

# 2022 North Sea Sandeel Age Reading Exchange on SmartDots (ID 424)

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# Summary

The 2022 North Sea Sandeel age reading exchange took place on SmartDots (ID 424) in May 2022 in preparation for the WKSANDEEL 2022. Seven readers took part, 3 from Norway (all advanced readers providing age data for stock assessment purposes) and 5 from Denmark (2 advanced readers providing age data for stock assessment purposes and 2 basic readers who do not provide age data for stock assessment purposes). The WKSANDEEL 2022 Working Document has been uploaded to SmartDots as the summary report.

A set of 120 otolith images were uploaded to the SmartDots platform and readers were asked to annotate, provide an age and a quality assurance score for each otolith image.

The otolith images were previously read in 2019

(<https://smartdots.ices.dk/SampleImages/2019/219/2019%20North%20Sea%20Sandeel%20Age%20Reading%20Exchange%20Report.pdf>). The same 3 readers from Norway took part in both exchanges, whereas from Denmark only 1 reader took part in both exchanges. Based only on age readers who provide age data for stock assessment purposes (advanced readers) the weighted average percentage agreement (PA) was 81 % and the weighted average coefficient of variation (CV) was 24 % (based on advanced readers only). In 2022, results improved and the weighted average percentage agreement (PA) was 87 % and the weighted average coefficient of variation (CV) was 20%.

In 2019, based on all readers the weighted average percentage agreement (PA) based on modal ages for all readers was 77 % and the weighted average coefficient of variation (CV) was 26 %. An improvement was also seen here with the weighted average percentage agreement (PA) increasing to 86 % and the weighted average CV at 24 %.

Included in both the 2019 and 2022 exchanges were a subset of 40 otoliths (from SA1) with 100% agreement in the 2016 exchange (WKSAND 2016 WD). Based on only these 40 otoliths, the weighted average percentage agreement (PA) in 2019 was 85 % and the weighted average coefficient of variation (CV) was 24%. An improvement was seen in 2022 when the weighted average percentage agreement (PA) was 92 % and the weighted average coefficient of variation (CV) was 17%.

In 2019 the following age reading issues were apparent; a) incorrect interpretation of the otolith edge in Q4 where some readers were counting an extra year and b) disagreement as to whether or not a faint innermost translucent zone (present in some otoliths) should be counted as a true winter ring or not. The former issue appears to be resolved as a result of repeated calibration of readers and feedback on age reading issues. The latter is a reoccurring issue (see Image Examples) which needs attention and requires otolith microstructure examination of problematic otoliths from different areas in order to validate whether or not this is a true winter ring.

2022 results do not show any indication that a single stock or month of capture (or age) is more difficult to read even though in 2019 concerns were raised over image quality of the otoliths from san.sa.3r and san.sa.5r which were mounted in eukit and which may have contributed to the lower PA for these areas/stocks. CV at modal age 1 is highest but it should be noted that the calculation of CV is dependent on age and CV at modal age 0 is not calculated for this reason. Even though PA at modal age 0 is high (84%) it is lower than PA at modal ages 1 (90%) and 2 (93%), indicating there are some difficulties in the correct interpretation of modal age 0 with a general pattern of positive bias in relation to modal age which is interpreted as an overestimation of age.

# Methods

Results presented here are based on output from SmartDots and a standardised r-script , there are a few examples (e.g. Sandeel\_2022\_018) of readers annotating some images incorrectly and placing a dot on the centre of the otolith, this will add an extra year to the age of the fish and will increase the CV and reduce the PA for those fish. In reality, the true results are slightly better.

The analysis follows traditional methods where the level of accuracy compared to modal age is indicated by percentage agreement (PA), bias tests and plots, and the level of precision, i.e. the reproducibility of age estimates is indicated by the coefficient of variation (CV). The tables and plots presented are from the Guus Eltink Excel sheet 'Age Reading Comparisons' (Eltink, A.T.G.W. 2000). Additional analyses of age data were included in the form of age error matrices (AEM's).

## Percentage Agreement

The table presents the percentage agreement (PA) per modal age and reader. This percentage is estimated as the number of times that a reader agreed with the modal age divided by the total number of otoliths read by a reader for each modal age.

$$PA = \frac{\text{number of readings that agree with modal age}}{\text{total number of readings by modal age}} \cdot 100\%$$

Added to the table is the PA of all readers combined per modal age and a weighted mean of the PA per reader.

## Co-efficient of Variation (CV)

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

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

Added to the table is the CV of all readers combined per modal age and a weighted mean of the CV per reader.

## Average Percentage Error (APE)

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

The average percentage error is calculated per image as:

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

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.

## 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. It has not been possible to include these in the current report due to discrepancies between the actual otolith measurements and the plots produced by the r-script.

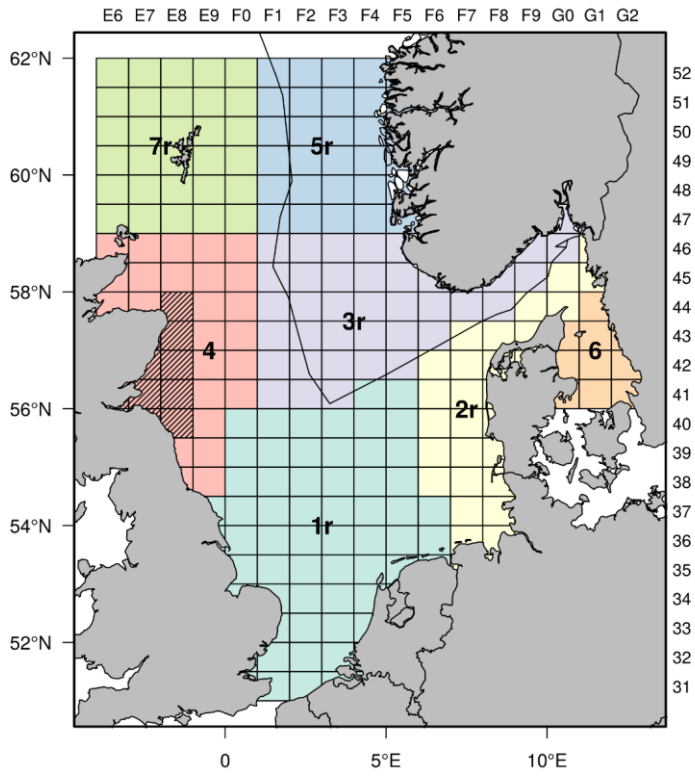
## Overview of samples and readers

**Table 1:** Overview of samples used for the 2022 North Sea Sandeel exchange. The modal age range for all samples is 0-9 and fish length range from 70-250mm. Samples in bold were included in the 2016, 2019 and 2022 exchanges.

Year	ICES area	Strata	Quarter	Number of samples	Modal age range	Length range
<b>2015</b>	<b>27.4.b</b>	<b>san.sa.1r</b>	<b>4</b>	<b>20</b>	<b>0-3</b>	<b>100-150 mm</b>
<b>2016</b>	<b>27.4.b</b>	<b>san.sa.1r</b>	<b>2</b>	<b>20</b>	<b>1-4</b>	<b>85-185 mm</b>
2018	27.4.b	san.sa.1r	4	20	0-4	70-165 mm
2016	27.4.a	san.sa.3r	2	9	1-5	135-245 mm
2016	27.4.b	san.sa.3r	2	4	2	125-160 mm
2017	27.4.a	san.sa.3r	2	7	1-8	100-250 mm
2018	27.3.a.20	san.sa.3r	4	2	0	70-80 mm
2018	27.4.b	san.sa.3r	4	18	0-4	45-200 mm
2011	27.4.a	san.sa.5r	2	11	2-9	95-215 mm
2017	27.4.a	san.sa.5r	2	9	1-7	85-175 mm

**Table 2:** Reader overview for the 2022 North Sea sandeel exchange.

Reader code	Expertise
R01 NO	Advanced
R02 NO	Advanced
R03 DK	Advanced
R04 NO	Advanced
R05 DK	Advanced
R06 DK	Basic
R07 DK	Basic



**Figure 1:** Map of Sandeel stocks agreed upon by WKSAND 2016

# Results

This section outlines the results based on all age readers, section 2.1.1 (basic and advanced) followed by the results based on advanced readers only section 2.1.2. Included in section 2.1.2 are results by stock and results of the re-reading of the 2016 agreed age set. Image examples in section 2.1.3 highlight the main age reading issues. In Annexes 3.2 and 3.3 the data output from SmartDots can be found. All images and readers annotations can be viewed in SmartDots.

## 1.1.1 All readers

The following results are based on both the age readings from the basic (those not providing age data for stock assessment purposes) and the advanced (those providing age data for stock assessment purposes) age readers.

The weighted average percentage agreement based on modal ages for all readers is 86 %, with the weighted average CV of 24 % and APE of 10 %.

**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.

Modal age	R01 NO	R02 NO	R03 DK	R04 NO	R05 DK	R06 DK	R07 DK	all
0	-	-	-	-	-	-	-	-
1	30 %	40 %	54 %	34 %	37 %	33 %	46 %	41 %
2	0 %	13 %	19 %	13 %	10 %	24 %	21 %	18 %
3	15 %	0 %	11 %	17 %	35 %	10 %	18 %	17 %
4	13 %	14 %	11 %	21 %	7 %	0 %	21 %	14 %
5	12 %	11 %	12 %	12 %	0 %	13 %	0 %	11 %
6	0 %	11 %	28 %	11 %	11 %	0 %	11 %	13 %
7	0 %	11 %	0 %	0 %	0 %	0 %	0 %	7 %
8	-	-	-	-	-	-	-	13 %
9	-	-	-	-	-	-	-	8 %
<b>Weighted Mean</b>	<b>13 %</b>	<b>21 %</b>	<b>29 %</b>	<b>21 %</b>	<b>20 %</b>	<b>22 %</b>	<b>28 %</b>	<b>24 %</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.

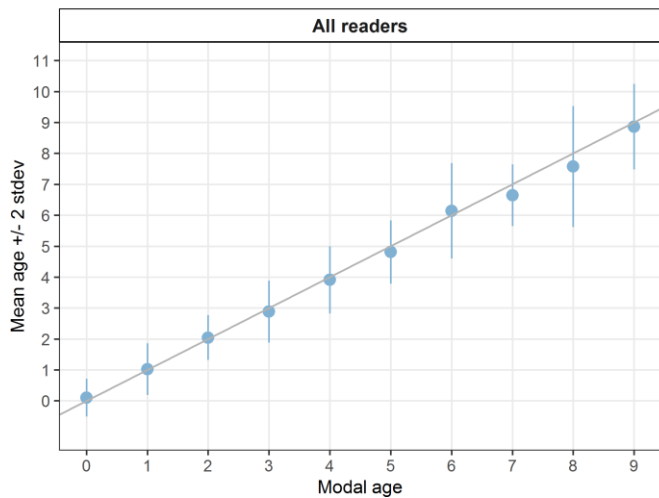
**Table 4:** Percentage agreement (PA) table represents the PA per modal age and reader, the PA of all readers combined per modal age and a weighted mean of the PA per reader.

Modal age	R01 NO	R02 NO	R03 DK	R04 NO	R05 DK	R06 DK	R07 DK	all
0	90 %	100 %	100 %	100 %	70 %	70 %	100 %	90 %
1	92 %	89 %	78 %	89 %	91 %	81 %	92 %	87 %
2	100 %	93 %	85 %	93 %	95 %	74 %	88 %	90 %
3	80 %	100 %	90 %	78 %	90 %	90 %	70 %	86 %
4	73 %	73 %	82 %	64 %	91 %	100 %	64 %	78 %
5	67 %	67 %	67 %	67 %	100 %	33 %	100 %	71 %
6	100 %	50 %	50 %	50 %	50 %	100 %	50 %	64 %
7	100 %	50 %	0 %	100 %	100 %	0 %	100 %	64 %
8	100 %	0 %	0 %	0 %	100 %	0 %	100 %	43 %
9	100 %	100 %	0 %	0 %	100 %	0 %	100 %	57 %
<b>Weighted Mean</b>	<b>92 %</b>	<b>88 %</b>	<b>80 %</b>	<b>85 %</b>	<b>91 %</b>	<b>76 %</b>	<b>87 %</b>	<b>86 %</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. Individual age reader bias plots can be found in Annex 3.2 (Figure 8).

**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.

Modal age	R01 NO	R02 NO	R03 DK	R04 NO	R05 DK	R06 DK	R07 DK	all
0	0.10	0.00	0.00	0.00	0.30	0.30	0.00	<b>0.10</b>
1	-0.08	0.08	-0.22	0.00	0.12	0.19	0.08	<b>0.02</b>
2	0.00	0.02	-0.15	0.02	0.05	0.31	0.05	<b>0.04</b>
3	-0.20	0.00	-0.10	0.00	-0.30	0.10	-0.30	<b>-0.11</b>
4	-0.27	-0.09	0.00	-0.09	0.09	0.00	-0.27	<b>-0.09</b>
5	-0.33	0.33	-0.33	-0.33	0.00	-0.67	0.00	<b>-0.19</b>
6	0.00	0.50	-1.00	0.50	0.50	0.00	0.50	<b>0.14</b>
7	0.00	-0.50	-1.00	0.00	0.00	-1.00	0.00	<b>-0.36</b>
8	0.00	-1.00	-2.00	1.00	0.00	-1.00	0.00	<b>-0.43</b>
9	0.00	0.00	-1.00	1.00	0.00	-1.00	0.00	<b>-0.14</b>
<b>Weighted Mean</b>	<b>-0.07</b>	<b>0.02</b>	<b>-0.20</b>	<b>0.02</b>	<b>0.07</b>	<b>0.15</b>	<b>0.00</b>	<b>0.00</b>



**Figure 2:** 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).

**Table 6:** 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	R01 NO	R02 NO	R03 DK	R04 NO	R05 DK	R06 DK	R07 DK
R01 NO	-	-	*	-	**	**	-
R02 NO	-	-	**	-	-	*	-
R03 DK	*	**	-	**	**	**	**
R04 NO	-	-	**	-	-	*	-
R05 DK	**	-	**	-	-	-	-
R06 DK	**	*	**	*	-	-	*
R07 DK	-	-	**	-	-	*	-
Modal age	*	-	**	-	*	**	-

## 1.1.2 Advanced readers

The following results are based only on the advanced age readers (those providing age data for stock assessment purposes). The weighted average percentage agreement is 87 % and the weighted average CV of 20 %.



All age readings in Table 7 were included in the calculation of modal age, coefficient of variation (Table 8), percentage agreement (Table 9), and bias (Table 10 and Figure 3). CV at modal age 1 is highest at 35% and shows a decreasing trend with an increase in age. PA is highest at modal age 2 (93%), compared to modal age 0 (84%). Relative bias is 0.19 at modal age 0 with all readers showing positive bias, indicating an overestimation of age in comparison to modal age, this is also seen in Figure 3.

**Table 7:** Number of age readings made per advanced reader for each modal age.

Modal age	R01 NO	R02 NO	R03 DK	R04 NO	R05 DK	total
0	12	12	11	12	11	58
1	35	35	34	33	33	170
2	42	43	41	43	43	212
3	11	11	11	10	11	54
4	10	10	10	10	10	50
5	3	3	3	3	3	15
6	2	2	2	2	2	10
7	2	2	2	2	2	10
8	1	1	1	1	1	5
9	1	1	1	1	1	5
<b>Total</b>	<b>119</b>	<b>120</b>	<b>116</b>	<b>117</b>	<b>117</b>	<b>589</b>

**Table 8:** Coefficient of Variation (CV) table presents the CV per modal age and advanced reader, the CV of all advanced readers combined per modal age and a weighted mean of the CV per reader.

Modal age	R01 NO	R02 NO	R03 DK	R04 NO	R05 DK	all
0	-	-	-	-	-	-
1	25 %	22 %	52 %	30 %	37 %	35 %
2	0 %	13 %	19 %	13 %	10 %	13 %
3	14 %	0 %	15 %	20 %	35 %	19 %
4	11 %	12 %	12 %	14 %	8 %	11 %
5	12 %	11 %	12 %	12 %	0 %	11 %
6	0 %	11 %	28 %	11 %	11 %	14 %
7	0 %	11 %	0 %	0 %	0 %	7 %
8	-	-	-	-	-	15 %
9	-	-	-	-	-	8 %
<b>Weighted Mean</b>	<b>11 %</b>	<b>15 %</b>	<b>28 %</b>	<b>19 %</b>	<b>21 %</b>	<b>20 %</b>

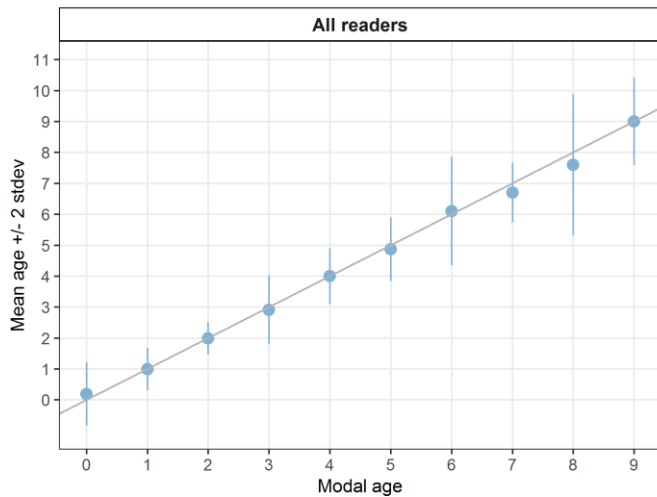
**Table 9:** Percentage agreement (PA) table represents the PA per modal age and reader, advanced the PA of all advanced readers combined per modal age and a weighted mean of the PA per reader.

Modal age	R01 NO	R02 NO	R03 DK	R04 NO	R05 DK	all
0	83 %	92 %	91 %	92 %	64 %	84 %
1	94 %	94 %	79 %	91 %	91 %	90 %
2	100 %	93 %	85 %	93 %	95 %	93 %
3	82 %	100 %	82 %	70 %	82 %	83 %
4	80 %	80 %	80 %	70 %	90 %	80 %
5	67 %	67 %	67 %	67 %	100 %	73 %
6	100 %	50 %	50 %	50 %	50 %	60 %
7	100 %	50 %	0 %	100 %	100 %	70 %
8	100 %	0 %	0 %	0 %	100 %	40 %
9	100 %	100 %	0 %	0 %	100 %	60 %
<b>Weighted Mean</b>	<b>92 %</b>	<b>90 %</b>	<b>79 %</b>	<b>85 %</b>	<b>89 %</b>	<b>87 %</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. Individual age reader bias plots can be found in Annex 3.3 (Figure 9).

**Table 10:** 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.

Modal age	R01 NO	R02 NO	R03 DK	R04 NO	R05 DK	all
0	0.17	0.25	0.09	0.08	0.36	<b>0.19</b>
1	-0.06	0.06	-0.21	0.03	0.12	<b>-0.01</b>
2	0.00	0.02	-0.15	0.02	0.05	<b>-0.01</b>
3	-0.18	0.00	0.00	-0.10	-0.18	<b>-0.09</b>
4	-0.20	0.00	0.00	0.10	0.10	<b>0.00</b>
5	-0.33	0.33	-0.33	-0.33	0.00	<b>-0.13</b>
6	0.00	0.50	-1.00	0.50	0.50	<b>0.10</b>
7	0.00	-0.50	-1.00	0.00	0.00	<b>-0.30</b>
8	0.00	-1.00	-2.00	1.00	0.00	<b>-0.40</b>
9	0.00	0.00	-1.00	1.00	0.00	<b>0.00</b>
<b>Weighted Mean</b>	<b>-0.04</b>	<b>0.05</b>	<b>-0.17</b>	<b>0.04</b>	<b>0.09</b>	<b>-0.01</b>



**Figure 3:** Age bias plot for advanced 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).

### Results by strata (stock)

A separate analysis of the age readings based on their strata (stock) shows the highest weighted mean PA (Table 13) for san.sa.1r. The age error matrices (AEM's) showing the proportions of age readings in agreement with modal age (Table 15, 16 and 17) are also highest for san.sa.1r. CV (Table 12) is highest for san.sa.1r but it should be noted that the modal age range is 0-4. For san.sa.3r the modal age range is 0-8 and there is much more variability around the modal age. For san.sa.5r the variability is even higher over a modal age range of 0-9. For all strata the relative bias (Table 14) is positive at modal age 0, with an average of 0.28 across strata indicating an overestimation of age in comparison to modal age 0.

**Table 11:** Number of age readings per strata for all advanced readers.

Modal age	san.sa.1r	san.sa.3r	san.sa.5r	total
0	29	25	4	58
1	115	38	17	170
2	113	64	35	212
3	29	20	5	54
4	10	30	10	50
5	0	5	10	15
6	0	5	5	10
7	0	5	5	10
8	0	5	0	5
9	0	0	5	5
<b>Total</b>	<b>296</b>	<b>197</b>	<b>96</b>	<b>589</b>

**Table 12:** Coefficient of Variation (CV) per modal age per strata. “all” is an average CV per modal age across strata.

Modal age	san.sa.1r	san.sa.3r	san.sa.5r	all
0	-	-	-	-
1	27 %	49 %	35 %	35 %
2	13 %	0 %	19 %	13 %
3	16 %	24 %	24 %	19 %
4	12 %	12 %	8 %	11 %
5	-	12 %	9 %	11 %
6	-	19 %	9 %	14 %
7	-	8 %	7 %	7 %
8	-	15 %	-	15 %
9	-	-	8 %	8 %
<b>Weighted Mean</b>	<b>20 %</b>	<b>17 %</b>	<b>18 %</b>	<b>20 %</b>

**Table 13:** Percentage agreement (PA) per modal age per strata. “all” is an average PA per modal age across strata.

Modal age	san.sa.1r	san.sa.3r	san.sa.5r	all
0	86 %	88 %	50 %	84 %
1	93 %	82 %	88 %	90 %
2	93 %	100 %	83 %	93 %
3	79 %	95 %	60 %	83 %
4	80 %	77 %	90 %	80 %
5	-	60 %	80 %	73 %
6	-	60 %	60 %	60 %
7	-	60 %	80 %	70 %
8	-	40 %	-	40 %
9	-	-	60 %	60 %
<b>Weighted Mean</b>	<b>91 %</b>	<b>86 %</b>	<b>79 %</b>	<b>87 %</b>

**Table 14:** Relative Bias per modal age per strata. “all” is an average relative bias per modal age across strata.

Modal age	san.sa.1r	san.sa.3r	san.sa.5r	all
0	0.21	0.12	0.50	0.28
1	-0.03	0.05	0.00	0.01
2	-0.05	0.00	0.11	0.02
3	-0.07	-0.15	0.00	-0.07
4	0.00	0.03	-0.10	-0.02
5	-	-0.40	0.00	-
6	-	-0.20	0.40	-
7	-	-0.40	-0.20	-
8	-	-0.40	-	-
9	-	-	0.00	-
<b>Weighted Mean</b>	<b>-0.02</b>	<b>-0.02</b>	<b>0.06</b>	<b>0.03</b>

**Table 15:** Age error matrix (AEM) for san.sa.1r. 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.

strata	Modal age	0	1	2	3	4	5	6	7	8	9
san.sa.1r	Age 0	0.86207	0.05217	-	-	-	-	-	-	-	-
san.sa.1r	Age 1	0.10345	0.93043	0.06195	-	-	-	-	-	-	-
san.sa.1r	Age 2	-	0.01739	0.92920	0.13793	-	-	-	-	-	-
san.sa.1r	Age 3	0.03448	-	0.00885	0.79310	0.1	-	-	-	-	-
san.sa.1r	Age 4	-	-	-	0.06897	0.8	-	-	-	-	-
san.sa.1r	Age 5	-	-	-	-	0.1	-	-	-	-	-

**Table 16:** Age error matrix (AEM) for san.sa.3r. 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.

strata	Modal age	0	1	2	3	4	5	6	7	8	9
san.sa.3r	Age 0	0.88	0.07895	-	0.05	-	-	-	-	-	-
san.sa.3r	Age 1	0.12	0.81579	-	-	-	-	-	-	-	-
san.sa.3r	Age 2	-	0.07895	1	-	-	-	-	-	-	-
san.sa.3r	Age 3	-	0.02632	-	0.95	0.1000	-	-	-	-	-
san.sa.3r	Age 4	-	-	-	-	0.7667	0.4	0.2	-	-	-
san.sa.3r	Age 5	-	-	-	-	0.1333	0.6	-	-	-	-
san.sa.3r	Age 6	-	-	-	-	-	-	0.6	0.4	0.2	-
san.sa.3r	Age 7	-	-	-	-	-	-	0.2	0.6	0.2	-
san.sa.3r	Age 8	-	-	-	-	-	-	-	-	0.4	-
san.sa.3r	Age 9	-	-	-	-	-	-	-	-	0.2	-

**Table 17:** Age error matrix (AEM) for san.sa.5r. 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.

strata	Modal age	0	1	2	3	4	5	6	7	8	9
san.sa.5r	Age 0	0.5	0.05882	-	-	-	-	-	-	-	-
san.sa.5r	Age 1	0.5	0.88235	0.02857	-	-	-	-	-	-	-
san.sa.5r	Age 2	-	0.05882	0.82857	0.2	-	-	-	-	-	-
san.sa.5r	Age 3	-	-	0.14286	0.6	0.1	-	-	-	-	-
san.sa.5r	Age 4	-	-	-	0.2	0.9	0.1	-	-	-	-
san.sa.5r	Age 5	-	-	-	-	-	0.8	-	-	-	-
san.sa.5r	Age 6	-	-	-	-	-	0.1	0.6	0.2	-	-
san.sa.5r	Age 7	-	-	-	-	-	-	0.4	0.8	-	-
san.sa.5r	Age 8	-	-	-	-	-	-	-	-	-	0.2
san.sa.5r	Age 9	-	-	-	-	-	-	-	-	-	0.6
san.sa.5r	Age 10	-	-	-	-	-	-	-	-	-	0.2

### Results of the re-reading of the 2016 agreed age set

Included in the 2019 and 2022 exchanges were 40 fish with 100% agreement in 2016. When comparing the results achieved in 2019 to those in 2022 an overall improvement is apparent with an increase in PA from 85.4% to 91.9% and a decrease in CV from 24.2% to 17.4% (Table 18).

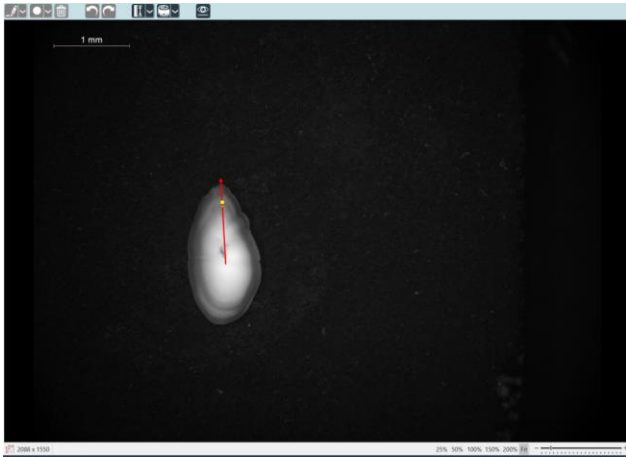
**Table 18:** Comparison of 2019 and 2022 results (Percentage Agreement (PA) and Coefficient of Variation (CV)) from the re-reading of the 40 otoliths with 100% agreement in 2016

Modal age	2019		2022	
	CV	PA	CV	PA
0	-	67%	-	75%
1	29.2%	85%	15.1%	94%

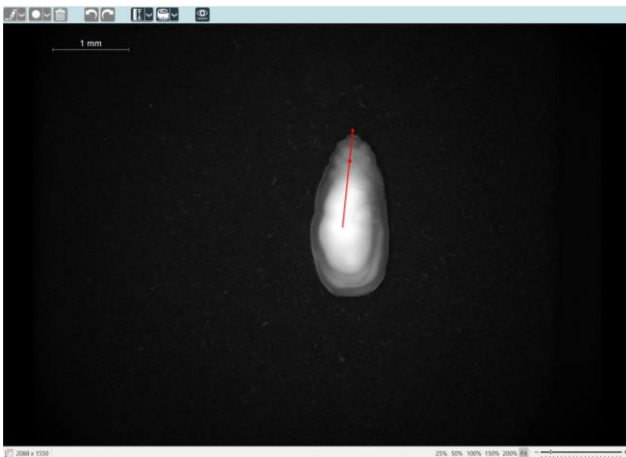
2	9.5%	92%	12.2%	89%
3	25.1%	61%	0.0%	100%
4	5.3%	92%	11.2%	80%
<b>Weighted Mean</b>	<b>24.4%</b>	<b>85.4%</b>	<b>17.4 %</b>	<b>91.9 %</b>

### 1.1.3 Image examples

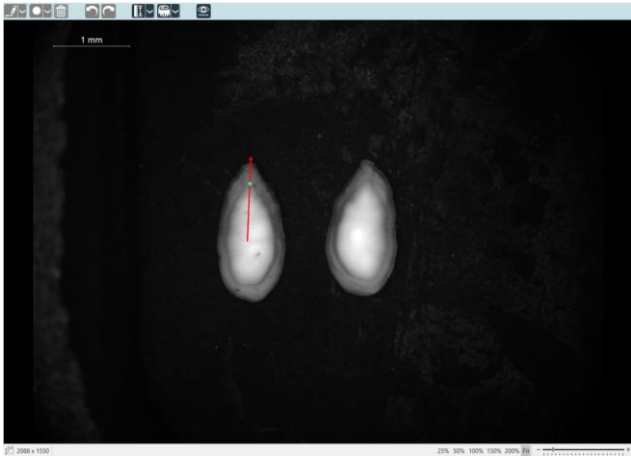
Figures 4, 5, 6 and 7 illustrate the disagreement between readers on whether or not to include a faint inner translucent zone when estimating the age of the fish. Images show the variability the width of the translucent zone between otoliths and also between the rostrum and post-rostrum.



**Figure 4:** Sandeel\_2022\_013, modal age 1, catch date 27-11-2018, TL 105mm. Three readers are counting a faint inner translucent zone as a winter ring and estimating the age to be 1 year. R01 NO and R03 DK estimating age 0.



**Figure 5:** Sandeel\_2022\_012, modal age 0, catch date 27-11-2018, TL 115mm. One reader is counting a faint inner translucent zone as a winter ring and estimating the age to be 1 year. R01 NO, R02 NO, R04 NO and R03 DK estimating age 0.



**Figure 7:** Sandeel\_2022\_034, modal age 0, catch date 21-11-2018, TL 100mm. Disagreement between readers on whether the innermost translucent zone should be counted as a winter ring or not. R01 NO and R03 DK estimating age 0.



**Figure 7:** Sandeel\_2022\_078, modal age 1, catch date 24-11-2015, TL 140mm. R01 NO is the only reader estimating age 0. In 2016 the agreed age was 1.

# Annexes

# 1.2 References

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

ICES (2014) Report of the Workshop on Statistical Analysis of Biological Calibration Studies (WKSABCAL). ICES CM  
2014/ACOM: 35

WKSAND (2016) Sandeel age reading exchange 2016 – Working Document for WKSAND 2016 Compiled by Julie Coad  
Davies, Technical University of Denmark, National Institute of Aquatic Resources, DTU Aqua.

North Sea Sandeel Age Reading Exchange 2016 (SmartDots ID219) Coordination and analysis: Julie Coad Davies,  
Technical University of Denmark, National Institute of Aquatic Resources, DTU Aqua.  
<https://smartdots.ices.dk/SampleImages/2019/219/2019%20North%20Sea%20Sandeel%20Age%20Reading%20Exchange%20Report.pdf>



# 1.3 Results all readers

**Table 19:** Data overview including modal age and statistics per sample.

Fish ID	Event ID	Image ID	length	sex	Catch date	ICES area	RO 1 NO	RO 2 NO	RO 3 DK	RO 4 NO	RO 5 DK	RO 6 DK	RO 7 DK	Modal age	PA %	CV %	AP E %
Sandeel_2022_001	424	-	200	F	25/11/2018 19:24:00	27.4.b	4	4	4	4	4	4	4	4	100	0	0
Sandeel_2022_002	424	-	190	M	25/11/2018 19:24:00	27.4.b	3	4	4	3	4	4	3	4	57	15	14
Sandeel_2022_003	424	-	185	M	25/11/2018 19:24:00	27.4.b	3	3	3	3	3	3	3	3	100	0	0
Sandeel_2022_004	424	-	175	F	05/12/2018 23:18:00	27.4.b	2	2	2	2	2	2	2	2	100	0	0
Sandeel_2022_005	424	-	170	F	05/12/2018 23:18:00	27.4.b	2	2	2	2	2	3	2	2	86	18	11
Sandeel_2022_006	424	-	165	M	05/12/2018 23:18:00	27.4.b	2	2	2	2	2	2	1	2	86	20	13
Sandeel_2022_007	424	-	160	F	05/12/2018 23:18:00	27.4.b	2	2	2	2	2	2	2	2	100	0	0
Sandeel_2022_008	424	-	155	F	25/11/2018 19:24:00	27.4.b	2	2	-	2	2	2	2	2	100	0	0
Sandeel_2022_009	424	-	150	F	25/11/2018 19:24:00	27.4.b	2	2	2	2	2	2	2	2	100	0	0
Sandeel_2022_010	424	-	140	M	25/11/2018 19:24:00	27.4.b	2	2	2	2	2	2	2	2	100	0	0
Sandeel_2022_011	424	-	140	F	25/11/2018 19:24:00	27.4.b	2	2	2	2	2	2	2	2	100	0	0
Sandeel_2022_012	424	-	115		27/11/2018 20:47:00	27.4.b	0	0	0	0	1	1	0	0	71	-	-
Sandeel_2022_013	424	-	105		27/11/2018 20:47:00	27.4.b	0	1	0	1	1	1	0	1	57	94	86
Sandeel_2022_014	424	-	100		27/11/2018 20:47:00	27.4.b	1	1	0	1	1	1	1	1	86	44	29
Sandeel_2022_015	424	-	135	F	25/11/2018 19:24:00	27.4.b	1	1	1	1	1	1	1	1	100	0	0
Sandeel_2022_016	424	-	125	F	25/11/2018 19:24:00	27.4.b	1	1	1	2	1	1	1	1	86	33	21
Sandeel_2022_017	424	-	95	F	05/12/2018 18:33:00	27.4.b	0	0	0	0	1	1	0	0	71	-	-
Sandeel_2022_018	424	-	80	U	03/12/2018 00:01:00	27.3.a.2	1	0	0	0	0	0	0	0	86	-	-
Sandeel_2022_019	424	-	70	U	03/12/2018 00:01:00	27.3.a.2	0	0	0	0	0	0	0	0	100	-	-
Sandeel_2022_020	424	-	45	U	05/12/2018 18:33:00	27.4.b	0	0	0	0	0	0	0	0	100	-	-
Sandeel_2022_021	424	-	165	M	21/11/2018 17:29:00	27.4.b	2	2	2	2	2	2	2	2	100	0	0
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Sandeel_2022_023	424	-	155	F	21/11/2018 17:29:00	27.4.b	3	3	4	2	4	4	2	4	43	29	23
Sandeel_2022_024	424	-	155	M	21/11/2018 17:29:00	27.4.b	2	2	2	2	2	3	2	2	86	18	11
Sandeel_2022_025	424	-	150	M	21/11/2018 17:29:00	27.4.b	2	2	2	2	2	2	2	2	100	0	0

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Sandeeel_2022_02_7	424	-	140	M	21/11/2018 17:29:00	27.4.b	2	2	2	2	2	3	2	2	86	18	11
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Sandeeel_2022_02_9	424	-	135	M	21/11/2018 17:29:00	27.4.b	2	2	2	2	2	2	2	2	10	0	0
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Sandeeel_2022_03_3	424	-	110	M	21/11/2018 17:29:00	27.4.b	1	1	0	1	1	1	1	1	86	44	29
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Sandeeel_2022_03_6	424	-	90		21/11/2018 17:29:00	27.4.b	0	0	0	0	0	0	0	0	10	-	-
Sandeeel_2022_03_7	424	-	80		21/11/2018 17:29:00	27.4.b	0	0	0	0	0	0	0	0	10	-	-
Sandeeel_2022_03_8	424	-	70		21/11/2018 17:29:00	27.4.b	0	0	0	0	0	0	0	0	10	-	-
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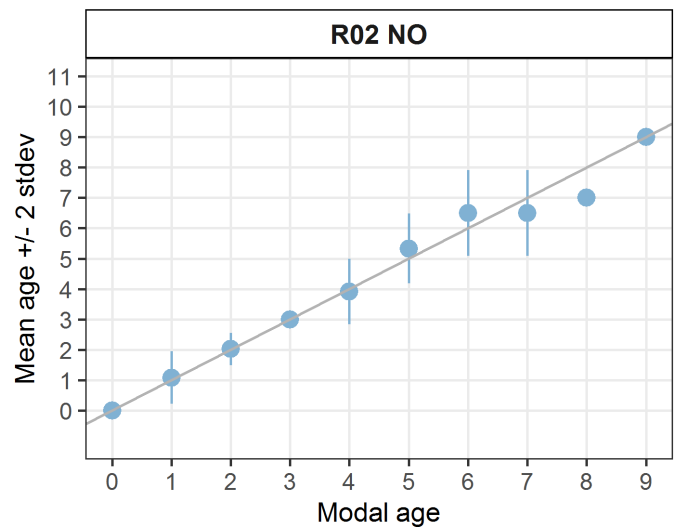
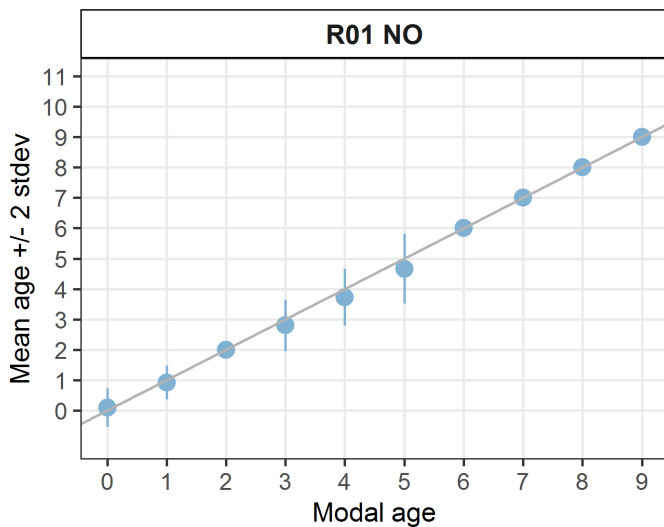
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Sandeeel_2022_07 5	424	-	130	U	28/11/201 5 00:00:00	27.4.b	1	1	0	1	1	1	1	1	86	44	29
Sandeeel_2022_07 6	424	-	120	U	28/11/201 5 00:00:00	27.4.b	1	1	0	1	1	1	1	1	86	44	29
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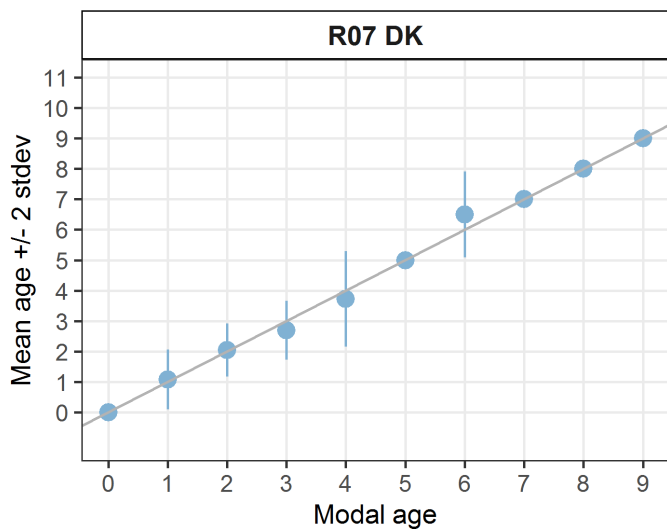
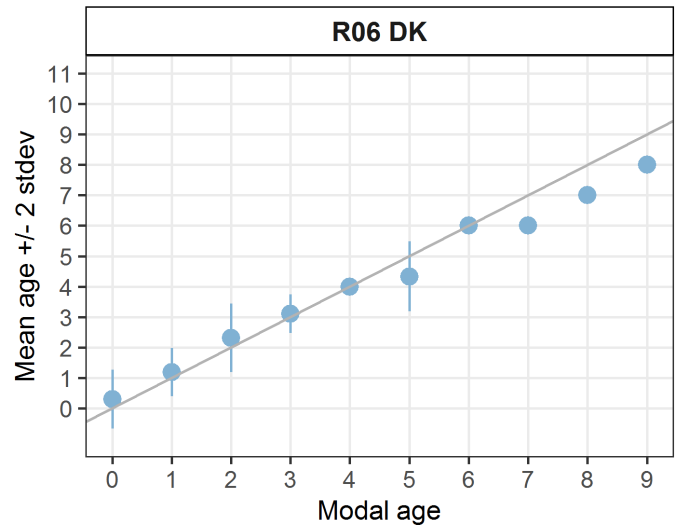
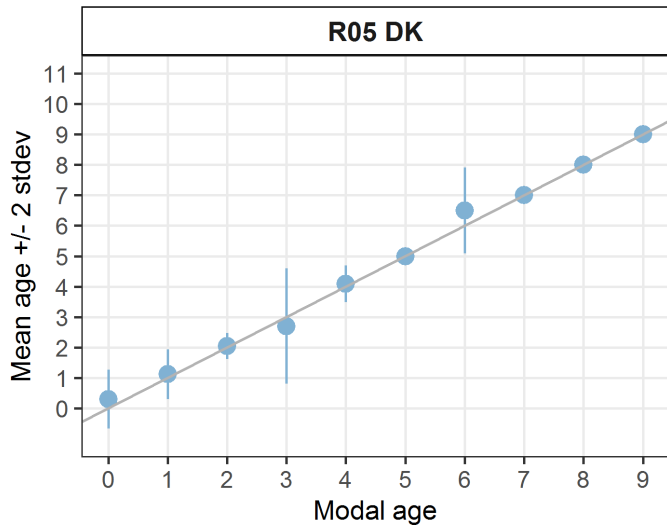
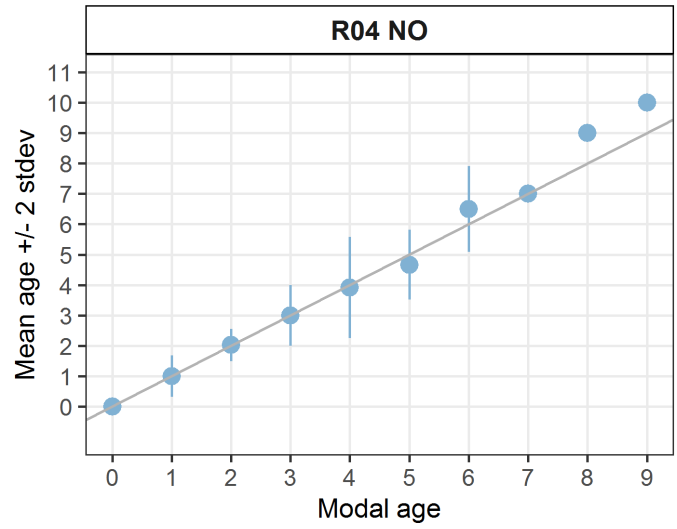
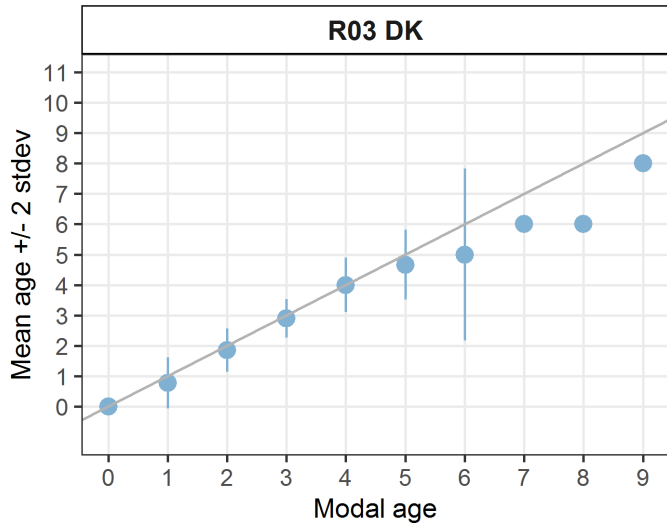
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Sandeeel_2022_08 6	424	-	165	13/05/201 6 00:00:00	27.4.a	4	4	4	4	4	4	4	4	10 0	0	0
Sandeeel_2022_08 7	424	-	180	13/05/201 6 00:00:00	27.4.a	4	5	3	5	4	4	4	4	57	17	12
Sandeeel_2022_08 8	424	-	200	09/05/201 6 00:00:00	27.4.a	4	4	4	4	4	4	4	4	10 0	0	0
Sandeeel_2022_08 9	424	-	200	26/04/201 7 00:00:00	27.4.a	3	3	3	3	3	3	3	3	10 0	0	0
Sandeeel_2022_09 0	424	-	195	26/04/201 7 00:00:00	27.4.a	3	3	3	3	0	3	3	3	86	44	29
Sandeeel_2022_09 1	424	-	210	26/04/201 7 00:00:00	27.4.a	3	3	3	3	3	3	3	3	10 0	0	0
Sandeeel_2022_09 2	424	-	185	09/05/201 6 00:00:00	27.4.a	2	2	2	2	2	2	2	2	10 0	0	0
Sandeeel_2022_09 3	424	-	160	28/04/201 6 00:00:00	27.4.b	2	2	2	2	2	2	2	2	10 0	0	0
Sandeeel_2022_09 4	424	-	140	28/04/201 6 00:00:00	27.4.b	2	2	2	2	2	2	2	2	10 0	0	0
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Sandeeel_2022_09 6	424	-	125	28/04/201 6 00:00:00	27.4.b	2	2	2	2	2	2	2	2	10 0	0	0
Sandeeel_2022_09 7	424	-	120	26/04/201 7 00:00:00	27.4.a	1	1	1	1	1	2	1	1	86	33	21
Sandeeel_2022_09 8	424	-	150	26/04/201 7 00:00:00	27.4.a	1	2	-	1	3	2	3	1	33	45	33
Sandeeel_2022_09 9	424	-	100	26/04/201 7 00:00:00	27.4.a	1	1	1	1	1	1	1	1	10 0	0	0
Sandeeel_2022_10 0	424	-	135	13/05/201 6 00:00:00	27.4.a	1	2	1	-	1	2	3	1	50	49	40
Sandeeel_2022_10 1	424	-	215	08/05/201 1 00:00:00	27.4.a	9	9	8	10	9	8	9	9	57	8	6
Sandeeel_2022_10 2	424	-	205	08/05/201 1 00:00:00	27.4.a	7	7	6	7	7	6	7	7	71	7	6
Sandeeel_2022_10 3	424	-	200	08/05/201 1 00:00:00	27.4.a	6	6	6	7	7	6	6	6	71	8	6
Sandeeel_2022_10 4	424	-	185	08/05/201 1 00:00:00	27.4.a	5	6	4	5	5	4	5	5	57	14	10
Sandeeel_2022_10 5	424	-	175	14/05/201 7 00:00:00	27.4.a	5	5	5	5	5	5	5	5	10 0	0	0
Sandeeel_2022_10 6	424	-	195	08/05/201 1 00:00:00	27.4.a	4	4	4	4	4	4	4	4	10 0	0	0
Sandeeel_2022_10 7	424	-	215	08/05/201 1 00:00:00	27.4.a	3	4	4	4	4	4	4	4	86	10	6
Sandeeel_2022_10 8	424	-	170	08/05/201 1 00:00:00	27.4.a	2	3	2	3	2	4	3	2	43	28	23
Sandeeel_2022_10 9	424	-	160	08/05/201 1 00:00:00	27.4.a	2	3	2	3	2	4	3	2	43	28	23
Sandeeel_2022_11 0	424	-	150	14/05/201 7 00:00:00	27.4.a	3	3	2	4	3	4	3	3	57	22	16
Sandeeel_2022_11 1	424	-	135	08/05/201 1 00:00:00	27.4.a	2	2	2	2	2	2	2	2	10 0	0	0
Sandeeel_2022_11 2	424	-	95	08/05/201 1 00:00:00	27.4.a	2	2	1	2	2	2	2	2	86	20	13

Sandeel_2022_11 3	424	-	145	08/05/201 1 00:00:00	27.4.a	2	2	2	2	2	2	2	2	10	0	0
Sandeel_2022_11 4	424	-	120	14/05/201 7 00:00:00	27.4.a	2	2	2	2	3	2	2	2	86	18	11
Sandeel_2022_11 5	424	-	105	14/05/201 7 00:00:00	27.4.a	1	1	1	1	1	2	1	1	86	33	21
Sandeel_2022_11 6	424	-	135	14/05/201 7 00:00:00	27.4.a	2	2	2	2	2	2	2	2	10	0	0
Sandeel_2022_11 7	424	-	95	14/05/201 7 00:00:00	27.4.a	1	1	1	1	2	2	1	1	71	38	32
Sandeel_2022_11 8	424	-	140	14/05/201 7 00:00:00	27.4.a	1	1	1	-	-	1	1	1	10	0	0
Sandeel_2022_11 9	424	-	110	14/05/201 7 00:00:00	27.4.a	1	1	1	0	-	1	1	1	83	49	33
Sandeel_2022_12 0	424	-	85	14/05/201 7 00:00:00	27.4.a	1	0	1	0	-	1	1	1	67	77	67

**Table 20:** 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	R01 NO	R02 NO	R03 DK	R04 NO	R05 DK	R06 DK	R07 DK	total
0	10	10	9	10	10	10	10	69
1	37	37	36	35	34	37	37	253
2	42	43	41	43	43	42	43	297
3	10	10	10	9	10	10	10	69
4	11	11	11	11	11	11	11	77
5	3	3	3	3	3	3	3	21
6	2	2	2	2	2	2	2	14
7	2	2	2	2	2	2	2	14
8	1	1	1	1	1	1	1	7
9	1	1	1	1	1	1	1	7
<b>Total</b>	<b>119</b>	<b>120</b>	<b>116</b>	<b>117</b>	<b>117</b>	<b>119</b>	<b>120</b>	<b>828</b>





**Figure 8:** Individual age bias plots. 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).

# 1.4 Results Advanced readers

**Table 21:** Data overview including modal age and statistics per sample.

Fish ID	Event ID	Image ID	length	sex	Catch date	ICES area	R01 NO	R02 NO	R03 DK	R04 NO	R05 DK	Modal age	PA %	CV %	APE %
Sandeel_2022_001	424	-	200	F	25/11/2018 19:24:00	27.4.b	4	4	4	4	4	4	100	0	0
Sandeel_2022_002	424	-	190	M	25/11/2018 19:24:00	27.4.b	3	4	4	3	4	4	60	15	13
Sandeel_2022_003	424	-	185	M	25/11/2018 19:24:00	27.4.b	3	3	3	3	3	3	100	0	0
Sandeel_2022_004	424	-	175	F	05/12/2018 23:18:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_005	424	-	170	F	05/12/2018 23:18:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_006	424	-	165	M	05/12/2018 23:18:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_007	424	-	160	F	05/12/2018 23:18:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_008	424	-	155	F	25/11/2018 19:24:00	27.4.b	2	2	-	2	2	2	100	0	0
Sandeel_2022_009	424	-	150	F	25/11/2018 19:24:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_010	424	-	140	M	25/11/2018 19:24:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_011	424	-	140	F	25/11/2018 19:24:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_012	424	-	115		27/11/2018 20:47:00	27.4.b	0	0	0	0	1	0	80	-	-
Sandeel_2022_013	424	-	105		27/11/2018 20:47:00	27.4.b	0	1	0	1	1	1	60	91	80
Sandeel_2022_014	424	-	100		27/11/2018 20:47:00	27.4.b	1	1	0	1	1	1	80	56	40
Sandeel_2022_015	424	-	135	F	25/11/2018 19:24:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_016	424	-	125	F	25/11/2018 19:24:00	27.4.b	1	1	1	2	1	1	80	37	27
Sandeel_2022_017	424	-	95	F	05/12/2018 18:33:00	27.4.b	0	0	0	0	1	0	80	-	-
Sandeel_2022_018	424	-	80	U	03/12/2018 00:01:00	27.3.a.20	1	0	0	0	0	0	80	-	-
Sandeel_2022_019	424	-	70	U	03/12/2018 00:01:00	27.3.a.20	0	0	0	0	0	0	100	-	-
Sandeel_2022_020	424	-	45	U	05/12/2018 18:33:00	27.4.b	0	0	0	0	0	0	100	-	-
Sandeel_2022_021	424	-	165	M	21/11/2018 17:29:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_022	424	-	160	M	21/11/2018 17:29:00	27.4.b	2	3	3	2	3	3	60	21	18
Sandeel_2022_023	424	-	155	F	21/11/2018 17:29:00	27.4.b	3	3	4	2	4	3	40	26	20
Sandeel_2022_024	424	-	155	M	21/11/2018 17:29:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_025	424	-	150	M	21/11/2018 17:29:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_026	424	-	145	F	21/11/2018 17:29:00	27.4.b	2	2	2	2	2	2	100	0	0

Sandeel_2022_027	424	-	140	M	21/11/2018 17:29:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_028	424	-	140	M	21/11/2018 17:29:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_029	424	-	135	M	21/11/2018 17:29:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_030	424	-	125	M	21/11/2018 17:29:00	27.4.b	1	1	1	1	2	1	80	37	27
Sandeel_2022_031	424	-	125	F	21/11/2018 17:29:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_032	424	-	115	M	21/11/2018 17:29:00	27.4.b	2	2	-	2	2	2	100	0	0
Sandeel_2022_033	424	-	110	M	21/11/2018 17:29:00	27.4.b	1	1	0	1	1	1	80	56	40
Sandeel_2022_034	424	-	100	F	21/11/2018 17:29:00	27.4.b	0	3	0	1	1	0	40	-	-
Sandeel_2022_035	424	-	100		21/11/2018 17:29:00	27.4.b	0	0	0	0	0	0	100	-	-
Sandeel_2022_036	424	-	90		21/11/2018 17:29:00	27.4.b	0	0	0	0	0	0	100	-	-
Sandeel_2022_037	424	-	80		21/11/2018 17:29:00	27.4.b	0	0	0	0	0	0	100	-	-
Sandeel_2022_038	424	-	70		21/11/2018 17:29:00	27.4.b	0	0	0	0	0	0	100	-	-
Sandeel_2022_039	424	-	165	F	21/11/2018 04:29:00	27.4.b	2	3	3	3	3	3	80	16	11
Sandeel_2022_040	424	-	155	M	21/11/2018 04:29:00	27.4.b	2	2	2	2	3	2	80	20	15
Sandeel_2022_041	424	-	125	U	24/11/2015 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_042	424	-	115	U	24/11/2015 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_043	424	-	110	U	24/11/2015 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_044	424	-	110	U	24/11/2015 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_045	424	-	105	U	24/11/2015 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_046	424	-	105	U	24/11/2015 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_047	424	-	105	U	24/11/2015 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_048	424	-	100	U	24/11/2015 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_049	424	-	140	U	26/11/2015 00:00:00	27.4.b	2	2	2	1	2	2	80	25	18
Sandeel_2022_050	424	-	125	U	26/11/2015 00:00:00	27.4.b	1	1	1	2	1	1	80	37	27
Sandeel_2022_051	424	-	145	U	24/11/2015 00:00:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_052	424	-	150	U	24/11/2015 00:00:00	27.4.b	3	3	3	-	3	3	100	0	0
Sandeel_2022_053	424	-	140	U	24/11/2015 00:00:00	27.4.b	3	3	3	3	3	3	100	0	0
Sandeel_2022_054	424	-	160	U	16/04/2016 00:00:00	27.4.b	4	4	4	5	4	4	80	11	8
Sandeel_2022_055	424	-	185	U	17/04/2016 00:00:00	27.4.b	4	3	4	4	4	4	80	12	8



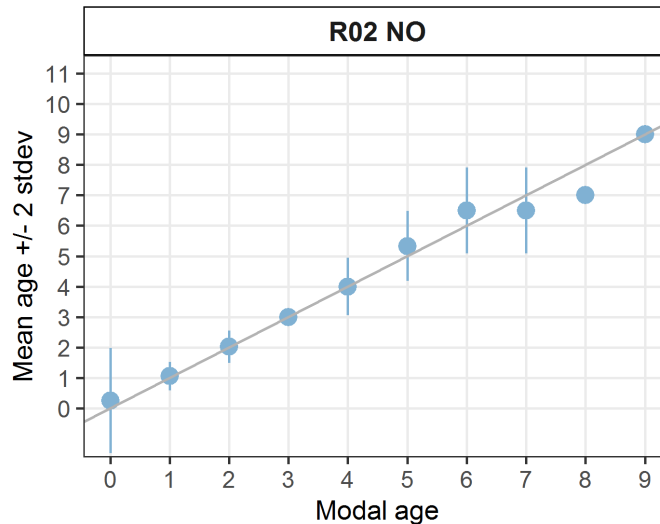
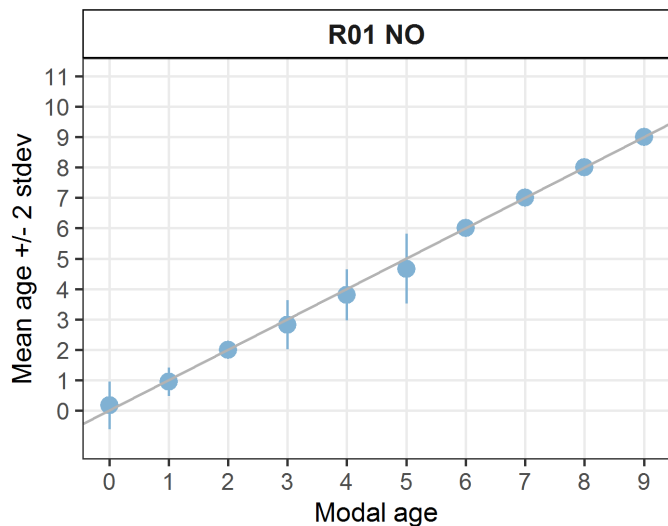
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Sandeel_2022_063	424	-	150	U	17/04/2016 00:00:00	27.4.b	2	2	1	2	2	2	80	25	18
Sandeel_2022_064	424	-	140	U	17/04/2016 00:00:00	27.4.b	2	2	1	2	2	2	80	25	18
Sandeel_2022_065	424	-	130	U	17/04/2016 00:00:00	27.4.b	2	2	1	2	2	2	80	25	18
Sandeel_2022_066	424	-	120	U	16/04/2016 00:00:00	27.4.b	2	2	1	2	2	2	80	25	18
Sandeel_2022_067	424	-	110	U	16/04/2016 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_068	424	-	100	U	16/04/2016 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_069	424	-	90	U	16/04/2016 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_070	424	-	85	U	16/04/2016 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_071	424	-	115	U	17/04/2016 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_072	424	-	110	U	17/04/2016 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_073	424	-	135	U	28/11/2015 00:00:00	27.4.b	1	1	0	1	1	1	80	56	40
Sandeel_2022_074	424	-	130	U	28/11/2015 00:00:00	27.4.b	1	1	1	1	1	1	100	0	0
Sandeel_2022_075	424	-	130	U	28/11/2015 00:00:00	27.4.b	1	1	0	1	1	1	80	56	40
Sandeel_2022_076	424	-	120	U	28/11/2015 00:00:00	27.4.b	1	1	0	1	1	1	80	56	40
Sandeel_2022_077	424	-	115	U	28/11/2015 00:00:00	27.4.b	1	1	0	1	1	1	80	56	40
Sandeel_2022_078	424	-	140	U	24/11/2015 00:00:00	27.4.b	0	1	1	1	1	1	80	56	40
Sandeel_2022_079	424	-	135	U	24/11/2015 00:00:00	27.4.b	0	0	-	0	1	0	75	-	-
Sandeel_2022_080	424	-	165	U	16/04/2016 00:00:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_081	424	-	250		26/04/2017 00:00:00	27.4.a	8	7	6	9	8	8	40	15	12
Sandeel_2022_082	424	-	225		09/05/2016 00:00:00	27.4.a	7	6	6	7	7	7	60	8	7
Sandeel_2022_083	424	-	245		09/05/2016 00:00:00	27.4.a	6	7	4	6	6	6	60	19	12
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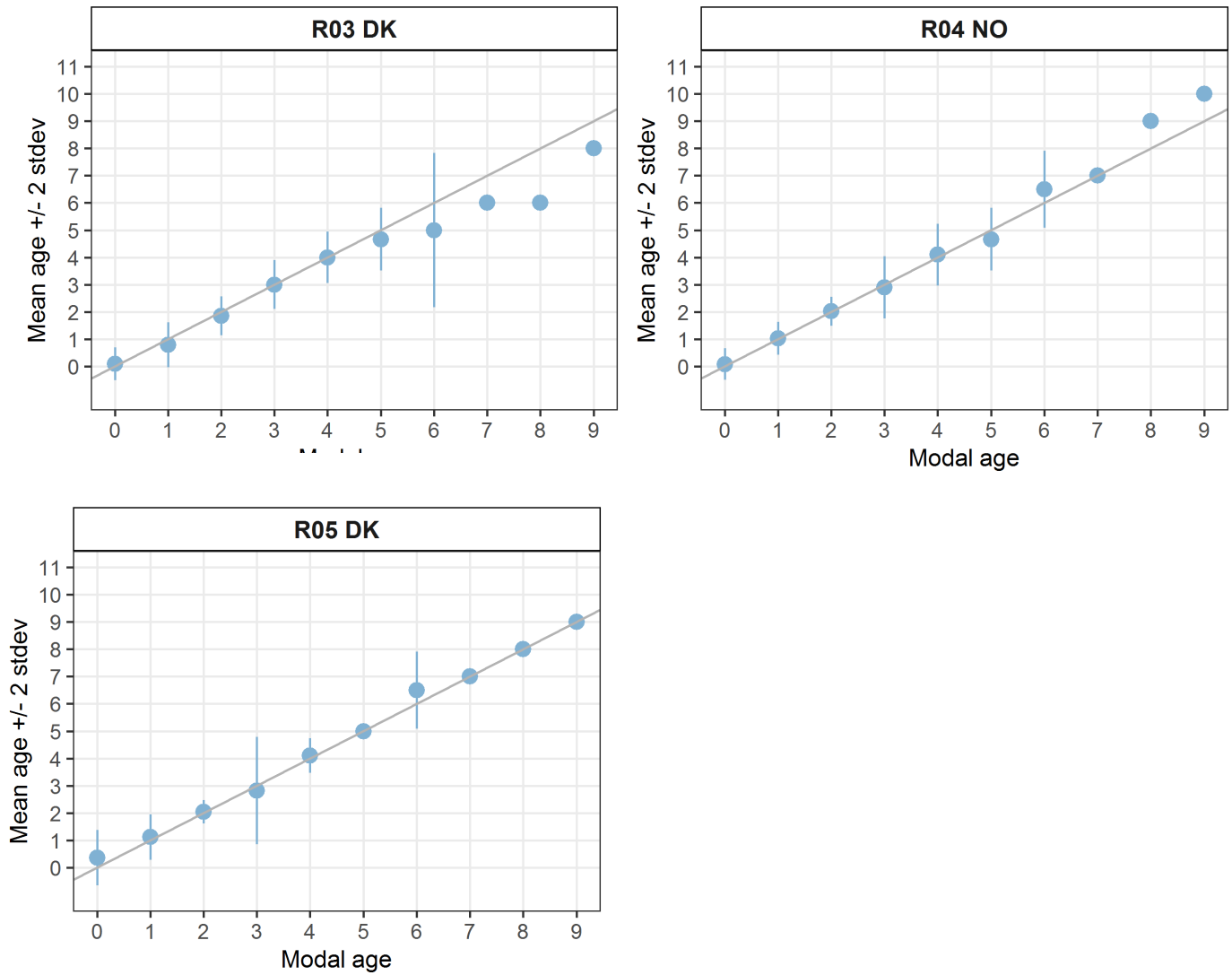
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Sandeel_2022_087	424	-	180	13/05/2016 00:00:00	27.4.a	4	5	3	5	4	4	40	20	15
Sandeel_2022_088	424	-	200	09/05/2016 00:00:00	27.4.a	4	4	4	4	4	4	100	0	0
Sandeel_2022_089	424	-	200	26/04/2017 00:00:00	27.4.a	3	3	3	3	3	3	100	0	0
Sandeel_2022_090	424	-	195	26/04/2017 00:00:00	27.4.a	3	3	3	3	0	3	80	56	40
Sandeel_2022_091	424	-	210	26/04/2017 00:00:00	27.4.a	3	3	3	3	3	3	100	0	0
Sandeel_2022_092	424	-	185	09/05/2016 00:00:00	27.4.a	2	2	2	2	2	2	100	0	0
Sandeel_2022_093	424	-	160	28/04/2016 00:00:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_094	424	-	140	28/04/2016 00:00:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_095	424	-	130	28/04/2016 00:00:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_096	424	-	125	28/04/2016 00:00:00	27.4.b	2	2	2	2	2	2	100	0	0
Sandeel_2022_097	424	-	120	26/04/2017 00:00:00	27.4.a	1	1	1	1	1	1	100	0	0
Sandeel_2022_098	424	-	150	26/04/2017 00:00:00	27.4.a	1	2	-	1	3	1	50	55	43
Sandeel_2022_099	424	-	100	26/04/2017 00:00:00	27.4.a	1	1	1	1	1	1	100	0	0
Sandeel_2022_100	424	-	135	13/05/2016 00:00:00	27.4.a	1	2	1	-	1	1	75	40	30
Sandeel_2022_101	424	-	215	08/05/2011 00:00:00	27.4.a	9	9	8	10	9	9	60	8	4
Sandeel_2022_102	424	-	205	08/05/2011 00:00:00	27.4.a	7	7	6	7	7	7	80	7	5
Sandeel_2022_103	424	-	200	08/05/2011 00:00:00	27.4.a	6	6	6	7	7	6	60	9	8
Sandeel_2022_104	424	-	185	08/05/2011 00:00:00	27.4.a	5	6	4	5	5	5	60	14	8
Sandeel_2022_105	424	-	175	14/05/2017 00:00:00	27.4.a	5	5	5	5	5	5	100	0	0
Sandeel_2022_106	424	-	195	08/05/2011 00:00:00	27.4.a	4	4	4	4	4	4	100	0	0
Sandeel_2022_107	424	-	215	08/05/2011 00:00:00	27.4.a	3	4	4	4	4	4	80	12	8
Sandeel_2022_108	424	-	170	08/05/2011 00:00:00	27.4.a	2	3	2	3	2	2	60	23	20
Sandeel_2022_109	424	-	160	08/05/2011 00:00:00	27.4.a	2	3	2	3	2	2	60	23	20
Sandeel_2022_110	424	-	150	14/05/2017 00:00:00	27.4.a	3	3	2	4	3	3	60	24	13
Sandeel_2022_111	424	-	135	08/05/2011 00:00:00	27.4.a	2	2	2	2	2	2	100	0	0
Sandeel_2022_112	424	-	95	08/05/2011 00:00:00	27.4.a	2	2	1	2	2	2	80	25	18
Sandeel_2022_113	424	-	145	08/05/2011 00:00:00	27.4.a	2	2	2	2	2	2	100	0	0

Sandeel_2022_114	424	-	120	14/05/2017 00:00:00	27.4.a	2	2	2	2	3	2	80	20	15
Sandeel_2022_115	424	-	105	14/05/2017 00:00:00	27.4.a	1	1	1	1	1	1	100	0	0
Sandeel_2022_116	424	-	135	14/05/2017 00:00:00	27.4.a	2	2	2	2	2	2	100	0	0
Sandeel_2022_117	424	-	95	14/05/2017 00:00:00	27.4.a	1	1	1	1	2	1	80	37	27
Sandeel_2022_118	424	-	140	14/05/2017 00:00:00	27.4.a	1	1	1	-	-	1	100	0	0
Sandeel_2022_119	424	-	110	14/05/2017 00:00:00	27.4.a	1	1	1	0	-	1	75	67	50
Sandeel_2022_120	424	-	85	14/05/2017 00:00:00	27.4.a	1	0	1	0	-	0	50	-	-

**Table 22:** 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	R01 NO	R02 NO	R03 DK	R04 NO	R05 DK	total
0	12	12	11	12	11	58
1	35	35	34	33	33	170
2	42	43	41	43	43	212
3	11	11	11	10	11	54
4	10	10	10	10	10	50
5	3	3	3	3	3	15
6	2	2	2	2	2	10
7	2	2	2	2	2	10
8	1	1	1	1	1	5
9	1	1	1	1	1	5
<b>Total</b>	<b>119</b>	<b>120</b>	<b>116</b>	<b>117</b>	<b>117</b>	<b>589</b>





**Figure 9:** Individual age bias plots. 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).