9 Icelandic cod

Summary

INPUT DATA: The total reported landings in 2008 were 147 kt. Total landings in the last 4 fishing year have been relatively close to the set TAC for the Icelandic fleet. The TAC for the current fishing year is set to 160 kt.

Mean weight at age in landings have been declining in the last 6-7 years and are in 2008 about 9 to 12 % (20 % for the small 2001 year class) below the long term average in age groups 4 to 9. Weights at age in the spring survey have also been declining over the same period and are generally very low in the 2009 survey.

Abundance indices by age from the spring and the fall surveys show that the year classes from 2001 onward are on average smaller than the ones from 1997 to 2000. The first measurement of the 2008 year class indicates that it may be above average. That year class will however not contribute significantly to the fisheries until 2013.

ASSESSMENT MODELS: Several assessment models were applied as in recent years, all giving similar results. The results from the AD-Model builder statistical Catch at Age Model (ADCAM) based on the spring survey, were as in previous years, adopted as a point estimate for forward projections. The survey indices were revised to take into account measurements from Iceland-Faeroe ridge (Rósagarðurinn).

COMPARISON WITH 2008 ASSESSMENT: The estimates of reference fishing mortality in 2007 is now 0.52 compared with 0.55 estimated last year. The SSB in 2008 is now estimated to have been 253 kt compared with 230 kt estimate last year. Half of this difference is caused by inclusion of the Iceland-Faeroe ridge in the survey area. The retrospective pattern of recruitment estimates in recent years, both historical and analytical, indicates a minor but constantly downward revision of year classes 2002 and younger. Since these revisions are on pre-recruits that have not entered the fishery they have minor effect on the estimates of the post-recruit metrics.

STATE OF THE STOCK: The spawning stock has been relatively small in the last 40 year compared with the time before that. It reached a historical low in 1993 (120 kt) but has since then increased and is estimated to be about 220 kt at present. In spite of major drawback around the year 2000 exploitation rate and fishing mortality have on the been lower after the implementation of the catch rule in 1995 compared with period 1980-1993. Fishing mortality has declined significantly in recent years, the present estimate of about 0.4 not seen since the early 1960's. Year classes from 2001 to 2007 are estimated to be below the long-term average . First measurement of the 2008 year class indicate that it may above medium size or even large . The low recruitment in recent years in addition to very low mean weight at age means that the productivity of the stock at present is very low.

9.1 Stock description and management units

The Icelandic cod stock is distributed all around Iceland and in the assessment it is assumed to be a single homogenous unit. Spawning takes place in late winter mainly off the southwest coast but smaller, variable regional spawning components have also been observed all around Iceland. The pelagic eggs and larvae from the main spawning grounds drift clockwise around the island to the main nursery grounds off the north coast. A larval drift to Greenland waters has been recorded in some years and substantial immigrations of mature cod from Greenland which are considered to

be of Icelandic origin have been observed in some years. The latest of such migration was from the 1984 year class in 1990, the number estimated around 30 millions. Extensive tagging experiments spanning with some hiatuses over the last 100 year show no indication of significant emigration from Iceland to other areas. In recent years it has been observed that cod tagged in Iceland has been recaptured inside Faroes waters close to the EEZ line separating Iceland and the Faroes islands.

The management unit of the Icelandic cod is limited the Icelandic EEZ zone.

9.2 Scientific data

The scientific data used for assessing Icelandic cod are the same as for most other species in Icelandic waters. The sampling programs i.e log books, surveys, sampling from landings etc. have been described in previous reports but have not yet been summarized in a form of a stock annex.

9.2.1 Catch: Landings, discards and misreporting

Landings of Icelandic cod in 2008 are estimated to have been 147 kt which are the lowest post-war landings (Table and Figure 9.2.1). Of the total landings 144 kt were taken by Icelandic fleet but 3 kt by other nations. The latter includes 1.8 kt of cod taken by the Faroese bottom trawl fleet inside the Faroese EEZ close to the line separating the Icelandic and Faroese EEZ. Allocations of those catches are based on analysis of tagging, described in detail in section 4.1.

Historically the landings of bottom trawlers constituted a larger portion of the total catches than today, in some years prior to 1990 reaching 60% of the total landings. In the 1990's the landings from bottom trawlers declined significantly, and have been just above 40% of the total landings in the last decade. (Figure 9.2.1). The share of long line has tripled over the last 20 years and is now on par with bottom trawl. The share of gill net has over the same time period declined and is now only half of what it was in the 1980's. Since the size of cod caught by the gillnet fleet is generally much larger than caught by other fleet, this change in fishing pattern is likely to have caused a significant reduction in the fishing mortality of older fish.

The trend in landings in recent years is largely a reflection of the set TAC (Figure 9.2.2) that is set for the fishing year (starting 1. September and ending 31 august) The TAC for the fishing year 2008/2009 was set at 160 kt and the TAC for the fishing year 2009-2010 is estimated to be around 150kt. Based on these numbers the landings for the 2009 calendar year are estimated to be around 160 kt.

Estimates of annual cod discards (Pálsson et al 2006, Pálsson et al 2009, in press) since 2001 are in the range of 1.4-4.3% of numbers landed and 0.4-1.8% of weight landed. Mean annual discard of cod over the period 2001-2008 was around 2 kt,or just over 1% of landings. In 2008 estimates of cod discards amounted to 1.1 kt, 0.8% of landings, the third lowest value int the period 2001-2008. The method used for deriving these estimates assumes that discarding only occurs as high grading but larger fish is usually higher priced.

In recent years misreporting has not been regarded as a major problem in the fishery of this stock. No study is though available to support that general perspective. Production figures from processing plants do though seem to be in "good" agreement with landings figures according to the Fisheries Directorate (personal communication).

9.2.2 Landings and weight by age

SAMPLING INTENSITY: Current sampling protocol for estimating the age composition of the cod has been in effect since 1991 and have been described previous reports. The sampling intensity in 2008 is similar as it has been in previous years.

LANDINGS IN NUMBERS BY AGE: The total landings-at-age (Table 9.2.2) show that in the past three decades age groups 7 and younger have been more than 90% of the landings in numbers. In 2008 the number of 4 year old in the catches is low, confirming the prior estimates from the survey that the 2004 year class is small. The small 2001 year class is however lasting longer in the catches than the medium sized year class from 2000. This phenomenon has been observed before with small year classes, possibly indicating that they recruit later to the fisheries than larger year classes. The catch at age matrix is reasonably consistent, with CV estimated to be approximately 0.2 for age groups 4-10 based on a Shepherd-Nicholson model (Shepherd and Nicholson 1991).

MEAN WEIGHT AT AGE IN THE LANDINGS: The mean weight age in the landings (Table 9.2.3 and Figure 9.2.4) delclined from 2001 to 2007, reaching then a historical low in many age groups. The weight at age in the landings in 2008 increased from that of 2007, but are still below the long term average. The decline in weight at age in the catches is in part a reflection of the decline in weight in the stock as seen in the measurements from the spring survey (Figure 9.2.5) but also change in fishing pattern. In recent years gillnet fisheries in the south have decreased but longline fishery in the north increased(section 9.2.1). Mean weights at age of cod caught by longlines is usually lower than of cod caught by gillnets. In addition mean weight at age is higher in the south than in the north.

Last year the estimates of mean weights in the landings of age groups 3-9 in 2008 were based on a prediction from the spring survey measurements in 2008 using the relationship between survey and landings weights in 2007. This gave slight underestimate of the weight at age in the catches in 2008. The reference biomass upon which the TAC is set based is derived from population numbers and catch weights. The biomass estimates for the start of 2008 was last year estimated being 590 kt based on the predicted 2008 catch weights but would have been 613kt based on the observed 2008 catch weights.

The same approach was used this year for predicting weight at age in the catches for 2009. The catch weights in 2009 were estimated from the weights in the spring survey 2009 using the relationship between survey and landings weight in 2008. Since the survey weights are low for some age groups in 2009 compared with 2008 (Figure 9.2.5), mean weights at age in the catches are predicted to decrease from 2008 to 2009 (Figure 9.2.4). The reference biomass of age groups four and older (B4+) in 2009 is based on those predicted weights.

9.2.3 Surveys

BIOMASS INDICES: The total biomass indices from the spring survey (Figure 9.2.6) indicate that the decline in total stock size observed in recent years has halted with the most recent observations indicating an increase in stock size. Indices of large fish are relatively high but indices of small fish relatively low, as would be expected in a situation where recruitment is poor and fishing mortality relatively low, as is considered to be the case for Icelandic cod.

In recent years the survey information used for tuning have not included the Iceland – Faeroe ridge. The proportion of the total survey index in this area varied from 3 – 10% in the years 1985-1995 when a decision was made not to survey this area. In 2004 it was noted that large part of the trawler fleet was in this area so a decision was made to start surveying in this area again. Since then 8-12 percent of the total survey biomass have been from this area. The cod in the area is typically large.

AGE BASED INDICES: Abundance indices by age from the spring and the fall surveys (Tables 9.2.6 and 9.2.7) show that the year classes from 2001 onward are significantly smaller than the ones from 1997 to 2000. However the first estimate of year class 2008, based on measurement from the 2009 spring survey indicate that is may be above average. That year class will not affect the landings and spawning stock until 2013. .

A residual plot of the spring survey indices by age and year ($U_{a,y}$) from consecutive years based on the model:

$$U_{a+1,y+1} = a + bU_{a,y} + \varepsilon$$

shows that in recent years later observed values (ages 1 vs 2 and ages 2 vs 3) of the incoming year classes are smaller than expected on average (Figure 9.2.7). Although the difference is relatively small it is persistent, resulting in some revision in the size of the incoming recruits to the fishery (age 3) in the assessments in recent year The difference would be even larger if the estimates of a and b in the equation above were only based on data until the year y. .

9.3 Information from the fishing industry

Unstandardised CPUE and effort indices, based on log book records where cod constitutes more than 70% of the catch, show a increase in CPUE in all gears in the early 1990's (Figure 9.3.1), coinciding with the time of the adoption of the HCR.. CPUE decreased from 1998-2001 but has increased since then and is now high for all gear type. The perception from logbook data is that effort towards cod has decreased in recent years but a proper method to calculate effort has not yet been implemented

The changes in cpue are to some extent a reflection of the dynamics in the stock although but they are confounded by other factors like abundance of other species caught with cod in mixed fisheries but this abundance affects the arbitrary selection criteria applied (cod >70% of catch). Haddock has probably the largest effect in this respect but the ration between landings of haddock and cod has been highly variable in the last 10 years.

9.4 Methods

INTRODUCTION: In recent years "the final assessment" of the Icelandic cod has been based on a statistical catch at age model (ADCAM, developed by Höskuldur Björnsson) tuned with the spring survey indices (SMB). The NWWG 2009 point estimators for the short term predictions as well as for the medium term projections (5 years) are based on the same script (ADCAM) as used last year, here after sometimes referred to as the SPALY (Same Procedure As Last Year) run. The model settings were identical to last years but the tuning data changed by addition of the Iceland-Faeroe ridge to the survey area (see section on the surveys). The Iceland – Faeroe ridge was not surveyed in 1996 – 2003 and to cover that gap the mean proportion of agegroup found in the area in 1994 – 1995 was used for the years 1996-2003. The proportion of the codstock in this area low in 1994-1995.

Icelandic cod has annually been assessed using a Time Series Analysis developed and run by Guðmundur Guðmundsson (199x, model description and details of numerous runs are given in WD xx, NWWG 2009). Models where the catch/fishing mortality is not modelled (XSA, ADAPT) were also run. A significant difference in the model setup of all but XSA is that correlation between the residuals of different age groups in the survey is not modelled. In addition all the assessment models were run using autumn groundfish survey (SMH conducted since 1996) for calibration. The results from the autumn survey 2009 were not available before the meeting..

The WG concluded that there was no basis to change model configuration applied last year. What follows is thus only done for the matter of completeness and includes a description of the method applied as well as the major conclusions from the assessment work carried out this year using the ADCAM (SPALY) framework. Analysis and conclusions using the TSA framework is also presented for comparison, since it contains analysis related to potential model misspecifications..

THE ADCAM (SPALY) MODEL:

Input data: The model used catch data from 1955 to 2008 and spring survey data from 1985 – 2009. Age groups included are 1-10 in the survey and 3 – 14 in the catches.

Parameter estimates and assumptions used:

- Fishing mortality is estimated for every year and age. Fishing mortality of each age group was constrained with a random walk term with standard deviation specified as proportion of the estimated CV in the catch at age data. In the input file the process error (variability in F) is specified to be larger than the measurement error for the younger ages but the measurement error is specified to be larger for the older age groups.
- Catchability in the survey was dependent on stock size for ages 1-5.
- CV's of the commercial catch and of survey indices as function of age are estimated. The CV of both catch and survey residuals are estimated. For the catches the CV is a parabola with 2 numbers estimated but for the catches the pattern with age is obtained from an Adapt run and a common multiplier estimated.
- Correlation of residuals of different age groups in the survey was estimated as a 1st order AR model. This is to take into account "year effects" in the survey.
- Migrations for specified years (y) in specified ages (a) are estimated (y=c(1958, 1959, 1960, 1962, 1964, 1969, 1970, 1972, 1980, 1981, 1990),a=(9, 9, 10, 9, 10, 8, 8, 9, 7, 8, 6)). The basis for allowing migration in these years and ages are anomalies in the catch and weight matrix.

The recruitment model, weight and maturity model (used for medium term projections):

- Recruitment was assumed to be lognormally distributed around a Ricker curve with the CV of the lognormal distribution estimated. Time trend in Rmax of the Ricker curve was allowed and CV of the residuals in the SSB-recruitment relationship depend on stock size.

Estimated Rmax decreases by 0.9% per year from 1955 to 1995 so predicted recruitment in 1995 is expected to be 67% of what it was in 1955 for the same spawning size of the spawning stock.

- The average weight at age in the catches and the spawning stock was assumed to be of the same as used for deterministic short term prediction. Deviations in weights at age were assumed to be lognormal with CV 0.1 and autocorrelation 0.35. The same deviations were applied to all age groups in the same year. Sexual maturity is fixed to that observed in the short term prediction with no CV modelled.

DIAGNOSTIC OF THE SPALY RUN: The diagnostic from the SPALY run are shown in Table and Figure 9.4.1 and 9.4.2. The log residuals from the spring survey are generally small but with apparent year effects. Of notice is the largely positive residual blocks for ages 1 and 2 in the most recent years. This is because more recent survey estimates of pre-recruits are smaller than expected (section 9.2.3). The "corrections" of the final year class size are largely between the first, second and third measurements as is apparent in the relatively good diagnostics seen in the retrospective plot on the recruitment at age 3 (Figure 9.4.2). Retrospective bias in the estimate of the reference biomass (Biomass of age 4 and older, B4+) is in the order of ±10%, with little indication of a persistent pattern in the last decade. The effect of the downward revision in pre-recruits in the recent years does not affect the accuracy of the the advice which is based on the B4+ in the assessment year. It does on the other hand affect short-medium term prediction if this pattern will persist as the estimated size of year classes 2007 and 2008, that are now age 2 and 1 will be reduced. Overall, the addition of one more year of data indicate relatively little changes in the perception of the state of the stock compared with last year (Table 9.4.7).

The relationship between the survey indices and estimated stock in numbers for age groups 1-9 for the SPALY run are shown in Figure 9.4.3. The regression line is only fitted to the period 1985-2005, the period were the stock in number estimates are not likely to change with addition of new data. Relatively high correlation is observed for most age groups indicating a good consistency between the catch at age and the survey data. The crosshair shows the SPALY estimates of population numbers in 2009 and the spring survey measurements in 2009. The estimated stock size is generally very close to that predicted from the survey measurements in 2009. Of significance with respect to reference biomass estimates is the somewhat larger stock size estimate of 4 year olds compared with that measured in the survey. Estimates based on the 2009 survey measurement point only would give a 20kt (<5%) lower biomass estimate than the final run indicate.

The fishing mortalities and stock in numbers by age are from the SPALY run are presented in Tables 9.4.3 and 9.4.4.

Working document 11 describes the results and diagnostics of the TSA model. The results of TSA calibrated with the March survey are similar to the Adcam results. The estimated recruitment is though lower but the amount of older fish is estimated to be higher and the fishing mortality of old fish therefore lower. The model differences causing these changes are most likely the parametric selection curves used in TSA and that transient changes in M on recruiting age groups are allowed in TSA.

The standardized residuals and model results for the spring survey are presented in Table 9.4.5 and Figure 9.4.1

COMPARISONS OF PRINCIPAL METRICS

Comparison of the principal assessment metrics for all the models run is shown in Table 9.4.7. The difference between models is relatively small with reference biomass in 2009 ranging from 651-790?? in models calibrated with the March survey and 740-850 ? in models calibrated with the autumn survey. In short the autumn survey indicates better state of the stock than the March survey.

The March survey is a longer time series with higher density of stations than the autumn survey. It has therefore been used as base in the assessment in recent years. The estimated standard deviation of the reference biomass 2009 from TSA is 41 kt when tuned with the March survey but 64 kt when tuned with the autumn survey. The most recent autumn survey has also been considered as an outlier as can for example be seen in Figure 9.2.6. The choice of survey used in the assessment is further discussed in section 9.9 on uncertainty in the assessment.

9.5 Reference points THIS WILL BE EXPANDED

No limit reference points have been defined for this stock by ICES, because the harvest rule (see section 9.11) was implemented prior to ICES defining such reference points on a larger scale. ICES considered the 1995 harvest control rule to be consistent with the precautionary approach provided the implementation error is minimal.

The SG on Precautionary Reference Points for Advice on Fishery Management (SGPRP – February 2003) suggested a candidate for Blim "somewhere in the range of 400kt". Due to a change in the method used to calculate the spawning stock biomass (implemented in 2005) from using catch weight and maturity from the catches to using estimated stock weights and stock maturity at age the historical spawning stock estimates presently used are lower than the ones that SGPRP 2003 based their suggestion on. Based on the present estimates on SSB and recruitment relationship presented in fig. x.x.x the size of SSB where recruitment becomes impaired seems to in the range of 210-230 kt which about the size of the SSB at present. In this report a Blim candidate of 220 kt is used to evaluate the results of medium term simulations.

9.6 State of the stock

The spawning stock has been relatively small in the last 40 year compared with the time before that. It reached a historical low in 1993 (120 kt) but has since then increased and is estimated to be about 220 kt at present. In spite of major drawback around the year 2000 explotation rate and fishing mortality have on the been lower after the implementation of the catch rule in 1995 compared with period 1980-1993. Fishing mortality has declined significantly in recent years, the present estimate of about 0.4 not seen since the early 1960's. Year classes from 2001 to 2007 are estimated to be below the long-term average . First measurement of the 2008 year class indicate that it may above medium size or even large . The low recruitment in recent years in addition to very low mean weight at age means that the productivity of the stock at present is very low.

9.7 Short term forecast

INPUT: The basis for the prediction for the weight in the catch in 2009, which are also used in the weight of the reference biomass (B_{4+}) were described in section 9.2.2. Weights in the catch and B_{4+} for 2010 onwards were assumed to be the same as those predicted for 2009. Weights and proportion mature in the spawning stock 2010 and

onwards were assumed to be the same as measured in the mature fish in the spring survey in 2009 (Tables 9.2.4 and 9.2.5). The fishing pattern used is the average of the years 2006-2008.

The estimated landings for the calendar year 2009 are 160kt as discussed in section 9.2.1. Using an Fsq constraint where F09=F08 would give the same landing predictions. Details of the inputs values used are shown in Table 9.7.1.

The catch in the next fishing year calculated as 20% of reference biomass in 2009 is 140 kt (Table 9.7.2). A buffer where the TAC in the current fishing year of 160 kt has a 50% weight results in a TAC of 150 kt. In predictions based on fishing year (ADCAM) 150 is used as the TAC in next fishing year.

OUTPUT: Fishing mortality is expected to decline further from a point estimate of 0.42 in 2008 and 2009, to 0.34-0.36, respectively in 2010. The reference biomass and the spawning stock are predicted to increase from 2009 to 2011. An advice based on Fmax =0.32, as was used by ICES last year would give 136 kt.

9.8 Medium term forecasts

The ADCAM script was used for medium term () simulation, the assumption and input being described in the method section (section 9.4). The projected landings removed were based on the following scenario:

$$Y_{y/y+1} = \frac{0.2B_{4+,y} + TAC_{y-1/y}}{2}$$

where the Y stands yield in the fishing year (y/y+1), TAC stands for the set TAC in the previous fishing year (y-1/y) and $B_{4+,y}$ is the estimated biomass in the assessment year. This scenario is in accordance with that advised domestically in 2007 as a medium term strategy and has now been informally adopted by Icelandic authorities as a part of a potential long term management plan The simulations start with a TAC of 150 kt for the fishing year 2009/2010 as described in last section.

The simulation is carried forward using as time horizon the year 2015 (in agreement with the Johannesburg Declaration). Median recruitment estimates (Figure 9.8.1) are projected to be low relative to the long term, this being based on the assumptions that Rmax has declined over the time period from 1955 to 1995 (described in the method section 9.4).

To investigate the effect of problem with recruitment estimates an alternative scenario was run where M of agegroups 1 and 2 was fixed at 0.2 before 1999 but estimated 1999 and later (the same value for all the years).

The results (Figures 9.8.1 and 9.8.2) indicate that there is a high probability that the spawning stock biomass (SSB) in 2015 will be above the potential Blim candidate and present estimate of 220 kt. The medium terms simulations also indicate the probability of SBB<Blim(candidate) in 2013 is less than 5%.. probability The reference biomass (B_{4+}) and catches will most likely increase from the present to 2015 The reference biomass is more dependent of the Ricker function applied for predicting recruitment than the other metrics i.e catch and SSB. The reason is that the younger age groups of the reference biomass do not contribute to the spawning stock and catches and, TAC in the prediction year is the mean of the TAC in the previous year and 20% of the reference biomass in the previous year. .

Estimating M of ages 1 and 2 1999 and later gives M of 0.3-0.35. The estimates are correlated so estimating 1 number would have been enough. The results give more pessimistic view of the stock but indicate that the probability of the spawning stock being below Blim in 2015 is less than 5%. (Figure 9.8.2)

9.9 Uncertainties in assessment and forecast

HISTORICAL ASSESSMENT UNCERTAINTIES: Relative to most southern gadoid stocks assessed by ICES the assessment of the Icelandic cod is likely to be a candidate that could be classified as precise, although the accuracy is unknown. The former is partly because three survey measurements (age 1 to 3) for each year class are available to assess year class strength before they actually enter the reference stock and the fisheries. Compared with last year assessment, the additional measurements have resulted in abundance estimates of incoming year classes being revised downwards, year class 2007 by 18% and year class 2006 by 4%. Since neither of these year classes have yet entered the reference stock (B_{4+}), and since fishing mortality estimates (F_{5-10}) are more or less in line with that predicted last year, those latter metrics are more or less the same as estimated last year.

As discussed in section 9.4 and shown in Table 9.4.7 there is considerable difference between results of assessment models calibrated with the autumn survey and those calibrated with the March survey. The estimated reference biomass in 2009 is 14% higher from TSA tuned with the autumn survey instead of the March survey.

According to the assessment models the standard deviation of stock estimates is considerably higher when calibrated with the autumn survey instead of the March survey (64kt vs 41 kt for the reference biomass 2009). That does not tell all the story as there are two potential problems with the March survey.

- Retrospective pattern in the recruitment estimates described before.
- Negative trend of close to 1% estimated with TSA. The trend is not significant but the P value is still uncomfortably high.

Neither of these patterns is observed in the autumn survey but the series is shorter and not as easy to detect those kind of problems. Allowing catchability trends in other assessment models than TSA like Adapt does give similar negative trend, increasing estimated stock size.

The causes of the trend are not clear. Tests on generated data using Adapt indicate that stock assessment based on too high M on data with negative trend in fishing mortality leads to negative trend in catchability being estimated. This could be an indication that M on the age groups in the catches is lower than 0.2??

SHORT TERM FORCAST: Uncertainties in the short term forecast have not been formally quantified, but are by nature larger current and historical stock estimates. Assessment models that are used for prediction show well how the uncertainty in the assessment increases, especially if a TAC constraint is used for the next few years. That is probably the most realistic scenario as fishing mortality is not known. With a TAC constraint the CV of the reference biomass in 2011 is 13% but only 6.3% on the reference biomass in 2009 (Spaly run). This is an underestimate of the "real uncertainty" as a number of factors is not included in the model.

Uncertainty in prediction of weights is something that is not covered by standard assessment models. Mean weight at age reduced from 1998-2004 and were always overestimated in that period. Since then the weights have stabilized and the

prediction of weight has at the same time improved but the model used for predicting weights is not very complicated, use the same weights as last year.

Looking at performance of historical assessments the estimates of the B4+ in the assessment year, which now is the basis for determining TAC in the advisory year, during the assessment period from 1991 to 2005 have on average been 12% higher relative to the current estimates.

In summary the assessment and prediction are reasonably precise but have tendency to overestimate.

MEDIUM TERM FORECAST: Sources of uncertainty are the same as in the short term forecast but uncertainty is larger as considerable changes can occur in the ecosystem. Here prediction with fixed TAC is not feasible so the catches have to be calculated as some proportion of the biomass and assessment error therefore included.

The main uncertainty seen today is due to the overestimate of recruitment from indices of ages 1 and 2 seen in recent year. Taking that into account by allowing natural morality of ages 1 and 2 to be different after 1999 predicts considerably slower increase of the stock in coming years.

9.10 Comparison with previous assessment and forecast

The reference stock in 2008 is now estimated to be 654 kt compared to 589 kt last year. 20 kt of the difference is caused by higher than predicted mean weight at age in the catches, 30 kt by inclusion of the Iceland-Faeroe ridge in the survey data and the rest by changes in stock numbers.

Fishing mortality in 2007 is now estimated 0.52 compared to 0.55 last year.

Estimate of year classes 2005 – 2007 is lower than in 2008, 18% lower for year class 2007 but 4% for year classes 2006 and 2005

9.11 Management plans and evaluations

THE 1995 HARVEST CONTROL RULE:

A formal Harvest Control Rule was implemented for this stock in 1995. The TAC for a fishing year (y/y+1) was set as a fraction (25%) of the "available biomass" which was computed as average of the biomass of age 4 and older fish B(4+) in the assessment year (y) and advisory year (y+1). In mathematical terms the 1995 catch rule was:

$$TAC_{y/y+1} = 0.25\frac{B_y + B_{y+1}}{2}$$

The rule followed work of a group set up by the minister of fisheries. The suggestions of the working group (xxx 1994) were somewhat different from what was implemented or

$$TAC_{y/y+1} = \frac{TAC_{y-1/y} + 0.22B_y}{2}$$

The HCR has since its introduction undergone a number of changes and for a number of years the catches exceeded the TAC. The main reason was that part of the small boat fleet was in an effort based system and there was to will to predict the landings of this fleet correctly.

The most recent version of the HCR is similar to the original proposed HCR except the proportion is 0.2 instead of 0.22. This HCR was implemented for the first time in 2007/2008 without a buffer reducing landings to 130kt. The TAC for the fishing year 2009/2010 was in the beginning set to 130kt according to the HCR. The TAC was then increased to 160 kt in December 2008. The basis for that increase is unclear but it did not include any longterm considerations. The situation today is relatively unclear but the government plans to follow the 2007 year class of the catch rule but use 160kt as buffer when the TAC for the fishing year 2009/2010 is calculated.

Ices advice last year was: However, taking into account 1) two amendments in the catch rule that resulted at the time they were set in less stringent action in limiting catches in the next fishing year than would have been the case with the original rule, 2) experienced implementation problems and, 3) the assessment errors and biases in recent 10 years, ICES suggested in 2007 that the original plan should be re-evaluated. Furthermore, ICES advised last year that "Given the relatively high proportions of younger fish in the fishable as well as in the spawning-stock biomass, the relatively weak incoming year classes, and low capelin abundance, lower fishing mortalities than those obtained by the Harvest Control Rule should be considered. In order to ensure a high probability of the SSB increasing in the next 5 years, the exploitation rate must be reduced to no more than 20%."

9.12 Management considerations

Prior to allocating the ITQ catches to the Icelandic fishing fleet, the managers should ensure subtracting all expected catches from other sources, including likely catches of the foreign fleets, likely catches of Faroese inside their own EEZ and "research landings". The amount is not known in advance but is likely to be of the similar order of magnitude as last year.

Cod and haddock are often caught in the same fishing operation. The TAC constraint on cod expected to result in significant reduction in fishing mortalities. This reduction is not in line with current fishing mortality trends in haddock. Anecdotal information from the fisheries indicates that the restrictions on the landings of cod are presently changing the behaviour of the fishing fleet, fishermen trying to avoid catching cod but targeting haddock. A lower exploitation rate of the haddock is thus advisable, in particular to avoid potential increase in discarding and misreporting of cod.

9.13 Ecosystem considerations

In Icelandic waters there are a number of areas closed to fishing activities. Although relatively small at present, such no-take zones areas are likely to be important for protection biological communities and species diversity. Findings from a recent study show that closed areas can benefit several fish species such as cod. Recent practices of reducing the size of some of the areas where no fishing activity has taken place for numerous years are counter to prevalent thinking of the importance of no-take zones as well as counter to the ecosystem based approach to fisheries management. The pressure to open closed areas could be an indication that fishing effort was too high

During the last few years the capelin stock has been low. This low abundance as well as anecdotal information about the low abundance of sandeel may have caused an increase in natural mortality in seabird populations around Iceland. It is possible that some of these changes are climate-driven but the effects of fishery induced mortality on the capelin cannot be ruled out.

9.14 Regulations and their effects

Exploitation rate and fishing mortality have been lower after the implementation of the catch rule in 1995 compared with the past.

A quick closure system has been in force since 1976, aimed at protecting juvenile fish. Fishing is prohibited, for at least two weeks, in areas where the number of small cod (< 55 cm) in the catches has been observed by inspectors to exceed 25%. A preliminary evaluation of the effectiveness of the system indicates that the relatively small areas closed for a short time do most likely not contribute much to the protection of juveniles. On the other hand, several consecutive quick closures often lead to closures of larger areas for a longer time and force the fleet to operate in other areas. The effect of these longer closures has not been evaluated analytically.

Since 1995, spawning areas have been closed for 2-3 weeks during the spawning season for all fisheries. The intent of this measure was to protect spawning fish. In 2005, the maximum allowed mesh size in gillnets was decreased to 8 inches in order to protect the largest spawners.

The mesh size in the codend in the trawling fishery was increased from 120 mm to 155 mm in 1977. Since 1998 the minimum codend mesh size allowed is 135 mm, provided that a so-called Polish cover is not used. Numerous areas are closed temporarily or permanently for all fisheries or specific gears for protecting juveniles and habitat, or for socio-political reasons. The effects of these measures have not been evaluated.

9.15 Changes in fishing technology and fishing patterns

Changes in the importance of the various gears used to catch cod are described in section 9.3. The decline in the gill net fishery and the increase in the long line fishery are likely to have resulted in shift in the fishing pattern to smaller fish. The increase in the long line fishery in the north is partly the reason for the decline in the observed mean weight at age in the catches.

Anecdotal information from the fishing industry in recent months indicate that to minimize cod catches in relative to other species (due to restrictive TAC),the fleet has shifted to somewhat shallower water. It has been hypothesised that this may lead to increased targeting of small cod. This hypothesis has not been supported with data.

9.16 Changes in the environment

An increased inflow of Atlantic water has been observed in Icelandic waters since 1997, resulting in higher temperature and higher salinity in the Icelandic waters. At present no relationships have been demonstrated between these environmental indicators and cod recruitment. A northward shift in distribution of immature capelin may be linked to these hydrographical changes, resulting in lower availability of capelin as fodder for cod.

In the past, weights-at-age of the cod have been clearly related to the biomass of capelin. The recent reduced mean weights-at-age are likely to be linked to the low abundance of capelin from the feeding areas for cod. These low weights were also used in forecasts, because estimates of the capelin biomass indicate that it will remain low.

In years of high recruitment a larval drift to Greenland is sometimes observed, resulting in a large year class at Greenland. In some other years an immigration of

adult cod from Greenland has taken place, which has been taken into account in the assessment. Based on the present status of cod stocks in Greenland, no substantial immigration to Iceland can be expected in the near future. It is, however possible that the relatively moderate 2003 year class presently found in Greenland waters is of Icelandic origin.

9.17 References

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Table 9.2.1. Icelandic cod in division Va. Nominal catches (tonnes) by countries 1973-2008 as officially reported to ICES and WG best estimates of landings.

Year	Belgium	Faeroe Islands	France	Germany	Germany, Fed. Rep	Greenland	Iceland	Norway	Poland	UK - Eng+Wales+N	UK - England & Wa	UK - Scotland	UK	Sum	WG estimates	Difference
1973	1110	14207	-	.	6839	-	235184	268	-	.	121320	957		379885	369205	-10680
1974	1128	12125	203	.	5554	-	238066	171	1	.	115395	2144		374787	368133	-6654
1975	1269	9440	23	.	2266	-	264975	144	-	.	91000	1897		371014	364754	-6260
1976	956	8772	-	.	2970	-	280831	514	-	.	53534	786		348363	346253	-2110
1977	1408	7261	-	.	1598	-	329676	108	-	.	-	-		340051	340086	35
1978	1314	7069	-	.	-	-	319648	189	-	.	-	-		328220	329602	1382
1979	1485	6163	-	.	-	-	360077	288	-	.	-	-		368013	366462	-1551
1980	840	4802	-	.	-	-	429044	358	-	.	-	-		435044	432237	-2807
1981	1321	6183	-	.	-	-	461038	559	-	.	-	-		469101	465032	-4069
1982	236	5297	-	.	-	-	382297	557	-	.	-	-		388387	380068	-8319
1983	188	5626	-	.	-	-	293890	109	-	.	-	-		299813	298049	-1764
1984	254	2041	-	.	-	-	281481	90	-	.	2	-		283868	282022	-1846
1985	207	2203	-	.	-	-	322810	46	-	.	1	-		325267	323428	-1839
1986	226	2554	-	.	-	-	365852	1	-	.	-	-		368633	364797	-3836
1987	597	1848	-	.	-	-	389808	4	-	.	-	-		392257	389915	-2342
1988	365	1966	-	.	-	-	375741	4	-	.	-	-		378076	377554	-522
1989	309	2012	-	.	-	-	353985	3	-	-	.	-		356309	363125	6816
1990	260	1782	-	.	-	-	333348	-	-	-	.	-		335390	335316	-74
1991	548	1323	-	-	.	-	306697	-	-	-	.	-		308568	307759	-809
1992	222	883	-	-	.	-	266662	-	-	-	.	-		267767	264834	-2933
1993	145	664	-	-	.	-	251170	-	-	<0.5	.	-		251979	250704	-1275
1994	136	754	-	-	.	-	177919	-	-	-	.	-		178809	178138	-671
1995	-	739	-	-	.	-	168685	-	-	-	.	-		169424	168592	-832
1996	-	599	-	<0.5	.	-	181052	7	-	-	.	-		181658	180701	-957
1997	-	408	-	-	.	-	202745	-	-	-	.	-		203153	203112	-41
1998	-	1078	-	9	.	-	241545	-	-	-	.	-		242632	243987	1355
1999	-	1247	.	21	.	25	258658	85	-	12	.	4		260052	260147	95
2000	-	.	-	15	.	-	234362	60	-	10	.	<0.5		234447	235092	645
2001	-	1143	-	11	.	-	233875	65	-	15	.	5		235114	234229	-885
2002	-	1175	-	15	.	-	206987	73	-	19	.	13		208282	208487	205
2003	-	2118	-	88	.	-	200327	56	-	104	.	42		202735	207543	4808
2004	-	2737	-	113	.	-	220020	90	-	310	.	102		223372	226762	3390
2005	-	2310	.	177	.	.	206343	77	-	224	.	220		209351	213403	4052
2006	-	1665	-	38	.	.	193425	78	-	15	.	5		195226	196276	1050
2007	-	1760	-	-	-	-	-	110	-	-	-	-	11	1880.6	170622	168741
2008															148000	

Table 9.2.2. Icelandic cod in Division Va. Observed catch in numbers by year and age in millions of fish in 1955-2008. The 2009 catches are estimates based on a landing estimates of 160 kt, the 2010 and beyond estimates are based on prediction from the adopted model applying a 20% catch rule with a buffer.

Year/age	3	4	5	6	7	8	9	10	11	12	13	14
1955	4.790	25.164	46.566	28.287	10.541	5.224	2.467	25.182	2.101	1.202	1.668	0.665
1956	6.709	17.265	31.030	27.793	14.389	4.261	3.429	2.128	16.820	1.552	1.522	1.545
1957	13.240	21.278	17.515	24.569	17.634	12.296	3.568	2.169	1.171	6.822	0.512	1.089
1958	25.237	30.742	14.298	10.859	15.997	15.822	12.021	2.003	2.125	0.771	3.508	0.723
1959	18.394	37.650	23.901	7.682	5.883	8.791	13.003	7.683	0.914	0.990	0.218	1.287
1960	14.830	28.642	27.968	14.120	8.387	6.089	6.393	11.600	3.526	0.692	0.183	0.510
1961	16.507	21.808	19.488	15.034	7.900	6.925	3.969	3.211	6.756	1.202	0.089	0.425
1962	13.514	28.526	18.924	14.650	12.045	4.276	8.809	2.664	1.883	2.988	0.405	0.324
1963	18.507	28.466	19.664	11.314	15.682	7.704	2.724	6.508	1.657	1.030	1.372	0.246
1964	19.287	28.845	18.712	11.620	7.936	18.032	5.040	1.437	2.670	0.655	0.370	1.025
1965	21.658	29.586	24.783	11.706	9.334	6.394	11.122	1.477	0.823	0.489	0.118	0.489
1966	17.910	30.649	20.006	13.872	5.942	7.586	2.320	5.583	0.407	0.363	0.299	0.311
1967	25.945	27.941	24.322	11.320	8.751	2.595	5.490	1.392	1.998	0.109	0.030	0.106
1968	11.933	47.311	22.344	16.277	15.590	7.059	1.571	2.506	0.512	0.659	0.047	0.098
1969	11.149	23.925	45.445	17.397	12.559	14.811	1.590	0.475	0.340	0.064	0.024	0.021
1970	9.876	47.210	23.607	25.451	15.196	12.261	14.469	0.567	0.207	0.147	0.035	0.050
1971	13.060	35.856	45.577	21.135	17.340	10.924	6.001	4.210	0.237	0.069	0.038	0.020
1972	8.973	29.574	30.918	22.855	11.097	9.784	10.538	3.938	1.242	0.119	0.031	0.001
1973	36.538	25.542	27.391	17.045	12.721	3.685	4.718	5.809	1.134	0.282	0.007	0.001
1974	14.846	61.826	21.824	14.413	8.974	6.216	1.647	2.530	1.765	0.334	0.062	0.028
1975	29.301	29.489	44.138	12.088	9.628	3.691	2.051	0.752	0.891	0.416	0.060	0.046
1976	23.578	39.790	21.092	24.395	5.803	5.343	1.297	0.633	0.205	0.155	0.065	0.029
1977	2.614	42.659	32.465	12.162	13.017	2.809	1.773	0.421	0.086	0.024	0.006	0.002
1978	5.999	16.287	43.931	17.626	8.729	4.119	0.978	0.348	0.119	0.048	0.015	0.027
1979	7.186	28.427	13.772	34.443	14.130	4.426	1.432	0.350	0.168	0.043	0.024	0.004
1980	4.348	28.530	32.500	15.119	27.090	7.847	2.228	0.646	0.246	0.099	0.025	0.004
1981	2.118	13.297	39.195	23.247	12.710	26.455	4.804	1.677	0.582	0.228	0.053	0.068
1982	3.285	20.812	24.462	28.351	14.012	7.666	11.517	1.912	0.327	0.094	0.043	0.011
1983	3.554	10.910	24.305	18.944	17.382	8.381	2.054	2.733	0.514	0.215	0.064	0.037
1984	6.750	31.553	19.420	15.326	8.082	7.336	2.680	0.512	0.538	0.195	0.090	0.036
1985	6.457	24.552	35.392	18.267	8.711	4.201	2.264	1.063	0.217	0.233	0.102	0.038
1986	20.642	20.330	26.644	30.839	11.413	4.441	1.771	0.805	0.392	0.103	0.076	0.044
1987	11.002	62.130	27.192	15.127	15.695	4.159	1.463	0.592	0.253	0.142	0.046	0.058
1988	6.713	39.323	55.895	18.663	6.399	5.877	1.345	0.455	0.305	0.157	0.114	0.025
1989	2.605	27.983	50.059	31.455	6.010	1.915	0.881	0.225	0.107	0.086	0.038	0.005
1990	5.785	12.313	27.179	44.534	17.037	2.573	0.609	0.322	0.118	0.050	0.015	0.020
1991	8.554	25.131	15.491	21.514	25.038	6.364	0.903	0.243	0.125	0.063	0.011	0.012
1992	12.217	21.708	26.524	11.413	10.073	8.304	2.006	0.257	0.046	0.032	0.009	0.008
1993	20.500	33.078	15.195	13.281	3.583	2.785	2.707	1.181	0.180	0.034	0.011	0.013
1994	6.160	24.142	19.666	6.968	4.393	1.257	0.599	0.508	0.283	0.049	0.018	0.006
1995	10.770	9.103	16.829	13.066	4.115	1.596	0.313	0.184	0.156	0.141	0.029	0.008
1996	5.356	14.886	7.372	12.307	9.429	2.157	0.837	0.208	0.076	0.065	0.055	0.005
1997	1.722	16.442	17.298	6.711	7.379	5.958	1.147	0.493	0.126	0.028	0.037	0.021
1998	3.458	7.707	25.394	20.167	5.893	3.856	2.951	0.500	0.196	0.055	0.033	0.013
1999	2.525	19.554	15.226	24.622	12.966	2.795	1.489	0.748	0.140	0.046	0.010	0.005
2000	10.493	6.581	29.080	11.227	11.390	5.714	1.104	0.567	0.314	0.074	0.022	0.006
2001	11.338	25.040	9.311	19.471	5.620	3.929	2.017	0.452	0.202	0.118	0.013	0.009
2002	5.934	18.482	24.297	6.874	8.943	2.227	1.353	0.689	0.123	0.040	0.041	0.002
2003	3.950	16.160	21.874	18.145	5.063	4.419	1.124	0.401	0.172	0.034	0.020	0.015
2004	1.778	19.184	25.003	17.384	9.926	2.734	2.023	0.481	0.126	0.062	0.014	0.005
2005	5.102	5.125	26.749	16.980	8.339	4.682	1.292	0.913	0.203	0.089	0.025	0.002
2006	3.258	12.884	8.438	22.041	10.418	4.523	2.194	0.497	0.336	0.067	0.027	0.002
2007	2.074	11.961	15.948	8.280	9.593	5.428	2.205	1.229	0.366	0.198	0.053	0.010
2008	2.616	4.850	12.585	11.973	5.238	4.582	2.040	0.831	0.308	0.053	0.037	0.004
2009	2.152	8.654	8.215	13.407	10.532	2.462	2.802	1.119	0.340	0.120	0.013	0.009
2010	1.980	6.538	11.834	7.294	8.357	5.581	1.271	1.413	0.488	0.149	0.048	0.005
2011	3.210	6.265	9.399	11.185	4.895	4.800	3.138	0.702	0.680	0.236	0.066	0.021
2012	1.953	10.389	9.271	9.224	7.853	2.955	2.846	1.837	0.360	0.351	0.112	0.030
2013	2.109	7.183	17.491	10.371	7.406	5.432	2.009	1.911	1.082	0.213	0.192	0.059

Table 9.2.3. Icelandic cod in Division Va. Observed mean weight at age in the landings (kg) in period the 1955-2008. The weights for age groups 3 to 9 in 2009 are based on predictions from the 2009 survey measurements, weight for 2010 onwards are set equal to those in 2009. The weights in the catches are used to calculate the reference biomass (B4+).

Year/age	3	4	5	6	7	8	9	10	11	12	13	14
1955	0.827	1.307	2.157	3.617	4.638	5.657	6.635	6.168	8.746	8.829	10.086	14.584
1956	1.080	1.600	2.190	3.280	4.650	5.630	6.180	6.970	6.830	9.290	10.965	12.954
1957	1.140	1.710	2.520	3.200	4.560	5.960	7.170	7.260	8.300	8.290	10.350	13.174
1958	1.210	1.810	3.120	4.510	5.000	5.940	6.640	8.290	8.510	8.840	9.360	13.097
1959	1.110	1.950	2.930	4.520	5.520	6.170	6.610	7.130	8.510	8.670	9.980	11.276
1960	1.060	1.720	2.920	4.640	5.660	6.550	6.910	7.140	7.970	10.240	10.100	12.871
1961	1.020	1.670	2.700	4.330	5.530	6.310	6.930	7.310	7.500	8.510	9.840	14.550
1962	0.990	1.610	2.610	3.900	5.720	6.660	6.750	7.060	7.540	8.280	10.900	12.826
1963	1.250	1.650	2.640	3.800	5.110	6.920	7.840	7.610	8.230	9.100	9.920	11.553
1964	1.210	1.750	2.640	4.020	5.450	6.460	8.000	9.940	9.210	10.940	12.670	15.900
1965	1.020	1.530	2.570	4.090	5.410	6.400	7.120	8.600	12.310	10.460	10.190	17.220
1966	1.170	1.680	2.590	4.180	5.730	6.900	7.830	8.580	9.090	14.230	14.090	17.924
1967	1.120	1.820	2.660	4.067	5.560	7.790	7.840	8.430	9.090	10.090	14.240	16.412
1968	1.170	1.590	2.680	3.930	5.040	5.910	7.510	8.480	10.750	11.580	14.640	16.011
1969	1.100	1.810	2.480	3.770	5.040	5.860	7.000	8.350	8.720	10.080	11.430	13.144
1970	0.990	1.450	2.440	3.770	4.860	5.590	6.260	8.370	10.490	12.310	14.590	21.777
1971	1.090	1.570	2.310	2.980	4.930	5.150	5.580	6.300	8.530	11.240	14.740	17.130
1972	0.980	1.460	2.210	3.250	4.330	5.610	6.040	6.100	6.870	8.950	11.720	16.000
1973	1.030	1.420	2.470	3.600	4.900	6.110	6.670	6.750	7.430	7.950	10.170	17.000
1974	1.050	1.710	2.430	3.820	5.240	6.660	7.150	7.760	8.190	9.780	12.380	14.700
1975	1.100	1.770	2.780	3.760	5.450	6.690	7.570	8.580	8.810	9.780	10.090	11.000
1976	1.350	1.780	2.650	4.100	5.070	6.730	8.250	9.610	11.540	11.430	14.060	16.180
1977	1.259	1.911	2.856	4.069	5.777	6.636	7.685	9.730	11.703	14.394	17.456	24.116
1978	1.289	1.833	2.929	3.955	5.726	6.806	9.041	10.865	13.068	11.982	19.062	21.284
1979	1.408	1.956	2.642	3.999	5.548	6.754	8.299	9.312	13.130	13.418	13.540	20.072
1980	1.392	1.862	2.733	3.768	5.259	6.981	8.037	10.731	12.301	17.281	14.893	19.069
1981	1.180	1.651	2.260	3.293	4.483	5.821	7.739	9.422	11.374	12.784	12.514	19.069
1982	1.006	1.550	2.246	3.104	4.258	5.386	6.682	9.141	11.963	14.226	17.287	16.590
1983	1.095	1.599	2.275	3.021	4.096	5.481	7.049	8.128	11.009	13.972	15.882	18.498
1984	1.288	1.725	2.596	3.581	4.371	5.798	7.456	9.851	11.052	14.338	15.273	16.660
1985	1.407	1.971	2.576	3.650	4.976	6.372	8.207	10.320	12.197	14.683	16.175	19.050
1986	1.459	1.961	2.844	3.593	4.635	6.155	7.503	9.084	10.356	15.283	14.540	15.017
1987	1.316	1.956	2.686	3.894	4.716	6.257	7.368	9.243	10.697	10.622	15.894	12.592
1988	1.438	1.805	2.576	3.519	4.930	6.001	7.144	8.822	9.977	11.732	14.156	13.042
1989	1.186	1.813	2.590	3.915	5.210	6.892	8.035	9.831	11.986	10.003	12.611	16.045
1990	1.290	1.704	2.383	3.034	4.624	6.521	8.888	10.592	10.993	14.570	15.732	17.290
1991	1.309	1.899	2.475	3.159	3.792	5.680	7.242	9.804	9.754	14.344	14.172	20.200
1992	1.289	1.768	2.469	3.292	4.394	5.582	6.830	8.127	12.679	13.410	15.715	11.267
1993	1.392	1.887	2.772	3.762	4.930	6.054	7.450	8.641	10.901	12.517	14.742	16.874
1994	1.443	2.063	2.562	3.659	5.117	6.262	7.719	8.896	10.847	12.874	14.742	17.470
1995	1.348	1.959	2.920	3.625	5.176	6.416	7.916	10.273	11.022	11.407	13.098	15.182
1996	1.457	1.930	3.132	4.141	4.922	6.009	7.406	9.772	10.539	13.503	13.689	16.194
1997	1.484	1.877	2.878	4.028	5.402	6.386	7.344	8.537	10.797	11.533	10.428	12.788
1998	1.230	1.750	2.458	3.559	5.213	7.737	7.837	9.304	10.759	14.903	16.651	18.666
1999	1.241	1.716	2.426	3.443	4.720	6.352	8.730	9.946	11.088	12.535	14.995	15.151
2000	1.308	1.782	2.330	3.252	4.690	5.894	7.809	9.203	10.240	11.172	13.172	17.442
2001	1.499	2.050	2.649	3.413	4.766	6.508	7.520	9.055	8.769	9.526	11.210	13.874
2002	1.294	1.926	2.656	3.680	4.720	6.369	7.808	9.002	10.422	13.402	9.008	16.893
2003	1.265	1.790	2.424	3.505	4.455	5.037	5.980	7.819	8.802	10.712	12.152	13.797
2004	1.257	1.771	2.323	3.312	4.269	5.394	5.872	7.397	10.808	11.569	13.767	12.955
2005	1.194	1.712	2.374	3.435	4.392	5.201	6.200	5.495	7.211	9.909	12.944	18.151
2006	1.070	1.614	2.185	3.052	4.347	5.177	5.382	5.769	6.258	5.688	7.301	15.412
2007	1.083	1.556	2.144	2.754	3.920	5.255	6.272	6.481	7.142	6.530	9.724	10.143
2008	1.162	1.627	2.318	3.120	3.846	5.367	6.771	7.648	8.282	11.181	14.266	17.320
2009	1.115	1.515	2.217	3.160	4.122	5.073	6.091	7.648	8.282	11.181	14.266	17.320
2010	1.115	1.515	2.217	3.160	4.122	5.073	6.091	7.648	8.282	11.181	14.266	17.320
2011	1.115	1.515	2.217	3.160	4.122	5.073	6.091	7.648	8.282	11.181	14.266	17.320
2012	1.115	1.515	2.217	3.160	4.122	5.073	6.091	7.648	8.282	11.181	14.266	17.320
2013	1.115	1.515	2.217	3.160	4.122	5.073	6.091	7.648	8.282	11.181	14.266	17.320

Table 9.2.4. Icelandic cod in Division Va. Estimated weight at age in the spawning stock (kg) in period the 1955-2009. The weights for the period 2010 onward are set equal to those in 2009. These weights are used to calculate the spawning stock biomass (SSB).

Year/age	3	4	5	6	7	8	9	10	11	12	13	14
1955	0.645	1.019	1.833	3.183	4.128	5.657	6.635	6.168	8.746	8.829	10.086	14.584
1956	0.645	1.248	1.862	2.886	4.138	5.630	6.180	6.970	6.830	9.290	10.965	12.954
1957	0.645	1.334	2.142	2.816	4.058	5.960	7.170	7.260	8.300	8.290	10.350	13.174
1958	0.645	1.412	2.652	3.969	4.450	5.940	6.640	8.290	8.510	8.840	9.360	13.097
1959	0.645	1.521	2.490	3.978	4.913	6.170	6.610	7.130	8.510	8.670	9.980	11.276
1960	0.645	1.342	2.482	4.083	5.037	6.550	6.910	7.140	7.970	10.240	10.100	12.871
1961	0.645	1.303	2.295	3.810	4.922	6.310	6.930	7.310	0.750	8.510	9.840	14.550
1962	0.645	1.256	2.218	3.432	5.091	6.660	6.750	7.060	7.540	8.280	10.900	12.826
1963	0.645	1.287	2.244	3.344	4.548	6.920	7.840	7.610	8.230	9.100	9.920	11.553
1964	0.645	1.365	2.244	3.538	4.850	6.460	8.000	9.940	9.210	10.940	12.670	15.900
1965	0.645	1.193	2.184	3.599	4.815	6.400	7.120	8.600	12.310	10.460	10.190	17.220
1966	0.645	1.310	2.202	3.678	5.100	6.900	7.830	8.580	9.090	14.230	14.090	17.924
1967	0.645	1.420	2.261	3.579	4.948	7.790	7.840	8.430	9.090	10.090	14.240	16.412
1968	0.645	1.240	2.278	3.458	4.486	5.910	7.510	8.480	10.750	11.580	14.640	16.011
1969	0.645	1.412	2.108	3.318	4.486	5.860	7.000	8.350	8.720	10.080	11.430	13.144
1970	0.645	1.131	2.074	3.318	4.325	5.590	6.260	8.370	10.490	12.310	14.590	21.777
1971	0.645	1.225	1.964	2.622	4.388	5.150	5.580	6.300	8.530	11.240	14.740	17.130
1972	0.645	1.139	1.878	2.860	3.854	5.610	6.040	6.100	6.870	8.950	11.720	16.000
1973	0.645	1.108	2.100	3.168	4.361	6.110	6.670	6.750	7.430	7.950	10.170	17.000
1974	0.645	1.334	2.066	3.362	4.664	6.660	7.150	7.760	8.190	9.780	12.380	14.700
1975	0.645	1.381	2.363	3.309	4.850	6.690	7.570	8.580	8.810	9.780	10.090	11.000
1976	0.645	1.388	2.252	3.608	4.512	6.730	8.250	9.610	11.540	11.430	14.060	16.180
1977	0.645	1.491	2.428	3.581	5.142	6.636	7.685	9.730	11.703	14.394	17.456	24.116
1978	0.645	1.430	2.490	3.480	5.096	6.806	9.041	10.865	13.068	11.982	19.062	21.284
1979	0.645	1.526	2.246	3.519	4.938	6.754	8.299	9.312	13.130	13.418	13.540	20.072
1980	0.645	1.452	2.323	3.316	4.681	6.981	8.037	10.731	12.301	17.281	14.893	19.069
1981	0.645	1.288	1.921	2.898	3.990	5.821	7.739	9.422	11.374	12.784	12.514	19.069
1982	0.645	1.209	1.909	2.732	3.790	5.386	6.682	9.141	11.963	14.226	17.287	16.590
1983	0.645	1.247	1.934	2.658	3.645	5.481	7.049	8.128	11.009	13.972	15.882	18.498
1984	0.645	1.346	2.207	3.151	3.890	5.798	7.456	9.851	11.052	14.338	15.273	16.660
1985	0.485	1.375	1.750	2.709	3.454	6.372	8.207	10.320	12.197	14.683	16.175	19.050
1986	0.758	1.597	2.882	3.246	4.581	6.155	7.503	9.084	10.356	15.283	14.540	15.017
1987	0.576	1.584	2.423	3.522	4.905	6.257	7.368	9.243	10.697	10.622	15.894	12.592
1988	0.610	1.475	2.261	3.277	4.398	6.001	7.144	8.822	9.977	11.732	14.156	13.042
1989	0.673	1.494	2.338	3.429	4.686	6.892	8.035	9.831	11.986	10.003	12.611	16.045
1990	0.563	1.035	2.170	2.798	4.422	6.521	8.888	10.592	10.993	14.570	15.732	17.290
1991	0.686	1.283	2.039	2.747	3.397	5.680	7.242	9.804	9.754	14.344	14.172	20.200
1992	0.619	1.336	2.094	3.029	3.753	5.582	6.830	8.127	12.679	13.410	15.715	11.267
1993	0.708	1.363	2.309	3.235	4.109	6.054	7.450	8.641	10.901	12.517	14.742	16.874
1994	0.847	1.728	2.254	3.340	4.514	6.262	7.719	8.896	10.847	12.874	14.742	17.470
1995	0.745	1.635	2.345	3.186	4.489	6.416	7.916	10.273	11.022	11.407	13.098	15.182
1996	0.678	1.753	2.490	3.531	4.273	6.009	7.406	9.772	10.539	13.503	13.689	16.194
1997	0.670	1.347	2.267	3.746	5.245	6.386	7.344	8.537	10.797	11.533	10.428	12.788
1998	0.599	1.516	2.261	3.263	4.474	7.737	7.837	9.304	10.759	14.903	16.651	18.666
1999	0.711	1.467	1.932	2.996	3.961	6.352	8.730	9.946	11.088	12.535	14.995	15.151
2000	0.600	1.355	1.915	2.881	4.319	5.894	7.809	9.203	10.240	11.172	13.172	17.442
2001	0.661	1.550	2.071	2.694	4.131	6.508	7.520	9.055	8.769	9.526	11.210	13.874
2002	0.630	1.590	2.259	3.120	3.984	6.369	7.808	9.002	10.422	13.402	9.008	16.893
2003	0.900	1.338	2.215	2.988	4.169	5.037	5.980	7.819	8.802	10.712	12.152	13.797
2004	0.900	1.453	2.099	3.057	3.757	5.394	5.872	7.397	10.808	11.569	13.767	12.955
2005	0.900	1.119	1.897	2.963	3.874	5.201	6.200	5.495	7.211	9.909	12.944	18.151
2006	0.900	1.383	1.998	2.905	4.385	5.177	5.382	5.769	6.258	5.688	7.301	15.412
2007	0.900	1.264	2.022	2.580	4.078	5.255	6.272	6.481	7.142	6.530	9.724	10.143
2008	1.017	1.841	2.227	2.924	3.920	5.367	6.771	7.648	8.282	11.181	14.266	17.320
2009	1.017	1.440	2.027	2.871	3.909	5.073	6.091	7.648	8.282	11.181	14.266	17.320
2010	1.017	1.440	2.027	2.871	3.909	5.073	6.091	7.648	8.282	11.181	14.266	17.320
2011	1.017	1.440	2.027	2.871	3.909	5.073	6.091	7.648	8.282	11.181	14.266	17.320
2012	1.017	1.440	2.027	2.871	3.909	5.073	6.091	7.648	8.282	11.181	14.266	17.320
2013	1.017	1.440	2.027	2.871	3.909	5.073	6.091	7.648	8.282	11.181	14.266	17.320

Table 9.2.5. Icelandic cod in Division Va. Estimated maturity at age in period the 1955-2009. The maturity for the period 2010 onward are set equal to those in 2009.

Year/age	3	4	5	6	7	8	9	10	11	12	13	14
1955	0.019	0.022	0.033	0.181	0.577	0.782	0.834	0.960	1.000	1.000	1.000	1.000
1956	0.019	0.025	0.033	0.111	0.577	0.782	0.818	0.980	0.980	1.000	1.000	1.000
1957	0.019	0.026	0.043	0.100	0.549	0.801	0.842	0.990	1.000	1.000	1.000	1.000
1958	0.019	0.028	0.086	0.520	0.682	0.801	0.834	1.000	1.000	1.000	1.000	1.000
1959	0.019	0.029	0.070	0.535	0.772	0.818	0.834	0.990	1.000	1.000	1.000	1.000
1960	0.019	0.026	0.066	0.577	0.782	0.826	0.834	0.990	1.000	1.000	1.000	1.000
1961	0.019	0.025	0.053	0.450	0.772	0.818	0.834	0.990	0.990	1.000	1.000	1.000
1962	0.019	0.025	0.048	0.281	0.791	0.834	0.834	0.990	0.990	1.000	1.000	1.000
1963	0.019	0.025	0.048	0.237	0.706	0.834	0.849	1.000	1.000	1.000	1.000	1.000
1964	0.019	0.026	0.048	0.329	0.762	0.826	0.849	1.000	1.000	1.000	1.000	1.000
1965	0.019	0.025	0.045	0.354	0.751	0.826	0.842	1.000	1.000	1.000	1.000	1.000
1966	0.019	0.026	0.045	0.394	0.791	0.849	0.849	1.000	1.000	1.000	1.000	1.000
1967	0.019	0.028	0.051	0.341	0.772	0.842	0.849	1.000	1.000	1.000	1.000	1.000
1968	0.019	0.025	0.051	0.292	0.682	0.801	0.842	1.000	1.000	1.000	1.000	1.000
1969	0.019	0.028	0.043	0.227	0.682	0.801	0.842	1.000	1.000	1.000	1.000	1.000
1970	0.019	0.023	0.041	0.227	0.644	0.772	0.818	1.000	1.000	1.000	1.000	1.000
1971	0.019	0.025	0.037	0.074	0.657	0.706	0.772	0.979	0.994	0.982	0.993	1.000
1972	0.019	0.023	0.035	0.106	0.450	0.772	0.809	0.979	0.994	0.982	0.993	1.000
1973	0.022	0.028	0.163	0.382	0.697	0.801	0.834	0.996	0.996	1.000	1.000	1.000
1974	0.020	0.031	0.085	0.346	0.636	0.790	0.818	0.989	1.000	1.000	1.000	1.000
1975	0.020	0.035	0.118	0.287	0.715	0.809	0.839	1.000	1.000	1.000	1.000	1.000
1976	0.025	0.026	0.086	0.253	0.406	0.797	0.841	1.000	1.000	1.000	1.000	1.000
1977	0.019	0.024	0.060	0.382	0.742	0.817	0.842	1.000	1.000	1.000	1.000	1.000
1978	0.025	0.025	0.052	0.192	0.737	0.820	0.836	1.000	1.000	1.000	1.000	1.000
1979	0.019	0.021	0.053	0.282	0.635	0.790	0.836	0.919	1.000	1.000	1.000	1.000
1980	0.026	0.021	0.047	0.225	0.653	0.777	0.834	0.977	1.000	0.964	1.000	1.000
1981	0.019	0.022	0.030	0.090	0.448	0.751	0.811	0.962	0.988	1.000	1.000	1.000
1982	0.021	0.025	0.038	0.065	0.297	0.705	0.815	0.967	1.000	1.000	1.000	1.000
1983	0.019	0.030	0.047	0.116	0.264	0.530	0.715	0.979	0.985	1.000	1.000	1.000
1984	0.019	0.024	0.053	0.169	0.444	0.620	0.716	0.949	0.969	0.948	1.000	1.000
1985	0.000	0.021	0.185	0.412	0.495	0.735	0.572	1.000	1.000	1.000	1.000	1.000
1986	0.001	0.023	0.149	0.395	0.682	0.734	0.941	0.962	0.988	1.000	1.000	1.000
1987	0.002	0.033	0.093	0.360	0.490	0.885	0.782	1.000	0.979	1.000	1.000	1.000
1988	0.006	0.029	0.225	0.511	0.448	0.683	0.937	0.946	0.974	0.821	1.000	1.000
1989	0.008	0.025	0.142	0.372	0.645	0.652	0.634	0.991	1.000	0.903	0.859	1.000
1990	0.006	0.012	0.155	0.437	0.581	0.796	0.814	0.986	1.000	1.000	1.000	1.000
1991	0.000	0.055	0.149	0.369	0.637	0.790	0.682	0.842	1.000	1.000	1.000	1.000
1992	0.002	0.062	0.265	0.402	0.813	0.917	0.894	1.000	1.000	1.000	1.000	1.000
1993	0.006	0.085	0.267	0.464	0.693	0.801	0.843	0.968	1.000	1.000	1.000	1.000
1994	0.008	0.110	0.339	0.591	0.702	0.917	0.698	0.852	0.985	1.000	1.000	1.000
1995	0.005	0.109	0.384	0.528	0.752	0.787	0.859	1.000	1.000	1.000	1.000	1.000
1996	0.002	0.031	0.186	0.499	0.650	0.733	0.812	1.000	1.000	0.986	0.971	1.000
1997	0.006	0.037	0.246	0.424	0.685	0.787	0.804	0.932	1.000	0.913	1.000	1.000
1998	0.000	0.061	0.209	0.491	0.782	0.814	0.810	0.925	0.998	1.000	1.000	1.000
1999	0.012	0.044	0.239	0.516	0.649	0.835	0.687	0.988	1.000	1.000	1.000	1.000
2000	0.001	0.065	0.248	0.512	0.611	0.867	0.998	0.980	1.000	1.000	1.000	1.000
2001	0.004	0.043	0.261	0.589	0.750	0.742	0.862	0.987	1.000	1.000	1.000	1.000
2002	0.008	0.086	0.322	0.656	0.759	0.920	0.550	0.979	1.000	1.000	1.000	1.000
2003	0.005	0.046	0.218	0.524	0.870	0.798	0.860	0.998	1.000	1.000	1.000	1.000
2004	0.000	0.038	0.246	0.549	0.626	0.843	0.816	0.990	1.000	1.000	1.000	1.000
2005	0.006	0.109	0.282	0.495	0.791	0.814	0.951	0.990	1.000	1.000	1.000	1.000
2006	0.002	0.023	0.294	0.448	0.751	0.869	0.743	1.000	1.000	1.000	1.000	1.000
2007	0.012	0.032	0.159	0.500	0.693	0.795	0.862	0.960	0.924	1.000	1.000	1.000
2008	0.001	0.041	0.275	0.550	0.730	0.826	0.846	0.954	0.736	1.000	1.000	1.000
2009	0.002	0.015	0.132	0.455	0.688	0.883	0.741	0.631	0.892	1.000	1.000	1.000
2010	0.002	0.015	0.132	0.455	0.688	0.883	0.741	0.631	0.892	1.000	1.000	1.000
2011	0.002	0.015	0.132	0.455	0.688	0.883	0.741	0.631	0.892	1.000	1.000	1.000
2012	0.002	0.015	0.132	0.455	0.688	0.883	0.741	0.631	0.892	1.000	1.000	1.000
2013	0.002	0.015	0.132	0.455	0.688	0.883	0.741	0.631	0.892	1.000	1.000	1.000

Table 9.2.6. Icelandic cod in Division Va. Survey indices of the spring bottom trawl survey (SMB).

year\age	1	2	3	4	5	6	7	8	9	10
1985	16.54	111.11	34.86	48.14	64.74	22.94	15.28	5.04	3.39	1.60
1986	15.10	60.90	95.61	22.47	21.52	27.46	7.18	2.80	0.93	0.82
1987	3.65	28.92	103.80	82.71	21.43	12.78	12.95	2.80	0.99	0.43
1988	3.45	7.45	72.11	103.77	69.71	8.39	6.41	6.94	0.68	0.28
1989	4.04	16.47	22.06	79.80	74.16	39.11	4.85	1.72	1.42	0.27
1990	5.56	11.80	26.17	14.18	27.83	35.22	16.74	1.76	0.59	0.48
1991	3.95	16.29	17.94	30.24	15.49	18.94	22.45	4.90	0.94	0.34
1992	0.72	17.24	33.32	18.94	16.58	6.87	6.35	5.76	1.48	0.23
1993	3.57	4.84	30.85	36.71	13.55	10.64	2.43	2.04	1.40	0.38
1994	14.40	15.03	9.00	26.91	22.43	6.09	3.96	0.80	0.54	0.49
1995	1.18	29.21	24.82	9.07	24.53	18.44	4.02	1.87	0.38	0.20
1996	3.72	5.52	42.74	29.71	13.17	15.34	15.09	4.20	1.16	0.22
1997	1.21	22.47	13.60	56.69	29.80	9.94	9.41	7.29	0.62	0.42
1998	8.07	5.58	30.05	16.21	63.36	29.72	7.02	5.73	3.37	0.76
1999	7.40	33.10	7.03	42.66	13.35	24.82	12.01	2.60	1.48	0.79
2000	18.84	28.02	54.90	7.00	30.79	8.69	8.83	4.58	0.56	0.35
2001	12.32	23.53	36.94	37.94	5.04	15.99	3.59	2.17	0.87	0.27
2002	0.92	38.85	41.36	40.70	37.16	7.45	9.01	1.67	0.82	0.35
2003	11.18	4.54	46.29	36.95	29.18	17.72	4.11	4.72	1.13	0.24
2004	7.01	26.61	8.16	64.43	38.37	27.79	15.92	3.03	3.21	0.51
2005	2.69	17.89	42.07	10.00	46.25	24.97	12.14	6.36	1.01	0.93
2006	9.11	7.59	24.94	40.60	11.75	31.57	11.63	4.07	1.62	0.25
2007	5.61	19.14	8.99	22.94	30.15	10.14	11.43	6.05	2.38	0.77
2008	6.75	12.41	23.02	9.86	22.38	22.99	9.46	7.97	3.05	0.78
2009	21.97	12.60	16.57	22.76	15.68	26.06	16.72	4.86	3.15	1.15

Table 9.2.7 Icelandic cod in Division Va. Survey indices of the fall bottom trawl survey (SMH).

year\age	1	2	3	4	5	6	7	8	9	10
1996	6.69	3.57	20.00	13.98	5.40	7.44	6.26	1.60	0.31	0.09
1997	0.67	16.89	6.83	29.57	15.76	4.09	3.62	2.36	0.25	0.17
1998	5.92	2.63	15.62	7.36	16.01	16.03	5.20	2.24	1.27	0.20
1999	8.61	14.54	5.68	23.38	7.42	9.94	4.05	0.59	0.34	0.36
2000	4.60	13.17	15.25	3.71	11.15	3.49	2.61	1.11	0.34	0.28
2001	7.11	11.51	19.53	21.13	3.30	6.73	1.60	0.76	0.17	0.03
2002	0.92	13.72	16.11	23.39	15.94	5.41	4.77	1.11	0.61	0.08
2003	5.16	2.68	25.66	16.98	13.22	8.99	1.89	2.55	0.38	0.10
2004	3.67	16.28	6.92	29.86	18.85	11.73	7.38	1.88	1.65	0.23
2005	2.15	9.03	20.37	6.82	25.62	10.88	3.86	1.91	0.29	0.31
2006	4.51	4.52	16.28	23.04	7.67	13.93	6.12	2.05	1.02	0.16
2007	3.73	9.82	4.93	11.73	15.68	6.34	5.91	3.14	0.76	0.50
2008	5.30	11.88	15.19	7.68	17.54	18.51	5.67	5.61	1.50	0.79

Table 9.4.1. Icelandic cod in Division Va. Catch at age residuals from the ADCAM model tuned with the spring groundfish survey (SMB).

Year/age	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1955			-0.12	-0.21	0.08	0.11	0.21	-0.12	-0.16	0.13	-0.10	-0.45	-0.21	-0.00
1956			-0.03	-0.05	0.03	-0.01	-0.13	-0.20	-0.01	0.01	0.17	0.09	0.23	0.22
1957			0.09	0.02	-0.02	0.17	-0.13	0.09	0.06	-0.15	-0.10	-0.12	-0.38	0.52
1958			0.15	0.18	-0.27	-0.07	0.06	0.08	0.13	-0.23	0.23	0.00	-0.23	0.39
1959			-0.21	0.21	0.26	-0.24	-0.22	-0.06	-0.07	0.28	-0.26	0.38	-0.23	-0.41
1960			0.10	-0.36	0.14	0.19	0.06	0.07	-0.03	-0.11	-0.04	0.03	-0.64	0.90
1961			0.05	0.04	-0.40	0.12	-0.02	0.27	0.20	-0.14	0.09	-0.19	-0.97	0.83
1962			0.09	-0.01	0.13	-0.24	0.12	-0.30	0.09	0.26	-0.06	0.03	-0.40	0.70
1963			-0.06	0.30	-0.17	0.01	-0.03	-0.07	-0.38	0.21	0.35	0.06	0.07	-0.62
1964			-0.13	-0.02	0.13	-0.25	-0.12	0.38	-0.10	-0.46	-0.01	0.27	-0.16	0.01
1965			-0.03	-0.11	0.08	0.16	-0.13	0.05	0.47	-0.48	-0.06	-0.51	-0.36	0.64
1966			-0.04	-0.04	-0.18	0.10	-0.07	0.12	-0.35	0.59	-0.83	0.28	0.01	1.06
1967			0.19	-0.13	0.02	-0.20	0.02	-0.37	0.49	0.05	0.67	-0.73	-0.84	-0.18
1968			0.04	-0.02	-0.27	-0.12	0.23	0.16	-0.42	0.37	-0.12	0.60	-0.66	0.66
1969			-0.09	-0.03	0.15	-0.01	0.05	-0.15	-0.33	-0.25	-0.04	-0.26	-0.81	-0.14
1970			-0.10	0.14	-0.05	-0.14	0.05	-0.16	0.48	-0.58	-0.12	0.24	0.29	0.45
1971			-0.10	0.07	0.09	0.18	-0.18	0.28	-0.17	0.05	-0.45	-0.02	0.12	0.36
1972			-0.17	-0.13	0.07	-0.03	0.12	-0.05	-0.10	0.29	-0.07	0.17	0.52	-2.76
1973			0.27	-0.02	-0.10	0.03	-0.00	-0.24	0.09	0.17	0.16	-0.20	-1.26	-2.09
1974			-0.16	0.21	-0.02	-0.18	-0.01	-0.00	-0.22	0.29	0.01	0.18	-0.44	0.81
1975			0.19	-0.07	0.04	-0.05	0.03	-0.15	-0.21	-0.01	0.41	-0.02	-0.12	0.10
1976			0.10	0.00	-0.17	0.08	-0.09	0.25	-0.16	-0.15	0.06	0.27	-0.23	0.25
1977			-0.40	-0.06	0.05	-0.09	0.13	0.05	0.31	0.03	-0.70	-0.48	-1.23	-2.48
1978			0.08	-0.01	0.04	-0.10	0.04	-0.21	0.12	-0.19	0.02	-0.05	0.53	1.21
1979			0.15	0.10	-0.22	0.10	-0.05	0.03	-0.31	-0.08	0.05	-0.15	0.40	-0.20
1980			0.21	0.01	0.08	0.06	-0.01	-0.09	0.12	-0.49	0.30	0.09	0.15	-1.08
1981			-0.30	-0.20	0.08	-0.13	0.07	0.09	0.02	0.33	-0.07	0.60	-0.03	1.17
1982			0.01	0.15	0.07	-0.06	-0.22	0.19	0.17	0.14	-0.23	-0.87	0.04	-0.85
1983			-0.32	-0.36	0.11	0.14	0.04	0.01	-0.04	-0.03	0.01	0.37	-0.20	0.60
1984			0.35	0.03	-0.06	-0.05	-0.10	-0.01	0.05	-0.13	-0.35	0.16	0.71	0.11
1985			0.05	0.18	-0.10	0.12	-0.10	-0.02	-0.15	0.14	0.04	-0.34	0.47	0.48
1986			0.14	-0.11	0.02	-0.02	0.17	-0.05	0.11	-0.21	0.09	0.06	-0.60	0.20
1987			-0.15	0.11	0.03	-0.16	0.06	0.03	-0.04	0.11	-0.38	-0.11	0.12	-0.28
1988			-0.08	-0.07	-0.06	0.15	-0.09	0.07	0.15	0.03	0.49	0.02	0.55	0.15
1989			-0.20	0.05	0.14	-0.08	0.00	-0.16	-0.33	-0.10	-0.02	0.52	-0.03	-1.38
1990			-0.00	-0.12	-0.09	0.01	0.03	0.10	-0.10	-0.24	0.29	0.11	-0.22	0.10
1991			0.09	0.04	-0.10	-0.06	0.09	-0.09	0.11	-0.09	-0.32	0.39	-0.58	0.15
1992			-0.22	0.10	0.05	0.05	0.10	-0.01	-0.06	-0.06	-0.75	-0.78	-0.58	-0.12
1993			0.25	0.05	-0.17	-0.05	-0.07	-0.13	0.06	0.48	0.52	-0.21	-0.97	0.48
1994			0.05	0.23	-0.12	-0.17	-0.05	0.07	-0.20	-0.14	0.44	0.54	0.54	-0.32
1995			0.27	-0.02	0.08	-0.03	-0.03	-0.13	-0.13	-0.30	-0.20	0.73	1.14	0.68
1996			0.01	-0.06	-0.15	0.07	0.05	0.04	0.11	0.16	-0.38	-0.41	0.60	0.01
1997			-0.14	0.02	-0.03	-0.10	-0.11	0.23	0.18	0.22	0.40	-0.76	-0.25	0.20
1998			-0.18	-0.15	0.08	0.07	0.03	-0.17	0.24	0.04	0.06	0.24	0.12	-0.70
1999			-0.09	0.02	0.07	0.04	0.09	-0.02	-0.26	-0.17	-0.23	-0.42	-0.47	-0.84
2000			0.15	-0.23	0.11	-0.01	0.00	0.11	0.03	-0.13	0.04	0.19	-0.11	0.04
2001			0.20	0.16	-0.14	-0.02	0.03	-0.19	0.06	0.27	-0.03	0.19	-0.43	0.13
2002			-0.04	0.09	0.01	-0.07	-0.04	0.01	-0.21	0.22	0.26	-0.35	0.45	-0.95
2003			-0.23	-0.01	0.01	-0.06	0.18	0.01	0.21	-0.38	-0.01	0.10	0.14	0.62
2004			-0.15	0.07	0.06	-0.07	-0.09	0.27	0.01	0.22	-0.55	-0.11	0.20	-0.29
2005			0.20	-0.24	0.11	-0.08	-0.13	-0.09	0.34	0.09	0.35	0.02	-0.01	-0.76
2006			-0.02	-0.03	-0.09	0.04	0.00	-0.05	-0.09	0.19	0.02	0.12	-0.20	-1.59
2007			-0.02	0.08	-0.07	0.17	-0.15	0.07	-0.09	-0.03	0.54	0.10	0.51	-0.58
2008			0.03	-0.06	0.04	-0.05	0.12	-0.09	-0.00	-0.03	-0.08	0.17	0.12	-0.13

Table 9.4.2. Icelandic cod in Division Va. Spring survey (SMB) at age residuals from the ADCAM model.

Year/age	1	2	3	4	5	6	7	8	9	10
1985	-0.39	0.07	0.17	0.41	0.15	0.27	0.43	0.22	0.34	0.54
1986	0.39	-0.06	-0.43	-0.25	-0.10	0.02	-0.14	-0.25	-0.22	-0.05
1987	0.41	0.01	0.08	-0.42	-0.03	-0.06	0.07	-0.06	-0.06	0.01
1988	-0.36	0.02	0.45	0.17	-0.09	-0.32	0.11	0.48	-0.08	-0.11
1989	0.18	0.02	0.48	0.55	0.25	0.20	-0.09	-0.08	0.24	0.10
1990	-0.52	0.09	0.01	0.01	-0.15	-0.13	0.10	-0.12	-0.01	0.15
1991	-0.34	-0.44	0.05	0.12	0.23	0.06	0.16	-0.13	0.25	0.25
1992	-0.49	-0.01	-0.23	0.09	-0.12	-0.11	-0.12	-0.12	-0.09	-0.00
1993	-0.64	-0.07	0.11	-0.05	0.04	-0.02	-0.18	-0.13	-0.19	-0.27
1994	0.44	-0.29	-0.03	0.06	-0.19	-0.29	-0.15	-0.20	-0.15	-0.10
1995	-0.41	0.10	-0.29	-0.10	0.14	0.01	-0.18	-0.08	-0.04	-0.21
1996	-0.74	-0.14	0.04	-0.15	0.18	-0.03	0.30	0.44	0.23	0.07
1997	-0.06	-0.08	0.09	0.26	-0.04	-0.02	-0.02	0.30	-0.30	0.07
1998	-0.22	0.10	-0.24	0.09	0.51	0.30	0.13	0.22	0.49	0.52
1999	-0.10	0.11	-0.09	0.02	-0.05	0.09	0.05	0.02	0.01	0.12
2000	0.73	0.13	0.19	-0.22	-0.09	-0.18	-0.18	0.01	-0.22	-0.22
2001	0.13	-0.05	-0.02	-0.16	-0.48	-0.20	-0.33	-0.55	-0.35	0.06
2002	-0.28	0.22	0.04	0.06	0.02	-0.12	-0.15	-0.24	-0.40	-0.17
2003	0.35	-0.04	-0.02	-0.10	-0.10	-0.21	-0.15	-0.04	0.20	-0.54
2004	0.18	0.15	-0.04	0.25	0.07	0.25	0.21	0.20	0.46	0.29
2005	0.27	0.03	0.15	-0.05	0.09	0.10	0.04	0.05	0.08	0.17
2006	0.45	0.11	-0.10	0.05	0.01	0.19	-0.08	-0.27	-0.32	-0.27
2007	0.29	0.11	-0.14	-0.27	-0.15	-0.06	-0.24	-0.03	0.07	-0.16
2008	0.36	-0.00	-0.15	-0.24	-0.27	-0.07	0.25	0.02	0.14	-0.09
2009	0.28	-0.07	-0.19	-0.27	0.03	0.11	-0.03	0.18	-0.13	-0.11

Table 9.4.3. Icelandic cod in Division Va. Estimates of fishing mortality 1955-2008 based on ACAM using catch at age and spring bottom survey indices. Estimates for 2009 are based on catch constraint; the prediction for 2010 is based on the 20% catch rule.

Year/age	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1955			0.04	0.17	0.25	0.27	0.30	0.30	0.28	0.32	0.32	0.31	0.32	0.32
1956			0.05	0.18	0.25	0.26	0.29	0.30	0.29	0.34	0.36	0.33	0.33	0.33
1957			0.08	0.21	0.27	0.27	0.30	0.33	0.33	0.36	0.36	0.33	0.30	0.30
1958			0.11	0.25	0.30	0.29	0.32	0.37	0.40	0.44	0.44	0.39	0.32	0.32
1959			0.09	0.23	0.28	0.26	0.30	0.34	0.35	0.40	0.38	0.32	0.23	0.23
1960			0.10	0.23	0.29	0.29	0.34	0.40	0.43	0.48	0.48	0.39	0.27	0.27
1961			0.09	0.23	0.26	0.26	0.33	0.40	0.42	0.46	0.44	0.35	0.23	0.23
1962			0.11	0.25	0.28	0.26	0.35	0.42	0.47	0.51	0.49	0.38	0.24	0.24
1963			0.13	0.28	0.33	0.31	0.38	0.49	0.59	0.65	0.63	0.46	0.29	0.29
1964			0.13	0.29	0.37	0.36	0.43	0.57	0.74	0.81	0.84	0.61	0.39	0.39
1965			0.12	0.28	0.38	0.40	0.47	0.60	0.74	0.85	0.88	0.66	0.43	0.43
1966			0.09	0.25	0.34	0.38	0.49	0.62	0.78	0.92	1.01	0.79	0.53	0.53
1967			0.08	0.23	0.30	0.34	0.48	0.61	0.75	0.88	0.93	0.73	0.46	0.46
1968			0.08	0.25	0.34	0.41	0.58	0.77	1.04	1.20	1.36	1.08	0.74	0.74
1969			0.06	0.23	0.32	0.35	0.50	0.61	0.72	0.84	0.87	0.72	0.45	0.45
1970			0.07	0.27	0.39	0.43	0.55	0.65	0.76	0.89	0.95	0.80	0.52	0.52
1971			0.09	0.31	0.48	0.53	0.62	0.72	0.80	0.96	1.04	0.89	0.59	0.59
1972			0.09	0.30	0.48	0.55	0.65	0.73	0.79	0.96	1.06	0.92	0.61	0.61
1973			0.12	0.32	0.49	0.56	0.67	0.75	0.80	0.95	1.04	0.91	0.60	0.60
1974			0.11	0.32	0.50	0.58	0.70	0.83	0.92	1.06	1.18	1.04	0.71	0.71
1975			0.11	0.31	0.50	0.60	0.72	0.89	1.02	1.13	1.26	1.11	0.79	0.79
1976			0.07	0.26	0.43	0.55	0.70	0.85	0.95	1.01	1.07	0.96	0.67	0.67
1977			0.03	0.20	0.33	0.43	0.61	0.72	0.73	0.74	0.70	0.64	0.42	0.42
1978			0.03	0.17	0.28	0.35	0.53	0.60	0.55	0.55	0.49	0.45	0.29	0.29
1979			0.03	0.17	0.27	0.34	0.50	0.57	0.50	0.49	0.42	0.40	0.25	0.25
1980			0.03	0.17	0.31	0.39	0.54	0.62	0.56	0.55	0.47	0.45	0.30	0.30
1981			0.02	0.18	0.35	0.49	0.65	0.82	0.85	0.82	0.76	0.70	0.53	0.53
1982			0.03	0.19	0.39	0.56	0.70	0.90	0.96	0.88	0.75	0.68	0.53	0.53
1983			0.02	0.18	0.38	0.55	0.71	0.88	0.92	0.86	0.74	0.69	0.54	0.54
1984			0.04	0.20	0.38	0.53	0.67	0.81	0.76	0.71	0.60	0.57	0.45	0.45
1985			0.05	0.23	0.42	0.58	0.71	0.83	0.77	0.71	0.60	0.58	0.46	0.46
1986			0.06	0.26	0.52	0.71	0.82	0.95	0.88	0.78	0.67	0.63	0.51	0.51
1987			0.06	0.27	0.55	0.81	0.91	1.06	1.00	0.86	0.75	0.72	0.60	0.60
1988			0.05	0.26	0.52	0.79	0.92	1.10	1.09	0.95	0.88	0.85	0.76	0.76
1989			0.04	0.24	0.46	0.65	0.79	0.89	0.80	0.73	0.65	0.65	0.54	0.54
1990			0.05	0.25	0.47	0.66	0.79	0.86	0.75	0.69	0.62	0.62	0.52	0.52
1991			0.09	0.30	0.56	0.80	0.88	0.95	0.85	0.78	0.72	0.71	0.62	0.62
1992			0.10	0.32	0.59	0.86	0.92	1.00	0.90	0.81	0.75	0.74	0.65	0.65
1993			0.14	0.31	0.55	0.79	0.89	1.03	1.03	0.94	0.91	0.89	0.82	0.82
1994			0.09	0.24	0.38	0.53	0.68	0.76	0.72	0.70	0.65	0.66	0.58	0.58
1995			0.06	0.20	0.32	0.42	0.57	0.62	0.56	0.57	0.52	0.54	0.47	0.47
1996			0.04	0.16	0.28	0.41	0.56	0.62	0.57	0.60	0.55	0.56	0.50	0.50
1997			0.03	0.15	0.27	0.42	0.59	0.66	0.66	0.68	0.65	0.65	0.59	0.59
1998			0.03	0.15	0.33	0.52	0.67	0.77	0.83	0.84	0.83	0.83	0.79	0.79
1999			0.04	0.18	0.39	0.64	0.74	0.85	0.93	0.92	0.90	0.90	0.88	0.88
2000			0.06	0.18	0.39	0.62	0.74	0.86	0.96	0.97	0.96	0.97	0.97	0.97
2001			0.07	0.19	0.38	0.58	0.70	0.83	0.97	1.00	1.01	1.02	1.04	1.04
2002			0.04	0.17	0.34	0.49	0.60	0.70	0.81	0.87	0.86	0.88	0.88	0.88
2003			0.03	0.15	0.33	0.50	0.58	0.65	0.71	0.77	0.75	0.78	0.77	0.77
2004			0.03	0.15	0.34	0.52	0.59	0.65	0.71	0.76	0.75	0.78	0.77	0.77
2005			0.03	0.13	0.30	0.48	0.56	0.62	0.67	0.74	0.73	0.77	0.76	0.76
2006			0.03	0.13	0.28	0.48	0.55	0.61	0.67	0.74	0.74	0.79	0.78	0.78
2007			0.03	0.12	0.24	0.36	0.50	0.58	0.74	0.96	1.17	1.29	1.47	1.47
2008			0.02	0.09	0.19	0.28	0.44	0.45	0.49	0.65	0.73	0.85	0.90	0.90
2009			0.02	0.09	0.21	0.33	0.40	0.44	0.49	0.56	0.59	0.63	0.65	0.65
2010			0.02	0.08	0.18	0.28	0.35	0.38	0.42	0.49	0.51	0.55	0.57	0.57
2011			0.02	0.07	0.16	0.26	0.31	0.34	0.38	0.44	0.46	0.50	0.51	0.51
2012			0.02	0.07	0.15	0.23	0.29	0.31	0.35	0.40	0.42	0.46	0.47	0.47
2013			0.02	0.07	0.15	0.25	0.30	0.33	0.37	0.42	0.44	0.48	0.49	0.49

Table 9.4.4. Icelandic cod in Division Va. Estimates of numbers at age in the stock 1955-2009 based on ACAM using catch at age and spring bottom survey indices. Estimates for 2010 are based on catch constraint for the year 2009; the predictions are based on the 20% catch rule.

Year/age	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1955	255	187	152	218	212	115	36	25	13	87.7	9.2	7.8	8.1	2.6
1956	329	208	153	120	150	135	72	22	15	8.0	51.9	5.5	4.7	4.8
1957	431	270	171	119	82	96	85	44	13	9.1	4.6	29.8	3.2	2.8
1958	230	353	221	129	79	51	60	52	35	7.8	5.2	2.6	17.5	1.9
1959	288	188	289	161	82	48	31	35	51	19.3	4.1	2.7	1.5	10.4
1960	192	236	154	216	105	51	30	19	21	37.5	10.6	2.3	1.6	1.0
1961	265	157	193	114	140	64	31	18	10	11.0	19.0	5.4	1.3	1.0
1962	304	217	129	144	75	89	40	18	24	5.6	5.7	10.0	3.1	0.8
1963	323	249	178	94	92	46	56	23	10	12.1	2.7	2.9	5.6	2.0
1964	342	264	204	128	58	54	28	31	12	4.4	5.2	1.2	1.5	3.5
1965	478	280	216	147	78	33	31	15	14	4.5	1.6	1.8	0.5	0.8
1966	256	391	229	157	91	44	18	16	7	5.6	1.6	0.5	0.8	0.3
1967	369	210	320	171	100	53	24	9	7	2.5	1.8	0.5	0.2	0.4
1968	269	302	172	243	111	60	31	12	4	2.7	0.8	0.6	0.2	0.1
1969	281	220	248	130	155	65	33	41	5	1.2	0.7	0.2	0.2	0.1
1970	208	230	180	192	85	92	37	33	18	1.9	0.4	0.2	0.1	0.1
1971	407	170	189	138	120	47	49	18	14	7.0	0.6	0.1	0.1	0.0
1972	267	334	139	141	83	61	23	22	23	5.2	2.2	0.2	0.0	0.0
1973	389	219	273	104	86	42	29	10	9	8.6	1.6	0.6	0.1	0.0
1974	549	319	179	199	62	43	20	12	4	3.2	2.7	0.5	0.2	0.0
1975	214	449	261	131	118	31	20	8	4	1.2	0.9	0.7	0.1	0.1
1976	338	175	368	192	79	58	14	8	3	1.3	0.3	0.2	0.2	0.1
1977	364	277	143	282	121	42	27	6	3	0.9	0.4	0.1	0.1	0.1
1978	208	298	227	114	190	71	22	12	2	1.1	0.3	0.2	0.0	0.0
1979	210	171	244	181	78	117	41	11	5	1.1	0.5	0.2	0.1	0.0
1980	197	172	140	194	125	49	72	20	5	2.7	0.5	0.3	0.1	0.1
1981	348	161	141	111	134	75	27	47	9	2.4	1.3	0.3	0.1	0.1
1982	207	285	132	113	76	77	38	12	17	3.1	0.8	0.5	0.1	0.1
1983	207	170	233	105	76	42	36	15	4	5.3	1.1	0.3	0.2	0.1
1984	496	169	139	186	72	43	20	15	5	1.3	1.8	0.4	0.1	0.1
1985	392	406	139	109	125	40	21	8	5	2.0	0.5	0.8	0.2	0.1
1986	260	321	332	108	71	67	19	8	3	2.0	0.8	0.2	0.4	0.1
1987	131	213	263	256	68	35	27	7	3	1.0	0.8	0.3	0.1	0.2
1988	194	107	174	203	160	32	13	9	2	0.8	0.3	0.3	0.1	0.0
1989	156	159	87	136	129	78	12	4	2	0.5	0.2	0.1	0.1	0.1
1990	258	128	130	69	87	100	33	4	1	0.9	0.2	0.1	0.1	0.0
1991	204	211	105	101	44	45	43	12	2	0.5	0.4	0.1	0.0	0.0
1992	114	167	173	79	61	20	16	14	4	0.5	0.2	0.1	0.0	0.0
1993	226	93	137	128	47	28	7	5	4	1.3	0.2	0.1	0.1	0.0
1994	247	185	76	97	76	22	10	2	2	1.3	0.4	0.1	0.0	0.0
1995	129	202	152	57	63	43	11	4	1	0.6	0.5	0.2	0.0	0.0
1996	242	105	166	117	39	37	23	5	2	0.4	0.3	0.2	0.1	0.0
1997	104	198	86	131	81	24	20	11	2	0.9	0.2	0.1	0.1	0.0
1998	262	85	162	69	93	51	13	9	4	0.9	0.4	0.1	0.1	0.1
1999	238	214	70	129	48	55	25	5	3	1.6	0.3	0.1	0.0	0.0
2000	244	195	176	54	89	27	24	10	2	1.1	0.5	0.1	0.0	0.0
2001	267	200	160	136	37	49	12	9	3	0.6	0.4	0.2	0.0	0.0
2002	108	219	163	122	92	21	23	5	3	1.0	0.2	0.1	0.0	0.0
2003	230	88	179	128	85	54	10	10	2	1.2	0.4	0.1	0.0	0.0
2004	201	188	72	142	90	50	27	5	4	0.8	0.5	0.1	0.0	0.0
2005	122	165	154	57	100	53	24	12	2	1.7	0.3	0.2	0.1	0.0
2006	199	100	135	122	41	61	27	11	5	0.9	0.7	0.1	0.1	0.0
2007	171	163	82	107	88	25	31	13	5	2.2	0.3	0.3	0.0	0.0
2008	181	140	133	65	78	57	14	15	6	2.0	0.7	0.1	0.1	0.0
2009	325	148	115	107	49	53	35	8	8	2.9	0.8	0.3	0.0	0.0
2010	215	266	121	92	80	32	31	19	4	4.0	1.3	0.4	0.1	0.0
2011	222	176	218	98	70	55	20	18	11	2.2	2.0	0.7	0.2	0.1
2012	230	182	144	176	74	48	35	12	11	6.1	1.1	1.0	0.3	0.1
2013	237	188	149	116	134	52	31	21	7	6.1	3.3	0.6	0.5	0.2

Table 9.4.5. Icelandic cod in division Va. Standardized catch and survey residuals from the TSA run based on tuning with the spring survey Estimation with a time series model of F

STANDARDISED CATCH RESIDUALS

	4	5	6	7	8	9	10	11
1987	1.17	1.06	-0.83	0.92	0.30	0.02	0.06	-0.34
1988	-1.23	0.39	0.89	-0.32	0.45	0.15	-0.05	1.11
1989	-1.24	-0.28	-0.54	-0.44	-0.56	-2.59	-2.40	-0.68
1990	-1.03	-2.05	0.23	0.80	0.97	-0.78	-1.89	0.10
1991	1.59	0.06	0.28	1.07	-0.53	-0.43	-0.18	-0.56
1992	1.19	0.61	0.08	-0.09	-0.88	-0.44	-0.89	-1.49
1993	0.91	-1.96	-0.79	-1.59	-1.00	0.33	2.10	1.45
1994	1.07	-0.49	-0.81	-0.69	1.31	-0.73	-0.50	0.96
1995	-0.53	-1.46	-0.83	0.32	-1.57	-2.98	-1.17	-0.77
1996	-0.47	-1.31	-0.61	1.34	0.73	0.62	0.86	-0.56
1997	-0.84	0.34	0.16	0.09	1.55	0.47	0.78	0.61
1998	-0.32	0.53	2.05	2.06	0.09	0.41	0.15	0.03
1999	1.61	2.20	0.44	0.70	-0.20	-0.95	-2.29	-1.18
2000	-0.68	0.80	0.47	-0.54	0.44	-0.20	-0.72	-0.85
2001	0.25	0.38	-0.74	-0.23	-1.05	-0.35	0.29	-0.36
2002	-0.73	-1.42	0.38	-0.54	0.28	0.22	0.28	-0.15
2003	-0.78	-0.57	-0.82	1.73	1.06	1.90	-0.44	-0.62
2004	-0.22	0.49	-0.31	0.00	1.63	0.83	0.39	-0.92
2005	-1.36	-0.01	-0.91	-1.38	-0.04	0.60	0.18	-0.15
2006	-0.85	0.56	-0.17	-0.17	0.45	0.09	-0.39	-0.37
2007	0.38	-1.32	0.34	-2.62	0.22	0.48	0.96	1.05
2008	-0.43	0.17	-0.53	0.74	0.58	-0.24	0.18	-0.53

$r_a = 0.38$; $r_t = 0.11$; $r_{coh} = 0.11$; $\gamma_1 = -2.39$; $\gamma_2 = 1.03$

STANDARDISED SURVEY RESIDUALS

	1	2	3	4	5	6	7	8	9
1987	-0.31	-0.52	1.53	-0.16	0.26	-0.43	0.37	-0.15	0.17
1988	-0.37	-1.59	2.11	1.08	1.02	-1.48	0.92	1.86	-0.48
1989	-0.19	1.02	1.60	1.39	0.89	0.74	0.02	0.63	0.38
1990	0.16	-0.24	0.22	-1.57	-2.11	-1.21	0.63	0.27	0.78
1991	-0.22	-0.14	-0.61	0.47	0.07	-0.36	0.02	-0.61	0.95
1992	-2.12	0.87	0.89	-0.22	-1.44	-1.01	-1.10	-0.93	0.00
1993	-0.33	0.92	0.62	0.71	-0.57	-0.06	-0.78	-0.13	-0.29
1994	1.23	0.81	-0.03	-0.40	-0.54	-0.89	-0.80	-0.39	-0.18
1995	-1.57	-0.37	0.26	-0.62	0.14	0.63	0.29	0.06	-0.26
1996	-0.29	0.07	-0.20	0.55	1.56	-0.09	1.93	2.63	1.61
1997	-1.54	1.82	0.93	1.16	1.04	1.01	-0.15	0.57	-1.81
1998	0.58	0.34	-0.05	0.45	1.84	1.44	1.09	0.85	0.43
1999	0.48	1.31	-1.78	1.25	-0.25	-1.34	-0.99	-0.56	-0.41
2000	1.53	1.03	0.88	-1.24	-0.44	-0.70	-1.42	-0.24	-1.29
2001	1.05	-1.65	-0.15	-0.99	-1.72	-1.54	-1.29	-1.85	-1.72
2002	-1.84	0.76	0.22	0.43	0.14	1.74	0.31	0.38	-0.04
2003	0.94	0.17	-0.51	-0.30	-0.25	-0.88	0.83	1.44	2.12
2004	0.42	-0.20	-0.48	1.36	0.73	1.10	1.57	1.69	2.51
2005	-0.65	-0.41	0.12	-0.14	0.28	-0.08	0.02	0.93	0.01
2006	0.71	-0.83	-0.71	-0.08	0.75	-0.48	-0.82	-0.60	-0.91
2007	0.17	-0.70	-2.05	-0.72	-0.75	0.20	-1.92	0.14	0.64
2008	0.38	-1.06	-1.42	-0.98	-0.45	-0.14	1.09	0.98	0.44
2009	1.70	-1.53	-1.42	-0.78	1.25	0.88	0.49	0.28	-0.14

$r_a = 0.47$; $r_t = 0.17$; $r_{coh} = 0.13$; $\gamma_1 = 1.21$; $\gamma_2 = -1.06$

Table 9.4.6. Icelandic cod in division Va. The estimate of fishing mortality, stock numbers and biomass from the TSA based on tuning with the spring survey. "Biom" refers to biomass of fish 4 years and older. Note that the numbers at age 1, 2 and 3 are unconventional, showing the 1st, 2nd and 3rd estimates of the size of the year class at age 4.

STOCK

	Biom	1	2	3	4	5	6	7	8	9	10	11
1985	903.	171.0	252.7	114.3	117.5	121.18	42.95	17.37	8.38	4.23	2.15	0.44
1986	841.	147.8	194.7	230.9	104.6	74.63	65.21	20.50	7.69	3.20	1.62	0.80
1987	990.	84.6	146.5	220.7	237.1	69.06	32.96	28.03	7.23	2.59	1.08	0.52
1988	1048.	93.5	76.8	171.1	224.6	148.82	33.30	11.54	9.97	2.16	0.75	0.34
1989	1097.	88.9	98.5	81.7	167.5	149.93	73.02	11.76	3.74	2.87	0.64	0.24
1990	850.	105.8	87.5	101.8	73.3	92.12	97.61	33.57	4.83	1.32	0.85	0.22
1991	700.	98.5	107.6	83.9	103.7	44.76	44.13	44.05	11.65	1.74	0.46	0.28
1992	559.	52.2	105.4	115.9	83.0	61.76	21.20	17.00	14.77	3.82	0.56	0.14
1993	563.	91.7	55.2	110.1	122.2	44.53	27.64	6.60	4.85	4.08	1.28	0.17
1994	583.	143.1	96.9	54.6	112.7	72.00	19.40	10.63	2.54	1.36	1.16	0.41
1995	569.	61.8	140.6	100.6	53.9	72.16	41.65	10.61	4.38	1.03	0.53	0.45
1996	654.	101.3	63.7	142.0	104.1	36.29	39.13	24.71	5.51	2.05	0.48	0.24
1997	806.	58.4	112.9	65.6	147.2	77.15	21.95	19.66	13.25	2.46	0.96	0.23
1998	751.	128.9	58.0	115.8	62.9	106.80	51.85	12.78	8.51	6.10	1.04	0.42
1999	754.	120.0	143.1	49.1	129.5	46.50	59.06	26.13	5.67	3.33	2.29	0.42
2000	592.	144.5	126.2	151.6	44.9	92.96	26.24	23.58	10.81	2.13	1.22	0.80
2001	718.	143.6	129.7	126.8	154.9	30.66	50.02	11.86	7.96	3.87	0.78	0.42
2002	766.	53.6	149.6	130.3	131.1	101.02	19.60	21.98	4.89	2.85	1.42	0.29
2003	772.	132.1	54.1	146.8	131.5	89.57	52.90	11.83	10.31	2.46	1.15	0.60
2004	843.	110.1	131.4	52.1	156.4	93.45	50.97	24.81	6.09	4.75	1.17	0.47
2005	742.	73.9	105.4	132.3	50.7	115.29	54.60	22.88	11.54	2.90	2.12	0.52
2006	733.	114.8	67.1	99.0	129.6	39.39	70.84	27.61	11.17	5.46	1.37	0.98
2007	661.	97.5	108.3	57.8	99.2	86.93	27.85	29.46	13.88	5.39	2.60	0.65
2008	636.	105.1	90.3	97.6	55.8	71.94	50.54	17.38	14.56	6.74	2.63	1.22
2009	651.	173.1	96.0	82.9	90.8	44.26	49.70	29.59	9.91	7.77	3.51	1.42

KALMAN FILTER ESTIMATION OF STANDARD DEVIATION OF BIOMASS AND LOG-STOCK

2008	34.	0.072	0.057	0.056	0.070	0.070	0.074	0.070	0.084	0.099	0.131	0.164
2009	41.	0.090	0.065	0.061	0.077	0.085	0.089	0.104	0.102	0.119	0.153	0.174

ADJUSTED FOR ERRORS IN PARAMETER ESTIMATES

2009	(42)	0.097	0.067	0.064	0.080	0.086	0.091	0.108	0.108	0.125	0.158	0.178

Standard deviation of prediction of stock at 4 years

2009	0.190	0.151	0.116

FISHING MORTALITY RATES

	F 5-10	4	5	6	7	8	9	10	11
1985	0.673	0.262	0.397	0.603	0.719	0.768	0.779	0.770	0.771
1986	0.816	0.243	0.526	0.704	0.893	0.935	0.919	0.921	0.922
1987	0.870	0.323	0.549	0.741	0.904	1.002	1.016	1.007	1.011
1988	0.890	0.216	0.527	0.889	0.937	1.014	0.997	0.975	0.985
1989	0.747	0.227	0.460	0.632	0.779	0.863	0.880	0.865	0.876
1990	0.757	0.222	0.430	0.672	0.830	0.877	0.865	0.868	0.874
1991	0.842	0.313	0.502	0.765	0.934	0.940	0.948	0.962	0.956
1992	0.932	0.350	0.623	0.914	1.042	1.031	0.981	1.001	0.999
1993	0.849	0.347	0.499	0.744	0.850	0.985	1.013	1.006	1.006
1994	0.608	0.261	0.354	0.480	0.624	0.742	0.720	0.727	0.732
1995	0.488	0.202	0.311	0.408	0.524	0.554	0.556	0.574	0.571
1996	0.487	0.164	0.257	0.432	0.506	0.568	0.577	0.581	0.577
1997	0.522	0.131	0.272	0.397	0.551	0.626	0.643	0.642	0.641
1998	0.608	0.143	0.317	0.532	0.664	0.696	0.725	0.713	0.713
1999	0.682	0.172	0.413	0.621	0.731	0.778	0.779	0.771	0.776
2000	0.713	0.173	0.411	0.610	0.777	0.830	0.823	0.825	0.824
2001	0.659	0.191	0.363	0.555	0.702	0.768	0.782	0.785	0.780
2002	0.536	0.163	0.311	0.429	0.561	0.609	0.658	0.649	0.647
2003	0.524	0.140	0.308	0.470	0.562	0.595	0.607	0.603	0.602
2004	0.519	0.134	0.325	0.469	0.549	0.595	0.588	0.591	0.587
2005	0.464	0.109	0.276	0.404	0.485	0.534	0.545	0.540	0.539
2006	0.457	0.114	0.238	0.434	0.491	0.529	0.526	0.522	0.524
2007	0.411	0.129	0.216	0.338	0.415	0.492	0.499	0.504	0.503
2008	0.328	0.089	0.189	0.276	0.353	0.382	0.382	0.386	0.384

ESTIMATED STANDARD DEVIATION OF LOG(F)

2007	0.029	0.070	0.066	0.058	0.066	0.075	0.087	0.088	0.088
2008	0.027	0.077	0.075	0.076	0.077	0.089	0.100	0.100	0.100

Table 9.4.7. Icelandic cod in division Va. Comparison of estimates of key metrics using various methodological approaches. All results shown are based on tuning with the spring survey (SMB) except TSA SMH and ADCAM SMH, where the fall survey is used. 2008 estimate refers to the estimates from the result from the ADCAM framework that was the basis for advice last year.

a)

Estimated fishing mortality rate in 2008:

Age	Estimated in 2008	ADCAM SMB	TSA SMB	ADAPT	XSA	ADCAM SMH	TSA SMH	ADCAM09 vs 2008
3	0.02	0.02		0.02	0.02	0.02		17.3%
4	0.10	0.09	0.09	0.08	0.08	0.10	0.09	-6.9%
5	0.21	0.19	0.19	0.20	0.20	0.19	0.18	-10.6%
6	0.33	0.28	0.28	0.25	0.23	0.28	0.27	-15.2%
7	0.37	0.44	0.35	0.44	0.46	0.40	0.35	17.9%
8	0.42	0.45	0.38	0.38	0.31	0.40	0.39	6.5%
9	0.46	0.49	0.38	0.47	0.37	0.38	0.39	7.5%
10	0.51	0.65	0.39	0.58	0.33	0.45	0.39	26.7%
11	0.52	0.73	0.38	0.64	0.59	0.42	0.39	40.1%
12	0.56	0.85		3.79	1.25	0.47		51.4%
13	0.56	0.90		0.11	1.67	0.42		60.3%
14	0.56	0.90		0.54	1.00	0.42		60.3%
F(5-10)	**0.38**	**0.42**	**0.33**	**0.39**	**0.31**	**0.35**	**0.33**	8.3%

b)

Estimated stock in numbers (millions) in 2009:

Age	Estimated in 2008	ADCAM SMB	TSA	ADAPT	XSA	ADCAM SMH	TSA SMH	ADCAM09 vs 2008
1	207	337	315	340	323	225	137	62.6%
2	170	151	143	152	151	188	134	-11.2%
3	116	98	101	117	116	143	142	-15.3%
4	110	96	91	109	110	113	116	-13.1%
5	46	48	44	50	52	47	47	3.3%
6	46	53	50	51	53	53	58	14.4%
7	30	35	30	39	42	36	35	17.2%
8	7	8	10	9	8	9	11	9.2%
9	8.0	8.0	7.8	9.0	11.2	9.2	9.0	-0.1%
10	3.0	2.9	3.5	3.1	4.2	3.8	3.9	-4.6%
11	1.1	0.8	1.4	0.9	1.9	1.4	1.8	-23.6%
12	0.4	0.3		0.3	0.3	0.6		-30.6%
13	0.1	0.0		0.0	0.0	0.1		
14	0.0	0.0		0.3	0.0	0.1		

c)

Recruitment (N3 abundance):

Yearcl.	Estimated in 2008	ADCAM SMB	TSA	ADAPT	XSA	ADCAM SMH	TSA SMH	ADCAM09 vs 2008
2002	147	154	158	159	167	156		4.8%
2003	122	134	121	133	137	135		10.1%
2004	79	80	68	83	86	79		1.5%
2005	137	120	111	137	138	141	141	-12.7%
2006	116	98	101	117	116	143	142	-15.3%
2007	139	98	110	124	124	154	134	-29.6%
2008		154	211	228	217		137	

d)

Estimated stock size (B4+, Thous. tonnes) in 1991-2010

Year	Estimated in 2008	ADCAM SMB	TSA	ADAPT	XSA	ADCAM SMH	TSA SMH	ADCAM09 vs 2008
1993	590	590	563	588	588	605		0.0%
1994	574	574	583	585	585	581		0.0%
1995	553	553	569	563	563	560	570	0.0%
1996	668	668	654	688	688	681	716	0.0%
1997	783	782	806	805	805	783	789	-0.1%
1998	718	718	751	740	739	718	727	0.0%
1999	731	731	754	755	751	735	760	-0.1%
2000	591	591	592	610	606	603	615	-0.1%
2001	698	696	718	706	702	702	721	-0.4%
2002	735	732	766	737	741	735	820	-0.4%
2003	748	746	772	752	763	751	815	-0.2%
2004	805	805	843	818	842	811	898	0.0%
2005	705	714	742	728	753	731	815	1.3%
2006	668	687	733	710	745	711	812	2.8%
2007	629	663	661	684	726	696	719	5.5%
2008	590	663	636	690	740	695	708	12.4%
2009	647	702	651	735	785	740	774	8.6%

Table 9.6.1. Icelandic cod in Division Va. Landings (thousand tonnes, average fishing mortality of age groups 5 to 10, recruitment to the fisheries at age 3 (millions), reference fishing biomass (B4+, thousand tonnes), spawning stock biomass (thousand tonnes) at spawning time and harvest ration. Shaded areas are predictions based on 20% harvest strategy.

Year	Landings	F5-10	SSB	N3	B4+	Hratio
1955	538	0.29	943	152	2362	0.24
1956	481	0.29	796	153	2086	0.24
1957	452	0.31	776	171	1882	0.24
1958	509	0.35	875	221	1868	0.28
1959	453	0.32	853	289	1829	0.25
1960	465	0.37	709	154	1754	0.29
1961	375	0.36	467	193	1497	0.25
1962	387	0.38	569	129	1493	0.28
1963	410	0.46	508	178	1316	0.32
1964	434	0.55	451	204	1219	0.39
1965	394	0.58	318	216	1023	0.38
1966	357	0.59	277	229	1031	0.33
1967	345	0.56	256	320	1103	0.30
1968	381	0.72	222	172	1223	0.30
1969	406	0.56	314	248	1326	0.31
1970	471	0.61	331	180	1337	0.39
1971	453	0.68	242	189	1098	0.43
1972	399	0.69	222	139	997	0.43
1973	383	0.70	245	273	843	0.44
1974	375	0.76	187	179	918	0.41
1975	371	0.81	168	261	895	0.40
1976	348	0.75	138	368	955	0.31
1977	340	0.59	198	143	1289	0.26
1978	330	0.48	212	227	1297	0.25
1979	368	0.45	304	244	1396	0.26
1980	434	0.49	356	140	1489	0.32
1981	469	0.66	263	141	1241	0.42
1982	388	0.73	166	132	970	0.44
1983	300	0.72	129	233	791	0.35
1984	284	0.64	140	139	913	0.31
1985	325	0.67	172	139	927	0.37
1986	369	0.78	197	332	851	0.39
1987	392	0.86	149	263	1031	0.38
1988	378	0.89	172	174	1036	0.37
1989	356	0.72	172	87	1005	0.39
1990	335	0.70	214	130	839	0.44
1991	309	0.80	161	105	696	0.50
1992	268	0.85	152	173	547	0.47
1993	252	0.87	123	137	590	0.43
1994	179	0.63	153	76	574	0.32
1995	169	0.51	178	152	553	0.28
1996	182	0.51	158	166	668	0.25
1997	203	0.55	189	86	782	0.27
1998	243	0.66	211	162	718	0.33
1999	260	0.74	185	70	731	0.39
2000	236	0.76	168	176	591	0.37
2001	235	0.74	164	160	696	0.33
2002	209	0.63	198	163	732	0.28
2003	208	0.59	187	179	746	0.27
2004	227	0.59	202	72	805	0.30
2005	214	0.56	231	154	714	0.30
2006	196	0.56	217	135	687	0.29
2007	170	0.56	194	82	663	0.26
2008	146	0.42	253	133	663	0.21
2009	162	0.40	223	115	702	0.23
2010	149	0.35	240	121	719	0.20
2011	148	0.32	261	218	759	0.18
2012	155	0.29	284	144	925	0.16
2013	185	0.30	327	149	1012	0.18

Table 9.7.1. Icelandic cod in Division Va. Inputs in the short term predictions

Mean weights in the stock and the catch

age\year	2008	2009	2010	2011	2012
3	1.162	1.115	1.115	1.115	1.115
4	1.627	1.515	1.515	1.515	1.515
5	2.318	2.217	2.217	2.217	2.217
6	3.120	3.160	3.160	3.160	3.160
7	3.846	4.122	4.122	4.122	4.122
8	5.367	5.073	5.073	5.073	5.073
9	6.771	6.091	6.091	6.091	6.091
10	7.648	7.648	7.648	7.648	7.648
11	8.282	8.282	8.282	8.282	8.282
12	11.181	11.181	11.181	11.181	11.181
13	14.266	14.266	14.266	14.266	14.266
14	17.320	17.320	17.320	17.320	17.320

Mean weights in the SSB

age\year	2008	2009	2010	2011
3	1.017	1.017	1.017	1.017
4	1.841	1.440	1.440	1.440
5	2.227	2.027	2.027	2.027
6	2.924	2.871	2.871	2.871
7	3.920	3.909	3.909	3.909
8	5.367	5.073	5.073	5.073
9	6.771	6.091	6.091	6.091
10	7.648	7.648	7.648	7.648
11	8.282	8.282	8.282	8.282
12	11.181	11.181	11.181	11.181
13	14.266	14.266	14.266	14.266
14	17.320	17.320	17.320	17.320

Sexual maturity at spawning time:

age\year	2008	2009	2010	2011	2012
3	0.00	0.00	0.00	0.00	0.00
4	0.04	0.02	0.02	0.02	0.02
5	0.28	0.13	0.13	0.13	0.13
6	0.55	0.46	0.46	0.46	0.46
7	0.73	0.69	0.69	0.69	0.69
8	0.83	0.88	0.88	0.88	0.88
9	0.85	0.74	0.74	0.74	0.74
10	0.95	0.63	0.63	0.63	0.63
11	0.74	0.89	0.89	0.89	0.89
12	1.00	1.00	1.00	1.00	1.00
13	1.00	1.00	1.00	1.00	1.00
14	1.00	1.00	1.00	1.00	1.00

Selection pattern

age\year	2008	2009	2010	2011
3	0.051	0.050	0.050	0.050
4	0.219	0.220	0.220	0.220
5	0.448	0.462	0.462	0.462
6	0.673	0.729	0.729	0.729
7	1.052	0.972	0.972	0.972
8	1.078	1.069	1.069	1.069
9	1.192	1.243	1.243	1.243
10	1.557	1.524	1.524	1.524
11	1.754	1.928	1.928	1.928
12	2.039	1.928	1.928	1.928
13	2.157	1.928	1.928	1.928
14	2.157	1.928	1.928	1.928

Natural Mortality

age\year	2008	2009	2010	2011	2012
3	0.20	0.20	0.20	0.20	0.20
4	0.20	0.20	0.20	0.20	0.20
5	0.20	0.20	0.20	0.20	0.20
6	0.20	0.20	0.20	0.20	0.20
7	0.20	0.20	0.20	0.20	0.20
8	0.20	0.20	0.20	0.20	0.20
9	0.20	0.20	0.20	0.20	0.20
10	0.20	0.20	0.20	0.20	0.20
11	0.20	0.20	0.20	0.20	0.20
12	0.20	0.20	0.20	0.20	0.20
13	0.20	0.20	0.20	0.20	0.20
14	0.20	0.20	0.20	0.20	0.20

Stock numbers

age\year	2008	2009	2010	2011
3	133.243	114.940	121.32	217.93
4	65.1791	106.802		
5	77.9885	48.724		
6	56.8477	53.005		
7	14.4244	35.202		
8	15.2352	7.630		
9	5.72593	7.971		
10	1.95675	2.858		
11	0.70361	0.839		
12	0.08477	0.278		
13	0.06043	0.030		
14	0.00838	0.020		

Prop. mort. before spawning

age\year	F	M
3	0.085	0.250
4	0.180	0.250
5	0.248	0.250
6	0.296	0.250
7	0.382	0.250
8	0.437	0.250
9	0.477	0.250
10	0.477	0.250
11	0.477	0.250
12	0.477	0.250
13	0.477	0.250
14	0.477	0.250

Table 9.7.2a. Icelandic cod in Division Va. Output of the short term predictions, domestic format

Prognosis - Summary table

2009				2010				2011				2012			
TAC	*4+ stofn 4+ stock*	*Hr. stofn Sp. stock*	*F (5-10)*	*TAC*	*4+ stofn 4+ stock*	*Hr. stofn Sp. stock*	*F (5-10)*	*TAC*	*4+ stofn 4+ stock*	*Hr. stofn Sp. stock*	*F (5-10)*	*TAC*	*4+ stofn 4+ stock*	*Hr. stofn Sp. stock*	*F (5-10)*
160	702	222	0.410	100	722	252	0.228	100	819	307	0.188	100	1043	368	0.150
				140	722	241	0.335	144	773	267	0.309	155	944	292	0.287
				150	722	239	0.362	147	762	260	0.323	151	929	284	0.287
				178	722	231	0.443	187	730	230	0.459	215	850	222	0.509
				200	722	225	0.512	200	705	212	0.529	200	808	203	0.513

```
Opt 1: Fixed 100 kt landings
Opt 2: 20% of B4+, no buffer
Opt 3: 20% of B4+, buffer
Opt 4: 1996 catch rule
Opt 5: Fixed 200 kt landings
```

Table 9.7.2b. Icelandic cod in Division Va. Output of the short term predictions, ICES format

2009			
B4+	SSB	Landings	Fbar
702	222	160	0.410

2010					2011	
B4+	Fmult	Fbar	SSB2010	Landings	B4+	SSB
722	0.000	0.000	277	0	934	406
	0.025	0.025	274	12	921	392
	0.050	0.050	271	24	907	380
	0.075	0.075	269	35	894	367
	0.100	0.100	266	46	881	356
	0.125	0.125	263	57	868	344
	0.150	0.150	260	68	856	333
	0.175	0.175	258	79	844	323
	0.200	0.200	255	89	832	313
	0.225	0.225	252	99	821	303
	0.250	0.250	250	109	809	294
	0.275	0.275	247	118	798	285
	0.300	0.300	245	128	788	276
	0.325	0.325	242	137	777	268
	0.350	0.350	240	146	767	259
	0.375	0.375	237	155	757	252
	0.400	0.400	235	163	747	244
	0.425	0.425	233	172	737	237
	0.450	0.450	230	180	727	230
	0.475	0.475	228	188	718	223
	0.500	0.500	226	196	709	217

Table 9.7.2b. Icelandic cod in Division Va. Output of the short term predictions, ICES format

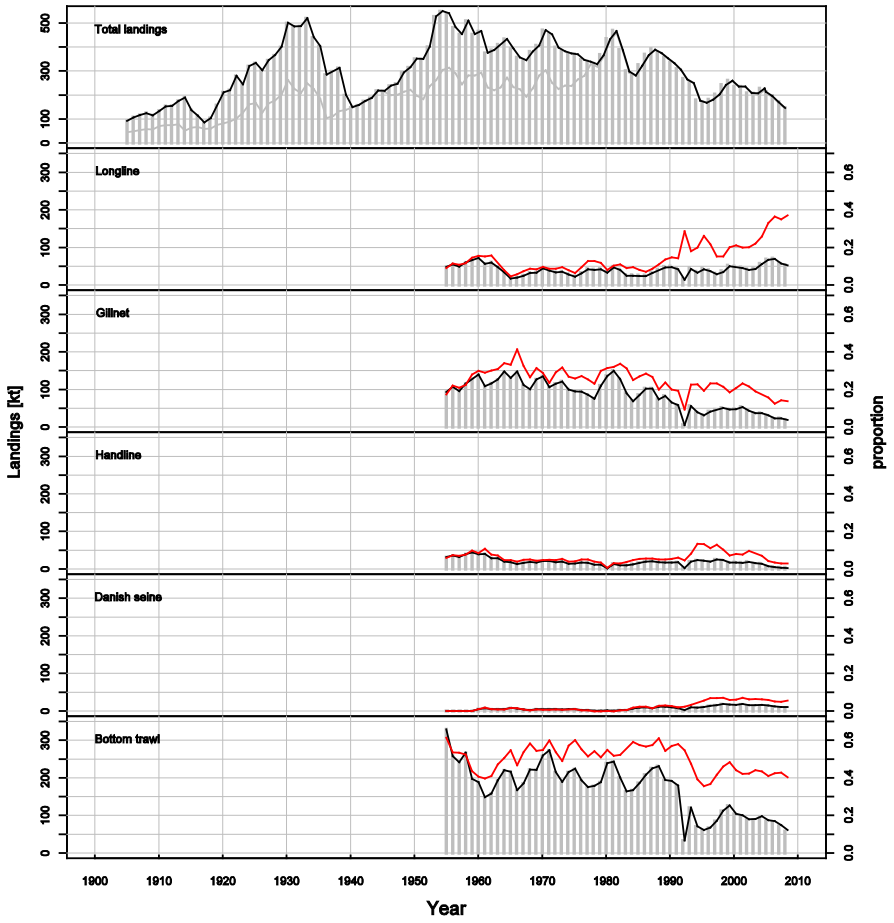

Figure 9.2.1 Icelandic cod division Va. Total landings from 1905 to 2008 and landings by principal gear from 1955 to 2008. The proportion of landings by each gear are shown by the red line.

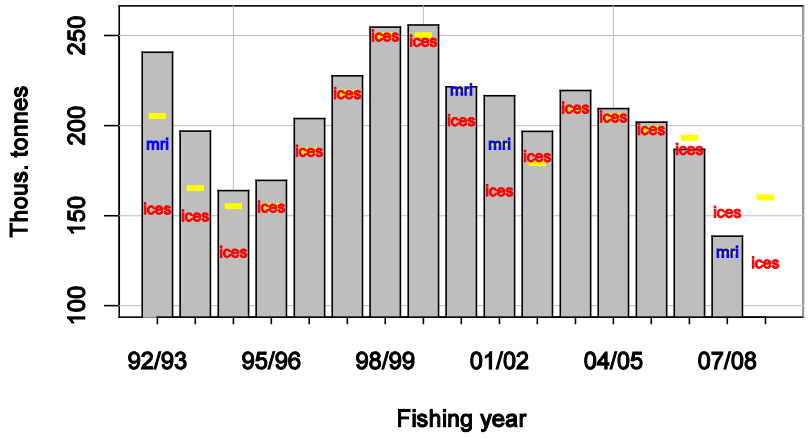

Figure 9.2.3. Icelandic cod division Va. ICES advice (ices), domestic advice (mri) if different from ICES advice and set TAC (yellow bar) and reported landings (grey bar) for the fishing year (September through August).

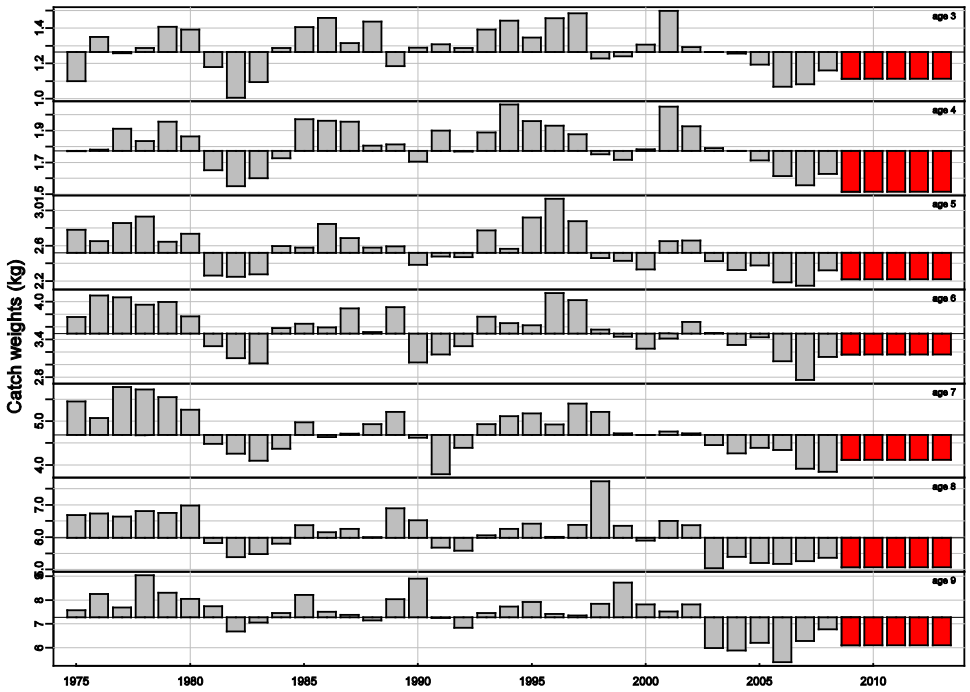

Figure 9.2.4. Icelandic cod division Va. Mean observed weight at age (numbers indicate age classes) in the catches 1974-2008, with predicted and assumed mean weight at age for 2009 and beyond.

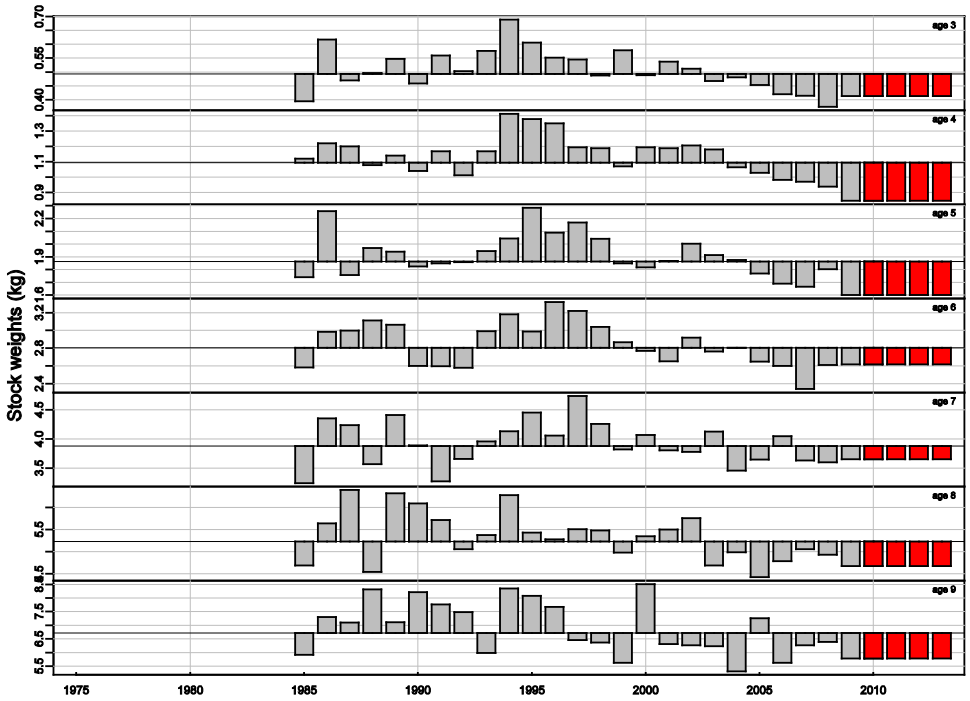

Figure 9.2.5. Icelandic cod division Va. Mean observed weight at age (numbers indicate age classes) in the March groundfish survey 1985-2009.

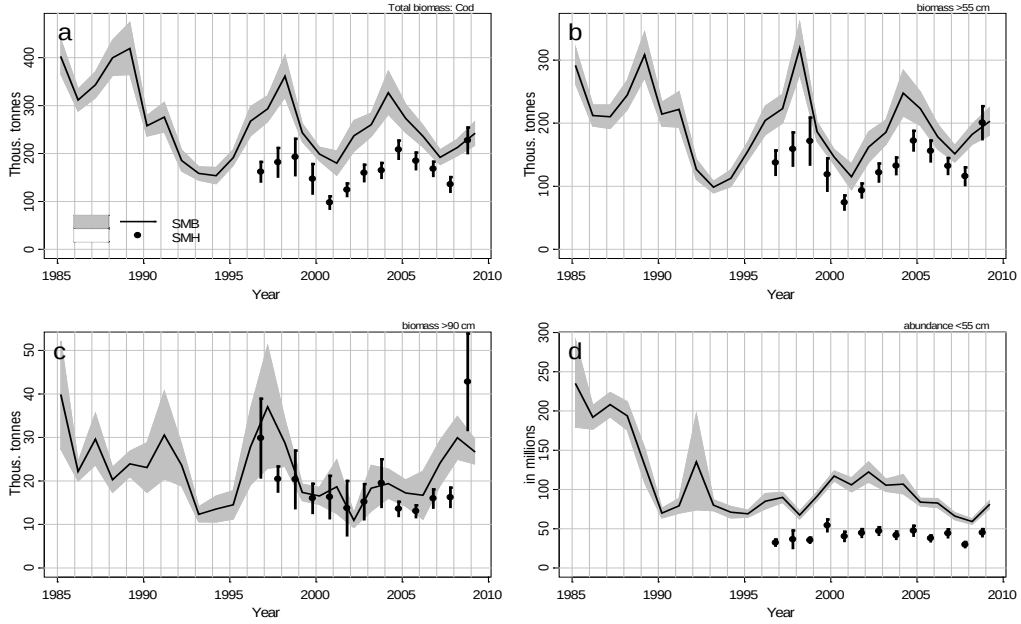

Figure 9.2.6. Icelandic cod division Va. Abundance indices of cod in the groundfish survey in March 1985-2009 (SMB, line, shaded area) and October 1996-2008 (SMH, points, vertical lines). a) Total biomass index, b) Biomass index of 55 cm and larger, c) Biomass index 90 cm and larger, d) Abundance index of < 55 cm. The shaded area and the vertical bar show ± 1 standard error of the estimate.

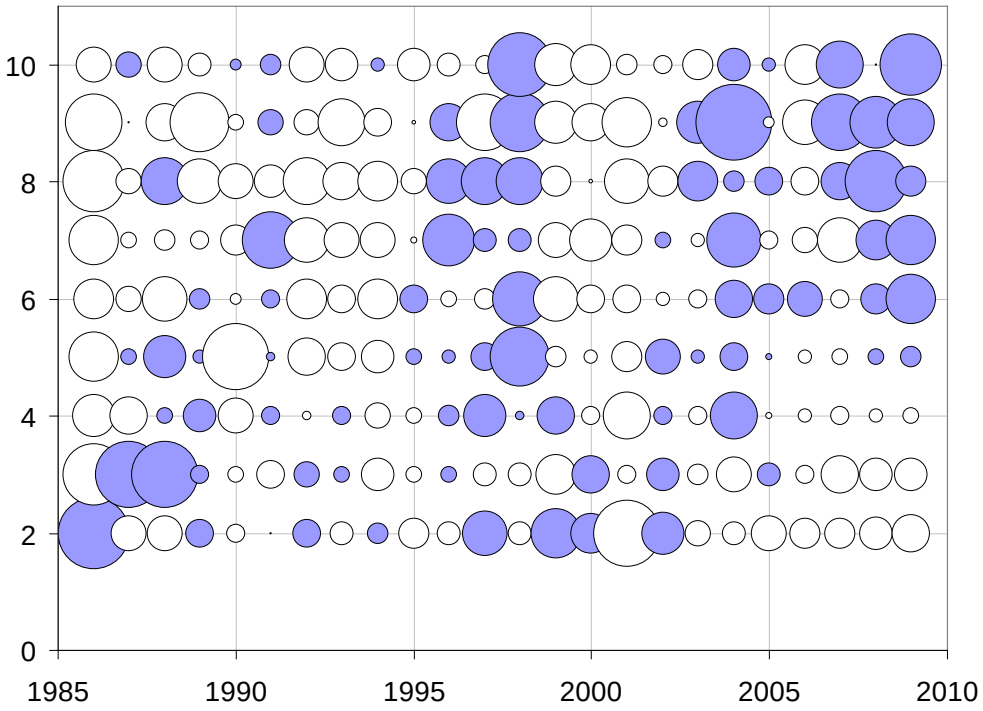

Figure 9.2.7. Icelandic cod division Va. Residual pattern of the observed vs. predicted spring survey indices by age and year from consecutive years. For further explanation see section 9.2.3.

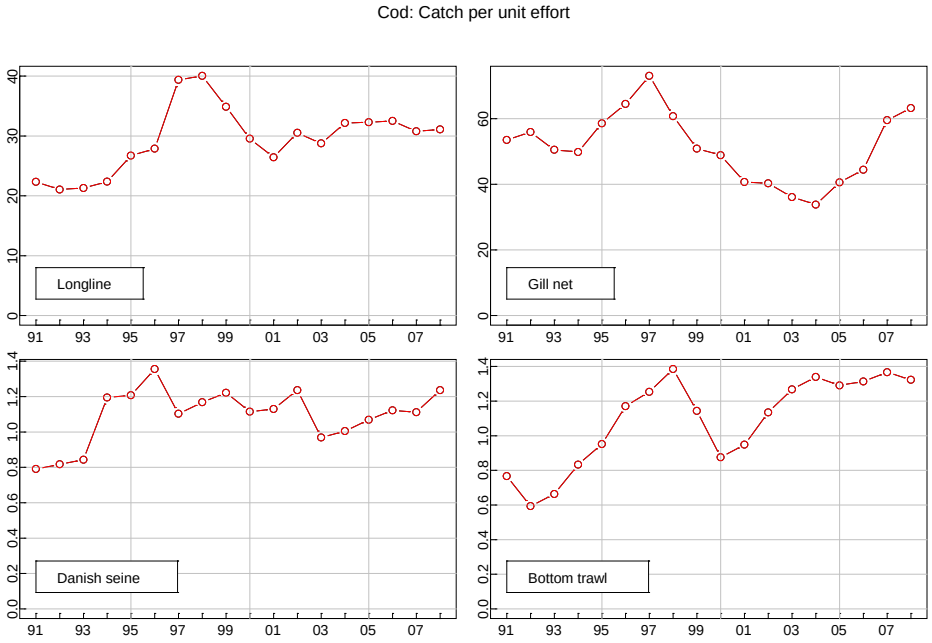

Figure 9.3.1. Icelandic cod division Va. Unstandardized index of catch per unit effort based on log book records where the proportion of cod in the catch is greater than 70%.

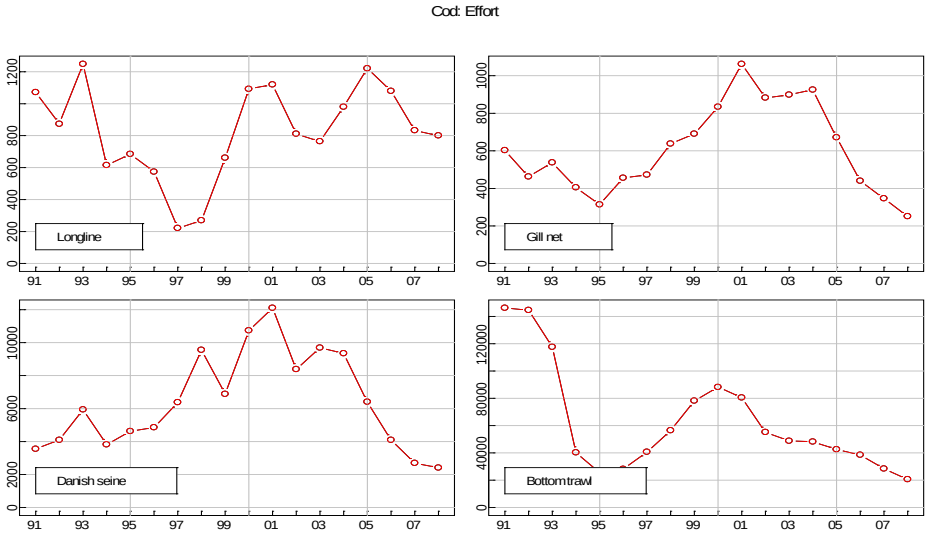

Figure 9.3.2. Icelandic cod division Va. Unstandardized index of effort based on log book records where the proportion of cod in the catch is greater than 70%.

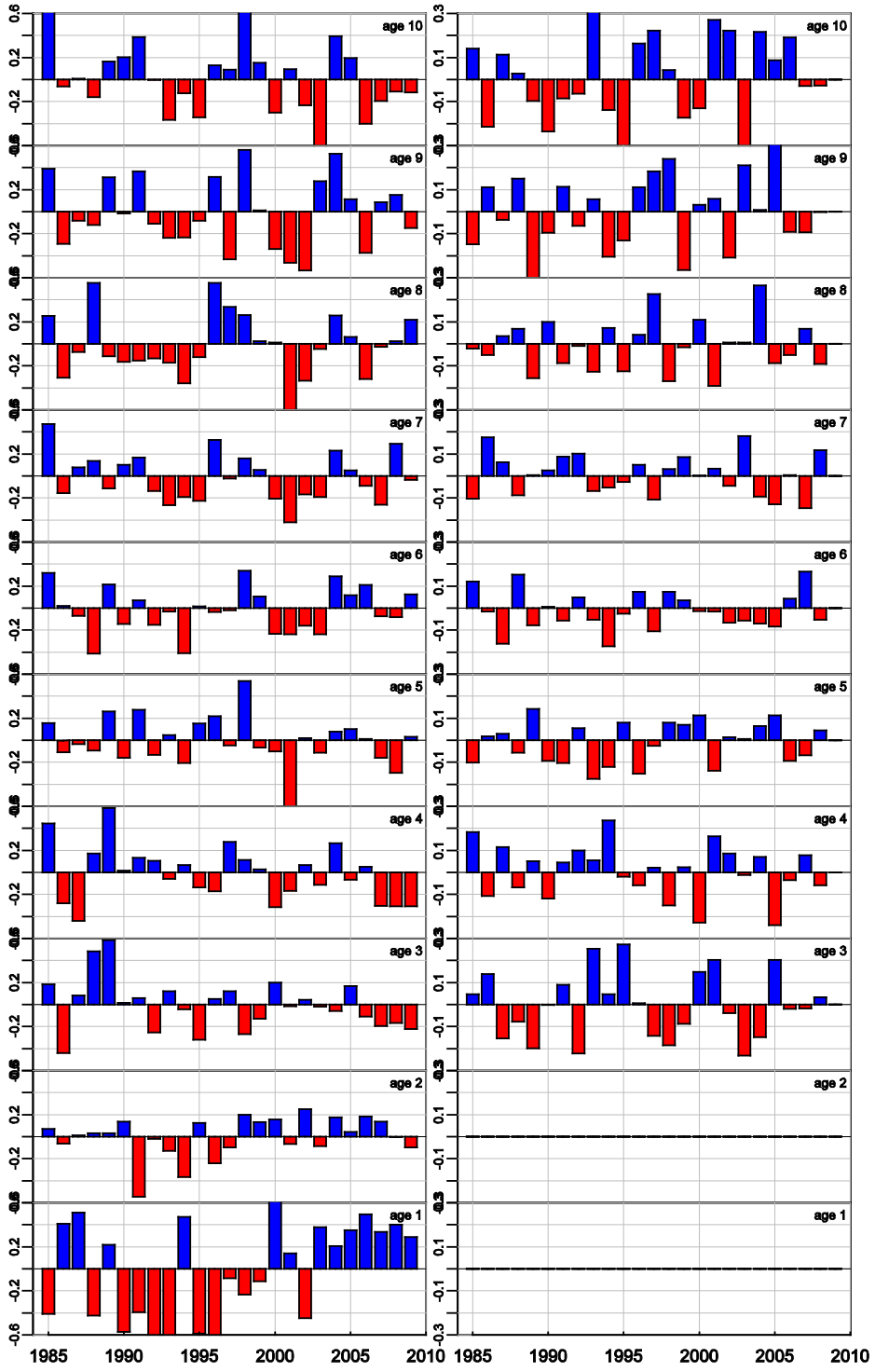

Figure 9.4.1.a Survey residuals (left) and catch residuals (right) by year and age from the ADCAM run.

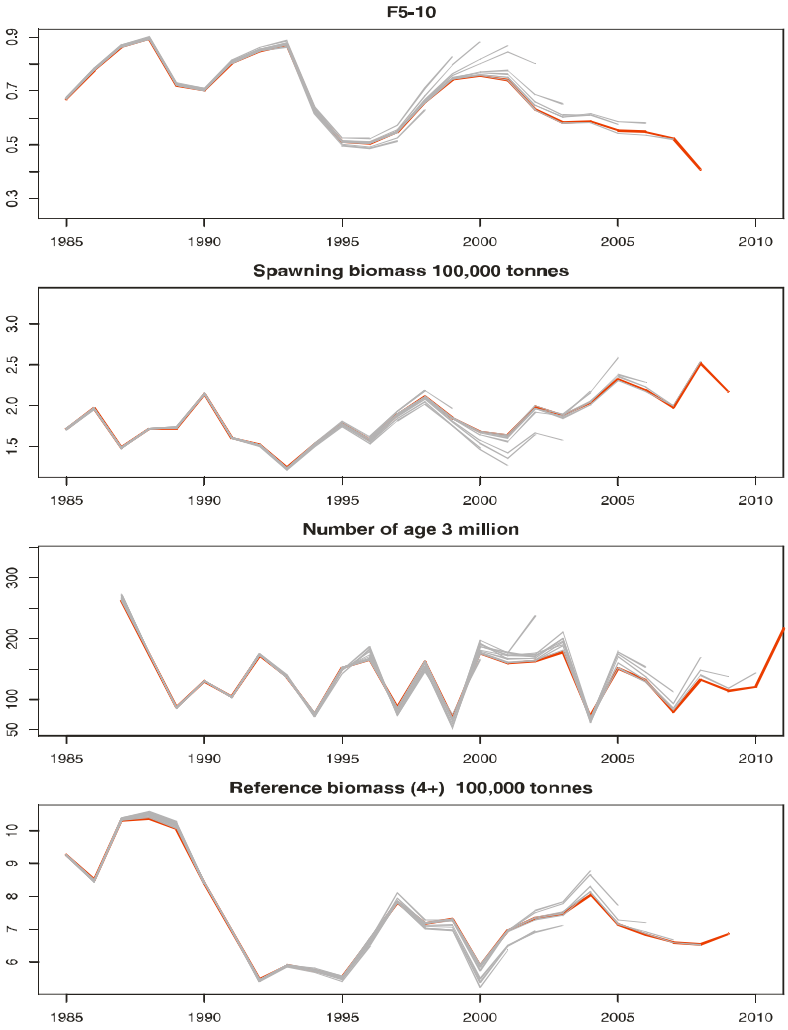

Figure 9.4.2. Icelandic cod in division Va. Retrospective pattern from the ADCAM SPALY fit with the spring survey. Note that the intercept of the y-axis on the x-axis is not set to zero and that the estimates of B4+ is shown, not the conventional SSB (which constitutes older portion of the stock).

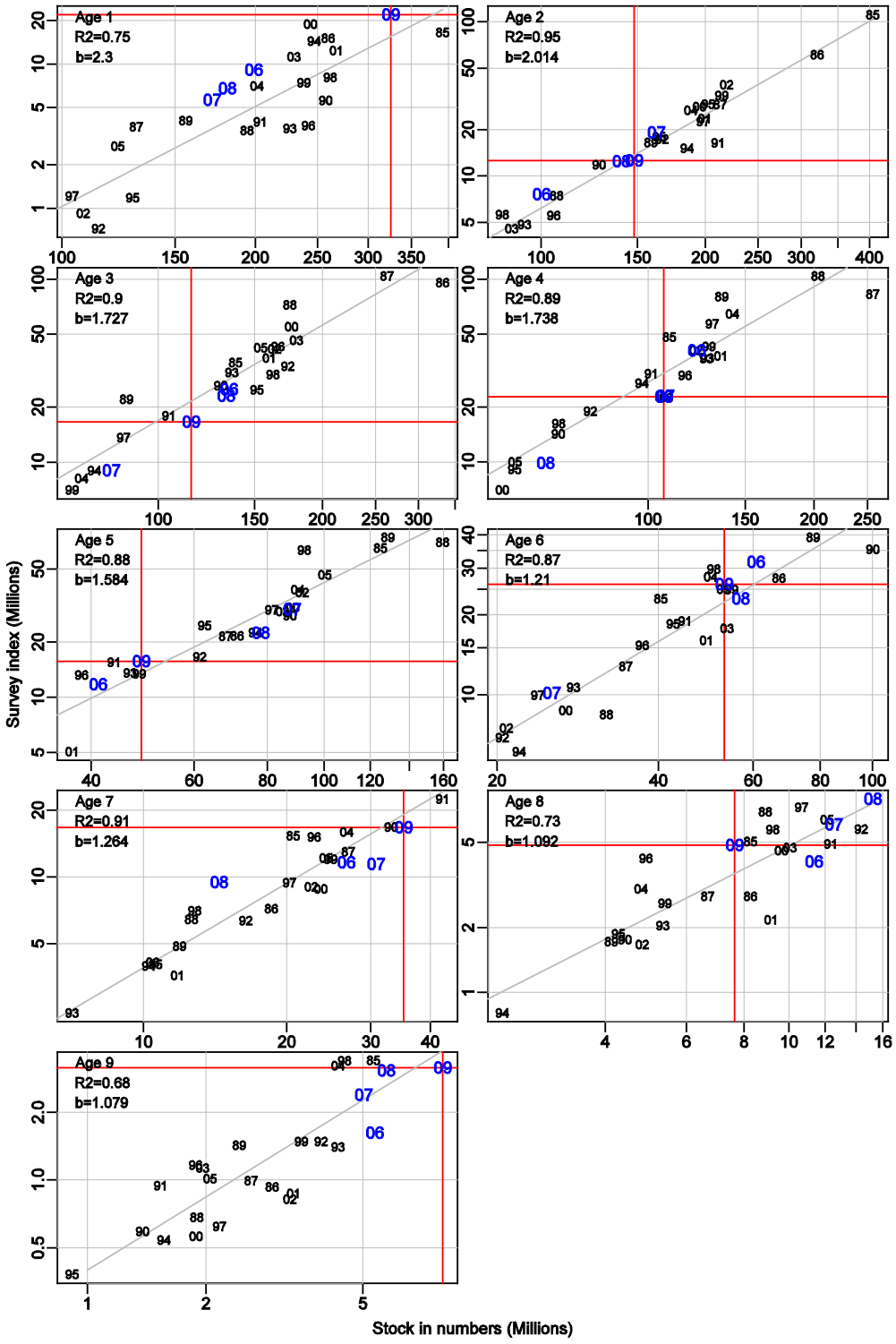

Figure 9.4.3. Icelandic cod in division Va. Log Indices from the spring groundfish survey vs. log number in stock. Line fitted on log scale (power curve) using data from 1985 to 2004. The red lines indicate the stock estimates in 2009 (Na,2009) from the ADCAM SPALY run and the corresponding spring survey measurement (Ua,2009).

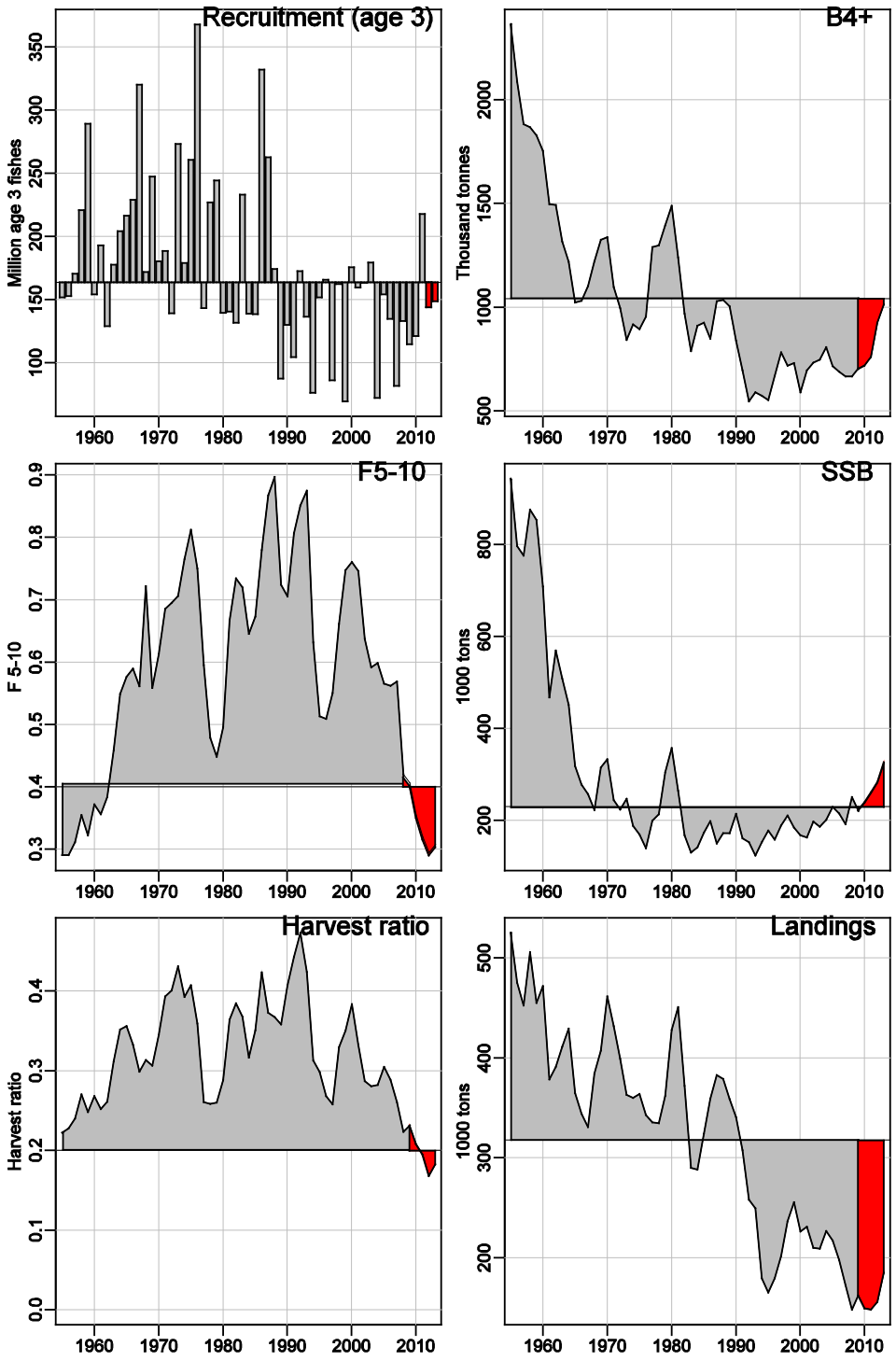

Figure 9.6.1. Icelandic cod in division Va. Summary plot. The x-axis on the recruitment plot refers to year class.

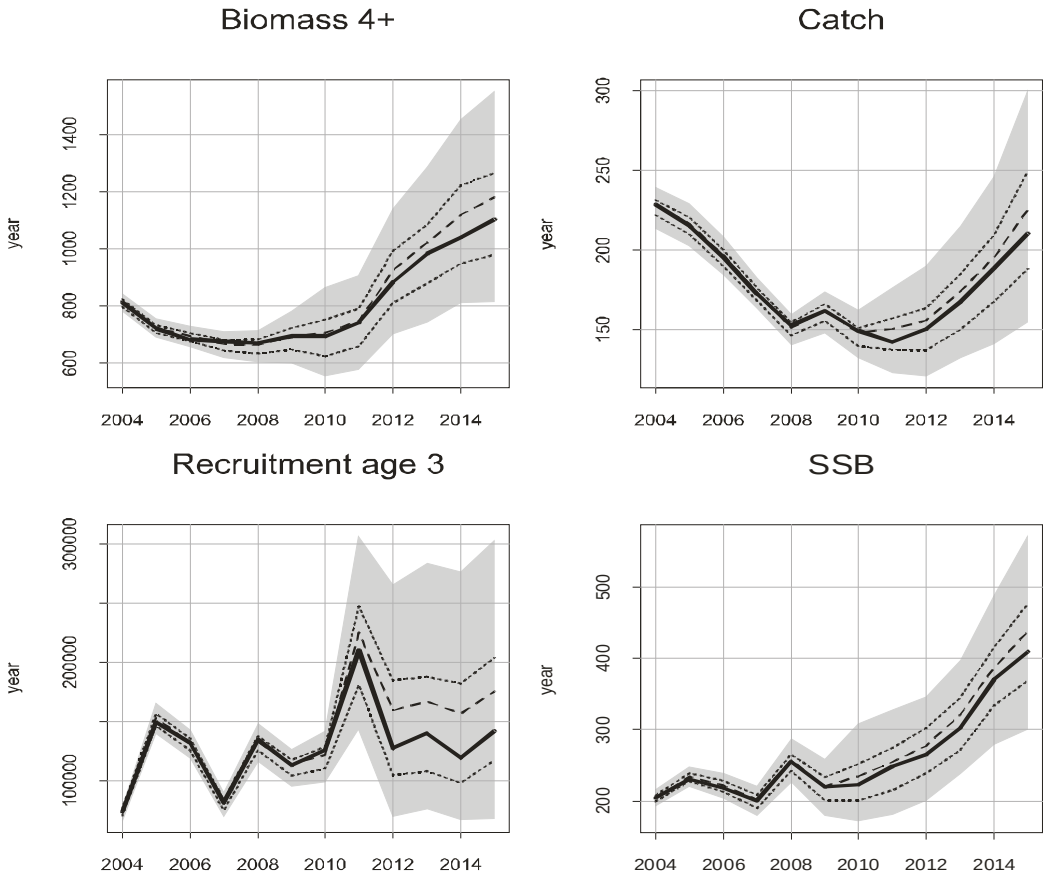

Figure 9.8.1. Icelandic cod in division Va. Medium term projections based showing 95% confidence interval.

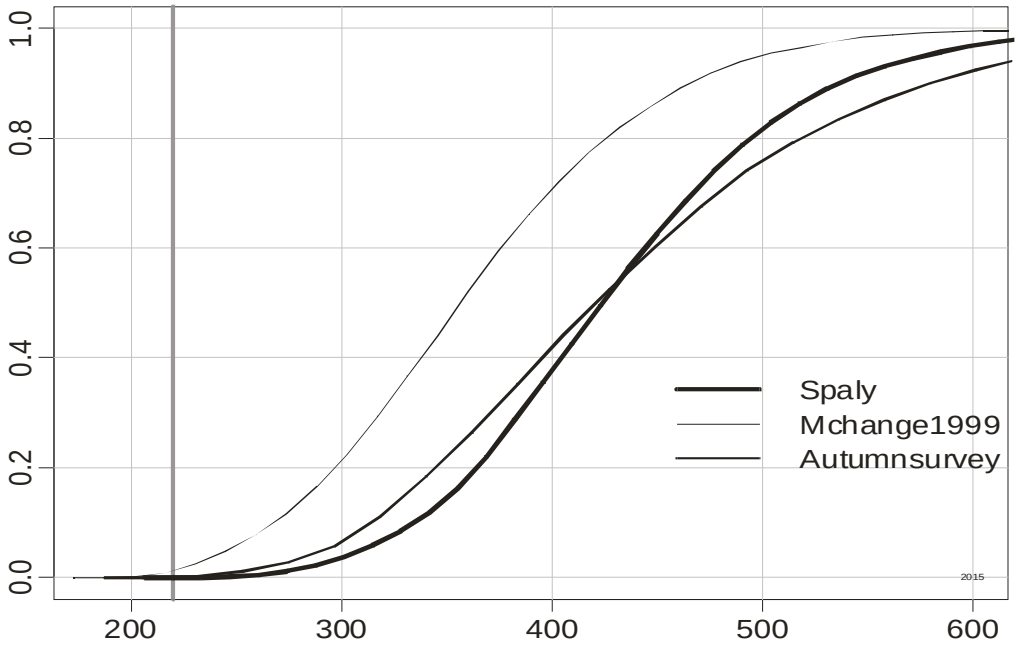

Figure 9.8.2. Icelandic cod in division Va. Cumulative probability distribution of the spawning stock in 2015