ICES AGCREFA REPORT 2008

ICES ADVISORY COMMITTEE

ICES CM 2008/ACOM:60

REF. ACOM

Report of the Ad hoc Group on Criteria for Reopening Fisheries Advice (AGCREFA)

20–22 August 2008

Copenhagen, Denmark

ICES International Council for the Exploration of the Sea

CIEM Conseil International pour l'Exploration de la Mer

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Recommended format for purposes of citation:

ICES. 2008. Report of the Ad hoc Group on Criteria for Reopening Fisheries Advice (AGCREFA), 20–22 August 2008, Copenhagen, Denmark. ICES CM 2008/ACOM:60. 30 pp.

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1 Introduction

The Ad hoc Group for a Criteria for Reopening Fisheries Advice (AGCRFA, hereafter referred to as the "Group") met at the ICES Headquarters (Copenhagen) 20–22 August 2008. The list of meeting participants is given in Appendix I. The purpose of the meeting was to prepare a protocol for reopening 2008 fisheries advice issuing in the first half of the year, based on the information content of resource survey data that becomes available by early autumn. The Terms of Reference for the meeting are given below.

1.1 Terms of Reference

1) Identify fisheries advice which are candidates for reopening based on new survey advice,

2) Evaluate candidate protocols for reopening fisheries advice including criteria (e.g. magnitude of expected change in advice, ability to distinguish signal from noise for a new survey data point),

3) Consider the feasibility of basing the protocol on survey data alone, without having to update the assessment,

4) Draft a protocol.

The need for a protocol for reopening fisheries advice was precipitated by changing the timing of the advice for many stocks from autumn (usually before the end of October) to the first half of the year (by the end of June). The change was requested by the European Commission and other users of fisheries advice in order to allow more time for deliberations prior to fisheries management decisions for the next calendar year. Although changing the timing of advice to earlier in the year allows more time for deliberations, it means that scientific information from resource surveys that occur during summer and early autumn (hereafter referred to as summer surveys) is not available for consideration in the preparation of advice. This means that there is an inherent trade-off between more time for deliberations and the reliability of advice.

In most cases the decrease in reliability of advice is small because the advice depends on several sources of information such that the results from a one or sometimes two summer surveys contribute only a small part of the information content. However, there may be some cases where summer surveys provide new information that would have had an important influence on advice had it been available when the advice was prepared. Summer survey information is most important for estimating the size of recruiting year classes to the fishery because there is little or no data on these year-classes from the fishery. It should also be noted that the sensitivity of advice to summer surveys will decrease as fishing mortality is reduced to target levels since the catch will be less dependent on recruiting year classes.

One way of partially mitigate the potential decrease in reliability of advice resulting from the change in timing is to reopen advice (i.e., allow it to be updated) when summer surveys provide reliable new information. However, care must be taken to not reopen advice too often, because doing so will undermine the purpose of advancing the timing of advice. If advice is reopened frequently, there will be a tendency to procrastinate seriously deliberating until it is determine whether or not the advice will be changed as a result of summer surveys. Also, reopening advice too often places an additional workload on an advisory system that is already working at or beyond its capacity.

The first year of the change in the timing of fisheries advice from autumn to spring was 2007. In that year, survey data that became available during summer was reviewed by Expert Groups to determine if the scientific analyses upon which advice was based should be updated (primarily by changing estimates of recruitment used in stock assessment forecasts). Depending on the outcome of these reviews, advice may or may not have been changes from the advice issued in spring. Unfortunately, the basis for decisions on whether or not to update assessment analyses and/or change advice was not always clear, and there were inconsistencies between stocks. Therefore, the ICES Advisory Committee (ACOM) agreed to prepare and consistently apply a transparent protocol to decisions on whether or not to reopening fisheries advice.

A protocol for reopening fisheries advice could be applied in many different situations, such as:

1) Stocks where the issuance of advice was changed from autumn to spring beginning in 2007 for which there are summer surveys which had contributed to fall advice before the change in timing;

2) Stocks for which additional scientific information becomes available after advice is issued, but before there are management decisions based on the advice; or

3) When there is an error in the process for preparing advice discovered after the advice is issued, but before there are management decisions based on the advice.

This report is not intended to comprehensively address the issues of the timing of advice relative to the annual cycle of data availability for all stocks and data sources. It addresses the need for a process for making decisions on whether or not fisheries advice for some specific stocks should be reopened in autumn of 2008. The specific stocks are those for which advice prior to 2007 was given in the autumn of the year, taking account of survey data that became available in summer of the year (Situation 1). In 2008, these are the only stocks that should be considered for reopening advice based on new summer survey information. As discussed later in this report, summer surveys are potentially most useful to estimate the size of incoming year classes for assessment forecasts.

If Situation 3 occurs, errors should be corrected, and decisions on whether or not the impact of an error is significant enough to merit reopening advice should be made on a case by case basis. In the longer term a more comprehensive protocol for within year decisions on reopening advice might be considered. It should be based on more thorough evaluation (including simulation testing) than was feasible for 2008.

To fulfil its Terms of Reference, the Group identified stocks that are candidates for reopening advice (i.e., Situation 1), reviewed statistical methods for evaluating the information content of summer survey data, prepared a protocols for making decisions on whether or not to reopen advice, and described a process for applying the protocol in 2008.

2 Consideration of candidate fisheries advice for reopening

As indicated in the previous section, the priority need for a protocol for reopening fisheries advice is for stocks where the issuance of advice was changed from autumn to spring beginning in 2007 and for which there are summer surveys which had contributed to autumn advice before the change (Situation 1). Therefore, all of the fisheries advice issued by ICES in the first half of 2008 was reviewed to determine which stocks fix Situation 1. The Situation 1 stocks are listed in Table 1. Stocks in the Barents/Norwegian Sea in the Icelandic and Faroese waters, widely distributed stocks, and herring stocks are not included because they are not Situation 1 although advice is given in spring and there may be relevant summer survey information.

The Table contains a description of summer surveys and the assessment process/methods in 2007. The column labelled "2007 test?" indicates whether the stock would be a candidate for application of the reopening screening methodology described later in this report. The method is applicable to advice that is based on an age structured forecast for the year of the advice. Thus the entries in the column are either "done" if the method was tested for 2007, could be done if there was a 2007 age structured forecast, or an indication why a test could not be done (e.g. no forecast). If there was a test performed, the result is given in the Column labelled "2007 results." The test result is given as a value of D, which will be described later in the report. The column labelled "Change in ICES 2007 Advice" indicates actual changes in advice that occurred in 2007 following evaluation of summer survey data. The column labelled "2008 assignment" indicates the recommended responsibility for screening 2008 summer survey data. This column will also be discussed later in the context of the recommended protocol.

Table 1. Stocks for which the timing of advice was changed from autumn to spring beginning in 2007, and for which data from summer surveys had been used as input to advice prior to 2007.

Stock	Survey	Sur-vey ages used	Assessment method	2007 test?	2007 results	Change in ICES 2007 advice	2008 assign-ment
Celtic Seas							
Cod VIIa (Irish Sea)	NIGFS-Oct UK(E&W) BTS	1	BAdapt	No forecast			NA
Cod VIIe-k (Celtic Sea Cod)	FR-EVHOE	1	Y	Done	D=0.96		NA[1)]
Haddock VIIa (Irish Sea)	NIGFS-Oct	--	SURBA	No forecast			NA
Haddock VIIb-k	FR-EVHOE	--	No assess	No forecast			NA
Whiting VIIa (Irish Sea)	NIGFS-Oct UK(E&W) BTS	--	No assess	No forecast			NA
Whiting VIIe-k	FR-EVHOE survey	1	XSA	Could be done			WGSSDS
Plaice VIIa (Irish Sea)	UKBTS Sept, IR-JPS	2	ICA	Could be done			WGNSDS
Celtic Sea Plaice (VIIf and g)	UK-BCCSBTS-S	1	XSA	Could be done			WGSSDS
Plaice VIIe (Western Channel)	WCBTS (October)	1–2 (RCT3)	XSA	Could be done			WGNSDS
Sole VIIa (Irish Sea)	UK BTS (September), Irish Juvenile Plaice Survey	2 (RCT3) 1 (RCT3)	XSA	Could be done			WGNSDS
Sole VIIf and g (Celtic Sea)	UK BTS (September)	1 (RCT3)	XSA	Could be done			WGSSDS
Sole VIIe (Western Channel)	WCBTS (October)	2 (RCT3)	XSA	Could be done			WGSSDS
Megrim in VIIb-k and VIIIa,b,d	UK-WCGFS-D FR-EVHOE	--	No assess	No forecast			NA
Anglerfish s in VIIb-k and VIIIa,b	FR-EVHOES	--	No assess	No forecast			NA

Stock	Survey	Survey ages used	Assessment method	2007 test?	2007 results	Change in ICES 2007 advice	2008 assignment
Cod VIa (West of Scotland)	ScoGFS-Q4	1	TSA	No forecast			NA
Haddock VIa (West of Scotland)	SCOQ4	1	TSA	No forecast			NA
Haddock VIb (Rockall)	SCOQ4	1	XSA	Could be done			WGNSDS
Whiting VIa (West of Scotland)	SCOQ4	--	SURBA	No forecast			NA
North Sea							
Cod in the Kattegat	IBTS Q3 Havfisken Q4	?	BAdapt	Could be done			WGBFAS
Cod in North Sea	IBTSq3	1–2	BAdapt	Done	Age 2: D=0.37	From zero to 22 000 t. total removals.	WGNSSK
Haddock in North Sea	ScoGFS, EngGFS	0–1	XSA	Done	SGFS age 0: D=0.52 SGFS+EGFS age 0: D=-0.55		WGNSSK
Whiting in North Sea	SCOGFS ENGGFS	0–1	XSA (2008)	No assessment in 2007			NA
Plaice IIIa	KASU Q4 IBTS Q3		No assessment	No forecast			NA
Plaice in North Sea	BTS-Isis BTS-Tridens SNS DFS	1–2	XSA	Done	Only BTS survey age 1: D=0.74 age 2: D=0.51	Increased from 26 to 35 tonnes	WGNSSK
Plaice VIId (Eastern Channel)	UK Beam Trawl Survey Q3 French GFS Q4 International YFS Q3	1–2	XSA	Could be done			WGNSSK

Stock	Survey	Survey ages used	Assessment method	2007 test?	2007 results	Change in ICES 2007 advice	2008 assignment
Sole in IV (North Sea)	BTS-Isis SNS DFS	1–2	XSA	Done	Only BTS survey: age1 : D=-0.75 age 2: D=0.67	Decreased from 13.9 to 9.8 tonnes	WGNSSK
Sole VIId (Eastern Channel)	UK Beam Trawl Survey International YFS Q3	1–2	XSA	Could be done			WGNSSK
Saithe in North Sea	IBTSq3 NorACU Q3	3	XSA	Could be done			WGNSSK
Bay of Biscay and Iberian							
Hake-Southern stock	Spanish GFS Q3 Portuguese GFS October	?	XSA Bayesian	No			NA
Megrim in VIIIc and IXa	UK-WCGFS-D FR-EVHOE	1–3	XSA	No			NA
Sole in VIIIa,b (Bay of Biscay)	FR-RESSGASC fourth quarter	2	XSA	Could be done			WGHMM
Widely distributed stocks							
Hake – Northern stock	FR-EVHOES	0–2	XSA	Could be done			WGHMM

1) Cod in VIIe–k does not qualify as Situation 1, but it is included in the Table because there was interest in reopening advice in 2007 based on the FR-EVHOE survey. However, 2008 advice on Celtic Sea cod should not be be considered for reopening because new survey data are not available until December. The proposed protocol for reopening advice calls for reopening decisions to be made earlier in the year.

The protocol recommended in this report is intended solely for the applicable stocks in Table 1.

One important conclusion from the Table of candidate stocks for reopening advice based on summer surveys is that survey information is most relevant to estimating the size of recruiting year classes used in the assessment forecasts.

3 Some general considerations for a protocol for reopening fisheries advice

The Group considered the conceptual basis for a protocol on whether or not to reopen fisheries advice. The advice issued in spring of the year reflects the information that was available when it was issued. If there is no new information (such as a summer survey), there is no reason to consider reopening advice (except for Situation 3 which is a special case as discussed above). The fact that a survey occurred does not necessarily mean that there is enough new information to reopen advice. A trivial example to illustrate the point is that advice on cod should not be reopened based on a survey for pelagic species which does not catch cod. However, judging the information content of a summer survey is not always trivial. There are usually two issues:

- Is survey information reliable? Resource surveys are not precise when it comes to measuring the relative abundance of a population. The issue is how much of a change from one survey to the next is a reliable indication that the abundance of the population has changed. The problem is to distinguish "signal" (real information about change) from "noise" (random variations) in survey data.
- Is the information new? Reliable information is not always new. The analyses conducted in spring might have used other sources of information to come to the same conclusion as they would have if they had summer survey data. For example, if fisheries advice is based on a spring assessment that estimates or assumes the size of a recruiting year class equals the long term average, a summer survey with a catch per tow of the recruiting year class equal to the survey average, probably does not add new information. The issue of the newness of summer survey information also depends on reliability. For the example just mentioned, whether or not a survey catch per tow 25% higher than the long term average is new information depends on the reliability of the survey data.

Therefore, the challenge is to design a protocol for reopening advice that has a sound statistical basis to judge if a summer surveys produce reliable new information indicating that the situation is different from the one indicated by the assessment that was used as the basis of spring advice. The statistical criteria (e.g. 95% confidence as is widely used in statistical tests, or a lower level that recognizes that fisheries data are typically not precise enough for this degree of confidence) used to test the reliability and newness of information is a judgement call. However, the criteria needs to be demanding enough so that advice is not reopened so often that the advantage of giving advice in spring is not undermined (see the discussion of this point in the Introduction).

A key source of uncertainty in fisheries management advice is the size of recruiting year classes. It is common for the size of recruiting year classes to be assumed based on the size of previous year classes. As indicated in Table 1, summer surveys usually provide information (often the first information) that is relevant to the size of recruiting year classes. Therefore, the Group decided that the protocol for reopening advice should be based on the reliable new information on the size of recruiting year classes.

The Group rejected the option of reopening advice based on an unexpected summer survey catch of year classes that were already recruited by 2008. Fisheries information and previous survey data on these year classes was available when spring advice was prepared. A summer survey that indicates that the size of recruited year classes is

significantly different than had been expected, usually means that there are inconsistencies in information. Resolving inconsistencies requires a more comprehensive and deliberate process than is practical in the time available. Typically, it requires waiting for the next survey to decide between conflicting sources of information.

4 Review of some methods to determine if summer surveys provide reliable new information

Three working papers describing statistical methods for analysing survey data were prepare for the meeting. One of the methods used catchability coefficients and their standard errors as estimated within assessment models to translate survey data into estimates of population size at age. If estimates of population size at age used in assessment forecasts are outside of the confidence intervals of estimates based on summer survey data, the summer survey data would be determine to contain reliable new information that could merit reopening advice.

Another working paper used a similar approach to the one described in the previous paragraph for data from the DATRAS survey database. However, instead of using catchability coefficients calculated within the assessment model, it rescaled survey catch per tow (by age) to the mean for the survey time-series. The confidence interval around the rescaled summer survey value is calculated using the estimated survey variance by bootstrapping (the standard procedure for the DATRAS database). As for the previous method, if the values used in assessment forecasts (also scaled by the mean of the time-series of year-class strengths at the age of recruitment) are outside the confidence intervals, there is a basis for reopening advice.

The third working paper method used a regression fit between survey data by age in spring of the year (which was available when spring advice was prepared) and summer survey data. If new summer survey data falls outside of the confidence intervals of the fitted regression line, it is deemed to contain different information from the information available in spring, and this could be used as a basis for reopening advice. The regression method could also be applied to estimates of recruitment from an assessment and data from a summer survey. If the recruitment value used in a forecast model is significantly different (i.e., outside of the confidence interval) from predicted recruitment according to the regression model, the summer survey would contain reliable new information justifying reopening advice.

During the meeting, the performance of the methods was tested by applying them to assessments used as the basis for spring 2007 advice and 2007 summer surveys. The methods are described in more detail in Appendix II, along with the results of tests run on 2007 data.

Conceptually, the three methods are similar. Some are more general than others. Although the first method's consistency between the assessment methodology and the evaluation of data from a summer survey is appealing, not all assessments have internally estimated catchability coefficients.

The three methods prepared in advance of the meeting were invaluable in shaping the Groups thinking, which lead to elaboration of another method during the meeting. As discussed earlier in this report, the Group recommends that 2008 spring advice be reopened if there is reliable new information from summer surveys that the size of a recruiting year class in 2009 is different from the estimated or assumed value used in 2009 assessment forecasts. The method proposed by the Group is referred the RCT3 method after the ICES software that is used to implement it. The method applies calibrated regression analysis for summer survey recruitment indices (Shepherd, J.G., 1997. Prediction of year-class strength by calibration regression analysis of multiple recruit index series. ICES Journal of Marine Science, 54: 741–752.).

The main advantages of the RCT3 method over the methods proposed in advance of the meeting are:

- It is generally applicable to the candidates for reopening advice based on summer survey information on recruiting year classes,
- It uses existing software that is readily available to the ICES community,
- It can be applied to a single survey or multiple surveys can be combined using inverse variance weighting,
- The statistical basis of the method is describe in the primary scientific literature,
- Software specifications can be standardized so that results are consistent and reproducible.

The RCT3 analysis gives a year-class strength prediction based on the survey information, and the standard error associated with the prediction. The difference between the assumed size of the recruiting year class in spring (before autumn surveys are available) and the RCT3 year-class strength estimates based on summer surveys, scaled to the internal standard error calculated by RCT3, is

$$D = \frac{R - A}{S} \qquad [1]$$

In this equation, R is the log Weighed Average Prediction from RCT3, A is the assumed year-class strength in spring assessment report, and S is the internal standard error from RCT3. Given recruitment series are indexed by j, and s is their respective standard error of an individual prediction, the internal standard error is defined as

$$S^2 = \left[\sum_j 1/s^2(j) \right]^{-1} \qquad [2]$$

based on the estimates of the individual standard errors by series. It represents a prior estimate of what we would expect the error of the final mean to be, taking account of the known errors of the individual estimates from which it is constructed (Shepherd, 1997).

It should be noted that this distance measure (D) in itself does not reflect the difference that updating the estimates would have on TAC advice. An estimate with a small distance can have a large effect on the TAC advice when used to update an assessment forecast and vice-versa. This depends on the population structure and the management system. However, a small distance means that it is unlikely that a summer survey provides reliable new information about recruitment. Why should advice be reopened to take account of nothing new and/or something unreliable? The fact that advice and management might be sensitive to summer survey data with a small D points to a management system (including the way advice is formulated) that amplifies noise rather than being robust. This is an important problem, but it cannot, and should not, be addressed through this protocol.

ICES expert groups often use the regression and weighing analysis in RCT3 in combination with its capability to weigh the estimates toward the assessment means. However, for the proposed for the protocol for reopening advice, the assessment mean estimation of the year-class strength should not be taken into account. Table 2 gives the specifications that should be used to standardize application of RCT3.

Table 2. Specification for standardizing application of RCT3.

Regression type?	C
Tapered time weighting required?	N
Shrink estimates toward mean?	N
Exclude surveys with SE's greater than that of mean:	N
Enter minimum log S.E. for any survey:	0.0
Min. no. of years for regression (3 is the default)	3
Apply prior weights to the surveys?	N

Several examples are given below for application of the method to stocks in Table 1 for which advice was given in spring 2007. The D values are given in the Table column labeled "2007 RESULTS." If there was a change in advice, it is indicated in the column labeled "CHANGE IN ICES 2007 ADVICE."

Haddock in the North Sea: Recruitment estimates in spring advice were based on the mean of past recruitments. Recruitment following a high year class had generally tended to be followed by a sequence of low recruitments. In order to take this feature into account, the average of the 5 lowest recruitment values over the period 1994–2003 was used by the expert group. This resulted in a recruitment estimate of 6269 million for 2007, 2008 and 2009 (age 0). In the RCT, the assessment estimates are in millions, so the log transformed estimate is 8.78. We take this as an estimate without variance.

At the time when the advice was reopened, only the SGFS0 survey data of 2007 was available. The RCT3 analysis results are as follows:

```
YC 2007  I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series          cept   Error          Pts  Value   Value    Error  Weights
SGFS0      .78   2.86    .72   .791      9   7.02    8.32     .877    1.000

                                Assessment Mean =    9.69    1.011     .000

Year     Weighted      Log     Int     Ext     Var
Class     Average      WAP     Std     Std    Ratio
          Prediction           Error   Error
2007        4122      8.32     .88     .00      .00
```

From this analysis, we can estimate the required distance to be (8.32–8.78)/0.88 = -0.52. Hence, the recruitment estimate from the survey is below the assumption done in spring, but well within 1 standard error of the prediction as calculated by the RCT3 software. The spring forecast used a value of 6494 million for age-0 in 2007, which was the mean of the five lowest age-0 abundance estimates in the time-series. The autumn forecast replaced this with a value of 7393 million from RCT3 (a 12% increase). The original value (6494 million) was retained in the forecast as a projection of age-0 abundance in 2008 and 2009, while older ages in 2007 were taken from XSA survivors' estimates. The results for landings, discards and subsequent SSB "represent a small change (less than 1%) in relation to the forecasts in May and as such do not merit reconsideration by ACFM" (ICES-WGNSSK 2007, p.607). For this reason the advice was not changed.

At the time the decision was made not to reopen 2007 advice, the English groundfish survey was not available. If it would have been available, the RCT3 analysis could have been done using both surveys. If this had been done, the results would have been as follows:

```
YC 2007  I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series          cept   Error          Pts  Value   Value    Error   Weights
EGFS0      .65   7.22    .18   .977     15   2.25    8.69     .205     .948
SGFS0      .78   2.86    .72   .791      9   7.02    8.32     .877     .052

                                       VPA Mean =    9.69    1.011     .000

Year     Weighted      Log     Int     Ext     Var     VPA      Log
Class     Average      WAP     Std     Std    Ratio             VPA
          Prediction           Error   Error
2007        5811      8.67     .20     .08      .16
```

It is apparent that the English Groundfish survey has a much better historical fit to the data. Hence, the EGFS gets most of the weight in the estimate and the internal standard error is much smaller. However, the distance does not change much, because the EGFS estimate is closer to the assumed value in May: (8.67–8.78) / 0.20 = -0.55.

Plaice in the North Sea: For plaice in the North Sea, two ages can be updated when autumn surveys become available: ages 1 and 2. Both cases will be described in turn. For age 1, spring estimate was 910 585 (log=13.72). This estimate was based on the geometric mean of age 1 in the assessment results. In autumn, the age 1 estimate of the BTS ISIS survey became available, and the RCT analysis of this survey data results in:

```
YC 2006  I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series          cept   Error          Pts  Value   Value    Error  Weights
BTS1     1.68   4.63    .80   .369     18   5.81   14.41     .879    1.000

                                     VPA Mean =   13.92     .598     .000

Year     Weighted      Log     Int     Ext     Var
Class     Average      WAP     Std     Std    Ratio
          Prediction           Error   Error
2006     1815466     14.41     .88     .00      .00
```

This leads to the conclusion that the BTS survey estimated the recruitment of age 1 higher than what was assumed in spring. However, compared to the standard error of the prediction, the distance is (14.41–13.72)/ 0.88 = 0.784.

For age 2, the estimate used in spring was based on the survivors of the assessment, being 403 208 (log transformed value is 12.90). The RCT analysis that can applied to the additional data from the BTS survey as follows:

```
YC 2005 I----------Regression---------I  I----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series          cept   Error          Pts  Value   Value    Error   Weights
BTS2       .87   9.38    .34   .755     19   4.27   13.09     .371    1.000

                                      VPA Mean =   13.64     .561     .000

Year     Weighted      Log     Int     Ext     Var
Class     Average      WAP     Std     Std    Ratio
          Prediction           Error   Error
2005      485712     13.09     .37     .00      .00
```

With the RCT3 estimate for year-class strength of age 2 based on the BTS Isis survey in autumn being 13.09, the distance is (13.09–12.90)/0.37 = 0.51. This is smaller than the distance for age 1. The Internal standard error is smaller than that of the estimate for age 1, but the difference between spring assumption and autumn estimate is also smaller.

In this case, it should be noted that both ages have the same (positive) sign. Thus the survey results in autumn were more optimistic about the year-class strength. The current process of evaluating if updating the advice is allowed does not account for this observation.

For the North Sea plaice, the advice was updated in autumn 2007, with the TAC advice going from 26 kt (in spring) to 35 kt (in autumn). This substantial update change would not have occurred if the procedure described here would have been followed unless a value of D implying a low probability of new information was allowed to trigger reopening of advice.

Cod in the Celtic Sea: In the spring advice of 2007, the year classes 2006 and upward were estimated to be 1633 thousand, based on a geometric mean of these year classes in the period 2002–2005. In autumn of 2007, the French EVHOE indicated a stronger year class. Note that advice on the Celtic Sea cod does not fall into situation 1 (as defined in Section 2) because the EVHOE survey had not been used in advice prior to the change in timing, and the results were not available at the time reopening advice was considered in autumn of 2007. Neverthess, the RCT3 approach was applied for illustrative purposes. The RCT3 output is:

```
YC 2007  I----------Regression---------I  I----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series          cept   Error          Pts  Value   Value    Error   Weights
EVHOE     4.07   6.94    .60   .620     10    .28    8.08     .705    1.000

                                      VPA Mean =    7.87     .723     .000

Year     Weighted      Log     Int     Ext     Var
Class     Average      WAP     Std     Std    Ratio
         Prediction           Error   Error
2007        3220      8.08     .71     .00      .00
```

From this output, the distance can be calculated to be (8.08-log(1633))/0.71 = (8.08–7.40)/0.71= 0.960. Although year-class estimate from the EVHOE survey is almost twice as large as the assumption that was used in spring, there is a large estimation error associated with this estimate.

Sole of the North Sea: As in plaice in the North Sea, ages 1 and 2 can be updated when autumn surveys become available. In spring of 2007, the recruiting age 1 was assumed to be 95 160 based on the geometric mean of the time-series. The log value is thus 11.46.

```
YC 2006 I----------Regression----------I  I----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series          cept   Error          Pts  Value   Value    Error   Weights
BTS1       .69   9.82    .37   .753     19   1.95   11.16     .404    1.000

                                      VPA Mean =   11.65     .624     .000

Year     Weighted      Log     Int     Ext     Var
Class     Average      WAP     Std     Std    Ratio
         Prediction           Error   Error
2006       70026     11.16     .40     .00      .00
```

The estimate of this year class from the BTS survey in summer is thus lower than the assumption made in spring. However, the difference is within the internal standard error (11.16–11.46)/0.4= -0.75

The log transformed estimate for age 2 in spring was 11.74, based on the XSA survivors. The RCT3 analysis results indicate that:

```
YC 2005 I----------Regression----------I  I----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series          cept   Error          Pts  Value   Value    Error   Weights
BTS2      1.12   8.68    .53   .594     20   3.08   12.13     .576    1.000

                                       VPA Mean =   11.52     .619     .000

Year     Weighted      Log     Int     Ext     Var
Class     Average      WAP     Std     Std    Ratio
         Prediction           Error   Error
2005      184646     12.13     .58     .00      .00
```

This leads to a distance estimate of (12.13–11.74)/0.58= 0.67 Thus, the estimate from the summer survey for age 2 is more optimistic than the spring assumption, but the absolute distance is smaller then for age 1.

There was a substantial TAC change between spring and autumn advice in 2007 from 13.9 to 9.8 tonnes. This change was based on using the RCT3 estimates for age 1 from the summer survey, while leaving the age 2 assumption unchanged.

Cod in the North Sea: In 2007, there was an update in the TAC advice in autumn. This update was triggered by high IBTS quarter 3 catches of age 2 cod. This is why this analysis focuses on age 2. However, the IBTS quarter 3 estimate that triggered the update was revised between autumn 2007 and spring 2008. Here we use the revised

estimate to test whether there would have been an update, given the correct IBTS q3 survey index if the threshold for revision of the advice being a distance > 1.

```
YC 2005 I-----------Regression----------I  I-----------Prediction---------I

Survey/  Slope  Inter-   Std  Rsquare  No.  Index Predicted   Std     WAP
Series           cept   Error          Pts  Value   Value    Error   Weights
IBTSQ3    1.09   9.55    .24   .898     16   1.97   11.70     .271    1.000

                                        VPA Mean =   11.32     .700     .000

Year     Weighted      Log     Int     Ext     Var     VPA      Log
Class     Average      WAP     Std     Std    Ratio             VPA
          Prediction           Error   Error
2005      120135     11.70     .27     .00      .00
```

The distance is thus 11.70–11.60/0.27 = 0.37. If a distance >1 rule would have been applied (as discussed below), no update TAC advice would have been issued. This example illustrates both the importance of having a statistically sound protocol to determine if there is reliable new information, and for adequate quality assurance of summer survey results before they are considered.

5 Recommended protocol for reopening spring 2008 fisheries advice when summer survey data provides reliable new information about recruitment

A key judgement that must be made, is how certain should ICES be that summer surveys provide reliable new information. In theory (assume normal statistics and that RCT3 estimates the internal standard error accurately), values of D can be interpreted as follows:

$-0.67 < D < 0.67$	means there is a 50% probability that there is new information
$-1.00 < D < 1.0$	means there is a 67% probability that there is new information
$-2.00 < D < 2.0$	means there is a 95% probability that there is new information

As discussed earlier in this report, it is important that the criteria used to trigger the reopening of advice be demanding enough (in terms of evidence that there is reliable new information) so that reopening is not common or frequent. Therefore the Group believes that there needs to be more than a 50:50 chance that there is new information, but it recognized that having 95% confidence (as is often used for statistical inferences) is to demanding for imprecise fisheries data. It recommends that reopening advice be triggered by a D value less than -1.0 or greater than 1.0.

The Group recommends the following protocol based on the discussion above and evaluation in the previous Sections of this report:

1) The appropriate Expert Group (according to Table 1, Column labelled "2008 Assignment") determines that 2008 summer survey data has been sufficiently quality assured to merit consideration as a basis for reopening advice. They document the steps that were taken to assure quality.

2) The appropriate Expert Group applies RCT3 (with the specification given in the previous Section) to predict the size of recruiting year classes in 2009 based on data from 2008 summer surveys.

3) The appropriate Expert Group calculates D according to Equation 1 using R and S form RTC3 (step 2) and A from the spring assessment.

4) If D is less than -1.0 or greater than 1.0, the process for reopening advice is triggered. If not, spring advice stands.

5) If reopening advice is triggered in step 4, the appropriate Expert Group updates assessment forecasts using the methodology deemed most scientifically appropriate by the expert group. In cases where the reopening of advice is triggered by recruitment that is higher than anticipated by the spring assessment, the trade-off between the short-term gain from increasing the catch in 2009 and the potential loss of catch in the medium term should be evaluated.

6) If reopening advice is triggered in step 4, the ACOM leadership designs a process to consider if spring 2008 advice should be changed to reflect the results of step 5.

7) If reopening advice is triggered in step 4, the appropriate Expert Group is available to responds to request from the ACOM leadership for additional information.

8) Following the process from step 6, ACOM decides if advice should be changed from the advice issued in spring, and it approves any changes in advice.

Steps 1–4 of the protocol should be completed as soon as possible so long as quality assurance is not neglected. When completed, the chair of ACOM should be informed if reopening advice has been triggered or not. The appropriate Expert Group must complete step 5 by October 15, 2008. The entire protocol through step 8 will be completed by November 14, 2008.

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Appendix II Methods to determine if summer surveys provide reliable new information

Expected survey value method using catchability coefficients from assessment models

The approach considers if summer survey information gives evidence that stock size is different form the spring assessment. The approach is to test if new survey results are outside the range of probable survey results.

1) From the latest assessment project the stock forward to the actual time of the summer survey.

2) Convert stock numbers to modelled survey values (using the model formulation from the latest assessment).

3) Apply some relevant survey uncertainty for setting upper and lower observed survey value as criteria for reopening advice.

The data needed is in most cases available in assessment working group reports. Few of the reported survey time-series contains direct estimates of survey uncertainty. Most assessments, however, give outputs with residuals between modelled and observed survey values, often reported as catchability residuals. Because these residuals reflect the way the surveys have been used in the particular assessment, uncertainties based on these residuals are relevant to our purpose. In many assessments the weighting between tuning fleets is strongly related to these residuals. Therefore, by using these uncertainty estimates there isn't a need for further consideration of how the tuning fleets are weighted in the actual assessment.

The experience is that such residuals tend to be closer to a lognormal than to a normal distribution. Thus it would be convenient to estimate uncertainty in the logarithmic domain (as is actually done in most assessment models). This leads to unsymmetrical error distributions for the predicted survey value.

The remaining question is how unlikely should the new survey result be to have a sufficient reason for making a new assessment and advice? How do we balance the risk of taking action (giving new advice) when it is not needed, and not taking action when it is needed?

Assuming the log-transformed data to be normally distributed, the following selected percentiles in the cumulative probability distribution of the predicted survey can be expressed as multiples of the estimated standard deviation (sd):

-2sd corresp to the 2.5 percentile

-1sd corresp to the 16 percentile

-0.67sd corresp to the 25 percentile

+0.67sd corresp to the 75 percentile

+1sd corresp to the 84 percentile

+2sd corresp to the 97.5 percentile

As a basis for evaluation these survey percentiles were calculated for the relevant summer surveys for the the 2007 and 2008 assessments of the North Sea stocks of cod, haddock and plaice.

For cod, B-adapt formulation is used for assessments, although haddock and plaice were assessed with the xsa-formulation. In nearly all cases the output gives, for each age group, the mean log q, (q = survey catchability) and SE_Log q (which is the sd of the log q residuals). The survey values (U) are in those cases modelled by:

> Log U = Log N + Log q, where N is the stock number at survey time. The exception was age 0 for haddock where q was modelled as cohort size dependant, in which case.
>
> Log U = (Log N – intercept)/ slope, where intercept and slope is estimated by regression. In this case the sd was not given in the output. The relevant value can be calculated as the residuals to the regression, but for this example it is just assumed equal to the maximum of the estimated SE for ages1–3.

The expected value (50-percentile) of the summer survey was calculated by the above equations, by using the N at survey time corresponding to the latest assessment. The various percentiles were estimated as Log U + X* SE_Log q, where X are the multiples listed above.

For 2007 the observed autumn survey values was compared to these percentiles of the predicted survey values: For cod the IBTS q3 survey value of age 3 was more than 1 sd away from the expected value. For haddock the EngGFSq3GOV survey value for age 0 and age 2 were more than 1 sd above and ages 5 and 7 were more than 1 sd below. The ScoGFSq3GOV for haddock was outside 1 sd for ages 3, 5, 6, 7. For plaice the BTS-Isis was more than 1 sd above for the ages 1, 3, 4, 5 and 6. If we only consider the two youngest ages and exclude the EngGFSq3GOV (that was not available for the 2007 revision process), the conclusion is that only plaice had a survey value outside 1 sd.

Here the final 2007 survey results have been used. At the actual update of advice in autumn 2007 only preliminary survey estimates were available. These differed somewhat from the final ones (particularly age 2 for cod), and the EngGFSq3GOV results were not available. In the 2007 updates the focus was on the recruits and in some cases (like cod and plaice) the following age group. This led to revision of the advice for cod and plaice.

Expected recruitment method using scaled data from DATRAS surveys

This analysis considers the DATRAS surveys as presented on the ICES website and only the incoming recruitment year class is considered in the form of an abundance index expected in the survey. If there is more than one summer survey, each survey is considered independently. The year class is considered irrespectively whether this year class contributes significantly to the yield prediction for the TAC year or not. However, the recruitment age is defined by the assessment groups that generally only include age-classes that are significant for the yield prediction.

The expected abundance index is derived from the year-class strength that is applied by spring advice. The basis for such estimates vary examples include using an average of recent years yearclass strength estimates, a long-term average, survey projections, estimates from fisheries, etc.

The expected index is compared to the observed index in a relative form

$$\left|\frac{\text{Observed} - \text{expected}}{\text{expected}}\right| > \text{Criterion}$$

The relative index obtained for the incoming year class shall differ more than 2 times the CV from the index implicit or explicit assumed in assessment that forms the basis for the advice.

The CV for an index is estimated in the bootstrap procedure that is standard in the DATRAS database. We calculate the average CV for the time-series (mostly 1991–2006) that we have available in the database for the relevant age group. Using the criterion

$$\left|\frac{\text{Observed} - \text{expected}}{\text{expected}}\right| > 2 * CV$$

we judge if the survey result indicates that the assessment should be reopened. Multiplying the CV by in intended to provide a small probability of reopening an assessment based on noise. The power of the criterion (probablility that a signal is missed) is unknown for this criterion.

The bootstrap procedure does not work well for stocks where the index is close to zero and the table includes a number of such examples, e.g. NS IBTS saithe and several of the EVHOE results. The results table includes these for consistency but it should obviously not be assumed that a trawl survey can provide accuracy in the order of 3% or even better. Annex I analyses the Celtic Sea Cod as an example of such a case.

The DATRAS database provides a graphical presentation of the accuracy in the form of the ratio $\frac{Index(75\%) - Index(25\%)}{Index(50\%)}$ for percentiles for the abundance index of 500 bootstraps. This is about 0.75*CV.

The results for the method described above for data from DATRAS databases are as follows

Survey	SpecCode	Genus	Family	IndexArea	AvgOfAge1	AvgOfCV_1	AvgOfAge_2	AvgOfCV_2
NS-IBTS	161722,00	Clupea	harengus	NS_Her	1245,55	0,30	502,52	0,27
NS-IBTS	161789,00	Sprattus	sprattus	NS_SpratIIIa	5122,79	0,54	722,27	0,50
NS-IBTS	161789,00	Sprattus	sprattus	NS_SpratIV	3036,67	0,33	1199,25	0,37
NS-IBTS	164712,00	Gadus	morhua	NS_Cod	17,75	0,21	5,44	0,17
NS-IBTS	164712,00	Gadus	morhua	NS_CodCat	69,97	0,31	9,72	0,36
NS-IBTS	164727,00	Pollachius	virens	NS_Saithe	6,07	0,00	3,72	0,14
NS-IBTS	164744,00	Melanogrammus	aeglefinus	NS_Had	475,72	0,12	199,49	0,13
NS-IBTS	164756,00	Trisopterus	esmarkii	NS_NorPout	2088,22	0,16	327,02	0,22
NS-IBTS	164758,00	Merlangius	merlangus	NS_Whit	502,32	0,20	205,79	0,19
NS-IBTS	172414,00	Scomber	scombrus	NS_Mack	59,52	0,34	40,07	0,29
NS-IBTS	172902,00	Pleuronectes	platessa	NS_PlaiceIIIa	25,83	0,53	42,48	0,45

Survey	SpecCode	Genus	Family	IndexArea	AvgOfAge1	AvgOfCV_1	AvgOfAge2	AvgOfCV_2
BTS	172902,00	Pleuronectes	platessa	BTS_Plaice-Isis	273,60	0,22	185,07	0,18
BTS	172902,00	Pleuronectes	platessa	BTS_PlaiceTridens	4,38	0,43	16,72	0,27
BTS	173001,00	Solea	vulgaris	BTS_Sole-Isis	28,27	0,29	15,07	0,21
BTS	173001,00	Solea	vulgaris	BTS_Sole-Tridens	0,26	0,47	0,89	0,37

Survey	SpecCode	Genus	Family	IndexArea	AvgOfAge1	AvgOfCV_1	AvgOfAge2	AvgOfCV_2
ALT-IBTS	164712,00	Gadus	morhua	SCO-CodVIa	6,68	0,04	6,50	0,08
ALT-IBTS	164727,00	Pollachius	virens	SCO-SaitheVIa	0,49	0,09	45,38	0,06
ALT-IBTS	164744,00	Melanogrammus	aeglefinus	SCO-HaddockVIa	1590,93	0,08	1033,83	0,09
ALT-IBTS	164756,00	Trisopterus	esmarkii	SCO-NorPoutVIa	5873,62	0,12	2739,90	0,22
ALT-IBTS	164758,00	Merlangius	merlangus	SCO-WhitingVIa	2232,54	0,06	912,09	0,10

Survey	SpecCode	Genus	Family	IndexArea	AvgOfAge_1	AvgOfCV_1	AvgOfAge_2	AvgOfCV_2
BITS	164712,00	Gadus	morhua	BS_CodEast	160,58	0,16	126,49	0,14
BITS	172894,00	Platichthys	flesus	BS_Flounder25	0,29	0,66	1,52	0,55

Survey	SpecCode	Genus	Family	IndexArea	AvgOfAge_1	AvgOfCV_1	AvgOfAge_2	AvgOfCV_2
EVHOE	164501,00	Lophius	piscatorius	EV_LopPisEV	1,08	0,11	0,36	0,09
EVHOE	164502,00	Lophius	budegassa	EV_LopBudEV	0,33	0,07	0,14	0,04
EVHOE	164712,00	Gadus	morhua	EV_CodCL	0,58	0,01	0,35	0,02
EVHOE	164758,00	Merlangius	merlangus	EV_WhitBB	2,49	0,10	0,75	0,12
EVHOE	164795,00	Merluccius	merluccius	EV_HakeEV	18,74	0,05	11,71	0,02
EVHOE	172835,00	Lepidorhombus	whiffiagonis	EV_MegEV	2,52	0,17	6,47	0,10

						2007,00				2008,00
Survey	Genus	Family	IndexArea	AvgOfAvgOfAge_1	AvgOfCV_1	Exp index	obs index	Obs/exp-1	Outside abs(2*CV) Y/N	Exp index
NS-IBTS	Clupea	harengus	NS_Her	1245,55	0,30					
NS-IBTS	Sprattus	sprattus	NS_SpratIIIa	5122,79	0,54					
NS-IBTS	Sprattus	sprattus	NS_SpratIV	3036,67	0,33					
NS-IBTS	Gadus	morhua	NS_Cod	17,75	0,21	12,01	9,08	-0,24	NO	13,32
NS-IBTS	Gadus	morhua	NS_CodCat	69,97	0,31					
NS-IBTS	Pollachius	virens	NS_Saithe	6,07	0,00	4,65	6,07	0,30	YES	4,81
NS-IBTS	Melanogrammus	aeglefinus	NS_Had	475,72	0,12	77,22	146,75	0,90	YES	51,97
NS-IBTS	Trisopterus	esmarkii	NS_NorPout	2088,22	0,16					
NS-IBTS	Merlangius	merlangus	NS_Whit	502,32	0,20	102,02	99,48	-0,02	NO	222,64
NS-IBTS	Scomber	scombrus	NS_Mack	59,52	0,34					
NS-IBTS	Pleuronectes	platessa	NS_PlaiceIIIa	25,83	0,53					

Survey	Genus	Family	IndexArea	AvgOfAvgOF_Age_1	AvgOfCV_1					
BTS	Pleuronectes	platessa	BTS_Plaice-Isis	273,60	0,22	239,71	333,86	0,39	NO	237,76
BTS	Pleuronectes	platessa	BTS_PlaiceTridens	4,38	0,43	3,83	28,96	6,55	YES	3,80
BTS	Solea	vulgaris	BTS_Sole-Isis	28,27	0,29	21,56	6,10	-0,72	YES	21,26
BTS	Solea	vulgaris	BTS_Sole-Tridens	0,26	0,47	0,20	0,00	-1,00	YES	0,19

Survey	Genus	Family	IndexArea	AvgOfAvgOfAvgOfAge_1	AvgOfCV_1	
ALT-IBTS	Gadus	morhua	SCO-CodVIa	6,68	0,04	3,58
ALT-IBTS	Pollachius	virens	SCO-SaitheVIa	0,49	0,09	
ALT-IBTS	Melanogrammus	aeglefinus	SCO-HaddockVIa	1590,93	0,08	361,14
ALT-IBTS	Trisopterus	esmarkii	SCO-NorPoutVIa	5873,62	0,12	
ALT-IBTS	Merlangius	merlangus	SCO-WhitingVIa	2232,54	0,06	

Survey	Genus	Family	IndexArea	AvgOfAvgOfAvgOfAge_1	AvgOfCV_1
BITS	Gadus	morhua	BS_CodEast	160,58	0,16
BITS	Platichthys	flesus	BS_Flounder25	0,29	0,66

Survey	Genus	Family	IndexArea	AvgOfAvgOfAge_1	AvgOfCV_1
EVHOE	Lophius	piscatorius	EV_LopPisEV	1,08	0,11
EVHOE	Lophius	budegassa	EV_LopBudEV	0,33	0,07
EVHOE	Gadus	morhua	EV_CodCL	0,58	0,01
EVHOE	Merlangius	merlangus	EV_WhitBB	2,49	0,10
EVHOE	Merluccius	merluccius	EV_HakeEV	18,74	0,05
EVHOE	Lepidorhombus	whiffiagonis	EV_MegEV	2,52	0,17

Regression analysis method

The approach is based on the assumption that new information from surveys in summer is all the more important the more different it is from assumptions used in assessment forecasts. The approach is to fix a regression between the size of year classes as calculated in the assessment (as the dependent variable) and the catch per tow of the year class by a summer survey in the year prior to recruitment (independent variable). Thus, the regression model could be used to input recruitment to the forecast for the year following the summer survey. The closer the values of recruitment used in a spring assessment forecast is to the recruitment predicted by the regression model, the less justification there is for reopening advice (i.e. the assessment working groups recruitment assumption was appropriate).

The regression is carried out for each relevant age group and each relevant survey. From these regressions the absolute residuals are extracted. The distribution of the absolute residuals is analysed for each age group by calculating the percentiles. If the residual for the assessment year is above a certain percentile (e.g. 75th percentile), the new information from the summer survey should be taken serious and a reopening of the advice should be considered. In a second step it has to be decided whether the age groups for which discrepancies are detected, contribute to a substantial part to total catches or SSB in the short-term forecasts relevant to negotiations on TAC in the year+1. A possible rule could be based on landings, total catch (landings and discards) or percentages of a year class recruited to fisheries and/or maturity ogives.

Some examples of the method for 2007 data were prepared for during the meeting. They are reviewed below.

North Sea haddock: The haddock assessment in 2007 used third quarter SGFS information for updating the recruitment-at-age 0 in September. The assessment in spring of 2007 had to make an assumption on the recruitment because no third quarter survey data were available. According to the analysis the assumed recruitment estimate was good enough to avoid a reopening of the advice. The assumed recruitment for 2007 is close to the regression line what means that the observed survey index in the third quarter SGFS in 2007 gives no new information (Figure 1). The residual for the 2007 data point is well below the 75th percentile. In addition, age 0 recruits in year y will not contribute much to the SSB and landings in year y+1.

North Sea plaice: In the assessment for North Sea plaice the third quarter BTS-Isis survey is used to update age 1 and age 2 estimates. In spring 2007 XSA estimates for age 2 had to be taken without any additional survey information. The age 1 recruitment was assumed to be at average level. For both age groups the residuals for the 2007 data point were below the 75th percentile threshold (Figure 2). By strictly applying the 75th threshold the assessment would be therefore not reopened. However, when looking at the regression for age 1 plaice the assumed year-class strength in the spring forecast was substantially underestimated in absolute terms (Figure 3). This means that the new survey information may be important, although the 75th percentile threshold was not reached because the relationship between survey index values and assessment results is weak in general. Only if deviations between assessment and survey can be interpreted fully as noise a strict application of the 75th percentile rule is justified. Otherwise the percentile threshold has to be reduced for regressions with very low R^2 values. The advice was reopened in 2007 and the new advice increased the TAC from 26 thousand to 35 thousand tones.

North Sea cod: The working group changed the advice in 2007 because of discrepancies observed for age 2 cod. When applying the regression analysis also a reopening is considered. The residual for 2007 is clearly above the 75th percentile threshold for

age 2. However, the index value was also revised after the new advice was given. With the adjusted survey value used in the regression analysis a reopening of the advice would be no longer necessary.

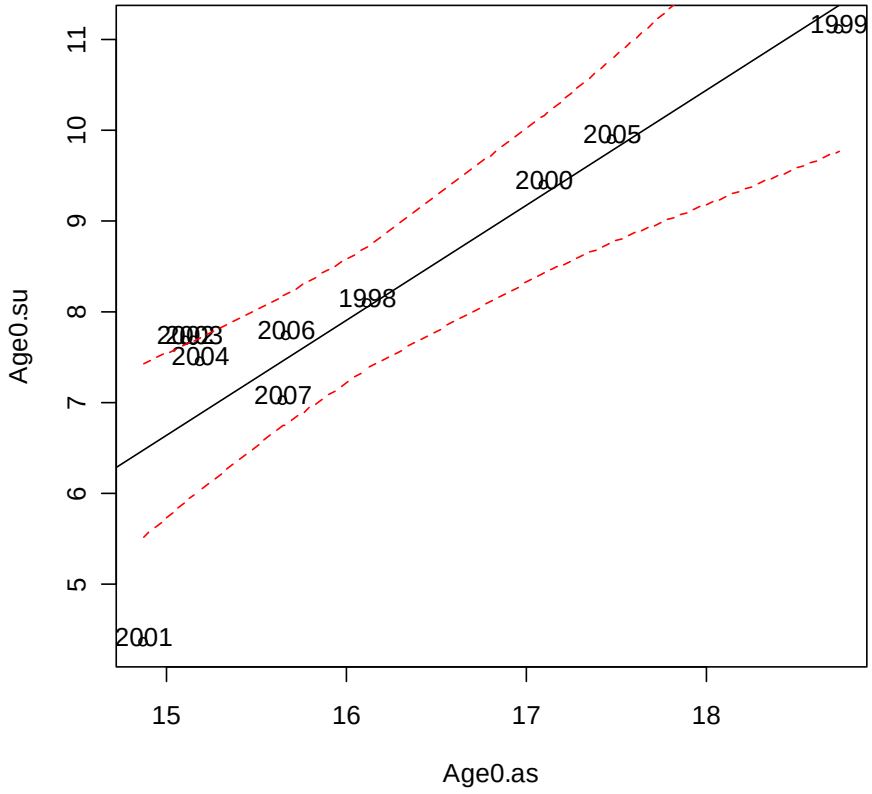

Figure 1. Regression between the logarithm of age 0 SGFS survey index values and the logarithm of age 0 assessment estimates. The data pair for 2007 consists of the recruitment estimate used in the forecast and the third quarter survey estimate. The dotted lines indicate the 95% confidence interval.

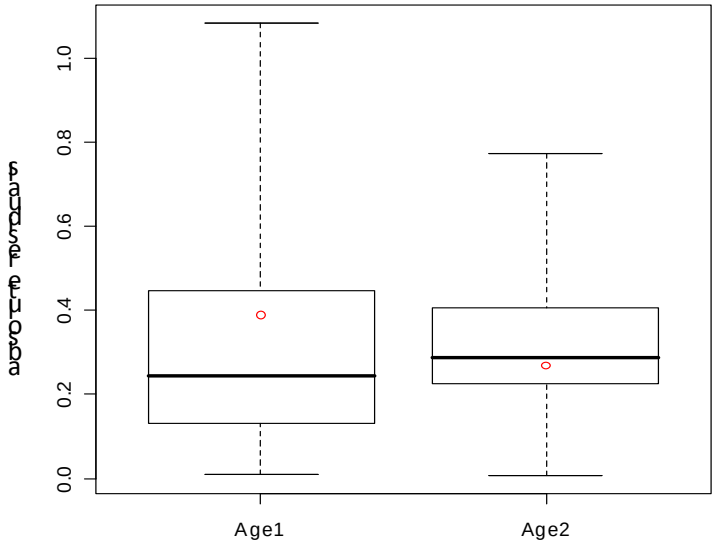

Figure 2. Distribution of the absolute residuals for the regression carried out for age 1 and age 2 plaice. The red circle marks the 2007 data point.

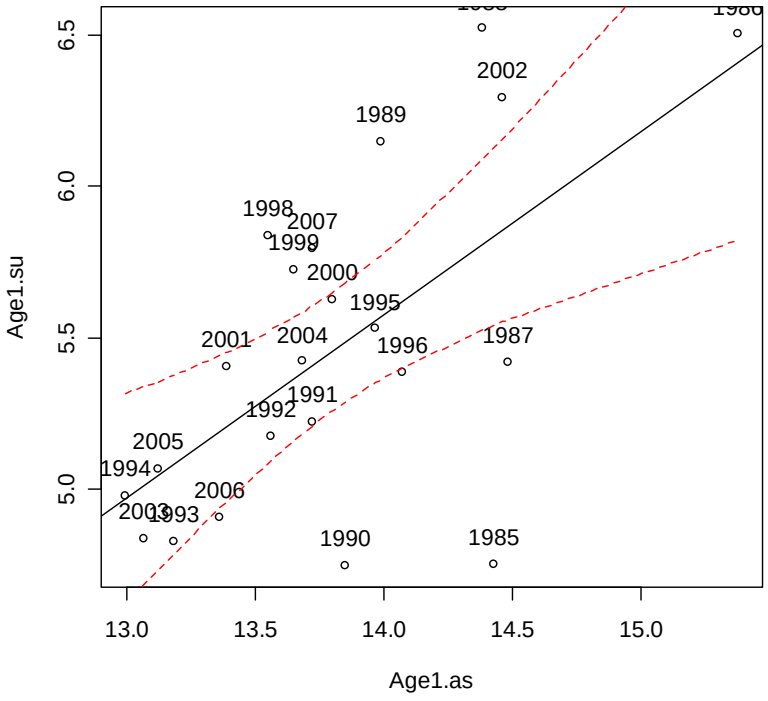

Figure 3. Regression between the logarithm of age 1 survey index values and the logarithm of age 1 assessment estimates. The data pair for 2007 consists of the recruitment estimate used in the forecast and the third quarter survey estimate. The dotted lines indicate the 95% confidence interval.