

Report of the 2016 Otolith Exchange – Plaice (*Pleuronectes platessa*) in the Baltic Sea

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Abstract

In 2015 a request was made from the Baltic Fisheries Assessment Working Group (WGBFAS) to the Working Group on Biological Parameters (WGBIOP) to conduct an otolith exchange for plaice in the Baltic Sea. The current exchange was initiated by DTU Aqua, National Institute of Aquatic Resources, Denmark and Thünen Institute of Baltic Sea Fisheries (OF), Rostock, Germany and both institutes provided the samples and corresponding otolith images. The exchange was completed by 7 participants from 4 countries (Denmark, Germany, Poland and Sweden) who supply age data for the stock assessment of plaice in Kattegat, the Sound and Western Baltic (PLE2123) and Baltic Sea (PLE2432). These readers use different otolith preparation methods when age reading plaice, thus images of whole and sectioned otoliths from the same fish were provided. The aim of the exchange was to assess the accuracy of the age readings i.e. the proximity of the estimated ages to the modal age which is determined by percentage agreement and relative bias values, and to assess the precision i.e. the reproducibility of age estimates between readers which is determined using the coefficients of variation (CV) and an index of average percentage error (APE). In addition, growth curves were compiled based on the measurements between annotations made on the otolith images, thus allowing for a more detailed examination of where the main age interpretation problems are. The results show varying levels of accuracy and precision depending on reader expertise, method applied and sample origin. A higher level of agreement was reached when only expert readers were included in the analysis and also for PLE2432 when compared against PLE2123. The level of agreement on sectioned otoliths was slightly higher than whole otoliths but there were no consistent patterns where one method always produced better results compared to the other. It is recommended that a plaice age reading workshop be held to help resolve the age determination differences outlined in the report.

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Introduction

During the Baltic Fisheries Assessment Working Group (WGBFAS) 2015 concerns were raised about the quality of the age data being used for the stock assessment of plaice in SD2123 (ICES, 2015a) and a request to conduct an otolith exchange was made to the Working Group on Biological Parameters (WGBIOP). Prior to this the last plaice otolith exchange was carried out in 2010 as part of the Workshop on Age Reading on North Sea (4) and Skagerrak-Kattegat (3a) Plaice (WKARP). No information is available on when the last workshop was held for Skagerrak-Kattegat plaice prior to this and no information is available on any otolith exchange carried out for plaice in the Baltic. Plaice occurring in different areas experience regional variation in environmental conditions which will influence the growth patterns observed in their otoliths i.e. the timing of the deposition of the summer growth zone, the distance from the centre to the first winter ring and split rings. WKARP (2010) noted that readers were often in doubt as to whether or not they could depend on a regular growth pattern or whether some rings should be interpreted as false. In addition, it appears that for plaice otoliths interpretation problems are more prevalent in some year classes (Bolle, 2002).

The current age calibration exercise was initiated by DTU Aqua National Institute of Aquatic Resources, Denmark and the Thünen Institute of Baltic Sea Fisheries (OF), Rostock, Germany. Samples from all ICES Subdivisions where landings occur were selected in order to cover the major distributional range of plaice in the area. Samples for SD's 21, 23 and 25 were selected and provided by DTU Aqua, Denmark and samples for SD's 22, 24 and 26 were selected and provided by Thünen Institute, Rostock, Germany. The stock structure of plaice in the Baltic is a result of the recommendation made by the Benchmark Workshop on Plaice (WKPLE) in February 2015 (ICES, 2015b) which confirmed the recommendation made by WKPESTO (ICES, 2012b); plaice in Skagerrak is included in the North Sea stock; plaice in Kattegat, the Sound and Western Baltic (Subdivisions 21, 22 and 23) are merged into one stock and plaice in Subdivisions 24–32 are regarded as a separate stock. For this reason one exchange set was compiled for SD2123 and another for SD2432.

Age readers at different institutes are accustomed to reading plaice otoliths using different methods, therefore for each fish one otolith was photographed whole and the other was sectioned and photographed. Otolith images were made available on WebGR for annotation. The aim of the age calibration exercise was to assess the accuracy and precision of the age readings of plaice in the above mentioned areas. It has been co-ordinated and analysed by Julie Coad Davies of DTU Aqua and carried out following the guidelines for otolith exchanges made by the Planning Group on Commercial Catches, Discards and Biological Sampling (PGCCDBS) (ICES, 2012a) and updated by WGBIOP (ICES, 2015c).

Participants

Age reader Information is given in Table 1. An age reader is considered an expert if they contribute age data to the stock assessment. Age readers in Sweden and Poland have experience in reading both whole and sectioned otoliths; in Denmark the readers only read whole otoliths while in Germany the readers only read sectioned otoliths. Initially, the intention was to compare the reliability of the age reading methods against each other but as only one reader is experienced in both methods (and only reading otoliths from SD21) this was not possible.

Table 1 Reader information

Reader Code	First name	Last name	Institution	Expertise section	Expertise whole	ALK
R1	Sven	Dressler	Johann Heinrich von Thünen Institute (Germany)	Expert	Trainee	Yes
R2	Helle	Rasmussen	DTU Aqua (Denmark)	Trainee	Expert	Yes
R3	Svend Erik	Levinsky	DTU Aqua (Denmark)	Trainee	Expert	Yes

R5	Jan Erik	Johansson	Swedish Board of Fisheries (Sweden)	Expert	Expert	Yes
R6	Zuzanna	Mirny	Marine Research Institute MRI (Poland)	Expert	Intermediate	Yes
R7	Frank Ivan	Hansen	DTU Aqua (Denmark)	Trainee	Expert	Yes
R8	Conny	Albrecht	Johann Heinrich von Thünen Institute (Germany)	Expert	Trainee	Yes

Samples

Table 2 Sample overview by ICES Subdivision (SD)

SD	N	Year	Quarter	Type	Length range
21	49	2010	1	Survey and Harbour	150-470 mm
		2012	4	Survey	
22	50	2014	1	Survey	125-425 mm
		2014	4	Survey	
23	48	2010, 2011, 2012	1	Survey	150-490 mm
		2011, 2012	4	Survey	
24	50	2014	1	Survey	115-465 mm
		2014	4	Survey	
25	45	2016	1	Survey	160-390 mm
26	30	2015	4	Survey	235-365 mm

The exchange consisted of both survey and commercial samples covering as many length classes as possible and from 6 ICES Subdivisions (SD), 21 - 26. A pair of plaice otoliths consists of a symmetrical and an asymmetrical otolith (Figure 1). Only samples where both otoliths were available from sexed fish could be used for the exchange. Images were taken of symmetrical otoliths whole and of the asymmetrical otoliths sectioned. For each area every effort was made to have a male to female ratio of 20:30, thus reflecting the sex ratio in the stocks.

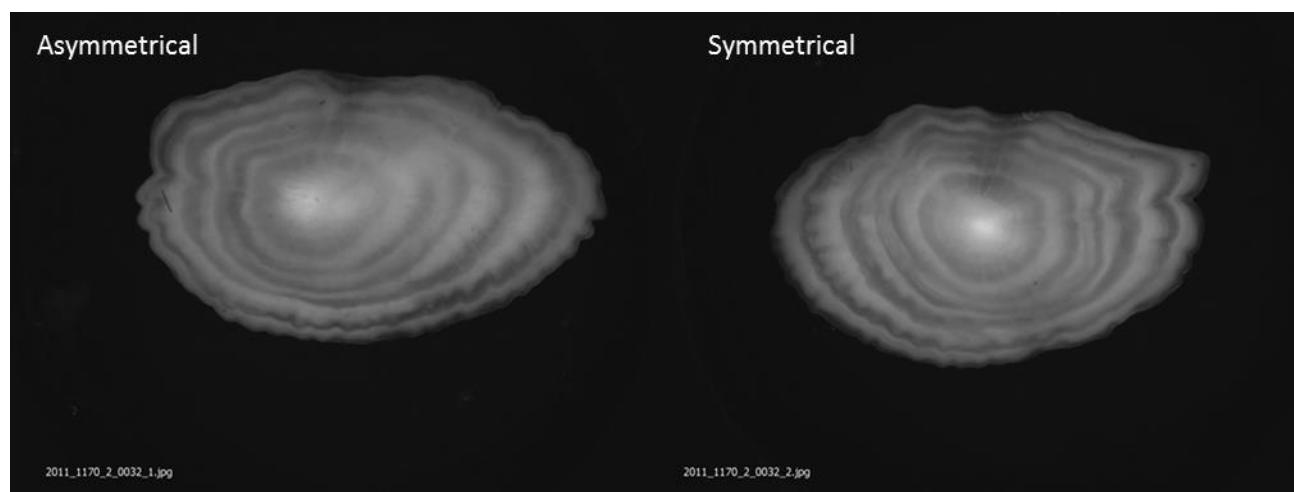


Figure 1a A pair of plaice otoliths

Methods

DTU Aqua was responsible for the images of whole otoliths. Images were taken on a black background under a circular reflected light source. Otoliths had been soaked in water for 2-3 hours prior to digitisation; all images were taken at the same magnification and scale bars marked on the images for reference. Thünen Institute of Baltic Sea Fisheries, Rostock was responsible for images of the sectioned otoliths. Most of the images were taken using transmitted light after the sections had been soaked in silicon oil; however

some images were taken using reflected light. Different magnifications were used for taking the images but the correct scale bars were marked on the images for reference.

The online annotating tool WebGR (available at <http://webgr.azti.es/>) was used for the exchange. Prior to the exercise readers were provided with written instructions on how to annotate the images and an image example indicating which axis to annotate (Annex A). Readers were asked to annotate both the images of the whole and the sectioned otoliths without comparing images from the same fish. They were asked to annotate the nucleus and the start of each translucent zone and give a final estimation of age. The exercises were initially run as blind tests where the readers could not see the annotations of the other readers. Due to an upgrade of WebGR during the exchange this feature of the tool was lost and it was possible for readers to view the annotations of other readers if they chose to. Readers were asked to complete all 4 calibration exercises. They were given information on the capture date, length, area and sex for each image.

A workshop called “Baltic Plaice 2016” was created in WebGR which consisted of 4 calibration exercises:

- **PLE2123 whole oto** (images of whole otoliths from SD's 21, 22 and 23)
- **PLE2123 sectioned oto** (images of sectioned otoliths from SD's 21, 22 and 23)
- **PLE2432 whole oto** (images of whole otoliths from SD's 24 and 26)
- **PLE2432 sectioned oto** (images of sectioned otoliths from SD's 24 and 26)

Analysis

During the initial analysis 2 issues became apparent; firstly, the images of the whole and sectioned otoliths from SD21 did not correspond, meaning the otoliths had become mixed up during the digitisation process. Subsequently, all images in the exchange were checked to ensure that images of the whole otoliths corresponded with the images of the sectioned otoliths and no other errors were found. An analysis of otoliths from SD21 could therefore not be carried out and the data was excluded from the exchange. The second issue encountered was that R1 had not followed the instructions and had annotated the images incorrectly, subsequently R1 reread all the sectioned images from SD's22-26.

Age data:

The traditional analyses of agreement between readers as used in the Guus Eltink spreadsheet (Eltink, A.T.G.W. 2000) was applied via an R script (R v.3.2.1 available at <http://www.R-project.org>):

- average % Agreement (nmodal age/ntotal*100)
- coefficient of variation (CV) (Standard deviation/average*100)
- bias tests and plots

In addition, an index of average percentage error (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 poses 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.

Age error matrices were produced following procedures outlined by WKSABCAL (ICES, 2014) where the matrix shows the proportion of each modal age mis-aged as other ages. The sum of each row is 1, equal to 100%.

Growth data:

WebGR provides a measure of distance between the annotations made by the readers and thus provides a measure of growth increment width. The “alldistances” dataset from WebGR was used to establish growth curves for each fish and for each reader. For each set of annotations belonging to a single fish and reader, the distance between two consecutive annotations was added to the sum of the previous distances and the distances were cumulated from centre point to the outermost annotated winter ring. These growth curves

were analysed using Linear Mixed Effects Models (LMM). The model that best fits the data is a model with log (winter ring) and reader as fixed effects and individual images as random effects.

While the age data provides information on whether the age readers agree in age estimates, the growth data can identify specifically where the problems are, i.e. differences in intercept only are attributable to problems with the first winter ring, while differences in slope indicate a general inconsistency in structures used for age estimation.

It was decided that the growth data from the sectioned otoliths was not suitable for analysis using the above mentioned methods, the reasons being manifold; not all images were taken at the same magnification, resolution and image size; poor image quality of some otoliths and many of the otoliths have a “pancake” like structure where the growth is vertical as opposed to horizontal, meaning that it is not possible to follow the growth curves of these otoliths.

The following analyses were carried out:

1. A comparison of age and growth data for **all readers** of each method and Subdivision separately; 22,23,24,25 and 26
- 2.a A comparison of age and growth data for **expert readers** of each method, for SD22 and SD23 combined (PLE2123)
- 2.b A comparison of age and growth data for **expert readers** of each method, for SD24, SD25 and SD26 combined (PLE2432)
- 3.a A comparison of modal age from **expert readers of whole otoliths and modal age of expert readers of sectioned otoliths**, SD22 and SD23 combined (PLE2123)
- 3.b A comparison of modal age from **expert readers of whole otoliths and modal age of expert readers of sectioned otoliths**, SD24 and SD25 and SD26 combined (PLE2432)

Results of analysis 1

The samples from each ICES Subdivision (SD) (excluding SD21) are analysed separately. Table 3 gives an overview of the results for each SD; percentage agreement (PA), average percentage error (APE) and coefficient of variation (CV). Annex A gives a comprehensive set of results for each reader and for each SD.

Table 3 Overview of the results for each SD; PA (percentage agreement), APE (average percentage error) and CV (coefficient of variation)

	Whole otoliths					
	All readers			Expert readers		
SD	PA	APE	CV	PA	APE	CV
22	61.1%	22%	23.8%	68.7%	15%	19.6%
23	73.2%	16%	21.3%	73.2%	13%	16.7%
24	63.9%	15%	19.9%	67.5%	13%	17.8%
25	73.7%	9%	11.7%	79.1%	8%	10.3%
26	57.9%	18%	24.0%	70.7%	13%	16.7%
Sectioned otoliths						
SD	All readers			Expert readers		
	PA	APE	CV	PA	APE	CV
22	66.7%	16%	21.7%	73.2%	15%	19.9%
23	59.2%	23%	30.9%	64.3%	16%	21.8%
24	72.1%	15%	20.4%	77.2%	11%	13.9%
25	74.0%	16%	21.8%	78.8%	10%	14.3%
26	67.3%	14%	19.7%	79.0%	9%	13.0%

The PA is a measure of accuracy when the reader estimates are compared against modal age, with higher values indicating a higher level of accuracy. In all areas the PA is below 80% with the highest PA's being reached by expert readers of whole otoliths in SD 25 (79.1%) and expert readers of sectioned otoliths in SD26 (79%). The lowest PA's based on expert readers alone are obtained from sectioned otoliths in SD23 (64.3%) and whole otoliths in SD24 (67.5%). When calculating the average PA over all SD's for each method the expert readers of the sectioned otoliths appear to have a slightly higher level of agreement at 74.5% and thus a higher level of accuracy compared to the expert readers of the whole otoliths at 71.8%. The APE is a measure of precision, with the lower values indicating a higher level of precision when comparing the reader estimates against modal age. The expert readers of whole otoliths in SD25 have the lowest APE at 8% and for the sectioned otoliths the lowest APE is for SD 26 at 9%. The CV is also a measure of precision with the lower values indicating a higher level of precision.

For all SD's the PA obtained from both whole and sectioned otoliths increases and the APE/CV decreases when only the age estimations of the expert readers are used in the analysis. Analysis 2 uses only age estimates of expert readers in each method. It is important to note that the modal ages obtained from the age estimates of the whole otolith method are not in agreement with the modal ages obtained from the age estimates of the sectioned otolith method even when based on expert readers alone. Analysis 3 compares the modal ages obtained from the expert readers of each method.

Results of analysis 2

The following analysis is based on the stock structure of plaice and includes only expert readers for each method. Samples from SD's 22 and 23 (PLE2123) are merged into one analysis (2.a) and samples from SD's 24, 25 and 26 (PLE2432) are merged into a separate analysis (2.b).

2.a. SD's 22 and 23 combined (PLE2123)

Whole otoliths

Age data

The overall percentage agreement based on modal age for all expert readers of whole otoliths in SD's 22 and 23 combined is 68.8% (Table 4), with an overall CV of 18.2% (Table 5). The APE is 13.9%. At modal age 1 (based on only 4 fish) the percentage agreement is only 56% which is very poor. This increases slightly to 76% at modal age 2 but decreases again for the subsequent ages with the exception of modal age 3 which has agreement of 70%.

Table 4 Percentage agreement (PA) based on modal age for all expert readers of whole otoliths in SD's 22 and 23 combined

Modal Age	R2	R3	R5	R7	All
1	100	25	0	100	56
2	75	63	88	78	76
3	50	88	79	63	70
4	61	89	56	44	63
5	58	83	67	82	72
6	63	75	63	75	69
7	67	100	33	33	58
8	33	100	33	67	58
9	0	100	100	0	50
Weighted mean	61.8	78.6	68.3	66.3	68.8
Rank	4	1	2	3	-

Table 5 Coefficient of variation (CV) between the modal age and the age estimation of expert whole readers in SD's 22 and 23 combined

Modal Age	R2	R3	R5	R7	All
1	0	86	40	0	61
2	26	27	22	30	20
3	26	12	27	21	18
4	22	8	19	19	16
5	17	9	19	14	12
6	11	9	12	9	10
7	9	0	13	17	14
8	20	0	52	8	20
9	0	0	0	0	9
Weighted Mean	20.9	16.5	22.6	19.3	18.2
Rank	3	1	4	2	-

Figure 2 shows the age estimations of the 4 readers for sample 2014_SOLEA_22_695_83, which has a modal age of 1 but just 50% agreement. All readers are in agreement as to where the first winter ring (wr) lies but no two readers agree on the position of the subsequent wr's. The relative bias values in Table 6 show that overall reader R7 shows the least amount of bias and tends to underestimate in comparison to modal age; reader R2 also tends to underestimate in comparison to modal age while readers R3 and R5 tend to overestimate in comparison to modal age. The age bias plots in Figure 3 confirm these results. Examination of the otolith images reveals that R2 will often omit to count what the other readers interpret as the first or second wr and thus the negative bias values. R5 will include many translucent zones in the count of age and thus the positive bias values.

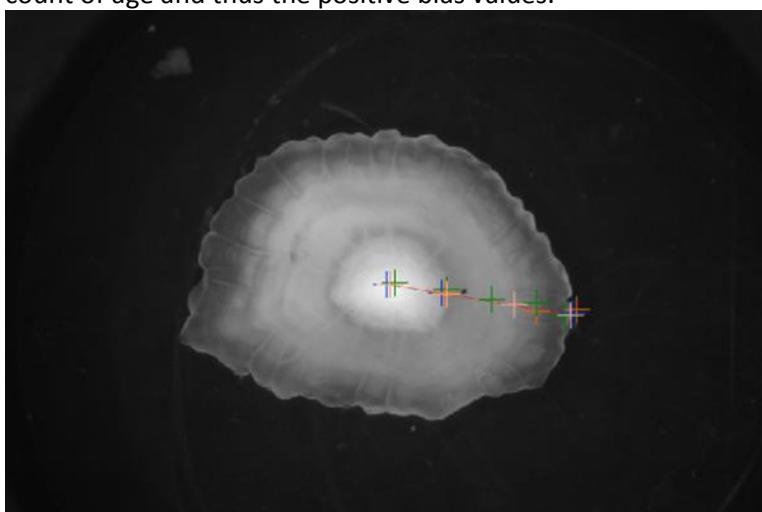


Figure 2 2014_SOLEA_22_695_83.jpg; modal age 1; 50% agreement; length 235mm; female; capture date 25/10/2014. Blue, Green, pink and orange crosses represent reader R2 (age 1), R3 (age 3), R5 (age 5) and R7 (age 1) respectively

Table 6. Relative bias values based on modal age for all expert readers of whole otoliths in SD's 22 and 23 combined (values in blue indicate a negative bias, those in black indicate a positive bias)

Modal Age	R2	R3	R5	R7	All
1	0	0.75	1.5	0	0.56
2	-0.17	0.46	0.17	0	0.11
3	-0.46	0.04	0.38	-0.12	-0.04
4	-0.17	-0.11	0.67	0	0.1

5	-0.17	0	0.67	-0.27	0.06
6	-0.12	0	0.5	0	0.09
7	-0.33	0	1	-1	-0.08
8	-0.33	0	2.67	-0.33	0.5
9	-1	0	0	-1	-0.5
Weighted Mean	-0.25	0.13	0.56	-0.11	0.08
Rank	3	2	4	1	-

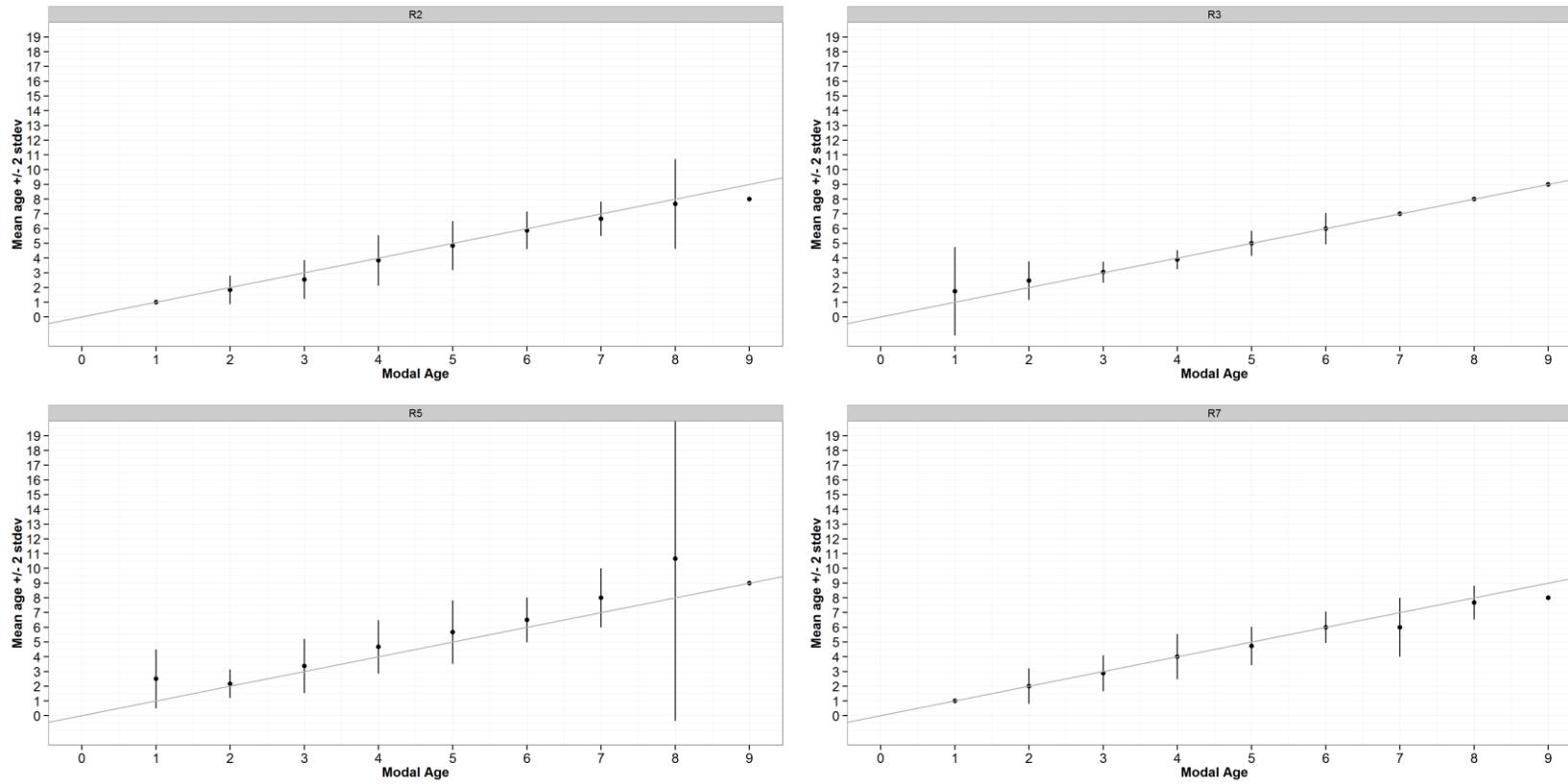


Figure 3 Age bias plots for each expert reader of whole otoliths for SD's 22 and 23 combined. They show the mean age recorded +/- 2stdev of each age reader plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line). The reader ID is shown at the top of each graph.

Growth data

Figure 4 shows the combined growth curves for all fish and all expert readers in the SD 22's and 23 exercise. The Linear Mixed Effects Model analysis showed a significant reader effect on both the intercept and slope of the LMEM (LMEM, $p < 0.05$) meaning that there are differences between readers in their interpretation of the first and subsequent wr's. In general there is little overlap between the average distances from the centre to wr 1 and wr 2 and thus these can be identified as 2 separate rings however, Reader 2_DNK1 will sometimes omit what the other readers interpret as the second wr and thus the average distance from the centre to wr's 2, 3 and 4 for this reader is greater in comparison to the other readers. As the age increases so does the overlap between the average distances from the centre to the subsequent wr's and this is reflected in the disagreement between readers on the estimated ages and which structures are in fact the true winter rings. Reader 5_SWE2 estimates one fish to be 17 years old (modal age 8).

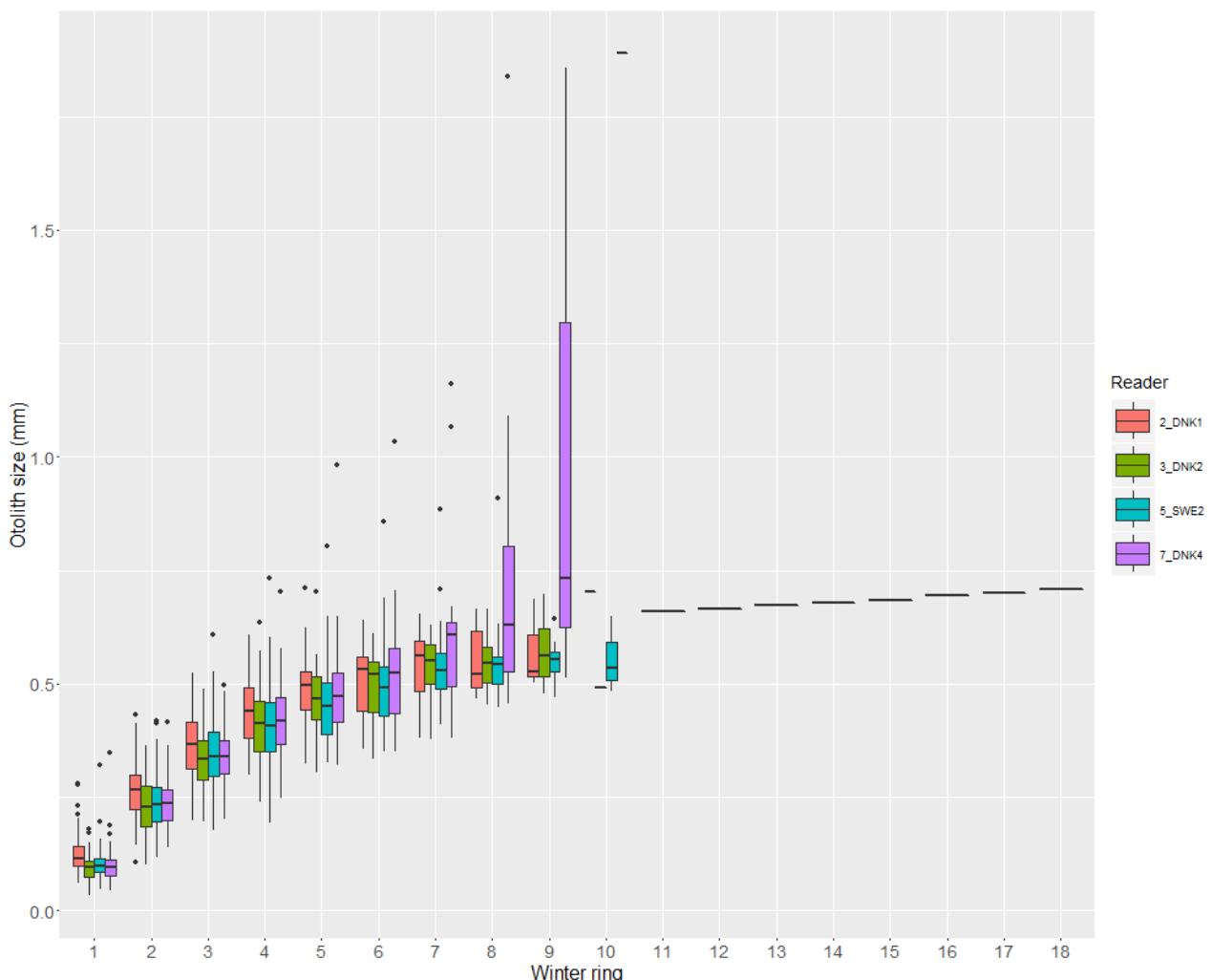


Figure 4 Plot of average distance to the centre for winter rings 1-17 and the edge for all expert readers of whole otoliths in SD 22 and 23 combined. The boxes represent the mean, upper and lower box boundaries of the interquartile range, whiskers represent the minimum and maximum values and the dots represent the outliers.

Sectioned otoliths

Age data

The overall percentage agreement (PA) with modal age for expert readers of sectioned otoliths in SD's 22 and 23 combined is 69% (Table 7), with an overall CV of 20.8% (Table 8). The APE is 15.4%. At modal ages 1, 2 and 3 the average PA is above 73%. At modal age 1 there are just 2 fish with reader R8 estimating age 2 for just one of these fish which lowers the PA. Overall the poor level of agreement and high CV values are mostly due to the R6 who is overestimating in comparison to modal age, sometimes by 2 or 3 years (Figure 5). The relative bias values in Table 9 and the age bias plots in Figure 6 confirm these results. In contrast, R1 and R8 will usually underestimate the age in comparison to modal age (Table 9). R1 and R8 are often in agreement while R6 is estimating a higher age in comparison. There are numerous examples where there is no agreed age for an otolith and a mean age is used instead of modal age (Figure 5).

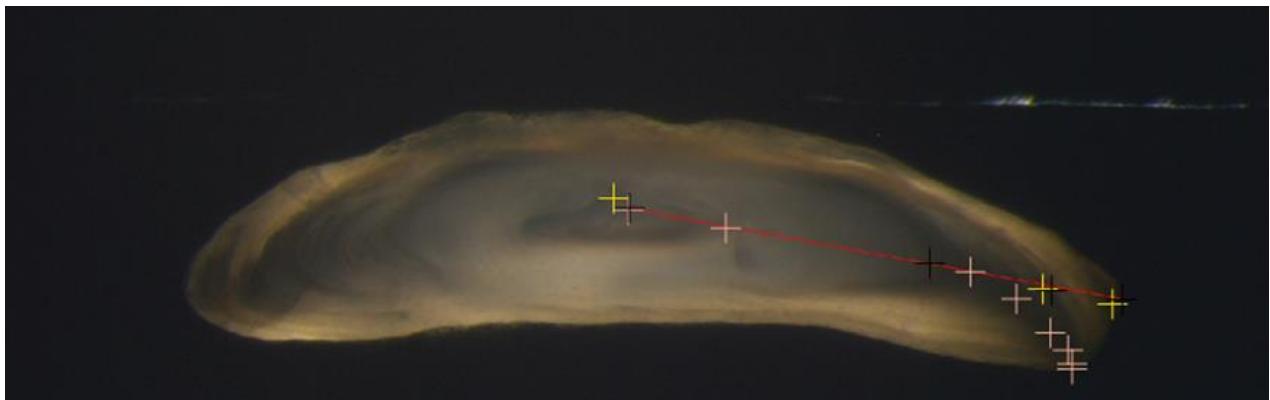


Figure 5 2989-06.jpg; modal age 4; 0% agreement; length 260mm; male; capture date 09/03/2010. Black, yellow and orange crosses represent R1 (age 3), R8 (age 2) and R6 (age 6) respectively.

Table 7 Percentage agreement based on modal age for all expert readers of sectioned otoliths in SD's 22 and 23 combined

modalAge	R1	R6	R8	All
1	100	100	50	83
2	95	35	95	75
3	93	39	86	73
4	78	43	82	68
5	86	43	83	70
6	89	33	33	52
7	50	50	100	67
8	0	0	0	0
9	-	-	-	-
10	-	-	-	-
11	50	50	50	50
12	-	100	-	100
13	-	-	-	-
14	-	100	-	100
Weighted mean	86.3	41.4	79.3	69
Rank	1	3	2	-

Table 8 Coefficient of variation (CV) between the modal age and the age estimation of expert section readers in SD's 22 and 23

Modal Age	R1	R6	R8	All
1	0	0	47	22
2	11	34	11	25

3	9	40	12	24
4	12	24	14	17
5	8	15	8	13
6	6	40	16	20
7	11	25	0	15
8	0	0	0	27
9	-	-	-	-
10	-	-	-	-
11	6	7	7	7
12	-	0	-	-
13	-	-	-	-
14	-	0	-	-
Weighted Mean	9.5	30	12.7	20.8
Rank	1	3	2	-

Table 9 Relative bias values based on modal age for all expert readers of sectioned in SD's 22 and 23 combined (values in red indicate a negative bias, those in black indicate a positive bias)

Modal Age	R1	R6	R8	All
1	0	0	0.5	0.17
2	-0.05	1.05	0.05	0.35
3	0	1.43	-0.14	0.43
4	-0.04	0.7	-0.23	0.14
5	-0.14	0.86	-0.17	0.18
6	-0.11	1.56	-0.56	0.3
7	-0.5	1.5	0	0.33
8	-2	2	-1	-0.33
9	-	-	-	-
10	-	-	-	-
11	0.5	-0.5	-0.5	-0.17
12	NaN	0	NaN	NaN
13	-	-	-	-
14	NaN	0	NaN	NaN
Weighted Mean	-0.25	0.13	0.56	-0.11
Rank	3	2	4	1

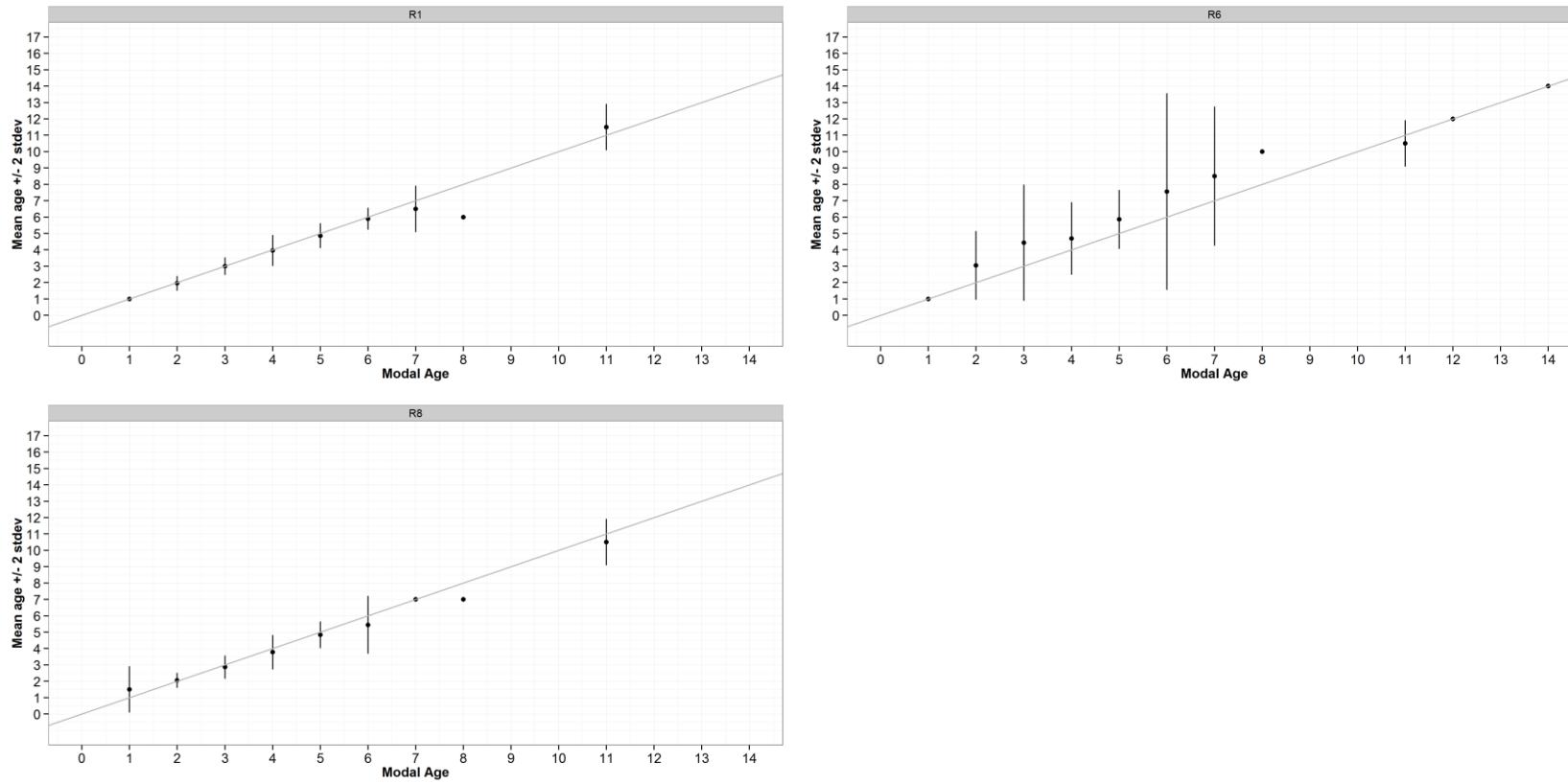


Figure 6 Age bias plots for each expert reader of sectioned otoliths for SD's 22 and 23 combined. They show the mean age recorded +/- 2stdev of each age reader plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line). The reader ID is shown at the top of each graph.

2.b SD's 24, 25 and 26 combined (PLE2432)

Whole otoliths

Age data

The overall percentage agreement (PA) based on modal age for all expert readers of whole otoliths in SD's 24, 25 and 26 combined is 71.9% (Table 10), with an overall CV of 14.8% (Table 11). The APE is 11%. For modal ages 1-4 the average PA is above 74%. An examination of the images reveals the poor level of agreement and the high coefficient of variation is due to a number of age reading issues. R5 includes many translucent zones in the count of age which the other readers do not consider to be true wr's. R2 will sometimes omit what the other readers interpret to be the second or third wr in the count of age and thus estimates the age of the fish to be lower than modal age. There are many examples where R7 has not included all of their annotated wr's in the final count of age and thus their ages are generally lower than modal age. At modal ages 5 and up R3 will sometimes omit the outermost wr in the count of age. The relative bias values (Table 12) and the age bias plots (Figure 7) confirm these observations.

Table 10 Percentage agreement based on modal age for all expert readers of whole otoliths in SD's 24, 25 and 26 combined

modalAge	R2	R3	R5	R7	All
1	100	75	75	100	88
2	84	93	81	79	84
3	64	94	52	82	74
4	67	90	65	77	76
5	75	64	36	57	56
6	25	33	33	83	45
7	100	67	0	50	52
8	67	67	0	33	42
Weighted mean	72.6	83.9	55.8	75.2	71.9
Rank	3	1	4	2	-

Table 11 Coefficient of variation (CV) between the modal age and the age estimation of expert whole readers in SD's 24, 25 and 26

modalAge	R2	R3	R5	R7	All
1	0	40	40	0	20
2	20	14	21	23	13
3	19	8	23	14	16
4	18	8	18	12	11
5	10	14	15	17	17
6	10	27	22	13	24
7	0	13	16	11	15
8	7	16	10	8	16
Weighted Mean	15.1	12.4	20.3	15.1	14.8
Rank	2	1	4	2	-

Table 12. Relative bias values based on modal age for all expert readers of whole otoliths in SD's 24, 25 and 26 combined (values in red indicate a negative bias, those in black indicate a positive bias)

modalAge	R2	R3	R5	R7	All
1	0	0.25	0.25	0	0.12

2	-0.16	0	0.04	-0.21	-0.08
3	-0.36	0	0.55	-0.18	0
4	-0.4	0.03	0.52	-0.16	0
5	-0.25	-0.43	0.86	-0.21	-0.01
6	-0.75	-1.5	1.5	0.33	-0.1
7	0	-0.5	1.5	-0.17	0.21
8	0.33	-0.67	2	-0.67	0.25
Weighted Mean	-0.26	-0.14	0.58	-0.17	0
Rank	3	1	4	2	-

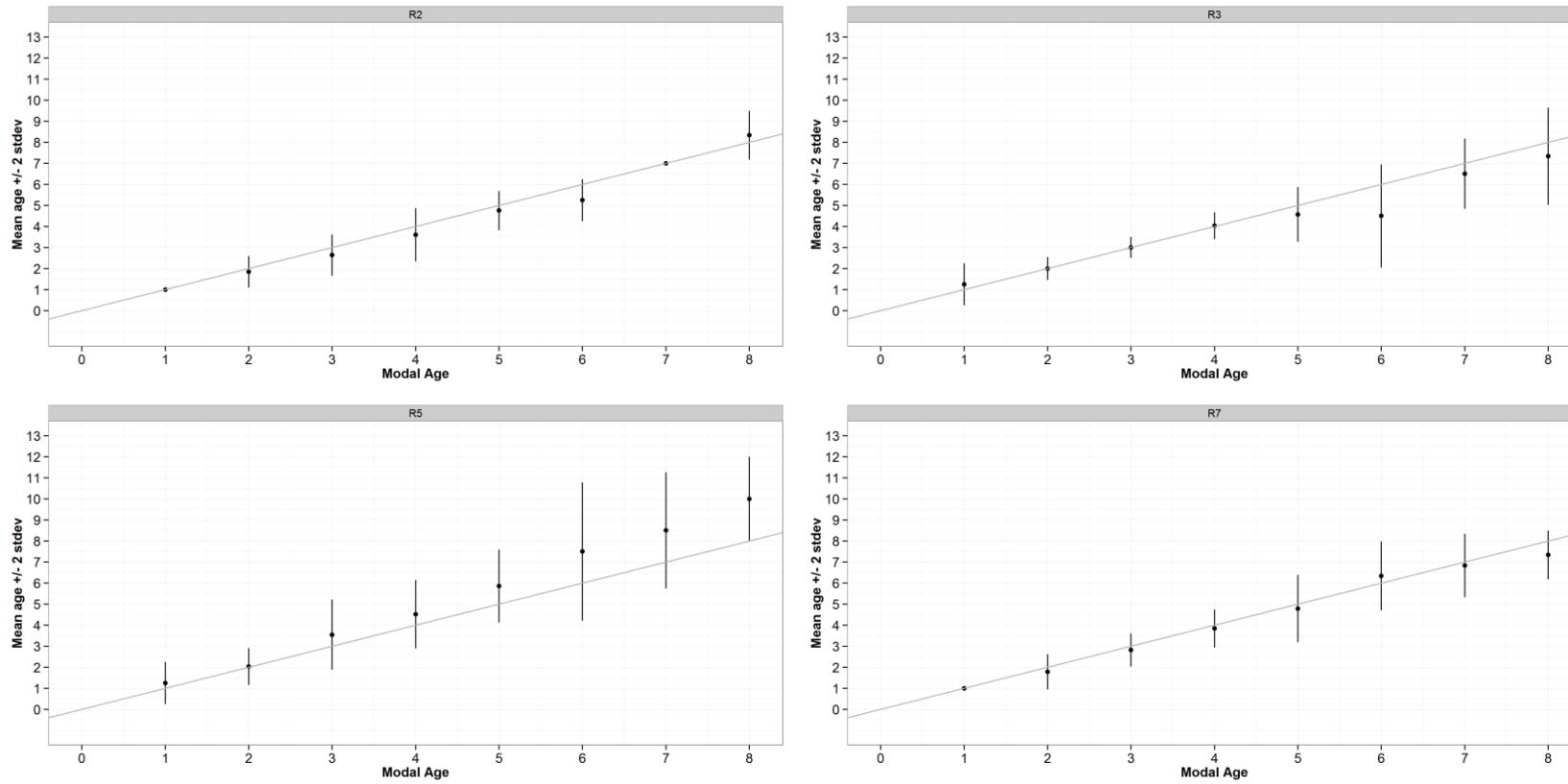


Figure 7 Age bias plots for each expert reader of whole otoliths for SD's 24, 25 and 26 combined. They show the mean age recorded \pm 2stdev of each age reader plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line). The reader ID is shown at the top of each graph.

Growth data

Figure 8 shows the combined growth curves for all fish and all expert readers in the SD's 24, 25 and 26 exercise. The Linear Mixed Effects Model analysis showed a significant reader effect on both the intercept and slope of the LMEM (LMEM, $p < 0.05$) meaning that there are differences between readers in their interpretation of the first and subsequent wr's. In general there is little overlap between the average distances from the centre to wr 1 and wr 2 and thus these are identified as 2 separate rings. Reader 2_DNK1 will sometimes omit what the other readers interpret as the second wr and thus the average distance from the centre to wr's 2, 3 and 4 for this reader is greater in comparison to the other readers. As the age increases so does the overlap between the average distances from the centre to the subsequent wr's and this is reflected in the disagreement between readers on which structures are in fact the true winter rings and the estimated ages. R5 has annotated up to 13 structures on one otolith but the highest calculated modal age is just 8.

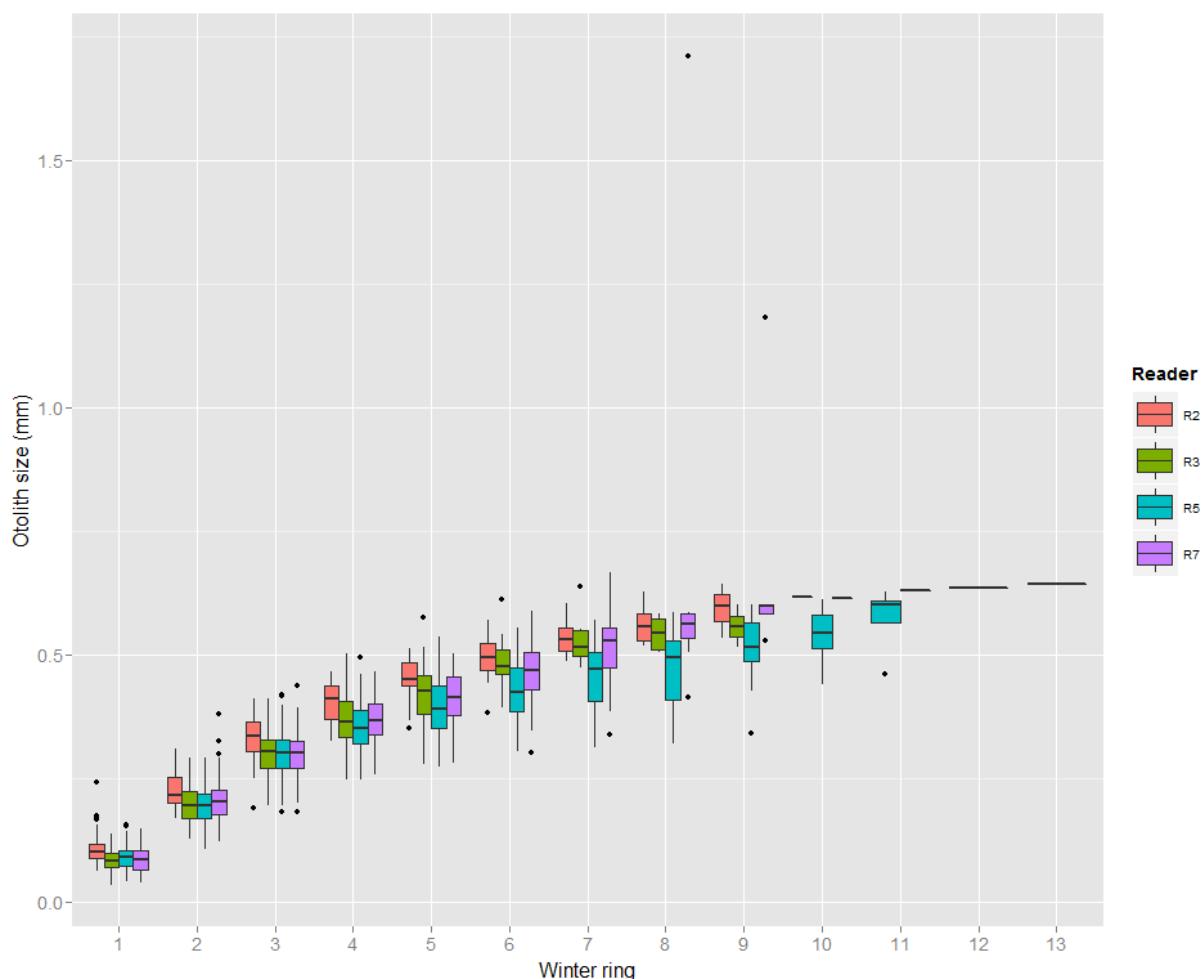


Figure 8 Plot of average distance to the centre for winter rings 1-13 and the edge for all expert readers of whole otoliths in SD 24, 25 and 26 combined. The boxes represent the mean, upper and lower box boundaries of the interquartile range, whiskers represent the minimum and maximum values and the dots represent the outliers.

Sectioned otoliths

Age data

The overall percentage agreement (PA) with modal age for expert readers of sectioned otoliths in SD's 24, 25 and 26 combined is 78% (Table 13), with an overall CV of 13.8% (Table 14). The APE is 10%. For modal

ages 1-5 the average PA is above 73%. An examination of the annotated images reveals that R6 is interpreting a larger number of translucent zones to be wr's in comparison to R1 and R8 and thus overestimating the age in comparison to modal age. This is the main reason for the low level of agreement and the high CV values. In addition, R8 will sometimes overestimate in comparison to modal age at age 1 and 2. The relative bias values (Table 15) and the age bias plots (Figure 9) confirm these results.

Table 13 Percentage agreement based on modal age for all expert readers of sectioned otoliths in SD's 24, 25 and 26 combined

modalAge	R1	R6	R8	All
1	100	83	83	89
2	100	89	65	85
3	89	53	95	78
4	93	59	78	76
5	88	44	89	73
6	100	33	33	56
7	100	0	100	67
8	-	-	-	-
9	0	100	100	67
10	100	0	100	67
Weighted mean	93.1	60.7	81.8	78
Rank	1	3	2	-

Table 14 Coefficient of variation (CV) between the modal age and the age estimation of expert sectioned readers in SD's 24, 25 and 26

modalAge	R1	R6	R8	All
1	0	35	35	14
2	0	16	26	13
3	11	37	8	17
4	7	17	12	11
5	7	12	7	10
6	0	33	11	22
7	0	20	0	18
8	-	-	-	-
9	0	0	0	7
10	0	6	0	13
Weighted Mean	5.7	23.8	13.8	13.8
Rank	1	3	2	-

Table 15 Relative bias values based on modal age for all expert readers of sectioned in SD's 24, 25 and 26 (values in red indicate a negative bias, those in black indicate a positive bias)

modalAge	R1	R6	R8	All
1	0	0.17	0.17	0.11
2	0	0.04	0.19	0.08
3	-0.05	0.7	0	0.22
4	-0.07	0.19	-0.16	-0.01
5	-0.12	0.67	-0.11	0.14
6	0	2	-0.67	0.44
7	0	2.5	0	0.83

8	-	-	-	-
9	-1	0	0	-0.33
10	0	2.5	0	0.83
Weighted Mean	-0.05	0.51	-0.02	0.15
Rank	2	3	1	-

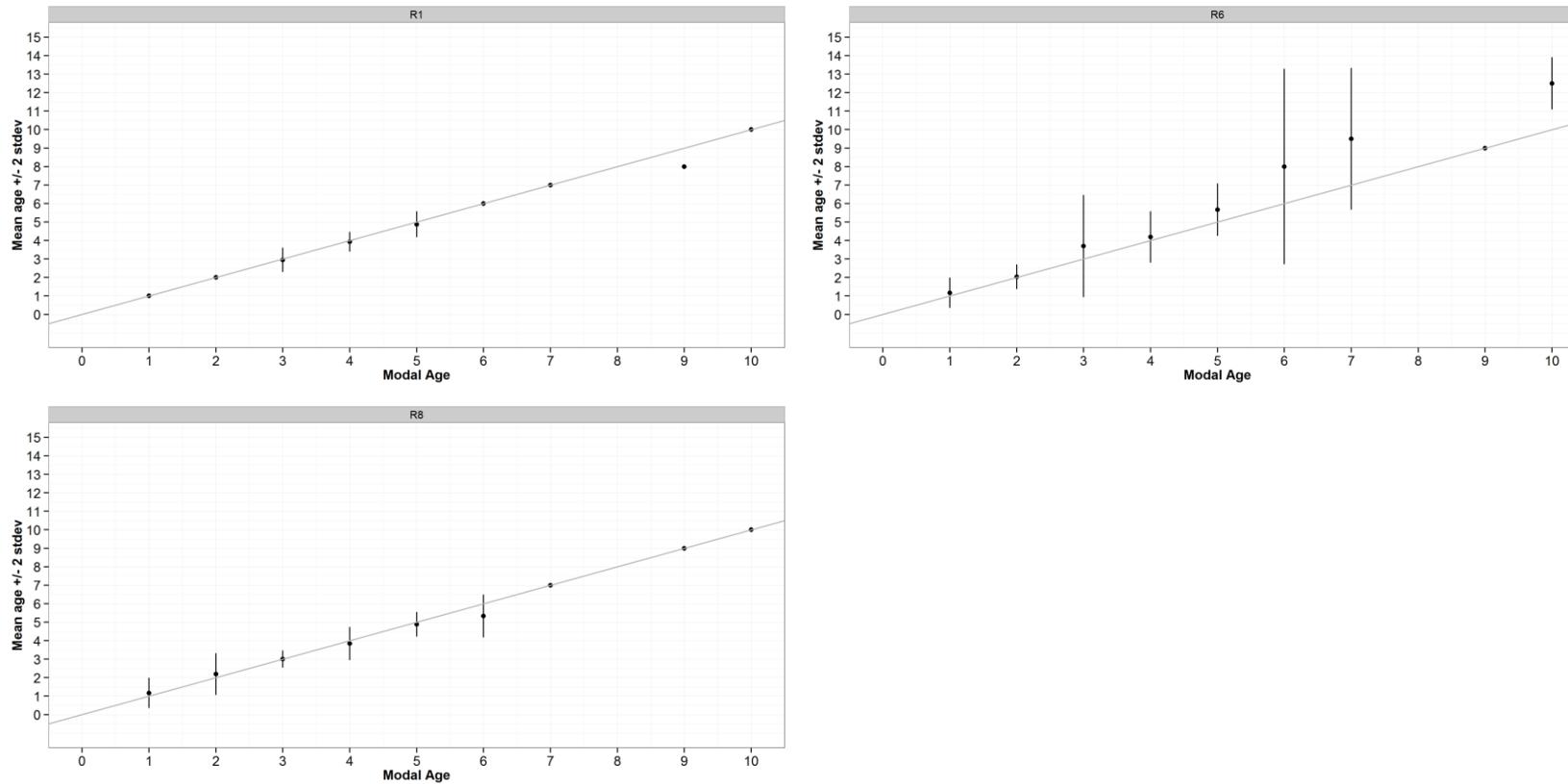


Figure 9 Age bias plots for each expert reader of sectioned otoliths for SD's 24, 25 and 26 combined. They show the mean age recorded \pm 2stdev of each age reader plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line). The reader ID is shown at the top of each graph.

Results of analysis 3

In many examples the ages estimated from the same fish using the two methods differ considerably, see Figure 10 where the modal age based on the whole otolith is 6 and the modal age based on the sectioned otolith is 4. As there are more expert readers of whole otoliths in comparison to expert readers of sectioned otoliths more weight would be given to readers of whole otoliths if the modal age was calculated across all expert readers. Thus, the following comparison utilises the results of analyses 2a and 2b; **modal age obtained from whole otoliths and the modal age obtained from the sectioned otoliths** and the modal ages from the whole otoliths are compared against the modal ages from the sectioned otoliths. The ICES SD's are combined based on the stock structure.

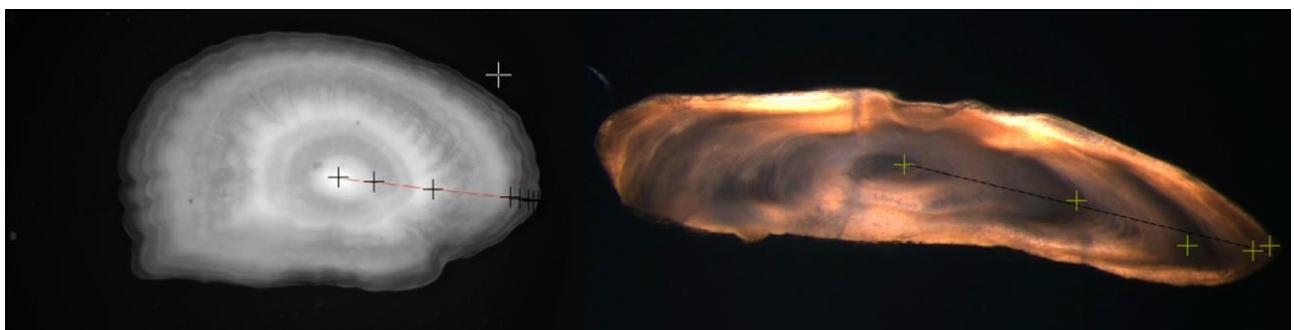


Figure 10 Image of a whole and sectioned otolith from fish 2014_SOLEA_24_685_5, capture date 08/02/2014, length 425 mm, female. Modal age based on whole otoliths is 6 and modal age based on sectioned otoliths is 4.

3.a SD's 22 and 23 combined (PLE2123)

A comparison of modal age from expert readers of whole otoliths (whole modal age) and modal age from expert readers of sectioned otoliths (section modal age) for SD's 22 and 23 combined (PLE2123). The PA is 71%, the CV 15% (Annex C) and the APE 11%. At ages 1-4 the overall PA is above 67%. The age error matrix (Table 16) show that at age 1, 25% of the otoliths are estimated to be older when read using the whole otolith method. At age 2, 18% of the otoliths are read to be older when using the whole otolith method and a smaller percentage (5%) read to be younger. From ages 3 and upwards (excluding age 6) the ages estimated by readers using the whole otoliths will be lower in comparison to those estimated by readers using sectioned otoliths from the same fish. The age comparison matrix (Table 17) show the actual number of otoliths used to compile the age error matrix.

Table 16 Age error matrix shows the proportion of each modal age estimated by reading sectioned otoliths (section modal age) assigned another modal age by those estimated using whole otoliths (whole modal age) for SD's 22 and 23 combined. Values in bold indicate the proportion in agreement between methods, those in blue indicate ages lower than section age and those in red indicate ages higher than section age.

section modal age	1	2	3	4	5	6	7	8	9	10	11	12	13	14
whole modal age														
1	0.75	0.05	0.02	0	0	0	0	0	0	0	0	0	0	0
2	0.25	0.78	0.17	0.04	0	0	0	0	0	0	0	0	0	0
3	0	0.18	0.69	0.13	0	0	0	0	0	0	0	0	0	0
4	0	0	0.12	0.67	0.14	0	0	0	0	0	0	0	0	0.5
5	0	0	0	0.11	0.79	0.11	0.25	0	0	0	0	0	0	0
6	0	0	0	0.04	0.07	0.78	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0.06	0.75	0.5	0	0	0	0	0	0
8	0	0	0	0	0	0.06	0	0.5	0	0	0.25	0.5	0	0
9	0	0	0	0	0	0	0	0	0	0	0.25	0	0	0

10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0.5	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0.5	0	0

Table 17 Age comparison matrix shows the number of each modal age estimated by reading sectioned otoliths (section modal age) assigned another modal age by those estimated using whole otoliths (whole modal age) for SD's 22 and 23 combined. Values in bold indicate the proportion in agreement between methods, those in blue indicate ages lower than section age and those in red indicate ages higher than section age.

section modal age	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
whole modal age															
1	1	2	1	0	0	0	0	0	0	0	0	0	0	0	4
2	1	11	10	2	0	0	0	0	0	0	0	0	0	0	24
3	0	7	11	6	0	0	0	0	0	0	0	0	0	0	24
4	0	0	7	8	2	0	0	0	0	0	0	0	0	1	18
5	0	0	0	5	4	2	1	0	0	0	0	0	0	0	12
6	0	0	0	2	1	5	0	0	0	0	0	0	0	0	8
7	0	0	0	0	0	1	1	1	0	0	0	0	0	0	3
8	0	0	0	0	0	1	0	0	0	0	1	1	0	0	3
9	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	2	20	29	23	7	9	2	1	0	0	2	1	0	1	97

3.b SD's 24, 25 and 26 combined (PLE2432)

A comparison of modal age from expert readers of whole otoliths (whole modal age) and modal age from expert readers of sectioned otoliths (section modal age) for SD's 24, 25 and 26 combined (PLE2432). The PA is 75%, the CV 12% (Annex C) and the APE 9%. At ages 1-4 the overall PA is above 72%. The age error matrix (Table 18) show that at ages 1 – 4 and age 6, a larger proportion of the otoliths are estimated to be older compared to the proportion estimated to be younger when read using the whole otolith method meaning that a higher age is attained from the whole otoliths. At ages 5 and 7 - 10, it is the opposite and more fish are assigned a younger age when read using the whole otoliths. The age comparison matrix (Table 19) show the actual number of otoliths used to compile the age error matrix.

Table 18 Age error matrix shows the proportion of each modal age estimated by reading sectioned otoliths (section modal age) assigned another modal age by those estimated using whole otoliths (whole modal age) for SD's 24, 25 and 26 combined. Values in bold indicate the proportion in agreement between methods, those in blue indicate ages lower than section age and those in red indicate ages higher than section age.

section modal age	1	2	3	4	5	6	7	8	9	10
whole modal age										
1	0.75	0.02	0	0	0	0	0	0	0	0
2	0.25	0.86	0.06	0	0	0	0	0	0	0

3	0	0.09	0.75	0.12	0	0	0	0	0	0	0
4	0	0.02	0.14	0.72	0.28	0	0	0	0	0	0
5	0	0.02	0.04	0.08	0.67	0.17	0.12	0	0	0	0
6	0	0	0.01	0.06	0.06	0.5	0	0	0	0	0
7	0	0	0	0.02	0	0.17	0.88	0	0	0.25	
8	0	0	0	0	0	0.17	0	0	0.5	0.25	
9	0	0	0	0	0	0	0	0	0.5	0	
10	0	0	0	0	0	0	0	0	0	0.5	
Total	1	1	1	1	1	1	1	0	1	1	

Table 19 Age comparison matrix shows the number of each modal age estimated by reading sectioned otoliths (section modal age) assigned another modal age by those estimated using whole otoliths (whole modal age) for SD's 24, 25 and 26 combined. Values in bold indicate the proportion in agreement between methods, those in blue indicate ages lower than section age and those in red indicate ages higher than section age.

section modal age	1	2	3	4	5	6	7	8	9	10	Total
whole modal age											
1	3	1	0	0	0	0	0	0	0	0	4
2	3	20	5	0	0	0	0	0	0	0	28
3	0	5	20	8	0	0	0	0	0	0	33
4	0	1	11	14	5	0	0	0	0	0	31
5	0	1	3	5	3	1	1	0	0	0	14
6	0	0	1	4	1	0	0	0	0	0	6
7	0	0	0	1	0	1	3	0	0	1	6
8	0	0	0	0	0	1	0	0	1	1	3
9	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0
Total	6	28	40	32	9	3	4	0	1	2	125

Discussion

The exchange was run over an extended period due to a number of unforeseen circumstances, in addition a number of problems were encountered which are outlined here. The initial analysis revealed major discrepancies between the estimated ages of some whole otoliths compared to the sectioned otoliths from the same fish. A visual examination of all images revealed that mixing of some samples had occurred in SD21 and these had to be excluded from the analysis. There are some examples where the readers annotations and corresponding age estimates do not match. These errors will confound results but it is not possible to visually check every image and reader annotation for such mistakes, it should be the readers responsibility to ensure that the data they provide is correct. A true comparison of the accuracy and precision in the age estimates obtained from the two age reading methods was not possible. To do this without introducing reader bias a number of highly experienced readers in both reading methods was needed and this was not the case in this exchange. It was not possible to analyse the growth data from the sectioned otoliths due to image quality issues and in some examples the otoliths increase in thickness with age, leading to a “pancake” like structure where it was not possible to measure growth on a horizontal plane. This also meant that it was not possible to examine differences between male and female growth patterns based on the annotated images of the otoliths. The growth analysis of the whole otoliths was highly sensitive to where on the annuli the annotations were placed however the plots are useful for reader comparisons.

Analysis 1 examined each ICES SD's separately. For expert readers of whole otoliths the SD's with percentage agreements (PA) below 70% are SD22 and SD24 while SD 25 has the highest PA (79%). For expert readers of sectioned otoliths the SD with PA below 70% is SD23 while SD26 has the highest PA (79%). The average percentage error (APE) for expert readers of all SD's is 10% or above with the exception of whole otoliths in SD25 and sectioned otoliths in SD26. These results indicate that both the levels of accuracy and precision are generally lowest in SD's 22, 23 and 24 with these otoliths being most difficult to interpret. Analysis 2 separated the samples based on the stock structure of plaice and analysed the results based on expert readers alone. Using only readers who are experts in a method allows for a more accurate calculation of modal age against which the individual readers can be compared. For PLE2123 only SD's 22 and 23 were combined, for whole otoliths the PA was 68% and the APE 13.9% and for the sectioned otoliths the PA was 69% and the APE 15.4%. The levels of accuracy are almost the same while the lower APE for whole otoliths indicates that the age estimates of readers using this method are more precise and less variable around the modal age. For PLE2432 samples from SD's 24, 25 and 26 were combined, for whole otoliths the PA was 71.9% and the APE 11%, and for the sectioned otoliths the PA was 78% and the APE 10%. The level of accuracy for sectioned otoliths is highest meaning the readers estimate the modal age more often when using this method. There is little difference in the APE between methods. For both stocks the readers which are contributing most to the bias in the age estimates are R5 (whole otoliths) and R6 (sectioned otoliths). Overall the levels of agreement are better for PLE2432 in comparison to PLE2123 but it should be noted that not all SD's are represented in the samples sets.

It is difficult to find consistent patterns in the levels of accuracy and precision across methods and areas. However, the results of analyses 1 and 2 reflect the opinion of the readers that plaice otoliths are easier to read when they belong to populations in the eastern Baltic. Samples from SD's 21 could not be analysed but readers of whole otoliths have expressed concerns about the difficulties interpreting the growth structures seen in these otoliths. Otoliths from the different areas vary greatly in their appearances and confounding issues are; the time of year that growth is laid down at the edge, the distance from the centre to the first winter ring, the growth rate of the individual fish and spilt rings. In addition, results of an otolith exchange of North Sea plaice held in 2002 suggested that interpretation problems are more prominent in some landing years / year classes than others (Bolle, 2002).

Analysis 3 utilised the results of analysis 2; modal age obtained from whole otoliths and modal age obtained from sectioned otoliths from the same fish. This comparison only gives a general indication of how comparable the age reading estimates are from the two age reading methods. Results showed that for PLE2123, section modal ages 1 and 2, a higher age is attained when reading whole otoliths in comparison to sectioned otoliths, whereas for section modal ages 3 and upwards (excluding age 6) a lower age is attained when reading whole otoliths. For PLE2432, section modal ages 1-4 and 6, a higher age is attained when reading whole otoliths, whereas for section modal ages 5 and 7-10 a lower age is attained when reading whole otoliths. Previous exchanges and workshops (Easey, 2003 and ICES, 2010) and a validation study (Etherton, 2015) based on age readings of whole and sectioned plaice otoliths from different areas have made comparisons of the two methods. Easey (2003) concluded that reading whole otoliths from the northern North Sea could lead to underestimation of ages in older fish and that the sectioning method showed much clearer growth zones in older fish. They also observed that agreement between methods is much better at modal age 1-6 but that underestimation can occur, especially by inexperienced readers. WKARP (ICES, 2010) readdressed this issue and results showed higher agreement and lower variability for whole otoliths and concluded that sectioning of plaice otoliths was not necessary. In contrast, Etherton (2015) presented results which indicated underestimation of ages and concerns from the readers around the difficulties in interpreting the growth zones in older fish when reading whole otoliths. From this exchange it cannot be concluded which method provides more reliable age estimates as such comparisons can only be made when readers are highly experienced in both methods. It does however give an indication

that the ages obtained when reading whole otoliths are higher than those obtained from sectioned otoliths at younger ages and lower at older ages.

Conclusions

The levels of agreement and precision resulting from this age reading exchange reveal that there are interpretation differences amongst the age readers of plaice in the Sound, Western Baltic Sea (SD's 22 and 23) and Baltic Sea (SD's 24–32). When examining the age estimations of only those readers who have supplied ages for assessment purposes there is an overall improvement in the results as would be expected. When looking at each SD separately the results from SD25 and SD26 are the best. When combined across all SD's the level of agreement based on sectioned otoliths is slightly higher than that based on whole otoliths but when comparing each SD there are no consistent patterns where one method will always produce better results compared to the other. When combining samples based on the stock structure the results showed the highest level of agreement reached was for sectioned otoliths in PLE2432 compared to readers of whole otoliths in SD2123 being the lowest. As a full age based analytical assessment is carried out for PLE2123 the age data should be considered with caution. PLE2432 is considered a data limited stock and therefore these results will not have the same consequences. Two readers appear to be reading differently from the other readers using the same method; R5 reading whole otoliths and R6 reading sectioned otoliths. Calculating modal age across readers of whole and sectioned otoliths for a single fish is not a reliable estimation of the true age of the fish as there often large differences in the ages attained when reading whole otoliths compared to sectioned otoliths. The age error matrices are produced to illustrate the differences in the results from the two methods and are not directly applicable to the stock assessment.

RECOMMENDATIONS	ADRESSED TO
1. A plaice age reading workshop to be held with a pre-workshop exchange including samples from ICES Subdivisions 21-26	WGBIOP
2. Otolith image collections are compiled from years/areas with obscure growth patterns	Age reading laboratories
3. Age readers should closely follow the instructions provided for annotation procedures for a specific exchange.	Age reading laboratories

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- R Development Core Team. 2009. R: a language and environment for statistical computing. R Foundation for Statistical Computing, Vienna. Available at <http://www.R-project.org/>
- WebGR-Web services for support of Growth and Reproduction Studies. Available at <http://webgr.azti.es/>

Annex A Reader Instructions for the 2016 Baltic Plaice Exchange in WebGR

The exchange consists of samples from 6 areas (SD's 21-26) with images of whole and sectioned otoliths from the same fish. You need to annotate both the image of the whole otolith and the sectioned otolith without comparing images from the same fish.

In WebGR you will find a Workshop called "**Baltic Plaice 2016**" with 4 calibration exercises (CE's):

PLE2123 whole oto (images of whole otoliths from SD's 21, 22 and 23)

PLE2123 sectioned oto (images of sectioned otoliths from SD's 21, 22 and 23)

PLE2432 whole oto (images of whole otoliths from SD's 24, 25 and 26)

PLE2432 sectioned oto (images of sectioned otoliths from SD's 24, 25 and 26)

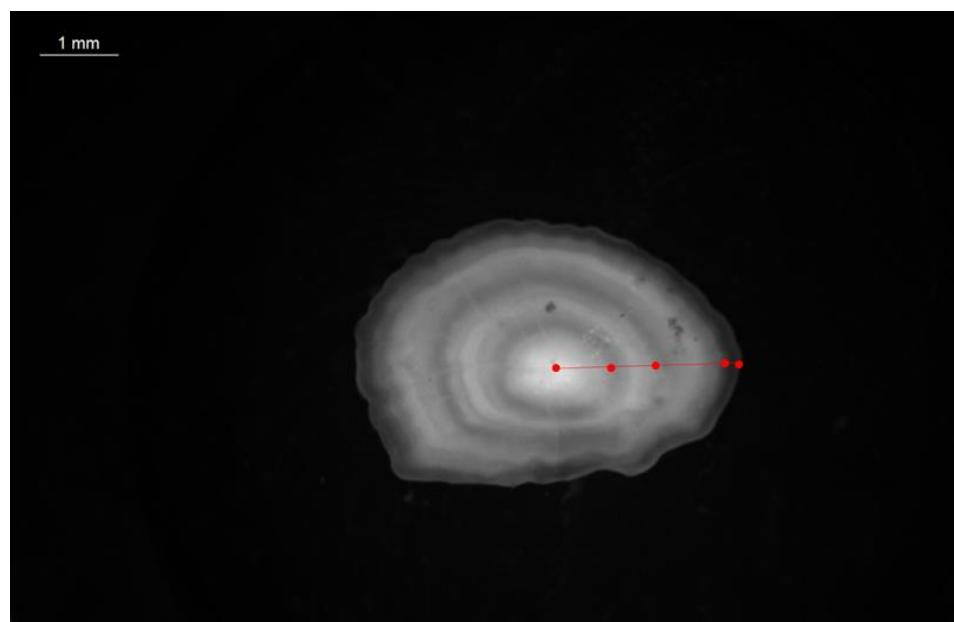
Please complete all 4 CE's

You will be given the capture date, length, area and sex for each image. All images of whole otoliths are taken at the same magnification. The magnification used for the sectioned otoliths vary but the scale bars are correct.

Important points for the exchange:

Images of whole otoliths

We hope to be able to include an analysis of the growth data in the results. This requires that the images are marked in a specific way. For this reason there are lines on the images along which you need to place your marks. See the image example below.



The following points are VERY important

- Place your marks along the annotation line in the correct order
- First, place a mark on the **centre point**
- Then place a mark at the **start of every winter ring**
- Place your final mark on the **edge**
- **You must enter the age in the box provided**

Be sure to "Save" and "Finalise" each of your readings

Images of sectioned otoliths

There are lines on the images of the sectioned otoliths. However, for many of the sectioned otoliths this line does not follow the direction of growth given the “pancake” structure of the otoliths where they increase in thickness and not in length. Please ignore the line.

The following points are VERY important

- Place your marks in the correct order
- First, place a mark on the **centre point**
- Then place a mark at the **start of every winter ring**
- Place your final mark on the **edge**
- **You must enter the age in the box provided**
- Be sure to “Save ” and “Finalise” each of your readings

If you need to improve the quality of the image you can adjust the brightness, colour and contrast of the images. There is also a zoom function. Refer to the “**WebGR Manual_User Friendly**” if you need to delete or change your annotations.

**Annex B Analysis 1: A comparison of each SD separately; 22,23,24,25 and 26 (all readers),
age and growth data of whole otoliths and age data from sectioned otoliths**

SD22 whole otoliths

Table B1. Biological data, age estimates, coefficient of variation (CV) and percentage agreement (PA) per whole otolith for all readers in SD 22

Image	Length (mm)	Sex	Capture date	R2	R3	R5	R6	R7	R8	Modal age	PA	CV
2014_SOLEA_22_685_100_.jpg	425	F	06/02/2014	6	6	6	7	7	6	6	66.7	8.2
2014_SOLEA_22_685_104_.jpg	415	F	06/02/2014	5	6	6	6	6	5	6	66.7	9.1
2014_SOLEA_22_685_108_.jpg	345	F	06/02/2014	5	5	5	5	5	5	5	100	0
2014_SOLEA_22_685_114_.jpg	295	F	06/02/2014	3	4	4	5	3	4	4	50	19.6
2014_SOLEA_22_685_132_.jpg	225	M	06/02/2014	2	2	2	2	2	2	2	100	0
2014_SOLEA_22_685_142_.jpg	325	M	06/02/2014	5	5	5	5	5	5	5	100	0
2014_SOLEA_22_685_160_.jpg	245	M	06/02/2014	2	2	2	3	2	3	2	66.7	22.1
2014_SOLEA_22_685_166_.jpg	225	F	06/02/2014	2	3	2	3	2	2	2	66.7	22.1
2014_SOLEA_22_685_177_.jpg	285	M	06/02/2014	2	3	2	3	2	3	3	50	21.9
2014_SOLEA_22_685_179_.jpg	425	F	07/02/2014	8	9	9	9	8	8	9	50	6.4
2014_SOLEA_22_685_188_.jpg	305	F	07/02/2014	4	4	4	6	3	4	4	66.7	23.6
2014_SOLEA_22_685_209_.jpg	275	F	07/02/2014	3	3	4	3	3	3	3	83.3	12.9
2014_SOLEA_22_685_22_.jpg	255	M	05/02/2014	3	3	3	3	3	3	3	100	0
2014_SOLEA_22_685_37_.jpg	215	M	05/02/2014	2	2	2	3	2	3	2	66.7	22.1
2014_SOLEA_22_685_38_.jpg	185	M	05/02/2014	2	2	2	2	2	2	2	100	0
2014_SOLEA_22_685_4_.jpg	235	F	05/02/2014	2	3	3	3	2	3	3	66.7	19.4
2014_SOLEA_22_685_5_.jpg	225	F	05/02/2014	2	2	2	4	2	3	2	66.7	33.5
2014_SOLEA_22_685_68_.jpg	205	M	06/02/2014	2	2	2	4	2	3	2	66.7	33.5
2014_SOLEA_22_685_7_.jpg	315	F	05/02/2014	2	3	3	3	4	4	3	50	23.8
2014_SOLEA_22_685_71_.jpg	375	M	06/02/2014	5	5	5	6	5	6	5	66.7	9.7
2014_SOLEA_22_685_75_.jpg	345	M	06/02/2014	4	5	6	5	5	4	5	50	15.6
2014_SOLEA_22_685_79_.jpg	385	F	06/02/2014	5	5	5	5	5	6	5	83.3	7.9
2014_SOLEA_22_695_102_.jpg	315	F	25/10/2014	4	4	4	5	4	4	4	83.3	9.8
2014_SOLEA_22_695_111_.jpg	305	M	25/10/2014	6	4	4	7	5	3	4	33.3	30.5
2014_SOLEA_22_695_117_.jpg	285	M	25/10/2014	2	3	2	5	4	3	3	33.3	36.9
2014_SOLEA_22_695_128_.jpg	225	F	25/10/2014	1	3	2	3	NA	3	3	60	37.3
2014_SOLEA_22_695_129_.jpg	125	F	25/10/2014	1	1	2	2	1	1	1	66.7	38.7
2014_SOLEA_22_695_134_.jpg	345	F	25/10/2014	2	3	3	5	2	2	2	50	41.3
2014_SOLEA_22_695_157_.jpg	335	F	25/10/2014	2	3	3	5	2	2	2	50	41.3
2014_SOLEA_22_695_158_.jpg	345	F	25/10/2014	2	3	3	4	2	3	3	50	26.6
2014_SOLEA_22_695_167_.jpg	195	M	25/10/2014	1	2	2	2	1	2	2	66.7	31
2014_SOLEA_22_695_171_.jpg	405	F	25/10/2014	3	4	4	5	3	3	3	50	22.3
2014_SOLEA_22_695_174_.jpg	385	F	25/10/2014	6	7	6	6	6	6	6	83.3	6.6
2014_SOLEA_22_695_188_.jpg	395	F	25/10/2014	4	4	5	5	4	4	4	66.7	11.9
2014_SOLEA_22_695_191_.jpg	335	M	25/10/2014	2	3	3	6	3	3	3	66.7	41
2014_SOLEA_22_695_194_.jpg	355	F	25/10/2014	2	3	3	5	4	3	3	50	31

2014_SOLEA_22_695_201.jpg	425	F	25/10/2014	6	5	8	7	5	7	6	16.7	19.1
2014_SOLEA_22_695_206.jpg	425	F	25/10/2014	5	6	7	6	6	5	6	50	12.9
2014_SOLEA_22_695_220.jpg	295	F	25/10/2014	2	3	3	3	2	2	3	50	21.9
2014_SOLEA_22_695_228.jpg	245	M	25/10/2014	3	4	3	5	3	3	3	66.7	23.9
2014_SOLEA_22_695_23.jpg	325	F	25/10/2014	4	5	5	5	4	4	5	50	12.2
2014_SOLEA_22_695_47.jpg	295	F	25/10/2014	1	2	4	4	3	3	3	33.3	41.3
2014_SOLEA_22_695_48.jpg	255	M	25/10/2014	1	3	4	4	1	2	3	16.7	55.1
2014_SOLEA_22_695_65.jpg	335	F	25/10/2014	2	4	3	7	2	4	4	33.3	50.8
2014_SOLEA_22_695_73.jpg	315	M	25/10/2014	4	4	6	6	4	4	4	66.7	22.1
2014_SOLEA_22_695_8.jpg	415	F	25/10/2014	4	4	4	7	4	4	4	83.3	27.2
2014_SOLEA_22_695_83.jpg	235	F	25/10/2014	1	3	2	4	1	2	2	33.3	54
2014_SOLEA_22_695_85.jpg	215	F	25/10/2014	1	0	2	3	1	2	2	33.3	69.9
2014_SOLEA_22_695_87.jpg	235	M	25/10/2014	1	2	2	3	1	2	2	50	41.1
2014_SOLEA_22_695_91.jpg	155	F	25/10/2014	1	2	2	2	2	2	2	83.3	22.3
Total read	-	-	-		50	50	50	50	49	50	-	-
Total NOT read	-	-	-		0	0	0	0	1	0	-	-
Means (CV and PA)	-	-	-		-	-	-	-	-	-	61.2	23.8

Table B2. Percentage agreement based on modal age for all readers of whole otoliths in SD 22

modalAge	R2	R3	R5	R6	R7	R8	All
1	100	100	0	0	100	100	67
2	64	64	86	29	71	71	64
3	27	80	53	47	43	80	55
4	63	100	63	0	50	88	60
5	67	100	83	83	83	33	75
6	60	60	60	60	60	40	57
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-
9	0	100	100	100	0	0	50
Weighted mean	52.1	79.9	68	40.2	59.1	67.9	61.1
Rank	5	1	2	6	4	3	-

Table B3 Coefficient of Variation (CV) between the modal age and the age estimation of all readers of whole otoliths in SD 22

modalAge	R2	R3	R5	R6	R7	R8	All
1	0	0	0	0	0	0	39
2	30	36	17	33	27	21	31
3	34	15	23	26	32	16	28
4	29	0	21	15	25	9	24
5	11	0	8	8	8	18	8
6	10	12	14	9	12	14	11
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-
9	0	0	0	0	0	0	6
Weighted Mean	25.6	15.8	17.4	21.3	23.1	15.7	23.8
Rank	6	2	3	4	5	1	-

Table B4. Relative bias values between the modal age and the age estimation of all readers of whole otoliths in SD 22 (values in red indicate a negative bias, those in black indicate a positive bias)

modalAge	R2	R3	R5	R6	R7	R8	All
1	0	0	1	1	0	0	0.33
2	-0.36	0.14	0.14	1.21	-0.29	0.29	0.19
3	-0.93	0.07	0.07	0.93	-0.21	-0.07	-0.02
4	-0.12	0	0.25	2	-0.38	-0.12	0.27
5	-0.33	0	0.17	0.17	-0.17	0	-0.03
6	-0.4	0	0.6	0.4	0	-0.2	0.07
7	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-
9	-1	0	0	0	-1	-1	-0.5
Weighted Mean	-0.5	0.06	0.2	1.02	-0.25	0	0.09
Rank	5	2	3	6	4	1	-

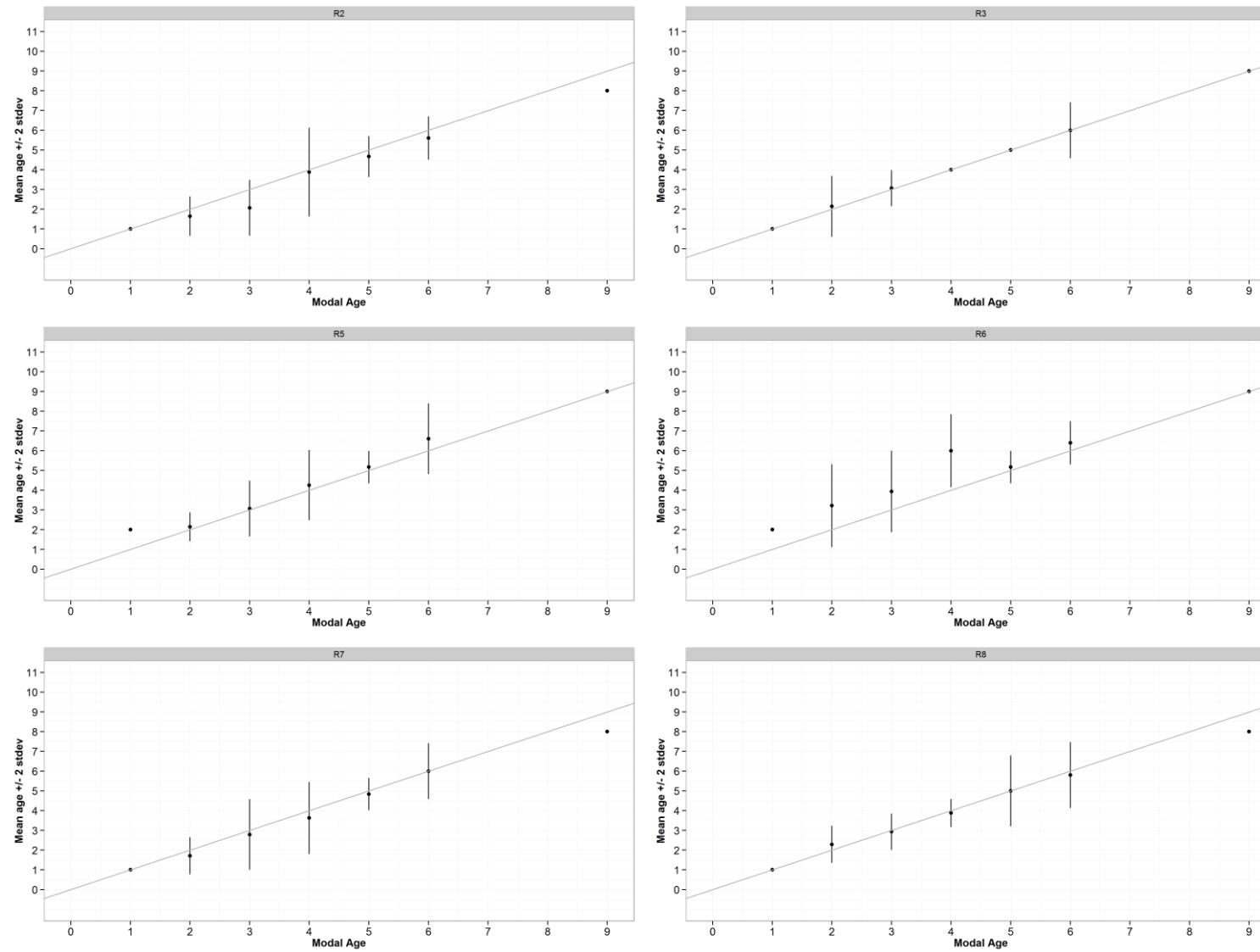


Figure B1. Age bias plots for all readers of whole otoliths in SD 22, reader ID is shown at the top of each graph. They show the mean age recorded +/- 2stddev of each age reader plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line).

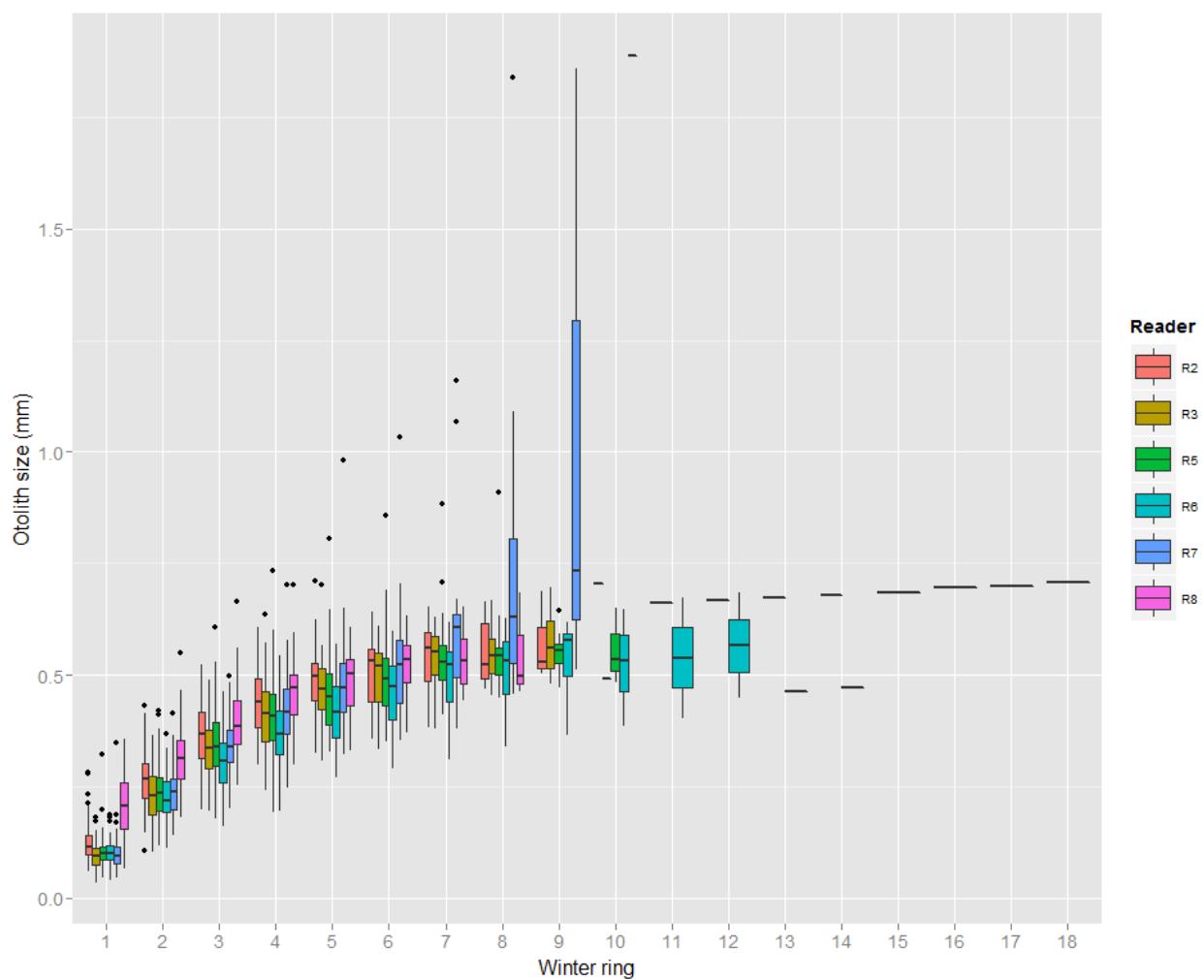


Figure B2. Plot of average distance to the centre for winter rings 1-17 and the edge for all readers of whole otoliths in SD 22. The boxes represent the mean, upper and lower box boundaries of the interquartile range, whiskers represent the minimum and maximum values and the dots represent the outliers.

SD22 sectioned otoliths

Table B5. Biological data, age estimates, coefficient of variation (CV) and percentage agreement (PA) per sectioned otolith for all readers in SD 22

Image	Length	Sex	Capture date	R1	R3	R6	R8	Modal age	PA	CV
gefS22Solea695_047.jpg	295	F	25/10/2014	3	3	3	3	3	100	0
gefS22Solea695_048.jpg	255	M	25/10/2014	3	3	4	3	3	75	15.4
gefS22Solea695_228.jpg	245	M	25/10/2014	2	3	5	2	2	50	47.1
S22Solea685_004.jpg	235	F	05/02/2014	3	2	3	2	3	50	23.1
S22Solea685_005.jpg	225	F	05/02/2014	2	0	4	2	2	50	81.6
S22Solea685_007.jpg	315	F	05/02/2014	3	4	6	3	3	50	35.4
S22Solea685_022.jpg	255	M	05/02/2014	4	3	6	4	4	50	29.6
S22Solea685_037.jpg	215	M	05/02/2014	4	3	4	3	4	50	16.5
S22Solea685_038.jpg	185	M	05/02/2014	3	2	3	2	3	50	23.1

S22Solea685_068.jpg	205	M	06/02/2014	2	2	3	2	2	75	22.2
S22Solea685_071.jpg	375	M	06/02/2014	5	4	7	5	5	50	24
S22Solea685_075.jpg	345	M	06/02/2014	4	4	4	4	4	100	0
S22Solea685_079.jpg	385	F	06/02/2014	5	5	6	5	5	75	9.5
S22Solea685_100.jpg	425	F	06/02/2014	6	5	6	6	6	75	8.7
S22Solea685_104.jpg	415	F	06/02/2014	4	4	5	4	4	75	11.8
S22Solea685_108.jpg	345	F	06/02/2014	5	5	5	5	5	100	0
S22Solea685_114.jpg	295	F	06/02/2014	4	3	4	3	4	50	16.5
S22Solea685_132.jpg	225	M	06/02/2014	3	3	3	3	3	100	0
S22Solea685_142.jpg	325	M	06/02/2014	5	5	4	4	5	50	12.8
S22Solea685_160.jpg	245	M	06/02/2014	3	4	5	3	3	50	25.5
S22Solea685_166.jpg	225	F	06/02/2014	3	2	3	2	3	50	23.1
S22Solea685_177.jpg	285	M	06/02/2014	4	4	3	3	4	50	16.5
S22Solea685_179.jpg	425	F	07/02/2014	12	10	10	11	10	50	8.9
S22Solea685_188.jpg	305	F	07/02/2014	4	3	3	4	4	50	16.5
S22Solea685_209.jpg	275	F	07/02/2014	3	3	4	2	3	50	27.2
S22Solea695_008.jpg	415	F	25/10/2014	4	4	4	4	4	100	0
S22Solea695_023.jpg	325	F	25/10/2014	4	5	7	4	4	50	28.3
S22Solea695_065.jpg	335	F	25/10/2014	3	3	6	3	3	75	40
S22Solea695_073.jpg	315	M	25/10/2014	3	5	3	3	3	75	28.6
S22Solea695_083.jpg	235	F	25/10/2014	2	2	2	2	2	100	0
S22Solea695_085.jpg	215	F	25/10/2014	2	3	3	2	3	50	23.1
S22Solea695_087.jpg	235	M	25/10/2014	2	2	2	2	2	100	0
S22Solea695_091.jpg	155	F	25/10/2014	1	2	1	2	2	50	38.5
S22Solea695_102.jpg	315	F	25/10/2014	3	5	3	3	3	75	28.6
S22Solea695_111.jpg	305	M	25/10/2014	3	4	4	3	4	50	16.5
S22Solea695_117.jpg	285	M	25/10/2014	2	2	5	2	2	75	54.5
S22Solea695_128.jpg	225	F	25/10/2014	2	2	3	2	2	75	22.2
S22Solea695_129.jpg	125	F	25/10/2014	1	1	1	1	1	100	0
S22Solea695_134.jpg	345	F	25/10/2014	2	3	2	2	2	75	22.2
S22Solea695_157.jpg	335	F	25/10/2014	2	3	4	2	2	50	34.8
S22Solea695_158.jpg	345	F	25/10/2014	2	4	5	2	2	50	46.2
S22Solea695_167.jpg	195	M	25/10/2014	2	2	2	NA	2	100	0
S22Solea695_171.jpg	405	F	25/10/2014	3	3	6	3	3	75	40
S22Solea695_174.jpg	385	F	25/10/2014	6	5	7	5	5	50	16.7
S22Solea695_188.jpg	395	F	25/10/2014	5	4	4	4	4	75	11.8
S22Solea695_191.jpg	335	M	25/10/2014	2	3	3	2	3	50	23.1
S22Solea695_194.jpg	355	F	25/10/2014	2	0	3	2	2	50	71.9
S22Solea695_201.jpg	425	F	25/10/2014	6	7	7	7	7	75	7.4
S22Solea695_206.jpg	425	F	25/10/2014	5	6	7	5	5	50	16.7
S22Solea695_220.jpg	295	F	25/10/2014	2	3	3	3	3	75	18.2
Total read	-	-	-	50	50	50	49	-	-	-
Total NOT read	-	-	-	0	0	0	1	-	-	-
Means (CV and PA)	-	-	-	-	-	-	-	-	66.5	21.7

Table B6. Percentage agreement based on modal age for all readers of sectioned otoliths in SD 22

modalAge	R1	R3	R6	R8	All
1	100	100	100	100	100
2	92	54	31	100	69
3	81	56	63	63	66
4	82	55	55	64	64
5	83	67	17	83	63
6	100	0	100	100	75
7	0	100	100	100	75
8	-	-	-	-	-
9	-	-	-	-	-
10	0	100	100	0	50
Weighted mean	81.8	58.1	50.4	75.7	66.7
Rank	1	3	4	2	-

Table B7. Coefficient of Variation (CV) between the modal age and the age estimation of all readers of sectioned otoliths in SD 22

modalAge	R1	R3	R6	R8	All
1	0	0	0	0	0
2	14	54	43	0	34
3	14	29	32	19	23
4	11	17	28	14	15
5	8	13	21	8	13
6	0	0	0	0	9
7	0	0	0	0	7
8	-	-	-	-	-
9	-	-	-	-	-
10	0	0	0	0	9
Weighted Mean	11.5	28.6	30.1	10.3	21.7
Rank	2	3	4	1	-

Table B8. Relative bias values between the modal age and the age estimation of all readers of sectioned otoliths in SD 22 (values in blue indicate a negative bias, those in black indicate a positive bias)

modalAge	R1	R3	R6	R8	All
1	0	0	0	0	0
2	-0.08	0.08	1.15	0	0.29
3	-0.19	0.19	0.81	-0.38	0.11
4	0	-0.27	0.36	-0.36	-0.07
5	0.17	0	1	-0.17	0.25
6	0	-1	0	0	-0.25
7	-1	0	0	0	-0.25
8	-	-	-	-	-
9	-	-	-	-	-
10	2	0	0	1	0.75
Weighted Mean	-0.04	0	0.76	-0.21	0.13

Rank	2	1	4	3	-
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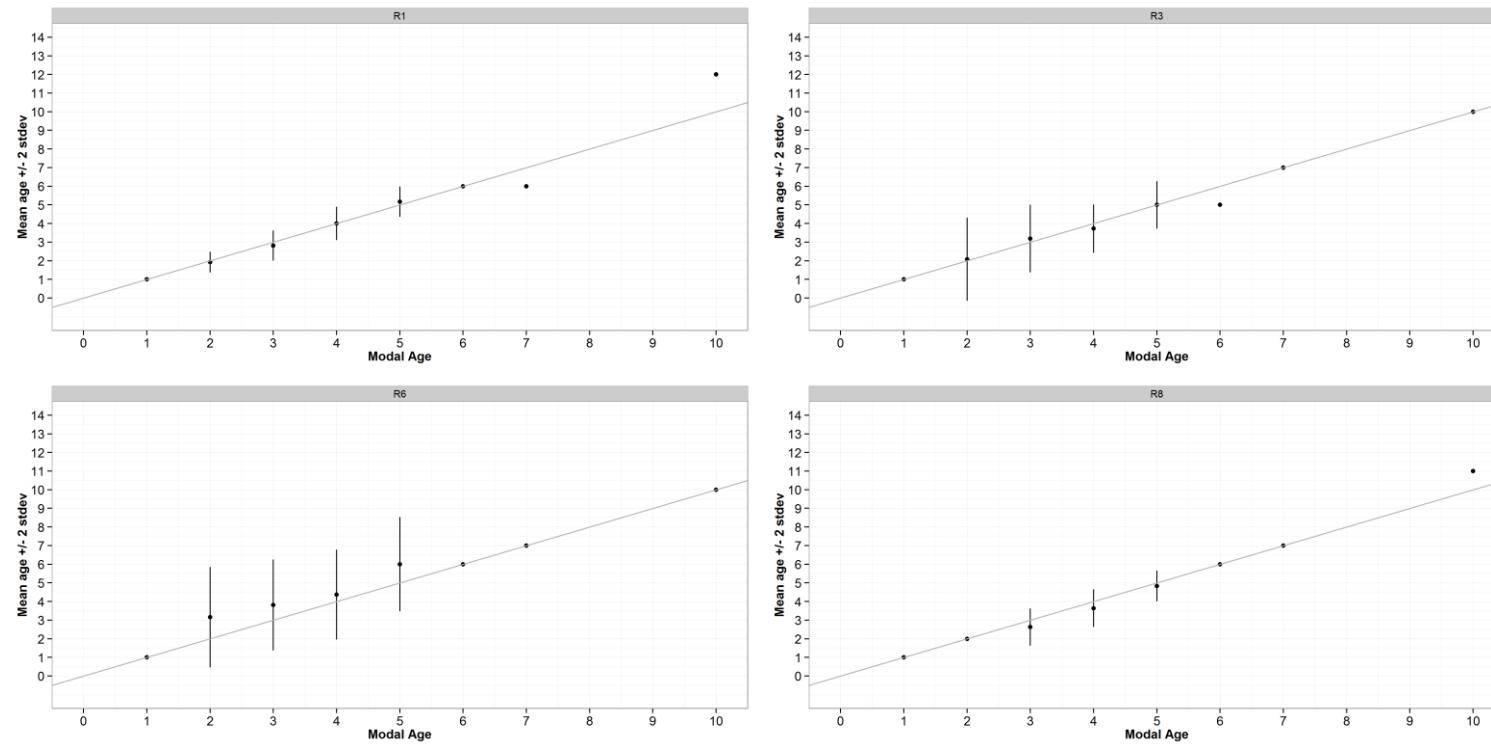


Figure B3 Age bias plots for all readers of sectioned otoliths in SD 22, reader ID is shown at the top of each graph. They show the mean age recorded +/- 2stdev of each age reader plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line).

SD23 whole otoliths

Table B9. Biological data, age estimates, coefficient of variation (CV) and percentage agreement (PA) per whole otolith for all readers in SD 23

Image	Length	Sex	Capture date	R2	R3	R5	R6	R7	R8	Modal age	PA	CV
2010_KASU1_2443_10_.jpg	150	M	07/03/2010	2	2	2	2	2	3	2	83.3	18.8
2010_KASU1_2443_14_.jpg	220	M	07/03/2010	2	2	2	3	3	3	3	50	21.9
2010_KASU1_2443_15_.jpg	230	M	07/03/2010	2	3	3	4	3	3	3	66.7	21.1
2010_KASU1_2443_16_.jpg	290	M	07/03/2010	6	5	6	5	5	5	5	66.7	9.7
2010_KASU1_2443_19_.jpg	270	F	07/03/2010	3	3	3	2	3	4	3	66.7	21.1
2010_KASU1_2443_2_.jpg	310	F	07/03/2010	6	5	7	5	5	6	5	50	14.4
2010_KASU1_2443_23_.jpg	210	F	07/03/2010	3	3	3	3	3	3	3	100	0
2010_KASU1_2443_26_.jpg	240	F	07/03/2010	3	3	3	3	4	5	3	66.7	23.9
2010_KASU1_2443_3_.jpg	490	F	07/03/2010	9	8	17	11	8	8	8	50	34.9
2010_KASU1_2443_30_.jpg	180	F	07/03/2010	2	2	2	2	2	3	2	83.3	18.8
2010_KASU1_2443_31_.jpg	150	M	07/03/2010	1	2	2	2	2	3	2	66.7	31.6
2010_KASU1_2443_4_.jpg	250	F	07/03/2010	3	3	3	4	3	4	3	66.7	15.5
2010_KASU1_2443_9_.jpg	240	F	07/03/2010	3	3	5	3	5	4	3	50	25.6
2010_KASU1_2444_1_.jpg	390	F	07/03/2010	4	4	6	8	5	4	4	50	31
2010_KASU1_2444_11_.jpg	330	F	07/03/2010	4	3	5	8	3	4	5	16.7	41.6
2010_KASU1_2444_13_.jpg	350	F	07/03/2010	3	3	7	8	3	3	3	66.7	52.1
2010_KASU1_2444_17_.jpg	320	F	07/03/2010	4	4	5	13	4	4	4	66.7	63.8
2010_KASU1_2444_20_.jpg	250	M	07/03/2010	2	3	2	2	2	3	2	66.7	22.1
2010_KASU1_2444_3_.jpg	400	F	07/03/2010	6	6	8	9	6	6	6	66.7	19.5
2010_KASU1_2444_4_.jpg	340	F	07/03/2010	3	4	7	5	NA	4	4	40	33
2010_KASU1_2444_6_.jpg	360	F	07/03/2010	3	4	4	4	5	4	4	66.7	15.8
2010_KASU2_2988_2_.jpg	290	M	08/03/2010	3	3	3	4	3	3	3	83.3	12.9
2010_KASU2_2989_11_.jpg	320	F	09/03/2010	4	4	4	4	4	4	4	100	0
2010_KASU2_2989_12_.jpg	330	M	09/03/2010	4	4	7	5	5	4	4	50	24.2
2010_KASU2_2989_13_.jpg	330	M	09/03/2010	5	5	5	6	3	5	5	66.7	20.3
2010_KASU2_2989_15_.jpg	290	M	09/03/2010	5	3	5	5	3	3	4	0	27.4
2010_KASU2_2989_5_.jpg	270	F	09/03/2010	3	3	4	3	3	3	3	83.3	12.9
2010_KASU2_2989_6_.jpg	260	M	09/03/2010	3	2	4	4	2	3	3	33.3	29.8
2010_KASU2_2989_7_.jpg	280	F	09/03/2010	4	4	5	4	4	5	4	66.7	11.9
2011_KASU1_3095_2_.jpg	400	F	07/03/2011	6	6	7	6	6	6	6	83.3	6.6
2011_KASU1_3095_3_.jpg	340	F	07/03/2011	7	7	7	7	6	8	7	66.7	9
2011_KASU2_3728_13_.jpg	240	M	04/11/2011	2	2	2	3	2	3	2	66.7	22.1
2011_KASU2_3728_2_.jpg	350	F	04/11/2011	6	8	7	8	8	7	8	50	11.1
2011_KASU2_3728_5_.jpg	220	F	04/11/2011	2	3	2	3	2	2	2	66.7	22.1
2011_KASU2_3728_8_.jpg	210	F	04/11/2011	2	3	2	3	1	2	2	50	34.7
2011_KASU2_3729_3_.jpg	240	M	05/11/2011	2	3	3	3	2	3	3	66.7	19.4
2011_KASU2_3729_7_.jpg	340	F	05/11/2011	3	3	3	5	3	3	3	83.3	24.5
2012_KASU1_3818_23_.jpg	390	F	04/03/2012	7	6	6	8	6	5	6	50	16.3
2012_KASU1_3818_25_.jpg	350	F	04/03/2012	4	4	4	6	4	4	4	83.3	18.8
2012_KASU1_3819_1_.jpg	360	F	04/03/2012	5	5	5	6	5	4	5	66.7	12.6

2012_KASU1_3819_3.jpg	470	F	04/03/2012	7	7	9	7	7	6	7	66.7	13.7
2012_KASU1_3820_17.jpg	320	F	05/03/2012	6	7	8	5	5	5	5	50	21.1
2012_KASU1_3820_8.jpg	400	F	05/03/2012	8	8	8	7	7	7	8	50	7.3
2012_KASU2_4287_2.jpg	280	M	02/11/2012	2	4	4	4	3	3	4	50	24.5
2012_KASU2_4287_4.jpg	210	M	02/11/2012	2	4	3	5	2	3	3	33.3	36.9
2012_KASU2_4288_20.jpg	270	F	02/11/2012	5	6	5	5	5	6	5	66.7	9.7
2012_KASU2_4288_21.jpg	310	F	02/11/2012	3	4	3	4	3	3	3	66.7	15.5
Total read	-	-	-		47	47	47	47	46	47	-	-
Total NOT read	-	-	-		0	0	0	0	1	0	-	-
Means (CV and PA)	-	-	-		-	-	-	-	-	-	61.8	21.3

Table B10. Percentage agreement based on modal age for all readers of whole otoliths in SD 23

modalAge	R2	R3	R5	R6	R7	R8	All
1	86	57	100	57	86	29	69
2	73	73	67	40	67	73	66
3	60	90	40	40	44	70	58
4	43	57	57	57	71	43	55
5	67	100	33	33	100	67	67
6	100	100	50	100	50	0	67
7	33	100	33	33	67	33	50
8	NA						
Weighted mean	65.9	76.4	59.6	46.7	67.4	55.3	62.2
Rank	3	1	4	6	2	5	-

Table B11. Coefficient of Variation (CV) between the modal age and the age estimation of all readers of whole otoliths in SD 23

modalAge	R2	R3	R5	R6	R7	R8	All
2	20	22	0	22	20	18	24
3	17	18	34	36	25	19	22
4	22	8	23	49	19	15	25
5	14	24	21	19	22	16	19
6	9	0	14	20	0	10	14
7	0	0	18	0	11	20	11
8	20	0	52	24	8	8	18
Weighted Mean	17	14.3	23.9	30.8	19.3	16.3	21.3
Rank	3	1	5	6	4	2	-

Table B12. Relative bias values between the modal age and the age estimation of all readers of whole otoliths in SD 23 (values in blue indicate a negative bias, those in black indicate a positive bias)

modalAge	R2	R3	R5	R6	R7	R8	All
2	-0.14	0.43	0	0.43	-0.14	0.71	0.21
3	-0.27	0	0.47	0.87	0	0.33	0.23
4	-0.3	-0.1	1.1	1.8	0.11	-0.1	0.42
5	0.29	0.14	0.86	0.71	-0.57	0	0.24

6	0.33	0	1	1.67	0	-0.33	0.44
7	0	0	1	0	-0.5	0	0.08
8	-0.33	0	2.67	0.67	-0.33	-0.67	0.33
Weighted Mean	-0.13	0.06	0.79	0.98	-0.13	0.13	0.28
Rank	2	1	5	6	2	2	-

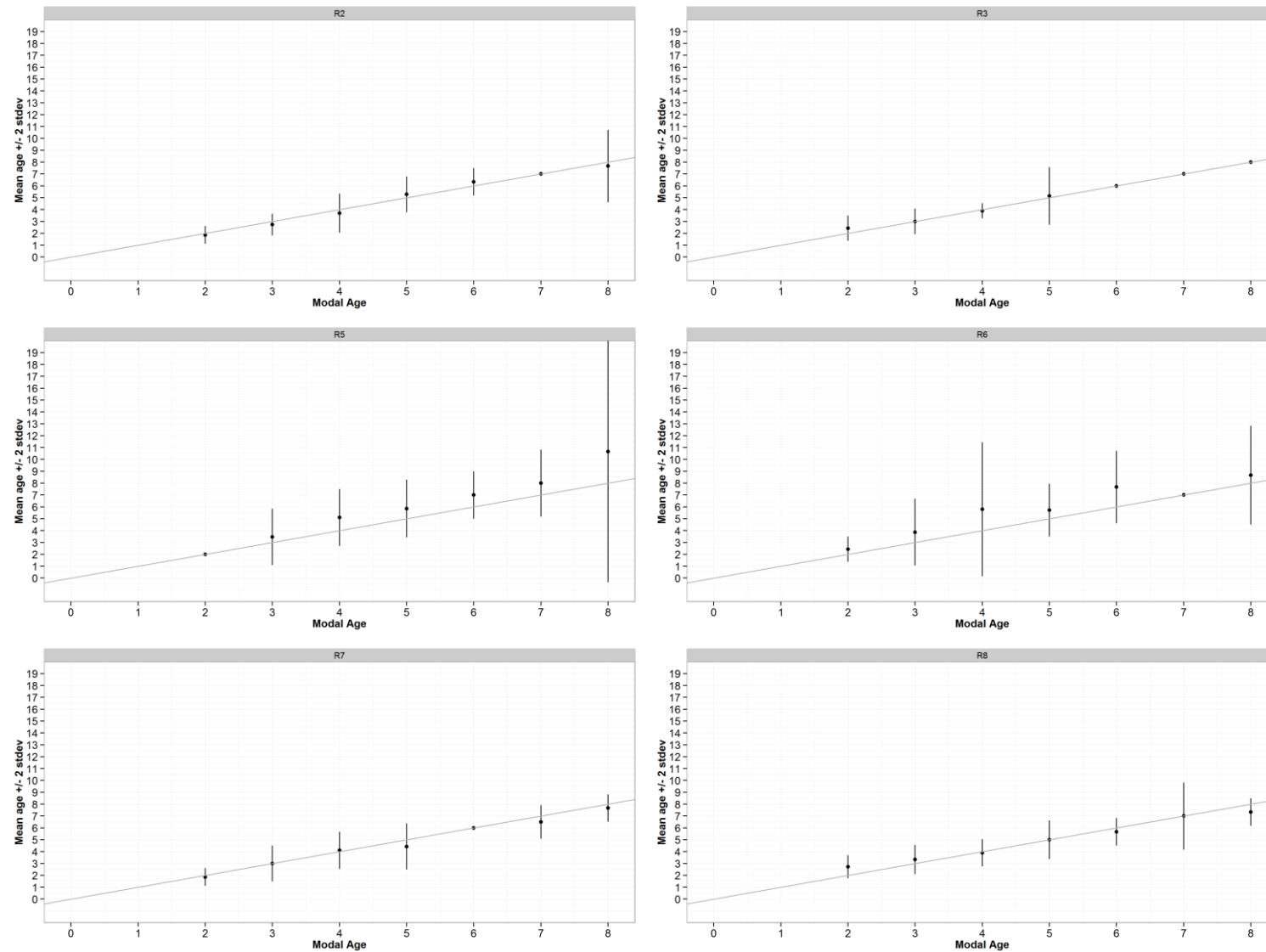


Figure B4. Age bias plots for all readers of whole otoliths in SD 23, reader ID is shown at the top of each graph. They show the mean age recorded +/- 2stdev of each age reader plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line).

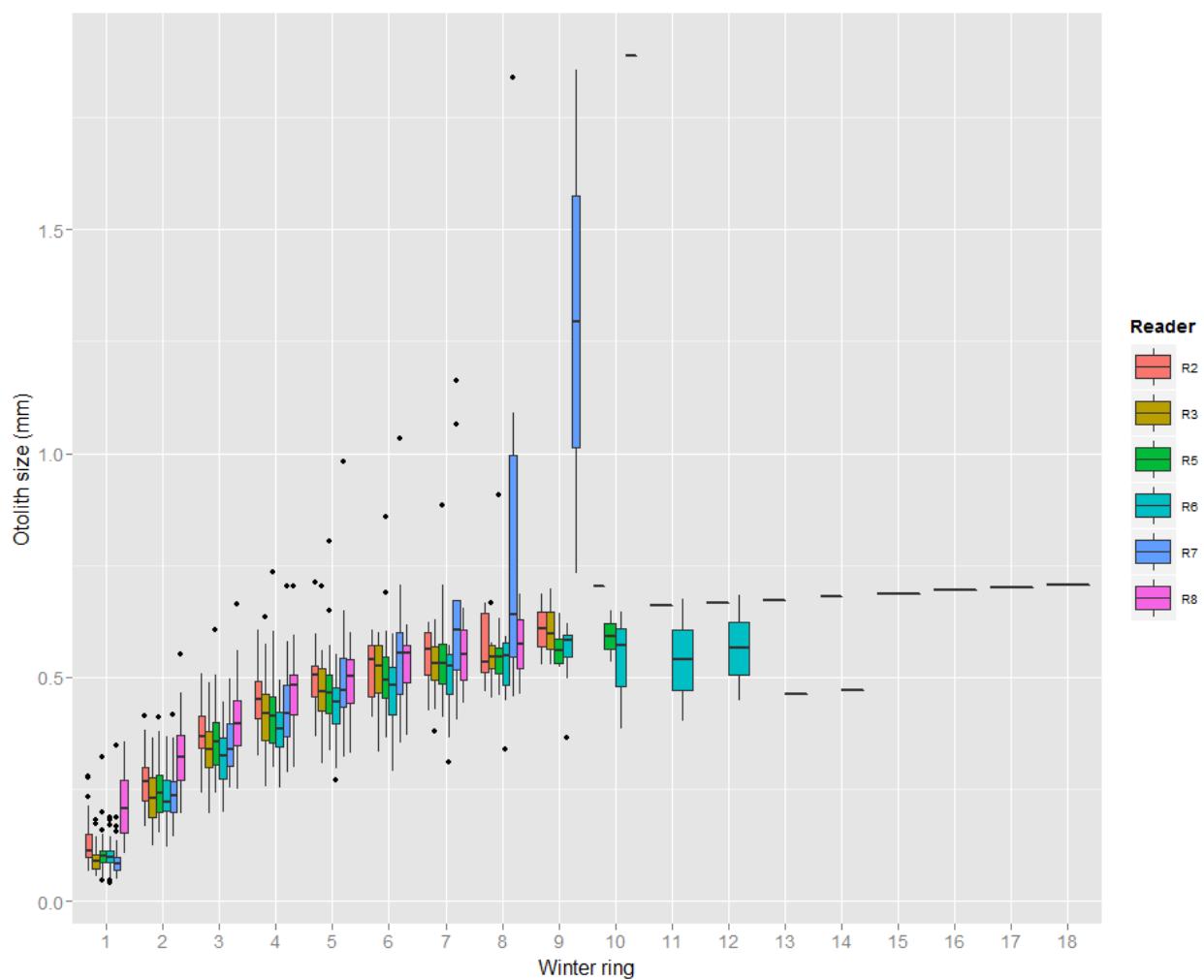


Figure B5. Plot of average distance to the centre for winter rings 1-17 and the edge for all readers of whole otoliths in SD 23. The boxes represent the mean, upper and lower box boundaries of the interquartile range, whiskers represent the minimum and maximum values and the dots represent the outliers.

SD23 sectioned otoliths

Table B13. Biological data, age estimates, coefficient of variation (CV) and percentage agreement (PA) per sectioned otolith for all readers in SD 23

Image	Length	Sex	Capture date	R1	R3	R6	R7	R8	Modal age	PA	CV
2443-02.jpg	310	F	07/03/2010	4	3	6	0	NA	3	25	76.9
2443-03.jpg	490	F	07/03/2010	11	9	11	11	10	11	60	8.6
2443-04.jpg	250	F	07/03/2010	3	2	3	0	3	3	60	59.3
2443-09.jpg	240	F	07/03/2010	4	4	5	3	4	4	60	17.7
2443-10.jpg	150	M	07/03/2010	2	1	2	1	2	2	60	34.2
2443-14.jpg	220	M	07/03/2010	3	3	5	3	3	3	80	26.3
2443-15.jpg	230	M	07/03/2010	3	3	4	3	3	3	80	14
2443-16.jpg	290	M	07/03/2010	4	3	4	3	4	4	60	15.2
2443-19.jpg	270	F	07/03/2010	4	3	3	3	4	3	60	16.1
2443-23.jpg	210	F	07/03/2010	3	3	5	2	3	3	60	34.2
2443-26.jpg	240	F	07/03/2010	4	4	4	3	4	4	80	11.8

2443-30.jpg	180	F	07/03/2010	2	3	2	2	2	2	80	20.3
2443-31.jpg	150	M	07/03/2010	3	2	NA	2	3	3	50	23.1
2444-01.jpg	390	F	07/03/2010	4	4	4	4	4	4	100	0
2444-03.jpg	400	F	07/03/2010	6	6	6	7	7	6	60	8.6
2444-04.jpg	340	F	07/03/2010	4	3	5	3	4	4	40	22
2444-06.jpg	360	F	07/03/2010	5	4	5	4	5	5	60	11.9
2444-11.jpg	330	F	07/03/2010	3	3	4	3	3	3	80	14
2444-13.jpg	350	F	07/03/2010	4	3	5	3	3	3	60	24.8
2444-17.jpg	320	F	07/03/2010	4	4	6	5	4	4	60	19.4
2444-20.jpg	250	M	07/03/2010	3	2	4	2	3	3	40	29.9
2988-02.jpg	290	M	08/03/2010	3	2	4	2	NA	2	50	34.8
2989-05.jpg	270	F	09/03/2010	3	3	7	3	3	3	80	47.1
2989-06.jpg	260	M	09/03/2010	3	3	6	2	2	3	40	51.3
2989-07.jpg	280	F	09/03/2010	3	3	6	3	3	3	80	37.3
2989-11.jpg	320	F	09/03/2010	4	5	7	0	4	4	40	63.7
2989-12.jpg	330	M	09/03/2010	NA	3	14	0	NA	6	0	130.1
2989-13.jpg	330	M	09/03/2010	5	4	9	7	4	4	40	37.4
2989-15.jpg	290	M	09/03/2010	3	3	11	0	3	3	60	103.1
3095-02.jpg	400	F	07/03/2011	6	6	6	NA	5	6	75	8.7
3095-03.jpg	340	F	07/03/2011	6	5	7	NA	5	5	50	16.7
3728-02.jpg	350	F	04/11/2011	NA	6	12	NA	NA	9	0	47.1
3728-05.jpg	220	F	04/11/2011	2	3	3	NA	2	3	50	23.1
3728-08.jpg	210	F	04/11/2011	1	2	3	NA	2	2	50	40.8
3728-13.jpg	240	M	04/11/2011	3	3	3	NA	3	3	100	0
3729-03.jpg	240	M	05/11/2011	2	2	2	NA	3	2	75	22.2
3729-07.jpg	340	F	05/11/2011	3	3	5	NA	4	3	50	25.5
3818-23.jpg	390	F	04/03/2012	6	4	7	NA	5	6	25	23.5
3818-25.jpg	350	F	04/03/2012	5	3	5	NA	4	5	50	22.5
3819-01.jpg	360	F	04/03/2012	6	4	5	NA	6	6	50	18.2
3819-03.jpg	470	F	04/03/2012	7	5	10	NA	7	7	50	28.4
3820-08.jpg	400	F	05/03/2012	6	6	15	NA	6	6	75	54.5
3820-17.jpg	320	F	05/03/2012	6	4	10	NA	7	7	25	37
4287-02.jpg	280	M	02/11/2012	3	3	5	NA	3	3	75	28.6
4287-04.jpg	210	M	02/11/2012	2	2	3	NA	2	2	75	22.2
4288-20.jpg	270	F	02/11/2012	4	5	5	NA	4	5	50	12.8
4288-21.jpg	310	F	02/11/2012	3	3	5	NA	3	3	75	28.6
Total read	-	-	-	45	47	46	29	43	-	-	-
Total NOT read	-	-	-	2	0	1	18	4	-	-	-
Means (CV and PA)	-	-	-	-	-	-	-	-	57.6	30.9	

Table B14. Percentage agreement based on modal age for all readers of sectioned otoliths in SD 23

modalAge	R1	R3	R6	R7	R8	All
1	67	67	50	67	80	65
2	100	0	100	100	0	60

3	79	84	22	50	78	64
4	88	63	38	13	100	60
5	50	50	75	0	50	53
6	100	50	33	0	40	50
7	50	0	0	-	100	38
8	-	-	-	-	-	-
9	-	0	0	-	-	0
10	-	-	-	-	-	-
11	NA	NA	NA	NA	NA	NA
Weighted mean	77.9	63.9	34.7	38.1	74.5	59.2
Rank	1	3	5	4	2	-

Table B15. Coefficient of Variation (CV) between the modal age and the age estimation of all readers of sectioned otoliths in SD 23

modalAge	R1	R3	R6	R7	R8	All
2	32	32	31	35	20	29.1
3	15	13	38	58	16	34.9
4	9	17	32	57	0	23.4
5	16	23	18	0	13	16
6	0	27	50	141	14	40.6
7	11	16	0	-	0	32.7
8	-	-	-	-	-	-
9	-	0	0	-	-	47.1
10	-	-	-	-	-	-
11	0	0	0	0	0	8.6
Weighted Mean	14.1	18.3	32.6	57.1	11.9	30.9
Rank	2	3	4	5	1	-

Table B16. Relative bias values between the modal age and the age estimation of all readers of sectioned otoliths in SD 23 (values in blue indicate a negative bias, those in black indicate a positive bias)

Is it wrong? new analysis cant reproduce relative bias table

modalAge	R1	R3	R6	R7	R8	All
2	0	0	0.67	-0.33	0.2	0.11
3	0.11	-0.16	2	-0.93	0	0.2
4	0.12	-0.12	1.5	-0.5	0	0.2
5	0	-0.75	0.5	-1	-0.5	-0.35
6	0	-1.17	2.83	-2.5	-0.2	-0.21
7	-0.5	-2.5	3	-	0	0
8	-	-	-	-	-	-
9	-	-3	3	-	-	0
10	-	-	-	-	-	-
11	0	-2	0	0	-1	-0.6
Weighted Mean	0.05	-0.51	1.74	-0.83	-0.07	0.07
Rank	1	3	5	4	2	-

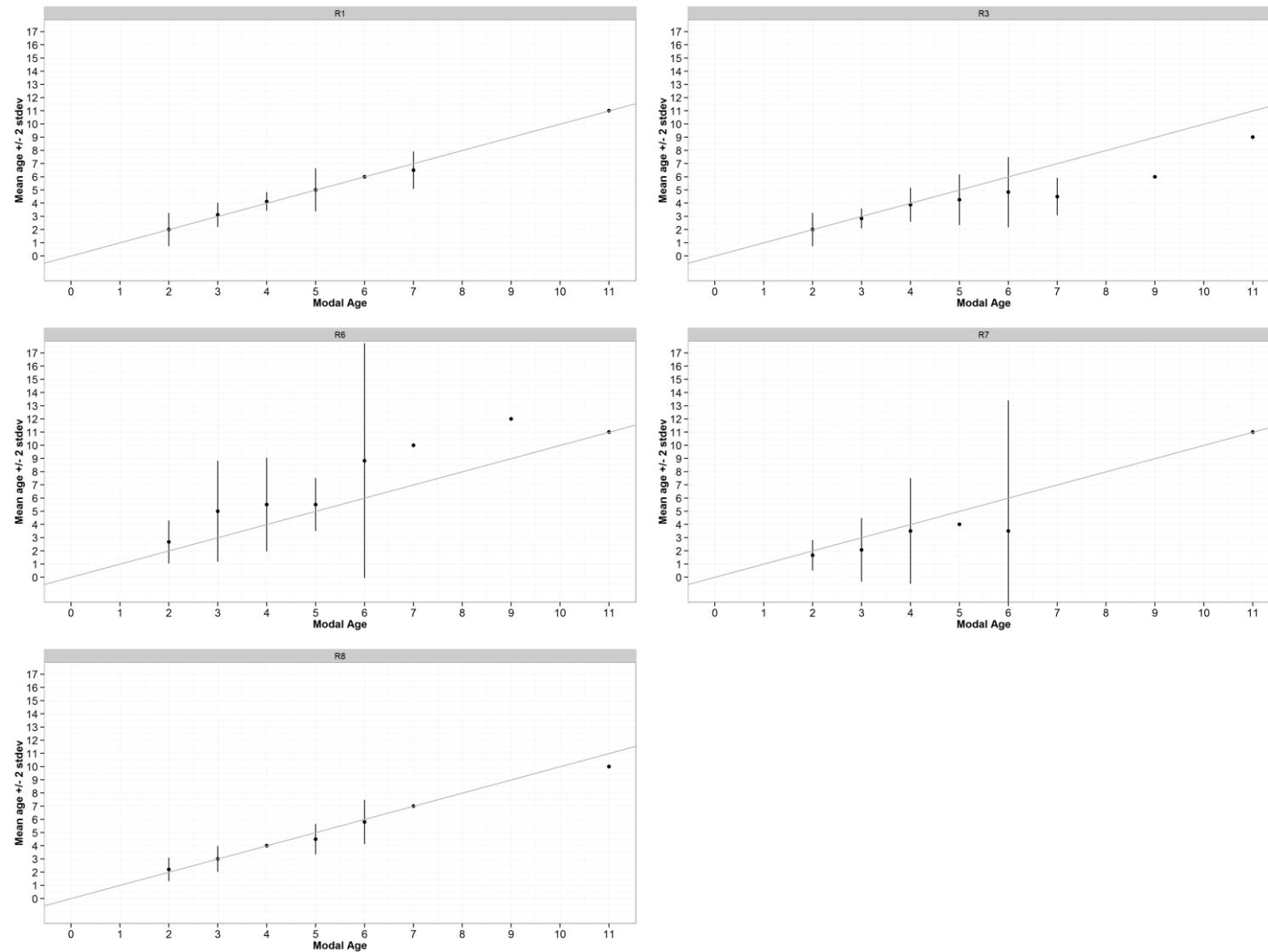


Figure B6. Age bias plots for all readers of sectioned otoliths in SD 23, reader ID is shown at the top of each graph. They show the mean age recorded \pm 2stdev of each age reader plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line).

SD24 whole otoliths

Table B17. Biological data, age estimates, coefficient of variation (CV) and percentage agreement (PA) per whole otolith for all readers in SD 24

Image	Length	Sex	Capture date	R2	R3	R5	R6	R7	R8	Modal age	PA	CV
2014_SOLEA_24_685_126.jpg	155	M	10/02/2014	2	2	1	2	2	2	2	83.3	22.3
2014_SOLEA_24_685_150.jpg	135	M	10/02/2014	2	2	1	2	2	2	2	83.3	22.3
2014_SOLEA_24_685_166.jpg	175	M	10/02/2014	2	2	2	2	2	2	2	100	0
2014_SOLEA_24_685_171.jpg	325	F	11/02/2014	5	5	6	8	5	5	5	66.7	21.4
2014_SOLEA_24_685_191.jpg	175	F	11/02/2014	2	3	3	2	2	3	3	50	21.9
2014_SOLEA_24_685_208.jpg	205	F	11/02/2014	2	2	2	2	2	2	2	100	0
2014_SOLEA_24_685_235.jpg	355	F	12/02/2014	7	6	6	5	7	5	6	33.3	14.9
2014_SOLEA_24_685_244.jpg	305	F	12/02/2014	5	4	10	7	6	4	4	33.3	38
2014_SOLEA_24_685_246.jpg	265	M	12/02/2014	5	4	6	5	5	4	5	50	15.6
2014_SOLEA_24_685_254.jpg	115	F	12/02/2014	2	1	2	1	1	1	1	66.7	38.7
2014_SOLEA_24_685_256.jpg	325	M	13/02/2014	4	4	4	4	4	4	4	100	0
2014_SOLEA_24_685_271.jpg	125	M	13/02/2014	1	2	2	1	2	2	2	66.7	31
2014_SOLEA_24_685_287.jpg	215	F	13/02/2014	2	2	3	3	1	3	3	50	35
2014_SOLEA_24_685_292.jpg	345	F	14/02/2014	6	6	9	10	8	5	6	33.3	26.8
2014_SOLEA_24_685_333.jpg	395	F	14/02/2014	7	7	10	7	7	7	7	83.3	16.3
2014_SOLEA_24_685_342.jpg	235	M	14/02/2014	3	3	3	3	3	3	3	100	0
2014_SOLEA_24_685_349.jpg	285	M	17/02/2014	3	3	3	4	3	3	3	83.3	12.9
2014_SOLEA_24_685_358.jpg	315	F	17/02/2014	4	4	6	5	6	4	4	50	20.3
2014_SOLEA_24_685_374.jpg	275	M	17/02/2014	3	3	6	4	3	3	3	66.7	33
2014_SOLEA_24_685_404.jpg	425	F	18/02/2014	7	5	9	6	6	7	7	33.3	20.5
2014_SOLEA_24_685_5.jpg	335	F	08/02/2014	5	3	6	6	6	4	6	50	25.3
2014_SOLEA_24_685_62.jpg	145	F	09/02/2014	1	2	2	2	1	2	2	66.7	31
2014_SOLEA_24_685_68.jpg	365	F	09/02/2014	7	7	9	7	8	8	7	50	10.6
2014_SOLEA_24_685_80.jpg	295	F	09/02/2014	4	4	4	4	4	4	4	100	0
2014_SOLEA_24_685_88.jpg	195	F	09/02/2014	2	2	2	2	2	3	2	83.3	18.8
2014_SOLEA_24_685_97.jpg	165	F	09/02/2014	2	2	2	2	2	2	2	100	0
2014_SOLEA_24_695_121.jpg	265	F	28/10/2014	2	2	3	3	2	2	2	66.7	22.1
2014_SOLEA_24_695_129.jpg	175	F	28/10/2014	1	1	1	2	1	1	1	83.3	35
2014_SOLEA_24_695_15.jpg	195	M	26/10/2014	1	2	2	2	1	2	2	66.7	31
2014_SOLEA_24_695_181.jpg	315	F	29/10/2014	5	4	6	7	6	4	5	16.7	22.7
2014_SOLEA_24_695_190.jpg	215	M	29/10/2014	2	3	4	4	4	3	4	50	24.5
2014_SOLEA_24_695_207.jpg	235	F	29/10/2014	2	2	2	3	2	2	2	83.3	18.8
2014_SOLEA_24_695_21.jpg	345	F	26/10/2014	5	4	5	5	4	4	5	50	12.2
2014_SOLEA_24_695_218.jpg	215	F	30/10/2014	2	2	3	3	2	3	3	50	21.9
2014_SOLEA_24_695_229.jpg	335	F	30/10/2014	5	5	6	5	5	4	5	66.7	12.6
2014_SOLEA_24_695_23.jpg	295	M	26/10/2014	4	4	5	5	4	4	4	66.7	11.9
2014_SOLEA_24_695_259.jpg	165	M	30/10/2014	1	1	2	2	1	2	2	50	36.5
2014_SOLEA_24_695_285.jpg	425	F	31/10/2014	8	8	9	8	7	7	8	50	9.6

2014_SOLEA_24_695_298.jpg	445	F	31/10/2014	7	7	8	8	6	6	7	33.3	12.8
2014_SOLEA_24_695_309.jpg	305	M	31/10/2014	4	4	4	6	4	4	4	83.3	18.8
2014_SOLEA_24_695_358.jpg	245	F	31/10/2014	2	2	2	4	2	2	2	83.3	35
2014_SOLEA_24_695_39.jpg	235	M	26/10/2014	2	3	2	3	3	3	3	66.7	19.4
2014_SOLEA_24_695_480.jpg	415	F	03/11/2014	9	8	10	10	8	6	9	16.7	17.8
2014_SOLEA_24_695_489.jpg	465	F	03/11/2014	8	6	11	9	7	8	8	33.3	21.1
2014_SOLEA_24_695_503.jpg	375	F	04/11/2014	5	5	6	8	5	5	5	66.7	21.4
2014_SOLEA_24_695_518.jpg	135	M	04/11/2014	1	1	1	1	1	1	1	100	0
2014_SOLEA_24_695_57.jpg	325	F	26/10/2014	4	4	5	4	3	3	4	50	19.6
2014_SOLEA_24_695_67.jpg	285	F	27/10/2014	4	4	6	5	3	4	4	50	23.8
2014_SOLEA_24_695_77.jpg	205	F	27/10/2014	2	2	2	3	1	2	2	66.7	31.6
2014_SOLEA_24_695_89.jpg	155	F	27/10/2014	1	2	1	2	1	2	2	50	36.5
Total read	-	-	-	50	50	50	50	50	50	-	-	-
Total NOT read	-	-	-	0	0	0	0	0	0	-	-	-
Means (CV and PA)	-	-	-	-	-	-	-	-	-	-	63.7	19.9

Table B18. Percentage agreement based on modal age for all readers of whole otoliths in SD 24

modalAge	R2	R3	R5	R6	R7	R8	All
1	67	100	67	67	100	100	83
2	67	93	73	67	67	93	77
3	43	71	71	57	57	100	67
4	78	89	44	44	56	78	65
5	100	50	17	50	67	33	53
6	33	67	67	33	33	0	39
7	100	75	0	50	25	50	50
8	100	50	0	50	0	50	42
9	100	0	0	0	0	0	17
Weighted mean	72.2	77.9	49.8	54	56.2	71.9	63.9
Rank	2	1	6	5	4	3	-

Table B19. Coefficient of Variation (CV) between the modal age and the age estimation of all readers of whole otoliths in SD 24

modalAge	R2	R3	R5	R6	R7	R8	All
1	43	0	43	43	0	0	25
2	29	13	28	31	29	12	23
3	22	18	38	22	32	0	21
4	20	9	36	22	26	12	18
5	0	12	7	24	13	12	18
6	17	35	25	38	14	12	22
7	0	15	9	12	14	12	15
8	0	20	14	8	0	9	15
9	0	0	0	0	0	0	18
Weighted Mean	19	13.6	26.4	25.4	21.4	9.2	19.9
Rank	3	2	6	5	4	1	-

Table B20. Relative bias values between the modal age and the age estimation of all readers of whole otoliths in SD 24 (values in blue indicate a negative bias, those in black indicate a positive bias)

modalAge	R2	R3	R5	R6	R7	R8	All
1	0.33	0	0.33	0.33	0	0	0.17
2	-0.33	-0.07	-0.13	0.27	-0.33	0.07	-0.09
3	-0.57	-0.29	0.29	0.14	-0.57	0	-0.17
4	-0.11	-0.11	1.33	0.89	0.22	-0.22	0.33
5	0	-0.5	0.83	1.33	0	-0.67	0.17
6	0	-1	1	1	1	-1.33	0.11
7	0	-0.5	2	0	-0.25	0	0.21
8	0	-1	2	0.5	-1	-0.5	0
9	0	-1	1	1	-1	-3	-0.5
Weighted Mean	-0.18	-0.3	0.68	0.54	-0.16	-0.26	0.05
Rank	2	4	6	5	1	3	-

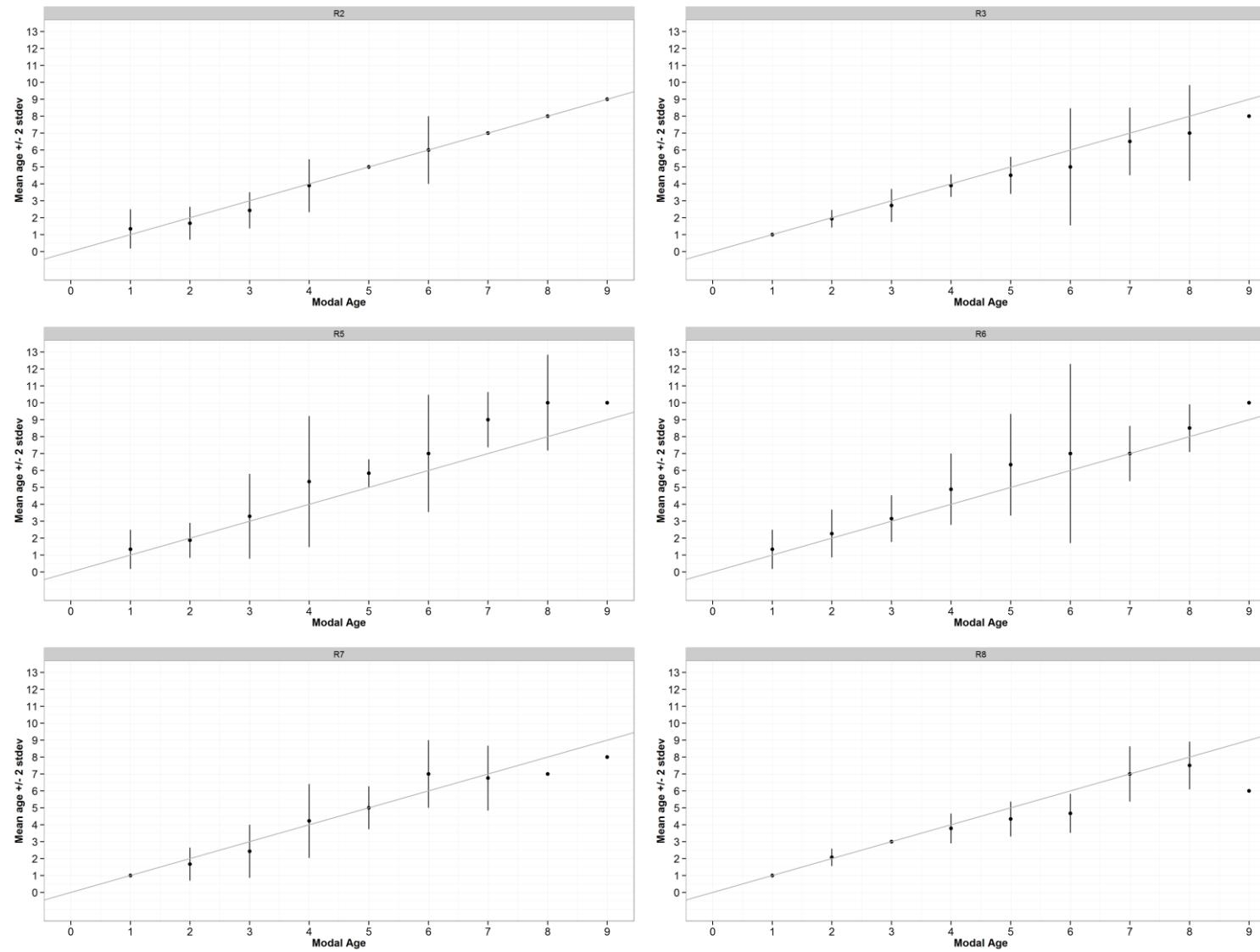


Figure B7. Age bias plots for all readers of whole otoliths in SD 24, reader ID is shown at the top of each graph. They show the mean age recorded $\pm 2\text{stddev}$ of each age reader plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line).

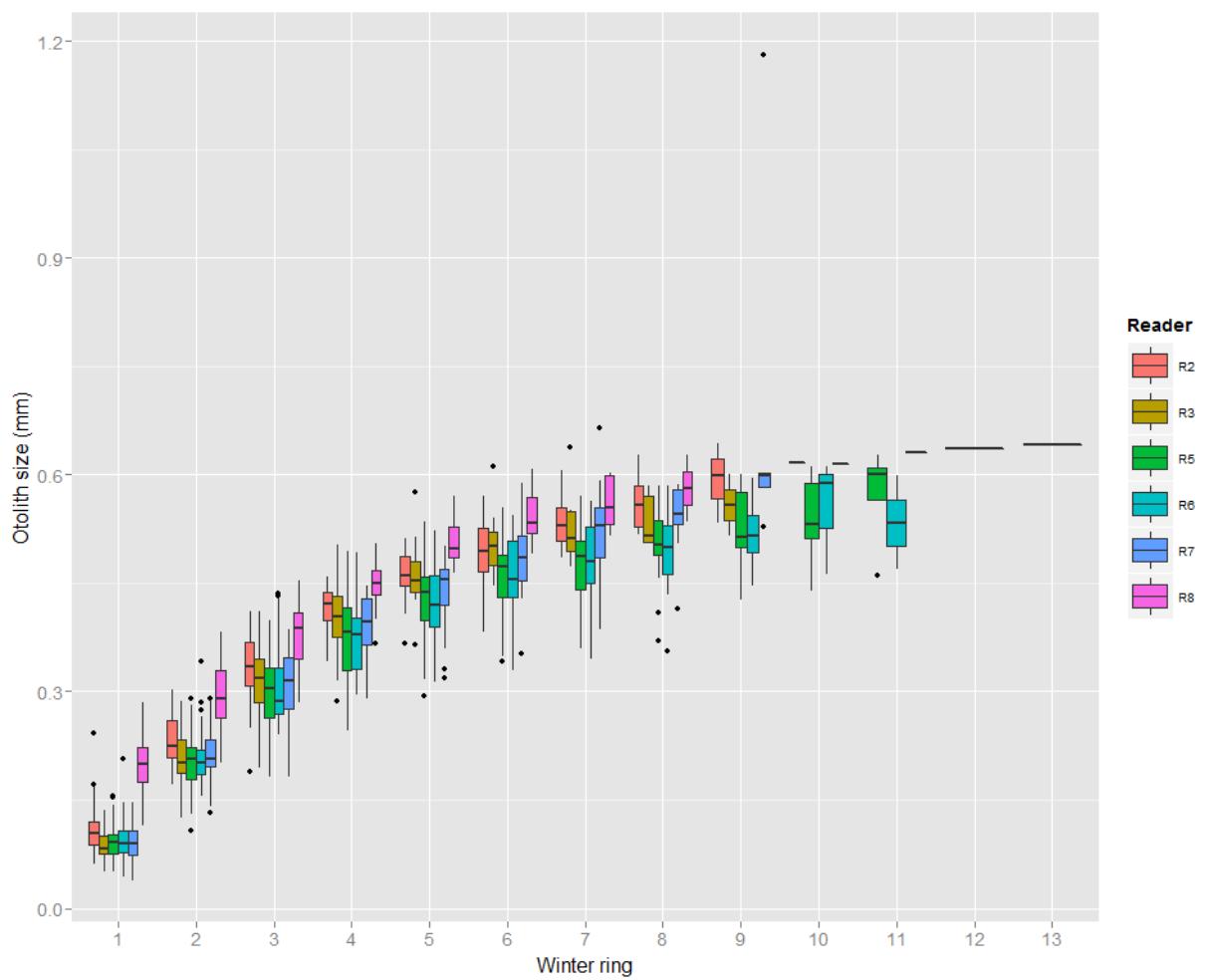


Figure B8. Plot of average distance to the centre for winter rings 1-12 and the edge for all readers of whole otoliths in SD 24. The boxes represent the mean, upper and lower box boundaries of the interquartile range, whiskers represent the minimum and maximum values and the dots represent the outliers.

SD24 sectioned otoliths

Table B21. Biological data, age estimates, coefficient of variation (CV) and percentage agreement (PA) per sectioned otolith for all readers in SD 24

Image	Length	Sex	Capture date	R1	R3	R6	R7	R8	Modal age	PA	CV
gefS24Solea695_089.jpg	155	F	27/10/2014	1	6	1	0	2	1	40	117.3
gefS24Solea695_298.jpg	445	F	31/10/2014	7	6	10	0	7	7	40	61.2
S24Solea685_005.jpg	335	F	08/02/2014	4	4	4	4	4	4	100	0
S24Solea685_062.jpg	145	F	09/02/2014	2	2	2	1	2	2	80	24.8
S24Solea685_068.jpg	365	F	09/02/2014	6	6	7	8	5	6	40	17.8
S24Solea685_080.jpg	295	F	09/02/2014	4	3	3	3	4	3	60	16.1
S24Solea685_088.jpg	195	F	09/02/2014	2	3	3	2	3	3	60	21.1
S24Solea685_097.jpg	165	F	09/02/2014	2	2	2	2	2	2	100	0
S24Solea685_126.jpg	155	M	10/02/2014	2	2	2	2	2	2	100	0
S24Solea685_150.jpg	135	M	10/02/2014	2	2	2	2	2	2	100	0

S24Solea685_166.jpg	175	M	10/02/2014	2	2	2	2	1	2	80	24.8
S24Solea685_171.jpg	325	F	11/02/2014	4	6	5	6	4	5	20	20
S24Solea685_191.jpg	175	F	11/02/2014	2	2	2	1	1	2	60	34.2
S24Solea685_208.jpg	205	F	11/02/2014	2	2	2	2	2	2	100	0
S24Solea685_235.jpg	355	F	12/02/2014	4	4	6	4	4	4	80	20.3
S24Solea685_244.jpg	305	F	12/02/2014	4	4	5	4	4	4	80	10.6
S24Solea685_246.jpg	265	M	12/02/2014	4	3	4	3	4	4	60	15.2
S24Solea685_254.jpg	115	F	12/02/2014	1	1	1	1	1	1	100	0
S24Solea685_256.jpg	325	M	13/02/2014	4	3	3	7	3	3	60	43.3
S24Solea685_271.jpg	125	M	13/02/2014	1	1	2	1	1	1	80	37.3
S24Solea685_287.jpg	215	F	13/02/2014	2	2	2	1	3	2	60	35.4
S24Solea685_292.jpg	345	F	14/02/2014	5	4	5	4	5	5	60	11.9
S24Solea685_333.jpg	395	F	14/02/2014	7	7	8	6	7	7	60	10.1
S24Solea685_342.jpg	235	M	14/02/2014	3	3	3	3	3	3	100	0
S24Solea685_349.jpg	285	M	17/02/2014	4	4	4	3	4	4	80	11.8
S24Solea685_358.jpg	315	F	17/02/2014	3	4	5	4	4	4	60	17.7
S24Solea685_374.jpg	275	M	17/02/2014	4	4	5	4	4	4	80	10.6
S24Solea685_404.jpg	425	F	18/02/2014	7	7	12	7	7	7	80	28
S24Solea695_015.jpg	195	M	26/10/2014	1	2	1	1	1	1	80	37.3
S24Solea695_021.jpg	345	F	26/10/2014	4	4	5	4	4	4	80	10.6
S24Solea695_023.jpg	295	M	26/10/2014	4	4	5	4	4	4	80	10.6
S24Solea695_039.jpg	235	M	26/10/2014	2	1	2	1	2	2	60	34.2
S24Solea695_057.jpg	325	F	26/10/2014	4	4	4	3	4	4	80	11.8
S24Solea695_067.jpg	285	F	27/10/2014	4	4	4	3	3	4	60	15.2
S24Solea695_077.jpg	205	F	27/10/2014	2	2	3	1	2	2	60	35.4
S24Solea695_121.jpg	265	F	28/10/2014	2	3	3	2	3	3	60	21.1
S24Solea695_129.jpg	175	F	28/10/2014	1	2	1	1	1	1	80	37.3
S24Solea695_181.jpg	315	F	29/10/2014	4	4	3	4	4	4	80	11.8
S24Solea695_190.jpg	215	M	29/10/2014	2	2	2	2	2	2	100	0
S24Solea695_207.jpg	235	F	29/10/2014	2	3	2	2	2	2	80	20.3
S24Solea695_218.jpg	215	F	30/10/2014	2	2	2	1	3	2	60	35.4
S24Solea695_229.jpg	335	F	30/10/2014	5	5	6	4	5	5	60	14.1
S24Solea695_259.jpg	165	M	30/10/2014	2	2	1	1	2	2	60	34.2
S24Solea695_285.jpg	425	F	31/10/2014	8	8	9	8	9	8	60	6.5
S24Solea695_309.jpg	305	M	31/10/2014	NA	3	4	3	3	3	75	15.4
S24Solea695_358.jpg	245	F	31/10/2014	2	2	2	2	3	2	80	20.3
S24Solea695_480.jpg	415	F	03/11/2014	6	6	11	8	6	6	60	29.6
S24Solea695_489.jpg	465	F	03/11/2014	10	8	13	12	10	10	40	18.4
S24Solea695_503.jpg	375	F	04/11/2014	4	5	5	5	5	5	80	9.3
S24Solea695_518.jpg	135	M	04/11/2014	1	1	1	1	1	1	100	0
Total read	-	-	-	49	50	50	50	50	-	-	-
Total NOT read	-	-	-	1	0	0	0	0	-	-	-
Means (CV and PA)	-	-	-	-	-	-	-	-	-	71.9	20.4

Table B22. Percentage agreement based on modal age for all readers of sectioned otoliths in SD 24

modalAge	R1	R3	R6	R7	R8	All
1	100	50	83	83	83	80
2	100	0	0	0	100	40
3	100	87	87	53	67	79
4	20	100	83	50	83	69
5	92	92	42	67	92	77
6	50	50	75	25	75	55
7	100	100	0	0	50	50
8	100	67	0	33	100	60
9	100	100	0	100	0	60
10	-	-	-	-	-	-
Weighted mean	85.8	80.2	62.1	53.9	78.1	72.1
Rank	1	2	4	5	3	-

Table B23. Coefficient of Variation (CV) between the modal age and the age estimation of all readers of sectioned otoliths in SD 24

modalAge	R1	R3	R6	R7	R8	All
1	0	90	35	49	35	39
2	0	19	19	34	29	20
3	33	0	13	56	13	20
4	7	7	18	13	7	12
5	13	16	10	20	11	14
6	0	0	31	0	13	24
7	0	9	20	87	0	33
8	0	0	0	0	0	7
9	-	-	-	-	-	-
10	0	0	0	0	0	18
Weighted Mean	6.1	20	19	32.7	17.5	20
Rank	1	4	3	5	2	-

Table B24 Relative bias values between the modal age and the age estimation of all readers of sectioned otoliths in SD 24 (values in blue indicate a negative bias, those in black indicate a positive bias)

modalAge	R1	R3	R6	R7	R8	All
1	0	1.17	0.17	-0.17	0.17	0.27
2	0	0	0	-0.47	0.07	-0.08
3	0	0	0.17	0.33	0.17	0.13
4	-0.08	-0.08	0.5	-0.33	-0.08	-0.02
5	-0.5	0	0.25	-0.25	-0.25	-0.15
6	0	0	3	2	-0.5	0.9
7	0	-0.33	3	-2.67	0	0
8	0	0	1	0	1	0.4
9	-	-	-	-	-	-
10	0	-2	3	2	0	0.6
Weighted Mean	-0.06	0.06	0.56	-0.26	0.02	0.06

Rank	2	2	5	4	1	-
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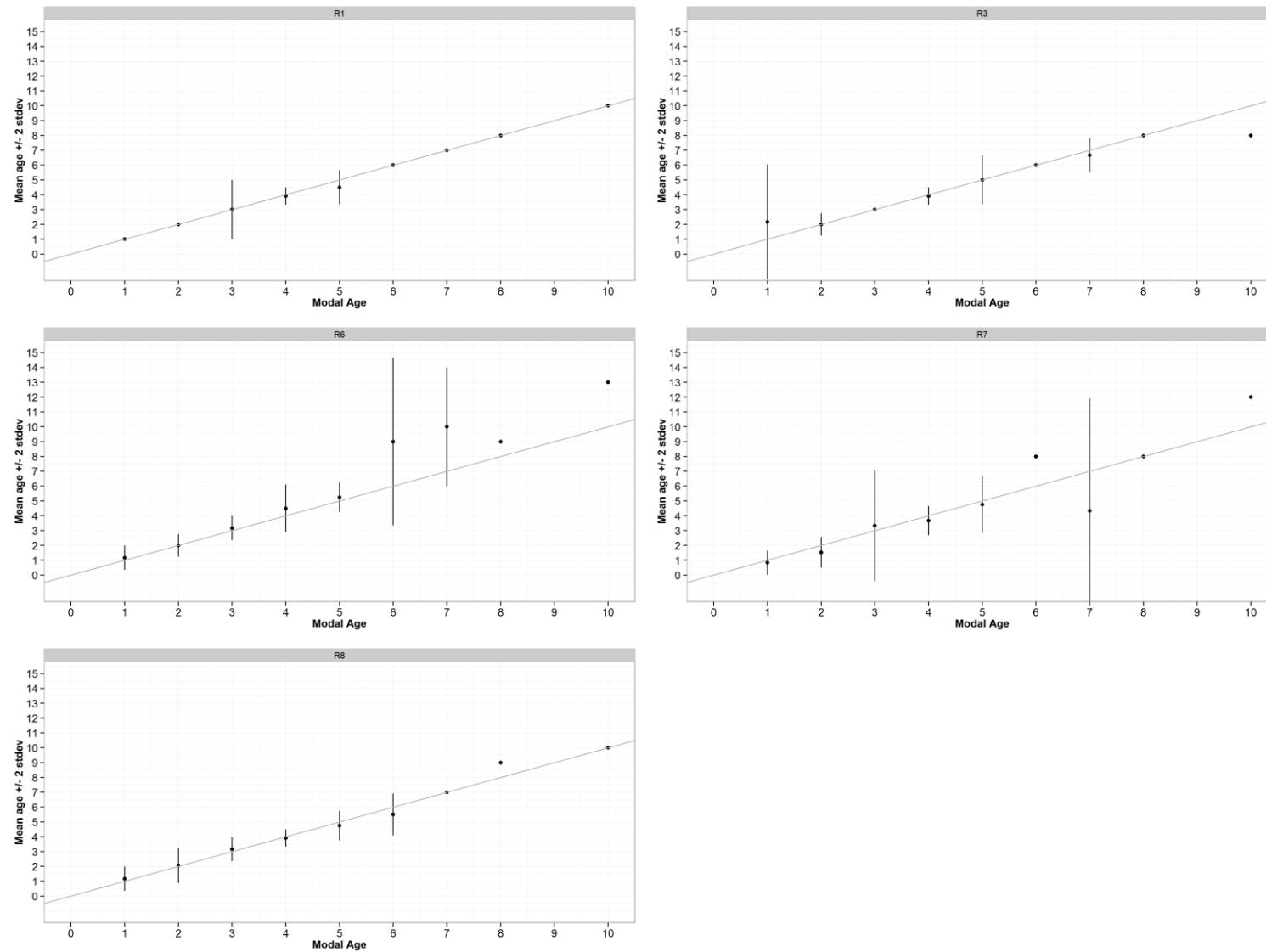


Figure B9. Age bias plots for all readers of sectioned otoliths in SD 24, reader ID is shown at the top of each graph. They show the mean age recorded +/- 2stdev of each age reader plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line).

SD25 whole otoliths

Table B25 Biological data, age estimates, coefficient of variation (CV) and percentage agreement (PA) per whole otolith for all readers in SD 25

Image	Length	Sex	Capture date	R3	R5	R6	R7	R8	Modal age	PA	CV
2016 BITS-1_19_1.jpg	330	F	05/03/2016	6	7	6	6	6	6	80	7.2
2016 BITS-1_19_10.jpg	300	F	05/03/2016	5	5	4	4	4	4	60	12.4
2016 BITS-1_19_12.jpg	220	M	05/03/2016	3	3	3	3	3	3	100	0
2016 BITS-1_19_14.jpg	180	M	05/03/2016	3	3	3	2	4	3	60	23.6
2016 BITS-1_19_15.jpg	200	M	05/03/2016	2	2	2	2	2	2	100	0
2016 BITS-1_19_3.jpg	250	M	05/03/2016	4	5	7	6	4	4	40	25.1
2016 BITS-1_19_4.jpg	260	F	05/03/2016	3	4	3	3	3	3	80	14
2016 BITS-1_19_5.jpg	280	F	05/03/2016	4	5	4	4	4	4	80	10.6
2016 BITS-1_19_6.jpg	350	F	05/03/2016	4	5	5	4	5	5	60	11.9
2016 BITS-1_19_7.jpg	230	M	05/03/2016	4	4	3	4	3	4	60	15.2
2016 BITS-1_19_8.jpg	390	F	05/03/2016	7	9	9	7	10	8	0	16
2016 BITS-1_194_1.jpg	270	F	17/03/2016	3	4	3	2	3	3	60	23.6
2016 BITS-1_196_1.jpg	300	F	17/03/2016	5	7	6	4	5	5	40	21.1
2016 BITS-1_198_15.jpg	260	F	17/03/2016	4	4	5	4	4	4	80	10.6
2016 BITS-1_198_16.jpg	260	F	17/03/2016	4	4	3	4	4	4	80	11.8
2016 BITS-1_198_18.jpg	280	F	17/03/2016	4	4	4	3	4	4	80	11.8
2016 BITS-1_198_19.jpg	290	F	17/03/2016	4	4	4	4	4	4	100	0
2016 BITS-1_200_10.jpg	170	M	17/03/2016	2	2	2	2	2	2	100	0
2016 BITS-1_200_11.jpg	170	U	17/03/2016	2	2	2	2	2	2	100	0
2016 BITS-1_200_12.jpg	210	F	17/03/2016	3	4	3	3	3	3	80	14
2016 BITS-1_200_2.jpg	240	F	17/03/2016	4	5	5	4	6	5	40	17.4
2016 BITS-1_200_3.jpg	300	F	17/03/2016	4	7	5	6	5	5	40	21.1
2016 BITS-1_200_4.jpg	260	F	17/03/2016	3	4	3	3	4	3	60	16.1
2016 BITS-1_200_5.jpg	320	F	17/03/2016	4	7	5	4	4	4	60	27.2
2016 BITS-1_200_6.jpg	270	F	17/03/2016	4	4	4	4	5	4	80	10.6
2016 BITS-1_200_7.jpg	170	M	17/03/2016	2	2	2	2	2	2	100	0
2016 BITS-1_200_8.jpg	270	F	17/03/2016	4	4	4	4	4	4	100	0
2016 BITS-1_200_9.jpg	180	M	17/03/2016	2	2	2	2	2	2	100	0
2016 BITS-1_51_1.jpg	200	M	07/03/2016	2	2	2	2	2	2	100	0
2016 BITS-1_51_10.jpg	180	M	07/03/2016	4	4	4	4	5	4	80	10.6
2016 BITS-1_51_11.jpg	240	M	07/03/2016	3	3	3	3	3	3	100	0
2016 BITS-1_51_12.jpg	270	F	07/03/2016	5	5	NA	5	4	5	75	10.5
2016 BITS-1_51_13.jpg	260	F	07/03/2016	5	5	5	3	4	5	60	20.3
2016 BITS-1_51_14.jpg	290	F	07/03/2016	4	4	4	3	4	4	80	11.8
2016 BITS-1_51_15.jpg	330	F	07/03/2016	5	4	7	4	7	5	20	28.1
2016 BITS-1_51_16.jpg	230	M	07/03/2016	3	3	3	3	3	3	100	0
2016 BITS-1_51_17.jpg	350	F	07/03/2016	5	6	5	5	4	5	60	14.1
2016 BITS-1_51_18.jpg	160	M	07/03/2016	2	2	2	2	2	2	100	0

2016_BITS-1_51_2.jpg	280	M	07/03/2016	3	4	4	3	3	3	60	16.1
2016_BITS-1_51_3.jpg	220	M	07/03/2016	3	3	4	3	3	3	80	14
2016_BITS-1_51_4.jpg	300	F	07/03/2016	4	5	5	4	4	4	60	12.4
2016_BITS-1_51_5.jpg	170	M	07/03/2016	2	2	2	1	2	2	80	24.8
2016_BITS-1_51_7.jpg	190	M	07/03/2016	2	2	2	2	3	2	80	20.3
2016_BITS-1_51_8.jpg	250	M	07/03/2016	4	4	4	4	4	4	100	0
2016_BITS-1_51_9.jpg	210	M	07/03/2016	3	3	3	2	2	3	60	21.1
Total read	-	-	-	45	45	44	45	45	-	-	-
Total NOT read	-	-	-	0	0	1	0	0	-	-	-
Means (CV and PA)	-	-	-	-	-	-	-	-	-	73.7	11.7

Table B26. Percentage agreement based on modal age for all readers of whole otoliths in SD 25

modalAge	R3	R5	R6	R7	R8	All
1	100	100	100	89	89	96
2	100	55	82	73	73	76
3	93	67	60	80	80	76
4	63	50	71	25	38	49
5	100	0	100	100	100	80
6	-	-	-	-	-	-
7	0	0	0	0	0	0
8	NA	NA	NA	NA	NA	NA
Weighted mean	88.9	64.7	75	69	71.3	73.7
Rank	1	5	2	4	3	-

Table B27. Coefficient of Variation (CV) between the modal age and the age estimation of all readers of whole otoliths in SD 25

modalAge	R3	R5	R6	R7	R8	All
2	0	0	0	18	16	5
3	0	15	13	17	17	13
4	6	19	23	16	11	11
5	11	19	14	21	21	18
6	0	0	0	0	0	7
7	-	-	-	-	-	-
8	0	0	0	0	0	16
Weighted Mean	4	13.4	13.3	16.8	14.8	12
Rank	1	3	2	5	4	-

Table B28. Relative bias values between the modal age and the age estimation of all readers of whole otoliths in SD 25 (values in blue indicate a negative bias, those in black indicate a positive bias)

modalAge	R3	R5	R6	R7	R8	All
2	0	0	0	-0.11	0.11	0
3	0	0.45	0.18	-0.27	0.09	0.09
4	0.07	0.47	0.27	0	0.07	0.17
5	-0.38	0.5	0.43	-0.62	0	-0.01

6	0	1	0	0	0	0.2
7	-	-	-	-	-	-
8	-1	1	1	-1	2	0.4
Weighted Mean	-0.07	0.4	0.23	-0.22	0.11	0.09
Rank	1	5	4	3	2	-

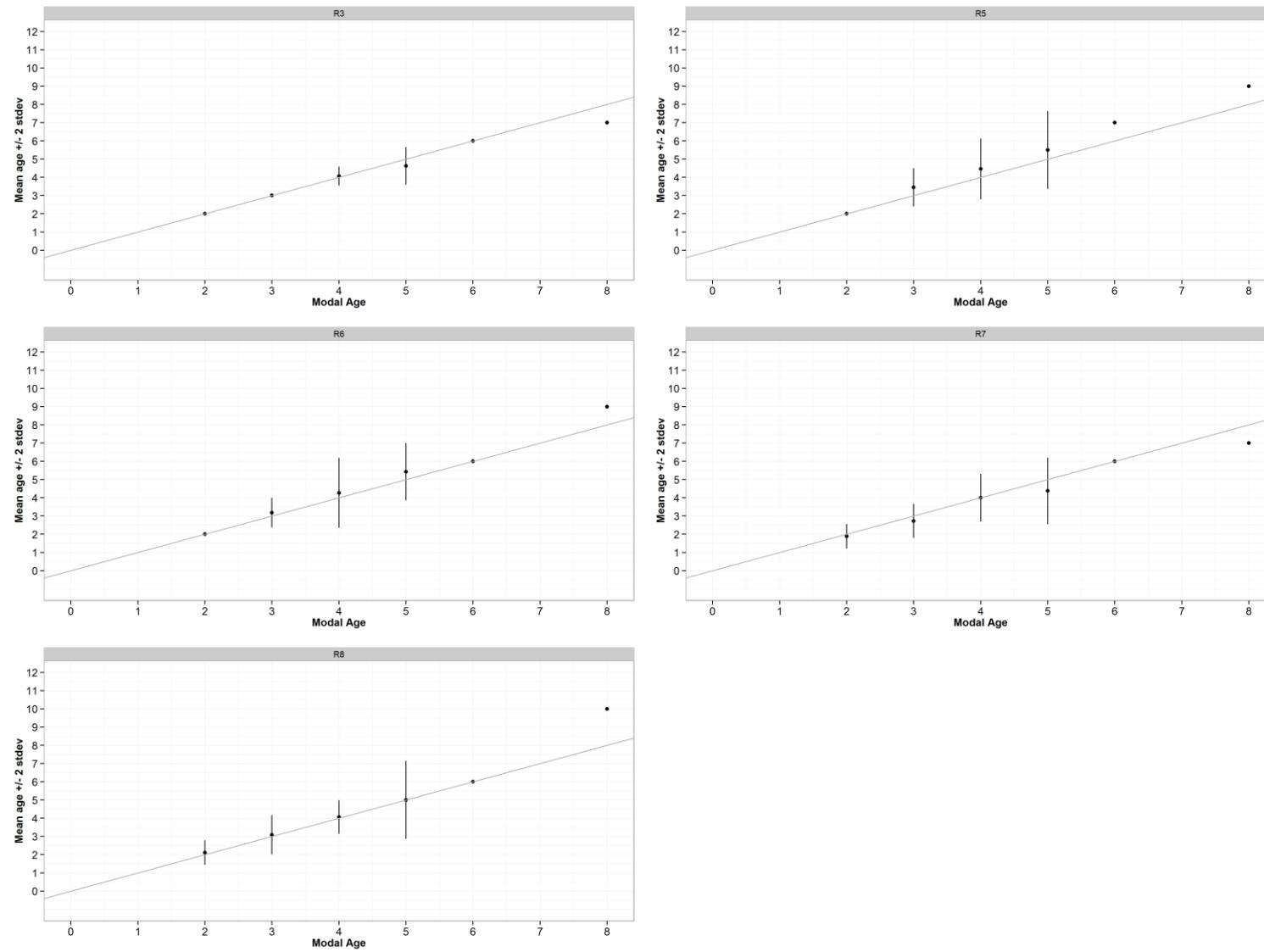


Figure B10. Age bias plots for all readers of whole otoliths in SD 25, reader ID is shown at the top of each graph. They show the mean age recorded +/- 2stdev of each age reader plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line).

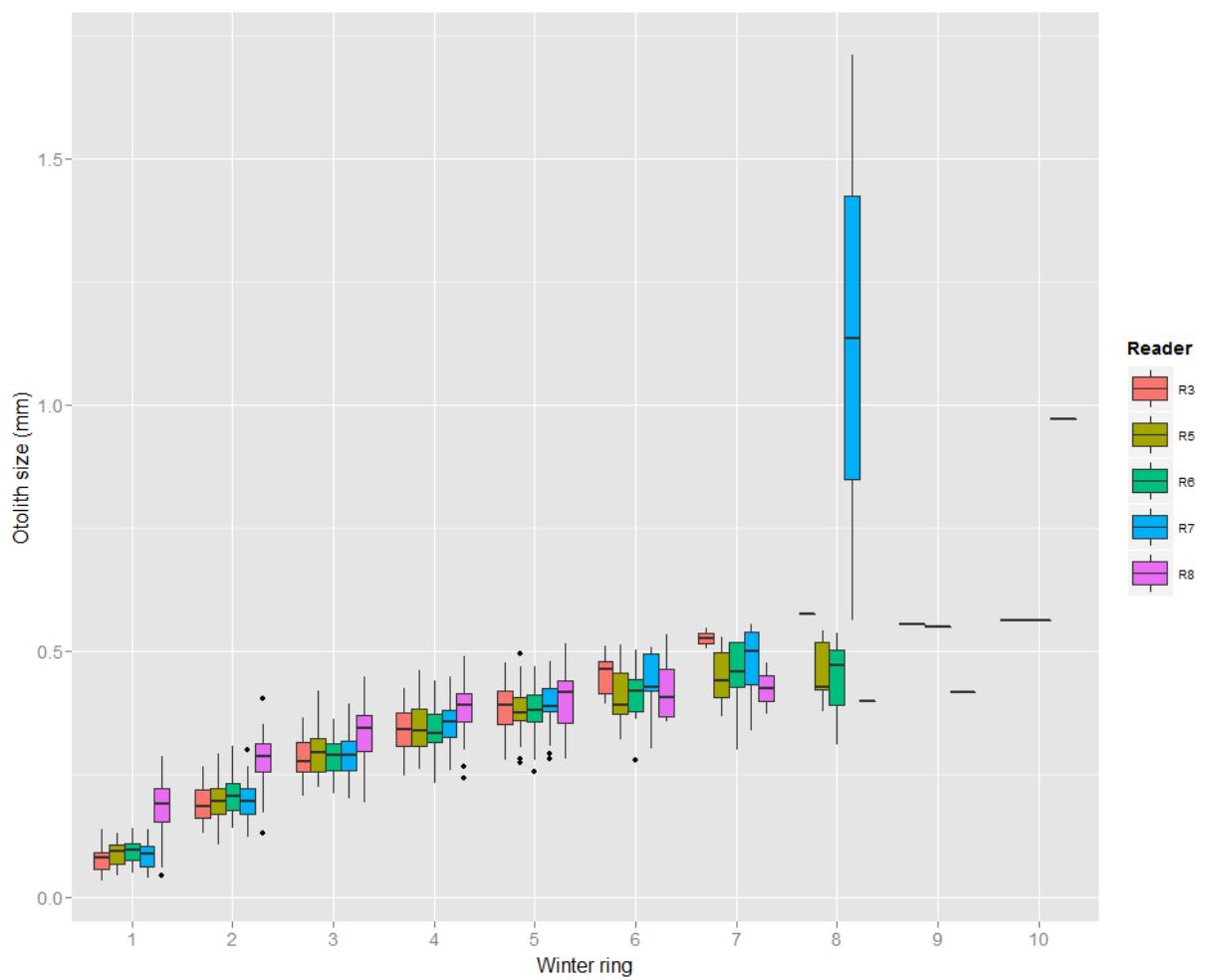


Figure B11. Plot of average distance to the centre for winter rings 1-9 and the edge for all readers of whole otoliths in SD 25. The boxes represent the mean, upper and lower box boundaries of the interquartile range, whiskers represent the minimum and maximum values and the dots represent the outliers.

SD25 sectioned otoliths

Table B29. Biological data, age estimates, coefficient of variation (CV) and percentage agreement (PA) per sectioned otolith for all readers in SD 25

Image	Length (mm)	Sex	Capture date	R1	R3	R6	R7	R8	Modal age	PA	CV
2016 BITS-1_19_1_s.jpg	330	F	05/03/2016	3	4	5	4	3	4	40	22
2016 BITS-1_19_10_s.jpg	300	F	05/03/2016	3	4	5	3	3	3	60	24.8
2016 BITS-1_19_12_s.jpg	220	M	05/03/2016	3	3	4	2	3	3	60	23.6
2016 BITS-1_19_14_s.jpg	180	M	05/03/2016	3	3	3	1	3	3	80	34.4
2016 BITS-1_19_15_s.jpg	200	M	05/03/2016	2	2	3	2	2	2	80	20.3
2016 BITS-1_19_3_s.jpg	250	M	05/03/2016	NA	2	2	0	NA	2	66.7	86.6
2016 BITS-1_19_4_s.jpg	260	F	05/03/2016	NA	3	4	0	3	3	50	69.3
2016 BITS-1_19_5_s.jpg	280	F	05/03/2016	3	4	5	4	3	4	40	22
2016 BITS-1_19_6_s.jpg	350	F	05/03/2016	3	3	8	3	3	3	80	55.9
2016 BITS-1_19_7_s.jpg	230	M	05/03/2016	NA	3	4	0	2	2	25	75.9

2016_BITS-1_19_8_s.jpg	390	F	05/03/2016	10	6	12	10	10	10	60	22.8
2016_BITS-1_194_1_s.jpg	270	F	17/03/2016	4	4	5	3	4	4	60	17.7
2016_BITS-1_196_1_s.jpg	300	F	17/03/2016	6	6	6	5	5	6	60	9.8
2016_BITS-1_198_15_s.jpg	260	F	17/03/2016	4	4	5	4	4	4	80	10.6
2016_BITS-1_198_16_s.jpg	260	F	17/03/2016	5	4	6	4	5	5	40	17.4
2016_BITS-1_198_18_s.jpg	280	F	17/03/2016	5	4	7	6	5	5	40	21.1
2016_BITS-1_198_19_s.jpg	290	F	17/03/2016	4	4	4	4	4	4	100	0
2016_BITS-1_200_10_s.jpg	170	M	17/03/2016	2	2	2	2	2	2	100	0
2016_BITS-1_200_11_s.jpg	170	U	17/03/2016	2	3	2	2	3	2	60	22.8
2016_BITS-1_200_12_s.jpg	210	F	17/03/2016	3	3	4	3	3	3	80	14
2016_BITS-1_200_2_s.jpg	240	F	17/03/2016	4	4	4	3	3	4	60	15.2
2016_BITS-1_200_3_s.jpg	300	F	17/03/2016	4	4	4	4	4	4	100	0
2016_BITS-1_200_4_s.jpg	260	F	17/03/2016	3	3	3	3	3	3	100	0
2016_BITS-1_200_5_s.jpg	320	F	17/03/2016	5	5	6	6	5	5	60	10.1
2016_BITS-1_200_6_s.jpg	270	F	17/03/2016	4	4	4	4	4	4	100	0
2016_BITS-1_200_7_s.jpg	170	M	17/03/2016	2	2	2	2	2	2	100	0
2016_BITS-1_200_8_s.jpg	270	F	17/03/2016	4	4	4	4	4	4	100	0
2016_BITS-1_200_9_s.jpg	180	M	17/03/2016	2	2	2	2	3	2	80	20.3
2016_BITS-1_51_1_s.jpg	200	M	07/03/2016	NA	3	3	0	NA	3	66.7	86.6
2016_BITS-1_51_10_s.jpg	180	M	07/03/2016	3	3	3	3	3	3	100	0
2016_BITS-1_51_11_s.jpg	240	M	07/03/2016	3	3	3	3	3	3	100	0
2016_BITS-1_51_12_s.jpg	270	F	07/03/2016	4	3	4	4	4	4	80	11.8
2016_BITS-1_51_13_s.jpg	260	F	07/03/2016	3	3	4	2	3	3	60	23.6
2016_BITS-1_51_14_s.jpg	290	F	07/03/2016	NA	3	4	3	3	3	75	15.4
2016_BITS-1_51_15_s.jpg	330	F	07/03/2016	5	5	5	5	5	5	100	0
2016_BITS-1_51_16_s.jpg	230	M	07/03/2016	3	3	3	3	3	3	100	0
2016_BITS-1_51_17_s.jpg	350	F	07/03/2016	5	5	6	6	5	5	60	10.1
2016_BITS-1_51_18_s.jpg	160	M	07/03/2016	2	2	2	2	2	2	100	0
2016_BITS-1_51_2_s.jpg	280	M	07/03/2016	3	3	8	6	3	3	60	50
2016_BITS-1_51_3_s.jpg	220	M	07/03/2016	3	3	4	3	3	3	80	14
2016_BITS-1_51_4_s.jpg	300	F	07/03/2016	4	4	4	4	4	4	100	0
2016_BITS-1_51_5_s.jpg	170	M	07/03/2016	2	2	2	1	2	2	80	24.8
2016_BITS-1_51_7_s.jpg	190	M	07/03/2016	NA	2	2	0	NA	2	66.7	86.6
2016_BITS-1_51_8_s.jpg	250	M	07/03/2016	3	4	4	3	3	3	60	16.1
2016_BITS-1_51_9_s.jpg	210	M	07/03/2016	3	3	4	2	3	3	60	23.6
Total read	-	-	-	39	45	45	45	42	-	-	-
Total NOT read	-	-	-	6	0	0	0	3	-	-	-
Means (CV and PA)	-	-	-	-	-	-	-	-	-	73.6	21.8

Table B30. Percentage agreement based on modal age for all readers of sectioned otoliths in SD 25

modalAge	R1	R3	R6	R7	R8	All
1	100	80	80	60	75	78
2	100	88	35	59	100	75

3	82	91	64	82	73	78
4	100	60	20	20	100	60
5	100	100	100	0	0	60
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	100	0	0	100	100	60
10	NA	NA	NA	NA	NA	NA
Weighted mean	94.9	82.2	51.1	60.1	85.8	74
Rank	1	3	5	4	2	-

Table B31. Coefficient of Variation (CV) between the modal age and the age estimation of all readers of sectioned otoliths in SD 25

modalAge	R1	R3	R6	R7	R8	All
2	0	19	29	73	21	34
3	0	11	37	54	0	27
4	11	8	12	11	13	9
5	0	12	12	17	0	12
6	0	0	0	0	0	10
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	0	0	0	0	0	23
Weighted Mean	3.1	11.7	24.7	41.2	7.4	22
Rank	1	3	4	5	2	-

Table B32. Relative bias values between the modal age and the age estimation of all readers of sectioned otoliths in SD 25 (values in red indicate a negative bias, those in black indicate a positive bias)

modalAge	R1	R3	R6	R7	R8	All
2	0	0.2	0.3	-0.7	0.25	0.01
3	0	0.12	1.18	-0.47	0	0.16
4	-0.18	-0.09	0.36	-0.18	-0.27	-0.07
5	0	-0.4	1	0.4	0	0.2
6	0	0	0	-1	-1	-0.4
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	0	-4	2	0	0	-0.4
Weighted Mean	-0.05	-0.07	0.76	-0.35	-0.05	0.05
Rank	1	3	5	4	1	-

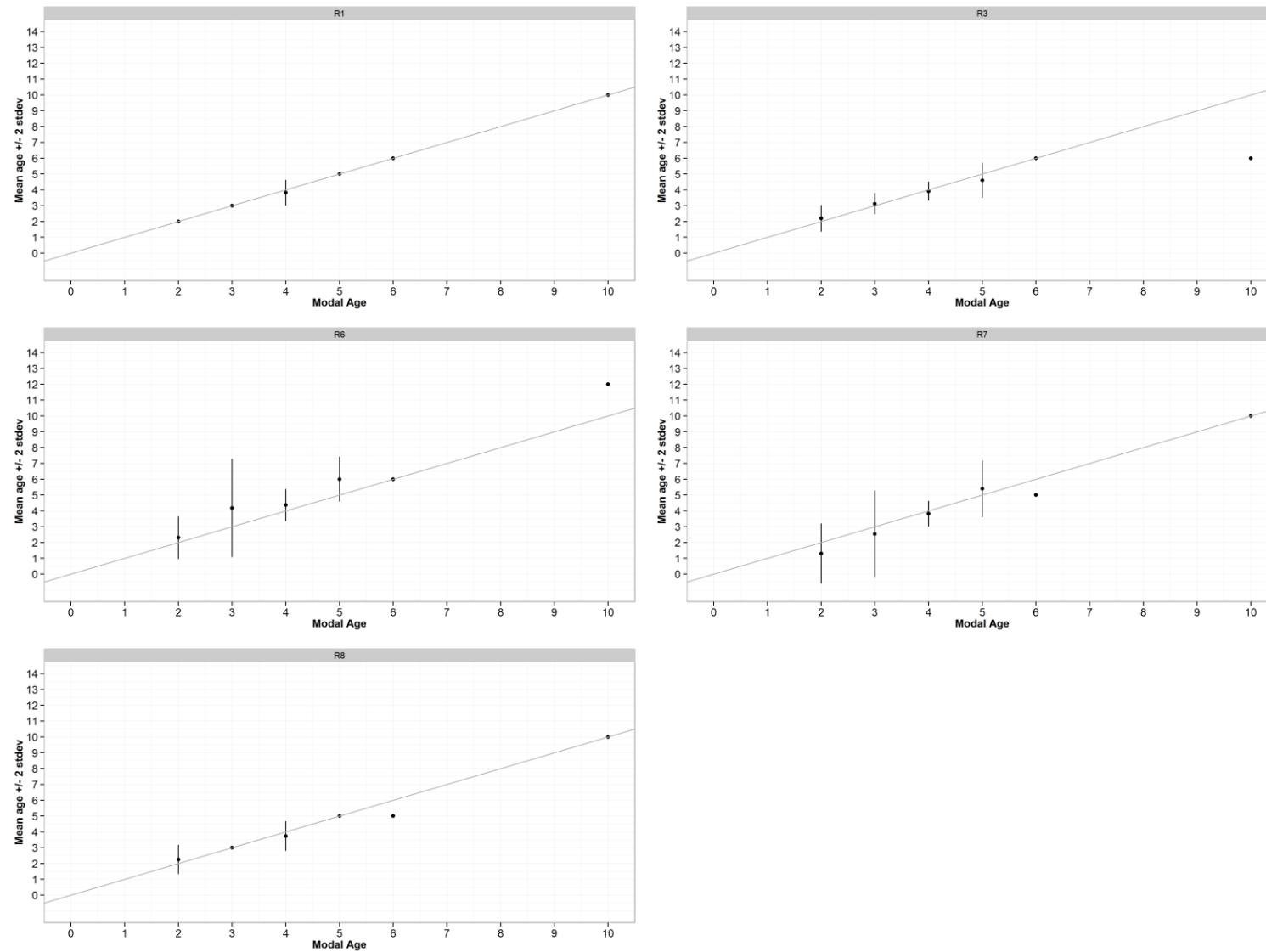


Figure B12. Age bias plots for all readers of sectioned otoliths in SD 25, reader ID is shown at the top of each graph. They show the mean age recorded +/- 2stddev of each age reader plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line).

SD26 whole otoliths

Table B33. Biological data, age estimates, coefficient of variation (CV) and percentage agreement (PA) per whole otolith for all readers in SD 26

Image	Length (mm)	Sex	Capture date	R2	R3	R5	R6	R7	R8	Modal age	PA	CV
S61510331_001_oto.jpg	305	F	21/10/2015	4	4	6	6	5	3	5	16.7	26
S61510331_002_oto.jpg	365	F	21/10/2015	5	5	6	6	5	9	5	50	25.8
S61510331_003_oto.jpg	235	M	21/10/2015	3	3	3	4	3	4	3	66.7	15.5
S61510331_005_oto.jpg	315	M	21/10/2015	3	4	5	4	4	4	4	66.7	15.8
S61510331_007_oto.jpg	275	F	21/10/2015	3	3	4	3	3	2	3	66.7	21.1
S61510331_008_oto.jpg	275	M	21/10/2015	3	4	4	5	4	3	4	50	19.6
S61510331_009_oto.jpg	235	M	21/10/2015	2	3	3	3	2	3	3	66.7	19.4
S61510331_010_oto.jpg	295	F	21/10/2015	4	3	8	4	5	6	4	33.3	35.8
S61510331_011_oto.jpg	295	F	21/10/2015	3	3	4	4	3	8	3	50	46.6
S61510331_014_oto.jpg	245	F	21/10/2015	2	3	3	4	3	4	3	50	23.8
S61510331_015_oto.jpg	265	F	21/10/2015	3	3	4	3	3	4	3	66.7	15.5
S61510331_017_oto.jpg	295	F	21/10/2015	3	4	4	4	3	3	4	50	15.6
S61510331_018_oto.jpg	255	M	21/10/2015	3	3	6	3	3	3	3	83.3	35
S61510331_019_oto.jpg	255	M	21/10/2015	2	3	3	3	3	3	3	83.3	14.4
S61510331_020_oto.jpg	275	F	21/10/2015	3	3	4	3	3	3	3	83.3	12.9
S61510331_021_oto.jpg	245	M	21/10/2015	2	3	3	3	3	3	3	83.3	14.4
S61510331_024_oto.jpg	235	M	21/10/2015	2	2	2	4	2	2	2	83.3	35
S61510331_025_oto.jpg	265	F	21/10/2015	3	4	3	4	3	4	4	50	15.6
S61510331_028_oto.jpg	255	M	21/10/2015	3	4	4	5	3	7	4	33.3	34.7
S61510331_029_oto.jpg	285	M	21/10/2015	2	3	3	4	2	7	4	16.7	53.5
S61510331_030_oto.jpg	305	F	21/10/2015	3	3	4	5	3	4	3	50	22.3
S61510331_031_oto.jpg	245	M	21/10/2015	2	2	2	3	2	3	2	66.7	22.1
S61510331_032_oto.jpg	305	F	21/10/2015	4	5	4	5	4	5	5	50	12.2
S61510331_033_oto.jpg	295	M	21/10/2015	3	3	4	6	3	5	3	50	31.6
S61510331_040_oto.jpg	285	F	21/10/2015	3	3	4	5	3	5	3	50	25.6
S61510331_043_oto.jpg	335	F	21/10/2015	4	4	6	6	4	4	4	66.7	22.1
S61510331_051_oto.jpg	285	F	21/10/2015	4	4	4	4	4	4	4	100	0
S61510331_059_oto.jpg	235	M	21/10/2015	2	2	3	4	3	2	2	50	30.6
S61510331_060_oto.jpg	285	F	21/10/2015	3	3	4	4	3	3	3	66.7	15.5
S61510331_061_oto.jpg	265	F	21/10/2015	2	3	NA	4	2	5	2	40	40.7
Total read	-	-	-	30	30	29	30	30	30	-	-	-
Total NOT read	-	-	-	0	0	1	0	0	0	-	-	-
Means (CV and PA)	-	-	-	-	-	-	-	-	-	58	24	

Table B34. Percentage agreement based on modal age for all readers of whole otoliths in SD 26

modalAge	R2	R3	R5	R6	R7	R8	All
1	100	75	67	0	75	50	61
2	71	100	36	50	93	43	65
3	33	78	44	67	44	44	52
4	33	67	0	33	67	33	39
5	NA	NA	NA	NA	NA	NA	NA
Weighted mean	59.7	86.8	38	46.7	73.3	43.2	57.9
Rank	3	1	6	4	2	5	-

Table B35. Coefficient of Variation (CV) between the modal age and the age estimation of all readers of whole otoliths in SD 26

modalAge	R2	R3	R5	R6	R7	R8	All
2	0	22	25	13	22	47	32
3	17	0	21	26	9	38	22
4	21	12	35	16	25	34	24
5	13	12	22	10	12	54	21
Weighted Mean	15.5	7.7	25.9	19.7	15.8	39.6	24
Rank	2	1	5	4	3	6	-

Table B36. Relative bias values between the modal age and the age estimation of all readers of whole otoliths in SD 26 (values in red indicate a negative bias, those in black indicate a positive bias)

modalAge	R2	R3	R5	R6	R7	R8	All
2	0	0.25	0.33	1.75	0.25	1	0.6
3	-0.29	0	0.79	0.79	-0.07	0.86	0.35
4	-0.78	-0.22	0.56	0.44	-0.44	0.67	0.04
5	-0.67	-0.33	0.33	0.67	-0.33	0.67	0.06
Weighted Mean	-0.44	-0.07	0.62	0.8	-0.16	0.8	0.26
Rank	3	1	4	5	2	5	-

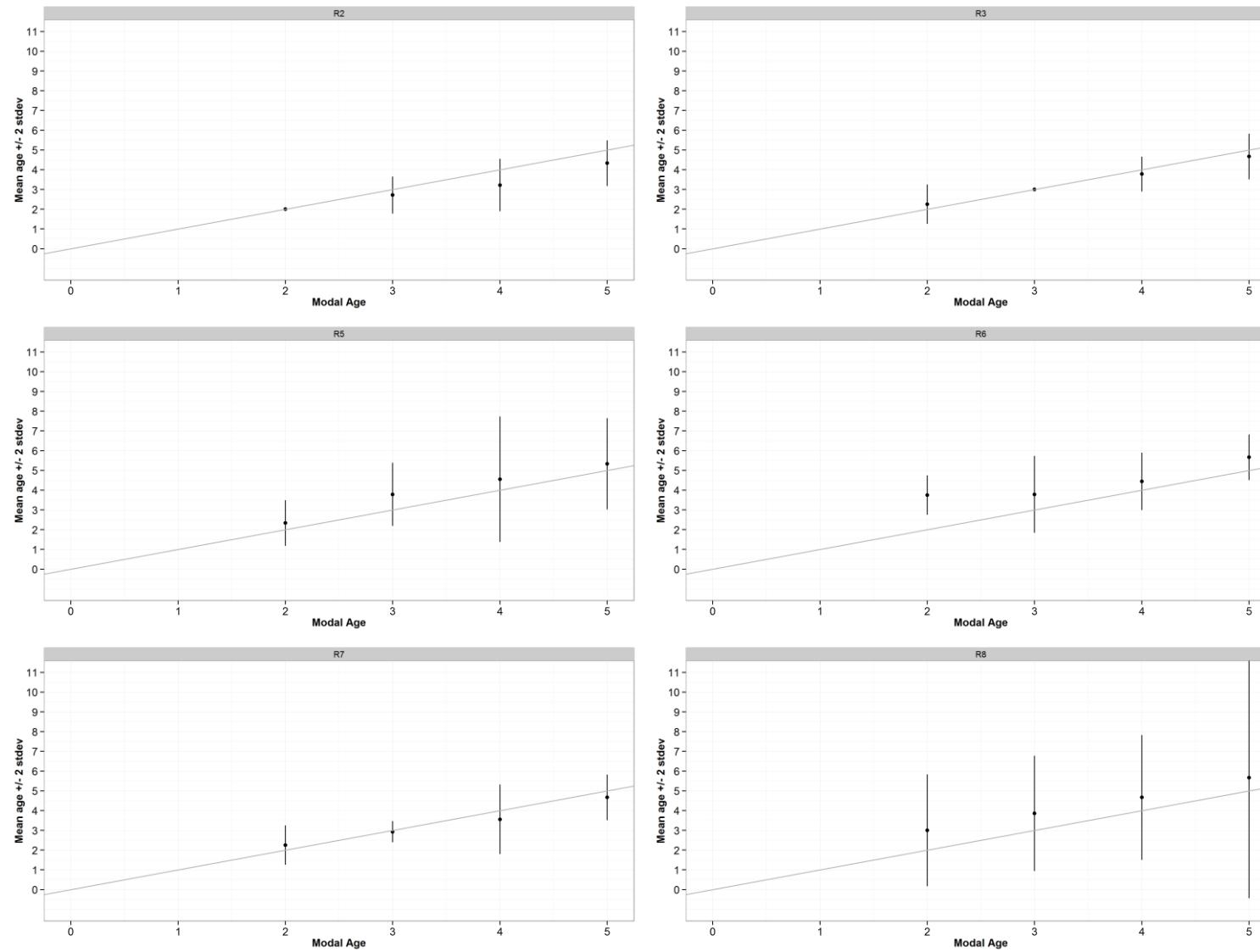


Figure B13. Age bias plots for all readers of whole otoliths in SD 26, reader ID is shown at the top of each graph. They show the mean age recorded +/- 2stdev of each age reader plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line).

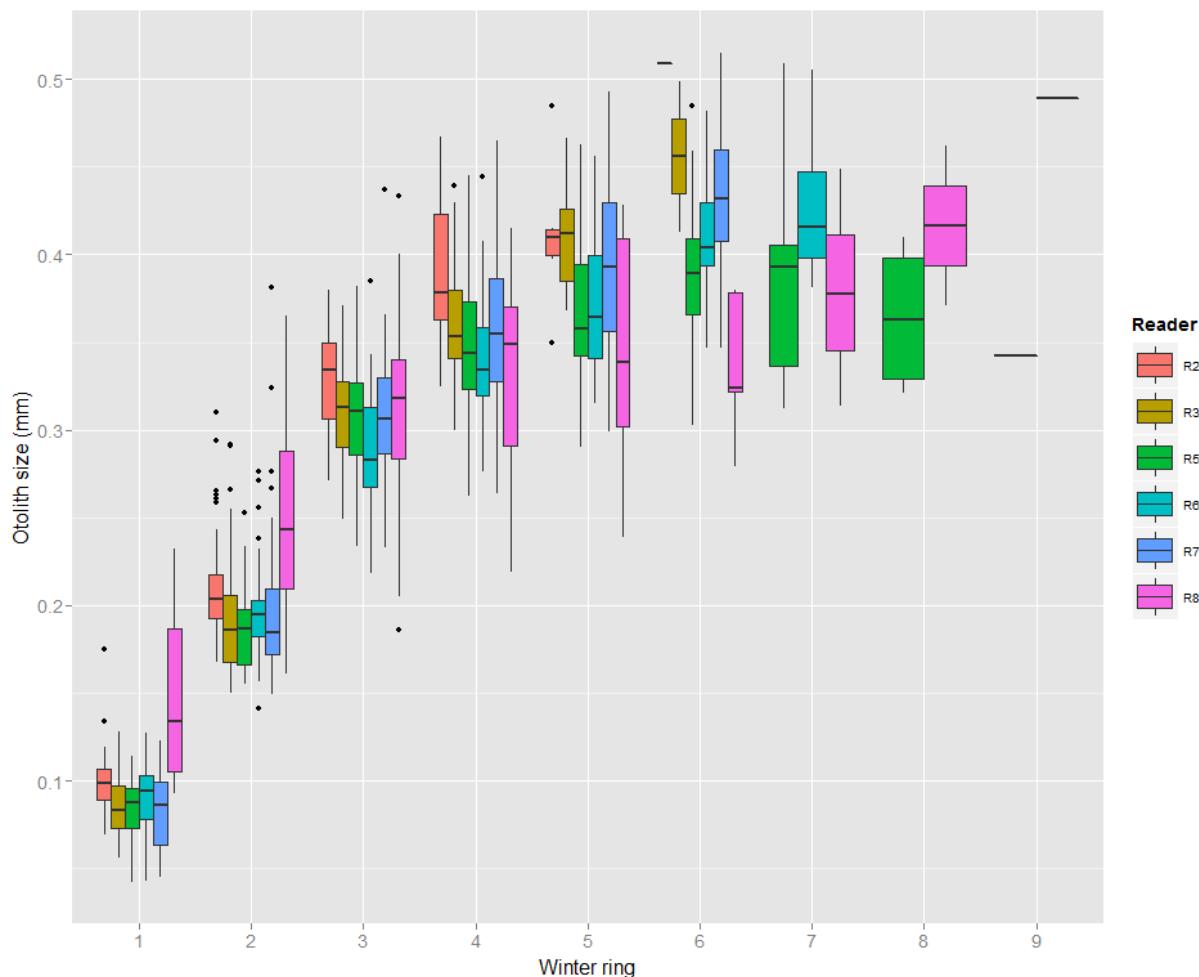


Figure B14. Plot of average distance to the centre for winter rings 1-8 and the edge for all readers of whole otoliths in SD 26. The boxes represent the mean, upper and lower box boundaries of the interquartile range, whiskers represent the minimum and maximum values and the dots represent the outliers.

SD26 sectioned otoliths

Table B37. Biological data, age estimates, coefficient of variation (CV) and percentage agreement (PA) per sectioned otolith for all readers in SD 26

Image	Length	Sex	Capture date	R1	R3	R6	R7	R8	Modal age	PA	CV
S61510331_001.jpg	305	F	21/10/2015	NA	4	4	4	3	4	75	13.3
S61510331_002.jpg	365	F	21/10/2015	7	5	8	6	7	7	40	17.3
S61510331_003.jpg	235	M	21/10/2015	2	3	2	2	3	2	60	22.8
S61510331_005.jpg	315	M	21/10/2015	3	4	4	3	3	3	60	16.1
S61510331_007.jpg	275	F	21/10/2015	3	3	3	3	3	3	100	0
S61510331_008.jpg	275	M	21/10/2015	3	4	7	5	3	3	40	38
S61510331_009.jpg	235	M	21/10/2015	3	3	4	2	3	3	60	23.6
S61510331_010.jpg	295	F	21/10/2015	3	4	3	2	3	3	60	23.6
S61510331_011.jpg	295	F	21/10/2015	3	3	5	2	3	3	60	34.2

S61510331_014.jpg	245	F	21/10/2015	3	3	2	1	3	3	60	37.3
S61510331_015.jpg	265	F	21/10/2015	4	4	3	3	4	4	60	15.2
S61510331_017.jpg	295	F	21/10/2015	3	3	3	3	3	3	100	0
S61510331_018.jpg	255	M	21/10/2015	3	3	2	3	3	3	80	16
S61510331_019.jpg	255	M	21/10/2015	2	3	2	2	3	2	60	22.8
S61510331_020.jpg	275	F	21/10/2015	3	4	3	2	3	3	60	23.6
S61510331_021.jpg	245	M	21/10/2015	2	4	3	2	4	3	20	33.3
S61510331_024.jpg	235	M	21/10/2015	2	4	2	2	2	2	80	37.3
S61510331_025.jpg	265	F	21/10/2015	3	3	3	3	3	3	100	0
S61510331_028.jpg	255	M	21/10/2015	3	3	3	3	3	3	100	0
S61510331_029.jpg	285	M	21/10/2015	NA	3	3	2	4	3	50	27.2
S61510331_030.jpg	305	F	21/10/2015	3	5	3	4	3	3	60	24.8
S61510331_031.jpg	245	M	21/10/2015	NA	2	3	1	NA	2	33.3	50
S61510331_032.jpg	305	F	21/10/2015	NA	4	5	4	4	4	75	11.8
S61510331_033.jpg	295	M	21/10/2015	3	4	4	4	4	4	80	11.8
S61510331_040.jpg	285	F	21/10/2015	3	4	3	2	3	3	60	23.6
S61510331_043.jpg	335	F	21/10/2015	4	4	4	4	4	4	100	0
S61510331_051.jpg	285	F	21/10/2015	3	3	3	2	3	3	80	16
S61510331_059.jpg	235	M	21/10/2015	2	2	2	2	2	2	100	0
S61510331_060.jpg	285	F	21/10/2015	4	3	4	2	5	4	40	31.7
S61510331_061.jpg	265	F	21/10/2015	3	3	2	2	3	3	60	21.1
Total read	-	-	-	26	30	30	30	29	-	-	-
Total NOT read	-	-	-	4	0	0	0	1	-	-	-
Means (CV and PA)	-	-	-	-	-	-	-	-	-	67.1	19.7

Table B38. Percentage agreement based on modal age for all readers of sectioned otoliths in SD 26

modalAge	R1	R3	R6	R7	R8	All
1	100	40	80	80	50	70
2	94	61	61	33	89	67
3	75	83	67	67	67	71
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	100	0	0	0	100	40
7	NA	NA	NA	NA	NA	NA
Weighted mean	92.2	59.9	63.3	46.5	79.4	67.3
Rank	1	4	3	5	2	-

Table B39. Coefficient of Variation (CV) between the modal age and the age estimation of all readers of sectioned otoliths in SD 26

modalAge	R1	R3	R6	R7	R8	All
2	0	30	20	25	23	27
3	8	18	36	36	10	20
4	13	11	16	24	16	14
5	-	-	-	-	-	-

6	-	-	-	-	-	-
7	0	0	0	0	0	17
Weighted Mean	7.2	18	28.1	30.6	12.7	20
Rank	1	3	4	5	2	-

Table B40. Relative bias values between the modal age and the age estimation of all readers of sectioned otoliths in SD 26 (values in blue indicate a negative bias, those in black indicate a positive bias)

modalAge	R1	R3	R6	R7	R8	All
2	0	0.8	0.2	-0.2	0.5	0.26
3	-0.06	0.44	0.28	-0.44	0.11	0.07
4	-0.25	-0.17	0	-0.5	0	-0.18
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	0	-2	1	-1	0	-0.4
Weighted Mean	-0.08	0.3	0.23	-0.43	0.14	0.04
Rank	1	4	3	5	2	-

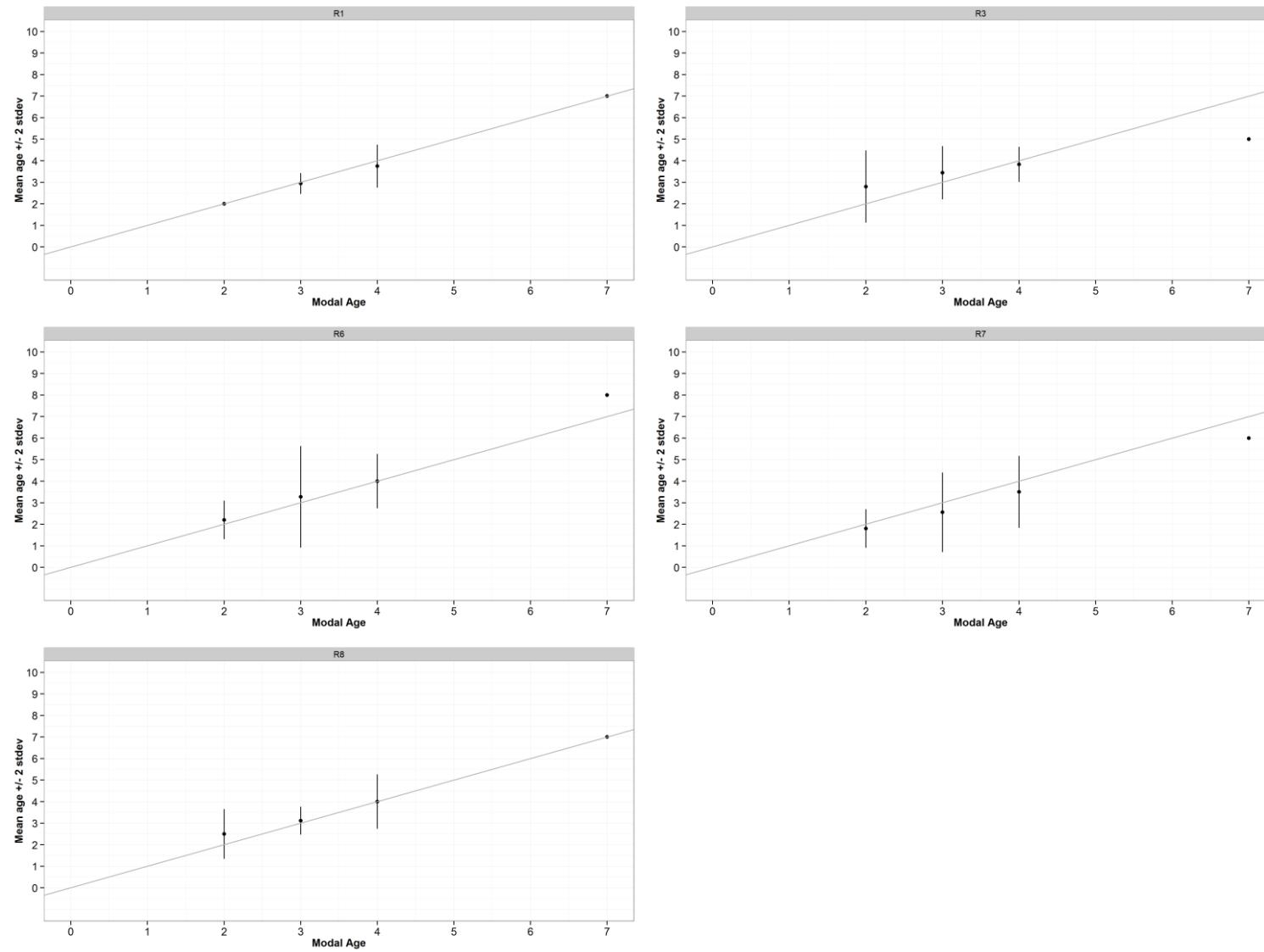


Figure B15. Age bias plots for all readers of sectioned otoliths in SD 26, reader ID is shown at the top of each graph. They show the mean age recorded +/- 2stdev of each age reader plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line).

Annex C Analysis 3: A comparison of modal age obtained from whole otoliths and modal age obtained from sectioned otoliths

SD's 22 and 23

Table C1. Sample data with modal age from sectioned (Section age) and whole (Whole age) otoliths, Modal age, coefficient of variation (CV) and percentage agreement (PA) per otolith in SD's 22 and 23 combined

Image	Length (mm)	Sex	Capture date	Section age	Whole age	Modal age	PA	CV
2443_10	150	M	07/03/2010	2	2	2	100	0
2443_14	220	M	07/03/2010	3	2	3	50	28
2443_15	230	M	07/03/2010	3	3	3	100	0
2443_16	290	M	07/03/2010	4	6	4	50	28
2443_19	270	F	07/03/2010	4	3	4	50	20
2443_2	310	F	07/03/2010	5	5	5	100	0
2443_23	210	F	07/03/2010	3	3	3	100	0
2443_26	240	F	07/03/2010	4	3	4	50	20
2443_3	490	F	07/03/2010	11	8	11	50	22
2443_30	180	F	07/03/2010	2	2	2	100	0
2443_31	150	M	07/03/2010	3	2	3	50	28
2443_4	250	F	07/03/2010	3	3	3	100	0
2443_9	240	F	07/03/2010	4	4	4	100	0
2444_1	390	F	07/03/2010	4	4	4	100	0
2444_11	330	F	07/03/2010	3	3	3	100	0
2444_13	350	F	07/03/2010	4	3	4	50	20
2444_17	320	F	07/03/2010	4	4	4	100	0
2444_20	250	M	07/03/2010	3	2	3	50	28
2444_3	400	F	07/03/2010	6	6	6	100	0
2444_4	340	F	07/03/2010	4	5	4	50	16
2444_6	360	F	07/03/2010	5	4	5	50	16
2988_2	290	M	08/03/2010	4	3	4	50	20
2989_11	320	F	09/03/2010	4	4	4	100	0
2989_12	330	M	09/03/2010	14	4	14	50	79
2989_13	330	M	09/03/2010	6	5	6	50	13
2989_15	290	M	09/03/2010	3	4	3	50	20
2989_5	270	F	09/03/2010	3	3	3	100	0
2989_6	260	M	09/03/2010	4	2	4	50	47
2989_7	280	F	09/03/2010	3	4	3	50	20
3095_2	400	F	07/03/2011	6	6	6	100	0
3095_3	340	F	07/03/2011	6	7	6	50	11
3728_13	240	M	04/11/2011	3	2	3	50	28
3728_2	350	F	04/11/2011	12	8	12	50	28
3728_5	220	F	04/11/2011	2	2	2	100	0
3728_8	210	F	04/11/2011	2	2	2	100	0

3729_3	240	M	05/11/2011	2	3	2	50	28
3729_7	340	F	05/11/2011	4	3	4	50	20
3818_23	390	F	04/03/2012	6	6	6	100	0
3818_25	350	F	04/03/2012	5	4	5	50	16
3819_1	360	F	04/03/2012	6	5	6	50	13
3819_3	470	F	04/03/2012	7	7	7	100	0
3820_17	320	F	05/03/2012	8	7	8	50	9
3820_8	400	F	05/03/2012	6	8	6	50	20
4287_2	280	M	02/11/2012	3	4	3	50	20
4287_4	210	M	02/11/2012	2	2	2	100	0
4288_20	270	F	02/11/2012	4	5	4	50	16
4288_21	310	F	02/11/2012	3	3	3	100	0
685_100	425	F	06/02/2014	6	6	6	100	0
685_104	415	F	06/02/2014	4	6	4	50	28
685_108	345	F	06/02/2014	5	5	5	100	0
685_114	295	F	06/02/2014	4	4	4	100	0
685_132	225	M	06/02/2014	3	2	3	50	28
685_142	325	M	06/02/2014	4	5	4	50	16
685_160	245	M	06/02/2014	3	2	3	50	28
685_166	225	F	06/02/2014	3	2	3	50	28
685_177	285	M	06/02/2014	3	2	3	50	28
685_179	425	F	07/02/2014	11	9	11	50	14
685_188	305	F	07/02/2014	4	4	4	100	0
685_209	275	F	07/02/2014	3	3	3	100	0
685_22	255	M	05/02/2014	4	3	4	50	20
685_37	215	M	05/02/2014	4	2	4	50	47
685_38	185	M	05/02/2014	3	2	3	50	28
685_4	235	F	05/02/2014	3	3	3	100	0
685_5	225	F	05/02/2014	2	2	2	100	0
685_68	205	M	06/02/2014	2	2	2	100	0
685_7	315	F	05/02/2014	3	3	3	100	0
685_71	375	M	06/02/2014	5	5	5	100	0
685_75	345	M	06/02/2014	4	5	4	50	16
685_79	385	F	06/02/2014	5	5	5	100	0
695_102	315	F	25/10/2014	3	4	3	50	20
695_111	305	M	25/10/2014	3	4	3	50	20
695_117	285	M	25/10/2014	2	2	2	100	0
695_128	225	F	25/10/2014	2	2	2	100	0
695_129	125	F	25/10/2014	1	1	1	100	0
695_134	345	F	25/10/2014	2	3	2	50	28
695_157	335	F	25/10/2014	2	3	2	50	28
695_158	345	F	25/10/2014	2	3	2	50	28
695_167	195	M	25/10/2014	2	2	2	100	0
695_171	405	F	25/10/2014	3	4	3	50	20
695_174	385	F	25/10/2014	6	6	6	100	0

695_188	395	F	25/10/2014	4	4	4	100	0
695_191	335	M	25/10/2014	2	3	2	50	28
695_194	355	F	25/10/2014	2	3	2	50	28
695_201	425	F	25/10/2014	7	5	7	50	24
695_206	425	F	25/10/2014	5	6	5	50	13
695_220	295	F	25/10/2014	3	3	3	100	0
695_228	245	M	25/10/2014	2	3	2	50	28
695_23	325	F	25/10/2014	4	5	4	50	16
695_47	295	F	25/10/2014	3	3	3	100	0
695_48	255	M	25/10/2014	3	1	3	50	71
695_65	335	F	25/10/2014	3	2	3	50	28
695_73	315	M	25/10/2014	3	4	3	50	20
695_8	415	F	25/10/2014	4	4	4	100	0
695_83	235	F	25/10/2014	2	1	2	50	47
695_85	215	F	25/10/2014	2	1	2	50	47
695_87	235	M	25/10/2014	2	2	2	100	0
695_91	155	F	25/10/2014	1	2	1	50	47
Total read	-	-	-	97	97	-	-	-
Total NOT read	-	-	-	0	0	-	-	-
Means (CV and PA)	-	-	-	-	-	-	71	15

SD's 24, 25 and 26

Table xx Sample data with modal age from sectioned (Section age) and whole (Whole age) otoliths, Modal age, coefficient of variation (CV) and percentage agreement (PA) per otolith in SD's 24, 25 and 26 combined

Image	Length (mm)	Sex	Capture date	Section age	Whole age	Modal age	PA	CV
19_1	330	F	05/03/2016	3	6	3	50	47
19_10	300	F	05/03/2016	3	5	3	50	35
19_12	220	M	05/03/2016	3	3	3	100	0
19_14	180	M	05/03/2016	3	3	3	100	0
19_15	200	M	05/03/2016	2	2	2	100	0
19_3	250	M	05/03/2016	2	5	2	50	61
19_4	260	F	05/03/2016	4	3	4	50	20
19_5	280	F	05/03/2016	3	4	3	50	20
19_6	350	F	05/03/2016	3	4	3	50	20
19_7	230	M	05/03/2016	3	4	3	50	20
19_8	390	F	05/03/2016	10	7	10	50	25
194_1	270	F	17/03/2016	4	3	4	50	20
196_1	300	F	17/03/2016	6	5	6	50	13
198_15	260	F	17/03/2016	4	4	4	100	0
198_16	260	F	17/03/2016	5	4	5	50	16
198_18	280	F	17/03/2016	5	4	5	50	16
198_19	290	F	17/03/2016	4	4	4	100	0

200_10	170	M	17/03/2016	2	2	2	100	0
200_11	170	U	17/03/2016	2	2	2	100	0
200_12	210	F	17/03/2016	3	3	3	100	0
200_2	240	F	17/03/2016	4	4	4	100	0
200_3	300	F	17/03/2016	4	6	4	50	28
200_4	260	F	17/03/2016	3	3	3	100	0
200_5	320	F	17/03/2016	5	4	5	50	16
200_6	270	F	17/03/2016	4	4	4	100	0
200_7	170	M	17/03/2016	2	2	2	100	0
200_8	270	F	17/03/2016	4	4	4	100	0
200_9	180	M	17/03/2016	2	2	2	100	0
51_1	200	M	07/03/2016	3	2	3	50	28
51_10	180	M	07/03/2016	3	4	3	50	20
51_11	240	M	07/03/2016	3	3	3	100	0
51_12	270	F	07/03/2016	4	5	4	50	16
51_13	260	F	07/03/2016	3	5	3	50	35
51_14	290	F	07/03/2016	4	4	4	100	0
51_15	330	F	07/03/2016	5	4	5	50	16
51_16	230	M	07/03/2016	3	3	3	100	0
51_17	350	F	07/03/2016	5	5	5	100	0
51_18	160	M	07/03/2016	2	2	2	100	0
51_2	280	M	07/03/2016	3	3	3	100	0
51_3	220	M	07/03/2016	3	3	3	100	0
51_4	300	F	07/03/2016	4	4	4	100	0
51_5	170	M	07/03/2016	2	2	2	100	0
51_7	190	M	07/03/2016	2	2	2	100	0
51_8	250	M	07/03/2016	3	4	3	50	20
51_9	210	M	07/03/2016	3	3	3	100	0
685_126	155	M	10/02/2014	2	2	2	100	0
685_150	135	M	10/02/2014	2	2	2	100	0
685_166	175	M	10/02/2014	2	2	2	100	0
685_171	325	F	11/02/2014	4	5	4	50	16
685_191	175	F	11/02/2014	2	3	2	50	28
685_208	205	F	11/02/2014	2	2	2	100	0
685_235	355	F	12/02/2014	4	7	4	50	39
685_244	305	F	12/02/2014	4	6	4	50	28
685_246	265	M	12/02/2014	4	5	4	50	16
685_254	115	F	12/02/2014	1	2	1	50	47
685_256	325	M	13/02/2014	3	4	3	50	20
685_271	125	M	13/02/2014	1	2	1	50	47
685_287	215	F	13/02/2014	2	2	2	100	0
685_292	345	F	14/02/2014	5	6	5	50	13
685_333	395	F	14/02/2014	7	7	7	100	0
685_342	235	M	14/02/2014	3	3	3	100	0
685_349	285	M	17/02/2014	4	3	4	50	20

685_358	315	F	17/02/2014	4	5	4	50	16
685_374	275	M	17/02/2014	4	3	4	50	20
685_404	425	F	18/02/2014	7	7	7	100	0
685_5	335	F	08/02/2014	4	6	4	50	28
685_62	145	F	09/02/2014	2	2	2	100	0
685_68	365	F	09/02/2014	6	7	6	50	11
685_80	295	F	09/02/2014	4	4	4	100	0
685_88	195	F	09/02/2014	3	2	3	50	28
685_97	165	F	09/02/2014	2	2	2	100	0
695_121	265	F	28/10/2014	3	2	3	50	28
695_129	175	F	28/10/2014	1	1	1	100	0
695_15	195	M	26/10/2014	1	2	1	50	47
695_181	315	F	29/10/2014	4	6	4	50	28
695_190	215	M	29/10/2014	2	4	2	50	47
695_207	235	F	29/10/2014	2	2	2	100	0
695_21	345	F	26/10/2014	4	5	4	50	16
695_218	215	F	30/10/2014	2	2	2	100	0
695_229	335	F	30/10/2014	5	5	5	100	0
695_23	295	M	26/10/2014	4	4	4	100	0
695_259	165	M	30/10/2014	2	1	2	50	47
695_285	425	F	31/10/2014	9	8	9	50	8
695_298	445	F	31/10/2014	7	7	7	100	0
695_309	305	M	31/10/2014	4	4	4	100	0
695_358	245	F	31/10/2014	2	2	2	100	0
695_39	235	M	26/10/2014	2	3	2	50	28
695_480	415	F	03/11/2014	6	8	6	50	20
695_489	465	F	03/11/2014	10	8	10	50	16
695_503	375	F	04/11/2014	5	5	5	100	0
695_518	135	M	04/11/2014	1	1	1	100	0
695_57	325	F	26/10/2014	4	4	4	100	0
695_67	285	F	27/10/2014	4	4	4	100	0
695_77	205	F	27/10/2014	2	2	2	100	0
695_89	155	F	27/10/2014	1	1	1	100	0
S61510331_1	305	F	21/10/2015	4	4	4	100	0
S61510331_10	295	F	21/10/2015	3	5	3	50	35
S61510331_11	295	F	21/10/2015	3	3	3	100	0
S61510331_14	245	F	21/10/2015	3	3	3	100	0
S61510331_15	265	F	21/10/2015	4	3	4	50	20
S61510331_17	295	F	21/10/2015	3	4	3	50	20
S61510331_18	255	M	21/10/2015	3	3	3	100	0
S61510331_19	255	M	21/10/2015	2	3	2	50	28
S61510331_2	365	F	21/10/2015	7	5	7	50	24
S61510331_20	275	F	21/10/2015	3	3	3	100	0
S61510331_21	245	M	21/10/2015	3	3	3	100	0
S61510331_24	235	M	21/10/2015	2	2	2	100	0

S61510331_25	265	F	21/10/2015	3	3	3	100	0
S61510331_28	255	M	21/10/2015	3	4	3	50	20
S61510331_29	285	M	21/10/2015	4	3	4	50	20
S61510331_3	235	M	21/10/2015	2	3	2	50	28
S61510331_30	305	F	21/10/2015	3	3	3	100	0
S61510331_31	245	M	21/10/2015	3	2	3	50	28
S61510331_32	305	F	21/10/2015	5	4	5	50	16
S61510331_33	295	M	21/10/2015	4	3	4	50	20
S61510331_40	285	F	21/10/2015	3	3	3	100	0
S61510331_43	335	F	21/10/2015	4	4	4	100	0
S61510331_5	315	M	21/10/2015	3	4	3	50	20
S61510331_51	285	F	21/10/2015	3	4	3	50	20
S61510331_59	235	M	21/10/2015	2	3	2	50	28
S61510331_60	285	F	21/10/2015	4	3	4	50	20
S61510331_61	265	F	21/10/2015	3	2	3	50	28
S61510331_7	275	F	21/10/2015	3	3	3	100	0
S61510331_8	275	M	21/10/2015	3	4	3	50	20
S61510331_9	235	M	21/10/2015	3	3	3	100	0
Total read	-	-	-	125	125	-	-	-
Total NOT read	-	-	-	0	0	-	-	-
Means (CV and PA)	-	-	-	-	-	-	75	12