

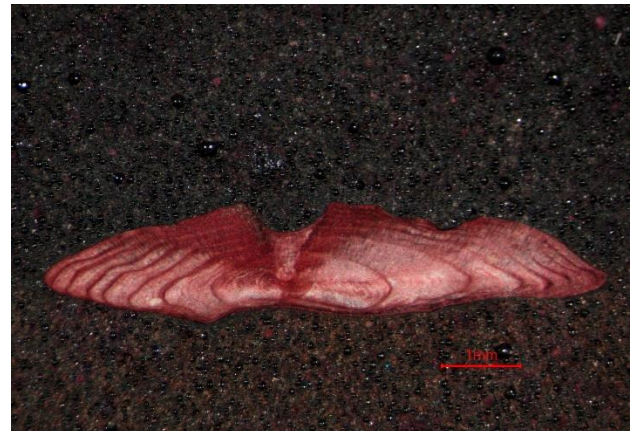
# European Sea bass (*Dicentrarchus labrax*) scale and otolith exchange report – SmartDots event 271

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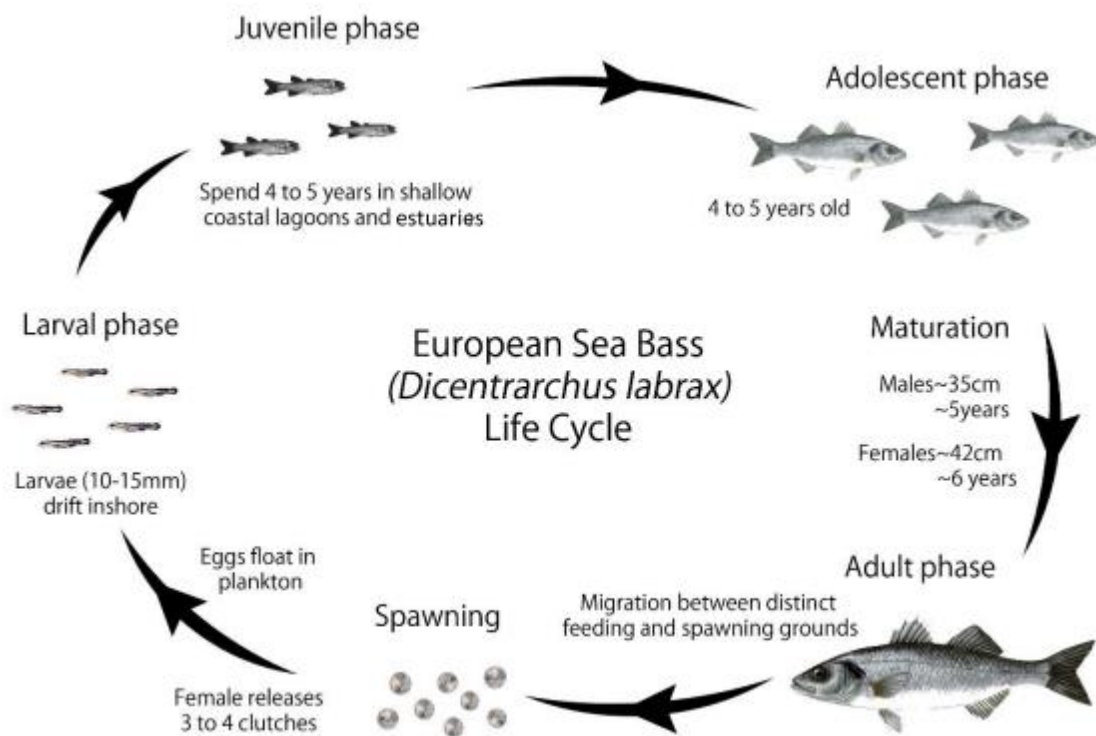


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# 1 Introduction

An overview of the European sea bass *Dicentrarchus labrax* life history was presented in 2014 (Carroll, 2014). The sea bass life cycle (Figure 1) can be split into four broad phases: eggs and larvae, juvenile, adolescent and adult (Dando and Demir, 1985). Sea bass reach maturity at between 4 and 7 years of age (~35 and 42 cm) and can continue to reproduce for up to 20 years (Pawson and Pickett, 1987). The oldest sea bass recorded was thought to be 28 years old (ICES, 2013). Sea bass exhibit sexual growth dimorphism where female bass mature at a greater size and age than males (Kennedy and Fitzmaurice, 1972). The juvenile stage occurs approximately two months after spawning which occurs between December to April (Kelley, 1988; Prat *et al.*, 1999) during which time larval bass remain in the plankton and are transported inshore by currents into post-larval habitats in estuaries and shallow coastal waters, where they arrive at a total length of around 10–15 mm (Jennings and Pawson, 1992). Sea bass can tolerate brackish water habitats such as those in estuaries and river mouths where they spend much of their juvenile stage (Kennedy and Fitzmaurice, 1972). Fully mature bass undertake seasonal migrations from summer coastal feeding grounds to winter offshore spawning grounds (Pawson *et al.*, 2007) coinciding with the decrease in coastal water temperature (Pawson and Pickett, 1987) that generally occurs in October. Numerous tagging studies have shown that sea bass have a strong fidelity to summer feeding grounds, where they will return year on year (Claridge and Potter, 1983; Pawson *et al.*, 1987; Kelley, 1988; Pawson and *et al.*, 2007). Some sea bass have been recaptured on the very same rock where they were first caught and tagged, but most recaptures have been within 80 km of their first release (Pickett *et al.*, 2004; Quayle and Righton, 2007).



**Figure 1:** Illustration of the European Sea bass (*Dicentrarchus labrax*) life cycle (In Carroll, 2014 from Dando and Demir, 1985; Pawson *et al.*, 1987; Jennings and Pawson, 1992; Pawson *et al.*, 2007).

The aims of the 2020 European Sea bass (*Dicentrarchus labrax*) scale and otolith exchange were (1) to clarify the interpretation of annual growth rings using stained otolith sections and scales from the same fish and (2) to develop existing reference collections of calcified structures and improve the existing database of scales images. Both aims represent the base and key points to be discussed during the Workshop on Age reading of Sea bass (*Dicentrarchus labrax*) (WKARDL2) in June 2021 at Cefas (UK).

Eight readers in total, 3 advanced and 5 basic, from three national laboratories (Cefas UK, Infremer FR, ILVO BE) were involved in this exchange, and read both otoliths and scales regardless of their expertise. The samples (n=100) used for this exchange were sourced from Cefas UK 2018 and 2019 collections and were representative of quarter 1 and 3 for the ICES area 27.7.

Here we present the results of the European Sea bass (*Dicentrarchus labrax*) scale and otolith exchange carried out on SmartDots (event 271) between March and June 2020.

### **Past ICES exchanges and workshops**

Two previous exchanges on bass otoliths and scales have been carried out in 2011 and 2013, followed by a Workshop on Age Reading of Sea Bass (*Dicentrarchus labrax*) (WKARDL) in 2015. The exchange presented herein was initially planned for 2019 but due to difficulties it was postponed in 2020 along with the identification of new coordinators.

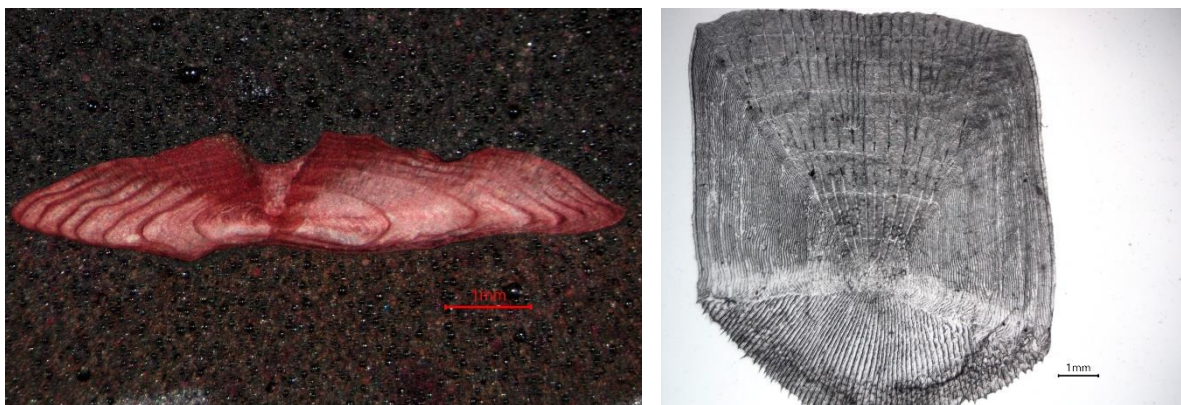
# 2 Methods

## Overview of samples and readers

The samples used for this exchange were sourced from Cefas UK 2018 and 2019 collections. Both otoliths and scales samples (n=100) come from the same specimen for the comparative aim of the exchange and were representative of quarter 1 and quarter 3 for the ICES rectangles 27.7 (see **Table 1**). Given their wide origin, the samples are considered adequately representative of the stock and cover the length range of the fish which are selected for age determination at national laboratories. In particular, otoliths sections used in this exchange were stained in neutral red (45 mins) to enhance banding visualization. Otoliths and scales images were taken at Cefas with a GXCAM-U3PRO camera and GX-Capture software on a Leica M60 Stereomicroscope under reflected light (Figure 2).

**Table 1:** Overview of samples used for the SmartDots exchange n.271.

| Year | ICES area | Quarter | Number of samples | Modal age range | Length range |
|------|-----------|---------|-------------------|-----------------|--------------|
| 2018 | 27.7.a    | 3       | 3                 | 4-5             | 35-40 mm     |
| 2018 | 27.7.f    | 3       | 32                | 2-11            | 25-55 mm     |
| 2019 | 27.7.d    | 3       | 8                 | 3-5             | 30-45 mm     |
| 2019 | 27.7.e    | 1       | 48                | 4-17            | 35-70 mm     |
| 2019 | 27.7.f    | 1       | 1                 | 6               | 40 mm        |
| 2019 | 27.7.f    | 3       | 7                 | 4-16            | 35-70 mm     |
| 2019 | 27.7.g    | 1       | 1                 | 12              | 55 mm        |



**Figure 2:** An example of an otolith and a scale samples used for this exchange.

Otolith images and associated data were uploaded to SmartDots in a single event (n.271) and made available for annotation from the 15 March to the 16 June 2020. Readers were provided with written instructions on how to complete the exercises (Annex 1). Readers, 3 advanced and 5 basic, were asked to read both otoliths and scales regardless of their expertise (Table 2). As a general rule, advanced readers are those who routinely provide ages for the assessment (e.g. senior/experienced readers) whereas basic readers are those who are

familiar with the species but do not provide readings for assessment yet (e.g. in-training readers). Three national laboratories were involved in this exchange, Cefas UK, Infremefr for France (FR), and ILVO from Belgium (BE).

**Table 2:** Reader overview.

| Reader code | Expertise |
|-------------|-----------|
| R02 GB      | Advanced  |
| R04 FR      | Advanced  |
| R06 GB      | Advanced  |
| R10 FR      | Basic     |
| R12 FR      | Basic     |
| R14 BE      | Basic     |
| R16 BE      | Basic     |
| R18 GB      | Basic     |

### Reading procedure

Date of birth is conventionally attributed to the 1st of January. One annulus consists of one opaque and one translucent zone. For age estimation, translucent zones are counted. Each reader was asked to annotate all samples in SmartDots, assign an age quality to his reading (from AQ1 to AQ3) and to approve his/her readings.

### SmartDots Reporting Tool

The SmartDots Reporting Tool generates standardised analyses of age comparison data, including tables and plots from the Guus Eltink 'Age Reading Comparisons' in Excel (Eltink, 2000). The following analyses are included in the SmartDots Reporting Tool.

### Percentage Agreement

The percentage agreement (PA) per modal age and reader is calculated as the ratio between the total number of age readings in agreement with modal age and the total number of age readings for that sample per reader and modal age:

$$PA = \frac{n_{modalage}}{n_{total}} * 100$$

### Co-efficient of Variation (CV)

The co-efficient of Variation (CV) is calculated as the ratio between the standard deviation ( $\sigma$ ) and mean value ( $\mu$ ) 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. Finally a rank value is added per reader, where the reader with the lowest weighted mean is assigned with a rank and so forth (in the situation of ties between two weighted means will every tied element be assigned to the lowest rank. This is the procedure for all ties methods when assigning ranks).

### **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:

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

where  $a_i$  is the age reading of reader  $i$  and  $\bar{a}$  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 mis-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.

### **Scale and 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.

### **Preparation method comparison analysis**

The method comparison analysis is based on the ATQCS (Age Training And Quality Control System) developed at Cefas for internal quality control. This has been adapted for this exchange providing a interpretation of all the readers readings (i.e. scales vs otoliths).

# 3 Results

All the participants read both calcified structures. Overall, all readers achieved 80% agreement for otoliths (9% CV) and 68% for scales (11% CV).

However, advanced readers scored 71% and 73% agreement for otoliths and scales, respectively. In particular, specific biases were found in modal ages 2, 3, and over 12 years.

Higher PA, and lower CV were observed in sectioned-and-stained otoliths than in the scale readings, the calibration statistics for the sectioned-and-stained otoliths were better than for scales. Despite the fact that most of the readers had less experience with sectioned-and-stained otoliths than with scales, sectioned-and-stained otoliths appeared to give better calibration results.



# 3.1 Section stained otoliths

## 3.1.1 All readers

### All samples included

The weighted average percentage agreement based on modal ages for all readers is 80 %, with the weighted average CV of 9 % and APE of 6 %.

**Table 3:** 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 GB     | R04 FR     | R06 GB     | R10 FR     | R12 FR     | R14 BE     | R16 BE     | R18 GB     | all        |
|----------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| 2                    | -          | -          | -          | -          | -          | -          | -          | -          | 21 %       |
| 3                    | 0 %        | 23 %       | 0 %        | 0 %        | 15 %       | 0 %        | 15 %       | 0 %        | 17 %       |
| 4                    | 0 %        | 7 %        | 5 %        | 0 %        | 0 %        | 0 %        | 0 %        | 5 %        | 10 %       |
| 5                    | 0 %        | 9 %        | 9 %        | 0 %        | 4 %        | 4 %        | 4 %        | 9 %        | 8 %        |
| 6                    | 0 %        | 18 %       | 5 %        | 0 %        | 0 %        | 5 %        | 5 %        | 7 %        | 8 %        |
| 7                    | 0 %        | 13 %       | 9 %        | 0 %        | 6 %        | 0 %        | 0 %        | 0 %        | 6 %        |
| 8                    | 0 %        | 6 %        | 0 %        | 0 %        | 0 %        | 0 %        | 0 %        | 0 %        | 3 %        |
| 9                    | -          | -          | -          | -          | -          | -          | -          | -          | 4 %        |
| 10                   | 0 %        | 9 %        | 0 %        | 0 %        | 0 %        | 0 %        | 0 %        | 0 %        | 4 %        |
| 11                   | 4 %        | 5 %        | 7 %        | 0 %        | 0 %        | 4 %        | 4 %        | 5 %        | 6 %        |
| 12                   | 0 %        | 13 %       | 0 %        | 5 %        | 0 %        | 0 %        | 0 %        | 9 %        | 5 %        |
| 13                   | -          | -          | -          | -          | -          | -          | -          | -          | -          |
| 14                   | -          | -          | -          | -          | -          | -          | -          | -          | -          |
| 15                   | -          | -          | -          | -          | -          | -          | -          | -          | -          |
| 16                   | 0 %        | 0 %        | 9 %        | -          | 10 %       | 4 %        | 4 %        | 5 %        | 29 %       |
| 17                   | -          | -          | -          | -          | -          | -          | -          | -          | 5 %        |
| <b>Weighted Mean</b> | <b>0 %</b> | <b>9 %</b> | <b>6 %</b> | <b>0 %</b> | <b>2 %</b> | <b>2 %</b> | <b>2 %</b> | <b>5 %</b> | <b>9 %</b> |

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:** 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. A rank is also assigned to each reader.

| Modal age | R02 GB | R04 FR | R06 GB | R10 FR | R12 FR | R14 BE | R16 BE | R18 GB | all  |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| 2         | 100 %  | 100 %  | 0 %    | 100 %  | 100 %  | 100 %  | 100 %  | 0 %    | 75 % |
| 3         | 100 %  | 50 %   | 0 %    | 100 %  | 75 %   | 100 %  | 75 %   | 0 %    | 62 % |
| 4         | 100 %  | 93 %   | 7 %    | 100 %  | 100 %  | 100 %  | 100 %  | 7 %    | 76 % |
| 5         | 100 %  | 80 %   | 43 %   | 100 %  | 96 %   | 96 %   | 96 %   | 48 %   | 83 % |
| 6         | 100 %  | 70 %   | 90 %   | 100 %  | 100 %  | 90 %   | 90 %   | 80 %   | 90 % |
| 7         | 100 %  | 50 %   | 67 %   | 100 %  | 83 %   | 100 %  | 100 %  | 100 %  | 88 % |
| 8         | 100 %  | 25 %   | 100 %  | 100 %  | 100 %  | 100 %  | 100 %  | 100 %  | 92 % |
| 9         | 100 %  | 100 %  | 100 %  | 100 %  | 100 %  | 100 %  | 0 %    | 100 %  | 88 % |
| 10        | 100 %  | 25 %   | 100 %  | 100 %  | 100 %  | 100 %  | 100 %  | 100 %  | 90 % |
| 11        | 75 %   | 0 %    | 50 %   | 100 %  | 100 %  | 75 %   | 75 %   | 75 %   | 69 % |
| 12        | 100 %  | 50 %   | 100 %  | 67 %   | 100 %  | 100 %  | 100 %  | 33 %   | 83 % |
| 13        | -      | -      | -      | -      | -      | -      | -      | -      | -    |

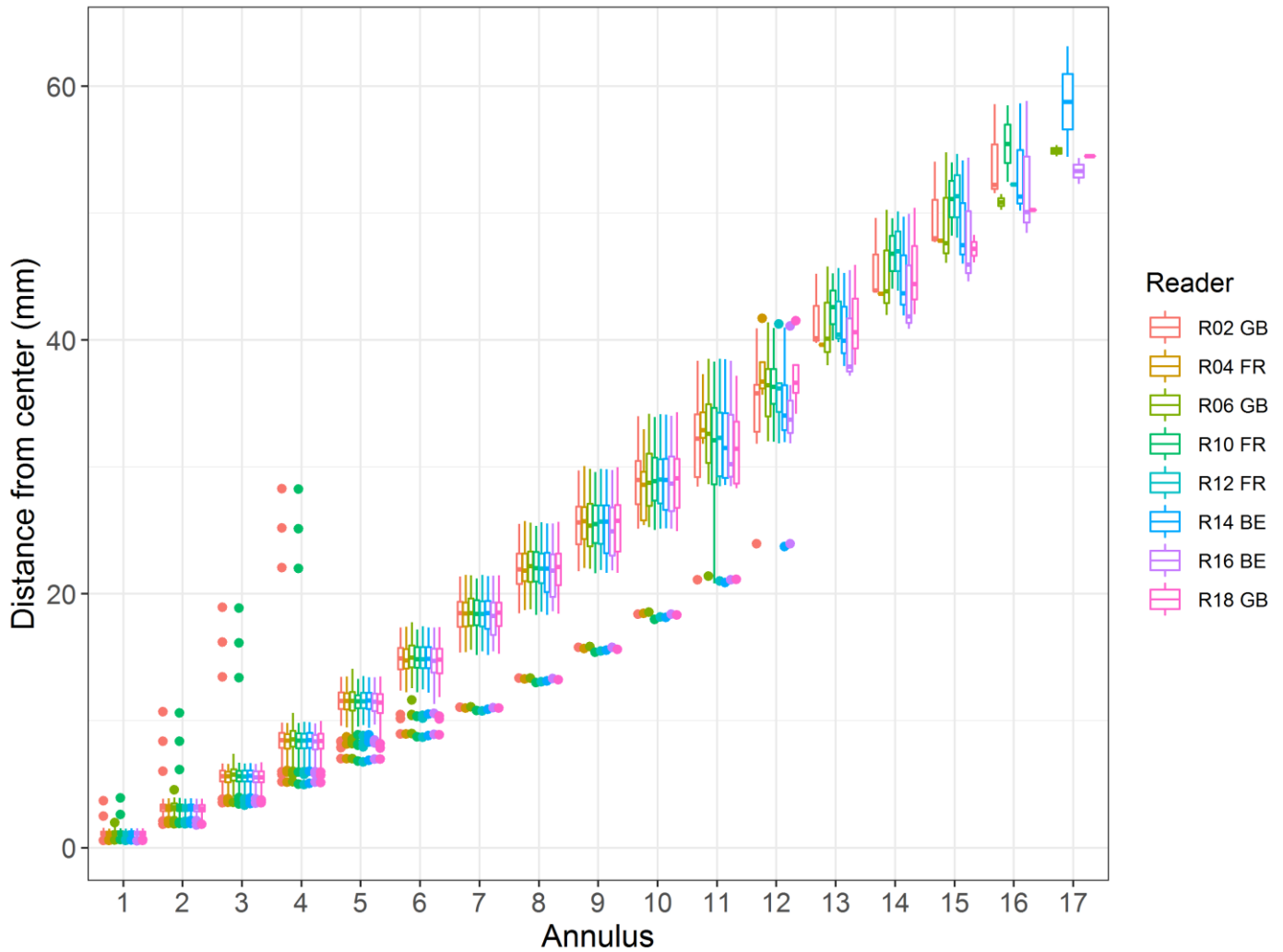
|                      |             |             |             |             |             |             |             |             |             |
|----------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 14                   | -           | -           | -           | -           | -           | -           | -           | -           | -           |
| 15                   | -           | -           | -           | -           | -           | -           | -           | -           | -           |
| 16                   | 100 %       | 0 %         | 0 %         | 50 %        | 0 %         | 50 %        | 50 %        | 0 %         | 31 %        |
| 17                   | 0 %         | 0 %         | 100 %       | 0 %         | 0 %         | 100 %       | 100 %       | 100 %       | 50 %        |
| <b>Weighted Mean</b> | <b>98 %</b> | <b>67 %</b> | <b>46 %</b> | <b>97 %</b> | <b>94 %</b> | <b>96 %</b> | <b>94 %</b> | <b>48 %</b> | <b>80 %</b> |

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 5:** 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 GB      | R04 FR       | R06 GB      | R10 FR       | R12 FR       | R14 BE      | R16 BE      | R18 GB      | all          |
|----------------------|-------------|--------------|-------------|--------------|--------------|-------------|-------------|-------------|--------------|
| 2                    | 0.00        | 0.00         | 1.00        | 0.00         | 0.00         | 0.00        | 0.00        | 1.00        | <b>0.25</b>  |
| 3                    | 0.00        | -0.50        | 1.00        | 0.00         | 0.25         | 0.00        | 0.25        | 1.00        | <b>0.25</b>  |
| 4                    | 0.00        | -0.07        | 0.93        | 0.00         | 0.00         | 0.00        | 0.00        | 0.93        | <b>0.22</b>  |
| 5                    | 0.00        | -0.20        | 0.57        | 0.00         | -0.04        | -0.04       | 0.04        | 0.52        | <b>0.11</b>  |
| 6                    | 0.00        | -0.50        | 0.10        | 0.00         | 0.00         | -0.10       | -0.10       | 0.20        | <b>-0.05</b> |
| 7                    | 0.00        | -0.67        | 0.00        | 0.00         | -0.17        | 0.00        | 0.00        | 0.00        | <b>-0.10</b> |
| 8                    | 0.00        | -0.75        | 0.00        | 0.00         | 0.00         | 0.00        | 0.00        | 0.00        | <b>-0.09</b> |
| 9                    | 0.00        | 0.00         | 0.00        | 0.00         | 0.00         | 0.00        | 1.00        | 0.00        | <b>0.12</b>  |
| 10                   | 0.00        | -1.00        | 0.00        | 0.00         | 0.00         | 0.00        | 0.00        | 0.00        | <b>-0.12</b> |
| 11                   | 0.25        | -1.25        | 0.00        | 0.00         | 0.00         | 0.25        | 0.25        | -0.25       | <b>-0.09</b> |
| 12                   | 0.00        | -1.00        | 0.00        | -0.33        | 0.00         | 0.00        | 0.00        | -1.00       | <b>-0.29</b> |
| 13                   | -           | -            | -           | -            | -            | -           | -           | -           | -            |
| 14                   | -           | -            | -           | -            | -            | -           | -           | -           | -            |
| 15                   | -           | -            | -           | -            | -            | -           | -           | -           | -            |
| 16                   | 0.00        | -4.00        | 0.00        | -8.00        | -2.00        | 0.50        | 0.50        | -1.50       | <b>-1.81</b> |
| 17                   | -1.00       | -2.00        | 0.00        | -1.00        | -1.00        | 0.00        | 0.00        | 0.00        | <b>-0.62</b> |
| <b>Weighted Mean</b> | <b>0.00</b> | <b>-0.46</b> | <b>0.48</b> | <b>-0.18</b> | <b>-0.06</b> | <b>0.00</b> | <b>0.04</b> | <b>0.40</b> | <b>0.03</b>  |

For each pair that is being compared, the differences between the readings per image are found and the frequency of each occurring difference is obtained. A rank value is calculated for the positive and the negative differences (R+ and R- in the Guus Eltink sheet). The value with the smallest rank is then used to calculate a z-value that determines the level of bias (not clear from Guus Eltink sheet how the equations are defined).



**Figure 3:** Plot of average distance from the centre to the winter rings for advanced readers by preparation method. The boxes represent the median, upper and lower box boundaries of the interquartile range, whiskers represent the minimum and maximum values and the dots represent the outliers.

### 3.1.2 Advanced readers

#### All samples included

**Table 6:** 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 GB | R04 FR | R06 GB | all  |
|-----------|--------|--------|--------|------|
| 2         | 22 %   | 0 %    | 16 %   | 30 % |
| 3         | 16 %   | 0 %    | 13 %   | 21 % |
| 4         | 7 %    | 0 %    | 8 %    | 13 % |
| 5         | 4 %    | 6 %    | 11 %   | 9 %  |
| 6         | 5 %    | 17 %   | 10 %   | 12 % |
| 7         | 0 %    | 14 %   | 7 %    | 9 %  |
| 8         | 0 %    | 6 %    | 0 %    | 6 %  |
| 9         | -      | -      | -      | 0 %  |
| 10        | 7 %    | 8 %    | 8 %    | 9 %  |
| 11        | -      | -      | -      | 11 % |

|                      |            |            |            |             |
|----------------------|------------|------------|------------|-------------|
| 12                   | 16 %       | 9 %        | 17 %       | 16 %        |
| 13                   | -          | -          | -          | -           |
| 14                   | -          | -          | -          | -           |
| 15                   | -          | -          | -          | 6 %         |
| <b>Weighted Mean</b> | <b>7 %</b> | <b>6 %</b> | <b>9 %</b> | <b>12 %</b> |

**Table 7:** 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. A rank is also assigned to each reader.

| Modal age            | R02 GB      | R04 FR      | R06 GB      | all         |
|----------------------|-------------|-------------|-------------|-------------|
| 2                    | 33 %        | 100 %       | 0 %         | 44 %        |
| 3                    | 50 %        | 100 %       | 0 %         | 50 %        |
| 4                    | 90 %        | 100 %       | 7 %         | 66 %        |
| 5                    | 96 %        | 91 %        | 48 %        | 79 %        |
| 6                    | 90 %        | 80 %        | 90 %        | 87 %        |
| 7                    | 100 %       | 60 %        | 80 %        | 80 %        |
| 8                    | 100 %       | 25 %        | 100 %       | 77 %        |
| 9                    | 100 %       | 100 %       | 100 %       | 100 %       |
| 10                   | 57 %        | 57 %        | 67 %        | 60 %        |
| 11                   | 100 %       | 0 %         | 100 %       | 67 %        |
| 12                   | 60 %        | 75 %        | 60 %        | 64 %        |
| 13                   | -           | -           | -           | -           |
| 14                   | -           | -           | -           | -           |
| 15                   | 0 %         | 100 %       | 0 %         | 33 %        |
| <b>Weighted Mean</b> | <b>85 %</b> | <b>82 %</b> | <b>45 %</b> | <b>71 %</b> |

**Table 8:** 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 GB      | R04 FR       | R06 GB      | all         |
|----------------------|-------------|--------------|-------------|-------------|
| 2                    | 0.67        | 0.00         | 1.67        | 0.78        |
| 3                    | 0.50        | 0.00         | 1.50        | 0.67        |
| 4                    | 0.10        | 0.00         | 1.03        | 0.38        |
| 5                    | 0.04        | -0.09        | 0.57        | 0.18        |
| 6                    | 0.10        | -0.40        | 0.20        | -0.03       |
| 7                    | 0.00        | -0.60        | -0.20       | -0.27       |
| 8                    | 0.00        | -0.75        | 0.00        | -0.25       |
| 9                    | 0.00        | 0.00         | 0.00        | 0.00        |
| 10                   | 0.57        | -0.57        | 0.50        | 0.17        |
| 11                   | 0.00        | -2.00        | 0.00        | -0.67       |
| 12                   | 1.60        | -0.50        | 1.60        | 0.90        |
| 13                   | -           | -            | -           | -           |
| 14                   | -           | -            | -           | -           |
| 15                   | 1.00        | 0.00         | 2.00        | 1.00        |
| <b>Weighted Mean</b> | <b>0.22</b> | <b>-0.24</b> | <b>0.71</b> | <b>0.23</b> |

# 3.2 Scales

## 3.2.1 All readers

### All samples included

The weighted average percentage agreement based on modal ages for all readers is 68 %, with the weighted average CV of 11 % and APE of 8 %.

**Table 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 GB     | R04 FR     | R06 GB     | R10 FR      | R12 FR     | R14 BE      | R16 BE     | R18 GB     | all         |
|----------------------|------------|------------|------------|-------------|------------|-------------|------------|------------|-------------|
| 2                    | -          | -          | -          | -           | -          | -           | -          | -          | 21 %        |
| 3                    | 0 %        | 0 %        | 0 %        | 0 %         | 0 %        | 18 %        | 0 %        | 0 %        | 15 %        |
| 4                    | 6 %        | 11 %       | 6 %        | 10 %        | 6 %        | 12 %        | 5 %        | 7 %        | 13 %        |
| 5                    | 0 %        | 7 %        | 10 %       | 10 %        | 7 %        | 12 %        | 4 %        | 11 %       | 10 %        |
| 6                    | 7 %        | 9 %        | 6 %        | 9 %         | 5 %        | 11 %        | 10 %       | 7 %        | 9 %         |
| 7                    | 7 %        | 5 %        | 9 %        | 11 %        | 7 %        | 8 %         | 7 %        | 0 %        | 8 %         |
| 8                    | 0 %        | 6 %        | 0 %        | 35 %        | 8 %        | 7 %         | 0 %        | 5 %        | 15 %        |
| 9                    | 7 %        | 0 %        | 0 %        | 0 %         | 0 %        | 8 %         | 0 %        | 0 %        | 5 %         |
| 10                   | 5 %        | 6 %        | 5 %        | 5 %         | 5 %        | 10 %        | 5 %        | 5 %        | 6 %         |
| 11                   | 5 %        | 13 %       | 7 %        | 5 %         | 5 %        | 10 %        | 5 %        | 5 %        | 10 %        |
| 12                   | 17 %       | 22 %       | 16 %       | 18 %        | 12 %       | 9 %         | 21 %       | 23 %       | 17 %        |
| 13                   | -          | -          | -          | -           | -          | -           | -          | -          | -           |
| 14                   | -          | -          | -          | -           | -          | -           | -          | -          | -           |
| 15                   | -          | -          | -          | -           | -          | -           | -          | -          | 13 %        |
| 16                   | -          | -          | -          | -           | -          | -           | -          | -          | 16 %        |
| <b>Weighted Mean</b> | <b>4 %</b> | <b>9 %</b> | <b>7 %</b> | <b>11 %</b> | <b>6 %</b> | <b>11 %</b> | <b>5 %</b> | <b>7 %</b> | <b>11 %</b> |

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 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. A rank is also assigned to each reader.

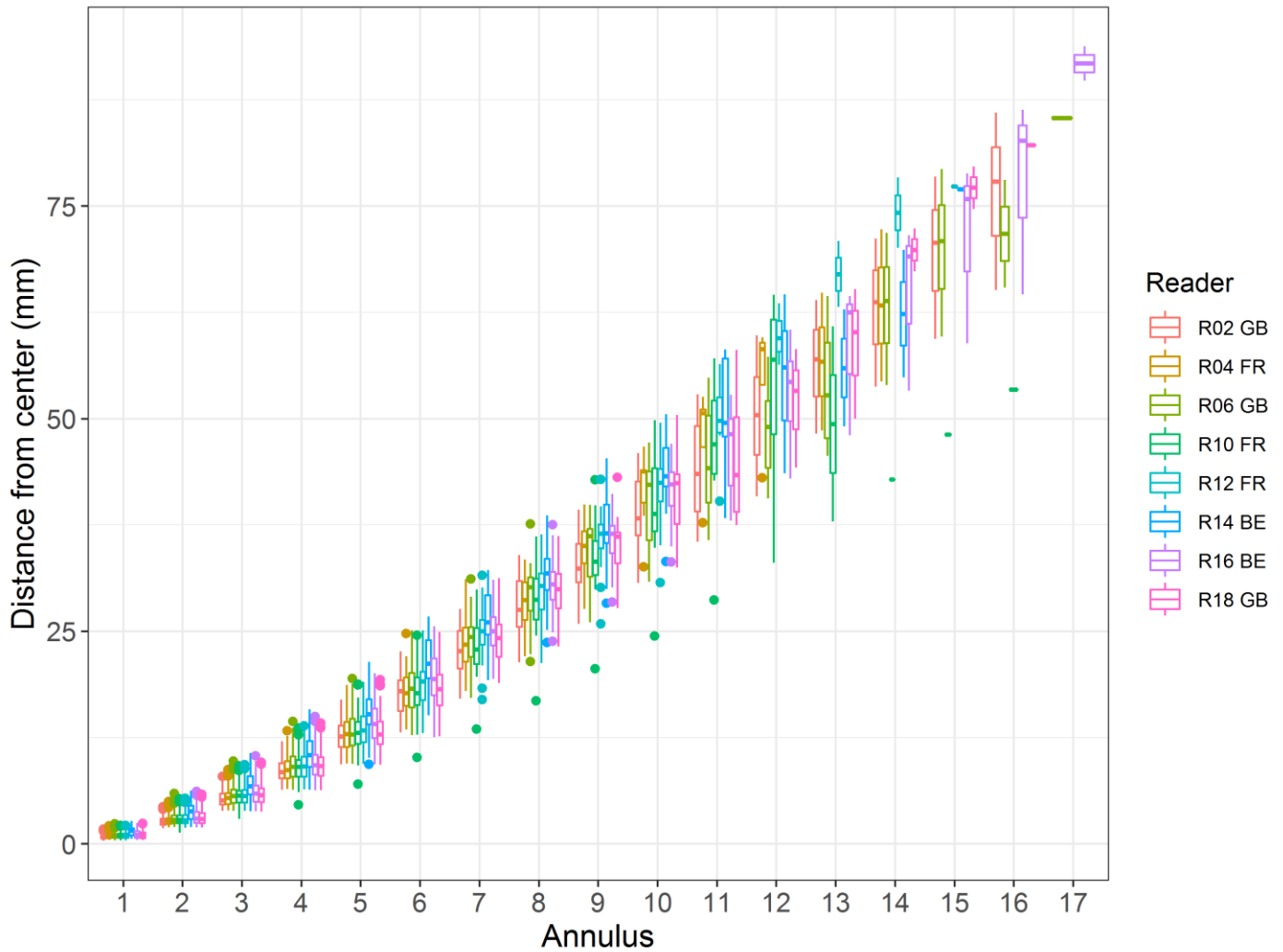
| Modal age            | R02 GB      | R04 FR      | R06 GB      | R10 FR      | R12 FR      | R14 BE      | R16 BE      | R18 GB      | all         |
|----------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 2                    | 100 %       | 100 %       | 0 %         | 100 %       | 100 %       | 100 %       | 100 %       | 0 %         | 75 %        |
| 3                    | 100 %       | 100 %       | 0 %         | 100 %       | 100 %       | 75 %        | 100 %       | 0 %         | 72 %        |
| 4                    | 93 %        | 86 %        | 7 %         | 83 %        | 93 %        | 73 %        | 97 %        | 7 %         | 68 %        |
| 5                    | 100 %       | 87 %        | 30 %        | 73 %        | 87 %        | 57 %        | 96 %        | 43 %        | 72 %        |
| 6                    | 83 %        | 92 %        | 83 %        | 75 %        | 92 %        | 25 %        | 67 %        | 82 %        | 75 %        |
| 7                    | 62 %        | 88 %        | 62 %        | 50 %        | 75 %        | 38 %        | 62 %        | 100 %       | 67 %        |
| 8                    | 100 %       | 71 %        | 100 %       | 71 %        | 67 %        | 29 %        | 100 %       | 86 %        | 78 %        |
| 9                    | 50 %        | 100 %       | 100 %       | 100 %       | 100 %       | 50 %        | 0 %         | 100 %       | 75 %        |
| 10                   | 75 %        | 50 %        | 75 %        | 75 %        | 75 %        | 50 %        | 75 %        | 75 %        | 69 %        |
| 11                   | 50 %        | 25 %        | 25 %        | 50 %        | 75 %        | 25 %        | 50 %        | 25 %        | 41 %        |
| 12                   | 67 %        | 33 %        | 33 %        | 33 %        | 33 %        | 33 %        | 67 %        | 0 %         | 38 %        |
| 13                   | -           | -           | -           | -           | -           | -           | -           | -           | -           |
| 14                   | -           | -           | -           | -           | -           | -           | -           | -           | -           |
| 15                   | 0 %         | 0 %         | 0 %         | 0 %         | 100 %       | 100 %       | 0 %         | 100 %       | 38 %        |
| 16                   | 100 %       | 0 %         | 100 %       | 0 %         | -           | 0 %         | 100 %       | 0 %         | 43 %        |
| <b>Weighted Mean</b> | <b>87 %</b> | <b>80 %</b> | <b>39 %</b> | <b>73 %</b> | <b>86 %</b> | <b>53 %</b> | <b>84 %</b> | <b>42 %</b> | <b>68 %</b> |

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 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 GB      | R04 FR       | R06 GB      | R10 FR       | R12 FR      | R14 BE       | R16 BE      | R18 GB      | all          |
|----------------------|-------------|--------------|-------------|--------------|-------------|--------------|-------------|-------------|--------------|
| 2                    | 0.00        | 0.00         | 1.00        | 0.00         | 0.00        | 0.00         | 0.00        | 1.00        | <b>0.25</b>  |
| 3                    | 0.00        | 0.00         | 1.00        | 0.00         | 0.00        | -0.25        | 0.00        | 1.00        | <b>0.22</b>  |
| 4                    | 0.07        | 0.18         | 0.97        | -0.03        | 0.07        | -0.27        | 0.03        | 0.97        | <b>0.25</b>  |
| 5                    | 0.00        | 0.04         | 0.61        | -0.18        | 0.04        | -0.35        | 0.04        | 0.48        | <b>0.09</b>  |
| 6                    | 0.00        | 0.17         | 0.17        | -0.08        | 0.08        | -0.83        | -0.17       | 0.18        | <b>-0.06</b> |
| 7                    | 0.38        | 0.12         | 0.12        | 0.00         | -0.25       | -0.62        | 0.38        | 0.00        | <b>0.02</b>  |
| 8                    | 0.00        | 0.29         | 0.00        | 1.00         | 0.00        | -0.71        | 0.00        | -0.14       | <b>0.05</b>  |
| 9                    | 0.50        | 0.00         | 0.00        | 0.00         | 0.00        | -0.50        | 1.00        | 0.00        | <b>0.12</b>  |
| 10                   | 0.25        | -0.50        | -0.25       | -0.25        | -0.25       | -0.75        | 0.25        | -0.25       | <b>-0.22</b> |
| 11                   | 0.50        | -1.25        | 1.00        | -0.50        | -0.25       | -1.25        | 0.50        | -0.75       | <b>-0.25</b> |
| 12                   | 1.33        | -0.33        | 0.67        | -0.67        | 0.33        | -1.00        | 1.67        | 0.67        | <b>0.33</b>  |
| 13                   | -           | -            | -           | -            | -           | -            | -           | -           | -            |
| 14                   | -           | -            | -           | -            | -           | -            | -           | -           | -            |
| 15                   | 1.00        | -3.00        | 2.00        | -3.00        | 0.00        | 0.00         | 2.00        | 0.00        | <b>-0.12</b> |
| 16                   | 0.00        | -2.00        | 0.00        | -6.00        | -           | -2.00        | 0.00        | -3.00       | -            |
| <b>Weighted Mean</b> | <b>0.14</b> | <b>-0.02</b> | <b>0.58</b> | <b>-0.13</b> | <b>0.01</b> | <b>-0.51</b> | <b>0.15</b> | <b>0.41</b> | <b>0.10</b>  |

For each pair that is being compared, the differences between the readings per image are found and the frequency of each occurring difference is obtained. A rank value is calculated for the positive and the negative differences (R+ and R- in the Guus Eltink sheet). The value with the smallest rank is then used to calculate a z-value that determines the level of bias (not clear from Guus Eltink sheet how the equations are defined).



**Figure 4:** Plot of average distance from the centre to the winter rings for advanced readers by preparation method. The boxes represent the median, upper and lower box boundaries of the interquartile range, whiskers represent the minimum and maximum values and the dots represent the outliers.

### 3.2.2 Advanced readers

#### All samples included

**Table 12:** 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 GB | R04 FR | R06 GB | all  |
|-----------|--------|--------|--------|------|
| 2         | -      | -      | -      | 25 % |
| 3         | 0 %    | 0 %    | 0 %    | 15 % |
| 4         | 6 %    | 10 %   | 8 %    | 13 % |
| 5         | 4 %    | 4 %    | 11 %   | 9 %  |
| 6         | 8 %    | 9 %    | 6 %    | 8 %  |
| 7         | 0 %    | 0 %    | 7 %    | 4 %  |
| 8         | 11 %   | 8 %    | 19 %   | 13 % |
| 9         | 8 %    | 0 %    | 5 %    | 7 %  |

|                      |            |            |            |             |
|----------------------|------------|------------|------------|-------------|
| 10                   | 0 %        | 0 %        | 0 %        | 0 %         |
| 11                   | -          | -          | -          | 5 %         |
| 12                   | 14 %       | 12 %       | 19 %       | 16 %        |
| 13                   | -          | -          | -          | -           |
| 14                   | -          | -          | -          | 7 %         |
| 15                   | -          | -          | -          | -           |
| 16                   | -          | -          | -          | 8 %         |
| <b>Weighted Mean</b> | <b>6 %</b> | <b>7 %</b> | <b>9 %</b> | <b>10 %</b> |

**Table 13:** 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. A rank is also assigned to each reader.

| Modal age            | R02 GB      | R04 FR      | R06 GB      | all         |
|----------------------|-------------|-------------|-------------|-------------|
| 2                    | 100 %       | 100 %       | 0 %         | 67 %        |
| 3                    | 100 %       | 100 %       | 0 %         | 67 %        |
| 4                    | 93 %        | 93 %        | 7 %         | 64 %        |
| 5                    | 96 %        | 96 %        | 39 %        | 77 %        |
| 6                    | 77 %        | 92 %        | 85 %        | 85 %        |
| 7                    | 100 %       | 100 %       | 80 %        | 93 %        |
| 8                    | 91 %        | 64 %        | 82 %        | 79 %        |
| 9                    | 25 %        | 100 %       | 75 %        | 67 %        |
| 10                   | 100 %       | 100 %       | 100 %       | 100 %       |
| 11                   | 100 %       | 0 %         | 100 %       | 67 %        |
| 12                   | 80 %        | 40 %        | 60 %        | 60 %        |
| 13                   | -           | -           | -           | -           |
| 14                   | 0 %         | 100 %       | 0 %         | 33 %        |
| 15                   | -           | -           | -           | -           |
| 16                   | 100 %       | 0 %         | 100 %       | 67 %        |
| <b>Weighted Mean</b> | <b>88 %</b> | <b>87 %</b> | <b>45 %</b> | <b>73 %</b> |

**Table 14:** 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 GB      | R04 FR       | R06 GB      | all         |
|----------------------|-------------|--------------|-------------|-------------|
| 2                    | 0.00        | 0.00         | 1.00        | 0.33        |
| 3                    | 0.00        | 0.00         | 1.00        | 0.33        |
| 4                    | 0.07        | 0.11         | 1.00        | 0.39        |
| 5                    | -0.04       | 0.04         | 0.52        | 0.17        |
| 6                    | -0.08       | 0.15         | 0.15        | 0.08        |
| 7                    | 0.00        | 0.00         | -0.20       | -0.07       |
| 8                    | 0.27        | 0.00         | 0.36        | 0.21        |
| 9                    | 1.00        | 0.00         | 0.25        | 0.42        |
| 10                   | 0.00        | 0.00         | 0.00        | 0.00        |
| 11                   | 0.00        | -1.00        | 0.00        | -0.33       |
| 12                   | 0.80        | -1.20        | 0.80        | 0.13        |
| 13                   | -           | -            | -           | -           |
| 14                   | 2.00        | 0.00         | 1.00        | 1.00        |
| 15                   | -           | -            | -           | -           |
| 16                   | 0.00        | -2.00        | 0.00        | -0.67       |
| <b>Weighted Mean</b> | <b>0.13</b> | <b>-0.03</b> | <b>0.57</b> | <b>0.22</b> |



### 3.3 Results by preparation method

For this exchange event both scales and stained otoliths were taken from 100 fish. The tables and figures below show comparisons between the two methods.

**Table 15:** Number of age readings per preparation method for all readers.

| Modal age    | Otolith    | Scale      | total       |
|--------------|------------|------------|-------------|
| 2            | 8          | 8          | 16          |
| 3            | 32         | 32         | 64          |
| 4            | 231        | 237        | 468         |
| 5            | 198        | 183        | 381         |
| 6            | 80         | 95         | 175         |
| 7            | 48         | 63         | 111         |
| 8            | 74         | 55         | 129         |
| 9            | 8          | 16         | 24          |
| 10           | 31         | 32         | 63          |
| 11           | 32         | 32         | 64          |
| 12           | 23         | 24         | 47          |
| 13           | 0          | 0          | 0           |
| 14           | 0          | 0          | 0           |
| 15           | 0          | 8          | 8           |
| 16           | 16         | 7          | 23          |
| 17           | 8          | -          | 8           |
| <b>Total</b> | <b>789</b> | <b>792</b> | <b>1581</b> |

**Table 16:** CV per preparation method.

| Modal age            | Otoliths   | Scales      |
|----------------------|------------|-------------|
| 2                    | 21 %       | 21 %        |
| 3                    | 17 %       | 15 %        |
| 4                    | 10 %       | 13 %        |
| 5                    | 8 %        | 10 %        |
| 6                    | 8 %        | 9 %         |
| 7                    | 6 %        | 8 %         |
| 8                    | 3 %        | 15 %        |
| 9                    | 4 %        | 5 %         |
| 10                   | 4 %        | 6 %         |
| 11                   | 6 %        | 10 %        |
| 12                   | 5 %        | 17 %        |
| 13                   | -          | -           |
| 14                   | -          | -           |
| 15                   | -          | 13 %        |
| 16                   | 29 %       | 16 %        |
| 17                   | 5 %        | -           |
| <b>Weighted Mean</b> | <b>9 %</b> | <b>11 %</b> |

**Table 17:** Percentage Agreement per preparation method.

| <b>Modal age</b>     | <b>Otoliths</b> | <b>Scales</b> |
|----------------------|-----------------|---------------|
| 2                    | 75 %            | 75 %          |
| 3                    | 62 %            | 72 %          |
| 4                    | 76 %            | 68 %          |
| 5                    | 83 %            | 72 %          |
| 6                    | 90 %            | 75 %          |
| 7                    | 88 %            | 67 %          |
| 8                    | 92 %            | 78 %          |
| 9                    | 88 %            | 75 %          |
| 10                   | 90 %            | 69 %          |
| 11                   | 69 %            | 41 %          |
| 12                   | 83 %            | 38 %          |
| 13                   | -               | -             |
| 14                   | -               | -             |
| 15                   | -               | 38 %          |
| 16                   | 31 %            | 43 %          |
| 17                   | 50 %            | -             |
| <b>Weighted Mean</b> | <b>80 %</b>     | <b>68 %</b>   |

**Table 18:** Relative Bias per per preparation method.

| <b>Modal age</b>     | <b>Otolith</b> | <b>Scale</b> |
|----------------------|----------------|--------------|
| 2                    | 0.78           | 0.25         |
| 3                    | 0.67           | 0.22         |
| 4                    | 0.38           | 0.24         |
| 5                    | 0.16           | 0.09         |
| 6                    | -0.03          | -0.06        |
| 7                    | -0.27          | 0.02         |
| 8                    | -0.23          | 0.05         |
| 9                    | 0.00           | 0.12         |
| 10                   | 0.15           | -0.22        |
| 11                   | -0.67          | -0.25        |
| 12                   | 1.00           | 0.33         |
| 13                   | -              | -            |
| 14                   | -              | -            |
| 15                   | 1.00           | -0.12        |
| 16                   | -              | -1.86        |
| <b>Weighted Mean</b> | <b>0.23</b>    | <b>0.08</b>  |

**Table 19:** Age reading results based on modal age per preparation method, Otoliths (all readers) and Scales (all readers) and by age group (Cv=Confidence intervals; STDEV= Standard Deviation).

| Age        | No. QC | No. Scales | No. Otolith | No. Agreed | % Agreed | APE   | Length-at-Age |         | Av. Otolith Age | STDEV | CV    | Conf  | 95% conf. interval |       | Bias  |
|------------|--------|------------|-------------|------------|----------|-------|---------------|---------|-----------------|-------|-------|-------|--------------------|-------|-------|
|            |        |            |             |            |          |       | Scale         | Otolith |                 |       |       |       |                    |       |       |
| 0          | 0      | 0          | 0           | 0          | -        |       | -             | -       |                 | 0.000 |       | 0.000 | 0.00               | 0.00  |       |
| 1          | 0      | 0          | 0           | 0          | -        |       | -             | -       |                 | 0.000 |       | 0.000 | 1.00               | 1.00  |       |
| 2          | 1      | 1          | 1           | 1          | 100.0    | 0.00  | 24            | 24      | 2.00            | 0.000 | 0.000 | 0.000 | 2.00               | 2.00  | 0.00  |
| 3          | 4      | 4          | 4           | 4          | 100.0    | 0.00  | 30            | 30      | 3.00            | 0.000 | 0.000 | 0.000 | 3.00               | 3.00  | 0.00  |
| 4          | 29     | 30         | 29          | 28         | 93.3     | 1.67  | 33            | 33      | 4.07            | 0.254 | 0.031 | 0.091 | 3.98               | 4.16  | 0.07  |
| 5          | 25     | 23         | 25          | 22         | 95.7     | 0.87  | 38            | 38      | 4.96            | 0.209 | 0.021 | 0.085 | 4.87               | 5.04  | -0.04 |
| 6          | 10     | 12         | 10          | 10         | 83.3     | 2.78  | 43            | 43      | 6.00            | 0.426 | 0.036 | 0.241 | 5.76               | 6.24  | 0.00  |
| 7          | 6      | 8          | 6           | 5          | 62.5     | 5.36  | 48            | 48      | 7.38            | 0.518 | 0.035 | 0.359 | 7.02               | 7.73  | 0.38  |
| 8          | 10     | 7          | 10          | 7          | 100.0    | 0.00  | 53            | 51      | 8.00            | 0.000 | 0.000 | 0.000 | 8.00               | 8.00  | 0.00  |
| 9          | 1      | 2          | 1           | 1          | 50.0     | 5.56  | 56            | 65      | 9.50            | 0.707 | 0.037 | 0.980 | 8.52               | 10.48 | 0.50  |
| 10         | 4      | 4          | 4           | 3          | 75.0     | 2.50  | 57            | 55      | 10.25           | 0.500 | 0.024 | 0.490 | 9.76               | 10.74 | 0.25  |
| 11         | 3      | 4          | 4           | 2          | 50.0     | 4.55  | 61            | 60      | 11.50           | 0.577 | 0.025 | 0.566 | 10.93              | 12.07 | 0.50  |
| 12         | 4      | 3          | 3           | 1          | 33.3     | 16.67 | 62            | 59      | 13.33           | 3.215 | 0.121 | 3.638 | 9.70               | 16.97 | 1.33  |
| 13         | 0      | 0          | 0           | 0          | -        |       | -             | -       |                 | 0.000 |       | 0.000 | 13.00              | 13.00 |       |
| 14         | 0      | 0          | 0           | 0          | -        |       | -             | -       |                 | 0.000 |       | 0.000 | 14.00              | 14.00 |       |
| 15         | 0      | 1          | 0           | 0          | -        | 6.67  | 69            | -       | 16.00           | 0.000 |       | 0.000 | 15.00              | 15.00 | 1.00  |
| 16         | 2      | 1          | 2           | 1          | 100.0    | 0.00  | 61            | 65      | 16.00           | 0.000 | 0.000 | 0.000 | 16.00              | 16.00 | 0.00  |
| 17         | 1      | 0          | 1           | 0          | -        |       | -             | 70      |                 | 0.000 |       | 0.000 | 17.00              | 17.00 |       |
| <b>Tot</b> | 100    | 100        | 100         | 85         | 85.0     | 2.42  |               |         |                 |       | 0.028 |       |                    |       | 0.13  |

**Table 20:** Scales modal age (all readers) vs. Otoliths modal age (all readers) agreement.

|                         |              |
|-------------------------|--------------|
| <b>TOT. NO. SAMPLED</b> | <b>100</b>   |
| <b>NO. AGED</b>         | 100          |
| <b>NO. EXCLUDED</b>     | -            |
| <b>NO. AGREED</b>       | 85           |
| <b>NO. DISAGREED</b>    | 15           |
| <b>AVERAGE AGE</b>      | 6.02         |
| <b>CHI-SQUARE</b>       | 9.667        |
| <b>DEG. FREEDOM</b>     | 9            |
| <b>P-VALUE</b>          | 0.378        |
| <b>BIAS</b>             | 0.130        |
| <b>CV</b>               | 0.028        |
| <b>APE</b>              | 2.42         |
| <b>% AGREED</b>         | <b>85.00</b> |

**Table 21:** Scales vs Otolith modal age for all readers comparison matrix (Green shaded area is agreement, blue represents under-ageing and brown represents over-ageing by otolith readers).

| Scale based age | Otolith based age |   |   |   |    |    |    |   |    |   |    |    |    |    |    |    |    |    |       |
|-----------------|-------------------|---|---|---|----|----|----|---|----|---|----|----|----|----|----|----|----|----|-------|
|                 | 0                 | 1 | 2 | 3 | 4  | 5  | 6  | 7 | 8  | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | Total |
| 0               | 1                 |   |   |   |    |    |    |   |    |   |    |    |    |    |    |    |    |    |       |
| 1               |                   | 1 |   |   |    |    |    |   |    |   |    |    |    |    |    |    |    |    |       |
| 2               |                   |   | 1 |   |    |    |    |   |    |   |    |    |    |    |    |    |    |    | 1     |
| 3               |                   |   |   | 4 |    |    |    |   |    |   |    |    |    |    |    |    |    |    | 4     |
| 4               |                   |   |   |   | 28 | 2  |    |   |    |   |    |    |    |    |    |    |    |    | 30    |
| 5               |                   |   |   |   | 1  | 22 |    |   |    |   |    |    |    |    |    |    |    |    | 23    |
| 6               |                   |   |   |   |    | 1  | 10 | 1 |    |   |    |    |    |    |    |    |    |    | 12    |
| 7               |                   |   |   |   |    |    |    | 5 | 3  |   |    |    |    |    |    |    |    |    | 8     |
| 8               |                   |   |   |   |    |    |    |   | 7  |   |    |    |    |    |    |    |    |    | 7     |
| 9               |                   |   |   |   |    |    |    |   |    | 1 | 1  |    |    |    |    |    |    |    | 2     |
| 10              |                   |   |   |   |    |    |    |   |    |   | 3  | 1  |    |    |    |    |    |    | 4     |
| 11              |                   |   |   |   |    |    |    |   |    |   |    | 2  | 2  |    |    |    |    |    | 4     |
| 12              |                   |   |   |   |    |    |    |   |    |   |    | 1  | 1  |    |    |    |    | 1  | 3     |
| 13              |                   |   |   |   |    |    |    |   |    |   |    |    |    | 1  |    |    |    |    |       |
| 14              |                   |   |   |   |    |    |    |   |    |   |    |    |    |    | 1  |    |    |    |       |
| 15              |                   |   |   |   |    |    |    |   |    |   |    |    |    |    |    | 1  |    |    | 1     |
| 16              |                   |   |   |   |    |    |    |   |    |   |    |    |    |    |    |    | 1  |    | 1     |
| 17              |                   |   |   |   |    |    |    |   |    |   |    |    |    |    |    |    |    | 1  |       |
| Total           |                   |   | 1 | 4 | 29 | 25 | 10 | 6 | 10 | 1 | 4  | 4  | 3  |    |    |    | 2  | 1  | 100   |

**Table 22:** Otolith modal age readings (all readers) differences from Scale modal age readings (all readers).

| AGE DIFFERENCE | -5 | -4 | -3 | -2 | -1 | 0  | 1  | 2 | 3 | 4 | 5 |
|----------------|----|----|----|----|----|----|----|---|---|---|---|
| NO.            | 0  | 0  | 0  | 0  | 3  | 85 | 11 | 0 | 0 | 0 | 1 |

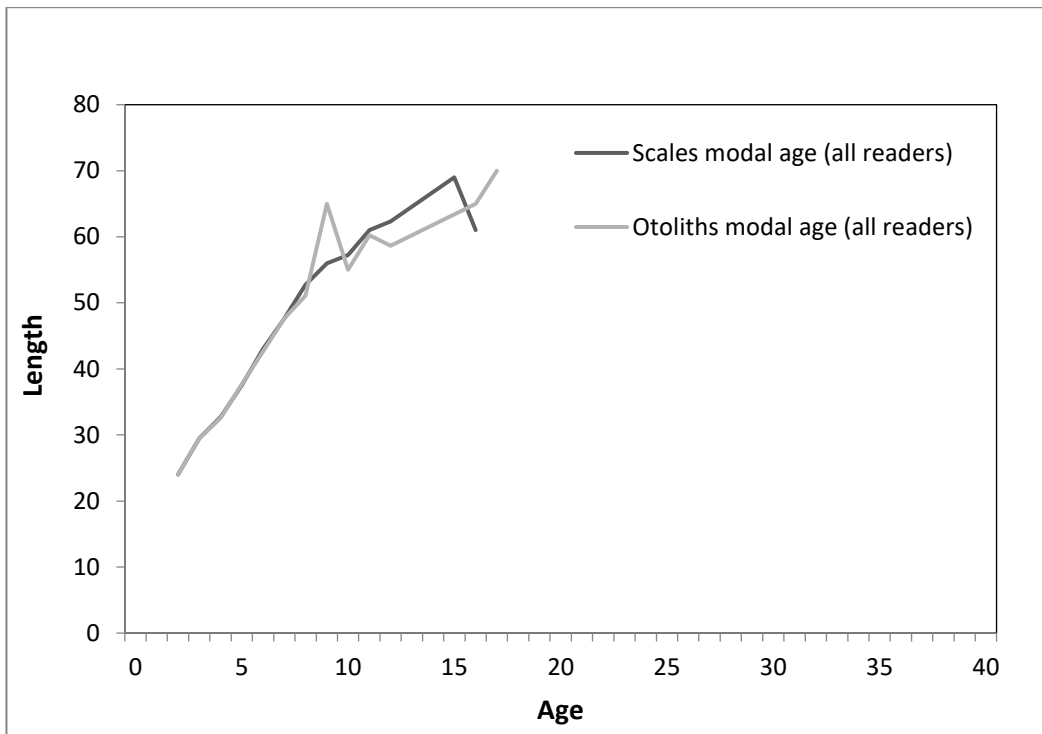


Figure 5: Length-at-Age curve by methods.

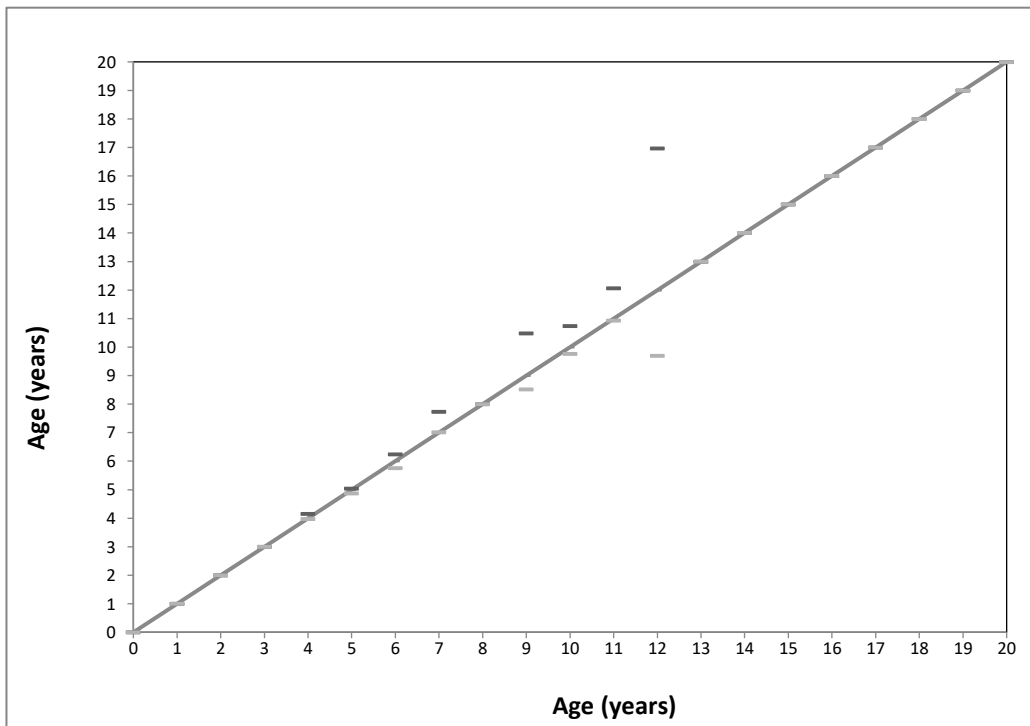
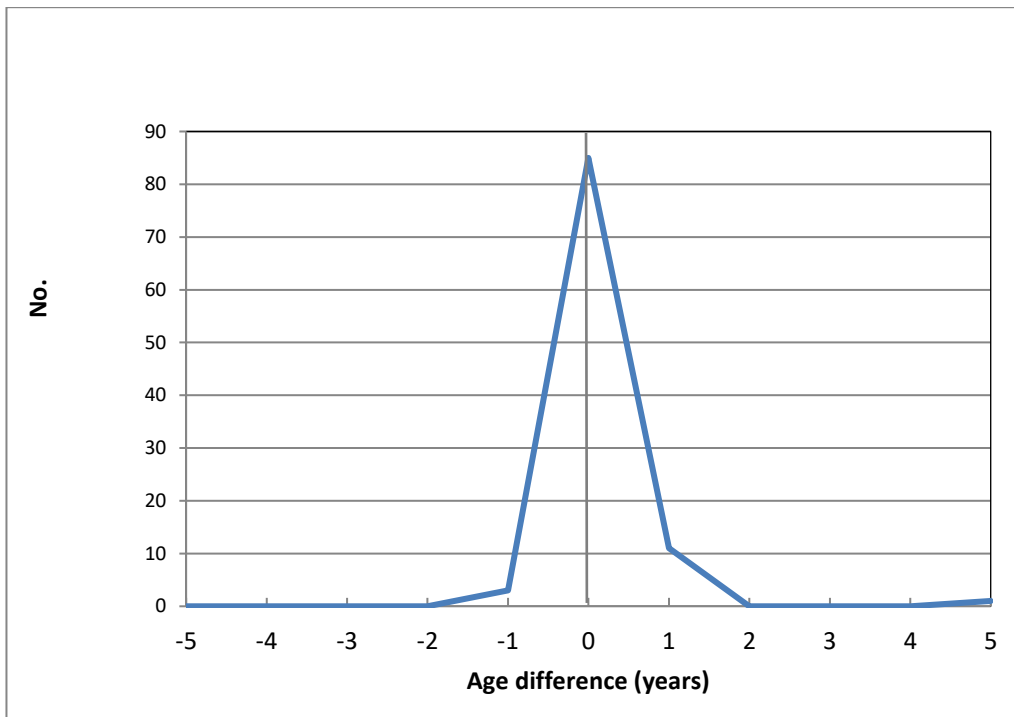


Figure 6: Variance (95% conf. interval).



**Figure 7:** Age differences – Otolith modal age readings (all readers) from Scales modal age readings (all readers).

**Table 23:** Age Reading Error Matrix per method - Otolith modal age readings (all readers) vs Scale modal age readings (all readers).

| Scale Age | Otolith Age |   |       |       |       |       |       |       |       |       |       |       |       |       |    |    |    |       |
|-----------|-------------|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|----|----|----|-------|
|           | 0           | 1 | 2     | 3     | 4     | 5     | 6     | 7     | 8     | 9     | 10    | 11    | 12    | 13    | 14 | 15 | 16 | 17    |
| 0         |             |   |       |       |       |       |       |       |       |       |       |       |       |       |    |    |    |       |
| 1         |             |   |       |       |       |       |       |       |       |       |       |       |       |       |    |    |    |       |
| 2         |             |   | 1.000 |       |       |       |       |       |       |       |       |       |       |       |    |    |    |       |
| 3         |             |   |       | 1.000 |       |       |       |       |       |       |       |       |       |       |    |    |    |       |
| 4         |             |   |       |       | 0.933 | 0.067 |       |       |       |       |       |       |       |       |    |    |    |       |
| 5         |             |   |       |       | 0.043 | 0.957 |       |       |       |       |       |       |       |       |    |    |    |       |
| 6         |             |   |       |       |       | 0.083 | 0.833 | 0.083 |       |       |       |       |       |       |    |    |    |       |
| 7         |             |   |       |       |       |       |       | 0.625 | 0.375 |       |       |       |       |       |    |    |    |       |
| 8         |             |   |       |       |       |       |       |       | 1.000 |       |       |       |       |       |    |    |    |       |
| 9         |             |   |       |       |       |       |       |       |       | 0.500 | 0.500 |       |       |       |    |    |    |       |
| 10        |             |   |       |       |       |       |       |       |       |       | 0.750 | 0.250 |       |       |    |    |    |       |
| 11        |             |   |       |       |       |       |       |       |       |       |       | 0.500 | 0.500 |       |    |    |    |       |
| 12        |             |   |       |       |       |       |       |       |       |       |       |       | 0.333 | 0.333 |    |    |    | 0.333 |
| 13        |             |   |       |       |       |       |       |       |       |       |       |       |       |       |    |    |    |       |
| 14        |             |   |       |       |       |       |       |       |       |       |       |       |       |       |    |    |    |       |
| 15        |             |   |       |       |       |       |       |       |       |       |       |       |       |       |    |    |    | 1.000 |
| 16        |             |   |       |       |       |       |       |       |       |       |       |       |       |       |    |    |    | 1.000 |
| 17        |             |   |       |       |       |       |       |       |       |       |       |       |       |       |    |    |    |       |

# 4 Discussion and Conclusion

## Scales

Agreements between age-readers were calculated using the Guus Eltink spreadsheet (Eltink, 2000). The scale calibration exercise showed an overall agreement of 68% (ranging between 35 and 78%) with a precision of 11% CV (ranging from 5 to 21%). These results are generally better than the last exchange (*The analyses did not show a high mean precision of age estimate for individual fish with Coefficient of Variation (CV) of 13.1% and percentage agreement to modal age of 54.1%. Among 155 fish, only two were read with 100% agreement (1.3%)*) but a different set of images were used and a new group of readers participated. However, these results are based on one scale sample image per fish and this does not occur in practice.

The misinterpretation of growth structures is more evident in ages older than ten. However, after reviewing the images, the lack of agreement can be due to the difficulty identifying the position of the first annulus, the dates of sample collection and the clarity of the rings in the images of the older fish. Out of the 100 scales, only 5 (5%) were read with 100% agreement.

## Otoliths

It is not common to use otoliths for age determination of sea bass because sampling of commercial bass is restricted to taking scale samples only, due to bass being sold whole at the fish markets. So although readers might be classified as 'expert' in age determination of sea bass it is unlikely they have had experience of age determination using sectioned otoliths, this has had an impact on these results. The results from the otolith exchange only 24 otoliths were read with 100% agreement. One reader's results consistently differed from the other seven readers which brought the overall agreement down considerably.

When looking in detail at the results of the otoliths readings, the main problems that occurred were the identification of the first ring and the lack of identification of the summer growth in the fish sampled in quarters 3 and 4.

The 2021 bass workshop will provide an opportunity to analyse and discuss these results with the readers.



# 5 References

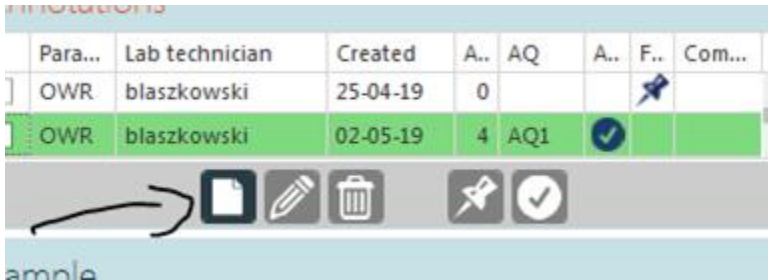
- Carroll, A. 2014. Population Dynamics of the European Sea Bass (*Dicentrarchus labrax*) in Welsh Waters, MSc Marine Environmental Protection Thesis, Bangor University.
- Claridge P.N. and Potter I.C. 1983. Movements, abundance, age composition and growth of bass, *Dicentrarchus labrax*, in the Severn Estuary and inner Bristol Channel. J Mar Biol Assoc UK:VOLUME: 871–879.
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- Pawson M.G., Kupschus S. and Pickett G.D. 2007. The status of seabass (*Dicentrarchus labrax*) stocks around England and Wales, derived using a separable catch-at-age model, and implications for fisheries management. ICES J Mar Sci 64: 346–356.
- Pawson M.G., Kelley D.F. and Pickett G.D. 1987. The distribution and migrations of bass, *Dicentrarchus labrax* L., in waters around England and Wales as shown by tagging. J Mar Biol Assoc UK 67:183–217.

# 6 Annex 1.

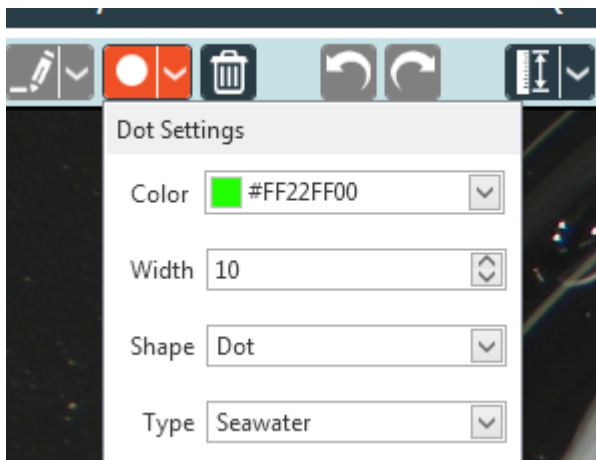
The event will run between 18th March – 31st May, to allow me time to analyse the results for WGBIOP 2020.

Once you open Event 271 you will get the standard SmartDots reading screen with all samples/images listed in the left upper corner. In order to start your annotations you need:

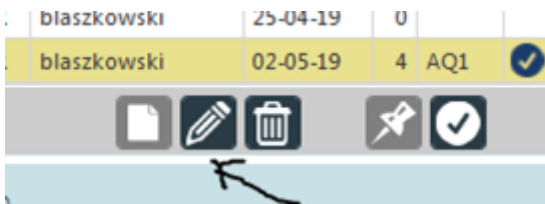
1. Create New Record- Click on New Annotation



2. Change the mark size to width= 10 (that will become default value for all annotations) - colour is up to you.



3. Annotate image-place mark at the end of each winter ring
4. Edit-add readability from the list (AQ1; AQ2; AQ3; AQ3\_QA) and any comments if required.



Please try to age all images and assign an AQcode to all images. Note that the definitions of the AQcodes are:

AQ1 Rings can be counted with certainty

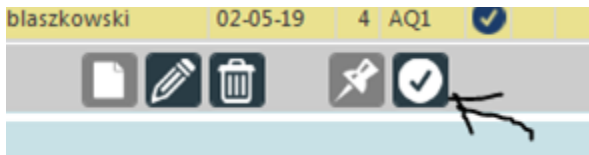
AQ2 Rings can be counted with difficulty and some doubt

AQ3 Rings cannot be counted, the calcified structure is considered unreadable (no age assigned)

AQ3\_QA Rings cannot be counted, the calcified structure is considered unreadable, age assigned for QA purposes only

The distinction between AQ3 and AQ3\_QA is new. If AQ3 is chosen then the annotations and age are removed. Please try to avoid this. For those of you who have finished the dab events, the formerly assigned AQ3's have been converted to AQ3\_QA.

5. Approve the final annotation- very important step-only approved annotations can be included in the reporting.



6. Remember to save your progress.

Please only place the mark at **the end of each winter ring**. You can easily zoom in and out on SmartDots in order to see the edge properly which might be crucial for age interpretation. Remember Smartdots will automatically give the age of the fish based on the number of annotations you make. In case of splits/checks/false rings please annotate only true rings. For each image, the reading line has been fixed and you can annotate only along that line. Please, annotate the **EDGE** type too (Opaque or Translucent) in the last box following "Comment".

Below you can find an example of annotation, please try to keep annotations in the same direction and across the same path of the otolith for your readings. Also, below are links to download SmartDots Application.

smartdots Login as vicconti, ICES Exchange (2770:2020 Seabass 74 74 74 74 74)

**Files**

| File       | Sample type | Measurement | Last picture |
|------------|-------------|-------------|--------------|
| Seabass 74 | Seabass 74  | Seabass 74  | Seabass 74   |
| Seabass 74 | Seabass 74  | Seabass 74  | Seabass 74   |
| Seabass 74 | Seabass 74  | Seabass 74  | Seabass 74   |
| Seabass 74 | Seabass 74  | Seabass 74  | Seabass 74   |
| Seabass 74 | Seabass 74  | Seabass 74  | Seabass 74   |
| Seabass 74 | Seabass 74  | Seabass 74  | Seabass 74   |
| Seabass 74 | Seabass 74  | Seabass 74  | Seabass 74   |
| Seabass 74 | Seabass 74  | Seabass 74  | Seabass 74   |
| Seabass 74 | Seabass 74  | Seabass 74  | Seabass 74   |

**Measurements**

File: Seabass 74  
 Date: 2020-07-14  
 Time: 14:30:00

**Details**

Species: Seabass  
 Length: 74 cm  
 Weight: 1.5 kg

**Signatures**

# 7 Annex 2 List of participants

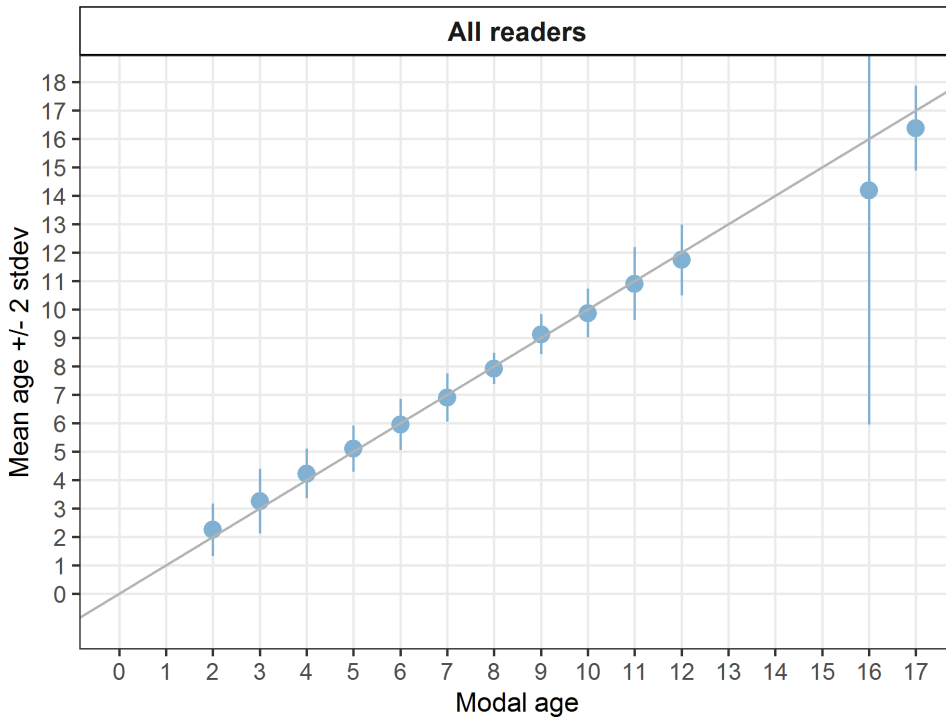
**Table 24:** Participants list.

| <b>Reader code</b> | <b>Expertise</b> |
|--------------------|------------------|
| R02 GB             | Advanced         |
| R04 FR             | Advanced         |
| R06 GB             | Advanced         |
| R10 FR             | Basic            |
| R12 FR             | Basic            |
| R14 BE             | Basic            |
| R16 BE             | Basic            |
| R18 GB             | Basic            |

# 8 Annex 2. Additional results

## Section stained otolith

### All readers



**Figure 8:** 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 25:** 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 GB | R04 FR | R06 GB | R10 FR | R12 FR | R14 BE | R16 BE | R18 GB |
|------------|--------|--------|--------|--------|--------|--------|--------|--------|
| R02 GB     | -      | **     | **     | -      | -      | -      | -      | **     |
| R04 FR     | **     | -      | **     | **     | **     | **     | **     | **     |
| R06 GB     | **     | **     | -      | **     | **     | **     | **     | -      |
| R10 FR     | -      | **     | **     | -      | -      | -      | *      | **     |
| R12 FR     | -      | **     | **     | -      | -      | -      | *      | **     |
| R14 BE     | -      | **     | **     | -      | -      | -      | -      | **     |
| R16 BE     | -      | **     | **     | *      | *      | -      | -      | **     |
| R18 GB     | **     | **     | -      | **     | **     | **     | **     | -      |
| Modal age  | -      | **     | **     | -      | -      | -      | -      | **     |

# Advanced readers

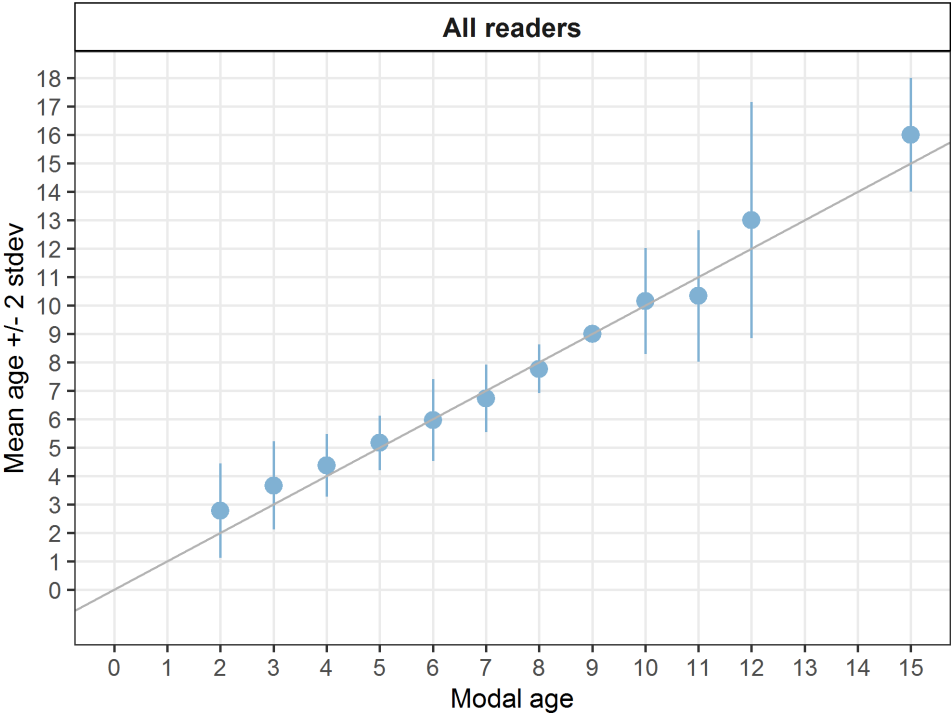
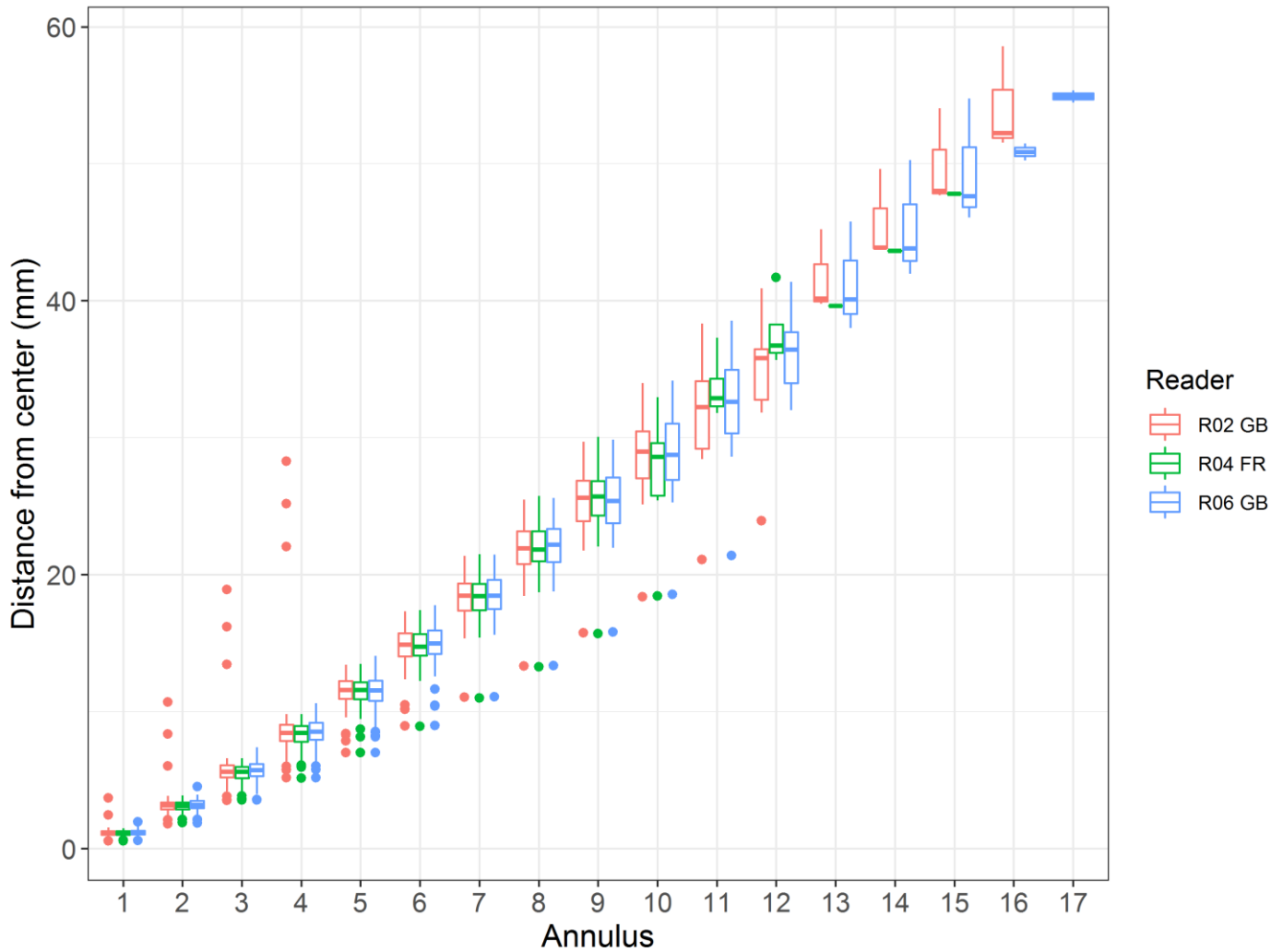


Figure 9: Age bias plot for advanced readers.



**Figure 10:** 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 26:** Age error matrix (AEM) for Otolith. 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 | 2      | 3      | 4       | 5       | 6       | 7       | 8      | 9 | 10   | 11     | 12      | 15     |
|---------|-----------|--------|--------|---------|---------|---------|---------|--------|---|------|--------|---------|--------|
| Otolith | Age 2     | 0.4444 | -      | -       | -       | -       | -       | -      | - | -    | -      | -       | -      |
| Otolith | Age 3     | 0.3333 | 0.5000 | -       | -       | 0.03333 | -       | -      | - | -    | -      | -       | -      |
| Otolith | Age 4     | 0.2222 | 0.3333 | 0.65556 | 0.02985 | -       | -       | -      | - | -    | -      | -       | -      |
| Otolith | Age 5     | -      | 0.1667 | 0.31111 | 0.79104 | 0.03333 | 0.06667 | -      | - | -    | -      | -       | -      |
| Otolith | Age 6     | -      | -      | 0.03333 | 0.16418 | 0.86667 | 0.13333 | -      | - | -    | -      | -       | -      |
| Otolith | Age 7     | -      | -      | -       | 0.01493 | 0.03333 | 0.80000 | 0.2308 | - | -    | -      | -       | -      |
| Otolith | Age 8     | -      | -      | -       | -       | 0.03333 | -       | 0.7692 | - | 0.05 | -      | -       | -      |
| Otolith | Age 9     | -      | -      | -       | -       | -       | -       | -      | 1 | 0.10 | 0.3333 | -       | -      |
| Otolith | Age 10    | -      | -      | -       | -       | -       | -       | -      | - | 0.60 | -      | 0.07143 | -      |
| Otolith | Age 11    | -      | -      | -       | -       | -       | -       | -      | - | 0.15 | 0.6667 | -       | -      |
| Otolith | Age 12    | -      | -      | -       | -       | -       | -       | -      | - | 0.10 | -      | 0.64286 | -      |
| Otolith | Age 15    | -      | -      | -       | -       | -       | -       | -      | - | -    | -      | 0.07143 | 0.3333 |
| Otolith | Age 16    | -      | -      | -       | -       | -       | -       | -      | - | -    | -      | 0.14286 | 0.3333 |
| Otolith | Age 17    | -      | -      | -       | -       | -       | -       | -      | - | -    | -      | 0.07143 | 0.3333 |



## Results by strata

**Table 27:** Number of age readings per strata for all readers.

| Modal age    | Otolith    | total      |
|--------------|------------|------------|
| 2            | 9          | 9          |
| 3            | 12         | 12         |
| 4            | 90         | 90         |
| 5            | 67         | 67         |
| 6            | 30         | 30         |
| 7            | 15         | 15         |
| 8            | 26         | 26         |
| 9            | 3          | 3          |
| 10           | 20         | 20         |
| 11           | 3          | 3          |
| 12           | 14         | 14         |
| 13           | 0          | 0          |
| 14           | 0          | 0          |
| 15           | 3          | 3          |
| <b>Total</b> | <b>292</b> | <b>292</b> |

**Table 28:** CV per strata.

| Modal age            | Otolith     | all         |
|----------------------|-------------|-------------|
| 2                    | 30 %        | 30 %        |
| 3                    | 21 %        | 21 %        |
| 4                    | 13 %        | 13 %        |
| 5                    | 9 %         | 9 %         |
| 6                    | 12 %        | 12 %        |
| 7                    | 9 %         | 9 %         |
| 8                    | 6 %         | 6 %         |
| 9                    | 0 %         | 0 %         |
| 10                   | 9 %         | 9 %         |
| 11                   | 11 %        | 11 %        |
| 12                   | 16 %        | 16 %        |
| 13                   | -           | -           |
| 14                   | -           | -           |
| 15                   | 6 %         | 6 %         |
| <b>Weighted Mean</b> | <b>12 %</b> | <b>12 %</b> |

**Table 29:** Percentage Agreement per strata.

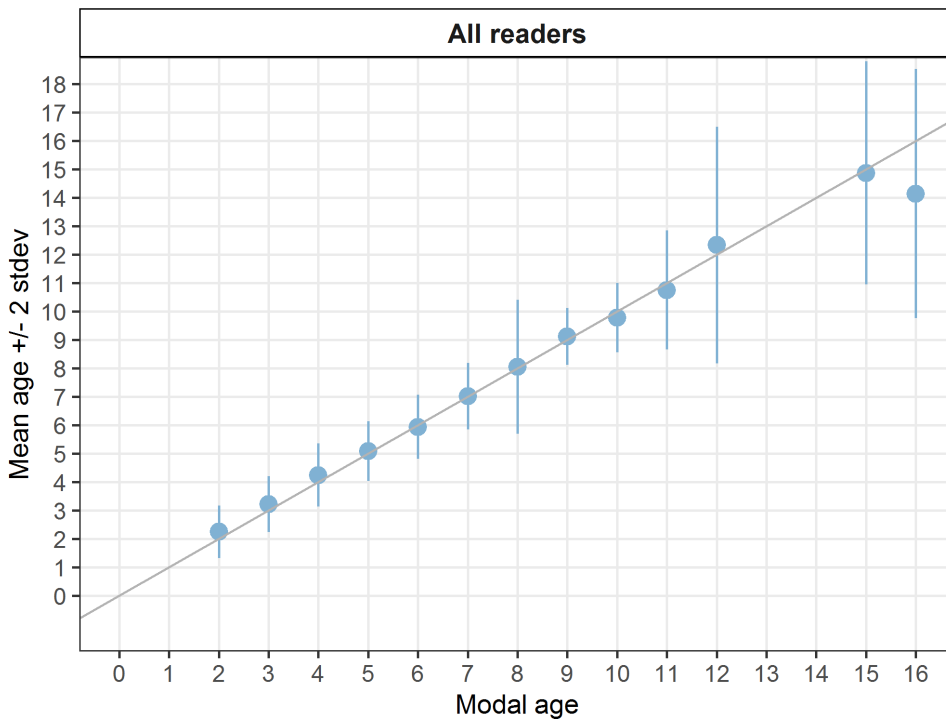
| Modal age            | Otolith     | all         |
|----------------------|-------------|-------------|
| 2                    | 44 %        | 44 %        |
| 3                    | 50 %        | 50 %        |
| 4                    | 66 %        | 66 %        |
| 5                    | 79 %        | 79 %        |
| 6                    | 87 %        | 87 %        |
| 7                    | 80 %        | 80 %        |
| 8                    | 77 %        | 77 %        |
| 9                    | 100 %       | 100 %       |
| 10                   | 60 %        | 60 %        |
| 11                   | 67 %        | 67 %        |
| 12                   | 64 %        | 64 %        |
| 13                   | -           | -           |
| 14                   | -           | -           |
| 15                   | 33 %        | 33 %        |
| <b>Weighted Mean</b> | <b>71 %</b> | <b>71 %</b> |

**Table 30:** Relative Bias per strata.

| Modal age            | Otolith     | all          |
|----------------------|-------------|--------------|
| 2                    | 0.78        | <b>0.78</b>  |
| 3                    | 0.67        | <b>0.67</b>  |
| 4                    | 0.38        | <b>0.38</b>  |
| 5                    | 0.16        | <b>0.16</b>  |
| 6                    | -0.03       | <b>-0.03</b> |
| 7                    | -0.27       | <b>-0.27</b> |
| 8                    | -0.23       | <b>-0.23</b> |
| 9                    | 0.00        | <b>0.00</b>  |
| 10                   | 0.15        | <b>0.15</b>  |
| 11                   | -0.67       | <b>-0.67</b> |
| 12                   | 1.00        | <b>1.00</b>  |
| 13                   | -           | -            |
| 14                   | -           | -            |
| 15                   | 1.00        | <b>1.00</b>  |
| <b>Weighted Mean</b> | <b>0.23</b> | <b>0.23</b>  |

## SCALES

### All readers



**Figure 11:** 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 man 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.

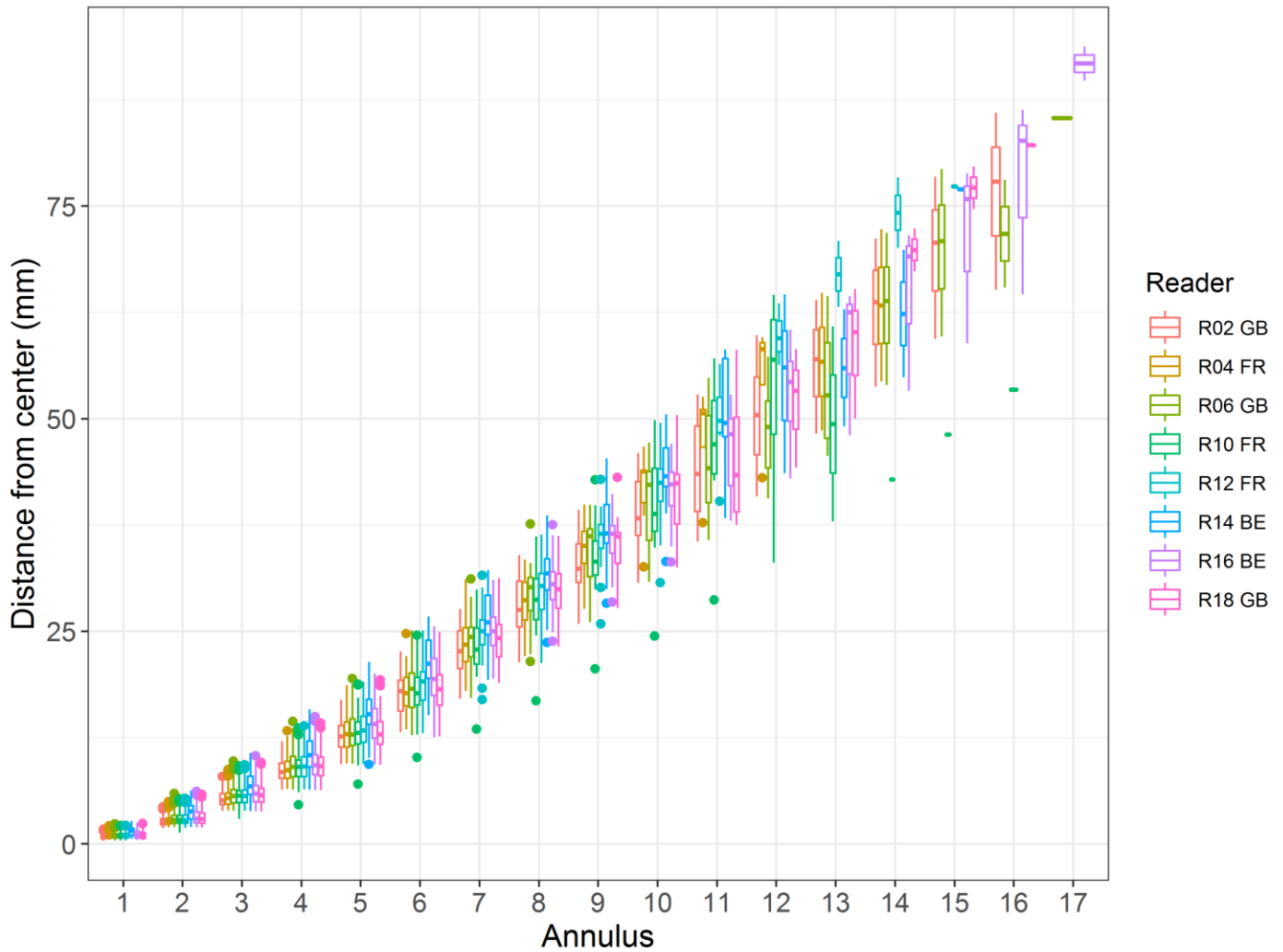
**Table 31:** Inter reader bias test. The Inter-reader bias test gives probability of bias between readers and with modal age. - = no sign of bias ( $p>0.05$ ), \* = possibility of bias ( $0.01<p<0.05$ ), \* \* = certainty of bias ( $p<0.01$ )

| Comparison | R02 GB | R04 FR | R06 GB | R10 FR | R12 FR | R14 BE | R16 BE | R18 GB |
|------------|--------|--------|--------|--------|--------|--------|--------|--------|
| R02 GB     | -      | -      | **     | **     | *      | **     | -      | **     |
| R04 FR     | -      | -      | **     | -      | -      | **     | -      | **     |
| R06 GB     | **     | **     | -      | **     | **     | **     | **     | *      |
| R10 FR     | **     | -      | **     | -      | -      | **     | **     | **     |
| R12 FR     | *      | -      | **     | -      | -      | **     | *      | **     |
| R14 BE     | **     | **     | **     | **     | **     | -      | **     | **     |
| R16 BE     | -      | -      | **     | **     | *      | **     | -      | **     |
| R18 GB     | **     | **     | *      | **     | **     | **     | **     | -      |
| Modal age  | **     | -      | **     | -      | -      | **     | *      | **     |

## Results by strata

**Table 32:** Number of age readings per strata for all readers.

| Modal age    | Scale      | total      |
|--------------|------------|------------|
| 2            | 8          | 8          |
| 3            | 32         | 32         |
| 4            | 237        | 237        |
| 5            | 183        | 183        |
| 6            | 95         | 95         |
| 7            | 63         | 63         |
| 8            | 55         | 55         |
| 9            | 16         | 16         |
| 10           | 32         | 32         |
| 11           | 32         | 32         |
| 12           | 24         | 24         |
| 13           | 0          | 0          |
| 14           | 0          | 0          |
| 15           | 8          | 8          |
| 16           | 7          | 7          |
| <b>Total</b> | <b>792</b> | <b>792</b> |



**Figure 12:** Plot of average distance from the centre to the winter rings for advanced readers by strata. The boxes represent the median, upper and lower box boundaries of the interquartile range, whiskers represent the minimum and maximum values and the dots represent the outliers.

**Table 33:** CV per strata.

| Modal age            | Scale       | all         |
|----------------------|-------------|-------------|
| 2                    | 21 %        | 21 %        |
| 3                    | 15 %        | 15 %        |
| 4                    | 13 %        | 13 %        |
| 5                    | 10 %        | 10 %        |
| 6                    | 9 %         | 9 %         |
| 7                    | 8 %         | 8 %         |
| 8                    | 15 %        | 15 %        |
| 9                    | 5 %         | 5 %         |
| 10                   | 6 %         | 6 %         |
| 11                   | 10 %        | 10 %        |
| 12                   | 17 %        | 17 %        |
| 13                   | -           | -           |
| 14                   | -           | -           |
| 15                   | 13 %        | 13 %        |
| 16                   | 16 %        | 16 %        |
| <b>Weighted Mean</b> | <b>11 %</b> | <b>11 %</b> |

**Table 34:** Percentage Agreement per strata.

| <b>Modal age</b>     | <b>Scale</b> | <b>all</b>  |
|----------------------|--------------|-------------|
| 2                    | 75 %         | <b>75 %</b> |
| 3                    | 72 %         | <b>72 %</b> |
| 4                    | 68 %         | <b>68 %</b> |
| 5                    | 72 %         | <b>72 %</b> |
| 6                    | 75 %         | <b>75 %</b> |
| 7                    | 67 %         | <b>67 %</b> |
| 8                    | 78 %         | <b>78 %</b> |
| 9                    | 75 %         | <b>75 %</b> |
| 10                   | 69 %         | <b>69 %</b> |
| 11                   | 41 %         | <b>41 %</b> |
| 12                   | 38 %         | <b>38 %</b> |
| 13                   | -            | -           |
| 14                   | -            | -           |
| 15                   | 38 %         | <b>38 %</b> |
| 16                   | 43 %         | <b>43 %</b> |
| <b>Weighted Mean</b> | <b>68 %</b>  | <b>68 %</b> |

**Table 35:** Relative Bias per strata.

| <b>Modal age</b>     | <b>Scale</b> | <b>all</b>   |
|----------------------|--------------|--------------|
| 2                    | 0.25         | <b>0.25</b>  |
| 3                    | 0.22         | <b>0.22</b>  |
| 4                    | 0.24         | <b>0.24</b>  |
| 5                    | 0.09         | <b>0.09</b>  |
| 6                    | -0.06        | <b>-0.06</b> |
| 7                    | 0.02         | <b>0.02</b>  |
| 8                    | 0.05         | <b>0.05</b>  |
| 9                    | 0.12         | <b>0.12</b>  |
| 10                   | -0.22        | <b>-0.22</b> |
| 11                   | -0.25        | <b>-0.25</b> |
| 12                   | 0.33         | <b>0.33</b>  |
| 13                   | -            | -            |
| 14                   | -            | -            |
| 15                   | -0.12        | <b>-0.12</b> |
| 16                   | -1.86        | <b>-1.86</b> |
| <b>Weighted Mean</b> | <b>0.08</b>  | <b>0.08</b>  |

# Advanced readers

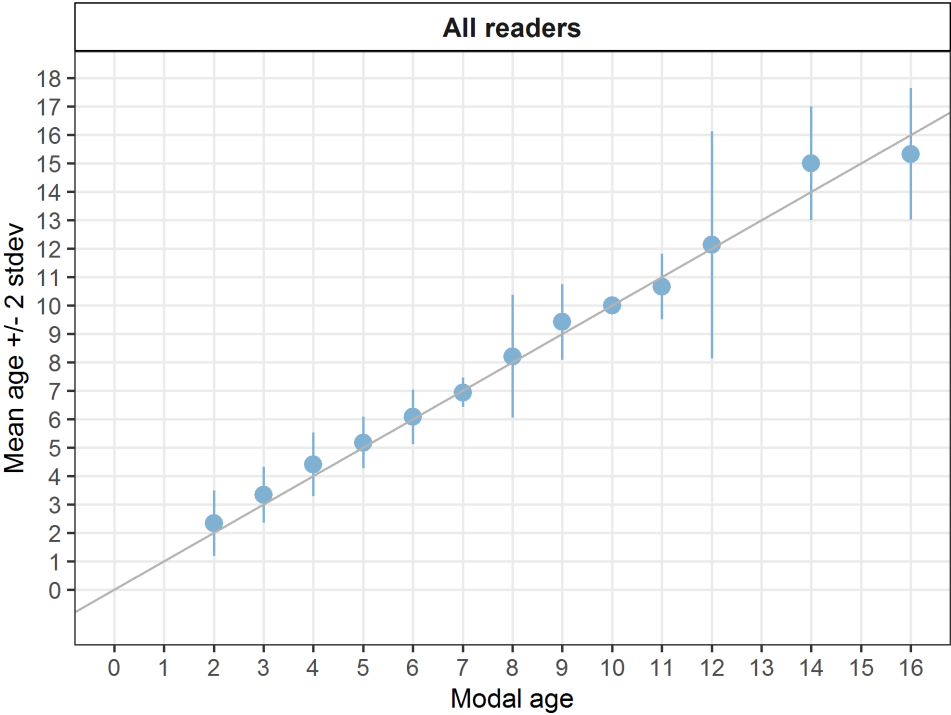


Figure 13: Age bias plot for advanced readers.

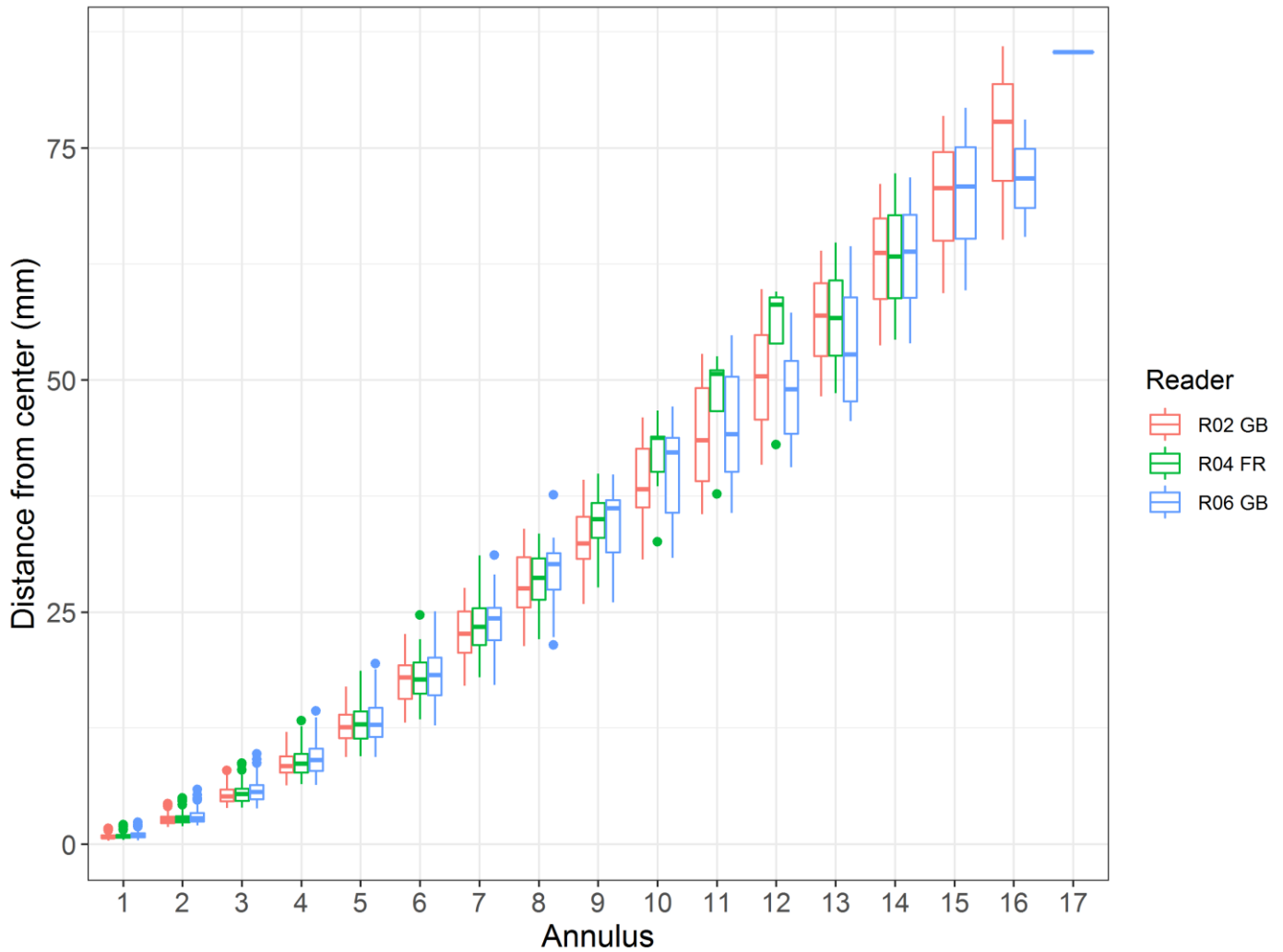


Figure 14: Age error matrices are calculated per area and only based on the age readings of the advanced readers.

Table 36: Age error matrix (AEM) for Scale. 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 | 2      | 3      | 4       | 5       | 6       | 7       | 8       | 9       | 10 | 11     | 12      | 14     | 16     |
|--------|-----------|--------|--------|---------|---------|---------|---------|---------|---------|----|--------|---------|--------|--------|
| Scale  | Age 2     | 0.6667 | -      | -       | -       | -       | -       | -       | -       | -  | -      | -       | -      | -      |
| Scale  | Age 3     | 0.3333 | 0.6667 | -       | -       | -       | -       | -       | -       | -  | -      | -       | -      | -      |
| Scale  | Age 4     | -      | 0.3333 | 0.63529 | 0.02899 | -       | -       | -       | -       | -  | -      | -       | -      | -      |
| Scale  | Age 5     | -      | -      | 0.32941 | 0.76812 | 0.05128 | -       | -       | -       | -  | -      | -       | -      | -      |
| Scale  | Age 6     | -      | -      | 0.03529 | 0.20290 | 0.84615 | 0.06667 | -       | -       | -  | -      | -       | -      | -      |
| Scale  | Age 7     | -      | -      | -       | -       | 0.07692 | 0.93333 | 0.09091 | -       | -  | -      | -       | -      | -      |
| Scale  | Age 8     | -      | -      | -       | -       | 0.02564 | -       | 0.78788 | -       | -  | -      | -       | -      | -      |
| Scale  | Age 9     | -      | -      | -       | -       | -       | -       | 0.06061 | 0.66667 | -  | -      | 0.06667 | -      | -      |
| Scale  | Age 10    | -      | -      | -       | -       | -       | -       | -       | 0.25000 | 1  | 0.3333 | 0.06667 | -      | -      |
| Scale  | Age 11    | -      | -      | -       | -       | -       | -       | 0.03030 | 0.08333 | -  | 0.6667 | 0.13333 | -      | -      |
| Scale  | Age 12    | -      | -      | -       | -       | -       | -       | -       | -       | -  | -      | 0.60000 | -      | -      |
| Scale  | Age 13    | -      | -      | -       | -       | -       | -       | 0.03030 | -       | -  | -      | -       | -      | -      |
| Scale  | Age 14    | -      | -      | -       | -       | -       | -       | -       | -       | -  | -      | -       | 0.3333 | 0.3333 |
| Scale  | Age 15    | -      | -      | -       | -       | -       | -       | -       | -       | -  | -      | -       | 0.3333 | -      |

|              |        |   |   |   |   |   |   |   |   |   |   |   |         |        |        |
|--------------|--------|---|---|---|---|---|---|---|---|---|---|---|---------|--------|--------|
| <b>Scale</b> | Age 16 | - | - | - | - | - | - | - | - | - | - | - | 0.06667 | 0.3333 | 0.6667 |
| <b>Scale</b> | Age 17 | - | - | - | - | - | - | - | - | - | - | - | 0.06667 | -      | -      |

## Results by strata

**Table 37:** Number of age readings per strata for all readers.

| <b>Modal age</b> | <b>Scale</b> | <b>total</b> |
|------------------|--------------|--------------|
| 2                | 3            | <b>3</b>     |
| 3                | 12           | <b>12</b>    |
| 4                | 85           | <b>85</b>    |
| 5                | 69           | <b>69</b>    |
| 6                | 39           | <b>39</b>    |
| 7                | 15           | <b>15</b>    |
| 8                | 33           | <b>33</b>    |
| 9                | 12           | <b>12</b>    |
| 10               | 6            | <b>6</b>     |
| 11               | 3            | <b>3</b>     |
| 12               | 15           | <b>15</b>    |
| 13               | 0            | <b>0</b>     |
| 14               | 3            | <b>3</b>     |
| 15               | 0            | <b>0</b>     |
| 16               | 3            | <b>3</b>     |
| <b>Total</b>     | <b>298</b>   | <b>298</b>   |

**Table 38:** CV per strata.

| <b>Modal age</b>     | <b>Scale</b> | <b>all</b>  |
|----------------------|--------------|-------------|
| 2                    | 25 %         | <b>25 %</b> |
| 3                    | 15 %         | <b>15 %</b> |
| 4                    | 13 %         | <b>13 %</b> |
| 5                    | 9 %          | <b>9 %</b>  |
| 6                    | 8 %          | <b>8 %</b>  |
| 7                    | 4 %          | <b>4 %</b>  |
| 8                    | 13 %         | <b>13 %</b> |
| 9                    | 7 %          | <b>7 %</b>  |
| 10                   | 0 %          | <b>0 %</b>  |
| 11                   | 5 %          | <b>5 %</b>  |
| 12                   | 16 %         | <b>16 %</b> |
| 13                   | -            | <b>-</b>    |
| 14                   | 7 %          | <b>7 %</b>  |
| 15                   | -            | <b>-</b>    |
| 16                   | 8 %          | <b>8 %</b>  |
| <b>Weighted Mean</b> | <b>10 %</b>  | <b>10 %</b> |

**Table 39:** Percentage Agreement per strata.

| <b>Modal age</b> | <b>Scale</b> | <b>all</b>   |
|------------------|--------------|--------------|
| 2                | 67 %         | <b>67 %</b>  |
| 3                | 67 %         | <b>67 %</b>  |
| 4                | 64 %         | <b>64 %</b>  |
| 5                | 77 %         | <b>77 %</b>  |
| 6                | 85 %         | <b>85 %</b>  |
| 7                | 93 %         | <b>93 %</b>  |
| 8                | 79 %         | <b>79 %</b>  |
| 9                | 67 %         | <b>67 %</b>  |
| 10               | 100 %        | <b>100 %</b> |
| 11               | 67 %         | <b>67 %</b>  |



|                      |             |             |
|----------------------|-------------|-------------|
| 12                   | 60 %        | 60 %        |
| 13                   | -           | -           |
| 14                   | 33 %        | 33 %        |
| 15                   | -           | -           |
| 16                   | 67 %        | 67 %        |
| <b>Weighted Mean</b> | <b>73 %</b> | <b>73 %</b> |

**Table 40:** Relative Bias per strata.

| <b>Modal age</b>     | <b>Scale</b> | <b>all</b>   |
|----------------------|--------------|--------------|
| 2                    | 0.33         | <b>0.33</b>  |
| 3                    | 0.33         | <b>0.33</b>  |
| 4                    | 0.40         | <b>0.40</b>  |
| 5                    | 0.17         | <b>0.17</b>  |
| 6                    | 0.08         | <b>0.08</b>  |
| 7                    | -0.07        | <b>-0.07</b> |
| 8                    | 0.21         | <b>0.21</b>  |
| 9                    | 0.42         | <b>0.42</b>  |
| 10                   | 0.00         | <b>0.00</b>  |
| 11                   | -0.33        | <b>-0.33</b> |
| 12                   | 0.13         | <b>0.13</b>  |
| 13                   | -            | -            |
| 14                   | 1.00         | <b>1.00</b>  |
| 15                   | -            | -            |
| 16                   | -0.67        | <b>-0.67</b> |
| <b>Weighted Mean</b> | <b>0.22</b>  | <b>0.22</b>  |

# 8.1 Otolith – Supplementary results for all readers

## OTOLITHS

### Data Overview for section stained otoliths

**Table 41:** Summary of statistics; PA (%), CV (%) and APE (%).

| CV  | PA   | APE |
|-----|------|-----|
| 9 % | 80 % | 6 % |

**Table 42:** Data overview including modal age and statistics per sample.

| Fish ID | Event ID | Image ID | length | sex | Catch date             | ICES area | R02 GB | R04 FR | R06 GB | R10 FR | R12 FR | R14 BE | R16 BE | R18 GB | Modal age | PA % | CV % | APE % |
|---------|----------|----------|--------|-----|------------------------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|------|------|-------|
| Bass01  | 271      | -        | 54     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 8      | 8      | 8      | 8      | 8      | 8      | 8      | 8      | 8         | 100  | 0    | 0     |
| Bass02  | 271      | -        | 49     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 6      | 5      | 6      | 6      | 6      | 6      | 6      | 6      | 6         | 88   | 6    | 4     |
| Bass03  | 271      | -        | 48     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 8      | 7      | 8      | 8      | 8      | 8      | 8      | 8      | 8         | 88   | 4    | 3     |
| Bass04  | 271      | -        | 49     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 7      | 7      | 6      | 7      | 7      | 7      | 7      | 7      | 7         | 88   | 5    | 3     |
| Bass05  | 271      | -        | 51     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 8      | 8      | 8      | 8      | 8      | 8      | 8      | 8      | 8         | 100  | 0    | 0     |
| Bass06  | 271      | -        | 64     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 12     | 10     | 11     | 11     | 11     | 12     | 12     | 11     | 11        | 50   | 6    | 5     |
| Bass07  | 271      | -        | 55     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 8      | 7      | 8      | 8      | 8      | 8      | 8      | 8      | 8         | 88   | 4    | 3     |
| Bass08  | 271      | -        | 52     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | -      | -      | -      | 8      | -      | 8      | 8      | -      | 8         | 100  | 0    | 0     |
| Bass09  | 271      | -        | 58     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 8      | 7      | 8      | 8      | 8      | 8      | 8      | 8      | 8         | 88   | 4    | 3     |
| Bass10  | 271      | -        | 59     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 10     | 9      | 10     | 10     | 10     | 10     | 10     | 10     | 10        | 88   | 4    | 2     |
| Bass100 | 271      | -        | 39     | -   | 23/09/2018<br>00:00:00 | 27.7.a    | 5      | 5      | 6      | 5      | 5      | 5      | 5      | 5      | 5         | 88   | 7    | 4     |
| Bass11  | 271      | -        | 42     | -   | 18/02/2019<br>00:00:00 | 27.7.f    | 6      | 3      | 6      | 6      | 6      | 5      | 5      | 6      | 6         | 62   | 20   | 15    |
| Bass12  | 271      | -        | 61     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 16     | 12     | 15     | 16     | 15     | 17     | 16     | 14     | 16        | 38   | 10   | 7     |
| Bass13  | 271      | -        | 60     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 10     | 9      | 10     | 10     | 10     | 10     | 10     | 10     | 10        | 88   | 4    | 2     |
| Bass14  | 271      | -        | 56     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 11     | 10     | 10     | 11     | 11     | 11     | 11     | 11     | 11        | 75   | 4    | 3     |
| Bass15  | 271      | -        | 45     | -   | 07/02/2019<br>00:00:00 | 27.7.e    | 8      | 7      | 8      | 8      | 8      | 8      | 8      | 8      | 8         | 88   | 4    | 3     |
| Bass16  | 271      | -        | 35     | -   | 07/02/2019<br>00:00:00 | 27.7.e    | 5      | 4      | 5      | 5      | 5      | 5      | 5      | 5      | 5         | 88   | 7    | 4     |
| Bass17  | 271      | -        | 33     | -   | 07/02/2019<br>00:00:00 | 27.7.e    | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6         | 100  | 0    | 0     |
| Bass18  | 271      | -        | 39     | -   | 07/02/2019<br>00:00:00 | 27.7.e    | 5      | 5      | -      | 5      | 5      | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass19  | 271      | -        | 37     | -   | 07/02/2019<br>00:00:00 | 27.7.e    | 4      | 4      | 4      | 4      | 4      | 4      | 4      | 4      | 4         | 100  | 0    | 0     |

|        |     |   |    |   |                        |        |    |    |    |    |    |    |    |    |    |     |    |   |
|--------|-----|---|----|---|------------------------|--------|----|----|----|----|----|----|----|----|----|-----|----|---|
| Bass20 | 271 | - | 47 | - | 21/02/2019<br>00:00:00 | 27.7.e | 7  | 6  | 8  | 7  | 7  | 7  | 7  | 7  | 7  | 75  | 8  | 4 |
| Bass21 | 271 | - | 37 | - | 21/02/2019<br>00:00:00 | 27.7.e | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 100 | 0  | 0 |
| Bass22 | 271 | - | 39 | - | 22/02/2019<br>00:00:00 | 27.7.e | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 100 | 0  | 0 |
| Bass23 | 271 | - | 65 | - | 06/02/2019<br>00:00:00 | 27.7.e | 9  | 9  | 9  | 9  | 9  | 9  | 10 | 9  | 9  | 88  | 4  | 2 |
| Bass24 | 271 | - | 70 | - | 06/02/2019<br>00:00:00 | 27.7.e | 16 | 15 | 17 | 16 | 16 | 17 | 17 | 17 | 17 | 50  | 5  | 4 |
| Bass25 | 271 | - | 67 | - | 06/02/2019<br>00:00:00 | 27.7.e | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 100 | 0  | 0 |
| Bass26 | 271 | - | 34 | - | 07/02/2019<br>00:00:00 | 27.7.e | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 100 | 0  | 0 |
| Bass27 | 271 | - | 35 | - | 07/02/2019<br>00:00:00 | 27.7.e | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 100 | 0  | 0 |
| Bass28 | 271 | - | 33 | - | 07/02/2019<br>00:00:00 | 27.7.e | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 100 | 0  | 0 |
| Bass29 | 271 | - | 56 | - | 18/02/2019<br>00:00:00 | 27.7.g | 12 | -  | 12 | 11 | 12 | 12 | 12 | 10 | 12 | 71  | 7  | 5 |
| Bass30 | 271 | - | 45 | - | 19/03/2019<br>00:00:00 | 27.7.e | 8  | 7  | 8  | 8  | 8  | 8  | 8  | 8  | 8  | 88  | 4  | 3 |
| Bass31 | 271 | - | 46 | - | 19/03/2019<br>00:00:00 | 27.7.e | 7  | 6  | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 88  | 5  | 3 |
| Bass32 | 271 | - | 42 | - | 20/03/2019<br>00:00:00 | 27.7.e | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 100 | 0  | 0 |
| Bass33 | 271 | - | 49 | - | 21/03/2019<br>00:00:00 | 27.7.e | 8  | -  | 8  | 8  | 8  | 8  | 8  | 8  | 8  | 100 | 0  | 0 |
| Bass34 | 271 | - | 54 | - | 21/03/2019<br>00:00:00 | 27.7.e | 10 | 10 | -  | 10 | 10 | 10 | 10 | 10 | 10 | 100 | 0  | 0 |
| Bass35 | 271 | - | 33 | - | 21/03/2019<br>00:00:00 | 27.7.e | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 100 | 0  | 0 |
| Bass36 | 271 | - | 43 | - | 22/03/2019<br>00:00:00 | 27.7.e | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 6  | 5  | 88  | 7  | 4 |
| Bass37 | 271 | - | 41 | - | 23/03/2019<br>00:00:00 | 27.7.e | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 100 | 0  | 0 |
| Bass38 | 271 | - | 42 | - | 23/03/2019<br>00:00:00 | 27.7.e | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 100 | 0  | 0 |
| Bass39 | 271 | - | 46 | - | 23/03/2019<br>00:00:00 | 27.7.e | 7  | 5  | 7  | 7  | 6  | 7  | 7  | 7  | 7  | 75  | 11 | 8 |
| Bass40 | 271 | - | 47 | - | 23/03/2019<br>00:00:00 | 27.7.e | 10 | 8  | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 88  | 7  | 4 |
| Bass41 | 271 | - | 41 | - | 23/03/2019<br>00:00:00 | 27.7.e | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 7  | 6  | 88  | 6  | 4 |
| Bass42 | 271 | - | 36 | - | 23/03/2019<br>00:00:00 | 27.7.e | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 100 | 0  | 0 |
| Bass43 | 271 | - | 38 | - | 23/03/2019<br>00:00:00 | 27.7.e | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 100 | 0  | 0 |
| Bass44 | 271 | - | 47 | - | 23/03/2019<br>00:00:00 | 27.7.e | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 6  | 100 | 0  | 0 |
| Bass45 | 271 | - | 51 | - | 23/03/2019<br>00:00:00 | 27.7.e | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 100 | 0  | 0 |
| Bass46 | 271 | - | 65 | - | 23/03/2019<br>00:00:00 | 27.7.e | 11 | 9  | 11 | 11 | 11 | 11 | 11 | 10 | 11 | 75  | 7  | 5 |
| Bass47 | 271 | - | 53 | - | 23/03/2019<br>00:00:00 | 27.7.e | 12 | 10 | 12 | 12 | 12 | 12 | 12 | 11 | 12 | 75  | 6  | 5 |
| Bass48 | 271 | - | 47 | - | 23/03/2019<br>00:00:00 | 27.7.e | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 7  | 100 | 0  | 0 |

|        |     |   |    |   |                        |        |    |    |    |   |    |    |    |    |    |     |    |    |
|--------|-----|---|----|---|------------------------|--------|----|----|----|---|----|----|----|----|----|-----|----|----|
| Bass49 | 271 | - | 54 | - | 27/03/2019<br>00:00:00 | 27.7.e | 8  | 7  | 8  | 8 | 8  | 8  | 8  | 8  | 8  | 88  | 4  | 3  |
| Bass50 | 271 | - | 49 | - | 27/03/2019<br>00:00:00 | 27.7.e | 6  | 6  | 6  | 6 | 6  | 6  | 6  | 6  | 6  | 100 | 0  | 0  |
| Bass51 | 271 | - | 42 | - | 18/07/2019<br>00:00:00 | 27.7.d | 5  | 4  | 5  | 5 | 4  | 4  | 5  | 5  | 5  | 62  | 11 | 10 |
| Bass52 | 271 | - | 44 | - | 18/07/2019<br>00:00:00 | 27.7.d | 5  | 4  | 6  | 5 | 5  | 5  | 5  | 6  | 5  | 62  | 13 | 9  |
| Bass53 | 271 | - | 39 | - | 18/07/2019<br>00:00:00 | 27.7.d | 5  | 5  | 6  | 5 | 5  | 5  | 5  | 6  | 5  | 75  | 9  | 7  |
| Bass54 | 271 | - | 30 | - | 22/07/2019<br>00:00:00 | 27.7.d | 3  | 2  | 4  | 3 | 3  | 3  | 3  | 4  | 3  | 62  | 21 | 14 |
| Bass55 | 271 | - | 35 | - | 22/07/2019<br>00:00:00 | 27.7.d | 5  | 4  | 6  | 5 | 5  | 5  | 5  | 5  | 5  | 75  | 11 | 5  |
| Bass56 | 271 | - | 29 | - | 22/07/2019<br>00:00:00 | 27.7.d | 3  | 2  | 4  | 3 | 3  | 3  | 3  | 4  | 3  | 62  | 21 | 14 |
| Bass57 | 271 | - | 32 | - | 22/07/2019<br>00:00:00 | 27.7.d | 4  | 3  | 5  | 4 | 4  | 4  | 4  | 5  | 4  | 62  | 16 | 11 |
| Bass58 | 271 | - | 32 | - | 22/07/2019<br>00:00:00 | 27.7.d | 3  | 3  | 4  | 3 | 4  | 3  | 4  | 4  | 3  | 50  | 15 | 14 |
| Bass59 | 271 | - | 39 | - | 10/09/2019<br>00:00:00 | 27.7.f | 5  | 4  | 6  | 5 | 5  | 5  | 5  | 6  | 5  | 62  | 13 | 9  |
| Bass60 | 271 | - | 35 | - | 10/09/2019<br>00:00:00 | 27.7.f | 5  | 5  | 6  | 5 | 5  | 5  | 5  | 6  | 5  | 75  | 9  | 7  |
| Bass61 | 271 | - | 37 | - | 11/09/2019<br>00:00:00 | 27.7.f | 5  | 5  | 6  | 5 | 5  | 5  | 5  | 6  | 5  | 75  | 9  | 7  |
| Bass62 | 271 | - | 34 | - | 11/09/2019<br>00:00:00 | 27.7.f | 5  | 5  | 6  | 5 | 5  | 5  | 6  | 6  | 5  | 62  | 10 | 9  |
| Bass63 | 271 | - | 36 | - | 13/09/2019<br>00:00:00 | 27.7.f | 4  | 3  | 5  | 4 | 4  | 4  | 4  | 5  | 4  | 62  | 16 | 11 |
| Bass64 | 271 | - | 40 | - | 13/09/2019<br>00:00:00 | 27.7.f | 6  | 5  | 7  | 6 | 6  | 6  | 6  | 7  | 6  | 62  | 10 | 7  |
| Bass65 | 271 | - | 69 | - | 13/09/2019<br>00:00:00 | 27.7.f | 16 | 12 | 17 | 0 | 13 | 16 | 17 | 15 | 16 | 25  | 43 | 28 |
| Bass66 | 271 | - | 29 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4 | 4  | 4  | 4  | 5  | 4  | 75  | 11 | 9  |
| Bass67 | 271 | - | 30 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4 | 4  | 4  | 4  | 5  | 4  | 75  | 11 | 9  |
| Bass68 | 271 | - | 31 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4 | 4  | 4  | 4  | 5  | 4  | 75  | 11 | 9  |
| Bass69 | 271 | - | 31 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4 | 4  | 4  | 4  | 5  | 4  | 75  | 11 | 9  |
| Bass70 | 271 | - | 32 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4 | 4  | 4  | 4  | 5  | 4  | 75  | 11 | 9  |
| Bass71 | 271 | - | 32 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4 | 4  | 4  | 4  | 5  | 4  | 75  | 11 | 9  |
| Bass72 | 271 | - | 27 | - | 16/09/2018<br>00:00:00 | 27.7.f | 3  | 3  | 4  | 3 | 3  | 3  | 3  | 4  | 3  | 75  | 14 | 12 |
| Bass73 | 271 | - | 34 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4 | 4  | 4  | 4  | 5  | 4  | 75  | 11 | 9  |
| Bass74 | 271 | - | 31 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4 | 4  | 4  | 4  | 5  | 4  | 75  | 11 | 9  |
| Bass75 | 271 | - | 31 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4 | 4  | 4  | 4  | 5  | 4  | 75  | 11 | 9  |
| Bass76 | 271 | - | 31 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4 | 4  | 4  | 4  | 5  | 4  | 75  | 11 | 9  |
| Bass77 | 271 | - | 30 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4 | 4  | 4  | 4  | 5  | 4  | 75  | 11 | 9  |

|        |     |   |    |   |                        |        |    |    |    |    |    |    |    |    |    |    |    |    |
|--------|-----|---|----|---|------------------------|--------|----|----|----|----|----|----|----|----|----|----|----|----|
| Bass78 | 271 | - | 29 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass79 | 271 | - | 30 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass80 | 271 | - | 24 | - | 16/09/2018<br>00:00:00 | 27.7.f | 2  | 2  | 3  | 2  | 2  | 2  | 2  | 3  | 2  | 75 | 21 | 17 |
| Bass81 | 271 | - | 56 | - | 16/09/2018<br>00:00:00 | 27.7.f | 11 | 10 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 75 | 5  | 2  |
| Bass82 | 271 | - | 35 | - | 16/09/2018<br>00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 5  | 5  | 5  | 6  | 5  | 75 | 9  | 7  |
| Bass83 | 271 | - | 30 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass84 | 271 | - | 32 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass85 | 271 | - | 33 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass86 | 271 | - | 32 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass87 | 271 | - | 34 | - | 17/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass88 | 271 | - | 37 | - | 17/09/2018<br>00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 5  | 5  | 5  | 6  | 5  | 75 | 9  | 7  |
| Bass89 | 271 | - | 33 | - | 17/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass90 | 271 | - | 36 | - | 17/09/2018<br>00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 5  | 5  | 5  | 6  | 5  | 75 | 9  | 7  |
| Bass91 | 271 | - | 33 | - | 17/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | -  | 4  | 86 | 9  | 6  |
| Bass92 | 271 | - | 35 | - | 17/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass93 | 271 | - | 37 | - | 17/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass94 | 271 | - | 32 | - | 20/09/2018<br>00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass95 | 271 | - | 40 | - | 20/09/2018<br>00:00:00 | 27.7.f | 5  | 5  | -  | 5  | 5  | 5  | 5  | 6  | 5  | 86 | 7  | 5  |
| Bass96 | 271 | - | 45 | - | 20/09/2018<br>00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 5  | 5  | 5  | 6  | 5  | 75 | 9  | 7  |
| Bass97 | 271 | - | 36 | - | 20/09/2018<br>00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 5  | 5  | 5  | 6  | 5  | 75 | 9  | 7  |
| Bass98 | 271 | - | 36 | - | 23/09/2018<br>00:00:00 | 27.7.a | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass99 | 271 | - | 39 | - | 23/09/2018<br>00:00:00 | 27.7.a | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 75 | 11 | 9  |

**Table 43:** 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 GB | R04 FR | R06 GB | R10 FR | R12 FR | R14 BE | R16 BE | R18 GB | total |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| 2         | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 8     |
| 3         | 4      | 4      | 4      | 4      | 4      | 4      | 4      | 4      | 32    |
| 4         | 29     | 29     | 29     | 29     | 29     | 29     | 29     | 28     | 231   |
| 5         | 25     | 25     | 23     | 25     | 25     | 25     | 25     | 25     | 198   |
| 6         | 10     | 10     | 10     | 10     | 10     | 10     | 10     | 10     | 80    |
| 7         | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 6      | 48    |
| 8         | 9      | 8      | 9      | 10     | 9      | 10     | 10     | 9      | 74    |
| 9         | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 8     |
| 10        | 4      | 4      | 3      | 4      | 4      | 4      | 4      | 4      | 31    |
| 11        | 4      | 4      | 4      | 4      | 4      | 4      | 4      | 4      | 32    |
| 12        | 3      | 2      | 3      | 3      | 3      | 3      | 3      | 3      | 23    |

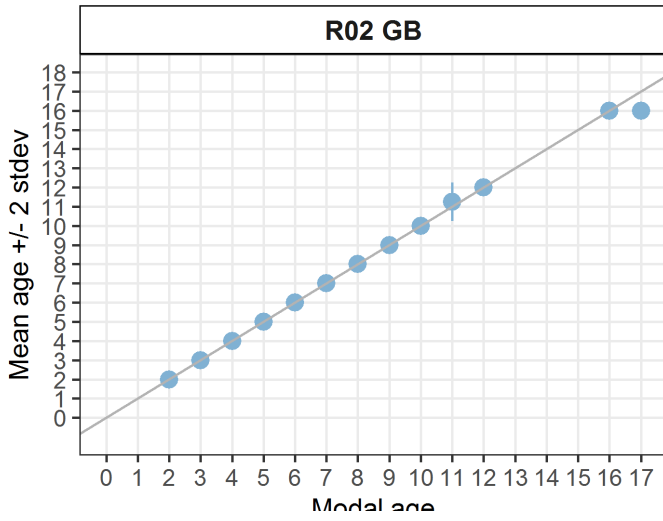
|              |           |           |           |            |           |            |            |           |            |
|--------------|-----------|-----------|-----------|------------|-----------|------------|------------|-----------|------------|
| 13           | 0         | 0         | 0         | 0          | 0         | 0          | 0          | 0         | 0          |
| 14           | 0         | 0         | 0         | 0          | 0         | 0          | 0          | 0         | 0          |
| 15           | 0         | 0         | 0         | 0          | 0         | 0          | 0          | 0         | 0          |
| 16           | 2         | 2         | 2         | 2          | 2         | 2          | 2          | 2         | 16         |
| 17           | 1         | 1         | 1         | 1          | 1         | 1          | 1          | 1         | 8          |
| <b>Total</b> | <b>99</b> | <b>97</b> | <b>96</b> | <b>100</b> | <b>99</b> | <b>100</b> | <b>100</b> | <b>98</b> | <b>789</b> |

**Table 44:** Age composition by reader gives a summary of number of readings per reader.

| Modal age    | R02 GB    | R04 FR    | R06 GB    | R10 FR     | R12 FR    | R14 BE     | R16 BE     | R18 GB    |
|--------------|-----------|-----------|-----------|------------|-----------|------------|------------|-----------|
| 0            | 0         | 0         | 0         | 1          | 0         | 0          | 0          | 0         |
| 2            | 1         | 3         | 0         | 1          | 1         | 1          | 1          | 0         |
| 3            | 4         | 5         | 1         | 4          | 3         | 4          | 3          | 1         |
| 4            | 29        | 32        | 6         | 29         | 31        | 30         | 30         | 6         |
| 5            | 25        | 23        | 37        | 25         | 24        | 25         | 25         | 38        |
| 6            | 10        | 9         | 23        | 10         | 11        | 9          | 10         | 21        |
| 7            | 6         | 9         | 5         | 6          | 5         | 6          | 6          | 8         |
| 8            | 9         | 3         | 10        | 10         | 9         | 10         | 10         | 9         |
| 9            | 1         | 4         | 1         | 1          | 1         | 1          | 0          | 1         |
| 10           | 4         | 5         | 4         | 4          | 4         | 4          | 5          | 6         |
| 11           | 3         | 0         | 2         | 5          | 4         | 3          | 3          | 4         |
| 12           | 4         | 3         | 4         | 2          | 3         | 4          | 4          | 1         |
| 13           | 0         | 0         | 0         | 0          | 1         | 0          | 0          | 0         |
| 14           | 0         | 0         | 0         | 0          | 0         | 0          | 0          | 1         |
| 15           | 0         | 1         | 1         | 0          | 1         | 0          | 0          | 1         |
| 16           | 3         | 0         | 0         | 2          | 1         | 1          | 1          | 0         |
| 17           | 0         | 0         | 2         | 0          | 0         | 2          | 2          | 1         |
| <b>Total</b> | <b>99</b> | <b>97</b> | <b>96</b> | <b>100</b> | <b>99</b> | <b>100</b> | <b>100</b> | <b>98</b> |

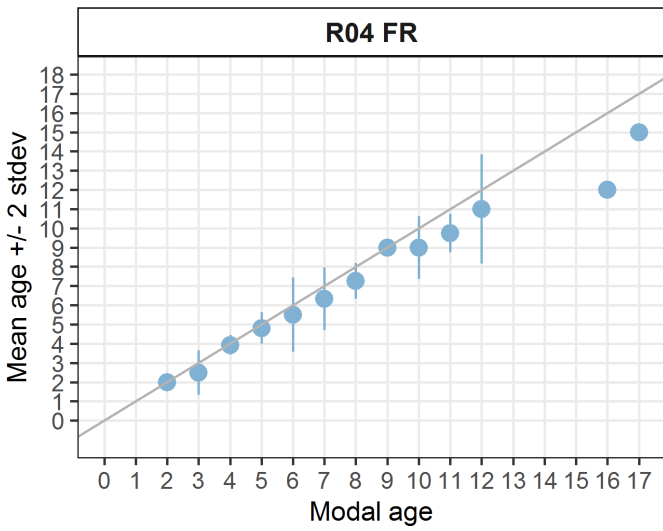
**Table 45:** Mean length at age per reader is calculated per reader and age (not modal age) and for all readers combined per age. A weighted mean is also given.

| Age                  | R02 GB       | R04 FR       | R06 GB       | R10 FR       | R12 FR       | R14 BE       | R16 BE       | R18 GB       |
|----------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 0                    | -            | -            | -            | 69 mm        | -            | -            | -            | -            |
| 2                    | 24 mm        | 28 mm        | -            | 24 mm        | 24 mm        | 24 mm        | 24 mm        | -            |
| 3                    | 30 mm        | 34 mm        | 24 mm        | 30 mm        | 29 mm        | 30 mm        | 29 mm        | 24 mm        |
| 4                    | 33 mm        | 34 mm        | 31 mm        | 33 mm        | 33 mm        | 33 mm        | 33 mm        | 31 mm        |
| 5                    | 38 mm        | 38 mm        | 34 mm        | 38 mm        | 38 mm        | 38 mm        | 38 mm        | 34 mm        |
| 6                    | 43 mm        | 43 mm        | 40 mm        | 43 mm        | 43 mm        | 43 mm        | 42 mm        | 40 mm        |
| 7                    | 48 mm        | 50 mm        | 46 mm        | 48 mm        | 48 mm        | 48 mm        | 48 mm        | 46 mm        |
| 8                    | 51 mm        | 51 mm        | 51 mm        | 51 mm        | 51 mm        | 51 mm        | 51 mm        | 51 mm        |
| 9                    | 65 mm        | 62 mm        | 65 mm        | 65 mm        | 65 mm        | 65 mm        | -            | 65 mm        |
| 10                   | 55 mm        | 57 mm        | 56 mm        | 55 mm        | 55 mm        | 55 mm        | 57 mm        | 57 mm        |
| 11                   | 59 mm        | -            | 64 mm        | 59 mm        | 60 mm        | 59 mm        | 59 mm        | 57 mm        |
| 12                   | 60 mm        | 66 mm        | 58 mm        | 60 mm        | 59 mm        | 60 mm        | 60 mm        | 67 mm        |
| 13                   | -            | -            | -            | -            | 69 mm        | -            | -            | -            |
| 14                   | -            | -            | -            | -            | -            | -            | -            | 61 mm        |
| 15                   | -            | 70 mm        | 61 mm        | -            | 61 mm        | -            | -            | 69 mm        |
| 16                   | 67 mm        | -            | -            | 66 mm        | 70 mm        | 69 mm        | 61 mm        | -            |
| 17                   | -            | -            | 70 mm        | -            | -            | 66 mm        | 70 mm        | 70 mm        |
| <b>Weighted Mean</b> | <b>41 mm</b> | <b>41 mm</b> | <b>41 mm</b> | <b>42 mm</b> | <b>41 mm</b> | <b>42 mm</b> | <b>42 mm</b> | <b>42 mm</b> |

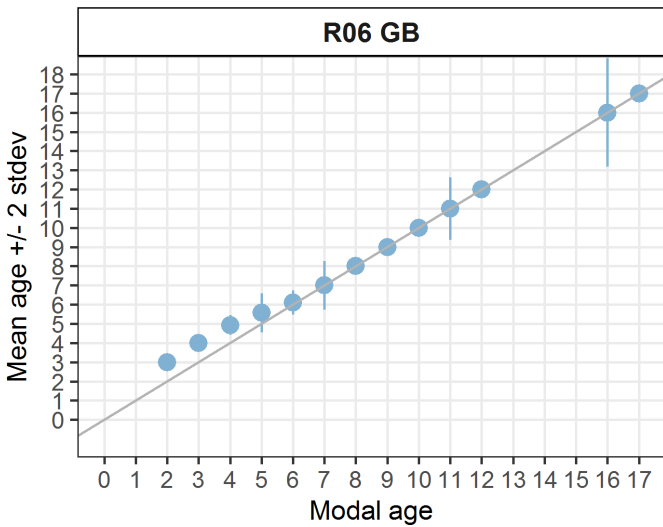


[[1]]

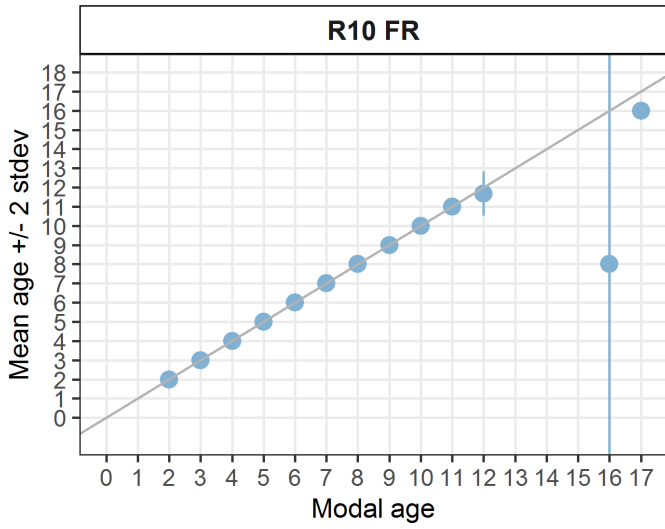
[[2]]



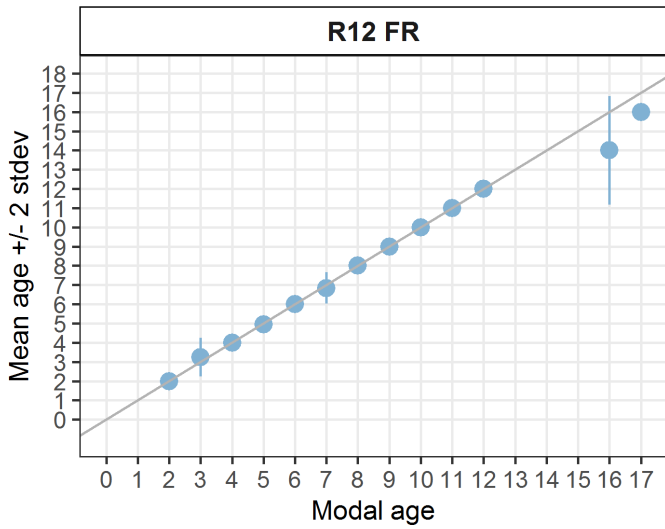
[[3]]



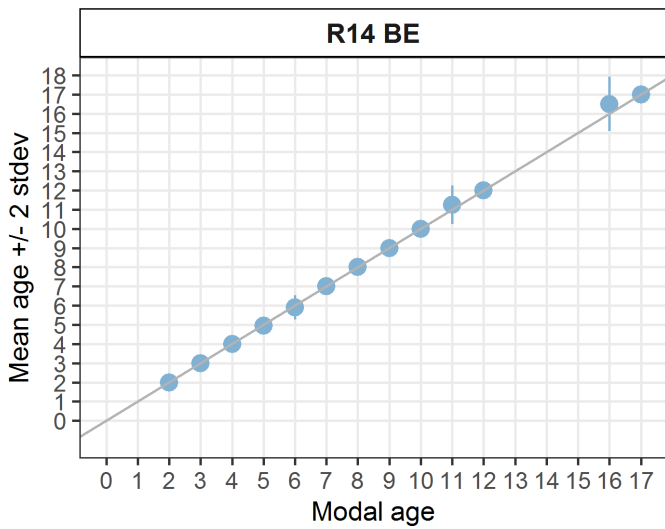
[[4]]



[[5]]

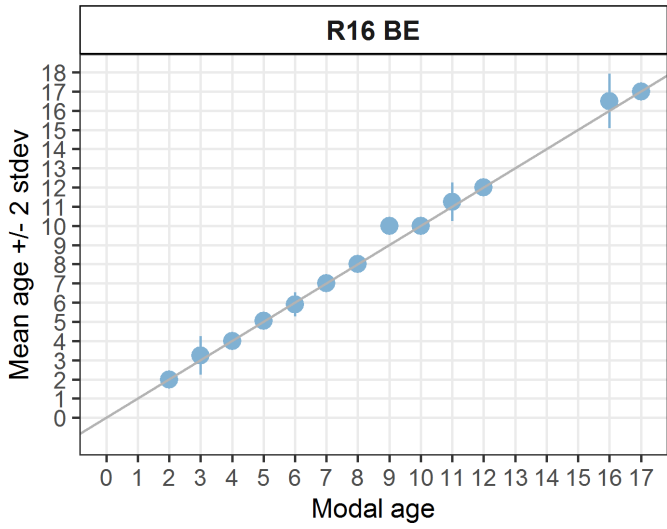


[[6]]

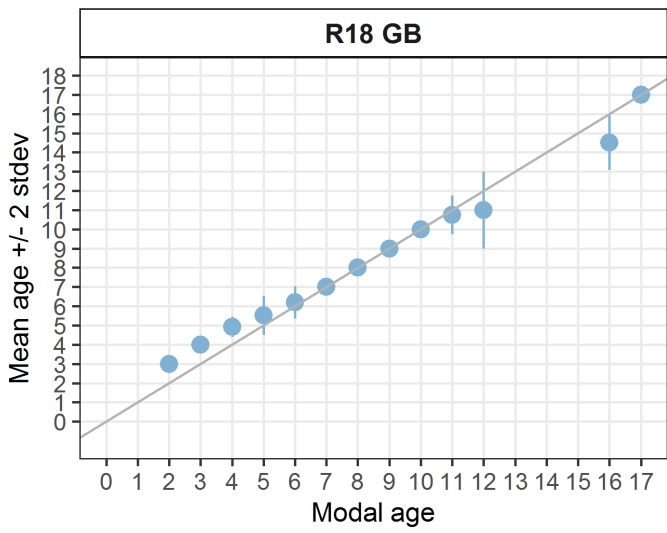


[[7]]





[[8]]



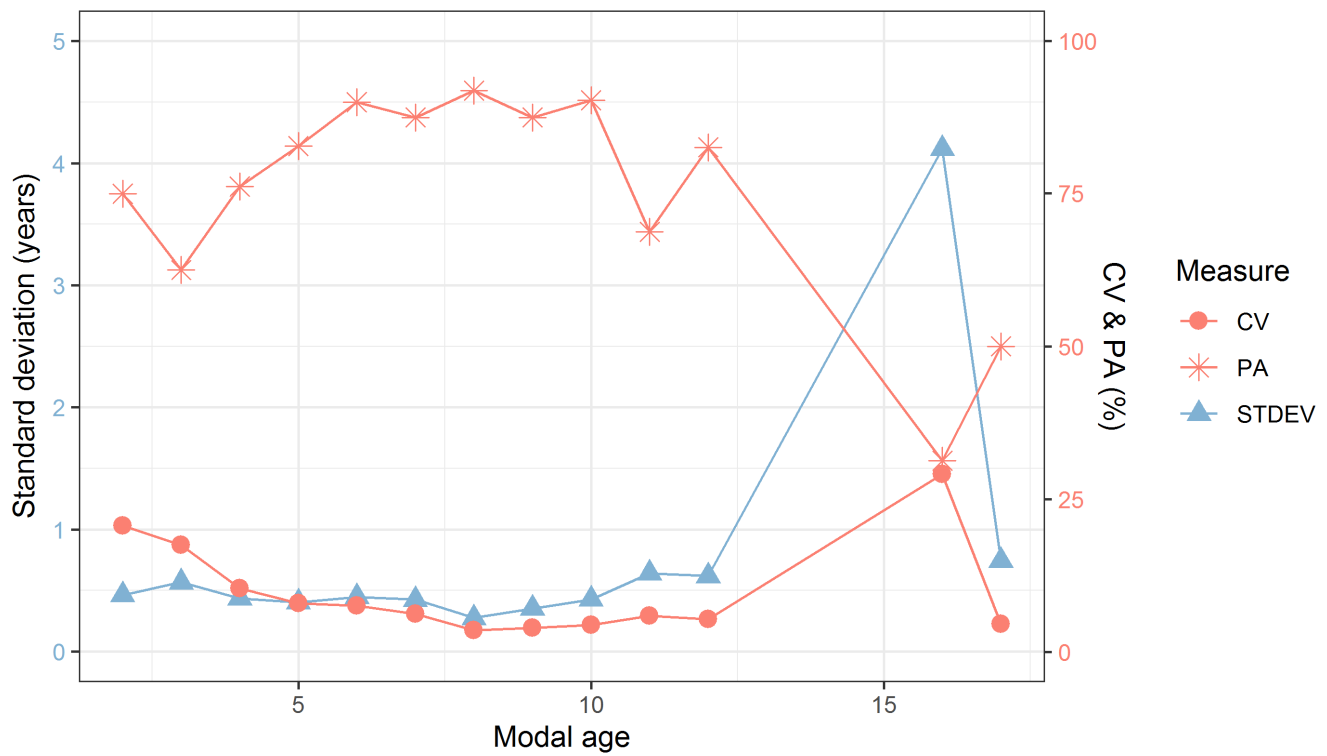


Figure 15: CV, PA and (STDEV (standard deviation) are plotted against modal age

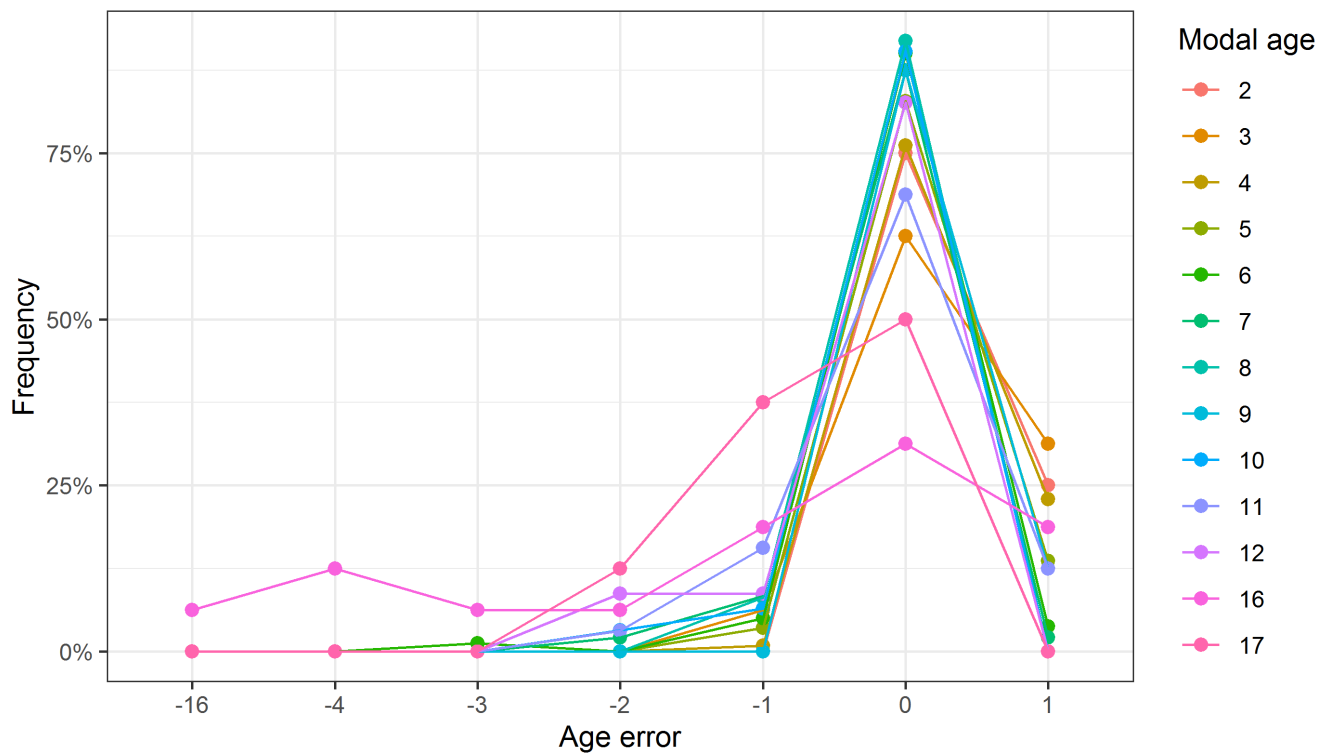
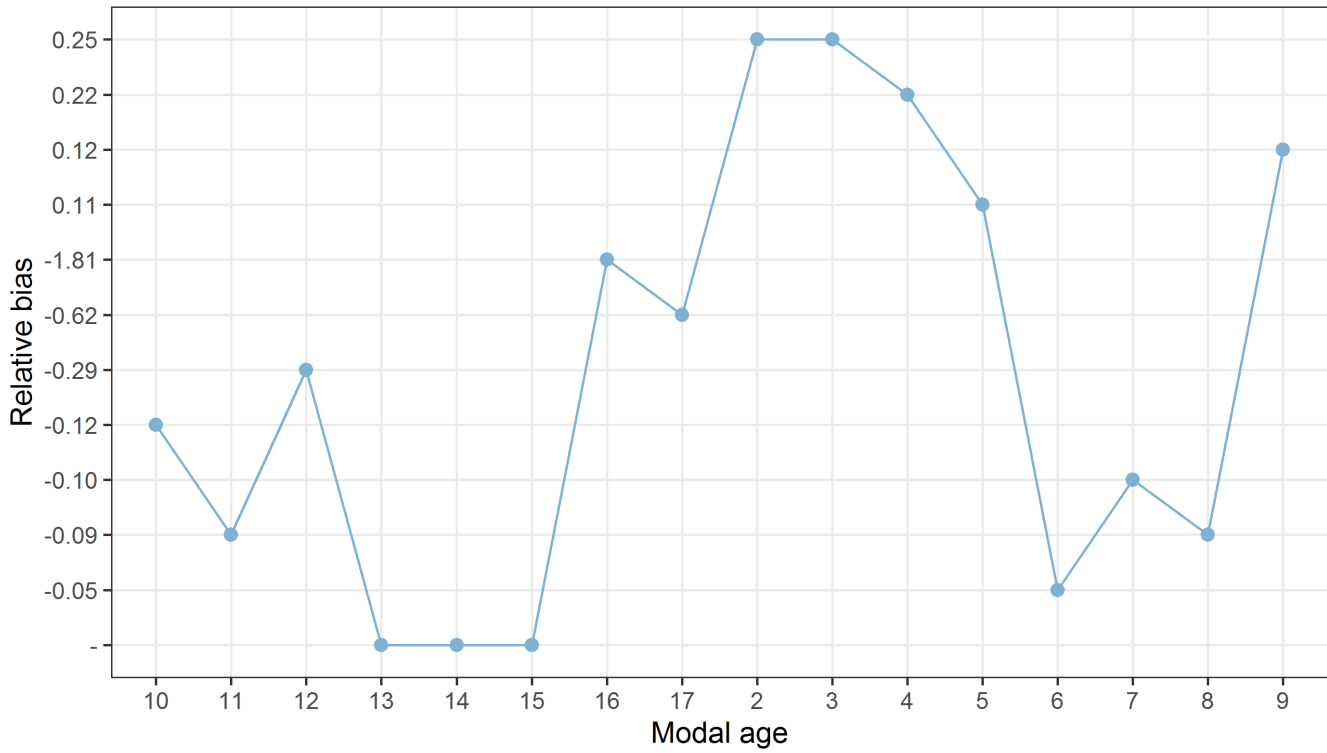
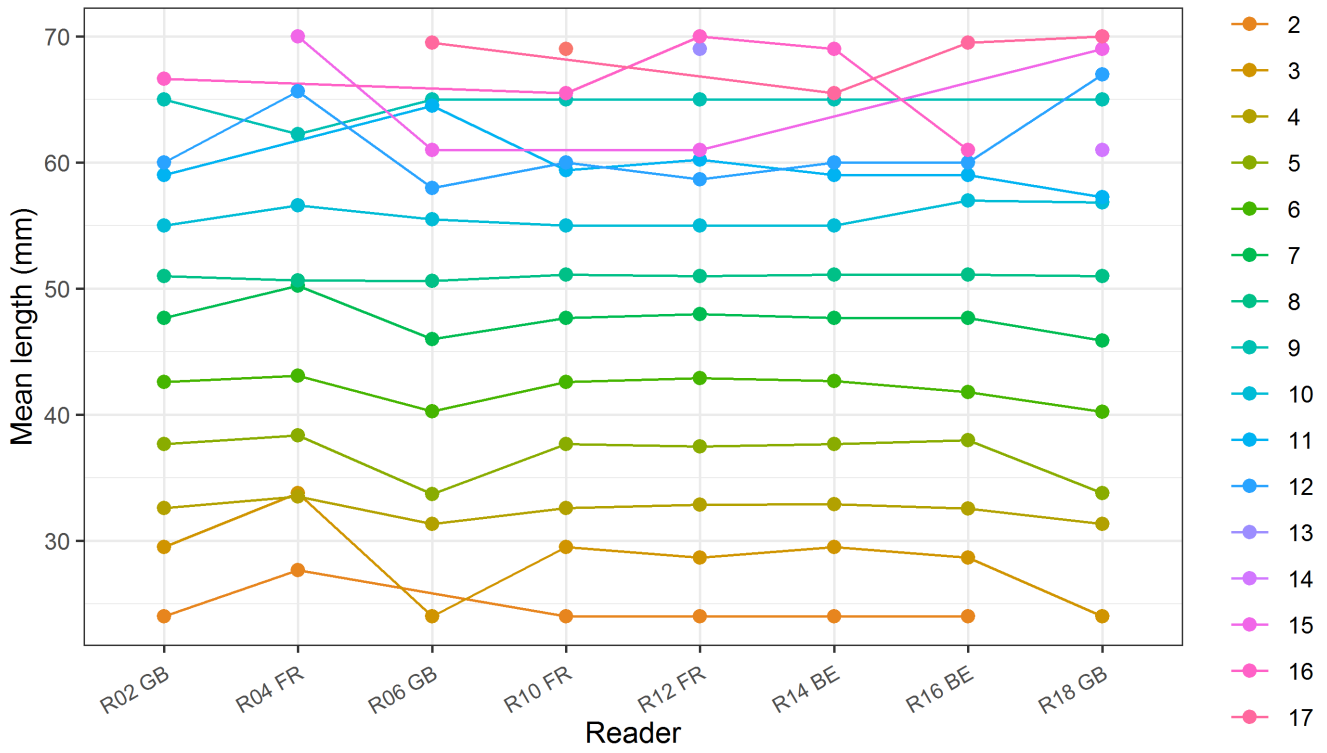


Figure 16: The distribution of the age reading errors in percentage by modal age as observed from the whole group of age readers in an age reading comparison to modal age. The achieved precision in age reading by MODAL age group is

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 17:** The relative bias by modal age as estimated by all age readers combined.



**Figure 18:** The mean length at age as estimated by each age reader.

# 8.2 Otoliths – Supplementary results for Advanced readers

## All samples included

### Data Overview for section stained otoliths

**Table 46:** Data overview including modal age and statistics per sample.

| Fish ID | Event ID | Image ID | length | sex | Catch date          | ICES area | R02 GB | R04 FR | R06 GB | Modal age | PA % | CV % | APE % |
|---------|----------|----------|--------|-----|---------------------|-----------|--------|--------|--------|-----------|------|------|-------|
| Bass01  | 271      | -        | 54     | -   | 06/02/2019 00:00:00 | 27.7.e    | 8      | 8      | 8      | 8         | 100  | 0    | 0     |
| Bass02  | 271      | -        | 49     | -   | 06/02/2019 00:00:00 | 27.7.e    | 6      | 5      | 6      | 6         | 67   | 10   | 8     |
| Bass03  | 271      | -        | 48     | -   | 06/02/2019 00:00:00 | 27.7.e    | 8      | 7      | 8      | 8         | 67   | 8    | 6     |
| Bass04  | 271      | -        | 49     | -   | 06/02/2019 00:00:00 | 27.7.e    | 7      | 7      | 6      | 7         | 67   | 9    | 7     |
| Bass05  | 271      | -        | 51     | -   | 06/02/2019 00:00:00 | 27.7.e    | 8      | 8      | 8      | 8         | 100  | 0    | 0     |
| Bass06  | 271      | -        | 64     | -   | 06/02/2019 00:00:00 | 27.7.e    | 12     | 10     | 11     | 10        | 33   | 9    | 6     |
| Bass07  | 271      | -        | 55     | -   | 06/02/2019 00:00:00 | 27.7.e    | 8      | 7      | 8      | 8         | 67   | 8    | 6     |
| Bass09  | 271      | -        | 58     | -   | 06/02/2019 00:00:00 | 27.7.e    | 8      | 7      | 8      | 8         | 67   | 8    | 6     |
| Bass10  | 271      | -        | 59     | -   | 06/02/2019 00:00:00 | 27.7.e    | 10     | 9      | 10     | 10        | 67   | 6    | 5     |
| Bass100 | 271      | -        | 39     | -   | 23/09/2018 00:00:00 | 27.7.a    | 5      | 5      | 6      | 5         | 67   | 11   | 8     |
| Bass11  | 271      | -        | 42     | -   | 18/02/2019 00:00:00 | 27.7.f    | 6      | 3      | 6      | 6         | 67   | 35   | 27    |
| Bass12  | 271      | -        | 61     | -   | 06/02/2019 00:00:00 | 27.7.e    | 16     | 12     | 15     | 12        | 33   | 15   | 11    |
| Bass13  | 271      | -        | 60     | -   | 06/02/2019 00:00:00 | 27.7.e    | 10     | 9      | 10     | 10        | 67   | 6    | 5     |
| Bass14  | 271      | -        | 56     | -   | 06/02/2019 00:00:00 | 27.7.e    | 11     | 10     | 10     | 10        | 67   | 6    | 4     |
| Bass15  | 271      | -        | 45     | -   | 07/02/2019 00:00:00 | 27.7.e    | 8      | 7      | 8      | 8         | 67   | 8    | 6     |
| Bass16  | 271      | -        | 35     | -   | 07/02/2019 00:00:00 | 27.7.e    | 5      | 4      | 5      | 5         | 67   | 12   | 10    |
| Bass17  | 271      | -        | 33     | -   | 07/02/2019 00:00:00 | 27.7.e    | 6      | 6      | 6      | 6         | 100  | 0    | 0     |
| Bass18  | 271      | -        | 39     | -   | 07/02/2019 00:00:00 | 27.7.e    | 5      | 5      | -      | 5         | 100  | 0    | 0     |
| Bass19  | 271      | -        | 37     | -   | 07/02/2019 00:00:00 | 27.7.e    | 4      | 4      | 4      | 4         | 100  | 0    | 0     |
| Bass20  | 271      | -        | 47     | -   | 21/02/2019 00:00:00 | 27.7.e    | 7      | 6      | 8      | 6         | 33   | 14   | 10    |
| Bass21  | 271      | -        | 37     | -   | 21/02/2019 00:00:00 | 27.7.e    | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass22  | 271      | -        | 39     | -   | 22/02/2019 00:00:00 | 27.7.e    | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass23  | 271      | -        | 65     | -   | 06/02/2019 00:00:00 | 27.7.e    | 9      | 9      | 9      | 9         | 100  | 0    | 0     |
| Bass24  | 271      | -        | 70     | -   | 06/02/2019 00:00:00 | 27.7.e    | 16     | 15     | 17     | 15        | 33   | 6    | 4     |
| Bass25  | 271      | -        | 67     | -   | 06/02/2019 00:00:00 | 27.7.e    | 12     | 12     | 12     | 12        | 100  | 0    | 0     |
| Bass26  | 271      | -        | 34     | -   | 07/02/2019 00:00:00 | 27.7.e    | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass27  | 271      | -        | 35     | -   | 07/02/2019 00:00:00 | 27.7.e    | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass28  | 271      | -        | 33     | -   | 07/02/2019 00:00:00 | 27.7.e    | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass29  | 271      | -        | 56     | -   | 18/02/2019 00:00:00 | 27.7.g    | 12     | -      | 12     | 12        | 100  | 0    | 0     |
| Bass30  | 271      | -        | 45     | -   | 19/03/2019 00:00:00 | 27.7.e    | 8      | 7      | 8      | 8         | 67   | 8    | 6     |
| Bass31  | 271      | -        | 46     | -   | 19/03/2019 00:00:00 | 27.7.e    | 7      | 6      | 7      | 7         | 67   | 9    | 7     |
| Bass32  | 271      | -        | 42     | -   | 20/03/2019 00:00:00 | 27.7.e    | 6      | 6      | 6      | 6         | 100  | 0    | 0     |
| Bass33  | 271      | -        | 49     | -   | 21/03/2019 00:00:00 | 27.7.e    | 8      | -      | 8      | 8         | 100  | 0    | 0     |
| Bass34  | 271      | -        | 54     | -   | 21/03/2019 00:00:00 | 27.7.e    | 10     | 10     | -      | 10        | 100  | 0    | 0     |
| Bass35  | 271      | -        | 33     | -   | 21/03/2019 00:00:00 | 27.7.e    | 4      | 4      | 4      | 4         | 100  | 0    | 0     |
| Bass36  | 271      | -        | 43     | -   | 22/03/2019 00:00:00 | 27.7.e    | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass37  | 271      | -        | 41     | -   | 23/03/2019 00:00:00 | 27.7.e    | 6      | 6      | 6      | 6         | 100  | 0    | 0     |
| Bass38  | 271      | -        | 42     | -   | 23/03/2019 00:00:00 | 27.7.e    | 6      | 6      | 6      | 6         | 100  | 0    | 0     |
| Bass39  | 271      | -        | 46     | -   | 23/03/2019 00:00:00 | 27.7.e    | 7      | 5      | 7      | 7         | 67   | 18   | 14    |
| Bass40  | 271      | -        | 47     | -   | 23/03/2019 00:00:00 | 27.7.e    | 10     | 8      | 10     | 10        | 67   | 12   | 10    |
| Bass41  | 271      | -        | 41     | -   | 23/03/2019 00:00:00 | 27.7.e    | 6      | 6      | 6      | 6         | 100  | 0    | 0     |
| Bass42  | 271      | -        | 36     | -   | 23/03/2019 00:00:00 | 27.7.e    | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass43  | 271      | -        | 38     | -   | 23/03/2019 00:00:00 | 27.7.e    | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass44  | 271      | -        | 47     | -   | 23/03/2019 00:00:00 | 27.7.e    | 6      | 6      | 6      | 6         | 100  | 0    | 0     |
| Bass45  | 271      | -        | 51     | -   | 23/03/2019 00:00:00 | 27.7.e    | 7      | 7      | 7      | 7         | 100  | 0    | 0     |
| Bass46  | 271      | -        | 65     | -   | 23/03/2019 00:00:00 | 27.7.e    | 11     | 9      | 11     | 11        | 67   | 11   | 9     |

|        |     |   |    |   |                     |        |    |    |    |    |     |    |    |
|--------|-----|---|----|---|---------------------|--------|----|----|----|----|-----|----|----|
| Bass47 | 271 | - | 53 | - | 23/03/2019 00:00:00 | 27.7.e | 12 | 10 | 12 | 12 | 67  | 10 | 8  |
| Bass48 | 271 | - | 47 | - | 23/03/2019 00:00:00 | 27.7.e | 7  | 7  | 7  | 7  | 100 | 0  | 0  |
| Bass49 | 271 | - | 54 | - | 27/03/2019 00:00:00 | 27.7.e | 8  | 7  | 8  | 8  | 67  | 8  | 6  |
| Bass50 | 271 | - | 49 | - | 27/03/2019 00:00:00 | 27.7.e | 6  | 6  | 6  | 6  | 100 | 0  | 0  |
| Bass51 | 271 | - | 42 | - | 18/07/2019 00:00:00 | 27.7.d | 5  | 4  | 5  | 5  | 67  | 12 | 10 |
| Bass52 | 271 | - | 44 | - | 18/07/2019 00:00:00 | 27.7.d | 5  | 4  | 6  | 4  | 33  | 20 | 13 |
| Bass53 | 271 | - | 39 | - | 18/07/2019 00:00:00 | 27.7.d | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass54 | 271 | - | 30 | - | 22/07/2019 00:00:00 | 27.7.d | 3  | 2  | 4  | 2  | 33  | 33 | 22 |
| Bass55 | 271 | - | 35 | - | 22/07/2019 00:00:00 | 27.7.d | 5  | 4  | 6  | 4  | 33  | 20 | 13 |
| Bass56 | 271 | - | 29 | - | 22/07/2019 00:00:00 | 27.7.d | 3  | 2  | 4  | 2  | 33  | 33 | 22 |
| Bass57 | 271 | - | 32 | - | 22/07/2019 00:00:00 | 27.7.d | 4  | 3  | 5  | 3  | 33  | 25 | 17 |
| Bass58 | 271 | - | 32 | - | 22/07/2019 00:00:00 | 27.7.d | 3  | 3  | 4  | 3  | 67  | 17 | 13 |
| Bass59 | 271 | - | 39 | - | 10/09/2019 00:00:00 | 27.7.f | 5  | 4  | 6  | 4  | 33  | 20 | 13 |
| Bass60 | 271 | - | 35 | - | 10/09/2019 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass61 | 271 | - | 37 | - | 11/09/2019 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass62 | 271 | - | 34 | - | 11/09/2019 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass63 | 271 | - | 36 | - | 13/09/2019 00:00:00 | 27.7.f | 4  | 3  | 5  | 3  | 33  | 25 | 17 |
| Bass64 | 271 | - | 40 | - | 13/09/2019 00:00:00 | 27.7.f | 6  | 5  | 7  | 5  | 33  | 17 | 11 |
| Bass65 | 271 | - | 69 | - | 13/09/2019 00:00:00 | 27.7.f | 16 | 12 | 17 | 12 | 33  | 18 | 13 |
| Bass66 | 271 | - | 29 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass67 | 271 | - | 30 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass68 | 271 | - | 31 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass69 | 271 | - | 31 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass70 | 271 | - | 32 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass71 | 271 | - | 32 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass72 | 271 | - | 27 | - | 16/09/2018 00:00:00 | 27.7.f | 3  | 3  | 4  | 3  | 67  | 17 | 13 |
| Bass73 | 271 | - | 34 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass74 | 271 | - | 31 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass75 | 271 | - | 31 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass76 | 271 | - | 31 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass77 | 271 | - | 30 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass78 | 271 | - | 29 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass79 | 271 | - | 30 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass80 | 271 | - | 24 | - | 16/09/2018 00:00:00 | 27.7.f | 2  | 2  | 3  | 2  | 67  | 25 | 19 |
| Bass81 | 271 | - | 56 | - | 16/09/2018 00:00:00 | 27.7.f | 11 | 10 | 12 | 10 | 33  | 9  | 6  |
| Bass82 | 271 | - | 35 | - | 16/09/2018 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass83 | 271 | - | 30 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass84 | 271 | - | 32 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass85 | 271 | - | 33 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass86 | 271 | - | 32 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass87 | 271 | - | 34 | - | 17/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass88 | 271 | - | 37 | - | 17/09/2018 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass89 | 271 | - | 33 | - | 17/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass90 | 271 | - | 36 | - | 17/09/2018 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass91 | 271 | - | 33 | - | 17/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass92 | 271 | - | 35 | - | 17/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass93 | 271 | - | 37 | - | 17/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass94 | 271 | - | 32 | - | 20/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass95 | 271 | - | 40 | - | 20/09/2018 00:00:00 | 27.7.f | 5  | 5  | -  | 5  | 100 | 0  | 0  |
| Bass96 | 271 | - | 45 | - | 20/09/2018 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass97 | 271 | - | 36 | - | 20/09/2018 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass98 | 271 | - | 36 | - | 23/09/2018 00:00:00 | 27.7.a | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass99 | 271 | - | 39 | - | 23/09/2018 00:00:00 | 27.7.a | 4  | 4  | 5  | 4  | 67  | 13 | 10 |

**Table 47:** 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 GB | R04 FR | R06 GB | total |
|-----------|--------|--------|--------|-------|
| 2         | 3      | 3      | 3      | 9     |
| 3         | 4      | 4      | 4      | 12    |

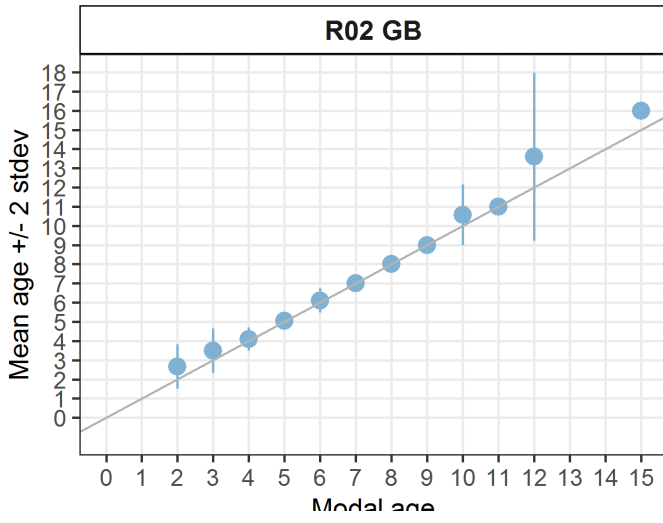
|              |           |           |           |            |
|--------------|-----------|-----------|-----------|------------|
| 4            | 30        | 30        | 30        | 90         |
| 5            | 23        | 23        | 21        | 67         |
| 6            | 10        | 10        | 10        | 30         |
| 7            | 5         | 5         | 5         | 15         |
| 8            | 9         | 8         | 9         | 26         |
| 9            | 1         | 1         | 1         | 3          |
| 10           | 7         | 7         | 6         | 20         |
| 11           | 1         | 1         | 1         | 3          |
| 12           | 5         | 4         | 5         | 14         |
| 13           | 0         | 0         | 0         | 0          |
| 14           | 0         | 0         | 0         | 0          |
| 15           | 1         | 1         | 1         | 3          |
| <b>Total</b> | <b>99</b> | <b>97</b> | <b>96</b> | <b>292</b> |

**Table 48:** Age composition by reader gives a summary of number of readings per reader.

| Modal age    | R02 GB    | R04 FR    | R06 GB    |
|--------------|-----------|-----------|-----------|
| 2            | 1         | 3         | 0         |
| 3            | 4         | 5         | 1         |
| 4            | 29        | 32        | 6         |
| 5            | 25        | 23        | 37        |
| 6            | 10        | 9         | 23        |
| 7            | 6         | 9         | 5         |
| 8            | 9         | 3         | 10        |
| 9            | 1         | 4         | 1         |
| 10           | 4         | 5         | 4         |
| 11           | 3         | 0         | 2         |
| 12           | 4         | 3         | 4         |
| 15           | 0         | 1         | 1         |
| 16           | 3         | 0         | 0         |
| 17           | 0         | 0         | 2         |
| <b>Total</b> | <b>99</b> | <b>97</b> | <b>96</b> |

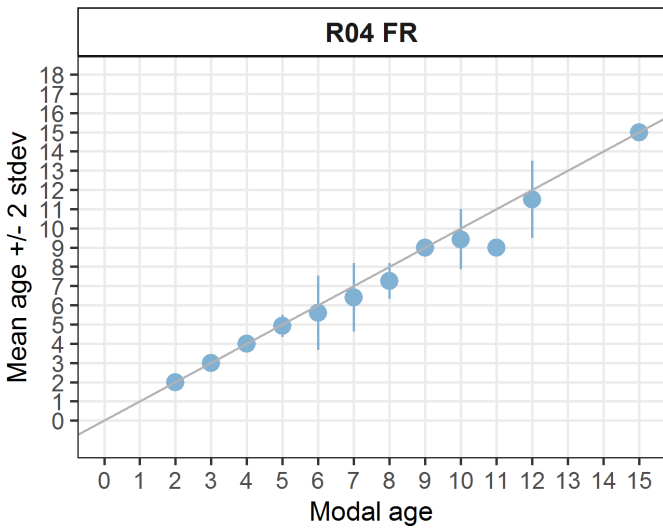
**Table 49:** Mean length at age per reader is calculated per reader and age (not modal age) and for all readers combined per age. A weighted mean is also given.

| Age                  | R02 GB       | R04 FR       | R06 GB       |
|----------------------|--------------|--------------|--------------|
| 2                    | 24 mm        | 28 mm        | -            |
| 3                    | 30 mm        | 34 mm        | 24 mm        |
| 4                    | 33 mm        | 34 mm        | 31 mm        |
| 5                    | 38 mm        | 38 mm        | 34 mm        |
| 6                    | 43 mm        | 43 mm        | 40 mm        |
| 7                    | 48 mm        | 50 mm        | 46 mm        |
| 8                    | 51 mm        | 51 mm        | 51 mm        |
| 9                    | 65 mm        | 62 mm        | 65 mm        |
| 10                   | 55 mm        | 57 mm        | 56 mm        |
| 11                   | 59 mm        | -            | 64 mm        |
| 12                   | 60 mm        | 66 mm        | 58 mm        |
| 15                   | -            | 70 mm        | 61 mm        |
| 16                   | 67 mm        | -            | -            |
| 17                   | -            | -            | 70 mm        |
| <b>Weighted Mean</b> | <b>41 mm</b> | <b>41 mm</b> | <b>41 mm</b> |

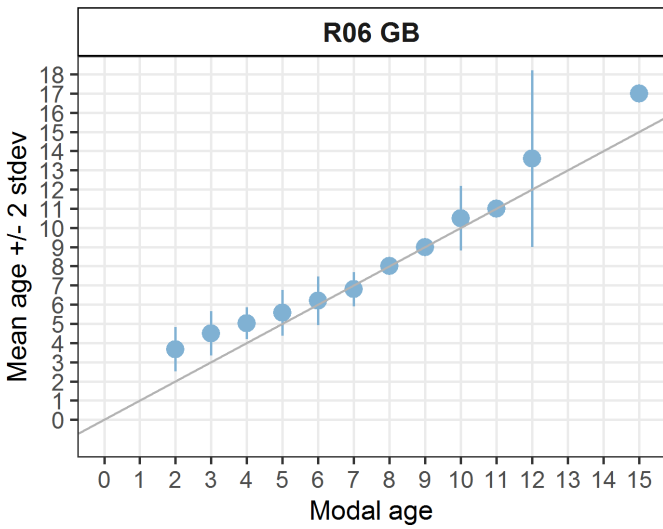


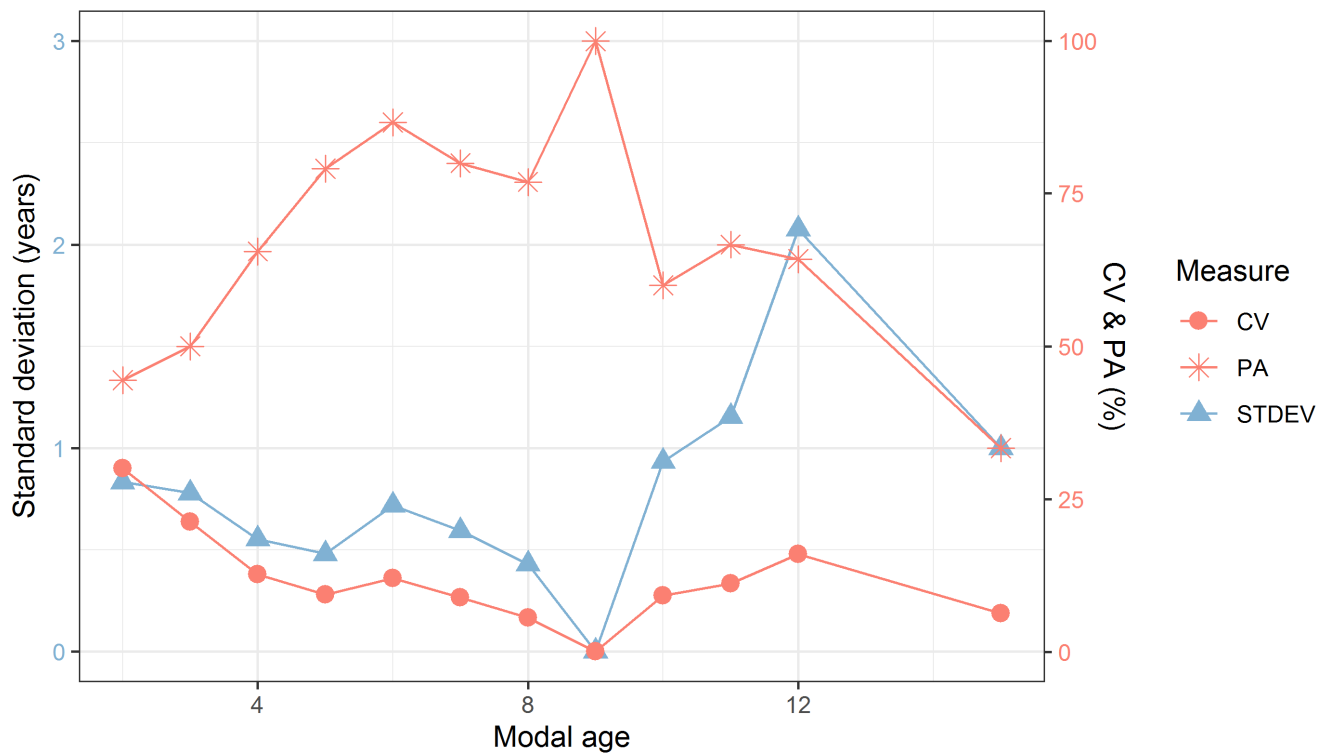
[[1]]

[[2]]

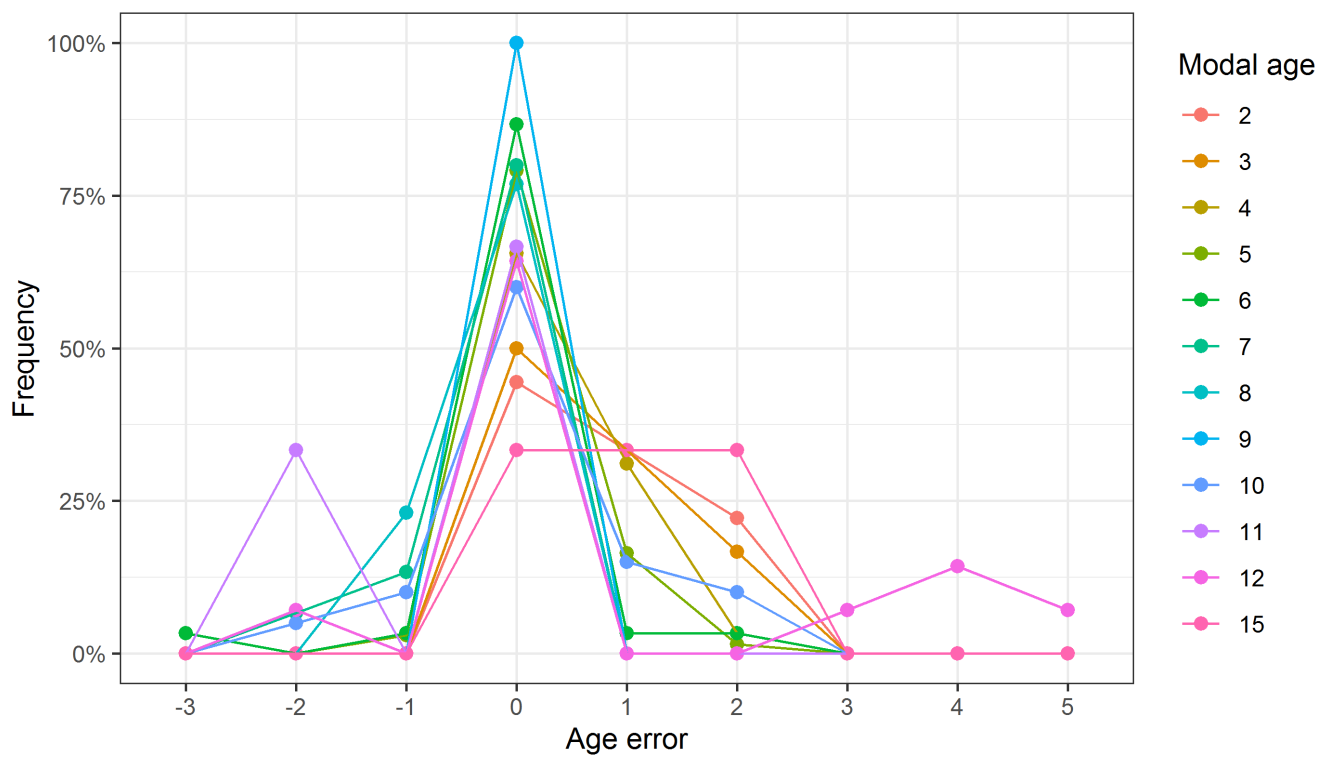


[[3]]





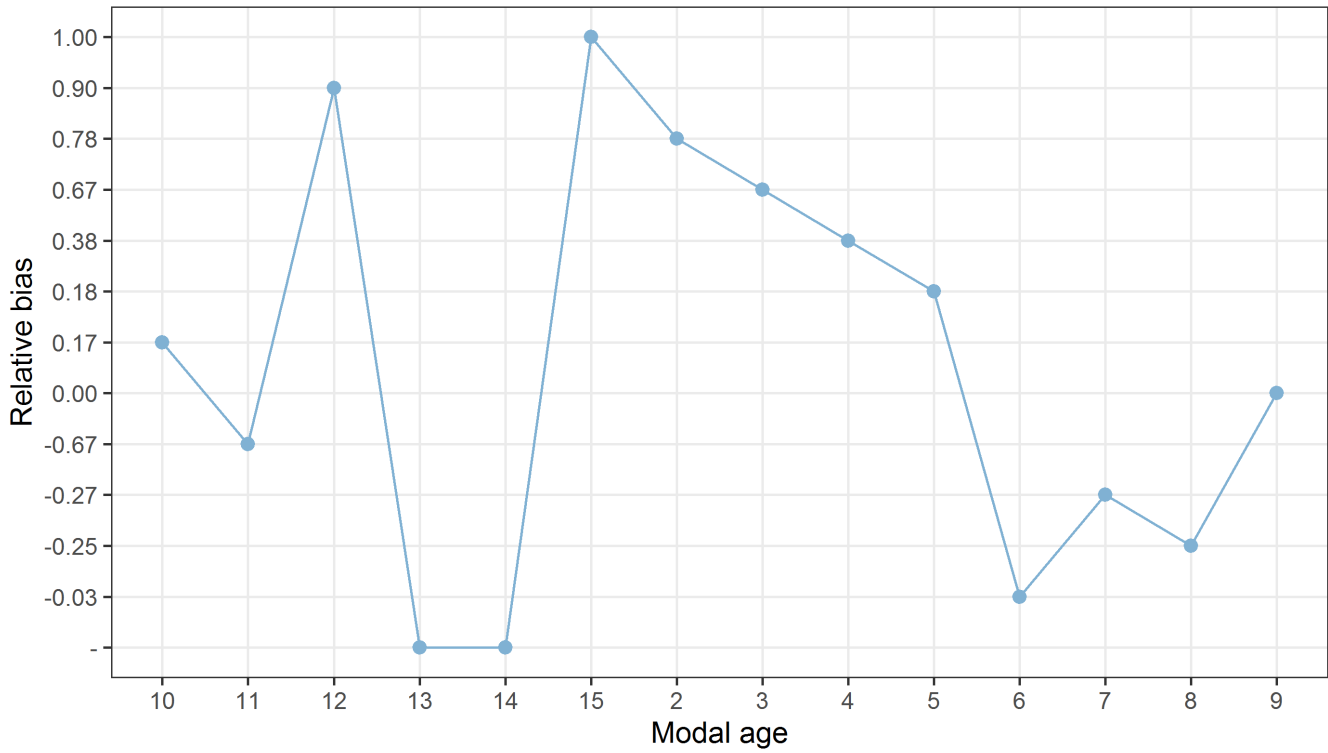
**Figure 19:** CV, PA and (STDEV (standard deviation) are plotted against modal age



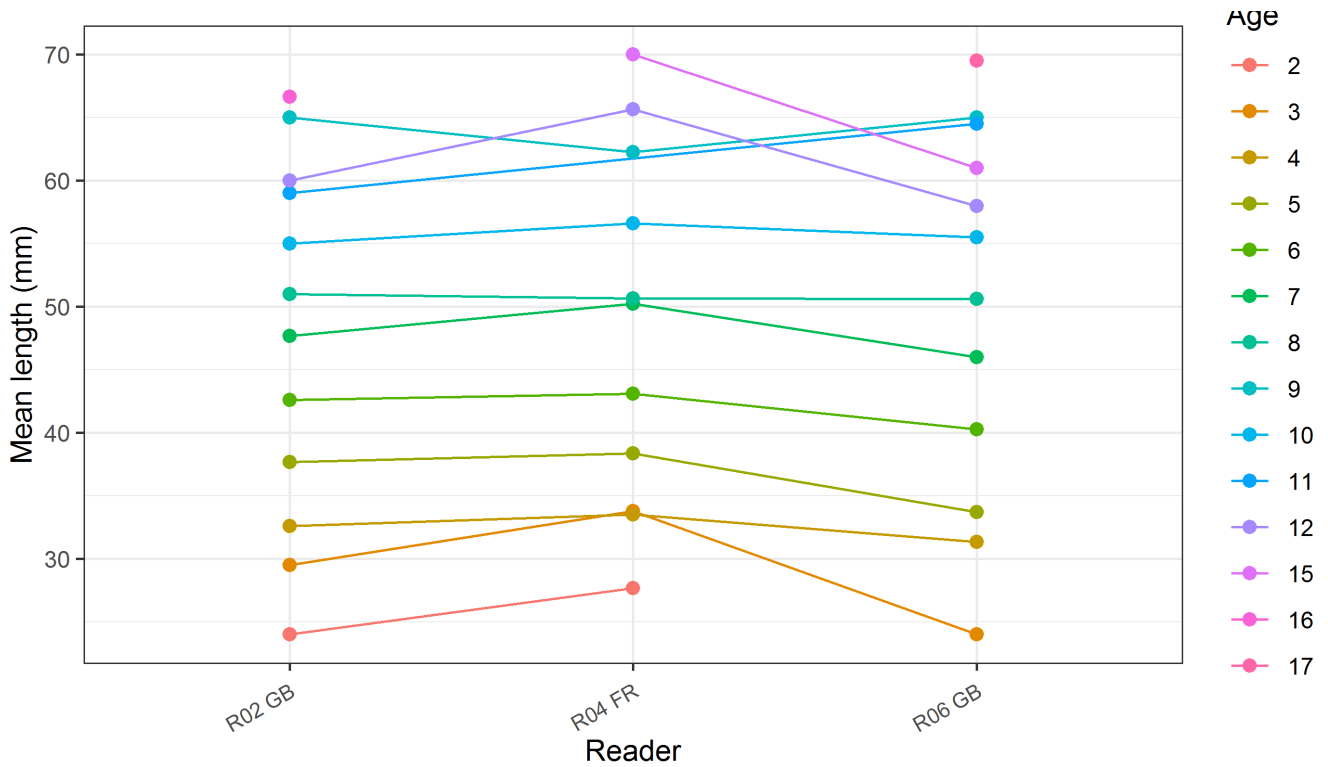
**Figure 20:** The distribution of the age reading errors in percentage by modal age as observed from the whole group of age readers in an age reading comparison to modal age. The achieved precision in age reading by MODAL age group is



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 21:** The relative bias by modal age as estimated by all age readers combined.



**Figure 22:** The mean length at age as estimated by each age reader.

# 8.3 Scales – Supplementary results for all readers

## SCALES

### Data Overview for scales

**Table 50:** Summary of statistics; PA (%), CV (%) and APE (%).

| CV   | PA   | APE |
|------|------|-----|
| 11 % | 68 % | 8 % |

**Table 51:** Data overview including modal age and statistics per sample.

| Fish ID | Event ID | Image ID | length | sex | Catch date             | ICES area | R02 GB | R04 FR | R06 GB | R10 FR | R12 FR | R14 BE | R16 BE | R18 GB | Modal age | PA % | CV % | APE % |
|---------|----------|----------|--------|-----|------------------------|-----------|--------|--------|--------|--------|--------|--------|--------|--------|-----------|------|------|-------|
| Bass01  | 271      | -        | 54     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 8      | 9      | 8      | 16     | 8      | 7      | 8      | 8      | 8         | 62   | 32   | 19    |
| Bass02  | 271      | -        | 49     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 6      | 8      | 6      | 6      | 7      | 6      | 6      | 6      | 6         | 75   | 12   | 9     |
| Bass03  | 271      | -        | 48     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 8      | 8      | 8      | 8      | -      | 7      | 8      | 8      | 8         | 86   | 5    | 3     |
| Bass04  | 271      | -        | 49     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 7      | 7      | 6      | 7      | 6      | 6      | 7      | 7      | 7         | 62   | 8    | 7     |
| Bass05  | 271      | -        | 51     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 8      | 8      | 8      | 8      | 9      | 7      | 8      | 8      | 8         | 75   | 7    | 3     |
| Bass06  | 271      | -        | 64     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 12     | 12     | 11     | 13     | 12     | 11     | 12     | 11     | 12        | 50   | 6    | 5     |
| Bass07  | 271      | -        | 55     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 8      | 9      | 8      | 8      | 7      | 7      | 8      | 8      | 8         | 62   | 8    | 6     |
| Bass08  | 271      | -        | 52     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 8      | 7      | 8      | 8      | 7      | 7      | 8      | 7      | 7         | 50   | 7    | 7     |
| Bass09  | 271      | -        | 58     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 8      | 8      | 8      | 8      | 8      | 8      | 8      | 8      | 8         | 100  | 0    | 0     |
| Bass10  | 271      | -        | 59     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 10     | 10     | 10     | 10     | 9      | 9      | 10     | 9      | 10        | 62   | 5    | 5     |
| Bass100 | 271      | -        | 39     | -   | 23/09/2018<br>00:00:00 | 27.7.a    | 5      | 5      | 6      | 5      | 5      | 5      | 5      | 5      | 5         | 88   | 7    | 4     |
| Bass11  | 271      | -        | 42     | -   | 18/02/2019<br>00:00:00 | 27.7.f    | 6      | 6      | 6      | 6      | 6      | 5      | 5      | 6      | 6         | 75   | 8    | 7     |
| Bass12  | 271      | -        | 61     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 16     | 14     | 16     | 10     | -      | 14     | 16     | 13     | 16        | 43   | 16   | 11    |
| Bass13  | 271      | -        | 60     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 10     | 10     | 10     | 10     | 10     | 10     | 10     | 10     | 10        | 100  | 0    | 0     |
| Bass14  | 271      | -        | 56     | -   | 06/02/2019<br>00:00:00 | 27.7.e    | 11     | 9      | 10     | 9      | 10     | 10     | 11     | 10     | 10        | 50   | 8    | 5     |
| Bass15  | 271      | -        | 45     | -   | 07/02/2019<br>00:00:00 | 27.7.e    | 8      | 8      | 7      | 8      | 7      | 7      | 8      | 7      | 7         | 50   | 7    | 7     |
| Bass16  | 271      | -        | 35     | -   | 07/02/2019<br>00:00:00 | 27.7.e    | 5      | 5      | 5      | 5      | 5      | 4      | 5      | 5      | 5         | 88   | 7    | 4     |
| Bass17  | 271      | -        | 33     | -   | 07/02/2019<br>00:00:00 | 27.7.e    | 6      | 6      | 6      | 6      | 6      | 5      | 6      | 6      | 6         | 88   | 6    | 4     |
| Bass18  | 271      | -        | 39     | -   | 07/02/2019<br>00:00:00 | 27.7.e    | 5      | 5      | 5      | 5      | 5      | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass19  | 271      | -        | 37     | -   | 07/02/2019<br>00:00:00 | 27.7.e    | 4      | 5      | 4      | 4      | 5      | 4      | 4      | 4      | 4         | 75   | 11   | 9     |

|        |     |   |    |   |                        |        |    |    |    |    |    |    |    |    |    |     |    |    |
|--------|-----|---|----|---|------------------------|--------|----|----|----|----|----|----|----|----|----|-----|----|----|
| Bass20 | 271 | - | 47 | - | 21/02/2019<br>00:00:00 | 27.7.e | 7  | 6  | 6  | 7  | 6  | 6  | 7  | 7  | 6  | 50  | 8  | 8  |
| Bass21 | 271 | - | 37 | - | 21/02/2019<br>00:00:00 | 27.7.e | 5  | 5  | 5  | 6  | 5  | 5  | 5  | 5  | 5  | 88  | 7  | 4  |
| Bass22 | 271 | - | 39 | - | 22/02/2019<br>00:00:00 | 27.7.e | 5  | 5  | 5  | 5  | 5  | 5  | 5  | 4  | 5  | 88  | 7  | 4  |
| Bass23 | 271 | - | 65 | - | 06/02/2019<br>00:00:00 | 27.7.e | 9  | 9  | 9  | 9  | 9  | 8  | 10 | 9  | 9  | 75  | 6  | 3  |
| Bass24 | 271 | - | 70 | - | 06/02/2019<br>00:00:00 | 27.7.e | 16 | 14 | 15 | 12 | 14 | 12 | 17 | 16 | 12 | 25  | 13 | 10 |
| Bass25 | 271 | - | 67 | - | 06/02/2019<br>00:00:00 | 27.7.e | 12 | 11 | 12 | 11 | 11 | 10 | 12 | 10 | 11 | 38  | 8  | 6  |
| Bass26 | 271 | - | 34 | - | 07/02/2019<br>00:00:00 | 27.7.e | 5  | 6  | 6  | 5  | 6  | 5  | 5  | 5  | 5  | 62  | 10 | 9  |
| Bass27 | 271 | - | 35 | - | 07/02/2019<br>00:00:00 | 27.7.e | 5  | 6  | 5  | 4  | 6  | 5  | 5  | 5  | 5  | 62  | 13 | 9  |
| Bass28 | 271 | - | 33 | - | 07/02/2019<br>00:00:00 | 27.7.e | 5  | 5  | 4  | 5  | 5  | 4  | 5  | 5  | 5  | 75  | 10 | 8  |
| Bass29 | 271 | - | 56 | - | 18/02/2019<br>00:00:00 | 27.7.g | 12 | 10 | 12 | 11 | 11 | 11 | 12 | 10 | 11 | 38  | 8  | 6  |
| Bass30 | 271 | - | 45 | - | 19/03/2019<br>00:00:00 | 27.7.e | 8  | 7  | 8  | 7  | 7  | 6  | 8  | 7  | 7  | 50  | 10 | 8  |
| Bass31 | 271 | - | 46 | - | 19/03/2019<br>00:00:00 | 27.7.e | 7  | 7  | 7  | 7  | 6  | 6  | 7  | 7  | 7  | 75  | 7  | 6  |
| Bass32 | 271 | - | 42 | - | 20/03/2019<br>00:00:00 | 27.7.e | 6  | 6  | 7  | 6  | 6  | 6  | 6  | 6  | 6  | 88  | 6  | 4  |
| Bass33 | 271 | - | 49 | - | 21/03/2019<br>00:00:00 | 27.7.e | 8  | 8  | 8  | 7  | 8  | 7  | 8  | 7  | 8  | 62  | 7  | 6  |
| Bass34 | 271 | - | 54 | - | 21/03/2019<br>00:00:00 | 27.7.e | 10 | 9  | 9  | 10 | 10 | 8  | 10 | 10 | 10 | 62  | 8  | 7  |
| Bass35 | 271 | - | 33 | - | 21/03/2019<br>00:00:00 | 27.7.e | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 4  | 100 | 0  | 0  |
| Bass36 | 271 | - | 43 | - | 22/03/2019<br>00:00:00 | 27.7.e | 5  | 6  | 6  | 6  | 6  | 4  | 5  | 6  | 6  | 62  | 14 | 11 |
| Bass37 | 271 | - | 41 | - | 23/03/2019<br>00:00:00 | 27.7.e | 6  | 6  | 6  | 6  | 6  | 5  | 5  | 6  | 6  | 75  | 8  | 7  |
| Bass38 | 271 | - | 42 | - | 23/03/2019<br>00:00:00 | 27.7.e | 6  | 6  | 6  | 6  | 6  | 5  | 6  | 6  | 6  | 88  | 6  | 4  |
| Bass39 | 271 | - | 46 | - | 23/03/2019<br>00:00:00 | 27.7.e | 7  | 7  | 7  | 6  | 7  | 7  | 7  | -  | 7  | 86  | 6  | 4  |
| Bass40 | 271 | - | 47 | - | 23/03/2019<br>00:00:00 | 27.7.e | 10 | 9  | 9  | 9  | 9  | 9  | 10 | 9  | 9  | 75  | 5  | 4  |
| Bass41 | 271 | - | 41 | - | 23/03/2019<br>00:00:00 | 27.7.e | 6  | 6  | 6  | 6  | 6  | 5  | 6  | -  | 6  | 86  | 6  | 4  |
| Bass42 | 271 | - | 36 | - | 23/03/2019<br>00:00:00 | 27.7.e | 5  | 5  | 5  | 5  | 5  | 4  | 5  | 5  | 5  | 88  | 7  | 4  |
| Bass43 | 271 | - | 38 | - | 23/03/2019<br>00:00:00 | 27.7.e | 5  | 5  | 6  | -  | 5  | 5  | 5  | 6  | 5  | 71  | 9  | 8  |
| Bass44 | 271 | - | 47 | - | 23/03/2019<br>00:00:00 | 27.7.e | 6  | 6  | 6  | 5  | 6  | 5  | 6  | 6  | 6  | 75  | 8  | 7  |
| Bass45 | 271 | - | 51 | - | 23/03/2019<br>00:00:00 | 27.7.e | 7  | 7  | 7  | 6  | 7  | 6  | 7  | 7  | 7  | 75  | 7  | 6  |
| Bass46 | 271 | - | 65 | - | 23/03/2019<br>00:00:00 | 27.7.e | 11 | 10 | 11 | 10 | 11 | 9  | 11 | 10 | 11 | 50  | 7  | 6  |
| Bass47 | 271 | - | 53 | - | 23/03/2019<br>00:00:00 | 27.7.e | 12 | 9  | 12 | 9  | 11 | 10 | 12 | 11 | 12 | 38  | 12 | 10 |
| Bass48 | 271 | - | 47 | - | 23/03/2019<br>00:00:00 | 27.7.e | 7  | 7  | 7  | 7  | 7  | 6  | 7  | 7  | 7  | 88  | 5  | 3  |

|        |     |   |    |   |            |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
|--------|-----|---|----|---|------------|--------|----|----|----|----|----|----|----|----|----|----|-----|----|----|
| Bass49 | 271 | - | 54 | - | 27/03/2019 | 27.7.e | 8  | 8  | 8  | 8  | 8  | 8  | 8  | 8  | 8  | 8  | 100 | 0  | 0  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass50 | 271 | - | 49 | - | 27/03/2019 | 27.7.e | 6  | 6  | 6  | 6  | 6  | 5  | 6  | 6  | 6  | 6  | 88  | 6  | 4  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass51 | 271 | - | 42 | - | 18/07/2019 | 27.7.d | 5  | 5  | 6  | 5  | 5  | 4  | 5  | 5  | 5  | 5  | 75  | 11 | 5  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass52 | 271 | - | 44 | - | 18/07/2019 | 27.7.d | 5  | 5  | 6  | 5  | 5  | 5  | 5  | 6  | 5  | 5  | 75  | 9  | 7  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass53 | 271 | - | 39 | - | 18/07/2019 | 27.7.d | 5  | 4  | 6  | 4  | 4  | 4  | 5  | 6  | 4  | 4  | 50  | 19 | 16 |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass54 | 271 | - | 30 | - | 22/07/2019 | 27.7.d | 3  | 3  | 4  | 3  | 3  | 3  | 3  | 4  | 3  | 3  | 75  | 14 | 12 |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass55 | 271 | - | 35 | - | 22/07/2019 | 27.7.d | 5  | 4  | 6  | 4  | 5  | 4  | 5  | 5  | 5  | 5  | 50  | 15 | 12 |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass56 | 271 | - | 29 | - | 22/07/2019 | 27.7.d | 3  | 3  | 4  | 3  | 3  | 3  | 3  | 4  | 3  | 3  | 75  | 14 | 12 |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass57 | 271 | - | 32 | - | 22/07/2019 | 27.7.d | 4  | 4  | 5  | 3  | 4  | 3  | 4  | 5  | 4  | 4  | 50  | 19 | 12 |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass58 | 271 | - | 32 | - | 22/07/2019 | 27.7.d | 3  | 3  | 4  | 3  | 3  | 3  | 3  | 4  | 3  | 3  | 75  | 14 | 12 |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass59 | 271 | - | 39 | - | 10/09/2019 | 27.7.f | 5  | 5  | 6  | 4  | 5  | 4  | 5  | 6  | 5  | 5  | 50  | 15 | 10 |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass60 | 271 | - | 35 | - | 10/09/2019 | 27.7.f | 5  | 5  | 6  | 5  | 5  | 5  | 5  | 6  | 5  | 5  | 75  | 9  | 7  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass61 | 271 | - | 37 | - | 11/09/2019 | 27.7.f | 5  | 5  | 6  | 4  | 5  | 4  | 5  | 6  | 5  | 5  | 50  | 15 | 10 |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass62 | 271 | - | 34 | - | 11/09/2019 | 27.7.f | 5  | 5  | 6  | 5  | 5  | 5  | 6  | 6  | 5  | 5  | 62  | 10 | 9  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass63 | 271 | - | 36 | - | 13/09/2019 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 4  | 75  | 11 | 9  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass64 | 271 | - | 40 | - | 13/09/2019 | 27.7.f | 6  | 6  | 7  | 5  | 6  | 5  | 6  | 7  | 6  | 6  | 50  | 13 | 8  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass65 | 271 | - | 69 | - | 13/09/2019 | 27.7.f | 16 | 12 | 17 | 12 | 15 | 15 | 17 | 15 | 15 | 15 | 38  | 13 | 10 |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass66 | 271 | - | 29 | - | 16/09/2018 | 27.7.f | 4  | 4  | 5  | 3  | 4  | 3  | 4  | 5  | 4  | 4  | 50  | 19 | 12 |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass67 | 271 | - | 30 | - | 16/09/2018 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 4  | 75  | 11 | 9  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass68 | 271 | - | 31 | - | 16/09/2018 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 4  | 75  | 11 | 9  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass69 | 271 | - | 31 | - | 16/09/2018 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 4  | 75  | 11 | 9  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass70 | 271 | - | 32 | - | 16/09/2018 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 4  | 75  | 11 | 9  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass71 | 271 | - | 32 | - | 16/09/2018 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 4  | 75  | 11 | 9  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass72 | 271 | - | 27 | - | 16/09/2018 | 27.7.f | 3  | 3  | 4  | 3  | 3  | 2  | 3  | 4  | 3  | 3  | 62  | 21 | 14 |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass73 | 271 | - | 34 | - | 16/09/2018 | 27.7.f | 4  | -  | 5  | 3  | 4  | 3  | 4  | 5  | 4  | 4  | 43  | 20 | 14 |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass74 | 271 | - | 31 | - | 16/09/2018 | 27.7.f | 4  | -  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 4  | 71  | 11 | 10 |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass75 | 271 | - | 31 | - | 16/09/2018 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 4  | 75  | 11 | 9  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass76 | 271 | - | 31 | - | 16/09/2018 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 4  | 75  | 11 | 9  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |
| Bass77 | 271 | - | 30 | - | 16/09/2018 | 27.7.f | 4  | 4  | 5  | 4  | 4  | 4  | 4  | 5  | 4  | 4  | 75  | 11 | 9  |
|        |     |   |    |   | 00:00:00   |        |    |    |    |    |    |    |    |    |    |    |     |    |    |

|        |     |   |    |   |                        |        |    |   |    |    |    |   |    |    |    |    |    |    |
|--------|-----|---|----|---|------------------------|--------|----|---|----|----|----|---|----|----|----|----|----|----|
| Bass78 | 271 | - | 29 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4 | 5  | 4  | 4  | 3 | 4  | -  | 4  | 71 | 14 | 7  |
| Bass79 | 271 | - | 30 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4 | 5  | 4  | 4  | 4 | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass80 | 271 | - | 24 | - | 16/09/2018<br>00:00:00 | 27.7.f | 2  | 2 | 3  | 2  | 2  | 2 | 2  | 3  | 2  | 75 | 21 | 17 |
| Bass81 | 271 | - | 56 | - | 16/09/2018<br>00:00:00 | 27.7.f | 11 | 8 | 13 | 10 | 10 | 9 | 11 | 11 | 11 | 38 | 15 | 11 |
| Bass82 | 271 | - | 35 | - | 16/09/2018<br>00:00:00 | 27.7.f | 5  | 5 | 6  | 5  | 5  | 4 | 5  | 6  | 5  | 62 | 13 | 9  |
| Bass83 | 271 | - | 30 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 5 | 5  | 4  | 4  | 3 | 4  | 5  | 4  | 50 | 17 | 13 |
| Bass84 | 271 | - | 32 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4 | 5  | 4  | 4  | 3 | 4  | 5  | 4  | 62 | 16 | 11 |
| Bass85 | 271 | - | 33 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4 | 5  | 4  | 4  | 3 | 4  | 5  | 4  | 62 | 16 | 11 |
| Bass86 | 271 | - | 32 | - | 16/09/2018<br>00:00:00 | 27.7.f | 4  | 4 | 5  | 4  | 5  | 4 | 4  | 5  | 4  | 62 | 12 | 11 |
| Bass87 | 271 | - | 34 | - | 17/09/2018<br>00:00:00 | 27.7.f | 4  | 6 | 5  | 5  | 4  | 4 | 4  | 5  | 4  | 50 | 16 | 14 |
| Bass88 | 271 | - | 37 | - | 17/09/2018<br>00:00:00 | 27.7.f | 5  | 5 | 6  | 5  | 5  | 5 | 5  | 6  | 5  | 75 | 9  | 7  |
| Bass89 | 271 | - | 33 | - | 17/09/2018<br>00:00:00 | 27.7.f | 4  | 4 | 5  | 4  | 4  | 4 | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass90 | 271 | - | 36 | - | 17/09/2018<br>00:00:00 | 27.7.f | 5  | 5 | 6  | 5  | 5  | 6 | 5  | 6  | 5  | 62 | 10 | 9  |
| Bass91 | 271 | - | 33 | - | 17/09/2018<br>00:00:00 | 27.7.f | 4  | 4 | 5  | 5  | 4  | 4 | 4  | 5  | 4  | 62 | 12 | 11 |
| Bass92 | 271 | - | 35 | - | 17/09/2018<br>00:00:00 | 27.7.f | 4  | 4 | 5  | 4  | 4  | 4 | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass93 | 271 | - | 37 | - | 17/09/2018<br>00:00:00 | 27.7.f | 4  | 4 | 5  | 4  | 4  | 4 | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass94 | 271 | - | 32 | - | 20/09/2018<br>00:00:00 | 27.7.f | 4  | 4 | 5  | 4  | 4  | 3 | 4  | 5  | 4  | 62 | 16 | 11 |
| Bass95 | 271 | - | 40 | - | 20/09/2018<br>00:00:00 | 27.7.f | 5  | 5 | 5  | 4  | 4  | 4 | 5  | 6  | 5  | 50 | 15 | 12 |
| Bass96 | 271 | - | 45 | - | 20/09/2018<br>00:00:00 | 27.7.f | 5  | 5 | 6  | 5  | 5  | 5 | 5  | 6  | 5  | 75 | 9  | 7  |
| Bass97 | 271 | - | 36 | - | 20/09/2018<br>00:00:00 | 27.7.f | 5  | 5 | 5  | 4  | 4  | 4 | 4  | 5  | 4  | 50 | 12 | 11 |
| Bass98 | 271 | - | 36 | - | 23/09/2018<br>00:00:00 | 27.7.a | 4  | 4 | 5  | 4  | 4  | 4 | 4  | 5  | 4  | 75 | 11 | 9  |
| Bass99 | 271 | - | 39 | - | 23/09/2018<br>00:00:00 | 27.7.a | 5  | 5 | 6  | 5  | 5  | 5 | 5  | 6  | 5  | 75 | 9  | 7  |

**Table 52:** 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 GB | R04 FR | R06 GB | R10 FR | R12 FR | R14 BE | R16 BE | R18 GB | total |
|-----------|--------|--------|--------|--------|--------|--------|--------|--------|-------|
| 2         | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 1      | 8     |
| 3         | 4      | 4      | 4      | 4      | 4      | 4      | 4      | 4      | 32    |
| 4         | 30     | 28     | 30     | 30     | 30     | 30     | 30     | 29     | 237   |
| 5         | 23     | 23     | 23     | 22     | 23     | 23     | 23     | 23     | 183   |
| 6         | 12     | 12     | 12     | 12     | 12     | 12     | 12     | 11     | 95    |
| 7         | 8      | 8      | 8      | 8      | 8      | 8      | 8      | 7      | 63    |
| 8         | 7      | 7      | 7      | 7      | 6      | 7      | 7      | 7      | 55    |
| 9         | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 2      | 16    |
| 10        | 4      | 4      | 4      | 4      | 4      | 4      | 4      | 4      | 32    |
| 11        | 4      | 4      | 4      | 4      | 4      | 4      | 4      | 4      | 32    |
| 12        | 3      | 3      | 3      | 3      | 3      | 3      | 3      | 3      | 24    |

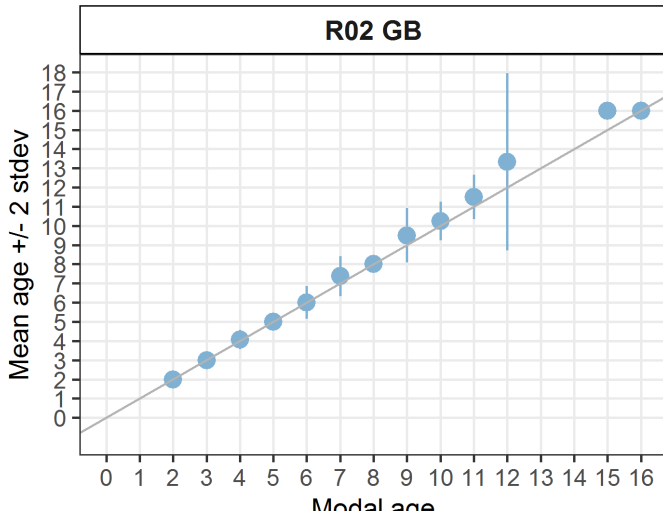
|              |            |           |            |           |           |            |            |           |            |
|--------------|------------|-----------|------------|-----------|-----------|------------|------------|-----------|------------|
| 13           | 0          | 0         | 0          | 0         | 0         | 0          | 0          | 0         | 0          |
| 14           | 0          | 0         | 0          | 0         | 0         | 0          | 0          | 0         | 0          |
| 15           | 1          | 1         | 1          | 1         | 1         | 1          | 1          | 1         | 8          |
| 16           | 1          | 1         | 1          | 1         | 0         | 1          | 1          | 1         | 7          |
| <b>Total</b> | <b>100</b> | <b>98</b> | <b>100</b> | <b>99</b> | <b>98</b> | <b>100</b> | <b>100</b> | <b>97</b> | <b>792</b> |

**Table 53:** Age composition by reader gives a summary of number of readings per reader.

| Modal age    | R02 GB     | R04 FR    | R06 GB     | R10 FR    | R12 FR    | R14 BE     | R16 BE     | R18 GB    |
|--------------|------------|-----------|------------|-----------|-----------|------------|------------|-----------|
| 2            | 1          | 1         | 0          | 1         | 1         | 2          | 1          | 0         |
| 3            | 4          | 4         | 1          | 7         | 4         | 11         | 4          | 1         |
| 4            | 28         | 25        | 7          | 30        | 29        | 32         | 29         | 7         |
| 5            | 26         | 23        | 34         | 20        | 22        | 21         | 26         | 36        |
| 6            | 10         | 14        | 27         | 12        | 15        | 9          | 9          | 22        |
| 7            | 6          | 7         | 7          | 6         | 8         | 8          | 6          | 10        |
| 8            | 10         | 8         | 9          | 7         | 4         | 4          | 10         | 6         |
| 9            | 1          | 7         | 3          | 4         | 4         | 4          | 0          | 3         |
| 10           | 4          | 4         | 3          | 6         | 4         | 4          | 5          | 6         |
| 11           | 3          | 1         | 2          | 2         | 4         | 2          | 3          | 3         |
| 12           | 4          | 2         | 3          | 2         | 1         | 1          | 4          | 0         |
| 13           | 0          | 0         | 1          | 1         | 0         | 0          | 0          | 1         |
| 14           | 0          | 2         | 0          | 0         | 1         | 1          | 0          | 0         |
| 15           | 0          | 0         | 1          | 0         | 1         | 1          | 0          | 1         |
| 16           | 3          | 0         | 1          | 1         | 0         | 0          | 1          | 1         |
| 17           | 0          | 0         | 1          | 0         | 0         | 0          | 2          | 0         |
| <b>Total</b> | <b>100</b> | <b>98</b> | <b>100</b> | <b>99</b> | <b>98</b> | <b>100</b> | <b>100</b> | <b>97</b> |

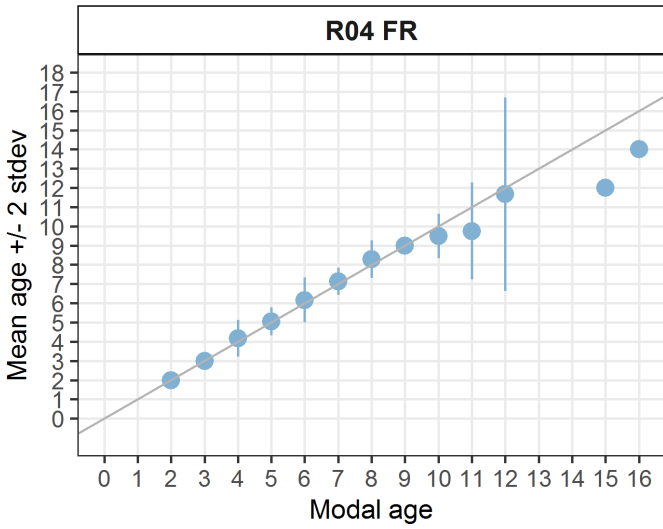
**Table 54:** Mean length at age per reader is calculated per reader and age (not modal age) and for all readers combined per age. A weighted mean is also given.

| Age                  | R02 GB       | R04 FR       | R06 GB       | R10 FR       | R12 FR       | R14 BE       | R16 BE       | R18 GB       |
|----------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 2                    | 24 mm        | 24 mm        | -            | 24 mm        | 24 mm        | 26 mm        | 24 mm        | -            |
| 3                    | 30 mm        | 30 mm        | 24 mm        | 30 mm        | 30 mm        | 31 mm        | 30 mm        | 24 mm        |
| 4                    | 32 mm        | 33 mm        | 32 mm        | 34 mm        | 33 mm        | 35 mm        | 32 mm        | 32 mm        |
| 5                    | 38 mm        | 37 mm        | 33 mm        | 38 mm        | 37 mm        | 40 mm        | 38 mm        | 34 mm        |
| 6                    | 43 mm        | 41 mm        | 40 mm        | 43 mm        | 42 mm        | 46 mm        | 42 mm        | 40 mm        |
| 7                    | 48 mm        | 48 mm        | 45 mm        | 47 mm        | 49 mm        | 50 mm        | 48 mm        | 47 mm        |
| 8                    | 51 mm        | 51 mm        | 52 mm        | 52 mm        | 54 mm        | 58 mm        | 51 mm        | 53 mm        |
| 9                    | 65 mm        | 55 mm        | 55 mm        | 55 mm        | 56 mm        | 57 mm        | -            | 57 mm        |
| 10                   | 55 mm        | 60 mm        | 58 mm        | 59 mm        | 56 mm        | 59 mm        | 57 mm        | 60 mm        |
| 11                   | 59 mm        | 67 mm        | 64 mm        | 62 mm        | 60 mm        | 60 mm        | 59 mm        | 58 mm        |
| 12                   | 60 mm        | 66 mm        | 59 mm        | 70 mm        | 64 mm        | 70 mm        | 60 mm        | -            |
| 13                   | -            | -            | 56 mm        | 64 mm        | -            | -            | -            | 61 mm        |
| 14                   | -            | 66 mm        | -            | -            | 70 mm        | 61 mm        | -            | -            |
| 15                   | -            | -            | 70 mm        | -            | 69 mm        | 69 mm        | -            | 69 mm        |
| 16                   | 67 mm        | -            | 61 mm        | 54 mm        | -            | -            | 61 mm        | 70 mm        |
| 17                   | -            | -            | 69 mm        | -            | -            | -            | 70 mm        | -            |
| <b>Weighted Mean</b> | <b>42 mm</b> | <b>42 mm</b> | <b>42 mm</b> | <b>42 mm</b> | <b>41 mm</b> | <b>42 mm</b> | <b>42 mm</b> | <b>42 mm</b> |

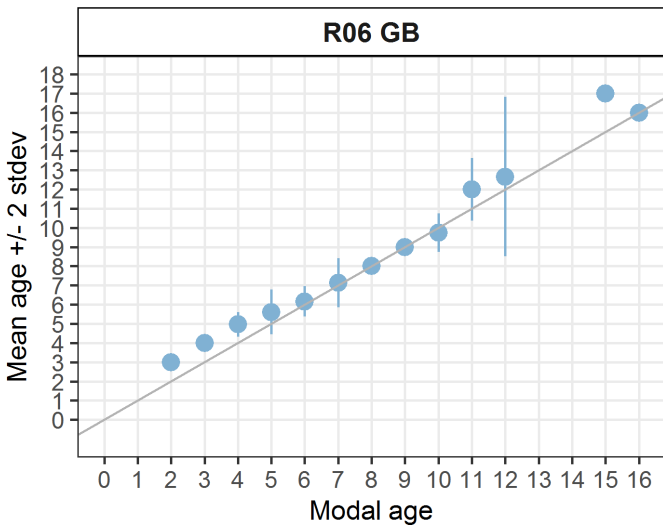


[[1]]

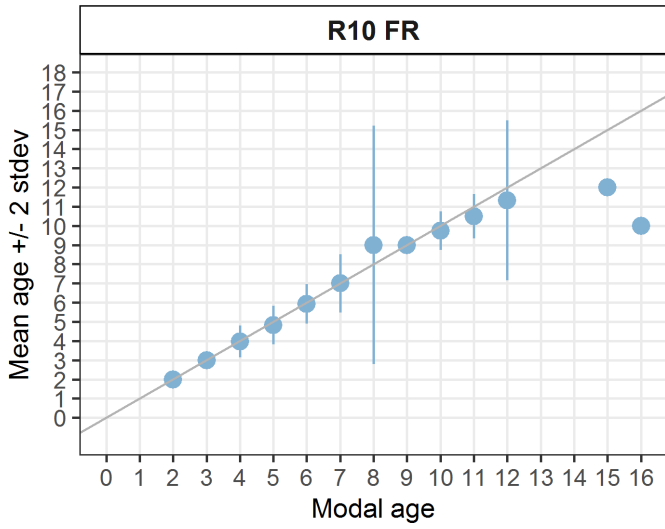
[[2]]



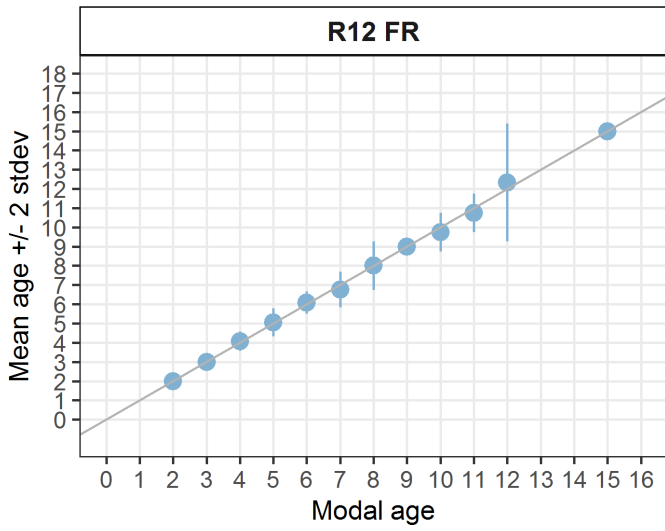
[[3]]



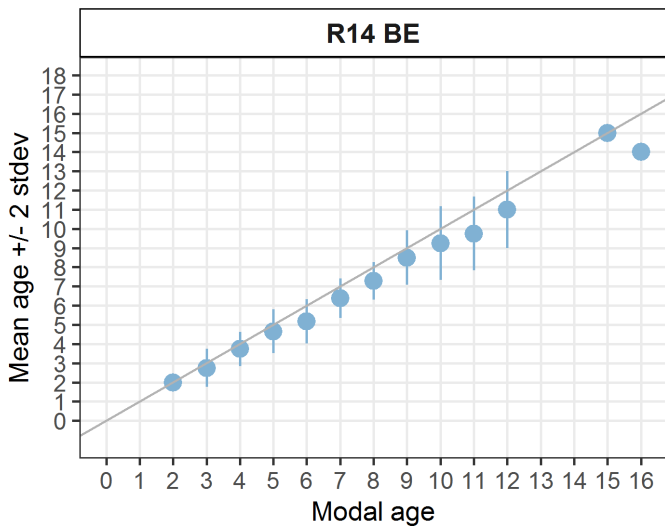
[[4]]



[[5]]

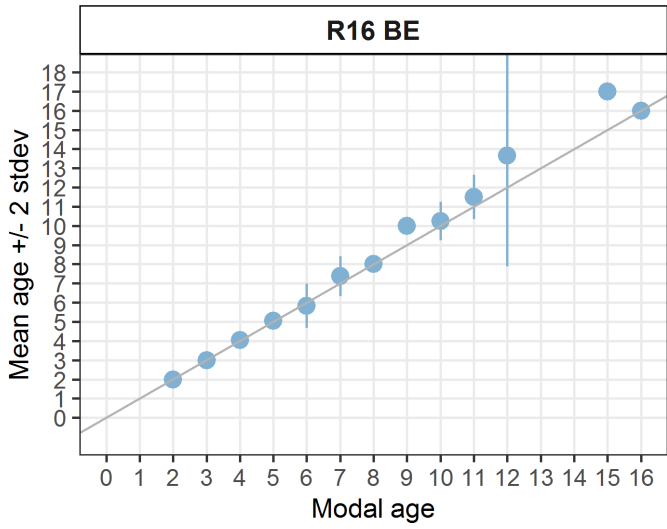


[[6]]

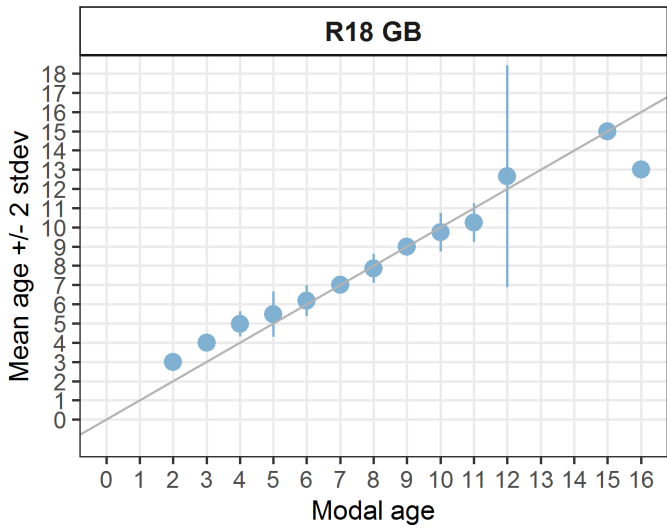


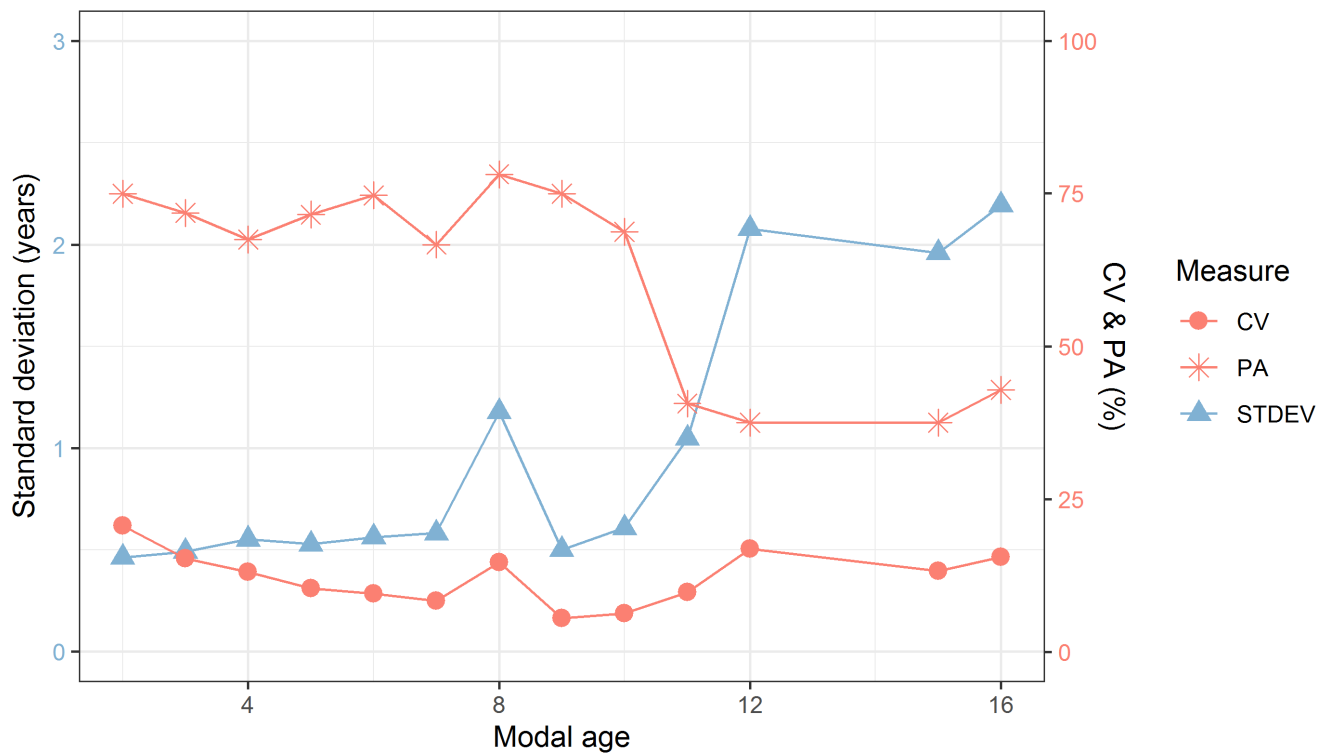
[[7]]



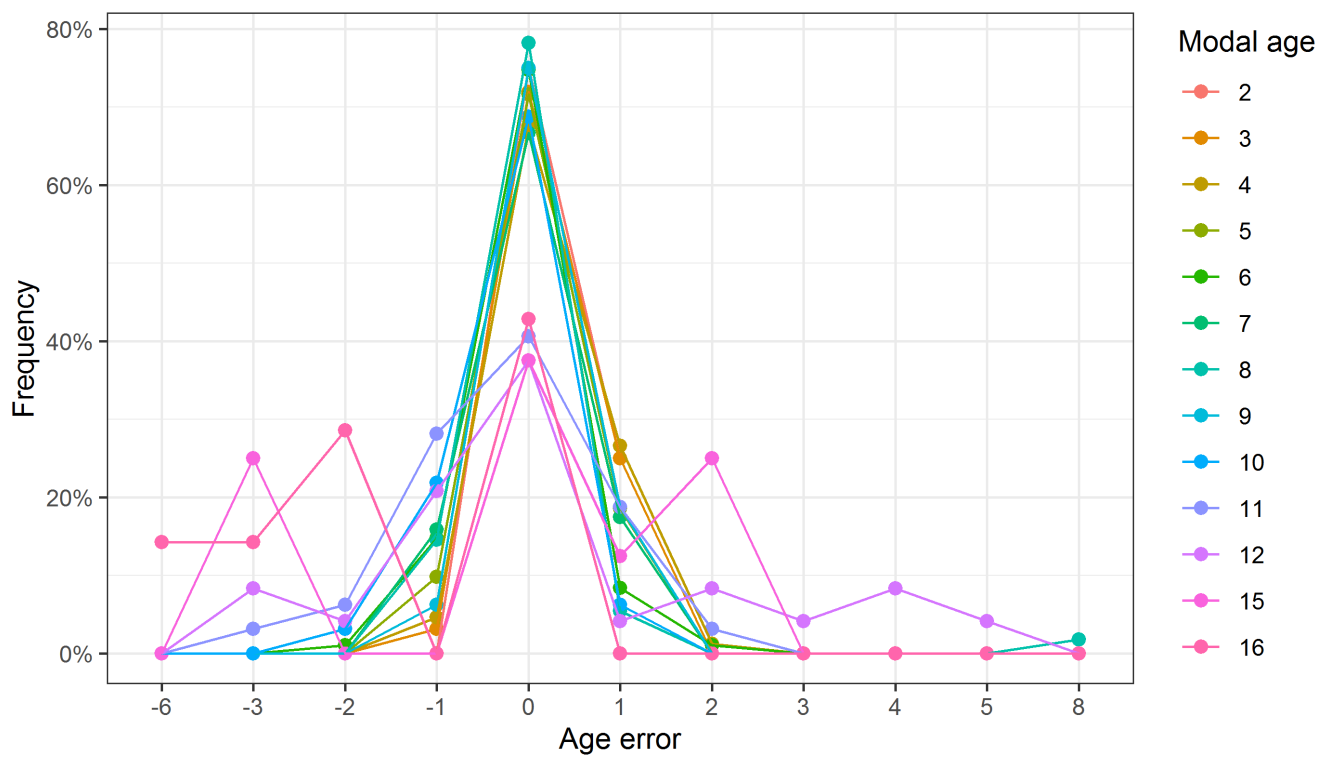


[[8]]



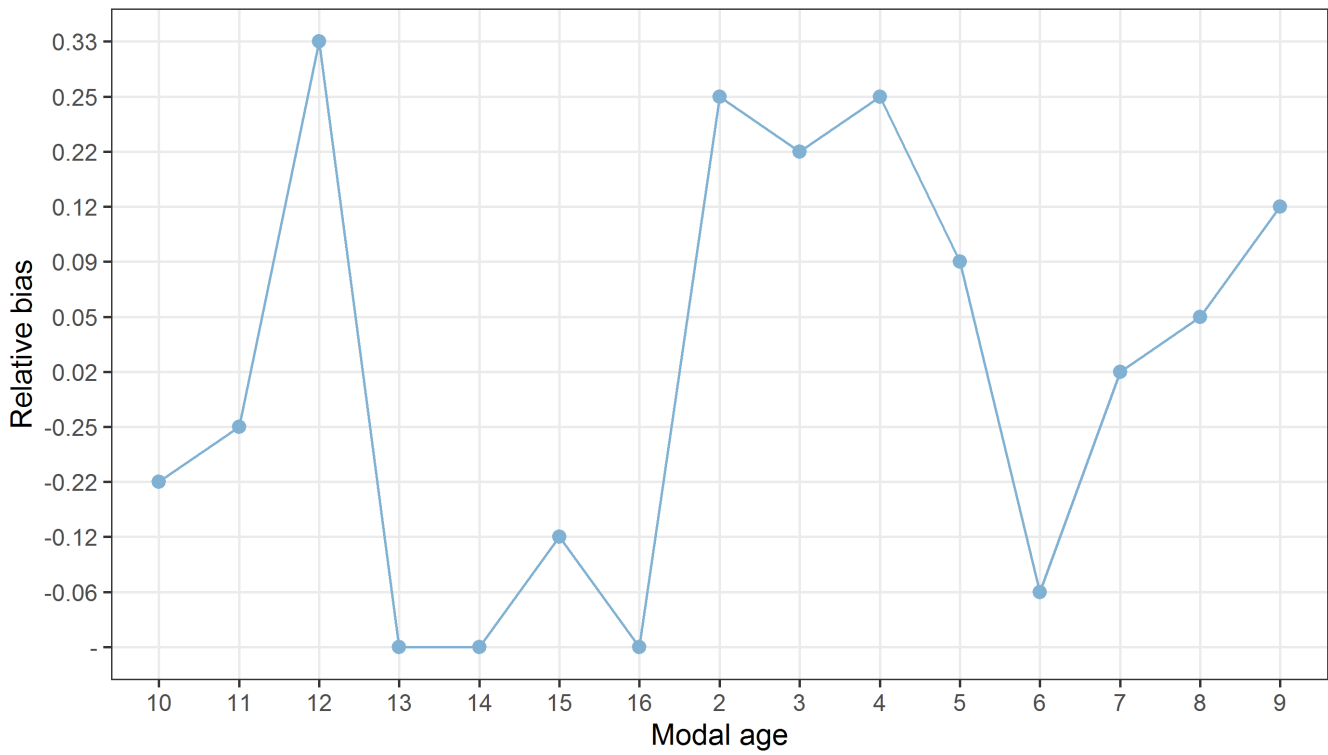


**Figure 23:** CV, PA and (STDEV (standard deviation) are plotted against modal age

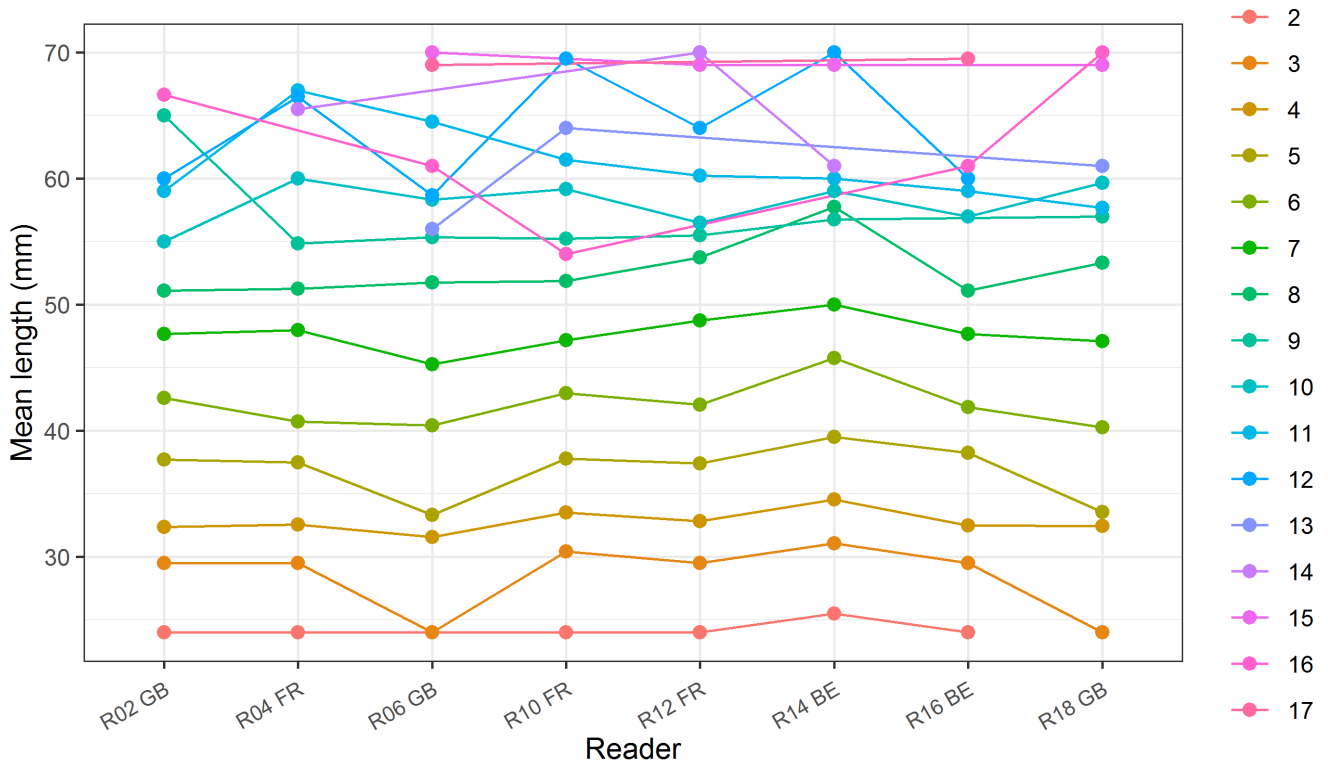


**Figure 24:** The distribution of the age reading errors in percentage by modal age as observed from the whole group of age readers in an age reading comparison to modal age. The achieved precision in age reading by MODAL age group is

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 25:** The relative bias by modal age as estimated by all age readers combined.



**Figure 26:** The mean length at age as estimated by each age reader.

# 8.4 Scales – Supplementary results for Advanced readers

All samples included

## Data Overview

Table 55: Data overview including modal age and statistics per sample.

| Fish ID | Event ID | Image ID | length | sex | Catch date          | ICES area | R02 GB | R04 FR | R06 GB | Modal age | PA % | CV % | APE % |
|---------|----------|----------|--------|-----|---------------------|-----------|--------|--------|--------|-----------|------|------|-------|
| Bass01  | 271      | -        | 54     | -   | 06/02/2019 00:00:00 | 27.7.e    | 8      | 9      | 8      | 8         | 67   | 7    | 5     |
| Bass02  | 271      | -        | 49     | -   | 06/02/2019 00:00:00 | 27.7.e    | 6      | 8      | 6      | 6         | 67   | 17   | 13    |
| Bass03  | 271      | -        | 48     | -   | 06/02/2019 00:00:00 | 27.7.e    | 8      | 8      | 8      | 8         | 100  | 0    | 0     |
| Bass04  | 271      | -        | 49     | -   | 06/02/2019 00:00:00 | 27.7.e    | 7      | 7      | 6      | 7         | 67   | 9    | 7     |
| Bass05  | 271      | -        | 51     | -   | 06/02/2019 00:00:00 | 27.7.e    | 8      | 8      | 8      | 8         | 100  | 0    | 0     |
| Bass06  | 271      | -        | 64     | -   | 06/02/2019 00:00:00 | 27.7.e    | 12     | 12     | 11     | 12        | 67   | 5    | 4     |
| Bass07  | 271      | -        | 55     | -   | 06/02/2019 00:00:00 | 27.7.e    | 8      | 9      | 8      | 8         | 67   | 7    | 5     |
| Bass08  | 271      | -        | 52     | -   | 06/02/2019 00:00:00 | 27.7.e    | 8      | 7      | 8      | 8         | 67   | 8    | 6     |
| Bass09  | 271      | -        | 58     | -   | 06/02/2019 00:00:00 | 27.7.e    | 8      | 8      | 8      | 8         | 100  | 0    | 0     |
| Bass10  | 271      | -        | 59     | -   | 06/02/2019 00:00:00 | 27.7.e    | 10     | 10     | 10     | 10        | 100  | 0    | 0     |
| Bass100 | 271      | -        | 39     | -   | 23/09/2018 00:00:00 | 27.7.a    | 5      | 5      | 6      | 5         | 67   | 11   | 8     |
| Bass11  | 271      | -        | 42     | -   | 18/02/2019 00:00:00 | 27.7.f    | 6      | 6      | 6      | 6         | 100  | 0    | 0     |
| Bass12  | 271      | -        | 61     | -   | 06/02/2019 00:00:00 | 27.7.e    | 16     | 14     | 16     | 16        | 67   | 8    | 6     |
| Bass13  | 271      | -        | 60     | -   | 06/02/2019 00:00:00 | 27.7.e    | 10     | 10     | 10     | 10        | 100  | 0    | 0     |
| Bass14  | 271      | -        | 56     | -   | 06/02/2019 00:00:00 | 27.7.e    | 11     | 9      | 10     | 9         | 33   | 10   | 7     |
| Bass15  | 271      | -        | 45     | -   | 07/02/2019 00:00:00 | 27.7.e    | 8      | 8      | 7      | 8         | 67   | 8    | 6     |
| Bass16  | 271      | -        | 35     | -   | 07/02/2019 00:00:00 | 27.7.e    | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass17  | 271      | -        | 33     | -   | 07/02/2019 00:00:00 | 27.7.e    | 6      | 6      | 6      | 6         | 100  | 0    | 0     |
| Bass18  | 271      | -        | 39     | -   | 07/02/2019 00:00:00 | 27.7.e    | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass19  | 271      | -        | 37     | -   | 07/02/2019 00:00:00 | 27.7.e    | 4      | 5      | 4      | 4         | 67   | 13   | 10    |
| Bass20  | 271      | -        | 47     | -   | 21/02/2019 00:00:00 | 27.7.e    | 7      | 6      | 6      | 6         | 67   | 9    | 7     |
| Bass21  | 271      | -        | 37     | -   | 21/02/2019 00:00:00 | 27.7.e    | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass22  | 271      | -        | 39     | -   | 22/02/2019 00:00:00 | 27.7.e    | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass23  | 271      | -        | 65     | -   | 06/02/2019 00:00:00 | 27.7.e    | 9      | 9      | 9      | 9         | 100  | 0    | 0     |
| Bass24  | 271      | -        | 70     | -   | 06/02/2019 00:00:00 | 27.7.e    | 16     | 14     | 15     | 14        | 33   | 7    | 4     |
| Bass25  | 271      | -        | 67     | -   | 06/02/2019 00:00:00 | 27.7.e    | 12     | 11     | 12     | 12        | 67   | 5    | 4     |
| Bass26  | 271      | -        | 34     | -   | 07/02/2019 00:00:00 | 27.7.e    | 5      | 6      | 6      | 6         | 67   | 10   | 8     |
| Bass27  | 271      | -        | 35     | -   | 07/02/2019 00:00:00 | 27.7.e    | 5      | 6      | 5      | 5         | 67   | 11   | 8     |
| Bass28  | 271      | -        | 33     | -   | 07/02/2019 00:00:00 | 27.7.e    | 5      | 5      | 4      | 5         | 67   | 12   | 10    |
| Bass29  | 271      | -        | 56     | -   | 18/02/2019 00:00:00 | 27.7.g    | 12     | 10     | 12     | 12        | 67   | 10   | 8     |
| Bass30  | 271      | -        | 45     | -   | 19/03/2019 00:00:00 | 27.7.e    | 8      | 7      | 8      | 8         | 67   | 8    | 6     |
| Bass31  | 271      | -        | 46     | -   | 19/03/2019 00:00:00 | 27.7.e    | 7      | 7      | 7      | 7         | 100  | 0    | 0     |
| Bass32  | 271      | -        | 42     | -   | 20/03/2019 00:00:00 | 27.7.e    | 6      | 6      | 7      | 6         | 67   | 9    | 7     |
| Bass33  | 271      | -        | 49     | -   | 21/03/2019 00:00:00 | 27.7.e    | 8      | 8      | 8      | 8         | 100  | 0    | 0     |
| Bass34  | 271      | -        | 54     | -   | 21/03/2019 00:00:00 | 27.7.e    | 10     | 9      | 9      | 9         | 67   | 6    | 5     |
| Bass35  | 271      | -        | 33     | -   | 21/03/2019 00:00:00 | 27.7.e    | 4      | 4      | 4      | 4         | 100  | 0    | 0     |
| Bass36  | 271      | -        | 43     | -   | 22/03/2019 00:00:00 | 27.7.e    | 5      | 6      | 6      | 6         | 67   | 10   | 8     |
| Bass37  | 271      | -        | 41     | -   | 23/03/2019 00:00:00 | 27.7.e    | 6      | 6      | 6      | 6         | 100  | 0    | 0     |
| Bass38  | 271      | -        | 42     | -   | 23/03/2019 00:00:00 | 27.7.e    | 6      | 6      | 6      | 6         | 100  | 0    | 0     |
| Bass39  | 271      | -        | 46     | -   | 23/03/2019 00:00:00 | 27.7.e    | 7      | 7      | 7      | 7         | 100  | 0    | 0     |
| Bass40  | 271      | -        | 47     | -   | 23/03/2019 00:00:00 | 27.7.e    | 10     | 9      | 9      | 9         | 67   | 6    | 5     |
| Bass41  | 271      | -        | 41     | -   | 23/03/2019 00:00:00 | 27.7.e    | 6      | 6      | 6      | 6         | 100  | 0    | 0     |
| Bass42  | 271      | -        | 36     | -   | 23/03/2019 00:00:00 | 27.7.e    | 5      | 5      | 5      | 5         | 100  | 0    | 0     |
| Bass43  | 271      | -        | 38     | -   | 23/03/2019 00:00:00 | 27.7.e    | 5      | 5      | 6      | 5         | 67   | 11   | 8     |
| Bass44  | 271      | -        | 47     | -   | 23/03/2019 00:00:00 | 27.7.e    | 6      | 6      | 6      | 6         | 100  | 0    | 0     |
| Bass45  | 271      | -        | 51     | -   | 23/03/2019 00:00:00 | 27.7.e    | 7      | 7      | 7      | 7         | 100  | 0    | 0     |

|        |     |   |    |   |                     |        |    |    |    |    |     |    |    |
|--------|-----|---|----|---|---------------------|--------|----|----|----|----|-----|----|----|
| Bass46 | 271 | - | 65 | - | 23/03/2019 00:00:00 | 27.7.e | 11 | 10 | 11 | 11 | 67  | 5  | 4  |
| Bass47 | 271 | - | 53 | - | 23/03/2019 00:00:00 | 27.7.e | 12 | 9  | 12 | 12 | 67  | 16 | 12 |
| Bass48 | 271 | - | 47 | - | 23/03/2019 00:00:00 | 27.7.e | 7  | 7  | 7  | 7  | 100 | 0  | 0  |
| Bass49 | 271 | - | 54 | - | 27/03/2019 00:00:00 | 27.7.e | 8  | 8  | 8  | 8  | 100 | 0  | 0  |
| Bass50 | 271 | - | 49 | - | 27/03/2019 00:00:00 | 27.7.e | 6  | 6  | 6  | 6  | 100 | 0  | 0  |
| Bass51 | 271 | - | 42 | - | 18/07/2019 00:00:00 | 27.7.d | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass52 | 271 | - | 44 | - | 18/07/2019 00:00:00 | 27.7.d | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass53 | 271 | - | 39 | - | 18/07/2019 00:00:00 | 27.7.d | 5  | 4  | 6  | 4  | 33  | 20 | 13 |
| Bass54 | 271 | - | 30 | - | 22/07/2019 00:00:00 | 27.7.d | 3  | 3  | 4  | 3  | 67  | 17 | 13 |
| Bass55 | 271 | - | 35 | - | 22/07/2019 00:00:00 | 27.7.d | 5  | 4  | 6  | 4  | 33  | 20 | 13 |
| Bass56 | 271 | - | 29 | - | 22/07/2019 00:00:00 | 27.7.d | 3  | 3  | 4  | 3  | 67  | 17 | 13 |
| Bass57 | 271 | - | 32 | - | 22/07/2019 00:00:00 | 27.7.d | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass58 | 271 | - | 32 | - | 22/07/2019 00:00:00 | 27.7.d | 3  | 3  | 4  | 3  | 67  | 17 | 13 |
| Bass59 | 271 | - | 39 | - | 10/09/2019 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass60 | 271 | - | 35 | - | 10/09/2019 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass61 | 271 | - | 37 | - | 11/09/2019 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass62 | 271 | - | 34 | - | 11/09/2019 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass63 | 271 | - | 36 | - | 13/09/2019 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass64 | 271 | - | 40 | - | 13/09/2019 00:00:00 | 27.7.f | 6  | 6  | 7  | 6  | 67  | 9  | 7  |
| Bass65 | 271 | - | 69 | - | 13/09/2019 00:00:00 | 27.7.f | 16 | 12 | 17 | 12 | 33  | 18 | 13 |
| Bass66 | 271 | - | 29 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass67 | 271 | - | 30 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass68 | 271 | - | 31 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass69 | 271 | - | 31 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass70 | 271 | - | 32 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass71 | 271 | - | 32 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass72 | 271 | - | 27 | - | 16/09/2018 00:00:00 | 27.7.f | 3  | 3  | 4  | 3  | 67  | 17 | 13 |
| Bass73 | 271 | - | 34 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | -  | 5  | 4  | 50  | 16 | 11 |
| Bass74 | 271 | - | 31 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | -  | 5  | 4  | 50  | 16 | 11 |
| Bass75 | 271 | - | 31 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass76 | 271 | - | 31 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass77 | 271 | - | 30 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass78 | 271 | - | 29 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass79 | 271 | - | 30 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass80 | 271 | - | 24 | - | 16/09/2018 00:00:00 | 27.7.f | 2  | 2  | 3  | 2  | 67  | 25 | 19 |
| Bass81 | 271 | - | 56 | - | 16/09/2018 00:00:00 | 27.7.f | 11 | 8  | 13 | 8  | 33  | 24 | 17 |
| Bass82 | 271 | - | 35 | - | 16/09/2018 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass83 | 271 | - | 30 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 5  | 5  | 5  | 67  | 12 | 10 |
| Bass84 | 271 | - | 32 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass85 | 271 | - | 33 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass86 | 271 | - | 32 | - | 16/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass87 | 271 | - | 34 | - | 17/09/2018 00:00:00 | 27.7.f | 4  | 6  | 5  | 4  | 33  | 20 | 13 |
| Bass88 | 271 | - | 37 | - | 17/09/2018 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass89 | 271 | - | 33 | - | 17/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass90 | 271 | - | 36 | - | 17/09/2018 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass91 | 271 | - | 33 | - | 17/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass92 | 271 | - | 35 | - | 17/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass93 | 271 | - | 37 | - | 17/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass94 | 271 | - | 32 | - | 20/09/2018 00:00:00 | 27.7.f | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass95 | 271 | - | 40 | - | 20/09/2018 00:00:00 | 27.7.f | 5  | 5  | 5  | 5  | 100 | 0  | 0  |
| Bass96 | 271 | - | 45 | - | 20/09/2018 00:00:00 | 27.7.f | 5  | 5  | 6  | 5  | 67  | 11 | 8  |
| Bass97 | 271 | - | 36 | - | 20/09/2018 00:00:00 | 27.7.f | 5  | 5  | 5  | 5  | 100 | 0  | 0  |
| Bass98 | 271 | - | 36 | - | 23/09/2018 00:00:00 | 27.7.a | 4  | 4  | 5  | 4  | 67  | 13 | 10 |
| Bass99 | 271 | - | 39 | - | 23/09/2018 00:00:00 | 27.7.a | 5  | 5  | 6  | 5  | 67  | 11 | 8  |

**Table 56:** 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 GB | R04 FR | R06 GB | total |
|-----------|--------|--------|--------|-------|
| 2         | 1      | 1      | 1      | 3     |

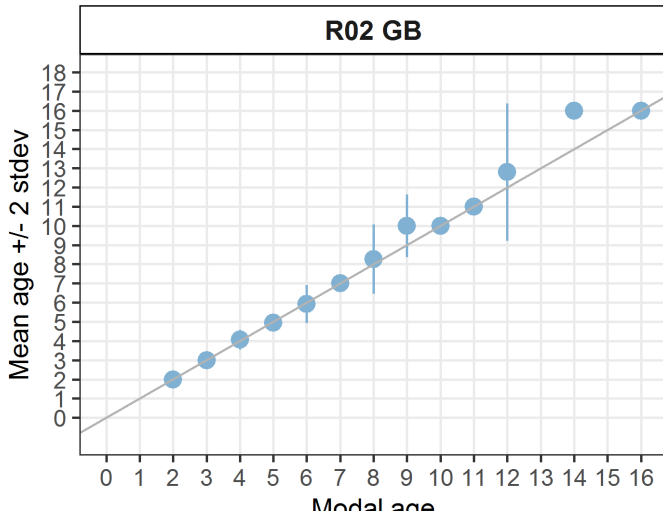
|              |            |           |            |            |
|--------------|------------|-----------|------------|------------|
| 3            | 4          | 4         | 4          | 12         |
| 4            | 29         | 27        | 29         | 85         |
| 5            | 23         | 23        | 23         | 69         |
| 6            | 13         | 13        | 13         | 39         |
| 7            | 5          | 5         | 5          | 15         |
| 8            | 11         | 11        | 11         | 33         |
| 9            | 4          | 4         | 4          | 12         |
| 10           | 2          | 2         | 2          | 6          |
| 11           | 1          | 1         | 1          | 3          |
| 12           | 5          | 5         | 5          | 15         |
| 13           | 0          | 0         | 0          | 0          |
| 14           | 1          | 1         | 1          | 3          |
| 15           | 0          | 0         | 0          | 0          |
| 16           | 1          | 1         | 1          | 3          |
| <b>Total</b> | <b>100</b> | <b>98</b> | <b>100</b> | <b>298</b> |

**Table 57:** Age composition by reader gives a summary of number of readings per reader.

| Modal age    | R02 GB     | R04 FR    | R06 GB     |
|--------------|------------|-----------|------------|
| 2            | 1          | 1         | 0          |
| 3            | 4          | 4         | 1          |
| 4            | 28         | 25        | 7          |
| 5            | 26         | 23        | 34         |
| 6            | 10         | 14        | 27         |
| 7            | 6          | 7         | 7          |
| 8            | 10         | 8         | 9          |
| 9            | 1          | 7         | 3          |
| 10           | 4          | 4         | 3          |
| 11           | 3          | 1         | 2          |
| 12           | 4          | 2         | 3          |
| 13           | 0          | 0         | 1          |
| 14           | 0          | 2         | 0          |
| 15           | 0          | 0         | 1          |
| 16           | 3          | 0         | 1          |
| 17           | 0          | 0         | 1          |
| <b>Total</b> | <b>100</b> | <b>98</b> | <b>100</b> |

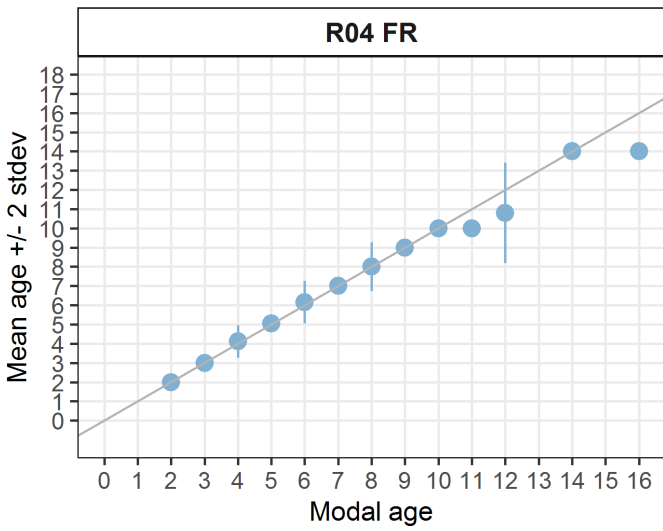
**Table 58:** Mean length at age per reader is calculated per reader and age (not modal age) and for all readers combined per age. A weighted mean is also given.

| Age                  | R02 GB       | R04 FR       | R06 GB       |
|----------------------|--------------|--------------|--------------|
| 2                    | 24 mm        | 24 mm        | -            |
| 3                    | 30 mm        | 30 mm        | 24 mm        |
| 4                    | 32 mm        | 33 mm        | 32 mm        |
| 5                    | 38 mm        | 37 mm        | 33 mm        |
| 6                    | 43 mm        | 41 mm        | 40 mm        |
| 7                    | 48 mm        | 48 mm        | 45 mm        |
| 8                    | 51 mm        | 51 mm        | 52 mm        |
| 9                    | 65 mm        | 55 mm        | 55 mm        |
| 10                   | 55 mm        | 60 mm        | 58 mm        |
| 11                   | 59 mm        | 67 mm        | 64 mm        |
| 12                   | 60 mm        | 66 mm        | 59 mm        |
| 13                   | -            | -            | 56 mm        |
| 14                   | -            | 66 mm        | -            |
| 15                   | -            | -            | 70 mm        |
| 16                   | 67 mm        | -            | 61 mm        |
| 17                   | -            | -            | 69 mm        |
| <b>Weighted Mean</b> | <b>42 mm</b> | <b>42 mm</b> | <b>42 mm</b> |

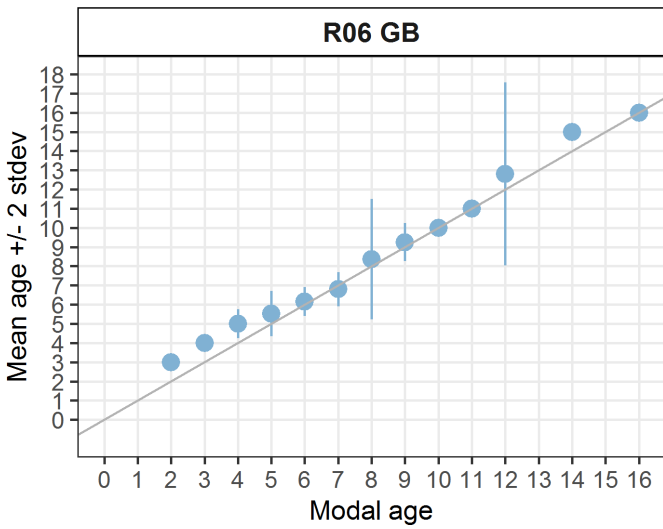


[[1]]

[[2]]



[[3]]



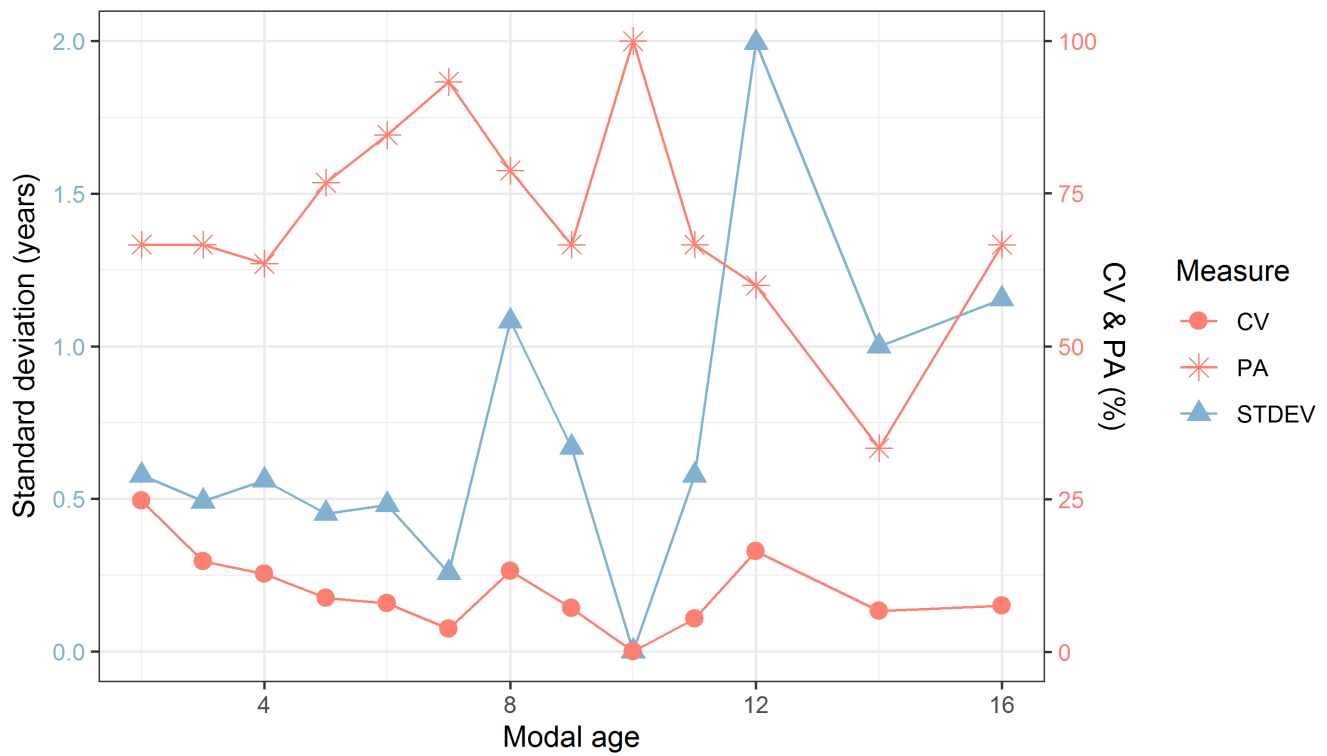


Figure 27: CV, PA and (STDEV (standard deviation) are plotted against modal age

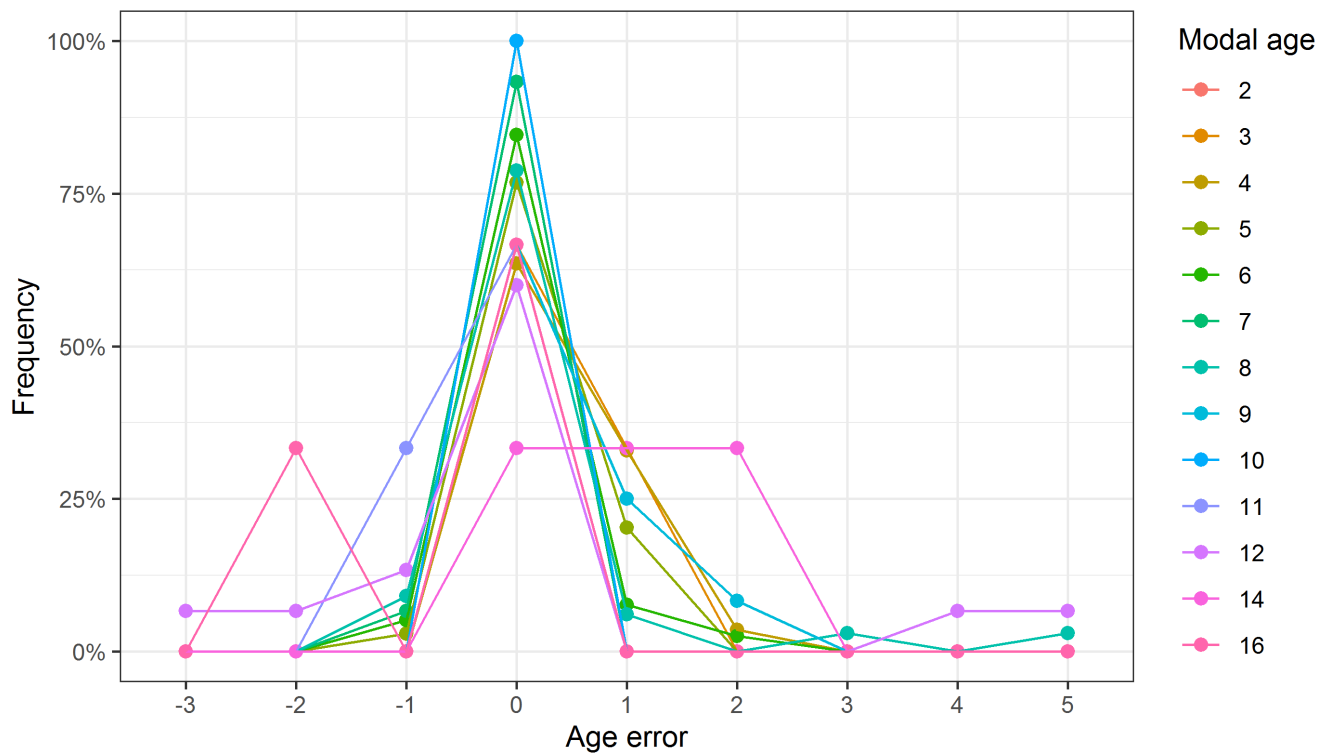
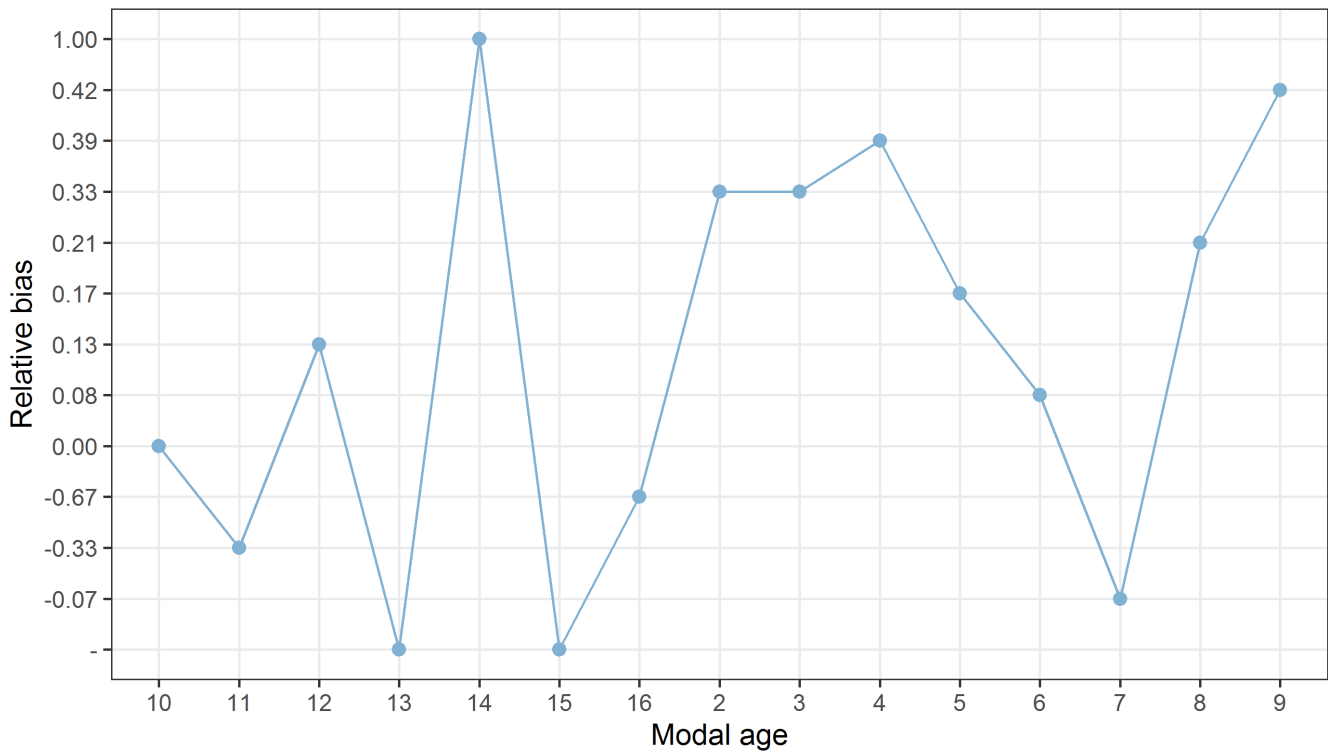


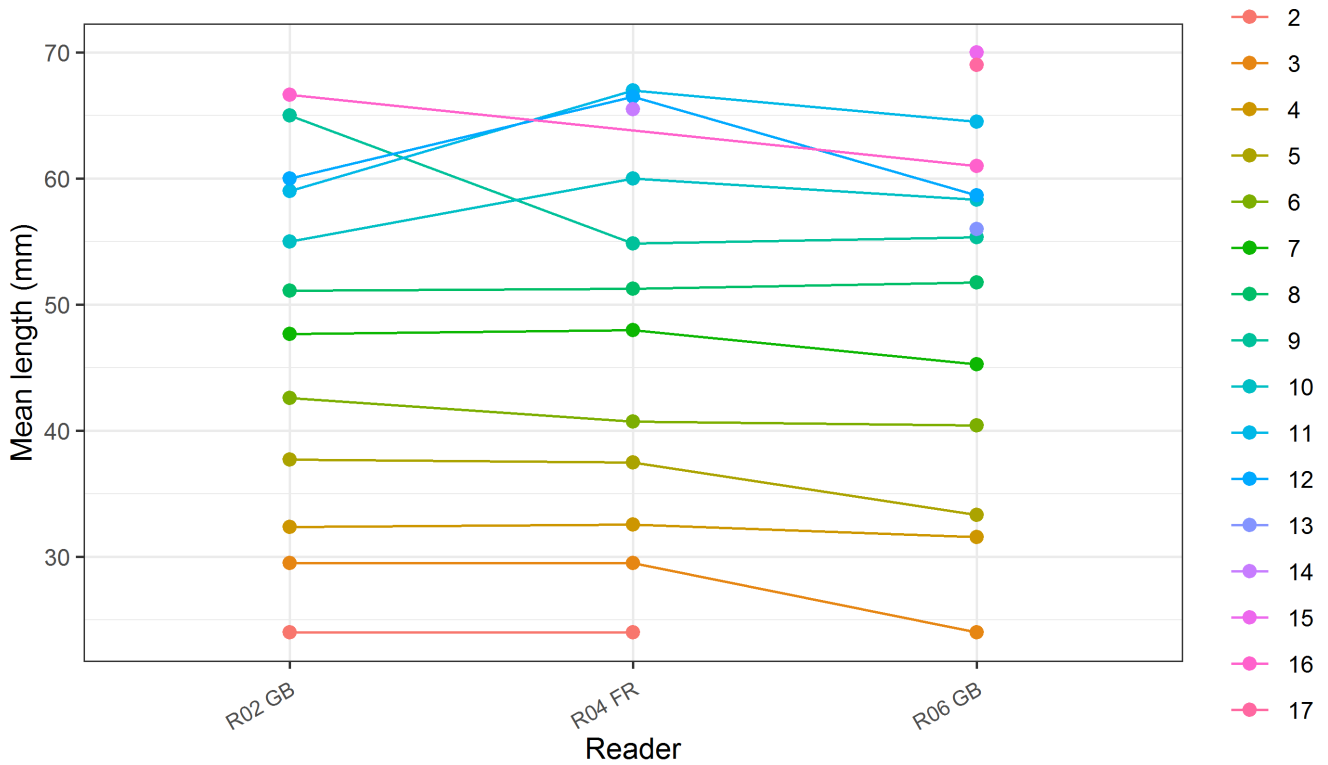
Figure 28: The distribution of the age reading errors in percentage by modal age as observed from the whole group of age readers in an age reading comparison to modal age. The achieved precision in age reading by MODAL age group is



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 29:** The relative bias by modal age as estimated by all age readers combined.



**Figure 30:** The mean length at age as estimated by each age reader.