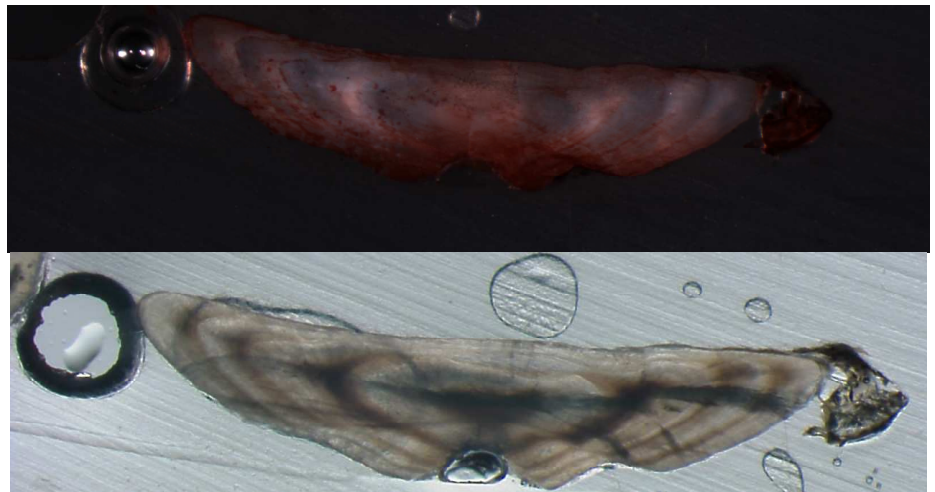


Report of the Sole
(Solea solea)
 in the Bay of Biscay
 Otolith Exchange
 Scheme 2011



Mahé, K., Moerman, M., Maertens, I., Holmes, I., Boiron, A., Elleboode, R., 2012.
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1. Introduction

The Planning Group on Commercial Catch, Discards and Biological Sampling (PGCCDBS) meeting in 2011 recommended a small exchange :

“7.2.1.3.1 Bay of Biscay sole (Solea solea)

The WGHMM identified a need to identify the cause of a discrepancy between French and Belgian weights at age. PGCCDBS recommends a small exchange in 2011 in order to clarify this issue and report back to WGHMM.”

3 countries took part in this exchange :

- ❖ Belgium
- ❖ France
- ❖ UK England

The objectives of the exchange were:

- ❖ to investigate the levels of agreement on age readings
- ❖ to analyse the relative differences between age readers and techniques

2. Participants

5 readers participated to this exchange.

Table 1 : List of the readers.

Name	Country	Institute
Martine Moerman	Belgium	ILVO
Ilse Maertens	Belgium	ILVO
Ian Holmes	UK England	CEFAS
Anne Boiron	France	IFREMER
Romain Elleboode	France	IFREMER

3. Otolith collection

The otolith collection (n=120) came from the 3 following samples realized at the fishing port of La Cotinière :

- ❖ 41 otoliths from 3 June 2010
- ❖ 32 otoliths from 8 June 2010
- ❖ 47 otoliths from 10 June 2010



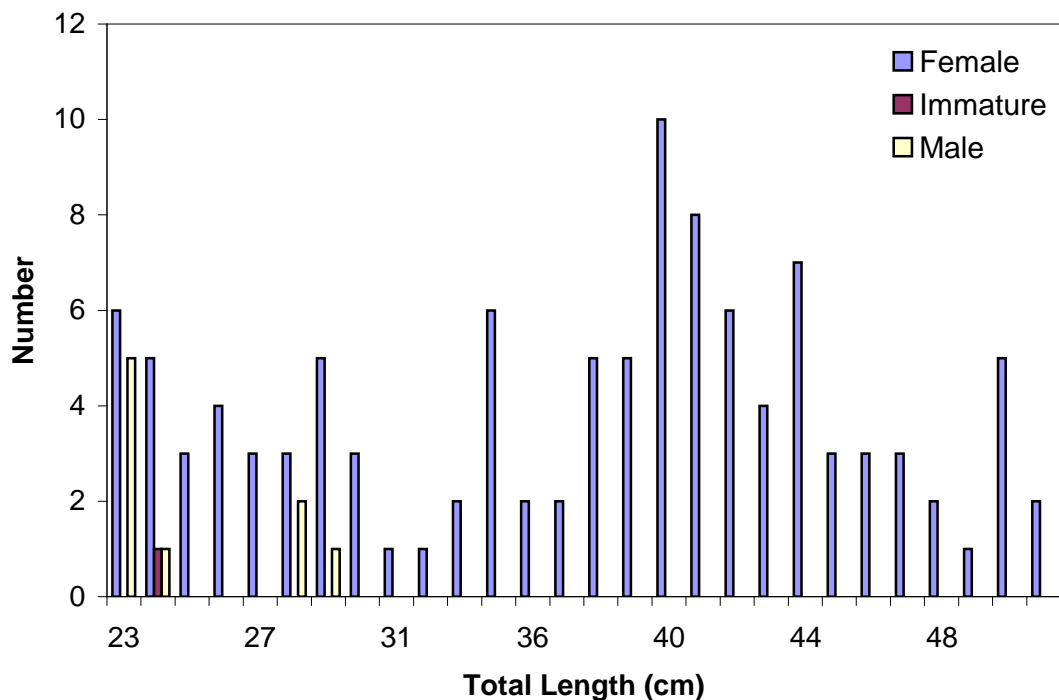


Figure 1 : Histograms of the samples.

At one otolith correspond two images of the section, whether it is stained or not.

4. Reading procedure

Date of birth is conventionally attributed to the 1st of January. One *annulus* consists of one opaque and one translucent zone. For age estimation, translucent zones are counted.

Each reader must complete the column of age reading quality such as :

AQ1: Easy to age with high precision.

If a scale of 1-100 is applied, where 100 represents the highest readers confidence in age reading and 1 indicates no confidence in the age reading. Age quality 1 (AQ1), will apply to approximately the top 25 % of the possible quality ratings. AQ1 is an indication that the age data is considered reliable for stock assessment.

AQ2: Normal quality.

Age quality 2 (AQ2), will apply approximately to age readings comprised between 25 and 75 percentiles of possible quality ratings. AQ2 is an indication that the age data is sufficiently reliable to be used for stock assessment purposes but an improvement is required.

AQ3: Difficult to age with acceptable precision.

Age quality 3 (AQ3), will apply to approximately the lowest 25 % of the possible quality ratings. AQ3 is an indication that there are serious concerns about the reliability of the age data and/or its value to stock assessment WGs.

5. Results

The spreadsheet (Eltink, 2000) has been completed according to instructions contained in the Guidelines and Tools for Age Reading Comparisons by Eltink *et al.* (2000). Modal ages were calculated for each otolith read, with percentage agreement, mean age and precision coefficient of variation as a definition :

- ❖ percentage agreement = $100 \times (\text{no. of readers agreeing with modal age} / \text{total no. of readers})$.
- ❖ precision c. v. = $100 \times (\text{standard deviation of age readings} / \text{mean of age readings})$.

The set of 120 otoliths was read by 5 readers. 2 readers interpreted only staining slice and 3 others readers the both preparations.

5.1. Precision¹

The first analyse presented the 8 readers results (5 reading stained otoliths and 3 reading unstained otoliths). Mean precision of age estimation for individual fish were Coefficient of Variation (CV) of 4.7% and percent agreement to modal age of 88.6%. On 120 otoliths, 67 were read with 100% agreement (56%) and thus a CV of 0%. There were only little variations in precision on age estimate between individual fish, with CV ranging from 0 to 27% and percent agreement range from 50 to 100%. Appendix 1 examines readings of individuals at each modal age and summarises the number of otoliths read, the precision CV, percentage agreement.

The second analyse presented the results of 5 readers (only staining sections). Mean precision of age estimation for individual fish were Coefficient of Variation (CV) of 4.7% and percent agreement to modal age of 88.6%. On 120 otoliths, 82 were read with 100% agreement (68%) and thus a CV of 0%. There were variations in precision of age estimate between individual fish, with a CV ranging from 0 to 31% and percent agreement range from 40 to 100%.

5.2. Relative bias (Accuracy)²

The minimal requirement for age reading's consistency is the absence of bias among readers and through the time. The hypothesis of an absence of bias between two readers

¹ Precision is defined as the variability in the age readings. The precision's errors in age readings are better described by the coefficient of variation (CV) by age group. This measure of precision is independent of the closeness to the true age (ICES, 2007).

² In absence of calcified structures of known age, the age readings can be compared to modal age, which is defined as the age determined for an individual structure whose most of the readers have a preference. Relative bias can be defined as a systematic over- or underestimation of age compared to the modal age. The age reading comparisons to modal age provide a low estimate of relative bias compared to absolute bias, when most readers have a similar serious bias in age reading (ICES, 2007).

or between a reader and the modal age estimated can be tested non-parametrically with a one-sample Wilcoxon signed rank test (Tab. 2).

Table 2 : Inter-reader bias test and reader against modal age bias test (-: no sign of bias ($p>0.05$); *: possibility of bias ($0.01<p<0.05$); **: certainty of bias ($p<0.01$)).

	France AB Reader 1	Belgium MM Reader 2	Belgium IM Reader 3	France RE Reader 4	JK England II Reader 5	France RE Reader 6	Belgium MM Reader 7	Belgium IM Reader 8
Reader 1								
Reader 2	—							
Reader 3	—	—						
Reader 4	—	*	—					
Reader 5	—	—	—	—				
Reader 6	—	**	**	—	*			
Reader 7	*	—	—	**	*	—		
Reader 8	—	—	—	—	—	**	*	
MODAL age	—	—	—	—	—	**	**	—

It should be noted that there are no bias among readers (from reader 1 to reader 5) and modal age from the staining technique. Moreover, for the 3 readers, there are no bias between both techniques for the same reader (Readers 2-7; Readers 3-8; Readers 4-6).

5.3. Age reading quality

Age reading quality was estimated by 3 readers on images of staining sections. The table 3 presented the images number by the level of Age reading quality for each reader and all readers. 15 images (12.5%) were classified in the level AQ3 corresponding to difficult to age with acceptable precision. The evoked reasons of this problem were :

- 1st annuli unclear
- poor quality of image

Table 3 : Level of Age reading quality by readers and all readers of the otoliths staining sections of sole (*Solea solea*).

Level of Quality	Reader 2	Reader 3	Reader 5	All Readers	All Readers (%)
AQ1	53	30	35	33	27.5
AQ2	48	57	55	72	60
AQ3	19	33	30	15	12.5

Age reading quality was estimated by 2 readers on images of otoliths unstained section. The table 4 presented the images number by the level of Age reading quality for each reader and all readers. 18 images (15%) were classified in the level AQ3 corresponding to difficult to age with acceptable precision.

Table 4 : Level of Age reading quality by readers and all readers of the sections without staining of sole (*Solea solea*).

Level of Quality	Reader 2	Reader 3	All Readers	All Readers (%)
AQ1	60	68	38	31.7
AQ2	31	33	64	53.3
AQ3	29	19	18	15.0

6. Executive Summary

There were an exchange and a workshop in 2002 of the sole in the Bay of Biscay. The Otolith Exchange Scheme 2011 was the second exercise for the sole in the Bay of Biscay. 5 readers participated in this exchange from Belgium (2 readers), from France (2 readers) and from UK England (1 reader). The otolith collection (n=120) came from 3 samples realized at the fishing port of La Cotinière during the month of June in 2010. For each otolith, readers had the images of otolith section before and after staining.

This analyse presented the results of 8 readers (5 readings of stained otoliths and 3 readings of unstained otoliths). Mean precision of age estimate for individual fish were Coefficient of Variation (CV) of 4.7% and percent agreement to modal age of 88.6%. On 120 otoliths, 67 were read with 100% agreement (56%) and thus a CV of 0%.



Figure 2 : Otolith section with and without staining. Estimation of age was 11 years with 100% agreement . It is a sole (*Solea solea*) female of 48 cm (TL). The date of catch is the 10 June 2010.

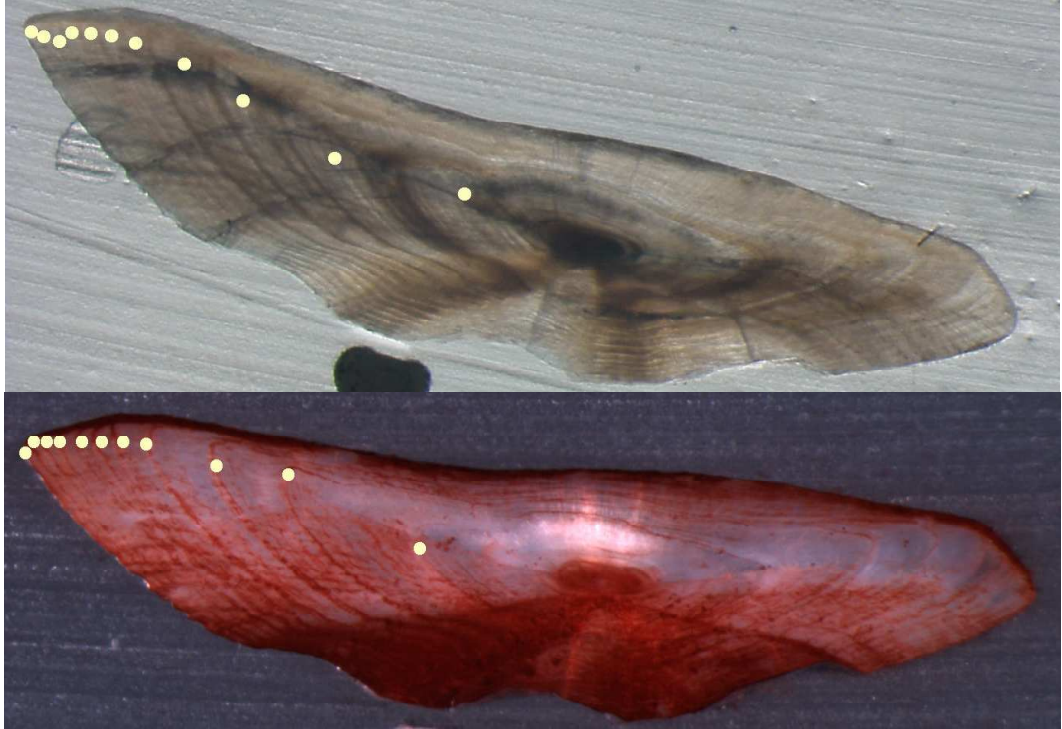


Figure 2 : Otolith section with and without staining. Estimation of age was 11 years with 100% agreement . It is a sole (*Solea solea*) female of 50 cm (TL). The date of catch is the 10 June 2010.

There were only little variations in precision of age estimation between individual fish, with CV ranging from 0 to 27% and percent agreement range from 50 to 100%.

There is no bias between the readers of Belgium (Ilse Maertens and Martine Moerman), France (Anne Boiron and Romain Elleboode) and the UK England (Ian Holmes).

7. References

Eltink, A. T. G. W., Newton, A. W., Morgado, C., Santamaria, M. T. G., Modin, J., 2000. Guidelines and Tools for Age Reading. (PDF document version 1.0 October 2000) Internet : <http://www.efan.no>

Eltink, A. T. G. W., 2000. Age reading comparisons. (MS Excel workbook version 1.0 October 2000) Internet : <http://www.efan.no>

ICES. 2007. Report of the Planning Group on Commercial Catch, Discards and Biological Sampling (PGCCDBS), 5–9 March 2007, Valetta, Malta. ACFM:09. 115p.



8. Appendix 1 : Details results of Sole from ICES VIIIa-b

The number of age readings, the coefficient of variation (CV), the percentage of 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 combined indicate the precision in age reading by reader and for all age readers combined.

NUMBER OF AGE READINGS										
MODAL age	France Reader 1	AB Belgium Reader 2	MM Belgium Reader 3	IM Belgium Reader 4	France RE Reader 5	RE K England Reader 6	France RE Reader 7	Belgium MM Reader 8	IM Belgium Reader 8	TOTAL
0	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-
3	35	35	35	35	35	35	35	35	35	280
4	29	29	29	29	29	29	29	29	29	232
5	17	17	17	17	17	17	17	17	17	136
6	10	10	10	10	10	10	10	10	10	80
7	4	4	4	4	4	4	4	4	4	32
8	1	1	1	1	1	1	1	1	1	8
9	6	6	6	6	6	6	6	6	6	48
10	8	8	8	8	8	8	8	8	8	64
11	2	2	2	2	2	2	2	2	2	16
12	3	3	3	3	3	3	3	3	3	24
13	1	1	1	1	1	1	1	1	1	8
14	1	1	1	1	1	1	1	1	1	8
15	-	-	-	-	-	-	-	-	-	-
16	1	1	1	1	1	1	1	1	1	8
17	-	-	-	-	-	-	-	-	-	-
18	1	1	1	1	1	1	1	1	1	8
19	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-
22	1	1	1	1	1	1	1	1	1	8
0-37	120	120	120	120	120	120	120	120	120	960

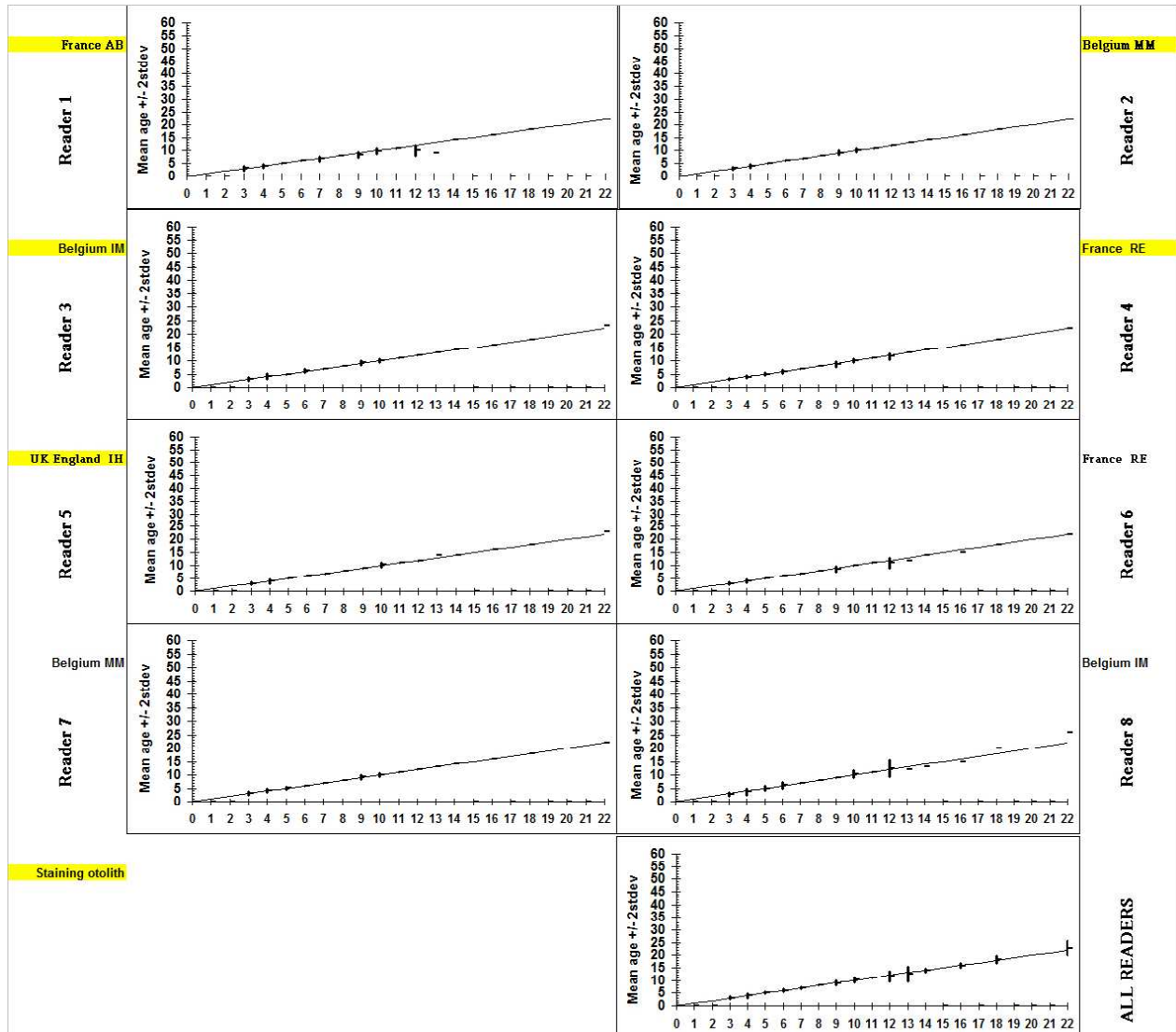
COEFFICIENT OF VARIATION (CV)										
MODAL age	France Reader 1	AB Belgium Reader 2	MM Belgium Reader 3	IM Belgium Reader 4	France RE Reader 5	RE K England Reader 6	France RE Reader 7	Belgium MM Reader 8	IM Belgium Reader 8	ALL Readers
1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-
3	14%	9%	11%	6%	8%	10%	9%	11%	5.6%	5.6%
4	9%	8%	12%	5%	11%	11%	8%	16%	7.0%	7.0%
5	0%	0%	0%	5%	0%	0%	6%	7%	1.7%	1.7%
6	0%	0%	5%	5%	0%	0%	0%	9%	2.5%	2.5%
7	7%	0%	0%	0%	0%	0%	0%	0%	1.3%	1.3%
8	-	-	-	-	-	-	-	-	-	-
9	6%	4%	4%	6%	0%	6%	4%	0%	4.0%	4.0%
10	5%	3%	3%	3%	5%	0%	3%	7%	2.7%	2.7%
11	0%	0%	0%	0%	0%	0%	0%	0%	0.0%	0.0%
12	10%	0%	0%	5%	0%	9%	0%	12%	8.4%	8.4%
13	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	-	-	-	-	-
16	-	-	-	-	-	-	-	-	-	-
17	-	-	-	-	-	-	-	-	-	-
18	-	-	-	-	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-
22	-	-	-	-	-	-	-	-	-	-
0-37	7.3%	5.1%	7.2%	4.6%	5.4%	5.9%	5.6%	9.8%	4.7%	4.7%
RANKING	7	2	6	1	3	5	4	8		

PERCENTAGE AGREEMENT										
MODAL age	France Reader 1	AB Belgium Reader 2	MM Belgium Reader 3	IM Belgium Reader 4	France RE Reader 5	RE K England Reader 6	France RE Reader 7	Belgium MM Reader 8	IM Belgium Reader 8	ALL
0	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-
3	80%	91%	89%	97%	94%	91%	91%	89%	90%	90%
4	86%	90%	86%	97%	79%	93%	90%	66%	86%	86%
5	100%	100%	100%	94%	100%	100%	94%	88%	97%	97%
6	100%	100%	90%	90%	100%	100%	100%	70%	94%	94%
7	75%	100%	100%	100%	100%	100%	100%	100%	97%	97%
8	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
9	33%	83%	83%	67%	100%	67%	83%	100%	77%	77%
10	75%	88%	88%	88%	75%	100%	88%	88%	86%	86%
11	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
12	0%	100%	100%	67%	100%	33%	100%	33%	67%	67%
13	0%	100%	100%	100%	0%	0%	100%	0%	50%	50%
14	100%	100%	100%	100%	100%	100%	100%	0%	88%	88%
15	-	-	-	-	-	-	-	-	-	-
16	100%	100%	100%	100%	100%	0%	100%	0%	75%	75%
17	-	-	-	-	-	-	-	-	-	-
18	100%	100%	100%	100%	100%	100%	100%	0%	88%	88%
19	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-
22	100%	100%	0%	100%	0%	100%	100%	0%	63%	63%
0-37	81.67%	93.33%	90.00%	93.33%	90.00%	90.83%	92.50%	77.50%	88.65%	88.65%
RANKING	7	1	5	1	5	4	3	8		

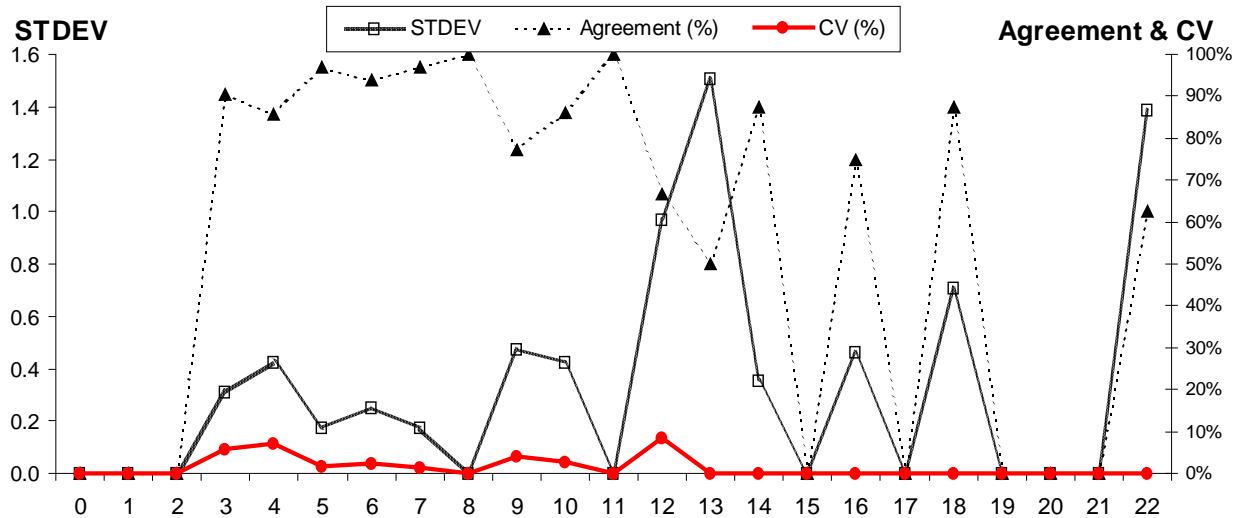
RELATIVE BIAS										
MODAL age	France Reader 1	AB Belgium Reader 2	MM Belgium Reader 3	IM Belgium Reader 4	France RE Reader 5	RE K England Reader 6	France RE Reader 7	Belgium MM Reader 8	IM Belgium Reader 8	ALL
0	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0
9	-1	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0
12	-2	0	0	0	0	-1	0	0	0	0
13	-4	0	0	0	1	-1	0	-1	-1	-1
14	0	0	0	0	0	0	0	-1	0	0
15	-	-	-	-	-	-	-	-	-	-
16	0	0	0	0	0	-1	0	-1	0	0
17	-	-	-	-	-	-	-	-	-	-
18	0	0	0	0	0	0	0	2	0	0
19	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	-	-	-	-	-
22	0	0	1	0	1	0	0	4	1	1
0-37	-0.08	0.05	0.04	-0.03	-0.02	-0.11	0.08	-0.05	-0.03	-0.03
RANKING	2	7	3	7	3	5	6	1		

Overall ranking									
	France Reader 1	AB Belgium Reader 2	MM Belgium Reader 3	IM Belgium Reader 4	France RE Reader 5	RE K England Reader 6	France RE Reader 7	Belgium MM Reader 8	IM Belgium Reader 8
Ranking Coefficient of Variation	7	2	6	1	3	5	4	8	
Ranking Percentage Agreement	7	1	5	1	5	4	3	8	
Ranking Relative bias	2	7	3	7	3	5	6	1	
OVFRAT I RANKING	7	2	5	1	3	5	4	8	

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.



The coefficient of variation (CV%), percentage of agreement and the standard deviation (STDEV) are plotted against MODAL age. CV is much less age dependent than the standard deviation (STDEV) and the percentage of 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.



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.

