Report of Otolith Exchange Analysis for Plaice (*Pleuronectes platessa*) in divisions 7.f-g

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1 Executive summary

This plaice age reading exchange took place between May and June 2019 using SmartDots software. No previous age calibration data is available for plaice stock in divisions 7.fg (Bristol Channel, Celtic Sea). Therefore, the Working Group on Biological Parameters (WGBIOP 2018) called for a full scale otoliths exchange in order to identify and resolve age interpretation differences between readers and laboratories. The most recent workshop on age reading of plaice was conducted in 2010 for North Sea and Skagerrak-Kattegat (WKARP).

A total of 14 participants were involved in the Plaice 7.fg otoliths exchange. Age readers represented all countries where landings of plaice from divisions 7.fg have been reported. Age estimation of plaice stock in 7fg is based on whole otoliths with the exception of UK-CEFAS where either sectioned otoliths or broken and burnt method are used. Following WGBIOP Guidelines for Otoliths Exchanges (2018) a set of 83 whole and 83 sectioned otoliths from the same fish were selected (stratified by age, quarter and ICES area) and uploaded for analysing using the SmartDots application. The samples were all provided by ILVO, 39 samples from area 7.f and 44 samples from area 7.g.

The objectives of the present exchange were:

- Evaluate the accuracy and precision in otolith age reading of plaice in divisions 7.fg (Bristol Channel, Celtic Sea)
- Identify issues related to age reading of plaice in divisions 7.f-g
- Report results to WGBIOP that will take place in October 2019

The statistics representing age reading performance were calculated for all readers combined and for experienced readers only. All areas were included and calculations were carried separately for each preparation method.

Age readers were specifically asked to annotate only preparation methods they are familiar with as otherwise the results may be biased. A total of 13 age readers annotated whole otoliths (8 advanced and 5 basic). Some of those readers were not used to reading plaice otoliths in area 7.f-g. Only 8 annotated sectioned plaice (5 advanced (but all were used to reading plaice “whole” and 3 basic). Remaining readers did not feel confident as they had none or very limited experience with this preparation method for plaice. Moreover, the quality of the sectioned images was rather poor (often AQ3 was given). Plaice otoliths are normally not sectioned by ILVO and due to this lack of routine, the light settings of the microscope could probably have been better.

As expected, agreement was higher and variance (APE & CV) was lower for advanced readers compared to all readers regardless of preparation method. In all cases the statistics were significantly better for whole otoliths than for sectioned otoliths. The average percentage agreement of 72% and variance CV=19%, APE=11% were reached by all readers annotating whole otoliths.

There was slight improvement when only advanced 7f-g readers were combined: PA=75%; CV=18%; APE = 10%. The results of the present exchange for whole otoliths (all readers) are in line with the statistics achieved during Workshop on Age Reading of North Sea (IV) and Skagerrak-Kattegat (IIIa) Plaice (WKARP 2010) and plaice in area 7-h-k of 2019. Overall average percentage agreement for sectioned otoliths PA=56% and variance CV=28%; APE=19% were much lower. There was some improvement when only advanced readers are included: PA=63%;

CV=28%; APE=18% . Lower agreement for sectioned otoliths was also observed in the plaice otolith exchange for area 7.h-k.

Differences in age determination mainly related to varied readers approach to otoliths irregular growth, edge interpretation and interpretation of the first ring. Age readers faced the same issues during Plaice Ageing Workshop back in 2010 (WKARP 2010).

It is recommended that readers involved in age determination of plaice in 7.f-g should familiarize themselves with current reference sets/ interpretation protocols and consistently follow them while ageing. Regular exchanges, both internally and externally in order to learn and to improve the agreements between readers should be organised using SmartDots application. Also, as the last plaice workshop took place 9 years ago, a new plaice workshop is recommended.

2 Introduction

Plaice (*Pleuronectes platessa*) is a commercially important flatfish of the family Pleuronectidae. They are widely distributed in the Northeast Atlantic. They inhabit mostly sandy bottoms, although they also live on gravel and mud (Ruiz, 2007) where they feed on thin-shelled molluscs and polychaetes. Spawning takes place from January to March. The offshore spawned eggs take between 16 and 20 days to hatch, during which time they are transported by currents and tidal movement to coastal areas. After 5 to 7 weeks spent in the water column, the larvae metamorphose and settle to the nursery grounds in shallow (< 10 m) coastal waters mainly of a sandy nature (Heindler et al, 2019).

Until now, no age reading exercises were conducted for plaice in divisions 7.f-g. Therefore, the Working Group on Biological Parameters (WGBIOP) recommended a full scale otolith exchange in 2018 (WGBIOP, 2018) for plaice in 7.f-g. The last plaice age reading workshop took place in 2010 for North Sea and Skagerrak-Kattegat in IJmuiden (WKARP 2010). The overall percentage agreement was 73% and 76% for sections and whole otoliths respectively in the North Sea. That was better than in Skagerrak-Kattegat where the percentage agreement was 69% and 71 % for sections and whole otoliths respectively.

The objectives of this new exchange were:

- Estimate the accuracy and precision of the age readings for whole otoliths and sectioned and stained otoliths.
- Detect any potential age reading problems.
- Compare the results between whole and sectioned otoliths

3 Methods and Analysis

3.1 Statistical analyses

This report contains statistical analyses and comparisons of age readings in the form of tables and graphical plots based on Guus Eltink Excel sheet 'Age Reading Comparisons' (Eltink, A.T.G.W. 2000) and R scripts specifically developed for SmartDots. For each individual fish the Coefficient of Variation (CV), percentage agreement (PA) and Average Percentage Error (APE) to modal age was calculated. Additionally, age error matrices (AEM) were produced for advanced age readers separately for whole and sectioned otoliths.

All statistical analyses were produced separately for whole and sectioned otoliths and for all and then for only advanced age readers who provide data for stock assessment.

Percentage Agreement

The percentage agreement per reader per modal age tells how large is the part of readings that are equal to the modal age. The weighted mean included at the bottom of the table is weighted according to number of age readings.

PA = (no. of readings agreeing with modal age/total no. of readings) x 100%.

Co-efficient of Variation (CV)

The table presents the CV per modal age and reader. The CV's are calculated as the ratio between the standard deviation (σ) and mean value (μ) per reader and modal age:

$$CV = \frac{\sigma}{\mu} \cdot 100\%$$

To the table is also added the CV of all readers combined per modal age and a weighted mean of the CV per reader.

Average Percentage Error (APE)

APE was calculated based on the method outlined by Beamish & Fournier (1981). This method is not independent of fish age and thus provides a better estimate of precision. As the calculations of both CV and APE pose problems if the mean age is close to 0, all observations for which modal age was 0 were omitted from the CV and APE calculations.

The average percentage error is calculated per image as:

$$APE = \frac{100\%}{n} \sum_{i=1}^{n} \left| \frac{a_i - \overline{a}}{\overline{a}} \right|$$

where a_i is the age reading of reader i and $\overline{a}$ is the mean of all readings from 1 to n.

Age error matrix (AEM)

Age error matrices (AEM) were produced following procedures outlined by WKSABCAL (2014) where the matrix shows the proportion of each modal age miss-aged as other ages. The sum of each row is 1, which equals 100%. The age data was analysed twice, the first time all readers were included and the second time only the "advanced" readers were included. If a reader is "advanced" then they are considered well trained and they provide ages for stock assessment or similar purposes. When the AEM is compiled for assessment purposes it uses only those readers who provide age data for the stock assessment in that specific area.

Otolith Growth Analysis

SmartDots provides a measure of distance between the annotations made by the readers and thus provides a measure of growth increment width. This data is used to establish growth curves for each fish and for each reader.

3.2 Overview of samples and readers

A total of 14 participants from 6 different countries were involved in the plaice 7.fg otoliths exchange. A list of the participants with a summary of their experience in age estimation of plaice is shown in Table 3.1. Age estimation of plaice is based on whole otoliths with the exception of UK where mainly broken & burnt otoliths are used.

Table 3.1: Reader overview.

Country	Reader code	Expertise	Preferred method	Whole	Sectioned
Ireland	R02 IE	Advanced 7.fg	Whole	X	X
France	R04 FR	Advanced 7.fg	Whole	X	X
Denmark	R06 DK	Advanced	Whole	X	
Sweden	R08 SE	Advanced	Whole	X	
Belgium	R10 BE	Advanced 7.fg	Whole	X	X
Belgium	R12 BE	Advanced 7.fg	Whole	X	X
Denmark	R14 DK	Advanced	Whole	X	
Ireland	R16 IE	Advanced 7.fg	Whole	X	X
France	R20 FR	Basic	Whole	X	X
France	R22 FR	Basic	Whole	X	
France	R24 FR	Basic	Whole	X	X
Denmark	R28 DK	Basic	Whole	X	
UK	R30 GB	Basic	Broken and burnt/sectioned		X
France	R36 FR	Basic	Whole	X	

Age readers represented all countries where landings of plaice from divisions 7.fg have been reported. Age estimation of plaice stock in 7fg is based on whole otoliths with the exception of UK-CEFAS where either sectioned otoliths or broken and burnt method are used. Following WGBIOP Guidelines for Otoliths Exchanges (2018) a set of 83 whole and 83 sectioned otoliths from the same fish were selected (stratified by age, quarter and ICES area) and uploaded for analysing using the SmartDots application. The samples were all provided by ILVO, 39 samples from area 7.f and 44 samples from area 7.g.

Table 3.2: Overview of samples used

Year	ICES area	Strata	Quarter	Number of samples	Modal age range	Length range
2010	27.7.f	WH	4	1	1	210 mm
2011	27.7.g	WH	1	1	1	190 mm
2011	27.7.g	WH	3	1	1	200 mm
2013	27.7.g	WH	2	1	1	180 mm
2015	27.7.g	WH	1	5	2-9	180-500 mm
2015	27.7.g	WH	3	6	5-9	260-450 mm
2016	27.7.f	WH	2	1	10	400 mm
2016	27.7.f	WH	3	6	2-8	220-435 mm
2016	27.7.g	WH	3	3	2-4	180-200 mm
2016	27.7.g	WH	4	1	1	200 mm
2017	27.7.f	WH	1	11	1-9	180-495 mm
2017	27.7.f	WH	2	7	2-7	200-400 mm
2017	27.7.f	WH	4	2	3-4	230-260 mm
2017	27.7.g	WH	1	2	3-6	230-270 mm
2017	27.7.g	WH	2	10	2-10	200-520 mm
2017	27.7.g	WH	4	11	2-10	230-410 mm
2018	27.7.f	WH	2	2	1-9	180-425 mm
2018	27.7.f	WH	3	3	2-9	240-445 mm
2018	27.7.f	WH	4	6	2-8	210-430 mm
2018	27.7.g	WH	1	3	7-8	330-395 mm

4 Results

4.1 All readers – whole otoliths

All samples included

The weighted average percentage agreement based on modal ages for all readers is 72 %, with the weighted average CV of 19 % and APE of 11 %.

Table 4.1: Coefficient of Variation (CV) table presents the CV per modal age and reader, the CV of all readers combined per modal age and a weighted mean of the CV per reader.

Modal age	R02 IE	R04 FR	R06 DK	R08 SE	R10 BE	R12 BE	R14 DK	R16 IE	R20 FR	R22 FR	R24 FR	R28 DK	R36 FR	all
1	0 %	58 %	82 %	0 %	0 %	0 %	0 %	33 %	37 %	33 %	59 %	90 %	79 %	**52 %**
2	0 %	30 %	15 %	16 %	53 %	16 %	0 %	21 %	19 %	0 %	0 %	0 %	24 %	**23 %**
3	16 %	24 %	8 %	13 %	20 %	19 %	13 %	16 %	9 %	20 %	8 %	23 %	15 %	**18 %**
4	20 %	26 %	29 %	0 %	11 %	11 %	32 %	0 %	12 %	25 %	12 %	13 %	29 %	**18 %**
5	24 %	19 %	12 %	19 %	18 %	18 %	13 %	8 %	14 %	26 %	13 %	14 %	6 %	**17 %**
6	0 %	18 %	9 %	12 %	12 %	12 %	17 %	10 %	9 %	14 %	18 %	9 %	0 %	**13 %**
7	5 %	11 %	7 %	19 %	18 %	14 %	17 %	12 %	11 %	11 %	17 %	8 %	5 %	**14 %**
8	5 %	13 %	11 %	10 %	10 %	11 %	7 %	7 %	24 %	8 %	19 %	5 %	0 %	**13 %**
9	10 %	16 %	6 %	8 %	6 %	8 %	16 %	30 %	14 %	8 %	8 %	7 %	3 %	**13 %**
10	10 %	6 %	0 %	6 %	6 %	0 %	0 %	0 %	0 %	6 %	6 %	12 %	6 %	**6 %**
Weighted Mean	**10 %**	**23 %**	**16 %**	**12 %**	**18 %**	**13 %**	**12 %**	**15 %**	**15 %**	**16 %**	**15 %**	**18 %**	**16 %**	**19 %**

The percentage agreement per reader per modal age tells how large part of the readings that are equal to the modal age. The weighted mean including at the bottom of the table is weighted according to number of age readings.

Table 4.2: Percentage agreement (PA) table represents the PA per modal age and reader, the PA of all readers combined per modal age and a weighted mean of the PA per reader.

Modal age	R02 IE	R04 FR	R06 DK	R08 SE	R10 BE	R12 BE	R14 DK	R16 IE	R20 FR	R22 FR	R24 FR	R28 DK	R36 FR	all
1	100 %	71 %	83 %	100 %	100 %	100 %	100 %	86 %	80 %	86 %	86 %	50 %	86 %	**87 %**
2	100 %	70 %	90 %	89 %	90 %	89 %	100 %	70 %	80 %	100 %	100 %	100 %	80 %	**89 %**
3	73 %	73 %	93 %	79 %	53 %	40 %	86 %	80 %	93 %	60 %	93 %	67 %	80 %	**75 %**
4	50 %	60 %	75 %	100 %	80 %	80 %	40 %	100 %	75 %	80 %	80 %	67 %	60 %	**73 %**
5	55 %	62 %	70 %	73 %	55 %	50 %	91 %	82 %	82 %	45 %	64 %	75 %	91 %	**69 %**
6	100 %	33 %	71 %	86 %	86 %	86 %	43 %	71 %	71 %	71 %	71 %	67 %	100 %	**74 %**
7	89 %	44 %	78 %	67 %	78 %	78 %	44 %	67 %	56 %	78 %	44 %	75 %	89 %	**68 %**
8	83 %	0 %	50 %	83 %	83 %	80 %	40 %	50 %	50 %	67 %	33 %	83 %	100 %	**62 %**
9	80 %	40 %	70 %	50 %	50 %	56 %	22 %	50 %	20 %	50 %	50 %	62 %	90 %	**53 %**
10	33 %	67 %	100 %	67 %	67 %	100 %	0 %	100 %	100 %	67 %	67 %	67 %	67 %	**69 %**
Weighted Mean	**79 %**	**54 %**	**79 %**	**78 %**	**71 %**	**69 %**	**64 %**	**73 %**	**70 %**	**69 %**	**71 %**	**72 %**	**86 %**	**72 %**

The relative bias is the difference between the mean age (per modal age per reader) and modal age. As for the previous tables, a combined bias for all readers and weighted means are calculated and finally a rank is assigned to each reader.

Table 4.3: Relative bias table represents the relative bias per modal age per reader, the relative bias of all readers combined per modal age and a weighted mean of the relative bias per reader.

Modal age	R02 IE	R04 FR	R06 DK	R08 SE	R10 BE	R12 BE	R14 DK	R16 IE	R20 FR	R22 FR	R24 FR	R28 DK	R36 FR	all
1	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.14	0.20	0.14	0.29	-0.17	0.43	**0.12**
2	0.00	-0.10	0.10	0.11	0.40	0.11	0.00	0.30	0.20	0.00	0.00	0.00	0.00	**0.09**
3	0.13	-0.20	0.07	0.21	0.60	0.73	-0.14	-0.07	0.07	0.13	0.07	0.25	0.07	**0.15**
4	0.00	-0.60	-0.50	0.00	0.20	0.20	-0.40	0.00	0.25	-0.40	-0.20	0.33	-0.20	**-0.10**
5	0.18	-0.25	-0.10	0.55	0.73	0.80	-0.18	0.18	-0.09	0.09	0.00	0.38	0.09	**0.18**
6	0.00	-1.00	-0.29	0.29	0.29	0.29	-0.86	0.00	-0.29	-0.43	-0.57	-0.33	0.00	**-0.22**
7	0.11	-0.67	-0.22	0.44	0.56	0.44	-0.89	0.56	-0.56	0.11	-0.33	0.00	0.11	**-0.03**
8	0.17	-1.67	-0.67	0.33	0.33	0.40	-0.60	-0.50	-0.83	0.00	-0.67	-0.17	0.00	**-0.30**
9	0.00	-1.10	-0.10	0.70	0.50	0.56	-1.11	-0.70	-0.70	0.10	-0.60	-0.12	0.10	**-0.19**
10	0.00	-0.33	0.00	0.33	-0.33	0.00	-1.00	0.00	0.00	-0.33	-0.33	-0.67	0.33	**-0.18**
Weighted Mean	**0.07**	**-0.54**	**-0.09**	**0.32**	**0.42**	**0.44**	**-0.46**	**0.00**	**-0.19**	**0.00**	**-0.19**	**0.00**	**0.08**	**-0.01**

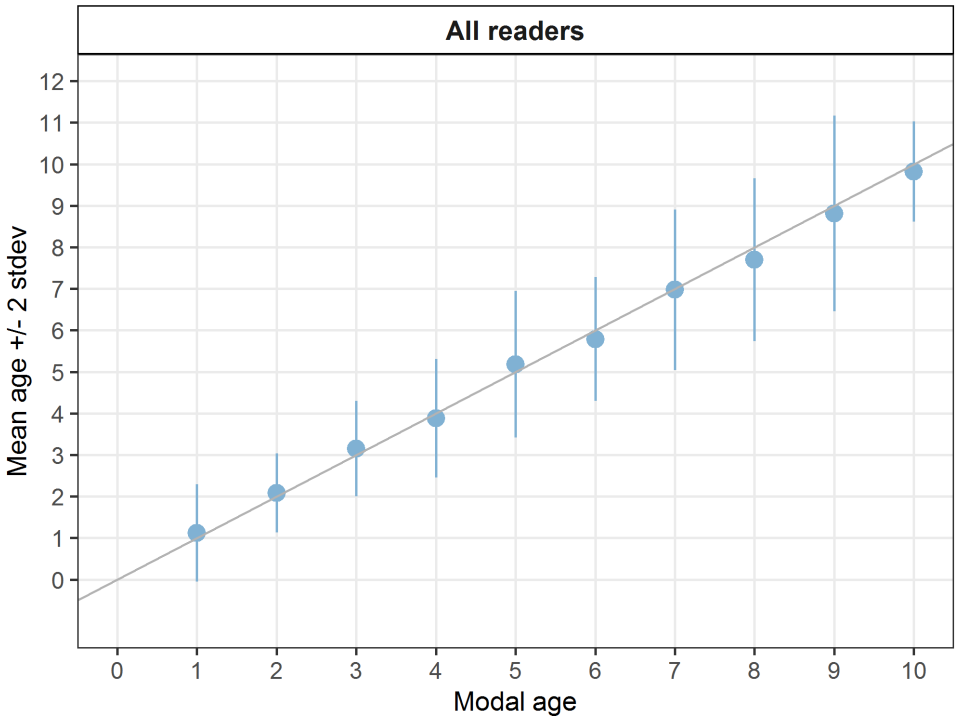


Figure 4.1: Age bias plot for all readers. Mean age recorded +/- 2 stdev of each reader and all readers combined are plotted against modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line). Relative bias is the age difference between estimated mean age and modal age.

Table 4.4: Inter reader bias test. The Inter-reader bias test gives probability of bias between readers and with modal age. - = no sign of bias (p>0.05), * = possibility of bias (0.01<p<0.05), * * = certainty of bias (p<0.01)

Comparison	R02 IE	R04 FR	R06 DK	R08 SE	R10 BE	R12 BE	R14 DK	R16 IE	R20 FR	R22 FR	R24 FR	R28 DK	R36 FR
R02 IE	-	**	-	**	**	**	**	-	*	-	*	-	-
R04 FR	**	-	**	**	**	**	-	**	**	**	**	**	**
R06 DK	-	**	-	**	**	**	**	-	-	-	-	-	*
R08 SE	**	**	**	-	-	-	**	**	**	**	**	**	*
R10 BE	**	**	**	-	-	-	**	**	**	**	**	**	**
R12 BE	**	**	**	-	-	-	**	**	**	**	**	**	**
R14 DK	**	-	**	**	**	**	-	**	**	**	**	**	**
R16 IE	-	**	-	**	**	**	**	-	-	-	-	-	-
R20 FR	*	**	-	**	**	**	**	-	-	-	-	-	*
R22 FR	-	**	-	**	**	**	**	-	-	-	-	-	-
R24 FR	*	**	-	**	**	**	**	-	-	-	-	*	**
R28 DK	-	**	-	**	**	**	**	-	-	-	*	-	-
R36 FR	-	**	*	*	**	**	**	-	*	-	**	-	-
Modal age	-	**	-	**	**	**	**	-	*	-	*	-	-

4.2 Advanced readers of area 7.f-g only – whole otoliths

The weighted average percentage agreement based on modal ages for all readers is 75 %, with the weighted average CV of 18 % and APE of 10 %.

Table 4.5: Coefficient of Variation (CV) table presents the CV per modal age and advanced reader, the CV of all advanced readers combined per modal age and a weighted mean of the CV per reader. A rank is also assigned to each reader.

Modal age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	all
1	0 %	58 %	0 %	0 %	33 %	**29 %**
2	0 %	30 %	15 %	29 %	19 %	**22 %**
3	14 %	14 %	28 %	22 %	0 %	**22 %**
4	14 %	38 %	0 %	0 %	22 %	**20 %**
5	16 %	18 %	7 %	7 %	7 %	**12 %**
6	6 %	18 %	5 %	5 %	8 %	**10 %**
7	17 %	13 %	19 %	14 %	11 %	**16 %**
8	10 %	14 %	0 %	0 %	14 %	**14 %**
9	8 %	17 %	5 %	8 %	29 %	**16 %**
10	10 %	20 %	0 %	0 %	13 %	**11 %**
Weighted Mean	**10 %**	**23 %**	**10 %**	**11 %**	**15 %**	**18 %**

Table 4.6: Percentage agreement (PA) table represents the PA per modal age and reader, advanced the PA of all advanced readers combined per modal age and a weighted mean of the PA per reader.

Modal age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	all
1	100 %	71 %	100 %	100 %	86 %	**91 %**
2	100 %	70 %	90 %	80 %	80 %	**84 %**
3	83 %	83 %	58 %	55 %	100 %	**76 %**
4	67 %	43 %	100 %	100 %	71 %	**76 %**
5	75 %	57 %	88 %	86 %	88 %	**79 %**
6	89 %	33 %	89 %	89 %	78 %	**79 %**
7	80 %	40 %	70 %	78 %	70 %	**67 %**
8	86 %	0 %	100 %	100 %	29 %	**62 %**

9	89 %	56 %	67 %	56 %	56 %	**64 %**
10	25 %	50 %	100 %	100 %	50 %	**65 %**
Weighted Mean	**83 %**	**53 %**	**83 %**	**81 %**	**73 %**	**75 %**

Table 4.7: Relative bias table represents the relative bias per modal age and advanced reader, the relative bias of all advanced readers combined per modal age and a weighted mean of the relative bias per reader. A rank is also assigned to each reader.

Modal age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	all
1	0.00	0.00	0.00	0.00	0.14	**0.03**
2	0.00	-0.10	0.10	0.30	0.20	**0.10**
3	0.00	-0.17	0.75	0.64	0.00	**0.24**
4	-0.33	-1.00	0.00	0.00	-0.43	**-0.35**
5	-0.38	-0.57	0.12	0.14	-0.12	**-0.16**
6	-0.11	-1.00	0.11	0.11	-0.22	**-0.22**
7	0.50	-0.50	0.80	0.44	0.50	**0.35**
8	-0.29	-2.00	0.00	0.00	-1.00	**-0.66**
9	-0.22	-0.89	0.33	0.56	-0.67	**-0.18**
10	-0.25	-1.50	0.00	0.00	-0.25	**-0.40**
Weighted Mean	**-0.07**	**-0.67**	**0.28**	**0.27**	**-0.14**	**-0.07**

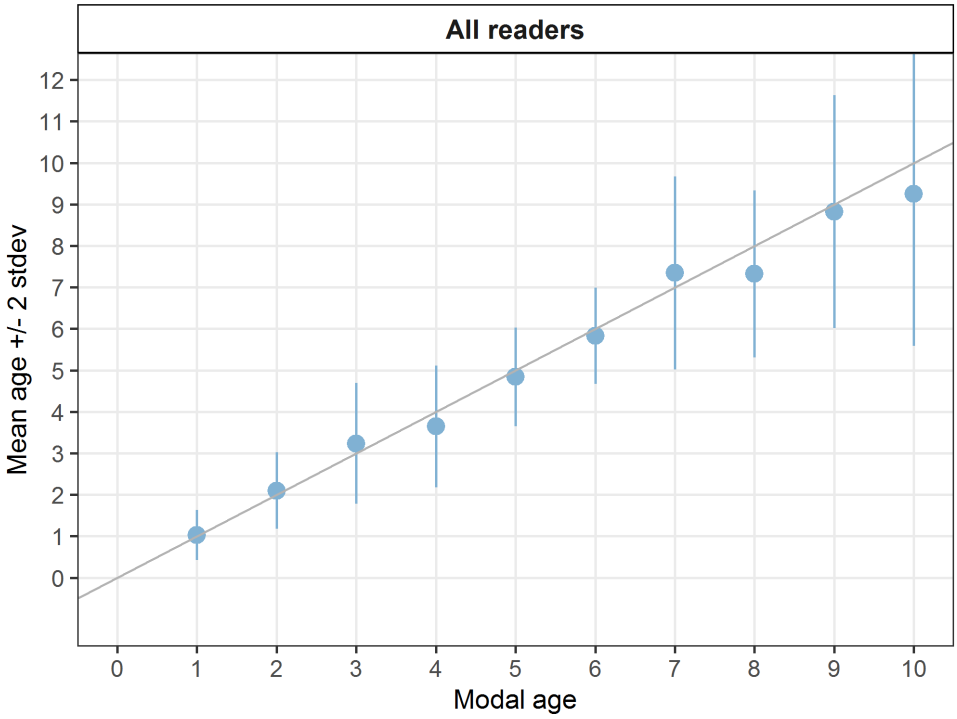


Figure 4.2: Age bias plot for advanced readers.

Age error matrices are calculated per area and only based on the age readings of the advanced readers.

Table 4.8: Age error matrix (AEM) for WH. The AEM shows the proportional distribution of age readings for each modal age. Age column should sum to one but due to rounding there might be small deviations in some cases. Only advanced readers are used for calculating the AEM.

strata	Modal age	1	2	3	4	5	6	7	8	9	10
WH	Age 0	0.02941	-	-	-	-	-	-	-	-	-
WH	Age 1	0.91176	0.04	-	0.02941	-	-	-	-	-	-
WH	Age 2	0.05882	0.84	0.05085	0.05882	-	-	-	-	0.02222	-

WH	Age 3	-	0.10	0.76271	0.14706	0.05263	-	-	-	-	-
WH	Age 4	-	0.02	0.10169	0.76471	0.10526	0.04762	-	-	-	-
WH	Age 5	-	-	0.06780	-	0.78947	0.11905	0.02041	0.08824	0.02222	-
WH	Age 6	-	-	0.01695	-	0.05263	0.78571	0.08163	0.11765	-	-
WH	Age 7	-	-	-	-	-	0.04762	0.67347	0.17647	0.04444	0.10
WH	Age 8	-	-	-	-	-	-	0.10204	0.61765	0.06667	0.05
WH	Age 9	-	-	-	-	-	-	0.04082	-	0.64444	0.10
WH	Age 10	-	-	-	-	-	-	0.04082	-	0.17778	0.65
WH	Age 11	-	-	-	-	-	-	0.04082	-	0.02222	0.10

4.3 All readers –sections

The weighted average percentage agreement based on modal ages for all readers is 56 %, with the weighted average CV of 28 % and APE of 19 %.

Table 4.9: Coefficient of Variation (CV) table presents the CV per modal age and reader, the CV of all readers combined per modal age and a weighted mean of the CV per reader. A rank is also assigned to each reader.

Modal age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	R20 FR	R24 FR	R30 GB	all
1	0 %	0 %	0 %	35 %	81 %	37 %	22 %	37 %	**66 %**
2	0 %	0 %	37 %	0 %	22 %	18 %	21 %	34 %	**31 %**
3	16 %	38 %	36 %	30 %	54 %	31 %	19 %	27 %	**38 %**
4	26 %	12 %	8 %	19 %	37 %	12 %	12 %	51 %	**36 %**
5	17 %	20 %	13 %	22 %	26 %	16 %	9 %	20 %	**22 %**
6	13 %	21 %	11 %	14 %	35 %	8 %	11 %	16 %	**21 %**
7	9 %	16 %	17 %	14 %	15 %	7 %	9 %	17 %	**17 %**
8	14 %	11 %	6 %	7 %	14 %	14 %	17 %	14 %	**18 %**
9	0 %	19 %	5 %	7 %	11 %	4 %	14 %	5 %	**13 %**
10	0 %	11 %	0 %	0 %	16 %	7 %	28 %	13 %	**18 %**
Weighted Mean	**11 %**	**17 %**	**15 %**	**17 %**	**32 %**	**16 %**	**15 %**	**23 %**	**28 %**

The percentage agreement per reader per modal age tells how large part of the readings that are equal to the modal age. The weighted mean including at the bottom of the table is weighted according to number of age readings. A rank is also assigned to each reader.

Table 4.10: Percentage agreement (PA) table represents the PA per modal age and reader, the PA of all readers combined per modal age and a weighted mean of the PA per reader.

Modal age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	R20 FR	R24 FR	R30 GB	all
1	100 %	100 %	100 %	83 %	17 %	50 %	17 %	0 %	**59 %**
2	100 %	100 %	43 %	100 %	57 %	86 %	71 %	29 %	**73 %**
3	77 %	54 %	62 %	69 %	46 %	62 %	69 %	8 %	**56 %**
4	56 %	78 %	89 %	78 %	44 %	78 %	67 %	22 %	**64 %**
5	67 %	33 %	56 %	75 %	33 %	67 %	67 %	22 %	**52 %**
6	75 %	38 %	50 %	75 %	25 %	62 %	62 %	25 %	**52 %**
7	90 %	40 %	80 %	80 %	22 %	80 %	60 %	30 %	**61 %**
8	64 %	0 %	82 %	70 %	36 %	73 %	18 %	27 %	**46 %**
9	100 %	25 %	75 %	62 %	38 %	88 %	38 %	0 %	**53 %**
10	0 %	0 %	100 %	100 %	50 %	50 %	0 %	50 %	**44 %**
Weighted Mean	**77 %**	**46 %**	**71 %**	**76 %**	**37 %**	**71 %**	**52 %**	**20 %**	**56 %**

The relative bias is the difference between the mean age (per modal age per reader) and modal age. As for the previous tables, a combined bias for all readers and weighted means are calculated and finally a rank is assigned to each reader.

Table 4.11: Relative bias table represents the relative bias per modal age per reader, the relative bias of all readers combined per modal age and a weighted mean of the relative bias per reader. A rank is also assigned to each reader.

Modal age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	R20 FR	R24 FR	R30 GB	all
1	0.00	0.00	0.00	0.17	1.67	0.50	0.83	1.40	**0.57**
2	0.00	0.00	0.86	0.00	0.43	0.14	0.29	1.29	**0.38**
3	-0.23	-0.31	0.15	0.00	1.00	0.08	0.38	1.58	**0.33**
4	-0.67	-0.22	0.11	-0.33	0.67	-0.22	0.33	2.11	**0.22**
5	-0.22	-0.56	0.56	0.25	1.00	0.22	0.33	1.56	**0.39**
6	-0.38	-1.00	0.62	0.12	0.50	0.38	-0.12	1.50	**0.20**
7	0.20	-0.90	0.50	0.20	1.78	0.00	-0.20	1.50	**0.38**
8	0.00	-2.27	0.00	-0.10	0.27	-0.55	-0.82	1.55	**-0.24**
9	0.00	-1.88	0.25	0.12	1.25	-0.12	-0.38	1.25	**0.06**
10	-1.00	-3.50	0.00	0.00	-1.00	-0.50	-2.50	1.00	**-0.94**
Weighted Mean	**-0.17**	**-0.91**	**0.31**	**0.04**	**0.88**	**0.00**	**-0.02**	**1.53**	**0.21**

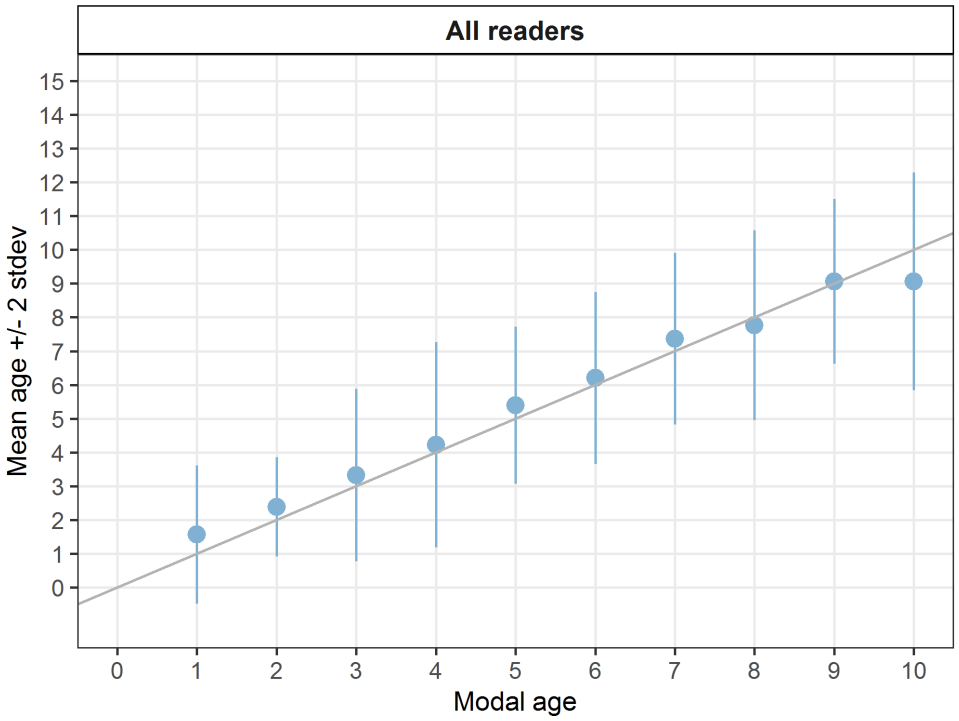


Figure 4.3:: Age bias plot for all readers. Mean age recorded +/- 2 stdev of each reader and all readers combined are plotted against modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line). Relative bias is the age difference between estimated mean age and modal age.

Table 4.12: Inter reader bias test. The Inter-reader bias test gives probability of bias between readers and with modal age. - = no sign of bias (p>0.05), * = possibility of bias (0.01<p<0.05), * * = certainty of bias (p<0.01)

Comparison	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	R20 FR	R24 FR	R30 GB
R02 IE	-	**	**	**	**	-	-	**
R04 FR	**	-	**	**	**	**	**	**
R10 BE	**	**	-	**	**	**	**	**
R12 BE	**	**	**	-	**	-	-	**
R16 IE	**	**	**	**	-	**	**	**
R20 FR	-	**	**	-	**	-	-	**
R24 FR	-	**	**	-	**	-	-	**
R30 GB	**	**	**	**	**	**	**	-
Modal age	*	**	**	-	**	-	-	**

4.4 Advanced readers only – sections

The weighted average percentage agreement based on modal ages for all readers is 63 %, with the weighted average CV of 28 % and APE of 19 %.

Table 4.13: Coefficient of Variation (CV) table presents the CV per modal age and advanced reader, the CV of all advanced readers combined per modal age and a weighted mean of the CV per reader.

Modal age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	all
0	-	-	-	-	-	**-**
1	33 %	82 %	96 %	33 %	73 %	**82 %**
2	15 %	15 %	31 %	16 %	60 %	**42 %**
3	10 %	35 %	19 %	13 %	43 %	**30 %**
4	22 %	0 %	9 %	0 %	40 %	**24 %**
5	12 %	19 %	12 %	19 %	24 %	**21 %**
6	10 %	18 %	8 %	0 %	37 %	**22 %**
7	5 %	18 %	6 %	0 %	14 %	**14 %**
8	9 %	11 %	6 %	6 %	10 %	**14 %**
9	0 %	19 %	5 %	7 %	11 %	**15 %**
10	0 %	11 %	0 %	0 %	16 %	**16 %**
11	14 %	24 %	22 %	-	0 %	**23 %**
Weighted Mean	**12 %**	**22 %**	**20 %**	**10 %**	**33 %**	**28 %**

Table 1.14: Percentage agreement (PA) table represents the PA per modal age and reader, advanced the PA of all advanced readers combined per modal age and a weighted mean of the PA per reader.

Modal age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	all
0	0 %	0 %	100 %	0 %	0 %	**20 %**
1	86 %	83 %	86 %	86 %	14 %	**71 %**
2	90 %	90 %	30 %	89 %	50 %	**69 %**
3	91 %	82 %	55 %	82 %	45 %	**71 %**
4	71 %	100 %	86 %	100 %	29 %	**77 %**
5	67 %	44 %	44 %	78 %	44 %	**56 %**
6	71 %	57 %	43 %	100 %	43 %	**62 %**
7	89 %	33 %	78 %	100 %	38 %	**68 %**
8	60 %	0 %	80 %	80 %	40 %	**52 %**
9	100 %	25 %	75 %	62 %	38 %	**60 %**
10	0 %	0 %	100 %	100 %	50 %	**50 %**
11	50 %	0 %	50 %	0 %	100 %	**44 %**
Weighted Mean	**77 %**	**52 %**	**64 %**	**84 %**	**40 %**	**63 %**

Table 4.15: Relative bias table represents the relative bias per modal age and advanced reader, the relative bias of all advanced readers combined per modal age and a weighted mean of the relative bias per reader. A rank is also assigned to each reader.

Modal age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	all
0	3.00	4.00	0.00	5.00	7.00	**3.80**
1	0.14	0.50	0.57	0.14	1.71	**0.61**
2	0.10	0.10	1.00	0.11	1.10	**0.48**
3	-0.09	-0.36	0.55	0.18	0.64	**0.18**
4	-0.43	0.00	0.14	0.00	0.86	**0.11**
5	-0.11	-0.44	0.67	0.44	1.22	**0.36**
6	0.00	-0.71	0.57	0.00	0.86	**0.14**
7	0.11	-1.11	0.22	0.00	1.25	**0.09**
8	-0.50	-2.20	0.00	0.00	0.00	**-0.54**
9	0.00	-1.88	0.25	0.12	1.25	**-0.05**
10	-1.00	-3.50	0.00	0.00	-1.00	**-1.10**
11	-1.00	-5.00	-1.50	-1.00	0.00	**-1.70**
Weighted Mean	**-0.10**	**-0.84**	**0.39**	**0.16**	**0.95**	**0.12**

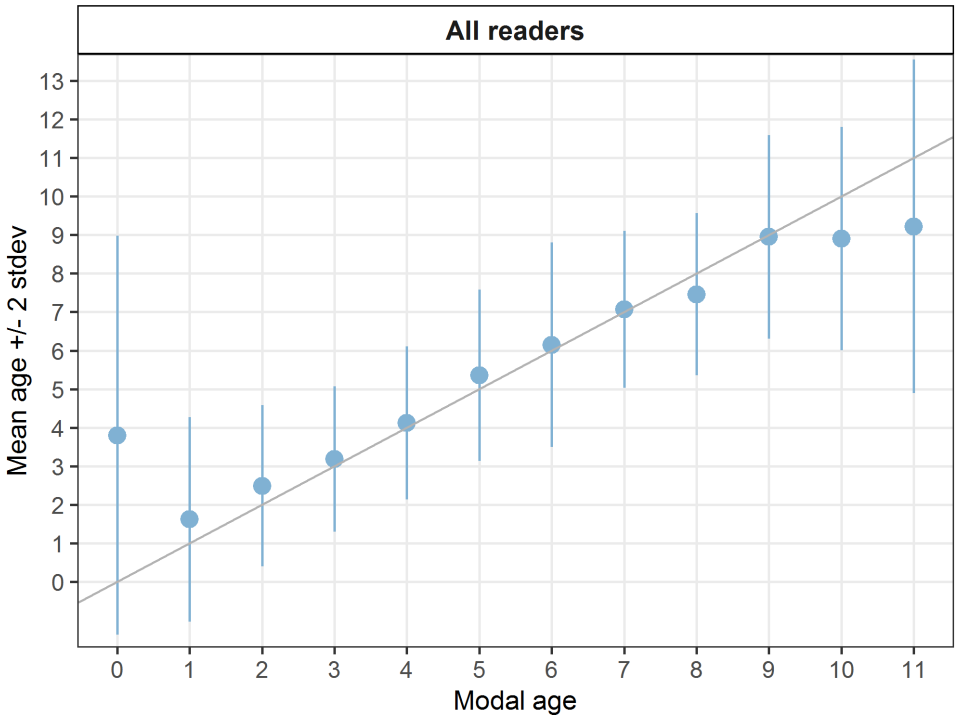


Figure 4.4: Age bias plot for advanced readers.

Age error matrices are calculated per area and only based on the age readings of the advanced readers.

Table 4.16: Age error matrix (AEM) for S. The AEM shows the proportional distribution of age readings for each modal age. Age column should sum to one but due to rounding there might be small deviations in some cases. Only advanced readers are used for calculating the AEM.

strata	Modal age	0	1	2	3	4	5	6	7	8	9	10	11
S	Age 0	0.2	-	-	0.01818	-	-	-	-	-	-	-	-
S	Age 1	-	0.70588	-	-	-	-	-	-	-	-	-	-
S	Age 2	-	0.17647	0.69388	0.07273	0.02857	-	-	-	-	-	-	-
S	Age 3	0.2	0.02941	0.22449	0.70909	0.08571	0.02222	0.02941	-	-	-	-	-
S	Age 4	0.2	0.02941	0.04082	0.14545	0.77143	0.11111	0.05882	0.02273	-	-	-	-

S	Age 5	0.2	0.02941	0.02041	0.01818	0.05714	0.55556	0.05882	0.04545	0.06	0.025	-	0.1111
S	Age 6	-	-	-	0.01818	-	0.20000	0.61765	0.06818	0.14	0.025	0.1	-
S	Age 7	0.2	0.02941	-	0.01818	0.02857	0.04444	0.17647	0.68182	0.18	0.100	0.1	0.1111
S	Age 8	-	-	0.02041	-	0.02857	0.04444	-	0.09091	0.52	0.025	0.1	0.1111
S	Age 9	-	-	-	-	-	0.02222	0.02941	0.06818	0.10	0.600	0.2	0.1111
S	Age 10	-	-	-	-	-	-	-	0.02273	-	0.125	0.5	0.1111
S	Age 11	-	-	-	-	-	-	0.02941	-	-	0.075	-	0.4444
S	Age 12	-	-	-	-	-	-	-	-	-	0.025	-	-

4.5 Comparison between whole and sectioned otoliths

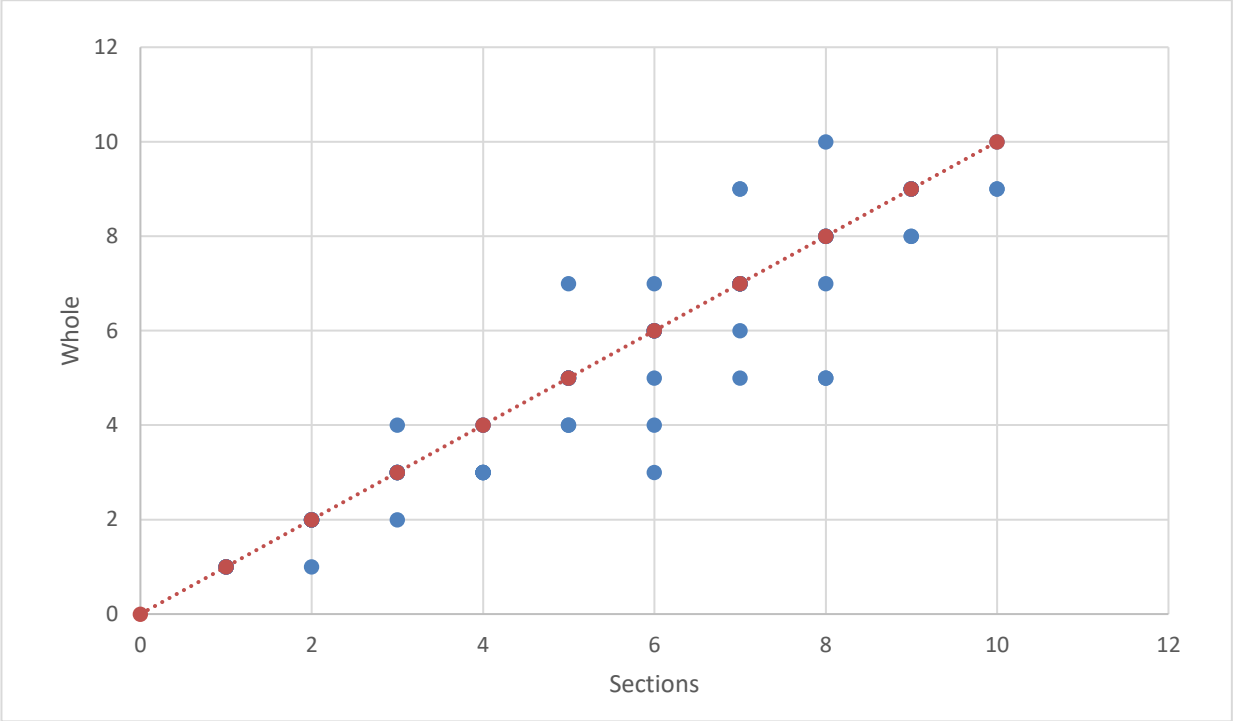


Figure 4.5: Comparison of age determinations based on whole and sectioned otoliths from the same fish. The y=x line indicates when both methods give the same result.

The same age is given 66% of the cases for whole and sectioned otoliths, 7 % are above the line (older age for whole) and 26 % are below the line (older age for sections). The outcome of the readings clearly differed depending on the method, indicating that one of the methods is less accurate. But quality of the sections was not good enough (lot of AQ3 given). Fish are generally assigned an older age when using sectioned otoliths compared to whole otoliths. This was evident for all readers combined. The deviation becomes clearer in older fish, as for fish aged from 0 to 2, 80% was given the same age for the two methods.

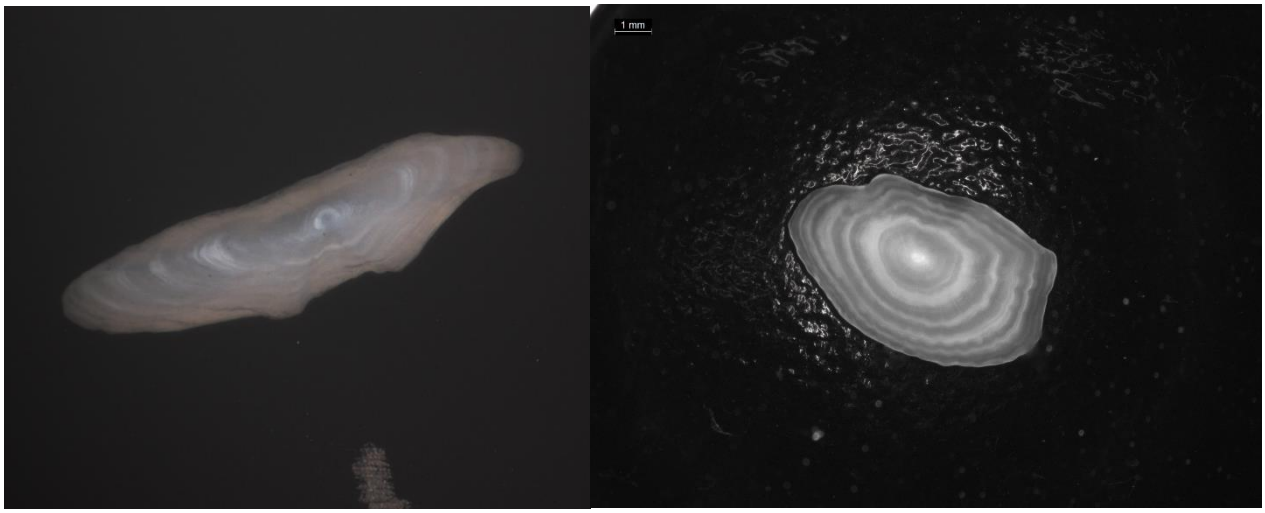


Figure 4.6 Example of the same age given (7) for both sectioned and whole otoliths.

5 Discussion

This exchange was an image only exchange executed in SmartDots. The statistics representing age reading performance were calculated for all readers combined and for experienced readers only, using the R-script as provided in SmartDots. Age readers were specifically asked to annotate only preparation methods they are familiar with as otherwise the results may be biased. A total of 13 age readers annotated whole otoliths (8 advanced and 5 basic). Three of those readers were not used to reading plaice otoliths in area 7.f-g. Only 8 readers annotated sectioned plaice (5 advanced (preferred method "whole" for all advanced readers and 3 basic readers). Remaining readers did not feel confident as they had none or very limited experience with this preparation method for plaice. Moreover, the quality of the sectioned images was rather poor (often AQ3 was given). Plaice otoliths are normally not sectioned by ILVO and due to this lack of routine, the light settings of the microscope could probably have been better.

For the calculations of the advanced "whole" readers, only the five advanced readers for area 7.f-g were included. Calculations were carried out separately for each preparation method. No advanced readers were used to reading sectioned otoliths. Only the readers from UK usually read sectioned otoliths, but in this exchange, only basic readers from UK participated, not reporting data for assessments. The statistics were better for whole otoliths than for sectioned otoliths. The average percentage agreement of 72 %, CV of 19 % and APE of 11 % was reached by all readers annotating stained sectioned otoliths. There was only a slight improvement when only advanced readers were combined: PA=75%, CV = 18%, APE = 10%. The results of the present exchange are in line with the statistics achieved for all readers during the plaice exchange in 7.h-k in 2019 (PA= 76% and CV =13% for all readers annotating whole otoliths; PA=78%; CV=12% for advanced readers only) and the statistics achieved during WKARP back in 2010: PA=76%; CV=9% for ICES area 4 and PA=71%; CV=15% for ICES area 3a.

During WKARP, threshold and target statistics were presented (agreement = 85% and CV = 5%) for North Sea plaice readers (whole). These thresholds could not be reached for the current plaice 7.f-g exchange.

For sectioned otoliths, the statistical results were not satisfactory. The average percentage agreement of 56 %, CV of 28 % and APE of 19 % was obtained by all readers, while for advanced readers, the results were better: PA=63 %, CV = 28%, APE = 19%. In sectioned otoliths, the different rings are often difficult to interpret. The quality of the sectioned images was rather poor (often AQ3 was given), moreover no advanced section readers were included in the exchange. This could partly explain the results.

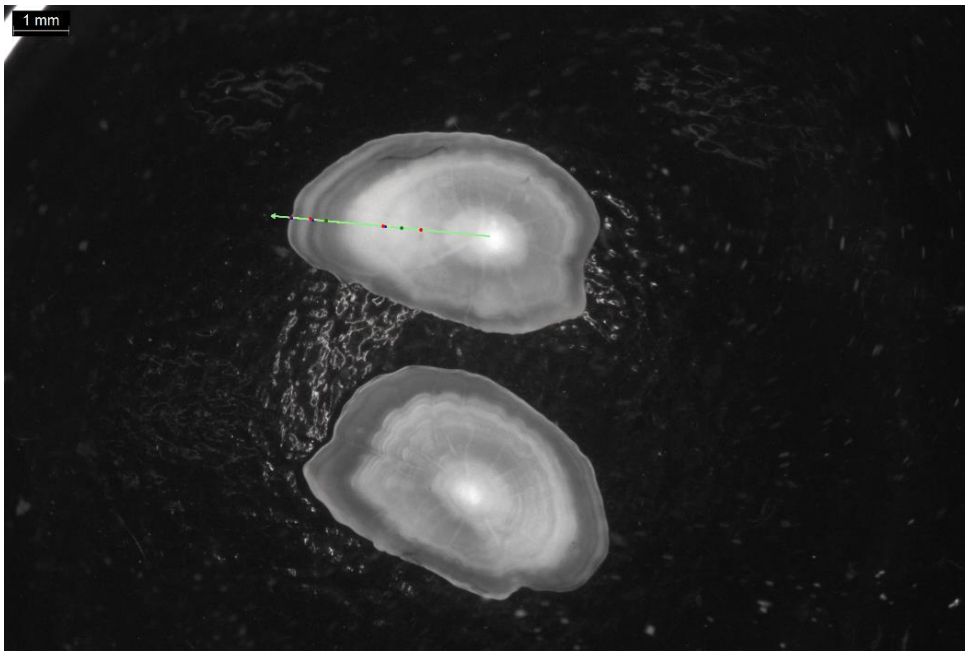
When comparing the ages of sectioned and whole otoliths of the same individual, the same age was given in 66% of the cases. Fish are generally assigned an older age when otoliths are sectioned. This has also been confirmed in other flatfish species. Often age is underestimated when using whole otoliths as compared to sections (Etherton, 2015). A study from Ireland showed that reading plaice otoliths whole did not increase the possibility of under-ageing fish in comparison to sectioned otoliths, for 7.a, 7.b, 7.g and 7.j otoliths up to age 10. However, it could be a problem in older fish, but these were not included in this exchange.

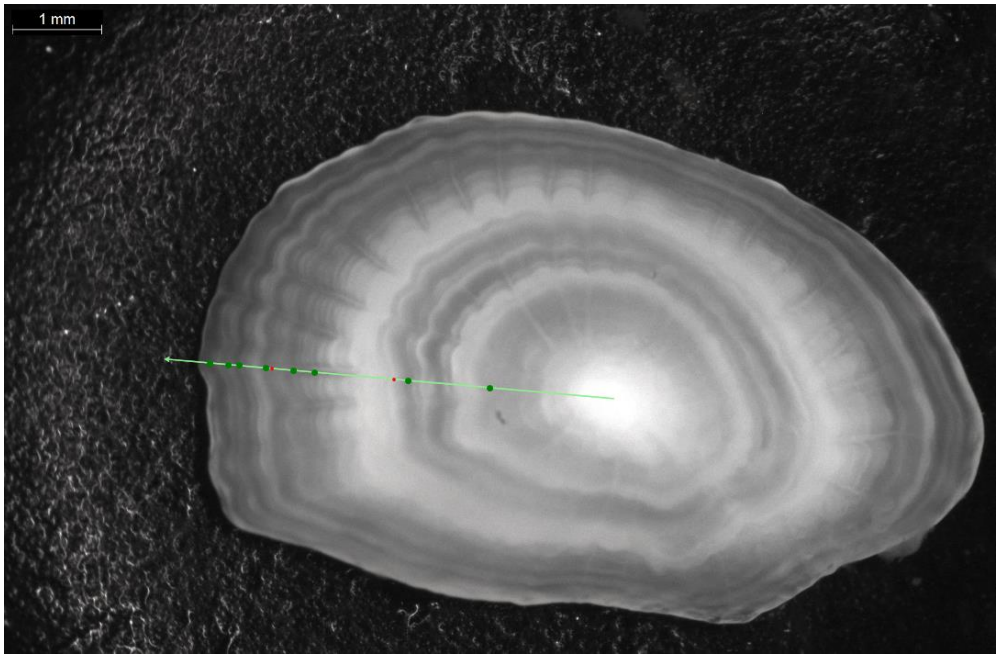
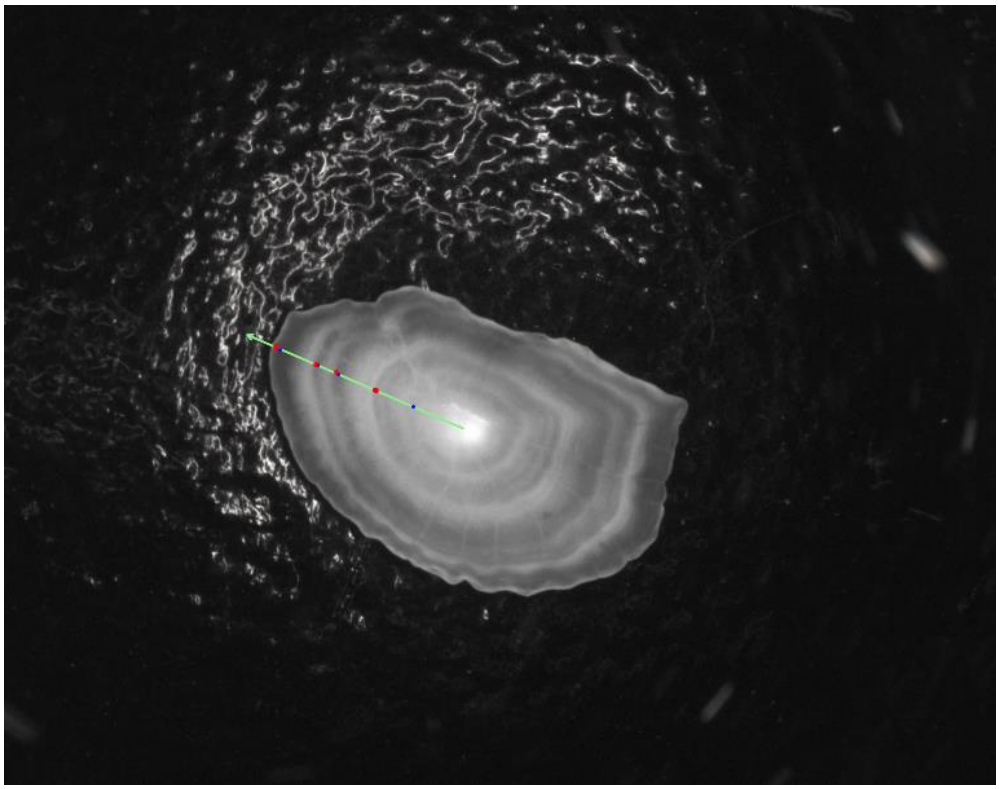
When analysing only the results of the whole otoliths (the preferred method of readers in this exchange), the percentage agreement decreases with age while standard deviation increases. The lower overall PA (72%) and higher APE (11%) attained when analysing the readings of all readers, is partly attributed to the poor level of agreement of readers R04 and R14, especially starting from modal age 6. Often, the age of the fish is underestimated by these readers. Moreover R04 is an advanced 7.f-g reader and thus influencing the results when only readings of the 5

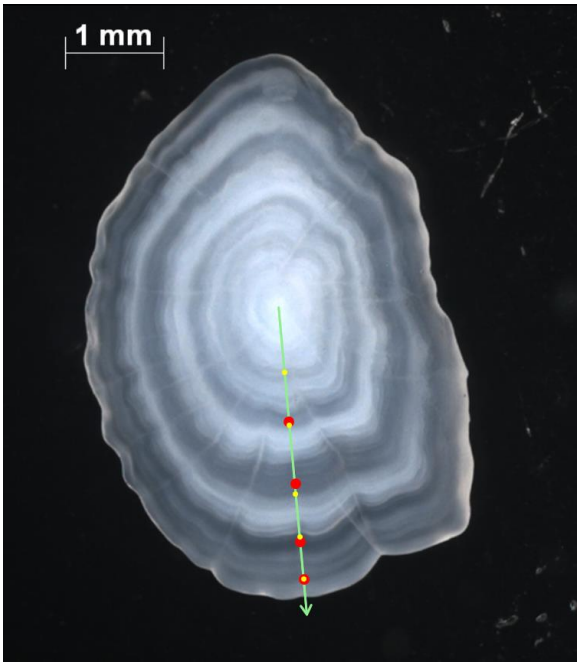
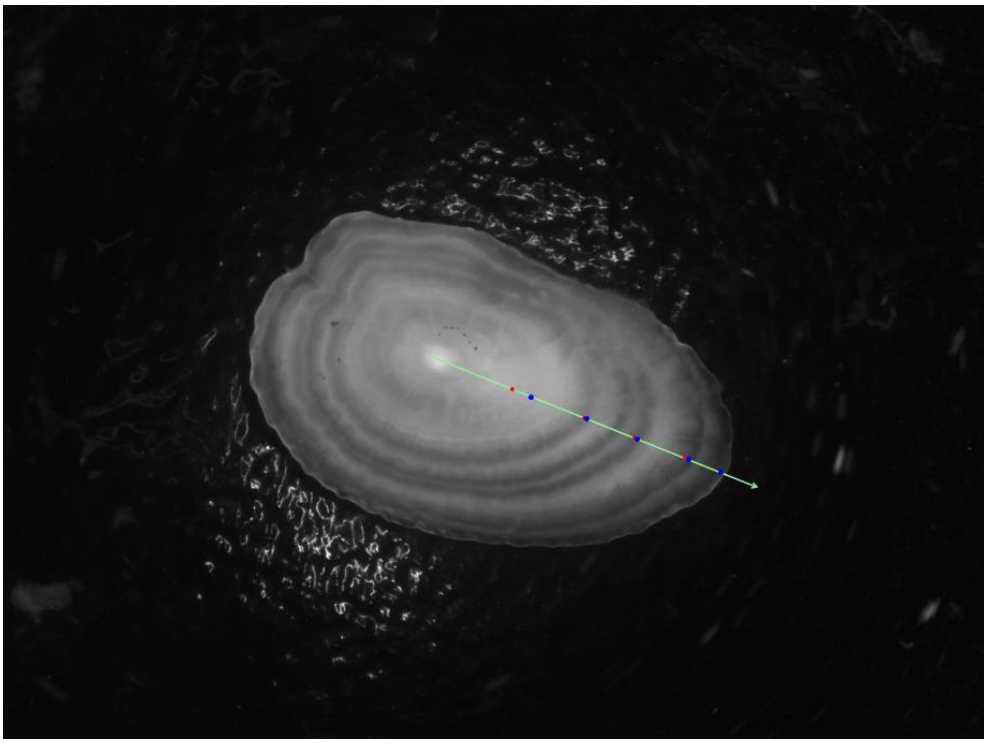
advanced 7.f-g readers are included. This can explain the poor improvement in results when analysing only advanced readers.

A closer examination of the annotated images shows that the main issue in age reading, is the interpretation of the first ring, the interpretation of splitted rings and the interpretation of the edge. These are the same issues as encountered during WKARP back in 2010. These issues could not be resolved without validation study.

Table 4.6: Images of whole and stained sectioned otoliths representing frequently encountered situations in the interpretation of the structures.

Whole otolith	**Comment**
 WH_001_BYDR01_PLE_7F_D_2017000068, 27/01/2017 Model age: 3; PA = 75 %; CV = 18 %; APE: = 10 %	Otolith with irregular growth. Translucent zones close together were counted as separate rings by some readers, and as split rings by others.

 WH_078_BYDR06_PLE_7G_L_M_2017100710132; 07/10/2017 Model age: 7; PA = 38%; CV = 19 %; APE: = 15 %	Otolith with irregular growth. Translucent zones close together were counted as separate rings by some readers, and as split rings by others. Age varied from 4 to 7.
 003_BYDR01_PLE_7F_D_2017000196; 27/01/2017 Model age: 3; PA = 62 %; CV = 24 %; APE: = 21 %	Difference in interpretation of the first ring between readers. Also ring 3 and 4 was counted as splitted ring or separate rings by the different readers

 WH_053_GNKT03_PLE_7G_D_2017042710036; 27/04/2017 Model age: 4; PA = 67%; CV = 11 %; APE: = 10 %	Difference in interpretation of the first ring between readers.
 WH_066_PTCT06_PLE_7G_D_051292; 18/07/2015 Model age: 4; PA = 55%; CV = 23 %; APE: = 21 %	Interpretation of edge in Q3. Some readers applied n-1 rule and discounted the last translucent zone despite the fact opaque edge formed at the edge-clearly visible. The problem of the interpretation of structures as splitted of separated rings was also present here.

6 Conclusion

Whole otoliths seem the best method to determine plaice age. This is in line with the results of WKARP (2010) and the plaice exchange in divisions 7h-k in 2019. However, the quality of the images of sectioned otoliths was poor and no advanced section readers participated in this exchange. This could bias the results for the sectioned otoliths. Main age reading discrepancies were related to interpretation of first ring, edge and splitted rings.

During WKARP (2010), threshold and target statistics were presented (agreement = 85% and CV = 5%) for North Sea plaice readers (whole). These thresholds could not be reached for the current plaice 7.f-g exchange.

To avoid readers to age under- or overage systematically, it is recommended that readers involved in age determination of plaice in 7.f-g should familiarize themselves with current reference sets/ interpretation protocols and consistently follow them while ageing. Regular exchanges, both internally and externally in order to learn and to improve the agreements between readers should be organised using SmartDots application.

As the last plaice workshop took place 9 years ago, a new plaice workshop is recommended.

7 References

Etherton M. (2015) European plaice (*Pleuronectes platessa*) and sole (*Solea solea*) indirect age validation using otoliths from mark-recapture experiments from the North Sea. Fisheries Research 170: 76–81.

ICES. 2010. Report of the Workshop on Age Reading of North Sea (IV) and Skagerrak-Kattegat (IIIa) Plaice (WKARP) , 2-5 November 2010, IJmuiden, The Netherlands. ICES CM 2010/ACOM: 45. 65 pp.

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Ruiz, A. 2007. *Pleuronectes platessa* Plaice. In Tyler-Walters H. and Hiscock K. (eds) *Marine Life Information Network: Biology and Sensitivity Key Information Reviews*, [on-line]. Plymouth: Marine Biological Association of the United Kingdom. [cited 04-05-2020]. Available from: https://www.marlin.ac.uk/species/detail/2172

8 Annex 1. List of participants

Table X: Participants list.

Reader code	Expertise
R02 IE	Advanced
R04 FR	Advanced
R06 DK	Advanced
R08 SE	Advanced
R10 BE	Advanced
R12 BE	Advanced
R14 DK	Advanced
R16 IE	Advanced
R20 FR	Basic
R22 FR	Basic
R24 FR	Basic
R28 DK	Basic
R36 FR	Basic

9 Annex 2. Additional results

9.1 Results all readers - whole

Data Overview

Table 9.1: Summary of statistics; PA (%), CV (%) and APE (%).

CV	PA	APE
19 %	72 %	11 %

Table 9.2: Data overview including modal age and statistics per sample.

Fish ID	Event ID	Image ID	length	sex	Catch date	ICES area	R02IE	R04FR	R06DK	R08SE	R10BE	R12BE	R14DK	R16IE	R20FR	R22FR	R24FR	R28DK	R36FR	Modal age	PA %	CV %	APE %
001_BYDR01_PLE_7F_D_2017000068	221	-	220	-	27/01/2017 00:00:00	27.7.f	2	3	3	-	3	4	3	2	3	3	3	3	3	3	75	18	10
002_BYDR01_PLE_7F_D_2017000074	221	-	250	-	27/01/2017 00:00:00	27.7.f	3	3	3	3	3	3	3	3	3	3	3	3	3	3	100	0	0
003_BYDR01_PLE_7F_D_2017000196	221	-	220	-	27/01/2017 00:00:00	27.7.f	4	3	3	3	5	5	3	3	3	3	3	5	4	3	62	24	21
004_BYDR01_PLE_7F_D_2017000200	221	-	180	-	27/01/2017 00:00:00	27.7.f	1	1	-	1	1	1	1	2	2	2	1	2	1	1	67	37	33
005_BYDR01_PLE_7F_D_2017000201	221	-	200	-	27/01/2017 00:00:00	27.7.f	2	1	2	2	2	2	2	2	2	2	2	2	2	2	92	14	7
006_BYDR01_PLE_7F_L_M_2017000566	221	-	340	-	27/01/2017 00:00:00	27.7.f	7	6	6	7	7	7	6	7	7	7	6	7	7	7	69	7	6
007_BYDR01_PLE_7F_L_M_2017000576	221	-	375	-	27/01/2017 00:00:00	27.7.f	8	6	7	8	8	8	7	8	8	8	8	8	8	8	77	8	6
008_BYDR01_PLE_7F_L_M_2017000579	221	-	345	-	27/01/2017 00:00:00	27.7.f	6	6	6	6	6	6	6	6	6	6	6	6	6	6	100	0	0
009_BYDR03_PLE_7F_D_2017033010048	221	-	260	-	30/03/2017 00:00:00	27.7.f	3	3	4	3	5	5	-	3	-	4	3	-	3	3	60	23	20

010_BYDR03_PLE_7F_L_M_2017033010147	221	-	495	-	30/03/2017 00:00:00	27.7.f	9	7	9	11	10	10	7	11	8	9	8	9	9	9	38	14	10
011_CDDR01_PLE_7F_L_M_2017001034	221	-	430	-	03/03/2017 00:00:00	27.7.f	9	9	9	9	9	9	8	8	9	9	9	8	9	9	77	5	4
012_BYDR04_PLE_7F_D_2018041510024	221	-	180	-	15/04/2018 00:00:00	27.7.f	1	1	4	1	1	1	-	1	-	1	3	-	4	1	70	73	62
013_CDDR02_PLE_7F_L_M_2018041210241	221	-	425	-	12/04/2018 00:00:00	27.7.f	9	8	8	9	9	9	10	10	9	10	9	-	9	9	58	7	5
014_CDDR03_PLE_7F_D_2017040610014	221	-	200	-	06/04/2017 00:00:00	27.7.f	2	2	2	-	2	2	2	2	2	2	2	2	2	2	100	0	0
015_CDDR03_PLE_7F_D_2017040610016	221	-	220	-	06/04/2017 00:00:00	27.7.f	3	3	3	3	4	4	3	3	3	4	3	3	3	3	77	14	11
016_CDDR03_PLE_7F_D_2017040610039	221	-	210	-	06/04/2017 00:00:00	27.7.f	5	4	4	4	5	5	5	4	5	4	4	5	4	4	54	12	11
017_CDDR03_PLE_7F_L_M_2017040610239	221	-	400	-	06/04/2017 00:00:00	27.7.f	7	7	7	7	7	7	7	7	7	7	7	7	7	7	100	0	0
018_CDDR03_PLE_7F_L_M_2017040610241	221	-	375	-	06/04/2017 00:00:00	27.7.f	6	6	6	6	6	6	6	6	6	6	6	6	6	6	100	0	0
019_CDDR03_PLE_7F_L_M_2017040610255	221	-	360	-	06/04/2017 00:00:00	27.7.f	8	6	5	7	8	8	5	5	5	8	5	-	6	5	42	22	19
020_CDDR04_PLE_7F_D_2017050710058	221	-	200	-	07/05/2017 00:00:00	27.7.f	3	3	3	3	3	3	3	3	3	3	3	3	3	3	100	0	0
021_GNKT04_PLE_7F_L_M_68727	221	-	400	-	20/05/2016 00:00:00	27.7.f	10	10	10	10	10	10	9	10	10	10	10	10	10	10	92	3	1
022_CDDR06_PLE_7F_D_70977	221	-	250	-	01/08/2016 00:00:00	27.7.f	2	2	2	3	2	3	2	3	3	2	2	2	2	2	69	21	18
023_CDDR06_PLE_7F_D_71001	221	-	220	-	01/08/2016 00:00:00	27.7.f	3	1	3	3	4	4	3	4	3	2	3	4	3	3	54	28	18
024_CDDR06_PLE_7F_L_M_71865	221	-	355	-	01/08/2016	27.7.f	6	-	6	6	6	6	5	6	6	6	6	5	6	6	83	7	5

				00:00:00																			
025_CDDR06_PLE_7F_L_M_71868	221	-	435	-	01/08/2016 00:00:00	27.7.f	7	7	7	6	7	7	6	9	7	7	7	-	7	7	75	11	5
026_CDDR06_PLE_7F_L_M_71878	221	-	385	-	01/08/2016 00:00:00	27.7.f	5	-	5	6	6	6	5	6	5	6	5	6	5	5	50	9	9
027_CDDR06_PLE_7F_L_M_71892	221	-	435	-	01/08/2016 00:00:00	27.7.f	8	7	8	8	8	-	7	8	8	8	8	8	8	8	83	5	4
028_GNKT05_PLE_7F_D_2018071710045	221	-	240	-	17/07/2018 00:00:00	27.7.f	2	2	2	2	2	2	2	2	2	2	2	2	2	2	100	0	0
029_GNKT05_PLE_7F_L_M_2018071710272	221	-	375	-	17/07/2018 00:00:00	27.7.f	9	9	9	9	9	9	9	2	10	9	9	9	9	9	85	23	12
030_GNKT05_PLE_7F_L_M_2018071710286	221	-	445	-	17/07/2018 00:00:00	27.7.f	9	9	9	10	10	10	9	9	10	9	9	8	9	9	62	6	5
031_BYDR07_PLE_7F_D_2018102310045	221	-	210	-	23/10/2018 00:00:00	27.7.f	2	1	2	2	2	2	-	2	2	2	2	-	1	2	82	22	16
032_BYDR07_PLE_7F_L_M_2018102310207	221	-	400	-	23/10/2018 00:00:00	27.7.f	6	-	5	5	6	6	5	5	5	4	6	-	5	5	55	12	10
033_BYDR07_PLE_7F_L_M_2018102310211	221	-	390	-	23/10/2018 00:00:00	27.7.f	6	5	6	6	8	8	6	7	6	6	6	6	6	6	69	14	10
034_BYDR07_PLE_7F_L_M_2018102310212	221	-	430	-	23/10/2018 00:00:00	27.7.f	5	5	6	5	5	5	5	5	6	5	6	5	5	5	77	8	7
035_BYDR07_PLE_7F_L_M_2018102310220	221	-	410	-	23/10/2018 00:00:00	27.7.f	9	7	8	10	10	10	8	8	9	9	9	8	8	8	38	11	9
036_BYDR07_PLE_7F_L_M_2018102310236	221	-	370	-	23/10/2018 00:00:00	27.7.f	6	5	-	8	7	7	5	6	5	6	5	7	5	5	42	17	14
037_PLE_D_004_GK_11_041210_7FG_1	221	-	210	-	04/12/2010 00:00:00	27.7.f	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	0	0
038_PTCT09_PLE_7F_D_2017102220028	221	-	230	-	22/10/2017 00:00:00	27.7.f	3	3	3	3	3	3	3	3	3	3	3	-	2	3	92	10	5

039_PTCT09_PLE_7F_D_2017102220041	221	-	260	-	22/10/2017 00:00:00	27.7.f	4	2	-	4	4	4	2	4	-	2	4	-	2	4	60	32	30
040_BYDR01_PLE_7G_D_2017000182	221	-	230	-	27/01/2017 00:00:00	27.7.g	4	4	3	3	4	4	3	2	3	3	4	-	3	3	50	20	17
041_BYDR01_PLE_7G_D_2017000188	221	-	270	-	27/01/2017 00:00:00	27.7.g	6	4	5	6	6	6	4	6	5	5	4	5	6	6	46	16	14
042_CDDR01_PLE_7G_L_M_2018030110203	221	-	385	-	01/03/2018 00:00:00	27.7.g	8	6	7	8	8	8	8	7	5	8	7	8	8	8	62	13	10
043_CDDR01_PLE_7G_L_M_2018030110209	221	-	330	-	01/03/2018 00:00:00	27.7.g	7	6	7	7	7	7	7	7	6	7	7	7	7	7	85	5	4
044_CDDR01_PLE_7G_L_M_2018030110230	221	-	395	-	01/03/2018 00:00:00	27.7.g	8	7	7	11	11	10	7	9	6	9	9	7	8	7	31	19	16
045_GNKT01_PLE_7G_D_000274	221	-	180	-	06/02/2015 00:00:00	27.7.g	2	3	3	2	6	-	2	3	2	2	2	-	3	2	55	44	29
046_GNKT01_PLE_7G_D_000275	221	-	210	-	06/02/2015 00:00:00	27.7.g	2	2	2	2	2	2	2	2	2	2	2	2	2	2	100	0	0
047_GNKT01_PLE_7G_D_000278	221	-	230	-	06/02/2015 00:00:00	27.7.g	3	3	3	3	3	3	3	3	3	3	3	3	3	3	100	0	0
048_GNKT01_PLE_7G_D_000293	221	-	270	-	06/02/2015 00:00:00	27.7.g	5	5	5	5	5	5	5	5	5	5	5	5	5	5	100	0	0
049_PLE_D_029_GK_3_27032011_7FG_9	221	-	190	-	27/03/2011 00:00:00	27.7.g	1	1	1	1	1	-	1	1	1	1	1	0	1	1	92	31	17
050_PTCT02_PLE_7G_L_M_1.0_002551	221	-	500	-	09/03/2015 00:00:00	27.7.g	9	9	10	10	9	10	8	9	8	8	9	9	9	9	54	8	5
051_GNKT03_PLE_7G_D_2017042710033	221	-	200	-	27/04/2017 00:00:00	27.7.g	2	2	2	2	2	2	2	2	2	2	2	2	2	2	100	0	0
052_GNKT03_PLE_7G_D_2017042710034	221	-	200	-	27/04/2017 00:00:00	27.7.g	-	4	2	4	4	4	3	4	4	4	4	-	5	4	73	20	13
053_GNKT03_PLE_7G_D_2017042710036	221	-	220	-	27/04/2017	27.7.g	4	-	4	5	5	5	5	5	5	4	4	5	5	5	67	11	10

				00:00:00																				
054_GNKT03_PLE_7G_D_2017042710037	221	-	230	-	27/04/2017 00:00:00	27.7.g	3	3	3	3	3	3	3	3	3	3	3	3	3	3	100	0	0
055_GNKT03_PLE_7G_D_2017042710040	221	-	240	-	27/04/2017 00:00:00	27.7.g	4	4	4	4	4	4	4	4	4	4	4	4	4	4	100	0	0
056_GNKT03_PLE_7G_L_M_2017042710261	221	-	485	-	27/04/2017 00:00:00	27.7.g	7	8	9	9	9	9	7	9	8	9	7	9	9	9	62	10	9
057_GNKT03_PLE_7G_L_M_2017042710266	221	-	520	-	27/04/2017 00:00:00	27.7.g	11	10	10	11	10	10	9	10	10	10	10	8	11	10	62	8	5
058_GNKT03_PLE_7G_L_M_2017042710268	221	-	390	-	27/04/2017 00:00:00	27.7.g	7	7	7	7	7	7	7	7	7	7	6	7	7	7	92	4	2
059_GNKT03_PLE_7G_L_M_2017042710272	221	-	465	-	27/04/2017 00:00:00	27.7.g	8	7	8	8	8	8	7	7	8	8	7	8	8	8	69	6	6
060_GNKT03_PLE_7G_L_M_2017042710288	221	-	360	-	27/04/2017 00:00:00	27.7.g	5	5	5	5	6	6	5	5	5	5	5	5	5	5	85	7	5
061_PLE_CT_D_058_NV_4_060613_7G_5	221	-	180	-	06/06/2013 00:00:00	27.7.g	1	2	1	1	1	1	1	1	-	1	1	0	1	1	83	43	17
062_CDDR06_PLE_7G_D_071012	221	-	180	-	26/08/2016 00:00:00	27.7.g	2	2	2	2	2	2	2	2	3	2	2	2	2	2	92	13	7
063_CDDR06_PLE_7G_D_071013	221	-	190	-	26/08/2016 00:00:00	27.7.g	3	2	3	3	3	3	2	3	3	3	3	2	3	3	77	16	13
064_CDDR06_PLE_7G_D_071015	221	-	200	-	26/08/2016 00:00:00	27.7.g	3	3	4	4	4	4	4	4	4	4	3	4	4	4	77	12	9
065_PLE_D_037_PC_6_310711_7G_5	221	-	200	-	31/07/2011 00:00:00	27.7.g	1	1	1	1	1	1	1	1	1	1	1	1	1	1	100	0	0
066_PTCT06_PLE_7G_D_051292	221	-	260	-	12/07/2015 00:00:00	27.7.g	3	4	5	5	5	-	3	5	3	3	5	-	5	5	55	23	21
067_PTCT06_PLE_7G_L_M_1.0_52263	221	-	320	-	18/07/2015 00:00:00	27.7.g	6	4	5	6	6	6	4	5	5	4	4	-	6	6	42	18	15

068_PTCT06_PLE_7G_L_M_1.0_52277	221	-	365	-	18/07/2015 00:00:00	27.7.g	8	5	6	8	8	8	-	7	5	7	5	7	8	8	42	19	15
069_PTCT07_PLE_7G_L_M_053326	221	-	420	-	31/07/2015 00:00:00	27.7.g	9	7	8	9	10	11	7	9	7	8	8	10	9	9	31	15	12
070_PTCT07_PLE_7G_L_M_053335	221	-	400	-	31/07/2015 00:00:00	27.7.g	7	6	6	7	7	7	6	7	6	7	7	7	7	7	69	7	6
071_PTCT07_PLE_7G_L_M_053367	221	-	450	-	31/07/2015 00:00:00	27.7.g	9	5	9	10	10	9	-	9	7	10	8	-	10	9	36	18	13
072_BYDR06_PLE_7G_D_2017100710016	221	-	250	-	07/10/2017 00:00:00	27.7.g	2	2	2	2	2	2	2	3	2	2	2	2	2	2	92	13	7
073_BYDR06_PLE_7G_D_2017100710018	221	-	260	-	07/10/2017 00:00:00	27.7.g	5	5	5	5	5	5	5	5	5	5	5	5	5	5	100	0	0
074_BYDR06_PLE_7G_D_2017100710021	221	-	260	-	07/10/2017 00:00:00	27.7.g	3	2	3	4	3	4	2	3	3	2	3	3	3	3	62	22	15
075_BYDR06_PLE_7G_D_2017100710028	221	-	240	-	07/10/2017 00:00:00	27.7.g	5	3	4	5	5	5	5	5	5	5	4	5	5	5	77	13	10
076_BYDR06_PLE_7G_D_2017100710031	221	-	230	-	07/10/2017 00:00:00	27.7.g	3	3	3	4	4	4	3	3	4	4	3	4	3	3	54	15	14
077_BYDR06_PLE_7G_D_2017100710033	221	-	250	-	07/10/2017 00:00:00	27.7.g	4	3	3	4	4	4	3	3	3	4	3	3	4	3	54	15	14
078_BYDR06_PLE_7G_L_M_2017100710132	221	-	410	-	07/10/2017 00:00:00	27.7.g	7	5	7	8	7	7	4	8	5	6	6	6	7	7	38	19	15
079_BYDR06_PLE_7G_L_M_2017100710137	221	-	380	-	07/10/2017 00:00:00	27.7.g	6	5	6	8	6	6	5	6	6	6	6	6	6	6	77	12	5
080_BYDR06_PLE_7G_L_M_2017100710158	221	-	410	-	07/10/2017 00:00:00	27.7.g	7	6	7	7	8	8	5	7	7	7	5	8	7	7	54	14	10
081_CDDR08_PLE_7G_D_224260	221	-	200	-	15/11/2016 00:00:00	27.7.g	1	0	1	1	1	1	1	1	1	1	1	1	1	1	92	30	15
082_GNKT06_PLE_7G_L_M_2017110210152	221	-	390	-	02/11/2017	27.7.g	9	9	10	10	9	10	9	10	10	9	9	10	10	10	54	5	5

					00:00:00																		
083_GNKT06_PLE_7G_L_M_2017110210154	22 1	-	39 5	-	02/11/2017 00:00:00	27.7.g	1 1	8	9	1 1	1 0	-	6	7	7	1 0	8	9	9	9	2 5	1 8	1 5

Table 9.3: Number of age readings table gives an overview of number of readings per reader and modal age. The total numbers of readings per reader and per modal age are summarized at the end of the table.

Modal age	R02 IE	R04 FR	R06 DK	R08 SE	R10 BE	R12 BE	R14 DK	R16 IE	R20 FR	R22 FR	R24 FR	R28 DK	R36 FR	total
1	7	7	6	7	7	6	6	7	5	7	7	6	7	**85**
2	10	10	10	9	10	9	9	10	10	10	10	8	10	**125**
3	15	15	15	14	15	15	14	15	14	15	15	12	15	**189**
4	4	5	4	5	5	5	5	5	4	5	5	3	5	**60**
5	11	8	10	11	11	10	11	11	11	11	11	8	11	**135**
6	7	6	7	7	7	7	7	7	7	7	7	6	7	**89**
7	9	9	9	9	9	9	9	9	9	9	9	8	9	**116**
8	6	6	6	6	6	5	5	6	6	6	6	6	6	**76**
9	10	10	10	10	10	9	9	10	10	10	10	8	10	**126**
10	3	3	3	3	3	3	3	3	3	3	3	3	3	**39**
Total	**82**	**79**	**80**	**81**	**83**	**78**	**78**	**83**	**79**	**83**	**83**	**68**	**83**	**1040**

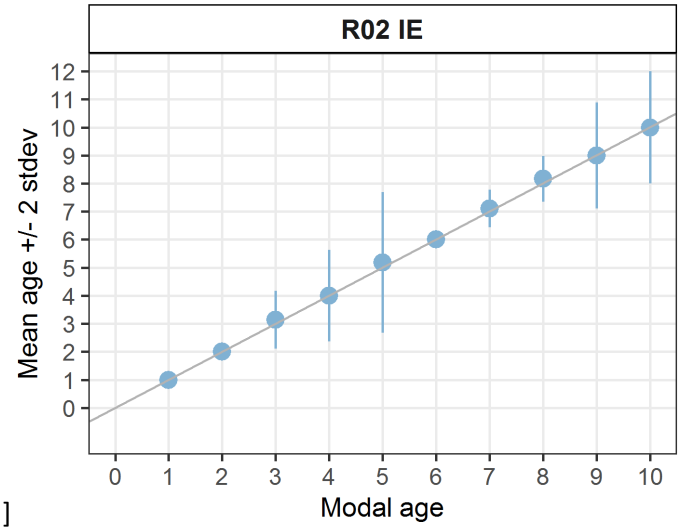
Table 9.4: Age composition by reader gives a summary of number of readings per reader.

Modal age	R02 IE	R04 FR	R06 DK	R08 SE	R10 BE	R12 BE	R14 DK	R16 IE	R20 FR	R22 FR	R24 FR	R28 DK	R36 FR
0	0	1	0	0	0	0	0	0	0	0	0	2	**0**
1	7	8	5	7	7	6	6	6	4	6	6	3	**7**
2	11	11	10	8	9	8	12	11	9	14	10	10	**10**
3	13	14	15	12	8	7	14	15	16	10	16	8	**13**
4	6	7	7	8	9	11	5	6	4	11	9	4	**6**
5	7	10	9	8	9	8	14	10	15	6	9	10	**11**
6	9	9	9	8	10	9	7	7	9	8	10	6	**8**
7	9	9	9	7	8	8	10	11	8	8	7	8	**8**
8	7	3	5	8	8	7	4	5	6	7	6	9	**7**
9	10	5	7	5	6	5	5	7	3	8	8	5	**9**
10	1	2	4	6	8	8	1	4	5	5	2	3	**3**
11	2	0	0	4	1	1	0	1	0	0	0	0	**1**
Total	**82**	**79**	**80**	**81**	**83**	**78**	**78**	**83**	**79**	**83**	**83**	**68**	**83**

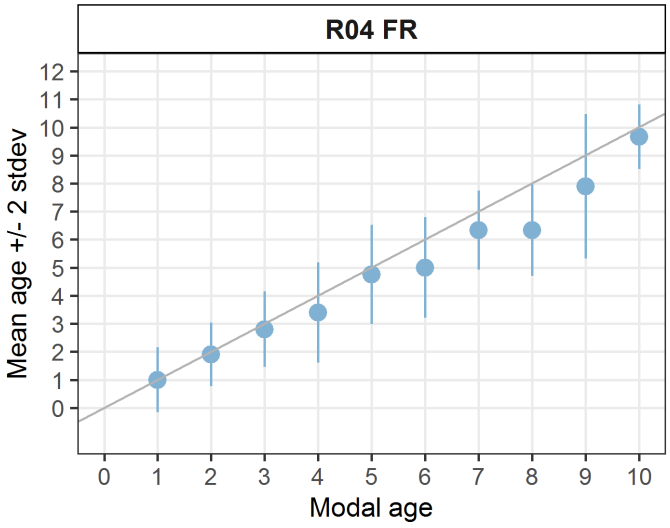
Table 9.5: Mean length at age per reader is calculated per reader and age (not modal age) and for all readers combined per age. A weighted mean is also given.

Age	R02 IE	R04 FR	R06 DK	R08 SE	R10 BE	R12 BE	R14 DK	R16 IE	R20 FR	R22 FR	R24 FR	R28 DK	R36 FR
0	-	200 mm	-	-	-	-	-	-	-	-	-	185 mm	**-**
1	191 mm	199 mm	196 mm	191 mm	191 mm	192 mm	193 mm	193 mm	200 mm	193 mm	193 mm	203 mm	**196 mm**
2	213 mm	220 mm	214 mm	209 mm	216 mm	211 mm	218 mm	222 mm	208 mm	217 mm	212 mm	210 mm	**222 mm**
3	229 mm	226 mm	224 mm	228 mm	226 mm	226 mm	228 mm	230 mm	228 mm	226 mm	224 mm	232 mm	**225 mm**
4	237 mm	247 mm	221 mm	231 mm	228 mm	230 mm	288 mm	222 mm	218 mm	250 mm	243 mm	222 mm	**217 mm**
5	308 mm	368 mm	321 mm	305 mm	263 mm	264 mm	332 mm	312 mm	322 mm	305 mm	338 mm	284 mm	**309 mm**
6	356 mm	369 mm	376 mm	359 mm	337 mm	354 mm	383 mm	354 mm	378 mm	376 mm	382 mm	381 mm	**349 mm**
7	400 mm	427 mm	392 mm	376 mm	384 mm	384 mm	419 mm	388 mm	405 mm	384 mm	414 mm	374 mm	**389 mm**

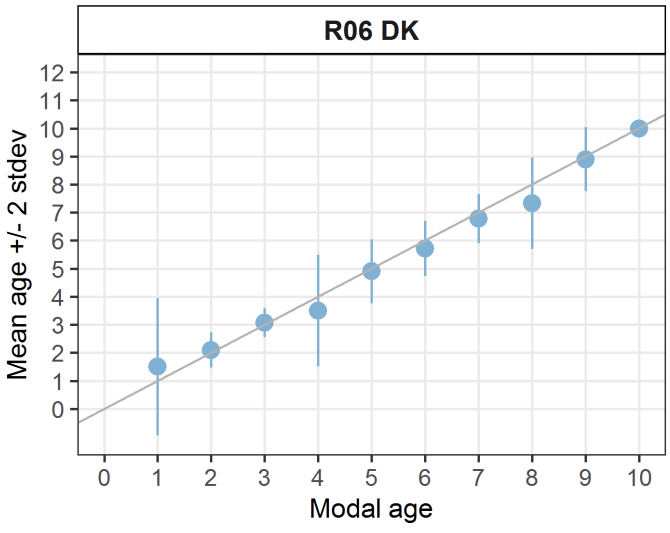
8	397 mm	435 mm	431 mm	398 mm	398 mm	393 mm	431 mm	412 mm	459 mm	420 mm	428 mm	431 mm	**404 mm**
9	434 mm	428 mm	439 mm	427 mm	434 mm	433 mm	426 mm	447 mm	422 mm	428 mm	421 mm	450 mm	**441 mm**
10	400 mm	460 mm	452 mm	432 mm	442 mm	444 mm	425 mm	434 mm	426 mm	438 mm	460 mm	403 mm	**413 mm**
11	458 mm	-	-	451 mm	395 mm	420 mm	-	495 mm	-	-	-	-	**520 mm**
Weighted Mean	**311 mm**	**308 mm**	**311 mm**	**312 mm**	**309 mm**	**310 mm**	**310 mm**	**309 mm**	**314 mm**	**309 mm**	**309 mm**	**313 mm**	**309 mm**



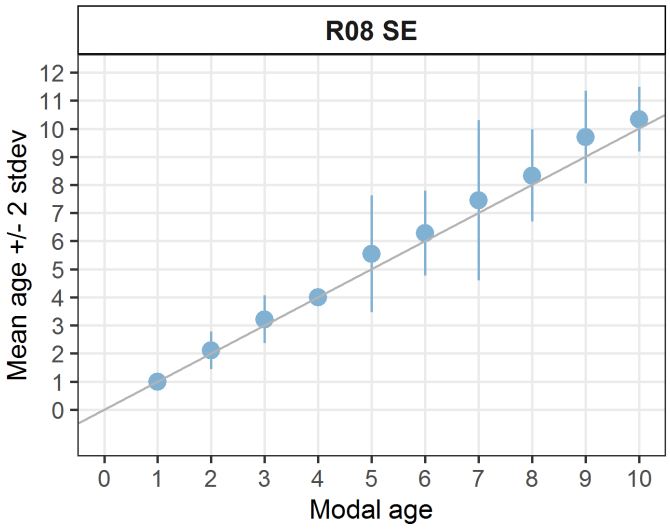
[[1]] [[2]]



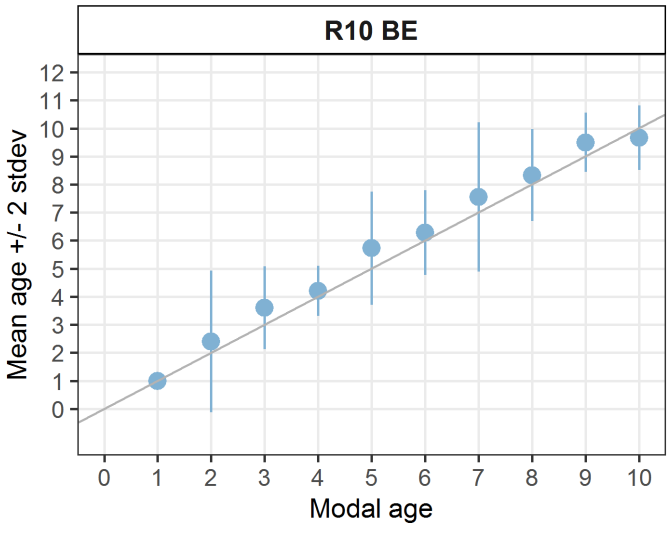
[[3]]


R06 DK
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12

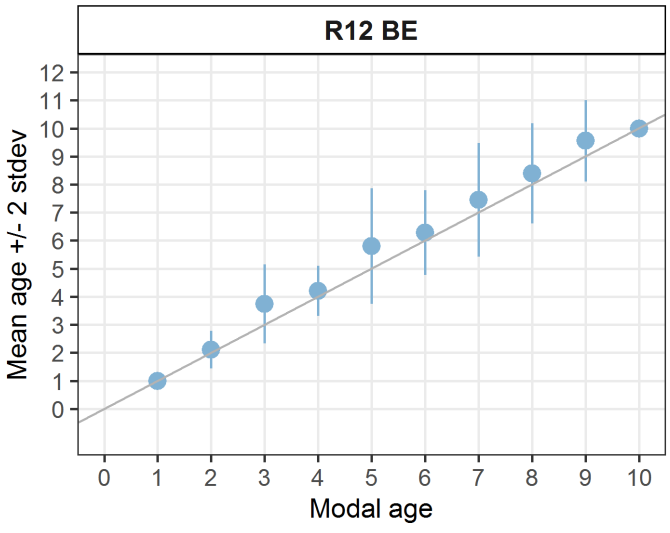
[[4]]


R08 SE
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12

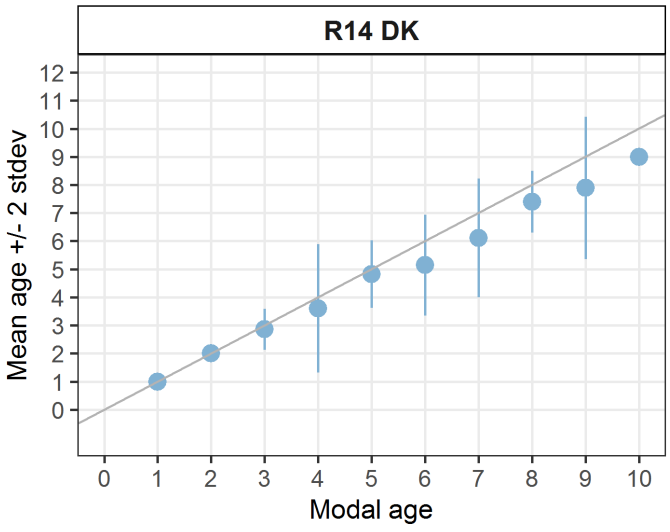
[[5]]


R10 BE
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12

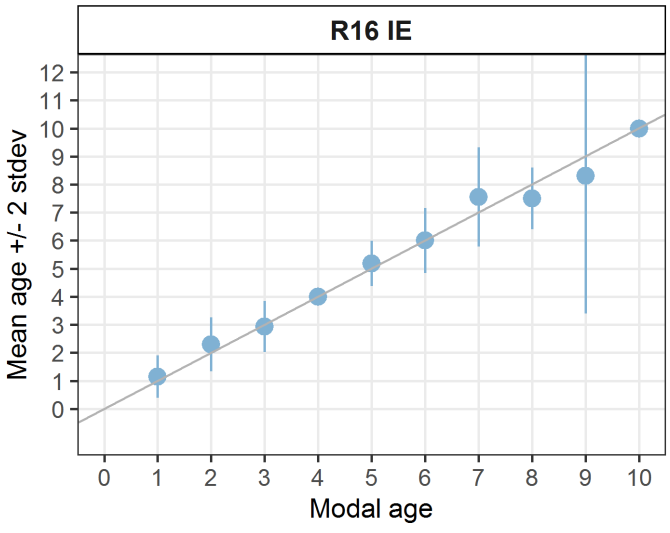
[[6]]


R12 BE
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12

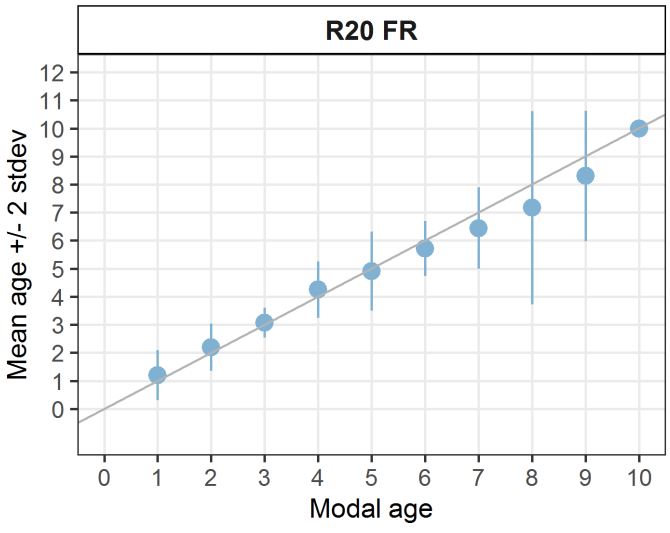
[[7]]


R14 DK
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12

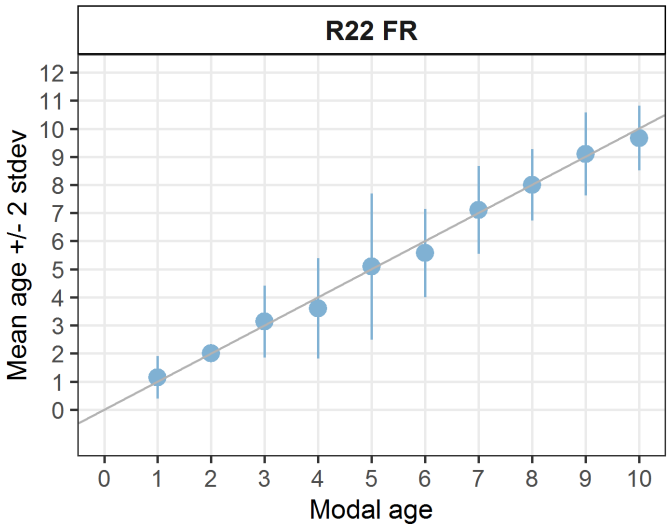
[[8]]


R16 IE
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12

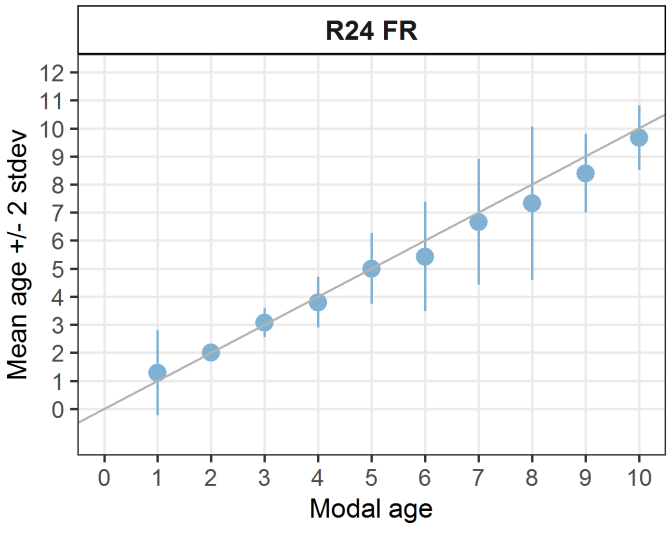
[[9]]


R20 FR
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12
0 1 2 3 4 5 6 7 8 9 10

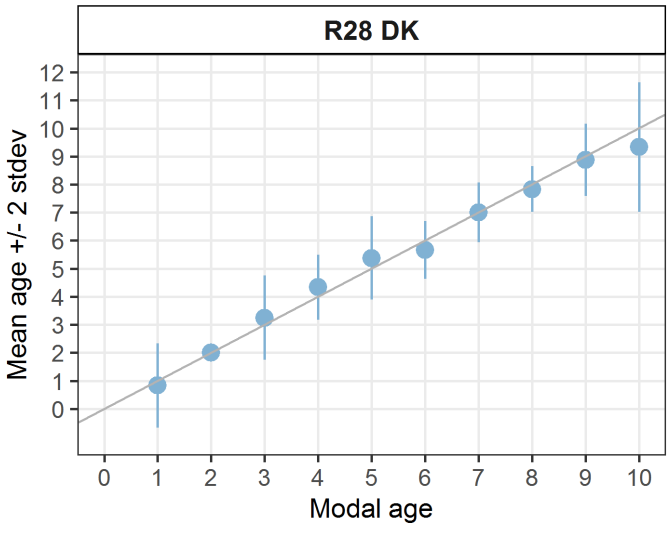
[[10]]


R22 FR
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12
0 1 2 3 4 5 6 7 8 9 10

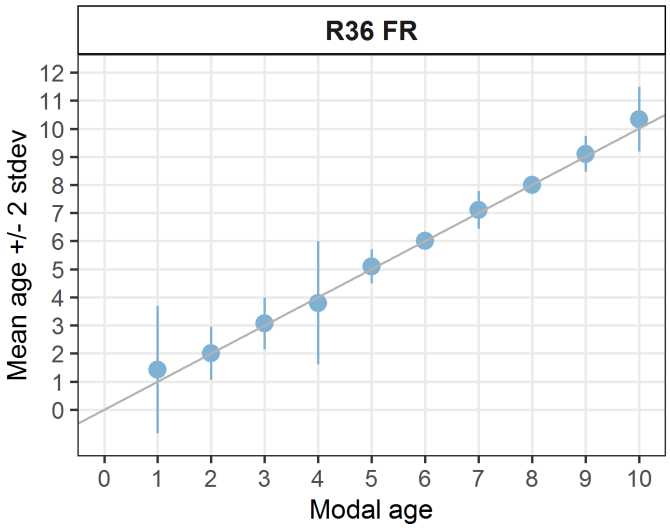
[[11]]


R24 FR
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12
0 1 2 3 4 5 6 7 8 9 10

[[12]]


R28 DK
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12

[[13]]


R36 FR
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12

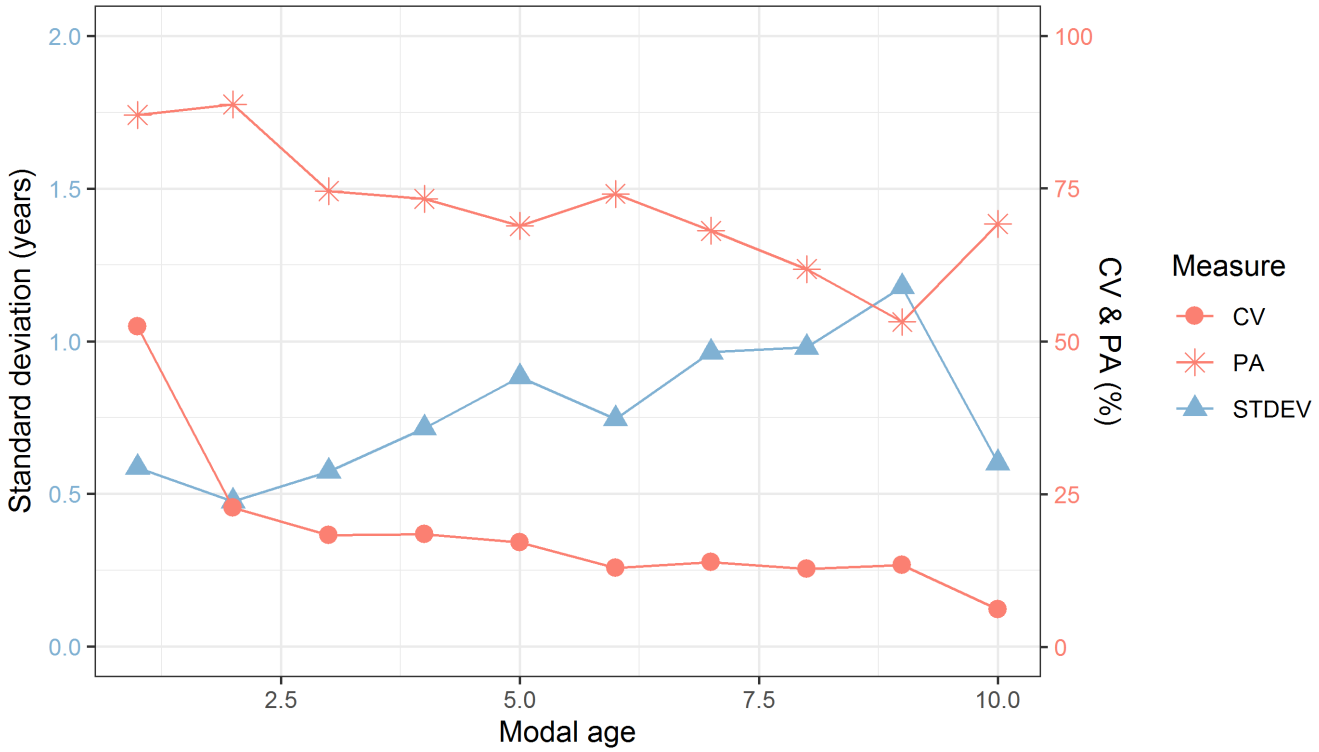


Figure 9.1: CV, PA and (STDEV (standard deviation) are plotted against modal age

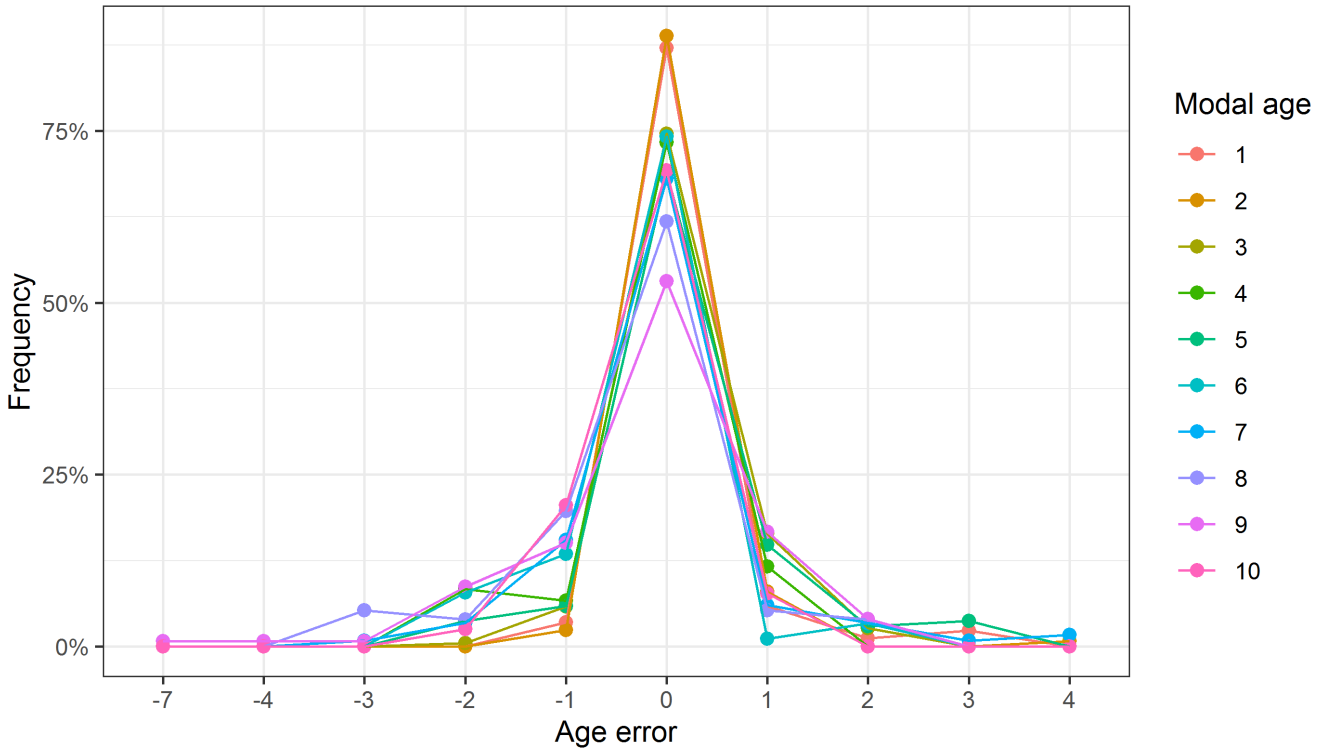


Figure 9.2: The distribution of the age reading errors in percentage by modal age as observed from the whole group of age readers in an age reading comparison to modal age. The achieved precision in age reading by MODAL age group is

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.

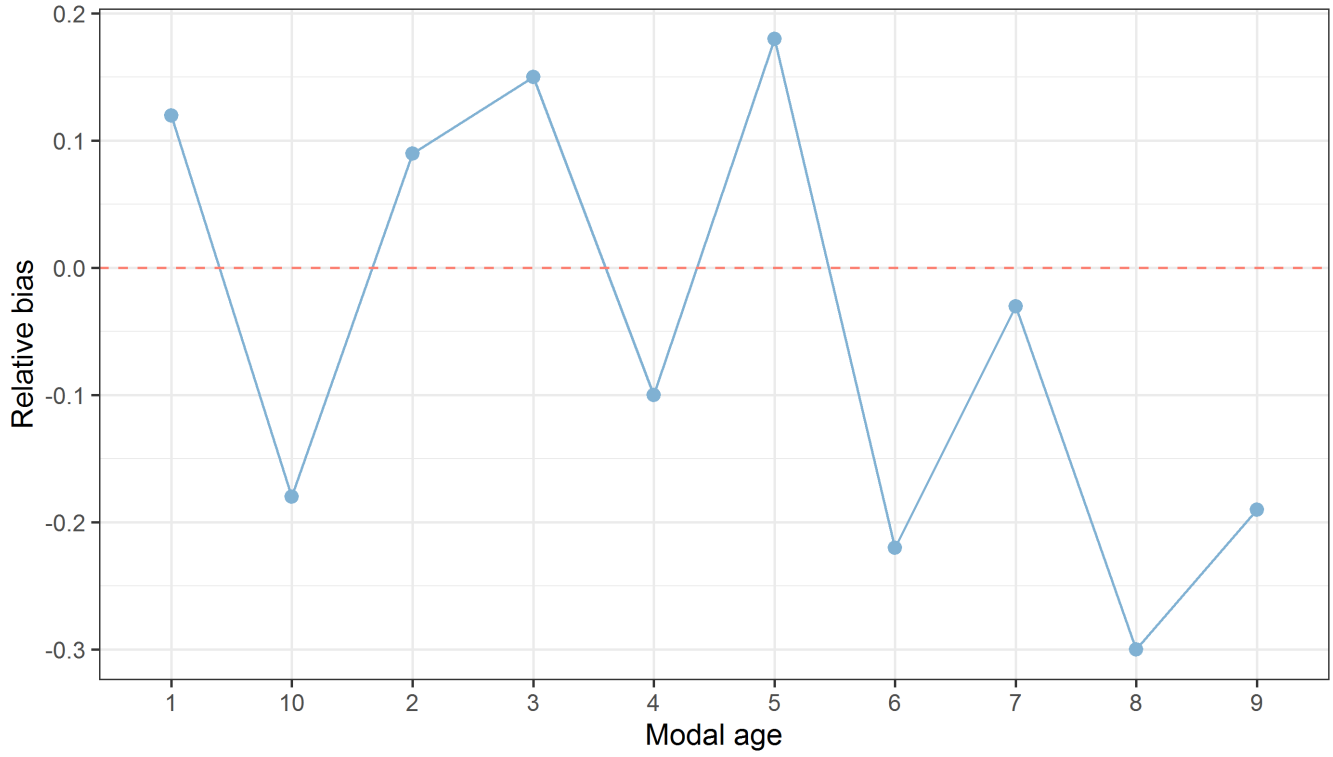


Figure 9.3: The relative bias by modal age as estimated by all age readers combined.

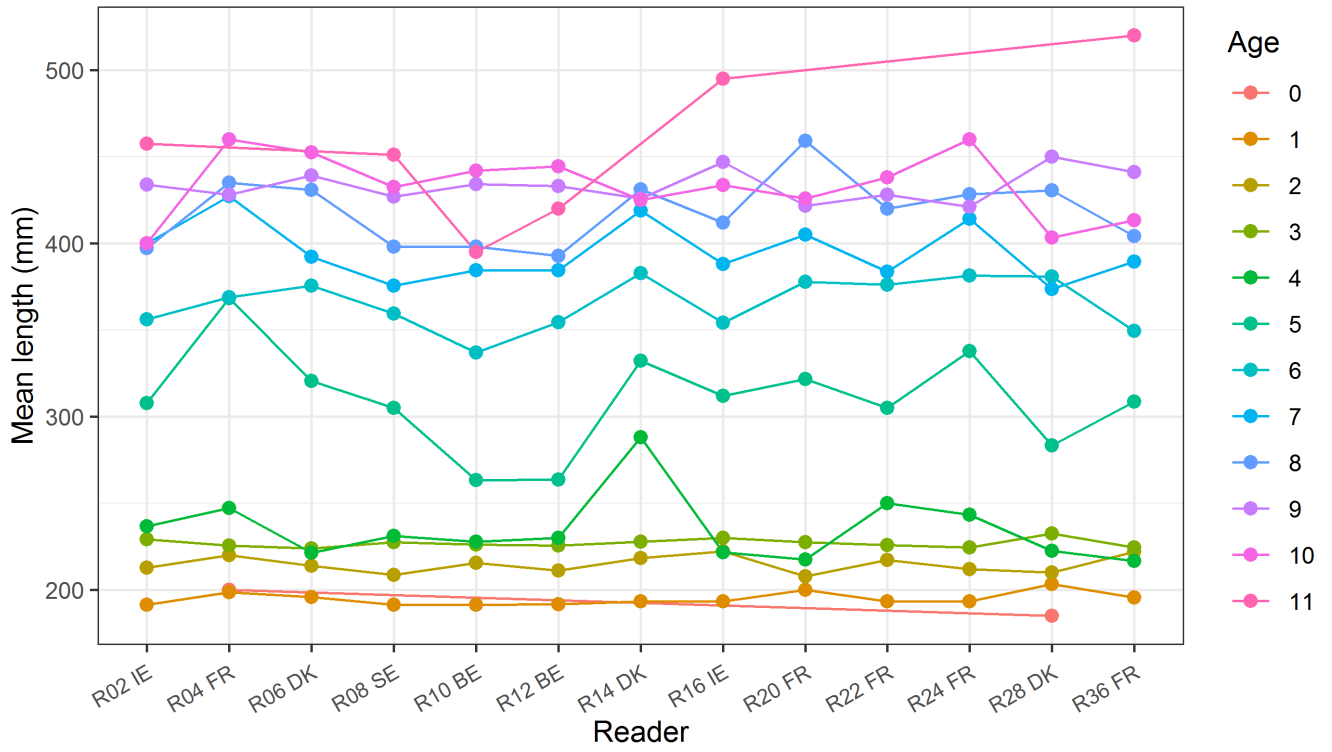


Figure 9.4: The mean length at age as estimated by each age reader.

9.2 Results Advanced readers – whole

All samples included

Data Overview

Table 9.6 : Data overview including modal age and statistics per sample.

Fish ID	Event ID	Image ID	length	sex	Catch date	ICES area	R02 IE	R04 FR	R06 DK	R08 SE	R10 BE	R12 BE	R14 DK	R16 IE	Modal age	PA %	CV %	APE %
001_BYDR01_PLE_7F_D_2017000068	221	-	220	-	27/01/2017 00:00:00	27.7.f	2	3	3	-	3	4	3	2	3	57	24	17
002_BYDR01_PLE_7F_D_2017000074	221	-	250	-	27/01/2017 00:00:00	27.7.f	3	3	3	3	3	3	3	3	3	100	0	0
003_BYDR01_PLE_7F_D_2017000196	221	-	220	-	27/01/2017 00:00:00	27.7.f	4	3	3	3	5	5	3	3	3	62	25	22
004_BYDR01_PLE_7F_D_2017000200	221	-	180	-	27/01/2017 00:00:00	27.7.f	1	1	-	1	1	1	1	2	1	86	33	21
005_BYDR01_PLE_7F_D_2017000201	221	-	200	-	27/01/2017 00:00:00	27.7.f	2	1	2	2	2	2	2	2	2	88	19	12
006_BYDR01_PLE_7F_L_M_2017000566	221	-	340	-	27/01/2017 00:00:00	27.7.f	7	6	6	7	7	7	6	7	7	62	8	7
007_BYDR01_PLE_7F_L_M_2017000576	221	-	375	-	27/01/2017 00:00:00	27.7.f	8	6	7	8	8	8	7	8	8	62	10	8
008_BYDR01_PLE_7F_L_M_2017000579	221	-	345	-	27/01/2017 00:00:00	27.7.f	6	6	6	6	6	6	6	6	6	100	0	0
009_BYDR03_PLE_7F_D_2017033010048	221	-	260	-	30/03/2017 00:00:00	27.7.f	3	3	4	3	5	5	-	3	3	57	26	22
010_BYDR03_PLE_7F_L_M_2017033010147	221	-	495	-	30/03/2017 00:00:00	27.7.f	9	7	9	11	10	10	7	11	7	25	17	14
011_CDDR01_PLE_7F_L_M_2017001034	221	-	430	-	03/03/2017 00:00:00	27.7.f	9	9	9	9	9	9	8	8	9	75	5	4
012_BYDR04_PLE_7F_D_2018041510024	221	-	180	-	15/04/2018 00:00:00	27.7.f	1	1	4	1	1	1	-	1	1	86	79	51
013_CDDR02_PLE_7F_L_M_2018041210241	221	-	425	-	12/04/2018 00:00:00	27.7.f	9	8	8	9	9	9	10	10	9	50	8	6
014_CDDR03_PLE_7F_D_2017040610014	221	-	200	-	06/04/2017 00:00:00	27.7.f	2	2	2	-	2	2	2	2	2	100	0	0
015_CDDR03_PLE_7F_D_2017040610016	221	-	220	-	06/04/2017 00:00:00	27.7.f	3	3	3	3	4	4	3	3	3	75	14	12

016_CDDR03_PLE_7F_D_2017040610039	221	-	210	-	06/04/2017 00:00:00	27.7.f	5	4	4	4	5	5	5	4	4	50	12	11
017_CDDR03_PLE_7F_L_M_2017040610239	221	-	400	-	06/04/2017 00:00:00	27.7.f	7	7	7	7	7	7	7	7	7	100	0	0
018_CDDR03_PLE_7F_L_M_2017040610241	221	-	375	-	06/04/2017 00:00:00	27.7.f	6	6	6	6	6	6	6	6	6	100	0	0
019_CDDR03_PLE_7F_L_M_2017040610255	221	-	360	-	06/04/2017 00:00:00	27.7.f	8	6	5	7	8	8	5	5	5	38	22	19
020_CDDR04_PLE_7F_D_2017050710058	221	-	200	-	07/05/2017 00:00:00	27.7.f	3	3	3	3	3	3	3	3	3	100	0	0
021_GNKT04_PLE_7F_L_M_68727	221	-	400	-	20/05/2016 00:00:00	27.7.f	10	10	10	10	10	10	9	10	10	88	4	2
022_CDDR06_PLE_7F_D_70977	221	-	250	-	01/08/2016 00:00:00	27.7.f	2	2	2	3	2	3	2	3	2	62	22	20
023_CDDR06_PLE_7F_D_71001	221	-	220	-	01/08/2016 00:00:00	27.7.f	3	1	3	3	4	4	3	4	3	50	32	21
024_CDDR06_PLE_7F_L_M_71865	221	-	355	-	01/08/2016 00:00:00	27.7.f	6	-	6	6	6	6	5	6	6	86	6	4
025_CDDR06_PLE_7F_L_M_71868	221	-	435	-	01/08/2016 00:00:00	27.7.f	7	7	7	6	7	7	6	9	7	62	13	7
026_CDDR06_PLE_7F_L_M_71878	221	-	385	-	01/08/2016 00:00:00	27.7.f	5	-	5	6	6	6	5	6	6	57	10	9
027_CDDR06_PLE_7F_L_M_71892	221	-	435	-	01/08/2016 00:00:00	27.7.f	8	7	8	8	8	-	7	8	8	71	6	5
028_GNKT05_PLE_7F_D_2018071710045	221	-	240	-	17/07/2018 00:00:00	27.7.f	2	2	2	2	2	2	2	2	2	100	0	0
029_GNKT05_PLE_7F_L_M_2018071710272	221	-	375	-	17/07/2018 00:00:00	27.7.f	9	9	9	9	9	9	9	2	9	88	30	19
030_GNKT05_PLE_7F_L_M_2018071710286	221	-	445	-	17/07/2018 00:00:00	27.7.f	9	9	9	10	10	10	9	9	9	62	6	5
031_BYDR07_PLE_7F_D_2018102310045	221	-	210	-	23/10/2018 00:00:00	27.7.f	2	1	2	2	2	2	-	2	2	86	20	13
032_BYDR07_PLE_7F_L_M_2018102310207	221	-	400	-	23/10/2018 00:00:00	27.7.f	6	-	5	5	6	6	5	5	5	57	10	9
033_BYDR07_PLE_7F_L_M_2018102310211	221	-	390	-	23/10/2018 00:00:00	27.7.f	6	5	6	6	8	8	6	7	6	50	16	13
034_BYDR07_PLE_7F_L_M_2018102310212	221	-	430	-	23/10/2018 00:00:00	27.7.f	5	5	6	5	5	5	5	5	5	88	7	4

035_BYDR07_PLE_7F_L_M_2018102310220	221	-	410	-	23/10/2018 00:00:00	27.7.f	9	7	8	10	10	10	8	8	8	38	13	11
036_BYDR07_PLE_7F_L_M_2018102310236	221	-	370	-	23/10/2018 00:00:00	27.7.f	6	5	-	8	7	7	5	6	5	29	18	14
037_PLE_D_004_GK_11_041210_7FG_1	221	-	210	-	04/12/2010 00:00:00	27.7.f	1	1	1	1	1	1	1	1	1	100	0	0
038_PTCT09_PLE_7F_D_2017102220028	221	-	230	-	22/10/2017 00:00:00	27.7.f	3	3	3	3	3	3	3	3	3	100	0	0
039_PTCT09_PLE_7F_D_2017102220041	221	-	260	-	22/10/2017 00:00:00	27.7.f	4	2	-	4	4	4	2	4	4	71	28	24
040_BYDR01_PLE_7G_D_2017000182	221	-	230	-	27/01/2017 00:00:00	27.7.g	4	4	3	3	4	4	3	2	4	50	22	19
041_BYDR01_PLE_7G_D_2017000188	221	-	270	-	27/01/2017 00:00:00	27.7.g	6	4	5	6	6	6	4	6	6	62	17	15
042_CDDR01_PLE_7G_L_M_2018030110203	221	-	385	-	01/03/2018 00:00:00	27.7.g	8	6	7	8	8	8	8	7	8	62	10	8
043_CDDR01_PLE_7G_L_M_2018030110209	221	-	330	-	01/03/2018 00:00:00	27.7.g	7	6	7	7	7	7	7	7	7	88	5	3
044_CDDR01_PLE_7G_L_M_2018030110230	221	-	395	-	01/03/2018 00:00:00	27.7.g	8	7	7	11	11	10	7	9	7	38	20	17
045_GNKT01_PLE_7G_D_000274	221	-	180	-	06/02/2015 00:00:00	27.7.g	2	3	3	2	6	-	2	3	2	43	47	29
046_GNKT01_PLE_7G_D_000275	221	-	210	-	06/02/2015 00:00:00	27.7.g	2	2	2	2	2	2	2	2	2	100	0	0
047_GNKT01_PLE_7G_D_000278	221	-	230	-	06/02/2015 00:00:00	27.7.g	3	3	3	3	3	3	3	3	3	100	0	0
048_GNKT01_PLE_7G_D_000293	221	-	270	-	06/02/2015 00:00:00	27.7.g	5	5	5	5	5	5	5	5	5	100	0	0
049_PLE_D_029_GK_3_27032011_7FG_9	221	-	190	-	27/03/2011 00:00:00	27.7.g	1	1	1	1	1	-	1	1	1	100	0	0
050_PTCT02_PLE_7G_L_M_1.0_002551	221	-	500	-	09/03/2015 00:00:00	27.7.g	9	9	10	10	9	10	8	9	9	50	8	6
051_GNKT03_PLE_7G_D_2017042710033	221	-	200	-	27/04/2017 00:00:00	27.7.g	2	2	2	2	2	2	2	2	2	100	0	0
052_GNKT03_PLE_7G_D_2017042710034	221	-	200	-	27/04/2017 00:00:00	27.7.g	-	4	2	4	4	4	3	4	4	71	22	17
053_GNKT03_PLE_7G_D_2017042710036	221	-	220	-	27/04/2017 00:00:00	27.7.g	4	-	4	5	5	5	5	5	5	71	10	9

054_GNKT03_PLE_7G_D_2017042710037	221	-	230	-	27/04/2017 00:00:00	27.7.g	3	3	3	3	3	3	3	3	3	100	0	0
055_GNKT03_PLE_7G_D_2017042710040	221	-	240	-	27/04/2017 00:00:00	27.7.g	4	4	4	4	4	4	4	4	4	100	0	0
056_GNKT03_PLE_7G_L_M_2017042710261	221	-	485	-	27/04/2017 00:00:00	27.7.g	7	8	9	9	9	9	7	9	9	62	11	9
057_GNKT03_PLE_7G_L_M_2017042710266	221	-	520	-	27/04/2017 00:00:00	27.7.g	11	10	10	11	10	10	9	10	10	62	6	4
058_GNKT03_PLE_7G_L_M_2017042710268	221	-	390	-	27/04/2017 00:00:00	27.7.g	7	7	7	7	7	7	7	7	7	100	0	0
059_GNKT03_PLE_7G_L_M_2017042710272	221	-	465	-	27/04/2017 00:00:00	27.7.g	8	7	8	8	8	8	7	7	8	62	7	6
060_GNKT03_PLE_7G_L_M_2017042710288	221	-	360	-	27/04/2017 00:00:00	27.7.g	5	5	5	5	6	6	5	5	5	75	9	7
061_PLE_CT_D_058_NV_4_060613_7G_5	221	-	180	-	06/06/2013 00:00:00	27.7.g	1	2	1	1	1	1	1	1	1	88	31	19
062_CDDR06_PLE_7G_D_071012	221	-	180	-	26/08/2016 00:00:00	27.7.g	2	2	2	2	2	2	2	2	2	100	0	0
063_CDDR06_PLE_7G_D_071013	221	-	190	-	26/08/2016 00:00:00	27.7.g	3	2	3	3	3	3	2	3	3	75	17	14
064_CDDR06_PLE_7G_D_071015	221	-	200	-	26/08/2016 00:00:00	27.7.g	3	3	4	4	4	4	4	4	4	75	12	10
065_PLE_D_037_PC_6_310711_7G_5	221	-	200	-	31/07/2011 00:00:00	27.7.g	1	1	1	1	1	1	1	1	1	100	0	0
066_PTCT06_PLE_7G_D_051292	221	-	260	-	12/07/2015 00:00:00	27.7.g	3	4	5	5	5	-	3	5	5	57	22	19
067_PTCT06_PLE_7G_L_M_1.0_52263	221	-	320	-	18/07/2015 00:00:00	27.7.g	6	4	5	6	6	6	4	5	6	50	17	14
068_PTCT06_PLE_7G_L_M_1.0_52277	221	-	365	-	18/07/2015 00:00:00	27.7.g	8	5	6	8	8	8	-	7	8	57	17	14
069_PTCT07_PLE_7G_L_M_053326	221	-	420	-	31/07/2015 00:00:00	27.7.g	9	7	8	9	10	11	7	9	9	38	16	12
070_PTCT07_PLE_7G_L_M_053335	221	-	400	-	31/07/2015 00:00:00	27.7.g	7	6	6	7	7	7	6	7	7	62	8	7
071_PTCT07_PLE_7G_L_M_053367	221	-	450	-	31/07/2015 00:00:00	27.7.g	9	5	9	10	10	9	-	9	9	57	20	12
072_BYDR06_PLE_7G_D_2017100710016	221	-	250	-	07/10/2017 00:00:00	27.7.g	2	2	2	2	2	2	2	3	2	88	17	10

073_BYDR06_PLE_7G_D_2017100710018	221	-	260	-	07/10/2017 00:00:00	27.7.g	5	5	5	5	5	5	5	5	5	100	0	0
074_BYDR06_PLE_7G_D_2017100710021	221	-	260	-	07/10/2017 00:00:00	27.7.g	3	2	3	4	3	4	2	3	3	50	25	17
075_BYDR06_PLE_7G_D_2017100710028	221	-	240	-	07/10/2017 00:00:00	27.7.g	5	3	4	5	5	5	5	5	5	75	16	12
076_BYDR06_PLE_7G_D_2017100710031	221	-	230	-	07/10/2017 00:00:00	27.7.g	3	3	3	4	4	4	3	3	3	62	15	14
077_BYDR06_PLE_7G_D_2017100710033	221	-	250	-	07/10/2017 00:00:00	27.7.g	4	3	3	4	4	4	3	3	3	50	15	14
078_BYDR06_PLE_7G_L_M_2017100710132	221	-	410	-	07/10/2017 00:00:00	27.7.g	7	5	7	8	7	7	4	8	7	50	21	16
079_BYDR06_PLE_7G_L_M_2017100710137	221	-	380	-	07/10/2017 00:00:00	27.7.g	6	5	6	8	6	6	5	6	6	62	15	8
080_BYDR06_PLE_7G_L_M_2017100710158	221	-	410	-	07/10/2017 00:00:00	27.7.g	7	6	7	7	8	8	5	7	7	50	14	10
081_CDDR08_PLE_7G_D_224260	221	-	200	-	15/11/2016 00:00:00	27.7.g	1	0	1	1	1	1	1	1	1	88	40	25
082_GNKT06_PLE_7G_L_M_2017110210152	221	-	390	-	02/11/2017 00:00:00	27.7.g	9	9	10	10	9	10	9	10	9	50	6	5
083_GNKT06_PLE_7G_L_M_2017110210154	221	-	395	-	02/11/2017 00:00:00	27.7.g	11	8	9	11	10	-	6	7	11	29	22	18

Table 9.7: Number of age readings table gives an overview of number of readings per reader and modal age. The total numbers of readings per reader and per modal age are summarized at the end of the table.

Modal age	R02 IE	R04 FR	R06 DK	R08 SE	R10 BE	R12 BE	R14 DK	R16 IE	total
1	7	7	6	7	7	6	6	7	**53**
2	10	10	10	9	10	9	9	10	**77**
3	14	14	14	13	14	14	13	14	**110**
4	5	6	5	6	6	6	6	6	**46**
5	10	8	9	10	10	9	10	10	**76**
6	8	6	8	8	8	8	8	8	**62**
7	10	10	10	10	10	10	10	10	**80**
8	6	6	6	6	6	5	5	6	**46**
9	9	9	9	9	9	9	8	9	**71**
10	2	2	2	2	2	2	2	2	**16**
11	1	1	1	1	1	0	1	1	**7**
Total	**82**	**79**	**80**	**81**	**83**	**78**	**78**	**83**	**644**

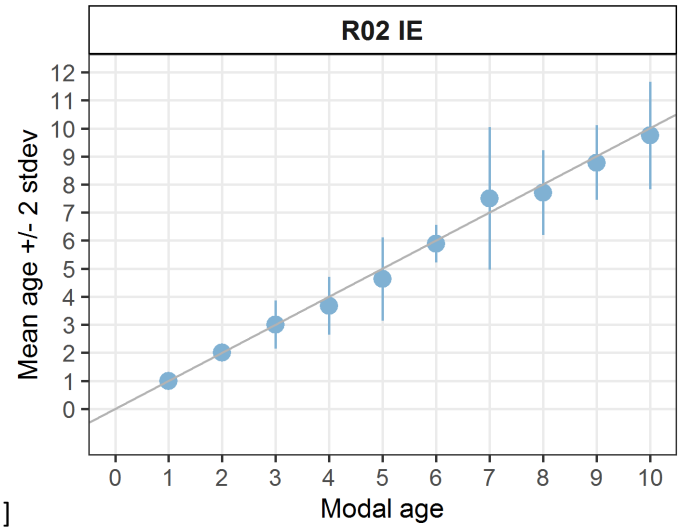
Table 9.8: Age composition by reader gives a summary of number of readings per reader.

Modal age	R02 IE	R04 FR	R06 DK	R08 SE	R10 BE	R12 BE	R14 DK	R16 IE
0	0	1	0	0	0	0	0	**0**
1	7	8	5	7	7	6	6	**6**
2	11	11	10	8	9	8	12	**11**
3	13	14	15	12	8	7	14	**15**
4	6	7	7	8	9	11	5	**6**
5	7	10	9	8	9	8	14	**10**

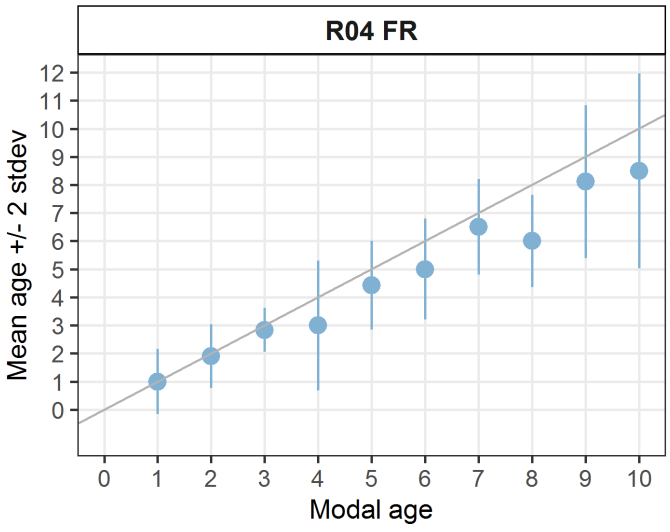
6	9	9	9	8	10	9	7	**7**
7	9	9	9	7	8	8	10	**11**
8	7	3	5	8	8	7	4	**5**
9	10	5	7	5	6	5	5	**7**
10	1	2	4	6	8	8	1	**4**
11	2	0	0	4	1	1	0	**1**
Total	**82**	**79**	**80**	**81**	**83**	**78**	**78**	**83**

Table 9.9: Mean length at age per reader is calculated per reader and age (not modal age) and for all readers combined per age. A weighted mean is also given.

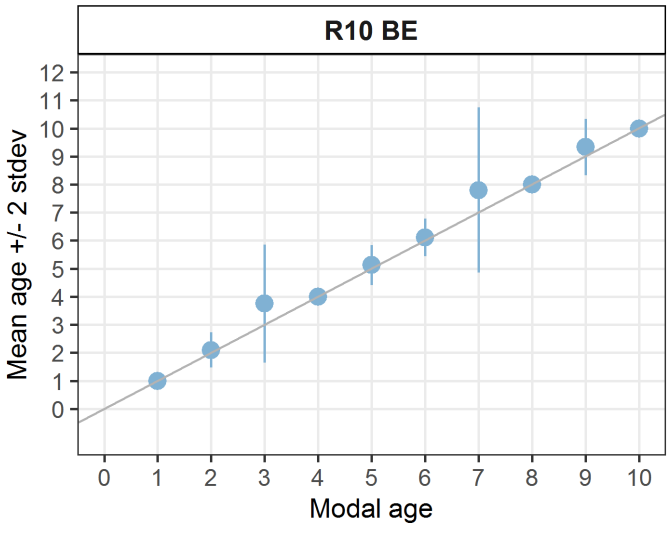
Age	R02 IE	R04 FR	R06 DK	R08 SE	R10 BE	R12 BE	R14 DK	R16 IE
0	-	200 mm	-	-	-	-	-	**-**
1	191 mm	199 mm	196 mm	191 mm	191 mm	192 mm	193 mm	**193 mm**
2	213 mm	220 mm	214 mm	209 mm	216 mm	211 mm	218 mm	**222 mm**
3	229 mm	226 mm	224 mm	228 mm	226 mm	226 mm	228 mm	**230 mm**
4	237 mm	247 mm	221 mm	231 mm	228 mm	230 mm	288 mm	**222 mm**
5	308 mm	368 mm	321 mm	305 mm	263 mm	264 mm	332 mm	**312 mm**
6	356 mm	369 mm	376 mm	359 mm	337 mm	354 mm	383 mm	**354 mm**
7	400 mm	427 mm	392 mm	376 mm	384 mm	384 mm	419 mm	**388 mm**
8	397 mm	435 mm	431 mm	398 mm	398 mm	393 mm	431 mm	**412 mm**
9	434 mm	428 mm	439 mm	427 mm	434 mm	433 mm	426 mm	**447 mm**
10	400 mm	460 mm	452 mm	432 mm	442 mm	444 mm	425 mm	**434 mm**
11	458 mm	-	-	451 mm	395 mm	420 mm	-	**495 mm**
Weighted Mean	**311 mm**	**308 mm**	**311 mm**	**312 mm**	**309 mm**	**310 mm**	**310 mm**	**309 mm**


R02 IE
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12

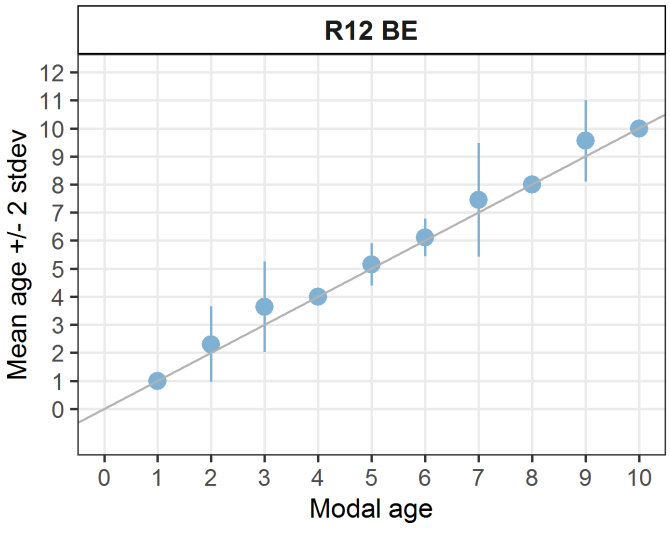
[[1]] [[2]]


R04 FR
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12

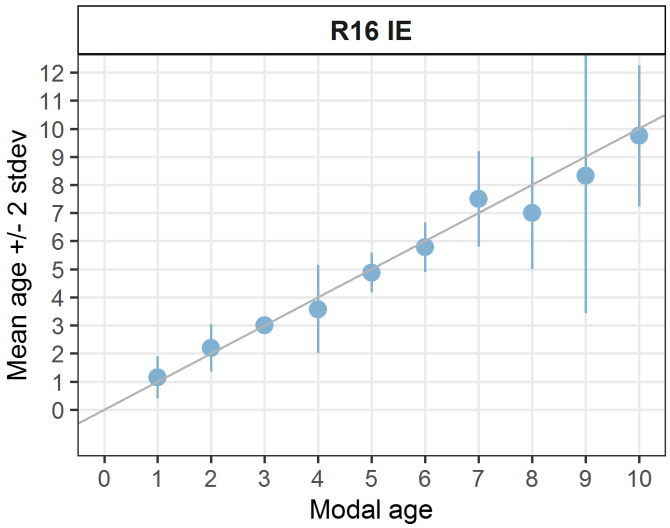
[[3]]


R10 BE
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12

[[4]]


R12 BE
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12

[[5]]


R16 IE
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11 12

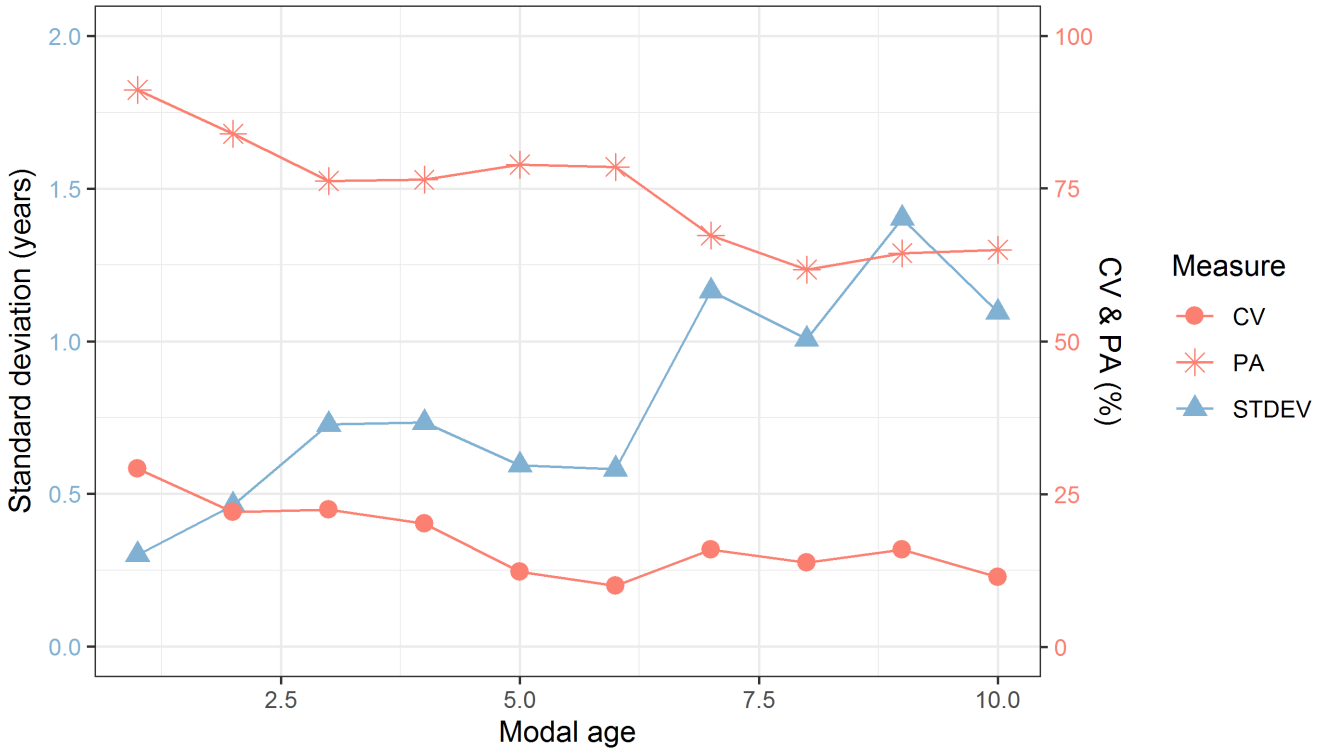


Figure 9.5: CV, PA and (STDEV (standard deviation) are plotted against modal age

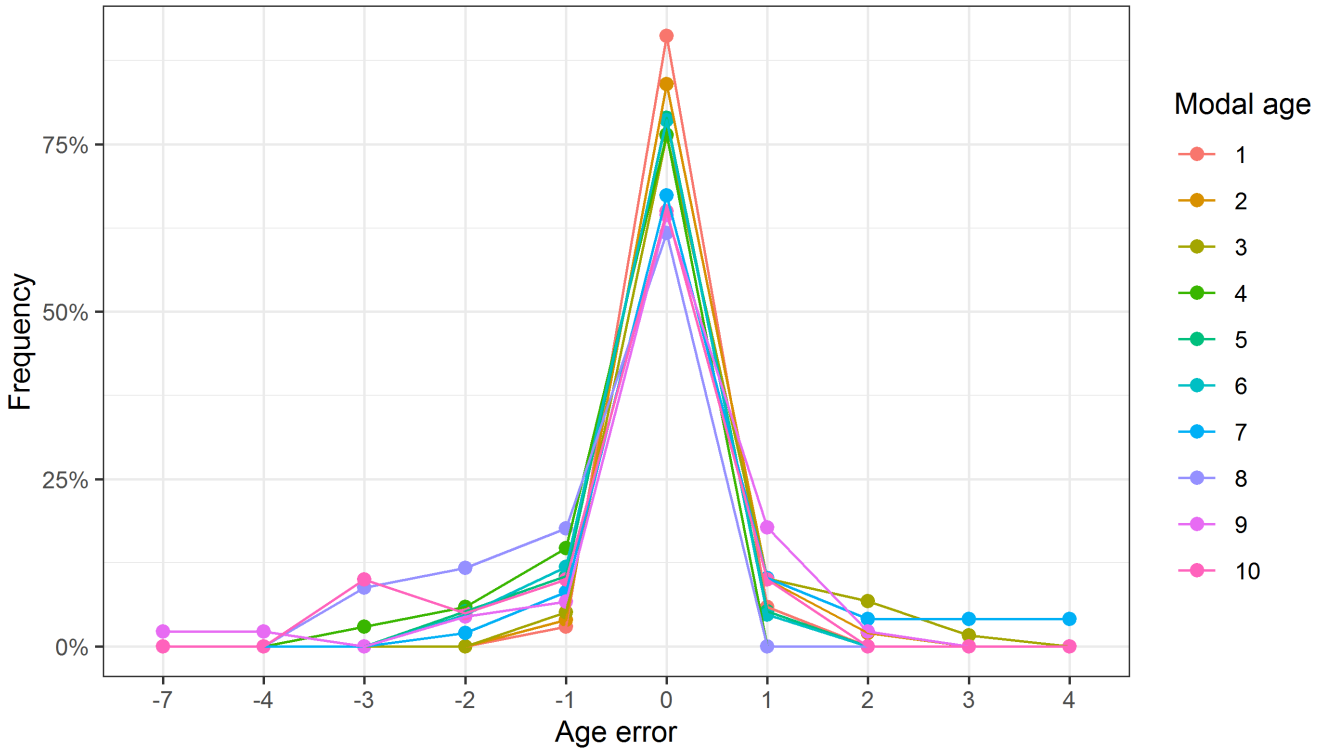


Figure 9.6: The distribution of the age reading errors in percentage by modal age as observed from the whole group of age readers in an age reading comparison to modal age. The achieved precision in age reading by MODAL age group is

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.

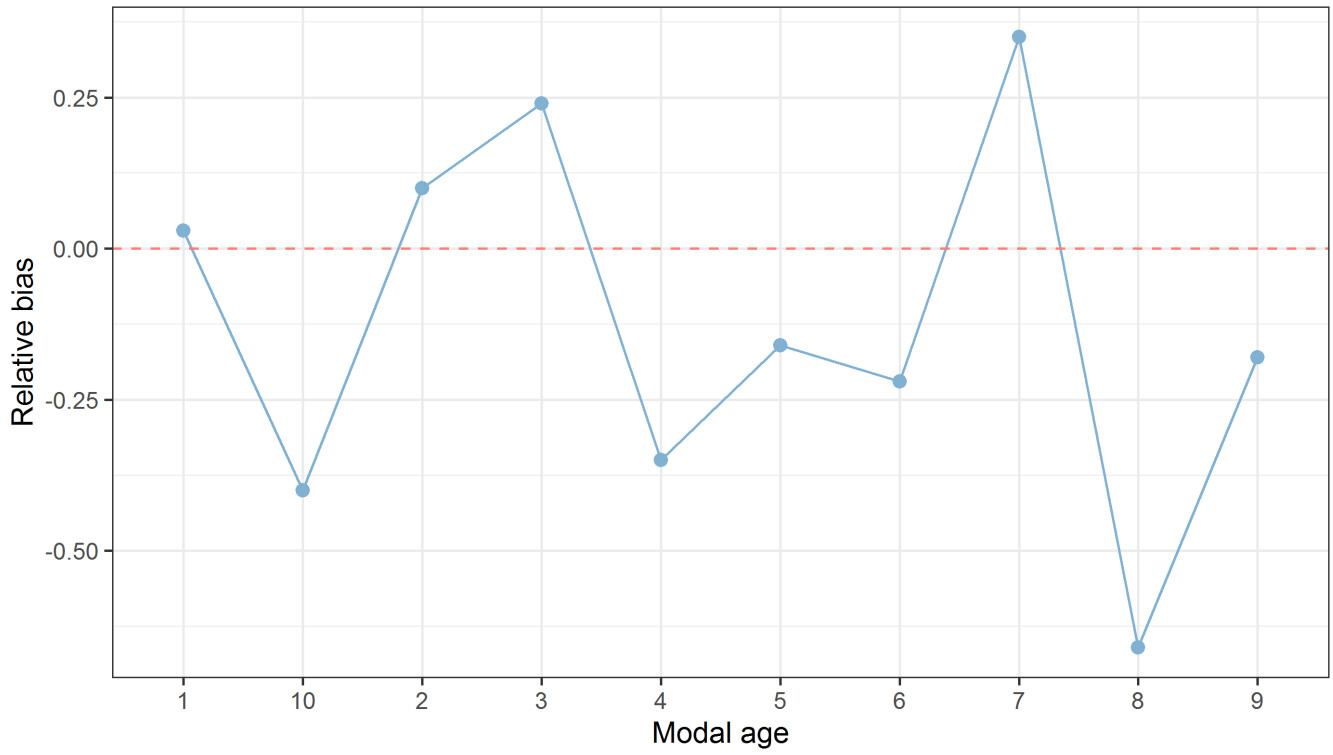


Figure 9.7: The relative bias by modal age as estimated by all age readers combined.

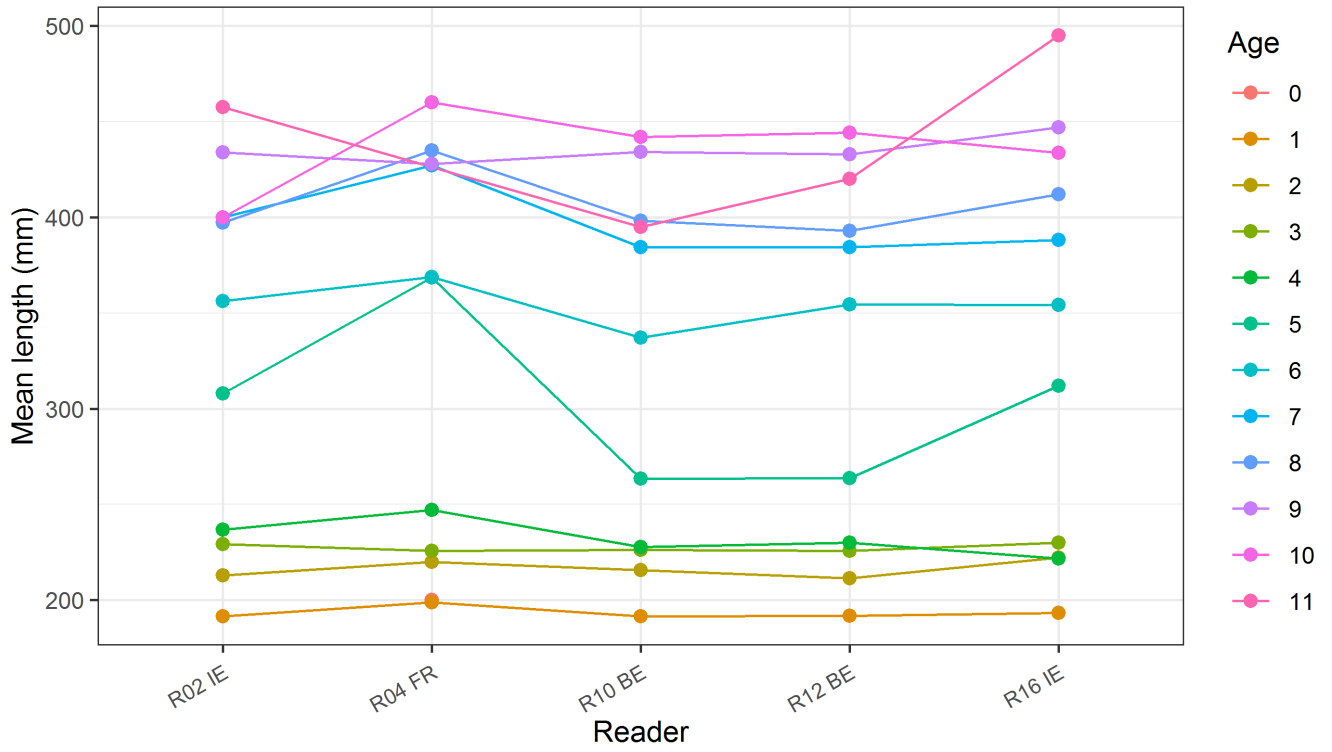


Figure 9.8: The mean length at age as estimated by each age reader.

9.3 Results all readers – Sections

Data Overview

Table 9.10: Summary of statistics; PA (%), CV (%) and APE (%).

CV	PA	APE
28 %	56 %	19 %

Table 9.11: Data overview including modal age and statistics per sample.

Fish ID	Event ID	Image ID	length	sex	Catch date	ICES area	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	R20 FR	R24 FR	R30 GB	Modal age	PA %	CV %	APE %
001_BYDR01_PLE_7F_D_2017000068	221	-	220	-	27/01/2017 00:00:00	27.7.f	2	4	4	4	8	3	4	5	4	50	41	26
002_BYDR01_PLE_7F_D_2017000074	221	-	250	-	27/01/2017 00:00:00	27.7.f	3	0	3	3	2	2	4	4	3	38	50	37
003_BYDR01_PLE_7F_D_2017000196	221	-	220	-	27/01/2017 00:00:00	27.7.f	4	3	6	5	5	6	6	6	6	50	22	17
004_BYDR01_PLE_7F_D_2017000200	221	-	180	-	27/01/2017 00:00:00	27.7.f	1	1	1	1	2	1	2	-	1	71	38	32
005_BYDR01_PLE_7F_D_2017000201	221	-	200	-	27/01/2017 00:00:00	27.7.f	2	2	3	2	3	2	3	5	2	50	38	27
006_BYDR01_PLE_7F_L_M_2017000566	221	-	340	-	27/01/2017 00:00:00	27.7.f	7	7	8	7	7	7	7	8	7	75	6	5
007_BYDR01_PLE_7F_L_M_2017000576	221	-	375	-	27/01/2017 00:00:00	27.7.f	8	6	7	8	9	5	5	8	8	38	22	18
008_BYDR01_PLE_7F_L_M_2017000579	221	-	345	-	27/01/2017 00:00:00	27.7.f	6	6	7	6	11	6	7	9	6	50	25	19
009_BYDR03_PLE_7F_D_2017033010048	221	-	260	-	30/03/2017 00:00:00	27.7.f	3	4	0	5	7	3	5	2	3	25	59	45
010_BYDR03_PLE_7F_L_M_2017033010147	221	-	495	-	30/03/2017 00:00:00	27.7.f	9	6	10	10	8	10	6	12	10	38	24	19
011_CDDR01_PLE_7F_L_M_2017001034	221	-	430	-	03/03/2017 00:00:00	27.7.f	9	7	9	9	11	9	9	11	9	62	14	9
012_BYDR04_PLE_7F_D_2018041510024	221	-	180	-	15/04/2018 00:00:00	27.7.f	1	-	1	1	7	2	2	2	1	43	94	59
013_CDDR02_PLE_7F_L_M_2018041210241	221	-	425	-	12/04/2018 00:00:00	27.7.f	9	5	9	9	12	9	9	10	9	62	21	11
014_CDDR03_PLE_7F_D_2017040610014	221	-	200	-	06/04/2017 00:00:00	27.7.f	2	3	4	2	4	3	5	4	4	38	31	26

015_CDDR03_PLE_7F_D_20170406100016	221	-	220	-	06/04/2017 00:00:00	27.7.f	3	4	4	4	7	4	5	7	4	50	31	25
016_CDDR03_PLE_7F_D_20170406100039	221	-	210	-	06/04/2017 00:00:00	27.7.f	5	4	5	5	5	4	5	6	5	62	13	9
017_CDDR03_PLE_7F_L_M_20170406100239	221	-	400	-	06/04/2017 00:00:00	27.7.f	7	7	7	7	9	7	7	7	7	88	10	6
018_CDDR03_PLE_7F_L_M_20170406100241	221	-	375	-	06/04/2017 00:00:00	27.7.f	6	6	7	6	7	7	6	7	6	50	8	8
019_CDDR03_PLE_7F_L_M_20170406100255	221	-	360	-	06/04/2017 00:00:00	27.7.f	8	5	8	7	7	6	6	8	8	38	16	13
020_CDDR04_PLE_7F_D_20170507100058	221	-	200	-	07/05/2017 00:00:00	27.7.f	3	3	3	3	3	3	3	3	3	100	0	0
021_GNKT04_PLE_7F_L_M_68727	221	-	400	-	20/05/2016 00:00:00	27.7.f	9	7	10	10	10	9	9	10	10	50	11	8
022_CDDR06_PLE_7F_D_70977	221	-	250	-	01/08/2016 00:00:00	27.7.f	2	3	3	3	6	3	3	5	3	62	37	29
023_CDDR06_PLE_7F_D_71001	221	-	220	-	01/08/2016 00:00:00	27.7.f	3	3	4	3	4	4	4	4	4	62	14	13
024_CDDR06_PLE_7F_L_M_71865	221	-	355	-	01/08/2016 00:00:00	27.7.f	6	5	6	6	6	6	5	8	6	62	15	8
025_CDDR06_PLE_7F_L_M_71868	221	-	435	-	01/08/2016 00:00:00	27.7.f	7	6	7	7	10	7	8	7	7	62	16	11
026_CDDR06_PLE_7F_L_M_71878	221	-	385	-	01/08/2016 00:00:00	27.7.f	5	5	6	5	6	5	6	6	5	50	10	9
027_CDDR06_PLE_7F_L_M_71892	221	-	435	-	01/08/2016 00:00:00	27.7.f	8	6	9	8	9	8	9	10	8	38	14	10
028_GNKT05_PLE_7F_D_20180717100045	221	-	240	-	17/07/2018 00:00:00	27.7.f	2	2	2	2	3	2	2	2	2	88	17	10
029_GNKT05_PLE_7F_L_M_20180717100272	221	-	375	-	17/07/2018 00:00:00	27.7.f	9	7	9	9	11	9	10	10	9	50	13	9
030_GNKT05_PLE_7F_L_M_20180717100286	221	-	445	-	17/07/2018 00:00:00	27.7.f	9	9	10	8	11	9	10	10	9	38	10	8
031_BYDR07_PLE_7F_D_20181023100045	221	-	210	-	23/10/2018 00:00:00	27.7.f	2	2	3	2	2	3	3	4	2	50	28	24
032_BYDR07_PLE_7F_L_M_20181023100207	221	-	400	-	23/10/2018 00:00:00	27.7.f	7	6	7	6	9	7	7	11	7	50	23	17
033_BYDR07_PLE_7F_L_M_20181023100211	221	-	390	-	23/10/2018 00:00:00	27.7.f	6	5	8	8	7	7	6	9	6	25	19	14

034_BYDR07_PLE_7F_L_M_2018102310212	221	-	430	-	23/10/2018 00:00:00	27.7.f	5	6	6	5	8	5	6	7	5	38	18	12
035_BYDR07_PLE_7F_L_M_2018102310220	221	-	410	-	23/10/2018 00:00:00	27.7.f	9	6	10	10	9	9	7	11	9	38	19	13
036_BYDR07_PLE_7F_L_M_2018102310236	221	-	370	-	23/10/2018 00:00:00	27.7.f	7	6	8	8	9	8	8	9	8	50	13	9
037_PLE_D_004_GK_11_041210_7FG_1	221	-	210	-	04/12/2010 00:00:00	27.7.f	1	1	1	2	2	1	2	4	1	50	59	43
038_PTCT09_PLE_7F_D_2017102220028	221	-	230	-	22/10/2017 00:00:00	27.7.f	3	3	4	3	7	5	4	6	3	38	34	28
039_PTCT09_PLE_7F_D_2017102220041	221	-	260	-	22/10/2017 00:00:00	27.7.f	4	4	4	4	3	4	4	5	4	75	13	6
040_BYDR01_PLE_7G_D_2017000182	221	-	230	-	27/01/2017 00:00:00	27.7.g	4	4	4	4	3	4	5	14	4	62	68	42
041_BYDR01_PLE_7G_D_2017000188	221	-	270	-	27/01/2017 00:00:00	27.7.g	6	4	6	6	3	6	5	7	6	50	24	19
042_CDDR01_PLE_7G_L_M_2018030110203	221	-	385	-	01/03/2018 00:00:00	27.7.g	8	7	8	8	7	8	6	11	8	50	19	12
043_CDDR01_PLE_7G_L_M_2018030110209	221	-	330	-	01/03/2018 00:00:00	27.7.g	7	5	7	7	7	7	6	8	7	62	13	9
044_CDDR01_PLE_7G_L_M_2018030110230	221	-	395	-	01/03/2018 00:00:00	27.7.g	8	5	8	7	8	8	8	9	8	62	16	11
045_GNKT01_PLE_7G_D_000274	221	-	180	-	06/02/2015 00:00:00	27.7.g	2	2	5	2	3	2	2	3	2	62	40	30
046_GNKT01_PLE_7G_D_000275	221	-	210	-	06/02/2015 00:00:00	27.7.g	2	2	3	-	2	2	2	4	2	71	32	25
047_GNKT01_PLE_7G_D_000278	221	-	230	-	06/02/2015 00:00:00	27.7.g	3	3	4	3	3	4	4	5	3	50	21	17
048_GNKT01_PLE_7G_D_000293	221	-	270	-	06/02/2015 00:00:00	27.7.g	5	5	5	5	5	5	5	6	5	88	7	4
049_PLE_D_029_GK_3_27032011_7FG_9	221	-	190	-	27/03/2011 00:00:00	27.7.g	1	1	1	1	1	2	2	2	1	62	38	34
050_PTCT02_PLE_7G_L_M_002551	221	-	500	-	09/03/2015 00:00:00	27.7.g	9	9	9	9	9	9	9	10	9	88	4	2
051_GNKT03_PLE_7G_D_2017042710033	221	-	200	-	27/04/2017 00:00:00	27.7.g	2	2	2	2	2	2	2	3	2	88	17	10
052_GNKT03_PLE_7G_D_2017042710034	221	-	200	-	27/04/2017 00:00:00	27.7.g	3	3	5	4	4	5	5	5	5	50	21	18

053_GNKT03_PLE_7G_D_2017042710036	221	-	220	-	27/04/2017 00:00:00	27.7.g	4	4	5	5	5	6	6	5	5	50	15	10
054_GNKT03_PLE_7G_D_2017042710037	221	-	230	-	27/04/2017 00:00:00	27.7.g	3	2	3	3	3	3	3	5	3	75	27	15
055_GNKT03_PLE_7G_D_2017042710040	221	-	240	-	27/04/2017 00:00:00	27.7.g	4	4	4	4	4	4	4	5	4	88	9	5
056_GNKT03_PLE_7G_L_M_2017042710261	221	-	485	-	27/04/2017 00:00:00	27.7.g	7	6	8	9	8	8	7	10	8	38	16	12
057_GNKT03_PLE_7G_L_M_2017042710266	221	-	520	-	27/04/2017 00:00:00	27.7.g	11	5	8	-	11	8	9	12	8	29	26	21
058_GNKT03_PLE_7G_L_M_2017042710268	221	-	390	-	27/04/2017 00:00:00	27.7.g	7	6	7	7	9	7	7	8	7	62	12	9
059_GNKT03_PLE_7G_L_M_2017042710272	221	-	465	-	27/04/2017 00:00:00	27.7.g	8	6	8	8	7	8	7	11	8	50	19	12
060_GNKT03_PLE_7G_L_M_2017042710288	221	-	360	-	27/04/2017 00:00:00	27.7.g	5	5	6	6	7	7	6	8	6	38	17	13
061_PLE_CT_D_058_NV_4_060613_7G_5	221	-	180	-	06/06/2013 00:00:00	27.7.g	2	2	3	3	8	1	3	4	3	38	65	42
062_CDDR06_PLE_7G_D_071012	221	-	180	-	26/08/2016 00:00:00	27.7.g	2	2	2	2	2	2	2	2	2	100	0	0
063_CDDR06_PLE_7G_D_071013	221	-	190	-	26/08/2016 00:00:00	27.7.g	3	3	3	3	3	3	3	-	3	100	0	0
064_CDDR06_PLE_7G_D_071015	221	-	200	-	26/08/2016 00:00:00	27.7.g	3	3	4	4	2	4	3	5	3	38	26	21
065_PLE_D_037_PC_6_310711_7G_5	221	-	200	-	31/07/2011 00:00:00	27.7.g	1	1	1	1	2	2	1	2	1	62	38	34
066_PTCT06_PLE_7G_D_051292	221	-	260	-	12/07/2015 00:00:00	27.7.g	2	4	5	1	3	3	3	6	3	38	47	36
067_PTCT06_PLE_7G_L_M_52263	221	-	320	-	18/07/2015 00:00:00	27.7.g	6	6	7	6	6	6	6	6	6	88	6	4
068_PTCT06_PLE_7G_L_M_52277	221	-	365	-	18/07/2015 00:00:00	27.7.g	8	6	8	8	8	8	7	9	8	62	11	8
069_PTCT07_PLE_7G_L_M_053326	221	-	420	-	31/07/2015 00:00:00	27.7.g	9	7	11	10	11	8	7	10	7	25	18	15
070_PTCT07_PLE_7G_L_M_053335	221	-	400	-	31/07/2015 00:00:00	27.7.g	7	7	7	7	-	7	7	7	7	100	0	0
071_PTCT07_PLE_7G_L_M_053367	221	-	450	-	31/07/2015 00:00:00	27.7.g	9	7	9	10	9	9	8	10	9	50	11	8

072_BYDR06_PLE_7G_D_2017100710016	221	-	250	-	07/10/2017 00:00:00	27.7.g	3	2	3	2	2	3	3	6	3	50	44	25
073_BYDR06_PLE_7G_D_2017100710018	221	-	260	-	07/10/2017 00:00:00	27.7.g	5	4	6	-	6	5	5	7	5	43	18	14
074_BYDR06_PLE_7G_D_2017100710021	221	-	260	-	07/10/2017 00:00:00	27.7.g	3	3	3	3	3	3	3	4	3	88	11	7
075_BYDR06_PLE_7G_D_2017100710028	221	-	240	-	07/10/2017 00:00:00	27.7.g	5	4	5	5	6	5	5	8	5	62	22	15
076_BYDR06_PLE_7G_D_2017100710031	221	-	230	-	07/10/2017 00:00:00	27.7.g	4	4	5	4	5	4	4	6	4	62	17	14
077_BYDR06_PLE_7G_D_2017100710033	221	-	250	-	07/10/2017 00:00:00	27.7.g	4	4	4	4	4	4	4	5	4	88	9	5
078_BYDR06_PLE_7G_L_M_2017100710132	221	-	410	-	07/10/2017 00:00:00	27.7.g	7	4	7	7	8	6	6	10	7	38	25	17
079_BYDR06_PLE_7G_L_M_2017100710137	221	-	380	-	07/10/2017 00:00:00	27.7.g	7	6	7	7	9	7	6	9	7	50	16	12
080_BYDR06_PLE_7G_L_M_2017100710158	221	-	410	-	07/10/2017 00:00:00	27.7.g	6	5	7	8	9	7	5	9	5	25	23	18
081_CDDR08_PLE_7G_D_224260	221	-	200	-	15/11/2016 00:00:00	27.7.g	1	1	1	1	2	1	2	2	1	62	38	34
082_GNKT06_PLE_7G_L_M_2017110210152	221	-	390	-	02/11/2017 00:00:00	27.7.g	9	7	9	9	10	8	7	10	9	38	14	11
083_GNKT06_PLE_7G_L_M_2017110210154	221	-	395	-	02/11/2017 00:00:00	27.7.g	7	5	8	8	8	7	7	8	8	50	14	10

Table 9.12: Number of age readings table gives an overview of number of readings per reader and modal age. The total numbers of readings per reader and per modal age are summarized at the end of the table.

Modal age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	R20 FR	R24 FR	R30 GB	total
1	6	5	6	6	6	6	6	5	**46**
2	7	7	7	6	7	7	7	7	**55**
3	13	13	13	13	13	13	13	12	**103**
4	9	9	9	9	9	9	9	9	**72**
5	9	9	9	8	9	9	9	9	**71**
6	8	8	8	8	8	8	8	8	**64**
7	10	10	10	10	9	10	10	10	**79**
8	11	11	11	10	11	11	11	11	**87**
9	8	8	8	8	8	8	8	8	**64**
10	2	2	2	2	2	2	2	2	**16**
Total	**83**	**82**	**83**	**80**	**82**	**83**	**83**	**81**	**657**

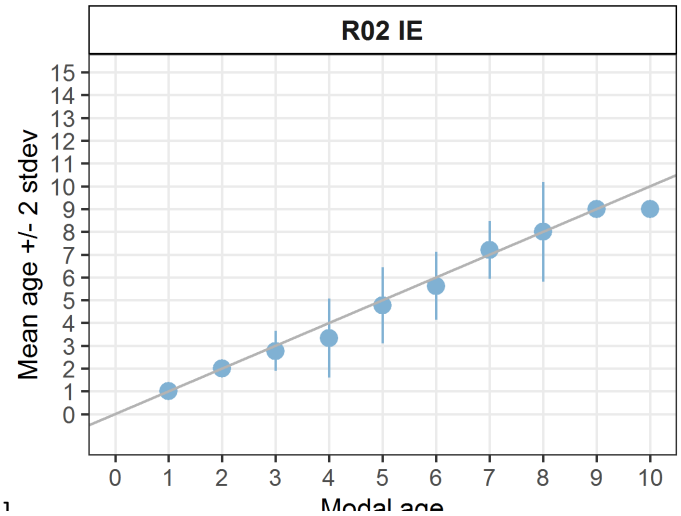
Table 9.13: Age composition by reader gives a summary of number of readings per reader.

Modal age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	R20 FR	R24 FR	R30 GB
0	0	1	1	0	0	0	0	**0**
1	6	5	6	6	1	4	1	**0**
2	12	10	3	9	11	10	10	**7**
3	13	11	11	10	12	11	11	**3**

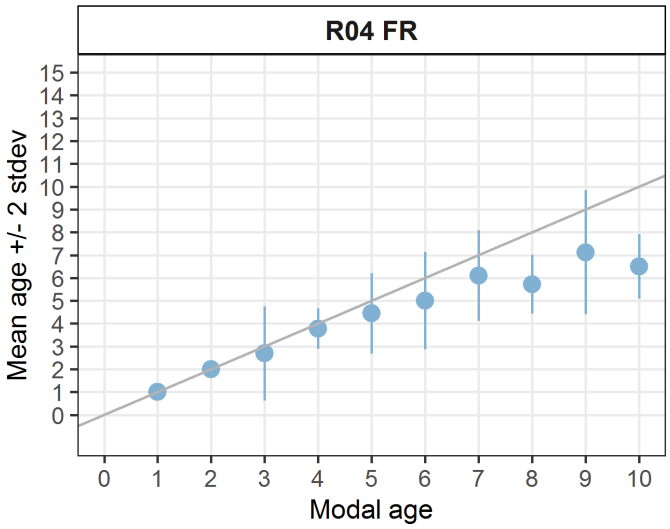
4	7	15	11	9	5	10	9	**8**
5	7	12	8	8	5	8	13	**11**
6	7	16	7	7	6	8	14	**9**
7	12	10	13	10	12	13	13	**8**
8	7	0	11	10	9	10	4	**9**
9	11	2	7	6	11	8	6	**7**
10	0	0	4	5	3	1	2	**11**
11	1	0	1	0	6	0	0	**5**
12	0	0	0	0	1	0	0	**2**
14	0	0	0	0	0	0	0	**1**
Total	**83**	**82**	**83**	**80**	**82**	**83**	**83**	**81**

Table 9.14: Mean length at age per reader is calculated per reader and age (not modal age) and for all readers combined per age. A weighted mean is also given.

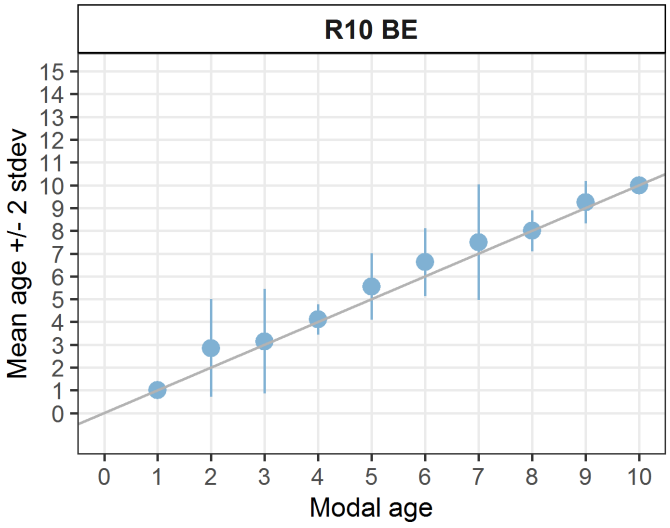
Age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	R20 FR	R24 FR	R30 GB
0	-	250 mm	260 mm	-	-	-	-	**-**
1	193 mm	196 mm	193 mm	202 mm	190 mm	192 mm	200 mm	**-**
2	211 mm	208 mm	207 mm	208 mm	208 mm	203 mm	197 mm	**207 mm**
3	226 mm	218 mm	221 mm	224 mm	229 mm	230 mm	221 mm	**193 mm**
4	236 mm	252 mm	227 mm	228 mm	222 mm	229 mm	237 mm	**218 mm**
5	308 mm	383 mm	226 mm	279 mm	230 mm	299 mm	269 mm	**227 mm**
6	352 mm	405 mm	326 mm	346 mm	302 mm	312 mm	361 mm	**264 mm**
7	395 mm	399 mm	382 mm	384 mm	325 mm	385 mm	400 mm	**349 mm**
8	397 mm	-	406 mm	404 mm	375 mm	423 mm	412 mm	**349 mm**
9	431 mm	472 mm	429 mm	434 mm	411 mm	429 mm	452 mm	**379 mm**
10	-	-	438 mm	435 mm	408 mm	495 mm	410 mm	**430 mm**
11	520 mm	-	420 mm	-	422 mm	-	-	**418 mm**
12	-	-	-	-	425 mm	-	-	**508 mm**
14	-	-	-	-	-	-	-	**230 mm**
Weighted Mean	**309 mm**	**311 mm**	**309 mm**	**309 mm**	**308 mm**	**309 mm**	**309 mm**	**312 mm**


R02 IE
Mean age +/- 2 stdev
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0 1 2 3 4 5 6 7 8 9 10
Modal age

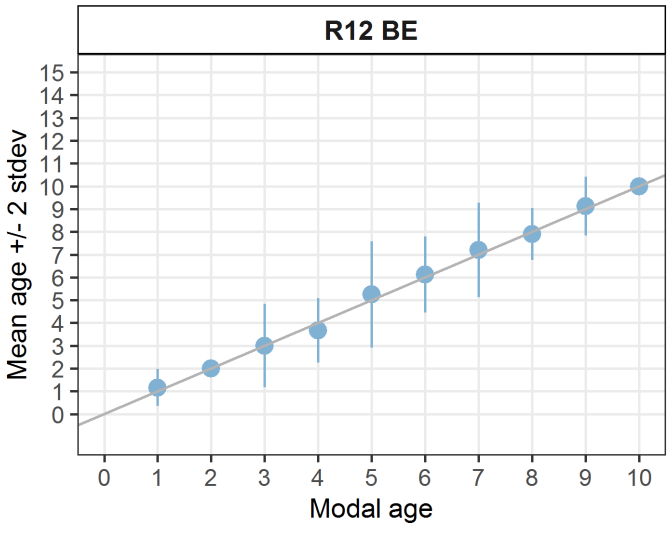
[[1]] [[2]]


R04 FR
Mean age +/- 2 stdev
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0 1 2 3 4 5 6 7 8 9 10
Modal age

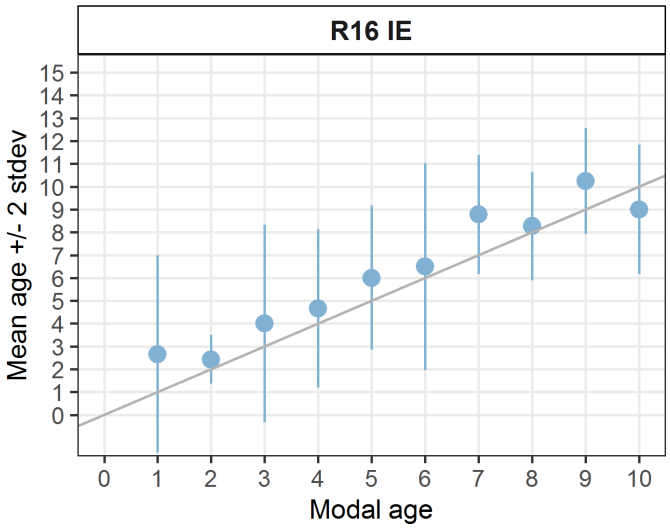
[[3]]


R10 BE
Mean age +/- 2 stdev
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0 1 2 3 4 5 6 7 8 9 10
Modal age

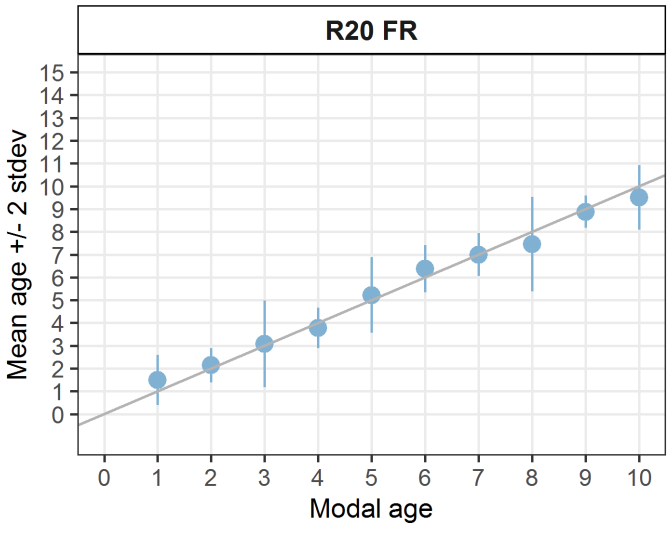
[[4]]


R12 BE
Mean age +/- 2 stdev
Modal age

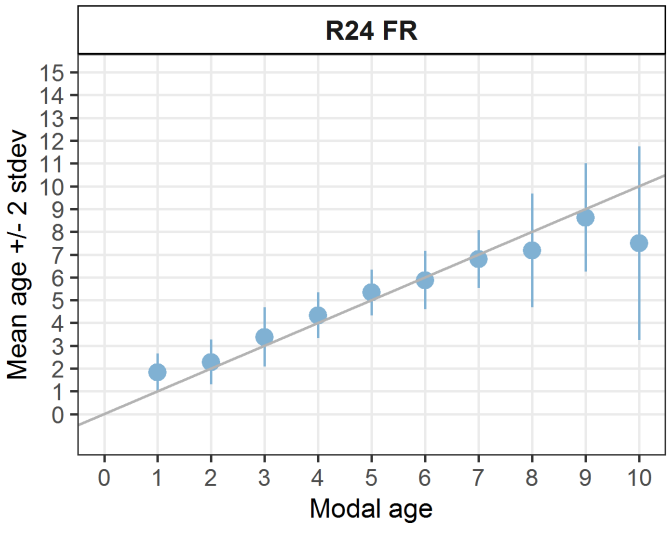
[[5]]


R16 IE
Mean age +/- 2 stdev
Modal age

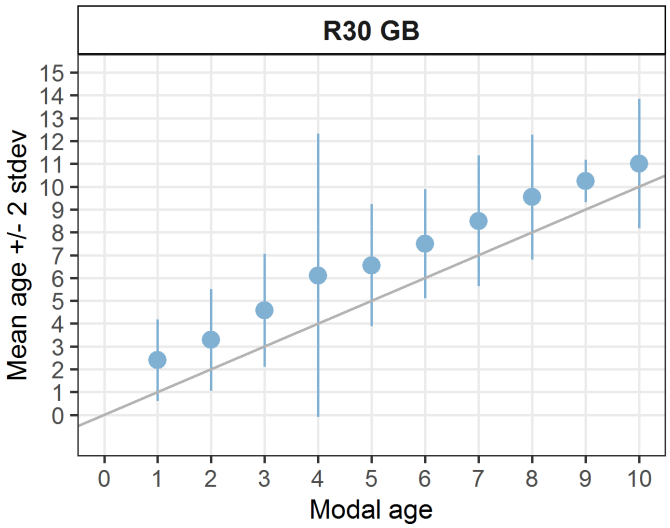
[[6]]


R20 FR
Mean age +/- 2 stdev
Modal age

[[7]]


R24 FR
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

[[8]]


R30 GB
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

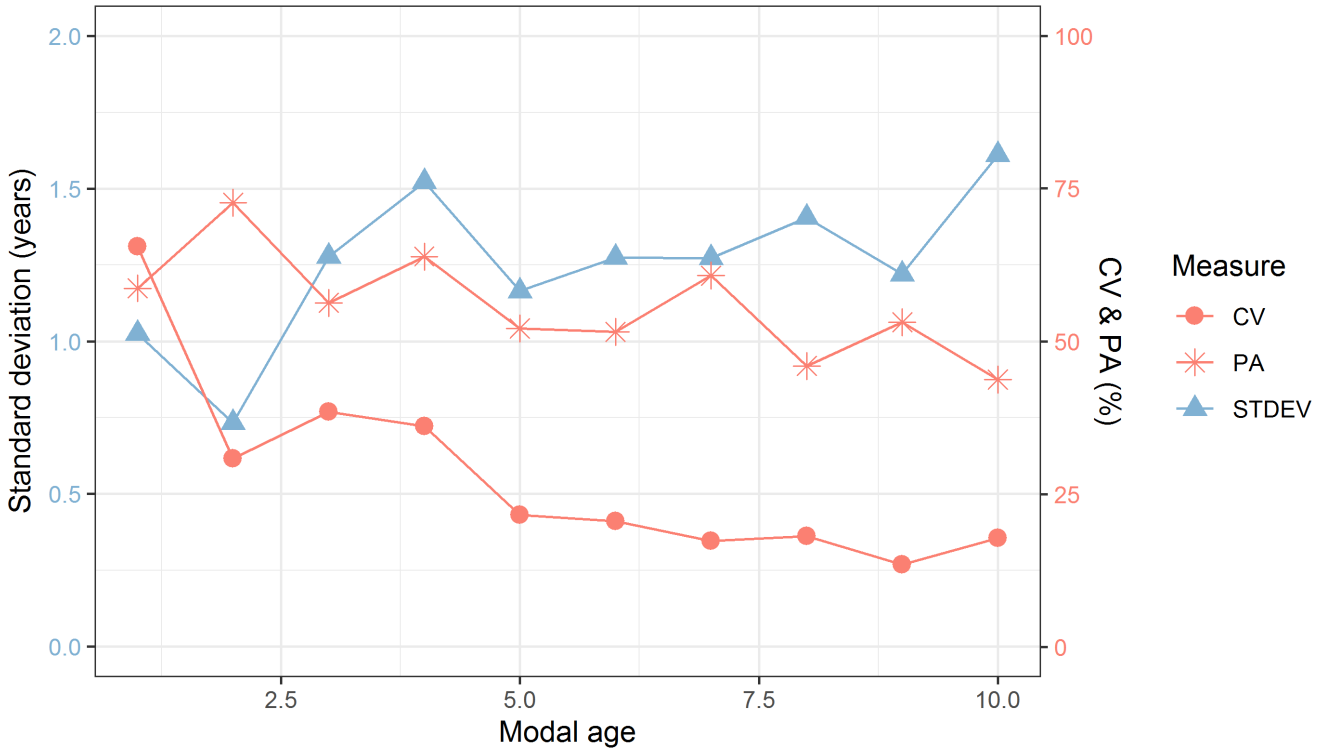


Figure 9.9: CV, PA and (STDEV (standard deviation) are plotted against modal age

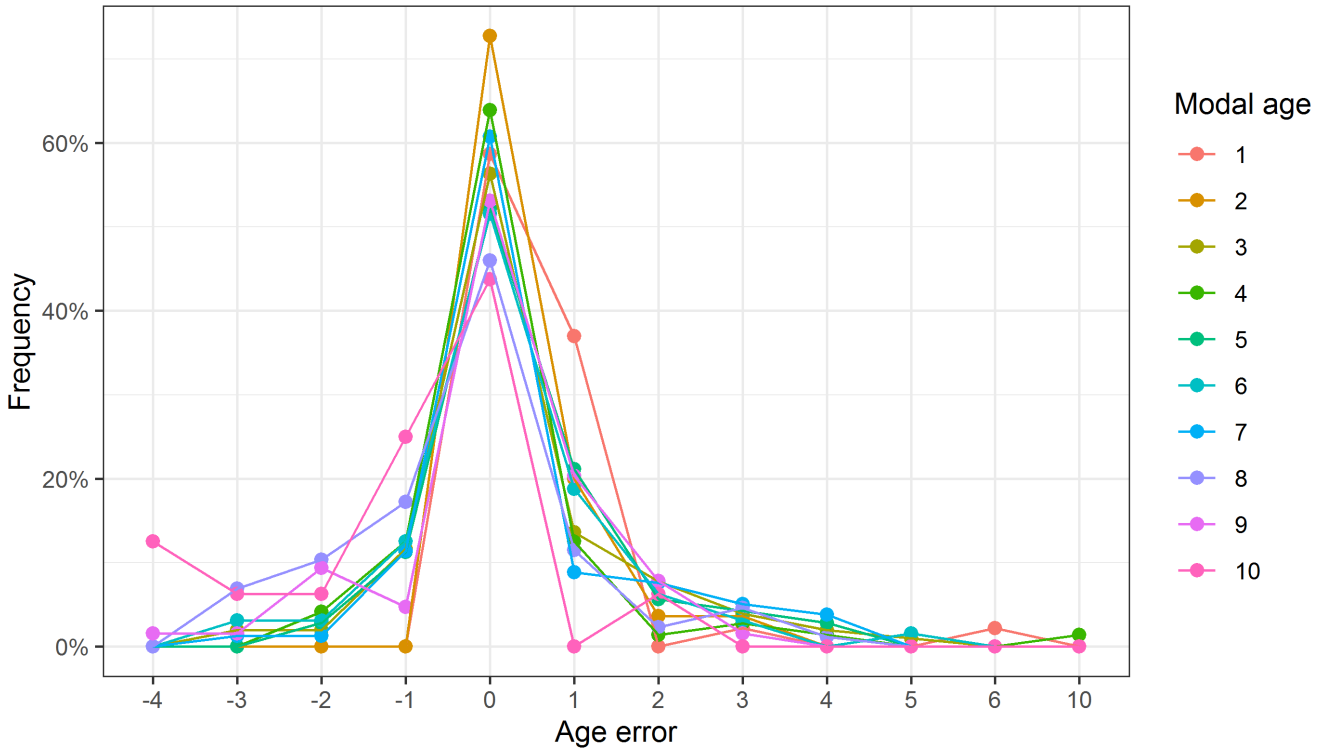


Figure 9.10: The distribution of the age reading errors in percentage by modal age as observed from the whole group of age readers in an age reading comparison to modal age. The achieved precision in age reading by MODAL age group is

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.

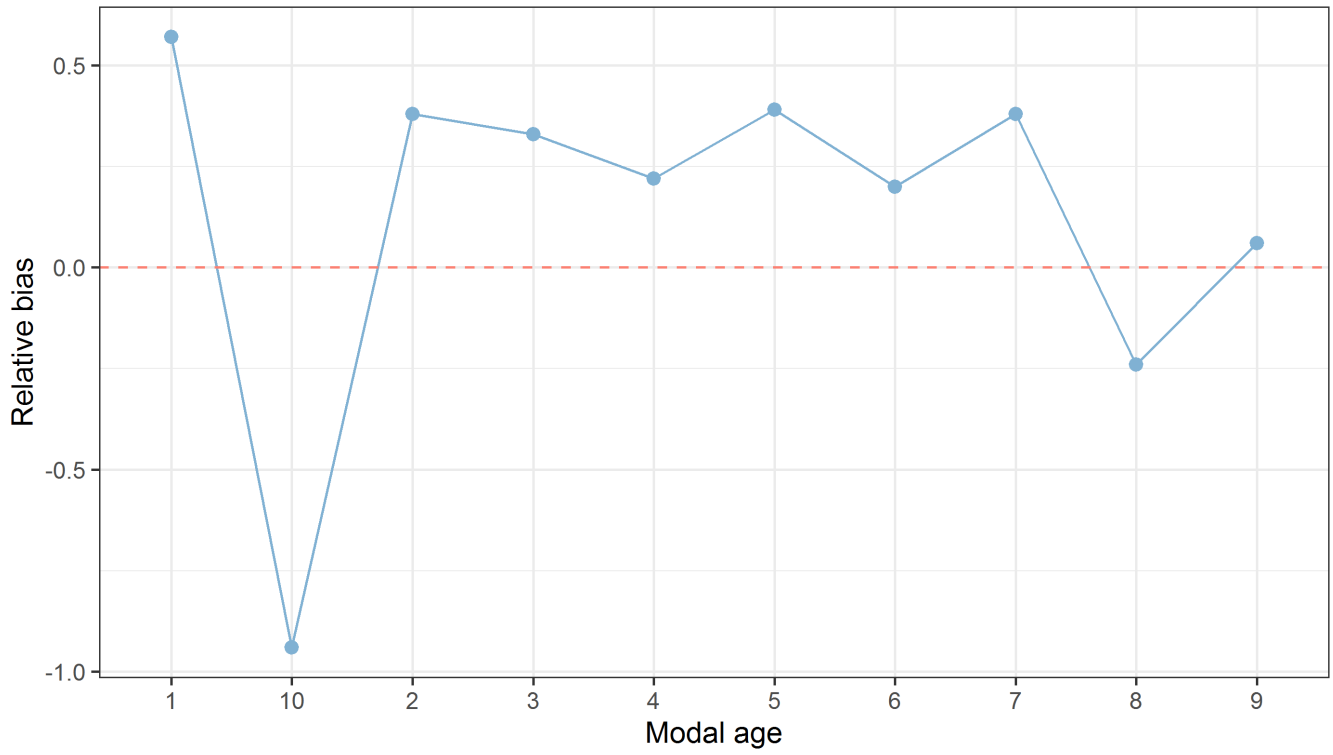


Figure 9.11: The relative bias by modal age as estimated by all age readers combined.

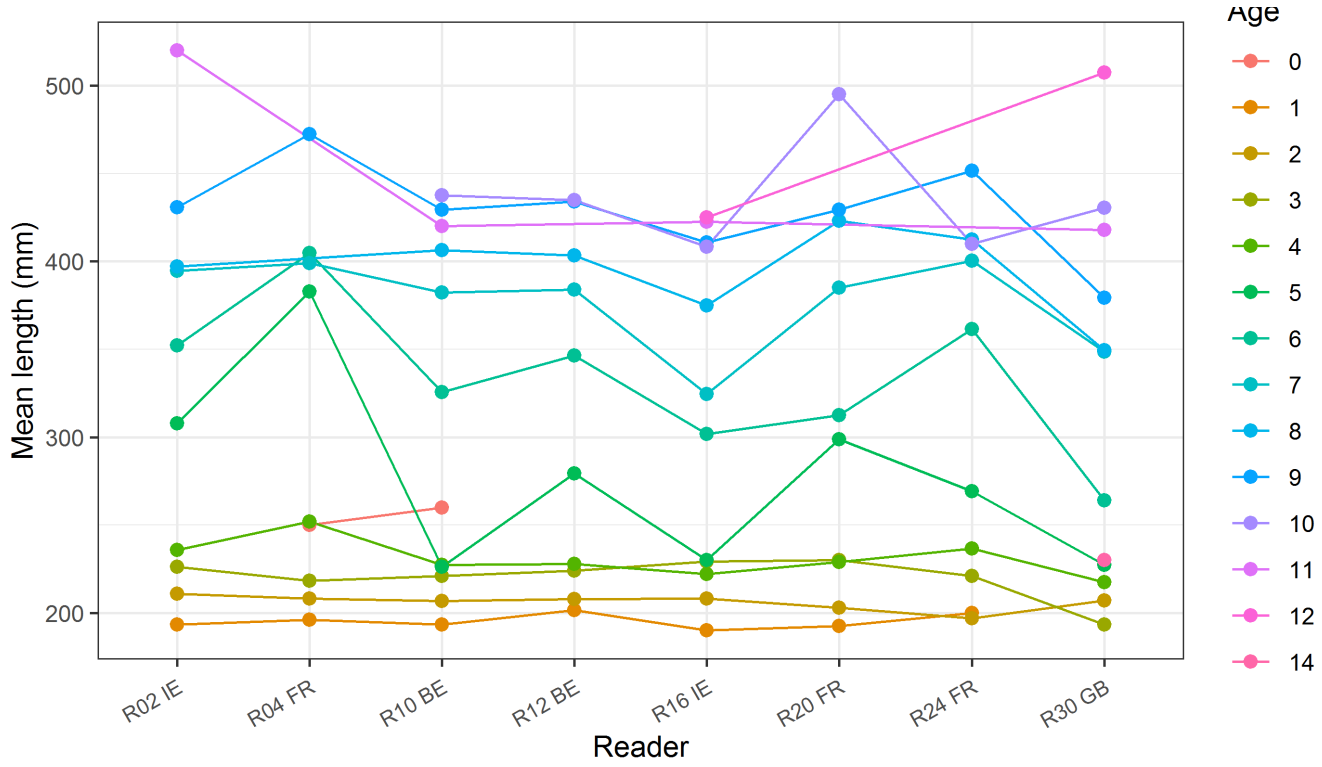


Figure 9.12: The mean length at age as estimated by each age reader.

9.4 Results Advanced readers –Sections

Data Overview

Table 9.15: Data overview including modal age and statistics per sample.

Fish ID	Event ID	Image ID	length	sex	Catch date	ICES area	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	Modal age	PA %	CV %	APE %
001_BYDR01_PLE_7F_D_2017000068	221	-	220	-	27/01/2017 00:00:00	27.7.f	2	4	4	4	8	4	60	50	33
002_BYDR01_PLE_7F_D_2017000074	221	-	250	-	27/01/2017 00:00:00	27.7.f	3	0	3	3	2	3	60	59	44
003_BYDR01_PLE_7F_D_2017000196	221	-	220	-	27/01/2017 00:00:00	27.7.f	4	3	6	5	5	5	40	25	19
004_BYDR01_PLE_7F_D_2017000200	221	-	180	-	27/01/2017 00:00:00	27.7.f	1	1	1	1	2	1	80	37	27
005_BYDR01_PLE_7F_D_2017000201	221	-	200	-	27/01/2017 00:00:00	27.7.f	2	2	3	2	3	2	60	23	20
006_BYDR01_PLE_7F_L_M_2017000566	221	-	340	-	27/01/2017 00:00:00	27.7.f	7	7	8	7	7	7	80	6	4
007_BYDR01_PLE_7F_L_M_2017000576	221	-	375	-	27/01/2017 00:00:00	27.7.f	8	6	7	8	9	8	40	15	12
008_BYDR01_PLE_7F_L_M_2017000579	221	-	345	-	27/01/2017 00:00:00	27.7.f	6	6	7	6	11	6	60	30	21
009_BYDR03_PLE_7F_D_2017033010048	221	-	260	-	30/03/2017 00:00:00	27.7.f	3	4	0	5	7	0	20	-	-
010_BYDR03_PLE_7F_L_M_2017033010147	221	-	495	-	30/03/2017 00:00:00	27.7.f	9	6	10	10	8	10	40	19	15
011_CDDR01_PLE_7F_L_M_2017001034	221	-	430	-	03/03/2017 00:00:00	27.7.f	9	7	9	9	11	9	60	16	9
012_BYDR04_PLE_7F_D_2018041510024	221	-	180	-	15/04/2018 00:00:00	27.7.f	1	-	1	1	7	1	75	120	90
013_CDDR02_PLE_7F_L_M_2018041210241	221	-	425	-	12/04/2018 00:00:00	27.7.f	9	5	9	9	12	9	60	28	17
014_CDDR03_PLE_7F_D_2017040610014	221	-	200	-	06/04/2017 00:00:00	27.7.f	2	3	4	2	4	2	40	33	27
015_CDDR03_PLE_7F_D_2017040610016	221	-	220	-	06/04/2017 00:00:00	27.7.f	3	4	4	4	7	4	60	34	24
016_CDDR03_PLE_7F_D_2017040610039	221	-	210	-	06/04/2017 00:00:00	27.7.f	5	4	5	5	5	5	80	9	7

017_CDDR03_PLE_7F_L_M_2017040610239	221	-	400	-	06/04/2017 00:00:00	27.7.f	7	7	7	7	9	7	80	12	9
018_CDDR03_PLE_7F_L_M_2017040610241	221	-	375	-	06/04/2017 00:00:00	27.7.f	6	6	7	6	7	6	60	9	8
019_CDDR03_PLE_7F_L_M_2017040610255	221	-	360	-	06/04/2017 00:00:00	27.7.f	8	5	8	7	7	7	40	17	11
020_CDDR04_PLE_7F_D_2017050710058	221	-	200	-	07/05/2017 00:00:00	27.7.f	3	3	3	3	3	3	100	0	0
021_GNKT04_PLE_7F_L_M_68727	221	-	400	-	20/05/2016 00:00:00	27.7.f	9	7	10	10	10	10	60	14	10
022_CDDR06_PLE_7F_D_70977	221	-	250	-	01/08/2016 00:00:00	27.7.f	2	3	3	3	6	3	60	45	31
023_CDDR06_PLE_7F_D_71001	221	-	220	-	01/08/2016 00:00:00	27.7.f	3	3	4	3	4	3	60	16	14
024_CDDR06_PLE_7F_L_M_71865	221	-	355	-	01/08/2016 00:00:00	27.7.f	6	5	6	6	6	6	80	8	6
025_CDDR06_PLE_7F_L_M_71868	221	-	435	-	01/08/2016 00:00:00	27.7.f	7	6	7	7	10	7	60	20	14
026_CDDR06_PLE_7F_L_M_71878	221	-	385	-	01/08/2016 00:00:00	27.7.f	5	5	6	5	6	5	60	10	9
027_CDDR06_PLE_7F_L_M_71892	221	-	435	-	01/08/2016 00:00:00	27.7.f	8	6	9	8	9	8	40	15	10
028_GNKT05_PLE_7F_D_2018071710045	221	-	240	-	17/07/2018 00:00:00	27.7.f	2	2	2	2	3	2	80	20	15
029_GNKT05_PLE_7F_L_M_2018071710272	221	-	375	-	17/07/2018 00:00:00	27.7.f	9	7	9	9	11	9	60	16	9
030_GNKT05_PLE_7F_L_M_2018071710286	221	-	445	-	17/07/2018 00:00:00	27.7.f	9	9	10	8	11	9	40	12	9
031_BYDR07_PLE_7F_D_2018102310045	221	-	210	-	23/10/2018 00:00:00	27.7.f	2	2	3	2	2	2	80	20	15
032_BYDR07_PLE_7F_L_M_2018102310207	221	-	400	-	23/10/2018 00:00:00	27.7.f	7	6	7	6	9	6	40	17	11
033_BYDR07_PLE_7F_L_M_2018102310211	221	-	390	-	23/10/2018 00:00:00	27.7.f	6	5	8	8	7	8	40	19	15
034_BYDR07_PLE_7F_L_M_2018102310212	221	-	430	-	23/10/2018 00:00:00	27.7.f	5	6	6	5	8	5	40	20	13
035_BYDR07_PLE_7F_L_M_2018102310220	221	-	410	-	23/10/2018 00:00:00	27.7.f	9	6	10	10	9	9	40	19	13

036_BYDR07_PLE_7F_L_M_2018102310236	221	-	370	-	23/10/2018 00:00:00	27.7.f	7	6	8	8	9	8	40	15	12
037_PLE_D_004_GK_11_041210_7FG_1	221	-	210	-	04/12/2010 00:00:00	27.7.f	1	1	1	2	2	1	60	39	34
038_PTCT09_PLE_7F_D_2017102220028	221	-	230	-	22/10/2017 00:00:00	27.7.f	3	3	4	3	7	3	60	43	30
039_PTCT09_PLE_7F_D_2017102220041	221	-	260	-	22/10/2017 00:00:00	27.7.f	4	4	4	4	3	4	80	12	8
040_BYDR01_PLE_7G_D_2017000182	221	-	230	-	27/01/2017 00:00:00	27.7.g	4	4	4	4	3	4	80	12	8
041_BYDR01_PLE_7G_D_2017000188	221	-	270	-	27/01/2017 00:00:00	27.7.g	6	4	6	6	3	6	60	28	24
042_CDDR01_PLE_7G_L_M_2018030110203	221	-	385	-	01/03/2018 00:00:00	27.7.g	8	7	8	8	7	8	60	7	6
043_CDDR01_PLE_7G_L_M_2018030110209	221	-	330	-	01/03/2018 00:00:00	27.7.g	7	5	7	7	7	7	80	14	10
044_CDDR01_PLE_7G_L_M_2018030110230	221	-	395	-	01/03/2018 00:00:00	27.7.g	8	5	8	7	8	8	60	18	13
045_GNKT01_PLE_7G_D_000274	221	-	180	-	06/02/2015 00:00:00	27.7.g	2	2	5	2	3	2	60	47	34
046_GNKT01_PLE_7G_D_000275	221	-	210	-	06/02/2015 00:00:00	27.7.g	2	2	3	-	2	2	75	22	17
047_GNKT01_PLE_7G_D_000278	221	-	230	-	06/02/2015 00:00:00	27.7.g	3	3	4	3	3	3	80	14	10
048_GNKT01_PLE_7G_D_000293	221	-	270	-	06/02/2015 00:00:00	27.7.g	5	5	5	5	5	5	100	0	0
049_PLE_D_029_GK_3_27032011_7FG_9	221	-	190	-	27/03/2011 00:00:00	27.7.g	1	1	1	1	1	1	100	0	0
050_PTCT02_PLE_7G_L_M_002551	221	-	500	-	09/03/2015 00:00:00	27.7.g	9	9	9	9	9	9	100	0	0
051_GNKT03_PLE_7G_D_2017042710033	221	-	200	-	27/04/2017 00:00:00	27.7.g	2	2	2	2	2	2	100	0	0
052_GNKT03_PLE_7G_D_2017042710034	221	-	200	-	27/04/2017 00:00:00	27.7.g	3	3	5	4	4	3	40	22	17
053_GNKT03_PLE_7G_D_2017042710036	221	-	220	-	27/04/2017 00:00:00	27.7.g	4	4	5	5	5	5	60	12	10
054_GNKT03_PLE_7G_D_2017042710037	221	-	230	-	27/04/2017 00:00:00	27.7.g	3	2	3	3	3	3	80	16	11

055_GNKT03_PLE_7G_D_20170427100 40	221	-	240	-	27/04/20 17 00:00:00	27.7. g	4	4	4	4	4	4	10 0	0	0
056_GNKT03_PLE_7G_L_M_201704271 0261	221	-	485	-	27/04/20 17 00:00:00	27.7. g	7	6	8	9	8	8	40	15	12
057_GNKT03_PLE_7G_L_M_201704271 0266	221	-	520	-	27/04/20 17 00:00:00	27.7. g	11	5	8	-	11	11	50	33	26
058_GNKT03_PLE_7G_L_M_201704271 0268	221	-	390	-	27/04/20 17 00:00:00	27.7. g	7	6	7	7	9	7	60	15	10
059_GNKT03_PLE_7G_L_M_201704271 0272	221	-	465	-	27/04/20 17 00:00:00	27.7. g	8	6	8	8	7	8	60	12	10
060_GNKT03_PLE_7G_L_M_201704271 0288	221	-	360	-	27/04/20 17 00:00:00	27.7. g	5	5	6	6	7	5	40	14	11
061_PLE_CT_D_058_NV_4_060613_7G _5	221	-	180	-	06/06/20 13 00:00:00	27.7. g	2	2	3	3	8	2	40	70	49
062_CDDR06_PLE_7G_D_071012	221	-	180	-	26/08/20 16 00:00:00	27.7. g	2	2	2	2	2	2	10 0	0	0
063_CDDR06_PLE_7G_D_071013	221	-	190	-	26/08/20 16 00:00:00	27.7. g	3	3	3	3	3	3	10 0	0	0
064_CDDR06_PLE_7G_D_071015	221	-	200	-	26/08/20 16 00:00:00	27.7. g	3	3	4	4	2	3	40	26	20
065_PLE_D_037_PC_6_310711_7G_5	221	-	200	-	31/07/20 11 00:00:00	27.7. g	1	1	1	1	2	1	80	37	27
066_PTCT06_PLE_7G_D_051292	221	-	260	-	12/07/20 15 00:00:00	27.7. g	2	4	5	1	3	1	20	53	40
067_PTCT06_PLE_7G_L_M_52263	221	-	320	-	18/07/20 15 00:00:00	27.7. g	6	6	7	6	6	6	80	7	5
068_PTCT06_PLE_7G_L_M_52277	221	-	365	-	18/07/20 15 00:00:00	27.7. g	8	6	8	8	8	8	80	12	8
069_PTCT07_PLE_7G_L_M_053326	221	-	420	-	31/07/20 15 00:00:00	27.7. g	9	7	11	10	11	11	40	17	13
070_PTCT07_PLE_7G_L_M_053335	221	-	400	-	31/07/20 15 00:00:00	27.7. g	7	7	7	7	-	7	10 0	0	0
071_PTCT07_PLE_7G_L_M_053367	221	-	450	-	31/07/20 15 00:00:00	27.7. g	9	7	9	10	9	9	60	12	8
072_BYDR06_PLE_7G_D_20171007100 16	221	-	250	-	07/10/20 17 00:00:00	27.7. g	3	2	3	2	2	2	60	23	20
073_BYDR06_PLE_7G_D_20171007100 18	221	-	260	-	07/10/20 17 00:00:00	27.7. g	5	4	6	-	6	6	50	18	14

074_BYDR06_PLE_7G_D_2017100721	221	-	260	-	07/10/2017 00:00:00	27.7.g	3	3	3	3	3	3	100	0	0
075_BYDR06_PLE_7G_D_2017100728	221	-	240	-	07/10/2017 00:00:00	27.7.g	5	4	5	5	6	5	60	14	8
076_BYDR06_PLE_7G_D_2017100731	221	-	230	-	07/10/2017 00:00:00	27.7.g	4	4	5	4	5	4	60	12	11
077_BYDR06_PLE_7G_D_2017100733	221	-	250	-	07/10/2017 00:00:00	27.7.g	4	4	4	4	4	4	100	0	0
078_BYDR06_PLE_7G_L_M_2017100710132	221	-	410	-	07/10/2017 00:00:00	27.7.g	7	4	7	7	8	7	60	23	16
079_BYDR06_PLE_7G_L_M_2017100710137	221	-	380	-	07/10/2017 00:00:00	27.7.g	7	6	7	7	9	7	60	15	10
080_BYDR06_PLE_7G_L_M_2017100710158	221	-	410	-	07/10/2017 00:00:00	27.7.g	6	5	7	8	9	5	20	23	17
081_CDDR08_PLE_7G_D_224260	221	-	200	-	15/11/2016 00:00:00	27.7.g	1	1	1	1	2	1	80	37	27
082_GNKT06_PLE_7G_L_M_2017110210152	221	-	390	-	02/11/2017 00:00:00	27.7.g	9	7	9	9	10	9	60	12	8
083_GNKT06_PLE_7G_L_M_2017110210154	221	-	395	-	02/11/2017 00:00:00	27.7.g	7	5	8	8	8	8	60	18	13

Table 9.16: Number of age readings table gives an overview of number of readings per reader and modal age. The total numbers of readings per reader and per modal age are summarized at the end of the table.

Modal age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE	total
0	1	1	1	1	1	**5**
1	7	6	7	7	7	**34**
2	10	10	10	9	10	**49**
3	11	11	11	11	11	**55**
4	7	7	7	7	7	**35**
5	9	9	9	9	9	**45**
6	7	7	7	6	7	**34**
7	9	9	9	9	8	**44**
8	10	10	10	10	10	**50**
9	8	8	8	8	8	**40**
10	2	2	2	2	2	**10**
11	2	2	2	1	2	**9**
Total	**83**	**82**	**83**	**80**	**82**	**410**

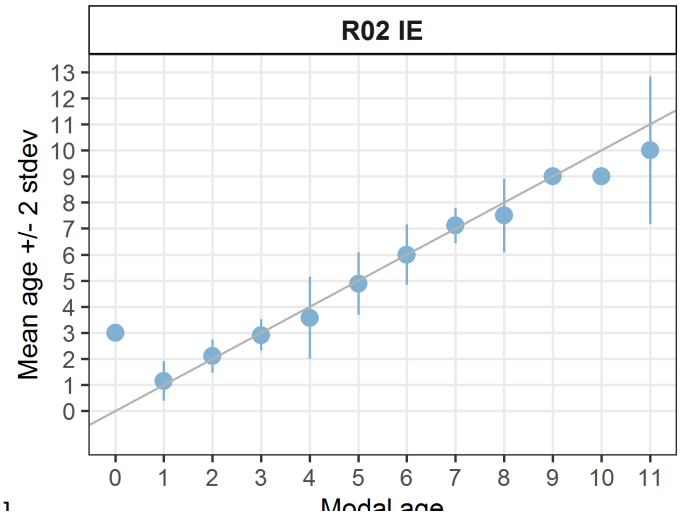
Table 9.17: Age composition by reader gives a summary of number of readings per reader.

Modal age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE
0	0	1	1	0	**0**
1	6	5	6	6	**1**
2	12	10	3	9	**11**
3	13	11	11	10	**12**
4	7	15	11	9	**5**
5	7	12	8	8	**5**
6	7	16	7	7	**6**
7	12	10	13	10	**12**

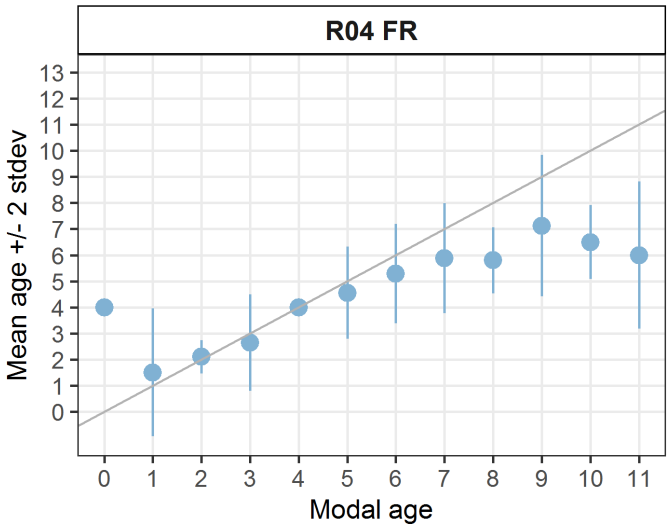
8	7	0	11	10	**9**
9	11	2	7	6	**11**
10	0	0	4	5	**3**
11	1	0	1	0	**6**
12	0	0	0	0	**1**
Total	**83**	**82**	**83**	**80**	**82**

Table 9.18: Mean length at age per reader is calculated per reader and age (not modal age) and for all readers combined per age. A weighted mean is also given.

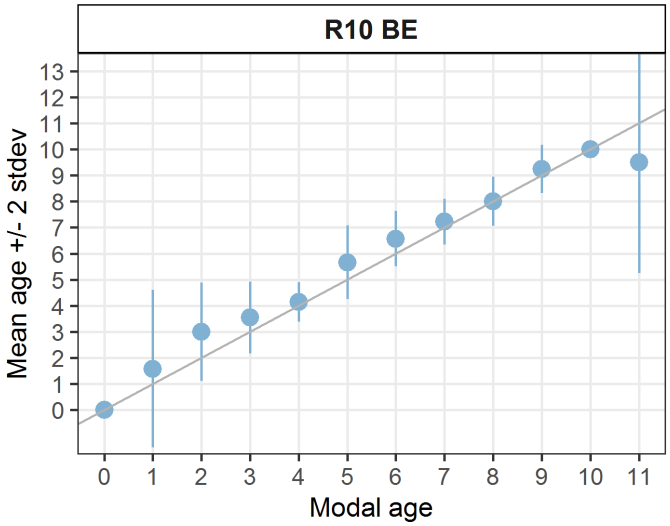
Age	R02 IE	R04 FR	R10 BE	R12 BE	R16 IE
0	-	250 mm	260 mm	-	**-**
1	193 mm	196 mm	193 mm	202 mm	**190 mm**
2	211 mm	208 mm	207 mm	208 mm	**208 mm**
3	226 mm	218 mm	221 mm	224 mm	**229 mm**
4	236 mm	252 mm	227 mm	228 mm	**222 mm**
5	308 mm	383 mm	226 mm	279 mm	**230 mm**
6	352 mm	405 mm	326 mm	346 mm	**302 mm**
7	395 mm	399 mm	382 mm	384 mm	**325 mm**
8	397 mm	-	406 mm	404 mm	**375 mm**
9	431 mm	472 mm	429 mm	434 mm	**411 mm**
10	-	-	438 mm	435 mm	**408 mm**
11	520 mm	-	420 mm	-	**422 mm**
12	-	-	-	-	**425 mm**
Weighted Mean	**309 mm**	**311 mm**	**309 mm**	**309 mm**	**308 mm**


R02 IE
Mean age +/- 2 stdev
0 1 2 3 4 5 6 7 8 9 10 11 12 13
0 1 2 3 4 5 6 7 8 9 10 11
Modal age

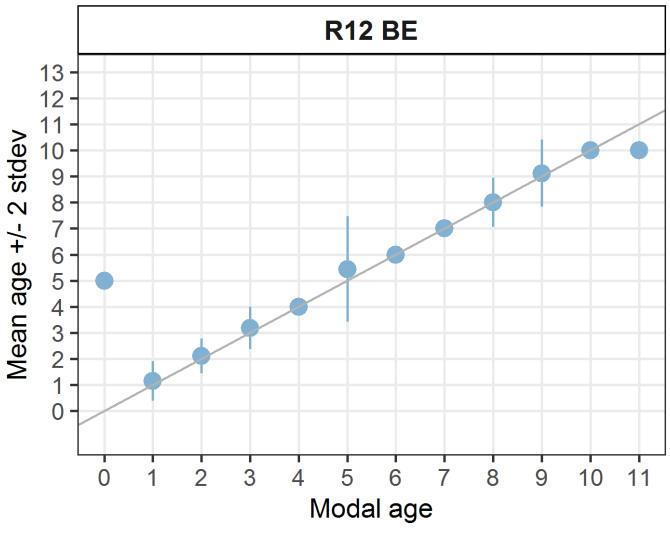
[[1]] [[2]]


R04 FR
Mean age +/- 2 stdev
0 1 2 3 4 5 6 7 8 9 10 11 12 13
0 1 2 3 4 5 6 7 8 9 10 11
Modal age

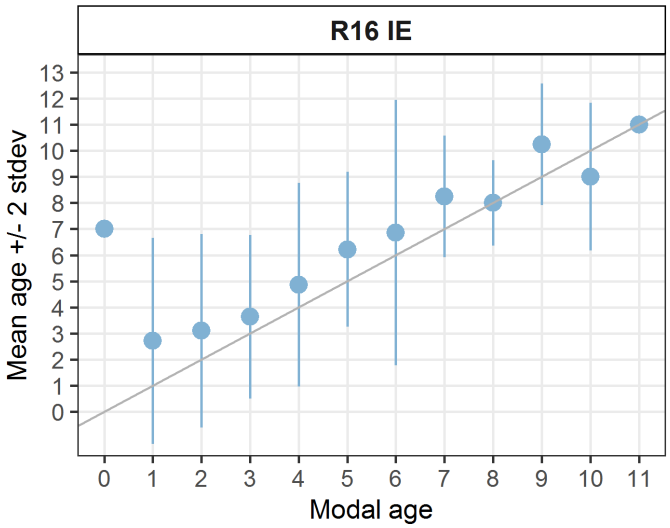
[[3]]


R10 BE
Mean age +/- 2 stdev
0 1 2 3 4 5 6 7 8 9 10 11 12 13
0 1 2 3 4 5 6 7 8 9 10 11
Modal age

[[4]]


R12 BE
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11
0 1 2 3 4 5 6 7 8 9 10 11 12 13

[[5]]


R16 IE
Mean age +/- 2 stdev
Modal age
0 1 2 3 4 5 6 7 8 9 10 11
0 1 2 3 4 5 6 7 8 9 10 11 12 13