Report of Whiting
(*Merlangius merlangus*)
otolith exchange 2014 - 2015

by

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1. Introduction

Whiting are generally regarded as the most difficult gadoid species to age due to problems determining true annuli. The last exchange and workshop was carried out in 2005 (FRS, Scotland & Cefas, England) (Easey, M *et al* 2005). It was therefore a recommendation of The Planning Group on Commercial Catch, Discards and Biological Sampling (PGCCDBS), that another otolith exchange should be carried out on this species.

The objective of the exchange was to estimate precision and relative/absolute bias in the age estimates of readers from a number of institutes. The majority of institutes use slides as a reading method, with one institute using the break and burn technique. However, to prevent confusion it was decide to stick with the majority technique of using slides and photographs on WEBGR (Web services for support of Growth and Reproduction Studies).

2. Participants

Reader	Firstname	Lastname	Institution	Country	Experience
1	Tom	Woods	CEFAS	United Kingdom	Expert
2	Jean Louis	Dufour	IFREMER	France	Expert
3	Betty	van Os	IMARES	Netherlands	Trainee
4	Fiona	Woods	Marine Institute	Ireland	Expert
5	Ian	McCausland	The Agri-Food & Biosciences Institute	United Kingdom	Expert
6	Ines	Wilhelms	Johann Heinrich von Thünen Institute	Germany	Expert
7	Helle	Rasmussen	DTU Aqua	Denmark	Expert
8	Hildegunn	Mjanger	Institute of Marine Research	Norway	Expert
9	Ilse	Maertens	Guest	Belgium	Expert
10	Selene	Hoey	Marine Institute	Ireland	Trainee
11	Imelda	Hehir	Marine Institute	Ireland	Expert
12	Gary	Burt	CEFAS	United Kingdom	Trainee
13	Gordon	Henderson	Marine Scotland	United Kingdom	Expert
14	Lisbet	Solbakken	Institute of Marine Research	Norway	Expert
15	Gerrit	Rink	IMARES	Netherlands	Expert
16	Friederike	Beußel	Johann Heinrich von Thünen Institute	Germany	Expert

Trainees were excluded from the final results but can be seen in Appendix IV

Contact addresses, names and e-mails of the organizers and participants are given in Appendix I.

3. Otolith collection

In total 135 whiting otoliths/photos ([Table AII.1](#)) were used in the exchange collected from areas IVb, VIIe, VIIg, throughout quarter 1 and 4s. Otoliths were used from 2010 and 2013 to obtain a range of samples across the areas and months.

Images were taken by Cefas and the Marine Institute using 16 x megapixels camera microscope. WEBGR was used to upload the otoliths and data, ready for readers to add their annotations.

3.1. Reading procedure

The otoliths were read following the guidelines in 'PGCCDBS Guide to exchanges'. The readers used the otoliths and photos to estimate an age and then annotated them on WEBGR. Each otolith had associated data including; length, sex, maturity and date of capture.

3.2. Datasheet

Datasheets were included on WEBGR for all users to access. The results were analysed using 'The AGE COMPARISON.XLSX excel workbook (by Guus Eltink, RIVO, Ijmuiden, The Netherlands)' and interpreted into this report (Eltink *et al.* 2000).

3.3. Time table

A timetable was created giving each institute one week to carry out the age estimation and the annotations on WEBGR. With a few changes to the schedule the time table ran from August 2014 – May 2015.

3.4. WebGR

WebGR is a European project that aids the development and organisation of online calibration workshops. The software uploads images of the whiting otoliths and gives participants the ability to annotate their age estimations.

All readers received a WebGR user manual and a quick-read manual. When all annotations were completed, a csv-file with the results was extracted and the data inserted into an excel sheet for analysis.

4. Results

There were sixteen readers, from ten institutes taking part in the otolith exchange.
Of the sixteen individuals thirteen were experienced readers and three were being trained (readers 3, 10 &12) in this species. This was maybe apparent in trainee 3's results (48 %) but not with the other two trainees (readers 10 & 12), who had fairly high agreements (67, 78%). Following recommendation from WGBIOP all trainee readers were removed from the final results. Removing these individuals increased the overall agreement rate slightly from 73 to 75 %. Appendix II shows the details, modal age, percentage agreement, CV of each otolith and the age estimation by each participant. Appendix IV shows the results including the trainees.

In Table AII.1 (Appendix II Table 1) modal ages were calculated for each otolith read, along with percentage agreement, mean age and precision CV, where percentage agreement = 100 x (no. of readers agreeing with modal age / total no. of readers) for each otolith and precision CV = 100 x (standard deviation of age readings/ mean of age readings) for each otolith. Overall percentage agreement ranged from 36 to 94 %, with an average of 75 % Out of the 135 otoliths 58 were read with at least 80 % agreement and 6 at 100% agreement. The overall precision CV ranged from 0% (corresponding to 100% agreement in readings) to 33%, with an average of 13%. Five participants read all of the 135 otoliths in the exchange, with the other eleven reading between 132 to136. Fish number 25 and 7 seemed to cause a problem for readers (38 % agreement) with ages estimated between 4 – 7 (modal age 7) and 3-7 (modal age 5) respectively (Appendix III). Both the images of these otoliths seemed to be of a good quality so it is likely to be the otolith features that are causing variation in the age estimates.

Table AII.2 examines the readings of individuals at each modal age and summarises the number of otoliths read, the precision CV, percentage agreement and relative bias of each reader. Percentage agreement showed eight readers reached at least 80% agreement, a further two exceeded 75%, whilst remaining three ranged between 34 and 58%. The lowest agreement came from reader 5 (34 %), this seemed to be due to underestimation of ages (see relative bias table). The highest agreement came from IFREMER (Reader 2 96%) and the Marine Institute (Reader 4 90 %). Four readers had CV below 10%, seven readers had CV between 10 and 15% and the remaining two had CV between 15-20%.

Figure AII.1 is a graphical representation of the relative bias table in Table AII.2.The relative bias tables demonstrate the difference between the mean age for each age group and the modal age for each age group. In these age bias plots any deviation of the points from the solid line indicates a bias when the reader's age estimates are compared with the modal age. Points above and below the line indicate a positive and negative bias, respectively. The vertical bars are drawn plus and minus two standard deviations from the mean age. Short bars indicate consistency of reading at a given modal age. Readers 4, 6, 7, 8, 11, 14 and 16 show positive relative bias by overestimating the age relative to modal age, while the other 7 readers underestimated ages. Individually the relative bias varied between + 0.54 to -0.64. Negative bias increased with fish age.

Figure AII.2 are graphical representations of the coefficient of variation and percentage agreement tables in Tables AII.2. Overall ranking showed readers 2 and 4 in the top two positions for CV, percentage agreement and relative bias. Readers 5 and 7 were the lowest ranking individuals taking part in the exchange.

Figure AII.3 shows the distribution of the age reading errors in percentage by modal age as observed from the whole group of age readers in an age reading comparison to modal age.

Table AII.3 shows the age compositions and the mean length-at-age obtained by each reader and all readers combined and also the "inter-reader bias test" and the "reader against modal age bias test". Reader 5 showed trends in the length classes indicating underestimation of age at length (see Mean length at age table in Table AII.3 and Figure AII.5). There were no other clear trends where length classes were over/under estimated.

The "inter-reader bias test" is presented in the bottom panel of Table AII.3. When comparing each reader to modal age, the percent showing certainty of bias, possible bias and no bias were 69, 0 and 31 percent respectively. There was no clear bias seen between readers, within institutes or between experts and trainees. However readers 5 & 7 did have high bias compared to all other readers.

The age readings are summarised by month of sampling in Table AII.4. Samples were obtained from all four seasons. Highest percentage agreement was found for samples collected in May and February, while samples from September/October had lower agreements. CV didn't vary much between seasons and there was no significant pattern in relative bias by month. There did

not seem to be a great difference in agreement between areas, ranging from 74% (IVb), 79 % VIIg and 77 % VIIe and institutes did not favour certain areas. Relative bias indicated underestimation of ages in area IVb and overestimation in VIIe & VIIg.

5. Conclusion/Recommendations

The percentage agreement across expert readers in the exchange was 75 %, which is higher than expected but lower than the previous exchange (81%) and the recommended level (90%). Nine readers also took part in the 2005 exchange, with five showing an improvement in agreement percentage. This value (75 %) does not improve greatly when the reader who uses a different technique (whole/burnt) is removed. This reader's percentage agreement was very low (46 %) and this may have been because they were unfamiliar with using slides (reader 7). Another reader (reader 4) with low agreement (33 %) seemed to be underestimating most of the otoliths by 1 year. For all readers agreement decreased with increased age estimation.

Percentage agreement lows and highs seemed to be similar for readers within the same institute, this is probably due to reading technique being passed down from expert to trainee within institutes. This highlights the importance of these international exchanges in ensuring that age reading techniques remain consistent across all institutes.

The overall percentage agreement was lower than in the 2005 exchange (81 %) and there were a number of disagreements between readers. Therefore, following this exchange and recommendation from WGBIOP 15 there will be a workshop (**WKARWHG2,** Lowestoft, 2016) to address the issues and combine knowledge on the best way to age this species. It was highlighted at WGBIOP that there is currently an issue with ageing whiting in area IIIA. It is unfortunte that this was not communicated before the exchange took place, however there will be a small calibration exercise at the workshop to address this.

6. Acknowledgements

The exchange was made possible due to the cooperation and participation of all ten institutes. Thanks are due especially to the Marine institue, Cefas and ILVO for prepartion of the images and to those who helped guide me in setting up the exchange and using WEBGR.

7. References

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Appendix II Guus Eltink spreadsheet data analyses for expert readers

Table AII.1

Stratum	year	no	Fish no	Fish length	Sex	Landing month	Tom Reader 1	Jean Louis Reader 2	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegurn Reader 8	Ilse Reader 9	Imelda Reader 11	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	modal age	Percent agreement	Precision CV
VIIG	2010	24205	WG 1	51	-	1	4	4	4	2	4	5	4	4	4	4	4	4	4	4	85%	16%
VIIG	2010	24205	WG10	45	-	1	5	5	5	4	5	5	5	5	5	5	5	5	5	5	92%	6%
IVB	2013	12623	WG134	28	-	7	2	2	2	1	2	2	2	2	2	2	2	1	2	2	85%	20%
IVB	2013	12623	WG135	29	-	7	3	3	3	2	3	3	3	3	3	3	3	3	3	3	85%	13%
IVB	2013	12623	WG136	29	-	7	3	3	3	3	3	3	3	3	3	4	2	3	3	3	77%	17%
IVB	2013	12623	wg 137	30	-	7	3	3	3	2	3	3	3	-	3	3	3	3	3	3	83%	14%
IVB	2013	12623	wg 138	30	-	7	4	4	4	3	4	4	4	4	4	3	4	3	4	4	77%	12%
IVB	2013	12623	wg 139	31	-	7	3	3	3	2	3	3	3	3	3	2	3	2	3	3	77%	16%
IVB	2013	12623	wg 150	31	-	7	3	3	3	3	3	4	4	3	3	4	3	3	3	3	77%	14%
VIIE	2010	65505	wg 151	35	-	1	3	3	-	3	3	3	3	3	3	3	3	3	3	3	100%	0%
VIIG	2010	24231	wg 17	36	-	1	3	3	3	3	3	3	5	3	3	3	5	3	3	3	85%	23%
VIIG	2010	24231	wg 18	39	-	1	3	3	3	3	3	4	4	3	3	3	4	3	3	3	77%	14%
VIIG	2010	24231	wg 19	31	-	1	2	2	2	2	3	3	3	4	3	3	3	3	3	2	54%	21%
VIIG	2010	24205	wg 2	38	-	1	4	3	3	3	3	3	4	3	4	3	3	3	3	3	77%	14%
VIIG	2010	24231	wg 20	29	-	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	100%	0%
VIIG	2010	25351	wg 21	34	-	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	92%	7%
VIIG	2010	25351	wg 22	38	-	4	5	5	5	3	5	5	5	5	5	5	5	5	5	5	92%	11%
VIIG	2010	25351	wg 23	40	-	4	6	6	6	4	7	7	6	6	6	6	6	6	7	6	69%	12%
VIIG	2010	25351	wg 24	42	-	4	4	4	4	4	4	5	5	5	4	4	4	6	5	4	62%	15%
VIIG	2010	25351	wg 25	38	-	4	5	6	6	4	7	7	7	5	7	5	7	6	7	6	46%	17%
VIIG	2010	25351	wg 26	42	-	4	6	6	6	6	6	6	7	6	6	6	7	6	6	6	62%	14%
VIIG	2010	25351	wg 27	34	-	4	4	4	4	4	4	4	5	4	4	4	4	4	4	4	92%	7%
VIIG	2010	25351	wg 28	40	-	4	5	5	5	4	5	5	5	5	5	5	5	5	5	5	85%	8%
VIIG	2010	25547	wg 29	37	-	5	3	3	3	3	3	3	3	4	3	3	3	3	3	3	92%	9%
VIIG	2010	24205	wg 3	51	-	1	7	7	7	5	6	8	-	7	7	6	7	7	7	7	58%	12%
VIIG	2010	25547	wg 30	37	-	5	4	4	4	3	4	4	4	4	4	4	4	4	4	4	92%	7%
VIIG	2010	25547	wg 31	33	-	5	3	3	3	2	3	3	3	3	3	3	3	3	3	3	92%	9%
VIIG	2010	25547	wg 32	39	-	5	3	3	3	3	3	3	5	3	3	3	5	3	3	3	85%	23%
VIIG	2010	25547	wg 33	39	-	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	100%	0%
VIIG	2010	25547	wg 34	31	-	5	3	3	3	3	3	3	3	3	3	3	-	3	3	3	92%	9%
VIIG	2010	25547	wg 35	33	-	5	3	3	3	2	3	3	3	3	3	3	3	3	3	3	92%	9%
VIIG	2010	25547	wg 36	31	-	5	3	3	3	3	4	4	3	3	3	3	3	4	4	3	69%	15%
VIIG	2010	26351	wg 37	32	-	9	2	2	2	2	2	2	2	2	2	2	2	2	2	2	100%	0%
VIIG	2010	26351	wg 38	35	-	9	3	4	4	2	4	4	3	3	2	3	4	4	4	4	46%	23%
VIIG	2010	26351	wg 39	43	-	9	3	3	3	2	3	3	4	3	4	3	4	3	3	3	69%	18%
VIIG	2010	24205	wg 4	47	-	1	4	4	4	3	4	5	4	4	4	4	4	4	4	4	85%	10%
VIIG	2010	26351	wg 40	30	-	9	2	2	2	2	2	3	2	2	2	2	3	3	4	2	54%	26%
VIIE	2010	65505	wg 41	31	-	1	2	2	2	2	2	3	2	2	2	2	3	3	2	2	69%	21%
VIIE	2010	65505	wg 42	33	-	1	4	3	3	3	3	4	4	3	3	4	4	4	3	3	54%	15%
VIIE	2010	65505	wg 43	34	-	1	3	4	4	3	4	4	4	4	4	4	4	4	4	4	85%	10%
VIIE	2010	65505	wg 44	35	-	1	3	3	4	3	3	4	4	4	3	4	4	4	3	3	54%	15%
VIIE	2010	65505	wg 45	35	-	1	4	4	4	3	5	5	4	4	4	4	4	3	5	4	62%	16%
VIIE	2010	65505	wg 46	35	-	1	2	2	2	2	3	3	-	2	2	2	-	2	3	2	73%	21%
VIIE	2010	65505	wg 47	37	-	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	100%	0%
VIIE	2010	65505	wg 48	37	-	1	7	7	7	6	8	8	7	7	7	7	8	8	8	7	46%	9%
VIIE	2010	65505	wg 49	44	-	1	4	4	4	4	5	5	6	4	4	4	7	4	5	4	62%	21%
VIIG	2010	24205	wg 5	47	-	1	4	4	4	4	4	5	5	4	4	4	5	4	4	4	77%	10%
VIIE	2010	65505	wg 50	45	-	1	6	6	6	4	6	6	6	5	6	6	6	6	6	6	85%	10%
VIIE	2010	65505	wg 51	45	-	1	3	4	3	4	4	6	5	3	3	4	5	4	4	4	46%	23%
IVB	2013	10189	wg 52	26	-	4	3	3	3	3	3	4	2	3	3	2	3	2	3	3	69%	19%
IVB	2013	10189	wg 53	27	-	4	3	3	3	2	3	4	3	3	3	3	3	3	4	3	77%	16%
IVB	2013	10189	wg 54	28	-	4	3	3	3	3	4	3	3	2	2	2	3	4	3	3	69%	19%
IVB	2013	10189	wg 55	29	-	4	3	3	3	2	3	3	3	3	3	3	4	3	3	3	85%	14%
IVB	2013	10189	wg 56	30	-	4	3	3	4	2	3	4	3	3	3	3	3	3	4	3	69%	18%
IVB	2013	10189	wg 57	34	-	4	5	5	4	3	5	6	5	5	4	5	5	5	6	5	62%	17%
IVB	2013	10189	wg 58	36	-	4	5	5	5	4	5	6	5	5	5	5	5	6	5	5	77%	10%
IVB	2013	10189	wg 59	38	-	4	6	6	6	5	6	6	6	6	6	6	6	6	6	6	92%	5%
V11G	2010	24205	wg 6	41	-	1	4	3	3	3	4	5	3	3	3	3	4	3	3	3	69%	19%
IVB	2013	13063	wg 60	34	-	8	3	3	3	3	4	3	3	3	2	3	2	3	3	3	77%	17%
IVB	2013	13063	wg 61	33	-	8	-	3	-	3	-	3	3	-	-	-	3	-	3	3	100%	0%
IVB	2013	13063	wg 62	33	-	8	4	3	4	3	4	5	3	4	4	3	3	2	4	4	46%	19%
IVB	2013	13063	wg 63	30	-	8	4	4	4	5	3	4	4	3	4	3	2	4	4	4	46%	23%
IVB	2013	13063	wg 64	32	-	8	3	3	3	2	3	3	3	3	3	3	2	3	3	3	85%	13%
IVB	2013	13063	wg 65	38	-	8	6	6	6	4	6	6	6	6	6	6	6	6	6	6	92%	9%
IVB	2013	13063	wg 66	34	-	8	4	4	5	3	5	5	5	4	5	4	5	4	5	5	54%	15%
IVB	2013	13063	wg 67	31	-	8	3	3	3	2	3	3	3	3	3	3	3	2	3	3	77%	16%
IVB	2013	13063	wg 68	32	-	8	3	3	3	3	3	4	3	3	3	3	3	2	3	3	77%	17%
IVB	2013	13063	wg 69	29	-	8	3	3	3	3	3	3	3	3	3	2	3	3	3	3	85%	13%
V11G	2010	24205	wg 7	41	-	1	4	5	4	6	7	6	5	5	4	4	5	4	6	6	38%	19%
IVB	2013	13063	wg 70	36	-	8	6	6	6	5	6	7	6	6	6	6	6	5	6	6	77%	8%
IVB	2013	13107	wg 71	36	-	9	4	4	4	3	4	5	4	3	4	4	3	4	4	4	62%	16%
IVB	2013	13107	wg 72	34	-	9	6	6	7	4	7	7	7	6	7	5	7	6	7	7	54%	15%
IVB	2013	13107	wg 73	34	-	9	7	7	7	5	7	7	7	7	7	6	7	6	7	7	77%	9%
IVB	2013	13107	wg 74	35	-	9	4	4	4	3	4	5	4	4	4	4	4	4	5	4	77%	12%
IVB	2013	13107	wg 75	32	-	9	3	3	3	2	3	3	3	3	4	3	3	2	3	3	85%	13%
IVB	2013	13107	wg 76	33	-	9	3	3	3	2	3	3	3	3	4	3	3	3	4	3	77%	16%
IVB	2013	13107	wg 77	38	-	9	4	4	4	3	4	4	4	4	4	4	4	4	4	4	92%	7%
IVB	2013	13107	wg 78	38	-	9	7	7	7	5	7	8	7	7	7	7	7	7	7	7	85%	9%
IVB	2013	13107	wg 79	41	-	9	3	3	3	3	5	3	3	3	2	3	4	3	4	3	69%	22%
IVB	2010	24205	wg 8	45	-	1	4	4	4	3	4	4	4	4	4	4	3	4	4	4	92%	7%
IVB	2013	13107	wg 80	41	-	9	4	4	4	3	4	6	4	4	4	4	5	3	4	4	69%	19%
IVB	2013	13107	wg 81	35	-	9	7	7	7	4	7	8	7	6	7	7	7	6	7	7	69%	14%
IVB	2013	13107	wg 82	37	-	9	5	6	6	5	6	7	6	6	6	6	6	5	6	6	69%	9%
IVB	2013	13107	wg 83	31	-	9	3	3	3	2	3	4	3	3	3	3	3	2	3	3	77%	17%
IVB	2013	13107	wg 84	32	-	9	7	7	8	6	8	8	8	7	8	7	8	7	9	8	46%	10%
IVB	2013	13107	wg 85	31	-	9	3	4	4	4	4	4	4	4	4	3	4	3	4	4	85%	10%
IVB	2013	13107	wg 86	43	-	9	4	3	4	2	3	4	4	3	3	3	3	2	3	3	54%	22%
IVB	2013	13107	wg 87	40	-	9	6	6	6	4	6	6	6	6	6	5	6	5	6	6	77%	11%
IVB	2013	13107	wg 88	43	-	9	5	5	6	4	6	6	6	5	6	6	5	4	5	6	46%	14%
IVB	2013	13107	wg 89	27	-	7	2	2	2	2	2	2	2	2	2	2	1	2	2	2	92%	14%
VIIG	2010	24205	wg 9	38	-	1	4	4	4	3	4	5	4	4	4	3	4	4	4	4	77%	13%
IVB	2013	12627	wg100	31	-	7	6	6	6	4	6	7	6	6	6	6	6	5	6	6	77%	12%
IVB	2013	12627	wg101	31	-	7	2	2	2	2	3	3	3	2	3	2	3	2	6	6	54%	21%
VIIE	2013	9745	wg102	59	-	2	6	6	6	6	7	7	6	6	6	6	6	6	6	6	85%	6%
VIIE	2013	9745	wg103	54	-	2	7	7	7	7	7	8	7	-	7	7	7	6	7	7	83%	6%
VIIE	2013	9745	wg104	52	-	2	6	6	6	5	6	7	6	6	6	6	6	6	6	6	85%	7%
VIIE	2013	9745	wg105	49	-	2	4	4	4	5	4	4	4	-	4	4	4	4	4	4	92%	7%
VIIE	2013	9745	wg106	47	-	2	4	4	4	4	3	6	3	3	4	-	4	4	3	4	50%	23%
VIIE	2013	9745	wg107	45	-	2	6	6	6	5	6	7	6	6	6	6	6	6	6	6	85%	7%
VIIE	2013	9745	wg108	43	-	2	4	4	4	3	4	4	4	4	4	4	4	4	4	4	92%	7%
VIIE	2013	9745	wg109	40	-	2	4	4	4	4	4	5	4	4	4	4	4	4	4	4	92%	7%
VIIE	2013	9745	wg110	38	-	2	6	6	6	4	6	7	6	6	6	6	6	6	6	6	85%	11%
VIIE	2013	9745	wg111	37	-	2	4	4	4	4	4	5	4	4	4	4	4	4	4	4	92%	7%
VIIE	2013	9745	wg112	35	-	2	4	4	4	5	4	5	4	4	4	4	4	4	4	4	85%	9%
VIIG	2013	9745	wg113	33	-	2	4	4	4	4	4	5	4	4	4	4	4	4	4	4	92%	7%
VIIE	2013	9745	wg114	33	-	2	3	3	3	3	3	4	3	3	3	3	3	2	4	3	77%	16%
VIIE	2013	9745	wg115	32	-	2	3	3	3	3	3	3	4	3	3	3	3	2	3	3	92%	9%
VIIH	2013	13886	wg116	52	-	10	5	5	5	4	5	4	5	6	5	-	5	4	5	5	67%	12%
VIIH	2013	13886	wg117	50	-	10	4	4	4	5	3	4	4	3	4	4	4	3	4	4	69%	14%
VIIH	2013	13886	wg118	40	-	10	4	4	4	4	4	4	3	4	3	4	4	3	4	4	62%	14%
VIIH	2013	13886	wg119	43	-	10	7	8	10	7	9	8	8	8	9	7	8	7	9	8	38%	12%
VIIH	2013	13886	wg120	38	-	10	3	3	3	4	3	4	3	3	4	3	3	3	4	3	69%	9%
VIIH	2013	13886	wg121	42	-	10	3	3	3	4	3	4	3	3	4	3	3	3	4	3	69%	15%
VIIE	2013	13886	wg122	24	-	7	4	4	4	4	4	4	4	4	4	4	4	4	5	4	92%	19%
VIIE	2013	12270	wg123	39	-	7	4	4	4	4	4	4	4	4	4	4	4	4	5	4	92%	7%
VIIE	2013	12270	wg124	39	-	7	3	3	3	4	3	3	3	3	3	3	3	3	3	3	92%	9%
VIIE	2013	12270	wg125	38	-	7	2	2	2	3	2	2	3	3	3	2	3	2	3	2	54%	21%
VIIE	2013	12270	wg126	34	-	7	2	2	2	3	2	3	3	3	3	3	3	3	3	3	54%	20%
VIIE	2013	12270	wg127	38	-	7	3	3	3	3	3	3	3	3	3	3	3	3	3	3	92%	9%
VIIE	2013	12270	wg128	28	-	7	1	1	1	2	1	2	1	1	1	1	1	1	1	1	85%	33%
VIIE	2013	12270	wg129	29	-	7	4	4	4	4	4	4	4	4	4	4	5	4	5	4	62%	17%
VIIE	2013	12270	wg130	29	-	7	2	2	2	2	2	3	2	2	2	2	2	2	2	2	92%	13%
VIIE	2013	12270	wg131	29	-	7	2	2	2	2	2	3	2	2	2	2	2	2	3	2	85%	17%
VIIH	2013	13886	wg148	55	-	10	5	6	6	7	6	5	6	6	7	6	7	6	6	6	62%	11%
VIIH	2013	13886	wg149	35	-	10	4	4	4	4	4	5	4	4	4	4	4	3	4	5	46%	19%
VIIE	2013	12495	wg90	43	-	6	4	4	4	3	5	5	5	5	5	4	4	4	4	5	62%	15%
VIIE	2013	12495	wg91	42	-	6	3	4	4	4	4	4	4	4	5	4	4	4	4	4	85%	10%
VIIE	2013	12495	wg92	38	-	6	4	4	4	4	4	4	4	4	4	4	4	4	4	4	92%	7%
VIIE	2013	12495	wg93	38	-	6	3	3	4	3	3	4	3	3	4	3	3	3	3	3	77%	14%
IVB	2013	12627	wg94	35	-	7	4	4	4	3	4	5	4	4	4	4	4	4	4	4	77%	13%
IVB	2013	12627	wg95	34	-	7	6	6	6	4	7	7	7	6	6	6	7	5	7	6	46%	15%
IVB	2013	12627	wg96	34	-	7	4	4	4	-	4	5	4	4	4	4	4	3	4	4	83%	11%
IVB	2013	12627	wg97	33	-	7	6	6	6	-	6	7	6	6	6	6	6	5	7	6	75%	8%
IVB	2013	12627	wg98	32	-	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	92%	9%
IVB	2013	12627	wg99	32	-	7	5	5	5	6	6	6	6	6	6	5	6	6	5	5	50%	12%
				Total read			134	135	133	131	134	135	133	131	134	132	133	134	135		75.3%	13.1%
				Total NOT read			1	0	2	4	1	0	2	4	1	3	2	1	0			

Table AII.2

The number of age readings, the coefficient of variation (CV), the percent agreement and the RELATIVE bias are presented by MODAL age for each age reader and for all readers combined. A weighted mean CV and a weighted mean percent agreement are given by reader and all readers combined. The CV's by MODAL age for each individual age reader and all readers combined indicate the precision in age reading by MODAL age. The weighted mean CV's over all MODAL age groups comined indicate the precision in age reading by reader and for all age readers combined.

NUMBER OF AGE READINGS

MODAL age	Tom Reader 1	Jean Louis Reader 2	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegurn Reader 8	Ilse Reader 9	Imelda Reader 11	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 14	0 Reader 15	TOTAL
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	13
2	13	13	13	13	13	13	12	13	13	13	12	13	13	-	-	167
3	46	47	45	46	46	47	47	45	46	46	46	46	47	-	-	600
4	38	38	38	37	38	38	38	37	38	37	38	38	38	-	-	491
5	9	9	9	8	9	9	9	9	9	8	9	9	9	-	-	115
6	17	17	17	16	17	17	17	17	17	17	17	17	17	-	-	220
7	8	8	8	8	8	8	7	7	8	8	8	8	8	-	-	102
8	2	2	2	2	2	2	2	2	2	2	2	2	2	-	-	26
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total 0-15	134	135	133	131	134	135	133	131	134	132	133	134	135	0	0	1734

COEFFICIENT OF VARIATION (CV)

MODAL age	Tom Reader 1	Jean Louis Reader 2	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegurn Reader 8	Ilse Reader 9	Imelda Reader 11	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 14	0 Reader 15	ALL Readers
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	0%	0%	0%	26%	21%	20%	20%	20%	17%	0%	21%	37%	21%	-	-	15.1%
3	11%	5%	12%	23%	11%	18%	18%	8%	13%	13%	19%	22%	12%	-	-	14.2%
4	8%	6%	6%	24%	15%	15%	14%	12%	7%	14%	17%	17%	13%	-	-	12.7%
5	9%	7%	9%	15%	10%	13%	7%	10%	7%	10%	7%	15%	8%	-	-	11.6%
6	7%	4%	4%	19%	6%	10%	5%	6%	4%	6%	6%	11%	8%	-	-	10.0%
7	11%	7%	5%	21%	8%	7%	5%	12%	0%	14%	5%	12%	8%	-	-	11.4%
8	0%	9%	16%	11%	8%	0%	0%	9%	8%	0%	0%	0%	0%	-	-	11.1%
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Weighted mean 0-15	8.4%	4.9%	7.3%	22.1%	12.1%	14.9%	13.5%	10.2%	9.1%	10.4%	14.8%	19.1%	11.9%			13.1%
RANKING	3	1	2	13	8	11	9	5	4	6	10	12	7			

PERCENTAGE AGREEMENT

MODAL age	Tom Reader 1	Jean Louis Reader 2	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegurn Reader 8	Ilse Reader 9	Imelda Reader 11	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 14	0 Reader 15	ALL
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	100%	100%	100%	0%	100%	0%	100%	100%	100%	100%	100%	100%	100%	-	-	85%
2	100%	100%	100%	69%	69%	46%	75%	77%	85%	100%	58%	69%	62%	-	-	78%
3	87%	98%	87%	50%	89%	55%	79%	93%	80%	85%	72%	59%	83%	-	-	78%
4	89%	95%	95%	35%	82%	39%	76%	78%	92%	78%	76%	66%	76%	-	-	75%
5	78%	89%	78%	0%	78%	56%	89%	78%	89%	75%	89%	44%	78%	-	-	71%
6	82%	94%	94%	6%	82%	35%	88%	88%	94%	88%	82%	53%	76%	-	-	75%
7	75%	75%	88%	13%	75%	38%	86%	57%	100%	50%	88%	25%	75%	-	-	65%
8	0%	50%	50%	0%	50%	100%	100%	50%	50%	0%	100%	0%	0%	-	-	42%
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Weighted mean 0-15	85.8%	94.1%	90.2%	35.9%	82.1%	46.7%	80.5%	83.2%	87.3%	81.1%	75.9%	57.5%	76.3%			75.1%
RANKING	4	1	2	13	6	12	8	5	3	7	10	11	9			

RELATIVE BIAS

MODAL age	Tom Reader 1	Jean Louis Reader 2	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegurn Reader 8	Ilse Reader 9	Imelda Reader 11	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 14	0 Reader 15	ALL
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	0.00	0.00	0.00	1.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-	-	0.15
2	0.00	0.00	0.00	0.15	0.31	0.54	0.25	0.23	0.15	0.00	0.42	0.08	0.38	-	-	0.19
3	0.09	-0.02	0.09	-0.37	0.07	0.51	0.17	0.07	0.20	-0.15	0.24	-0.20	0.17	-	-	0.07
4	-0.11	0.00	0.00	-0.46	0.08	0.66	0.05	-0.16	-0.03	-0.19	0.16	-0.34	0.16	-	-	-0.01
5	-0.22	-0.11	-0.22	-1.50	0.00	0.22	0.11	0.00	-0.11	-0.25	0.11	-0.33	0.22	-	-	-0.15
6	-0.18	-0.06	-0.06	-1.38	0.18	0.53	0.12	-0.12	0.06	-0.12	0.18	-0.53	0.12	-	-	-0.09
7	-0.38	-0.25	-0.13	-2.00	0.00	0.63	0.14	-0.57	0.00	-0.75	0.13	-0.50	0.00	-	-	-0.28
8	-1.00	-0.50	1.00	-1.50	0.50	0.00	0.00	-0.50	0.50	-1.00	0.00	-1.00	1.00	-	-	-0.19
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Weighted mean 0-15	-0.07	-0.04	0.02	-0.64	0.10	0.54	0.13	-0.05	0.08	-0.20	0.20	-0.29	0.19			-0.00
RANKING	4	2	1	13	6	12	7	3	5	9	10	11	8			

Overall ranking

	Tom Reader 1	Jean Louis Reader 2	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegurn Reader 8	Ilse Reader 9	Imelda Reader 11	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 14	0 Reader 15
Ranking Coefficient of Variation	3	1	2	13	8	11	9	5	4	6	10	12	7		
Ranking Percentage Agreement	4	1	2	13	6	12	8	5	3	7	10	11	9		
Ranking Relative bias	4	2	1	13	6	12	7	3	5	9	10	11	8		
OVERALL RANKING	3	1	2	13	6	12	8	5	4	7	10	11	8		

Table AII.3

Upper table: The age compositions estimated by each age reader and all age readers combined.
Middle table: The estimated mean length at age by age reader and by all age readers combined.
Lower table: Bias tests: non-parametrically with a one-sample Wilcoxon rank sum test. The inter-reader bias test and the reader against MODAL age bias test.

AGE COMPOSITION

Age	Tom Reader 1	Jean Louis Reader 2	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegurn Reader 8	Ilse Reader 9	Imelda Reader 11	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 14	0 Reader 15	TOTAL
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	1	1	1	1	1	-	1	1	1	1	1	3	1	-	-	14
2	14	14	14	32	10	7	11	10	11	21	9	25	8	-	-	186
3	44	47	40	48	48	34	44	52	41	45	41	38	46	-	-	568
4	41	37	43	32	36	34	35	33	45	31	38	36	37	-	-	478
5	11	10	9	11	10	27	14	11	9	11	14	12	14	-	-	163
6	15	18	17	4	16	13	17	18	16	17	16	15	17	-	-	199
7	8	7	7	3	10	13	8	5	9	6	11	4	9	-	-	100
8	-	1	1	-	2	7	3	1	1	-	3	1	1	-	-	21
9	-	-	-	-	1	-	-	-	1	-	-	-	2	-	-	4
10	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	1
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total 0-15	134	135	133	131	134	135	133	131	134	132	133	134	135	0	0	1734

MEAN LENGTH AT AGE

Age	Tom Reader 1	Jean Louis Reader 2	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegurn Reader 8	Ilse Reader 9	Imelda Reader 11	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 14	0 Reader 15	ALL
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	28.0	28.0	28.0	28.0	28.0	-	28.0	28.0	28.0	28.0	28.0	27.7	28.0	-	-	27.9
2	31.6	31.6	31.6	32.1	31.6	31.3	29.9	30.9	30.9	31.9	29.7	32.4	30.5	-	-	31.5
3	33.7	33.7	33.7	35.6	34.4	32.9	34.0	34.6	33.5	34.1	33.2	35.6	34.2	-	-	34.1
4	38.8	38.9	38.7	39.9	37.5	36.5	37.7	37.7	38.2	39.8	37.8	38.7	37.5	-	-	38.3
5	40.9	40.4	38.8	42.3	40.3	39.1	40.9	39.5	40.2	37.5	40.8	36.8	40.5	-	-	39.8
6	40.3	40.8	41.3	42.3	41.0	40.2	41.5	41.1	40.7	41.6	40.6	42.7	41.5	-	-	41.1
7	40.5	40.1	40.4	50.7	40.7	39.3	38.6	38.4	41.8	39.8	41.7	41.0	37.8	-	-	40.4
8	-	43.0	32.0	-	34.5	41.4	37.3	43.0	32.0	-	37.3	37.0	37.0	-	-	38.4
9	-	-	-	-	43.0	-	-	-	43.0	-	-	-	37.5	-	-	40.3
10	-	-	43.0	-	-	-	-	-	-	-	-	-	-	-	-	43.0
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
weighted mean 0-15	36.7	36.7	36.8	36.8	36.7	36.7	36.6	36.6	36.7	36.6	36.7	36.7	36.7	-	-	36.7

Inter-reader bias test and reader against MODAL age bias test

	Tom Reader 1	Jean Louis Reader 2	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegurn Reader 8	Ilse Reader 9	Imelda Reader 11	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 14	0 Reader 15
Reader 1	[shaded]	—	*	**	**	**	**	—	**	**	**	**	**		
Reader 2	—	[shaded]	**	**	**	**	**	—	**	—	**	—	**		
Reader 4	*	—	[shaded]	**	—	**	—	—	—	**	**	**	**		
Reader 5	**	**	**	[shaded]	**	**	**	**	**	**	**	**	**		
Reader 6	**	**	—	**	[shaded]	**	—	**	—	**	—	*	—		
Reader 7	**	**	**	**	**	[shaded]	**	**	**	**	**	**	**		
Reader 8	**	**	—	**	—	**	[shaded]	**	—	**	*	**	—		
Reader 9	—	—	—	**	**	**	**	[shaded]	—	**	**	**	**		
Reader 11	**	**	—	**	—	**	—	**	[shaded]	**	*	**	*		
Reader 13	**	—	**	**	**	**	**	—	**	[shaded]	**	—	**		
Reader 14	**	**	**	**	—	**	*	**	*	**	[shaded]	**	—		
Reader 15	**	—	**	**	*	**	**	**	**	—	**	[shaded]	**		
Reader 16	**	**	**	**	—	**	—	**	*	**	—	**	[shaded]		
MODAL age	—	—	—	**	**	**	**	—	**	**	**	**	**		

—	= no sign of bias (p>0.05)
*	= possibility of bias (0.01<p<0.05)
**	= certainty of bias (p<0.01)

Table AII.4

| NUMBER OF OTOLITHS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Nr of |
MODAL age	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	otoliths
0	-	-	-	-	-	-	-	-	-	-	-	-	0
1	-	-	-	-	-	-	1	-	-	-	-	-	1
2	5	-	-	-	-	-	6	-	2	-	-	-	13
3	7	2	-	5	7	1	10	7	6	2	-	-	47
4	10	7	-	3	1	2	5	1	6	3	-	-	38
5	1	-	-	4	-	1	1	1	-	1	-	-	9
6	1	4	-	3	-	-	3	2	3	1	-	-	17
7	2	1	-	1	-	-	-	-	4	-	-	-	8
8	-	-	-	-	-	-	-	-	1	1	-	-	2
9	-	-	-	-	-	-	-	-	-	-	-	-	0
10	-	-	-	-	-	-	-	-	-	-	-	-	0
11	-	-	-	-	-	-	-	-	-	-	-	-	0
12	-	-	-	-	-	-	-	-	-	-	-	-	0
13	-	-	-	-	-	-	-	-	-	-	-	-	0
14	-	-	-	-	-	-	-	-	-	-	-	-	0
15	-	-	-	-	-	-	-	-	-	-	-	-	0
TOTAL	26	14	0	16	8	4	26	11	22	8	0	0	135

| COEFFICIENT OF VARIATION (CV) | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Mean |
MODAL age	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	CV
0	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	33%	-	-	-	-	-	-
2	12%	-	-	-	-	-	18%	-	13%	-	-	-	15.1%
3	14%	13%	-	17%	11%	14%	14%	14%	18%	12%	-	-	14.2%
4	15%	10%	-	10%	7%	9%	12%	23%	14%	16%	-	-	12.7%
5	6%	-	-	11%	-	15%	12%	15%	-	12%	-	-	11.6%
6	10%	8%	-	10%	-	-	12%	9%	12%	11%	-	-	10.0%
7	10%	6%	-	17%	-	-	-	-	12%	-	-	-	11.4%
8	-	-	-	-	-	-	-	-	10%	12%	-	-	11.1%
9	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean CV Weighted	13.2%	9.2%	-	13.0%	10.2%	11.3%	14.9%	13.7%	14.2%	13.2%	-	-	12.8%

Note: Higher CV's might be expected during months of opaque material deposition and during the juvenile phase, when false rings

| PERCENTAGE AGREEMENT | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Agree- |
MODAL age	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	ment
0	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	85%	-	-	-	-	-	84.6%
2	79%	-	-	-	-	-	77%	-	77%	-	-	-	77.8%
3	73%	85%	-	74%	89%	77%	78%	79%	72%	81%	-	-	78.2%
4	71%	85%	-	82%	92%	88%	78%	46%	72%	59%	-	-	75.4%
5	92%	-	-	79%	-	62%	50%	54%	-	67%	-	-	71.3%
6	85%	85%	-	74%	-	-	66%	85%	64%	62%	-	-	74.5%
7	52%	83%	-	46%	-	-	-	-	71%	-	-	-	64.7%
8	-	-	-	-	-	-	-	-	46%	38%	-	-	42.3%
9	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean CV Weighted	73.0%	84.9%	-	75.0%	89.3%	78.8%	75.6%	74.5%	69.9%	63.1%	-	-	75.1%

| RELATIVE BIAS | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Mean |
MODAL age	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	bias
0	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	0.15	-	-	-	-	-	0.15
2	0.21	-	-	-	-	-	0.15	-	0.27	-	-	-	0.19
3	0.30	0.00	-	0.02	0.07	0.23	-0.03	-0.04	0.06	0.19	-	-	0.07
4	0.15	0.02	-	0.15	-0.08	-0.04	0.02	-0.31	-0.17	-0.38	-	-	-0.01
5	-0.08	-	-	-0.10	-	-0.46	0.33	-0.54	-	-0.17	-	-	-0.15
6	-0.23	0.02	-	-0.05	-	-	0.03	-0.12	-0.38	0.08	-	-	-0.09
7	0.04	0.00	-	-0.92	-	-	-	-	-0.35	-	-	-	-0.28
8	-	-	-	-	-	-	-	-	-0.46	0.08	-	-	-0.19
9	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-
Mean	0.17	0.02	-	-0.06	0.05	-0.08	0.05	-0.12	-0.14	-0.10	-	-	-0.00

14

Table AII.5

2STDEV

MODAL age	Tom Reader 1	Jean Louis Reader 2	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegum Reader 8	Ilse Reader 9	Imelda Reader 11	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 14	0 Reader 15	2STDEV ALL
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.751
2	0.000	0.000	0.000	1.109	0.961	1.038	0.905	0.877	0.751	0.000	1.030	1.519	1.013	-	-	0.903
3	0.709	0.292	0.716	1.219	0.653	1.242	1.128	0.505	0.802	0.726	1.206	1.238	0.760	-	-	0.999
4	0.622	0.465	0.465	1.673	1.263	1.416	1.134	0.884	0.567	1.037	1.435	1.254	1.093	-	-	1.198
5	0.882	0.667	0.882	1.069	1.000	1.333	0.667	1.000	0.667	0.926	0.667	1.414	0.882	-	-	1.221
6	0.786	0.485	0.485	1.770	0.786	1.249	0.664	0.664	0.485	0.786	1.249	0.970	-	-	1.240
7	1.488	0.926	0.707	2.138	1.069	1.035	0.756	1.574	0.000	1.773	0.707	1.512	1.069	-	-	1.697
8	0.000	1.414	2.828	1.414	1.414	0.000	0.000	1.414	1.414	0.000	0.000	0.000	0.000	-	-	1.791
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

MEAN AGE

MODAL age	Tom Reader 1	Jean Louis Reader 2	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegum Reader 8	Ilse Reader 9	Imelda Reader 11	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 14	0 Reader 15	ALL
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	1.00	1.00	1.00	2.00	1.00	2.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	-	-	1.15
2	2.00	2.00	2.00	2.15	2.31	2.54	2.25	2.23	2.15	2.00	2.42	2.08	2.38	-	-	2.19
3	3.09	2.98	3.09	2.63	3.07	3.51	3.17	3.07	3.20	2.85	3.24	2.80	3.17	-	-	3.07
4	3.89	4.00	4.00	3.54	4.08	4.66	4.05	3.84	3.97	3.81	4.16	3.66	4.16	-	-	3.99
5	4.78	4.89	4.78	3.50	5.00	5.22	5.11	5.00	4.89	4.75	5.11	4.67	5.22	-	-	4.85
6	5.82	5.94	5.94	4.63	6.18	6.53	6.12	6.06	5.88	6.06	5.88	5.47	6.12	-	-	5.91
7	6.63	6.75	6.88	5.00	7.00	7.63	7.14	6.43	7.00	6.25	7.13	6.50	7.00	-	-	6.72
8	7.00	7.50	9.00	6.50	8.50	8.00	8.00	7.50	8.50	7.00	8.00	7.00	9.00	-	-	7.81
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0-15	3.93	3.95	4.02	3.34	4.10	4.53	4.11	3.93	4.08	3.80	4.22	3.71	4.18	-	-	3.99

MEAN AGE +2STDEV

MODAL age	Tom Reader 1	Jean Louis Reader 2	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegum Reader 8	Ilse Reader 9	Imelda Reader 11	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 14	0 Reader 15	ALL
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.90
2	2.000	2.000	2.000	3.263	3.268	3.576	3.155	3.108	2.905	2.000	3.447	3.596	3.397	-	-	3.10
3	3.796	3.270	3.805	3.849	3.719	4.753	4.298	3.571	3.998	3.574	4.445	4.042	3.930	-	-	4.07
4	4.517	4.465	4.465	5.214	5.342	6.074	5.187	4.721	4.541	4.848	5.593	4.912	5.251	-	-	5.19
5	5.660	5.556	5.660	4.569	6.000	6.556	5.778	6.000	5.556	5.676	5.778	6.081	6.104	-	-	6.07
6	6.609	6.426	6.426	6.395	6.962	7.778	6.782	6.547	6.544	6.547	6.962	6.719	7.088	-	-	7.15
7	8.113	7.676	7.582	7.138	8.069	8.660	7.899	8.002	7.000	8.023	7.832	8.012	8.069	-	-	8.41
8	7.000	8.914	11.828	7.914	9.914	8.000	8.000	8.914	9.914	7.000	8.000	7.000	9.000	-	-	9.60
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

MEAN AGE -2STDEV

MODAL age	Tom Reader 1	Jean Louis Reader 2	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegum Reader 8	Ilse Reader 9	Imelda Reader 11	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 14	0 Reader 15	ALL
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.403
2	2.000	2.000	2.000	1.044	1.347	1.501	1.345	1.354	1.403	2.000	1.387	0.558	1.372	-	-	1.288
3	2.378	2.687	2.373	1.411	2.412	2.268	2.042	2.562	2.393	2.122	2.033	1.566	2.410	-	-	2.068
4	3.273	3.535	3.535	1.868	2.816	3.242	2.919	2.954	3.407	2.774	2.723	2.404	3.065	-	-	2.789
5	3.896	4.222	3.896	2.431	4.000	3.889	4.444	4.000	4.222	3.824	4.444	3.252	4.340	-	-	3.631
6	5.038	5.456	5.456	2.855	5.391	5.281	5.453	5.218	5.574	5.218	5.391	4.222	5.148	-	-	4.669
7	5.137	5.824	6.168	2.862	5.931	6.590	6.387	4.855	7.000	4.477	6.418	4.988	5.931	-	-	5.018
8	7.000	6.086	6.172	5.086	7.086	8.000	8.000	6.086	7.086	7.000	8.000	7.000	9.000	-	-	6.017
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure AII.1

In the age bias plots below the mean age recorded +/- 2stdev of each age reader and all readers combined are plotted against the MODAL age. The estimated mean age corresponds to MODAL age, if the estimated mean age is on the 1:1 equilibrium line (solid line). RELATIVE bias is the age difference between estimated mean age and MODAL age.
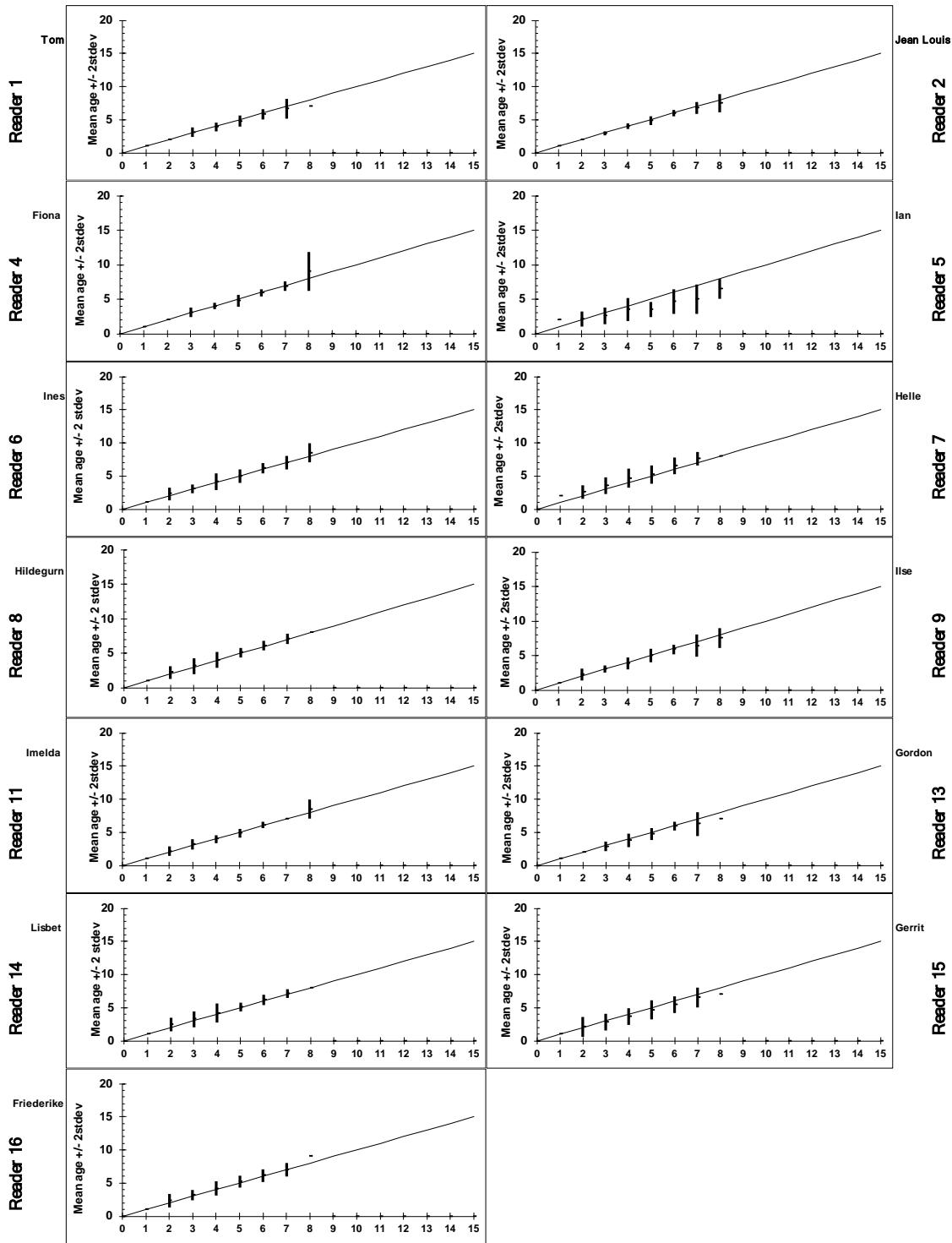
Figure AII.2
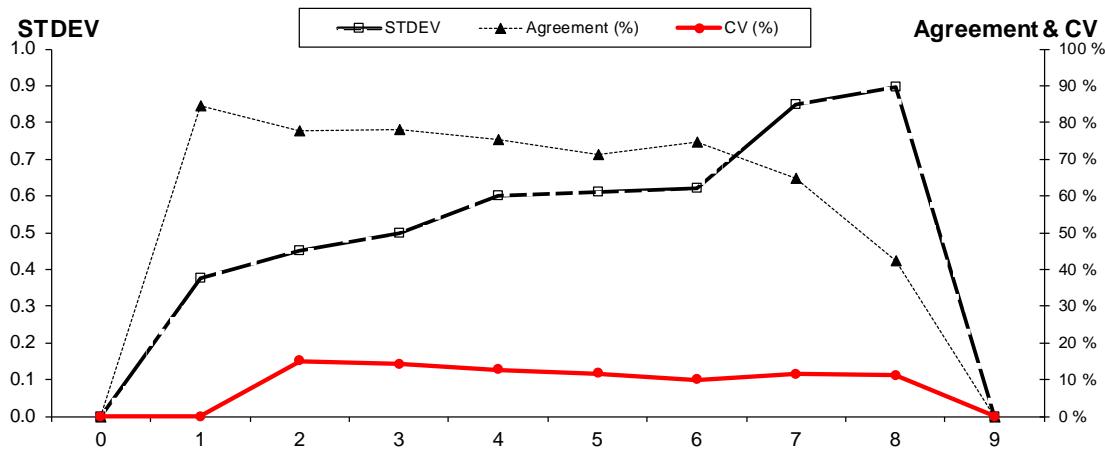
The coefficient of variation (CV%), percent agreement and the standard deviation (STDEV) are plotted against MODAL age.
CV is much less age dependent than the standard deviation (STDEV) and the percent agreement.
CV is therefore a better index for the precision in age reading. Problems in age reading are indicated by relatively high CV's at age.

Figure AII.3
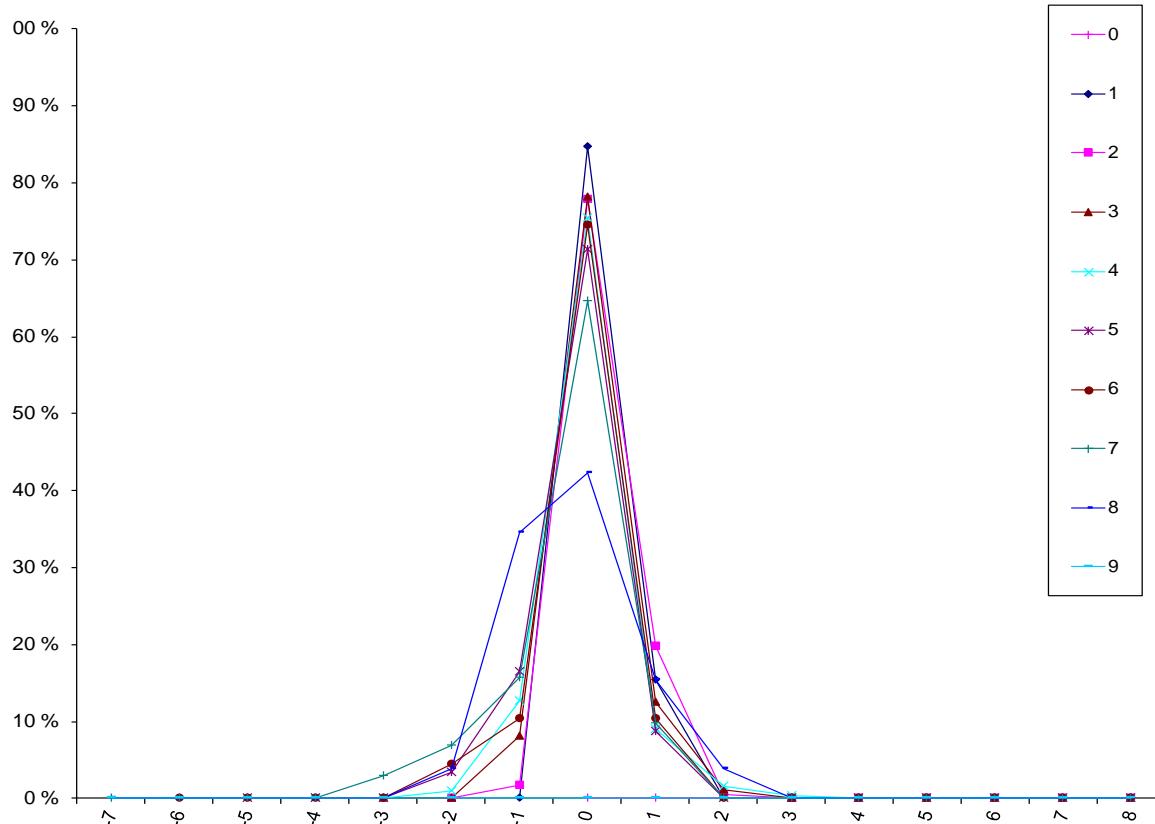
The distribution of the age reading errors in percentage by MODAL age as observed from the whole group of age readers in an age reading comparison to MODAL age. The achieved precision in age reading by MODAL age group is shown by the spread of the age readings errors. There appears to be no RELATIVE bias, if the age reading errors are normally distributed. The distributions are skewed, if RELATIVE bias occurs.

Figure AII.4
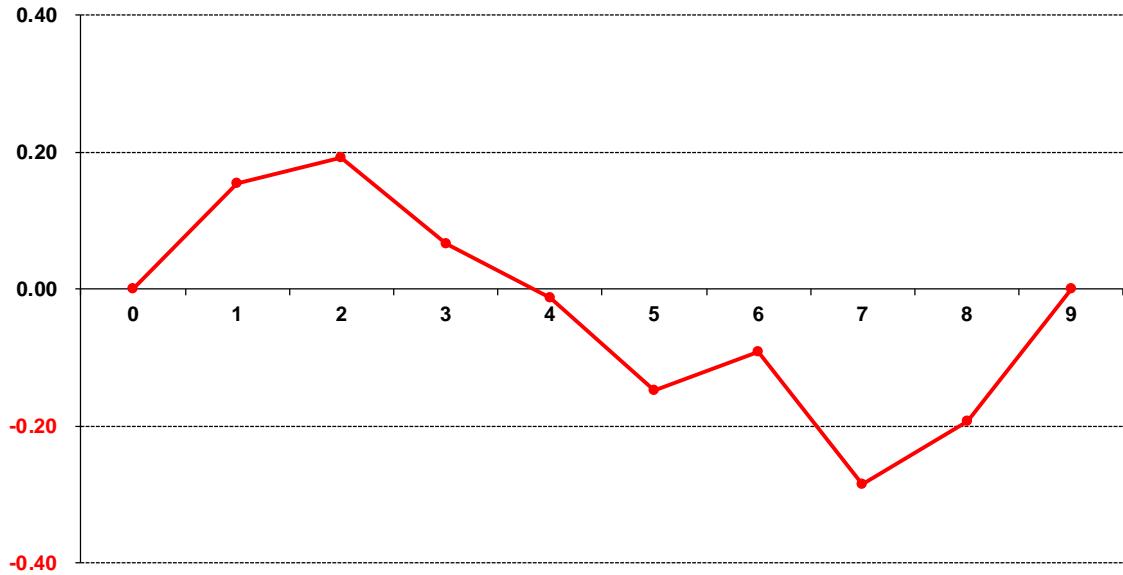
Figure 4   The RELATIVE bias by MODAL age as estimated by all age readers combined.

Figure AII.5
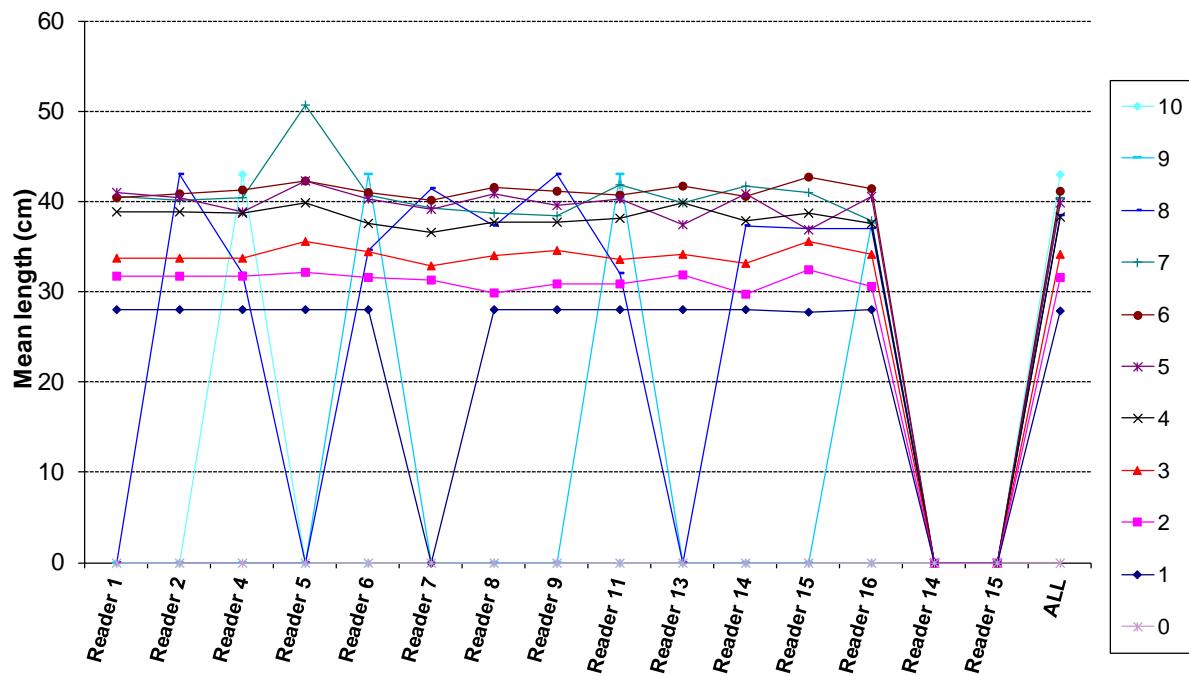
Figure 5   The mean length at age as estimated by each age reader.

Appendix III Images of otoliths with low percentage agreement

Figure A111.1 Image of otolith number 7, modal age 5 (January 2010, VIIg 41cm)

Figure AIII.2 Image of otolith number 25, modal age 7 (April 2010, VIIg 38cm)

Appendix IV Guus Eltink spreadsheet data analyses for all readers

Table AIV.1

year	no	Fish no	Fish length	Sex	Landing month	Tom Reader 1	Jean Louis Reader 2	Betty Reader 3	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegum Reader 8	Ilse Reader 9	Selene Reader 10	Imelda Reader 11	Gary Reader 12	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	modal age	Percent agreement	Precision CV
2010	24205	WG 1	51	-	1	4	4	4	4	2	4	5	4	4	5	4	3	4	5	4	4	4	81%	16%
2010	24205	WG10	45	-	1	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	94%	5%
2013	12623	WG134	28	-	7	2	2	1	2	1	2	2	2	2	2	2	2	2	2	1	2	2	81%	22%
2013	12623	WG135	29	-	7	3	3	1	3	2	3	2	2	3	3	3	3	3	3	3	3	3	81%	21%
2013	12623	WG136	29	-	7	3	3	2	3	2	3	3	3	3	3	3	3	4	2	3	3	3	75%	17%
2013	12623	wg 137	30	-	7	3	3	2	3	2	3	3	3	-	3	3	3	3	3	2	3	3	80%	15%
2013	12623	wg 138	30	-	7	4	4	4	3	4	3	4	4	4	4	4	4	4	3	4	4	4	75%	12%
2013	12623	wg 139	31	-	7	3	3	2	3	2	3	3	3	4	4	4	4	3	2	3	3	3	75%	16%
2013	12623	wg 150	31	-	7	3	3	3	3	3	3	4	4	3	4	3	3	4	3	3	3	3	75%	14%
2010	65505	wg 151	35	-	1	3	3	3	-	3	3	3	3	3	3	3	3	3	3	3	3	3	100%	0%
2010	24231	wg 17	36	-	1	3	3	3	3	3	3	4	5	3	3	3	3	5	3	3	3	3	88%	21%
2010	24231	wg 18	39	-	1	3	3	3	3	3	3	4	4	3	3	3	3	5	4	3	3	3	81%	13%
2010	24231	wg 19	31	-	1	2	2	2	2	2	3	3	3	2	2	3	2	3	2	3	2	2	56%	21%
2010	24205	wg 2	38	-	1	4	3	3	3	3	3	4	3	4	3	3	3	3	3	3	3	3	81%	13%
2010	24231	wg 20	29	-	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	100%	0%
2010	25351	wg 21	34	-	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	4	88%	9%
2010	25351	wg 22	38	-	4	5	5	3	5	3	5	5	5	5	5	5	4	5	5	5	5	5	81%	15%
2010	25351	wg 23	40	-	4	6	6	5	6	4	7	7	6	6	6	6	5	6	6	6	7	6	63%	13%
2010	25351	wg 24	42	-	4	4	4	3	4	4	5	5	5	4	4	4	4	6	4	4	5	4	63%	16%
2010	25351	wg 25	38	-	4	5	6	4	6	4	7	7	7	5	6	7	6	5	7	6	7	7	38%	18%
2010	25351	wg 26	42	-	4	6	6	4	6	4	6	6	7	6	6	6	5	6	7	5	6	6	56%	15%
2010	25351	wg 27	34	-	4	4	4	3	4	4	4	5	4	4	4	4	4	4	4	4	4	4	88%	9%
2010	25351	wg 28	40	-	4	5	5	4	5	4	4	5	5	5	5	5	4	5	5	5	5	5	75%	9%
2010	25547	wg 29	37	-	5	3	3	2	3	3	3	3	3	4	3	3	3	3	3	3	3	3	88%	12%
2010	24205	wg 3	51	-	1	7	7	6	7	5	6	8	-	7	7	7	6	6	7	7	6	7	53%	11%
2010	25547	wg 30	33	-	5	4	4	3	4	3	4	4	4	4	4	4	4	4	4	4	4	4	88%	9%
2010	25547	wg 31	33	-	5	3	3	2	3	2	3	3	3	3	3	3	2	3	5	3	3	3	81%	14%
2010	25547	wg 32	39	-	5	3	3	2	3	3	3	3	5	3	3	3	2	3	5	3	3	3	75%	26%
2010	25547	wg 33	39	-	5	3	3	2	3	3	3	3	3	3	3	2	3	-	3	3	3	3	87%	12%
2010	25547	wg 34	31	-	5	3	3	2	3	2	3	3	3	3	3	3	3	3	3	3	3	3	88%	12%
2010	25547	wg 35	33	-	5	3	3	2	3	2	3	3	3	3	3	3	3	3	3	3	3	3	88%	12%
2010	25547	wg 36	31	-	5	3	3	2	3	3	4	4	3	3	4	3	3	3	3	4	4	3	63%	18%
2010	26351	wg 37	32	-	9	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	2	94%	12%
2010	26351	wg 38	35	-	9	3	4	2	2	4	4	4	3	3	3	4	2	3	4	4	3	3	44%	24%
2010	26351	wg 39	43	-	9	3	3	2	3	2	3	3	4	3	4	3	4	3	3	3	3	3	63%	20%
2010	24205	wg 4	47	-	1	4	4	4	4	3	4	5	4	4	4	4	4	4	4	4	4	4	88%	9%
2010	26351	wg 40	30	-	9	2	2	2	2	3	3	3	2	2	3	2	3	2	3	4	3	2	50%	25%
2010	65505	wg 41	31	-	1	2	2	2	2	2	2	3	2	2	3	2	2	2	3	2	2	2	69%	21%
2010	65505	wg 42	33	-	1	4	3	3	3	3	3	4	4	4	4	4	3	3	4	3	3	3	56%	15%
2010	65505	wg 43	34	-	1	3	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	88%	9%
2010	65505	wg 44	35	-	1	3	3	3	4	3	3	3	4	4	4	3	3	4	4	4	3	3	56%	15%
2010	65505	wg 45	35	-	1	4	4	4	4	3	5	5	4	4	4	4	4	4	4	3	5	4	69%	14%
2010	65505	wg 46	35	-	1	2	2	2	2	2	3	3	-	2	3	2	2	2	3	3	2	2	71%	21%
2010	65505	wg 47	37	-	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	94%	12%
2010	65505	wg 48	37	-	1	7	7	7	7	6	8	8	8	7	7	7	8	7	8	8	8	7	50%	8%
2010	65505	wg 49	44	-	1	4	4	4	4	4	5	5	6	4	4	4	4	7	4	5	4	4	69%	20%
2010	24205	wg 5	47	-	1	4	4	5	4	4	5	5	4	4	4	4	4	5	4	5	4	4	75%	11%
2010	65505	wg 50	45	-	1	6	6	6	6	4	6	6	6	5	7	6	5	6	6	6	6	6	75%	11%
2010	65505	wg 51	45	-	1	3	4	4	5	3	4	6	5	5	3	4	4	5	4	4	4	4	44%	21%
2013	10189	wg 52	26	-	4	3	3	3	3	3	3	4	2	3	3	3	3	2	2	3	3	3	75%	17%
2013	10189	wg 53	27	-	4	3	3	3	3	3	2	3	4	3	3	3	3	3	3	4	3	3	75%	16%
2013	10189	wg 54	28	-	4	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	3	75%	17%
2013	10189	wg 55	29	-	4	3	3	3	3	2	3	4	3	3	3	3	3	3	3	4	3	3	88%	12%
2013	10189	wg 56	30	-	4	3	3	3	4	2	3	4	3	3	4	3	3	3	3	4	3	3	63%	18%
2013	10189	wg 57	34	-	4	5	5	5	4	3	5	6	5	5	5	4	6	5	5	5	6	5	63%	16%
2013	10189	wg 58	36	-	4	4	4	5	5	4	5	6	5	5	6	5	5	6	5	6	5	5	31%	12%
2013	10189	wg 59	34	-	4	6	6	6	6	5	6	6	6	7	6	6	6	6	6	6	6	6	88%	6%
2010	24205	wg 6	41	-	1	4	4	3	3	3	4	5	3	3	3	3	3	4	3	3	3	3	75%	18%
2013	13063	wg 60	34	-	8	3	3	3	2	3	3	3	4	3	3	3	2	3	2	3	3	3	69%	20%
2013	13063	wg 61	33	-	8	-	3	2	-	3	-	3	3	-	3	-	3	-	3	3	3	3	89%	12%
2013	13063	wg 62	33	-	8	4	3	3	4	3	4	5	3	3	3	4	3	3	3	3	3	3	63%	18%
2013	13063	wg 63	30	-	8	4	4	4	5	3	4	5	3	4	4	4	4	3	3	4	3	4	50%	22%
2013	13063	wg 64	32	-	8	4	4	3	2	3	2	3	3	3	3	3	3	3	2	3	3	3	81%	14%
2013	13063	wg 65	38	-	8	6	6	6	6	4	6	6	6	6	7	6	6	6	6	6	6	6	81%	11%
2013	13063	wg 66	34	-	8	4	4	4	3	5	5	5	5	4	5	5	4	4	5	4	5	5	50%	16%
2013	13063	wg 67	31	-	8	3	3	2	3	2	3	5	3	3	3	3	3	3	2	3	3	3	75%	16%
2013	13063	wg 68	32	-	8	3	3	2	3	2	3	4	3	3	3	3	3	3	2	3	3	3	69%	20%
2013	13063	wg 69	29	-	8	3	3	2	3	2	3	3	3	3	3	3	3	3	2	3	3	3	81%	14%
2010	24205	wg 7	41	-	1	4	4	5	6	4	5	6	5	5	6	5	5	6	5	4	5	6	31%	22%
2013	13063	wg 70	38	-	8	6	6	6	6	5	6	7	6	6	6	6	6	6	6	5	6	6	75%	9%
2013	13107	wg 71	36	-	9	4	4	3	4	3	4	5	4	3	4	4	4	3	4	3	4	4	63%	15%
2013	13107	wg 72	34	-	9	6	6	6	7	4	7	7	7	6	7	7	6	5	7	6	7	7	50%	14%
2013	13107	wg 73	34	-	9	7	7	6	7	5	7	7	7	7	8	7	6	6	7	6	7	7	63%	11%
2013	13107	wg 74	35	-	9	4	4	4	4	4	4	5	4	4	4	4	4	4	4	5	4	4	81%	11%
2013	13107	wg 75	32	-	9	3	3	2	3	2	3	3	3	3	3	3	4	3	3	3	3	3	81%	14%
2013	13107	wg 76	33	-	9	3	3	3	3	2	3	3	3	3	3	4	3	3	3	3	4	3	81%	14%
2013	13107	wg 77	38	-	9	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	81%	11%
2013	13107	wg 78	38	-	9	7	7	6	7	5	7	8	7	7	7	7	7	7	7	7	7	7	81%	9%
2013	13107	wg 79	41	-	9	3	3	3	3	3	3	5	3	3	3	3	3	2	4	3	3	3	75%	21%
2010	24205	wg 8	45	-	1	4	4	4	4	3	4	4	4	4	4	4	4	4	4	4	4	4	94%	6%
2013	13107	wg 80	41	-	9	4	4	5	4	3	4	6	4	4	6	4	4	4	5	3	4	4	63%	20%
2013	13107	wg 81	35	-	9	7	7	7	6	7	6	7	6	7	7	6	6	7	7	6	6	6	63%	13%
2013	13107	wg 82	31	-	9	5	6	6	6	5	5	6	7	6	6	6	6	6	5	6	6	6	69%	9%
2013	13107	wg 83	31	-	9	3	3	3	3	2	3	4	3	3	3	3	3	3	3	2	3	3	81%	15%
2013	13107	wg 84	32	-	9	7	7	6	8	6	8	8	8	7	8	8	8	7	8	7	9	8	50%	11%
2013	13107	wg 85	31	-	9	4	4	3	4	3	4	4	4	4	4	4	4	4	3	3	4	4	81%	11%
2013	13107	wg 86	43	-	9	6	6	5	6	4	6	6	6	6	7	6	6	5	6	6	6	6	69%	12%
2013	13107	wg 87	40	-	9	6	6	6	5	4	6	6	6	7	6	6	5	6	6	6	6	6	69%	12%
2013	13107	wg 88	43	-	9	5	5	5	6	4	6	6	6	5	6	6	5	6	6	4	5	5	44%	13%
2013	13107	wg 89	27	-	7	2	2	1	2	2	2	2	2	2	2	2	2	2	2	1	2	2	88%	18%
2010	24205	wg 9	38	-	1	4	4	4	4	3	4	4	4	4	4	4	4	3	4	3	3	4	75%	12%
2013	12627	wg100	31	-	7	6	6	7	6	4	6	7	6	6	6	6	5	6	6	5	6	6	69%	12%
2013	12627	wg101	31	-	7	2	2	2	2	2	3	3	3	2	2	3	2	3	2	3	2	2	56%	21%
2013	9745	wg102	59	-	2	6	6	6	6	6	7	7	6	6	7	6	6	6	6	6	6	6	81%	7%
2013	9745	wg103	54	-	2	7	7	7	7	7	7	8	7	-	7	7	6	7	6	6	7	7	80%	7%
2013	9745	wg104	52	-	2	6	6	6	6	6	6	7	6	6	6	6	6	6	6	6	6	6	88%	6%
2013	9745	wg105	49	-	2	4	4	4	4	4	5	4	4	-	4	4	4	4	4	4	4	4	93%	6%
2013	9745	wg106	47	-	2	4	4	5	4	3	6	3	3	6	4	4	3	-	4	3	4	4	47%	23%
2013	9745	wg107	45	-	2	6	6	6	6	5	6	7	6	6	7	6	6	6	6	6	6	6	81%	7%
2013	9745	wg108	43	-	2	4	4	4	4	4	4	5	4	4	4	4	4	4	4	4	4	4	94%	5%
2013	9745	wg109	40	-	2	4	4	4	4	4	5	4	4	4	4	4	4	4	4	4	4	4	88%	9%
2013	9745	wg110	38	-	2	6	6	6	6	4	6	7	6	6	6	6	5	6	6	6	6	6	81%	11%
2013	9745	wg111	37	-	2	4	4	4	4	4	5	4	4	4	4	4	4	4	4	4	4	4	94%	6%
2013	9745	wg112	35	-	2	4	4	4	4	5	4	5	4	4	4	4	4	4	4	4	4	4	88%	8%
2013	9745	wg113	34	-	2	4	4	4	4	4	4	5	4	4	4	4	4	4	4	4	4	4	94%	6%
2013	9745	wg114	38	-	2	3	3	3	3	3	3	4	3	3	3	3	3	3	2	3	3	3	75%	16%
2013	9745	wg115	32	-	2	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	94%	9%
2013	13886	wg116	52	-	10	5	5	4	5	4	5	6	5	5	4	-	5	4	5	4	5	5	63%	14%
2013	13886	wg117	50	-	10	4	4	3	4	4	5	5	4	4	3	4	4	4	4	3	4	4	56%	14%
2013	13886	wg118	40	-	10	4	4	4	4	4	4	4	3	4	4	4	4	4	4	4	4	4	88%	9%
2013	13886	wg119	43	-	10	7	8	7	10	7	9	8	8	8	9	9	8	7	8	7	9	8	38%	12%
2013	13886	wg120	38	-	10	3	3	3	3	3	4	3	3	3	3	3	3	3	3	3	3	3	94%	8%
2013	13886	wg121	42	-	10	3	3	3	3	3	4	3	3	3	3	3	3	4	3	3	3	3	69%	14%
2013	13886	wg122	24	-	7	3	3	3	3	2	3	4	3	3	4	3	3	4	3	3	3	3	63%	18%
2013	12270	wg123	39	-	7	4	4	4	4	4	4	4	4	4	5	4	3	4	4	4	5	4	88%	8%
2013	12270	wg124	39	-	7	3	3	3	3	3	3	3	3	3	4	3	3	3	4	3	3	3	94%	8%
2013	12270	wg125	38	-	7	2	2	2	2	3	2	2	3	3	3	3	2	2	3	2	3	2	56%	21%
2013	12270	wg126	34	-	7	3	3	3	3	3	4	4	3	3	3	3	3	3	3	3	3	3	81%	14%
2013	12270	wg127	34	-	7	3	3	2	3	3	3	3	3	3	3	3	3	5	3	3	3	3	81%	14%
2013	12270	wg128	28	-	7	1	1	-	1	2	1	2	1	1	2	1	1	1	1	1	1	1	80%	35%
2013	12270	wg129	32	-	7	4	4	3	4	3	4	5	4	4	4	4	4	5	4	5	6	4	63%	18%
2013	12270	wg130	29	-	7	2	2	1	2	3	2	3	2	2	3	2	2	2	2	2	2	2	88%	18%
2013	12270	wg131	31	-	7	2	2	1	2	3	2	3	2	2	3	2	2	2	2	2	2	2	75%	24%
2013	13886	wg148	55	-	10	5	6	7	6	7	6	5	6	6	4	6	7	6	6	6	6	6	56%	12%
2013	13886	wg149	35	-	10	4	4	4	4	4	4	3	3	3	4	3	3	3	2	3	4	3	50%	18%
2013	12495	wg90	43	-	6	4	4	5	3	4	4	5	5	5	5	5	4	5	4	4	5	4	75%	16%
2013	12495	wg91	42	-	6	3	4	3	4	3	4	4	4	4	4	5	4	4	4	4	4	4	75%	13%
2013	12495	wg92	39	-	6	3	4	4	3	4	4	4	4	4	4	5	4	4	4	4	4	4	81%	11%
2013	12495	wg93	33	-	6	4	4	4	4	3	4	4	4	4	5	4	4	4	4	3	4	4	81%	13%
2013	12627	wg94	35	-	7	4	4	3	4	3	4	4	4	4	4	4	4	3	4	3	4	4	75%	13%
2013	12627	wg95	34	-	7	6	6	6	6	4	7	7	7	6	6	6	6	6	7	5	7	6	56%	13%
2013	12627	wg96	34	-	7	7	4	4	4	4	4	6	6	4	4	5	6	6	5	4	4	6	80%	12%
2013	12627	wg97	33	-	7	6	6	6	6	-	6	7	6	6	7	6	6	6	6	5	7	6	73%	8%
2013	12627	wg98	32	-	7	3	3	3	3	-	3	3	3	3	3	2	3	3	3	3	3	3	87%	13%
2013	12627	wg99	32	-	7	5	5	5	5	-	6	6	6	5	5	5	5	6	4	6	6	5	60%	11%
Total read						134	135	134	133	131	134	135	133	131	135	134	135	132	133	134	135		73.1%	14.0%
Total NOT read						1	0	1	2	4	1	0	2	4	0	1	0	3	2	1	0			

Table AIV.2

The number of age readings, the coefficient of variation (CV), the percent agreement and the RELATIVE bias are presented by MODAL age for each age reader and for all readers combined. A weighted mean CV and a weighted mean percent agreement are given by reader and all readers combined. The CV's by MODAL age for each individual age reader and all readers combined indicate the precision in age reading by MODAL age. The weighted mean CV's over all MODAL age groups comined indicate the precision in age reading by reader and for all age readers combined.

NUMBER OF AGE READINGS

modal age	Tom Reader 1	Jean Louis Reader 2	Betty Reader 3	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegunn Reader 8	Ilse Reader 9	Selene Reader 10	Imelda Reader 11	Gary Reader 12	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 17	0 Reader 18	TOTAL
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	1	1	-	1	1	1	1	1	1	1	1	1	1	1	1	1	-	-	15
2	14	14	14	14	14	14	14	13	14	14	14	14	14	13	14	14	-	-	222
3	46	47	47	45	46	46	47	47	45	47	46	47	46	46	46	47	-	-	741
4	37	37	37	37	36	37	37	37	36	37	37	37	36	37	37	37	-	-	589
5	10	10	10	10	9	10	10	10	10	10	10	10	9	10	10	10	-	-	158
6	16	16	16	16	15	16	16	16	16	16	16	16	16	16	16	16	-	-	255
7	8	8	8	8	8	8	8	7	7	8	8	8	8	8	8	8	-	-	126
8	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	-	-	32
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total 0-15	134	135	134	133	131	134	135	133	131	135	134	135	132	133	134	135	0	0	2138

COEFFICIENT OF VARIATION (CV)

modal age	Tom Reader 1	Jean Louis Reader 2	Betty Reader 3	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegunn Reader 8	Ilse Reader 9	Selene Reader 10	Imelda Reader 11	Gary Reader 12	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 17	0 Reader 18	ALL Readers
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2	0%	0%	27%	0%	26%	21%	20%	21%	21%	19%	19%	17%	0%	21%	35%	21%	-	-	18.3%
3	11%	0%	24%	11%	24%	10%	18%	18%	8%	14%	13%	10%	12%	19%	22%	12%	-	-	15.2%
4	8%	4%	22%	6%	24%	16%	14%	13%	11%	14%	7%	10%	13%	17%	15%	13%	-	-	12.9%
5	9%	6%	22%	12%	15%	11%	13%	8%	9%	8%	9%	14%	9%	8%	15%	8%	-	-	12.5%
6	6%	0%	14%	4%	19%	7%	10%	6%	4%	10%	4%	8%	4%	7%	9%	7%	-	-	10.2%
7	11%	7%	15%	5%	21%	8%	7%	5%	12%	8%	0%	12%	14%	5%	12%	8%	-	-	11.3%
8	0%	9%	11%	16%	11%	8%	0%	0%	9%	8%	8%	0%	0%	0%	0%	0%	-	-	11.2%
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Weighted mean 0-15	8.0%	2.1%	21.8%	7.3%	22.5%	12.1%	14.6%	13.6%	10.1%	13.0%	9.8%	10.8%	9.7%	14.8%	18.4%	12.0%	-	-	14.0%
RANKING	3	1	15	2	16	9	12	11	6	10	5	7	4	13	14	8			

PERCENTAGE AGREEMENT

modal age	Tom Reader 1	Jean Louis Reader 2	Betty Reader 3	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegunn Reader 8	Ilse Reader 9	Selene Reader 10	Imelda Reader 11	Gary Reader 12	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 17	0 Reader 18	ALL
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	100%	100%	-	100%	0%	100%	0%	100%	100%	0%	100%	100%	100%	100%	100%	100%	-	-	80%
2	100%	100%	71%	100%	64%	71%	43%	69%	71%	36%	79%	86%	100%	54%	71%	57%	-	-	73%
3	87%	100%	49%	87%	48%	89%	55%	79%	93%	72%	78%	91%	87%	72%	59%	81%	-	-	77%
4	89%	97%	43%	95%	33%	81%	41%	78%	81%	78%	92%	81%	81%	78%	68%	76%	-	-	75%
5	80%	90%	50%	70%	0%	70%	50%	80%	80%	80%	80%	50%	78%	80%	40%	80%	-	-	66%
6	88%	100%	50%	94%	7%	81%	31%	88%	94%	50%	94%	69%	94%	81%	56%	81%	-	-	73%
7	75%	75%	25%	88%	13%	75%	38%	86%	57%	75%	100%	13%	50%	88%	25%	75%	-	-	60%
8	0%	50%	0%	50%	0%	50%	100%	100%	50%	50%	50%	100%	0%	100%	0%	0%	-	-	44%
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Weighted mean 0-15	86.6%	96.3%	47.8%	89.5%	34.4%	81.3%	45.9%	79.7%	84.0%	67.4%	85.1%	77.8%	83.3%	75.2%	58.2%	75.6%			73.0%
RANKING	3	1	14	2	16	7	15	8	5	12	4	9	6	11	13	10			

RELATIVE BIAS

modal age	Tom Reader 1	Jean Louis Reader 2	Betty Reader 3	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegunn Reader 8	Ilse Reader 9	Selene Reader 10	Imelda Reader 11	Gary Reader 12	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 17	0 Reader 18	ALL
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	0.00	0.00	-	0.00	1.00	0.00	1.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	-	-	0.20
2	0.00	0.00	-0.29	0.00	0.21	0.29	0.57	0.31	0.29	0.64	0.21	0.14	0.00	0.46	0.07	0.43	-	-	0.21
3	0.13	0.00	-0.45	0.13	-0.35	0.11	0.51	0.17	0.07	0.28	0.22	-0.04	-0.13	0.24	-0.30	0.19	-	-	0.06
4	-0.11	0.03	-0.30	0.00	-0.47	0.08	0.70	0.08	-0.14	0.16	-0.03	-0.19	-0.17	0.19	-0.30	0.16	-	-	-0.02
5	-0.20	-0.10	-0.80	-0.10	-1.44	0.10	0.30	0.20	0.00	0.20	0.00	-0.30	-0.22	0.20	-0.40	0.20	-	-	-0.14
6	-0.13	0.00	-0.31	-0.06	-1.33	0.19	0.56	0.13	-0.06	0.56	0.06	-0.31	-0.06	0.19	-0.44	0.19	-	-	-0.05
7	-0.38	-0.25	-1.00	-0.13	-2.00	0.00	0.63	0.14	-0.57	0.00	0.00	-0.63	-0.75	0.13	-0.50	0.00	-	-	-0.33
8	-1.00	-0.50	-1.50	1.00	-1.50	0.50	0.00	0.00	-0.50	0.50	0.50	0.00	-1.00	0.00	-1.00	1.00	-	-	-0.22
9	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Weighted mean 0-15	-0.05	-0.02	-0.45	0.04	-0.62	0.13	0.56	0.15	-0.03	0.30	0.10	-0.15	-0.17	0.23	-0.27	0.21			-0.00
RANKING	4	1	14	3	16	6	15	8	2	13	5	7	9	11	12	10			

Overall ranking

	Tom Reader 1	Jean Louis Reader 2	Betty Reader 3	Fiona Reader 4	Ian Reader 5	Ines Reader 6	Helle Reader 7	Hildegunn Reader 8	Ilse Reader 9	Selene Reader 10	Imelda Reader 11	Gary Reader 12	Gordon Reader 13	Lisbet Reader 14	Gerrit Reader 15	Friederike Reader 16	0 Reader 17	0 Reader 18
Ranking Coefficient of Variation	3	1	15	2	16	9	12	11	6	10	5	7	4	13	14	8		
Ranking Percentage Agreement	3	1	14	2	16	7	15	8	5	12	4	9	6	11	13	10		
Ranking Relative bias	4	1	14	3	16	6	15	8	2	13	5	7	9	11	12	10		
OVERALL RANKING	3	1	15	2	16	7	14	9	4	11	5	8	6	11	13	10		

Table AIV.3 Trainee readers age versus modal age

Age	modal age	Betty
0	-	-
1	-	5
2	14	32
3	47	41
4	37	22
5	10	14
6	16	15
7	8	5
8	2	-
9	-	-
10	-	-
11	-	-
12	-	-
N	134	134
%		48%
cv		22%
bias		-0.45

Age	modal age	Selene
0	-	-
1	1	-
2	14	6
3	47	45
4	37	42
5	10	12
6	16	13
7	8	13
8	2	3
9	-	1
10	-	-
11	-	-
12	-	-
N	135	135
%		67%
cv		13%
bias		0.30

Age	modal age	Gary
0	-	-
1	1	1
2	14	15
3	47	52
4	37	35
5	10	10
6	16	18
7	8	1
8	2	3
9	-	-
10	-	-
11	-	-
12	-	-
N	135	135
%		78%
cv		11%
bias		-0.15