Advisory Committee on Fisheries Management **ICES CM 2002/ACFM19**

REPORT OF THE

NORTHERN PELAGIC AND BLUE WHITING FISHERIES WORKING GROUP

Vigo, Spain
29 April - 8 May 2002

International Council for the Exploration of the Sea

Conseil International pour l'Exploration de la Mer

Palægade 2–4 DK–1261 Copenhagen K Denmark

1 INTRODUCTION

A note from the Chair

Around noon on the final day of the meeting Sergei Belikov, on behalf of the 'Russian delegation', presented a document, which is an annex to this report. The Working Group did not have time to consider its contents.

1.1 Terms of reference

The **Northern Pelagic and Blue Whiting Fisheries Working Group** [WGNPBW] (Chair: A. Gudmundsdottir, Iceland) will meet in Vigo, Spain from 29 April to 8 May 2002 to:

a) assess the status of and provide catch options for 2003 for the Norwegian spring-spawning herring stock;

b) assess the status of and provide catch options for the 2002–2003 season for the Icelandic summer-spawning herring stocks;

c) assess the status of capelin in Subareas V and XIV and provide catch options for the summer/autumn 2002 and winter 2003 seasons;

d) assess the status of and provide catch options for capelin in Subareas I and II (excluding Division IIa west of 5°W) in 2003;

e) assess the status of and provide catch options for 2003 for the blue whiting stock. Review the biological reference points for blue whiting. If a rebuilding plan is required, provide relevant information for establishing such a plan;

f) provide specific information on possible deficiencies in the assessments including at least: Major inadequacies in the data on catches, effort or discards; major inadequacies if any in research vessel surveys data and major difficulties if any in model formulation; including inadequacies in available software. The Group should clarify the consequences from these deficiencies for a) assessment of the status of the stocks and b) for the projection;

g) for stocks for which a full analytical assessment is presented, comment on this meeting's assessments compared to the last assessment of the same stock;

h) consider the results presented in the reports of the WGMG and the SGPA with a view to applying these in the assessments;

i) review the draft Quality Handbook.

WGNPBW will report by 9 May 2002 for the attention of ACFM.

1.2 List of participants

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1.3 Non-standard assessment methods

This WG has traditionally developed assessment specific software for several of its stocks, instead of using software that has become standard in ICES. The main motive for this is to be able to take stock-specific biological features into account, as well as the types of data that are available. Thus, for Norwegian spring spawning herring, the stock is dominated by a few very large year classes, which are estimated by tuning to the survey data, while the data for the other year classes generally are of poorer quality and should not be allowed to influence the assessment too strongly. In addition, there are tag recapture data that carry valuable information about the stock abundance. For blue whiting, ICA has been the standard software for some years, but the assessment has always been problematic due to noisy and to some extent conflicting data. This year AMCI was attempted in order to solve some of these problems, or at least get a better understanding of the impact of the various data sources.

Another motive for developing alternative software is to apply insight and solutions made by others to approach problems also for our stocks. Thus, the WG has in some cases preferred to use bootstrap to estimate uncertainty in the assessment rather than deriving the variance from the Hessian matrix (delta method), to take more direct account of the noise in the data. The Sea Star model uses bootstrap, and the AMCI can do both methods. The gradually changing selection pattern in AMCI has some similarity to the time series models (Gudmundson, 1994; Ianelli and Fournier, 1998). The separate handling of outstanding year classes has recently been used for Western horse mackerel (ICES 2001)

For medium projections, no standard has been firmly adopted by ICES, and the choice of method has been mostly dependent on traditions in the group, and on the software used for historic assessment. Thus, assessment by ICA naturally leads to using ICP for medium term predictions. For some of the stocks analysed by this WG, a spreadsheet programme has been used for some years, with the @Risk add-in in EXCEL as a tool for making stochastic predictions. Recent work has shown that the outcome of medium term projections to quite some extent is dependent on the method used, as well as the assumptions made within the method framework, which to some extent carry over from the assessment. (Patterson & al, 2000). The methods also vary with respect to which kind of scenarios they may simulate. This year, the STPR software was used, partly because it allows a range of simulation scenarios, partly because it is independent of ICA, and finally to avoid the use of spreadsheets that are generally error-prone.

This section gives a brief description of the various non-standard methods used by this WG.

1.3.1 SeaStar

The assessment program SeaStar is essentially the same model as used during the 2000 and 2001 meetings for tuning Norwegian spring-spawning herring. The model is documented on the web site www.assessment.imr.no, where the user guide and the Mathematica code can be found, as well as supplementary documentation material. A provisional user guide and model description is a Working Document to this meeting (WD by Tjelmeland). Before the 2002 meeting the documentation has been somewhat expanded. The analysis of young fish has been changed from linear regressions with a time trend to regressions based on a power-law dependence of the 0-group on the independent data (0-group index and acoustic surveys in the Barents Sea). Also, a provisional way of dealing with the problem that more scales are discarded as unreadable as the fish grows older was implemented prior to the meeting.

1.3.1.1 Tuning

SeaStar is a traditional back-calculating tuning model using a VPA based on Pope's approximation. If needed, solving the catch equation is implemented in case the model should be used for a stock with high fishing mortality. The stock is assessed by running the VPA, which is dependent on the F-values in the last year and the F-values for the oldest true age group. Taking the historic stock as the expectation value in underlying distributions for the observed survey data the probability of observing the survey data is calculated. This probability is referred to as the likelihood function. There is provision for selecting different functions to describe the survey distribution. In the present tuning the gamma distribution with a constant CV is chosen, in accordance with recent practice. Similarly, the probability of observing the tag return data is calculated and included in the likelihood function. It is assumed that the probability of tag returns, which are rare events, follows a Poisson distribution. At the 2000 meeting also a larval observation series was added, where the probability of observation is based on the spawning stock.

The historic stock is assessed by varying the unknown parameters until the maximum of the likelihood function is reached. The parameters that are varied (free parameters, tuning parameters) are:

- Catchabilities for the surveys

- CVs of the surveys and of the larval data
- Tagging survival
- Terminal F-values

SeaStar provides for basing the likelihood only on the strongest year classes. Also, only the terminal F values for the strongest year classes may be used as tuning variables. The rationale for this is to stabilise the tuning by avoiding bias from large relative errors in the catch in the terminal year of weak year classes, which mediated by the catchabilities would propagate also to the stronger year classes. The terminal F values of the weak year classes are linearly interpolated between the terminal F values that are tuning parameters. The terminal F values of the fish younger than the youngest tuned year class are linearly interpolated to zero at age -1.

The most important output variable is the estimated spawning stock in the assessment year, which is calculated on the basis of number-at-age, weight-at-age, and maturity-at-age at January 1 in the assessment year. Number-at-age is taken from the VPA by calculating forward one year using the catch information in the last year. Maturation-at-age in the assessment year is assumed equal to the maturation-at-age in the last year in the VPA. Weight-at-age in the assessment year is input data. However, it is assumed that the "timeBeforeSpawning" part of a year spreads into the assessment year, and in order to calculate the decrease until spawning time the same F as in the last year of catch is assumed also to apply for the assessment year. However, the WG will also assume that a fixed catch of "catchAssessmentYear" million tonnes will be taken in the assessment year, which may correspond to a somewhat different F. Also, the number-at-age at January 1 in the assessment year for fish younger than the youngest year class in the tuning (in the list "estimateTerminalFYearclasses") is determined by the analysis of the young, and may differ from the number that results from the tuning process since the latter comes from a rather arbitrary assumption that F decreases linearly to 0.0 at age -1. This is corrected for when the exploratory runs table is made. However, it is not possible to make a fully consistent correction, since then the bootstrap would have to be run for all exploratory runs. Normally, it will be possible to run the bootstrap for only the run chosen by the WG to be the most appropriate. For this run the ratio of the corrected and uncorrected spawning stock is calculated and applied to all other runs.

This correction of the exploratory spawning stock in the exploratory runs is more important this year than earlier, since the un-tuned 1998 year class now starts to mature.

Analysis of assessment uncertainty using bootstrap

The analysis of assessment uncertainty is done using bootstrap. The assessment is run many times, each time new data sets are generated by resampling from the original data set. Catch, survey data, tagging data and larval data may be resampled separately or jointly by appropriate settings which are asked for when the routine Bootstrap is invoked from the main menu, - see the chapter "Running an assessment/Uncertainty analysis by bootstrapping" for details.

Surveys

The surveys are resampled from the distribution that is assumed when the likelihood function is constructed, based on the unperturbed surveys. This is done by a call to the routine drawSurveys from the routine doOneRun before the likelihood function is evaluated.

Tagging

The number of tags recovered are sampled from the same distribution as assumed when the likelihood function is evaluated, i.e. Poisson. The number of fish screened for tags is assumed normally distributed with a CV specified in the input data list. The uncertainty in the number of screened fish stems from uncertainty regarding the amount of fish screened and uncertainty in the calculation of number-at-age screened from biological samples taken from the catch. The number of tagged fish released is also assumed uncertain where the normal distribution with a CV specified in the input data list is assumed.

Catch

The catches are considered certain, so there is no distribution from which to draw catch data. The best method would be to base the catch data bootstrap on the biological samples used for distributing the catch on age. However, a possibly large source of error in the age distribution of the catch data comes from using biological samples from one space-time domain on catches from another space-time domain. This is necessary because of inadequate biological sampling of the catch from the countries involved in the fishery. The associated error cannot be dealt with, however, without implementation of the biological samples from all countries and by using a time-space model of the fish distribution. This is an important, but large project that ideally should be a joint effort of the countries involved.

An alternative might be to base the uncertainty in catch at numbers on a parametric distribution. The multinomial distribution based on the number of age samples and assuming perfect mixing has been tried earlier. This approach yielded a very narrow distribution, and the approach is not very satisfactory in that the underlying correlation between age groups takes little notice of the causes for a correlation between age groups. There is reason to believe that the strongest correlation between age groups is due to mis-reading of nearby age groups. Thus, in the present assessment program an algorithm based on the assumption that the error in number by age stems from transfer of catch between neighbouring age groups is implemented. For two neighbouring age groups with number-at-age of stock1 and stock2 (as based on the unperturbed assessment) the catch to transfer is calculated as:

transferred=maxTransferCoefficient(1.0 - Abs(stock1-stock2)/(stock1+stock2))

where maxTransferCoefficient is a setting. Thus, it has not been possible to avoid subjective elements altogether. However, the proposed formulation to some extent allows the bootstrap to be based on whatever knowledge one may have of misreading fish in neighbouring age groups.

Uncertainty in last year's catch or in the last true age of tuned year classes may be especially significant. Therefore, the possibility of not taking into account the uncertainty of the last (or several of the last) years has been built into the software, so this effect can be studied.

Larvae

As for the surveys, the larval data are resampled from the assumed distribution.

In bootstrap runs first a run with the original data is performed. In the first run the setting perform<bootstrap Tag>Bootstrap must be True and the setting draw<bootstrap tag>Bootstrap must be False, where <bootstrap Tag> is Survey, Catch or Tagging. The first run may then be used as a basis for bias correction of the bootstrap.

The bootstrap replicates contain all the information that may be requested later by other assessment programs: historic spawning stocks, historic recruitments, and when the program is used for tuning Northeast Arctic cod, even the cod stock-dependent part of the predation by cod on capelin.

The bootstrap replicates may be viewed by the top-level routine showBootstrapEntities, which is also used when the standard output is produced.

Bias in the assessment due to discarding of old scales

When the herring grows older the yearly growth zones in the scales become closer together and will eventually become difficult to distinguish from one another. When the age readers are uncertain about the age using a certain scale they may discard the scale. Thus, more scales from old fish than from young fish will be discarded. This may introduce a bias in the assessment that may be serious.

A procedure for dealing with this effect has been proposed (Tore Schweder, pers. comm.). If the readers are not sure about the age they record a minimum age and signify this with a special code on the raw data sheet. The fish could be either the minimum age or older. However, implementing this method on the historic material by re-reading scales is a huge undertaking, and simpler, but statistically stringent methods should be found.

This problem becomes especially important this year as the strong 1991 and 1992 year classes grow into the problematic age range. Earlier, we have dealt with the problem that fish have been transferred from the 1983 year class to the 1985 year class, probably because of the same effect.

As a coarse way of investigating the seriousness of this effect a vector over age of the proportion of discarded scales was introduced at the present meeting. 5% of the scales from 5-year-old herring were assumed discarded and the proportion was linearly increased to 32.5% at age 15. These numbers have some support from investigations of the number of discarded scale as a function of length (WD by Slotte). In one exploratory run (Run 4) this correction vector was applied to numbers-at-age in all acoustic surveys and to the catch numbers-at-age. The result is an increase in the perceived spawning stock of about 0.75 million tonnes, which is an indication that this effect may be serious. A method for implementing corrections, preferably on a year-by-year and survey-by-survey basis should be found.

Analysis of young herring

The analysis of young fish included into SeaStar at the 2001 meeting was modified for the present meeting. The linear trend was removed and a power-law instead of a linear regression was performed. The logarithm was taken for all entities, including the logarithmic 0-group index. For the acoustic surveys in the Barents Sea, acoustic estimates of one- and two-year-old fish made during the joint IMR-PINRO survey in September were included during the present meeting. These numbers were calculated to the time of the May-June survey used in the regressions. However, estimates of herring are scarce in these surveys which are directed towards capelin. No measurements were available in 1995 or earlier for use in the regression period which ends in 1993. Measurements were however available for the 1998 and 1999 year classes as 1- and 2-year-old fish. When the regressions were used for assessing the young fish a draw was made whether to use the May-June or the September measurements, before the year class as 0-group was calculated from the regression formula. At the present implementation it is assumed that there is no catch between the 0-group stage and the age at which the herring is measured in the acoustic surveys used in the regressions.

Medium-term predictions

Medium-term projections are performed by first making a draw from the bootstrap replicates of tuned assessments of older fish. Next, the regressions of younger fish are performed and one draw for each year class as 0-group is made and calculated to the assessment year (2001). Thereafter the parameters in a Beverton-Holt recruitment model (log-scale) are estimated, and the stock is projected forward 10 years using the current harvesting control rule.

Recruitment model

The recruitment model is a traditional Beverton-Holt model where the parameters are estimated on log-scale. However, the recruitment is highly dynamic with a few outstanding year classes. To better adopt the model to this stock the 10% highest recruitments are excluded from the regression. When a draw from the recruitment model is made these year classes are selected with 10% probability and a draw with equal probability is made. If the highest recruitments are not selected the recruitment is given as the exponentiation of the logarithm of the Beverton-Holt model with a random draw from the residuals added.

Weight-at-age model

The weight-at-age is not random in the model, but explicitly given by year. However, there is a provision for changing the weight at some given year.

Maturation-at-age model

The maturation-at-age is constant. However, there is a provision for changing the maturation at some given year.

Harvesting control rule

The harvesting control rule is based on a fixed F-value (target F) combined with a catch ceiling. Two reference points are defined, $\mathbf{B}_{\mathrm{lim}}$ and $\mathbf{B}_{\mathrm{pa}}$. When the spawning stock falls below $\mathbf{B}_{\mathrm{pa}}$ the F-value is linearly interpolated between the target F-value at $\mathbf{B}_{\mathrm{pa}}$ and a specified lower value at $\mathbf{B}_{\mathrm{lim}}$.

Sampling

During simulation the spawning stock and the yield are sampled. Stability of catches is calculated by first calculating the relative change in catches from one year to the next, then averaging over one trajectory and finally taking the median over trajectories.

1.3.2 AMCI

The AMCI (Assessment Model Combining Information from various sources) is similar to ICA in many respects, but is more flexible with respect to separability of fishing mortality, type of input data, in the way in which information from various data is combined, estimated parameters, and with respect to how uncertainty can be estimated. The underlying population model is age-disaggregated, describing stock numbers-at-age in each time step. The stock numbers are related within the year classes through mortalities given by a parametric mortality model. The initial abundance in numbers of each year class is also specified as parameters. Thus, the population is in principle self-contained, being defined uniquely by parameters. Additional models describe the relation between the modeled population and the observed data or data derived from the observations. An objective function measures the deviance of the model from the observations. The parameters are estimated by minimizing the objective function. Uncertainty in the estimates and in the modeled population can be derived from the derivatives of the objective function with respect to the parameters, or by bootstrapping. This design places the program in the category 'statistical catch-at-age models'.

Within this framework, AMCI has some special features:

- The observation data that can be related to the model include measures of spawning stock biomass and tagging data, in addition to age-structured catch and survey data.
- The model operates internally on a quarterly basis, and it is possible (but not necessary), to use quarter-wise catch data.
- Catch data are treated fleet-wise, with individually defined fishing mortality models for each fleet.
- The model allows for spatially disaggregated data.
- Several selection models are available.
- Recruitments in some years can be substituted by expected values according to a stock-recruitment function.
- The user can choose which parameters one will regard as known and which are to be estimated by attaching ‘active flags’ to the parameters.
- There is a range of different objective functions that can be combined and weighted as specified by the user.
- Basically, fishing mortalities are modeled as separable. It is possible to recursively update the selection at age, allowing for a slow change in the selection, according to the yearly catches. In the extreme, this leads to a VPA-like algorithm.
- The diagnostics include computation of the first and second derivative of each term in the objective function with respect to the parameters (Jacobian matrix).
- The uncertainty in the assessment is primarily estimated by bootstrapping (parametric or non-parametric) of the data. In addition, variances of the parameters and correlations between parameters can be obtained from the Hessian matrix.
- The model runs forwards in time. It is therefore straightforward to extend the time range beyond the present, as a short time prediction, provided that the necessary parameters are specified. If the model is run in the bootstrap mode, stochastic recruitments are used for the future years, giving a stochastic prediction with uncertainty at the present stock numbers and future recruitments.

The present version (Version 2.1) is documented in a manual, which was presented to the Working Group.

An earlier version of the model was used by the WGMHSA (ICES CM2001/ACFM:06) as an alternative assessment model for mackerel, in order to make use of the tagging data, and on sardine in order to clarify possible shifts in the selection pattern.

1.3.3 STPR

The STPR is a program for making stochastic medium-term projections (Skagen, 1997, Patterson, & al 2000) and was originally developed for evaluating harvest control rules for North Sea herring (ICES 1997a, Patterson, Skagen, Pastoors, & Lassen, 1997).

It is in most respects rather similar to ICP in that it projects the stock forwards with stochastic parameters, and presents statistics of a large number (normally 1000) of replicas. The stochastic elements are recruitments, weights, maturities and initial stock numbers, while STPR, unlike ICP, takes fishing mortality as fixed inputs. The recruitment is assumed to be log-normally distributed with expectation values according to a stock-recruitment function. For weights and maturities, historical data are used, by drawing a random year each time such data are needed, and using all the data from that year. Initial stock numbers are input. If a covariance matrix can be provided, the initial numbers are regarded as multinormally distributed on the log scale. The model allows two fleets and allows simulating simple harvest control rules, where fishing mortalities or catch ceilings are stated for each of 3 levels of current SSB. For the first (intermediate year), a TAC constraint is always assumed, for the subsequent years, F-constraints can be specified which would overrule the harvest control rule. The harvest control rule can either be applied to the current stock abundance, or to a stock abundance that is altered by a random term to simulate bias in the assessments or overfishing or TAC's. The output includes the distribution of catches, recruitments, SSB's and fishing mortalities for each year. In addition, the probability of exceeding reference levels of SSB each year and at least once in the projection period is tabulated. There is also included a measure of stability, which is the range of catches over the last 5 years, divided by the mean catch over that period.

1.3.4 Iceland summer spawning herring assessment

An ADAPT-type of assessment has been used by the stock assessment of the Icelandic summer spawners for several years. It assumes a one-to-one relationship between the acoustic estimate in numbers and the stock numbers derived from a classical VPA. The objective is to find an F which minimizes $\sum(\log(ac_{4+}) - \log(vpa_{4+}))^2$ over all years in the assessment, where ac_{4+} is the sum of the numbers of 4 ringers and older in the acoustic survey and corresponding for the VPA.

When the abundance of juvenile 2–4 ringed herring has been assessed by acoustic surveys, the resulting abundance estimates have been used in the tuning process. In cases where no such information is available for the youngest age group (2 ringers) the size of this age group is set at 400 millions, which is close to the lower quartile of the recruitment observed since 1980.

1.3.5 Capelin in the Iceland–East Greenland–Jan Mayen area

The preliminary TAC should be set at a level to open the fishery, when appropriate, before the October/November survey, and to keep the residual spawning stock at or above 400,000 tonnes. Thus the prognosis procedure needs to predict the fishable stock in the beginning of the season in order to predict the effects of fishing. To account for the highly variable year class strength and maturing ratio, the procedure needs to predict separately the two major components of the mature stock (age groups 2 and 3). These predictions need to be done in spring.

Available data include acoustic survey estimates of the different age groups in August, October and January. It has been found that, when available, autumn (October/November) acoustic estimates of the abundance of age groups 1 and 2 can be used as predictors of fishable stock abundance about 8 months prior to the fishery.

The maturing part of age group 2 in summer (N_{2mat}) is a part of the survivors of the 1-group of the previous autumn (N_1), which is measured in October/November in the year before. A prediction model based on a linear relationship between the historic back-calculated numerical abundance of maturing capelin at age 2 (N_{2mat}) and the autumn acoustic estimates of the same year classes at age 1 ($N_{1acoust}$) is used to predict the adult 2-group abundance at the beginning of the fishing season some 8 months later.

The maturing part of the 3-group in summer corresponds to that part of the year class, which did not mature and spawn in the year before. Because autumn surveys of immature capelin of age 2 (N_{2imm}) have usually produced underestimates of varying magnitude such data have little predictive value. Similarly, January/February surveys of this year class only estimate the part that will spawn and thus are no indicators of what will appear in summer of next year.

However, maturity at age 2 is inversely related to year class size (N_{2tot}), i.e. the maturing ratio is a function of year class abundance. Therefore, the total abundance of age group 2 in summer should be an indication of what will appear as 3-group in the following season. A regression relating the back-calculated total abundance of year classes at age 2 (N_{2tot}) on 1 August to their abundance at age 3 (N_{3mat}) is therefore used to predict the numerical abundance of age 3 capelin.

During the last ten years the weight at age of adult capelin has been inversely related to the total adult stock abundance in numbers. Linear regressions of total adult stock in numbers on the mean weight at age in autumn are used for predicting the mean weights of age groups 2 and 3.

The data sets comprising all comparisons of numbers by age and maturity, as well as total numbers and weight at age relevant to these prediction models are given in Tables 5.4.1, 5.5.1.1 and 5.5.1.2.

The above regressions have been updated as new data became available. A comparison of the predicted TAC updated with data from the autumn surveys is given in Table 5.5.1.3.

1.3.6 ISVPA

This assessment model is designed specifically to assess stocks where only catch at age data are available, or other data are considered to be too noisy.

Instead of assuming the fishing mortality to be separable, it considers the instantaneous mortality

$\varphi(a,y) = C(a,y)/(N(a,y)*exp(-M(a,y)/2)$

and regards φ as separable:

$\varphi_{a,y} = s_a f_y$

In addition, it puts constraints on the matrix of φ residuals. The objective function which is minimised is the median of the squared log catch residuals. Using the median instead of the sum renders the estimate more robust to outliers in the data.

The separability assumption is widely used in various cohort models (Pope, 1974; Doubleday, 1976; Pope and Shepherd, 1982; Fournier and Archibald, 1982; Deriso et al., 1985; Kimura, 1986; Gudmundsson, 1986; Patterson, 1995; etc.). A simple version of separable cohort model, named ISVPA, was also proposed by Kizner and Vasilyev (Kizner and Vasilyev, 1997; Vasilyev, 1998, 1998a, 2000). The model ISVPA is similar in many aspects to other separable models. But its parameter-estimating procedure is based on some principles of robust statistics which helps to diminish the influence of error (noise) in catch-at-age data on the results if the assessment. Besides, special parameterization of the model makes it unnecessary to use any preliminary assumptions about the age of unit selectivity and about the shape of selectivity pattern. This helps to get unique solution in cases when catch-at-age data are noisy and auxiliary information is too controversial or is not available. Otherwise ISVPA may be used in order to outline stock tendencies from catch-at-age data taken alone.

Basic equations of the model are the consequence of traditional separable VPA and cohort analysis by Pope, which implies the assumption that catch is taken within a short time interval. One of the main differences of ISVPA lies in representation of fishing mortality (it is expressed in terms of fractions).

Following are the main equations of the ***catch-controlled*** version of ISVPA:

$$N_{a,y} = (N_{a+1,y+1}e^{M/2} + C_{a,y})e^{M/2}, \quad (1)$$

$$C_{a,y}=\varphi_{a,y}\, N_{a,y}e^{-M/2}, \quad (2)$$

$\varphi_{a,y} = s_a f_y,$ $(a=1,..., m-1; y=1,...,n-1)$, where

a: age index, *m*: total number of age groups, *y*: year index, *n*: total number of years, $N_{a,y}$: abundance of the age group a in year y, $C_{a,y}$: catch from age group a in year y, M: natural mortality coefficient, φ(a,y): fraction of the abundance of age group a, taken as a catch in the middle of the year y (plays the role similar to that of $F_{a,y}$ in traditional VPA), f_y: year factor (or effort factor), s_a: age factor (or selectivity factor).

Selectivity factors are normalized: $$\sum_{a=1}^{m} s_a = 1, \quad (3)$$

It is not needed to use in calculations any additional assumption about s_a, except that s_a for the two oldest ages are equal to each other (if the oldest age group is a "+ group", then the three oldest s_a should be equal to each other). This seems to be a rather weak restriction if a sufficient number of ages are included into analysis.

Estimated values of $\varphi_{a,y}$ may be recalculated into instantaneous fishing mortality coefficients $F_{a,y}$ by the formula: $F_{a,y} = -\ln[1- \varphi_{a,y}]$, which is obvious if you rewrite expression (1) as: $\ln[N_{a,y}/N_{a+1,y+1}] = M - \ln[1-\varphi_{a,y}]$ and compare it with the traditional VPA equation: $\ln[N_{a,y}/N_{a+1,y+1}] = M + F_{a,y}$.

The catch-controlled version is more appropriate if there is much more confidence in the precision of catch-at-age data than in the validity of the separability assumption.

The ***effort-controlled*** version of ISVPA is obtained by substitution of the estimated catch, $\hat{C}_{a,y} = s_a f_y N_{a,y} e^{-M/2}$ for $C_{a,y}$ in (1), that is, by replacing equation (1) with

$$N_{a,y} = \frac{N_{a+1,y+1} e^{M}}{1 - s_a f_y}. \qquad (4)$$

This version of the ISVPA is more appropriate when catch-at-age data include a very high level of noise, that is rather often, except when fishery is known to be extremely nonseparable.

In practice in most cases both assumptions (that catch-at-age data are precise or fishery is well separable) are rather far from reality. If there are some ideas about their relative validity it is possible to use ***mixed*** version of ISVPA in which the equation of stock dynamics is a mixture (with the coefficient given by user) of equations (1) and (4). In this version of the ISVPA the same weight (or "level of relative confidence") of the two assumptions is used for all points.

Since often the user has no preliminary ideas about relative validity of the above-mentioned assumptions and since the relative weight of these assumptions may be strongly different for different points (*a,y*), the 4th version of ISVPA named ***mixed with weighting by points*** (or ***mixed WBP*** in menu) is also available. In this version for *every point (a,y)* the equations (1) and (4) are weighted by reciprocal squared residuals between the given catch*(a,y)* value and its respective "theoretical" value: $\hat{C}_{a,y} = s_a f_y N_{a,y} e^{-M/2}$ where $N_{a,y}$ is calculated by equation (1) or (4). These weights are recalculated in every iteration within the iterative procedure of the model parameters estimation (see below).

For each version of the ISVPA the algorithm consists of a '*core*', in which all the model parameters are evaluated from the iterative procedure at a given natural mortality coefficient, *M*, and terminal fishing effort, f_n, and an outward '*shell*', a loop in which the best *M* and f_n are fitted. The 'core' is represented in the program ***by 4 iterative procedures***. The first, **"basic"**, iterative procedure ensures unbiased separabilisation:

$$\sum_{a=1}^{m} \varepsilon_{a,y} = 0, \quad \text{and} \quad \sum_{y=1}^{n} \varepsilon_{a,y} = 0 \ \text{, where} \quad \varphi_{a,y} = s_a \cdot f_y + \varepsilon_{a,y}.$$

The second **"Logarithmic" (geometrical mean)** procedure ensures unbiased model estimates of log-transformed catches:

$$\sum_{a=1}^{m} [\ln C_{a,y} - \ln \hat{C}^{*}_{a,y}] = 0 \ \text{and} \ \sum_{y=1}^{n} [\ln C_{a,y} - \ln \hat{C}^{*}_{a,y}] = 0 \ \text{, where} \ \hat{C}_{a,y} = s_a f_y N_{a,y} e^{-M/2}$$

It can be simply shown that this procedure provides unbiased estimates of logarithms of all parameters.

The third **"Weighted arithmetical mean"** procedure may be more appropriate when errors corresponding to different age groups hardly can be regarded as equally distributed. In this version inverse selectivities serve as weights. This version ensures unbiased separabilization, but weighted by selectivities.

The 4-th procedure is intended to produce the best fit to catch-at-age data, but the solution will be free from any restriction on bias.

Median minimization. Minimization of the median, *MDN*, of squared residuals (that is, the use of the least median or LMSQ principle) instead of their sum (the classical LSQ-principle) is sometimes thought to be more resistant with respect to outliers, those elements of the data set which overstep considerably reasonable confidence limits and, hence, are suspected of containing extremely high errors (Hampel et al., 1986).

According to this concept, an alternative ISVPA solution may be looked for as providing estimates of M and f_n, which secure a minimum of the median of the distribution of the squared logarithmic residuals,

$$SE_{a,y} = (\ln C_{a,y} - \ln \hat{C}^*_{a,y})^2$$

(a = 1,...,m; y=1,...,n). The corresponding loss function will be denoted as $MDN^*(M, f_n)$.

In practice, the median of a random series is estimated by rearranging its elements in a descending or increasing order and taking the central element of the new series or the mean of two central elements (depending on whether the total number of the elements is odd or even). However, when used within the framework of ISVPA, this estimate may sometimes cause a certain roughness of the surface $MDN(M, f_n)$. In order to make the loss function smoother, the median is estimated here as the mean of a number (for example, 10) central elements of the ordered series of $SE_{a,y}$.

Dealing with zeros in catch-at-age matrix. Existence of zeros in catch-at-age matrix is known to be a rather complicated problem (and may be logically controversial in dealing with logarithmic residuals), and it is solved in different ways in different methods. In ISVPA the following algorithm is applied:

1. If $C_{a,y}$=0, then the value of $\varphi_{a,y}$ is taken equal to its "theoretical" value, that is $\varphi_{a,y} = s_a f_y$.

2. Residuals for points of zero catches are taken equal zero.

3. Stock abundance is estimated as follows: if $N_{a+1,y+1}$>0 and $C_{a,y}$=0, then $N_{a,y}$ is calculated by equation (1); if $N_{a+1,y+1}$>0 and $C_{a,y}$>0, then $N_{a,y}$ is calculated by equation (1) or (4) or their mixture according to the version chosen; if $N_{a+1,y+1}$=0, then $N_{a,y}$ is calculated by formula (2) – the same way as for terminal points.

1.4 Quality Control

Commercial catch data input, quality control

Input spreadsheet and initial data processing

Since 1997 (catch data 1996), the Working Group members 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 Northern Pelagic and Blue Whiting Fisheries Working Group. The current version used for reporting the 2001 catch data was v1.4.1. The majority of commercial catch data of multinational fleets was again provided on these spreadsheets and 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, 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.

Comments on the ICES quality control handbook

The WG was again asked to comment on the ICES quality control handbook (see Terms of reference: i). In the light of the little development the QC handbook has undergone in the last year, and that ACFM has been unable to review the comments of the different working groups, WGNPBW decided not to comment on this issue again. However, the group is prepared to revisit the topic whenever significant progress is visible.

1.5 Special requests concerning Blue Whiting

The Working Group was asked to consider the following requests with regards to Blue Whiting:

1. A NEAFC request dated 16 November 2001:

"Regarding blue whiting stocks: provide medium-term projections using scenarios as considered appropriate". *This request is answered in Section 6.6 "Medium-term projections".*

2. A request from the European Community, the Faroe Islands, Greenland, Iceland, Norway, and the Russian Federation dated 11-12 February 2002 (this request was delivered to ICES shortly before the 2002 WG meeting):

"Request to the International Council for the Exploration of the Sea

The European Community, the Faroe Islands, Greenland, Iceland, Norway, and the Russian Federation at the Meeting on the Management Measures for the Blue Whiting Stock held in Reykjavik on the 11 to 12 February 2002 agreed on the need to develop a multi-annual recovery plan that ensures a safe recovery of the blue whiting stock.

The parties agreed that the plan should include:

- A harvest rule specifying the upper limits of the catches to be taken during the recovery period
- Measures to enhance the exploitation pattern with the aim of securing a low fishing mortality on juveniles.

Within the above context, ICES is requested to provide advice on possible harvest rules and technical measures to be included in a recovery plan.

Harvest rules

1) ICES is requested to identify candidate harvest rules and to evaluate them, in particular with respect to risks associated with a range of TAC's in the rebuilding phase and a range of targets for the rebuilding. In addition to the uncertainty about initial numbers and future exploitation pattern and weights and maturates, ICES should at least take into account:

- The uncertainty in the estimates of those year classes that will enter the spawning stock in the rebuilding period, given the present lack of information about the stock at these ages;
- A range of levels of exploitation on juveniles;
- A range of scenarios for how the recruitment will respond to SSB being below $\mathbf{B}_{\mathrm{lim}}$;
- The robustness to bias in the assessment;
- The robustness to a sequence of poor year classes.

The performance criteria to be evaluated should include:

- The probability that the SSB will be below $\mathbf{B}_{\mathrm{lim}}$;
- The probability that the stock will reach a target level within various time frames;
- The year-to-year variation in the catches in the recovery period.

2) In order to establish realistic targets for the rebuilding and as a guideline for future harvest rules, ICES is requested to revisit the reference point. In particular, the fact that fishing at the current $\mathbf{F}_{\mathrm{pa}}$ will lead to a substantial probability of SSB<$\mathbf{B}_{\mathrm{pa}}$ should be considered.

3) As a guideline for evaluating harvest rules for the situation where the state of the stock is satisfactory, ICES is requested to provide the likely range of yearly catches in stochastic long-term simulations, for a range of combinations of fishing mortality on adult and juvenile fish.

Exploitation pattern

ICES is requested to provide as detailed information as possible on the age/size composition in different segments of the blue whiting fishery and to evaluate the effect on the stock and the fisheries of possible measures to reduce exploitation of juveniles.

The evaluation should include, but not be restricted to the effects of introducing a minimum size and closed areas/seasons."

In connection with a meeting of the ICES SGPA meeting in March 2002, work was undertaken that partly answered this request. Those calculations were based on the assessment made during the 2001 WGNPBW meeting. It was planned to redo all calculations during the 2002 WGNPBW meeting to include the latest data available, but due to lack of time not all the model runs could be redone during this meeting. However, the studies of long-term equilibria presented to the SGPA are probably unaffected by one extra year of data, and most of the medium-term simulations were made during the 2002 WGNPBW meeting.

Due to exceptionally strong incoming year classes, the assessment made by the 2002 WGNPBW is more optimistic than that made in 2001 (Section 6.4.5, 6.5 and 6.6). The need for a *rebuilding plan* is, accordingly, not as urgent as it appeared in 2001. However, even if the SSB is currently above the present $\mathbf{B}_{pa}$, and also above a suggested *action level of B* as introduced below, the current high fishing mortality will, in the medium term, reduce the stock size heavily. Unless the recruitment should continue to be above the long-term average value also in the coming years, the current F will bring the SSB below the $\mathbf{B}_{lim}$ in 2004–2005. In this situation the WG put more effort into suggesting a harvest control rule than to concentrate on a rebuilding plan.

In the request, ICES is asked to revisit the biological reference points. This task was also in the terms of reference from ICES to the WGNPBW, and this task is covered in Section 6.7.

Harvest rules

The harvest control rules explored included:

- A fixed fishing mortality at high SSB;
- Below an 'action level' of SSB, the fishing mortality was reduced linearly with SSB, to reach F=0.05 at and below a $\mathbf{B}_{lim}$ of 1.5 million tonnes;
- A maximum allowable catch of 1.2 million tonnes. Some alternative runs were made with 0.8 million tonnes instead of 1.2 million tonnes;
- Runs were made with and without a normally distributed error with C.V. = 30% in the stock estimates on which decisions about next years fishing mortality was made.

The performance of the simulated scenarios was evaluated according to the following criteria:

- Probability of SSB < 1.5 million tonnes in the true stock ***at least once*** in the 10-year simulation period;
- Probability that the decision would be taken to apply the fishing mortality valid for SSB < 1.5 million tonnes ***at least once*** in the 10-year simulation period. This probability deviates from the one above both because of error in the assessment, and because the decision rule, applied in situations where a low F will bring the SSB above a limit, while a higher F will bring it below the limit, applies the lower F;
- The 50th percentile of SSB in year 10;
- The 50th percentile of the year-to-year variation of the catch in years 5–10, measured as the range of catches in the period divided by the mean, within each replica;
- The 50th percentile of the mean catch in years 1–10.

The main results are shown in Figure 1.5.1.

Inferences:

- The risk of bringing SSB below the 1.5 million tonnes limit is quite sensitive to the fishing mortality, as expected. If there is error in the future assessment, the risk that SSB in reality is below the limit generally is higher, but not much. However, managers will far more often be led to act as if this were the case.
- Beginning to reduce the fishing mortality at some level above 1.5 million tonnes has a substantial effect in reducing the risks.

- The long-term average catch increases somewhat with increasing fishing mortality, but the increase is modest, and is little influenced by the choice of 'action level'. Noisy assessments lead to a slightly higher average catch.
- In addition to what is shown in Figure 1.5.1, it was found that the year-to-year variation in the catches increased with increasing fishing mortality, and that it became much higher when noisy assessments were assumed.

These simulations were made with an upper limit on the yearly catch of 1.2 million tonnes. This limit was rarely reached except in the cases with the highest fishing mortality and errors in the assessment, where it was reached with 3-5 % probability. With a lower limit of 800 000 tonnes, the limit was reached more often. This led to a slight reduction in the risk of reaching 1.5 million tonnes SSB, but led to a considerable reduction in the long-term yield.

Conclusions

1) One should hesitate to allow SSB to fall below the $\mathbf{B}_{loss}$ of 1.5 million tonnes. A fishing mortality in the order of 0.25 could be appropriate as an $\mathbf{F}_{pa}$, provided that the exploitation of juveniles is kept low, and that the weights-at-age remain within the historical range. This would give an approximately 1–2% risk that SSB falls below $\mathbf{B}_{lim}$ in any year. The risk increases quite rapidly when F increases above this. The long-term average catch will be about 7% below the maximum catch achievable, but this maximum catch requires that the recruitment does not decline at low SSBs.
2) Even a moderate increase in the exploitation of juveniles will require a substantial reduction in adult F in order to keep the risk of dropping below 1.5 million tonnes at a low level. Fishery for juveniles should therefore be kept at a minimum.
3) The present $\mathbf{B}_{pa}$, which represents a safety margin to the limit SSB, but in practise, serves as a target biomass, is not useful as guidance for management.
4) This stock illustrates quite clearly the dilemma when there is no experience of recruitment failure, and the $\mathbf{B}_{loss}$ is the lower bound of a relatively narrow range of historical SSB values. If the uncertainty of the assessment were to be taken properly into account, this would lead to a $\mathbf{B}_{pa}$, which is difficult to reach even at a very moderate exploitation. Adopting such a $\mathbf{B}_{pa}$ would imply that the stock, even if exploited very moderately, would be outside safe biological limits most of the time, which is unnecessarily restrictive.
5) An alternative framework for advice, with emphasis on advising on fishing mortalities aimed at keeping the probability of SSB being above the historical low should be considered. In such a regime, it may be feasible to have an 'action level', below which the fishing mortality is reduced according to the SSB. An upper limit on the catch may be considered as an extra precaution, but does not seem to have any substantial beneficial effect.

Based on these considerations, the following advisory framework is suggested for the blue whiting:

- Keep $\mathbf{B}_{lim}$ at 1.5 mill tonnes.

- Let $\mathbf{B}_{pa}$ be undefined.

- Define a ***precautionary management*** with:
  a) An F target associated with low risk of reaching $\mathbf{B}_{lim}$ in the long term (i.e. F in the order of0.25);
  b) A gradual reduction of F below some action level of SSB (SSB in the order of 2.0 million tonnes);
  c) A catch ceiling to protect against too high catches caused by an overly optimistic assessment in the order of 0.8 – 1.2 million tonnes may also be considered, but this measure may be relatively unimportant;
  d) A strong restriction on the F on juveniles, e.g. approximately F 0-1 = 0.03, which corresponds to F0-1 at the proposed F with the historical selection pattern.

- If a $\mathbf{F}_{lim}$ is needed, it may be in the order of 0.35, which according to the present calculations implies an approximately 20% probability of falling below $\mathbf{B}_{lim}$, and a 5 percentile for SSB of about 1.3 mill. tonnes.

A graphical representation of the suggested harvest control rule for blue whiting is shown in Figure 1.5.2.

ICES is requested by NEAFC (The European Community, the Faroe Islands, Greenland, Iceland, Norway, and the Russian Federation) to:

- provide as detailed information as possible on the age/size composition in different segments of the blue whiting fishery and to evaluate the effect on the stock and the fisheries of possible measures to reduce exploitation of juveniles.

The evaluation should include but not be restricted to the effects of introducing a minimum size and closed areas/seasons.

To be able to provide age/size composition in different segments of the blue whiting fishery and to evaluate the effect on the stock the following information is needed.

- Homogeneous definition of “Fisheries”, where following parameters are taken into account:
  - Gear and mesh size;
  - Area and time.

- Implementation of biological sampling schemes, which follows the above definitions.

At this WGNPBW meeting the issues on defining “different segments of the blue whiting fishery” was discussed in order to provide catch at age from the different “Fisheries”, and the following “Fisheries” were defined:

In the North Sea and Skagerrak area blue whiting is taken in:

- a directed fishery for blue whiting using trawls with a mesh size of >=40 mm;
- a fishery where blue whiting is taken as by-catch. In this fishery trawl with mesh sizes less than 40 mm is used.

In the Northern areas outside the North Sea and Skagerrak blue whiting is taken in:

- a directed blue whiting fishery where trawls with mesh sizes of at least 40 mm are used;
- fisheries for Norwegian Spring-spawning herring where blue whiting is taken as by-catch. This fishery is carried out by purse seiners and trawlers using gears with mesh sizes of at least 36 mm;
- fisheries for other species where blue whiting is taken as by-catch, using gears with mesh sizes less than 36 mm.

Landings of blue whiting caught in the Southern area is taken in:

- a directed offshore fishery for blue whiting using trawls with a mesh size of >=55 mm;
- a more coastal fishery where blue whiting is taken as by-catch. In this fishery trawl with mesh sizes less than 65 mm is used.

It was only possible to provide catch by fisheries for the North Sea and Skagerrak and only for 2001.

In order to evaluate the effect different “Fisheries” have on the blue whiting stock, landing figures by “Fishery” for at least five years should be available. With the very short time notice old data for and for some areas even new (2001) data could not be obtained. It was in relation also discussed whether it within the next year is possible to give historical data on this aggregation level. The general view was that it will be a very time-consuming task and that it will probably not be possible to raise sampled catch to total catch as done at previous WG meetings.

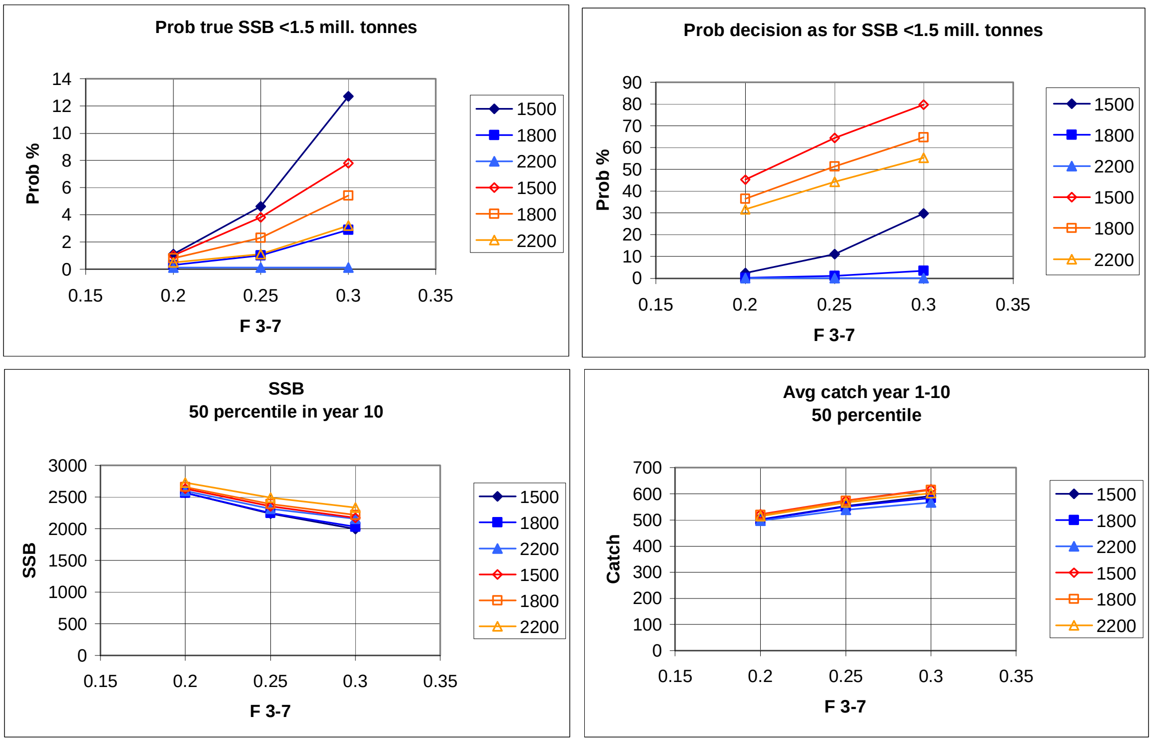


Figure 1.5.1 Results of medium-term simulations. Each curve represents one 'action level' for SSB. Filled symbols are assuming that future assessments are exact, open symbols are assuming errors in future assessments with a C.V. of 30%. The probabilities of SSB being below the limit is the probability that this will happen *at least once* in the 10-year simulation period.

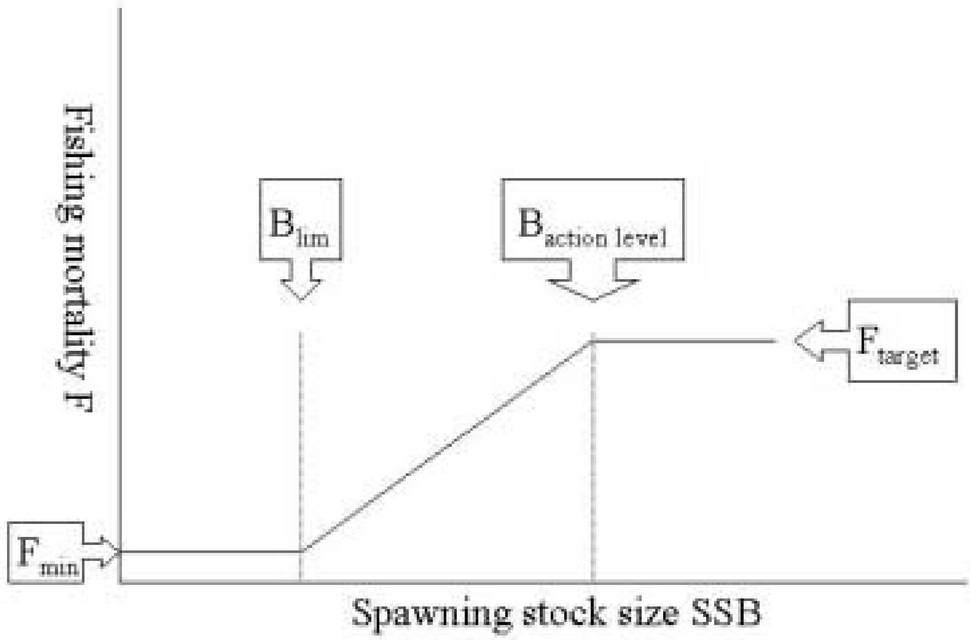


Figure 1.5.2. Graphical representation of the suggested harvest control rule for Blue Whiting. According to the simulations done, an F_{target} associated with low risk of reaching $\mathbf{B}_{lim}$ in the long-term would be in the order 0.25. When SSB decreases below the action level, F is reduced gradually, eventually to reach $\mathbf{F}_{min}$ (the lowest attainable F, associated with unavoidable by-catch of Blue Whiting in other fisheries) at $\mathbf{B}_{lim}$. The action level of SSB could be in the order of 2.0 million tonnes. $\mathbf{B}_{lim}$ is suggested to be at the $\mathbf{B}_{loss}$ (1 500 000 t.). The two other components suggested being included in the harvest control rule, a catch ceiling and strong restrictions on fishing mortality on the juveniles are not shown in this figure.

2 ECOLOGICAL CONSIDERATIONS

2.1 Barents Sea

2.1.1 Climate

Figure 2.1.1.1 gives an overview of the surface currents of the Nordic and Barents Seas. Figure 2.1.1.2 shows the position of standard sections and fixed stations worked by the Institute of Marine Research, Bergen, The University of Bergen, and PINRO, Murmansk.

Transport of Atlantic water to the Barents Sea has been measured since August 1997 (Figure 2.1.1.3). The flow of Atlantic water is very variable. Most of the time there is a net inflow of Atlantic water to the Barents Sea, but in some periods large outflows are observed. Large outflows occurred in April in both 1998 and 1999. In 2000 there were two periods with strong outflows, one in January and a second one in June. In spring 2001, the net inflow was much lower than in earlier years. Results from a wind-driven model show similar results. The inflow during the first four months was stronger than average, while the model gave reduced inflow during late spring and summer.

There was a period of warming up in the western Barents Sea from 1989 to 1995 followed by cooling in 1996-1997. In winter and spring 1998 the temperature in the Fugløya-Bear Island section (Figure 2.1.1.4) increased to the long-term mean, and in January 1999 the temperature was 1°C above the long-term mean. The latter value represents the highest temperature measured in January since 1983. Thereafter the temperature decreased to 0.87°C above the long-term mean in March, 0.36°C above the long-term mean in April 1999, and 0.3°C above the long-term mean in summer 1999. During autumn 1999 there was a significant increase in temperature and in January 2000 the temperature was 1.1°C above the long-term mean. Throughout 2000 the temperature in the western parts of the Barents Sea decreased, and in October the temperature was only 0.1°C above the long-term mean. In January 2001 the temperature was 0.4°C above the long-term mean. In the first half of 2001, the temperature in the Atlantic water in the western part of the Barents Sea was 0.6-0.8°C above the long-term mean. The temperature decreased during summer, and in late August the temperature was only 0.1°C above the long-term mean. In January 2002, the conditions were exactly the same with a temperature of 0.1°C above the long-term mean, the coldest January since 1997. During the first half of 2001 the temperature in the Kola Section ($33^{\circ}30$ E, $70^{\circ}30$-$72^{\circ}30$ N) was 0.7–0.8°C above the long-term mean. In January and February 2002, temperatures were close to the mean. It is expected that the temperature in the eastern Barents Sea will continue to decrease in 2002 because of the decreasing temperature in the western Barents Sea.

Fig 2.1.1.5 shows the Barents Sea ice index. The variability in ice coverage is closely linked to the temperature of the inflowing Atlantic water. The ice has a relatively short response time to temperature change (about one year), but usually the sea ice distribution in the eastern Barents Sea responds more slowly than in the western part. The ice coverage in 2001 was the lowest since 1970. This was not due to the winter situation because during the winter 2001 there was slightly more ice than the previous winter. The ice melt during summer, however, was extremely high, resulting in the extreme value of the ice index. The ice coverage in the beginning of 2002 is greater than in 2001 because of the reduced sea temperature.

Conclusions:

- The inflow of Atlantic water was lower in 2001 than observed earlier.
- 2001 was warmer than average, especially in the eastern Barents Sea. There was a clear signal of decreasing temperature during fall.
- The temperature in 2002 is expected to be lower than in 2001, and will be close to the long-term mean in most of the Barents Sea.

2.1.2 Predicting Barents Sea temperature

Prediction of Barents Sea temperature is complicated because the variation is governed by processes of both external and local origin that operate on different time scales (WD by Loeng *et al*.). The volume flux and temperature of inflowing Atlantic water masses as well as heat exchange with the atmosphere is important in determining the temperature of the Barents Sea. Both slowly moving advective propagation and rapid barotropic responses due to large-scale changes in air pressure must be considered. The major changes in Barents Sea climate take place during the winter months. The variability in the amount of heat flowing in with Atlantic water masses from the south is particularly high in the winter. Furthermore, variability in low-pressure passages and cloud cover has a strong influence on the winter atmosphere-ocean heat exchange.

This seasonal difference is reflected in the utility of simple six-month forecasts of Kola-section temperature based on linear regression models. The tendency is that persistence across the spring and summer months is higher than for other seasons, allowing for reasonably reliable forecasts from spring until autumn. Data available until February 2002 allow for a six-month forecast for August 2002. The value for February 2002 of 3.6 ºC is inserted into the equation $T_{August} = 2.37 + 0.67^* T_{February}$, statistically derived from data for the years 1921-1997 (WD by Loeng *et al*.). This gives an objective temperature forecast for August 2002 of 4.8 ºC. This will be slightly above the 1921-1999 mean of 4.67 ºC. We conclude that summer sea temperatures in the southern Barents Sea are expected to be approximately equal to, or marginally above the long-term mean.

Assuming that temperatures in the Barents Sea fluctuate periodically, it is possible to forecast using statistical methods. The results of Anon. (2002) indicate a decrease in Barents Sea temperatures towards a minimum in 2002-2003, followed by temperatures around or below the long-term mean. A Russian prognosis (V. K. Ozhigin, PINRO, Murmansk, pers. comm.) to 2006 shows much the same development, but with a minimum in 2003, a year later than that of Anon. (2002). However, the precision of such forecasts has low accuracy. Ottersen et al. (2000) showed that historically only about 25% of the variability in the time-series was explained by forecasts as those given by Anon. (2002). With this in mind these predictions should be treated with caution.

Conclusions:

- Summer sea temperatures in the southern Barents Sea in 2002 are predicted to be approximately equal to, or marginally above the long-term mean.
- A relatively uncertain long-term prediction indicates that the temperature will decrease for another 1-2 years.

2.1.3 Zooplankton

The standing stock of zooplankton has been monitored in the Barents Sea from the early eighties in connection with the joint Norwegian/Russian 0-group and capelin surveys in August-October. At this time of the year most of the production has taken place and zooplankton biomass can be seen as an expression of the size of the overwintering population of zooplankton. The samples are taken with dip nets and MOCNESS (Multiple Opening Closing Net and Environmental Sensing System) hauls and are subdivided into three different size categories 180-1000µm, 1000-2000µm, and above 2000 µm. The mean values for zooplankton for the whole Barents Sea from 1988 to present are shown in Figure 2.1.3.1.

There was a marked increase in zooplankton biomass during the period 1991-94. After 1994 the biomass of zooplankton decreased, and in 2001 zooplankton biomass was reduced to the level of the period prior to 1991. This development was most pronounced in the western parts of the sea. Expected temperatures at the long-term mean in 2002 together with reduced overwintering zooplankton biomass will result in reduced zooplankton production and feeding conditions for capelin, herring, and juvenile fish in the Barents Sea in 2002 compared to 2001.

Figure 2.1.3.2 shows the total biomass of zooplankton together with capelin stock size. A commonly observed inverse relationship between capelin stock size and zooplankton biomass can be seen from the figure, indicating that capelin exerts strong feedback control on the system through its predation pressure on zooplankton.

Conclusion:

- Expected temperatures close to the long-term mean in 2002 together with an overwintering zooplankton biomass close to the average will result in average zooplankton production and feeding conditions for capelin and juvenile fish in the Barents Sea.

2.1.4 Prediction of capelin recruitment

Predictions of the recruitment in fish stocks are essential for future harvesting of the fish stocks. Traditionally prediction methods have not included effects of climate variability. Multiple linear regression models can be used to incorporate both climate and fish parameters. Especially interesting are the cases where a time lag exists between the predictor and response variables since this gives the opportunity to make a prognostic prediction.

Models (WD by Loeng *et al*.), based on climate (e.g. NAO winter index and sea surface temperature in the Barents Sea) and fish parameters (e.g. SSB from VPA, maturing biomass, 0-group index), to predict recruitment have been given. The model of capelin recruitment predicted 206 10^9 one-year-old fish of Barents Sea Capelin in September 2002. The prognosis can be extended for another year in September 2002.

The models are preliminary. However, the fit of the model is encouraging, and the models might at present prove useful as background information in stock assessment.

Conclusions:

- The number of recruits of Barents Sea capelin is expected to be at a medium level in 2002.

2.1.5 Consumption by cod, saithe, blue whiting, harp seals, and minke whales

Bogstad *et al.* (2000) reviewed the estimated consumption of fish in the Barents Sea by various predators. The three most important predator species are cod, harp seal, and minke whale. The consumption by cod of various prey species for the period 1984-2001 is given in Table 2.1, using the same method as described by Bogstad and Mehl (1997). The changes in the diet of cod from 2000 to 2001 were moderate. The consumption of shrimp decreased by about 40%, while that of blue whiting increased to 159 000 tonnes, the highest value in the 18-year time-series. There was also some decrease in the consumption of capelin by cod.

The consumption by minke whales (Folkow *et al.*, 2000) and by harp seals (Nilssen *et al.*, 2000) is given in Table 2.2. These consumption estimates are based on stock size estimates of 85 000 minke whales in the Barents Sea and Norwegian coastal waters (Schweder *et al*., 1997) and of 2 223 000 harp seals in the Barents Sea (ICES 1999/ACFM:7). The consumption by harp seals is calculated both for situations with high and low capelin stock, while the consumption by minke whale is calculated for a situation with a high herring stock and a low capelin stock. It is worth noting that the abundance estimate of harp seals was revised considerably upwards in 1998 (ICES 1999/ACFM:7), which also increased estimates of the consumption by harp seals correspondingly. Food consumption by harp seals and minke whales combined is at about the same level as the food consumption by cod, and the predation by these two marine mammal species needs to be considered when calculating the mortality of capelin and young herring in the Barents Sea.

In the period 1992-1999, the mean annual consumption of immature herring by minke whales in the southern Barents Sea varied considerably (640-118 000 t) (Lindstrøm *et al.*, 2002). The major part of the consumed herring belonged to the strong 1991 and 1992 year classes and there was a substantial reduction in the dietary importance of herring to whales after 1995, when a major part of both the 1991 and 1992 year classes migrated out of the Barents Sea. In 1992-1997, minke whales may have consumed 230 000 and 74 000 t, corresponding to 14.6 and 2.8×10^9 individuals of the herring year classes of 1991 and 1992, respectively. The dietary importance of herring to whales appeared to increase non-linearly with herring abundance.

According to Bogstad *et al.* (2000), the total consumption of capelin by these three predators is higher than both the acoustic abundance estimates of capelin and the calculated MOB (M-output-biomass, i.e. the biomass output through natural mortality, see (Gjøsæter, 1997)) in several of the years with low capelin abundance. However, the total consumption of herring by the three main predators is much lower than the MOB (based on M=0.9 on ages 1 and 2) in those years. These discrepancies merit consideration in the assessment of the capelin and herring stocks in the Barents Sea.

The consumption estimates in Table 2.1 do not include the consumption by mature cod in the period when it is outside the Barents Sea (assumed to be 3 months during the first half of the year). During this period it may consume significant amounts of adult herring (Bogstad and Mehl, 1997).

Conclusion:

- The changes in the diet of cod from 2000 to 2001 were moderate. The consumption of shrimp decreased by about 40%, while the consumption of blue whiting increased to 159 000 tonnes, the highest value in the 18-year time-series. There was also some decrease in the consumption of capelin by cod.

2.2 Norwegian Sea

2.2.1 Hydrography and climate

During the last decades the Nordic Seas have been characterized by increased input of Arctic waters. The Arctic waters to the Norwegian Sea are mainly carried by the East Icelandic Current and also to some extent by the Jan Mayen Current. During periods of increased Arctic water input, the western extension of Atlantic water is moved eastward. As a result, over the last 25 years the southern and western Norwegian Sea has become colder and fresher while the eastern Norwegian Sea has warmed. Atmospheric forcing drives this trend. Since the mid-1960’s the North Atlantic Oscillation index (NAO) has increased (Figure 2.2.1.1). NAO as it is used here is the normalised air pressure difference at sea level between Lisbon, Portugal, and Reykjavik, Iceland, and is an indicator of the strength of the westerly winds into the Norwegian Sea. A high NAO index (i.e. stronger westerly winds) will force Atlantic and Arctic waters more eastward.

The Institute of Marine Research, Norway, has measured temperature and salinity in three standard sections in the Norwegian Sea since 1978 (WD by Melle *et al.*). The sections are 1) the Svinøy section, which runs NW from 62.37° N at the Norwegian coast, 2) the Gimsøy section, which also runs NW from the Lofoten Islands, and 3) the Sørkapp section, which is a zonal section at 76.33° N just south of Svalbard (Figure 2.1.1.2).

Figure 2.2.1.2 shows the time-series of summer (July-August) temperature and salinity from 1978 to 2000 in the three sections: Svinøy, Gimsøy, and Sørkapp. The values are averaged vertically between 50 and 200 m and horizontally over 3 stations in the core of Atlantic water. Since 1981, distinct trends in the temperature and salinity are only seen in the Sørkapp section. There, the temperature shows a slight increase while the salinity has a decreasing trend. Compared with 2000, the temperature in 2001 decreased in the Svinøy section while it increased both in the Gimsøy and Sørkapp sections. Compared with the long-term average, the southernmost section had temperatures close to the long-term average, while the temperatures in the two other sections were about 0.2°C above the long-term mean. The salinity showed the same trend as the temperature in 2001.

Figure 2.2.1.3 shows time-series of temperature and salinity during the spring in the Svinøy and Gimsøy sections from 1978 to 2001. The values are calculated using the same procedure as mentioned above. The low salinities in 1978 and 1979 are a result of the Great Salinity Anomaly during the 1970's. In 1994 a large salinity anomaly comparable with the anomaly in 1978 and 1979 was seen in the Svinøy section. The temperature was also a minimum that year. The 1994 anomaly was a result of increased influence of Arctic water from the East Icelandic Current. In 2001 the salinity increased in both sections while the temperature increased in the Svinøy section and remained approximately constant in the Gimsøy section. Both the temperature and the salinity decreased in the Gimsøy section from 2001 to 2002.

The area of Atlantic water (defined with salinity>35) in the Svinøy-section has been calculated. The mean temperature within the limited area has also been calculated, and the results are shown in Figure 2.2.1.4. There are considerable variations both in the area of Atlantic water distribution and its temperature. The distribution area of Atlantic water has decreased since the beginning of the 1980s, while the temperature has shown a steady increase. During 1997-1999 the temperatures were the highest observed in this time-series, while there was a considerable drop in temperature in 2000 followed by approximately the same value in 2001. The area of Atlantic water increased in 2001 and had the highest value since 1991. The temperature has increased by approximately 0.3°C since the early 1980s.

Conclusions:

- Significant long-term trends are seen in the Sørkapp section with an increase in temperature and decrease in salinity.
- Compared with 2000, temperature and salinity in July-August 2001 decreased in the Svinøy section while they increased in the Gimsøy and Sørkapp sections.
- Temperature and salinity in the Gimsøy section decreased in March-April 2002 compared with 2001.
- The averaged temperature of the Atlantic water in the Svinøy section has increased by approximately 0.3°C since early 1980s.
- The low winter NAO in 2001 coincided with an increased influence of Atlantic water in the upper layer of the central and northern parts of the Norwegian Sea.
- A higher winter NAO in 2002 suggests a more eastern extension of Atlantic water compared with 2001.

2.2.2 Phytoplankton

The development of phytoplankton in the Atlantic water is closely related to the increase of incoming solar irradiance during March and to the development of stratification in the upper mixed layer due to warming. In 1990 the Institute of Marine Research, Norway, started a long-term study of the mechanisms controlling the development of phytoplankton at Ocean Weather Station Mike situated at 66°N, 2°E (WD by Melle *et al.*).

Figure 2.2.2.1 shows the development of the phytoplankton bloom for 2001. The data from Ocean Weather Station Mike have shown that the timing of the bloom varies. In 1997 the spring bloom reached its maximum 20 May (day of the year 140), in 1998 about one month earlier, 18 April (day of the year 108). The timing of the bloom in 1999 was similar to that in 1998, but did not show the same high maximum in chlorophyll. This may be related to the weekly measurements in 1999, as opposed to daily measurements in 1997 and 1998. On the other hand, weekly measurements prior to 1997 have revealed pronounced maxima in chlorophyll. The reason for the low algal biomass in 1999 may have been early and strong grazing from the over-wintering zooplankton stock, although the over-wintering biomass was not particularly large this year. In all these years a strong peak has characterized the bloom. The situation in 2001 was different. First, the spring bloom started somewhat later (first week of May) compared to 1998 and 1999 and was followed by relatively moderate chlorophyll concentrations, culminating with a major peak in the first week of June. Also a distinct early autumn bloom was observed in the middle of August. The development of the phytoplankton prior to the spring bloom may be separated into two phases. The first phase, from day 1 to about day 50, is characterised by extremely low phytoplankton biomass expressed as chlorophyll *a*. This is the winter season during which phytoplankton growth is mainly limited by the low incoming irradiance. The second phase, from about day 50 to day 100, is characterised by a gradual increase of phytoplankton biomass, but without reaching bloom conditions. This is the pre-bloom phase during which the increase in biomass is related to the increase in incoming irradiance, and the lack of a bloom is due to the deep upper mixed layer still present at this time.

Figure 2.2.2.2 shows the extension in time for these two phases and the timing of the spring bloom for the period 1991-2001. In a "normal" year the winter season extends to about 2 March. The pre-bloom phase extends on average from the 2 March to 16 April. The spring bloom usually starts on 16 April and reaches its maximum on 21 May, but the year-to-year variations are much larger than those of the previous phases. From 1991 to 1995 the trend was towards earlier spring blooms. This trend was broken in 1996, and thereafter year-to-year variability in the timing of the bloom has been greater.

Conclusions:

- The phytoplankton bloom in 2001 developed later than in 1997, 1998, and 1999.
- Chlorophyll *a* concentrations peaked first in early May 2001, and then again in early June 2001. This could have been the result of a relaxation in the grazing pressure after the first peak as indicated by a decrease of the phaeopigment concentrations relative to chlorophyll *a* between the two peaks.

2.2.3 Zooplankton

Zooplankton biomass distribution in the Norwegian Sea has been mapped annually in May (since 1995) and in July (since 1994). Zooplankton samples for biomass estimation were collected by vertical net hauls (WP2) or oblique net hauls (MOCNESS). In the present report results based on samples from the upper 200 m are analysed (WD by Melle *et al.*). Total zooplankton biomass (g dry weight m^{-2}) in May was averaged over sampling stations within three water masses, Atlantic water (salinity >35 at 20 m depths), Arctic water (salinity <35, west of 1.4°E), and Coastal water (salinity <35, east of 1.4°E) (Figure 2.2.3.1). In Atlantic and Arctic water masses the zooplankton biomass decreased to a minimum in 1997. Thereafter the zooplankton biomass increased until 2001, when the biomass decreased again. Due to reduced cruise time the Arctic water mass was not sampled in 2001. In the Coastal water masses, which include the Norwegian continental shelf and slope waters influenced by Norwegian coastal water, the trend was different with a general increase towards a maximum in 1998 and a decrease the following years.

In July the total zooplankton biomass (g dry weight m^{-2}) in the upper 200 m was calculated by integrating biomass at sampling stations within a selected area in the central and eastern Norwegian Sea. There is no obvious trend in the zooplankton biomass in July since 1994 (Figure 2.2.3.2).

Conclusions:

- Average zooplankton biomass in Atlantic water masses of the Norwegian Sea in May 2001 was the lowest since 1997.
- Zooplankton biomass in July 2001 was somewhat lower than in 2000.

2.2.4 Herring growth and food availability

Individual growth of the Norwegian spring-spawning herring during the 1990s, as measured by condition or length-specific weight after the summer feeding period in the Norwegian Sea, has been characterised by large fluctuations (Figure 2.2.4.1). During 1991 and 1993 individual condition was good, but from 1994 on the condition of the herring started to decline and by 1997 it reached the lowest level during the 1990's. The level observed in 1997 corresponds with the absolute long-term low level observed during the period 1935–1994 (Holst, 1996). After 1997 the condition of the herring in the Norwegian Sea improved until 1999, when the condition started to decrease again. In 2001 the condition was at the lowest since 1997.

Since 1995, when the large-scale migration pattern of the herring has been mapped during two annual cruises, May and July-August, herring have been feeding most heavily in Atlantic water. The herring condition index obtained after the feeding period in the Norwegian Sea is related to the average zooplankton biomass of Atlantic water (Figure 2.2.4.2). This indicates that variation in the production of zooplankton in Atlantic water is a major reason for the observed variability in herring growth. It was noticed, however, that in 1999, the herring was feeding mostly in Arctic water where the zooplankton biomass is much higher than in Atlantic water. This year the herring condition index was especially high, while the zooplankton biomass in Atlantic water was moderate.

Conclusions:

- The herring condition decreased from 2000 to 2001.
- There is a direct relationship between zooplankton biomass in May and herring condition in the autumn during the years 1995–2001.

2.2.5 Predictions for zooplankton biomass and herring feeding conditions

A factor possibly governing zooplankton biomass is the size of the zooplankton spawning stock, or the size of the over-wintering population. Zooplankton biomass in July represents the mixed population of zooplankton species at the start of the over-wintering period. A linear regression between the biomass in July and the biomass in May the following year explains 63% of the total variation (Figure 2.2.5.1). The moderate to low biomass in July 2001 suggests that the zooplankton biomass in May 2002 will be rather low (Figure 2.2.5.1). However, the time-series is short, the variability is large, and there is no trend in the July zooplankton biomass that could be related to the trend observed in the May data. Thus, this time-series should be expanded before it is used for prediction.

The North Atlantic Oscillation index (NAO) is a proxy for the strength and duration of southwesterly winds, and is correlated with the inflow of Atlantic water to the Norwegian Sea. In the Norwegian Sea the winter NAO (December to March) was most strongly correlated with zooplankton biomass in May the following year (Figure 2.2.5.2). A multiple regression analysis showed that biomass in May was directly related both to the winter NAO index the previous year and the same year (equation 1). The one-year lag in the relationship may be related to the influence of ocean climate on the production of recruits that will become the zooplankton spawning stock next year. The relationship between zooplankton biomass and the winter NAO the same year may be due to the effect of rapid changes in the NAO from one year to the other, such as in 1996 and 2001. Equation 1 predicts a biomass of ~9 g m^{-2} in May 2002, less than one g higher than in 2001 (Figure 2.2.5.2). The winter NAO for the winter 2001-2002 was not available at the time when this report was finished, but correlation with other available NAO time-series suggests a winter NAO of 0.96 in 2002 (R^2=0.97).

$$Biomass = 1.2*NAO\ yr1+0.93*NAO\ yr2+9.56 \qquad (1)$$

R^2=0.84, P=0.027(NAOyr1=NAO winter index of the previous year)

(NAOyr2=NAO winter index of the same year)

The time-series for the herring condition index has been calculated for the period from 1991 to 2001. A multiple regression of the herring condition index on the NAO winter index the previous year and the same year explained 65% of the variation in the data (equation 2). Figure 2.2.5.3 shows that the herring condition in 1996 and in 2001 appeared to be lower than predicted from the NAO. The reason for this is not clear, but as commented on above, the zooplankton production these years was lower than what could be predicted from the NAO. The NAO winter index is known after March, and offers the opportunity to predict the herring condition in the autumn (9 months time period). The herring condition index for 2002 is predicted to be 0.81. In 2001 the herring condition was 0.80. Thus, the decrease in herring condition that started in 2000 is expected to stop. Prediction of the herring condition using only the NAO winter index the previous year (Figure 2.2.5.3) gives a condition factor of 0.84 in 2003.

$$Condition=0.009*NAO\ yr1+0.011*NAO\ yr2+0.806 \qquad (2)$$

R^2=0.66, P=0.013

(NAOyr1=NAO winter index of the previous year)

(NAOyr2=NAO winter index of the same year)

Conclusions:

- A direct, but weak, relationship between the zooplankton biomass in July and the zooplankton biomass in May the following year is suggested by the time-series from 1994 to 2001.
- The winter NAO the previous year and the same year are directly related to the zooplankton biomass in May and herring condition in the autumn.
- The NAO winter index for the winters 2001 and 2002 predicts the zooplankton biomass to be ~9 g m^{-2} in May 2002 and the herring condition index to be 0.81 in the autumn 2002.
- Unless the NAO for 2003 increases considerably, the production of zooplankton and herring growth in the Norwegian Sea in 2003 will be moderate.

2.2.6 Elements of herring biomass production

When studying ecosystems, the production of biomass by important species or groups in the ecosystem is of considerable interest. Biomass production can be described as the sum of the following processes:

- Change in the biomass of the stock from 1 January of one year to 1 January of the next year ("growth").
- Loss of biomass through natural mortality.
- Loss of biomass through fishing mortality (catch).
- "Loss" of biomass through the release of spawning products. For Norwegian spring-spawning herring the main spawning period is February - March, and the biomass of the spawning products is not reflected in the change of stock biomass from one year to the next.

The contribution of these elements to the total biomass has been estimated (WD by A. Dommasnes) and the results are given in Figs. 2.2.6.1 and 2.2.6.2. For 1–3 year old herring growth dominates the production, with natural mortality as the second most important process. For 4+ herring, growth is less important, and is partly replaced by the production of spawning products. Overall, for 4+ herring after the commencement of the international fishery in 1994, the four processes of growth, production of spawning products, natural mortality, and catch contribute about equally to the overall production of the stock.

2.2.7 Natural mortality of herring

2.2.7.1 Possible variation in M due to constant predation

In traditional VPA-based models for Norwegian spring-spawning herring (NSSH), and in the prognoses for the stock, the natural mortality (M) is assumed to be a constant instantaneous value. This means that the biomass lost to natural mortality is a fixed proportion of the biomass of the stock. The Northern Pelagic and Blue Whiting Fisheries Working Group (WGNPBW) has used M=0.9 for ages 0-2 and M=0.15 for ages 3+. Although all of the major predators on herring such as cod, saithe, and minke whales feed on a range of prey organisms, they have now had several years to establish a dependency on herring as an important prey and, possibly, a "preference" for herring as food. The question then arises how the predators locate herring schools, and whether they are able to locate herring schools even when the herring stock is reduced to a level considerably lower than the present. If the herring stock is reduced, will predators still take only a fixed proportion of the stock, or will some of the predators be able to take what they need until the stock reaches a very low level? These issues were analysed in a WD by Dommasnes and Nøttestad. For example, a constant predation of 470 000 t can result in a sharp increase in M when the spawning stock biomass falls below 1.5–2.0 million tonnes.

2.3 Icelandic Waters

2.3.1 Hydrography and climate

Due to the proximity of the oceanic Polar Front in the northern North Atlantic, hydrographic conditions in the sea north of Iceland are highly variable. Changes in intensity of the influx of Atlantic water and/or the variable admixture of polar water to the surface layers north of Iceland may lead to marked fluctuations in temperatures and salinities, both in space and time. Off the south and west coasts, where Atlantic water predominates, fluctuations are much smaller.

Climatic conditions in the North Atlantic improved greatly around 1920 and remained good until the mid-1960s, when they deteriorated suddenly. In the area north and east of Iceland temperature and salinity declined sharply in 1965 and these severely cold conditions lasted until 1971. After that, climatic conditions of the area north and east of Iceland improved again, but were variable and warm years have alternated with cold years (Figure 2.3.1.1).

In the latter half of 1997, there was a pronounced increase in the intensity of the Irminger Current south and west of Iceland, resulting in temperatures (6-8˚C) and salinities (35.0-35.2) similar to those recorded in these waters in the 1950s and the early 1960s. There were no signs of a reduction of this flow of warm water off South and West Iceland in February or May 2001. Thus, the inflow of Atlantic water to the north Icelandic area was quite pronounced in these months and the cold East Icelandic Current was weak and relatively far offshore.

In November 2001, high temperatures still prevailed in the Atlantic water south and west of Iceland while salinities were lower. Atlantic water predominated to the 250 m isobath off the southern part of the Vestfirdir peninsula (NW-Iceland), but to the Northwest of Vestfirdir the warm water only reached 20-25 nautical miles offshore. From there, a broad tongue of cold, low salinity water of about 100 m thickness covered the outer part of the shelf east to 21˚W. Off the central west coast relatively warm water reached out over the shelf break. East of the Siglunes section (central N-coast) the warm water area was narrow as usual, but the 5˚C isotherm reached east past the Langanes promontory (NE-Iceland). Both temperature and salinity were above average in the shelf region east of Iceland. The western border of the East Icelandic current was observed in a position similar to previous years, while both temperatures and salinities of the East-Icelandic Current were lower than in previous years.

In February 2002, both temperatures and salinities of the Atlantic water south and west of Iceland were high. On the other hand, there was considerable drift ice in the Denmark Strait and north of Iceland where the inflow of Atlantic water had been reduced. In this area, temperatures were generally 1–2˚C lower and salinities considerably reduced compared to the last few years. Furthermore, bottom temperatures off N- and NE-Iceland were 1–2˚C lower than in 2001. This situation is similar to that observed in February 1997. On the other hand, average hydrographic conditions were recorded over the shelf east of Iceland.

Although not clearly evident from Icelandic hydrographic data, it seems likely that the East-Icelandic Current at present must be considerably stronger and reach farther southeast towards the Faroes than observed in recent years. An indication of such a situation is the fishery of about 20 000 t of pre-spawning capelin in the Faroese EEZ where some of the catch was taken as far as 50 nautical miles inside the Faroese zone. Although such deviations from the 'usual' migration pattern have probably occurred before, this is the first record of such a scenario.

2.3.2 Zooplankton

In the area north of Iceland, zooplankton biomass is significantly higher during years with a strong inflow of Atlantic water than in years when Atlantic inflow is weak and salinity lowered in the surface layer. A continued strong inflow of Atlantic water to the north Icelandic area will therefore indicate that the zooplankton biomass will be above average in spring and summer 2002.

Long-term changes of zooplankton biomass north of Iceland are shown in Figure 2.3.2.1. The values represent averages of all stations on the Siglunes section. In north Icelandic waters, the high values of zooplankton in the beginning of the series dropped drastically with the onset of the 'Great Salinity Anomaly' of the 1960s. Since then the zooplankton biomass was variable throughout the 1970s and 1980s, but has increased in the 1990s as compared to the period 1965-1990.

2.4 Hydrography of the waters west of the British Isles

The hydrography of the waters west of the British Isles is described in a WD by Godø et al. (a). The horizontal distribution of temperature at 10 and 400 meters depths are shown in Figure 2.4.1 and 2.4.2 respectively. The maps are based on data collected onboard Johan Hjort and CTD data provided by the scientists onboard the Russian ships Fridtjof Nansen and Atlantniro, who were running simultaneous surveys.

On the shelf and on the Rockall Bank the water is well mixed with only small vertical variation in salinity and temperature from the surface to the bottom. South of the Wyville Thompson ridge (~60°N) this is true for the waters off the shelf, with temperatures at 1000 m typically between 7 and 8°C, i.e. the vertical temperature decreases by only 2-3°C from the surface to 1000 m depth (Figure 2.4.3, Porcupine section). In the Faroe-Shetland channel the situation is different with a layer of warm saline Atlantic water overlying cold deep waters originating in the Norwegian Sea (Figure 2.4.4, Faroe-Shetland section).

The horizontal gradients are generally very small in the area south of the Wyville Thompson ridge. In particular the north-south gradients are very small, and along the shelf the temperature drops only by about 2°C from 50°N to 60°N. Thus, along the shelf edge warm water penetrates far north, with the 10°C isotherm at 10 m depth extending north to about 60°N. This warm water also has high salinity, above 35.4, and is associated with the shelf edge current flowing north along the shelf edge.

The warm saline water along the shelf edge is typical for the hydrographic conditions in the area; however, both the temperatures and the salinities are higher than in the previous years. Visual inspection indicates that this year's temperatures are typically 0.5 °C and salinities about 0.05 higher than the previous years. On the section in the Faroe-Shetland channel, the warm saline water extends farther towards the Faroes than normal, but this is a dynamically active region and it may be due to an eddy located to the north of the section.

The high temperatures and salinities are confirmed by a study of the temperatures and salinities on all blue whiting cruises from 1986 through 2002. Since the hydrographic surveys have been dependent on the fishery surveys, the CTD stations have been distributed along the shelf edge and have in general not been in the same positions from year-to-year. In order to make time-series, the data were grouped in boxes with horizontal dimensions of 2°latitude times 2°longitude, and for each year the mean temperature and salinity from 50 to 600 m of all the stations in each box was calculated. Some of the boxes had good coverage nearly every year, while others had many years missing. However, in general the same variation from year-to-year was seen in the boxes along the shelf edge south of the Wyville Thompson ridge. The box with limits, 52° to 54°N and 16° to 14°W, had few gaps; the temperature is shown in Figure 2.4.5. The pattern seen is that after some years with temperatures around 10.1°C in the 1980s, it dropped to a minimum in 1994 (~9.8°C). After 1994 an increase in temperature is seen, and in 1998 temperature reaches a local maximum (~10.5°C) with the three following years a few tenths of a degree colder. 2002 is the warmest on record with ~10.7°C. There is no clear linear trend, but the last five years are warmer than the average of the whole period, and about 0.5°C above the first years in the period. Even though the increase is not as evident in the salinity curve, the high temperatures are associated with high salinities (Figure 2.4.5). Thus the high temperatures and salinities are probably mainly caused by advection of warm and saline water from lower latitudes, with local winter cooling as the secondary effect.

Table 2.1. Consumption by Northeast Arctic cod (thousand tonnes).

Year	Amphipods	Krill	Shrimp	Capelin	Herring	Polar cod	Cod	Haddock	Redfish	G. halibut	Blue whiting	Other	Total
1984	27	112	431	713	77	15	21	50	359	0	0	501	2306
1985	169	58	154	1602	181	3	31	47	222	0	1	1148	3616
1986	1212	107	141	828	132	140	81	109	310	0	0	658	3718
1987	1075	67	189	227	32	203	25	4	319	1	0	674	2816
1988	1226	314	128	336	8	91	9	3	221	0	4	403	2742
1989	794	239	131	575	3	32	8	10	230	0	0	719	2742
1990	135	82	192	1578	7	6	19	15	240	0	85	1433	3792
1991	65	75	186	2870	8	12	26	20	309	7	10	1065	4652
1992	101	155	369	2428	328	96	54	105	187	19	2	1003	4847
1993	250	702	312	3010	162	275	282	71	99	2	2	774	5940
1994	564	705	518	1086	147	581	225	49	79	0	1	669	4623
1995	979	514	362	629	116	254	392	116	194	1	0	853	4410
1996	633	1162	341	537	47	104	534	68	96	0	10	640	4173
1997	389	522	313	905	5	113	341	41	36	0	56	433	3154
1998	363	466	331	746	92	149	173	34	11	0	15	449	2828
1999	144	278	251	1715	133	217	71	26	19	1	32	395	3284
2000	152	301	407	1619	51	181	74	49	7	0	35	375	3251
2001	151	352	233	1354	57	188	47	77	4	0	159	565	3188

Table 2.2. Consumption by minke whale and harp seal (thousand tonnes).

Prey	Minke whale consumption	Harp seal consumption (low capelin stock)	Harp seal consumption (high capelin stock)
Capelin	142	23	812
Herring	633	394	213
Cod	256	298	101
Haddock	128	47	[1]
Krill	602	550	605
Amphipods	0	304	313[2]
Shrimp	0	[1]	[1]
Polar cod	[1]	880	608
Other fish	55	622	406
Other crustaceans	0	356	312
Total	1817	3491	3371

[1] the prey species is included in the relevant 'other' group for this predator.
[2] only Parathemisto

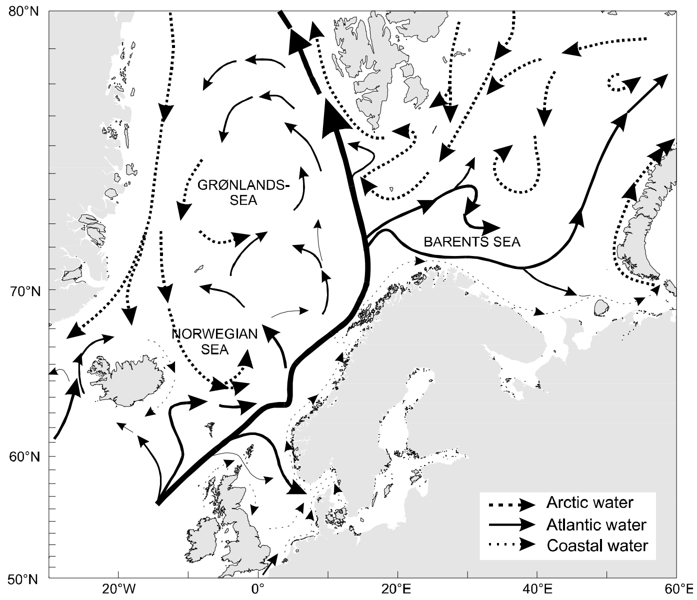


Figure 2.1.1.1. Main surface currents of the Nordic and Barents Seas.

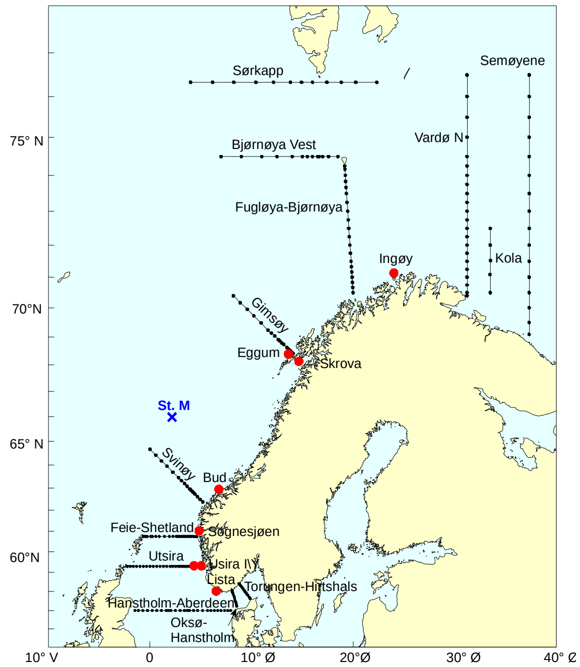


Figure 2.1.1.2. Standard Sections and fixed oceanographic stations surveyed by the Institute of Marine Research, Bergen. The University of Bergen is responsible for station M, while the Kola Section is operated by PINRO, Murmansk (Anon. 2001).

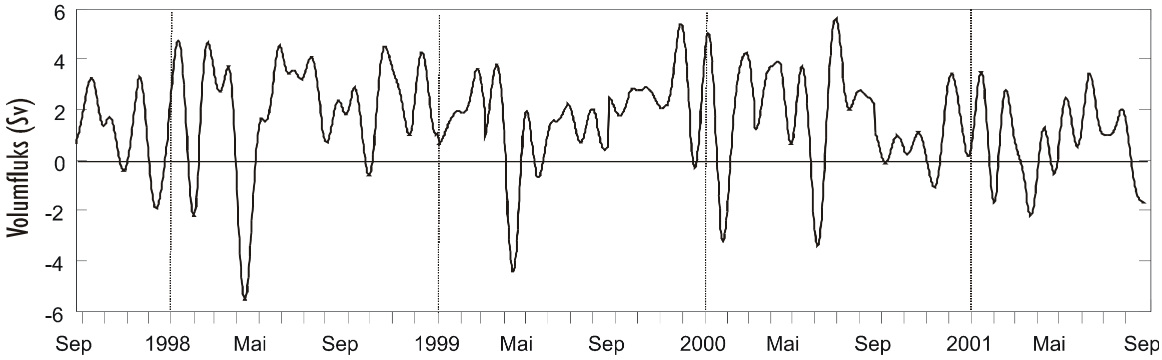


Figure 2.1.1.3. Total volume flux across the Section Norway-Bear Island. All data have been low pass filtered over 30 days.

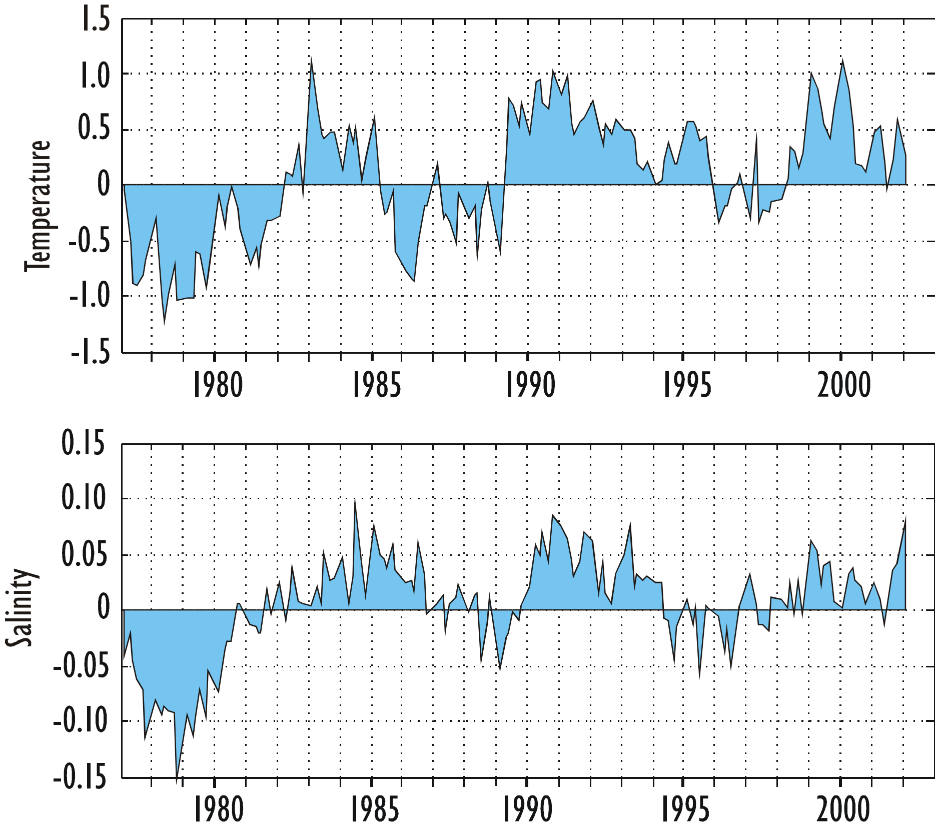


Figure 2.1.1.4. Temperature anomalies (upper panel) and salinity anomalies (lower panel) in the Section Fugløya – Bear Island (Anon., 2002).

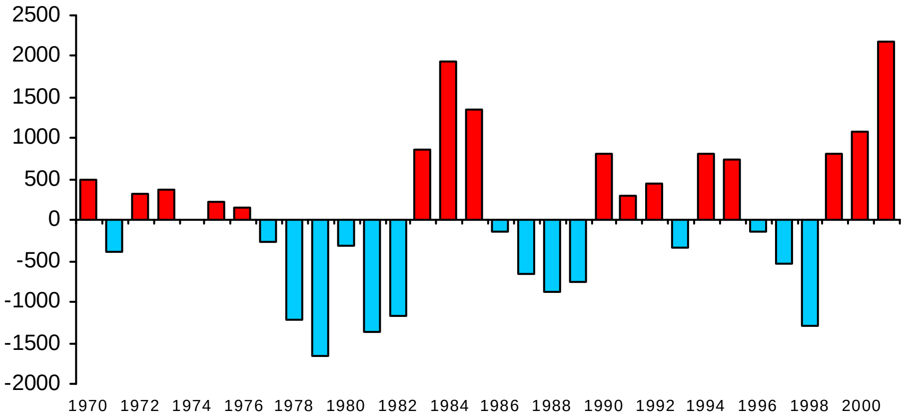
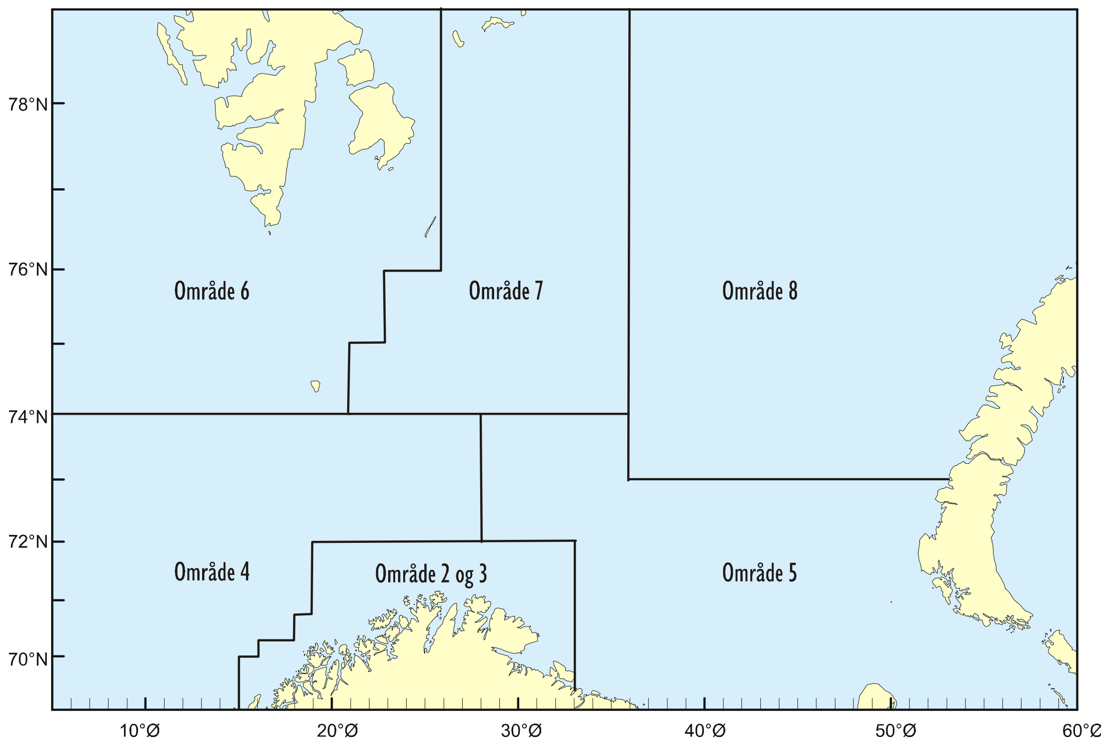


Figure 2.1.1.5. Ice index for the period 1970-2001. Positive values mean less ice than average, while negative values show more severe ice conditions.



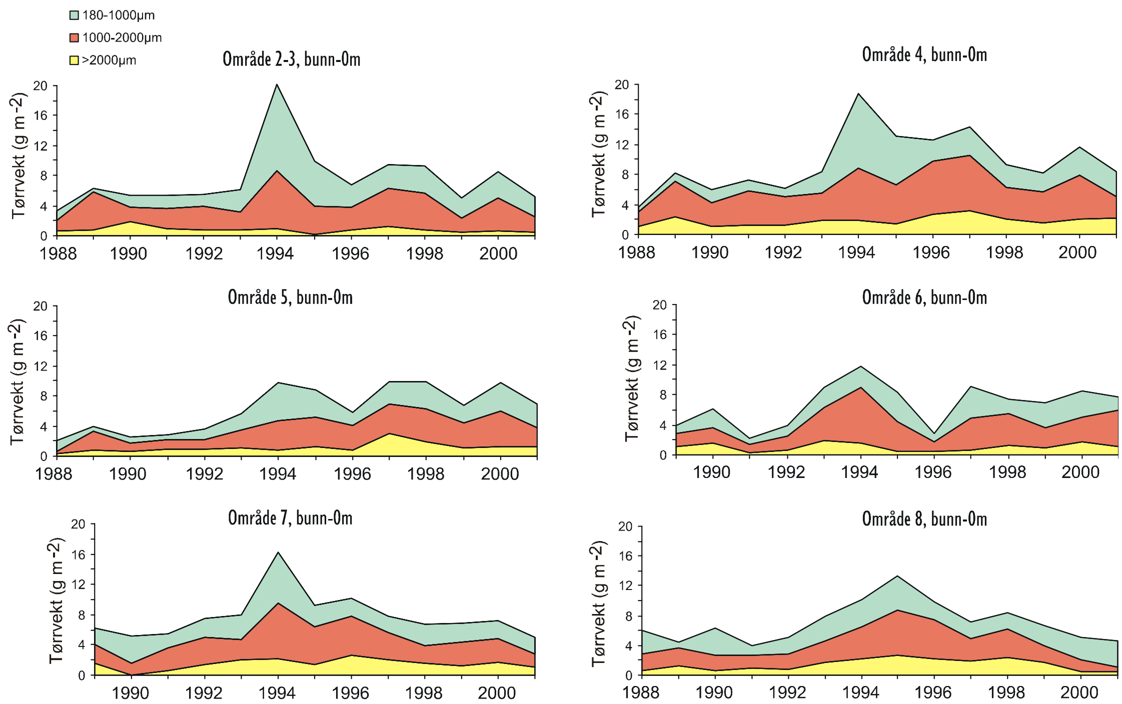


Figure 2.1.3.1. Average zooplankton biomass (g m^{-2}) for the 7 different areas in the Barents Sea during 1988-2001 (Anon.2002).

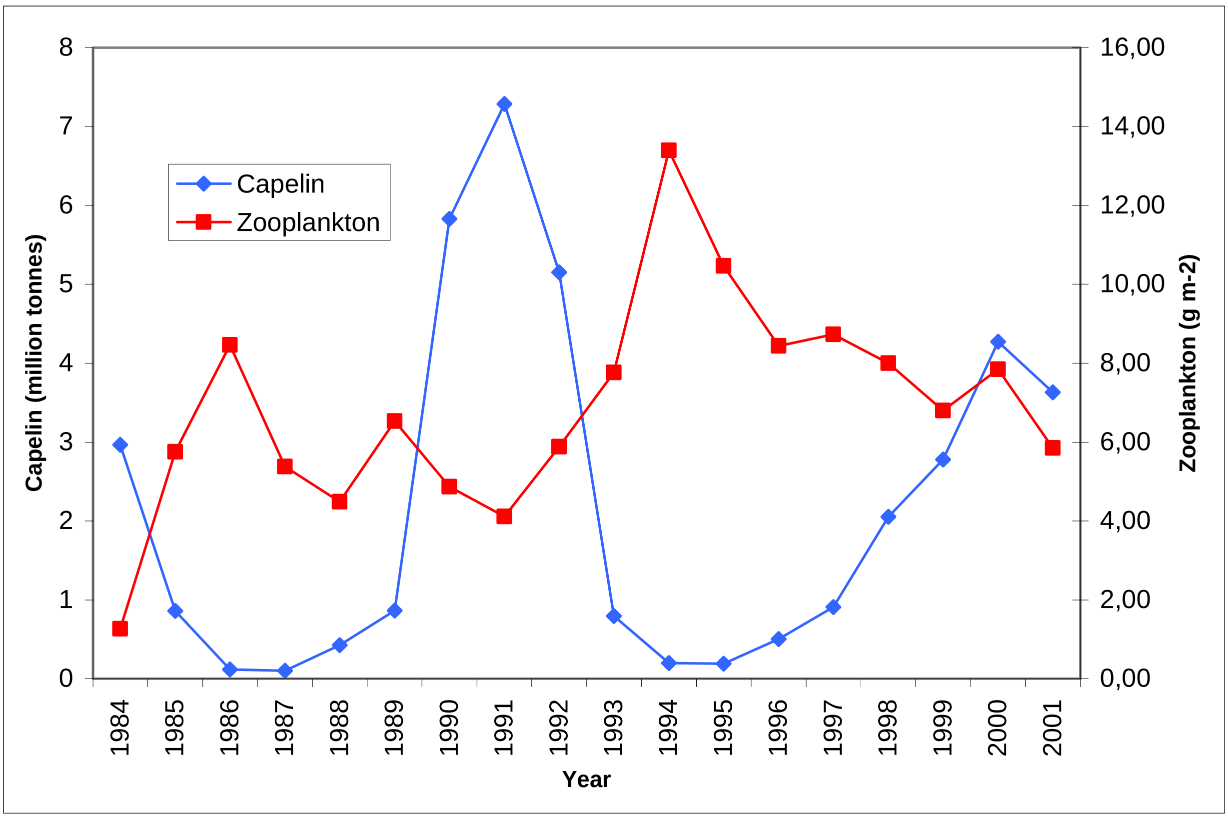


Figure 2.1.3.2. Average zooplankton biomass (g m^{-2}) together with biomass of one year and older capelin (million tonnes) during 1973 – 2001, in the Barents Sea (capelin data from Gjøsæter *et al.* (2000) updated to 2001). (Dalpadado *et al.* 2002).

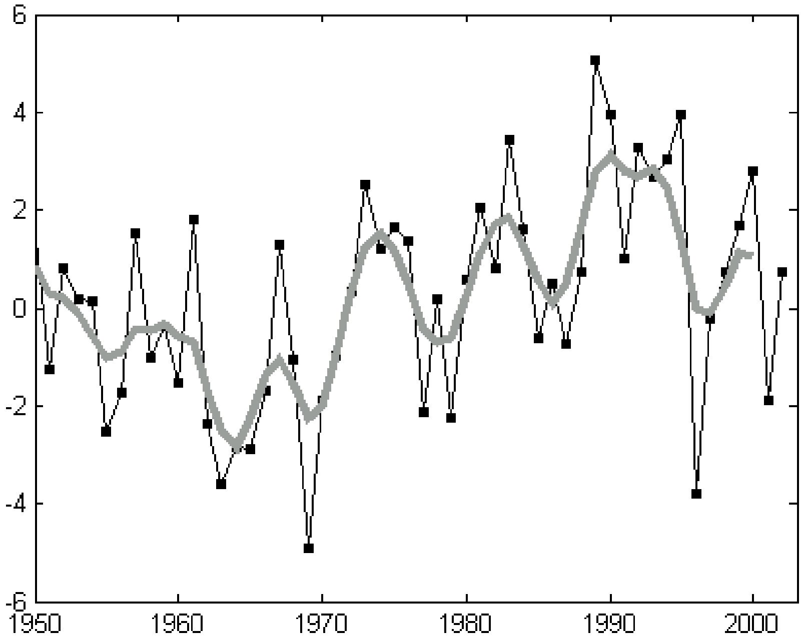


Figure 2.2.1.1. Winter (December-March) North Atlantic Oscillation index (NAO).

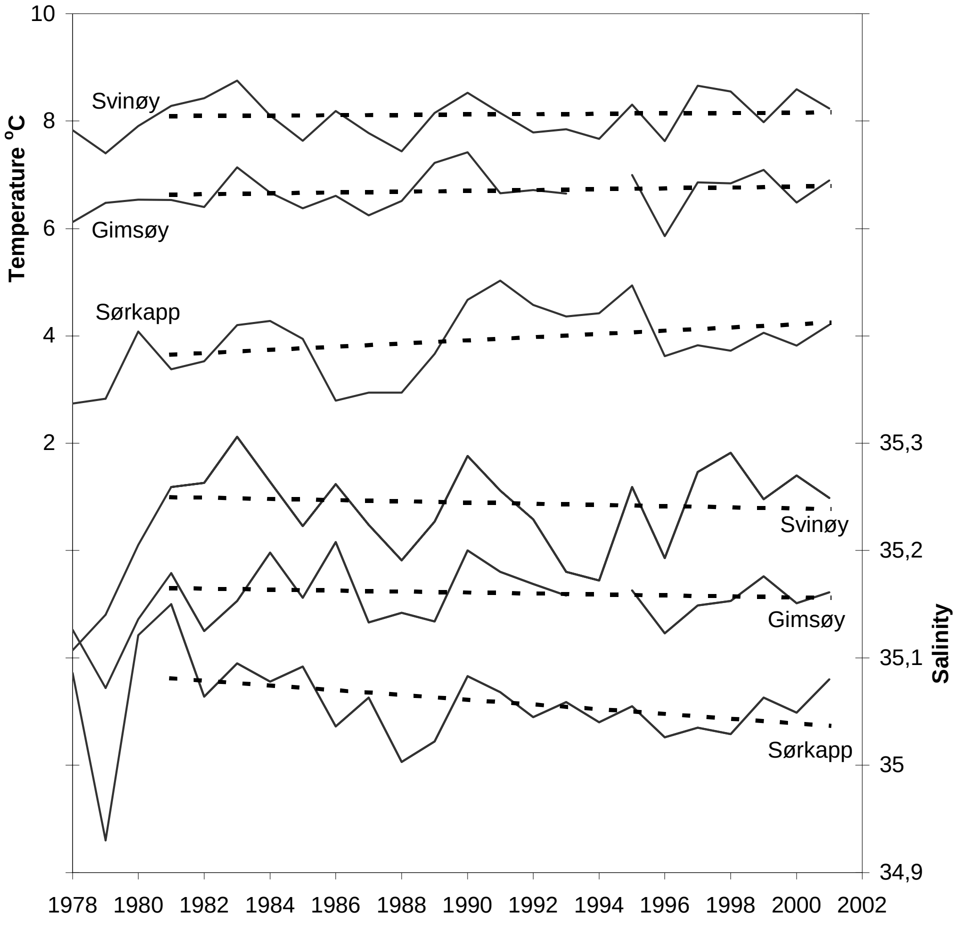
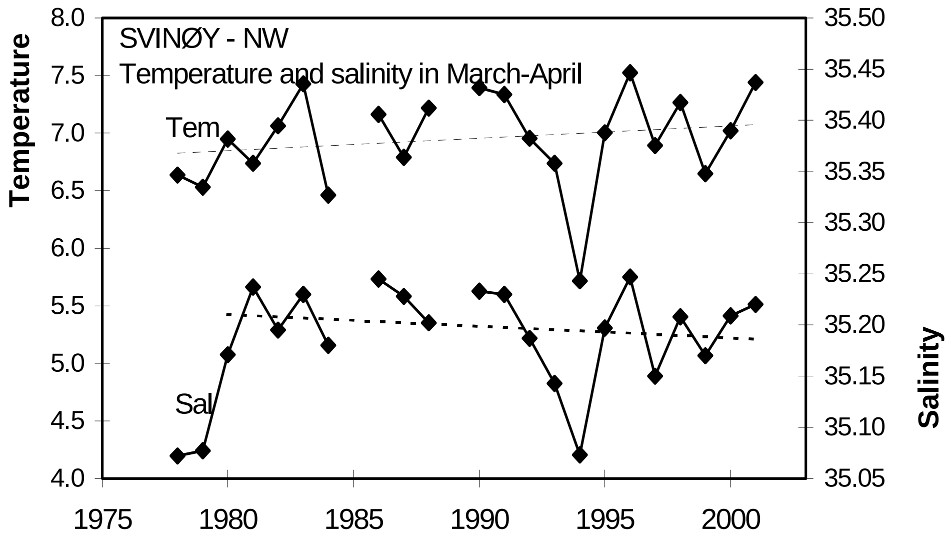


Figure 2.2.1.2. Temperature (ºC) and salinity observed during July/August, in the core of Atlantic Water beyond the shelf edge in the Sections Svinøy - NW, Gimsøy - NW and Sørkapp - W, averaged between 50 and 200 m depth and horizontally over three stations across the core.



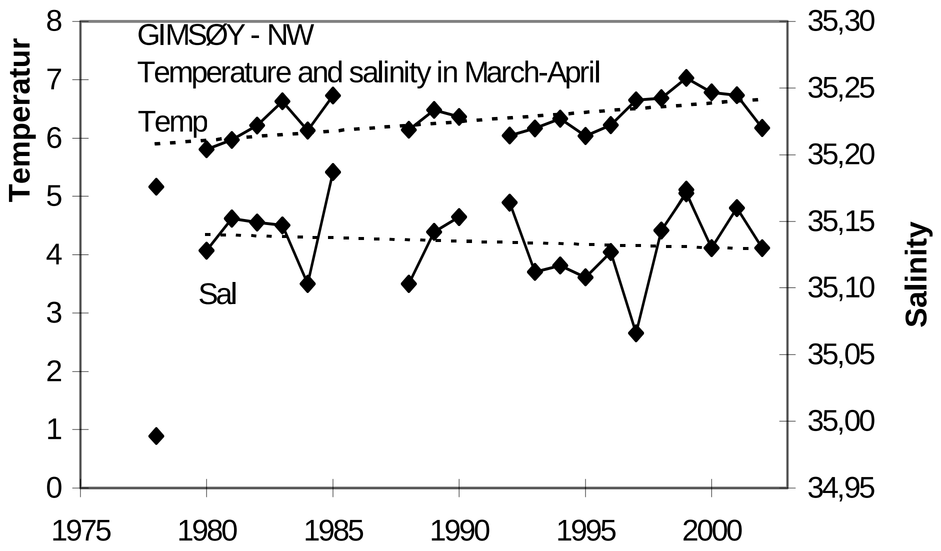


Figure 2.2.1.3. Temperature and salinity in the Sections Svinøy – NW and Gimsøy - NW, observed during March/April, in the core of Atlantic Water near the shelf edge, averaged between 50 and 200 m depth and horizontally over three stations across the core.

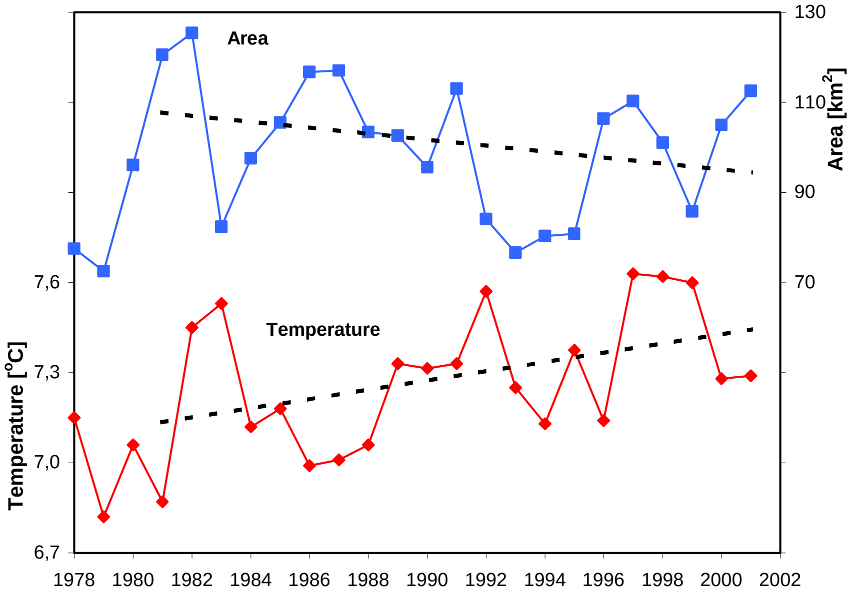


Figure 2.2.1.4. Time-series of area (in km^2) and averaged temperature (blue) of Atlantic water in the Svinøy Section, observed in July/August 1978-2001.

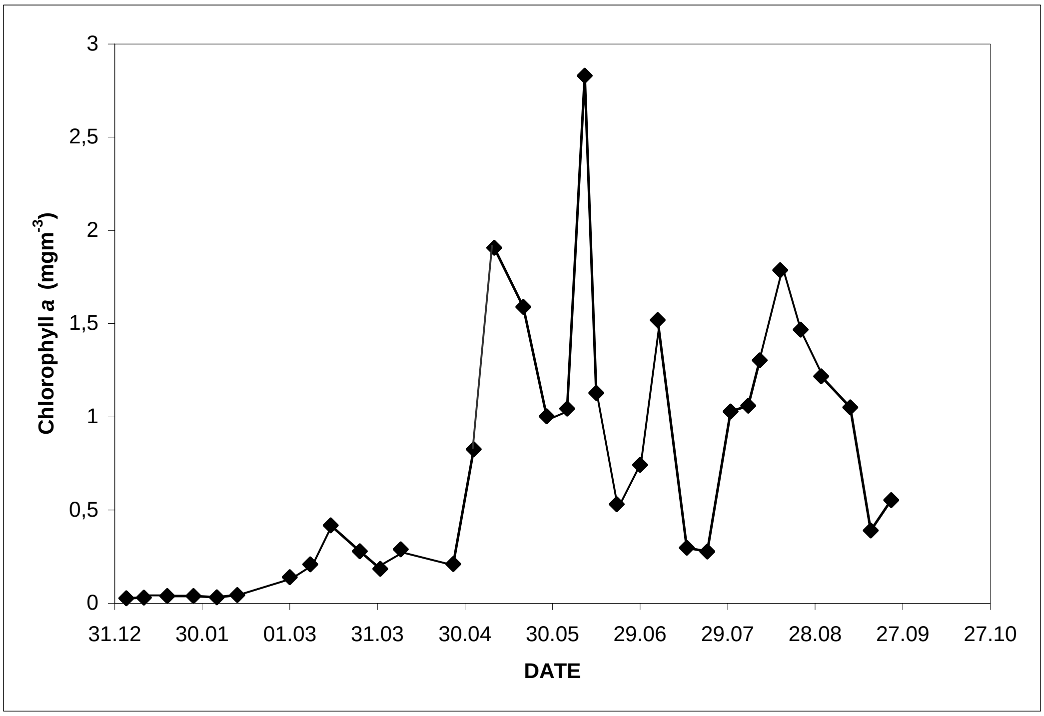


Figure 2.2.2.1. Distribution of chlorophyll *a* at 10 m depth during the year at Weather Station Mike in 2001.

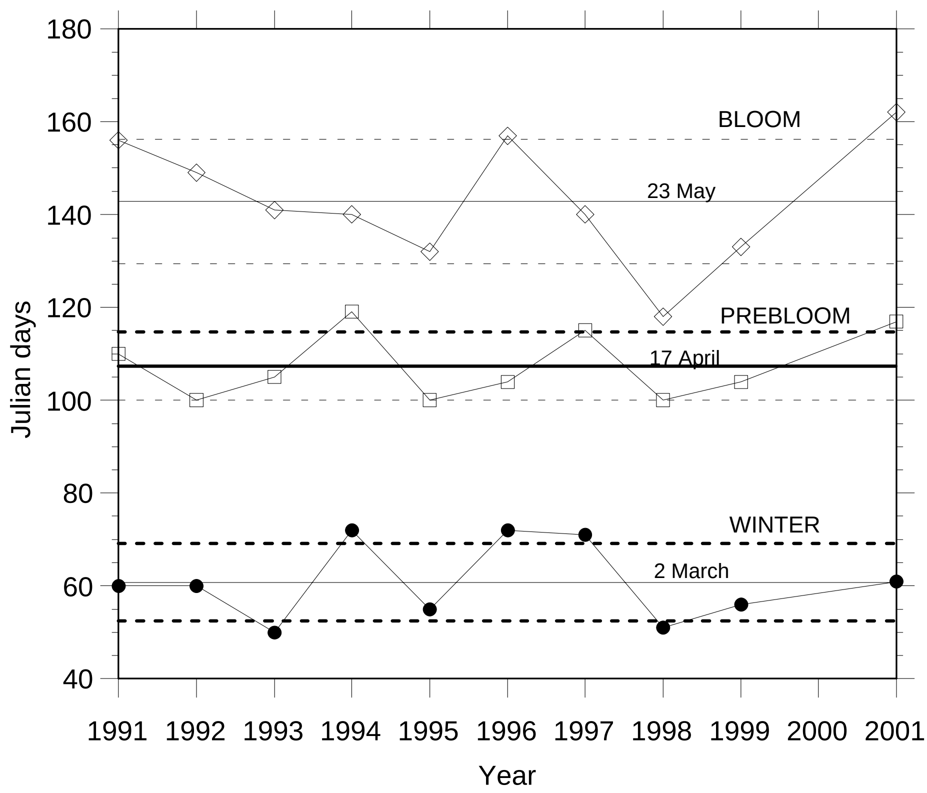


Figure 2.2.2.2. Year-to-year variation in the different phases of the development of phytoplankton at Weather Station Mike in the period 1991 to 2001. Circles: winter phase; squares: pre-bloom phase; diamonds: spring bloom. Continuous lines represent the average for each period. Broken lines represent one standard deviation for each period.

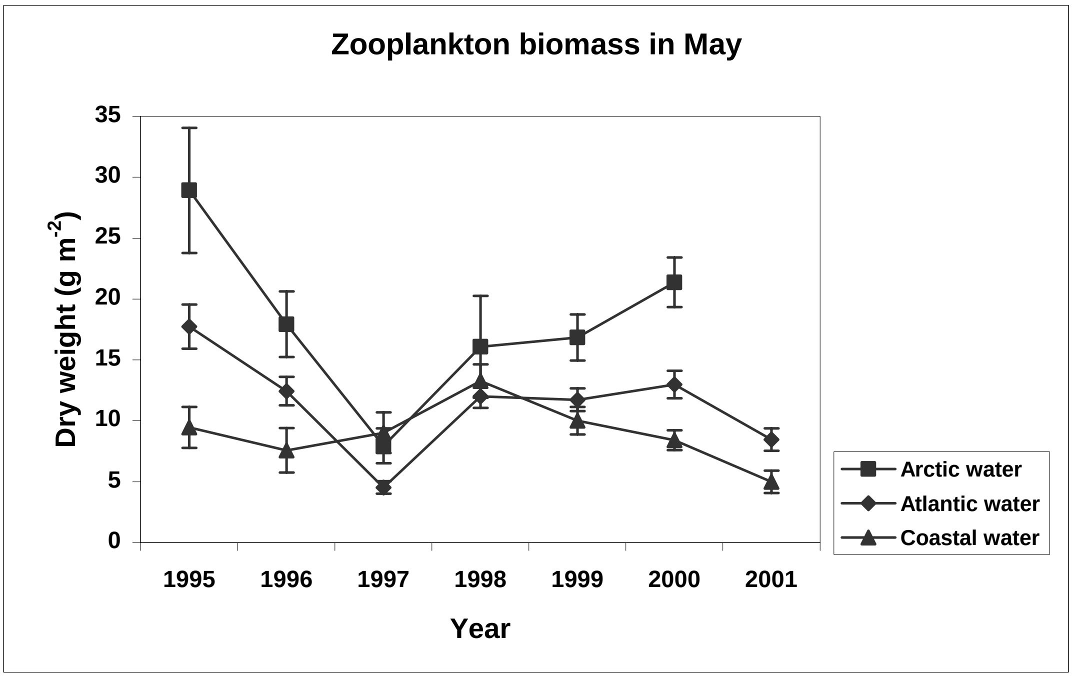


Figure 2.2.3.1. Zooplankton biomass (dry weight) in the upper 200 m in May. A: Arctic influenced water (salinity <35, west of 1.4ºE). B: Atlantic water (salinity >35). B: Norwegian Coastal water (salinity <35, east of 1.4ºE). Error bars: 95% confidence limits.

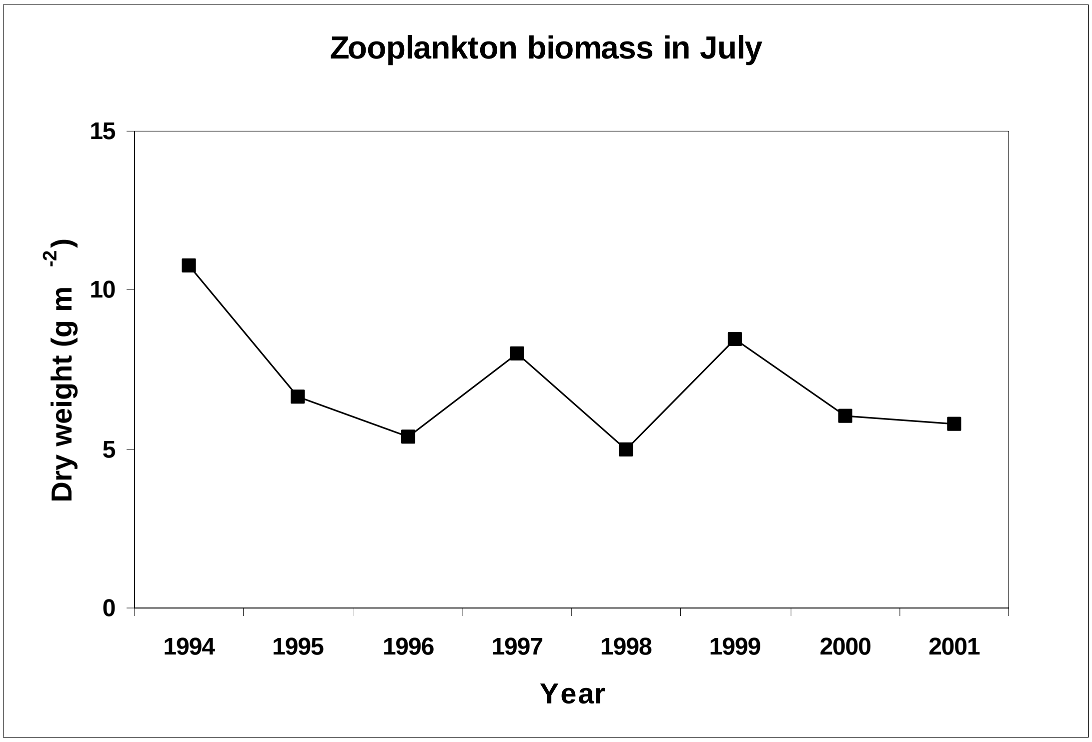


Figure 2.2.3.2. Zooplankton biomass in July-August in the eastern Norwegian Sea (0-200 m). Integrated biomass within a fixed geographical region divided by its area.

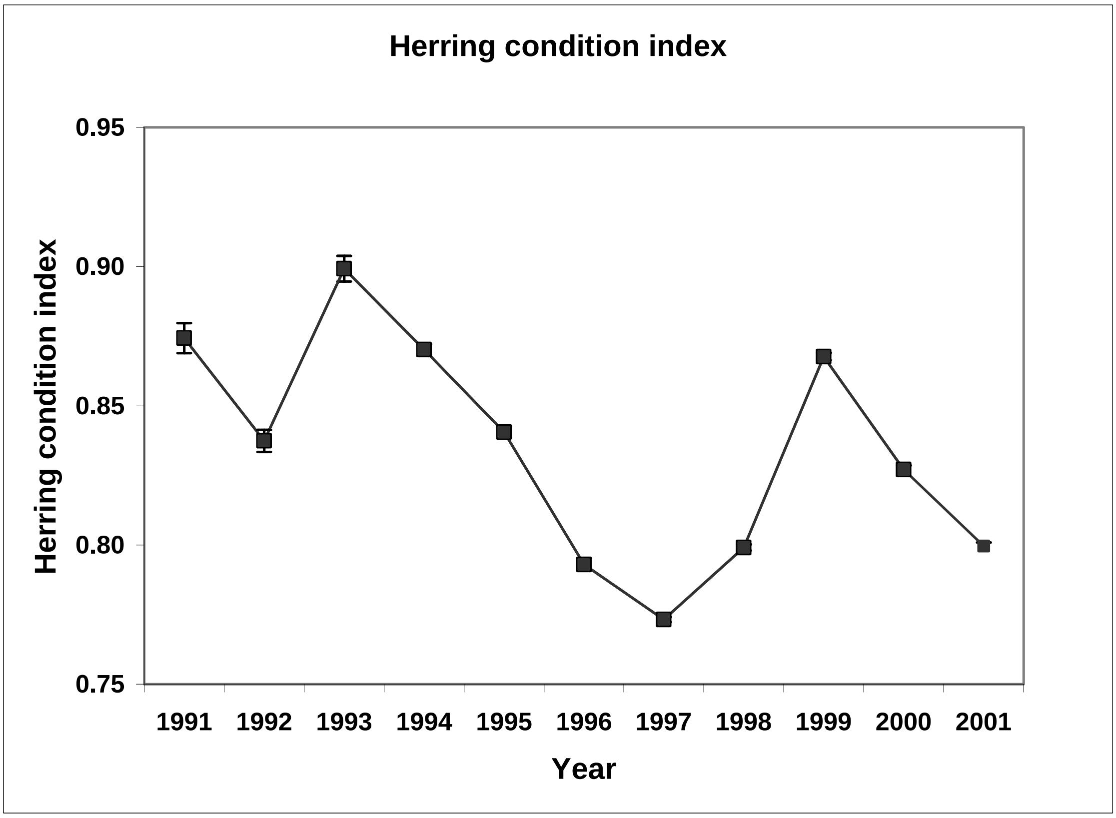


Figure 2.2.4.1. Individual weight-to-length ratio (herring condition index) for Norwegian spring-spawning herring. Data from November and December for herring 30-35 cm body length. Error bars: 95% confidence limits.

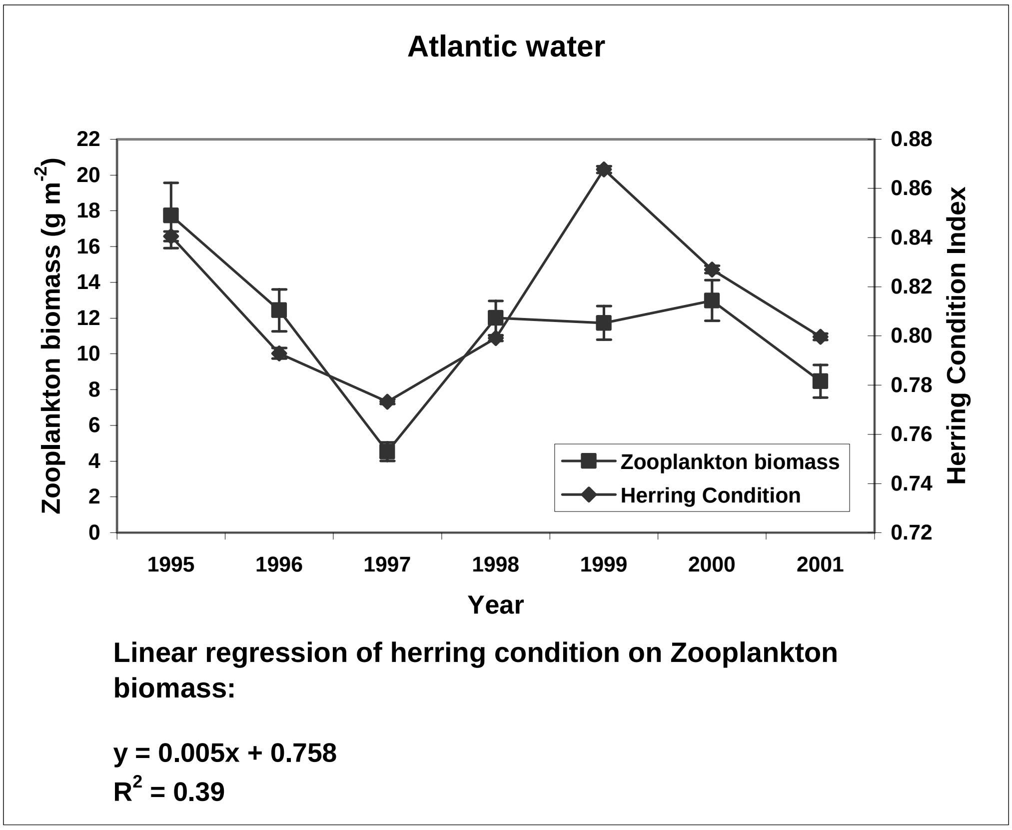


Figure 2.2.4.2. Zooplankton biomass (dry weight) in Atlantic water in the Norwegian Sea in May (0-200 m) and herring condition index (individual weight-to-length ratio, November and December, 30-35 cm). Error bars: 95% confidence limits.

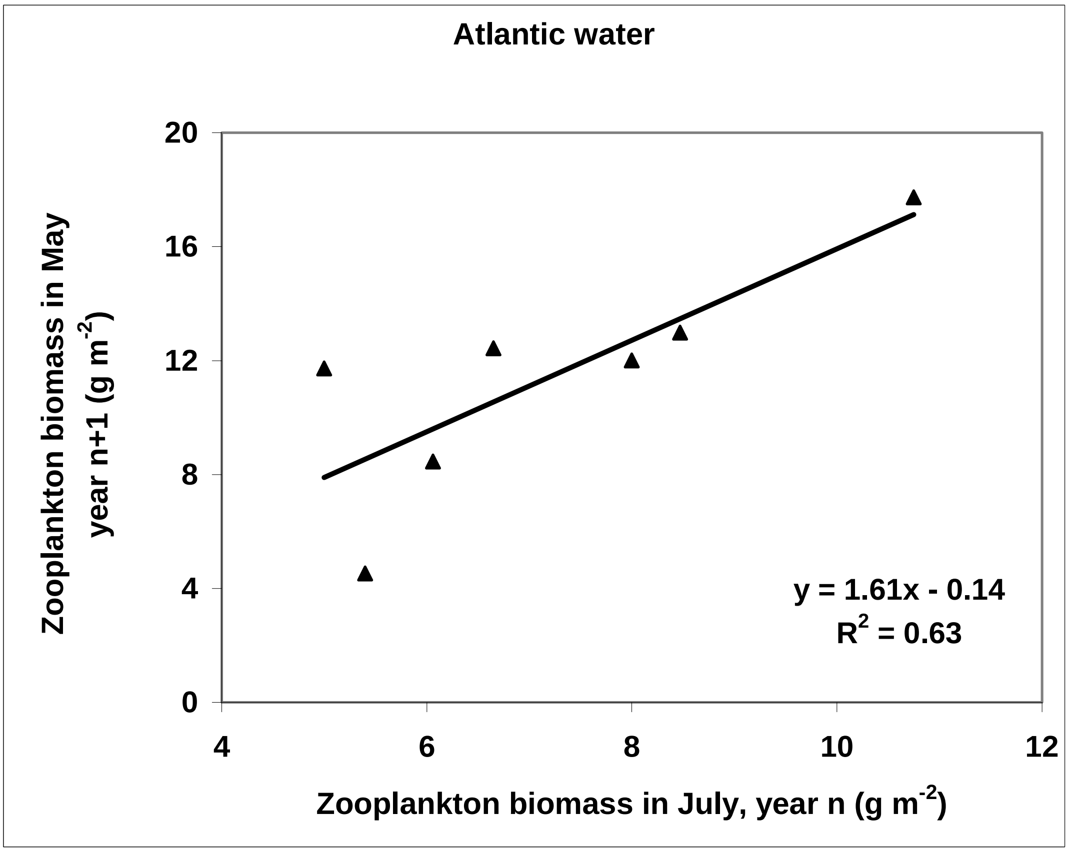
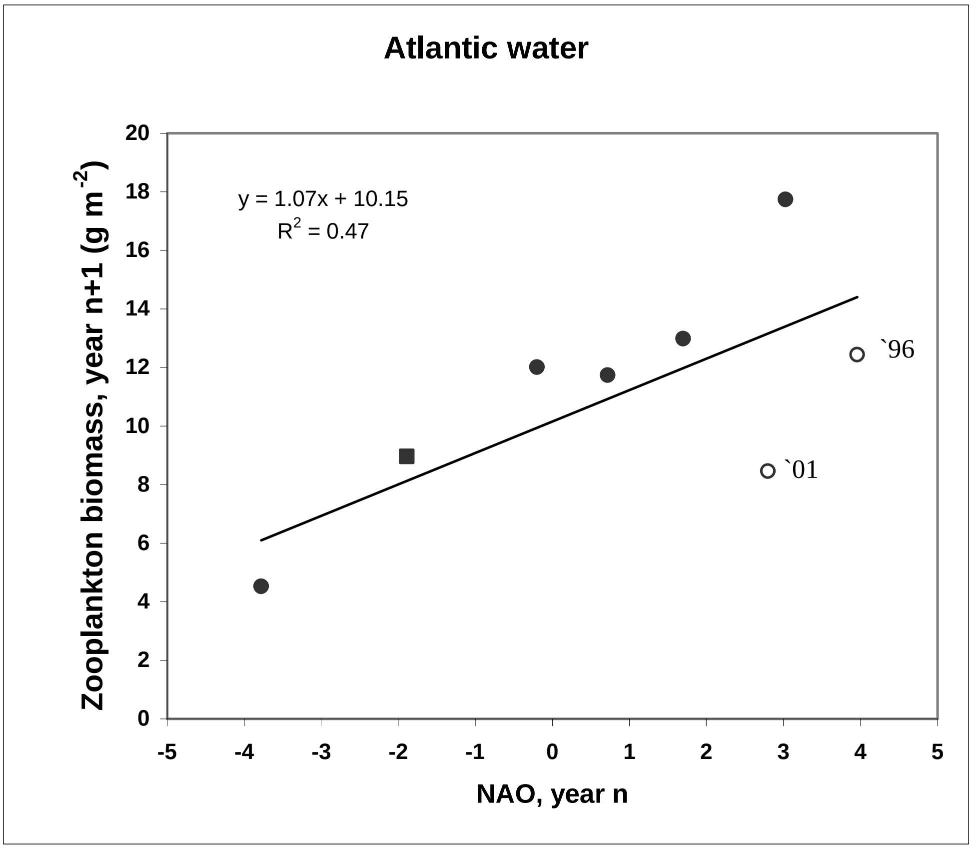


Figure 2.2.5.1. Zooplankton biomass in July (year n) vs. zooplankton biomass in May (year n+1).



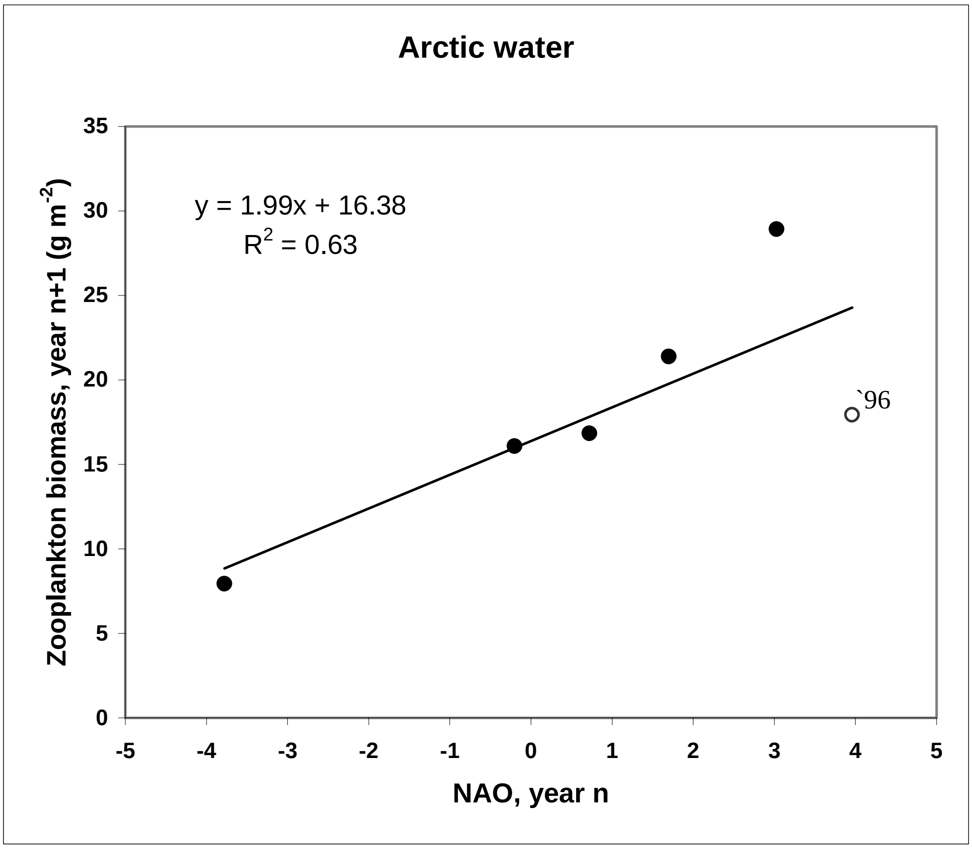


Figure 2.2.5.2. Winter (December-March) North Atlantic oscillation index (NAO) (year n) vs. zooplankton biomass in May (year n+1). Open circles: 1996 and 2001. Square: prediction of zooplankton biomass in May 2002 based on equation (1).

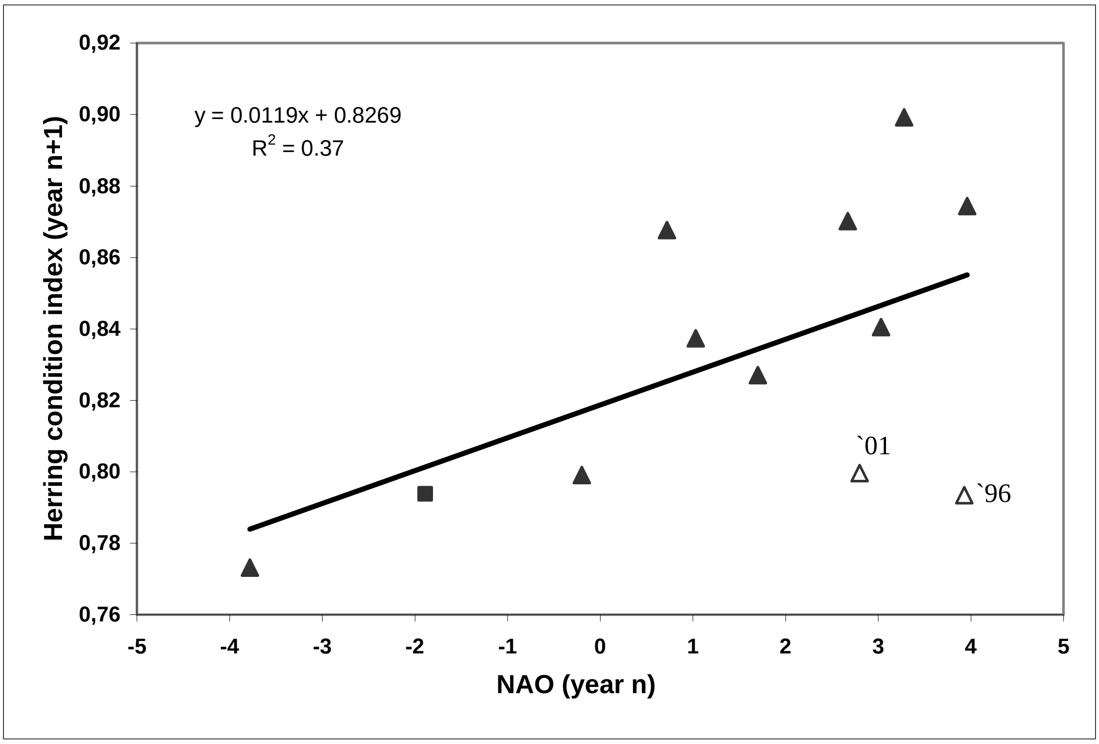


Figure 2.2.5.3. Herring condition index (year n+1) vs. winter NAO (year n). Open triangles: 1996 and 2001. Square: prediction of herring condition in 2002 based on equation (2).

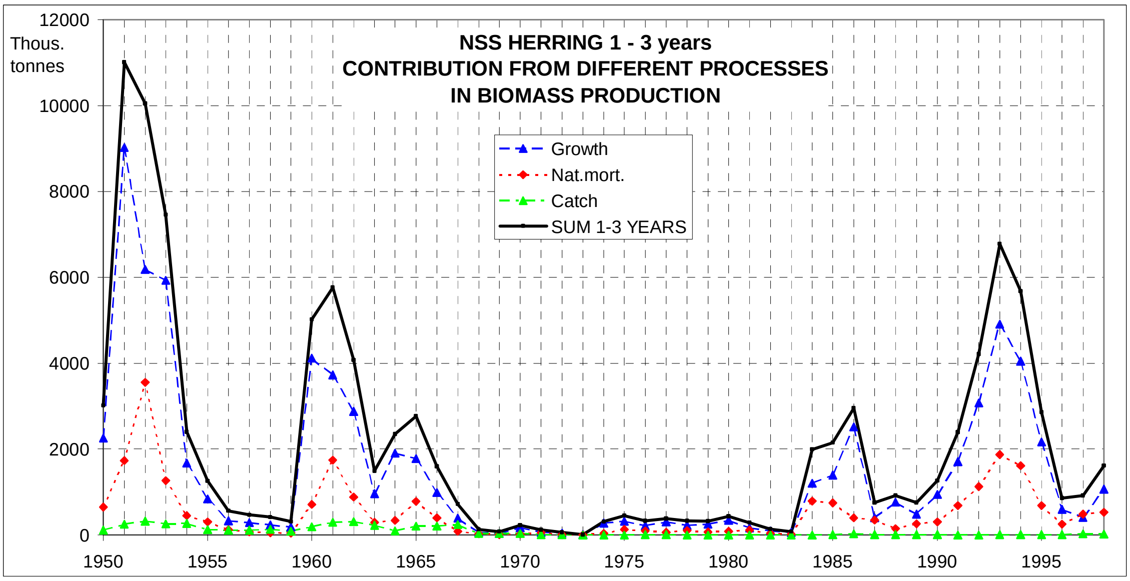


Figure 2.2.6.1. Biomass production for Norwegian spring-spawning herring during the years 1950 - 1998 for ages 1 – 3 showing the contribution from growth, natural mortality, and catch.

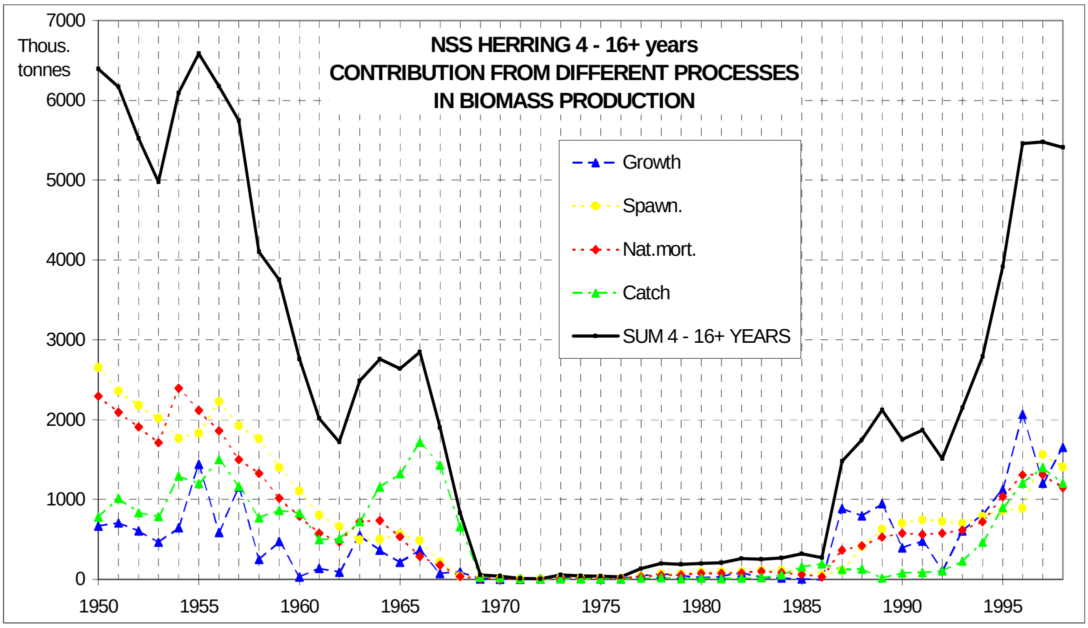


Figure 2.2.6.2. Biomass production for Norwegian spring-spawning herring during the years 1950 - 1998 for ages 4+ showing the contribution from growth, spawning products, natural mortality, and catch.

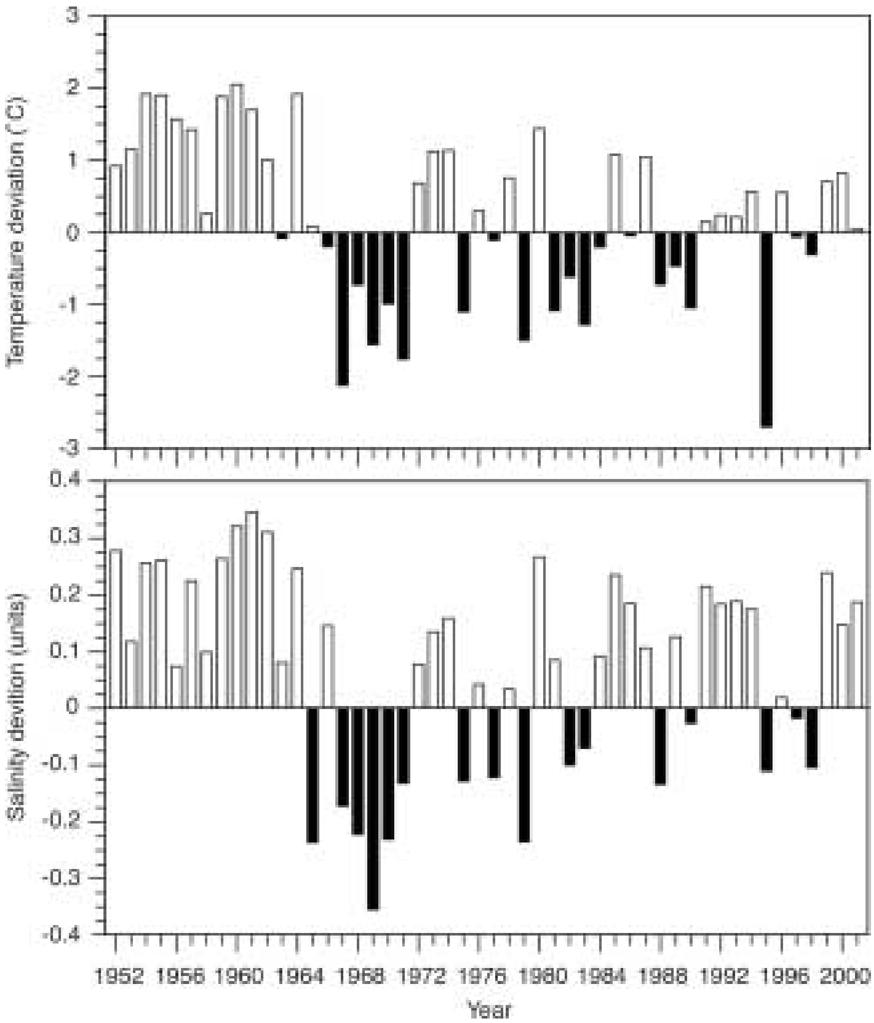


Figure. 2.3.1.1. Temperature (upper panel) and salinity (lower panel) deviations on the Siglunes section off the central north coast of Iceland 1952-2000.

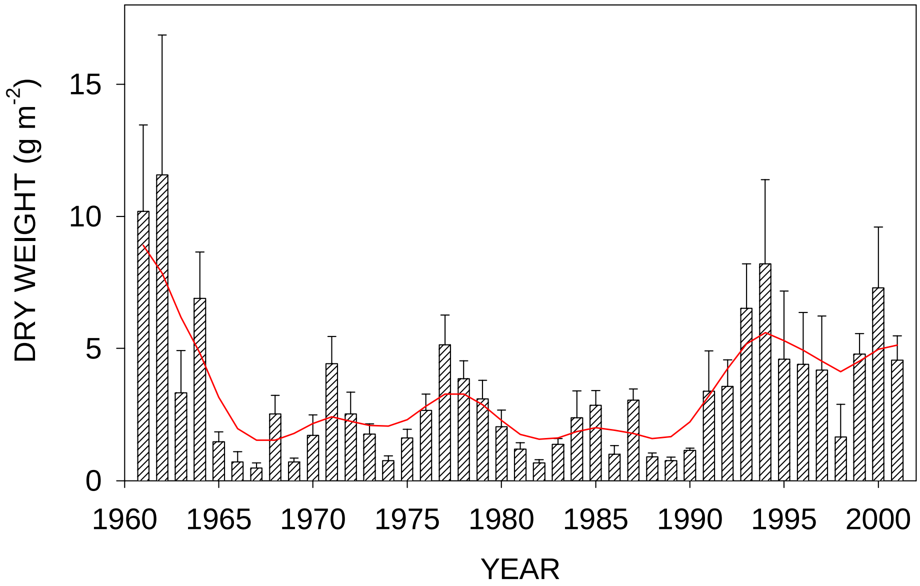


Figure 2.3.2.1. Variations in zooplankton biomass (g dry weight m-2, 0-50 m) in spring at Siglunes (A) and Selvogsbanki (B) sections. The columns show means for all stations at the respective sections and the vertical bars denote standard error. The curved line shows the 7-year running mean.

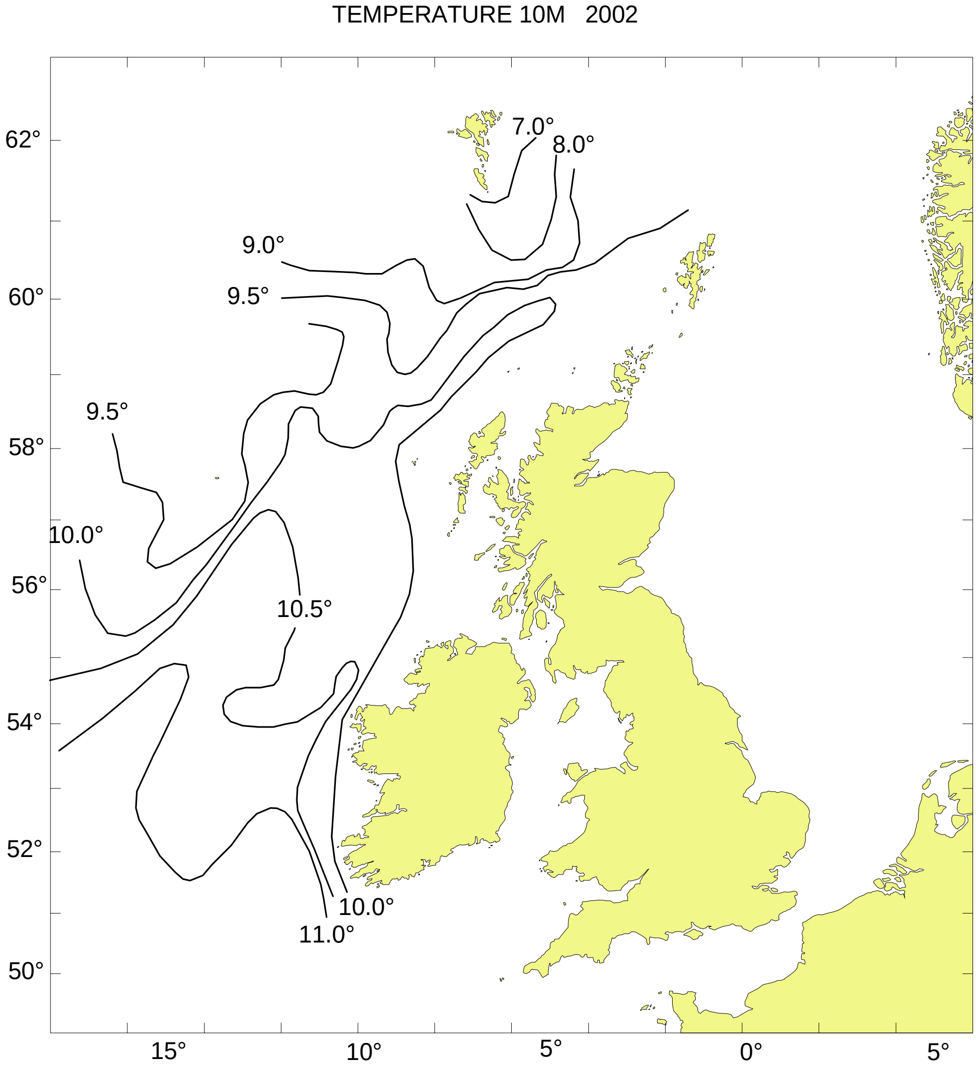


Figure 2.4.1. Horizontal temperature distribution, °C, at 10 m depth.

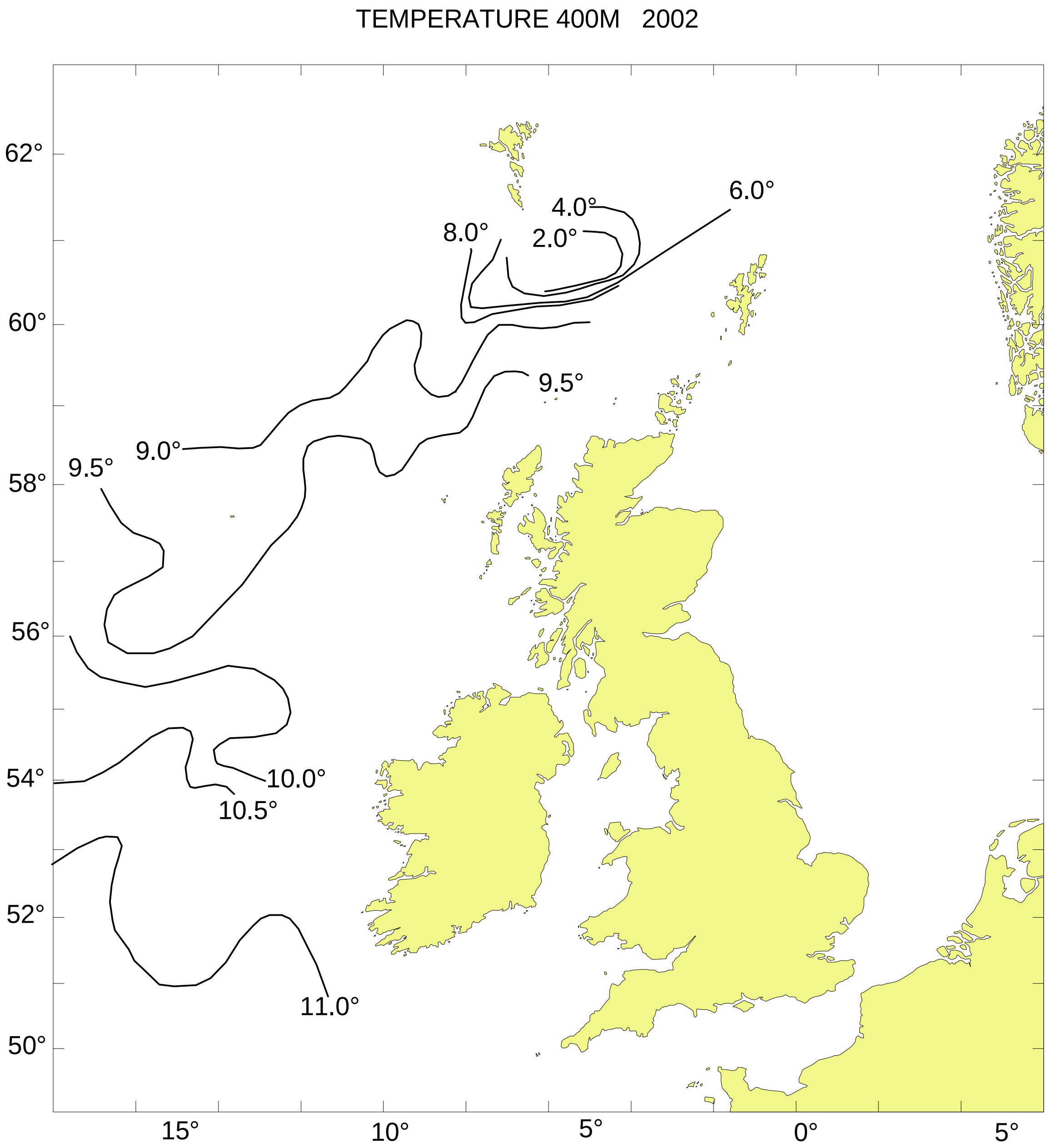
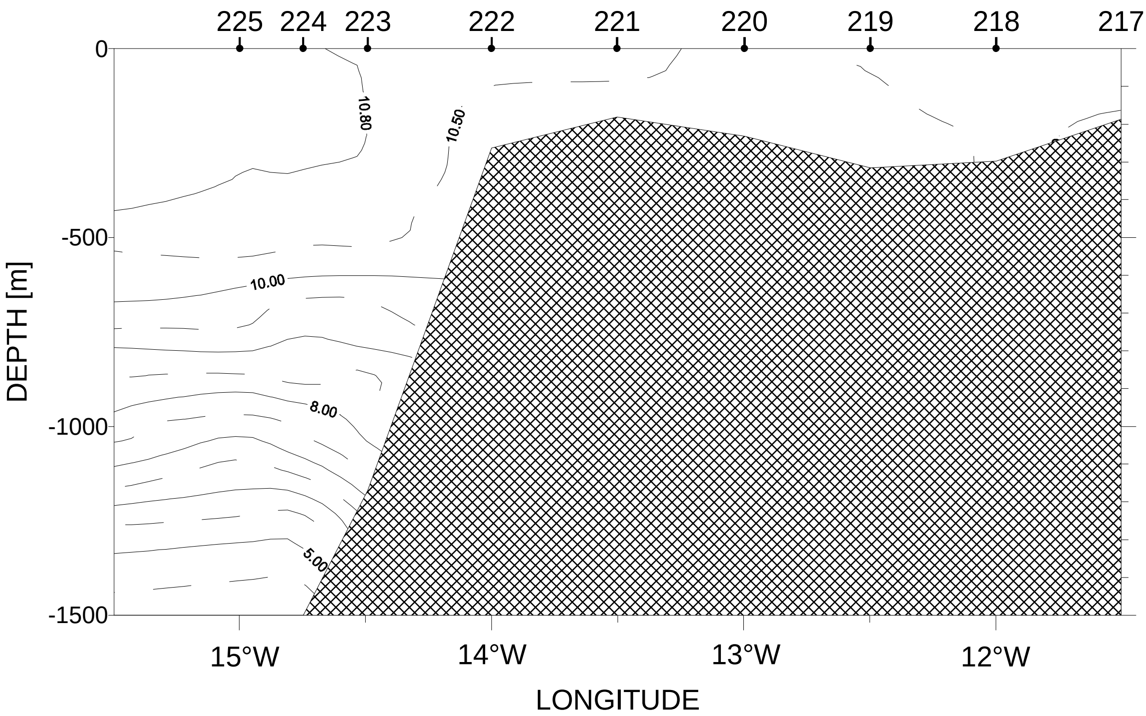


Figure 2.4.2. Horizontal temperature (°C) distribution at 400 m depth.



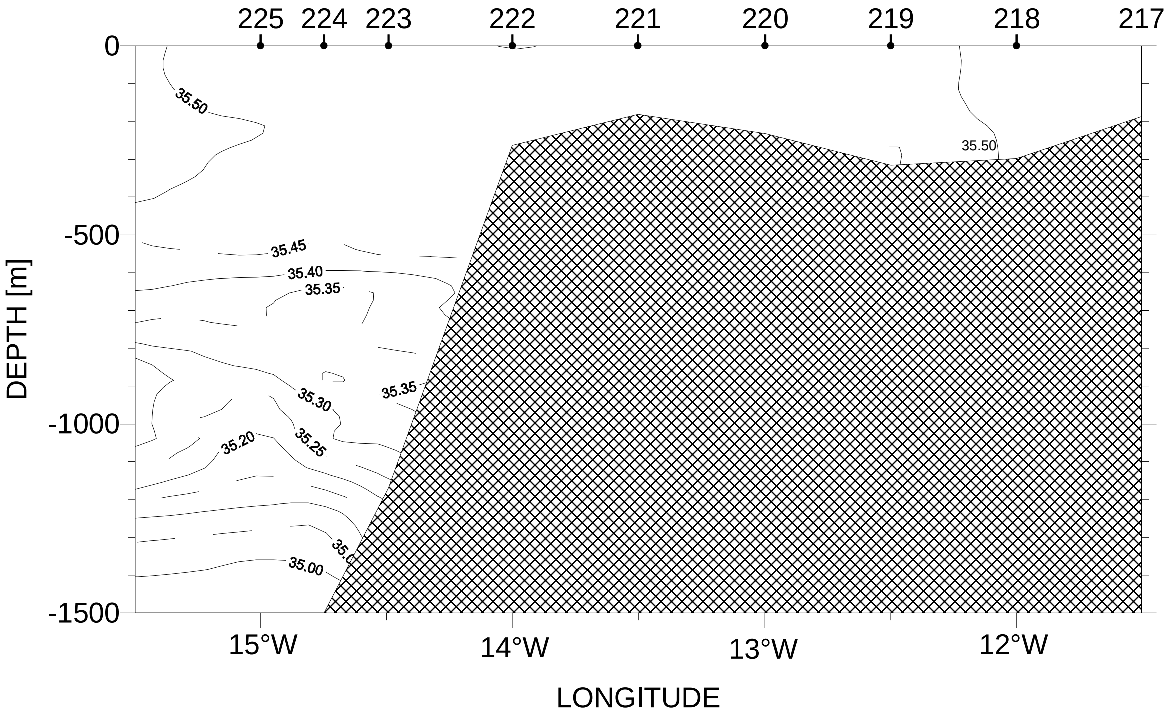


Figure 2.4.3. Vertical distribution of temperature (°C) and salinity in a section crossing the Porcupine Bank at 53° 30'N. Station numbers at the top of the panels.

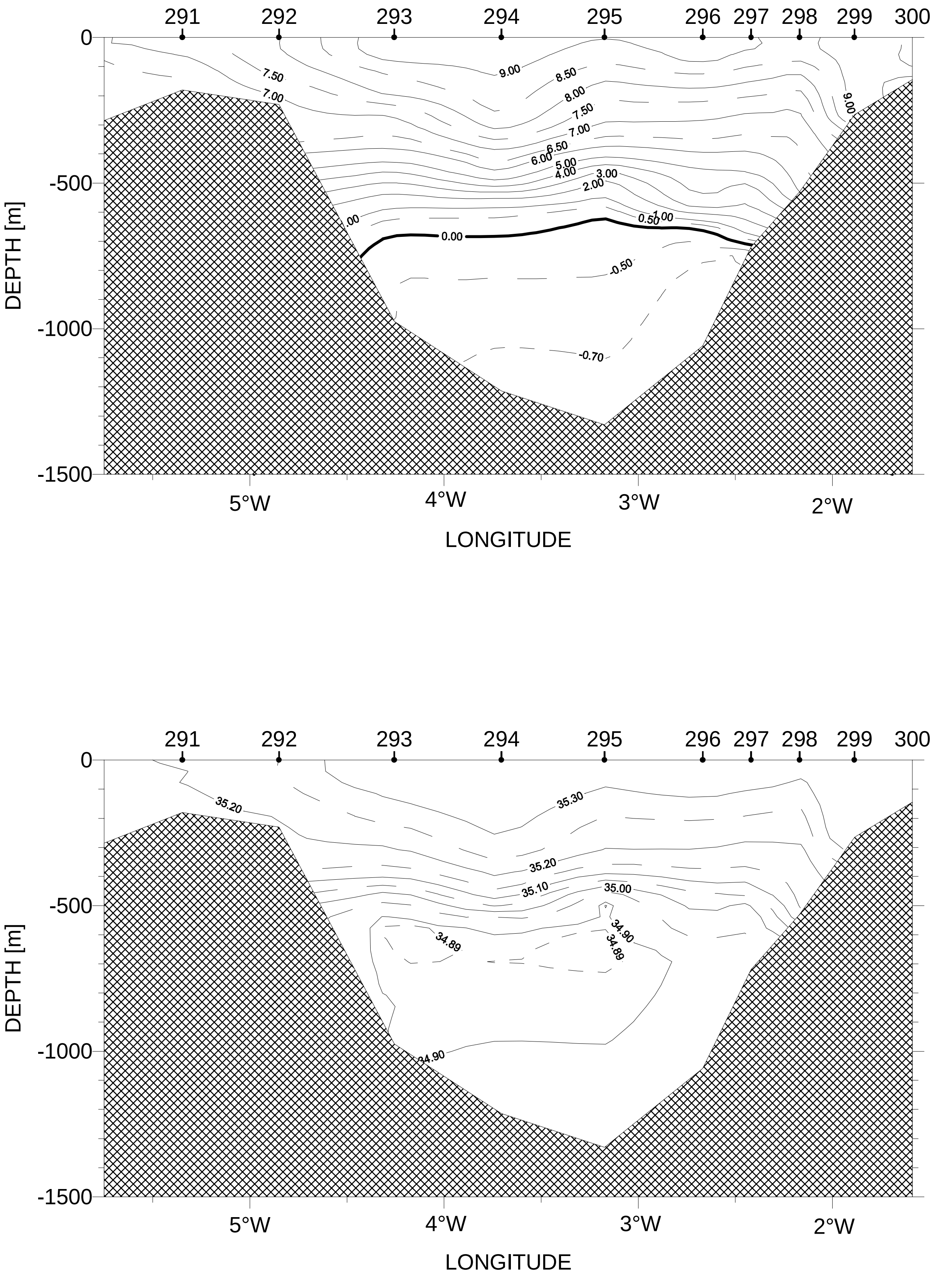


Figure 2.4.4. Vertical distribution of temperature (°C) and salinity in a section from the Faroes to Shetland (Nolsø-Flugga). Station numbers at the top of the panels.

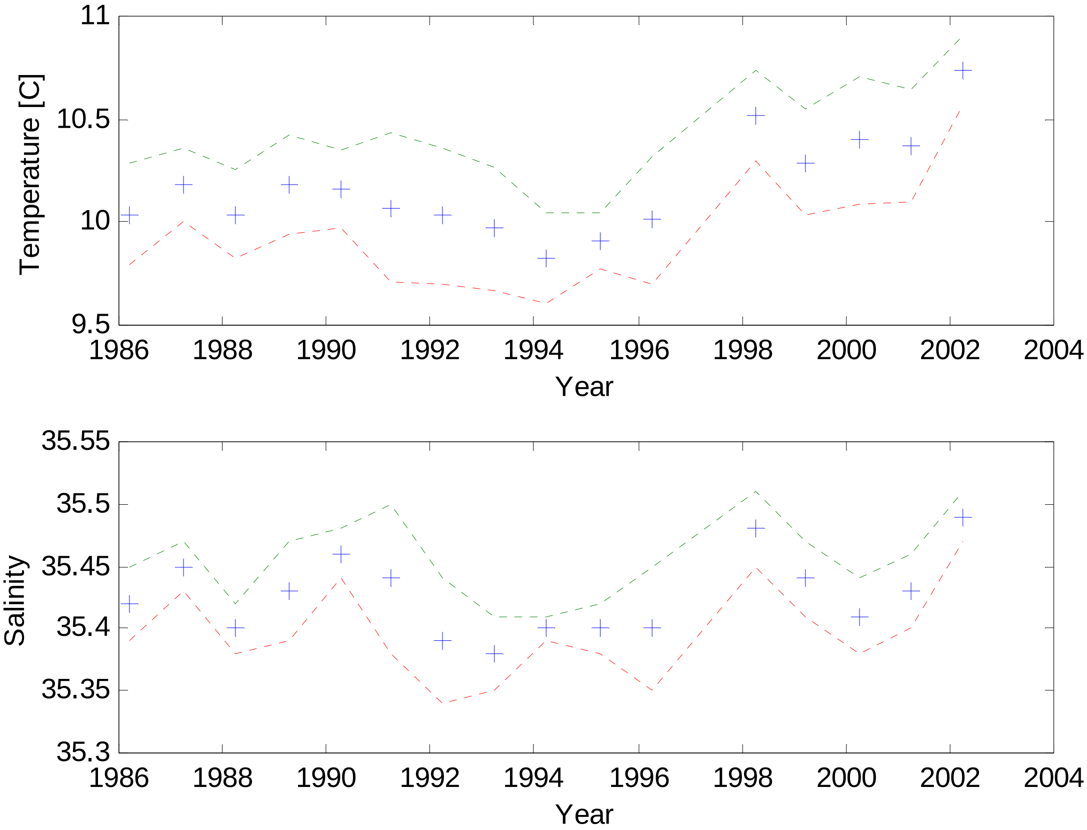


Figure 2.4.5. Temperature and salinity from 50-600 m means (crosses) of all stations in a box west of the Porcupine bank bounded by 52° to 54°N and 16 to 14°W. Dotted lines are drawn at plus-minus one standard deviation of all observations in each box, each year.

3 NORWEGIAN SPRING-SPAWNING HERRING

3.1 TAC and Fisheries

3.1.1 TAC agreements for 2001 and 2002

At the annual meeting in Skagen, Denmark in October 2000 the coastal states (European Union, Faroe Islands, Iceland, Norway, and Russia) agreed to limit their catches to 850 000 t in 2001.

At the corresponding annual meeting in Harstad, Norway in October 2001 the Parties agreed to prolong this catch limit (850 000 t) for 2002.

3.1.2 The Fisheries

3.1.2.1 Description of the national fisheries in 2001

The catches of Norwegian spring-spawning herring by all countries in 2001 by ICES rectangles are shown in Figure 3.1.1 (total whole year) and in Figure 3.1.2 (per quarter). In 2001 the catch provided as catch by rectangle represented approximately 756 845 tonnes or 98.3% of the total catch. In general the development of the international fishery shown by these figures follows the known migration pattern for Norwegian spring-spawning herring. The migration pattern, together with environmental factors, was mapped in 2001 during the ICES PGSPFN (Working Group on Surveys on Pelagic Fish in the Norwegian Sea) investigations (ICES 2001/D:07 Ref ACFM, ACME).

Denmark: The Danish fishery of Norwegian spring-spawning herring is carried out mostly by purse seiners (84%) and most of the landings were landed in Norway. In 2001 the first fishing period started in the southern part of Division IIa in February and continued into March where app. 8 500 t were caught. The second fishing period started in May and ended in the beginning of July and the fishery was carried out in the Norwegian Sea and in the Jan Mayen area (app. 11 300 t). Finally the third period began in the Jan Mayen area in August and ended in mid-September (4 200 t).

The Faroes: The Faroese herring fishery (9 vessels) started in late February in Norwegian EEZ (IIa), relatively close to the coast west of Møre and continued in that area the first two weeks of March. In mid-May the fishery resumed in the international waters and in the Jan Mayen zone north of 70°N (ICES Division IIa), and the spring and summer fishery terminated in late June in the northern part of IIa (71–73°30'N). The autumn fishery started in the northern part of the Norwegian zone close to the Svalbard zone (IIa) in late August and lasted one week into September. After that the fishery again resumed in the Lofoten area in mid-September and lasted to the first week of October. All catches were taken with purse-seine.

France: France reported no catches in 2001.

Germany: The information from the German fishery was restricted to the amount and location of catches.

Iceland: The Icelandic fishery in 2001 began in the third week of May when about 5 000 tonnes were taken, mostly in international waters near 72˚N, between 05˚E and 06˚E. A few individual catches were taken in international waters further to the SW and in the southeastern EEZ of Jan Mayen. The herring were scattered and below purse seining depth most of the time. Catch rates improved in late May-early June and during 29 May-3 June the catch was about 32 200 tonnes. As before, almost all of this catch was taken between 71˚40'N and 72˚30'N, and 6˚E-7˚E. There were very few catch records from the Jan Mayen EEZ. The week of 4–10 June yielded about 10 100 tonnes. All of this catch was taken near the eastern boundary of the international zone between 72˚N and 73˚30'N. About 17 500 tonnes were caught during 11–17 June. Again, most of the catch was taken very close to the eastern limit of the international zone, between 72˚40'N and 72˚45'N as well as between 71˚N and 72˚15'N. Small catches were also taken east of Jan Mayen, between about 3˚30'W and the zero meridian. The week 19–25 June yielded only some 200 tonnes, taken in 4 sets just south of 72˚N, and the Icelandic fleet caught only 600 tonnes in July. The August catch was 5300 tonnes, mostly taken near 73˚N, 12˚E. Almost all of the September catch of 6200 tonnes was taken in the Norwegian EEZ northwest of Lofoten, between 68˚N and 69˚30'N. The total Icelandic catch of Norwegian spring-spawning was 77 693 tonnes of which about 75% were taken by purse seine and 25% with pelagic trawl.

Ireland: Ireland reported no catches in 2001.

Netherlands: The information from the Dutch fishery was restricted to the amount and location of catches.

Norway: The Norwegian fishery is carried out by many size categories of vessels. Of the total national quota of 484 500, 51% is allocated to purse seiners, 9% to trawlers and 39% to smaller coastal purse seiners. By far the larger part of the Norwegian fishery takes place in northern Norwegian coastal waters (Vestfjorden area) where the herring winters in the period from September until March. Here the herring occurs in concentrations that usually are easily available to the fishery. In 2001 approximately 120 000 t were caught in the wintering area in Northern Norway in January-February, and 64 000 t in the spawning area on the Norwegian coast in February-March. Only 700 t were caught in the spring/summer fishery in the Norwegian Sea, and the remaining part of the Norwegian quota (approximately 320 000 t) were taken in the period September-December on the herring migrating to, and wintering in, the wintering areas in Northern Norway. Approximately 90% of the Norwegian catches were utilized for human consumption.

Russia: In 2001 the Russian fishery started within the shelf region of the Norwegian EEZ, near Sklinna and Halten Bank (approximately 65 ^{o}N-66 ^{o} N) in the beginning of February and Buagrunnen Bank (approximately 63^{o}N) in the end of this month. In March the fishing was in progress in the same regions. In February and March the catch was 27 474 t.

In May-June the commercial vessels conducted fishing in the northern part of the international area in the Norwegian Sea in the Polar Front region and in the Jan Mayen area. In May-June the catch was 14 765 t. In July-August vessels caught herring in the international area in the Norwegian Sea in the Polar Front region and the zone of Spitsbergen. In September Russian vessels followed the southward migrating fish and continued their fishery in the Norwegian EEZ. In September the fishery of the herring was prolonged in the EEZ of Norway. The herring migrated southwestwards, along the depths of the continental slope. In July-September the catch was 66 815 t. The entire Russian catch was utilized for human consumption.

Sweden: The information on the Swedish fishery was restricted to catch per ICES area.

UK (Scotland): The information from the Scottish fishery was restricted to the amount and location of catches.

3.2 Catch statistics

The total annual catches of Norwegian spring-spawning herring for the period 1973–2001 (2001 preliminary) are presented in Tables 3.2.1 (by fishery) and 3.2.2 (by country).

The Working Group noted that in this fishery an unaccounted mortality caused by fishing operations and underreporting probably exists. In general, it was not possible to assess the magnitude of these extra removals from the stock, and taking into account the large catches taken in recent years, the relative importance of such additional mortality is probably low. Therefore, no extra amount to account for these factors has been added in 1994 and later years. In previous years, when the stock and the quotas were much smaller, an estimated amount of fish was added to the catches (Table 3.2.1).

The combination of national catch-at-age and weight-at-age data for 2001 to obtain the total international catch-at-age and weight-at-age was done using the computer programme SALLOC, a standard ICES software. The official catch, sampled catch, and catch as used by the Working Group, together with number of samples, catch-at-age, and weight-at-age for each fishery are given in Tables 3.2.3 and 3.2.4.

The Working Group noted that not all nations participating in the international fishery for Norwegian spring-spawning herring in 2001 had carried out an adequate sampling of their fishery. The allocation of catches for which no samples were taken and the final catch-at-age and weight-at-age by ICES area is given in Table 3.2.5. In general one used the Norwegian age distribution and weights for un-sampled fisheries in the Norwegian Sea in quarter 1–4, and the Russian age distributions and weight keys for quarter 3 for un-sampled fisheries in quarter 2. The Russian age distribution in quarter 3 was calculated using Russian length samples and the Norwegian age-length key for quarter 3 and 4 (WD by Slotte).

In addition to the sampling described in Table 3.2.3, size group information was used to calculate the Norwegian catch in number (WD by Slotte) as in the years 1994–2001. In year 2001 a major part of the catches landed in Norway in quarter 1 and 2 were sampled for size group composition: 1555 samples representing 185 222 t. The catch in quarter 3–4 was not sampled for size group composition this year, but this type of sampling will start again in 2002. In general the catches used for consumption are divided into 5 size groups, as follows:

Group	Weight (g)
1	> 333
2	200–333
3	125–200
4	83–125
5	< 83

The percentage of the total catch in kg is calculated for each size group, by taking out sub-samples of the catch during the production process. These percentages are registered by the Norwegian sales organisation for pelagic fish. The age composition within each size group is then estimated from age-sampled catches, and the total catch in number is calculated (WD by Slotte).

3.3 Surveys

3.3.1 Spawning areas

There was no acoustic survey to determine the abundance of herring in the spawning areas in 2002 (Table 3.3.1.1).

3.3.2 Wintering areas

The wintering area was surveyed acoustically in November 2001 (WD by I. Røttingen). The abundance estimate obtained during this survey is given in Table 3.3.2.1. There was no acoustic survey of the wintering area in January 2001 (Table 3.3.2.2).

3.3.3 Feeding areas

The feeding area in the Norwegian Sea was surveyed acoustically during the ICES coordinated herring survey (PGSPFN) in 27 April - 08 June 2001 (ICES 2001/Ref ACFM. The PGSPFN reports from 1995 can be viewed on the site www.iMrno\PGSPFN). The abundance estimate is given in Table 3.3.3.1.

3.3.4 Nursery area

The nursery area of the Norwegian spring-spawning herring is Norwegian fjord and coastal areas, and in the Barents Sea. Since 1988, when the 1983 year class spawned for the first time, the latter area has increased in importance as a nursery area for the herring.

Results from the Russian acoustic survey in the Barents Sea in June 2001 (WD by A. Krysov) are given in Table 3.3.4.1. This year the Working Group decided to include data on immature herring obtained during the annual the joint Norwegian-Russian capelin survey in September in estimating the younger year classes (Section 3.3.5). The results from this survey are given in Table 3.3.4.4. The results from the 0-group herring survey in Norwegian Fjords and Coastal areas are given in Table 3.3.4.2 and the results from the joint Norwegian-Russian 0-group survey in the Barents Sea are given in Table 3.3.4.3.

3.3.5 Herring larval survey 2002

The larval survey in 2002 was carried out during the period 8–25 April. The survey started at Tromsøflaket (70°N) and the Norwegian shelf south to 58°N was covered. High densities of herring larvae were found from the start of the survey. Between 100 to 1000 larvae m^{-2} were found on the banks outside Senja, Vesterålen, and at the Røstbank. Most of these larvae were in the first post-yolk-sac stages. In contrast to the last years a relative high abundance of large larvae was found all the way from Lofoten to Møre (62°N), with few areas with densities above 1000 larvae m^{-2}. South of Stad (62 °N) few larvae were recorded. A higher proportion of larvae were found in the northern part of the investigated area, compared to what has been found the previous years. The reason for this can be strong advection from the central spawning areas, or that more of the spawning took place on the northern spawning grounds. The mean length of larvae was 13.51 mm, which are the longest larvae recorded in the middle of April since 1985. The relative high number of larvae in addition to the high mean length in the middle of April is a positive first step towards a strong 2002 year class. The estimated index is given in Table 3.3.5.1 and the geographical distribution of the larvae is given in Fig 3.3.5.1.

3.4 Tagging experiments

The annual tagging experiments were also carried out in March-April 2001. However, this year the herring left the coast immediately after spawning and were not available for the tagging crew. Thus, no herring were tagged during the three weeks cruise. Consequently, the tagging experiment will be carried out in the wintering areas in autumn 2002. This would imply tagging on maturing herring instead of spent herring. In this regard it should be mentioned that tagging experiments on captive herring carried out in 2000–2001 indicated that neither tagging mortality nor tag loss is significantly influenced by this shift of tagging season.

Recovery of tags from supervised detector plants has continued, as well as recovery from the standard magnets in the production line of fish processing plants and from individuals.

During the tagging process, the total length of each tagged herring is measured. For each purse seine catch that is used for tagging, a sample of 100 fish is taken to determine the age distribution within each length group. The age composition in this batch of tagged herring is then estimated from the age distribution in the sample.

If it is later found, from the age composition or other criteria, that a batch of tagged herring may have contained herring from one of the local stocks in the fjords, this batch is not used for stock assessment.

Recoveries are made from commercial catches and from tag detectors installed at fish processing factories.

For stock assessment purposes, tags are used only from supervised factories where detector efficiency has been tested, and where it is known that the detectors have been working as intended. Two factories met these criteria in 2001, and a total of 31.887 million herring were screened at these factories. Magnet efficiency in 2001 was 100% with few exceptions, in which the number of herring screened was reduced corresponding to the efficiency before being included in the total. The numbers of fish screened given in Table 3.4.1 are thus corrected for efficiency.

All tagged herring which were recovered were measured, weighed, and aged.

In 2001, 34 tags were recovered from the year classes 1983+, 1985, 1989, 1990, 1991, 1992, and 1994, that filled the criteria above (Table 3.4.1).

3.5 Stock Assessment

The assessment model SeaStar was used for assessing the Norwegian spring-spawning herring stock.

3.5.1 Model

SeaStar is described in Section 1.3.1. A more elaborate documentation of the model is available (Tjelmeland, WD). The model is written in Mathematica and the code can be viewed on the site www.assessment.iMrno.

3.5.2 Data

The year and age range, natural mortality and handling of missing data in the catch-at-age matrix were unchanged from last year.

The analysis was run for ages 0 to 15 with a 16+ group. M is set equal to 0.15 for ages 3 and older and 0.9 for ages 0 to 2 in all years. The proportion of F and M before spawning is set to 0.1, as has been the case earlier. In the 2001 assessment this proportion due to an error was 0.0. The weight-at-age in the stock was updated by copying the weight-at-age in the stock in the assessment year 2001. However, the weight-at-age in the stock in 1999 is the same as in 1998, and needs to be updated. The proportion mature at age was copied from last year, since there is no new data.

The catch-at-age, weight-at-age in the stock and in the catch and maturity ogive are given in Tables 3.5.2.1–3.5.2.4.

3.5.2.1 Survey data

The same surveys as used at previous WG meetings were used also this year (Tables 3.3.1.1, 3.3.2.1, 3.3.2.2, 3.3.3.1 and 3.3.4.1). The age groups included in the tuning are age 4 and older in the December survey and age 5 and older in the other surveys. During the 1998 meeting of this WG some points were perceived as outliers because of the noise they generated in the assessment and were consequently excluded from the analysis. These points have been excluded also in later meetings. Also, acoustic data earlier than 1991 were excluded in 1998 because the WG then felt that the different acoustic equipment before 1991 made the earlier points incompatible to those from 1991 and later years.

3.5.2.2 Tagging data

The same tagging data series as used last year were included in the likelihood function this year (Table 3.4.1). The first recoveries used were those obtained two years after release.

3.5.2.3 Larval indices

The two larval indices available for SeaStar are shown in Table 3.3.5.1. The numbers for 2000 were in error during the previous WG meeting and were corrected at the present meeting.

3.5.2.4 Weight-at-age in the stock in the assessment year

The weight-at-age at 1 January 2002 was taken as the unweighted mean of Norwegian samples from November and December for corresponding year classes, except for age 2 and 3 for which the mean weight of the corresponding year classes in the joint IMR-PINRO survey in the Barents Sea in September 2001 was used (Anon. 2001).

3.5.3 Implementation of survey data and tagging data in the assessment model

The survey structural relationship is unchanged from last year. Also this year only terminal F-values for the most abundant year classes were included among the free parameters to be estimated, and only these year classes (1983, 1990, 1991, 1992, and 1993) were included in the likelihood function. The year classes 1998 and 1999 were not recruited to the acoustic series used for tuning.

The assumption that the probability of tag return follows the Poisson distribution used last year was assumed also for this meeting.

3.5.4 Stock assessment

The parameters estimated in the run considered the most appropriate by the Working Group were:

- Catchability of the survey on the spawning grounds
- Catchability of the December survey in Lofoten
- Catchability of the January survey in Lofoten
- Catchability of the international survey in the Norwegian Sea
- Catchability of the larval survey index
- F in the last year of catch data for the 1983 year class not being in the plus-group (1998)
- F in the last year of catch data for the 1990 year class
- F in the last year of catch data for the 1991 year class
- F in the last year of catch data for the 1992 year class
- F in the last year of catch data for the 1993 year class
- Survival of tagged fish in the tagging year
- CV of the survey probability distributions
- CV of the larval survey index

Altogether 13 parameters were estimated. It should be noted that the herring is considered fully recruited to the acoustic survey series used. The catchabilities are therefore scalars, i.e., no dependence of the survey observation model on abundance or age is assumed.

The following exploratory runs were made:

Run 1: Settings unchanged from 2001

Run 2: With respect to Run 1 the tagging data for the 1986–1989 year classes were not grouped

Run 3: With respect to Run 1 the tagging data for the 1994 year class were included

Run 4: With respect to Run 1 a coarse correction for the aging problem of the old was attempted

Run 5: With respect to Run 1 the tags were left one year more in the sea (used 3 years after release)

Run 6: With respect to Run 1 the larval production index was included

Run 7: With respect to Run 3 the tagging data for the 1986–1989 year classes were not grouped

Run 8: With respect to Run 1 the larval production index was used instead of the larval index

Run 9: Only tags were used as independent information

Run 10: With respect to Run 1 the M-value was estimated

Run 11: With respect to Run 9 the M-value was estimated

These runs are summarized in Table 3.5.1. The spawning stocks shown are corrected for analysis of young fish by multiplying the ratio of corrected spawning stock to original spawning stock for Run 1 to all runs. Run 1 gives a spawning stock that is somewhat smaller than the spawning stock prognoses in 2002 at the 2001 WG meeting (5.5 million tonnes). However, all time-series used for tuning exhibit a downward trend, and the WG found no reason to discard this run in favour of any other run. The difference between runs is small and gives confidence in the robustness of the model. The catchability of the survey in the Norwegian Sea is close to 1, and this survey also gives the best fit to the VPA, as is seen in Figure 3.5.1.1 to 3.5.1.4. There is one notable exception to reasonable good fits when there are more than a couple of points. The 1991 year class in the wintering area December survey recruited to this survey rather late.

The surveys fitted as well as at the WG meeting 2001, as is seen from the log likelihood per term. The tags fitted better, and the larvae somewhat worse. Run 2 where the tag data for the 1986–1989 year classes are not treated as a group gave a notably better fit to the tag data.

In run 10 the M is estimated at 0.14, which is strikingly close to the M of 0.15 adopted by the Working Group

Run 4 where the older age groups were increased in an attempt to simulate the effect that more scales from older fish are discarded as basis for age-readings compared with scales from younger fish. (WD by Slotte) gave an estimate of SSB about 0.7 million tonnes higher than that of Run 1. This is an indication that this effect may become serious as the 1991 and 1992 year classes grow older, and the WG strongly recommends that measures are taken to deal with this problem in a statistically stringent way.

The Working Group adopted Run 1.

3.5.4.1 Retrospective analysis

A retrospective analysis was performed by setting the assessment year to 2002, 2001, 2000, 1999, 1998, and 1997 using the same settings as in Run 1. However, year classes younger than 5 years were deleted from the tuning. Figure 3.5.2 shows the retrospective plot. The spawning stocks shown in the figure have not been corrected for analysis of young fish. There is good agreement between assessments for the three last years. The stock as perceived by assessments in 1999 and 1998 is much higher. This is connected to unexpected increases in year class estimates in the surveys on the wintering and spawning areas these years (Tables 3.3.1.1, 3.3.2.1 and 3.3.2.2). The reason for these increases remains unclear. Such increases were not seen in the survey in the Norwegian Sea. The somewhat lower level of the estimate made in 1997 is because to the 1991 and 1992 year classes had not recruited to the survey indices by then.

3.5.4.2 Diagnostics

The probability distribution of the cumulative density function (CDF) is uniform between 0 and 1 if the assumptions made of the probability distribution of a measurement are met by the realised model. The CDF values from all measurements can thus be combined, and the relative number of CDF values smaller than, say, 0.1 should be 0.1. Figure 3.5.3 shows the number of CDF values smaller than the quantiles given on the X-axis for the survey and larvae terms in the likelihood. The points lie on a straight line showing that the assumptions made are well met by the realised model. This diagnostic is appropriate only for continuous distributions, however, so the Poisson distribution used for the tag returns cannot be tested in the same way.

Figure 3.5.4 shows the log-likelihood function as a function of one parameter at a time varied 50% to each side of the maximum likelihood estimate. As in previous years the likelihood is skewed.

Figure 3.5.5.1 shows a histogram of the new spawning stock estimates (uncorrected for young fish) obtained by deleting terms from the surveys one by one, by deleting terms from the tag return data one by one (Figure 3.5.5.2), and by deleting terms from the larval data one by one (Figure 3.5.5.3). Except for a couple of points the spawning stock estimate is not much affected by removing individual terms from tagging. This is also the case for the larvae terms. The survey points, however, may influence the spawning stock estimate quite considerably. The survey points that affect the spawning stock estimate the most should be evaluated, preferably together with an evaluation of survey points that the WG has earlier considered as outliers and consequently removed from the analysis.

3.5.4.3 Assessment using ISVPA

Because the Norwegian spring-spawning herring fishery is known to have a strongly variable selection pattern, only the catch-controlled and mixed versions of the ISVPA were applied. The range of data was restricted to 1986–2001 to describe only the recent state of fishery. The ages used in the ISVPA runs were 2–16+. The 0 and 1 age groups, which have not occurred in the catches during the last 7 years, were excluded from the analysis. The ISVPA model is described in Section 1.3.6.

Using SSE as ISVPA loss function revealed no minima, while use of a more robust loss function, the median of squared residuals in log-scaled catches, was successful for both versions of the model, and for the latter version the minimum was more profound (Figure 3.5.6).

The estimates of SSB, TSB, recruitment at age 2, and F(2–13) from the two versions of ISVPA, are presented in Figure 3.5.7 and Table 3.5.2. Abundance estimates and tables of residuals for the catch control versions are presented in Tables 3.5.3a and Table 3.5.3.b, respectively. Abundance estimates and tables of residuals for the mixed version are presented in Tables 3.5.4a and Table 3.5.4b, respectively. Table 3.5.4c represents the final weights of the catch-controlled routine in the mixed version of ISVPA by points. As it can be seen, in this version of the model the estimates of older ages are mostly based on the catch-controlled routine, while the weights of catch-controlled and effort-controlled routines become almost equal to each other for younger age groups.

Both versions of ISVPA indicate that the decrease in SSB which started in 1997 has finished. In 2001 the SSB value (6.7–7.6 million tonnes on 1 of January) is somewhat higher than in 2000 (6.6–7.2 million tonnes). The value of F(2–13) in 2001 is estimated as 0.119 and 0.106 for the catch-controlled and mixed versions of ISVPA, respectively.

3.5.5 Analysis of young fish not in the tuning

The youngest year class in the tuning is the 1993 year class. Younger year classes are assessed using information from the 0-group surveys in the Barents Sea and acoustic surveys in the Barents Sea. At the WG meeting 2001 the one- and two-year-old herring in the May/June surveys in the Barents Sea were used. These surveys were conducted in the period 1984 to 1995 by Norway and in 1996–1997 as a joint Russian-Norwegian survey. From 1998 this survey has been conducted by Russia only, because Norwegian vessels have not been permitted to enter the Russian EEZ. In order to bring in more information and because of the conflicting evidence about the 1999 year class from these surveys, acoustic estimates of herring from the joint Russian-Norwegian surveys in September (Table 3.3.4.4) were included as auxiliary information on the 1998 and 1999 year classes at the present WG meeting. Also at the present WG meeting the one- and two-year-old herring from the estimates in the Barents Sea were used. The method used is described in Section 1.3.1. Figure 3.5.8 shows the resulting percentiles of the younger year classes. Table 3.6.2.1 gives the median of the youngest year classes that are used as input data for the short-term prognosis.

3.5.6 The final VPA

The final VPA was run using the values of the terminal F from the WG’s best estimate (Run 1, Section 3.5.4). The results from the VPA are presented thus:

Fishing mortality:	Table 3.5.6.1
Stock numbers:	Table 3.5.6.2
Stock biomass at age:	Table 3.5.6.3
Spawning stock biomass:	Table 3.5.6.4
Summary:	Table 3.5.6.5 and Figure 3.5.9
Summary of fishing mortality:	Table 3.5.6.6

Following the advice given by ACFM at its November 1995 meeting, it was decided to use F5–14 weighted by the population number as the reference F for this stock. The $F_{5-14,W}$ is given in the summary table of fishing mortalities (Table 3.5.6.6).

Toresen and Østvedt (2000) made a long-term VPA run back to 1907. The WG this year included the biological information from that run in its database, thus giving a VPA run of 95 years in the present report (Tables 3.5.6.1–3.5.6.6 and Figure 3.5.9).

There was not time at the meeting for an extensive discussion of the results. The long period includes changes in spawning areas, time of spawning, and environment. These changes should be discussed in detail before being utilized further in the assessment, and the Working Group has therefore at present not included information on stock and recruitment from the period 1907–1949 in the stock/recruitment relationship used in the medium-term. Furthermore, possible differences between the WG long-term VPA and the VPA given in Toresen and Østvedt (2000) have not been discussed.

3.5.7 Yield-per-recruit analysis

The yield-per-recruit *vs* F is plotted in Figure 3.5.9.

3.6 Short-term predictions

3.6.1 Input data to the short-term prediction

The number-at-age at January 1, 2002, was taken from the final VPA for the year classes 1996 and older. The numbers-at-age for the 1997–2001 year classes were taken from median values from the results from the SeaStar bootstrap replicates of year classes not included in the likelihood (Figure 3.5.8). The 1993 year class is the oldest in the likelihood and an alternative is to use year classes 1994 and younger from the bootstrap replicates. However, the 1994–1996 year classes have been several years in the fishery and the WG felt that the results from the VPA gave a better fit to the relative year class strengths. The VPA results for the year classes 1994–1996 were used.

The weight-at-age in the stock in 2002 was set equal to the weight-at-age obtained from biological samples taken during November-December 2001. This weight-at-age in the stock was also used for 2003 and 2004. The weight in catch for the period 2002–2004 is set equal to the average for the years 1999–2001. The maturity-at-age for 2002 is set equal to that estimated for 2001. For 2003 and 2004 the maturity-at-age was set to 0.1 for 3 years old, 0.5 for 4 years old, 0.9 for 5 years old, and 1.0 for older years, reflecting an expected earlier maturation of the 1999 year class. The natural mortality was set to the same values as used in the assessment, i.e., 0.15 on ages 3 and older. The exploitation pattern was the same as the last years (Table 3.6.1.1). No deterministic estimates of year classes 2002–2005, thus the input for these year classes was set to zero. Thus the estimate of the total stock in the short term will be an underestimate.

3.6.2 Results of the short-term prediction

The short-term prediction was made with the use of the MFDP-program, and in the following discussions unweighted fishing mortalities are considered. The results of the short term prediction are given in Table 3.6.2.1, which also includes the input data on stock numbers and weight-at-age in 2002.

The international agreed TAC of 850 000 t will generate a fishing mortality of approximately 0.18 in 2002. The resulting spawning stock in 2003 will be approximately 6 million t. That is an increase compared to 2002, due to the recruitment of the 1998 and 1999 year classes to the spawning stock. The international agreed maximum fishing mortality of 0.125 will in 2003 generate a catch of 593 000 t. This catch will result in a spawning stock in 2004 of approximately the same size (6 million t) as in 2003. This is 1 million t above the agreed $\mathbf{B}_{pa}$ level. A catch of 850 000 tonnes in 2003 (same level as agreed TAC for 2002) will generate a fishing mortality in 2003 of approximately 0.18 and a resulting spawning biomass in 2004 of 5.8 million tonnes.

3.7 Assessment of uncertainty

The assessment of uncertainty was based on bootstrapping where the input data are resampled from the assumed distributions, as explained in Section 1.3.1. The resulting file of assessment replicates is the basis for the medium-term projections. Figure 3.7.1 shows the histogram of the spawning stock in 2002 from 492 bootstrap replicates. The distribution is somewhat skewed and the mean value is 0.11 million tonnes larger than the baseline value, which is a smaller deviation than seen at the 2001 assessment. The median is 0.04 million tonnes smaller than the baseline value. The standard deviation is 1.0 million tones, which is the same as obtained at the 2001 assessment.

3.8 Long-Term Management Plan and Precautionary Reference Points

At the meeting in Tórshavn in October 1999 (Section 3.1.1), the coastal states (European Union, Faroe Islands, Iceland, Norway, and Russia) agreed to implement a long-term management plan for Norwegian spring-spawning herring. At the coastal meeting in Harstad in October 2001 the coastal states agreed to extend the plan to include a recovery plan in case the SSB falls below $\mathbf{B}_{pa}$. The agreed long-term management plan now consists of the following elements:

1) Every effort shall be made to maintain a level of Spawning Stock Biomass (SSB) greater than the critical level ($\mathbf{B}_{lim}$) of 2 500 000 tonnes.
2) For the year 2001 and subsequent years, the Parties agreed to restrict their fishing on the basis of a TAC consistent with a fishing mortality rate of less than 0.125 for appropriate age groups as defined by ICES, unless future scientific advice requires modification of this fishing mortality rate.
3) Should the SSB fall below a reference point of 5 000 000 tonnes ($\mathbf{B}_{pa}$), the fishing mortality rate, referred under paragraph 2, shall be adapted in the light of scientific estimates of the conditions then prevailing to ensure a safe and rapid recovery of the SSB to a level in excess of 5 000 000 tonnes. The basis for such adaptation should be at least a linear reduction in the biomass mortality rate from 0.125 at $\mathbf{B}_{pa}$ (5 000 000) to 0.05 at $\mathbf{B}_{lim}$ (2 500 000 tonnes).
4) The Parties shall, as appropriate, review and revise these management measures and strategies on the basis of any new advice provided by ICES.

The WGNPBW has in accordance with the agreed long-term management plan used the following values in the reference run in the medium-term simulations.

$\mathbf{B}_{pa}$ = 5.0 million tonnes
$\mathbf{B}_{lim}$ = 2.5 million tonnes
Fishing mortality (F) above $\mathbf{B}_{pa}$ = 0.125
Linear reduction in F from 0.125 at SSB=5 000 000 tonnes to 0.05 at SSB=2 500 000 tonnes

3.9 Harvest control rule

3.9.1 Evaluation of adaptive recovering strategies in the event SSB falls below $\mathbf{B}_{pa}$

An extensive evaluation of different adaptive recovery strategies is given in the WG Report for 2001. On the basis of this ACFM suggested that the use of a recovery strategy, including linear decrease in fishing mortality from $\mathbf{B}_{pa}$ to 0.05 at $\mathbf{B}_{lim}$, could be suitable for this stock.

At the coastal states meeting in Harstad in October 2001 the management agency decided to incorporate this type of recovery strategy in the long-term management plan for this stock.

The issue on recovery strategies is therefore not further elaborated in this years report. The agreed recovery strategy is applied in the present medium-term considerations (Section 3.10).

3.10 Medium-term projections

The WG run for the medium-term predation followed the same options as last year. The medium-term projections were done with the SeaStar model, which is described in Section 3.1.1. For each simulation one historic assessment was selected at random. Based on the selected historic assessment regressions of young fish were performed. Numbers-at-age for young fish were then selected at random. This procedure ensures proper correlation properties between age groups in the initial stock. Thereafter the parameters in the recruitment model were estimated and the simulation carried out.

The Beverton-Holt recruitment model was used also this year. The largest year classes were treated separately, as described in Section 1.3.1. A ceiling of 1000 billion 0-group fish was enforced, as was done at the 2001 WG meeting. Figure 3.10.1 shows the recruitment points labelled with recruitment year and the estimated Beverton-Holt function, which appears rather linear below a spawning stock of 15 million tonnes. The highest recruitment points are plotted in red. When the spawning stock has been below 1.0 million tonnes the recruitment has invariably been poor, with exception of the 1983 year class. It is also interesting to note periods of similar recruitment for spawning stocks of similar magnitude.

The projections started at January 1 2002 and the allocated catch of 0.85 million tonnes for 2002 was implemented by solving for F. The F-value by age applied during the simulation is the F-value in the harvest control rule multiplied by the exploitation pattern given in Table 3.6.1.1 and divided by the population weighted average over ages 5–14 of these numbers. Assumptions about weight-at-age, exploitation pattern, proportion mature at age, and weight-at-age in the catch are the same as those used for the short-term prediction, see Section 3.6. From 2005 the weight-at-age in the stock is the average over the last ten years and the proportion mature by age is the same as assumed for 2002.

A summary of the medium-term simulations are given in Table 3.10.1. The medium-term simulations give a more negative picture of the stock in the medium term compared to the medium-term simulation given in the last report. The main reason for this is the high estimate (more than 100 billion individuals) of the 1999 year class obtained in the acoustic surveys in the Barents Sea in May 2000 (Table 3.3.4.1) which had a main impact on the medium-term simulations carried out in 2001. However, the high estimate of the 1999 year class has not been confirmed during the investigations carried out in 2001 (Tables 3.3.4.1 and 3.3.4.4). The input estimate of this year class in the medium term this year is therefore considerably lower.

Figures 3.10.2 and 3.10.3 show the development of SSB and yield for F=0.125 above $\mathbf{B}_{pa}$ =5.0 million t with a linear reduction to F=0.05 at $\mathbf{B}_{lim}$= 2.5 million t and a catch ceiling of 1.5 million t. 5, 25, 50, 75, and 95 percentiles are given to illustrate the uncertainty in the prognosis.

According to the medium-term simulations the following conclusions may be drawn:

1) Continued fishing at F=0.125 (international agreed maximum fishing mortality) and a reduction in F below $\mathbf{B}_{pa}$ as in the pre-agreed recovery plan, and with a catch ceiling of 1.5 million t, gives a low probability of the stock falling below $\mathbf{B}_{lim}$ in the medium term (5 and 10 years). This harvesting strategy results in a 15% average annual change in the TAC.
2) There is, however, a probability of about 50% of the spawning stock falling below $\mathbf{B}_{pa}$
3) There are no signals in the medium-term simulations that indicate that the present agreed long time strategy and recovery plan for this stock is not in accordance with the precautionary approach in fisheries.

The text table below gives the option and the technical performance values:

Parameter	**Options**	**Technical performance values**
Fishing mortality for SSB above $\mathbf{B}_{pa}$	0.0, 0.05, 0.08, 0.10, 0.125, 0.15, 0.2	As options
Catch ceiling	None	1.5 million t. One run with catch ceiling of 850 000 t, the level of the TAC for 2001 and 2002.
Value of $\mathbf{B}_{pa}$	5.0 million t	As option
Value of $\mathbf{B}_{lim}$	2.5 million t	As option
Time range	5 and 10 years	As option
Fishing mortality for F below $\mathbf{B}_{pa}$		Linear decrease in F from 0.125 at $\mathbf{B}_{pa}$ to 0.05 at $\mathbf{B}_{lim}$ in accordance with long-term management plan (Section 3.8) (similar decreases were also made with other requested F's (0.05, 0.08, 0.10, 0.15, 0.2)).
Measure of stability of catches	average percentage change in catches from year-to-year	As option
Yield	average catches over the same ten year period	Average annual yield (tonnes) of the time range for the simulation run (5 or 10 years).
Risk	Probability that SSB will fall below $\mathbf{B}_{pa}$ and $\mathbf{B}_{lim}$ in a 5 and 10 year period	Risk to fall below $\mathbf{B}_{pa}$ and $\mathbf{B}_{lim}$ within the time range for the simulation run (5 or 10 years).

3.11 Management considerations

The immatures and adults of this stock form a central part of the ecosystem in the Barents Sea and Norwegian Sea, respectively. The herring has an important role as a transformer of the production of zooplankton biomass and energy to a form that is available to organisms at a higher level of the food chain.

The Coastal states European Union, Faroe Islands, Iceland, Norway, and Russia have agreed on a long-term management plan, including a maximum fishing mortality of 0.125, and on a precautionary reference point ($\mathbf{B}_{pa}$ = 5.0 million t) and limit reference point ($\mathbf{B}_{lim}$ = 2.5 million t) for this stock. The limit reference point (2.5 million t) is seen as a spawning stock threshold that, if crossed, can result in a high probability of impaired recruitment, and the $\mathbf{B}_{pa}$ as a safeguard measure. In 2001 the coastal states incorporated a pre-agreed recovery strategy to the long time management plan, the main element being a reduction of fishing mortality from 0.125 at $\mathbf{B}_{pa}$ (5.0 million t) to 0.05 at $\mathbf{B}_{lim}$ (2.5 million t).

The current stock assessment indicates a spawning stock of approximately 5 million t in 2002, the spawning stock abundance having declined from more than 8 million t in 1997. The future prospects indicate, if exploited at the agreed level (maximum fishing mortality of 0.125), an increasing spawning stock to approximately 6 million t in 2003–2004 due to the recruitment of the 1998 and 1999 year classes. However, a new decline in the spawning stock is expected when the weak year classes 2000 and 2001 recruit to the spawning stock from 2005.

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

Year	A	B[1]	C	D	Total	Total catch used in WG
1972	-	9895	3,266[2]	-	13,161	13,161
1973	139	6,602	276	-	7,017	7,017
1974	906	6,093	620	-	7,619	7,619
1975	53	3,372	288	-	3,713	13,713
1976	-	247	189	-	436	10,436
1977	374	11,834	498	-	12,706	22,706
1978	484	9,151	189	-	9,824	19,824
1979	691	1,866	307	-	2,864	12,864
1980	878	7,634	65	-	8,577	18,577
1981	844	7,814	78	-	8,736	13,736
1982	983	10,447	225	-	11,655	16,655
1983	3,857	13,290	907	-	18,054	23,054
1984	18,730	29,463	339	-	48,532	53,532
1985	29,363	37,187	197	4,300	71,047	169,872
1986	71,122[3]	55,507	156	-	126,785	225,256
1987	62,910	49,798	181	-	112,899	127,306
1988	78,592	46,582	127	-	125,301	135,301
1989	52,003	41,770	57	-	93,830	103,830
1990	48,633	29,770	8	-	78,411	86,411
1991	48,353	31,280	50	-	79,683	84,683
1992	43,688	55,737	23	-	99,448	104,448
1993	117,195	110,212	50	-	227,457	232,457
1994	288,581	190,643	4	-	479,228	479,228
1995	320,731	581,495	0	-	902,226	902,226
1996	462,248	758,035	0	-	1,220,283	1,220,283
1997[5]			0	-	1,426,507	1,426,507
1998[5]			0	-	1,223,131	1,223,131
1999[6]			0	-	1,235,433	1,235,433
2000[7]			0	-	1,207,201	1,207,201
2001[8]			0	-	770,066	770,066

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

[1] Includes also by-catches of adult herring in other fisheries
[2] In 1972, there was also a directed herring 0-group fishery
[3] Includes 26,000 t of immature herring (1983 year class) fished by USSR in the Barents Sea
[4] Preliminary, as provided by Working Group members
[5] Details of catches by fishery and ICES area given in ICES 1999
[6] Details of catches by fishery and ICES area given in ICES 2000
[7] Details of catches by fishery and ICES area given in ICES 2001
[8] Details of catches by fishery and ICES area given in Tables 3.2.3-3.2.5

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

Data provided by Working Group members.

Year	Norway	USSR/ Russia	Denmark	Faroes	Iceland	Ireland	Nether- lands	Greenland	UK	Germany	France	Sweden	Total
1972	13,161	-	-	-	-	-	-	-	-	-	-	-	13,161
1973	7,017	-	-	-	-	-	-	-	-	-	-	-	7,017
1974	7,619	-	-	-	-	-	-	-	-	-	-	-	7,619
1975	13,713	-	-	-	-	-	-	-	-	-	-	-	13,713
1976	10,436	-	-	-	-	-	-	-	-	-	-	-	10,436
1977	22,706	-	-	-	-	-	-	-	-	-	-	-	22,706
1978	19,824	-	-	-	-	-	-	-	-	-	-	-	19,824
1979	12,864	-	-	-	-	-	-	-	-	-	-	-	12,864
1980	18,577	-	-	-	-	-	-	-	-	-	-	-	18,577
1981	13,736	-	-	-	-	-	-	-	-	-	-	-	13,736
1982	16,655	-	-	-	-	-	-	-	-	-	-	-	16,655
1983	23,054	-	-	-	-	-	-	-	-	-	-	-	23,054
1984	53,532	-	-	-	-	-	-	-	-	-	-	-	53,532
1985	167,272	2,600	-	-	-	-	-	-	-	-	-	-	169,872
1986	199,256	26,000	-	-	-	-	-	-	-	-	-	-	225,256
1987	108,417	18,889	-	-	-	-	-	-	-	-	-	-	127,306
1988	115,076	20,225	-	-	-	-	-	-	-	-	-	-	135,301
1989	88,707	15,123	-	-	-	-	-	-	-	-	-	-	103,830
1990	74,604	11,807	-	-	-	-	-	-	-	-	-	-	86,411
1991	73,683	11,000	-	-	-	-	-	-	-	-	-	-	84,683
1992	91,111	13,337	-	-	-	-	-	-	-	-	-	-	104,448
1993	199,771	32,645	-	-	-	-	-	-	-	-	-	-	232,457
1994	380,771	74,400	-	2,911	21,146	-	-	-	-	-	-	-	479,228
1995	529,838	101,987	30,577	57,084	174,109	-	7,969	2,500	881	556	-	-	905,501
1996	699,161	119,290	60,681	52,788	164,957	19,541	19,664	-	46,131	11,978	-	22,424	1,220,283
1997	860,963	168,900	44,292	59,987	220,154	11,179	8,694	-	25,149	6,190	1,500	19,499	1,426,507
1998	743,925	124,049	35,519	68,136	197,789	2,437	12,827	-	15,971	7,003	605	14,863	1,223,131
1999	740,640	157,328	37,010	55,527	203,381	2,412	5,871	-	19,207	-	-	14,057	1,235,433
2000	713,500	163,261	34,968	68,625	186,035	8,939	-	-	14,096	3,298	-	14,749	1,207,201
2001[1]	495,036	109,054	24,038	34,170	77,693	-	6,439	-	12,230	1,588	-	9,818	770,066

[1] Preliminary, as provided by Working Group members.

Table 3.2.3. Catch-at-age by country.

Record No	Country	Quarter	Area	Sampled Catch	WG Catch	No. of samples	No. fish aged	No. fish measured	CN 0	CN 1	CN 2	CN 3	CN 4	CN 5	CN 6	CN 7	CN 8	CN 9	CN 10	CN 11	CN 12	CN 13	CN 14	CN 15+
Norwegian		0	15	2001																				
1	Norway	1	IIa	184778	184778	43	2468	4370	0	0	490	11165	44332	158964	4843	21029	65685	236630	98547	21001	4355	0	709	3132
2	Norway	2	IIa	665	665	12	560	560	0	0	0	35	138	236	30	43	465	800	214	31	103	0	0	48
3	Norway	3	IIa	49531	49531	26	1259	3335	0	0	214	9453	11328	23555	1849	5861	14349	46202	34772	4374	986	175	60	1345
4	Norway	4	IIa	257251	257251	54	2801	6579	0	0	1160	51138	61280	127428	10005	30626	77626	249940	188108	23665	5336	949	324	7277
5	Norway	1	IVa	0	2790	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	Norway	2	IVa	0	64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7	Norway	3	IVa	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	Norway	4	IVa	0	54	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	Russia	1	IIa	27474	27474	137	697	27482	0	0	0	6305	9366	23622	1402	1460	11382	34549	13201	2296	276	958	590	594
10	Russia	2	IIa	0	14765	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Russia	3	IIa	62444	62444	120	973	24103	0	0	0	7006	6287	19035	2031	7346	19235	62329	46868	5510	1356	236	145	3300
12	Russia	3	IIb	0	4371	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Denmark	1	IIa	8497	8497	3	387	387	0	0	0	439	1931	19130	6625	4432	7064	2501	1272	219	219	0	0	0
14	Denmark	2	IIa	0	11324	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Denmark	3	IIa	0	4217	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	Iceland	2	IIa	64366	64366	22	975	1023	0	0	0	227	2274	4237	7110	11180	39816	69247	62574	7911	2477	969	1382	969
17	Iceland	3	IIa	0	8229	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	Iceland	2	IIb	678	678	3	142	150	0	0	0	0	0	16	31	220	408	659	737	94	31	31	0	0
19	Iceland	3	IIb		4408	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	Sweden	2	IIa	0	9743	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	Sweden	2	IIb	0	75	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	Germany	1	IIa	1658	1658	3	497	498	0	0	0	24	78	577	71	575	2265	2066	0	0	0	0	0	0
23	Germany	2	IIa	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	UK(Scot)	1	IIa	0	7793	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	UK(Scot)	2	IIa	0	1062	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	UK(Scot)	3	IIa	0	3045	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	UK(Scot)	4	IIa	0	340	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	Faroes	1	IIa	0	5690	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	Faroes	2	IIa	0	16152	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	Faroes	3	IIa	0	11356	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	Faroes	4	IIa	0	972	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	Netherlands	2	IIa	3469	3469	6	160	571	0	0	0	4027	175	175	263	1751	2539	4114	0	0	0	0	0	0
33	Netherlands	3	IIa	2980	2980	13	325	947	0	0	28	681	624	369	142	851	2270	4257	0	0	0	0	0	0
-1																								

Table 3.2.4. Weight (kg) at age by country.

Record No	Country	Quarter	Area	Sampled Catch	WG Catch	No. of samples	No. fish aged	No. fish measured	CW 0	CW 1	CW 2	CW 3	CW 4	CW 5	CW 6	CW 7	CW 8	CW 9	CW 10	CW 11	CW 12	CW 13	CW 14	CW 15+
Norwegian	0	15	2001																					
1	Norway	1	IIa	184778	184778	43	2468	4370	0.000	0.000	0.087	0.135	0.178	0.235	0.255	0.293	0.295	0.308	0.322	0.345	0.262	0.000	0.435	0.421
2	Norway	2	IIa	666	666	12	660	660	0.000	0.000	0.089	0.139	0.177	0.236	0.241	0.296	0.295	0.306	0.316	0.336	0.342	0.000	0.000	0.393
3	Norway	3	IIa	49631	49631	26	1269	3335	0.000	0.000	0.081	0.169	0.242	0.287	0.335	0.333	0.338	0.346	0.354	0.390	0.402	0.367	0.367	0.437
4	Norway	4	IIa	257251	257251	54	2801	6579	0.000	0.000	0.120	0.177	0.242	0.276	0.302	0.311	0.314	0.329	0.342	0.374	0.406	0.416	0.467	0.421
5	Norway	1	IVa	0	2790	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	Norway	2	IVa	0	64	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
7	Norway	3	IVa	0	13	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	Norway	4	IVa	0	54	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
9	Russia	1	IIa	27474	27474	137	697	27482	0.000	0.000	0.000	0.122	0.176	0.214	0.235	0.301	0.280	0.299	0.308	0.335	0.398	0.344	0.372	0.370
10	Russia	2	IIa	0	14765	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
11	Russia	3	IIa	62444	62444	120	973	24103	0.000	0.000	0.000	0.187	0.273	0.296	0.358	0.360	0.367	0.365	0.367	0.417	0.412	0.457	0.462	0.480
12	Russia	3	IIb	0	4371	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
13	Denmark	1	IIa	8497	8497	3	387	387	0.000	0.000	0.000	0.145	0.138	0.168	0.179	0.207	0.236	0.266	0.279	0.256	0.372	0.000	0.000	0.000
14	Denmark	2	IIa	0	11324	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
15	Denmark	3	IIa	0	4217	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
16	Iceland	2	IIa	64366	64366	22	976	1023	0.000	0.000	0.000	0.177	0.180	0.254	0.266	0.291	0.299	0.306	0.317	0.331	0.366	0.354	0.372	0.393
17	Iceland	3	IIa	0	6229	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
18	Iceland	2	IIb	678	678	3	142	150	0.000	0.000	0.000	0.000	0.000	0.233	0.271	0.297	0.296	0.301	0.308	0.344	0.359	0.373	0.000	0.000
19	Iceland	3	IIb		4408	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
20	Sweden	2	IIa	0	9743	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
21	Sweden	2	IIb	0	75	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
22	Germany	1	IIa	1558	1558	3	497	498	0.000	0.000	0.000	0.148	0.188	0.217	0.275	0.272	0.274	0.292	0.000	0.000	0.000	0.000	0.000	0.000
23	Germany	2	IIa	0	30	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
24	UK(Scot)	1	IIa	0	7793	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
25	UK(Scot)	2	IIa	0	1062	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
26	UK(Scot)	3	IIa	0	3045	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
27	UK(Scot)	4	IIa	0	340	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
28	Faroes	1	IIa	0	5690	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
29	Faroes	2	IIa	0	16152	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
30	Faroes	3	IIa	0	11356	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
31	Faroes	4	IIa	0	972	0	0	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
32	Netherland	2	IIa	3459	3459	6	150	671	0.000	0.000	0.000	0.146	0.223	0.223	0.267	0.310	0.307	0.334	0.000	0.000	0.000	0.000	0.000	0.000
33	Netherland	3	IIa	2980	2980	13	325	947	0.000	0.000	0.112	0.183	0.227	0.260	0.293	0.325	0.340	0.360	0.000	0.000	0.000	0.000	0.000	0.000
-1																								

Table 3.2.5

Summary of Sampling by Country

AREA : IVa

Country	Sampled Catch	Working Catch	No. of samples	No. measured	No. aged	SOP %
Norway	0.00	2921.00	0	0	0	0.00
Total IVa	0.00	2921.00	0	0	0	0.00

Unallocated Catch : 0.00
Working Group Catch : 2921.00

AREA : IIb

Country	Sampled Catch	Working Catch	No. of samples	No. measured	No. aged	SOP %
Sweden	0.00	75.00	0	0	0	0.00
Russia	0.00	4371.00	0	0	0	0.00
Iceland	678.00	5086.00	3	150	142	100.09
Total IIb	678.00	9532.00	3	150	142	100.09

Unallocated Catch : 0.00
Working Group Catch : 9532.00

AREA : IIa

Country	Sampled Catch	Working Catch	No. of samples	No. measured	No. aged	SOP %
UK(Scot)	0.00	12230.00	0	0	0	0.00
Sweden	0.00	9743.00	0	0	0	0.00
Russia	89918.00	104683.00	257	51585	1670	101.05
Norway	492115.00	492115.00	135	14844	7088	100.63
Netherlands	6439.00	6439.00	19	1518	475	99.79
Iceland	64366.00	72595.00	22	1023	975	100.00
Germany	1558.00	1588.00	3	498	497	99.05
Faroes	0.00	34170.00	0	0	0	0.00
Denmark	8497.00	24038.00	3	387	387	99.71
Total IIa	662893.00	757601.00	439	69855	11092	100.60

Unallocated Catch : 0.00
Working Group Catch : 757601.00

PERIOD : 1

Country	Sampled Catch	Working Catch	No. of samples	No. measured	No. aged	SOP %
UK(Scot)	0.00	7793.00	0	0	0	0.00
Russia	27474.00	27474.00	137	27482	697	99.99
Norway	184778.00	187568.00	43	4370	2468	101.60
Germany	1558.00	1558.00	3	498	497	99.05
Faroes	0.00	5690.00	0	0	0	0.00
Denmark	8497.00	8497.00	3	387	387	99.71
Period Total	222307.00	238580.00	186	32737	4049	101.31

Unallocated Catch : 0.00
Working Group Catch : 238580.00

PERIOD : 2

Country	Sampled Catch	Working Catch	No. of samples	No. measured	No. aged	SOP %
UK(Scot)	0.00	1052.00	0	0	0	0.00
Sweden	0.00	9818.00	0	0	0	0.00
Russia	0.00	14765.00	0	0	0	0.00
Norway	555.00	619.00	12	560	560	111.50
Netherlands	3459.00	3459.00	6	571	150	99.39
Iceland	65044.00	65044.00	25	1173	1117	100.00
Germany	0.00	30.00	0	0	0	0.00
Faroes	0.00	16152.00	0	0	0	0.00
Denmark	0.00	11324.00	0	0	0	0.00
Period Total	69058.00	122263.00	43	2304	1827	100.06

Unallocated Catch : 0.00
Working Group Catch : 122263.00

PERIOD : 3

Country	Sampled Catch	Working Catch	No. of samples	No. measured	No. aged	SOP %
UK(Scot)	0.00	3045.00	0	0	0	0.00
Russia	62444.00	66815.00	120	24103	973	101.52
Norway	49531.00	49544.00	26	3335	1259	100.02
Netherlands	2980.00	2980.00	13	947	325	100.26
Iceland	0.00	12637.00	0	0	0	0.00
Faroes	0.00	11356.00	0	0	0	0.00
Denmark	0.00	4217.00	0	0	0	0.00
Period Total	114955.00	150594.00	159	28385	2557	100.84

Unallocated Catch : 0.00
Working Group Catch : 150594.00

PERIOD : 4

Country	Sampled Catch	Working Catch	No. of samples	No. measured	No. aged	SOP %
UK(Scot)	0.00	340.00	0	0	0	0.00
Norway	257251.00	257305.00	54	6579	2801	100.02
Faroes	0.00	972.00	0	0	0	0.00
Period Total	257251.00	258617.00	54	6579	2801	100.02

Unallocated Catch : 0.00
Working Group Catch : 258617.00

Total over all Areas and Periods

Country	Sampled Catch	Working Catch	No. of samples	No. measured	No. aged	SOP %
UK(Scot)	0.00	12230.00	0	0	0	0.00
Sweden	0.00	9818.00	0	0	0	0.00
Russia	89918.00	109054.00	257	51585	1670	101.05
Norway	492115.00	495036.00	135	14844	7088	100.63
Netherlands	6439.00	6439.00	19	1518	475	99.79
Iceland	65044.00	77681.00	25	1173	1117	100.00
Germany	1558.00	1588.00	3	498	497	99.05
Faroes	0.00	34170.00	0	0	0	0.00
Denmark	8497.00	24038.00	3	387	387	99.71
Total for Stock	663571.00	770054.00	442	70005	11234	100.60

Unallocated Catch : 0.00
Working Group Catch : 770054.00

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DETAILS OF DATA FILLING-IN
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  Filling-in for record : (  5)   Norway                 1 IVa
Using Only
  >>  (  1)  Norway                 1 IIa

  Filling-in for record : (  6)   Norway                 2 IVa
Using Only
  >>  (  2)  Norway                 2 IIa

  Filling-in for record : (  7)   Norway                 3 IVa
Using Only
  >>  (  3)  Norway                 3 IIa

  Filling-in for record : (  8)   Norway                 4 IVa
Using Only
  >>  (  4)  Norway                 4 IIa

  Filling-in for record : ( 10)   Russia                 2 IIa
Using Only
  >>  ( 11)  Russia                 3 IIa

  Filling-in for record : ( 12)   Russia                 3 IIb
Using Only
  >>  ( 11)  Russia                 3 IIa

  Filling-in for record : ( 14)   Denmark                2 IIa
Using Only
  >>  (  2)  Norway                 2 IIa

  Filling-in for record : ( 15)   Denmark                3 IIa
Using Only
  >>  (  3)  Norway                 3 IIa

  Filling-in for record : ( 17)   Iceland                3 IIa
Using Only
  >>  (  3)  Norway                 3 IIa

  Filling-in for record : ( 19)   Iceland                3 IIb
Using Only
  >>  (  3)  Norway                 3 IIa

  Filling-in for record : ( 20)   Sweden                 2 IIa
Using Only
  >>  (  2)  Norway                 2 IIa

  Filling-in for record : ( 21)   Sweden                 2 IIb
Using Only
  >>  (  2)  Norway                 2 IIa

  Filling-in for record : ( 23)   Germany                2 IIa
Using Only
  >>  (  2)  Norway                 2 IIa

  Filling-in for record : ( 24)   UK(Scot)               1 IIa
Using Only
  >>  (  1)  Norway                 1 IIa

  Filling-in for record : ( 25)   UK(Scot)               2 IIa
Using Only
  >>  (  2)  Norway                 2 IIa

  Filling-in for record : ( 26)   UK(Scot)               3 IIa
Using Only
  >>  (  3)  Norway                 3 IIa

  Filling-in for record : ( 27)   UK(Scot)               4 IIa
Using Only
  >>  (  4)  Norway                 4 IIa

  Filling-in for record : ( 28)   Faroes                 1 IIa
Using Only
  >>  (  1)  Norway                 1 IIa

  Filling-in for record : ( 29)   Faroes                 2 IIa
Using Only
  >>  (  2)  Norway                 2 IIa

  Filling-in for record : ( 30)   Faroes                 3 IIa
```

```
Using Only
  >>  (  3)  Norway                3 IIa

  Filling-in for record : ( 31)   Faroes                 4 IIa
Using Only
  >>  (  4)  Norway                4 IIa
```

Catch Numbers at Age by Area

Ages	IVa	IIb	IIa	Total
0	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00
2	7.70	19.04	2049.66	2076.41
3	185.83	1336.41	100771.22	102293.46
4	701.13	1466.86	158510.50	160678.50
5	2430.06	3476.45	420916.06	426822.59
6	79.17	341.77	38328.17	38749.12
7	330.39	1243.82	94417.49	95991.70
8	1065.47	3094.25	292300.53	296460.25
9	3729.77	9241.79	826165.31	839136.88
10	1561.27	7141.15	498403.81	507106.22
11	326.79	873.15	72473.10	73673.03
12	79.01	227.59	23416.17	23722.77
13	0.25	63.09	3442.50	3505.84
14	10.79	15.49	3330.19	3356.47
15	54.71	357.18	21752.48	22164.37

Mean Weight at Age by Area (Kg)

Ages	IVa	IIb	IIa	Total
0	0.0000	0.0000	0.0000	0.0000
1	0.0000	0.0000	0.0000	0.0000
2	0.0880	0.0810	0.1051	0.1049
3	0.1380	0.1755	0.1660	0.1661
4	0.1794	0.2505	0.2142	0.2144
5	0.2356	0.2897	0.2514	0.2516
6	0.2561	0.3376	0.2678	0.2684
7	0.2936	0.3335	0.3045	0.3048
8	0.2954	0.3399	0.3072	0.3075
9	0.3084	0.3513	0.3225	0.3228
10	0.3226	0.3551	0.3370	0.3372
11	0.3455	0.3967	0.3631	0.3634
12	0.2765	0.3966	0.3531	0.3532
13	0.4068	0.3935	0.3781	0.3784
14	0.4351	0.4293	0.4004	0.4006
15	0.4183	0.4640	0.4266	0.4272

Table 3.3.1.1 Norwegian Spring-spawning herring. Estimates obtained on the acoustic surveys on the spawning stock in February-March. Numbers in millions.

Year Age	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
2		101	183	44			16		407			106	1516
3	255	5	187	59			128	1792	231			1366	690
4	146	373	0	54			676	7621	7638		381	337	1996
5	6805	103	345	12			1375	3807	11243		1905	1286	164
6	202	5402	112	354			476	2151	2586		10640	2979	592
7		182	4489	122			63	322	957		6708	11791	1997
8			146	4148			13	20	471		1280	7534	7714
9				102			140	1	0		434	1912	4240
10							35	124	0		130	568	553
11							1820	63	165		39	132	71
12								2573	0		0	0	3
13									2024		175	0	0
14											0	392	6
15+											804	437	361
Total	7408	6166	5462	4895	-	-	4742	18474	25756	-	22496	28840	19903

In 1992, 1993 and 1997 there was no estimate due to poor weather conditions.
No surveys have been conducted after 2000.

Table 3.3.2.1 Norwegian Spring-spawning herring. Estimates obtained on the acoustic surveys in the wintering areas in November-December. Numbers in millions.

Year Age	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
1		72		380		9	65	74	56	362
2	36	1518	16	183	1465	73	1207	159	322	522
3	1247	2389	3708	5133	3008	661	441	2425	1522	3916
4	1317	3287	4124	5274	13180	1480	1833	296	5260	1528
5	173	1267	2593	1839	5637	6110	3869	837	165	2615
6	16	13	1096	1040	994	4458	12052	2066	497	82
7	208	13	34	308	552	1843	8242	6601	1869	338
8	139	158	25	19	92	743	2068	4168	4785	864
9	3742	26	196	13	0	66	629	755	3635	3160
10	69	4435	29	111	7	0	111	212	668	2216
11			3239	39	41	0	14	0	205	384
12				907	15	126	0	15	0	127
13					393	0	392	0	0	0
14+						842	221	146	168	18
Total	6947	13178	15209	15246	25384	16411	31144	17754	19152	16132

Table 3.3.2.2 Norwegian Spring-spawning herring. Estimates obtained on the acoustic surveys in the wintering areas in January. Numbers in millions. No surveys carried out in 2000.

Year Age	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
2	90			73				214	0
3	220	410	61	642	47	315		267	1358
4	70	820	1905	3431	3781	10442		1938	199
5	20	260	2048	4847	4013	13557		4162	1455
6	180	60	256	1503	2445	4312		9647	4452
7	150	510	27	102	1215	1271		6974	12971
8	5500	120	269	29	42	290		1518	7226
9	440	4690	182	161	24	22		743	1876
10		30	5691	131	267	25		16	499
11			128	3679	29	200		4	16
12					4326	58		0	16
13						1146		181	0
14								7	156
15+								314	220
Total	6670	6900	10567	14598	16189	31638	-	25985	30444

In 1997 there was no estimate due to poor weather conditions.
In 2000 there was no estimate due to technical problems, since then no surveys have been conducted in January.

Table 3.3.3.1 Norwegian spring-spawning herring. Estimates obtained in the international acoustic surveys on the feeding areas in the Norwegian Sea in May. Numbers in millions.

Year Age	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
3	4114	1169	367	2191	1353	8312
4	22461	3599	1099	322	2783	1430
5	13244	18867	4410	965	92	1463
6	4916	13546	16378	3067	384	179
7	2045	2473	10160	11763	1302	204
8	424	1771	2059	6077	7194	3215
9	14	178	804	853	5344	5433
10	7	77	183	258	1689	1220
11	155	288	0	5	271	94
12	0	415	0	14	0	178
13	3134	60	112	0	114	0
14		2472	0	158	1135	0
15+			415	128	1135	85
Total	50504	44915	35987	25801	21661	21810

Table 3.3.4.1 Norwegian spring-spawning herring. Acoustic estimates (billion individuals) of immature herring in the Barents Sea in May/June. 1990-2001.See footnotes.

Year Age	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**[1]	**1997**[2]	**1998**[3]	**1999**	**2000**	**2001**
1	24.3	32.6	102.7	6.6	0.5	0.1	2.6	9.5	49.5	105.4	0.3
2	5.2	14.0	25.8	59.2	7.7	0.25	0.04	4.7	4.9	27.9	7.6
3		5.7	1.5	18.0	8.0	1.8	0.4	0.01	0.00	0.00	8.8
4				1.7	1.1	0.6	0.35	0.01	0.00	0.00	0.00
5						0.03	0.05	0.00	0.00	0.00	0.00

[1] Average of Norwegian and Russian estimates
[2] Combination of Norwegian and Russian estimates as described in 1998 WG report, since then only Russian estimates

Table 3.3.4.2 Norwegian spring spawners. Acoustic abundance (TS = 20 logL - 71.9) of 0-group herring in Norwegian coastal waters in 1975–2001 (numbers in millions).

Year		**Area**			**Total**
	South of 62°N	62°N-65°N	65°N-68°N	North of 68°30'	
1975		164	346	28	538
1976		208	1 305	375	1 888
1977		35	153	19	207
1978		151	256	196	603
1979		455	1 130	144	1 729
1980		6	2	109	117
1981		132	1	1	134
1982		32	286	1 151	1 469
1983		162	2 276	4 432	6 866
1984		2	234	465	701
1985		221	177	104	502
1986		5	72	127	204
1987		327	26	57	410
1988		14	552	708	1 274
1989		575	263	2 052	2 890
1990		75	146	788	1 009
1991		80	299	2 428	2 807
1992		73	1 993	621	2 891
1993	290	109	140	288	827
1994	157	452	323	6 168	7 101
1995	0	27	2	0	29
1996	0	20	114	8 800	8 934
1997	208	69	544	5 244	6 065
1998	424	273	442	11 640	12 779
1999	121	658	271	6 329	7 379
2000	570	127	996	7 237	8 930
2001	89	324	134	1421	1968

Table 3.3.4.3 Norwegian spring-spawning herring. Abundance indices for 0-group herring in the Barents Sea, 1973-2001.

Year	Log index	Year	Log index
1974	0.01	1988	0.30
1975	0.00	1989	0.58
1976	0.00	1990	0.31
1977	0.01	1991	1.19
1978	0.02	1992	1.05
1979	0.09	1993	0.75
1980	0.00	1994	0.28
1981	0.00	1995	0.16
1982	0.00	1996	0.65
1983	1.77	1997	0.39
1984	0.34	1998	0.59
1985	0.23	1999	0.41
1986	0.00	2000	0.30
1987	0.00	2001	0.13

Table 3.3.4.4 Norwegian spring-spawning herring. Acoustic estimates (billion individuals) of immature herring in the Barents Sea in September/October . 2000-2001.

Year Age	**2000**	**2001**
1	14.7	0.5
2	11.5	10.5
3	0.00	1.7
4	0.00	0.00
5	0.00	0.00

Table 3.3.5.1 The indices for herring larvae for the period 1981-2002 ($N*10^{-12}$).

Year	Index 1	Index 2	Year	Index 1	Index 2
1981	0.3		1992	6.3	27.8
1982	0.7		1993	24.7	78.0
1983	2.5		1994	19.5	48.6
1984	1.4		1995	18.2	36.3
1985	2.3		1996	27.7	81.7
1986	1.0		1997	66.6	147.5
1987	1.3	4.0	1998	42.4	138.6
1988	9.2	25.5	1999	19.9	73.0
1989	13.4	28.7	2000	19.8	127.5
1990	18.3	29.2	2001	40.7	
1991	8.6	23.5	2002	27.1	

Table 3.4.1. Tagging data included in the tuning. Numbers screened and recovered every year by year class.

Tagging data for the 1983+ year class

Year	Number screened in million	Number tagged	Recaptured											
			87 release	88 release	89 release	90 release	91 release	92 release	93 release	94 release	95 release	96 release	97 release	98 release
1987		33067												
1988		38152												
1989	10695	20620	12											
1990	5489	24585	4	10										
1991	5545	12558	1	7	5									
1992	1737	15262	4	0	2	2								
1993	9372	15839	6	13	6	12	9							
1994	9474	5364	2	10	7	8	4	11						
1995	11554	859	6	10	5	15	6	9	7					
1996	4038	2879	3	2	6	10	2	1	4	3				
1997	3867	2266	0	3	1	3	2	3	0	0	0			
1998	509	648	1	3	1	1	2	2	0	0	0	1		
1999	379	0	0	0	1	1	0	0	1	0	0	0	1	
2000	413		0	1	0	3	0	1	0	0	0	0	0	0
2001	35		0	1	0	0	0	0	0	0	0	0	0	0

Tagging data for the 1984 year class

Year	Number screened in million	Number tagged	Recaptured										
			88 release	89 release	90 release	91 release	92 release	93 release	94 release	95 release	96 release	97 release	98 release
1988		1342											
1989		1175											
1990	157	1097	0										
1991	138	257	0	0									
1992	30	767	0	0	0								
1993	287	479	2	1	1	0							
1994	267	160	0	0	0	2	1						
1995	264	56	0	0	0	0	0	0					
1996	281	113	0	0	0	0	0	0	0				
1997	0	0	0	0	0	0	0	0	0	0			
1998	1	0	0	0	0	0	0	0	0	0	0		
1999	0	0	0	0	0	0	0	0	0	0	0	0	
2000	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0	0	0	0	0

Tagging data for the 1985 year class

Year	Number screened in million	Number tagged	Recaptured									
			89 release	90 release	91 release	92 release	93 release	94 release	95 release	96 release	97 release	98 release
1989		2982										
1990		1081										
1991	355	1154	0									
1992	114	851	0	0								
1993	573	1465	1	1	1							
1994	345	368	2	0	0	1						
1995	735	167	0	0	0	2	1					
1996	427	564	1	0	0	0	0	0				
1997	888	555	0	2	0	3	1	1	1			
1998	497	778	0	1	0	0	1	0	0	0		
1999	623	0	1	0	0	0	0	0	0	0	1	
2000	703		0	0	0	0	1	0	0	0	0	2
2001	139		1	0	0	0	0	0	0	0	0	1

Table 3.4.1. Continued.

Tagging data for the 1986 year class

Year	Number screened in million	Number tagged	Recaptured 90 release	91 release	92 release	93 release	94 release	95 release	96 release	97 release	98 release
1990		381									
1991		165									
1992	17	210	0								
1993	19	52	0	0							
1994	65	256	0	0	0						
1995	104	0	1	0	0	0					
1996	92	213	0	0	1	0	0				
1997	166	15	0	0	0	0	0	0			
1998	0	84	0	0	0	0	0	0	0		
1999	0	0	0	0	0	0	0	0	0	0	
2000	3		0	0	0	0	0	0	0	0	0
2001	0		0	0	0	0	0	0	0	0	0

Tagging data for the 1987 year class

Year	Number screened in million	Number tagged	Recaptured 91 release	92 release	93 release	94 release	95 release	96 release	97 release	98 release
1991		634								
1992		1146								
1993	329	1569	0							
1994	259	315	0	0						
1995	90	27	1	0	1					
1996	43	0	0	0	1	0				
1997	224	135	0	0	0	0	0			
1998	8	0	0	1	0	0	0	0		
1999	81	0	0	0	0	0	0	0	0	
2000	0		0	0	0	0	0	0	0	0
2001	22		0	0	0	0	0	0	0	0

Tagging data for the 1988 year class

Year	Number screened in million	Number tagged	Recaptured 92 release	93 release	94 release	95 release	96 release	97 release	98 release
1992		5827							
1993		5267							
1994	3506	4473	3						
1995	3729	1041	4	0					
1996	1176	2109	3	3	2				
1997	811	1940	0	0	0	0			
1998	148	215	1	0	1	0	0		
1999	12	0	0	0	0	0	0	0	
2000	75		0	0	0	0	0	0	0
2001	0		0	1	0	0	0	0	0

Tagging data for the 1989 year class

Year	Number screened in million	Number tagged	Recaptured 93 release	94 release	95 release	96 release	97 release	98 release
1993		7584						
1994		11873						
1995	9463	2348	4					
1996	4636	5170	1	5				
1997	3346	4103	2	7	0			
1998	1183	1176	0	0	0	1		
1999	1179	0	1	0	0	1	1	
2000	790		0	2	0	0	0	1
2001	841		1	1	0	2	0	0

Table 3.4.1. Continued.

Tagging data for the 1990 year class

Year	Number screened in million	Number tagged	Recaptured 94 release	95 release	96 release	97 release	98 release
1994		10784					
1995		3868					
1996	9009	6171	9				
1997	9830	4057	7	3			
1998	2828	2381	1	1	1		
1999	3402	0	1	2	2	1	
2000	3146		0	2	2	0	1
2001	1052		2	0	0	0	0

Tagging data for the 1991 year class

Year	Number screened in million	Number tagged	Recaptured 95 release	96 release	97 release	98 release
1995		21528				
1996		25683				
1997	30952	7129	21			
1998	12459	6002	8	6		
1999	14968	0	7	14	4	
2000	18461		7	10	1	9
2001	10032		3	5	2	1

Tagging data for the 1992 year class

Year	Number screened in million	Number tagged	Recaptured 96 release	97 release	98 release
1996		8417			
1997		8353			
1998	20695	22320	7		
1999	23790	0	4	9	
2000	31430		15	7	20
2001	14668		4	0	8

Tagging data for the 1993 year class

Year	Number screened in million	Number tagged	Recapt. 97 release	98 release
1997		976		
1998		2015		
1999	8046	0	0	
2000	9049		0	3
2001	3994		0	0

Tagging data for the 1994 year class

Year	Number screened in million	Number tagged	Recapt. 98 release
1998		3752	
1999		0	
2000	2450		1
2001	1104		1

Table 3.5.1 Exploratory runs for Norwegian spring-spawning herring

For explanations of each run, see the text

	Run 1	Run 2	Run 3	Run 4	Run 5	Run 6	Run 7	Run 8	Run 9	Run 10	Run 11
SSB 2002	4.76	4.98	4.92	5.53	5.24	5.30	4.92	5.06	2.68	4.61	1.18
SSB 2001	5.30	5.51	5.44	6.13	5.77	5.80	5.44	5.57	3.10	5.10	1.68
SSB 2000	5.71	5.90	5.83	6.60	6.16	6.14	5.83	5.94	3.45	5.48	2.34
SSB 1999	6.88	7.08	7.00	7.85	7.34	7.30	7.00	7.10	4.50	6.58	3.22
Total log-likelihood	-489.62	-508.01	-491.93	-497.27	-408.92	-564.51	-491.93	-497.24	-269.60	-489.36	-265.32
Log-likelihood surveys per term	-1.55	-1.55	-1.55	-1.60	-1.54	-1.55	-1.55	-1.55		-1.55	
Number survey terms	95.00	95.00	95.00	95.00	95.00	95.00	95.00	95.00	0.00	95.00	0.00
Log-likelihood tag returns per term	-1.75	-1.35	-1.75	-1.77	-1.64	-1.76	-1.75	-1.76	-1.72	-1.75	-1.69
Number tag return terms	157.00	218.00	159.00	157.00	119.00	157.00	159.00	157.00	157.00	157.00	157.00
Log-likelihood larval index per term	-3.05	-3.04	-3.05	-3.07	-3.03	-3.72	-3.05	-4.65		-3.07	
Number larval index terms	22.00	22.00	22.00	22.00	22.00	38.00	22.00	16.00	0.00	22.00	0.00
Catchability Spawning grounds	0.82	0.80	0.80	0.73	0.80	0.80	0.80	0.80		0.86	
Catchability December in Ofoten	0.71	0.69	0.70	0.62	0.67	0.67	0.70	0.69		0.74	
Catchability January in Ofoten	0.80	0.78	0.79	0.70	0.77	0.77	0.79	0.78		0.84	
Catchability Young herring in the Barents Sea											
Catchability Herring in the Norwegian Sea	1.03	1.00	1.01	0.92	0.98	0.97	1.01	1.00		1.08	
Terminal F 1983	0.44	0.42	0.43	0.39	0.42	0.41	0.43	0.43	1.37	0.47	2.31
Terminal F 1990	0.11	0.11	0.11	0.10	0.11	0.10	0.11	0.11	0.16	0.12	1.09
Terminal F 1991	0.18	0.17	0.17	0.15	0.16	0.16	0.17	0.17	0.53	0.19	10.07
Terminal F 1992	0.18	0.17	0.17	0.15	0.16	0.16	0.17	0.17	0.59	0.18	43.04
Terminal F 1993	0.15	0.15	0.15	0.13	0.14	0.14	0.15	0.14	0.17	0.16	0.24
Distribution parameter	0.42	0.42	0.42	0.42	0.41	0.42	0.42	0.42		0.42	
Catchability larval index	4.09	4.03	4.08	3.52	3.97	3.96	4.08			4.26	
Larval distribution parameter	0.60	0.60	0.60	0.61	0.59	0.55	0.60	0.48		0.61	
Tagging survival	0.40	0.42	0.40	0.45	0.39	0.41	0.40	0.40	0.33	0.37	0.21

Table 3.5.2. NSS herring
Results of stock assessment by means of ISVPA
1 and 2 refer to catch control version and the mixed version respectively of ISVPA

		1	2	1	2	1	2	1	2
1986	225	2014	1729	414	405	1548	1461	0.862	1.300
1987	127	7074	9110	808	761	2889	2847	0.393	0.438
1988	135	1643	2590	2514	2329	3179	3084	0.298	0.325
1989	104	1610	1791	3084	2795	3642	3510	0.068	0.075
1990	86	4060	2955	3363	3225	4017	3829	0.068	0.076
1991	85	11623	9207	3516	3344	4196	3881	0.029	0.033
1992	104	19354	16837	3413	3255	4816	4406	0.031	0.035
1993	232	53847	53497	3313	3082	5923	5466	0.023	0.024
1994	479	69157	74800	3801	3442	8040	7683	0.073	0.079
1995	906	20313	22762	4735	4329	9178	8933	0.115	0.123
1996	1220	6702	6937	6471	6307	9558	9626	0.148	0.148
1997	1427	2592	2797	8056	8357	9315	9727	0.294	0.287
1998	1223	32562	36874	7537	7972	8757	9331	0.217	0.212
1999	1235	20144	23698	7173	7649	9146	9905	0.155	0.150
2000	1207	27094	32815	6563	7220	9628	10790	0.183	0.171
2001	770	2185	2683	6746	7634	8711	9971	0.119	0.106

Table 3.5.2.1

Run title : Herring spring-spawn (run: SVPBJA12/V12)
At 6/05/2002 14:07

Table 1 Catch numbers-at-age Numbers*10**-4

YEAR,	1907,	1908,	1909,	1910,	1911,
AGE					
0,	64356,	133467,	145485,	174766,	226214,
1,	95002,	128128,	160034,	51402,	309160,
2,	10832,	20641,	52337,	51833,	33125,
3,	46100,	49359,	77259,	49760,	36437,
4,	15420,	8564,	279,	6637,	164,
5,	12850,	5176,	20986,	4345,	1432,
6,	10280,	5882,	5757,	25543,	8427,
7,	8752,	6164,	2182,	3247,	26139,
8,	13406,	4847,	2554,	1337,	1759,
9,	2362,	7152,	3250,	1958,	818,
10,	1598,	2729,	7057,	1194,	1105,
11,	1181,	2023,	1161,	1814,	450,
12,	1528,	1835,	1114,	382,	532,
13,	625,	1600,	650,	334,	82,
14,	347,	612,	929,	143,	0,
15,	0,	471,	511,	239,	0,
+gp,	0,	0,	0,	0,	0,
0 TOTALNUM,	284639,	378649,	481543,	374933,	645842,
TONSLAND,	207600,	233400,	288500,	250000,	253500,
SOPCOF %,	76,	95,	96,	104,	94,

Table 1 Catch numbers-at-age Numbers*10**-4

YEAR,	1912,	1913,	1914,	1915,	1916,	1917,	1918,	1919,	1920,	1921,
AGE										
0,	403272,	307011,	225428,	191652,	293272,	191445,	379924,	395199,	196325,	255174,
1,	161309,	76753,	548869,	149989,	76034,	122525,	113015,	450527,	178706,	287750,
2,	39131,	13352,	30534,	38019,	9408,	19896,	47394,	32862,	33965,	18797,
3,	11509,	18248,	12214,	9505,	22908,	15571,	12287,	21032,	10103,	21429,
4,	402,	849,	1435,	588,	6732,	16635,	1372,	5146,	2914,	764,
5,	1005,	1893,	2218,	5749,	4997,	12098,	22247,	5682,	3816,	8973,
6,	1930,	3068,	3718,	2809,	10479,	2475,	12251,	35485,	2844,	1623,
7,	6837,	1436,	2805,	3267,	2707,	4881,	3528,	13401,	20466,	1861,
8,	23567,	7245,	3457,	2287,	3192,	1650,	7743,	2573,	8256,	13221,
9,	2976,	42753,	9327,	3463,	2637,	1787,	2646,	5039,	2289,	5584,
10,	965,	2480,	32806,	8167,	3192,	1444,	2450,	2144,	3538,	1432,
11,	1207,	2089,	3326,	34758,	7634,	2131,	2352,	2359,	1041,	1957,
12,	523,	587,	2152,	2548,	24637,	5087,	4410,	1823,	1041,	1002,
13,	563,	2676,	2087,	653,	1457,	18973,	8331,	2680,	1318,	1002,
14,	80,	0,	1109,	653,	416,	1031,	28912,	2037,	1318,	621,
15,	161,	0,	717,	392,	486,	412,	1666,	28302,	20466,	8973,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTALNUM,	655436,	480440,	882201,	454500,	470188,	418040,	650529,	1006289,	488405,	630163,
TONSLAND,	245200,	290700,	356000,	306100,	296900,	276200,	433500,	498100,	316500,	258500,
SOPCOF %,	105,	101,	90,	100,	101,	99,	103,	96,	99,	94,

Table 1 Catch numbers-at-age Numbers*10**-4

YEAR,	1922,	1923,	1924,	1925,	1926,	1927,	1928,	1929,	1930,	1931,
AGE										
0,	289750,	171875,	140436,	220343,	210773,	227876,	799203,	224268,	828385,	220609,
1,	89998,	87720,	283992,	102947,	581441,	618521,	95904,	797396,	23226,	676215,
2,	46833,	14049,	12800,	12814,	6290,	19579,	37728,	25721,	42368,	3207,
3,	42630,	15843,	3976,	6540,	12719,	9147,	104076,	69814,	5084,	11403,
4,	8633,	3395,	2511,	2751,	1456,	18602,	8162,	16317,	3441,	249,
5,	16096,	40458,	6696,	5217,	16014,	12440,	33413,	15494,	15312,	2363,
6,	11487,	12920,	32110,	7209,	4913,	8138,	15814,	31262,	11871,	22382,
7,	878,	9431,	11642,	38036,	6915,	4999,	8162,	17414,	39571,	11688,
8,	2341,	1226,	7609,	14133,	28752,	7906,	7907,	5896,	23227,	26858,
9,	11267,	2075,	1674,	10813,	12829,	32320,	13773,	8913,	9291,	14300,
10,	3292,	9431,	1750,	2182,	7370,	11626,	20150,	13712,	13420,	5844,
11,	1317,	2358,	4261,	1707,	1911,	7441,	5994,	15631,	12216,	6590,
12,	1756,	1415,	1141,	5312,	1729,	1860,	3826,	5485,	28216,	5720,
13,	1098,	1132,	761,	1613,	4367,	2441,	2168,	2742,	7570,	20641,
14,	1390,	849,	685,	759,	1092,	2558,	1530,	1508,	3785,	3109,
15,	13535,	8582,	4337,	5122,	3276,	5929,	1913,	2057,	3269,	4476,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTALNUM,	542302,	382758,	516380,	437497,	901847,	991382,	1159721,	1253630,	1070252,	1035655,
TONSLAND,	349900,	330500,	295000,	355500,	403800,	489900,	611900,	624600,	704500,	538200,
SOPCOF %,	102,	99,	94,	100,	89,	91,	103,	89,	107,	89,

Table 3.5.2.1 Continued

Table 1 Catch numbers-at-age Numbers*10**-4

YEAR,	1932,	1933,	1934,	1935,	1936,	1937,	1938,	1939,	1940,	1941,
AGE										
0,	853301,	1053080,	657522,	334444,	273771,	818806,	360691,	269555,	1181358,	737439,
1,	330737,	618820,	354379,	721694,	587802,	127370,	564157,	667468,	937535,	919347,
2,	45673,	49899,	92484,	26110,	22859,	6669,	3376,	25322,	19625,	23376,
3,	1281,	152952,	35847,	15343,	12320,	14391,	7249,	3939,	30696,	57884,
4,	5047,	1120,	1760,	6780,	22580,	14550,	10019,	2713,	299,	1525,
5,	701,	4481,	5720,	69682,	23332,	41005,	35859,	9256,	2246,	803,
6,	5467,	871,	5532,	8475,	99601,	12566,	65389,	32716,	28144,	4335,
7,	26636,	6473,	691,	7722,	10035,	78923,	15029,	39419,	24551,	24888,
8,	10514,	28382,	3080,	942,	6774,	6834,	74354,	8937,	34431,	13247,
9,	32804,	13942,	12572,	7157,	1254,	4630,	5010,	34951,	6138,	13809,
10,	18505,	30000,	5657,	22976,	7276,	1543,	6592,	1436,	32036,	3693,
11,	5748,	15311,	11440,	10735,	20071,	4189,	791,	5107,	898,	11320,
12,	6309,	4979,	7292,	24106,	10537,	18518,	5273,	958,	5090,	1525,
13,	3645,	4730,	1509,	14690,	20572,	8377,	13974,	1756,	599,	1445,
14,	18225,	1369,	1006,	2448,	10788,	13448,	5801,	7660,	599,	401,
15,	3084,	12697,	5657,	10546,	10788,	14109,	23730,	14523,	14671,	2810,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTALNUM,	1367676,	1999109,	1202147,	1283847,	1140358,	1185928,	1197294,	1125717,	2318914,	1817848,
TONSLAND,	652600,	818200,	451700,	649400,	775200,	695900,	783600,	703400,	923100,	594000,
SOPCOF %,	103,	96,	103,	81,	84,	88,	80,	100,	109,	98,

Table 1 Catch numbers-at-age Numbers*10**-4

YEAR,	1942,	1943,	1944,	1945,	1946,	1947,	1948,	1949,	1950,	1951,
AGE										
0,	533526,	702770,	258788,	375255,	196012,	242324,	254610,	321128,	511260,	163550,
1,	577313,	109802,	270716,	573554,	297393,	117378,	415863,	450521,	200000,	760770,
2,	32791,	24161,	7257,	28817,	15686,	9132,	8101,	16663,	60000,	40000,
3,	26023,	30120,	7852,	4502,	16409,	13958,	12291,	8071,	27620,	660,
4,	615,	2259,	3423,	5015,	5581,	29493,	48299,	12539,	18480,	38380,
5,	5077,	8209,	3516,	11830,	5883,	6320,	106195,	51722,	1855,	17240,
6,	1616,	25305,	17577,	6301,	11313,	5568,	9288,	54269,	54700,	16440,
7,	7077,	1732,	26366,	18387,	7391,	9781,	8050,	4310,	62860,	51560,
8,	26386,	5046,	2128,	32917,	22324,	4966,	10217,	3331,	7950,	60200,
9,	10847,	12427,	6846,	2572,	38916,	17154,	6502,	5682,	8860,	7710,
10,	9924,	7305,	14247,	9772,	5129,	27085,	24149,	4114,	10950,	8270,
11,	3846,	4293,	7679,	21088,	11011,	4213,	37772,	10188,	8690,	10310,
12,	6770,	3013,	3978,	8486,	25039,	8426,	5883,	20180,	19450,	10760,
13,	308,	2033,	3793,	5015,	8899,	16702,	14242,	3331,	36830,	25350,
14,	1692,	151,	833,	1672,	3620,	5267,	21053,	5682,	6640,	34800,
15,	2693,	1431,	1573,	1543,	4224,	5568,	16100,	13518,	10700,	4740,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	23730,	30510,
0 TOTALNUM,	1246504,	940057,	636571,	1106725,	674829,	523333,	998615,	985248,	1070575,	1281250,
TONSLAND,	592700,	556600,	587800,	554400,	586200,	710400,	1012600,	783000,	933000,	1278400,
SOPCOF %,	124,	157,	152,	94,	96,	139,	97,	110,	104,	100,

Table 1 Catch numbers-at-age Numbers*10**-4

YEAR,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,	1961,
AGE										
0,	1372160,	569720,	1067600,	517560,	536390,	500190,	966700,	1789630,	1288430,	620750,
1,	914970,	505500,	707110,	287110,	202370,	329080,	279810,	198530,	1358080,	1607560,
2,	123290,	58130,	85540,	51010,	62710,	21950,	66640,	32550,	39250,	288480,
3,	3930,	74010,	26630,	9300,	11650,	2330,	1750,	1510,	12170,	3120,
4,	6050,	4660,	143550,	27640,	25160,	37330,	1790,	2680,	1820,	810,
5,	60230,	10090,	14290,	204510,	31420,	15380,	11090,	2590,	2810,	410,
6,	13630,	35560,	23600,	11430,	255510,	22850,	8930,	14660,	2440,	1500,
7,	20450,	8190,	49030,	18960,	11000,	198530,	19440,	11480,	9620,	1940,
8,	38020,	11090,	12810,	27470,	20390,	7200,	97350,	24070,	7330,	6160,
9,	37790,	31410,	19980,	8530,	26420,	12730,	7070,	110380,	20390,	4920,
10,	7920,	39490,	44040,	19340,	13070,	18250,	12300,	8860,	116300,	1361,
11,	8570,	6170,	46070,	29560,	19830,	8840,	20090,	12430,	8520,	72810,
12,	10770,	9120,	8840,	20320,	27280,	12120,	9870,	19800,	12970,	4970,
13,	10680,	9410,	10060,	5870,	16330,	14930,	7740,	8850,	15350,	4500,
14,	18650,	9880,	13300,	8460,	6300,	13160,	7090,	7740,	5670,	6300,
15,	25630,	21550,	12680,	10360,	8890,	3370,	6940,	8520,	4720,	2170,
+gp,	30810,	51490,	67640,	47700,	47620,	24770,	18620,	15070,	12170,	3840,
0 TOTALNUM,	2703550,	1455470,	2352770,	1305130,	1322340,	1243010,	1543220,	2269350,	2918040,	2631601,
TONSLAND,	1254800,	1090600,	1644500,	1359800,	1659400,	1319500,	986600,	1111100,	1101800,	830100,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	107,

Table 3.5.2.1 Continued

Table 1 Catch numbers-at-age Numbers*10**-4

YEAR,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,
AGE										
0,	369320,	480700,	361300,	230300,	392650,	42680,	178360,	56120,	11930,	3050,
1,	408110,	211920,	272830,	378090,	66280,	987710,	43700,	50710,	52940,	4290,
2,	104130,	204530,	22030,	285360,	167800,	7040,	38830,	14190,	3320,	8510,
3,	184380,	76040,	11460,	8990,	204870,	139230,	9910,	18820,	630,	182,
4,	800,	83580,	39900,	25620,	2690,	325400,	188050,	80,	1860,	102,
5,	310,	530,	204580,	57110,	46660,	2660,	138740,	880,	60,	124,
6,	720,	180,	1370,	219970,	130600,	42130,	1422,	470,	330,	36,
7,	2020,	360,	150,	1950,	288450,	113200,	9400,	70,	330,	111,
8,	1190,	1830,	300,	1490,	3790,	172080,	13410,	1170,	100,	113,
9,	5910,	930,	2490,	740,	1430,	890,	34510,	3360,	1340,	36,
10,	5260,	10770,	2930,	1910,	1740,	570,	200,	3600,	2620,	441,
11,	11700,	9250,	9560,	4000,	2620,	350,	110,	30,	2810,	691,
12,	81350,	17410,	8240,	10050,	1100,	850,	83,	20,	30,	545,
13,	4420,	92370,	15300,	10780,	6910,	890,	250,	20,	10,	0,
14,	5470,	7960,	77280,	13870,	7210,	1750,	260,	20,	20,	2,
15,	6560,	6040,	4580,	70400,	9670,	1430,	180,	40,	10,	12,
+gp,	8670,	12490,	29100,	17910,	46000,	9010,	1520,	200,	190,	0,
0 TOTALNUM,	1200320,	1216890,	1063400,	1338540,	1380470,	1847870,	658935,	149800,	78530,	18245,
TONSLAND,	848600,	984500,	1281800,	1547700,	1955000,	1677200,	712200,	67800,	62300,	21100,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

Table 1 Catch numbers-at-age Numbers*10**-4

YEAR,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,
AGE										
0,	34710,	2930,	6590,	3060,	2010,	4300,	2010,	3260,	690,	830,
1,	4100,	350,	780,	360,	240,	620,	240,	380,	80,	110,
2,	2040,	170,	390,	180,	120,	310,	120,	190,	40,	1190,
3,	3538,	239,	10,	327,	2325,	2210,	302,	635,	641,	417,
4,	348,	2520,	24,	13,	544,	2360,	1216,	187,	581,	459,
5,	358,	65,	2451,	91,	0,	34,	2032,	687,	228,	860,
6,	248,	151,	26,	3067,	0,	0,	87,	1122,	817,	220,
7,	69,	28,	20,	1,	1309,	42,	0,	33,	1584,	451,
8,	149,	18,	0,	0,	0,	1077,	62,	0,	44,	828,
9,	20,	0,	0,	0,	0,	0,	503,	0,	1,	35,
10,	0,	0,	0,	0,	0,	0,	0,	253,	0,	10,
11,	49,	0,	0,	0,	0,	0,	0,	0,	269,	11,
12,	59,	0,	0,	0,	0,	0,	0,	0,	0,	96,
13,	59,	0,	0,	0,	0,	0,	0,	0,	0,	0,
14,	0,	18,	0,	0,	0,	0,	0,	0,	0,	0,
15,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTALNUM,	45748,	6489,	10291,	7099,	6548,	10953,	6572,	6747,	4975,	5518,
TONSLAND,	13161,	7017,	7619,	13713,	10436,	22706,	19824,	12864,	18577,	13736,
SOPCOF %,	99,	100,	101,	100,	100,	100,	100,	100,	100,	100,

Table 1 Catch numbers-at-age Numbers*10**-4

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,
AGE										
0,	2260,	12700,	3386,	2857,	1381,	1385,	1549,	712,	102,	10,
1,	110,	468,	170,	1315,	138,	633,	279,	193,	40,	337,
2,	20,	168,	249,	20722,	309,	3577,	911,	2520,	1554,	333,
3,	1382,	318,	448,	2150,	53979,	1978,	6292,	289,	1863,	844,
4,	789,	2119,	539,	1550,	1759,	50139,	2506,	362,	266,	278,
5,	451,	952,	6154,	1650,	1450,	1867,	55037,	565,	1188,	141,
6,	626,	618,	1820,	13000,	1550,	350,	945,	32429,	1085,	1470,
7,	196,	682,	1264,	5900,	10500,	706,	368,	347,	22628,	887,
8,	508,	129,	1561,	5500,	7500,	2800,	596,	80,	129,	21885,
9,	605,	460,	722,	6300,	4200,	1200,	1458,	68,	152,	250,
10,	12,	733,	1634,	1000,	7700,	950,	887,	330,	204,	46,
11,	4,	14,	648,	3100,	1947,	450,	282,	138,	242,	9,
12,	4,	4,	0,	5000,	6600,	783,	336,	68,	65,	69,
13,	12,	14,	0,	0,	8000,	650,	268,	32,	18,	10,
14,	0,	86,	0,	0,	0,	700,	157,	26,	59,	26,
15,	0,	0,	165,	0,	0,	45,	54,	0,	17,	53,
+gp,	0,	0,	0,	264,	247,	0,	0,	0,	31,	1,
0 TOTALNUM,	6978,	19466,	18760,	70309,	107260,	68213,	71925,	38158,	29641,	26648,
TONSLAND,	16655,	23054,	53532,	169872,	225256,	127306,	135301,	103830,	86411,	84683,
SOPCOF %,	100,	100,	100,	100,	100,	100,	100,	100,	100,	100,

Table 3.5.2.1 Continued

Table 1 Catch numbers-at-age Numbers*10**-4

YEAR,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,
AGE										
0,	163,	657,	43,	0,	0,	0,	0,	0,	0,	0,
1,	15,	13,	2,	0,	0,	0,	0,	0,	0,	0,
2,	134,	724,	810,	113,	3014,	2182,	8289,	503,	1440,	208,
3,	1259,	2841,	3250,	5759,	3437,	13045,	7032,	13763,	8402,	10229,
4,	3310,	10687,	11009,	34646,	71363,	27095,	24237,	3582,	56038,	16068,
5,	498,	8727,	36392,	62281,	157100,	179578,	36831,	13481,	3493,	42682,
6,	119,	863,	16480,	63784,	94058,	199362,	176032,	42943,	11072,	3875,
7,	1198,	365,	1558,	23109,	40628,	76121,	126375,	160496,	40446,	9599,
8,	575,	2960,	814,	1551,	10341,	32649,	38148,	116426,	129925,	29646,
9,	22568,	1863,	3733,	1585,	568,	6087,	12997,	29139,	104500,	83914,
10,	248,	41011,	3566,	6975,	737,	2002,	4250,	10601,	21698,	50711,
11,	64,	0,	64541,	8374,	6609,	3241,	2534,	1452,	7159,	7367,
12,	25,	0,	283,	91188,	1757,	9052,	348,	4004,	1626,	2372,
13,	124,	0,	46,	407,	83655,	1912,	11260,	720,	2270,	351,
14,	0,	0,	10,	25,	0,	37033,	563,	8860,	2332,	336,
15,	0,	0,	207,	0,	0,	30,	10852,	0,	3447,	0,
+gp,	0,	0,	0,	45,	0,	0,	0,	6398,	3734,	2216,
0 TOTALNUM,	30300,	70711,	142742,	299842,	473266,	589388,	459749,	412369,	397582,	259573,
TONSLAND,	104448,	232457,	479228,	905501,	1220283,	1426507,	1223131,	1235433,	1207201,	770054,
SOPCOF %,	100,	100,	102,	100,	101,	100,	100,	100,	100,	99,

Table 3.5.2.2. Run title : Herring spring-spawn (run: SVPBJA12/V12) At 6/05/2002 14:07

Table 2 Catch weights-at-age (kg)

YEAR,	1907,	1908,	1909,	1910,	1911,
AGE					
0,	.0080,	.0080,	.0080,	.0080,	.0080,
1,	.0230,	.0230,	.0230,	.0230,	.0230,
2,	.0580,	.0580,	.0580,	.0580,	.0580,
3,	.1100,	.1100,	.1100,	.1100,	.1100,
4,	.1970,	.1970,	.1970,	.1970,	.1970,
5,	.2510,	.2510,	.2510,	.2510,	.2510,
6,	.2780,	.2780,	.2780,	.2780,	.2780,
7,	.3020,	.3020,	.3020,	.3020,	.3020,
8,	.3240,	.3240,	.3240,	.3240,	.3240,
9,	.3390,	.3390,	.3390,	.3390,	.3390,
10,	.3550,	.3550,	.3550,	.3550,	.3550,
11,	.3670,	.3670,	.3670,	.3670,	.3670,
12,	.3730,	.3730,	.3730,	.3730,	.3730,
13,	.3800,	.3800,	.3800,	.3800,	.3800,
14,	.3880,	.3880,	.3880,	.3880,	.3880,
15,	.3970,	.3970,	.3970,	.3970,	.3970,
+gp,	.4010,	.4010,	.4010,	.4010,	.4010,
0 SOPCOFAC,	.7618,	.9508,	.9602,	1.0354,	.9350,

Table 2 Catch weights-at-age (kg)

YEAR,	1912,	1913,	1914,	1915,	1916,	1917,	1918,	1919,	1920,	1921,
AGE										
0,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,
1,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,
2,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,
3,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,
4,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,
5,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,
6,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,
7,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,
8,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,
9,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,
10,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,
11,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,
12,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,
13,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,
14,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,
15,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,
+gp,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,
0 SOPCOFAC,	1.0506,	1.0145,	.8962,	.9958,	1.0087,	.9936,	1.0348,	.9581,	.9928,	.9405,

1

Table 3.5.2.2 Continued

Table 2 Catch weights-at-age (kg)

YEAR,	1922,	1923,	1924,	1925,	1926,	1927,	1928,	1929,	1930,	1931,
AGE										
0,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,
1,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,
2,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,
3,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,
4,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,
5,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,
6,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,
7,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,
8,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,
9,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,
10,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,
11,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,
12,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,
13,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,
14,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,
15,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,
+gp,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,
0 SOPCOFAC,	1.0229,	.9948,	.9403,	1.0013,	.8856,	.9057,	1.0322,	.8874,	1.0668,	.8947,

Table 2 Catch weights-at-age (kg)

YEAR,	1932,	1933,	1934,	1935,	1936,	1937,	1938,	1939,	1940,	1941,
AGE										
0,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,
1,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,
2,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,
3,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,
4,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,
5,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,
6,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,
7,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,
8,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,
9,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,
10,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,
11,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,
12,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,
13,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,
14,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,
15,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,
+gp,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,
0 SOPCOFAC,	1.0326,	.9588,	1.0350,	.8064,	.8408,	.8841,	.8003,	1.0026,	1.0923,	.9767,

Table 2 Catch weights-at-age (kg)

YEAR,	1942,	1943,	1944,	1945,	1946,	1947,	1948,	1949,	1950,	1951,
AGE										
0,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0070,	.0090,
1,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0230,	.0250,	.0290,
2,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0580,	.0680,
3,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1100,	.1300,
4,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1970,	.1880,	.2220,
5,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2510,	.2110,	.2490,
6,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2780,	.2340,	.2760,
7,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.3020,	.2530,	.2980,
8,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.2660,	.3140,
9,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.2800,	.3300,
10,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.3550,	.2940,	.3460,
11,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3670,	.3030,	.3570,
12,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3730,	.3120,	.3680,
13,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3200,	.3770,
14,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3880,	.3230,	.3810,
15,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3970,	.3310,	.3900,
+gp,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.4010,	.3350,	.3950,
0 SOPCOFAC,	1.2394,	1.5694,	1.5171,	.9445,	.9584,	1.3948,	.9669,	1.0998,	1.0412,	1.0009,

Table 3.5.2.2 Continued

Table 2 Catch weights-at-age (kg)

YEAR,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,	1961,
AGE										
0,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0090,	.0090,	.0060,	.0060,
1,	.0260,	.0270,	.0260,	.0270,	.0280,	.0280,	.0300,	.0300,	.0110,	.0100,
2,	.0610,	.0630,	.0620,	.0630,	.0660,	.0660,	.0700,	.0710,	.0740,	.0450,
3,	.1150,	.1200,	.1170,	.1190,	.1260,	.1270,	.1330,	.1350,	.1190,	.0870,
4,	.1970,	.2050,	.2010,	.2040,	.2150,	.2160,	.2270,	.2310,	.1880,	.1590,
5,	.2210,	.2300,	.2250,	.2290,	.2410,	.2430,	.2550,	.2590,	.2770,	.2760,
6,	.2450,	.2550,	.2500,	.2540,	.2680,	.2690,	.2830,	.2870,	.3370,	.3220,
7,	.2650,	.2750,	.2690,	.2740,	.2890,	.2900,	.3050,	.3100,	.3180,	.3720,
8,	.2790,	.2900,	.2840,	.2890,	.3040,	.3060,	.3210,	.3270,	.3630,	.3630,
9,	.2930,	.3050,	.2990,	.3040,	.3200,	.3220,	.3380,	.3440,	.3790,	.3930,
10,	.3080,	.3200,	.3130,	.3180,	.3360,	.3380,	.3550,	.3600,	.3600,	.4070,
11,	.3170,	.3300,	.3230,	.3280,	.3460,	.3480,	.3660,	.3720,	.4200,	.3970,
12,	.3270,	.3400,	.3330,	.3380,	.3570,	.3590,	.3770,	.3830,	.4110,	.4220,
13,	.3350,	.3470,	.3410,	.3460,	.3650,	.3670,	.3860,	.3920,	.4390,	.4470,
14,	.3390,	.3510,	.3450,	.3500,	.3690,	.3710,	.3900,	.3970,	.4500,	.4650,
15,	.3460,	.3590,	.3520,	.3580,	.3780,	.3800,	.3990,	.4060,	.4440,	.4520,
+gp,	.3510,	.3640,	.3570,	.3630,	.3830,	.3850,	.4040,	.4110,	.4480,	.4520,
0 SOPCOFAC,	.9963,	.9994,	1.0006,	.9995,	1.0013,	1.0030,	.9985,	1.0004,	1.0014,	1.0658,

Table 2 Catch weights-at-age (kg)

YEAR,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,
AGE										
0,	.0090,	.0080,	.0090,	.0090,	.0080,	.0090,	.0100,	.0090,	.0080,	.0110,
1,	.0230,	.0260,	.0240,	.0160,	.0170,	.0150,	.0270,	.0210,	.0580,	.0530,
2,	.0550,	.0470,	.0590,	.0480,	.0400,	.0360,	.0490,	.0470,	.0850,	.1210,
3,	.0850,	.0980,	.1390,	.0890,	.0630,	.0660,	.0750,	.0720,	.1050,	.1770,
4,	.1480,	.1710,	.2190,	.2170,	.2460,	.0930,	.1080,	.1050,	.1710,	.2160,
5,	.2880,	.2750,	.2390,	.2340,	.2600,	.3050,	.1580,	.1520,	.2560,	.2500,
6,	.3330,	.2680,	.2980,	.2620,	.2650,	.3050,	.3750,	.2960,	.2160,	.2770,
7,	.3600,	.3230,	.2950,	.3310,	.3010,	.3100,	.3830,	.3760,	.2770,	.3050,
8,	.3520,	.3290,	.3390,	.3600,	.4100,	.3330,	.3640,	.3290,	.2980,	.3330,
9,	.3500,	.3360,	.3500,	.3670,	.4250,	.3590,	.3820,	.3290,	.3040,	.3530,
10,	.3740,	.3410,	.3580,	.3860,	.4560,	.4130,	.4410,	.3410,	.3050,	.3660,
11,	.3840,	.3580,	.3510,	.3950,	.4600,	.4460,	.4100,	.3630,	.3090,	.3770,
12,	.3740,	.3850,	.3670,	.3930,	.4670,	.4010,	.4420,	.3850,	.3570,	.3880,
13,	.3940,	.3530,	.3750,	.4040,	.4460,	.4080,	.5170,	.3770,	.3480,	.3990,
14,	.3990,	.3810,	.3720,	.4010,	.4590,	.4390,	.4910,	.4510,	.3570,	.4190,
15,	.4110,	.3860,	.4270,	.4290,	.4650,	.4270,	.4640,	.4230,	.3670,	.4440,
+gp,	.4160,	.3860,	.4340,	.4370,	.4740,	.4310,	.4870,	.4290,	.3760,	.4440,
0 SOPCOFAC,	.9997,	1.0003,	.9995,	.9995,	1.0001,	1.0005,	.9990,	1.0036,	1.0030,	1.0001,

Table 2 Catch weights-at-age (kg)

YEAR,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,
AGE										
0,	.0110,	.0060,	.0060,	.0090,	.0070,	.0110,	.0120,	.0100,	.0120,	.0100,
1,	.0290,	.0530,	.0550,	.0790,	.0620,	.0910,	.1000,	.0880,	.1010,	.0820,
2,	.0620,	.1060,	.1170,	.1690,	.1320,	.1930,	.2100,	.1810,	.2020,	.1630,
3,	.1030,	.1610,	.1680,	.2410,	.1890,	.3160,	.2740,	.2930,	.2660,	.1960,
4,	.1540,	.2130,	.2220,	.3180,	.2500,	.3500,	.4240,	.3590,	.3990,	.2910,
5,	.2150,	.2390,	.2490,	.3580,	.2800,	.3980,	.4540,	.4160,	.4490,	.3410,
6,	.2580,	.2550,	.2650,	.3810,	.2980,	.4390,	.4950,	.4360,	.4600,	.3680,
7,	.2950,	.2770,	.2880,	.4130,	.3230,	.4950,	.5240,	.4820,	.4850,	.3800,
8,	.3220,	.2870,	.2990,	.4290,	.3360,	.5110,	.5960,	.4820,	.4720,	.3970,
9,	.3410,	.3240,	.3370,	.4840,	.3790,	.5580,	.6130,	.5390,	.6180,	.4360,
10,	.3540,	.3380,	.3520,	.5060,	.3960,	.5830,	.6500,	.5530,	.6450,	.4500,
11,	.3650,	.2570,	.2670,	.3840,	.3000,	.5370,	.5900,	.5180,	.6080,	.4920,
12,	.3760,	.2570,	.3240,	.4660,	.3640,	.5370,	.5900,	.5180,	.5940,	.4810,
13,	.3870,	.2570,	.3240,	.4660,	.3640,	.5370,	.5900,	.5180,	.5940,	.4810,
14,	.4060,	.2570,	.3240,	.4660,	.3640,	.5370,	.5900,	.5180,	.5940,	.4810,
15,	.4300,	.2570,	.3240,	.4660,	.3640,	.5370,	.5900,	.5180,	.5940,	.4810,
+gp,	.4300,	.2570,	.3240,	.4660,	.3640,	.5370,	.5900,	.5180,	.5940,	.4810,
0 SOPCOFAC,	.9935,	1.0011,	1.0051,	1.0002,	1.0004,	.9991,	.9998,	1.0016,	.9999,	1.0007,

Table 3.5.2.2 Continued

Table 2 Catch weights-at-age (kg)

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,
AGE										
0,	.0100,	.0110,	.0090,	.0090,	.0070,	.0100,	.0080,	.0100,	.0070,	.0070,
1,	.0870,	.0900,	.0470,	.0220,	.0770,	.0750,	.0620,	.0600,	.0780,	.0150,
2,	.1590,	.1650,	.1450,	.0220,	.0970,	.0910,	.0750,	.2040,	.1020,	.1040,
3,	.2560,	.2170,	.2180,	.2140,	.0550,	.1240,	.1240,	.1880,	.2300,	.2080,
4,	.3120,	.2650,	.2620,	.2770,	.2490,	.1730,	.1540,	.2640,	.2390,	.2500,
5,	.3780,	.3370,	.3250,	.2950,	.2940,	.2530,	.1940,	.2600,	.2660,	.2880,
6,	.4150,	.3780,	.3460,	.3380,	.3120,	.2320,	.2410,	.2820,	.3050,	.3120,
7,	.4350,	.4100,	.3810,	.3600,	.3520,	.3120,	.2650,	.3060,	.3080,	.3160,
8,	.4490,	.4260,	.4000,	.3810,	.3740,	.3280,	.3040,	.3090,	.3760,	.3300,
9,	.4480,	.4350,	.4130,	.3970,	.3980,	.3490,	.3050,	.3910,	.4070,	.3440,
10,	.5060,	.4440,	.4050,	.4090,	.4020,	.3530,	.3170,	.4220,	.4120,	.3720,
11,	.4930,	.4680,	.4260,	.4170,	.4010,	.3700,	.3080,	.3640,	.4240,	.3540,
12,	.4990,	.4610,	.4150,	.4350,	.4100,	.3850,	.3340,	.4290,	.4280,	.3980,
13,	.4990,	.4610,	.4150,	.4350,	.4100,	.3850,	.3340,	.4290,	.4280,	.3980,
14,	.4990,	.4610,	.4150,	.4350,	.4100,	.3850,	.3340,	.4290,	.4280,	.3980,
15,	.4990,	.4610,	.4150,	.4350,	.4100,	.3850,	.3340,	.4290,	.4280,	.3980,
+gp,	.4990,	.4610,	.4150,	.4350,	.4100,	.3850,	.3340,	.4290,	.4280,	.3980,
0 SOPCOFAC,	1.0001,	.9981,	.9999,	.9997,	1.0010,	.9979,	.9998,	1.0007,	.9992,	1.0015,

Table 2 Catch weights-at-age (kg)

YEAR,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,
AGE										
0,	.0070,	.0070,	.0070,	.0070,	.0070,	.0070,	.0070,	.0070,	.0070,	.0070,
1,	.0750,	.0300,	.0630,	.0630,	.0630,	.0630,	.0630,	.0630,	.0630,	.0630,
2,	.1030,	.1060,	.1020,	.1020,	.1360,	.0890,	.1110,	.0960,	.1240,	.1050,
3,	.1910,	.1530,	.1940,	.1530,	.1360,	.1670,	.1500,	.1730,	.1750,	.1660,
4,	.2330,	.2430,	.2390,	.1920,	.1680,	.1840,	.2160,	.2280,	.2220,	.2140,
5,	.3040,	.2820,	.2800,	.2340,	.2060,	.2070,	.2210,	.2620,	.2420,	.2520,
6,	.3370,	.3200,	.3170,	.2830,	.2620,	.2320,	.2490,	.2740,	.2890,	.2680,
7,	.3650,	.3300,	.3280,	.3280,	.3090,	.2770,	.2770,	.2920,	.3030,	.3050,
8,	.3610,	.3650,	.3560,	.3490,	.3370,	.3050,	.3160,	.3070,	.3100,	.3080,
9,	.3710,	.3730,	.3720,	.3560,	.3660,	.3310,	.3380,	.3350,	.3280,	.3220,
10,	.4030,	.3790,	.3900,	.3740,	.3600,	.3280,	.3740,	.3620,	.3490,	.3370,
11,	.3650,	.3800,	.3790,	.3660,	.3610,	.3440,	.3720,	.3710,	.3830,	.3630,
12,	.3940,	.3850,	.3990,	.3930,	.3670,	.3430,	.3660,	.3990,	.4110,	.3530,
13,	.4040,	.3900,	.4030,	.3870,	.3790,	.3970,	.3960,	.3960,	.4100,	.3780,
14,	.4060,	.3950,	.4050,	.4000,	.3790,	.3570,	.3770,	.4000,	.4190,	.4000,
15,	.4080,	.4000,	.4070,	.4000,	.3790,	.5100,	.4060,	.4000,	.4090,	.4270,
+gp,	.4100,	.4050,	.4050,	.4000,	.3790,	.5100,	.4060,	.4040,	.4090,	.4270,
0 SOPCOFAC,	1.0024,	.9981,	1.0192,	1.0000,	1.0075,	.9996,	.9995,	1.0020,	.9996,	.9892,

Table 3.5.2.3. Run title : Herring spring-spawn (run: SVPBJA12/V12)
At 6/05/2002 14:07

Table 3 Stock weights-at-age (kg)

YEAR,	1907,	1908,	1909,	1910,	1911,
AGE					
0,	.0010,	.0010,	.0010,	.0010,	.0010,
1,	.0080,	.0080,	.0080,	.0080,	.0080,
2,	.0470,	.0470,	.0470,	.0470,	.0470,
3,	.1000,	.1000,	.1000,	.1000,	.1000,
4,	.1990,	.1990,	.1990,	.1990,	.1990,
5,	.2370,	.2370,	.2370,	.2370,	.2370,
6,	.2670,	.2670,	.2670,	.2670,	.2670,
7,	.2860,	.2860,	.2860,	.2860,	.2860,
8,	.3070,	.3070,	.3070,	.3070,	.3070,
9,	.3150,	.3150,	.3150,	.3150,	.3150,
10,	.3240,	.3240,	.3240,	.3240,	.3240,
11,	.3320,	.3320,	.3320,	.3320,	.3320,
12,	.3390,	.3390,	.3390,	.3390,	.3390,
13,	.3480,	.3480,	.3480,	.3480,	.3480,
14,	.3540,	.3540,	.3540,	.3540,	.3540,
15,	.3680,	.3680,	.3680,	.3680,	.3680,
+gp,	.3700,	.3700,	.3700,	.3700,	.3700,

Table 3 Stock weights-at-age (kg)

YEAR,	1912,	1913,	1914,	1915,	1916,	1917,	1918,	1919,	1920,	1921,
AGE										
0,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,
1,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,
2,	.0470,	.0470,	.0470,	.0470,	.0470,	.0470,	.0470,	.0470,	.0470,	.0470,
3,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,
4,	.1990,	.1990,	.1990,	.1990,	.1990,	.1990,	.1990,	.1990,	.1990,	.1990,
5,	.2370,	.2370,	.2370,	.2370,	.2370,	.2370,	.2370,	.2370,	.2370,	.2370,
6,	.2670,	.2670,	.2670,	.2670,	.2670,	.2670,	.2670,	.2670,	.2670,	.2670,
7,	.2860,	.2860,	.2860,	.2860,	.2860,	.2860,	.2860,	.2860,	.2860,	.2860,
8,	.3070,	.3070,	.3070,	.3070,	.3070,	.3070,	.3070,	.3070,	.3070,	.3070,
9,	.3150,	.3150,	.3150,	.3150,	.3150,	.3150,	.3150,	.3150,	.3150,	.3150,
10,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,
11,	.3320,	.3320,	.3320,	.3320,	.3320,	.3320,	.3320,	.3320,	.3320,	.3320,
12,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,
13,	.3480,	.3480,	.3480,	.3480,	.3480,	.3480,	.3480,	.3480,	.3480,	.3480,
14,	.3540,	.3540,	.3540,	.3540,	.3540,	.3540,	.3540,	.3540,	.3540,	.3540,
15,	.3680,	.3680,	.3680,	.3680,	.3680,	.3680,	.3680,	.3680,	.3680,	.3680,
+gp,	.3700,	.3700,	.3700,	.3700,	.3700,	.3700,	.3700,	.3700,	.3700,	.3700,

1

Table 3 Stock weights-at-age (kg)

YEAR,	1922,	1923,	1924,	1925,	1926,	1927,	1928,	1929,	1930,	1931,
AGE										
0,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,
1,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,
2,	.0470,	.0470,	.0470,	.0470,	.0470,	.0470,	.0470,	.0470,	.0470,	.0470,
3,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,
4,	.1990,	.1990,	.1990,	.1990,	.1990,	.1990,	.1990,	.1990,	.1990,	.1990,
5,	.2370,	.2370,	.2370,	.2370,	.2370,	.2370,	.2370,	.2370,	.2370,	.2370,
6,	.2670,	.2670,	.2670,	.2670,	.2670,	.2670,	.2670,	.2670,	.2670,	.2670,
7,	.2860,	.2860,	.2860,	.2860,	.2860,	.2860,	.2860,	.2860,	.2860,	.2860,
8,	.3070,	.3070,	.3070,	.3070,	.3070,	.3070,	.3070,	.3070,	.3070,	.3070,
9,	.3150,	.3150,	.3150,	.3150,	.3150,	.3150,	.3150,	.3150,	.3150,	.3150,
10,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,	.3240,
11,	.3320,	.3320,	.3320,	.3320,	.3320,	.3320,	.3320,	.3320,	.3320,	.3320,
12,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,	.3390,
13,	.3480,	.3480,	.3480,	.3480,	.3480,	.3480,	.3480,	.3480,	.3480,	.3480,
14,	.3540,	.3540,	.3540,	.3540,	.3540,	.3540,	.3540,	.3540,	.3540,	.3540,
15,	.3680,	.3680,	.3680,	.3680,	.3680,	.3680,	.3680,	.3680,	.3680,	.3680,
+gp,	.3700,	.3700,	.3700,	.3700,	.3700,	.3700,	.3700,	.3700,	.3700,	.3700,

Table 3.5.2.3 Continued.

Table 3 Stock weights-at-age (kg)

YEAR	1932	1933	1934	1935	1936	1937	1938	1939	1940	1941
AGE										
0	.0010	.0010	.0010	.0010	.0010	.0010	.0010	.0010	.0010	.0010
1	.0080	.0080	.0080	.0080	.0080	.0080	.0080	.0080	.0080	.0080
2	.0470	.0470	.0470	.0600	.0600	.0470	.0500	.0600	.0470	.0470
3	.1000	.1000	.1000	.1290	.1230	.1160	.0870	.0980	.1000	.0600
4	.1990	.1990	.1990	.1800	.1570	.1730	.1620	.1720	.1860	.1020
5	.2370	.2370	.2370	.1850	.2010	.1910	.1850	.2050	.2060	.1970
6	.2670	.2670	.2670	.2470	.2290	.2290	.2160	.2180	.2120	.2170
7	.2860	.2860	.2860	.2730	.2700	.2460	.2530	.2390	.2490	.2340
8	.3070	.3070	.3070	.2840	.2980	.2820	.2660	.2640	.2640	.2700
9	.3150	.3150	.3150	.3050	.3070	.2940	.2880	.2760	.2840	.2810
10	.3240	.3240	.3240	.3060	.3180	.3140	.3070	.2920	.2910	.2950
11	.3320	.3320	.3320	.3030	.3260	.3120	.3080	.3110	.3140	.3020
12	.3390	.3390	.3390	.3090	.3200	.3190	.3160	.3000	.3170	.3040
13	.3480	.3480	.3480	.3100	.3250	.3160	.3170	.3110	.3240	.3240
14	.3540	.3540	.3540	.3090	.3300	.3220	.3140	.3090	.3210	.3210
15	.3680	.3680	.3680	.3210	.3350	.3210	.3190	.3080	.3180	.3210
+gp	.3700	.3700	.3700	.3350	.3400	.3350	.3350	.3150	.3300	.3300

Table 3 Stock weights-at-age (kg)

YEAR	1942	1943	1944	1945	1946	1947	1948	1949	1950	1951
AGE										
0	.0010	.0010	.0010	.0010	.0010	.0010	.0010	.0010	.0010	.0010
1	.0080	.0080	.0080	.0080	.0080	.0080	.0080	.0080	.0080	.0080
2	.0470	.0470	.0470	.0470	.0470	.0470	.0470	.0470	.0470	.0470
3	.1000	.1000	.1000	.1000	.1000	.1000	.1190	.1000	.1000	.1000
4	.1990	.1990	.1990	.1990	.1990	.1990	.1940	.1990	.2040	.2040
5	.2370	.2370	.2370	.2370	.2370	.2370	.2230	.2370	.2300	.2300
6	.2670	.2670	.2670	.2670	.2670	.2670	.2780	.2670	.2550	.2550
7	.2860	.2860	.2860	.2860	.2860	.2860	.2970	.2860	.2750	.2750
8	.3070	.3070	.3070	.3070	.3070	.3070	.3050	.3070	.2900	.2900
9	.3150	.3150	.3150	.3150	.3150	.3150	.3040	.3150	.3050	.3050
10	.3240	.3240	.3240	.3240	.3240	.3240	.3120	.3240	.3150	.3150
11	.3320	.3320	.3320	.3320	.3320	.3320	.3160	.3320	.3250	.3250
12	.3390	.3390	.3390	.3390	.3390	.3390	.3260	.3390	.3300	.3300
13	.3480	.3480	.3480	.3480	.3480	.3480	.3310	.3480	.3400	.3400
14	.3540	.3540	.3540	.3540	.3540	.3540	.3330	.3540	.3450	.3450
15	.3680	.3680	.3680	.3680	.3680	.3680	.3490	.3680	.3620	.3620
+gp	.3700	.3700	.3700	.3700	.3700	.3700	.3650	.3700	.3650	.3650

Table 3 Stock weights-at-age (kg)

YEAR	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961
AGE										
0	.0010	.0010	.0010	.0010	.0010	.0010	.0010	.0010	.0010	.0010
1	.0080	.0080	.0080	.0080	.0080	.0080	.0080	.0080	.0080	.0080
2	.0470	.0470	.0470	.0470	.0470	.0470	.0470	.0470	.0470	.0470
3	.1000	.1000	.1000	.1000	.1000	.1000	.1000	.1000	.1000	.1000
4	.2040	.2040	.2040	.1950	.2050	.1360	.2040	.2040	.2040	.2320
5	.2300	.2300	.2300	.2130	.2300	.2280	.2420	.2520	.2700	.2500
6	.2550	.2550	.2550	.2600	.2490	.2550	.2920	.2600	.2910	.2920
7	.2750	.2750	.2750	.2750	.2750	.2620	.2950	.2900	.2930	.3020
8	.2900	.2900	.2900	.2900	.2900	.2900	.2930	.3000	.3210	.3040
9	.3050	.3050	.3050	.3050	.3050	.3050	.3050	.3050	.3180	.3230
10	.3150	.3150	.3150	.3150	.3150	.3150	.3150	.3150	.3200	.3220
11	.3250	.3250	.3250	.3250	.3250	.3250	.3300	.3250	.3440	.3210
12	.3300	.3300	.3300	.3300	.3300	.3300	.3400	.3300	.3490	.3440
13	.3400	.3400	.3400	.3400	.3400	.3400	.3450	.3400	.3700	.3570
14	.3450	.3450	.3450	.3450	.3450	.3450	.3520	.3450	.3790	.3630
15	.3620	.3620	.3620	.3620	.3620	.3620	.3600	.3550	.3750	.3650
+gp	.3650	.3650	.3650	.3650	.3650	.3650	.3650	.3600	.3800	.3700

Table 3.5.2.3 Continued.

Table 3 Stock weights-at-age (kg)

YEAR,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,
AGE										
0,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,
1,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0080,	.0150,
2,	.0470,	.0470,	.0470,	.0470,	.0470,	.0470,	.0470,	.0470,	.0470,	.0800,
3,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,
4,	.2190,	.1850,	.1940,	.1860,	.1850,	.1800,	.1150,	.1150,	.2090,	.1900,
5,	.2910,	.2530,	.2130,	.1990,	.2190,	.2280,	.2060,	.1450,	.2720,	.2250,
6,	.3000,	.2940,	.2640,	.2360,	.2220,	.2690,	.2660,	.2700,	.2300,	.2500,
7,	.3160,	.3120,	.3170,	.2600,	.2490,	.2700,	.2750,	.3000,	.2950,	.2750,
8,	.3240,	.3290,	.3630,	.3630,	.3060,	.2940,	.2740,	.3060,	.3170,	.2900,
9,	.3260,	.3270,	.3530,	.3500,	.3540,	.3240,	.2850,	.3080,	.3230,	.3100,
10,	.3350,	.3340,	.3490,	.3700,	.3770,	.4200,	.3500,	.3180,	.3250,	.3250,
11,	.3380,	.3410,	.3540,	.3600,	.3910,	.4300,	.3250,	.3400,	.3290,	.3350,
12,	.3340,	.3490,	.3570,	.3780,	.3790,	.3660,	.3630,	.3680,	.3800,	.3450,
13,	.3470,	.3410,	.3590,	.3870,	.3780,	.3680,	.4080,	.3600,	.3700,	.3550,
14,	.3540,	.3580,	.3650,	.3900,	.3610,	.4330,	.3880,	.3930,	.3800,	.3650,
15,	.3580,	.3750,	.4020,	.3940,	.3830,	.4140,	.3780,	.3970,	.3910,	.3900,
+gp,	.3580,	.3750,	.4020,	.3940,	.3830,	.4140,	.3780,	.3970,	.3910,	.3900,

Table 3 Stock weights-at-age (kg)

YEAR,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,
AGE										
0,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,
1,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,
2,	.0700,	.0850,	.0850,	.0850,	.0850,	.0850,	.0850,	.0850,	.0850,	.0850,
3,	.1500,	.1700,	.1700,	.1810,	.1810,	.1810,	.1800,	.1780,	.1750,	.1700,
4,	.1500,	.2590,	.2590,	.2590,	.2590,	.2590,	.2940,	.2320,	.2830,	.2240,
5,	.1400,	.3420,	.3420,	.3420,	.3420,	.3430,	.3260,	.3590,	.3470,	.3360,
6,	.2100,	.3840,	.3840,	.3840,	.3840,	.3840,	.3710,	.3850,	.4020,	.3780,
7,	.2400,	.4090,	.4090,	.4090,	.4090,	.4090,	.4090,	.4200,	.4210,	.3870,
8,	.2700,	.4040,	.4440,	.4440,	.4440,	.4440,	.4610,	.4440,	.4650,	.4080,
9,	.3000,	.4610,	.4610,	.4610,	.4610,	.4610,	.4760,	.5050,	.4650,	.3970,
10,	.3250,	.5200,	.5200,	.5200,	.5200,	.5200,	.5200,	.5200,	.5200,	.5200,
11,	.3350,	.5340,	.5430,	.5430,	.5430,	.5430,	.5430,	.5510,	.5340,	.5430,
12,	.3450,	.5000,	.4820,	.4820,	.4820,	.4820,	.5000,	.5000,	.5000,	.5120,
13,	.3550,	.5000,	.4820,	.4820,	.4820,	.4820,	.5000,	.5000,	.5000,	.5120,
14,	.3650,	.5000,	.4820,	.4820,	.4820,	.4820,	.5000,	.5000,	.5000,	.5120,
15,	.3900,	.5000,	.4820,	.4820,	.4820,	.4820,	.5000,	.5000,	.5000,	.5120,
+gp,	.3900,	.5000,	.4820,	.4820,	.4820,	.4820,	.5000,	.5000,	.5000,	.5120,

Table 3 Stock weights-at-age (kg)

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,
AGE										
0,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,
1,	.0100,	.0100,	.0100,	.0100,	.0100,	.0100,	.0150,	.0150,	.0080,	.0110,
2,	.0850,	.0850,	.0850,	.0230,	.0850,	.0550,	.0500,	.1000,	.0480,	.0370,
3,	.1700,	.1550,	.1400,	.1480,	.0540,	.0900,	.0980,	.1540,	.2190,	.1470,
4,	.2040,	.2490,	.2040,	.2340,	.2060,	.1430,	.1350,	.1750,	.1980,	.2100,
5,	.3030,	.3040,	.2950,	.2650,	.2650,	.2410,	.1970,	.2090,	.2580,	.2440,
6,	.3550,	.3680,	.3380,	.3120,	.2890,	.2790,	.2770,	.2520,	.2880,	.3000,
7,	.3830,	.4040,	.3760,	.3460,	.3390,	.2990,	.3150,	.3050,	.3090,	.3240,
8,	.3950,	.4240,	.3950,	.3700,	.3680,	.3160,	.3390,	.3670,	.4280,	.3360,
9,	.4130,	.4370,	.4070,	.3950,	.3910,	.3420,	.3430,	.3770,	.3700,	.3430,
10,	.4530,	.4360,	.4130,	.3970,	.3820,	.3430,	.3590,	.3590,	.4030,	.3820,
11,	.4680,	.4930,	.4220,	.4280,	.3880,	.3620,	.3650,	.3950,	.3870,	.3660,
12,	.5060,	.4950,	.4370,	.4280,	.3950,	.3760,	.3760,	.3960,	.4400,	.4250,
13,	.5060,	.4950,	.4370,	.4280,	.3950,	.3760,	.3760,	.3960,	.4400,	.4250,
14,	.5060,	.4950,	.4370,	.4280,	.3950,	.3760,	.3760,	.3960,	.4400,	.4250,
15,	.5060,	.4950,	.4370,	.4280,	.3950,	.3760,	.3760,	.3960,	.4400,	.4250,
+gp,	.5060,	.4950,	.4370,	.4280,	.3950,	.3760,	.3760,	.3960,	.4400,	.4250,

Table 3.5.2.3 Continued.

Table 3 Stock weights-at-age (kg)

AGE	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,
0,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,	.0010,
1,	.0070,	.0080,	.0100,	.0180,	.0180,	.0180,	.0180,	.0180,	.0180,	.0180,
2,	.0300,	.0250,	.0250,	.0250,	.0250,	.0250,	.0250,	.0250,	.0250,	.0250,
3,	.1280,	.0810,	.0750,	.0660,	.0760,	.0960,	.0740,	.1020,	.1020,	.0750,
4,	.2240,	.2010,	.1510,	.1380,	.1180,	.1180,	.1470,	.1500,	.1500,	.1780,
5,	.2960,	.2650,	.2540,	.2300,	.1880,	.1740,	.1740,	.2230,	.2230,	.2380,
6,	.3270,	.3230,	.3180,	.2960,	.2610,	.2290,	.2170,	.2400,	.2400,	.2470,
7,	.3550,	.3540,	.3710,	.3460,	.3160,	.2860,	.2420,	.2640,	.2640,	.2960,
8,	.3450,	.3580,	.3470,	.3880,	.3460,	.3230,	.2780,	.2830,	.2830,	.3070,
9,	.3670,	.3810,	.4120,	.3630,	.3740,	.3700,	.3040,	.3150,	.3150,	.3140,
10,	.3410,	.3690,	.3820,	.4090,	.3900,	.3780,	.3100,	.3450,	.3450,	.3280,
11,	.3610,	.3960,	.4070,	.4140,	.3900,	.3860,	.3590,	.3860,	.3860,	.3510,
12,	.4300,	.3930,	.4100,	.4220,	.3840,	.3600,	.3400,	.3860,	.3860,	.3760,
13,	.4700,	.3740,	.4100,	.4100,	.3980,	.3930,	.3440,	.3860,	.3860,	.4060,
14,	.4700,	.4030,	.4100,	.4100,	.3980,	.3910,	.3850,	.3820,	.3820,	.4140,
15,	.4700,	.4000,	.4100,	.4050,	.3980,	.3910,	.3630,	.3820,	.3820,	.4250,
+gp,	.4500,	.4000,	.4100,	.4470,	.3980,	.3910,	.3750,	.4070,	.4070,	.4250,

Table 3.5.2.4 Run title : Herring spring-spawn (run: SVPBJA12/V12)

At 6/05/2002 14:07

Table 5 Proportion mature at age

AGE	1907,	1908,	1909,	1910,	1911,
0,	.0000,	.0000,	.0000,	.0000,	.0000,
1,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0300,	.0300,	.0300,	.0300,	.0300,
4,	.1600,	.1600,	.1600,	.1600,	.1600,
5,	.3800,	.3800,	.3800,	.3800,	.3800,
6,	.7400,	.7400,	.7400,	.7400,	.7400,
7,	.9700,	.9700,	.9700,	.9700,	.9700,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
15,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

AGE	1912,	1913,	1914,	1915,	1916,	1917,	1918,	1919,	1920,	1921,
0,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,
4,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,
5,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,
6,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,
7,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
15,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 3.5.2.4 Continued

Table 5 Proportion mature at age

YEAR,	1922,	1923,	1924,	1925,	1926,	1927,	1928,	1929,	1930,	1931,
AGE										
0,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,
4,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,
5,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,
6,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,
7,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
15,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1932,	1933,	1934,	1935,	1936,	1937,	1938,	1939,	1940,	1941,
AGE										
0,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,
4,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,
5,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,
6,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,
7,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
15,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1942,	1943,	1944,	1945,	1946,	1947,	1948,	1949,	1950,	1951,
AGE										
0,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0300,	.0000,	.0000,
4,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1600,	.1000,	.1000,
5,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3800,	.3000,	.3000,
6,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.7400,	.6000,	.6000,
7,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9700,	.9000,	.9000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
15,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 3.5.2.4 Continued

Table 5 Proportion mature at age

YEAR,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,	1961,
AGE										
0,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0000,	.0000,	.0800,	.0800,	.0000,	.0800,	.0800,	.0800,	.0400,
4,	.1000,	.1000,	.1000,	.2200,	.2200,	.0000,	.2200,	.2200,	.2200,	.3500,
5,	.3000,	.3000,	.3000,	.3700,	.3700,	.5000,	.3700,	.3700,	.3700,	.6800,
6,	.6000,	.6000,	.6000,	.8500,	.8500,	.6000,	.8500,	.8500,	.8500,	.9400,
7,	.9000,	.9000,	.9000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
15,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,
AGE										
0,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.0400,	.0200,	.0000,	.0100,	.0000,	.0000,	.6200,	.0600,	.1000,
4,	.1100,	.0300,	.0600,	.3400,	.1500,	.0100,	.0000,	.8900,	.1300,	.2500,
5,	.6700,	.3200,	.2800,	.3500,	1.0000,	.2300,	.0100,	.9500,	.3100,	.6000,
6,	1.0000,	.9000,	.3200,	.7600,	.9600,	1.0000,	.7600,	1.0000,	.1700,	.9000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
15,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,
AGE										
0,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.1000,	.1000,	.1000,	.1000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.0000,	.5000,	.5000,	.5000,	.5000,	.7300,	.1300,	.1000,	.2500,	.3000,
4,	.1000,	.9000,	.9000,	1.0000,	.9000,	.8900,	.9000,	.6200,	.5000,	.5000,
5,	.2500,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9500,	.9700,	.9000,
6,	.6000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	.9000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
15,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 3.5.2.4 Continued

Table 5 Proportion mature at age

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,
AGE										
0,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.4000,	.1000,
4,	.4800,	.5000,	.5000,	.5000,	.2000,	.3000,	.3000,	.3000,	.8000,	.7000,
5,	.7000,	.6900,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,	1.0000,
6,	1.0000,	.7100,	.9500,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	.9000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
15,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 5 Proportion mature at age

YEAR,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,
AGE										
0,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
3,	.1000,	.0100,	.0100,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
4,	.2000,	.3000,	.3000,	.3000,	.3000,	.3000,	.3000,	.3000,	.3000,	.3000,
5,	.8000,	.8000,	.8000,	.8000,	.9000,	.9000,	.9000,	.9000,	.9000,	.9000,
6,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
7,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
8,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
9,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
10,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
11,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
12,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
13,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
14,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
15,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,
+gp,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,	1.0000,

Table 3.5.3a. NSS herring abunance estimates (ISVPA, catch-controlled version)

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1986	2013525	1.94E+07	107269.8	38931.85	42632.48	236469.6	116748.3	72578.17	115674.3	37570.98	83878.16	96589.3	929.7274	0	2773.225
1987	7074454	816667.3	1.62E+07	76005.26	20056.67	22314.09	106118.2	30905.4	23503.38	28125.56	14275.41	10963.53	8915.7	800.2238	0
1988	1642925	2853450	684565	1.35E+07	48095.51	14013.98	12657.91	65360	15467.6	11415.99	20033.04	5019.015	3406.068	1179.61	0
1989	1609794	662153.5	2397611	565962.3	1.11E+07	32627.15	8648.774	5361.698	42726.59	5082.148	7211.451	14129.09	1831.698	0	0
1990	4059823	638423.1	567239.6	2060282	481886.5	9260306	24864.11	6701.875	3984.918	33716.35	3098.598	5577.016	11863.22	1337.199	2529.401
1991	1.16E+07	1640691	532209.2	485761.8	1762284	404693.8	7760490	20204.88	4359.115	1540.965	26779.43	2067.666	4634.116	9668.037	181.73
1992	1.94E+07	4723616	1404327	455497.6	416790.9	1503176	340096.9	6476478	15072.07	3324.235	1245.608	22409.13	0	0	0
1993	5.38E+07	7867894	4053977	1178007	387430.2	357628.4	1282680	287391.4	5364986	10669.06	2268.367	842.9517	18141.02	0	0
1994	6.92E+07	2.19E+07	6745604	3390146	932957.1	325462.5	304429.3	1076549	230075.3	4237209	9182.946	1952.402	725.5352	15614.12	0
1995	2.03E+07	2.81E+07	1.88E+07	5703861	2580299	650115.2	265674.8	254470.1	891962.6	164945.3	3048230	5282.96	1254.614	0	2202.983
1996	6702216	8258058	2.41E+07	1.59E+07	4331555	1629133	345169	214276.4	204316	703010.2	64282.31	1777645	772.0975	0	0
1997	2591987	2705698	7075895	2.01E+07	1.22E+07	2855592	1025282	201153.6	179162.6	169022.6	543768.2	39024.13	753926.3	664.5505	0
1998	3.26E+07	1039913	2207797	5838908	1.56E+07	8650881	1751619	579573.2	116667.4	135634.2	115415.6	384047.2	15849.92	305335.5	0
1999	2.01E+07	1.32E+07	829818.6	1675415	4683896	1.18E+07	6273446	1153714	378262.6	60984.66	93229.61	96112.43	226084.9	0	241710.2
2000	2.71E+07	8186570	1.12E+07	680999.7	1316972	3633062	8698742	4319468	722672	227227.3	39015.44	43095.69	76043.13	112396.8	121761.6
2001	2184578	1.10E+07	6968301	9138455	553733	1030809	2751771	6281703	2748307	420707.8	129160.1	18495.79	16032.1	0	105880.6

Table 3.5.3b. NSS herring: residuals in LnC (ISVPA, catch-controlled version)

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Sum
1986	-0.9681	-0.3528	0.5143	0.6286	0.2002	0.1143	0.3379	0.0184	-0.1646	-0.3628	0.0073	0.0273	0.0000	0.0000	0.0000	0.0000
1987	0.6768	-0.0372	-0.7020	0.6653	-0.0805	0.2279	-0.0991	0.0722	-0.2107	-1.0851	0.0997	0.1457	0.3271	0.0000	0.0000	0.0000
1988	0.9779	0.0778	-0.3240	-0.9221	0.2464	0.2503	0.6894	-0.2732	0.3480	-0.4429	-0.8782	0.2505	0.0000	0.0000	0.0000	0.0000
1989	3.3243	-0.2334	-2.2027	-1.0205	-0.3518	0.6550	0.3700	0.4691	-0.3493	0.9575	-0.1457	-1.5987	0.1263	0.0000	0.0000	0.0001
1990	1.9159	1.6668	-1.0710	-1.5698	-0.6111	-0.8154	-0.2090	1.0512	1.5410	-0.3715	0.6492	-1.2532	-0.9232	0.0000	0.0000	0.0000
1991	0.1379	0.7444	-0.1488	-1.4422	-0.7910	-0.1109	-0.0042	1.2591	0.7795	0.2041	-0.6280	0.0000	0.0000	0.0000	0.0000	0.0000
1992	-1.3399	0.0277	1.2990	-0.1750	-1.9194	-1.1811	-0.5752	-0.0667	1.1637	1.3703	1.3537	0.0429	0.0000	0.0000	0.0000	0.0000
1993	-0.9764	0.0331	1.1124	1.4399	-0.1667	-1.2329	-0.5622	0.2556	0.0974	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1994	-1.6346	-1.3752	0.1131	1.2909	1.3846	-0.2068	-0.9345	-0.8900	0.2843	0.3192	0.9745	0.6743	0.0000	0.0000	0.0000	0.0000
1995	-2.8020	-1.4789	-0.1912	0.8826	1.2954	1.3729	-0.5791	-0.7293	-0.8251	1.0978	0.5212	1.4357	0.0000	0.0000	0.0000	0.0000
1996	1.3607	-0.9973	0.0545	0.5575	0.9386	0.7913	0.8289	-1.8116	-1.8266	-0.8158	0.2040	0.7158	0.0000	0.0000	0.0000	0.0000
1997	1.4060	0.8711	-0.2680	-0.1274	0.0730	0.2766	0.3086	0.0425	-1.2768	-0.6846	-0.8735	0.1747	0.0778	0.0000	0.0000	0.0000
1998	0.4560	1.4553	1.0311	-0.2288	-0.0547	-0.0791	0.1745	-0.0113	0.1509	-0.4645	-2.3368	-0.0929	0.0000	0.0000	0.0000	0.0000
1999	-1.5712	-0.1187	0.3923	0.3092	0.0354	0.1410	0.3091	0.4022	0.1832	0.0728	0.6148	-1.1625	0.3923	0.0000	0.0000	0.0000
2000	-0.9633	-0.2827	0.3909	-0.2881	-0.1984	-0.2033	-0.0552	0.2120	0.1050	0.2054	0.4375	0.6404	0.0000	0.0000	0.0000	0.0000
2001	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	0.0000
Sum:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0000	0.0000	

Table 3.5.4a. NSS herring abunance estimates (ISVPA, mixed version)

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1986	1729057	1.84E+07	77275.87	31450.36	35044.25	240976.8	105396.4	75758.98	125522.7	38213.44	83726.01	95974.56	845.9818	0	2461.832
1987	9110194	699773.9	1.53E+07	54417.63	16783.37	17318.59	110352.7	27580.53	25051.71	34743.4	13619.37	10470.87	8312.122	728.1432	0
1988	2589818	3685238	585041.1	1.25E+07	34450.73	11254.92	9294.003	66647.31	13065.58	11664.38	21955.27	4573.865	3119.935	1080.514	0
1989	1790508	1048366	3108509	478090.7	9.88E+06	22516.69	6778.361	3886.833	41547.18	4054.417	6790.412	13777.88	1629.298	0	0
1990	2954574	719610.1	898315.7	2653642	402464.1	8149517	17118.11	5239.717	2868.019	31987.33	2615.14	5154.343	10949.5	1177.036	2226.442
1991	9.21E+06	1195748	608828.6	765991.3	2242331	332985	6684376	13573.71	3568.018	1307.388	24762.14	1791.219	4061.418	8473.233	159.2713
1992	1.68E+07	3741497	1023881	520925.4	653956.3	1902321	278321.1	5554257	10258.68	2763.83	1053.968	20372.91	0	0	0
1993	5.35E+07	6843407	3209874	862631.8	442660.5	555878.3	1606813	232610.3	4569331	7376.394	2006.808	761.3606	16385.12	0	0
1994	7.48E+07	2.17E+07	5866121	2699992	694420.3	371365.3	467415.8	1337727	185740	3584609	6348.921	1727.275	655.3091	14102.8	0
1995	2.28E+07	3.04E+07	1.86E+07	4957164	2114118	504471.3	301688.2	383130.3	1079642	132028.9	2582619	3708.487	1158.045	0	2033.418
1996	6937068	9247513	2.60E+07	1.57E+07	3866533	1445604	300383.1	237618.4	299537.4	809256.7	61020.06	1548286	771.6663	0	0
1997	2797130	2808473	7899107	2.17E+07	1.24E+07	2728313	973645.8	190213.2	185553.5	227084.8	593411.3	37711.97	741824.2	664.1794	0
1998	3.69E+07	1128632	2332725	6504166	1.69E+07	8872241	1735327	576977.7	109974.6	123226.4	147623.9	377825.3	15846.37	305267.1	0
1999	2.37E+07	1.49E+07	931168.6	1854635	5203083	1.29E+07	6425061	1169838	377074.3	58495.1	78775.3	108144.6	216931.2	0	242779.5
2000	3.28E+07	9625175	1.27E+07	773151.9	1485405	4074764	9635851	4585612	778425.3	234310.9	37721.47	39385.1	78942.93	116682.9	126404.8
2001	2683360	1.33E+07	8192863	10516930	627082.9	1162420	3083357	7035042	3061532	475979.9	141511.7	19924.19	17471.92	0	115389.7

Table 3.5.4.b. NSS herring: residuals in LnC (ISVPA, mixed version)

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Sum
1986	-0.8152	-0.3130	0.7990	0.7774	0.3154	0.0105	0.3489	-0.1164	-0.3435	-0.4614	-0.1047	-0.0971	0.0000	0.0000	0.0000	0.0000
1987	0.4491	0.1280	-0.6592	0.9595	0.0417	0.4211	-0.2049	0.1188	-0.3469	-1.3534	0.0577	0.0857	0.3028	0.0000	0.0000	0.0000
1988	0.5547	-0.1606	-0.1788	-0.8752	0.5308	0.4159	0.9383	-0.3532	0.4510	-0.5147	-1.0522	0.2440	0.0000	0.0000	0.0000	0.0000
1989	3.2307	-0.6946	-2.4934	-0.9041	-0.3029	0.9532	0.5346	0.7112	-0.4062	1.1140	-0.1870	-1.6920	0.1365	0.0000	0.0000	0.0000
1990	2.2257	1.5247	-1.5824	-1.8960	-0.5202	-0.7810	0.0645	1.1970	1.7642	-0.4090	0.6966	-1.3135	-0.9707	0.0000	0.0000	0.0000
1991	0.3587	1.0339	-0.3393	-1.9750	-1.1254	-0.0136	0.0409	1.5522	0.8698	0.2740	-0.6762	0.0000	0.0000	0.0000	0.0000	0.0000
1992	-1.2134	0.2335	1.5584	-0.3872	-2.4640	-1.5149	-0.4795	-0.0183	1.4379	1.4599	1.3937	-0.0060	0.0000	0.0000	0.0000	0.0000
1993	-0.9356	0.1924	1.3364	1.7206	-0.3470	-1.7252	-0.8451	0.4090	0.1945	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1994	-1.6952	-1.3652	0.2269	1.4712	1.6165	-0.4063	-1.4373	-1.1818	0.4185	0.4221	1.2471	0.6834	0.0000	0.0000	0.0000	0.0000
1995	-2.8763	-1.5319	-0.1864	0.9973	1.4530	1.5806	-0.7585	-1.1914	-1.0742	1.2777	0.6122	1.6978	0.0000	0.0000	0.0000	0.0000
1996	1.4242	-1.0271	0.0342	0.6016	1.0688	0.9233	0.9740	-1.9095	-2.2089	-0.9408	0.2397	0.8206	0.0000	0.0000	0.0000	0.0000
1997	1.4490	0.9384	-0.3027	-0.1509	0.0973	0.3558	0.3875	0.1251	-1.2904	-0.9430	-0.9561	0.1968	0.0934	0.0000	0.0000	0.0000
1998	0.4511	1.4783	1.0517	-0.2824	-0.0943	-0.0704	0.2114	0.0203	0.2317	-0.3313	-2.5778	-0.0884	0.0000	0.0000	0.0000	0.0000
1999	-1.6096	-0.1346	0.3574	0.2665	-0.0269	0.0974	0.3174	0.4200	0.2127	0.1563	0.7930	-1.2877	0.4381	0.0000	0.0000	0.0000
2000	-0.9979	-0.3021	0.3781	-0.3231	-0.2429	-0.2465	-0.0923	0.2169	0.0900	0.2496	0.5140	0.7563	0.0000	0.0000	0.0000	0.0000
2001	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	0.0000
Sum:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	

Table 3.5.4c. NSS herring: final weights of catch-controlled routine in mixed version of ISVPA.
77 - as for terminal points

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1986	0.503	0.522	0.558	0.627	0.702	0.777	0.826	0.902	0.995	0.984	0.997	1	1	77	77
1987	0.502	0.514	0.535	0.576	0.619	0.664	0.694	0.746	0.849	0.826	0.853	0.870	0.902	77	77
1988	0.502	0.511	0.528	0.560	0.594	0.629	0.653	0.694	0.778	0.758	0.782	0.797	77.000	77	77
1989	0.500	0.503	0.508	0.516	0.525	0.533	0.539	0.548	0.568	0.564	0.569	0.573	0.580	77	77
1990	0.500	0.503	0.508	0.516	0.525	0.534	0.539	0.549	0.570	0.565	0.571	0.574	0.582	77	77
1991	0.500	0.501	0.503	0.507	0.511	0.515	0.517	0.521	0.530	0.528	0.530	77	77	77	77
1992	0.500	0.501	0.504	0.508	0.512	0.516	0.518	0.523	0.532	0.530	0.532	0.534	77	77	77
1993	0.500	0.502	0.505	0.510	0.515	0.520	0.524	0.529	0.541	1	1	1	1	77	77
1994	0.500	0.503	0.508	0.517	0.526	0.535	0.541	0.551	0.573	0.568	0.574	0.577	77	77	77
1995	0.501	0.505	0.512	0.526	0.539	0.553	0.563	0.579	0.612	0.604	0.614	0.620	77	77	77
1996	0.501	0.506	0.514	0.530	0.547	0.564	0.575	0.594	0.635	0.625	0.636	0.644	1	77	77
1997	0.501	0.510	0.526	0.554	0.585	0.616	0.637	0.674	0.750	0.732	0.753	0.767	0.794	77	77
1998	0.501	0.508	0.520	0.542	0.565	0.589	0.605	0.633	0.690	0.677	0.693	0.704	77	77	77
1999	0.501	0.506	0.515	0.531	0.548	0.565	0.576	0.596	0.637	0.627	0.639	0.646	0.661	77	77
2000	0.501	0.506	0.517	0.535	0.554	0.573	0.586	0.608	0.655	0.644	0.657	0.666	77	77	77
2001	77	77	77	77	77	77	77	77	77	77	77	77	77	77	77

Table 3.5.6.1 Run title : Herring spring-spawn (run: SVPBJA12/V12)
At 6/05/2002 14:08

Table 8 Fishing mortality (F) at age

YEAR,	1907,	1908,	1909,	1910,	1911,
AGE					
0,	.0060,	.0177,	.0371,	.0305,	.0654,
1,	.0293,	.0296,	.0541,	.0334,	.1436,
2,	.0040,	.0160,	.0307,	.0453,	.0552,
3,	.0175,	.0327,	.1117,	.0532,	.0588,
4,	.0955,	.0038,	.0002,	.0119,	.0002,
5,	.2289,	.0399,	.0109,	.0040,	.0030,
6,	.1957,	.1472,	.0540,	.0157,	.0090,
7,	.2109,	.1633,	.0709,	.0371,	.0189,
8,	.2636,	.1639,	.0893,	.0537,	.0241,
9,	.2815,	.2072,	.1494,	.0869,	.0400,
10,	.1830,	.5709,	.3059,	.0713,	.0614,
11,	.1990,	.3494,	.4794,	.1133,	.0329,
12,	.1963,	.5043,	.3116,	.2689,	.0418,
13,	.0757,	.3057,	.3154,	.1366,	.0801,
14,	.0587,	.0936,	.2761,	.1000,	.0000,
15,	.0000,	.1000,	.1000,	.1000,	.0000,
+gp,	.0000,	.1000,	.1000,	.1000,	.0000,
0 FBAR 2-13,	.1626,	.2087,	.1608,	.0748,	.0354,

Table 8 Fishing mortality (F) at age

YEAR,	1912,	1913,	1914,	1915,	1916,	1917,	1918,	1919,	1920,	1921,
AGE										
0,	.0662,	.0484,	.0816,	.0570,	.0494,	.0355,	.0211,	.0544,	.0192,	.0270,
1,	.1256,	.0327,	.2422,	.1490,	.0589,	.0534,	.0538,	.0641,	.0641,	.0723,
2,	.0496,	.0278,	.0330,	.0485,	.0253,	.0399,	.0536,	.0404,	.0124,	.0173,
3,	.0352,	.0424,	.0462,	.0185,	.0539,	.0771,	.0450,	.0438,	.0224,	.0139,
4,	.0008,	.0031,	.0040,	.0027,	.0155,	.0478,	.0083,	.0227,	.0072,	.0020,
5,	.0015,	.0043,	.0094,	.0187,	.0265,	.0331,	.0792,	.0407,	.0199,	.0263,
6,	.0047,	.0053,	.0098,	.0140,	.0408,	.0156,	.0403,	.1655,	.0244,	.0100,
7,	.0085,	.0041,	.0057,	.0101,	.0159,	.0228,	.0264,	.0537,	.1285,	.0190,
8,	.0202,	.0106,	.0115,	.0054,	.0116,	.0114,	.0434,	.0229,	.0403,	.1087,
9,	.0490,	.0440,	.0161,	.0136,	.0073,	.0076,	.0216,	.0341,	.0243,	.0329,
10,	.0576,	.0499,	.0409,	.0166,	.0148,	.0047,	.0122,	.0208,	.0287,	.0180,
11,	.0837,	.1612,	.0830,	.0528,	.0184,	.0116,	.0089,	.0139,	.0119,	.0189,
12,	.0462,	.0507,	.2348,	.0801,	.0457,	.0145,	.0285,	.0081,	.0072,	.0135,
13,	.0539,	.3291,	.2409,	.0982,	.0571,	.0427,	.0281,	.0206,	.0068,	.0081,
14,	.1000,	.0000,	.2081,	.1045,	.0795,	.0495,	.0804,	.0081,	.0120,	.0038,
15,	.1000,	.0000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,
+gp,	.1000,	.0000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,
0 FBAR 2-13,	.0342,	.0610,	.0613,	.0316,	.0277,	.0274,	.0329,	.0406,	.0278,	.0240,

1

Table 8 Fishing mortality (F) at age

YEAR,	1922,	1923,	1924,	1925,	1926,	1927,	1928,	1929,	1930,	1931,
AGE										
0,	.0202,	.0071,	.0106,	.0122,	.0370,	.0865,	.1583,	.1047,	.0611,	.0347,
1,	.0241,	.0153,	.0291,	.0194,	.0824,	.3101,	.0981,	.5273,	.0287,	.1346,
2,	.0306,	.0094,	.0056,	.0033,	.0029,	.0072,	.0572,	.0705,	.0983,	.0099,
3,	.0718,	.0185,	.0047,	.0050,	.0057,	.0075,	.0692,	.2113,	.0257,	.0501,
4,	.0066,	.0069,	.0035,	.0038,	.0013,	.0098,	.0079,	.0131,	.0136,	.0015,
5,	.0501,	.0364,	.0160,	.0084,	.0259,	.0129,	.0208,	.0176,	.0145,	.0110,
6,	.0404,	.0491,	.0348,	.0204,	.0093,	.0156,	.0194,	.0231,	.0159,	.0252,
7,	.0063,	.0401,	.0541,	.0500,	.0233,	.0111,	.0185,	.0254,	.0350,	.0185,
8,	.0284,	.0104,	.0392,	.0816,	.0460,	.0318,	.0206,	.0158,	.0406,	.0285,
9,	.1207,	.0301,	.0167,	.0682,	.0939,	.0635,	.0676,	.0277,	.0296,	.0301,
10,	.0232,	.1332,	.0304,	.0258,	.0575,	.1094,	.0487,	.0843,	.0503,	.0222,
11,	.0196,	.0197,	.0778,	.0356,	.0269,	.0719,	.0718,	.0460,	.0954,	.0299,
12,	.0201,	.0250,	.0112,	.1245,	.0436,	.0314,	.0456,	.0825,	.1038,	.0560,
13,	.0174,	.0153,	.0160,	.0187,	.1354,	.0759,	.0441,	.0396,	.1482,	.0976,
14,	.0132,	.0159,	.0109,	.0188,	.0150,	.1039,	.0592,	.0371,	.0670,	.0793,
15,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,
+gp,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,
0 FBAR 2-13,	.0363,	.0328,	.0258,	.0371,	.0393,	.0373,	.0409,	.0547,	.0559,	.0317,

Table 3.5.6.1 Continued

Table 8 Fishing mortality (F) at age

YEAR,	1932,	1933,	1934,	1935,	1936,	1937,	1938,	1939,	1940,	1941,
AGE										
0,	.0754,	.0643,	.0371,	.0171,	.0436,	.0233,	.0135,	.0225,	.0885,	.0795,
1,	.1384,	.1496,	.0566,	.1069,	.0771,	.0523,	.0408,	.0637,	.2132,	.1933,
2,	.0244,	.0570,	.0616,	.0106,	.0089,	.0022,	.0035,	.0046,	.0048,	.0149,
3,	.0070,	.1561,	.0767,	.0186,	.0089,	.0099,	.0043,	.0072,	.0099,	.0250,
4,	.0268,	.0072,	.0023,	.0177,	.0327,	.0123,	.0081,	.0019,	.0006,	.0006,
5,	.0049,	.0284,	.0436,	.1100,	.0740,	.0727,	.0360,	.0087,	.0018,	.0020,
6,	.0301,	.0071,	.0422,	.0797,	.2143,	.0493,	.1503,	.0396,	.0314,	.0041,
7,	.0359,	.0430,	.0066,	.0724,	.1212,	.2484,	.0727,	.1206,	.0359,	.0334,
8,	.0197,	.0463,	.0246,	.0105,	.0796,	.1075,	.3685,	.0535,	.1393,	.0232,
9,	.0419,	.0312,	.0247,	.0695,	.0164,	.0681,	.1017,	.2792,	.0449,	.0723,
10,	.0471,	.0465,	.0150,	.0545,	.0888,	.0239,	.1239,	.0363,	.4191,	.0326,
11,	.0260,	.0474,	.0213,	.0340,	.0585,	.0642,	.0145,	.1263,	.0273,	.2411,
12,	.0343,	.0269,	.0273,	.0542,	.0402,	.0668,	.1019,	.0208,	.1694,	.0560,
13,	.0436,	.0309,	.0096,	.0668,	.0568,	.0386,	.0624,	.0424,	.0154,	.0629,
14,	.1111,	.0197,	.0078,	.0184,	.0608,	.0454,	.0322,	.0419,	.0173,	.0122,
15,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,
+gp,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,
0 FBAR 2-13,	.0285,	.0440,	.0296,	.0499,	.0667,	.0637,	.0873,	.0618,	.0750,	.0473,

Table 8 Fishing mortality (F) at age

YEAR,	1942,	1943,	1944,	1945,	1946,	1947,	1948,	1949,	1950,	1951,
AGE										
0,	.1040,	.0380,	.0158,	.0492,	.0383,	.0204,	.0368,	.0724,	.0104,	.0181,
1,	.1722,	.0573,	.0374,	.0904,	.1031,	.0592,	.0903,	.1763,	.1217,	.0390,
2,	.0191,	.0198,	.0097,	.0101,	.0064,	.0083,	.0104,	.0094,	.0658,	.0661,
3,	.0296,	.0315,	.0114,	.0106,	.0101,	.0101,	.0198,	.0185,	.0278,	.0013,
4,	.0003,	.0030,	.0042,	.0085,	.0154,	.0214,	.0415,	.0240,	.0508,	.0465,
5,	.0022,	.0049,	.0055,	.0172,	.0118,	.0207,	.0950,	.0542,	.0042,	.0581,
6,	.0047,	.0129,	.0122,	.0116,	.0195,	.0131,	.0363,	.0610,	.0709,	.0440,
7,	.0077,	.0059,	.0159,	.0150,	.0160,	.0199,	.0224,	.0201,	.0884,	.0839,
8,	.0427,	.0065,	.0084,	.0235,	.0216,	.0127,	.0247,	.0110,	.0446,	.1085,
9,	.0226,	.0242,	.0103,	.0119,	.0332,	.0197,	.0196,	.0163,	.0346,	.0527,
10,	.0646,	.0180,	.0331,	.0173,	.0282,	.0276,	.0331,	.0147,	.0375,	.0390,
11,	.0409,	.0341,	.0225,	.0596,	.0230,	.0277,	.0465,	.0166,	.0369,	.0427,
12,	.2101,	.0388,	.0381,	.0296,	.0885,	.0209,	.0466,	.0300,	.0379,	.0556,
13,	.0136,	.0852,	.0595,	.0586,	.0373,	.0744,	.0424,	.0319,	.0666,	.0602,
14,	.0925,	.0078,	.0433,	.0319,	.0519,	.0265,	.1200,	.0203,	.0780,	.0787,
15,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.0459,	.0697,
+gp,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.1000,	.0459,	.0697,
0 FBAR 2-13,	.0382,	.0237,	.0192,	.0228,	.0259,	.0231,	.0365,	.0256,	.0472,	.0549,

Table 8 Fishing mortality (F) at age

YEAR,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,	1961,
AGE										
0,	.2455,	.1082,	.4996,	.3874,	.3407,	.3741,	.6958,	.0689,	.1068,	.1360,
1,	.2826,	.2894,	.4172,	.5567,	.5949,	.8899,	.9181,	.7079,	.1421,	.4130,
2,	.0160,	.0533,	.1521,	.0987,	.5132,	.2514,	1.2034,	.5811,	.6955,	.0835,
3,	.0118,	.0171,	.0449,	.0320,	.0426,	.0462,	.0414,	.1057,	.7587,	.1583,
4,	.0141,	.0165,	.0396,	.0570,	.1079,	.1763,	.0431,	.0781,	.1696,	.0927,
5,	.0908,	.0279,	.0612,	.0692,	.0806,	.0844,	.0689,	.0769,	.1041,	.0497,
6,	.0565,	.0674,	.0799,	.0605,	.1097,	.0736,	.0612,	.1160,	.0916,	.0705,
7,	.0673,	.0415,	.1184,	.0808,	.0723,	.1105,	.0785,	.0990,	.0985,	.0928,
8,	.0779,	.0448,	.0800,	.0854,	.1111,	.0587,	.0689,	.1249,	.0804,	.0802,
9,	.0873,	.0810,	.1009,	.0666,	.1049,	.0891,	.0714,	.0987,	.1403,	.0675,
10,	.0668,	.1173,	.1476,	.1270,	.1307,	.0930,	.1105,	.1140,	.1357,	.0118,
11,	.0490,	.0645,	.1846,	.1325,	.1759,	.1163,	.1330,	.1475,	.1449,	.1118,
12,	.0544,	.0641,	.1175,	.1098,	.1647,	.1469,	.1741,	.1777,	.2138,	.1117,
13,	.0682,	.0584,	.0886,	.1012,	.1147,	.1209,	.1249,	.2207,	.1925,	.1012,
14,	.0545,	.0789,	.1039,	.0949,	.1424,	.1208,	.0736,	.1678,	.2032,	.1069,
15,	.0726,	.0782,	.1304,	.1044,	.1295,	.1000,	.0820,	.1127,	.1387,	.1057,
+gp,	.0726,	.0782,	.1304,	.1044,	.1295,	.1000,	.0820,	.1127,	.1387,	.1057,
0 FBAR 2-13,	.0550,	.0545,	.1013,	.0851,	.1440,	.1139,	.1816,	.1617,	.2355,	.0860,

Table 3.5.6.1 Continued

Table 8 Fishing mortality (F) at age

YEAR,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,
AGE										
0,	.3679,	.0451,	.0621,	.5500,	.1392,	.1961,	.7997,	.0921,	.3347,	.2441,
1,	.2658,	.9250,	.0665,	.1786,	.7192,	1.7622,	.7439,	1.6597,	.2501,	.4295,
2,	.0871,	.4621,	.5117,	.1927,	.2389,	.3323,	.6937,	1.7485,	1.2205,	.1204,
3,	.1028,	.1240,	.0612,	.6736,	.3137,	.5034,	3.2066,	2.0406,	.5307,	.2855,
4,	.0525,	.0588,	.0840,	.1789,	.4084,	1.1192,	4.5599,	.2604,	1.4843,	.1419,
5,	.0442,	.0424,	.1886,	.1573,	.5321,	.8588,	4.7169,	.7590,	.2998,	.3119,
6,	.1096,	.0310,	.1391,	.2997,	.5982,	1.3102,	1.8057,	.6023,	.6842,	.2794,
7,	.1213,	.0697,	.0309,	.2829,	.7536,	1.6834,	1.2122,	.3507,	1.1086,	.4857,
8,	.0718,	.1458,	.0724,	.4469,	1.3073,	1.4826,	.9377,	.4226,	1.1726,	1.6241,
9,	.0976,	.0700,	.2847,	.2419,	.9789,	1.3296,	1.5726,	.6056,	1.1825,	2.5238,
10,	.0907,	.2443,	.3074,	.3472,	1.3384,	1.4496,	1.2945,	.6310,	1.3751,	1.9510,
11,	.1256,	.2153,	.3356,	.8375,	1.0666,	1.0769,	1.3204,	.6261,	1.5563,	2.2737,
12,	.1666,	.2626,	.2856,	.6639,	.5451,	1.2609,	.7690,	.8732,	3.9033,	1.8357,
13,	.1302,	.2729,	.3657,	.6932,	1.3723,	1.1286,	1.9490,	.3927,	1.6255,	.2170,
14,	.1628,	.3429,	.3634,	.6227,	1.4701,	1.9718,	1.2342,	.8364,	.8120,	2.7742,
15,	.1466,	.2569,	.3195,	.6204,	1.1880,	1.4777,	1.3620,	.5776,	1.4061,	2.0280,
+gp,	.1466,	.2569,	.3195,	.6204,	1.1880,	1.4777,	1.3620,	.5776,	1.4061,	2.0280,
0 FBAR 2-13,	.1000,	.1666,	.2223,	.4180,	.7878,	1.1279,	2.0032,	.7761,	1.3453,	1.0042,

Table 8 Fishing mortality (F) at age

YEAR,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,
AGE										
0,	.7939,	.0035,	.0118,	.0159,	.0030,	.0130,	.0050,	.0040,	.0068,	.0116,
1,	1.7489,	.0323,	.0023,	.0016,	.0031,	.0023,	.0018,	.0023,	.0002,	.0027,
2,	.9309,	.7288,	.0937,	.0013,	.0013,	.0099,	.0011,	.0035,	.0006,	.0089,
3,	.0983,	.4069,	.1233,	.1561,	.0300,	.0432,	.0171,	.0103,	.0210,	.0110,
4,	1.2887,	.0893,	.0609,	.2243,	.3938,	.0365,	.0286,	.0124,	.0110,	.0178,
5,	.9578,	.8552,	.1115,	.3212,	.0022,	.0354,	.0379,	.0192,	.0179,	.0193,
6,	1.8090,	1.5110,	.9654,	.1880,	.0005,	.0026,	.1147,	.0251,	.0272,	.0205,
7,	1.2502,	1.1078,	.7734,	.0379,	.1083,	.2687,	.0030,	.0544,	.0426,	.0179,
8,	2.9486,	1.3527,	.0086,	.0141,	.0090,	.1158,	.7485,	.0035,	.0920,	.0268,
9,	1.7610,	.0147,	.0192,	.0101,	.0083,	.0106,	.0690,	.0021,	.0333,	.0916,
10,	.0388,	.0293,	.0174,	.0228,	.0119,	.0097,	.0124,	.0427,	.0025,	.6964,
11,	1.5553,	.0471,	.0351,	.0206,	.0271,	.0140,	.0114,	.0146,	.0553,	.3917,
12,	2.0473,	.0090,	.0576,	.0424,	.0244,	.0325,	.0165,	.0134,	.0173,	.0240,
13,	1.1132,	.0136,	.0105,	.0714,	.0517,	.0291,	.0391,	.0195,	.0158,	.0205,
14,	.3301,	1.2442,	.0161,	.0124,	.0899,	.0636,	.0350,	.0474,	.0232,	.0186,
15,	2.1062,	.6032,	.0165,	.0190,	.0146,	.1157,	.0793,	.0422,	.0581,	.0276,
+gp,	2.1062,	.6032,	.0165,	.0190,	.0146,	.1157,	.0793,	.0422,	.0581,	.0276,
0 FBAR 2-13,	1.3166,	.5138,	.1897,	.0925,	.0557,	.0507,	.0916,	.0184,	.0280,	.1122,

Table 8 Fishing mortality (F) at age

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,
AGE										
0,	.0148,	.0005,	.0045,	.0006,	.0018,	.0022,	.0010,	.0001,	.0000,	.0000,
1,	.0038,	.0076,	.0000,	.0043,	.0001,	.0021,	.0011,	.0003,	.0000,	.0001,
2,	.0012,	.0144,	.0101,	.0052,	.0025,	.0043,	.0073,	.0241,	.0058,	.0004,
3,	.0182,	.0340,	.0701,	.1654,	.0238,	.0285,	.0132,	.0041,	.0321,	.0056,
4,	.0247,	.0333,	.0705,	.3436,	.1875,	.0264,	.0435,	.0009,	.0044,	.0057,
5,	.0207,	.0357,	.1211,	.3000,	.5875,	.2929,	.0347,	.0117,	.0034,	.0027,
6,	.0166,	.0339,	.0841,	.3781,	.4797,	.2553,	.2236,	.0245,	.0266,	.0049,
7,	.0216,	.0214,	.0853,	.3991,	.5624,	.3946,	.4372,	.1131,	.0203,	.0260,
8,	.0238,	.0169,	.0592,	.5933,	1.2624,	.2676,	.6414,	.1497,	.0531,	.0233,
9,	.0233,	.0257,	.1171,	.3356,	1.2486,	.6434,	.2055,	.1275,	.4384,	.1310,
10,	.0399,	.0338,	.1136,	.2228,	.8276,	1.0630,	1.4616,	.0619,	.6363,	.2163,
11,	.5462,	.0575,	.0359,	.3073,	.8219,	.0924,	1.0588,	.9170,	.0559,	.0455,
12,	.1999,	2.2586,	.0005,	.3953,	2.0562,	.9048,	.0876,	.7529,	1.6749,	.0193,
13,	.0035,	3.2773,	.2937,	.0006,	2.1502,	1.5336,	.8806,	.0102,	.4237,	1.6296,
14,	.0243,	.0298,	.2407,	.5035,	.0007,	1.4985,	4.7159,	.1734,	.0220,	1.9531,
15,	.0221,	.0290,	.0698,	.3792,	1.3962,	.4168,	.3809,	.0897,	.1527,	.0238,
+gp,	.0221,	.0290,	.0698,	.3792,	1.3962,	.4168,	.3809,	.0897,	.1527,	.0238,
0 FBAR 2-13,	.0783,	.4869,	.0884,	.2872,	.8509,	.4589,	.4246,	.1831,	.2812,	.1759,

Table 3.5.6.1 Continued

Table 8 Fishing mortality (F) at age

YEAR,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	FBAR 99-**
AGE											
0,	.0000,	.0001,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
1,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,	.0000,
2,	.0001,	.0002,	.0002,	.0001,	.0080,	.0176,	.0070,	.0012,	.0053,	.0510,	.0192,
3,	.0028,	.0034,	.0015,	.0024,	.0051,	.0626,	.1051,	.0205,	.0356,	.0680,	.0414,
4,	.0257,	.0279,	.0156,	.0186,	.0345,	.0484,	.1499,	.0679,	.1031,	.0840,	.0850,
5,	.0119,	.0831,	.1186,	.1092,	.1043,	.1082,	.0815,	.1105,	.0829,	.1010,	.0981,
6,	.0027,	.0244,	.2105,	.2954,	.2258,	.1767,	.1394,	.1221,	.1181,	.1180,	.1194,
7,	.0047,	.0095,	.0532,	.4787,	.2934,	.2719,	.1536,	.1724,	.1532,	.1350,	.1536,
8,	.0200,	.0135,	.0251,	.0653,	.3851,	.3828,	.2010,	.1955,	.1948,	.1520,	.1808,
9,	.0286,	.0791,	.0202,	.0593,	.0291,	.3874,	.2435,	.2200,	.2550,	.1760,	.2170,
10,	.1762,	.0632,	.2018,	.0452,	.0335,	.1288,	.4836,	.3025,	.2394,	.1790,	.2403,
11,	.4904,	.0001,	.1270,	.9284,	.0522,	.1911,	.2255,	.2844,	.3244,	.1130,	.2406,
12,	.1664,	.0012,	.3500,	.2510,	.4705,	.0891,	.0267,	.6202,	.5558,	.1600,	.4454,
13,	.0413,	.0009,	.9446,	1.1850,	.3619,	1.3907,	.1446,	.0672,	.8315,	.2070,	.3686,
14,	.0483,	.0000,	.1000,	4.0282,	.0007,	.2543,	6.3344,	.1534,	.3020,	.2540,	.2365,
15,	.0286,	.0592,	.1000,	.0000,	.3033,	.2616,	.1040,	.1300,	.0780,	.0000,	.0693,
+gp,	.0286,	.0592,	.1000,	.0000,	.3033,	.2616,	.1040,	.1300,	.0780,	.0000,	
0 FBAR 2-13,	.0809,	.0255,	.1724,	.2865,	.1670,	.2713,	.1634,	.1820,	.2416,	.1287,	

Table 3.5.6.2 Run title : Herring spring-spawn (run: SVPBJA12/V12)
At 6/05/2002 14:08

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

YEAR,	1907,	1908,	1909,	1910,	1911,
AGE					
0,	1643653,	1149111,	604944,	879716,	539051,
1,	497680,	664293,	458975,	237005,	346913,
2,	408242,	196496,	262198,	176776,	93197,
3,	286811,	165312,	78618,	103382,	68686,
4,	18210,	242589,	137712,	60516,	84372,
5,	6745,	14246,	208004,	118504,	51472,
6,	6213,	4618,	11782,	177086,	101595,
7,	4943,	4397,	3430,	9607,	150052,
8,	6209,	3445,	3215,	2750,	7968,
9,	1033,	4106,	2517,	2530,	2243,
10,	1026,	671,	2873,	1866,	1997,
11,	703,	736,	326,	1821,	1495,
12,	921,	496,	446,	174,	1399,
13,	923,	652,	258,	281,	114,
14,	655,	736,	413,	162,	211,
15,	0,	532,	577,	270,	126,
+gp,	0,	0,	0,	0,	0,
0 TOTAL,	2883967,	2452434,	1776288,	1772448,	1450895,

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

YEAR,	1912,	1913,	1914,	1915,	1916,	1917,	1918,	1919,	1920,	1921,
AGE										
0,	949725,	981538,	433684,	522640,	919982,	831067,	2751370,	1127752,	1560332,	1448895,
1,	205280,	361383,	380200,	162505,	200721,	356018,	326112,	1095233,	434238,	622295,
2,	122182,	73606,	142206,	121332,	56922,	76939,	137221,	125646,	417638,	165580,
3,	35857,	47272,	29104,	55938,	46994,	22564,	30058,	52879,	49063,	167707,
4,	55744,	29796,	38997,	23919,	47266,	38326,	17979,	24733,	43565,	41293,
5,	72605,	47942,	25567,	33432,	20533,	40058,	31447,	15348,	20811,	37227,
6,	44169,	62398,	41089,	21800,	28242,	17210,	33358,	25006,	12683,	17558,
7,	86662,	37838,	53422,	35021,	18503,	23337,	14583,	27576,	18241,	10653,
8,	126729,	73957,	32434,	45721,	29840,	15675,	19634,	12225,	22494,	13806,
9,	6696,	106893,	62984,	27596,	39141,	25388,	13339,	16182,	10284,	18596,
10,	1855,	5487,	88043,	53347,	23431,	33444,	21686,	11236,	13461,	8639,
11,	1616,	1507,	4493,	72740,	45159,	19872,	28652,	18438,	9472,	11258,
12,	1245,	1279,	1104,	3559,	59389,	38162,	16906,	24443,	15651,	8056,
13,	1155,	1023,	1047,	751,	2828,	48834,	32375,	14143,	20869,	13375,
14,	91,	942,	634,	708,	586,	2299,	40274,	27093,	11924,	17840,
15,	182,	71,	811,	443,	549,	466,	1883,	31987,	23131,	10141,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTAL,	1711794,	1832934,	1335819,	1181453,	1540086,	1589659,	3516876,	2649919,	2683857,	2612920,

1

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

YEAR,	1922,	1923,	1924,	1925,	1926,	1927,	1928,	1929,	1930,	1931,
AGE										
0,	2195963,	3706119,	2017392,	2759655,	877780,	414567,	818286,	339483,	2108952,	978195,
1,	573373,	874971,	1496203,	811558,	1108417,	343917,	154589,	283983,	124301,	806584,
2,	235357,	227576,	350334,	590836,	323616,	415011,	102547,	56980,	68143,	49108,
3,	66162,	92807,	91660,	141646,	239427,	131185,	167524,	39376,	21589,	25111,
4,	142361,	52999,	78412,	78524,	121310,	204898,	112064,	134551,	27437,	18110,
5,	35471,	121731,	45302,	67257,	67331,	104277,	174633,	95698,	114297,	23296,
6,	31210,	29039,	101026,	38371,	57405,	56469,	88600,	147212,	80932,	96958,
7,	14962,	25798,	23797,	83979,	32358,	48954,	47849,	74793,	123810,	68559,
8,	8997,	12797,	21331,	19404,	68758,	27210,	41672,	40428,	62761,	102898,
9,	10659,	7527,	10901,	17655,	15393,	56517,	22688,	35134,	34250,	51868,
10,	15488,	8132,	6286,	9227,	14194,	12061,	45652,	18252,	29415,	28618,
11,	7303,	13026,	6126,	5248,	7740,	11535,	9305,	37426,	14440,	24074,
12,	9509,	6164,	10993,	4879,	4359,	6485,	9239,	7454,	30765,	11298,
13,	6841,	8022,	5174,	9356,	3707,	3592,	5409,	7598,	5908,	23868,
14,	11419,	5786,	6799,	4383,	7903,	2787,	2865,	4455,	6285,	4384,
15,	15298,	9699,	4902,	5789,	3702,	6701,	2162,	2324,	3695,	5059,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTAL,	3380371,	5202194,	4276639,	4647767,	2953402,	1846166,	1805084,	1325148,	2856980,	2317990,

Table 3.5.6.2 Continued

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

YEAR,	1932,	1933,	1934,	1935,	1936,	1937,	1938,	1939,	1940,	1941,
AGE										
0,	1771991,	2552840,	2733436,	2987647,	970236,	5374021,	4069980,	1834130,	2101857,	1455025,
1,	384136,	668111,	973277,	1070898,	1194090,	377641,	2134511,	1632511,	729108,	782183,
2,	286649,	135992,	233896,	373943,	391244,	449440,	145714,	833144,	622764,	239525,
3,	19768,	113731,	52226,	89418,	150425,	157660,	182318,	59035,	337170,	251987,
4,	20557,	16896,	83740,	41632,	75541,	128330,	134365,	156251,	50447,	287360,
5,	15565,	17226,	14439,	71913,	35205,	62927,	109107,	114721,	134235,	43392,
6,	19833,	13332,	14412,	11898,	55446,	28140,	50364,	90587,	97883,	115329,
7,	81378,	16563,	11394,	11892,	9456,	38516,	23057,	37299,	74938,	81641,
8,	57926,	67575,	13657,	9743,	9520,	7210,	25858,	18453,	28456,	62225,
9,	86077,	48883,	55533,	11469,	8298,	7567,	5573,	15396,	15055,	21306,
10,	43318,	71048,	40782,	46633,	9209,	7026,	6084,	4333,	10024,	12390,
11,	24091,	35570,	58373,	34578,	38009,	7252,	5905,	4627,	3596,	5674,
12,	20110,	20202,	29197,	49182,	28767,	30856,	5854,	5009,	3510,	3012,
13,	9194,	16725,	16927,	24454,	40098,	23783,	24843,	4551,	4222,	2550,
14,	18633,	7576,	13957,	14429,	19688,	32607,	19695,	20088,	3754,	3579,
15,	3486,	14350,	6394,	11920,	12193,	15946,	26820,	16414,	16581,	3176,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTAL,	2862711,	3816622,	4351639,	4861648,	3047426,	6748924,	6970046,	4846549,	4233598,	3370353,

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

YEAR,	1942,	1943,	1944,	1945,	1946,	1947,	1948,	1949,	1950,	1951,
AGE										
0,	813257,	2847228,	2496907,	1180478,	787959,	1821387,	1064689,	693743,	7473747,	1382719,
1,	546361,	298000,	1114383,	999227,	456891,	308308,	725601,	417213,	262358,	3007097,
2,	262126,	186985,	114415,	436427,	371125,	167560,	118142,	269535,	142205,	94445,
3,	95944,	104553,	74535,	46071,	175662,	149922,	67562,	47534,	108558,	54134,
4,	211524,	80168,	87199,	63425,	39236,	149673,	127745,	57012,	40165,	90878,
5,	247192,	182003,	68792,	74736,	54126,	33254,	126092,	105477,	47909,	32858,
6,	37274,	212289,	155891,	58884,	63229,	46041,	28036,	98697,	85994,	41064,
7,	98863,	31932,	180374,	132547,	50098,	53374,	39112,	23270,	79923,	68950,
8,	67963,	84436,	27323,	152806,	112381,	42435,	45033,	32918,	19630,	62971,
9,	52330,	56052,	72207,	23320,	128471,	94658,	36064,	37814,	28024,	16159,
10,	17060,	44036,	47093,	61515,	19834,	106971,	79884,	30438,	32020,	23300,
11,	10322,	13764,	37225,	39214,	52041,	16596,	89561,	66519,	25817,	26545,
12,	3837,	8528,	11449,	31328,	31798,	43771,	13894,	73587,	56309,	21416,
13,	2451,	2677,	7061,	9486,	26178,	25051,	36894,	11414,	61467,	46664,
14,	2061,	2081,	2116,	5726,	7700,	21707,	20015,	30435,	9515,	49494,
15,	3043,	1617,	1777,	1744,	4773,	6292,	18196,	15278,	25669,	7575,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	56929,	48758,
0 TOTAL,	2471607,	4156351,	4498748,	3316934,	2381504,	3087000,	2636519,	2010885,	8556240,	5075027,

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

YEAR,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,	1961,
AGE										
0,	938988,	835771,	397029,	237538,	274771,	236506,	278105,	4053427,	1913386,	732827,
1,	552100,	298670,	304949,	97946,	65556,	79456,	66148,	56387,	1538204,	699104,
2,	1175817,	169209,	90917,	81693,	22821,	14702,	13267,	10738,	11294,	542521,
3,	35944,	470458,	65225,	31748,	30092,	5554,	4649,	1619,	2442,	2291,
4,	46533,	30573,	398069,	53673,	26464,	24821,	4564,	3839,	1254,	984,
5,	74664,	39490,	25883,	329322,	43636,	20449,	17911,	3763,	3056,	911,
6,	26685,	58688,	33055,	20954,	264511,	34649,	16177,	14389,	2999,	2370,
7,	33821,	21705,	47220,	26265,	16977,	204017,	27707,	13096,	11028,	2355,
8,	54572,	27216,	17923,	36105,	20851,	13593,	157223,	22047,	10209,	8601,
9,	48627,	43450,	22398,	14241,	28532,	16060,	11033,	126308,	16749,	8109,
10,	13194,	38355,	34489,	17428,	11467,	22112,	12644,	8841,	98496,	12529,
11,	19288,	10623,	29358,	25611,	13211,	8660,	17343,	9744,	6790,	74015,
12,	21893,	15808,	8572,	21008,	19308,	9537,	6636,	13068,	7237,	5056,
13,	17436,	17846,	12761,	6559,	16201,	14095,	7087,	4799,	9416,	5030,
14,	37816,	14018,	14488,	10052,	5102,	12433,	10750,	5384,	3312,	6686,
15,	39378,	30821,	11151,	11239,	7869,	3809,	9483,	8596,	3918,	2327,
+gp,	47336,	73642,	59483,	51748,	42150,	27995,	25443,	15205,	10102,	4117,
0 TOTAL,	3184092,	2196343,	1572969,	1073130,	909520,	748449,	686170,	4371250,	3649892,	2109831,

Table 3.5.6.2 Continued

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

YEAR,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,
AGE										
0,	177129,	1646402,	905560,	79326,	453493,	35822,	46386,	96073,	6207,	2098,
1,	260052,	49849,	639834,	345996,	18608,	160413,	11970,	8476,	35624,	1806,
2,	188063,	81052,	8037,	243395,	117663,	3686,	11196,	2313,	655,	11279,
3,	202893,	70081,	20760,	1959,	81610,	37672,	1075,	2275,	164,	79,
4,	1683,	157564,	53282,	16807,	860,	51327,	19600,	37,	254,	83,
5,	772,	1374,	127875,	42166,	12097,	492,	14426,	177,	25,	50,
6,	746,	636,	1134,	91146,	31010,	6115,	179,	111,	71,	16,
7,	1901,	575,	531,	849,	58137,	14675,	1420,	25,	52,	31,
8,	1847,	1450,	462,	443,	551,	23551,	2346,	364,	15,	15,
9,	6833,	1480,	1078,	370,	244,	128,	4602,	791,	205,	4,
10,	6524,	5334,	1188,	698,	250,	79,	29,	822,	371,	54,
11,	10658,	5128,	3596,	752,	425,	56,	16,	7,	376,	81,
12,	56966,	8091,	3559,	2213,	280,	126,	17,	4,	3,	68,
13,	3892,	41507,	5355,	2302,	980,	140,	31,	7,	1,	0,
14,	3913,	2940,	27193,	3198,	991,	214,	39,	4,	4,	0,
15,	5171,	2862,	1796,	16274,	1476,	196,	26,	10,	1,	1,
+gp,	6834,	5918,	11413,	4140,	7024,	1235,	216,	49,	27,	0,
0 TOTAL,	935876,	2082241,	1812652,	852033,	785698,	335927,	113574,	111544,	44057,	15664,

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

YEAR,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,
AGE										
0,	9074,	127017,	85007,	29426,	100187,	50393,	61332,	124347,	15393,	10919,
1,	668,	1668,	51461,	34155,	11775,	40609,	20224,	24812,	50355,	6216,
2,	478,	47,	657,	20874,	13864,	4773,	16472,	8207,	10064,	20468,
3,	4065,	77,	9,	243,	8476,	5629,	1921,	6690,	3325,	4089,
4,	51,	3172,	44,	7,	179,	7080,	4641,	1626,	5699,	2803,
5,	62,	12,	2497,	36,	5,	104,	5875,	3881,	1382,	4851,
6,	31,	20,	4,	1922,	22,	4,	86,	4868,	3277,	1168,
7,	10,	4,	4,	1,	1371,	19,	4,	66,	4086,	2745,
8,	16,	3,	1,	2,	1,	1059,	13,	3,	54,	3370,
9,	3,	1,	1,	1,	1,	1,	812,	5,	3,	42,
10,	0,	0,	1,	0,	1,	1,	1,	652,	4,	2,
11,	7,	0,	0,	1,	0,	1,	1,	1,	538,	4,
12,	7,	1,	0,	0,	0,	0,	1,	1,	1,	438,
13,	9,	1,	1,	0,	0,	0,	0,	1,	1,	1,
14,	0,	3,	1,	1,	0,	0,	0,	0,	0,	1,
15,	0,	0,	1,	1,	1,	0,	0,	0,	0,	0,
+gp,	0,	0,	1,	1,	1,	0,	0,	0,	0,	0,
0 TOTAL,	14482,	132026,	139688,	86671,	135886,	109675,	111382,	175161,	94183,	57118,

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

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,
AGE										
0,	23297,	3692372,	114045,	771347,	115167,	97144,	245711,	725372,	1326004,	3496035,
1,	4388,	9333,	1500424,	46159,	313430,	46738,	39411,	99803,	294870,	539107,
2,	2520,	1777,	3766,	610017,	18686,	127423,	18963,	16006,	40565,	119883,
3,	8248,	1024,	712,	1516,	246737,	7578,	51586,	7654,	6352,	16397,
4,	3481,	6971,	851,	572,	1106,	207367,	6339,	43817,	6561,	5295,
5,	2370,	2923,	5804,	683,	349,	789,	173837,	5224,	37680,	5622,
6,	4096,	1998,	2428,	4426,	435,	167,	507,	144524,	4444,	32322,
7,	985,	3467,	1662,	1921,	2610,	232,	111,	349,	121388,	3724,
8,	2321,	830,	2921,	1314,	1109,	1280,	135,	62,	268,	102383,
9,	2824,	1951,	702,	2370,	625,	270,	843,	61,	46,	219,
10,	33,	2375,	1636,	538,	1458,	154,	122,	591,	46,	25,
11,	1,	28,	1976,	1257,	370,	549,	46,	24,	478,	21,
12,	2,	0,	22,	1641,	796,	140,	431,	14,	8,	389,
13,	368,	2,	0,	19,	951,	88,	49,	339,	6,	1,
14,	0,	316,	0,	0,	17,	95,	16,	17,	289,	3,
15,	0,	0,	264,	0,	0,	14,	18,	0,	13,	244,
+gp,	0,	0,	0,	90,	35,	0,	0,	0,	24,	5,
0 TOTAL,	54937,	3725366,	1637215,	1443868,	703881,	490029,	538125,	1043858,	1839043,	4321675,

Table 3.5.6.2 Continued

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

YEAR,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,	2002,	GMST 7-99	AMST 7-99
AGE													
0,	3924332,	1073137,	347152,	114822,	1093623,	384802,	250441,	3816,	0,	0,	0,	492600,	1190663,
1,	1421381,	1595504,	436265,	141139,	46683,	444634,	156449,	101822,	1552,	0,	0,	194055,	470745,
2,	219164,	577890,	648683,	177372,	57383,	18980,	180775,	63607,	41398,	631,	0,	66245,	179254,
3,	48720,	89097,	234908,	263685,	72107,	23144,	7582,	72987,	25830,	16742,	244,	24200,	73743,
4,	14035,	41817,	76423,	201886,	226422,	61745,	18712,	5875,	61545,	21454,	13463,	18021,	60910,
5,	4532,	11773,	35002,	64758,	170554,	188272,	50634,	13864,	4725,	47785,	16978,	13531,	50928,
6,	4826,	3854,	9325,	26759,	49973,	132255,	145425,	40171,	10685,	3743,	37178,	9901,	41738,
7,	27683,	4143,	3237,	6503,	17141,	34319,	95395,	108881,	30601,	8172,	2863,	7038,	33464,
8,	3124,	23716,	3532,	2642,	3468,	11002,	22507,	70417,	78870,	22597,	6145,	4946,	26106,
9,	86094,	2635,	20138,	2965,	2131,	2031,	6457,	15845,	49843,	55871,	16707,	3272,	20674,
10,	165,	72010,	2096,	16987,	2405,	1781,	1187,	4357,	10944,	33245,	40328,	2245,	16806,
11,	18,	119,	58182,	1474,	13975,	2002,	1348,	630,	2771,	7415,	23925,	1530,	13641,
12,	17,	9,	103,	44105,	501,	11416,	1423,	926,	408,	1724,	5700,	1046,	11052,
13,	329,	13,	8,	62,	29536,	270,	8988,	1193,	429,	201,	1265,	671,	8844,
14,	0,	271,	11,	3,	16,	17703,	58,	6694,	960,	161,	141	424,	6995,
15,	0,	0,	233,	8,	0,	14,	11815,	0,	4942,	611,	107	215,	5514,
+gp,	0,	0,	0,	0,	0,	0,	0,	5643,	5354,	0,	526,		
0 TOTAL,	5754419,	3495990,	1875298,	1065169,	1785917,	1334368,	959196,	516726,	330856,	220352,	165569,		

Table 3.5.6.3 Run title : Herring spring-spawn (run: SVPBJA12/V12)
At 6/05/2002 14:08

Table 12 Stock biomass at age (start of year) Tonnes*10**-1

YEAR,	1907,	1908,	1909,	1910,	1911,
AGE					
0,	16437,	11491,	6049,	8797,	5391,
1,	39814,	53143,	36718,	18960,	27753,
2,	191874,	92353,	123233,	83085,	43803,
3,	286811,	165312,	78618,	103382,	68686,
4,	36237,	482751,	274047,	120427,	167901,
5,	15985,	33762,	492970,	280855,	121988,
6,	16590,	12329,	31457,	472820,	271258,
7,	14136,	12576,	9811,	27477,	429150,
8,	19061,	10577,	9869,	8444,	24463,
9,	3254,	12933,	7928,	7971,	7067,
10,	3325,	2174,	9307,	6045,	6470,
11,	2334,	2442,	1083,	6045,	4964,
12,	3123,	1681,	1514,	589,	4743,
13,	3211,	2267,	897,	979,	398,
14,	2319,	2607,	1462,	573,	748,
15,	0,	1957,	2124,	993,	464,
+gp,	0,	0,	0,	0,	0,
0 TOTALBIO,	654511,	900357,	1087089,	1147443,	1185246,

Table 12 Stock biomass at age (start of year) Tonnes*10**-1

YEAR,	1912,	1913,	1914,	1915,	1916,	1917,	1918,	1919,	1920,	1921,
AGE										
0,	9497,	9815,	4337,	5226,	9200,	8311,	27514,	11278,	15603,	14489,
1,	16422,	28911,	30416,	13000,	16058,	28481,	26089,	87619,	34739,	49784,
2,	57426,	34595,	66837,	57026,	26753,	36161,	64494,	59054,	196290,	77823,
3,	35857,	47272,	29104,	55938,	46994,	22564,	30058,	52879,	49063,	167707,
4,	110931,	59294,	77603,	47599,	94059,	76269,	35778,	49218,	86694,	82173,
5,	172073,	113623,	60594,	79233,	48663,	94938,	74529,	36374,	49322,	88227,
6,	117933,	166604,	109707,	58207,	75406,	45950,	89065,	66767,	33865,	46881,
7,	247855,	108217,	152788,	100160,	52920,	66745,	41708,	78868,	52169,	30468,
8,	389058,	227049,	99574,	140364,	91609,	48123,	60278,	37531,	69056,	42385,
9,	21091,	336713,	198401,	86928,	123293,	79971,	42017,	50974,	32394,	58577,
10,	6011,	17779,	285260,	172844,	75918,	108359,	70262,	36403,	43615,	27991,
11,	5366,	5004,	14917,	241498,	149929,	65974,	95124,	61214,	31447,	37378,
12,	4222,	4337,	3743,	12066,	201327,	129367,	57312,	82862,	53057,	27310,
13,	4020,	3562,	3643,	2615,	9840,	169943,	112663,	49217,	72625,	46544,
14,	322,	3335,	2244,	2507,	2076,	8138,	142571,	95910,	42213,	63155,
15,	669,	260,	2984,	1630,	2021,	1715,	6930,	117713,	85120,	37320,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTALBIO,	1198752,	1166369,	1142152,	1076841,	1026064,	991010,	976391,	973880,	947272,	898211,

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Table 3.5.6.3 Continued

Table 12 Stock biomass at age (start of year) Tonnes*10**-1

YEAR,	1922,	1923,	1924,	1925,	1926,	1927,	1928,	1929,	1930,	1931,
AGE										
0,	21960,	37061,	20174,	27597,	8778,	4146,	8183,	3395,	21090,	9782,
1,	45870,	69998,	119696,	64925,	88673,	27513,	12367,	22719,	9944,	64527,
2,	110618,	106961,	164657,	277693,	152099,	195055,	48197,	26781,	32027,	23081,
3,	66162,	92807,	91660,	141646,	239427,	131185,	167524,	39376,	21589,	25111,
4,	283297,	105467,	156040,	156263,	241407,	407747,	223008,	267757,	54600,	36040,
5,	84065,	288502,	107365,	159399,	159575,	247137,	413881,	226805,	270885,	55213,
6,	83330,	77534,	269740,	102451,	153272,	150772,	236561,	393057,	216089,	258877,
7,	42792,	73783,	68060,	240181,	92545,	140008,	136848,	213908,	354097,	196079,
8,	27620,	39286,	65487,	59571,	211088,	83536,	127932,	124113,	192678,	315897,
9,	33577,	23709,	34337,	55613,	48487,	178030,	71466,	110674,	107888,	163383,
10,	50182,	26347,	20367,	29896,	45990,	39077,	147912,	59136,	95304,	92724,
11,	24246,	43245,	20340,	17424,	25696,	38295,	30892,	124256,	47941,	79927,
12,	32235,	20895,	37266,	16538,	14777,	21983,	31320,	25268,	104294,	38299,
13,	23807,	27916,	18006,	32558,	12902,	12499,	18823,	26440,	20558,	83061,
14,	40422,	20484,	24070,	15516,	27977,	9866,	10143,	15770,	22250,	15520,
15,	56296,	35694,	18039,	21303,	13624,	24660,	7956,	8554,	13596,	18618,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTALBIO,	1026480,	1089690,	1235303,	1418574,	1536318,	1711510,	1693014,	1688007,	1584828,	1476139,

Table 12 Stock biomass at age (start of year) Tonnes*10**-1

YEAR,	1932,	1933,	1934,	1935,	1936,	1937,	1938,	1939,	1940,	1941,
AGE										
0,	17720,	25528,	27334,	29876,	9702,	53740,	40700,	18341,	21019,	14550,
1,	30731,	53449,	77862,	85672,	95527,	30211,	170761,	130601,	58329,	62575,
2,	134725,	63916,	109931,	224366,	234747,	211237,	72857,	499886,	292699,	112577,
3,	19768,	113731,	52226,	115349,	185023,	182885,	158617,	57854,	337170,	151192,
4,	40909,	33623,	166643,	74938,	118599,	222012,	217671,	268751,	93831,	293107,
5,	36888,	40826,	34220,	133039,	70762,	120190,	201847,	235177,	276523,	85482,
6,	52953,	35596,	38479,	29387,	126972,	64442,	108787,	197479,	207512,	250263,
7,	232742,	47371,	32587,	32464,	25530,	94749,	58333,	89146,	186595,	191040,
8,	177833,	207456,	41926,	27670,	28370,	20332,	68783,	48717,	75123,	168008,
9,	271142,	153982,	174930,	34980,	25476,	22247,	16050,	42494,	42757,	59871,
10,	140350,	230195,	132135,	142698,	29284,	22063,	18678,	12652,	29169,	36549,
11,	79981,	118092,	193797,	104770,	123911,	22627,	18186,	14389,	11292,	17134,
12,	68174,	68486,	98978,	151971,	92053,	98431,	18500,	15026,	11126,	9157,
13,	31996,	58202,	58906,	75809,	130319,	75156,	78753,	14153,	13681,	8262,
14,	65959,	26819,	49407,	44587,	64970,	104996,	61841,	62073,	12051,	11488,
15,	12828,	52809,	23529,	38262,	40845,	51187,	85555,	50555,	52726,	10194,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTALBIO,	1414700,	1330084,	1312891,	1345838,	1402091,	1396505,	1395920,	1757295,	1721603,	1481450,

Table 12 Stock biomass at age (start of year) Tonnes*10**-1

YEAR,	1942,	1943,	1944,	1945,	1946,	1947,	1948,	1949,	1950,	1951,
AGE										
0,	8133,	28472,	24969,	11805,	7880,	18214,	10647,	6937,	74737,	13827,
1,	43709,	23840,	89151,	79938,	36551,	24665,	58048,	33377,	20989,	240568,
2,	123199,	87883,	53775,	205121,	174429,	78753,	55527,	126682,	66837,	44389,
3,	95944,	104553,	74535,	46071,	175662,	149922,	80399,	47534,	108558,	54134,
4,	420932,	159535,	173526,	126216,	78080,	297850,	247826,	113454,	81936,	185391,
5,	585845,	431348,	163037,	177124,	128278,	78811,	281185,	249980,	110191,	75574,
6,	99520,	566813,	416228,	157220,	168823,	122930,	77940,	263522,	219285,	104712,
7,	282747,	91325,	515870,	379086,	143281,	152649,	116163,	66553,	219789,	189613,
8,	208648,	259218,	83883,	469115,	345009,	130275,	137350,	101059,	56926,	182615,
9,	164840,	176565,	227452,	73459,	404685,	298174,	109634,	119113,	85474,	49285,
10,	55274,	142677,	152582,	199308,	64261,	346585,	249237,	98619,	100863,	73395,
11,	34268,	45698,	123588,	130189,	172775,	55098,	283013,	220843,	83905,	86272,
12,	13008,	28908,	38814,	106204,	107796,	148385,	45294,	249460,	185821,	70672,
13,	8531,	9316,	24571,	33012,	91101,	87177,	122118,	39719,	208988,	158658,
14,	7296,	7368,	7490,	20270,	27259,	76844,	66649,	107741,	32827,	170756,
15,	11199,	5951,	6541,	6418,	17566,	23156,	63503,	56225,	92923,	27421,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	207790,	177966,
0 TOTALBIO,	2163091,	2169470,	2176012,	2220554,	2143436,	2089489,	2004534,	1900818,	1957839,	1905249,

Table 3.5.6.3 Continued

Table 12 Stock biomass at age (start of year) Tonnes*10**-1

YEAR,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,	1961,
AGE										
0,	9390,	8358,	3970,	2375,	2748,	2365,	2781,	40534,	19134,	7328,
1,	44168,	23894,	24396,	7836,	5244,	6356,	5292,	4511,	123056,	55928,
2,	552634,	79528,	42731,	38396,	10726,	6910,	6236,	5047,	5308,	254985,
3,	35944,	470458,	65225,	31748,	30092,	5554,	4649,	1619,	2442,	2291,
4,	94927,	62369,	812060,	104662,	54252,	33756,	9311,	7832,	2558,	2283,
5,	171727,	90828,	59530,	701456,	100364,	46624,	43345,	9482,	8252,	2277,
6,	68046,	149653,	84290,	54480,	658633,	88355,	47236,	37412,	8726,	6922,
7,	93007,	59690,	129854,	72230,	46685,	534524,	81735,	37980,	32312,	7112,
8,	158259,	78927,	51977,	104703,	60469,	39420,	460663,	66142,	32772,	26148,
9,	148313,	132523,	68313,	43434,	87023,	48982,	33650,	385239,	53261,	26191,
10,	41561,	120818,	108642,	54899,	36121,	69653,	39829,	27850,	315187,	40344,
11,	62687,	34524,	95412,	83235,	42936,	28146,	57231,	31669,	23357,	237588,
12,	72246,	52166,	28286,	69326,	63717,	31472,	22562,	43124,	25257,	17392,
13,	59283,	60675,	43388,	22302,	55083,	47924,	24451,	16315,	34841,	17957,
14,	130466,	48363,	49985,	34680,	17603,	42893,	37841,	18574,	12553,	24268,
15,	142548,	111573,	40366,	40685,	28485,	13788,	34139,	30517,	14692,	8492,
+gp,	172778,	268794,	217113,	188878,	153848,	102182,	92867,	54738,	38387,	15234,
0 TOTALBIO,	2057984,	1853140,	1925538,	1655328,	1454029,	1148905,	1003816,	818584,	752095,	752740,

Table 12 Stock biomass at age (start of year) Tonnes*10**-1

YEAR,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,
AGE										
0,	1771,	16464,	9056,	793,	4535,	358,	464,	961,	62,	21,
1,	20804,	3988,	51187,	27680,	1489,	12833,	958,	678,	2850,	271,
2,	88390,	38094,	3777,	114396,	55302,	1732,	5262,	1087,	308,	9023,
3,	202893,	70081,	20760,	1959,	81610,	37672,	1075,	2275,	164,	79,
4,	3685,	291492,	103368,	31261,	1590,	92389,	22540,	43,	532,	157,
5,	2247,	3477,	272374,	83911,	26492,	1121,	29718,	256,	68,	112,
6,	2238,	1869,	2993,	215104,	68842,	16450,	477,	300,	164,	40,
7,	6008,	1795,	1682,	2208,	144762,	39622,	3905,	76,	154,	85,
8,	5986,	4769,	1677,	1607,	1685,	69240,	6428,	1113,	49,	43,
9,	22275,	4839,	3807,	1294,	863,	416,	13116,	2435,	662,	13,
10,	21854,	17816,	4145,	2583,	942,	331,	102,	2614,	1207,	176,
11,	36024,	17486,	12729,	2706,	1660,	243,	52,	23,	1238,	271,
12,	190266,	28236,	12704,	8363,	1061,	460,	60,	13,	12,	236,
13,	13504,	141538,	19225,	8908,	3706,	514,	125,	24,	5,	0,
14,	13851,	10527,	99253,	12471,	3576,	926,	151,	15,	15,	1,
15,	18513,	10732,	7221,	64121,	5655,	811,	97,	39,	5,	6,
+gp,	24467,	22192,	45879,	16313,	26900,	5113,	818,	193,	104,	0,
0 TOTALBIO,	674775,	685396,	671836,	595677,	430670,	280233,	85348,	12145,	7599,	10532,

Table 12 Stock biomass at age (start of year) Tonnes*10**-1

YEAR,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,
AGE										
0,	91,	1270,	850,	294,	1002,	504,	613,	1243,	154,	109,
1,	67,	167,	5146,	3416,	1178,	4061,	2022,	2481,	5036,	622,
2,	334,	40,	558,	17743,	11785,	4057,	14002,	6976,	8555,	17398,
3,	6098,	130,	16,	440,	15341,	10189,	3458,	11908,	5819,	6952,
4,	76,	8215,	114,	18,	463,	18337,	13643,	3772,	16128,	6278,
5,	87,	41,	8538,	122,	17,	356,	19153,	13934,	4795,	16301,
6,	66,	78,	17,	7381,	85,	16,	320,	18744,	13174,	4416,
7,	25,	18,	16,	6,	5606,	78,	15,	278,	17204,	10623,
8,	44,	10,	6,	7,	5,	4700,	58,	14,	251,	13752,
9,	8,	3,	3,	5,	6,	5,	3863,	26,	12,	168,
10,	1,	2,	3,	2,	5,	6,	5,	3390,	23,	11,
11,	22,	1,	2,	3,	2,	4,	5,	4,	2871,	20,
12,	25,	6,	1,	1,	2,	2,	3,	4,	3,	2242,
13,	33,	4,	5,	1,	1,	2,	1,	3,	3,	3,
14,	0,	13,	3,	4,	1,	1,	2,	1,	2,	3,
15,	0,	0,	3,	3,	4,	0,	1,	1,	1,	2,
+gp,	0,	0,	3,	3,	4,	0,	1,	1,	1,	2,
0 TOTALBIO,	6977,	10000,	15283,	29448,	35506,	42318,	57164,	62781,	74033,	78902,

Table 3.5.6.3 Continued

Table 12 Stock biomass at age (start of year) Tonnes*10**-1

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,
AGE										
0,	233,	36924,	1140,	7713,	1152,	971,	2457,	7254,	13260,	34960,
1,	439,	933,	150042,	4616,	31343,	4674,	5912,	14971,	23590,	59302,
2,	2142,	1511,	3201,	140304,	15883,	70083,	9482,	16006,	19471,	44357,
3,	14022,	1586,	997,	2243,	133238,	6820,	50554,	11787,	13912,	24103,
4,	7102,	17359,	1737,	1337,	2278,	296535,	8558,	76680,	12991,	11119,
5,	7180,	8886,	17122,	1810,	925,	1901,	342458,	10918,	97215,	13719,
6,	14541,	7352,	8206,	13809,	1258,	466,	1403,	364199,	12799,	96965,
7,	3773,	14008,	6250,	6647,	8848,	694,	350,	1064,	375088,	12067,
8,	9167,	3519,	11539,	4861,	4082,	4045,	456,	227,	1147,	344005,
9,	11664,	8524,	2858,	9361,	2443,	924,	2892,	230,	170,	750,
10,	151,	10354,	6758,	2135,	5570,	529,	439,	2121,	186,	97,
11,	4,	136,	8339,	5380,	1437,	1986,	167,	96,	1850,	77,
12,	11,	2,	98,	7023,	3143,	527,	1619,	54,	37,	1654,
13,	1862,	8,	0,	82,	3757,	329,	183,	1344,	24,	6,
14,	2,	1562,	0,	0,	65,	359,	61,	69,	1273,	13,
15,	2,	2,	1152,	0,	0,	54,	69,	0,	55,	1035,
+gp,	2,	2,	1,	383,	137,	0,	0,	0,	105,	19,
0 TOTALBIO,	72299,	112668,	219441,	207705,	215560,	390896,	427062,	507022,	573173,	644250,

Table 12 Stock biomass at age (start of year) Tonnes*10**-1

YEAR,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,
AGE										
0,	39243,	10731,	3472,	1148,	10936,	3848,	2504,	38,	0,	0,
1,	99497,	127640,	43626,	25405,	8403,	80034,	28161,	18328,	279,	0,
2,	65749,	144472,	162171,	44343,	14346,	4745,	45194,	15902,	10349,	158,
3,	62362,	72169,	176181,	174032,	54801,	22219,	5611,	74446,	26346,	12557,
4,	31438,	84053,	115399,	278602,	267178,	72859,	27507,	8813,	92317,	38187,
5,	13414,	31198,	88906,	148943,	320642,	327593,	88104,	30916,	10537,	113728,
6,	15782,	12449,	29654,	79205,	130429,	302864,	315572,	96410,	25643,	9246,
7,	98276,	14666,	12011,	22499,	54166,	98151,	230857,	287445,	80787,	24188,
8,	10776,	84904,	12256,	10252,	11998,	35535,	62569,	199279,	223203,	69373,
9,	315964,	10040,	82970,	10761,	7968,	7514,	19630,	49911,	157006,	175436,
10,	563,	265719,	8005,	69478,	9379,	6733,	3678,	15031,	37757,	109045,
11,	64,	472,	236800,	6102,	54503,	7726,	4839,	2431,	10697,	26025,
12,	74,	37,	421,	186123,	1925,	41099,	4839,	3574,	1574,	6483,
13,	1544,	47,	33,	255,	117553,	1059,	30919,	4604,	1654,	817,
14,	1,	1093,	44,	11,	65,	69218,	222,	25572,	3667,	665,
15,	2,	1,	957,	34,	0,	55,	42890,	0,	18879,	2596,
+gp,	2,	1,	0,	0,	0,	0,	0,	22967,	21790,	0,
0 TOTALBIO,	754749,	859692,	972906,	1057196,	1064293,	1081251,	913094,	855666,	722488,	588504,

Table 3.5.6.4 Run title : Herring spring-spawn (run: SVPBJA12/V12)
At 6/05/2002 14:08

Table 13 Spawning stock biomass at age (spawning time) Tonnes*10**-1

YEAR,	1907,	1908,	1909,	1910,	1911,
AGE					
0,	0,	0,	0,	0,	0,
1,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,
3,	8461,	4870,	2298,	3039,	2018,
4,	5657,	76061,	43194,	18959,	26464,
5,	5848,	12588,	184338,	105094,	45652,
6,	11859,	8856,	22808,	344139,	197565,
7,	13226,	11823,	9308,	26159,	409302,
8,	18289,	10250,	9636,	8273,	24041,
9,	3116,	12479,	7695,	7784,	6934,
10,	3217,	2023,	8892,	5913,	6334,
11,	2254,	2323,	1017,	5888,	4874,
12,	3016,	1574,	1445,	565,	4653,
13,	3140,	2166,	856,	952,	389,
14,	2271,	2544,	1401,	559,	737,
15,	0,	1909,	2072,	968,	457,
+gp,	0,	0,	0,	0,	0,
0 TOTSPBIO,	80355,	149467,	294961,	528293,	729420,

Table 13 Spawning stock biomass at age (spawning time) Tonnes*10**-1

YEAR,	1912,	1913,	1914,	1915,	1916,	1917,	1918,	1919,	1920,	1921,
AGE										
0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	1056,	1391,	856,	1650,	1381,	662,	884,	1556,	1447,	4949,
4,	17483,	9343,	12227,	7500,	14802,	11964,	5635,	7740,	13655,	12949,
5,	64405,	42516,	22662,	29605,	18168,	35422,	27679,	13561,	18426,	32940,
6,	85930,	121387,	79896,	42372,	54746,	33444,	64665,	47873,	24626,	34141,
7,	236638,	103365,	145915,	95612,	50487,	63634,	39749,	74959,	49214,	29059,
8,	382492,	223432,	97978,	138200,	90140,	47352,	59123,	36887,	67754,	41303,
9,	20675,	330243,	195133,	85518,	121369,	78721,	41302,	50044,	31834,	57515,
10,	5887,	17427,	279865,	169988,	74677,	106696,	69131,	35787,	42842,	27524,
11,	5242,	4851,	14574,	236650,	147425,	64917,	93625,	60219,	30942,	36752,
12,	4140,	4251,	3602,	11791,	197426,	127257,	56299,	81562,	52230,	26867,
13,	3938,	3395,	3503,	2551,	9638,	166699,	110675,	48384,	71495,	45814,
14,	314,	3285,	2165,	2444,	2028,	7977,	139324,	94405,	41534,	62191,
15,	653,	257,	2910,	1590,	1971,	1673,	6758,	114807,	83019,	36399,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTSPBIO,	828853,	865143,	861286,	825471,	784262,	746418,	714851,	667786,	529019,	448405,

1

Table 13 Spawning stock biomass at age (spawning time) Tonnes*10**-1

YEAR,	1922,	1923,	1924,	1925,	1926,	1927,	1928,	1929,	1930,	1931,
AGE										
0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	1941,	2738,	2708,	4184,	7072,	3874,	4917,	1139,	636,	738,
4,	44623,	16612,	24586,	24620,	38045,	64205,	35122,	42148,	8594,	5680,
5,	31312,	107606,	40127,	59620,	59581,	92395,	154611,	84753,	101256,	20646,
6,	60501,	56244,	195953,	74532,	111629,	109738,	172115,	285870,	157275,	188243,
7,	40865,	70222,	64684,	228363,	88226,	133638,	130524,	203883,	337178,	187018,
8,	27132,	38661,	64260,	58207,	206990,	82031,	125768,	122072,	189039,	310308,
9,	32681,	23286,	33770,	54413,	47318,	174269,	69928,	108724,	105967,	160466,
10,	49320,	25612,	20002,	29375,	45045,	38076,	145002,	57767,	93413,	91141,
11,	23838,	42518,	19882,	17104,	25245,	37454,	30214,	121844,	46779,	78502,
12,	31692,	20533,	36670,	16091,	14494,	21588,	30713,	24687,	101680,	37518,
13,	23412,	27458,	17710,	32014,	12539,	12220,	18462,	25943,	19954,	81029,
14,	39768,	20147,	23686,	15256,	27520,	9618,	9933,	15478,	21772,	15169,
15,	54906,	34813,	17593,	20777,	13287,	24052,	7760,	8343,	13260,	18158,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTSPBIO,	461991,	486448,	561630,	634556,	696993,	803159,	935069,	1102652,	1196804,	1194616,

Table 3.5.6.4 Continued

Table 13 Spawning stock biomass at age (spawning time) Tonnes*10**-1

YEAR,	1932,	1933,	1934,	1935,	1936,	1937,	1938,	1939,	1940,	1941,
AGE										
0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	584,	3309,	1532,	3403,	5463,	5400,	4686,	1709,	9955,	4457,
4,	6431,	5296,	26260,	11791,	18632,	34950,	34281,	42352,	14788,	46196,
5,	13802,	15240,	12754,	49257,	26294,	44666,	75288,	87960,	103496,	31993,
6,	38486,	25930,	27932,	21253,	90598,	46746,	78121,	143389,	150798,	182364,
7,	221602,	45072,	31118,	30798,	24102,	88317,	55337,	84163,	177664,	181942,
8,	174840,	203424,	41200,	27229,	27726,	19815,	65308,	47735,	72981,	165123,
9,	265988,	151217,	171901,	34221,	25056,	21767,	15651,	40709,	41931,	58555,
10,	137611,	225716,	129972,	139809,	28593,	21682,	18174,	12419,	27555,	35888,
11,	78585,	115783,	190505,	102860,	121354,	22148,	17889,	13997,	11094,	16477,
12,	66929,	67285,	97239,	148900,	90319,	96320,	18039,	14772,	10776,	8970,
13,	31383,	57159,	57973,	74183,	127652,	73751,	77097,	13883,	13456,	8088,
14,	64259,	26368,	48634,	43842,	63615,	102964,	60724,	60893,	11851,	11303,
15,	12511,	51505,	22948,	37317,	39837,	49924,	83443,	49306,	51425,	9942,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
0 TOTSPBIO,	1113012,	993305,	859970,	724862,	689240,	628451,	604039,	613287,	697770,	761299,

Table 13 Spawning stock biomass at age (spawning time) Tonnes*10**-1

YEAR,	1942,	1943,	1944,	1945,	1946,	1947,	1948,	1949,	1950,	1951,
AGE										
0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	2827,	3080,	2200,	1360,	5186,	4426,	2371,	1402,	0,	0,
4,	66344,	25138,	27339,	19877,	12288,	46846,	38900,	17840,	8031,	18178,
5,	219258,	161393,	60998,	66191,	47963,	29441,	104265,	93072,	32551,	22205,
6,	72515,	412663,	303053,	114478,	122830,	89497,	56611,	190935,	128696,	61620,
7,	269972,	87216,	492163,	361694,	136694,	145575,	110752,	63468,	193150,	166707,
8,	204666,	255194,	82565,	461048,	339138,	128173,	134971,	99446,	55829,	177955,
9,	162020,	173516,	223836,	72279,	397340,	293156,	107791,	117148,	83911,	48296,
10,	54100,	140299,	149814,	196002,	63126,	340483,	244715,	97009,	98989,	72021,
11,	33620,	44864,	121474,	127488,	169811,	54128,	277507,	217194,	82351,	84626,
12,	12548,	28368,	38090,	104313,	105256,	145870,	44412,	245011,	182362,	69234,
13,	8392,	9099,	24062,	32330,	89411,	85242,	119790,	39003,	204510,	155357,
14,	7121,	7253,	7346,	19904,	26714,	75500,	64874,	105922,	32087,	166896,
15,	10922,	5804,	6380,	6259,	17132,	22584,	61935,	54836,	91121,	26825,
+gp,	0,	0,	0,	0,	0,	0,	0,	0,	203759,	174098,
0 TOTSPBIO,	1124305,	1353888,	1539320,	1583224,	1532890,	1460923,	1368896,	1342285,	1397347,	1244019,

Table 13 Spawning stock biomass at age (spawning time) Tonnes*10**-1

YEAR,	1952,	1953,	1954,	1955,	1956,	1957,	1958,	1959,	1960,	1961,
AGE										
0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	0,	0,	2494,	2361,	0,	365,	126,	178,	89,
4,	9338,	6134,	79681,	22554,	11632,	0,	2009,	1684,	545,	780,
5,	50293,	26768,	17486,	253913,	36288,	22772,	15690,	3429,	2977,	1518,
6,	39993,	87861,	49424,	45343,	545487,	51841,	39312,	30965,	7240,	6364,
7,	81908,	52702,	113774,	70581,	45659,	520777,	79888,	37046,	31519,	6942,
8,	154693,	77404,	50795,	102268,	58910,	38606,	450687,	64349,	32026,	25553,
9,	144835,	129497,	66621,	42503,	84833,	47824,	32913,	375776,	51737,	25627,
10,	40670,	117631,	105456,	53399,	35121,	67982,	38804,	27125,	306308,	39697,
11,	61452,	33791,	92272,	80917,	41559,	27406,	55634,	30741,	22678,	231448,
12,	70784,	51061,	27539,	67548,	61743,	30551,	21842,	41734,	24355,	16943,
13,	58003,	59424,	42365,	21749,	53644,	46643,	23788,	15722,	33668,	17512,
14,	127825,	47269,	48731,	33841,	17096,	41747,	37004,	17993,	12118,	23653,
15,	139410,	109056,	39250,	39664,	27700,	13447,	33356,	29726,	14274,	8278,
+gp,	168975,	262730,	211109,	184134,	149608,	99659,	90738,	53319,	37294,	14849,
0 TOTSPBIO,	1148177,	1061326,	944504,	1020908,	1171641,	1009257,	922030,	729733,	576917,	419252,

Table 3.5.6.4 Continued

Table 13 Spawning stock biomass at age (spawning time) Tonnes*10**-1

YEAR,	1962,	1963,	1964,	1965,	1966,	1967,	1968,	1969,	1970,	1971,
AGE										
0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	0,	2727,	407,	0,	779,	0,	0,	1133,	9,	8,
4,	397,	8564,	6059,	10285,	226,	814,	0,	37,	59,	38,
5,	1476,	1091,	73726,	28480,	24745,	233,	183,	222,	20,	64,
6,	2181,	1652,	931,	156291,	61324,	14215,	298,	278,	26,	34,
7,	5847,	1756,	1652,	2114,	132254,	32985,	3408,	72,	136,	80,
8,	5854,	4630,	1640,	1514,	1457,	58810,	5766,	1051,	43,	36,
9,	21730,	4734,	3645,	1245,	771,	358,	11041,	2258,	580,	10,
10,	21334,	17127,	3959,	2458,	812,	282,	88,	2418,	1036,	143,
11,	35044,	16859,	12126,	2452,	1470,	215,	45,	22,	1044,	212,
12,	184337,	27095,	12162,	7710,	990,	400,	55,	12,	8,	193,
13,	13130,	135677,	18259,	8188,	3183,	453,	101,	23,	4,	0,
14,	13425,	10021,	94286,	11543,	3041,	749,	131,	13,	13,	1,
15,	17972,	10304,	6890,	59367,	4947,	690,	83,	36,	5,	5,
+gp,	23752,	21307,	43775,	15103,	23531,	4345,	703,	180,	89,	0,
0 TOTSPBIO,	346480,	263544,	279515,	306748,	259530,	114549,	21903,	7754,	3072,	823,

Table 13 Spawning stock biomass at age (spawning time) Tonnes*10**-1

YEAR,	1972,	1973,	1974,	1975,	1976,	1977,	1978,	1979,	1980,	1981,
AGE										
0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	3,	51,	1621,	1077,	0,	0,	0,	0,	0,
3,	0,	62,	8,	213,	7534,	7296,	442,	1172,	1430,	2052,
4,	7,	7218,	100,	18,	395,	16018,	12061,	2301,	7935,	3087,
5,	19,	37,	8318,	116,	16,	350,	18796,	13015,	4574,	14424,
6,	32,	66,	15,	7135,	84,	16,	312,	18418,	12943,	4342,
7,	19,	16,	14,	6,	5463,	75,	14,	273,	16876,	10446,
8,	32,	9,	5,	7,	5,	4577,	53,	13,	245,	13511,
9,	6,	3,	3,	5,	6,	5,	3779,	25,	12,	164,
10,	1,	2,	3,	2,	5,	6,	4,	3326,	22,	10,
11,	19,	1,	2,	3,	2,	4,	5,	4,	2813,	19,
12,	20,	6,	1,	1,	2,	2,	3,	4,	3,	2203,
13,	29,	4,	5,	1,	1,	2,	1,	3,	3,	3,
14,	0,	12,	3,	4,	1,	1,	2,	1,	2,	3,
15,	0,	0,	3,	3,	4,	0,	1,	1,	1,	2,
+gp,	0,	0,	3,	3,	4,	0,	1,	1,	1,	2,
0 TOTSPBIO,	185,	7440,	8534,	9138,	14598,	28351,	35475,	38558,	46861,	50269,

Table 13 Spawning stock biomass at age (spawning time) Tonnes*10**-1

YEAR,	1982,	1983,	1984,	1985,	1986,	1987,	1988,	1989,	1990,	1991,
AGE										
0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	1379,	156,	98,	217,	13094,	670,	4974,	1161,	5464,	2373,
4,	3350,	8522,	850,	637,	440,	87405,	2518,	22660,	10233,	7663,
5,	4941,	6019,	14997,	1557,	773,	1637,	302573,	9669,	86162,	13511,
6,	14300,	5125,	7615,	13099,	1182,	447,	1352,	357901,	11317,	95475,
7,	3709,	13770,	6105,	6292,	8240,	657,	331,	1036,	331880,	11857,
8,	9009,	3460,	11300,	4513,	3545,	3880,	422,	220,	1124,	338096,
9,	11464,	8375,	2783,	8917,	2124,	854,	2791,	224,	160,	729,
10,	148,	10166,	6582,	2056,	5051,	469,	373,	2077,	172,	94,
11,	4,	133,	8186,	5140,	1304,	1938,	148,	87,	1812,	76,
12,	11,	2,	96,	6650,	2521,	474,	1581,	50,	31,	1626,
13,	1834,	5,	0,	81,	2985,	278,	166,	1323,	23,	5,
14,	2,	1534,	0,	0,	64,	304,	38,	67,	1251,	11,
15,	2,	2,	1127,	0,	0,	51,	65,	0,	54,	1017,
+gp,	2,	2,	1,	364,	118,	0,	0,	0,	102,	19,
0 TOTSPBIO,	50156,	57271,	59740,	49523,	41441,	99064,	317331,	396474,	449785,	472551,

Table 3.5.6.4 Continued

Table 13 Spawning stock biomass at age (spawning time) Tonnes*10**-1

YEAR,	1992,	1993,	1994,	1995,	1996,	1997,	1998,	1999,	2000,	2001,
AGE										
0,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
1,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
2,	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,
3,	6142,	711,	1735,	0,	0,	0,	0,	0,	0,	0,
4,	6178,	24771,	34051,	82183,	78688,	21428,	8008,	2587,	27003,	11191,
5,	10559,	24384,	69240,	116106,	281331,	287317,	77479,	27109,	9265,	99818,
6,	15542,	12234,	28604,	75755,	125619,	293129,	306570,	93822,	24965,	9002,
7,	96768,	14434,	11769,	21128,	51816,	94097,	223953,	278324,	78374,	23509,
8,	10594,	83527,	12043,	10033,	11373,	33691,	60411,	192510,	215639,	67309,
9,	310370,	9813,	81570,	10538,	7827,	7121,	18873,	48098,	150775,	169809,
10,	545,	260112,	7728,	68135,	9208,	6548,	3452,	14366,	36316,	105515,
11,	60,	465,	230331,	5479,	53412,	7467,	4660,	2327,	10201,	25350,
12,	72,	36,	400,	178808,	1809,	40127,	4754,	3309,	1467,	6285,
13,	1515,	46,	29,	223,	111687,	908,	30021,	4505,	1500,	789,
14,	1,	1077,	43,	7,	64,	66475,	116,	24808,	3505,	639,
15,	2,	1,	934,	34,	0,	53,	41814,	0,	18453,	2557,
+gp,	2,	1,	0,	0,	0,	0,	0,	22333,	21299,	0,
0 TOTSPBIO,	458349,	431611,	478479,	568430,	732835,	858362,	780111,	714098,	598762,	521773,

Table 3.5.6.5 Run title : Herring spring-spawn (run: SVPBJA12/V12),

At 6/05/2002 14:08

Table 16 Summary (without SOP correction)

,	RECRUITS, Age 0	TOTALBIO,	TOTSPBIO,	LANDINGS,	YIELD/SSB,	FBAR 2-13,
1907,	164365264,	6545115,	803555,	207600,	.2584,	.1626,
1908,	114911136,	9003567,	1494670,	233400,	.1562,	.2087,
1909,	60494424,	10870889,	2949608,	288500,	.0978,	.1608,
1910,	87971592,	11474429,	5282926,	250000,	.0473,	.0748,
1911,	53905144,	11852464,	7294199,	253500,	.0348,	.0354,
1912,	94972448,	11987521,	8288534,	245200,	.0296,	.0342,
1913,	98153792,	11663692,	8651432,	290700,	.0336,	.0610,
1914,	43368360,	11421515,	8612863,	356000,	.0413,	.0613,
1915,	52263976,	10768414,	8254712,	306100,	.0371,	.0316,
1916,	91998232,	10260643,	7842621,	296900,	.0379,	.0277,
1917,	83106728,	9910096,	7464179,	276200,	.0370,	.0274,
1918,	275137024,	9763913,	7148507,	433500,	.0606,	.0329,
1919,	112775144,	9738795,	6677863,	498100,	.0746,	.0406,
1920,	156033152,	9472722,	5290193,	316500,	.0598,	.0278,
1921,	144889488,	8982107,	4484050,	258500,	.0576,	.0240,
1922,	219596272,	10264798,	4619909,	349900,	.0757,	.0363,
1923,	370611936,	10896899,	4864480,	330500,	.0679,	.0328,
1924,	201739232,	12353034,	5616303,	295000,	.0525,	.0258,
1925,	275965472,	14185738,	6345559,	355500,	.0560,	.0371,
1926,	87778040,	15363178,	6969931,	403800,	.0579,	.0393,
1927,	41456696,	17115098,	8031588,	489900,	.0610,	.0373,
1928,	81828616,	16930140,	9350691,	611900,	.0654,	.0409,
1929,	33948260,	16880070,	11026518,	624600,	.0566,	.0547,
1930,	210895152,	15848282,	11968044,	704500,	.0589,	.0559,
1931,	97819544,	14761387,	11946162,	538200,	.0451,	.0317,
1932,	177199056,	14146996,	11130121,	652600,	.0586,	.0285,
1933,	255283968,	13300836,	9933054,	818200,	.0824,	.0440,
1934,	273343584,	13128912,	8599695,	451700,	.0525,	.0296,
1935,	298764704,	13458381,	7248624,	649400,	.0896,	.0499,
1936,	97023624,	14020911,	6892399,	775200,	.1125,	.0667,
1937,	537402112,	13965046,	6284506,	695900,	.1107,	.0637,
1938,	406997952,	13959195,	6040393,	783600,	.1297,	.0873,
1939,	183413024,	17572954,	6132873,	703400,	.1147,	.0618,
1940,	210185680,	17216028,	6977698,	923100,	.1323,	.0750,
1941,	145502496,	14814504,	7612994,	594000,	.0780,	.0473,
1942,	81325672,	21630908,	11243054,	592700,	.0527,	.0382,
1943,	284722784,	21694702,	13538880,	556600,	.0411,	.0237,
1944,	249690640,	21760122,	15393198,	587800,	.0382,	.0192,
1945,	118047744,	22205536,	15832243,	554400,	.0350,	.0228,
1946,	78795904,	21434354,	15328896,	586200,	.0382,	.0259,
1947,	182138736,	20894888,	14609226,	710400,	.0486,	.0231,
1948,	106468888,	20045338,	13688959,	1012600,	.0740,	.0365,
1949,	69374288,	19008182,	13422845,	783000,	.0583,	.0256,
1950,	747374656,	19578392,	13973473,	933000,	.0668,	.0472,
1951,	138271856,	19052486,	12440190,	1278400,	.1028,	.0549,
1952,	93898752,	20579838,	11481773,	1254800,	.1093,	.0550,
1953,	83577056,	18531402,	10613262,	1090600,	.1028,	.0545,
1954,	39702936,	19255380,	9445040,	1644500,	.1741,	.1013,
1955,	23753764,	16553276,	10209083,	1359800,	.1332,	.0851,
1956,	27477146,	14540287,	11716413,	1659400,	.1416,	.1440,
1957,	23650648,	11489048,	10092566,	1319500,	.1307,	.1139,
1958,	27810502,	10038164,	9220304,	986600,	.1070,	.1816,
1959,	405342656,	8185840,	7297327,	1111100,	.1523,	.1617,
1960,	191338608,	7520952,	5769169,	1101800,	.1910,	.2355,
1961,	73282680,	7527398,	4192520,	830100,	.1980,	.0860,
1962,	17712882,	6747753,	3464804,	848600,	.2449,	.1000,
1963,	164640160,	6853956,	2635437,	984500,	.3736,	.1666,
1964,	90556040,	6718364,	2795154,	1281800,	.4586,	.2223,
1965,	7932618,	5956773,	3067483,	1547700,	.5046,	.4180,
1966,	45349292,	4306700,	2595295,	1955000,	.7533,	.7878,
1967,	3582245,	2802332,	1145486,	1677200,	1.4642,	1.1279,
1968,	4638550,	853483,	219026,	712200,	3.2517,	2.0032,
1969,	9607348,	121451,	77541,	67800,	.8744,	.7761,
1970,	620670,	75989,	30718,	62300,	2.0281,	1.3453,
1971,	209800,	105320,	8231,	21100,	2.5633,	1.0042,
1972,	907351,	69767,	1854,	13161,	7.0991,	1.3166,
1973,	12701698,	100002,	74400,	7017,	.0943,	.5138,
1974,	8500675,	152834,	85341,	7619,	.0893,	.1897,
1975,	2942588,	294481,	91377,	13713,	.1501,	.0925,
1976,	10018746,	355060,	145980,	10436,	.0715,	.0557,
1977,	5039343,	423184,	283511,	22706,	.0801,	.0507,
1978,	6133163,	571644,	354752,	19824,	.0559,	.0916,
1979,	12434718,	627810,	385577,	12864,	.0334,	.0184,
1980,	1539331,	740332,	468611,	18577,	.0396,	.0280,
1981,	1091881,	789022,	502691,	13736,	.0273,	.1122,
1982,	2329740,	722993,	501560,	16655,	.0332,	.0783,
1983,	369237184,	1126681,	572712,	23054,	.0403,	.4869,
1984,	11404527,	2194407,	597396,	53532,	.0896,	.0884,
1985,	77134728,	2077049,	495227,	169872,	.3430,	.2872,
1986,	11516681,	2155599,	414411,	225256,	.5436,	.8509,
1987,	9714410,	3908961,	990639,	127306,	.1285,	.4589,
1988,	24571120,	4270615,	3173305,	135301,	.0426,	.4246,
1989,	72537216,	5070218,	3964735,	103830,	.0262,	.1831,
1990,	132600400,	5731729,	4497853,	86411,	.0192,	.2812,
1991,	349603520,	6442496,	4725509,	84683,	.0179,	.1759,

Table 3.5.6.5 Continued.

1992,	392433184,	7547493,	4583487,	104448,	.0228,	.0809,
1993,	107313712,	8596920,	4316113,	232457,	.0539,	.0255,
1994,	34715184,	9729062,	4784792,	479228,	.1002,	.1724,
1995,	11482169,	10571957,	5684302,	905501,	.1593,	.2865,
1996,	109362248,	10642925,	7328347,	1220283,	.1665,	.1670,
1997,	38480160,	10812513,	8583621,	1426507,	.1662,	.2713,
1998,	25044138,	9130939,	7801115,	1223131,	.1568,	.1634,
1999,	381638,	8556661,	7140983,	1235433,	.1730,	.1820,
2000,	0,	7224881,	5987621,	1207201,	.2016,	.2416,
2001,	0,	5885045,	5217729,	770054,	.1476,	.1287,
Arith. Mean ,	116559667,	9963056,	6078259,	582557,	.2895,	.1994,
0 Units,	(Thousands),	(Tonnes),	(Tonnes),	(Tonnes),		

Table 3.5.6.6 Summary of unweighted and weighted fishing mortalites.

Range of years 5-14

Year	FBAR 5-14	FWEI 5-14
1907	0.1893	0.2161
1908	0.2545	0.1331
1909	0.2063	0.0222
1910	0.0888	0.0140
1911	0.0311	0.0139
1912	0.0425	0.0126
1913	0.0659	0.0209
1914	0.0860	0.0224
1915	0.0414	0.0240
1916	0.0318	0.0251
1917	0.0214	0.0213
1918	0.0369	0.0417
1919	0.0388	0.0432
1920	0.0304	0.0328
1921	0.0259	0.0263
1922	0.0339	0.0371
1923	0.0375	0.0376
1924	0.0307	0.0315
1925	0.0452	0.0370
1926	0.0477	0.0339
1927	0.0527	0.0307
1928	0.0416	0.0276
1929	0.0399	0.0276
1930	0.0600	0.0362
1931	0.0398	0.0301
1932	0.0395	0.0377
1933	0.0327	0.0386
1934	0.0223	0.0221
1935	0.0570	0.0660
1936	0.0811	0.0954
1937	0.0785	0.0891
1938	0.1064	0.0973
1939	0.0769	0.0516
1940	0.0903	0.0498
1941	0.0543	0.0266
1942	0.0507	0.0158
1943	0.0242	0.0120
1944	0.0253	0.0150
1945	0.0285	0.0215
1946	0.0338	0.0272
1947	0.0273	0.0233
1948	0.0518	0.0526
1949	0.0283	0.0341
1950	0.0463	0.0510
1951	0.0607	0.0662
1952	0.0645	0.0680
1953	0.0616	0.0605
1954	0.1077	0.1046
1955	0.0878	0.0687
1956	0.1156	0.0966
1957	0.0941	0.0893
1958	0.0880	0.0677
1959	0.1243	0.0966
1960	0.1289	0.1144
1961	0.0702	0.0767
1962	0.0985	0.1163
1963	0.1525	0.1967
1964	0.2171	0.2063
1965	0.4422	0.2775
1966	0.9889	0.6998
1967	1.3621	1.5174
1968	1.6898	3.4514
1969	0.5782	0.5946
1970	1.3777	1.3252
1971	1.3101	1.5272
1972	1.5170	1.5716
1973	0.9425	1.3382
1974	0.1922	0.0681
1975	0.0623	0.1072
1976	0.0246	0.0558
1977	0.0589	0.0588
1978	0.1121	0.0390
1979	0.0263	0.0223
1980	0.0390	0.0322
1981	0.1352	0.0224
1982	0.0910	0.0207
1983	0.4170	0.0299
1984	0.0841	0.0902
1985	0.3228	0.3771
1986	1.0615	1.0917
1987	0.7044	0.3886
1988	1.1038	0.0472
1989	0.2273	0.0298
1990	0.3288	0.0212
1991	0.3393	0.0229
1992	0.0957	0.0268
1993	0.0295	0.0630
1994	0.2183	0.1289
1995	0.6669	0.2126
1996	0.2190	0.1744
1997	0.3675	0.1670
1998	0.7888	0.1444
1999	0.2333	0.1752
2000	0.3057	0.2040
2001	0.1595	0.1481

Table 3.6.1.1 Norwegian spring-spawning herring. Selection pattern.

Age	Selection
0	0.000
1	0.000
2	0.019
3	0.041
4	0.085
5	0.098
6	0.119
7	0.154
8	0.181
9	0.217
10	0.240
11	0.241
12	0.445
13	0.369
14	0.265
15	0.078
16	0.078

Table 3.6.2.1 Norwegian spring-spawning herring. Short term prediction

Table includes number (million) at age on 1 January 2002 and weight-at-age used for 2002.

MFDP version 1
Run: test22
TestProjection index file 15/3/99.
Time and date: 12:24 07.05.2002
Fbar age range: 5-14
Input units are millions and kg output is kilotonnes.

	Input 2002		2002					2003					2004	
Age	N	W	Biomass	SSB	FMult	FBar	Landings	Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
0	0	0.001	7266	5288	0.7711	0.1795	850	7055	6141	0	0	0	6999	6636
1	5000	0.01							6135	0.05	0.0116	60	6941	6573
2	3240	0.023							6129	0.1	0.0233	119	6884	6511
3	7010	0.057							6124	0.15	0.0349	177	6828	6450
4	9860	0.177							6118	0.2	0.0466	235	6772	6390
5	3060	0.241							6112	0.25	0.0582	292	6717	6330
6	3717	0.275							6107	0.3	0.0699	349	6663	6271
7	286	0.302							6101	0.35	0.0815	405	6609	6213
8	614	0.311							6095	0.4	0.0931	460	6556	6156
9	1670	0.314							6090	0.45	0.1048	515	6503	6099
10	4032	0.328							6084	0.5	0.1164	569	6451	6043
11	2392	0.341							6079	0.55	0.1281	622	6400	5988
12	570	0.372							6073	0.6	0.1397	675	6349	5934
13	126	0.405							6067	0.65	0.1514	727	6299	5880
14	14	0.415							6062	0.7	0.163	779	6249	5827
15	10	0.467							6056	0.75	0.1746	830	6200	5774
16	52	0.409							6051	0.8	0.1863	880	6151	5722
									6045	0.85	0.1979	930	6103	5671
									6040	0.9	0.2096	980	6056	5620
									6034	0.95	0.2212	1029	6009	5570
									6029	1	0.2328	1077	5962	5521

Table 3.10.1

Medium-term simulation

	5 Years				10 years			
	Mean yield	RiskBlim	RiskBpa	Stability	Mean yield	RiskBlim	RiskBpa	Stability
Ceiling 1.5 F = 0.	0.17	0.00	0.22	0.25	0.08	0.00	0.15	0.11
Ceiling 1.5 F = 0.05	0.38	0.00	0.34	0.23	0.33	0.02	0.29	0.15
Ceiling 1.5 F = 0.08	0.48	0.00	0.37	0.19	0.44	0.02	0.35	0.14
Ceiling 1.5 F = 0.1	0.55	0.01	0.40	0.16	0.49	0.04	0.39	0.13
Ceiling 1.5 F = 0.125	0.60	0.01	0.52	0.14	0.54	0.04	0.48	0.15
Ceiling 1.5 F = 0.15	0.69	0.00	0.53	0.13	0.61	0.03	0.50	0.15
Ceiling 1.5 F = 0.2	0.78	0.01	0.67	0.20	0.67	0.06	0.59	0.20
Ceiling 0.85 F = 0.125	0.60	0.00	0.52	0.14	0.53	0.03	0.48	0.15

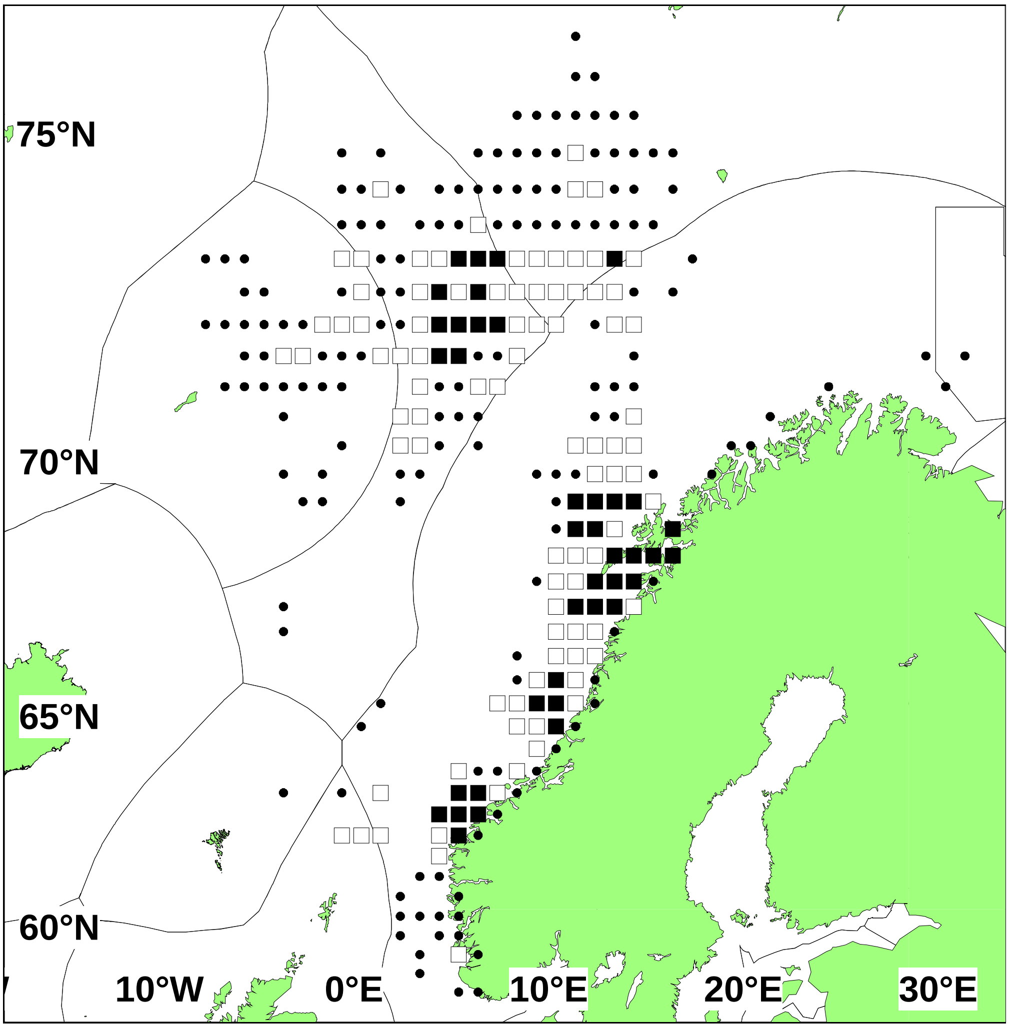


Figure 3.1.1. Total catches of Norwegian spring-spawning herring in 2001 by ICES rectangle. Grading of the symbols: black dots less than 300 t, open squares 300-3 000 t, and black squares > 3 000 t.

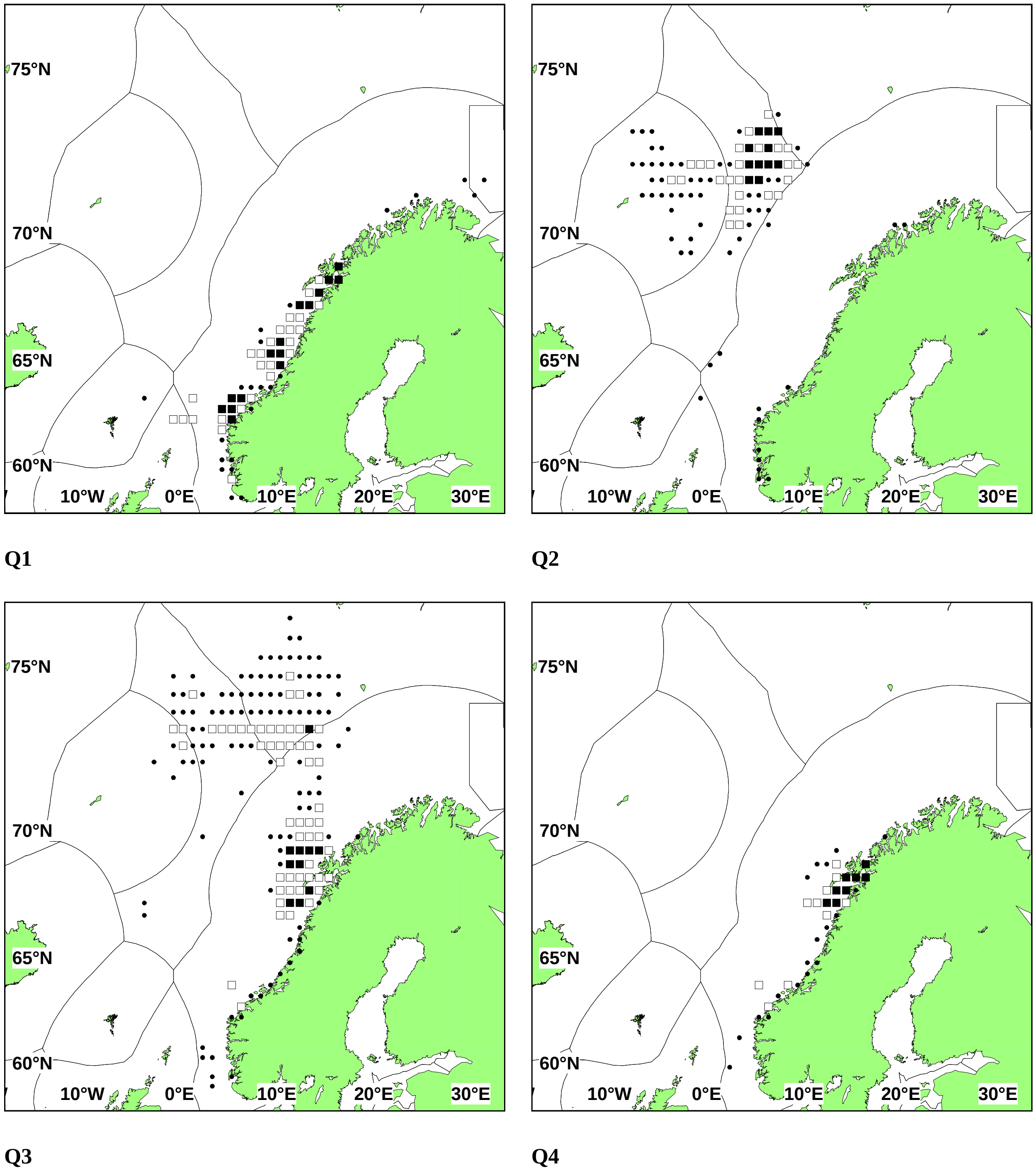


Figure 3.1.2. Total catches of Norwegian spring-spawning herring in 2001 by quarter and ICES rectangle. Grading of the symbols: black dots less than 300 t, open squares 300-3 000 t, and black squares > 3 000 t.

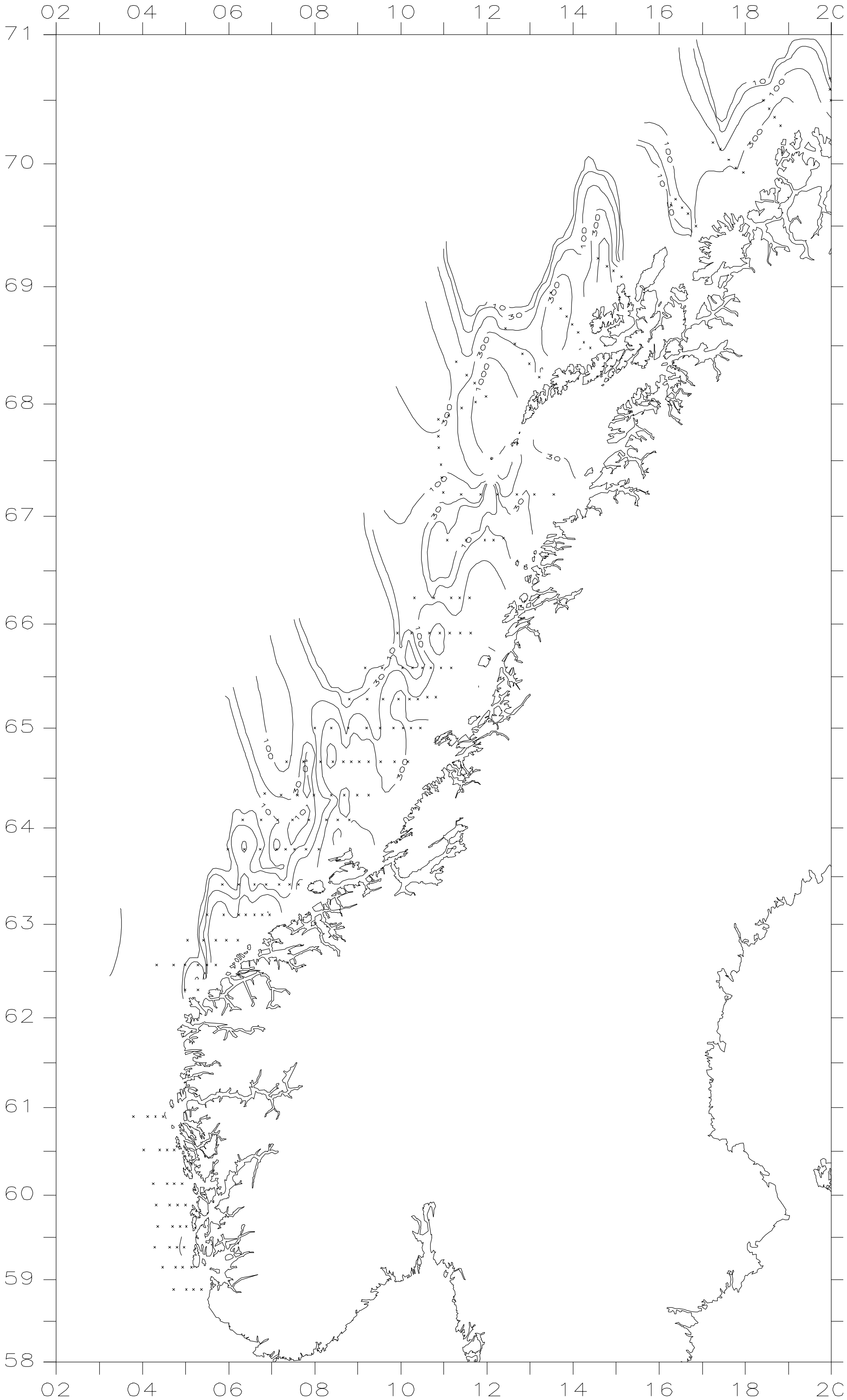


Figure 3.3.5.1 Herring larvae distribution in April 2002.

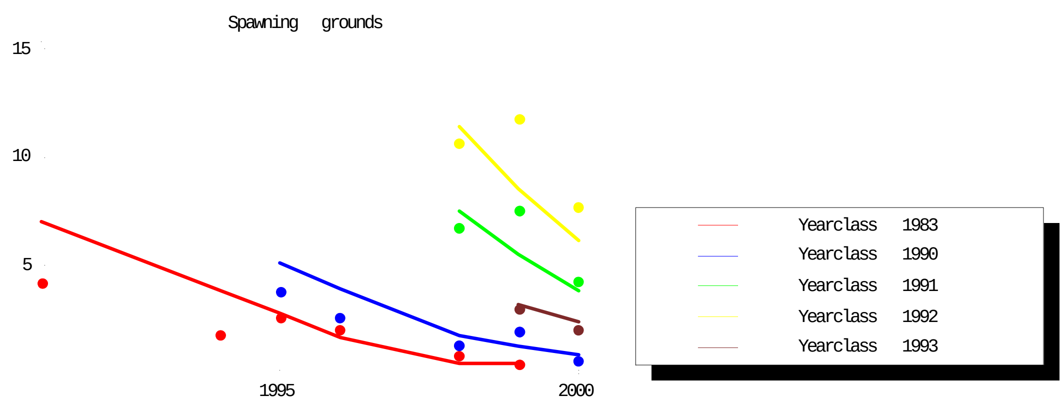


Figure 3.5.1.1 Fit of Spawning grounds to the VPA.

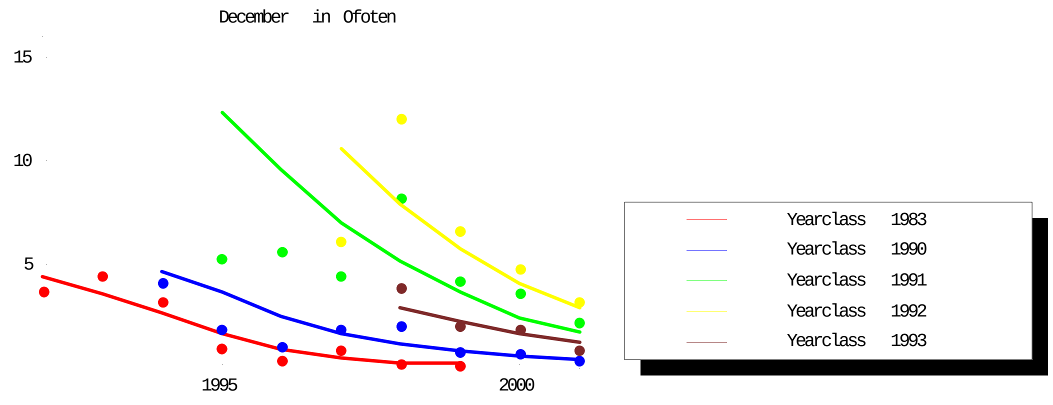


Figure 3.5.1.2 Fit of wintering area in December to the VPA.

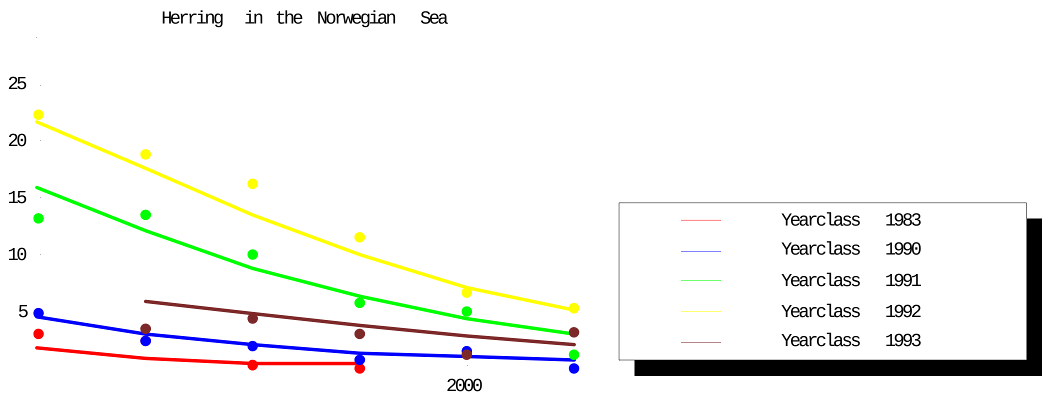


Figure 3.5.1.3 Fit of January in wintering area to the VPA.

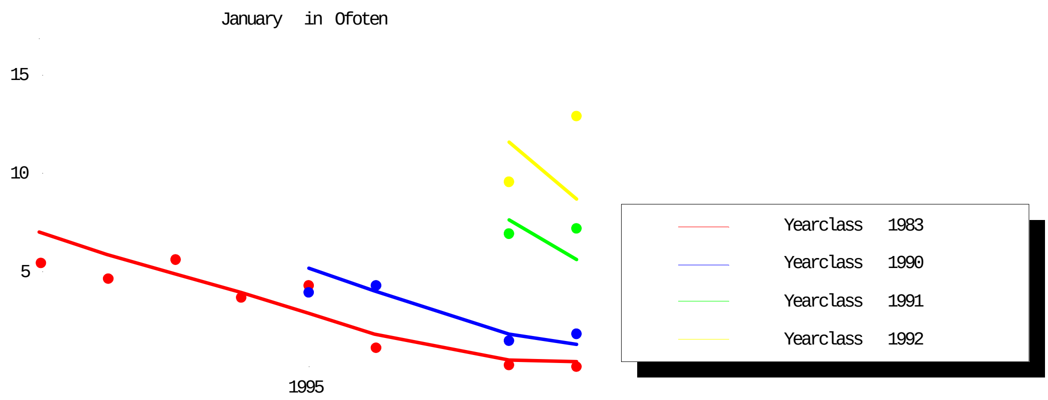


Figure 3.5.1.4 Fit of Norwegian Sea to the VPA.

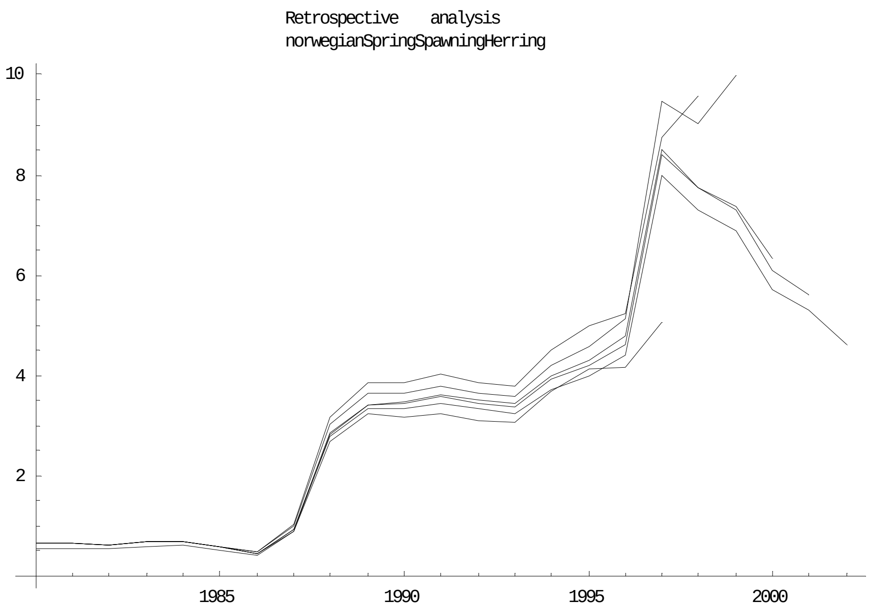


Figure 3.5.2. Retrospective plot for Norwegian spring-spawning herring.

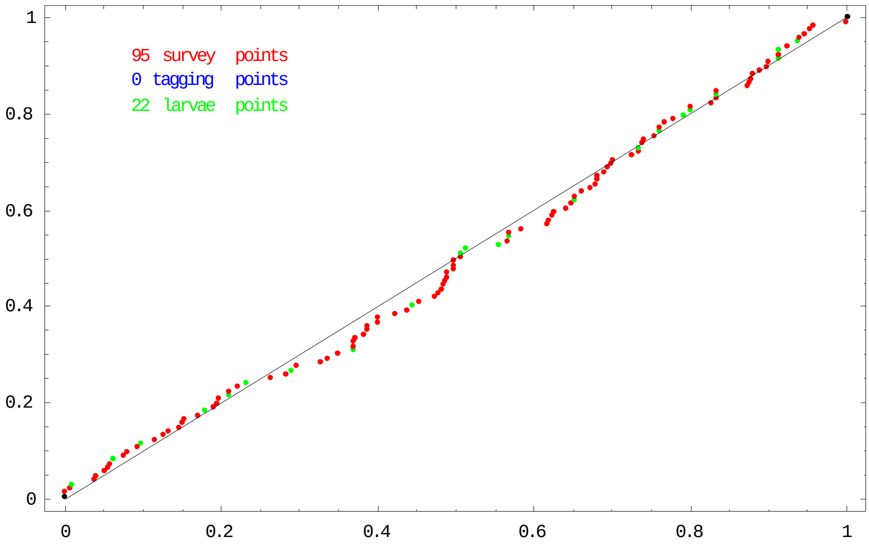


Figure 3.5.3. Quantile-quantile plot for the survey and larvae terms.

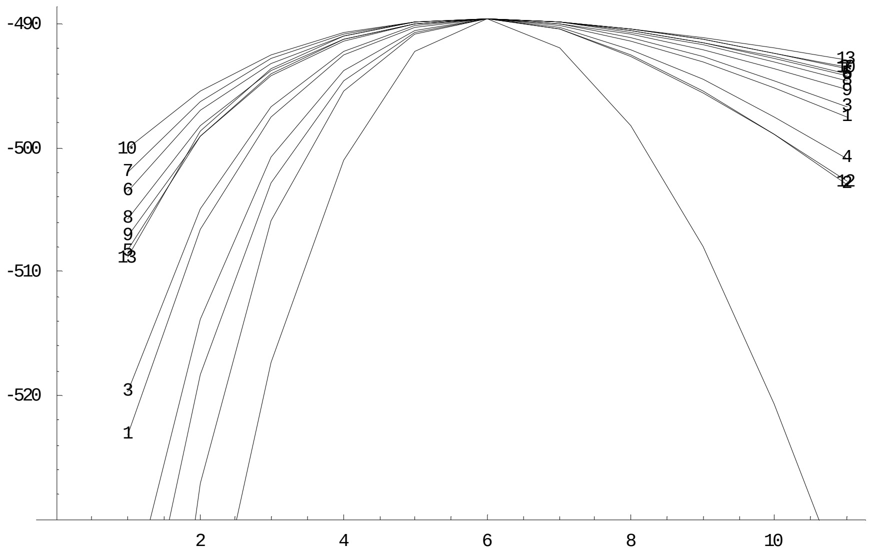


Figure 3.5.4. The log-likelihood for Norwegian spring-spawning herring as a function of parameters which are varied 50% to each side of the maximum likelihood estimate. Parameter numbering in the text.

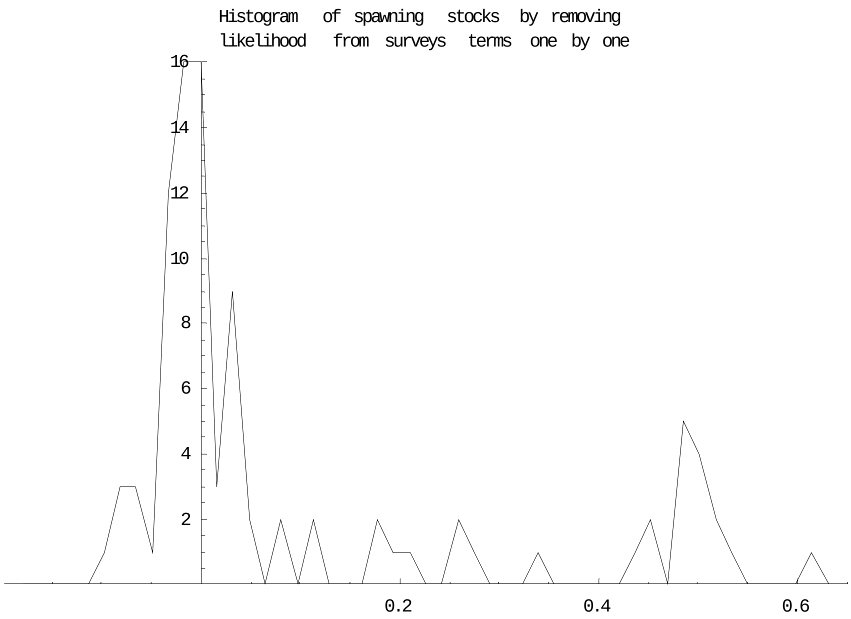


Figure 3.5.5.1. Histogram of spawning stock estimates obtained by deleting survey points one by one.

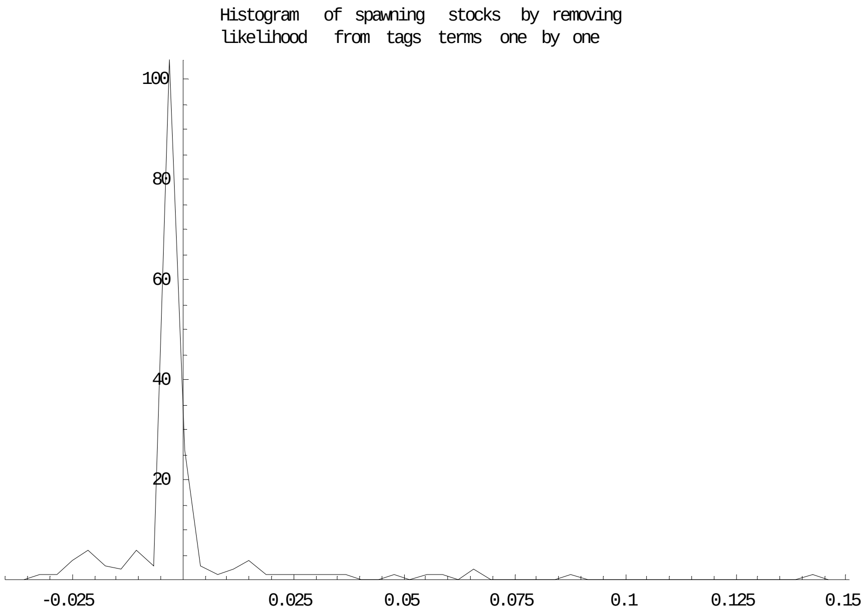


Figure 3.5.5.2. Histogram of spawning stock estimates obtained by deleting tagging points one by one.

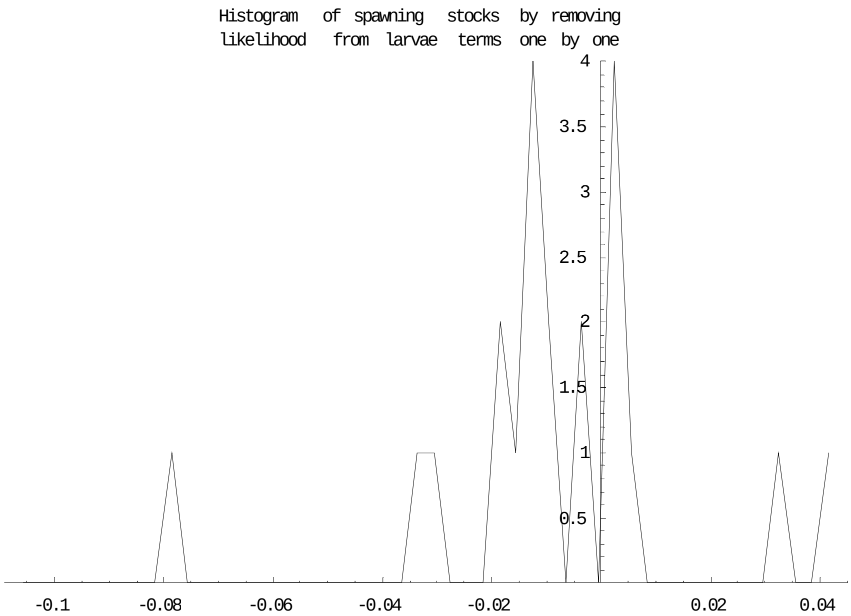


Figure 3.5.5.3. Histogram of spawning stock estimates obtained by deleting larvae points one by one.

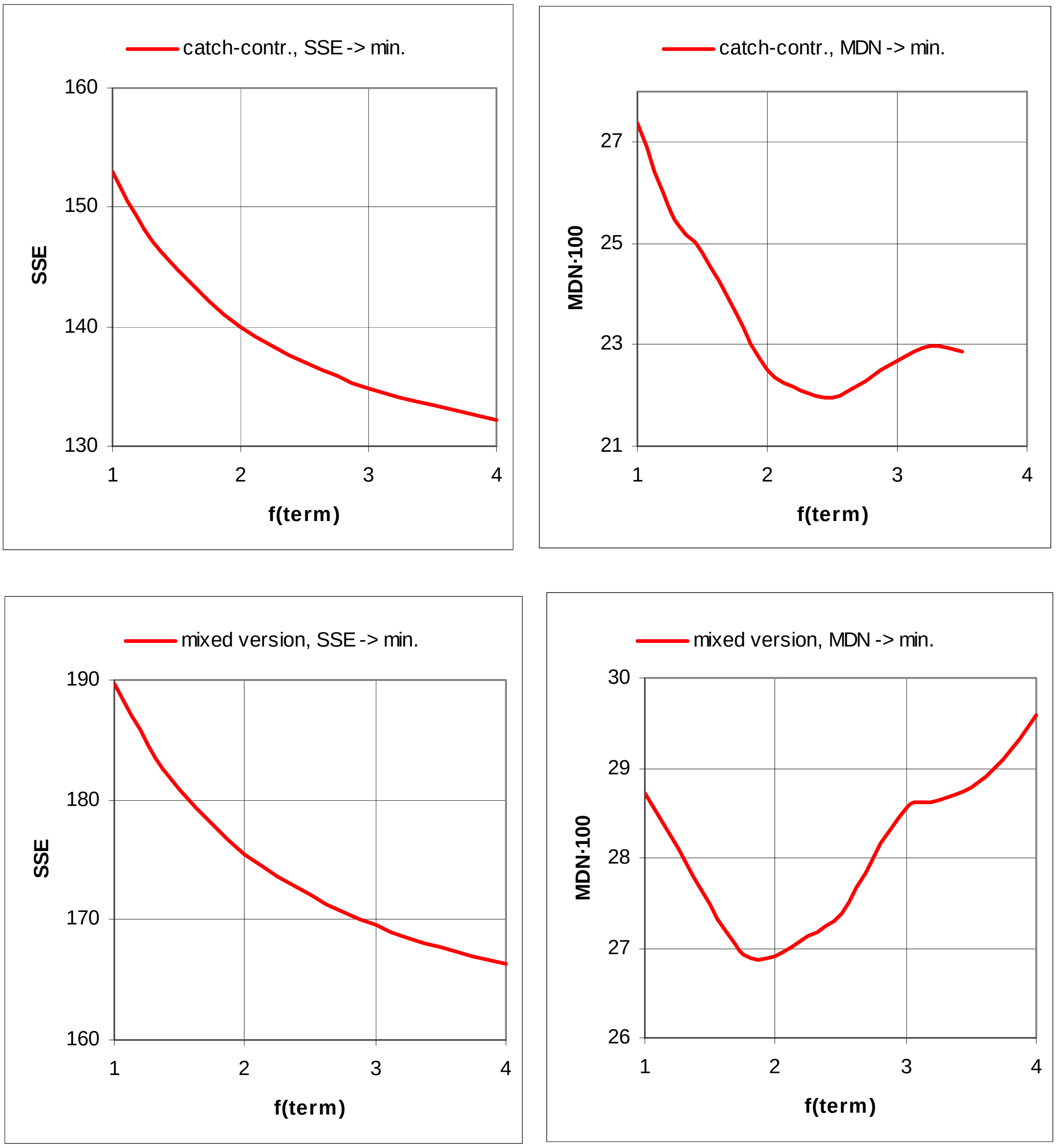
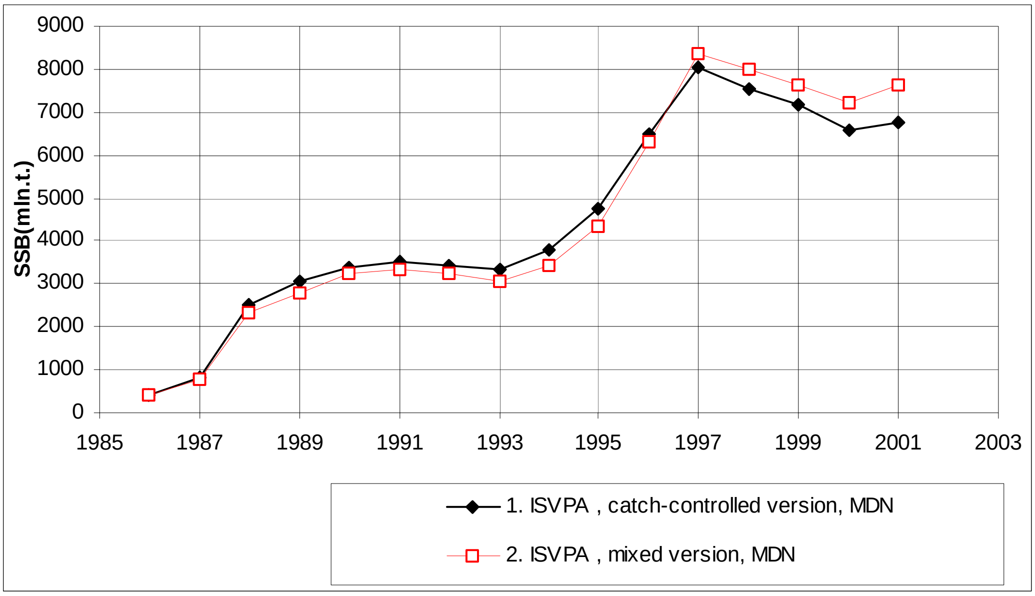
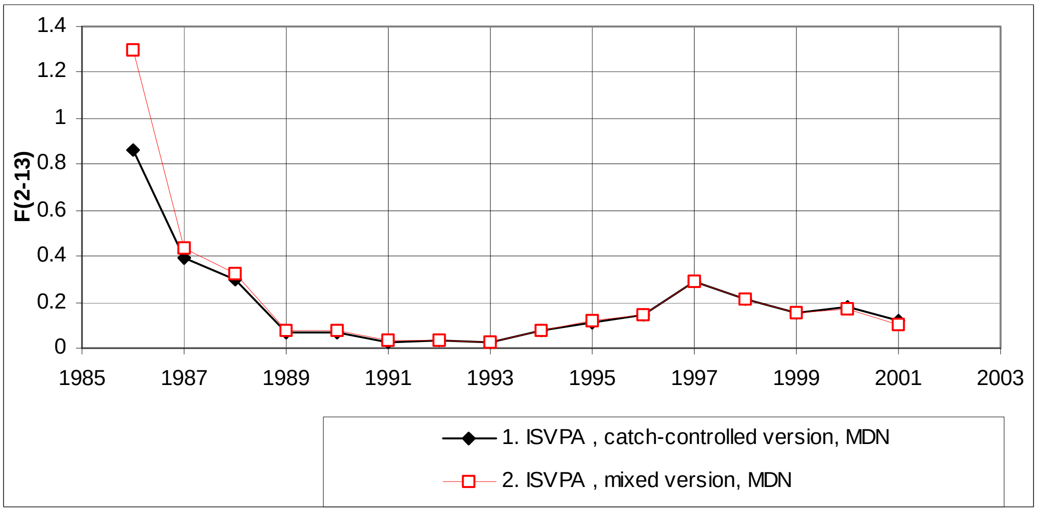


Figure.3.5.6 NSS herring: profiles of ISVPA loss function





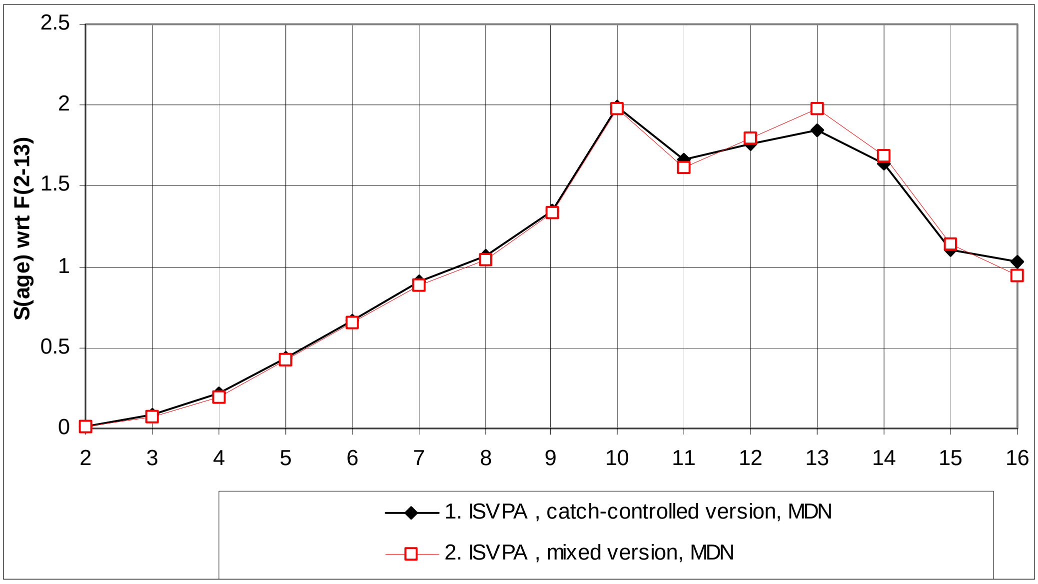


Figure.3.5.7 NSS herring: ISVPA results.

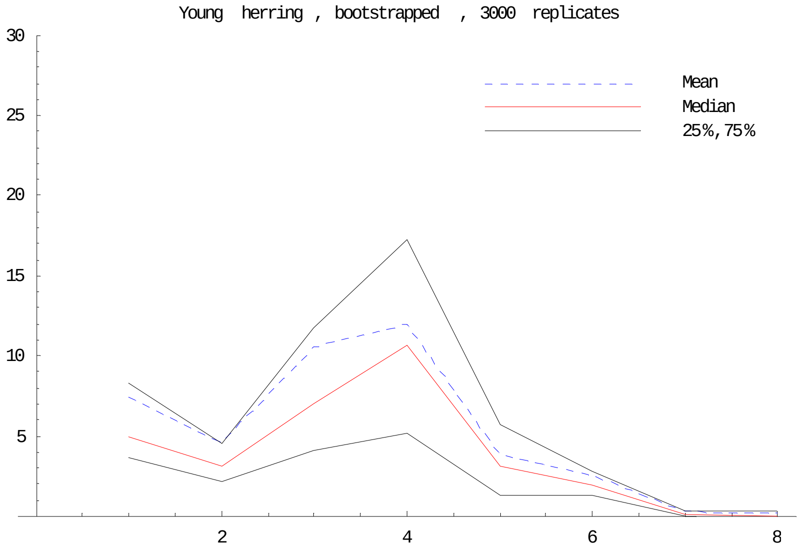


Figure 3.5.8. Percentiles of young herring at 1 January 2002.

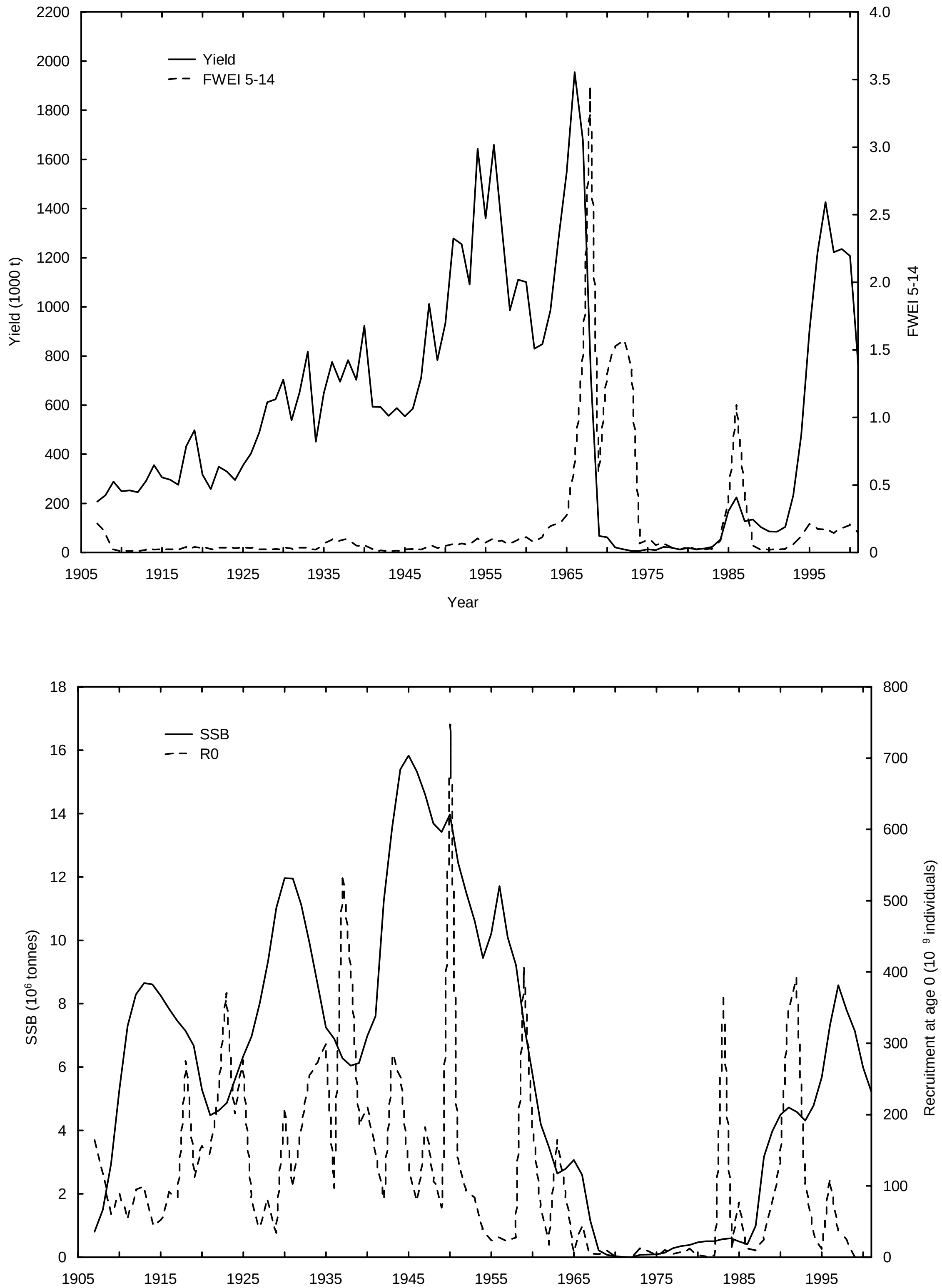


Figure. 3.5.9 Stock summary.

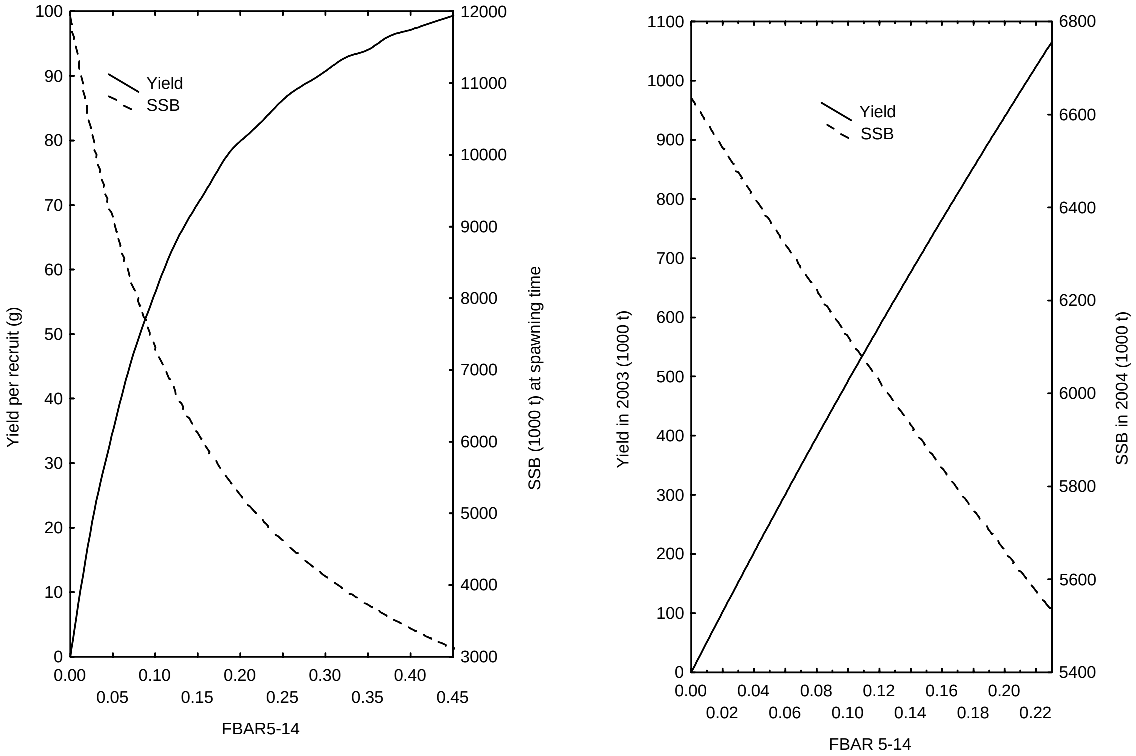


Figure 3.5.10 Results of yield per recruit analysis

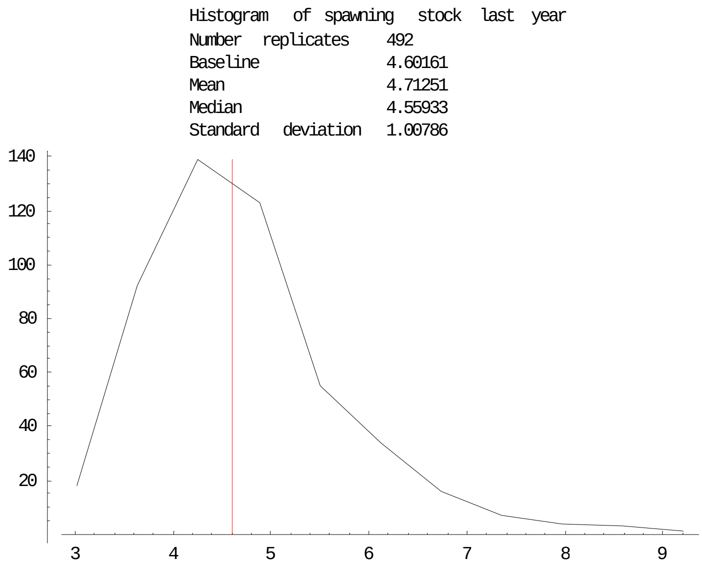


Figure 3.7.1. Histogram of bootstrap replicates of the spawning stock uncorrected for young fish not in the tuning

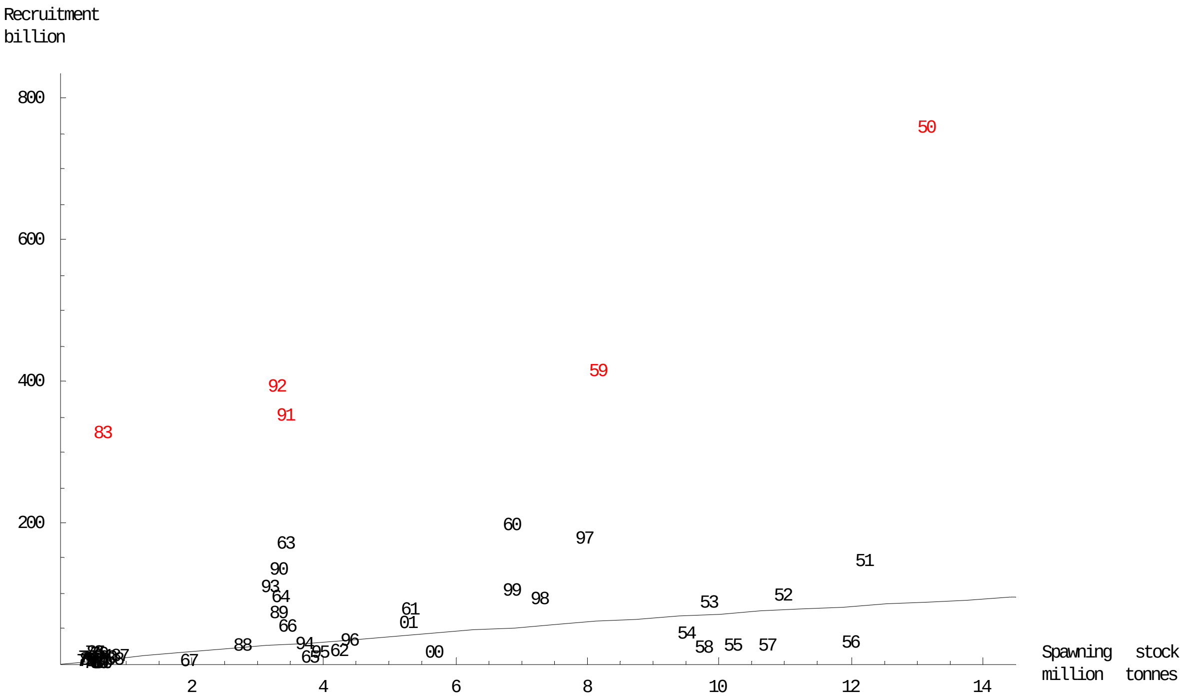


Figure 3.10.1. Beverton-Holt recruitment model for Norwegian spring-spawning herring. Rich year classes treated separately are shown in red.

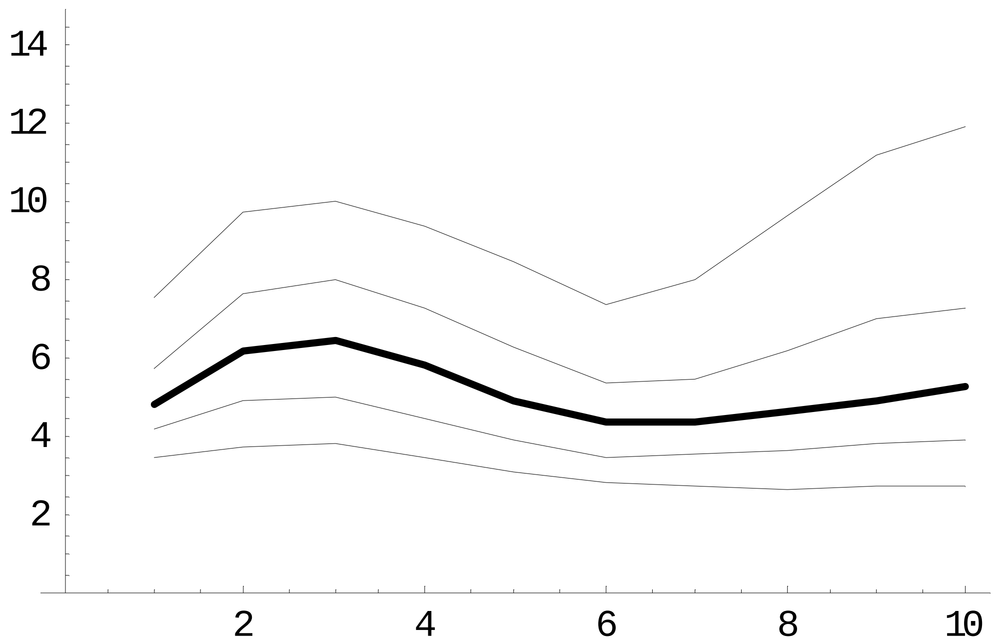


Figure 3.10.2. Development of the spawning stock in the medium term for default options. 5%, 25%, 50%, 75% and 95% quantiles.

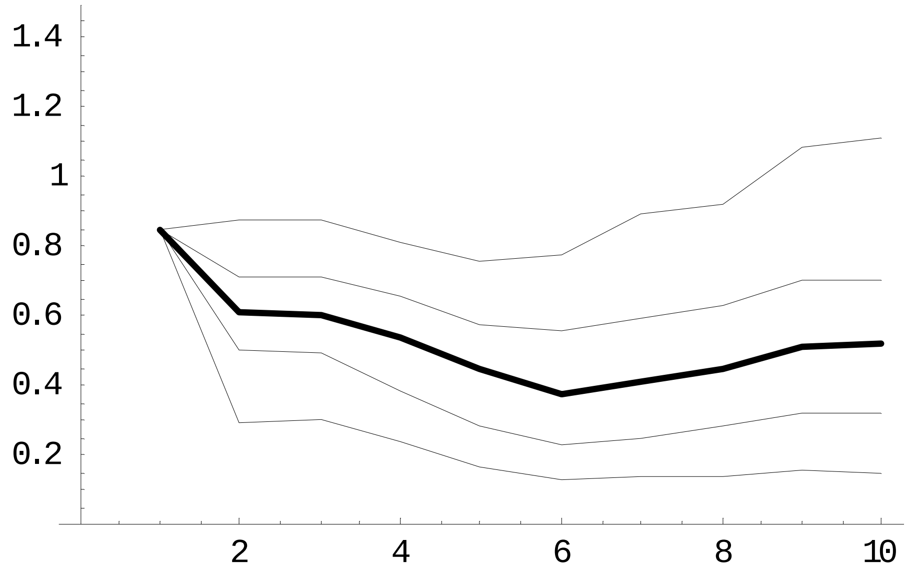


Figure 3.10.3. Development of the catch in the medium term for default options. 5%, 25%, 50%, 75% and 95% quantiles.

4 BARENTS SEA CAPELIN

4.1 Regulation of the Barents Sea Capelin Fishery

Since 1979, the Barents Sea capelin fishery has been regulated by a bilateral fishery management agreement between Russia (former USSR) and Norway. A TAC has been set separately for the winter fishery and for the autumn fishery. In recent years no autumn fishery has taken place, except for a small Russian experimental fishery. The fishery was closed from 1 May to 15 August until 1984. During the period 1984 to 1986, the fishery was closed from 1 May to 1 September. A minimum landing size of 11 cm has been in force for several years. From the autumn of 1986 to the winter of 1991, and from the autumn 1993 to the winter 1999 no fishery took place. The fishery was re-opened in the winter season 1991 and again in the winter season 1999, on a recovered stock.

In its autumn meeting of 2001, ACFM considered a harvest control rule, which was consistent with the precautionary approach. This rule defined the harvest level based on a maximum probability of 5% that SSB would fall below $\mathbf{B}_{lim}$ (corresponding to a catch of 650 000 t of pre-spawning capelin in 2002). ACFM also recommended that this harvest control rule be applied in 2002 (See also Section 4.5). During its Autumn 2001 meeting the Mixed Russian Norwegian Fishery Commission decided to set a quota of 650 000 t on Barents Sea capelin for the winter season 2001, divided by 60% (378 000 t) to Norway and 40% (252 000 t) to Russia.

4.2 Catch Statistics

The international catch by country and season in the years 1965-2001 is given in Table 4.2.1. The catch by age and length groups during the spring season 2001 is given in Table 4.2.2. The total catch in winter 2001 given in Table 4.2.1 was 557 000 t. This is 73 000 tonnes below the quota and the maximum TAC recommended by ACFM. The catch by age and length taken in the Russian experimental fishery during autumn 2001 (11 000 t) is shown in Table 4.2.3.

The final catch statistics for the winter-spring season 2002 are not available yet. By April 1 both Norway and Russia had landed their quotas.

4.3 Stock Size Estimates

4.3.1 Larval and 0-group estimates in 2001

Norwegian larval surveys based on Gulf III plankton samples have been carried out in June each year since 1981. The estimated total number of larvae is shown in Table 4.3.1.1. These larval abundance estimates do not show a high correlation with year-class strength at age one, but should reflect the amount of larvae produced each year (Gundersen and Gjøsæter, 1998). The year 1986 was exceptional, in that no larvae were found. This may have been due to late spawning that year, and eggs may have hatched after the survey was carried out. Also in other years some spawning is known to have taken place during the summer, and offspring from such late spawning is not reflected in the larval abundance estimates in Table 4.3.1.1. Since 1997, permission has not been granted to enter the Russian EEZ during the larval survey, and consequently the total larval distribution area has not been covered. The estimate of $10.7 \cdot 10^{12}$ larvae in 2001 is slightly higher than the average for the period 1981–2001, but is much lower than during the two previous years. During the international 0-group surveys in August an area-based index for the abundance of 0-group capelin is calculated (Table 4.3.1.1). Gundersen and Gjøsæter (1998) found these indices to be well correlated (r^2= 0.75) with the 1-group acoustic estimates for the same year class obtained by the annual capelin acoustic surveys in autumn. Data points up to 1994 were included in this analysis. When this regression is updated with the survey results from 1981–2000 the parameters in the regression were slightly changed and the r^2 was reduced to 0.68. Based on this regression, (ln 1-group estimate = -1.77 + 1.19 · ln 0-group index), the 0-group index obtained in 2001 of 221 would correspond to a year class strength of 107 billion one-year-olds in autumn 2002. A year class of this size would be about half the size of an average year class in the period 1972–2001, and the smallest since 1995.

4.3.2 Acoustic stock size estimates in 2001

Two Russian and two Norwegian vessels jointly carried out the 2001 acoustic survey in the period 10 September to 5 October (WD by Bogstad *et al.*). As previously the Norwegian vessels had restricted access to the Russian EEZ, but since two (partly three) of the four vessels available to the survey could work in the Russian EEZ, the coverage of the total stock was considered complete. The results from the survey are given in Table 4.3.2.1, and are compared to previous years' results in Table 4.3.2.2. The stock size was estimated at 3.6 million tonnes. The 2000 year class (one-year-olds) constituted about 30% by numbers and 10% by weight of the total stock and was considerably less abundant than the 1999 year class at the same age. About 50% (2.0 mill t) of the stock biomass consisted of maturing fish (> 14 cm).

4.3.3 Other surveys

Russian observations of capelin were made during a survey from 8 February to 5 March 2002 (WD by Ushakov and Prozorkevitch). An acoustic abundance estimate of 1.4 million tonnes of pre-spawning capelin corresponds well with the amount of maturing fish estimated during autumn 2001 after accounting for natural mortality. During the Norwegian demersal fish survey in February 2002 observations of capelin by acoustics and by pelagic and demersal trawls were made (WD by Gjøsæter). However, no stock size estimate was attempted. Samples of cod stomachs during this period give valuable information for the modelling of maturing capelin as prey for cod (Bogstad and Gjøsæter, 2001).

4.4 Historical stock development

An overview of the development of the Barents Sea capelin stock in the period 1991–2001 is given in Tables 4.4.1–4.4.7. The methods and assumptions used for constructing the tables are explained in Appendix A to ICES 1995 Assess: 9. In that report, the complete time-series back to 1973 can also be found. It should be noted that several of the assumptions and parameter values used in constructing these tables are provisional and future research may alter some of the tables considerably. For instance, M-values for immature capelin will be calculated using new estimates of the length at maturity and M-values for mature capelin will be calculated taking the predation by cod into account. This will also affect the estimates of spawning stock biomass given in the stock summary table (Table 4.4.7). Also, it should be noted that these values, coming from a deterministic model cannot directly be compared to those coming from the probabilistic assessment model used for this stock. However, as a crude overview of the development of the Barents Sea capelin stock the tables may be adequate.

Estimates of stock in number by age group and total biomass for the period are shown in Table 4.4.1. Catch in numbers at age and total landings are shown for the spring and autumn seasons in Tables 4.4.2 and 4.4.3. Natural mortality coefficients by age group for immature and mature capelin are shown in Table 4.4.4. Stock size at 1 January in numbers at age and total biomass is shown in Table 4.4.5. Spawning stock biomass per age group is shown in Table 4.4.6. Table 4.4.7 gives an aggregated summary for the entire period 1973–2001.

4.5 Stock assessment autumn 2001

As decided by the Northern Pelagic and Blue Whiting Fisheries Working Group at its 2001 meeting (ICES 2001/ACFM:17), the assessment of Barents Sea capelin was left to the parties responsible for the autumn survey, i.e., IMR in Bergen and PINRO in Murmansk, who reported directly to ACFM before its autumn 2001 meeting (Bogstad *et al.,* WD).

A probabilistic projection of the spawning stock to the time of spawning at 1 April 2002 was presented, using the spreadsheet model CapTool, implemented using the @RISK add-on for EXCEL. The projection was based on a probabilistic maturation model with parameters estimated by the model Bifrost (former CapSex), with uncertainty taken into account; data on size and composition of the cod stock (from the Arctic Fisheries Working Group, ICES 2002/ACFM:19, but made probabilistic in CapTool in accordance with the risk analysis made by the Arctic Fisheries Working Group).

There is clearly a need for a target biomass reference point for capelin. Calculations of B_{target} were not made, but are planned for the future. A $\mathbf{B}_{lim}$ ($SS\mathbf{B}_{lim}$) management approach was suggested for this stock. As in 2000, the meeting suggested the spawning stock size in 1989 as a $\mathbf{B}_{lim.}$ The rationale behind this was that this biomass produced one of the strongest year classes observed during the period 1972–2001. It should also be noted that this year is within the time range for which quantitative stomach content data are available. It can be argued that the SSB in 1989 was sufficiently large to produce a good year class under favourable recruitment conditions in a "non-herring situation" (Gjøsæter and Bogstad, 1998).

Probabilistic prognoses for the maturing stock from October 1 2001 until April 1 2002 were made, with a CV of 0.20 on the abundance estimate. The meeting concluded that capelin recruitment in 2002 would probably not be influenced to any noticeable degree by the stock of young herring now found in the Barents Sea.

ACFM at its autumn 2001 meeting (ICES 2001/CRR:246) took most of the points in the report into account. ACFM agreed to the view that fishing mortality reference points and a $\mathbf{B}_{pa}$ are not relevant for this stock, and that a target escapement management strategy is the most useful way of ensuring a minimum amount of spawners. Further ACFM agreed to the strategy adopted of directing the fishery at the spawning stock just prior to spawning, to allow the capelin to be available to predators as long as possible. The idea of a stochastic $\mathbf{B}_{\mathrm{lim}}$ set equal to the modelled density distribution of the spawning stock in 1989 was considered “a good basis for such a reference point in a non-herring situation”. Because the assessment method may not yet account for all sources of uncertainty, and because there are inconsistencies in the data series, ACFM did not adopt the suggested $\mathbf{B}_{\mathrm{lim}}$. Rather, ACFM set a $\mathbf{B}_{\mathrm{lim}}$ of 200 000 t and consequently advised that a TAC should not exceed 630 000 t. This was based on adopting the forecast of the SSB using the limit reference points referred above, and following the harvest control rule that the SSB should fall below $\mathbf{B}_{\mathrm{lim}}$ with a maximum 5% probability. ACFM also considered that adjustments of the harvest control rule should be further investigated for the purpose of taking better account of the uncertainty in the predicted amount of abundance of spawners, the likely interactions with herring, and the role of capelin as prey.

4.6 Management considerations

Since the assessment of the stock is directly based on the acoustic survey conducted annually in September-October, and the main fishing season does not begin until January, advice for this stock must be given during the autumn ACFM meeting and the TAC must be set by the Mixed Norwegian-Russian Fishery Commission during its meeting in November-December. As previously decided by the Northern Pelagic and Blue Whiting Fisheries Working Group, the assessment of Barents Sea capelin is left to the parties responsible for the autumn survey, i.e., IMR in Bergen and PINRO in Murmansk, who will report directly to the 2002 ACFM autumn meeting.

4.7 Sampling

The sampling from scientific surveys and from commercial fishing on capelin is summarised below:

Investigation	No. of samples	Length measurements	Aged individuals
Acoustic survey 2001 (Norway)	144	11460	6750
Acoustic survey 2001 (Russia)	175	33158	1281
Norwegian bottom trawl survey winter 2002	221	6578	2331
Russian winter capelin survey 2002	93	9105	900
Norwegian fishery winter 2002	58	5949	300
Russian fishery autumn 2001	213	22153	900
Russian fishery winter 2002	106	13145	751

Table 4.2.1 Barents Sea CAPELIN. International catch (‘000 t) as used by the Working Group.

Year	Winter				Summer-Autumn			Total
	Norway	Russia	Others	Total	Norway	Russia	Total	
1965	217	7	0	224	0	0	0	224
1966	380	9	0	389	0	0	0	389
1967	403	6	0	409	0	0	0	409
1968	460	15	0	475	62	0	62	537
1969	436	1	0	437	243	0	243	680
1970	955	8	0	963	346	5	351	1314
1971	1300	14	0	1314	71	7	78	1392
1972	1208	24	0	1232	347	11	358	1591
1973	1078	35	0	1112	213	10	223	1336
1974	749	80	0	829	237	82	319	1149
1975	559	301	43	903	407	129	536	1439
1976	1252	231	0	1482	739	366	1105	2587
1977	1441	345	2	1788	722	477	1199	2987
1978	784	436	25	1245	360	311	671	1916
1979	539	343	5	887	570	326	896	1783
1980	539	253	9	801	459	388	847	1648
1981	784	428	28	1240	454	292	746	1986
1982	568	260	5	833	591	336	927	1760
1983	751	374	36	1161	758	439	1197	2358
1984	330	257	42	628	481	367	849	1477
1985	340	234	17	590	113	164	278	868
1986	72	51	0	123	0	0	0	123
1987	0	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0
1991	528	156	20	704	31	195	226	929
1992	620	247	24	891	73	159	232	1123
1993	402	170	14	586	0	0	0	586
1994	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	1	1	1
1998	0	0	0	0	0	1	1	1
1999	46	32	0	78	0	23	23	101
2000	283	95	8	386	0	28	28	414
2001	368	180	8	557	0	11	11	568

Table 4.2.2 Barents Sea CAPELIN. International catch in number (10^6) and biomass (t) during the spring season 2001, as used by the Working Group.

Length	Age 1		Age 2		Age 3		Age 4		Age 5+		Sum			
cm	N	B	N	B	N	B	N	B	N	B	N	%	B	%
5.0–5.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.5–6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.0–6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.5–7.0	2	2	0	0	0	0	0	0	0	0	2	0	2	0
7.0–7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.5–8.0	0	0	2	3	0	0	0	0	0	0	2	0	3	0
8.0–8.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.5–9.0	0	0	38	88	0	0	0	0	0	0	38	0	88	0
9.0–9.5	0	0	38	100	0	0	0	0	0	0	38	0	100	0
9.5–10.0	2	0	38	149	0	0	0	0	0	0	41	0	149	0
10.0–10.5	7	0	77	295	0	0	0	0	0	0	84	0	295	0
10.5–11.0	7	0	154	694	0	0	0	0	0	0	161	1	694	0
11.0–11.5	7	0	77	463	0	0	0	0	0	0	84	0	463	0
11.5–12.0	12	0	0	88	0	0	0	0	0	0	12	0	88	0
12.0–12.5	15	0	38	570	0	0	0	0	0	0	53	0	570	0
12.5–13.0	20	0	10	155	38	323	0	0	0	0	69	0	478	0
13.0–13.5	10	0	18	159	102	1037	0	0	0	0	130	1	1196	0
13.5–14.0	0	0	0	47	462	5379	0	0	0	0	462	2	5426	1
14.0–14.5	5	0	0	0	753	10341	29	420	0	0	787	4	10761	2
14.5–15.0	0	0	0	0	1164	17506	149	2502	0	0	1313	6	20008	4
15.0–15.5	0	0	13	220	1325	22193	619	11095	0	0	1957	9	33509	6
15.5–16.0	0	0	7	111	1149	21805	1134	23055	37	634	2327	10	45605	8
16.0–16.5	0	0	0	0	933	20023	1871	41496	85	1913	2889	13	63432	11
16.5–17.0	0	0	0	0	795	19714	1891	47194	121	3005	2807	12	69913	13
17.0–17.5	0	0	0	0	522	14502	1826	50960	332	9432	2680	12	74894	13
17.5–18.0	0	0	0	0	225	6815	1807	56001	406	12685	2439	11	75501	14
18.0–18.5	0	0	0	0	55	1777	1248	42747	295	9955	1598	7	54478	10
18.5–19.0	0	0	0	0	35	1273	834	31091	489	18205	1358	6	50570	9
19.0–19.5	0	0	0	0	0	0	484	19652	249	10170	733	3	29822	5
19.5–20.0	0	0	0	0	0	0	154	6886	114	5431	268	1	12317	2
20.0–20.5	0	0	0	0	0	0	77	3631	50	2372	127	1	6003	1
20.5–21.0	0	0	0	0	0	0	7	356	0	12	8	0	368	0
21.0–21.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21.5–22.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	90	2	512	3143	7560	142688	12132	337087	2177	73814	22470	100	556734	100

Table 4.2.3 Barents Sea CAPELIN. Russian catch in number (10^6) and biomass (t) during the autumn season 2001, as used by the Working Group.

Length	Age 1		Age 2		Age 3		Age 4		Age 5+		Sum			
cm	N	B	N	B	N	B	N	B	N	B	N	%	B	%
5.0–5.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.5–6.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.0–6.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.5–7.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.0–7.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.5–8.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.0–8.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.5–9.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.0–9.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.5–10.0	1	4	0	0	0	0	0	0	0	0	1	0	4	0
10.0–10.5	1	3	0	0	0	0	0	0	0	0	1	0	3	0
10.5–11.0	1	4	0	2	0	0	0	0	0	0	1	0	6	0
11.0–11.5	2	10	2	13	0	0	0	0	0	0	4	1	23	0
11.5–12.0	0	0	7	50	0	0	0	0	0	0	7	1	50	0
12.0–12.5	1	3	12	99	0	0	0	0	0	0	13	2	102	1
12.5–13.0	0	0	23	204	0	0	0	0	0	0	23	4	204	2
13.0–13.5	0	0	27	279	0	0	0	0	0	0	27	5	279	2
13.5–14.0	0	0	43	488	0	0	0	0	0	0	43	7	488	4
14.0–14.5	1	6	39	494	1	14	0	0	0	0	41	7	514	5
14.5–15.0	0	0	49	640	1	12	0	0	0	0	50	8	652	6
15.0–15.5	0	0	51	851	5	87	0	0	0	0	56	10	937	8
15.5–16.0	0	0	45	777	11	168	0	0	0	0	56	9	945	8
16.0–16.5	0	0	37	783	19	423	0	0	0	0	56	9	1207	11
16.5–17.0	0	0	30	591	21	416	1	11	0	0	51	9	1018	9
17.0–17.5	0	0	16	411	28	731	0	0	0	0	44	8	1142	10
17.5–18.0	0	0	8	223	40	1098	4	103	0	0	52	9	1424	13
18.0–18.5	0	0	3	84	26	833	7	222	0	0	36	6	1139	10
18.5–19.0	0	0	0	0	14	468	3	101	0	0	17	3	569	5
19.0–19.5	0	0	0	0	7	250	2	61	0	0	9	1	310	3
19.5–20.0	0	0	0	0	2	59	0	0	0	0	2	0	59	1
20.0–20.5	0	0	0	0	2	62	2	65	0	0	3	1	128	1
20.5–21.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21.0–21.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21.5–22.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	6	30	393	5989	175	4620	18	564	0	0	592	100	11204	100

Table 4.3.1.1 Barents Sea CAPELIN. Larval abundance estimate (10^{12}) in June, and 0-group index in August.

Year	Larval abundance	0-group index
1981	9.7	570
1982	9.9	393
1983	9.9	589
1984	8.2	320
1985	8.6	110
1986	0.0	125
1987	0.3	55
1988	0.3	187
1989	7.3	1300
1990	13.0	324
1991	3.0	241
1992	7.3	26
1993	3.3	43
1994	0.1	58
1995	0.0	43
1996	2.4	291
1997	6.9	522
1998	14.1	428
1999	36.5	722
2000	19.1	303
2001	10.7	221

Table 4.3.2.1 Barents Sea CAPELIN. Estimated stock size from the acoustic survey in September-October 2001. Based on TS value 19.1 log L –74.0 dB, corresponding to $\sigma = 5.0 \cdot 10^{7} \cdot L^{1.91}$.

Length (cm)		1	2	3	4	5+	Sum	Biomass	Mean
		1999	1998	1997	1996	1995	(10^{9})	(10^{3} t)	weight (g)
5.0 -	5.5	0.034					0.034	0.000	0.500
5.5 -	6.0						0.000	0.000	
6.0 -	6.5	0.296					0.296	0.300	0.900
6.5 -	7.0	1.199					1.199	1.300	1.100
7.0 -	7.5	2.592					2.592	2.800	1.100
7.5 -	8.0	3.756					3.756	5.000	1.300
8.0 -	8.5	5.134					5.134	9.700	1.900
8.5 -	9.0	9.207					9.207	21.000	2.300
9.0 -	9.5	17.351	0.003				17.353	46.100	2.700
9.5 -	10.0	23.350	0.042				23.391	74.300	3.200
10.0 -	10.5	25.616	0.381				25.998	93.500	3.600
10.5 -	11.0	15.014	2.457				17.471	77.200	4.400
11.0 -	11.5	7.086	8.039				15.125	80.600	5.300
11.5 -	12.0	2.815	24.258				27.073	169.200	6.300
12.0 -	12.5	0.085	32.271	0.006			32.362	236.900	7.300
12.5 -	13.0	0.029	32.591	0.063			32.683	266.200	8.100
13.0 -	13.5		28.541	0.052			28.592	275.700	9.600
13.5 -	14.0	0.023	21.965	0.089			22.078	251.300	11.400
14.0 -	14.5		21.221	0.209	0.019		21.450	282.400	13.200
14.5 -	15.0		17.545	0.372			17.917	270.200	15.100
15.0 -	15.5		9.455	2.430			11.885	199.000	16.700
15.5 -	16.0		7.900	3.588	0.050		11.538	223.800	19.400
16.0 -	16.5		4.619	4.476	0.007		9.102	200.600	22.000
16.5 -	17.0		3.888	6.355	0.007		10.250	259.600	25.300
17.0 -	17.5		2.315	4.657	0.280		7.253	213.800	29.500
17.5 -	18.0		1.024	3.171	0.059		4.253	139.900	32.900
18.0 -	18.5		0.119	3.685	0.198		4.002	146.800	36.700
18.5 -	19.0		0.044	0.860	0.351	0.061	1.316	54.400	41.300
19.0 -	19.5		0.060	0.463	0.046		0.569	24.700	43.400
19.5 -	20.0			0.025	0.034		0.059	2.900	49.100
20.0 -	20.5				0.011		0.011	0.500	48.000
20.5 -	21.0								
TSN (10^{9})		113.587	218.737	30.500	1.063	0.061	363.948		
TSB (10^{3} t)		374.8	2401.1	813.8	37.7	2.5		3630	
Mean length (cm)		9.80	13.40	16.80	18.00	18.80	12.6		
Mean weight (g)		3.3	11.0	26.7	35.5	41.4			10.0
SSN (10^{9})		0.000	68.190	30.291	1.062	0.061	99.605		
SSB (10^{3} t)		0.0	1167.0	811.6	37.7	2.5		2018.8	

Table 4.3.2.2 Barents Sea CAPELIN. Stock size in numbers by age, total stock biomass and biomass of the maturing component. Stock in numbers (unit:10^9) and stock and maturing stock biomass (unit:10^3 tonnes) are given at 1 October.

Year	Stock in numbers (10^9)						Stock in weight ('000 t)	
	Age 1	Age 2	Age 3	Age 4	Age 5	Total	Total	Maturing
1973	528	375	40	17	0	961	5144	1350
1974	305	547	173	3	0	1029	5733	907
1975	190	348	296	86	0	921	7806	2916
1976	211	233	163	77	12	696	6417	3200
1977	360	175	99	40	7	681	4796	2676
1978	84	392	76	9	1	561	4247	1402
1979	12	333	114	5	0	464	4162	1227
1980	270	196	155	33	0	654	6715	3913
1981	403	195	48	14	0	660	3895	1551
1982	528	148	57	2	0	735	3779	1591
1983	515	200	38	0	0	754	4230	1329
1984	155	187	48	3	0	393	2964	1208
1985	39	48	21	1	0	109	860	285
1986	6	5	3	0	0	14	120	65
1987	38	2	0	0	0	39	101	17
1988	21	29	0	0	0	50	428	200
1989	189	18	3	0	0	209	864	175
1990	700	178	16	0	0	894	5831	2617
1991	402	580	33	1	0	1016	7287	2248
1992	351	196	129	1	0	678	5150	2228
1993	2	53	17	2	2	75	796	330
1994	20	3	4	0	0	28	200	94
1995	7	8	2	0	0	17	193	118
1996	82	12	2	0	0	96	503	248
1997	99	39	2	0	0	140	911	312
1998	179	73	11	1	0	263	2056	931
1999	156	101	27	1	0	285	2776	1718
2000	449	111	34	1	0	595	4273	2099
2001	114	219	31	1	0	364	3630	2019

Table 4.4.1 Barents Sea CAPELIN. Estimated stock size in numbers (unit:10^9) by age group and total, and biomass ('000 t) of total stock, by 1 August, back-calculated from the survey in September-October.

Age		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	1	396.2	3.1	29.5	8.3	88.9	111.8	188.4	171.4	474.7	128.0
	2	223.9	73.0	5.1	9.4	12.5	44.2	76.5	111.5	116.8	246.6
	3	162.8	25.3	6.4	1.6	2.2	2.2	12.1	27.9	35.9	33.0
	4	1.6	3.7	0.3	0.4	0.1	0.1	0.7	0.9	0.8	1.2
	5	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1
Sum		784.4	105.0	41.4	19.7	103.7	158.3	277.8	311.7	628.4	408.8
Biomass		5371	991	259	189	467	866	1860	2580	3840	3480

Table 4.4.2 Barents Sea CAPELIN. Catch in numbers (unit:10^9) by age group and total landings ('000 t) in the spring season.

Age		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
	2	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5
	3	23.8	4.8	0.0	0.0	0.0	0.0	0.0	1.6	5.5	7.6
	4	17.3	26.8	0.0	0.0	0.0	0.0	0.0	1.2	8.4	12.1
	5	2.1	1.4	0.0	0.0	0.0	0.0	0.0	0.1	1.0	2.2
Sum		43.4	33.5	0.0	0.0	0.0	0.0	0.0	3.0	15.1	22.5
Landings		891	586	0	0	0	0	0	78	386	557

Table 4.4.3 Barents Sea CAPELIN. Catch in numbers (unit:10^9) by age group and total landings ('000 t) in the autumn season.

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1	0.0
2	5.8	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9	0.4
3	7.9	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4	0.2
4	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sum	15.3	0.0	0.0	0.0	0.0	0.0	0.1	1.6	1.5	0.6
Landings	232	0	0	0	0	1	1	23	28	11

Table 4.4.4 Barents Sea CAPELIN. Natural mortality coefficients (per month) for immature fish (Mimm), used for the whole year, and for mature fish (per season) (Mmat) used January to March, by age group and average for age groups 1–5.

	1992		1993		1994		1995		1996	
Age	Mimm	Mmat	Mimm	Mmat	Mimm	Mmat	Mimm	Mmat	Mimm	Mmat
1	0.059	0.178	0.157	0.471	0.201	0.602	0.073	0.219	0.041	0.122
2	0.058	0.174	0.157	0.470	0.201	0.602	0.073	0.219	0.041	0.122
3	0.107	0.322	0.190	0.571	0.201	0.602	0.019	0.058	0.041	0.122
4	0.074	0.221	0.214	0.642	0.282	0.847	0.044	0.133	0.050	0.149
5	0.071	0.212	0.214	0.642	0.282	0.847	0.044	0.133	0.050	0.149
Avr	0.074	0.222	0.186	0.559	0.221	0.700	0.052	0.152	0.043	0.133

Table 4.4.4 (Continued)

	1997		1998		1999		2000		2001	
Age	Mimm	Mmat	Mimm	Mmat	Mimm	Mmat	Mimm	Mmat	Mimm	Mmat
1	0.062	0.185	0.026	0.077	0.047	0.142	0.028	0.083	0.060	0.180
2	0.062	0.185	0.026	0.077	0.047	0.142	0.028	0.083	0.060	0.180
3	0.062	0.185	0.071	0.212	0.025	0.074	0.026	0.079	0.040	0.120
4	0.014	0.041	0.071	0.212	0.025	0.074	0.026	0.079	0.040	0.120
5	0.014	0.041	0.071	0.212	0.025	0.074	0.026	0.079	0.040	0.120
Avr	0.042	0.127	0.053	0.158	0.034	0.101	0.027	0.080	0.048	0.144

Table 4.4.5 Barents Sea CAPELIN. Estimated stock size in numbers (unit:109) by age group and total, and biomass (‘000 t) of total stock, by 1 January.

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	600.1	9.2	120.3	13.8	118.2	172.0	225.5	238.5	576.1	194.7
2	382.0	293.7	1.4	10.8	5.7	72.5	82.2	165.8	135.3	413.3
3	548.6	162.6	33.3	1.9	6.5	10.2	32.5	67.3	88.1	100.9
4	25.7	89.2	9.8	2.4	1.4	1.8	1.6	8.5	24.7	31.1
5	0.3	0.5	1.3	0.1	0.3	0.1	0.1	0.5	0.8	0.7
Sum	1556.8	555.2	166.1	28.9	132.2	256.6	341.9	480.6	824.9	740.6
Biomass	8299	4372	737	156	313	779	1240	2456	3571	4558

Table 4.4.6 Barents Sea CAPELIN. Estimated spawning stock biomass (‘000 t) by 1 April.

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1	3	1	1	2	24	0
3	919	129	34	15	71	175	217	650	819	836
4	79	331	60	38	24	49	34	193	472	852
5	0	0	11	1	7	2	2	10	0	0
Sum	998	460	105	55	105	228	254	856	1315	1688

Table 4.4.7 Barents Sea CAPELIN. Stock summary table. Recruitment (number of 1 year old fish (unit:10^9) and stock biomass ('000 t) given at 1 August, spawning stock ('000 t) at time of spawning (1. April). Landings ('000 t) are the sum of the total landings in the two fishing seasons within the year indicated. The SSB is obtained by projecting the stock forward assuming a natural mortality that does not take the current predation mortality fully into account.

Year	Stock biomass	Recruit-ment Age 1	Spawning stock biomass	Landings
1965				224
1966				389
1967				409
1968				537
1969				680
1970				1314
1971				1392
1972	5831			1592
1973	6630	1140	1242	1336
1974	7121	737	343	1149
1975	8841	494	90	1439
1976	7584	433	1147	2587
1977	6254	830	890	2987
1978	6119	855	460	1916
1979	6576	551	193	1783
1980	8219	592	87	1648
1981	4489	466	1731	1986
1982	4205	611	546	1760
1983	4772	612	47	2358
1984	3303	183	171	1477
1985	1087	47	106	868
1986	157	9	13	123
1987	107	46	16	0
1988	361	22	11	0
1989	771	195	141	0
1990	4901	708	179	0
1991	6647	415	1584	929
1992	5371	396	998	1123
1993	991	3	460	586
1994	259	30	105	0
1995	189	8	55	0
1996	467	89	105	0
1997	866	112	228	1
1998	1860	188	254	1
1999	2580	171	856	106
2000	3840	475	1315	414
2001	3480	128	1688	568

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

5.1 The Fishery

5.1.1 Regulation of the fishery

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

The fishery of the Iceland-East Greenland-Jan Mayen capelin has, therefore, been regulated by preliminary catch quotas set prior to each fishing season (July–March). Predictions of TACs have been computed based on data from surveys of the abundance of 1- and 2-year-old capelin, carried out in the autumn of the year before. The process includes historical relationships between such data and the back-calculated abundance of the same year classes, growth rate and stock in numbers, natural mortality, and the provision of a remaining spawning stock biomass of 400 000 t. Final catch quotas for each season have then been set according to the results of acoustic surveys of the maturing, fishable stock, carried out in autumn (October–November) and/or winter (January/February) in that fishing season. A more detailed description of the method is given in Section 1.3.5. A summary of the results of this catch regulation procedure is given in Table 5.1.1.

Over the years, fishing has not been permitted during April-June and the season opened in July/August or later, depending on the state of the stock. Due to very low stock abundance there was a fishing ban lasting from December 1981 to November 1983. In addition, areas with high abundances of juvenile age 1 and 2 capelin (in the shelf region off NW-, N-, and NE-Iceland) have usually been closed to the summer and autumn fishery.

5.1.2 The fishery in the 2001/2002 season

In accordance with a previously determined procedure, ACFM recommended that the preliminary TAC should not exceed 700 000 t. This is 2/3 of the total TAC predicted for the 2001/2002 season, i.e. 1 050 000 t. This advice was accepted by all parties concerned.

The season opened on 20 June and the fishery began in deep waters north of the shelf edge northeast and north of Iceland. As usual the fishing grounds gradually shifted to the northwest and north in July. Catch rates were low in the beginning, but improved considerably in July as the capelin migrated north. Towards the end of July the northward migration stopped, the capelin began moving back south again, and soon scattered. By the end of July, the total catch was 276 000 t. After July the capelin remained scattered and no catches were made for the rest of the year, except for 18 000 t taken in December.

The total catch in the 2001 summer and autumn season was approximately 294 000 t.

In January 2002, large fishable concentrations of adult capelin were located in deep waters off the shelf east of Iceland and resulted immediately in a successful fishery. A total catch of approximately 250 000 t of capelin was taken in deep waters east and southeast of Iceland, before the first spawning migration approached shallow waters off the eastern south coast. In addition, Faroese vessels took about 20 000 t within the Faroese EEZ, some of it up to 40-50 nautical miles on the Faroese side of the division line. While capelin have occasionally been recorded near the EEZ boundary between the Faroes and Iceland, these are the first catches made within the Faroese EEZ in recorded history.

Catch rates were extremely high in the Icelandic coastal area throughout February and in the first 20 days of March. The total catch during these 6 weeks almost reached 600 000 t. A small body of capelin, assessed acoustically at 105 000 t, arrived at the central west coast spawning grounds in the third week of March. These capelin were smaller and less mature, thus prolonging the winter fishery by about one week.

The total catch during the 2002 winter season was 955 000 t, the highest on record.

5.2 Catch Statistics

The total annual catch of capelin in the Iceland-East Greenland-Jan Mayen area since 1964 is given by weight, season, and fleet in Table 5.2.1.

The total catch in numbers during the summer/autumn 1979–2001 and winter 1980–2002 seasons is given by age and years in Tables 5.2.2 and 5.2.3.

The distribution of the catch during the summer-autumn 2000 and winter 2001 seasons is given by length groups-at-age in Tables 5.2.4 and 5.2.5.

5.3 Surveys of Stock Abundance

5.3.1 0-group surveys

The distribution and abundance of 0-group capelin in the Iceland-East Greenland-Jan Mayen area has been recorded during surveys carried out in August since 1970. The survey methods and computations of abundance indices were described by Vilhjálmsson and Fridgeirsson (1976). The abundance indices of 0-group capelin, divided according to areas, are given in Table 5.3.1.1.

Acoustic estimates of the abundance of 1-group capelin have also been obtained during the August 0-group surveys (e.g. Vilhjálmsson 1994). The abundance of 1-group capelin by number, mean length, and weight for 1983–2000 is given in Table 5.3.1.2.

5.3.2 Stock abundance in autumn 2001 and winter 2002

An acoustic survey was carried out by two research vessels in the period 12-28 November (WD by Vilhjalmsson). The distribution of the stock was more or less continuous, reaching from 28^{o}W, west of the NW-peninsula of Iceland (Vestfirdir), across the outer part of the shelf northwest and north of Iceland to 15^{o}W off the eastern north coast. The most extensive and dense capelin concentrations were recorded over the outer shelf northwest and north of Vestfirdir and the western north coast.

Due to drift ice it was not possible to carry out an adequate survey of parts of the Denmark Strait and a period of prolonged storms precluded surveying northeast and east of Iceland. In the area surveyed, the capelin were almost exclusively recorded as scattering layers of varying densities at depths of 50-150 m in darkness, but somewhat deeper in the daytime. In most of the area surveyed, the echo recordings consisted of a mixture of adults and juveniles (age groups 1 and 2), with a predominance of age group 1 in the juvenile component.

According to the autumn 2001 survey, the immature stock amounted to 100.3 and 2.4 * 10^9 fish, belonging to age groups 1 and 2 respectively (year classes 2000 and 1999). The estimated total fishable/spawning stock abundance was only 24.3 * 10^9 fish in late November 2001. The observed mean weight in the fishable stock was 16.1 g and the estimated fishable/spawning stock biomass was only 390 000 t.

Both total adult stock biomass and the contribution of the older age group to it were below expectations. For these reasons and due to the fact that parts of the potential distribution area could not be surveyed, it was concluded that the autumn 2001 survey had probably failed to locate a large part of the fishable stock. The same can be said for the age 2 immatures. On the other hand, the survey registered fairly large numbers of immature age 1's. However, large areas that normally contain this age group could not be surveyed and therefore the abundance of age group 1 was also underestimated. Details of the autumn 2001 acoustic estimate of adult capelin are given in Table 5.3.2.1, and those of the immature stock in Table 5.3.2.2.

During 10-21 January 2002, the abundance of mature capelin was assessed at and outside the shelf edge east of Iceland. Surveying conditions were exemplary in January 2002. Thus, most of the capelin were located in areas with clear outer boundaries. Although the survey occasionally came across extremely dense schools, the ship's sonar usually showed the presence of more schools of similar densities in the neighbourhood. However, as a rule capelin were recorded as large aggregations having moderate densities.

It is common knowledge that capelin migrate south off the east coast of Iceland in January. However, these migrations do not maintain a steady pace and may even stop altogether for a day or two. Consequently, the speed of migration has to be considered when assessing stock abundance during the migration period. There are models available that adjust for migration against or with the direction of the survey; however, they cannot be used unless the speed of the migration is known. Although the capelin probably was migrating south during the survey, the position and progress of the fishery indicated that the speed of migration was slow. Because the area with the dense distribution south of 64˚45' was surveyed in a couple of days, it is unlikely that migration affected the estimate there to any great extent. On the other hand, the more northern and larger part of the distribution area was surveyed over a longer time period and against the direction of migration. The January survey may therefore have underestimated adult stock abundance somewhat. In addition, a short survey of a migration, in the process of arriving at the West Iceland spawning grounds, was carried out during 11-15 March 2002.

The total biomass of adult capelin east of Iceland in January 2002 was estimated to be 1 330 000 t, and an additional 105 000 t were recorded when more capelin arrived at the central west coast in early March. Practically no immature capelin were recorded east of Iceland in January 2002. However, the survey could not be continued to search for and assess the concentrations of immature capelin in deeper waters east and northeast of Iceland.

Details of the winter 2001 acoustic estimates of adult capelin are given in Tables 5.3.2.3.

5.4 Historical Stock Abundance

The historical estimates of stock abundance are based on the "best" acoustic estimates of the abundance of maturing capelin in autumn and/or winter surveys, the "best" in each case being defined as that estimate on which the final decision of TAC was based. Taking account of the catch in number and a monthly natural mortality rate of M = 0.035 (ICES 1991/Assess:17) abundance estimates of each age group are then projected to the appropriate point in time. Since natural mortality rates of juvenile capelin are not known, their abundance by number has been projected using the same natural mortality rate.

The annual abundance by number and weight-at-age for mature and immature capelin in the Iceland-East Greenland-Jan Mayen area has been calculated with reference to 1 August and 1 January of the following year for the 1978/79–2000/01 seasons. The results are given in Tables 5.4.1 and 5.4.2 (1 August and 1 January, respectively). Table 5.4.2 also gives the remaining spawning stock by number and biomass in March/April 1979–2001.

The observed annual mean weight-at-age was used to calculate the stock biomass on 1 January. With the exception of juvenile capelin, which are surveyed in summer, the average weight-at-age of adult capelin in autumn (Table 5.5.1.2) is used to calculate stock biomass of the maturing components in summer. Because there is a small weight increase among mature capelin in February and March, the remaining spawning stock biomass is underestimated.

5.5 Stock Prognoses

5.5.1 Stock prognosis and TAC in the 2001/2002 season

The models (ICES 1993/Assess:6; Section 3.1.5) for predicting the numbers of maturing capelin of ages 2 and 3 from the November 1999 acoustic assessment of the 1998 and 1997 year classes gave estimates of 77.1 and $16.9 * 10^9$ maturing 2- and 3-group capelin on 1 August 2001.

During the last ten years the weight-at-age of adult capelin has been inversely related to adult stock abundance. Simple linear regressions of these data result in $R^2 = 0.66$ and 0.76 for age groups 2 and 3, respectively. The two regression plots are shown in Figure 5.5.3.2. Applying the appropriate regression equations, $y = -0.035x + 19.4$; $r^2 = 0.66$; $p<0.05$ for the younger component, and $y = -0.070x + 29.0$; $r^2 = 0.76$; $p<0.05$ for the older one, and using the predicted abundance of age groups 2 and 3 on 1 August 2001 combined, *i.e.* $95.0 * 10^9$ fish, results in estimated mean weights of 16.1 and 22.4 g for age groups 2 and 3, respectively.

The fishable stock biomass, obtained by multiplying the stock in numbers by the predicted mean weight of maturing capelin in autumn, was projected forward to spawning time in March 2001 assuming a monthly M = 0.035 and a remaining spawning stock of 400 000 t. This resulted in a predicted TAC of 1 050 000 t spread evenly over August 2001-March 2002 (Table 5.5.1.3). Using the same approach as in previous years, *i.e.* that the preliminary TAC be set at 2/3 of the predicted total for the season, the Working Group recommended that a preliminary TAC for the 2001/02 capelin fishery be set at 700 000 t.

According to the January and March 2002 survey results described in Section 5.3.2, the fishable spawning stock was estimated at $65.9 * 10^9$ fish on 20 January 2001. At that time the observed mean weight in the fishable stock was 21.6 g and the stock biomass was about 1 425 000 t. With the usual prerequisites of a monthly natural mortality rate of 0.035 and a remaining spawning stock of 400 000 t, the above abundance estimate indicated a TAC of 975 000 t was available for the remainder of the 2002 winter fishery. Adding this to the catch of 350 000 t already taken from June 2001–January 2002 resulted in a total TAC of 1 325 000 t for the 2001/2002 season.

The difference between the predicted TAC and the final TAC calculated for the 2001/2002 season is due to a larger contribution by numbers of the 1999 year class and a higher mean weight than expected. About 75 000 t of the TAC remained at the end of the winter fishery. As a result, 475 000 t of capelin remained to spawn in 2002.

5.5.2 Stock prognosis and assessment for the 2002/2003 season

Calculations of expected TAC for the 2002/2003 season, based on the method described in Section 3.1.5 and data from Table 5.5.1.1, were used to predict the abundance of maturing capelin of ages 2 and 3 on 1 August 2002.

An updated linear regression of the measured abundance of 1-group capelin (N_1) on the backcalculated abundance of mature 2-group fish (N_{2mat}) gives $y = 0.577x + 19.3$; $R^2 = 0.83$; $p < 0.05$. Similarly for the older stock component, where N_{2tot} is regressed on N_{3mat}, gives $y = 0.285x - 7.1$; $R^2 = 0.51$; $p < 0.05$. The two regression plots are shown in Figure 5.5.3.1.

The Working Group decided that the November 2001 estimate of the abundance of 1-group capelin (year class 2000) was a reasonable basis for predicting the abundance of maturing capelin of the 2000 year class on 1 August 2002.

Projections of 77.2 and 17.3 billion mature fish belonging to the 2000 and 1999 year classes respectively, are given in Table 5.5.1.1.

During the last ten years the weight-at-age of adult capelin has been inversely related to adult stock abundance, and simple linear regressions result in $R^2 = 0.64$ and 0.68 for age groups 2 and 3, respectively. These two regression plots are shown in Figure 5.5.3.2. Applying the appropriate regression equations, $y = -0.034x + 19.4$; $r^2 = 0.64$; $p<0.05$ for the younger component, and $y = -0.068x + 29.0$; $r^2 = 0.68$; $p<0.05$ for the older one and using the predicted abundance of age groups 2 and 3 on 1 August 2001 combined, *i.e.* $95.6 * 10^9$ fish, results in estimated mean weights of 16.2 and 22.6 g for age groups 2 and 3, respectively.

Applying the estimated mean weight results in a predicted TAC of 1 040 000 t spread evenly from August 2002-March 2003. This corresponds to a preliminary TAC of 690 000 t. As in previous years, decisions on the final TAC for the 2002/2003 season should be based on surveys carried out in October/November 2002 and January/February 2003.

5.5.3 Management of capelin in the Iceland-East Greenland-Jan Mayen area

The fishable stock consists of 2 age groups (2- and 3-year-olds, spawning at ages 3 and 4). The fishing season usually begins in June/July and ends in March of the following year when the remainder of the fishable stock spawns and dies. The fishable stock, which is also the maturing stock, is thus renewed annually and its exploitation must of necessity be cautious. Due to the short life span and high spawning mortality, stock abundance can only be assessed by acoustic surveys.

Since 1992, the key elements in the management of capelin in the Iceland-East Greenland-Jan Mayen area have been as follows:

Acoustic survey estimates of juvenile capelin abundance have been used to predict fishable stock abundance in the following year (fishing season). Historical average mean weight-at-age (in later years a relationship between numerical stock abundance and growth), growth rates, and natural mortality have been used for calculations and projections of maturing and fishable stock biomass.

Based on the data described above, a TAC is predicted in the spring of the year in which the season begins, allowing for 400 000 t to spawn at the end of the season. For precautionary purposes, a preliminary TAC, corresponding to 2/3 of the predicted total TAC for the season, has then been allocated to the period July–December. With regard to a precautionary approach, the Working Group stresses the importance of the continued setting of a preliminary TAC for the first half of the season.

The final decision on a TAC for each fishing season has been based on the results of acoustic stock abundance surveys in late autumn or in January/February of the following year during the fishing season.

The procedure just described has worked well in the past for 'normal' ranges of stock abundance. However, it is clear that extra care should be taken when dealing with stock abundance below or above the norm, corresponding to TACs lower than 500 000 t or greater than 1 600 000 t.

5.6 Precautionary Approach to Fisheries Management

Due to the short life span of capelin and their high spawning mortality, the main management objective is to maintain enough spawners for the propagation of the stock. Since 1979 the targeted remaining spawning stock for capelin in the Iceland-East Greenland Jan Mayen area has been 400 000 t. Although there have been large fluctuations in stock abundance during this period, these appear to be environmentally induced and not due to excessive fishing. Therefore, the criterion of maintaining a remaining spawning stock may be defined as $\mathbf{B}_{lim}$, i.e. stock abundance below which no fishery should be permitted.

The definition of other precautionary reference points is more problematic. However, due to uncertainties inherent in predicting the abundance of short-lived species and the importance of capelin as forage fish for predators such as cod, saithe, Greenland halibut, baleen whales, and sea birds, extra precaution should be taken when stock biomass projections indicate TACs lower than 500 000 t and greater than 1 600 000 t. In the former case, the fishery should not be opened until after the completion of a stock assessment survey in autumn/winter in that season. The latter simply represents a scenario where projected stock abundance is beyond the highest historical abundance on record. In such cases the preliminary TAC should not exceed 1 100 000 t.

5.7 Special Comments

In most years, the largest capelin can be caught in late June, July, and the first half of August. After that, the average size in the catches has usually declined drastically and does not increase again until late autumn. There are two main reasons for this. First, the oldest and largest fish migrate ahead of other stock components to feed in the plankton-rich oceanic area between Iceland, Greenland, and Jan Mayen. Later on, these larger capelin are joined by younger, slower-growing adults and even juveniles in parts of the fishing area, their? location is variable from year to year. Second, as the food supply diminishes in the southern part of the feeding area in August, the fishable stock becomes more scattered and sometimes mixes with juveniles.

The Working Group recommends that the 2002 summer/autumn season be opened around 20 June. To prevent catches of juvenile capelin (ages 1 and 2) it is recommended that the authorities responsible for the management of this stock (Greenland, Iceland, and Norway) monitor the fishery and be prepared to intervene quickly on short notice, using area closures to prevent fishing on mixed concentrations of juveniles and adults.

An overview of stock development during 1978–2001 is given in Table 5.7.1.

5.8 Sampling

Investigation	No. of samples	Length meas. individuals	Aged individuals
Fishery 2001	20	3540	1955
Survey 2001	42	4200	4135
Fishery 2002	77	7700	7534
Survey 2002	32	3200	3176

Table 5.1.1 Preliminary TACs for the summer/autumn fishery, recommended TACs for the entire season, landings and remaining spawning stock (000 tonnes) in the 1989/90–2001/02 seasons.

Season	89/90	90/91	91/92	92/93	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02
Prelim. TAC	900	600	0	500	900	950	800	1100	850	950	866	975	1050
Rec. TAC	-	250	740	900	1250	850	1390	1600	1265	1200	1000	1090	1325
Landings	808	314	677	788	1179	842	930	1571	1245	1100	934	1065	1249
Spawn. stock	115	330	475	460	460	420	830	430	492	500	650	450	475

Table 5.2.1 The international capelin catch 1964–2002 (thousand tonnes).

Year	Winter season					Summer and autumn season						Total
	Iceland	Nor-way	Faroes	Green-land	Season total	Iceland	Nor-way	Faroes	Green-land	EU	Season total	
1964	8.6	-	-		8.6	-	-	-		-	-	8.6
1965	49.7	-	-		49.7	-	-	-		-	-	49.7
1966	124.5	-	-		124.5	-	-	-		-	-	124.5
1967	97.2	-	-		97.2	-	-	-		-	-	97.2
1968	78.1	-	-		78.1	-	-	-		-	-	78.1
1969	170.6	-	-		170.6	-	-	-		-	-	170.6
1970	190.8	-	-		190.8	-	-	-		-	-	190.8
1971	182.9	-	-		182.9	-	-	-		-	-	182.9
1972	276.5	-	-		276.5		-	-		-	-	276.5
1973	440.9	-	-		440.9	-	-	-		-	-	440.9
1974	461.9	-	-		461.9	-	-	-		-	-	461.9
1975	457.1	-	-		457.1	3.1	-	-		-	3.1	460.2
1976	338.7	-	-		338.7	114.4	-	-		-	114.4	453.1
1977	549.2	-	24.3		573.5	259.7	-	-		-	259.7	833.2
1978	468.4	-	36.2		504.6	497.5	154.1	3.4		-	655.0	1,159.6
1979	521.7	-	18.2		539.9	442.0	124.0	22.0		-	588.0	1,127.9
1980	392.1	-	-		392.1	367.4	118.7	24.2		17.3	527.6	919.7
1981	156.0	-	-		156.0	484.6	91.4	16.2		20.8	613.0	769.0
1982	13.2	-	-		13.2	-	-	-		-	-	13.2
1983	-	-	-		-	133.4	-	-		-	133.4	133.4
1984	439.6	-	-		439.6	425.2	104.6	10.2		8.5	548.5	988.1
1985	348.5	-	-		348.5	644.8	193.0	65.9		16.0	919.7	1,268.2
1986	341.8	50.0	-		391.8	552.5	149.7	65.4		5.3	772.9	1,164.7
1987	500.6	59.9	-		560.5	311.3	82.1	65.2		-	458.6	1,019.1
1988	600.6	56.6	-		657.2	311.4	11.5	48.5		-	371.4	1,028.6
1989	609.1	56.0	-		665.1	53.9	52.7	14.4		-	121.0	786,1
1990	612.0	62.5	12.3		686,8	83.7	21.9	5.6		-	111.2	798.0
1991	202.4	-	-		202.4	56.0	-	-		-	56.0	258.4
1992	573.5	47.6	-		621.1	213.4	65.3	18.9	0.5		298.1	919.2
1993	489.1	-	-	0.5	489.6	450.0	127.5	23.9	10.2		611.6	1,101.2
1994	550.3	15.0	-	1.8	567.1	210.7	99.0	12.3	2.1		324.1	891.2
1995	539.4	-	-	0.4	539.8	175.5	28.0	-	2.2		205.7	745.5
1996	707.9	-	10.0	5.7	723.6	474.3	206.0	17.6	15.0	60.9	773.8	1,497.4
1997	774.9	-	16.1	6.1	797.1	536.0	153.6	20.5	6.5	47.1	763.6	1,561.5
1998	457.0	-	14.7	9.6	481.3	290.8	72.9	26.9	8.0	41.9	440.5	921.8
1999	607.8	14.8	13.8	22.5	658.9	83.0	11.4	6.0	2.0		102.4	761.3
2000	761.4	14.9	32.0	22.0	830.3	126.5	80.1	30.0	7.5	21.0	265.1	1,095.4
2001	767.2	-	10.0	29.0	806.2	150.0	106.0	12.0	9.0	17.0	294.0	1,061.2
2002	901.0	-	28.0	26.0	955.0							

Table 5.2.2 The total international catch of capelin in the Iceland-East Greenland-Jan Mayen area by age group in numbers (billions) and the total catch by numbers and weight (thousand tonnes) in the autumn season (August-December) 1980–2001.

	Year										
Age	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
1	4.9	0.6	-	0.6	0.5	0.8	+	+	0.3	1.7	0.8
2	17.2	27.9	-	7.2	9.8	25.6	10.0	27.7	13.6	6.0	5.9
3	5.4	2.0	-	0.8	7.8	15.4	23.3	6.7	5.4	1.5	1.0
4	-	+	-	-	0.1	0.2	0.5	+	+	+	+
Total number	27.5	30.5	-	8.6	18.2	42.0	33.8	34.4	19.3	9.2	7.7
Total weight	527.6	613.0	-	133.4	548.5	919.7	772.9	458.6	371.4	121.0	111.2

	Year										
Age	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
1	0.3	1.7	0.2	0.6	1.5	0.2	1.8	0.9	0.3	0.2	+
2	2.7	14.0	24.9	15.0	9.7	25.2	33.4	25.1	4.7	12.9	17.6
3	0.4	2.1	5.4	2.8	1.1	12.7	10.2	2.9	0.7	3.3	1.2
4	+	+	0.2	+	+	0.2	0.4	+	+	0.1	+
Total number	3.4	17.8	30.7	18.4	12.3	38.4	45.8	28.9	5.7	16.5	18.8
Total weight	56.0	298.1	611.6	324.1	205.7	773.7	763.6	440.5	102.4	265.1	294.0

Table 5.2.3 The total international catch of capelin in the Iceland-East Greenland-Jan Mayen area by age group in numbers (billions) and the total catch by numbers and weight (thousand tonnes) in the winter season (January-March) 1981–2002.

	Year										
Age	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
2	1.7	-	-	2.1	0.4	0.1	+	+	0.1	1.4	0.5
3	7.1	0.8	-	18.1	9.1	9.8	6.9	23.4	22.9	24.8	7.4
4	1.9	0.1	-	3.4	5.4	6.9	15.5	7.2	7.8	9.6	1.5
5	-	-	-	-	-	0.2	-	0.3	+	0.1	+
Total number	10.7	0.9	-	23.6	14.5	17.0	22.4	30.9	30.8	35.9	9.4
Total weight	156.0	13.2	-	439.6	348.5	391.8	560.5	657.2	665.1	686.8	202.4

	Year										
Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2	2.7	0.2	0.6	1.3	0.6	0.9	0.3	0.5	0.3	0.4	0.1
3	29.4	20.1	22.7	17.6	27.4	29.1	20.4	31.2	36.3	27.9	33.1
4	2.8	2.5	3.9	5.9	7.7	11.0	5.4	7.5	5.4	6.7	4.2
5	+	+	+	+	+	+	+	+	+	+	+
Total number	34.9	22.8	27.2	24.8	35.7	41.0	26.1	39.2	42.0	35.0	37.4
Total weight	621.1	489.6	567.1	539.8	723.6	797.6	481.3	658.9	830.3	787.2	955.0

Table 5.2.4 The total international catch in numbers (millions) of capelin in the Iceland-East Greenland-Jan Mayen area in the summer/autumn season of 2000 by age and length, and the catch in weight (thousand tonnes) by age group.

Total length (cm)	Age 1	Age 2	Age 3	Age 4	Total	Percentage
11.5	-	34	0	-	34	0.2
12	-	495	0	-	495	2.6
12.5	-	1383	0	-	1383	7.4
13	+	2356	17	-	2373	12.7
13.5	+	3158	34	-	3192	17.0
14	-	3499	102	-	3602	19.2
14.5	+	2851	222	-	3072	16.4
15	-	1946	171	-	2117	11.3
15.5	-	1195	256	+	1451	7.7
16	-	393	256	+	649	3.5
16.5	-	239	68	-	307	1.6
17	-	34	34	+	68	0.4
Total number	+	17581	1161	+	16415	
Percentage	+	94.0	6.0	+	100.0	100.0
Total weight	+	270.7	23.2		294.0	

Table 5.2.5 The total international catch in numbers (millions) of capelin in the Iceland-East Greenland-Jan Mayen area in the winter season of 2002 by age and length, and the catch in weight (thousand tonnes) by age group.

Total length (cm)	Age 2	Age 3	Age 4	Age 5	Total	Percentage
11.5	-	15	0	-	15	0.0
12	-	15	0	-	15	0.0
12.5	-	120	0	-	120	0.3
13	+	344	15	-	359	0.8
13.5	+	1423	15	-	1438	3.1
14	-	2995	105	-	3100	6.7
14.5	+	4867	150	-	5016	10.9
15	-	6993	255	-	7247	15.7
15.5	-	5885	524	-	6409	13.9
16	-	6544	824	-	7367	16.0
16.5	-	5286	854	-	6139	13.3
17	-	3279	913	+	4193	9.1
17.5	-	1737	854	-	2591	5.6
18	-	854	479	+	1333	2.9
18.5	-	120	374	-	494	1.1
19	-	90	165	+	255	0.6
19.5	-	45	15	-	60	0.1
Total number	35	40610	5540	5	46190	
Percentage	+	88.0	12.0	+	100.0	100.0
Total weight	0.1	807.3	147.3	+	954.7	

Table 5.3.1.1 Abundance indices of 0-group capelin 1970-2001 and their division by areas.

	Year												
Area	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
NW-Irminger Sea	1	+	+	14	26	3	2	2	+	4	3	10	+
W-Iceland	8	7	30	39	44	37	5	19	2	19	18	13	8
N-Iceland	2	12	52	46	57	46	10	19	29	25	19	6	5
East Iceland	-	+	7	17	7	3	15	3	+	1	+	-	+
Total	11	19	89	116	134	89	32	43	31	49	40	29	13

	Year												
Area	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
NW-Irminger Sea	+	+	1	+	1	3	1	+	8	3	2	3	+
W-Iceland	3	2	8	16	6	22	13	7	2	11	21	12	6
N-Iceland	18	17	19	17	6	26	24	12	43	20	13	69	10
East Iceland	1	9	3	4	1	1	2	2	1	+	15	10	8
Total	22	28	31	37	14	52	40	21	54	34	51	94	24

	Year					
	1996	1997	1998	1999	2000	2001
NW-Irminger Sea	2	5	+			
W-Iceland	17	14	7	25	1	25
N-Iceland	57	30	34	51	7	53
East Iceland	6	12	5	7	4	4
Total	82	61	46	83	12	82

Table 5.3.1.2 Estimated numbers, mean length and weight of age 1 capelin in the August surveys for 1983–2001.

	Year													
	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
Number (10^9)	155	286	31	71	101	147	111	36	50	87	33	85	189	138
Mean length (cm)	10.4	9.7	10.2	9.5	9.1	8.8	10.1	10.4	10.7	9.7	9.4	9.0	9.8	9.3
Mean weight (g)	4.2	3.6	3.8	3.3	3.0	2.6	3.4	4.0	5.1	3.4	3.0	2.8	3.4	2.9

	Year				
	1997	1998	1999	2000	2001
Number (10^9)	143	87	55	94	99
Mean length (cm)	9.3	9.0	9.5	9.5	10.0
Mean weight (g)	2.8	2.9	3.2	3.1	3.7

Table 5.3.2.1 Acoustic abundance estimate of maturing capelin, 12-28 November 2001.

	NUMBERS (10^{-9})					BIOMASS (10^{-9})			
	(Age) Year class				Avgwt	(Age) Year class			
Length (cm)	(1) 2000	(2) 1999	(3) 1998	Total	(g)	(1) 2000	(2) 1999	(3) 1998	Total
11.5	0.160	-	-	0.160	5.7	0.9	0.0	0.0	0.9
12	0.000	-	-	-		0.0	0.0	0.0	0.0
12.5	0.250	0.059	-	0.309	7.5	1.9	0.4	0.0	2.3
13	0.385	0.346	-	0.731	.7	3.3	3.0	0.0	6.3
13.5	0.381	1.664	-	2.045	10.3	3.9	17.2	0.0	21.1
14	0.133	3.165	0.000	3.298	11.8	1.6	37.5	0.0	39.0
14.5	0.116	4.792	0.077	4.985	13.7	1.6	65.5	1.1	68.2
15	0.025	2.825	0.050	2.901	15.4	0.4	43.5	0.8	44.7
15.5	0.038	3.342	0.114	3.494	17.9	0.7	59.8	2.0	62.5
16	-	2.944	0.000	2.944	20.3	0.0	59.8	0.0	59.8
16.5	-	1.958	0.154	2.112	22.8	0.0	44.6	3.5	48.1
17	-	0.566	0.068	0.634	26.5	0.0	15.0	1.8	16.8
17.5	-	0.257	0.096	0.353	28.3	0.0	7.3	2.7	10.0
18	-	0.107	0.064	0.171	35.1	0.0	3.7	2.2	6.0
18.5	-	0.047	0.071	0.118	34.9	0.0	1.6	2.5	4.1
19	-	0.022	-	0.022	38.5	0.0	0.8	0.0	0.8
Total	1.489	22.093	0.694	24.276	16.1	14.3	359.9	16.6	390.8
Average length						13.2	15.0	16.5	15.0
Average weight						9.6	16.3	23.9	16.1

Table 5.3.2.2 Acoustic estimate of immature capelin, 12-28 November 2001.

	NUMBERS (10^{-9})					BIOMASS (10^{-6} t)			
	(Age) Year class				AvgWt	(Age) Year class			
Length (cm)	(1) 2000	(2) 1999	(3) 1998	Total	(g)	(1) 2000	(2) 1999	(3) 1998	Total
7.5	0.244	0.000	0.000	0.244	1.167	0.3	0.0	0.0	0.3
8	2.225	0.000	0.000	2.225	1.600	3.6	0.0	0.0	3.6
8.5	8.820	0.000	0.000	8.820	2.025	17.9	0.0	0.0	17.9
9	14.901	0.000	0.000	14.901	2.435	36.3	0.0	0.0	36.3
9.5	17.191	0.000	0.000	17.191	2.996	51.5	0.0	0.0	51.5
10	17.523	0.000	0.000	17.523	3.552	62.2	0.0	0.0	62.2
10.5	15.028	0.059	0.000	15.087	4.072	61.2	0.2	0.0	61.4
11	11.311	0.056	0.000	11.367	4.778	54.0	0.3	0.0	54.3
11.5	6.567	0.208	0.000	6.775	5.544	36.4	1.2	0.0	37.6
12	4.084	0.280	0.000	4.365	6.375	26.0	1.8	0.0	27.8
12.5	1.710	0.402	0.000	2.113	7.475	12.8	3.0	0.0	15.8
13	0.626	0.562	0.000	1.187	8.664	5.4	4.9	0.0	10.3
13.5	0.108	0.471	0.000	0.579	10.323	1.1	4.9	0.0	6.0
14	0.007	0.172	0.000	0.179	11.838	0.1	2.0	0.0	2.1
14.5	0.002	0.075	0.001	0.079	13.673	0.0	1.0	0.0	1.1
15	0.001	0.076	0.001	0.078	15.400	0.0	1.2	0.0	1.2
15.5	0.000	0.037	0.001	0.038	17.887	0.0	0.7	0.0	0.7
Total	100.348	2.399	0.004	102.751	3.796	368.9	21.1	0.1	390.0
Average length (cm)						10.0	12.9	15.0	10.1
Average weight (g)						3.7	8.8	15.7	3.8

Table 5.3.2.3 Acoustic abundance estimate of mature capelin, 10-21 January 2002.

Length (cm)	NUMBERS (10^{-3}) (Age) Year class (2) 2000	(3) 1999	(4) 1998	Total	Avgwt (g)	BIOMASS (10^{-3} t) (Age) Year class (2) 2000	(3) 1999	(4) 1998	Total
12.5	0.024	0.019	0	0.043	6.9	0.2	0.1	0.0	0.3
13	0.010	0.199	0	0.209	8.4	0.1	1.7	0.0	1.8
13.5	0.055	0.718	0.014	0.787	9.6	0.5	6.9	0.1	7.5
14	0.017	2.146	0.034	2.196	11.1	0.2	23.7	0.4	24.3
14.5	0.000	3.504	0.034	3.538	12.6	0.0	44.2	0.4	44.6
15	0.000	5.244	0.243	5.487	14.2	0.0	74.7	3.5	78.2
15.5	0.000	5.983	0.443	6.426	16.1	0.0	96.1	7.1	103.3
16	0.000	6.444	0.590	7.034	18.5	0.0	119.2	10.9	130.1
16.5	0.000	6.022	0.726	6.748	20.6	0.0	124.3	15.0	139.3
17	0.000	6.406	1.039	7.445	23.3	0.0	149.4	24.2	173.6
17.5	0.000	5.510	1.804	7.314	26.0	0.0	143.4	47.0	190.4
18	0.000	3.159	1.231	4.390	30.2	0.0	95.5	37.2	132.7
18.5	0.000	3.516	1.295	4.812	33.6	0.0	118.1	43.5	161.6
19	0.000	1.618	0.809	2.427	36.9	0.0	59.7	29.8	89.5
19.5	0.000	0.550	0.350	0.900	40.1	0.0	22.1	14.0	36.1
20	0.000	0.225	0.150	0.375	45.7	0.0	10.3	6.9	17.1
Total	0.106	51.263	8.761	60.130	22.1	1.0	1089.3	240.0	1330.3
Average length						13.3	16.4	17.5	16.6
Average weight						9.1	21.2	27.4	22.1

Table 5 Acoustic estimate of a spawning migration, arriving at Snæfellsnes, W-Iceland, from the northwest, 12-15 February 2002.

Length (cm)	NUMBERS (10^{-9}) (Age) Year class (3) 1999	(4) 1998	Total	Avg. wt.	BIOMASS (10^{-3} t) (Age) Year class (3) 1999	(4) 1998	Total
12	0.029	0.000	0.029	8.6	0.2	0.0	0.2
12.5	0.039	0.000	0.039	9.7	0.4	0.0	0.4
13	0.194	0.000	0.194	10.5	2.0	0.0	2.0
13.5	0.523	0.000	0.523	11.6	6.1	0.0	6.1
14	0.736	0.010	0.746	12.6	9.3	0.1	9.4
14.5	0.726	0.068	0.794	14.6	10.6	1.0	11.6
15	0.620	0.126	0.746	17.0	10.6	2.0	12.7
15.5	0.814	0.203	1.017	19.5	16.1	3.8	19.9
16	0.445	0.242	0.688	21.5	9.7	5.1	14.8
16.5	0.329	0.155	0.484	23.8	7.9	3.7	11.5
17	0.097	0.242	0.339	27.1	2.8	6.4	9.2
17.5	0.000	0.107	0.107	31.2	0.0	3.3	3.3
18	0.019	0.019	0.039	35.1	0.7	0.6	1.4
18.5	0.000	0.048	0.058	36.6	0.0	1.7	2.1
19	0.010	0.000	0.010	44.0	0.4	0.0	0.4
Total	4.581	1.220	5.801	18.1	76.9	27.8	104.9
Average length (cm)					14.8	16.2	15.2

Average weight (g)	16.8	22.8	18.1

Table 5.4.1 The estimated number (billions) of capelin on 1 August 1978–2002 by age and maturity groups. The total number (billions) and weight (thousand tonnes) of the immature and maturing (fishable) stock components are also given.

	Year									
Age/maturity	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
1 juvenile	163.8	60.3	66.1	48.9	146.4	124.2	250.5	98.9	156.2	144.0
2 immature	15.3	16.4	4.2	3.7	15.0	42.5	40.9	100.0	29.4	37.2
2 mature	81.9	91.3	35.4	39.7	17.1	53.7	40.7	64.6	35.6	65.4
3 mature	29.1	10.1	10.8	2.8	2.3	9.8	27.9	27.0	65.8	20.1
4 mature	0.4	0.3	+	+	+	0.1	0.4	0.4	0.7	0.1
Number immat.	179.2	76.7	70.3	52.6	161.4	166.7	291.4	198.9	185.6	181.2
Number mature	111.4	101.7	46.2	42.5	19.4	63.6	69.0	92.0	102.1	85.6
Weight immat	751	366	283	209	683	985	1067	1168	876	950
Weight mature	2081	1769	847	829	355	1085	1340	1643	2260	1689

	Year									
Age/maturity	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
1 juvenile	80.8	63.9	117.5	132.9	162.9	144.3	224.1	197.3	191.2	165.4
2 immature	24.0	10.3	10.1	9.7	16.6	20.1	35.2	45.1	28.7	35.2
2 mature	70.3	42.8	31.9	67.7	70.7	86.9	59.8	102.2	100.7	90.3
3 mature	24.5	15.8	6.8	6.7	6.4	10.9	13.2	23.0	29.6	19.0
4 mature	0.4	+	+	+	+	0.2	-	+	+	+
Number immat.	104.8	74.2	127.6	142.6	179.5	164.7	259.2	242.4	219.9	200.6
Number mature	95.2	58.6	38.7	74.4	77.1	98.0	73.0	125.1	130.3	109.3
Weight immat	438	309	542	702	747	702	1019	1188	985	758
Weight mature	1663	1173	751	1273	1311	1585	1268	2037	2200	1659

	Year				
Age/maturity	1998	1999	2000	2001	2002
1 juvenile	167.9	138.0	*174.1	*122.4	
2 immature	19.2	24.4	*25.0	*27.7	
2 mature	89.5	85.9	65.7	86.7	**77.2
3 mature	23.2	12.6	16.0	16.9	**17.3
4 mature	+	+			
Number immat.	187.1	162.4	*199.1	*150.1	
Number mature	112.7	98.5	81.7	103.6	**94.5
Weight immat	621	612	*714	*622	
Weight mature	1682	1703	1519	1817	**1640

* Preliminary

** Predicted

Table 5.4.2 The estimated number (billions) of capelin on 1 January 1979–2002 by age and maturity groups. The total number (billions) and weight (thousand tonnes) of the immature and maturing (fishable) stock components and the remaining spawning stock by number and weight are also given.

	Year									
Age/maturity	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
2 juvenile	137.6	50.6	55.3	41.2	123.7	105.0	211.6	83.2	131.9	120.5
3 immature	12.8	13.8	3.5	3.0	12.6	35.7	34.3	83.9	25.6	31.2
3 mature	51.8	53.4	16.3	8.0	14.3	39.8	25.2	34.5	22.1	34.1
4 mature	14.8	3.6	4.9	0.5	2.0	7.6	15.6	10.5	37.0	11.7
5 mature	0.3	0.2	+	+	+	0.1	0.3	0.2	0.2	+
Number immat.	150.4	64.4	58.8	44.2	136.3	140.7	245.9	167.1	157.5	151.3
Number mature	66.9	57.2	21.2	8.5	16.3	47.5	41.1	45.2	59.1	45.8
Weight immat.	1028	502	527	292	685	984	1467	1414	1003	1083
Weight mature	1358	980	471	171	315	966	913	1059	1355	993
Number sp.st.	29.0	17.5	7.7	6.8	13.5	21.6	20.7	19.6	18.3	18.5
Weight sp. st	600	300	170	140	260	440	460	460	420	400

	Year									
Age/maturity	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
2 juvenile	67.8	53.9	98.9	111.6	124.6	121.3	188.1	165.2	160.0	138.8
3 immature	20.1	8.6	8.6	8.1	13.9	16.9	29.5	37.9	24.1	29.5
3 mature	48.8	31.2	22.3	54.8	46.5	50.5	35.1	75.5	72.4	50.1
4 mature	16.0	12.1	4.5	5.3	3.5	4.6	8.7	20.1	24.8	7.9
5 mature	0.3	+	+	+	+	+	+	+	+	+
Number immat.	87.9	62.5	107.5	119.7	138.5	138.2	217.6	203.1	184.1	168.3
Number mature	64.8	43.3	26.8	60.1	50.0	55.1	43.8	95.6	97.2	58.0
Weight immat.	434	291	501	487	622	573	696	800	672	621
Weight mature	1298	904	544	1106	1017	1063	914	1820	1881	1106
Number sp.st.	22.0	5.5	16.3	25.8	23.6	24.8	19.2	42.8	21.8	27.6
Weight sp. st.	440	115	330	475	499	460	420	830	430	492

	Year			
Age/maturity	1999	2000	2001	2002
2 juvenile	140.9	115.8	*148.6	*102.4
3 immature	16.1	20.5	17.2	*24.1
3 mature	53.2	68.2	46.3	59.3
4 mature	16.0	10.0	10.5	10.5
5 mature	+	+	+	+
Number immat.	157.0	136.3	*161.2	*126.5
Number mature	69.3	78.2	56.8	69.8
Weight immat.	585	535	*621	*591
Weight mature	1171	1485	1197	1445
Number sp.st.	29.5	34.2	21.3	22.9
Weight sp. st.	500	650	450	475

*Preliminary/Predicted

Table 5.5.1.1 The data used in the comparisons between abundance of age groups (numbers) when predicting fishable stock abundance for the calculation of preliminary TACs.

Year class	Age 1 Acoustics N_1	Age 2 Back-calc. Mature N_{2mat}	Age 2 Acoustics Immature N_{2imm}	Age 2 Back-calc. Total N_{2tot}	Age 3 Back-calc. Mature N_{3tot}
1980	23.7	17.1	1.7	32.1	9.8
1981	68.0	53.7	8.2	96.2	27.9
1982	44.1	40.7	4.6	81.6	27.0
1983	73.8	64.6	12.6	164.6	65.8
1984	33.8	35.6	1.4	65.0	20.1
1985	58.0	65.4	5.4	102.6	24.5
1986	70.2	70.3	6.7	94.6	15.8
1987	43.9	42.8	1.8	53.1	6.8
1988	29.2	31.9	1.3	42.0	6.7
1989	*39.2	67.7	5.2	77.2	6.4
1990	60.0	70.7	2.3	87.3	10.9
1991	104.6	86.9	10.8	107.0	13.2
1992	100.4	59.8	6.9	95.0	24.0
1993	119.0	102.2	46.3	147.2	29.6
1994	165.0	100.7	16.4	129.4	19.0
1995	111.9	90.3	30.8	125.5	23.2
1996	128.5	89.5	6.3	108.0	12.6
1997	121.0	85.9	5.0	98.5	16.0
1998	89.8	65.7	11.0	84.1.	16.9
1999	103.0	86.7	2.4	*89.1	
2000	100.3				

* Invalid due to ice conditions.
** Preliminary

Table 5.5.1.2 Mean weight (g) in autumn of maturing capelin.

	1981	1982	1983	1984	1985	1986	1987	1988
Age 2	19.2	16.5	16.1	15.8	15.5	18.1	17.9	15.5
Age 3	24.0	24.1	22.5	25.7	23.8	24.1	25.8	23.4

	1989	1990	1991	1992	1993	1994	1995	1996
Age 2	18.0	18.1	16.3	16.5	16.2	16.0	15.3	15.8
Age 3	25.5	25.5	25.4	22.6	23.3	23.6	20.5	20.6

	1997	1998	1999	2000	2001
Age 2	14.3	14.1	16.8	17.1	16.3
Age 3	20.3	18.1	20.6	24.7	23.9

Table 5.5.1.3 Predictions of fishable stock abundance and TACs for the 1984/85–2000/01 seasons.
The last row gives contemporary advice on TACs for comparison.
Age 2 and age 3 = Numbers in billions in age groups at the beginning of season.
Fishable stock = calculated weight of maturing capelin in thousand tonnes (ref. August).
TAC calc = predicted in thousand tonnes.

Season	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93
Year classes	82-81	83-82	84-83	85-84	86-85	87-86	88-87	89-88	90-89
Age 2	43.4	67.8	34.9	55.5	64.8	43.2	31.1	39.4	56.4
Age 3	26.3	20.2	55.0	13.7	29.0	25.5	8.2	3.7	18.3
Fishable stock	1373	1637	1926	1268	1800	1350	724	755	1398
Calculated TAC	733	963	1215	642	1105	713	170	197	755
Advised TAC	897	1311	1333	1115	1036	550	265	740	*900

Season	93/94	94/95	95/96	96/97	97/98	98/99	99/00	00/01	01/02
Year classes	91-90	92-91	93-92	94-93	95-94	96-95	97/96	98 /97	99/98
Age 2	93.1	89.6	92.5	90.0	83.8	94.4	89.2	65.7	78.1
Age 3	22.6	27.0	14.9	35.0	30.9	30.8	23.3	16.0	16.9
Fishable stock	2123	2170	1916	2352	2019	2088	1885	1416	1636
Calculated TAC	1385	1427	1200	1635	1265	1420	1285	975	1050
Advised TAC	1250	850	1390	1600	1265	1200	1000	**1090	1350

*In January 1993, 80 000 t were added to the 820 000 t recommended after the October 1992 survey due to an unexpected large increase in mean weights.
** In March 2001, 100 000t were added to the 990 000 t recommended after the January/February 2001 survey due to much higher mean weights in the catch during 1 February-10 March than measured during the survey.

Table 5.7.1 Capelin in the Iceland-East Greenland-Jan Mayen area. Recruitment of 1-year-old fish (unit 10^9) and total stock biomass ('000 t) are given for 1 August. Spawning stock biomass ('000 t) is given at the time of spawning (March next year). Landings ('000 t) are the sum of the total landings in the season starting in the summer/autumn of the year indicated and ending in March of the following year.

Year	Recruitment	Total Stock biomass	Landings	Spawning stock biomass
1978	164	2832	1195	600
1979	60	2135	980	300
1980	66	1130	684	170
1981	49	1038	626	140
1982	146	1020	0	260
1983	124	2070	573	440
1984	251	2427	897	460
1985	99	2811	1312	460
1986	156	3106	1333	420
1987	144	2639	1116	400
1988	81	2101	1037	440
1989	64	1482	808	115
1990	118	1293	314	330
1991	133	1975	677	475
1992	163	2058	788	499
1993	144	2363	1179	460
1994	224	2287	864	420
1995	197	3174	929	830
1996	191	3310	1571	430
1997	165	3014	1245	492
1998	168	2197	1100	500
1999	138	2314	934	650
2000	*174	*2233	1071	450
2001	*122	*2260	1249	475

*Preliminary

Figure 5.5.3.1. The relationship between the measured numbers of immature 1-group capelin in autumn acoustic surveys and the numbers of maturing capelin in 1 August of the following year (left hand figure), and between measured total numbers of 2-group capelin and the maturing 3-group capelin in the following year (right hand figure).

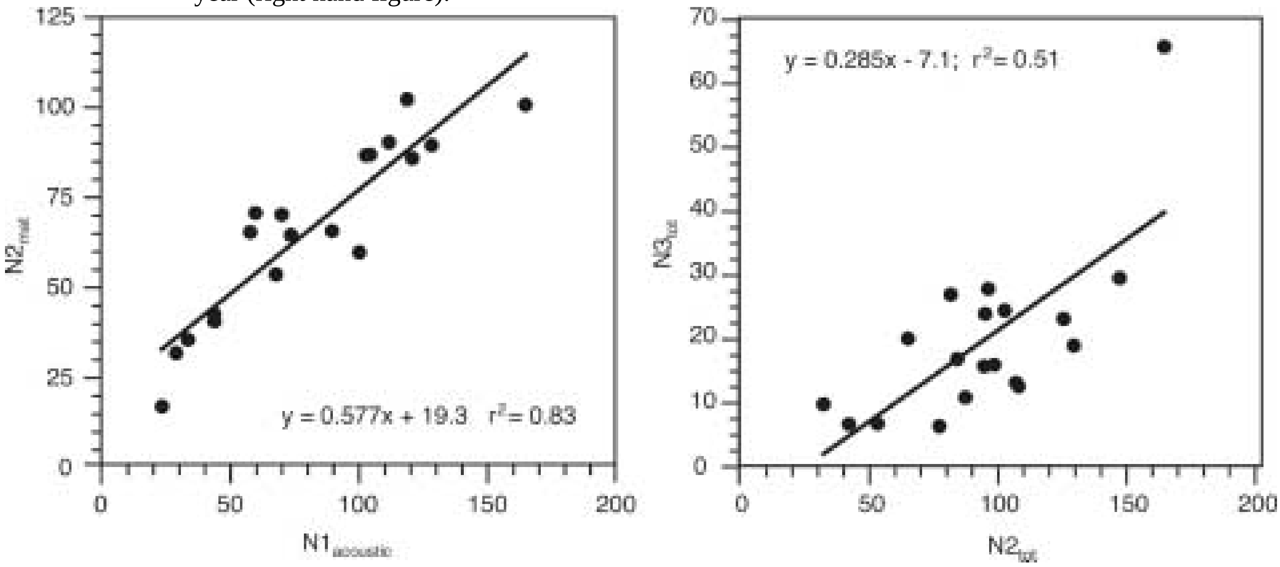
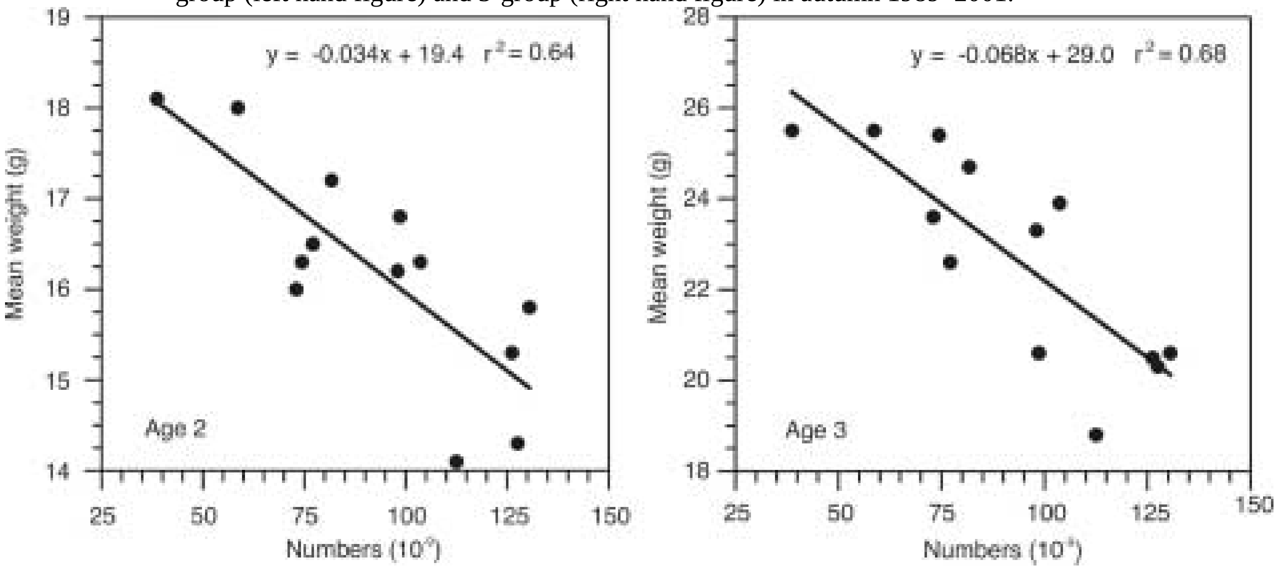


Figure 5.5.3.2. The relationship between the total numbers in the maturing stock and the mean weight of maturing 2-group (left hand figure) and 3-group (right hand figure) in autumn 1989–2001.



6 BLUE WHITING

6.1 Stock Identity and Stock Separation

Blue whiting stock is treated as a single stock for assessment purposes although morphological, physiological, and genetic research has indicated that the southern and northern components of the stock may mix in the spawning area west of the British Isles (ICES C.M. 2000/ACFM:16).

6.1.1 ACFM advice and management applicable to 2001 and 2002

At the ACFM (May) meeting in 2001, it was stated that the stock was considered to be outside safe biological limits, and in recent years the stock has rapidly declined. SSB was estimated to have been at $\mathbf{B}_{pa}$ (2.25 mill. t) in 2000 and expected to be close to $\mathbf{B}_{lim}$ (1.5 mill. t) in 2001. Fishing mortality has increased from around the proposed $\mathbf{F}_{pa}$ (0.32) in 1997, to well above $\mathbf{F}_{pa}$ in 1998 and 1999, and well above $\mathbf{F}_{lim}$ (0.51) in 2000. Total landings in 2000 were 1.4 million t, far above the ICES recommended catch of 800 000 t. Landings in 2000 consisted mainly of the strong 1996 and 1997 year classes.

Therefore ICES advised that the fishery in 2002 for blue whiting in all areas be closed until a rebuilding plan has been implemented.

At present there are no agreed management objectives implemented for this stock, and there is no agreed TAC for the combined area.

6.2 Fisheries in 2001

Estimates of the total landings of blue whiting in 2001 by various fisheries are given by country in Tables 6.2.1 - 6.2.5 and summarised in Table 6.2.6.

Landings of 1 780 000 t in 2001 were the highest ever and were 368 000 t more than the total landings of 1 412 000 t in 2000. Total landings for 1999 were 1 256 000 tonnes.

As in previous years, nearly 60% of blue whiting catches were taken in the spawning area. The catch there was 1 044 000 t in 2001 compared to 997 000 t in 2000, representing a slight increase of 5% from 2000 to 2001.

Blue whiting is caught by different gears and mesh sizes and can be grouped in two types of fisheries:

A directed fishery, where by-catches of other species are insignificant. These landings are used for human consumption or for meal and oil production.

A mixed fishery, where varying proportions of blue whiting are caught together with Norway pout or other species. The majority of these landings are for meal and oil production.

As in previous years, the predominant part (1 676 000 t or 94%) of the total landings in 2001 was taken in the directed fishery and 104 000 t taken as by-catch in other fisheries, such as the Norway pout fishery. Most (74 000 t) of the by-catch of blue whiting is taken in the North Sea (Table 6.2.3).

The fishery in 2001 took place mainly in the second and third quarter. In the first quarter the fishery occurred on the spawning grounds from the Porcupine Bank to Rockall. The fishery continued in the area west of Rockall and in the shelf area off the Hebrides. In the second quarter the fishery was conducted mainly in Division VIa and in Division Vb and southeast of Iceland (Table 6.2.7 and Figure 6.8.1). During summer and autumn a significant fishery also took place in the southern part of the Norwegian Sea (Figure 6.8.1).

The landings from the Norwegian Sea (Divisions I and II) and the area southeast of Iceland between Iceland and the Faroe Islands increased from 277 000 t in 2000 to 592 000 t in 2001 (Tables 6.2.1 and 6.2.6).

6.2.1 Description of the national fisheries

Denmark:

The Danish blue whiting fishery is conducted by trawlers using a minimum mesh size of 40 mm in the directed fishery, and the fisheries where blue whiting is taken as by-catch uses trawl with mesh sizes between 16 and 36 mm. The directed fishery caught 44 600 t mainly in Divisions IIa, Iva, and Vb, with small catches from Divisions VIa and VIIc. By-catches of blue whiting (8 700 t) are caught mainly in the Norway pout fishery in the North Sea and in the Skagerrak. Some blue whiting by-catches are also taken during the human consumption herring fishery in the Skagerrak.

Germany:

As there was no participation from Germany at this WG meeting, no information on the German fishery was available to the Working Group.

Faroe Islands:

The Faroese blue whiting fishery in 2001 was carried out by 10 vessels and most of the landings were taken by trawls with mesh sizes of 40-44 mm.The fishery began in ICES Division VIIc on the western edge of the Porcupine Bank in February. In March the fishery continued in VIIc and gradually moved northwards into VIb and VIa. In April the fishery continued in VIa, and later in the month the blue whiting had entered the southern part of the Faroese waters (Vb). During May the fishery continued in the area south and west of the Faroe plateau (Vb), indicating that the fish migrated west of the Faroe Islands on their way north. In June the fleet had entered Icelandic waters east of Iceland on the northern edge of the Faroe-Iceland ridge (Divisions Va and IIa). The fishery continued in the Icelandic zone in the first part of July and then moved eastwards into the Faroese zone later in July (Vb and IIa). In August the fishery continued north of the Faroes (Vb and IIa) and later in the month fished on the southern side of the Faroe-Iceland ridge (Areas Va and Vb). In September and October the fishery gradually diminished in the Icelandic zone and resumed in the southwestern part of the Faroese zone during both months. In November and December the fishery continued in the Faroese zone southwest of the Faroe Islands.

France:

As there was no participation from France at this WG meeting, no information on the French fishery was available to the Working Group.

Iceland:

Iceland:

The first icelandic catches of 1800 t were taken late March within in the icelandic EEZ. The fishery then had to be abondoned because of a strike. The fishery resumed in mid May in the Faeroese EEZ, but had by the end of the month shifted NW to the Icelandic EEZ. They May-June catch was about 55 000 t. The fishery continued in the Icelandic EEZ until the latter half of July when some catches were taken in the Faroese EEZ, close to the boundary with Iceland and about 80 nautical miles north of the Faroes. The July catch was about 100 000 t. The August fishery yielded about 75 000 t caught mainly within the Icelandic EEZ to the southeast of Iceland. In early September the fishery shifted to approximately 70 nautical miles south of the Faroe Islands. The September catch was taken in Faroese waters and the remainder in the Icelandic EEZ. Icelandic vessels continued to fish blue whiting during October, November until mid-December. The total catch in this period was 18 000 t. In November and December almost all the catch was taken within Faroese jurisdiction, to the northwest, west and south of the Faroe Islands, indicating the start of the southward spawning migration. The Icelandic fishery was carried out by trawlers mainly using a mesh size of 40 mm.

Ireland:

As there was no participation from Ireland at this WG meeting, no information on the Irish fishery was available to the Working Group.

Netherlands:

As there was no participation from the Netherlands at this WG meeting, no information on the Dutch fishery was available to the Working Group.

Norway:

Norway set a blue whiting quota of 250 000 t for the Norwegian EEZ, Jan Mayen zone, and international waters for 2001. In addition, through international agreements, 190 640 t in the EEZ of EU and 47 000 t in the Faroese zone were made available to the Norwegian fishery. The total quota for Norwegian vessels in 2001 was 487 640 t.

The main Norwegian fishery is a directed pelagic trawl fishery, regulated by vessel quotas, and is carried out on and west of the spawning areas west of the British Isles. The Norwegian fishery in 2001 started at the end of January in international waters. The fishery moved to the Porcupine bank area, the main fishing area, at the end of March/beginning of April. Later the main fishery was at St. Kilda. From there the fishery shifted to the Faroese zone. The Norwegian fishery was stopped in the Faroese zone on 9 May when the quota for that area was taken.

In July-August a directed fishery by purse seiners and pelagic trawlers was conducted on blue whiting in the Norwegian EEZ and in international waters north of 62^{o}N. This fishery was stopped on 20 August when the quota for this area was reached. The catch in the summer fishery was 54 000 t in the Norwegian EEZ and 9000 t in international waters in the Norwegian Sea.

In addition, young blue whiting are fished by Norway as by-catch in other fisheries in the North Sea (areas south of 64^{o}N). An estimated catch of approximately 70 000 t was taken in this fishery in 2001.

Portugal:

As there was no participation from Portugal at this WG meeting, no information on the Portuguese fishery was available to the Working Group.

Russia:

The Russian blue whiting fishery occurs year round from January to December. Wintering concentrations of blue whiting in January are fished in the Faroese fishery zone (Vb1). In February–April Russian fishing vessels are located in international waters to the west off the British Isles. In May–September Russian fleets fish on feeding concentrations of blue whiting in the Faroese fishery zone (Vb1), Norwegian EEZ (IIa), and in international waters of the Norwegian Sea. In October–December the Russian fishery operates mostly in the Faroese fishery zone (Vb1). The directed blue whiting fishery occurred in all seasons by large fishing vessels using trawls with mesh sizes of 35-40 mm.

Spain:

The Spanish blue whiting fishery is carried out mainly by bottom pair trawlers in a directed fishery and by single bottom trawlers in a by-catch fishery, both using a minimum mesh size of app. 55 mm. The pair trawl fleet landed 20 273 t, taken mainly on the border between Divisions VIIIc and IXa. By-catches of blue whiting (2 878 t) were caught mainly in the bottom trawl fishery in Spanish waters in Divisions VIIIc and IXa; small quantities (67 t) were also caught by longliners. These coastal fisheries have trip durations of 1 or 2 days, and all catches are for human consumption. Thus, coastal landings are rather stable due mainly to market forces.

Sweden:

As there was no participation from Sweden at this WG meeting, no information on the Swedish fishery was available to the Working Group.

UK (Scotland):

As there was no participation from UK at this WG meeting, no information on the Scottish fishery was available to the Working Group.

6.3 Biological Characteristics

6.3.1 Length composition of catches

Data on the combined length composition of the 2001 commercial catch from the directed fisheries in the Norwegian Sea and the spawning area of the blue whiting stock by quarter of the year were provided by the Faroes, Iceland, Ireland, Netherlands, Norway, Russia, and partly from Germany. Length composition of blue whiting varied from 14 to 40 cm, with most fish ranging from 23 – 29 cm in length with a mode of 25.3 cm (Table 6.3.1.1). Length compositions of the blue whiting by-catch from “other fisheries” in the North Sea and Skagerrak were presented by Norway and Denmark (Table 6.3.1.2). The catches of blue whiting from the mixed industrial fisheries consisted of fish with lengths of 14 - 38 cm and a mode of 22.4 cm. Spain and Portugal caught blue whiting in the Southern area. The Spanish data used for length distribution of catches showed a length range from 15 - 30 cm with a modal length of 21.1 cm (Table 6.3.1.3).

6.3.2 Age composition of catches

For the directed fisheries in the northern area in 2001, age compositions were provided by the Faroe Islands, Iceland, Ireland, Norway, and Russia, which together accounted for 86 % of the catch. Estimates of catch in numbers for unsampled catches were raised according to the knowledge of how, where, and when the catches were taken. The age compositions in the directed fisheries are given in Table 6.3.2.1.

Age compositions for blue whiting by-catches from “other fisheries” in the North Sea and Skagerrak were available for 78% of catches. Norwegian data were used for allocation of the remaining part of the total in that area. The age compositions are given in Table 6.3.2.2.

For the fisheries in the Southern area, age compositions representing 100% of the catch were presented by Spain and Portugal. The age compositions in the southern fishery are given in Table 6.3.2.3.

The combined age composition for the directed fisheries in the Northern area, i.e. the spawning area and the Norwegian Sea, as well as for the by-catch of blue whiting in “other fisheries” and for landings in the Southern area, were assumed to represent the overall age composition of the total landings for the blue whiting stock. The catch numbers-at-age used in the stock assessment are given in Table 6.3.2.4. The 1999 and 2000 year classes were the most numerous in the catches, followed by the 1997 and 1998 year classes. To calculate the total international catch-at-age, and to document how it was done, the program SALLOC was used (ICES 1998/ACFM:18). The allocations are shown in Table 6.3.2.5 (ALLOC files).

6.3.3 Weight-at-age

Mean weight-at-age data were available from Norway, Russia, the Faroes, Iceland, Ireland, and Spain. Mean weight-at-age for other countries was based on the allocations shown in Table 6.3.2.5 (ALLOC files) and was estimated by the SALLOC program for the total international catch. Table 6.3.3.1 shows the mean weight-at-age for the total catch during 1982 - 2001 used in the stock assessment. The weight-at-age for the stock was assumed to be the same as the weight-at-age for the catch.

6.3.4 Maturity-at-age

Maturity-at-age used in the assessment was obtained by combining maturity ogives from the southern and northern areas, weighted by catch in numbers-at-age (ICES 1995/Assess:7). These are the same as those used since 1994 (Table 6.5.1). However, during the spring survey to the spawning area in 2002, more than 85 % of the 2-year-olds were mature (Figure 6.4.1.3) comprising more than 50 % of the spawning stock.

6.3.5 The value of the natural mortality coefficient M for blue whiting

The correct choice of *M* might be regarded as less important for species with a relatively low natural mortality and stable catches. However, for pelagic species natural and fishing mortalities are often of the same level of magnitude, and a more precise choice of *M* is becoming more important in a management context, especially in the case of dramatic rise of catches. At present, *M* equal to 0.2 is used, according to the results of investigations undertaken by the Blue Whiting Working Group in the early 1980s that were based on analysis of the age distribution in the stock before the large industrial fishery started.

One possible reason for biomass estimates of blue whiting in stock assessment by means of cohort models normally being significantly lower than survey estimates could lie in a somewhat underestimated value of the natural mortality coefficient. On the other hand, preliminary experiments undertaken during the Norwegian acoustic survey on the spawning grounds in 2002 (WD Godø et al., 2002b) indicate that the TS value presently used for blue whiting in acoustic surveys may be too low, and the biomass obtained by this method may consequently be too high.

In a WD to the 2002 WG by Vasilyev and Belikov, an attempt was made to apply the ISVPA model for estimation of the natural mortality coefficient for blue whiting using catch-at-age data only. An estimate of M close to 0.4 for an age range of 3-10 was established. The ISVPA model runs carried out at the present WG meeting that included catch-at-age data for 2001 also indicated that the value of M may be higher than the presently used value (see Section 6.4.4.2 with ISVPA results).

Another indication that the value of M for blue whiting might be higher than presently assumed comes from the application of biological methods, based on relationships found for other species between M and some “physiological” characteristics (age of mass maturity, maximum age, growth parameters, etc.). In the WD by Vasilyev and Belikov the methods by Richter & Efanov (1977) and by Alverson & Carney (1975) were applied. The value of M for blue whiting estimated by these methods was in the range of 0.38-0.60. The estimate of M equal to 0.35 for age groups 2-10 was also obtained previously by Timoshenko (1982) who used Tyurin’s method (Tyurin 1972).

All estimates of M for blue whiting are point estimates that do not involve any assessment of uncertainty associated with the estimate. The Working Group considers the incorporation of a more accurate estimate of the natural mortality coefficient into blue whiting models to be important and requiring further investigations.

6.4 Stock estimates

6.4.1 Acoustic surveys

6.4.1.1 Surveys in the spawning season

Three vessels, R.V. “Atlantniro” and R.V. “Fridtjof Nansen” from Russia and R.V. “Johan Hjort” from Norway, participated in the spawning stock investigations in February–April 2002. Survey strategies and acoustic instrumentation of all these vessels were similar, but the survey tracks and timing of surveys were different. The main results of these surveys are presented in a joint report (WD Godø et al., 2002a), whereas more details are to be found in individual reports (WD Godø et al., 2002b, WD Timoshenko 2002). Significant discrepancies in the results of these surveys precluded a joint estimation of spawning stock to be made available to the WG.

Estimates of total and spawning biomass of blue whiting in the spawning area made by Russian, Norwegian, and Faroese surveys since 1983 are given in Table 6.4.1.1. Usually, the acoustic estimates have been well above the assessments, and these estimates have therefore been used only as relative indices. A factor contributing to the high acoustic estimates is the value of target strength that is probably too low (WD Godø et al., 2002b).

Norwegian and Russian surveys yield strikingly different abundance estimates, despite the comparable spatial coverage of the surveys. Furthermore, the estimated age structure is different: the Norwegian estimate is dominated by ages 2 and 3, whereas the Russian estimates show considerable numbers of older fish as well. A number of factors contributing to these differences have been identified (WD Godø et al., 2002b): 1) Timing and spatial coverage of the spawning area in relation to the migrations of blue whiting, 2) Performance of acoustics, with the instrumentation in the Norwegian vessel giving higher acoustic densities than those in the Russian vessels, 3) Selectivity of sampling, with the Norwegian trawl under-sampling large fish relative to the Russian trawls, and 4) Differences in onboard age readings.

Russian surveys. R.V. “Atlantniro” carried out a survey in the international waters west of the British Isles (between 54°10’N and 58°40’N) in 21 February–12 March (WD Timoshenko 2002). This survey gives a stock estimate of 2.1 million t (20.4 x 10^9 individuals) in the survey area, which is lower than in the spring 2001 (3.5 million t). The modal length in 2002 is slightly lower than in 2001. The area was surveyed for a second time in 15 March–10 April, yielding an estimate of 1.2 million t. The difference reflects the movement of blue whiting shoals over the limits of the survey area.

Russian spawning stock survey was carried out by R.V. “Fridtjof Nansen” and R.V. “Atlantniro”; the contribution from R.V. “Atlantniro” corresponds to the latter survey period of that vessel mentioned above (WD Timoshenko 2002, WD Godø et al., 2002b). This is the first Russian survey with an extensive spatial coverage after 1996. The total stock biomass in the survey region was estimated to be 5.3 million t (69.3 x 10^9 individuals), which is slightly above the average of this time-series. The most abundant year class is that of 2000, although year class 1997 makes the highest contribution to the total biomass.

Norwegian survey. R.V. "Johan Hjort" surveyed the blue whiting stock in the shelf edge and bank areas west of the British Isles and in the southern Faroese waters (WD Godø et al., 2002a). High recordings of blue whiting were observed on northwestern parts of the Rockall bank, and on the western part of the Porcupine Bank, where the high recordings extended northwards along the shelf edge. The highest values were recorded west and northwest of the Hebrides (Figure 6.4.1.1).

The spawning stock was estimated to be 10.9 million t (146.8 x 10^9 individuals), while the immature part of the stock in the survey area was estimated at 1.2 million t (28.8 x 10^9 individuals). Both the number and biomass of the spawning stock are about twice as high as the estimate of 2001. The age-stratified estimate of the total stock for 2002 is given in Table 6.4.1.2.

The decreasing tendency observed in the stock sizes between 1999 and 2001 appears now to be reversed. The increase in biomass is largely due to the presence of two very strong year classes (1999 and 2000) in the spawning area (Figure 6.4.1.2). The estimated abundance of the 2000 year class is the highest in this survey time-series, whereas the abundance of the 1999 year class is the third highest. These year classes dominated the whole survey area, except in the northernmost area (>60ºN) where year class 2001 appeared as more abundant than that of 1999. The spawning stock, therefore, continues to be dominated by very young fish. A significant proportion of age-1 fish (year class 2001) in the survey area are mature, and virtually all fish are mature by age 3 (Figure 6.4.1.3).

Examination of development of year class abundance over consecutive years indicates that catchability in the 2002 survey was exceptionally high, whereas in 2001 the catchability appears to have been lower than average.

6.4.1.2 Surveys in the feeding season

Since 1995, Norway, Russia, Iceland, and Faroes, and since 1997 also the EU, have coordinated their survey effort on pelagic fish stocks in the Norwegian Sea. Holst *et al.* (2001) reported on distributions and migrations of blue whiting in 2001.

When the Russian survey was conducted, blue whiting were distributed over most of the surveyed area with the main concentrations to the south of 65° N, eastwards from 3° W, and in the northwestern part of the Norwegian Sea. Blue whiting were registered mainly as scattering layers at different depths from 150 m to 300 m. The acoustic registrations consisted of blue whiting with a length distribution of mostly 17-27 cm fish, corresponding to the 1999 and 2000 year classes. The total biomass, recorded in June in the southern part of the Norwegian Sea, was estimated at about 2.4 million t (text table below) and 32.8 10^9 fish, while in July about 1.3 million t and 14.9 10^9 fish were recorded in the northern part.

Year	Russian survey (million t)
2000	1.2
2001	2.4

For both the Icelandic EEZ and Norwegian Sea age-stratified estimates of blue whiting were reported; these are given in Tables 6.4.1.3 and 6.4.1.4, respectively.

The Norwegian and Icelandic surveys conducted in July–August in 1998–2001 covered approximately the same area from year to year. There has been a steady downward trend in the biomass estimate in the surveys from 1998 to 2000. The biomass estimated in 2001 was more than two times higher than the 2000 estimate, as shown in the text table below.

Year	Norwegian survey (million t)	Icelandic survey (million t)	Total (million t)
1998	6.6	1.6	8.2
1999	4.2	1.8	6.0
2000	2.5	1.0	3.5
2001	5.9	2.1	8.0

The biomass estimates of blue whiting from the Faroese area and the Norwegian Sea in 2001 were about twice the estimates in 2000, consisting of mainly one-year-old fish (50% of the biomass). This indicates that the 2000 year class might be strong. Generally the blue whiting stock is presently dominated by the immature year classes of 1999 and 2000. The biomass estimate of blue whiting from the Icelandic area was also much higher in 2001 than in 2000 (67% higher) and in fact higher than in any previous surveys. The 0-group blue whiting was even more numerous in Icelandic waters than in 1999 and 2000, indicating that this may also be a strong year class.

6.4.2 Bottom trawl surveys in the southern area

Bottom trawl surveys have been conducted off the Galician (NW Spain) and Portuguese coasts since 1980 and 1979 respectively, following a stratified random sampling design and covering depths down to 500 m. Since 1983, the area covered in the Spanish survey was extended to completely cover Spanish waters in Division VIIIc. The area covered in the Portuguese survey was also extended in 1989 to the 750 m contour. A new stratification in the Spanish surveys has been established since 1997. Stratified mean catches and standard errors from the Spanish and Portuguese surveys are shown in Tables 6.4.2.1 and 6.4.2.2. In both areas larger mean catch rates are observed in the 100 - 500 m depth range. Since 1988 the highest catch rates in the Spanish survey were observed in 1999 (124 kg/haul). The 2001 estimate is relatively low (42 kg/haul). The Portuguese summer surveys generally give higher values than in the autumn surveys, and a better correlation with the Spanish surveys (Figure 6.4.2.1).

6.4.3 Catch per unit effort

Only new CPUE data for Spanish commercial pair trawlers in Divisions VIIIc and IXa have been submitted to the Working Group since 1984 and they are used as tuning data (see below).

CPUE data from the Norwegian commercial fleet (pelagic trawl) in the spawning area were not updated this year.

6.4.4 Data exploration

To explore various interpretations of the assessment data, the models ICA (Patterson 1999), AMCI (Section 1.3.2) and ISVPA (section 1.3.6) were used.

Only one ICA run, comparable to the final AMCI run, was made in 2002. The key ICA run had the same settings as last year except that the number of years with a separability constraint was decreased from 5 to 4 years, which is the same as in 2000. Furthermore, age 1 in Spanish CPUE tuning series was down-weighted, as in the final AMCI run. The options are given in Table 6.4.4.1, and the results in Table 6.4.4.2. Some diagnostic plots are given in Figure 6.4.4.1.

6.4.4.1 Stock assessment with AMCI

Based on previous experience and inspection of the data, various problems were identified. Among those was that the surveys cover the distribution area of the stock to a variable extent, and the indices may not be representative for the state of the stock as a whole. Additionally, not all age groups in the tuning series or in the catch-at-age matrix are equally representative for the real population.

To address such problems, a series of preliminary runs were made using the model AMCI (Section 1.3.2). Based on the comparison of the methods made in 2001 and the conclusions drawn by the 2001 WG (ICES 2001/ACFM:17), AMCI was selected as the assessment software for the Working Group also in 2002.

The effect of the various tuning fleets on the assessment was explored by comparing assessments with only one tuning series to the basic run (all fleets included) by AMCI. In previous years each of the tuning series from acoustic surveys was split according to which year the Simrad EK500 was introduced on the vessels participating, since it has been shown that the higher performance of that echo sounder could change the catchabilities of the time-series. However, in the current version of AMCI the catchabilities for various parts of a survey time-series may be estimated, and the previously split series could therefore be rejoined. This is only a technical change in the way data are treated and has no influence on the results.

None of the tuning series completely cover the distribution area of the stock. The survey at the spawning grounds is probably the best for the adult stock. The Spanish CPUE index represents a fleet exploiting blue whiting over a small part of the distribution of this species. The relevance of this index has been questioned by ACFM, and the 2001 WG was requested in the technical minutes to address this. The 2001 WG decided to keep the series in the tuning, since single fleet tuning runs showed that it made little difference to the overall result. The Norwegian Sea acoustic survey also covers only part of the area and is based on a cruise track with very wide spacing of transects. The sampling on this survey is sparse, and the coverage area does not include Icelandic waters where considerable amounts of blue whiting have been observed in the same period.

The results showed that survey series 1 (Norwegian acoustic survey in spawning areas), 2 (Russian acoustic survey in spawning areas; discontinued in 1996), and 4 (Acoustic survey in the Norwegian Sea in July) showed similar development of the stock, while series 3 (CPUE from Spanish bottom trawl survey) predicted substantially lower recruitment in recent years, in particular for the 2000 year class (Fig 6.4.4.2). Similar signals in the three tuning series from the northern areas were confirmed by a run where these were combined and gave similar results to those from the single-fleet tuning runs on these series. Seemingly, the 2000 year class shows up as a very strong one in the northern areas and, although being stronger than average also in the southern series, does not appear as strong as in the north. Similar situations have been encountered by the WG before, and the WG reasoned that this could well reflect a real biological situation. The 2000 year class has been encountered over large areas in the north, in addition to those covered by surveys included in the tuning, e.g. in Icelandic waters and in the south-western Barents Sea (WD by Belikov). This could be caused by a more northerly distribution of the 2000 year class than normal, and may have resulted in lower abundance in the southern area relative to the northern area. The WG considered leaving out the whole series from the southern area. However, since the age groups older than 1 year reflects the year-class strength quite well, it was decided to keep the series in, but instead, to down-weight heavily the 1-year-olds (weight 0.01).

Scrutinizing various diagnostics produced by AMCI revealed that some data points gave rise to particularly high residuals, for instance the youngest age groups in the tuning series from the northern area in recent years. It was considered to down-weight such points based on their influence and magnitude of residuals. However, the WG realised that in doing this, one would reduce the influence of the few data points that carried information about the apparently strong 2000 year class. This would in turn leave the estimation of the strength of this year class to relay heavily on the two data points in the catch matrix carrying information about this year class (age 0 in 2000 and age 1 in 2001). Knowing that the age groups 0 and 1 only to a small degree enter into the fishery, this was not considered to be a good solution. Consequently, the WG decided to give the relevant data points in the tuning files equal weight to the others. The WG noted, however, that the estimated abundance of the 2000 year class will be extremely uncertain.

6.4.4.2 Stock assessment with ISVPA

This year the blue whiting ISVPA runs were used to analyze abundance trends using catch-at-age data, and to estimate the instantaneous natural mortality coefficient (M) using catch-at-age data. The ISVPA model is described in Section 1.3.6 of ICES (2001)

In agreement with the results of preliminary runs with data for 1981-2000 (WD Vasilyev and Belikov), the estimate of the value of M for age interval 3-10+ for 1981-2001 catch-at-age data was found close to 0.38 (Fig. 6.4.4.3). Additionally, the value of M was estimated for the 1-10+ age interval and was found equal to 0.47 (Fig. 6.4.4.4). In both cases the effort-controlled version of ISVPA with minimization of median was used. Both estimates are in rather good agreement with the results of the application of “physiological” methods by Rikhter and Efanov (1977) and by Alverson and Carney (1975), presented in the WD by Vasilyev and Belikov.

Bearing in mind that the estimates of M for the whole interval of ages used in ISVPA runs (1-10+) made for shorter intervals of years are extremely unstable, the stock assessment by ISVPA was undertaken for three values of natural mortality: M=0.38 (the value found for age interval 3-10+, here applied to age groups 1 and 2 as well), M=0.47 (the value found for age groups 1-10+), and the traditional M=0.2.

For M=0.2 and M=0.38 a reliable minimum of the effort-controlled version ISVPA loss function was found, even for traditional sum of squared errors (SSE) in the log-transformed catch-at-age. For the catch-controlled version of ISVPA, considering catch-at-age data as true and attributing the residuals to violation of assumption about stability of the selection pattern, minimization of SSE revealed no minima (Fig. 6.4.4.6). However, the minimum appears when the median of the distribution of squared errors in log-transformed catches (MDN) was used instead of SSE, and moreover, it was found approximately at the same place as for the effort-controlled version of ISVPA with minimization of SSE. The estimates of SSB, TSB, recruitment at age 1, selection pattern, and F(3-7), found for the 4 cases described above, are presented in Fig. 6.4.4.5 and Table 6.4.4.3. Residuals are given in the Table 6.4.4.4a-d.

The results of the application of ISVPA to blue whiting catch-at-age data indicates that for the traditionally used M=0.2 the estimate of SSB in 2001 is about 7.4-8.3 million t and F(3-7) is about 0.25-0.28.

Among the four cases tested, ISVPA runs with “estimated” values of M gave the lowest SSE values between the estimates of SSB from Norwegian surveys and ISVPA-derived estimates for the case of M=0.38, while M=0.47 gave the best, although rather low, correlation between them (see table in Fig. 6.4.4.5). The WG considers the problem of correction of the value of the natural mortality coefficient for blue whiting to be important, but at present it needs more investigations.

6.4.5 Stock assessment

There are six tuning fleets available for the blue whiting stock: the Norwegian Sea acoustic survey, which covers the feeding area of the northern stock component, the Norwegian and the Russian acoustic surveys on the spawning grounds, the CPUE from Spanish pair trawlers, the Spanish bottom trawl survey, and the Portuguese bottom trawl survey, where the last three fleets cover the southern component of the stock. The WG decided to leave the two last fleets out of the tuning in 1998.

In 1999 the WG decided to split three of the tuning series (the Norwegian Sea acoustic survey, and the Norwegian survey and the Russian survey on the spawning grounds). The reason for splitting these index series was the change to a Simrad EK-500 echosounder in 1991 in the first two series and in 1992 in the Russian tuning series. However, the AMCI version used during the 2002 WG meeting allows estimation of separate catchabilities for different time periods. Therefore, it was possible to reunite the index series split in 1999. Consequently there are now four tuning fleets. The indices are shown in Table 6.4.5.1.

The final assessment was done with the AMCI model v. 2.1 (see Section 1.3.2) with the following data and settings:

Catches-at-age 0-10, with age 10 treated as a plus group, 1981-2001

Survey indices:

Norwegian acoustic survey on the spawning grounds, ages 2-8, 1981-2002

Russian acoustic survey on the spawning grounds, ages 3-8, 1982-1996

Spanish pair trawlers CPUE, ages 1-6, 1983-2001

Norwegian Sea acoustic survey, ages 1-7, 1981-2001

The objective functions were a sum of the following partial objective functions:

Log sum of squares of catches-at-age, weight 1

Log sum of squares of yearly yields, weight 1

Log sum of squares for survey indices at age, weight 1 for each fleet

Note that the weight applied to log sum of squares of yearly yields corresponds to the weighting used by the WG in 2001, but the actual numerical value is changed because of an internal change in AMCI.

Catch-at-age data were down-weighted by a factor of 0.1 for age 0 and with a factor of 0.5 for age 1, and the tuning index for age 1 in fleet 3 was down-weighted by a factor of 0.01.

Fishing mortality was modelled as separable, but with a gradual change in the selection. The gain factor for change in selection was 0.5 for age 0, 0.2 for age 1, and 0.1 for the older ages. This implies that the selection at ages 0 and 1 is allowed to vary more according to the year-to-year variation in the catches than the selection at the older ages. The selection in 1981 was fixed at values equal to the average of 1981-1989, as obtained after one iteration. This was done because the fishing mortality and stock numbers in the initial year tend to be highly correlated. Fishing mortality in 2002 was assumed to be equal to that in 2001, and the recruitment in 2001 was estimated according to the stock-recruitment function. The stock-recruitment function was the 'Ockham's razor', with a constant recruitment at SSB > 1 500 000 t, and a linear decrease towards the origin below that SSB value. This function was fitted to the data by minimising the sum of the squared log residuals independent of the overall objective function. Survey indices were assumed to be related to the stock numbers by simple proportionality. Survey catchabilities were estimated at each age and assumed constant for the periods 1981-1990 and 1991-2001/2002 (tuning fleets 1 and 4), or for the periods 1982-1991 and 1992-1996 (tuning fleet 2), or over the whole period (tuning fleet 3).

The model accepts yearly catch-at-age data, but operates internally on a quarterly basis. The spawning stock is derived from the mean stock numbers in the first quarter, and the survey indices are related to the mean values in the survey season. The yearly fishing mortality was split on quarters assuming that the proportion 0.35 of the total annual fishing mortality occurs in the first and in the second quarter, 0.2 in the third quarter, and 0.1 in the fourth quarter. Natural mortality was assumed constant at 0.2 for all ages.

The model was run until 2004. The results for 2002 to 2004 are predicted values assuming a fishing mortality as in 2001. The results are presented in Tables 6.4.5.2 to 6.4.5.6. A bootstrap run was made where catches-at-age and survey indices at age, as well as recruitments in the years 2001 - 2004 were drawn randomly. This was done by non-parametric bootstrap, i.e. catch-at-age and survey indices were drawn by using the modelled values and their residuals, and drawing residuals randomly to each data point, which were added to the modelled values. Recruitments were drawn assuming a lognormal distribution. New parameter estimation was done for each replicate set of data. 1000 replicates were run. The results are summarised in Figure 6.4.5.1. A retrospective run for terminal year set to 1994-2001 was made, to compare the 2002 assessment to those of recent years (Figure 6.4.5.2).

The results of the assessment (Table 6.4.5.6) show a strong increase in fishing mortality over the last years, reaching F=0.82 in 2001. Spawning stock has declined in the last years, but the estimated SSB for 2002, 2.4 million t, is still above the $\mathbf{B}_{lim}$=1.5 million t. However, the estimated F is well above the $\mathbf{F}_{lim}$=0.51. The abundances of strong 1995 and 1996 and older year classes are considerably reduced, and the stock is dominated by young fish. The 1999 year class is strong, at the same level as the large year classes 1995 and 1997, but somewhat less abundant than the very rich 1996 year class. The 2000 year class seems even more abundant than the 1995, 1997, and 1999 year classes, although the strength of this year class is still poorly estimated. It can be concluded that only because of exceptionally good recruitment since 1995 this stock has managed to uphold an SSB at a level above the $\mathbf{B}_{pa}$ since 1998, despite the increased catch level.

The retrospective plot (Fig. 6.4.5.2) shows that there is a tendency to underestimate the recruiting year classes at age 0. This underestimation will, in turn, lead to an underestimation of SSB and an overestimation of fishing mortality. A possible reason could be that the 0-group is poorly represented in the catch-at-age matrix, and none of the tuning series included in the model seem to reflect the year-class strength reliably at this age. On the other hand, an underestimation of recruitment in the model could also be caused by other factors.

The estimated age structure implies that the stock will decline if the fishing mortality is maintained at the level of 2001 (F=0.82) also in 2002. This F corresponds to a catch of about 1.5 million t in 2002.

The bootstrap run (Figure 6.4.5.1) gives an indication of the uncertainty in the assessment. The trend in fishing mortality and SSB are consistently estimated in the bootstrap datasets. However, the strengths of the 1999 and 2000 year classes are still highly uncertain, which influences also the estimations of fishing mortality and SSB in the ultimate year.

6.5 Short-Term Projection

Based on the final AMCI run, a deterministic short-term projection was made using the MFDP (version 1a) program, and the yield-per-recruit estimations were made by means of the MFYPR (version 2a) program, with the input stated in Table 6.5.1. The weight in the stock and catch were taken from the average of the last three years values. The selection pattern and the reference F in 2001 from the final AMCI run were used as input values in 2002. The recruitment in 2002-2004 was set as the geometric mean of the recruitment values in the period 1981-2000 in the AMCI run. For all ages the output values in 2002 from the AMCI run were used as the initial stock size. The proportion of F and M before spawning was set to 0.25, taking into account the proportion of the catches that take place before the spawning period.

The results are given in Table 6.5.2 and the standard plots are given in Figure 6.5.1. Continuing fishing at the 2001 level predicts a catch of 1.5 million t in 2001 (this value is close to the sum of the autonomous quotas set by the coastal states) and 1.3 million t in 2002. This exploitation rate implies a decreasing trend of SSB with 2.2 million t in 2002 and 1.9 and 1.4 million t in 2003 and 2004, respectively. The predicted total stock biomass will also decrease from 5.1 million t in 2002 to 4.1 and 3.3 million t in the following years.

6.6 Medium-Term Projection

Medium-term projections this year were done using the STPR software (see Section 1.3.3), which appeared to be the most convenient way to use the outputs produced by AMCI.

An 'Ockham's razor' stock-recruitment function was assumed, with a constant expected recruitment at SSB above 1.5 million t, a linear decline towards the origin at lower SSB, and a constant coefficient of variation. This function was chosen because the recruitment shows no dependence on the SSB within the range for which there is data. The function is shown in Figure 6.6.1.

Initial numbers were taken from the final AMCI run. The program uses the numbers at the start of the last assessment year and a catch constraint for that year. Accordingly, the stock numbers at the start of 2001 and the total catch in 2001 were used. Initial numbers in 2002 were taken from bootstrap runs of AMCI. The selection pattern used was that for 2001. This pattern has been relatively stable over the whole time period. Weights-at-age were taken from the historical values, and the maturity ogive was the standard ogive used in the assessment.

Runs were made with two options for catch in 2002, one with an F constraint where F was equal to the F in 2001 (0.82), and the other with a catch constraint where the catch was set equal to the sum of the autonomous quotas indicated by the coastal states to be applied for 2002 (1 450 000 t). For the future years, various levels of constant fishing mortality were simulated, in order to outline the risk of bringing the SSB below the limit and pa-levels, and the prospect of bringing it above these levels. The results are summarised in Table 6.6.1.

The results indicate that with $F_{2002} = F_{2001}$ (generating a median catch in 2002 equal to 1 374 000 t), there is a risk of 4% to 9% that the SSB in 2003 will be below $\mathbf{B}_{lim}$, depending on the fishing mortality applied in 2003. At low fishing mortality from 2003 onwards, the probability of SSB being below $\mathbf{B}_{lim}$ becomes small within a few years, but this risk persists at fishing mortalities above 0.25. The prospects for bringing SSB above $\mathbf{B}_{pa}$=2 250 000 t is between 30% and 40% in 2003, but is fairly high in the medium term for F's below 0.25.

With a higher F corresponding to a catch of 1 450 000 t in 2002, the risk that SSB shall be below $\mathbf{B}_{lim}$ is considerably higher (18-25% in 2003), but the probability of reaching the $\mathbf{B}_{pa}$ in the medium term is high if the future fishing mortality is moderate (below 0.25).

Thus, according to the medium-term projections, the stock will benefit considerably from a rapid reduction of the fishing mortality to lower levels.

6.7 Precautionary Reference Points

The reference points for blue whiting have been revisited (WD by Skagen). The reference points set have been criticised as there may be an inconsistency between the chosen $\mathbf{B}_{pa}$ and $\mathbf{F}_{pa}$. This discussion is based on the 2001 assessment.

The present values and their technical basis are:

$\mathbf{B}_{lim}$: 1.5 mill tonnes; $\mathbf{B}_{loss}$

$\mathbf{B}_{pa}$: 2.25 mill. tonnes; $\mathbf{B}_{lim}$*1.5

$\mathbf{F}_{lim}$: 0.51; $\mathbf{F}_{loss}$

$\mathbf{F}_{pa}$: 0.32; $\mathbf{F}_{med}$.

The inconsistency problem is that fishing at $\mathbf{F}_{pa}$ implies a high probability of bringing the stock below $\mathbf{B}_{pa}$. The recent increase in the fishery has become a matter of concern, and work has been initiated by several coastal states to develop recovery plans. This adds to the need to revise the reference points, because of their role as targets for rebuilding and guidelines for future exploitation. In particular, one may question whether the present $\mathbf{B}_{pa}$ is an adequate target for management purposes.

Recruitment dynamics can be summarised as:

Within the range of historical observations, there is no trend in recruitment as a function of SSB. Thus, bringing the stock below $\mathbf{B}_{lim}$ implies 'unknown dynamics' in the ACFM terminology.

Historically, there have been strong year classes with 6-7 years intervals, and a sequence of 3-4 weak year classes inbetween.

The SSB has increased each time a strong year class entered the spawning stock, and decreased in the periods where the spawning stock was dominated by weak year classes.

The $\mathbf{F}_{med}$ is intended to stabilise the SSB around the mean historical value. The $\mathbf{F}_{med}$ replacement line implies an SSB – recruitment ratio that, with geometric mean recruitment, is at equilibrium with an SSB about 1.9 million tonnes, which is well below $\mathbf{B}_{pa}$.

In recent years, there has been an improvement in the recruitment. The 1995 year class was strong, which might be expected, but the 1996 year class was far stronger. The 1997 year class was also strong, and there are indications of strong year classes both in 1999 and 2000. The strong year classes have been most prominent in the north and may have led to a more northerly distribution of the stock as a whole. The reason for this is not known.

Exploitation of the blue whiting stocks can be summarised as:

Over the years, the fishing mortality has fluctuated between 0.2 and 0.45. It was reduced in 1991 because the stock was declining. The stock improved both because of this and because a new strong year class came in.

In recent years, there has been a dramatic increase in catches and in the fishing mortality.

The exploitation pattern has been relatively stable according to the 2001 assessment, with the major exploitation being on adults. The exploitation of juveniles has been modest.

In 2001, a large fishery developed in the Norwegian Sea and in the areas between Iceland and the Faroe Islands in the summer, and the proportion of juveniles was large in that fishery. Thus, it is likely that a new specific fishery for juveniles is developing.

The stock assessments carried out have shown that SSB has been in the range between $\mathbf{B}_{lim}$ and $\mathbf{B}_{pa}$ in most of the historical years. Except for the most recent period, the stock has mostly been moderately exploited, and there is no trend in the recruitment as a function of SSB. Thus, the safety margin built into the $\mathbf{B}_{pa}$ is so wide that the stock at moderate exploitation is dependent on well above average year classes to reach the present $\mathbf{B}_{pa}$.

On the basis of the analyses made on long-term and medium-term simulations and on the stock assessment carried out it could be suggested that $\mathbf{B}_{lim}$ could be kept at 1.5 million t and that $\mathbf{B}_{pa}$ could be undefined. An appropriate $\mathbf{F}_{pa}$ of 0.25 could be set on the assumption that exploitation of juveniles is kept low and that the weights-at-age remain within the historical range. This would give a 1 - 2% risk that SSB falls below $\mathbf{B}_{lim}$ in any year. If $\mathbf{F}_{lim}$ is needed, it may be in the order of 0.35, which according to the calculations made implies an approximately 20 % probability of falling below $\mathbf{B}_{lim}$, and a 5 percentile for SSB of about 1.3 million t.

6.8 Spatial and temporal distribution

Geographical distribution of the catches of blue whiting in 2001 is given by quota and ICES rectangles in Figure 6.8.1. The distribution of the catch for the whole year is given in Figure 6.8.2. In 2001 the catch provided as catch by rectangle represented approximately 1.75 million t (98.4%).

6.9 Management consideration

The fishery for blue whiting has expanded rapidly in recent years, while no agreement on TAC has been reached. The reported catches in 1998 to 2001 were all well above 1 million t reaching 1.7 million t in 2001, corresponding to an F of 0.82. In spite of this very high exploitation rate, the SSB has been at a fairly high level, due to exceptionally good recruitment in recent years. The year classes 1995, 1996, 1997, 1999, and 2000 are all far above average strength. The estimated strength of the 1999 and 2000 year classes are highly uncertain (Figure 6.4.5.1). Without these strong year classes the extensive fishery would lead to a severe depletion of the stock before now.

However, the assessment made in 2002 gives a more optimistic view of the present stock situation compared to that made in 2001. The main reason is that the incoming year classes are seemingly stronger than estimated previously. The SSB in 2001 is at present above the $\mathbf{B}_{pa}$ presently used. The reference F is, on the other hand at 0.82, and the exploitation on younger fish is also considerable. Lowering the F will increase the long-term yield.

Quality of Catch Data and Biological Sampling Data

The Working Group members generally accepted that the total landings data seem to be reliable and that misreporting of landings by area was minor. As there was no agreed TAC for this stock, there is unlikely to be a motive for over- or underreporting landings. Therefore discarding of blue whiting was assumed to be insignificant.

In total 985 samples were collected from the commercial fishery, 174 000 fish measured and 18 000 fish aged. However, sampling was not evenly distributed throughout all quarters and areas.

The text table below shows the number of samples and total landings by the three areas, Northern, North Sea and Skagerrak, and Southern, and by quarter.

Quarter		Northern	NS-SK	Southern	Total
1	Number of samples	73	9	134	216
	Landings (t)	370 262	16 932	6 357	393 552
2	Number of samples	94	35	154	283
	Landings (t)	614 383	63 863	6 457	684 703
3	Number of samples	136	7	146	289
	Landings (t)	485 815	18 481	6 148	510 444
4	Number of samples	42	18	137	197
	Landings (t)	162 222	19 247	6 003	191 471
Total	Number of samples	345	69	571	985
	Landings (t)	1 636 683	118 523	24 964	1 780 170

On average there was one sample for every 4 744 t landed in Northern, one sample for every 1 854 t landed in the North Sea and Skagerrak, and one sample for every 44 t landed in Southern.

The WG used the samples to estimate catch in numbers and mean length and mean weight. The overall sampling level is considered acceptable, however improvements are required because some countries do not have adequate sampling. Detailed information on the number of samples, number of fish measured, and number of fish aged by country and quarter is given in Table 6.10.1. As can be seen, no sampling is carried out by France, Scotland, and Sweden and only limited sampling by Denmark, Germany, and Ireland.

Therefore, the WG recommends that all countries that exploit this stock should develop appropriate sampling schemes. In this context it should be mentioned that with the implementation of the EU Data Collection of Fisheries Data in 2002 (EU Commissions Regulation 1639/2001), sampling is expected to improve when minimum sampling requirements (1 sample per 1000 t landed) are met by EU countries.

6.10 Recommendations

The WGNPBW recommends that:

all countries that exploit the blue whiting stock should develop appropriate sampling schemes,

catch data for 2002 as well as catch data for 2001 shall be made available by “Fishery”, quarter, and area level by country at the WGNPBW meeting in 2003,

research seeking to clarify the population biology and ecological role of blue whiting in the ecosystems of the northeast Atlantic is given a high priority in the research agenda of national fisheries research institutions,

national fisheries research institutions intensify their efforts on making ecological data on blue whiting available to each other.

Table 6.2.1 Landings (tonnes) of BLUE WHITING from the directed fisheries (Sub-areas I and II, Division Va, XIVa and XIVb) 1987–2001, as estimated by the Working Group.

Country	1987	1988	1989 [3]	1990	1991	1992	1993	1994 [2]	1995 [3]	1996	1997	1998	1999	2000	2001
Denmark													15	7,721	5,723
Estonia	-	-	-	-	-	-	-	-	-	377	161	904	-	-	-
Faroes	9,290	-	1,047	-	-	-	-	-	-	345	-	44,594	11,507	17,980	64,496
Germany	1,010	3	1,341	-	-	-	-	2	3	32	-	78	-	-	3117
Greenland	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Iceland	-	-	4,977	-	-	-	-	-	369	302	10,464	64,863 [4]	99,092	146,903	245,814
Latvia	-	-	-	-	-	-	-	422	-	-	-	-	-	-	-
Netherlands	-	-	-	-	-	-	-	-	72	25	-	63	435	-	5180
Norway [5]															64,581
Norway [6]	-	-	-	566	100	912	240	-	-	58	1,386	12,132	5,455	-	28,812
Poland	56	10	-	-	-	-	-	-	-	-	-	-	-	-	-
USSR/Russia [1]	112,686	55,816	35,250	1,540	78,603	61,400	43,000	22,250	23,289	22,308	50,559	51,042	65,932	103,941	173,860
Total	123,042	55,829	42,615	2,106	78,703	62,312	43,240	22,674	23,733	23,447	62,570	173,676	182,436	276,545	591,583

[1]) From 1992 only Russia

[2]) Includes Vb for Russia.

[3]) Icelandic mixed fishery in Va.

[4]) include mixed in Va and directed in Vb.

[5] Directed fishery

[6] By-catches of blue whiting in other fisheries.

Table 6.2.2 Landings (tonnes) of BLUE WHITING from directed fisheries (Division Vb,VIa,b, VIIb,c. VIIg-k and Sub-area XII) 1987–2001, as estimated by the Working Group.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998 [1]	1999	2000	2001
Denmark	2,655	797	25	-	-	3,167	-	770	-	269	-	5051	19,625	11,856	18,110
Estonia	-	-	-	-	-	6,156	1,033	4,342	7754	10,605	5,517	5,416	-	-	-
Faroes	70,625	79,339	70,711	43,405	10,208	12,731	14,984	22,548	26,009	18,258	22,480	26,328	93,234	129,969	188,464
France	-	-	2,190	-	-	-	1,195	-	720	6,442	12,446	7,984	6,662	13,481	13,480
Germany	3,850	5,263	4,073	1,699	349	1,307	91	-	6,310	6,844	4,724	17,891	3,170	12,655	15,862
Iceland	-	-	-	-	-	-	-	-	-	-	-	-	61,438	113,280	119,287
Ireland	3,706	4,646	2,014	-	-	781	-	3	222	1,709	25,785	45635	35,240	25,200	29,854
Japan	-	-	-	-	-	918	1,742	2,574	-	-	-	-	-	-	-
Latvia	-	-	-	-	-	10,742	10,626	2,160	-	-	-	-	-	-	-
Lithauen	-	-	-	-	-	-	2,046	-	-	-	-	-	-	-	-
Netherlands[2])	5,627	800	2,078	7,280	17,359	11,034	18,436	21,076	26,703	17,644	23,676	27,884	35,408	46,128	68,415
Norway	191,012	208,416	258,386	281,036	114,866	148,733	198,916	226,235	261,272	337,434	318,531	519,622	475,004	460,274	399,932
UK (Scotland)	3,315	5,071	8,020	6,006	3,541	6,849	2,032	4,465	10,583	14,325	33,398	92,383	98,853	42,478	50,147
USSR/Russia [3])	165,497	121,705	127,682	124,069	72,623	115,600	96,000	94,531	83,931	64,547	68,097	79,000	112,247	141,257	141,549
Total	446,287	426,037	475,179	463,495	218,946	318,018	347,101	378,704	423,504	478,077	514,654	827,194	940,881	996,578	1,045,100

[1]) Including some directed fishery also in Division IVa.

[2]) Revised for the years 1987, 1988, 1989, 1992, 1995,1996,1997

[3]) From 1992 only Russia

Table 6.2.3 Landings (tonnes) of BLUE WHITING from directed fisheries and by-catches caught in other fisheries in Divisions IIIa, IVa 1987–2001, as estimated by the WG.

Country	1987	1988	1989	1990	1991	1992	1993 [3]	1994	1995	1996	1997	1998 [2]	1999	2000	2001
Denmark [4]	28,541	18,144	3,632	10,972	5,961	4,438	25,003	5,108	4,848	29,137	9,552	40,143	36,492	30,360	21,995
Denmark [5]			22,973	16,080	9,577	26,751	16,050	14,578	7,591	22,695	16,718	16,329	8,521	7,749	7,505
Faroes [4) 6)]	7,051	492	3,325	5,281	355	705	1,522	1,794	-	6,068	6,066	-	-	-	60
Faroes [5) 6)]												296	265	42	6,741
Germany [1]	115	280	3	-	-	25	9	-	-	-	-			-	81
Netherlands	-	-	-	20	-	2	46	-	-	-	793			-	-
Norway [4]	24,969	24,898	42,956	29,336	22,644	31,977	12,333	3,408	78,565	57,458	27,394	28,814	48,338	73,006	21,804
Norway [5]															58,182
Russia															69
Sweden	2,013	1,229	3,062	1,503	1,000	2,058	2,867	3,675	13,000	4,000	4,568	9,299	12,993	3,319	2,086
UK	-	100	7	-	335	18	252	-	-	1	-			-	-
Total	62,689	45,143	75,958	63,192	39,872	65,974	58,082	28,563	104,004	119,359	65,091	94,881	106,609	114,476	118,523

[1]) Including directed fishery also in Division IVa.

[2]) Including mixed industrial fishery in the Norwegian Sea

[3]) Imprecise estimates for Sweden: reported catch of 34265 t in 1993 is replaced by the mean of 1992 and 1994, i.e. 2,867 t, and used in the assessment.

[4)] Directed fishery

[5)] By-catches of blue whiting in other fisheries.

[6)] For the periode 1987-2000 landings figures also include landings from mixed fisheries in Division Vb.

Table 6.2.4 Landings (tonnes) of BLUE WHITING from the Southern areas (Sub-areas VIII and IX and Divisions VIIg-k and VIId,e) 1987–2001, as estimated by the Working Group.

Country	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Netherlands	-	-	-	450	10	-	-	-	-	-	-	10 [1)]	-	-	-
Norway	4	-	-	-	-	-	-	-	-	-	-			-	-
Portugal	9,148	5,979	3,557	2,864	2,813	4,928	1,236	1,350	2,285	3,561	2,439	1,900	2,625	2,032	1,746
Spain	23,644	24,847	30,108	29,490	29,180	23,794	31,020	28,118	25,379	21,538	27,683	27,490	23,777	22,622	23,218
UK	23	12	29	13	-	-	-	5	-	-	-	-	-	-	-
France	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Total	32,819	30,838	33,695	32,817	32,003	28,722	32,256	29,473	27,664	25,099	30,122	29,390	26,402	24,654	24,964

[1)] Directed fisheries in VIIIa

IIa	5,723	39,694		3,117	74,700	5,180		93,393		148,015				369,821
IIb										25,812				25,812
IIIa	2,954							22					2,040	5,016
IVa	26,546	6,801		81				79,964		69			46	113,507
IXa									1,746					1,746
Va		24,801			171,114									195,915
Vb	13,632	114,591			119,287			63,282		94,776				405,568
Vb VI VII			13,480											13,480
VIa	1,023	28,753		11,619		25,572	18,357	148,789			36,264			270,376
VIb		6,480		650		4,447	567	35,820		37,193	2,963			88,120
VIIb				51		10,595	1,563				6,816			19,025
VIIbc								75,756						75,756
VIIc	3,455	36,816		3,488		25,820	8,438				4,044			82,061
VIIgk+XII		1,824						76,285		9,580				87,689
VIIh				2										2
VIIIc+IXa												23,218		23,218
VIIj				52		1,982	929				60			3,023
Grand Total	53,333	259,761	13,480	19,060	365,101	73,595	29,854	573,310	1,746	315,478	50,147	23,218	2,086	1,780,170

Table 6.2.6 Landings (tonnes) of BLUE WHITING from the main fisheries, 1987–2001, as estimated by the Working Group.

Area	Norwegian Sea fishery (Sub-areas 1+2 and Divisions Va, XIVa-b)	Fishery in the spawning area (Divisions Vb, VIa, VIb and VIIb-c)	Directed- and mixed fisheries (Divisions IIIa and IV)	**Total northern areas**	Total southern areas (Subareas VIII and IX and Divisions VIId, e, g-k)	**Grand total**
1987	123,042	446,287	62,689	**632,018**	32,819	**664,837**
1988	55,829	426,037	45,143	**527,009**	30,838	**557,847**
1989	42,615	475,179	75,958	**593,752**	33,695	**627,447**
1990	2,106	463,495	63,192	**528,793**	32,817	**561,610**
1991	78,703	218,946	39,872	**337,521**	32,003	**369,524**
1992	62,312	318,081	65,974	**446,367**	28,722	**475,089**
1993	43,240	347,101	58,082	**448,423**	32,256	**480,679**
1994	22,674	378,704	28,563	**429,941**	29,473	**459,414**
1995	23,733	423,504	104,004	**551,241**	27,664	**578,905**
1996	23,447	478,077	119,359	**620,883**	25,099	**645,982**
1997	62,570	514,654	65,091	**642,315**	30,122	**672,437**
1998	173,676	827,194	94,881	**1,095,751**	29,400	**1,125,151**
1999	182,436	940,881	106,609	**1,229,926**	26,402	**1,256,328**
2000	276,545	996,577	114,477	**1,387,599**	24,654	**1,412,253**
2001	591,583	1,045,100	118,523	**1,755,206**	24,964	**1,780,170**

Table 6.2.7 Total landings of blue whiting by quarter and area for 2001 in tonnes. Landing figures provided by Working Group members.

Area	**Quarter 1**	**Quarter 2**	**Quarter 3**	**Quarter 4**	**Grand Total**
I			25	8	33
IIa	6,361	106,969	223,525	32,966	369,821
IIb			9,000	16,812	25,812
IIIa	225	1,708	2,201	882	5,016
IVa	16,707	62,155	16,280	18,365	113,507
Va	2,118	7,847	171,762	14,188	195,915
Vb	11,454	210,924	81,091	102,099	405,568
Vb VI VII	10,166	3,168		146	13,480
VIa	47,206	223,169	0		270,376
VIb	32,178	55,530	412		88,120
VIIb	16,274	2,751			19,025
VIIbc	75,756				75,756
VIIc	81,060	1,001			82,061
VIIgk+XII	85,727	1,961			87,689
VIIh				2	2
VIIj	1,960	1,064			3,023
VIIIc+IXa	6,130	5,836	5,641	5,612	23,218
IXa	227	621	507	391	1,746
Grand Total	393,552	684,703	510,444	191,471	1,780,170

Table 6.3.1.1. Blue whiting. Landings in numbers ('000) by length group (cm) and quarters for the Northern Area in 2001.

Length (cm)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	All year
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15	8	1			8
16	16	3	2		21
17	4	27	44	2	77
18	5	58	171	5	240
19	5	104	305	13	427
20	11	85	232	27	354
21	19	46	237	28	330
22	43	490	72	30	635
23	87	1 489	54	15	1 645
24	112	2 469	58	13	2 652
25	155	1 611	55	12	1 834
26	231	1 628	36	10	1 906
27	287	1 774	27	7	2 094
28	276	2 273	7	5	2 561
29	210	818	7	4	1 039
30	136	270	2	3	411
31	111	217		1	330
32	77	289		1	367
33	59	151	2	2	213
34	21	29		1	51
35	9	18			27
36	9	12			21
37	1	17			18
38	4	11			15
39	1	2			3
40	1				1
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
TOTAL numbers ('000)	1 899	13 889	1 312	181	17 281

Official Catch (t.)	370 262	614 383	485 815	166 222	1636 683

Table 6.3.1.2. Blue whiting. Landings in numbers ('000) by length group (cm) and quarters for the North Sea and Skagerrak in 2001.

Length (cm)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	All year
5					
6					
7					
8					
9					
10					
11					
12					
13					
14	1				1
15	7			2	9
16	15	3	2	9	29
17	9	26	24	21	79
18	12	52	51	15	130
19	10	92	84	15	202
20	12	73	65	27	177
21	15	31	60	33	140
22	18	62	25	35	140
23	19	110	16	18	164
24	18	92	16	17	143
25	11	95	16	14	135
26	12	55	12	14	93
27	13	61	7	7	88
28	11	40	3	4	58
29	8	22	2	3	35
30	5	16	1	2	24
31	4	9		1	14
32	3	6		1	11
33	2	3	1	1	7
34	1	3		1	4
35		2			2
36		1			1
37		2			2
38		1			1
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
TOTAL numbers ('000)	209	858	382	240	1 689
Official Catch (t.)	16 932	63 863	18 481	19 247	118 523

Table 6.3.1.3. Blue whiting. Landings in numbers ('000) by length group (cm) and quarters for the Southern Area in 2001.

Length (cm)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	All year
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15	1				1
16	5	1	1		7
17	10	7	3	2	23
18	9	18	10	6	42
19	4	22	18	9	54
20	9	15	12	10	46
21	17	13	10	12	51
22	16	15	11	12	54
23	14	11	10	12	47
24	9	7	8	8	31
25	6	3	6	7	21
26	2	2	3	3	11
27	1	1	2	2	6
28		1	1	1	3
29					1
30					1
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
TOTAL numbers ('000)	104	116	95	83	398

Official Catch (t.)	6 357	6 457	6 148	6 003	24 964

Table 6.3.2.1 BLUE WHITING. Catch in number (millions) by age group in the directed fisheries (Sub-areas I and II, Divisions Va, and XIVa+b, Vb, Via+b, VIIbc and VIIg-k) in 1990-2001.

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	8	64	-	-	-	1	4	167	15	61	41	119
1	538	33	82	37	44	99	497	1352	984	544	912	3459
2	353	533	52	130	31	143	327	1079	3535	1180	752	3924
3	566	384	1509	335	190	338	451	751	3211	5257	3119	2728
4	709	244	510	1348	362	416	425	526	929	3235	4834	3644
5	489	330	200	376	1242	566	248	268	346	362	1517	2474
6	562	235	139	196	294	769	430	238	311	186	500	555
7	292	150	92	108	201	246	619	270	298	143	210	160
8	76	40	87	60	103	154	214	391	257	146	144	91
9	27	4	85	38	88	58	88	101	209	66	57	69
10+	92	14	15	14	32	40	70	164	85	138	139	55
Total	3,711	2,032	2,770	2,641	2,588	2,829	3,373	5,307	10,180	11,318	12,225	17,281
Tonnes	465,601	297,649	379,549	389,010	401,378	447,015	493,373	545,058	1,000,870	1,123,317	1,273,123	1,636,683

Table 6.3.2.2 BLUE WHITING. Catch in number (million) by age group in the directed fishery and by-catches from other fisheries (Divisions IIIa and IV) for 1990-2001.

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	1	25	-	132	95	3303	812	29	11	60	56	9
1	875	8	160	167	33	101	1334	621	576	188	822	770
2	168	398	64	39	21	88	71	269	524	286	317	416
3	50	42	167	91	18	29	58	50	259	434	253	174
4	12	11	75	97	37	11	71	14	47	168	143	149
5	7	11	25	15	6	6	39	14	6	16	22	109
6	4	11	17	7	3	11	45	5	4	5	3	29
7	5	6	7	8	1	2	33	4	3	5	0	9
8	1	3	3	-	1	2	14	6	4	6	7	6
9	0	1	1	-	0	1	9	1	4	1	1	8
10+	-	0	1	-	-	1	11	2	12	3	1	11
Total	1,121	518	519	556	214	3,555	2,499	1,015	1,450	1,172	1,627	1,689
Tonnes	63,195	39,872	66,174	55,215	28,563	104,004	119,359	65,091	94,881	106,609	114,477	118,523

Table 6.3.2.3 BLUE WHITING. Catch in number (millions) by age group in the Southern area, 1990-2001.

Age	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	74	70	19	25	13	3	9	11	18	18	32	33
1	198	181	139	41	12	96	43	118	97	57	80	134
2	182	182	205	146	56	123	131	143	122	82	123	146
3	57	70	95	181	149	55	117	86	71	130	93	60
4	25	39	43	62	72	38	36	26	69	57	35	14
5	24	17	12	12	27	44	33	8	32	35	9	10
6	11	8	6	7	9	20	17	4	7	15	10	1
7	2	3	2	2	5	6	5	3	2	3	3	0
8+	2	3	1	1	4	5	3	3	4	2	0	0
Total	575	573	522	477	347	390	394	402	422	399	384	398
Tonnes	32,817	32,003	28,722	32,256	29,468	27,664	25,099	30,122	29,400	26,402	24,654	24,964

Table 6.3.2.4 Blue Whiting. Total catch in numbers at age (millions) in 1982-2001

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	3,512	437	584	1,174	84	341	46	1,949	83	161
1	148	2,283	2,291	1,305	650	838	425	865	1,611	267
2	274	567	2,331	2,044	816	578	721	718	703	1,024
3	326	270	455	1,933	1,862	728	614	1,340	672	514
4	548	286	260	303	1,717	1,897	683	791	753	302
5	264	299	285	188	393	726	1,303	837	520	363
6	276	304	445	321	187	137	618	708	577	258
7	266	287	262	257	201	105	84	139	299	159
8	272	286	193	174	198	123	53	50	78	49
9	284	225	154	93	174	103	33	25	27	5
10+	673	334	255	259	398	195	50	38	95	10
Total	6,843	5,578	7,515	8,051	6,680	5,771	4,630	7,460	5,418	3,112
Tonnes	576,419	570,072	641,776	695,596	826,986	664,837	557,847	627,447	561,610	369,524

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	19	198	42	3,307	833	212	43	139	129	162
1	408	263	307	296	1,893	2,131	1,657	788	1,815	4,364
2	654	305	108	354	534	1,519	4,181	1,549	1,193	4,486
3	1,642	621	368	422	632	904	3,541	5,821	3,466	2,962
4	569	1,571	389	465	537	578	1,045	3,461	5,015	3,807
5	217	411	1,222	616	323	296	384	413	1,550	2,593
6	154	191	281	800	497	252	323	207	514	586
7	110	107	174	254	663	282	303	151	213	170
8	80	65	90	160	232	407	264	153	151	97
9	32	38	79	60	98	104	212	69	58	77
10+	12	17	31	42	83	169	86	141	140	66
Total	3,896	3,788	3,091	6,775	6,327	6,854	12,039	12,891	14,244	19,369
Tonnes	475,089	480,679	459,414	578,905	645,982	672,437	1,125,151	1,256,328	1,412,253	1,780,170

The table is revised according to the figures used in the asessment runs (CANUM file). There were minor correction for some years. For 1997 there was a revision from 7,127 to 6,854 mill.

Table 6.3.2.5. Blue whiting. Documentation of “DETAILS OF DATA FILLING-IN” of the landings data for 2001.

Filling-in for record : (1) Denmark 1 IIa
Using Only
>> (49) Faroe Islands 1 IVa

Filling-in for record : (2) Denmark 2 IIa
Mean Weighted by Sampled Catches of:
>> (46) Faroe Islands 2 IIa
>> (110) Iceland 2 IIa
>> (122) The Netherlands 2 IIa
>> (182) Russia 2 IIa

Filling-in for record : (3) Denmark 3 IIa
Mean Weighted by Sampled Catches of:
>> (47) Faroe Islands 3 IIa
>> (111) Iceland 3 IIa
>> (155) Norway 3 IIa
>> (183) Russia 3 IIa

Filling-in for record : (4) Denmark 4 IIa
Mean Weighted by Sampled Catches of:
>> (48) Faroe Islands 4 IIa
>> (112) Iceland 4 IIa
>> (184) Russia 4 IIa

Filling-in for record : (7) Denmark 3 IIIa
Mean Weighted by Sampled Catches of:
>> (47) Faroe Islands 3 IIa
>> (111) Iceland 3 IIa
>> (155) Norway 3 IIa
>> (183) Russia 3 IIa

Filling-in for record : (8) Denmark 4 IIIa
Mean Weighted by Sampled Catches of:
>> (48) Faroe Islands 4 IIa
>> (112) Iceland 4 IIa
>> (184) Russia 4 IIa

Filling-in for record : (9) Denmark 1 IVa
Using Only
>> (49) Faroe Islands 1 IVa

Filling-in for record : (10) Denmark 2 IVa
Using Only
>> (162) Norway 2 IVa

Filling-in for record : (11) Denmark 3 IVa
Mean Weighted by Sampled Catches of:
>> (47) Faroe Islands 3 IIa
>> (111) Iceland 3 IIa
>> (155) Norway 3 IIa
>> (183) Russia 3 IIa

Filling-in for record : (12) Denmark 4 IVa
Mean Weighted by Sampled Catches of:
>> (48) Faroe Islands 4 IIa
>> (112) Iceland 4 IIa
>> (184) Russia 4 IIa

Table 6.3.2.5 (continued)

Filling-in for record : (14) Denmark 2 Vb
Mean Weighted by Sampled Catches of:
>> (58) Faroe Islands 2 Vb
>> (118) Iceland 2 Vb
>> (166) Norway 2 Vb
>> (194) Russia 2 Vb

Filling-in for record : (16) Denmark 4 Vb
Mean Weighted by Sampled Catches of:
>> (60) Faroe Islands 4 Vb
>> (120) Iceland 4 Vb
>> (196) Russia 4 Vb

Filling-in for record : (18) Denmark 2 VIa
Mean Weighted by Sampled Catches of:
>> (62) Faroe Islands 2 VIa
>> (134) The Netherlands 2 VIa
>> (170) Norway 2 VIa

Filling-in for record : (21) Denmark 1 VIIc
Mean Weighted by Sampled Catches of:
>> (37) Ireland 1 VIIc
>> (69) Faroe Islands 1 VIIc

Filling-in for record : (25) Ireland 1 VIa
Using Only
>> (61) Faroe Islands 1 VIa

Filling-in for record : (26) Ireland 2 VIa
Mean Weighted by Sampled Catches of:
>> (62) Faroe Islands 2 VIa
>> (134) The Netherlands 2 VIa
>> (170) Norway 2 VIa

Filling-in for record : (29) Ireland 1 VIb
Mean Weighted by Sampled Catches of:
>> (65) Faroe Islands 1 VIb
>> (137) The Netherlands 1 VIb
>> (173) Norway 1 VIb

Filling-in for record : (33) Ireland 1 VIIb
Mean Weighted by Sampled Catches of:
>> (37) Ireland 1 VIIc
>> (69) Faroe Islands 1 VIIc

Table 6.3.2.5. (con't)

```
 Filling-in for record : (34)    Ireland          2 VIIb
Using Only
  >>  (142)  The Netherlands 2 VIIb

 Filling-in for record : (41)    Ireland          1 VIIj
Mean Weighted by Sampled Catches of:
  >>  (37)  Ireland              1 VIIc
  >>  (69)  Faroe Islands        1 VIIc

  Filling-in for record : (42)   Ireland          2 VIIj
Using Only
  >>  (174)  Norway              2 VIb

 Filling-in for record : (78)    Germany          2 IIa
Mean Weighted by Sampled Catches of:

  >>  (46)  Faroe Islands        2 IIa
  >>  (110)  Iceland             2 IIa
  >>  (122)  The Netherlands 2 IIa
  >>  (182)  Russia              2 IIa

  Filling-in for record : (79)  Germany           3 IIa
Mean Weighted by Sampled Catches of:
  >>  (47)  Faroe Islands        3 IIa
  >>  (111)  Iceland             3 IIa
  >>  (155)  Norway              3 IIa
  >>  (183)  Russia              3 IIa

  Filling-in for record : (80)   Germany          4 IIa
Mean Weighted by Sampled Catches of:
  >>  (48)  Faroe Islands        4 IIa
  >>  (112)  Iceland             4 IIa
  >>  (184)  Russia              4 IIa

  Filling-in for record : (82)   Germany          2 IVa
Using Only
  >>  (162)  Norway              2 IVa

  Filling-in for record : (85)   Germany          1 VIa
Using Only
  >>  (61)  Faroe Islands        1 VIa

  Filling-in for record : (86)   Germany          2 VIa
Mean Weighted by Sampled Catches of:
  >>  (62)  Faroe Islands        2 VIa
  >>  (134)  The Netherlands 2 VIa
  >>  (170)  Norway              2 VIa

  Filling-in for record : (89)   Germany          1 VIb
Mean Weighted by Sampled Catches of:
  >>  (65)  Faroe Islands        1 VIb
  >>  (137)  The Netherlands 1 VIb
  >>  (173)  Norway              1 VIb

  Filling-in for record : (93)   Germany          1 VIIb
Mean Weighted by Sampled Catches of:
  >>  (37)  Ireland              1 VIIc
  >>  (69)  Faroe Islands        1 VIIc
```

Table 6.3.2.5. (con't)

Filling-in for record : (97) Germany 1 VIIc
Mean Weighted by Sampled Catches of:
>> (37) Ireland 1 VIIc
>> (69) Faroe Islands 1 VIIc

Filling-in for record : (104) Germany 4 VIIh
Mean Weighted by Sampled Catches of:
>> (184) Russia 4 IIa
>> (188) Russia 4 IIb
>> (56) Faroe Islands 4 Va
>> (60) Faroe Islands 4 Vb

Filling-in for record : (105) Germany 1 VIIj
Mean Weighted by Sampled Catches of:
>> (37) Ireland 1 VIIc
>> (69) Faroe Islands 1 VIIc

Filling-in for record : (106) Germany 2 VIIj
Using Only
>> (174) Norway 2 VIb

Filling-in for record : (117) Iceland 1 Vb
Using Only
>> (61) Faroe Islands 1 VIa

Filling-in for record : (133) Netherlands 1 VIa
Using Only
>> (61) Faroe Islands 1 VIa

Filling-in for record : (141) Netherlands 1 VIIb
Mean Weighted by Sampled Catches of:
>> (37) Ireland 1 VIIc
>> (69) Faroe Islands 1 VIIc

Filling-in for record : (146) Netherlands 2 VIIc
Using Only
>> (174) Norway 2 VIb

Filling-in for record : (149) Netherlands 1 VIIj
Mean Weighted by Sampled Catches of:
>> (37) Ireland 1 VIIc
>> (69) Faroe Islands 1 VIIc

Filling-in for record : (150) Netherlands 2 VIIj
Using Only
>> (174) Norway 2 VIb

Filling-in for record : (158) Norway 2 IIIa
Mean Weighted by Sampled Catches of:
>> (46) Faroe Islands 2 IIa
>> (110) Iceland 2 IIa
>> (122) The Netherlands 2 IIa
>> (182) Russia 2 IIa

Filling-in for record : (169) Norway 1 VIa
Using Only
>> (61) Faroe Islands 1 VIa

Table 6.3.2.5. (con't)

Filling-in for record : (179) Russia 3 I
Using Only
>> (180) Russia 4 I

Filling-in for record : (181) Russia 1 IIa
Using Only
>> (49) Faroe Islands 1 IVa

Filling-in for record : (187) Russia 3 IIb
Using Only
>> (188) Russia 4 IIb

Filling-in for record : (189) Russia 1 IVa
Using Only
>> (49) Faroe Islands 1 IVa

Filling-in for record : (191) Russia 3 IVa
Mean Weighted by Sampled Catches of:
>> (47) Faroe Islands 3 IIa
>> (111) Iceland 3 IIa
>> (155) Norway 3 IIa
>> (183) Russia 3 IIa

Filling-in for record : (193) Russia 1 Vb
Using Only
>> (61) Faroe Islands 1 VIa

Filling-in for record : (197) Russia 1 VIb
Mean Weighted by Sampled Catches of:
>> (65) Faroe Islands 1 VIb
>> (137) The Netherlands 1 VIb
>> (173) Norway 1 VIb

Filling-in for record : (198) Russia 2 VIb
Using Only
>> (174) Norway 2 VIb

Filling-in for record : (199) Russia 3 VIb
Mean Weighted by Sampled Catches of:
>> (55) Faroe Islands 3 Va
>> (115) Iceland 3 Va
>> (59) Faroe Islands 3 Vb
>> (119) Iceland 3 Vb
>> (195) Russia 3 Vb

Filling-in for record : (201) Russia 1 VIIgk+XII
Using Only
>> (73) Faroe Islands 1 VIIgk+XII

Filling-in for record : (205) Scotland 1 VIa
Using Only
>> (61) Faroe Islands 1 VIa
Filling-in for record : (206) Scotland 2 VIa
Mean Weighted by Sampled Catches of:
>> (62) Faroe Islands 2 VIa
>> (134) The Netherlands 2 VIa
>> (170) Norway 2 VIa

Table 6.3.2.5. (con't)

Filling-in for record : (207) Scotland 3 VIa
Mean Weighted by Sampled Catches of:
>> (55) Faroe Islands 3 Va
>> (115) Iceland 3 Va
>> (59) Faroe Islands 3 Vb
>> (119) Iceland 3 Vb
>> (195) Russia 3 Vb

Filling-in for record : (209) Scotland 1 VIb
Mean Weighted by Sampled Catches of:
>> (65) Faroe Islands 1 VIb
>> (137) The Netherlands 1 VIb
>> (173) Norway 1 VIb

Filling-in for record : (213) Scotland 1 VIIb
Mean Weighted by Sampled Catches of:
>> (37) Ireland 1 VIIc
>> (69) Faroe Islands 1 VIIc

Filling-in for record : (217) Scotland 1 VIIc
Mean Weighted by Sampled Catches of:
>> (37) Ireland 1 VIIc
>> (69) Faroe Islands 1 VIIc
Filling-in for record : (221) Scotland 1 VIIj
Mean Weighted by Sampled Catches of:
>> (37) Ireland 1 VIIc
>> (69) Faroe Islands 1 VIIc

Filling-in for record : (222) France 1 VbVIVII
Mean Weighted by Sampled Catches of:
>> (37) Ireland 1 VIIc
>> (69) Faroe Islands 1 VIIc

Filling-in for record : (223) France 2 VbVIVII
Using Only
>> (174) Norway 2 VIb

Filling-in for record : (225) France 4 VbVIVII
Mean Weighted by Sampled Catches of:
>> (184) Russia 4 IIa
>> (188) Russia 4 IIb
>> (56) Faroe Islands 4 Va
>> (60) Faroe Islands 4 Vb

Table 6.3.3.1 Blue Whiting. Mean weights at age for the total catch in 1981-2001

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
0	0.018	0.020	0.026	0.016	0.030	0.023	0.031	0.014	0.034	0.036
1	0.045	0.046	0.035	0.038	0.040	0.048	0.053	0.059	0.045	0.055
2	0.072	0.074	0.078	0.074	0.073	0.086	0.076	0.079	0.070	0.091
3	0.111	0.118	0.089	0.097	0.108	0.106	0.097	0.103	0.106	0.107
4	0.143	0.140	0.132	0.114	0.130	0.124	0.128	0.126	0.123	0.136
5	0.156	0.153	0.153	0.157	0.165	0.147	0.142	0.148	0.147	0.174
6	0.177	0.176	0.161	0.177	0.199	0.177	0.157	0.158	0.168	0.190
7	0.195	0.195	0.175	0.199	0.209	0.208	0.179	0.171	0.175	0.206
8	0.200	0.200	0.189	0.208	0.243	0.221	0.199	0.203	0.214	0.230
9	0.204	0.204	0.186	0.218	0.246	0.222	0.222	0.224	0.217	0.232
10+	0.231	0.228	0.206	0.237	0.257	0.254	0.260	0.253	0.256	0.266

Age	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
0	0.024	0.028	0.033	0.022	0.018	0.031	0.033	0.035	0.031	0.038
1	0.057	0.066	0.061	0.064	0.041	0.047	0.048	0.063	0.057	0.050
2	0.083	0.082	0.087	0.091	0.080	0.072	0.072	0.078	0.075	0.078
3	0.119	0.109	0.108	0.118	0.102	0.102	0.094	0.088	0.086	0.094
4	0.140	0.137	0.137	0.143	0.116	0.121	0.125	0.109	0.104	0.108
5	0.167	0.163	0.164	0.154	0.147	0.140	0.149	0.142	0.133	0.129
6	0.193	0.177	0.189	0.167	0.170	0.166	0.178	0.170	0.156	0.163
7	0.226	0.200	0.207	0.203	0.214	0.177	0.183	0.199	0.179	0.186
8	0.235	0.217	0.217	0.206	0.230	0.183	0.188	0.193	0.187	0.193
9	0.284	0.225	0.247	0.236	0.238	0.203	0.221	0.192	0.232	0.231
10+	0.294	0.281	0.254	0.256	0.279	0.232	0.248	0.245	0.241	0.243

Table 6.4.1.1. BLUE WHITING Biomass estimate (million tonnes) in the spawning area.

Year	Russia total	Russia spawning	Norway total	Norway spawning	Faroes total	Faroes spawning
1983	3.6	3.6	4.7	4.4		
1984	3.4	2.7	2.8	2.1	2.4	2.2
1985	2.8	2.7			6.4	1.7
1986	6.4	5.6	2.6	2.0		
1987	5.4	5.1	4.3	4.1		
1988	3.7	3.1	7.1	6.8		
1989	6.3	5.7	7.0	6.1		
1990	5.4	5.1	6.3	5.7		
1991	4.6	4.2	5.1	4.8		
1992	3.6	3.3	4.3	4.2		
1993	3.8	3.7	5.2	5.0		
1994			4.1	4.1		
1995	6.8	6.0	6.7	6.1		
1996	7.1	5.8	5.1	4.5		
1997						
1998			5.5	4.7		
1999			8.9	8.5		
2000			8.3	7.8		
2001			6.7	5.6		
2002	5.2		12.2	10.9		
Mean	4.9	4.4	5.9	5.4	4.4	2.0

Table 6.4.1.2. Age stratified estimates of blue whiting in the spawning area west of The British Isles, R.V."J.Hjort" March/April 2002. Numbers in millions, weight in thousand t, mean length in cm, mean weight in grams.

Age	1	2	3	4	5	6	7	8	9+	Total
Numbers	20455	71996	54740	12757	5266	8404	1450	305	15120	175634
Percentage	12	41	31	7	3	5	1	0	9	100
Mean length	19.7	22.8	25.7	27.4	28.9	29.1	30.1	32.4	33.6	24.2
Mean weight	37	55.7	78.3	96.1	114.7	117.4	131.4	180.3	191.4	69.3
Weight	757	4010	4286	1226	604	987	191	55	2894	12170

Table 6.4.1.3 Age stratified estimates of blue whiting in the Icelandic EEZ in July 2001
Numbers in millions, weight in thousand t, length in cm, mean weight in grams.

Age	0	1	2	3	4	5	6	7	8	9	Total
Numbers	27305	4090	5215	1657	1614	398	132	37	6	2	40456
Mean length	15.1	22.4	25.3	26.4	28.1	29.9	31.8	32.6	33.0	37.0	18.3
Mean weight	24	72	109	127	143	165	190	218	194	234	50.8
Percentage	65.5	10.1	12.9	4.1	4.0	1.0	0.3	0.1	0.0	0.0	100
Weight	661	294	568	211	231	66	25	8	1	0	2063

Table 6.4.1.4 Age stratified estimates of blue whiting in the Norwegian Sea, R.V. G.O. Sars, July 2001.
Numbers in millions, weight in thousand t, length in cm, mean weight in grams.

Age	0	1	2	3	4	5	6	7	8	9	Total
Numbers	641	61470	22051	7883	3225	1824	156	12	0	68	97330
Mean length	16.32	20.18	24.00	25.55	27.14	28.28	29.47	31.17	0.0	38.49	21.9
Mean weight	25	47	78	91	106	119	124	147	0	345	61.8
Percentage	0.7	63.2	22.7	8.1	3.3	1.9	0.2	0.0	0.0	0.1	100.0
Weight	16	2866	1715	713	342	216	19	2	0	23	5913

Table 6.4.2.1 Stratified mean catch (Kg/haul and Number/haul) and standard error of BLUE WHITING in bottom trawl surveys in Spanish waters (Divisions VIIIc and IXa north). All surveys in September-October.

Kg/haul	30-100 m		101-200 m		201-500 m		TOTAL 30-500 m	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1985	9.50	5.87	119.75	45.99	68.18	13.79	92.83	28.24
1986	9.74	7.13	45.41	12.37	29.54	8.70	36.93	7.95
1987	-	-	-	-	-	-	-	-
1988	2.90	2.59	154.12	38.69	183.07	141.94	143.30	45.84
1989	14.17	12.03	76.92	17.08	18.79	6.23	59.00	11.68
1990	6.25	3.29	52.54	9.00	18.80	4.99	43.60	6.60
1991	64.59	34.65	126.41	26.06	46.07	18.99	97.10	17.16
1992	6.37	2.59	44.12	6.64	29.50	6.16	34.60	4.23
1993	1.06	0.63	14.07	3.73	51.08	22.02	22.59	6.44
1994	8.04	5.28	37.18	8.45	25.42	5.27	29.70	5.19
1995	19.97	13.87	36.43	4.82	15.97	4.10	28.52	3.66
1996	7.27	3.95	49.23	7.19	92.54	17.76	54.52	6.36

	70-120 m		121-200 m		201-500 m		TOTAL 70-500 m	
1997	17.87	7.35	44.68	10.52	57.14	16.60	42.62	7.29
1998	14.13	4.17	42.78	8.13	78.88	22.01	47.14	7.58
1999	92.66	14.60	111.76	19.87	169.21	50.26	124.27	17.83
2000	62.39	12.00	91.99	14.75	58.72	24.94	76.19	10.61
2001	8.35	3.31	50.18	10.09	52.41	16.71	42.02	7.02

Number/haul	30-100 m		101-200 m		201-500 m		TOTAL 30-500 m	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1985	267	181.71	3669	1578.86	1377	262.98	2644	963.20
1986	368	237.56	2486	1006.67	752	238.87	1763	616.40
1987	-	-	-	-	-	-	-	-
1988	83	71.74	6112	1847.36	7276	6339.88	5694	2086.00
1989	629	537.29	3197	876.75	566	213.11	2412	599.00
1990	220	115.48	2219	426.46	578	185.43	1722	276.00
1991	2922	1645.73	5563	1184.69	1789	847.33	4214	780.88
1992	124	50.81	1412	233.99	845	199.12	1069	146.87
1993	14	8.61	257	69.61	894	427.77	401	124.53
1994	346	234.12	2002	456.50	997	245.91	1487	689.00
1995	1291	864.97	2004	341.48	485	137.81	1493	240.37
1996	147	82.71	1167	167.20	2097	385.23	1263	142.30

	70-120 m		121-200 m		201-500 m		TOTAL 70-500 m	
1997	552	235.60	1443	361.89	1183	323.14	1180	209.94
1998	351	105.96	1463	320.26	2012	590.04	1387	234.82
1999	2502	427.23	4358	847.87	6119	2026.39	4474	727.32
2000	2267	414.97	3930	604.11	2009	859.71	3027	400.87
2001	171	77.34	1310	263.84	1232	381.49	1048	172.74

Table 6.4.2.2 BLUE WHITING. Stratified mean catch (Kg/haul) and standard error of in bottom trawl surveys in Portuguese waters (Division IXa).

		20-100 m		100-200 m		200-500 m		500-750 m		TOTAL: 20-500 m		TOTAL: 20-750 m	
Year	Month	y	sy	y	sy	y	sy	y	sy	y	sy	y	sy
1979	June	0	0	33	23	86	35	-	-	31	12	-	-
	Oct./Nov.	5	5	17	8	103	48	-	-	28	9	-	-
1980	March	0	0	178	173	5	1	-	-	72	69	-	-
	May/June	1	3	4	2	45	18	-	-	11	4	-	-
	October	4	3	10	4	587	306	-	-	117	58	-	-
1981	March	0	0	24	17	186	113	-	-	42	22	-	-
	June	0	0	4	2	178	25	-	-	34	4	-	-
1982	April/May	0	0	3	3	136	39	-	-	26	7	-	-
	September	1	1	85	42	271	123	-	-	86	29	-	-
1983	March	1	1	14	10	259	96	-	-	54	18	-	-
	June	0	0	23	8	177	47	-	-	42	9	-	-
1985	June	0	0	194	146	405	162	-	-	159	68	-	-
	October	4	3	133	84	341	39	-	-	120	35	-	-
1986	June	4	1	59	19	196	31	-	-	65	10	-	-
	October	2	1	357	144	650	111	-	-	276	63	-	-
1987	October	3	0	297	64	747	229	-	-	263	50	-	-
1988	October	4	2	165	47	457	106	-	-	155	28	-	-
1989	July	0	0	42	21	323	143	79	36	-	-	78	24
	October	7	4	70	26	306	84	24	2	-	-	79	16
1990	July	2	2	153	103	242	42	50	5	-	-	96	35
	October	11	5	90	28	762	234	42	10	-	-	153	35
1991	July	1	1	140	40	268	38	64	18	-	-	98	15
	October	8	5	83	18	259	53	121	27	-	-	91	11
1992	February	7	7	43	35	249	21	73	3			68	12
	July	1	1	29	18	216	43	27	5	-	-	47	9
	October	1	1	22	7	208	44	80	3	-	-	54	7
1993	February	0	0	19	14	105	31	36	0	-	-	42	10
	July	0	0	3	3	151	28	55	5	-	-	34	4
	November	0	0	90	0	189	43	6	1	-	-	86	9
1994	October	0	0	374	30	283	32	49	7	-	-	174	11
1995	July	0	0	18	14	130	20	52	3	-	-	35	5
	October	18	15	103	21	328	91	31	12	-	-	94	16
1996	October	25	24	12	2	36	6	25	7			22	8
1997	June	0	0	3	3	116	42	45	12	-	-	27	7
	October	2	1	54	20	77	13	7	2	-	-	32	8
1998	July	0	0	8	5	105	17	38	3	-	-	25	3
	October	1	1	384	87	427	101	20	2	-	-	212	36
1999	July	1		60		66		25		-	-	37	n/a
	October	0		70		78		18		-	-	41	n/a
2000	July	n/a		n/a		n/a		n/a		-	-	n/a	n/a
	October	n/a		n/a		n/a		n/a		-	-	n/a	n/a
2001	July	n/a		n/a		n/a		n/a		-	-	n/a	n/a
	October	n/a		n/a		n/a		n/a		-	-	n/a	n/a

Table 6.4.4.1 The ICA log

```
Enter the name of the index file -->combbw.ndx
.\data\CombbwCN.DAT
.\data\CombbwCW.DAT
 Stock weights in 2002 used for the year 2001
.\data\CombbwSW.DAT
 Natural mortality in 2002 used for the year 2001
.\data\CombbwNM.DAT
 Maturity ogive in 2002 used for the year 2001
.\data\CombbwMO.DAT
 Name of age-structured index file (Enter if none) : -->combbw.tun
 Name of the SSB index file (Enter if none) -->
No indices of spawning biomass to be used.
 No of years for separable constraint ?--> 4
 Reference age for separable constraint ?--> 5
 Constant selection pattern model (Y/N) ?-->y
 S to be fixed on last age ?-->    1.500000000000000
 First age for calculation of reference F ?--> 3
 Last age for calculation of reference F ?--> 7
 Use default weighting (Y/N) ?-->n
Enter relative weights-at-age
 Weight for age 0-->    0.100000000000000
 Weight for age 1-->    0.500000000000000
 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
 Weight for age 10-->    1.000000000000000
Enter relative weights by year
 Weight for year 1998-->    1.000000000000000
 Weight for year 1999-->    1.000000000000000
 Weight for year 2000-->    1.000000000000000
 Weight for year 2001-->    1.000000000000000
 Is the last age of Norway Spawning Area/Acoustic 1981-90 a plus-group (Y/N)-->n
 Is the last age of Norway Spawning Area/Acoustic 1991-2002 a plus-group (Y/-->n
 Is the last age of Russian Spawning Area/Acoustic 1982-91 a plus-group (Y/N-->n
 Is the last age of Russian Spawning Area/Acoustic 1992-1996 a plus-group (Y-->n
 Is the last age of CPUE Spanish Pair Trawlers a plus-group (Y/N) ?-->n
 Is the last age of Norwegian Sea acoustic - Blue Wh. 1981-9 a plus-group (Y-->n
 Is the last age of Norwegian Sea acoustic - Blue Wh. 1991++ a plus-group (Y-->n
 Model for Norway Spawning Area/Acoustic 1981-90 is to be A/L/P ?-->l
 Model for Norway Spawning Area/Acoustic 1991-2002 is to be A/L/P ?-->L
 Model for Russian Spawning Area/Acoustic 1982-91 is to be A/L/P ?-->L
 Model for Russian Spawning Area/Acoustic 1992-1996 is to be A/L/P ?-->L
 Model for CPUE Spanish Pair Trawlers is to be A/L/P ?-->L
 Model for Norwegian Sea acoustic - Blue Wh. 1981-9 is to be A/L/P ?-->L
 Model for Norwegian Sea acoustic - Blue Wh. 1991++ 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-->    1.500000000000000
Mapping the F-dimension of the SSQ surface
      F  SSQ
+--------+-------------------
    0.05  98.8798096450
    0.13  74.6637114976
    0.20  62.1800378936
    0.28  55.1971158100
```

Table 6.4.4.1 (continued)

```
   0.36  51.0669668497
   0.43  48.5153805483
   0.51  46.8922504108
   0.58  45.8469441609
   0.66  45.1802269083
   0.74  44.7733502752
   0.81  44.5524529617
   0.89  44.4698532447
   0.97  44.4938029246
   1.04  44.6056529037
   1.12  44.7935885707
   1.19  45.0405209983
   1.27  45.3393179482
   1.35  45.6854065908
   1.42  46.0763528290
   1.50  46.5117273685
Lowest SSQ is for F =     0.908
----------------------------------------------------------------
No of years for separable analysis : 4
Age range in the analysis : 0  . . . 10
Year range in the analysis : 1981  . . . 2001
Number of indices of SSB : 0
Number of age-structured indices : 7
Parameters to estimate : 71
Number of observations : 497
Conventional single selection vector model to be fitted.
----------------------------------------------------------------
 Survey weighting to be Manual (recommended) or Iterative (M/I) ?-->m
 Enter weight for Norway Spawning Area/Acoustic 1981-90  at age 2-->    1.000000000000000
 Enter weight for Norway Spawning Area/Acoustic 1981-90  at age 3-->    1.000000000000000
 Enter weight for Norway Spawning Area/Acoustic 1981-90  at age 4-->    1.000000000000000
 Enter weight for Norway Spawning Area/Acoustic 1981-90  at age 5-->    1.000000000000000
 Enter weight for Norway Spawning Area/Acoustic 1981-90  at age 6-->    1.000000000000000
 Enter weight for Norway Spawning Area/Acoustic 1981-90  at age 7-->    1.000000000000000
 Enter weight for Norway Spawning Area/Acoustic 1981-90  at age 8-->    1.000000000000000
 Enter weight for Norway Spawning Area/Acoustic 1991-2002  at age 2-->    1.000000000000000
 Enter weight for Norway Spawning Area/Acoustic 1991-2002  at age 3-->    1.000000000000000
 Enter weight for Norway Spawning Area/Acoustic 1991-2002  at age 4-->    1.000000000000000
 Enter weight for Norway Spawning Area/Acoustic 1991-2002  at age 5-->    1.000000000000000
 Enter weight for Norway Spawning Area/Acoustic 1991-2002  at age 6-->    1.000000000000000
 Enter weight for Norway Spawning Area/Acoustic 1991-2002  at age 7-->    1.000000000000000
 Enter weight for Norway Spawning Area/Acoustic 1991-2002  at age 8-->    1.000000000000000
 Enter weight for Russian Spawning Area/Acoustic 1982-91  at age 3-->    1.000000000000000
 Enter weight for Russian Spawning Area/Acoustic 1982-91  at age 4-->    1.000000000000000
 Enter weight for Russian Spawning Area/Acoustic 1982-91  at age 5-->    1.000000000000000
 Enter weight for Russian Spawning Area/Acoustic 1982-91  at age 6-->    1.000000000000000
 Enter weight for Russian Spawning Area/Acoustic 1982-91  at age 7-->    1.000000000000000
 Enter weight for Russian Spawning Area/Acoustic 1982-91  at age 8-->    1.000000000000000
 Enter weight for Russian Spawning Area/Acoustic 1992-1996  at age 3-->    1.000000000000000
 Enter weight for Russian Spawning Area/Acoustic 1992-1996  at age 4-->    1.000000000000000
 Enter weight for Russian Spawning Area/Acoustic 1992-1996  at age 5-->    1.000000000000000
 Enter weight for Russian Spawning Area/Acoustic 1992-1996  at age 6-->    1.000000000000000
 Enter weight for Russian Spawning Area/Acoustic 1992-1996  at age 7-->    1.000000000000000
 Enter weight for Russian Spawning Area/Acoustic 1992-1996  at age 8-->    1.000000000000000
 Enter weight for CPUE Spanish Pair Trawlers  at age 1-->   1.0000000000000000E-02
 Enter weight for CPUE Spanish Pair Trawlers  at age 2-->    1.000000000000000
 Enter weight for CPUE Spanish Pair Trawlers  at age 3-->    1.000000000000000
 Enter weight for CPUE Spanish Pair Trawlers  at age 4-->    1.000000000000000
 Enter weight for CPUE Spanish Pair Trawlers  at age 5-->    1.000000000000000
 Enter weight for CPUE Spanish Pair Trawlers  at age 6-->    1.000000000000000
 Enter weight for Norwegian Sea acoustic - Blue Wh. 1981-9  at age 1-->    1.000000000000000
```

Table 6.4.4.1 (continued)

Enter weight for Norwegian Sea acoustic - Blue Wh. 1981-9 at age 2--> 1.000000000000000
Enter weight for Norwegian Sea acoustic - Blue Wh. 1981-9 at age 3--> 1.000000000000000
Enter weight for Norwegian Sea acoustic - Blue Wh. 1981-9 at age 4--> 1.000000000000000
Enter weight for Norwegian Sea acoustic - Blue Wh. 1981-9 at age 5--> 1.000000000000000
Enter weight for Norwegian Sea acoustic - Blue Wh. 1981-9 at age 6--> 1.000000000000000
Enter weight for Norwegian Sea acoustic - Blue Wh. 1981-9 at age 7--> 1.000000000000000
Enter weight for Norwegian Sea acoustic - Blue Wh. 1991++ at age 1--> 1.000000000000000
Enter weight for Norwegian Sea acoustic - Blue Wh. 1991++ at age 2--> 1.000000000000000
Enter weight for Norwegian Sea acoustic - Blue Wh. 1991++ at age 3--> 1.000000000000000
Enter weight for Norwegian Sea acoustic - Blue Wh. 1991++ at age 4--> 1.000000000000000
Enter weight for Norwegian Sea acoustic - Blue Wh. 1991++ at age 5--> 1.000000000000000
Enter weight for Norwegian Sea acoustic - Blue Wh. 1991++ at age 6--> 1.000000000000000
Enter weight for Norwegian Sea acoustic - Blue Wh. 1991++ at age 7--> 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 Norway Spawning Area/Acoustic 1981-90--> 1.000000000000000
Enter value for Norway Spawning Area/Acoustic 1991-2002--> 1.000000000000000
Enter value for Russian Spawning Area/Acoustic 1982-91--> 1.000000000000000
Enter value for Russian Spawning Area/Acoustic 1992-1996--> 1.000000000000000
Enter value for CPUE Spanish Pair Trawlers--> 1.000000000000000
Enter value for Norwegian Sea acoustic - Blue Wh. 1981-9--> 1.000000000000000
Enter value for Norwegian Sea acoustic - Blue Wh. 1991++--> 1.000000000000000

Do you want to shrink the final fishing mortality (Y/N) ?-->N

Aged index weights

Norway Spawning Area/Acoustic 1981-90

Age :	2	3	4	5	6	7	8
Wts :	0.143	0.143	0.143	0.143	0.143	0.143	0.143

Norway Spawning Area/Acoustic 1991-2002

Age :	2	3	4	5	6	7	8
Wts :	0.143	0.143	0.143	0.143	0.143	0.143	0.143

Russian Spawning Area/Acoustic 1982-91

Age :	3	4	5	6	7	8
Wts :	0.167	0.167	0.167	0.167	0.167	0.167

Russian Spawning Area/Acoustic 1992-1996

Age :	3	4	5	6	7	8
Wts :	0.167	0.167	0.167	0.167	0.167	0.167

CPUE Spanish Pair Trawlers

Age :	1	2	3	4	5	6
Wts :	0.002	0.167	0.167	0.167	0.167	0.167

Norwegian Sea acoustic - Blue Wh. 1981-9

Age :	1	2	3	4	5	6	7
Wts :	0.143	0.143	0.143	0.143	0.143	0.143	0.143

Norwegian Sea acoustic - Blue Wh. 1991++

Age :	1	2	3	4	5	6	7
Wts :	0.143	0.143	0.143	0.143	0.143	0.143	0.143

F in 2001 at age 5 is 0.793101 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 6.4.4.2 Output Generated by ICA Version 1.4

Blue whiting combined stock, 2002 WG

Catch in Number

AGE	1981	1982	1983	1984	1985	1986	1987	1988
0	48.0	3512.0	437.0	584.0	1174.0	84.0	341.0	46.0
1	258.0	148.0	2283.0	2291.0	1305.0	650.0	838.0	425.0
2	348.0	274.0	567.0	2331.0	2044.0	816.0	578.0	721.0
3	681.0	326.0	270.0	455.0	1933.0	1862.0	728.0	614.0
4	334.0	548.0	286.0	260.0	303.0	1717.0	1897.0	683.0
5	548.0	264.0	299.0	285.0	188.0	393.0	726.0	1303.0
6	559.0	276.0	304.0	445.0	321.0	187.0	137.0	618.0
7	466.0	266.0	287.0	262.0	257.0	201.0	105.0	84.0
8	634.0	272.0	286.0	193.0	174.0	198.0	123.0	53.0
9	578.0	284.0	225.0	154.0	93.0	174.0	103.0	33.0
10	1460.0	673.0	334.0	255.0	259.0	398.0	195.0	50.0

x 10 ^ 6

Catch in Number

AGE	1989	1990	1991	1992	1993	1994	1995	1996
0	1949.0	83.0	161.1	19.0	197.7	42.0	3306.6	832.6
1	865.0	1611.0	266.7	407.7	263.2	307.0	296.1	1893.5
2	718.0	703.0	1024.5	653.8	305.2	107.9	353.9	534.2
3	1340.0	672.0	514.0	1641.7	621.1	368.0	421.6	632.4
4	791.0	753.0	301.6	569.1	1571.2	389.3	465.4	537.3
5	837.0	520.0	363.2	217.4	411.4	1221.9	616.0	323.3
6	708.0	577.0	258.0	154.0	191.2	281.1	800.2	497.5
7	139.0	299.0	159.2	109.6	107.0	174.3	253.8	663.1
8	50.0	78.0	49.4	79.7	64.8	90.4	159.8	232.4
9	25.0	27.0	5.1	32.0	38.1	79.0	59.7	98.4
10	38.0	95.0	9.6	11.7	17.5	30.6	41.8	82.5

x 10 ^ 6

Catch in Number

AGE	1997	1998	1999	2000	2001
0	211.7	43.0	139.0	129.1	161.9
1	2131.5	1656.9	788.2	1814.9	4363.7
2	1519.3	4181.2	1549.1	1192.7	4486.3
3	904.1	3541.2	5820.8	3465.7	2962.2
4	577.7	1044.9	3460.6	5014.9	3806.5
5	295.7	383.7	412.8	1550.1	2592.9
6	251.6	322.8	207.2	513.7	585.7
7	282.1	303.1	151.2	213.1	170.0
8	406.9	264.1	153.1	151.4	97.0
9	104.3	212.5	68.8	58.3	76.6
10	169.2	85.5	140.5	139.8	66.4

x 10 ^ 6

Table 6.4.4.2 (continued)

Predicted Catch in Number

AGE	1998	1999	2000	2001
0	37.9	89.7	226.8	161.9
1	1143.6	672.0	2536.3	5315.3
2	3339.1	1586.6	1472.7	4514.9
3	3269.4	5663.9	4089.7	2957.7
4	1420.8	2466.9	6355.3	3309.8
5	504.7	508.6	1352.4	2399.3
6	353.3	230.4	352.9	660.8
7	252.2	174.3	170.9	182.6
8	223.3	128.4	130.4	86.2
9	212.5	75.9	65.1	42.6

x 10 ^ 6

Weights-at-age in the catches (Kg)

AGE	1981	1982	1983	1984	1985	1986	1987	1988
0	0.03800	0.01800	0.02000	0.02600	0.01600	0.03000	0.02300	0.03100
1	0.05200	0.04500	0.04600	0.03500	0.03800	0.04000	0.04800	0.05300
2	0.06500	0.07200	0.07400	0.07800	0.07400	0.07300	0.08600	0.07600
3	0.10300	0.11100	0.11800	0.08900	0.09700	0.10800	0.10600	0.09700
4	0.12500	0.14300	0.14000	0.13200	0.11400	0.13000	0.12400	0.12800
5	0.14100	0.15600	0.15300	0.15300	0.15700	0.16500	0.14700	0.14200
6	0.15500	0.17700	0.17600	0.16100	0.17700	0.19900	0.17700	0.15700
7	0.17000	0.19500	0.19500	0.17500	0.19900	0.20900	0.20800	0.17900
8	0.17800	0.20000	0.20000	0.18900	0.20800	0.24300	0.22100	0.19900
9	0.18700	0.20400	0.20400	0.18600	0.21800	0.24600	0.22200	0.22200
10	0.21300	0.23100	0.22800	0.20600	0.23700	0.25700	0.25400	0.26000

Weights-at-age in the catches (Kg)

AGE	1989	1990	1991	1992	1993	1994	1995	1996
0	0.01400	0.03400	0.03600	0.02400	0.02800	0.03300	0.02200	0.01800
1	0.05900	0.04500	0.05500	0.05700	0.06600	0.06100	0.06400	0.04100
2	0.07900	0.07000	0.09100	0.08300	0.08200	0.08700	0.09100	0.08000
3	0.10300	0.10600	0.10700	0.11900	0.10900	0.10800	0.11800	0.10200
4	0.12600	0.12300	0.13600	0.14000	0.13700	0.13700	0.14300	0.11600
5	0.14800	0.14700	0.17400	0.16700	0.16300	0.16400	0.15400	0.14700
6	0.15800	0.16800	0.19000	0.19300	0.17700	0.18900	0.16700	0.17000
7	0.17100	0.17500	0.20600	0.22600	0.20000	0.20700	0.20300	0.21400
8	0.20300	0.21400	0.23000	0.23500	0.21700	0.21700	0.20600	0.23000
9	0.22400	0.21700	0.23200	0.28400	0.22500	0.24700	0.23600	0.23800
10	0.25300	0.25600	0.26600	0.29400	0.28100	0.25400	0.25600	0.27900

Weights-at-age in the catches (Kg)

AGE	1997	1998	1999	2000	2001
0	0.03100	0.03300	0.03500	0.03100	0.03800
1	0.04700	0.04800	0.06300	0.05700	0.05000
2	0.07200	0.07200	0.07800	0.07500	0.07800
3	0.10200	0.09400	0.08800	0.08600	0.09400
4	0.12100	0.12500	0.10900	0.10400	0.10800
5	0.14000	0.14900	0.14200	0.13300	0.12900
6	0.16600	0.17800	0.17000	0.15600	0.16300
7	0.17700	0.18300	0.19900	0.17900	0.18600
8	0.18300	0.18800	0.19300	0.18700	0.19300
9	0.20300	0.22100	0.19200	0.23200	0.23000
10	0.23200	0.24800	0.24500	0.24100	0.24300

Table 6.4.4.2 (continued)

Weights-at-age in the stock (Kg)

AGE	1981	1982	1983	1984	1985	1986	1987	1988
0	0.03800	0.01800	0.02000	0.02600	0.01600	0.03000	0.02300	0.03100
1	0.05200	0.04500	0.04600	0.03500	0.03800	0.04000	0.04800	0.05300
2	0.06500	0.07200	0.07400	0.07800	0.07400	0.07300	0.08600	0.07600
3	0.10300	0.11100	0.11800	0.08900	0.09700	0.10800	0.10600	0.09700
4	0.12500	0.14300	0.14000	0.13200	0.11400	0.13000	0.12400	0.12800
5	0.14100	0.15600	0.15300	0.15300	0.15700	0.16500	0.14700	0.14200
6	0.15500	0.17700	0.17600	0.16100	0.17700	0.19900	0.17700	0.15700
7	0.17000	0.19500	0.19500	0.17500	0.19900	0.20900	0.20800	0.17900
8	0.17800	0.20000	0.20000	0.18900	0.20800	0.24300	0.22100	0.19900
9	0.18700	0.20400	0.20400	0.18600	0.21800	0.24600	0.22200	0.22200
10	0.21300	0.23100	0.22800	0.20600	0.23700	0.25700	0.25400	0.26000

Weights-at-age in the stock (Kg)

AGE	1989	1990	1991	1992	1993	1994	1995	1996
0	0.01400	0.03400	0.03600	0.02400	0.02800	0.03300	0.02200	0.01800
1	0.05900	0.04500	0.05500	0.05700	0.06600	0.06100	0.06400	0.04100
2	0.07900	0.07000	0.09100	0.08300	0.08200	0.08700	0.09100	0.08000
3	0.10300	0.10600	0.10700	0.11900	0.10900	0.10800	0.11800	0.10200
4	0.12600	0.12300	0.13600	0.14000	0.13700	0.13700	0.14300	0.11600
5	0.14800	0.14700	0.17400	0.16700	0.16300	0.16400	0.15400	0.14700
6	0.15800	0.16800	0.19000	0.19300	0.17700	0.18900	0.16700	0.17000
7	0.17100	0.17500	0.20600	0.22600	0.20000	0.20700	0.20300	0.21400
8	0.20300	0.21400	0.23000	0.23500	0.21700	0.21700	0.20600	0.23000
9	0.22400	0.21700	0.23200	0.28400	0.22500	0.24700	0.23600	0.23800
10	0.25300	0.25600	0.26600	0.29400	0.28100	0.25400	0.25600	0.27900

Weights-at-age in the stock (Kg)

AGE	1997	1998	1999	2000	2001
0	0.03100	0.03300	0.03500	0.03100	0.03800
1	0.04700	0.04800	0.06300	0.05700	0.05000
2	0.07200	0.07200	0.07800	0.07500	0.07800
3	0.10200	0.09400	0.08800	0.08600	0.09400
4	0.12100	0.12500	0.10900	0.10400	0.10800
5	0.14000	0.14900	0.14200	0.13300	0.12900
6	0.16600	0.17800	0.17000	0.15600	0.16300
7	0.17700	0.18300	0.19900	0.17900	0.18600
8	0.18300	0.18800	0.19300	0.18700	0.19300
9	0.20300	0.22100	0.19200	0.23200	0.23000
10	0.23200	0.24800	0.24500	0.24100	0.24300

Natural Mortality (per year)

AGE	1981	1982	1983	1984	1985	1986	1987	1988
0	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000
1	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000
2	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
4	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
6	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
8	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000
9	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000
10	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000

Table 6.4.4.2 (continued)

Natural Mortality (per year)

AGE	1989	1990	1991	1992	1993	1994	1995	1996
0	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000
1	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000
2	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
4	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
6	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
8	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000
9	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000
10	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000	0.20000

Natural Mortality (per year)

AGE	1997	1998	1999	2000	2001
0	0.20000	0.20000	0.20000	0.20000	0.20000
1	0.20000	0.20000	0.20000	0.20000	0.20000
2	0.20000	0.20000	0.20000	0.20000	0.20000
3	0.20000	0.20000	0.20000	0.20000	0.20000
4	0.20000	0.20000	0.20000	0.20000	0.20000
5	0.20000	0.20000	0.20000	0.20000	0.20000
6	0.20000	0.20000	0.20000	0.20000	0.20000
7	0.20000	0.20000	0.20000	0.20000	0.20000
8	0.20000	0.20000	0.20000	0.20000	0.20000
9	0.20000	0.20000	0.20000	0.20000	0.20000
10	0.20000	0.20000	0.20000	0.20000	0.20000

Proportion of fish spawning

AGE	1981	1982	1983	1984	1985	1986	1987	1988
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.1100	0.1100	0.1100	0.1100	0.1100	0.1100	0.1100	0.1100
2	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000
3	0.8200	0.8200	0.8200	0.8200	0.8200	0.8200	0.8200	0.8200
4	0.8600	0.8600	0.8600	0.8600	0.8600	0.8600	0.8600	0.8600
5	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100
6	0.9400	0.9400	0.9400	0.9400	0.9400	0.9400	0.9400	0.9400
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
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Proportion of fish spawning

AGE	1989	1990	1991	1992	1993	1994	1995	1996
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.1100	0.1100	0.1100	0.1100	0.1100	0.1100	0.1100	0.1100
2	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000	0.4000
3	0.8200	0.8200	0.8200	0.8200	0.8200	0.8200	0.8200	0.8200
4	0.8600	0.8600	0.8600	0.8600	0.8600	0.8600	0.8600	0.8600
5	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100	0.9100
6	0.9400	0.9400	0.9400	0.9400	0.9400	0.9400	0.9400	0.9400
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
10	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000

Table 6.4.4.2 (continued)

Proportion of fish spawning

AGE	1997	1998	1999	2000	2001
0	0.0000	0.0000	0.0000	0.0000	0.0000
1	0.1100	0.1100	0.1100	0.1100	0.1100
2	0.4000	0.4000	0.4000	0.4000	0.4000
3	0.8200	0.8200	0.8200	0.8200	0.8200
4	0.8600	0.8600	0.8600	0.8600	0.8600
5	0.9100	0.9100	0.9100	0.9100	0.9100
6	0.9400	0.9400	0.9400	0.9400	0.9400
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
10	1.0000	1.0000	1.0000	1.0000	1.0000

AGE-STRUCTURED INDICES

Norway Spawning Area/Acoustic 1981-90

AGE	1981	1982	1983	1984	1985	1986	1987	1988
2	2372.	999990.	297.	15767.	999990.	1003.	4960.	9712.
3	7583.	999990.	2108.	1721.	999990.	5829.	8417.	9090.
4	3253.	999990.	2723.	1616.	999990.	4122.	22589.	12367.
5	3647.	999990.	6511.	1719.	999990.	624.	4735.	20392.
6	4611.	999990.	3735.	1858.	999990.	228.	282.	7355.
7	4638.	999990.	3650.	1128.	999990.	203.	417.	723.
8	3654.	999990.	3153.	567.	999990.	250.	385.	599.

Norway Spawning Area/Acoustic 1981-90

AGE	1989	1990
2	6787.	14169.
3	22270.	12670.
4	9973.	11228.
5	10504.	5587.
6	7803.	6556.
7	933.	3273.
8	293.	516.

Norway Spawning Area/Acoustic 1991-2002

AGE	1991	1992	1993	1994	1995	1996	1997	1998
2	11147.	1232.	4489.	1603.	8538.	8781.	999990.	18218.
3	6340.	26123.	3321.	2950.	9874.	7433.	999990.	34991.
4	8497.	4719.	26771.	4476.	7906.	8371.	999990.	4697.
5	7407.	1574.	2643.	11354.	6861.	2399.	999990.	1674.
6	4558.	1386.	1270.	1742.	9467.	4455.	999990.	279.
7	2019.	810.	557.	1687.	1795.	4111.	999990.	407.
8	545.	616.	426.	908.	1083.	1202.	999990.	381.

Norway Spawning Area/Acoustic 1991-2002

AGE	1999	2000	2001	2002
2	19034.	8613.	44162.	71996.
3	60309.	31011.	12843.	54740.
4	26103.	41382.	13805.	12757.
5	1481.	6843.	8292.	5266.
6	316.	898.	718.	8404.
7	72.	427.	175.	1450.
8	153.	228.	51.	305.

Table 6.4.4.2 (continued)

Russian Spawning Area/Acoustic 1982-91

AGE	1982	1983	1984	1985	1986	1987	1988	1989
3	540.	2330.	2900.	13220.	18750.	4480.	3710.	11910.
4	2750.	2930.	800.	930.	23180.	19170.	4550.	7120.
5	1340.	9390.	1100.	580.	2540.	5860.	8610.	6670.
6	1380.	3880.	4200.	1780.	610.	1070.	4130.	6970.
7	1570.	1970.	2200.	860.	620.	500.	1270.	4580.
8	2350.	1370.	1200.	610.	750.	810.	480.	2750.

Russian Spawning Area/Acoustic 1982-91

AGE	1990	1991
3	9740.	10300.
4	12140.	5350.
5	5740.	5130.
6	2580.	2630.
7	1470.	1770.
8	220.	870.

Russian Spawning Area/Acoustic 1992-1996

AGE	1992	1993	1994	1995	1996
3	20010.	4728.	999990.	12657.	15285.
4	6700.	12337.	999990.	10028.	10629.
5	1350.	5304.	999990.	8942.	4897.
6	440.	2249.	999990.	2651.	6940.
7	390.	1316.	999990.	1093.	1482.
8	170.	621.	999990.	408.	653.

CPUE Spanish Pair Trawlers

AGE	1983	1984	1985	1986	1987	1988	1989	1990
1	7196.	13710.	14573.	3721.	25328.	7778.	15272.	21444.
2	16392.	27286.	23823.	14131.	13153.	21473.	18486.	19407.
3	9311.	14845.	14126.	14745.	6664.	18436.	17160.	5194.
4	7476.	4836.	6256.	7113.	2938.	6391.	8374.	1803.
5	6326.	1755.	1232.	1278.	1029.	1300.	3760.	1357.
6	1718.	1750.	217.	505.	166.	781.	1003.	451.

CPUE Spanish Pair Trawlers

AGE	1991	1992	1993	1994	1995	1996	1997	1998
1	15924.	10007.	4036.	543.	9090.	3905.	8742.	5884.
2	15370.	24235.	13991.	6066.	14409.	14557.	15875.	13236.
3	4989.	9671.	22493.	15917.	6833.	14449.	11134.	9803.
4	2329.	4316.	7979.	7474.	4551.	3931.	3698.	10844.
5	1045.	1194.	1354.	2990.	1990.	3639.	1046.	5229.
6	440.	462.	658.	1055.	623.	1834.	450.	1153.

CPUE Spanish Pair Trawlers

AGE	1999	2000	2001
1	2048.	6207.	16223.
2	10268.	15518.	16488.
3	20242.	13987.	6830.
4	9833.	5375.	1620.
5	6287.	1264.	1148.
6	3047.	1414.	162.

Table 6.4.4.2 (continued)

Norwegian Sea acoustic - Blue Wh. 1981-9

AGE	1981	1982	1983	1984	1985	1986	1987	1988
1	182.	184.	22356.	30380.	5969.	2324.	8204.	4992.
2	728.	460.	396.	13916.	23876.	2380.	4032.	2880.
3	4542.	1242.	468.	833.	12502.	7224.	5180.	2640.
4	3874.	4715.	756.	392.	658.	6944.	5572.	3480.
5	2678.	3611.	1404.	539.	423.	1876.	1204.	912.
6	2834.	3128.	576.	539.	188.	952.	224.	120.
7	2964.	2323.	468.	343.	235.	336.	168.	96.

Norwegian Sea acoustic - Blue Wh. 1981-9

AGE	1989	1990
1	1172.	999990.
2	1125.	999990.
3	812.	999990.
4	379.	999990.
5	410.	999990.
6	212.	999990.
7	22.	999990.

Norwegian Sea acoustic - Blue Wh. 1991++

AGE	1991	1992	1993	1994	1995	1996	1997	1998
1	999990.	792.	830.	999990.	6974.	23464.	30227.	24244.
2	999990.	1134.	125.	999990.	2811.	1057.	25638.	47815.
3	999990.	6939.	1070.	999990.	1999.	899.	1524.	16282.
4	999990.	766.	6392.	999990.	1209.	649.	779.	556.
5	999990.	247.	1222.	999990.	1622.	436.	300.	212.
6	999990.	172.	489.	999990.	775.	505.	407.	100.
7	999990.	90.	248.	999990.	173.	755.	260.	64.

Norwegian Sea acoustic - Blue Wh. 1991++

AGE	1999	2000	2001
1	14367.	25813.	61470.
2	9750.	3298.	22051.
3	23701.	2721.	7883.
4	9754.	3078.	3225.
5	1733.	23.	1824.
6	466.	46.	156.
7	79.	6.	12.

Fishing Mortality (per year)

AGE	1981	1982	1983	1984	1985	1986	1987	1988
0	0.0098	0.1731	0.0204	0.0491	0.1204	0.0087	0.0444	0.0046
1	0.0853	0.0377	0.1626	0.1411	0.1475	0.0905	0.1125	0.0716
2	0.1019	0.1226	0.1975	0.2483	0.1803	0.1295	0.1085	0.1337
3	0.1702	0.1309	0.1707	0.2406	0.3356	0.2480	0.1632	0.1609
4	0.1247	0.2012	0.1622	0.2466	0.2500	0.5638	0.4295	0.2268
5	0.3096	0.1372	0.1609	0.2409	0.2835	0.5932	0.4969	0.5957
6	0.3620	0.2528	0.2314	0.3801	0.4672	0.5056	0.4243	1.0873
7	0.3802	0.2928	0.4528	0.3197	0.3947	0.6060	0.5988	0.5030
8	0.4571	0.3999	0.5879	0.6331	0.3644	0.6047	0.9651	0.7024
9	0.5110	0.3820	0.6822	0.7444	0.7321	0.7626	0.7478	0.7641
10	0.5110	0.3820	0.6822	0.7444	0.7321	0.7626	0.7478	0.7641

Table 6.4.4.2 (continued)

Fishing Mortality (per year)

AGE	1989	1990	1991	1992	1993	1994	1995	1996
0	0.0814	0.0085	0.0240	0.0031	0.0289	0.0043	0.1315	0.0189
1	0.1112	0.0895	0.0340	0.0781	0.0541	0.0573	0.0381	0.1035
2	0.1660	0.1242	0.0756	0.1092	0.0772	0.0282	0.0866	0.0894
3	0.3906	0.2309	0.1256	0.1665	0.1436	0.1257	0.1466	0.2195
4	0.3202	0.3974	0.1539	0.1994	0.2377	0.1258	0.2313	0.2814
5	0.4771	0.3607	0.3393	0.1583	0.2166	0.2939	0.2989	0.2494
6	0.7740	0.7189	0.3058	0.2353	0.2035	0.2255	0.3190	0.4200
7	0.7826	0.9195	0.4402	0.2056	0.2548	0.2888	0.3263	0.4770
8	0.6428	1.6257	0.3671	0.4129	0.1801	0.3554	0.4683	0.5620
9	0.8800	0.8973	0.4000	0.4311	0.3553	0.3472	0.4209	0.5948
10	0.8800	0.8973	0.4000	0.4311	0.3553	0.3472	0.4209	0.5948

Fishing Mortality (per year)

AGE	1997	1998	1999	2000	2001
0	0.0091	0.0025	0.0022	0.0032	0.0039
1	0.0616	0.0625	0.0559	0.0805	0.0970
2	0.1131	0.1294	0.1156	0.1666	0.2007
3	0.2142	0.3757	0.3358	0.4838	0.5829
4	0.3194	0.6079	0.5433	0.7828	0.9431
5	0.2466	0.5113	0.4569	0.6583	0.7931
6	0.3133	0.5214	0.4659	0.6714	0.8088
7	0.4483	0.5948	0.5315	0.7659	0.9226
8	0.6108	0.7856	0.7020	1.0116	1.2187
9	0.5338	0.7669	0.6853	0.9875	1.1897
10	0.5338	0.7669	0.6853	0.9875	1.1897

Population Abundance (1 January)

AGE	1981	1982	1983	1984	1985	1986	1987	1988
0	5443.	24309.	23892.	13433.	11400.	10682.	8653.	11105.
1	3477.	4413.	16740.	19166.	10471.	8275.	8670.	6777.
2	3957.	2614.	3479.	11648.	13627.	7397.	6189.	6343.
3	4788.	2926.	1893.	2338.	7440.	9316.	5321.	4546.
4	3136.	3306.	2102.	1307.	1505.	4355.	5952.	3700.
5	2259.	2266.	2214.	1463.	836.	960.	2029.	3172.
6	2019.	1357.	1617.	1543.	942.	516.	434.	1011.
7	1616.	1151.	863.	1051.	864.	483.	255.	233.
8	1892.	904.	703.	449.	625.	477.	216.	115.
9	1580.	981.	496.	320.	195.	355.	213.	67.
10	3992.	2324.	737.	529.	544.	813.	404.	102.

x 10 ^ 6

Population Abundance (1 January)

AGE	1989	1990	1991	1992	1993	1994	1995	1996
0	27456.	10839.	7479.	6753.	7640.	10716.	29538.	48973.
1	9050.	20721.	8800.	5978.	5511.	6077.	8736.	21203.
2	5165.	6630.	15512.	6964.	4527.	4275.	4698.	6885.
3	4543.	3582.	4794.	11776.	5112.	3431.	3403.	3527.
4	3169.	2517.	2328.	3462.	8162.	3626.	2477.	2406.
5	2415.	1884.	1385.	1634.	2322.	5269.	2617.	1609.
6	1431.	1227.	1075.	808.	1142.	1531.	3215.	1589.
7	279.	540.	490.	648.	523.	763.	1000.	1914.
8	115.	104.	176.	258.	432.	332.	468.	591.
9	46.	50.	17.	100.	140.	296.	190.	240.
10	71.	174.	32.	37.	64.	115.	133.	201.

x 10 ^ 6

Table 6.4.4.2 (continued)

Population Abundance (1 January)

AGE	1997	1998	1999	2000	2001	2002
0	25643.	16697.	44240.	77641.	46013.	27616.
1	39344.	20804.	13636.	36139.	63363.	37526.
2	15652.	30289.	16001.	10558.	27300.	47083.
3	5155.	11445.	21789.	11670.	7317.	18287.
4	2319.	3407.	6435.	12751.	5890.	3345.
5	1487.	1379.	1519.	3060.	4772.	1878.
6	1027.	951.	677.	787.	1297.	1768.
7	855.	615.	462.	348.	329.	473.
8	972.	447.	278.	222.	132.	107.
9	276.	432.	167.	113.	66.	32.
10	447.	174.	309.	242.	103.	42.

x 10 ^ 6

Weighting factors for the catches in number

AGE	1998	1999	2000	2001
0	0.1000	0.1000	0.1000	0.1000
1	0.5000	0.5000	0.5000	0.5000
2	1.0000	1.0000	1.0000	1.0000
3	1.0000	1.0000	1.0000	1.0000
4	1.0000	1.0000	1.0000	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
9	1.0000	1.0000	1.0000	1.0000

Predicted Age-Structured Index Values

Norway Spawning Area/Acoustic 1981-90 Predicted

AGE	1981	1982	1983	1984	1985	1986	1987	1988
2	2604.	999990.	2244.	7433.	999990.	4839.	4067.	4146.
3	7779.	999990.	3076.	3743.	999990.	14892.	8658.	7401.
4	6592.	999990.	4384.	2678.	999990.	8349.	11738.	7615.
5	5229.	999990.	5286.	3436.	999990.	2093.	4515.	6913.
6	4432.	999990.	3650.	3375.	999990.	1098.	941.	1905.
7	3713.	999990.	1953.	2446.	999990.	1059.	559.	521.
8	4568.	999990.	1651.	1045.	999990.	1115.	468.	263.

Norway Spawning Area/Acoustic 1981-90 Predicted

AGE	1989	1990
2	3353.	4342.
3	7048.	5746.
4	6394.	4997.
5	5396.	4313.
6	2882.	2499.
7	589.	1109.
8	267.	197.

Table 6.4.4.2 (continued)

Norway Spawning Area/Acoustic 1991-2002 Predicted

AGE	1991	1992	1993	1994	1995	1996	1997	1998
2	13229.	5897.	3859.	3682.	3997.	5855.	999990.	25540.
3	9460.	23037.	10048.	6769.	6684.	6824.	999990.	21427.
4	6446.	9495.	22208.	10099.	6749.	6486.	999990.	8576.
5	2540.	3113.	4370.	9758.	4842.	3008.	999990.	2441.
6	1516.	1156.	1645.	2195.	4522.	2188.	999990.	1282.
7	612.	851.	679.	984.	1280.	2373.	999990.	744.
8	268.	388.	682.	504.	695.	860.	999990.	621.

Norway Spawning Area/Acoustic 1991-2002 Predicted

AGE	1999	2000	2001	2002
2	13531.	8833.	22678.	39112.
3	41136.	21358.	13116.	32779.
4	16421.	30940.	13818.	7847.
5	2718.	5250.	7958.	3131.
6	924.	1028.	1646.	2243.
7	567.	406.	372.	534.
8	392.	295.	168.	136.

Russian Spawning Area/Acoustic 1982-91 Predicted

AGE	1982	1983	1984	1985	1986	1987	1988	1989
3	3775.	2423.	2948.	9195.	11727.	6818.	5828.	5550.
4	5810.	3723.	2275.	2617.	7091.	9969.	6467.	5430.
5	4668.	4537.	2949.	1670.	1796.	3875.	5934.	4632.
6	3265.	3909.	3614.	2165.	1176.	1007.	2040.	3087.
7	3152.	2286.	2862.	2317.	1239.	654.	609.	689.
8	2977.	2224.	1408.	2072.	1503.	631.	354.	360.

Russian Spawning Area/Acoustic 1982-91 Predicted

AGE	1990	1991
3	4525.	6192.
4	4244.	4131.
5	3702.	2734.
6	2677.	2558.
7	1298.	1300.
8	266.	585.

Russian Spawning Area/Acoustic 1992-199 Predicted

AGE	1992	1993	1994	1995	1996
3	26427.	11527.	999990.	7668.	7828.
4	9383.	21946.	999990.	6670.	6410.
5	3491.	4901.	999990.	5430.	3373.
6	1146.	1632.	999990.	4484.	2170.
7	706.	563.	999990.	1062.	1968.
8	252.	443.	999990.	451.	559.

Table 6.4.4.2 (continued)

CPUE Spanish Pair Trawlers Predicted

AGE	1983	1984	1985	1986	1987	1988	1989	1990
1	9061.	10487.	5711.	4644.	4812.	3839.	5026.	11634.
2	6047.	19735.	23886.	13299.	11244.	11380.	9118.	11952.
3	4018.	4791.	14538.	19019.	11332.	9693.	8636.	7375.
4	3350.	1997.	2295.	5678.	8300.	5710.	4666.	3566.
5	2404.	1527.	854.	840.	1863.	2772.	2239.	1851.
6	1177.	1043.	609.	327.	287.	480.	794.	700.

CPUE Spanish Pair Trawlers Predicted

AGE	1991	1992	1993	1994	1995	1996	1997	1998
1	5080.	3376.	3150.	3467.	5032.	11821.	22401.	11839.
2	28651.	12648.	8354.	8085.	8630.	12630.	28374.	54460.
3	10405.	25039.	10995.	7446.	7307.	7304.	10703.	21919.
4	3725.	5415.	12526.	5884.	3814.	3612.	3416.	4345.
5	1376.	1777.	2453.	5354.	2653.	1672.	1547.	1257.
6	754.	587.	843.	1118.	2240.	1053.	717.	599.

CPUE Spanish Pair Trawlers Predicted

AGE	1999	2000	2001
1	7786.	20382.	35443.
2	28968.	18633.	47367.
3	42570.	21174.	12635.
4	8477.	14900.	6352.
5	1423.	2592.	3778.
6	438.	460.	707.

Norwegian Sea acoustic - Blue Wh. 1981- Predicted

AGE	1981	1982	1983	1984	1985	1986	1987	1988
1	1212.2	1588.6	5538.6	6434.4	3500.0	2874.6	2967.1	2384.2
2	1552.2	1011.2	1279.5	4139.0	5069.5	2847.8	2416.7	2435.0
3	2733.7	1715.7	1080.8	1273.1	3799.4	5047.3	3052.4	2611.9
4	2167.0	2170.1	1416.3	831.9	955.7	2237.6	3348.8	2387.1
5	1444.4	1627.4	1564.5	979.8	544.0	506.5	1142.9	1671.6
6	1061.8	768.6	929.2	801.8	461.3	246.2	218.9	325.8
7	895.2	676.4	455.3	606.5	474.0	229.9	121.7	118.6

Norwegian Sea acoustic - Blue Wh. 1981- Predicted

AGE	1989	1990
1	3100.1	*******
2	1940.0	*******
3	2235.4	*******
4	1919.2	*******
5	1378.7	*******
6	570.1	*******
7	117.8	*******

Table 6.4.4.2 (continued)

Norwegian Sea acoustic - Blue Wh. 1991+ Predicted

AGE	1991	1992	1993	1994	1995	1996	1997	1998
1	999990.	3620.	3392.	999990.	5435.	12621.	24092.	12731.
2	999990.	2665.	1770.	999990.	1825.	2670.	5974.	11433.
3	999990.	6486.	2860.	999990.	1900.	1875.	2750.	5474.
4	999990.	1643.	3776.	999990.	1151.	1081.	1015.	1227.
5	999990.	428.	585.	999990.	624.	397.	367.	285.
6	999990.	207.	300.	999990.	781.	360.	250.	201.
7	999990.	107.	84.	999990.	153.	264.	120.	78.

Norwegian Sea acoustic - Blue Wh. 1991+ Predicted

AGE	1999	2000	2001
1	8382.	21849.	37884.
2	6096.	3886.	9821.
3	10706.	5189.	3043.
4	2422.	4082.	1692.
5	325.	572.	815.
6	149.	151.	226.
7	61.	39.	34.

Fitted Selection Pattern

AGE	1981	1982	1983	1984	1985	1986	1987	1988
0	0.0316	1.2613	0.1267	0.2039	0.4245	0.0147	0.0894	0.0077
1	0.2755	0.2746	1.0105	0.5857	0.5203	0.1526	0.2265	0.1202
2	0.3291	0.8935	1.2274	1.0309	0.6359	0.2183	0.2184	0.2244
3	0.5498	0.9535	1.0606	0.9989	1.1835	0.4180	0.3284	0.2701
4	0.4030	1.4661	1.0080	1.0240	0.8818	0.9504	0.8643	0.3807
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.1694	1.8423	1.4381	1.5780	1.6478	0.8522	0.8539	1.8254
7	1.2281	2.1334	2.8142	1.3275	1.3919	1.0215	1.2050	0.8444
8	1.4767	2.9141	3.6540	2.6284	1.2852	1.0193	1.9423	1.1792
9	1.6508	2.7831	4.2401	3.0907	2.5818	1.2854	1.5050	1.2827
10	1.6508	2.7831	4.2401	3.0907	2.5818	1.2854	1.5050	1.2827

Fitted Selection Pattern

AGE	1989	1990	1991	1992	1993	1994	1995	1996
0	0.1707	0.0235	0.0708	0.0196	0.1336	0.0147	0.4400	0.0759
1	0.2331	0.2483	0.1002	0.4936	0.2496	0.1949	0.1274	0.4151
2	0.3480	0.3442	0.2227	0.6896	0.3563	0.0961	0.2899	0.3583
3	0.8187	0.6403	0.3702	1.0520	0.6627	0.4276	0.4905	0.8801
4	0.6711	1.1018	0.4534	1.2597	1.0972	0.4281	0.7737	1.1281
5	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.6224	1.9934	0.9012	1.4862	0.9395	0.7673	1.0672	1.6840
7	1.6404	2.5496	1.2975	1.2988	1.1764	0.9828	1.0918	1.9125
8	1.3473	4.5076	1.0819	2.6086	0.8316	1.2093	1.5666	2.2533
9	1.8446	2.4879	1.1789	2.7233	1.6403	1.1813	1.4082	2.3849
10	1.8446	2.4879	1.1789	2.7233	1.6403	1.1813	1.4082	2.3849

Table 6.4.4.2 (continued)

Fitted Selection Pattern

AGE	1997	1998	1999	2000	2001
0	0.0371	0.0049	0.0049	0.0049	0.0049
1	0.2497	0.1223	0.1223	0.1223	0.1223
2	0.4585	0.2531	0.2531	0.2531	0.2531
3	0.8687	0.7349	0.7349	0.7349	0.7349
4	1.2953	1.1891	1.1891	1.1891	1.1891
5	1.0000	1.0000	1.0000	1.0000	1.0000
6	1.2707	1.0198	1.0198	1.0198	1.0198
7	1.8182	1.1633	1.1633	1.1633	1.1633
8	2.4771	1.5366	1.5366	1.5366	1.5366
9	2.1650	1.5000	1.5000	1.5000	1.5000
10	2.1650	1.5000	1.5000	1.5000	1.5000

STOCK SUMMARY

Year	Recruits Age 0 thousands	Total Biomass tonnes	Spawning Biomass tonnes	Landings tonnes	Yield /SSB ratio	Mean F Ages 3- 7	SoP (%)
1981	5442920	3918763	2786762	909556	0.3264	0.2693	98
1982	24309470	3358019	2191665	576419	0.2630	0.2030	93
1983	23891580	3224553	1565010	570072	0.3643	0.2356	101
1984	13433200	3218896	1426162	641776	0.4500	0.2856	101
1985	11400140	3253266	1691693	695596	0.4112	0.3462	99
1986	10681890	3537773	1981859	826986	0.4173	0.5033	97
1987	8652910	3075041	1691114	664431	0.3929	0.4225	100
1988	11104620	2814979	1440515	553446	0.3842	0.5147	99
1989	27456210	2876458	1354865	625433	0.4616	0.5489	95
1990	10839360	3109647	1276178	561610	0.4401	0.5255	100
1991	7479390	3593411	1706849	369524	0.2165	0.2730	99
1992	6752720	3641897	2250989	474245	0.2107	0.1930	99
1993	7640250	3452678	2161122	480679	0.2224	0.2112	99
1994	10716240	3448826	2083489	459414	0.2205	0.2119	100
1995	29538030	3710758	1886935	578683	0.3067	0.2644	100
1996	48973350	4105879	1732812	644273	0.3718	0.3295	101
1997	25643340	5445118	1925356	646652	0.3359	0.3084	100
1998	16696820	5942080	2525639	1125151	0.4455	0.5222	99
1999	44239670	6858482	2890001	1256328	0.4347	0.4667	99
2000	77641440	8306539	2619994	1413145	0.5394	0.6725	99
2001	46013320	9324157	2653127	1781457	0.6715	0.8101	100

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-----------------------------------------------------------------
No of years for separable analysis : 4
Age range in the analysis : 0  . . . 10
Year range in the analysis : 1981  . . . 2001
Number of indices of SSB : 0
Number of age-structured indices : 7

Parameters to estimate : 71
Number of observations : 497

Conventional single selection vector model to be fitted.

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Table 6.4.4.2 (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	1998		0.5113	18	0.3589	0.7283	0.4268	0.6124	0.5197
2	1999		0.4569	17	0.3216	0.6492	0.3819	0.5466	0.4643
3	2000		0.6583	18	0.4619	0.9383	0.5495	0.7888	0.6692
4	2001		0.7931	22	0.5140	1.2237	0.6357	0.9895	0.8128
Separable Model: Selection (S) by age									
5	0		0.0049	62	0.0014	0.0167	0.0026	0.0092	0.0060
6	1		0.1223	30	0.0673	0.2221	0.0901	0.1658	0.1281
7	2		0.2531	23	0.1583	0.4047	0.1992	0.3216	0.2604
8	3		0.7349	22	0.4725	1.1431	0.5866	0.9207	0.7538
9	4		1.1891	21	0.7821	1.8079	0.9602	1.4725	1.2166
	5		1.0000	Fixed : Reference Age					
10	6		1.0198	21	0.6699	1.5526	0.8230	1.2637	1.0436
11	7		1.1633	20	0.7776	1.7404	0.9472	1.4288	1.1882
12	8		1.5366	18	1.0616	2.2241	1.2724	1.8556	1.5642
	9		1.5000	Fixed : Last true age					
Separable model: Populations in year 2001									
13	0		46013326	118	4495802	470934027	14045542	150740080	93034618
14	1		63362552	39	29164321	137661803	42648493	94137278	68527419
15	2		27300295	24	16730070	44548892	21264857	35048725	28165785
16	3		7317277	19	4999529	10709519	6024920	8886847	7456761
17	4		5889508	17	4147512	8363159	4924695	7043340	5984524
18	5		4772023	18	3336280	6825627	3975543	5728075	4852254
19	6		1297188	18	910972	1847144	1083147	1553524	1318451
20	7		329408	18	227777	476386	272890	397632	335296
21	8		132462	21	87144	201347	106981	164011	135520
22	9		66234	26	39622	110719	50961	86085	68549
Separable model: Populations at age									
23	1998		432211	33	222749	838638	308190	606139	457649
24	1999		166847	27	97869	284438	127092	219037	173142
25	2000		112624	24	70279	180483	88540	143260	115932
Age-structured index catchabilities									
Norway Spawning Area/Acoustic 1981-90									
Linear model fitted. Slopes at age :									
26	2	Q	.7011E-03	29	.5282E-03	.1679E-02	.7011E-03	.1265E-02	.9835E-03
27	3	Q	.1756E-02	29	.1323E-02	.4205E-02	.1756E-02	.3168E-02	.2464E-02
28	4	Q	.2251E-02	29	.1696E-02	.5389E-02	.2251E-02	.4060E-02	.3157E-02
29	5	Q	.2576E-02	29	.1941E-02	.6167E-02	.2576E-02	.4646E-02	.3613E-02
30	6	Q	.2471E-02	29	.1861E-02	.5915E-02	.2471E-02	.4456E-02	.3466E-02
31	7	Q	.2596E-02	29	.1956E-02	.6215E-02	.2596E-02	.4682E-02	.3641E-02
32	8	Q	.2771E-02	29	.2088E-02	.6635E-02	.2771E-02	.4999E-02	.3887E-02
Norway Spawning Area/Acoustic 1991-2002									
Linear model fitted. Slopes at age :									
33	2	Q	.9036E-03	25	.7044E-03	.1948E-02	.9036E-03	.1518E-02	.1211E-02
34	3	Q	.2113E-02	25	.1652E-02	.4513E-02	.2113E-02	.3529E-02	.2822E-02
35	4	Q	.2983E-02	25	.2332E-02	.6371E-02	.2983E-02	.4981E-02	.3983E-02
36	5	Q	.2054E-02	25	.1605E-02	.4398E-02	.2054E-02	.3436E-02	.2746E-02
37	6	Q	.1568E-02	25	.1225E-02	.3359E-02	.1568E-02	.2624E-02	.2097E-02
38	7	Q	.1430E-02	25	.1116E-02	.3071E-02	.1430E-02	.2397E-02	.1914E-02
39	8	Q	.1708E-02	26	.1329E-02	.3707E-02	.1708E-02	.2883E-02	.2297E-02
Russian Spawning Area/Acoustic 1982-91									
Linear model fitted. Slopes at age :									
40	3	Q	.1383E-02	24	.1094E-02	.2850E-02	.1383E-02	.2254E-02	.1819E-02
41	4	Q	.1912E-02	24	.1512E-02	.3939E-02	.1912E-02	.3116E-02	.2514E-02
42	5	Q	.2211E-02	24	.1749E-02	.4556E-02	.2211E-02	.3604E-02	.2908E-02
43	6	Q	.2646E-02	24	.2093E-02	.5452E-02	.2646E-02	.4312E-02	.3480E-02
44	7	Q	.3038E-02	24	.2403E-02	.6260E-02	.3038E-02	.4952E-02	.3996E-02
45	8	Q	.3733E-02	24	.2953E-02	.7692E-02	.3733E-02	.6084E-02	.4910E-02
Russian Spawning Area/Acoustic 1992-199									
Linear model fitted. Slopes at age :									
46	3	Q	.2424E-02	38	.1673E-02	.7602E-02	.2424E-02	.5247E-02	.3842E-02
47	4	Q	.2948E-02	38	.2035E-02	.9245E-02	.2948E-02	.6381E-02	.4673E-02
48	5	Q	.2304E-02	38	.1590E-02	.7225E-02	.2304E-02	.4987E-02	.3652E-02
49	6	Q	.1555E-02	38	.1073E-02	.4878E-02	.1555E-02	.3367E-02	.2465E-02
50	7	Q	.1186E-02	38	.8184E-03	.3719E-02	.1186E-02	.2567E-02	.1880E-02

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   51   8  Q  .1110E-02  38 .7660E-03 .3481E-02 .1110E-02 .2403E-02 .1759E-02
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Table 6.4.4.2 (continued)

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        CPUE Spanish Pair Trawlers
 Linear model fitted. Slopes at age :
   52   1  Q  .6489E-03 177 .1184E-03 .1231     .6489E-03 .2247E-01 .1836E-01
   53   2  Q  .2120E-02  17 .1785E-02 .3600E-02 .2120E-02 .3032E-02 .2576E-02
   54   3  Q  .2554E-02  17 .2152E-02 .4331E-02 .2554E-02 .3649E-02 .3102E-02
   55   4  Q  .1910E-02  17 .1609E-02 .3239E-02 .1910E-02 .2729E-02 .2320E-02
   56   5  Q  .1301E-02  17 .1096E-02 .2206E-02 .1301E-02 .1859E-02 .1580E-02
   57   6  Q  .9031E-03  17 .7608E-03 .1532E-02 .9031E-03 .1291E-02 .1097E-02

        Norwegian Sea acoustic - Blue Wh. 1981-
 Linear model fitted. Slopes at age :
   58   1  Q  .4226E-03  27 .3236E-03 .9626E-03 .4226E-03 .7370E-03 .5801E-03
   59   2  Q  .4809E-03  27 .3682E-03 .1095E-02 .4809E-03 .8387E-03 .6601E-03
   60   3  Q  .7331E-03  27 .5613E-03 .1670E-02 .7331E-03 .1278E-02 .1006E-02
   61   4  Q  .8605E-03  27 .6589E-03 .1960E-02 .8605E-03 .1501E-02 .1181E-02
   62   5  Q  .9017E-03  27 .6904E-03 .2054E-02 .9017E-03 .1573E-02 .1238E-02
   63   6  Q  .7687E-03  27 .5886E-03 .1751E-02 .7687E-03 .1341E-02 .1055E-02
   64   7  Q  .8198E-03  27 .6277E-03 .1867E-02 .8198E-03 .1430E-02 .1125E-02

        Norwegian Sea acoustic - Blue Wh. 1991+
 Linear model fitted. Slopes at age :
   65   1  Q  .7306E-03  28 .5546E-03 .1709E-02 .7306E-03 .1297E-02 .1015E-02
   66   2  Q  .4715E-03  28 .3593E-03 .1090E-02 .4715E-03 .8304E-03 .6513E-03
   67   3  Q  .7054E-03  28 .5380E-03 .1626E-02 .7054E-03 .1240E-02 .9734E-03
   68   4  Q  .6216E-03  28 .4741E-03 .1433E-02 .6216E-03 .1093E-02 .8577E-03
   69   5  Q  .3339E-03  28 .2546E-03 .7703E-03 .3339E-03 .5873E-03 .4608E-03
   70   6  Q  .3446E-03  28 .2626E-03 .7963E-03 .3446E-03 .6069E-03 .4760E-03
   71   7  Q  .2176E-03  28 .1656E-03 .5050E-03 .2176E-03 .3843E-03 .3011E-03
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RESIDUALS ABOUT THE MODEL FIT

Separable Model Residuals

Age	1998	1999	2000	2001
0	0.1261	0.4376	-0.5634	0.0001
1	0.3708	0.1595	-0.3347	-0.1973
2	0.2249	-0.0239	-0.2109	-0.0064
3	0.0799	0.0273	-0.1655	0.0015
4	-0.3073	0.3385	-0.2369	0.1398
5	-0.2741	-0.2088	0.1364	0.0776
6	-0.0904	-0.1062	0.3755	-0.1207
7	0.1838	-0.1421	0.2205	-0.0715
8	0.1676	0.1761	0.1491	0.1178
9	0.0000	-0.0978	-0.1106	0.5877

AGE-STRUCTURED INDEX RESIDUALS

Norway Spawning Area/Acoustic 1981-90

Age	1981	1982	1983	1984	1985	1986	1987	1988
2	-0.093	*******	-2.022	0.752	*******	-1.574	0.199	0.851
3	-0.026	*******	-0.378	-0.777	*******	-0.938	-0.028	0.206
4	-0.706	*******	-0.476	-0.505	*******	-0.706	0.655	0.485
5	-0.360	*******	0.208	-0.692	*******	-1.210	0.048	1.082
6	0.040	*******	0.023	-0.597	*******	-1.572	-1.205	1.351
7	0.223	*******	0.625	-0.774	*******	-1.652	-0.293	0.328
8	-0.223	*******	0.647	-0.612	*******	-1.496	-0.196	0.825

Norway Spawning Area/Acoustic 1981-90

Age	1989	1990
2	0.705	1.183
3	1.151	0.791
4	0.445	0.810
5	0.666	0.259
6	0.996	0.964
7	0.460	1.082
8	0.092	0.962

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Table 6.4.4.2 (continued)

Norway Spawning Area/Acoustic 1991-2002

Age	1991	1992	1993	1994	1995	1996	1997	1998
2	-0.171	-1.566	0.151	-0.832	0.759	0.405	*******	-0.338
3	-0.400	0.126	-1.107	-0.831	0.390	0.085	*******	0.490
4	0.276	-0.699	0.187	-0.814	0.158	0.255	*******	-0.602
5	1.070	-0.682	-0.503	0.152	0.349	-0.226	*******	-0.377
6	1.101	0.182	-0.259	-0.231	0.739	0.711	*******	-1.525
7	1.194	-0.050	-0.198	0.539	0.338	0.549	*******	-0.603
8	0.711	0.463	-0.470	0.588	0.444	0.334	*******	-0.489

Norway Spawning Area/Acoustic 1991-2002

Age	1999	2000	2001	2002
2	0.341	-0.025	0.666	0.610
3	0.383	0.373	-0.021	0.513
4	0.463	0.291	-0.001	0.486
5	-0.607	0.265	0.041	0.520
6	-1.072	-0.135	-0.830	1.321
7	-2.064	0.050	-0.754	0.998
8	-0.942	-0.257	-1.192	0.808

Russian Spawning Area/Acoustic 1982-91

Age	1982	1983	1984	1985	1986	1987	1988	1989
3	-1.945	-0.039	-0.016	0.363	0.469	-0.420	-0.452	0.764
4	-0.748	-0.240	-1.045	-1.035	1.184	0.654	-0.352	0.271
5	-1.248	0.727	-0.986	-1.058	0.347	0.414	0.372	0.365
6	-0.861	-0.007	0.150	-0.196	-0.657	0.060	0.705	0.815
7	-0.697	-0.149	-0.263	-0.991	-0.693	-0.269	0.734	1.894
8	-0.236	-0.485	-0.160	-1.223	-0.695	0.250	0.305	2.033

Russian Spawning Area/Acoustic 1982-91

Age	1990	1991
3	0.767	0.509
4	1.051	0.259
5	0.439	0.629
6	-0.037	0.028
7	0.124	0.309
8	-0.189	0.397

Russian Spawning Area/Acoustic 1992-199

Age	1992	1993	1994	1995	1996
3	-0.278	-0.891	*******	0.501	0.669
4	-0.337	-0.576	*******	0.408	0.506
5	-0.950	0.079	*******	0.499	0.373
6	-0.957	0.321	*******	-0.526	1.163
7	-0.593	0.849	*******	0.029	-0.284
8	-0.393	0.338	*******	-0.101	0.156

Table 6.4.4.2 (continued)

CPUE Spanish Pair Trawlers

Age	1983	1984	1985	1986	1987	1988	1989	1990
1	-0.230	0.268	0.937	-0.222	1.661	0.706	1.111	0.612
2	0.997	0.324	-0.003	0.061	0.157	0.635	0.707	0.485
3	0.840	1.131	-0.029	-0.255	-0.531	0.643	0.687	-0.351
4	0.803	0.885	1.003	0.225	-1.038	0.113	0.585	-0.682
5	0.967	0.139	0.366	0.420	-0.593	-0.757	0.518	-0.311
6	0.378	0.518	-1.032	0.434	-0.547	0.488	0.233	-0.440

CPUE Spanish Pair Trawlers

Age	1991	1992	1993	1994	1995	1996	1997	1998
1	1.143	1.087	0.248	-1.854	0.591	-1.108	-0.941	-0.699
2	-0.623	0.650	0.516	-0.287	0.513	0.142	-0.581	-1.415
3	-0.735	-0.951	0.716	0.760	-0.067	0.682	0.039	-0.805
4	-0.470	-0.227	-0.451	0.239	0.177	0.085	0.079	0.915
5	-0.275	-0.398	-0.594	-0.583	-0.288	0.778	-0.391	1.425
6	-0.539	-0.239	-0.248	-0.058	-1.280	0.555	-0.466	0.655

CPUE Spanish Pair Trawlers

Age	1999	2000	2001
1	-1.335	-1.189	-0.781
2	-1.037	-0.183	-1.055
3	-0.743	-0.415	-0.615
4	0.148	-1.020	-1.366
5	1.486	-0.718	-1.191
6	1.939	1.123	-1.474

Norwegian Sea acoustic - Blue Wh. 1981-

Age	1981	1982	1983	1984	1985	1986	1987	1988
1	-1.896	-2.156	1.395	1.552	0.534	-0.213	1.017	0.739
2	-0.757	-0.788	-1.173	1.213	1.550	-0.179	0.512	0.168
3	0.508	-0.323	-0.837	-0.424	1.191	0.359	0.529	0.011
4	0.581	0.776	-0.628	-0.752	-0.373	1.132	0.509	0.377
5	0.617	0.797	-0.108	-0.598	-0.252	1.309	0.052	-0.606
6	0.982	1.404	-0.478	-0.397	-0.898	1.353	0.023	-0.999
7	1.197	1.234	0.027	-0.570	-0.702	0.380	0.322	-0.211

Norwegian Sea acoustic - Blue Wh. 1981-

Age	1989	1990
1	-0.973	*******
2	-0.545	*******
3	-1.013	*******
4	-1.622	*******
5	-1.213	*******
6	-0.989	*******
7	-1.678	*******

Table 6.4.4.2 (continued)

Norwegian Sea acoustic - Blue Wh. 1991+

Age	1991	1992	1993	1994	1995	1996	1997	1998
1	*******	-1.520	-1.408	*******	0.249	0.620	0.227	0.644
2	*******	-0.854	-2.650	*******	0.432	-0.927	1.457	1.431
3	*******	0.067	-0.983	*******	0.051	-0.735	-0.590	1.090
4	*******	-0.763	0.526	*******	0.049	-0.510	-0.265	-0.792
5	*******	-0.551	0.736	*******	0.955	0.094	-0.202	-0.296
6	*******	-0.187	0.490	*******	-0.007	0.337	0.486	-0.700
7	*******	-0.176	1.087	*******	0.126	1.052	0.772	-0.200

Norwegian Sea acoustic - Blue Wh. 1991+

Age	1999	2000	2001
1	0.539	0.167	0.484
2	0.470	-0.164	0.809
3	0.795	-0.645	0.952
4	1.393	-0.282	0.645
5	1.672	-3.214	0.806
6	1.141	-1.187	-0.372
7	0.252	-1.883	-1.029

PARAMETERS OF THE DISTRIBUTION OF ln(CATCHES-AT-AGE)

Separable model fitted from 1998 to 2001

Variance	0.1008
Skewness test stat.	2.1918
Kurtosis test statistic	0.5222
Partial chi-square	0.1192
Significance in fit	0.0000
Degrees of freedom	15

PARAMETERS OF THE DISTRIBUTION OF THE AGE-STRUCTURED INDICES

DISTRIBUTION STATISTICS FOR Norway Spawning Area/Acoustic 1981-90

Linear catchability relationship assumed

Age	2	3	4	5	6	7	8
Variance	0.2000	0.0739	0.0611	0.0775	0.1638	0.1091	0.0965
Skewness test stat.	-0.9703	0.3213	0.0453	-0.2481	-0.2152	-0.8830	-0.5938
Kurtosis test statisti	-0.4861	-0.5670	-1.0521	-0.4645	-0.7630	-0.2127	-0.3617
Partial chi-square	0.1724	0.0585	0.0490	0.0661	0.1563	0.1081	0.1057
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	8	8	8	8	8	8	8
Degrees of freedom	7	7	7	7	7	7	7
Weight in the analysis	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429

DISTRIBUTION STATISTICS FOR Norway Spawning Area/Acoustic 1991-2002

Linear catchability relationship assumed

Age	2	3	4	5	6	7	8
Variance	0.0712	0.0434	0.0321	0.0416	0.1192	0.1195	0.0695
Skewness test stat.	-1.3675	-1.3312	-1.0798	0.6298	-0.1818	-1.1853	-0.6081
Kurtosis test statisti	0.1316	-0.2625	-0.6638	-0.4116	-0.7175	0.2904	-0.8289
Partial chi-square	0.0806	0.0465	0.0349	0.0520	0.1617	0.1868	0.1243
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	11	11	11	11	11	11	11
Degrees of freedom	10	10	10	10	10	10	10
Weight in the analysis	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429

Table 6.4.4.2 (continued)

DISTRIBUTION STATISTICS FOR Russian Spawning Area/Acoustic 1982-91

Linear catchability relationship assumed

Age	3	4	5	6	7	8
Variance	0.1101	0.1107	0.0987	0.0445	0.1175	0.1255
Skewness test stat.	-1.7857	0.1159	-1.0475	-0.0385	1.4125	1.4369
Kurtosis test statisti	0.8375	-0.8436	-0.7594	-0.3394	0.4029	0.8257
Partial chi-square	0.1180	0.1194	0.1103	0.0515	0.1542	0.1770
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	10	10	10	10	10	10
Degrees of freedom	9	9	9	9	9	9
Weight in the analysis	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667

DISTRIBUTION STATISTICS FOR Russian Spawning Area/Acoustic 1992-199

Linear catchability relationship assumed

Age	3	4	5	6	7	8
Variance	0.0873	0.0482	0.0720	0.1471	0.0641	0.0168
Skewness test stat.	-0.2522	-0.0649	-0.7534	0.2204	0.5000	-0.1881
Kurtosis test statisti	-0.6286	-0.7558	-0.3545	-0.5831	-0.4282	-0.5566
Partial chi-square	0.0284	0.0156	0.0262	0.0588	0.0297	0.0087
Significance in fit	0.0013	0.0005	0.0011	0.0037	0.0013	0.0002
Number of observations	4	4	4	4	4	4
Degrees of freedom	3	3	3	3	3	3
Weight in the analysis	0.1667	0.1667	0.1667	0.1667	0.1667	0.1667

DISTRIBUTION STATISTICS FOR CPUE Spanish Pair Trawlers

Linear catchability relationship assumed

Age	1	2	3	4	5	6
Variance	0.0017	0.0766	0.0750	0.0808	0.0972	0.1171
Skewness test stat.	-0.2980	-1.0719	0.3530	-0.6129	1.0282	0.4527
Kurtosis test statisti	-1.0468	-0.5774	-1.2647	-0.6921	-0.6123	-0.0281
Partial chi-square	0.0036	0.1385	0.1464	0.1711	0.2319	0.3267
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	19	19	19	19	19	19
Degrees of freedom	18	18	18	18	18	18
Weight in the analysis	0.0017	0.1667	0.1667	0.1667	0.1667	0.1667

DISTRIBUTION STATISTICS FOR Norwegian Sea acoustic - Blue Wh. 1981-

Linear catchability relationship assumed

Age	1	2	3	4	5	6	7
Variance	0.2760	0.1261	0.0731	0.1135	0.0893	0.1416	0.1229
Skewness test stat.	-0.5867	0.5758	0.1240	-0.6176	0.2461	0.5470	-0.3219
Kurtosis test statisti	-0.7651	-0.6549	-0.6016	-0.5230	-0.5344	-0.8880	-0.3614
Partial chi-square	0.2851	0.1284	0.0753	0.1208	0.1043	0.1832	0.1747
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	9	9	9	9	9	9	9
Degrees of freedom	8	8	8	8	8	8	8
Weight in the analysis	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429

DISTRIBUTION STATISTICS FOR Norwegian Sea acoustic - Blue Wh. 1991+

Linear catchability relationship assumed

Age	1	2	3	4	5	6	7
Variance	0.1028	0.2477	0.0894	0.0760	0.2799	0.0708	0.1365
Skewness test stat.	-1.4610	-0.9466	0.2753	0.8382	-1.5953	-0.1473	-0.8447
Kurtosis test statisti	-0.2194	-0.1234	-0.9233	-0.3680	0.7706	-0.4114	-0.2623
Partial chi-square	0.0971	0.2469	0.0865	0.0804	0.3583	0.1099	0.2702
Significance in fit	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Number of observations	9	9	9	9	9	9	9
Degrees of freedom	8	8	8	8	8	8	8
Weight in the analysis	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429	0.1429

Table 6.4.4.2 (continued)

ANALYSIS OF VARIANCE

Unweighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	291.6748	497	71	426	0.6847
Catches-at-age	2.1421	40	25	15	0.1428
Aged Indices					
Norway Spawning Area/Acoustic 1981-90	38.3182	56	7	49	0.7820
Norway Spawning Area/Acoustic 1991-200	34.7553	77	7	70	0.4965
Russian Spawning Area/Acoustic 1982-91	32.7772	60	6	54	0.6070
Russian Spawning Area/Acoustic 1992-19	7.8394	24	6	18	0.4355
CPUE Spanish Pair Trawlers	66.8944	114	6	108	0.6194
Norwegian Sea acoustic - Blue Wh. 1981	52.7826	63	7	56	0.9425
Norwegian Sea acoustic - Blue Wh. 1991	56.1657	63	7	56	1.0030

Weighted Statistics

Variance

	SSQ	Data	Parameters	d.f.	Variance
Total for model	7.6956	497	71	426	0.0181
Catches-at-age	1.5127	40	25	15	0.1008
Aged Indices					
Norway Spawning Area/Acoustic 1981-90	0.7820	56	7	49	0.0160
Norway Spawning Area/Acoustic 1991-200	0.7093	77	7	70	0.0101
Russian Spawning Area/Acoustic 1982-91	0.9105	60	6	54	0.0169
Russian Spawning Area/Acoustic 1992-19	0.2178	24	6	18	0.0121
CPUE Spanish Pair Trawlers	1.3399	114	6	108	0.0124
Norwegian Sea acoustic - Blue Wh. 1981	1.0772	63	7	56	0.0192
Norwegian Sea acoustic - Blue Wh. 1991	1.1462	63	7	56	0.0205

Table 6.4.4.3 Results of stock assessment with the ISVPA.

Year	Catch th.t.	R(1) mln.				SSB th.t.				B(1+) th.t.				F(3-7)			
		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1981	909	4461	10847	17995	3508	4275	7496	10482	3484	4960	8974	12786	3998	0.220	0.131	0.097	0.266
1982	576	6342	13983	22454	4472	3430	5772	7868	2638	4091	7111	9902	3105	0.162	0.103	0.079	0.206
1983	570	2922	5827	9195	16915	2455	3888	5153	1887	2990	4867	6586	2868	0.294	0.200	0.157	0.307
1984	641	11857	25590	42230	19444	1774	2697	3531	1681	2387	3895	5406	2936	0.391	0.274	0.215	0.376
1985	695	11843	27059	46316	10695	1579	2426	3269	1985	2465	4221	6159	3140	0.417	0.293	0.228	0.384
1986	827	17751	43677	77519	8720	1843	2953	4164	2364	3031	5552	8538	3292	0.477	0.328	0.250	0.447
1987	664	7608	19817	36051	8881	1876	3291	4920	2011	3077	5939	9377	2971	0.457	0.303	0.224	0.410
1988	553	7952	21796	40229	7073	1820	3306	5024	1732	2713	5396	8638	2567	0.427	0.271	0.196	0.387
1989	625	9450	26420	48560	9456	1767	3308	5086	1659	2761	5774	9412	2606	0.515	0.307	0.216	0.492
1990	561	15378	43459	79146	21478	1627	3274	5142	1575	2705	6084	10097	2885	0.517	0.280	0.191	0.455
1991	369	8261	22944	40769	9425	1808	3979	6361	2002	3005	7039	11608	3526	0.222	0.117	0.080	0.208
1992	474	6538	17829	31129	6696	2235	4679	7211	2649	3170	6957	10993	3732	0.223	0.121	0.085	0.212
1993	480	9578	25586	43814	6396	2196	4379	6518	2585	3265	6983	10806	3535	0.184	0.104	0.075	0.181
1994	459	6268	15305	25073	6669	2318	4344	6229	2550	3273	6493	9614	3426	0.174	0.104	0.078	0.167
1995	579	7303	16608	26249	9387	2339	4136	5742	2374	3266	6091	8721	3408	0.232	0.147	0.114	0.221
1996	638	15436	32951	50515	27427	2135	3538	4738	2274	3145	5578	7778	3794	0.321	0.212	0.168	0.285
1997	634	50043	102532	153947	56894	2212	3691	4962	2666	4974	9190	13099	6126	0.291	0.201	0.163	0.250
1998	1125	52699	102728	151013	48986	3199	5261	7037	4028	7338	12952	18050	8415	0.387	0.278	0.230	0.329
1999	1256	34684	65167	94392	35202	4703	7427	9735	5541	9049	15077	20423	10024	0.273	0.206	0.175	0.233
2000	1413	68282	124098	177459	75222	5892	8636	10957	6500	11338	17992	23962	12432	0.296	0.241	0.210	0.257
2001	1780	75511	133642	189259	87893	7429	10255	12738	8262	14027	21078	27501	15852	0.282	0.250	0.225	0.253

Table 6.4.4.4 Residuals ($Ln(C_{observed}(a,y))-Ln(C_{estimated}(a,y)))$ from the ISVPA stock assessment.

a. ISVPA, M=0.2, effort-controlled

Year \ Age	1	2	3	4	5	6	7	8
1981	0.218	0.102	-0.352	-1.090	0.490	0.459	0.200	-0.027
1982	-0.413	0.411	0.031	-0.188	-0.781	0.294	0.383	0.263
1983	**2.569**	0.244	-0.435	-0.560	-1.103	-1.011	0.123	0.173
1984	0.935	**2.224**	-0.471	-0.559	-0.472	-0.658	-0.915	-0.084
1985	0.323	0.661	**1.758**	-0.720	-0.527	-0.029	-0.654	-0.811
1986	-0.884	-0.356	0.242	**1.758**	-0.138	-0.238	0.035	-0.418
1987	0.251	-1.061	-0.641	0.551	**1.404**	-0.703	-0.068	0.267
1988	-0.419	0.056	-1.158	-0.406	0.686	**1.732**	-0.452	-0.039
1989	-0.025	-0.142	0.314	-0.820	0.087	0.340	**0.745**	-0.499
1990	0.107	-0.323	-0.405	0.012	-0.740	0.202	0.237	**0.910**
1991	-0.375	0.262	-0.134	-0.233	0.481	-0.255	0.374	-0.120
1992	0.280	0.374	0.449	0.071	-0.294	-0.165	-0.722	0.006
1993	-0.367	0.019	0.214	0.685	0.189	-0.033	0.038	-0.745
1994	0.265	-1.357	-0.034	-0.116	0.726	0.042	0.275	0.200
1995	-0.184	-0.008	-0.552	0.017	0.313	0.212	0.013	0.190
1996	0.643	-0.015	0.015	-0.476	-0.349	0.045	0.149	-0.013
1997	-0.332	0.382	0.343	0.174	-0.641	-0.208	0.075	0.208
1998	**-0.872**	-0.024	0.733	0.401	-0.145	-0.508	0.220	0.196
1999	**-0.905**	-0.757	0.369	1.208	0.168	-0.097	-0.375	0.388
2000	**-0.816**	-0.692	-0.286	0.290	0.648	0.582	0.318	-0.045
2001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

b. ISVPA, M=0.38, effort-controlled

Year \ Age	1	2	3	4	5	6	7	8
1981	0.265	0.123	-0.351	-1.106	0.475	0.441	0.184	-0.031
1982	-0.321	0.431	0.029	-0.200	-0.808	0.269	0.359	0.242
1983	**2.679**	0.288	-0.456	-0.585	-1.129	-1.049	0.098	0.152
1984	0.930	**2.320**	-0.439	-0.585	-0.499	-0.684	-0.945	-0.099
1985	0.255	0.662	**1.859**	-0.683	-0.548	-0.047	-0.670	-0.829
1986	-1.017	-0.406	0.261	**1.874**	-0.087	-0.243	0.033	-0.416
1987	0.095	-1.157	-0.655	0.595	**1.539**	-0.633	-0.061	0.276
1988	-0.586	-0.055	-1.212	-0.391	0.752	**1.888**	-0.371	-0.024
1989	-0.173	-0.264	0.243	-0.845	0.124	0.424	**0.908**	-0.416
1990	0.029	-0.395	-0.461	-0.020	-0.745	0.249	0.303	**1.040**
1991	-0.343	0.268	-0.135	-0.251	0.462	-0.262	0.378	-0.117
1992	0.302	0.401	0.451	0.071	-0.312	-0.186	-0.731	0.005
1993	-0.355	0.035	0.237	0.687	0.190	-0.052	0.016	-0.758
1994	0.313	-1.370	-0.039	-0.102	0.724	0.038	0.257	0.180
1995	-0.130	0.007	-0.592	-0.001	0.320	0.205	0.014	0.178
1996	0.708	0.012	0.007	-0.529	-0.375	0.045	0.142	-0.012
1997	-0.258	0.432	0.357	0.155	-0.704	-0.244	0.068	0.194
1998	**-0.797**	0.023	0.759	0.398	-0.176	-0.580	0.183	0.190
1999	**-0.825**	-0.701	0.399	1.218	0.151	-0.139	-0.453	0.350
2000	**-0.771**	-0.653	-0.264	0.299	0.647	0.561	0.287	-0.105
2001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

c. ISVPA, M=0.47, effort-controlled

Year \ Age	1	2	3	4	5	6	7	8
1981	0.297	0.146	-0.340	-1.113	0.461	0.421	0.166	-0.038
1982	-0.284	0.447	0.039	-0.197	-0.820	0.252	0.339	0.224
1983	**2.699**	0.304	-0.456	-0.583	-1.130	-1.061	0.087	0.141
1984	0.894	**2.337**	-0.424	-0.584	-0.493	-0.679	-0.950	-0.102
1985	0.188	0.638	**1.889**	-0.658	-0.538	-0.033	-0.658	-0.828
1986	-1.105	-0.452	0.255	**1.918**	-0.050	-0.222	0.054	-0.399
1987	0.010	-1.214	-0.675	0.609	**1.597**	-0.585	-0.037	0.295
1988	-0.659	-0.111	-1.244	-0.392	0.779	**1.955**	-0.322	-0.006
1989	-0.222	-0.314	0.208	-0.862	0.133	0.457	**0.973**	-0.374
1990	0.019	-0.413	-0.483	-0.038	-0.753	0.260	0.324	**1.085**
1991	-0.306	0.282	-0.132	-0.263	0.446	-0.275	0.371	-0.122
1992	0.331	0.425	0.454	0.068	-0.327	-0.204	-0.744	-0.002
1993	-0.331	0.051	0.250	0.685	0.184	-0.069	-0.001	-0.769
1994	0.348	-1.366	-0.039	-0.098	0.717	0.030	0.242	0.166
1995	-0.095	0.020	-0.606	-0.011	0.319	0.196	0.008	0.168
1996	0.745	0.030	0.006	-0.552	-0.390	0.041	0.134	-0.014
1997	-0.221	0.458	0.365	0.146	-0.733	-0.263	0.062	0.185
1998	**-0.763**	0.046	0.772	0.398	-0.191	-0.612	0.165	0.187
1999	**-0.792**	-0.676	0.413	1.223	0.144	-0.158	-0.486	0.331
2000	**-0.753**	-0.638	-0.254	0.303	0.647	0.552	0.273	-0.130
2001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

d. ISVPA, M=0.20, catch-controlled

Year \ Age	1	2	3	4	5	6	7	8
1981	0.350	0.102	-0.007	-0.554	0.135	0.060	-0.053	-0.033
1982	-0.224	0.508	-0.030	0.102	-0.355	-0.015	0.009	0.004
1983	**0.837**	0.601	-0.119	-0.442	-0.565	-0.411	0.047	0.052
1984	0.531	**0.639**	0.016	-0.223	-0.371	-0.169	-0.377	-0.046
1985	0.550	0.330	**0.292**	-0.235	-0.233	-0.021	-0.239	-0.444
1986	-0.063	-0.105	-0.096	**0.320**	0.237	-0.067	-0.031	-0.196
1987	0.241	-0.237	-0.415	0.169	**0.174**	-0.153	0.049	0.171
1988	-0.165	0.035	-0.419	-0.341	0.347	**0.559**	-0.061	0.045
1989	0.068	0.031	0.208	-0.268	-0.018	0.143	**0.080**	-0.244
1990	-0.071	-0.184	-0.208	0.005	-0.246	0.140	0.204	**0.360**
1991	-0.390	0.009	-0.113	-0.200	0.400	0.044	0.310	-0.060
1992	0.362	0.314	0.148	0.028	-0.312	-0.141	-0.440	0.041
1993	0.115	0.076	0.118	0.342	0.120	-0.140	-0.021	-0.611
1994	0.295	-0.873	0.009	-0.215	0.471	0.019	0.144	0.150
1995	-0.331	0.031	-0.124	0.039	0.196	0.086	-0.004	0.107
1996	0.229	-0.139	0.076	-0.047	-0.265	0.039	0.092	0.015
1997	-0.268	-0.008	0.194	0.230	-0.214	-0.186	0.069	0.182
1998	**-0.607**	0.001	0.295	0.232	-0.054	-0.162	0.129	0.165
1999	**-0.721**	-0.548	0.349	0.793	0.055	-0.062	-0.171	0.306
2000	**-0.735**	-0.581	-0.177	0.263	0.497	0.436	0.262	0.035
2001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 6.4.5.1 Tuning data for the blue whiting assessment with input values framed.

BLUE WHITING-COMBINED, 2002 WG, 4 fleets

1 2 8 0 Norway Spawning Acoustic 1981-2002

Year	Seas.	Num.	Res.	2	3	4	5	6	7	8	9	10
1981	1	1	1	2372	7583	3253	3647	4611	4638	3654	2591	1785
1982	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1983	1	1	1	297	2108	2723	6511	3735	3650	3153	2279	1182
1984	1	1	1	15767	1721	1616	1719	1858	1128	567	440	348
1985	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1986	1	1	1	1003	5829	4122	624	228	203	250	137	170
1987	1	1	1	4960	8417	22589	4735	282	417	385	159	27
1988	1	1	1	9712	9090	12367	20392	7355	723	599	326	398
1989	1	1	1	6787	22270	9973	10504	7803	933	293	177	46
1990	1	1	1	14169	12670	11228	5587	6556	3273	516	183	108
1991	1	1	1	11147	6340	8497	7407	4558	2019	545	96	16
1992	1	1	1	1232	26123	4719	1574	1386	810	616	257	19
1993	1	1	1	4489	3321	26771	2643	1270	557	426	108	22
1994	1	1	1	1603	2950	4476	11354	1742	1687	908	770	207
1995	1	1	1	8538	9874	7906	6861	9467	1795	1083	482	149
1996	1	1	1	8781	7433	8371	2399	4455	4111	1202	459	162
1997	1	1	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1998	1	1	1	18218	34991	4697	1674	279	407	381	351	86
1999	1	1	1	19034	60309	26103	1481	316	72	153	141	0
2000	1	1	1	8613	31011	41382	6843	898	427	228	139	115
2001	1	1	1	44162	12843	13805	8292	718	175	51	0	0
2002	1	1	1	71996	54740	12757	5266	8404	1450	305	15	176

2 3 8 0 Russian spawning acoustic 1982-96

Year	Seas.	Num.	Res.	3	4	5	6	7	8	9	10
1982	1	2	10	540	2750	1340	1380	1570	2350	1730	1290
1983	1	2	10	2330	2930	9390	3880	1970	1370	780	660
1984	1	2	10	2900	800	1100	4200	2200	1200	1700	1200
1985	1	2	10	13220	930	580	1780	860	610	580	540
1986	1	2	10	18750	23180	2540	610	620	750	640	710
1987	1	2	10	4480	19170	5860	1070	500	810	860	670
1988	1	2	10	3710	4550	8610	4130	1270	480	250	260
1989	1	2	10	11910	7120	6670	6970	4580	2750	1880	810
1990	1	2	10	9740	12140	5740	2580	1470	220	80	10
1991	1	2	10	10300	5350	5130	2630	1770	870	300	220
1992	1	2	1	20010	6700	1350	440	390	170	0	0
1993	1	2	1	4728	12337	5304	2249	1316	621	386	150
1994	1	2	1	-1	-1	-1	-1	-1	-1	-1	-1
1995	1	2	1	12657	10028	8942	2651	1093	408	131	14
1996	1	2	1	15285	10629	4897	6940	1482	653	85	0

3 1 6 0 CPUE Spanish Pair Trawlers 1983-2001

Year	Seas.	Num.	Res.	1	2	3	4	5	6
1983	3	3	50	7196	16392	9311	7476	6326	1718
1984	3	3	50	13710	27286	14845	4836	1755	1750
1985	3	3	50	14573	23823	14126	6256	1232	217
1986	3	3	50	3721	14131	14745	7113	1278	505
1987	3	3	50	25328	13153	6664	2938	1029	166
1988	3	3	50	7778	21473	18436	6391	1300	781
1989	3	3	50	15272	18486	17160	8374	3760	1003
1990	3	3	50	21444	19407	5194	1803	1357	451
1991	3	3	50	15924	15370	4989	2329	1045	440
1992	3	3	50	10007	24235	9671	4316	1194	462
1993	3	3	50	4036	13991	22493	7979	1354	658
1994	3	3	50	543	6066	15917	7474	2990	1055
1995	3	3	50	9090	14409	6833	4551	1990	623
1996	3	3	50	3905	14557	14449	3931	3639	1834
1997	3	3	50	8742	15875	11134	3698	1046	450
1998	3	3	50	5884	13236	9803	10844	5229	1153
1999	3	3	50	2048	10268	20242	9833	6287	3047
2000	3	3	50	6207	15518	13987	5375	1264	1414
2001	3	3	50	16223	16488	6830	1620	1148	162

4 1 7 0 Norwegian Sea acoustic 1981-2001

Year	Seas.	Num.	Res.	1	2	3	4	5	6	7	8	9
1981	3	4	1	182	728	4542	3874	2678	2834	2964	2756	2054
1982	3	4	1	184	460	1242	4715	3611	3128	2323	1679	874
1983	3	4	1	22356	396	468	756	1404	576	468	432	324
1984	3	4	1	30380	13916	833	392	539	539	343	49	49
1985	3	4	1	5969	23876	12502	658	423	188	235	141	376
1986	3	4	1	2324	2380	7224	6944	1876	952	336	308	140
1987	3	4	1	8204	4032	5180	5572	1204	224	168	56	84
1988	3	4	1	4992	2880	2640	3480	912	120	96	24	48
1989	3	4	1	1172	1125	812	379	410	212	22	32	-1
1990	3	4	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1991	3	4	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1992	3	4	1	792	1134	6939	766	247	172	90	11	18
1993	3	4	1	830	125	1070	6392	1222	489	248	58	88
1994	3	4	1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1995	3	4	1	6974	2811	1999	1209	1622	775	173	61	1
1996	3	4	1	23464	1057	899	649	436	505	755	69	41
1997	3	4	1	30227	25638	1524	779	300	407	260	137	123
1998	3	4	1	24244	47815	16282	556	212	100	64	10	255
1999	3	4	1	14367	9750	23701	9754	1733	466	79	48	91
2000	3	4	1	25813	3298	2721	3078	23	46	6		
2001	3	4	1	61470	22051	7883	3225	1824	156	12	0	68

Table 6.4.5.2.a Modelled catches by year (tonnes)

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

Modelled catches by year

	1981	1982	1983	1984	1985	1986	1987	1988
0	95457.2	5025307.1	4492118.0	2675763.6	2575782.6	1649875.3	1050472.6	589274.1
1	208086.3	170914.7	859751.6	1777741.9	1342309.0	1253210.2	1061209.9	764014.0
2	318686.4	180711.2	265203.8	1060646.4	1790099.2	1480266.4	1060574.4	942038.2
3	674755.8	283199.8	234793.0	356438.9	1120122.0	2019412.2	1185026.9	884629.2
4	548764.6	438819.8	280780.1	261513.5	321291.4	1055798.4	1386343.5	856749.1
5	515784.9	300084.5	357543.0	261758.0	201799.3	276736.9	596703.1	803582.9
6	625051.2	303856.8	283470.2	391506.2	240212.9	195706.3	173661.7	392448.9
7	580111.3	293471.9	234515.8	242741.1	265756.7	164099.5	92110.2	87585.3
8	577954.3	267817.8	225257.3	192185.4	158168.1	178148.5	75854.2	44396.0
9	507555.6	235289.9	180270.7	158509.0	105061.7	91903.1	69969.1	28147.9
10	1255967.8	768963.7	664625.7	598207.0	431816.9	329159.1	162380.3	87152.1

Modelled catches by year

	1989	1990	1991	1992	1993	1994	1995	1996
0	3328079.3	802632.7	282637.3	148618.2	346252.7	257247.2	4583293.3	5823483.7
1	1027961.0	2349730.5	412351.2	318991.2	249965.7	264275.9	370411.2	1436086.1
2	987342.1	1090317.9	1203358.2	570265.3	356839.0	269353.3	350114.9	525000.0
3	1091897.4	931785.3	495064.1	1392511.1	586489.9	382817.8	386651.6	513117.6
4	863232.3	815650.9	337909.5	468487.4	1198064.3	507638.7	419695.7	426173.3
5	683222.4	544885.5	258620.8	279432.6	346087.5	912371.4	504454.1	397524.1
6	642024.9	421410.5	176362.1	213985.3	213683.0	270469.6	848391.0	448719.3
7	230381.5	282598.7	92338.1	107896.3	122026.0	133163.6	212413.1	647690.8
8	54219.1	112143.9	71086.6	64759.7	68304.0	83258.4	112516.0	172177.6
9	20794.9	19240.3	23006.9	46664.5	37422.3	45154.9	66532.6	80875.9
10	57108.7	37244.1	9172.8	21559.7	41314.3	46792.9	63888.8	87609.8

Modelled catches by year

	1997	1998	1999	2000	2001	2002	2003	2004
0	1765313.0	775095.0	1019635.4	1022923.3	402125.7	563657.7	563657.7	563657.7
1	2516058.7	1782629.3	949821.8	2606751.2	4585236.0	1379789.7	1934044.7	1934044.7
2	1604052.2	4057563.7	1933926.6	1417395.4	4209700.1	5267259.5	1585024.2	2221721.0
3	674021.9	2870342.7	4875338.4	3143588.6	2293792.1	4726883.0	5914368.8	1779752.4
4	473358.3	817197.8	2307308.7	4939775.6	2935410.8	1366955.8	2816924.8	3524591.7
5	324206.3	458014.6	480220.9	1618668.6	3020746.1	1097559.7	511109.2	1053257.4
6	296542.5	319651.6	284330.1	396747.9	1116786.8	1389793.3	504968.3	235152.6
7	278892.3	247399.0	163744.6	192707.3	209555.4	403579.7	502237.7	182483.3
8	427457.2	233920.2	124841.4	106421.0	96214.2	65647.3	126429.1	157335.6
9	95636.7	288276.3	89306.4	55584.6	34218.2	16384.2	11179.0	21529.5
10	96416.9	126935.3	166013.6	127646.9	68134.4	17497.3	5182.7	2109.2

Table 6.4.5.2.b Observed catches by year (tonnes)

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

Observed catches by year

	1981	1982	1983	1984	1985	1986	1987	1988
0	48000.0	3512000.0	437000.0	584000.0	1174000.0	84000.0	341000.0	46000.0
1	258000.0	148000.0	2283000.0	2291000.0	1305000.0	650000.0	838000.0	425000.0
2	348000.0	274000.0	567000.0	2331000.0	2044000.0	816000.0	578000.0	721000.0
3	681000.0	326000.0	270000.0	455000.0	1933000.0	1862000.0	728000.0	614000.0
4	334000.0	548000.0	286000.0	260000.0	303000.0	1717000.0	1897000.0	683000.0
5	548000.0	264000.0	299000.0	285000.0	188000.0	393000.0	726000.0	1303000.0
6	559000.0	276000.0	304000.0	445000.0	321000.0	187000.0	137000.0	618000.0
7	466000.0	266000.0	287000.0	262000.0	257000.0	201000.0	105000.0	84000.0
8	634000.0	272000.0	286000.0	193000.0	174000.0	198000.0	123000.0	53000.0
9	578000.0	284000.0	225000.0	154000.0	93000.0	174000.0	103000.0	33000.0
10	1460000.0	673000.0	334000.0	255000.0	259000.0	398000.0	195000.0	50000.0

Observed catches by year

	1989	1990	1991	1992	1993	1994	1995	1996
0	1949000.0	83000.0	161080.0	19000.0	197689.0	41999.0	3306610.0	832587.0
1	865000.0	1611000.0	266686.0	407730.0	263184.0	306951.0	296100.0	1893453.0
2	718000.0	703000.0	1024468.0	653838.0	305180.0	107935.0	353949.0	534221.0
3	1340000.0	672000.0	513959.0	1641714.0	621085.0	367962.0	421560.0	632361.0
4	791000.0	753000.0	301627.0	569094.0	1571236.0	389264.0	465358.0	537280.0
5	837000.0	520000.0	363204.0	217386.0	411367.0	1221919.0	615994.0	323324.0
6	708000.0	577000.0	258038.0	154044.0	191241.0	281120.0	800201.0	497458.0
7	139000.0	299000.0	159153.0	109580.0	107005.0	174256.0	253818.0	663133.0
8	50000.0	78000.0	49431.0	79663.0	64769.0	90429.0	159797.0	232420.0
9	25000.0	27000.0	5060.0	31987.0	38118.0	79014.0	59670.0	98415.0
10	38000.0	95000.0	9570.0	11706.0	17476.0	30614.0	41811.0	82521.0

Observed catches by year

	1997	1998	1999	2000	2001
0	211664.0	42985.0	139000.0	129117.0	161897.0
1	2131494.0	1656926.0	788200.0	1814851.0	4363690.0
2	1519327.0	4181175.0	1549100.0	1192657.0	4486315.0
3	904074.0	3541231.0	5820800.0	3465739.0	2962163.0
4	577676.0	1044897.0	3460600.0	5014862.0	3806520.0
5	295671.0	383658.0	412800.0	1550063.0	2592933.0
6	251642.0	322777.0	207200.0	513663.0	585666.0
7	282056.0	303058.0	151200.0	213057.0	170020.0
8	406910.0	264105.0	153100.0	151429.0	97032.0
9	104320.0	212452.0	68800.0	58277.0	76624.0
10	169235.0	85513.0	140500.0	139791.0	66410.0

Table 6.4.5.2.c Log catch residuals

Blue whiting, Output from final AMCI run

Residuals: log (Obs/mod), fleet 1 area 1

	1981	1982	1983	1984	1985	1986	1987	1988
0	-0.7	-0.4	-2.3	-1.5	-0.8	-3.0	-1.1	-2.6
1	0.2	-0.1	1.0	0.3	0.0	-0.7	-0.2	-0.6
2	0.1	0.4	0.8	0.8	0.1	-0.6	-0.6	-0.3
3	0.0	0.1	0.1	0.2	0.5	-0.1	-0.5	-0.4
4	-0.5	0.2	0.0	0.0	-0.1	0.5	0.3	-0.2
5	0.1	-0.1	-0.2	0.1	-0.1	0.4	0.2	0.5
6	-0.1	-0.1	0.1	0.1	0.3	0.0	-0.2	0.5
7	-0.2	-0.1	0.2	0.1	0.0	0.2	0.1	0.0
8	0.1	0.0	0.2	0.0	0.1	0.1	0.5	0.2
9	0.1	0.2	0.2	0.0	-0.1	0.6	0.4	0.2
10	0.2	-0.1	-0.7	-0.9	-0.5	0.2	0.2	-0.6

Residuals: log (Obs/mod), fleet 1 area 1

	1989	1990	1991	1992	1993	1994	1995	1996
0	-0.5	-2.3	-0.6	-2.1	-0.6	-1.8	-0.3	-1.9
1	-0.2	-0.4	-0.4	0.2	0.1	0.1	-0.2	0.3
2	-0.3	-0.4	-0.2	0.1	-0.2	-0.9	0.0	0.0
3	0.2	-0.3	0.0	0.2	0.1	0.0	0.1	0.2
4	-0.1	-0.1	-0.1	0.2	0.3	-0.3	0.1	0.2
5	0.2	0.0	0.3	-0.3	0.2	0.3	0.2	-0.2
6	0.1	0.3	0.4	-0.3	-0.1	0.0	-0.1	0.1
7	-0.5	0.1	0.5	0.0	-0.1	0.3	0.2	0.0
8	-0.1	-0.4	-0.4	0.2	-0.1	0.1	0.4	0.3
9	0.2	0.3	-1.5	-0.4	0.0	0.6	-0.1	0.2
10	-0.4	0.9	0.0	-0.6	-0.9	-0.4	-0.4	-0.1

Residuals: log (Obs/mod), fleet 1 area 1

	1997	1998	1999	2000	2001
0	-2.1	-2.9	-2.0	-2.1	-0.9
1	-0.2	-0.1	-0.2	-0.4	0.0
2	-0.1	0.0	-0.2	-0.2	0.1
3	0.3	0.2	0.2	0.1	0.3
4	0.2	0.2	0.4	0.0	0.3
5	-0.1	-0.2	-0.2	0.0	-0.2
6	-0.2	0.0	-0.3	0.3	-0.6
7	0.0	0.2	-0.1	0.1	-0.2
8	0.0	0.1	0.2	0.4	0.0
9	0.1	-0.3	-0.3	0.0	0.8
10	0.6	-0.4	-0.2	0.1	0.0

Table 6.4.5.3.a Modelled surveys indices by year, Norwegian spawningground acoustic survey

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

Modelled surveys indices by year

	1981	1982	1983	1984	1985	1986	1987	1988
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2	2368.9	1739.4	2063.7	5658.6	8368.3	5630.9	4526.8	4433.0
3	7506.4	4231.0	3167.5	3659.5	9536.1	13653.7	8907.7	7358.3
4	6584.2	6962.6	4081.4	2985.3	3285.2	8084.8	10927.8	7391.9
5	6121.4	4889.0	5435.6	3102.9	2147.2	2254.4	5082.1	6954.0
6	5230.9	3453.6	2943.8	3177.8	1693.9	1111.5	1071.8	2466.3
7	4283.5	2930.7	2110.1	1723.7	1699.1	830.1	488.9	499.2
8	3668.0	2258.5	1706.7	1164.0	855.3	775.8	327.8	201.3
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

	1989	1990	1991	1992	1993	1994	1995	1996
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2	3884.4	4295.3	14324.2	6575.9	4587.5	3943.2	4405.9	5573.4
3	7229.5	6136.8	8526.5	23152.4	10626.4	7491.3	6470.9	7111.1
4	6171.4	5696.3	5978.6	7970.4	21590.4	10048.7	7108.0	5977.3
5	4756.8	3697.9	2308.1	2521.5	3349.1	9176.9	4303.6	2945.2
6	3318.0	2040.7	1055.1	1302.3	1434.3	1939.7	5315.5	2380.9
7	1138.0	1350.0	532.3	612.7	765.0	868.9	1184.2	3090.8
8	209.1	432.2	344.1	301.5	347.7	449.8	510.0	650.1
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

	1997	1998	1999	2000	2001	2002
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2	16828.4	29905.4	14973.6	8531.8	18672.8	23363.8
3	8852.0	26255.2	44870.6	22219.7	11844.5	24408.4
4	6379.2	7698.8	21111.9	35332.1	15539.6	7236.5
5	2384.4	2467.1	2693.2	7143.0	10397.3	3777.8
6	1572.2	1234.5	1156.3	1242.4	2856.9	3555.3
7	1308.8	834.6	570.3	530.6	463.2	892.0
8	1597.5	644.3	343.8	228.3	166.4	113.5
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

Table 6.4.5.3.b Observed surveys indices by year, Norwegian spawningground acoustic survey

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

Observed surveys indices by year

	1981	1982	1983	1984	1985	1986	1987	1988
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2	2372.0	-1.0	297.0	15767.0	-1.0	1003.0	4960.0	9712.0
3	7583.0	-1.0	2108.0	1721.0	-1.0	5829.0	8417.0	9090.0
4	3253.0	-1.0	2723.0	1616.0	-1.0	4122.0	22589.0	12367.0
5	3647.0	-1.0	6511.0	1719.0	-1.0	624.0	4735.0	20392.0
6	4611.0	-1.0	3735.0	1858.0	-1.0	228.0	282.0	7355.0
7	4638.0	-1.0	3650.0	1128.0	-1.0	203.0	417.0	723.0
8	3654.0	-1.0	3153.0	567.0	-1.0	250.0	385.0	599.0
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

	1989	1990	1991	1992	1993	1994	1995	1996
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2	6787.0	14169.0	11147.0	1232.0	4489.0	1603.0	8538.0	8781.0
3	22270.0	12670.0	6340.0	26123.0	3321.0	2950.0	9874.0	7433.0
4	9973.0	11228.0	8497.0	4719.0	26771.0	4476.0	7906.0	8371.0
5	10504.0	5587.0	7407.0	1574.0	2643.0	11354.0	6861.0	2399.0
6	7803.0	6556.0	4558.0	1386.0	1270.0	1742.0	9467.0	4455.0
7	933.0	3273.0	2019.0	810.0	557.0	1687.0	1795.0	4111.0
8	293.0	516.0	545.0	616.0	426.0	908.0	1083.0	1202.0
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

	1997	1998	1999	2000	2001	2002
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2	-1.0	18218.0	19034.0	8613.0	44162.0	71996.0
3	-1.0	34991.0	60309.0	31011.0	12843.0	54740.0
4	-1.0	4697.0	26103.0	41382.0	13805.0	12757.0
5	-1.0	1674.0	1481.0	6843.0	8292.0	5266.0
6	-1.0	279.0	316.0	898.0	718.0	8404.0
7	-1.0	407.0	72.0	427.0	175.0	1450.0
8	-1.0	381.0	153.0	228.0	51.0	305.0
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

Table 6.4.5.3.c Modelled surveys indices by year, Norwegian spawninggrounds acoustic survey

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

Survey residuals by year

	1981	1982	1983	1984	1985	1986	1987	1988
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	-1.94	1.02	0.00	-1.73	0.09	0.78
3	0.01	0.00	-0.41	-0.75	0.00	-0.85	-0.06	0.21
4	-0.71	0.00	-0.40	-0.61	0.00	-0.67	0.73	0.51
5	-0.52	0.00	0.18	-0.59	0.00	-1.28	-0.07	1.08
6	-0.13	0.00	0.24	-0.54	0.00	-1.58	-1.34	1.09
7	0.08	0.00	0.55	-0.42	0.00	-1.41	-0.16	0.37
8	0.00	0.00	0.61	-0.72	0.00	-1.13	0.16	1.09
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	1989	1990	1991	1992	1993	1994	1995	1996
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.56	1.19	-0.25	-1.67	-0.02	-0.90	0.66	0.45
3	1.13	0.72	-0.30	0.12	-1.16	-0.93	0.42	0.04
4	0.48	0.68	0.35	-0.52	0.22	-0.81	0.11	0.34
5	0.79	0.41	1.17	-0.47	-0.24	0.21	0.47	-0.21
6	0.86	1.17	1.46	0.06	-0.12	-0.11	0.58	0.63
7	-0.20	0.89	1.33	0.28	-0.32	0.66	0.42	0.29
8	0.34	0.18	0.46	0.71	0.20	0.70	0.75	0.61
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	1997	1998	1999	2000	2001	2002
0	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	-0.50	0.24	0.01	0.86	1.13
3	0.00	0.29	0.30	0.33	0.08	0.81
4	0.00	-0.49	0.21	0.16	-0.12	0.57
5	0.00	-0.39	-0.60	-0.04	-0.23	0.33
6	0.00	-1.49	-1.30	-0.32	-1.38	0.86
7	0.00	-0.72	-2.07	-0.22	-0.97	0.49
8	0.00	-0.53	-0.81	0.00	-1.18	0.99
9	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00

Table 6.4.5.3.d Modelled surveys indices by year, Russian spawninggrounds acoustic survey

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

Modelled surveys indices by year, fleet 2

	1981	1982	1983	1984	1985	1986	1987	1988
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
3	-1.0	3476.9	2602.9	3007.2	7836.4	11220.0	7320.0	6046.7
4	-1.0	5855.4	3432.4	2510.6	2762.8	6799.2	9190.0	6216.4
5	-1.0	4230.3	4703.2	2684.8	1857.9	1950.7	4397.3	6017.0
6	-1.0	3836.0	3269.7	3529.7	1881.4	1234.6	1190.5	2739.3
7	-1.0	3816.5	2747.8	2244.6	2212.6	1081.0	636.7	650.1
8	-1.0	2941.1	2222.5	1515.7	1113.8	1010.2	426.9	262.2
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

	1989	1990	1991	1992	1993	1994	1995	1996
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
3	5940.9	5043.0	5769.6	26132.7	11994.2	8455.6	7303.8	8026.4
4	5190.0	4790.5	4245.3	8347.7	22612.6	10524.4	7444.5	6260.3
5	4115.9	3199.7	3080.6	3296.1	4377.9	11995.9	5625.6	3850.0
6	3685.3	2266.6	1859.8	1219.5	1343.1	1816.5	4977.8	2229.6
7	1481.9	1758.0	1100.0	544.6	680.0	772.3	1052.6	2747.3
8	272.3	562.8	711.2	268.0	309.1	399.8	453.3	577.8
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

Table 6.4.5.3.e Observed surveys indices by year, Russian spawninggrounds acoustic survey

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

	1981	1982	1983	1984	1985	1986	1987	1988
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
3	-1.0	540.0	2330.0	2900.0	13220.0	18750.0	4480.0	3710.0
4	-1.0	2750.0	2930.0	800.0	930.0	23180.0	19170.0	4550.0
5	-1.0	1340.0	9390.0	1100.0	580.0	2540.0	5860.0	8610.0
6	-1.0	1380.0	3880.0	4200.0	1780.0	610.0	1070.0	4130.0
7	-1.0	1570.0	1970.0	2200.0	860.0	620.0	500.0	1270.0
8	-1.0	2350.0	1370.0	1200.0	610.0	750.0	810.0	480.0
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

	1989	1990	1991	1992	1993	1994	1995	1996
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
2	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
3	11910.0	9740.0	10300.0	20010.0	4728.0	-1.0	12657.0	15285.0
4	7120.0	12140.0	5350.0	6700.0	12337.0	-1.0	10028.0	10629.0
5	6670.0	5740.0	5130.0	1350.0	5304.0	-1.0	8942.0	4897.0
6	6970.0	2580.0	2630.0	440.0	2249.0	-1.0	2651.0	6940.0
7	4580.0	1470.0	1770.0	390.0	1316.0	-1.0	1093.0	1482.0
8	2750.0	220.0	870.0	170.0	621.0	-1.0	408.0	653.0
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

Table 6.4.5.3.f Surveys residuals by year, Russian spawninggrounds acoustic survey

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

	1981	1982	1983	1984	1985	1986	1987	1988
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	-1.86	-0.11	-0.04	0.52	0.51	-0.49	-0.49
4	0.00	-0.76	-0.16	-1.14	-1.09	1.23	0.74	-0.31
5	0.00	-1.15	0.69	-0.89	-1.16	0.26	0.29	0.36
6	0.00	-1.02	0.17	0.17	-0.06	-0.71	-0.11	0.41
7	0.00	-0.89	-0.33	-0.02	-0.95	-0.56	-0.24	0.67
8	0.00	-0.22	-0.48	-0.23	-0.60	-0.30	0.64	0.60
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	1989	1990	1991	1992	1993	1994	1995	1996
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.70	0.66	0.58	-0.27	-0.93	0.00	0.55	0.64
4	0.32	0.93	0.23	-0.22	-0.61	0.00	0.30	0.53
5	0.48	0.58	0.51	-0.89	0.19	0.00	0.46	0.24
6	0.64	0.13	0.35	-1.02	0.52	0.00	-0.63	1.14
7	1.13	-0.18	0.48	-0.33	0.66	0.00	0.04	-0.62
8	2.31	-0.94	0.20	-0.46	0.70	0.00	-0.11	0.12
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 6.4.5.3.g Modelled surveys indices by year, Spanish CPUE

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

	1981	1982	1983	1984	1985	1986	1987	1988
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	-1.0	-1.0	6574.9	9828.3	6683.0	5368.9	5218.3	4583.2
2	-1.0	-1.0	5766.1	15299.7	22288.1	14577.0	11916.3	11817.0
3	-1.0	-1.0	4306.0	4814.7	12186.7	16670.9	11124.3	9366.3
4	-1.0	-1.0	2957.6	2084.1	2246.3	5155.7	7025.5	4866.2
5	-1.0	-1.0	2004.1	1095.7	741.0	723.8	1654.3	2274.2
6	-1.0	-1.0	1118.2	1135.7	579.0	348.4	348.5	807.6
7	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
8	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

	1989	1990	1991	1992	1993	1994	1995	1996
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	5089.2	12189.2	5517.9	3846.4	3296.7	3690.5	4687.9	14198.7
2	10108.0	11179.9	29678.9	13597.5	9548.5	8264.7	9159.3	11460.8
3	8785.5	7448.9	9592.1	25954.7	12011.4	8525.3	7258.8	7811.1
4	3855.7	3532.8	3671.2	4868.9	13288.8	6255.5	4339.3	3545.8
5	1444.7	1111.9	1292.1	1414.2	1899.3	5234.5	2390.5	1592.2
6	992.2	588.3	623.3	772.4	869.2	1191.1	3174.1	1364.2
7	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
8	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

	1997	1998	1999	2000	2001
0	-1.0	-1.0	-1.0	-1.0	-1.0
1	25452.2	12789.5	7339.9	16354.9	20597.4
2	34576.0	59601.1	29991.3	16608.1	34667.6
3	9656.9	27009.9	46215.9	21526.4	10332.1
4	3758.0	4189.9	11395.2	17568.7	6676.4
5	1287.0	1229.5	1358.6	3317.6	4285.5
6	900.6	635.0	607.2	577.1	1161.8
7	-1.0	-1.0	-1.0	-1.0	-1.0
8	-1.0	-1.0	-1.0	-1.0	-1.0
9	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0

Table 6.4.5.3.h Observed surveys indices by year, Spanish CPUE

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

	1981	1982	1983	1984	1985	1986	1987	1988
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	-1.0	-1.0	7196.0	13710.0	14573.0	3721.0	25328.0	7778.0
2	-1.0	-1.0	16392.0	27286.0	23823.0	14131.0	13153.0	21473.0
3	-1.0	-1.0	9311.0	14845.0	14126.0	14745.0	6664.0	18436.0
4	-1.0	-1.0	7476.0	4836.0	6256.0	7113.0	2938.0	6391.0
5	-1.0	-1.0	6326.0	1755.0	1232.0	1278.0	1029.0	1300.0
6	-1.0	-1.0	1718.0	1750.0	217.0	505.0	166.0	781.0
7	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
8	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

	1989	1990	1991	1992	1993	1994	1995	1996
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	15272.0	21444.0	15924.0	10007.0	4036.0	543.0	9090.0	3905.0
2	18486.0	19407.0	15370.0	24235.0	13991.0	6066.0	14409.0	14557.0
3	17160.0	5194.0	4989.0	9671.0	22493.0	15917.0	6833.0	14449.0
4	8374.0	1803.0	2329.0	4316.0	7979.0	7474.0	4551.0	3931.0
5	3760.0	1357.0	1045.0	1194.0	1354.0	2990.0	1990.0	3639.0
6	1003.0	451.0	440.0	462.0	658.0	1055.0	623.0	1834.0
7	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
8	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

	1997	1998	1999	2000	2001
0	-1.0	-1.0	-1.0	-1.0	-1.0
1	8742.0	5884.0	2048.0	6207.0	16223.0
2	15875.0	13236.0	10268.0	15518.0	16488.0
3	11134.0	9803.0	20242.0	13987.0	6830.0
4	3698.0	10844.0	9833.0	5375.0	1620.0
5	1046.0	5229.0	6287.0	1264.0	1148.0
6	450.0	1153.0	3047.0	1414.0	162.0
7	-1.0	-1.0	-1.0	-1.0	-1.0
8	-1.0	-1.0	-1.0	-1.0	-1.0
9	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0

Table 6.4.5.3.i Survey residuals by year, Spanish CPUE

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

	1981	1982	1983	1984	1985	1986	1987	1988
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.00	0.00	0.09	0.33	0.78	-0.37	1.58	0.53
2	0.00	0.00	1.04	0.58	0.07	-0.03	0.10	0.60
3	0.00	0.00	0.77	1.13	0.15	-0.12	-0.51	0.68
4	0.00	0.00	0.93	0.84	1.02	0.32	-0.87	0.27
5	0.00	0.00	1.15	0.47	0.51	0.57	-0.47	-0.56
6	0.00	0.00	0.43	0.43	-0.98	0.37	-0.74	-0.03
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	1989	1990	1991	1992	1993	1994	1995	1996
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	1.10	0.56	1.06	0.96	0.20	-1.92	0.66	-1.29
2	0.60	0.55	-0.66	0.58	0.38	-0.31	0.45	0.24
3	0.67	-0.36	-0.65	-0.99	0.63	0.62	-0.06	0.62
4	0.78	-0.67	-0.46	-0.12	-0.51	0.18	0.05	0.10
5	0.96	0.20	-0.21	-0.17	-0.34	-0.56	-0.18	0.83
6	0.01	-0.27	-0.35	-0.51	-0.28	-0.12	-1.63	0.30
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	1997	1998	1999	2000	2001
0	0.00	0.00	0.00	0.00	0.00
1	-1.07	-0.78	-1.28	-0.97	-0.24
2	-0.78	-1.50	-1.07	-0.07	-0.74
3	0.14	-1.01	-0.83	-0.43	-0.41
4	-0.02	0.95	-0.15	-1.18	-1.42
5	-0.21	1.45	1.53	-0.96	-1.32
6	-0.69	0.60	1.61	0.90	-1.97
7	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00

Table 6.4.5.3.j Modelled surveys indices by year, Norwegian Sea acoustic survey

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

Modelled surveys indices by year

	1981	1982	1983	1984	1985	1986	1987	1988
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	1212.1	1436.9	4007.3	5990.1	4073.1	3272.2	3180.4	2793.4
2	1426.0	1064.7	1246.4	3307.1	4817.6	3150.9	2575.7	2554.3
3	2775.5	1615.2	1197.3	1338.7	3388.5	4635.4	3093.1	2604.3
4	2104.0	2315.5	1342.2	945.8	1019.4	2339.8	3188.3	2208.4
5	1515.1	1275.8	1404.4	767.8	519.2	507.2	1159.2	1593.7
6	1321.3	936.2	783.6	795.8	405.7	244.2	244.2	565.9
7	1042.2	773.5	543.3	413.9	392.6	172.0	103.9	109.8
8	845.2	571.7	418.6	263.0	183.4	146.5	61.4	39.0
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

	1989	1990	1991	1992	1993	1994	1995	1996
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	3101.7	7429.0	6144.6	4283.2	3671.1	4109.7	5220.4	15811.3
2	2184.9	2416.6	6209.1	2844.7	1997.7	1729.1	1916.2	2397.7
3	2442.8	2071.2	2379.9	6439.6	2980.1	2115.2	1801.0	1938.0
4	1749.8	1603.3	991.8	1315.3	3589.9	1689.9	1172.3	957.9
5	1012.4	779.2	306.2	335.1	450.0	1240.3	566.4	377.3
6	695.3	412.3	147.7	183.0	205.9	282.2	752.1	323.2
7	232.6	270.6	73.9	84.7	108.3	124.0	162.9	406.7
8	35.9	74.1	45.5	39.4	46.7	61.4	66.0	78.4
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

	1997	1998	1999	2000	2001
0	-1.0	-1.0	-1.0	-1.0	-1.0
1	28342.8	14242.0	8173.5	18212.3	22936.7
2	7233.7	12469.2	6274.5	3474.6	7252.8
3	2396.0	6701.4	11466.6	5340.9	2563.5
4	1015.2	1131.9	3078.4	4746.1	1803.6
5	305.0	291.3	321.9	786.1	1015.4
6	213.4	150.4	143.9	136.7	275.3
7	171.3	95.6	66.3	53.9	39.2
8	191.8	65.3	34.8	18.6	10.1
9	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0

Table 6.4.5.3.k Observed surveys indices by year, Norwegian Sea acoustic survey

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

	1981	1982	1983	1984	1985	1986	1987	1988
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	182.0	184.0	22356.0	30380.0	5969.0	2324.0	8204.0	4992.0
2	728.0	460.0	396.0	13916.0	23876.0	2380.0	4032.0	2880.0
3	4542.0	1242.0	468.0	833.0	12502.0	7224.0	5180.0	2640.0
4	3874.0	4715.0	756.0	392.0	658.0	6944.0	5572.0	3480.0
5	2678.0	3611.0	1404.0	539.0	423.0	1876.0	1204.0	912.0
6	2834.0	3128.0	576.0	539.0	188.0	952.0	224.0	120.0
7	2964.0	2323.0	468.0	343.0	235.0	336.0	168.0	96.0
8	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

	1989	1990	1991	1992	1993	1994	1995	1996
0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
1	1172.0	-1.0	-1.0	792.0	830.0	-1.0	6974.0	23464.0
2	1125.0	-1.0	-1.0	1134.0	125.0	-1.0	2811.0	1057.0
3	812.0	-1.0	-1.0	6939.0	1070.0	-1.0	1999.0	899.0
4	379.0	-1.0	-1.0	766.0	6392.0	-1.0	1209.0	649.0
5	410.0	-1.0	-1.0	247.0	1222.0	-1.0	1622.0	436.0
6	212.0	-1.0	-1.0	172.0	489.0	-1.0	775.0	505.0
7	22.0	-1.0	-1.0	90.0	248.0	-1.0	173.0	755.0
8	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
9	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0

	1997	1998	1999	2000	2001
0	-1.0	-1.0	-1.0	-1.0	-1.0
1	30227.0	24244.0	14367.0	25813.0	61470.0
2	25638.0	47815.0	9750.0	3298.0	22051.0
3	1524.0	16282.0	23701.0	2721.0	7883.0
4	779.0	556.0	9754.0	3078.0	3225.0
5	300.0	212.0	1733.0	23.0	1824.0
6	407.0	100.0	466.0	46.0	156.0
7	260.0	64.0	79.0	6.0	12.0
8	-1.0	-1.0	-1.0	-1.0	-1.0
9	-1.0	-1.0	-1.0	-1.0	-1.0
10	-1.0	-1.0	-1.0	-1.0	-1.0

Table 6.4.5.3.l Survey residuals by year, Norwegian Sea acoustic survey

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

	1981	1982	1983	1984	1985	1986	1987	1988
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	-1.90	-2.06	1.72	1.62	0.38	-0.34	0.95	0.58
2	-0.67	-0.84	-1.15	1.44	1.60	-0.28	0.45	0.12
3	0.49	-0.26	-0.94	-0.47	1.31	0.44	0.52	0.01
4	0.61	0.71	-0.57	-0.88	-0.44	1.09	0.56	0.45
5	0.57	1.04	0.00	-0.35	-0.20	1.31	0.04	-0.56
6	0.76	1.21	-0.31	-0.39	-0.77	1.36	-0.09	-1.55
7	1.05	1.10	-0.15	-0.19	-0.51	0.67	0.48	-0.13
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	1989	1990	1991	1992	1993	1994	1995	1996
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	-0.97	0.00	0.00	-1.69	-1.49	0.00	0.29	0.39
2	-0.66	0.00	0.00	-0.92	-2.77	0.00	0.38	-0.82
3	-1.10	0.00	0.00	0.07	-1.02	0.00	0.10	-0.77
4	-1.53	0.00	0.00	-0.54	0.58	0.00	0.03	-0.39
5	-0.90	0.00	0.00	-0.30	1.00	0.00	1.05	0.14
6	-1.19	0.00	0.00	-0.06	0.86	0.00	0.03	0.45
7	-2.36	0.00	0.00	0.06	0.83	0.00	0.06	0.62
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

	1997	1998	1999	2000	2001
0	0.00	0.00	0.00	0.00	0.00
1	0.06	0.53	0.56	0.35	0.99
2	1.27	1.34	0.44	-0.05	1.11
3	-0.45	0.89	0.73	-0.67	1.12
4	-0.26	-0.71	1.15	-0.43	0.58
5	-0.02	-0.32	1.68	-3.53	0.59
6	0.65	-0.41	1.18	-1.09	-0.57
7	0.42	-0.40	0.17	-2.19	-1.18
8	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00

Table 6.4.5.4 Fishing mortalities at age and Fref=F3-7

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

	1981	1982	1983	1984	1985	1986	1987	1988
0	0.0248	0.3775	0.2366	0.2080	0.2406	0.1674	0.1265	0.0647
1	0.0758	0.0528	0.0939	0.1283	0.1418	0.1635	0.1433	0.1185
2	0.1138	0.0871	0.1084	0.1605	0.1844	0.2295	0.2029	0.1829
3	0.1911	0.1401	0.1559	0.2079	0.2540	0.3265	0.2906	0.2602
4	0.2467	0.1831	0.2008	0.2602	0.2933	0.4039	0.3908	0.3532
5	0.2914	0.2070	0.2229	0.2916	0.3283	0.4428	0.4208	0.4132
6	0.3913	0.2790	0.3080	0.4052	0.4760	0.6139	0.5562	0.5446
7	0.4511	0.3215	0.3611	0.4724	0.5339	0.7078	0.6679	0.6129
8	0.5375	0.3882	0.4386	0.5695	0.6532	0.8571	0.8693	0.8186
9	0.5916	0.4377	0.4937	0.6389	0.7167	1.0543	1.0507	0.9888
10	0.5645	0.4011	0.4175	0.5116	0.5582	0.7391	0.7030	0.6226
Fref	0.3143	0.2262	0.2497	0.3275	0.3771	0.4990	0.4652	0.4368

Total yearly fishing mortalities at age

	1989	1990	1991	1992	1993	1994	1995	1996
0	0.1468	0.0863	0.0443	0.0275	0.0566	0.0334	0.1797	0.1308
1	0.1422	0.1359	0.0542	0.0601	0.0550	0.0520	0.0573	0.0730
2	0.2212	0.2207	0.0957	0.0989	0.0884	0.0774	0.0904	0.1077
3	0.3336	0.3354	0.1476	0.1531	0.1400	0.1292	0.1521	0.1854
4	0.4361	0.4477	0.1948	0.2030	0.1910	0.1730	0.2040	0.2496
5	0.5305	0.5464	0.2477	0.2448	0.2271	0.2179	0.2601	0.3033
6	0.6890	0.7471	0.3406	0.3342	0.3000	0.2790	0.3236	0.3894
7	0.7301	0.7614	0.3553	0.3613	0.3237	0.3097	0.3688	0.4398
8	1.0139	1.0160	0.4351	0.4550	0.4107	0.3838	0.4690	0.5815
9	1.2815	1.4255	0.5898	0.5755	0.5233	0.5284	0.6095	0.7439
10	0.7467	1.1502	0.5061	0.4861	0.4151	0.3715	0.4184	0.4941
Fref	0.5439	0.5676	0.2572	0.2593	0.2363	0.2217	0.2617	0.3135

Total yearly fishing mortalities at age

	1997	1998	1999	2000	2001	2002	2003	2004
0	0.0792	0.0615	0.0361	0.0279	0.0363	0.0363	0.0363	0.0363
1	0.0713	0.0996	0.0926	0.1132	0.1555	0.1555	0.1555	0.1555
2	0.1090	0.1573	0.1494	0.1946	0.2693	0.2693	0.2693	0.2693
3	0.1963	0.2893	0.2874	0.3842	0.5494	0.5494	0.5494	0.5494
4	0.2606	0.3864	0.3993	0.5292	0.7595	0.7595	0.7595	0.7595
5	0.3057	0.4327	0.4133	0.5444	0.7335	0.7335	0.7335	0.7335
6	0.3898	0.5615	0.5285	0.7235	0.9351	0.9351	0.9351	0.9351
7	0.4483	0.6620	0.6371	0.8541	1.1451	1.1451	1.1451	1.1451
8	0.5889	0.8612	0.8630	1.2164	1.6980	1.6980	1.6980	1.6980
9	0.7660	1.0730	1.0142	1.3562	2.5700	2.5700	2.5700	2.5700
10	0.5550	0.7722	0.7361	0.9857	1.3548	1.3548	1.3548	1.3548
Fref	0.3202	0.4664	0.4531	0.6071	0.8245	0.8245	0.8245	0.8245

Table 6.4.5.5 Stock numbers-at-age (*106)

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

Data by 1. Jan., except at youngest age which are
at recruitment time

	1981	1982	1983	1984	1985	1986	1987	1988
0	4055.3	16639.7	22220.2	14847.7	12544.8	11151.7	9213.8	9810.1
1	3074.8	3579.4	10322.6	15869.9	10911.7	8923.6	8534.8	7346.6
2	3192.6	2333.8	2779.7	7694.0	11428.3	7752.7	6204.0	6054.6
3	4174.6	2332.7	1751.3	2042.0	5365.4	7781.3	5045.6	4146.5
4	2698.9	2823.3	1660.2	1226.9	1358.0	3407.4	4596.4	3089.4
5	2193.0	1726.5	1924.8	1111.9	774.4	829.3	1862.8	2545.9
6	2071.4	1341.7	1149.2	1261.0	680.1	456.6	436.0	1001.2
7	1713.5	1146.7	831.0	691.5	688.5	345.9	202.3	204.7
8	1488.8	893.6	680.7	474.2	353.0	330.5	139.5	84.9
9	1216.5	712.1	496.2	359.4	219.7	150.4	114.8	47.9
10	3117.3	2498.1	2089.7	1601.0	1081.4	673.4	344.0	201.4

	1989	1990	1991	1992	1993	1994	1995	1996
0	25384.2	10114.2	6792.6	5701.1	6554.0	8169.1	29012.2	49460.8
1	8320.7	19833.2	8395.2	5879.8	5018.5	5604.0	7149.2	21933.0
2	5343.0	5909.2	14174.1	6510.8	4533.4	3888.9	4355.6	5527.3
3	4128.4	3506.5	3879.8	10545.4	4828.6	3397.4	2946.7	3257.8
4	2617.0	2421.2	2052.8	2740.7	7408.1	3437.0	2444.5	2072.2
5	1776.7	1385.3	1266.9	1383.3	1831.6	5010.7	2367.0	1632.0
6	1378.9	855.8	656.7	809.7	886.7	1194.9	3299.2	1494.1
7	475.5	566.8	331.9	382.5	474.6	537.8	740.1	1954.5
8	90.8	187.6	216.7	190.5	218.2	281.1	323.0	419.1
9	30.7	27.0	55.6	114.8	99.0	118.5	156.8	165.5
10	116.1	58.1	24.9	60.3	131.0	162.5	201.2	241.7

	1997	1998	1999	2000	2001	2002	2003	2004
0	24158.8	13545.7	29937.1	38754.5	11760.0	16483.9	16483.9	16483.9
1	39265.3	20195.4	11525.8	26126.8	34102.0	10262.0	14384.2	14384.2
2	16693.8	29934.3	14967.6	8601.7	19101.3	23900.0	7192.0	10081.0
3	4063.3	12256.1	20940.4	10554.0	5797.4	11946.8	14948.1	4498.2
4	2215.8	2733.9	7513.4	12862.7	5884.2	2740.1	5646.7	7065.2
5	1321.8	1397.9	1521.0	4126.5	6203.8	2254.1	1049.7	2163.1
6	986.6	797.1	742.5	823.7	1960.1	2439.2	886.3	412.7
7	828.7	547.0	372.2	358.4	327.1	630.0	784.0	284.8
8	1030.8	433.3	231.0	161.2	124.9	85.2	164.1	204.2
9	191.8	468.4	150.0	79.8	39.1	18.7	12.8	24.6
10	243.2	252.8	341.5	217.6	97.7	25.1	7.4	3.0

Table 6.4.5.6 Results of stock assessment

Blue whiting, Output from final AMCI run
Run id 20020504 152739.761

SUMMARY TABLE

Year	Recruits age 0 (10^3)	SSB	Mean F at age 3-7	Catch (SOP)
1981	4055289	2524227	0.3143	924804
1982	16639719	2076892	0.2262	613859
1983	22220166	1701049	0.2497	562084
1984	14847654	1415142	0.3275	630753
1985	12544761	1543316	0.3771	696998
1986	11151699	1728281	0.4990	849665
1987	9213750	1546722	0.4652	662561
1988	9810064	1365409	0.4368	553690
1989	25384230	1293635	0.5439	657602
1990	10114204	1175685	0.5676	560950
1991	6792609	1514241	0.2572	369806
1992	5701122	2026704	0.2593	475048
1993	6554003	1987685	0.2363	480733
1994	8169103	1959444	0.2217	459082
1995	29012229	1819742	0.2617	577921
1996	49460845	1694646	0.3135	636090
1997	24158783	1870973	0.3202	646242
1998	13545724	2648888	0.4664	1133373
1999	29937139	3043905	0.4531	1265898
2000	38754471	2784253	0.6071	1416451
2001	11760000	2561316	0.8245	1777957

Table 6.5.1. Blue Whiting. Input data for the deterministic short-term prediction

MFDP version 1a
Run: bw02
Time and date: 17:29 04/05/02
Fbar age range: 3-7

2002								
Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. spaw.	Prop. of M bef. spaw.	Weight in stock	Exploit. pattern	Weight in catch
0	13983	0.2	0.00	0.25	0.25	0.035	0.036	0.035
1	10262	0.2	0.11	0.25	0.25	0.057	0.156	0.057
2	23900	0.2	0.40	0.25	0.25	0.077	0.269	0.077
3	11947	0.2	0.82	0.25	0.25	0.089	0.549	0.089
4	2740	0.2	0.86	0.25	0.25	0.107	0.760	0.107
5	2254	0.2	0.91	0.25	0.25	0.135	0.734	0.135
6	2439	0.2	0.94	0.25	0.25	0.163	0.935	0.163
7	630	0.2	1.00	0.25	0.25	0.188	1.145	0.188
8	85	0.2	1.00	0.25	0.25	0.191	1.698	0.191
9	19	0.2	1.00	0.25	0.25	0.218	2.570	0.218
10	25	0.2	1.00	0.25	0.25	0.243	1.355	0.243

2003								
Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. spaw.	Prop. of M bef. spaw.	Weight in stock	Exploit. pattern	Weight in catch
0	13983	0.2	0.00	0.25	0.25	0.035	0.036	0.035
1	.	0.2	0.11	0.25	0.25	0.057	0.156	0.057
2	.	0.2	0.40	0.25	0.25	0.077	0.269	0.077
3	.	0.2	0.82	0.25	0.25	0.089	0.549	0.089
4	.	0.2	0.86	0.25	0.25	0.107	0.760	0.107
5	.	0.2	0.91	0.25	0.25	0.135	0.734	0.135
6	.	0.2	0.94	0.25	0.25	0.163	0.935	0.163
7	.	0.2	1.00	0.25	0.25	0.188	1.145	0.188
8	.	0.2	1.00	0.25	0.25	0.191	1.698	0.191
9	.	0.2	1.00	0.25	0.25	0.218	2.570	0.218
10	.	0.2	1.00	0.25	0.25	0.243	1.355	0.243

2004								
Age	Stock size	Natural mortality	Maturity ogive	Prop. of F bef. spaw.	Prop. of M bef. spaw.	Weight in stock	Exploit. pattern	Weight in catch
0	13983	0.2	0.00	0.25	0.25	0.035	0.036	0.035
1	.	0.2	0.11	0.25	0.25	0.057	0.156	0.057
2	.	0.2	0.40	0.25	0.25	0.077	0.269	0.077
3	.	0.2	0.82	0.25	0.25	0.089	0.549	0.089
4	.	0.2	0.86	0.25	0.25	0.107	0.760	0.107
5	.	0.2	0.91	0.25	0.25	0.135	0.734	0.135
6	.	0.2	0.94	0.25	0.25	0.163	0.935	0.163
7	.	0.2	1.00	0.25	0.25	0.188	1.145	0.188
8	.	0.2	1.00	0.25	0.25	0.191	1.698	0.191
9	.	0.2	1.00	0.25	0.25	0.218	2.570	0.218
10	.	0.2	1.00	0.25	0.25	0.243	1.355	0.243

Input units are millions and kg - output in kilotonnes

Table 6.5.2 Blue Whiting. Prediction with management option table:
Basis for 2002: F2002 = F2001; Recruitment: GM 1981-2000 = 13 983 millions

MFDP version 1a
run: bw02
Blue whiting combined stock, 2002 WG
Time and date: 17:29 04/05/02
Fbar age range: 3-7
Basis for 2002: F2002 = F2001; Recruitment: GM 1981-2000 = 13 982 millions

2002					2003					2004	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
5113	2238	1	0.8245	1505	4073	2238	0.0	0.000	0	4720	2756
					.	2202	0.1	0.083	169	4537	2559
					.	2167	0.2	0.165	327	4365	2378
					.	2132	0.3	0.247	476	4204	2214
					.	2098	0.4	0.330	615	4053	2063
					.	2065	0.5	0.412	747	3912	1924
					.	2033	0.6	0.495	870	3779	1797
					.	2001	0.7	0.577	986	3654	1680
					.	1969	0.8	0.660	1096	3536	1573
					.	1938	0.9	0.742	1199	3425	1474
					.	1908	1.0	0.825	1296	3321	1383
					.	1878	1.1	0.907	1388	3222	1298
					.	1849	1.2	0.989	1475	3129	1220
					.	1820	1.3	1.072	1557	3042	1148
					.	1792	1.4	1.154	1635	2958	1082
					.	1764	1.5	1.237	1709	2880	1020
					.	1737	1.6	1.319	1779	2805	962
					.	1711	1.7	1.402	1846	2735	909
					.	1684	1.8	1.484	1909	2668	860
					.	1659	1.9	1.567	1969	2605	814
					.	1633	2.0	1.649	2026	2545	771

Input units are millions and kg - output in kilotonnes

Table 6.6.1 Blue whiting. Medium term projections

Catch in 2002 1.45 million tonn

	Probabilities (%)				Year when	Year when	Fractiles of catch in 2002			Fractiles of catch in 2003		
F in 2003	B<Blim		B>Bpa		risk B<Blim is	prob. B>Bpa						
and after	2003	2012	2003	2012	below 5%	is above 95%	25%	50%	75%	25%	50%	75%
0.05	17.9	0.0	38.5	100.0	2004	2006		1450		77	98	121
0.10	18.8	0.0	37.6	100.0	2004	2006				151	192	238
0.15	19.5	0.0	36.3	100.0	2005	2007				223	283	350
0.20	20.5	0.0	35.4	97.5	2005	2010				291	370	458
0.25	21.2	0.0	34.3	89.5	2005	>2012				358	454	561
0.30	22.6	0.7	33.5	74.1	2006	>2012				422	534	660
0.32=Fpa	22.9	1.6	33.2	67.3	2006	>2012				446	565	699
0.35	23.5	2.9	32.3	57.3	2007	>2012				483	612	756
0.40	24.7	7.1	31.2	37.9	>2012	>2012				541	686	847

F in 2002 equals F in 2001 (F=0.8245)

	Probabilities (%)				Year when	Year when	Fractiles of catch in 2002			Fractiles of catch in 2003		
F in 2003	B<Blim		B>Bpa		risk B<Blim is	prob. B>Bpa						
and after	2003	2012	2003	2012	below 5%	is above 95%	25%	50%	75%	25%	50%	75%
0.05	4.1	0.0	38.8	100.0	2003	2005	1216	1374	1558	89	102	117
0.10	4.6	0.0	36.9	100.0	2003	2005				174	200	230
0.15	5.5	0.0	35.8	99.8	2004	2006				255	294	336
0.20	5.8	0.0	34.4	97.7	2004	2008				334	384	440
0.25	6.6	0.0	32.2	89.7	2004	>2012				409	470	540
0.30	7.4	0.6	30.7	74.6	2004	>2012				481	554	635
0.32=Fpa	7.4	1.3	30.4	68.2	2004	>2012				509	586	672
0.35	7.8	2.6	29.9	58.1	2004	>2012				551	634	726
0.40	8.7	6.9	28.2	38.8	>2012	>2012				618	711	815

Table 6.10.1 Blue whiting. Total landings, No. of samples, No. fish measured and No. fish aged by country and quarter for 2001.

Country	Quarter	Landings (t)	No. of samples	No. fish measured	No. fish aged
Denmark	1	14,952	5	402	
	2	18,480			
	3	7,499	4	161	
	4	12,402	13	258	
	Total	53,333	22	821	0
Faroe Islands	1	53,131	17	3,138	1,568
	2	116,732	13	2,749	1,095
	3	71,431	11	2,368	1,000
	4	18,468	9	2,049	800
	Total	259,761	50	10,304	4,463
France	1	10,166			
	2	3,168			
	3	0			
	4	146			
	Total	13,480	0	0	0
Germany	1	7,123	5	2,596	
	2	9,439			
	3	2,379			
	4	119			
	Total	19,060	5	2,596	0
Iceland	1	1,802	1	100	50
	2	51,335	17	1,240	779
	3	240,549	52	4,710	2,549
	4	71,415	5	500	250
	Total	365,101	75	6,550	3,628
Ireland	1	16,990	6	504	504
	2	12,864	1	88	
	3	0			
	4	0			
	Total	29,854	7	592	504
Norway	1	169,665	28	1,905	500
	2	309,857	79	5,243	2,064
	3	83,941	45	3,164	1,110
	4	9,848	7	403	150
	Total	573,310	159	10,715	3,824
Portugal	1	227	51	5,712	245
	2	621	82	9,256	96
	3	507	72	8,114	81
	4	391	60	7,255	107
	Total	1,746	265	30,337	529
Russia	1	28,972	18	4,523	
	2	117,758	14	12,707	694
	3	98,009	31	14,188	1,327
	4	70,739	18	53,565	830
	Total	315,478	81	84,983	2,851
Scotland	1	37,258			
	2	12,889			
	3	0			
	4	0			
	Total	50,147	0	0	0
Spain	1	6,130	83	6,218	268
	2	5,836	72	5,604	446
	3	5,641	74	5,657	273
	4	5,612	77	5,455	834
	Total	23,218	306	22,934	1,821
Sweden	1	230			
	2	1,051			
	3	488			
	4	317			
	Total	2,086	0	0	0
The Netherlands	1	46,906	2	349	50
	2	24,674	5	1,284	125
	3	0			
	4	2,015	8	2,088	200
	Total	73,595	15	3,721	375
Grand Total		1,780,170	985	173,553	17,995

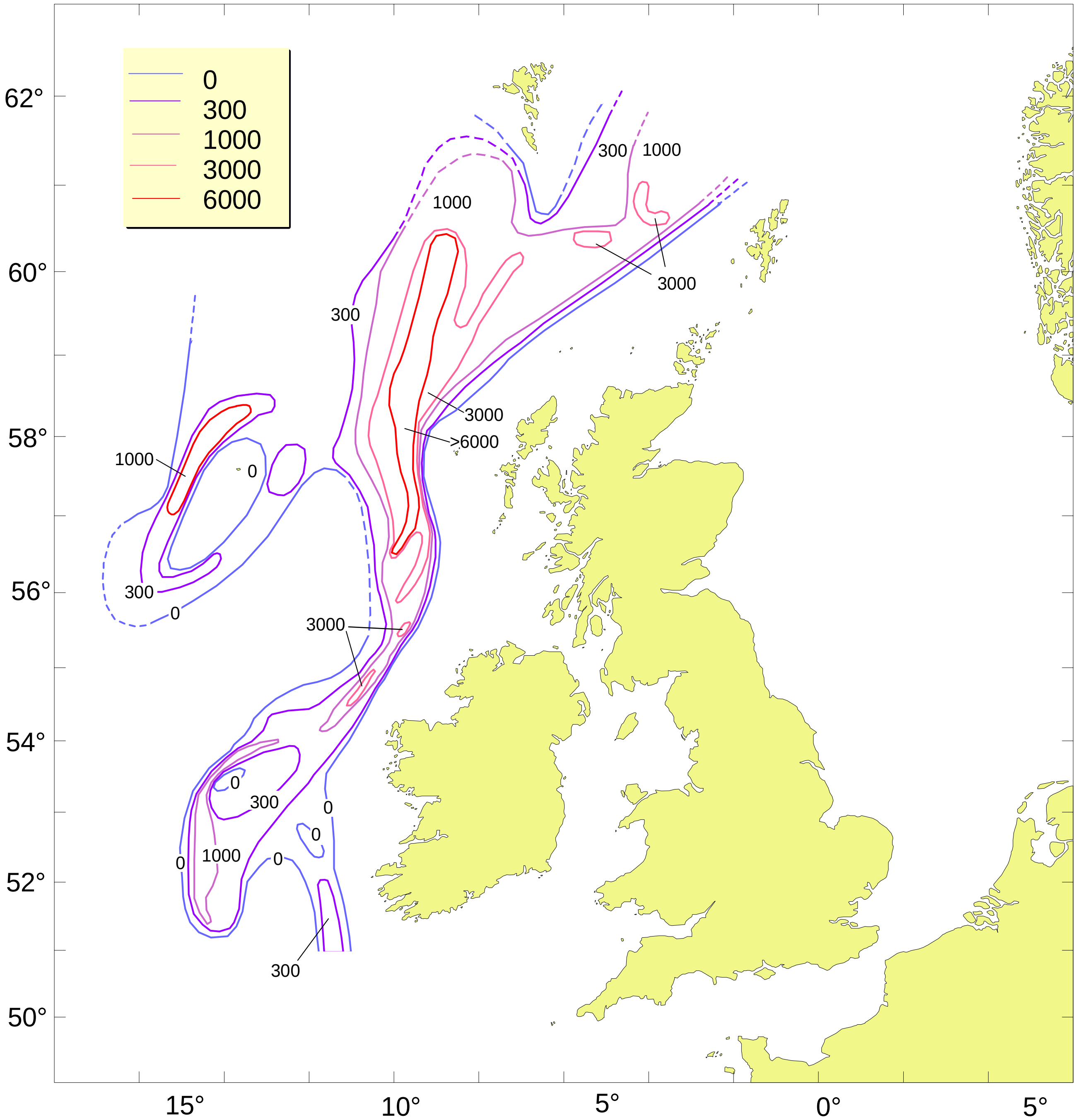


Figure 6.4.1.1. Distribution of blue whiting, R.V. "Johan Hjort" , spring 2002. Echo intensity (S_A-values) in $m^2/(n.mile)^2$.

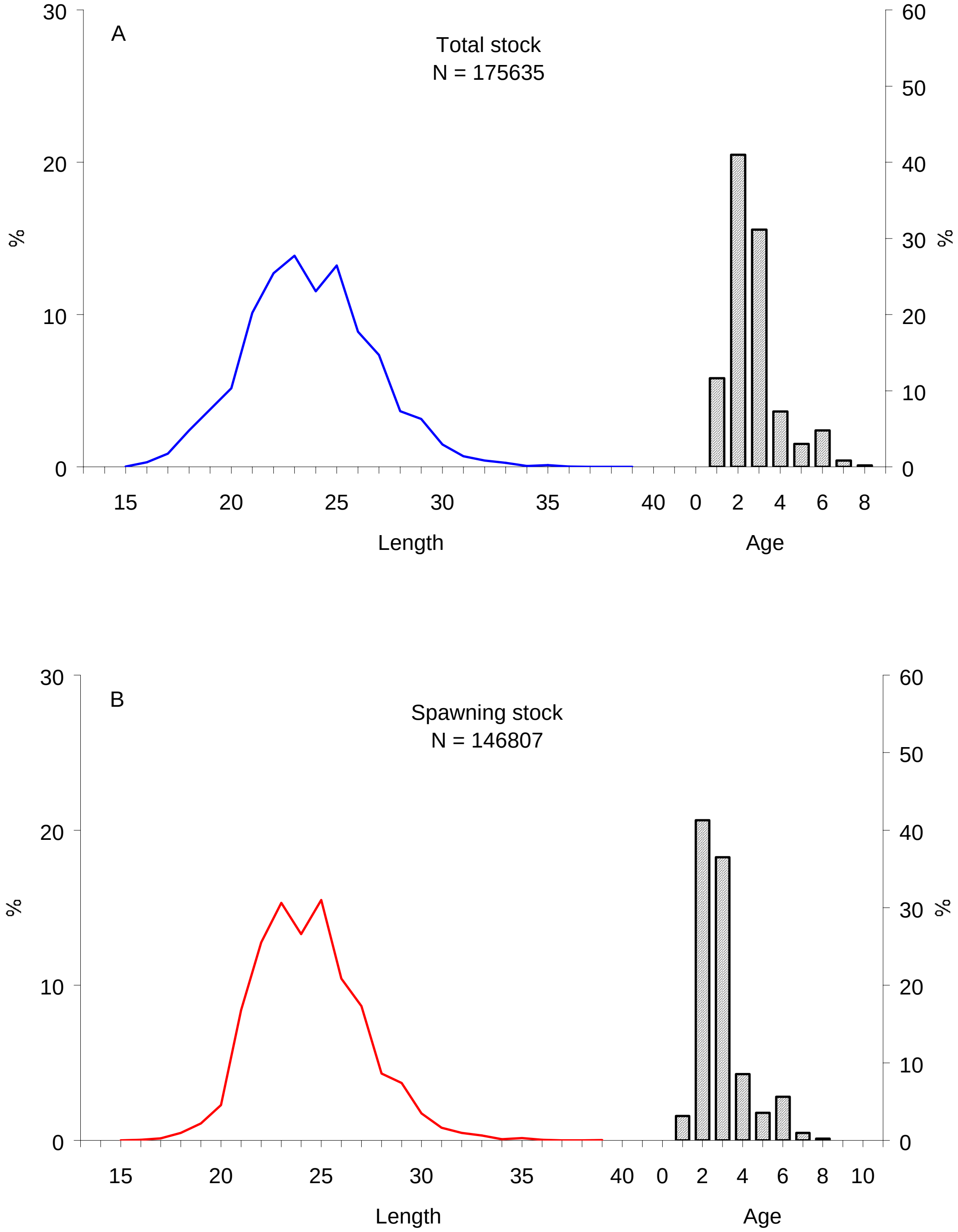
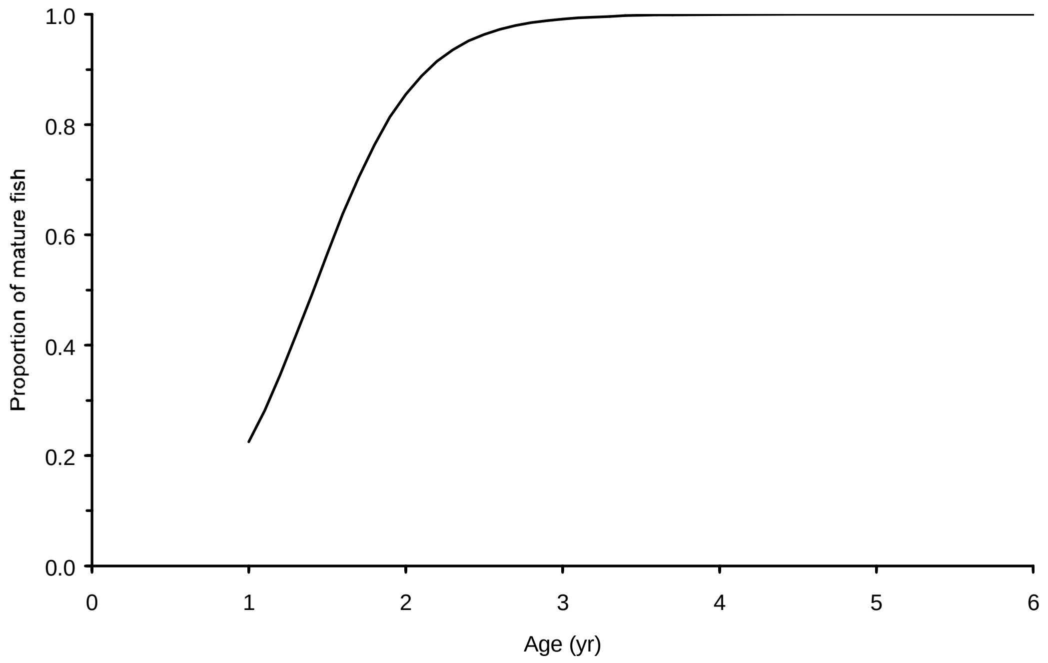


Figure 6.4.1.2 Total (A) and spawning (B) stocks length and age distribution of blue whiting in the area to the west of The British Isles, spring 2002. N*10^{-6}, weighted by abundance in survey strata.



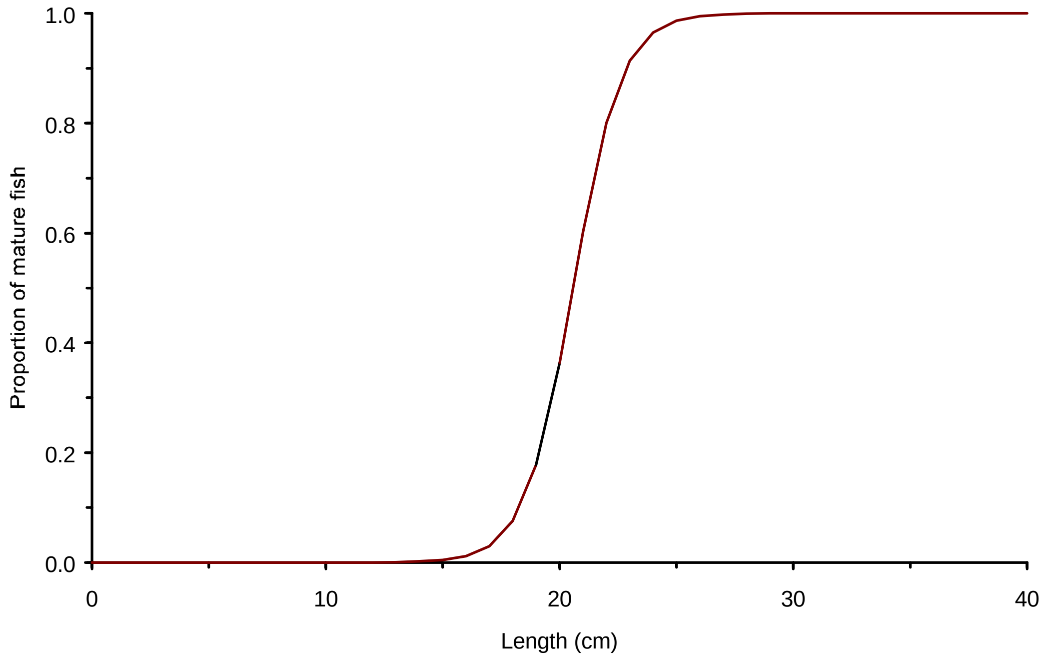


Figure 6.4.1.3. Maturity ogive of blue whiting in the area to the west of The British Isles in spring 2002 by age (upper panel) and length (lower panel).

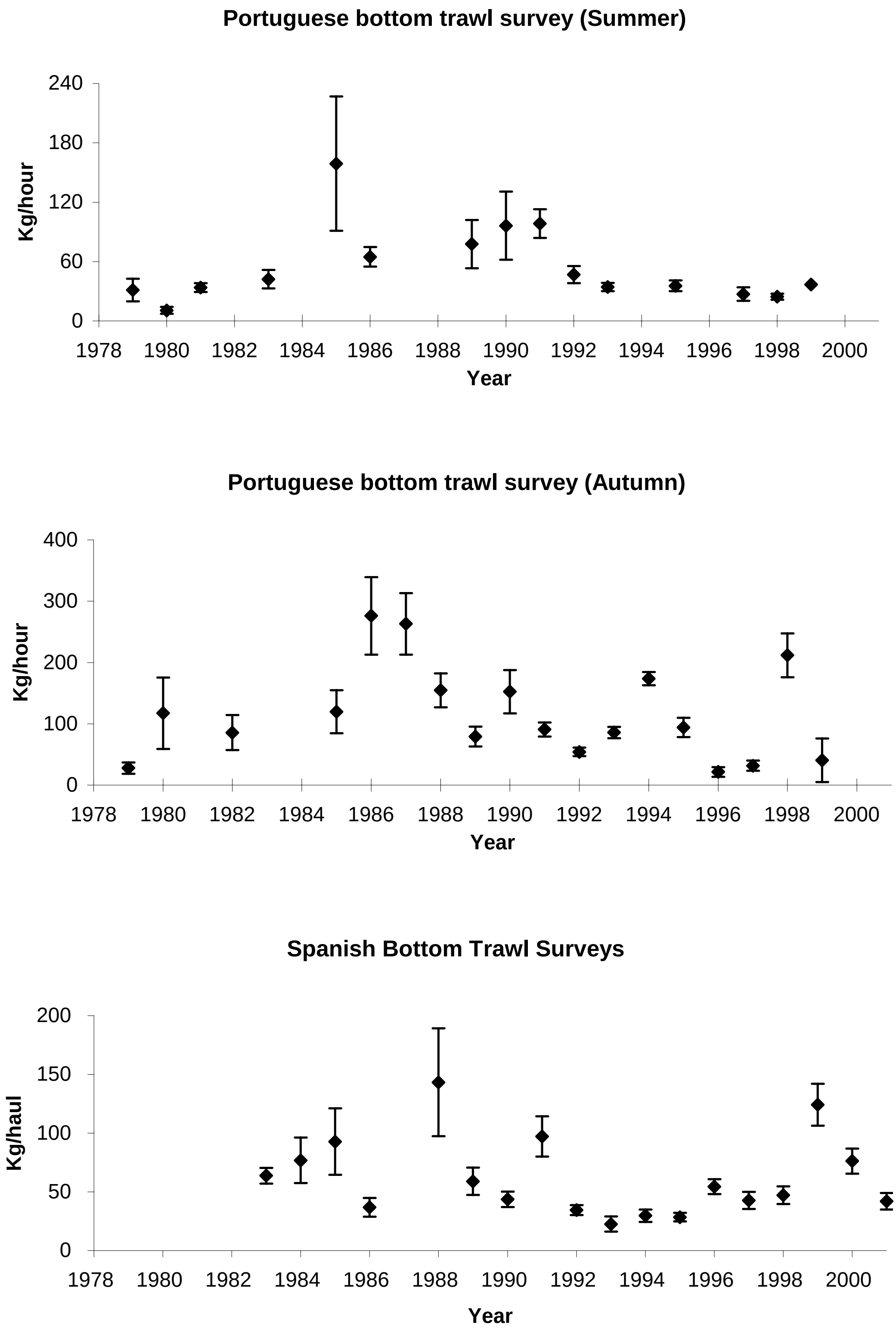


Figure 6.4.2.1 Mean catch rates in the bottom trawl surveys from the southern area.

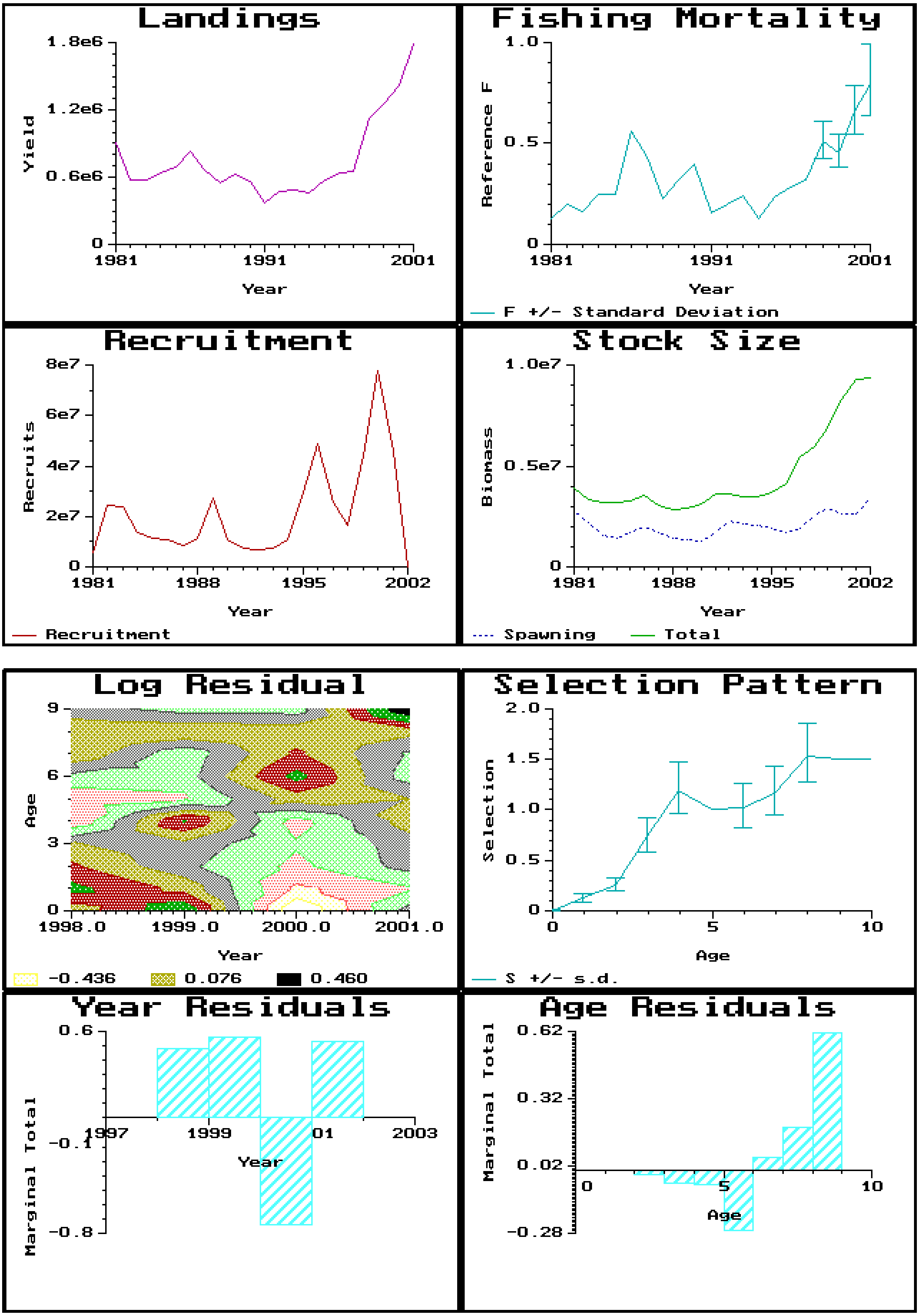
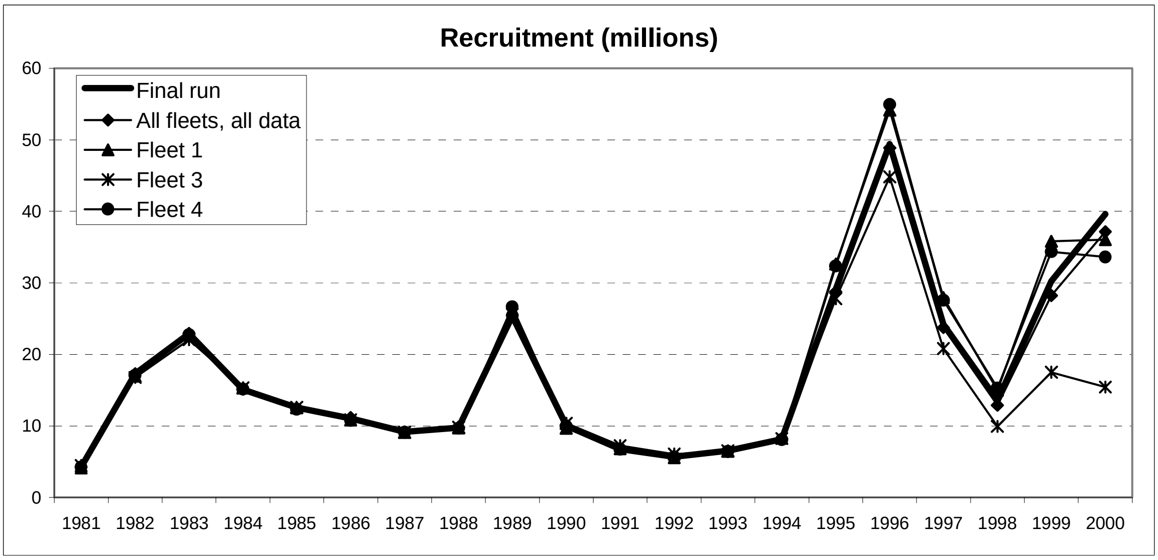
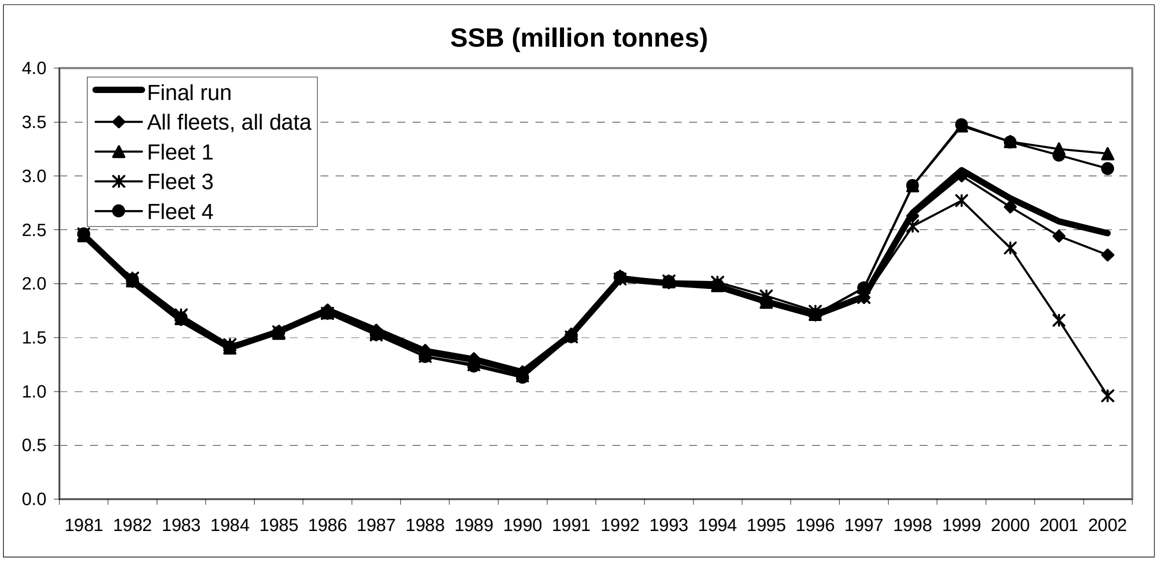
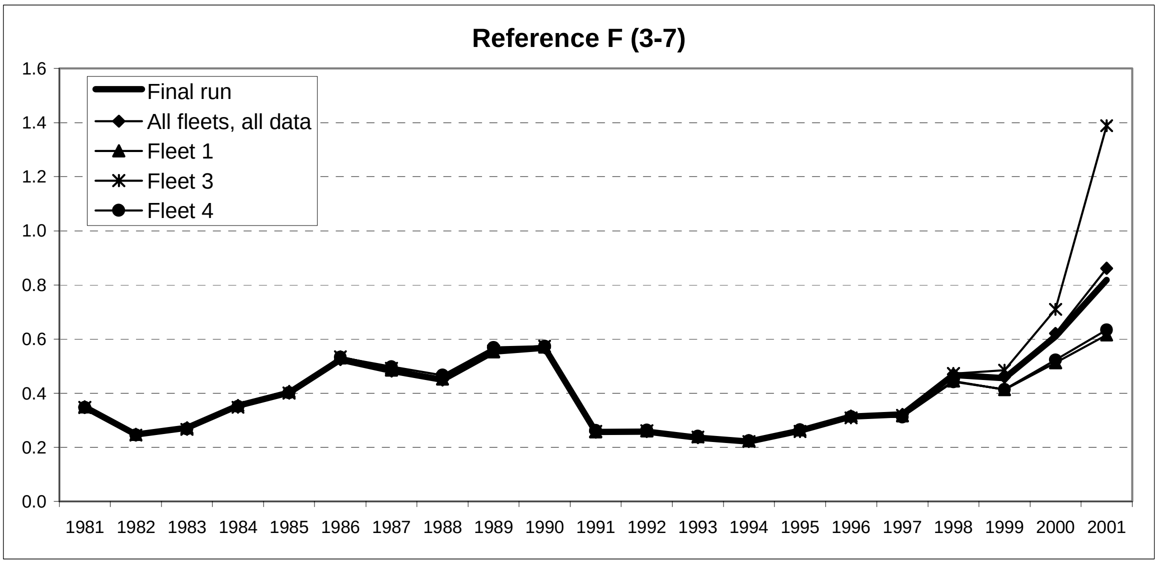


Figure 6.4.4.1 ICA diagnostics.

Figure 6.4.4.2 Results of the AMCI assessment single fleet tuning compared to the final run (Fleet no 2 was discontinued in 1996 and is not shown)







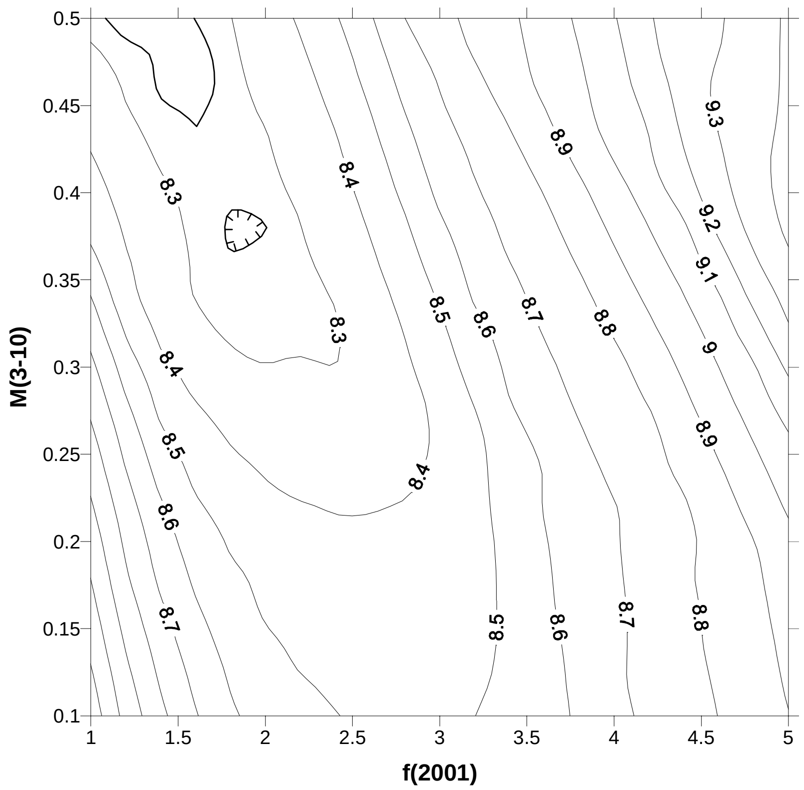


Fig. 6.4.4.3 Surface of the ISVPA loss function (MDN, 20-points window) with respect to M(3-10) and f(term); effort-controlled version.

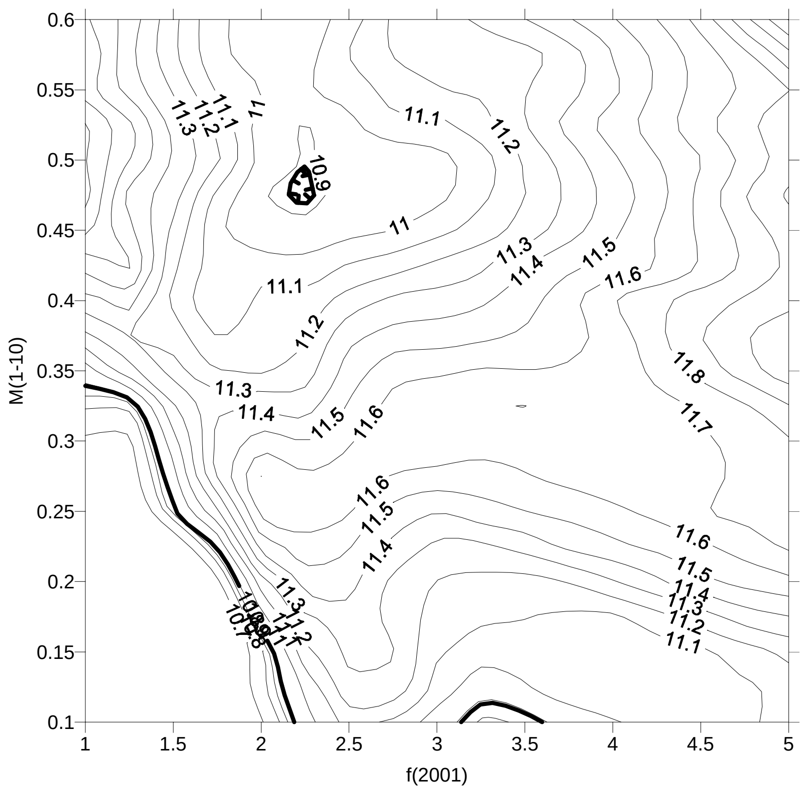
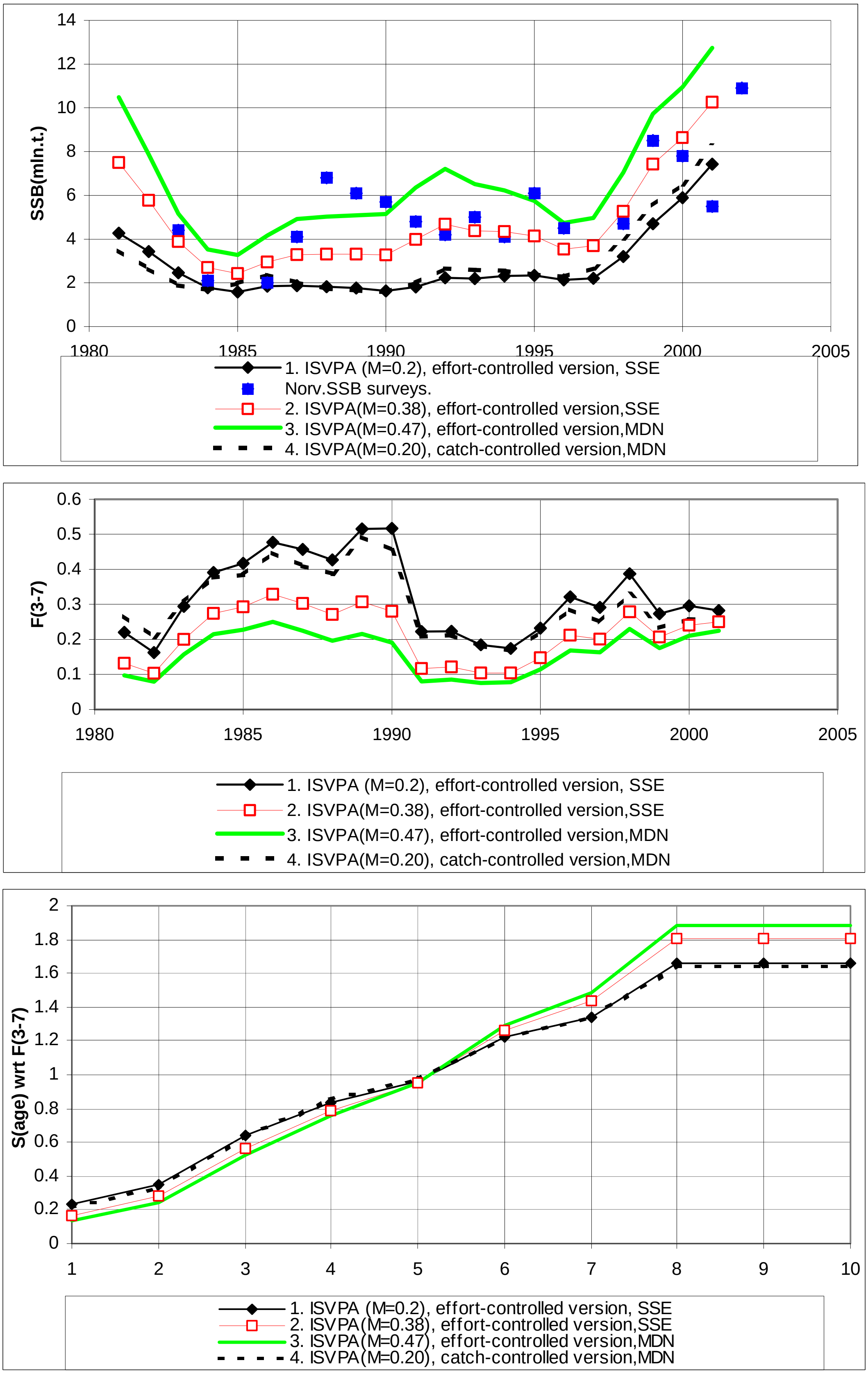


Fig. 6.4.4.4 Surface of the ISVPA loss function (MDN) with respect to M(1-10) and f(term). Based on the effort-controlled ISVPA version with unbiased estimates of log-catches.



	Model 1	Model 2	Model 3	Model 4
Correlation between survey and model-derived SSB	0.478	0.541	0.578	0.571
SSE between survey and model-derived SSB	136.6	59.0	100.3	134.7

Fig. 6.4.4.5 ISVPA results.

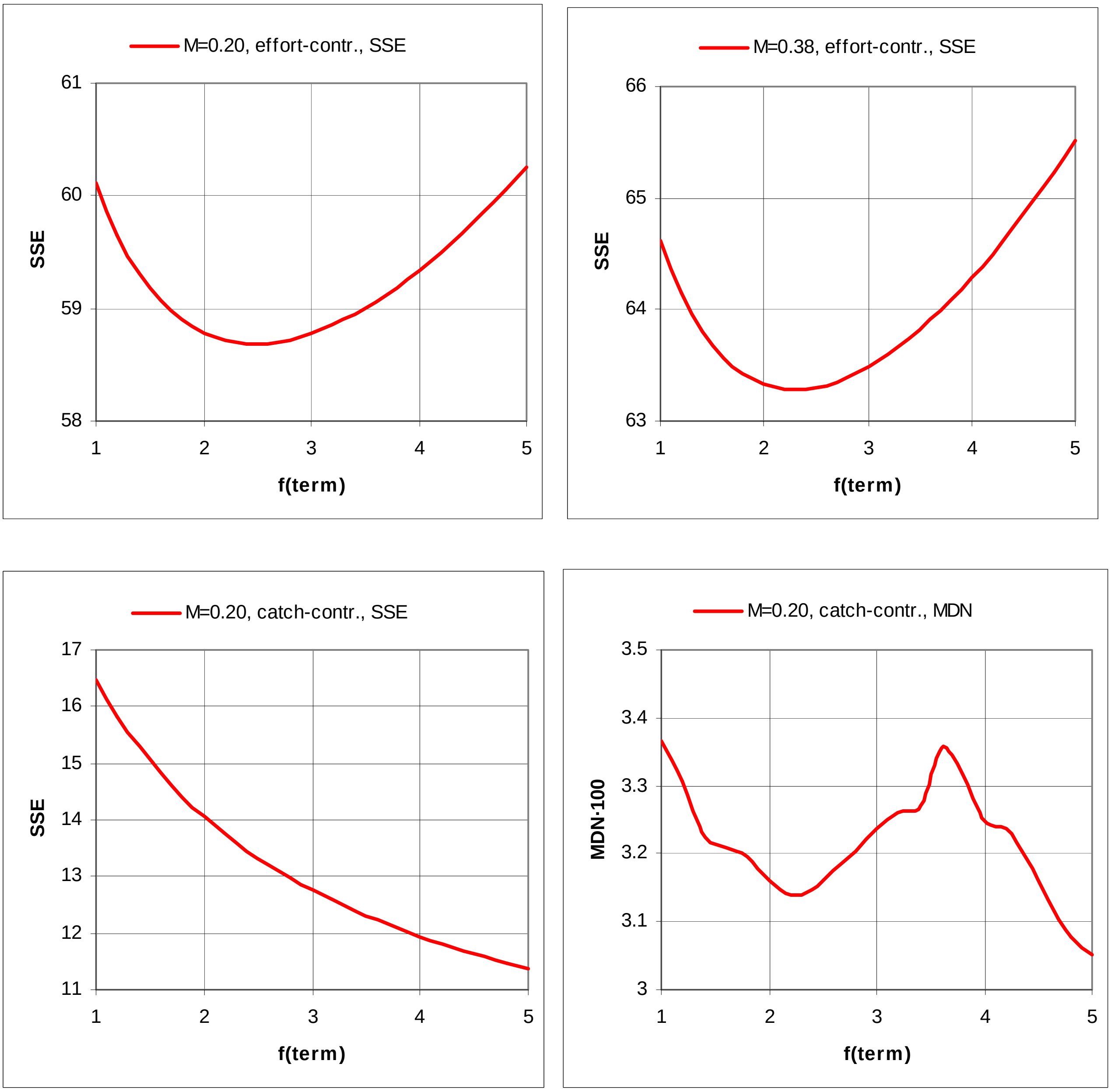


Fig. 6.4.4.6 ISVPA loss function with respect to f(term) for M(1-10) fixed at 0.20 and 0.38.

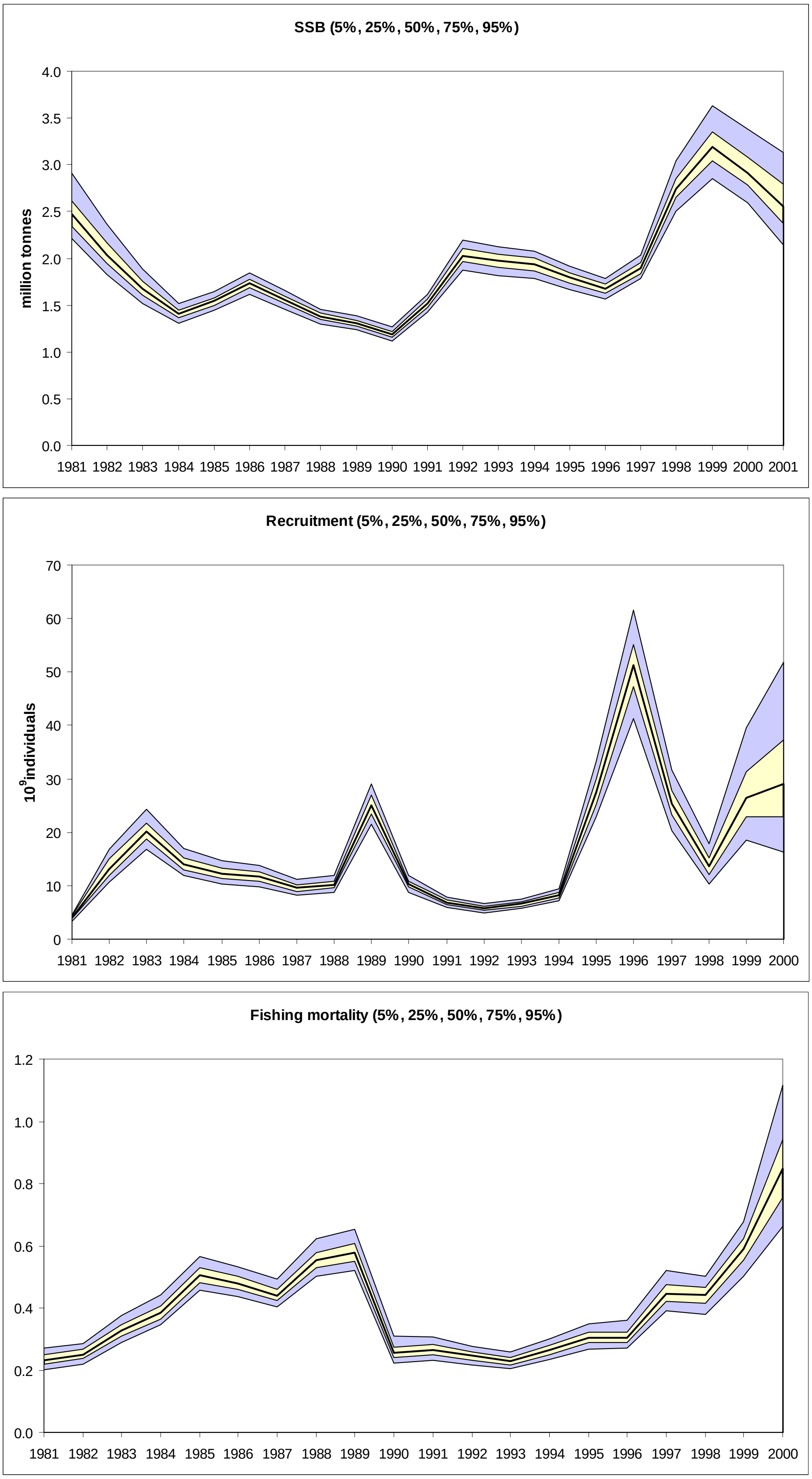


Figure 6.4.5.1 Results of the bootstrap AMCI runs.

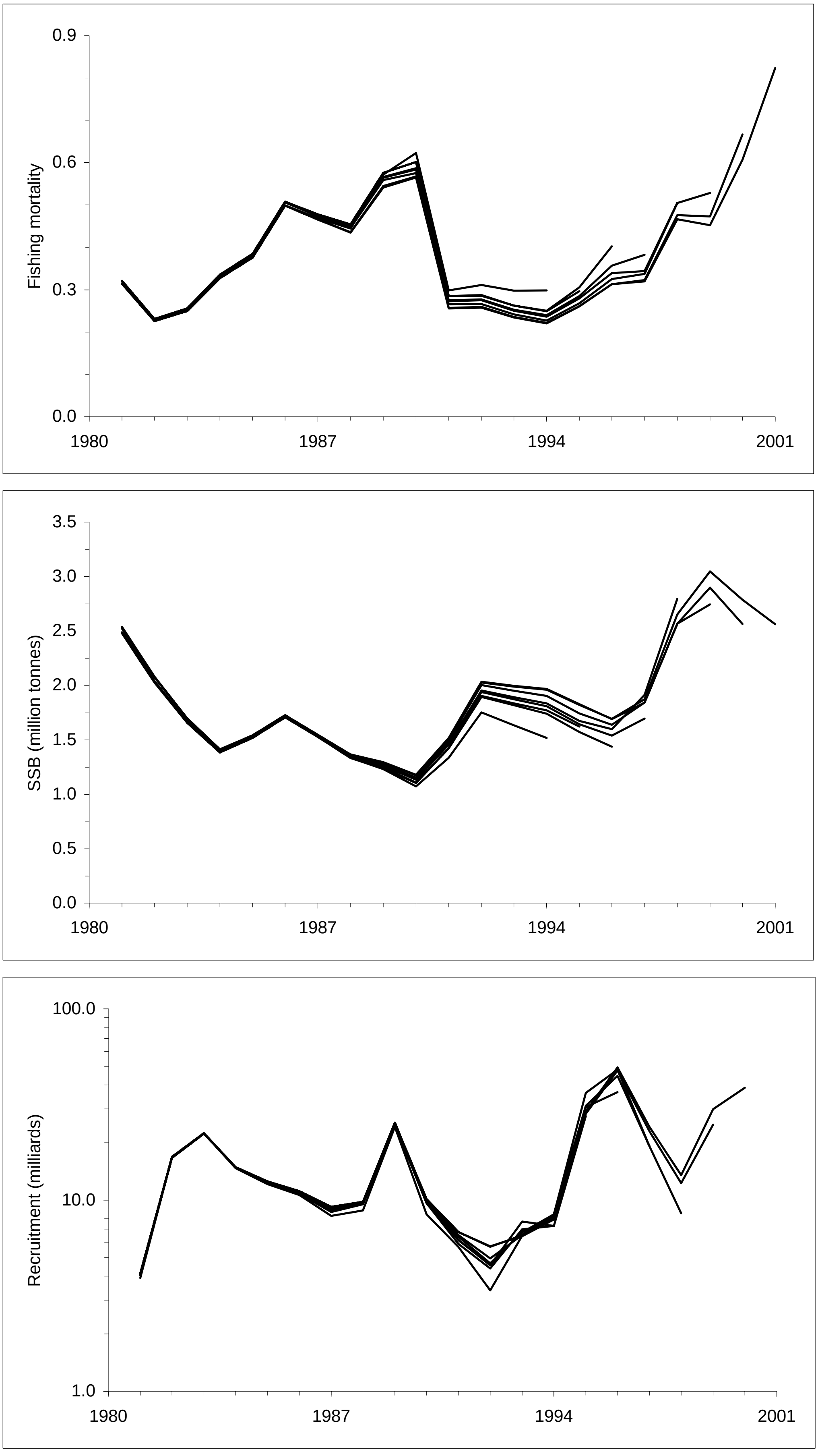


Figure 6.4.5.2 Retrospective AMCI runs.

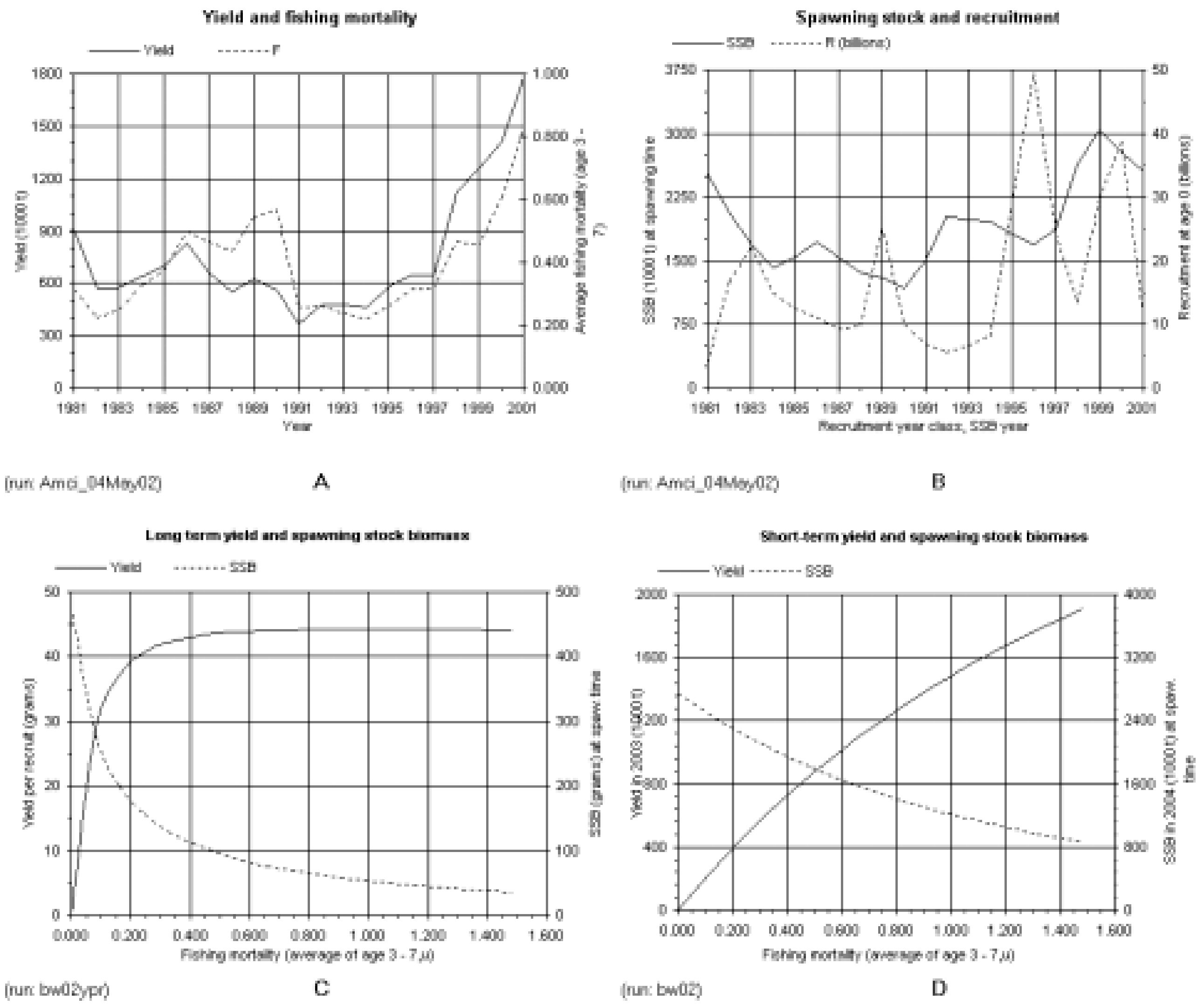


Figure 6.5.1. Blue Whiting. Standard plots from the short-term projection.

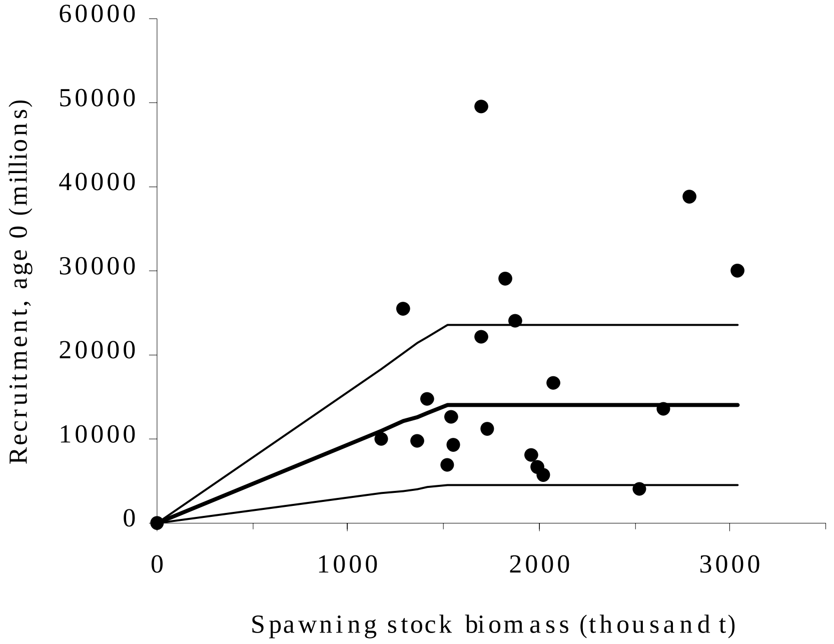


Figure 6.6.1. The relationship between spawning stock and recruitment of blue whiting in 1981-2000, and the fitted “Ockham’s razor” (with average and ±1 S.D.) assuming a break point at 1500 thousand t.

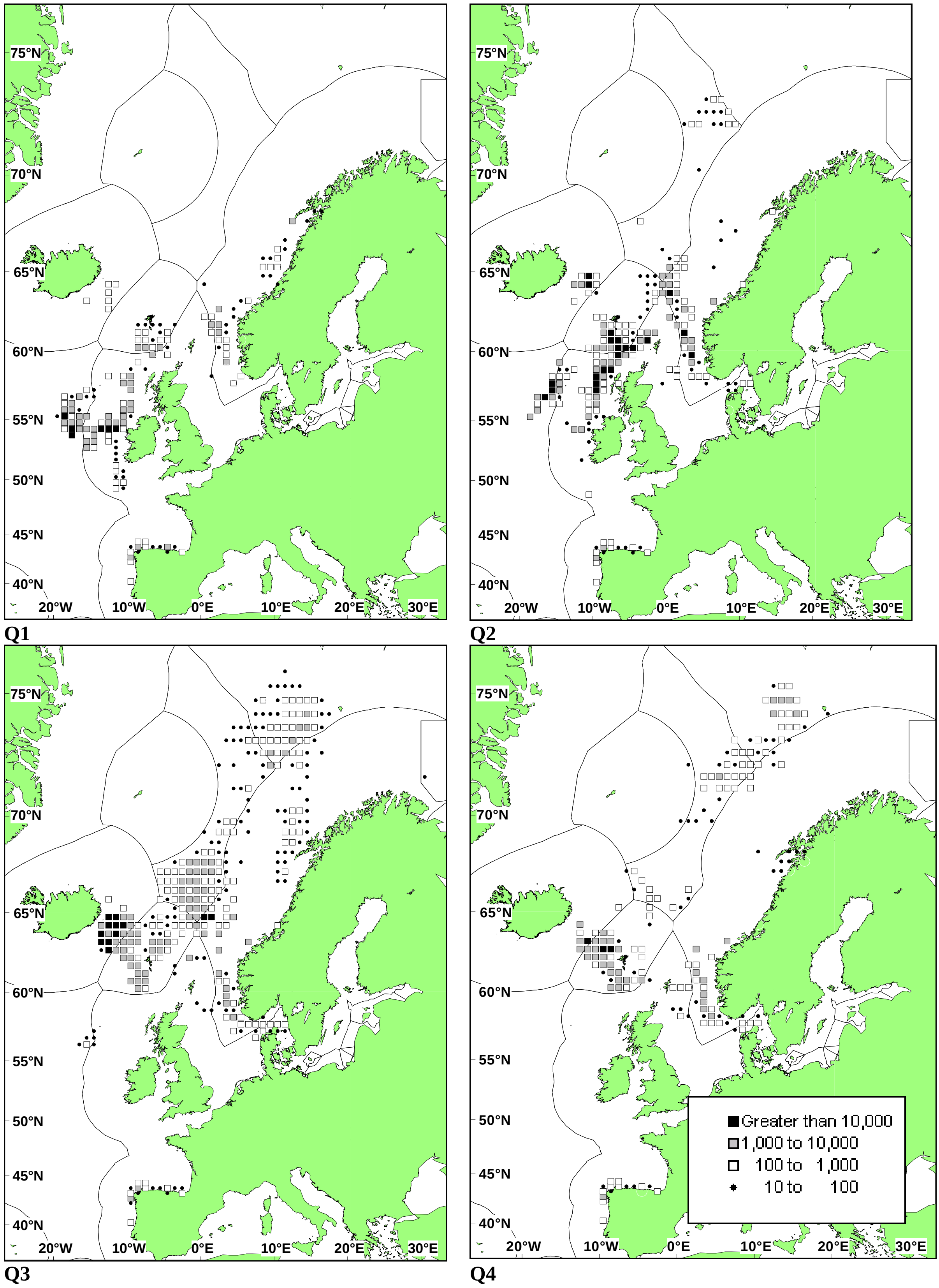


Figure 6.8.1. Total catches of blue whiting in 2001 by quarter and ICES rectangle. Grading of the symbols: small dots 10-100 t, white squares 100-1 000 t, grey squares 1 000-10 000 t, and black squares > 10 000 t.

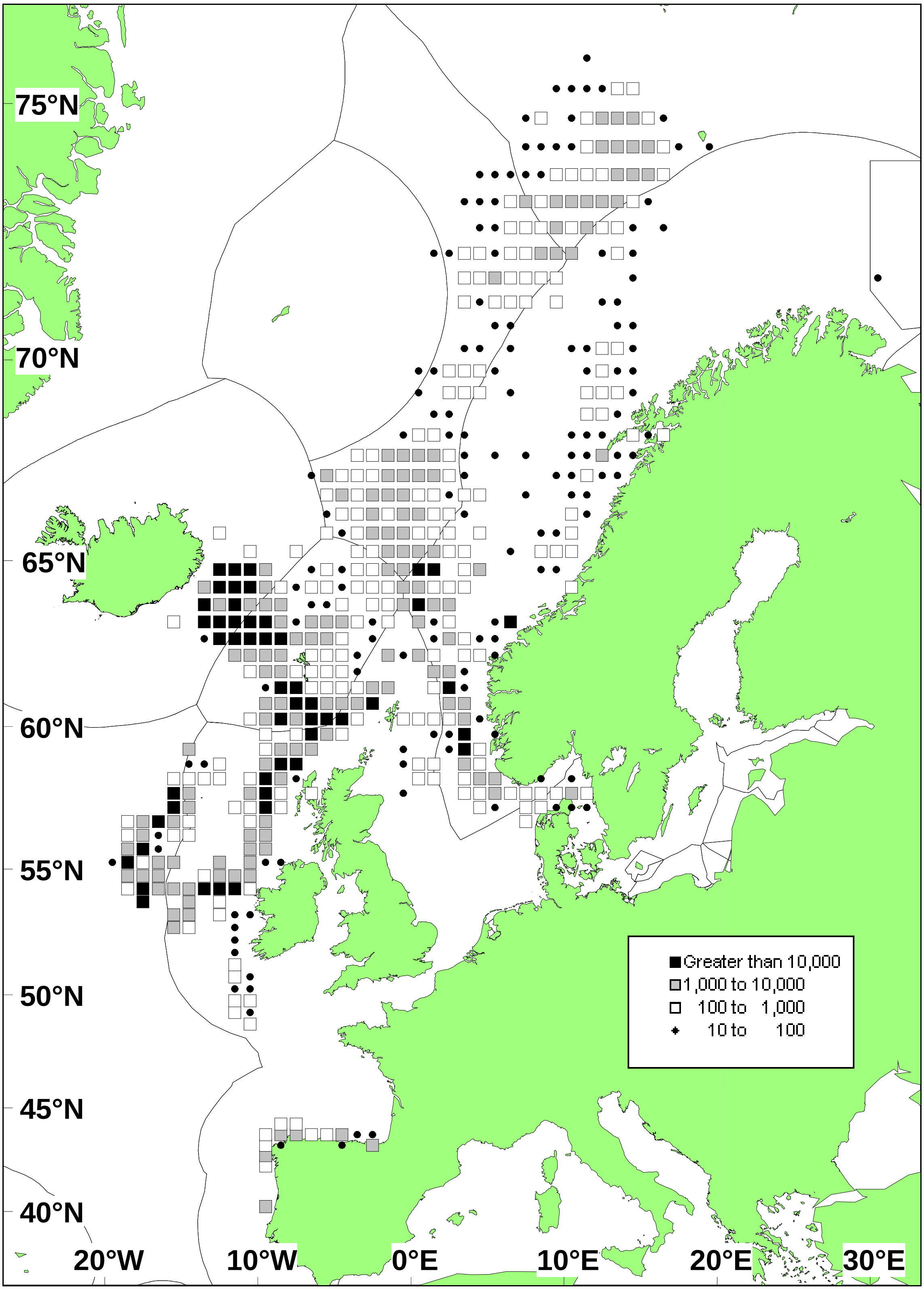


Figure 6.8.2. Total catches of blue whiting in 2001 by ICES rectangle. Grading of the symbols: small dots 10-100 t, white squares 100-1 000 t, grey squares 1 000-10 000 t, and black squares > 10 000 t.

7 ICELANDIC SUMMER-SPAWNING HERRING

7.1 The fishery

The catches of Icelandic summer-spawning herring from 1982 - 2001 are given in Tables 7.1.1, 7.1.2, and 7.1.3. No estimate of discards was made for the 2001/2002 season. The fishery started in September and terminated in January. The catch in September-January was 95 278 t, see Table 7.1.2. The catch was taken with traditional purse-seines and pelagic trawls. The main purse-seine fishery took place off the east coast of Iceland in September-November and only minor quantities were taken west of Iceland in October-January. The pelagic trawl fishery started in September, which is unusually early, but only 2500 t were taken east of Iceland throughout the month. In October-January the pelagic trawl fishery took place both east and west of Iceland. In the 1997/98 season 59% of the catch was taken by purse seines, 78% in 1998/99, 61% in 1999/2000, and 72% in 2000/2001. Only 47% of the catch in the 2001/2002 season was taken by seines and the remainder by pelagic trawl.

The proportion used for reduction to meal and oil was 29% in 1997/98 and increased to 72% in 1998/99. This decreased again to 69% in 1999/2000, and to 64% in 2000/2001. Only 12% of the catch taken in the 2001/2002 season was reduced to meal and oil. The remainder was either salted or frozen for human consumption.

Until 1990, the herring fishery took place during the last three months of the calendar year, but since 1990 the autumn fishery has continued in January and early February of the following year. In 1994 the fishery started in September. Therefore, all references to the years 1990-1993 imply seasons starting in October of that year, but after that in September. Landings, catches, and recommended TACs since 1984 are given in thousand tonnes in Table 7.1.1.

7.2 Catch in numbers, weight-at-age and maturity

The catches of the Icelandic summer-spawners in numbers-at-age for the period 1981-2000 are given in Table 7.1.3. Age is now given as real age instead of rings, as in earlier WG reports.

During the 1995/96 - 1997/98 seasons, catches were mainly distributed on the 4 year classes from 1988–1991. On the other hand, catches during the 1998/99 and 1999/2000 seasons were dominated by the strong 1994 year class. In 2000/2001 the very strong 1994 and 1996 year classes were most abundant in the catch, while in 2001/2002 the 1996 year class was the most abundant.

The weight-at-age for each year is given in Table 7.2.1, and the proportion mature-at-age is given in Table 7.2.2.

7.3 Acoustic surveys

The Icelandic summer-spawning herring stock has been monitored by annual acoustic surveys since 1973. These surveys have been conducted in October-December or January. The 2001 survey was carried out during 29 November – 11 December. The estimated size of the adult stock was about 360 000 t, which is much less than expected. On the traditional fishing grounds off the east coast the survey recorded 180 000 t, while only 60 000 t were located in this region in 2000. West of Iceland, about 180 000 t were recorded, which is similar to last year's findings. However, extremely difficult weather conditions prevailed during the 2001 survey. Furthermore, the groundfish surveys conducted in autumn 2001 and spring 2002, indicated the presence of herring in large areas west and northwest of Iceland, in particular in areas farther offshore than usual. It is therefore likely that the acoustic survey failed to locate all of the stock west of Iceland. For these reasons, a new survey was conducted in January 2002, but also failed due to adverse weather conditions. In the January survey only a small amount of 3-year-old herring was located at the spawning grounds southwest of the Reykjanes promontory.

In spite of the difficulties just described, the 2001/2002 acoustic assessment surveys confirmed that the 1999 year class is well above average (Table 7.3.1).

The sum of results obtained in winter 2001/2002 acoustic surveys have been used as the basis for the present assessment of age 5 (age 6 on 1 January) and older herring (Table 7.3.1).

Jakobsson *et al.* (1993) formally tested whether it was feasible to maintain a one-to-one relationship between acoustic and VPA estimates of stock size. It was found that a modification of the target strength, from TS=21.7 log(L) - 75.5 dB to TS=20 log(L)-72 dB, gave a much better fit between the two data sets. The resulting target strength TS = 20 log(L) - 72 dB was used to recalculate historic acoustic stock assessments. This TS = 20 log(L) - 72 dB has been the basis of calculations of stock abundance from acoustic survey data since 1993.

7.4 Stock assessment

7.4.1 ADAPT-type of VPA

Using the results from the acoustic survey and the catch in numbers, a first estimate of F was made. In this analysis, herring at age 6 (on 1 Jan 2002) and older have been grouped for estimating the fishing mortality for the oldest herring. For F on the oldest age group, an average F for ages 7-14 was used. The resulting ADAPT-type run gave an F of 0.16, see Figure 7.4.1.1. The resulting stock trend from VPA is plotted together with the acoustic estimates in Figure 7.4.1.2 and the relationship between the two estimates is shown in Figure 7.4.1.3.

A retrospective plot (Figure 7.4.1.4) shows that the terminal F values have been underestimated in the last 4 years. Therefore, like last year, the terminal F this year was increased by 27%, which is the mean underestimate in the last 4 years, resulting in an F of 0.2.

Using the catch data given in Table 7.1.3 and the erased F to 0.2, a final VPA was run, using a natural mortality rate of 0.1 for all age groups and the proportion of M before spawning as 0.5. Fishing mortality-at-age for 1982–2001 and stock in numbers-at-age and spawning stock biomass on 1 July 1982–2001 are given in Tables 7.4.1.1, 7.4.1.2, and 7.4.1.3, respectively. The standard plots of the time-series of spawning stock biomass and recruitment and trends in yield and fishing mortality are shown in Figure 7.4.1.5. In the absence of reliable abundance estimates for the 1997, 1998, 1999, and 2000 year classes, the RCT3 programme was used. It estimated the sizes of these year classes as 803, 588, 1159, and 684 millions respectively (see Tables 7.4.1.4 and 7.4.1.5).

According to the present assessment, the spawning stock biomass was about 540 000 t on 1 July 2001, which is about 150 000 t lower than the estimate from last year. The main reason for this difference is the much lower number of the 1996 year class this year. This is most likely due to inconclusive acoustic survey results and a bias in the age readings.

7.4.2 AMCI assessment

The assessment program AMCI21 (Section 1.3.2) was also used. The objective function was a sum of the following partial objective function:

Log sum of squares of catches at age, weight 1

Log sum of squares of yearly yields, weight 1

Log sum of squares for the acoustic survey indices at age, weight 1

Fishing mortality was modelled as separable, with a gradual change in selection. The gain factor for a change in selection was 0.5 for ages 2 and 3, 0.2 for age 4, and 0.1 for older ages. For 1981 the fishing mortality was derived through parameter estimation. In 2002 the fishing mortality was assumed to be 0.22 and the recruitment 650 millions, which is close to the long-term mean of 2-year-old recruiting herring. The yearly fishing mortality was split on quarters, assuming 0.05 in the third quarter of the year and 0.95 in the fourth quarter. Natural mortality of 0.1 was assumed.

The model was run until 2003. The results for 2002 and 2003 are predicted values assuming a fishing mortality of 0.22. The results are presented in Tables 7.4.2.1 to 7.4.2.5.

A retroplot was also made (Figure 7.4.2.1). It can be seen from this figure that although AMCI has overestimated the F, it is more consistent in the last 3 years than the ADAPT-VPA.

A bootstrap run was made with the same settings as described above, using the option of resampling of log residuals from the assessment, both for the catch and the survey. One thousand replicates were run. The results are shown in Figure 7.4.2.2. A slight decrease in fishing mortality can be seen in the last years. The uncertainty in the recruitment in the late nineties influences the spawning stock biomass in the most recent years.

According to this assessment the spawning stock biomass was 575 000 t at 1 January 2002. The annual unweighted fishing mortality, F 5-15, amounted to 0.25, which corresponds to a weighted F of 0.18. The results from this assessment are in line with the results from the ADAPT-type of VPA assessment.

7.4.3 ISVPA assessment

As a third assessment program ISVPA (Section 1.3.6) was also run. Several possibilities were explored. The options chosen were:

- The catch-controlled version
- f(y) and s(a) were found by log (GM) procedure
- minimisation of the AMD=median(abs(resid(a,y)-median(resid(a,y)))
- natural mortality assumed 0.1 for all ages
- part of the year (from start) when catch was taken was assumed 0.8

The results are shown in Table 7.4.3.1-7.4.3.4. It looks as if ISVPA has difficulties estimating the stock numbers in the last years, especially for the younger ages and therefore does not give similar results to the ADAPT-type of VPA and AMCI.

7.5 Catch and stock projections

Based on the ADAPT-VPA assessment short-term projections were made using the MFDP program. The input data are given in Table 7.5.1.

As in previous years, a regression of increase in weight on mean weight in the previous year has been used to predict the weight-at-age for ages 3–9, using as input the weight-at-ages 2–8 in the year before. Data for the regression included the period 1991–2001 as starting years. For one-year-old herring and 10+, a simple average of mean weights-at-age for the period 1997–2001 was used for the prediction. Weights-at-age for 2–8 ringers in the catch were obtained using the relationship:

$W_{y+1} - W_y = -0.24 * W_y + 95.01$ (g)

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

As a selection pattern, the mean selection pattern of 1997–2000 is used, assuming 1 on age 5 and older.

Outputs of the prediction, assuming catches corresponding to a fishing mortality rate of $\mathbf{F}_{0.1}$= 0.22 (weighted F), are given in Table 7.5.2, and projections of spawning stock biomass and catches (tonnes) for a range of values of Fs are given in Table 7.5.3.

Yield per recruit, spawning stock per recruit and short-term yield and spawning stock biomass are shown in Figure 7.4.5, using the long-term average (1982-2001) values given in Table 7.5.4.

7.6 Management consideration

During the last 20 years the Icelandic summer-spawning herring stock has been managed at levels corresponding fairly closely to fishing at $\mathbf{F}_{0.1}$. Exploiting the stock at a fishing mortality rate of $\mathbf{F}_{0.1}$=0.22 during the 2002/2003 season would result in a catch of about 105 000 t (Table 7.5.2 and 7.5.3). The spawning stock biomass in 2002 is expected to be about 550 000 t and about 603 000 t in the year 2002.

Due to the AMCI assessment, a catch of 96 000 t in 2002 would exploit the stock at a fishing mortality level of a weighted F of 0.18. The spawning stock would be about 570 000 t on 1 January. The results from both of these assessments support each other, so a catch of 105 000 t is within safe limits.

The Working Group points out that managing this stock at an exploitation rate at or near $\mathbf{F}_{0.1}$ has been successful in the past. Thus the Working Group agreed in 1998 with the SGPAFM on using $\mathbf{F}_{pa}= \mathbf{F}_{0.1}= 0.22$, $\mathbf{B}_{pa}= \mathbf{B}_{lim} * e^{1.645\sigma}= 300\ 000$ t where $\mathbf{B}_{lim}= 200\ 000$ t.

Jakobsson and Stefansson (1999) made a risk analysis and stated that the probability of stock collapse needs no further consideration as long as the target fishing mortality is kept below 0.25. The present F for this stock is estimated to be

0.18, which is well below $\mathbf{F}_{pa}$=0.22. Furthermore, the spawning stock is estimated to be 695 000 t compared to $\mathbf{B}_{pa}$=300 000 t. Therefore, the stock is in a healthy state and well above any "alarm level".

7.7 Stock recruitment

A stock recruitment plot is shown in Figure 7.7.1.

7.8 Sampling

Investigation	No. of samples	Length-measured individuals	Aged individuals
Fishery	69	3642	3429
Acoustic, wintering area	22	3873	647

Table 7.1.1 Icelandic summer spawners. Landings, catches and recommended TACs in thousand tonnes.

Year	Landings	Catches	Recommended TACs
1984	50.3	50.3	50.0
1985	49.1	49.1	50.0
1986	65.5	65.5	65.0
1987	73.0	73.0	70.0
1988	92.8	92.8	100.0
1989	97.3	101.0	90.0
1990/1991	101.6	105.1	90.0
1991/1992	98.5	109.5	79.0
1992/1993	106.7	108.5	86.0
1993/1994	101.5	102.7	90.0
1994/1995	132.0	134.0	120.0
1995/1996	125.0	125.9	110.0
1996/1997	95.9	95.9	100.0
1997/1998	64.7	64.7	100.0
1998/1999	87.0	87.0	90.0
1999/2000	92.9	92.9	100.0
2000/2001	100.3	100.3	110.0
2001/2002*	95.3	95.3	125.0

*Preliminary

Table 7.1.2 Icelandic summer spawners. Catch in tonnes by Icelandic squares, ICES rectangles and months.

Icelandic Squares	ICES rectangles	September 2000	October 2000	November 2000	December 2000	January 2001
312	55D7	42				
313	55D6	63				
319	55D0					369
323	55C6		2387			
324	55C5		3061			
326	55C3				285	
363	55D6	216				
364	56D5			221		
366	56D3			90	2311	63
372	56C7					32
373	56C6		685			
374	56C5		848			
375	56C4		105			
376	56C3		32			
412	57D7	74	69	2856		163
413	57D6	7360	2213	8098		
414	57D5	1702	53	32		
416	57D3				42	
423	57C6			258		
424	57C5		53			
425	57C4			148		379
426	57C3			53	63	
462	58D7					179
463	58D6		1117			
475	58C4			464	21	775
476	58C3			320	1992	11
477	58C2				53	
512	59D7			148		37
513	59D6			158		
525	59C4		316	211	627	11
526	59C3		74	3641	8325	1033
527	59C2				221	
561	60D8			469	2254	647
562	60D7		200	2474	4953	1660
563	60D6	446	2529	1117	74	
564	60D5		195			
575	60C4		453	1049	63	74
576	60C3		532	6689	2961	1085
612	61D7		16	5380	221	
613	61D6		643	838		
625	61C4		446	232		21
626	61C3		316	137		232
662	62D7			63		
672	62C7		32			
674	62C5		2147	126		
675	62C4		137			
676	62C3				179	
823	62B6		32			

Table 7.1.3 Icelandic summer spawners. Catch in numbers (millions) and total catch in weight (thous. tonnes).

Age/Year	1982	1983	1984	1985	1986	1987	1988
2	0.454	1.475	0.421	0.112	0.100	0.029	0.879
3	19.187	22.499	18.015	12.872	8.172	3.144	4.757
4	28.109	151.718	32.244	24.659	33.938	44.590	41.331
5	38.280	30.285	141.354	21.656	23.452	60.285	99.366
6	16.623	21.599	17.043	85.210	20.681	20.622	69.331
7	38.308	8.667	7.113	11.903	77.629	19.751	22.955
8	43.770	14.065	3.916	5.740	18.252	46.240	20.131
9	6.813	13.713	4.113	2.336	10.986	15.232	32.201
10	6.633	3.728	4.517	4.363	8.594	13.963	12.349
11	10.457	2.381	1.828	4.053	9.675	10.179	10.250
12	2.354	3.436	0.202	2.773	7.183	13.216	7.378
13	0.594	0.554	0.255	0.975	3.682	6.224	7.284
14	0.075	0.100	0.260	0.480	2.918	4.723	4.807
15	0.211	0.003	0.003	0.581	1.788	2.280	1.957
Catch	56.528	58.867	50.304	49.368	65.500	75.439	92.828

Age/year	1989	1990	1991	1992	1993	1994	1995
2	3.974	11.009	35.869	12.006	0.869	6.225	7.411
3	22.628	14.345	92.758	79.782	35.560	110.079	26.221
4	26.649	57.024	51.047	131.543	170.106	99.377	159.170
5	77.824	34.347	87.606	43.787	87.363	150.310	86.940
6	188.654	77.819	33.436	56.083	25.146	90.824	105.542
7	43.114	152.236	54.840	41.932	28.802	23.926	74.326
8	8.116	32.265	109.418	36.224	18.306	20.809	20.076
9	5.897	8.713	9.251	44.765	24.268	19.164	13.797
10	7.292	4.432	3.796	9.244	14.318	17.973	8.873
11	4.780	4.287	2.634	2.259	3.639	16.222	9.140
12	3.449	2.517	1.826	0.582	0.878	2.955	7.079
13	1.410	1.226	0.516	0.305	0.300	1.433	2.376
14	0.844	1.019	0.262	0.203	0.200	0.345	0.927
15	0.348	0.610	0.298	0.102	0.100	0.345	0.124
Catch	101.000	105.097	109.489	108.504	102.741	134.003	125.851

Age/Year	1996	1997	1998	1999	2000	2001
2	1.100	9.323	16.161	0.629	7.958	10.206
3	18.723	27.072	37.787	43.537	52.921	23.944
4	45.304	28.397	151.853	65.871	131.153	76.666
5	92.948	29.451	42.833	145.127	44.334	107.849
6	69.878	42.267	19.872	24.653	102.925	46.646
7	86.261	35.285	30.280	20.614	10.962	51.585
8	37.447	28.506	22.572	25.853	9.312	18.504
9	13.207	21.828	32.779	21.163	17.218	11.356
10	6.854	8.160	14.366	14.436	9.471	7.933
11	4.012	3.815	4.802	6.973	7.610	8.547
12	1.672	1.696	2.199	2.164	1.930	5.090
13	4.179	6.570	1.084	2.426	5.199	4.346
14	1.672	1.378	5.081	0.473	0.552	1.611
15	0.100	1.802	3.036	0.961	0.166	0.864
Catch	95.882	64.682	86.998	92.896	100.332	95.278

Table 7.2.1 Icelandic summer spawners. Weight-at-age (g).

Age/Year	1982	1983	1984	1985	1986	1987	1988
2	65	59	49	53	60	60	75
3	141	132	131	146	140	168	157
4	186	180	189	219	200	200	221
5	217	218	217	266	252	240	239
6	274	260	245	285	282	278	271
7	293	309	277	315	298	304	298
8	323	329	315	335	320	325	319
9	354	356	322	365	334	339	334
10	385	370	351	388	373	356	354
11	389	407	334	400	380	378	352
12	400	437	362	453	394	400	371
13	394	459	446	469	408	404	390
14	390	430	417	433	405	424	408
15	420	472	392	447	439	430	437

Age/Year	1989	1990	1991	1992	1993	1994	1995
2	63	75	74	63	74	67	69
3	130	119	139	144	150	135	129
4	206	198	188	190	212	204	178
5	246	244	228	232	245	249	236
6	261	273	267	276	288	269	276
7	290	286	292	317	330	302	292
8	331	309	303	334	358	336	314
9	338	329	325	346	373	368	349
10	352	351	343	364	387	379	374
11	369	369	348	392	401	398	381
12	389	387	369	444	425	387	400
13	380	422	388	399	387	421	409
14	434	408	404	419	414	402	438
15	409	436	396	428	420	390	469

Age/Year	1996	1997	1998	1999	2000	2001	2002*
2	78	62	78	64	58	78	70
3	140	137	147	143	158	140	154
4	166	197	184	211	214	217	201
5	208	234	213	236	256	242	259
6	258	270	246	268	284	281	278
7	294	299	286	300	326	294	307
8	312	323	314	318	333	309	317
9	324	342	341	349	366	339	329
10	360	358	351	347	383	350	363
11	349	363	354	377	402	367	376
12	388	373	350	359	405	375	389
13	403	412	372	403	422	403	402
14	385	394	400	408	406	426	409
15	420	429	437	445	444	425	428

* Predicted

Table 7.2.2 Icelandic summer spawners. Proportion mature-at-age.

Age/Year	1982	1983	1984	1985	1986	1987	1988
2	0.020	0.000	0.000	0.000	0.000	0.000	0.000
3	0.050	0.000	0.010	0.000	0.030	0.010	0.045
4	0.850	0.640	0.820	0.900	0.890	0.870	0.900
5	1.000	1.000	1.000	1.000	1.000	1.000	1.000
6	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7	1.000	1.000	1.000	1.000	1.000	1.000	1.000
8	1.000	1.000	1.000	1.000	1.000	1.000	1.000
9	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000
15	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Age/Year	1989	1990	1991	1992	1993	1994	1995
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.060	0.000	0.013	0.020	0.049	0.054	0.157
4	0.930	0.780	0.720	0.930	0.999	1.000	0.982
5	1.000	1.000	1.000	1.000	1.000	0.992	0.998
6	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7	1.000	1.000	1.000	1.000	1.000	1.000	1.000
8	1.000	1.000	1.000	1.000	1.000	1.000	1.000
9	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000
15	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Age/Year	1996	1997	1998	1999	2000	2001	2002*
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	0.049	0.160	0.265	0.074	0.279	0.101	0.151
4	0.990	0.925	0.935	0.879	0.831	0.981	0.897
5	1.000	0.989	0.995	0.977	0.992	0.997	0.988
6	1.000	1.000	1.000	1.000	1.000	1.000	1.000
7	1.000	1.000	1.000	1.000	1.000	1.000	1.000
8	1.000	1.000	1.000	1.000	1.000	1.000	1.000
9	1.000	1.000	1.000	1.000	1.000	1.000	1.000
10	1.000	1.000	1.000	1.000	1.000	1.000	1.000
11	1.000	1.000	1.000	1.000	1.000	1.000	1.000
12	1.000	1.000	1.000	1.000	1.000	1.000	1.000
13	1.000	1.000	1.000	1.000	1.000	1.000	1.000
14	1.000	1.000	1.000	1.000	1.000	1.000	1.000
15	1.000	1.000	1.000	1.000	1.000	1.000	1.000

* Predicted (mean of 1999-2001)

Table 7.3.1 Acoustic estimates (in millions) of the Icelandic summer-spawning herring, 1974-2000. The surveys are conducted in October-December or January. The year given is the following year, i.e. if the survey is conducted in the season 1973/1974, then 1974 is given.

	Ages															
Year	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	6+
1974	-1	154	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1975	-1	5	137	19	21	2	2	-1	-1	-1	-1	-1	-1	-1	-1	25
1976	-1	136	20	133	17	10	3	3	-1	-1	-1	-1	-1	-1	-1	33
1977	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1978	-1	212	424	46	19	139	18	18	10	-1	-1	-1	-1	-1	-1	204
1979	-1	158	334	215	49	20	111	30	30	20	-1	-1	-1	-1	-1	260
1980	-1	19	177	360	253	51	41	93	10	-1	-1	-1	-1	-1	-1	448
1981	625	361	462	85	170	182	33	29	58	10	-1	-1	-1	-1	-1	482
1982	-1	17	75	159	42	123	162	24	8	46	10	-1	-1	-1	-1	415
1983	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1984	-1	171	310	724	80	39	15	27	26	10	5	12	-1	-1	-1	214
1985	-1	28	67	56	360	65	32	16	17	18	9	7	4	5	5	538
1986	201	652	208	110	86	425	67	41	17	27	26	16	6	6	1	718
1987	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1988	406	126	352	836	287	53	37	76	25	21	14	17	8	6	3	547
1989	370	725	181	249	381	171	42	23	30	16	10	9	5	3	2	692
1990	-1	178	593	177	302	538	185	-1	-1	-1	18	-1	-1	-1	-1	1043
1991	710	805	227	304	137	176	387	40	10	2	-1	-1	-1	-1	-1	752
1992	465	745	850	353	273	94	81	210	32	11	-1	17	-1	-1	-1	718
1993	1418	254	858	687	160	99	87	44	92	39	-1	-1	-1	-1	-1	521
1994	183	234	533	860	443	55	69	43	86	55	2	-1	6	-1	-1	753
1995	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
1996	845	98	165	515	316	361	166	110	52	29	16	27	19	8	2	1105
1997	266	792	65	139	459	280	410	150	101	50	35	15	65	32	-1	1597
1998	1629	237	716	100	116	240	161	130	97	35	15	11	43	8	15	870
1999	-1	-1	188	790	240	101	73	47	77	47	10	10	-1	22	-1	627
2000	1069	527	740	296	606	99	71	164	108	98	15	44	5	13	7	1230
2001	2832	101	561	1069	323	609	30	31	38	13	18	6	9	4	1	1082
2002	561	942	247	187	265	173	302	69	48	55	54	16	18	1	-1	1001

Table 7.4.1.1 Icelandic summer spawners. Fishing mortality at age.

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Virtual Population Analysis : Fishing mortality

Age	1982	1983	1984	1985	1986	1987	1988
2	0.002	0.007	0.001	0.000	0.000	0.000	0.002
3	0.026	0.116	0.101	0.031	0.008	0.006	0.017
4	0.159	0.258	0.218	0.175	0.097	0.048	0.089
5	0.300	0.229	0.360	0.199	0.224	0.222	0.130
6	0.221	0.246	0.175	0.341	0.264	0.280	0.378
7	0.390	0.154	0.107	0.160	0.525	0.384	0.506
8	0.566	0.216	0.087	0.106	0.347	0.605	0.746
9	0.212	0.307	0.081	0.061	0.271	0.481	1.014
10	0.336	0.154	0.140	0.104	0.298	0.572	0.801
11	0.576	0.173	0.095	0.162	0.313	0.602	0.980
12	0.259	0.333	0.018	0.183	0.420	0.806	1.078
13	1.540	0.080	0.033	0.101	0.347	0.690	1.390
14	1.967	1.159	0.044	0.072	0.432	0.882	1.836
15	0.731	0.322	0.076	0.119	0.369	0.628	1.044
W.Av 5-15	0.366	0.225	0.255	0.228	0.360	0.381	0.297
Ave 5-15	0.645	0.307	0.111	0.146	0.346	0.559	0.900

Age	1989	1990	1991	1992	1993	1994	1995
2	0.011	0.012	0.034	0.018	0.001	0.019	0.021
3	0.055	0.045	0.124	0.088	0.061	0.181	0.092
4	0.110	0.172	0.201	0.232	0.245	0.217	0.382
5	0.214	0.181	0.382	0.237	0.213	0.317	0.267
6	0.344	0.306	0.241	0.399	0.186	0.319	0.341
7	0.379	0.455	0.327	0.472	0.327	0.242	0.414
8	0.298	0.480	0.612	0.332	0.345	0.369	0.293
9	0.446	0.529	0.218	0.481	0.344	0.644	0.395
10	0.582	0.627	0.410	0.312	0.247	0.410	0.622
11	0.746	0.718	0.847	0.405	0.174	0.431	0.335
12	0.965	1.033	0.683	0.395	0.242	0.187	0.301
13	0.529	1.018	0.530	0.200	0.323	0.677	0.202
14	0.493	0.813	0.543	0.363	0.175	0.661	1.171
15	0.555	0.709	0.521	0.370	0.272	0.453	0.467
W.Av 5-15	0.316	0.371	0.401	0.363	0.243	0.332	0.333
Ave 5-15	0.505	0.624	0.483	0.361	0.259	0.428	0.437

Age	1996	1997	1998	1999	2000	2001	1997-2000
2	0.001	0.016	0.016	0.001	0.014	0.009	0.012
3	0.060	0.029	0.077	0.049	0.080	0.049	0.059
4	0.202	0.110	0.204	0.167	0.182	0.142	0.166
5	0.357	0.176	0.215	0.273	0.145	0.200	0.202
6	0.317	0.243	0.155	0.166	0.283	0.200	0.212
7	0.457	0.234	0.246	0.213	0.093	0.200	0.196
8	0.337	0.238	0.206	0.305	0.126	0.200	0.219
9	0.284	0.298	0.418	0.271	0.304	0.200	0.323
10	0.310	0.254	0.291	0.291	0.167	0.200	0.251
11	0.564	0.253	0.208	0.200	0.219	0.200	0.220
12	0.084	0.438	0.203	0.123	0.070	0.200	0.208
13	0.260	0.478	0.491	0.320	0.424	0.200	0.428
14	0.191	0.115	0.739	0.365	0.100	0.200	0.330
15	0.311	0.288	0.350	0.261	0.188	0.200	0.272
W.Av 5-15	0.355	0.237	0.246	0.252	0.202	0.200	0.219
Ave 5-15	0.316	0.274	0.320	0.253	0.193	0.200	0.260

Table 7.4.1.2 Icelandic summer spawners. VPA stock size.

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Virtual Population Analysis : Stock in numbers, millions

Age	1982	1983	1984	1985	1986	1987	1988
2	237.907	219.289	488.503	1220.902	628.367	332.913	490.373
3	794.226	214.836	197.019	441.615	1104.612	568.475	301.204
4	200.729	700.405	173.019	161.155	387.354	991.725	511.388
5	154.837	154.935	489.803	125.951	122.407	318.249	854.969
6	88.040	103.795	111.451	309.190	93.408	88.501	230.748
7	124.127	63.885	73.423	84.664	198.975	64.898	60.517
8	105.935	76.008	49.575	59.679	65.304	106.548	40.002
9	37.358	54.430	55.425	41.137	48.547	41.785	52.662
10	24.342	27.336	36.245	46.243	35.002	33.505	23.383
11	24.980	15.736	21.195	28.506	37.697	23.520	17.103
12	10.805	12.708	11.978	17.441	21.945	24.934	11.651
13	0.785	7.543	8.240	10.646	13.148	13.050	10.078
14	0.090	0.152	6.299	7.214	8.706	8.406	5.924
15	0.425	0.011	0.043	5.452	6.071	5.113	3.148
Total No	1804.585	1651.071	1722.218	2559.794	2771.544	2621.621	2613.149

Age	1989	1990	1991	1992	1993	1994	1995
2	380.102	931.883	1131.659	706.140	770.040	353.656	379.286
3	442.872	340.153	832.736	989.872	627.528	695.934	314.083
4	268.019	379.222	294.148	665.385	819.870	534.017	525.199
5	423.454	217.198	288.992	217.700	477.231	580.436	388.878
6	679.230	309.291	163.920	178.455	155.431	348.896	382.656
7	143.074	435.726	206.053	116.593	108.324	116.767	229.564
8	33.022	88.593	250.056	134.442	65.783	70.704	82.951
9	17.171	22.182	49.606	122.746	87.300	42.167	44.250
10	17.286	9.951	11.823	36.105	68.671	55.984	20.029
11	9.493	8.740	4.812	7.101	23.902	48.549	33.625
12	5.807	4.073	3.856	1.867	4.284	18.173	28.560
13	3.588	2.001	1.312	1.763	1.138	3.043	13.638
14	2.270	1.912	0.654	0.699	1.306	0.745	1.398
15	0.855	1.255	0.768	0.344	0.440	0.992	0.348
Total No	2426.244	2752.180	3240.395	3179.212	3211.249	2870.064	2444.467

Age	1996	1997	1998	1999	2000	2001	2002
2	1085.741	603.625	1078.142	803.000	588.000	1159.000	684.000
3	336.147	981.373	537.319	960.179	725.987	524.470	1038.999
4	259.281	286.365	862.248	450.280	827.426	606.649	451.777
5	324.354	191.603	232.137	636.053	344.885	624.170	476.158
6	269.390	205.372	145.408	169.392	437.846	269.961	462.397
7	246.173	177.486	145.720	112.700	129.864	298.545	199.992
8	137.289	141.037	127.111	103.121	82.409	107.091	221.168
9	56.015	88.718	100.565	93.590	68.788	65.722	79.335
10	26.964	38.156	59.572	59.935	64.606	45.912	48.688
11	9.729	17.897	26.783	40.276	40.538	49.465	34.012
12	21.759	5.007	12.575	19.676	29.824	29.458	36.645
13	19.128	18.100	2.923	9.291	15.748	25.152	21.823
14	10.085	13.343	10.155	1.619	6.106	9.324	18.633
15	0.392	7.538	10.764	4.387	1.016	5.000	6.907
Total No	2802.448	2775.620	3351.423	3463.498	3363.044	3819.919	3780.533

Table 7.4.1.3 Icelandic summer spawners.

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Virtual Population Analysis : SSB in 1000 x tons

Age	1982	1983	1984	1985	1986	1987	1988
2	0.294	0.000	0.000	0.000	0.000	0.000	0.000
3	5.326	0.000	0.246	0.000	4.404	0.906	2.026
4	30.204	76.624	25.453	30.215	65.718	164.390	96.798
5	32.005	32.143	101.010	31.845	29.296	72.594	194.047
6	22.921	25.661	25.963	83.910	25.074	23.378	59.483
7	34.631	18.753	19.339	25.336	56.384	18.748	17.154
8	32.548	23.765	14.836	18.995	19.884	32.970	12.134
9	12.572	18.458	16.961	14.283	15.442	13.466	16.711
10	8.905	9.626	12.091	17.076	12.409	11.340	7.874
11	9.236	6.091	6.730	10.860	13.612	8.448	5.719
12	4.115	5.278	4.123	7.515	8.222	9.492	4.116
13	0.294	3.291	3.498	4.749	5.100	5.010	3.743
14	0.034	0.062	2.501	2.970	3.352	3.391	2.302
15	0.170	0.005	0.016	2.317	2.535	2.090	1.307
Total	193.256	219.757	232.768	250.069	261.432	366.223	423.414

Age	1989	1990	1991	1992	1993	1994	1995
2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
3	3.299	0.000	1.427	2.719	4.373	4.816	6.065
4	48.938	55.851	37.793	111.545	164.858	103.830	87.481
5	99.049	50.391	62.704	47.981	111.356	136.498	87.192
6	168.633	80.289	41.617	46.936	42.551	89.375	100.499
7	39.536	118.374	57.272	35.146	33.962	33.522	63.720
8	10.407	26.040	72.048	42.739	22.383	22.584	24.800
9	5.516	6.936	15.326	40.422	30.958	14.752	14.707
10	5.794	3.322	3.856	12.491	25.260	20.162	7.125
11	3.328	3.068	1.593	2.650	9.120	18.366	12.174
12	2.147	1.499	1.354	0.789	1.733	6.697	10.880
13	1.297	0.802	0.484	0.669	0.419	1.219	5.306
14	0.938	0.742	0.252	0.278	0.514	0.285	0.583
15	0.333	0.521	0.289	0.140	0.175	0.368	0.155
Total	389.214	347.835	296.016	344.506	447.662	452.475	420.688

Age	1996	1997	1998	1999	2000	2001
2	0.000	0.000	0.000	0.000	0.000	0.000
3	2.200	20.522	19.883	9.672	30.346	7.069
4	40.581	49.739	141.260	79.365	139.837	122.617
5	64.330	42.161	46.865	139.740	83.313	143.074
6	66.087	52.726	33.957	43.264	118.242	72.108
7	68.868	50.514	39.657	32.204	40.234	83.378
8	40.797	43.280	38.027	31.213	26.112	31.508
9	17.274	28.904	32.611	31.079	23.916	21.212
10	9.236	12.994	19.879	19.760	23.513	15.285
11	3.227	6.177	9.016	14.436	15.506	17.264
12	8.029	1.775	4.192	6.723	11.490	10.516
13	7.340	7.097	1.033	3.558	6.329	9.647
14	3.697	5.004	3.859	0.628	2.356	3.783
15	0.157	3.075	4.471	1.856	0.430	2.022
Total	331.823	323.968	394.710	413.497	521.623	539.483

Table 7.4.1.4 Icelandic summer spawners. Input data for the RCT3 program.

```
Iceland Herring: VPA and acoustic survey data
3 21 2
'Yearcl'   'VPAage2'  'Surv4''Surv3''Surv2'
1980   238 310 -11 -11
1981   219 67  171 -11
1982   489 208 28  -11
1983   1221    -11 652 -11
1984   628 352 -11 201
1985   333 181 126 -11
1986   490 593 725 406
1987   380 227 178 370
1988   932 850 805 -11
1989   1132    858 745 710
1990   706 533 254 465
1991   770 -11 234 1418
1992   354 165 -11 183
1993   379 65  98  -11
1994   1086    716 792 845
1995   604 188 237 266
1996   1078    740 -11 1629
1997   -11 561 527 -11
1998   -11 247 101 1069
1999   -11 -11 942 2832
2000   -11 -11 -11 561
```

Table 7.4.1.5 Icelandic summer spawners. Output from the RCT3 program.

Analysis by RCT3 ver3.1 of data from file :

data2002.txt

Iceland Herring: VPA and acoustic survey data
Data for 3 surveys over 21 years : 1980 - 2000

Regression type = C
Tapered time weighting applied
power = 3 over 20 years
Survey weighting not applied
Final estimates shrunk towards mean
Minimum S.E. for any survey taken as .20
Minimum of 3 points used for regression

Forecast/Hindcast variance correction used.

Yearclass = 1997

	I-----------Regression	----------I				I-----------Prediction	---------I		
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Surv4	.68	2.48	.34	.707	15	6.33	6.76	.399	.458
Surv3	.71	2.40	.46	.547	13	6.27	6.86	.556	.236
Surv2									
					VPA Mean =		6.45	.488	.307

Yearclass = 1998

	I-----------Regression	----------I				I-----------Prediction	---------I		
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Surv4	.66	2.61	.33	.719	15	5.51	6.23	.387	.360
Surv3	.69	2.51	.42	.579	13	4.62	5.71	.556	.175
Surv2	.71	2.07	.38	.604	10	6.98	7.03	.484	.230
					VPA Mean =		6.47	.479	.235

Yearclass = 1999

	I-----------Regression	----------I				I-----------Prediction	---------I		
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Surv4									
Surv3	.67	2.64	.39	.618	13	6.85	7.24	.524	.328
Surv2	.70	2.14	.37	.617	10	7.95	7.69	.578	.270
					VPA Mean =		6.48	.473	.402

Yearclass = 2000

	I-----------Regression	----------I				I-----------Prediction	---------I		
Survey/ Series	Slope	Inter- cept	Std Error	Rsquare	No. Pts	Index Value	Predicted Value	Std Error	WAP Weights
Surv4									
Surv3									
Surv2	.68	2.23	.37	.632	10	6.33	6.56	.464	.505
					VPA Mean =		6.49	.469	.495

Year Class	Weighted Average Prediction	Log WAP	Int Std Error	Ext Std Error	Var Ratio	VPA	Log VPA
1997	803	6.69	.27	.12	.18		
1998	588	6.38	.23	.25	1.13		
1999	1159	7.06	.30	.36	1.41		
2000	684	6.53	.33	.03	.01		

Table 7.4.2.1 Summer-spawning herring, from final AMCI run

Modelled catches by year, fleet 1 area 1

	1981	1982	1983	1984	1985	1986	1987	1988
2	1123.6	554.5	1244.2	917.2	991.4	500.2	138.8	326.2
3	4780.8	16911.6	17545.9	18100.9	20783.6	34556.4	12304.9	4876.5
4	14280.3	25500.6	82964.4	25602.3	34960.3	84038.3	153065.5	101551.9
5	16217.8	21486.7	20396.8	49766.4	23502.5	49595.0	89588.9	210908.7
6	36939.6	26910.2	16548.7	13609.9	40261.2	26738.0	37156.9	76744.3
7	41843.1	48308.2	16267.8	8675.9	11986.1	47596.5	20713.0	32648.7
8	17499.1	39165.3	20510.8	6923.8	6680.2	13199.2	33046.2	16349.6
9	7028.9	14208.6	14295.7	7271.5	4554.1	6477.8	8373.9	23533.6
10	8965.8	7598.9	7099.5	6623.8	6235.5	5773.4	5619.3	7990.5
11	1787.9	6721.3	2603.7	2466.1	4274.0	5972.0	3826.1	4347.9
12	396.9	1903.0	3173.9	1073.1	1896.4	4789.6	4713.0	3296.6
13	204.0	455.5	946.9	1335.3	889.6	2236.3	3697.5	3751.6
14	109.0	110.3	110.3	240.2	657.2	742.9	1318.4	2490.7
15	64.3	105.0	43.5	34.4	180.5	742.0	512.6	657.8

Modelled catches by year, fleet 1 area 1

	1989	1990	1991	1992	1993	1994	1995	1996
2	2232.8	7330.2	24246.8	12481.3	4200.3	4848.1	6394.3	6423.9
3	15119.9	14291.4	62392.8	77498.0	36702.7	79519.3	35146.2	23078.7
4	36577.0	60898.5	51867.8	84154.1	107353.9	101846.3	97022.7	42655.2
5	99708.5	52701.8	76607.7	55209.3	70827.7	149899.5	91928.6	56339.2
6	124571.0	86328.6	38825.3	49281.5	34385.2	88180.4	118079.1	58724.6
7	42455.3	96289.0	55675.9	25075.9	30481.3	43286.6	70632.3	77378.9
8	15523.4	29352.0	57872.6	30606.5	12600.3	30852.8	28309.1	36594.8
9	6962.6	10149.1	14911.6	23054.5	13171.3	11509.9	17908.0	13696.1
10	13112.2	5597.3	6566.9	9048.4	11530.1	12404.5	6202.4	7877.0
11	3788.9	9218.6	3262.4	3498.0	4605.6	12200.1	7787.7	2954.4
12	2005.5	2413.6	4869.7	1490.0	1583.1	4331.3	6859.2	3207.4
13	1404.4	1057.4	982.4	1774.2	550.0	1319.7	2390.4	3070.8
14	1438.6	794.9	464.9	399.3	744.2	479.5	752.7	1157.7
15	564.6	588.4	280.4	149.0	136.8	546.6	283.1	259.4

Modelled catches by year, fleet 1 area 1

	1997	1998	1999	2000	2001	2002	2003
2	4931.1	11280.4	1501.7	4860.8	11653.3	4855.6	4855.6
3	32925.0	28019.0	46788.7	33248.5	29505.8	75006.7	35527.2
4	37993.2	113116.3	78716.7	140523.9	41771.3	41660.9	120894.9
5	29398.7	40877.2	89900.1	62269.1	147741.8	30489.8	34877.4
6	39390.6	28482.8	26395.2	57909.2	55620.2	115994.8	27472.5
7	44745.9	41308.3	20551.6	18128.6	47842.1	39978.7	95847.2
8	47182.9	38149.0	24226.3	11688.3	15119.3	33843.2	32545.8
9	21622.4	39875.4	22125.4	14214.8	9764.7	10536.1	27172.6
10	7451.6	16463.5	20010.7	10931.9	9172.4	5278.8	6571.2
11	4614.3	6041.4	8837.3	10678.9	8130.1	5916.6	3918.5
12	1413.6	3116.4	2705.9	3794.9	6378.3	4115.3	3445.7
13	2144.8	1301.5	2009.5	2190.1	4414.5	6493.0	4804.6
14	1692.4	1636.1	669.5	964.7	1134.8	1973.6	3346.4
15	577.8	1311.2	736.5	341.7	629.9	636.9	1210.3

Observed catches by year, fleet 1 area 1

	1981	1982	1983	1984	1985	1986	1987	1988
2	2283.0	454.0	1475.0	421.0	112.0	100.0	29.0	879.0
3	4629.0	19187.0	22499.0	18015.0	12872.0	8172.0	3144.0	4757.0
4	16771.0	28109.0	151718.0	32244.0	24659.0	33938.0	44590.0	41331.0
5	12126.0	38280.0	30285.0	141354.0	21656.0	23452.0	60285.0	99366.0
6	36871.0	16623.0	21599.0	17043.0	85210.0	20681.0	20622.0	69331.0
7	41917.0	38308.0	8667.0	7113.0	11903.0	77629.0	19751.0	22955.0
8	7299.0	43770.0	14065.0	3916.0	5740.0	18252.0	46240.0	20131.0
9	4863.0	6813.0	13713.0	4113.0	2336.0	10986.0	15232.0	32201.0
10	13416.0	6633.0	3728.0	4517.0	4363.0	8594.0	13963.0	12349.0
11	1032.0	10457.0	2381.0	1828.0	4053.0	9675.0	10179.0	10250.0
12	884.0	2354.0	3436.0	202.0	2773.0	7183.0	13216.0	7378.0
13	760.0	594.0	554.0	255.0	975.0	3682.0	6224.0	7284.0
14	101.0	75.0	100.0	260.0	480.0	2918.0	4723.0	4807.0
15	62.0	211.0	3.0	3.0	581.0	1788.0	2280.0	1957.0

Observed catches by year, fleet 1 area 1

	1989	1990	1991	1992	1993	1994	1995	1996
2	3974.0	11009.0	35869.0	12006.0	869.0	6225.0	7411.0	1100.0
3	22628.0	14345.0	92758.0	79782.0	35560.0	110079.0	26221.0	18723.0
4	26649.0	57024.0	51047.0	131543.0	170106.0	99377.0	159170.0	45304.0
5	77824.0	34347.0	87606.0	43787.0	87363.0	150310.0	86940.0	92948.0
6	188654.0	77819.0	33436.0	56083.0	25146.0	90824.0	105542.0	69878.0

Table 7.4.2.1 (continued)

7	43114.0	152236.0	54840.0	41932.0	28802.0	23926.0	74326.0	86261.0
8	8116.0	32265.0	109418.0	36224.0	18306.0	20809.0	20076.0	37447.0
9	5897.0	8713.0	9251.0	44765.0	24268.0	19164.0	13797.0	13207.0
10	7292.0	4432.0	3796.0	9244.0	14318.0	17973.0	8873.0	6854.0
11	4780.0	4287.0	2634.0	2259.0	3639.0	16222.0	9140.0	4012.0
12	3449.0	2517.0	1826.0	582.0	878.0	2955.0	7079.0	1672.0
13	1410.0	1226.0	516.0	305.0	300.0	1433.0	2376.0	4179.0
14	844.0	1019.0	262.0	203.0	200.0	345.0	927.0	1672.0
15	348.0	610.0	298.0	102.0	100.0	345.0	124.0	100.0

Observed catches by year, fleet 1 area 1

	1997	1998	1999	2000	2001	2002	2003
2	9323.0	16161.0	629.0	7958.0	10206.0	0.0	0.0
3	27072.0	37787.0	43537.0	52921.0	23944.0	0.0	0.0
4	28397.0	151853.0	65871.0	131153.0	76666.0	0.0	0.0
5	29451.0	42833.0	145127.0	44334.0	107849.0	0.0	0.0
6	42267.0	19872.0	24653.0	102925.0	46646.0	0.0	0.0
7	35285.0	30280.0	20614.0	10962.0	51585.0	0.0	0.0
8	28506.0	22572.0	25853.0	9312.0	18504.0	0.0	0.0
9	21828.0	32779.0	21163.0	17218.0	11356.0	0.0	0.0
10	8160.0	14366.0	14436.0	9471.0	7933.0	0.0	0.0
11	3815.0	4802.0	6973.0	7610.0	8547.0	0.0	0.0
12	1696.0	2199.0	2164.0	1930.0	5090.0	0.0	0.0
13	6570.0	1084.0	2426.0	5199.0	4346.0	0.0	0.0
14	1378.0	5081.0	473.0	552.0	1611.0	0.0	0.0
15	1802.0	3036.0	961.0	166.0	864.0	0.0	0.0

Residuals: log (Obs/mod), fleet 1 area 1

	1981	1982	1983	1984	1985	1986	1987	1988
2	0.7	-0.2	0.2	-0.8	-2.2	-1.6	-1.6	1.0
3	0.0	0.1	0.2	0.0	-0.5	-1.4	-1.4	0.0
4	0.2	0.1	0.6	0.2	-0.3	-0.9	-1.2	-0.9
5	-0.3	0.6	0.4	1.0	-0.1	-0.7	-0.4	-0.8
6	0.0	-0.5	0.3	0.2	0.7	-0.3	-0.6	-0.1
7	0.0	-0.2	-0.6	-0.2	0.0	0.5	0.0	-0.4
8	-0.9	0.1	-0.4	-0.6	-0.2	0.3	0.3	0.2
9	-0.4	-0.7	0.0	-0.6	-0.7	0.5	0.6	0.3
10	0.4	-0.1	-0.6	-0.4	-0.4	0.4	0.9	0.4
11	-0.5	0.4	-0.1	-0.3	-0.1	0.5	1.0	0.9
12	0.8	0.2	0.1	-1.7	0.4	0.4	1.0	0.8
13	1.3	0.3	-0.5	-1.7	0.1	0.5	0.5	0.7
14	-0.1	-0.4	-0.1	0.1	-0.3	1.4	1.3	0.7
15	0.0	0.7	-2.7	-2.4	1.2	0.9	1.5	1.1

Residuals: log (Obs/mod), fleet 1 area 1

	1989	1990	1991	1992	1993	1994	1995	1996
2	0.6	0.4	0.4	0.0	-1.6	0.2	0.1	-1.8
3	0.4	0.0	0.4	0.0	0.0	0.3	-0.3	-0.2
4	-0.3	-0.1	0.0	0.4	0.5	0.0	0.5	0.1
5	-0.2	-0.4	0.1	-0.2	0.2	0.0	-0.1	0.5
6	0.4	-0.1	-0.1	0.1	-0.3	0.0	-0.1	0.2
7	0.0	0.5	0.0	0.5	-0.1	-0.6	0.1	0.1
8	-0.6	0.1	0.6	0.2	0.4	-0.4	-0.3	0.0
9	-0.2	-0.2	-0.5	0.7	0.6	0.5	-0.3	0.0
10	-0.6	-0.2	-0.5	0.0	0.2	0.4	0.4	-0.1
11	0.2	-0.8	-0.2	-0.4	-0.2	0.3	0.2	0.3
12	0.5	0.0	-1.0	-0.9	-0.6	-0.4	0.0	-0.7
13	0.0	0.1	-0.6	-1.8	-0.6	0.1	0.0	0.3
14	-0.5	0.2	-0.6	-0.7	-1.3	-0.3	0.2	0.4
15	-0.5	0.0	0.1	-0.4	-0.3	-0.5	-0.8	-1.0

Residuals: log (Obs/mod), fleet 1 area 1

	1997	1998	1999	2000	2001	2002	2003
2	0.6	0.4	-0.9	0.5	-0.1	0.0	0.0
3	-0.2	0.3	-0.1	0.5	-0.2	0.0	0.0
4	-0.3	0.3	-0.2	-0.1	0.6	0.0	0.0
5	0.0	0.0	0.5	-0.3	-0.3	0.0	0.0
6	0.1	-0.4	-0.1	0.6	-0.2	0.0	0.0
7	-0.2	-0.3	0.0	-0.5	0.1	0.0	0.0
8	-0.5	-0.5	0.1	-0.2	0.2	0.0	0.0
9	0.0	-0.2	0.0	0.2	0.2	0.0	0.0
10	0.1	-0.1	-0.3	-0.1	-0.1	0.0	0.0
11	-0.2	-0.2	-0.2	-0.3	0.1	0.0	0.0
12	0.2	-0.3	-0.2	-0.7	-0.2	0.0	0.0
13	1.1	-0.2	0.2	0.9	0.0	0.0	0.0
14	-0.2	1.1	-0.3	-0.6	0.4	0.0	0.0
15	1.1	0.8	0.3	-0.7	0.3	0.0	0.0

Table 7.4.2.2 Summer-spawning herring, from final AMCI run

Modelled surveys indices by year, fleet 1

	1981	1982	1983	1984	1985	1986	1987	1988
2	483.2	217.7	-1.0	544.7	1043.8	613.1	-1.0	441.3
3	85.1	235.7	-1.0	150.0	265.8	509.8	-1.0	139.1
4	99.4	122.2	-1.0	143.9	208.3	377.5	-1.0	433.5
5	117.4	98.8	-1.0	301.8	138.5	202.4	-1.0	678.6
6	187.4	96.7	-1.0	89.5	240.6	109.7	-1.0	246.0
7	169.8	140.2	-1.0	53.1	71.1	187.3	-1.0	100.4
8	67.9	106.2	-1.0	39.9	37.5	49.8	-1.0	46.4
9	30.2	44.0	-1.0	46.9	29.1	27.2	-1.0	72.0
10	35.7	21.6	-1.0	40.2	37.2	23.0	-1.0	21.9
11	9.9	24.7	-1.0	18.7	31.5	29.0	-1.0	12.5
12	1.9	6.1	-1.0	7.4	12.3	20.6	-1.0	8.8
13	1.1	1.7	-1.0	11.5	7.4	12.2	-1.0	14.4
14	1.2	0.9	-1.0	3.8	10.2	6.5	-1.0	14.3
15	1.4	1.3	-1.0	1.0	3.5	9.0	-1.0	5.7

	1989	1990	1991	1992	1993	1994	1995	1996
2	396.1	706.4	1021.4	655.5	549.8	298.6	-1.0	748.5
3	215.6	192.6	342.0	488.3	314.8	266.9	-1.0	150.3
4	202.0	307.4	274.1	459.3	664.4	438.1	-1.0	186.5
5	394.6	193.7	290.1	260.8	439.7	649.2	-1.0	288.8
6	445.1	281.1	134.4	203.4	196.2	352.2	-1.0	293.4
7	155.4	295.7	178.9	88.0	142.9	151.1	-1.0	331.6
8	55.1	93.1	162.2	100.7	51.8	93.9	-1.0	142.8
9	25.9	34.5	55.3	89.8	60.9	34.3	-1.0	52.3
10	44.6	17.6	22.5	37.4	62.0	44.5	-1.0	33.7
11	12.5	28.8	10.9	14.6	26.2	47.1	-1.0	13.5
12	5.7	6.2	13.9	5.4	8.1	16.1	-1.0	15.7
13	6.4	4.3	4.4	10.5	4.6	7.6	-1.0	21.7
14	10.0	4.8	3.1	3.3	8.6	4.1	-1.0	11.2
15	5.8	5.5	2.7	1.7	2.1	6.4	-1.0	4.1

	1997	1998	1999	2000	2001	2002	2003
2	641.6	1436.9	365.8	405.8	1164.4	550.9	-1.0
3	363.0	311.4	697.3	178.1	196.1	563.9	-1.0
4	205.1	512.1	439.5	995.8	238.7	268.1	-1.0
5	170.8	195.9	472.5	422.4	991.6	230.3	-1.0
6	221.9	135.0	147.9	365.1	343.9	805.9	-1.0
7	218.6	170.4	99.1	113.5	287.5	269.7	-1.0
8	211.6	145.6	107.3	65.7	80.5	202.1	-1.0
9	92.9	144.4	93.9	72.9	47.7	57.7	-1.0
10	35.8	66.3	96.8	66.7	54.8	35.4	-1.0
11	23.9	26.4	46.0	71.5	52.4	42.8	-1.0
12	7.7	14.3	14.9	27.7	45.7	33.2	-1.0
13	14.6	7.4	13.1	14.3	27.9	46.0	-1.0
14	18.5	12.4	6.0	11.0	12.0	23.3	-1.0
15	8.1	14.0	8.6	5.0	8.6	9.6	-1.0

Observed surveys indices by year, fleet 1

	1981	1982	1983	1984	1985	1986	1987	1988
2	625.0	-1.0	-1.0	-1.0	-1.0	201.0	-1.0	406.0
3	361.0	17.0	-1.0	171.0	28.0	652.0	-1.0	126.0
4	462.0	75.0	-1.0	310.0	67.0	208.0	-1.0	352.0
5	85.0	159.0	-1.0	724.0	56.0	110.0	-1.0	836.0
6	170.0	42.0	-1.0	80.0	360.0	86.0	-1.0	287.0
7	182.0	123.0	-1.0	39.0	65.0	425.0	-1.0	53.0
8	33.0	162.0	-1.0	15.0	32.0	67.0	-1.0	37.0
9	29.0	24.0	-1.0	27.0	16.0	41.0	-1.0	76.0
10	58.0	8.0	-1.0	26.0	17.0	17.0	-1.0	25.0
11	10.0	46.0	-1.0	10.0	18.0	27.0	-1.0	21.0
12	-1.0	10.0	-1.0	5.0	9.0	26.0	-1.0	14.0
13	-1.0	-1.0	-1.0	12.0	7.0	16.0	-1.0	17.0
14	-1.0	-1.0	-1.0	-1.0	4.0	6.0	-1.0	8.0
15	-1.0	-1.0	-1.0	-1.0	5.0	6.0	-1.0	6.0

	1989	1990	1991	1992	1993	1994	1995	1996
2	370.0	-1.0	710.0	465.0	1418.0	183.0	-1.0	845.0
3	725.0	178.0	805.0	745.0	254.0	234.0	-1.0	98.0
4	181.0	593.0	227.0	850.0	858.0	533.0	-1.0	165.0
5	249.0	177.0	304.0	353.0	687.0	860.0	-1.0	515.0
6	381.0	302.0	137.0	273.0	160.0	443.0	-1.0	316.0
7	171.0	538.0	176.0	94.0	99.0	55.0	-1.0	361.0
8	42.0	185.0	387.0	81.0	87.0	69.0	-1.0	166.0
9	23.0	-1.0	40.0	210.0	44.0	43.0	-1.0	110.0
10	30.0	-1.0	10.0	32.0	92.0	86.0	-1.0	52.0
11	16.0	-1.0	2.0	11.0	39.0	55.0	-1.0	29.0
12	10.0	18.0	-1.0	-1.0	-1.0	2.0	-1.0	16.0

13	9.0	-1.0	-1.0	17.0	-1.0	-1.0	-1.0	27.0

Table 7.4.2.2 (continued)

14	5.0	-1.0	-1.0	-1.0	-1.0	6.0	-1.0	19.0
15	3.0	-1.0	-1.0	-1.0	-1.0	-1.0	-1.0	8.0

	1997	1998	1999	2000	2001	2002	2003
2	266.0	1629.0	-1.0	1069.0	2832.0	561.0	-1.0
3	792.0	237.0	-1.0	527.0	101.0	942.0	-1.0
4	65.0	716.0	188.0	740.0	561.0	247.0	-1.0
5	139.0	100.0	790.0	296.0	1069.0	187.0	-1.0
6	459.0	116.0	240.0	606.0	323.0	265.0	-1.0
7	280.0	240.0	101.0	99.0	609.0	173.0	-1.0
8	410.0	161.0	73.0	71.0	30.0	302.0	-1.0
9	150.0	130.0	47.0	164.0	31.0	69.0	-1.0
10	101.0	97.0	77.0	108.0	38.0	48.0	-1.0
11	50.0	35.0	47.0	98.0	13.0	55.0	-1.0
12	35.0	15.0	10.0	15.0	18.0	54.0	-1.0
13	15.0	11.0	10.0	44.0	6.0	16.0	-1.0
14	65.0	43.0	-1.0	5.0	9.0	18.0	-1.0
15	32.0	8.0	22.0	13.0	4.0	1.0	-1.0

Survey residuals by year, fleet 1

	1981	1982	1983	1984	1985	1986	1987	1988
2	0.26	0.00	0.00	0.00	0.00	-1.12	0.00	-0.08
3	1.44	-2.63	0.00	0.13	-2.25	0.25	0.00	-0.10
4	1.54	-0.49	0.00	0.77	-1.13	-0.60	0.00	-0.21
5	-0.32	0.48	0.00	0.88	-0.91	-0.61	0.00	0.21
6	-0.10	-0.83	0.00	-0.11	0.40	-0.24	0.00	0.15
7	0.07	-0.13	0.00	-0.31	-0.09	0.82	0.00	-0.64
8	-0.72	0.42	0.00	-0.98	-0.16	0.30	0.00	-0.23
9	-0.04	-0.61	0.00	-0.55	-0.60	0.41	0.00	0.05
10	0.48	-0.99	0.00	-0.44	-0.78	-0.30	0.00	0.13
11	0.01	0.62	0.00	-0.63	-0.56	-0.07	0.00	0.52
12	0.00	0.50	0.00	-0.39	-0.31	0.23	0.00	0.46
13	0.00	0.00	0.00	0.04	-0.05	0.27	0.00	0.17
14	0.00	0.00	0.00	0.00	-0.94	-0.08	0.00	-0.58
15	0.00	0.00	0.00	0.00	0.37	-0.40	0.00	0.05

	1989	1990	1991	1992	1993	1994	1995	1996
2	-0.07	0.00	-0.36	-0.34	0.95	-0.49	0.00	0.12
3	1.21	-0.08	0.86	0.42	-0.21	-0.13	0.00	-0.43
4	-0.11	0.66	-0.19	0.62	0.26	0.20	0.00	-0.12
5	-0.46	-0.09	0.05	0.30	0.45	0.28	0.00	0.58
6	-0.16	0.07	0.02	0.29	-0.20	0.23	0.00	0.07
7	0.10	0.60	-0.02	0.07	-0.37	-1.01	0.00	0.08
8	-0.27	0.69	0.87	-0.22	0.52	-0.31	0.00	0.15
9	-0.12	0.00	-0.32	0.85	-0.32	0.23	0.00	0.74
10	-0.40	0.00	-0.81	-0.16	0.40	0.66	0.00	0.43
11	0.25	0.00	-1.69	-0.28	0.40	0.15	0.00	0.77
12	0.56	1.07	0.00	0.00	0.00	-2.09	0.00	0.02
13	0.33	0.00	0.00	0.48	0.00	0.00	0.00	0.22
14	-0.69	0.00	0.00	0.00	0.00	0.38	0.00	0.53
15	-0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.67

	1997	1998	1999	2000	2001	2002	2003
2	-0.88	0.13	0.00	0.97	0.89	0.02	0.00
3	0.78	-0.27	0.00	1.08	-0.66	0.51	0.00
4	-1.15	0.34	-0.85	-0.30	0.85	-0.08	0.00
5	-0.21	-0.67	0.51	-0.36	0.08	-0.21	0.00
6	0.73	-0.15	0.48	0.51	-0.06	-1.11	0.00
7	0.25	0.34	0.02	-0.14	0.75	-0.44	0.00
8	0.66	0.10	-0.38	0.08	-0.99	0.40	0.00
9	0.48	-0.10	-0.69	0.81	-0.43	0.18	0.00
10	1.04	0.38	-0.23	0.48	-0.37	0.30	0.00
11	0.74	0.28	0.02	0.32	-1.39	0.25	0.00
12	1.51	0.04	-0.40	-0.61	-0.93	0.49	0.00
13	0.03	0.40	-0.27	1.12	-1.54	-1.06	0.00
14	1.25	1.25	0.00	-0.79	-0.29	-0.26	0.00
15	1.37	-0.56	0.94	0.95	-0.77	-2.27	0.00

Table 7.4.2.3 Summer-spawning herring, from final AMCI run

Total yearly fishing mortalities at age

	1981	1982	1983	1984	1985	1986	1987	1988
2	0.0022	0.0024	0.0037	0.0016	0.0009	0.0008	0.0005	0.0007
3	0.0284	0.0365	0.0861	0.0621	0.0398	0.0344	0.0207	0.0176
4	0.1245	0.1862	0.2247	0.1566	0.1470	0.2001	0.1879	0.2117
5	0.1507	0.2489	0.1996	0.1828	0.1887	0.2852	0.3023	0.3778
6	0.2373	0.3540	0.2751	0.1779	0.1976	0.3024	0.3192	0.4066
7	0.3239	0.4891	0.3338	0.2027	0.2100	0.3359	0.3599	0.4541
8	0.3239	0.5033	0.3511	0.2063	0.2123	0.3346	0.3658	0.4745
9	0.2846	0.4203	0.3065	0.1802	0.1822	0.2922	0.3265	0.4270
10	0.3285	0.4993	0.3404	0.2030	0.2072	0.3284	0.3934	0.5227
11	0.2393	0.3889	0.2815	0.1693	0.1750	0.2792	0.3351	0.5312
12	0.2437	0.3826	0.2852	0.1603	0.1705	0.2702	0.3296	0.4764
13	0.2722	0.4306	0.2962	0.1666	0.1736	0.2773	0.3073	0.4207
14	0.3408	0.5104	0.3698	0.2335	0.2387	0.4696	0.5890	0.8428
15	0.3065	0.6356	0.4088	0.2272	0.3610	0.6504	0.7785	1.0785
Fref	0.2774	0.4421	0.3135	0.1918	0.2106	0.3478	0.4006	0.5466

	1989	1990	1991	1992	1993	1994	1995	1996
2	0.0052	0.0096	0.0222	0.0177	0.0071	0.0151	0.0190	0.0080
3	0.0356	0.0377	0.0954	0.0825	0.0599	0.1609	0.1300	0.0797
4	0.1596	0.1760	0.1674	0.1616	0.1411	0.2099	0.2683	0.2061
5	0.2955	0.3222	0.3112	0.2412	0.1781	0.2663	0.2652	0.2201
6	0.3562	0.3988	0.3702	0.3004	0.2080	0.3122	0.3088	0.2413
7	0.3664	0.4549	0.4296	0.3854	0.2739	0.3880	0.3920	0.3038
8	0.3597	0.4126	0.4823	0.3946	0.3027	0.4344	0.4194	0.3214
9	0.3367	0.3751	0.3380	0.3188	0.2616	0.4412	0.4292	0.3267
10	0.3975	0.4394	0.3937	0.3143	0.2326	0.3727	0.4010	0.3020
11	0.4461	0.4768	0.4392	0.3342	0.2329	0.3655	0.3760	0.3008
12	0.4422	0.5037	0.4411	0.3263	0.2213	0.3182	0.3205	0.2330
13	0.3388	0.3917	0.3490	0.2527	0.1713	0.2589	0.2595	0.2070
14	0.6419	0.7712	0.6879	0.5145	0.3381	0.4879	0.5099	0.4167
15	0.8227	0.9427	0.9092	0.6930	0.4788	0.6823	0.6378	0.4569
Fref	0.4367	0.4990	0.4683	0.3705	0.2636	0.3934	0.3927	0.3027

Total yearly fishing mortalities at age

	1997	1998	1999	2000	2001	2002	2003
2	0.0071	0.0073	0.0038	0.0111	0.0093	0.0082	0.0082
3	0.0463	0.0459	0.0340	0.0977	0.0780	0.0687	0.0687
4	0.1636	0.1983	0.1577	0.1221	0.1538	0.1353	0.1353
5	0.1916	0.2373	0.2140	0.1617	0.1636	0.1440	0.1440
6	0.2110	0.2562	0.2122	0.1862	0.1903	0.1675	0.1675
7	0.2612	0.3177	0.2651	0.1977	0.2069	0.1821	0.1821
8	0.2735	0.3301	0.2776	0.2118	0.2251	0.1981	0.1981
9	0.2845	0.3477	0.2886	0.2326	0.2456	0.2162	0.2162
10	0.2644	0.3241	0.2622	0.2018	0.2067	0.1819	0.1819
11	0.2591	0.3162	0.2577	0.1946	0.2031	0.1787	0.1787
12	0.2053	0.2494	0.2035	0.1503	0.1530	0.1346	0.1346
13	0.2155	0.2637	0.2255	0.2255	0.2337	0.2057	0.2057
14	0.3587	0.5695	0.4594	0.3410	0.3735	0.3287	0.3287
15	0.5300	0.7701	0.6808	0.4994	0.5481	0.4824	0.4824
Fref	0.2777	0.3620	0.3042	0.2366	0.2499	0.2200	0.2200

Table 7.4.2.4 Summer-spawning herring, from final AMCI run

Stocknumbers-at-age, in area 1

	1981	1982	1983	1984	1985	1986	1987	1988
2	570094.0	256835.9	363509.8	642660.5	1231587.1	723444.9	335991.2	520732.8
3	185892.4	514734.2	231847.9	327690.3	580598.8	1113408.5	654106.8	303880.6
4	132969.6	163487.4	449077.9	192485.8	278659.6	504857.2	973385.5	579729.1
5	126310.8	106235.5	122792.7	324562.1	148927.8	217676.8	373979.5	729880.6
6	190501.2	98301.1	74948.1	91001.2	244612.9	111586.5	148083.5	250100.8
7	164729.3	135960.4	62429.1	51505.3	68924.1	181649.0	74619.3	97378.0
8	68890.8	107816.5	75435.2	40457.1	38051.6	50550.4	117463.4	47110.1
9	30915.3	45089.5	58977.4	48045.2	29782.0	27845.8	32733.8	73725.8
10	34871.8	21045.7	26799.7	39276.2	36304.7	22458.4	18812.2	21367.2
11	9151.0	22717.6	11557.7	17253.4	29009.1	26703.4	14632.2	11485.5
12	1999.0	6517.8	13933.1	7891.7	13180.3	22035.3	18276.9	9469.7
13	932.5	1417.5	4022.5	9479.1	6082.8	10056.6	15218.2	11893.5
14	882.9	642.7	833.9	2706.5	7260.7	4627.0	6895.7	10126.5
15	570.0	519.8	303.3	397.6	1398.7	3619.6	2201.7	2297.7

	1989	1990	1991	1992	1993	1994	1995	1996
2	467361.7	833447.8	1205097.3	773476.8	648749.9	352326.2	369763.3	883148.0
3	470857.0	420685.1	746909.0	1066516.1	687566.4	582872.2	314018.1	328271.4
4	270155.7	411143.4	366563.9	614334.9	888631.1	585951.7	449024.2	249490.5
5	424471.2	208392.7	311995.0	280559.4	472926.2	698241.7	429813.2	310678.1
6	452616.2	285816.1	136629.2	206815.0	199448.0	358104.1	484068.1	298314.8
7	150697.8	286806.3	173569.4	85375.8	138572.0	146576.8	237135.4	321649.9
8	55951.5	94528.1	164663.7	102205.8	52544.9	95344.5	89980.0	144978.9
9	26523.2	35332.6	56617.6	91986.6	62324.0	35126.9	55875.7	53526.9
10	43526.8	17138.8	21971.2	36537.4	60514.9	43411.6	20444.7	32915.2
11	11463.9	26466.3	9993.9	13410.6	24144.2	43391.9	27058.5	12388.3
12	6109.7	6640.1	14866.2	5828.8	8687.4	17306.9	27241.1	16810.0
13	5321.2	3552.5	3630.7	8654.1	3805.7	6300.2	11391.8	17889.6
14	7066.0	3431.0	2172.7	2317.3	6082.0	2901.4	4400.2	7952.0
15	2334.8	2229.0	1087.0	693.5	841.1	2571.9	1398.6	1654.4

	1997	1998	1999	2000	2001	2002	2003
2	757070.1	1695355.0	431626.9	478755.2	1373837.5	650000.0	650000.0
3	792771.7	680164.7	1522904.1	389072.2	428403.0	1231610.1	583356.9
4	274279.9	684871.5	587824.5	1331861.4	319268.5	358546.5	1040458.9
5	183705.1	210728.5	508219.9	454301.4	1066599.5	247713.2	283360.3
6	225583.3	137245.7	150389.9	371252.6	349689.3	819469.7	194084.9
7	212050.0	165292.7	96116.5	110064.3	278844.0	261589.9	627149.9
8	214786.7	147771.6	108859.0	66716.3	81721.6	205153.7	197289.5
9	95120.0	147846.0	96118.1	74624.6	48846.7	59042.9	152272.0
10	34936.1	64758.4	94485.7	65167.2	53512.7	34574.4	43039.3
11	22020.3	24267.6	42373.5	65773.7	48190.6	39379.7	26081.0
12	8297.8	15377.0	16004.9	29631.5	48988.2	35591.1	29800.1
13	12048.9	6114.8	10842.4	11814.8	23070.8	38038.9	28147.3
14	13160.5	8788.5	4250.3	7830.1	8531.9	16524.4	28019.1
15	3282.4	5674.4	3474.3	2033.8	3488.4	3894.7	7401.5

Table 7.4.2.5 Summer-spawning herring, from final AMCI run

SUMMARY TABLE

Year	Recruits age 2	SSB	F 5 -15	Catch SOP	Weighted F 5-15
1981	570094	186495	0.2774	39461	0.2597
1982	256835	177008	0.4421	56472	0.4102
1983	363509	172964	0.3135	58694	0.2843
1984	642660	179600	0.1918	50132	0.1856
1985	1231587	229954	0.2106	49309	0.1966
1986	723444	273480	0.3478	65361	0.3094
1987	335991	373578	0.4006	75295	0.3276
1988	520732	418844	0.5466	92711	0.4058
1989	467361	349238	0.4367	100868	0.3409
1990	833447	312132	0.4990	104854	0.4055
1991	1205097	275004	0.4683	109235	0.3836
1992	773476	327511	0.3705	108275	0.3045
1993	648749	460584	0.2636	102513	0.2142
1994	352326	489949	0.3934	133753	0.3132
1995	369763	439064	0.3927	125673	0.325
1996	883147	348587	0.3027	95722	0.2687
1997	757070	343377	0.2777	64261	0.2436
1998	1695354	381127	0.3620	86849	0.3013
1999	431626	410574	0.3042	92735	0.2385
2000	478755	590025	0.2366	100406	0.1847
2001	1373837	575053	0.2499	95352	0.1829
2002	650000	570915	0.2200	0	0.1745
2003*	650000	644693	0.2200	0	0.1822

Table 7.4.3.1 Summer spawners, catch residuals from final ISVPA run.

Year	2	3	4	5	6	7	8	9
1982	-0.61	-0.75	-0.16	0.09	-0.28	0.15	0.40	-0.51
1983	0.84	0.90	0.46	0.04	0.00	-0.48	-0.21	0.07
1984	-0.28	1.69	1.23	1.35	0.61	0.10	-0.14	-0.24
1985	-2.58	0.51	0.98	0.78	1.15	0.41	0.00	-0.55
1986	-2.59	-1.43	-0.12	0.33	0.37	0.88	0.51	0.27
1987	-3.36	-1.88	-0.96	0.18	0.26	0.47	0.79	0.58
1988	-0.87	-1.38	-0.91	-0.86	-0.01	0.14	0.39	0.56
1989	0.90	-0.22	-0.74	-0.43	-0.12	-0.08	-0.35	-0.04
1990	0.87	-0.53	-0.45	-0.73	-0.37	-0.09	-0.05	-0.05
1991	1.79	0.38	-0.34	-0.12	-0.64	-0.42	0.06	-0.76
1992	1.41	0.23	-0.02	-0.31	0.01	0.06	-0.25	0.06
1993	-0.89	0.38	0.45	0.04	-0.18	0.24	0.22	0.20
1994	1.39	0.80	-0.17	-0.21	-0.28	-0.56	-0.25	0.11
1995	1.55	0.27	0.29	-0.29	-0.25	-0.10	-0.41	-0.18
1996	-1.01	0.37	0.30	0.39	0.23	0.39	0.18	0.01
1997	1.70	-0.46	-0.29	-0.17	-0.08	-0.12	-0.23	0.04
1998	1.43	0.33	0.02	-0.16	-0.56	-0.30	-0.42	0.03
1999	-1.18	0.16	0.21	0.30	-0.13	0.02	0.21	0.16
2000	1.49	0.62	0.20	-0.23	0.26	-0.71	-0.45	0.24
2001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Year	10	11	12	13	14	15
1982	-0.30	0.19	-0.05	0.93	0.90	0.00
1983	-0.64	-0.84	0.04	-1.14	0.97	0.00
1984	0.27	-0.25	-1.96	-1.50	-0.90	0.00
1985	-0.06	0.30	0.51	-0.54	-0.91	0.00
1986	0.35	0.33	0.78	0.28	0.05	0.00
1987	0.71	0.70	1.10	0.78	0.65	0.00
1988	0.40	0.48	0.75	0.65	0.66	0.00
1989	0.18	0.28	0.67	0.09	-0.14	0.00
1990	0.08	0.16	0.57	0.39	0.19	0.00
1991	-0.31	0.19	0.33	-0.10	-0.07	0.00
1992	-0.24	-0.18	0.07	-0.58	-0.26	0.00
1993	-0.03	-0.33	0.04	0.16	-0.31	0.00
1994	-0.23	-0.16	-0.60	0.08	0.09	0.00
1995	0.09	-0.43	-0.18	-0.71	0.34	0.00
1996	0.10	0.45	-1.02	-0.01	-0.37	0.00
1997	-0.12	-0.14	0.45	0.25	-0.84	0.00
1998	-0.12	-0.49	-0.27	0.20	0.31	0.00
1999	0.09	-0.08	-0.41	0.30	0.35	0.00
2000	-0.20	-0.18	-0.79	0.48	-0.71	0.00
2001	0.00	0.00	0.00	0.00	0.00	0.00

Table 7.4.3.2 Summer spawners, fishing mortality from final ISVPA run

Year	2	3	4	5	6	7	8	9
1982	0.00	0.05	0.19	0.27	0.30	0.33	0.34	0.35
1983	0.00	0.05	0.15	0.22	0.25	0.26	0.27	0.28
1984	0.00	0.02	0.06	0.08	0.09	0.10	0.10	0.10
1985	0.00	0.02	0.06	0.09	0.10	0.10	0.11	0.11
1986	0.00	0.03	0.11	0.16	0.17	0.19	0.19	0.20
1987	0.00	0.04	0.13	0.19	0.21	0.22	0.23	0.24
1988	0.00	0.07	0.24	0.35	0.39	0.42	0.44	0.46
1989	0.00	0.07	0.25	0.36	0.41	0.44	0.46	0.47
1990	0.01	0.08	0.29	0.42	0.48	0.52	0.55	0.57
1991	0.01	0.09	0.31	0.45	0.52	0.56	0.59	0.61
1992	0.00	0.07	0.25	0.36	0.41	0.44	0.46	0.48
1993	0.00	0.05	0.15	0.22	0.24	0.26	0.27	0.28
1994	0.01	0.08	0.29	0.43	0.49	0.53	0.55	0.57
1995	0.01	0.08	0.29	0.43	0.49	0.53	0.56	0.58
1996	0.00	0.05	0.18	0.26	0.29	0.31	0.32	0.33
1997	0.00	0.06	0.20	0.28	0.32	0.34	0.35	0.36
1998	0.00	0.07	0.25	0.36	0.41	0.44	0.46	0.48
1999	0.00	0.05	0.18	0.25	0.29	0.31	0.32	0.33
2000	0.00	0.06	0.19	0.27	0.31	0.33	0.34	0.35
2001	0.00	0.06	0.20	0.28	0.32	0.34	0.35	0.37

Year	10	11	12	13	14	15
1982	0.36	0.38	0.30	0.38	0.44	0.44
1983	0.29	0.30	0.24	0.31	0.35	0.35
1984	0.10	0.11	0.09	0.11	0.13	0.13
1985	0.11	0.12	0.09	0.12	0.13	0.13
1986	0.20	0.21	0.17	0.22	0.24	0.24
1987	0.24	0.26	0.20	0.26	0.30	0.30
1988	0.46	0.50	0.38	0.50	0.58	0.58
1989	0.48	0.51	0.40	0.52	0.60	0.60
1990	0.58	0.62	0.47	0.63	0.73	0.73
1991	0.62	0.67	0.51	0.68	0.80	0.80
1992	0.49	0.52	0.40	0.52	0.61	0.61
1993	0.28	0.30	0.24	0.31	0.35	0.35
1994	0.58	0.62	0.48	0.63	0.74	0.74
1995	0.58	0.63	0.48	0.64	0.74	0.74
1996	0.34	0.36	0.28	0.36	0.41	0.41
1997	0.37	0.39	0.31	0.40	0.46	0.46
1998	0.48	0.52	0.40	0.52	0.61	0.61
1999	0.34	0.36	0.28	0.36	0.41	0.41
2000	0.36	0.38	0.30	0.39	0.44	0.44
2001	0.37	0.39	0.31	0.40	0.46	0.46

Table 7.4.3.3 Summer spawners, stock in numbers from final Ispva run.

Year	2	3	4	5	6	7	8	9
1982	245.630	820.688	207.319	159.894	90.591	128.449	109.632	41.484
1983	226.366	221.811	723.782	160.037	107.156	65.676	78.676	56.296
1984	495.863	203.378	178.649	506.191	115.123	75.787	50.931	57.403
1985	1248.341	448.263	166.366	130.043	319.466	87.462	61.603	42.246
1986	644.063	1129.436	392.988	126.364	96.440	205.542	67.471	50.115
1987	342.230	582.674	1013.946	322.324	91.351	66.991	109.890	43.160
1988	497.247	309.634	524.143	873.749	232.560	62.444	41.256	54.108
1989	376.403	449.066	275.506	433.752	693.203	142.471	34.001	17.598
1990	927.703	336.688	384.152	223.166	316.192	442.317	86.652	22.810
1991	1143.139	828.629	290.587	291.700	168.263	209.824	251.004	46.780
1992	673.553	999.196	658.854	212.898	178.070	119.476	136.103	119.866
1993	751.954	597.688	825.908	467.217	149.718	106.152	67.005	87.644
1994	309.186	679.544	505.955	580.575	337.123	110.823	67.818	42.685
1995	312.468	273.662	506.978	360.397	377.992	216.016	76.824	40.968
1996	932.835	275.469	221.918	302.714	240.883	238.569	122.605	49.835
1997	485.077	842.986	230.902	156.392	182.800	149.465	131.313	74.232
1998	889.703	429.778	736.229	181.094	112.642	123.974	100.656	90.876
1999	634.270	789.195	351.840	517.322	121.876	82.444	82.496	68.952
2000	527.152	573.294	671.419	253.792	325.839	86.113	54.393	49.304
2001	2908.505	469.187	466.865	478.969	186.184	193.944	67.173	40.089

Year	10	11	12	13	14	15
1982	32.381	29.793	10.404	0.797	0.093	0.643
1983	30.858	22.798	16.708	7.106	0.139	0.011
1984	37.497	24.267	18.295	11.750	5.887	0.028
1985	47.909	29.502	20.166	16.356	10.382	5.072
1986	35.936	39.073	22.721	15.529	13.844	8.923
1987	34.577	24.092	25.871	13.518	10.442	9.666
1988	24.122	17.600	11.822	10.455	6.131	4.819
1989	17.396	9.722	5.878	3.465	2.320	0.836
1990	10.143	8.593	4.112	1.938	1.753	1.272
1991	12.099	4.834	3.573	1.253	0.552	0.588
1992	33.261	7.227	1.792	1.443	0.628	0.243
1993	64.581	21.035	4.325	1.051	1.007	0.369
1994	55.516	44.401	15.466	3.053	0.657	0.715
1995	19.838	32.616	24.275	11.098	1.358	0.256
1996	23.545	9.253	20.553	15.026	7.713	0.320
1997	32.147	14.586	4.440	16.958	9.500	5.340
1998	45.772	21.089	9.459	2.355	8.905	7.245
1999	50.098	27.335	14.376	6.403	1.069	3.077
2000	41.646	31.180	17.898	10.886	3.416	0.503
2001	27.735	28.400	20.754	14.303	4.754	2.550

Table 7.4.3.4 Summer spawners, ISVPA summary

Age	M(age)	s(age)
2	0.1000000	0.0010528
3	0.1000000	0.0153116
4	0.1000000	0.0492700
5	0.1000000	0.0675585
6	0.1000000	0.0751697
7	0.1000000	0.0798027
8	0.1000000	0.0826494
9	0.1000000	0.0849908
10	0.1000000	0.0858175
11	0.1000000	0.0902968
12	0.1000000	0.0735857
13	0.1000000	0.0911637
14	0.1000000	0.1016654
15	0.1000000	0.1016654

Year	f(year)	Total Stock (in N)	Total Stock (in W)
1982	3.494805	1877.798	346.3869
1983	2.90457	1717.42	332.9702
1984	1.156186	1781.049	313.8574
1985	1.220622	2633.175	411.5255
1986	2.135056	2848.444	486.8043
1987	2.513398	2690.733	540.3919
1988	4.327212	2670.091	550.9971
1989	4.436238	2461.617	499.9507
1990	5.109221	2767.492	498.0368
1991	5.404311	3252.825	526.2543
1992	4.480162	3142.609	551.5833
1993	2.883899	3145.653	605.1643
1994	5.141267	2753.516	569.528
1995	5.160583	2254.745	473.0732
1996	3.332499	2461.237	426.5601
1997	3.59588	2336.139	421.5805
1998	4.465239	2759.776	466.9193
1999	3.327948	2750.751	495.518
2000	3.51495	2646.835	527.7458
2001	3.610545	4909.411	689.1036

Table 7.4.5 Input data for medium-term predictions.

MFDP version 1
Run: run6
Time and date: 15:59 5/6/2002
Fbar age range: 5-15

2002

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
2	684000	0.1	0	0	0.5	0.07	0.009	0.069
3	1038999	0.1	0.151	0	0.5	0.154	0.047	0.154
4	451777	0.1	0.897	0	0.5	0.201	0.132	0.201
5	476158	0.1	0.988	0	0.5	0.259	0.149	0.259
6	462397	0.1	1	0	0.5	0.278	0.2	0.278
7	199992	0.1	1	0	0.5	0.307	0.2	0.307
8	221168	0.1	1	0	0.5	0.317	0.2	0.317
9	79335	0.1	1	0	0.5	0.329	0.2	0.329
10	48688	0.1	1	0	0.5	0.363	0.2	0.363
11	34012	0.1	1	0	0.5	0.376	0.2	0.376
12	36645	0.1	1	0	0.5	0.389	0.2	0.389
13	21823	0.1	1	0	0.5	0.402	0.2	0.402
14	18633	0.1	1	0	0.5	0.409	0.2	0.409
15	6907	0.1	1	0	0.5	0.428	0.2	0.428

2003

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
2	650000	0.1	0	0	0.5	0.07	0.009	0.069
3	.	0.1	0.151	0	0.5	0.154	0.047	0.154
4	.	0.1	0.897	0	0.5	0.201	0.132	0.201
5	.	0.1	0.988	0	0.5	0.259	0.149	0.259
6	.	0.1	1	0	0.5	0.278	0.2	0.278
7	.	0.1	1	0	0.5	0.307	0.2	0.307
8	.	0.1	1	0	0.5	0.317	0.2	0.317
9	.	0.1	1	0	0.5	0.329	0.2	0.329
10	.	0.1	1	0	0.5	0.363	0.2	0.363
11	.	0.1	1	0	0.5	0.376	0.2	0.376
12	.	0.1	1	0	0.5	0.389	0.2	0.389
13	.	0.1	1	0	0.5	0.402	0.2	0.402
14	.	0.1	1	0	0.5	0.409	0.2	0.409
15	.	0.1	1	0	0.5	0.428	0.2	0.428

2004

Age	N	M	Mat	PF	PM	SWt	Sel	CWt
2	650000	0.1	0	0	0.5	0.07	0.009	0.069
3	.	0.1	0.151	0	0.5	0.154	0.047	0.154
4	.	0.1	0.897	0	0.5	0.201	0.132	0.201
5	.	0.1	0.988	0	0.5	0.259	0.149	0.259
6	.	0.1	1	0	0.5	0.278	0.2	0.278
7	.	0.1	1	0	0.5	0.307	0.2	0.307
8	.	0.1	1	0	0.5	0.317	0.2	0.317
9	.	0.1	1	0	0.5	0.329	0.2	0.329
10	.	0.1	1	0	0.5	0.363	0.2	0.363
11	.	0.1	1	0	0.5	0.376	0.2	0.376
12	.	0.1	1	0	0.5	0.389	0.2	0.389
13	.	0.1	1	0	0.5	0.402	0.2	0.402
14	.	0.1	1	0	0.5	0.409	0.2	0.409
15	.	0.1	1	0	0.5	0.428	0.2	0.428

Input units are thousands and kg - output in tonnes

Table 7.5.2

MFDP version 1
Run: run6
Time and date: 15:59 5/6/2002
Fbar age range: 5-15

Year:		2002	F multiplier:	1.12	Fbar:	0.2188				
Age	F		CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
	2	0.0101	6529	450	684000	47880	0	0	0	0
	3	0.0526	50723	7811	1038999	160006	156889	24161	149237	22983
	4	0.1478	59157	11891	451777	90807	405244	81454	385480	77481
	5	0.1669	69741	18063	476158	123325	470444	121845	447500	115903
	6	0.224	88472	24595	462397	128546	462397	128546	439846	122277
	7	0.224	38265	11747	199992	61398	199992	61398	190238	58403
	8	0.224	42317	13414	221168	70110	221168	70110	210382	66691
	9	0.224	15179	4994	79335	26101	79335	26101	75466	24828
	10	0.224	9316	3382	48688	17674	48688	17674	46313	16812
	11	0.224	6508	2447	34012	12789	34012	12789	32353	12165
	12	0.224	7011	2727	36645	14255	36645	14255	34858	13560
	13	0.224	4175	1679	21823	8773	21823	8773	20759	8345
	14	0.224	3565	1458	18633	7621	18633	7621	17724	7249
	15	0.224	1322	566	6907	2956	6907	2956	6570	2812
Total			402281	105225	3780534	772240	2162177	577682	2056726	549509

Year:		2003	F multiplier:	1	Fbar:	0.1954				
Age	F		CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
	2	0.009	5542	382	650000	45500	0	0	0	0
	3	0.047	26780	4124	612702	94356	92518	14248	88006	13553
	4	0.132	105074	21120	891917	179275	800050	160810	761031	152967
	5	0.149	46508	12046	352605	91325	348374	90229	331383	85828
	6	0.2	63003	17515	364625	101366	364625	101366	346842	96422
	7	0.2	57785	17740	334429	102670	334429	102670	318118	97662
	8	0.2	24993	7923	144644	45852	144644	45852	137590	43616
	9	0.2	27639	9093	159960	52627	159960	52627	152158	50060
	10	0.2	9914	3599	57379	20829	57379	20829	54581	19813
	11	0.2	6084	2288	35214	13240	35214	13240	33496	12595
	12	0.2	4250	1653	24599	9569	24599	9569	23399	9102
	13	0.2	4579	1841	26504	10654	26504	10654	25211	10135
	14	0.2	2727	1115	15783	6455	15783	6455	15014	6141
	15	0.2	2329	997	13476	5768	13476	5768	12819	5487
Total			387209	101436	3683837	779486	2417554	634317	2299649	603381

Year:		2004	F multiplier:	1	Fbar:	0.1954				
Age	F		CatchNos	Yield	StockNos	Biomass	SSNos(Jan)	SSB(Jan)	SSNos(ST)	SSB(ST)
	2	0.009	5542	382	650000	45500	0	0	0	0
	3	0.047	25477	3923	582875	89763	88014	13554	83722	12893
	4	0.132	62313	12525	528942	106317	474461	95367	451321	90715
	5	0.149	93284	24160	707242	183176	698755	180978	664676	172151
	6	0.2	47497	13204	274884	76418	274884	76418	261478	72691
	7	0.2	46674	14329	270121	82927	270121	82927	256947	78883
	8	0.2	42808	13570	247751	78537	247751	78537	235668	74707
	9	0.2	18515	6091	107155	35254	107155	35254	101929	33535
	10	0.2	20476	7433	118501	43016	118501	43016	112722	40918
	11	0.2	7345	2762	42507	15983	42507	15983	40434	15203
	12	0.2	4507	1753	26087	10148	26087	10148	24815	9653
	13	0.2	3149	1266	18224	7326	18224	7326	17335	6969
	14	0.2	3393	1388	19634	8030	19634	8030	18677	7639
	15	0.2	2020	865	11693	5004	11693	5004	11122	4760
Total			382999	103652	3605615	787399	2397787	652542	2280845	620717

Table 7.5.3

MFDP version 1
Run: run6
MFDP Index file 06/05/2002
Time and date: 15:59 5/6/2002
Fbar age range: 5-15

2002				
Biomass	SSB	FMult	FBar	Landings
772240	549509	1.12	0.2188	105225

2003					2004	
Biomass	SSB	FMult	FBar	Landings	Biomass	SSB
779486	603381	0	0	0	894824	721451
.	603381	0.1	0.0195	10937	883244	710584
.	603381	0.2	0.0391	21690	871860	699903
.	603381	0.3	0.0586	32260	860667	689403
.	603381	0.4	0.0781	42653	849662	679081
.	603381	0.5	0.0977	52870	838842	668934
.	603381	0.6	0.1172	62915	828204	658959
.	603381	0.7	0.1368	72791	817743	649153
.	603381	0.8	0.1563	82501	807457	639512
.	603381	0.9	0.1758	92049	797344	630034
.	603381	1.00	0.1954	101436	787399	620717
.	603381	1.10	0.2149	110666	777620	611556
.	603381	1.20	0.2344	119741	768003	602550
.	603381	1.30	0.254	128665	758547	593695
.	603381	1.40	0.2735	137440	749248	584988
.	603381	1.50	0.293	146069	740103	576428
.	603381	1.60	0.3126	154554	731110	568012
.	603381	1.70	0.3321	162898	722265	559737
.	603381	1.80	0.3517	171104	713567	551600
.	603381	1.90	0.3712	179173	705013	543599
.	603381	2.00	0.3907	187108	696600	535732

Input units are thousands and kg - output in tonnes

Table 7.5.4 Input data for Yield per recruit.

MFYPR version 1
Run: run2
finMFYPR Index file 06/05/2002
Time and date: 17:05 5/6/2002
Fbar age range: 5-15

Age	M	Mat	PF	PM	SWt	Sel	CWt
2	0.1	0.001	0	0.5	0.066	0.006	0.066
3	0.1	0.071	0	0.5	0.141	0.05	0.141
4	0.1	0.887	0	0.5	0.198	0.141	0.198
5	0.1	0.997	0	0.5	0.236	0.183	0.236
6	0.1	1	0	0.5	0.271	0.205	0.271
7	0.1	1	0	0.5	0.3	0.22	0.3
8	0.1	1	0	0.5	0.323	0.22	0.323
9	0.1	1	0	0.5	0.345	0.22	0.345
10	0.1	1	0	0.5	0.364	0.22	0.364
11	0.1	1	0	0.5	0.375	0.22	0.375
12	0.1	1	0	0.5	0.394	0.22	0.394
13	0.1	1	0	0.5	0.41	0.22	0.41
14	0.1	1	0	0.5	0.412	0.22	0.412
15	0.1	1	0	0.5	0.429	0.22	0.429

Weights in kilograms

Figure 7.4.1.1 Icelandic summer spawners. Sum of squares used for fitting VPA to acoustic data, as a function of terminal fishing mortality.

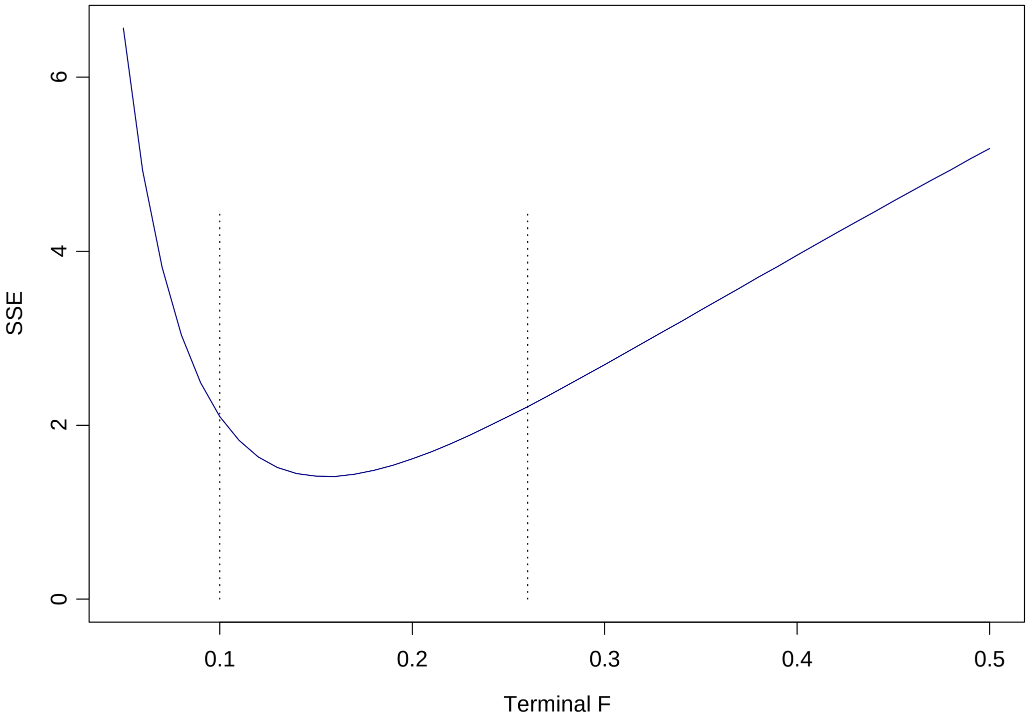


Figure 7.4.1.2 Icelandic summer spawners. Trend in acoustics and VPA stock numbers.

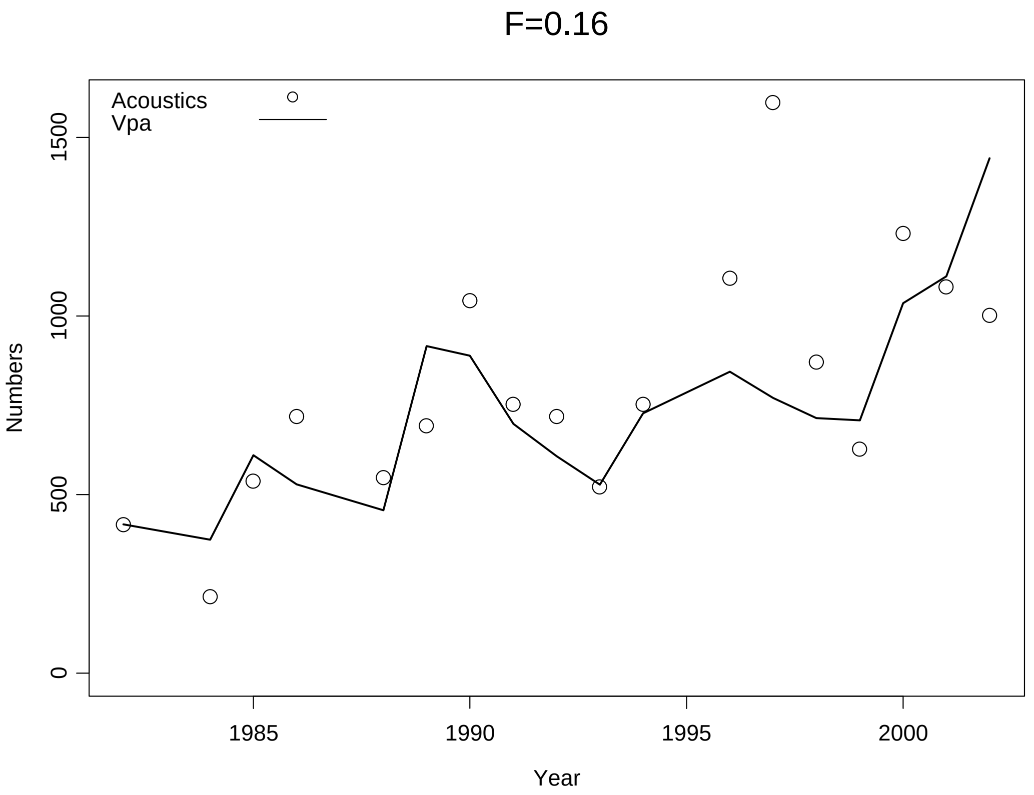


Figure 7.4.1.3 Icelandic summer spawners. Acoustics estimates vs VPA stock numbers (at the 1st of January)

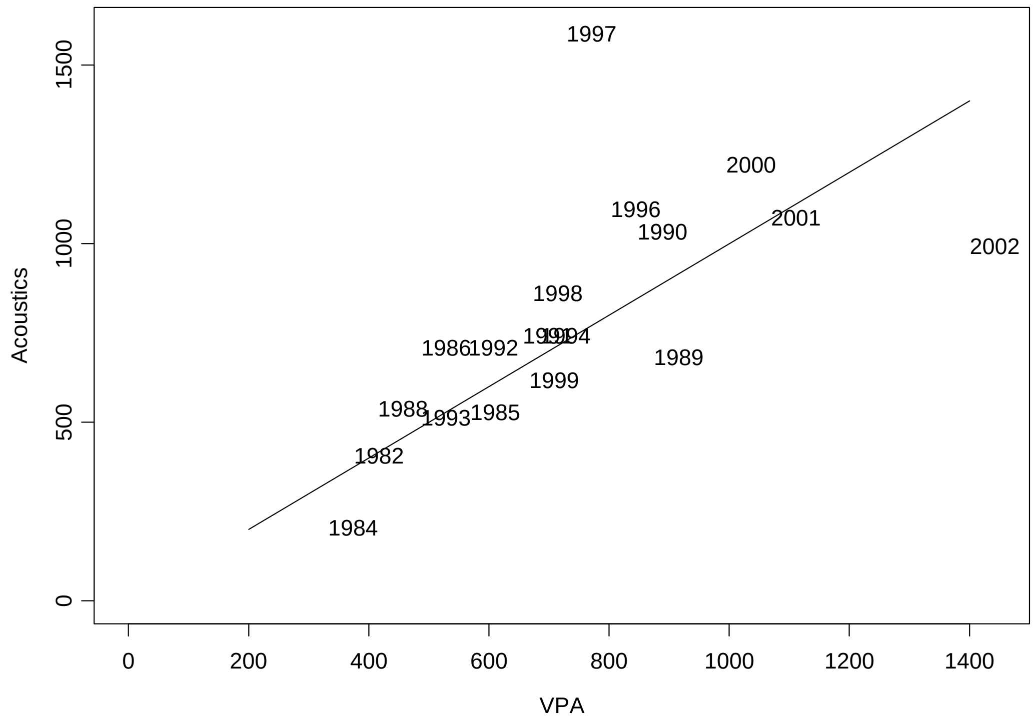


Figure 7.4.1.4 Retrospective plots

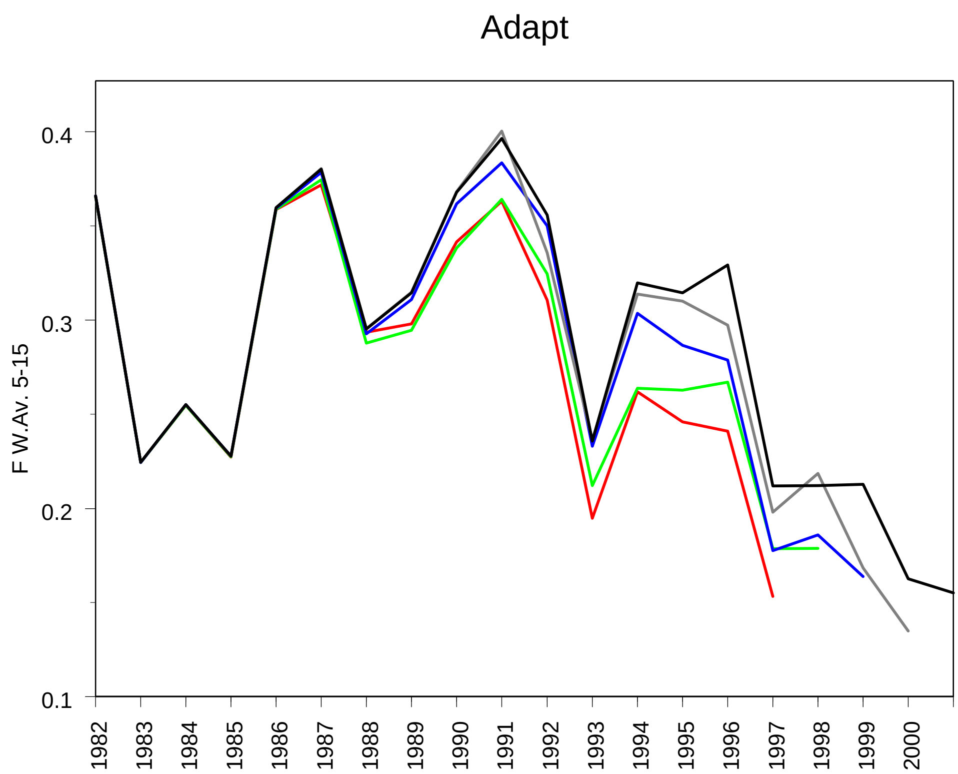
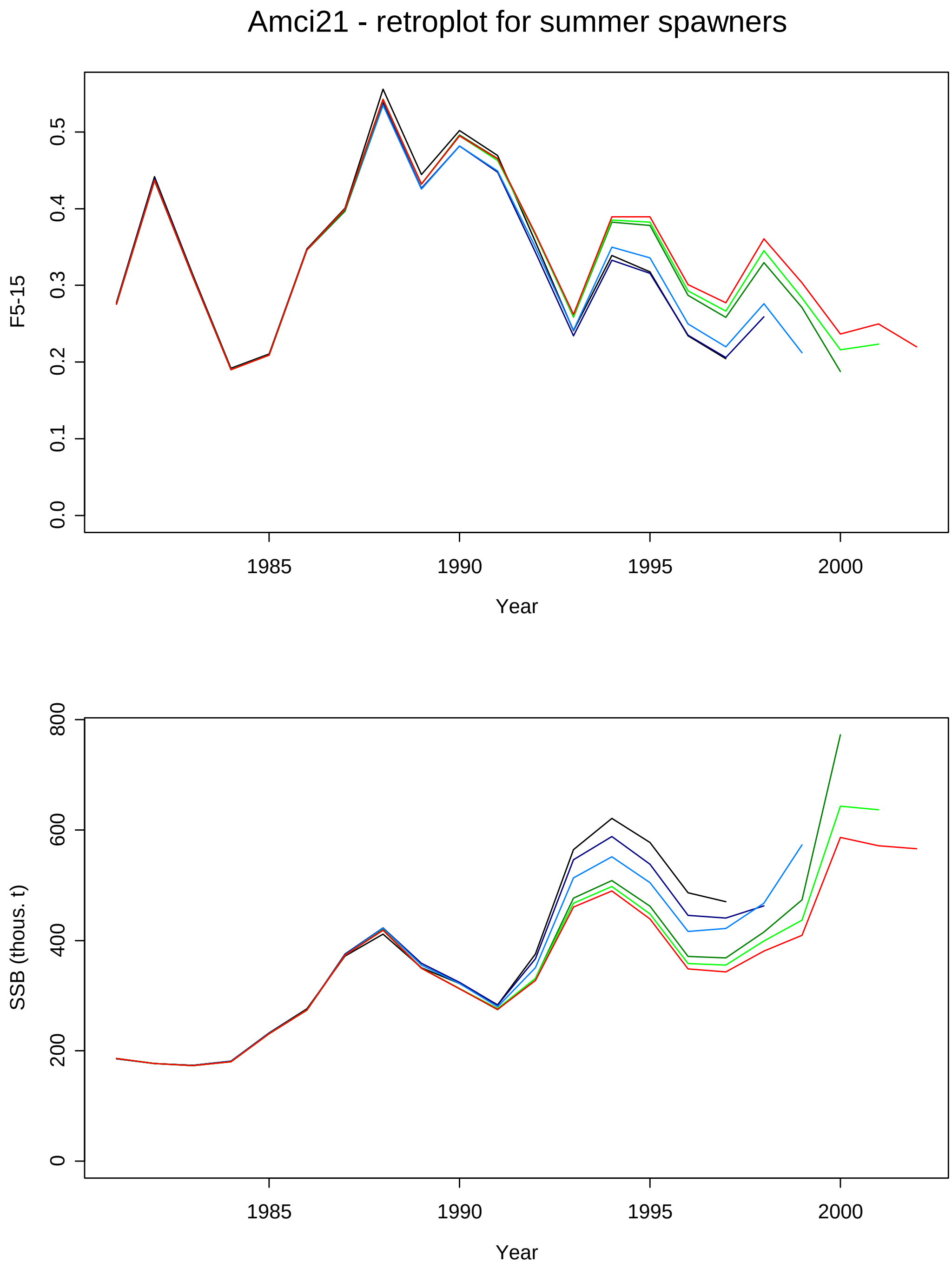
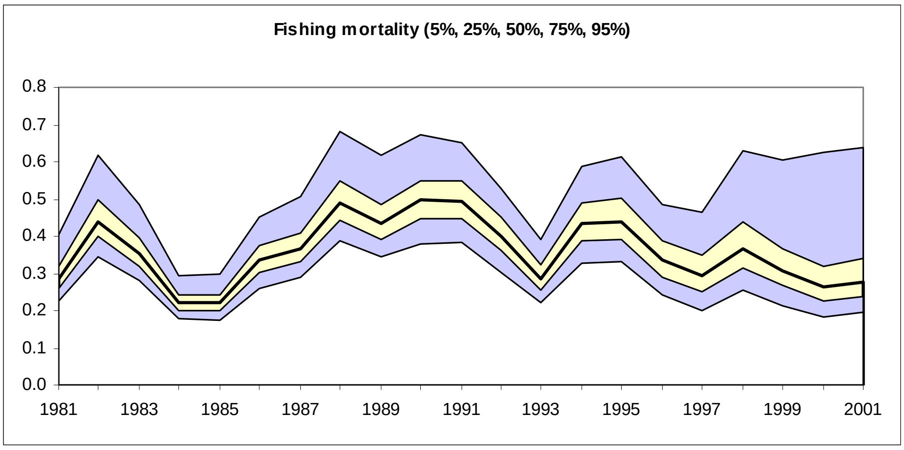


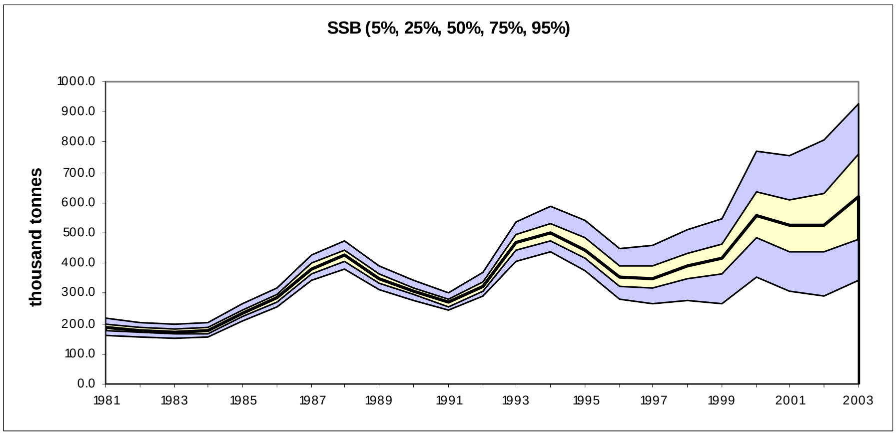
Figure 7.4.2.1

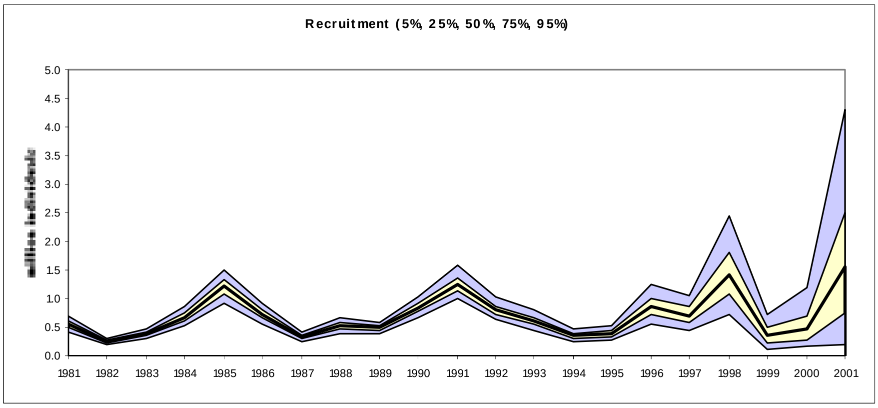


Amci21 - retroplot for summer spawners
F5-15
0.0
0.1
0.2
0.3
0.4
0.5
1985
1990
1995
2000
Year
SSB (thous. t)
0
200
400
600
800
1985
1990
1995
2000
Year

Figure 7.4.2.2


Fishing mortality (5%, 25%, 50%, 75%, 95%)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001


SSB (5%, 25%, 50%, 75%, 95%)
thousand tonnes
0.0
100.0
200.0
300.0
400.0
500.0
600.0
700.0
800.0
900.0
1000.0
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003


Recruitment (5%, 25%, 50%, 75%, 95%)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001

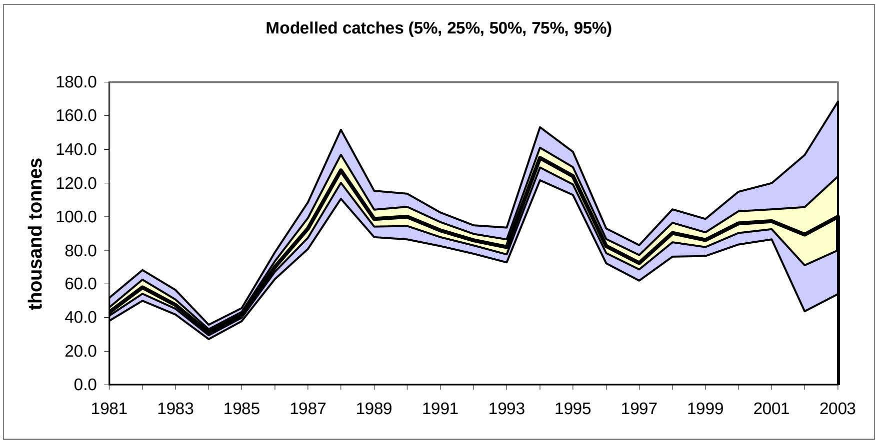

Modelled catches (5%, 25%, 50%, 75%, 95%)
thousand tonnes
0.0
20.0
40.0
60.0
80.0
100.0
120.0
140.0
160.0
180.0
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003

Figure 7.4.1.5 Fish stock summary. Herring Icelandic Summer-spawning (Fishing Area Va)

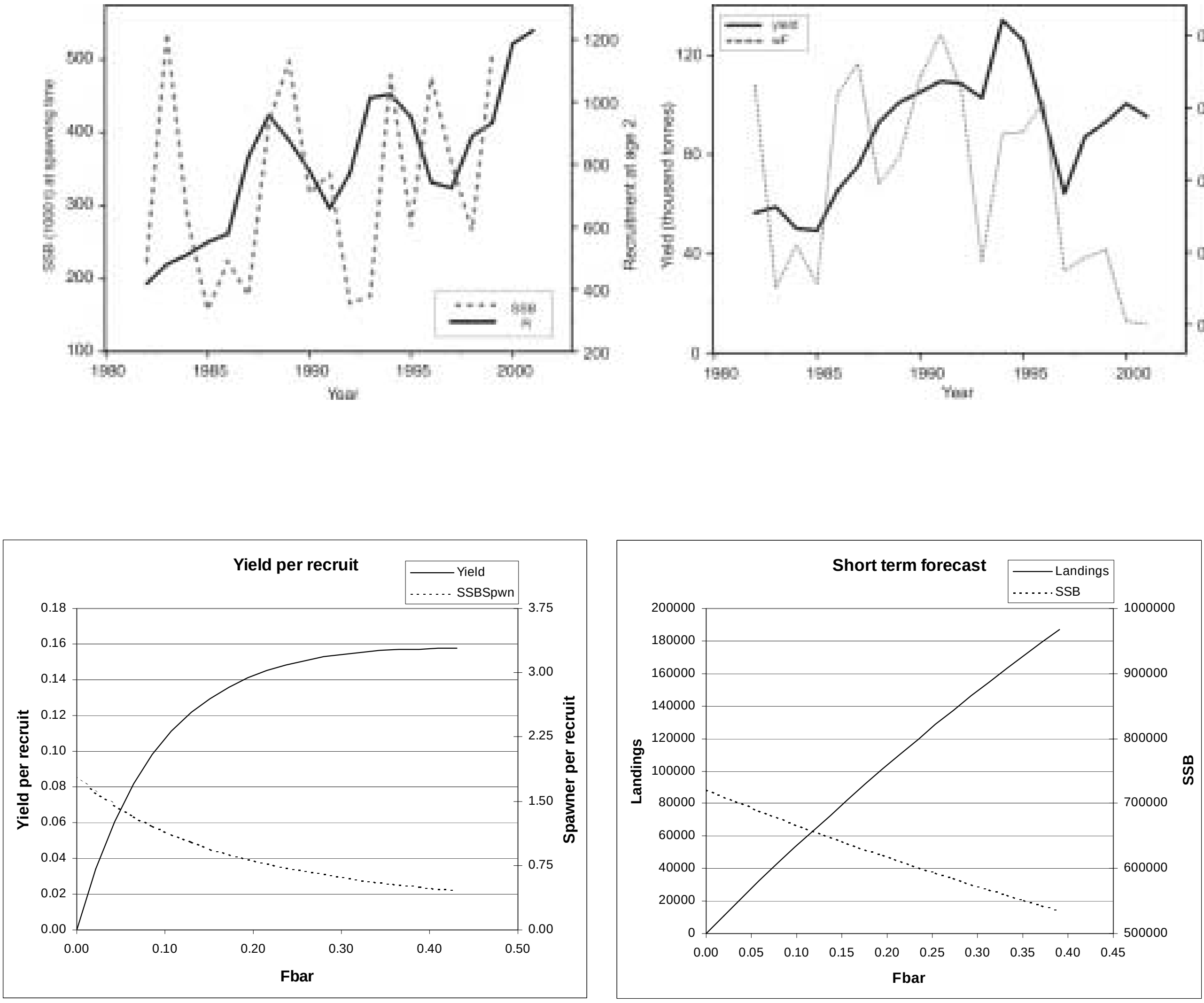
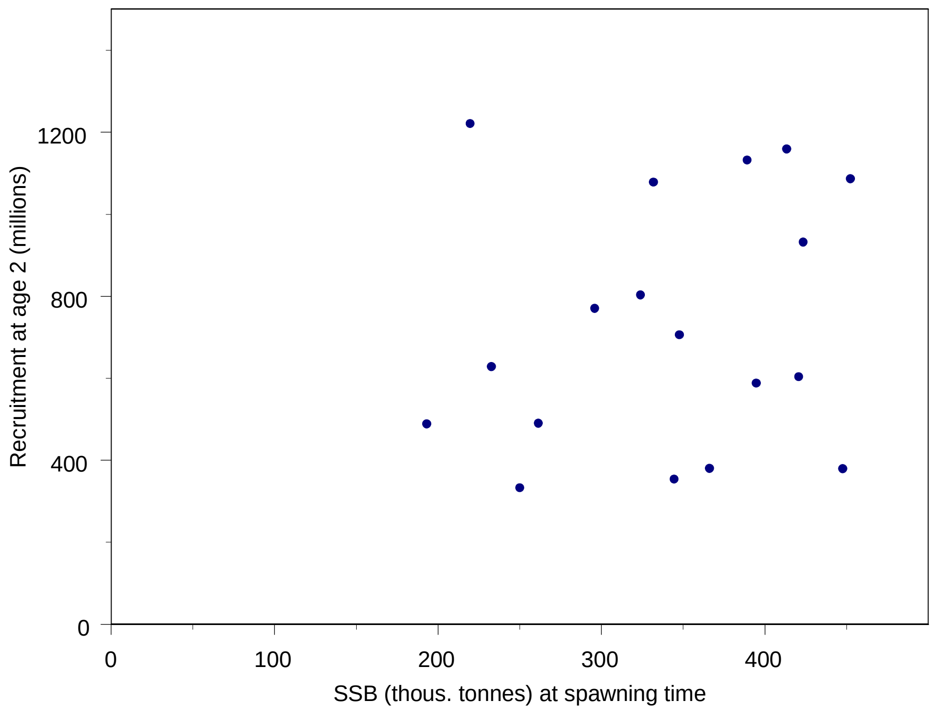


Figure 7.7.1 Stock-recruitment relationship from 1982-1999



8 REFERENCES AND WORKING DOCUMENTS

8.1 References

Alverson D.L. and M.J.Carney. 1975. A graphic review of the growth and decay of population cohorts. J.Cons.Int.Explor.Mer., 36:133-143.

Anon. 2001. Havets Miljø 2001. FiskenHav. Særnr. 2, 2001. Institute of Marine Research, Bergen, Norway. In Norwegian with English subtitles.

Anon. 2002. Havets Miljø 2002. FiskenHav. Særnr. 2, 2002. Institute of Marine Research, Bergen, Norway. In Norwegian with English subtitles.

Bogstad, B. and Gjøsæter, H. 2001. Predation by cod (*Gadus morhua*) on capelin (*Mallotus villosus*) in the Barents Sea: implications for capelin stock assessment. Fisheries Research, 53:197-209.

Bogstad, B. and Mehl, S. 1997. Interactions between cod and its prey species in the Barents Sea. Proceedings of the International Symposium on The Role of Forage Fishes in Marine Ecosystems. University of Alaska, Fairbanks. Alaska Sea Grant College Program Report No. 97-01, p. 591-615.

Bogstad, B., Haug, T. and Mehl, S. 2000. Who eats whom in the Barents Sea? NAMMCO Sci. Publ., 2 :98-119.

Dalpadado, P., Bogstad, B., Gjøsæter, H., Mehl, S. and Skjoldal, H. R. 2002. Zooplankton-fish interactions in the Barents Sea. In Large Marine Ecosystems. Blackwell Science Inc.

Folkow, L. P., Haug, T., Nilssen, K.T., and Nordøy, E.S. 2000. Estimated food consumption of minke whales *Balaenoptera acutorostrata* in Northeast Atlantic waters in 1992-1995. NAMMCO Sci. Publ. 2.

Gjøsæter, H. 1997. The Barents Sea capelin stock (*Mallotus villosus*): A brief review. Proceedings of the International Symposium on The Role of Forage Fishes in Marine Ecosystems. University of Alaska, Fairbanks. Alaska Sea Grant College Program Report No. 97-01, p. 469-484.

Gjøsæter, H. and Bogstad, B. 1998. Effects of the presence of herring (*Clupea harengus*) on the stock-recruitment relationship of Barents Sea capelin (*Mallotus villosus*). Fisheries Research, 38:57-71.

Gjøsæter,H., Dalpadado, P., Hassel, A. and Skjoldal, H. R. 2000. Growth of the Barents Sea capelin (*Mallotus villosus* Müller). In H.Gjøsæter, Dr. philos. thesis, University of Bergen, Norway. Paper IV.

Gundersen, A.C. and Gjøsæter, H. 1998. A comparison between abundance estimates of the Barents Sea capelin (Mallotus villosus Müller) at the larval, 0-group and 1-group stage, for the year classes 1981-1994. ICES Journal of Marine Science, 55: 95-101.

Holst et al. 2000. Report on surveys of the distribution, abundance and migrations of the Norwegian spring-spawning herring, other pelagic fish and the environment in the Norwegian Sea and adjacent waters in late winter, spring and summer of 2000. ICES C.M. 2000/D:03. 42 pp.

Holst, J.C. 1996. Long-term trends in the growth of the Norwegian spring spawning herring (*Clupea harengus* L.). Dr.scient thesis, University of Bergen, Norway.

ICES 1991/Assess:17. Report of the Atlanto-Scandian Herring and Capelin Working Group. Copenhagen, 8-12April 1991. ICES C.M. 1991/Assess:17, 62 pp.

ICES 1993/Assess:6. Report of the Atlanto-Scandian Herring and Capelin Working Group. Copenhagen, 19-23 October 1992. ICES C.M. 1993/Assess:6, 74 pp.

ICES 1995/Assess:7. Report of the Blue Whiting Assessment Working Group, Vigo, Spain 8 - 14 September 1994. ICES C.M. 1995/Assess:7.

ICES 1995/Assess:9. Report of the Atlanto-Scandian Herring and Capelin Working Group, Copenhagen 17-21 October 1994. ICES CM 1995/Assess:9 101pp.

ICES 1998/ACFM:18. Report of the Northern Pelagic and Blue Whiting Fisheries Working Group. ICES Headquarters 28 April - 6 May 1998. ICES CM 1998/ACFM:18, 276 pp.

ICES 1999/ACFM:7. Report of the Joint ICES/NAFO Working Group on harp and hooded seals. Tromsø, Norway, 29 September – 2 October 1998. ICES CM 1999/ACFM:7, 36 pp.

ICES 2000/ACFM:16. Report of the Northern Pelagic and Blue Whiting Fisheries Working Group. ICES Headquarters 26 April - 4 May 2000. ICES CM 2000/ACFM:16. 307 pp.

ICES 2001/ACFM:6. Report of the Working Group on the Assessment of Mackerel, Horse Mackerel, Sardine and Anchovy. ICES Headquarters, 4-13, September 2001. ICES 2001/ACFM:6

ICES 2001/ACFM:17. Report of the Northern Pelagic and Blue Whiting Fisheries Working Group. Reykjavik, Iceland, 18-27 April 2001. ICES CM 2001/ACFM:17.

ICES 2001/ACFM:19. Report of the Arctic Fisheries Working Group. Bergen, Norway, 24 April – 3 May 2001. ICES CM 2001/ACFM:19.

ICES 2001/CRR:246. Report from the ICES Advisory Committee on Fishery Management, 2001. Part 1. 300 pp.

Jakobsson, J., Gudmundsdottir, A., and Stefansson, G. 1993. Stock-related changes in biological parameters of the Icelandic summer-spawning herring. Fisheries Oceanography, 2:260-277.

Jakobsson, J. and Stefansson, G. 1999. Management of summer-spawning herring off Iceland. ICES Journar of Marine Science, 56:827-833.

Lindstrøm, U., Haug, T. and Røttingen. 2002. Predation on herring, Clupea harengus, by minke whales, *Balaenoptera acutorostrata*, in the Barents Sea. ICES Journal of Marine Science, 59:58-70.

Nilssen, K. T., Pedersen, O.-P., Folkow, L. P., and Haug, T. 2000. Food consumption estimates of Barents Sea harp seals. NAMMCO Scientific Publications, 2:9-27.

Ottersen, G., Ådlandsvik, B., and Loeng, H. 2000. Predictability of Barents Sea temperature. Fisheries Oceanography, 9:121-136.

Patterson, K.R. 1999. Integrated catch at age analysis. Version 1.4. Marine Laboratory, Aberdeen.

Patterson, K.R., Skagen D., Pastoors, M., and Lassen H. 1997. HAWG 1997. Harvest control rules for North Sea herring. Working Document to ACFM 1997.

Rikhter V.A. and V.N. Efanov. 1977. About one of possible approaches to estimation of natural mortality of fish populations. Trudi AtlantNIRO, 73:77-85 (in Russian).

Røttingen, I. A revew of the process leading to the establishment of limit and precautionary reference points for the stock of Norwegian-spring spawning herring

Schweder, T., Skaug, H. J., Dimakos,X. K., Langaas, M. and Øien, N. 1997. Abundance of northeastern Atlantic minke whales estimates for 1989 and 1995. Report of the International Whaling Commision, 47:453-483.

Tjelmeland, S. and Bogstad, B. 1998. Multspec - a review of a multspecies modelling project for the Barents Sea. Fisheries Research, 37:127-142.

Timoshenko N. 1982.Preliminary results of studies on blue whiting from the areas south of Ireland. ICES C.M.1982/H:25.

Toresen, R. and Østvedt, O.J. 2000. Variation in abundance of Norwegian spring-spawning herring (*Clupea harengus*, Clupeidae) throughout the 20th century and the influence of climatic fluctuations. Fish and Fisheries, 1:231-256.

Tyurin, P.V., 1972. "Normal" curves of the survival and natural mortality rates of the fish as a theoretical basis for fishery regulation. Izvestiya GOSNIORKh, 7l:71-128.

Vilhjálmsson, H., 1994. The Icelandic capelin stock. Capelin *Mallotus villosus* (Müller) in the Iceland, Greenland, Jan Mayen area. Rit Fiskideildar, 13: 281 pp.

Vilhjálmsson, H. and E. Friðgeirsson 1976. A review of 0-group surveys in the Iceland-East Greenland area in the years 1970 - 1975. ICES Coop. Res. Rep. 54: 1-34.

Working Documents

Belikov, S. V. Results of Russian research on blue whiting in the Barents Sea in autumn and winter 2001.

Bogstad, B., Dolgolenko, I., Gjøsæter, H., Prokhorova, T., Prozorkevich, D., Ratushnyy, S., Tjelemeland, S., Trofimov, A., and Ushakov, N. Report from the 2001 joint Russian- Norwegian meeting to assess the Barents Sea capelin stock. Vadsø, October 5-7, 2001.

Dommasnes, A. and Nøttestad, L. Natural mortality for herring (*Clupea harengus* L.) may be a function of population size.

Dommasnes, A. Biomass production 1950-1998 from a virtual population of Norwegian spring-spawning herring.

Gjøsæter, H. First draft of chapter 4, Barents Sea capelin.

Gjøsæter, H. Survey report from the joint Norwegian/Russian acoustic survey of pelagic fish in the Barents Sea September-October 2001.

Gjøsæter, H., Maslova, R., Prokhorova, T., Prozorkevich, D., Røttingen, B., Røttingen, J., Tereschenko, E., Ushakov, N. Age compositions of capelin otoliths by Norwegian and Russian readers 1999-2001.

Godø, O. R., Heino, M., Oganin, I., Ratushnyy, S., Sentyabov, E., Gerber, E. and Timoshenko, N (a). Report and preliminary evaluation of Norwegian and Russian blue whiting surveys in 2002.

Godø, O. R., Heino, M., Søiland, H., Alvarez, J., Dahl, M., de Lange, J., Gullaksen, O., Tangen, O. and Torkelsen, T. (b). Blue whiting survey during spring 2002.

Krysov, A. Report on a survey of the distribution of immature herring and environmental conditions in the Barents Sea during 17 May-6 June 2001.

Loeng, H., Dalpadado, P., Ingvaldsen, R., Ottersen, G., Stiansen, J. E. The Barents Sea ecosystem, 2001-2002.

Melle, W., Mork, K., A, Holst, J. C. and Rey, F. The Norwegian Sea; Hydrography, plankton and herring feeding. Status report April 2002.

Røttingen, B., Anthonypillai, V., Gjøsæter, H. Report on Norwegian research and capelin fishery during winter 2002.

Røttingen, I. Acoustic estimates of Norwegian spring spawning herring in the wintering area in November 2001.

Skagen, D. Reference points for blue whiting revisited.

Slotte, A Data from tagging experiments on Norwegian spring spawning herring in 2001.

Slotte, A. The Norwegian age specific fishery of Norwegian spring spawning herring in 2001.

Slotte, A. Underestimated abundance of old individuals in the Norwegian spring spawning herring stock: artifacts of age readings.

Sveinbjörnsson, S. Cruise no. A9/2001. A survey report on blue whiting biomass estimates assessment in Icelandic waters 17 July-30 July 2001.

Timoshenko, N. The blue whiting distribution detected by RV "Atlantniro" in spring 2002.

Ushakov, N. G. and Prozorkevich, D. V. Russian investigations of the Barents Sea capelin.

Vasilyev, D. A. and Belikov, S. V. Blue whiting: what about natural mortality?

Vilhjálmsson, H. A summary of acoustic assessment surveys of capelin in the Iceland-East Greenland-Jan Mayen area during autumn 2001 and winter 2002.

APPENDIX

Special opinion of the Russian delegation

On the basis of scientific materials presented to the Working Group and results of modelling undertaken by the Russian delegation at the meeting of the Working Group using the international data approved by the Working Group, the Russian delegation considers it necessary to formulate the following special opinion:

1. Considering the state of the stock and perspectives of fishery of blue whiting:

The state of the stock is currently in a much better state than is shown in the Summary Sheet. The value of SSB in 2001 is about 7.4 million tonnes (see Section 6.4.4.2. of the Report) and in 2002 - about 8.7 million tons, which is much more in agreement with survey results and fishery experience. Assuming that the total catch in 2002 will be equal to 1.4 million tonnes, the catch forecast for 2003 is the following:

F(3-7) in 2003	SSB in 2003	catch in 2003	SSB in 2004
0	8.6	0	9.7
0.05	8.6	0.4	9.2
0.1	8.6	0.8	8.9
0.15	8.6	1.2	8.5
0.2	8.6	1.5	8.2
0.25	8.6	1.9	7.8

Forecast options: recruitment-at-age 1 for 2001-2004 is taken equal to its mean historical value; weight-at-age and selection pattern are also taken equal to historical mean values of the estimates obtained with the effort-controlled version of ISVPA for M=0.2. The estimates of SSB in the table above are given on 1 of January.

2. Considering the state of the stock and perspectives of fishery of Norwegian spring-spawning herring:

The results of the assessment (see Section 3.5.4.3) show that the spawning stock biomass in 2001 has stopped declining and has stabilized at a level above 6.7 million tonnes, while in 2002 the SSB value is estimated as 7.45 million tonnes. Assuming that the total catch in 2002 will be equal to 850 000 tonnes, the catch forecast for 2003 is the following:

F(2-13) in 2003	**F(5-14),** weighted by abundance	SSB in 2003	catch in 2003	SSB in 2004
0	0	7.54	0	7.72
0.05	0.047	7.54	0.365	7.37
0.1	0.094	7.54	0.707	7.04
0.125	0.118	7.54	0.870	6.88
0.13	0.123	7.54	0.902	6.85
0.135	0.127	7.54	0.934	6.82

Forecast options: recruitment-at age-2 for 2002-2004 is taken equal to its mean historical value; weight-at-age and selection pattern are also taken equal to historical mean values of the estimates obtained with the catch-controlled version of ISVPA. The estimates of SSB in the table above are given on 1 of January.

S. Belikov