correspond to the official statistics and cannot be used for management purposes.

Year	France	Germany	Ireland	Netherlands	U.K.	Unallocated	Discards	Total
1988	-	-	16,800	-	-	-	2,400	19,200
1989	+	-	16,000	1,900	-	1,300	3,500	22,700
1990	+	-	15,800	1,000	200	700	2,500	20,200
1991	+	100	19,400	1,600	-	600	1,900	23,600
1992	500	-	18,000	100	+	2,300	2,100	23,000
1993	-	--	19,000	1,300	+	-1,100	1,900	21,100
1994	+	200	17,400	1,300	+	-1,500	1,700	19,100
1995	200	200	18,000	100	+	-200	700	19,000
1996	1,000	0	18,600	1,000	-	-1,800	3,000	21,800
1997	1,300	0	18,000	1,400	-	-2,600	700	18,800
1998	+	-	19,300	1,200	-	-200	-	20,300
1999		200	17,900	1300	+	-1300	-	18,100
2000	573	228	18,038	44	1	-617	-	18,267
2001	1,359	219	17,729	-	-	-1578	-	17,729
2002	734	-	10,550	257	-	-991	-	10,550
2003	800	-	10,875	692	14	-1,506	-	10,875
2004	801	41	11,024	-	-	-801	-	11,065

Table 4.1.3.2. Celtic Sea & Division VIIj herring landings (t) by season (1 April–31 March) 1988/1989-2004/2005. (Data provided by Working Group members.) These figures may not in all cases correspond to the official statistics and cannot be used for management purposes.

Year	France	Germany	Ireland	Netherlands	U.K.	Unallocated	Discards	Total
1988/1989	-	-	17,000	-	-	-	3,400	20,400
1989/1990	+	-	15,000	1,900	-	2,600	3,600	23,100
1990/1991	+	-	15,000	1,000	200	700	1,700	18,600
1991/1992	500	100	21,400	1,600	-	-100	2,100	25,600
1992/1993	-	-	18,000	1,300	-	-100	2,000	21,200
1993/1994	-	-	16,600	1,300	+	-1,100	1,800	18,600
1994/1995	+	200	17,400	1,300	+	-1,500	1,900	19,300
1995/1996	200	200	20,000	100	+	-200	3,000	23,300
1996/1997	1,000	-	17,900	1,000	-	-1,800	750	18,800
1997/1998	1,300	-	19,900	1,400	-	-2100	-	20,500
1998/1999	+	-	17,700	1,200	-	-700	-	18,200
1999/2000		200	18,300	1300	+	-1300	-	18,500
2000/2001	573	228	16,962	44	1	-617	-	17,191
2001/2002	-	-	15,236	-	-	-	-	15,236
2002/2003	734	-	7,465	257	-	-991	-	7,465
2003/2004	800	-	11,536	610	14	-1,424		11,536
2004/2005	801	41	12,702	-	-	-801	-	12,743

Table 4.2.1.1 Comparison of age distributions (percentages) in the catches of Celtic Sea and VIIj herring over recent seasons.

	1	2	3	4	5	6	7	8	9+
1980/1981	11	47	18	10	4	3	2	2	1
1981/1982	40	22	22	6	5	4	1	0	1
1982/1983	20	55	11	6	2	2	2	0	1
1983/1984	9	68	18	2	1	0	0	1	0
1984/1985	11	53	24	9	1	1	0	0	0
1985/1986	14	44	28	12	2	0	0	0	0
1986/1987	3	39	29	22	6	1	0	0	0
1987/1988	4	42	27	15	9	2	1	0	0
1988/1989	2	61	23	7	4	2	1	0	0
1989/1990	5	27	44	13	5	2	2	0	0
1990/1991	2	35	21	30	7	3	1	1	0
1991/1992	1	40	24	11	18	3	2	1	0
1992/1993	8	19	25	20	7	13	2	5	0
1993/1994	1	72	7	8	3	2	5	1	0
1994/1995	10	29	50	3	2	4	1	1	0
1995/1996	6	49	14	23	2	2	2	1	1
1996/1997	3	46	29	6	12	2	1	1	1
1997/1998	3	26	37	22	6	4	1	1	0
1998/1999	5	34	22	23	11	3	2	0	0
1999/2000	11	27	28	11	12	7	1	2	0
2000/2001	7	58	14	9	4	5	2	0	0
2001/2002	12	49	28	5	3	1	1	0	0
2002/2003	6	46	32	9	2	2	1	0	0
2003/2004	3	41	27	16	6	4	3	0	1
2004/2005	5	10	50	24	9	2	1	0	0

Table 4.2.1.2 Length frequency distributions of the Irish catches (raised numbers in '000s) in the 2004/2005 season in the Celtic Sea and VIIj fishery.

length cm	VIIaS Quarter 3 2004	VIIg Quarter 3 2004	VIIaS Quarter 4 2004	VIIg Quarter 4 2004	VIIj Quarter 4 2004	VIIa south Q1 outside the harbour 2005	VIIa south Q 1 inside the harbour	VIIg Quarter 1 2005
18								
18.5						14		
19		10				71		
19.5	5					156		
20	21	29	34	17		127	38	74
20.5	21	78	90	50		241	51	74
21	51	88	213	33		99	127	74
21.5	46	156	269	17		127	102	74
22	26	146	246	50		227	76	74
22.5	72	176	213	83	13	142	38	147
23	108	410	280	100	26	255	89	147
23.5	262	732	515	183	26	1176	89	294
24	641	2059	1355	482	93	1785	317	956
24.5	836	3356	2900	815	265	3230	482	1618
25	775	4410	3583	1746	583	3598	356	2943
25.5	580	4000	3370	1364	636	2720	394	3090
26	308	3747	2777	748	1033	2012	178	1839
26.5	174	2303	1657	366	888	1048	127	368
27	62	1151	885	183	848	467	51	221
27.5	5	468	280	116	689	156	25	74
28	5	332	78	17	146	14	13	39
28.5	10	78	34	17	212	14		
29	5	49	11	33	53	14		
29.5		20			26	14		
30					26			
30.5								
Nos./t	6986	6536	7368	7110	5845	7979	10208	7948

Table 4.2.3.1 Celtic Sea & Division VIIj (2004/2005). Sampling intensity of commercial catches.

ICES area	Year	Quarter	Landings (t)	No. Samples	No. Aged	No. Measured	Aged/1000 t
VIIa south	2004	3	578	5	314	787	543
	2004	4	2550	12	915	1678	359
	2005	1	2457	12	891	1249	363
VIIg	2004	3	3641	18	1154	2439	317
	2004	4	903	3	192	386	213
	2005	1	1518	3	91	164	60
VIIj	2004	4	952	3	244	420	256

Table 4.3.1.1. Celtic Sea & Division VIIj herring. Acoustic surveys of Celtic Sea and VIIj herring, by season. Number of surveys per season and type indicated along with biomass and SSB estimates.

Season	No.	Type	Biomass	SSB	Reference
1990/1991	2	Autumn and winter spawners	103	91	Nash, 1990
1991/1992	2	Autumn and winter spawners	84	77	Reid & Simmonds, 1992
1992/1993	2	Autumn and winter spawners	89	71	Reid & Simmonds, 1993
1993/1994	2	Autumn and winter spawners	104	90	Reid & Simmonds, 1994
1994/1995	2	Autumn and winter spawners	52	51	Fernandes, 1995a
1995/1996	2	Autumn and winter spawners	135	114	Fernandes & Reid 1995
1996/1997	1	Autumn spawners	151	146	Fernandes, 1996a
1997/1998	-		-	-	-
1998/1999	1	Autumn spawners	111	111	Breslin, 1998
1999/2000	1	Feeding phase	58	23	Breslin, 1999a
1999/2000	1	Winter-spawners	30	26	Breslin, 1999b
2000/2001	2	Autumn and winter spawners	33	32	Breslin, 2001a,b
2001/2002	2	Pre-spawning	80	74	Breslin & Griffin, 2002
2002/2003	1	Pre-spawning	49	39	Breslin and Griffn, 2003
2003/2004	1	Pre-spawning	89	86	Griffin, 2004
2004/2005	1	Pre-spawning	13	10	O' Donnell *et al* , 2005

Table 4.3.1.2. Celtic Sea & Division VIIj herring. Total stock numbers-at-age (10^6) estimated using combined acoustic surveys (age refers in winter rings, biomass and SSB in 000's tonnes). Bold text denotes the years used as inputs to assessment input files.

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996***	**1997**	**1998***	**1999****	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2000	2001	2002	2003	2004	2005
0	205	214	142	259	41	5	3	-	-	13	-	23	19	0	25	26
1	132	63	427	217	38	280	134	-	21	398	23	18	30	41	73	13
2	249	195	117	438	127	551	757	-	157	208	97	143	160	176	323	29
3	109	95	88	59	160	138	250	-	150	48	85	36	176	142	253	32
4	153	54	50	63	11	94	51	-	201	8	16	19	40	27	61	16
5	32	85	22	26	11	8	42	-	109	1	21	7	44	6	16	3
6	15	22	24	16	7	9	1	-	32	1	8	3	23	8	5	1
7	6	5	10	25	2	8	14	-	30	0	2	2	17	3	2	0
8	3	6	2	2	3	9	1	-	4	0	1	0	11	0	0	0
9+	2	-	1	2	1	5	2	-	1	0	0	1	23	0	0	0
Total	904	739	882	1107	399	1107	1253		705	677	252	250	542	404	758	119
Biomass	103	84	89	104	52	135	151		111	58	30	33	80	49	89	13
SSB	91	77	71	90	51	114	146		111	23	26	32	74	39	86	10

***November survey only, likely to be an underestimate of stock size.**

**** Poor survey coverage due to bad weather, likely to be an underestimate. This survey is not included in assessment.**

Additional fish located inshore during the 2004/2005 survey, not included in estimate.

Table 4.6.1. Celtic Sea & Division VIIj herring. Results of trial assessment, using the same procedure as last year, with updated catch and 2004 survey data.

Population Abundance (1 January)

AGE	1958	1959	1960	1961	1962	1963	1964	1965
1	323.1	1065.3	356.7	252.1	494.6	280.5	1037.4	369.8
2	38.5	117.9	391.2	129.6	91.5	181.5	103.0	377.3
3	123.6	25.3	65.5	228.2	82.3	52.0	90.4	63.5
4	69.0	71.4	18.7	31.5	158.0	49.5	30.8	58.5
5	41.5	38.1	46.4	13.3	23.2	97.4	40.8	21.6
6	66.4	25.6	24.0	29.0	10.1	13.3	68.5	35.3
7	33.4	37.4	17.7	17.5	21.4	5.8	9.5	53.7
8	32.8	15.0	17.0	10.2	13.2	11.2	3.9	7.4
9	19.5	29.4	16.1	33.1	18.4	12.6	14.8	40.0

x 10 ^ 6

Population Abundance (1 January)

AGE	1966	1967	1968	1969	1970	1971	1972	1973
1	663.1	686.9	850.4	460.4	242.6	875.9	274.5	317.6
2	136.0	239.8	248.3	305.7	163.9	88.5	314.9	96.1
3	219.6	84.1	143.5	137.3	147.4	89.7	45.7	117.2
4	43.5	126.0	50.8	82.0	63.2	75.8	39.9	21.5
5	38.0	30.0	67.5	35.0	42.8	32.1	29.0	21.1
6	16.3	21.8	18.4	39.7	20.1	21.0	11.3	12.5
7	27.6	9.4	10.8	12.0	19.0	10.7	9.1	5.9
8	37.1	21.6	4.8	5.8	6.3	11.2	5.7	5.4
9	16.3	22.4	18.1	9.3	9.8	5.1	2.4	2.8

x 10 ^ 6

Population Abundance (1 January)

AGE	1974	1975	1976	1977	1978	1979	1980	1981
1	137.8	152.8	207.7	174.0	135.7	237.4	146.1	410.1
2	103.3	47.5	48.9	68.7	59.3	48.3	80.8	49.6
3	39.0	40.4	22.1	26.7	40.2	32.5	24.0	34.4
4	46.1	16.6	17.2	11.6	14.2	22.2	15.5	9.2
5	12.8	20.4	8.0	8.9	5.5	7.5	11.9	7.8
6	9.9	7.6	10.9	4.6	6.5	3.5	4.1	8.1
7	6.3	5.4	3.5	4.5	2.3	4.5	1.9	1.6
8	2.1	2.9	3.4	1.3	3.1	1.6	2.9	0.6
9	2.0	3.0	4.8	1.6	1.7	1.8	1.3	1.6

x 10 ^ 6

Population Abundance (1 January)

AGE	1982	1983	1984	1985	1986	1987	1988	1989
1	663.1	733.6	568.3	589.5	537.1	1031.9	425.7	523.0
2	128.3	235.0	262.0	197.8	206.5	195.2	376.2	155.3
3	18.8	58.8	87.4	115.5	98.1	104.8	87.8	208.8
4	8.8	7.6	24.0	34.8	62.0	42.0	47.3	44.2
5	3.1	3.4	3.8	6.6	16.4	25.0	16.2	33.8
6	2.9	1.4	1.3	1.1	3.8	6.5	9.1	9.1
7	4.1	0.8	0.9	0.2	0.8	2.4	3.3	5.4
8	0.7	2.1	0.4	0.5	0.1	0.7	1.1	2.2
9	1.3	0.7	0.3	0.4	0.0	1.0	0.3	1.9

x 10 ^ 6

Table 4.6.1. Celtic Sea & Division VIIj herring. Continued.

Population Abundance (1 January)

AGE	1990	1991	1992	1993	1994	1995	1996	1997
1	448.7	186.8	888.3	327.9	709.9	666.4	328.4	400.2
2	187.6	163.5	67.6	320.8	119.7	254.1	239.7	118.8
3	79.0	103.4	67.1	27.5	157.8	58.3	121.1	124.9
4	109.6	42.6	50.4	23.8	14.1	73.9	27.5	64.9
5	21.4	65.8	22.5	19.5	11.8	9.6	32.4	17.4
6	22.8	11.7	32.7	10.8	13.4	7.8	5.2	14.0
7	4.6	17.0	6.0	12.5	7.1	7.6	3.9	2.8
8	2.4	2.5	13.0	2.6	5.7	4.8	4.4	2.0
9	1.6	1.6	1.4	1.5	1.6	2.2	3.0	1.5

x 10 ^ 6

Population Abundance (1 January)

AGE	1998	1999	2000	2001	2002	2003	2004	2005
1	237.5	360.5	372.2	399.9	394.1	68.1	74.7	260.2
2	145.0	84.0	126.0	129.6	141.0	141.7	23.6	25.0
3	56.2	72.2	35.7	51.7	60.4	81.4	55.7	6.3
4	54.8	21.9	25.6	12.0	21.1	34.0	25.7	9.8
5	29.0	22.9	8.8	9.7	5.5	13.2	12.2	5.2
6	7.9	13.7	8.0	2.9	4.0	3.3	4.0	1.9
7	6.9	3.6	3.6	2.0	0.9	2.1	0.7	0.4
8	1.4	3.7	0.9	0.8	0.6	0.5	0.4	0.1
9	0.9	1.0	1.0	0.8	0.7	0.9	0.1	0.1

x 10 ^ 6

Weighting factors for the catches in number

AGE	1999	2000	2001	2002	2003	2004
1	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Predicted Age-Structured Index Values

FLT02: Celtic combined acc data (Catch: Predicted

AGE	1990	1991	1992	1993	1994	1995	1996	1997
2	331.77	215.36	88.10	506.03	187.05	388.42	400.62	*******
3	168.70	199.53	94.21	55.84	292.92	109.08	256.98	*******
4	197.61	67.60	58.60	35.56	28.92	97.16	52.20	*******
5	31.86	88.96	29.35	36.48	21.37	14.23	38.25	*******

Table 4.6.1. Celtic Sea & Division VIIj herring. Continued.

FLT02: Celtic combined acc data (Catch: Predicted

AGE	1998	1999	2000	2001	2002	2003	2004
2	231.43	114.60	165.78	193.73	261.14	178.80	20.27
3	86.63	101.49	47.60	83.41	134.73	101.84	39.02
4	68.82	26.35	29.28	16.55	39.73	36.56	15.71
5	37.42	21.82	7.85	10.86	8.87	11.02	5.24

Fitted Selection Pattern

AGE	1958	1959	1960	1961	1962	1963	1964	1965
1	0.0232	0.0172	0.0238	0.0801	0.0080	0.0052	0.0490	0.0014
2	0.3419	2.7710	0.4499	0.9189	0.8607	1.2345	0.7831	1.3612
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.4226	3.1892	0.4489	1.2369	1.2427	0.2885	1.0903	1.8740
5	1.0959	3.4683	0.6973	1.0405	1.4701	0.7828	0.1923	1.0198
6	1.3636	2.6165	0.4053	1.2078	1.4997	0.7381	0.6087	0.8191
7	2.0140	6.6250	0.8445	1.1048	1.7638	0.9065	0.6604	1.5251
8	1.0249	2.9165	0.5942	1.0157	1.1680	0.8205	0.7172	1.2335
9	1.0249	2.9165	0.5942	1.0157	1.1680	0.8205	0.7172	1.2335

Fitted Selection Pattern

AGE	1966	1967	1968	1969	1970	1971	1972	1973
1	0.0480	0.0580	0.0636	0.0572	0.0185	0.0378	0.0890	0.1685
2	0.5097	0.7017	0.8115	0.7456	0.6504	0.5887	1.2371	0.8227
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	0.7685	1.7242	0.7554	0.9540	1.2402	1.4081	0.9661	0.5718
5	1.2750	1.2798	1.1971	0.7889	1.3180	1.5390	1.3326	0.8901
6	1.2547	1.9820	0.9154	1.1006	1.1295	1.2016	1.0063	0.8056
7	0.4123	1.8866	1.4333	0.9347	0.9232	0.8803	0.7647	1.2413
8	0.7988	1.2503	0.9310	0.8566	0.9613	1.0106	1.0330	0.8245
9	0.7988	1.2503	0.9310	0.8566	0.9613	1.0106	1.0330	0.8245

Fitted Selection Pattern

AGE	1974	1975	1976	1977	1978	1979	1980	1981
1	0.0990	0.2137	0.2369	0.1761	0.0840	0.1448	0.1052	0.1393
2	0.9739	0.7089	0.6766	0.5410	0.7622	0.7435	0.7271	0.5752
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0878	0.9491	1.2454	1.4894	1.3484	0.9687	0.7683	0.8452
5	0.6477	0.9422	1.0463	0.4758	0.9129	0.9502	0.3727	0.7673
6	0.7627	1.0180	1.5548	1.3159	0.6850	0.9408	1.0850	0.5010
7	1.0460	0.5799	1.9853	0.6402	0.7081	0.6545	1.3923	0.6172
8	0.8898	0.8220	1.0899	0.8442	0.8754	0.8344	0.8060	0.6905
9	0.8898	0.8220	1.0899	0.8442	0.8754	0.8344	0.8060	0.6905

Fitted Selection Pattern

AGE	1982	1983	1984	1985	1986	1987	1988	1989
1	0.0526	0.0426	0.0773	0.1164	0.0190	0.0154	0.0177	0.0568
2	0.6794	0.9926	0.7219	0.9520	0.5835	0.8358	0.5918	0.8458
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.2041	0.8454	1.6476	1.5547	1.2457	1.4238	0.4799	1.4036
5	0.9972	1.2238	1.5316	1.0699	1.2671	1.5254	0.9942	0.6601
6	1.6112	0.4096	2.6879	0.5537	0.5678	0.9612	0.8840	1.3176
7	0.7865	0.8946	0.7506	1.7257	0.2059	1.2019	0.6575	1.5816
8	0.9554	0.8813	1.2383	1.0747	0.7983	1.0803	0.7129	1.0332
9	0.9554	0.8813	1.2383	1.0747	0.7983	1.0803	0.7129	1.0332

Table 4.6.1. Celtic Sea & Division VIIj herring. Continued.

Fitted Selection Pattern

AGE	1990	1991	1992	1993	1994	1995	1996	1997
1	0.0229	0.0314	0.0223	0.0166	0.0490	0.0411	0.0397	0.0246
2	0.7064	1.1343	0.7161	0.8757	0.7506	0.8008	0.8281	0.7184
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	0.9821	1.0334	1.0118	1.2767	0.5028	1.3188	0.8478	1.1335
5	1.2079	1.1547	0.7593	0.5906	0.5583	0.9291	1.7299	1.1128
6	0.4600	1.0994	1.0263	0.6770	0.8364	1.1047	1.2667	0.9810
7	1.1562	0.3338	0.8956	1.4645	0.5220	0.8253	1.3214	0.9163
8	0.8641	0.9574	0.8422	0.9239	0.6731	0.9424	1.0569	0.9125
9	0.8641	0.9574	0.8422	0.9239	0.6731	0.9424	1.0569	0.9125

Fitted Selection Pattern

AGE	1998	1999	2000	2001	2002	2003	2004
1	0.0529	0.0614	0.0614	0.0614	0.0614	0.0614	0.0614
2	0.5339	0.6639	0.6639	0.6639	0.6639	0.6639	0.6639
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0375	0.9728	0.9728	0.9728	0.9728	0.9728	0.9728
5	0.8668	1.1376	1.1376	1.1376	1.1376	1.1376	1.1376
6	0.9249	1.4738	1.4738	1.4738	1.4738	1.4738	1.4738
7	0.6990	1.5689	1.5689	1.5689	1.5689	1.5689	1.5689
8	0.7843	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	0.7843	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 4.6.1. Celtic Sea & Division VIIj herring. Continued.

STOCK SUMMARY

Year	Recruits Age 1 thousands	Total Biomass tonnes	Spawning Biomass tonnes	Landings tonnes	Yield /SSB ratio	Mean F Ages 2- 7	SoP (%)
1958	323130	110805	77937	22978	0.2948	0.4197	89
1959	1065340	155487	82464	15086	0.1829	0.3414	88
1960	356710	120705	83890	18283	0.2179	0.3403	88
1961	252060	105532	78718	15372	0.1953	0.1820	128
1962	494570	130471	82301	21552	0.2619	0.4032	98
1963	280500	105822	75293	17349	0.2304	0.2656	99
1964	1037400	178208	94638	10599	0.1120	0.1701	97
1965	369750	154776	112277	19126	0.1703	0.2243	86
1966	663050	186243	115142	27030	0.2348	0.3093	103
1967	686880	189200	115833	27658	0.2388	0.4342	90
1968	850350	210741	123223	30236	0.2454	0.3672	100
1969	460440	176714	115298	44389	0.3850	0.5308	99
1970	242590	126063	88458	31727	0.3587	0.4857	99
1971	875850	172558	87391	31396	0.3593	0.6743	96
1972	274480	122062	78001	38203	0.4898	0.5850	100
1973	317600	97350	57568	26936	0.4679	0.6507	95
1974	137810	64968	42137	19940	0.4732	0.6036	97
1975	152810	52687	32021	15588	0.4868	0.5677	107
1976	207650	53652	29382	9771	0.3325	0.5599	94
1977	174030	49675	29067	7833	0.2695	0.3958	100
1978	135680	46024	29356	7559	0.2575	0.3555	91
1979	237390	55695	30116	10321	0.3427	0.4723	100
1980	146090	45649	27929	13130	0.4701	0.6787	107
1981	410090	70669	31717	17103	0.5392	0.8365	101
1982	663100	105058	45657	13000	0.2847	0.7388	101
1983	733600	130532	62837	24981	0.3975	0.6210	104
1984	568330	112910	62408	26779	0.4291	1.0000	99
1985	589540	117749	64421	20426	0.3171	0.4818	102
1986	537060	125352	70446	25024	0.3552	0.5265	100
1987	1031940	161226	79302	26200	0.3304	0.6905	99
1988	425690	121793	79321	20447	0.2578	0.3743	100
1989	523020	124905	74258	23254	0.3132	0.5042	100
1990	448650	111195	69874	18404	0.2634	0.3841	99
1991	186750	83045	59027	25562	0.4331	0.4988	101
1992	888340	127790	59419	21127	0.3556	0.7558	95
1993	327920	89766	57558	18618	0.3235	0.4586	100
1994	709880	122256	64525	19300	0.2991	0.3880	99
1995	666400	119147	66484	23305	0.3505	0.5488	100
1996	328360	88805	57990	18816	0.3245	0.4949	100
1997	400170	86743	51186	20496	0.4004	0.6087	99
1998	237530	66933	42002	18041	0.4295	0.6284	99
1999	360510	65276	35122	18485	0.5263	0.9496	99
2000	372150	62063	31612	17191	0.5438	1.0114	99
2001	399910	58778	30400	15269	0.5023	0.7934	99
2002	394110	67983	36602	7465	0.2039	0.4257	100
2003	68050	38073	26463	11536	0.4359	1.0830	100
2004	**400034***	22904	**46,622***	12743	0.9541	1.7426	99

No of years for separable analysis : 6
Age range in the analysis : 1 . . . 9
Year range in the analysis : 1958 . . . 2004
Number of indices of SSB : 0
Number of age-structured indices : 1

Parameters to estimate : 29
Number of observations : 104

Conventional single selection vector model to be fitted.

* Values altered as described in Section 4.6.1.

Table 4.6.1. Celtic Sea & Division VIIj herring. Continued.

PARAMETER ESTIMATES

Parm. No.		Maximum Likelh. Estimate	CV (%)	Lower 95% CL	Upper 95% CL	-s.e.	+s.e.	Mean of Param. Distrib.
Separable model : F by year								
1	1999	0.8358	20	0.5594	1.2486	0.6810	1.0257	0.8535
2	2000	0.8902	19	0.6105	1.2981	0.7343	1.0791	0.9068
3	2001	0.6983	20	0.4702	1.0371	0.5707	0.8545	0.7127
4	2002	0.3747	22	0.2418	0.5807	0.2996	0.4685	0.3842
5	2003	0.9532	18	0.6618	1.3729	0.7913	1.1482	0.9699
6	2004	1.5338	21	1.0109	2.3271	1.2399	1.8973	1.5689
Separable Model: Selection (S) by age								
7	1	0.0614	68	0.0161	0.2335	0.0310	0.1213	0.0774
8	2	0.6639	24	0.4086	1.0788	0.5182	0.8505	0.6846
	3	1.0000	Fixed : Reference Age					
9	4	0.9728	22	0.6212	1.5233	0.7738	1.2229	0.9986
10	5	1.1376	20	0.7585	1.7062	0.9251	1.3990	1.1622
11	6	1.4738	20	0.9899	2.1942	1.2030	1.8056	1.5045
12	7	1.5689	19	1.0712	2.2979	1.2914	1.9062	1.5990
	8	1.0000	Fixed : Last true age					
Separable model: Populations in year 2004								
13	1	74741	163	3037	1838939	14583	383051	284074
14	2	23613	33	12149	45894	16823	33144	25010
15	3	55746	26	33259	93439	42832	72554	57716
16	4	25698	23	16280	40562	20359	32436	26404
17	5	12170	22	7880	18795	9750	15191	12473
18	6	4046	23	2577	6351	3214	5092	4154
19	7	721	29	406	1281	538	967	753
20	8	420	33	217	811	300	587	444
Separable model: Populations at age								
21	1999	3705	49	1414	9710	2267	6057	4181
22	2000	869	39	403	1873	587	1286	939
23	2001	811	36	398	1649	564	1165	866
24	2002	589	32	308	1125	424	819	622
25	2003	467	27	271	806	354	617	486

Age-structured index catchabilities

FLT02: Celtic combined acc data (Catch:

Linear model fitted. Slopes at age :

26	2	Q	.3207E-02	13	.2804E-02	.4851E-02	.3207E-02	.4242E-02	.3725E-02
27	3	Q	.3963E-02	13	.3467E-02	.5985E-02	.3963E-02	.5236E-02	.4599E-02
28	4	Q	.3003E-02	13	.2626E-02	.4545E-02	.3003E-02	.3973E-02	.3489E-02
29	5	Q	.2724E-02	14	.2377E-02	.4146E-02	.2724E-02	.3618E-02	.3171E-02

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals

Age	1999	2000	2001	2002	2003	2004
1	0.2214	-0.2326	0.3906	-0.4843	0.0990	0.0000
2	0.0838	0.4511	0.3912	-0.0192	-0.4546	-0.3441
3	-0.0400	-0.0218	0.4079	0.0737	-0.6336	0.1300
4	0.2281	-0.1649	0.0491	-0.1450	-0.2887	0.1307
5	0.1403	-0.0247	-0.1862	-0.2544	-0.3852	-0.1152
6	-0.0521	0.1006	-0.0026	-0.2422	0.3524	-0.9106
7	-0.2967	-0.1243	-0.0861	0.0979	0.4089	-0.2984
8	0.0000	0.2967	0.1764	-0.1346	0.3400	-0.5101

Table 4.6.1. Celtic Sea & Division VIIj herring. Continued.

AGE-STRUCTURED INDEX RESIDUALS

FLT02: Celtic combined acc data (Catch:

Age	1990	1991	1992	1993	1994	1995	1996	1997
2	-0.287	-0.098	0.284	-0.145	-0.386	0.349	0.636	*******
3	-0.440	-0.745	-0.070	0.050	-0.603	0.238	-0.028	*******
4	-0.259	-0.225	-0.167	0.578	-1.013	-0.038	-0.031	*******
5	0.017	-0.048	-0.279	-0.339	-0.701	-0.588	0.091	*******

FLT02: Celtic combined acc data (Catch:

Age	1998	1999	2000	2001	2002	2003	2004
2	-0.387	-0.171	-0.150	-0.189	-0.394	0.591	0.347
3	0.546	-0.176	-0.275	0.745	0.052	0.908	-0.203
4	1.074	-0.483	-0.450	0.878	-0.369	0.518	-0.013
5	1.065	-0.021	-0.180	1.389	-0.340	0.356	-0.421

PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES AT AGE)

Separable model fitted from 1999 to 2004	
Variance	0.1622
Skewness test stat.	-2.8265
Kurtosis test statistic	1.5694
Partial chi-square	0.4490
Significance in fit	0.0000
Degrees of freedom	23

Table 4.6.1. Celtic Sea & Division VIIj herring. Continued.

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PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES
 ------------------------------------------------------------

   DISTRIBUTION STATISTICS FOR FLT02: Celtic combined acc data (Catch:

 Linear catchability relationship assumed
 Age                         2         3         4         5
 Variance               0.1281    0.2226    0.3165    0.3374
Skewness test stat.     0.8824    0.6430    0.5956    1.8825
Kurtosis test statisti -0.8633   -0.4369   -0.3688    0.5151
Partial chi-square      0.3213    0.6059    1.1757    1.6357
Significance in fit     0.0000    0.0000    0.0000    0.0001
Number of observations      14        14        14        14
Degrees of freedom          13        13        13        13
Weight in the analysis  0.9625    0.9625    0.9625    0.9625
 ANALYSIS OF VARIANCE
--------------------------
 Unweighted Statistics

Variance
                                       SSQ     Data    Parameters d.f. Variance
Total for model                        17.7497     104          29   75   0.2367
Catches at age                          4.1803      48          25   23   0.1818

 Aged Indices
FLT02: Celtic combined acc data (Catch 13.5694      56           4   52   0.2610

 Weighted Statistics

Variance
                                       SSQ     Data    Parameters d.f. Variance
Total for model                        16.3011     104          29   75   0.2173
Catches at age                          3.7303      48          25   23   0.1622

 Aged Indices
FLT02: Celtic combined acc data (Catch 12.5708      56           4   52   0.2417
```

Table 4.6.2. Celtic Sea & Division VIIj herring. Results of trial assessment, using the same procedure as last year, with updated catch excluding 2004 survey data.

Population Abundance (1 January)

AGE	1958	1959	1960	1961	1962	1963	1964	1965
1	323.3	1062.5	354.9	251.8	494.5	280.2	1036.9	369.9
2	38.6	118.0	390.2	128.9	91.4	181.5	102.9	377.1
3	123.7	25.4	65.5	227.5	81.8	51.9	90.3	63.4
4	68.8	71.5	18.8	31.6	157.4	49.1	30.8	58.4
5	41.4	37.9	46.5	13.4	23.2	96.8	40.4	21.5
6	66.2	25.6	23.9	29.1	10.2	13.4	68.0	34.9
7	33.2	37.2	17.6	17.4	21.5	5.8	9.5	53.2
8	32.2	14.8	16.8	10.2	13.0	11.3	3.9	7.4
9	19.1	29.1	16.0	33.0	18.2	12.7	15.0	40.2

x 10 ^ 6

Population Abundance (1 January)

AGE	1966	1967	1968	1969	1970	1971	1972	1973
1	662.9	686.9	850.3	460.2	242.6	875.9	274.5	317.5
2	136.0	239.7	248.3	305.7	163.8	88.5	314.9	96.1
3	219.5	84.1	143.5	137.3	147.4	89.6	45.7	117.2
4	43.5	125.9	50.8	81.9	63.2	75.7	39.8	21.5
5	37.9	29.9	67.4	35.0	42.8	32.1	29.0	21.0
6	16.2	21.8	18.3	39.6	20.1	20.9	11.3	12.5
7	27.3	9.4	10.8	11.9	19.0	10.8	9.1	5.9
8	36.7	21.3	4.8	5.8	6.3	11.1	5.7	5.4
9	16.1	22.1	18.0	9.3	9.7	5.0	2.4	2.8

x 10 ^ 6

Population Abundance (1 January)

AGE	1974	1975	1976	1977	1978	1979	1980	1981
1	137.8	152.8	207.7	174.0	135.7	237.4	146.1	410.0
2	103.3	47.5	48.9	68.7	59.3	48.3	80.8	49.6
3	39.0	40.4	22.1	26.7	40.2	32.5	24.0	34.4
4	46.1	16.6	17.2	11.6	14.2	22.2	15.5	9.2
5	12.8	20.5	8.0	8.9	5.5	7.5	11.9	7.8
6	9.9	7.6	10.9	4.6	6.5	3.5	4.1	8.1
7	6.3	5.4	3.5	4.5	2.3	4.5	1.9	1.6
8	2.1	2.8	3.3	1.3	3.1	1.6	2.9	0.6
9	2.0	3.0	4.7	1.6	1.7	1.8	1.3	1.6

x 10 ^ 6

Population Abundance (1 January)

AGE	1982	1983	1984	1985	1986	1987	1988	1989
1	663.1	733.5	568.4	589.4	537.1	1032.0	425.6	522.6
2	128.2	235.0	262.0	197.8	206.4	195.2	376.2	155.2
3	18.8	58.8	87.4	115.5	98.1	104.7	87.8	208.8
4	8.8	7.6	24.0	34.8	62.0	42.0	47.2	44.2
5	3.1	3.4	3.8	6.6	16.4	25.0	16.3	33.8
6	2.9	1.4	1.3	1.1	3.8	6.5	9.1	9.1
7	4.1	0.8	0.9	0.2	0.8	2.4	3.3	5.3
8	0.7	2.1	0.4	0.5	0.1	0.6	1.1	2.2
9	1.3	0.7	0.3	0.4	0.0	1.0	0.3	1.9

x 10 ^ 6

Population Abundance (1 January)

Table 4.6.2. Celtic Sea & Division VIIj herring. Continued.

AGE	1990	1991	1992	1993	1994	1995	1996	1997
1	448.6	186.7	888.3	327.5	707.0	662.5	331.4	414.7
2	187.5	163.4	67.6	320.7	119.5	253.0	238.2	119.9
3	79.0	103.3	67.1	27.5	157.8	58.2	120.3	123.9
4	109.7	42.6	50.3	23.8	14.1	73.9	27.4	64.2
5	21.4	65.8	22.5	19.4	11.8	9.6	32.3	17.3
6	22.8	11.7	32.7	10.8	13.3	7.8	5.2	14.0
7	4.6	17.0	6.0	12.5	7.1	7.5	3.8	2.8
8	2.4	2.6	12.9	2.6	5.7	4.8	4.3	2.0
9	1.6	1.6	1.4	1.5	1.6	2.2	2.9	1.4

x 10 ^ 6

Population Abundance (1 January)

AGE	1998	1999	2000	2001	2002	2003	2004	2005
1	257.9	376.5	435.2	463.5	588.1	139.3	366.3	368.3
2	150.3	91.5	132.4	152.7	164.7	212.9	49.7	132.3
3	57.1	76.1	37.1	52.4	71.6	98.4	104.7	28.7
4	54.0	22.5	27.0	12.7	22.7	43.5	45.6	60.8
5	28.4	22.1	8.8	10.2	6.1	15.2	22.2	29.2
6	7.8	13.2	8.2	3.1	4.7	4.0	7.5	13.9
7	6.9	3.5	3.7	2.2	1.2	2.8	1.6	4.2
8	1.4	3.7	0.9	1.0	0.8	0.7	1.1	0.9
9	0.9	1.0	1.0	0.9	0.8	1.3	0.3	0.9

x 10 ^ 6

Weighting factors for the catches in number

AGE	1999	2000	2001	2002	2003	2004
1	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Predicted Age-Structured Index Values

FLT02: Celtic combined acc data (Catch: Predicted

AGE	1990	1991	1992	1993	1994	1995	1996	1997
2	297.08	192.97	78.95	453.59	167.32	345.93	356.07	*******
3	158.37	187.05	88.40	52.40	275.07	102.06	238.95	*******
4	185.41	63.37	54.74	33.31	27.11	91.13	48.70	*******
5	30.39	84.87	27.96	34.60	20.34	13.55	36.47	*******

FLT02: Celtic combined acc data (Catch: Predicted

AGE	1998	1999	2000	2001	2002	2003	2004
2	218.82	106.63	150.63	205.82	282.98	300.91	*******
3	83.87	100.44	47.35	84.58	161.83	169.76	*******
4	62.37	24.80	28.73	17.14	42.94	62.61	*******
5	34.33	21.24	8.15	12.14	10.39	19.48	*******

Table 4.6.2. Celtic Sea & Division VIIj herring. Continued.

Fitted Selection Pattern

AGE	1958	1959	1960	1961	1962	1963	1964	1965
1	0.0232	0.0173	0.0240	0.0799	0.0080	0.0052	0.0490	0.0014
2	0.3413	2.7783	0.4517	0.9208	0.8558	1.2327	0.7837	1.3602
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.4296	3.1942	0.4476	1.2304	1.2399	0.2905	1.0924	1.8725
5	1.0986	3.4992	0.6963	1.0316	1.4563	0.7866	0.1940	1.0214
6	1.3692	2.6293	0.4087	1.1992	1.4790	0.7345	0.6134	0.8264
7	2.0324	6.6808	0.8473	1.1106	1.7424	0.8960	0.6576	1.5383
8	1.0504	2.9639	0.5998	1.0150	1.1734	0.8129	0.7081	1.2261
9	1.0504	2.9639	0.5998	1.0150	1.1734	0.8129	0.7081	1.2261

Fitted Selection Pattern

AGE	1966	1967	1968	1969	1970	1971	1972	1973
1	0.0479	0.0580	0.0635	0.0573	0.0185	0.0377	0.0890	0.1686
2	0.5092	0.7022	0.8112	0.7457	0.6508	0.5881	1.2370	0.8229
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	0.7692	1.7271	0.7547	0.9546	1.2398	1.4068	0.9679	0.5719
5	1.2749	1.2833	1.1991	0.7884	1.3191	1.5364	1.3330	0.8934
6	1.2588	1.9854	0.9181	1.1046	1.1279	1.2025	1.0051	0.8062
7	0.4169	1.9001	1.4361	0.9397	0.9285	0.8773	0.7672	1.2383
8	0.8087	1.2704	0.9405	0.8599	0.9694	1.0195	1.0289	0.8292
9	0.8087	1.2704	0.9405	0.8599	0.9694	1.0195	1.0289	0.8292

Fitted Selection Pattern

AGE	1974	1975	1976	1977	1978	1979	1980	1981
1	0.0989	0.2136	0.2369	0.1760	0.0841	0.1447	0.1052	0.1393
2	0.9742	0.7084	0.6768	0.5408	0.7624	0.7434	0.7271	0.5754
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0872	0.9487	1.2468	1.4889	1.3493	0.9681	0.7686	0.8453
5	0.6476	0.9408	1.0465	0.4765	0.9130	0.9507	0.3725	0.7679
6	0.7672	1.0172	1.5522	1.3160	0.6865	0.9406	1.0867	0.5006
7	1.0469	0.5850	1.9846	0.6382	0.7086	0.6562	1.3921	0.6193
8	0.8849	0.8229	1.1059	0.8433	0.8723	0.8348	0.8097	0.6904
9	0.8849	0.8229	1.1059	0.8433	0.8723	0.8348	0.8097	0.6904

Fitted Selection Pattern

AGE	1982	1983	1984	1985	1986	1987	1988	1989
1	0.0526	0.0426	0.0772	0.1164	0.0190	0.0154	0.0177	0.0569
2	0.6792	0.9924	0.7218	0.9516	0.5839	0.8354	0.5918	0.8461
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.2036	0.8458	1.6488	1.5550	1.2466	1.4219	0.4803	1.4035
5	0.9970	1.2233	1.5343	1.0718	1.2686	1.5259	0.9927	0.6608
6	1.6144	0.4097	2.6870	0.5556	0.5697	0.9621	0.8855	1.3141
7	0.7851	0.8993	0.7509	1.7245	0.2068	1.2074	0.6591	1.5862
8	0.9615	0.8790	1.2531	1.0757	0.7979	1.0867	0.7191	1.0369
9	0.9615	0.8790	1.2531	1.0757	0.7979	1.0867	0.7191	1.0369

Table 4.6.2. Celtic Sea & Division VIIj herring. Continued.

Fitted Selection Pattern

AGE	1990	1991	1992	1993	1994	1995	1996	1997
1	0.0229	0.0313	0.0223	0.0167	0.0492	0.0412	0.0390	0.0234
2	0.7068	1.1331	0.7160	0.8752	0.7519	0.8027	0.8274	0.7017
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	0.9817	1.0325	1.0140	1.2775	0.5031	1.3152	0.8447	1.1365
5	1.2072	1.1528	0.7595	0.5932	0.5593	0.9275	1.7164	1.1082
6	0.4604	1.0973	1.0252	0.6775	0.8422	1.1047	1.2589	0.9699
7	1.1504	0.3338	0.8943	1.4620	0.5229	0.8322	1.3176	0.9086
8	0.8679	0.9489	0.8437	0.9220	0.6717	0.9423	1.0668	0.9101
9	0.8679	0.9489	0.8437	0.9220	0.6717	0.9423	1.0668	0.9101

Fitted Selection Pattern

AGE	1998	1999	2000	2001	2002	2003	2004
1	0.0497	0.0541	0.0541	0.0541	0.0541	0.0541	0.0541
2	0.5221	0.7206	0.7206	0.7206	0.7206	0.7206	0.7206
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0854	1.0041	1.0041	1.0041	1.0041	1.0041	1.0041
5	0.9108	1.0706	1.0706	1.0706	1.0706	1.0706	1.0706
6	0.9593	1.3959	1.3959	1.3959	1.3959	1.3959	1.3959
7	0.7145	1.4541	1.4541	1.4541	1.4541	1.4541	1.4541
8	0.8058	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	0.8058	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 4.6.2. Celtic Sea & Division VIIj herring. Continued.

STOCK SUMMARY

Year	Recruits Age 1 thousands	Total Biomass tonnes	Spawning Biomass tonnes	Landings tonnes	Yield /SSB ratio	Mean F Ages 2- 7	SoP (%)
1958	323340	110514	77639	22978	0.2960	0.4210	89
1959	1062530	155105	82256	15086	0.1834	0.3421	88
1960	354880	120358	83681	18283	0.2185	0.3405	88
1961	251770	105281	78511	15372	0.1958	0.1822	128
1962	494460	130209	82062	21552	0.2626	0.4028	98
1963	280220	105625	75126	17349	0.2309	0.2655	99
1964	1036850	177979	94458	10599	0.1122	0.1704	97
1965	369870	154585	112090	19126	0.1706	0.2252	86
1966	662900	185946	114870	27030	0.2353	0.3100	103
1967	686940	189001	115636	27658	0.2392	0.4352	90
1968	850320	210643	123130	30236	0.2456	0.3677	100
1969	460180	176635	115241	44389	0.3852	0.5316	99
1970	242590	125995	88394	31727	0.3589	0.4861	99
1971	875920	172520	87349	31396	0.3594	0.6743	96
1972	274470	122055	77994	38203	0.4898	0.5853	100
1973	317540	97325	57549	26936	0.4681	0.6507	95
1974	137810	64959	42128	19940	0.4733	0.6042	97
1975	152790	52670	32007	15588	0.4870	0.5683	107
1976	207680	53627	29356	9771	0.3328	0.5598	94
1977	174010	49672	29066	7833	0.2695	0.3958	100
1978	135680	46024	29356	7559	0.2575	0.3557	91
1979	237390	55691	30112	10321	0.3428	0.4725	100
1980	146070	45642	27924	13130	0.4702	0.6790	107
1981	410030	70661	31713	17103	0.5393	0.8370	101
1982	663060	105047	45649	13000	0.2848	0.7393	101
1983	733540	130520	62830	24981	0.3976	0.6218	104
1984	568430	112909	62400	26779	0.4291	1.0006	99
1985	589400	117731	64413	20426	0.3171	0.4821	102
1986	537080	125344	70436	25024	0.3553	0.5269	100
1987	1032010	161223	79294	26200	0.3304	0.6914	99
1988	425620	121782	79315	20447	0.2578	0.3745	100
1989	522620	124855	74239	23254	0.3132	0.5043	100
1990	448560	111161	69849	18404	0.2635	0.3838	99
1991	186710	83020	59006	25562	0.4332	0.4989	101
1992	888320	127762	59392	21127	0.3557	0.7562	95
1993	327460	89702	57524	18618	0.3237	0.4589	100
1994	706990	121932	64400	19300	0.2997	0.3888	99
1995	662490	118627	66223	23305	0.3519	0.5507	100
1996	331420	88747	57776	18816	0.3257	0.4969	100
1997	414730	87965	51457	20496	0.3983	0.6120	99
1998	257860	69462	43040	18041	0.4192	0.6310	99
1999	376480	68061	36575	18485	0.5054	0.9267	99
2000	435170	69072	34291	17191	0.5013	0.9634	99
2001	463490	66890	34434	15269	0.4434	0.7035	99
2002	588140	91525	46667	7465	0.1600	0.3306	100
2003	139320	54977	38937	11536	0.2963	0.6303	100
2004	**404152****	60726	**46,622***	12743	0.3510	0.3809	99

No of years for separable analysis : 6
Age range in the analysis : 1 . . . 9
Year range in the analysis : 1958 . . . 2004
Number of indices of SSB : 0
Number of age-structured indices : 1

Parameters to estimate : 29
Number of observations : 100

Conventional single selection vector model to be fitted.

*** Values altered as described in Section 4.6.1.**

Table 4.6.2. Celtic Sea & Division VIIj herring. Continued.

PARAMETER ESTIMATES

Parm. No.		Maximum Likelh. Estimate	CV (%)	Lower 95% CL	Upper 95% CL	-s.e.	+s.e.	Mean of Param. Distrib.
Separable model : F by year								
1	1999	0.8367	20	0.5644	1.2402	0.6844	1.0228	0.8537
2	2000	0.8699	19	0.5978	1.2657	0.7184	1.0533	0.8859
3	2001	0.6352	20	0.4222	0.9556	0.5157	0.7824	0.6491
4	2002	0.2985	23	0.1874	0.4754	0.2354	0.3785	0.3070
5	2003	0.5691	26	0.3398	0.9530	0.4374	0.7403	0.5891
6	2004	0.3439	38	0.1623	0.7287	0.2344	0.5044	0.3701
Separable Model: Selection (S) by age								
7	1	0.0541	66	0.0146	0.2000	0.0278	0.1054	0.0676
8	2	0.7206	25	0.4395	1.1813	0.5599	0.9273	0.7439
	3	1.0000	Fixed : Reference Age					
9	4	1.0041	22	0.6420	1.5703	0.7992	1.2614	1.0306
10	5	1.0706	21	0.7067	1.6220	0.8661	1.3234	1.0949
11	6	1.3959	19	0.9491	2.0531	1.1465	1.6996	1.4232
12	7	1.4541	19	0.9932	2.1288	1.1971	1.7663	1.4819
	8	1.0000	Fixed : Last true age					
Separable model: Populations in year 2004								
13	1	366345	162	15043	8921224	71858	1867695	1380509
14	2	49698	56	16532	149396	28344	87140	58185
15	3	104664	33	54362	201509	74928	146200	110676
16	4	45616	28	25952	80179	34209	60826	47544
17	5	22221	26	13122	37630	16984	29072	23038
18	6	7497	26	4453	12619	5747	9778	7766
19	7	1634	32	864	3090	1180	2261	1722
20	8	1101	37	529	2293	758	1601	1181
Separable model: Populations at age								
21	1999	3703	47	1464	9366	2306	5945	4142
22	2000	936	38	444	1974	639	1370	1006
23	2001	949	36	467	1925	661	1361	1012
24	2002	788	33	405	1534	561	1107	835
25	2003	685	29	385	1217	510	918	715

Age-structured index catchabilities

FLT02: Celtic combined acc data (Catch:

Linear model fitted. Slopes at age :

26	2	Q	.2875E-02	13	.2518E-02	.4325E-02	.2875E-02	.3788E-02	.3332E-02
27	3	Q	.3721E-02	13	.3263E-02	.5583E-02	.3721E-02	.4895E-02	.4308E-02
28	4	Q	.2817E-02	13	.2469E-02	.4231E-02	.2817E-02	.3708E-02	.3263E-02
29	5	Q	.2597E-02	13	.2273E-02	.3918E-02	.2597E-02	.3429E-02	.3013E-02

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals

Age	1999	2000	2001	2002	2003	2004
1	0.3001	-0.2435	0.4598	-0.5345	0.0125	0.0000
2	-0.0640	0.3581	0.2375	-0.0450	-0.5241	-0.0012
3	-0.0940	-0.0443	0.4621	0.0965	-0.4692	0.5103
4	0.1764	-0.2228	0.0365	-0.0560	-0.2037	0.5423
5	0.2115	0.0222	-0.1251	-0.1145	-0.1508	0.2793
6	0.0145	0.1194	0.0028	-0.1811	0.4710	-0.6597
7	-0.2377	-0.1011	-0.1039	0.1048	0.4401	-0.2623
8	0.0000	0.2377	0.0866	-0.2327	0.3098	-0.4722

Table 4.6.2. Celtic Sea & Division VIIj herring. Continued.

AGE-STRUCTURED INDEX RESIDUALS

FLT02: Celtic combined acc data (Catch:

Age	1990	1991	1992	1993	1994	1995	1996	1997
2	-0.177	0.011	0.393	-0.035	-0.274	0.465	0.754	*******
3	-0.377	-0.681	-0.007	0.114	-0.540	0.305	0.045	*******
4	-0.195	-0.160	-0.099	0.644	-0.948	0.026	0.038	*******
5	0.064	-0.001	-0.231	-0.286	-0.651	-0.539	0.139	*******

FLT02: Celtic combined acc data (Catch:

Age	1998	1999	2000	2001	2002	2003	2004
2	-0.331	-0.099	-0.054	-0.250	-0.474	0.070	*******
3	0.579	-0.165	-0.269	0.731	-0.131	0.397	*******
4	1.173	-0.423	-0.431	0.843	-0.447	-0.020	*******
5	1.151	0.006	-0.217	1.277	-0.498	-0.213	*******

PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES AT AGE)

Separable model fitted from 1999 to 2004

Variance	0.1449
Skewness test stat.	0.0111
Kurtosis test statistic	0.0976
Partial chi-square	0.3992
Significance in fit	0.0000
Degrees of freedom	23

Table 4.6.2. Celtic Sea & Division VIIj herring. Continued.

```
PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES
 ------------------------------------------------------------
   DISTRIBUTION STATISTICS FOR FLT02: Celtic combined acc data (Catch:

 Linear catchability relationship assumed
 Age                           2          3          4          5
 Variance                 0.1173     0.1724     0.3241     0.3345
Skewness test stat.       1.2160     0.2100     0.8941     1.8680
Kurtosis test statisti   -0.1150    -0.6381    -0.1648     0.4082
Partial chi-square        0.2551     0.4305     1.1110     1.4148
Significance in fit       0.0000     0.0000     0.0000     0.0001
Number of observations        13         13         13         13
Degrees of freedom            12         12         12         12
Weight in the analysis    0.9625     0.9625     0.9625     0.9625
 ANALYSIS OF VARIANCE
--------------------------
 Unweighted Statistics

Variance
                                       SSQ     Data    Parameters d.f. Variance
Total for model                        15.7361     100          29   71   0.2216
Catches at age                          3.9143      48          25   23   0.1702

 Aged Indices
FLT02: Celtic combined acc data (Catch 11.8218      52           4   48   0.2463

 Weighted Statistics

Variance
                                       SSQ     Data    Parameters d.f. Variance
Total for model                        14.2841     100          29   71   0.2012
Catches at age                          3.3323      48          25   23   0.1449

 Aged Indices
FLT02: Celtic combined acc data (Catch 10.9518      52           4   48   0.2282
```

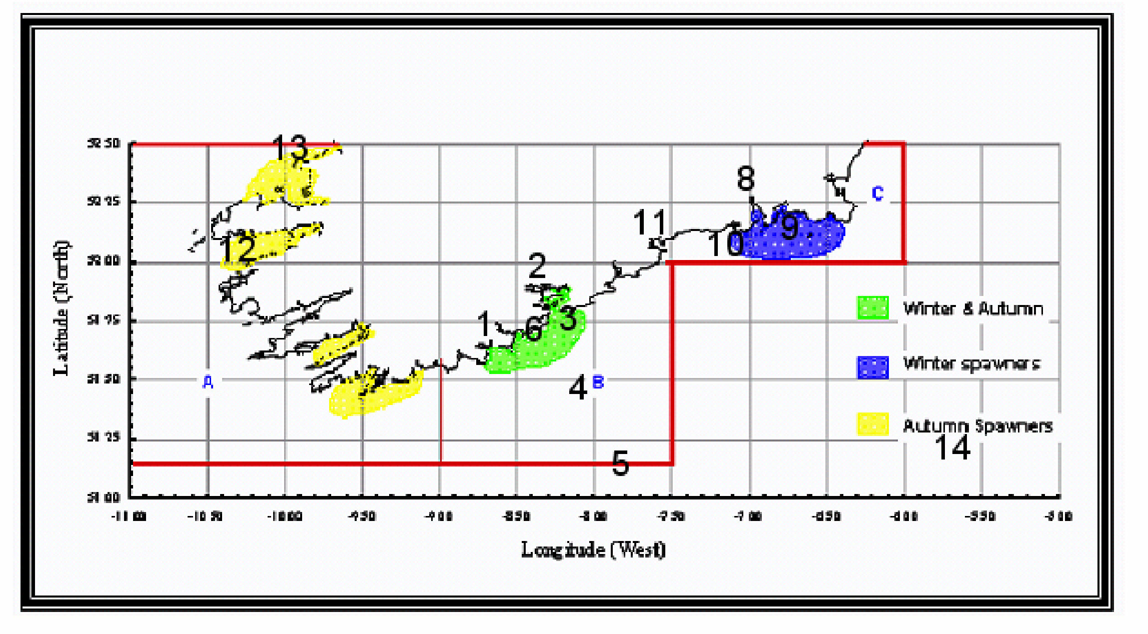


Figure 4.1.1.1 Celtic Sea and VIIj herring, areas mentioned in the text and spawning boxes (A, B and C, south of Ireland. One of these boxes is closed each season, under EU legislation. 1 Courtmacsherry, 2 Cork Harbour, 3 Daunt Rock, 4 Kinsale Gas Field, 5 Labadie Bank, 6 Kinsale, 8 Waterford Harbour, 9, Baginbun Bay, 10, Tramore Bay/ Dunmore East, 11, Ballycotton Bay, 12, Valentia Island, 13 Kerry Head to Loop Head, 14, The Smalls.

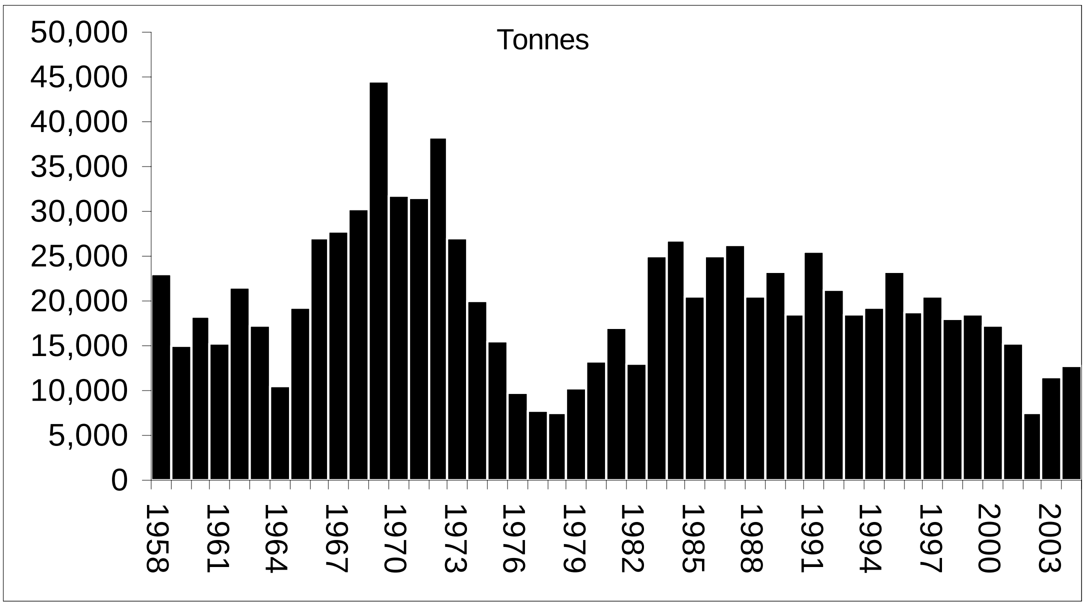
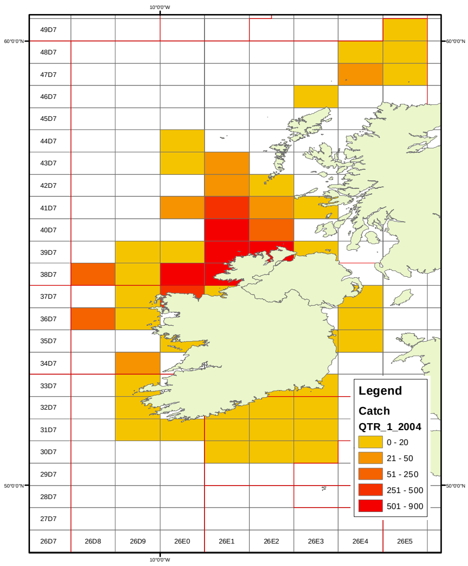
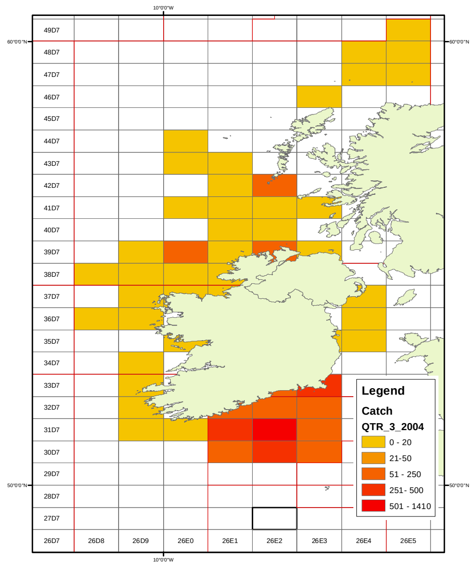


Figure 4.1.2.1 Celtic Sea and Division VIIj – working group estimates of herring landings per season.





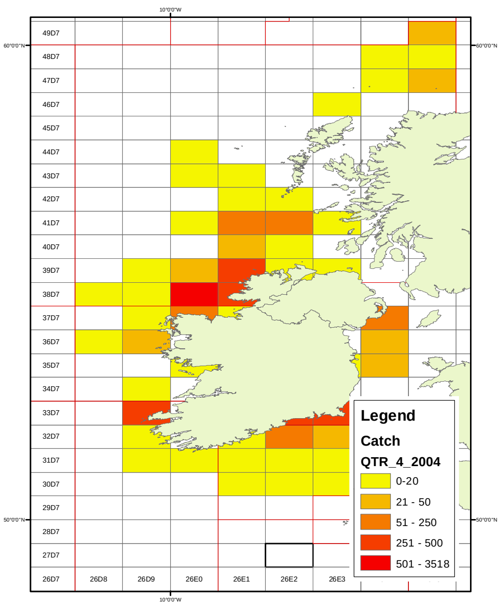


Figure 4.1.2.2 Herring catches by statistical rectangle in the third and fourth quarters of 2004 and the first quarter of 2005. Catches in ICES division V11a south, VIIg and VIIj are those in the 33 series of statistical rectangles and lower.

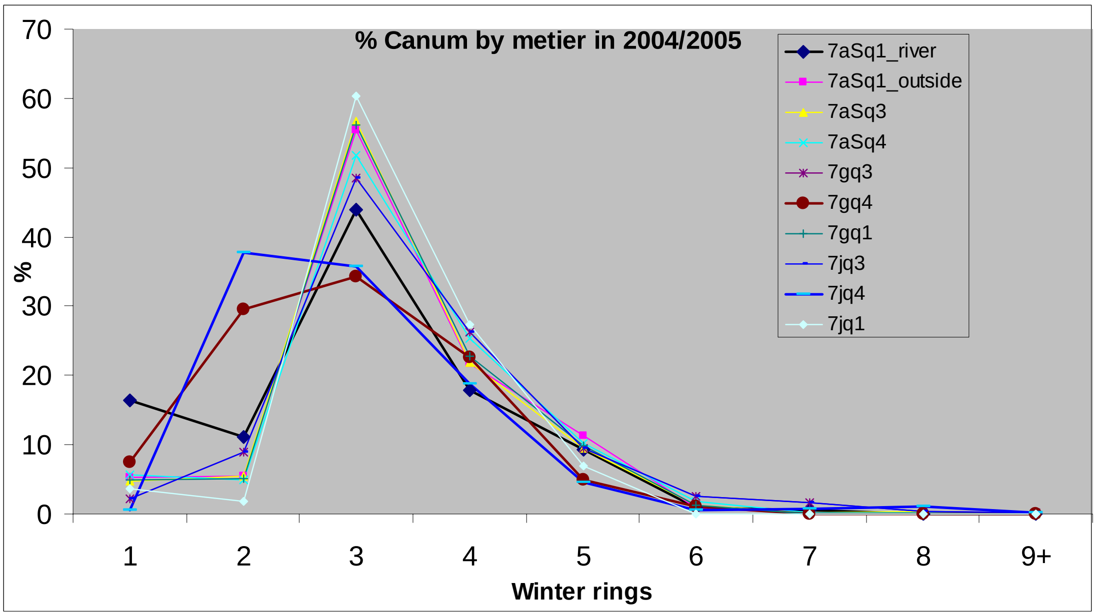


Figure 4.2.1.1 Celtic Sea and Division VIIj – percentage age composition by metier (ICES Division and quarter).

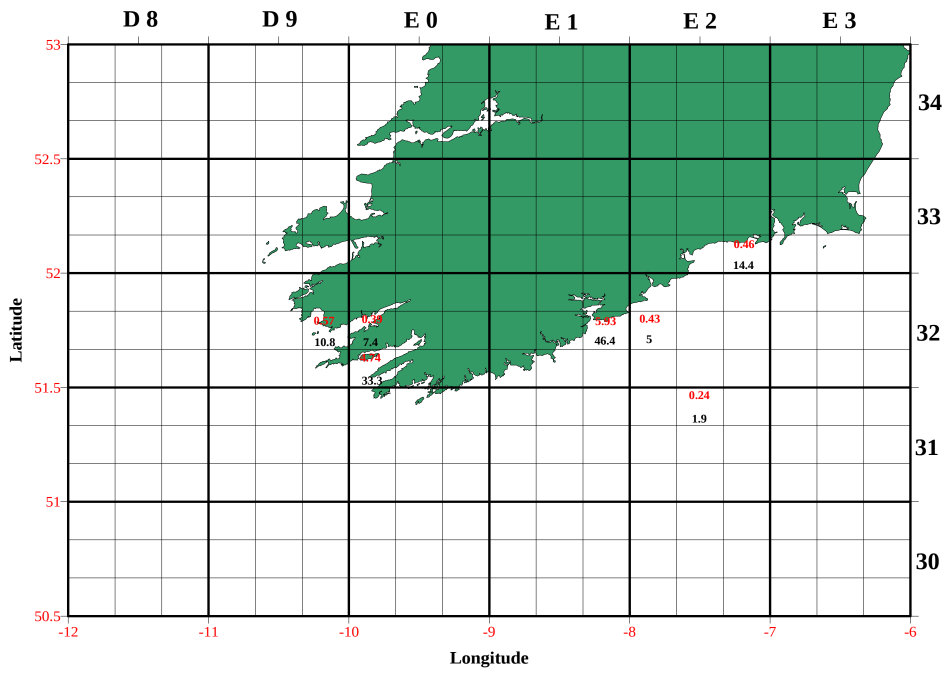


Figure 4.3.1.1a Celtic Sea and Division VIIj acoustic survey 2004, survey track and haul positions from acoustic survey, October and November 2004.

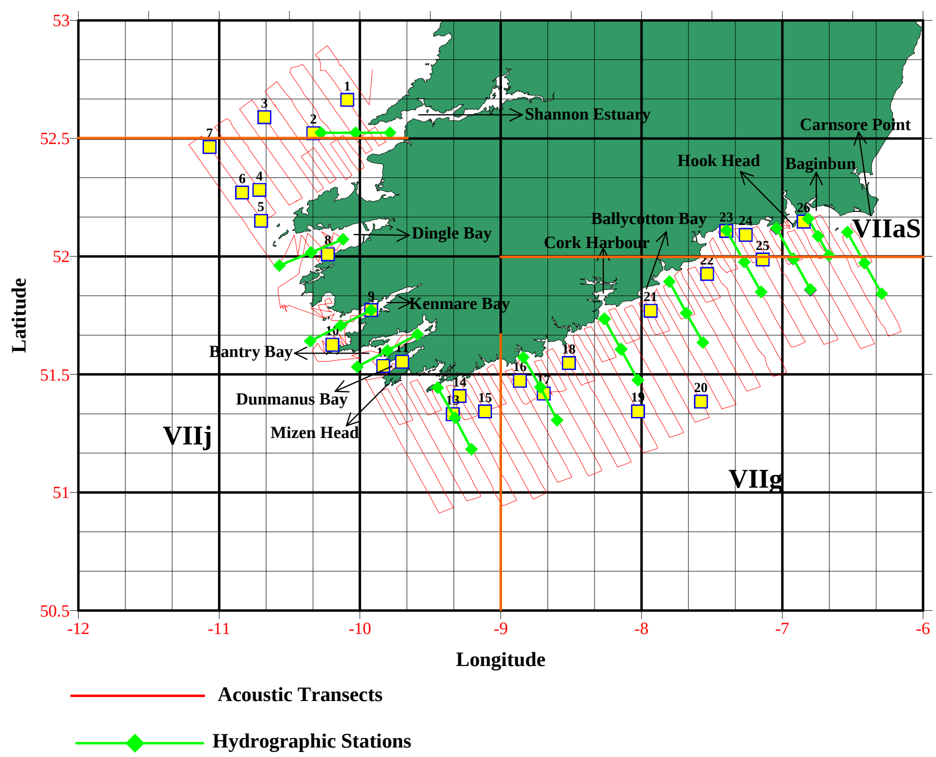


Figure 4.3.1.1b Celtic Sea and Division VIIj acoustic survey 2004, total Sa values for herring obtained in October and November/December 2004.

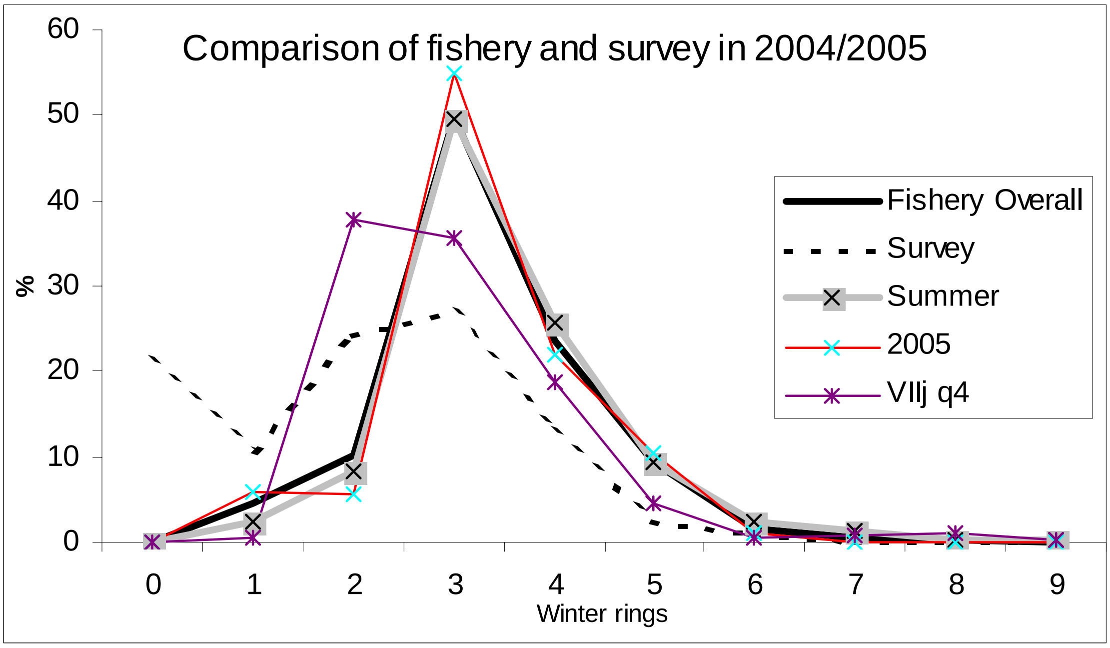


Figure 4.3.1.2 Celtic Sea & Division VIIj herring, comparison of percentage catches-at-age from the commercial fishery and from the acoustic survey in the 2003/2004 season.

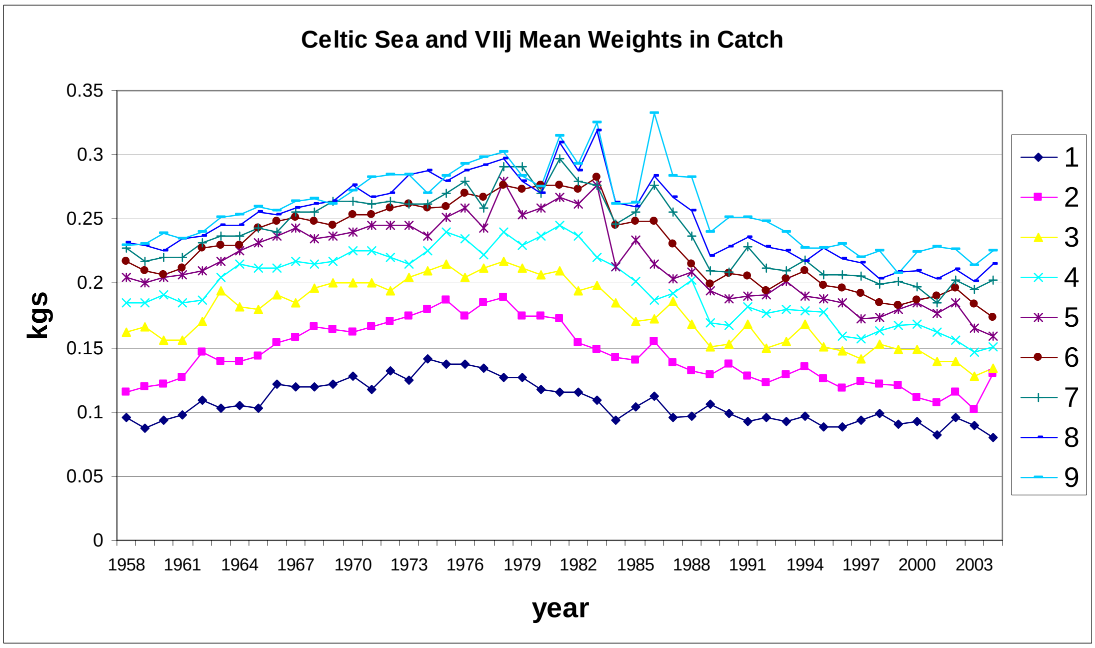


Figure 4.4.1. Celtic Sea and VIIj herring, trends over time in mean weights in the catch.

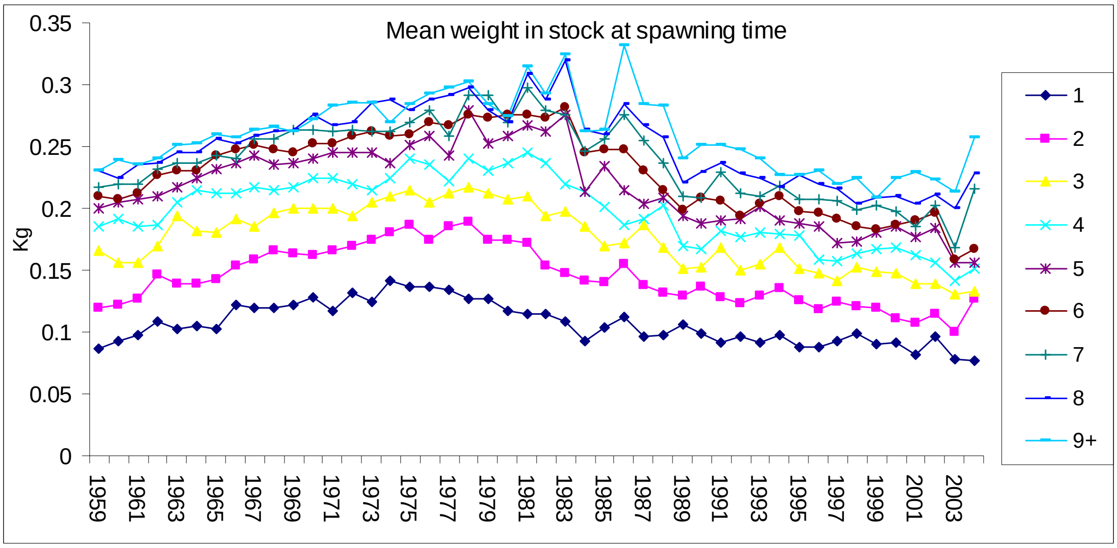


Figure 4.4.2. Celtic Sea and VIIj herring, trends over time in mean weights in the stock at spawning time.

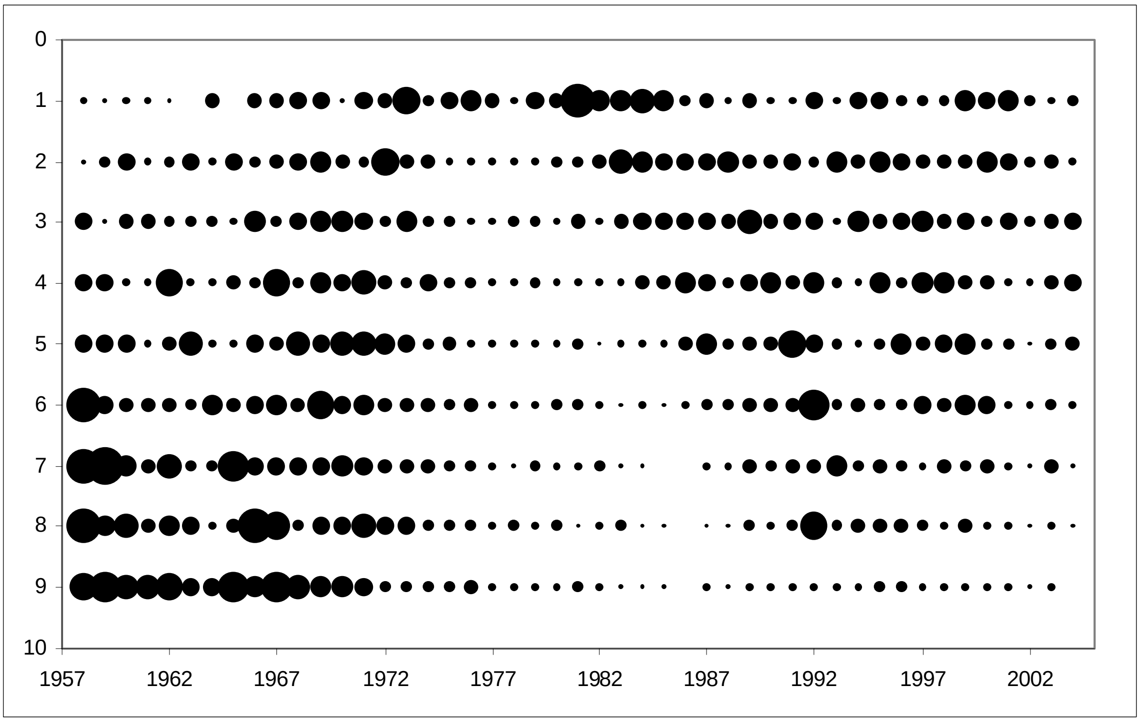


Figure 4.6.1.1. Celtic Sea and VIIj herring. Mean standardised catch numbers at age distribution, 1958 to 2004.

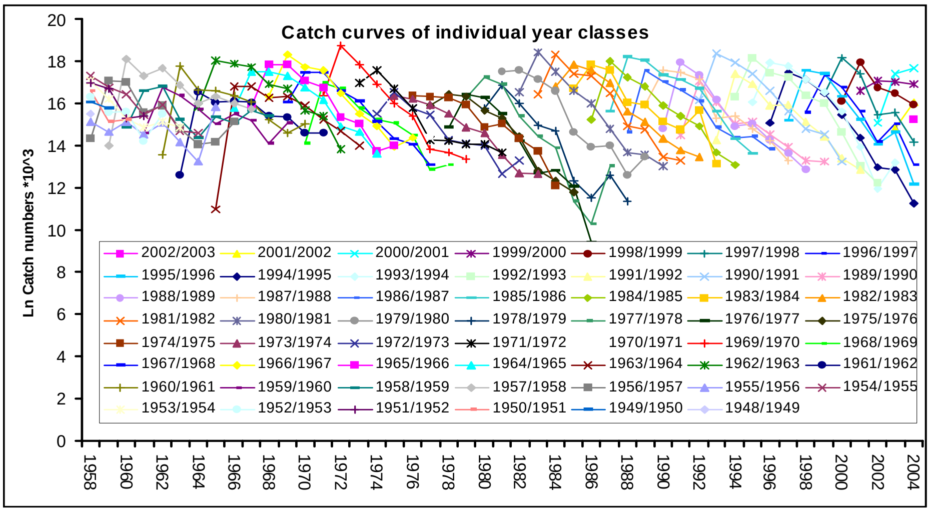


Figure 4.6.1.2. Celtic Sea and VIIj herring. Log catch numbers by year class.

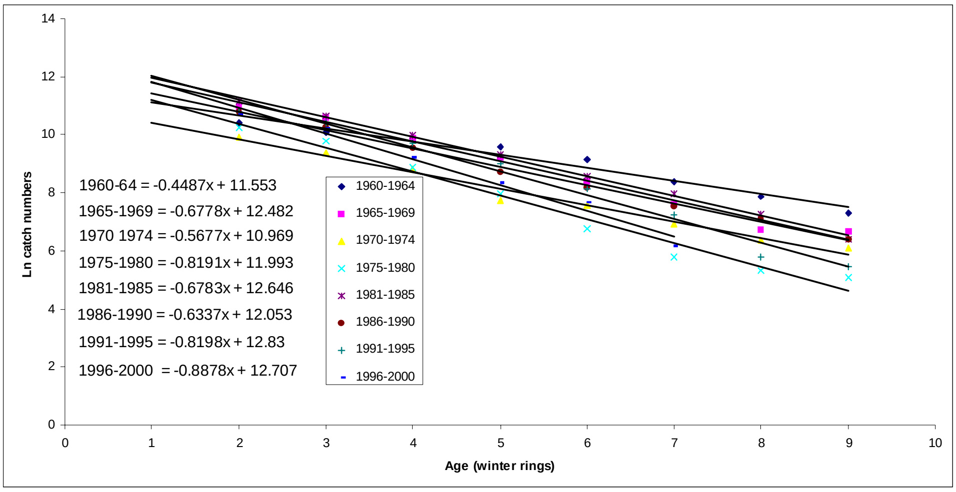


Figure 4.6.1.3. Celtic Sea and VIIj herring. Mean log catch numbers for year classes, combined over several years. Slopes are a crude estimator of mortality, assuming constant catchability, interceptvalues contain information on the effect of recruitment.

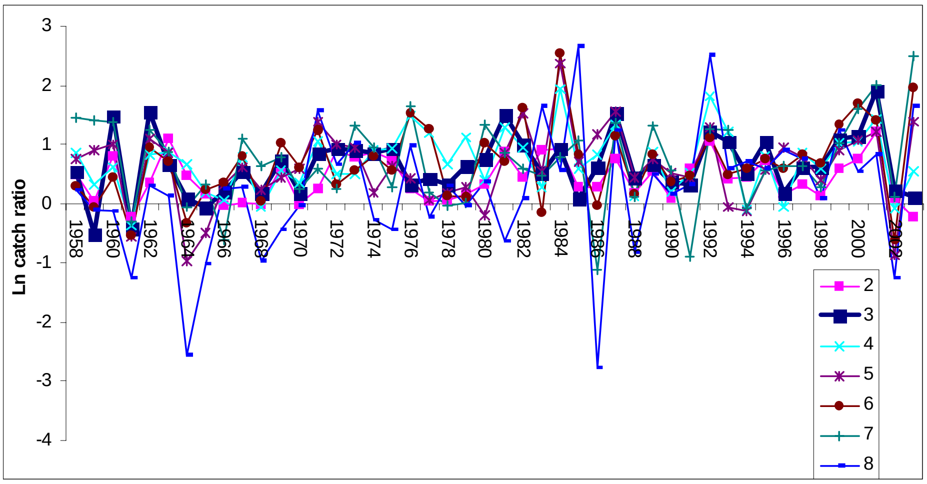


Figure 4.6.1.4. Celtic Sea and VIIj herring. Log catch ratios.

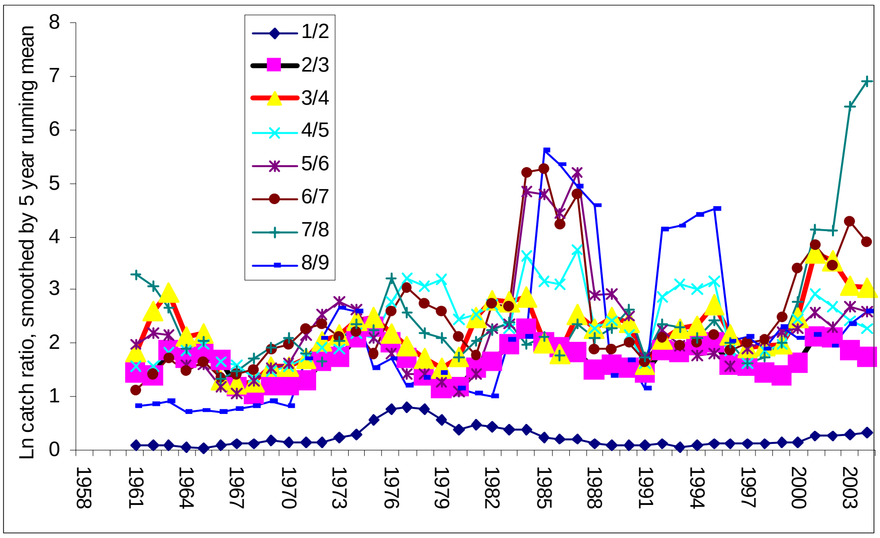


Figure 4.6.1.5. Celtic Sea and VIIj herring. Log catch ratios, smoothed by a 5 year running average.

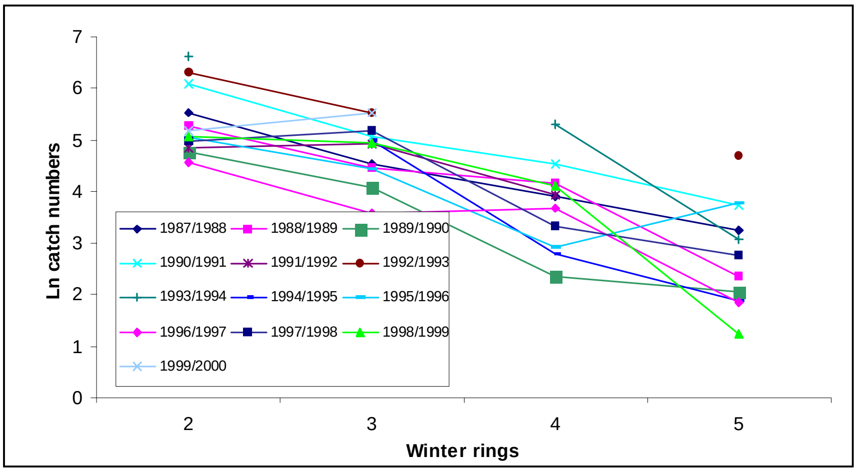


Figure 4.6.1.6. Celtic Sea and VIIj herring. Log abundance by year class (2-5 ringers) as estimated by the Celtic Sea and VIIj herring acoustic survey.

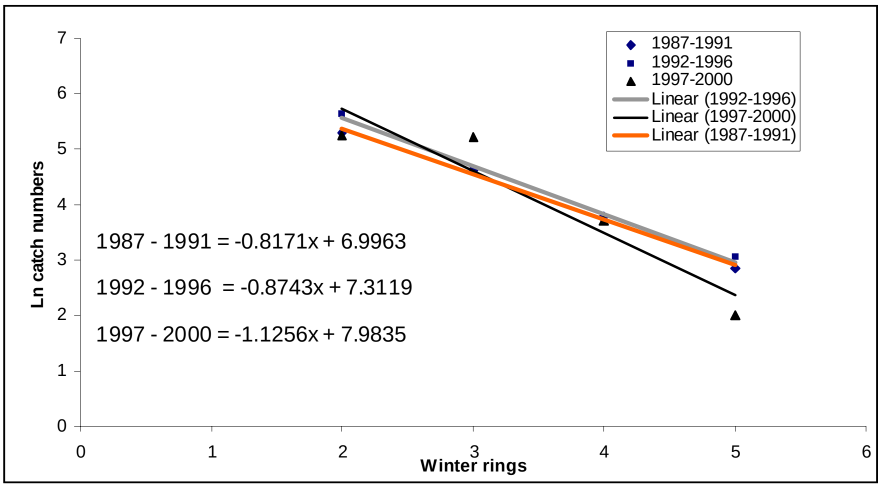


Figure 4.6.1.7. Celtic Sea and VIIj herring. Mean log abundance numbers for year classes, combined over several years. Slopes are a crude estimator of mortality, assuming constant catchability, intercept values contain information on the effect of recruitment.

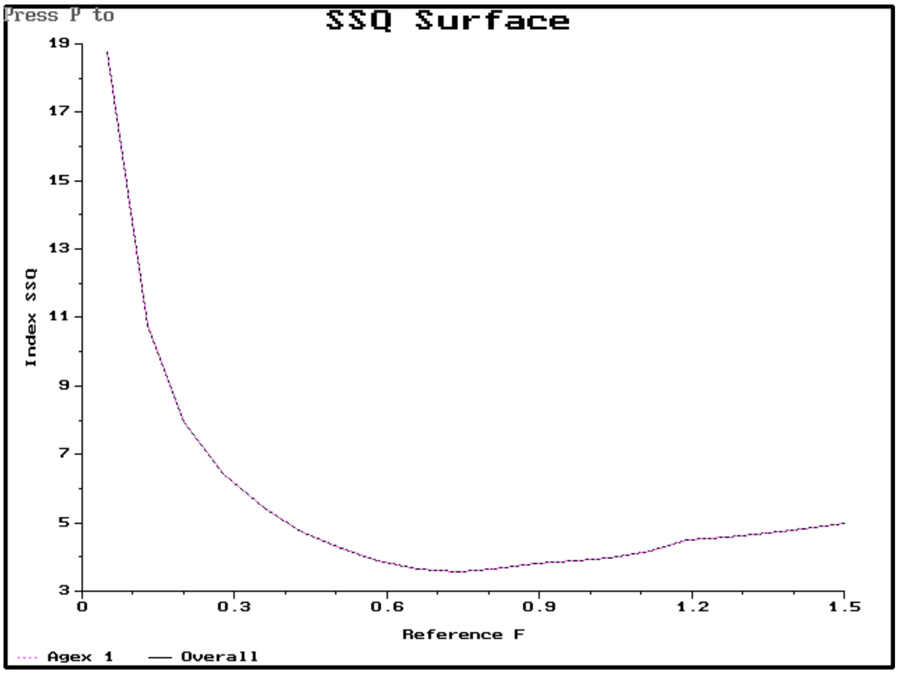


Figure 4.6.1.8 **Herring in Celtic Sea and Division VIIj. Trial assessment using updated catch and survey data, SSQ surface.**

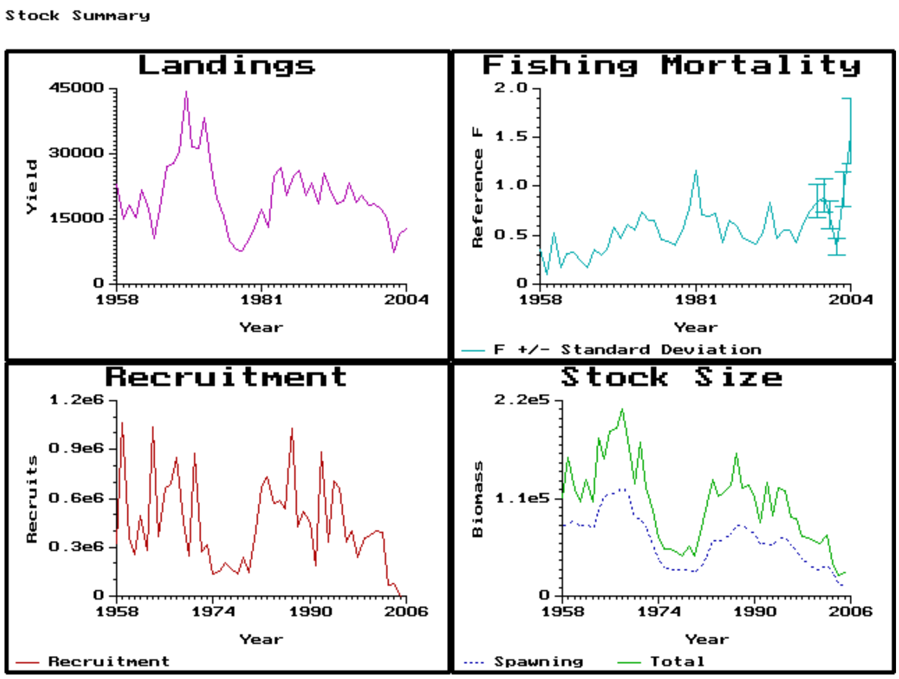


Figure 4.6.1.9 **Herring in Celtic Sea and Division VIIj. Trial assessment using updated catch and survey data, results. Summary of estimates of landings, fishing mortality-at-age 3, recruitment age 1, stock size on Jan. 1 and spawning stock size at spawning time. Note: age corresponds to winter rings.**

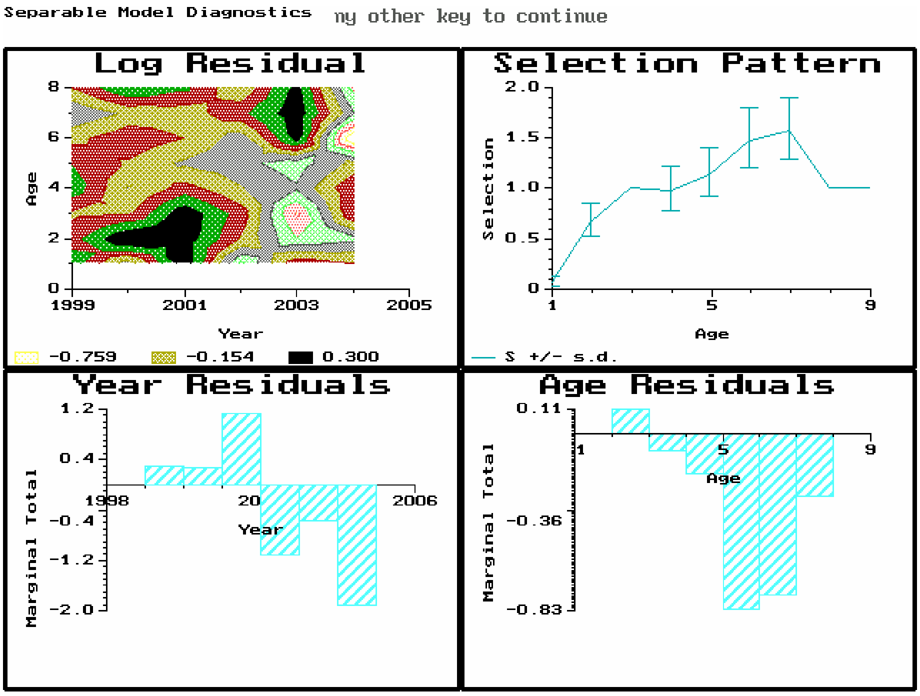


Figure 4.6.1.10 Herring in the Celtic Sea and Division VIIj. Trial assessment using updated catch and survey data, results. Selection pattern diagnostics. Top left, contour plot of selection pattern residuals. Top right, estimated selection (relative to age 3) +/- standard deviation. Bottom, marginal totals of residuals by year and age (rings).

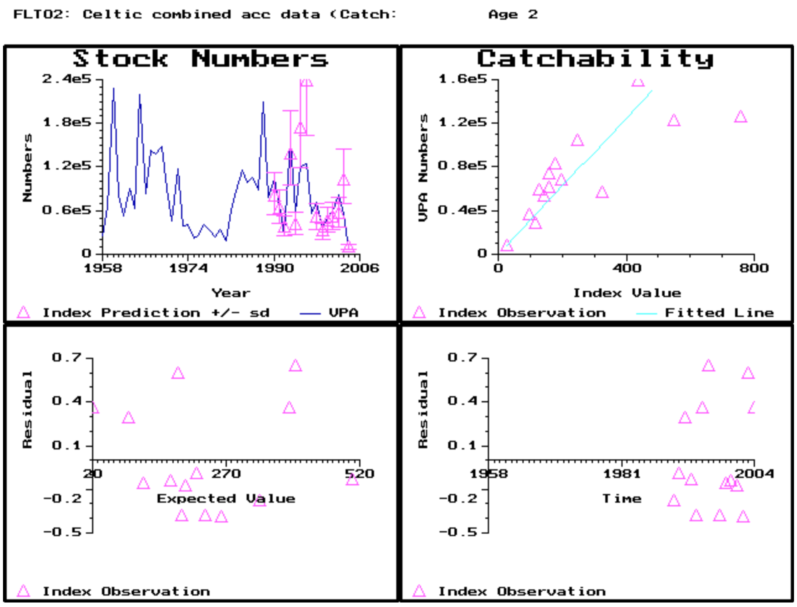


Figure 4.6.1.11 Herring in the Celtic Sea and Division VIIj. Trial assessment using updated catch and survey data, results. Diagnostics of the fit of the acoustic survey index at age 2 against the estimated spawning biomass. Top left, spawning biomass from the fitted populations (line), and predictions of spawning biomass in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of spawning biomass from the fitted populations and larvae survey index observations. Bottom, residuals, as ln(observed index) – ln(expected index) plotted against expected values and time.marginal totals of residuals by year and age(rings).

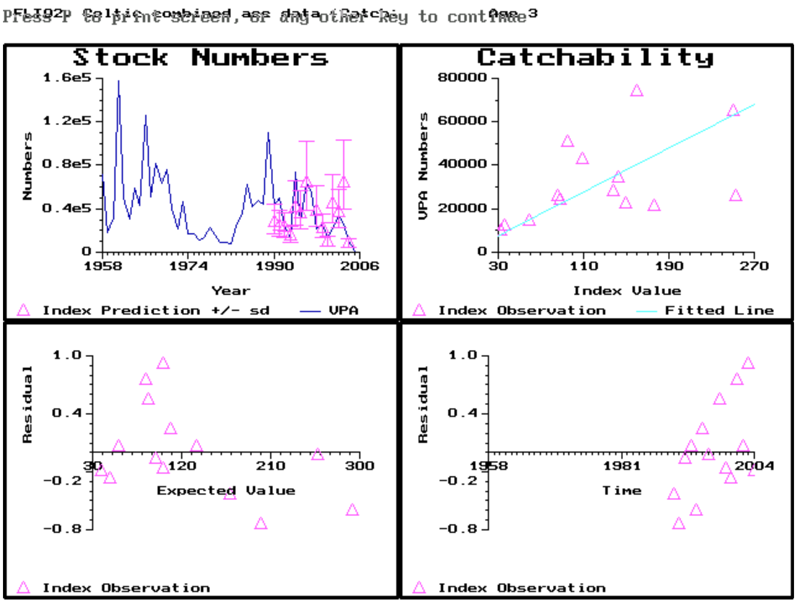


Figure 4.6.1.10 Herring in the Celtic Sea and Division VIIj. Trial assessment using updated catch and survey data, results. Diagnostics of the fit of the acoustic survey index at age 3 against the estimated spawning biomass. Top left, spawning biomass from the fitted populations (line), and predictions of spawning biomass in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of spawning biomass from the fitted populations and larvae survey index observations. Bottom, residuals, as ln(observed index) – ln(expected index) plotted against expected values and time.

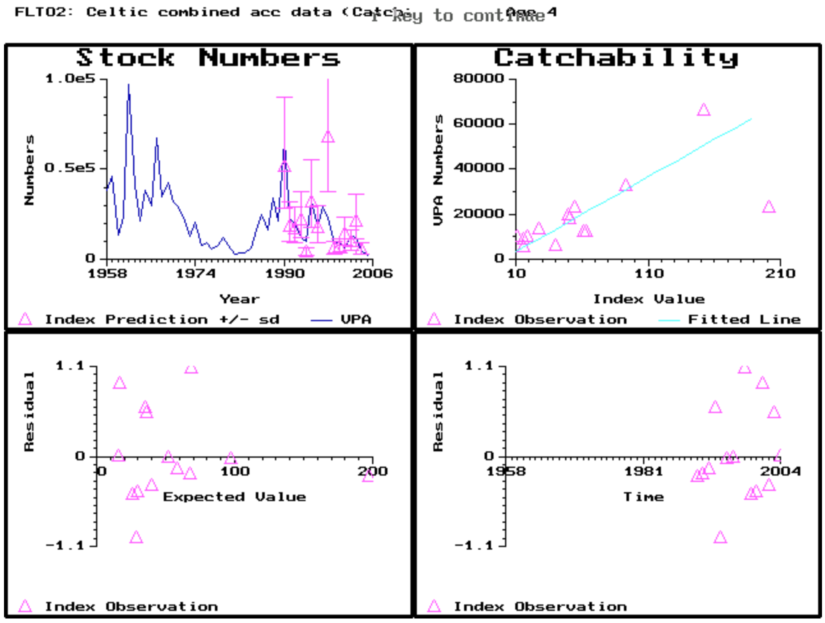


Figure 4.6.1.11 **Herring in the Celtic Sea and Division VIIj. Trial assessment using updated catch and survey data, results. Diagnostics of the fit of the acoustic survey index at age 4 against the estimated spawning biomass. Top left, spawning biomass from the fitted populations (line), and predictions of spawning biomass in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of spawning biomass from the fitted populations and larvae survey index observations. Bottom, residuals, as ln(observed index) – ln(expected index) plotted against expected values and time.**

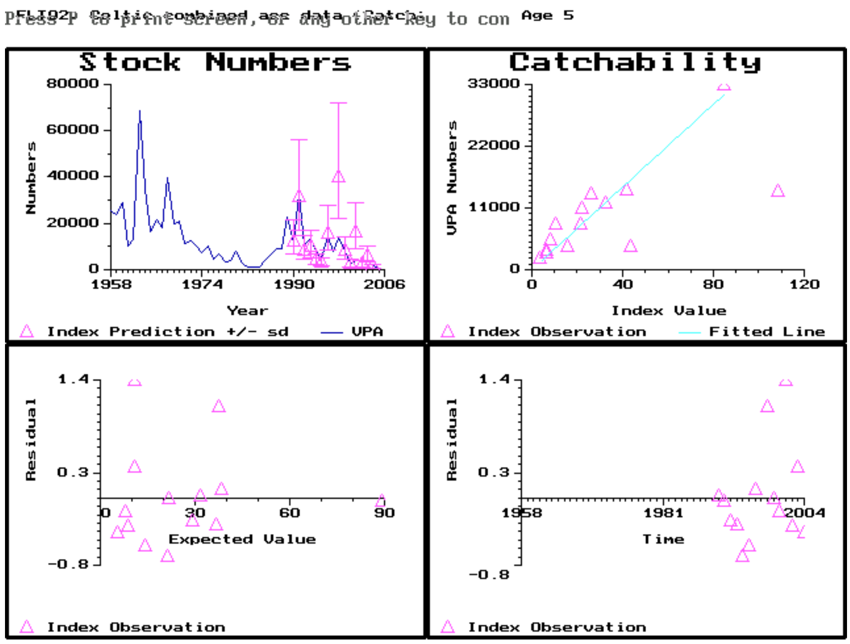


Figure 4.6.1.12 **Herring in the Celtic Sea and Division VIIj. Trial assessment using updated catch and survey data, results. Diagnostics of the fit of the acoustic survey index at age (rings) 5 against the estimated spawning biomass. Top left, spawning biomass from the fitted populations (line), and predictions of spawning biomass in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of spawning biomass from the fitted populations and larvae survey index observations. Bottom, residuals, as ln(observed index) – ln(expected index) plotted against expected values and time.**

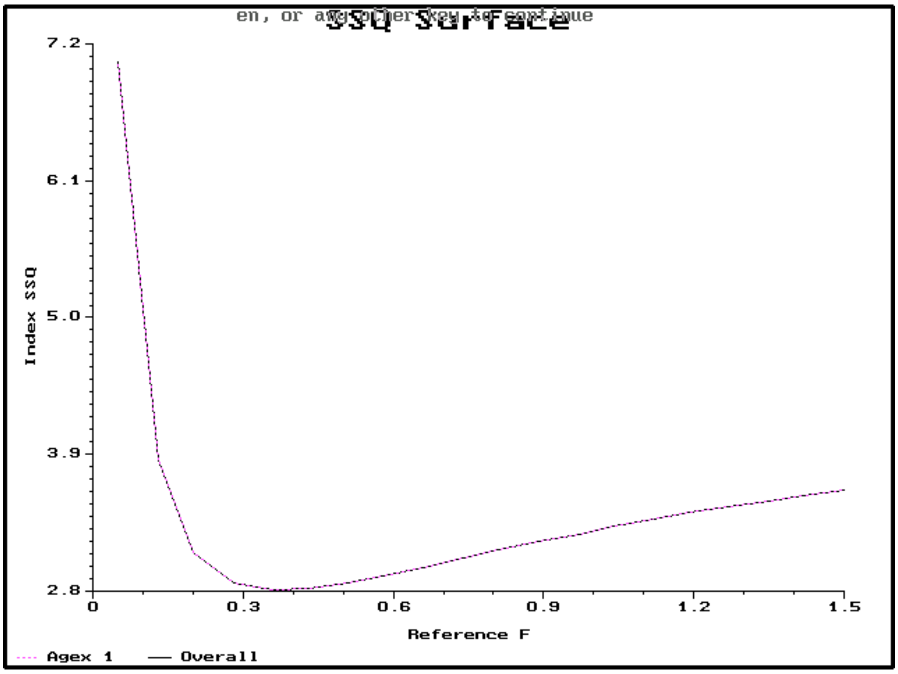


Figure 4.6.1.13 Herring in Celtic Sea and Division VIIj. Trial assessment using updated catch data, excluding the 2004 survey data. SSQ surface.

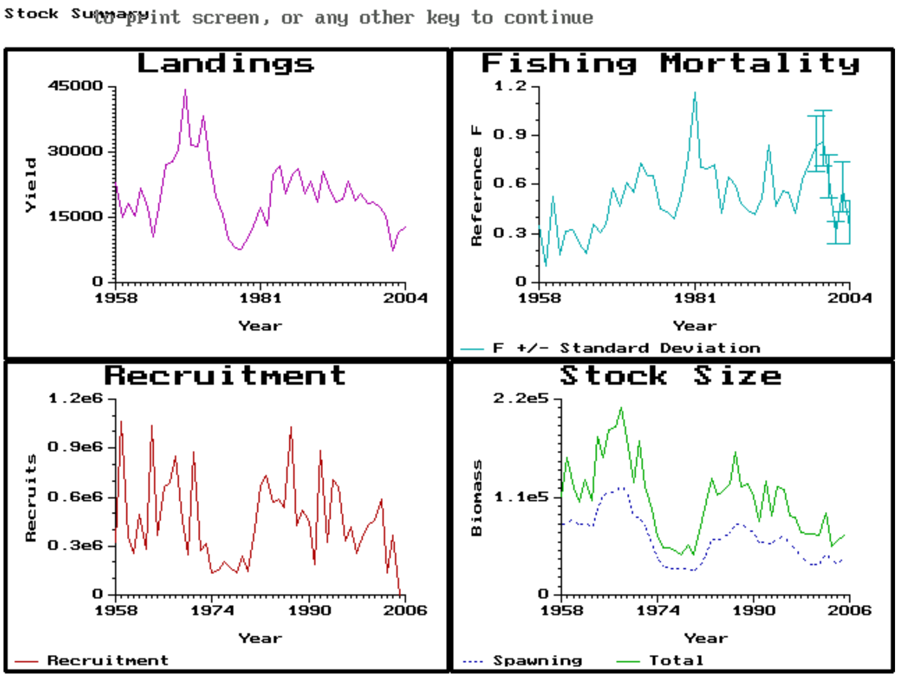


Figure 4.6.1.14. Herring in Celtic Sea and Division VIIj. Trial assessment using updated catch data, excluding the 2004 survey data. Summary of estimates of landings, fishing mortality-at-age 3, recruitment age 1, stock size on Jan. 1 and spawning stock size at spawning time. Note: age corresponds to winter rings.

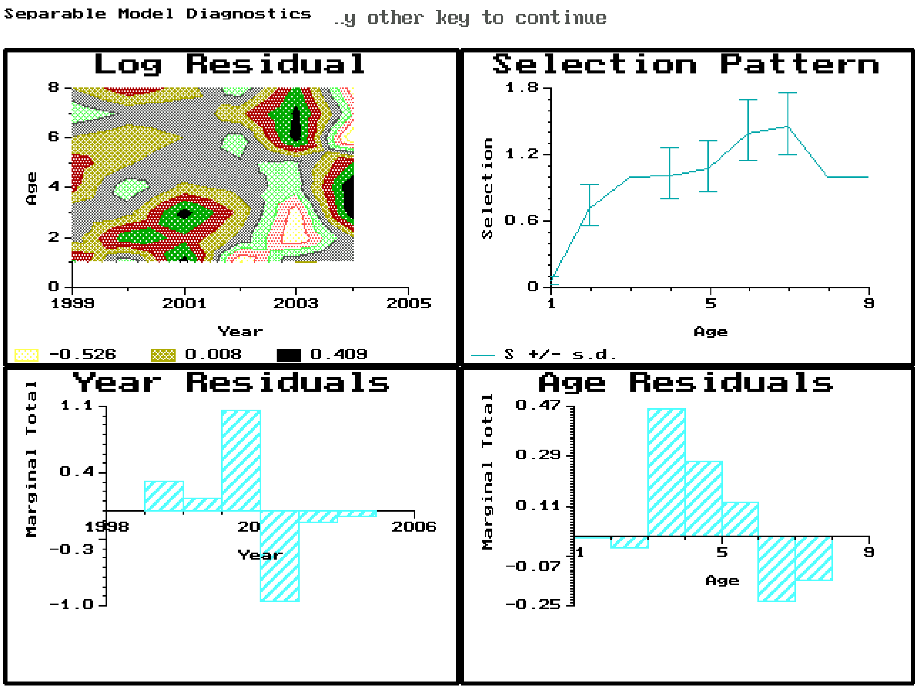


Figure 4.6.1.15. Herring in the Celtic Sea and Division VIIj. Trial assessment using updated catch data, excluding the 2004 survey data. Selection pattern diagnostics. Top left, contour plot of selection pattern residuals. Top right, estimated selection (relative to age 3) +/- standard deviation. Bottom, marginal totals of residuals by year and age (rings).

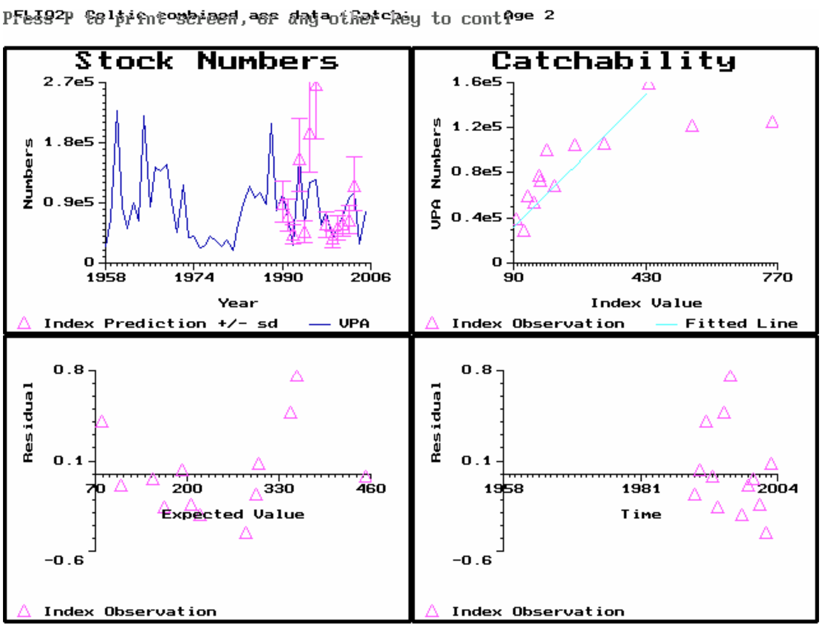


Figure 4.6.1.16. Herring in the Celtic Sea and Division VIIj. Trial assessment using updated catch data, excluding the 2004 survey data. Diagnostics of the fit of the acoustic survey index at age 2 against the estimated spawning biomass. Top left, spawning biomass from the fitted populations (line), and predictions of spawning biomass in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of spawning biomass from the fitted populations and larvae survey index observations. Bottom, residuals, as ln(observed index) – ln(expected index) plotted against expected values and time.marginal totals of residuals by year and age(rings).

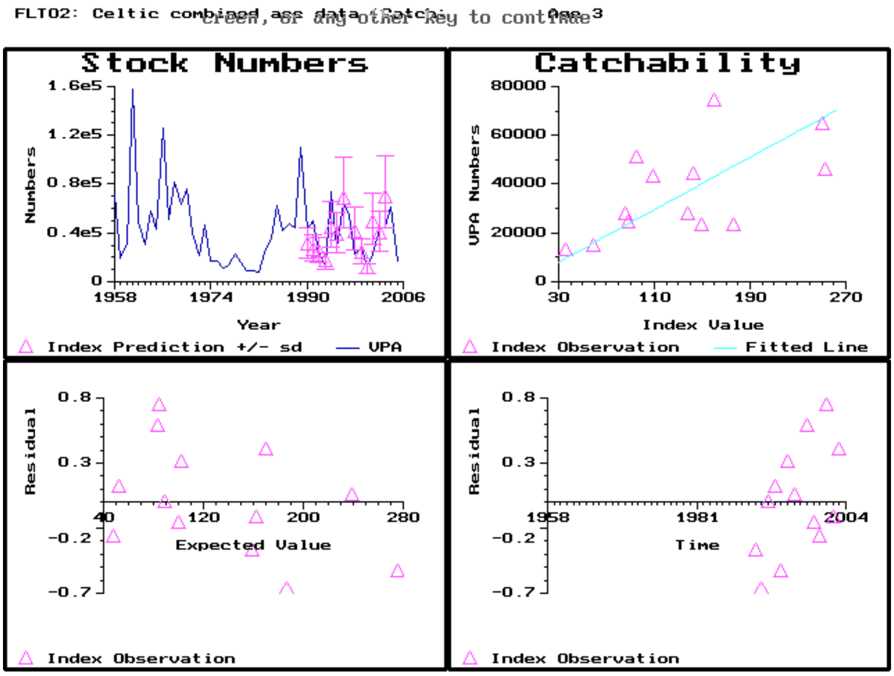


Figure 4.6.1.17 Herring in the Celtic Sea and Division VIIj. Trial assessment using updated catch data, excluding the 2004 survey data. Diagnostics of the fit of the acoustic survey index at age 3 against the estimated spawning biomass. Top left, spawning biomass from the fitted populations (line), and predictions of spawning biomass in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of spawning biomass from the fitted populations and larvae survey index observations. Bottom, residuals, as ln(observed index) – ln(expected index) plotted against expected values and time.

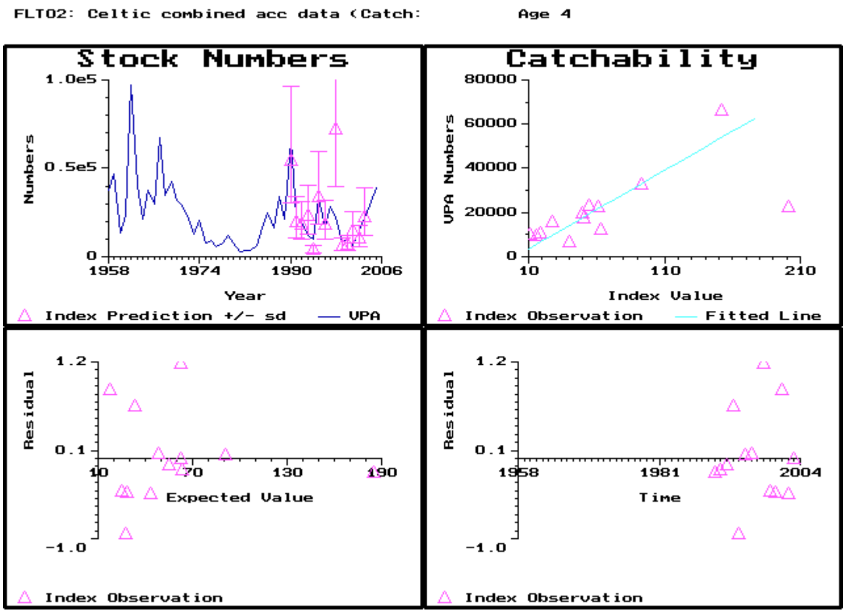


Figure 4.6.1.18. Herring in the Celtic Sea and Division VIIj. Trial assessment using updated catch data, excluding the 2004 survey data. Diagnostics of the fit of the acoustic survey index at age 4 against the estimated spawning biomass. Top left, spawning biomass from the fitted populations (line), and predictions of spawning biomass in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of spawning biomass from the fitted populations and larvae survey index observations. Bottom, residuals, as ln(observed index) – ln(expected index) plotted against expected values and time.

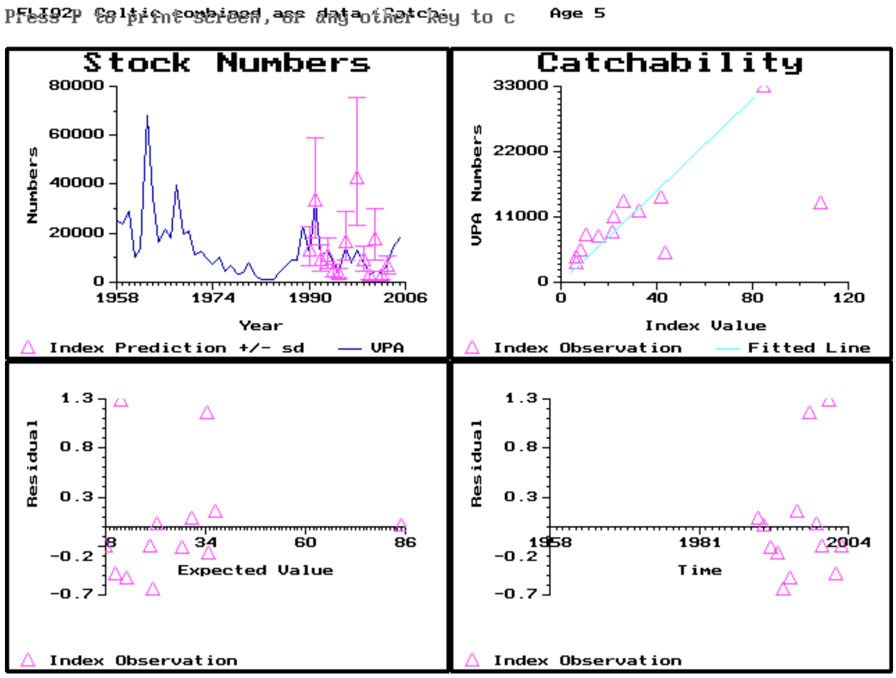


Figure 4.6.1.19. Herring in the Celtic Sea and Division VIIj. Trial assessment using updated catch data, excluding the 2004 survey data. Diagnostics of the fit of the acoustic survey index at age 5 against the estimated spawning biomass. Top left, spawning biomass from the fitted populations (line), and predictions of spawning biomass in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of spawning biomass from the fitted populations and larvae survey index observations. Bottom, residuals, as ln(observed index) – ln(expected index) plotted against expected values and time.

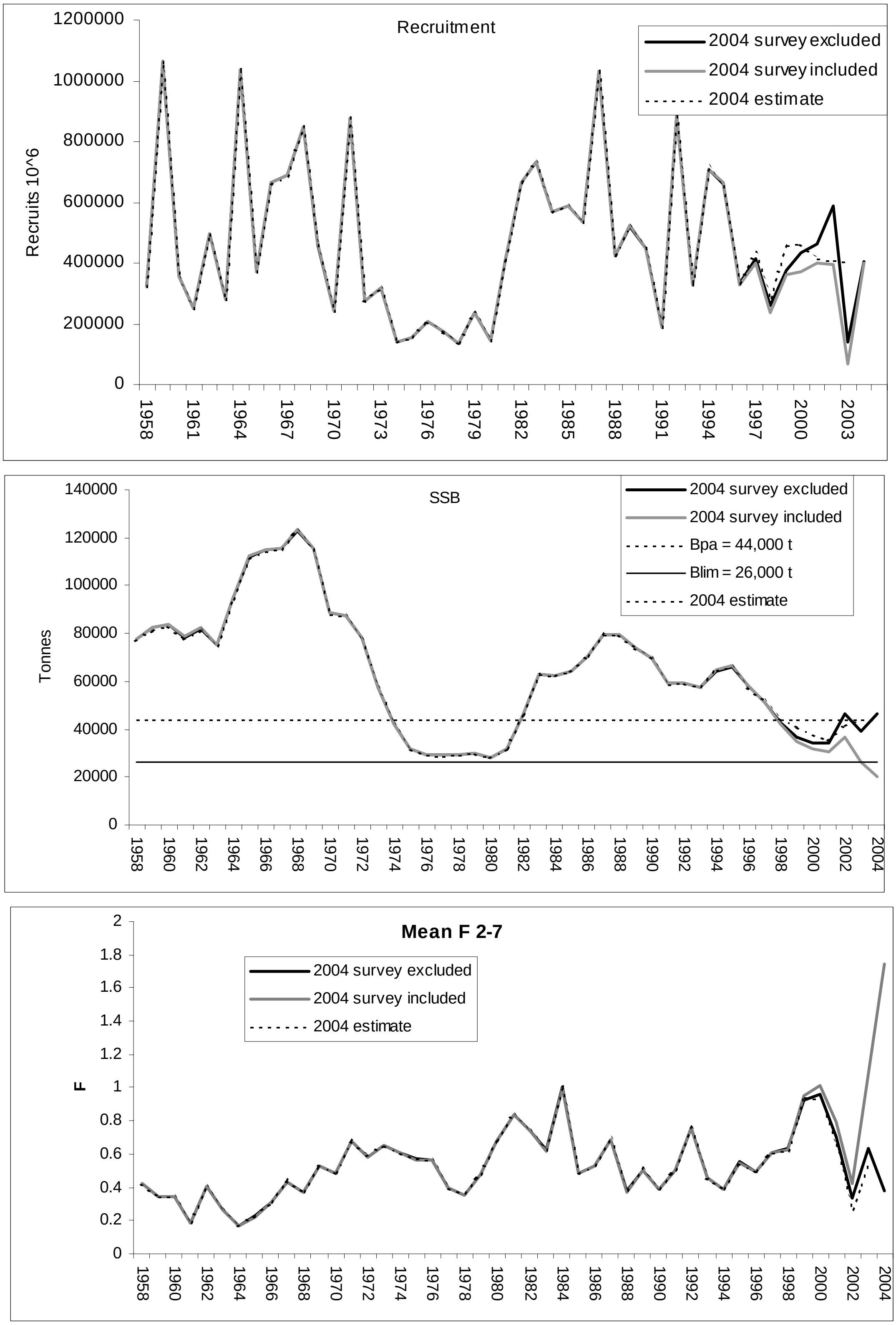
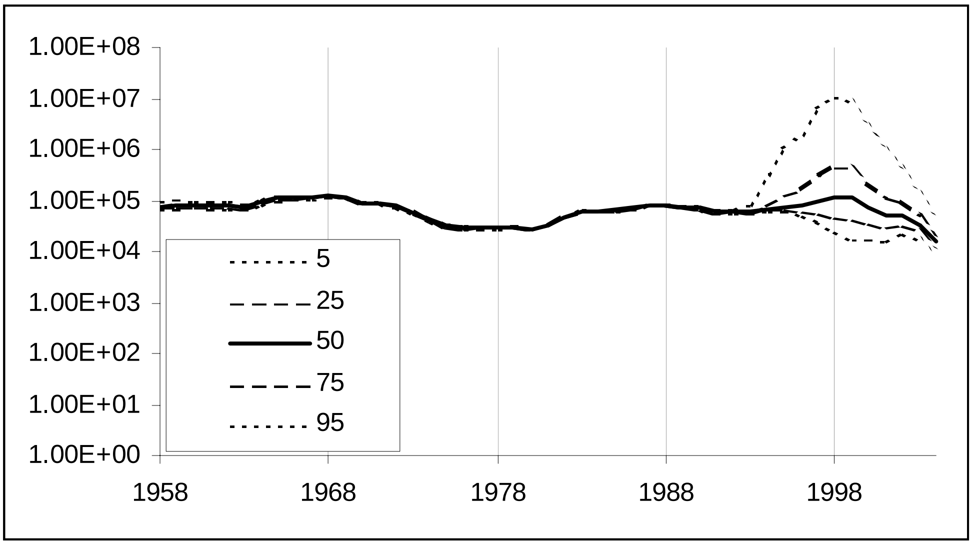


Figure 4.6.1.20 Celtic Sea and VIIj herring. Comparison of the two trial assessments conducted in 2005, along with the 2004 estimates



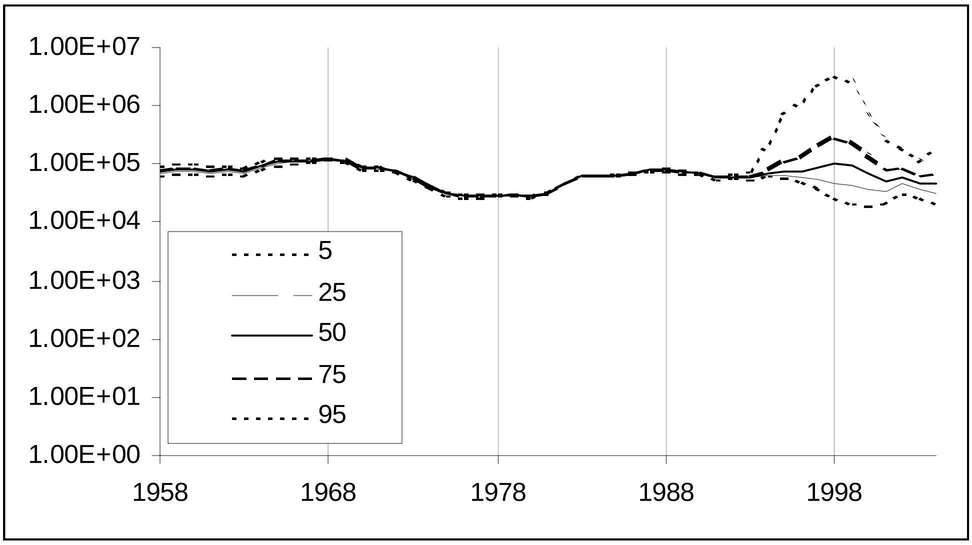


Figure 4.6.1.21 Celtic Sea and VIIj Herring. Uncertainty around estimates of SSB from the two trial assessments conducted by the HAWG in 2005. Based on 1,000 bootstrapped resampling of the model outputs and 5th, 25th, 50th, 75th and 95th percentiles. SSB presented on a logarithmic scale for ease of viewing.

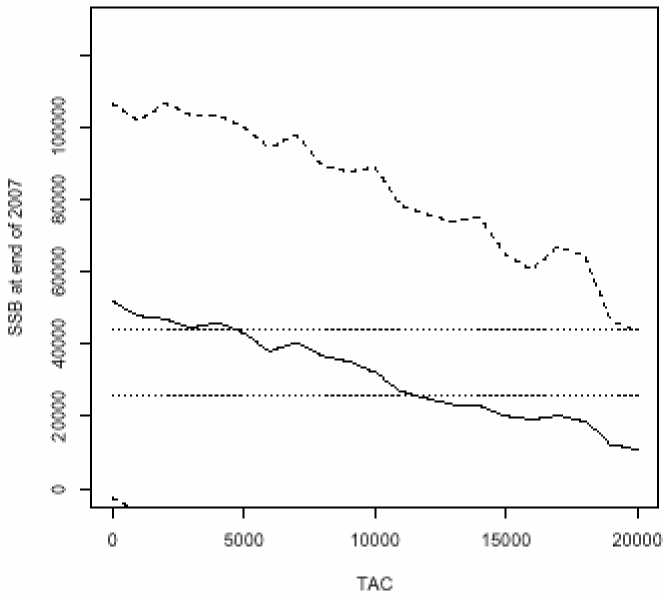


Figure 4.8.1. Celtic Sea and VIIj herring. Results of preliminary stock projection using FSSSPS. Projection of SSB to the end of 2007, under a variety of TAC levels.

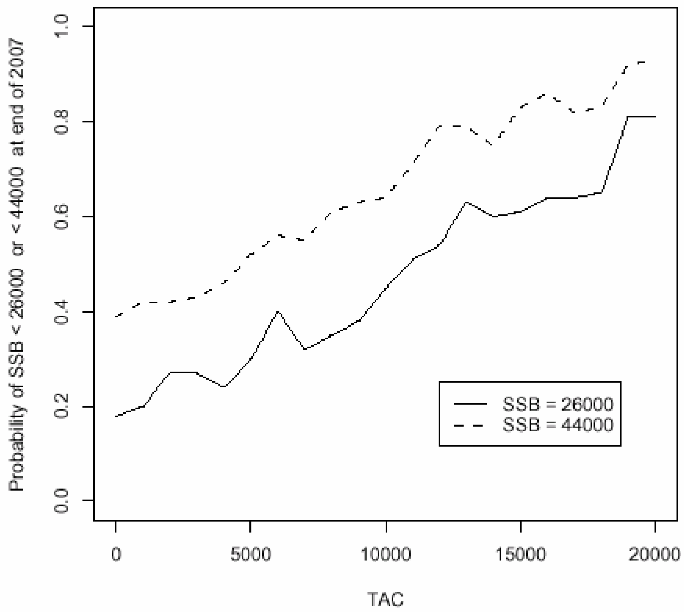


Figure 4.8.2. Celtic Sea and VIIj herring. Results of preliminary stock projection using FSSSPS. Probability that SSB at the end of 2007 being below Precautionary Approach reference points. B_{pa} = 44,000 t and B_{lim} = 26,000 t.

5 West of Scotland Herring

5.1 Division VIa (North) Advice and Fishery

5.1.1 ACFM Advice Applicable to 2004 and 2005

ACFM reported in 2004 that based on the most recent estimates of SSB, ICES classified the stock as having full reproductive capacity. The assessment showed a relatively stable SSB over the last three years, substantially higher than the previous ten years. Fishing mortality has stabilised at a low level. The 1998, 1999 and 2000 year classes are abundant. Current fishing mortality is at a level where the stock remains within PA bounds. Consequently, ACFM recommended that fishing mortality be maintained at *status quo* (=0.19), corresponding to catches in 2005 of 30,000 t.

The agreed TAC for 2005 is 30,100 t. The TAC in 2004 was 30,000 t.

There are no explicit management objectives for this stock. A $\mathbf{B}_{lim}$ of 50,000 t has been agreed by ACFM for this stock.

5.1.2 The VIa (North) Fishery

Historically, catches have been taken from this area by three fisheries.

i. A Scottish domestic pair trawl fleet and the Northern Irish fleet operated in shallower, coastal areas, principally fishing in the Minches and around the Island of Barra in the south; younger herring are found in these areas. This fleet has reduced in recent years.

ii. The Scottish single boat trawl and purse seine fleets, with refrigerated seawater tanks, targeting herring mostly in the northern North Sea, but also operated in the northern part of VIa (N). This fleet now operates mostly with trawls but many vessels can deploy either gear.

iii. An international freezer-trawler fishery has historically operated in deeper water near the shelf edge where older fish are distributed. These vessels are mostly registered in the Netherlands, Germany, France and England but most are Dutch owned.

In recent years the catch of these last two fleets has become more similar and has been dominated by younger adults resulting from increased recruitment into the stock.

In 2004, the Scottish trawl fleet fished both in areas similar to the freezer trawler fishery, and in the coastal areas in the southern part of VIa (N), unlike the previous year where the Scottish fleet tended to omit these costal areas.

As a result of perceived problems of area misreporting of catch from IVa into VIa (N), Scotland introduced a fishery regulation in 1997 with the aim to improve reporting accuracy. Under this regulation, Scottish vessels fishing for herring were required to hold a license either to fish in the North Sea or in the west of Scotland area (VIa (N)). Only one licensed option could be held at any one time. However in 2004, the requirement to carry only a single licence was rescinded. Area misreporting of catch taken in area IVa into area VIa (N) seems to have increased. In addition some herring caught during the 4th quarter mackerel fishery in VIa (N) was area misreported as IIa herring, presumably because the VIa (N) quota had been exhausted. It is possible that the relaxation of this single area licence has contributed to a resurgence in area misreporting. Reinstating this single area licence requirement should be considered as it appears to be helpful to management for this area.

5.1.3 Catches in 2004 and Allocation of Catches to Area for VIa (North)

In the past, fishery-independent information confirmed that large catches were being reported from areas with low abundances of fish, and informal information from the fishery and from other sources confirmed that most catches of fish recorded between 4°W and 5°W were most probably misreported North Sea catches. The WG considered that the serious problems with misreporting of catches from this stock, with many examples of vessels operating and landing herring catches distant from VIa (N) but reporting catches from that area, had been reducing in recent years, from some 30,000 t to around 5,000 t in 2002 and none reported in 2003, but there appears to be an increase in 2004, with over 6,000 t being area misreported (see section 5.1.2). The problem was detailed in the Herring Assessment WG report in 2002 (ICES 2002/ACFM:12). Reallocation information was obtained from only some of the fleets.

For 2004, the preliminary report of official catches corresponding to the VIa (N) herring stock unit total 29,854 t, compared with the TAC of 30,000 t. The Working Group's estimates of area misreported catches are 6,762 t. An additional 123 t of herring has been reported as discarded. At such a low level currently, discarding is not perceived to be a problem.

The Working Group’s best estimate of removals from the stock in 2004 is 23,092 t. Details of estimated national catches from 1983 to 2004 are given in Table 5.1.1.

5.2 Biological Composition of Commercial Catches in VIa(North)

Age composition data, by country and by quarter, are detailed in Table 5.2.1. The number of samples used to allocate an age-distribution for the VIa (N) catches has steadily decreased from 52 in 2002, 37 in 2003 down to 10 in 2004. This is due to two problems;

i. the difficulty of targeting sampling on vessels that fish in this area because these vessels fish in other herring areas and there may be no prior knowledge of the fishing intentions of the vessel before departure from port.
ii. the area misreporting recorded of catch taken in other in other areas and reported as VIa (N) can result in successfully collected samples being subsequently reallocated correctly to their true area thus loosing numbers of samples from the sampling program, see sections 5.1.2 and 5.1.3.

Samples were obtained from the Scottish and Netherlands fleets, these were used to allocate a mean age-structure (weighted by the sampled catch) to unsampled catches, in the same quarter, or in adjacent quarters if no samples were available in the corresponding quarter. If no sampling data were available for a quarter, a mean age-structure of all samples from adjacent quarters was used. The allocation of age structures to unsampled catches, and the calculation of total international catch-at-age and mean weight-at-age in the catches were made using the ‘sallocl’ programme (Patterson, 1998). While only a limited number of samples were obtained, these did come from the major fisheries by fleet area and season and are thought to be representative of the catches.

Catch in number-at-age information is given in Table 5.2.2. Several large yearclasses can be seen clearly at age 2 and older in the catch at age table; the 1995 yearclass age 8 in 2004 and the 1988 yearclass age 5 in 2004. No catch at age 1 ring was seen in any of the samples this year. Age 1 ring herring in the catch are variable and are rarely representative of yearclass strength and are down-weighted in the assessment, see section 5.6

In the past concern has been raised over the quality of sampling of commercial catch. It was suggested in the 2001 ACFM technical minutes that an analysis of catch by quarter and country might shed some light on the variability in the catch information. In practice the fishery is often dominated by a single quarter catch, and a single country dominates sampling. Thus such an analysis is impossible. In 2002 the Working Group conducted an extensive analysis of the sensitivity of the assessment to missing catch information (Section 5.1.12 in ICES 2002/ACFM:12). Although sampling is relatively poor the analysis indicated that sampling for age information was not the major source of variability in the assessment at that stage.

5.3 Fishery-independent Information in VIa(North)

5.3.1 Acoustic Survey

The 2003 acoustic survey was carried out from 6-25 July using a chartered commercial fishing vessel (MFV *Enterprise*). The total biomass estimate obtained was lower than in the previous year (396,000 t this year compared to 739,200 t in 2003 and 548,800 t in 2002), and is the similar to the 2001 value. Biomass estimated from the acoustic survey tends to be noisy and similar fluctuations have been observed in previous years. The distribution was generally more northerly than in previous years and while herring were found in areas similar to those in 2003, namely south of the Hebrides off Barra Head, west of the Hebrides and along the shelf edge the greater abundance was found in the North. Further details are available in the Report of the Planning Group for Herring Surveys (ICES 2005/G:04). Estimates of abundance by age and in aggregate spawning stock biomass for 2003 and for previous years are given in Table 5.3.1. The same large yearclasses seen in the catch can be seen clearly at age 2 and older in the acoustic survey table; the 1995 yearclass age 8 in 2004 and the 1988 yearclass age 5 in 2004.

5.4 Mean Weight-at-age and Maturity-at-age VIa(North)

5.4.1 Mean Weight-at-age

Weights-at-age in the catches and weights-at-age in the stock from acoustic surveys are given in Table 5.4.1. The weights-at-age in the stock appear to be near or at the long term low. This contrasts with last years weights which were only slightly lower than the long-term mean across the rest of the age range. It’s unclear from the data if this is a trend or just measurement error. Further investigations of mean weights from this area is required for the future.

5.4.2 Maturity Ogive

The maturity ogive is obtained from the acoustic survey and collated in Table 5.4.2 for the period 1992 to 2004.

In 2004, maturity for age 2 wr herring is higher than in 2003. This is in contrast to the mean weights at age, which are lower. In the North Sea there is some evidence for a direct relationship between proportion mature at age and growth. This type of relationship is currently not seen in the data for VIa (N).

5.5 Recruitment VIa(North)

There are no specific recruitment indices for this stock. Although both catch and acoustic survey have catches-at-age 1-ring both the fishery and survey encounter this age only incidentally. The first reliable appearance of a cohort appears at 2-ring in both the catch and the stock. Thus in predictions, estimates of both 1- and 2-ring herring numbers from the assessment need to be replaced for prediction years.

5.6 Stock Assessment VIa(North)

5.6.1 Data Exploration and Preliminary Modelling

As last year, an exploratory assessment of the stock was carried out by fitting an integrated catch-at-age model (ICA version 1.4w described in the methods section in the 2003 Working

Group report (ICES 2003/ACFM:17, Section 1.6.1)). An age-structured index was available from the acoustic survey from 1987, 1991-1996 and 1998-2004 (Section 5.3.1).

In 2004 a selection pattern of 8 years 1996-2003 was used, this length of period was found to be sufficiently long to smooth out noise in the data. ICA was then run for the available time-series, 1957-2004, to compare the model fit for this year with the 2004 working Group assessment.

The residual patterns for the two runs are very similar (Figure 5.6.1). The magnitude and location of residuals shown in the bubble plots are consistent and the year residuals follow the same pattern shifted by one year. The age residuals are more different, with a relatively larger value for 4-ringers this year. However, the age residuals values are small and there are no trends with age.

The selection pattern for the 2005assessment is essentially identical to the two previous years (Figure 5.6.2). It was concluded that as ACFM recommended an update assessment was appropriate for this stock.

5.6.2 Stock Assessment

This is an update assessment using the same settings as in 2004, with the 8 year separable period moved forward one year from 1995-2003 to 1996 to 2004.

Assessment of the stock was carried out by fitting an integrated catch-at-age model (ICA version 1.4w). The model settings are the same as for 2003 and 2004. The run log for the assessment is shown in Table 5.6.1. The catch and survey data were down-weighted for 1-ring herring (see the 2001 Working Group assessment report (ICES 2001/ACFM:12)). The input data are given in Tables 5.6.2 to 5.6.8. The output data are given in Tables 5.6.9 to 5.6.18. The assessment results in an SSB for 2004 of 124,000 t and a mean fishing mortality (3-6 ringers) of 0.17 (Table 5.6.14). The model diagnostics (Tables 5.6.13 to 5.6.18 and Figures 5.6.3 to 5.6.14) show that the total residuals by age and year between the catch and the separable model are reasonably trend-free and small. The acoustic survey age and year residuals patterns are trend-free. The acoustic survey residuals are of similar magnitude to the catch model residuals but show more evidence of year effects. This year’s estimate of SSB in 2003 (155,000 t) shows a small decrease in biomass from last year’s estimate (162,000 t). The large 1998 yearclass is still seen as a peak in numbers of 5-ringers in 2004 in the assessment the catch and acoustic survey data. The 2000 year class is abundant as 3-ringers in the acoustic survey. The 2001 yearclass is seen to be small in both the survey and the catch data. Initial indications of the 2002 yearclass are that it is not small, but the data available to estimate this is rather poor.

The assessment is consistent with last year assessment and shows a drop in SSB, though the stock is still substantially higher than during the period 1997 to 2000. Fishing mortality has stabilised at a low level.

Figure 5.6.15 shows the trajectories of 5, 25, 50, 75 and 95 percentiles from the estimates of historical uncertainty of F, SSB and recruits produced in the final assessment. These are based on 1000 bootstrapped samples of residuals. Uncertainty in the 2004 Working Group assessment is comparable to that in the 2003 Working Group assessment. In 2003 uncertainty was found to be considerably reduced from previous years (ICES 2003/ACFM:17), reflecting the stability of the input data over the final two or three years to that date. The greatest uncertainty in F is in 1997/98 when catch data were poorly sampled due to area misreporting. This year area misreporting has increased again, see section 5.2. and only 10 samples of catch at age were obtained, suggesting that the catch might be poorly evaluated. However, the stability of the selection pattern seen in the assessment suggests that the poor sampling may not have had a bad affect on the assessment. Figure 5.6.16 shows the same uncertainty data for the terminal year plotted as F against SSB.

5.7 Harvest Control rule options for the management of VIa (north) herring

The review and development of medium term management options for VIa herring has been carried out following the structure contained in the SGMAS report (ICES 2005). The review concentrates on management options for medium term exploitation of herring in this area and considers in detail the implications of the productivity of the stock, or more explicitly the possible range of stock relationships and their influence on management choices.

A.a Broad objectives

There are no explicit management objectives for this stock but the implied objectives are to obtain maximum stable yield within the precautionary approach.

A.b Operational Objectives

The operational objectives are to keep the stock above B_{lim}, which is currently estimated to be 50,000 t (see section 5.8). Yield requirements include consideration of year-to-year stability and maximising long term yield.

B. Conformity of a HCR to the management strategy

The stock is currently managed with a TAC. It is thought that this type of management, backed up with enforcement is applicable for this fishery.

An HCR with an F target and year on year restrictions on changing TAC would therefore be an appropriate choice of HCR.

The current assessment provides a reasonable basis for evaluation of an HCR.

The stock was depleted in the 70s and has never recovered to the SSB seen in the 1960s. The stock recruit relationship observed in recent years may be different from the one describing the full time-series. For management there is a need to consider if there is a requirement to allow the possibility that the stock will recover to biomass levels seen in the 60s. If this option is selected as a management objective, this will then require selection of a long term F that will allow this to happen. In this context an explicit biomass target for the stock may not be appropriate because the biomass levels seen in the early 60s may be unachievable. In addition to this criteria, management should be based on currently observed levels of recruitment and annual growth.

TAC implementation and management control in for this stock is variable, the main problem is area misreporting of catch in such a way that catches have often been less that the TAC and rarely more. Discarding in the herring fishery is low through some discarding of herring may occur in the mackerel fishery in the same area and there may be some high grading in the freezer trawler fleets.

C. HCR simulation parameterisation

C.a Biological operating model

The simulation was carried out using STPR3 and S3S (Skagen 2004) as a simulation program. The chosen model consists of three stages.

1. Depleted stage with fixed F (F1) less than or equal to intermediate F for biomass below Blim of 50,000 t.

2. Intermediate stage with a fixed intermediate F (F2) when the biomass is above Blim but below Btrig (B2)
3. Long term stage long term F (F3) above a biomass trigger (B2)

This may collapsed to two stages if F1 and F2 are equal (combining stages 2 and 3). The rule may be modified with an option of a year on year constraint on the change in TAC.

C.a.a Selection of Stock / Recruitment relationship.

Data on the state of stock is available from 1957 to 2004, the recruitment in the last 4 years is still uncertain so has been omitted from the study. The stock experienced heavy fishing in the 1960's and the fishery was closed in 1979 / 1980. The SSB during the period 1957 to 1975 is greater in every year than the SSB during the subsequent period 1976 to 2000. This could be due to a number of possibilities

- reduced productivity in the area,
- the average fishing mortality at mean F = 0.35 is too high to allow recovery.
- The stock depletion removed some important component of the stock.
- Area closure of 50% of the spawning grounds may have caused excess pressure on the remaining 50%

The stock (SSB) and recruitment data are plotted together with fitted models for the period 1976 onwards and for the complete period in Figures 5.7.1 and 5.7.2 respectively. The parameters of the fitted stock recruit relationships are given in Table 5.7.1.

Within each data period, the different models (Figures 5.7.1 and 5.7.2) do not give major differences in perception of the stock. Though there are considerable differences between the stock recruit relationships depending on whether the whole period is considered to be representative of the current situation (statistically / biological stationarity) or if the recent period is regarded as different. The model that fits best in both periods is the Shepherd, as the AIC value is lowest in both cases, implying the increase of parameters is helpful in functionally describing the observed recruitment data. In addition to the low Akaike Information Criteria (AIC) the pattern of residuals around the Shepherd model is perhaps slightly better behaved than for the other models (see Figure 5.7.3 and 5.7.4) but the difference is small. There is however, a biological problem with concluding that the Shepherd reflects the truncated series correctly as this implies reduced recruitment at higher biomass. We know from the longer time-series that increased recruitment at higher biomass has been observed. In order to model the short time period both Shepherd and Change Point models have been used in management exploration. The latter model is preferred as it gives recruitment that does not decrease at higher biomass, and may thus be regarded as compromise option between the Shepherd model for long and truncated data series.

For the simulated recruitment Figures 5.7.5 to 5.7.7 show the comparison of the simulated probability density functions (pdfs) expressed as a cumulative probability distributions and observed recruitment. In all three cases the simulated pdfs area a reasonable representation of the observed recruitment.

C.a.b Natural mortality;

Natural mortality used in the assessment is taken from the assessment of North Sea herring, the adjacent area. This is based on MSVPA run for the North Sea. (Table 5.6.5)

C.a.c Growth;

Growth is obtained as observed weights at age from annual acoustic surveys of the area and is available as individual estimates of growth for each year since 1991and is used as a stochastic variable in the simulation, taking each year as a single set of observations. (Table 5.6.4)

C.a.d Maturity;

Maturity is obtained from annual acoustic surveys of the area and is available as individual estimates of fraction adult for each year since 1991and is used as a stochastic variable in the simulation, taking each year as a single set of observations. (Table 5.6.6).

Maturity and weights at age are selected as an annual set from the same year in the stochastic simulations. So while cohort dependent growth is not fully simulated correlations between weight at age an maturity are included in the simulation.

C.a.e Other issues;

There are no other major issues included in the simulation. There are no major multi-species interactions. There has been some limited spatial restrictions with a spawning area closure, however, it has not been possible to show any benefit to the stock and the extent to which this restriction has actually been operational is unknown. There are no density or growth dependent effects observed with this stock. With the exception of weights and maturities all the variables are treated as independent without correlation or auto-correlation.

C.b The fishery

The fishery is a mostly a directed pelagic trawling fishery which is currently dominated by two fleets of trawlers. There is occasional discard or slippage of herring and limited high grading. Some herring are caught as a by-catch within a seasonal mackerel fishery and either landed or discarded depending on availability of quota. Some of the VIa north herring quota is taken in adjacent areas and misreported as VIa north herring. This aspect has been limited by the use of single area licence restrictions. This was relaxed last year but continuation of this measure is thought to be helpful and is under consideration. The selection pattern for the fishery has been stable for the last 3 years (Figure 5.6.2) and is taken from the ICA assessment (Table 5.6.15).

C.c Representation of the knowledge and decision process in the simulation

The general error levels in measurement and implementation bias and variability are included. However, not all the elements for management are fully included, for example there is no feedback between implementation and implementation error.

C.c.a Observation error on biological parameters

Observation error on growth and maturity is included and characterised as part of the stochastic variability seen in the observed data.

C.c.b Assessment error

Assessment as a source of observation error is implemented as SD of 30% and a bias of 10%, these values are very slightly larger than the observed values taken from the ICES quality control sheets for the period 1995 to 2003.

C.c.c Advice and decision making.

No systematic implementation error is included in the simulation, although there is some evidence for over-reporting of catch due to area-misreporting. However, including systematic under utilisation of quota that cannot be guaranteed into the future is not thought to be applicable. In 2003 implementation of regulations seemed to be reasonably effective, and last years deterioration may have been due to relaxation of regulations. To model some level of implementation error a 10% stochastic variable is used for implementation to reflect the uncertainty in implementation. This may slightly exceed observed variability but may be used to account for some area misreporting.

D Management measures

Management measures currently consist of, a TAC regime and a spawning seasonal closure covering approximately 50% of the spawning area. As this is a largely directed pelagic fishery with a only a small amount of discarding and by-catch a TAC is an appropriate method of setting limits for catch. Only the TAC is simulated.

E The robustness of the management evaluation

The current assessment method is ICA tuned with a single acoustic survey. The assessment is rather noisy, and precision and bias in the assessment has been taken into account in two ways.

i. The current state of the stock is used as a starting point using variance covariance matrix obtained from ICA. As indicated above the historic time-series of assessments suggests that a precision of 30% is appropriate.
ii. The method has been checked for sensitivity to the precision of the estimation by using other error levels (20% and 40%) and although, the level of risk is sensitive to this no major differences occur.

Sensitivity of the HCR to assessment bias has been examined by using different values, the current bias of 10% slightly over estimates the values observed from about 8 years ago. The assessment bias was more severe in the earlier years (1994-1997) but has been less severe after this (1998-2000). It is possible that the stability of the bias is dependent on stock and regulations applied but there is insufficient data to establish this.

Sensitivity to management failure is considered through examination of recent implementation. Current management is through a role-over TAC and there has been little change in recent years. Implementation failure has been associated with under shooting the TAC through area misreporting rather than over exploitation. Any undeclared landings that are occurring are not included in the data and the simulations assume these will be stable. There are area restrictions due to a spawning season closure but they may not be fully effective and the stock has shown no signs of benefiting from the closure. Stock productivity was higher before the closure was implemented.

F Results

The sensitivity of the HCR to the S/R relationship is the critical aspect of management for this area. Figure 5.7.8, 5.7.9 and 5.7.10 summarise the range of possible yield and risk for different values of long term F from 0.2 to 0.6. Included in this set of evaluations is a full range of values of intermediate and depleted F (F1 and F2), trigger biomass (B2) and year on year constraint on TAC. The colour of the symbol indicates the risk of SSB falling below Blim. Risk is dealt with in 5 classes, 0-1%, 1-2.5%, 2.5-5%, 5 to 10% and >10% risk if SSB falling below Blim at least once in the 10 years of the simulation. For clarity the strategies with risk less than 5% are shown separately in the lower panel of each figure. It is not intended that these plots are examined in detail, it is the broad areas of colour that indicate the main possibilities.

The maximum achievable median yield for each long term F (F3) with a risk less than 5% are given separately for each stock recruit relationship in Figure 5.7.11 to show how the different stock recruitment relationships affect the results. The difference between the two models for the truncated period (1976 to 2000) is small, it is difficult to say which of these models is correct, though there is a small statistical preference for selecting the Shepherd model over the change-point model. However, the Shepherd model implies reduced recruitment at an SSB 150,000 t. This is in contrast to the longer time-series which gives a model delivering elevated recruitment at these SSBs. The Change Point model which gives no reduction in recruitment at higher biomass is therefore preferred though not on statistical grounds.

The implications for management of the long series is illustrated in two ways.

i. Figure 5.7.12 illustrates that all three S/R models explain the current state of the stock quite well. Using historic exploitation: at F = 0.355 with a standard deviation of 0.248. This conforms to the observed conditions for the last 30 years. As can be seen from this figure exploitation in this way delivers a stock at a level close the current SSB. This supports the view that the current state of the stock does not preclude the longer series model being appropriate.

ii. The development of median yield and SSB and median recruitment and SSB are shown in figure 5.7.13a and b respectively for different values of long term F from 0.2 to 0.4. From this it can be seen that the most probable direction for the development of the stock depends on whether F long term is above or below 0.35

The value of long term F 0.35, which is to be used as guidance, should not be regarded as a precise value that can be used as an exact management target but rather as a general indication of where this change in exploitation occurs.

Example Selection of HCR.

1) Potential increase in biomass and yield from a large stock is to be allowed. F long term selected as 3.0 or below. Table 4.7.2 indicates that F=0.3 gives rather low potential increase, a reduction of F to 0.25 gives approximately 1,000 t reduction in catch but a much higher potential increase in SSB. A further reduction to F=0.2 with 2,000 t reduction seems to great. So long term F is chosen to be F=0.25. Some reduction is required in the even for stock decline so F2 is selected as F=0.2

2) Figure 5.7.2 panel b illustrates the trade off between yield, year-on-year given the choice from (1) above F3 = 0.25 an F2=0.2. The risk of SSB falling below Blim in the options illustrated in this panel is always under 1% so all options may be judged precautionary. Maximum yield is seen to occur at two locations on the panel, at

   a. B2 = 75,000 t and catch constraint (CC) of 1,000 t.

   b. B2 = 120,000 t and CC= 2,000t.

At first sight this may seem unusual that there are two maxima, but point (b) occurs with the HCR often giving SSB in stage 2 of the rule and thus F=0.2 where as point (a) is mostly in stage 3. If minimum year-on-year change in TAC is an objective then point (a) gives the maximum yield. Point (a) seems to be the best solution. The chosen HCR becomes:-

F=0.25	if SSB > 0.75,000 t year.	TAC changes by less than 1000 t each
F=0.2	if SSB < 0.75,000t	No constraint on TAC.

G Conclusions

There is one major management option to be considered first. Should management choose a strategy that has some reasonable probability for the stock to expand to the levels observed in the 70s? Exploitation at an F of over 0.35 is thought to have a higher probability of keeping the stock at its current lower level or causing it to decline. Exploitation at F 0.3 or lower is thought have an increased probability of allowing expansion of the stock. So exploitation below this level at say F = 0.25 is recommended if it is considered important to allow the stock to increase. If for biological reasons expansion of the stock is currently not possible then this choice of F<0.3 delivers a yield that is a little reduced from the maximum. Reduction of F below 0.25 would probably produce even lower yields.

Having already selected the long term F (F3) Figure 5.7.14 illustrated the choice among other parameters in the HCR. These panels show yield, risk, and the range in change in TAC for different values of B trigger (B2) and year on year constraint on change in TAC. This figure needs to be considered only after the decision to exploit above or below F=0.35 has already been taken. The main features of these options are summarised in Table 5.7.2 The Following text box contains an evaluation of the choice of HCR parameter for panel a in Figure 5.7.2.

The WG considers that these simulations provide a good basis for managers to decide on the basic form of a HCR for VIa (N) herring. However, experience with the North Sea suggest that rules that use constraints on year-on-year change in TAC need more detailed evaluation than is provided here. In particular the influence of correlation in recruitment should be investigated further. Managers can use this study to decide on the main elements of the HCR they require such as the most suitable long term F. If there is a wish to have a year-on-year constraint on change in the TAC then the chosen scenario can be evaluated in more detail to ensure it is robust.

H Additional information

The study carried out here has examined assessment precision from 20% to 40% and bias of 0, 10% and 20%, though the results shown here are only for 30% precision and 10% bias. In these simulations implementation error was constrained to be within a 10% SD. Currently the TAC is often not fully taken but should management fail to keep catches in line with the TAC, this suggested HCR may need to be re-examined.

Natural Mortality has been assumed to be known and stable.

Recruitment simulations do not include significant autocorrelation, excluding that resulting from the relationship it's self.

The choices here depend very much on a rather uncertain S/R relationship. Research on the validity of this relationship would be helpful. If the stock continues to provide reduced recruitment at SSBs above 120,000 t the S/R relationship and HCR should be re-evaluated.

Its is suggested that the situation should be reviewed approximately every 5 years.

5.8 Projections

5.8.1 Deterministic short-term projections

Two scenarios for deterministic short-term projections are presented: *status quo* F for 2005 and TAC constraint for 2005. The status quo option is consistent with both the current fishery which did not take the TAC in 2004.

Short-term projections were carried out using MFDP. Input data are stock numbers on 1st January in 2005 from the 2005 ICA assessment (Section 5.6, Table 5.6.11), with geometric mean replacing recruitment at 1- and 2-ring in 2005 and 1-ring in 2004. The retrospective assessment of recruitment in the 2003 Working Group (ICES 2003/ACFM:17) showed the substantial revision of 1- and 2-ring herring abundance in subsequent assessments, justifying the use of geometric means for these ages. The selection pattern used is as estimated by ICA (Table 5.6.13). For the projections, data for maturity, natural mortality, mean weights-at-age in the catch and in the stock are means of the three previous years (i.e., 2002 - 2004) (Table 5.8.1.1). Two examples have been run F *status quo* and a second option with TAC constraint. The results of short-term projection is shown in the text table below, illustrating that at *status quo* F catches can be expected to be stable at around 25,000 t.

SCENARIO	2005	2006	2007
1 – *status quo* F	F_{2005}= F_{2004} = 0.19 *Status quo* F Catch = 25,057 t	F_{2006}= F_{2004} = 0.19 *Status quo* F Catch = 26,417 t	F_{2007}= F_{2004} = 0.19 *Status quo* F Catch = 25,988 t SSB = 148,000 t
TAC Constraint	F_{2005} = 0.2271 *TAC* Catch = 30,100 t	F_{2005}= F_{2003} = 0.19 *Status quo* F Catch = 25,600 t	F_{2006}= F_{2003} = 0.19 *Status quo* F Catch = 25,382 t SSB = 145,000 t

The results of the F *status quo* short-term projections can be seen in Tables 5.8.1.2 – 5.8.1.3. Table 5.8.1.2 shows single option predictions for 2006 and 2007. Table 5.8.1.3 shows the multiple options for 2006. SSB rises from approximately 137,000 t in 2005 to 148,000 t in 2007. The results of the TAC constraint for 2005 short-term projections can be seen in Tables 5.8.1.4 – 5.8.1.4. SSB rises from approximately 133,000 t in 2005 to 145,000 t in 2007.

5.8.2 Yield-per-recruit

A yield-per-recruit analysis was carried out using MFYPR to provide a yield-per-recruit plot for VIa (N) (Figure 5.8.2.1) the values for $\mathbf{F}_{0.1}$ and $\mathbf{F}_{med}$ are 0.16 and 0.27 respectively. These may be compared with the current F (2004 assessment) of 0.19.

5.8.3 Stochastic medium-term projections

Four sets of medium-term projections were carried out on the basis of four selected HCRs evaluated in section 5.7. The main settings are summarised in the table below.

	LONG TERM F (F3)	INTERMEDIATE F (F2)	DEPLETED F (F1)	TRIGGER BIOMASS (B2)	YEAR-ON-YEAR TAC CONSTRAINT
Scenario 1	0.2	0.2	0.2	Not relevant	2,000 t
Scenario 2	0.25	0.2	0.2	75,000	1,000
Scenario 3	0.3	0.25	0.2	120,000	1,000
Scenario 4	0.35	0.25	0.2	105,000	2,000

The method for simulation used is the same as the method described in Section 5.7. The starting numbers in 2005 are taken from the last column of Table 5.6.11 substituting arithmetic mean recruitment at age 1 (1.021 million) and age 2 (388,200) obtained from the period 1976 to 2002. Arithmetic mean values are used here in preference to geometric means used in the short term predictions because the arithmetic mean combined with the stochastic variability gives the correct projections. Weights-at-age catch (Table 5.6.3), and the stock (Table 5.6.4) and maturity at age (Table 5.6.6) were taken stochastically from the observed values from 1991 onwards. Natural Mortality was taken as fixed (Table 5.6.5). The stock-recruit relationship used in the medium-term projection was the Change Point option with simulated recruitment as shown in Figure 5.7.5.

The results of the stochastic medium-term projection are given in Figure 5.8.3.1-4. Scenarios 1 and 2 give a rise in SSB to levels where the stock might expand further if the conditions match those seen in the 1950s and 60s. Scenario 3 shows a small decline and Scenario 4 shows a decline in SSB to levels where further expansion is unlikely

5.9 Reference Points

Only the Blim (at 50,000 t) is defined and agreed reference point for VIa (N) herring. Previously some difficulties were encountered obtaining plausible Flim, Bpa and Fpa values for this stock. The use of HCR simulations presented in Section 5.7 only requires the definition of Blim. The reference point table from ACFM report May 2004 is given below for information.

Reference points – Precautionary Approach points defined in 2004

$\mathbf{B}_{lim}$ is considered to be defined at 50 000 t	$\mathbf{B}_{pa}$ was proposed as 75 000 t
$\mathbf{F}_{lim}$ not defined	$\mathbf{F}_{pa}$ not defined

5.10 Quality of the assessment

The 2002 and 2003 Working Groups inspected a number of possible sources of model uncertainty, including sensitivity to choice of length of separable period and sensitivity to a small number of isolated large cohort estimates in the acoustic survey. They suggested that despite the large noise in the signals, the assessment was consistent and credible, although the choice of the length of the separable period was an important consideration in maintaining consistency. There appears to be much greater stability in the assessment compared to 5-7 years ago and the assumptions used in the ICA model are credible and consistent with the information given in the catch and biological data.

In the late 1990s there was concern about the retrospective error in the assessment, in particular sensitivity to poor sampling of catch. For the 2005 assessment the number of samples used to allocate an age-distribution for the VIa (N) catches has decreased from 52 in 2002 to 10 in 2004. Although this is a rather small number of samples they came from the major fisheries by fleet area and season and are thought to be representative of the catches. This is confirmed by the similarity in selection pattern and residual pattern seen in this years assessment and compared with last years (see section 5.6). Whereas the assessments in current years appears to be more stable, a low level of sampling in coming years could result in problems with the consistency of the model in the near future.

Under- or overestimation of the catches due to area misreporting implies bias on the estimation of stock status, since the stock size is estimated using these catches. Misreporting decreased from 30,000t the mid 1990s to 5,000t in 2002, while in 2003 it was estimated to be effectively zero. However during 2004 area misreporting seems to have increased to 6,000t, possibly to relaxation in the area licence requirements, increasing uncertainty.

Retrospective analyses of the assessment from 2004 to 2000 were carried out. Figure 5.9.1 shows the recruitment, SSB and mean $F_{3\text{-}6}$ from ICA assessments, with an 8 year separable period for assessments in 2001 to 2004 and a 7 year separable period in 2000. The retrospective analyses show similar patterns in recruitment from 2002 onwards, but more variable estimates in the years before this period. Estimates of SSB are variable, while estimates of mean $F_{3\text{-}6}$ are rather stable.

Analysis of the analytical retrospective for each cohort (Figure 5.9.2) generally showed stability of information once cohorts are full recruited to the fishery at age 4. In some years the estimated fish abundance from some of the smaller cohorts is unstable (1997, 1999, 2001 year-classes), particularly for 1- and 2-ringers. The larger cohorts (1995, 1998 and 2000 year-classes) are estimated more reliably. The 1-ringers are down-weighted in the assessment and the 1- and 2-ringer estimates are not used in the projections (where geometric mean values are used). The retrospective analysis indicates that the problems (raised over the last few years) in estimating catch-at-age in both 1997 and 1998 are now causing little influence to the current assessment.

Generally while this is a noisy assessment, it is sufficiently accurate to confirm the conclusions that the SSB is well above Blim and fishing mortality is low and the assessment provides a suitable basis for the management of the stock and for the HCR evaluation.

5.11 Clyde herring

5.11.1 Advice and management applicable to 2004 and 2005

Management of herring in the Clyde is complicated by the presence of two stocks that are not separated currently; a resident spring-spawning population and the immigrant autumn-spawning component. Management strategies have been directed towards rebuilding the highly depleted spring-spawning component to historical levels.

The measures which remain in force in order to protect the indigenous spring-spawning stock are:

- A complete ban on herring fishing from 1 January to 30 April;
- A complete ban on all forms of active fishing from 1 February to 1 April, on the Ballantrae Bank spawning grounds, to protect the demersal spawn and prevent disturbance of the spawning shoals;
- A ban on herring fishing between 00:00 Saturday morning and 24:00 Sunday night;
- The TACs in 2004 and 2005 were maintained at the same level as in recent years (1,000 tonnes).

5.11.2 The fishery in 2004

Annual landings from 1955 to 2004 are presented in Table 5.10.1. There were no landings recorded in 2004. Along with a reduction in the fishery the number of samples from the fishery have been reduced in recent years (Table 5.10.2), with no fishery this year no samples were collected for Clyde herring in 2004.

5.11.3 Weight-at-age and stock composition

The catch in numbers-at-age for the period 1970 to 2004 is given in Table 5.10.3. Weights-at-age are given in Table 5.10.4. Mean weights in the stock have not been available from research vessel surveys since 1991, therefore the weights in the stock used are the weights-at-age in the catches.

5.11.4 Fishery-independent information

There were no surveys carried out in 2004. Historical estimates from these surveys are tabulated in (ICES 1995/ACFM:13).

5.11.5 Stock Assessment

The structure of the stock in the Clyde remains uncertain. No survey data are available from recent years therefore no assessment could be attempted.

5.11.6 Stock and catch projections

In the absence of an analytical assessment no stock projections can be provided.

5.12 Management Considerations

5.12.1 VIa (N) Management Considerations

In the 1990s management of this stock was complicated by area misreporting from area IVa in particular. Due to changes in the fishery and some management changes (in particular Vessel Monitoring Systems –VMS- and single area licenses) area misreporting into VIa (N) has declined from a high of 30,000t in the mid 1990s to 5000 t in 2002. It was estimated at effectively zero in 2003 but has risen again in 2004 to 6,000 t. However, this followed relaxation of single area licensing. It is considered that any measures that ensure TACs are taken correctly in the area will improve management.

The assessment presented here is more certain than those from the mid-1990s due to the improvements in the quality of the catch-at-age input data and the longer time-series for the acoustic survey. Current $F_{3\text{-}6}$ is thought to be below 0.2 and SSB at 125,000 t is well above the suggested $\mathbf{B}_{lim}$ of 50,000 t. Figure 5.6.15 indicates that SSB than $F_{3\text{-}6}$ are similarly uncertain but that this assessment provides a sound basis for assuming that the stock is currently lightly exploited and able to sustain the current fishery. The yield-per-recruit indicates that a fishery at the same or slightly higher level is sustainable the medium-term. Harvest Control Rule simulations provided in section 5.7 give a range of management options, summarised in Table 5.7.2 and figure 5.7.14. Projections (Figure 5.8.3.1-4) are provided to illustrate yield and stock under assumptions of Change Point Stock recruitment. For this stock it is important to remember that F >0.35 gives low probability of stock moving to higher biomass and if the is desired by managers an F below this level is required. In the short term F=0.25 (34,500 t) in 2006 compatible with a rising SSB and sustainable in the medium term.

The WG considers that this assessment, while noisy, is sufficiently accurate to confirm the conclusions that the SSB is well above Blim and fishing mortality is low and that it provides a suitable basis for the management of the stock. The WG also considers that the HCR simulations provide a good basis for managers to decide on the basic form of a HCR for VIa (N) herring. However, experience with the North Sea suggest that rules that use constraints on year-on-year change in TAC need more detailed evaluation than is provided here. If managers can use this study to decide on the main elements of the HCR they require such as the most suitable long term F then the chosen scenario can be evaluated in more detail for year-year change.

5.12.2 Clyde herring Management Considerations

In the absence of surveys and catches, nothing is currently known about the state of the spring-spawning stock. All the management measures, currently in force, need to remain. TACs should remain at the current low level until more is known about the dynamics of this stock.

Table 5.1.1 Herring in VIa (N). Catch in tonnes by country, 1983-2004. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

COUNTRY	1983	1984	1985	1986	1987	1988	1989	1990
Denmark		96						
Faroes	834	954	104	400				326
France	1313		20	18	136	44	1342	1287
Germany	6283	5564	5937	2188	1711	1860	4290	7096
Ireland				6000	6800	6740	8000	10000
Netherlands	20200	7729	5500	5160	5212	6131	5860	7693
Norway	7336	6669	4690	4799	4300	456		1607
UK	31616	37554	28065	25294	26810	26894	29874	38253
Unallocated	-4059	16588	-502	37840	18038	5229	2123	2397
Discards							1550	1300
Total	63523	75154	43814	81699	63007	47354	53039	69959
Area-Misreported		-19142	-4672	-10935	-18647	-11763	-19013	-25266
WG Estimate	63523	56012	39142	70764	44360	35591	34026	44693
Source (WG)	1985	1986	1987	1988	1989	1990	1991	1992

Country	1991	1992	1993	1994	1995	1996	1997	1998
Denmark								
Faroes	482							
France	1168	119	818	274	3672	2297	3093	1903
Germany	6450	5640	4693	5087	3733	7836	8873	8253
Ireland	8000	7985	8236	7938	3548	9721	1875	11199
Netherlands	7979	8000	6132	6093	7808	9396	9873	8483
Norway	3318	2389	7447	8183	4840	6223	4962	5317
UK	32628	32730	32602	30676	42661	46639	44273	42302
Unallocated	-10597	-5485	-3753	-4287	-4541	-17753	-8015	-11748
Discards	1180	200		700			62	90
Total	50608	51578	56175	54664	61271	64359	64995	65799
Area-Misreported	-22079	-22593	-24397	-30234	-32146	-38254	-29766	-32446
WG Estimate	28529	28985	31778	24430	29575	26105	35233*	33353
Source (WG)	1993	1994	1995	1996	1997	1997	1998	1999

Country	1999	2000	2001	2002	2003	2004
Denmark						
Faroes				800	400	228
France	463	870	760	1340	1370	625
Germany	6752	4615	3944	3810	2935	1046
Ireland	7915	4841	4311	4239	3581	1894
Netherlands	7244	4647	4534	4612	3609	8232
Norway	2695					
UK	36446	22816	21862	20604	16947	17706
Unallocated	-8155			878	-7	
Discards						123
Total	61514	37789	35411	36283	28835	29854
Area-Misreported	-23623	-14626	-10437	-4496		-6762
WG Estimate	29736	23163	24974	31787	28835	23092
Source (WG)	2000	2001	2002	2003	2004	2005

*WG estimate for 1997 has been revised according to the Bayesian assessment (see text Section 5.1.3 of 2000 report).

Table 5.2.1 Herring in VIa (N). Catch and sampling effort by nations participating in the fishery.

Total over all areas and periods

QUARTER: 1

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
Faroes	0.00	228.00	0	0	0	0.00
Ireland	0.00	568.00	0	0	0	0.00
Netherlands	2256.00	1334.00	4	674	100	100.14
Scotland	0.00	175.00	0	0	0	0.00
Scotland discard	0.00	123.00	0	0	0	0.00
Period Total	2256.00	2428.00	4	674	100	100.14

Sum of Offical Catches : 2428.00
Unallocated : 526.00
Working Group Catch : 2954.00

QUARTER: 2

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
England & Wales	0.00	1338.00	0	0	0	0.00
France	0.00	57.00	0	0	0	0.00
Netherlands	0.00	163.00	0	0	0	0.00
Period Total	0.00	1558.00	0	0	0	0.00

Sum of Offical Catches : 1558.00
Unallocated : -163.00
Working Group Catch : 1395.00

QUARTER: 3

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
England & Wales	0.00	500.00	0	0	0	0.00
France	0.00	568.00	0	0	0	0.00
Germany	0.00	1046.00	0	0	0	0.00
Ireland	0.00	31.00	0	0	0	0.00
N. Ireland	0.00	1470.00	0	0	0	0.00
Netherlands	0.00	6735.00	0	0	0	0.00
Scotland	4125.00	13543.00	5	1198	248	99.16
Period Total	4125.00	23893.00	5	1198	248	99.16

Sum of Offical Catches : 23893.00
Unallocated : -12073.00
Working Group Catch : 11820.00

QUARTER: 4

Country	Sampled Catch	Official Catch	No. of samples	No. measured	No. aged	SOP %
Ireland	0.00	1295.00	0	0	0	0.00
N. Ireland	0.00	71.00	0	0	0	0.00
Scotland	5745.00	609.00	1	297	36	100.00
Period Total	5745.00	1975.00	1	297	36	100.00

Sum of Offical Catches : 1975.00
Unallocated : 4948.00
Working Group Catch : 6923.00

Table 5.2.2 Herring in VIa (N). Estimated catch numbers-at-age (thousands), 1976-2004. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

AGE	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	69053	34836	22525	247	2692	36740	13304	81923	2207	40794	33768
2	319604	47739	46284	142	279	77961	250010	77810	188778	68845	154963
3	101548	95834	20587	77	95	105600	72179	92743	49828	148399	86072
4	35502	22117	40692	19	51	61341	93544	29262	35001	17214	118860
5	25195	10083	6879	13	13	21473	58452	42535	14948	15211	18836
6	76289	12211	3833	8	9	12623	23580	27318	11366	6631	18000
7	10918	20992	2100	4	8	11583	11516	14709	9300	6907	2578
8	3914	2758	6278	1	1	1309	13814	8437	4427	3323	1427
9	12014	1486	1544	0	0	1326	4027	8484	1959	2189	1971
	1987	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
1	19463	1708	6216	14294	26396	5253	17719	1728	266	1952	1193
2	65954	119376	36763	40867	23013	24469	95288	36554	82176	37854	55810
3	45463	41735	109501	40779	25229	24922	18710	40193	30398	30899	34966
4	32025	28421	18923	74279	28212	23733	10978	6007	21272	9219	31657
5	50119	19761	18109	26520	37517	21817	13269	7433	5376	7508	23118
6	8429	28555	7589	13305	13533	33869	14801	8101	4205	2501	17500
7	7307	3252	15012	9878	7581	6351	19186	10515	8805	4700	10331
8	3508	2222	1622	21456	6892	4317	4711	12158	7971	8458	5213
9	5983	2360	3505	5522	4456	5511	3740	10206	9787	31108	9883
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**				
1	9092	7635	4511	147	1145	53	0				
2	74167	35252	22960	82214	35410	32709	6259				
3	34571	93910	21825	15295	90204	48449	20185				
4	31905	25078	51420	9490	9506	56629	25822				
5	22872	13364	15505	24896	19916	7987	41945				
6	14372	7529	9002	9493	29288	4667	3824				
7	8641	3251	3898	6785	9628	13527	7448				
8	2825	1257	1836	4271	1290	10376	12419				
9	3327	1089	576	1015	1203	1330	689				

Table 5.3.1 Herring in VIa (N). Estimates of abundance from Scottish acoustic surveys. housands of fish at age and spawning biomass (SSB, tonnes). N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Age	1987	1991	1992	1993	1994	1995	1996	1997#	1998
1	249 100	338 312	74 310	2 760	494 150	441 240	41 220	792 320	1 221 700
2	578 400	294 484	503 430	750 270	542 080	1103 400	576 460	641 860	794 630
3	551 100	327 902	210 980	681 170	607 720	473 220	802 530	286 170	666 780
4	353 100	367 830	258 090	653 050	285 610	450 270	329 110	167 040	471 070
5	752 600	488 288	414 750	544 000	306 760	152 970	95 360	66 100	179 050
6	111 600	176 348	240 110	865 150	268 130	187 100	60 600	49 520	79 270
7	48 100	98 741	105 670	284 110	406 840	169 080	77 380	16 280	28 050
8	15 900	89 830	56 710	151 730	173 740	236 540	78 190	28 990	13 850
9+	6 500	58 043	63 440	156 180	131 880	201 500	114 810	24 440	36 770
SSB:	273 000*	452 000	351 460	866 190	533 740	452 120	370300	140 910	375 890

Age	1999	2000	2001	2002	2003	2004
1	534 200	447 600	313 100	424 700	438 800	564 000
2	322 400	316 200	1 062 000	436 000	1 039 400	274 500
3	1 388 800	337 100	217 700	1 436 900	932 500	760 200
4	432 000	899 500	172 800	199 800	1 471 800	442 300
5	308 000	393 400	437 500	161 700	181 300	577 200
6	138 700	247 600	132 600	424 300	129 200	55 700
7	86 500	199 500	102 800	152 300	346 700	61 800
8	27 600	95 000	52 400	67 500	114 300	82.200
9+	35 400	65 000	34 700	59 500	75 200	76.300
SSB:	460 200	500 500	359 200	548 800	739 200	395.900

***Biomass of 2+ ringers in November.**

 # The 1997 survey is not on the same basis as the other years, it was conducted in June (all other surveys were carried out in July) and it is not used for assessment purposes.

Table 5.4.1 Herring in VIa (N). Mean weights-at-age (g). N.B. In this table "age" refers to number of rings (winter rings in the otolith).

WEIGHTS IN THE CATCH																		
Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	73	80	82	79	84	91	89	83	105	81	89	97	76	83	49	107	72	0
2	143	112	142	129	118	122	128	142	142	134	136	138	130	137	140	146	143	155
3	183	157	145	173	160	172	158	167	180	178	177	159	158	164	163	159	158	172
4	211	177	191	182	203	194	197	190	191	210	205	182	175	183	183	171	167	194
5	220	203	190	209	211	216	206	195	198	230	222	199	191	201	192	156	183	213
6	238	194	213	224	229	224	228	201	213	233	223	218	210	215	196	173	196	217
7	241	240	216	228	236	236	223	244	207	262	219	227	225	239	205	182	193	193
8	253	213	204	237	261	251	262	234	227	247	238	212	223	281	224	245	185	185
9+	256	228	243	247	271	258	263	266	277	291	263	199	226	253	271	277	290	313

WEIGHT IN THE STOCK FROM ACOUSTIC SURVEYS														
Age	Historical	1992	1993	1994	1995	1996	1997[#]	1998	1999	2000	2001	2002	2003	2004
1	90	68	75	52	45	45	57	65	54	62	62	62	64	53.7
2	164	152	162	150	144	140	150	138	137	141	132	153	138	135.7
3	208	186	196	192	191	180	189	177	166	173	170	177	176	157.0
4	233	206	206	220	202	209	209	193	188	183	190	198	190	180.0
5	246	232	226	221	225	219	225	214	203	194	198	212	204	189.2
6	252	252	234	233	226	222	233	226	219	204	212	215	213	201.7
7	258	271	254	241	247	229	248	234	225	211	220	225	217	213.4
8	269	296	260	270	260	242	266	225	235	222	236	243	223	213.6
9+	292	305	276	296	293	263	287	249	245	230	254	259	228	205.6

[#] The 1997 survey is not on the same basis as the other years, it was conducted in June (all other surveys were carried out in July) and it is not used for assessment purposes.

Table 5.4.2 Herring in VIa (N). Maturity ogive used in estimates of spawning stock biomass taken from acoustic surveys. Values measured in 1997 were measured in June whilst other values are measured in July. The mean value 92-96 is used in the assessment for the years 1976-1991 and 1997.

YEAR \AGE (WINTER RING)	2	3	>3
Mean 92-96	0.57	0.96	1.00
1992	0.47	1.00	1.00
1993	0.93	0.96	1.00
1994	0.48	0.92	1.00
1995	0.19	0.98	1.00
1996	0.76	0.94	1.00
1997[#]	0.41	0.88	1.00
1998	0.85	0.97	1.00
1999	0.57	0.98	1.00
2000	0.45	0.92	1.00
2001	0.93	0.99	1.00
2002	0.92	1.00	1.00
2003	0.76	1.00	1.00
2004	0.83	0.97	1.00

[#] The 1997 survey is not on the same basis as the other years, it was conducted in June (all other surveys were carried out in July) and it is not used for assessment purposes.

Table 5.6.1. Herring in VIa (N). ICA run log for the maximum-likelihood ICA calculation for the 8 year separable period. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

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                      Integrated Catch at Age Analysis
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                                Version 1.4 w

                                K.R.Patterson
                          Fisheries Research Services
                               Marine Laboratory
                                   Aberdeen

 Enter the name of the index file -->index.dat
canum.dat
weca.dat
 Stock weights in 2005  used for the year 2004
west.dat
 Natural mortality in 2005  used for the year 2004
natmor.dat
 Maturity ogive in 2005  used for the year 2004
matprop.dat
 Name of age-structured index file (Enter if none) : -->fleet.dat
 Name of the SSB index file (Enter if none) -->
No indices of spawning biomass to be used.
 No of years for separable constraint ?--> 8
 Reference age for separable constraint ?--> 4
 Constant selection pattern model (Y/N) ?-->y
 S to be fixed on last age ?-->    1.000000000000000
 First age for calculation of reference F ?--> 3
 Last age for calculation of reference F ?--> 6
 Use default weighting (Y/N) ?-->n
Enter relative weights at age
 Weight for age 1-->    0.100000000000000
 Weight for age 2-->    1.000000000000000
 Weight for age 3-->    1.000000000000000
 Weight for age 4-->    1.000000000000000
 Weight for age 5-->    1.000000000000000
 Weight for age 6-->    1.000000000000000
 Weight for age 7-->    1.000000000000000
 Weight for age 8-->    1.000000000000000
 Weight for age 9-->    1.000000000000000
Enter relative weights by year
 Weight for year 1997-->    1.000000000000000
 Weight for year 1998-->    1.000000000000000
 Weight for year 1999-->    1.000000000000000
 Weight for year 2000-->    1.000000000000000
 Weight for year 2001-->    1.000000000000000
 Weight for year 2002-->    1.000000000000000
 Weight for year 2003-->    1.000000000000000
 Weight for year 2004-->    1.000000000000000
Enter new weights for specified years and ages if needed
 Enter year, age, new weight or -1,-1,-1 to end.  -1 -1   -1.000000000000000
 Is the last age of FLT01: West Scotland Summer Acoustic Sur a plus-group (Y--
>y
You must choose a catchability model for each index.

Models:   A  Absolute:  Index = Abundance . e
          L  Linear:    Index = Q. Abundance . e
          P  Power:     Index = Q. Abundance^ K .e

   where Q and K are parameters to be estimated, and
   e is a lognormally-distributed error.

 Model for FLT01: West Scotland Summer Acoustic Sur  is to be A/L/P ?-->L
There are     1  missing observations for fitting the separable model.
Fit a stock-recruit relationship (Y/N) ?-->n
 Enter lowest feasible F-->   2.0000000000000000E-02
 Enter highest feasible F-->    0.500000000000000
```

Table 5.6.1. continued.

```
Mapping the F-dimension of the SSQ surface
    F                 SSQ
+--------+------------------
    0.02        18.5300471970
    0.05        14.0129529294
    0.07        12.3069809296
    0.10        11.6777373205
    0.12        11.5103707635
    0.15        11.5578063632
    0.17        11.7100170023
    0.20        11.9140727744
    0.22        12.1430257935
    0.25        12.3825214536
    0.27        12.6247886666
    0.30        12.8655278138
    0.32        13.1023311905
    0.35        13.3339427321
    0.37        13.5597644561
    0.40        13.7795857974
    0.42        13.9933863289
    0.45        14.2013206372
    0.47        14.4036128265
    0.50        14.6005445773
Lowest SSQ is for F =     0.126
-----------------------------------------------------------------
No of years for separable analysis : 8
Age range in the analysis : 1  . . . 9
Year range in the analysis : 1957  . . . 2004
Number of indices of SSB : 0
Number of age-structured indices : 1

Parameters to estimate : 38
Number of observations : 189

Conventional single selection vector model to be fitted.
-----------------------------------------------------------------
 Survey weighting to be Manual (recommended) or Iterative (M/I) ?-->M
Enter weight for FLT01: West Scotland Summer Acoustic Sur  at age 1-->    0.100000000000000
Enter weight for FLT01: West Scotland Summer Acoustic Sur  at age 2-->    1.000000000000000
Enter weight for FLT01: West Scotland Summer Acoustic Sur  at age 3-->    1.000000000000000
Enter weight for FLT01: West Scotland Summer Acoustic Sur  at age 4-->    1.000000000000000
Enter weight for FLT01: West Scotland Summer Acoustic Sur  at age 5-->    1.000000000000000
Enter weight for FLT01: West Scotland Summer Acoustic Sur  at age 6-->    1.000000000000000
Enter weight for FLT01: West Scotland Summer Acoustic Sur  at age 7-->    1.000000000000000
Enter weight for FLT01: West Scotland Summer Acoustic Sur  at age 8-->    1.000000000000000
Enter weight for FLT01: West Scotland Summer Acoustic Sur  at age 9-->    1.000000000000000
Enter estimates of the extent to which errors
in the age-structured indices are correlated
across ages. This can be in the range 0 (independence)
to 1 (correlated errors).
Enter value for FLT01: West Scotland Summer Acoustic Sur-->            1.000000000000000
 Do you want to shrink the final fishing mortality (Y/N) ?-->N
Seeking solution. Please wait.

Aged index weights
FLT01: West Scotland Summer Acoustic Sur
 Age   :       1     2     3     4     5     6     7     8     9
 Wts :     0.011 0.111 0.111 0.111 0.111 0.111 0.111 0.111 0.111
F in 2004  at age 4  is 0.149117  in iteration 1
 Detailed, Normal or Summary output (D/N/S)-->D
 Output page width in characters (e.g. 80..132) ?--> 132
 Estimate historical assessment uncertainty ?-->y
 Sample from Covariances or Bayes MCMC (C/B) ?-->c
 Use default percentiles (Y/N)  ?-->y
 How many samples to take  ?--> 1000
 Enter SSB reference level (e.g. MBAL, Bpa..) [t]-->   5.0000000000000000E+04
Succesful exit from ICA
```

Table 5.6.2. Herring in VIa (N). Catch number at age (millions). N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Output Generated by ICA Version 1.4

Herring VIa (north) (run: ICAPGF08/I08)

Catch in Number

AGE	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
1	6.50	15.62	53.09	3.56	13.08	55.05	11.80	26.55	299.48	211.68	207.95	220.25	37.71	238.23	207.71
2	74.62	30.98	67.97	102.12	45.20	92.81	78.25	82.61	19.77	500.85	27.42	94.44	92.56	99.01	335.08
3	58.09	145.39	35.26	60.29	61.62	22.28	53.45	70.08	62.64	33.46	218.69	21.00	71.91	253.72	412.82
4	25.76	39.07	116.39	22.78	33.13	67.45	11.86	26.68	59.38	60.50	37.07	159.12	23.31	111.90	302.21
5	33.98	24.91	24.95	48.88	22.50	44.36	40.52	7.28	22.27	40.91	39.25	13.99	211.24	27.74	101.96
6	19.89	27.63	17.33	11.63	12.41	19.76	26.17	24.23	5.12	19.34	29.79	23.58	21.01	142.40	25.56
7	8.88	17.41	17.00	10.35	5.34	24.14	8.69	18.64	22.89	5.56	11.77	15.68	42.76	21.61	154.42
8	1.43	9.86	7.37	6.35	4.81	6.15	13.66	8.80	18.93	17.81	5.53	6.38	26.03	27.07	16.82
9	4.42	7.16	8.60	4.62	2.58	7.08	6.09	15.10	19.53	27.08	25.80	10.81	26.21	24.08	32.00

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	534.96	51.17	309.02	172.88	69.05	34.84	22.52	0.25	2.69	36.74	13.30	81.92	2.21	40.79	33.77
2	621.50	235.63	124.94	202.09	319.60	47.74	46.28	0.14	0.28	77.96	250.01	77.81	188.78	68.84	154.96
3	175.14	808.27	151.03	89.07	101.55	95.83	20.59	0.08	0.10	105.60	72.18	92.74	49.83	148.40	86.07
4	54.20	131.48	519.18	63.70	35.50	22.12	40.69	0.02	0.05	61.34	93.54	29.26	35.00	17.21	118.86
5	66.71	63.07	82.47	188.20	25.20	10.08	6.88	0.01	0.01	21.47	58.45	42.53	14.95	15.21	18.84
6	25.72	54.64	49.68	30.60	76.29	12.21	3.83	0.01	0.01	12.62	23.58	27.32	11.37	6.63	18.00
7	10.34	18.24	34.63	12.30	10.92	20.99	2.10	0.00	0.01	11.58	11.52	14.71	9.30	6.91	2.58
8	55.76	6.51	22.47	13.12	3.91	2.76	6.28	0.00	0.00	1.31	13.81	8.44	4.43	3.32	1.43
9	16.63	32.22	21.04	13.70	12.01	1.49	1.54	0.00	0.00	1.33	4.03	8.48	1.96	2.19	1.97

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	19.46	1.71	6.22	14.29	26.40	5.25	17.72	1.73	0.27	1.95	1.19	9.09	7.63	4.51	0.15
2	65.95	119.38	36.76	40.87	23.01	24.47	95.29	36.55	82.18	37.85	55.81	74.17	35.25	22.96	82.21
3	45.46	41.73	109.50	40.78	25.23	24.92	18.71	40.19	30.40	30.90	34.97	34.57	93.91	21.83	15.30
4	32.02	28.42	18.92	74.28	28.21	23.73	10.98	6.01	21.27	9.22	31.66	31.91	25.08	51.42	9.49
5	50.12	19.76	18.11	26.52	37.52	21.82	13.27	7.43	5.38	7.51	23.12	22.87	13.36	15.50	24.90
6	8.43	28.55	7.59	13.30	13.53	33.87	14.80	8.10	4.21	2.50	17.50	14.37	7.53	9.00	9.49
7	7.31	3.25	15.01	9.88	7.58	6.35	19.19	10.52	8.80	4.70	10.33	8.64	3.25	3.90	6.78
8	3.51	2.22	1.62	21.46	6.89	4.32	4.71	12.16	7.97	8.46	5.21	2.83	1.26	1.84	4.72
9	5.98	2.36	3.50	5.52	4.46	5.51	3.74	10.21	9.79	31.11	9.88	3.33	1.09	0.58	1.02

Table 5.6.2. Herring in VIa (N). Catch number at age (millions). Continued

Catch in Number

AGE	2002	2003	2004
1	1.14	0.05	0.00
2	35.41	32.71	6.26
3	90.20	48.45	20.18
4	9.51	56.63	25.82
5	19.92	7.99	41.94
6	29.29	4.67	3.82
7	9.63	13.53	7.45
8	1.29	10.38	12.42
9	1.20	1.33	0.69

x 10 ^ 6

Table 5.6.3. Herring in VIa (N). Weight in the catch (kg). N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Weights at age in the catches (Kg)

AGE	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
1	0.07900	0.07900	0.07900	0.07900	0.07900	0.07900	0.07900	0.07900	0.07900	0.07900	0.07900	0.07900	0.07900	0.07900	0.07900
2	0.10400	0.10400	0.10400	0.10400	0.10400	0.10400	0.10400	0.10400	0.10400	0.10400	0.10400	0.10400	0.10400	0.10400	0.10400
3	0.13000	0.13000	0.13000	0.13000	0.13000	0.13000	0.13000	0.13000	0.13000	0.13000	0.13000	0.13000	0.13000	0.13000	0.13000
4	0.15800	0.15800	0.15800	0.15800	0.15800	0.15800	0.15800	0.15800	0.15800	0.15800	0.15800	0.15800	0.15800	0.15800	0.15800
5	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400
6	0.17000	0.17000	0.17000	0.17000	0.17000	0.17000	0.17000	0.17000	0.17000	0.17000	0.17000	0.17000	0.17000	0.17000	0.17000
7	0.18000	0.18000	0.18000	0.18000	0.18000	0.18000	0.18000	0.18000	0.18000	0.18000	0.18000	0.18000	0.18000	0.18000	0.18000
8	0.18300	0.18300	0.18300	0.18300	0.18300	0.18300	0.18300	0.18300	0.18300	0.18300	0.18300	0.18300	0.18300	0.18300	0.18300
9	0.18500	0.18500	0.18500	0.18500	0.18500	0.18500	0.18500	0.18500	0.18500	0.18500	0.18500	0.18500	0.18500	0.18500	0.18500

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	0.07900	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.08000	0.08000	0.08000	0.06900	0.11300
2	0.10400	0.12100	0.12100	0.12100	0.12100	0.12100	0.12100	0.12100	0.12100	0.12100	0.14000	0.14000	0.14000	0.10300	0.14500
3	0.13000	0.15800	0.15800	0.15800	0.15800	0.15800	0.15800	0.15800	0.15800	0.15800	0.17500	0.17500	0.17500	0.13400	0.17300
4	0.15800	0.17500	0.17500	0.17500	0.17500	0.17500	0.17500	0.17500	0.17500	0.17500	0.20500	0.20500	0.20500	0.16100	0.19600
5	0.16400	0.18600	0.18600	0.18600	0.18600	0.18600	0.18600	0.18600	0.18600	0.18600	0.23100	0.23100	0.23100	0.18200	0.21500
6	0.17000	0.20600	0.20600	0.20600	0.20600	0.20600	0.20600	0.20600	0.20600	0.20600	0.25300	0.25300	0.25300	0.19900	0.23000
7	0.18000	0.21800	0.21800	0.21800	0.21800	0.21800	0.21800	0.21800	0.21800	0.21800	0.27000	0.27000	0.27000	0.21300	0.24200
8	0.18300	0.22400	0.22400	0.22400	0.22400	0.22400	0.22400	0.22400	0.22400	0.22400	0.28400	0.28400	0.28400	0.22300	0.25100
9	0.18500	0.22400	0.22400	0.22400	0.22400	0.22400	0.22400	0.22400	0.22400	0.22400	0.29500	0.29500	0.29500	0.23100	0.25800

Table 5.6.3. Herring in VIa (N). Weight in the catch (kg). Continued

Weights at age in the catches (Kg)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	0.07300	0.08000	0.08200	0.07900	0.08400	0.09100	0.08900	0.08300	0.10600	0.08100	0.08900	0.09700	0.07600	0.08340	0.04900
2	0.14300	0.11200	0.14200	0.12900	0.11800	0.11900	0.12800	0.14200	0.14200	0.13400	0.13600	0.13800	0.13000	0.13730	0.13960
3	0.18300	0.15700	0.14500	0.17300	0.16000	0.18300	0.15800	0.16700	0.18100	0.17800	0.17700	0.15900	0.15800	0.16370	0.16270
4	0.21100	0.17700	0.19100	0.18200	0.20300	0.19600	0.19700	0.19000	0.19100	0.21000	0.20500	0.18200	0.17500	0.18290	0.18260
5	0.22000	0.20300	0.19000	0.20900	0.21100	0.22700	0.20600	0.19500	0.19800	0.23000	0.22200	0.19900	0.19100	0.20140	0.19200
6	0.23800	0.19400	0.21300	0.22400	0.22900	0.21900	0.22800	0.20100	0.21400	0.23300	0.22300	0.21800	0.21000	0.21470	0.19570
7	0.24100	0.24000	0.21600	0.22800	0.23600	0.24400	0.22300	0.24400	0.20800	0.26200	0.21900	0.22700	0.22500	0.23940	0.20450
8	0.25300	0.21300	0.20400	0.23700	0.26100	0.25600	0.26200	0.23400	0.22700	0.24700	0.23800	0.21200	0.22300	0.28120	0.22440
9	0.25600	0.22800	0.24300	0.24700	0.27100	0.25600	0.26300	0.26600	0.27700	0.29100	0.26300	0.19900	0.22600	0.25260	0.27130

AGE	2002	2003	2004
1	0.10660	0.07200	0.00000
2	0.14620	0.14290	0.15510
3	0.15940	0.15780	0.17230
4	0.17090	0.16650	0.19400
5	0.15640	0.18300	0.21310
6	0.17250	0.19580	0.21670
7	0.18200	0.19270	0.19270
8	0.24510	0.18450	0.18490
9	0.27710	0.29010	0.31320

Table 5.6.4. Herring in VIa (N). Weight in the stock (kg). N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Weights at age in the stock (Kg)

AGE	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
1	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000
2	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400
3	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800
4	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300
5	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600
6	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200
7	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800
8	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900
9	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200

Table 5.6.4. Herring in VIa (N). Continued.

Weights at age in the stock (Kg)

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000
2	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400
3	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800
4	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300
5	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600
6	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200
7	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800
8	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900
9	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	0.09000	0.09000	0.09000	0.09000	0.09000	0.09000	0.07500	0.05200	0.04200	0.04500	0.05700	0.06600	0.05400	0.06200	0.06200
2	0.16400	0.16400	0.16400	0.16400	0.16400	0.16400	0.16200	0.15000	0.14400	0.14000	0.15000	0.13800	0.13700	0.14100	0.13200
3	0.20800	0.20800	0.20800	0.20800	0.20800	0.20800	0.19600	0.19200	0.19100	0.18000	0.18900	0.17600	0.16600	0.17300	0.17000
4	0.23300	0.23300	0.23300	0.23300	0.23300	0.23300	0.20600	0.22000	0.20200	0.20900	0.20900	0.19400	0.18800	0.18300	0.19000
5	0.24600	0.24600	0.24600	0.24600	0.24600	0.24600	0.22600	0.22100	0.22500	0.21900	0.22500	0.21400	0.20300	0.19400	0.19800
6	0.25200	0.25200	0.25200	0.25200	0.25200	0.25200	0.23400	0.23300	0.22700	0.22200	0.23300	0.22600	0.21900	0.20400	0.21200
7	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25400	0.24100	0.24700	0.22900	0.24800	0.23400	0.22500	0.21100	0.22000
8	0.26900	0.26900	0.26900	0.26900	0.26900	0.26900	0.26000	0.27000	0.26000	0.24200	0.26600	0.22500	0.23500	0.22200	0.23600
9	0.29200	0.29200	0.29200	0.29200	0.29200	0.29200	0.27600	0.29600	0.29300	0.26300	0.28700	0.24900	0.24500	0.23000	0.25400

AGE	2002	2003	2004
1	0.06200	0.06400	0.05900
2	0.15300	0.13800	0.13800
3	0.17700	0.17600	0.15900
4	0.19800	0.19000	0.18000
5	0.21200	0.20400	0.18900
6	0.21500	0.21300	0.20200
7	0.22500	0.21700	0.21300
8	0.24300	0.22300	0.21400
9	0.25900	0.22800	0.20600

Table 5.6.5. Herring in VIa (N). Natural mortality. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Natural Mortality (per year)

AGE	1957	1958	1959	1960	1961	----	2000	2001	2002	2003	2004
1	1.0000	1.0000	1.0000	1.0000	1.0000	----	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.3000	0.3000	0.3000	0.3000	0.3000	----	0.3000	0.3000	0.3000	0.3000	0.3000
3	0.2000	0.2000	0.2000	0.2000	0.2000	----	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.1000	0.1000	0.1000	0.1000	0.1000	----	0.1000	0.1000	0.1000	0.1000	0.1000
5	0.1000	0.1000	0.1000	0.1000	0.1000	----	0.1000	0.1000	0.1000	0.1000	0.1000
6	0.1000	0.1000	0.1000	0.1000	0.1000	----	0.1000	0.1000	0.1000	0.1000	0.1000
7	0.1000	0.1000	0.1000	0.1000	0.1000	----	0.1000	0.1000	0.1000	0.1000	0.1000
8	0.1000	0.1000	0.1000	0.1000	0.1000	----	0.1000	0.1000	0.1000	0.1000	0.1000
9	0.1000	0.1000	0.1000	0.1000	0.1000	----	0.1000	0.1000	0.1000	0.1000	0.1000

Table 5.6.6. Herring in VIa (N). Proportion mature. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Proportion of fish spawning

AGE	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700
3	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700	0.5700
3	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600	0.9600
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 5.6.6. Herring in VIa (N). Proportion mature. Continued

Proportion of fish spawning

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.5700	0.5700	0.5700	0.5700	0.5700	0.4700	0.9300	0.4800	0.1900	0.7600	0.5700	0.8500	0.5700	0.4500	0.9300
3	0.9600	0.9600	0.9600	0.9600	0.9600	1.0000	0.9600	0.9200	0.9800	0.9400	0.9600	0.9700	0.9800	0.9200	0.9900
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	2002	2003	2004
1	0.0000	0.0000	0.0000
2	0.9200	0.7600	0.8300
3	1.0000	1.0000	0.9700
4	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000

Table 5.6.7. Herring in VIa (N). Tuning indices. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

AGE-STRUCTURED INDICES

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	249.1	*******	*******	*******	338.3	74.3	2.8	494.2	460.6	41.2	*******	1221.7	534.2	447.6	313.1
2	578.4	*******	*******	*******	294.5	503.4	750.3	542.1	1085.1	576.5	*******	794.6	322.4	316.2	1062.0
3	551.1	*******	*******	*******	327.9	211.0	681.2	607.7	472.7	802.5	*******	666.8	1388.0	337.1	217.7
4	353.1	*******	*******	*******	367.8	258.1	653.0	285.6	450.2	329.1	*******	471.1	432.0	899.5	172.8
5	752.6	*******	*******	*******	488.3	414.8	544.0	306.8	153.0	95.4	*******	179.1	308.0	393.4	437.5
6	111.6	*******	*******	*******	176.3	240.1	865.2	268.1	187.1	60.6	*******	79.3	138.7	247.6	132.6
7	48.1	*******	*******	*******	98.7	105.7	284.1	406.8	169.2	77.4	*******	28.1	86.5	199.5	102.8
8	15.9	*******	*******	*******	89.8	56.7	151.7	173.7	236.6	78.2	*******	13.8	27.6	95.0	52.4
9	6.5	*******	*******	*******	58.0	63.4	156.2	131.9	201.5	114.8	*******	36.8	35.4	65.0	34.7

x 10 ^ 3

Table 5.6.7. Herring in VIa (N). Tuning indices. Continued

AGE	2002	2003	2004
1	424.7	438.8	564.0
2	436.0	1039.4	274.5
3	1436.9	932.5	760.2
4	199.8	1471.8	442.3
5	161.7	181.3	577.2
6	424.3	129.2	55.7
7	152.3	346.7	61.8
8	67.5	114.3	82.2
9	59.5	75.2	76.3

x 10 ^ 3

Table 5.6.8. Herring in VIa (N). Weighting factors for the catch in numbers. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Weighting factors for the catches in number

AGE	1997	1998	1999	2000	2001	2002	2003	2004
1	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 5.6.9. Herring in VIa (N). Predicted catch in number. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Predicted Catch in Number

AGE	1997	1998	1999	2000	2001	2002	2003	2004
1	4.51	1.37	0.62	3.03	1.28	0.99	0.23	1.93
2	74.37	115.53	25.60	16.18	80.90	38.29	29.31	5.87
3	44.33	54.56	63.76	20.72	13.63	76.87	35.98	24.27
4	33.49	24.09	22.47	39.33	13.36	9.94	55.49	22.90
5	21.48	22.88	12.67	17.76	32.57	12.52	9.22	45.53
6	12.19	10.53	8.65	7.34	10.82	22.53	8.57	5.58
7	8.39	7.00	4.70	5.90	5.27	8.81	18.17	6.12
8	5.21	3.20	2.04	2.11	2.78	2.82	4.67	8.48

x 10 ^ 6

Table 5.6.10. Herring in VIa (N). Fishing mortality (per year). N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Fishing Mortality (per year)

AGE	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
1	0.0090	0.0111	0.0386	0.0087	0.0158	0.0369	0.0086	0.0432	0.0612	0.3613	0.1385	0.0879	0.0200	0.1148	0.0348
2	0.0962	0.0898	0.1016	0.1631	0.2472	0.2534	0.1123	0.1284	0.0677	0.2353	0.1223	0.1453	0.0804	0.1116	0.4155
3	0.3077	0.2910	0.1480	0.1302	0.1482	0.1965	0.2412	0.1474	0.1437	0.1653	0.1619	0.1373	0.1665	0.3483	0.9813
4	0.2027	0.3321	0.3785	0.1279	0.0932	0.2275	0.1447	0.1729	0.1704	0.1908	0.2638	0.1613	0.2109	0.3971	0.8593
5	0.2803	0.2743	0.3257	0.2405	0.1612	0.1560	0.1859	0.1117	0.1912	0.1525	0.1634	0.1347	0.2964	0.3686	0.6729
6	0.2764	0.3432	0.2780	0.2213	0.0795	0.1860	0.1167	0.1451	0.0963	0.2259	0.1423	0.1255	0.2732	0.2971	0.6032
7	0.1684	0.3677	0.3264	0.2377	0.1346	0.1956	0.1047	0.1025	0.1780	0.1294	0.1869	0.0932	0.3113	0.4409	0.5342
8	0.2045	0.2545	0.2336	0.1737	0.1486	0.2021	0.1452	0.1318	0.1291	0.1833	0.1647	0.1314	0.1973	0.2952	0.6460
9	0.2045	0.2545	0.2336	0.1737	0.1486	0.2021	0.1452	0.1318	0.1291	0.1833	0.1647	0.1314	0.1973	0.2952	0.6460

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	0.3665	0.0777	0.3342	0.1367	0.1915	0.0910	0.0393	0.0003	0.0048	0.0354	0.0274	0.0433	0.0030	0.0543	0.0606
2	0.2358	0.5018	0.4945	0.7356	0.7650	0.3456	0.2902	0.0005	0.0007	0.3192	0.6556	0.3874	0.2264	0.2057	0.5413
3	0.4270	0.5856	0.7708	0.8806	1.2093	0.5930	0.2615	0.0007	0.0004	0.4286	0.5926	0.5888	0.4950	0.2973	0.4566
4	0.2987	0.6275	0.9069	0.8514	1.0747	0.9236	0.5141	0.0003	0.0006	0.3938	0.8021	0.4839	0.4373	0.2996	0.3902
5	0.4055	0.5916	0.9254	0.8955	0.8839	0.9319	0.7395	0.0002	0.0002	0.3010	0.7072	0.9610	0.4331	0.3061	0.5474
6	0.3125	0.6014	1.2010	0.9788	1.0446	1.4173	1.0391	0.0014	0.0002	0.3024	0.5540	0.7570	0.6499	0.3093	0.6296
7	0.4631	0.3390	0.8591	1.0119	1.0631	0.8237	0.9075	0.0021	0.0016	0.2995	0.4395	0.7127	0.5561	0.9501	0.1695
8	0.3316	0.5264	0.7926	0.8439	0.9576	0.7559	0.5510	0.0008	0.0006	0.3327	0.6146	0.5912	0.4255	0.3485	0.4519
9	0.3316	0.5264	0.7926	0.8439	0.9576	0.7559	0.5510	0.0008	0.0006	0.3327	0.6146	0.5912	0.4255	0.3485	0.4519

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	0.0145	0.0029	0.0111	0.0512	0.1117	0.0106	0.0483	0.0032	0.0006	0.0032	0.0043	0.0039	0.0025	0.0022	0.0019
2	0.2775	0.1954	0.1340	0.1578	0.1840	0.2466	0.4767	0.2267	0.3518	0.1936	0.2729	0.2476	0.1572	0.1375	0.1226
3	0.3192	0.3024	0.2939	0.2288	0.1461	0.3302	0.3221	0.4052	0.3180	0.2294	0.3876	0.3517	0.2232	0.1952	0.1741
4	0.2900	0.3205	0.2068	0.3151	0.2323	0.1892	0.2247	0.1537	0.3692	0.1423	0.3934	0.3570	0.2266	0.1982	0.1767
5	0.2519	0.2607	0.3094	0.4388	0.2318	0.2530	0.1378	0.2089	0.1795	0.1917	0.4983	0.4522	0.2870	0.2511	0.2238
6	0.4474	0.1990	0.1353	0.3486	0.3723	0.3012	0.2431	0.1050	0.1570	0.1066	0.4752	0.4311	0.2736	0.2394	0.2134
7	0.5005	0.2757	0.1370	0.2335	0.3048	0.2668	0.2486	0.2435	0.1427	0.2356	0.5378	0.4880	0.3097	0.2709	0.2415
8	0.3249	0.2469	0.1925	0.2634	0.2267	0.2540	0.2885	0.2203	0.2625	0.1777	0.3934	0.3570	0.2266	0.1982	0.1767
9	0.3249	0.2469	0.1925	0.2634	0.2267	0.2540	0.2885	0.2203	0.2625	0.1777	0.3934	0.3570	0.2266	0.1982	0.1767

Table 5.6.10. Herring in VIa (N). Fishing mortality (per year). Continued.

Fishing Mortality (per year)

AGE	2002	2003	2004
1	0.0019	0.0019	0.0016
2	0.1223	0.1206	0.1034
3	0.1737	0.1712	0.1469
4	0.1763	0.1738	0.1491
5	0.2234	0.2202	0.1889
6	0.2130	0.2099	0.1801
7	0.2410	0.2376	0.2038
8	0.1763	0.1738	0.1491
9	0.1763	0.1738	0.1491

Table 5.6.11. Herring in VIa (N). Population abundance (1 January, millions). N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Population Abundance (1 January)

AGE	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
1	1142.6	2233.3	2210.7	651.0	1316.7	2397.8	2168.2	990.4	7944.9	1072.5	2514.3	4109.1	3001.1	3442.6	9583.1
2	939.6	416.6	812.5	782.5	237.4	476.8	850.1	790.8	348.9	2749.4	274.9	805.3	1384.4	1082.1	1129.1
3	240.7	632.2	282.1	543.8	492.4	137.4	274.1	562.9	515.2	241.6	1609.8	180.2	515.9	946.4	717.0
4	147.3	144.9	386.9	199.2	390.9	347.7	92.4	176.4	397.7	365.4	167.7	1121.0	128.6	357.6	547.0
5	145.8	108.8	94.0	239.8	158.6	322.2	250.6	72.3	134.2	303.5	273.2	116.5	863.2	94.3	217.5
6	86.3	99.7	74.9	61.4	170.6	122.1	249.4	188.2	58.5	100.3	235.8	209.9	92.2	580.7	59.0
7	60.2	59.3	64.0	51.3	44.6	142.6	91.7	200.8	147.3	48.1	72.4	185.0	167.5	63.5	390.4
8	8.1	46.0	37.1	41.8	36.6	35.2	106.1	74.8	164.0	111.6	38.2	54.4	152.5	111.0	36.9
9	25.1	33.4	43.3	30.4	19.6	40.6	47.3	128.4	169.3	169.6	178.3	92.2	153.6	98.8	70.3

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	2677.2	1075.8	1674.8	2116.2	617.1	628.7	920.9	1219.1	894.8	1667.5	775.9	3044.6	1162.5	1215.2	903.5
2	3404.9	682.7	366.2	441.1	679.0	187.5	211.2	325.7	448.3	327.6	592.1	277.7	1072.6	426.4	423.4
3	552.1	1992.6	306.2	165.4	156.6	234.1	98.3	117.0	241.2	331.9	176.4	227.7	139.7	633.6	257.1
4	220.0	294.9	908.3	116.0	56.2	38.3	105.9	62.0	95.8	197.4	177.0	79.8	103.5	69.7	385.4
5	209.6	147.7	142.5	331.9	44.8	17.3	13.7	57.3	56.0	86.6	120.5	71.8	44.5	60.5	46.7
6	100.4	126.4	74.0	51.1	122.6	16.7	6.2	5.9	51.8	50.7	58.0	53.7	24.9	26.1	40.3
7	29.2	66.5	62.7	20.1	17.4	39.0	3.7	2.0	5.4	46.9	33.9	30.1	22.8	11.7	17.4
8	207.0	16.6	42.9	24.0	6.6	5.4	15.5	1.3	1.8	4.8	31.5	19.8	13.4	11.8	4.1
9	61.7	82.4	40.1	25.1	20.3	2.9	3.8	10.1	10.3	4.9	9.2	19.9	5.9	7.8	5.7

x 10 ^ 6

Table 5.6.11. Herring in VIa (N). Population abundance (1 January, millions). Continued.

Population Abundance (1 January)

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	2136.7	922.0	887.3	451.4	391.5	789.7	591.7	867.0	674.0	976.2	1654.1	553.9	396.0	2204.4	1045.1
2	312.8	774.7	338.2	322.8	157.8	128.8	287.5	207.4	317.9	247.8	358.0	605.9	203.0	145.3	809.2
3	182.6	175.6	472.1	219.1	204.2	97.2	74.6	132.2	122.5	165.7	151.3	201.9	350.4	128.5	93.8
4	133.4	108.6	106.2	288.1	142.7	144.5	57.2	44.2	72.2	73.0	107.8	84.1	116.3	229.5	86.5
5	236.0	90.3	71.3	78.2	190.2	102.4	108.2	41.4	34.3	45.1	57.3	65.8	53.2	83.9	170.3
6	24.5	166.0	62.9	47.4	45.6	136.5	71.9	85.3	30.4	26.0	33.7	31.5	37.9	36.1	59.0
7	19.4	14.2	123.1	49.7	30.2	28.4	91.4	51.0	69.5	23.5	21.1	19.0	18.5	26.1	25.7
8	13.3	10.7	9.7	97.1	35.6	20.2	19.7	64.5	36.2	54.5	16.8	11.2	10.5	12.3	18.0
9	22.6	11.3	21.0	25.0	23.0	25.8	15.6	54.1	44.4	200.5	31.8	11.6	5.6	3.4	6.6

Population Abundance (1 January)

AGE	2002	2003	2004	2005
1	811.0	187.9	1863.8	756.8
2	383.7	297.8	69.0	684.5
3	530.3	251.5	195.5	46.1
4	64.5	364.9	173.5	138.2
5	65.6	49.0	277.5	135.3
6	123.2	47.5	35.5	207.9
7	43.2	90.1	34.8	26.9
8	18.3	30.7	64.3	25.7
9	7.8	8.7	5.2	54.2

x 10 ^ 6

Table 5.6.12. Herring in VIa (N). Predicted index values. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Predicted Age-Structured Index Values

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	642.1	*******	*******	*******	111.6	237.8	174.6	262.1	204.1	295.2	*******	167.4	119.8	666.9	316.2
2	668.8	*******	*******	*******	354.9	280.1	551.4	455.9	652.8	554.6	*******	1316.6	463.3	335.3	1882.5
3	594.9	*******	*******	*******	731.4	315.0	242.6	411.1	399.4	567.0	*******	646.3	1203.2	448.0	330.9
4	487.5	*******	*******	*******	538.4	558.0	216.8	174.2	252.7	289.1	*******	296.3	440.0	882.0	336.5
5	819.7	*******	*******	*******	667.9	355.3	399.9	147.0	124.0	162.0	*******	205.0	181.3	291.4	600.6
6	76.0	*******	*******	*******	147.6	459.2	249.7	319.3	110.5	97.1	*******	98.6	129.4	125.7	208.3
7	59.0	*******	*******	*******	102.2	98.1	318.5	178.3	256.6	82.4	*******	58.0	62.4	89.8	90.1
8	35.6	*******	*******	*******	101.1	56.4	54.0	183.5	100.7	158.8	*******	29.5	29.9	35.4	52.5
9	84.6	*******	*******	*******	91.0	100.2	59.7	214.5	172.1	813.2	*******	42.7	22.3	13.5	26.7

AGE	2002	2003	2004
1	245.4	56.8	564.0
2	892.8	693.5	162.1
3	1870.7	888.5	699.9
4	251.0	1421.3	685.0
5	231.5	173.0	997.5
6	434.8	167.9	127.7
7	151.0	315.9	124.4
8	53.3	89.6	190.2
9	31.7	35.6	21.5

x 10 ^ 3

Table 5.6.13. Herring in VIa (N). Fitted selection pattern. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Fitted Selection Pattern

AGE	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
1	0.0445	0.0335	0.1020	0.0679	0.1697	0.1621	0.0597	0.2497	0.3590	1.8930	0.5252	0.5452	0.0951	0.2891	0.0405
2	0.4746	0.2704	0.2684	1.2749	2.6522	1.1139	0.7763	0.7430	0.3973	1.2327	0.4635	0.9009	0.3812	0.2811	0.4835
3	1.5183	0.8763	0.3911	1.0178	1.5899	0.8634	1.6668	0.8525	0.8432	0.8663	0.6139	0.8509	0.7895	0.8771	1.1420
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.3828	0.8260	0.8605	1.8806	1.7299	0.6858	1.2851	0.6462	1.1221	0.7992	0.6196	0.8349	1.4058	0.9282	0.7831
6	1.3639	1.0335	0.7346	1.7305	0.8529	0.8176	0.8066	0.8395	0.5653	1.1839	0.5395	0.7780	1.2955	0.7483	0.7019
7	0.8308	1.1072	0.8624	1.8584	1.4440	0.8596	0.7237	0.5931	1.0446	0.6781	0.7088	0.5776	1.4765	1.1104	0.6217
8	1.0090	0.7662	0.6171	1.3580	1.5942	0.8882	1.0038	0.7626	0.7578	0.9606	0.6243	0.8147	0.9356	0.7434	0.7517
9	1.0090	0.7662	0.6171	1.3580	1.5942	0.8882	1.0038	0.7626	0.7578	0.9606	0.6243	0.8147	0.9356	0.7434	0.7517

Table 5.6.13. Herring in VIa (N). Fitted selection pattern. Continued.

Fitted Selection Pattern

AGE	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
1	1.2270	0.1238	0.3685	0.1606	0.1782	0.0986	0.0765	0.9947	8.5184	0.0898	0.0342	0.0896	0.0069	0.1813	0.1554
2	0.7893	0.7997	0.5453	0.8640	0.7118	0.3742	0.5644	1.5662	1.2870	0.8105	0.8174	0.8006	0.5177	0.6867	1.3871
3	1.4295	0.9333	0.8500	1.0343	1.1253	0.6420	0.5086	2.2532	0.7765	1.0882	0.7388	1.2169	1.1320	0.9922	1.1701
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.3577	0.9429	1.0204	1.0518	0.8225	1.0091	1.4383	0.7396	0.4354	0.7643	0.8816	1.9859	0.9905	1.0219	1.4029
6	1.0462	0.9585	1.3243	1.1497	0.9719	1.5346	2.0210	4.3962	0.3258	0.7679	0.6907	1.5643	1.4863	1.0324	1.6135
7	1.5503	0.5403	0.9473	1.1886	0.9892	0.8918	1.7652	6.5992	2.8010	0.7606	0.5479	1.4728	1.2717	3.1713	0.4344
8	1.1102	0.8389	0.8740	0.9912	0.8910	0.8185	1.0717	2.4328	1.0510	0.8448	0.7662	1.2216	0.9731	1.1631	1.1581
9	1.1102	0.8389	0.8740	0.9912	0.8910	0.8185	1.0717	2.4328	1.0510	0.8448	0.7662	1.2216	0.9731	1.1631	1.1581

AGE	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	0.0500	0.0092	0.0538	0.1624	0.4807	0.0559	0.2151	0.0205	0.0017	0.0223	0.0110	0.0110	0.0110	0.0110	0.0110
2	0.9570	0.6096	0.6478	0.5008	0.7919	1.3035	2.1216	1.4749	0.9528	1.3604	0.6937	0.6937	0.6937	0.6937	0.6937
3	1.1008	0.9434	1.4212	0.7263	0.6290	1.7458	1.4334	2.6361	0.8612	1.6124	0.9851	0.9851	0.9851	0.9851	0.9851
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	0.8685	0.8134	1.4957	1.3928	0.9975	1.3373	0.6133	1.3591	0.4862	1.3476	1.2667	1.2667	1.2667	1.2667	1.2667
6	1.5427	0.6209	0.6542	1.1063	1.6023	1.5923	1.0821	0.6833	0.4253	0.7496	1.2078	1.2078	1.2078	1.2078	1.2078
7	1.7259	0.8601	0.6622	0.7412	1.3116	1.4102	1.1066	1.5838	0.3865	1.6561	1.3669	1.3669	1.3669	1.3669	1.3669
8	1.1204	0.7703	0.9306	0.8362	0.9756	1.3429	1.2838	1.4332	0.7111	1.2490	1.0000	1.0000	1.0000	1.0000	1.0000
9	1.1204	0.7703	0.9306	0.8362	0.9756	1.3429	1.2838	1.4332	0.7111	1.2490	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	2002	2003	2004
1	0.0110	0.0110	0.0110
2	0.6937	0.6937	0.6937
3	0.9851	0.9851	0.9851
4	1.0000	1.0000	1.0000
5	1.2667	1.2667	1.2667
6	1.2078	1.2078	1.2078
7	1.3669	1.3669	1.3669
8	1.0000	1.0000	1.0000
9	1.0000	1.0000	1.0000

Table 5.6.14. Herring in VIa (N). Stock summary. N.B. In this table “age” refers to number of rings (winter rings in the otolith).

STOCK SUMMARY

Year	Recruits Age 1 thousands	Total Biomass tonnes	Spawning Biomass tonnes	Landings tonnes	Yield /SSB ratio	Mean F Ages 3- 6	SoP (%)
1957	1142600	423964	195006	43438	0.2228	0.2668	137
1958	2233280	523884	214239	59669	0.2785	0.3102	133
1959	2210650	562165	230608	65221	0.2828	0.2826	137
1960	650960	454235	267233	63759	0.2386	0.1800	176
1961	1316730	460009	267140	46353	0.1735	0.1205	171
1962	2397760	571718	256605	58195	0.2268	0.1915	129
1963	2168180	603607	281103	49030	0.1744	0.1721	143
1964	990370	551632	329003	64234	0.1952	0.1443	173
1965	7944920	1151424	336409	68669	0.2041	0.1504	116
1966	1072530	874703	447179	100619	0.2250	0.1837	98
1967	2514340	852935	476691	90400	0.1896	0.1828	123
1968	4109110	971405	451299	84614	0.1875	0.1397	125
1969	3001080	999083	489299	107170	0.2190	0.2367	132
1970	3442590	1012074	452907	165930	0.3664	0.3528	136
1971	9583050	1523784	322748	207167	0.6419	0.7792	98
1972	2677210	1123574	450283	164756	0.3659	0.3609	97
1973	1075830	805822	388841	210270	0.5408	0.6015	95
1974	1674820	579213	206519	178160	0.8627	0.9510	88
1975	2116220	437730	108846	114001	1.0474	0.9016	98
1976	617140	266681	75124	93642	1.2465	1.0531	100
1977	628720	165808	53731	41341	0.7694	0.9664	109
1978	920880	173807	50606	22156	0.4378	0.6385	99
1979	1219120	221327	76967	60	0.0008	0.0007	99
1980	894760	258263	126894	306	0.0024	0.0004	99
1981	1667470	367739	134101	51420	0.3834	0.3565	103
1982	775930	309001	112097	92360	0.8239	0.6640	96
1983	3044640	435637	83577	63523	0.7601	0.6977	97
1984	1162470	362105	123779	56012	0.4525	0.5038	105
1985	1215220	357269	153372	39142	0.2552	0.3031	99
1986	903510	322914	139572	70764	0.5070	0.5059	95
1987	2136720	392057	130666	44360	0.3395	0.3271	102
1988	922040	345738	155513	35591	0.2289	0.2706	97
1989	887290	332190	172677	34026	0.1970	0.2364	98
1990	451370	283696	164571	44693	0.2716	0.3328	101
1991	391520	219249	134519	28529	0.2121	0.2456	93
1992	789720	225957	110920	28985	0.2613	0.2684	99
1993	591700	191289	104992	31778	0.3027	0.2319	100
1994	866950	186061	95777	24430	0.2551	0.2182	100
1995	673990	166276	76860	29575	0.3848	0.2559	99
1996	976180	210639	125104	26105	0.2087	0.1675	95
1997	1654100	238686	82719	35233	0.4259	0.4386	99
1998	553870	203048	106749	33353	0.3124	0.3980	100
1999	395980	156339	93223	29736	0.3190	0.2526	99
2000	2204430	254040	82857	23163	0.2796	0.2210	100
2001	1045060	261823	147507	24974	0.1693	0.1970	99
2002	810990	272213	170175	31787	0.1868	0.1966	99
2003	187860	215216	155027	28835	0.1860	0.1938	99
2004	1863770	263691	124145	23092	0.1860	0.1662	99

No of years for separable analysis : 8
Age range in the analysis : 1 . . . 9
Year range in the analysis : 1957 . . . 2004
Number of indices of SSB : 0
Number of age-structured indices : 1

Parameters to estimate : 38
Number of observations : 189

Conventional single selection vector model to be fitted.

Table 5.6.15. Herring in VIa (N). Parameter estimates. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

PARAMETER ESTIMATES

Parm. No.		Maximum Likelh. Estimate	CV (%)	Lower 95% CL	Upper 95% CL	-s.e.	+s.e.	Mean of Param. Distrib.
Separable model : F by year								
1	1997	0.3934	15	0.2929	0.5285	0.3384	0.4574	0.3979
2	1998	0.3570	15	0.2640	0.4827	0.3061	0.4164	0.3612
3	1999	0.2266	16	0.1642	0.3126	0.1922	0.2670	0.2296
4	2000	0.1982	17	0.1417	0.2772	0.1670	0.2352	0.2011
5	2001	0.1767	18	0.1237	0.2525	0.1473	0.2120	0.1797
6	2002	0.1763	19	0.1197	0.2598	0.1447	0.2149	0.1798
7	2003	0.1738	22	0.1125	0.2684	0.1392	0.2170	0.1781
8	2004	0.1491	25	0.0902	0.2466	0.1154	0.1927	0.1541
Separable Model: Selection (S) by age								
9	1	0.0110	36	0.0054	0.0223	0.0076	0.0158	0.0117
10	2	0.6937	15	0.5152	0.9341	0.5960	0.8074	0.7017
11	3	0.9851	14	0.7479	1.2976	0.8559	1.1338	0.9949
	4	1.0000		Fixed : Reference Age				
12	5	1.2667	12	0.9868	1.6258	1.1152	1.4387	1.2770
13	6	1.2078	12	0.9521	1.5321	1.0697	1.3636	1.2167
14	7	1.3669	12	1.0786	1.7323	1.2113	1.5425	1.3769
	8	1.0000		Fixed : Last true age				
Separable model: Populations in year 2004								
15	1	1863771	276	8274	419779041	117509	29560586	84945322
16	2	68977	36	34041	139767	48109	98897	73603
17	3	195535	29	110440	346196	146098	261700	204019
18	4	173527	25	104366	288519	133878	224918	179464
19	5	277530	24	173082	445010	218116	353129	285701
20	6	35544	23	22335	56565	28042	45052	36557
21	7	34833	23	22002	55147	27554	44035	35803
22	8	64280	24	40147	102919	50557	81728	66160
Separable model: Populations at age								
23	1997	16786	30	9203	30614	12353	22808	17593
24	1998	11156	23	6981	17827	8783	14170	11479
25	1999	10538	22	6819	16285	8439	13158	10801
26	2000	12285	20	8183	18444	9985	15116	12552
27	2001	18001	20	11973	27063	14619	22164	18394
28	2002	18293	20	12186	27461	14869	22506	18690
29	2003	30685	21	20089	46870	24721	38088	31410

Age-structured index catchabilities

Linear model fitted. Slopes at age :

30	1	Q	.5224	74	.2562	4.698	.5224	2.304	1.445
31	2	Q	2.929	23	2.331	5.922	2.929	4.713	3.822
32	3	Q	4.324	23	3.448	8.695	4.324	6.933	5.630
33	4	Q	4.521	23	3.608	9.068	4.521	7.236	5.880
34	5	Q	4.207	23	3.356	8.443	4.207	6.736	5.473
35	6	Q	4.186	23	3.335	8.430	4.186	6.718	5.453
36	7	Q	4.214	23	3.350	8.555	4.214	6.800	5.509
37	8	Q	3.389	24	2.685	6.947	3.389	5.504	4.448
38	9	Q	4.719	23	3.753	9.557	4.719	7.602	6.162

Table 5.6.16. Herring in VIa (N). Residuals about the model fit. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals

Age	1997	1998	1999	2000	2001	2002	2003	2004
1	-1.329	1.893	2.508	0.398	-2.164	0.144	-1.452	*******
2	-0.287	-0.443	0.320	0.350	0.016	-0.078	0.110	0.064
3	-0.237	-0.456	0.387	0.052	0.116	0.160	0.298	-0.184
4	-0.056	0.281	0.110	0.268	-0.342	-0.045	0.020	0.120
5	0.074	0.000	0.054	-0.136	-0.269	0.464	-0.144	-0.082
6	0.362	0.311	-0.139	0.205	-0.131	0.262	-0.608	-0.378
7	0.208	0.211	-0.369	-0.415	0.253	0.088	-0.295	0.196
8	0.000	-0.124	-0.483	-0.137	0.530	-0.782	0.799	0.381

AGE-STRUCTURED INDEX RESIDUALS

Age	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	-0.947	*******	*******	*******	1.109	-1.163	-4.147	0.634	0.814	-1.969	*******	1.988	1.495	-0.399	-0.010
2	-0.145	*******	*******	*******	-0.187	0.586	0.308	0.173	0.508	0.039	*******	-0.505	-0.363	-0.059	-0.572
3	-0.077	*******	*******	*******	-0.802	-0.401	1.032	0.391	0.169	0.347	*******	0.031	0.143	-0.284	-0.419
4	-0.323	*******	*******	*******	-0.381	-0.771	1.103	0.494	0.578	0.130	*******	0.464	-0.018	0.020	-0.667
5	-0.085	*******	*******	*******	-0.313	0.155	0.308	0.735	0.210	-0.530	*******	-0.135	0.530	0.300	-0.317
6	0.384	*******	*******	*******	0.178	-0.648	1.243	-0.175	0.527	-0.471	*******	-0.219	0.069	0.678	-0.452
7	-0.204	*******	*******	*******	-0.035	0.074	-0.114	0.825	-0.416	-0.063	*******	-0.727	0.327	0.798	0.132
8	-0.807	*******	*******	*******	-0.118	0.006	1.032	-0.055	0.855	-0.708	*******	-0.755	-0.080	0.987	-0.001
9	-2.566	*******	*******	*******	-0.450	-0.457	0.961	-0.487	0.158	-1.958	*******	-0.150	0.464	1.572	0.263

Age	2002	2003	2004
1	0.549	2.044	0.000
2	-0.717	0.405	0.526
3	-0.264	0.048	0.083
4	-0.228	0.035	-0.437
5	-0.359	0.047	-0.547
6	-0.025	-0.262	-0.830
7	0.008	0.093	-0.700
8	0.236	0.244	-0.839
9	0.630	0.749	1.267

Table 5.6.17. Herring in VIa (N). Parameters of distributions. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES AT AGE)

Separable model fitted from 1997 to 2004	
Variance	0.2068
Skewness test stat.	0.1098
Kurtosis test statistic	-0.2372
Partial chi-square	0.8469
Significance in fit	0.0000
Degrees of freedom	34

PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES

DISTRIBUTION STATISTICS FOR FLT01: West Scotland Summer Acoustic Su

Linear catchability relationship assumed

Age	1	2	3	4	5	6	7	8	9
Variance	0.0311	0.0210	0.0217	0.0304	0.0172	0.0355	0.0231	0.0456	0.1484
Skewness test stat.	-1.5428	-0.2410	0.7288	0.6962	0.3833	0.9231	0.3824	0.3762	-1.3519
Kurtosis test statisti	0.5567	-0.9560	0.4680	-0.3340	-0.7131	-0.1499	-0.2030	-0.7431	0.1314
Partial chi-square	0.0338	0.0205	0.0219	0.0313	0.0179	0.0381	0.0260	0.0538	0.1718
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	14	14	14	14	14	14	14	14	14
Degrees of freedom	13	13	13	13	13	13	13	13	13
Weight in the analysis	0.0111	0.1111	0.1111	0.1111	0.1111	0.1111	0.1111	0.1111	0.1111

Table 5.6.18. Herring in VIa (N). Analysis of variance. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

ANALYSIS OF VARIANCE

Unweighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	100.3266	189	38	151	0.6644
Catches at age	23.7788	63	29	34	0.6994
Aged Indices					
FLT01: West Scotland Summer Acoustic S	76.5477	126	9	117	0.6543

Weighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	7.5308	189	38	151	0.0499
Catches at age	7.0312	63	29	34	0.2068
Aged Indices					
FLT01: West Scotland Summer Acoustic S	0.4996	126	9	117	0.0043

Table 5.7.1 Herring in VIa (N) parameters of stock recruit relationships fitted to the stock SSB and recruitment data from the 2003 assessment, for full period 1957 to 2000 and a truncated period 1976 to 2000.

	Data from 1957 to 2000				Data 1976 to 2000			
	Change-point	Ricker	Beverton-Holt	Shepherd	Change-point	Ricker	Beverton-Holt*	Shepherd
alpha	7.7625	9.99245	4.57E+03	3.77E+01	1.78E+01	4.09E+01	7.78E+02	2.29E+01
beta	491.5	1.22E-03	3.70E+02	1.04E+01	53.96	1.36E-02	-1.85E+01	9.51E+01
Gamma				4.62E-01				2.63
AIC	82.04	79.37	78.46	74.40	32.13	30.07	31.39	28.22

* This model was biologically implausible for the data and was therefore not used in the evaluation.

Table 5.7.2. Herring in VIa (N) summary of general outcomes for different options of long term exploitation F from 0.2 to 0.4. Showing a small range of harvest options, effect on SSB if the long period S/R relationship holds, and yield options under the short term period S/R relationship. For more details of the latter see figure 5.7.14.

F3 (Long term)	**F2 (intermediate)**	**Stock Recruit period 1957-2000**	**Stock Recruit period 1976-2000** **Range of Median Yield**	**B2 (B trigger)**	**Year on Year Constraint**	**Risk (falling below Blim)**
0.2	0.2	Median SSB increases by approx. 95 % over 10 year period	37,300t unless stock increases	Not relevant	Highest yield at 2000 t constraint	0
0.25	0.2	Median SSB increases by approx. 44 % over 10 year period	38,400 to 39,400t unless stock increases	Max yield at 75,000t	Lowest yield at 4000 t Highest at 1000 t constraint	Less than 1%
0.3	0.25	Median SSB almost stable	39,300 to 40,800t	Max yield at 120,000t	Lowest yield at 4000 t+, Highest at 1000 t constraint	Less than 1%
0.35	0.25	Median SSB decreases by approx. 18 % over 10 year period	40,100 to 41,600t	Max yield at 105,000t	Lowest yield at 6000 t+, Highest at 2000 t constraint	0.7% to 1.6%
0.4	0.25	Median SSB decreases by approx. 35 % over 10 year period	33,400 to 43,000t	Max yield at 95,000t	Lowest yield at 6000 t, Highest at 2000 t constraint	1.3% to 4.0%

Table 5.8.1.1 Herring in VIa (N). Input data for short-term predictions, numbers at age from the assessment with ages 1 and 2 replaced by geometric mean values - natural mortality (M), proportion mature (Mat), proportion of fishing mortality prior to spawning (PF), proportion of natural mortality prior to spawning (PM), mean weights at age in the stock (SWt), selection pattern (Sel), mean weights at age in the catch (CWt). All biological data are taken as mean of the last 3 years. VIa (N) herring appears to have considerable annual variability in mean weights and in faction mature. Last years values are not applicable. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

2005

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	925834	1	0	0.67	0.67	6.17E-02	1.83E-03	5.95E-02
2	339974	0.3	0.836667	0.67	0.67	0.143	0.11545	0.148067
3	46079	0.2	0.99	0.67	0.67	0.170667	0.163947	0.163167
4	138220	0.1	1	0.67	0.67	0.189333	0.166427	0.177133
5	135260	0.1	1	0.67	0.67	0.201667	0.210803	0.184167
6	207900	0.1	1	0.67	0.67	0.21	0.201003	0.195
7	26862	0.1	1	0.67	0.67	0.218333	0.227487	0.189133
8	25707	0.1	1	0.67	0.67	0.226667	0.166427	0.204833
9	54173	0.1	1	0.67	0.67	0.231	0.166427	0.293467

2006

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	925834	1	0	0.67	0.67	6.17E-02	1.83E-03	5.95E-02
2		0.3	0.836667	0.67	0.67	0.143	0.11545	0.148067
3		0.2	0.99	0.67	0.67	0.170667	0.163947	0.163167
4		0.1	1	0.67	0.67	0.189333	0.166427	0.177133
5		0.1	1	0.67	0.67	0.201667	0.210803	0.184167
6		0.1	1	0.67	0.67	0.21	0.201003	0.195
7		0.1	1	0.67	0.67	0.218333	0.227487	0.189133
8		0.1	1	0.67	0.67	0.226667	0.166427	0.204833
9		0.1	1	0.67	0.67	0.231	0.166427	0.293467

2007

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	925834	1	0	0.67	0.67	6.17E-02	1.83E-03	5.95E-02
2		0.3	0.836667	0.67	0.67	0.143	0.11545	0.148067
3		0.2	0.99	0.67	0.67	0.170667	0.163947	0.163167
4		0.1	1	0.67	0.67	0.189333	0.166427	0.177133
5		0.1	1	0.67	0.67	0.201667	0.210803	0.184167
6		0.1	1	0.67	0.67	0.21	0.201003	0.195
7		0.1	1	0.67	0.67	0.218333	0.227487	0.189133
8		0.1	1	0.67	0.67	0.226667	0.166427	0.204833
9		0.1	1	0.67	0.67	0.231	0.166427	0.293467

Table 5.8.1.2 Herring in VIa (N). Short-term prediction single option table, *status quo* F. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Year:	2005	F multiplier:	1	Fbar:	0.1855				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0018	1068	64	925834	57093	0	0	0	0
2	0.1155	32118	4756	339974	48616	284445	40676	215334	30793
3	0.1639	6332	1033	46079	7864	45618	7786	35747	6101
4	0.1664	20194	3577	138220	26170	138220	26170	115624	21891
5	0.2108	24508	4514	135260	27277	135260	27277	109833	22150
6	0.201	36086	7037	207900	43659	207900	43659	169930	35685
7	0.2275	5211	986	26862	5865	26862	5865	21570	4709
8	0.1664	3756	769	25707	5827	25707	5827	21504	4874
9	0.1664	7915	2323	54173	12514	54173	12514	45317	10468
Total		137187	25057	1900009	234885	918185	169773	734858	136672

Year:	2006	F multiplier:	1	Fbar:	0.1855				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0018	1068	64	925834	57093	0	0	0	0
2	0.1155	32118	4756	339974	48616	284445	40676	215333	30793
3	0.1639	30838	5032	224398	38297	222154	37914	174082	29710
4	0.1664	4678	829	32022	6063	32022	6063	26787	5072
5	0.2108	19187	3534	105892	21355	105892	21355	85986	17340
6	0.201	17206	3355	99126	20817	99126	20817	81022	17015
7	0.2275	29848	5645	153862	33593	153862	33593	123549	26975
8	0.1664	2829	579	19360	4388	19360	4388	16195	3671
9	0.1664	8941	2624	61197	14137	61197	14137	51192	11825
Total		146712	26417	1961664	244359	978057	178942	774146	142401

Year:	2007	F multiplier:	1	Fbar:	0.1855				
Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0018	1068	64	925834	57093	0	0	0	0
2	0.1155	32118	4756	339974	48616	284445	40676	215333	30793
3	0.1639	30838	5032	224397	38297	222153	37914	174082	29710
4	0.1664	22783	4036	155940	29525	155940	29525	130447	24698
5	0.2108	4445	819	24532	4947	24532	4947	19920	4017
6	0.201	13470	2627	77604	16297	77604	16297	63430	13320
7	0.2275	14231	2692	73361	16017	73361	16017	58908	12862
8	0.1664	16202	3319	110893	25136	110893	25136	92764	21027
9	0.1664	9017	2646	61716	14256	61716	14256	51627	11926
Total		144171	25988	1994251	250185	1010644	184768	806511	148352

Table 5.8.1.3 Herring in VIa (N). Short-term prediction multiple option table, *status quo* F.

2005

Biomass	SSB	FMult	FBar	Landings
234885	136672	1	0.1855	25057

2006					2007	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
244359	160277	0	0	0	277508	190931
.	158388	0.1	0.0186	2855	274547	186100
.	156522	0.2	0.0371	5661	271639	181406
.	154679	0.3	0.0557	8417	268784	176846
.	152859	0.4	0.0742	11126	265980	172416
.	151062	0.5	0.0928	13787	263226	168112
.	149286	0.6	0.1113	16402	260522	163930
.	147533	0.7	0.1299	18972	257867	159867
.	145801	0.8	0.1484	21497	255260	155918
.	144090	0.9	0.167	23978	252699	152081
.	142401	1	0.1855	26417	250185	148352
.	140732	1.1	0.2041	28813	247715	144728
.	139084	1.2	0.2227	31168	245290	141206
.	137456	1.3	0.2412	33482	242908	137782
.	135848	1.4	0.2598	35757	240568	134454
.	134260	1.5	0.2783	37992	238271	131219
.	132691	1.6	0.2969	40189	236014	128075
.	131142	1.7	0.3154	42348	233798	125017
.	129611	1.8	0.334	44470	231621	122045
.	128100	1.9	0.3525	46556	229483	119155
.	126606	2	0.3711	48606	227383	116345
.	125132	2.1	0.3896	50622	225320	113613
.	123675	2.2	0.4082	52602	223294	110956
.	122236	2.3	0.4268	54549	221304	108371
.	120814	2.4	0.4453	56463	219349	105858
.	119410	2.5	0.4639	58345	217429	103414

Table 5.8.1.4 Herring in VIa (N). Short-term prediction single option table, TAC catch constraint. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Year: 2005 F multiplier: 1.2238 Fbar: 0.2271

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0022	1307	78	925834	57093	0	0	0	0
2	0.1413	38838	5751	339974	48616	284445	40676	211637	30264
3	0.2006	7618	1243	46079	7864	45618	7786	34879	5953
4	0.2037	24280	4301	138220	26170	138220	26170	112774	21352
5	0.258	29333	5402	135260	27277	135260	27277	106415	21460
6	0.246	43233	8430	207900	43659	207900	43659	164884	34626
7	0.2784	6226	1178	26862	5865	26862	5865	20846	4551
8	0.2037	4516	925	25707	5827	25707	5827	20974	4754
9	0.2037	9516	2793	54173	12514	54173	12514	44200	10210
Total		164866	30100	1900009	234885	918185	169773	716609	133170

Year: 2006 F multiplier: 1 Fbar: 0.1855

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0018	1068	64	925834	57093	0	0	0	0
2	0.1155	32105	4754	339835	48596	284328	40659	215245	30780
3	0.1639	30051	4903	218673	37320	216486	36947	169641	28952
4	0.1664	4510	799	30868	5844	30868	5844	25822	4889
5	0.2108	18485	3404	102020	20574	102020	20574	82842	16706
6	0.201	16413	3200	94558	19857	94558	19857	77288	16230
7	0.2275	28535	5397	147093	32115	147093	32115	118114	25788
8	0.1664	2688	551	18399	4170	18399	4170	15391	3489
9	0.1664	8614	2528	58959	13620	58959	13620	49321	11393
Total		142468	25600	1936238	239190	952711	173787	753662	138228

Year: 2007 F multiplier: 1 Fbar: 0.1855

Age	F	CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
1	0.0018	1068	64	925834	57093	0	0	0	0
2	0.1155	32118	4756	339974	48616	284445	40676	215333	30793
3	0.1639	30825	5030	224306	38281	222063	37899	174010	29698
4	0.1664	22202	3933	151962	28771	151962	28771	127119	24068
5	0.2108	4285	789	23648	4769	23648	4769	19203	3873
6	0.201	12977	2531	74766	15701	74766	15701	61111	12833
7	0.2275	13575	2568	69980	15279	69980	15279	56193	12269
8	0.1664	15489	3173	106014	24030	106014	24030	88683	20102
9	0.1664	8659	2541	59265	13690	59265	13690	49577	11452
Total		141198	25382	1975749	246231	992143	180815	791229	145087

Table 5.8.1.5 Herring in VIa (N). Short-term prediction multiple option table, TAC catch constraint.

2005				
Biomass	SSB	FMult	FBar	Landings
234885	133170	1.2238	0.2271	30100

2006					2007	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
239190	155517	0	0	0	272698	186434
.	153690	0.1	0.0186	2766	269830	181744
.	151885	0.2	0.0371	5484	267014	177188
.	150103	0.3	0.0557	8155	264248	172761
.	148343	0.4	0.0742	10780	261533	168460
.	146605	0.5	0.0928	13359	258866	164281
.	144888	0.6	0.1113	15893	256247	160219
.	143192	0.7	0.1299	18383	253675	156273
.	141516	0.8	0.1484	20831	251149	152437
.	139862	0.9	0.167	23236	248668	148710
.	138228	1	0.1855	25600	246231	145087
.	136614	1.1	0.2041	27923	243839	141565
.	135019	1.2	0.2227	30206	241488	138142
.	133444	1.3	0.2412	32449	239180	134815
.	131889	1.4	0.2598	34655	236913	131580
.	130352	1.5	0.2783	36822	234686	128436
.	128835	1.6	0.2969	38952	232499	125378
.	127336	1.7	0.3154	41046	230351	122406
.	125855	1.8	0.334	43104	228241	119515
.	124392	1.9	0.3525	45127	226168	116705
.	122948	2	0.3711	47116	224132	113972

Table 5.11.1 Herring from the Firth of Clyde. Catch in tonnes by country, 1955–2004. Spring and autumn-spawners combined.

Year	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
All Catches														
Total	4,050	4,848	5,915	4,926	10,530	15,680	10,848	3,989	7,073	14,509	15,096	9,807	7,929	9,433

Year	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	
All Catches														
Total	10,594	7,763	4,088	4,226	4,715	4,061	3,664	4,139	4,847	3,862	1,951	2,081	2,135	

Year	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
Scotland	2,506	2,530	2,991	3,001	3,395	2,895	1,568	2,135	2,184	713	929	852	608	392
Other UK	-	273	247	22	-	-	-	-	-	-	-	1	-	194
Unallocated[1]	262	293	224	433	576	278	110	208	75	18	-	-	-	-
Discards	1,253	1,265	2,308[3]	1,344[3]	679[3]	439[4]	245[4]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]	-[2]
Agreed TAC			3,000	3,000	3,100	3,500	3,200	3,200	2,600	2,900	2,300	1,000	1,000	1,000
Total	4,021	4,361	5,770	4,800	4,650	3,612	1,923	2,343	2,259	731	929	853	608	586

Year	1996	1997	1998	1999	2000	2001	2002	2003	2004
Scotland	598	371	779	16	1	78	46	88	-
Other UK	127	475	310	240	0	392	335	240	-
Unallocated[1]	-	-	-	-	-	-	-	-	-
Discards	-	-	-	-	-	-	-	-	-
Agreed TAC	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
Total	725	846	1089	256	1	480	381	328	0

[1]Calculated from estimates of weight per box and in some years estimated by-catch in the sprat fishery

[2]Reported to be at a low level, assumed to be zero, for 1989-1995.

[3]Based on sampling.

[4]Estimated assuming the same discarding rate as in 1986

Table 5.11.2 HERRING from the Firth of Clyde. Sampling levels 1988-2004.

Year	Reported catch (tonnes)	No. of samples	No. of fish measured	No. of fish aged	Discards
1988	1,568	41	5,955	2,574	Based on local reports
1989	2,135	45	8,368	4,152	" "
1990	2,184	37	5,926	3,803	" "
1991	713	29	4,312	2,992	No information
1992	929	23	4,604	1,579	No information
1993	853	16	3,408	798	No information
1994	608	16	3,903	1,388	No information
1995	586	16	2,727	1,073	No information
1996	725	9	1,915	679	No information
1997	846	3	650	383	No information
1998	1089	3	462	196	
1999	256	3	251	126	
2000[1]	1	1	105	96	
2001	480	3	799	143	
2002	381	0	0	0	
2003	328	1	1,175	50	
2004	0	0	0	0	

[1] One sample collected in first quarter, but not applied to catch, which was taken in third quarter.

Table 5.11.3 HERRING from the Firth of Clyde. Catch in numbers-at-age. Spring- and autumn-spawners combined. Thousands of fish. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Age(Rings)	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
1	5008	2207	1351	9139	53081	2694	6194	1041	14123	507	333	312
2	7551	6503	8983	5258	8841	1876	10480	7524	1796	4859	5633	2372
3	10338	1976	3181	4548	2817	2483	913	6976	2259	807	1592	2785
4	8745	4355	1684	1811	2559	1024	1049	1062	2724	930	567	1622
5	2306	3432	3007	918	1140	1072	526	1112	634	888	341	1158
6	741	1090	1114	1525	494	451	638	574	606	341	204	433
7	760	501	656	659	700	175	261	409	330	289	125	486
8	753	352	282	307	253	356	138	251	298	156	48	407
9	227	225	177	132	87	130	178	146	174	119	56	74
10+	117	181	132	114	59	67	100	192	236	154	68	18
Age(Rings)	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
1	220	314	4156	1639	678	508	0	845	716	42	145	3
2	11311	10109	11829	2951	4574	1376	1062	1523	1004	615	411	418
3	4079	5232	5774	4420	4431	3669	1724	9239	839	472	493	261
4	2440	1747	3406	4592	4622	4379	2506	876	7533	703	385	268
5	1028	963	1509	2806	2679	3400	2014	452	576	1908	1947	1305
6	663	555	587	2654	1847	1983	1319	252	359	169	333	327
7	145	415	489	917	644	1427	510	146	329	92	91	78
8	222	189	375	681	287	680	234	29	119	113	69	111
9	63	85	74	457	251	308	66	16	49	22	32	38
10+	53	38	80	240	79	175	16	5	16	9	10	0
Age(Rings)	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	
1	399	118	494	275	323	123	0	0	-	0	-	
2	964	1425	1962	2005	2731	418	3	1427	-	153	-	
3	964	186	1189	429	1779	318	2	67	-	645	-	
4	358	189	273	346	667	393	1	20	-	466	-	
5	534	149	544	18	344	122	1	406	-	92	-	
6	319	130	183	52	77	36	0	40	-	111	-	
7	76	66	208	0	55	36	0	0	-	138	-	
8	57	35	127	5	35	13	0	22	-	-	-	
9	16	15	52	61	55	19	0	0	-	-	-	
10+	17	1	9	*								

*change to 9+ in 1997.

Table 5.11.4 HERRING in the Firth of Clyde. Mean weights-at-age in the catch and stock (g). N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Weight in the catch

Age (rings)	1970-81	1982-85	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	-	-	-	-	-	-	-	-	-	-	-	102	90	112	103	87	97	-	-	-	-
2	225	149	166	149	156	149	170	143	141	141	92	151	146	142	148	152	140	136	-	179	-
3	270	187	199	194	194	174	186	163	187	174	157	174	184	174	174	169	162	156	-	185	-
4	290	228	224	203	207	203	202	188	188	198	184	201	203	192	189	184	180	201	-	215	-
5	310	253	253	217	211	221	216	192	216	213	212	226	233	231	204	197	194	196	-	235	-
6	328	272	265	225	222	227	237	198	227	216	249	241	255	228	218	202	213	235	-	232	-
7	340	307	297	236	230	235	234	210	206	229	248	249	257	189	229	220	242	-	-	242	-
8	345	291	298	247	225	237	234	222	218	261	240	252	255	286	240	229	249	288	-	-	-
9	350	300	298	255	244	219	257	200	201	233	249	242	284	218	246	241	256	-	-	-	-
10+	350	300	321	258	230	254	272	203	221	254	294	270	239	*							

* change to 9+ in 1997

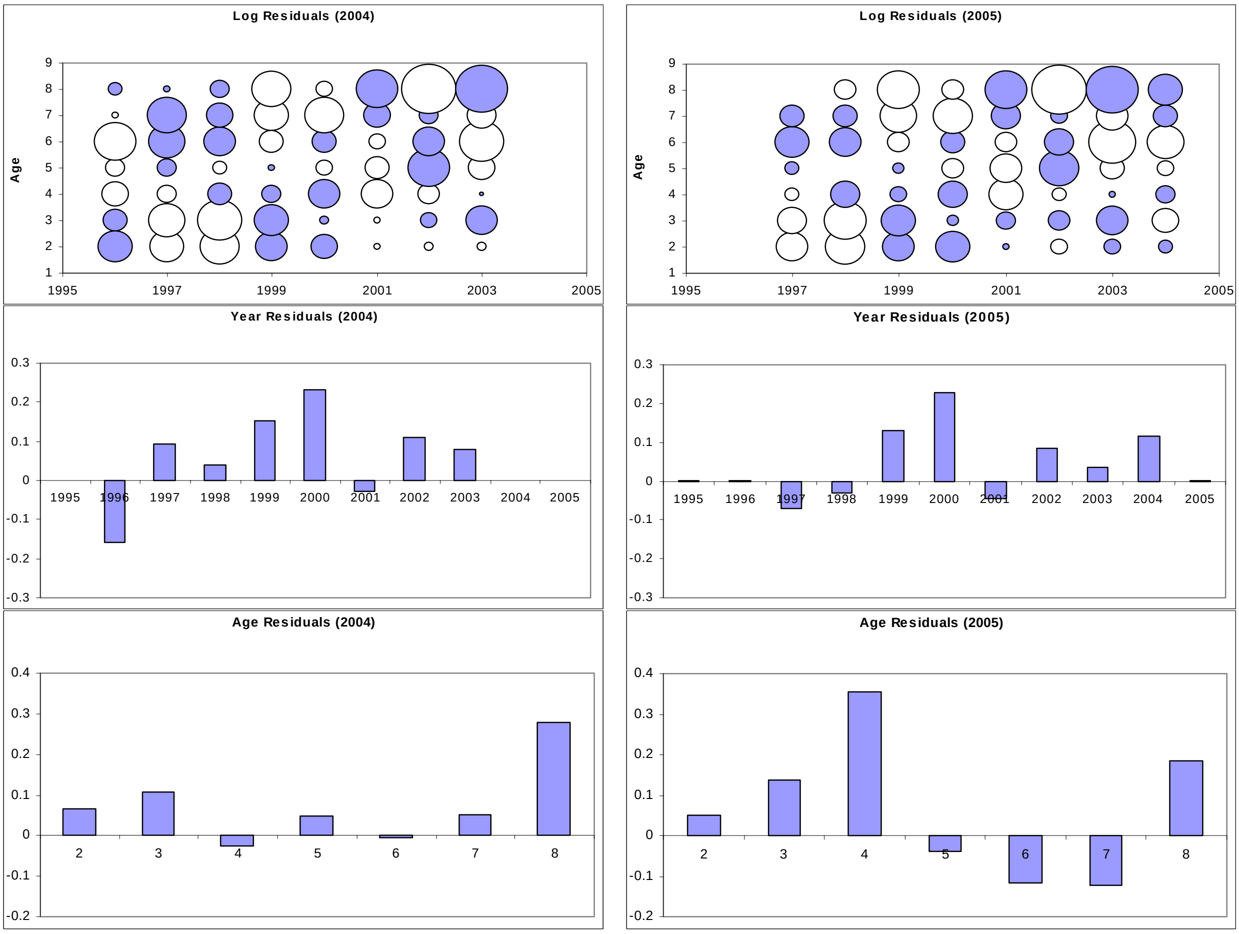


Figure 5.6.1 Herring in VIa (N), selection pattern residual plots for this years assessment compared with last years assessment to show the consistency in the year residuals and small differences in the low age residuals with the update assessment.

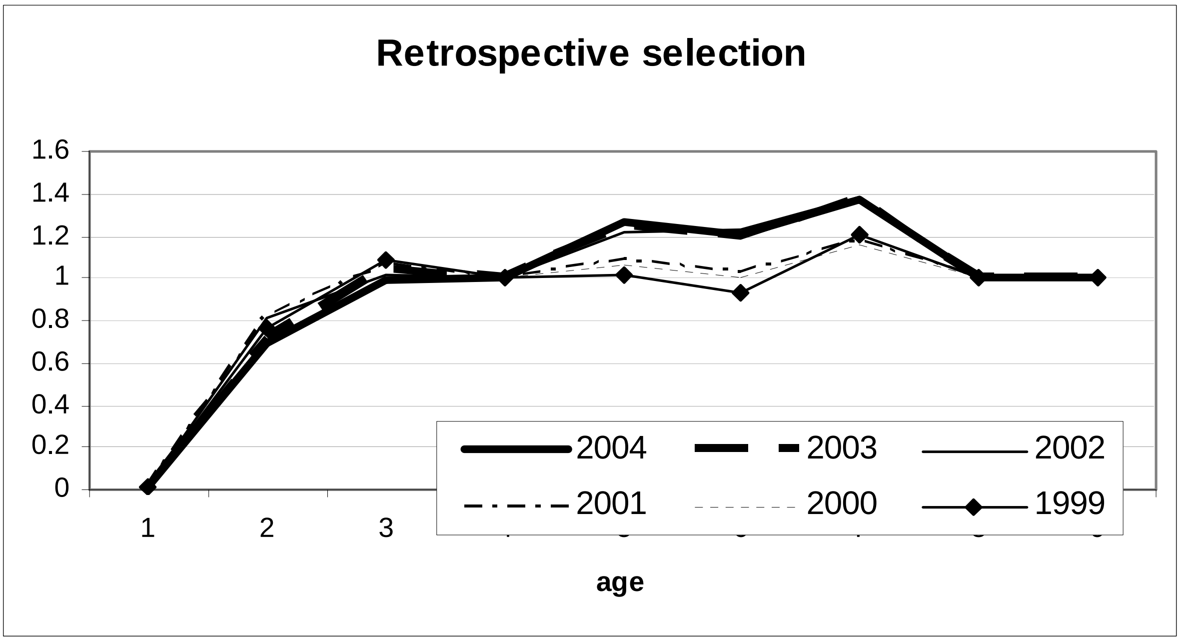


Figure 5.6.2 Herring in VIa (N), plot to show the selection pattern in assessments over last 6 years showing the consistency in the selection pattern in recent assessments by terminal year of the assessment.

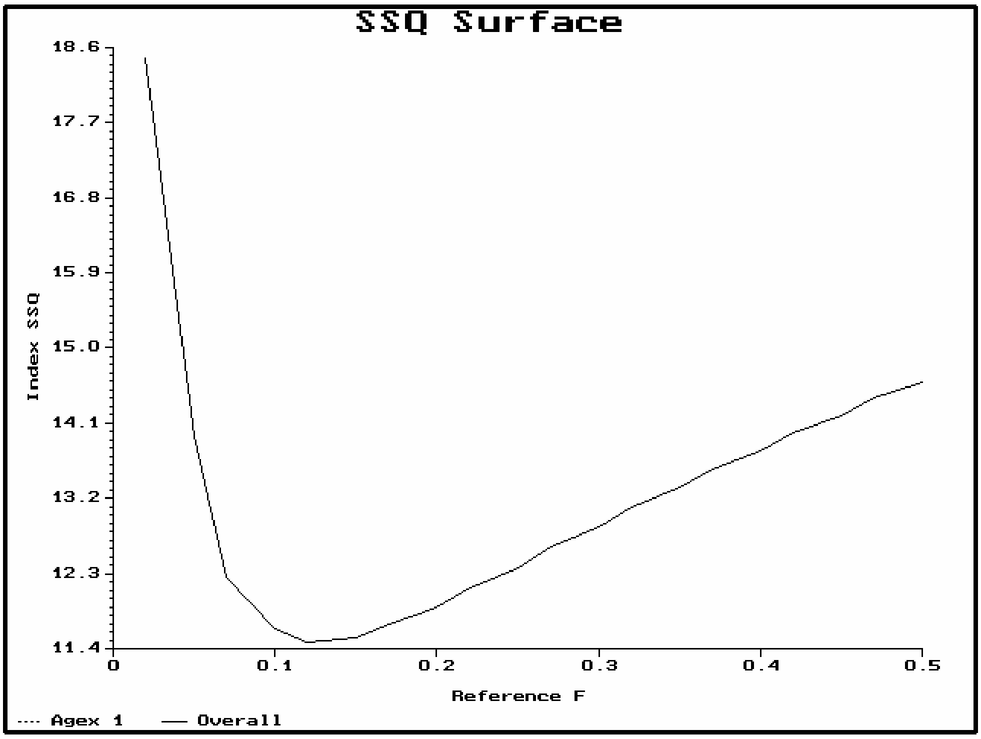


Figure 5.6.3 Herring in VIa (N,. SSQ surface for the deterministic calculation of the 8-year separable period. Agex 1- age disaggregated acoustic estimates

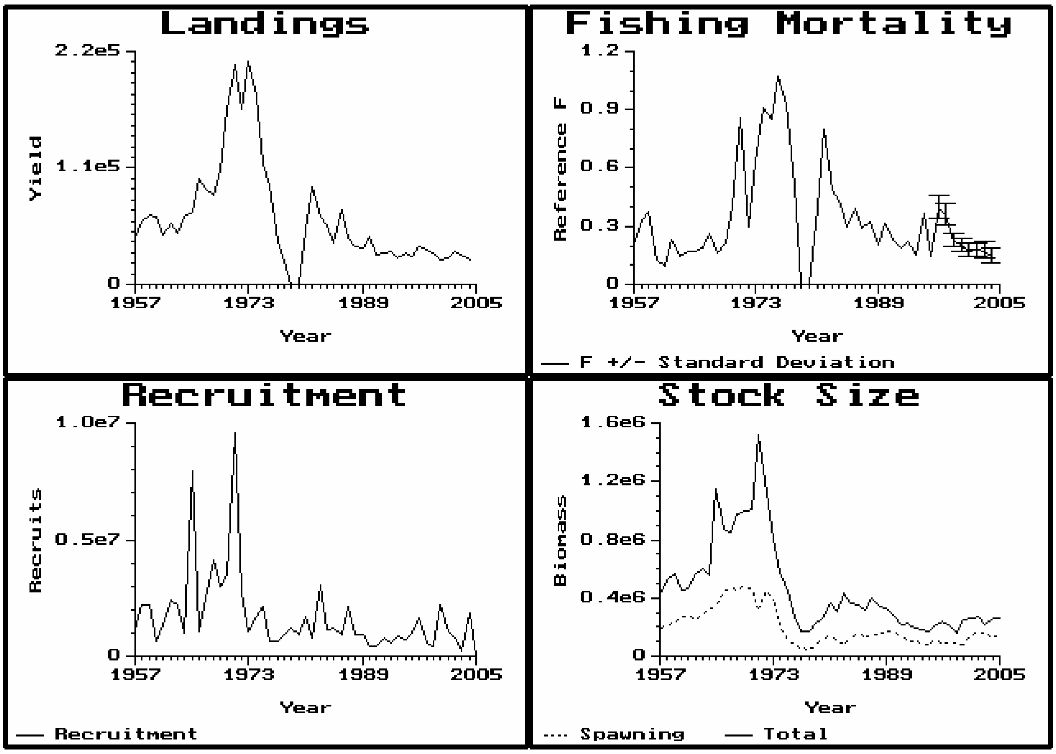


Figure 5.6.4 Herring in VIa (N), illustration of stock trends from deterministic calculation (8-year separable period). Summary of estimates of landings, fishing mortality at 4-ring, recruitment at 1-ring, stock size on 1 January and spawning stock at spawning time.

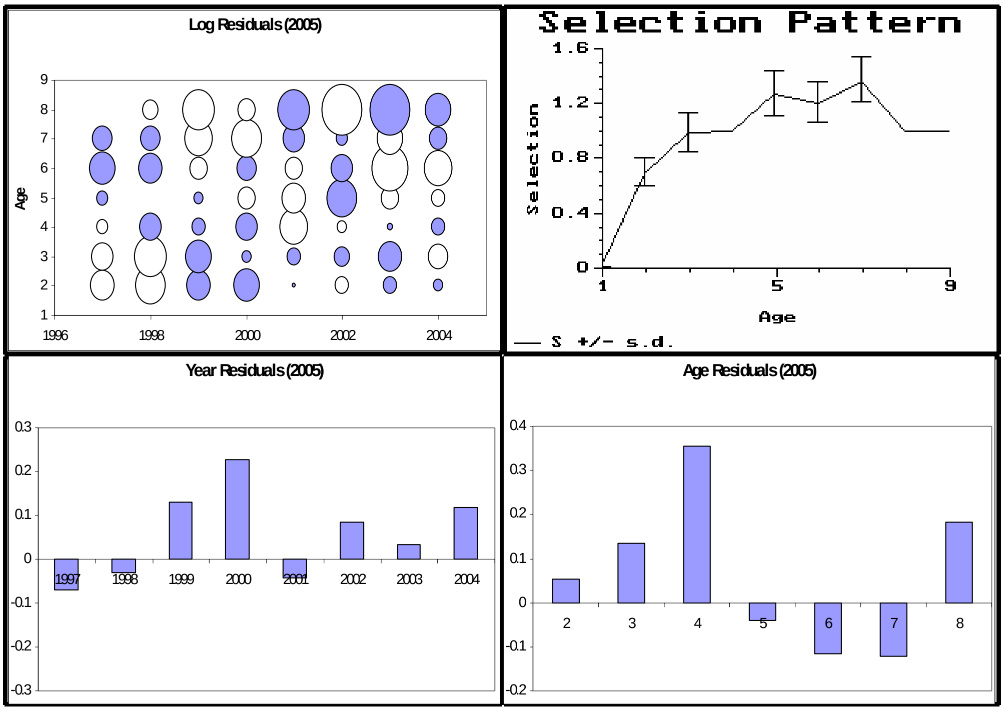


Figure 5.6.5 Herring in VIa (N), illustration of selection patterns diagnostics, from deterministic calculation (8-year separable period). Top left, a bubble plot of selection pattern residuals. Top right, estimated selection (relative to 4-ringers) +/- standard deviation. Bottom, marginal totals of residuals by year and ring.

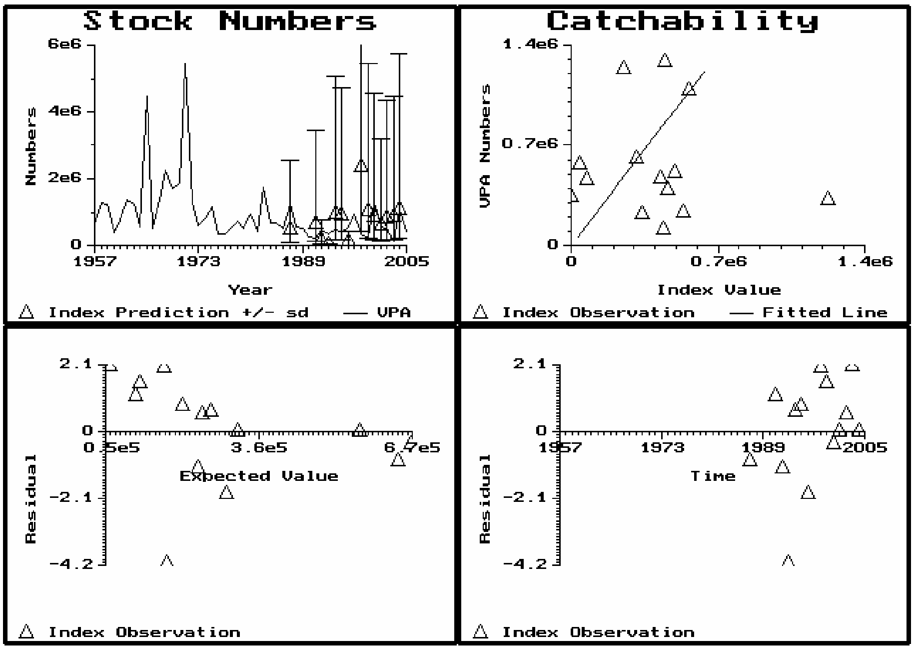


Figure 5.6.6 Herring in VIa (N), illustration of residuals from deterministic calculation (8-year separable period). Diagnostics of the fit of the 1-ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 1-ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time. N.B. 1-ringers are down-weighted in the catch and survey in the assessment.

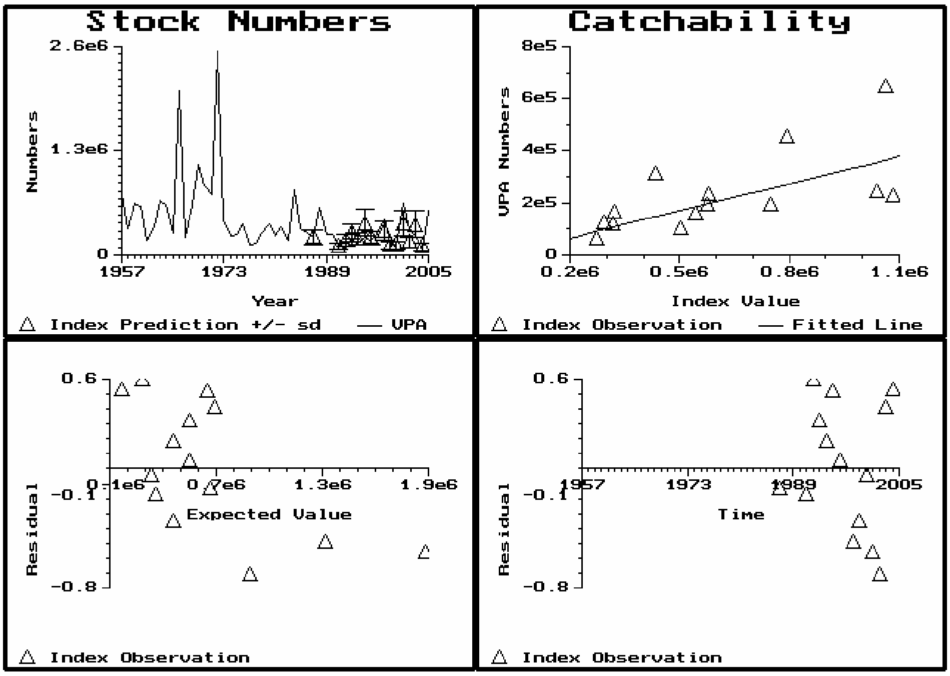


Figure 5.6.7 Herring in VIa (N), illustration of residuals from deterministic calculation (8-year separable period). Diagnostics of the fit of the 2-ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 2-ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

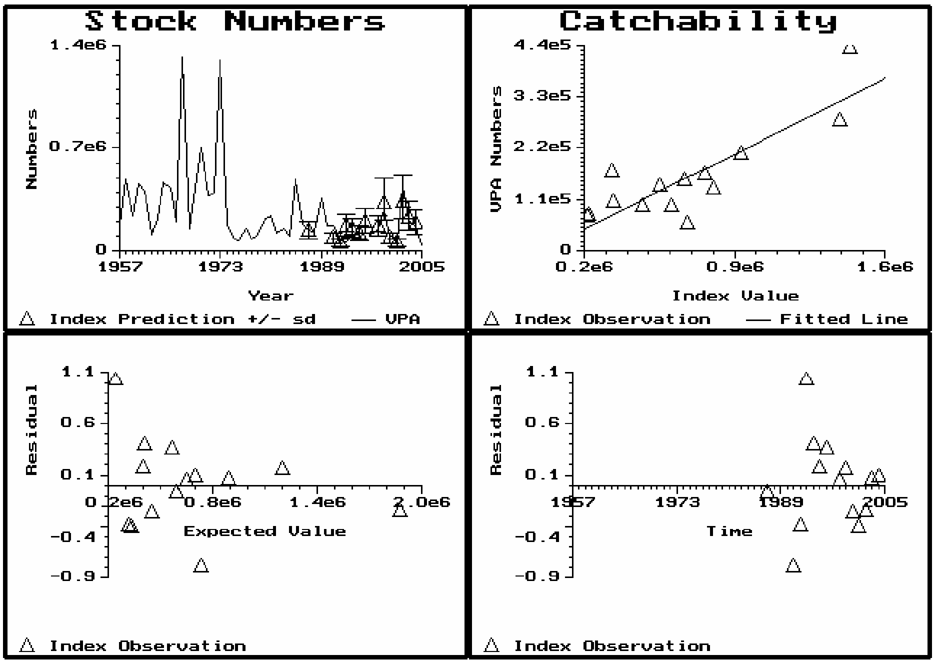


Figure 5.6.8 Herring in VIa (N), illustration of residuals from deterministic calculation (8-year separable period). Diagnostics of the fit of the 3-ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 3-ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

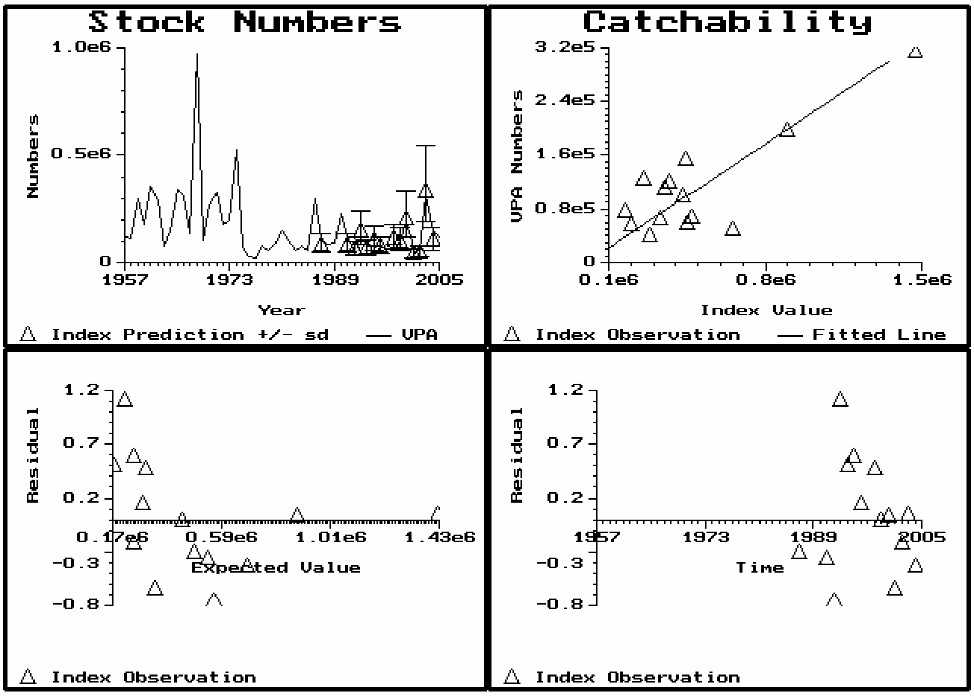


Figure 5.6.9 Herring in VIa (N), illustration of residuals from deterministic calculation (8-year separable period). Diagnostics of the fit of the 4-ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 4-ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

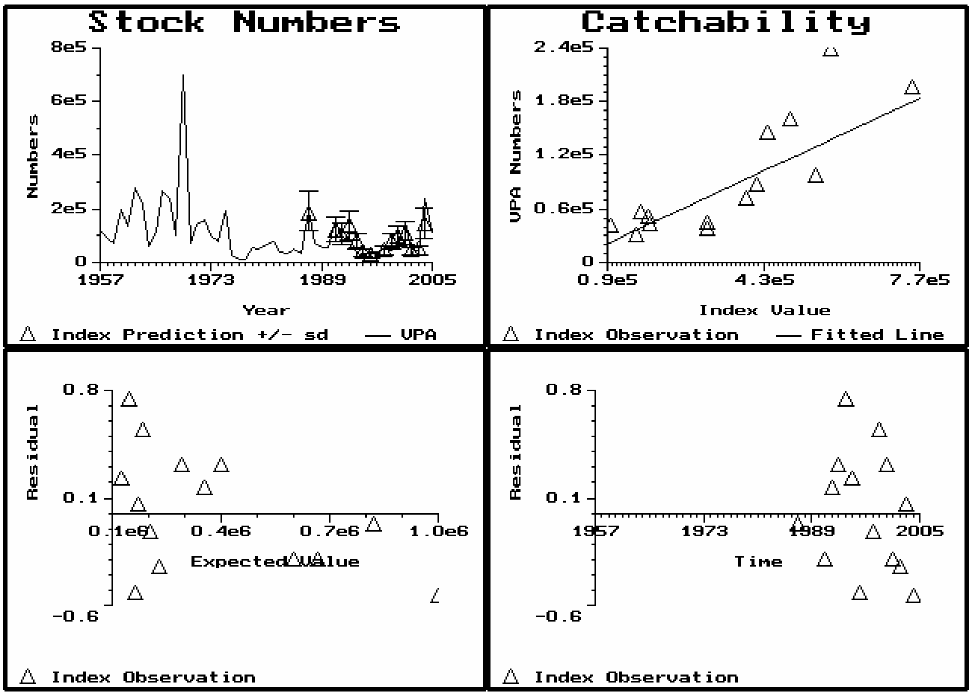


Figure 5.6.10 Herring in VIa (N), illustration of residuals from deterministic calculation (8-year separable period). Diagnostics of the fit of the 5 ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 5 ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

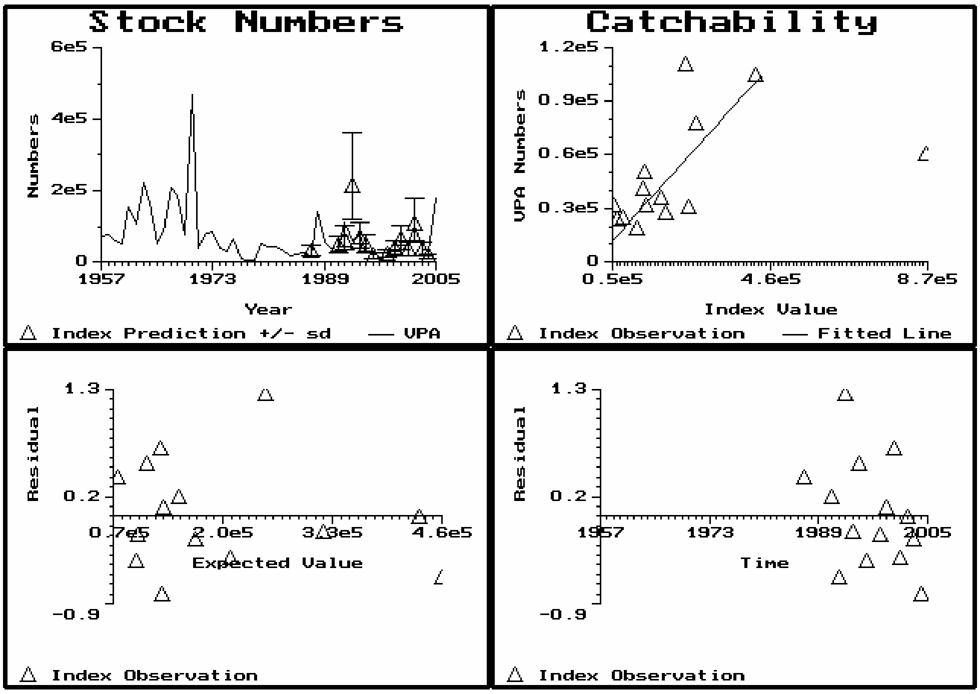


Figure 5.6.11 Herring in VIa (N), illustration of residuals from deterministic calculation (8-year separable period). Diagnostics of the fit of the 6 ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 6 ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

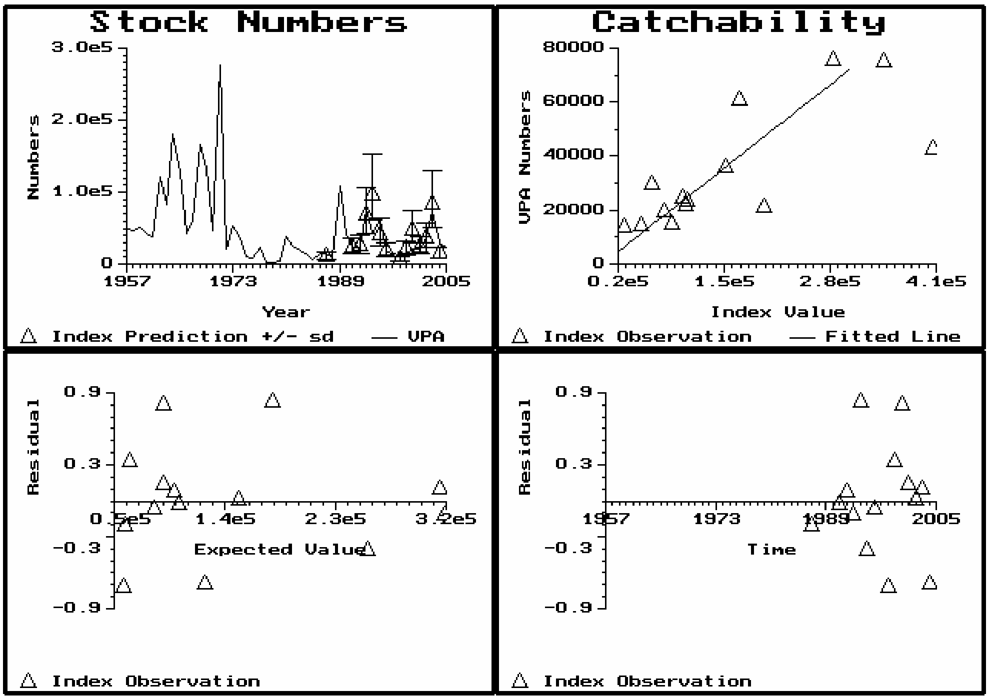


Figure 5.6.12 Herring in VIa (N), illustration of residuals from deterministic calculation (8-year separable period). Diagnostics of the fit of the 7 ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 7 ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

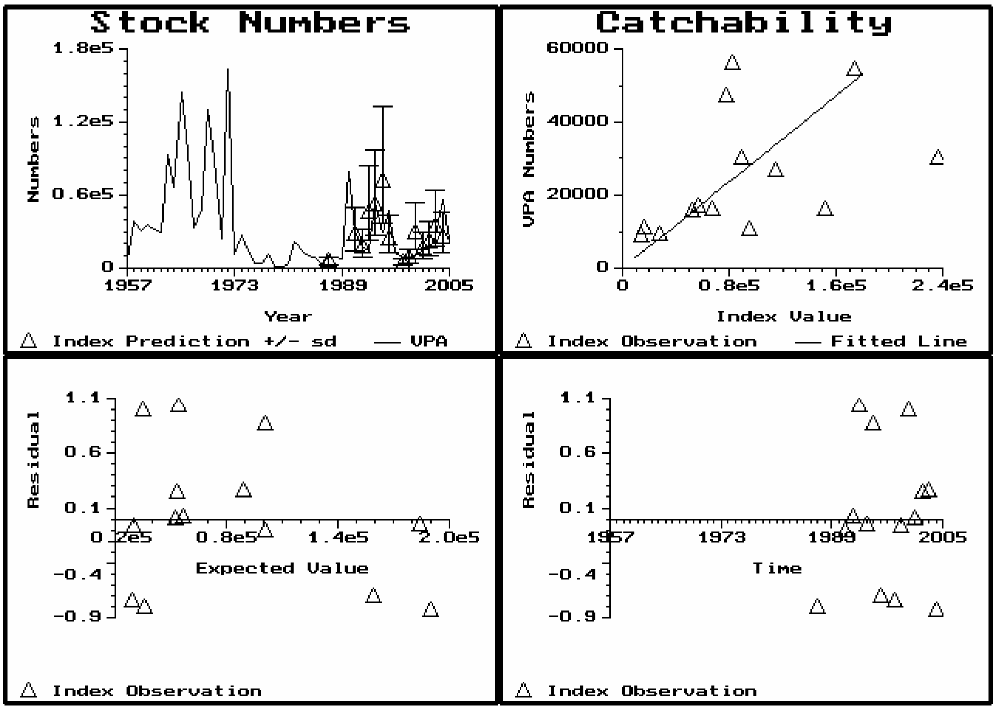


Figure5.6.13 Herring in VIa (N), illustration of residuals from deterministic calculation (8-year separable period). Diagnostics of the fit of the 8 ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 8 ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

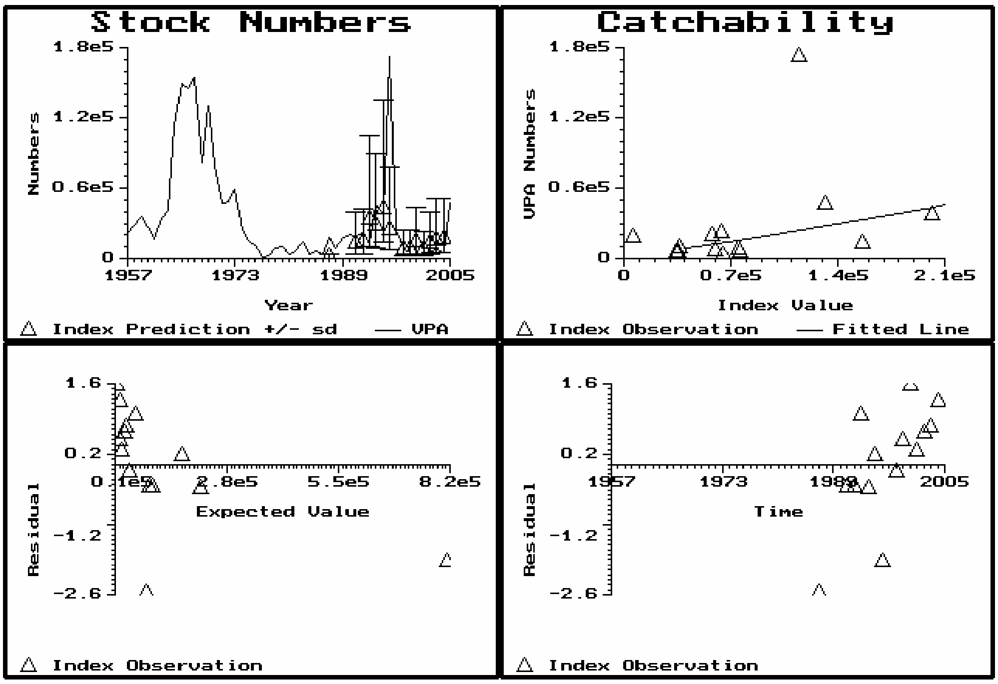


Figure 5.6.14 Herring in VIa (N), illustration of residuals from deterministic calculation (8-year separable period). Diagnostics of the fit of the 9 ring index against the acoustic surveys. Top left, fitted populations (line), and predictions of abundance in each year made from the index observations and estimated catchability (triangles +/- standard deviation), plotted by year. Top right, scatter plot and fitted relationship of abundance from fitted populations of 9 ringers in acoustic surveys. Bottom, residuals, as ln(observed index) - ln(expected index) plotted against expected values and against time.

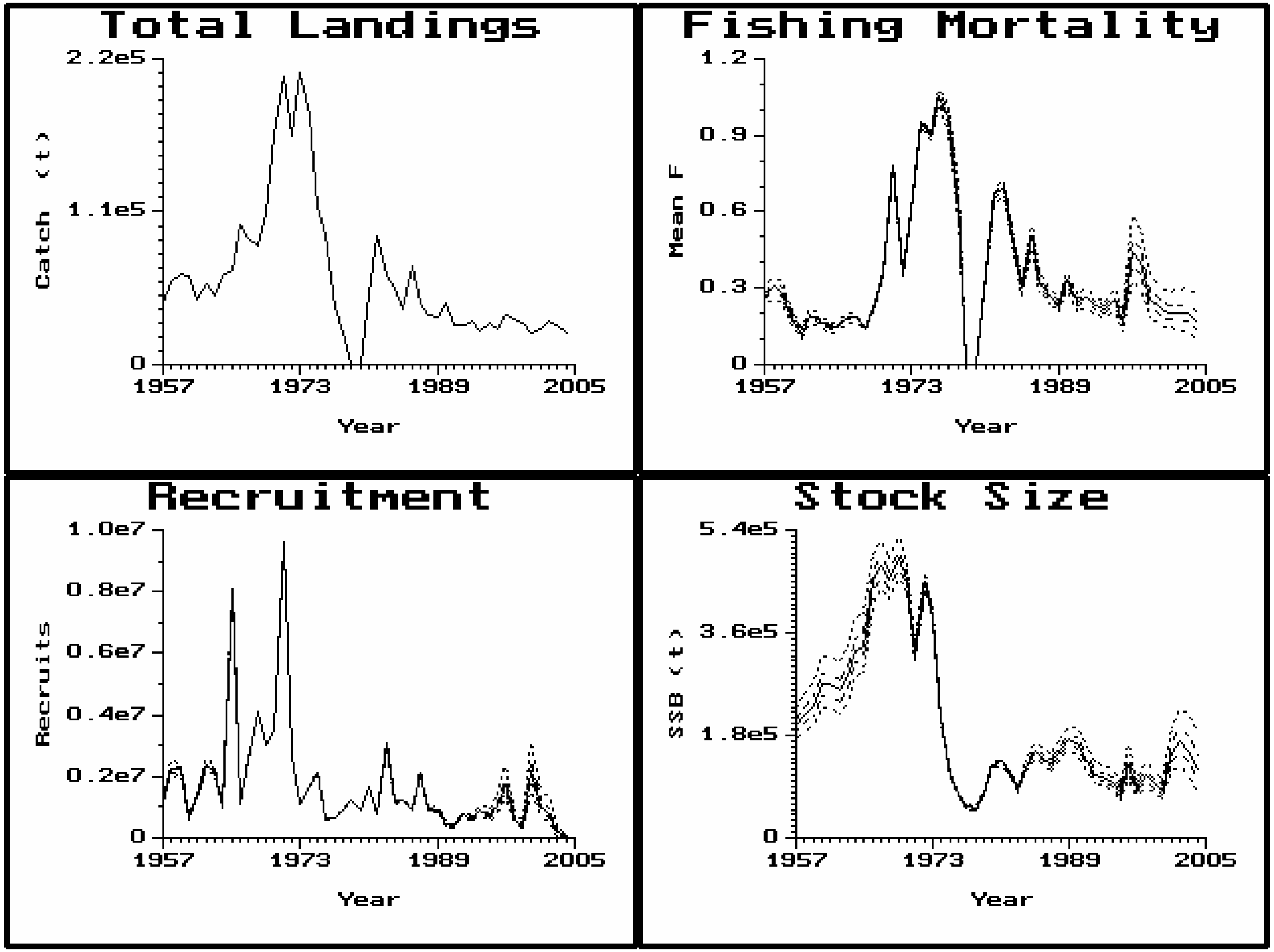


Figure 5.6.15 Herring in VIa (N), trajectories of 5, 25, 50, 75 and 95 percentiles from the estimates of historical uncertainty of F, SSB and recruits produced in the final assessment. These were based on 1000 samples.

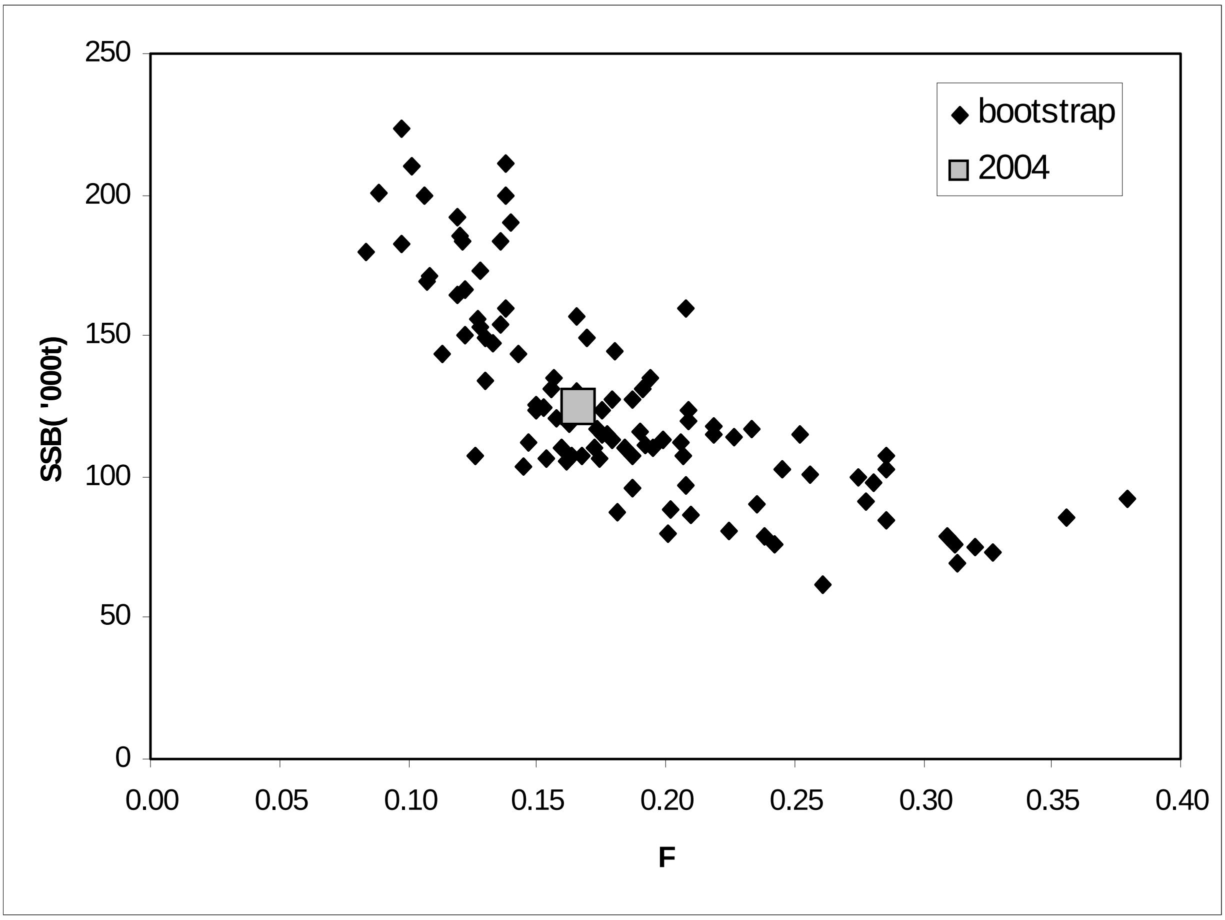


Figure 5.6.16 Herring in VIa (N), scatter plot of estimates of F and SSS for the terminal year using parameter estimate variance covariance matrix estimates in a bootstrap evaluation of precision of the assessment.

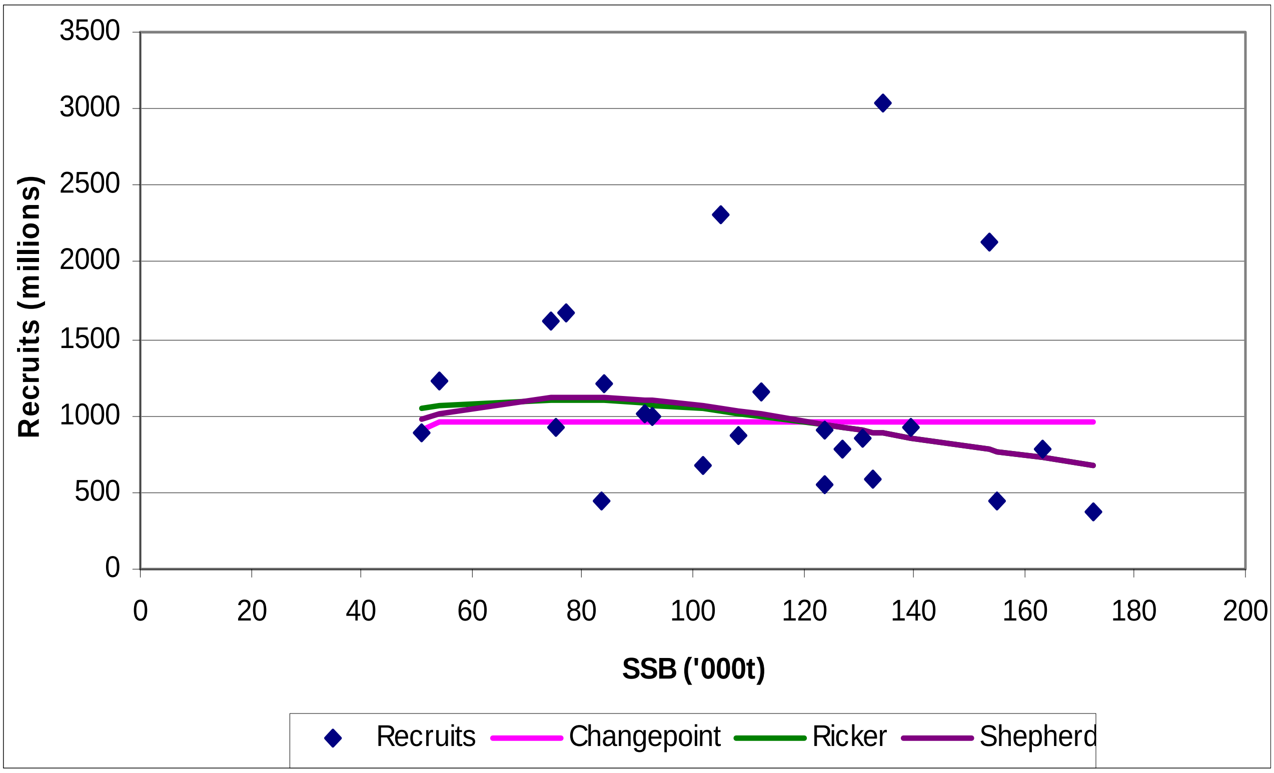


Figure 5.7.1 **Herring in VIa (N), stock recruit data and fitted models (Change point, Ricker and Shepherd) using observed stack and recruitment from the ICA assessment for the years the 1976 to 2000. Note that the period 1976 to 2000 has no SSB values above 170,000 t and no overlapping SSB values with those in the earlier period 1957 to 1974 included in Figure 5.7.2.**

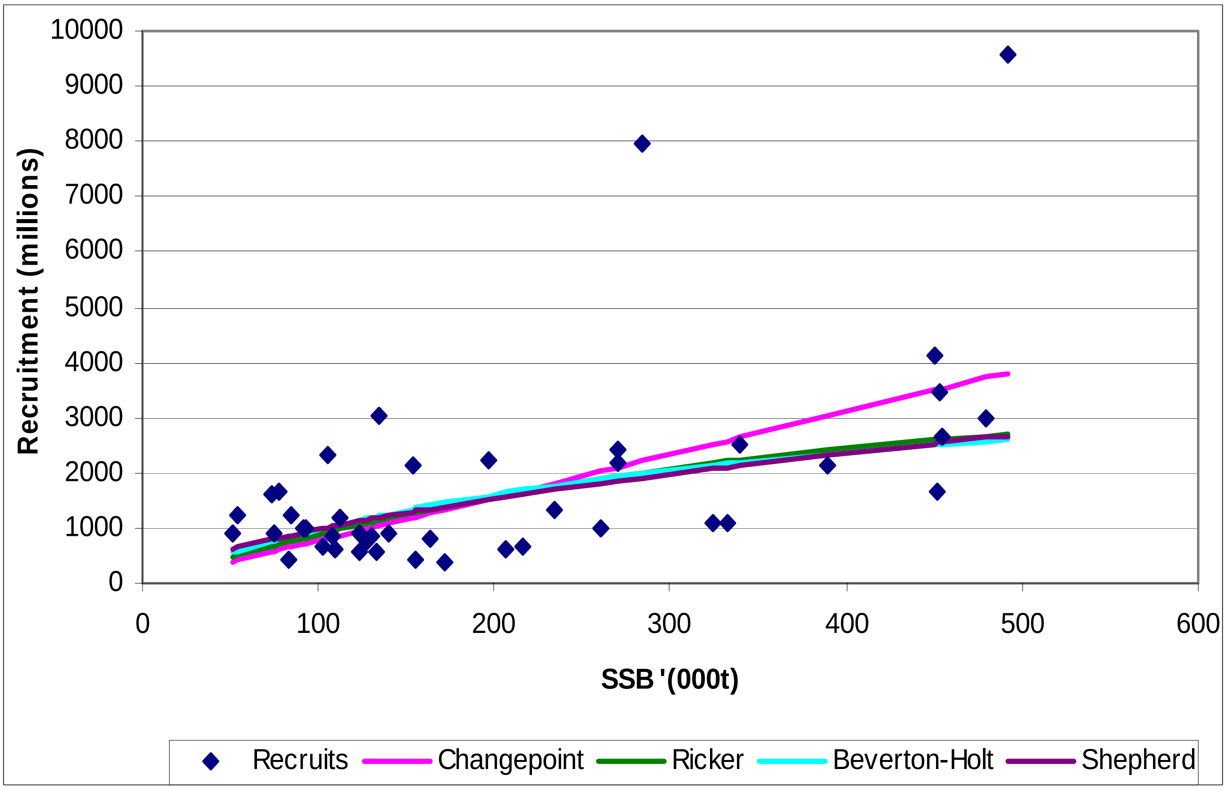


Figure 5.7.2 **Herring in VIa (N), stock recruit data and fitted models (Change point, Ricker Beverton and Holt and Shepherd) using observed stack and recruitment from the ICA assessment for the years the 1957 to 2000. Note that the period 1957 to 1974 has only SSB values above 170,000 t and no overlapping SSB values with those in Figure 5.7.1.**

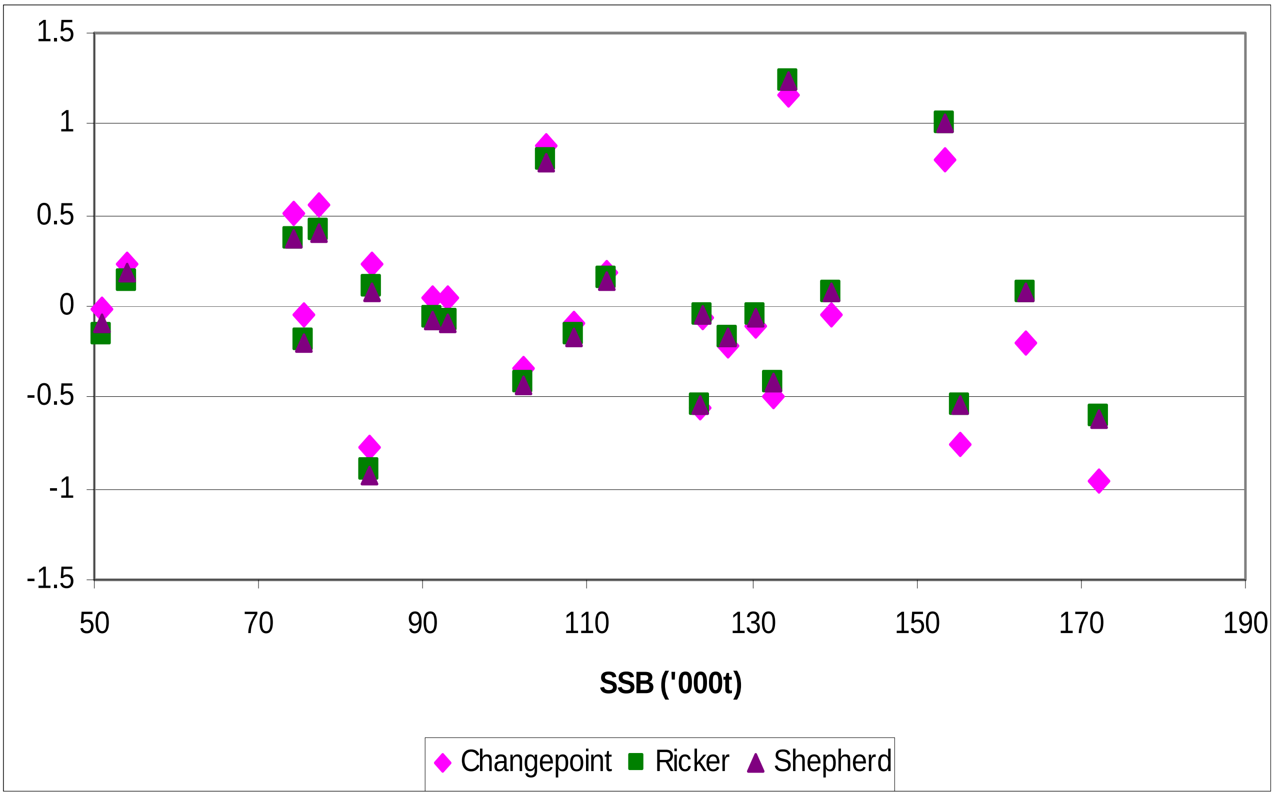


Figure 5.7.3 **Herring in VIa (N), residuals around the fitted stock recruit (S/R) models for stock recruit data from 1976 to 2000 using values from ICA assessment.**

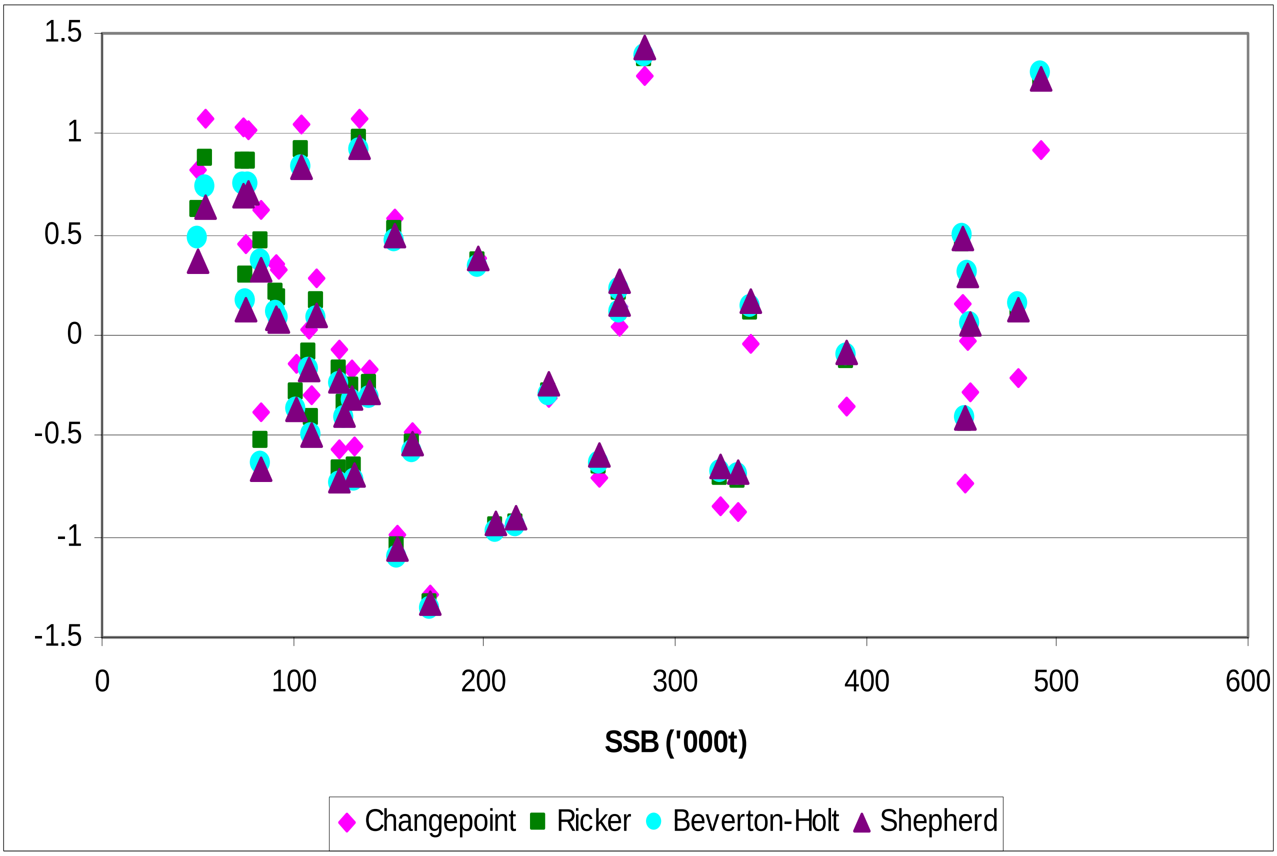


Figure 5.7.4 **Herring in VIa (N), residuals around the models for stock recruit (S/R) data from 1957 to 2000 using values from ICA assessment.**

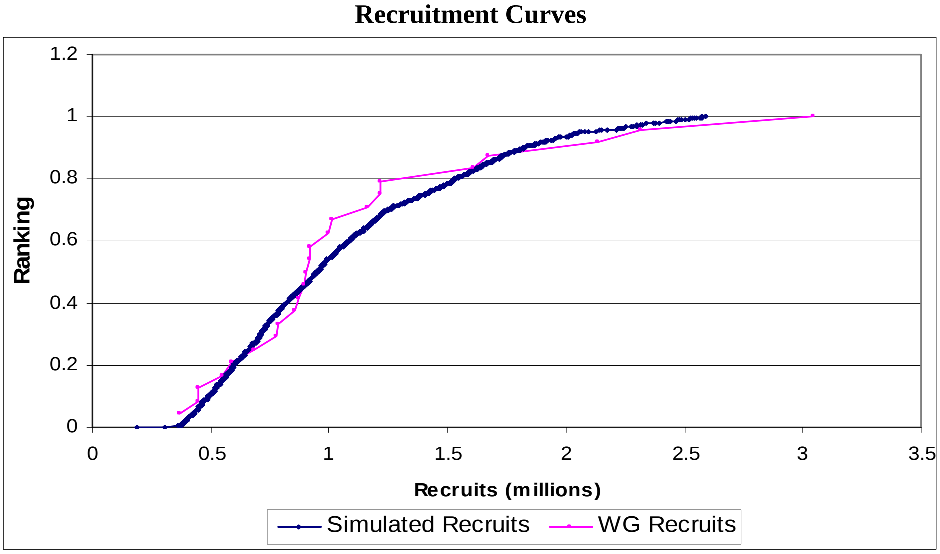


Figure 5.7.5 Herring in VIa (N), comparison between stock recruit data 1957 to 2000 and simulated values for the Change Point S/R relationship fitted to the observations for the long time-series 1957 to 2000.

Figure 5.7.6 Herring in VIa (N), comparison between stock recruit data 1976 to 2000 and simulated values for the Shepherd S/R relationship fitted to the observations for the long time-series 1976 to 2000.

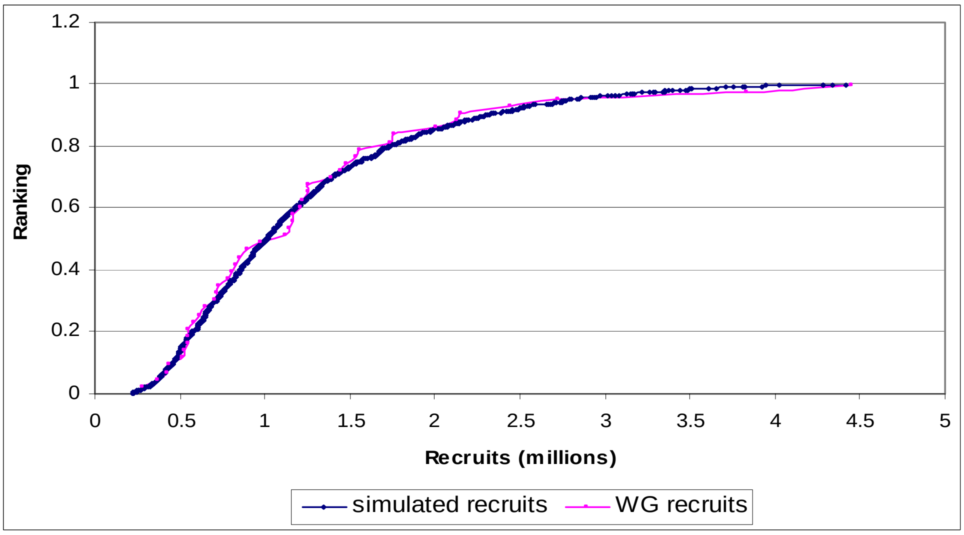
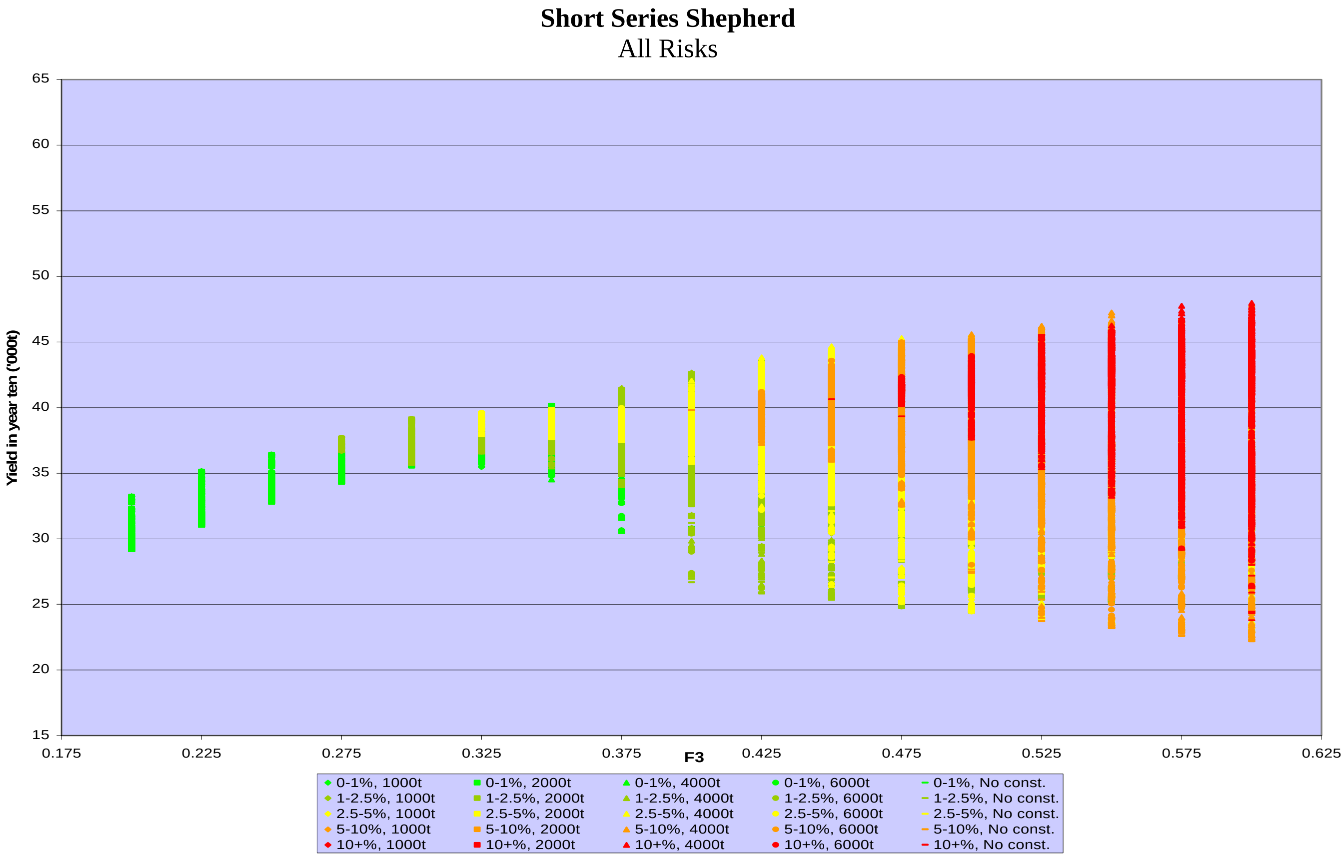


Figure 5.7.7 Herring in VIa (N), comparison between stock recruit data 1957 to 2000 and simulated values for the Shepherd S/R relationship fitted to the observations for the long time-series 1957 to 2000.



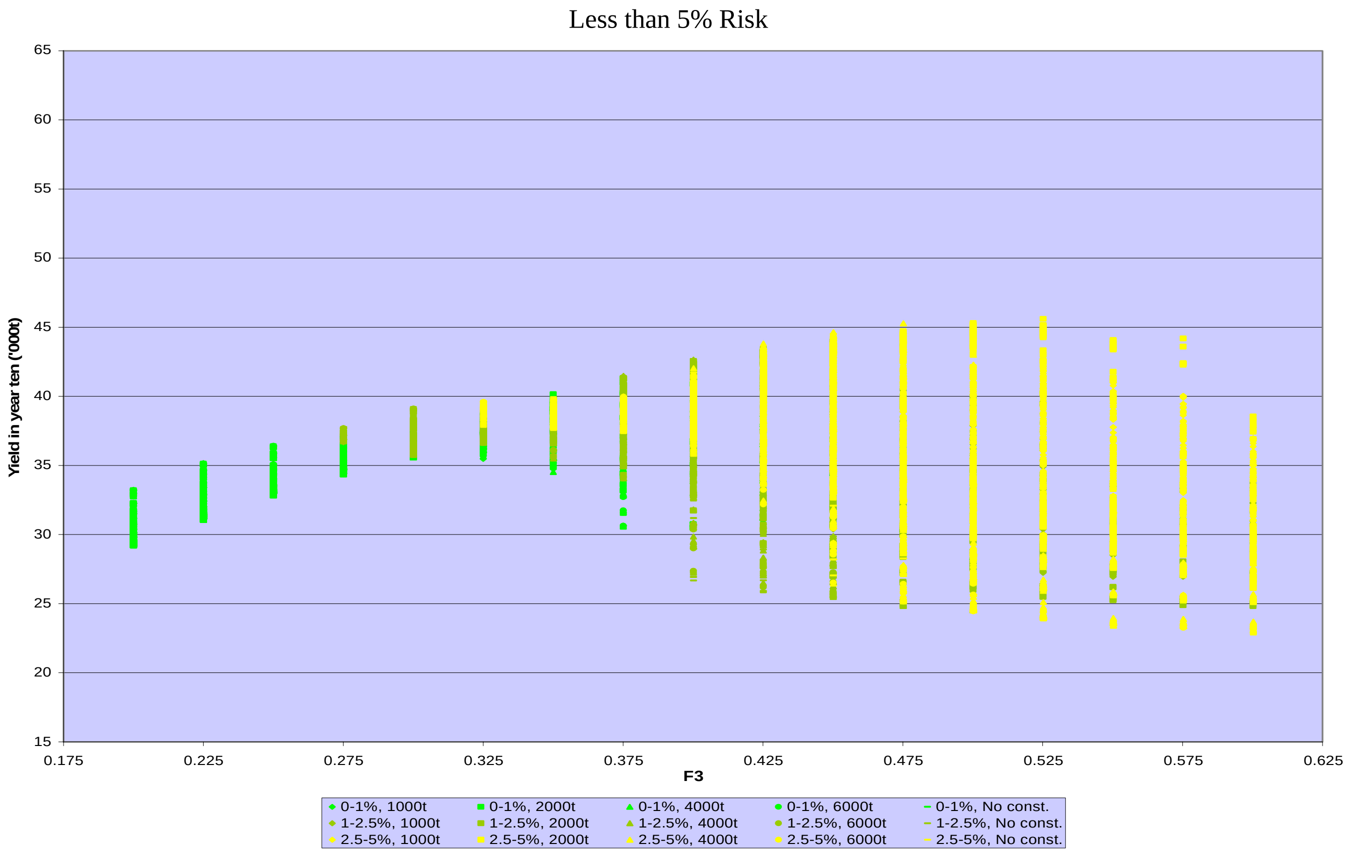


Figure 5.7.8 **Herring in VIa (N), median yield in year 10 for short time-series Shepherd S/R relationship; yield verses long term F for the full range of HCRS studied, the colour indicates risk of SSB falling below Blim. Upper panel includes all risks, lower panel shows only risks less than 5%.**

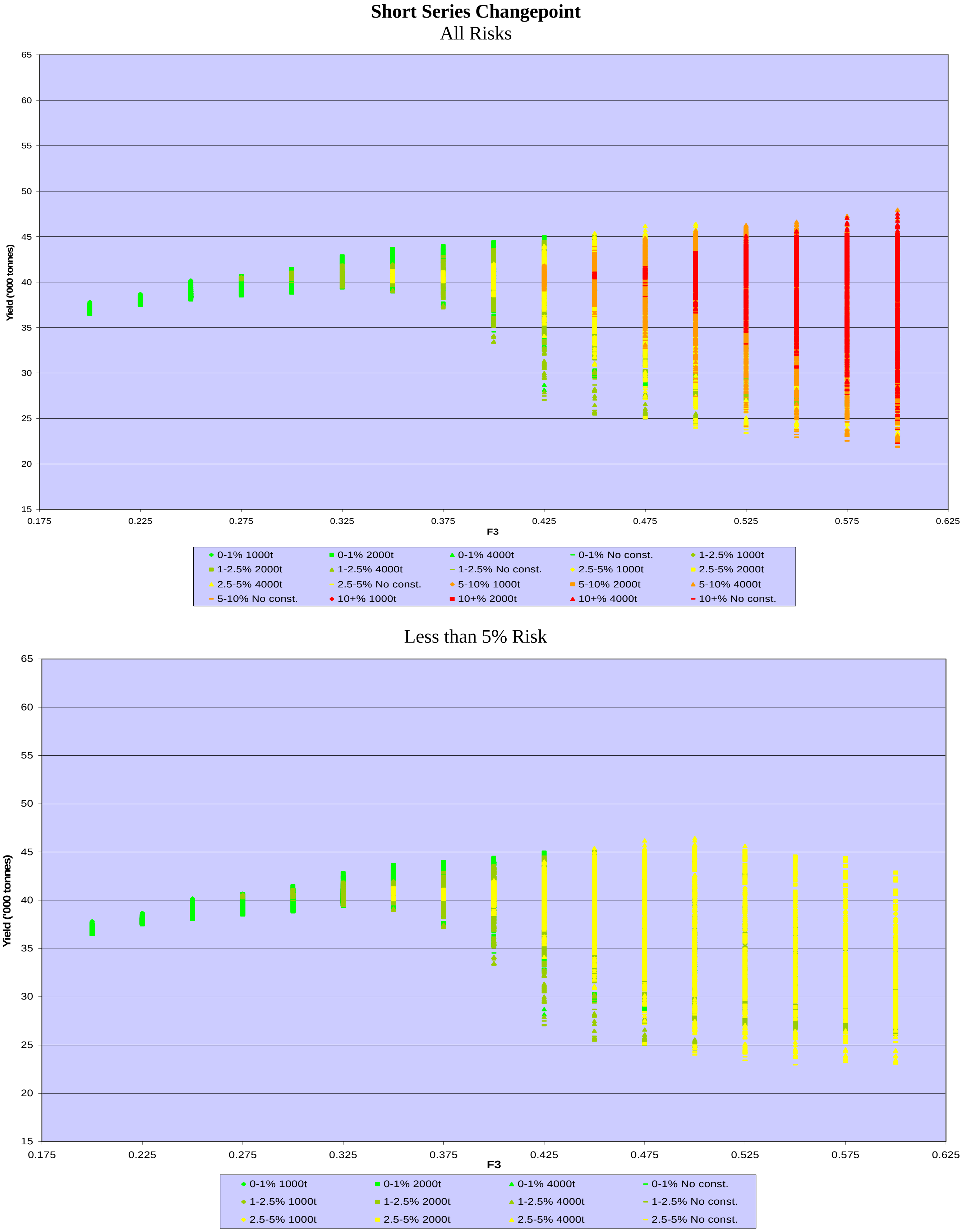
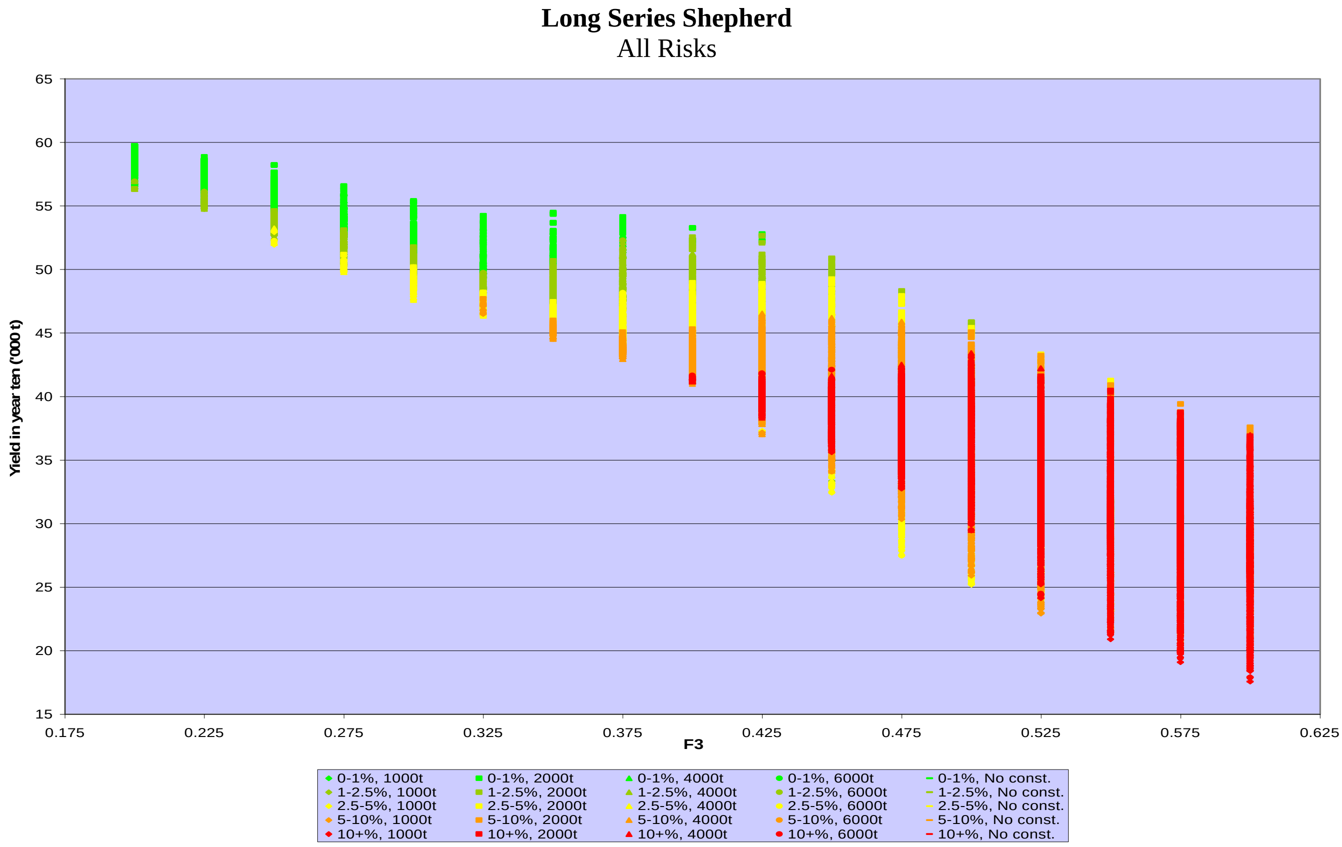


Figure 5.7.9 Herring in VIa (N), median yield in year 10 for Short time-series Change Point S/R relationship; yield verses long term F for the full range of HCRS studied, the colour indicates risk of SSB falling below Blim. Upper panel includes all risks, lower panel shows only risks less than 5%.



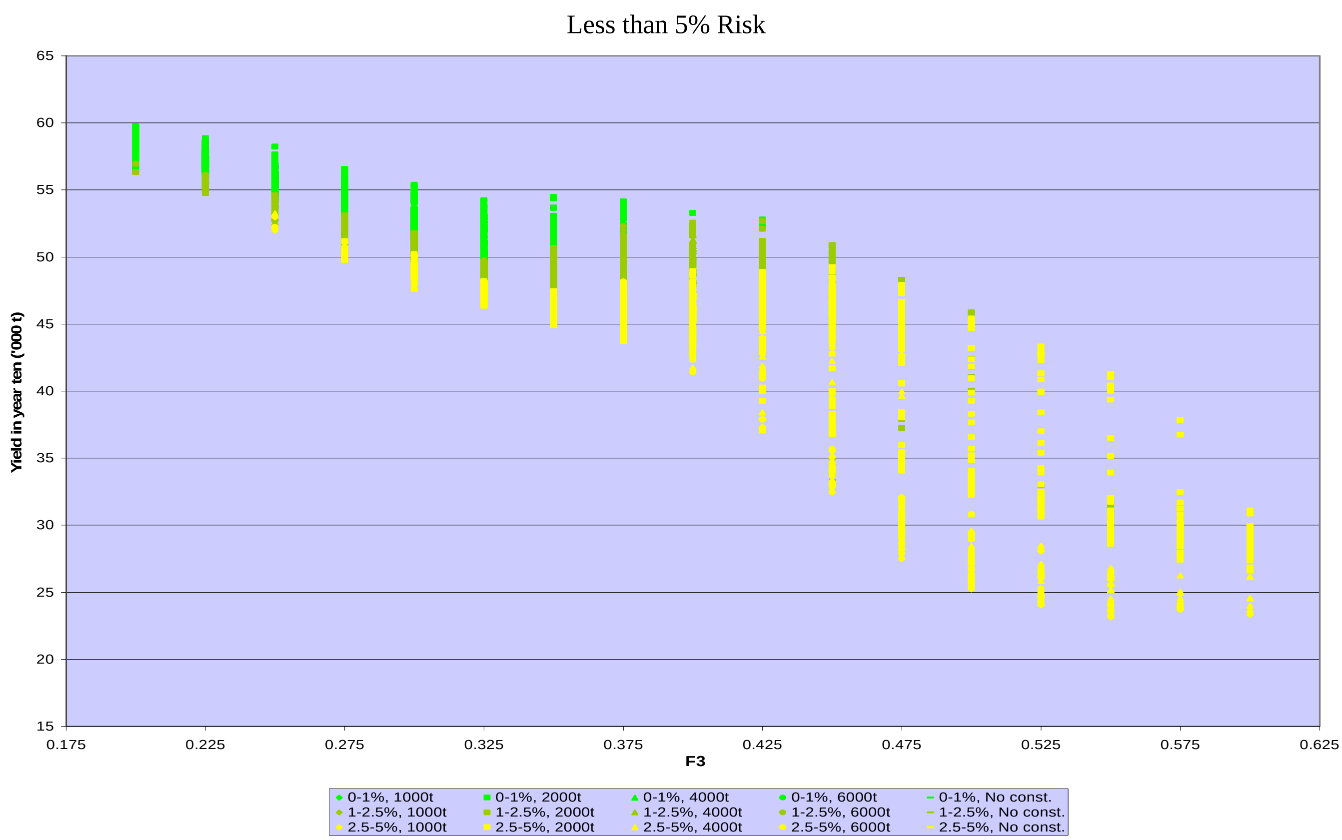


Figure 5.7.10 Herring in VIa (N), median yield in year 10 for long time-series Shepherd S/R relationship; yield verses long term F for the full range of HCRS studied, the colour indicates risk of SSB falling below Blim. Upper panel includes all risks, lower panel shows only risks less than 5%. Note the rise in yield with lower F.

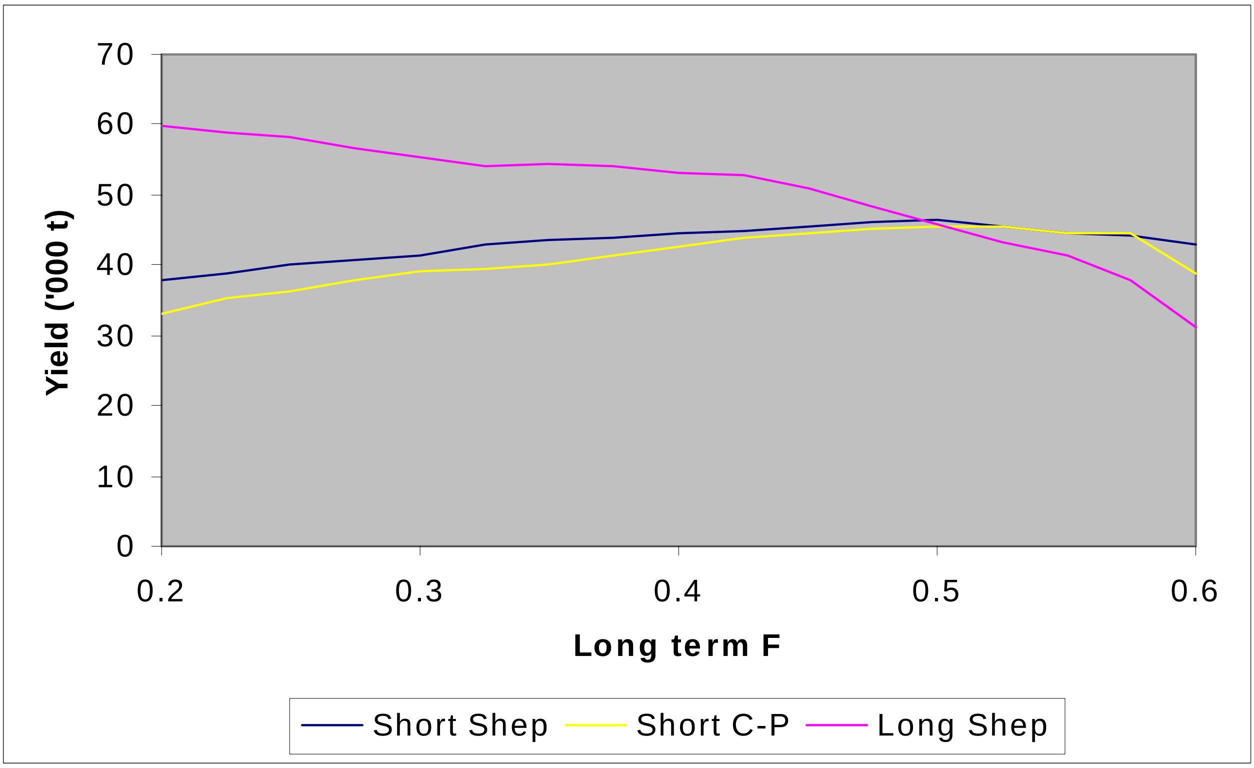


Figure 5.7.11 **Herring in VIa (N), the maximum median yield in year 10 obtained for all HCRs with risk of SSB < Blim of less than 5% (Fig 8 to 10 lower panels) plotted against long term F for the three S/R relationships studied.. Showing similarity for the two models for the truncated time-series and the higher yields at lower F for the longer time-series.**

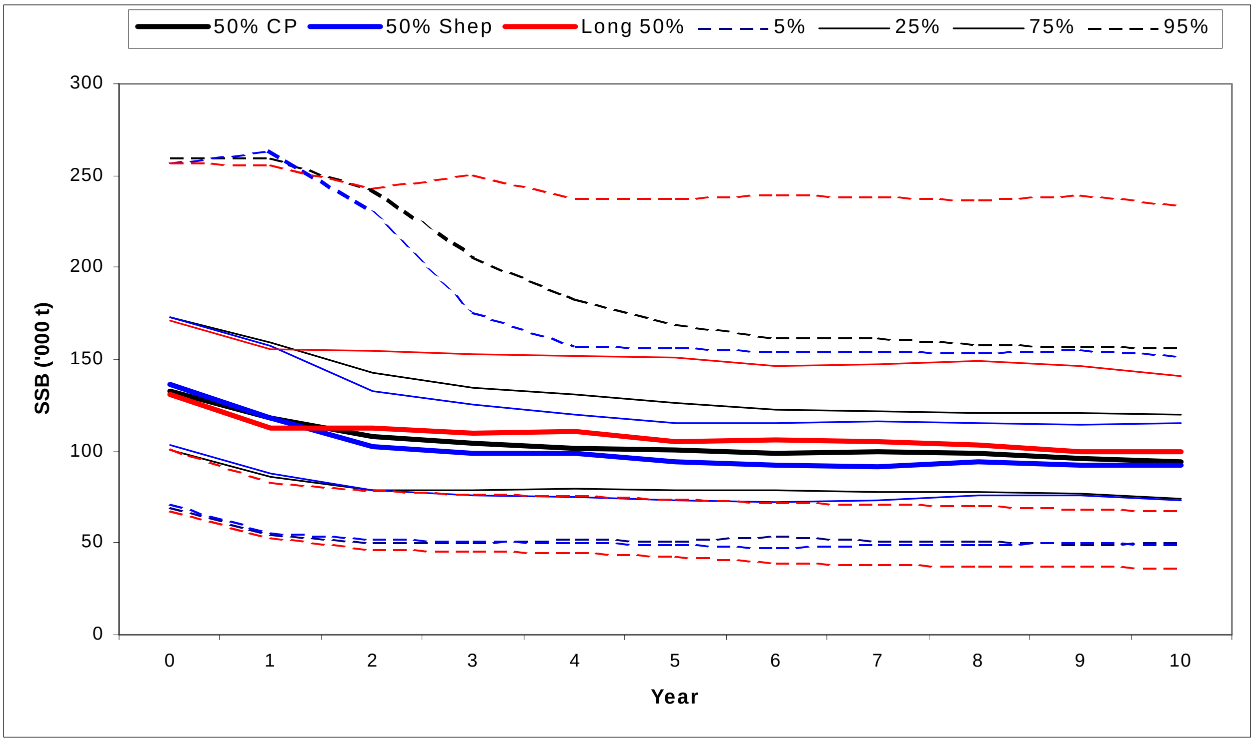


Figure 5.7.12 **Herring in VIa (N), comparison of stock trajectory (5,25,50,75,95 percentiles) from current state of the stock assuming exploitation equivalent to the mean (0.36) and standard deviation (0.25) of the exploitation experienced since 1976. For the three main Stock Recruit relationships studied, truncated data series Change Point (CP) and Shepherd (Shep), and long data series Shepherd (Long). Showing that the expected state of stock depends little on the choice of stock recruit relationship if exploitation is at this level.**

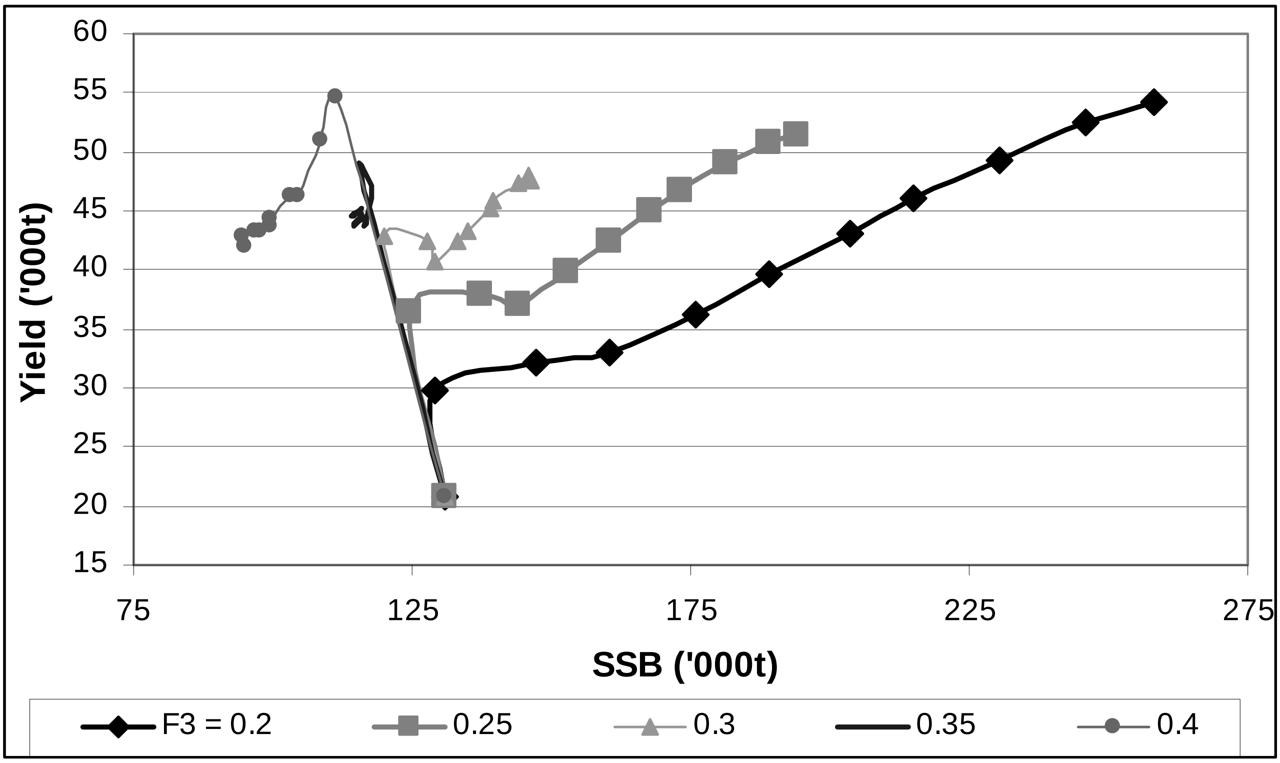


Figure 5.7.13a Herring in VIa (N), illustration of stock exploitation expressed as median yield v. median SSB for different long term Fs assuming the long time-series S/R model. Exploitation at F =0.35 gives approximate stability.

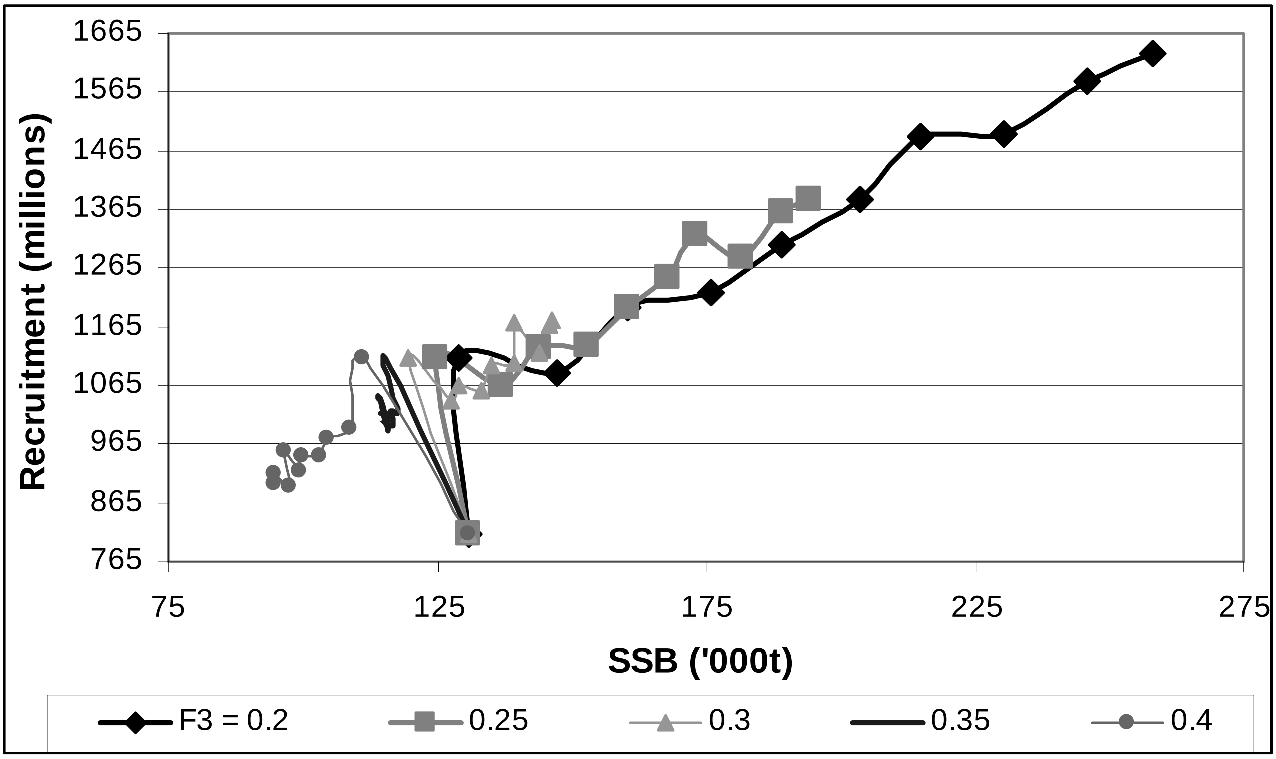


Figure 5.7.13b Herring in VIa (N), illustration of stock development expressed as median recruitment v. median SSB for different long term Fs assuming the long time-series S/R model. Exploitation at F =0.35 gives approximate stability.

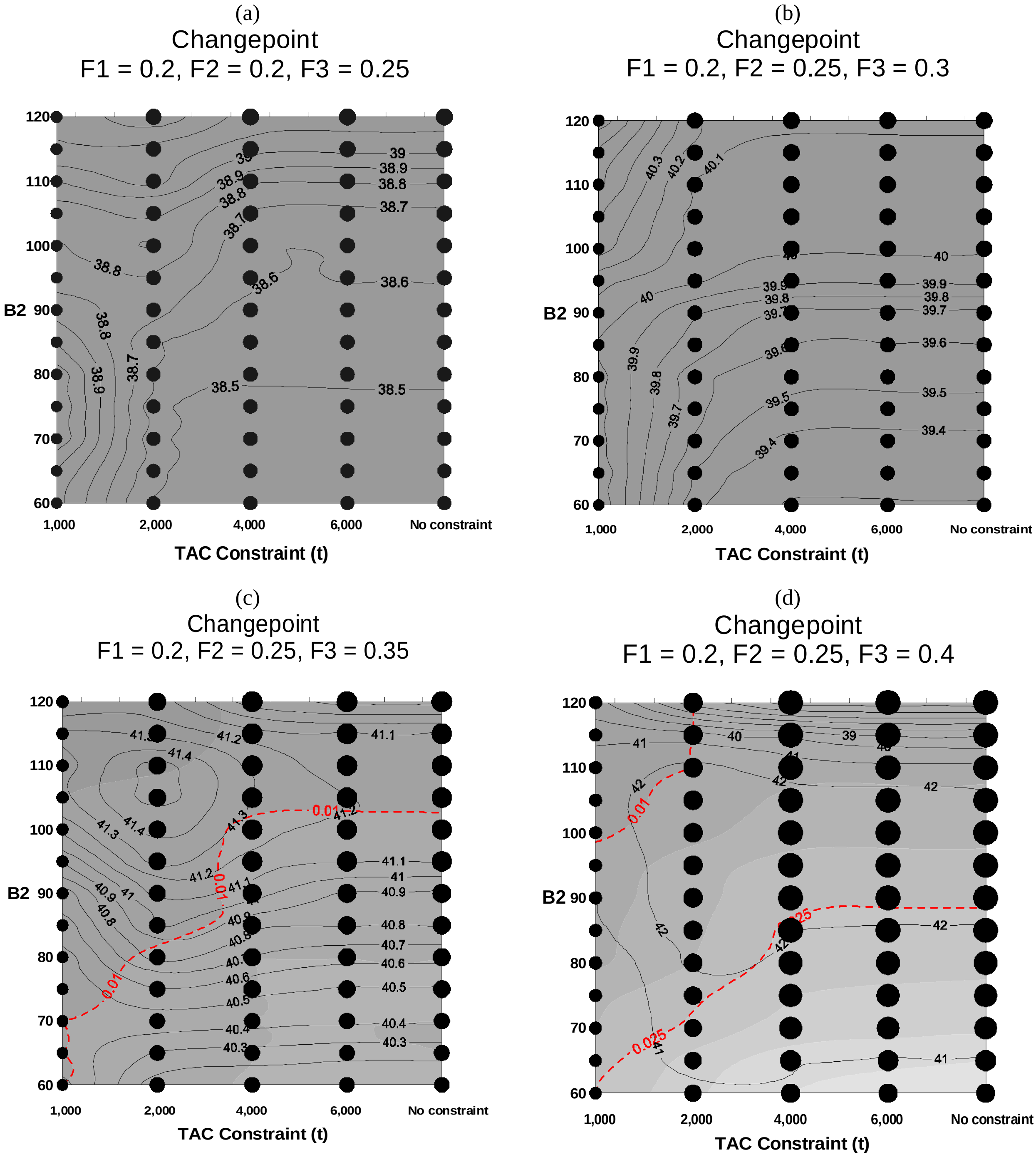
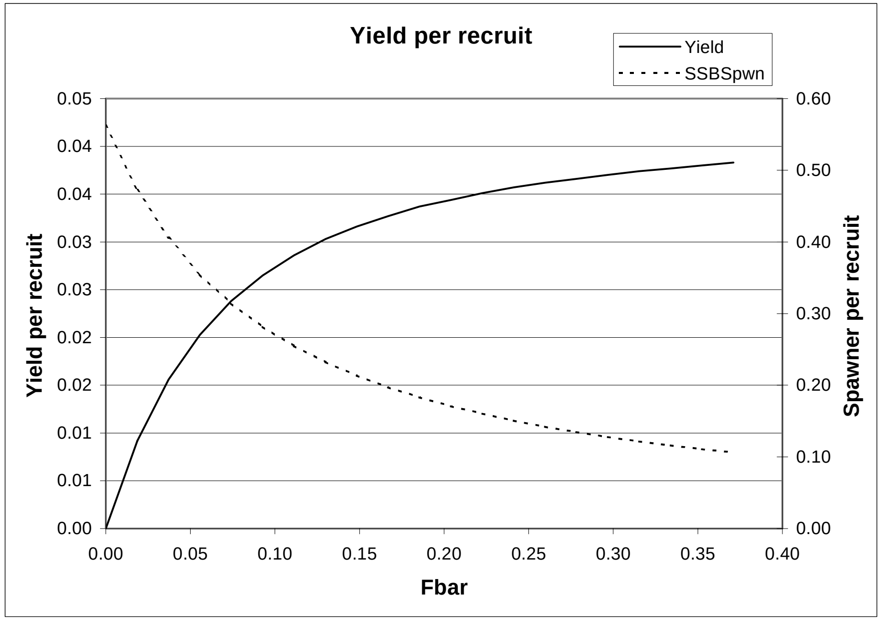
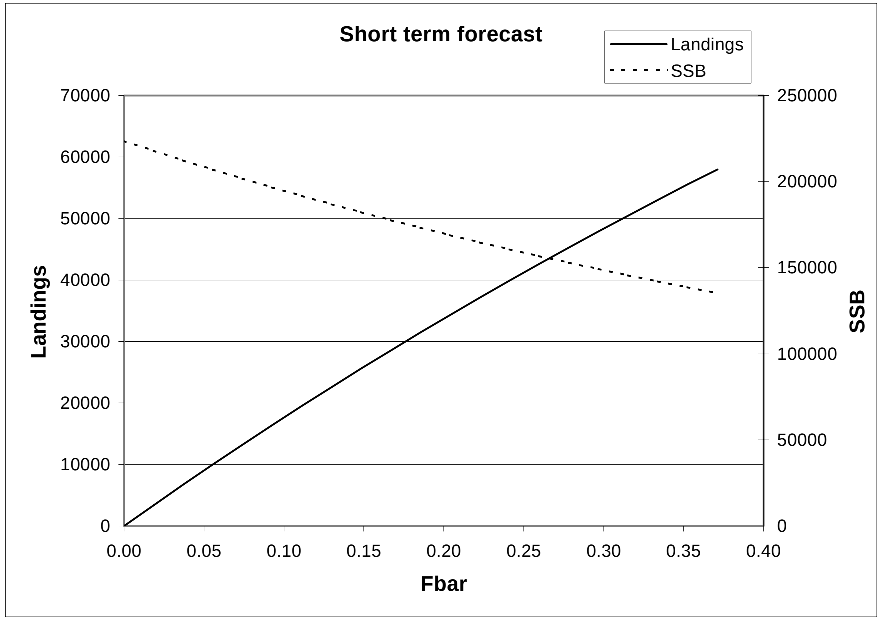


Figure 5.7.14 herring in VIa (N), comparison of yield (black contours), risk of SSB falling below Blim (colour dark grey low (0%), pale grey higher (5%)), and 5% to 95% spread of year to year change in TAC (black circles) for: F3 = 0.25 (panel a), F3= 0.30 (panel b), F3= 0.35 (panel c) and F3= 0.4 (panel d). Each panel is for values of biomass trigger (B2 in '000 t) on the vertical axis and for constraints in year to year change in TAC on the horizontal axis. The dotted contour lines represent risk values of 1% and 2.5%, panels a and b both fall below the 1% risk level, hence no dotted contour line present. There is an increase in risk from the top left corner of the panels to bottom right. This is clearly observed in panel d, where there is a low risk (<1%) in the upper left corner, increasing to 4% in the lower right.

The range of year on year change in TAC (black circles) goes from 1,700 t for the smallest circles up to 3,800 t for the largest.





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Time and date: 11:57 13/03/2005

Reference point	F multiplier	Absolute F
Fbar(3-6)	1.0000	0.1855
FMax	71.3401	13.2368
F0.1	0.8503	0.1578
F35%SPR	0.9021	0.1674
Flow	0.3264	0.0606
Fmed	1.4812	0.2748
Fhigh	5.1972	0.9643

MFDP version 1
Run: VIAN 1 TAC contraint
Herring VIa (north) (run: ICAPGF08/I08)
Time and date: 11:10 13/03/2005
Fbar age range: 3-6

Input units are thousands and kg - output in tonnes

Figure 5.8.2.1 Herring in VIa (N). Yield-per-recruit and short-term forecast. (Note that F_{low}, F_{med} and F_{high} were calculated from the stock and recruit data using the correct time lag of one year for autumn spawning herring).

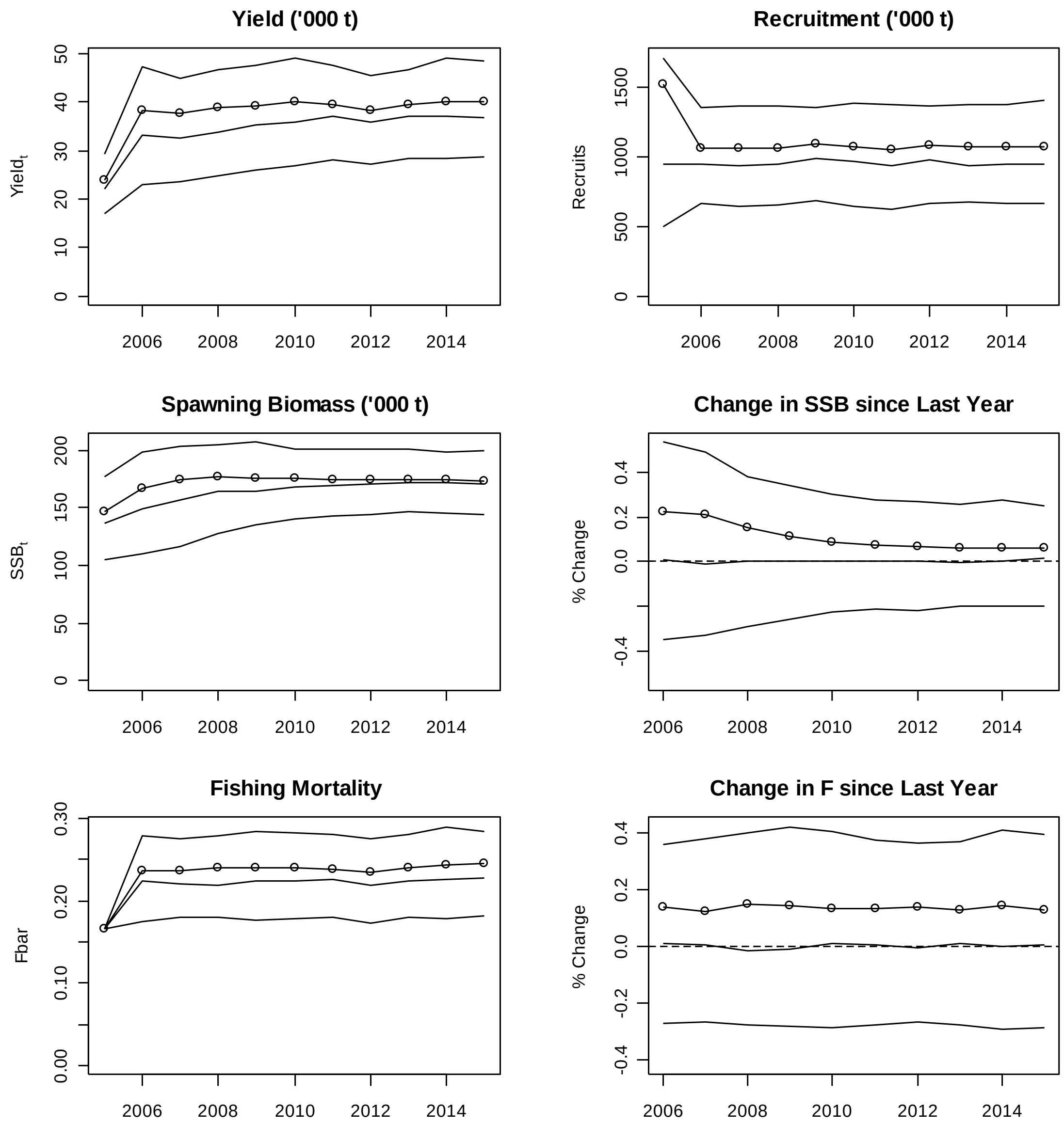

Figure 5.8.3.1 Herring in VIa (N) medium term projections for scenario 1 (Table 5.8.1) with a long fishing mortality F=0.2. Graphs show 25, 50 and 75 percentiles with marked line (-o—o-) indicating average values.

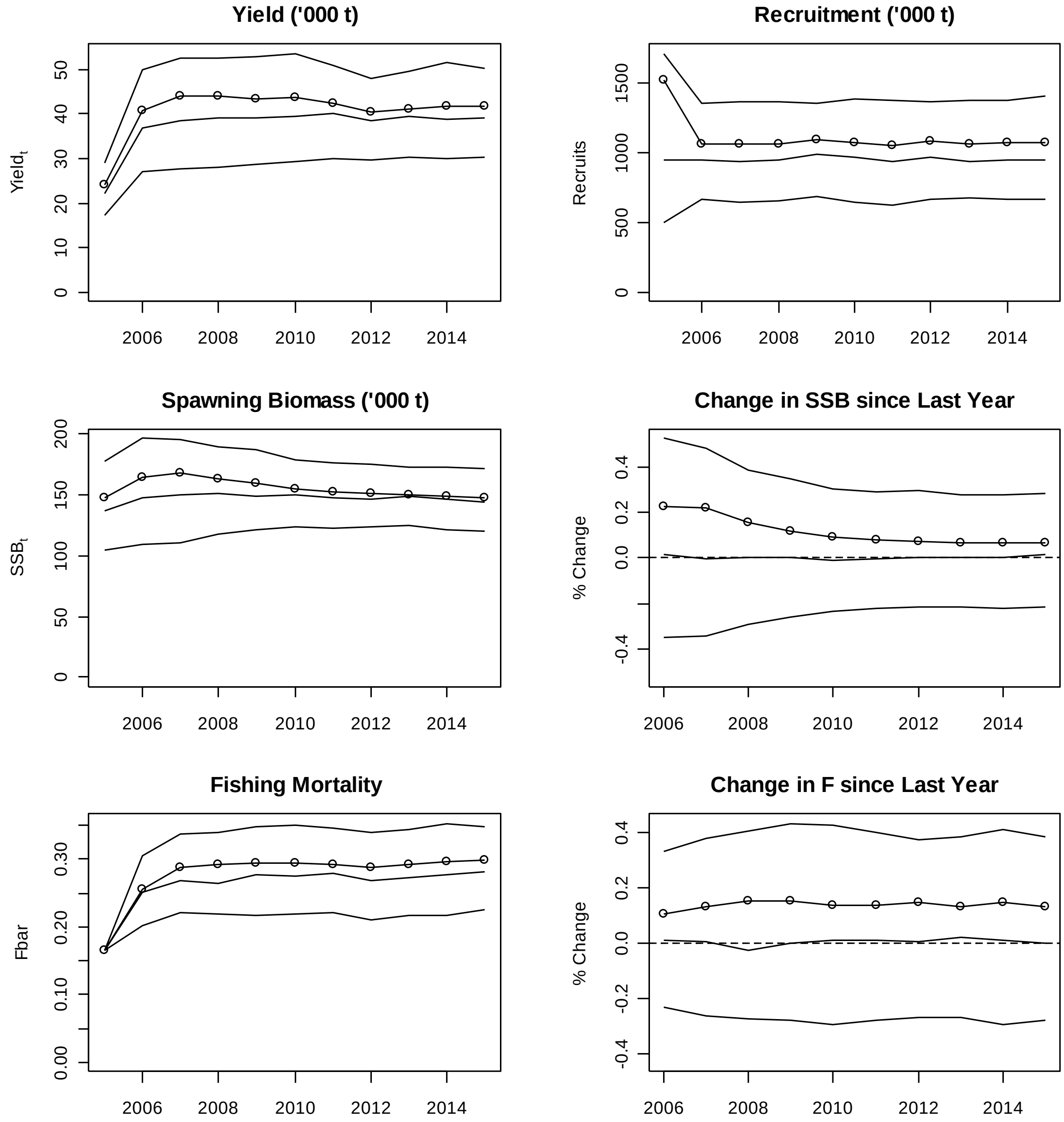

Figure 5.8.3.2 Herring in VIa (N) medium term projections for scenario 2 (Table 5.8.1) with a long fishing mortality F=0.25. Graphs show 25, 50 and 75 percentiles with marked line (-o—o-) indicating average values.

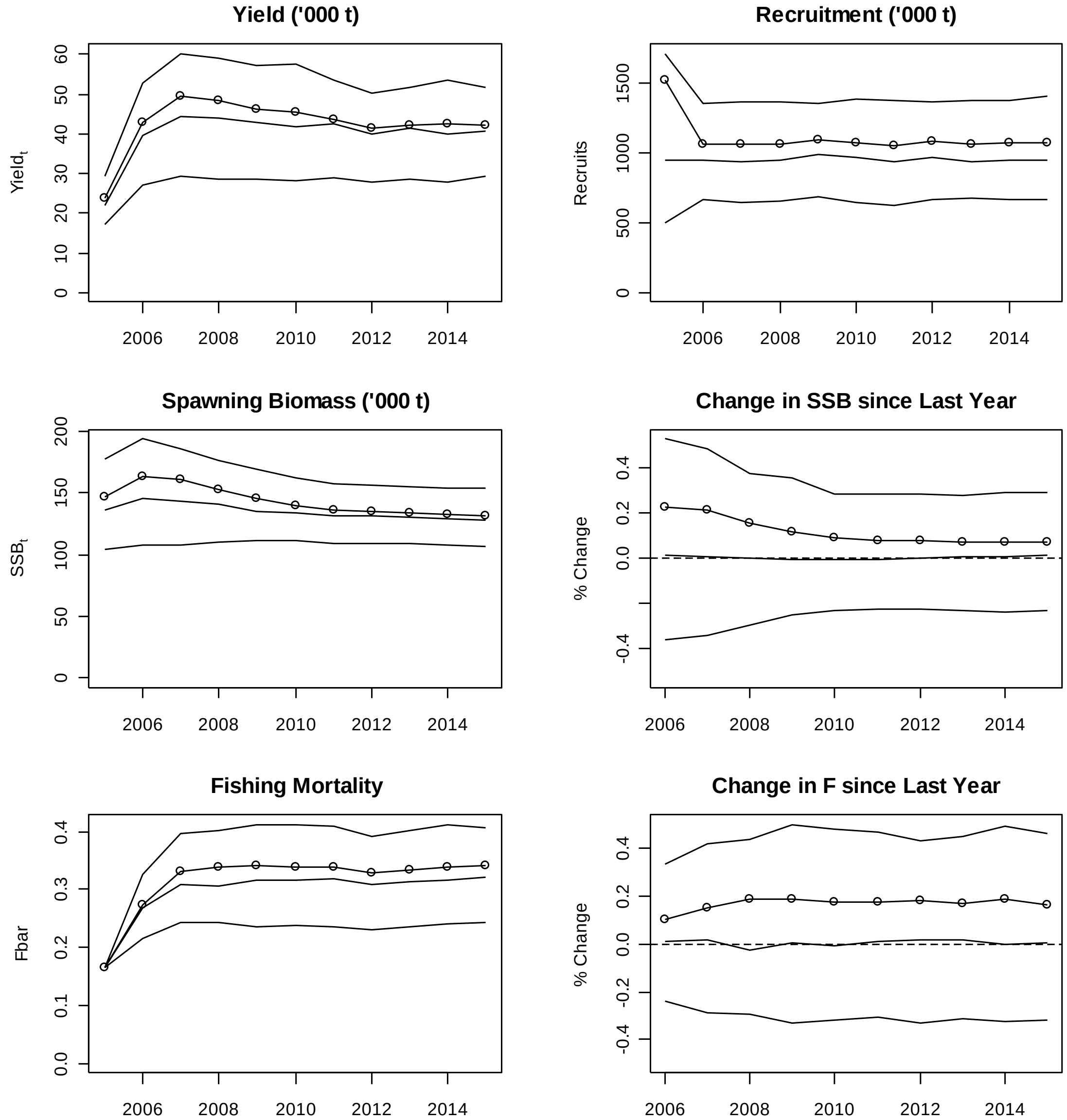

Figure 5.8.3.3 Herring in VIa (N) medium term projections for scenario 3 (Table 5.8.1) with a long fishing mortality F=0.3. Graphs show 25, 50 and 75 percentiles with marked line (-o—o-) indicating average values.

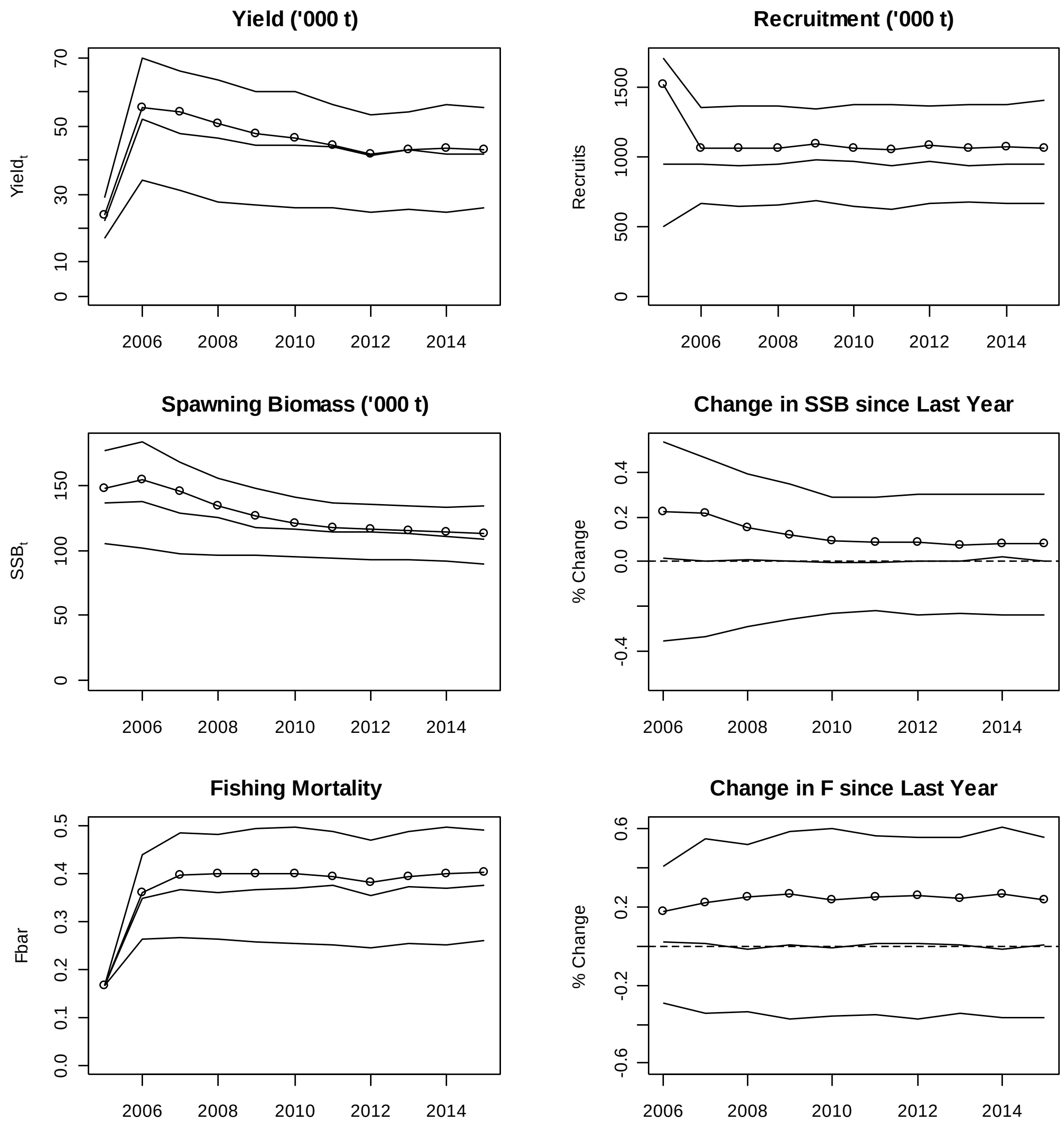

Figure 5.8.3.4 Herring in VIa (N) medium term projections for scenario 4 (Table 5.8.1) with a long fishing mortality F=0.3.5. Graphs show 25, 50 and 75 percentiles with marked line (-o—o-) indicating average values.

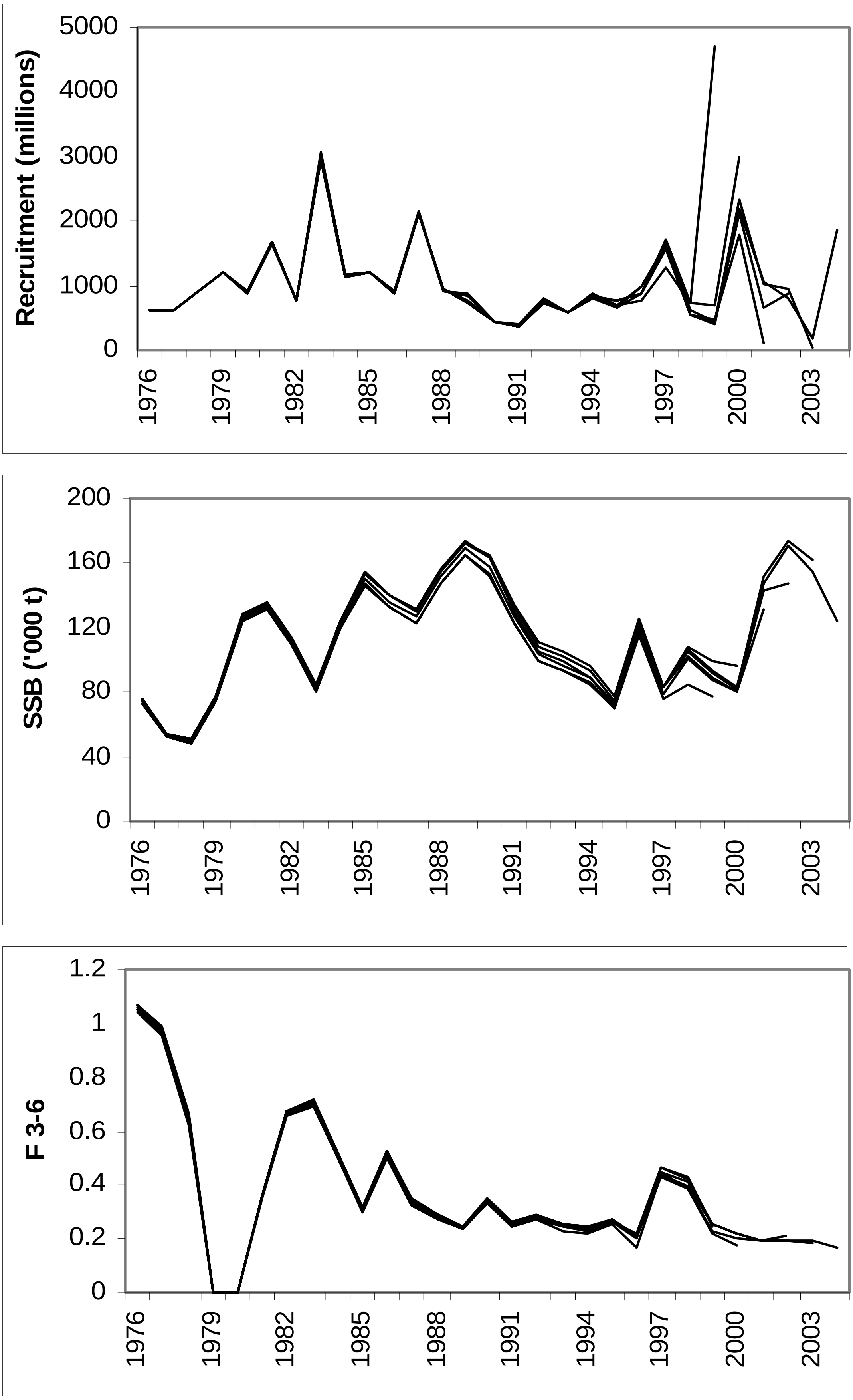

Figure 5.10.1 Herring in VIa (N), analytical retrospective patterns of recruitment, SSB and mean $F_{3\text{-}6}$ from the assessments.

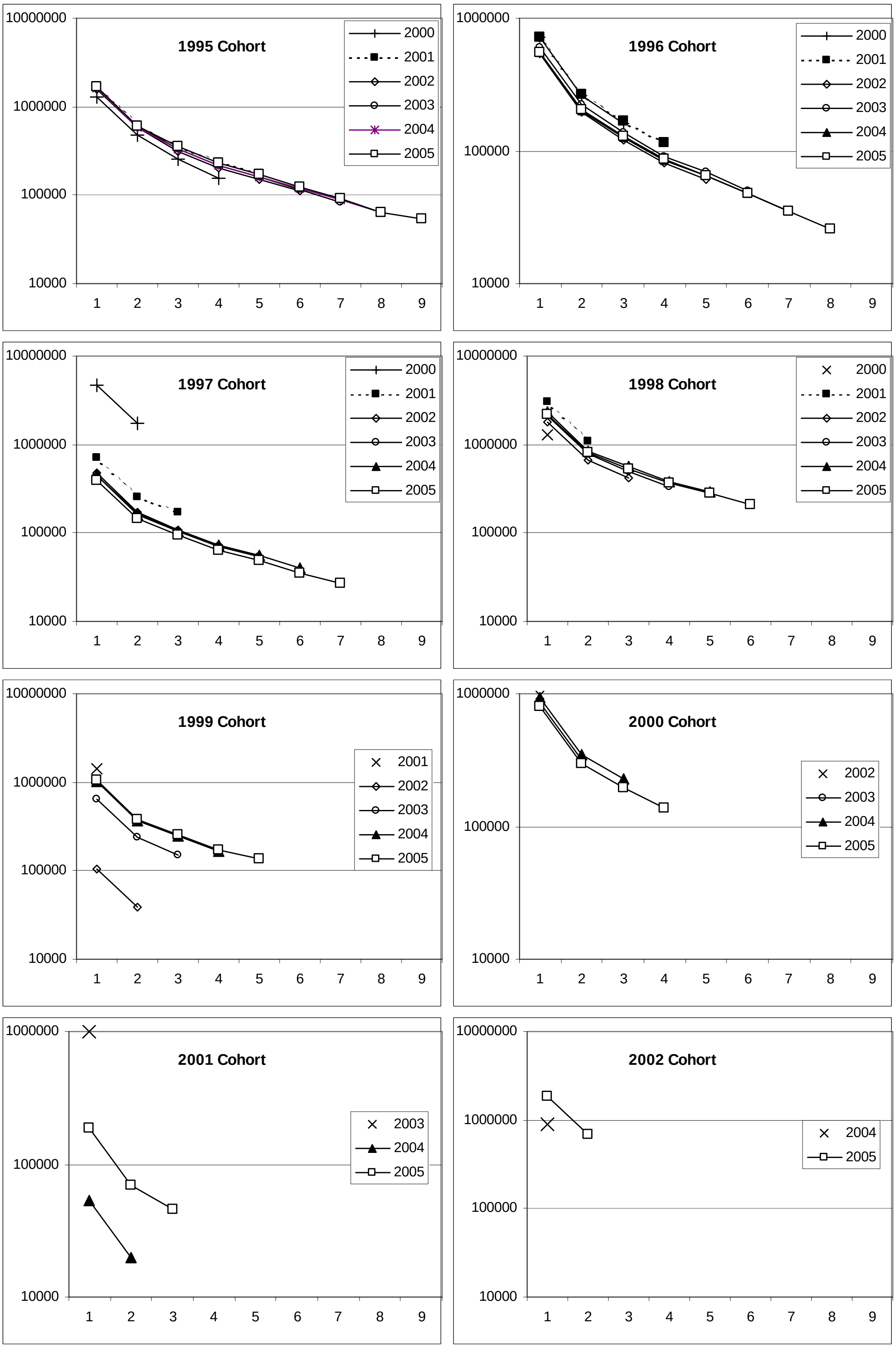

Figure 5.10.2 Herring in VIa (N), retrospective analysis of cohort development, showing stability of information once cohorts are full recruited to the fishery at age 4 with some of the smaller cohorts (1997, 1999 and 2001) particularly uncertain for early years. The larger cohorts (1995, 1998 and 2000) are estimated more reliably.

6 Herring in Divisions VIa (South) and VIIb,c

6.1 The Fishery

The TAC for this area for 2004 was 14,000 t. This was the same TAC as the previous 6 years. For 2004, ICES advised that catches should not exceed 14,000 t. In 2004 ACFM considered the state of the stock to be unknown with respect to safe biological limits because estimates of SSB and fishing mortality were highly uncertain over the previous 2-3 years. The final year SSB was unknown but thought likely to be below B_{pa} (110,000 t). For SSB to be above B_{lim} (81,000 t) there would have to have been very strong recruitment in recent years but no evidence has been found for such year classes. The recent TAC's are approximately 50% of the average catches taken in the 1970's when the productivity of the stock was comparable to the present. ACFM considered that if SSB is not reliably found to be increasing, further catch reductions will be necessary, and that in the meantime, the fishery should not be allowed to expand.

In 2000, the Irish North West Pelagic Management Committee was established to deal with the management of this stock. The committee has the following objectives:

- To rebuild this stock to above the B_{pa} level of 110,000 t.
- In the event of the stock remaining below this level, additional conservation measures will need to be implemented.
- In the longer term it is the policy of the committee to further rebuild the stock to the level at which it can sustain annual catches of around 25,000 t.
- Implement a closed season from March to October.
- Regulate effort further through boat quotas allocated on a weekly basis in the open season.

This committee manages the whole fishery for this stock at present, given that Ireland currently accounts for the entire catch.

6.1.1 Catches in 2004

The working group estimates of landings from this fishery in 2004 are given in Table 6.1.1.1. Ireland is the dominant country in this fishery. Irish catch estimates for this WG have been based on the preliminary official reported data from the EU Logbook Scheme. The total Irish catch for 2004 was around 12,200 t, compared with almost 12,900 t in 2003. These data are an underestimate of the landings over this period September to December 2004. They are included for reasons of consistency with the time series of catches in this fishery (see Stock Annex, section B.1.).

The catches and landings recorded by each country fishing in this area from 1988–2004 are shown in Table 6.1.1.1. and the total catches from 1970 to 2004 are shown in Figure 6.1.1.1. There were no estimates of discards reported for 2004 and anecdotal reports from the industry are that discarding is not a major problem at the moment. The Irish catches by statistical rectangle in these areas are shown in Figure 6.1.1.2.

6.1.2 The fishery in 2004

The number of Irish vessels that participated in the fishery has remained static in recent years and fall into three categories. These are refrigerated seawater (RSW) vessels >40m, RSW vessels between 25 and 40m, and dry hold vessels all of which are under 25m in length. Quotas are allocated on a fortnightly basis and there is some capacity to carry unused allocation into the following fortnight with overruns being deducted. Most fish are landed into Killybegs with smaller amounts going to Rosaveal and Dingle further south. As in the Celtic Sea the grounds furthest offshore are the preserve of the larger RSW vessels and this applies in particular to those grounds on the borders of VIa north and VIa south. In the case of larger boats there may also be a tendency to prioritise effort for mackerel and horse mackerel and take their herring allocations opportunistically. The dryhold boats, not having the same access to these stocks direct all their effort at herring until the fisheries close. About thirty vessels participated in the fishery in 2004.

The great majority of fish in VIIbc and VIa south are landed in the first and fourth quarter from grounds around the northern boundary of VIIb along the north Connacht coast, the southern boundary of ICES division VIa south around Donegal Bay, and off Co. Donegal from off Tory Island to Inishtrahull. In 2004 fishermen reported that the fishing in the fourth quarter improved from the first quarter in terms of the availability of fish. In particular they remarked on the strength and resilience of herring marks on the traditional inshore grounds around Counties Donegal and Mayo. Figure 6.1.1.2 shows the distribution of catches by statistical rectangle and quarter and Figure 6.1.2.1 shows the herring spawning grounds of north west Ireland.

The pattern of this fishery has changed over time. In the early part of the 20^{th} Century the main spawning components were the winter spawners off Co. Donegal, and this was where the main fishery took place. In the 1970's and 1980's the west of Ireland autumn spawning components were dominant and the fishery was mainly distributed along west Connacht, in Counties Galway and Mayo. More recently the northern grounds are more important again with most of the catches from VIIb concentrated between Clew Bay and Killala near to the boundary of VIa south.

In 2004 there was a greater range of lengths in fish caught in the fourth quarter than in the first (Table 6.1.2.1). A particular aspect of the first quarter fishery in VIa S has been the appearance of large fish off the north Donegal coast in February. These fish are usually over 31 cm TL.

6.2 Biological composition of the catch

6.2.1 Catch in numbers-at-age

The catches-at-age for this fishery since 1970 are shown in Table 6.2.1.1. In recent years the catch numbers at age have been derived from Irish sampling data. The dominant year classes in 2004 were the 2, 3, and 4 ringers accounting for 18% and 38% and 23% respectively. In the short term the relative proportions of 2, 3 and 4 ringer fish have remained quite stable. However over the entire life time of the data series the relative proportions of 2, 3, and 4 ringers in the catches have shown an increasing trend. The percentage contribution of 6 ringers and older has declined over the time series (Table 6.2.1.2).

6.2.2 Quality of the catch and biological data

The management of the Irish fishery in recent years has tightened considerably and the accuracy of reported catches is also believed to have improved. The numbers of samples and the associated biological data are shown in Table 6.2.2.1. Changes in targeting by sections of the fleet mean that there is now a need to get more samples from the larger RSW vessels and from the opportunistic catches that occur in south VIIb. It is worth noting that sampling in this fishery relies heavily on the small RSW and dry hold sector which concentrate on the inshore grounds. This might lead to the proportion of older ages being underestimated in the sample data.

6.3 Fishery Independent Information

6.3.1 Ground Fish Surveys

There are currently no recruitment indices available for this stock. However an Irish ground fish survey conducted in the area since the early 1990's regularly catches herring. Preliminary investigations show that this survey is of little utility as a herring recruit index, because gear, timing and survey vessel changed throughout. However, the western IBTS, may be useful, when a time series becomes available.

6.3.2 Acoustic Survey

The total biomass estimate for the area surveyed was 41,693 with a SSB of 41,300, the highest in the series, and much higher than 10,300 t biomass t and 9500 t SSB in 2003. The 2005 survey estimate is still in preparation, but it is highly likely that it will produce a higher estimate of SSB. This is because good registrations of herring were obtained, see below. However both surveys did not fully contain the stock, and are thus underestimates of stock size. In 2006, the usefulness of this acoustic time series will be explored. At that point, an 8 survey series should be available.

In the mid 1990's, surveys were carried out in summer, however since 1999, surveys of this stock have been carried out in winter. A description of acoustic surveys in this area is presented in Table 6.3.2.1. The 2004 survey was carried out on the RV *Celtic Explorer*, and was the first such survey on the new vessel. It took place from the 5th to the 20th January 2004. The survey covered an area extending from Inishtrahull to west of Glen Bay, from close inshore to up to 50 nm (nautical miles) offshore, the northern limits of Sub-Division VIaS. Survey track and trawl positions are shown in Figure 6.3.2.1 and S_A values and their distribution on the survey track are shown in and Figure 6.3.2.2. A persistent challenge of the winter acoustic survey series has been synchronising the survey with the peak spawning event to ensure containment of the stock within the survey area.

Spawning is thought to proceed in a succession of waves with older fish being the first to arrive on the spawning grounds. The maturity stages encountered and the size composition of the survey catches were taken as an indication that the stock may not have been fully contained by the survey and that the first wave of spawning had been completed at the time of the survey. The majority of fish recorded during the survey were ripe, accounting for 56% of the biomass and 53% of the numbers. Spent fish accounted for 43% of the total biomass and 45% of the total numbers. The catches in the survey were characterised by the high numbers of older fish especially compared to the commercial catches (Figure 6.3.2.3). Fishing success was reasonably good, although the majority of the estimate was attributed to "herring in a mixture" and "probably herring". Anecdotal information from fishermen suggests peak spawning time now occurs between January and February.

Age distributions and abundance estimates for acoustic surveys are shown in Table 6.3.2.2. The age distributions of the abundance estimate from the survey and of the commercial fishery in 2004 along with abundance estimates for the 2003 and 2004 surveys and the raw estimates for the 2005 survey, are presented in Figure 6.3.2.3. The dominant ages in the acoustic survey in 2004 were the 3 to 6 ringers compared to 2, 3 and 4 ringers for the fishery over the whole season. When the survey age distribution is compared with that portion of the fishery that took place in the same quarter the lag in ages is even greater, as the proportion of two year olds in the fishery is even more pronounced in this quarter than in the year as a whole. This might be a further indication that the stock is not contained in the survey.

In 2005, the VIaS and VIIb winter acoustic survey was conducted on the Celtic Explorer from the 5th to 26th January. There were severe storms for the first week and in addition, a breakdown kept the vessel in port for part of the survey. However this allowed for a high degree of consultation with the fishermen and the survey track was then adapted to obtain the best coverage of fish distribution.

In contrast to the 2004 survey, in 2005 most of the herring traces were assigned as "definitely herring" and were associated with large homogeneous schools. Fishing success was high with many hauls of mostly herring. On the Mayo coast the fish were mostly spent (stage 7), this area is of autumn and winter spawners. Off Donegal the majority of fish were ripe or running (stages 5 and 6). This indicates that the timing coincided well with the full range of the spawning season, having covered the western fish before they dispersed and the northern fish just as they were arriving at the beds. The abundance and biomass estimates are in preparation. However it is clear that this survey will produce the highest estimate of stock size yet. This experience is in line with the very good fishing reported by the fishing industry in 2004 and 2005.

6.4 Mean weights-at-age

The mean weights (kg) at age in the catches in 2004 are based on Irish catches and are very similar to 2004 for ringers 1-6 (Table 6.4.1). These mean weights in recent years display quite a stable pattern over the time series. Though there appears to be a slight increase in mean weights in the past three years (Figure 6.4.4.1).

The mean weights in the stock at spawning time have been calculated from Irish samples taken during the main spawning period that extends from October to February (Table 6.4.2). As in the mean weights at age, in recent years mean weights in the stock appear quite stable for the majority of age groups (Figure 6.4.4.2.). However a more pronounced increase in size among the older groups may indicate there have been changes in targeting in the fishery.

6.5 Recruitment

There is little information on recruitment in the catch at age data and there are as yet no recruitment indices from the surveys.

6.6 Stock Assessment

There is no reliable tuning series for this stock, and tuned assessments have not been carried out for a number of years. Recently, the group has carried out separable VPA's, screening over a range of terminal F's. This approach allows for a study of the development of the stock, but prevents any conclusions being made about stock status in the most recent years.

6.6.1 Data exploration and preliminary assessments

6.6.1.1 Trends and patterns in basic data

There have been no obvious year class effects in the catch at age matrix since the mid nineteen nineties (Table 6.2.1.1 and Figure 6.6.1.1).

From around 1985 to 1995 older fish, 5 rings and older, dominated the catches. Prior to that the age profile of the catches was relatively stable. Since 1998, when catches attained 38,000 t, younger fish, i.e. <5 ring,s have dominated the age profile of the catches.

This pronounced shift in the age composition of the catches from old fish to young fish has been maintained, and 2, 3 and 4 ringers now make up the bulk of the catch.

While the numbers of large fish in the catches have fallen the rate at which they are being removed has remained relatively high. This is reflected in the bunched catch curves in the Log of catch numbers by year class in Figure 6.6.1.2.

There is further evidence in the catch and sampling data to show that the catch rates for older age groups has continued to increase even as their proportion in the total catch decreases. See log catch ratios and smoothed log catch ratios in Figure 6.6.1.2. These show an upward trend for all fully recruited year classes in the last three years with the exception of 3 to 4 ringers. Overall, the catch sample data show a diminishing range of ages in the catches and older fish are at their lowest levels in the catches since the time series began.

It is unclear from our understanding of current understanding of fleet dynamics as to whether older fish have been fished out or if changes in targeting have shifted the selection pattern to younger fish.

Comparison of acoustic survey and fisheries data show differences in the relative strength of year classes. (Fig 6.3.2.3). There are also strong year effects in the acoustic survey data that do not appear in the fishery data. These are the 2 and 5 ringers in years 2002 and 2004 (Table 6.3.2.2).

A separable VPA was used to screen over three terminal fishing mortalities, 0.2, 0.4 and 0.6. This was achieved in the Lowestoft VPA software (Darby and Flatman, 1994). Reference age for calculation of fishing mortality was 3-7 and terminal selection was fixed at 1, relative to age 4 (winter rings). Default downweighting was chosen. This assessment is still experimental, and no assessment has been accepted by ACFM in recent years.

6.6.2 Results of the assessment

Three assessments are presented, based on the three choices of terminal F. Without access to a sufficient time series of tuning data, the group was unable to make an informed choice between them. The general development of the stock is presented in Figure 6.6.2.1. Last year's results are included in this figure, for comparative purposes. This figure is more informative for earlier years, but in most recent years has little information on the situation. Outputs from separable VPAs with terminal F's of 0.2, 0.4 and 0.6 are presented in Tables 6.6.2.1, 6.6.2.2 and 6.6.2.3 respectively. Residual plots for the three trial assessments are presented in Figures 6.6.2.2 to 6.6.2.4, respectively.

Under the two more optimistic scenarios of terminal F, the current assessment suggests declining fishing mortality since 2001. However, using a terminal F of 0.6 suggests an increase in fishing mortality in 2004. The landings have been declining slightly since 2000, and this may provide evidence that terminal F's in the range 0.2 to 0.4 are more realistic.

Recruitment appears to have remained stable at a low level, under the more pessimistic scenarios, or increased very slightly. These results are consistent with the preliminary data screening, that shows no stronger year classes in the fishery in recent years (Section 6.6.1). Using a terminal F of 0.2, produces a slight increase in recruitment in 2004. However these 1-ringer fish are poorly selected in the fishery and thus there is little information in the catch at age matrix on their strength in the final year. This can be seen with reference to the residual plots (Figure 6.6.2.2)

SSB is either stable at a low level or declining slightly, assuming terminal F of 0.6. If SSB is stable, it is stable at the lowest level in the series. In interpreting these data, it should be noted that herring is not entirely a target fishery in this area at present.

6.7 Stock Forecasts and Catch Predictions

In the absence of an agreed assessment, it was not considered informative to carry out any predictions.

6.8 Medium Term Projections

No medium term projections were carried out for this stock because of the absence of information. A management plan is currently being implemented to rebuild this stock.

6.9 Reference Points

As this assessment is still uncertain there was no revision of the precautionary reference points. The precautionary reference points for this stock were discussed in the 1999 Working Group Report (ICES 1999 ACFM:12). The present analysis, although uncertain, presents a similar picture of the stock as that shown in recent years. The SGPRP (ICES 2003/ACFM: 15) has reviewed the methodology for the calculation of biological reference points, and applying a segmented regression to the stock and recruit data from the 2002 HAWG assessment showed that the fit to the stock and recruit data for this stock was not significant. The stock is still likely below Bpa (110,000 t) but the fishing mortality has been reduced, since 1998.

6.10 Quality of the Assessment

The assessment presented was based on the results from a separable VPA without a tuning index, therefore the estimates of SSB and F for recent years depend on the choice of terminal F. Although landings seem to have been low and stable in recent years the real F cannot be determined. Therefore the VPA was run for a range of terminal F values and the current perception of the stock would be highly influenced by that choice. Further, there is no information on recent recruitment levels both because the selectivity of the fishery appears to be low for the juveniles and for the lack of a recruitment index.

As some of the components of the fishery are opportunistic changes in fishing patterns are to be expected. Consequently catch at age data is likely to be a poor indicator of cohort decline. A consistent time series of fishery independent data would provide a tuning fleet that would improve the assessment.

The group considers that the survey series available since 1999 is problematic because the surveys before 2001 were targeting autumn spawners, and those afterwards were targeting winter spawners. In 2006, five winter surveys will be available as a time series and this should be considered in tuning the assessment.

Unallocated/misreported catches are not considered to have a large effect on the assessment at present.

6.11 Management Considerations

The results of the non-tuned assessment suggest that the sharp decline in SSB may have stopped but the current level of SSB is uncertain. There is no evidence that large year classes have recruited to the stock in recent years and F appears to have been reduced due to the reduction in catch. The management of the Irish fishery (which takes most of the catch) has improved in recent years and catches have been considerably reduced since 1999. The reduced catches over this period have resulted in a reduction in fishing mortality, although it is not possible to be precise about the current levels.

SSB may be stable at an historic low level or declining slightly. Though the peak in SSB in the 1980’s may have been an isolated event the HAWG suggests that this stock should be exploited with great caution. F appears to have been substantially reduced since 1998. Though little information on recruitment is available, it is unlikely that it is above average. Certainly every effort should be taken to maintain catches at or below the current level. In particular the HAWG commends the tight enforcement of catch quotas, and this should be continued and if necessary intensified.

The opportunistic nature of the fishery means that there is a lack of information in the data and this impedes the provision of more accurate perceptions of stock status. There are essentially two fleets exploiting this stock, the smaller dry hold vessels tend to target the stock more than the larger boats. The HAWG notes that increased accuracy in the catch data over the past 3 years gives a greater confidence in the perception of stock development. It will be necessary to collect biological data from each fleet separately, in order to refine the information from catch at age data. In order to obtain a proper assessment of this stock for the most recent years, reliable survey data are required. The current acoustic survey index dates from 1999. By the next working group, 8 years of data will be available and it should be possible to use this a tuning index. However the timing of the surveys means that they only cover part of the stock.

Anecdotal information and observations by scientists shows that industrial fisheries have been in operation in the area just north of the boundary of VIaN and VIaS. The Stanton Bank, in this area, is known as a juvenile herring area and as an area for feeding of VIaN, VIaS and VIIaN herring. The by-catch of herring in industrial fisheries in this area should be evaluated.

Table 6.1.1.1 VIa(S) & VIIb,c. Estimated Herring catches in tonnes, 1988–2004. These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
France	-	-	+	-	-	-	-	-	-	-	-	-	-	-	515	-	-
Germany, Fed.Rep.	-	-	-	-	250	-	-	11	-	-	-	-	-	-	-	-	-
Ireland	15,000	18,200	25,000	22,500	26,000	27,600	24,400	25,450	23,800	24,400	25,200	16,325	10,164	11,278	13,072	12,921	10,950
Netherlands	300	2,900	2,533	600	900	2,500	2,500	1,207	1,800	3,400	2,500	1,868	1,234	2,088	366	-	64
UK (N.Ireland)	-	-	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-
UK (England + Wales)	-	-	-	-	-	-	50	24	-	-	-	-	-	-	-	-	-
UK Scotland	-	+	-	+	-	200	-	-	-	-	-	-	-	-	-	-	-
Unallocated	13,800	7,100	13,826	11,200	4,600	6,250	6,250	1,100	6,900	-700	11,200	7,916	3,607	695	366	-	1,375
Total landings	29,100	28,200	41,439	34,300	31,750	36,550	33,200	27,792	32,500	27,100	38,900	26,109	15,005	14,060	13,587	12,921	12,289
Discards	-	1,000	2,530	3,400	100	250	700	-	-	50	-	-	-	-	-	-	-
Total catch	29,100	29,200	43,969	37,700	31,850	36,800	33,900	27,792	32,500	27,150	38,900	26,109	15,005	14,060	13,587	12,921	12,289

Table 6.1.2.1. VIa(S) and Division VIIb,c herring. Length distribution of Irish catches/quarter (thousands) 2004.

Length	VIaSq1	VIaSq3	VIaSq4	VIIbcq4
17				
17.5				9
18				9
18.5				9
19				9
19.5				9
20				9
20.5			14	53
21	14		14	62
21.5	14		41	160
22	43		68	142
22.5	170		150	160
23	383	4	191	142
23.5	879	4	191	160
24	1716	4	560	160
24.5	2355	4	1611	205
25	2383	11	3140	409
25.5	2482	49	3590	489
26	2766	56	5201	632
26.5	2440	113	6198	552
27	1986	240	6867	650
27.5	2213	311	5420	507
28	2071	300	3181	427
28.5	2028	183	1925	151
29	1135	155	751	53
29.5	284	88	341	9
30	156	25	218	9
30.5	142	21	55	9
31	142	7	27	
31.5	128	4	14	
32	57	4	14	
32.5	113		14	
33	57		14	
33.5	99		14	
34	71		27	
34.5	43		14	
Numbers/t	6640	8540	5969	7030

Table 6.2.1.1 VIa(S) & VIIb,c herring. Catch in numbers-at-age (winter rings) from 1970 to 2004.

	1	2	3	4	5	6	7	8	9+
1970	135	35114	26007	13243	3895	40181	2982	1667	1911
1971	883	6177	7038	10856	8826	3938	40553	2286	2160
1972	1001	28786	20534	6191	11145	10057	4243	47182	4305
1973	6423	40390	47389	16863	7432	12383	9191	1969	50980
1974	3374	29406	41116	44579	17857	8882	10901	10272	30549
1975	7360	41308	25117	29192	23718	10703	5909	9378	32029
1976	16613	29011	37512	26544	25317	15000	5208	3596	15703
1977	4485	44512	13396	17176	12209	9924	5534	1360	4150
1978	10170	40320	27079	13308	10685	5356	4270	3638	3324
1979	5919	50071	19161	19969	9349	8422	5443	4423	4090
1980	2856	40058	64946	25140	22126	7748	6946	4344	5334
1981	1620	22265	41794	31460	12812	12746	3461	2735	5220
1982	748	18136	17004	28220	18280	8121	4089	3249	2875
1983	1517	43688	49534	25316	31782	18320	6695	3329	4251
1984	2794	81481	28660	17854	7190	12836	5974	2008	4020
1985	9606	15143	67355	12756	11241	7638	9185	7587	2168
1986	918	27110	24818	66383	14644	7988	5696	5422	2127
1987	12149	44160	80213	41504	99222	15226	12639	6082	10187
1988	0	29135	46300	41008	23381	45692	6946	2482	1964
1989	2241	6919	78842	26149	21481	15008	24917	4213	3036
1990	878	24977	19500	151978	24362	20164	16314	8184	1130
1991	675	34437	27810	12420	100444	17921	14865	11311	7660
1992	2592	15519	42532	26839	12565	73307	8535	8203	6286
1993	191	20562	22666	41967	23379	13547	67265	7671	6013
1994	11709	56156	31225	16877	21772	13644	8597	31729	10093
1995	284	34471	35414	18617	19133	16081	5749	8585	14215
1996	4776	24424	69307	31128	9842	15314	8158	12463	6472
1997	7458	56329	25946	38742	14583	5977	8351	3418	4264
1998	7437	72777	80612	38326	30165	9138	5282	3434	2942
1999	2392	51254	61329	34901	10092	5887	1880	1086	949
2000	3101	26133	29430	23216	10090	2068	1107	522	1211
2001	2207	20694	20754	16707	17581	9484	1659	979	484
2002	3093	24878	28772	14392	8859	7786	2094	1223	491
2003	1364	25916	22624	19006	7410	4069	1983	726	238
2004	1254	13538	29536	17654	8063	4408	1385	873	289

©Table 6.2.1.2 VIa(S) & VIIb,c herring. Percentage age composition (winter rings).

	1	2	3	4	5	6	7	8	9
1994	6	28	15	8	11	7	4	16	5
1995	0	23	23	12	13	11	4	6	9
1996	3	13	38	17	5	8	4	7	4
1997	5	34	16	23	9	4	5	2	3
1998	3	29	32	15	12	4	2	1	1
1999	1	30	36	21	6	3	1	1	1
2000	3	27	30	24	10	2	1	1	1
2001	2	23	23	18	19	10	2	1	1
2002	3	27	31	16	10	9	2	1	1
2003	2	31	27	23	9	5	2	1	0
2004	2	18	38	23	10	6	2	1	0

Table 6.2.2.1 Divisions VIa (S) and VIIb,cN. Sampling intensity of herring catches in 2004.

N

ICES area	Quarter/Year	Landings (t)	No. Samples	No. Ages	No. Measured	Aged/1000 t
VIa south	Quarter 1	3971	10	727	1859	183
	Quarter 2	300	3	153	448	510
	Quarter 4	6678	22	1112	2920	167
VIIb	Quarter 4	739	5	230	584	311

N

N

Table 6.3.2.1. VIa(S) & VIIb,c herring. Details of acoustic surveys of herring in VIaS and VIIbc, 1996 – 2004. The references cited are dealt with by O'Donnell et al. (in prep.).

Year	Type	Biomass	SSB	Reference
1994	Feeding phase	-	353,772	Fernandes, 1994
1995	Feeding phase	137,670	125,800	Fernandes, 1995
1996	Feeding phase	34,290	12,550	Fernandes, 1996
1997	-	-	-	-
1998	-	-	-	-
1999	Autumn spawners	23,762	22,788	Breslin, 1999
2000	Autumn spawners	21,000	20,500	Breslin and Griffin, 2001
2001	Autumn spawners	11,100	9,800	Breslin and Griffin, 2002
2002	Winter spawners	8,900	7,200	Breslin and Griffin, 2003
2003	Winter spawners	10,300	9,500	Breslin and Griffin, 2003
2004	Winter spawners	41,700	41,399	Griffin, 2004
2005	Winter spawners			In prep.

Table 6.3.2.2. VIa(S) & VIIb,c herring. Time series of acoustic surveys since 1999.

Winter rings	1999	2000	2001	2002	2003	2004
0	0	0	5	19.36	0	0.09
1	18.99	10.71	22.69	51.65	10.28	0
2	104.77	60.88	52.33	102.93	26.26	3.9
3	32.53	48.96	6.41	48.15	30.02	62.35
4	11.34	25.57	6.47	10.87	11.08	54.93
5	1.65	9.43	2.63	9.17	2.94	80.07
6	0.94	2.35	1.94	5.54	0.64	47.14
7	0.3	1.28	0.12	3.95	0.94	13.81
8	0.17	0.43	0.24	1.68	0.3	11.77
9+	0.11	0.75	0.07	2.06	0.14	0
Abundance (millions)	170.8	160.36	97.9	255.36	82.6	274.06
Total Biomass (t)	23,762	21,048	11,062	29,400	10,300	41,700
SSB (t)	22,788	20,500	9,800	28,400	9,500	41,300

Table 6.6.1 VIa(S) & VIIb,c herring. Mean weight-at-age (winter rings) in the catch, 1970 to 2004.

	1	2	3	4	5	6	7	8	9+
1970	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1971	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1972	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1973	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1974	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1975	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1976	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1977	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1978	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1979	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1980	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1981	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1982	0.110	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1983	0.090	0.129	0.165	0.191	0.209	0.222	0.231	0.237	0.241
1984	0.106	0.141	0.181	0.210	0.226	0.237	0.243	0.247	0.248
1985	0.077	0.122	0.161	0.184	0.196	0.206	0.212	0.225	0.230
1986	0.095	0.138	0.164	0.194	0.212	0.225	0.239	0.208	0.288
1987	0.085	0.102	0.150	0.169	0.177	0.193	0.205	0.215	0.220
1988		0.098	0.133	0.153	0.166	0.171	0.183	0.191	0.201
1989	0.080	0.130	0.141	0.164	0.174	0.183	0.192	0.193	0.203
1990	0.094	0.138	0.148	0.160	0.176	0.189	0.194	0.208	0.216
1991	0.089	0.134	0.145	0.157	0.167	0.185	0.199	0.207	0.230
1992	0.095	0.141	0.147	0.157	0.165	0.171	0.180	0.194	0.219
1993	0.112	0.138	0.153	0.170	0.181	0.184	0.196	0.229	0.236
1994	0.081	0.141	0.164	0.177	0.189	0.187	0.191	0.204	0.220
1995	0.080	0.140	0.161	0.173	0.182	0.198	0.194	0.206	0.217
1996	0.085	0.135	0.172	0.182	0.199	0.209	0.220	0.233	0.237
1997	0.093	0.135	0.155	0.181	0.201	0.217	0.217	0.231	0.239
1998	0.095	0.136	0.145	0.173	0.191	0.196	0.202	0.222	0.217
1999	0.106	0.144	0.145	0.163	0.186	0.195	0.200	0.216	0.222
2000	0.102	0.129	0.154	0.172	0.180	0.184	0.204	0.203	0.204
2001	0.086	0.122	0.139	0.167	0.183	0.188	0.222	0.222	0.213
2002	0.097	0.127	0.140	0.155	0.175	0.196	0.204	0.218	0.226
2003	0.102	0.134	0.150	0.167	0.183	0.196	0.216	0.210	0.228
2004	0.085	0.140	0.150	0.167	0.182	0.193	0.222	0.221	0.285

Table 6.6.2 VIa(S) & VIIb,c herring. Mean weight at age (winter rings) in the stock for

	1	2	3	4	5	6	7	8	9+
1970	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1971	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1972	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1973	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1974	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1975	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1976	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1977	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1978	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1979	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1980	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1981	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1982	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1983	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1984	0.120	0.169	0.210	0.236	0.260	0.273	0.283	0.290	0.296
1985	0.100	0.150	0.196	0.227	0.238	0.251	0.252	0.269	0.284
1986	0.098	0.169	0.209	0.238	0.256	0.276	0.280	0.287	0.312
1987	0.097	0.164	0.206	0.233	0.252	0.271	0.280	0.296	0.317
1988	0.097	0.164	0.206	0.233	0.252	0.271	0.280	0.296	0.317
1989	0.138	0.157	0.168	0.182	0.200	0.217	0.227	0.238	0.245
1990	0.113	0.152	0.170	0.180	0.200	0.217	0.225	0.233	0.255
1991	0.102	0.149	0.174	0.190	0.195	0.206	0.226	0.236	0.248
1992	0.102	0.144	0.167	0.182	0.194	0.197	0.214	0.218	0.242
1993	0.118	0.166	0.196	0.205	0.214	0.220	0.223	0.242	0.258
1994	0.098	0.156	0.192	0.209	0.216	0.223	0.226	0.230	0.247
1995	0.090	0.144	0.181	0.203	0.217	0.226	0.227	0.239	0.246
1996	0.086	0.137	0.186	0.206	0.219	0.234	0.233	0.249	0.253
1997	0.094	0.135	0.169	0.194	0.210	0.224	0.231	0.230	0.239
1998	0.095	0.136	0.145	0.173	0.191	0.196	0.202	0.222	0.217
1999	0.104	0.145	0.154	0.174	0.200	0.222	0.230	0.240	0.246
2000	0.100	0.134	0.157	0.177	0.197	0.207	0.217	0.230	0.245
2001	0.091	0.125	0.150	0.172	0.191	0.200	0.203	0.203	0.216
2002	0.092	0.127	0.146	0.170	0.190	0.201	0.210	0.227	0.229
2003	0.094	0.131	0.155	0.175	0.192	0.203	0.232	0.222	0.243
2004	0.081	0.133	0.151	0.175	0.194	0.207	0.238	0.233	0.276

herring in VIaS and VIIb,c, 1970 to 2004.

Table 6.6.2.1 VIa(S) and Division VIIb,c herring. Outputs from the separable VPA terminal

Run title : Herring VIa(S) VIIbc (run 2: wg 2005

At 10/03/2005 11:39

Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR	1970	1971	1972	1973	1974
AGE					
1	0.0005	0.0017	0.0022	0.0192	0.0091
2	0.3822	0.049	0.1176	0.19	0.1936
3	0.2409	0.1289	0.2409	0.3062	0.3201
4	0.175	0.1423	0.1519	0.302	0.4983
5	0.1606	0.1519	0.1905	0.2452	0.5307
6	0.1453	0.2163	0.2312	0.2976	0.4562
7	0.1666	0.1916	0.3387	0.3046	0.4109
8	0.187	0.1667	0.3165	0.2319	0.5776
+gp	0.187	0.1667	0.3165	0.2319	0.5776
0 FBAR 3- 6	0.1804	0.1599	0.2036	0.2877	0.4513

Table 8 Fishing mortality (F) at age

YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
AGE										
1	0.0289	0.0389	0.0123	0.0156	0.0097	0.0087	0.0038	0.0017	0.001	0.0047
2	0.25	0.2604	0.2364	0.2491	0.1666	0.1402	0.1447	0.0886	0.2213	0.1175
3	0.2677	0.4031	0.1951	0.2347	0.1905	0.3594	0.2256	0.1662	0.3917	0.235
4	0.3744	0.4742	0.3087	0.2867	0.2579	0.3861	0.2805	0.2221	0.3755	0.2256
5	0.4778	0.5701	0.3691	0.2859	0.298	0.4458	0.3087	0.2332	0.3698	0.1547
6	0.6226	0.5582	0.4055	0.2442	0.3399	0.3824	0.4426	0.2922	0.3434	0.2231
7	0.5528	0.6245	0.3643	0.2718	0.3716	0.4598	0.2616	0.2204	0.3696	0.1601
8	0.6581	0.685	0.289	0.3846	0.4418	0.5051	0.2935	0.371	0.2507	0.1607
+gp	0.6581	0.685	0.289	0.3846	0.4418	0.5051	0.2935	0.371	0.2507	0.1607
0 FBAR 3- 6	0.4356	0.5014	0.3196	0.2629	0.2716	0.3935	0.3144	0.2284	0.3701	0.2096
1										

Run title : Herring VIa(S) VIIbc (run 2: wg 2005

At 10/03/2005 11:39

Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE										
1	0.0124	0.0015	0.006	0	0.0051	0.0017	0.0021	0.01	0.0005	0.0234
2	0.052	0.0728	0.1602	0.029	0.0475	0.1188	0.1447	0.1032	0.1712	0.3363
3	0.1423	0.1193	0.3374	0.2669	0.1079	0.1937	0.1992	0.284	0.2281	0.4519
4	0.148	0.1929	0.283	0.2738	0.225	0.2948	0.1727	0.2846	0.4736	0.2515
5	0.1938	0.2259	0.432	0.2278	0.2014	0.3006	0.2883	0.2366	0.3808	0.4269
6	0.2185	0.1839	0.3438	0.3219	0.2004	0.2631	0.3355	0.314	0.3822	0.3552
7	0.2202	0.2247	0.4342	0.232	0.2601	0.3096	0.2813	0.2357	0.4678	0.3952
8	0.2789	0.1753	0.3524	0.1259	0.1925	0.1142	0.3258	0.2209	0.3063	0.3728
+gp	0.2789	0.1753	0.3524	0.1259	0.1925	0.1142	0.3258	0.2209	0.3063	0.3728
0 FBAR 3- 6	0.1756	0.1805	0.3491	0.2726	0.1837	0.263	0.2489	0.2798	0.3662	0.3714

Table 8 Fishing mortality (F) at age

YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	FBAR **-**
AGE											
1	0.001	0.0093	0.0151	0.0241	0.01	0.0098	0.006	0.0056	0.0039	0.0029	0.0041
2	0.1492	0.1852	0.2452	0.3465	0.4027	0.2442	0.1399	0.1441	0.0969	0.0796	0.1069
3	0.393	0.5348	0.3255	0.7107	0.5951	0.4576	0.3325	0.3121	0.1989	0.1631	0.2247
4	0.5068	0.6785	0.619	1.0752	0.7433	0.4468	0.4855	0.3841	0.3301	0.2247	0.313
5	0.4426	0.4872	0.6984	1.3223	0.8276	0.4358	0.6362	0.4562	0.3089	0.2036	0.3229
6	0.5694	0.6765	0.5467	1.1943	0.9051	0.3465	0.8336	0.5718	0.3461	0.2729	0.3969
7	0.2217	0.5625	0.8719	1.2265	0.7447	0.3672	0.4569	0.3839	0.2447	0.1701	0.2662
8	0.7621	0.8947	0.4308	0.9988	0.797	0.4159	0.5672	0.6372	0.197	0.1455	0.3266
+gp	0.7621	0.8947	0.4308	0.9988	0.797	0.4159	0.5672	0.6372	0.197	0.1455	
0 FBAR 3- 6	0.478	0.5943	0.5474	1.0756	0.7678	0.4217	0.5719	0.431	0.296	0.2161	
1											

F = 0.2. Age in winter rings.

Table 6.6.2.1. Continued

Run title : Herring VIa(S) VIIbc (run 2: wg 2005

At 10/03/2005 11:39

Traditional vpa Terminal populations from weighted Separable populations

Table 9 Relative F at age

	YEAR	1970	1971	1972	1973	1974
	AGE					
	1	0.0029	0.0107	0.0106	0.0668	0.0202
	2	2.118	0.3064	0.5775	0.6603	0.429
	3	1.3349	0.8063	1.1833	1.0642	0.7093
	4	0.9699	0.8902	0.7458	1.0495	1.104
	5	0.8899	0.9501	0.9354	0.852	1.1759
	6	0.8053	1.3534	1.1354	1.0343	1.0108
	7	0.9232	1.1987	1.6635	1.0584	0.9104
	8	1.0365	1.043	1.5543	0.8058	1.2798
	+gp	1.0365	1.043	1.5543	0.8058	1.2798
0	REFMEA	0.1804	0.1599	0.2036	0.2877	0.4513

Table 9 Relative F at age

	YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
	AGE										
	1	0.0664	0.0775	0.0385	0.0593	0.0357	0.0221	0.0121	0.0075	0.0028	0.0224
	2	0.574	0.5193	0.7397	0.9475	0.6133	0.3562	0.4603	0.3878	0.598	0.5604
	3	0.6146	0.804	0.6106	0.8928	0.7015	0.9136	0.7176	0.7276	1.0584	1.1213
	4	0.8594	0.9457	0.9657	1.0905	0.9496	0.9814	0.8924	0.9722	1.0145	1.0765
	5	1.0968	1.1369	1.155	1.0875	1.0974	1.1331	0.982	1.0211	0.9991	0.7379
	6	1.4292	1.1133	1.2686	0.9291	1.2515	0.972	1.408	1.2792	0.928	1.0643
	7	1.269	1.2455	1.1398	1.0341	1.3684	1.1686	0.8323	0.9647	0.9987	0.7637
	8	1.5107	1.3661	0.9043	1.4629	1.6266	1.2837	0.9338	1.6243	0.6774	0.7669
	+gp	1.5107	1.3661	0.9043	1.4629	1.6266	1.2837	0.9338	1.6243	0.6774	0.7669
0	REFMEA	0.4356	0.5014	0.3196	0.2629	0.2716	0.3935	0.3144	0.2284	0.3701	0.2096
	1										

Run title : Herring VIa(S) VIIbc (run 2: wg 2005

At 10/03/2005 11:39

Traditional vpa Terminal populations from weighted Separable populations

Table 9 Relative F at age

	YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
	AGE										
	1	0.0708	0.0086	0.0171	0	0.0275	0.0066	0.0086	0.0356	0.0013	0.0631
	2	0.2961	0.4033	0.4588	0.1063	0.2587	0.4515	0.5815	0.3687	0.4674	0.9055
	3	0.8102	0.6611	0.9667	0.979	0.5875	0.7363	0.8002	1.015	0.623	1.2169
	4	0.8425	1.0688	0.8107	1.0043	1.225	1.1208	0.6939	1.0171	1.2934	0.6771
	5	1.1033	1.2515	1.2376	0.8358	1.0965	1.1427	1.1583	0.8456	1.0399	1.1495
	6	1.244	1.0186	0.985	1.181	1.0909	1.0002	1.3477	1.1223	1.0437	0.9565
	7	1.2538	1.2448	1.2439	0.8512	1.4161	1.177	1.1299	0.8424	1.2775	1.0641
	8	1.5881	0.971	1.0095	0.4619	1.0482	0.4343	1.3087	0.7894	0.8365	1.0038
	+gp	1.5881	0.971	1.0095	0.4619	1.0482	0.4343	1.3087	0.7894	0.8365	1.0038
0	REFMEA	0.1756	0.1805	0.3491	0.2726	0.1837	0.263	0.2489	0.2798	0.3662	0.3714

Table 9 Relative F at age

	YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	MEAN **-**
	AGE											
	1	0.0021	0.0156	0.0276	0.0224	0.013	0.0233	0.0105	0.013	0.013	0.0135	0.0132
	2	0.3122	0.3116	0.4479	0.3222	0.5245	0.5792	0.2445	0.3344	0.3275	0.3686	0.3435
	3	0.8221	0.9	0.5946	0.6608	0.7751	1.0853	0.5813	0.724	0.6719	0.7548	0.7169
	4	1.0604	1.1418	1.1309	0.9996	0.9681	1.0596	0.8488	0.8911	1.1153	1.04	1.0155
	5	0.9261	0.8199	1.2759	1.2293	1.078	1.0335	1.1123	1.0584	1.0436	0.9423	1.0148
	6	1.1914	1.1384	0.9987	1.1103	1.1789	0.8217	1.4575	1.3265	1.1693	1.2629	1.2529
	7	0.4638	0.9465	1.5927	1.1403	0.9699	0.8708	0.7989	0.8905	0.8267	0.7872	0.8348
	8	1.5944	1.5056	0.7869	0.9285	1.038	0.9862	0.9917	1.4782	0.6657	0.6734	0.9391
	+gp	1.5944	1.5056	0.7869	0.9285	1.038	0.9862	0.9917	1.4782	0.6657	0.6734	
0	REFMEA	0.478	0.5943	0.5474	1.0756	0.7678	0.4217	0.5719	0.431	0.296	0.2161	
	1											

Table 6.6.2.1. Continued

Run title : Herring VIa(S) VIIbc (run 2: wg 2005

At 10/03/2005 11:39

Traditional vpa Terminal populations from weighted Separable populations

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1970	1971	1972	1973	1974
AGE					
1	406339	815387	732520	533210	589169
2	126751	149405	299451	268898	192425
3	133508	64074	105392	197228	164734
4	86547	85908	46115	67813	118885
5	27554	65738	67423	35848	45366
6	311831	21233	51100	50427	25384
7	20393	243997	15475	36693	33883
8	10253	15621	182280	9979	24485
+gp	11753	14760	16632	258380	72817
0 TOTAL	1134929	1476123	1516389	1458476	1267148

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
AGE										
1	407223	687455	578939	1038604	969688	522650	674251	689695	2309089	943429
2	214781	145535	243262	210372	376169	353286	190611	247101	253290	848585
3	117458	123912	83099	142268	121487	235916	227491	122185	167540	150386
4	97928	73578	67791	55974	92113	82211	134832	148641	84719	92714
5	65359	60939	41436	45050	38024	64401	50560	92158	107713	52660
6	24144	36677	31181	25920	30627	25538	37312	33598	66040	67336
7	14555	11722	18990	18809	18371	19727	15764	21686	22698	42386
8	20329	7577	5680	11937	12968	11463	11271	10980	15742	14192
+gp	69429	33088	17333	10906	11992	14076	21511	9716	20102	28411
0 TOTAL	1031206	1180483	1087710	1559840	1671439	1329268	1363604	1375761	3046933	2240099

1

Run title : Herring VIa(S) VIIbc (run 2: wg 2005

At 10/03/2005 11:39

Traditional vpa Terminal populations from weighted Separable populations

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE										
1	1227848	936559	3225627	468656	703250	802572	497912	413589	613882	797966
2	345442	446115	344008	1179574	172409	257408	294740	182779	150643	225724
3	558983	242942	307286	217131	848885	121798	169338	188926	122133	94043
4	97337	396956	176530	179530	136133	623916	82161	113604	116439	79597
5	66947	75960	296163	120360	123542	98361	420390	62550	77334	65612
6	40821	49905	54834	173973	86717	91395	65894	285108	44674	47815
7	48746	29687	37572	35180	114088	64218	63567	42631	188456	27583
8	32680	35390	21456	22022	25240	79591	42635	43417	30475	106811
+gp	9338	13883	35938	17426	18189	10989	28873	33270	23888	33977
0 TOTAL	2428142	2227397	4499414	2413853	2228453	2150248	1665511	1365874	1367925	1479127

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	GMST 70-**	AMST 70
AGE													
1	453017	817762	786986	493415	380909	502055	584563	878007	557469	678850	0	703718	802492
2	286753	166490	298060	285181	177197	138737	182892	213765	321202	204293	249007	249401	286904
3	119468	182983	102492	172801	149396	87758	80506	117807	137105	215970	139758	154390	183071
4	48999	66029	87758	60602	69505	67457	45466	47268	70596	92009	150213	94227	116093
5	56008	26709	30313	42758	18711	29908	39044	25318	29129	45918	66499	59168	76855
6	38739	32553	14847	13642	10311	7400	17503	18700	14517	19353	33895	39607	58581
7	30330	19834	14975	7777	3739	3774	4735	6881	9552	9293	13330	24166	39361
8	16810	21987	10226	5666	2064	1607	2365	2713	4241	6767	7093	15162	26300
+gp	27834	11418	12757	4854	1804	3727	1169	1089	1390	2240	7047		
0 TOTAL	1077959	1345766	1358415	1086696	813637	842423	958245	1311548	1145201	1274694	666841		

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Table 6.6.2.1. Continued

Run title : Herring VIa(S) VIIbc (run 2: wg 2005

At 10/03/2005 11:39

Traditional vpa Terminal populations from weighted Separable populations

Table 12 Stock biomass at age (start of year) Tonnes

	YEAR	1970	1971	1972	1973	1974
	AGE					
	1	48761	97846	87902	63985	70700
	2	21421	25250	50607	45444	32520
	3	28037	13456	22132	41418	34594
	4	20425	20274	10883	16004	28057
	5	7164	17092	17530	9320	11795
	6	85130	5797	13950	13766	6930
	7	5771	69051	4379	10384	9589
	8	2973	4530	52861	2894	7101
	+gp	3479	4369	4923	76481	21554
0	TOTALBI(	223161	257664	265169	279696	222839

Table 12 Stock biomass at age (start of year) Tonnes

	YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
	AGE										
	1	48867	82495	69473	124632	116363	62718	80910	82763	277091	113211
	2	36298	24595	41111	35553	63573	59705	32213	41760	42806	143411
	3	24666	26022	17451	29876	25512	49542	47773	25659	35183	31581
	4	23111	17364	15999	13210	21739	19402	31820	35079	19994	21880
	5	16993	15844	10773	11713	9886	16744	13146	23961	28005	13692
	6	6591	10013	8512	7076	8361	6972	10186	9172	18029	18383
	7	4119	3317	5374	5323	5199	5583	4461	6137	6423	11995
	8	5895	2197	1647	3462	3761	3324	3268	3184	4565	4116
	+gp	20551	9794	5130	3228	3550	4166	6367	2876	5950	8410
0	TOTALBI(	187092	191641	175471	234073	257943	228157	230146	230593	438047	366679
	1										

Run title : Herring VIa(S) VIIbc (run 2: wg 2005

At 10/03/2005 11:39

Traditional vpa Terminal populations from weighted Separable populations

Table 12 Stock biomass at age (start of year) Tonnes

	YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
	AGE										
	1	122785	91783	312886	45460	97049	90691	50787	42186	72438	78201
	2	51816	75393	56417	193450	27068	39126	43916	26320	25007	35213
	3	109561	50775	63301	44729	142613	20706	29465	31551	23938	18056
	4	22096	94476	41131	41830	24776	112305	15611	20676	23870	16636
	5	15933	19446	74633	30331	24708	19672	81976	12135	16549	14172
	6	10246	13774	14860	47147	18818	19833	13574	56166	9828	10663
	7	12284	8312	10520	9850	25898	14449	14366	9123	42026	6234
	8	8791	10157	6351	6519	6007	18545	10062	9465	7375	24567
	+gp	2652	4332	11392	5524	4456	2802	7161	8051	6163	8392
0	TOTALBI(	356164	368447	591492	424840	371393	338128	266918	215673	227194	212133

Table 12 Stock biomass at age (start of year) Tonnes

	YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	AGE										
	1	40771	70328	73977	46874	39615	50206	53195	80777	52402	54987
	2	41292	22809	40238	38785	25694	18591	22862	27148	42077	27171
	3	21624	34035	17321	25056	23007	13778	12076	17200	21251	32612
	4	9947	13602	17025	10484	12094	11940	7820	8036	12354	16102
	5	12154	5849	6366	8167	3742	5892	7457	4810	5593	8908
	6	8755	7617	3326	2674	2289	1532	3501	3759	2947	4006
	7	6885	4621	3459	1571	860	819	961	1445	2216	2212
	8	4018	5475	2352	1258	495	370	480	616	942	1577
	+gp	6847	2889	3049	1053	444	913	253	249	338	618
0	TOTALBI(	152293	167225	167113	135922	108239	104040	108605	144040	140120	148192
	1										

Table 6.6.2.1. Continued

Table 17 Summary (with SOP correction)

Traditional vpa Terminal populations from weighted Separable populations

	RECR Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	SOPCOFA	FBAR 3- 6
1970	406339	200121	125376	20306	0.162	0.8968	0.1804
1971	815387	224353	114397	15044	0.1315	0.8707	0.1599
1972	732520	237981	122507	23474	0.1916	0.8975	0.2036
1973	533210	284216	166517	36719	0.2205	1.0162	0.2877
1974	589169	217530	101601	36589	0.3601	0.9762	0.4513
1975	407223	210228	105773	38764	0.3665	1.1237	0.4356
1976	687455	200686	75158	32767	0.436	1.0472	0.5014
1977	578939	189127	83372	20567	0.2467	1.0778	0.3196
1978	1038604	237853	82084	19715	0.2402	1.0161	0.2629
1979	969688	275064	112954	22608	0.2002	1.0664	0.2716
1980	522650	219842	113713	30124	0.2649	0.9636	0.3935
1981	674251	237323	115983	24922	0.2149	1.0312	0.3144
1982	689695	237525	119617	19209	0.1606	1.0301	0.2284
1983	2309089	439884	115718	32988	0.2851	1.0042	0.3701
1984	943429	355245	190424	27450	0.1442	0.9688	0.2096
1985	1227848	350681	184027	23343	0.1268	0.9846	0.1756
1986	936559	368506	223156	28785	0.129	1.0002	0.1805
1987	3225627	561195	190878	48600	0.2546	0.9488	0.3491
1988	468656	424521	298360	29100	0.0975	0.9992	0.2726
1989	703250	371755	222144	29210	0.1315	1.001	0.1837
1990	802572	338337	191844	43969	0.2292	1.0006	0.263
1991	497912	266156	165093	37700	0.2284	0.9971	0.2489
1992	413589	214613	131889	31856	0.2415	0.9951	0.2798
1993	613882	228549	111264	36763	0.3304	1.006	0.3662
1994	797966	211708	93915	33908	0.3611	0.998	0.3714
1995	453017	160288	81470	27792	0.3411	1.0525	0.478
1996	817762	166473	60815	32534	0.535	0.9955	0.5943
1997	786986	167384	62197	27225	0.4377	1.0016	0.5474
1998	493415	135752	49496	38895	0.7858	0.9988	1.0756
1999	380909	108435	40678	26109	0.6418	1.0018	0.7678
2000	502055	104155	36854	15005	0.4071	1.0011	0.4217
2001	584563	108471	38271	14061	0.3674	0.9988	0.5719
2002	878007	143907	45417	13587	0.2992	0.9991	0.431
2003	557469	140394	67157	12921	0.1924	1.002	0.296
2004	678850	148282	73733	12289	0.1667	1.0006	0.2161
Arith. Mean	791958	242473	117539	27569	.2837		.3623
0 Units	(Thousands	(Tonnes)	(Tonnes)	(Tonnes)			

1

Table 6.6.2.2. VIa(S) and Division VIIb,c. Outputs from the separable VPA terminal F = 0.4. Age in winter rings.

Run title : Herring VIa(S) VIIbc (run 1: wg 2005

At 10/03/2005 14:25

Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR	1970	1971	1972	1973	1974
AGE					
1	0.0005	0.0017	0.0021	0.0191	0.009
2	0.3799	0.0488	0.117	0.189	0.1924
3	0.2386	0.1279	0.2397	0.3044	0.3178
4	0.1725	0.1406	0.1505	0.2999	0.4939
5	0.1573	0.1493	0.1878	0.2425	0.5251
6	0.142	0.211	0.2265	0.2924	0.4492
7	0.162	0.1864	0.3277	0.2965	0.4007
8	0.1802	0.1613	0.3055	0.222	0.5541
+gp	0.1802	0.1613	0.3055	0.222	0.5541
0 FBAR 3- 6	0.1776	0.1572	0.2011	0.2848	0.4465

Table 8 Fishing mortality (F) at age

YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
AGE										
1	0.0287	0.0385	0.0122	0.0154	0.0096	0.0086	0.0038	0.0017	0.001	0.0046
2	0.2483	0.2579	0.234	0.2464	0.1646	0.1382	0.1427	0.0875	0.2183	0.116
3	0.2656	0.3992	0.1928	0.2317	0.1879	0.3539	0.2217	0.1635	0.3854	0.231
4	0.3707	0.4686	0.3043	0.2824	0.2537	0.3791	0.2746	0.2173	0.3674	0.2207
5	0.471	0.561	0.3626	0.2805	0.2921	0.4356	0.3009	0.2269	0.3593	0.1504
6	0.6109	0.5452	0.3951	0.2384	0.3312	0.3718	0.427	0.2823	0.3312	0.2147
7	0.5389	0.6031	0.3511	0.2623	0.3596	0.4425	0.2517	0.2097	0.3524	0.1528
8	0.6305	0.6537	0.2739	0.3646	0.4198	0.4801	0.2778	0.3519	0.2356	0.1511
+gp	0.6305	0.6537	0.2739	0.3646	0.4198	0.4801	0.2778	0.3519	0.2356	0.1511
0 FBAR 3- 6	0.4295	0.4935	0.3137	0.2582	0.2662	0.3851	0.3061	0.2225	0.3608	0.2042

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Run title : Herring VIa(S) VIIbc (run 1: wg 2005

At 10/03/2005 14:25

Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE										
1	0.0123	0.0015	0.0059	0	0.005	0.0017	0.0021	0.01	0.0005	0.0235
2	0.0514	0.0721	0.1589	0.0288	0.0473	0.1184	0.1445	0.1032	0.1714	0.3368
3	0.1402	0.1178	0.3334	0.2642	0.1072	0.1928	0.1985	0.2834	0.2281	0.4526
4	0.1449	0.1896	0.2785	0.2693	0.2221	0.2924	0.1717	0.2833	0.4723	0.2514
5	0.1886	0.2203	0.4219	0.2232	0.1973	0.2957	0.2851	0.2349	0.3784	0.425
6	0.2112	0.178	0.3326	0.3111	0.1953	0.2564	0.328	0.3093	0.3786	0.352
7	0.2099	0.2155	0.4155	0.2221	0.2486	0.2997	0.2719	0.2287	0.4574	0.3897
8	0.2633	0.1654	0.3333	0.1189	0.1824	0.1082	0.3116	0.2115	0.2946	0.3604
+gp	0.2633	0.1654	0.3333	0.1189	0.1824	0.1082	0.3116	0.2115	0.2946	0.3604
0 FBAR 3- 6	0.1713	0.1764	0.3416	0.267	0.1805	0.2593	0.2458	0.2777	0.3643	0.3703

Table 8 Fishing mortality (F) at age

YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	FBAR **-
AGE											
1	0.001	0.0094	0.0155	0.0255	0.0114	0.0124	0.0087	0.0095	0.0077	0.0069	0.0081
2	0.1496	0.1866	0.2488	0.3586	0.4321	0.2836	0.1798	0.2158	0.1716	0.1667	0.1847
3	0.3939	0.5368	0.3287	0.7282	0.6292	0.5112	0.4082	0.433	0.3286	0.3238	0.3618
4	0.508	0.6813	0.6232	1.0978	0.7821	0.4914	0.5839	0.5236	0.5379	0.44	0.5005
5	0.4426	0.4891	0.7041	1.3469	0.8732	0.4779	0.7551	0.6247	0.4948	0.4088	0.5094
6	0.5654	0.6763	0.5503	1.2203	0.9561	0.3814	1.0045	0.8025	0.5779	0.5483	0.6429
7	0.219	0.5555	0.8713	1.2472	0.7871	0.4069	0.5295	0.5513	0.4255	0.351	0.4426
8	0.743	0.8758	0.4221	0.9971	0.8335	0.4593	0.6728	0.8379	0.3301	0.2999	0.4893
+gp	0.743	0.8758	0.4221	0.9971	0.8335	0.4593	0.6728	0.8379	0.3301	0.2999	
0 FBAR 3- 6	0.4775	0.5959	0.5516	1.0983	0.8101	0.4655	0.6879	0.5959	0.4848	0.4302	

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Table 6.6.2.2.. continued.

Traditional vpa Terminal populations from weighted Separable populations

Table 9 Relative F at age

	YEAR	1970	1971	1972	1973	1974
	AGE					
	1	0.0029	0.0108	0.0107	0.0671	0.0202
	2	2.1394	0.3101	0.5819	0.6635	0.4308
	3	1.3434	0.8136	1.1916	1.0689	0.7118
	4	0.9715	0.8945	0.7484	1.053	1.1062
	5	0.8856	0.9498	0.9339	0.8515	1.176
	6	0.7995	1.3421	1.1261	1.0266	1.006
	7	0.9122	1.1859	1.6294	1.0411	0.8973
	8	1.0146	1.0262	1.5191	0.7794	1.2409
	+gp	1.0146	1.0262	1.5191	0.7794	1.2409
0	REFMEA	0.1776	0.1572	0.2011	0.2848	0.4465

Table 9 Relative F at age

	YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
	AGE										
	1	0.0668	0.078	0.0389	0.0597	0.0359	0.0222	0.0123	0.0076	0.0028	0.0227
	2	0.578	0.5227	0.746	0.954	0.6182	0.3588	0.4661	0.393	0.6051	0.5679
	3	0.6182	0.8089	0.6147	0.8973	0.7059	0.919	0.7245	0.7347	1.0682	1.1313
	4	0.8629	0.9495	0.9701	1.0934	0.9529	0.9845	0.8973	0.9768	1.0183	1.081
	5	1.0966	1.1368	1.1557	1.0863	1.0971	1.1311	0.9831	1.0199	0.9957	0.7365
	6	1.4223	1.1048	1.2596	0.9231	1.2441	0.9653	1.3952	1.2687	0.9178	1.0512
	7	1.2546	1.2221	1.1191	1.0156	1.3506	1.1491	0.8223	0.9425	0.9767	0.7483
	8	1.4678	1.3246	0.8729	1.4119	1.5769	1.2467	0.9077	1.5816	0.653	0.7402
	+gp	1.4678	1.3246	0.8729	1.4119	1.5769	1.2467	0.9077	1.5816	0.653	0.7402
0	REFMEA	0.4295	0.4935	0.3137	0.2582	0.2662	0.3851	0.3061	0.2225	0.3608	0.2042
	1										

Run title : Herring VIa(S) VIIbc (run 1: wg 2005

At 10/03/2005 14:25

Traditional vpa Terminal populations from weighted Separable populations

Table 9 Relative F at age

	YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
	AGE										
	1	0.072	0.0087	0.0174	0	0.0279	0.0067	0.0087	0.0359	0.0014	0.0635
	2	0.3001	0.4086	0.4651	0.1079	0.2621	0.4566	0.5879	0.3714	0.4703	0.9096
	3	0.8188	0.6677	0.976	0.9897	0.5938	0.7434	0.8074	1.0206	0.6261	1.2224
	4	0.8462	1.0748	0.8153	1.0089	1.2308	1.1275	0.6986	1.02	1.2963	0.6791
	5	1.1014	1.2488	1.2351	0.8361	1.0931	1.1403	1.1598	0.8458	1.0386	1.1479
	6	1.2335	1.0088	0.9736	1.1654	1.0823	0.9888	1.3342	1.1136	1.039	0.9506
	7	1.2259	1.2214	1.2162	0.8317	1.3771	1.1558	1.1062	0.8236	1.2555	1.0524
	8	1.5376	0.9375	0.9758	0.4452	1.0105	0.4173	1.2676	0.7617	0.8085	0.9734
	+gp	1.5376	0.9375	0.9758	0.4452	1.0105	0.4173	1.2676	0.7617	0.8085	0.9734
0	REFMEA	0.1713	0.1764	0.3416	0.267	0.1805	0.2593	0.2458	0.2777	0.3643	0.3703

Table 9 Relative F at age

	YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	MEAN **-
	AGE											
	1	0.0021	0.0158	0.0281	0.0232	0.014	0.0266	0.0126	0.016	0.0159	0.016	0.016
	2	0.3134	0.3131	0.4511	0.3265	0.5334	0.6092	0.2613	0.3621	0.354	0.3875	0.3679
	3	0.8249	0.9009	0.596	0.663	0.7767	1.0983	0.5933	0.7265	0.6778	0.7526	0.719
	4	1.064	1.1433	1.1298	0.9996	0.9654	1.0558	0.8488	0.8786	1.1095	1.0227	1.0036
	5	0.9269	0.8209	1.2765	1.2264	1.0778	1.0267	1.0977	1.0483	1.0206	0.9501	1.0064
	6	1.1841	1.1349	0.9977	1.1111	1.1801	0.8193	1.4602	1.3466	1.1921	1.2745	1.2711
	7	0.4587	0.9322	1.5797	1.1356	0.9716	0.8741	0.7698	0.9251	0.8777	0.8158	0.8729
	8	1.5562	1.4698	0.7652	0.9079	1.0288	0.9868	0.978	1.406	0.681	0.697	0.928
	+gp	1.5562	1.4698	0.7652	0.9079	1.0288	0.9868	0.978	1.406	0.681	0.697	
0	REFMEA	0.4775	0.5959	0.5516	1.0983	0.8101	0.4655	0.6879	0.5959	0.4848	0.4302	
	1											

Table 6.6.2.2.. continued

Run title : Herring VIa(S) VIIbc (run 1: wg 2005

At 10/03/2005 14:25

Traditional vpa Terminal populations from weighted Separable populations

Table 10 Stock number at age (start of year) Numbers*10**-3

	YEAR	1970	1971	1972	1973	1974
	AGE					
	1	408177	819014	736174	536318	592882
	2	127384	150082	300786	270242	193568
	3	134667	64541	105893	198216	165729
	4	87702	86856	46498	68223	119693
	5	28089	66782	68281	36194	45736
	6	318630	21717	52045	51202	25697
	7	20926	250148	15913	37548	34584
	8	10609	16103	187844	10375	25257
	+gp	12161	15215	17139	268624	75115
0	TOTAL	1148345	1490458	1530572	1476941	1278261

Table 10 Stock number at age (start of year) Numbers*10**-3

	YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
	AGE										
	1	410547	693452	584534	1049922	982656	529538	682514	698247	2337270	954462
	2	216147	146758	245468	212430	380333	358057	193145	250140	256436	858953
	3	118304	124922	84003	143900	123010	238998	231024	124061	169791	152714
	4	98741	74270	68616	56714	93448	83457	137351	151531	86254	94552
	5	66089	61673	42061	45796	38693	65608	51686	94435	110327	54048
	6	24479	37336	31844	26485	31302	26143	38403	34616	68100	69699
	7	14838	12024	19584	19408	18882	20337	16311	22672	23618	44248
	8	20963	7832	5952	12474	13510	11925	11821	11475	16633	15023
	+gp	71594	34202	18163	11398	12493	14643	22562	10154	21240	30077
0	TOTAL	1041700	1192468	1100225	1578527	1694326	1348705	1384816	1397331	3089669	2273776
	1										

Run title : Herring VIa(S) VIIbc (run 1: wg 2005

At 10/03/2005 14:25

Traditional vpa Terminal populations from weighted Separable populations

Table 10 Stock number at age (start of year) Numbers*10**-3

	YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
	AGE										
	1	1239362	943540	3246044	470604	705250	803717	497950	413180	613034	796057
	2	349502	450350	346576	1187085	173126	258143	295161	182793	150493	225412
	3	566660	245949	310423	219033	854449	122329	169883	189237	122143	93932
	4	99241	403240	178991	182094	137688	628471	82596	114049	116694	79605
	5	68610	77683	301847	122586	125861	99768	424509	62943	77737	65842
	6	42077	51409	56392	179109	88730	93492	67166	288832	45029	48179
	7	50883	30823	38933	36588	118731	66039	65463	43781	191822	27904
	8	34364	37323	22483	23252	26514	83789	44281	45132	31515	109852
	+gp	9820	14641	37658	18399	19107	11569	29988	34585	24703	34944
0	TOTAL	2460518	2254958	4539348	2438749	2249455	2167316	1676996	1374532	1373172	1481727

Table 10 Stock number at age (start of year) Numbers*10**-3

	YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
	AGE											
	1	449849	807152	764925	466468	334450	398826	404596	515399	278395	288443	0
	2	286051	165325	294157	277065	167284	121646	144917	147559	187806	101628	105383
	3	119237	182464	101630	169913	143402	80446	67866	89691	88096	117189	63727
	4	48909	65841	87334	59897	67161	62579	39502	36943	47628	51928	69409
	5	56016	26627	30144	42375	18080	27798	34639	19934	19802	25167	30261
	6	38947	32560	14773	13489	9971	6832	15597	14730	9657	10925	15131
	7	30659	20022	14981	7710	3603	3468	4222	5168	5974	4903	5713
	8	17100	22285	10395	5672	2004	1484	2089	2250	2695	3532	3123
	+gp	28315	11573	12969	4859	1751	3442	1033	903	883	1169	3152
0	TOTAL	1075084	1333848	1331308	1047449	747707	706521	714461	832577	640937	604883	295899
	1											

Table 6.6.2.2. continued.

Traditional vpa Terminal populations from weighted Separable populations

	RECR Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	SOPCOFAC	FBAR 3- 6
1970	408177	203002	127869	20306	0.1588	0.8968	0.1776
1971	819014	227218	116712	15044	0.1289	0.8707	0.1572
1972	736174	240878	124837	23474	0.188	0.8975	0.2011
1973	536318	288885	170512	36719	0.2153	1.0162	0.2848
1974	592882	219797	103319	36589	0.3541	0.9762	0.4465
1975	410547	212683	107658	38764	0.3601	1.1237	0.4295
1976	693452	202950	76570	32767	0.4279	1.0472	0.4935
1977	584534	191568	84933	20567	0.2422	1.0778	0.3137
1978	1049922	240945	83634	19715	0.2357	1.0161	0.2582
1979	982656	279012	115002	22608	0.1966	1.0664	0.2662
1980	529538	223241	116046	30124	0.2596	0.9636	0.3851
1981	682514	241419	118780	24922	0.2098	1.0312	0.3061
1982	698247	241684	122446	19209	0.1569	1.0301	0.2225
1983	2337270	446759	118913	32988	0.2774	1.0042	0.3608
1984	954462	361316	194686	27450	0.141	0.9688	0.2042
1985	1239362	356132	187917	23343	0.1242	0.9846	0.1713
1986	943540	373997	227542	28785	0.1265	1.0002	0.1764
1987	3246044	567557	195040	48600	0.2492	0.9488	0.3416
1988	470604	429946	303114	29100	0.096	0.9992	0.267
1989	705250	375848	225658	29210	0.1294	1.001	0.1805
1990	803717	341763	194925	43969	0.2256	1.0006	0.2593
1991	497950	268552	167336	37700	0.2253	0.9971	0.2458
1992	413180	216445	133651	31856	0.2384	0.9951	0.2777
1993	613034	229863	112612	36763	0.3265	1.006	0.3643
1994	796057	212593	94938	33908	0.3572	0.998	0.3703
1995	449849	160146	81643	27792	0.3404	1.0525	0.4775
1996	807152	165411	60700	32534	0.536	0.9955	0.5959
1997	764925	164589	61590	27225	0.442	1.0016	0.5516
1998	466468	131439	47953	38895	0.8111	0.9988	1.0983
1999	334450	100560	37982	26109	0.6874	1.0018	0.8101
2000	398826	88816	32449	15005	0.4624	1.0011	0.4655
2001	404596	83044	30334	14061	0.4635	0.9988	0.6879
2002	515399	93996	30972	13587	0.4387	0.9991	0.5959
2003	278395	80881	38412	12921	0.3364	1.002	0.4848
2004	288443	73164	35371	12289	0.3474	1.0006	0.4302
Arith. Mean	755798	238174	116630	27569	.3005		.3817
0 Units	(Thousands)	(Tonnes)	(Tonnes)	(Tonnes)			

1

Table 6.6.2.3. VIa(S) and Division VIIb,c. Outputs from the separable VPA terminal F = 0.6. age in winter rings.

Run title : Herring VIa(S) VIIbc (run 1: wg 2005

At 10/03/2005 14:39

Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR	1970	1971	1972	1973	1974
AGE					
1	0.0005	0.0017	0.0021	0.019	0.009
2	0.3786	0.0486	0.1167	0.1884	0.1916
3	0.2372	0.1273	0.2389	0.3034	0.3165
4	0.1711	0.1397	0.1497	0.2986	0.4914
5	0.1554	0.1479	0.1863	0.241	0.5218
6	0.1401	0.208	0.2238	0.2894	0.4451
7	0.1595	0.1836	0.3217	0.292	0.3948
8	0.1765	0.1584	0.2996	0.2167	0.5413
+gp	0.1765	0.1584	0.2996	0.2167	0.5413
0 FBAR 3- 6	0.176	0.1557	0.1997	0.2831	0.4437

Table 8 Fishing mortality (F) at age

YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
AGE										
1	0.0286	0.0383	0.0121	0.0153	0.0095	0.0085	0.0037	0.0017	0.001	0.0046
2	0.2472	0.2565	0.2327	0.2448	0.1634	0.137	0.1415	0.0868	0.2166	0.1151
3	0.2643	0.3968	0.1915	0.23	0.1864	0.3507	0.2195	0.1619	0.3817	0.2287
4	0.3685	0.4653	0.3018	0.2799	0.2513	0.3751	0.2712	0.2146	0.3628	0.2179
5	0.4671	0.5557	0.3587	0.2774	0.2886	0.4297	0.2964	0.2233	0.3533	0.1479
6	0.6042	0.5376	0.3892	0.235	0.3263	0.3657	0.4182	0.2767	0.3242	0.2099
7	0.531	0.591	0.3436	0.2568	0.3527	0.4328	0.2461	0.2039	0.3429	0.1488
8	0.6152	0.6363	0.2655	0.3536	0.4077	0.4663	0.2692	0.3414	0.2275	0.146
+gp	0.6152	0.6363	0.2655	0.3536	0.4077	0.4663	0.2692	0.3414	0.2275	0.146
0 FBAR 3- 6	0.426	0.4889	0.3103	0.2556	0.2632	0.3803	0.3013	0.2191	0.3555	0.2011
1										

Run title : Herring VIa(S) VIIbc (run 1: wg 2005

At 10/03/2005 14:39

Traditional vpa Terminal populations from weighted Separable populations

Table 8 Fishing mortality (F) at age

YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE										
1	0.0123	0.0015	0.0059	0	0.005	0.0017	0.0021	0.01	0.0005	0.0235
2	0.051	0.0717	0.1581	0.0287	0.0472	0.1182	0.1444	0.1031	0.1714	0.337
3	0.139	0.1169	0.3311	0.2627	0.1067	0.1922	0.198	0.2831	0.228	0.4528
4	0.1432	0.1877	0.2759	0.2668	0.2205	0.2909	0.1711	0.2825	0.4714	0.2513
5	0.1857	0.2171	0.4162	0.2206	0.1949	0.2928	0.2832	0.2339	0.3769	0.4238
6	0.2071	0.1746	0.3262	0.3051	0.1925	0.2526	0.3237	0.3066	0.3764	0.35
7	0.2042	0.2103	0.405	0.2165	0.2422	0.2941	0.2667	0.2248	0.4515	0.3864
8	0.2548	0.16	0.3229	0.115	0.1768	0.1049	0.3038	0.2064	0.2881	0.3535
+gp	0.2548	0.16	0.3229	0.115	0.1768	0.1049	0.3038	0.2064	0.2881	0.3535
0 FBAR 3- 6	0.1687	0.1741	0.3374	0.2638	0.1787	0.2571	0.244	0.2765	0.3632	0.3695

Table 8 Fishing mortality (F) at age

YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
AGE										
1	0.001	0.0094	0.0157	0.026	0.0119	0.0135	0.0102	0.0124	0.0113	0.0113
2	0.1497	0.1871	0.2501	0.3627	0.4426	0.2992	0.1985	0.2586	0.2299	0.2536
3	0.3942	0.5375	0.3298	0.7342	0.6413	0.5314	0.4407	0.4969	0.4202	0.4802
4	0.5083	0.6821	0.6245	1.1055	0.796	0.5081	0.6252	0.5939	0.6815	0.6496
5	0.4423	0.4896	0.7059	1.3551	0.8893	0.4937	0.8048	0.7107	0.616	0.6159
6	0.5626	0.6755	0.5513	1.2286	0.9739	0.3945	1.0791	0.9276	0.741	0.8227
7	0.2174	0.5507	0.8691	1.2528	0.8014	0.4217	0.5589	0.6453	0.5624	0.5368
8	0.7322	0.8644	0.4162	0.9908	0.8438	0.4749	0.7162	0.9369	0.4255	0.46
+gp	0.7322	0.8644	0.4162	0.9908	0.8438	0.4749	0.7162	0.9369	0.4255	0.46
0 FBAR 3- 6	0.4768	0.5962	0.5529	1.1059	0.8251	0.4819	0.7375	0.6823	0.6147	0.6421

Table 6.6.2.3. Continued

Run title : Herring VIa(S) VIIbc (run 1: wg 2005

At 10/03/2005 14:39

Traditional vpa Terminal populations from weighted Separable populations

Table 9 Relative F at age

	YEAR	1970	1971	1972	1973	1974
	AGE					
	1	0.003	0.0109	0.0107	0.0672	0.0203
	2	2.1514	0.3122	0.5845	0.6654	0.4319
	3	1.348	0.8176	1.1963	1.0716	0.7134
	4	0.9723	0.8969	0.7498	1.0549	1.1074
	5	0.8833	0.9496	0.933	0.8512	1.176
	6	0.7964	1.3359	1.1209	1.0222	1.0032
	7	0.9065	1.1789	1.611	1.0315	0.8899
	8	1.0033	1.0174	1.5001	0.7654	1.2199
	+gp	1.0033	1.0174	1.5001	0.7654	1.2199
0	REFMEA	0.176	0.1557	0.1997	0.2831	0.4437

Table 9 Relative F at age

	YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
	AGE										
	1	0.0671	0.0784	0.0391	0.06	0.0361	0.0223	0.0124	0.0077	0.0029	0.0229
	2	0.5803	0.5246	0.7498	0.9578	0.6211	0.3603	0.4695	0.3961	0.6091	0.5723
	3	0.6203	0.8117	0.6171	0.8999	0.7084	0.9222	0.7284	0.7388	1.0738	1.1371
	4	0.8649	0.9518	0.9726	1.0951	0.9549	0.9864	0.9	0.9794	1.0204	1.0834
	5	1.0965	1.1367	1.156	1.0855	1.0968	1.13	0.9836	1.0191	0.9937	0.7356
	6	1.4182	1.0998	1.2543	0.9195	1.2399	0.9615	1.388	1.2628	0.912	1.0439
	7	1.2464	1.209	1.1072	1.005	1.3403	1.1382	0.8167	0.9304	0.9646	0.7397
	8	1.4442	1.3016	0.8557	1.3835	1.5493	1.2262	0.8934	1.5581	0.6398	0.7258
	+gp	1.4442	1.3016	0.8557	1.3835	1.5493	1.2262	0.8934	1.5581	0.6398	0.7258
0	REFMEA	0.426	0.4889	0.3103	0.2556	0.2632	0.3803	0.3013	0.2191	0.3555	0.2011
	1										

Run title : Herring VIa(S) VIIbc (run 1: wg 2005

At 10/03/2005 14:39

Traditional vpa Terminal populations from weighted Separable populations

Table 9 Relative F at age

	YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
	AGE										
	1	0.0726	0.0088	0.0175	0	0.0281	0.0067	0.0088	0.0361	0.0014	0.0637
	2	0.3024	0.4117	0.4687	0.1088	0.2641	0.4596	0.5916	0.373	0.4719	0.9121
	3	0.824	0.6715	0.9813	0.9959	0.5974	0.7475	0.8116	1.0237	0.6279	1.2255
	4	0.8484	1.0783	0.818	1.0114	1.2341	1.1314	0.7013	1.0217	1.2979	0.6802
	5	1.1002	1.2471	1.2337	0.8362	1.0911	1.1389	1.1606	0.846	1.0378	1.1469
	6	1.2275	1.0031	0.967	1.1566	1.0774	0.9822	1.3265	1.1086	1.0364	0.9474
	7	1.2104	1.2081	1.2004	0.8207	1.3557	1.1438	1.0927	0.8131	1.2432	1.0459
	8	1.5099	0.9193	0.9571	0.4359	0.9897	0.408	1.2449	0.7463	0.7932	0.9567
	+gp	1.5099	0.9193	0.9571	0.4359	0.9897	0.408	1.2449	0.7463	0.7932	0.9567
0	REFMEA	0.1687	0.1741	0.3374	0.2638	0.1787	0.2571	0.244	0.2765	0.3632	0.3695

Table 9 Relative F at age

	YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	AGE										
	1	0.0021	0.0158	0.0284	0.0235	0.0144	0.0281	0.0138	0.0182	0.0183	0.0177
	2	0.314	0.3138	0.4523	0.328	0.5364	0.6208	0.2692	0.3791	0.374	0.3949
	3	0.8266	0.9015	0.5965	0.6639	0.7772	1.1027	0.5976	0.7283	0.6835	0.7478
	4	1.0661	1.1442	1.1296	0.9997	0.9647	1.0543	0.8478	0.8705	1.1087	1.0117
	5	0.9275	0.8213	1.2767	1.2254	1.0778	1.0245	1.0913	1.0416	1.0021	0.9592
	6	1.1798	1.133	0.9971	1.111	1.1803	0.8185	1.4632	1.3596	1.2056	1.2813
	7	0.4559	0.9237	1.572	1.1329	0.9713	0.8749	0.7579	0.9458	0.915	0.8361
	8	1.5355	1.4499	0.7529	0.896	1.0227	0.9854	0.9712	1.3731	0.6922	0.7165
	+gp	1.5355	1.4499	0.7529	0.896	1.0227	0.9854	0.9712	1.3731	0.6922	0.7165
0	REFMEA	0.4768	0.5962	0.5529	1.1059	0.8251	0.4819	0.7375	0.6823	0.6147	0.6421

Table 6.6.2.3. Continued.

Traditional vpa Terminal populations from weighted Separable populations

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1970	1971	1972	1973	1974
AGE					
1	409277	821203	738363	538178	595097
2	127762	150486	301591	271047	194252
3	135355	64820	106193	198812	166325
4	88376	87419	46726	68468	120181
5	28397	67392	68790	36400	45958
6	322562	21996	52597	51663	25884
7	21226	253705	16165	38047	35001
8	10809	16375	191062	10603	25709
+gp	12391	15472	17433	274518	76457
0 TOTAL	1156156	1498869	1538919	1487736	1284863

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
AGE										
1	412533	697016	587862	1056699	990402	533662	687470	703351	2353921	960982
2	216962	147489	246779	213655	382826	360906	194662	251964	258314	865078
3	118810	125525	84544	144870	123915	240844	233134	125185	171141	154103
4	99229	74684	69108	57156	94242	84198	138859	153257	87174	95656
5	66529	62114	42435	46241	39093	66326	52356	95799	111888	54879
6	24679	37733	32241	26823	31704	26505	39051	35222	69333	71110
7	15007	12204	19943	19767	19188	20701	16638	23257	24166	45363
8	21339	7985	6115	12799	13835	12201	12150	11770	17163	15518
+gp	72879	34867	18660	11694	12793	14982	23189	10415	21916	31068
0 TOTAL	1047965	1199617	1107687	1589703	1707997	1360325	1397509	1410219	3115016	2293756
1										

Run title : Herring VIa(S) VIIbc (run 1: wg 2005

At 10/03/2005 14:39

Traditional vpa Terminal populations from weighted Separable populations

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
AGE										
1	1246199	947665	3258087	471761	706497	804509	498093	413072	612769	795440
2	351900	452866	348093	1191516	173551	258602	295452	182846	150453	225314
3	571197	247725	312286	220156	857732	122644	170223	189453	122183	93902
4	100378	406953	180445	183616	138606	631157	82854	114327	116871	79637
5	69607	78711	305206	123901	127238	100598	426938	63177	77988	66001
6	42828	52311	57322	182143	89919	94738	67917	291029	45241	48407
7	52159	31503	39749	37429	121475	67115	66590	44460	193808	28095
8	35373	38477	23098	23989	27274	86271	45254	46150	32129	111646
+gp	10108	15094	38689	18983	19655	11912	30647	35365	25185	35515
0 TOTAL	2479749	2271306	4562975	2453494	2261947	2177546	1683968	1379879	1376626	1483957

Table 10 Stock number at age (start of year) Numbers*10**-3

YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
AGE											
1	448806	803638	757698	457740	319408	364718	344749	396370	191118	175726	0
2	285824	164941	292864	274406	164074	116113	132369	125543	144018	69520	63917
3	119165	182295	101346	168957	141439	78079	63776	80404	71808	84782	39966
4	48885	65782	87197	59665	66385	60983	37573	33604	40052	38623	42944
5	56045	26605	30091	42252	17872	27100	33198	18194	16789	18332	18251
6	39091	32586	14753	13442	9861	6645	14966	13432	8088	8205	8960
7	30865	20152	15005	7692	3560	3369	4053	4603	4807	3488	3261
8	17273	22471	10513	5693	1988	1445	2000	2097	2185	2478	1845
+gp	28600	11669	13115	4877	1738	3353	989	842	716	820	1884
0 TOTAL	1074554	1330141	1322582	1034724	726325	661804	633672	675088	479580	401976	181029

Table 6.6.2.3. Continued

Run title : Herring VIa(S) VIIbc (run 1: wg 2005

At 10/03/2005 14:39

Traditional vpa Terminal populations from weighted Separable populations

Table 12 Stock biomass at age (start of year) Tonnes

	YEAR	1970	1971	1972	1973	1974
	AGE					
	1	49113	98544	88604	64581	71412
	2	21592	25432	50969	45807	32829
	3	28425	13612	22300	41751	34928
	4	20857	20631	11027	16158	28363
	5	7383	17522	17885	9464	11949
	6	88059	6005	14359	14104	7066
	7	6007	71799	4575	10767	9905
	8	3135	4749	55408	3075	7455
	+gp	3668	4580	5160	81257	22631
0	TOTALBI	228238	262874	270287	286965	226539

Table 12 Stock biomass at age (start of year) Tonnes

	YEAR	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984
	AGE										
	1	49504	83642	70543	126804	118848	64039	82496	84402	282471	115318
	2	36667	24926	41706	36108	64698	60993	32898	42582	43655	146198
	3	24950	26360	17754	30423	26022	50577	48958	26289	35940	32362
	4	23418	17625	16309	13489	22241	19871	32771	36169	20573	22575
	5	17298	16150	11033	12023	10164	17245	13613	24908	29091	14269
	6	6737	10301	8802	7323	8655	7236	10661	9615	18928	19413
	7	4247	3454	5644	5594	5430	5858	4708	6582	6839	12838
	8	6188	2316	1773	3712	4012	3538	3524	3413	4977	4500
	+gp	21572	10321	5523	3461	3787	4435	6864	3083	6487	9196
0	TOTALBI	190581	195094	179088	238935	263857	233792	236493	237043	448960	376668
	1										

Run title : Herring VIa(S) VIIbc (run 1: wg 2005

At 10/03/2005 14:39

Traditional vpa Terminal populations from weighted Separable populations

Table 12 Stock biomass at age (start of year) Tonnes

	YEAR	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994
	AGE										
	1	124620	92871	316034	45761	97497	90910	50806	42133	72307	77953
	2	52785	76534	57087	195409	27248	39307	44022	26330	24975	35149
	3	111955	51775	64331	45352	144099	20849	29619	31639	23948	18029
	4	22786	96855	42044	42783	25226	113608	15742	20808	23959	16644
	5	16567	20150	76912	31223	25448	20120	83253	12256	16689	14256
	6	10750	14438	15534	49361	19512	20558	13991	57333	9953	10795
	7	13144	8821	11130	10480	27575	15101	15049	9514	43219	6349
	8	9515	11043	6837	7101	6491	20101	10680	10061	7775	25679
	+gp	2871	4709	12264	6017	4815	3037	7600	8558	6498	8772
0	TOTALBI	364992	377196	602174	433486	377911	343592	270762	218632	229323	213627

Table 12 Stock biomass at age (start of year) Tonnes

	YEAR	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	AGE										
	1	40393	69113	71224	43485	33218	36472	31372	36466	17965	14234
	2	41159	22597	39537	37319	23791	15559	16546	15944	18866	9246
	3	21569	33907	17127	24499	21782	12258	9566	11739	11130	12802
	4	9924	13551	16916	10322	11551	10794	6463	5713	7009	6759
	5	12162	5827	6319	8070	3574	5339	6341	3457	3223	3556
	6	8835	7625	3305	2635	2189	1376	2993	2700	1642	1698
	7	7006	4695	3466	1554	819	731	823	967	1115	830
	8	4128	5595	2418	1264	477	332	406	476	485	577
	+gp	7036	2952	3134	1058	427	821	214	193	174	226
0	TOTALBI	152210	165863	163446	130206	97829	83682	74723	77654	61610	49930

Table 6.6.2.3. Continued.

Table 17 Summary (with SOP correction)

Traditional vpa Terminal populations from weighted Separable populations

	RECR Age 1	TOTALBIO	TOTSPBIO	LANDINGS	YIELD/SSB	SOPCOFA	FBAR 3- 6
1970	409277	204674	129312	20306	0.157	0.8968	0.176
1971	821203	228889	118055	15044	0.1274	0.8707	0.1557
1972	738363	242574	126195	23474	0.186	0.8975	0.1997
1973	538178	291602	172829	36719	0.2125	1.0162	0.2831
1974	595097	221141	104335	36589	0.3507	0.9762	0.4437
1975	412533	214148	108781	38764	0.3564	1.1237	0.426
1976	697016	204302	77414	32767	0.4233	1.0472	0.4889
1977	587862	193025	85866	20567	0.2395	1.0778	0.3103
1978	1056699	242794	84560	19715	0.2331	1.0161	0.2556
1979	990402	281371	116225	22608	0.1945	1.0664	0.2632
1980	533662	225272	117439	30124	0.2565	0.9636	0.3803
1981	687470	243868	120450	24922	0.2069	1.0312	0.3013
1982	703351	244169	124136	19209	0.1547	1.0301	0.2191
1983	2353921	450843	120821	32988	0.273	1.0042	0.3555
1984	960982	364923	197223	27450	0.1392	0.9688	0.2011
1985	1246199	359373	190231	23343	0.1227	0.9846	0.1687
1986	947665	377257	230148	28785	0.1251	1.0002	0.1741
1987	3258087	571329	197511	48600	0.2461	0.9488	0.3374
1988	471761	433161	305931	29100	0.0951	0.9992	0.2638
1989	706497	378279	227737	29210	0.1283	1.001	0.1787
1990	804509	343805	196749	43969	0.2235	1.0006	0.2571
1991	498093	269990	168670	37700	0.2235	0.9971	0.244
1992	413072	217557	134705	31856	0.2365	0.9951	0.2765
1993	612769	230690	113428	36763	0.3241	1.006	0.3632
1994	795440	213198	95571	33908	0.3548	0.998	0.3695
1995	448806	160201	81799	27792	0.3398	1.0525	0.4768
1996	803638	165117	60718	32534	0.5358	0.9955	0.5962
1997	757698	163711	61428	27225	0.4432	1.0016	0.5529
1998	457740	130044	47455	38895	0.8196	0.9988	1.1059
1999	319408	98005	37103	26109	0.7037	1.0018	0.8251
2000	364718	83775	31014	15005	0.4838	1.0011	0.4819
2001	344749	74631	27721	14061	0.5072	0.9988	0.7375
2002	396370	77582	26175	13587	0.5191	0.9991	0.6823
2003	191118	61731	28892	12921	0.4472	1.002	0.6147
2004	175726	49961	22813	12289	0.5387	1.0006	0.6421
Arith. Mean	745717	237514	116841	27569	.3122		.3945
0 Units	(Thousands	(Tonnes)	(Tonnes)	(Tonnes)			
1							

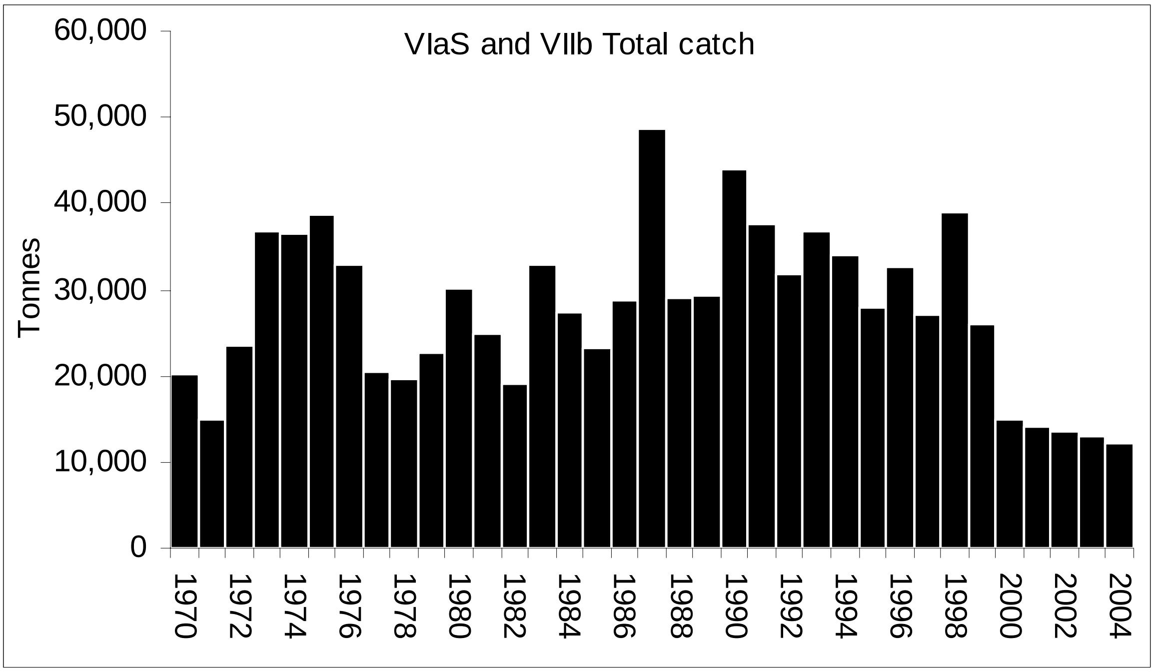


Figure 6.1.1.1 VIa(S) & VIIb,c herring catches from 1970-2004.

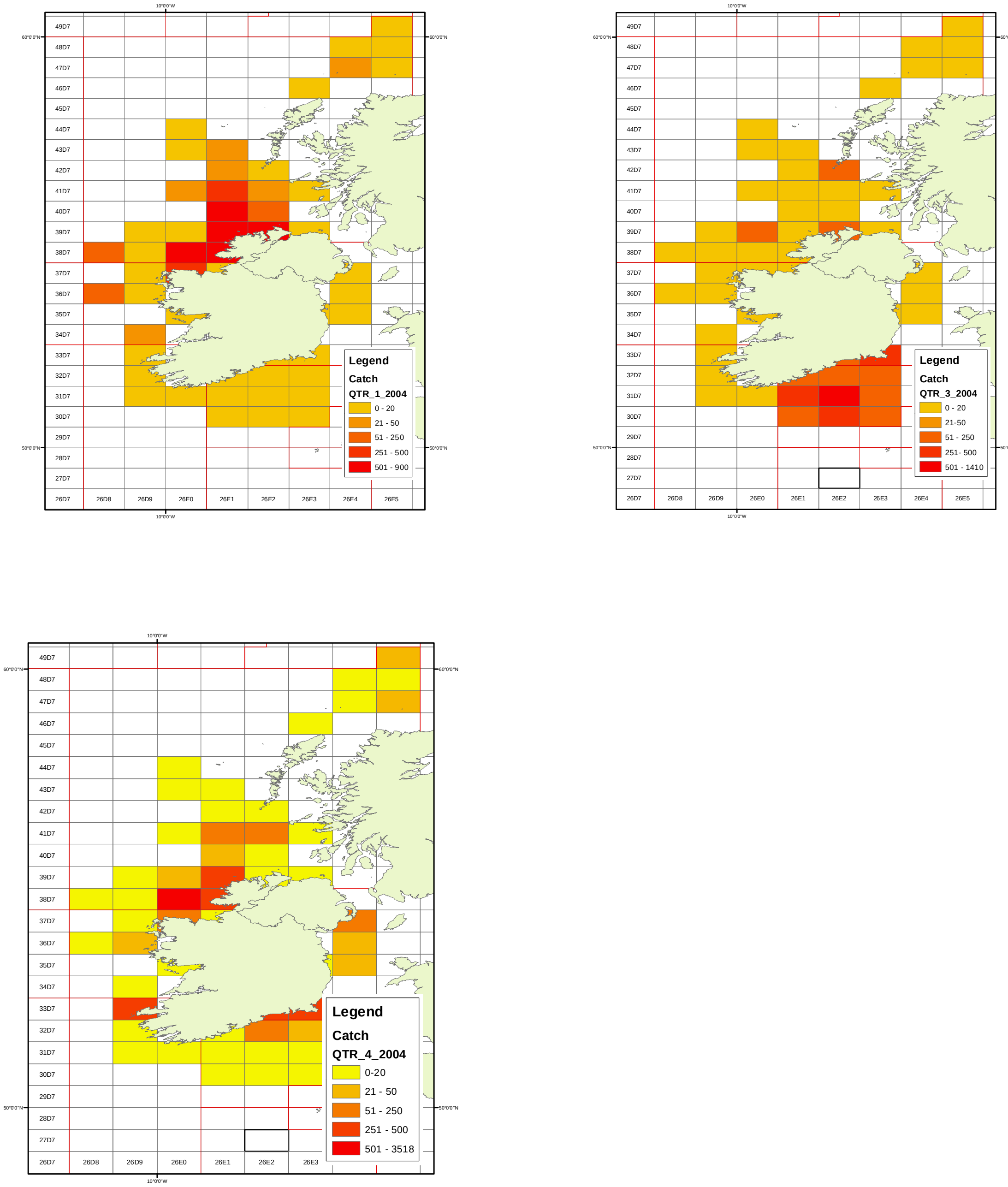


Figure 6.1.1.2 VIa(S) & Division VIIb,c herring. Catches of herring by statistical rectangle in 2004, around Ireland.

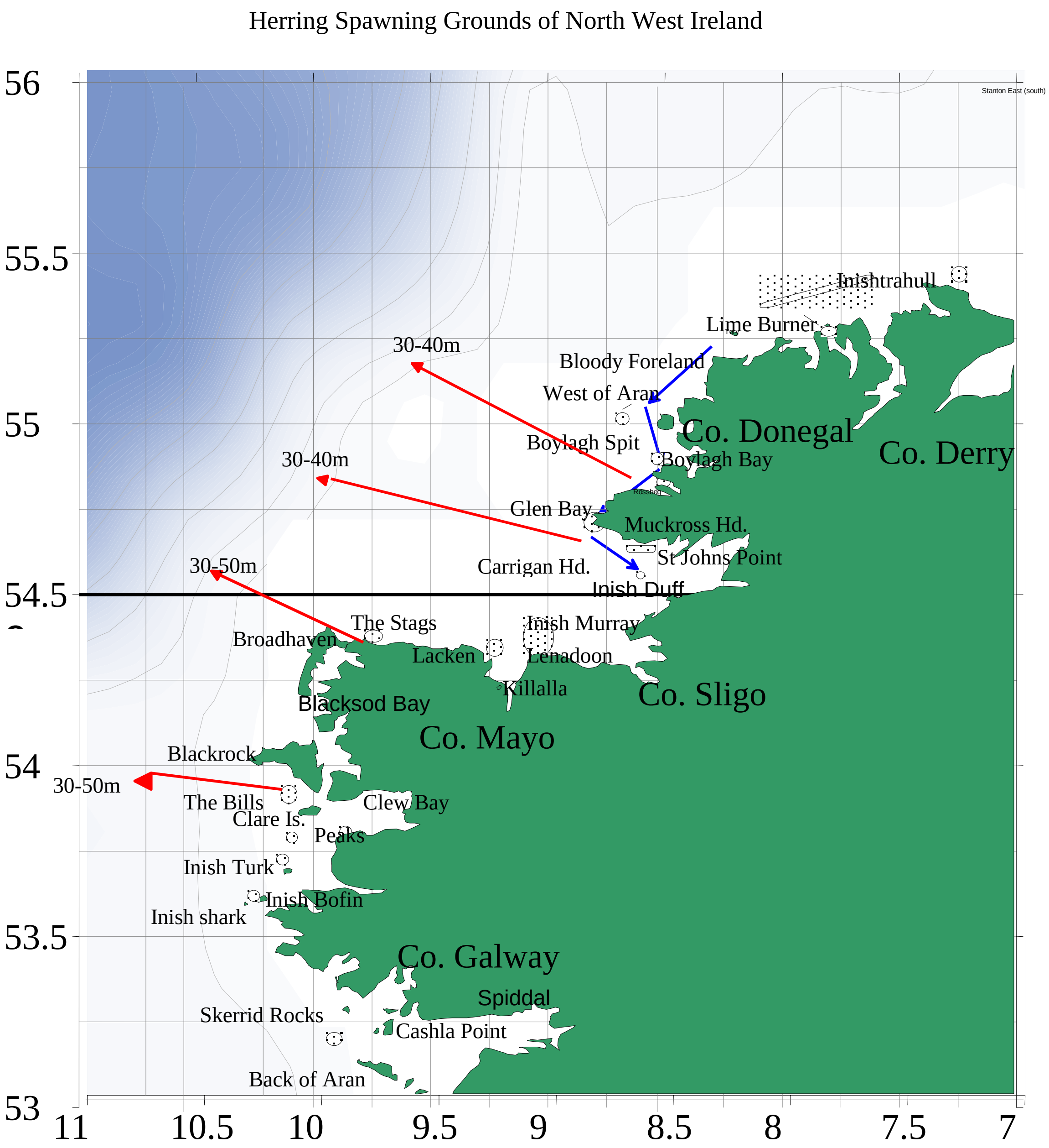


Figure 6.1.2.1 Herring spawning grounds of the North West Ireland

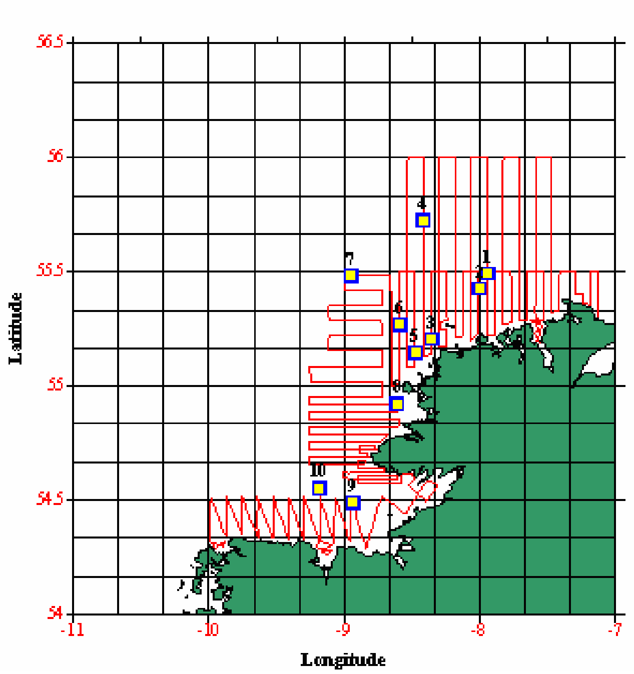


Figure 6.3.2.1 VIa(S) & Division VIIb,c herring. Cruise track and trawl positions during the 2003 north and west coast herring survey.

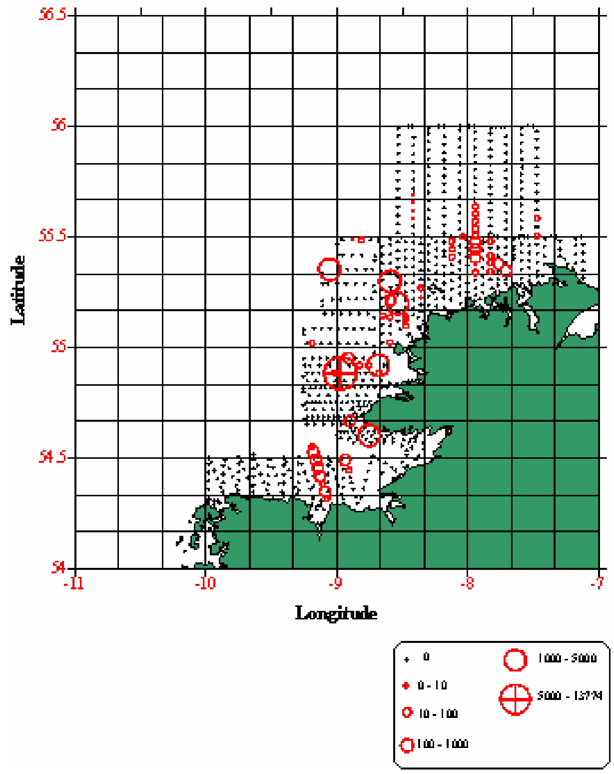
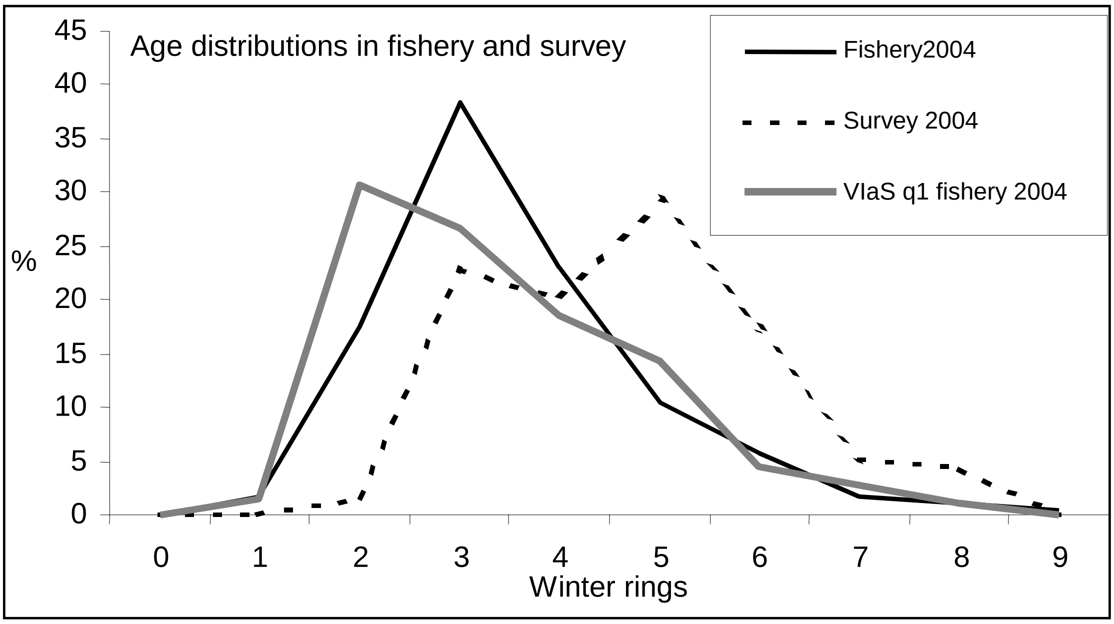


Figure 6.3.2.2 VIa(S) & Division VIIb,c herring. Post plot showing the distribution of total herring SA values obtained during the 2003 Irish northwest coast herring acoustic survey.



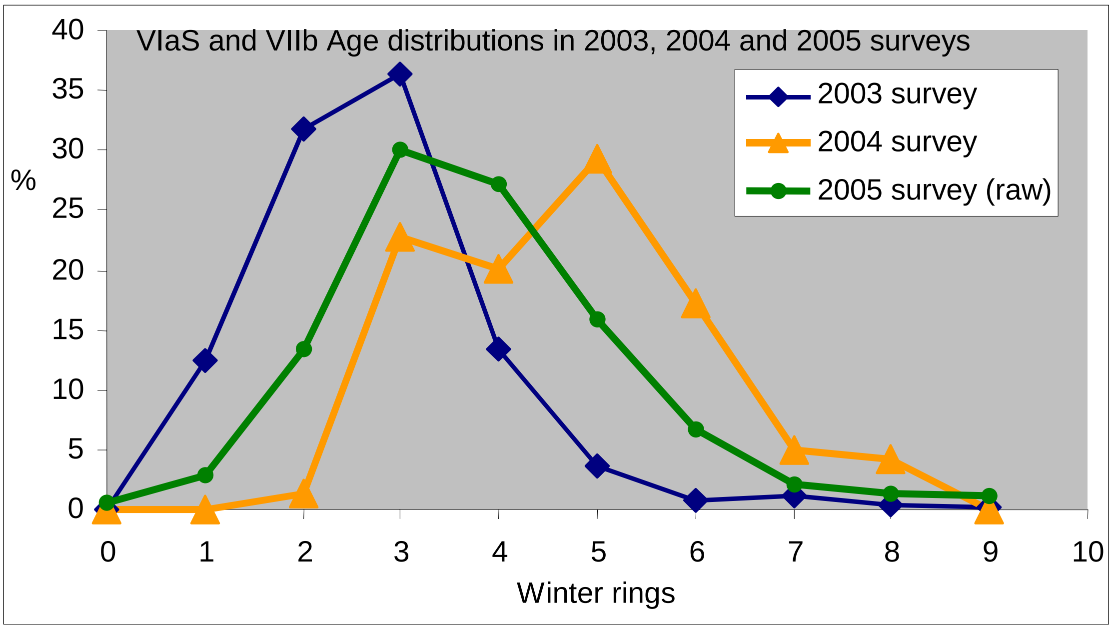


Figure 6.3.2.3. VIa(S) & Division VIIb,c herring. **Age (winter rings) distributions of the abundance estimate from the 2004 acoustic survey and of the fishery in 2004 (Above). Age distribution of the abundance estimates from 3 acoustic surveys; 2003, 2004, and 2005 (Below).**

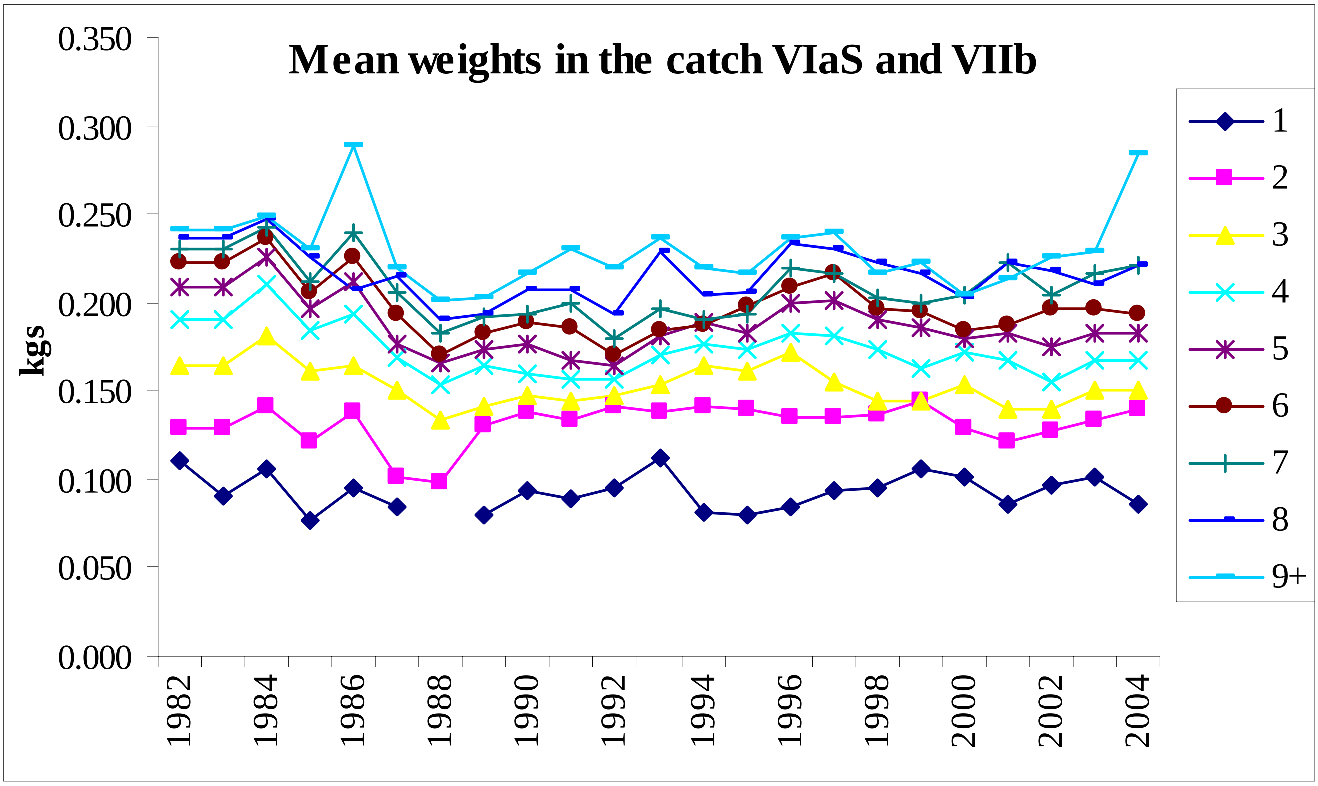


Figure 6.4.4.1. VIa(S) & Division VIIb,c herring. **Mean weight in the catch 1970 – 2004.**

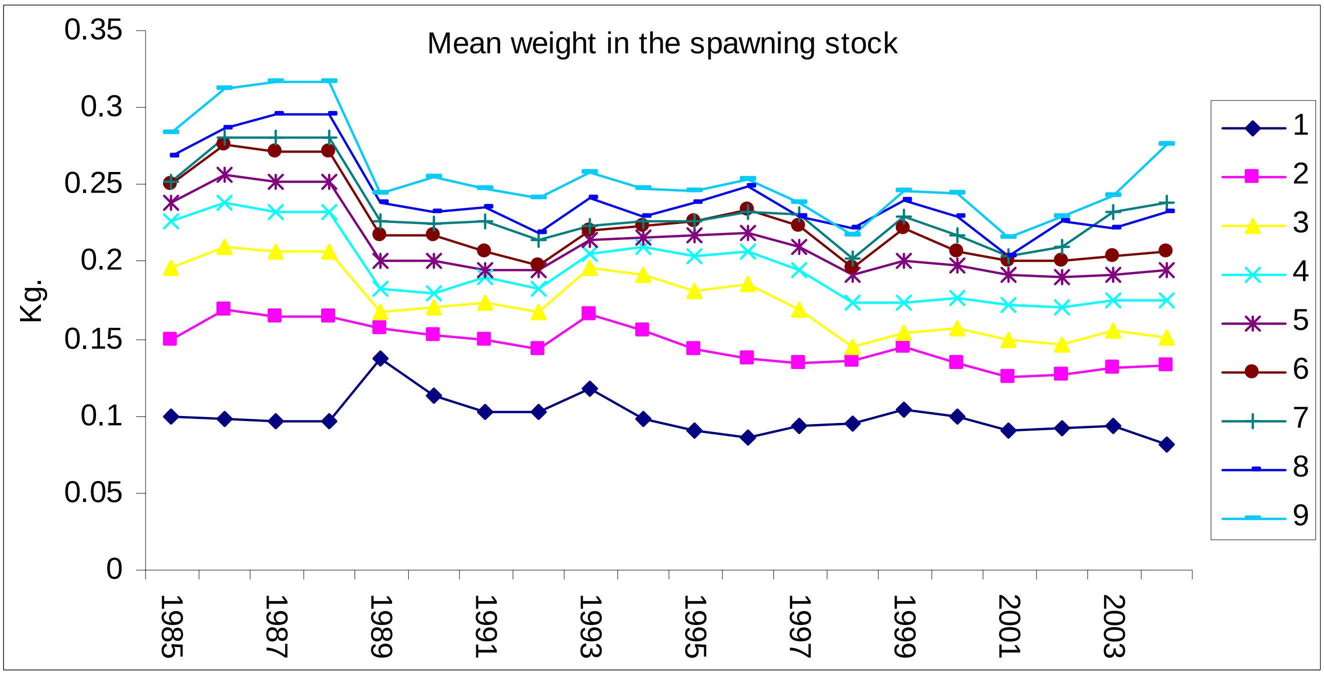


Figure 6.4.4.2. VIa(S) & Division VIIb,c herring. **Mean weight in the catch 1970 – 2004.**

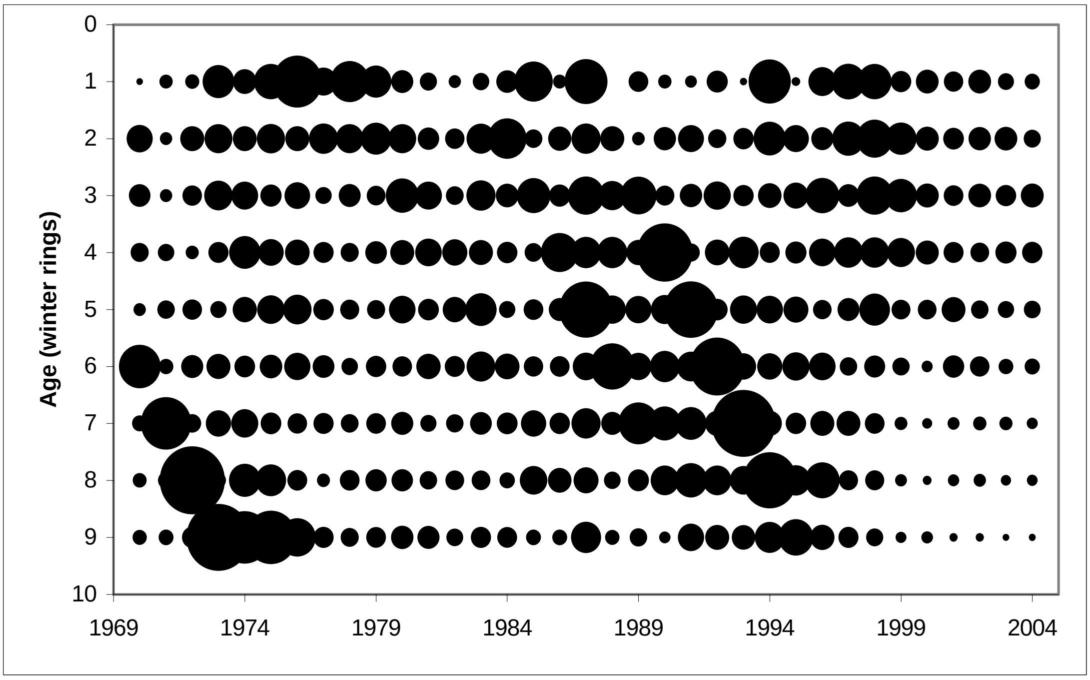
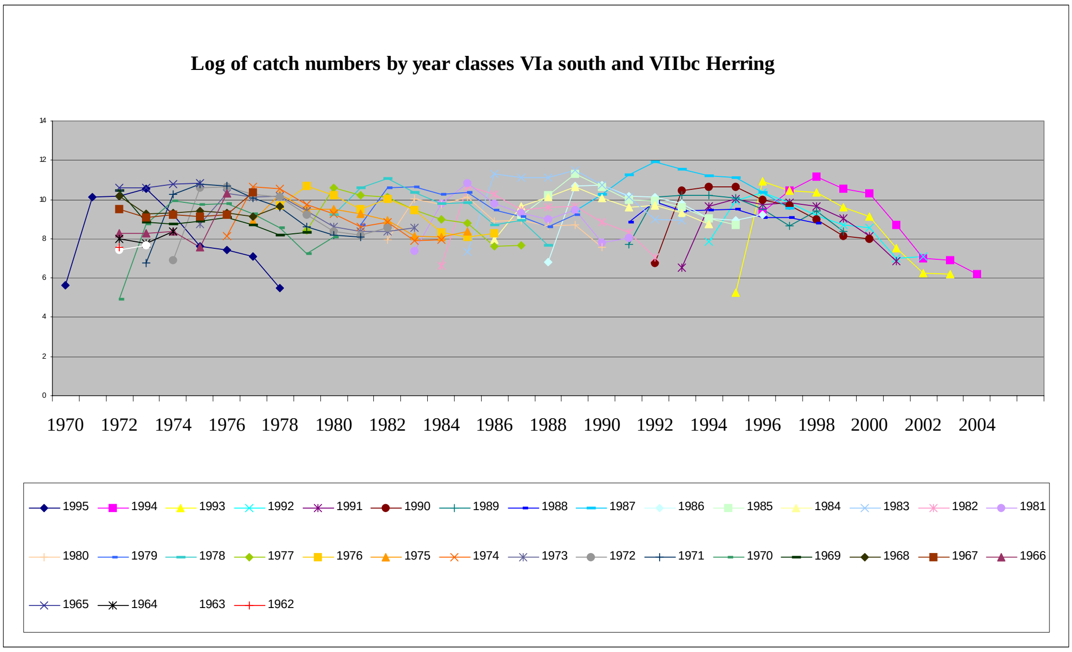
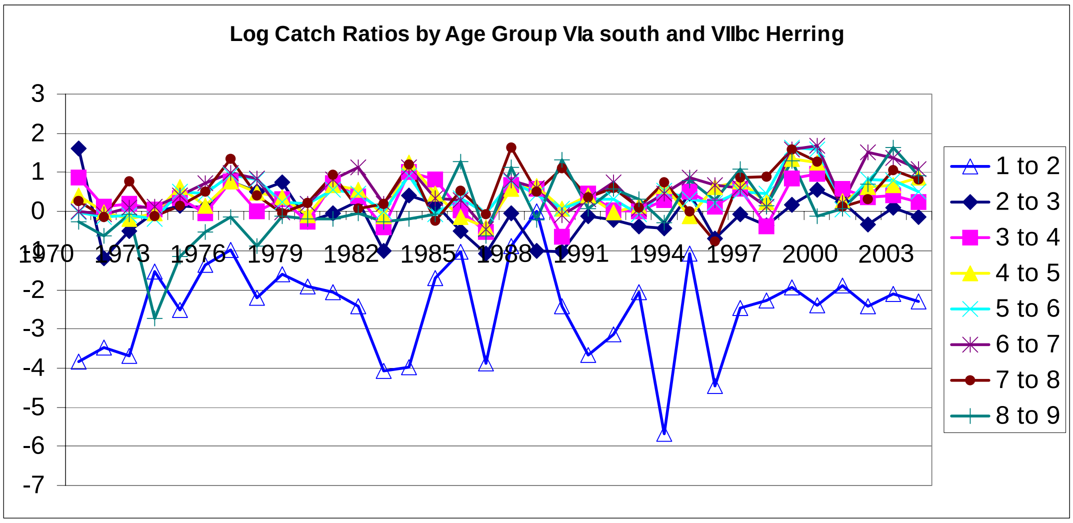


Figure 6.6.1.1 VIa south and VIIb herring. Mean standardised catch numbers at age.





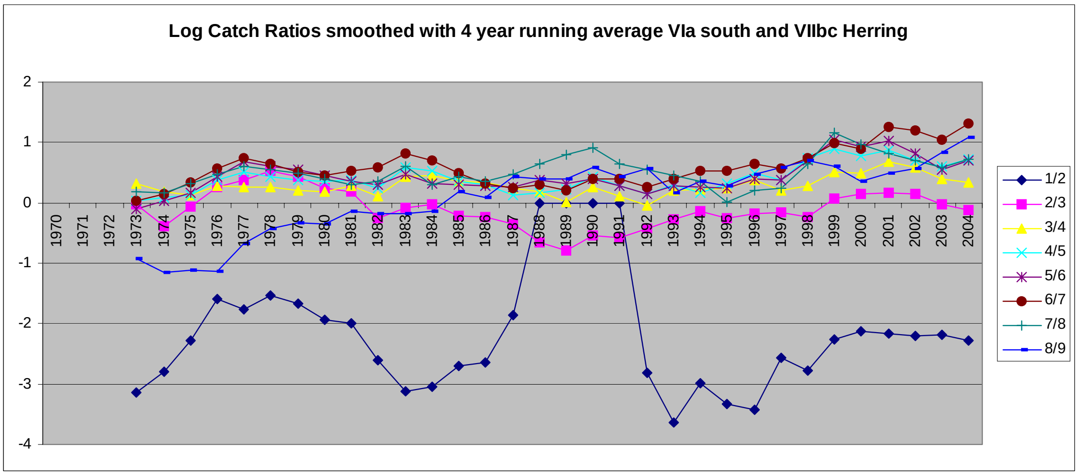


Figure 6.6.1.2 VIa(S) & Division VIIb,c herring. Basic data exploration, VIa south and VIIbc herring

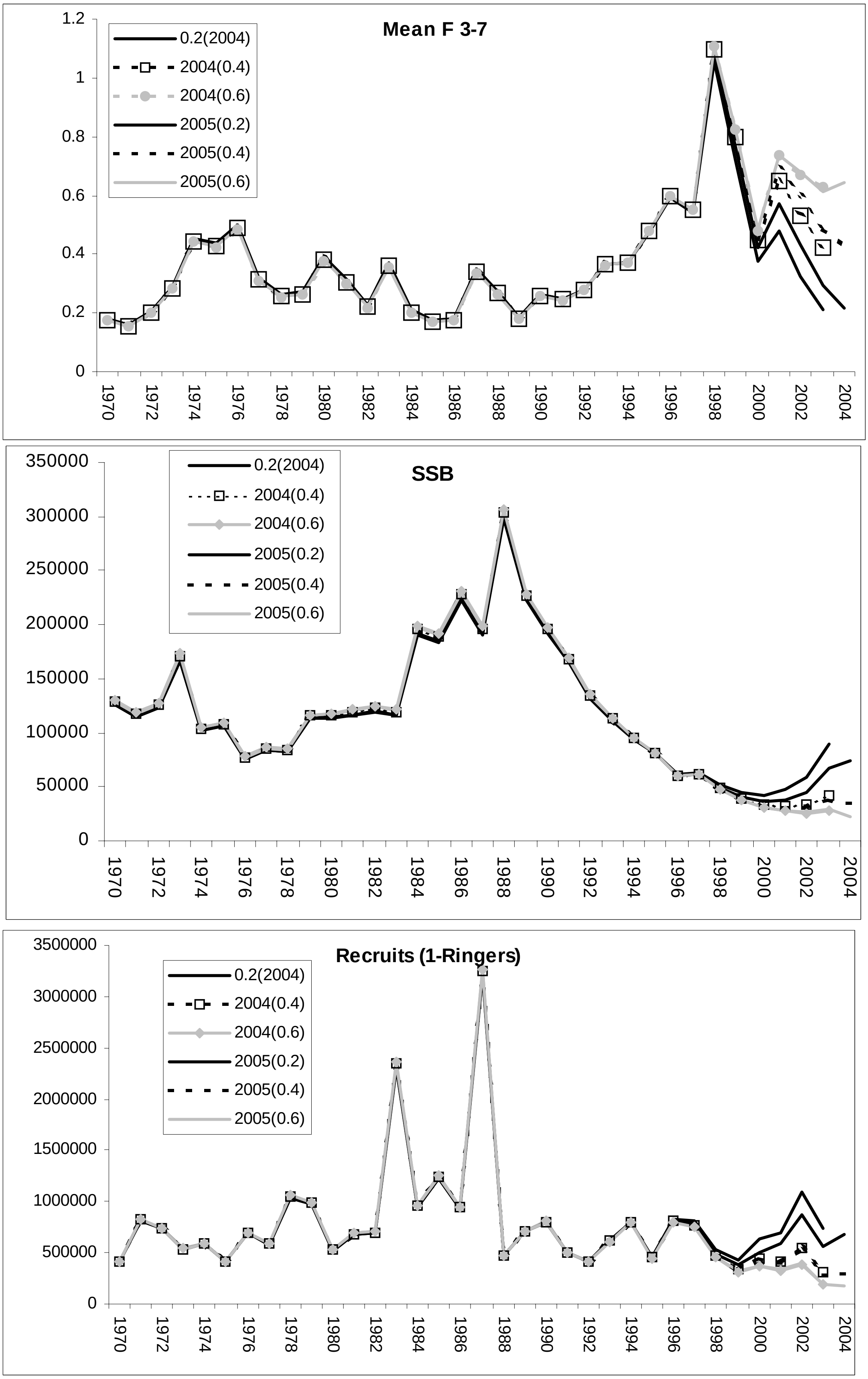


Figure 6.6.2.1. Comparison of three separable VPAs run in the current working group and the corresponding runs from 2004 working group. Runs correspond to terminal F's of 0.2, 0.4 and 0.6.

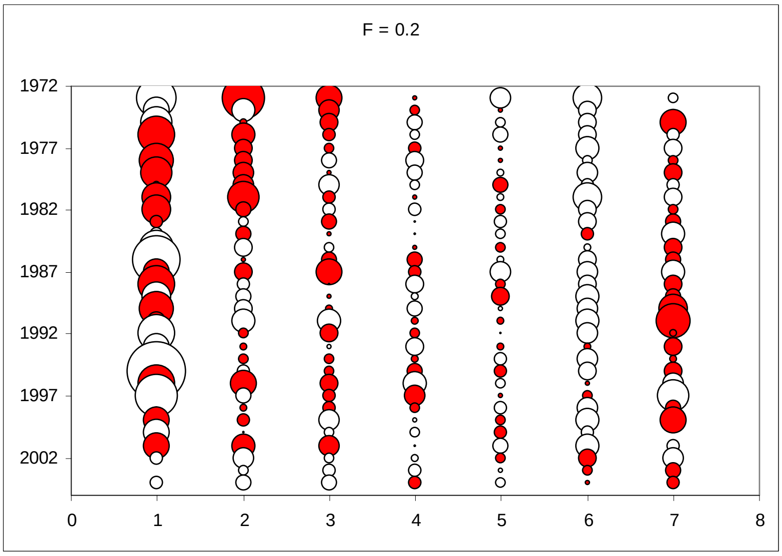


Figure 6.6.2.2. Herring in VIaS and VIIb, residuals from separable VPA, run 4, with terminal F of 0.2.

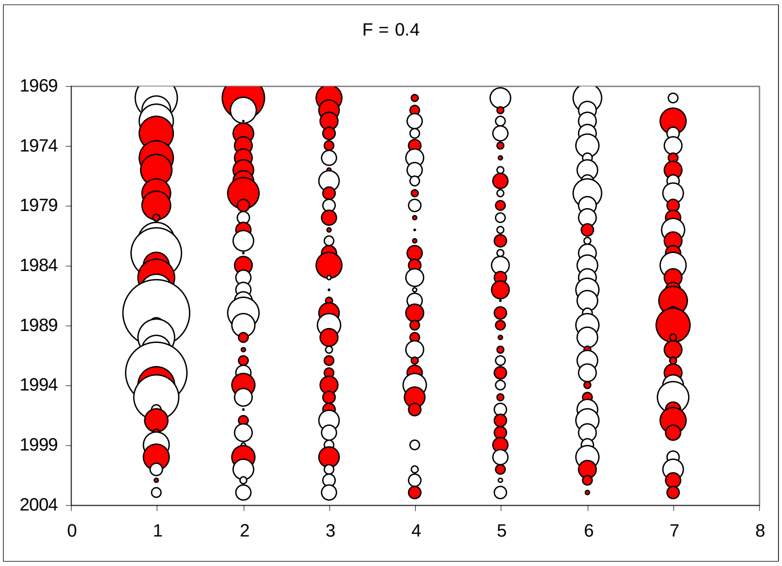


Figure 6.6.2.3. Herring in VIaS and VIIb, residuals from separable VPA, run 4, with terminal F of 0.4.

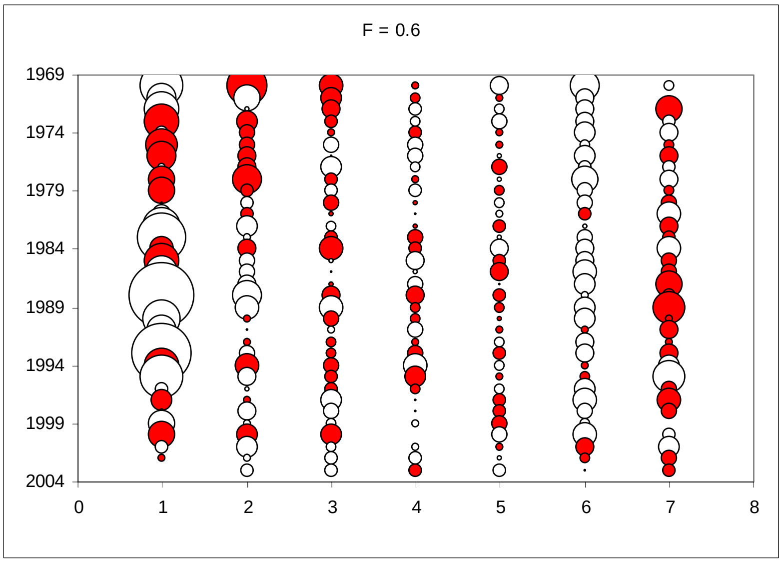


Figure 6.6.2.4. Herring in VIaS and VIIb, residuals from separable VPA, run 4, with terminal F of 0.6.

7 Irish Sea Herring [Division VIIA(North)]

7.1 The Fishery

7.1.1 Advice and Management Applicable to 2003 and 2004

ACFM did not accept the HAWG 2003 and 2004 assessments due to conflicting signals in the survey data, a lack of a recruitment index, and the possibility of more than one stock in the management area. HAWG noted that although only juveniles from different stocks mix in the Irish Sea, the stock identity of the adults is clear. ACFM commented in 2004 that current exploitation levels appear to give a relatively stable stock. The advice was a TAC equal to that in 2004 (4,800 t). This TAC was subsequently adopted for 2005. This was partitioned as 3,550 t to the UK and 1,250 t to the Republic of Ireland.

7.1.2 The fishery in 2004

The catches reported from each country, for the period 1986 to 2004 are given in Table 7.1.1 and total catches from 1961 to 2004 in Figure 7.1.1 (catch-at-age in Figure 7.2.1). Reported international landings in 2004 for the Irish Sea amounted to 2531 t. The UK took only 50% of its quota for 2004, whilst the Republic of Ireland took 60% of its quota.

As in recent years, very few vessels targeted herring in the Irish Sea in 2004. 70% of the total international catch was taken during the 3rd and 4th quarters of the year by a single team of pair-trawlers from Northern Ireland. These vessels commenced fishing in mid August and made their final landing of herring at the end of October.

Closed areas for herring fishing in the Irish Sea along the east coast of Ireland and within 12 nautical miles of the west coast of Britain were maintained throughout the year. The area to the east of the Isle of Man, encompassing the Douglas Bank spawning ground (described in ICES 2001, ACFM:10), was closed from 21 September to 15 November. Boats from the Republic of Ireland are not permitted to fish east of the Isle of Man.

7.2 Biological composition of the Catch

7.2.1 Catch in numbers

Catches in numbers-at-age are given in Table 7.2.1 for the years 1972 to 2004 and a graphical representation is given in Figure 7.2.1. The predominant year class in 2004 was the 2- ringers (2002-year class), with the relatively strong 1996 year-class still detectable. The catch in numbers at length is given in Table 7.2.2 for 1990 to 2004.

7.2.2 Quality of catch and biological data

There are no estimates of discarding or slippage of herring in the Irish Sea fisheries that target herring. Biological sampling was carried out on seven out of the 18 landings (1,770 t) made by the Northern Ireland pair-trawlers. Two landings into the Republic of Ireland (from a total of 749 tonnes landed) were sampled.

7.3 Fishery-independent information

7.3.1 Acoustic surveys

The information on the time-series of acoustic surveys in the Irish Sea is given in Table 7.3.1. As in last year's assessment, the SSB estimates from the survey are calculated using the same (annually varying) maturity ogives that are input to ICA (see Table 7.4.3; estimated from the commercial catch data).

The acoustic survey in 2004 was carried out over nine days in the period 6 to 29 September, with poor weather stopping the survey from 17 –27 September. A survey design of stratified, systematic transects was employed, as in previous years. Very few trawl catches of adult herring have been made off the Irish and English coasts over the time-series of the surveys, and a more intensive survey of these regions, at the expense of time spent around the Isle of Man, remains unwarranted at present. In general, there are few samples on the age composition of the herring in the acoustic survey data. The survey followed the methods described in Armstrong et al., 2005 WD 23; see Annex 7).

The bulk of the acoustic scatter attributed to pelagic fish was identified as sprat, which were abundant around the periphery of the Irish Sea (Fig. 7.3.1.1.B). Mixed herring targets were detected at a number of locations off the west and south coasts of the Isle of Man (Fig.7.3.1.2.A). Trawl samples taken inshore off the west coast of the Isle of Man contained predominantly 1-ringers or a mixture of predominantly 1 – 4 ringers with some older fish. Variable size/age composition was also recorded in two trawl catches inshore off the NE coast of the Isle of Man. The distribution of 1+ ring herring around the Isle of Man was similar to the pattern observed by a team of commercial pair trawlers operating at the same time. Herring mixed with sprat were predominantly 0-ringers, and these were most prevalent in the identification trawls made off the northwest coast of the Isle of Man (Fig. 7.3.1.2.B).

As in previous years, no herring schools were detected in the area immediately north of the Isle of Man, despite an abundance of early-stage larvae in this area in November (Figure 7.3.2). It is possible that spawning in this area only commences after the date of the acoustic survey.

The estimate of herring SSB of 21 kt for 2004 was slightly above the average for the series up to 2003 (20 kt) (Table 7.3.1.1). The approximate coefficient of variation of 0.41 was close to the average for the series of surveys. The biomass estimate for 1+ ringers (34 kt) was slightly above the average for 1994-2003 (33 kt), whilst the approximate CV of 0.41 for the stratified mean estimate was above-average for the series. Given the approximate CVs of the estimates, it is not possible to discern any trend in 1+ biomass or SSB since 1999.

The estimated age composition of the herring population, excluding 0-ring fish, is given in Table 7.3.1.2.

7.3.2 Larvae surveys

A larvae survey was undertaken by Northern Ireland (30 October - 3 November 2004) but there was no survey by the Port Erin Marine Laboratory. The survey followed the methods and designs of previous surveys in the time-series (see Annex 7). The production estimate for 2004 in the NE Irish Sea was slightly below the average for the previous years (Table 7.3.2). As in recent years, there were very few larvae caught off the Mourne coast (Northern Ireland), Figure 7.3.2.

7.3.3 Groundfish surveys of Area VIIa(N)

Groundfish surveys (see Annex 7), carried out by Northern Ireland since 1991 in the Irish Sea, were used by the 1996 to 1999 Herring Assessment Working Groups to obtain indices for 0- and 1-ring herring in the Irish Sea. These indices have performed poorly in the assessment and have not been used since 1999. Indices for 1991 – 2003 are shown in Table 7.3.3. The 2004 indices were not available at the time of the WG.

7.4 Mean length, weight, maturity and natural mortality-at-age

Mean lengths-at-age were calculated using the catch data and are given for the years 1985 to 2004 in Table 7.4.1. In general, mean lengths have been relatively stable over the last few years.

Mean weights-at-age in the catch are given in Table 7.4.2. Mean weights-at-age of all ages were still generally low compared with previous years. There has been a change in mean weight over the time period 1961 to the present (ICES 2003 ACFM:17). Mean weights-at-age increased between the early 1960s and the late 1970s whereupon there was been a steady decline to the early 1990s. In the assessment, mean weights-at-age for the period 1972 to 1984 are taken as unchanging. In extending the data series back from 1971 to 1961, mean weights-at-age in the catch were taken from samples recorded by the Port Erin Marine Laboratory (see ICES 2003 ACFM:17).

Mean weights-at-age in the third-quarter catches (for the whole time-series 1961 to present) have been used as estimates of stock weights at spawning time. There was some uncertainty in the mean weights-at-age for 2003 presented to the WG last year, and consequently the WG replaced these with the average mean stock weights-at-age for the preceding five years (1998 – 2002). There was no further information this year to improve the 2003 values, and these remain as the 5-year mean.

Maturity-at-age (in the catches) for each year (1961 to 2004) are given in Table 7.4.3. Due to inconsistencies in the maturity data collected in 2003, last year's WG used a mean maturity ogive for the preceding nine years for 2003. The rationale for the 9 years was that there appeared to be a shift in the maturity ogive around 1993. As with the stock weights, the figures used last year have not been revised. Both mean weights and maturity at age for 2004 were based on 2004 biological samples.

As in previous years, natural mortality per year was assumed to be 1.0 on 1-ringers, 0.3 for 2-ringers, 0.2 for 3-ringers and 0.1 for all older age classes. These are based on the natural mortality rates estimated for herring in the North Sea using MSVPA.

7.5 Recruitment

An estimate of total abundance of 1-ringers is provided by the Northern Ireland acoustic survey. However, there is evidence that a fraction of those is of Celtic Sea origin. Separation of the trawl catches of juveniles into autumn and winter spawning components, based on otolith microstructure and/or length composition, could result in a survey index of recruitment for the Irish Sea stock that could be used directly in the assessment.

7.6 Stock Assessment

7.6.1 Data exploration and preliminary modelling

This year previous ICA assessment was updated and no extensive exploration of alternative assessment models was carried out. In 2004 three fishery independent survey indices were used as tuning indices to run ICA: Douglas Bank larvae abundance (DBL), Northern Irish larvae production (NINEL) and the age dis-aggregated abundance index from the acoustic survey (ACAGE). Also, the preliminary modelling used catch-at-age data derived from the official landings, extended back to 1961.

This year new data were added to the Northern Irish larvae series (NINEL) and to the Northern Irish acoustic survey (total biomass, SSB and age-structured indices). No new data were added to the Douglas Bank larvae series (DBL). Due to the problems associated with mixing of Irish Sea and Celtic Sea juveniles none of the groundfish surveys were considered suitable tuning fleets. The survey series available for inclusion in an assessment using the ICA package are documented in Appendix 7.

Initial fits within integrated catch-at-age analysis (ICA), were performed with DBL, NINEL and ACAGE. The following model settings were used:

- Separable constraint over the last 6-years (weighting = 1.0 for each year)
- Reference age = 4
- Constant selection pattern model
- Selectivity on oldest age = 1.0
- First age for calculation of mean F = 2
- Last age for calculation of mean F = 6
- Weighting on 1-rings = 0.1; all other age classes = 1.0
- Weighting for all years = 1.0
- All indices treated as linear
- No S/R relationship fitted
- Lowest and highest feasible F = 0.05 and 2.0
- All survey weights fitted by hand i.e., 1.0 with the 1-rings in the acoustic survey weighted to 0.1.
- Correlated errors assumed i.e., = 1.0
- No shrinkage applied

The initial fit corresponds to the same procedure as last year (SPALY).

Examination of the sum of squares surface from SPALY indicated that the Douglas Bank larvae index (DBL) was having no influence in the assessment estimates for the current year. Therefore, the WG agreed on removing DBL from the analysis. Examination of the SSQ surface (Fig. 7.6.1) shows a relatively clear minimum where both indices coincide. Estimates of uncertainty from the ICA bootstrapped mean F and SSB for SPALY and the NINEL-ACAGE run are shown in Figure 7.6.2. The comparison highlights a gain in precision for both F and SSB in the NINEL-ACAGE run. Comparison with similar plots produced in 2004 (not shown) indicates an increase in precision in the 2005 assessment compared to 2004.

Examination of the exploitation rate estimated as the ratio of the catch to the acoustic estimated 1+ biomass carried out in 2004, suggested an increase from 1995 to 1998 and a relatively lower exploitation rate over the period 1999 to 2003, suggesting that the fishing mortality had probably been relatively stable over this time period. The analysis was not repeated this year but uptake in 2004 has been low and preliminary calculations result in a similar exploitation rate to the ones computed for 2002 and 2003. Moreover, the fleets did not take their full quota (4,800 t) in 2004, therefore there is every possibility that fishing mortality in 2004 did not rise dramatically. These low levels of fishing should allow the stock to maintain a status quo SSB, if not allow the SSB to rise.

Two-stage biomass model

An Assessment of Irish Sea VIIa herring using a Two-Stage Biomass model given additional variance in the recruitment index was presented by Roel and De Oliveira (2005 WD10). The authors further developed the two-stage biomass model they presented in 2004. This year, a more constrained model (e.g. not allowing the recruitments to vary so freely) with only one catchability parameter was attempted to address concerns of over-parameterisation. Also, estimation of the component of the variance resulting from the occurrence of juvenile Celtic Sea herring mixed with Irish Sea herring in the survey area was attempted by introducing an extra parameter: the additional variance (λ^2). A better fit to the data was obtained when recruitment was allowed to vary more freely which is to be expected. However, in that case the estimated additional variance which could reflect the variability related to the Celtic sea recruits is practically zero which is an unlikely outcome. Alternatively, when recruitment variability is further constrained the additional variance, although imprecise, represents a large component of the total 1 year-old biomass variability. On the basis of these results the authors concluded that additional information on the variability of Irish Sea herring recruitment is required to estimate additional variance in the context of the two-stage biomass model presented.

Conclusion to explorations

The results from the exploratory runs carried out with ICA using NINEL and ACAGE as tuning indices indicate an increase in precision compared to 2004. Moreover, the clear minimum in the SSQ surface graph suggests good consistency between the separable model and the indices. Therefore results from the assessment are presented in this report.

7.6.2 Stock Assessment

The results presented correspond to ICA runs using the acoustics data as an age-structured index (ACAGE) and the Northern Ireland larval survey (NInel) as an index of biomass. The model settings are the same as for 2004. The run log for the assessment is shown in Table 7.6.1. The output from ICA assessment, the residuals and fitted values are given in Tables 7.6.2 - 19. The SSQ for the index shows a clear minimum at a relatively low level of fishing mortality (Figure 7.6.1). The model diagnostics (Figure 7.6.3) show that the total residuals by age between the catch and the separable model are reasonably trend-free, however although the sum of the year residuals are small, they show a negative pattern. The estimate for $F_{(2-6)}$ for 2004 was 0.18 (Table 7.6.15) with a corresponding SSB estimate of approximately 11,100 tonnes, well above Bpa = 9500 tonnes.

The assessment results do suggest that the stock has been relatively stable in recent years. A slight increase in SSB is shown in 2004 (Fig 7.6.4). This increase is not the result from the increase in the 2004 larvae index, which is below the estimated trend in SSB (Fig. 7.6.5). Rather it appears linked to the large estimate of numbers of 2 years-old in the ICA assessment. Further, the acoustic survey estimated large numbers of 2 year-olds and as this information was not in contradiction with the catch data, ICA fitted the acoustic data closely, resulting in the increase in SSB mentioned above (Fig. 7.6.6). This year-class is fully mature (Table 7.4.3) so it will be contributing substantially to the SSB.

The log-residual plot for the separable period (Fig. 7.6.3) suggests variability in the selectivity for the separable period probably related to a predominance of young fish in the catches compared to previous years. However, there is no direct information of a major shift in selection pattern within this fishery in recent years. Comparison between the selection pattern estimated in the current assessment and the SPALY run in 2004 (Fig. 7.6.7) show differences in selection regarding the younger years which illustrates de level of uncertainty in the estimates.

7.7 Stock and Catch Projection

7.7.1 Deterministic short-term predictions

Two scenarios for deterministic short-term predictions are presented: $F_{\text{status quo}}$ for 2005 and TAC constraint = 4800 tonnes. This is because the current effort in the fishery results in underfishing of the TAC. Short-term projections were carried out using MFDP. Input data are the historic time series used in the ICA assessment with geometric mean (1980-2002) replacing recruitment 1-wr in 2005 and 2006. 2-wr in 2005 resulted from assuming geometric mean recruitment in 2004 and taking into account mortality. Input data is shown in Table 7.7.1. The selection pattern used is as estimated by ICA. For the projections data for maturity, mean weights-at-age and natural mortality are the means of the three preceding years.

The results of the short-term projections are shown in Tables 7.7.1. to 7.7.3. The short-term forecast for landings and SSB at status quo F is shown in Fig 7.7.1. Results from short-term predictions suggest that regardless of the constraints assumed for 2005 ($F_{st\ quo}$ or TAC), estimates of SSB in 2006 are well above Bpa = 9,500t. Assuming $F_{st\ quo}$ in 2005, SSB remains at about 14,000 tonnes in the short-term.

7.7.2 Yield-per-recruit

A yield-per-recruit analysis was carried out using MFYPR to provide a yield-per-recruit plot for VIIa (N) (Fig. 7.7.1). The values for F0.1 and F35% SPR are 0.16 and 0.14 respectively. These may be compared with the current F of 0.18 as estimated by the assessment.

7.8 Medium-term predictions of stock size

The Working Group decided that there was no basis for undertaking medium-term projections of stock size until there is agreement that advice based on the assessment can be provided.

7.9 Reference points

The estimation of $\mathbf{B}_{pa}$ (9,500 t) and $\mathbf{B}_{lim}$ (6,000 t) were not revisited this year. There were no new points to add to the discussions and deliberations presented in 2000 (ICES 2000/ACFM:12).

7.10 Quality of the Assessment

Retrospective analysis of the assessment with data from 2001 to 2004 was carried out. Figure 7.9.1 shows the retrospectives for SSB and $F_{2\text{-}6}$ from the ICA assessment (NINEL + ACAGE) with a 6-year separable period. These retrospectives show rather stable estimation of SSB at a level just below B_{pa} and though there was a tendency to over-estimate SSB in the last assessment year, adding data in 2005 practically did not revise the 2004 estimates. The retrospective pattern of $F_{2\text{-}6}$ is relatively stable and although there was a tendency to revise F upwards for 2003 and 2002, the addition of data in 2005 had very little effect on the 2004 estimates. $F_{2\text{-}6}$ is likely to be at a lower level than during the mid 1990's and seems to have stabilized at this low level in the past 4 years.

The very large deviation seen in the recruitment retrospective results from the extremely high estimate of recruitment in 2002 (Figure 7.9.1). As information on recruitment is down-weighted in both the catch at age and the survey, that is not surprising.

For some years, the assessment for this stock has not been accepted by ACFM. Both the catches and survey data are noisy. This year the assessment seems to have improved as more years are added to the acoustic survey series, and the conflicting signals in survey data seen in previous assessments are not observed in this assessment. Given the noise in the data it is difficult to detect abrupt changes in the stock dynamics. Nevertheless some inferences can be made that are quite robust, even though the absolute estimates of SSB and fishing mortality may be less reliable. In particular, it seems likely that the stock is relatively stable at a level close to Bpa, and that the fishing mortality has been low since the late 1990's. Therefore, an advice to maintain catches at the current level is supported by the assessment.

7.11 Spawning and Juvenile Fishing Area Closures

The arrangement of closed areas in Division VIIa(N) prior to 1999 are discussed in detail in ICES (1996/ACFM:10) with a change to the closed area to the east of the Isle of Man being altered in 1999 (see ICES 2001/ACFM:10). The closed areas consist of: all year juvenile closures along part of the east coast of Ireland, and the west coast of Scotland, England and Wales; spawning closures along the east coast of the Isle of Man from 21st September- 15th November, and along the east coast of Ireland all year round. The Working Group recommends that any alterations to the present closures are considered carefully, in the context of this report, to ensure protection for all components of this stock.

7.12 Management considerations

The different survey series for Irish Sea herring are characterized by generally poor precision caused by the very patchy distribution of the fish as well as assumptions inherent in the methods (e.g. target strength, larval growth and mortality; relationship between larval production and SSB). Nonetheless, there is evidence of some coherence between the longer-term signals in the different survey series. The acoustic survey provides estimates of abundance at age but the juveniles in the area are a mixture of two adjacent stocks (Celtic Sea and VIIa(N)). Separation of trawl catches of juveniles into autumn and winter spawning components, based on otolith microstructure and/or length composition, could result in acoustic and trawl survey indices of juveniles appropriate for the Irish Sea assessment.

The catches have been low in recent years and there are no indications of problems in the catch-at-age for this stock. An improvement in precision was noted in this assessment and SSB is estimated to be above B_{pa}. However, analytical retrospectives show that considerable downward revision of SSB took place in subsequent assessments in recent years. The current assessment indicates that SSB is relatively stable. Further, a broad range of year classes is present in the stock. Therefore, the maintenance of recommended catch levels of approximately 5,000 t, in the short-term, should not be detrimental to the stock.

©Table 7.1.1 Irish Sea Herring Division VIIa(N). Working group catch estimates in tonnes by country, 1987-2004. The total catch does not in all cases correspond to the official statistics and cannot be used for management purposes.

COUNTRY	1987	1988	1989	1990	1991	1992	1993	1994	1995
Ireland	1,200	2,579	1,430	1,699	80	406	0	0	0
UK	3,290	7,593	3,532	4,613	4,318	4,864	4,408	4,828	5,076
Unallocated	1,333	-	-	-	-	-	-	-	-
Total	5,823	10,172	4,962	6,312	4,398	5,270	4,408	4,828	5,076

Country	1996	1997	1998	1999	2000	2001	2002	2003	2004
Ireland	100	0	0	0	0	862	286	0	749
UK	5,180	6,651	4,905	4,127	2,002	4,599	2,107	2,399	1782
Unallocated	22	-	-	-	-	-		-	-
Total	5,302	6,651	4,905	4,127	2,002	5,461	2,393	2,399	2531

©Table 7.2.1 Irish Sea Herring Division VIIa(N). Catch in numbers (thousands) by year.

				Age (rings)				
Year	1	2	3	4	5	6	7	8+
1972	40640	46660	26950	13180	13750	6760	2660	1670
1973	42150	32740	38240	11490	6920	5070	2590	2600
1974	43250	109550	39750	24510	10650	4990	5150	1630
1975	33330	48240	39410	10840	7870	4210	2090	1640
1976	34740	56160	20780	15220	4580	2810	2420	1270
1977	30280	39040	22690	6750	4520	1460	910	1120
1978	15540	36950	13410	6780	1740	1340	670	350
1979	11770	38270	23490	4250	2200	1050	400	290
1980	5840	25760	19510	8520	1980	910	360	230
1981	5050	15790	3200	2790	2300	330	290	240
1982	5100	16030	5670	2150	330	1110	140	380
1983	1305	12162	5598	2820	445	484	255	59
1984	1168	8424	7237	3841	2221	380	229	479
1985	2429	10050	17336	13287	7206	2651	667	724
1986	4491	15266	7462	8550	4528	3198	1464	877
1987	2225	12981	6146	2998	4180	2777	2328	1671
1988	2607	21250	13343	7159	4610	5084	3232	4213
1989	1156	6385	12039	4708	1876	1255	1559	1956
1990	2313	12835	5726	9697	3598	1661	1042	1615
1991	1999	9754	6743	2833	5068	1493	719	815
1992	12145	6885	6744	6690	3256	5122	1036	392
1993	646	14636	3008	3017	2903	1606	2181	848
1994	1970	7002	12165	1826	2566	2104	1278	1991
1995	3204	21330	3391	5269	1199	1154	926	1452
1996	5335	17529	9761	1160	3603	780	961	1364
1997	9551	21387	7562	7341	1641	2281	840	1432
1998	3069	11879	3875	4450	6674	1030	2049	451
1999	1810	16929	5936	1566	1477	1989	444	622
2000	1221	3743	5873	2065	558	347	251	147
2001	2713	11473	7151	13050	3386	936	650	803
2002	179	9021	1894	1866	2395	953	474	343
2003	694	4694	3345	2559	882	2945	872	605
2004	3225	8833	5405	2161	623	213	673	127

Table 7.2.2 Irish Sea Herring Division VIIa (N). Catch-at-length for 1990-2004. Numbers of fish in thousands.

LENGTH	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
14															
.5															
15			95												
.5			169							10					
16	6		343			21	21	17		19	12	9			
.5	6	2	275			55	51	94		53	49	27			13
17	50	1	779		84	139	127	281	26	97	67	53			25
.5	7	4	1106		59	148	200	525	30	82	97	105			84
18	224	31	1263		69	300	173	1022	123	145	115	229			102
.5	165	56	1662		89	280	415	1066	206	135	134	240	36		114
19	656	168	1767	39	226	310	554	1720	317	234	164	385	18		203
.5	318	174	1189	75	241	305	652	1263	277	82	97	439	0	29	269
20	791	454	1268	75	253	326	749	1366	427	218	109	523	0	73	368
.5	472	341	705	57	270	404	867	1029	297	242	85	608	18	215	444
21	735	469	705	130	400	468	886	1510	522	449	115	1086	307	272	862
.5	447	296	597	263	308	782	1258	1192	549	362	138	1201	433	290	1007
22	935	438	664	610	700	1509	1530	2607	1354	1261	289	1748	1750	463	1495
.5	581	782	927	1224	785	2541	2190	2482	1099	2305	418	1763	1949	600	2140
23	2400	1790	1653	2016	1035	4198	2362	3508	2493	4784	607	2670	2490	1158	2089
.5	1908	1974	1156	2368	1473	4547	2917	3902	2041	4183	951	2254	1552	1380	2214
24	3474	2842	1575	2895	2126	4416	3649	4714	3695	4165	1436	3489	1029	1273	2054
.5	2818	2311	2412	2616	2564	3391	4077	4138	2769	3397	1783	4098	758	1249	2269
25	4803	2734	2792	2207	3315	3100	4015	5031	2625	2620	2144	5566	776	1163	1749
.5	3688	2596	3268	2198	3382	2358	3668	3971	2797	1817	1791	4785	1335	1211	1206
26	4845	3278	3865	2216	3480	2334	2480	3871	3115	1694	1349	3814	1570	1140	823
.5	3015	2862	3908	2176	2617	1807	2177	2455	2641	1547	840	2243	1552	1573	587
27	3014	2412	3389	2299	2391	1622	1949	1711	2992	1475	616	1489	776	1607	510
.5	1134	1449	2203	2047	1777	990	1267	1131	1747	867	479	644	433	1189	383
28	993	922	1440	1538	1294	834	906	638	1235	276	212	496	162	726	198
.5	582	423	569	944	900	123	564	440	170	169	58	179	108	569	51
29	302	293	278	473	417	248	210	280	111	61	42	10	36	163	
.5	144	129	96	160	165	56	79	59	92		12	0	36	129	
30	146	82	70	83	9	40	32	8	84		6	9		43	
.5	57	36	36	15	27	5	0	5	3					43	
31	54	12	2	4		1	2							43	
.5	31	3													
32	29														
.5															
33															
.5															
34															

Table 7.2.3 Irish Sea Herring Division VIIa (N). Sampling intensity of commercial landings in 2004.

Quarter	Country	Landings (t)	No. samples	No. fish measured	No. fish aged	Estimation of discards
	Ireland	0	-	-	-	-
	UK (N. Ireland)	0	-	-	-	-
1	UK (Isle of Man)	0	-	-	-	-
	UK (Scotland)	0	-	-	-	-
	UK (England & Wales)	0	-	-	-	-
	Ireland	0	-	-	-	-
	UK (N. Ireland)	1	0	0	0	-
2	UK (Isle of Man)	*	0	0	0	-
	UK (Scotland)	0	-	-	-	-
	UK (England & Wales)	0	-	-	-	-
	Ireland	0	-	-	-	-
	UK (N. Ireland)	1662	7	991	350	No
3	UK (Isle of Man)	*	0	0	0	-
	UK (Scotland)	0	-	-	-	-
	UK (England & Wales)	0	-	-	-	-
	Ireland	749	2	190	133	No
	UK (N. Ireland)	120	0	0	0	No
4	UK (Isle of Man)	0	0	0	0	-
	UK (Scotland)	0	0	0	0	-
	UK (England & Wales)	0	-	-	-	-

*** no information, but catch is likely to be negligible**

Table 7.3.1.1 Irish Sea Herring Division VIIa (N): Summary of acoustic survey information for the period 1989-2004. Small clupeoids include sprat and 0-ring herring unless otherwise stated. CVs are approximate. Biomass in t. All surveys carried out at 38kHz except December 1996, which was at 120kHz.

YEAR	AREA	DATES	HERRING BIOMASS (1+years)	CV	HERRING BIOMASS (SSB)	CV	SMALL CLUPEOIDS biomass	CV
1989	Douglas Bank	25-26 Sept			18000	-	-	-
1990	Douglas Bank	26-27 Sept			26,600	-	-	-
1991	Western Irish Sea	26 July - 8 Aug	12,760	0.23			66,000[1]	0.20
1992	Western Irish Sea + IOM east coast	20 - 31 July	17,490	0.19			43,200	0.25
1994	Area VIIa(N)	28 Aug - 8 Sep	31,400	0.36	25,133	-	68,600	0.10
	Douglas Bank	22-26 Sept			28,200	-	-	-
1995	Area VIIa(N)	11-22 Sept	38,400	0.29	20,167	-	348,600	0.13
	Douglas Bank	10-11 Oct		-	9,840	-	-	-
	Douglas Bank	23-24 Oct			1,750	0.51	-	-
1996	Area VIIa(N)	2-12 Sept	24,500	0.25	21426	0.25	-[2]	-
1997	Area VIIa(N)-reduced	8-12 Sept	20,100	0.28	10,702	0.35	46,600	0.20
1998	Area VIIa(N)	8-14 Sept	14,500	0.20	9,157	0.18	228,000	0.11
1999	Area VIIa(N)	6-17 Sept	31,600	0.59	21,040	0.75	272,200	0.10
2000	Area VIIa(N)	11-21 Sept	40,200	0.26	33,144	0.32	234,700	0.11
2001	Area VIIa(N)	10-18 Sept	35,400	0.40	13,647	0.42	299,700	0.08
2002	Area VIIa(N)	9-20 Sept	41,400	0.56	25,102	0.83	413,900	0.09
2003	Area VIIa(N)	7-20 Sept	49,500	0.22	24,390	0.24	265,900	0.10
2004	Area VIIa(N)	6-10, 15/16, 28/29 Sept	34,437	0.41	21,593	0.41	281,000	0.07

[1] sprat only; [2]Data can be made available for the IoM waters only

Table 7.3.1.2 Irish Sea Herring Division VIIa (N). Age-disaggregated acoustic estimates of herring abundance from the Northern Ireland surveys in September (ACAGE).

AGE (RINGS)	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1	66.8	319.1	11.3	134.1	110.4	157.8	78.5	387.6	391.0	349.2	241.0
2	68.3	82.3	42.4	50.0	27.3	77.7	103.4	93.4	71.9	220.0	115.5
3	73.5	11.9	67.5	14.8	8.1	34.0	105.3	10.1	31.7	32.0	29.6
4	11.9	29.2	9.0	11.0	9.3	5.1	27.5	17.5	24.8	4.7	15.4
5	9.3	4.6	26.5	7.8	6.5	10.3	8.1	7.7	31.3	3.9	2.1
6	7.6	3.5	4.2	4.6	1.8	13.5	5.4	1.4	14.8	4.1	2.3
7	3.9	4.9	5.9	0.6	2.3	1.6	4.9	0.6	2.8	1.0	2.4
8+	10.1	6.9	5.8	1.9	0.8	6.3	2.4	2.2	4.5	0.9	2.4

Table 7.3.2 Irish Sea Herring Division VIIa (N). Larval production (10^{11}) indices for the Manx component.

YEAR	Douglas Bank			Northeast Irish Sea					
		Isle of Man			Isle of Man			Northern Ireland	
	Date	Production	SE	Date	Production	SE	Date	Production	CV
1989	26 Oct	3.39	1.54						
1990	19 Oct	1.92	0.78						
1991	15 Oct	1.56	0.73						
1992	16 Oct	15.64	2.32	20 Nov	128.9				
1993	19 Oct	4.81	0.77	22 Nov	1.1		17 Nov	38.3	0.48
1994	13 Oct	7.26	2.26	24 Nov	12.5		16 Nov	71.2	0.12
1995	19 Oct	1.58	1.68				28 Nov	15.1	0.62
1996				26 Nov	0.3		19 Nov	4.7	0.30
1997	15 Oct	5.59	1.25	1 Dec	35.9		4 Nov	29.1	0.11
1998	6 Nov	2.27	1.43	1 Dec	3.5		3 Nov	5.8	1.02
1999	25 Oct	3.87	0.88				9 Nov	16.7	0.57
2000							11 Nov	35.5	0.12
2001				11 Dec	198.6		7 Nov	55.3	0.55
2002				6 Dec	19.8		4 Nov	31.5	0.47
2003							9 Nov	15.8	0.58
2004							30 Oct	22.7	0.48

SE = Standard Error

Table 7.3.3 Irish Sea herring Division VIIa (N). Northern Ireland groundfish survey indices for herring (Nos. per 3 miles.)

(a) 0-ring herring: October survey

	WESTERN IRISH SEA			EASTERN IRISH SEA			TOTAL IRISH SEA		
Survey	Mean	N.obs	SE	Mean	N.obs.	SE	Mean	N. obs	SE
1991	54	34	22						
1992	210	31	99	240	8	149	177	46	68
1993	633	26	331	498	10	270	412	44	155
1994	548	26	159	8	7	5	194	41	55
1995	67	22	23	35	9	18	37	35	11
1996	90	26	58	131	9	79	117	42	50
1997	281	26	192	68	9	42	138	43	70
1998	980	26	417	12	9	10	347	43	144
1999	389	26	271	90	9	29	186	43	96
2000	202	24	144	367	9	190	212	38	89
2001	553	26	244	236	11	104	284	45	93
2002	132	26	84	18	11	10	63	45	31
2003	1203	26	855	75	11	47	446	45	296
2004	No	data	available						

(b) 1-ring herring: March Surveys. a. Unusually large catch removed, b. unusually large catch retained.

	WESTERN IRISH SEA			EASTERN IRISH SEA			TOTAL IRISH SEA		
Survey	Mean	N.obs	SE	Mean	N.obs.	SE	Mean	N.obs	SE
1992	392	20	198	115	10	73	190	34	77
1993	1755	27	620	175	10	66	681	45	216
1994	2472	25	1852	106	9	51	923	39	641
1995	1299	26	679	73	8	32	480	42	235
1996	1055	22	638	285	9	164	487	39	230
1997	1473	26	382	260	9	96	612	43	137
1998	3953	26	1331	250	9	184	1472	43	466
1999	5845	26	1860	736	9	321	2308	42	655
2000	2303	26	853	546	10	217	1009	44	306
2001	3518	26	916	1265	11	531	1763	45	381
2002[a]	2255	25	845	185	11	84	852	44	294
2002[b]	7870	26	5667	185	11	84	2794	45	1960
2003	2103	26	876	896	11	604	1079	45	382
2004	No	data	available						

(c) 1-ring herring: October Surveys

	WESTERN IRISH SEA			EASTERN IRISH SEA			TOTAL IRISH SEA		
Survey	Mean	N.obs	SE	Mean	N.obs.	SE	Mean	N.obs	SE
1991	102	34	34	n/a	n/a	n/a	n/a	n/a	n/a
1992	36	31	18	20	8	11	21	46	8
1993	122	26	66	4	10	2	44	44	23
1994	490	26	137	17	6	10	176	40	47
1995	153	22	61	3	9	1	55	35	21
1996	30	26	13	2	9	1	11	42	5
1997	612	26	369	0.2	9	0.2	302	43	156
1998	39	26	15	13	9	10	53	43	35
1999	81	26	41	104	9	95	74	43	40
2000	455	24	250	74	9	52	579	38	403
2001	1412	26	641	5	11	3	513	45	223
2002	370	26	111	4	11	2	291	45	158
2003	314	26	143	410	11	350	267	45	144
2004	No	data	available						

Table 7.4.1 Irish Sea Herring Division VIIa (N). Mean length-at-age in the catch.

Year	Lengths-at-age (cm)							
	Age (rings)							
	1	2	3	4	5	6	7	8+
1985	22.1	24.3	26.1	27.6	28.3	28.6	29.5	30.1
1986	19.7	24.3	25.8	26.9	28.0	28.8	28.8	29.8
1987	20.0	24.1	26.3	27.3	28.0	29.2	29.4	30.1
1988	20.2	23.5	25.7	26.3	27.2	27.7	28.7	29.6
1989	20.9	23.8	25.8	26.8	27.8	28.2	28.0	29.5
1990	20.1	24.2	25.6	26.2	27.7	28.3	28.3	29.0
1991	20.5	23.8	25.4	26.1	26.8	27.3	27.7	28.7
1992	19.0	23.7	25.3	26.2	26.7	27.2	27.9	29.4
1993	21.6	24.1	25.9	26.7	27.2	27.6	28.0	28.7
1994	20.1	23.9	25.5	26.5	27.0	27.4	27.9	28.4
1995	20.4	23.6	25.2	26.3	26.8	27.0	27.6	28.3
1996	19.8	23.5	25.3	26.0	26.6	27.6	27.6	28.2
1997	19.6	23.6	25.1	26.0	26.5	27.1	27.7	28.2
1998	20.8	23.8	25.2	26.1	27.0	26.8	27.2	28.7
1999	19.8	23.6	25.0	26.1	26.5	27.1	27.2	28.0
2000	19.7	23.8	25.3	26.3	27.1	27.7	27.7	28.1
2001	20.0	22.9	24.8	25.7	26.2	26.9	27.5	27.8
2002	21.1	23.1	24.8	26.0	26.6	26.7	27.0	28.1
2003	21.1	23.7	25.0	26.5	26.9	27.1	27.8	28.5
2004	20.7	23.1	24.6	25.8	26.1	27.1	27.6	28.3

Table 7.4.2 Irish Sea Herring Division VIIa (N). Mean weights-at-age in the catch.

Year	Weights-at-age (g)							
	Age (rings)							
	1	2	3	4	5	6	7	8+
1985	87	125	157	186	202	209	222	258
1986	68	143	167	188	215	229	239	254
1987	58	130	160	175	194	210	218	229
1988	70	124	160	170	180	198	212	232
1989	81	128	155	174	184	195	205	218
1990	77	135	163	175	188	196	207	217
1991	70	121	153	167	180	189	195	214
1992	61	111	136	151	159	171	179	191
1993	88	126	157	171	183	191	198	214
1994	73	126	154	174	181	190	203	214
1995	72	120	147	168	180	185	197	212
1996	67	116	148	162	177	199	200	214
1997	64	118	146	165	176	188	204	216
1998	80	123	148	163	181	177	188	222
1999	69	120	145	167	176	188	190	210
2000	64	120	148	168	188	204	200	213
2001	67	106	139	156	168	185	198	205
2002	85	113	144	167	180	184	191	217
2003*	81	116	136	160	167	172	186	199
2004	73	107	130	157	165	187	200	205

*** Average for the preceding five years**

Table 7.4.3 Irish Sea Herring Division VIIa(N). Maturity ogive (maturity in the catch).

YEAR				AGE (RINGS)				
	1	2	3	4	5	6	7	8+
1961	0.00	0.22	0.63	1.00	1.00	1.00	1.00	1.00
1962	0.00	0.24	0.83	0.92	1.00	1.00	1.00	1.00
1963	0.00	0.34	0.88	0.89	1.00	1.00	1.00	1.00
1964	0.00	0.53	0.81	1.00	1.00	1.00	1.00	1.00
1965	0.00	0.61	0.90	1.00	1.00	1.00	1.00	1.00
1966	0.00	0.47	0.91	1.00	1.00	1.00	1.00	1.00
1967	0.02	0.37	0.75	0.83	1.00	1.00	1.00	1.00
1968	0.00	0.88	0.94	0.94	1.00	1.00	1.00	1.00
1969	0.00	0.71	0.92	0.94	1.00	1.00	1.00	1.00
1970	0.02	0.92	0.94	0.96	1.00	1.00	1.00	1.00
1971	0.15	0.87	0.97	0.98	1.00	1.00	1.00	1.00
1972	0.11	0.88	0.90	1.00	1.00	1.00	1.00	1.00
1973	0.12	0.77	0.89	0.97	1.00	1.00	1.00	1.00
1974	0.36	0.99	0.96	1.00	1.00	1.00	1.00	1.00
1975	0.40	0.99	1.00	0.94	1.00	1.00	1.00	1.00
1976	0.07	0.96	0.98	1.00	1.00	1.00	1.00	1.00
1977	0.03	0.92	0.96	1.00	1.00	1.00	1.00	1.00
1978	0.04	0.81	0.88	0.91	1.00	1.00	1.00	1.00
1979	0.00	0.84	0.81	0.78	1.00	1.00	1.00	1.00
1980	0.20	0.88	0.95	0.95	1.00	1.00	1.00	1.00
1981	0.19	0.89	0.90	0.94	1.00	1.00	1.00	1.00
1982	0.10	0.80	0.89	0.91	1.00	1.00	1.00	1.00
1983	0.02	0.73	0.88	0.90	1.00	1.00	1.00	1.00
1984	0.00	0.69	0.83	0.93	1.00	1.00	1.00	1.00
1985	0.14	0.62	0.71	0.88	1.00	1.00	1.00	1.00
1986	0.31	0.73	0.66	0.81	1.00	1.00	1.00	1.00
1987	0.00	0.85	0.91	0.87	1.00	1.00	1.00	1.00
1988	0.00	0.90	0.96	0.99	1.00	1.00	1.00	1.00
1989	0.07	0.63	0.93	0.95	1.00	1.00	1.00	1.00
1990	0.06	0.66	0.90	0.95	1.00	1.00	1.00	1.00
1991	0.04	0.30	0.74	0.82	1.00	1.00	1.00	1.00
1992	0.28	0.48	0.72	0.81	1.00	1.00	1.00	1.00
1993	0.00	0.46	0.99	1.00	1.00	1.00	1.00	1.00
1994	0.19	0.68	0.99	0.97	1.00	1.00	1.00	1.00
1995	0.10	0.86	0.94	0.99	1.00	1.00	1.00	1.00
1996	0.02	0.60	0.96	0.83	1.00	1.00	1.00	1.00
1997	0.04	0.82	0.95	1.00	1.00	1.00	1.00	1.00
1998	0.30	0.83	0.97	0.99	1.00	1.00	1.00	1.00
1999	0.02	0.84	0.95	0.97	1.00	1.00	1.00	1.00
2000	0.14	0.79	0.99	1.00	1.00	1.00	1.00	1.00
2001	0.15	0.54	0.88	0.97	1.00	1.00	1.00	1.00
2002	0.02	0.92	0.95	0.98	1.00	1.00	1.00	1.00
*2003	0.11	0.76	0.95	0.97	1.00	1.00	1.00	1.00
2004	0.11	1.00	0.97	1.00	1.00	1.00	1.00	1.00

* Average for the preceding nine years

Table 7.6.1 Irish Sea herring VIIa(N). ICA run log for the maximun-likelihood ICA calculation for the 6 year separable period. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

```
                         Integrated Catch at Age Analysis
                         --------------------------------
                                 Version 1.4 w

                                 K.R.Patterson
                          Fisheries Research Services
                               Marine Laboratory
                                    Aberdeen
Enter the name of the index file -->index.txt
canum.txt
weca.txt
 Stock weights in 2005  used for the year 2004
west.txt
 Natural mortality in 2005  used for the year 2004
natmor.txt
 Maturity ogive in 2005  used for the year 2004
matprop.txt
 Name of age-structured index file (Enter if none) : -->fleet.txt
 Name of the SSB index file (Enter if none) -->ssb.txt
 No of years for separable constraint ?--> 6
 Reference age for separable constraint ?--> 4
 Constant selection pattern model (Y/N) ?-->y
 S to be fixed on last age ?-->    1.000000000000000
 First age for calculation of reference F ?--> 2
 Last age for calculation of reference F ?--> 6
 Use default weighting (Y/N) ?-->n
Enter relative weights at age
 Weight for age 1-->    0.100000000000000
 Weight for age 2-->    1.000000000000000
 Weight for age 3-->    1.000000000000000
 Weight for age 4-->    1.000000000000000
 Weight for age 5-->    1.000000000000000
 Weight for age 6-->    1.000000000000000
 Weight for age 7-->    1.000000000000000
 Weight for age 8-->    1.000000000000000
Enter relative weights by year
 Weight for year 1999-->    1.000000000000000
 Weight for year 2000-->    1.000000000000000
 Weight for year 2001-->    1.000000000000000
 Weight for year 2002-->    1.000000000000000
 Weight for year 2003-->    1.000000000000000
 Weight for year 2004-->    1.000000000000000
Enter new weights for specified years and ages if needed
 Enter year, age, new weight or -1,-1,-1 to end.  -1 -1   -1.000000000000000
 Is the last age of FLT01: Northern Ireland acoustic surveys a plus-group (Y--
>y
You must choose a catchability model for each index.

Models:   A  Absolute:  Index = Abundance . e
          L  Linear:    Index = Q. Abundance . e
          P  Power:     Index = Q. Abundance^ K .e

   where Q and K are parameters to be estimated, and
   e is a lognormally-distributed error.
```

Table 7.6.1 Irish Sea herring VIIa(N). ICA run log. Continued.

```
 Model for   NINEL  is to be A/L/P ?-->L
 Model for FLT01: Northern Ireland acoustic surveys  is to be A/L/P ?-->L
 Fit a stock-recruit relationship (Y/N) ?-->n
 Enter lowest feasible F-->   5.0000000000000003E-02
 Enter highest feasible F-->    2.000000000000000
Mapping the F-dimension of the SSQ surface

    F                  SSQ
+--------+------------------
    0.05         27.1836691837
    0.15         18.2248559697
    0.26         17.2788217970
    0.36         17.3731192042
    0.46         17.8199934750
    0.56         18.4453884727
    0.67         19.2073375834
    0.77         20.1829746139
    0.87         20.9884230143
    0.97         21.6120959814
    1.08         22.2182617898
    1.18         22.8053996324
    1.28         23.3731980658
    1.38         23.9220365372
    1.49         24.4529886040
    1.59         24.9671427370
    1.69         25.4661750285
    1.79         25.9457794450
    1.90         26.3527910683
    2.00         26.7579711518
Lowest SSQ is for F =     0.286
-----------------------------------------------------------------
No of years for separable analysis : 6
Age range in the analysis : 1  . . . 8
Year range in the analysis : 1961  . . . 2004
Number of indices of SSB : 1
Number of age-structured indices : 1

Parameters to estimate : 32
Number of observations : 142

Conventional single selection vector model to be fitted.
 -----------------------------------------------------------------
 Survey weighting to be Manual (recommended) or Iterative (M/I) ?-->M
 Enter weight for   NINEL-->    1.000000000000000
 Enter weight for FLT01: Northern Ireland acoustic surveys  at age 1-->    0.100000000000000
 Enter weight for FLT01: Northern Ireland acoustic surveys  at age 2-->    1.000000000000000
 Enter weight for FLT01: Northern Ireland acoustic surveys  at age 3-->    1.000000000000000
 Enter weight for FLT01: Northern Ireland acoustic surveys  at age 4-->    1.000000000000000
 Enter weight for FLT01: Northern Ireland acoustic surveys  at age 5-->    1.000000000000000
 Enter weight for FLT01: Northern Ireland acoustic surveys  at age 6-->    1.000000000000000
 Enter weight for FLT01: Northern Ireland acoustic surveys  at age 7-->    1.000000000000000
 Enter weight for FLT01: Northern Ireland acoustic surveys  at age 8-->    1.000000000000000
Enter estimates of the extent to which errors
in the age-structured indices are correlated
across ages. This can be in the range 0 (independence)
to 1 (correlated errors).
  Enter value for FLT01: Northern Ireland acoustic surveys-->    1.000000000000000
 Do you want to shrink the final fishing mortality (Y/N) ?-->N
Seeking solution. Please wait.
```

Table 7.6.1 Irish Sea herring VIIa(N). ICA run log. Continued.

```
SSB index weights
  1.000
Aged index weights
FLT01: Northern Ireland acoustic surveys
 Age   :       1     2     3     4     5     6     7     8
 Wts :     0.012 0.125 0.125 0.125 0.125 0.125 0.125 0.125
F in 2004  at age 4  is 0.179098  in iteration 1
 Detailed, Normal or Summary output (D/N/S)-->D
 Output page width in characters (e.g. 80..132) ?--> 80
 Estimate historical assessment uncertainty ?-->y
 Sample from Covariances or Bayes MC
```

Table 7.6.2 Irish Sea herring VIIa(N). Catch number-at-age (millions). N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Output Generated by ICA Version 1.4

Herring Irish Sea

Catch in Number

AGE	1961	1962	1963	1964	1965	1966	1967	1968
1	4.54	0.38	4.84	1.51	0.85	0.94	4.44	1.02
2	11.47	12.30	9.44	18.09	27.08	15.05	40.92	30.18
3	2.63	7.34	2.34	4.35	8.18	15.63	5.60	13.46
4	12.43	1.81	2.89	0.71	0.99	2.00	4.63	4.08
5	0.24	5.43	2.26	0.53	0.70	0.12	1.35	0.82
6	0.48	0.19	2.26	0.71	0.99	0.35	0.00	0.61
7	1.20	0.19	0.55	0.00	0.42	0.12	0.00	0.00
8	2.15	0.67	0.62	0.18	0.70	0.00	0.00	0.00

AGE	1969	1970	1971	1972	1973	1974	1975	1976
1	1.32	5.61	12.17	40.64	42.15	43.25	33.33	34.74
2	42.80	31.18	66.92	46.66	32.74	109.55	48.24	56.16
3	16.91	33.63	31.94	26.95	38.24	39.75	39.41	20.78
4	12.68	16.46	29.41	13.18	11.49	24.51	10.84	15.22
5	1.32	12.61	5.07	13.75	6.92	10.65	7.87	4.58
6	2.64	1.75	3.55	6.76	5.07	4.99	4.21	2.81
7	0.53	2.10	1.01	2.66	2.59	5.15	2.09	2.42
8	0.00	1.05	1.01	1.67	2.60	1.63	1.64	1.27

AGE	1977	1978	1979	1980	1981	1982	1983	1984
1	30.28	15.54	11.77	5.84	5.05	5.10	1.30	1.17
2	39.04	36.95	38.27	25.76	15.79	16.03	12.16	8.42
3	22.69	13.41	23.49	19.51	3.20	5.67	5.60	7.24
4	6.75	6.78	4.25	8.52	2.79	2.15	2.82	3.84
5	4.52	1.74	2.20	1.98	2.30	0.33	0.45	2.22
6	1.46	1.34	1.05	0.91	0.33	1.11	0.48	0.38
7	0.91	0.67	0.40	0.36	0.29	0.14	0.26	0.23
8	1.12	0.35	0.29	0.23	0.24	0.38	0.06	0.48

Table 7.6.2 Irish Sea herring VIIa(N). Catch number-at-age (millions). Continued.

AGE	1985	1986	1987	1988	1989	1990	1991	1992
1	2.43	4.49	2.23	2.61	1.16	2.31	2.00	12.14
2	10.05	15.27	12.98	21.25	6.38	12.84	9.75	6.88
3	17.34	7.46	6.15	13.34	12.04	5.73	6.74	6.74
4	13.29	8.55	3.00	7.16	4.71	9.70	2.83	6.69
5	7.21	4.53	4.18	4.61	1.88	3.60	5.07	3.26
6	2.65	3.20	2.78	5.08	1.25	1.66	1.49	5.12
7	0.67	1.46	2.33	3.23	1.56	1.04	0.72	1.04
8	0.72	0.88	1.67	4.21	1.96	1.61	0.81	0.39

AGE	1993	1994	1995	1996	1997	1998	1999	2000
1	0.65	1.97	3.20	5.33	9.55	3.07	1.81	1.22
2	14.64	7.00	21.33	17.53	21.39	11.88	16.93	3.74
3	3.01	12.16	3.39	9.76	7.56	3.88	5.94	5.87
4	3.02	1.83	5.27	1.16	7.34	4.45	1.57	2.06
5	2.90	2.57	1.20	3.60	1.64	6.67	1.48	0.56
6	1.61	2.10	1.15	0.78	2.28	1.03	1.99	0.35
7	2.18	1.28	0.93	0.96	0.84	2.05	0.44	0.25
8	0.85	1.99	1.45	1.36	1.43	0.45	0.62	0.15

AGE	2001	2002	2003	2004
1	2.71	0.18	0.69	3.23
2	11.47	9.02	4.69	8.83
3	7.15	1.89	3.35	5.41
4	13.05	1.87	2.56	2.16
5	3.39	2.40	0.88	0.62
6	0.94	0.95	2.94	0.21
7	0.65	0.47	0.87	0.67
8	0.80	0.34	0.60	0.06

x 10 ^ 6

Table 7.6.3 Irish Sea herring VIIa(N). Weight in the catch (kg). N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Weights at age in the catches (Kg)

AGE	1961	1962	1963	1964	1965	1966	1967	1968
1	0.08200	0.06700	0.06700	0.07800	0.06500	0.09200	0.09300	0.09100
2	0.12300	0.12500	0.13100	0.12900	0.13200	0.14000	0.14900	0.15300
3	0.17800	0.15200	0.18400	0.15600	0.17600	0.18500	0.18000	0.19600
4	0.19800	0.17700	0.20800	0.17100	0.19200	0.21800	0.19900	0.23100
5	0.23200	0.19900	0.22800	0.22600	0.21000	0.25800	0.22300	0.24600
6	0.22600	0.21400	0.23400	0.24000	0.23000	0.25300	0.24300	0.26900
7	0.25300	0.27500	0.26600	0.00000	0.27200	0.22500	0.22700	0.23400
8	0.24800	0.25100	0.25800	0.29600	0.26500	0.26400	0.27500	0.26400

Table 7.6.3 Irish Sea herring VIIa(N). Weight in the catch (kg). Continued.

AGE	1969	1970	1971	1972	1973	1974	1975	1976
1	0.07400	0.10100	0.10800	0.07400	0.07400	0.07400	0.07400	0.07400
2	0.15200	0.16200	0.15800	0.15500	0.15500	0.15500	0.15500	0.15500
3	0.20400	0.20600	0.18900	0.19500	0.19500	0.19500	0.19500	0.19500
4	0.23100	0.22500	0.21400	0.21900	0.21900	0.21900	0.21900	0.21900
5	0.25400	0.24500	0.22500	0.23200	0.23200	0.23200	0.23200	0.23200
6	0.26600	0.25100	0.26600	0.25100	0.25100	0.25100	0.25100	0.25100
7	0.23900	0.26900	0.24100	0.25800	0.25800	0.25800	0.25800	0.25800
8	0.27000	0.25800	0.24100	0.27800	0.27800	0.27800	0.27800	0.27800

AGE	1977	1978	1979	1980	1981	1982	1983	1984
1	0.07400	0.07400	0.07400	0.07400	0.07400	0.07400	0.07400	0.07600
2	0.15500	0.15500	0.15500	0.15500	0.15500	0.15500	0.15500	0.14200
3	0.19500	0.19500	0.19500	0.19500	0.19500	0.19500	0.19500	0.18700
4	0.21900	0.21900	0.21900	0.21900	0.21900	0.21900	0.21900	0.21300
5	0.23200	0.23200	0.23200	0.23200	0.23200	0.23200	0.23200	0.22100
6	0.25100	0.25100	0.25100	0.25100	0.25100	0.25100	0.25100	0.24300
7	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.24000
8	0.27800	0.27800	0.27800	0.27800	0.27800	0.27800	0.27800	0.27300

AGE	1985	1986	1987	1988	1989	1990	1991	1992
1	0.08700	0.06800	0.05800	0.07000	0.08100	0.09600	0.07300	0.06200
2	0.12500	0.14300	0.13000	0.12400	0.12800	0.14000	0.12300	0.11400
3	0.15700	0.16700	0.16000	0.16000	0.15500	0.16600	0.15500	0.14000
4	0.18600	0.18800	0.17500	0.17000	0.17400	0.17500	0.17100	0.15500
5	0.20200	0.21500	0.19400	0.18000	0.18400	0.18700	0.18100	0.16500
6	0.20900	0.22800	0.21000	0.19800	0.19500	0.19500	0.19000	0.17400
7	0.22200	0.23900	0.21800	0.21200	0.20500	0.20700	0.19800	0.18100
8	0.25800	0.25400	0.22900	0.23200	0.21800	0.21800	0.21700	0.19700

AGE	1993	1994	1995	1996	1997	1998	1999	2000
1	0.08900	0.07000	0.07500	0.06700	0.06400	0.08000	0.06900	0.06400
2	0.12700	0.12300	0.12100	0.11600	0.11800	0.12300	0.12000	0.12000
3	0.15700	0.15300	0.14600	0.14800	0.14600	0.14800	0.14500	0.14800
4	0.17100	0.17000	0.16400	0.16200	0.16500	0.16300	0.16700	0.16800
5	0.18200	0.18000	0.17600	0.17700	0.17600	0.18100	0.17600	0.18800
6	0.19100	0.18900	0.18100	0.19900	0.18800	0.17700	0.18800	0.20400
7	0.19800	0.20200	0.19300	0.20000	0.20400	0.18800	0.19000	0.20000
8	0.21200	0.21200	0.20700	0.21400	0.21600	0.22200	0.21000	0.21300

AGE	2001	2002	2003	2004
1	0.06700	0.08500	0.08100	0.07300
2	0.10600	0.11300	0.11600	0.10700
3	0.13900	0.14400	0.13600	0.13000
4	0.15600	0.16700	0.16000	0.15700
5	0.16800	0.18000	0.16700	0.16500
6	0.18500	0.18400	0.17200	0.18700
7	0.19800	0.19100	0.18600	0.20000
8	0.20500	0.21700	0.19900	0.20000

Table 7.6.4 Irish Sea herring VIIa(N). Weight in the stock (kg). N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Weights at age in the stock (Kg)

AGE	1961	1962	1963	1964	1965	1966	1967	1968
1	0.08200	0.06700	0.06700	0.07800	0.06500	0.09200	0.09300	0.09100
2	0.12300	0.12500	0.13100	0.12900	0.13200	0.14000	0.14900	0.15300
3	0.17800	0.15200	0.18400	0.15600	0.17600	0.18500	0.18000	0.19600
4	0.19800	0.17700	0.20800	0.17100	0.19200	0.21800	0.19900	0.23100
5	0.23200	0.19900	0.22800	0.22600	0.21000	0.25800	0.22300	0.24600
6	0.22600	0.21400	0.23400	0.24000	0.23000	0.25300	0.24300	0.26900
7	0.25300	0.27500	0.26600	0.00000	0.27200	0.22500	0.22700	0.23400
8	0.24800	0.25100	0.25800	0.29600	0.26500	0.26400	0.27500	0.26400

AGE	1969	1970	1971	1972	1973	1974	1975	1976
1	0.07400	0.10100	0.10800	0.07400	0.07400	0.07400	0.07400	0.07400
2	0.15200	0.16200	0.15800	0.15500	0.15500	0.15500	0.15500	0.15500
3	0.20400	0.20600	0.18900	0.19500	0.19500	0.19500	0.19500	0.19500
4	0.23100	0.22500	0.21400	0.21900	0.21900	0.21900	0.21900	0.21900
5	0.25400	0.24500	0.22500	0.23200	0.23200	0.23200	0.23200	0.23200
6	0.26600	0.25100	0.26600	0.25100	0.25100	0.25100	0.25100	0.25100
7	0.23900	0.26900	0.24100	0.25800	0.25800	0.25800	0.25800	0.25800
8	0.27000	0.25800	0.24100	0.27800	0.27800	0.27800	0.27800	0.27800

AGE	1977	1978	1979	1980	1981	1982	1983	1984
1	0.07400	0.07400	0.07400	0.07400	0.07400	0.07400	0.07400	0.07600
2	0.15500	0.15500	0.15500	0.15500	0.15500	0.15500	0.15500	0.14200
3	0.19500	0.19500	0.19500	0.19500	0.19500	0.19500	0.19500	0.18700
4	0.21900	0.21900	0.21900	0.21900	0.21900	0.21900	0.21900	0.21300
5	0.23200	0.23200	0.23200	0.23200	0.23200	0.23200	0.23200	0.22100
6	0.25100	0.25100	0.25100	0.25100	0.25100	0.25100	0.25100	0.24300
7	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.25800	0.24000
8	0.27800	0.27800	0.27800	0.27800	0.27800	0.27800	0.27800	0.27300

AGE	1985	1986	1987	1988	1989	1990	1991	1992
1	0.08700	0.06800	0.05800	0.07000	0.08100	0.07700	0.07000	0.06100
2	0.12500	0.14300	0.13000	0.12400	0.12800	0.13500	0.12100	0.11100
3	0.15700	0.16700	0.16000	0.16000	0.15500	0.16300	0.15300	0.13600
4	0.18600	0.18800	0.17500	0.17000	0.17400	0.17500	0.16700	0.15100
5	0.20200	0.21500	0.19400	0.18000	0.18400	0.18800	0.18000	0.15900
6	0.20900	0.22900	0.21000	0.19800	0.19500	0.19600	0.18900	0.17100
7	0.22200	0.23900	0.21800	0.21200	0.20500	0.20700	0.19500	0.17900
8	0.25800	0.25400	0.22900	0.23200	0.21800	0.21700	0.21400	0.19100

AGE	1993	1994	1995	1996	1997	1998	1999	2000
1	0.08800	0.07300	0.07200	0.06700	0.06300	0.07300	0.06800	0.06300
2	0.12600	0.12600	0.12000	0.11500	0.11900	0.12100	0.12100	0.12000
3	0.15700	0.15400	0.14700	0.14800	0.14800	0.15000	0.14500	0.14900
4	0.17100	0.17400	0.16800	0.16200	0.16700	0.16600	0.16800	0.17100
5	0.18300	0.18100	0.18000	0.17700	0.17800	0.17900	0.17800	0.18800
6	0.19100	0.19000	0.18500	0.19500	0.18900	0.19000	0.18900	0.20400
7	0.19800	0.20300	0.19700	0.19900	0.20600	0.20000	0.19900	0.20500
8	0.21400	0.21400	0.21200	0.21200	0.21400	0.23000	0.21400	0.21500

Table 7.6.4 Irish Sea herring VIIa(N). Weight in the stock (kg). Continued.

Weights at age in the stock (Kg)

AGE	2001	2002	2003	2004
1	0.06600	0.08500	0.08100	0.06700
2	0.10500	0.11300	0.11600	0.11400
3	0.13900	0.14400	0.13600	0.14400
4	0.15600	0.16700	0.16000	0.16100
5	0.16700	0.18000	0.16700	0.17000
6	0.18300	0.18400	0.17200	0.19200
7	0.19900	0.19100	0.18600	0.20200
8	0.20500	0.21700	0.19900	0.20500

Table 7.6.5 Irish Sea herring VIIa(N). Natural mortality. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Natural Mortality (per year)

AGE	1961	1962	1963	1964	1965	1966	1967	1968
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
3	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
5	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
6	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
7	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
8	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000

AGE	1969	1970	1971	1972	1973	1974	1975	1976
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
3	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
5	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
6	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
7	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
8	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000

AGE	1977	1978	1979	1980	1981	1982	1983	1984
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
3	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
5	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
6	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
7	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
8	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000

Table 7.6.5 Irish Sea herring VIIa(N). Natural mortality. Continued.

Natural Mortality (per year)

AGE	1985	1986	1987	1988	1989	1990	1991	1992
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
3	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
5	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
6	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
7	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
8	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000

AGE	1993	1994	1995	1996	1997	1998	1999	2000
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000	0.3000
3	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000	0.2000
4	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
5	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
6	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
7	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
8	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000

AGE	2001	2002	2003	2004
1	1.0000	1.0000	1.0000	1.0000
2	0.3000	0.3000	0.3000	0.3000
3	0.2000	0.2000	0.2000	0.2000
4	0.1000	0.1000	0.1000	0.1000
5	0.1000	0.1000	0.1000	0.1000
6	0.1000	0.1000	0.1000	0.1000
7	0.1000	0.1000	0.1000	0.1000
8	0.1000	0.1000	0.1000	0.0000

Table 7.6.6 Irish Sea herring VIIa(N). Proportion mature. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Proportion of fish spawning

AGE	1961	1962	1963	1964	1965	1966	1967	1968
1	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0200	0.0000
2	0.2200	0.2400	0.3400	0.5300	0.6100	0.4700	0.3700	0.8800
3	0.6300	0.8300	0.8800	0.8100	0.9000	0.9100	0.7500	0.9400
4	1.0000	0.9200	0.8900	1.0000	1.0000	1.0000	0.8300	0.9400
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 7.6.6 Irish Sea herring VIIa(N). Proportion mature. Continued.

Proportion of fish spawning

AGE	1969	1970	1971	1972	1973	1974	1975	1976
1	0.0000	0.0200	0.1500	0.1100	0.1200	0.3600	0.4000	0.0700
2	0.7100	0.9200	0.8700	0.8800	0.7700	0.9900	0.9900	0.9600
3	0.9200	0.9400	0.9700	0.9000	0.8900	0.9600	1.0000	0.9800
4	0.9400	0.9600	0.9800	1.0000	0.9700	1.0000	0.9400	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1977	1978	1979	1980	1981	1982	1983	1984
1	0.0300	0.0400	0.0000	0.2000	0.1900	0.1000	0.0200	0.0000
2	0.9200	0.8100	0.8400	0.8800	0.8900	0.8000	0.7300	0.6900
3	0.9600	0.8800	0.8100	0.9500	0.9000	0.8900	0.8800	0.8300
4	1.0000	0.9100	0.7800	0.9500	0.9400	0.9100	0.9000	0.9300
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1985	1986	1987	1988	1989	1990	1991	1992
1	0.1400	0.3100	0.0000	0.0000	0.0700	0.0600	0.0400	0.2800
2	0.6200	0.7300	0.8500	0.9000	0.6300	0.6600	0.3000	0.4800
3	0.7100	0.6600	0.9100	0.9600	0.9300	0.9000	0.7400	0.7200
4	0.8800	0.8100	0.8700	0.9900	0.9500	0.9500	0.8200	0.8100
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	1993	1994	1995	1996	1997	1998	1999	2000
1	0.0000	0.1900	0.1000	0.0200	0.0400	0.3000	0.0200	0.1400
2	0.4600	0.6800	0.8600	0.6000	0.8200	0.8300	0.8400	0.7900
3	0.9900	0.9900	0.9400	0.9600	0.9500	0.9700	0.9500	0.9900
4	1.0000	0.9700	0.9900	0.8300	1.0000	0.9900	0.9700	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

AGE	2001	2002	2003	2004
1	0.1500	0.0200	0.1100	0.1140
2	0.5400	0.9200	0.7600	1.0000
3	0.8800	0.9500	0.9500	0.9700
4	0.9700	0.9800	0.9700	1.0000
5	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000

Table 7.6.7 Irish Sea herring VIIa(N). Indices of spawning biomass.

INDICES OF SPAWNING BIOMASS

NINEL

	1993	1994	1995	1996	1997	1998	1999	2000
1	38300.	71200.	15100.	4700.	29100.	5800.	16700.	35500.

	2001	2002	2003	2004
1	55300.	31500.	15800.	22700.

x 10 ^ -3

Table 7.6.8 Irish Sea herring VIIa(N). Tuning indices. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

AGE-STRUCTURED INDICES

AGE	1994	1995	1996	1997	1998	1999	2000	2001
1	66.83	319.12	11.34	134.15	110.44	157.76	78.52	387.56
2	68.29	82.26	42.37	49.98	27.31	77.72	103.44	93.40
3	73.53	11.94	67.47	14.81	8.08	34.02	105.29	10.19
4	11.86	29.25	8.95	10.98	9.27	5.11	27.54	17.49
5	9.30	4.57	26.47	1.75	6.48	10.26	8.07	7.70
6	7.55	3.50	4.17	4.55	1.78	13.52	5.43	1.37
7	3.87	4.89	5.91	0.57	2.25	1.59	4.90	0.63
8	10.12	6.89	5.82	1.91	0.78	6.29	2.36	2.26

AGE	2002	2003	2004
1	390.98	349.22	241.01
2	71.94	220.01	115.53
3	31.70	31.98	29.59
4	24.80	4.74	15.40
5	31.28	3.92	2.07
6	14.83	4.09	2.30
7	2.76	0.98	0.24
8	4.46	0.91	0.02

x 10 ^ 3

Table 7.6.9 Irish Sea herring VIIa(N). Fishing mortality (per year). N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Fishing Mortality (per year)

AGE	1961	1962	1963	1964	1965	1966	1967	1968
1	0.1133	0.0114	0.0611	0.0107	0.0109	0.0040	0.0199	0.0029
2	0.5133	1.0110	0.8086	0.6232	0.4774	0.4860	0.4268	0.3155
3	0.3140	0.8029	0.5707	1.3322	0.7033	0.6078	0.3586	0.2571
4	0.7541	0.3514	0.8375	0.3193	1.3652	0.3461	0.3431	0.4564
5	0.1555	0.7847	0.8653	0.3121	0.5312	0.4911	0.3694	0.0832
6	0.7140	0.1609	0.7954	0.6497	1.3652	0.4911	0.2993	0.2535
7	0.5051	0.6173	0.7954	0.3193	0.9192	0.4911	0.3431	0.4564
8	0.5051	0.6173	0.7954	0.3193	0.9192	0.4911	0.3431	0.4564

AGE	1969	1970	1971	1972	1973	1974	1975	1976
1	0.0056	0.0185	0.0393	0.1663	0.1043	0.2140	0.1523	0.2298
2	0.2717	0.3008	0.5772	0.3618	0.3443	0.8249	0.7523	0.7932
3	0.3121	0.3795	0.6186	0.5226	0.6146	1.0133	0.9075	0.9766
4	0.3882	0.5366	0.6347	0.5335	0.4188	1.0056	0.8257	1.1025
5	0.2324	0.7335	0.2774	0.6128	0.5261	0.7579	0.9555	0.9136
6	0.3707	0.4825	0.4117	0.6342	0.4233	0.7995	0.6844	0.9973
7	0.3216	0.5011	0.5052	0.5474	0.4708	0.8900	0.8362	0.9749
8	0.3216	0.5011	0.5052	0.5474	0.4708	0.8900	0.8362	0.9749

AGE	1977	1978	1979	1980	1981	1982	1983	1984
1	0.1584	0.1040	0.1440	0.0622	0.0380	0.0364	0.0092	0.0145
2	0.8585	0.5384	0.7584	1.0920	0.4203	0.2790	0.1932	0.1253
3	0.9976	0.9275	0.8744	1.3554	0.3900	0.2781	0.1569	0.1785
4	0.9955	0.9169	0.8396	0.9008	0.6669	0.4680	0.2059	0.1459
5	1.0798	0.6681	0.7745	1.1263	0.5748	0.1329	0.1472	0.2218
6	0.7482	1.0142	1.0004	0.7650	0.4876	0.5352	0.2617	0.1621
7	0.9483	0.8305	0.8683	1.0534	0.5201	0.3495	0.1987	0.1702
8	0.9483	0.8305	0.8683	1.0534	0.5201	0.3495	0.1987	0.1702

AGE	1985	1986	1987	1988	1989	1990	1991	1992
1	0.0266	0.0429	0.0132	0.0379	0.0124	0.0321	0.0469	0.0998
2	0.2856	0.4075	0.2890	0.2882	0.2082	0.3209	0.3171	0.3955
3	0.4340	0.3799	0.3037	0.5837	0.2798	0.3108	0.2964	0.4040
4	0.5392	0.3755	0.2445	0.6552	0.3966	0.3610	0.2363	0.5083
5	0.3932	0.3142	0.2829	0.6334	0.3131	0.5288	0.2894	0.4126
6	0.3963	0.2698	0.2881	0.5771	0.3102	0.4453	0.3856	0.4689
7	0.4164	0.3522	0.2865	0.5595	0.3082	0.4056	0.3128	0.4473
8	0.4164	0.3522	0.2865	0.5595	0.3082	0.4056	0.3128	0.4473

Table 7.6.9 Irish Sea herring VIIa(N). Fishing mortality (per year). Continued.

Fishing Mortality (per year)

AGE	1993	1994	1995	1996	1997	1998	1999	2000
1	0.0155	0.0152	0.0388	0.0733	0.1150	0.0241	0.0203	0.0086
2	0.2901	0.4066	0.3958	0.5552	0.9081	0.3588	0.3620	0.1539
3	0.3201	0.4461	0.3766	0.3384	0.5345	0.4310	0.3969	0.1688
4	0.3013	0.3109	0.3349	0.2019	0.4354	0.6643	0.3568	0.1517
5	0.3827	0.4008	0.3073	0.3575	0.4294	0.7910	0.3364	0.1430
6	0.3266	0.4672	0.2814	0.2993	0.3577	0.4652	0.3113	0.1324
7	0.3311	0.4147	0.3424	0.3551	0.5353	0.5555	0.3568	0.1517
8	0.3311	0.4147	0.3424	0.3551	0.5353	0.5555	0.3568	0.1517

AGE	2001	2002	2003	2004
1	0.0315	0.0150	0.0168	0.0102
2	0.5631	0.2672	0.3000	0.1817
3	0.6174	0.2930	0.3289	0.1992
4	0.5550	0.2634	0.2957	0.1791
5	0.5232	0.2483	0.2787	0.1688
6	0.4843	0.2298	0.2580	0.1563
7	0.5550	0.2634	0.2957	0.1791
8	0.5550	0.2634	0.2957	0.1791

Table 7.6.10 Irish Sea herring VIIa(N). Population abundance (1 January, millions). N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Population Abundance (1 January)

AGE	1961	1962	1963	1964	1965	1966	1967	1968
1	66.45	53.12	128.50	224.16	122.87	368.19	355.22	563.84
2	32.66	21.83	19.32	44.47	81.59	44.71	134.90	128.10
3	10.71	14.48	5.88	6.38	17.67	37.50	20.37	65.22
4	24.51	6.40	5.31	2.72	1.38	7.16	16.72	11.65
5	1.74	10.43	4.08	2.08	1.79	0.32	4.58	10.73
6	0.98	1.35	4.31	1.55	1.38	0.95	0.18	2.87
7	3.15	0.43	1.04	1.76	0.73	0.32	0.53	0.12
8	5.68	1.51	1.19	0.68	1.22	0.71	0.57	0.70

AGE	1969	1970	1971	1972	1973	1974	1975	1976
1	376.91	482.19	498.47	414.06	667.44	349.05	368.54	262.68
2	206.83	137.89	174.13	176.32	128.99	221.22	103.67	116.42
3	69.22	116.77	75.62	72.43	90.97	67.72	71.83	36.19
4	41.29	41.48	65.42	33.35	35.16	40.28	20.13	23.73
5	6.68	25.34	21.94	31.38	17.70	20.93	13.33	7.98
6	8.94	4.79	11.01	15.05	15.38	9.46	8.88	4.64
7	2.01	5.58	2.68	6.60	7.22	9.12	3.85	4.05
8	0.47	2.79	2.68	4.14	7.25	2.89	3.02	2.13

x 10 ^ 6

Table 7.6.10 Irish Sea herring VIIa(N). Population abundance (1 January, millions). Continued.

Population Abundance (1 January)

AGE	1977	1978	1979	1980	1981	1982	1983	1984
1	322.84	246.70	137.19	152.46	213.72	224.81	226.39	128.22
2	76.79	101.37	81.79	43.70	52.70	75.69	79.74	82.52
3	39.02	24.11	43.83	28.38	10.86	25.65	42.42	48.70
4	11.16	11.78	7.81	14.97	5.99	6.02	15.90	29.69
5	7.13	3.73	4.26	3.05	5.50	2.78	3.41	11.71
6	2.89	2.19	1.73	1.78	0.90	2.80	2.20	2.67
7	1.55	1.24	0.72	0.58	0.75	0.50	1.48	1.54
8	1.91	0.65	0.52	0.37	0.62	1.35	0.34	3.21

AGE	1985	1986	1987	1988	1989	1990	1991	1992
1	145.90	168.63	268.67	110.43	147.79	115.70	68.82	200.61
2	46.49	52.26	59.43	97.54	39.11	53.70	41.22	24.16
3	53.93	25.89	25.76	32.98	54.17	23.53	28.86	22.24
4	33.35	28.61	14.49	15.57	15.06	33.53	14.12	17.57
5	23.22	17.60	17.78	10.27	7.31	9.17	21.14	10.09
6	8.49	14.18	11.63	12.13	4.93	4.84	4.89	14.32
7	2.05	5.17	9.80	7.89	6.16	3.27	2.81	3.01
8	2.23	3.09	7.03	10.28	7.73	5.07	3.18	1.14

AGE	1993	1994	1995	1996	1997	1998	1999	2000
1	66.30	206.45	132.74	118.69	137.83	203.85	67.23	80.68
2	66.79	24.02	74.80	46.97	40.58	45.20	73.21	24.24
3	12.05	37.02	11.85	37.30	19.97	12.12	23.39	37.76
4	12.16	7.16	19.40	6.66	21.77	9.58	6.45	12.87
5	9.56	8.14	4.75	12.56	4.92	12.75	4.46	4.08
6	6.04	5.90	4.93	3.16	7.95	2.90	5.23	2.88
7	8.11	3.94	3.35	3.37	2.12	5.03	1.65	3.47
8	3.15	6.14	5.25	4.78	3.61	1.11	2.17	1.10

AGE	2001	2002	2003	2004	2005
1	104.98	93.87	144.01	365.34	117.94
2	29.42	37.42	34.02	52.10	133.04
3	15.39	12.41	21.22	18.67	32.18
4	26.11	6.80	7.58	12.51	12.53
5	10.01	13.56	4.73	5.10	9.46
6	3.20	5.37	9.58	3.24	3.90
7	2.29	1.79	3.86	6.69	2.50
8	1.97	1.53	2.48	0.36	5.36

x 10 ^ 6

Table 7.6.11 Irish Sea herring VIIa(N). Weighting factors in number. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Weighting factors for the catches in number

AGE	1999	2000	2001	2002	2003	2004
1	0.1000	0.1000	0.1000	0.1000	0.1000	0.1000
2	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
7	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 7.6.12 Irish Sea herring VIIa(N). Predicted SSB Index values. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Predicted SSB Index Values

	1993	1994	1995	1996	1997	1998	1999	2000
1	21817.	24312.	26546.	22287.	19261.	21885.	22252.	24689.

	2001	2002	2003	2004
1	15865.	19081.	19479.	28285.

x 10 ^ -3

Table 7.6.13 Irish Sea herring VIIa(N). Predicted age-structured Index values. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Predicted Age-Structured Index Values

AGE	1994	1995	1996	1997	1998	1999	2000	2001
1	224.90	142.07	123.78	139.32	220.60	72.97	88.32	112.98
2	44.20	138.80	77.34	51.27	86.22	139.32	53.92	48.16
3	47.74	16.10	52.15	24.10	15.81	31.29	59.96	17.46
4	8.51	22.65	8.59	23.57	8.74	7.41	17.24	25.85
5	8.00	5.01	12.75	4.74	9.35	4.60	4.87	8.98
6	5.11	4.91	3.11	7.48	2.52	5.09	3.21	2.74
7	2.11	1.89	1.89	1.04	2.42	0.92	2.26	1.10
8	5.52	4.97	4.49	2.97	0.89	2.04	1.20	1.59

AGE	2002	2003	2004
1	102.28	156.69	399.50
2	76.47	67.83	113.50
3	17.95	29.88	28.98
4	8.37	9.11	16.41
5	14.95	5.09	5.97
6	5.56	9.71	3.54
7	1.07	2.26	4.28
8	1.54	2.43	0.42

x 10 ^ 3

Table 7.6.14 Irish Sea herring VIIa(N). Fitted selection pattern. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

Fitted Selection Pattern

AGE	1961	1962	1963	1964	1965	1966	1967	1968
1	0.1502	0.0324	0.0729	0.0335	0.0080	0.0117	0.0581	0.0063
2	0.6806	2.8772	0.9654	1.9518	0.3497	1.4040	1.2441	0.6913
3	0.4164	2.2847	0.6814	4.1721	0.5151	1.7560	1.0454	0.5633
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	0.2062	2.2332	1.0331	0.9773	0.3891	1.4187	1.0768	0.1823
6	0.9469	0.4578	0.9497	2.0347	1.0000	1.4187	0.8725	0.5555
7	0.6698	1.7567	0.9497	1.0000	0.6733	1.4187	1.0000	1.0000
8	0.6698	1.7567	0.9497	1.0000	0.6733	1.4187	1.0000	1.0000

AGE	1969	1970	1971	1972	1973	1974	1975	1976
1	0.0143	0.0345	0.0618	0.3116	0.2491	0.2128	0.1845	0.2085
2	0.6999	0.5605	0.9095	0.6781	0.8221	0.8203	0.9111	0.7194
3	0.8042	0.7071	0.9747	0.9794	1.4675	1.0077	1.0990	0.8859
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	0.5989	1.3668	0.4370	1.1485	1.2561	0.7537	1.1572	0.8287
6	0.9550	0.8991	0.6488	1.1887	1.0107	0.7951	0.8289	0.9046
7	0.8285	0.9337	0.7960	1.0259	1.1241	0.8851	1.0127	0.8843
8	0.8285	0.9337	0.7960	1.0259	1.1241	0.8851	1.0127	0.8843

AGE	1977	1978	1979	1980	1981	1982	1983	1984
1	0.1591	0.1135	0.1715	0.0690	0.0569	0.0779	0.0445	0.0994
2	0.8624	0.5872	0.9033	1.2123	0.6303	0.5961	0.9384	0.8588
3	1.0021	1.0116	1.0415	1.5047	0.5848	0.5944	0.7620	1.2233
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.0847	0.7287	0.9225	1.2504	0.8619	0.2841	0.7149	1.5203
6	0.7515	1.1061	1.1915	0.8493	0.7311	1.1436	1.2709	1.1107
7	0.9526	0.9058	1.0342	1.1695	0.7798	0.7468	0.9650	1.1664
8	0.9526	0.9058	1.0342	1.1695	0.7798	0.7468	0.9650	1.1664

AGE	1985	1986	1987	1988	1989	1990	1991	1992
1	0.0494	0.1142	0.0539	0.0579	0.0314	0.0888	0.1983	0.1964
2	0.5297	1.0852	1.1821	0.4398	0.5250	0.8888	1.3419	0.7781
3	0.8049	1.0117	1.2421	0.8908	0.7055	0.8609	1.2543	0.7948
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	0.7292	0.8368	1.1571	0.9667	0.7894	1.4647	1.2247	0.8118
6	0.7349	0.7185	1.1782	0.8808	0.7820	1.2334	1.6318	0.9225
7	0.7723	0.9381	1.1719	0.8538	0.7771	1.1235	1.3239	0.8800
8	0.7723	0.9381	1.1719	0.8538	0.7771	1.1235	1.3239	0.8800

AGE	1993	1994	1995	1996	1997	1998	1999	2000
1	0.0515	0.0489	0.1159	0.3631	0.2640	0.0362	0.0568	0.0568
2	0.9630	1.3080	1.1816	2.7498	2.0855	0.5402	1.0146	1.0146
3	1.0626	1.4352	1.1245	1.6760	1.2276	0.6489	1.1124	1.1124
4	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
5	1.2704	1.2893	0.9176	1.7708	0.9863	1.1908	0.9427	0.9427
6	1.0840	1.5029	0.8402	1.4825	0.8215	0.7003	0.8725	0.8725
7	1.0989	1.3339	1.0224	1.7589	1.2294	0.8363	1.0000	1.0000
8	1.0989	1.3339	1.0224	1.7589	1.2294	0.8363	1.0000	1.0000

Table 7.6.14 Irish Sea herring VIIa(N). Fitted selection pattern. Continued.

Fitted Selection Pattern

AGE	2001	2002	2003	2004
1	0.0568	0.0568	0.0568	0.0568
2	1.0146	1.0146	1.0146	1.0146
3	1.1124	1.1124	1.1124	1.1124
4	1.0000	1.0000	1.0000	1.0000
5	0.9427	0.9427	0.9427	0.9427
6	0.8725	0.8725	0.8725	0.8725
7	1.0000	1.0000	1.0000	1.0000
8	1.0000	1.0000	1.0000	1.0000

Table 7.6.15 Irish Sea herring VIIa(N). Stock summary. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

STOCK SUMMARY

Year	Recruits Age 1 thousands	Total Biomass tonnes	Spawning Biomass tonnes	Landings tonnes	Yield /SSB ratio	Mean F Ages 2- 6	SoP (%)
1961	66450	19054	5239	5710	1.0898	0.4902	99
1962	53110	12485	3126	4343	1.3889	0.6222	100
1963	128490	15847	2368	3947	1.6662	0.7755	100
1964	224150	25724	2580	3593	1.3924	0.6473	99
1965	122860	23345	5278	5923	1.1220	0.8885	99
1966	368190	49211	6067	5666	0.9338	0.4844	99
1967	355210	61469	8844	8721	0.9861	0.3595	99
1968	563830	90006	23102	8660	0.3748	0.2732	100
1969	376900	87669	31545	14141	0.4483	0.3150	99
1970	482190	114059	36942	20622	0.5582	0.4866	100
1971	498460	118793	35282	26807	0.7598	0.5039	100
1972	414060	93308	33754	27350	0.8103	0.5330	112
1973	667440	106669	31310	22600	0.7218	0.4654	100
1974	349040	92531	28883	38640	1.3378	0.8802	99
1975	368540	68909	21234	24500	1.1538	0.8251	102
1976	262670	54389	13383	21250	1.5878	0.9566	99
1977	322830	49155	9110	15410	1.6915	0.9359	95
1978	246690	43164	9937	11080	1.1149	0.8130	92
1979	137190	34839	8351	12338	1.4774	0.8495	92
1980	152450	28272	5946	10613	1.7849	1.0479	97
1981	213720	29281	8184	4377	0.5348	0.5079	90
1982	224800	36540	11580	4855	0.4193	0.3386	98
1983	226380	42691	15488	3933	0.2539	0.1930	98
1984	128220	41374	19569	4066	0.2078	0.1667	96
1985	145900	40669	14526	9187	0.6324	0.4097	102
1986	168630	37694	15636	7440	0.4758	0.3494	97
1987	268660	39604	15056	5823	0.3867	0.2816	103
1988	110430	36056	15203	10172	0.6691	0.5475	105
1989	147790	33250	13010	4949	0.3804	0.3016	100
1990	115700	30310	11818	6312	0.5341	0.3933	101
1991	68810	22535	8775	4398	0.5012	0.3050	100
1992	200600	25404	7749	5270	0.6801	0.4379	101
1993	66300	23404	8578	4409	0.5140	0.3242	101
1994	206440	29753	9559	4828	0.5050	0.4063	102
1995	132740	27073	10437	5076	0.4863	0.3392	99
1996	118680	24476	8763	5301	0.6049	0.3505	100
1997	137820	23692	7573	6651	0.8782	0.5330	100
1998	203850	27851	8605	4905	0.5700	0.5421	100
1999	67230	20480	8749	4127	0.4717	0.3527	99
2000	80670	18121	9707	2002	0.2062	0.1500	100
2001	104980	19349	6238	5461	0.8754	0.5486	99
2002	93860	19231	7502	2393	0.3190	0.2603	100
2003	144000	23357	7659	2399	0.3132	0.2922	99
2004	365340	38034	11121	2531	0.2276	0.1770	100

No of years for separable analysis : 6
Age range in the analysis : 1 . . . 8
Year range in the analysis : 1961 . . . 2004
Number of indices of SSB : 1
Number of age-structured indices : 1

Parameters to estimate : 32
Number of observations : 142

Conventional single selection vector model to be fitted.

Table 7.6.16 Irish Sea herring VIIa(N). Parameter estimates. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

PARAMETER ESTIMATES

Parm. No.		Maximum Likelh. Estimate	CV (%)	Lower 95% CL	Upper 95% CL	-s.e.	+s.e.	Mean of Param. Distrib.
Separable model : F by year								
1	1999	0.3568	24	0.2216	0.5746	0.2798	0.4550	0.3675
2	2000	0.1517	24	0.0938	0.2454	0.1187	0.1939	0.1564
3	2001	0.5550	23	0.3516	0.8761	0.4397	0.7006	0.5703
4	2002	0.2634	26	0.1582	0.4386	0.2030	0.3417	0.2725
5	2003	0.2957	27	0.1734	0.5042	0.2252	0.3882	0.3068
6	2004	0.1791	29	0.0999	0.3211	0.1330	0.2412	0.1872
Separable Model: Selection (S) by age								
7	1	0.0568	58	0.0179	0.1799	0.0315	0.1023	0.0675
8	2	1.0146	24	0.6265	1.6430	0.7934	1.2975	1.0457
9	3	1.1124	22	0.7135	1.7345	0.8868	1.3953	1.1413
	4	1.0000	Fixed : Reference Age					
10	5	0.9427	20	0.6335	1.4028	0.7696	1.1547	0.9623
11	6	0.8725	20	0.5864	1.2981	0.7124	1.0686	0.8906
	7	1.0000	Fixed : Last true age					
Separable model: Populations in year 2004								
12	1	365343	123	32548	4100874	106389	1254600	782025
13	2	52095	40	23394	116003	34626	78375	56626
14	3	18670	33	9602	36301	13298	26211	19776
15	4	12504	29	6965	22446	9277	16853	13074
16	5	5103	28	2899	8982	3824	6809	5319
17	6	3235	28	1837	5695	2424	4317	3372
18	7	6693	28	3810	11756	5021	8921	6975
Separable model: Populations at age								
19	1999	1646	42	718	3771	1078	2512	1800
20	2000	3464	34	1765	6799	2456	4887	3675
21	2001	2285	28	1302	4007	1715	3043	2380
22	2002	1784	31	971	3279	1308	2434	1872
23	2003	3858	28	2191	6793	2890	5149	4022

SSB Index catchabilities
NINEL
Linear model fitted. Slopes at age :

24	1	Q	.2543E-02	13	.2227E-02	.3830E-02	.2543E-02	.3354E-02	.2949E-02

Age-structured index catchabilities
FLT01: Northern Ireland acoustic survey

Linear model fitted. Slopes at age :

25	1	Q	2.333	109	.8172	59.20	2.333	20.74	12.63
26	2	Q	3.127	35	2.227	8.900	3.127	6.339	4.739
27	3	Q	2.094	35	1.492	5.954	2.094	4.242	3.172
28	4	Q	1.618	35	1.152	4.610	1.618	3.282	2.453
29	5	Q	1.431	35	1.016	4.116	1.431	2.922	2.179
30	6	Q	1.326	36	.9363	3.876	1.326	2.737	2.034
31	7	Q	.7877	37	.5519	2.359	.7877	1.653	1.222
32	8	Q	1.321	36	.9326	3.866	1.321	2.729	2.028

Table 7.6.17 Irish Sea herring VIIa(N). Residuals about the model fit. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals

Age	1999	2000	2001	2002	2003	2004
1	0.751	1.026	0.273	-1.595	-0.782	0.322
2	-0.135	0.221	0.033	0.167	-0.492	0.162
3	-0.164	0.097	0.097	-0.416	-0.483	0.567
4	-0.165	0.179	0.205	0.218	0.324	0.101
5	0.194	0.073	-0.141	-0.172	-0.218	-0.193
6	0.399	0.018	-0.227	-0.098	0.350	-0.739
7	-0.061	-0.616	-0.359	0.184	-0.078	-0.441

SPAWNING BIOMASS INDEX RESIDUALS

NINEL

	1993	1994	1995	1996	1997	1998	1999	2000
1	0.563	1.075	-0.564	-1.556	0.413	-1.328	-0.287	0.363

	2001	2002	2003	2004
1	1.249	0.501	-0.209	-0.220

AGE-STRUCTURED INDEX RESIDUALS

Age	1994	1995	1996	1997	1998	1999	2000	2001
1	-1.214	0.809	-2.390	-0.038	-0.692	0.771	-0.118	1.233
2	0.435	-0.523	-0.602	-0.026	-1.150	-0.584	0.652	0.662
3	0.432	-0.299	0.258	-0.487	-0.671	0.083	0.563	-0.538
4	0.331	0.256	0.042	-0.764	0.059	-0.372	0.468	-0.391
5	0.150	-0.091	0.730	-0.995	-0.367	0.801	0.505	-0.153
6	0.390	-0.339	0.295	-0.496	-0.347	0.976	0.525	-0.692
7	0.605	0.949	1.142	-0.597	-0.072	0.543	0.774	-0.565
8	0.607	0.326	0.259	-0.440	-0.137	1.128	0.677	0.350

Age	2002	2003	2004
1	1.341	0.801	-0.505
2	-0.061	1.177	0.018
3	0.568	0.068	0.021
4	1.086	-0.655	-0.064
5	0.738	-0.261	-1.061
6	0.982	-0.865	-0.432
7	0.945	-0.838	-2.889
8	1.067	-0.988	-2.852

Table 7.6.18 Irish Sea herring VIIa(N). Residuals about the model fit. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

```
PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES AT AGE)
 ----------------------------------------------------

 Separable model fitted from 1999  to 2004
 Variance                            0.1952
Skewness test stat.                 -2.0041
Kurtosis test statistic             -0.3386
Partial chi-square                   0.5201
Significance in fit                  0.0000
Degrees of freedom                       19


 PARAMETERS OF DISTRIBUTIONS OF THE SSB INDICES
 ----------------------------------------------


   DISTRIBUTION STATISTICS FOR   NINEL


 Linear catchability relationship assumed
 Last age is a plus-group

 Variance                            0.7512
Skewness test stat.                 -0.5621
Kurtosis test statistic             -0.4976
Partial chi-square                   2.7174
Significance in fit                  0.0060
Number of observations                   12
Degrees of freedom                       11
Weight in the analysis               1.0000

 PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES
 ------------------------------------------------------------


   DISTRIBUTION STATISTICS FOR FLT01: Northern Ireland acoustic survey


 Linear catchability relationship assumed
```

Age	1	2	3	4	5	6	7	8
Variance	0.0164	0.0592	0.0246	0.0361	0.0543	0.0541	0.1761	0.1606
Skewness test stat.	-0.9533	0.0870	-0.2257	0.5496	-0.4018	0.4224	-1.7882	-2.0435
Kurtosis test statisti	-0.2277	-0.5744	-0.8910	-0.2231	-0.7196	-0.8947	0.7553	1.1435
Partial chi-square	0.0139	0.0528	0.0244	0.0385	0.0618	0.0634	0.2220	0.2459
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	11	11	11	11	11	11	11	11
Degrees of freedom	10	10	10	10	10	10	10	10
Weight in the analysis	0.0125	0.1250	0.1250	0.1250	0.1250	0.1250	0.1250	0.1250

Table 7.6.19 Irish Sea herring VIIa(N). Analyses of variance. N.B. In this table "age" refers to number of rings (winter rings in the otolith).

ANALYSIS OF VARIANCE

Unweighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	74.7798	142	32	110	0.6798
Catches at age	8.1634	42	23	19	0.4297
SSB Indices					
NINEL	8.2628	12	1	11	0.7512
Aged Indices					
FLT01: Northern Ireland acoustic surve	58.3536	88	8	80	0.7294

Weighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	12.6800	142	32	110	0.1153
Catches at age	3.7088	42	23	19	0.1952
SSB Indices					
NINEL	8.2628	12	1	11	0.7512
Aged Indices					
FLT01: Northern Ireland acoustic surve	0.7084	88	8	80	0.0089

Table 7.7.1. Irish Sea herring VIIa(N). Input data for short-term predictions. Recruitment is geometric mean 1980-2002, weights at age and maturity data are averages for the last three preceding years.

MFDP version 1
Run: TACconst
Time and date: 14:49 14/04/2005
Fbar age range: 2-6

2005

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	136.04	1	8.13E-02	0.9	0.75	77.66667	0.0102	79.66667
2	50	0.3	0.893333	0.9	0.75	114.3333	0.1817	112
3	32.18	0.2	0.956667	0.9	0.75	141.3333	0.1992	136.6667
4	12.53	0.1	0.983333	0.9	0.75	162.6667	0.1791	161.3333
5	9.46	0.1	1	0.9	0.75	172.3333	0.1688	170.6667
6	3.9	0.1	1	0.9	0.75	182.6667	0.1563	181
7	2.5	0.1	1	0.9	0.75	193	0.1791	192.3333
8	5.36	0.1	1	0.9	0.75	207	0.1791	207

2006

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	136.04	1	8.13E-02	0.9	0.75	77.66667	0.0102	79.66667
2	.	0.3	0.893333	0.9	0.75	114.3333	0.1817	112
3	.	0.2	0.956667	0.9	0.75	141.3333	0.1992	136.6667
4	.	0.1	0.983333	0.9	0.75	162.6667	0.1791	161.3333
5	.	0.1	1	0.9	0.75	172.3333	0.1688	170.6667
6	.	0.1	1	0.9	0.75	182.6667	0.1563	181
7	.	0.1	1	0.9	0.75	193	0.1791	192.3333
8	.	0.1	1	0.9	0.75	207	0.1791	207

2007

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
1	136.04	1	8.13E-02	0.9	0.75	77.66667	0.0102	79.66667
2	.	0.3	0.893333	0.9	0.75	114.3333	0.1817	112
3	.	0.2	0.956667	0.9	0.75	141.3333	0.1992	136.6667
4	.	0.1	0.983333	0.9	0.75	162.6667	0.1791	161.3333
5	.	0.1	1	0.9	0.75	172.3333	0.1688	170.6667
6	.	0.1	1	0.9	0.75	182.6667	0.1563	181
7	.	0.1	1	0.9	0.75	193	0.1791	192.3333
8	.	0.1	1	0.9	0.75	207	0.1791	207

Input units are millions and grams - output in tonnes

Table 7.7.2. Irish Sea herring VIIa(N). TAC constraint in 2005, management table.

MFDP version 1
Run: TACconst
Index file for VIIaN herring
Time and date: 14:49 14/04/2005
Fbar age range: 2-6

2005 Biomass	SSB	FMult	FBar	Landings
26803	9827	2.1021	0.3721	4800

2006 Biomass	SSB	FMult	FBar	Landings	2007 Biomass	SSB
26497	13569	0.0000	0.0000	0	31211	17745
.	13355	0.1000	0.0177	264	30936	17224
.	13145	0.2000	0.0354	523	30666	16720
.	12938	0.3000	0.0531	778	30400	16232
.	12734	0.4000	0.0708	1029	30140	15759
.	12534	0.5000	0.0885	1275	29884	15302
.	12337	0.6000	0.1062	1517	29632	14858
.	12143	0.7000	0.1239	1756	29385	14429
.	11953	0.8000	0.1416	1990	29142	14013
.	11765	0.9000	0.1593	2220	28904	13611
.	11581	1.0000	0.1770	2446	28670	13221
.	11399	1.1000	0.1947	2668	28440	12843
.	11221	1.2000	0.2124	2887	28214	12477
.	11045	1.3000	0.2301	3102	27992	12122
.	10872	1.4000	0.2478	3313	27774	11779
.	10702	1.5000	0.2655	3520	27560	11446
.	10535	1.6000	0.2832	3725	27349	11124
.	10370	1.7000	0.3009	3925	27142	10812
.	10208	1.8000	0.3186	4123	26939	10509
.	10049	1.9000	0.3363	4317	26740	10216
.	9893	2.0000	0.3540	4507	26544	9932

Input units are millions and grams - output in tonnes

Table 7.7.3. Irish Sea herring VIIa(N). $F_{status\ quo}$ in 2005, management table.

MFDP version 1
Run: Fstq
Index file for VIIaN herring
Time and date: 15:16 14/04/2005
Fbar age range: 2-6

2005				
Biomass	SSB	FMult	FBar	Landings
26803	11708	1	0.177	2500

2006					2007	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
28874	15667	0	0	0	33463	19817
.	15419	0.1	0.0177	303	33147	19227
.	15176	0.2	0.0354	601	32837	18656
.	14936	0.3	0.0531	895	32532	18104
.	14700	0.4	0.0708	1183	32233	17569
.	14468	0.5	0.0885	1466	31939	17051
.	14239	0.6	0.1062	1744	31651	16549
.	14015	0.7	0.1239	2017	31367	16064
.	13794	0.8	0.1416	2286	31089	15594
.	13576	0.9	0.1593	2550	30815	15138
.	13362	1	0.177	2810	30546	14698
.	13152	1.1	0.1947	3065	30283	14271
.	12945	1.2	0.2124	3316	30023	13857
.	12741	1.3	0.2301	3563	29769	13457
.	12541	1.4	0.2478	3806	29519	13069
.	12344	1.5	0.2655	4044	29273	12694
.	12150	1.6	0.2832	4278	29032	12330
.	11959	1.7	0.3009	4509	28795	11977
.	11772	1.8	0.3186	4735	28562	11636
.	11587	1.9	0.3363	4958	28333	11305
.	11406	2	0.354	5177	28108	10985

Input units are millions and grams - output in tonnes

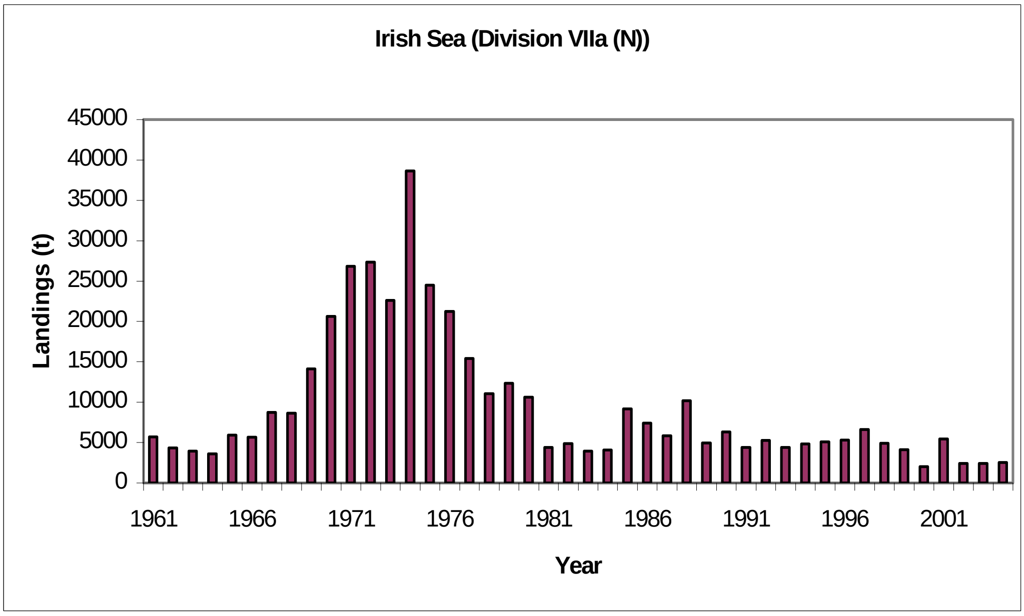


Figure 7.1.1 Irish Sea Herring VIIa(N). Landings of herring from VIIa(N) from 1961 to 2004.

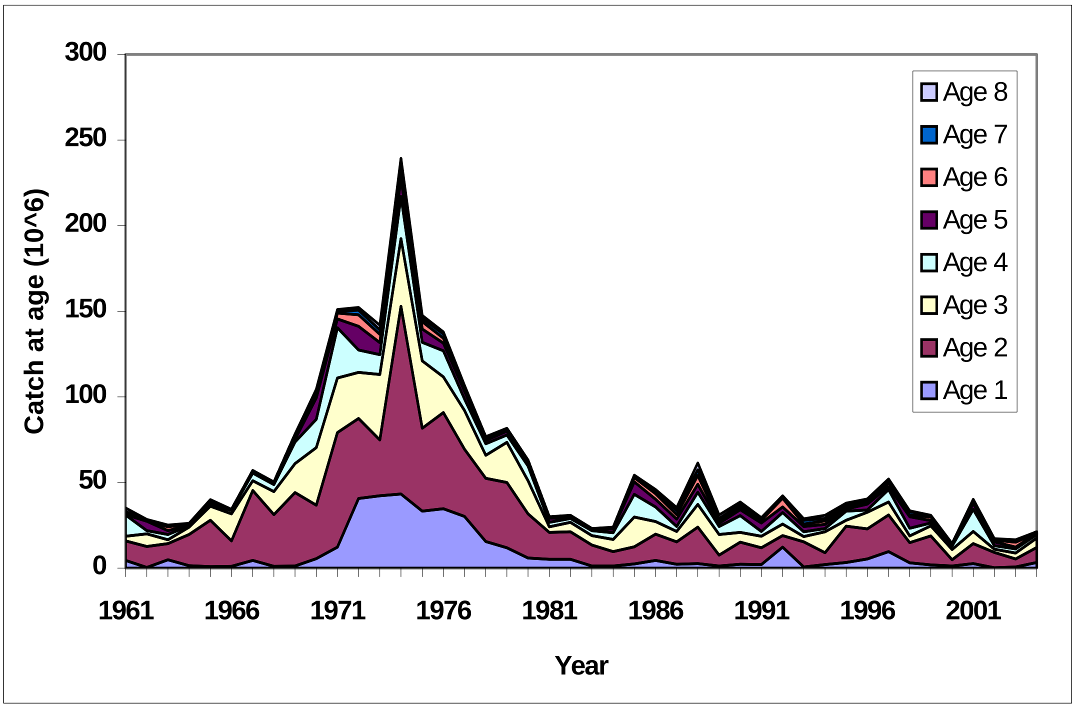


Figure 7.2.1 Irish Sea Herring VIIa(N). Landings (catch-at-age) of herring from VIIa(N) from 1961 to 2004.

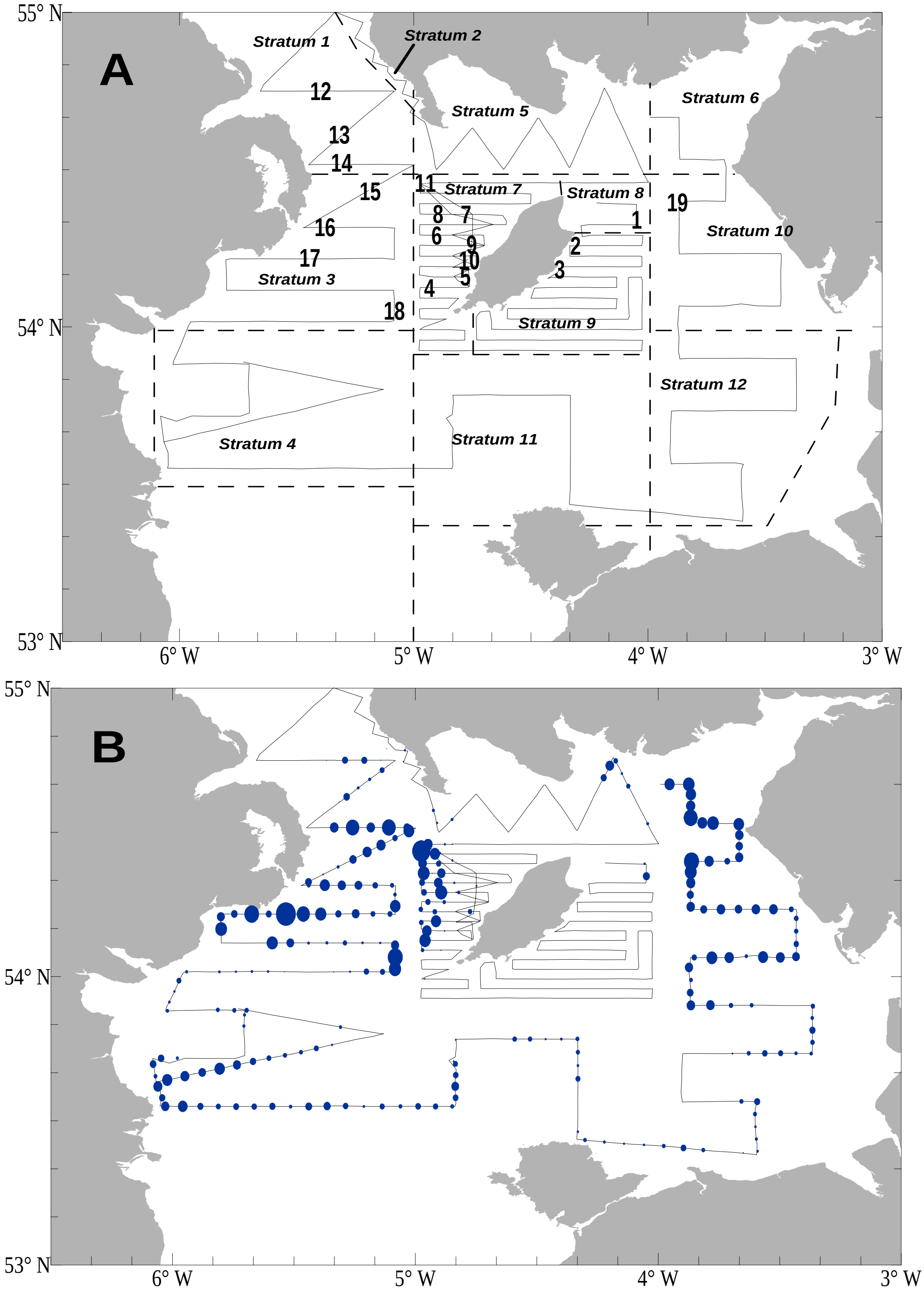


Figure 7.3.1.1 (A) Irish Sea Herring. Transects, stratum boundaries and trawl positions for the September 2004 acoustic survey; (B) Density distribution of sprats (size of ellipses is proportional to square root of the fish density (t n.mile^{-2}) per 15-minute interval). Maximum density was 660 t n.mile^{-2}.

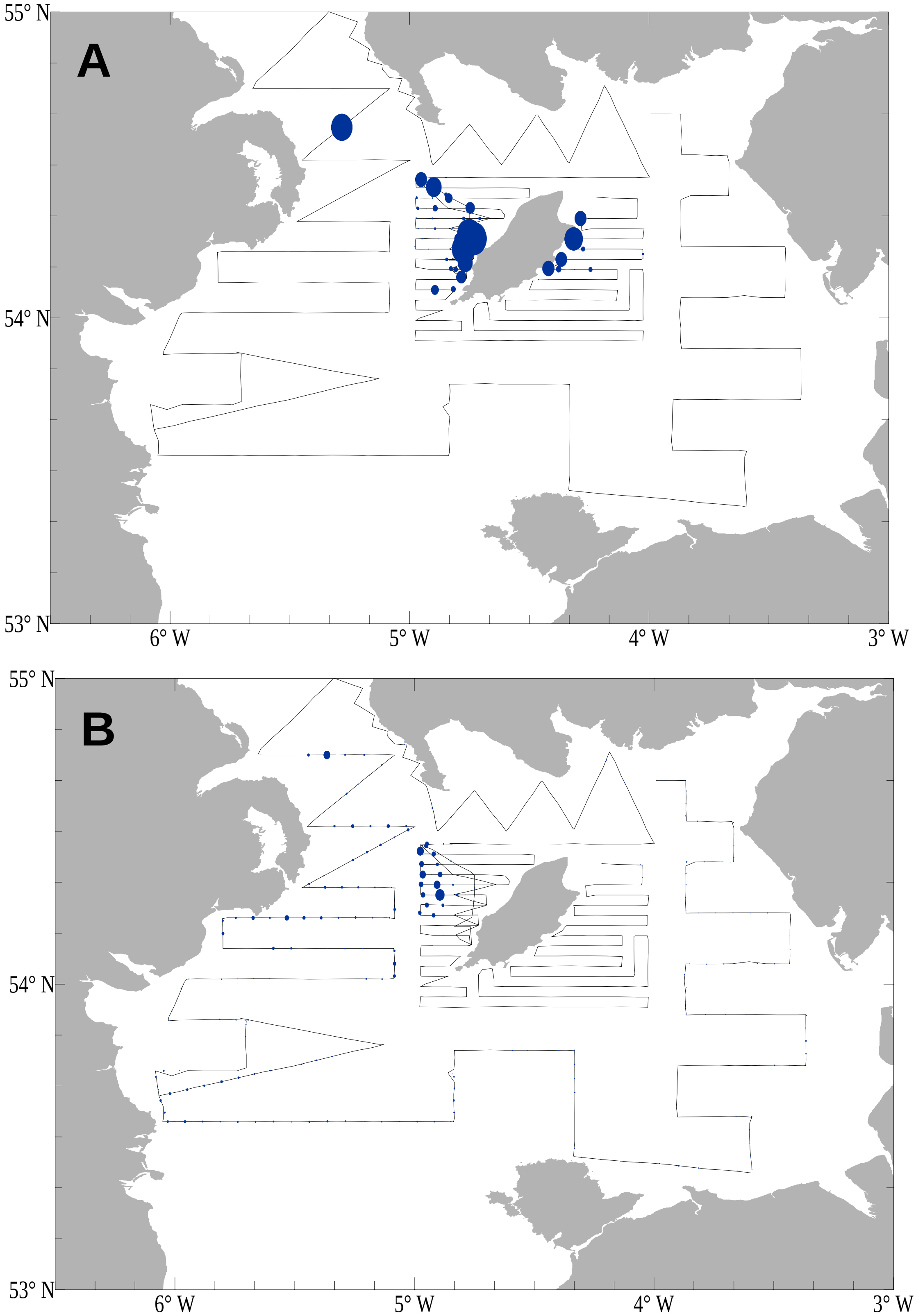


Figure 7.3.1.2 (A) Irish Sea Herring. Density distribution of 1-ring and older herring (size of elipses is proportional to square root of the fish density (t n.mile^{-2}) per 15-minute interval). Maximum density was 1180 t n.mile^{-2}. (B) Density distribution of 0-ring herring. Maximum density was 137 t n.mile^{-2}. Note: same scaling of elipse sizes on Fig. 1 B and Figs 2 A and B.

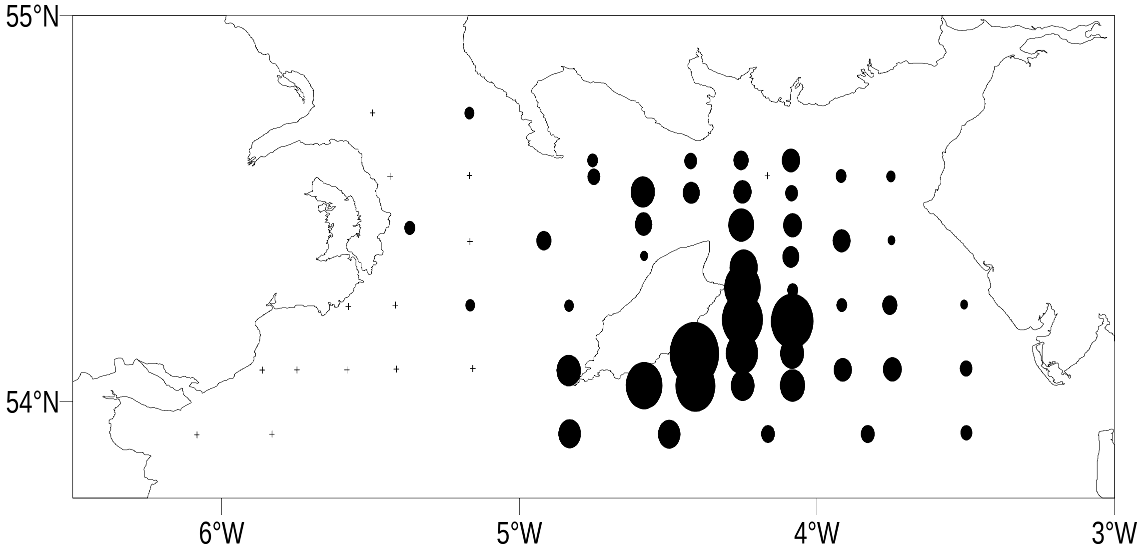


Figure 7.3.2 Irish Sea Herring. Estimates of larval herring abundance in the Northern Irish Sea, 30 October – 3 November 2004. Crosses indicate sampling stations where no herring larvae were caught. Areas of the circles are proportional to herring abundance (maximum abundance = 315 per m²).

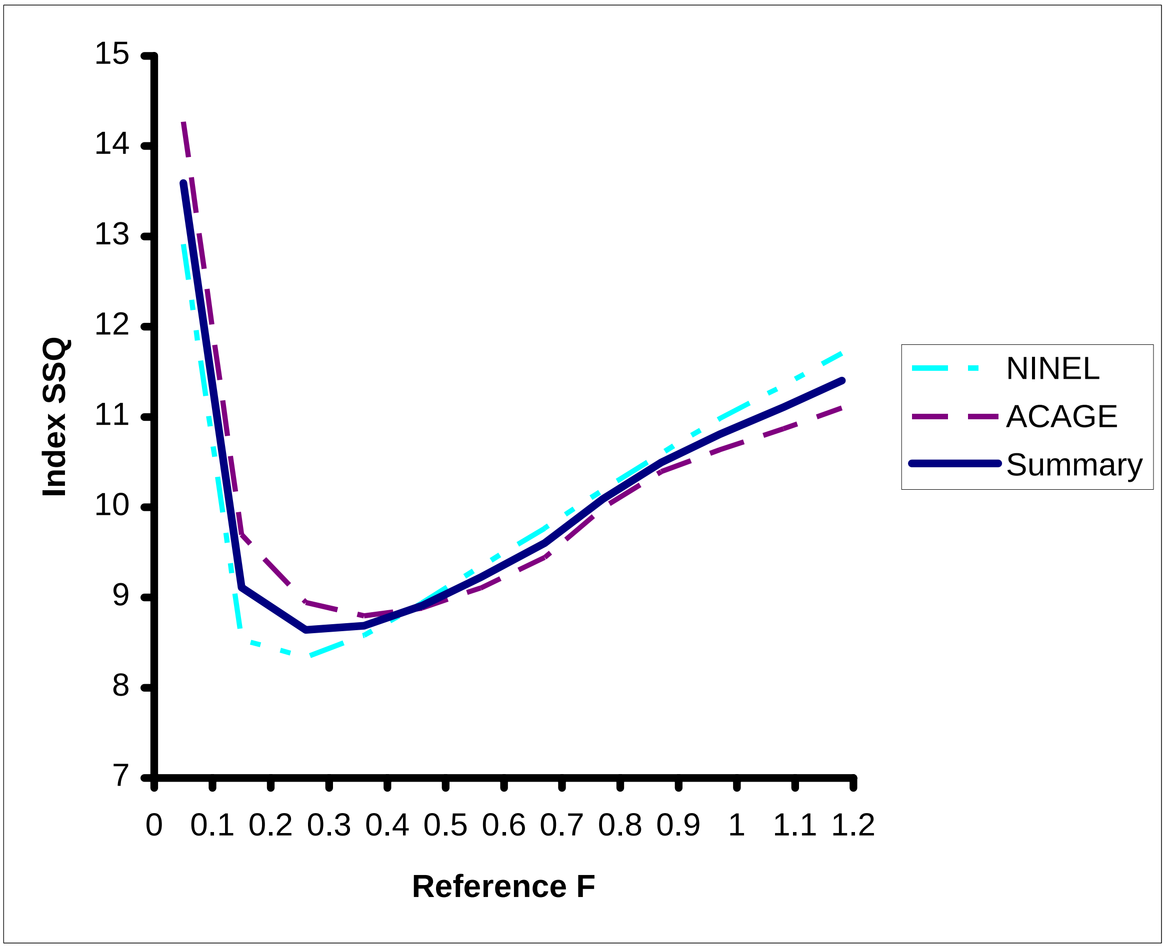


Figure 7.6.1. Irish Sea herring in VIIa(N). SSQ surface for the deterministic calculation of the 6-year separable period. NINEL is the Northern Ireland larvae SSB index and ACAGE is the age-disaggregated acoustic index.

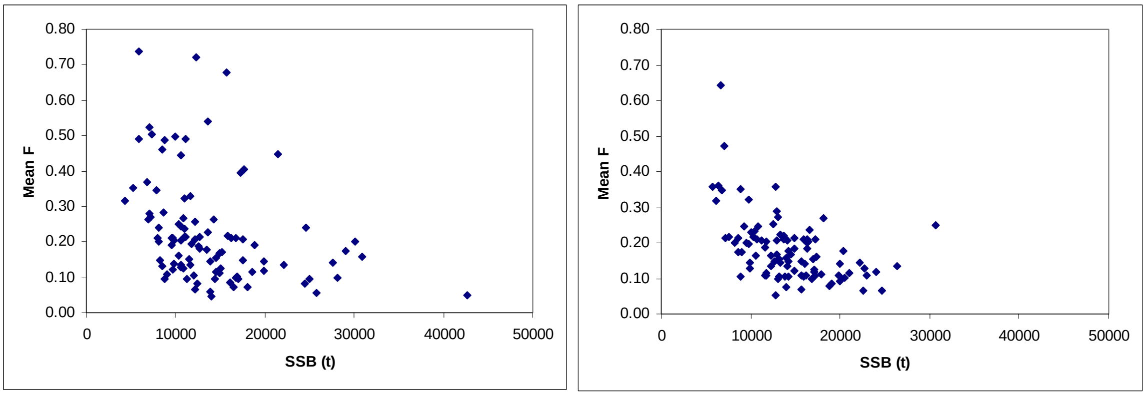


Figure 7.6.2 Irish Sea Herring VIIa(N). Estimates of uncertainty from the ICA bootstrapped mean F and SSB for the Spaly run (left panel) which uses: Larvae production (NINEL and Douglas Bank series) and Acoustic numbers at age (ACAGE); run using only NINEL and ACAGE (right panel).

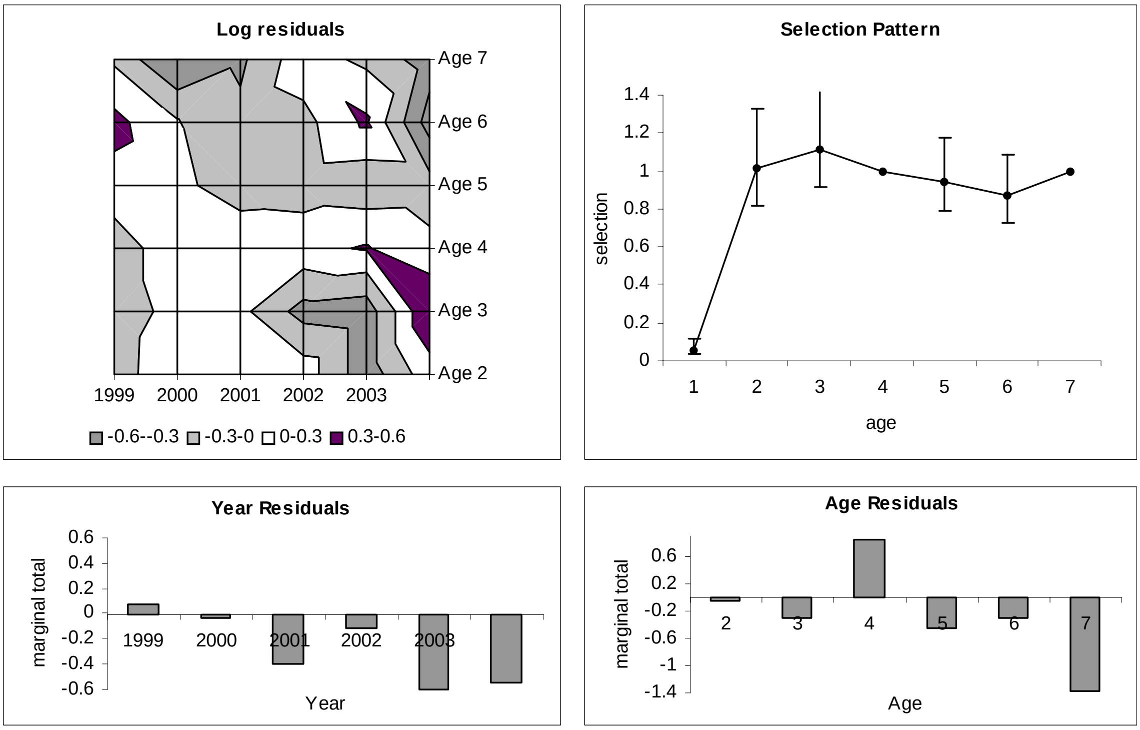


Figure 7.6.3 Irish Sea herring VIIa(N). Selection pattern diagnostics from deterministic calculations (6-year separable period). Top left, a contour plot of selection pattern residuals. Top right, estimated selection (relative to 4-wr)+/- standard deviation. Bottom, marginal totals of residuals by year and ring (ages 2-7 only).

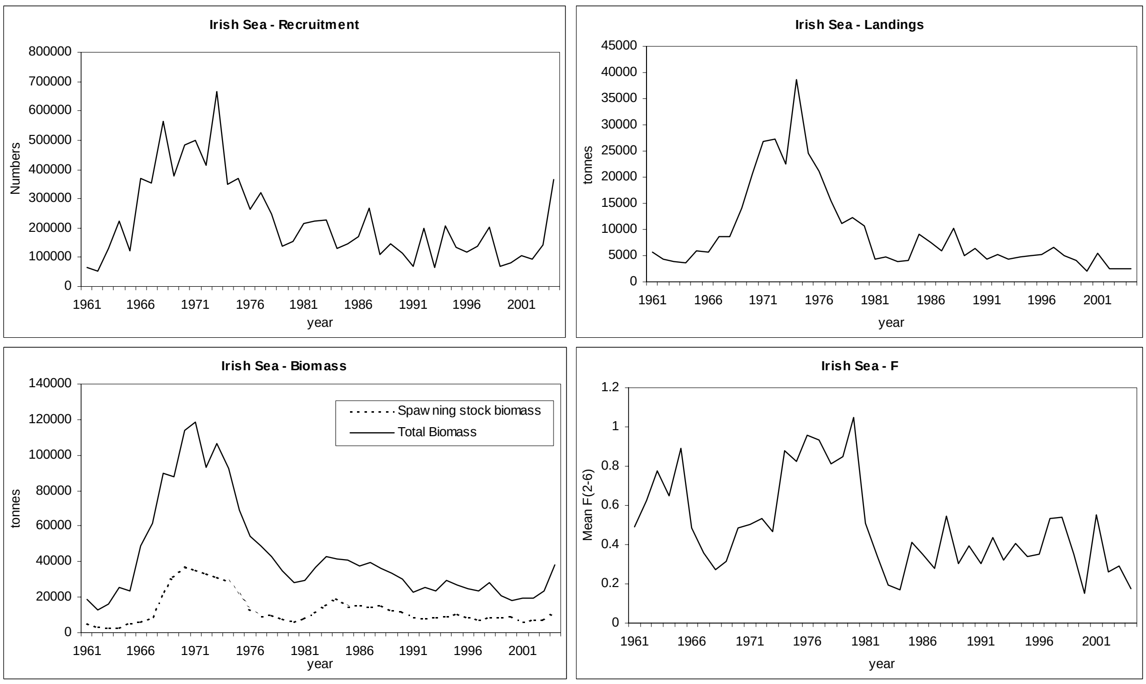


Figure 7.6.4 Irish Sea herring VIIa(N). Illustration of stock trends from deterministic calculation (6-year separable period). Summary of estimates of landings, fishing mortality of 2-6-ring, recruitment at 1-ring, stock size on 1st January and spawning stock at spawning time.

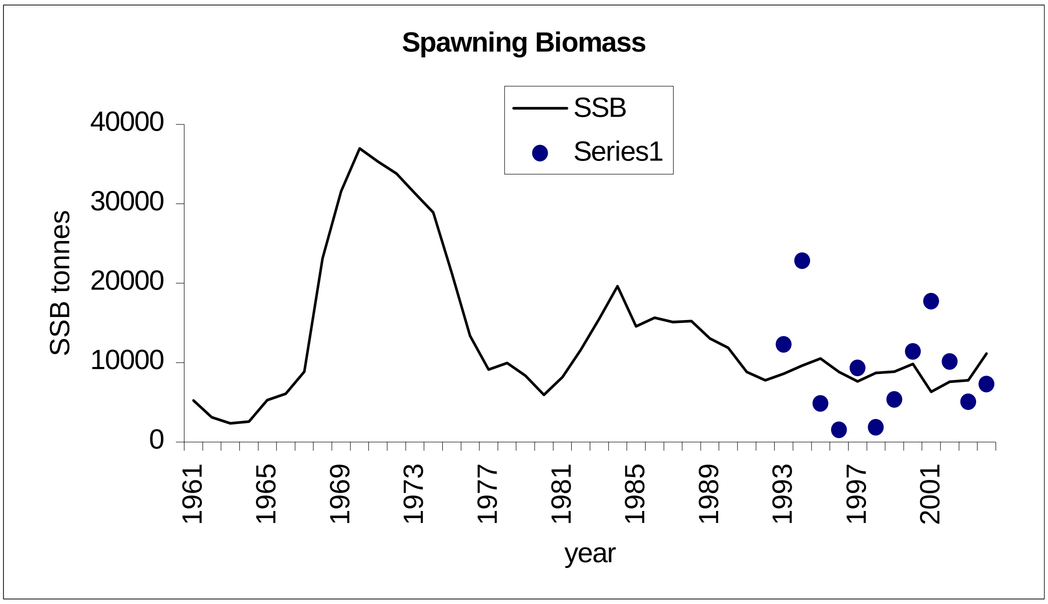


Figure 7.6.5 Irish Sea Herring VIIa(N). ICA predicted SSB and re-scaled larvae index (NINEL).

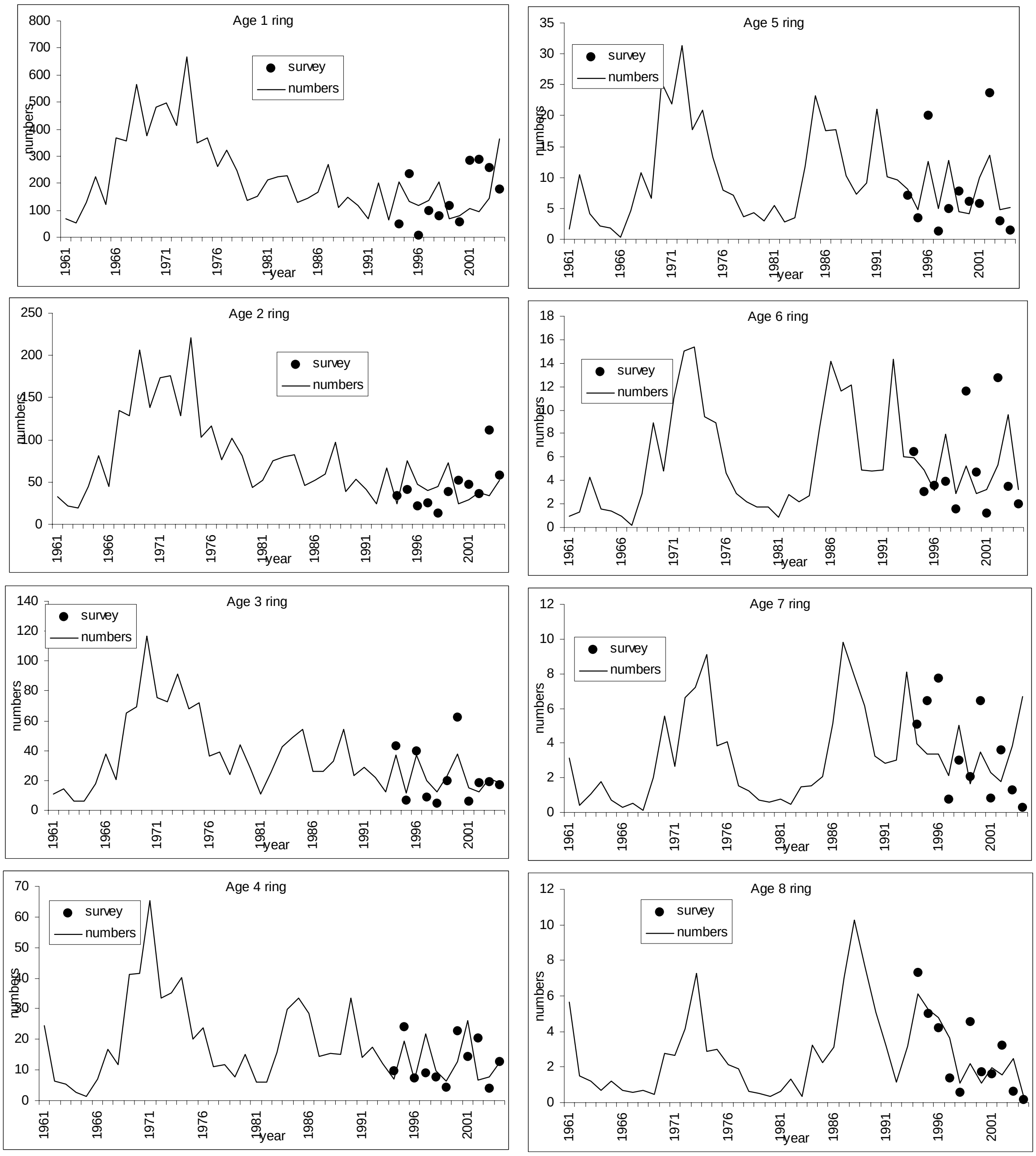


Figure 7.6.6. Irish Sea Herring VIIa(N). Fitted numbers-at-age (line) and predicted numbers from acoustic estimates-at-age and estimated catchability.

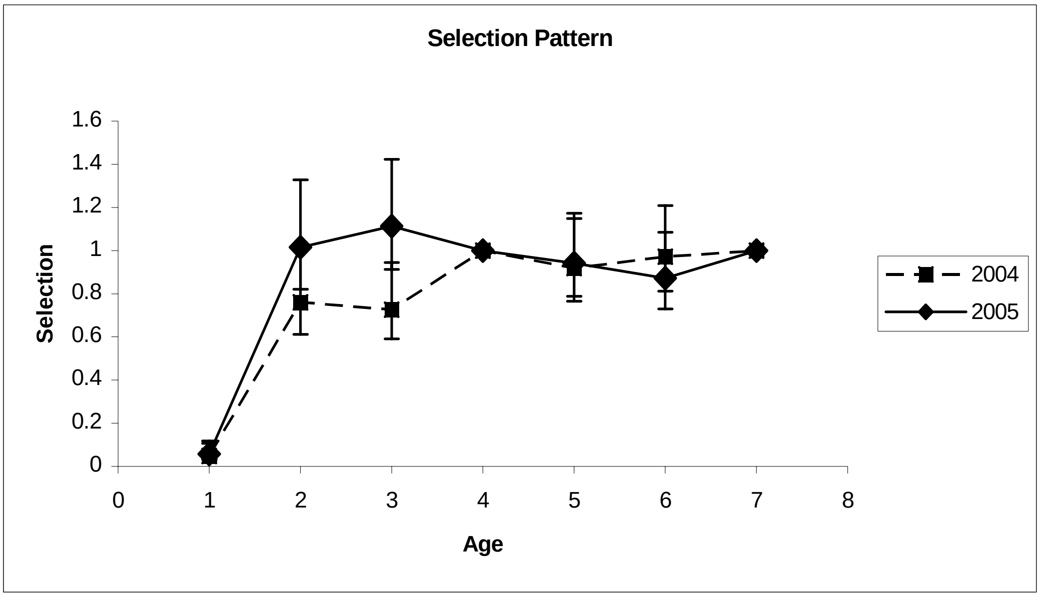
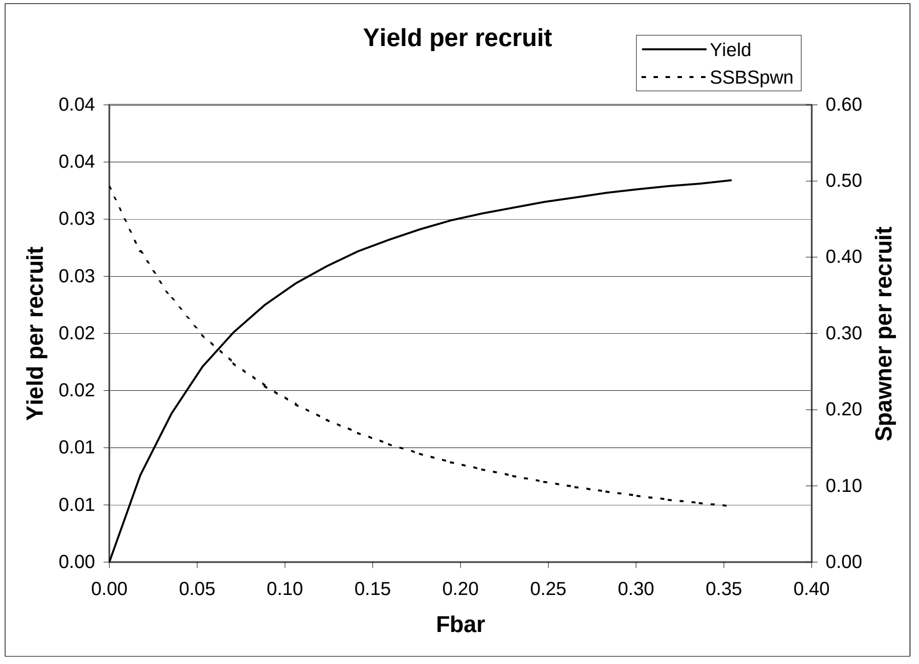
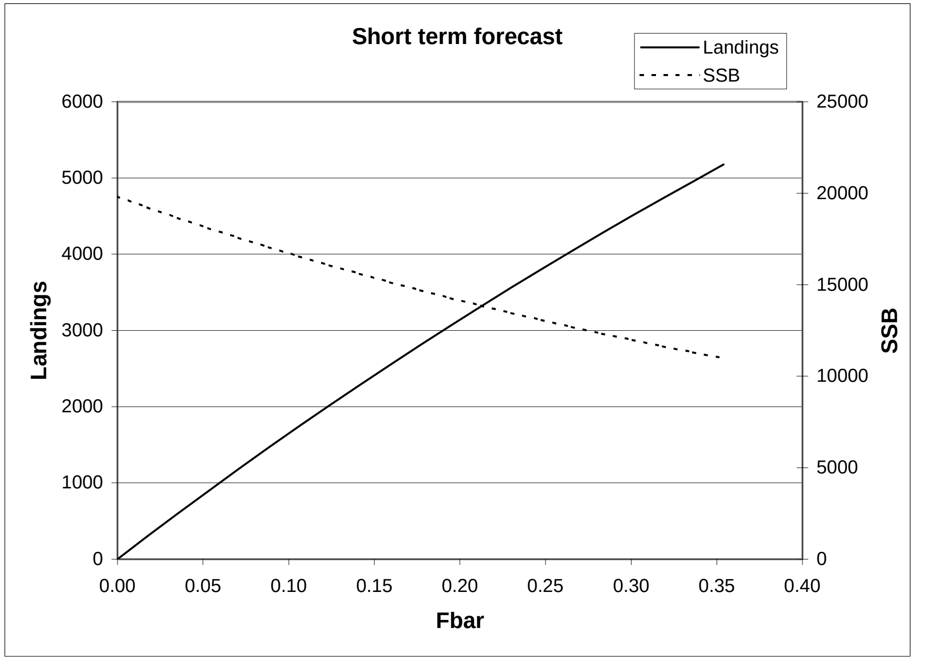


Figure 7.6.7 **Irish Sea herring VIIa(N). Plot showing the selection pattern in two assessments: 2004 assessment (SPALY) and 2005.**





MFYPR version 2a
Run: Fstq14Apr
Time and date: 15:04 14/04/2005

Reference point	F multiplier	Absolute F
Fbar(2-6)	1.0000	0.1770
FMax	>=1000000	
F0.1	0.9257	0.1639
F35%SPR	0.7826	0.1385

Weights in kilograms

MFDP version 1
Run: Fstq
Index file for VIIaN herring
Time and date: 15:16 14/04/2005
Fbar age range: 2-6

Input units are millions and grams - output in tonnes

Figure 7.7.1 Irish Sea herring VIIa(N). Yield-per-recruit and short-term forecast under Fstatus quo in 2005.

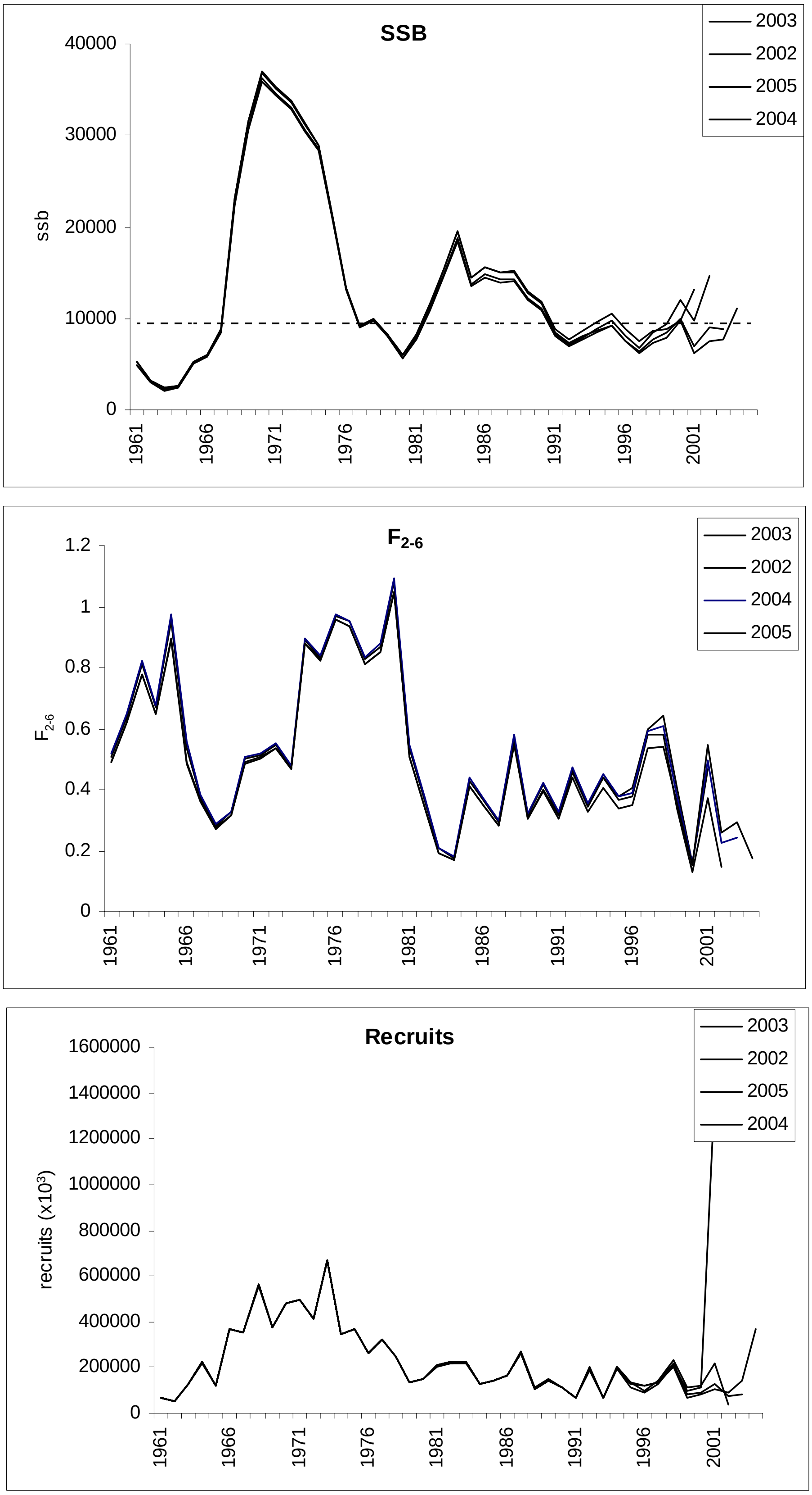


Figure 7.9.1 **Irish Sea Herring VIIaN. Retrospective trends in SSB, fishing mortality ($F_{2\text{-}6}$) and recruitment from ICA tunned with Northern Ireland larvae index (NINEL) and acoustic age – structured (ACAGE).**

8 Sprat in the North Sea

8.1 The Fishery

8.1.1 ACFM advice applicable for 2004 and 2005

ACFM advised that a catch of 257,000 t in 2004 would allow the SSB to remain near or above the long-term average. This was based on the historic relationship between survey and catch. From 2002 to 2005 the TAC set by management for Subarea IV (EU zone) and Division IIa (EU zone) has been 257,000 t.

8.1.2 Total landings in 2004

Landing statistics for sprat for the North Sea by area and country are presented in Table 8.1.1 for 1987–2004. As in previous years, sprats from the fjords of western Norway are not included in the landings for the North Sea. Landings from the fjords are presented separately (Table 8.1.2) due to their uncertain stock identity. Table 8.1.3 shows the landings for 1994–2003 by year, quarter, and area in the North Sea. The Norwegian vessels are not allowed to fish in the 2nd and 3rd quarter in the EU and the Norwegian zone and not allowed to fish in the Norwegian zone until the quota has been taken in the EU-zone.

The landings in 2004 were 194,000 t. This was an increase compared to the landings in 2003 (176,500 t.) and 2002 (143,600 t.). This increase was due to an increase in landings during the 4th quarter by the Danish fleet. Anecdotal information states that in November and December the sprat stock was not as widely spread as in previous years facilitating sprat catches without large by-catches of herring. The Norwegian fishery in 2004 was insignificant. Neither Denmark nor UK (England and Wales) took their quota in 2004. The Danish fishery took all catches in the second and third quarter.

No sprat by-catches were reported in the landings from the Norwegian or the Swedish small-meshed fishery targeted at sandeel and Norway pout.

The quarterly and annual distributions of catches by rectangle for Subarea IV are shown in Figures 8.1.1–8.1.2.

8.2 Biological Composition of the Catch

8.2.1 By-catches in the North Sea sprat fishery

Data on the species composition of the by-catch is given in Table 8.2.1. Only data on by-catch from the Danish fishery were available to the Working Group. In general, more than 80% of the catches consist of sprat and in 2004 close to 90% of the catch consisted of sprat. The amount of herring caught as by-catch in the sprat fishery in 2004 is less than 5% of the total catch. This herring by-catch is the lowest since 1999.

8.2.2 Catches in number

The estimated quarterly catch-at-age in numbers for the years 1995 to 2004 is presented in Table 8.2.2. Denmark provided age composition data of commercial landings in 2004 for third and fourth quarter. The catches in the first quarter was predominantly taken during January and assuming little or no growth during winter, Danish samples from December 2003 were used to raise the catches in quarter 1 2004, only adding a year to the age-groups. For the second quarter age-length keys from July have been applied to the actual length distributions. Danish samples were used to raise the catches from Norway, England and Wales.

1-ringer sprat dominates the catches over all the years although the relative importance does vary with year. 0-ringer sprat catches in 2004 were only slightly lower compared to 2003, however still being slightly above the average for the whole time period. The majority of the total sprat catches are taken during the fourth quarter.

8.2.3 Quality of catch and biological data

The sampling intensity for biological samples, i.e., age and weight-at-age, is given in Table 8.2.4. The sampling level in 2004 is lower than in previous years. In Denmark the provisions in the EU regulation 1639/2001 have been implemented. This provision requires 1 sample per 2000 tonnes landed. This sampling level is lower than the guidelines (1 sample per 1000 tonnes) previously used by the HAWG, but as the fishery was carried out in a limited area and a limited season, the recommended sampling level can be regarded as adequate.

The Danish monitoring schemes for management purposes for species composition in the Danish small-meshed fisheries has worked well in 2004. A total of 834 samples were collected from landings taken in the North Sea by Danish vessels. The sampling figure for 2003 was 900 samples. The total landings from the Danish small mesh fishery in 2004 were 531,924 t (all species) compared to 506,000 t in 2003. This small increase is mainly due to changes in the sandeel fishery. The recommended sampling levels for species composition were achieved. The species composition in the Danish sprat fishery is shown in Table 8.2.1.

8.3 Fishery-independent information

The acoustic surveys for the North Sea Herring in June-July have estimated sprat abundance since 1996. In June-July 1998, sprat was mainly detected west of 1°W (R/V Tridens) (Simmonds *et al*, 1999). The acoustic estimates of sprat biomass in 1996–1998 were in the range of 40,000 t to 210,000 t. In 1999 the acoustic estimate of sprat was very low. The low value was not thought to be representative mainly due to inappropriate coverage of the south-eastern area (ICES 2000/D:07), the area expected to have the highest abundance of sprat in the North Sea. In 2000 the survey was extended by 30 n.mi to the south and covered for the first time the south-eastern area considered to have the highest abundance of sprat in the North Sea. By doing so, the estimate of sprat increased significantly. This year, there are indications that an area with higher density was encountered further north than in 2003. The estimated number of sprat increased by nearly 80% compared to 2003. The total sprat biomass estimated for the North Sea, was 360,000 tonnes (ICES 2005/G:04). In the eastern - south eastern area of the North Sea small 0-group sprat (<5-6 cm) accounted for 34% of this years total abundance. This is the first time that 0-group sprat have been recorded by this survey since 1998. It is, however, not clear whether the component of 0-ringer is recruiting from autumn spawning sprat or from an early spring spawning component (ICES 2004/AFM:18). The length distribution indicates that only the largest of this age group have been sampled and the abundance of 0-group sprat is thus considered an underestimate.

8.4 Mean Weight-at-age and Maturity-at-age

Mean weights (g) at age in the catches during 2004 are presented by quarter in Table 8.2.3. The table includes mean weights-at-age for 1995-2003 for comparison.

During the Working Group in 2002, data on maturity and age were compiled from the Danish commercial catches during quarters 1, 3 and 4 in 2001. Data on maturity were provided from the German Acoustic surveys in June-July during 1996-2001. No other countries contributed with data on maturity. No new data on sprat maturity has been available since 2001 and thus the time-series was not updated during the Working Group 2005.

8.5 Recruitment

The IBTS (February) sprat indices (no. per hour) in IVb (sprat standard area) are used as an index of abundance. The historical data were revised in 1995 (ICES 1995/Assess:13) and 1999 (ICES 1999/ACFM:12). The IBTS Working Group redefined the sprat index to be calculated as an area weighted mean over means by rectangles for the entire North Sea sprat stock. Based on this, the IBTS WG asked ICES Secretariat to carry out new calculations in 2001 (ICES 2000/D:07), which are the ones used in the present report. The old and the revised IBTS index is available in the Working Group report from 2003 for comparison (ICES 2003/ACFM:17). The fishing method (gear) in the IBTS-survey was standardised in 1983 and the data series from 1984, are comparable. The IBTS-indices for 1984–2005 are shown in Table 8.5.1 for age groups 1–4, 5+ and total. The index of 1-group increased significantly and is the highest in the whole time-series. The total-abundance index is at the level of the highest in the whole time-series. This is driven by the high abundance of age group 1 (2004 year class). The old IBTS-indices are available in ICES 2001/ACFM:12.

The IBTS data by rectangle are given in Figure 8.3.1a-c for age groups 1, 2 and 3+. Age 1-group was again found to be concentrated in the south-eastern areas of Division IVb and Division IVc. The mean lengths (mm) of age group 1 by rectangle are presented in Figure 8.3.2.

8.6 State of the Stock

8.6.1 Data Exploration and Preliminary Modelling

Sprat is a relatively short-living species and the catches consisting mostly of 1 and 2 year-olds. In addition, there are difficulties in age reading resulting in unreliable estimates of numbers-at-age both from the surveys and the commercial catches. Given those limitations a data exploration using Catch-Survey Analysis (CSA) was carried out. The Catch-survey Analysis and the inputs, were described in the working group report in 2003 and 2004 (ICES 2003/ ACFM:10 and ICES 2004/ ACFM:18). The model assumes that the population consists of two stages: the recruits (preferably a single year class which corresponds to the 1 year-old) and the fully recruited ages (the 2+ group).

Model input data consisting of the time-series of catch numbers for each stage, mean weight for each stage in the stock at the start of the year and the 1st quarter IBTS index of abundance for the 1 year-old sprat and older than 2 years-old are shown in Table 8.6.1 Given low sampling levels in years previous to 1995 and low inter-annual fluctuations in weight-at-age, constant weight-at-age based on commercial data from the 1st quarter was assumed for the whole period (1984-2004). Reservations regarding the ability of the IBTS 1-year-old index to fully reflect strong and weak cohorts for sprat were expressed in previous Working Group reports (see ICES 1998/ACFM:14). Those were linked to difficulties in age reading and/or a possible prolonged spawning and recruitment season. Another problem identified in some surveys was related to large catches in small areas, which could have been very influential on the results.

In 2003 the Working Group examined the biomass and the 1 year-old index trajectories and concluded that the data suggests that observed fluctuations in overall biomass are related to a large extent to observed fluctuations in the 1 year-old index. This is to be expected in a population where the recruits account for a large proportion of the stock, so a model that takes into account recruitment in the dynamics, is required

CSA requires a value for the instantaneous rate of natural mortality (M) and a parameter *s* corresponding to the ratio of the survey catchability of the recruits to the fully recruited ages which are fixed externally. The value of natural mortality is based on predation mortality estimates from a multispecies VPA (ICES 2002 /D:04). Estimates of predation mortality at-age and 90% confidence intervals representing the variation over time of the M values from the MSVPA were presented in last years report (ICES 2004/ACFM:18).

Model fits for M=0.7 to the IBTS indices are shown in Figure 8.6.1. An observation-error only model which estimates catchability of the fully recruited stage by close-form solution $q_n = \exp(mean(Log(n_t / N_t)))$ was implemented. Numbers at the start of the year of fish >2-year-old in the first year of data and all the recruit numbers were estimated by least-squares minimisation. The recruits corresponding to the last year in the series were computed from the survey index and the recruitment catchability. The model is sensitive to the choice of the M and *s* parameters. Given the constraints of the model which in its present form does not allow variations of M over time the model was run for M = 0.7 and 0.8. The input data used by this working group is shown in Table 8.6.1. In the absence of data that would support an alternative value *s* was equated to 1. Model output is shown in Table 8.6.2 for M = 0.7.

The model does not fit well the high IBTS 2+ index in 1998 given a low recruitment index in 1997; this could be an example of a late recruitment scenario where IBTS underestimated total recruitment (Figure 8.6.1). Estimated numbers of recruits and fully recruited and total biomass are shown in Figure 8.6.2. Examination of the residuals suggests patterns in the fit to the recruits index, but less so in the case of the fully recruited. (Fig. 8.6.3). Confidence intervals for the parameters were estimated by means of non-parametric bootstrapping. Biomass point estimates and 95% confidence intervals are shown in Figure 8.6.4 for M=0.7 together with the estimated biomass for M = 0.8. The biomass trajectory estimated by using M = 0.8 falls close to the confidence intervals for M= 0.7.

Results from a retrospective analysis are shown on Figure 8.6.5 suggesting a recent period of negative bias preceded by a long period where the biomass was revised upwards. The Working Group concluded that the retrospective bias was relatively small.

The WG still regards this present assessment as exploratory.

8.7 Projections of Catch and Stock

The Working Group in 2004 considered that previous SHOT-approach is inappropriate for a short-lived species like sprat. Therefore the projection was based on the results from CSA. Biomass projections for 2005 and 2006 assuming median recruitment in 2006 and assuming annual catches in 2005 and 2006 which corresponds to the same exploitation rate as in 2004. This is shown in Figure 8.7.1. The biomass trajectories suggest that the stock, depending on 2005 recruitment, would remain relatively stable under that level of exploitation.

A catch prediction for assessment year was provided in the past on the basis of a linear regression of catch versus IBTS estimated biomass. The results for 2005 are shown on Figure 8.7.2 and corresponds to a catch for 2005 of 244 000 t (agreed TAC for 2005 is 257 000 t).

8.8 Quality of the Assessment

Trends in the mean weights-at -age during the first quarter used to compute the biomass index from the IBTS was reviewed in 2004. No trend was observed in the mean weights-at-age over time, therefore an average over all the years was used to compute stock biomass using the Catch Survey Analysis. The model fits time-series of abundance for 2 stages in the stock: the recruits and the fully recruited to the fishery. The IBTS indices for the 1st quarter were used as indicators. The Working Group is aware of problems associated with sprat in the IBTS (February) which may have hatched in autumn. However examination of the residuals from the model fit suggests that the problem results in additional noise in the data but the model still attains a reasonably good fit to the data. The results are sensitive to the value assumed for the catchability ratio *s*, the estimated biomass being scaled accordingly. Therefore, when examining the model output, emphasis should be placed on stock trends rather than on absolute values until an independent estimate of *s* becomes available.

Given the dynamics of this short-living species recent estimates of biomass are likely to correspond to the trajectories derived from M = 0.7. Likewise, a value of s = 1 for IBTS is compatible with perceptions that catchability of recruits is no different from the one of the fully recruited. The Working Group agreed that an approach like CSA seemed a promising tool to assess sprat in the North Sea. Further, the method, although not specifically designed for short-lived species, does show potential for assessment in that context and therefore **it is recommended that the Working Group of Methods again considers assessment methods for short-lived species in the light of recent developments.**

8.9 Management Considerations

The sprat stock shows signs of being in good conditions as the biomass appears to be increasing. One of the highest IBTS (February) 1-gr indices in the time series is seen in the 2005-indices recruiting to the 2005 fishery. The fishery in a given year is very dependent on that year's incoming year class; therefore a catch projection for 2005 assuming average recruitment is meaningless. Despite the short-comings of the exploratory assessment presented here there are indications that the stock is lightly exploited.

There are indications that larvae from autumn spawning will over-winter as larvae and metamorphose the year after. Therefore, better knowledge of spawning seasons and recruitment from a possible autumn spawning is required.

Table 8.1.1. Sprat in the North Sea. Catches (' 000 t) 1987-2004. Catch in fjords of western Norway excluded. (Data provided by Working Group members except where indicated). These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Division IVa West (North Sea) stock																		
Denmark	0.2	0.1				0.3	0.6						0.7		0.1	1.1		0.0
Netherlands																		
Norway					0.1													
Sweden															0.1			
UK(Scotland)								0.1										
Total	0.2	0.1			0.1	0.3	0.6	0.1					0.7		0.2	1.1		0.0
Division IVa East (North Sea) stock																		
Denmark										0.3								
Norway						0.5	2.5		0.1									
Sweden					2.5													
Total					2.5	0.5	2.5		0.1	0.3								
Division IVb West																		
Denmark	3.4	1.4	2.0	10.0	9.4	19.9	13.0	19.0	26.0	1.8	82.2	21.1	13.2	18.8	11.1	16.3	22.0	53.8
Norway		3.5	0.1	1.2	4.4	18.4	16.8	12.6	21.0	1.9	2.3				0.9	0.0		
UK(Engl.&Wales)						0.5	0.5											
UK(Scotland)	0.1						0.5						0.8					
Total	3.5	4.9	2.1	11.2	13.8	38.8	30.8	31.6	47.0	3.7	84.5	21.1	14.0	18.8	12.0	16.3	22.0	53.8
Division IVb East																		
Denmark	28.0	80.7	59.2	59.2	67.0	66.6	136.2	251.7	283.2	74.7	10.9	98.2	147.1	144.1	132.9	109.8	130.9	122.2
Germany																		
Norway		0.6		0.6	25.1	9.5	24.1	19.1	14.7	50.9	0.8	15.3	13.1	0.9	5.0			0.1
Sweden				+	+				0.2	0.5		1.7	2.1		1.4			
UK(Scotland)													0.6					
Total	28.0	81.3	59.2	59.8	92.1	76.1	160.3	270.8	298.1	126.1	11.7	115.2	162.9	145.0	139.3	109.8	131.0	122.2
Division IVc																		
Denmark		0.1	0.5	1.5	1.7	2.5	3.5	10.1	11.4	3.9	5.7	11.8	3.3	28.2	13.1	14.8	22.3	16.8
France									+									
Netherlands		0.4	0.4										0.2					
Norway							0.4	4.6	0.4		0.1	16.0	5.7	1.8	3.6			
UK(Engl.&Wales)	0.7	0.6	0.9	0.2	1.8	6.1	2.0	2.9	0.2	2.6	1.4	0.2	1.6	2.0	2.0	1.6	1.3	1.5
Total	0.7	1.1	1.8	1.7	3.5	8.6	5.9	17.6	12.0	6.5	7.2	28.0	10.8	32.0	18.7	16.4	23.6	18.3
Total North Sea																		
Denmark	31.6	82.3	61.7	70.7	78.1	89.2	153.3	280.8	320.6	80.7	98.8	131.1	164.3	191.1	157.2	142.0	175.2	192.7
France									+									
Germany																		
Netherlands		0.4	0.4										0.2					
Norway		4.1	0.1	1.8	29.6	28.4	43.8	36.3	36.2	52.8	3.2	31.3	18.8	2.7	9.5	0.0		0.1
Sweden					2.5								2.7		1.4			
UK(Engl.&Wales)	0.7	0.6	0.9	0.2	1.8	6.6	2.5	2.9	0.2	2.6	1.4	0.2	1.6	2.0	2.0	1.6	1.3	1.5
UK(Scotland)	0.1						0.5	0.1					0.8					
Total	32.4	87.4	63.1	72.7	112.0	124.3	200.1	320.1	357.0	136.1	103.4	162.6	188.4	195.9	170.1	143.6	176.5	194.3

Table 8.1.2. Sprat catches ('000 t) in the fjords of western Norway, 1985-2004.

1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*	2001	2002	2003	2004 [1]
7.1	2.2	8.3	5.3	2.4	2.7	3.2	3.8	1.9	5.3	3.7	3.3	3.1	2.5	3.3	2.6	1.4	1.1	2.2	0.4

[1] = preliminary

*2000-2003: revised

Table 8.1.3. Sprat in the North Sea. Catches (tonnes) by quarter*. Catches in fjords of Western Norway excluded.

Year	Quarter			Area			Total
		IVaW	IVaE	IVbW	IVbE	IVc	
1994	1		42	2,616	17,227	16,081	35,966
	2			242	10,857	1	11,100
	3			10,479	184,747		195,226
	4	109		18,224	57,959	1,503	77,796
Total		109	42	31,561	270,790	17,586	320,088
1995	1			17,752	16,900	7,324	41,976
	2			1,138	5,752	1	6,891
	3		86	25,305	183,500	6	208,897
	4		5	2,826	92,054	4,693	99,578
Total			91	47,021	298,206	12,024	357,342
1996	1		459	2,471	81,020	6,103	90,053
	2			615	2,102	18	2,735
	3			242	6,259		6,501
	4		353	411	36,273	386	37,423
Total			812	3,739	125,654	6,507	136,712
1997	1			1,025	147	7,089	8,261
	2			189	1,054		1,243
	3		3	27,487	569		28,059
	4		81	55,814	9,878		65,773
Total			84	84,515	11,648	7,089	103,336
1998	1			1,917	3,726	1,616	7,259
	2		4	529	206	4	743
	3			4,926	55,155	215	60,296
	4			13,712	54,433	25,984	94,129
Total			4	21,084	113,520	27,819	162,427
1999	1			450	20,862	9,071	30,383
	2			108	1,048		1,156
	3	1	17	7,840	121,186	415	129,459
	4	679	31	5,550	19,731	1,167	27,158
Total		680	48	13,948	162,827	10,653	188,156
2000	1			2,686	15,440	28,063	46,189
	2			1,599	123	45	1,767
	3			14,405	116,901	1,216	132,522
	4			158	12,522	2,718	15,398
Total				18,848	144,986	32,042	195,876
2001	1	115		1,643	39,260	9,716	50,734
	2	0		699	372		1,071
	3	0		947	43,226	481	44,655
	4	79		8,681	56,421	8,538	73,719
Total		194		11,970	139,279	18,735	170,177
2002	1	1,136		222	1,960	2,790	6,108
	2			122	313	93	528
	3			9,131	61,373	647	71,151
	4			6,809	46,133	12,911	65,853
Total		1,136		16,284	109,779	16,441	143,640
2003	1			6,008	5,451	7,727	19,185
	2			57	568	26	652
	3			3,593	52,614	165	56,372
	4			12,389	72,240	15,651	100,280
Total				22,047	130,873	23,570	176,489
2004	1			76	751	1,831	2,657
	2	7		125	135	16	283
	3			627	53,533	496	54,657
	4			52,927	67,757	15,937	136,622
Total		7	0	53,755	122,177	18,280	194,219

Table 8.2.1. North Sea sprat. Species composition in the Danish sprat fishery in tonnes and percentage of the total catch. Data is reported for 1998-2004.

	Year	Sprat	Herring	Horse-mackerel	Whiting	Haddock	Mackerel	Cod	Sandeel	Other species	Total
Tonnes	1998	129,315	11,817	573	673	6	220	11	2,174	1,188	145,978
Tonnes	1999	157,003	7,256	413	1,088	62	321	7	4,972	635	171,757
Tonnes	2000	188,463	11,662	3,239	2,107	66	766	4	423	1,911	208,641
Tonnes	2001	136,443	13,953	67	1,700	223	312	4	17,020	1,142	170,862
Tonnes	2002	140,568	16,644	2,078	2,537	27	715	0	4,102	800	167,471
Tonnes	2003	172,456	10,244	718	1,106	15	799	11	5,357	3,509	194,214
Tonnes	2004	179,944	10,144	474	334		4,351	3	3,836	1,821	200,906
Percent	1998	88.6	8.1	0.4	0.5	0.0	0.2	0.0	1.5	0.8	100.0
Percent	1999	91.4	4.2	0.2	0.6	0.0	0.2	0.0	2.9	0.4	100.0
Percent	2000	90.3	5.6	1.6	1.0	0.0	0.4	0.0	0.2	0.9	100.0
Percent	2001	79.9	8.2	0.0	1.0	0.1	0.2	0.0	10.0	0.7	100.0
Percent	2002	83.9	9.9	1.2	1.5	0.0	0.4	0.0	2.4	0.5	100.0
Percent	2003	88.8	5.3	0.4	0.6	0.0	0.4	0.0	2.8	1.8	100.0
Percent	2004	89.6	5.0	0.2	0.2	0.0	2.2	0.0	1.9	0.9	100.0

Table 8.2.2 North Sea Sprat. Catch in numbers (millions) by quarter and by age 1995-2004.

Year	Quarter	Age						
		0	1	2	3	4	5+	Total
1995	1		5.9	2,990.5	991.4	54.0		4,041.7
	2		2.3	595.1	182.5			779.9
	3	531.3	12,097.4	7,990.0	262.6	3.3		20,884.7
	4		4,541.1	3,309.7	377.8			8,228.6
	Total	531.3	16,646.7	14,885.3	1,814.3	57.3		33,934.8
1996	1		524.7	4,615.4	2,621.9	316.4	11.3	8,089.7
	2		1.9	241.5	32.7	15.5	0.3	291.9
	3		400.5	100.7	22.9	0.3		524.5
	4		1,190.7	1,069.0	339.6	5.6		2,604.8
	Total		2,117.9	6,026.6	3,017.0	337.8	11.5	11,510.8
1997	1		74.4	314.0	229.2	55.3	2.5	675.4
	2		11.3	47.8	34.9	8.4	0.4	102.9
	3		1,991.9					1,991.9
	4	127.6	3,597.2	996.2	117.8	58.1	0.0	4,896.9
	Total	127.6	5,674.8	1,358.1	381.9	121.8	2.8	7,667.1
1998	1		683.2	537.2	18.3	0.1		1,238.8
	2		70.9	55.3	1.8			127.9
	3	74.2	3,356.6	693.3				4,124.2
	4	772.4	4,822.4	2,295.1	483.5	39.5		8,412.8
	Total	846.6	8,933.1	3,580.9	503.6	39.6		13,903.7
1999	1		728.1	2,226.0	554.2	86.6	9.2	3,604.2
	2		38.6	58.4	18.1	2.6		117.7
	3		12,919.0	38.9				12,957.8
	4	105.0	2,143.2	211.5				2,459.7
	Total	105.0	15,828.9	2,534.8	572.3	89.2	9.2	19,139.5
2000	1		559.2	3,177.3	797.5	247.5	72.0	4,853.7
	2		6.8	107.4	60.1	12.8	0.5	187.6
	3		9,928.9	1,111.9	77.8			11,118.6
	4		1,153.7	129.2	9.0			1,291.9
	Total		11,648.7	4,525.8	944.4	260.3	72.6	17,451.8
2001	1		746.3	3,197.7	1,321.9	22.2		5,023.1
	2		15.9	66.2	26.1			108.2
	3	0.4	3,338.8	299.9				3,559.1
	4	1,205.0	4,178.7	1,224.6	261.9			6,651.4
	Total	1,205.4	8,279.8	4,788.4	1,609.9	22.2		15,341.7
2002	1	0.0	104.7	400.3	30.2	11.2		546.4
	2	0.0	13.7	27.9	2.4	0.6		44.6
	3	40.9	5,745.6	582.1	42.3	4.1		6,415.0
	4	415.0	4,578.0	626.2	119.8	3.1		5,742.1
	Total	455.9	10,441.9	1,636.5	194.8	19.0		12,748.1
2003	1	0.0	1,953.9	1,218.9	85.3	11.3	0.0	3,269.3
	2	0.0	41.8	46.3	4.7	0.6	0.0	93.3
	3	1.1	3,481.3	772.0	42.9	0.0	0.0	4,297.2
	4	539.3	7,051.8	1,115.1	93.8	36.5	21.9	8,858.4
	Total	540.4	12,528.7	3,152.3	226.6	48.4	21.9	16,518.2
2004	1	0.0	16.5	214.0	26.3	1.6	0.6	259.0
	2	0.0	22.1	14.9	3.0	0.1	0.0	40.1
	3	210.0	3,661.9	558.2	31.4	0.0	0.0	4,461.5
	4	15,674.4	5,582.8	632.1	59.2	0.0	0.0	21,948.5
	Total	15,884.4	9,283.2	1,419.2	119.8	1.8	0.6	26,709.1

Table 8.2.3 North Sea Sprat. Mean weight (g) by quarter and by age for 1995 - 2004.

Year	Quarter	Age 0	1	2	3	4	5+	SOP Tonnes
1995	1		3.0	9.4	12.9	19.4		41,976.0
	2		3.0	8.4	10.3			6,891.0
	3	2.4	7.6	13.9	16.4	20.7		208,897.0
	4		10.5	13.9	16.2			99,578.0
Weighted mean		2.40	8.38	12.79	13.83	19.47		357,342.0
1996	1		3.9	9.3	14.9	15.3	16.1	88,807.0
	2		6.9	8.4	11.6	20.0	15.2	2,735.0
	3		11.6	14.2	18.2	21.5		6,501.0
	4		12.1	15.9	17.2	20.5		37,359.0
Weighted mean			9.97	10.49	15.12	15.58	16.03	135,401.0
1997	1		8.0	10.0	15.0	17.0	19.0	8,161.0
	2		8.0	10.0	15.0	17.0	19.0	1,243.0
	3		14.2					28,285.0
	4	3.7	11.9	16.4	19.1	19.6		63,083.0
Weighted mean		3.73	12.67	14.66	16.26	18.24	19.00	100,772.0
1998	1		5.6	6.0	8.7	15.0		7,232.0
	2		5.6	6.0	8.3			743.0
	3	3.7	14.7	15.3				60,149.0
	4	4.1	10.6	13.8	16.3	14.6		94,173.0
Weighted mean		4.03	11.69	12.80	15.98	14.65		162,297.0
1999	1		3.3	8.7	12.5	14.4	16.3	30,168.0
	2		3.1	10.1	13.6	15.4		993.0
	3		10.0	18.3				129,383.0
	4	4.4	11.0	14.4				27,126.0
Weighted mean		4.42	9.78	9.39	12.49	14.43	16.34	187,670.0
2000	1		4.2	10.1	10.7	10.2	10.5	46,192.0
	2		3.3	9.0	10.2	12.8	10.5	1,767.0
	3		11.9	11.9	11.0			132,563.0
	4		11.9	11.9	11.0			15,403.0
Weighted mean			11.55	10.56	10.68	10.33	10.52	195,925.0
2001	1		3.3	9.7	12.9	16.5		50,794.0
	2		3.3	10.3	12.9			1,071.0
	3	4.0	12.0	15.3				44,656.0
	4	3.8	11.6	12.6	19.1			73,444.0
Weighted mean		3.75	10.99	10.80	13.91	16.53		169,967.0
2002	1		7.0	12.0	14.0	13.0		61,057
	2		5.3	11.2	12.5	12.4		4,231
	3	2.0	10.9	15.0	15.0	24.0		721,732
	4	3.9	12.0	15.0	15.7	24.0		679,018
Weighted mean		3.73	11.24	13.43	14.93	14.80		1,466,038
2003	1		3.6	9.4	11.0	15.0		19,598.6
	2		3.1	9.9	11.0	15.0		648.0
	3	3.0	13.0	16.0	13.0			58,168.6
	4	4.6	10.8	14.8	16.9	15.0	18.0	97,670.1
Weighted mean		4.60	10.26	12.93	13.82	15.00	18.00	176,085.3
2004	1	0.0	3.6	10.3	13.8	16.6	16.1	2,663
	2	0.0	6.0	8.5	7.3	10.2		282
	3	4.5	11.9	17.0	20.0			54,639
	4	4.0	11.4	14.6	18.3			136,653
Weighted mean		4.00	11.00	10.90	14.50	16.80	16.12	194,238.4

Table 8.2.4. North Sea Sprat. Sampling commercial landings for biological samples in 2004.

Country	Quarter	Landings ('000 tonnes)	No. samples	No. measured	No. aged
Denmark	1	1.3	7	306	0
	2	0.3	32	164	0
	3	54.7	11	1039	448
	4	136.4	21	2229	783
	Total	192.7	71	3738	1231
UK(England)	1	1.4	0	0	0
	2	0.0			
	3	0.0			
	4	0.1	0	0	0
	Total	1.5	0	0	0
Norway	1	0.0			
	2	0.0			
	3	0.0			
	4	1.1	0	0	0
	Total	1.1	0	0	0
Total North Sea		195.3	71	3738	1231

Samples are not comparable to biological sampling tables for herring as many samples are from by-catch of sprat in other fisheries.

Table 8.5.1 North Sea sprat. Abundance indices by age from IBTS (February) from 1984-2005.

Year	Age					
	1	2	3	4	5+	Total
1984	232.4	330.2	39.6	6.2	0.3	608.7
1985	375.9	195.3	26.7	3.8	0.4	602.1
1986	44.2	73.6	22.0	1.2	0.2	141.2
1987	542.4	66.8	19.6	2.0	0.2	631.0
1988	91.4	887.2	61.6	6.9	0.0	1047.1
1989	2297.2	472.8	269.8	5.4	1.6	3046.8
1990	234.9	452.0	102.1	28.1	2.2	819.3
1991	677.3	93.3	23.3	2.6	0.1	796.6
1992	1041.0	291.9	42.4	7.1	0.5	1382.9
1993	1030.6	604.4	118.4	6.1	0.3	1759.8
1994	2428.5	932.6	91.4	3.6	0.5	3456.6
1995	647.4	1613.9	87.3	2.5	0.8	2351.9
1996	182.4	387.2	146.8	18.3	0.7	735.4
1997	591.4	412.4	179.6	15.5	2.2	1201.1
1998	1171.1	1457.2	306.1	15.8	3.4	2953.6
1999	2509.5	562.4	80.4	4.8	25.1	3182.2
2000	1058.8	907.0	277.5	43.9	0.9	2288.1
2001	883.1	1055.8	185.2	17.5	0.1	2141.7
2002	1382.6	604.5	74.4	8.4	0.6	2070.5
2003	1823.1	292.3	39.2	2.3	0.0	2156.9
2004	1491.6	560.7	123.2	4.5	3.1	2183.1
2005	3018.0	340.1	48.1	1.1	0.0	3407.3

Table 8.6.1. North Sea sprat. CSA Input data. Catch in numbers (CatRec and CatFull), abundance indices (Urec and Ufull), recruits and fully-recruited mean weights in the stock, and catchability ratio (Srat). M=0.7

Year	CatRec	CatFull	Urec	Ufull	Wrec	Wfull	Srat
1984	6455.2	1432.4	232.4	376.3	4.5	9.67	1
1985	2361.16	1680.36	375.9	226.2	4.5	9.67	1
1986	917.33	385.20	44.2	97,0	4.5	9.67	1
1987	2102.31	464.56	542.4	88.6	4.5	9.67	1
1988	529.28	5460.05	91.4	955.7	4.5	9.67	1
1989	2658.36	3431.79	2297.2	749.6	4.5	9.67	1
1990	1415.95	1421.13	234.9	584.4	4.5	9.67	1
1991	2653.3	1890.71	677.3	119.3	4.5	9.67	1
1992	8801.13	2590.83	1041,0	341.9	4.5	9.67	1
1993	4992.73	4069.87	1030.6	729.2	4.5	9.67	1
1994	36190.2	5173.0	2428.5	1028.1	4.5	9.67	1
1995	16646.7	16756.9	647.4	1704.5	4.5	9.67	1
1996	2117.9	9392.9	182.4	553,0	4.5	9.67	1
1997	5674.8	1864.6	591.4	609.7	4.5	9.67	1
1998	8933.1	4124.1	1171.1	1782.5	4.5	9.67	1
1999	15828.9	3205.5	2509.5	672.7	4.5	9.67	1
2000	11648.7	5803.1	1058.8	1229.3	4.5	9.67	1
2001	8279.8	6420.5	883.1	1258.6	4.5	9.67	1
2002	10442,0	1850.3	1382.6	687.9	4.5	9.67	1
2003	12528.7	3449.1	1823.1	333.8	4.5	9.67	1
2004	9283.2	1541.5	3018.03	389.27	4.5	9.67	1

Table 8.6.2. North Sea sprat. CSA output. Estimated 1-year old (RecN) and 2+(FullN) numbers in stock, total stock biomass, fishing mortality and harvest rates for the 1-year old and the 2+.

Year	RecN	FullN	TSBiom	F*	HRrec	HRfull	CatRec	CatFull	Sratio	M
1984	13762.6	21407.6	268943.5	0.383	0.469	0.067	6455.2	1432.4	1	0.7
1985	15872.0	11906.7	186562.2	0.231	0.149	0.141	2361.2	1680.4	1	0.7
1986	2812.8	10946.5	118510.2	0.144	0.326	0.035	917.3	385.2	1	0.7
1987	85418.6	5914.8	441579.8	0.041	0.025	0.079	2102.3	464.6	1	0.7
1988	6333.7	43546.0	449591.4	0.187	0.084	0.125	529.3	5460.1	1	0.7
1989	63886.6	20548.9	486197.7	0.108	0.042	0.167	2658.4	3431.8	1	0.7
1990	11191.9	37637.8	414320.7	0.086	0.127	0.038	1416.0	1421.1	1	0.7
1991	38301.6	22248.8	387503.6	0.113	0.069	0.085	2653.3	1890.7	1	0.7
1992	76599.8	26866.4	604496.7	0.17	0.115	0.096	8801.1	2590.8	1	0.7
1993	79194.5	43352.0	775589.0	0.111	0.063	0.094	4992.7	4069.9	1	0.7
1994	216470.5	54468.5	1500827.6	0.244	0.167	0.095	36190.2	5173.0	1	0.7
1995	47190.4	105396.2	1231537.8	0.372	0.353	0.159	16646.7	16756.9	1	0.7
1996	13999.0	52233.1	568089.8	0.283	0.151	0.18	2117.9	9392.9	1	0.7
1997	77268.0	24778.4	587312.7	0.111	0.073	0.075	5674.8	1864.6	1	0.7
1998	68041.2	45361.8	744833.8	0.178	0.131	0.091	8933.1	4124.1	1	0.7
1999	148029.3	47113.0	1121714.7	0.149	0.107	0.068	15828.9	3205.5	1	0.7
2000	66460.3	83491.5	1106434.3	0.181	0.175	0.07	11648.7	5803.1	1	0.7
2001	45924.1	62165.8	807801.9	0.214	0.18	0.103	8279.8	6420.5	1	0.7
2002	54092.7	43316.8	662290.4	0.197	0.193	0.043	10442.0	1850.3	1	0.7
2003	94735.8	39709.9	810305.6	0.185	0.132	0.087	12528.7	3449.1	1	0.7
2004	94758.4	55504.4	963140.2	0	0.098	0.028	9283.2	1541.5	1	0.7

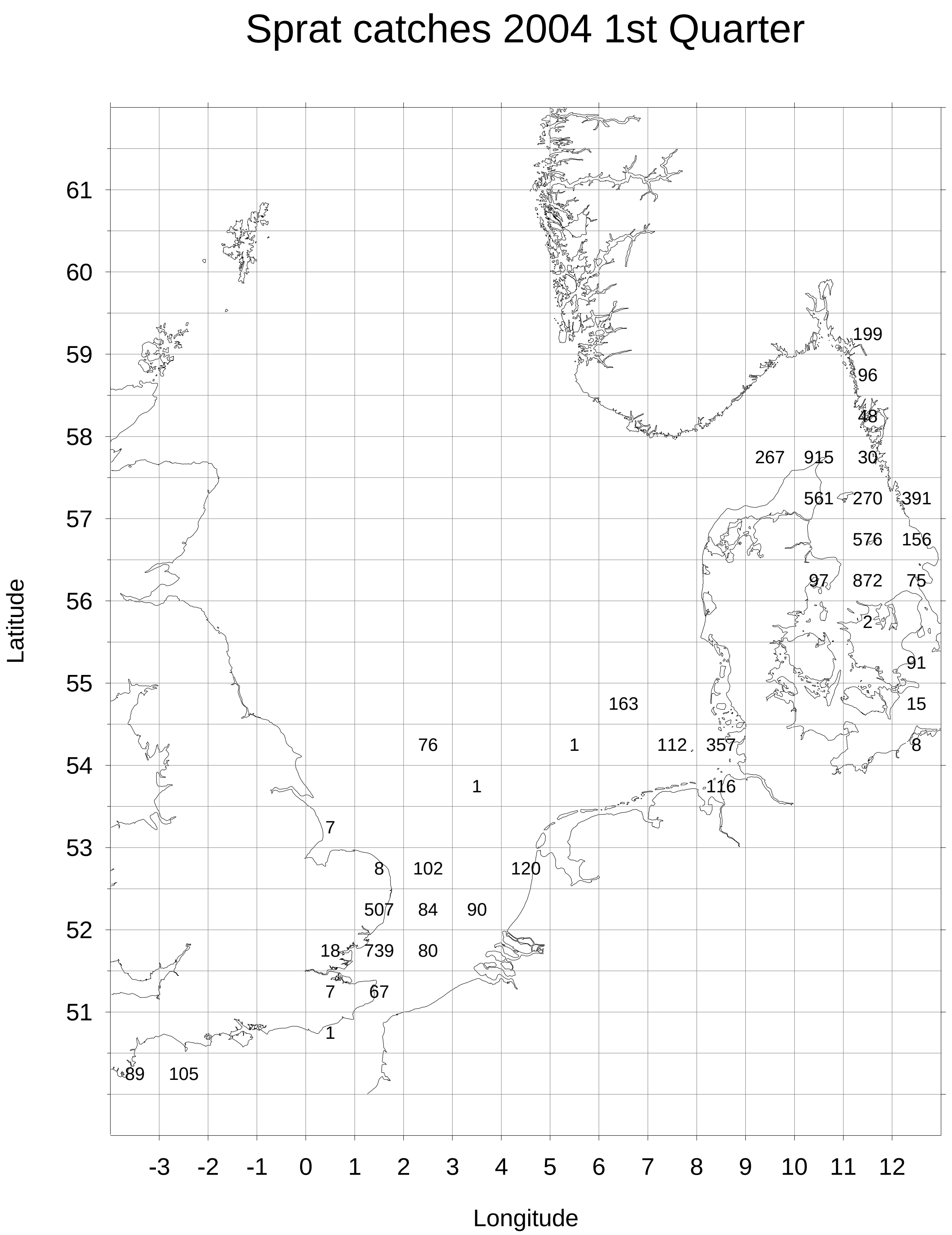


Figure 8.1.1.1a. Sprat catches (in tonnes) in the North Sea and Div. IIIa in 2004 by statistical rectangle. Working group estimates. First quarter.

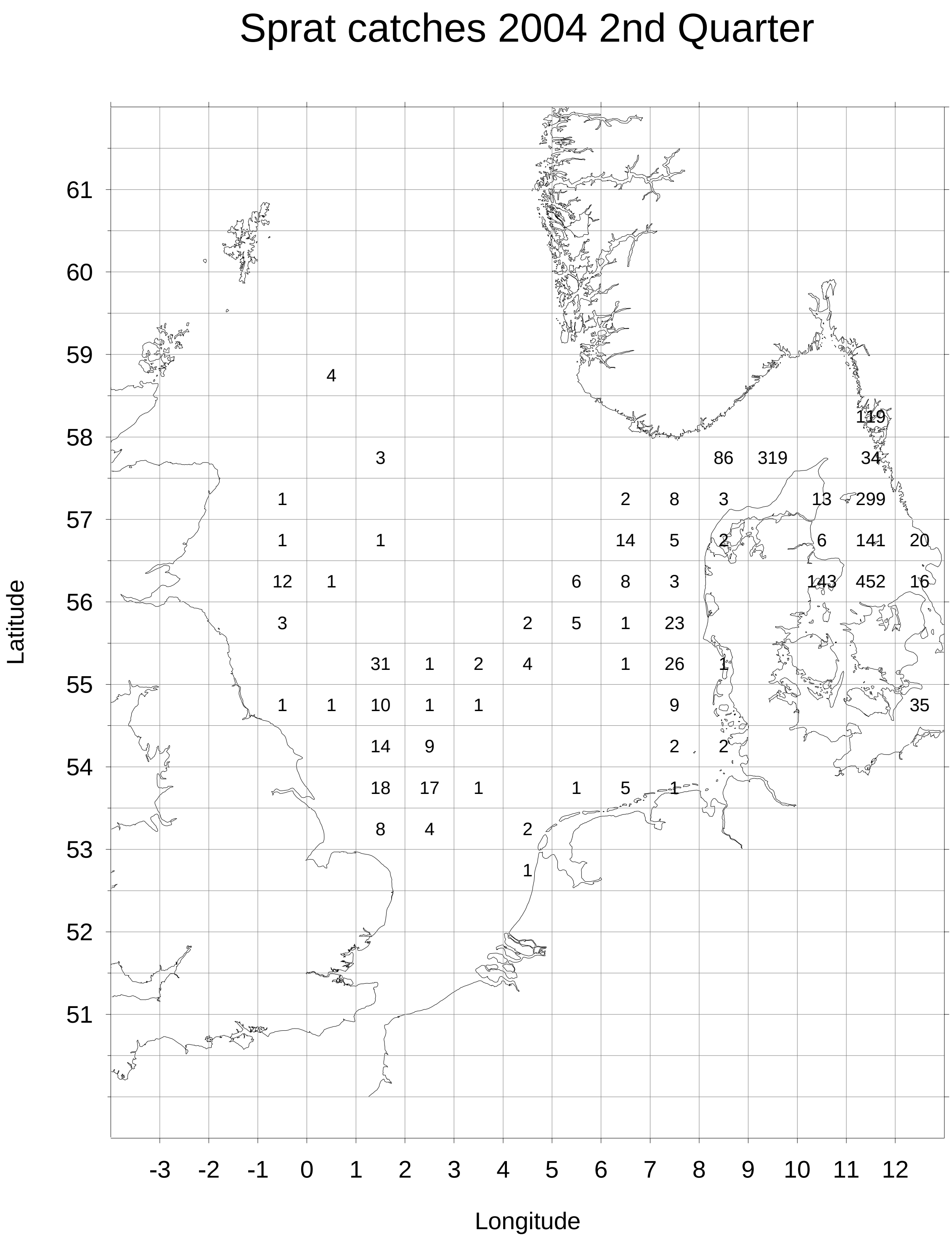


Figure 8.1.1.1b. Sprat catches (in tonnes) in the North Sea and Div. IIIa in 2004 by statistical rectangle. Working group estimates. Second quarter.

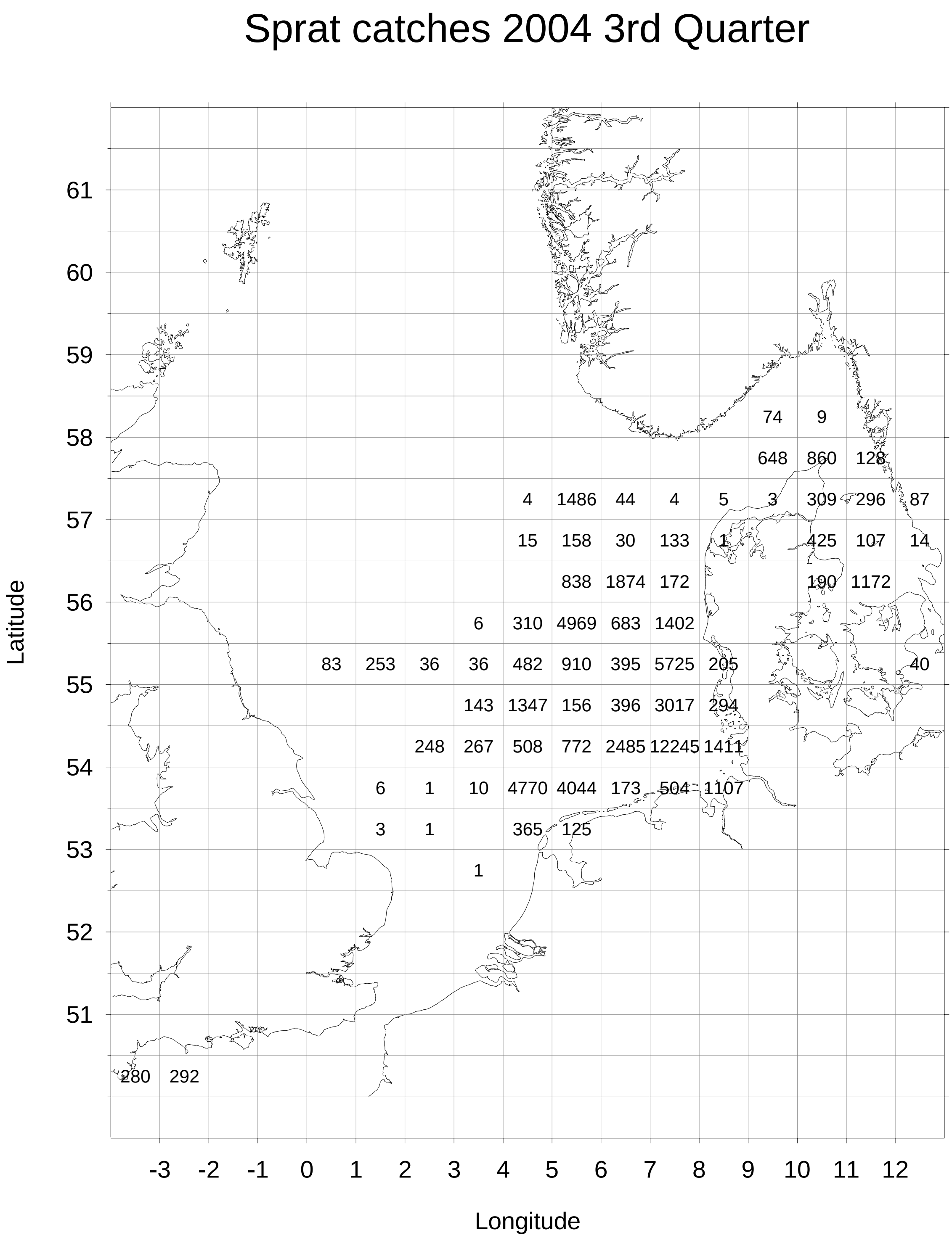


Figure 8.1.1.1c. Sprat catches (in tonnes) in the North Sea and Div. IIIa in 2004 by statistical rectangle. Working group estimates. Third quarter.

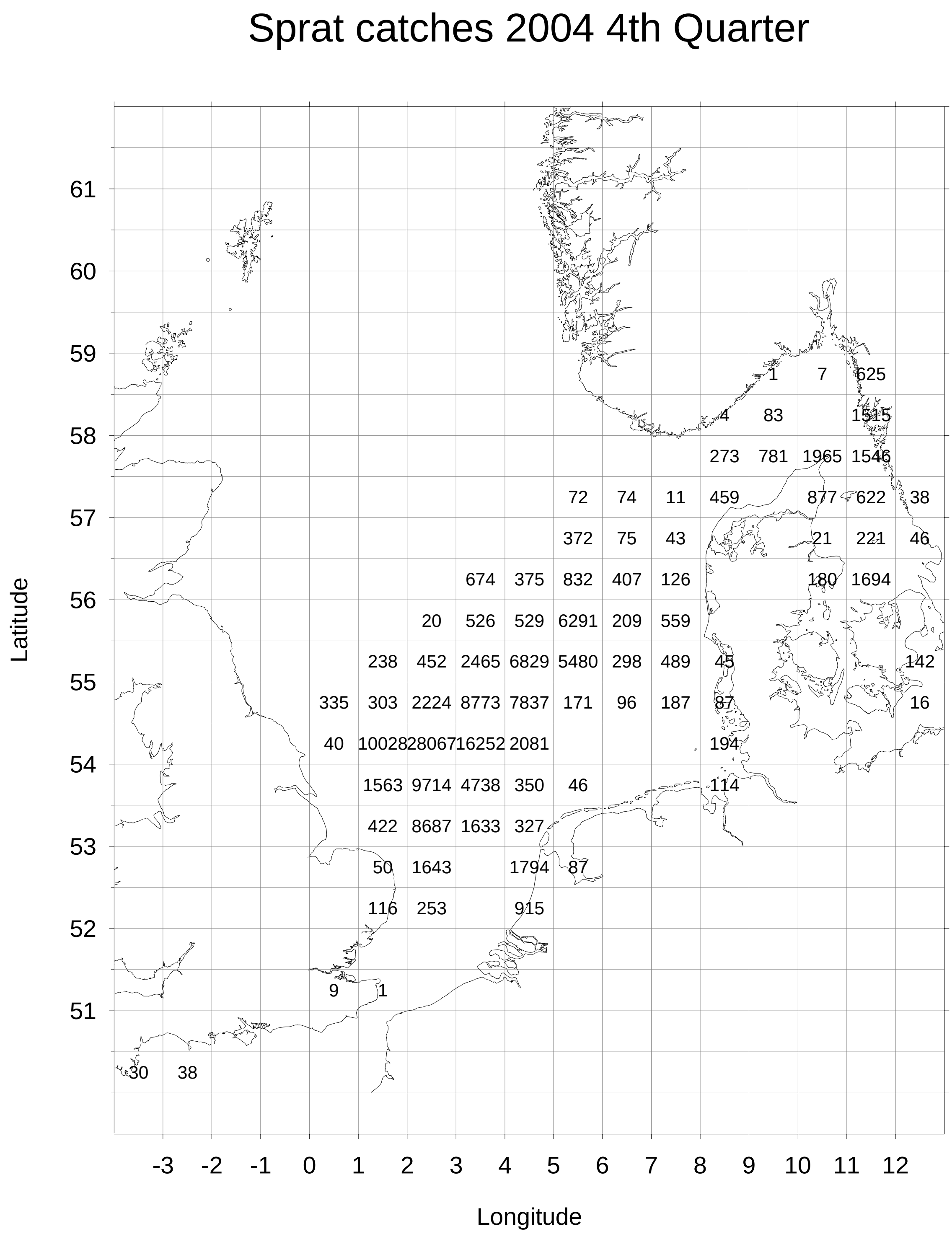


Figure 8.1.1.1d. Sprat catches (in tonnes) in the North Sea and Div. IIIa in 2004 by statistical rectangle. Working group estimates. Fourth quarter.

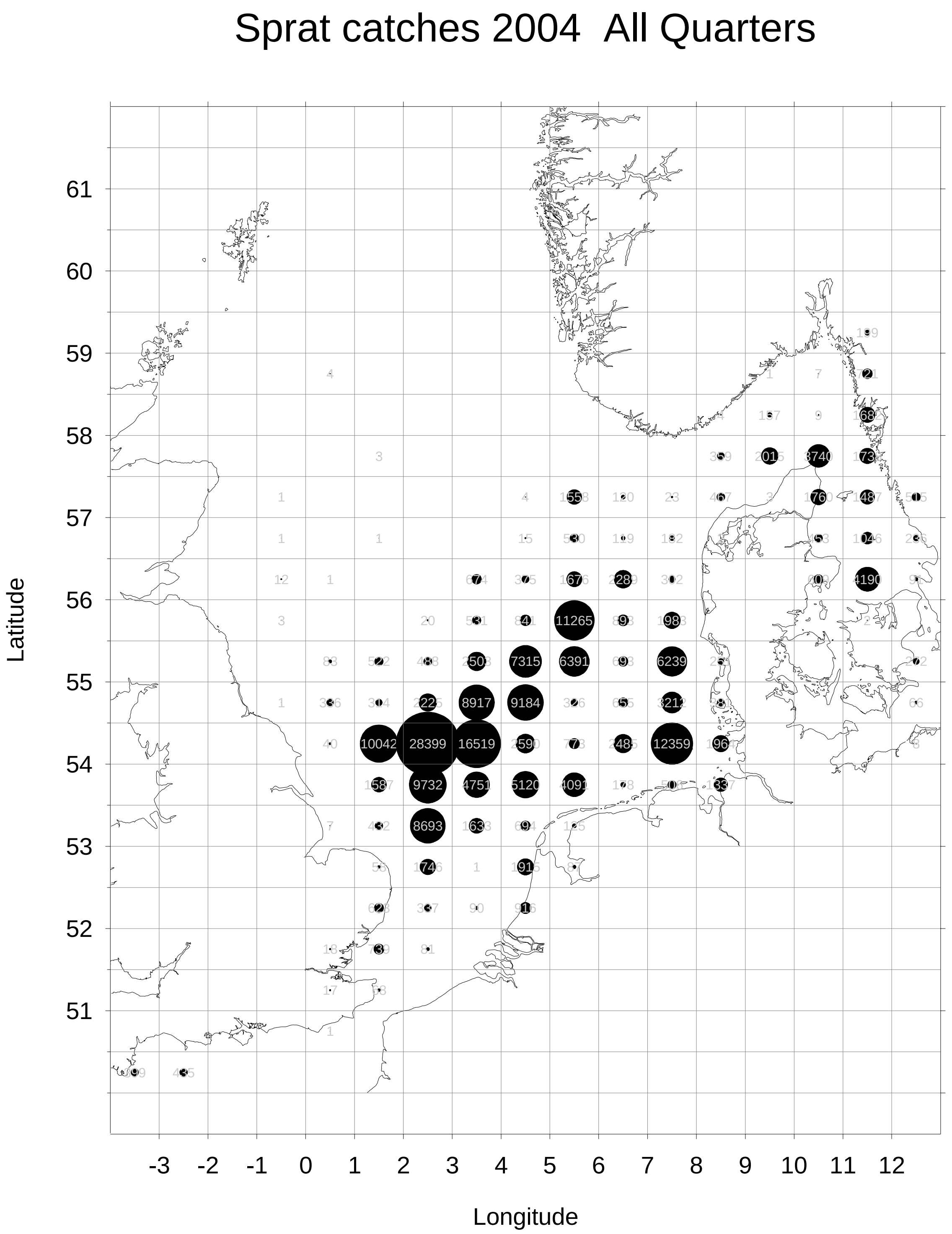


Figure 8.1.2. Total sprat catches (in tonnes) in the North Sea and Div. IIIa in 2004 by statistical rectangle. Working group estimates.

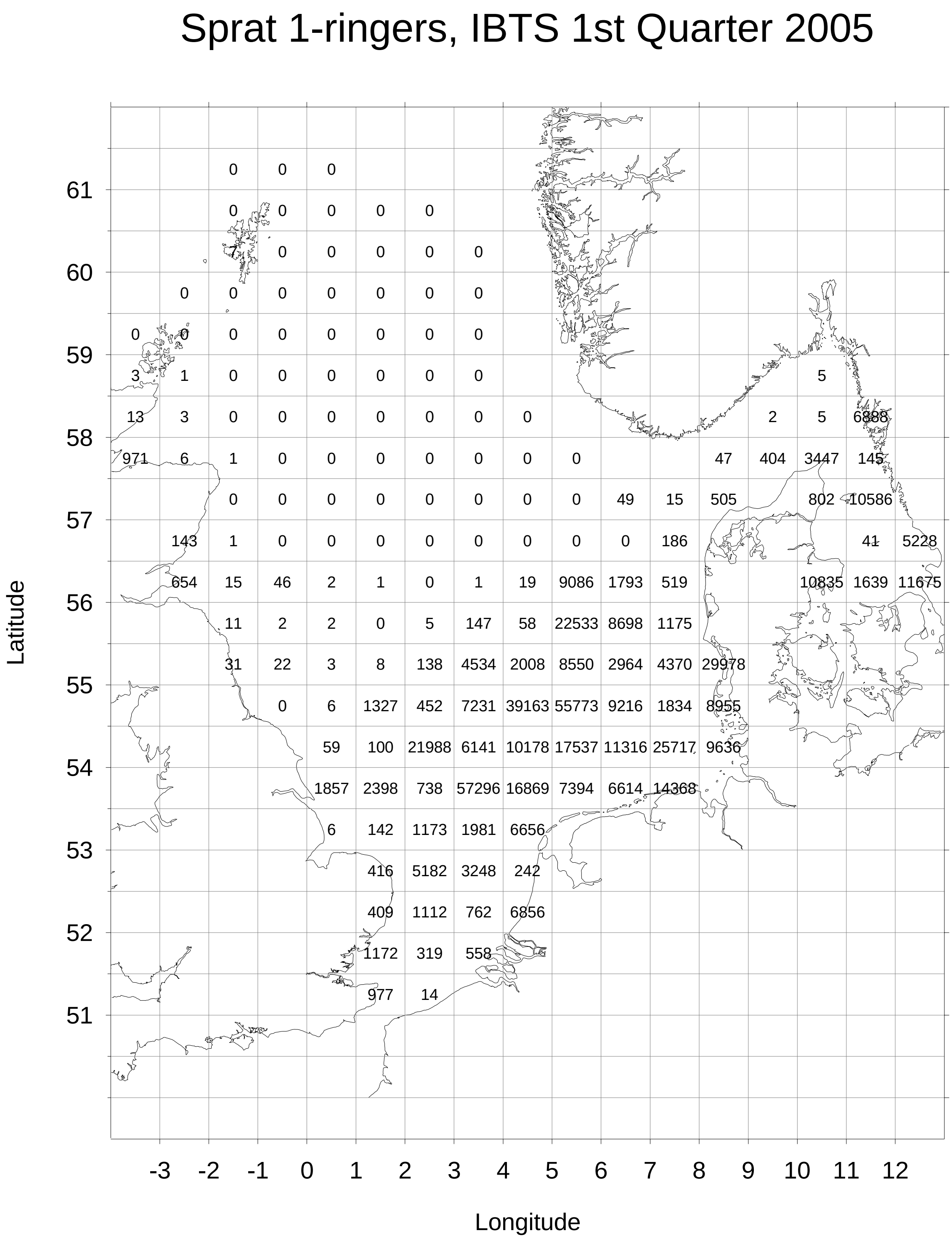


Figure 8.3.1a. Distribution of age group 1 in the IBTS (February) 2005 in the North Sea and Division IIIa.

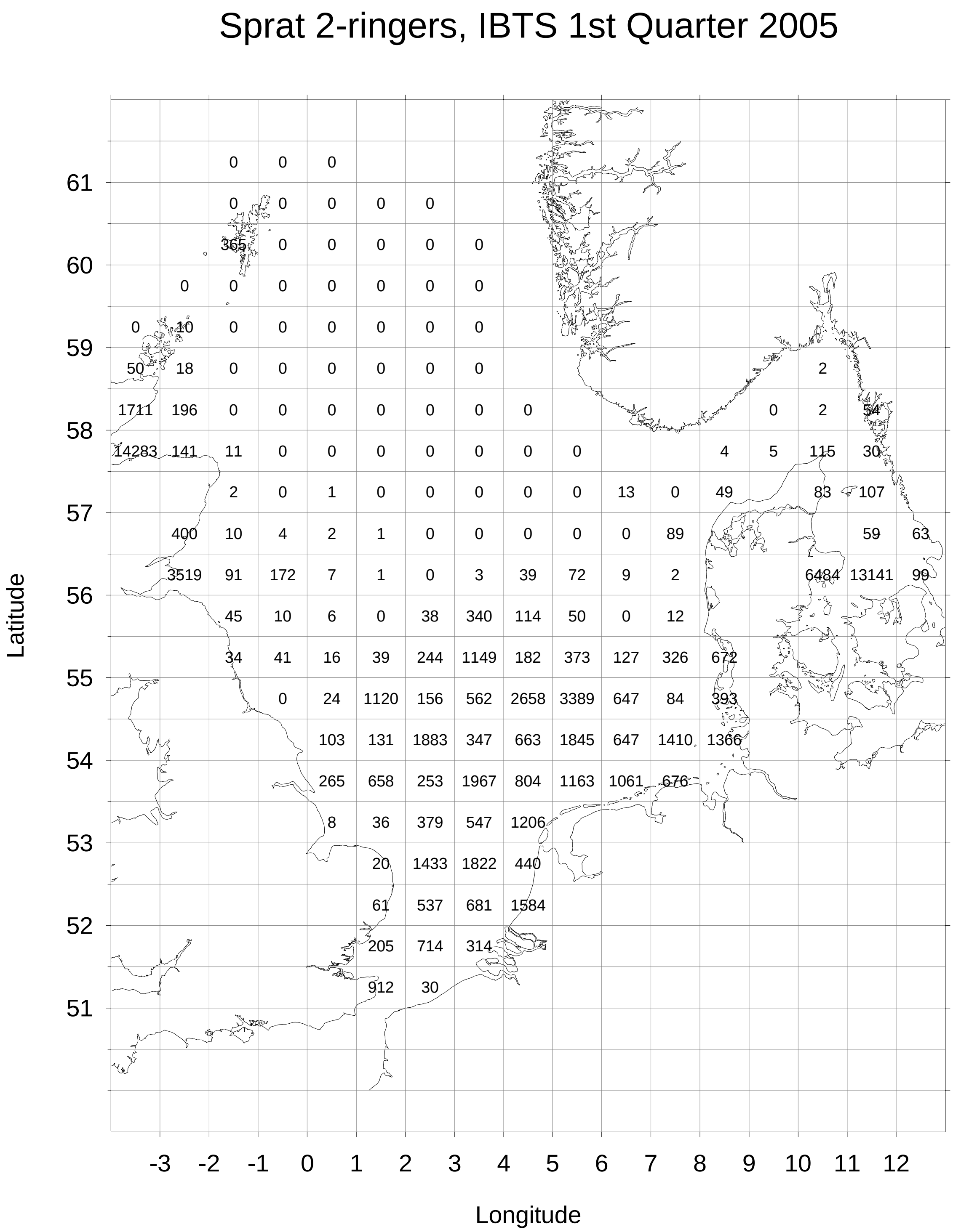


Figure 8.3.1b. Distribution of age group 2 in the IBTS (February) 2005 in the North Sea and Division IIIa.

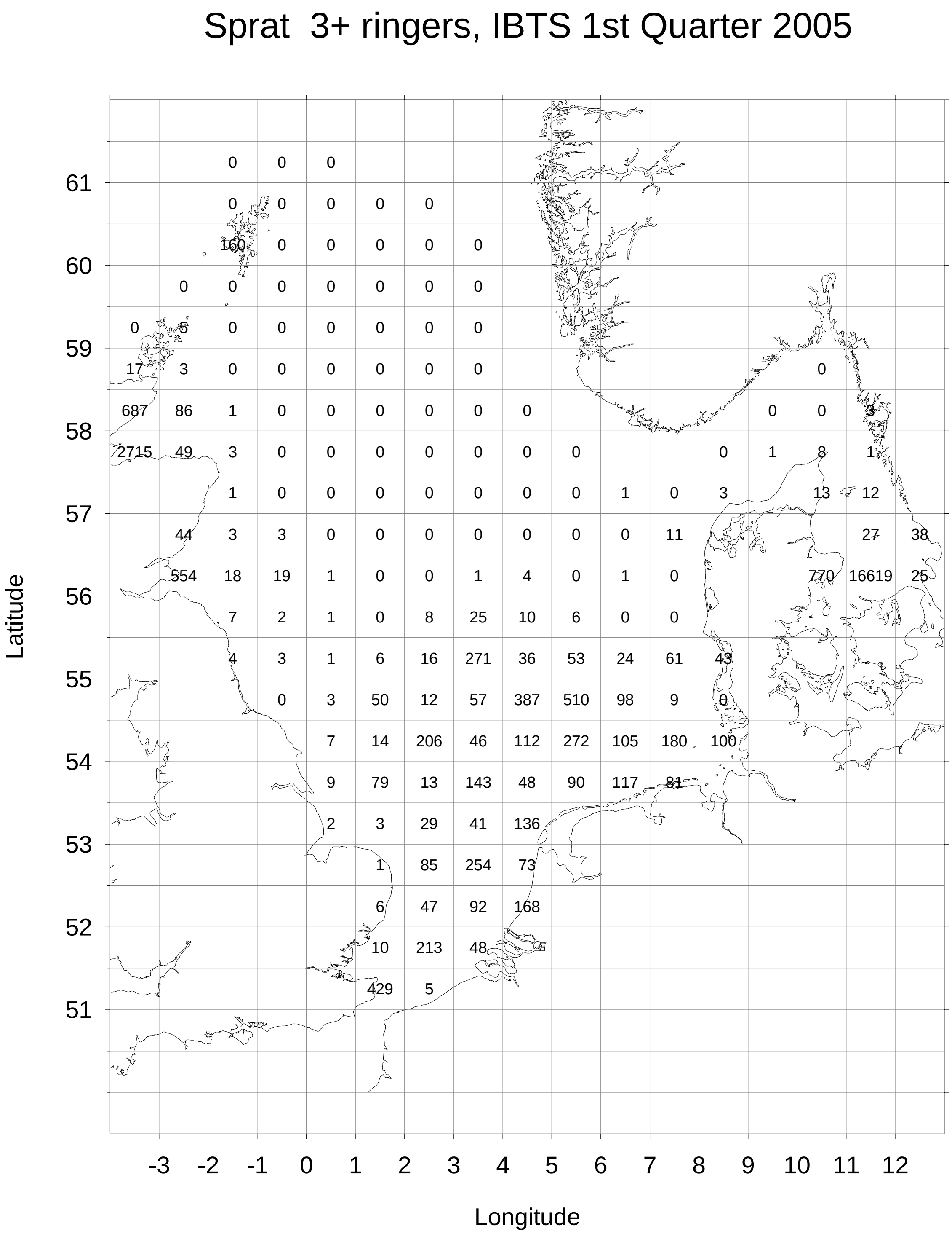


Figure 8.3.1c. Distribution of age group 3+ in the IBTS (February) 2005 in the North Sea and Division IIIa.

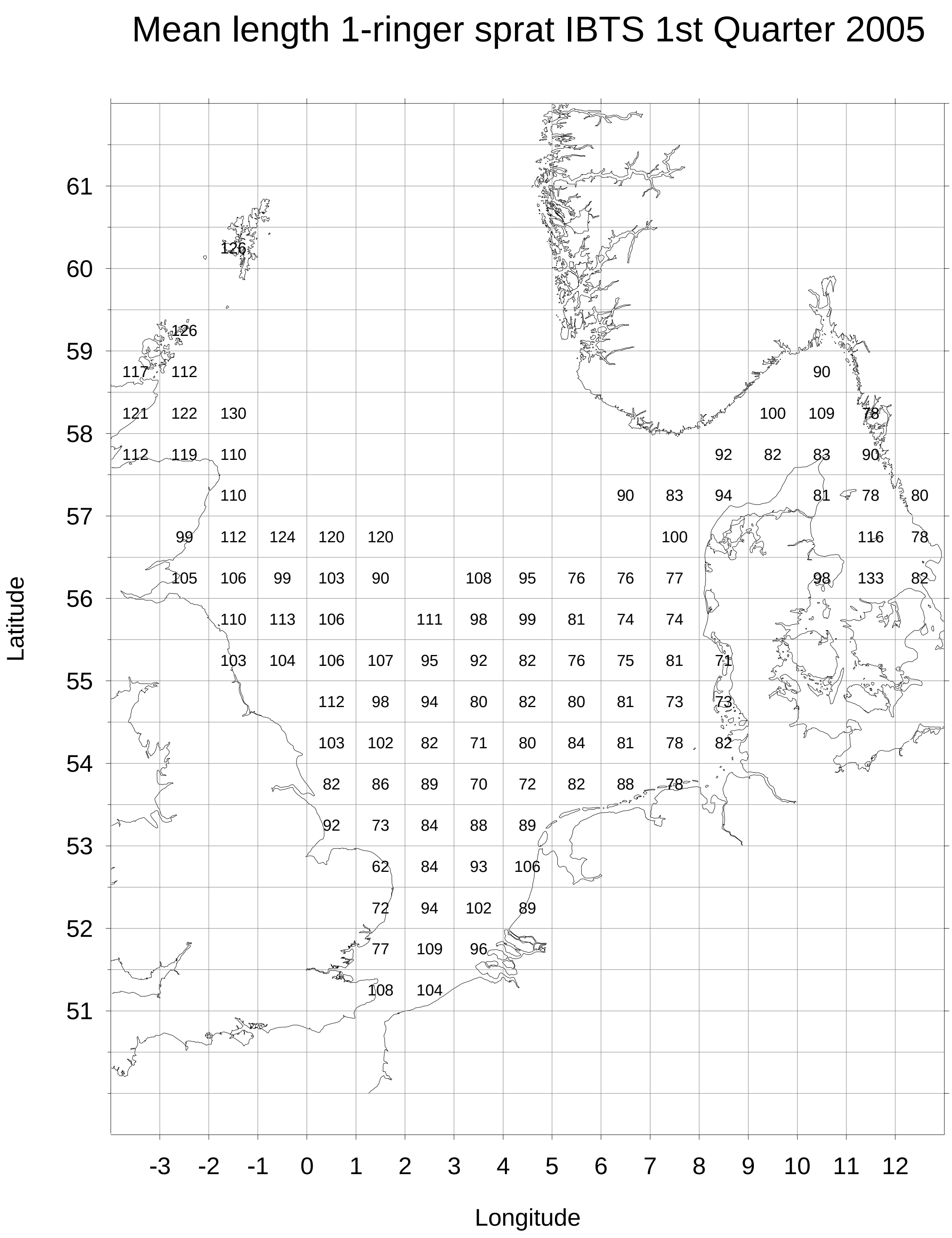
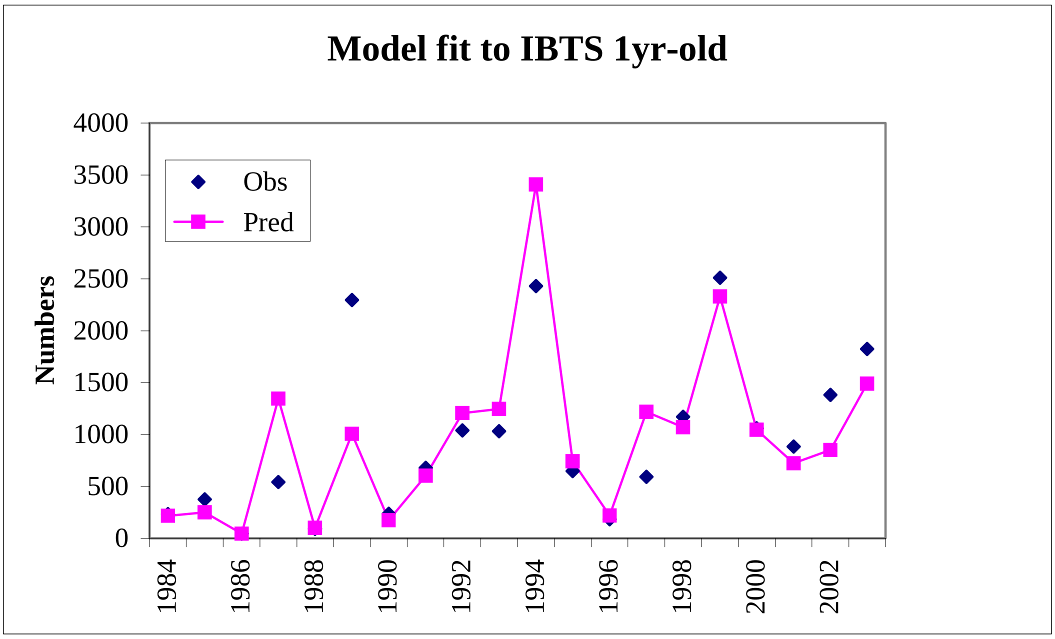


Figure 8.3.2 Mean length (mm) of age group 1 sprat in the IBTS (February) 2005 in the North Sea and Division IIIa.



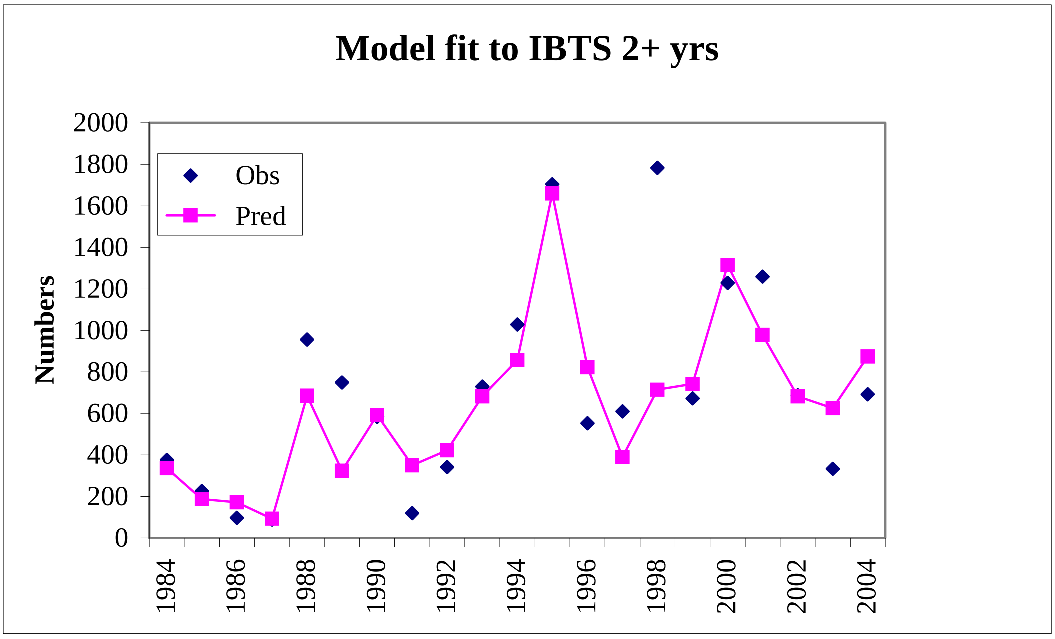


Figure 8.6.1. North Sea sprat. CSA model fits to the IBTS indices of recruits (1-yr old) and 2+. M=0.7

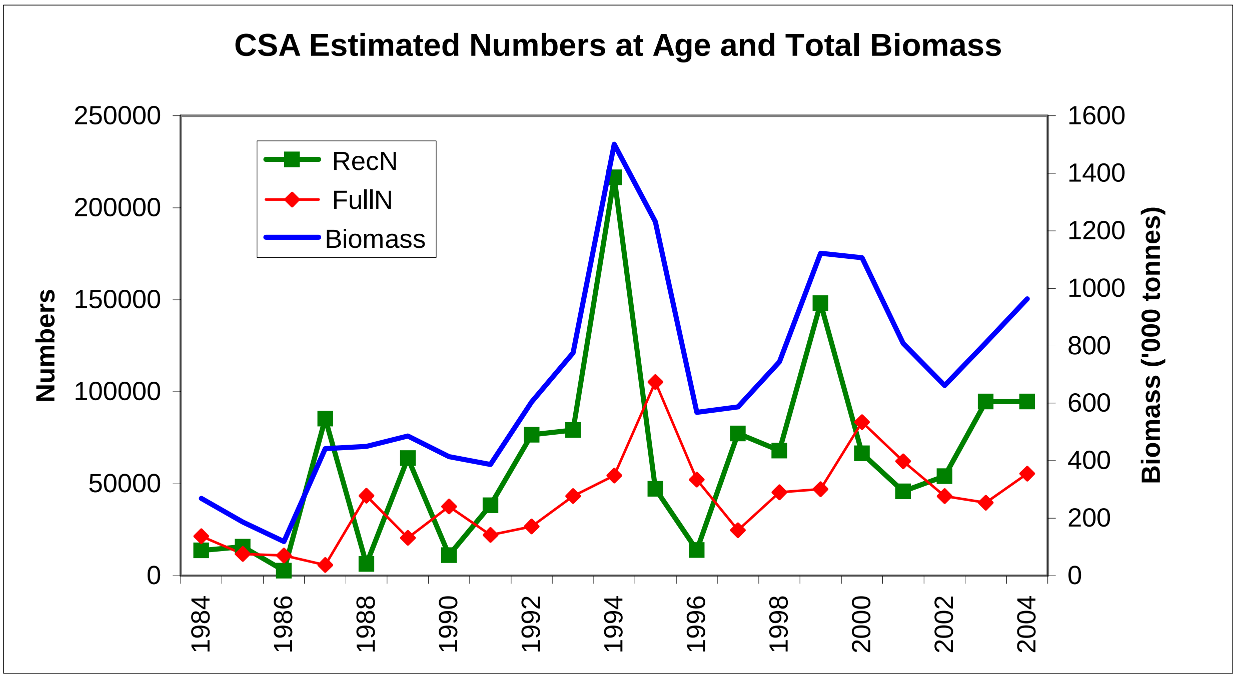
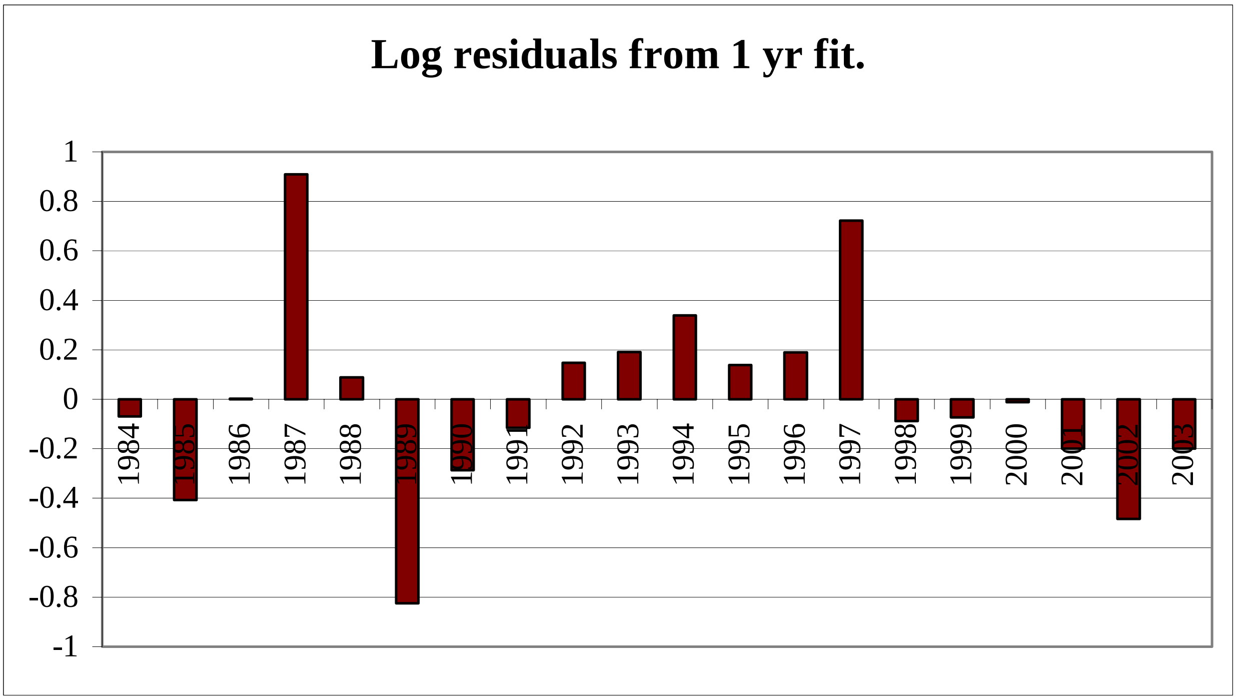


Figure 8.6.2 North Sea sprat. Biomass and numbers at age estimated by CSA



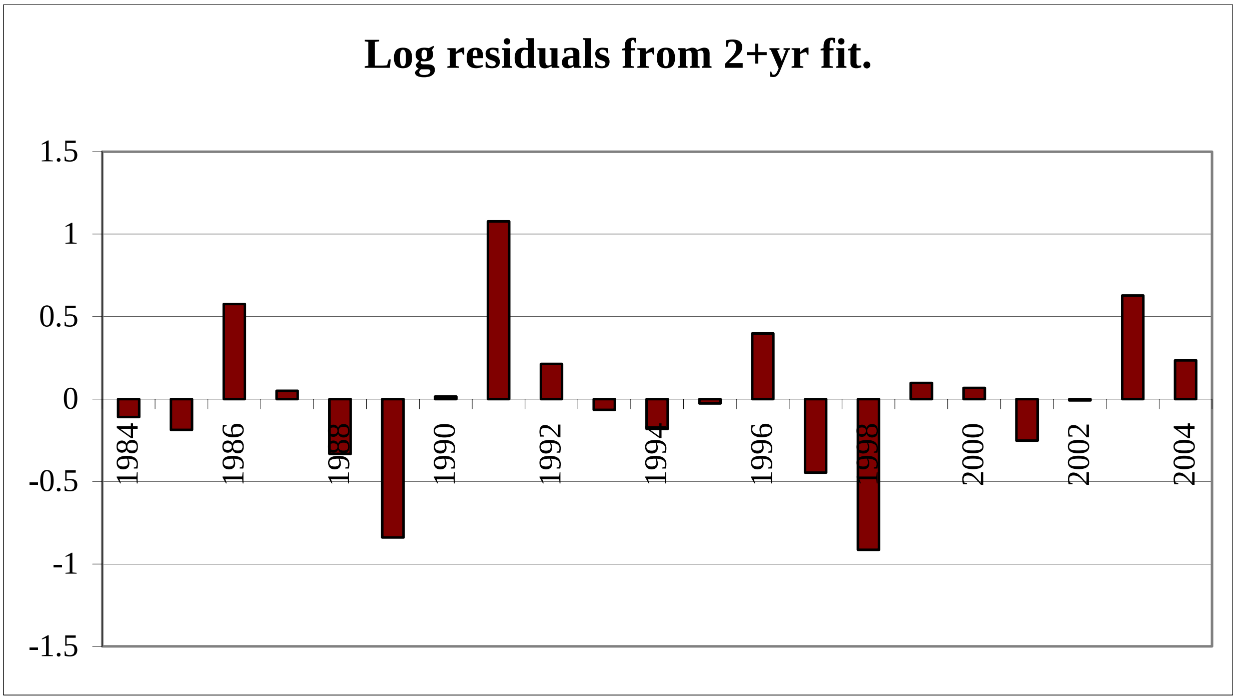


Figure 8.6.3. North Sea sprat. Log-residuals from the CSA model fit to the two stages. M=0.7

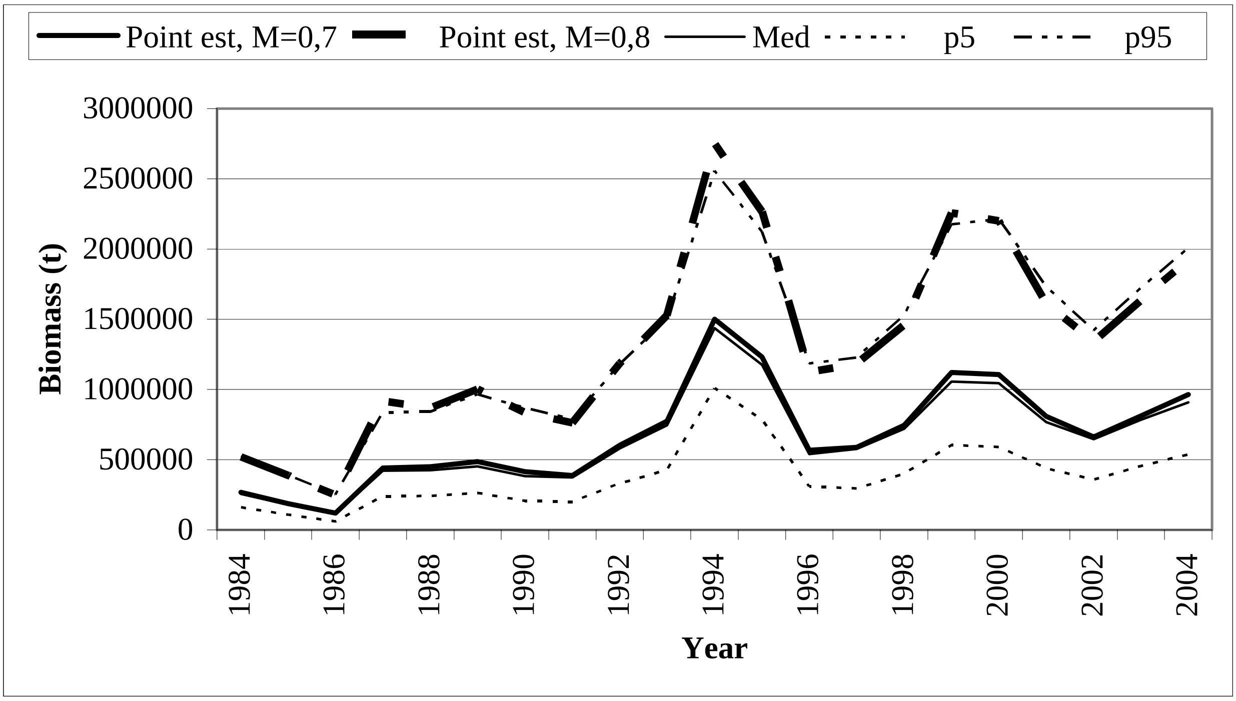


Figure 8.6.4. North Sea sprat. CSA estimated stock biomass, median and 95% C.I. For M=0.7. Stock biomass estimate for M=0.8 is shown as dotted line.

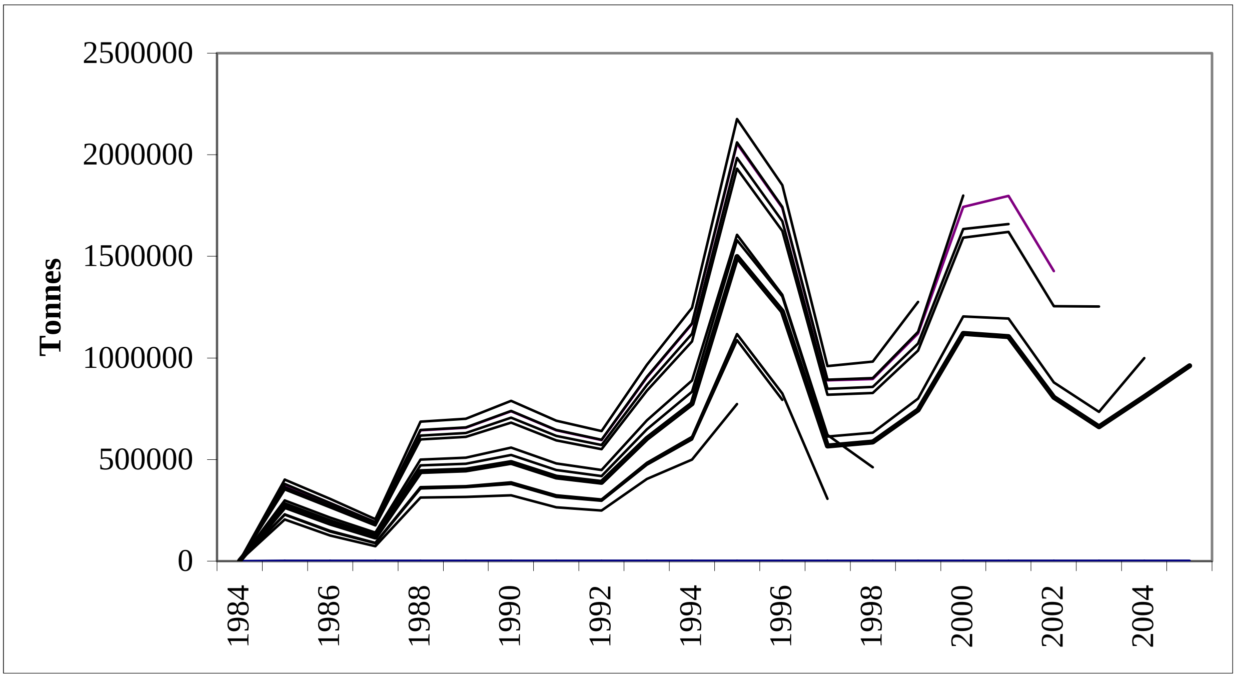


Figure 8.6.5. North Sea sprat. CSA estimated biomass, retrospective plot (M=0.7).

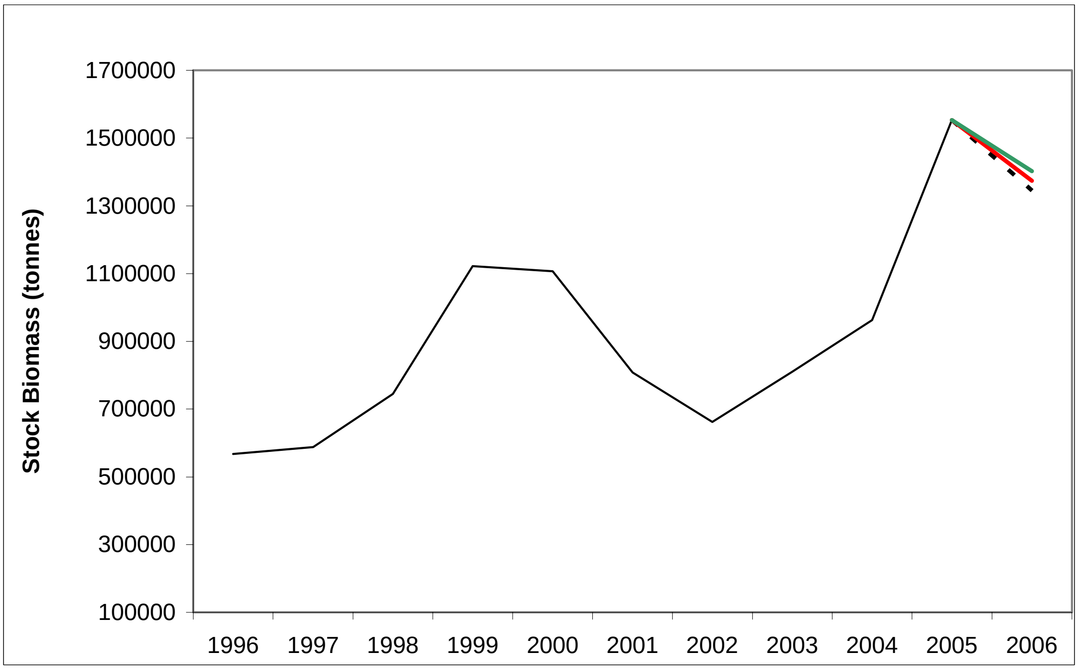


Figure 8.7.1. North Sea sprat. Stock biomass prediction for 2005 and three catch levels in 2006: 257 kt, 200 kt and 150 kt.

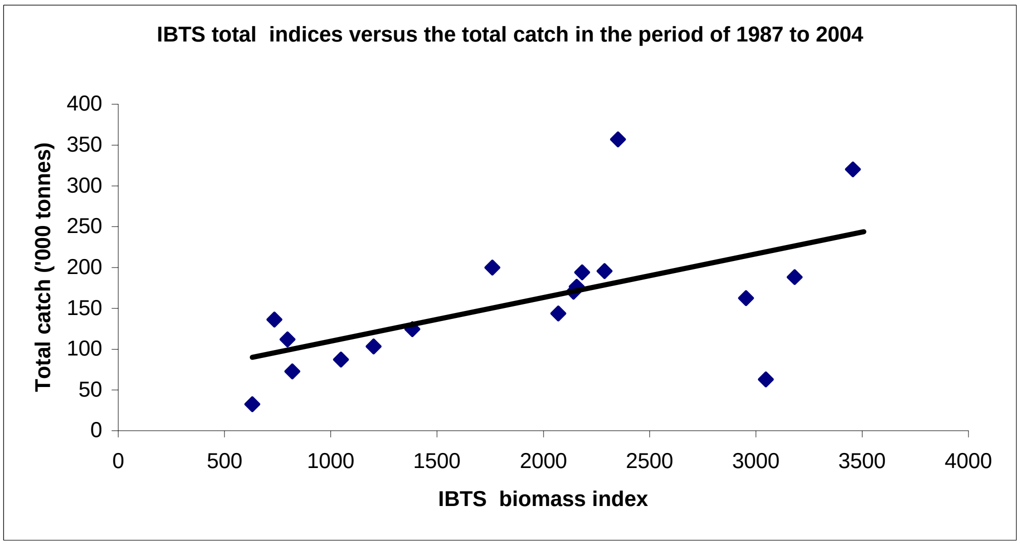


Figure 8.7.2. North Sea sprat. IBTS indices versus the total catch (1987-2004). A fitted regression line to the data results in a R-square of 0.34.

9 Sprat in Divisions VIId,e

9.1 The fishery

9.1.1 ACFM advice applicable for 2004

The TAC for this fishery was set to 9,600 t for 2003, 2004 and for 2005. No ACFM advice has been provided in recent years.

9.1.2 Catches in 2003

Table 9.1.1 shows the nominal landings in 1985–2004. The landings in 2004, as reported by UK (England and Wales) decreased and were the lowest for the period. Monthly catches for the Lyme Bay sprat fishery in the period from 1991 to 2002 are shown in Table 9.1.2. For 2003-2004 catch data per quarter were available to the working group.

9.1.3 Catch Composition

No data for the period 1999-2003 have been available to the working group. Data on catch compositions and the mean weights for 1991–1998, can be seen in the 2004-report (ICES 2004/ ACFM.18).

Table 9.1.1 Divisions VIId,e, sprat. Nominal catch (t) in 1985–2004.

Country	1985	1986	1987	1988	1989	1990	1991	1992
Denmark		15	250	2 529	2 092	608		
France	14		23	2	10			35
Netherlands								
UK (Engl.&Wales)	3 771	1 163	2 441	2 944	1 319	1 508	2 567	1 790
Total	3 785	1 178	2 714	5 475	3 421	2 116	2 567	1 825

Country	1993	1994	1995	1996	1997	1998*	1999*	2000*
Denmark								
France	2	1	0					18
Netherlands							1	1
UK (Engl.&Wales)	1 798	3 177	1 515	1 789	1 621	2 024	3 559	1 692
Total	1 800	3 178	1 515	1 789	1 621	2 024	3 560	1 711

Country	2001	2002	2003	2004*
Denmark				
France				
Netherlands				
UK (Engl.&Wales)	1 349	1 196	1 377	836
Total	1 349	1 196	1 377	836

* Preliminary

Table 9.1.2 Lyme Bay sprat fishery. Monthly catches (t) 1991-2003. UK vessels only.

Season	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
1991/92	0	0	0	205	450	952	60	358	258	109	51	0	2443
1992/93	0	0	0	302	472	189	294	248	284	158	78	0	2025
1993/94	0	8	0	156	82	302	529	208	417	134	53	0	1889
1994/95	0	0	0	299	834	545	608	232	112	68	0	0	2698
1995/96	0	0	0	154	409	301	307	151	15	80	28	4	1449
1996/97	0	0	0	309	452	586	47	243	239	74	30	0	1980
1997/98	2	0	14	259	625	105	255	19	50	184	45	0	1558
1998/99	0	0	0	337	728	206	56	318	15	149	33	0	1842
1999/00	0	0	0	699	1306	547	544	242	75	34	0	0	3447
2000/01	0	0	0.02	173	541	586	163	114	74	35.6	0	0	1686
2001/02	0	0	0	458	338	171	50	213	60	34	5	0	1329
2002/03	0	0	0	236	631	121	51	55	-	-	-	-	1094
2003/04	-	-	-	-	-	-	-	-					

10 Sprat in Division IIIa

10.1 The Fishery

10.1.1 ACFM advice applicable for 2004 and 2005

The ACFM advice on sprat management is that exploitation of sprat will be limited by the restrictions imposed on fisheries for juvenile herring. This is a result of sprat being fished mainly together with juvenile herring. The sprat fishery is controlled by by-catch ceilings of herring as well as by-catch percentage limits. No ACFM advice on sprat TAC has been given in recent years. The sprat TAC for 2004 was 50,000 t, with a restriction on by-catches of herring not exceeding 21,000 t. For 2005 the same value of TAC was set, with a restriction of a by-catch ceiling of herring of 24,150t has been set for the EU fleet. This was based on scientific information regarding the prevailing abundance of herring in relation to sprat in Div. IIIa.

10.1.2 Landings

The total landings for Division IIIa by area and country are given in Table 10.1.1 for 1974 - 2004. The total landings increased by 33% from 2003 to 2004. This increase in landings was from Skagerrak where the total landings were doubled from 5,600 t to 11,800 t. In Kattegat, the landings were approximately at the same level as in 2003. The Norwegian and Swedish landings include the coastal and fjord fisheries.

Landings by countries and by quarter are shown in Table 10.1.2. There were landings taken in all quarters. Approximately 50% of the total catch was taken in the 4th quarter. Only minor landings were taken in the 2nd. Denmark has a total ban on the sprat fishery in Division IIIa from May to September.

The Danish monitoring schemes for management purposes for species composition in the Danish small-meshed fisheries has worked well in 2004. A total of 293 samples were collected from landings taken in Division IIIa by Danish vessels. The sampling figure for 2003 was 309 samples. The total landings from the Danish small mesh fishery in 2004 were 52,100 t (all species) compared to 52,600 t in 2003.

10.1.3 Fleets

Fleets from Denmark, Norway and Sweden carry out the sprat fishery in Division IIIa.

The Danish sprat fishery consists of trawlers using a 16 mm-mesh size codend and all landings are used for fishmeal and oil production. Some of the sprat landings from Denmark and Sweden are by-catches in the herring fishery using 32 mm mesh-size cod ends.

There is a Swedish fishery directed at sprat with by-catches of herring. There is also a fishery carried out with small purse seiners at the West Coast of Sweden for human consumption.

The Norwegian sprat fishery in Division IIIa is a coastal purse seine fishery for human consumption.

10.2 Biological Composition of the Catch

10.2.1 Catches in number and weight-at-age

The numbers and the mean weight-at-age in the landings from 1995 to 2004 are presented in Table 10.2.1 and Table 10.2.2, respectively. Landings, for which samples were collected, were raised using a combination of Swedish and Danish samples, without any differentiation in types of fleets. Quarterly and annual distributions of catches by rectangle are shown in Figures 8.1.1–8.1.2.

10.2.2 Quality of catch and biological data

In 2004 Denmark has provided biological samples from all the quarters where there were landings. Sweden provided biological samples from 1st and 4th quarter in Skagerrak and only one in the 4th quarter in Kattegat. No Norwegian samples were collected. The required level of one sample per 1,000 t landed was more than met in 2004 with 59 samples from a total landing of 14,390 tonnes.

The samples were used to estimate the numbers of sprat-at-age and the mean weight-at-age, in all sprat landings (Tables 10.2.1 and Table 10.2.2 respectively). The sample size (71 samples) has decreased compared to the level in 2003 (87 samples). Thus the decrease in sampling level, the level is more than adequate. As in previous years, no samples of sprat were taken from the fisheries for human consumption. Therefore, data from the industrial landings were used for the estimation of numbers of sprat-at-age and the mean weight-at-age. Details on the sampling for biological data per country, area and quarter are shown in Table 10.2.3.

10.3 Fishery-independent information

Acoustic estimates of sprat have been available from the ICES co-ordinated Herring Acoustic surveys in Div. IIIa since 1996. In 1996 the total estimate was 7.9 x 10^8 fish or 14,267 tonnes. About 95 % of the biomass was recorded in Kattegat. There were very low estimates of sprat from 1997 to 2002, but the estimates increased to 15,000 tonnes in 2003. In 2004 the abundance was estimated to be 1,090 million individuals or 15,000 tonnes. Again sprat was only encountered in the south eastern Kattegat (ICES CM 2005/G:04). No sprat has been reported from the survey in Skagerrak in the last years.

10.4 Mean weight-at-age

Mean weights-at-age (g) in the catches during 2004 are presented, by quarter, in Table 10.2.2. The table includes mean weights-at-age for 1995-2003 for comparison. These have been very variable over time, but whether this is due to actual variation in mean weight or difficulties in ageing of sprat is uncertain.

10.5 Recruitment

The IBTS (February) sprat indices for 1984-2005 are presented in Table 10.5.1. The IBTS data are provided by rectangle in Figure 8.3.1 for age groups 1, 2 and 3+, and the mean length (mm) of 1-ringer sprat in Figure 8.3.2. The indices are calculated as mean no./hr (CPUE) weighted by area where water depths are between 10 and 150 m (ICES 1995/Assess:13). The indices were revised in 2002 (ICES 2002/ACFM:12) based on an agreement in the IBTS WG in 1999, where it was decided to calculate the sprat index as an area weighted mean over means by rectangles for the IIIa (ICES 1999/D:2). The old time-series of IBTS indices (from 1984-2001) is shown in ICES 2001/ACFM:10.

The total IBTS index for 2005 is much higher than the total index in 2004, and the second highest since 1996. In 2004 all the indices were among the lowest for the period. The 1-group and the 2+ indices in 2005 are well above the average for the period 1984-2004. The procedure for the 2005 survey did not differ from previous years. The indices does not fully reflect strong and week cohorts in sprat. This was also expressed in previous working group report (ICES 1998 ACFM :14). This can still be linked to difficulties in age determination

10.6 State of the Stock

No assessments of the sprat stock in Division IIIa have been presented since 1985 and this year is no exception. A Schaefer model was fit to the data in 1999 (ICES 1999/ACFM:12) but that attempt was not successful and was subsequently abandoned. In 2003 the Working Group agreed to explore the data for sprat in Division IIIa by means of Catch-Survey Analysis (CSA) as performed for sprat in the North Sea (ICES 2003/ACFM:17). This was re-done this year with the time series 1995-2004. The mean weights used for recruitment and fully recruited, were the same as used for the North Sea. There is a pattern in the residuals with a negative trend in the 1-group but they are small values. The estimated biomass for 2004 was about 900,000 tonnes which is considered very high for the area. It also contradict biomass estimates from the acoustic survey and the exploratory SHOT-estimate. This suggests that there may be a scaling problem with in the model which has not been solved by the working group.

The signal in the IBTS (February)-index for 2005, is an increase in the sprat stock from last year and appears to be at a level above the average for the time-series 1984-2004.

10.7 Projection of Catch and Stock

There is no relationship between the IBTS (February) index (no./h) and the total catch in the same year and the index was not considered useful for management of sprat in Division IIIa.

The estimated yield for 2005 using the total IBTS index was at the level of 30,000 tonnes (Table 10.6.1) in a SHOT-estimate (Shepherd, 1991). This is one of the highest estimated yield for the period; however, this method is not considered to provide any reliable projection under the present management regime and the IBTS index is poor for this particular stock (Figure 10.7.1).

10.8 Reference Points

There are no reference points for this stock.

10.9 Management Considerations

Sprat in Division IIIa is short-lived with large inter-annual fluctuations in stock biomass. The natural inter-annual variability in stock abundance, mainly driven by recruitment variability, is high and does not appear to be strongly influenced by the observed levels of fishing effort.

The sprat has mainly been fished together with herring, except for 1994 and 1995 when a directed sprat fishery was carried out with low by-catches of herring. The human consumption fishery takes only a minor part of the total catch. With the current management regime, where there is a by-catch ceiling limitation of herring as well as by-catch percentage limits, the sprat fishery is controlled by these factors. Attempts to assess this stock have demonstrated the need for:

- Development of a suitable biomass index
- Improvement of the ageing techniques

There is also a need for better knowledge of spawning seasons and possible recruitment from the North Sea stock.

Table 10.1.1 Division IIIa sprat. Landings in ('000 t) 1974-2004.
(Data provided by Working Group members). These figures do not in all cases correspond to the official statistics and cannot be used for management purposes.
In the period from 1982 to 1992 Sweden only reported total catches from division IIIa.

	Skagerrak				**Kattegat**			Div. IIIa	**Div. IIIa**
Year	Denmark	Sweden	Norway	**Total**	Denmark	Sweden	**Total**	Sweden	**total**
1974	17.9	2	1.2	21.1	31.6	18.6	50.2		71.3
1975	15	2.1	1.9	19	60.7	20.9	81.6		100.6
1976	12.8	2.6	2	17.4	27.9	13.5	41.4		58.8
1977	7.1	2.2	1.2	10.5	47.1	9.8	56.9		67.4
1978	26.6	2.2	2.7	31.5	37	9.4	46.4		77.9
1979	33.5	8.1	1.8	43.4	45.8	6.4	52.2		95.6
1980	31.7	4	3.4	39.1	35.8	9	44.8		83.9
1981	26.4	6.3	4.6	37.3	23	16	39		76.3
1982	10.5		1.9	12.4	21.4		21.4	5.9	39.7
1983	3.4		1.9	5.3	9.1		9.1	13.0	27.4
1984	13.2		1.8	15	10.9		10.9	10.2	36.1
1985	1.3		2.5	3.8	4.6		4.6	11.3	19.7
1986	0.4		1.1	1.5	0.9		0.9	8.4	10.8
1987	1.4		0.4	1.8	1.4		1.4	11.2	14.4
1988	1.7		0.3	2	1.3		1.3	5.4	8.7
1989	0.9		1.1	2	3.0		3	4.8	9.8
1990	1.3		1.3	2.6	1.1		1.1	6.0	9.7
1991	4.2		1.0	5.2	2.2		2.2	6.6	14.0
1992	1.1		0.6	1.7	2.2		2.2	6.6	10.5
1993	0.6	4.7	1.3	6.6	0.8	1.7	2.5		9.1
1994	47.7	32.2	1.8	81.7	11.7	2.6	14.3		96.0
1995	29.1	9.7	0.5	39.3	11.7	4.6	16.3		55.6
1996	7.0	3.5	1.0	11.5	3.4	3.1	6.5		18.0
1997	7.0	3.1	0.4	10.5	4.6	0.7	5.3		15.8
1998	3.9	5.2	1.0	10.1	7.3	1.0	8.3		18.4
1999	6.8	6.4	0.2	13.4	10.4	2.9	13.3		26.7
2000	5.1	4.3	0.9	10.3	7.7	2.1	9.8		20.1
2001	5.2	4.5	1.4	11.2	14.9	3.0	18.0		29.1
2002	3.5	2.8	0.0	6.3	9.9	1.4	11.4		17.7
2003	2.3	2.4	0.8	5.6	7.9	3.1	10.9		16.5
2004	6.2	4.5	1.1	11.8	8.2	2.0	10.2		22.0

Table 10.1.2. Division IIIa sprat. Landings of sprat ('000 t) by quarter by countries, 1994-2004.
(Data provided by the Working Group members)

	Quarter	Denmark	Norway	Sweden	Total
1994	1	0.3	0.0	0.5	0.8
	2	6.0	0.0	0.3	6.3
	3	37.0	0.1	23.0	60.1
	4	16.1	1.7	11.0	28.8
	Total	59.4	1.8	34.8	96.0
1995	1	4.8	0.1	4.8	9.7
	2	10.4	0.0	0.9	11.3
	3	19.3	0.0	2.3	21.6
	4	6.3	0.4	6.3	13.0
	Total	40.8	0.5	14.3	55.6
1996	1	5.6	+	4.2	9.8
	2	3.4		0.2	3.6
	3	+	0.4	+	0.4
	4	1.4	0.6	2.2	4.2
	Total	10.4	1.0	6.6	18.0
1997	1	0.7	-	0.3	1.0
	2	0.4	-	1.2	1.6
	3	2.3	-	0.1	2.4
	4	8.2	0.4	2.2	10.8
	Total	11.6	0.4	3.8	15.8
1998	1	4.0	0.1	0.1	4.2
	2	0.9		+	0.9
	3	1.1	0.3	0.4	1.8
	4	5.4	0.7	5.7	11.7
	Total	11.4	1.1	6.1	18.6
1999	1	3.5	0.0	4.0	7.5
	2	0.1		0.2	0.3
	3	7.4	0.1	1.9	9.4
	4	6.2	0.1	3.3	9.6
	Total	17.2	0.2	9.3	26.7
2000	1	4.1	0.1	2.3	6.5
	2	0.0		1.9	1.9
	3	4.8	0.1	0.0	4.9
	4	3.8	0.7	2.3	6.8
	Total	12.7	0.9	6.4	20.0
2001	1	2.5		2.6	5.2
	2	6.6		0.1	6.7
	3	10.2		0.1	10.2
	4	0.9	1.4	4.8	7.1
	Total	20.2	1.4	7.6	29.1
2002	1	3.8	0.0	1.4	5.2
	2	2.1		0.4	2.4
	3	5.9	0.0	0.1	6.0
	4	1.7	0.0	2.4	4.1
	Total	13.4	0.0	4.3	17.7
2003	1	3.5	0.1 [1]	1.7	5.3
	2	0.6		0.8	1.4
	3	1.0		0.7	1.7
	4	5.0	0.8 [1]	2.3	8.1
	Total	10.2	0.8 [1]	5.5	16.5
2004	1	3.1	0.0	1.4	4.5
	2	0.6		0.9	1.5
	3	3.7		0.4	4.1
	4	6.9	1.1	3.8	11.9
	Total	14.4	1.1	6.5	22.0

+ Catch record, but amount not precisely known.
[1] Preliminary figures

Table 10.2.1 Division IIIa sprat. Landed numbers (millions) of sprat by age groups in 1995-2004.

	Quarter	Age						Total
		0	1	2	3	4	5+	
1995	1		312.04	784.37	53.50	27.29	9.01	1,186.20
	2		1248.72	993.29	61.06	15.24	4.77	2,323.08
	3		1724.02	133.56	14.17			1,871.74
	4		902.76	139.95	29.95	10.58		1,083.25
	Total		4187.54	2051.17	158.68	53.12	13.77	6,464.27
1996	1		288.42	546.53	62.11	15.65	5.07	917.78
	2		0.89	414.10	42.76	0.71	0.06	458.51
	3		0.34	1.81	0.30	0.02		2.47
	4		31.19	165.65	27.34	2.03		226.21
	Total		320.84	1128.08	132.51	18.41	5.13	1,604.97
1997	1			3.43	18.31	20.60	4.59	46.94
	2		1.00	2.76	19.56	1.51	0.25	25.07
	3	4.35	209.25	9.51	1.92	6.24		231.26
	4	32.39	644.28	58.31	7.16	28.02		770.16
	Total	36.74	854.53	74.01	46.95	56.37	4.84	1,073.43
1998	1		14.91	103.38	94.00	76.99	6.34	295.61
	2		3.24	21.49	20.59	16.63	1.33	63.28
	3	53.62	26.03	41.84	5.65	0.74		127.88
	4	192.13	253.98	226.55	53.14	29.80		755.61
	Total	245.75	298.16	393.25	173.38	124.17	7.67	1,242.38
1999	1	0.0	560.5	158.0	151.2	77.4	6.8	953.9
	2		32.8	1.6	1.7	1.1	0.3	37.6
	3	9.6	741.7	46.7	6.3	5.9		810.0
	4	8.5	645.4	20.5	6.8	0.6	0.3	682.1
	Total	18.0	1,980.4	226.8	166.0	85.0	7.4	2,483.6
2000	1		116.6	384.3	40.3	7.3	1.6	550.0
	2		17.3	127.4	11.2			155.9
	3	2.1	223.3	51.4	12.2			289.1
	4	18.0	277.6	81.4	13.1	0.8		390.9
	Total	20.2	634.8	644.6	76.8	8.1	1.6	1,386.0
2001	1	0.0	342.6	173.0	73.3	10.0	1.6	600.4
	2	0.0	1746.4	13.4	0.4	0.0	0.0	1,760.2
	3	5.7	924.1	31.7	0.0	0.0	0.0	961.5
	4	22.9	488.1	39.1	18.5	1.5	0.5	570.6
	Total	28.6	3,501.2	257.2	92.2	11.5	2.1	3,892.8
2002	1	0.0	63.8	323.2	38.5	24.7	2.4	452.6
	2	0.0	185.5	63.2	4.8	1.0	0.0	254.5
	3	1.3	326.2	102.0	23.9	6.6	0.6	460.5
	4	21.3	205.4	45.9	10.6	5.9	0.4	289.6
	Total	22.5	780.9	534.3	77.9	38.2	3.4	1,457.2
2003	1	0.0	17.5	221.4	100.7	17.6	4.3	361.5
	2	0.0	2.6	49.8	24.0	5.5	2.1	84.1
	3	192.7	10.9	31.6	5.4	2.7	0.0	243.3
	4	321.6	131.7	100.6	42.5	3.4	2.3	602.2
	Total	514.3	162.7	403.4	172.6	29.2	8.8	1,291.1
2004	1		539.6	39.3	47.2	20.7	8.0	654.8
	2		36.7	22.3	44.9	11.8	1.1	116.8
	3	10.0	254.4	19.4	4.1	2.4		290.3
	4	874.0	366.8	33.0	24.9	3.4	0.3	1,302.3
	Total	883.9	1,197.5	113.9	121.1	38.3	9.3	2,364.2

Table 10.2.2. Division IIIa Sprat. Quarterly mean weight-at-age (g) in the landings. (1994-1995 and 1998-2004 Danish and Swedish data, 1996-1997 Danish data)

Year	Age							SOP
	Quarter	0	1	2	3	4	5+	Corrected landings
1995	1		2.3	8.9	18.8	22.9	26.1	9,519
	2		2.9	7.3	12.4	23.7	27.0	12,054
	3		10.5	18.4	15.5			20,765
	4		11.5	15.6	15.5	18.2		13,262
Weighted mean			7.8	9.2	15.3	22.2	26.4	55,600.3
1996	1		9.2	10.6	14.2	17.4	17.7	9,724
	2		8.6	12.5	15.1	17.4	17.0	5,847
	3		4.2	10.9	15.5	21.0		26
	4		4.2	10.9	15.5	21.0		2,403
Weighted mean			8.7	7.6	14.8	19.6	17.7	18,000.3
1997	1			17.3	18.6	21.8	26.0	968
	2		8.3	17.6	20.0	22.1	31.0	489
	3	4.1	13.6	17.2	21.1			3,062
	4	4.7	14.7	17.5		19.5		11,176
Weighted mean		4.6	14.4	17.5	19.6	20.4	26.3	15,696.2
1998	1		6.6	14.0	18.0	19.0	21.3	4,828
	2		6.6	13.9	17.8	18.7	21.0	1,027
	3	4.6	17.7	20.7	22.1	24.7		1,718
	4	4.8	17.5	20.4	22.5	27.5		11,998
Weighted mean		4.8	16.9	18.5	19.6	21.2	21.2	19,570.0
1999	1		4.6	6.4	17.3	13.4	13.1	7,319
	2		5.3	17.1	18.6	22.2	17.8	264
	3	3.0	11.4	12.6	16.8	18.3		9,257
	4	4.8	13.9	17.6	20.8	21.2	23.5	9,521
Weighted mean		3.8	10.2	8.8	17.4	13.9	13.7	26,361.0
2000	1		5.3	13.1	15.3	20.7	22.7	6,438
	2		5.2	12.8	14.1			1,873
	3	4.3	16.6	18.0	21.9			4,897
	4	7.0	16.9	19.9	22.1	24.6		6,742
Weighted mean		6.7	14.3	14.3	17.3	21.1	22.7	19,949.3
2001	1		3.77	14.34	16.24	17.75	17.33	5,168
	2		3.72	6.49	21.00			6,598
	3	5.35	10.50	12.06		13.00		10,114
	4	5.06	12.00	19.66	22.64	19.35	25.60	7,200
Weighted mean		5.1	6.7	14.5	17.5	18.0	19.2	29,078.5
2002	1		5.70	12.70	17.30	19.30	20.60	5,411
	2		7.90	13.70	16.00	17.00		2,175
	3	8.00	12.40	15.10	18.10	17.00	17.00	5,900
	4	5.70	15.60	18.20	21.60	21.50	22.00	4,278
Weighted mean		5.8	11.6	13.7	18.1	19.2	20.1	17,763.2
2003	1		6.00	14.10	16.20	18.90	23.76	5,293
	2		5.00	16.00	17.60	21.60	22.76	1,401
	3	4.00	12.00	19.00	19.00	21.00		1,661
	4	8.90	16.40	21.10	21.70	25.20	24.33	8,211
Weighted mean		7.1	14.8	16.5	17.8	20.3	23.7	16,565.3
2004	1		4.60	14.60	17.80	17.30	17.30	4,392
	2		7.00	13.60	16.70	17.00	19.50	1,532
	3	3.00	14.10	16.70	20.00	21.40		4,075
	4	3.50	16.80	19.90	22.20	20.90	28.00	10,508
Weighted mean		3.5	10.4	16.3	18.4	17.8	17.9	20,507.7

Table 10.2.3 Division IIIa sprat. Sampling commercial landings for biological samples in 2004.

Country Area	**Quarter**	**Landings (tonnes)**	**No. samples**	**No. meas.**	**No. aged**
Denmark	1	1182	4	423	197
Skagerrak	2	5	3	4	0
	3	1456	2	442	88
	4	3564	12	2,280	644
	Total	6207	21	3,149	929
Denmark	1	1924	14	2,358	758
Kattegat	2	638	1	207	100
	3	2242	11	1,953	621
	4	3378	12	1,874	576
	Total	8183	38	6,392	2,055
Norway	1				
Skagerrak	2				
	3				
	4	1100	0	0	0
	Total	1100	0	0	0
Sweden	1	360	4	318	307
Skagerrak	2	557	0	0	0
	3	192	0	0	0
	4	3342	7	450	447
	Total	4451	11	768	754
Sweden	1	990	0	0	0
Kattegat	2	310	0	0	0
	3	247	0	0	0
	4	491	1	100	100
	Total	2038	1	100	100
Denmark		14390	59	9,541	2,984
Norway		1100			
Sweden		6489	12	868	854
	Total	21979	71	10,409	3,838

[1] Preliminary data

Table 10.5.1. Division IIIa sprat. IBTS(February) indices of sprat per age group 1984-2005. (Mean number per hour per rectangle weighted by area. Only hauls taken in depth of 10-150 m are included).

Year	No Rect	No hauls	Age Group					
			1	2	3	4	5+	Total
1984	15	38	5,676	869	205	79	64	6,892
1985	14	38	2,158	2,347	393	140	51	5,089
1986	15	38	629	1,979	2,035	144	38	4,825
1987	16	38	2,736	2,846	3,003	2,582	157	11,324
1988	13	38	915	5,263	1,485	2,088	453	10,203
1989	14	38	414	911	989	555	136	3,004
1990	15	38	418	224	65	61	46	814
1991	14	38	496	732	700	128	376	2,433
1992	16	38	5,994	599	264	204	75	7,135
1993	16	38	1,590	4,169	907	199	240	7,105
1994	16	38	1,789	716	1,021	313	70	3,908
1995	17	38	2,204	1,770	35	45	4	4,058
1996	15	38	186	5,627	751	128	218	6,909
1997	16	41	233	391	1,239	139	135	2,137
1998	15	39	72	1,585	620	1,618	522	4,416
1999	16	42	4,535	355	250	44	314	5,498
2000	16	41	292	738	60	51	24	1,165
2001	16	42	6,540	1,144	677	92	46	8,499
2002	16	42	1,119	966	87	58	13	2,242
2003	17	46	463	1,247	1,172	381	125	3,388
2004	16	41	403	49	157	87	24	719
2005	17	50	3,314	1,563	471	837	538	6,723

Table 10.6.1. Division IIIa Sprat. SHOT forecast of landings in 2005 using total landings and the total IBTS-indices as input data.

IIIa SHOT forecast spreadsheet version 4

Total Index February 2005

running recruitment weights

older	0.00		G-M =	0.00
central	1.00		exp(d)	1.00
younger	0.00	ex	exp(d/2)	1.00

Year	Land -ings	Recrt Index	W'td Index	Y/B Ratio	Hang -over	Act'l Prodn	Est'd Prodn	Est'd SQC.	Act'l Expl Biom	Est'd Expl Biom	Est'd Land -ings
1984	36.1	6892		0.77	0.23				47		
1985	19.7	5089	5089	0.77	0.23	15			26		
1986	10.8	4825	4825	0.77	0.23	8	14	15	14	20	15
1987	14.4	11324	11324	0.77	0.23	15	26	23	19	29	23
1988	8.7	10203	10203	0.77	0.23	7	18	18	11	23	18
1989	9.8	3004	3004	0.77	0.23	10	4	5	13	7	5
1990	9.7	814	814	0.77	0.23	10	1	3	13	4	3
1991	14	2433	2433	0.77	0.23	15	4	6	18	7	6
1992	10.5	7135	7135	0.77	0.23	9	15	15	14	19	15
1993	9.1	7105	7105	0.77	0.23	9	14	13	12	17	13
1994	96	3908	3908	0.77	0.23	122	7	8	125	10	8
1995	55.6	4058	4058	0.77	0.23	44	16	34	72	45	34
1996	18	6909	6909	0.77	0.23	7	30	36	23	47	36
1997	15.8	2137	2137	0.77	0.23	15	9	11	21	14	11
1998	18.4	4416	4416	0.77	0.23	19	18	18	24	23	18
1999	26.7	5498	5498	0.77	0.23	29	23	22	35	28	22
2000	20.1	1165	1165	0.77	0.23	18	5	10	26	13	10
2001	29.1	8499	8499	0.77	0.23	32	37	33	38	43	33
2002	17.7	2242	2242	0.77	0.23	14	10	14	23	18	14
2003	16.5	3388	3388	0.77	0.23	16	15	16	21	20	16
2004	22	719	719	0.77	0.23	22	3	6	29	8	6
2005		6723	6723	0.77	0.23		31	29		38	29

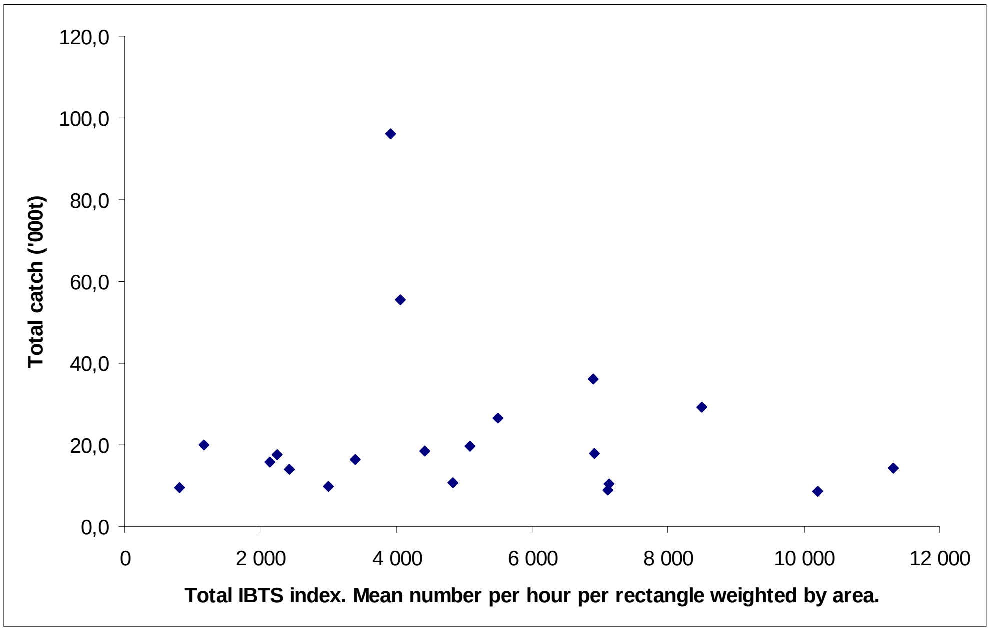


Figure 10.7.1. Division IIIa sprat IBTS indices vs the total catches in 1984-2005.

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2. Dutch discard programme. Olvin van Keeken
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5. Spatial Distribution of the German Pelagic Freezer Trawler Fleet´s Activity in 2003 and 2004 obtained by VMS. Jens Ulleweit, Christopher Zimmermann
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23. Survey indices of abundance for herring in the Irish Sea (Area VIIaN): 1992 – 2004. Beatriz Roel
24. Comparison of North Sea herring management 1962 to 1978 and 1987 to 2003. John Simmonds
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Appendix 1

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

8 - 17 March 2005

LIST OF PARTICIPANTS

NAME	ADDRESS	TELEPHONE	FAX	E-MAIL
John Boyd	Marine Institute Galway Ireland	+353 91 730444	+ 353 91 730477	John.boyd@marine.ie
Max Cardinale	Institute for Marine Research P.O. Box 4 45332 Lysekil Sweden	+46 523 18750	+46 523 13977	massimiliano.cardinale@fiskeriverket.se
Maurice Clarke	The Marine Institute Parkmore Galway Ireland	+353 1 8228354	+353 1 8205078	maurice.clarke@marine.ie
Lotte Worsøe Clausen	Danish Institute of Fisheries Research Charlottenlund Castle Dk-2920 Charlottenlund Denmark	+45 33 96 33 64	+45 33 96 33 33	law@dfu.min.dk
Mark Dickey-Collas (Chair)	RIVO P.O. Box 68 1970 AB IJmuiden The Netherlands	+31 255 564 685	+31 255 564 644	mark.dickeycollas@wur.nl
Jørgen Dalskov	Danish Institute of Fisheries Research Charlottenlund Castle Dk-2920 Charlottenlund Denmark	+45 33 96 33 80	+45 33 96 33 33	jd@dfu.min.dk
Tomas Gröhsler	Institute for Baltic Sea Fisheries An der Jägerbäk 2 18069 Rostock-Marienehe Germany	+49 381 810 267	+49 381 810 445	tomas.groehsler@ior.bfa-fisch.de
Stephen Keltz	Fisheries Research Services Marine Laboratory P.O. Box 101 375 Victoria Road Aberdeen AB11 9DB United Kingdom	+44 1224	+44 1224 295511	s.j.keltz@marlab.ac.uk
Olvin van Keeken	RIVO P.O. Box 68 1970 AB IJmuiden The Netherlands	+31 255 564 675	+31 255 564 644	olvin.vankeeken@wur.nl
Henrik Mosegaard	Danish Institute of Fisheries Research Charlottenlund Castle Dk-2920 Charlottenlund Denmark	+45 33 96 34 61	+45 33 96 33 33	hm@dfu.min.dk

NAME	ADDRESS	TELEPHONE	FAX	E-MAIL
Peter Munk	Danish Institute of Fisheries Research Charlottenlund Castle Dk-2920 Charlottenlund Denmark	+45 33 96 34 09	+45 33 96 34 34	pm@dfu.min.dk
Beatriz Roel	CEFAS Laboratory Pakefield Road Lowestoft Suffolk NR33 OHT United Kingdom	+44 1 502 52 4358	+44 1502 524 511	b.a.roel@ cefas.co.uk
Norbert Rohlf	Leibniz-Institut für Meereswissenschaften Düsternbrooker Weg 20 D-24105 Kiel Germany	+49 431 600 1821	+49 431 600 1800	nrohlf@ifm-geomar.de
John Simmonds	FRS Marine Laboratory Aberdeen P.O. Box 101 Victoria Road Aberdeen AB11 9DB United Kingdom	+44 1224 295 366	+44 1224 295511	simmondsej@ marlab.ac.uk
Dankert Skagen	Institute of Marine Research P.O. Box 1870, Nordnes 5024 Bergen Norway	+47 55 238 419	+47 55 238 555	dankert@imr.no
Else Torstensen	Institute of Marine Research, Flødevigen N-4817 His Norway	+47 370 59 000 Direct +47 370 59 053	+44 370 59 001	else.torstensen@ imr.no
Jens Ulleweit	Bundesforschungsanstalt für Fischerei Institut für Seefischerei Palmaille 9 D-22767 Hamburg Germany	+49 40 38905 217	+49 40 38905 263	jens.ulleweit@ish.bfa-fisch.de
Christopher Zimmermann	Institute for Sea Fisheries Palmaille 9 D-22767 Hamburg Germany	+49 40 38905 266	+49 40 38905 263	czimmermann@ish.bfa-fisch.de

Appendix 2 - Stock Annex

Quality Handbook ANNEX: hawg-her47d3

Stock specific documentation of standard assessment procedures used by ICES.

Stock: North Sea Autumn Spawning Herring (NSAS)

Working Group: Herring Assessment WG for the Area south of 62°N

Date: 17 March 2005

Authors: C. Zimmermann (ed.), J. Dalskov, M. Dickey-Collas, H. Mosegaard, P. Munk, J. Nichols, M. Pastoors, N. Rohlf, E.J. Simmonds, D. Skagen

A. General

A.1. Stock definition: Autumn spawning herring distributed in ICES area IV, Division IIIa and VIId. Mixing with other stocks occurs especially in Division IIIa (with Western Baltic Spring Spawning herring).

A.2. Fishery

North Sea Autumn Spawners are exploited by a variety of fleets, ranging from small purse seiners to large freezer trawlers, of different nations (Norway, Denmark, Sweden, Germany, The Netherlands, Belgium, France, UK, Faroe Islands). The majority of the fishery takes place in the Shetland-Orkney area in the 2nd and 3rd quarter, and in the English Channel (Division VIId) in the 4th quarter. Juveniles are caught in Division IIIa and as by-catch in the industrial fishery in the central North Sea. For management purposes, 4 fleets are currently defined: Fleet A is harvesting herring for human consumption in IV and VIId, but includes herring by-catches in the Norwegian industrial fishery; fleet B is the industrial (small mesh, <32 mm mesh size) fleet of EU nations operating in IV and VIId. North Sea Autumn spawners are also caught in IIIa in fleets C (human consumption) and D (small mesh).

A.3. Ecosystem aspects:

Herring is the key pelagic species in the North Sea and is thus considered to have major impact as prey and predator to most other fish stocks in that area.

The North Sea is semi-enclosed and situated on the continental shelf of North-western Europe and is bounded by England, Scotland, Norway, Sweden, Denmark, Germany, the Netherlands, Belgium and France. It covers an area of 745,950 km^2 of which the greater part is shallower than 200 m. It is one of the most diverse coastal regions in the world, with a variety of coastal habitats (fjords, estuaries, deltas, banks, beaches, sandbanks and mudflats, marshes, rocks and islands), and four ecological seasons. It is a highly productive (>300 gC m^{-2} yr^{-1}) ecosystem but with primary productivity varying considerably across the sea. The highest values of primary productivity occur in the coastal regions, influenced by terrestrial inputs of nutrients, and in areas such as the Dogger Bank and tidal fronts. Changes observed in trophic structure are indicative of a trend towards a decreasing resilience of this ecosystem. This trend is partially a response to inter-annual changes in the physical oceanography of the North Atlantic.

Herring are an integral and important part of the pelagic ecosystem in the North Sea. As plankton feeders they form an important part of the food chain up to the higher trophic levels. Both as juveniles and as adults they are an important source of food for some demersal fish and for sea mammals. Over the past century the top predator, man, has exerted the greatest influence on the abundance and distribution of herring in the North Sea. Spawning stock biomass has fluctuated from estimated highs of around 4.5 million tonnes in the late 1940s to a lows of less than 100,000 tonnes in the late 1970s. The species has demonstrated a robustness in relation to recovery from such low levels once fishing mortality is curtailed in spite of recruitment levels being adversely affected.

Their spawning and nursery areas, being near the coasts, are particularly sensitive and vulnerable to anthropogenic influences. The most serious of these is the ever increasing pressure for marine sand and gravel extraction. This has the potential to seriously damage and destroy the spawning habitat and disturb spawning shoals and destroy spawn if carried out during the spawning season. Similarly, trawling at or close to the bottom in known spawning areas can have the same detrimental effects. It is possible that the disappearance of spawning on the western edge of the Dogger bank could well be attributable to such anthropogenic influences.

In more recent years the oil and gas exploration in the North Sea has represented a potential threat to herring spawning although great care has been taken by the industry to restrict their activities in areas and at times of known herring spawning activity.

By-catch and Discard

By-catch consists of the retained ‘incidental’ catch of non-target species and discard is a deliberately (or accidentally) abandoned part of the catch returned to the sea as a result of economic, legal, or personal considerations. This section therefore deals with these two elements of the fishery, looking specifically at fishery-related issues. Cetacean, seabird and other threatened, rare and iconic species which may form part of a by-catch are considered separately in the next section.

Incidental Catch: The incidental catch of non-target species in the North Sea pelagic herring fishery in general is considered to be low. A recent study (Pierce et al, 2002) investigated incidental catch from commercial pelagic trawlers over the period January to August 2001. The target species, herring, accounted for 98% by weight of the overall catch with an overall incidental catch of 2.3%. Mackerel, which are known to occur in mixed schools with herring in division IVa was the main by-catch species, accounting for 69% of by-catch by weight. Haddock (25.7% of by-catch by weight), horse mackerel *Trachurus trachurus* (4.8%) and whiting *Merlangius merlangus* (0.4%) were all present in samples. However, onboard sampling over 2002 by Scottish and German observers found substantial discards of herring, taken as by-catch in the mackerel fishery over the 3 rd and 4th quarters, after herring quotas had been exhausted.

Discards and slipping: The indications are that large-scale discarding is not widespread in the directed North Sea herring fishery. A number of direct-observer surveys have recently been conducted on Scottish and Norwegian pelagic trawlers, based on observation of 222 hauls catching 9,889 tonnes fish (Napier et al, 2002) over 2000 - 2002. The overall discard rate was 4.2%, although that from pelagic trawlers of 6.6% was substantially higher than that from pursers (0.6%). These discard rates were higher than the overall figure of 2.8% recorded in an earlier study (Napier et al, 1999) which were evenly distributed between pursers and trawlers. This indicates that the different discard rates between the different fishing types in the later study were more a function of fishing location and stock size compositions rather than any gear-specific size selectivity. Some discarding, in the form of wastage (i.e. fish left meshed in the net or in the cod-end of trawls), was associated with almost all pelagic catches but the actual quantities of fish involved were low (2% of total discarded fish). In both studies by Napier et al., most of the observed discarding occurred through slipping, i.e. opening the net and releasing the fish before they were pumped on-board. This occurred when catch volumes were too small, or the size of fish was too small or the fish were poor in quality. For both pursers and trawlers ‘poor’ fish quality was a significant cause of discarding. The size of the catch was also a significant cause of discarding from trawlers, either because the catch was too small or too large, with boats either discarding a small proportion or all of the catch. The recent influence of strong herring year classes was apparent in the composition of discards with smaller, younger fish accounting for a high proportion of the fish discarded in 2001. However surveys on the reasons why vessels discarded fish showed that larger discarding events (i.e. those >500 kg) were equally likely to the fish being of poor quality (trawlers) or the catch exceeded the vessel’s capacity or market requirements (pursers). No data on survival of discarded fish has been collected but it is considered likely that mortality rates will be significant.

Ecosystem Considerations. The incidental non-target fish catch by directed North Sea herring fisheries appears to be low (ca. 2%), mainly consisting of mackerel when fishing mixed shoals. This infers that the ecosystem level implications of incidental fish catches are negligible. The discard of unwanted herring, mostly in the form of high-grading to improve catch quality and grade sizes of fish between 2-4 years of age (see Section above) is also low, being around 3,250 tonnes (2000) and 750 tonnes (2001) for the Scottish and Norwegian and Scottish pursers and refrigerated seawater tank (RSW) pelagic trawlers operating in ICES division IVa. For both years, this was equivalent to about 10.4% by weight of the total landings. Of more concern are discards of herring from other pelagic fisheries, especially that for mackerel, where more substantial discarding of herring occurs when quotas for herring are exhausted. National reports to ICES over 1996 to 2002 suggest that total herring discards have varied between 1,500 tonnes to an unprecedented 17,000 tonnes in 2002 (reflecting onboard sampling by Scotland and Germany that observed substantial discards of herring in the mackerel fishery in the 3rd and 4th quarter in Division IVa (W)). Assuming a distribution and yield of the international mackerel fishery in IVa in 2002 to be similar to that in 2001, herring discards of all fleets could be as high as 50,000 t. This would increase the total catch in the North Sea by almost 15% and would certainly have an influence on the North Sea autumn spawning stock assessment and the perception of stock size. Discarding behaviour appears to have changed again in 2003, when herring TAC has been increased by 50%, and at the same time the mackerel TAC has been reduced by more than 5%.

Interactions with Rare, Protected or Icon Species: Interactions between the directed North Sea herring fishery with rare, protected or icon species are, in general, considered to be exceptional. Species which may interact with the fishery are considered below.

Cetacean by-catch: Since 2000, the Sea Mammal Research Unit (SMRU) of St. Andrew’s University in Scotland, under contract to DEFRA, has carried out a number of surveys to estimate the level of by-catch in UK pelagic fisheries. SMRU, in collaboration with the Scottish Pelagic Fishermen’s Association, placed observers on board thirteen UK vessels for a total of 190 days at sea, covering 206 trawling operations around the UK. To date, no cetacean by-catch has been observed in the herring pelagic fishery in the North Sea. There is currently an ongoing observer programme in the UK monitoring cetacean by-catch rates in pelagic trawl fisheries with results due at the end of September 2003 and it is understood that this confirms that cetacean by-catch by the pelagic trawl fishery is negligible (Northridge, pers. comm.). Pierce (2002) also reports that no by-catches of marine mammals were observed over 69 studies hauls and considers that the underlying rate for marine mammals in the pelagic fisheries studies (pelagic trawls in IVa and VIa) is no more than 0.05 (i.e. five events per 100 hauls) and may well be considerably lower than this.

Other than the above, there are no reliable estimates of by-catch for pelagic trawl fisheries, though observations have been made and by-catch rates have been established for several fisheries. Kuklik and Skóra (2003) refer to a single record of a harbour porpoise (*Phocoena phocoena*) bycaught in a herring trawl in the Baltic. Observations in several other pelagic trawl fisheries were reported by Morizur et al. (1999) and Couperus (1997). All appear to agree that incidental catches of cetaceans in the Dutch pelagic trawl fishery are largely restricted to late-winter/early-spring in an area along the continental slope southwest of Ireland.

On 24 July 2003 the European Commission issued a proposal for a Council Regulation to address the problem of cetacean by-catch in various fisheries. For the North Sea (ICES IV) 5% of pelagic trawl fisheries would have to be monitored by observers. In the eastern channel 5% of pelagic trips would have to be monitored from April to November but 10% from December to March. The Commission has asked the Council to adopt this proposal by 1 July 2004.

Seal by-catch: The by-catch of seals in directed pelagic herring fishery in the North Sea is reported to be “very rare” (Aad Jonker, pers. comm.). Independent verification also confirms this to be so, with perhaps one animal being caught by the whole North Sea fleet a year (Bram Couperus (RIVO), pers. comm.). Northridge (2003) observed 49 seals taken in 312 pelagic trawl tows throughout UK waters and reports that the fishery in North-western Scotland has the highest observed seal by-catch levels of UK pelagic trawl fisheries, possible amounting to dozens per year. Although not confirmed, it was assumed that the majority were grey seal *Halichoerus grypus*. This species is mainly distributed around the Orkneys and Outer Hebrides – out of a UK population of 129,000, only around 7,000 and 5,900 are distributed off the Scottish and English North Sea coasts respectively (SCOS, 2002), and so by-catch rates in the North Sea are likely to be substantially less than off the NW Scottish coast. The eastern Atlantic population of the Grey seal is not considered to be threatened.

Other by-catch: Sharks are occasionally caught by pelagic trawlers in the North Sea, although this is rare with a maximum of two fish per trip (Aad Jonker, pers. comm.). Survival rates are apparently high, with sharks being released during or after the cod-end is being emptied. The species are unknown, although blue shark *Prionace glauca*, which preys primarily upon schooling fishes such as anchovies, sardines, herring, are known to have been caught by pelagic trawls off the SW English coast (Bram Couperus (RIVO), pers. comm.). Gannets (*Morus bassanus*), which frequently dive at and around nets, were observed by Napier et al. (2002) entangled in the nets but were not present in samples. Actual mortality rates of caught gannets have not been assessed in detail, and some have been observed alive after release from the gear. An extrapolation from observed mortalities corresponds to around 560 gannet deaths per year, although this is based on a relatively low sample frame. Seabird by-catch in the North Sea is considered to be comparatively rare compared to the NW Scotland where 1-3 birds may be caught, esp. in grounds off St. Kilda (Aad Jonker (former freezer trawler skipper), pers. comm.). RIVO observers in the North Sea only recorded one incident of seabird by-catch over 10 trips (Bram Couperus (RIVO), pers. comm.).

B. Data

B.1. Commercial catch:

Commercial catch is obtained from national laboratories of nations exploiting herring in the North Sea. Since 1999 (catch data 1998), these labs have used a spreadsheet to provide all necessary landing and sampling data, which was developed originally for the Mackerel Working Group (WGMHSA) and further adapted to the special needs of the Herring Assessment Working Group. The current version used for reporting the 2003 catch data was v1.6.4. The majority of commercial catch data of multinational fleets was provided on these spreadsheets and further processed with the SALLOCL-application (Patterson, 1998). This program gives the needed standard outputs on sampling status and biological parameters. It also clearly documents any decisions made by the species co-ordinators for filling in missing data and raising the catch information of one nation/quarter/area with information from another data set.

Transparency of data handling by the Working Group. The current practice of data handling by the Working Group is that the data received by the co-ordinators is available in a folder called "archive". These high-resolution data are not reproduced in the report. The archived data contains the disaggregated dataset (disfad), the allocations of samples to unsampled catches (alloc), the aggregated dataset (sam.out) and (in some cases) a document describing any problems with the data in that year.

Current methods of compiling fisheries assessment data. The species co-ordinator is responsible for compiling the national data to produce the input data for the assessments. In addition to checking the major task involved is to allocate samples of catch numbers, mean length and mean weight-at-age to unsampled catches. There are at present no defined criteria on how this should be done, but the following general process is implemented by the species co-ordinators. Searches are made for appropriate samples by gear (fleet) area quarter, if an exact match is not available the search will move to a neighbouring area if the fishery extends to this area in the same quarter. More than one sample may be allocated to an unsampled catch, in this case a straight mean or weighted mean of the observations may be used. If there are no samples available the search will move to the closest non-adjacent area by gear (fleet) and quarter, but not in all cases.

The Working Group acknowledges the effort some members have made to provide "corrected" data, which in some cases differ significantly from the officially reported catches. Most of this valuable information is gathered on the basis of personal knowledge of the fishery and good relations between the scientist responsible and the fishermen. The WG is aware of the problem that this knowledge might be lost if the scientist leaves, and asks the national laboratories to ensure continuity in data provision. In addition the Working Group recognises and would like to highlight the inherent conflict of interest in obtaining details of unallocated catches by country and increasing the transparency of data handling by the Working Group. This issue will have to be carefully considered in light of any future development by ICES of a standard platform to store all fisheries disaggregated data, particularly with regard to confidentiality.

The WG considered the need of a **long-term data storage** for commercial catches and sampling, and the documentation of any primary data processing of these data. From 2000 on (catch data for 1999), the latest (consistency checked) versions of the input files together with standard outputs and a documentation of filling-in decisions made by the co-ordinators, ideally in the SALLOC-formats, are stored in a separate "archive" folder. This is updated annually, and the complete collection (which is supposed to be kept confidential as it will contain data on misreporting and unallocated catches) will be available for WG members on request. As there was very little historical information available, WG members were asked to provide as much as possible national catch and historical data sets in any available format which is then stored in a "~historic" folder within "Archive". They will be consistency checked and transferred into a database system as soon as this is available.

B.2. Biological

Catch-at-age data (catch numbers-at-age, mean weights-at-age in the catch, mean length-at-age) is derived from the raised national figures received from the national laboratories. The data is obtained either by market sampling or by onboard observers, and processed as described above. For information on recent sampling levels and nations providing samples, see Sec. 2.2. of the most recent HAWG report.

Mean weights-at-age in the stock and proportions mature (maturity ogive) are derived from the June/July international acoustic survey (see next paragraph).

B.3. Surveys

B.3.1 Acoustic: ICES Co-ordinated Acoustic Surveys for herring in North Sea, Skagerrak and Kattegat

The ICES Coordinated acoustic surveys started in 1979 around Orkney and Shetland with first major coverage in 1984. An index derived from that survey has been used in assessments since 1994 with the time-series data extending back to 1989. The survey was extended to IIIa to include the overlapping Western Baltic spring spawning stock in 1989, and the index has been used with a number of other tuning indices since 1991. The early survey had occasionally covered VIa (North) during the 1980s and was extended westwards in 1991 to cover the whole of VIa (North) annually since 1991, and provides the only tuning index for VIa (North) herring, By carrying out the co-ordinated survey at the same time from the Kattegat to South of the Hebrides all herring in these areas are covered simultaneously, reducing uncertainly due to area boundaries as well as providing input indices to three distinct stocks. The surveys are co-ordinated under ICES Planning Group for Herring Surveys ICES PGHERS.

At present, six surveys are carried out during late June and July covering most of the continental shelf north of 52°N in the North Sea and to the west of Scotland to a northern limit of 62°N. The eastern edge of the survey area is bounded by the Norwegian and Danish, Swedish and German coasts, and to the west by the shelf edge between 200 and 400 m depth. The surveys are reported individually in the report of the planning group for herring surveys, and a combined report is prepared from the data from all surveys. The combined survey results provide spatial distributions of herring abundance by number and biomass at age by statistical rectangle; and distributions of mean weight and fraction mature at age.

The acoustic recordings are carried out using Simrad EK60, EK500 and EY500 38 kHz sounder echo-integrator with transducers mounted on the hull, drop keel or towed bodies. Further data analysis is carried out using either BI500, Echoview or Echoann software. The survey track is selected to cover the area giving a basic sampling intensity over the whole area based on the limits of herring densities found in previous years. A transect spacing of 15 nautical miles is used in most parts of the area with the exception of some relatively high density sections, east and west of Shetland, in the Skagerrak where short additional transects were carried out at 7.5 nmi spacing, and in the southern area where a 30 nmi transect spacing is used.

The following target strength to fish length relationships have been used to analyse the data:

herring	TS = 20 log L - 71.2 dB
sprat	TS = 20 log L -71.2 dB
gadoids	TS = 20 log L - 67.5 dB
mackerel	TS = 21.7 log L - 84.9 dB

Data is reported through standardised data exchange format and combined at FRS Marine Lab Aberdeen. The exchange format currently holds information on the ICES statistical rectangle level, with at least one entry for each rectangle covered, but more flexible strata are accommodated by allowing multiple entries for abundance belonging to different strata. Data submitted consists of the ICES rectangle definition, biological stratum, herring abundance by proportion of Autumn spawners (North Sea and VIa North) and Spring spawners (Western Baltic, age and maturity, and survey weight (survey track length). Data are be presented according to the following age/maturity classes: 1 immature (maturity stage 1 or 2), 1 mature (maturity stage 3+), 2 immature, 2 mature, 3 immature, 3 mature, 4, 5, 6, 7, 8, 9+. In addition to proportions at age data on mean weights and mean length are reported at age/maturity by biological strata. Data is combined using an effort weighted mean based on survey effort reported as number of nautical miles of cruise track per statistical rectangle. A combined survey report is produced annually. Apart from the Biomass index for 1-9+-ringers,mean weights at age in the catch and proportions mature are derived from the survey to be used in the NSAS assessment.

B.3.2 International Bottom Trawl Survey:

The International Bottom Trawl Survey (IBTS) started out as a Young Herring Survey (IYHS) in 1966 with the objective of obtaining annual recruitment indices for the combined North Sea herring stocks. It has been carried out every year since, and it was realized that the survey could provide recruitment indices not only for herring, but for roundfish species as well. Examination of the catch data from the 1st quarter IBTS showed that these surveys also gave indications of the abundances of the adult stages of herring, and subsequently the catches have been used for estimating 2-5+ ringer abundances. The surveys are carried out in 1st quarter (February) and in 3rd quarter (August-September) using standardized procedures among all participants. The standard gear is a GOV trawl, and at least two hauls are made in each statistical rectangle.

In 1977 sampling for late stage herring larvae was introduced at the IBTS 1st quarter, using Isaccs-Kidd Midwater trawls. These catches appeared as a good indicator of herring recruitment, however examination of IKMT performance showed deficiencies in its catchability for herring larvae, and a more applicable gear, a ring net (MIK) was suggested as an alternative gear. Hence, gear type was changed in the mid 90'ies, and the MIK has been the standard gear of the program since. This ring net is of 2 meter in diameter, has a long two-legged bridle, and is equipped with a black netting of 1.5 mm mesh size. Oblique hauls are made during night in at least two statistical rectangles.

Indices of 2-5+ ringer herring abundances in the North Sea (1st quarter). Fishing gear and survey practices were standardised from 1983, and herring abundance estimates of 2-5+ ringers from 1983 onwards has shown the most consistent results in assessments of these age groups. This series is used in North Sea herring assessment. The catches in DivisionIIIa is not included in this index. Table 2.3.3.1 in the HAWG report shows the time series of abundance estimates of 2-5+ ringers from the 1st quarter IBTS for the whole period.

Index of 1-ringer recruitment in the North Sea (1st quarter). The 1-ringer index of recruitment is based on trawl catches in the entire survey area, hence, all 1-ringer herring caught in Div IIIa is included in this index. Indices are calculated as an area weighted mean over means by ICES statistical rectangle, and are available for year classes 1977 to recent (Table 2.3.3.3 of HAWG report). The Downs herring hatch later than the other autumn spawned herring and generally appears as a smaller sized group during the 1st quarter IBTS. A recruitment index of smaller sized 1-ringers is calculated using the standard procedure, but solely based on abundance estimates of herring <13 cm (see discussion of procedures in earlier reports (ICES CM 2000/ ACFM:10, and ICES CM 2001/ ACFM:12).

MIK index of 0-ringer recruitment in the North Sea (1st quarter). The MIK catches of late stage herring larvae is used to calculate and 0-ringer index of autumn spawned herring in the North Sea. A flowmeter at the gear opening is used for estimation of volume filtered by the gear, and using this information together with information on bottom depth, the density of herring larvae per square meter is estimated. A mean herring density in statistical rectangles is raised to mean within subareas, and based on areas of these subareas an index of total abundance is estimated (see also ICES 1996/Asses:10). The series of estimates for subareas as well as the total index are shown in the actual report's Table 2.3.3.4.

B.3.3. Larvae:

Surveys of larval herring have a long tradition in the North Sea. Sporadic surveys started around 1880, and available scientific data goes back to the middle of the 20th century. The co-ordination of the International Herring Larvae Surveys in the North Sea and adjacent waters (IHLS) by ICES started in 1967, and from 1972 onwards all relevant data are achieved in a data base. The surveys are carried out annually to map larval distribution and abundance. Larval abundance estimates are of value as relative indicators of the herring spawning biomass in the assessment.

Nearly all countries surrounding the North Sea have participated in the history of the IHLS. Most effort was undertaken by the Netherlands, Germany, Scotland, England, Denmark and Norway. A number of other nations have contributed occasionally. A sharp reduction in ship time and number of participating nations occurred in the end of the 1980s. Since 1994 only the Netherlands and Germany contribute to the larvae surveys, with one exception in 2000 when also Norway participated.

Larvae Abundance Index (LAI): The total area covered by the surveys is divided into 4 sub areas corresponding to the main spawning grounds. These sub areas have to be sampled in different given time intervals. The sampling grid is standardized and stations are approximately 10 nautical miles apart. The standard gear is a GULF III sampler or one of its national modifications. Newly hatched larvae less than 10 mm total length (11 mm for the Southern North Sea) are used in the index calculation. To estimate larval abundance, the mean number of larvae per square meter obtained from the Ichthyoplankton hauls is raised to rectangles of 30x30 nautical miles and the corresponding surface area. These values are summed up within the given unit and provide the larval abundance per unit and time interval.

Multiplicative Larval Abundance Index (MLAI): The traditional LAI and LPE (Larval Production Estimates) rely on a complete coverage of the survey area. Due to the substantial decline in ship time and sampling effort since the end of the 80s, these indices could not be calculated in their traditional form since 1994. Instead, a multiplicative model was introduced for calculating a Multiplicative Larvae Abundance Index (MLAI, Patterson & Beveridge, 1995). In this approach the larvae abundances are calculated for a series of sampling units. The total time series of data is used to estimate the year and sampling unit effects on the abundance values. The unit effects are used to fill unsampled units so that an abundance index can be estimated for each year.

Calculation of the linearised multiplicative model was done using the equation:

$$\ln(\text{Indexyear,LAI unit}) = \text{MLAIyear} + \text{MLAI}_{\text{LAI}}\ \text{unit} + \text{uyear, LAI unit}$$

where MLAIyear is the relative spawning stock size in each year, MLAI_{LAI} unit are the relative abundances of larvae in each sampling unit and year, LAI unit are the corresponding residuals. The unit effects are converted such that the first sampling unit is used as a reference (Orkney/Shetland 01-15.09.72) and the parameters for the other sampling units are redefined as differences from this reference unit. The model is fitted to abundances of larvae less than 10 mm in length (11 mm for SNS). The MLAI is updated annually and represent all larval data since 1972. The time series is used as a biomass index in the herring assessment.

B.4. Commercial CPUE

Not used for pelagic stocks.

B.5. Other relevant data

B.5.1 Separation of North Sea Autumn Spawners and IIIa-type Spring Spawners

North Sea Autumn Spawners and IIIa-type Spring Spawners occur in mixtures in fisheries operating in Divisions IIIa and IVaE (ICES, 1991/Assess:15): mainly 2+ ringers of the Western Baltic spring-spawners and 0-2-ringers from the North Sea autumn-spawners, including winter-spawning Downs herring. In addition, several local spawning stocks have been identified with a minor importance for the herring fisheries (ICES, 2001/ACFM 12).

The method of separating herring in Norwegian samples, using vertebral counts as described in former reports of this Working Group (ICES 1990/ Assess:14) assumes that for autumn spawners, the mean vertebral count is 56.5 and for Spring spawners 55.80. The fractions of spring spawners (fsp) are estimated from the formula (56.50-v)/(56.5-55.8), where v is the mean vertebral count of the (mixed) sample with the restriction that the proportion should be one if fsp>=1 and zero if fsp<=0. The method is quite sensitive to within-stock variation (e.g. between year classes) in mean vertebral counts.

Experience within the Herring Assessment Working Group has shown that separation procedures based on size distributions often will fail. The introduction of otolith microstructure analysis in 1996-97 (Mosegaard and Popp-Madsen, 1996) enables an accurate and precise split between three groups, autumn, winter and spring-spawners; however, different populations with similar spawning periods are not resolved with the present level of analysis. Different stock components that are not easily distinguished by their otolith microstructure (OM), are considered to have different mean vertebral counts (vs) as, e.g., winter-spawning Downs herring: 56.6 (Hulme, 1995), and the small local stocks, the Skagerrak winter/spring-spawners: 57 (Rosenberg and Palmén, 1982). Further, the estimated stock specific mean vs count varies somewhat among different studies; North Sea: 56.5, Western Baltic Sea: 55.6 (Gröger and Gröhsler, 2001) and North Sea: 56.5, Western Baltic Sea: 55.8 (ICES 1992/H:5). Comparison between separation methods using frequency distributions of vertebral counts and otolith microstructure showed reasonable correspondence. Using this information the years from 1991 to 1996 was reworked in 2001, applying common splitting keys for all years by using a combination of the vertebral count and otolith microstructure methods (ICES, 2001/ACFM:12). From 2001 and onwards, the otolith-based method only has been used for the Division IIIa.

Different methods of identifying herring stocks in the Division IIIa and Subdivisions 22-24 were recently evaluated in a EU CFP study project (EC study 98/026). The study involved several inter-calibration sessions between microstructure readers in the different laboratories involved with the WBSS herring. After the study was finished a close collaboration concerning reader interpretations has been kept between the Danish and Swedish laboratories. Subsamples of the 2002 and 2003 Danish, Swedish, and German microstructure analyses were double-checked by the same Danish expert reader for consistency in interpretation. The overall impression is an increasingly good agreement among readers.

New molecular genetic approaches for stock separation are being developed within the EU-FP5 project HERGEN (EU project QLRT 200-01370). Sampling of spawning aggregations during spring, autumn and winter has been carried out in 2002 and in 2003 in Division IIIa and in the Western Baltic at more than 10 different locations. Preliminary results point at a substantial genetic variation between North Sea and Western Baltic herring.

After the introduction of otolith microstructure analysis in 1996 it was discovered that in the western Baltic a small percentage of the herring landings might consist of autumn-spawners individuals. Before molecular genetic methods became available for Atlantic herring the existence of varying proportions of autumn spawners in Subdivisions 22–24 in different years was considered a potential problem for the assessment.

C. Historical Stock Development

Model used:

Details on input parameters and model setup for the final ICA assessment are presented in Table 2.6.2.1. of the most recent HAWG report. The assessment has the same set-up and basic assumption as the assessment that was carried out last year. Input data are given in Tables 2.6.2.2. The ICA program operates by minimising the following general objective function*:*

$$\sum \lambda_c \left(C - \hat{C}\right)^2 + \sum \lambda_i \left(I - \hat{I}\right)^2 + \sum \lambda_r \left(R - \hat{R}\right)^2$$

which is the sum of the squared differences for the catches (separable model), the indices (catchability model) and the stock recruitment model.

The final objective function chosen for the stock assessment model was:

$$\sum_{a=0,y=1997}^{a=8,y=2002} \lambda_a \left(\ln(\hat{C}_{a,y}) - \ln(C_{a,y}) \right)^2 +$$

$$\sum_{y=1979}^{y=2002} \lambda_{mlai} \left(\ln(q_{mlai} \cdot S\hat{S}B_y^K) - \ln(MLAI_y) \right)^2 +$$

$$\sum_{a=1,y=1983^{**}}^{a=5+,y=2003} \lambda_{a,ibtsa} \left(\ln(q_{a,ibtsa} \cdot \hat{N}_{a,y}) - \ln(IBTS_{a,y}) \right)^2 +$$

$$\sum_{a=1,y=1989}^{a=9+,y=2002} \lambda_{a,acoust} \left(\ln(q_{a,acoust} \cdot \hat{N}_{a,y}) - \ln(ACOUST_{a,y}) \right)^2 +$$

$$\sum_{y=1977}^{y=2003} \lambda_{mik} \left(\ln(q_{mik} \cdot \hat{N}_{0,y}) - \ln(MIK_y) \right)^2 +$$

$$\sum_{y=1960}^{y=2002} \lambda_{ssr} \left(\ln(\hat{N}_{0,y+1}) - \ln\left(\frac{\alpha\, S\hat{S}B_y}{\beta + S\hat{S}B_y} \right) \right)^2$$

** except for 1 ring IBTS which runs from 1979 to 2002

with the following variables:

a,y	age (rings) and year
C	Catch at age (rings)
$\hat{C}$	Estimated catch at age (rings) in the separable model
$\hat{N}$	Estimated population numbers
$S\hat{S}B$	Estimated spawning stock size
MLAI	MLAI index (biomass index)
ACOUST	Acoustic index (age disaggregated)
IBTS	IBTS index (1-5+ ringers)
MIK	MIK index (0-ringers)
q	Catchability
k	power of catchability model
α, β	parameters to the Beverton stock-recruit model
λ	Weighting factor

Software used: ICA (Patterson, 1998; Needle, 2000)

Model Options chosen:

Input data types and characteristics:

TYPE	NAME	YEAR RANGE	AGE RANGE	VARIABLE FROM YEAR TO YEAR YES/NO
Caton	Catch in tonnes			
Canum	Catch at age in numbers	1960-2002	1-9+	Yes
Weca	Weight at age in the commercial catch	1960-2002	1-9+	Yes (smoothed)
West	Weight at age of the spawning stock at spawning time.	1960-2002	1-9+	Yes (smoothed)
Mprop	Proportion of natural mortality before spawning	1960-2002	1-9+	No
Fprop	Proportion of fishing mortality before spawning	1960-2002	1-9+	No
Matprop	Proportion mature at age	1960-2002	1-9+	Yes (smoothed)
Natmor	Natural mortality	1960-2002	1-9+	No

Tuning data:

TYPE	NAME	YEAR RANGE	AGE RANGE (WR)
Tuning fleet 1	IBTS Q1	1979-2003	1
Tuning fleet 1	IBTS Q1	1983-2003	2-5
Tuning fleet 2	MIK	1977-2002	0
Tuning fleet 3	Acoustic	1984-2002	1
Tuning fleet 3	Acoustic	1095-2002	2-9+
Tuning fleet 4	MLAI	1972-2002	SSB

D. Short-Term Projection

The short-term prediction method was substantially modified in 2002. Following the review by SGEHAP (ICES 2001/ACFM:22), which recommended that a simple multi-fleet method would be preferable, the complex split-factor method used for a number of years prior to 2002 has not been used since. The multi-fleet, multi-option, deterministic short-term prediction programme (MFSP) was accepted by ACFM and was developed further last year. It is intended to continue to use this programme in the future. The good agreement between predicted biomass for the actual year and SSB taken from the assessment for the most recent year one year after demonstrates that the current prediction procedure for stock numbers is working well. In 2004, the Working Group has included prediction of low maturation into projections for 2005 and expects to monitor growth and maturation of North Sea herring carefully in the future and when deemed necessary will include these changes in predictions in the future.

Model used: Age-structured model, by fleet and area fished

Software used: MFSP

Initial stock size: output from ICA

Maturity: average of the two most recent years used

F and M before spawning: 0.67 for both (assumes spawning starts around September)

Weight at age in the stock: from last year in assessment (already smoothed, see assessment data description)

Weight at age in the catch: average of last two years BY FLEET

Exploitation pattern:

Intermediate year assumptions: Status quo F

Stock recruitment model used: Recent average recruitment (arithmetic, recent 10 years) is used, (unless there is some strong reason for using something else, e.g. if SSB is very low, we may use a prediction from the stock-recruit relationship)

Procedures used for splitting projected catches:

There are 4 values input for this parameter:

a. IBTS 1-ringer proportion in last assessment year (y) is used for 1-ringers in y
b. IBTS 1-ringer proportion in y+1 is used for 1-ringers in y+1, AND for 0-ringers in y.
c. GLM (between MIK index and IBTS 1-ringer proportion) is applied to MIK index in y+1 to predict proportion for 1-ringers in y+2, AND for 0-ringers in y+1

GLM, as in (c), is applied to the Average MIK index for 1981 to year y to predict proportion for 1-ringers in y+3 (not relevant), AND for 0-ringers in y+2 (relevant)

E. Medium-Term Projections – *still to be filled in -*

Model used:

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight at age in the stock:

Weight at age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock recruitment model used:

Uncertainty models used:

1. Initial stock size:
2. Natural mortality:
3. Maturity:
4. F and M before spawning:
5. Weight at age in the stock:
6. Weight at age in the catch:
7. Exploitation pattern:
8. Intermediate year assumptions:
9. Stock recruitment model used:

F. Long-Term Projections – *still to be filled in -*

Model used:

Software used:

Maturity:

F and M before spawning:

Weight at age in the stock:

Weight at age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological Reference Points

There is a well functioning harvest control rule in place for this stock, and apart from B_{lim}, the current reference points are derived from this HCR. The target F in the HCR was adopted by ACFM as the F_{pa}, while the trigger point at which F should be reduced below the target is adopted as B_{pa}. The HCR was briefly revisited in 2004, and the results support the initial definitions of limits.

Reference points currently in use are: B_{lim} is 800 000 t (below this value poor recruitment has been experienced); B_{pa} be set at 1.3 mill. T (as part of a harvest control rule based on simulations); F_{lim} is not defined, F_{pa} be set at $F_{ages\ 0\text{-}1}$= 0.12, $F_{ages\ 2\text{-}6}$= 0.25 (as part of a harvest control rule).

H. Other Issues

H.1 Biology of the species in the distribution area

The herring (*Clupea harengus*) is a pelagic species which is widespread in its distribution throughout the North Sea. The herring's unique habit is that it produces benthic eggs which are attached to a gravely substrate on the seabed. This points strongly to an evolutionary history in which herring spawned in rivers and at some later date re-adapted to the marine environment. The spawning grounds in the southern North Sea are in fact located in the beds of rivers which existed in geological times and some groups of spring spawning herring still spawn in very shallow inshore waters and estuaries. Spawning typically occurs on coarse gravel (0.5-5 cm) to stone (8-15 cm) substrates and often on the crest of a ridge rather than hollows. For example, in a spawning area in the English Channel, eggs were found attached to flints 2.5-25 cm in length, where these occurred in gravel, over a 3.5 km by 400m wide strip.

As a consequence of the requirement for a very specific substrate, spawning occurs in small discrete areas in the near coastal waters of the western North Sea. They extend from the Shetland Isles in the north through into the English Channel in the south. Within these specific areas actual patches of spawn can be extremely difficult to find.

The fecundity of herring is length related and varies between approximately 10,000 and 60,000 eggs per female. This is a relatively low fecundity for teleosts, probably because, in evolutionary terms, the benthic egg is a potentially less hazardous phase of development compared with the planktonic egg of most other teleosts. The age of first maturity is 3 years old (2 ringers) but the proportion mature at age may vary from year to year dependent on feeding conditions. Over the past 15 years the proportion mature at age 3 years (2 ringers) has ranged from 47% to 86% and for 4 year old fish (3 winter ringers) from 63% to 100%. Above that age, all are considered to be mature.

The benthic eggs take about three weeks to hatch dependant on the temperature. The larvae on hatching are 6mm to 9mm long and are immediately planktonic. Their yolk sac lasts for a few days during which time they will begin to feed on phytoplankton and small planktonic animals. Their planktonic development lasts around three to four months during which time they are passively subjected to the residual drift which takes them to various coastal nursery areas on both sides of the North Sea and into the Skagerrak and Kattegat.

Herring continue to be mainly planktonic feeders throughout their life history although there are numerous records of them taking small fish, such as sprat and sandeels, on an opportunistic basis. Calanoid copepods, such as *Calanus*, *Pseudocalanus* and *Temora* and the Euphausids, *Meganyctiphanes* and *Thysanoessa* still form the major part of their diet during the spring and summer and are responsible for the very high fat content of the fish at this time.

In the past, herring age has been determined by using the annual rings on the scales. In more recent years the growth rings on the otolith have proved more reliable for age determination. Herring age is expressed as number of winter rings on the otolith rather than age in years as for most other teleost species where a nominal 1 January birthdate is applied. Autumn spawning herring do not lay down a winter ring during their first winter and therefore remain as ‘0’ winter ringers until the following winter. When looking at year classes, or year of hatching, it must be remembered that they were spawned in the year prior to their classification as ‘0’ winter ringers.

North Sea herring comprise both spring and autumn spawning groups but the major fisheries are carried out on the offshore autumn spawning fish. The spring spawners are found mainly as small discrete coastal groups in areas such as The Wash and the Thames estuary. Juveniles of the spring spawning stocks found in the Baltic, Skagerrak and Kattegat may also be found in the North Sea as well as Norwegian coastal spring spawners.

The main autumn spawning begins in the northern North Sea in August and progresses steadily southwards through September and October in the central North Sea to November and as late as January in the southern North Sea and eastern English Channel. The widespread but discrete location of the herring spawning grounds throughout the western North Sea has been well known and described since the early part of the 20 th Century. This led to considerable scientific debate and eventually to investigation and research on stock identity. The controversy centred on whether or not the separate spawning grounds represented discrete stocks or ‘races’ within the North Sea autumn spawning herring complex. Resolution of this issue became more urgent as the need for the introduction of management measures increased during the 1950’s. The International Council for the Exploration of the Sea (ICES) encouraged tagging and other racial studies and a review of all the historic evidence to resolve this problem. The conclusions were the basis for establishing the working hypothesis that the North Sea autumn spawning herring comprise a complex of three separate stocks each with separate spawning grounds, migration routes and nursery areas, illustrated in the figure below.

The three stock units are:

• The Buchan or Scottish group which spawn from July to early September in the Orkney Shetland area and off the Scottish east coast. Nursery areas for fish up to two years old are found along the east coast of Scotland and also across the North Sea and into the Skagerrak and Kattegat.

• The Banks or central North Sea group, which derive their name from their former spawning grounds around the western edge of the Dogger Bank. These spawning grounds have now all but disappeared and spawning is confined to small areas along the English east coast, from the Farne Islands to the Dowsing area, from August to October. The juveniles are found along the east coast of England, down to the Wash, and also off the west coast of Denmark.

• The Downs group which spawns in very late Autumn through to February in the southern Bight of the North Sea and in the eastern English Channel. The drift of their larvae takes them north-eastwards to nursery areas along the Dutch coast and into the German Bight (Burd 1985).

At certain times of the year, individuals from the three stock units may mix and are caught together as juveniles and adults but they cannot be readily separated in the commercial catches. As a consequence, North Sea autumn spawning herring have to be managed as a single unit.

A further complication is that juveniles of the North Sea stocks are found, outside the North Sea, in the Skagerrak and Kattegat areas and are caught in various fisheries there. The proportions of juveniles of North Sea origin, found in these areas varies with the strength of the year class, with higher proportions in the Skagerrak and Kattegat when the year class is good.

H.2 Historic stock development and history of the fishery

Over many centuries the North Sea herring fishery has been a cause of international conflict sometimes resulting in war, but in more recent times in bitter political argument. There have also been fundamental changes in the nature of the fisheries. These have been driven both by changes in catching power and in response to changes in market requirements, particularly the demand for fish meal and oil. Most of these changes have resulted in greater exploitation pressures that increasingly led to the urgent need to ensure a more rational exploitation of North Sea herring. Such pressures really began to exert themselves for the first time during the 1950’s when the spawning stock biomass of North Sea autumn spawning herring fell from 5 million tonnes in 1947 to 1.4 million tonnes by 1957. That period also witnessed the decline and eventual disappearance of a traditional autumn drift net fishery in the southern North Sea.

The annual landings from 1947 through to the early 1960’s were high, but stable, averaging around 650,000t. Over the period 1952-62 the high fishing mortality (F 0.4 ages 2-6) resulted in a rapid decline in the spawning stock biomass from around 5 million tonnes to 1.5 million tonnes. Recruitment over this period was reasonable, but there were fewer and fewer year classes present in the adult stock, a clear indication that the stocks were being over-fished and that they were also being impacted by the developing industrial fishery in the eastern North Sea.

This period witnessed the complete collapse of the historic East Anglian autumn drift net fishery, which was based entirely on the Downs stock moving south to the Southern Bight and eastern English Channel to spawn. The reasons for that failure have been attributed both to high mortality of the juveniles in the North Sea industrial fisheries, and to heavy fishing by bottom trawlers on the spawning concentrations, in the English Channel, during the 1950’s. Such intensive trawling, on vulnerable spawning fish, not only generated a high mortality but also disturbed spawning aggregations, destroyed the spawn and damaged the substrate on which successful spawning depends.

Fishing mortality on the herring in the central and northern North Sea began to increase rapidly in the late 1960’s and had increased to F1.3 ages 2-6, or over 70% per year of those age classes, by 1968. Landings peaked at over 1 million tonnes in 1965, around 80% of which were juvenile fish. This was followed by a very rapid decline in the SSB and the total landings. By 1975 the SSB had fallen to 83,500t although the total landings were still over 300,000t. At the same time, spawning in the central North Sea had contracted to the grounds off the east coast of England whilst spawning grounds around the edge of the Dogger Bank were no longer used. This heralded the serious decline and near collapse of the North Sea autumn spawning herring stock which led to the moratorium on directed herring fishing in the North Sea from 1977 to 1981.

International larvae surveys and acoustic surveys were used to monitor the state of the stocks during the moratorium. By 1980 these surveys were indicating a modest recovery in the SSB from its 1977 low point of 52,000t. By 1981 the SSB had increased to over 200,000t. Prior to the moratorium there had been no control, other than market forces, on catches in the North Sea directed herring fishery. Once the fishery re-opened in 1981 the North Sea autumn spawning herring stock was managed by a Total Allowable Catch (TAC) constraint. It should be noted that the TAC was only applied to the directed herring fishery in the North Sea which exploited mainly adult fish for human consumption. Targeted fishing for herring for industrial purposes was banned in the North Sea in 1976 but there was a 10% by-catch allowance in the fisheries for other species, including the small meshed fisheries for industrial purposes, mainly for sprat. Following the re-opening of the now controlled fishery the SSB steadily increased, peaking at 1.3 million tonnes in 1989. Annual recruitment, measured as ‘0’group fish, was well above the longterm average over this period. The 1985 year class was the biggest recorded since 1960 and the third highest in the records dating back to 1946. Landings also steadily increased over this period reaching a peak of 876,000 tonnes in 1988. This resulted from a steady increase in fishing mortality to $F_{ages\ 2\text{-}6}$ = 0.6 (ca. 45%) in 1985 and a high by-catch of juveniles in the industrial fisheries for sprat. Following a period of four years of below average recruitment (year classes 1987-91) SSB fell rapidly to below 500,000 tonnes in 1993. Fishing mortality increased rapidly averaging $F_{ages\ 2\text{-}6}$=0.75 (ca. 52%) over the period 1992–95 and recorded landings regularly exceeded the TAC. The North Sea industrial fishery for sprat developed rapidly over this period with the annual catch increasing from 33,000 tonnes in 1987 to 357,000 tonnes by 1995. With the 10% by-catch limit as the only control on the catch of immature herring, there was a consequent high mortality on juvenile herring which averaged 76% of the total catch in numbers of North Sea autumn spawners over this period.

During the summer of 1991 the presence of the parasitic fungus *Ichthyophonus* spp was noted in the North Sea herring stock. All the evidence suggested that the parasite was lethal to herring and that its occurrence could have a significant effect on natural mortality in the stock and ultimately on spawning stock biomass. High levels of infection were recorded in the northern North Sea north of latitude 60°N whilst infection rates in the southern North Sea and English Channel were very low. Efforts were made to estimate the prevalence of the disease in the stock through a programme of research vessel and commercial catch sampling. This led to estimates of annual mortality up to 16% (Anon., 1993) which was of the same order as the estimate of fishing mortality at the time. It was recognised that the behavioural changes and catchability of infected fish affected the reliability of the estimate of prevalence of the disease in the population. The uncertainty about the effect on stock size varied between estimates of 5% to 10% and 20%. Continued monitoring of the progress of the disease showed that by 1994 the prevalence in the northern North Sea had fallen from 5% in 1992 to below 1% and confirmed that the infection did not appear to be spreading to younger fish. Ultimately it was concluded that the disease had caused high mortality in the northern North Sea during 1991 and subsequently declined to the point where by 1995 the disease induced increase in natural mortality was insignificant.

The increased fishing pressure during the first half of the 1990’s and the disease induced increase in natural mortality led to serious concerns about the possibilities of a stock collapse similar to that in the late 1970’s. Reported landings continued at around 650,000 tonnes per year whilst the spawning stock began to decline again from over 1 million tonnes in 1990. The assessments at that time were providing an over optimistic perception of the size of the spawning stock and, for example, it was not until 1995 that it was realised that the SSB in 1993 had already fallen below 500,000 tonnes. This was well below the minimum biologically accepted level of 800,000 tonnes (MBAL) which had been set for this stock at that time.

H.3 Management and ACFM advice

In 1996, the total allowable catches (TACs) for Herring caught in the North Sea (ICES areas IV and Division VIId) were changed mid-year with the intention of reducing the fishing mortality by 50% for the adult part of the stock and by 75% for the juveniles. For 1997, the regulations were altered again to reduce the fishing mortality on the adult stock to 0.25 and for juveniles to less than 0.1 with the aim of rebuilding the SSB up to 1.1 million t in 1998.

According to the EU and Norway agreement adopted in December 1997, efforts should be made to maintain the SSB above the MBAL (Minimum Biologically Acceptable Level) of 800,000 tonnes. An SSB reference point of 1.3 million has been set above which the TACs will be based on an F= 0.25 for adult herring and F= 0.12 for juveniles. If the SSB falls below 1.3 million tonnes, other measures will be agreed and implemented taking account of scientific advice. Relevant parts of the agreement (last amended Dec. 2001) read:

1. Every effort shall be made to maintain a level of Spawning Stock Biomass (SSB) greater than the Minimum Biological Acceptable Level (MBAL) of 800,000 tonnes.
2. A medium-term management strategy, by which annual quotas shall be set for the directed fishery and for by-catches in other fisheries as defined by ICES, reflecting a fishing mortality rate of 0.25 for 2-ringers and older and 0.12 for 0-1-ringers, shall be implemented.
3. Should the SSB fall below a reference point of 1.3 million tonnes, the fishing mortality rates referred under paragraph 2, will be adapted in the light of scientific estimates of the precise conditions then prevailing, to ensure rapid recovery of SSB to levels in excess of 1.3 million tonnes.
4. The recovery plan referred to above may, inter alia, include additional limitations on effort in the form of special licensing of vessels, restrictions on fishing days, closing of areas and/or seasons, special reporting requirements or other appropriate control measures.
5. By-catches of herring may only be landed in ports where adequate sampling schemes to effectively monitor the landings have been set up. All catches landed shall be deducted from the respective quotas set, and the fisheries shall be stopped immediately in the event that the quotas are exhausted.
6. The allocation of the TAC for the directed fishery for herring shall be 29% to Norway and 71% to the Community. The by-catch quota for herring shall be allocated to the Community.
7. The parties shall, if appropriate, consult and adjust management measures and strategies on the basis of any new advice provided by ICES including that from the assessment of the abundance of the most recent year class.
8. A review of this arrangement shall take place no later than 31 December 2004.
9. This arrangement entered into force on 1 January 2002.

Until 2002, the SSB has been below the precautionary level of 1.3 million tonnes ($\mathbf{B}_{pa}$), and since 1998 other measures taken have consisted of an adoption of a $F_{2\text{-}6}$ of 0.2 and a $F_{0\text{-}1} < 0.1$ to allow the rebuilding of the spawning biomass to above $\mathbf{B}_{pa}$.

Since 2002, the SSB is considered to have been above $\mathbf{B}_{pa}$. From then on, ACFM gave fleet-wise catch option tables for fishing mortalities within the constraints the EU-Norway management scheme.

H.4 Sampling of commercial catch

Sampling of commercial catch is conducted by the national institutes. HAWG has recommended for years that sampling of commercial catches should be improved for most of the stocks. In January 2002, a new directive for the collection of fisheries data was implemented for all EU member states (Commission Regulation 1639/2001). The provisions in the “data directive” define specific sampling levels. As most of the nations participating in the fisheries on herring assessed here have to obey this data directive, the definitions applicable for herring and the area covered by HAWG are given below:

Area	Sampling level per 1000 t catch		
Baltic area (IIIa (S) and IIIb-c)	*1 sample of which*	*100 fish measured and*	*50 aged*
Skagerrak (IIIa (N))	*1 sample*	*100 fish measured*	*100 aged*
North Sea (IV and VId):	*1 sample*	*50 fish measured*	*25 aged*
NE Atlantic and Western Channel ICES areas II, V, VI, VII (excluding d) VIII, IX, X, XII, XIV	*1 sample*	*50 fish measured*	*25 aged*

Exemptions to the above mentioned sampling rules are:

Concerning lengths:

(1) the national programme of a Member State can exclude the estimation of the length distribution of the landings for stocks for which TACs and quotas have been defined under the following conditions:

(i) the relevant quotas must correspond to less than 5 % of the Community share of the TAC or

to less than 100 tonnes on average during the previous three years;

(ii) the sum of all quotas of Member States whose allocation is less than 5 %, must account for

less than 15 % of the Community share of the TAC.

If the condition set out in point (i) is fulfilled, but not the condition set out in point (ii), the relevant Member States may set up a coordinated programme to achieve for their overall landings the implementation of the sampling scheme described above, or another sampling scheme, leading to the same precision.

Concerning ages:

(1) the national programme of a Member State can exclude the estimation of the age distribution of the landings for stocks for which TACs and quotas have been defined under the following conditions:

(i) the relevant quotas correspond to less than 10 % of the Community share of the TAC or to

less than 200 tonnes on average during the previous three years;

(ii) the sum of all quotas of Member States whose allocation is less than 10 %, accounts for less than 25 % of the Community share of the TAC.

If the condition set out in point (i) is fulfilled, but not the condition set out in point (ii), the relevant Member States may set up a coordinated programme as mentioned for length sampling.

If appropriate, the national programme may be adjusted until 31 January of every year to take into account the exchange of quotas between Member States;

The HAWG reviewed the implementation of the new sampling regime for the EU countries in 2003. It was expected that the overall sampling level might be improved, and this was demonstrated e.g. for North Sea herring in 2002 and 2003. However, there is concern that the new regime may lead to a deterioration of sampling quality, because it does not assure an appropriate sampling of different métiers (each combination of fleet/nation/area and quarter). Given the diversity of the fleets harvesting most stocks assessed by HAWG, an appropriate spread of sampling effort over the different métiers is more important to the quality of catch at age data than a sufficient overall sampling level. The EU data directive appears to not assure this. The WG therefore recommends that all metiers with substantial catch should be sampled (including by-catches in the industrial fisheries), that catches landed abroad should be sampled and information on these samples should be made available to the national laboratories.

H.5 Terminology

The WG uses “rings” rather than “age” or “winter rings” throughout the report to denominate the age of herring, with the intention to avoid confusion It should be observed that, for autumn spawning stocks, there is a difference of one year between “age” and “rings”. HAWG in 1992 (ICES 1992/Assess:11) stated that

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

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

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

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

The text table below gives an example for the correlation between age, rings and year class for the different spawning types in late 2002:

YEAR CLASS (AUTUMN SPAWNERS)	2001/2002	2000/2001	1999/2000	1998/1999
Rings	**0**	**1**	**2**	**3**
Age (autumn spawners)	1	2	3	4
Year class (spring spawners)	**2002**	**2001**	**2000**	**1999**
Rings	**0**	**1**	**2**	**3**
Age (spring spawners)	0	1	2	3

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Appendix 3 – Stock Annex

Quality Handbook ANNEX: Hawg-herring wbss

Stock specific documentation of standard assessment procedures used by ICES.

Stock Western Baltic Spring spawning herring (WBSS)

Working Group: Herring Assessment Working Group for the Area South of 62° N

Date: 18.03.2004

Authors: M. Cardinale, J. Dalskov, T. Gröhsler, H. Mosegaard,

A. General

A.1. Stock definition

Herring caught in Division IIIa are a mixture of North Sea autumn spawners and Baltic spring spawners. Spring-spawning herring in the eastern part of the North Sea, Skagerrak, Kattegat and SDs 22, 23 and 24 are considered to be one stock.

Catches of herring in the Kattegat, the Skagerrak and the Eastern part of the North Sea are taken from a mixture of two main spawning stocks (ICES, 1991/Assess:15): mainly 2+ ringers of the Western Baltic spring-spawners and 0-2-ringers from the North Sea autumn-spawners, including winter-spawning Downs herring. In addition, several local spawning stocks have been identified with a minor importance for the herring fisheries (ICES, 2001/ACFM 12).

The method of separating herring in Norwegian samples, using vertebral counts as described in former reports of this Working Group (ICES 1991/ Assess:15) assumes that for autumn spawners, the mean vertebral count is 56.5 and for Spring spawners 55.80. The fractions of spring spawners (fsp) are estimated from the formula (56.50-v)/(56.5-55.8), where v is the mean vertebral count of the (mixed) sample with the restriction that the proportion should be one if fsp>=1 and zero if fsp<=0. The method is quite sensitive to within-stock variation (e.g. between year classes) in mean vertebral counts.

Experience within the Herring Assessment Working Group has shown that separation procedures based on size distributions often will fail. The introduction of otolith microstructure analysis in 1996-97 (Mosegaard and Popp-Madsen, 1996) enables an accurate and precise split between three groups, autumn, winter and spring-spawners; however, different populations with similar spawning periods are not resolved with the present level of analysis. Different stock components that are not easily distinguished by their otolith microstructure (OM), are considered to have different mean vertebral counts (vs) as, e.g., winter-spawning Downs herring: 56.6 (Hulme, 1995), and the small local stocks, the Skagerrak winter/spring-spawners: 57 (Rosenberg and Palmén, 1982). Further, the estimated stock specific mean vs count varies somewhat among different studies; North Sea: 56.5, Western Baltic Sea: 55.6 (Gröger and Gröhsler, 2001) and North Sea: 56.5, Western Baltic Sea: 55.8 (ICES 1992/H:5). Comparison between separation methods using frequency distributions of vertebral counts and otolith microstructure showed reasonable correspondence. Using this information the years from 1991 to 1996 was reworked in 2001, applying common splitting keys for all years by using a combination of the vertebral count and otolith microstructure methods (ICES, 2001/ACFM:12). From 2001 and onwards, the otolith-based method only has been used for the Div. IIIa.

Different methods of identifying herring stocks in the Division IIIa and Subdivisions 22-24 were recently evaluated in a EU CFP study project (EC study 98/026). The study involved several inter-calibration sessions between microstructure readers in the different laboratories involved with the WBSS herring. After the study was finished a close collaboration concerning reader interpretations has been kept between the Danish and Swedish laboratories. Subsamples of the 2002 and 2003 Danish, Swedish, and German microstructure analyses were double-checked by the same Danish expert reader for consistency in interpretation. The overall impression is an increasingly good agreement among readers.

New molecular genetic approaches for stock separation are being developed within the EU-FP5 project HERGEN (EU project QLRT 200-01370). Sampling of spawning aggregations during spring, autumn and winter has been carried out in 2002 and in 2003 in Div. IIIa and in the Western Baltic at more than 10 different locations. Preliminary results point at a substantial genetic variation between North Sea and Western Baltic herring, but significant variation has also been found among spawning populations in DivIIIa and subdiv. 22-24.

For Subdivisions 22, 23 and 24 it is assumed that all individuals caught belong to the Western Baltic spring spawning stock.

After the introduction of otolith microstructure analysis in 1996 it was discovered that in the western Baltic a small percentage of the herring landings might consist of autumn-spawners individuals. Before molecular genetic methods became available for Atlantic herring the existence of varying proportions of autumn spawners in Subdivisions 22–24 in different years was considered a potential problem for the assessment.

Although local aggregations of winter and autumn spawning herring are found in the Western Baltic area these aggregations are genetically more closely related to the Western Baltic spring spawners than to the North Sea autumn spawners (HERGEN, EU project QLRT 200-01370). Therefore, with the present genetic perception in mind, when herring with otolith microstructure indicating autumn hatch are found in subdivisions 22-24 these are treated as belonging to the WBSS stock.

A.2. Fishery

The fleet definitions used since 1998 for the fishery in Div. IIIa are:

- **Fleet C**: directed fishery for herring in which trawlers (with 32 mm minimum mesh size) and purse seiners participate.
- **Fleet D**: All fisheries in which trawlers (with mesh sizes less than 32 mm) and small purse seiners, fishing for sprat along the Swedish coast and in the Swedish fjords, participate. For most of the landings taken by this fleet, herring is landed as by-catch.

Danish and Swedish by-catches of herring from the sprat fishery and the Norway pout and blue-whiting fisheries are listed under fleet D.

In SDs 22–24 most of the catches are taken in a directed fishery for herring and some as by-catch in a directed sprat fishery. All landings from SDs22–24 are treated as one fleet.

A.3. Ecosystem aspects

Applying new molecular genetic methods and results emerging from ongoing research projects on herring (HERGEN and WESTHER) the possibility of considering genetic diversity is within reach. Preliminary results indicate an increase in genetic distance between herring populations in the Baltic and successive populations in subdivisions 24, 22, 21, and 20 and finally the North Sea where genetic distance reach a maximum constant difference to the Baltic. Further, genetic differences are larger among populations within the Divisions IIIa and Western Baltic than among populations in the North Sea.

B. Data

B.1. Commercial catch

The level of sampling of the landings for the human consumption fishery and the small-meshed fishery landings was generally acceptable in the Skagerrak, the Kattegat and SDs 22-24 during the last years. Where sampling was missing in areas and quarters on national landings, sampling from either other nations or adjacent areas and quarters were used to estimate catch in numbers and mean weight-at-age.

Based on the proportions of spring- and autumn spawners in the landings, number and mean weights by age and spawning stock are calculated.

The text table below the shows different input data provided by country:

	DATA		
Country	Caton (catch in weight)	Canum (catch-at-age in numbers)	Weca (weight-at-age in the catch)
Denmark	x	x	x
Germany	x	x	x
Norway	x		
Poland	x	x	x
Sweden	x	x	x

B.2. Biological

Mean weights-at-age in the catch in the 1st quarter were used as stock weights.

The proportions of F and M before spawning was assumed constant between years. F-prop was set to be 0.1 and M-prop 0.25 for all age groups.

Natural mortality was assumed constant at 0.2 for all years and 2+ ringers. A predation mortality of 0.1 and 0.2 was added to the 0 and 1 ringers, which resulted in an increase in their natural mortality to 0.3 and 0.5, respectively (Table 3.6.4). The estimates of predation mortality were derived as a mean for the years 1977–1995 from the Baltic MSVPA (ICES 1997/J:2).

The maturity ogive was assumed constant between years:

W-rings	0	1	2	3	4	5	6	7	8+
Maturity	0.00	0.00	0.20	0.75	0.90	1.00	1.00	1.00	1.00

B.3. Surveys

The summer Danish acoustic survey in Division IIIa is part of an annual survey covering the North Sea and Division IIIa in July-August. R/V DANA conducted the survey in Division IIIa. For each sub area the mean back scattering cross section was estimated for herring, sprat, gadoids and mackerel by the TS relationships given in the Manual for Herring Acoustic Surveys in ICES Division III, IV, and IVa (ICES 2002/G:02). Used in the final assessment.

The first joint acoustic survey was carried out with R/V 'Solea' in Subdivisions 22-24 in October 1987. Since 1989 the survey was repeated every year as a part of an international hydracoustic survey in the Baltic. Used in the final assessment.

The IBTS 3rd quarter survey in Div. IIIa, which is a part of the North Sea and Div. IIIa bottom trawl survey that is carried out in the 1st and 3rd quarter. The IBTS has been conducted annually in the 1st quarter since 1977 and 3rd quarters from 1991. From 1983 and onwards the survey was standardised according to the IBTS manual (ICES 2002/D:03). During the HAWG 2002 the IBTS survey data (both quarter) were revised from 1991 to 2002. Historical catch rates are heavily skewed and therefore the survey indices by winter rings 1-5 were calculated as geometric means from observed abundances ($n \cdot h^{-1}$) at age at trawl stations. Used in the final assessment.

The German herring larvae monitoring started in 1977 and takes place every year from March/April to June in the main spawning grounds of the spring spawning herring in the Western Baltic. These are the Greifswalder Bodden and adjacent waters. For the calculation of the number of larvae per station and area unit, the methods of Smith and Richardson (1977) and Klenz (1993) were used and projected to length-classes. Further details concerning the surveys and the treatment of the samples are given in Brielmann (1989), Müller and Klenz (1994) and Klenz (2002). Used in the final assessment.

B.4. Commercial CPUE

B.5. Other relevant data

C. Historical Stock Development

Model used: ICA
Software used: ICA Vs 1.4

Model Options chosen:
No of years for separable constraint: 5
Reference age for separable constraint: 4
Constant selection pattern model : yes
S to be fixed on last age: 1.0
First age for calculation of reference F: 3
Last age for calculation of reference F: 6
Relative weights-at-age: 0.1 for 0-group, all others 1
Relative weights by year: all 1
Catchability model used: for all indices linear
Survey weighting: Manual all 1
Estimates of the extent to which errors in the age-structured indices are correlated across ages: all 1
No shrinkage applied

Input data types and characteristics:

TYPE	NAME	YEAR RANGE	AGE RANGE	VARIABLE FROM YEAR TO YEAR YES/NO
Caton	Catch in tonnes	1991- last data year	0-8+	Yes
Canum	Catch-at-age in numbers	1991- last data year	0-8+	Yes
Weca	Weight-at-age in the commercial catch	1991- last data year	0-8+	Yes
West	Weight-at-age of the spawning stock at spawning time.	1991- last data year	0-8+	Yes, assumed as the Mw in the catch first quarter
Mprop	Proportion of natural mortality before spawning	1991- last data year	0-8+	No, set to 0.25 for all ages in all years
Fprop	Proportion of fishing mortality before spawning	1991- last data year	0-8+	No, set to 0.1 for all ages in all years
Matprop	Proportion mature at age	1991- last data year	0-8+	No, constant for all years
Natmor	Natural mortality	1991- last data year	0-8+	No, constant for all years

Presently used Tuning data:

TYPE	NAME	YEAR RANGE	AGE RANGE
Tuning fleet 1	Danish Acoustic Survey Div. IIIa	1989 – last year data	2-8+
Tuning fleet 2	German Acoustic Survey SDs 22-24	1989 – last year data	0-5
Tuning fleet 3	IBTS Quarter 3	1991 – last years data	1-5
….			

D. Short-Term Projection

Model used: Age structured

Software used: MFDP Vs 1a

Initial stock size: ICA estimates of population numbers were used except for

- the numbers of 0-ringers in the last two years and the start year of the projection, where a geometric mean of the recruitment over the period of ten years was taken
- the numbers of 1-ringers in the start of the projection, where the geometric mean over the period of ten years excluding the last year was used

Maturity: The same values as in the assessment is used for all years

F and M before spawning: The same ogive as in the assessment is used for all years

Weight-at-age in the stock: Average weight of the three last years

Weight-at-age in the catch: Average weight of the three last years
Exploitation pattern: Average weight of the three last years

Intermediate year assumptions: Status quo fishing mortality

Stock recruitment model used: None

Procedures used for splitting projected catches: Not relevant

E. Medium-Term Projections

Model used: none

Software used:

Initial stock size:

Natural mortality:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock recruitment model used:
Uncertainty models used: none

1. Initial stock size:
2. Natural mortality:
3. Maturity:
4. F and M before spawning:
5. Weight-at-age in the stock:
6. Weight-at-age in the catch:
7. Exploitation pattern:
8. Intermediate year assumptions:
9. Stock recruitment model used:

F. Long-Term Projections

Model used: none

Software used:

Maturity:

F and M before spawning:

Weight-at-age in the stock:

Weight-at-age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological Reference Points

Reference points have neither been defined nor proposed for this stock.

H. Other Issues

I. Reference

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Appendix 4 - Stock Annex

Quality Handbook ANNEX: Herring in Celtic Sea and VIIj

Stock specific documentation of standard assessment procedures used by ICES.

Stock	Herring in the Celtic Sea and VIIj
Working Group:	Herring Assessment Working Group for the area south of 62^0 N.
Date:	19^{th} April 2004

A. General

A.1. Stock definition

The herring to the south of Ireland in the Celtic Sea and in Division VIIj comprise both autumn and winter spawning components. For the purpose of stock assessment and management, these areas have been combined since 1982. Spawning in VIIj has traditionally taken place in the autumn and in VIIg and VIIaS, later in the autumn and in the winter.

A.2. Fishery

In recent years, this fishery has been prosecuted entirely by Ireland. The fishing season is the same as the assessment period, 1^{st} April to the 31^{st} March the following year. The TAC is set on an annual basis, however.

In the past season season, the fishery was allowed to remain open throughout. This was to allow vessels to target fish outside the spawning seasons when the fish are of better quality and marketability. The spawning grounds are protected by rotating box closures implemented under EU legislation. In addition to these, one box was voluntarily closed in the recent seasons. This initiative was initiated by the Irish Southwest Pelagic Management Committee to afford extra protection to first time spawners. The Irish Southwest Pelagic Management Committee was established to manage the Irish fishery for this herring stock. This committee, therefore, has responsibility for management of the entire fishery for this stock at present.

Landings have decreased markedly in recent years from around 20,000 t in the 1997/1998 season to around 11,000 t in the 2003/2004 season. The fishery is currently prosecuted by Irish RSW pelagic trawlers and by Irish polyvalent trawlers using pelagic gear.

A.3. Ecosystem aspects

B. Data

B.1. Commercial catch

The commercial catches are provided by national laboratories belonging toe the nations that have quota for this stock. In recent years, only Ireland has caught herring in this area, so catch-at-age, mean weights and stock weights are derived entirely from Irish sampling. Sampling is performed as part of commitments under the EU Council Regulation 1639/2001.

Commercial catch at age data are submitted in Exchange sheet v 1.6.4. These data are usually processed using SALLOCL. This program (Patterson, 1998). This program gives outputs on sampling status and available biological parameters and documents actions taken to raise unsampled metiers using other data sets. The species co-ordinator allocates samples of catch numbers, mean length and mean weight-at-age to unsampled catches using appropriate samples by gear (fleet) area quarter and if an exact match is not available then a neighbouring area if the fishery extends to this area in the same quarter.

B.2. Biological

Mean weights at age in the catch in the 4th and 1st quarter are used as stock weights. This is a new procedure first used in 2004, because much of the catch was taken in the summer, before the spawning period.

The natural mortality is based on the results of the MSVPA for North Sea herring.

B.3. Surveys

A series of acoustic surveys have been carried out on this stock from 1990-1996. The series was interrupted in 1997 due to the lack of the survey vessel, it was resumed in 1998. For the 2002/2003 season one acoustic survey was carried out to determine stock abundance. It was decided that a single survey carried out on fish approaching the grounds would be sufficient to contain the stock. A review of this survey series is in preparation (O’Donnell et al. in prep.).

B.4. Commercial CPUE

Not used for this stock.

B.5. Other relevant data

C. Historical Stock Development

Model used:

Recent WG’s have used the results of the acoustic surveys in the ICA programme but stated that the results should be taken as minimum estimates.

Software used: The ICA package is used.

Model Options chosen:

The period of separable constraint is 6 years, with areference age of 3-ring. Terminal selection is fixed at 1.0. Reference F is calculated for 2-ring to 7-ring fish. Fish of 1-ring are down weighted by 0.1, all other ages are not down weighted.

The acoustic abundance estimates are included for ages 2-5 only (winter rings). The acoustic estimates are treated as a relative index, using a linear model.

Input data types and characteristics:

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes	1958-2003	1-9	Yes
Canum	Catch at age in numbers	1958-2003	1-9	Yes
Weca	Weight at age in the commercial catch	1958-2003	1-9	Yes
West	Weight at age of the spawning stock at spawning time.	1958-2003	1-9	Yes
Mprop	Proportion of natural mortality before spawning	1958-2003	1-9	No
Fprop	Proportion of fishing mortality before spawning	1958-2003	1-9	No
Matprop	Proportion mature at age	1958-2003	1-9	No
Natmor	Natural mortality	1958-2003	1-9	No

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1	CSHAS	1990-2003	2-5
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-Term Projection

Model used: Multi fleet Deterministic Projection (Smith, 2000).

Software used: MFDP Software

A short-term projection is carried out under the following assumptions. The number of 1 ringers was based on the geometric mean from 1958 to 2001. . This was followed to allow for the inclusion of the period of recruitment failure. This value was 406 million fish. Mean weights in the catch and in the stock were calculated as means over the period 1998-2003. Population numbers of 2-ringers in the 2004/2005 season was calculated by the degradation of geometric mean recruitment (1958-2001) using the equation, following the same procedure as last year.

$N_{t+1} = N_t * e^{-F+M}$

Following the same procedure as last year, two scenarios are presented, one based on $\mathbf{F}_{sq}$ (=F_{2003}), the other on a catch constraint of 13,000 (the TAC for 2004).

E. Medium-Term Projections

Not performed

F. Long-Term Projections

Not performed

G. Biological Reference Points

$\mathbf{B}_{pa}$ is set at 44,000 t and $\mathbf{B}_{lim}$ at 26,000 t. F reference points are not defined for this stock.

H. Other Issues

I. References

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Appendix 5 - Stock Annex

Quality Handbook ANNEX: Her VIaN

Stock specific documentation of standard assessment procedures used by ICES.

Stock:	Herring in VIa (North)
Working Group:	Herring Assessment WG for the Area south of 62°N
Date:	18 March 2004
Authors:	E.M.C. Hatfield and E.J. Simmonds

A. General

A.1. Stock definition

The stock is distributed over ICES Division VIa (N). Some of the larger adults typically found close to the shelf break may be caught in division Vb.

A.2. Fishery

The dominant fleet fishing in VIa (N) since 1957 has been the Scottish fleet. In the early years the Scottish fishery was prosecuted using a mixture of vessel size and gear, including gill nets, ring-nets and trawls. The boats were small, and targeted the coastal stock, primarily fishing in the winter. Until 1970 the only other nations fishing in this area on a regular basis were the former German Federal Republic, and to a much lesser extend the Netherlands. These fleets operated in deeper water near the shelf edge.

In 1970 a large increase in exploitation occurred with the entry of fleets from Norway and the Faroes, and an increased Netherlands catch. In addition, considerably smaller catches were taken by France and Iceland.

Throughout this period juvenile herring catches from the Moray Firth, in the north-east of Scotland, were included in the VIa catch figures, as tagging programs showed there to be some links between herring spawning to the west of Scotland and the Moray Firth juveniles.

Prior to 1982 herring stocks in ICES Area VIa were assessed as one stock, along with the herring by-catch from the sprat fishery in the Moray Firth. In the 1982 herring assessment working group report, and in subsequent years, Area VIa was split into a northern and a southern area at 56^{o}N (ICES, 1982).

In 1979 and 1981 the fishery was closed. After re-opening the nature of the fishery changed to an extent, with fewer Scottish boats targeting the coastal stock than before the closure. The Scottish domestic pair trawl fleet and the Northern Irish fleet operated in shallower, coastal areas, principally fishing in the Minches and around the Island of Barra in the south; younger herring are found in these areas. Since 1986 Irish trawlers have operated in the south of the area, from the VIa (S) line up to the south-western Hebrides. The Scottish and Norwegian purse seine fleets targeted herring mostly in the northern North Sea, but also operated in the northern part of VIa (N). An international freezer-trawler fishery operated in deeper water near the shelf edge where older fish are distributed. These vessels are mostly registered in the Netherlands, Germany, France and England. In recent years the catch of these fleets has become more similar and has been dominated by younger adults resulting from increased recruitment into the stock.

In recent years the Scottish fleet has changed to a predominantly purse-seine fleet to a trawl fleet. Norwegian vessels fish less in the area than in the past. Scottish catches still comprise around half of the total, the rest is dominated by the offshore, international fishery.

A recent EU-funded programme WESTHER aims to elucidate stock structures of herring throughout the western seaboard of the British Isles using a combination of morphometric measurements, otolith structure, genetics and parasite loads. The results of this should provide the best-available information on mixing of stocks within and beyond VIa (N).

A.3. Ecosystem aspects

Herring in this area is an important food source for sea birds, sea mammals and many piscivorous fish.

Adult herring in VIa (N) can consume eggs of other fish species in the area. However, it has not been possible to demonstrate a relationship between herring abundance and recruitment to other stocks, and stomach investigations of herring do not indicate that the predation effect on eggs has significant impact on egg survival for other stocks.

B. Data

B.1. Commercial catch

Commercial catch is obtained from national laboratories of nations exploiting herring in VIa (N). Since 1999 (catch data 1998), these labs have used a spreadsheet to provide all necessary landing and sampling data, which was developed originally for the Mackerel Working Group (WGMHSA) and further adapted to the special needs of the Herring Assessment Working Group. The current version used for reporting the 2002 catch data was v1.6.4. The majority of commercial catch data of multinational fleets was provided on these spreadsheets and further processed with the SALLOCL-application (Patterson, 1998a). This program gives the needed standard outputs on sampling status and biological parameters. It also clearly documents any decisions made by the species co-ordinators for filling in missing data and raising the catch information of one nation/quarter/area with information from another data set.

Transparency of data handling by the Working Group. The current practice of data handling by the Working Group is that the data received by the co-ordinators is available in a folder called “archive”. These high-resolution data are not reproduced in the report. The archived data contains the disaggregated dataset (disfad), the allocations of samples to unsampled catches (alloc), the aggregated dataset (sam.out) and (in some cases) a document describing any problems with the data in that year.

Current methods of compiling fisheries assessment data. The species co-ordinator is responsible for compiling the national data to produce the input data for the assessments. In addition to checking the major task involved is to allocate samples of catch numbers, mean length and mean weight-at-age to unsampled catches. There are at present no defined criteria on how this should be done, but the following general process is implemented by the species co-ordinators. Searches are made for appropriate samples by gear (fleet) area quarter, if an exact match is not available the search will move to a neighbouring area if the fishery extends to this area in the same quarter. More than one sample may be allocated to an unsampled catch, in this case a straight mean or weighted mean of the observations may be used. If there are no samples available the search will move to the closest non-adjacent area by gear (fleet) and quarter, but not in all cases.

Until 2003 the VIa(N) catch data extended back to the early 1970s; since 1986 the series has run from 1976 to present. In 2004 the data set was extended back to 1957. Details are given below.

Historic Catches from 1957 to 1975

The working group has obtained preliminary estimates of catch and catch-at-age for the period 1957 to 1975. These have been estimated from records of catch presented in HAWG reports from 1973, 1974, 1981 and 1982. Intervening reports were also consulted to check for changes or updates during the period. Catch-at-age data were available from 1970 to 1975 from the 1982 Working Group report, and catches-at-age for the period 1957 to 1972 were estimated from paper records of catch-at-age by national fleets for 1957 to 1972, held at FRS Marine Laboratory Aberdeen. The fishing practices of national fleets were established for the period 1970 to 1980 from catches in VIa and VIa (N) recorded in the 1981 and 1982 Working Group reports respectively. This procedure suggested that, on average, more than 90% of catch by national fleet could be fully assigned to either VIa (N) or VIa (S). The remaining catch was assigned assuming historic proportions. During this period catches were split into autumn and spring spawning components; anecdotal information on trials to verify this separation suggests it was not a robust procedure. Currently about 5% of herring in VIa (N) is found to be spent at the time of the acoustic surveys in July, and thought to be spring spawning herring. However, at present the Working Group assesses VIa (N) herring as one stock, regardless of spawning stock affiliation. In the earlier period higher proportions were allocated as spring spawners. The Working Group considered that it was preferable to combine all catch in the earlier period as VIa (N) catch, as the spawning components are currently mixed and the historic separation was uncertain. Similarly, a small Moray Firth juvenile fishery was also included in VIa (N) catch in earlier years because it was thought that these juveniles were part of the VIa (N) stock. Separating this component in the historic data was difficult, and as the fishery ceased in the very early 70s this has no implications for current allocation of these fish. The Moray Firth is, geographically, part of IVa (ICES stat. rectangles 44E6, 44E7, 45E6) and is now managed as part of that area. Currently there are no juvenile herring catches from the Moray Firth. Full details of the analysis carried out is provided as an appendix (Appendix 11) to the 2004 Working Group report.

Allocation of catch and misreporting

This fishery had a strong tradition of misreporting. It is believed that the shortfall between the TAC and the catch was used to misreport catches from other areas (from IVa to the east and from VIa (S) to the south). In the past, fishery-independent information confirmed that large catches were being reported from areas with low abundances of fish, and informal information from the fishery and from other sources confirmed that most catches of fish recorded between 4^{o}W and 5^{o}W were most probably misreported North Sea catches. The problem was detailed in the Working Group report in 2002 (ICES 2002/ACFM:12). Improved information from the fishery in 1998 - 2002 allowed for re-allocation of many catches due to area misreporting (principally from VIa (N) to IVa (W)). This information was obtained from only some of the fleets

As a result of perceived problems of area misreporting of catch from IVa into VIa (N), Scotland introduced a new fishery regulation in 1997 aiming to improve reporting accuracy. Under this regulation, Scottish vessels fishing for herring are required to hold a license either to fish in the North Sea or in the west of Scotland area (VIa (N)). Only one of these options can be held at any one time.

The Working Group considers that the serious problems with misreporting of catches from this stock, with many examples of vessels operating and landing herring catches distant from VIa (N) but reporting catches from that area, have been reduced in recent years from some 30,000 t in the mid 1990s to around 5,000 t in 2002. In 2003, for the first time since 1983, observer data indicated there was no misreported catch..

Catches are included in the assessment. Biases and sampling designs are not documented. Discards are not included. Slippage and high grading are not recorded.

B.2. Biological

Catch-at-age data (catch numbers-at-age, mean weights-at-age in the catch, mean length-at-age) are derived from the raised national figures received from the national laboratories. The data are obtained either by market sampling or by onboard observers, and processed as described in Section B.1 above. For information on recent sampling levels and nations providing samples, see Section 2.2. in the most recent HAWG report.

Proportions mature (maturity ogive) and mean weights-at-age in the stock derived from the acoustic survey (see next section) have been used since 1992 and 1993, respectively. Prior to these years, time-invariant values derived from ??? were used.

Biological sampling of the catches was extremely poor in recent history (particularly in 1999). This was particularly the case for the freezer trawler fishery that takes the larger component of the stock based around the shelf break. The lack of samples was due in part to the fact that national vessels tend to land in foreign ports, avoiding national sampling programs. The same fleet is thought to high grade. The long length of fishing trips makes observer programs difficult. Even when samples are taken, age determination is limited for most nations.

Sampling has improved over the last few years. The number of age readings per 1,000 t of catch increased from the low in 1999 of 52 to a high in 2001 of 93. Numbers have decreased again since then to 57 per 1,000 t in 2003. From 1999 to 2003 the sampling has been dominated by Scotland (ranging between 70 and 98% of the age readings), except in 2001, when only 43% of the age determination was on Scottish landings in VIa (N).

Natural mortality (M) varies with age (expressed in number of winter rings) according to the following:

Rings	M
1	1
2	0.3
3	0.2
4+	0.1

Those values have been held constant from 1957 to date. Those values correspond to estimates for North Sea herring based on recommendations by the Multi-species WG (Anon. 1987a) that were applied to adjacent areas (Anon. 1987b).

B.3. Surveys

B.3.1 Acoustic survey

An acoustic survey has been carried out for VIa (N) herring in the years 1987, 1991-2003. The 1997 survey was invalidated due to its unusual timing (June as oppose to July).

Biomass estimated from the acoustic survey tends to be variable. Herring are found in similar area each year, namely south of the Hebrides off Barra Head, west of the Hebrides and along the shelf edge.

The stock is highly contagious in its spatial distribution, which explains some of the high variability in the time series. Effort stratification has improved with knowledge of the distribution and this may be less of a problem in more recent years. The survey uses the same target strength as for the North Sea surveys and there is no reason to suppose why this should be any different. Species identification is generally not a great problem.

B.3.2 Larvae survey

Larvae surveys for this stock were carried out from 1973 to 1993. Larval production estimates (LPE) and a larval abundance index (LAI) were produced for the time series. These values were used in the assessment, the LPE until 2001. However, in 2002 it was decided that the LAI had no influence on the assessment and has not been used since. Documentation of this survey time-series is given in ICES CM 1990/H:40.

B.4. Commercial CPUE Not used for pelagic stocks

B.5. Other relevant data

C. Historical Stock Development

An experimental survey-data-at-age model was formulated at the 2000 HAWG. In 1999 and 1998 a Bayesian modification to ICA was used to account for the uncertainty in misreporting.

Model used: ICA

Software used: ICA (Patterson 1998b)

Model Options chosen:
- Separable constraint over last 8 years (weighting = 1.0 for each year)
- Reference age = 4
- Constant selection pattern model
- Selectivity on oldest age = 1.0
- First age for calculation of mean F = 3
- Last age for calculation of mean F = 6
- Weighting on 1-rings = 0.1; all other age classes = 1.0
- Weighting for all years = 1.0
- All indices treated as linear
- No S/R relationship fitted
- Lowest and highest feasible F = 0.02 and 0.5
- All survey weights fitted by hand i.e., 1.0 with the 1 ringers in the acoustic survey weighted to 0.1.
- Correlated errors assumed i.e., = 1.0

No shrinkage applied

Input data types and characteristics:

TYPE	NAME	YEAR RANGE	AGE RANGE	VARIABLE FROM YEAR TO YEAR YES/NO
Caton	Catch in tonnes	1957 - 2003	NA	Yes
Canum	Catch at age in numbers	1957 – 2003	1-9+	Yes
Weca	Weight at age in the commercial catch	1957 –1972 1973-1981 1982-1984 1985-last data year	1-9+ 1-9+ 1-9+ 1-9+	No No No Yes
West	Weight at age of the spawning stock at spawning time.	1957 – 1992 1993-last data year	1-9+ 1-9+	No Yes
Mprop	Proportion of natural mortality before spawning	1957–last data year	NA	No
Fprop	Proportion of fishing mortality before spawning	1957–last data year	NA	No
Matprop	Proportion mature at age	1957 – 1991 1992-last data year	1-9+ 1-9+	No Yes
Natmor	Natural mortality	1957-last data year	1-9+	No

Tuning data:

TYPE	NAME	YEAR RANGE	AGE RANGE
Tuning fleet 1	VIa (N) Acoustic Survey	1987, 1991-1996 1998-2003	1-9+ 1-9+ 1-9+

D. Short-Term Projection

Model used: Age structured

Software used: MFDP ver 1a

Initial stock size: Taken from the last year of the assessment. 1- and 2-ring recruits taken from a geometric mean for the years 1976 to one year prior to the last year.

Maturity: Mean of the last three years of the maturity ogive used in the assessment.

F and M before spawning: Set to 0.67 for all years.

Weight at age in the stock: Mean of the last three years in the assessment.

Weight at age in the catch: Mean of the last three years in the assessment.

Exploitation pattern: Mean of the previous three years, scaled by the Fbar (3-6) to the level of the last year.

Intermediate year assumptions: *status quo* F constraint.

Stock recruitment model used:

None used

Procedures used for splitting projected catches: Not relevant

E. Medium-Term Projections

Model used: ICP as described in ICES 1996/ACFM:10

Software used: ICP (Patterson 1999)?

Initial stock size: Population parameters (vector of abundance at age in 2003, fishing mortality at reference age in 2003, selection at age) are drawn from a multivariate normal distribution with mean equal to the values estimated in the stock assessment model, and with covariance as estimated in the same model fit. Geometric mean recruitment for 1- and 2-ringers is used to replace the values in the assessment for the first projected year, however, the covariance values produced by ICA are retained.

Natural mortality: Mean of the last three years in the assessment.

Maturity: Mean of the last three years of the maturity ogive used in the assessment.

F and M before spawning: Set to 0.67 for all years.

Weight at age in the stock: Mean of the last three years in the assessment.

Weight at age in the catch: Mean of the last three years in the assessment.

Exploitation pattern: ???

Intermediate year assumptions: F or TAC constraint

Stock recruitment model used: Ockham option using the converged VPA 1972 to three years prior to last year in the assessment.

Uncertainty models used:

1. Initial stock size:
2. Natural mortality:
3. Maturity:
4. F and M before spawning:
5. Weight at age in the stock:
6. Weight at age in the catch:
7. Exploitation pattern:
8. Intermediate year assumptions:
9. Stock recruitment model used:

F. Long-Term Projections

Model used:

Software used:

Maturity:

F and M before spawning:

Weight at age in the stock:

Weight at age in the catch:

Exploitation pattern:

Procedures used for splitting projected catches:

G. Biological Reference Points

The report of SGPRP (ICES 2003/ACFM:15) proposed a $\mathbf{B}_{\mathrm{lim}}$ of 50,000 t for VIa (N) herring. This is calculated from the values in the converged part of the VPA (1976-1999) and the Working Group endorsed this value in 2003 (ICES 2003/ACFM:17).

In 2003 the Working Group estimated retrospective error in terminal SSB from 4 years and gave a mean of the absolute values of 20% and a maximum of 38%. Since there are so few data points and they are close in time to the current year the maximum value might be an underestimate of the range of values. The Working Group felt that the 90$^{\mathrm{th}}$ percentile on a normal distribution that had a mean error of 20% might be a more appropriate measure; this would give a factor close to 50%.

$\mathbf{B}_{\mathrm{pa}} = \mathbf{B}_{\mathrm{lim}} * 1.50$ and gives $\mathbf{B}_{\mathrm{pa}} = 75{,}000$ t

The Working Group had considerable trouble developing F reference points but proposed a value based on rather limited data on errors of estimation. $\mathbf{F}_{\mathbf{lim}}$ was derived directly from the equilibrium exploitation rate for an SSB for $\mathbf{B}_{\mathbf{lim}}$. $\mathbf{F}_{\mathbf{pa}}$ was obtained in a similar manner to $\mathbf{B}_{\mathbf{pa}}$ with a factor of 50%. Full details of the method are given in last year's Working Group report.

The Working Group did not repeat the extensive analysis carried out in 2003 (ICES 2003/ACFM:17) but suggests that, at the very least, a $\mathbf{B}_{\mathbf{lim}}$ of 50,000 and a $\mathbf{B}_{\mathbf{pa}}$ of 75,000 are suitable as Biomass limit and reference points for VIa (N). Reference points are urgently needed for the management of this stock and these values are as well founded as many others currently in use.

Suggested Precautionary Approach reference points:

$\mathbf{B}_{\mathrm{LIM}}$ **IS 50,000 T**	$\mathbf{B}_{\mathrm{PA}}$ **BE SET AT 75,000 T**
$\mathbf{F}_{\mathrm{lim}}$ is 0.75	$\mathbf{F}_{\mathrm{pa}} = 0.35$

Technical basis:

$\mathbf{B}_{\mathrm{LIM}}$: $\mathbf{B}_{\mathrm{LOSS}}$ **ESTIMATED SSB FOR SUSTAINED RECRUITMENT**	$\mathbf{B}_{\mathrm{PA}}$: $= 1.5 * \mathbf{B}_{\mathrm{LIM}}$
$\mathbf{F}_{\mathrm{lim}}$ corresponding to $\mathbf{B}_{\mathrm{lim}}$ from the yield-per-recruit $\mathbf{F}_{\mathrm{lim}} = 0.75$	$\mathbf{F}_{\mathrm{pa}} = 0.5 * \mathbf{B}_{\mathrm{lim}}$

H. Other Issues

H.1 Terminology

The WG uses "rings" rather than "age" or "winter rings" throughout the report to denominate the age of herring, with the intention to avoid confusion. It should be observed that, for autumn spawning stocks, there is a difference of one year between "age" and "rings". HAWG in 1992 (ICES 1992/Assess:11) stated that

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

The use of winter rings in ICES working groups has introduced a certain amount of confusion and errors. In specifying the age of the herring, people always have to state explicitly whether they are talking about rings or years, and whether the herring are autumn- or spring spawners. These details tend to get lost in working group reports, which can make these reports con-

fusing for outsiders, and even for herring experts themselves. As the age of all other fish species (and of herring in other parts of the world) is expressed in years, one could question the justification of treating West-European herring in a special way. Especially with the present trend towards multispecies assessment and integration of ICES working groups, there might be a case for a uniform system of age definition throughout all ICES working groups.

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

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

The text table below gives an example for the correlation between age, rings and year class for the different spawning types in late 2002:

YEAR CLASS (AUTUMN SPAWNERS)	2001/2002	2000/2001	1999/2000	1998/1999
Rings	**0**	**1**	**2**	**3**
Age (autumn spawners)	1	2	3	4
Year class (spring spawners)	**2002**	**2001**	**2000**	**1999**
Rings	**0**	**1**	**2**	**3**
Age (spring spawners)	0	1	2	3

I. References

Anon, 1982. Herring Assessment Working Group for the Area South of 62°N. ICES C.M. 1982/Assess:7.

Anon. 1987a. Report of the ad hoc Multispecies Assessment WG. ICES, Doc. C.M. 1987/Assess:9.

Anon. 1987b. Report of the Herring Assessment Working Group for the Area South of 62°N. ICES Doc. C.M. 1987/Assess:19.

Anon. 1990. Report of the ICES Herring Larvae Surveys in the North Sea and adjacent waters. ICES CM 1990/H:40

ICES 1992. Report of the Herring Assessment Working Group for the Area South of 62°N. ICES 1992/Assess:11

ICES 1996. Report of the Herring Assessment Working Group for the Area South of 62°N. ICES CM 1996/Assess:10.

ICES 2002. Report of the Herring Assessment Working Group for the Area South of 62° N. CM 2001/ACFM:12.

ICES 2003. Report of the Study Group on Precautionary Reference Points for Advice on Fishery Management. ICES CM 2003/ACFM:15

ICES 2003. Report of the Herring Assessment Working Group for the Area South of 62° N. ICES 2003/ACFM:17

Patterson, K.R. 1998a: A programme for calculating total international catch-at-age and weight-at-age. WD to HAWG 1998.

Patterson, K.R. 1998b. Integrated Catch at Age Analysis Version 1.4. Scottish Fisheries Research Report. No. 38.

Patterson 1999 ICP

Appendix 6 - Stock Annex

Quality Handbook ANNEX: Herring in VIaS and VIIb

Stock specific documentation of standard assessment procedures used by ICES.

Stock:	Herring in VIaS and VIIb
Working Group:	Herring Assessment Working Group for the area south of 62^0 N
Date:	19th April 2004

A. General

A.1. Stock definition

The herring to the northwest of Ireland comprise both autumn and winter spawning components. For the purpose of stock assessment and management, these areas have been separated from VIaN since 1982. Spawning in VIIb has traditionally taken place in the autumn and in VIaS, later in the autumn and in the winter.

A.2. Fishery

The TAC is taken mainly by Ireland, which has over 90% of the quota. In recent years, only Ireland has exploited herring in this area. In 2000 the Irish North West Pelagic Management Committee was established to deal with the management of this stock.

Landings have decreased markedly from about 44,000 t in 1990 to around 13,000 t in 2003.

A.3. Ecosystem aspects

B. Data

B.1. Commercial catch

The commercial catches are provided by national laboratories belonging toe the nations that have quota for this stock. In recent years, only Ireland has caught herring in this area, so catch-at-age, mean weights and stock weights are derived entirely from Irish sampling. Sampling is performed as part of commitments under the EU Council Regulation 1639/2001.

Commercial catch at age data are submitted in Exchange sheet v 1.6.4. These data are usually processed using SALLOCL. This program (Patterson, 1998) gives outputs on sampling status and available biological parameters and documents actions taken to raise unsampled metiers using other data sets. The species co-ordinator allocates samples of catch numbers, mean length and mean weight-at-age to unsampled catches using appropriate samples by gear (fleet) area quarter and if an exact match is not available then a neighbouring area if the fishery extends to this area in the same quarter.

B.2. Biological

Mean weights at age in the catch in the 4th and 1st quarter are used as stock weights.

B.3. Surveys

Not used in assessment

B.4. Commercial CPUE

Not used in assessment

B.5. Other relevant data

C. Historical Stock Development

Model used:

A separable VPA is used to track the historic development of this stock.

Software used:

Lowestoft VPA Package (Darby and Flatman , 1994). No final assessment has been accepted by the working group. However several scenarios are run, screening over a range of terminal F's and each is presented in the report.

Input data types and characteristics:

TYPE	NAME	YEAR RANGE	AGE RANGE	VARIABLE FROM YEAR TO YEAR YES/NO
Caton	Catch in tonnes	1970-2003	1-9	Yes
Canum	Catch at age in numbers	1970-2003	1-9	Yes
Weca	Weight at age in the commercial catch	1970-2003	1-9	Yes
West	Weight at age of the spawning stock at spawning time.	1970-2003	1-9	Yes
Mprop	Proportion of natural mortality before spawning	1970-2003	1-9	No
Fprop	Proportion of fishing mortality before spawning	1970-2003	1-9	No
Matprop	Proportion mature at age	1970-2003	1-9	No
Natmor	Natural mortality	1970-2003	1-9	No

Tuning data:

TYPE	NAME	YEAR RANGE	AGE RANGE
Tuning fleet 1			
Tuning fleet 2			
Tuning fleet 3			
….			

D. Short-Term Projection

Not conducted

E. Medium-Term Projections

Not conducted

F. Long-Term Projections

Not conducted

G. Biological Reference Points

$\mathbf{B}_{pa\,=}$ 110,000 t and $\mathbf{B}_{lim}$ = 81,000 t. $\mathbf{F}_{pa}$ = 0.22 and F lim = 0.33.

H. Other Issues

I. References

Darby, C.D. and Flatman, S. 1994. Virtual Population Analysis version 3.1 (Windows/DOS) user guide. Lowestoft: MAFF Information Technology Series No. 1.

Appendix 7 – Stock Annex

Quality Handbook ANNEX:_hawg-nirs_

Stock specific documentation of standard assessment procedures used by ICES.

Stock:	Irish Sea herring
Working Group	Herring Assessment Working Group (HAWG)
Date:	17 March 2004

A. General

A.1. Stock definition

Herring spawning grounds in the Irish Sea are found in coastal waters to the west and north of the Isle of Man and on the Irish Coast at around 54°N (ICES 1994, Dickey-Collas *et al*. 2001). Spawning takes place from September to November in both areas, occurring slightly later on average on the Irish Coast than off the Isle of Man. ICES Herring Assessment Working Groups from 19XX to 1983 used v ertebral counts to separate catches into Manx and Mourne stocks associated with these spawning grounds. However, taking account of inaccuracies in this method and the results of biochemical analyses, the 1984 WG combined the data from the two components to provide a "more meaningful and accurate estimate of the total stock biomass in the N.Irish Sea." All subsequent assessments have treated the VIIa(N) data as coming from a single stock. During the 1970s, catches from the Manx component were about three times larger than those from the Mourne component. By the early 1980s, following the collapse of the stock, the catches were of similar magnitude. The fishery off the Mourne coast declined substantially in the 1990s then ceased, whilst acoustic and larva surveys in this period indicate that the spawning population in this area has been very small compared to the biomass off the Isle of Man.

The occurrence in the Irish Sea of juvenile herring from a winter-spring spawning stock has been recognized since the 1960s based on vertebral counts (ICES 1994). More recently, Brophy and Danilowicz (2002) used otolith microstructure to show that nursery grounds in the western Irish Sea were generally dominated by winter-spawned fish. Samples from the eastern Irish Sea were mainly autumn-spawned fish. Recaptures from 10,000 herring tagged off the SW of the Isle of Man in July 1991 occurred both on the Manx spawning grounds and along the Irish Coast with increasing proportions from the Celtic Sea in subsequent years (Molloy *et al.*, 1993). The pattern of recaptures indicated a movement towards spawning grounds in the Celtic Sea as the fish matured.

A proportion of the Irish Sea herring stocks may occur to the north of the Irish Sea outside of the spawning period. This was indicated by the recapture on the Manx spawning grounds of 3-6 ring herring tagged during summer in the Firth of Clyde (Morrison and Bruce 1981). Aggregations of post-spawning adult herring were detected along the west coast of England during an acoustic survey in December 1996 (Department of Agriculture and Rural Development for Northern Ireland, unpublished data), showing that a component of the stock may remain within the Irish Sea.

A recent EU-funded programme WESTHER aims to elucidate stock structures of herring throughout the western seaboard of the British Isles using a combination of morphometric measurements, otolith structure, genetics and parasite loads. The results of this should provide the best-available information on mixing of stocks within and beyond the Irish Sea.

A.2. Fishery

There have been three types of fishery on herring in the Irish Sea in the last 40 years:

i. Isle of Man- aimed at adult fish that spawn around the Isle of Man.
ii. Mourne- aimed at adult fish that spawn off the Northern Irish eastern coast.
iii. Mornington- a mixed industrial fishery that caught juveniles in the western Irish Sea.

The Mornington fishery started in 1969 and at its peak it caught 10,000 tonnes per year. It took place throughout the year. The fishery was closed due to management concerns in 1978 (ICES, 1994). In the 1970s the catch of fish from the Mourne fishery made up over a third of the total Irish Sea catch. The fishery was carried out by UK and Republic of Ireland vessels using trawls, seines and drift nets in the autumn. However the fishery declined and ceased in the early 1990s (ICES, 1994). The biomass of Mourne herring, determined from larval production estimates is now 2-4% of the total Irish Sea stock (Dickey-Collas *et al*., 2001).

The main herring fishery in the Irish Sea has been on the fish that spawn in the vicinity of the Isle of Man. The fish are caught as they enter the North Channel, down the Scottish coast, and around the Isle of Man. Traditionally this fishery supplied the Manx Kipper Industry, which requires fish in June and July. However the fish appeared to spawn slightly later in the year in the 1990s and this lead to problems of supply for the Manx Kipper Industry. In 1998 the Kipper companies decided to buy in fish from other areas. Generally the fishery has occurred from June to November, but is highly dependent on the migratory behaviour of the herring.

The fishery has been prosecuted mainly by UK and Irish vessels. TACs were first introduced in 1972, and vessels from France, Netherlands and the USSR also reported catches from the Irish Sea during the 1970s before the closure of the fisheries from 1978 to 1981. By the 1990s only the fishery on the Manx fish remained, and by the late 1990s this was dominated by Northern Irish boats. The number of Northern Irish vessels landing herring declined from 24 in 1995-96 to 6-10 in 1997-99 and to 4 in 2000. Only two vessels operated in 2002 and 2003. However, total landings have remained relatively stable since the 1980s whilst the mean amount of fish landed per fishing trip has increased, reflecting the increase in average vessel size

A.3. Ecosystem aspects

The main fish predators on herring in the Irish Sea include whiting (*Merlangius merlangus*), hake (*Merluccius merluccius*) and spurdogfish (*Squalus acanthias*). The size composition of herring in the stomach contents indicates that predation by whiting is mainly on 0-ring and 1-ring herring whilst adult hake and spurdogfish also eat older herring (Armstrong, 1979; Newton, 2000; Patterson, 1983). Sampling since the 1980s has shown cod (*Gadus morhua*), taken by both pelagic and demersal trawls in the Irish Sea, to be minor predators on herring. Small clupeids are an important source of food for piscivorous seabirds including gannets, guillemots and razorbills (ref…) which nest at several locations in and around the Irish Sea. Marine mammal predators include grey and harbour seals (ref.) and possibly pilot whales, which occur seasonally in areas where herring aggregate.

Whilst small juvenile herring occur throughout the coastal waters of the western and eastern Irish Sea, their distribution overlaps extensively with sprats (*Sprattus sprattus*). The biomass of small herring has typically been less than 5% of the combined biomass of small clupeids estimated by acoustics (ICES HAWG reports).

B. Data

B.1. Commercial catch

National landings estimates

The current ICES assessment of Irish Sea herring extends back to 1961, and is based on landings only. ICES WG reports (ICES 1981, 1986 and 1991) highlight the occurrence of discarding and slippage of catches, which can occur in areas where adult and juvenile herring co-occur. Discarding has been practised on an increasing scale since 1980 (ICES 1986). This increase is primarily related to the onset of slippage of catches that coincided with the cessation of the industrial fishery in early 1979 (ICES 1980). As a result of sorting practices, slippage has led to marked changes in the age composition of the catch since 1979 and considerable change in the mean weights at age in the catch of the three youngest age groups (ICES 1981). Estimates of discarding were sporadically performed in the 1980s (ICES 1981, 1982, 1985 and 1986), but there are no estimates of discarding or slippage of herring in the Irish Sea fisheries since 1986. Highly variable annual discard rates are evident from the 1980s surveys. For example, discards estimates of juvenile herring (0-group) for the Mourne stock taken in the 1981 *Nephrops* fishery was estimated at 1.9×10^6 of vessels landing in Northern Ireland, which amounts to approximately 20% of the Mourne fishery (ICES 1982). In 1982, at least 50% of 1-group herring caught were discarded at sea by vessels participating in the Isle of Man fishery (ICES 1983). A more comprehensive survey programme to determine the rate of discarding in 1985 revealed discard estimates of 82% by numbers of 1-ring fish, 30% of 2-ring and 6% of 3-ring fish, with the dominant age group in the landed catch being 3 ring (ICES 1986). A similar survey in 1986, however, found the discarding of young fish fell to a very low level (ICES 1987). The 1991 WG discussed the discard problem in herring fisheries in general and suggested possible measures to reduce discarding. No quantitative estimates were given, but reports of fishermen suggesting discards of up to 50% of catch as a result of sorting practices by using sorting machines (ICES 1991). The variation in discard rates since 1980, as a result of changes in discard practices, can probably be attributed to several changes in the management of the fishery. These include the availability of different fishing areas, the change to fortnightly catch quotas per boat (ICES 1987) and level of TAC, where lower discard rates are observed with a higher TAC (ICES 1989). The level of slippage is also related to the fishing season, since slippage is often at a high level in the early months (ICES 1987). Due to the variable nature of discard estimates and the lack of a continuous data series, it has not been included in the annual catch at age estimates (with the exception of the 1983 assessment when the catch in numbers of 1-ringers was doubled based on a 50% discard estimate of this age group).

Landings data for herring in Division VIIa(N) are generally collated from all participating countries providing official statistics to ICES, namely UK (England & Wales, Northern Ireland, Scotland and the Isle of Man), Ireland, France, the Netherlands and what was formally the USSR. The data for the period 1971 to present are reported in the various Herring Assessment Working Group Reports and are reproduced in Table 1. The official Statistics for Irish landings from VIIa have been processed to remove data from the Dunmore East fishery in area VIIa(S), and represent landings from VIIa(N) only.

Over the past three decades, the WG highlighted the under- or misreporting of catches as the major problem with regards to the accuracy of the landing data. Related to this are the problems of illegal landings during closed periods and paper landings. Area misreporting was also recognised (ICES 1999), although a less prominent problem that is mostly corrected for.

The 1980 WG first identified the problem of misreporting of landings based on the results of a 3-year sampling programme, which was initiated after 1975 when herring were being landed in metric units at ports bordering the Irish Sea (1 unit = 100 kg nominal weight). The study showed the weight of a unit to be very variable, but was usually well in excess of 100 kg. An initial attempt to allow for misreporting using adjusted catches made very little difference to any of the values of fishing mortality (ICES 1980). Subsequently, despite serious concerns about considerable under-reporting being raised (ICES 1990, 1994, 2000 and 2001), the WG made no attempts to examination the extent of the problem. This uncertainty signifies no estimates of under-reporting and consequently no allowance for under-reporting of landings has been made. Considerable doubt was raised as to the accuracy of landing data over the period 1981-87 (ICES 1994). However, after apparent re-examination all WG landing statistics are assumed to be accurate up to 1997 (ICES 2000), but with no reliable estimates of landings from 1998-2000 (ICES 2001). The WG acknowledged that poor quality landing data bring the catch in numbers at age data into question and hence the accuracy of any assessment using data from such periods (ICES 1994).

In 2002 the ICES assessment was extended back to include data for 1961-1970 with the intention of showing the stock development prior to the large expansion in fishing effort and stock size in the early 1970s. This has now been extended further back to 1955. Landings data for this period were extracted from the UK fisheries data bases (England & Wales, Scotland and Northern Ireland: Table 1, columns8-10) and publications by Bowers and Brand (1973) for Isle of Man landings (column 11). Landings data for Ireland and France were not available.

To estimate the VIIa(N) herring landings for Ireland and France during 1955-1970, the NE Atlantic herring catches for each country were obtained from the FAO database (column 16). Using the ICES landings data for each country (column 17) the mean proportion of the VIIa(N) catch to the NE Atlantic catch during 1971 to 1981 was estimated (column 18). This was applied to the NE Atlantic catches from each country, for the period 1955 to 1970, to give an estimated landing for both France and Ireland (column 19). These landings were added to the known catches from the CEFAS database to give the total landings. The landings data (tonnes) used in the assessment are given in Table 1, column 14. It is anticipated that landings data for VIIa(N) for years prior to 1971 can be extracted from the Irish databases. However, the French landings will remain as estimates.

[Need discussion on magnitude of errors in the old data]

[Need discussion on errors due to misreporting]

Catch at age data

Age classes in the ICES Canum file refer to numbers of winter rings in otoliths. As the Irish Sea stock comprises autumn spawners, *i*-ring fish taken in year *y* will comprise fish in their i_{th} year of life if caught prior to the spawning season and $(i+1)_{th}$ year if caught after the spawning period. An *i*-ring fish will belong to year-class *y*-2. As spawning stock is estimated at spawning time (autumn), spawning stock and recruitment relationships require estimates of recruitment of *i*-ring fish in year *y* and estimates of SSB in year *i*-2. The current assessment estimates recruitment as numbers of 1-ring fish.

The most recent description of sampling and raising methods for estimating catch at age of herring stocks is in ICES (1996). This includes sampling by UK(E&W) and Ireland, but not UK(NI) and Isle of Man

UK(NI): A random sample of 10-20kg of herring is taken from each landing into the main landing port (Ardglass) by the NI Department of Agriculture and Rural Development. Samples are also collected from any catches landed into Londonderry. Prior to the 1990s, the samples were mostly processed fresh. During the 1990s, there was an increasing tendency for samples to be frozen for a period of weeks before processing. No corrections have been applied to weight measurements to allow for changes due to freezing and defrosting. The length frequency (total length) of each sample is recorded to the nearest 0.5cm below. A sample of herring is then taken for biological analysis as follows: one fish per 0.5 cm length class, followed by a random sample to make the sample up to 50 fish.

Otoliths are removed from each fish, mounted in resin on a black slide and read by reflected light. Ages are assigned according to number of winter rings.

Length frequencies (LFDs) for VIIa(N) catches are aggregated by quarter. The weight of the aggregate LFD is calculated using a length-weight relationship derived from the biological samples. The LFD is then raised to the total quarterly landings of herring by the NI fleets. A quarterly age-length key, derived from commercial catch samples only, is applied to the raised LFD to give numbers at age and mean weight at age.

IOM: IOM sampling covers the period 1923 – 1997. Samples are collected from any landings into Peel, by staff of the Port Erin Marine Laboratory (Liverpool University). The sampling and raising procedures are the same as described for UK(NI) with the following exceptions: i) the weight of the aggregate quarterly LFD is obtained from the original sample weights rather than using a length-weight relationship, and ii) the biological samples are random rather than stratified by length. The 1993 ICES herring assessment WGs noted a potential under-estimation by one ring, of herring sampled in the IOM. This was caused by a change in materials used for mounting otoliths and appears to have been a problem for ageing older herring in 1990-92. This was since rectified. However, the bias for the 1990-92 period has not yet been quantified and will be examined in the near future.

Ireland: Irish sampling of VIIa(N) herring covers the period 19xx – 2001. Some samples are from landings into NI but transported to factories in southern Ireland. Irish sampling schemes for herring in Div. VIa(S), VIIb, Celtic Sea and VIIj are described in ICES (1996). Methods for sampling catches in VIIa(N) are similar. The procedure is the same as described above for UK(NI) except that the biological samples are random rather than length stratified. ICES (1996) notes that a length-stratified scheme should be adopted to ensure proper coverage at the extremes of the LFDs.

Quality control of herring ageing has fallen under the remit of EU funded programmes EFAN and TACADAR, to which the laboratories sampling VIIa(N) herring contribute. An otolith exchange exercise was initiated in 2002 and is currently being completed.

B.2. Biological

Natural mortality (M) varies with age (expressed in number of winter rings) according to the following:

Rings	M
1	1
2	0.3
3	0.2
4+	0.1

Those values have been held constant from 1972 to date. Those values correspond to estimates for North Sea herring based on recommendations by the Multi-species WG (Anon. 1987a). which were applied to adjacent areas (Anon. 1987b).

Maturity at age. Combined, year-specific maturity ogives were used in the 2003 Assessment (ICES 2003). The way those values were derived is documented on Dickey-Collas *et al.*

(2003). Prior to 2003 annually invariant estimates of the proportion of fish mature by age were used. Those were based on estimates from the 1970s (ICES, 1994). The use of the variable maturity ogive in 2003 did not change greatly the perception of the stock state (Dickey-Collas *et al., op cit*).

SSB in September is estimated in the assessment. The survey larvae estimate is used as a relative index of SSB. The proportions of M and F before spawning are held constant over time in the assessment.

Stock weights at age have been derived from the age samples of the 3rd quarter landings since 1984 (R. Nash *pers comm.*). The stock mean weights for 1975-83 are time invariant and were re-examined in 1985 (Anon. 1985). They result from combining Manx and Mourne data sets. The weight at age of those stocks were considered relatively stable over time.

B.3. Surveys

The following surveys provide data for the VIIa(N) assessment:

SURVEY ACRONYM	TYPE	ABUNDANCE DATA	AREA AND MONTH	PERIOD
AC(VIIaN)	Acoustic survey	Numbers at age (1-ring and older); SSB	VIIa(N) from 53^0 20'N – 55^{o}N; September	1994 – present
NINEL	Larva survey	Production of larvae at 6mm TL	VIIa(N) from 53^o 50'N – 54^o 50'N; November	1993 – present
DBL	Larva survey	Production of larvae at 6mm TL	East coast of Isle of Man; October	1989 – 1999 (1996 missing)
GFS-oct	Groundfish survey	Mean nos. caught per 3 n.miles (1&2 ringers), by region	VIIa(N) from 53^0 20'N – 54^o 50'N (stratified); October	1993 - present
GFS-mar	Groundfish survey	Mean nos. caught per 3 n.miles (1&2 ringers), by region	VIIa(N) from 53^0 20'N – 54^o 50'N (stratified); March	1993 - present

Data from a number of earlier surveys have been documented in the ICES WG reports. These include:

NW Irish Sea young herring surveys (Irish otter trawl survey using commercial trawler; 1980 – 1988)

Douglas Bank (East Isle of Man) larva surveys (ring net surveys; 1974 – 1988) (Port Erin Marine Lab)

Douglas Bank spawning aggregation acoustic surveys (1989, 1990, 1994, 1995) (Port Erin Marine Lab)

Western Irish Sea acoustic survey (July 1991, 1992) (UK(NI))

Eastern Irish Sea acoustic survey (December 1996)

Surveys used in recent assessments are described below.

AC(VIIaN) acoustic survey

This survey uses a stratified design with systematic transects, during the first two weeks of September. Vessel used is the R.V. *Lough Foyle* (UK(NI)). Starting positions are randomized each year (see recent HAWG reports for transect design and survey results). The survey is most intense around the Isle of Man (2 to 4 n.mile transect spacing) where highest densities of adult herring are expected based on previous surveys and fishery data. Transect spacing of 6 to 10 n.miles are used elsewhere. A sphere-calibrated EK-500 38kHz sounder is employed, and data are archived and analysed using Echoview (SonarData, Tasmania). Targets are identified by midwater trawling. Acoustic records are manually partitioned to species by scrutinising the echograms and using trawl compositions where appropriate. ICES-recommended target strengths are used for herring, sprat, mackerel, horse mackerel and gadoids. The survey design and implementation follows, where possible, the guidelines for ICES herring acoustic surveys in the North Sea and West of Scotland. The survey data are analysed in 15-minute elementary distance sampling units (approx. 2.5 n.miles). An estimate of density by age class, and spawning stock biomass, is obtained for each EDSU and a distance-weighted average calculated for each stratum. These are raised by stratum area to give population numbers and SSB by stratum.

NINEL larva survey

The DARD herring larva survey has been carried out in November each year since 1993 . Sampling is carried out on a systematic grid of stations covering the spawning grounds and surrounding regions in the NE and NW Irish Sea (Figure 1). Larvae are sampled using a Gulf-VII high-speed plankton sampler with 280 μm net. Double-oblique tows are made to within 2m of the seabed at each station. Internal and external flow rates, and temperature and salinity profiles, were recorded during each tow. Lengths of all herring larva captured are recorded.

Mean catch-rates (nos.m^{-2}) are calculated over stations to give separate indices of abundance for the NE and NW Irish Sea. Larval production rates (standardised to a larva of 6mm), and birth-date distributions, are computed based on the mean density of larvae by length class. A growth rate of 0.35mm day^{-1} and instantaneous mortality of 0.14 day^{-1} are assumed based on estimates made in 1993 - 1997. More recent studies have indicated a mortality rate of 0.09, and this value is also applied to examine the effect on trends in estimates of larval production

DBL larva survey

Herring larvae were sampled on the east side of the Isle of Man in September or October each year. Double oblique tows with a 60 cm Gulf VII/PRO-NET high-speed plankton sampler with a 40cm aperture nose cone were undertaken on a 5 Nm square grid. The tow profile was followed with a FURUNO net sonde attached to the top of the equipment. The volume of water filtered was calculated from the nose cone mouth flow meter. The samples were preserved in 4% seawater buffered formalin and stored in 70% alcohol.

All herring larvae were sorted from the samples. The numbers of larvae per m^3 were calculated from the volume of water filtered and the number of larvae per tow. Up to 100 larvae from each tow were measured with an ocular graticule in a stereo microscope. Each sample was assigned to a sampling square and the total number of larvae per 0.5mm size class calculated from the average depth of the square and the surface area.

The total production and time of larvae hatch was calculated using an instantaneous mortality coefficient (k) of 0.14 and a growth rate of 0.35 mm d^{-1} in the formula:

$$N_t = N_o e^{-(kt)}$$

Production was calculated as the sum of all size classes/hatching dates. Spawning dates were taken as 10 days prior to the hatching date (Bowers 1952).

GFS-oct and –mar groundfish surveys

The DARD groundfish survey of ICES Division VIIaN are carried out in March and October 2003 at standard stations between 53° 20’N and 54° 45’N (Figure 2). Data from additional stations fished in the St George's Channel since October 2001 have not been used in calculating herring indices of abundance. As in previous surveys, the area was divided into strata according to depth contour and sediment type, with fixed station positions (note that the strata in Fig. 2 differ from those in the September acoustic survey shown in Fig. 1). The sampling gear was a Rockhopper otter trawl fitted with non-rotating rubber discs of approximately 15 cm diameter on the footrope. The trawl fishes with an average headline height of 3.0 m and door spread of 30 - 40 m depending on depth and tide. A 20mm stretched-mesh codend liner was fitted. During March, trawling was carried out at an average speed of 3 knots across the ground, over a standard distance of 3 nautical miles at standard stations and 1 nautical mile in the St. George's Channel. Since 2002, all survey stations in the October survey have been of 1-mile distance. Comparative trawling exercises during the October surveys and during an independent exercise in February 2003 indicate roughly similar catch-rates per mile between 1-mile and 3-mile tows. It is planned to continue with some comparative trawling experiments during future surveys to improve the statistical power of significance tests between the 1-mile and 3-mile tows.

As the surveys are targeted at gadoids, ages were not recorded for herring. The length frequencies in each survey were sliced into length ranges corresponding to 0-ring and 1-ring herring according to the appearance of modes in the overall weighted mean length frequency for each survey. Some imprecision will have resulted because of the overlap in length-at-age distributions of 1-ring and 2-ring herring. The error is considered to be comparatively small for most of the surveys where clear modes are apparent. There was no clear division between 1-ring and 2-ring herring in the March 2003 groundfish survey, and the estimate for 1-ringers may include a significant component of small 2-ringers. The arithmetic mean catch-rate and approximate variance of the mean was computed for each age-class in each survey stratum, and averaged over strata using the areas of the strata as weighting factors.

B.4. Commercial CPUE

Commercial CPUE’s are not used for this stock.

B.5. Other relevant data

C. Historical Stock Development

Model used: ICA
Software used: ICA (Patterson 1998)

Model Options chosen:

- Separable constraint over last 6 years (weighting = 1.0 for each year)
- Reference age = 4
- Constant selection pattern model
- Selectivity on oldest age = 1.0
- First age for calculation of mean F = 2
- Last age for calculation of mean F = 6
- Weighting on 1-rings = 0.1; all other age classes = 1.0
- Weighting for all years = 1.0
- All indices treated as linear
- No S/R relationship fitted
- Lowest and highest feasible F = 0.05 and 2.0
- All survey weights fitted by hand i.e., 1.0 with the 1 ringers in the acoustic survey weighted to 0.1.
- Correlated errors assumed i.e., = 1.0
- No shrinkage applied

Input data types and characteristics:

Type	Name	Year range	Age range	Variable from year to year Yes/No
Caton	Catch in tonnes	1961-last data year	NA	Yes
Canum	Catch at age in numbers	1961-last data year	1-8+	Yes
Weca	Weight at age in the commercial catch	1961-1971 1972-1983 1984-last data year	1-8+ 1-8+ 1-8+	Yes No Yes
West	Weight at age of the spawning stock at spawning time.	1961-1971 1972-1983 1984-last data year	1-8+ 1-8+ 1-8+	Yes No Yes
Mprop	Proportion of natural mortality before spawning	1961-last data year	NA	No
Fprop	Proportion of fishing mortality before spawning	11961-last data year	NA	No
Matprop	Proportion mature at age	1961-last data year	1-8+	Yes
Natmor	Natural mortality	1961-last data year	1-8+	No

Tuning data:

Type	Name	Year range	Age range
Tuning fleet 1	NINEL	1993-2003	SSB
Tuning fleet 2	DBL	1989-1999	SSB
Tuning fleet 3	GFS-octtot	1993-2005	1 & 2
Tuning fleet 4	GFS-martot	1992-2003	1
Tuning fleet 5	ACAGE	1994-2003	1-8+
Tuning fleet 6	AC_VIIa(N)	1994-2003	SSB
Tuning fleet 7	AC_1+	1994-2003	SSB/Total biomass

D. Short-Term Projection

NOT USED IN 2004

Model used: Age structured

Software used: MFDP ver 1a

Initial stock size: Taken from the last year of the assessment. 1-ring recruits taken from a geometric mean for the years 1983 to two years prior to the current year. Where 1-ringers are absurdly estimated in the assessment 2-ringers are estimated as a geometric mean of the previous 10 year period.

Maturity: Mean of the previous three years of the maturity ogive used in the assessment.

F and M before spawning: Set to 0.9 and 0.75 respectively for all years.

Weight at age in the stock: Mean of the previous three years in the assessment.

Weight at age in the catch: Mean of the previous three years in the assessment.

Exploitation pattern: Mean of the previous three years, scaled by the Fbar (2-6) to the level of the last year.

Intermediate year assumptions: TAC constraint.

Stock recruitment model used: None used

Procedures used for splitting projected catches: Not relevant

E. Medium-Term Projections

F. Long-Term Projections

Not done

G. Biological Reference Points

Until there is confidence in the assessment the Working Group decided not to revisit the estimation of $\mathbf{B}_{pa}$ (9,500 t) and $\mathbf{B}_{lim}$ (6,000 t). There were no new points to add to the discussions and deliberations presented in 2000 (ICES 2000/ACFM:10).

H. Other Issues

I. References

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Table 1. Biological sampling of Irish Sea (VIIa(N)) landings. Country denotes sampling nation.

	COVERAGE	% OF LANDINGS SAMPLED	NO OF SAMPLES	TOTAL LANDINGS	LANDINGS BY Q?	IRELAND				NORTHERN IRELAND				ISLE OF MAN				OTHERR UK/UK OFFSHORE				TOTAL			
Year						Landings	Samples	Lengths	Ages	Landings	Samples	Lengths	Ages	Landings	Samples	Lengths	Ages	Landings	Samples	Lengths	Ages	Landings	Samples	Lengths	Ages
1988	(4)					**2579																	0	0	0
1989	(3) temp spread good		88	4962	NO	1430	21	1843	555		45	11464	2249		21	5173	1057		1	96	0	4962	88	18576	3861
1990	p(1,2)	68%	100	6312	YES	1699	44	5176	1022	2322	38	9310	1900	542	18	5276	897	179/1570	0	0	0	6312	100	19762	3819
1991	g	90%	138	4398	YES	80	5	1255	247	3298	105	16724	2484	629	28	8280	1392	0/391	0	0	0	4398	138	26259	4123
1992	g	98%	32	5270	YES	406	3	593	99	4120	16	1588	770	741	13	3488	680	3	0	0	0	5270	32	5669	1549
1993	p (1)	65%	48	4408	YES	0	5	1378	245	3632	34	3744	832	776	9	1560	448	0	0	0	0	4408	48	6682	1525
1994	v.g	95%	59	4828	YES	0	2[1]	569	100	3956	43	3691	1175	716	14	3724	614	156	0	0	0	4828	59	7984	1889
1995	g (1)	87%	85	5076	YES	0	2[1]	569	100	3860	75	8282	2545	615	8	2182	400	601	0	0	0	5076	85	11033	3045
1996	g (1,5)	70%	51	5301	YES	100	1	537	55	4335	45	4813	1050	537	5	997	228	329	0	0	0	5301	51	6347	1333
1997	g (1,2)	91%	34	6649	YES	0	2	473	50	5679	25	2900	1199	765	7	2246	340	205	0	234	76	6649	34	5853	1665
1998	g (2)	84%	31	4904	YES	0	2	150	50	4131	29	2979	1450	0	0	0	0	773[2]	0	0	0	4904	31	3129	1500
1999	g (2)	72%	32	4127	YES	0	4	0	200	2967	28	2518	1400	0	0	0	0	1160[2]	0	0	0	4127	32	2518	1600
2000	v.g	97%	28	2002	YES	0	5	932	0	2002	23	1915	1150	0	0	0	0	0	0	0	0	2002	28	2847	1150
2001	p (2)	70%	31	5461	YES	862	8	1031	222	3786	23	2915	1149	86	0	0	0	727[2]	0	0	0	5461	31	3946	1371
2002	p (1)	62%	9	2392	YES	286	0	0	0	2051	9	949	450	4	0	0	0	51	0	0	0	2392	9	949	450
2003																									

COVERAGE: Sum of the landings (by Q and Nation(UK disaggregated))/total landings. From 1993 (possibly from 1990) to date landings and sampling levels are presented by quarter so coverage is related to this level of detail:

VERY GOOD (v.g) : all landings which individually are >10% of the total were sampled, all Q for which there were landings were sampled

GOOD (g) : landings that constitute the majority of the catch (adding to approx 70% or more of total) were sampled

POOR (p) : some of the large landings not sampled

(1): unsampled quarters

(2): large landings with few samples or unsampled. High level of sampling corresponds to 1 sample per 100t landed (WG rep 1997)

(3): Comment from WG rep. From 1990 going back, Report landings and sampling levels are shown aggregated for the whole year. UK landings lumped in one figure.

(4): no information in the WGrep of level of sampling prior to 1988. Sampling levels believed to be good. Actual figures to be provided by R. Nash, M Armstrong and CEFAS after going back to their labs.

(5): NO samples for NI landings in 4th Q, there is a suspicion that the figures correspond to 'paper landings'.

[1]Samples applied to NI landings: [2]Large unsampled landings.

Table ??: Data and method used to estimate landings from Division VIIa(N) herring.

																ESTIMATES OF MAXIMUM LIKELY CATCH FOR VIIA(N) INCL. OF FRENCH AND ROI CATCHES							
Column No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	**16**		**17**		**18**		**19**	
	ICES table							British Isles catches						**CATCH IN ASSESS-MENT**		NE Atlantic catch		ICES 7a catch		% of NE atlantic		max likely catch	
	Ireland	UK	France	Netherlands	USSR / Russia	Unallocated	Total	England	Northern Ireland	Wales	Manx	Irish	Total			France	Ireland	France	Ireland	France	Ireland	France	Ireland
1955								0	0	72	3815		3887	**8056**		60500	4900					3630	539
1956								5	0	20	4762		4787	**8743**		52000	7600					3120	836
1957								21	0	1638	2832		4491	**7966**		36100	11900					2166	1309
1958								31	0	12	2482		2525	**6261**		38800	12800					2328	1408
1959								20	0	96	3577		3693	**7833**		40400	15600					2424	1716
1960								1	0	9	2093		2103	**6607**		36200	21200					2172	2332
1961								32	0	144	1941		2117	**5710**		36600	12700					2196	1397
1962								4	0	21	1528		1552	**4343**		29100	9500					1746	1045
1963								5	0	34	974		1013	**3947**		33500	8400					2010	924
1964								2	0	0	556		558	**3593**		35000	8500					2100	935
1965								1629	0	398	1135		3162	**5923**		26400	10700					1584	1177
1966								2041	0	46	596		2683	**5666**		22400	14900					1344	1639
1967								2911	0	8	1959		4878	**8721**		20600	23700					1236	2607

1968								1504	0	5	3253		4762	**8660**		22800	23000					1368	2530
1969								3591	0	63	5044		8698	**14141**		27100	34700					1626	3817
1970								4662	0	16	9782		14461	**20622**		24400	42700					1464	4697
1971	3131	21861	1815				26807							**26807**		23500	31200	1815	3131	0.08	0.10		
1972	2529	23337	1224	260			27350							**27350**		29900	47800	1224	2529	0.04	0.05		
1973	3614	18587	254	143			22598							**22598**		30800	38900	254	3614	0.01	0.09		
1974	5894	27489	3194	1116	945		38638							**38638**		21199	39608	3194	5894	0.15	0.15		
1975	4790	18244	813	630	26		24503							**24503**		25645	29752	813	4790	0.03	0.16		
1976	3205	16401	651	989			21246							**21246**		20466	22227	651	3205	0.03	0.14		
1977	3331	11498	85	500			15414							**15414**		4164	23436	85	3331	0.02	0.14		
1978	2371	8432	174	98			11075							**11075**		4201	27717	174	2371	0.04	0.09		
1979	1805	10078	455				12338							**12338**		3596	27454	455	1805	0.13	0.07		
1980	1340	9272	1				10613							**10613**		6126	36917	1	1340	0.00	0.04		
1981	283	4094					4377							**4377**		6952	29926			0.00	0.00		
1982	300	3375				1180	4855							**4855**									
1983	860	3025	48				3933							**3933**						0.06	0.11		
1984	1084	2982					4066							**4066**									
1985	1000	4077				4110	9187							**9187**									
1986	1640	4376				1424	7440							**7440**									
1987	1200	3290				1333	5823							**5823**									
1988	2579	7593					10172							**10172**									

1989	1430	3532					4962							**4962**									
1990	1699	4613					6312							**6312**									
1991	80	4318					4398							**4398**									
1992	406	4864					5270							**5270**									
1993	0	4408					4408							**4408**									
1994	0	4828					4828							**4828**									
1995	0	5076					5076							**5076**									
1996	100	5180				22	5302							**5302**									
1997	0	6651					6651							**6651**									
1998	0	4905					4905							**4905**									
1999	0	4127					4127							**4127**									
2000	0	2002					2002							**2002**									
2001	862	4599					5461							**5461**									
2002	286	2107					2393							**2393**									

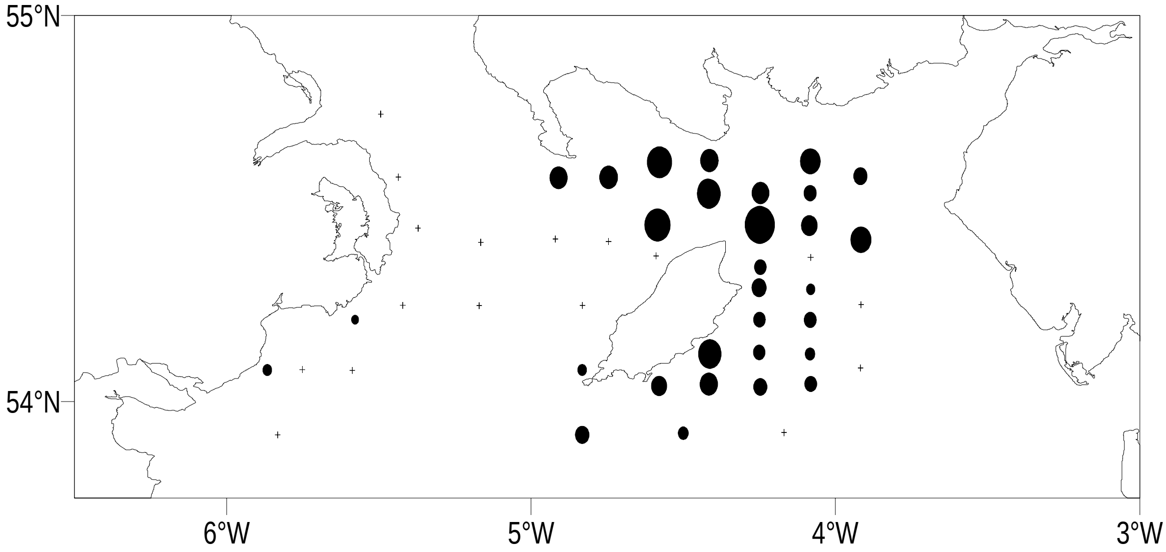
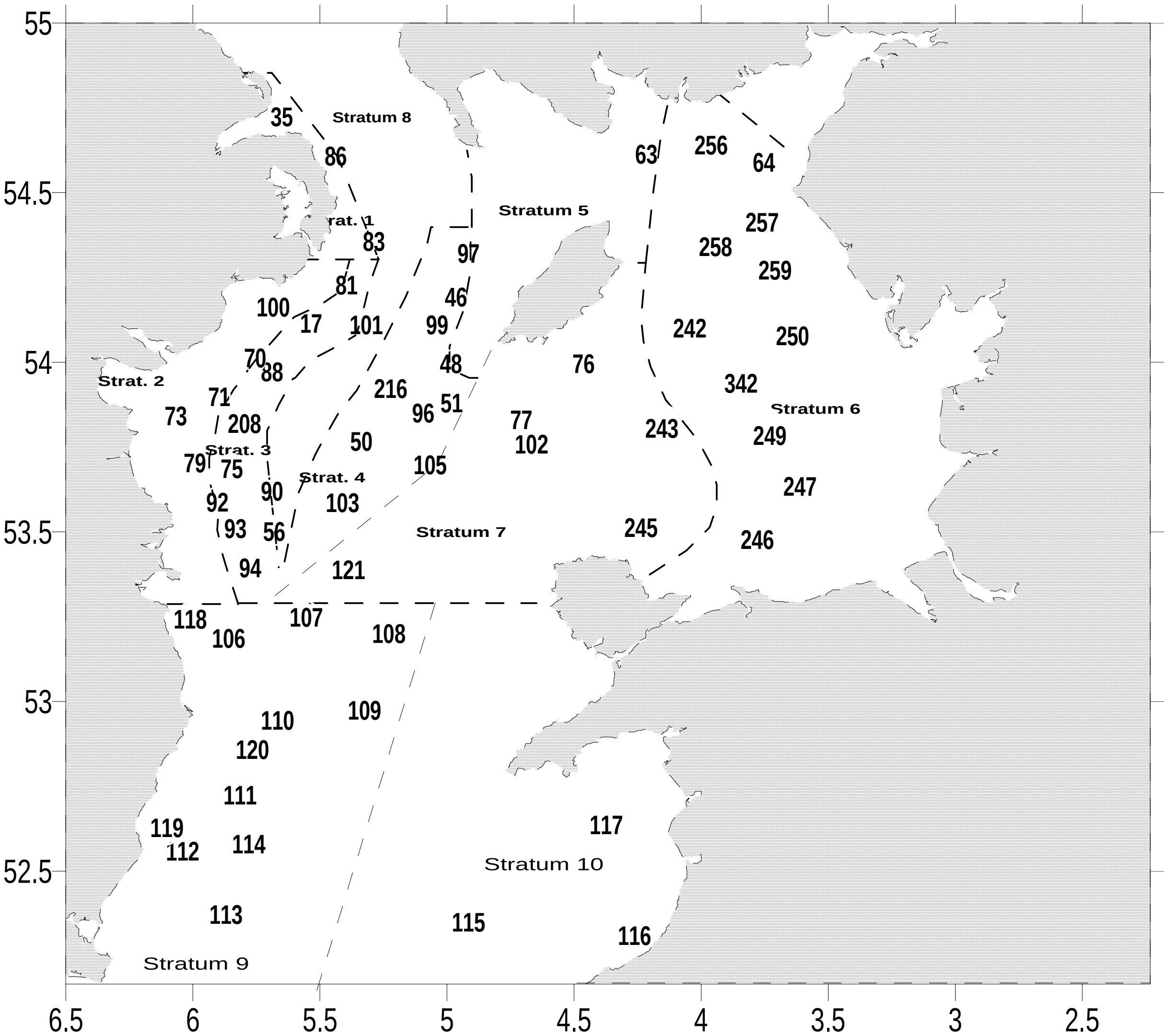


Figure 1. Sampling stations for larvae in the North Irish Sea (NINEL). Sampling is undertaken in November each year.



Key to strata:

1. Irish Coast (N), <100m, Mixed sediments
2. Irish Coast, < 50m, sand and finer sediments
3. Irish Coast, 50 - 100m, Muddy sediments
4. W and SW Isle of Man, 50 - 100m, mud and muddy sand
5. N Isle of Man, <50m, gravel sediments
6. Eastern Irish Sea, <50m, sand and finer sediments
7. S. Isle of Man, <100m, gravel sediments
8. Deep western channel and North Channel >100m
9. St George's Channel west; sandy/mixed sediments; <100m
10. St George's Channel east; sandy/mixed sediments; <100m

Figure 2. Standard station positions for DARD groundfish survey of the Irish Sea in March and October. Boundaries of survey strata are shown. Indices for the "Western Irish Sea" use data from strata 2 - 4. Indices for the "Eastern Irish Sea" use data from stratum 6 only (few juvenile herring are found in stratum 7). (Note different stratification to Fig. 1.). New stations fished in the St Georges Channel (strata 9 and 10) since October 2001 are not included in the survey indices. Stratum 5 (1 station only in recent years) is also excluded from the index. There are no stations in stratum 8 due to difficult trawling conditions for the gear used in the survey. Station 121 in stratum 7 has been fished only once and is excluded from the index.

Appendix 8 - Stock Annex

Quality Handbook ANNEX: Sprat in the North Sea

Stock specific documentation of standard assessment procedures used by ICES.

Stock: Sprat in the North Sea

Working Group (HAWG) Herring Assessment Working Group

Date: 4^{TH} March 2004

A. General

A.1. Stock definition

Sprat in ICES area IV.

A.2. Fishery

The Danish small meshed fishery is responsible for the majority of the landings. A study undertaken in 2000 showed that the species composition in the Danish sprat fishery has changed towards a fishery with low by-catches of other species (ICES CM 2001/ACFM:12). The Norwegian sprat fishery is carried out by purse- seiners. A closure of the Norwegian fishery was introduced for the second and third quarter in 1999 and this management regime is still in force. On top of this management regime, a maximum quota (900 t) per vessel is set for the Norwegian vessels; and they are not allowed to fish in Norwegian waters until the Norwegian quota in EU waters has been taken. The majority of the catches in both fisheries is taken in the 4th quarter, though some fishery takes place during January and February.

There was a considerable increase in landings from about 10,000 t in 1986 to a peak of 320,000 t in 1995. From 2000 the landings have been relatively stable around 150,000 to 170,000 t.

A.3. Ecosystem aspects

B. Data

B.1. Commercial catch

The commercial catch is provided by the national laboratories belonging to nations exploiting the sprat in the North Sea. The sampling intensity for biological samples, i.e., age and weight-at-age is mainly performed following the EU regulation 1639/2001 as the country landing most of the catches follows this regulation. This provision requires 1 sample per 2000 tonnes landed. This sampling level is lower than the guidelines (1 sample per 1000 tonnes) previously used by the HAWG, but as the fishery is carried out in a limited area, the recommended sampling level can be regarded as adequate.

The majority of commercial catch and sampling data are submitted in the Exchange sheet v. 1.6.4 and further processed with the SALLOCL-application (Patterson 1998). This program gives outputs on sampling status and available biological parameters and documents actions taken to raise unsampled metiers using other data sets. The species co-ordinator allocates samples of catch numbers, mean length and mean weight-at-age to unsampled catches using appropriate samples by gear (fleet) area quarter and if an exact match is not available then a neighbouring area if the fishery extends to this area in the same quarter.

B.2. Biological

Mean weights at age in the catch in the 1st quarter are used as stock weights.

Natural mortality. Results from the multi-species VPA (.Report from the ICES Workshop on Multi-species VPA in the North Sea, Charlottenlund, Denmark 8th-12th April 2002: ICES CM 2002/D:04) are used as a basis to fix the value of M in the CSA model. The estimated values presented in table XX correspond to predation mortality. To estimate total natural mortality a value of 0.2 to account for other sources of natural mortality should be added to the predation mortality.

B.3. Surveys

The acoustic surveys for the North Sea Herring in June-July have estimated sprat abundance since 1996. In the initial years low sprat biomass was estimated but those were not thought to be representative mainly due to inappropriate coverage of the south-eastern area (ICES CM 2000/D:07), the area expected to have the highest abundance of sprat in the North Sea. In 2000 the survey was extended by 30 n.mi to the south and covered for the first time the south-eastern area considered to have the highest abundance of sprat in the North Sea. By doing so, the estimate of sprat increased significantly. The distribution pattern in 2002 demonstrates, however, that the southern distribution border was still not reached by the survey. Further, the inshore areas were sprat is expected to be abundant are not covered so, the survey can only be seen as indicative of trends in biomass.

The IBTS (February) sprat indices (no per hour) in IVb (sprat standard area) are used as an index of abundance. The historical data were revised in 1995 (ICES 1995/Assess:13) and 1999 (ICES 1999/ACFM:12). The IBTS Working Group redefined the sprat index to be calculated as an area weighted mean over means by rectangles for the entire North Sea sprat stock. Based on this, the IBTS WG asked ICES Secretariat to carry out new calculations in 2001 (ICES 2000/D:07), which are the ones used at present. The fishing method (gear) in the IBTS-survey was standardised in 1983 and the data series from 1984, are comparable. The old IBTS-indices are available in ICES 2001/ACFM:12.

B.4. Commercial CPUE

Not used for this stock.

B.5. Other relevant data

C. Historical Stock Development

Model used:

Sprat is a relatively short-lived species, the stock and the catches, consisting mostly of 1 and 2 year-olds. In addition, there are difficulties in age reading resulting in unreliable estimates of numbers at age both from the surveys and the commercial catch. Given those limitations a data exploration using Catch-Survey Analysis (CSA), an assessment method designed for cases where full age-structured data are missing, was undertaken by the WG in 2003. The method is based on the "modified DeLury" two-stage model (Conser 1995) and on an implementation tested on simulated data presented to the Methods Working Group in 2003 (Mesnil 2003). The model assumes that the population consists of two stages: the recruits (preferably a single year-class) and the fully recruited ages.

Software used:
CSA executable version made available by B. Mesnil (IFREMER).

Model Options chosen:

Input data types and characteristics:

Model input data consisting of the time-series of catch numbers for each stage, mean weight for each stage in the stock at the start of the year and the 1st quarter IBTS index of abundance for the 1 year-old sprat (age = number of winter rings) and older than 2 years-old. Given low sampling levels in years previous to 1995, constant weight at age based on commercial data from the 1st quarter was assumed for the whole period. Reservations regarding the ability of the IBTS 1-year-old index to fully reflect strong and weak cohorts for sprat were expressed in previous WG reports (see ICES 1998 ACFM:14). Those were linked to difficulties in age reading and/or a possible prolonged spawning and recruitment season. Another problem identified in some surveys was related to large catches in small areas which could have been very influential on the results. Examination of the biomass and the 1 year-old index trajectories by the WG in 2003, suggested that the observed fluctuations in overall biomass are related to a large extent to observed fluctuations in the 1 year-old index. This is to be expected in a population where the recruits account for a large proportion of the stock. A unique value for the instantaneous rate of natural mortality ($M = 0.4$) and a parameter corresponding to the ratio of the survey catchability of the recruits to the fully recruited ages ($s = 1$) were fixed externally.

D. Short-Term Projection

Model used:

The SHOT- approach (Shepherd, 1991) was used in the past by the WG to estimate the landings in the assessment year. The 2003 WG considered that approach inappropriate for a short-lived stock like sprat therefore the projection was based on the results from CSA.

A catch prediction for the assessment year is based on a linear regression of annual catch versus IBTS estimated biomass for the period starting in 1987.

Software used:

Initial stock size:

Maturity:

F and M before spawning:

Weight at age in the stock:

Weight at age in the catch:

Exploitation pattern:

Intermediate year assumptions:

Stock recruitment model used:

Procedures used for splitting projected catches:

E. Medium-Term Projections

Not performed

F. Long-Term Projections

Not performed

G. Biological Reference Points

Not set.

H. Other Issues

Only in-year catch forecasts are available. The stock consists of only a few year classes, with a predominance of 1-year-old fish in the catch.

I. References

Conser, R.J. 1995. A modified DeLury modelling framework for data-limited assessments : bridging the gap between surplus production models and age-structured models. Working document to the ICES Working Group on Methods of Fish Stock Assessment, Copenhagen, February 1995, 85 pp.

Mesnil, B. 2003. Catch-Survey Analysis (CSA): A very promising method for stock assessment, particularly when age data are missing or uncertain. WD at WGMFSA, ICES CM 2003/D:03

Appendix 9 - Stock Annex.

Quality Handbook ANNEX:_Sprat VIIde

Stock specific documentation of standard assessment procedures used by ICES.

Stock: Sprat in Division VIId,e

Working Group: Herring Assessment Working Group (HAWG)

Date: 16TH March 2004

A. General

A.1. Stock definition

Sprat in ICES area VIId, VIIe,f.

A.2. Fishery

Vessels from UK (England and Wales) are responsible for the vast majority of the catches. The majority of the catches are taken in the 3rd and 4th quarter.

The landings in this area are very small and have never been above 6,000 t since 1985. Since 2000 the landings have been stable around 1,500 t.

A.3. Ecosystem aspects

B. Data

B.1. Commercial catch

The commercial catch is provided by the national laboratories belonging to nations exploiting the sprat in the Division VIId and VIIe,f. The sampling intensity for biological samples, i.e., age and weight-at-age has not been performed since 1999, but as the fishery is so small, this is not considered to be a problem.

B.2. Biological

B.3. Surveys

There are no surveys targeting sprat in this area.

B.4. Commercial CPUE

Not used for this stock.

B.5. Other relevant data

C. Historical Stock Development

Not performed for this stock.

D. Short-Term Projection

Not performed for this stock.

E. Medium-Term Projections

Not performed

F. Long-Term Projections

Not performed

G. Biological Reference Points

Not set.

H. Other Issues

I. References

Appendix 10 Stock Annex

Quality Handbook ANNEX: Sprat IIIa

Stock specific documentation of standard assessment procedures used by ICES.

Stock:	Sprat in Division IIIa
Working Group:	Herring Assessment Working Group (HAWG)
Date:	16th March 2004

A. General

A.1. Stock definition

Sprat in ICES area IIIa

A.2. Fishery

Fleets from Denmark, Norway and Sweden carry out the sprat fishery in Division IIIa. The Danish sprat fishery consists of trawlers using a 16 mm-mesh size codend and all landings are used for fishmeal and oil production. Some of the sprat landings from Denmark and Sweden are by-catches in the herring fishery using 32 mm mesh-size cod ends. The Swedish fishery is directed at sprat with by-catches of herring but also includes a fishery carried out with small purse seiners at the West Coast of Sweden for human consumption. The Norwegian sprat fishery in Division IIIa is an inshore purse seine fishery for human consumption.

The majority of the landings are made by the Danish fleet. In 1997 a mixed-clupeoid fishery management regime was changed to a new agreement between the EU and Norway that resulted in a TAC for sprat as well as a by-catch ceiling for herring. Catches are taken in all quarters, though with the bulk of catches in the first and fourth quarter. Denmark has a total ban on the sprat fishery in Division IIIa from May to September.

There was a considerable increase in landings from about 10,000 t in 1993 to a peak of 96,000 t in 1994. From 1996 the landings has been stabilising around 20,000 t.

A.3. Ecosystem aspects

B. Data

B.1. Commercial catch

The commercial catch is provided by the national laboratories belonging to nations exploiting the sprat in Division IIIa. The sampling intensity for biological samples, i.e., age and weight-at-age is mainly performed following the EU regulation 1639/2001 as Denmark landing most of the catches follows this regulation. This provision requires 1 sample per 2000 tonnes landed.

The majority of commercial catch and sampling data are submitted in the Exchange sheet v. 1.6.4 and further processed with the SALLOCL-application (Patterson 1998). This program gives outputs on sampling status and available biological parameters and documents actions taken to raise unsampled metiers using other data sets. The species co-ordinator allocates samples of catch numbers, mean length and mean weight-at-age to unsampled catches using appropriate samples by gear (fleet) area quarter and if an exact match is not available then a neighbouring area if the fishery extends to this area in the same quarter.

B.2. Biological

Mean weights-at-age (g) in the catches have been very variable over time, but whether this is due to actual variation in mean weight or difficulties in ageing of sprat is uncertain.

No estimation of natural mortality is made for this stock.

B.3. Surveys

Acoustic estimates of sprat have been available from the ICES co-ordinated Herring Acoustic surveys since 1996. The estimated biomass of sprat has been very variable with low values in the period from 1997 to 2002, but recently the biomass has increased. The majority of the biomass during the acoustic survey is recorded in the Kattegat area.

The IBTS (February) sprat indices (no per hour) in Division IIIa are used as an index of abundance, however, the index has not been considered useful for management of sprat in Division IIIa. The indices are calculated as mean no./hr (CPUE) weighted by area where water depths are between 10 and 150 m (ICES 1995/Assess:13). The indices were revised in 2002 (ICES 2002/ACFM:12) based on an agreement in the IBTS WG in 1999, where it was decided to calculate the sprat index as an area weighted mean over means by rectangles for the IIIa (ICES 1999/D:2). The old time-series of IBTS indices (from 1984-2001) is shown in ICES 2001/ACFM:10.

B.4. Commercial CPUE

Not used for this stock.

B.5. Other relevant data

C. Historical Stock Development

Not performed

D. Short-Term Projection

Not perfomed

E. Medium-Term Projections

Not performed

F. Long-Term Projections

Not performed

G. Biological Reference Points

Not set.

H. Other Issues

I. References

Patterson, K.R. 1998: A programme for calculating total international catch-at-age and weight-at-age. Working Document to Herring Assessment Working Group South of 62oN. ICES CM 1998/ACFM:14.

Annex 1: TECHNICAL MINUTES

Herring Assessment Work Group (HAWG)

Vigo, 27 May 2005

Present:

Reviewers: Carmela Porteiro, Spain (Chair)
Andre Forest (France)
Jari Raitaniemi (Finland)

Chair HAWG::Mark Dickey-Collas

Observers

Pablo Abaunza (Spain)
Santiago Cerviño (Spain)
Julio Martinez (Spain)

General

The reviewers would like to acknowledge the effort made by the WG in compiling all the information and particularly to Mark Dickey–Collas for his excellent presentations on the different stocks and for the high quality of the Working Group report.

All together 10 stocks are considered; this year full analytical assessment has been carried out only for 3 stocks. For the rest, the assessment has either been updated or is experimental.

North Sea Autumn Spawners (NSAS)

The assessment was accepted as a good assessment (similar to last year).

The differences between official landings and the information provided by WG members (official figures are consistently lower across all years) were noted. Landings have been well above the TAC. The fact that misreporting is still substantial and has increased from last year (i.e. catch area misreported) was also noted.

The reviewers point out that landings abroad should be covered by the respective countries to be sure that biological data is collected.

The reviewers noted that the cohort of 2000 shows a significant decrease in mean weight-at-age and also in the proportion of maturity comparing with the previous cohorts. It should be interesting to search for the possible causes, i.e. density –dependent effects or environmental aspects.,

The reviewers note that there is a sign of three poor year classes coming in after a period of good recruitment, although SSB is well above the precautionary biomass and F has stabilised over the last few years. It should be very useful to include a figure showing the contribution (proportion) of each year-class in the predictions.

The assessment is very well driven and it is based on a consistent catch matrix data and tuning surveys. The reviewers also appreciated the application of various assessment models for exploratory analysis. The reasons why the SURBA model gives a different trend in the last year estimate of SSB and F, comparing with the results of ICA and XSA, could be explored with more detail.

The reviewers noted that the pattern in residuals show that the catch and surveys show different signals (Figure 2.6.1.1), and support the request for North Sea herring to be a benchmark assessment next year, to allow further exploration of these data.

The reviewers noted that generally the proposed harvest control rules meet precautionary criteria except however for the 15% limit in variation in TAC between years. Simulations showed that this was probably out side of the precautionary approach.

Downs herring (IVc and VIId)

The reviewers acknowledged the need for better understanding of the dynamics of the stock and welcomed the addition information provided this year.

The reviewers noted the lack of data available for this stock and the need for more historical information. Downs herring has shown independent trends in exploitation rate and recruitment but its current state is unknown.

It is a political stock component; it is important at least in some areas and the new information provided by HAWG in 2005 suggests that its importance as a source of North Sea production has increased recently.

Western Baltic Spring Spawners (WBSS)

The assessment for this stock is accepted (same as last year).

This stock is exploited jointly with NSAS, which implies the need for a mixed stock analysis. This analysis is well implemented.

The reviewers noted the lack of survey coverage of the whole stock at the same time, could be a problem and the Subgroup recommends the development of a single joint survey for this stock through PGHERS, in order to improve the efficiency of the indices. They also indicated the problem that juvenile herring from the North Sea stock has a feeding area in the Skagerrak and Kattegat.The residuals from surveys (IBTS and the two acoustic surveys) are very high and show year effects. The retrospective analysis shows some problems that could be investigated further. The selection pattern of the stock has changed through the assessment period.

It was noted that the relationships between the recruitment indices have improved although there is still some noise.

A figure showing the contributions by different cohorts to the projections would also be useful for this stock.

The reviewers noted that the mean weight-at-age is still decreasing and suggest that HAWG also prioritise the development of an annually varying maturity ogive for this stock as the adjacent stock of North Sea herring shows large inter-annual variability that can effect estimates of SSB and projections.

The review group were worried about the effect of using the current year's proportion of spawner types on the projections. A sensitivity analysis of this assumption would be of great benefit and the review recommends, now that a long time series is available, further exploration of the dynamics of the annually variation splits.

Celtic Sea and Division VIIj herring

The stock is problematic, the assessment was not accepted but it was last year.

The reviewers note that the ICA model does not fit well in this case (specially no tuning data available for the assessment.).

The reviewers noted a change in the exploitation pattern from adults to juveniles in the recent years. The reviewers did not accept the description of this fishery as a recruitment fishery, and pointed out that it is just overexploited.

The review would like to have a description of the fleets that exploit this stock.

The reviewers hope the data from BTS UK-1q will be made available to the assessment group soon. The reviewers are worried about the low estimate of abundance given by the surveys in the last year.

Maturity at age is very variable and (is assumed to be) very different from North Sea stock.

Herring in the VIa North

Assessment was accepted last year. The assessment is the same as the last year. The stock has full reproductive capacity and is lightly exploited.

The reviewers note that the sampling coverage has been reduced significantly and that the problem of misreporting catches is still continuing. The mean weight-at-age from the acoustic surveys is the lowest of the time series available.

There was no clarity in the determination of F status quo, and unscaled mean averages appeared to have been used, rather than the final year or a scaled mean.

In the short term forecast it is observed that the TAC constraint option is not maintained through the three years forecast. It should be for the whole three years period of forecasting and not only for the first year.

The reviewers appreciate very much the initiative of designing a harvest control rule for this stock. However the conclusion of the simulations with regard to the possible range of candidate fishing mortalities produce some Fs that seem to be too close to F_{med} to be considered precautionary.

Herring in Divisions VIa (South) and VIIb,c

The state of the stock is unknown with respect to biological limits.

In the absence of tuning data, the assessments have been carried out by assuming various terminal F values on the catch-at-age data. Tuning indices are necessary to gain precision in estimates. The reviewers expect a preliminary exploration of an assessment with the acoustic tuning series next year.

The reviewers note that it is necessary to perform a yield per recruit analysis to obtain estimates of Fmax and F0.1.

Irish Sea herring (VIIa north)

The assessment for this stock was not accepted by the WG.

The reviewers acknowledge the effort in assessing this stock and a there has been an improvement in the assessment method but the results are still too imprecise especially when looking at the retrospective pattern.

It should be interesting to recover the index of abundance of the incoming year-classes from IBTS using otolith microstructure.

The reviewers appreciate the arguments given in section 1.10 on the approach to the western stocks and look forward to the results from WESTHER. Next year, in light of these new results the review group would like to see some exploration of the dynamics of the western stocks, within a metapopulation framework. .

Sprat in the North Sea (Subarea IV)

The assessment is regarded as exploratory.

Due to the characteristics of the stock (short-lived species, with the stock dominated by 1-and 2-year olds and with unreliable numbers-at age from surveys and catches), Catch Survey Analysis (CSA) has been used for data exploration as it was used last year. The model results are very sensitive to M (the natural mortality, which is very difficult to estimate) and s (ratio of the survey catchability of the recruits to the fully recruited) parameters. The reviewers recommend that the new version of CSA (that has a subroutine to estimate s) be used in the future. The model is very sensitive to assumptions about M and these can be further explored with the new version.

The IBTS index shows a higher recruitment for the last year. The reviewers point out to include the information (i.e. number-at-age) from the IBTS and the acoustic survey in the report.

Sprat in Division IIIa

There is no assessment on this stock and its state is unknown.

It shows a high variability in the catches driven by the strength of the incoming recruitment.

The index of recruits used in the shot forecast was the total catch in numbers instead of the age 1 recruits.

Its exploitation is mainly controlled by the regulation of the herring fishery.