Report of Otolith Exchange Analysis for Anchovy

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April-September 2018

Table of Contents

1 Executive summary

During the last anchovy workshop (WKARA2) held in 2016 a great effort of standardization of procedures among different labs and groups for age determination was carried out. These efforts produced a general agreement on anchovy growth patterns among areas (both Mediterranean and Atlantic waters) and common reading criteria were adopted. According to all these new insights, along the meeting it was proposed to test if the mentioned efforts finally produced an increase of agreement among readers and labs compared to the previous exchange. Therefore it was recommended the realization of a small exchange to be carried out in 2018 and this was adopted by WGBIOP 2017. Preliminary results were delivered to WGBIOP in 2018, but not finished due difficulties in managing results by stock with SmartDots. This complete report will be presented at WGBIOP 2019.

The Objectives of the present exchange were: 1) Evaluate if the updated Age reading protocol in WKARA2 have been adopted by all readers (at least the participants in WKARA2). 2) Evaluate if the accuracy and precision in otolith age reading of anchovy among readers of fishery and surveys samples throughout the year has improved. 3) Report results to the WGBIOP that will take place in October 2018.

To that purpose an exchange program of anchovy otoliths was organized by IEO, AZTI and IAMC-CNR between April and September 2018, before WGBIOP 2018. A set of altogether 160 images of anchovy otoliths were selected and uploaded for analysis using the SmartDots application, distributed in the Bay of Biscay and the Strait of Sicily. These areas have been chosen for the following reasons: 1) The Atlantic and Mediterranean areas are represented with these two stocks; 2) They have differences in the complexity of otolith interpretation: easier otoliths of the Bay of Biscay than those of the Strait of Sicily; 3) different conventional birth date are used: 1st of January in the Bay of Biscay and 1st of July in the Strait of Sicily and 4) by practical logistical reasons, more simple and quick to obtain the images for the exchange since the coordinators are involved in these areas. A protocol for the exchange of age readings was provided to all participants (including WKARA2 age reading protocol).

Twenty-five readers from fourteen institutes and nine countries (Germany, England, France, Spain, Portugal, Tunisia, Italy, Croatia and Greece) participated. From all readers fourteen readers have a long time experience reading anchovy otoliths (experts); seven was intermediate and four trainees. Thirteen of the 25 readers also took part in the last anchovy workshop (WKARA2 2016), representing the 52% of the total readers of this Exchange, and twelve readers attended the exchange directly without participating in the WKARA2 (48%). Seventeen of the participants to this Exchange (13 experts, 3 medium and 1 trainee readers) are readers providing input to the assessment of anchovy (71%). Participants' coverage in the Exchange was very good, it is the first time that readers from all the main areas of the European anchovy distribution participate in this kind of exchanges.

Overall agreement between all readers and areas is very low, 63.6%. CV= 49.5%, very similar (slightly lower) than in 2014 (PA=65.5;CV=58.2%). By stock, the agreement with the modal age of all readers was low (between 56 and 71%) and CV was high (between 47 and 59%). In the case of the advanced and expert group, agreements and CVs are variable, depending on the stock, showing the highest agreement in the ane.27.8 stock (which results in 76% and 83% of agreement and CVs of 38% and 26%). The results of the stock readers group are much better than the other groups of readers (including advanced and expert group), for Bay of Biscay readers and Strait of Sicily readers (91% & 96% of agreement; CV of 9% & 9%, respectively, although in the latter area only two readers of the same institute participate on this stock).

Comparing the results of Exchange 2018 with that of 2014 for all readers, there has been a small decrease of the overall level of agreement and a decrease of CV in those areas that were analyzed in the two exchanges. For the Bay of Biscay stock readers there is no variation from one exchange to another with a high PA and low CV in the two exchanges. For the anchovy of the Strait of Sicily there is no improvement for the expert's readers. Restricting the comparison to those who participated in the 2014 exchange (and in WKARA) no improvement is seen either (similar PA for the case of the Bay of Biscay and some decline of agreement in GSA16), with a bit greater variability --CVs -- in the two areas. This leads to conclude that no improvement can be noticed in general in agreement and precision, nor for the all readers neither for the WKARA readers.

In spite of not having met the quality standards for age determination agreed in WKARA2, and of not having noticed any improvement *vs* the 2014 exchange, it seems that many readers and mainly those who attended the WKARA2 tend to follow the same growth pattern in the otoliths of the two areas when interpreting the winter marks. This is supported by the rather high consistency achieved in the analysis of distance of winter marks from the core of otolith in both areas. For the future the most problematic issue which requires to be improved is the application of the age determination rule, although there are still some readers who need improving as well the discrimination between actual winter marks and checks and to understand the correct annual growth pattern.

In view of the current results and that there are new readers a new workshop might be considered for 2021. Meanwhile, we recommend the readers to review and read the WKARA2 report (where there are many examples) and to review the collection of otoliths of reference that is in the Age Forum Reader.

2 Terms of reference

Objectives of the present exchange:

- Evaluate if the updated Age reading protocol in WKARA2 have been adopted by all readers (at least the participants in WKARA2).
- Evaluate if the accuracy and precision in otolith age reading of anchovy among readers of fishery and surveys samples throughout the year has improved.
- Report results to the WGBIOP that will take place in October 2018.

3 Participant list

A total of 32 participants were involved in the present Exchange, from 15 institutes (DTU-Aqua, ICES, Thuenen, CEFAS, IFREMER, IEO, IPMA, INSTM, CNR, COISPA, IOR, HCMR and FRI) and 10 countries (Denmark, Germany, England, France, Spain, Portugal, Tunisia, Italy, Croatia and Greece). Of these participants three were coordinators and two as experts in the new software SmartDot. Three potential readers at the beginning of the exchange did not read finally.

Finally, 25 readers of anchovy participated in the Exchange: 13 expert readers, 8 intermediate readers and 4 trainee readers. Thirteen of the 25 readers also took part in the last anchovy workshop (WKARA2 2016), representing the 52% of the total readers of this Exchange. All WKARA2 readers participated in this exchange, except one reader (she did not actually work in this area). And twelve readers attended the exchange directly without participating in the WKARA2 (48%). Seventeen of the participants to this Exchange (12 experts, 4 medium and 1 trainee readers) are readers for the assessment of anchovy (71%). A list of the participants with a summary about their experience in age estimation of anchovy and the area where they are readers is shown in the **Table 3.1**.

Participants' coverage in the Exchange was very good, it is the first time that it is practically represented by readers from all the main areas of the European anchovy distribution (**Figure 3.1**)

Figure 3.1. Areas / stocks of European anchovy represented by the readers participating in the exchange

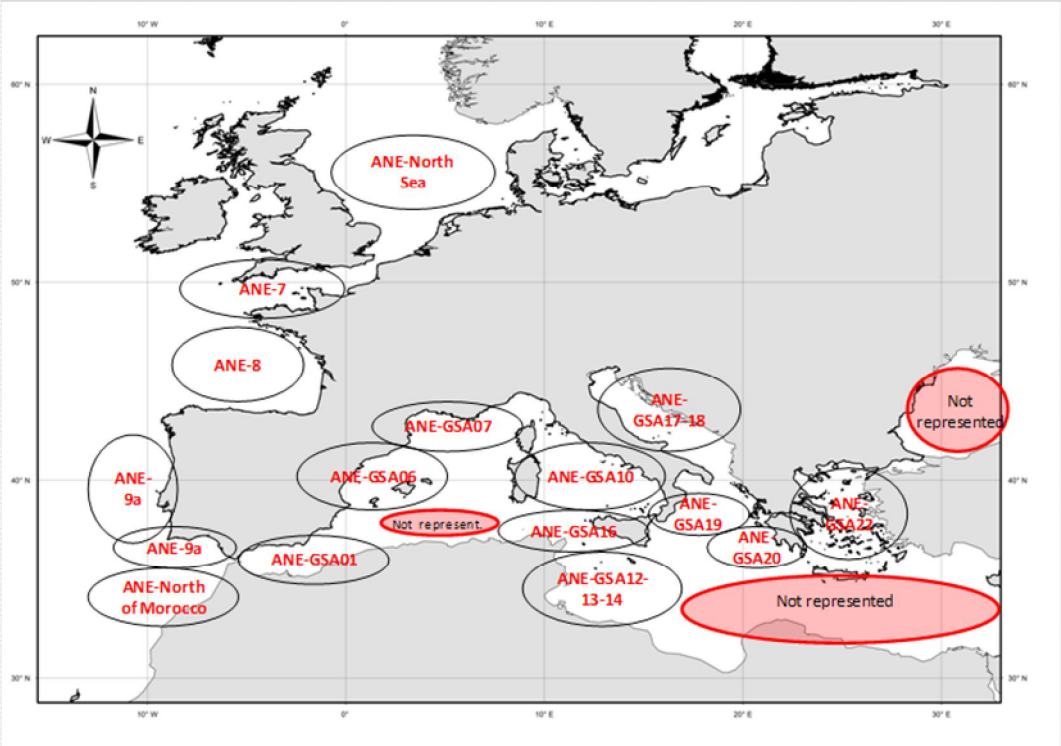


Table 3.1. Participants and qualification of readers. **Advanced being those who provide age data for assessment purposes and Basic if they do not*

Country	Participants in Exchange 2018 (preliminary list, contact person in bold)	Email	Age reading expertise: Trainee / Intermediate / Expert	Reads for assessment (Yes/No)	Level of expertise in Smartdots (Advanced/ Basic)*	Anchovy Stock/Area of Expertise	Participation in Exchange 2014 (Yes/No)	Participation in Workshop 2016 (Yes/No)	Reader No in SmartDots	Final readers 4/09/2018
Spain-IEO	**Begoña Villamor**	begona.villamor@ieo.es	Coordinator	Yes	Advanced	Bay of Biscay (Subarea 8) and Sub-Division 9a North	Yes (coordinator)	Yes (Co-chair)	-	-
	Clara Dueñas	clara.duenas@ieo.es	Expert	Yes	Advanced		Yes	Yes	3	Yes
	Ana Antolinez	ana.antolinez@ieo.es	Expert	No	Basic		Yes	Yes	6	Yes
	Jorge Tornero	jorge.tornero@ieo.es	Expert	Yes	Advanced	Gulf of Cadiz (Sub-Division 9a-South)	Yes	Yes	10	Yes
	Verónica Duque Nogal	veronica.duque@ieo.es	Trainee	No	Basic	Morocco	No	Yes	16	Yes
	Pedro Torres	pedro.torres.ieo.es	Expert	Yes	Advanced	GSA 011 & GSA 06	Yes	Yes	11	Yes
Italy-CNR	**Gualtiero Basilone**	gualtiero.basilone@iamc.cnr.it	Coordinator	No	Advanced	GSA 16	Yes	Yes (Co-chair)	-	-
	Salvatore Mangano	salvatore.mangano@iamc.cnr.it	Expert	Yes	Advanced		Yes	Yes	4	Yes
	Maurizio Pulizzi	maurizio.pulizzi@iamc.cnr.it	Expert	Yes	Advanced		Yes	Yes	5	Yes
Spain-AZTI	**Andrés Uriarte**	auriarte@azti.es	Coordinator	Yes	Advanced	Bay of Biscay (Subarea 8)	Yes (coordinator)	Yes (Co-chair)	1	Yes
	Iñaki Rico	irico@azti.es	Expert	Yes	Advanced		Yes	Yes	2	Yes
Croatia-IOR	**Denis Gašparević**	denis@izor.hr	Intermediate	Yes	Advanced	GSA 17	No	Yes	14	Yes
Germany	Gitta Hemken	gitta.hemken@thuenen.de	Trainee	No	Basic	North sea	No	No	26	-
	Gertrud Delfs	gertrud.delfs.@thuenen.de	Intermediate	Yes	Advanced	North sea	No	No	22	Yes
England-Cefas	**Richard Humphreys**	richard.humphreys@cefas.co.uk	Expert	No	Basic	Celtic sea,Western channel,Bristol channel (Sub area 7 e-g)	No	No	21	-
	Louise Straker Cox	louise.cox@cefas.co.uk	Intermediate (Expert Herring	No	Basic		No	No	24	Yes
France - IFREMER	**Kélig mahé**	kelig.mahe@ifremer.fr	Coordinator	No	Advanced				-	-
	erwan duhamel	erwan.duhamel@ifremer.fr	expert	yes	Advanced	Bay of Biscay	No	No	7	Yes
	geoffrey Bled Defruit	Geoffrey.Bled.Defruit@ifremer.fr	expert	yes	Advanced	37,1,2 & 37,1,3	No	No	8	Yes
	celina Chantre	celina.chantre@ifremer.fr	expert	no	Basic		No	No	9	Yes
Greece-HCMR	**Ioannis Fytilakos**	fytilakos@hcmr.gr	Trainee	Yes	Advanced	GSA 22, 20 (Aegean Sea)	No	Yes	15	Yes
Greece-FRI	**Ofridopoulou Konstantina**	ofridopoulouk@inale.gr	Intermediate	No	Basic	GSA 20, 22, 23	No	No	25	Yes
Tunisia-INSTM	Sana Khemiri	sana.khemiri@instm.rnrt.tn	Expert	yes	Advanced	GSA 12, 13, 14	NO	yes	12	Yes
	Adel Gaamour	gaamour.adel@instm.rnrt.tn	Expert	yes	Advanced	GSA 12, 13, 14	NO	yes	13	Yes
Denmark_DTU Aqua	**Julie Olivia Coad**	joco@aqua.dtu.dk	Expert in the new software SmartDots	No	Basic	-	No	No	29	-
Portugal - IPMA	**Eduardo Soares**	esoares@ipma.pt	Intermediate	yes	Advanced	Portuguese Coast (Sub-Divs. IXa CN, CS and S)	Yes	No	19	Yes
	Raquel Milhazes	rmilhazes@ipma.pt	Trainee	No	Basic		No	No	27	Yes
	Diana Feijó	dfeijo@ipma.pt	Trainee	No	Basic		No	No	28	Yes
Italy-COISPA	**Carbonara Pierluigi**	carbonara@coispa.it	Expert	yes	Advanced	GSA 19 (West Ionian Sea)	yes	yes	17	-
	Loredana Casciaro	casciaro@coispa.eu	Intermediate	yes	Advanced		yes	no	18	Yes
	Michele Palmisano	palmisano@coispa.eu	Intermediate	no	Basic		no	no	20	Yes
Italy-ISMAR	Ilaria Constantine	ilaria.costantini@an.ismar.cnr.it	Intermediate	yes	Advanced	GSA17 West and GSA18 West-East	No	No	23	Yes

4 Introduction

European anchovy (*Engraulis encrasicolus*) is a small pelagic species of high commercial importance in European waters, in both the Atlantic and the Mediterranean Sea, and is assessed in most of the stocks that are distributed in these areas. The assessments are conducted within the framework of ICES for stocks in the Atlantic area (ICES, 2017) and in the GFCM for stocks in the Mediterranean Sea (GFCM-FAO, 2017).

Ages reading on anchovy are important input data for the assessment and carried out by number of laboratories using international ageing criteria. There is an international age reading protocol and a consensual age reading criteria for Atlantic and Mediterranean areas from the Workshop on Anchovy age reading in 2009 (ICES, 2009), which was revised and updated in WKARA2 (ICES 2016).

In the past, since the 1990s, exchanges, workshops and cross-checking of the procedures for age determination of European anchovy otoliths in Atlantic areas have been made in the Bay of Biscay (Astudillo et al., 1990; Villamor and Uriarte, 1996; Uriarte, 2002a; Uriarte et al., 2002, 2006 and 2007) and in the Gulf of Cadiz (Garcia, 1998; Uriarte et al., 2002). However, no proper exchanges or workshops on reading procedures of European anchovy otoliths had been held in Mediterranean areas until 2009 (ICES, 2009).

Since 2009, there have been two exchanges and one workshop on Anchovy otoliths taking into accounts the Atlantic and the Mediterranean areas together. 2008 PGCCDBS (ICES, 2008) recommends the realization of first otolith exchange and workshop of anchovy between the Atlantic and Mediterranean areas together (ICES, 2009; Villamor et al., 2009). In 2014, the PGCCDBS (ICES, 2014) identified the need of a fullscale European Anchovy otolith exchange to take place in 2014 (Villamor and Uriarte, 2015), and 2015 WGBIOP (ICES, 2015) recommends the realization of a Workshop on Age Reading of Anchovy for all European countries in 2016 (WKARA2), in order to ascertain the current level of precision among institutes and the difficulties that the age reading of anchovy otoliths present.

During the last anchovy workshop (WKARA2) held in 2016 (ICES, 2016) a great effort of standardization of procedures among different labs and groups for age determination was carried out. These efforts produced a general agreement on anchovy growth patterns among areas (both Mediterranean and Atlantic waters) and common reading criteria were adopted. According to all these new insights, along the meeting it was proposed to test if the mentioned efforts finally produced an increase of agreement among readers and labs compared to the previous exchange (Villamor and Uriarte, 2015). Therefore it was recommended the realization of a small exchange to be carried out in 2018 and this was adopted by WGBIOP (ICES, 2017b).

The Working Group on Biological Parameters (WGBIOP) met in October 2017 (ICES, 2017), and identified anchovy as one of the species requiring confirmation of the ages being assigned by Fisheries Institutes. The WGBIOP indicated that a small otolith exchange on anchovy should be organized in 2018, in order to see if the update Age reading protocol in WKARA2 have been adopted by all readers (at least the participants in WKARA2) and to see if the accuracy and precision has improved.

To that purpose an exchange program of anchovy otoliths is organized by IEO, AZTI and IAMC-CNR between April-September 2018 before a Working Group on Biological Parameters (WGBIOP), will meet in Ghent, Belgium, 1-5 October, 2018.

5 Methods

As the main objective of the exchange is to know if the updated protocol for the age reading of the anchovy otoliths has been adopted by the readers of this species in the different European laboratories, only two areas have been selected so that it does not exceed of 200 otoliths.

A set of altogether 160 images of anchovy otoliths were selected and uploaded for analyzing using the SmartDots application (http://www.ices.dk/marine-data/tools/Pages/smartdots.aspx), distributed the Bay of Biscay and the Strait of Sicily (**Table 5.1.1**). These areas have been chosen for the following reasons: 1) The Atlantic and Mediterranean areas are represented with these two stocks; 2) They have differences in the complexity of otolith interpretation: easier otoliths of the Bay of Biscay than those of the Strait of Sicily; 3) different conventional birth date are used: 1st of January in the Bay of Biscay and 1st of July in the Strait of Sicily and 4) by practical logistical reasons, more simple and quick to obtain the images for the exchange since the coordinators are involved in these areas.

Table 5.1.1: Overview of samples used for the Anchovy Exchange 2018.

Year	ICES area	Strata	Quarter	Number of samples	Modal age range	Length range
2016	16	GSA16	1	26	0-2	100-160 mm
2016	16	GSA16	2	14	0-2	105-140 mm
2016	16	GSA16	3	30	0-2	50-155 mm
2016	16	GSA16	4	10	1-2	130-155 mm
2016	27.8.b	ane.27.8	3	11	1-2	120-145 mm
2016	27.8.b	ane.27.8	4	9	0-2	115-150 mm
2016	27.8.c	ane.27.8	4	11	0-2	120-160 mm
2017	27.8.b	ane.27.8	1	7	1-3	140-155 mm
2017	27.8.b	ane.27.8	2	13	1-3	140-160 mm
2017	27.8.c	ane.27.8	1	4	2-3	160-190 mm
2017	27.8.c	ane.27.8	2	16	1-3	125-180 mm
2017	27.8.c	ane.27.8	4	9	0	60-155 mm

A protocol on age reading of anchovy was provided to all participants (Villamor et al., 2018).

Reports from SmartDots have been sent to the coordinators of Anchovy Exchange, but after discussing the results, we decided to use the raw data with the Eltink spreadsheet (Eltink, 2000) to modify some parameters before producing the analysis:

- To modify the data with AQ3 precision level which often showed “age group 0” by no data
- To present detailed results by stock and for the group of readers that participated in the WKARA2 exchange
- To present the results by stock for the readers who provide age determination for inputs to the stock assessment for the selected stock (for instance to infer the age error matrix, etc.).

Analyses were performed for all samples and for each stock. For each stock overall age reading of all readers were analysed and two additional analyses were performed: Analysis only with the advanced readers (those who provide age data for assessment purposes but across different stocks) and analysis only with the readers who participated in the WKARA2 2016 , in order to evaluate if the updated age reading protocol in this workshop have been adopted by the participants in this workshop and if the accuracy and precision in otolith age reading of anchovy among readers throughout the year has improved. We have also analyzed the results of the expert readers, since they are not the same as the advanced readers. And finally we have also analyzed only the readings of the readers involved in each stock (stock readers).

Mean precision of age is defined as the variability in the age reading estimates. For individual fish the Coefficient **of Variation (CV)** and **percentage agreement (PA)** to modal age was calculated. This measure of precision is independent of the closeness to the true age (ICES, 2007). The spreadsheet was completed according to the instructions contained in Guidelines and Tools for Age Reading Comparisons by Eltink et al. (2000). Modal ages were calculated for each otolith read, with percentage agreement, mean age and precision coefficient of variation as a definition (for each otolith):

- percentage of agreement = 100x(no. of readers agreeing with modal age/total no. of readers).
- precision c. v. = 100x(standard deviation of age readings/mean of age readings).

Table 5.1.2 shows readers which finally participated in the exchange and presents the codes of the 25 readers.

Table 5.1.2: Reader overview.

Reader code	Expertise
R01 ES	Advanced
R02 ES	Advanced
R03 ES	Advanced
R04 IT	Advanced
R05 IT	Advanced
R06 ES	Basic
R07 FR	Advanced
R08 FR	Advanced
R09 FR	Basic
R10 ES	Advanced
R11 ES	Advanced
R12 TN	Advanced
R13 TN	Advanced
R14 HR	Advanced
R15 GR	Advanced
R16 ES	Basic
R18 IT	Advanced
R19 PT	Advanced
R20 IT	Basic
R22 DE	Advanced
R23 IT	Advanced
R24 GB	Basic
R25 GR	Basic
R27 PT	Basic
R28 PT	Basic

Age error matricx (AEM)

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

Otolith Growth Analysis

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

6 Analysis of age calibration exercise

6.1 All areas

Analyses were performed for the total areas and each area. For each area overall age reading were analyzed and six additional analyses were performed: Analysis only with the advanced readers, analysis referring to expert group, analysis only with WKARA2 readers (all and experts) and analysis only with the stock readers (all and advanced).

Overall age reading results for each otolith and reader are shown in **Annex 1**. From the total of 160 pictures of anchovy otoliths seven readers analyzed all images; nine readers analyzed between 150 to 159 images, seven readers analyzed between 140 to 149 images and two readers analyzed 131 and 114 respectively.

The weighted average percentage agreement based on modal ages for all readers and samples is 63.6 %, with the weighted average CV of 49.5 %. Most of the anchovy otoliths were not well classified by some of the readers during the 2018 exchange. Only 2 out of the 160 otoliths reached 100% of agreement.

By areas, the agreement with the modal age of all readers and for advanced readers was low (between 56 and 76%) and CV was high (between 38 and 59%) (**Table 6.1.1 and Figure 6.1.1**). In general for the two areas, the relative bias indicate overall high bias (around 0.24). In the case of the expert group and WKARA2 readers (all and experts), also reveals agreements and CV highly variable, depending on the areas, showing the highest agreement in the area of Bay of Biscay (Ane.27.8), with more of 80% agreement, and high variation of CV (between 23% and 27% respectively). In general, the results of the expert group and WKARA2 readers improved compared to those of all readers in the two areas, although the improvement in the Strait of Sicily (GSA 16) is very small. The results of the stock readers group are much better (higher % agreement and lower CV) than the other groups of readers (including expert group). These advanced stock readers show high overall agreement and low CV for the two stocks (91% & 96% of agreement; CV of 9%, respectively). (**Tables 6.1.1 to 6.1.4 and Figures 6.1.1 and 6.1.2**).

Figures 6.1.3 to 6.1.5 show the average distance from the centre to the winter rings for all readers and all samples; for all readers by stock and for advanced readers by stock respectively. The average distance from the centre to the winter rings show rather regular increases for the first three winter rings in all areas, followed by a reduction of the width of the subsequent increases. The comparisons by areas shows wider increments in the Bay of Biscay than in GSA16 (Figures 6.1.4 & 5). The “outliers” out of the box-whisker usually are remarkable for the Bay of Biscay and they lay usually within the range of the distances of the following winter rings. This may indicative of alternatives interpretations of the otoliths in the Bay of Biscay.

Table 6.1.1 Summary of the average percentage of agreement (PA), Coefficient of variation (CV) and relative bias by area y total.

PA

Set	All readers	Advanced readers	Expert readers	WKARA 2 readers	WKARA2 readers (experts)	Area readers	Area readers (Advanced)
Total	63.6%						
Ane.27.8	71%	76%	83%	81%	84%	88%	91%
GSA 16	56%	58%	59%	64%	63%	96%	96%

CV

Areas	All readers	Advanced readers	Expert readers	WKARA 2 readers	WKARA2 readers (experts)	Area readers	Area readers (Advanced)
Total	49.5%						
Ane.27.8	41%	38%	26%	27%	23%	14%	9%
GSA 16	59%	52%	57%	57%	56%	9%	9%

Bias

Areas	All readers	Advanced readers	Expert readers	WKARA 2 readers	WKARA2 readers (experts)	Area readers	Area readers (Advanced)
Total	0.22						
Ane.27.8	0.24	0.15	0.07	0.04	0.04	0.07	0.05
GSA 16	0.21	0.30	0.11	0.11	0.05	-0.04	-0.04

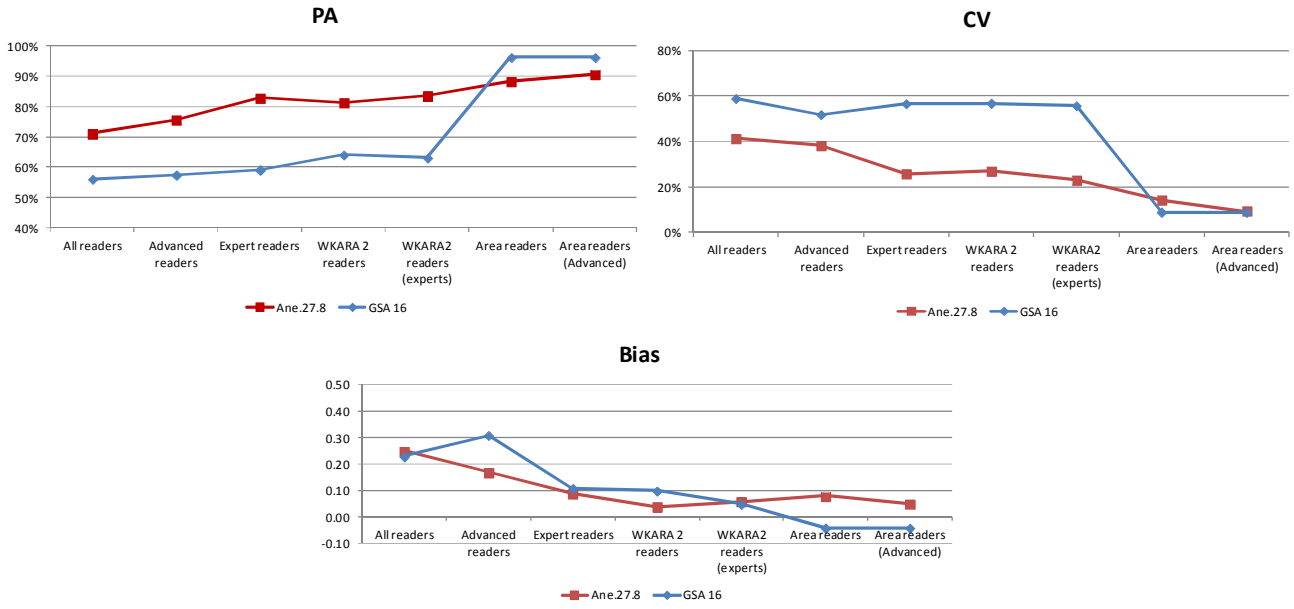


Figure 6.1.1 Summary of the average percentage of agreement, CV and relative bias by area.

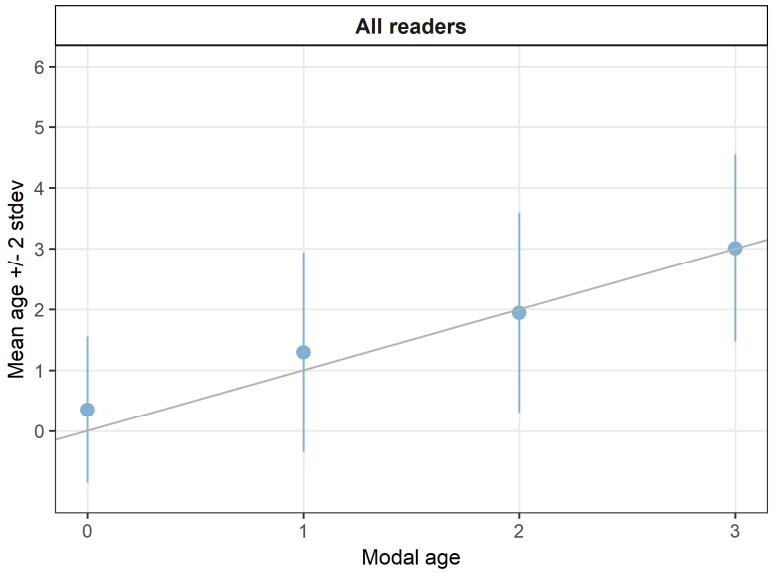


Figure 6.1.2: Age bias plot for all readers and all samples. Mean age recorded +/- 2 stdev of each reader and all readers combined are plotted against modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line). Relative bias is the age difference between estimated mean age and modal age.

Table 6.1.2: Percentage Agreement per strata.

Modal age	ane.27.8	GSA16	all
0	79 %	69 %	**73 %**
1	69 %	52 %	**59 %**
2	71 %	47 %	**62 %**
3	62 %	-	**62 %**
Weighted Mean	**71 %**	**56 %**	**64 %**

Table 6.1.3: CV per strata.

Modal age	ane.27.8	GSA16	all
0	-	-	**-**
1	51 %	62 %	**57 %**
2	32 %	48 %	**38%**
3	24 %	-	**24 %**
Weighted Mean	**41 %**	**59 %**	**50 %**

Table 6.1.4: Relative Bias per strata.

Modal age	ane.27.8	GSA16	all
0	0.24	0.38	**0.32**
1	0.38	0.24	**0.30**
2	0.13	-0.34	**-0.03**
3	-0.01	-	**-0.01**
Weighted Mean	**0.24**	**0.21**	**0.22**

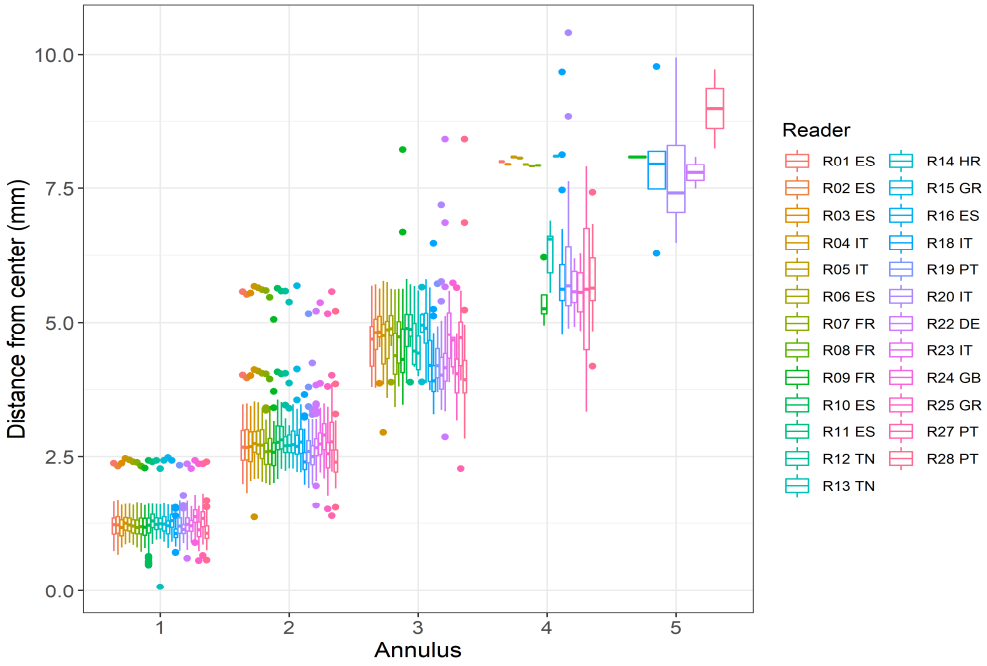


Figure 6.1.3: Plot of average distance from the centre to the winter rings for all readers and all samples. The boxes represent the mean, upper and lower box boundaries of the interquartile range, whiskers represent the minimum and maximum values and the dots represent the outliers.

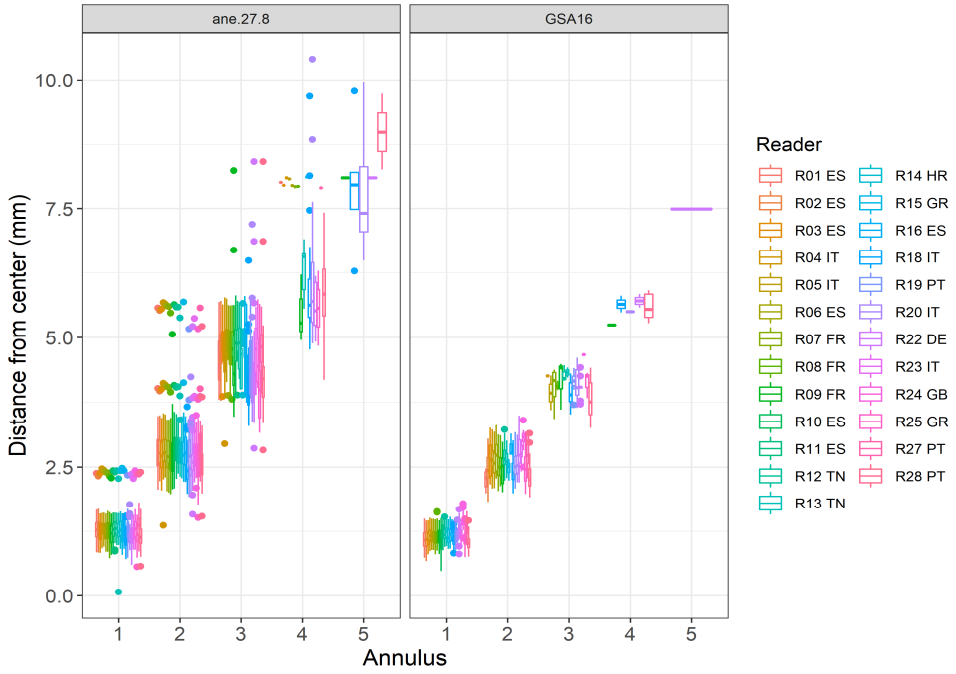
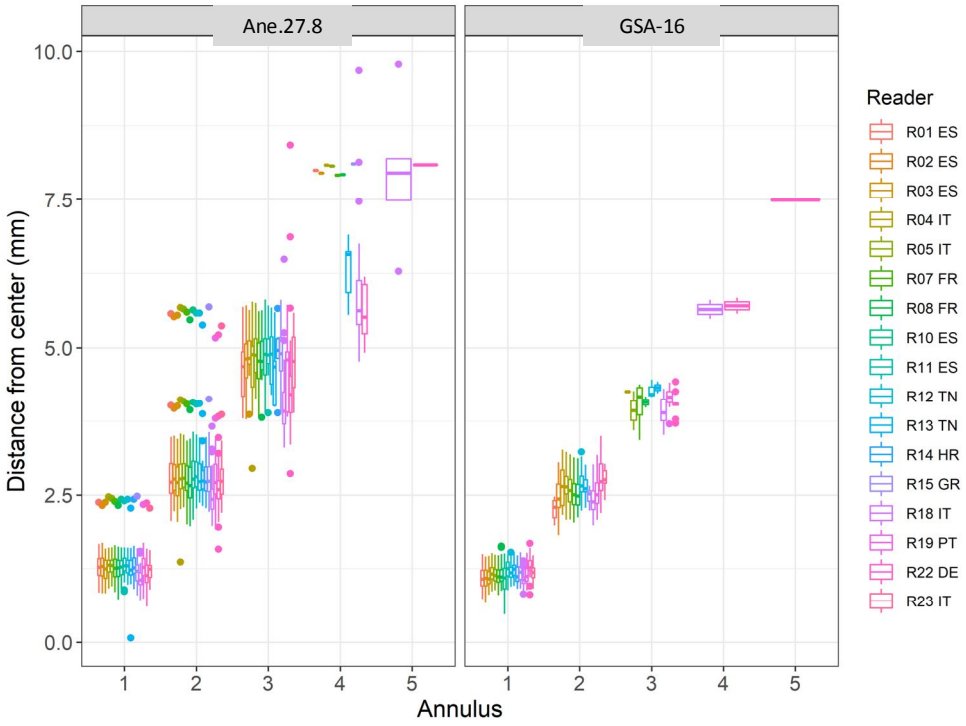


Figure 6.1.4: Plot of average distance from the centre to the winter rings for all readers by stock.



6.1.5: Plot of average distance from the centre to the winter rings for advanced readers by stock.

6.2 Anchovy in the Bay of Biscay (Ane.27.8)

Overall age reading results are shown **Annex 1**. From the total of 80 pictures of anchovy otoliths nine readers analyzed all images, eight readers between 70 and 79 images, seven readers analyzed between 60-69 images and one reader only 50 images.

Table 6.2.1 and Figure 6.2.1 shows the PA and CV by readers group. Overall agreement for all readers is 71 % (**Table 6.2.1**). The best agreements are reached for age 0 (79 %), for age 1 and 2 agreements are 69 and 71% respectively, and the lowest agreement for age 3 (62%). Analysis only for advanced readers improves with respect to all readers but still remains low (76%).

Analysis referring to experts group shows an overall agreement of 83%, and analysis of WKARA2 readers group (all and experts) shows an overall agreement of 81% and 83%, higher than the agreement between all readers. Analysis only done with the Bay of Biscay group (7 readers) and for advanced readers of this stock (5 readers) shows the highest overall agreement of 88% and 91% (**Table 6.2.1**) respectively.

The analysis including all age readers revealed a very high overall coefficient of variation (CV) of 41% (**Table 6.2.1 and Figure 6.2.1**). CV peaked at 51% for modal age 1 (the CV was not calculated at age 0). Lowest CVs were revealed for modal age group 3 (24%). Overall CV for the Bay of Biscay readers group all and advanced was 14 and 9% respectively, for the expert group was 26%, and for the WKARA2 readers group all and expert 27% and 23% respectively. Bay of Biscay advanced readers shows lower CV at ages 2 and 3 (8 and 3% respectively). In all reader groups the highest CVs were at age 1.

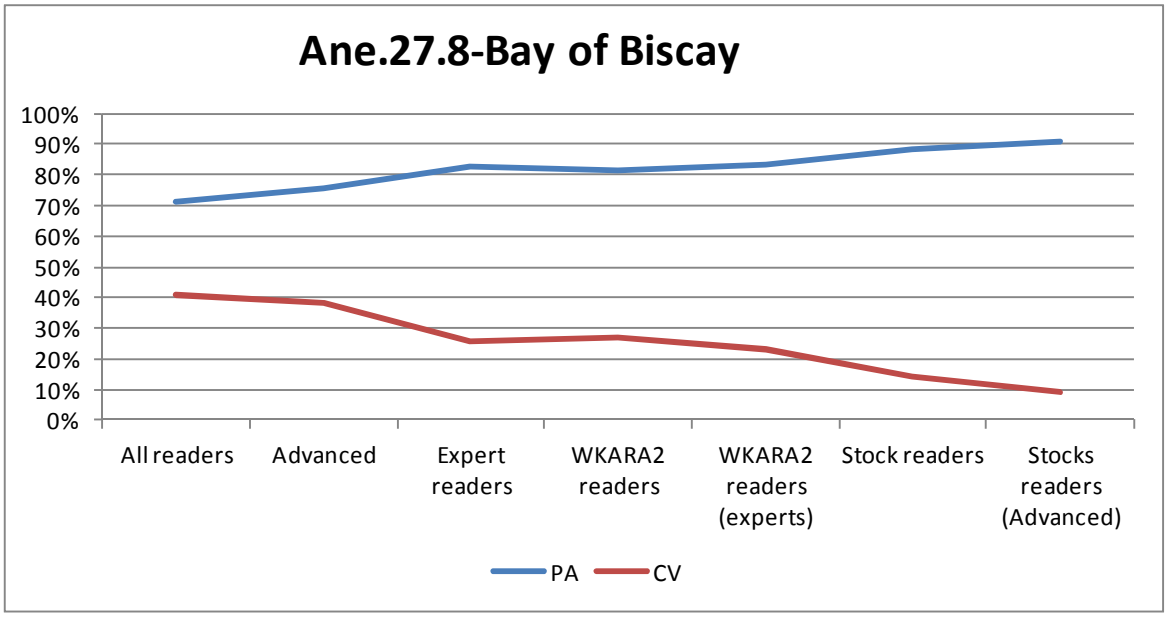


Figure 6.2.1: Ane.27.8. Percentage of agreement (PA), Coefficient of variation (CV) by readers group.

Table 6.2.1: Ane.27.8. Summary of the average percentage of agreement (PA), Coefficient of variation (CV) and relative bias by age, by readers group.

All readers

Modal Age	Otolith N	PA	CV	Bias
0	18	79%		0.24
1	33	69%	51%	0.38
2	21	71%	32%	0.13
3	8	62%	24%	-0.01
4	-	-	-	-
5	-	-	-	-
Total	**80**	**71%**	**41%**	**0.24**

Advanced

Modal Age	Otolith N	PA	CV	Bias
0	17	80%		0.21
1	33	74%	49%	0.26
2	21	79%	29%	0.04
3	9	68%	22%	-0.08
4	-	-	-	-
5	-	-	-	-
Total	**80**	**76%**	**38%**	**0.15**

Expert readers

Modal Age	Otolith N	PA	CV	Bias
0	17	82%		0.18
1	34	83%	29%	0.12
2	21	84%	20%	0.00
3	7	86%	15%	-0.07
4	1	54%	-	-0.46
5	-	-	-	-
Total	**80**	**83%**	**26%**	**0.07**

WKARA2 readers

Modal Age	Otolith N	PA	CV	Bias
0	17	87%		0.13
1	33	81%	33%	0.09
2	22	80%	22%	-0.07
3	8	75%	15%	-0.10
4	-	-	-	-
5	-	-	-	-
Total	**80**	**81%**	**27%**	**0.04**

WKARA2 readers (experts)

Modal Age	Otolith N	PA	CV	Bias
0	17	85%		0.15
1	33	82%	28%	0.10
2	22	84%	18%	-0.03
3	7	85%	13%	-0.11
4	1	50%	-	-0.50
5	-	-	-	-
Total	**80**	**83%**	**23%**	**0.04**

Stock readers

Modal Age	Otolith N	PA	CV	Bias
0	18	84%		0.18
1	32	91%	15%	0.05
2	22	86%	16%	0.03
3	7	96%	5%	0.02
4	1	71%	-	-0.29
5	-	-	-	-
Total	**80**	**88%**	**14%**	**0.07**

Stocks readers (Advanced)

Modal Age	Otolith N	PA	CV	Bias
0	19	84%		0.20
1	31	93%	12.1%	0.03
2	21	92%	8.1%	-0.02
3	8	95%	2.6%	-0.05
4	1	80%	-	-0.20
5	-	-	-	-
Total	**80**	**91%**	**9.3%**	**0.05**

Figure 6.2.2 shows age bias plots with the mean age recorded and the standard deviation of all readers combined plotted against the modal age by readers group. Annex 1 shows de ages bias plot for each reader. Deviations from the modal age (solid line) can be seen for the all ages in some readers. There are some readers who overestimate all ages, which means that they are giving false rings as true. In general, most readers showed a trend to underestimate the older ages (age 3) and overestimate age 1. In the case of the expert group and the group of Bay of Biscay readers, the largest deviations are in the 1 year old.

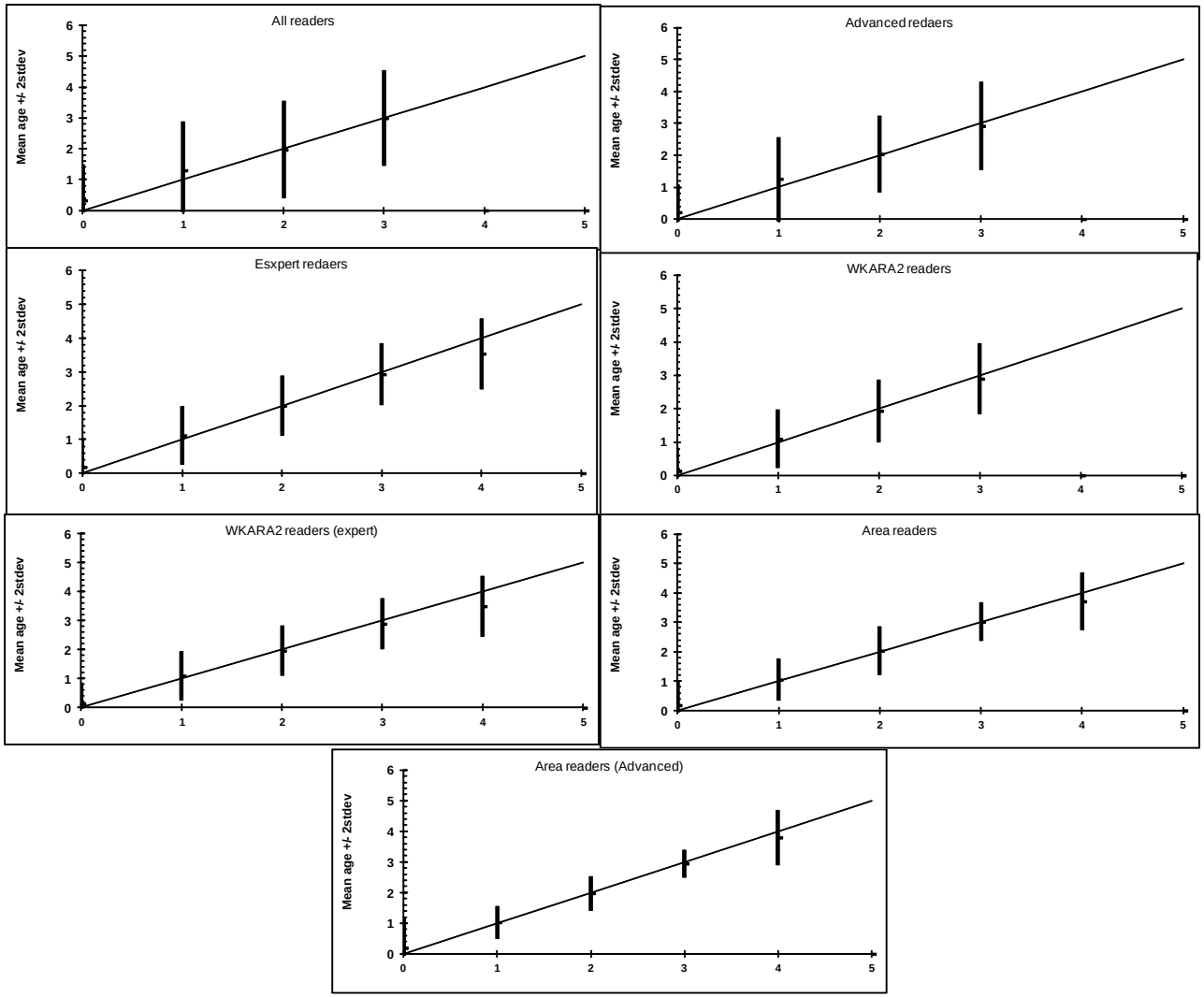


Figure 6.2.2: Ane.27.8. Age bias plot for all readers by readers group. Mean age recorded +/- 2 stdev of each reader and all readers combined are plotted against modal age by group. The estimated mean age corresponds to modal age when the estimated mean age is on the 1:1 equilibrium line (solid line). Relative bias is the age difference between estimated mean age and modal age.

Age error matrices (AEM) are calculated per area based on the age readings of all advanced readers (**Table 6.2.2**) and stock advanced readers (those who provide age determinations for the assessment of this stock) (**Table 6.2.3**). The AEM based on the age readings of Bay of Biscay stock advanced readers (5 readers) in the 2018 exchange shows smaller errors compared to the AEM of all advanced readers, which corresponds with the higher percentage agreement in this exchange. All AEMs presented here assume modal age to be a close approximation of true age. In this exchange all readers, ages, seasons and areas are included in the assessment to obtain a realistic AEM. By readers, reader 8 is the least accurate at age 0 (38%), overestimating this age. The other readers have a very high agreement with the modal age (above 84% in all ages) and with very small deviations (**Table 6.2.4**)

Table 6.2.2: Age error matrix (AEM) for ane.27.8: AEM of all advanced readers (17) in the 2018 anchovy exchange. Modal age is assumed to be the true age.

strata	Modal age	Assigned age 0	Assigned age 1	Assigned age 2	Assigned age 3
ane.27.8	Age 0	**0.80**	0.10	0.00	0.00
ane.27.8	Age 1	0.20	**0.70**	0.10	0.00
ane.27.8	Age 2	0.00	0.20	**0.80**	0.10
ane.27.8	Age 3	0.00	0.00	0.10	**0.70**
ane.27.8	Age 4	-	0.00	0.00	0.10

Table 6.2.3: Age error matrix (AEM) for ane.27.8: AEM of the all Bay of Biscay stock advanced readers (5 readers: R01, R02, R03, R07, R08) in the 2018 anchovy exchange. Modal age is assumed to be the true age.

strata	Modal age	0	1	2	3	4
ane.27.8	Age 0	**0.84**	0.02	0.00	0.00	0.00
ane.27.8	Age 1	0.13	**0.93**	0.05	0.00	0.00
ane.27.8	Age 2	0.03	0.05	**0.92**	0.05	0.00
ane.27.8	Age 3	0	0	0.03	**0.95**	0.2
ane.27.8	Age 4	0	0	0	0	**0.8**

Table 6.2.4: Age error matrix (AEM) for ane.27.8: AEM of the each Bay of Biscay stock advanced readers (5 readers: R01, R02, R03, R07, R08) in the 2018 anchovy exchange. Modal age is assumed to be the true age.

R01:

strata	Modal age	0	1	2	3	4
ane.27.8	Age 0	1.00	0.06	0.00	0.00	0.00
ane.27.8	Age 1	0.00	0.94	0.05	0.00	0.00
ane.27.8	Age 2	0.00	0.00	0.81	0.00	0.00
ane.27.8	Age 3	0.00	0.00	0.14	1.00	0.00
ane.27.8	Age 4	0.00	0.00	0.00	0.00	1.00

R02:

strata	Modal age	0	1	2	3	4
ane.27.8	Age 0	0.95	0.03	0.00	0.00	0.00
ane.27.8	Age 1	0.05	0.97	0.10	0.00	0.00
ane.27.8	Age 2	0.00	0.00	0.90	0.00	0.00
ane.27.8	Age 3	0.00	0.00	0.00	1.00	1.00
ane.27.8	Age 4	0.00	0.00	0.00	0.00	0.00

R03:

strata	Modal age	0	1	2	3	4
ane.27.8	Age 0	0.84	0.00	0.00	0.00	0.00
ane.27.8	Age 1	0.16	0.94	0.05	0.00	0.00
ane.27.8	Age 2	0.00	0.06	0.95	0.13	0.00
ane.27.8	Age 3	0.00	0.00	0.00	0.88	0.00
ane.27.8	Age 4	0.00	0.00	0.00	0.00	1.00

R07:

strata	Modal age	0	1	2	3	4
ane.27.8	Age 0	0.95	0.00	0.00	0.00	0.00
ane.27.8	Age 1	0.05	0.90	0.00	0.00	0.00
ane.27.8	Age 2	0.00	0.10	1.00	0.00	0.00
ane.27.8	Age 3	0.00	0.00	0.00	1.00	0.00
ane.27.8	Age 4	0.00	0.00	0.00	0.00	1.00

R08:

strata	Modal age	0	1	2	3	4
ane.27.8	Age 0	0.38	0.00	0.00	0.00	0.00
ane.27.8	Age 1	0.44	0.90	0.05	0.00	0.00
ane.27.8	Age 2	0.19	0.10	0.95	0.13	0.00
ane.27.8	Age 3	0.00	0.00	0.00	0.88	0.00
ane.27.8	Age 4	0.00	0.00	0.00	0.00	1.00

6.3 Anchovy of Strait of Sicily (GSA16)

Overall age reading results are shown **Annex 1**. From the total of 80 pictures of anchovy otoliths 16 readers analysed all images, six readers between 73-79 images and three readers analyzed between 64-69 images.

Table 6.3.1 and Figure 6.3.2 shows the % agreement (PA) and CV by readers group. Overall agreement is only 56% (**Table 6.3.1**). The best agreements are reached for age 0 (69 %), and for age 1 and 2 agreements are 52 and 47% respectively. Analysis only for advanced readers improves very little with respect to all readers (58%).

Analysis referring to experts group shows also an overall agreement low of 59%, and analysis of WKARA2 readers group (all and experts) shows an overall agreement of 64% and 63%, a little bit higher than the agreement between all readers. Analysis only done with the Strait of Sicily readers group (2 readers), being also the advanced readers of this stock, shows the highest overall agreement of 96% (**Table 6.3.1**).

The analysis including all age readers revealed a very high overall coefficient of variation (CV) of 59% (**Table 6.3.1 and Figure 6.3.1**). CV peaked at 62% for modal age 1 (the CV was not calculated at age 0). Overall CV for the Strait of Sicily readers group was 9%, for the expert group was 57%, and for the WKARA2 readers group (all and expert) 57 and 56% respectively. Strait of Sicily readers shows lower CV at ages 2 (3%). In all readers groups the highest CVs were at age 1. Therefore the results show that there is strong consistency (PA=96%) between the 2 stock readers in this area, but the consistency among the readers within any other group drops down to a maximum PA of 64%; this means that these otoliths seem difficult allowing ample ranges of different interpretations for the readers of the exchange.

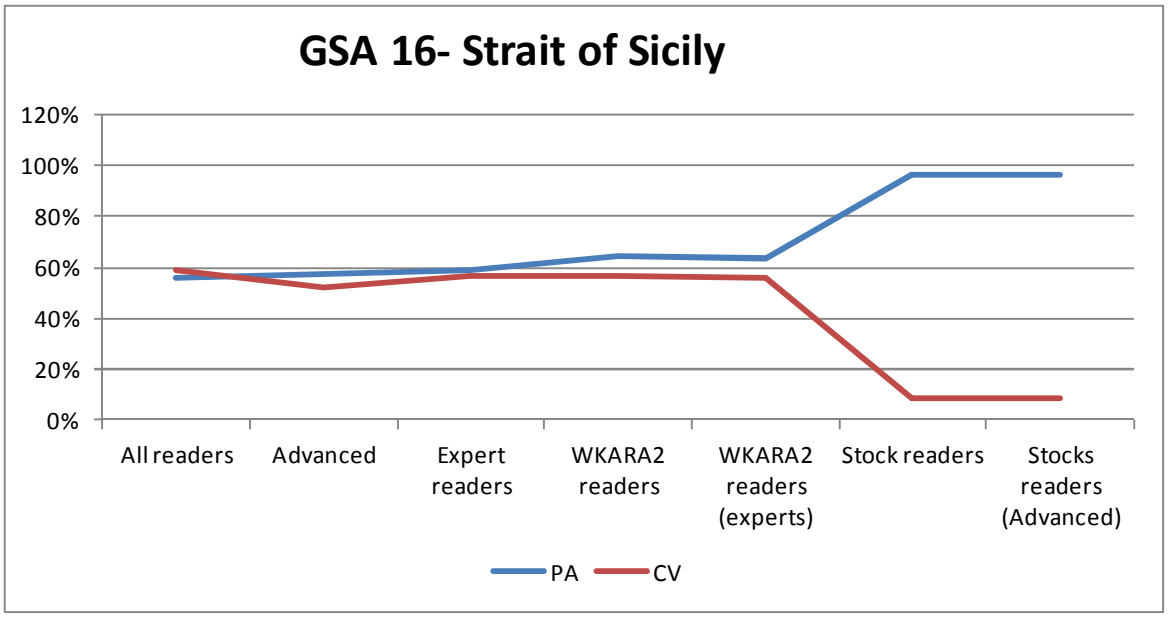


Figure 6.3.1: GSA 16. Percentage of agreement (PA), Coefficient of variation (CV) by readers group.

Table 6.3.1: GSA 16. Summary of the average percentage of agreement (PA), Coefficient of variation (CV) and relative bias by age, by readers group

All readers

Modal Age	Otolith N	PA	CV	Bias
0	24	69.2%		0.38
1	45	51.5%	61.5%	0.24
2	11	47.1%	47.8%	-0.34
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
Total	**80**	**56.1%**	**58.8%**	**0.21**

Advanced

Modal Age	Otolith N	PA	CV	Bias
0	33	63.1%		0.47
1	38	55.1%	52%	0.32
2	9	47.7%	49%	-0.41
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
Total	**80**	**57.5%**	**52%**	**0.30**

Expert readers

Modal Age	Otolith N	PA	CV	Bias
0	20	71.2%		0.35
1	48	55.4%	61.0%	0.13
2	12	54.6%	38.6%	-0.38
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
Total	**80**	**59.2%**	**56.5%**	**0.11**

WKARA2 readers

Modal Age	Otolith N	PA	CV	Bias
0	28	73.1%		0.28
1	45	59.9%	59.0%	0.09
2	7	55.6%	42.2%	-0.51
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
Total	**80**	**64.1%**	**56.7%**	**0.11**

WKARA2 readers (experts)

Modal Age	Otolith N	PA	CV	Bias
0	23	74.3%		0.26
1	45	58.0%	60.5%	0.07
2	12	60.3%	37.2%	-0.43
3	-	-	-	-
4	-	-	-	-
5	-	-	-	-
Total	**80**	**63.1%**	**55.6%**	**0.05**

Stock readers

Modal Age	Otolith N	PA	CV	Bias
0	17	100.0%		0.00
1	32	95.3%	13.3%	-0.05
2	29	96.5%	3.3%	-0.04
3	2	75.0%	14.1%	-0.25
4	-	-	-	-
5	-	-	-	-
Total	**80**	**96.3%**	**8.8%**	**-0.04**

Stocks readers (Advanced)

Modal Age	Otolith N	PA	CV	Bias
0	17	100.0%		0.00
1	32	95.3%	13.3%	-0.05
2	29	96.5%	3.3%	-0.04
3	2	75.0%	14.1%	-0.25
4	-	-	-	-
5	-	-	-	-
Total	**80**	**96.3%**	**8.8%**	**-0.04**

Figure 6.3.2 shows age bias plots with the mean age recorded and the standard deviation of all readers combined plotted against the modal age by readers groups. **Annex 1** shows the age bias plot for each reader. Deviations from the modal age (solid line) can be seen for the all ages in most readers, some readers overestimating and other readers underestimating. In general, except for the stock reader group, in all other groups there is a tendency to overestimate age 0 and underestimate age 2.

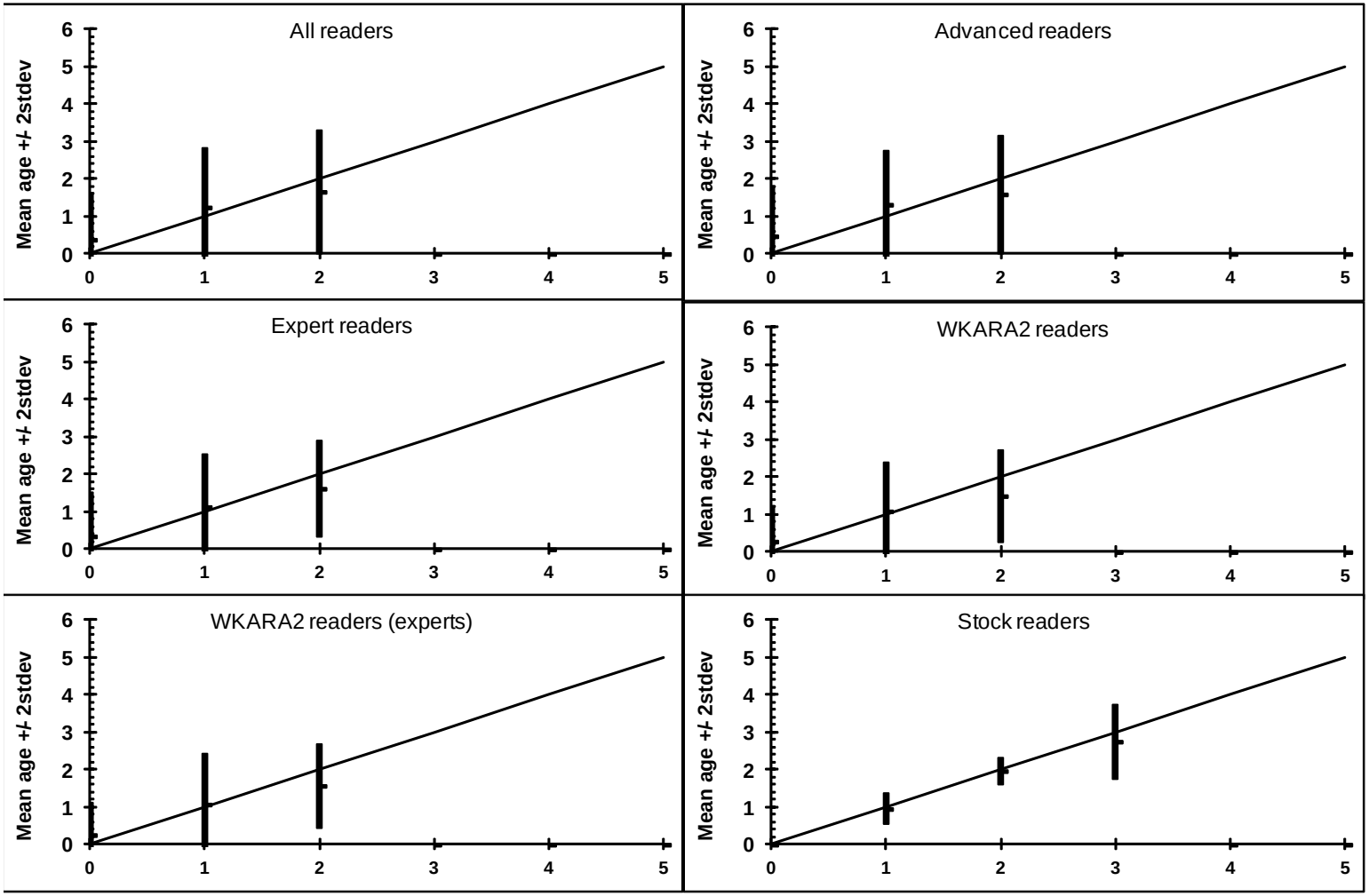


Figure 6.3.2: GSA 16. Age bias plot for all readers by readers groups. Mean age recorded +/- 2 stdev of each reader and all readers combined are plotted against modal age by group. The estimated mean age corresponds to modal age when the estimated mean age is on the 1:1 equilibrium line (solid line). Relative bias is the age difference between estimated mean age and modal age.

Age error matrices are calculated per area and only based on the age readings of the all advanced readers (**Table 6.3.2**) and stock advanced readers (those who provide age determinations for the assessment of this stock) (**Table 6.3.3**). The AEM based on the age readings of Strait of Sicily stock advanced readers (2 readers) in the 2018 exchange shows smaller errors compared to the AEM of all advanced readers, which corresponds with the higher percentage agreement in this exchange. All AEMs presented here assume modal age to be a close approximation of true age. In this exchange all readers, ages, seasons and areas are included in the assessment to obtain a realistic AEM. The two readers have a very high agreement with the modal age (above 90% in all ages) and with very small deviations (**Table 6.3.4**). Again this shows the high consistency for the two area stock readers and the larger discrepancies among all advanced readers.

Table 6.3.2: Age error matrix (AEM) for GSA16: AEM of all advanced readers (17) in the 2018 anchovy exchange. Modal age is assumed to be the true age.

strata	Modal age	Assigned age 0	Assigned age 1	Assigned age 2	Assigned age 3
GSA16	Age 0	**0.60**	0.10	0.10	-
GSA16	Age 1	0.30	**0.50**	0.30	-
GSA16	Age 2	0.10	0.30	**0.50**	-
GSA16	Age 3	-	0.10	0.10	**-**

Table 6.3.3: Age error matrix (AEM) for GSA16. : AEM of stock advanced readers (2 readers: R04 and R05) in the 2018 anchovy exchange. Modal age is assumed to be the true age.

strata	Modal age	0	1	2	3
GSA16	Age 0	**1.00**	0.05	0.00	0.00
GSA16	Age 1	0.00	**0.95**	0.04	0.00
GSA16	Age 2	0.00	0.00	**0.96**	0.25
GSA16	Age 3	0.00	0.00	0.00	**0.75**

Table 6.3.4: Age error matrix (AEM) for GSA16: AEM of each stock advanced readers (2 readers: R04 and R05) in the 2018 anchovy exchange. Modal age is assumed to be the true age

R04:

strata	Modal age	0	1	2	3
GSA16	Age 0	1.00	0.03	0.00	0.00
GSA16	Age 1	0.00	0.97	0.07	0.00
GSA16	Age 2	0.00	0.00	0.93	0.50
GSA16	Age 3	0.00	0.00	0.00	0.50

R05:

strata	Modal age	0	1	2	3
GSA16	Age 0	1.00	0.06	0.00	0.00
GSA16	Age 1	0.00	0.94	0.00	0.00
GSA16	Age 2	0.00	0.00	1.00	0.00
GSA16	Age 3	0.00	0.00	0.00	1.00

6.4 Age reading quality

Age reading quality was estimated by all readers. The **Table 6.4.1** presented the image number by the level of Age reading quality for each reader and all readers by all areas and by stock. 6% of total images were classified in the level AQ3 corresponding to difficult to age with acceptable precision. The readings of otoliths being qualified as very poor quality level (AQ3) were discarded from the analysis for the readers who gave such a bad qualification. Although the percentages of agreement were greater for the Bay of Biscay, more images of this stock were assigned with AQ3 than in the Strait of Sicily. Many readers (17) assigned at least one AQ3 in the Bay of Biscay (8%), except the stock readers who assigned all the otoliths as AQ1 and in smaller quantity as AQ2. In the case of the Strait of Sicily, although the otoliths seem more difficult to interpret, only 9 readers assigned at least one otolith as AQ3 (3%).

Table 6.4.1: Level of Age reading quality for each reader and all readers by all areas and by stock.

Level of Quality — **All areas**

	AU	IR	CD	SM	MP	AA	ED	GBD	CCH	JT	PT	SK	AG	DG	IF	VD	LC	ES	MP	GD	IC	LS	OK	RM	DF	Total	
Age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	**N**	**%**
AQ1	97	103	153	105	102	148	122	99	92	126	109	36	44	107	136	46	81	134	60	89	116	144	123	102	33	**2507**	**62.9%**
AQ2	62	57	7	38	44	12	36	58	58	29	44	113	97	33	21	95	64	25	71	69	30	16	37	55	81	**1252**	**31.4%**
AQ3				17	13			3	10	4	7	9	17	19	1	19	15	1	29	1	14			1	46	**226**	**5.7%**
Total	159	160	160	160	159	160	158	160	160	159	160	158	158	159	158	160	160	160	160	159	160	160	160	158	160	**3985**	

Level of Quality — **Ane.27.8**

	AU	IR	CD	SM	MP	AA	ED	GBD	CCH	JT	PT	SK	AG	DG	IF	VD	LC	ES	MP	GD	IC	LS	OK	RM	DF	Total	
Age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	**N**	**%**
AQ1	51	78	77	46	46	72	71	41	36	60	61	16	21	51	59	29	27	74	20	44	49	77	51	51	13	**1221**	**61.3%**
AQ2	28	2	3	18	21	8	8	36	34	16	15	53	41	20	19	39	41	6	44	34	18	3	29	28	37	**601**	**30.2%**
AQ3				16	13			3	10	4	4	9	17	8	1	12	12		16	1	13			1	30	**170**	**8.5%**
Total	79	80	80	80	80	80	79	80	80	80	80	78	79	79	79	80	80	80	80	79	80	80	80	80	80	**1992**	

Level of Quality — **GSA 16**

	AU	IR	CD	SM	MP	AA	ED	GBD	CCH	JT	PT	SK	AG	DG	IF	VD	LC	ES	MP	GD	IC	LS	OK	RM	DF	Total	
Age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	**N**	**%**
AQ1	46	25	76	59	56	76	51	58	56	66	48	20	23	56	77	17	54	60	40	45	67	67	72	51	20	**1286**	**64.5%**
AQ2	34	55	4	20	23	4	28	22	24	13	29	60	56	13	2	56	23	19	27	35	12	13	8	27	44	**651**	**32.7%**
AQ3				1							3			11		7	3	1	13		1				16	**56**	**2.8%**
Total	80	80	80	80	79	80	79	80	80	79	80	80	79	80	79	80	80	80	80	80	80	80	80	78	80	**1993**	

6.5 Comparison of the 2014 and 2018 exchanges: Improvement in the determination of age?

Comparing the results of Exchange 2018 with that of 2014 for all readers, there has been a small decrease of the level of agreement and a decrease of CV in those areas that were analyzed in the two exchanges, as can be seen in the **Table 6.4.1**. Only 11 readers of the participants in the 2014 exchange were also participating in the current exchange of 25 participants. The results of the recent exchange for those who participated in WKARA in the former meeting show no improvement (similar PA for the case of the Bay of Biscay and some decline of agreement in GSA16), with a bit greater variability --CVs -- in the two areas.

In the case of the Bay of Biscay anchovy no clear improvement is seen for the expert readers group nor for the readers who participated in the WKARA2 in 2016 (13 readers), where the otolith reading criteria bases were adopted for the age determination of the anchovy. For the stock readers there is no variation from one exchange to another with a high PA and low CV in the two exchanges.

For the anchovy of the Strait of Sicily there is no improvement, but perhaps slight decreases in the percentage of agreements (as reflected in the lower PA for the expert's readers). And for the readers who participated in the WKARA2 with small decrease and increase of CV respectively. For the stock readers the agreement is very high and CV is low in both exchanges, with some increase in the percentage of agreement occurring in the latest exchange.

Table 6.4.1. Summary of the average percentage of agreement and CV by sets from 2014 and 2018 Anchovy otolith Exchanges.

	2014				2018			
ANE_27.8	All readers	Expert readers	WKARA readers	Stock readers (Advanced)	All readers	Expert readers	WKARA readers	Stock readers (Advanced)
PA	74.3%	80.8%	81.4%	89.9%	71.1%	82.9%	81.3%	90.7%
CV	45%	22%	22%	10%	41%	26%	27%	9%
Bias	0.11	0.00	-0.03	-0.01	0.24	0.07	0.04	0.05

	2014				2018			
GSA 16	All readers	Expert readers	WKARA readers	Stock readers (Advanced)	All readers	Expert readers	WKARA readers	Stock readers (Advanced)
PA	58.5%	59.9%	70.9%	85.6%	56.1%	59.2%	64.1%	96.3%
CV	79%	74%	42%	11%	59%	57%	57%	9%
Bias	0.26	0.18	-0.01	-0.13	0.21	0.11	0.11	-0.04

Looking at the age compositions estimated by each age reader for the whole group (**Table 6.4.2**) it can be seen that some readers are interpreting the age structure of anchovy distinctly from the majority of readers. There seems to be a difference of criteria among some readers. In particular some readers of Mediterranean (R18, R20) and Atlantic areas (R22 and R28) tend to age older the fishes than the rest of the readers. None of these four readers participated in the WKARA2, two of them are advanced readers, that is, they give the age readings for the anchovy stock assessment, and none of them is qualified as an expert in reading anchovy otoliths.

To analyze in more detail if there has been an improvement or not of the readers who participated in the last WKARA2, in **Table 6.4.3** we can see the agreements and CVs between the readers that participated in the WKARA2 and the modal ages from the expert group readers (13 readers) for the two stocks.

In the Bay of Biscay, the agreement between seven WKARA2 readers and modal age is above 83%, four readers between 70-73 % and two readers 58% and 63% respectively. Of the readers with the lowest agreements (<73%) none are readers of the Bay of Biscay stock, they are the majority readers of Mediterranean area. From this it follows that a little less than half of the readers who participated in the WKARA2 still have problems with determining the age of anchovy or that they might maintain the criteria prior to those adopted in the WKARA2. The agreement between advanced stock readers of the Bay of Biscay and the modal age is between 83-94% (**Table 6.4.4**)

In the case of Strait of Sicily, the agreement between the WKARA2 readers and modal age is very variable between readers (of 44% and 70%) with a low agreement, none above 70% (**Table 6.4.3**). The agreement between Strait of Sicily assessment readers and modal age is below 70% (**Table 6.4.4**); the two readers for assessment have a very high internal consistency of 96% (both from the same institute) (see **Table 6.3.1**), and are the ones also having among the highest PA with the rest of all the expert readers (**Table 6.4.4**). Taking as example the low percentage of overall agreement for the area GSA16, this suggests that there is still quite much room for debate of the interpretation of the anchovy otoliths in the Mediterranean.

All this probably means that the criterion of reading the age of the anchovy adopted in the last workshop has not been well applied by the majority of the readers who participated in the WKARA2, including the readers that produce the ages for the stock assessment (although problems with SmartDots --see below-- may have also played a role).

In order to further examine results and understand the major source of discrepancies, it is postulated that if major difficulties arises from the application of the age determination rule in the cases of birthdate in the middle of the year then major discrepancies should occur in GSA16 during the first half of the year, but not so much during the second half of the year, whilst if discrepancies arise from both the general interpretation of the otolith and the application of the rule for a birthdate at the middle of the year, then major discrepancies would be evidenced all year around. Such analysis is made in **Table 6.4.5** and **6.4.6** for the Bay of Biscay and Sicily anchovy age readings respectively. For the Bay of Biscay general agreement relative to overall modal age reached about 71% in both halves of the year with CV a bit smaller in the first than in the second half of the year (37.6% versus 47.4%, **Table 6.4.7**). For the otoliths from Siciliy (GSA16) general agreement and CV were poorer in the first than in the second half of the year (PA 47% vs 65% and CV 70.5% vs 48% respectively) (**Table 6.4.7**). This suggests that for the strait of Sicily (GSA16) the fact that the birth date of 1st July makes the age determination rule to change at the middle of the year adds a substantial difficulty to the application of the rule during the first half of the year making the agreement and the CV to be poorer than in the second half of the year. Among the WKARA2 readers, there are two contrasting groups of readers during the first half of the year: those who allocated most of the fishes (more than 25 fishes) to age 0 (readers 1,2 10 & 11) and those who allocated just a minority (less than 10 fishes) to age 0 (readers 3-9, 12-13). This may effectively be an indication of an incorrect application of the age determination rule in the first half of the year for fishes with birthdate in July. But in addition, it may happen as well that the inability of SmartDot to properly assign the age according to the number of marks of true winter rings during the first half of the year for fishes with birthdate at the middle of the year might have amplified the discrepancies in age determination between readers. To overcome this inability of SmartDot it was advised to not mark the last winter ring for the otoliths of GSA16 from the first half of the year, but this recommendation might not have been well followed by all readers. Examples of otoliths showing this discrepancy between age determination 0 or 1 in the first half of the year in GSA16 appear in **Annex 6** in **Figures 13.1 to 13.3**. In

those examples, annotating or not the marked winter ring leads to age determinations 1 and 0 respectively. According to the rule if there is only a single winter mark then the age determination should be 0.

The poorer level of agreement in the second half of the year in GSA16 than in the Bay of Biscay may reflect as well larger difficulties in the age determination with those otoliths as mentioned in WKARA2. During the second half of the year the proportion of age 0 fishes assigned do not vary much between readers, but (among the WKARA2 readers) there are again two groups of readers: one gathering most of the remaining age determinations in age 1 (readers 1-2, 8-11 and 13) and the others (readers 3-7 and 12) spreading most of the remaining age determinations between ages 1 and 2. Examples of otoliths leading to these discrepancies appear in **Annex 6** in **Figures 13.4 & 13.5**. In those examples the interpretation of the marks close to the edge as winter marks or not leads to rather divergent age determinations. Therefore this is indicative of discrepancies in the interpretation of the growth pattern and marks. These kinds of discrepancies do also appear in otoliths of the Bay of Biscay area (see examples in **Annex 4 & 5)**.

The general conclusions of these results and analysis are:

a) No improvement can be noticed in WKARA2 readers in agreements or precision of age determination between the 2016 workshop and the 2018 exchange exercise.
b) The major problems generating the discrepancies seem to be similar to those highlighted in 2016 WKARA2: i) the incorrect application of the age determination rule in the first half of the year for fishes with birthdate in July (evidenced in poor agreements and high CV of the GSA16 otoliths in the first half of the year), coupled in this case with the inability of SmartDots to properly assign the age according to the number of marks of true winter rings during the first half of the year for fishes with birthdate at the middle of the year. And ii) discrepancies in the interpretation of the growth pattern and marks (reflected in the discrepancies appearing in the age determination in both areas of work).

Table 6. 4.2: The age composition estimated by each reader and all age reader combined by areas and total.

AGE COMPOSITION **All areas**

		AU	IR	CD	SM	MP	AA	ED	GBD	CCH	JT	PT	SK	AG	DG	IF	VD	LC	ES	MP	GD	IC	LS	OK	RM	DF	
	Age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	TOTAL
	0	66	57	30	22	26	30	29	20	19	57	65	15	25	65	38	59	15	23	15	44	54	50	41	52	16	**933**
	1	60	61	74	54	51	72	46	70	86	70	66	65	84	55	78	62	32	67	24	29	47	63	34	61	18	**1429**
	2	22	33	48	56	60	50	69	57	27	19	18	61	26	14	35	15	38	58	30	53	42	42	64	39	28	**1004**
	3	11	9	7	10	9	7	15	9	14	6	8	10	5	6	7	5	39	11	39	26	3	5	19	5	31	**316**
	4	1	-	1	1	1	1	1	1	3	-	-	-	3	-	1	-	16	-	17	5	-	-	2	2	19	**75**
	5	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	5	-	6	2	-	-	-	-	2	**16**
Total	**0-5**	**160**	**160**	**160**	**143**	**147**	**160**	**160**	**157**	**150**	**152**	**157**	**151**	**143**	**140**	**159**	**141**	**145**	**159**	**131**	**159**	**146**	**160**	**160**	**159**	**114**	**3773**
		0.88	**0.96**	**1.22**	**1.40**	**1.37**	**1.23**	**1.46**	**1.37**	**1.33**	**0.83**	**0.80**	**1.44**	**1.14**	**0.72**	**1.09**	**0.76**	**2.17**	**1.36**	**2.28**	**1.53**	**0.96**	**1.01**	**1.42**	**1.02**	**2.22**	**1.26**
DifMean		-0.38	-0.30	-0.04	0.14	0.11	-0.03	0.19	0.11	0.06	-0.43	-0.46	0.17	-0.12	-0.54	-0.17	-0.50	0.90	0.10	1.02	0.27	-0.30	-0.25	0.16	-0.24	0.96	

AGE COMPOSITION **Ane.27.8**

		AU	IR	CD	SM	MP	AA	ED	GBD	CCH	JT	PT	SK	AG	DG	IF	VD	LC	ES	MP	GD	IC	LS	OK	RM	DF	
	Age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	TOTAL
	0	21	19	16	4	7	16	18	6	7	20	18	4	11	21	13	20	4	11	4	14	18	19	16	23	6	**336**
	1	30	33	33	21	21	32	29	36	35	27	36	32	30	30	28	31	9	36	6	14	17	31	10	28	7	**642**
	2	17	19	23	29	31	24	24	27	13	19	18	28	16	14	30	12	10	28	8	27	29	26	36	22	8	**538**
	3	11	9	7	9	7	7	8	7	12	6	8	7	3	6	7	5	24	5	23	19	3	4	16	5	13	**231**
	4	1	-	1	1	1	1	1	1	2	-	-	-	3	-	1	-	16	-	17	4	-	-	2	1	14	**67**
	5	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	5	-	6	1	-	-	-	-	2	**15**
Total	**0-5**	**80**	**80**	**80**	**64**	**67**	**80**	**80**	**77**	**70**	**72**	**80**	**71**	**63**	**71**	**79**	**68**	**68**	**80**	**64**	**79**	**67**	**80**	**80**	**79**	**50**	**1829**
		1.26	**1.23**	**1.30**	**1.72**	**1.61**	**1.31**	**1.31**	**1.49**	**1.57**	**1.15**	**1.20**	**1.54**	**1.32**	**1.07**	**1.43**	**1.03**	**2.79**	**1.34**	**2.95**	**1.85**	**1.25**	**1.19**	**1.73**	**1.15**	**2.56**	**1.51**
DifMean		-0.24	-0.28	-0.21	0.21	0.11	-0.19	-0.19	-0.01	0.07	-0.35	-0.31	0.03	-0.19	-0.44	-0.08	-0.48	1.29	-0.17	1.45	0.34	-0.25	-0.32	0.22	-0.35	1.05	

Table 6.4.2 (cont.)

AGE COMPOSITION **GSA 16**

		AU	IR	CD	SM	MP	AA	ED	GBD	CCH	JT	PT	SK	AG	DG	IF	VD	LC	ES	MP	GD	IC	LS	OK	RM	DF	
	Age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	**TOTAL**
	0	45	38	14	18	19	14	11	14	12	37	47	11	14	44	25	39	11	12	11	30	36	31	25	29	10	**597**
	1	30	28	41	33	30	40	17	34	51	43	30	33	54	25	50	31	23	31	18	15	30	32	24	33	11	**787**
	2	5	14	25	27	29	26	45	30	14	-	-	33	10	-	5	3	28	30	22	26	13	16	28	17	20	**466**
	3	-	-	-	1	2	-	7	2	2	-	-	3	2	-	-	-	15	6	16	7	-	1	3	-	18	**85**
	4	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	5	**8**
	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	**1**
Total	**0**	**80**	**80**	**80**	**79**	**80**	**80**	**80**	**80**	**80**	**80**	**77**	**80**	**80**	**69**	**80**	**73**	**77**	**79**	**67**	**80**	**79**	**80**	**80**	**80**	**64**	**1944**
		0.50	**0.70**	**1.14**	**1.14**	**1.18**	**1.15**	**1.60**	**1.25**	**1.11**	**0.54**	**0.39**	**1.35**	**1.00**	**0.36**	**0.75**	**0.51**	**1.61**	**1.38**	**1.64**	**1.21**	**0.71**	**0.84**	**1.11**	**0.89**	**1.95**	**1.03**
DifMean		-0.53	-0.33	0.10	0.10	0.14	0.12	0.57	0.22	0.08	-0.50	-0.64	0.32	-0.03	-0.67	-0.28	-0.53	0.58	0.35	0.61	0.18	-0.33	-0.20	0.08	-0.15	0.92	

Table 6. 4.3: Percentage of agreement and CV between the readers and modal age by stock. Modal age corresponds to the modal age of expert readers (expert readers in orange). Cells in yellow correspond to the WKARA2 readers.

Modal age of Expert Readers

AU	IR	CD	SM	MP	AA	ED	GBD	CCH	JT	PT	SK	AG	DG	IF	VD	LC	ES	MP	GD	IC	LS	OK	RM	DF
R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT

ANE_27.8: Bay of Biscay (in yelow WKARA2 readers)

MODAL experts	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	**ALL**
PA	88%	91%	94%	70%	73%	95%	93%	83%	71%	92%	89%	58%	70%	83%	73%	63%	12%	76%	9%	49%	75%	73%	50%	71%	32%	71%
CV	24%	18%	14%	24%	20%	11%	18%	14%	35%	19%	19%	26%	29%	25%	22%	33%	20%	22%	18%	27%	27%	28%	27%	36%	26%	42%
Bias	0.00	-0.04	0.04	0.25	0.21	0.05	0.05	0.18	0.20	-0.03	-0.06	0.17	0.00	-0.17	0.16	-0.19	1.49	0.08	1.66	0.59	-0.09	-0.08	0.46	-0.11	1.12	0.21

ANE GSA16: Strait of Sicily (in yelow WKARA2 readers)

MODAL experts	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	**ALL**
PA	60%	65%	66%	69%	68%	65%	38%	46%	70%	44%	51%	58%	70%	55%	70%	59%	40%	45%	35%	40%	55%	64%	63%	46%	21%	54%
CV	69%	58%	27%	29%	30%	27%	28%	34%	33%	69%	69%	26%	32%	65%	38%	63%	28%	32%	26%	54%	60%	49%	40%	62%	39%	63%
Bias	-0.40	-0.20	0.24	0.25	0.28	0.25	0.70	0.35	0.21	-0.36	-0.49	0.45	0.10	-0.46	-0.15	-0.33	0.78	0.50	0.86	0.31	-0.20	-0.06	0.21	-0.01	0.93	0.15

Table 6.4.4: Percentage of agreement and CV between the readers and modal age by stock. Modal age corresponds to the modal age of expert readers (expert readers in orange). Cells in green correspond to the assessment readers for each stock

Modal age of Expert Readers

AU	IR	CD	SM	MP	AA	ED	GBD	CCH	JT	PT	SK	AG	DG	IF	VD	LC	ES	MP	GD	IC	LS	OK	RM	DF
R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT

ANE_27.8: Bay of Biscay (in green B&B assessment readers)

MODAL experts	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	**ALL**
PA	88%	91%	94%	70%	73%	95%	93%	83%	71%	92%	89%	58%	70%	83%	73%	63%	12%	76%	9%	49%	75%	73%	50%	71%	32%	71%
CV	24%	18%	14%	24%	20%	11%	18%	14%	35%	19%	19%	26%	29%	25%	22%	33%	20%	22%	18%	27%	27%	28%	27%	36%	26%	42%
Bias	0.00	-0.04	0.04	0.25	0.21	0.05	0.05	0.18	0.20	-0.03	-0.06	0.17	0.00	-0.17	0.16	-0.19	1.49	0.08	1.66	0.59	-0.09	-0.08	0.46	-0.11	1.12	0.21

ANE GSA16: Strait of Sicily (in green GSA16 assessment readers)

MODAL experts	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	**ALL**
PA	60%	65%	66%	69%	68%	65%	38%	46%	70%	44%	51%	58%	70%	55%	70%	59%	40%	45%	35%	40%	55%	64%	63%	46%	21%	54%
CV	69%	58%	27%	29%	30%	27%	28%	34%	33%	69%	69%	26%	32%	65%	38%	63%	28%	32%	26%	54%	60%	49%	40%	62%	39%	63%
Bias	-0.40	-0.20	0.24	0.25	0.28	0.25	0.70	0.35	0.21	-0.36	-0.49	0.45	0.10	-0.46	-0.15	-0.33	0.78	0.50	0.86	0.31	-0.20	-0.06	0.21	-0.01	0.93	0.15

Table 6. 4. 5: Ane. 27.8: The age composition estimated by each reader and all age reader combined by semester.

AGE COMPOSITION		Ane.27.8									Semester 1															
		AU	IR	CD	SM	MP	AA	ED	GBD	CCH	JT	PT	SK	AG	DG	IF	VD	LC	ES	MP	GD	IC	LS	OK	RM	DF	
	Age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	TOTAL
	0	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	2
	1	19	19	16	9	9	16	17	19	20	16	19	10	13	18	9	18	-	17	-	8	8	24	6	13	4	327
	2	12	12	16	17	19	16	14	13	7	13	13	20	10	11	22	7	4	17	2	11	22	13	19	20	4	334
	3	8	9	7	9	7	7	8	7	10	6	8	6	3	6	7	5	9	5	9	16	2	3	13	5	5	180
	4	1	-	1	1	1	1	1	1	-	-	-	-	3	-	1	-	14	-	15	4	-	-	2	1	9	56
	5	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	5	-	6	1	-	-	-	-	2	15
Total	0-5	40	40	40	36	36	40	40	40	38	36	40	36	29	35	39	30	32	40	32	40	32	40	40	39	24	914

AGE COMPOSITION		Ane.27.8									Semester 2															
		AU	IR	CD	SM	MP	AA	ED	GBD	CCH	JT	PT	SK	AG	DG	IF	VD	LC	ES	MP	GD	IC	LS	OK	RM	DF	
	Age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	TOTAL
	0	21	19	16	4	7	16	18	6	7	19	18	4	11	21	13	20	4	10	4	14	18	19	16	23	6	334
	1	11	14	17	12	12	16	12	17	15	11	17	22	17	12	19	13	9	19	6	6	9	7	4	15	3	315
	2	5	7	7	12	12	8	10	14	6	6	5	8	6	3	8	5	6	11	6	16	7	13	17	2	4	204
	3	3	-	-	-	-	-	-	-	2	-	-	1	-	-	-	-	15	-	14	3	1	1	3	-	8	51
	4	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	2	-	2	-	-	-	-	-	5	11
	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	0-5	40	40	40	28	31	40	40	37	32	36	40	35	34	36	40	38	36	40	32	39	35	40	40	40	26	915

Table 6. 4. 6: Ane. GSA 16: The age composition estimated by each reader and all age reader combined by semester.

AGE COMPOSITION		GSA 16			Semester 1																					
		AU	IR	CD	SM	MP	AA	ED	GBD	CCH	JT	PT	SK	AG	DG	IF	VD	LC	ES	MP	GD	IC	LS	OK	RM	DF	
	Age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	TOTAL
	0	31	25	4	8	9	4	1	-	1	35	32	1	2	29	11	28	1	1	1	20	25	19	14	2	1	305
	1	5	10	35	23	21	35	3	12	27	5	6	22	30	6	24	7	18	9	15	9	14	11	20	20	7	394
	2	4	5	1	9	10	1	30	26	9	-	-	14	6	-	5	2	13	23	9	7	1	10	6	17	14	222
	3	-	-	-	-	-	-	6	2	2	-	-	3	2	-	-	-	8	6	7	3	-	-	-	-	9	48
	4	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	5	8
	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	0	40	40	40	40	40	40	40	40	40	40	38	40	40	35	40	37	40	39	32	40	40	40	40	40	36	977

AGE COMPOSITION		GSA 16			Semester 2																					
		AU	IR	CD	SM	MP	AA	ED	GBD	CCH	JT	PT	SK	AG	DG	IF	VD	LC	ES	MP	GD	IC	LS	OK	RM	DF	
	Age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	ALL
	0	14	13	10	10	10	10	10	14	11	2	15	10	12	15	14	11	10	11	10	10	11	12	11	27	9	292
	1	25	18	6	10	9	5	14	22	24	38	24	11	24	19	26	24	5	22	3	6	16	21	4	13	4	393
	2	1	9	24	18	19	25	15	4	5	-	-	19	4	-	-	1	15	7	13	19	12	6	22	-	6	244
	3	-	-	-	1	2	-	1	-	-	-	-	-	-	-	-	-	7	-	9	4	-	1	3	-	9	37
	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
mean	0	40	40	40	39	40	40	40	40	40	40	39	40	40	34	40	36	37	40	35	40	39	40	40	40	28	967

Table 6. 4. 7. Summary of the average percentage of agreement (PA), Coefficient of variation (CV) and relative bias by age, by area and by half of the year for all readers group.

Bay of Biscay									
Semester 1					Semester 2				
Modal Age	Otolith N	PA	CV	Bias	Modal Age	Otolith N	PA	CV	Bias
0	-	-	-	-	**0**	18	79.0%	-	0.24
1	19	72.9%	47.7%	0.41	**1**	14	64.4%	54.9%	0.35
2	13	73.0%	31.2%	0.21	**2**	8	66.5%	34.2%	0.01
3	8	62.2%	23.8%	-0.01	**3**	-	-	-	-
4	-	-	-	-	**4**	-	-	-	-
5	-	-	-	-	**5**	-	-	-	-
Total	**40**	**70.7%**	**37.6%**	**0.25**	**Total**	**40**	**71.5%**	**47.4%**	**0.23**

Strat of Sicily									
Semester 1					Semester 2				
Modal Age	Otolith N	PA	CV	Bias	Modal Age	Otolith N	PA	CV	Bias
0	13	50.6%	-	0.62	**0**	11	90.9%	-	0.10
1	20	46.5%	76.1%	0.09	**1**	25	55.5%	49.8%	0.37
2	7	43.1%	54.4%	-0.32	**2**	4	54.2%	36.4%	-0.39
3	-	-	-	-	**3**	-	-	-	-
4	-	-	-	-	**4**	-	-	-	-
5	-	-	-	-	**5**	-	-	-	-
Total	**40**	**47.3%**	**70.5%**	**0.20**	**Total**	**40**	**65.5%**	**47.9%**	**0.22**

6.6 SmartDots experience

The SmartDots program functioned reasonably well for viewing and annotation of otolith images. The participants know that it is a new application and its use will be better in the upcoming years.

The feedback file with possible improvements in the SmartDots made with readers and administrators who have already used the SmatDots in 2018 is uploaded to the sharepoint of the WGBIOP2018:

• It would be useful from the point of view of the administrator, but also of the reader, that the color of the mark be assigned randomly for each reader, and that it is different to the color of the annotation line. On the other hand the size of the mark changes according to the magnification of the image, it would be useful to keep the size chosen by the reader in all the images

• It would be very useful for the readers to see the measures of the annotations, since in some cases to distinguish false rings (especially the 1st ring) they use validated measures. Now readers do it by comparing a rule about calibrated scale bar.

• Include in the viewer the agreed birth date for the species so that readers do not depend on "memory"; for example, next to the capture date in the sample part.

• Add in the manual, be very careful when pinning the line so that it reaches the end of the otolith and for the longer part, otherwise the readers have problems adding their annotations if the line does not reach the edge.

• It also seems that it could be useful distinguish the images in which the annotations have been approved by the reader (for example another color in the File part). In this way, it would be easy for the reader to visualize what is done or not, and thus no annotations without approval would be left or double readings by same user.

• Given that age class 0 appears by default in the readings, there is no way to differentiate when considering an illegible otolith (which should be left blank) from an otolith age class 0 with little security (AQ3). It should be possible to select another AQ- "illegible" that left the Age field blank.

•The response of the software when changing contrast/brightness of the image is very slow, and that matters when you have to adjust almost all images. In fact, default values of brightness and contrast hide most of hyaline edges, so it was necessary for me to modify contrast/brightness almost always.

We want to emphasize essential improvements:

- Be able to change the birthday date in the software. Currently SmartDots automatically give the age of the fish based on the number of ring annotations that you make; this implies that SmartDots already has a pre-established birthday date (1st of January). This has been a problem in the case of the anchovy from Mediterranean area (birthday on 1st of July) and it was necessary to leave the last winter ring unmarked so that the automatic age determination agreed with the one corresponding with birthday date on July 1. This implied that for otoliths from the first half of the year it was not possible to compare the position of the winter rings which were not annotated with other area results.

- Flexible results extraction, depending on the needs of each stock and that can be obtained directly by the administrator / coordinator of the exchange / calibration / workshop:

  -By area and stock

  - By readers / groups of readers that the administrator selects, not only the advanced readers:

For it we suggest that a set of readers plus a stock(or area) can be selected by the coordinator (administrator) to produce a separate analysis and report.

6.7 Discussion

Within the participating institutes the methods of treatment of the otoliths before reading are relatively well standardized. Most institutes are reading whole otoliths embedded in resin, and some, immersed in water or ethanolic solution (70 %). In this exchange images of otoliths were used which were treated with the same methods. Exclusively using images has of course the disadvantage that the readers are not able to re-adjust the sharpness on different levels of the otoliths which can make the interpretation more difficult.

The exchange was carried out by using the SmartDots application and made the whole exchange process quite easy, although some problems were found for being the first time this program was used, as detailed in Section 6.6 and also because birthdate in the middle of the year was a priori not considered in the procedure of age allocation in this program (see former section).

In this exercise, for the two areas and all readers the average percentage of agreement (64%) and CV (50%) is not satisfactory. Most of the anchovy otoliths were not well aged by some of the readers during the 2018 exchange. Only 2 out of the 160 otoliths reached 100% of agreement. For the Bay of Biscay, the results of the expert group and WKARA2 readers improved compared to those of intermediate & training group, but for the Strait of Sicily no improvement is noticed. For the two regions, the results of the stock readers group are better (higher % agreement and lower CV) than the other groups of readers (including expert group). This may mean that there are some different criteria reading of the experts of the two areas with the rest of readers, so that only when comparing the readers of the same area results show greater accuracy because they all follow the same age determination criteria. This reflect also that they are more familiar with the otoliths of their respective areas. Possibly the greater agreements in the age readings for the Bay of Biscay anchovy, compared with the other set, may also be linked to a more pronounced formation of marks (as mentioned in WKARA2) and the fact that the birthdate of first of January make the application of the age determination rule easier. In the case of Strait of Sicily some readers were not familiar with the application of the age determination rule for fishes of birthdate at the middle of the year. In addition the great accuracy of the stock area readers is facilitated by the fact that there are only two readers and of the same institute and therefore would have very consistent criteria. For instance, if the Tunisian readers would have been incorporated in the analysis of the GSA16 (as area-stock readers) (even though they work with a neighbour area GSA 12-13) the PA would drop to 78%.

The results of the recent exchange for all readers show very similar levels (just a minor decline) of agreement and a slight improvement in the CV (a bit lower variability) in the two areas comparing with the 2014 Exchange. Although for the case of the Bay of Biscay anchovy a minor improvement can be seen for the expert readers group, this is not observed for the readers who participated in the WKARA2 in 2016, therefore no improvement in the age determination can be deduced to have happened between the two exchanges

The analysis of distance of winter marks from the core of otolith in the both areas show that globally the winter rings are similarly placed by most readers. This means that the growth pattern is being commonly identified in both areas (with some higher discrepancies in the Bay of Biscay).

The age compositions estimated by each age reader show that some readers are assigning ages of anchovy distinctly from the other readers. None of these readers participated in the last workshop. There is a group of readers who

tend to age younger ages while another group tend to assign older ages which in addition are spread out over a wider range of ages.

In the current exchange exercise there can be several reasons that might explain the agreement and discrepancies appearing in the exchange: A major reason (already mentioned in the 2016 workshop) could be the difficulty of correctly applying the age determination rule for the first half of the year to fishes with birthdate in July (GSA16Anchovy). This might have been amplified in the 2018 exercise because of the inability of SmartDots to properly assign the age according to the number of marks of true winter rings during the first half of the year for fishes with birthdate at the middle of the year (because Smartdots presumes that birthdate is 1st January). In addition, the reasons already highlighted in last exchange / workshop are still appearing now, as for instance: a) Difficulties in differentiating between true annual rings and false rings (or checks), b) Insufficient typical annual growth pattern recognition and insufficient criteria regarding the otolith edge that can be expected to be seen along the year.

Individual otolith cases of disagreement and their examination is shown in **Annex 4, 5 and 6**. These Annexes show images of otoliths resulting in divergent annotations/interpretations. In **Annex 4 and 5** examples of otoliths with all readers from all areas are shown. In **Annex 6** the annotations of the selected otoliths are shown only for the stock readers from the Bay of Biscay and Strait of Sicily to evidence the difficulties/discrepancies in the application of the age determinations rule during of the first half of the year according to the different birthdates. In the latter case these readers were selected to reduce the potential variability in the interpretations, letting aside readers not familiar with these otoliths. Readers interested in complete information on the individual readers' annotations of all images in the exchange can consult them in the following link: https://smartdots.ices.dk/manage/ViewEvent?tblEventID=81. In this link you can click on each image and you will see the annotations of all the readers and each reader of the selected image (SmartDots > Manage events and users > View event > View Image Annotations).

Globally the former discussion recalls on the need to review the convenience of setting date of birthdate at the middle of the year for anchovies in some Mediterranean areas and to consider to move it to 1st January, because of the difficulties perceived during the exchange on the application of a changing rule for the first and second halves of the year (as associated to birthdate 1 July) for the stocks in the northern hemisphere (where winter marks are laid down around January-February) and also for simplicity and coherence in naming age classes in correspondence with the year classes used in most of the assessments, based on natural calendar year (Jan-Dec). In addition this adds difficulties when organizing exchanges and workshops because readers are familiar with one or another way of applying the age determination rules for allocating otoliths to age groups and this tend to increase the discrepancies in age determinations resulting in lower PA and greater estimates of CVs in this exercises.

Data of these age calibration provide an uncertainty measure of the age assignments. Age Error Matrices (AEM) were constructed. The error matrix gives the probabilities that a sampled fish of assigned age *a* corresponds to any true age. 'True age' is assumed to be modal age. As AEM is calculated based on modal age then it will reflect the variance in age readings and not a potential (absolute) bias. To obtain a good estimate of the actual age reading uncertainty in a stock assessment it is important that all age readers who supply data to the assessment participate in these exchanges. Furthermore, the exchange set should cover all ages, seasons and areas included in the assessment adequately (ICES, 2018b). All the advanced readers of each stock have participated in this exchange, and the samples covered all sizes / ages and seasons of the year.

Error matrices produced from this exchange provide a general idea of the magnitude and statistical distribution of the errors in age determination for the two stocks analyzed here. Ageing errors affect all the input data to the assessment which are structured by age: catch-at-age, age-structured abundance indices, mean fish weight-at-age, proportion mature-at-age.

There is a major contrast in the level of errors shown by the AEM matrixes based solely on the stock readers and those based on the entire set of expert readers. This is indicative of the unsolved issues on the age determination of the anchovy. The Error matrices require that that true age is known, but this is not correct for the current status of knowledge on anchovy age determination. The fact that there are groups of age determination some producing far younger/older age distribution than the others, even within the expert group of readers, gives a warning on the reliability of the modal age as true age. At this stage of knowledge, the actual problem for assessment is not so much the dispersion around modal age but to clarify the correct age determination procedure. The age determination criteria adopted in WKARA 2016 tend to age younger ages than previously suspected in many Mediterranean areas, as a result of a better understanding of the anchovy growth pattern and the typical false marks (checks) occurring throughout the first years of growth. In addition the correct application of the rule in the first half of the year for fishes with birthdate in July also lead to younger age determination compared to those not properly applying the rule. Therefore the implications in terms of assessment can be far greater than those shown by the current Age (AEM) Error Matrices solely based on the stock readers.

Given the difficulties of the anchovy otolith readings in many places of the Mediterranean Sea and taking as reference the Bay of Biscay anchovy where several workshops and exchanges have regularly taken place (since 1989) (and age validations are achieved), WKARA2 suggest threshold values of agreements around 80% and of CVs around 20% in the training process as a minimum for age readers to be operative to deliver inputs for assessment. And targets should be for agreements above 90% and CV of 10% or less. The results of this exchange 2018 are in the levels of the objectives of agreement and CV of the readers for stock assessment, for the readers of the two areas analysed Bay of Biscay and Strait of Sicily stocks. However, the discrepancies outlined among the stock readers and the rest of the WKARA2 readers do not allow inferring that the age determinations are accurate in particular for those areas where no validation of age determination is already achieved (as in GSA16). Therefore standardization and validations are compulsory for a proper quality checking of the accuracy of age determinations.

In general, it seems that the experience of readers determines the interpretation they make of the otolith structure and the level of agreement achieved with the rest of expert readers. It is therefore recommended, as far as possible, that only the age readings of the most expert readers are used for the assessment inputs and second that new readers pass a training processes from validated set of otoliths of the area they have to work with. There has not been any improvement in the agreements among the readers who participated in the WKARA2 in comparison with the 2014 exchange exercise. This means that despite the importance of participating in the workshops where the agreements / disagreements of the previous exchanges and the growth pattern are analyzed and the interpretation criteria are agreed, this might not be enough. Validation and Production of a collection of age validated otoliths by areas (or at least of agreed age determination by experts) is recommended for the purposes of helping in the training of new age readers and for keeping/fixing the agreed criteria among the expert readers as well. Certainly these results stress the great relevance of having regular exchanges, both internally and externally, to learn and to improve the agreements between readers across and within areas, but also of validation studies and setting up agreed collection of otoliths.

In spite of not having met the quality standars for age determination agreed in WKARA2, and of not having noticed any improvement vs the 2014 exchange, it seems that many readers and mainly those who attended the WKARA2 tend to follow the same growth pattern in the otoliths of the two areas when interpreting the winter marks. This is supported by the rather high consistency achieved in the analysis of distance of winter marks from the core of otolith in the both areas. For the future the most problematic issue which requires to be improved is the application of the age determination rule, although there are still some readers who need improving as well the discrimination between of actual winter marks and checks and to understand the correct annual growth pattern.

6.8 Conclusion

- Overall agreement between all readers and areas is very low, 63.6%. CV= 49.5%, very similar (slightly lower) than in 2014 (PA=65.5;CV=58.2%)
- By stock, the agreement with the modal age of all readers was low (between 56 and 71%) and CV was high (between 47 and 59%)
- In the case of the advanced and expert group, agreements and CVs are variable, depending on the stock, showing the highest agreement in the ane.27.8 stock (which results in 76% and 83% of agreement and CVs of 38% and 26% respective to the advanced and expert group).
- The results of the stock readers group are much better than the other groups of readers (including advanced and expert group), for Bay of Biscay readers and Strait of Sicily readers (91% & 96% of agreement; CV of 9% & 9%, respectively, although in the latter area only two readers of the same institute participate on this stock).
- The analysis of distance of winter marks from the core of otolith in the both areas show that globally the winter rings are similarly placed by most readers. This means that the growth pattern is being commonly identified in both areas (witha some higher discrepancies in the Bay of Biscay).
- Comparing the results of Exchange 2018 with that of 2014 for all readers, there has been a small decrease of the overall level of agreement and a decrease of CV in those areas that were analyzed in the two exchanges. For the Bay of Biscay stock readers there is no variation from one exchange to another with a high PA and low CV in the two exchanges. However, for the anchovy of the Strait of Sicily there is no improvement for the expert's readers. Restricting the comparison to those who participated in the 2014 exchange (and in WKARA) no improvement is seen either (similar PA for the case of the Bay of Biscay and some decline of agreement in GSA16), with a bit greater variability --CVs -- in the two areas. This leads to conclude that no improvement can be noticed in general in agreement and precision, nor for the all readers neither for the WKARA readers.
- There seems to be a difference of criteria among some readers (of Mediterranean R18, R20 and Atlantic areas R22 and R28) which tend to age older the fishes than the rest of the readers. None of these readers participated in the WKARA2, two of them are advanced readers, that is, they give the age readings for the anchovy stock assessment, and none of them is qualified as an expert in reading anchovy otoliths.
- The major problems generating the discrepancies seem to be similar to those highlighted in 2016 WKARA2: i) the incorrect application of the age determination rule in the first half of the year for fishes with birthdate in July (evidenced in poor agreements and high CV of the GSA16 otoliths in the first half of the year), coupled in this case with the inability of SmartDots to properly assign the age according to the number of marks of true winter rings during the first half of the year for fishes with birthdate at the middle of the year. And ii) discrepancies in the interpretation of the growth pattern and marks (reflected in the discrepancies appearing in the age determination in both areas of work).
- Error matrices produced from this exchange provide a general idea of the magnitude and statistical distribution of the errors in age determination for the two stocks analyzed here. The AEM based on the age readings of Bay of Biscay advanced readers (5 readers) and Strait of Sicily advanced readers (2 readers) in the 2018 exchange shows less variance and less skewness (compared to the all advanced readers AEM), which corresponds with the higher percentage agreement in this exchange. In the case of Bay of Biscay, reader 8 is the least accurate, especially at age 0 (38%), but the other 4 readers have a very high agreement

with the modal age (above 84% in all ages) and with very small deviations. The two readers of Strait of Sicily have a very high agreement with the modal age (above 90% in all ages) and with very small deviations. The Error matrices require however that that true age is known, but this is not correct for the current status of knowledge on anchovy age determination in GSA 16 where still no age validation is available and application of this AEM to correct catches at age may be premature at this stage.

- Production of a collection of age validated otoliths by areas (or at least of agreed age determination by experts) is recommended for the purposes of helping in the training of new age readers. A first collection of otoliths by areas/stock with agreed age assignment is already available in the Age Reader's Forum website (https://community.ices.dk/ExternalSites/arf/default.aspx) in the folder called '*Engraulis encrasicolus* Otolith Reference Collection'.
- And finally it is also recommended to have regular exchanges, both internally and externally, to learn and to improve the agreements between readers across and within areas.
- Further validation studies as suggested in WKARA2 (ICES 2016) are encouraged: Research by micro-increments counting on several selected otoliths by areas to validate first annual winter mark and Other Validations and corroboration methods (as progression of length frequency modes throughout time to track cohorts, Corroboration of inner consistency of age determination by following cohorts in catches and surveys and Studies on the seasonal formation of hyaline and opaque edges).
- In view of the current results and that there are new readers a new workshop might be considered for 2021 (**Annex 3**). Meanwhile, we recommend the readers to review and read the WKARA2 report (where there are many examples) and to review the collection of otoliths of reference which is in the Age Reader's Forum website (https://community.ices.dk/ExternalSites/arf/default.aspx) in the folder called '*Engraulis encrasicolus* Otolith Reference Collection'.

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8 Annex 1. Additional results

8.1 Results all readers

Data Overview

Table 8.1.1: Summary of statistics; PA (%), CV (%) and APE (%).

CV	PA	APE
55 %	62 %	40 %

Table 8.1.2: Data overview including modal age and statistics per sample.

Fish ID	Event ID	Image ID	length	sex	Catch date	ICES area	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	Modal age	PA %	CV %	APE %
1969	81	904	123	-	19/04/2017 00:00:00	27.8.c	1	1	1	1	1	1	1	1	1	1	1	1	1	-	1	1	2	1	2	1	1	1	1	1	1	1	92	26	14
1970	81	905	130	-	05/06/2017 00:00:00	27.8.c	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	1	1	1	1	1	1	1	92	26	14
1971	81	906	133	-	05/06/2017 00:00:00	27.8.c	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	1	1	1	1	1	1	1	92	26	14
1972	81	907	135	-	05/04/2017 00:00:00	27.8.c	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	3	1	1	1	1	1	1	1	92	48	25
1973	81	908	137	-	19/04/2017 00:00:00	27.8.c	2	2	2	2	2	2	-	2	3	2	2	-	2	1	2	1	3	2	3	3	2	2	2	1	2	2	70	28	16
1974	81	909	147	-	19/04/2017 00:00:00	27.8.c	2	2	2	2	2	2	2	2	3	2	2	3	2	1	2	1	3	2	3	4	2	3	2	1	2	2	64	32	22
1975	81	910	148	-	31/05/2017 00:00:00	27.8.c	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	4	2	2	1	2	2	2	1	72	55	41
1976	81	911	151	-	19/04/2017 00:00:00	27.8.c	2	2	2	2	2	2	2	2	3	2	2	2	2	1	2	1	4	2	4	3	2	1	2	2	3	2	68	35	23
1977	81	912	154	-	05/06/2017 00:00:00	27.8.c	1	1	1	3	1	1	1	1	2	1	1	1	2	1	-	1	4	1	4	2	2	1	1	2	0	1	62	65	50
1978	81	913	156	-	05/06/2017 00:00:00	27.8.c	2	2	2	2	2	2	2	2	3	2	2	3	2	2	2	1	4	2	4	3	2	2	2	2	3	2	72	30	22
1979	81	914	157	-	05/06/2017 00:00:00	27.8.c	1	1	1	1	1	1	1	1	1	1	1	1	2	1	2	1	4	1	4	1	1	1	1	1	0	1	80	70	43
1980	81	915	162	-	05/06/2017 00:00:00	27.8.c	1	1	1	1	1	1	1	1	1	2	1	2	3	1	2	1	5	1	5	1	2	1	3	1	3	1	64	70	54
1981	81	916	162	-	16/03/2017 00:00:00	27.8.c	2	2	2	2	2	2	2	2	2	2	2	2	3	2	2	1	4	2	5	4	2	2	3	2	4	2	72	38	29
1982	81	917	168	-	05/06/2017 00:00:00	27.8.c	2	2	2	2	2	2	2	2	2	2	2	3	4	1	2	2	4	2	4	2	2	2	2	2	3	2	76	32	23
1983	81	918	170	-	16/03/2017 00:00:00	27.8.c	3	3	3	3	3	3	3	3	3	3	3	2	4	2	3	2	4	2	4	3	2	2	2	3	3	3	60	22	17
1984	81	919	172	-	31/05/2017 00:00:00	27.8.c	3	3	3	3	3	3	3	3	5	3	3	3	3	3	3	3	5	3	5	5	3	3	3	3	4	3	80	23	17
1985	81	920	172	-	16/03/2017 00:00:00	27.8.c	2	2	2	2	2	2	2	2	3	2	2	2	4	2	2	2	4	1	5	3	2	2	3	2	4	2	68	38	29
1986	81	921	179	-	31/05/2017 00:00:00	27.8.c	3	3	3	3	3	3	3	3	3	3	3	3	4	3	3	2	4	2	4	2	2	2	2	2	4	3	56	23	17
1987	81	922	181	-	31/05/2017 00:00:00	27.8.c	4	3	4	4	4	4	4	4	3	3	3	3	3	3	4	3	5	3	5	3	3	3	3	4	5	3	52	20	17
1988	81	923	188	-	16/03/2017 00:00:00	27.8.c	3	3	3	3	3	3	3	3	3	3	3	2	4	3	3	2	4	0	4	3	2	2	2	3	4	3	60	30	20
1989	81	924	59	-	06/10/2017 00:00:00	27.8.c	-	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	92	-	-
1990	81	925	89	-	06/10/2017 00:00:00	27.8.c	0	0	0	0	0	0	0	2	1	0	0	1	0	0	1	0	0	2	0	1	0	0	0	0	0	0	76	-	-
1991	81	926	102	-	23/10/2017 00:00:00	27.8.c	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	88	-	-
1992	81	927	106	-	23/10/2017	27.8.c	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	84	-	-

					00:00:00																																
1993	81	928	111	-	13/10/2017 00:00:00	27.8.c	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	84	-	-
1994	81	929	116	-	17/10/2017 00:00:00	27.8.c	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	1	1	1	0	0	0	0	0	1	0	76	-	-
1995	81	930	122	-	23/11/2016 00:00:00	27.8.c	0	0	1	1	1	1	0	2	1	0	0	1	1	0	1	0	1	1	1	2	0	0	0	0	0	0	48	-	-
1996	81	931	125	-	23/11/2016 00:00:00	27.8.c	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0	1	0	72	-	-
1997	81	932	133	-	09/10/2016 00:00:00	27.8.c	0	0	1	1	0	1	0	1	2	0	0	1	1	0	1	0	2	1	2	1	0	0	1	0	0	0	48	-	-
1998	81	933	134	-	09/10/2017 00:00:00	27.8.c	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	2	1	2	0	0	0	0	0	0	0	76	-	-
1999	81	934	135	-	09/10/2017 00:00:00	27.8.c	0	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	2	0	2	0	0	0	0	0	0	0	80	-	-
2000	81	935	138	-	23/11/2016 00:00:00	27.8.c	0	0	1	1	1	1	1	2	2	0	0	1	1	0	1	0	2	1	2	2	0	1	2	0	3	1	40	87	64
2001	81	936	140	-	22/10/2016 00:00:00	27.8.c	2	2	1	2	2	2	2	2	4	2	2	2	2	1	2	1	3	2	3	2	2	2	3	1	4	2	64	37	24
2002	81	937	144	-	23/11/2016 00:00:00	27.8.c	0	0	1	1	0	1	1	1	1	1	1	1	2	0	1	0	2	1	2	1	0	1	2	0	2	1	52	76	56
2003	81	938	150	-	23/11/2016 00:00:00	27.8.c	1	1	1	1	1	1	1	2	1	1	1	1	1	1	2	0	3	1	3	1	0	1	2	1	0	1	68	64	43
2004	81	939	151	-	23/11/2016 00:00:00	27.8.c	2	2	2	1	1	2	2	2	3	2	2	2	2	2	2	1	4	2	4	2	2	2	2	2	4	2	72	37	24
2005	81	940	154	-	09/10/2017 00:00:00	27.8.c	0	1	0	1	1	0	0	1	0	0	1	1	1	0	0	1	3	1	3	0	0	0	2	0	0	0	52	-	-
2006	81	941	155	-	23/11/2016 00:00:00	27.8.c	0	1	1	1	1	1	1	1	1	1	1	1	2	0	2	1	3	1	3	2	0	0	3	1	4	1	56	78	59
2007	81	942	156	-	09/10/2016 00:00:00	27.8.c	1	1	1	2	1	1	1	2	4	1	1	2	1	1	1	2	3	1	3	2	2	2	1	1	3	1	56	52	44
2008	81	943	162	-	12/10/2016 00:00:00	27.8.c	1	1	1	2	2	1	1	1	3	1	1	2	2	1	1	2	3	2	3	1	2	2	2	2	4	1	44	47	38
2528	81	1206	119	-	21/01/2016 00:00:00	16	0	0	1	1	1	1	2	2	1	0	0	1	1	0	0	0	1	1	1	0	0	0	-	1	1	1	50	96	83
2529	81	1207	128	-	21/01/2016 00:00:00	16	0	0	0	1	0	0	1	2	1	0	0	1	1	0	0	0	1	1	1	0	0	0	0	1	1	0	56	-	-
2530	81	1208	114	-	30/03/2016 00:00:00	16	0	0	1	0	0	1	2	1	1	0	0	1	1	0	0	0	1	2	1	0	0	0	0	0	1	0	56	-	-
2531	81	1209	124	-	30/03/2016 00:00:00	16	0	0	1	1	1	1	-	2	1	0	0	1	1	0	1	0	2	2	2	0	0	0	1	0	2	0	42	-	-
2532	81	1210	123	-	30/03/2016 00:00:00	16	0	0	1	1	1	1	-	2	1	1	0	1	1	0	1	0	1	2	1	0	0	0	1	1	2	1	54	83	67
2533	81	1211	104	-	23/05/2016 00:00:00	16	0	0	1	0	0	1	2	2	1	0	0	1	1	0	1	0	1	2	1	0	0	0	0	1	1	0	48	-	-
2534	81	1212	112	-	23/05/2016 00:00:00	16	0	0	1	0	0	1	2	2	1	0	0	1	1	0	1	0	1	2	1	0	0	0	0	2	2	0	48	-	-
2535	81	1213	114	-	23/05/2016 00:00:00	16	0	0	1	0	0	1	2	2	1	0	0	1	1	0	1	0	1	2	2	0	0	0	1	2	2	0	44	-	-
2536	81	1214	132	-	23/06/2016 00:00:00	16	0	0	1	0	1	1	2	2	1	0	0	1	1	0	1	0	2	2	2	0	0	0	0	2	2	0	44	-	-
2537	81	1215	100	-	28/01/2016 00:00:00	16	0	0	0	0	0	0	-	1	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	79	-	-
2538	81	1178	125	-	21/01/2016 00:00:00	16	0	1	1	1	1	1	2	2	1	0	0	2	2	0	1	0	1	2	1	2	0	1	1	1	2	1	48	71	52
2539	81	1179	121	-	21/01/2016 00:00:00	16	0	1	1	1	1	1	2	2	1	0	0	2	1	0	2	0	2	2	2	1	0	1	0	1	3	1	40	80	62
2540	81	1180	110	-	21/01/2016 00:00:00	16	0	0	1	1	1	1	2	2	1	0	0	1	1	0	1	0	1	1	1	1	0	1	0	1	2	1	56	81	64
2541	81	1181	108	-	21/01/2016 00:00:00	16	0	0	0	1	1	0	2	1	1	0	0	1	0	0	0	0	1	1	1	1	0	1	0	1	1	0	48	-	-
2542	81	1182	124	-	21/01/2016 00:00:00	16	0	0	0	1	1	0	1	1	1	-	0	1	1	0	0	0	2	1	2	0	0	0	0	1	2	0	50	-	-
2543	81	1183	160	-	21/01/2016 00:00:00	16	1	2	1	1	1	1	3	1	3	1	1	3	3	1	1	1	3	2	3	2	2	2	1	2	4	1	48	51	44
2544	81	1184	111	-	21/01/2016 00:00:00	16	0	0	1	1	1	1	2	1	1	0	0	1	1	0	0	0	1	1	1	0	0	1	1	1	2	1	56	85	72
2545	81	1185	117	-	30/03/2016 00:00:00	16	0	0	1	1	1	1	2	2	2	0	0	2	1	0	1	1	1	1	1	0	1	1	1	2	2	1	52	71	48
2546	81	1186	124	-	30/03/2016 00:00:00	16	0	0	1	1	1	1	2	2	2	0	0	1	1	0	1	1	1	2	1	0	1	1	1	2	3	1	52	76	52
2547	81	1187	127	-	30/03/2016 00:00:00	16	0	0	1	1	1	1	2	2	2	0	0	2	1	0	1	1	2	2	2	0	1	1	1	2	3	1	40	73	59

2548	81	1188	127	-	30/03/2016 00:00:00	16	0	0	1	1	-	1	2	2	1	0	0	1	1	0	1	1	2	2	3	0	1	1	1	2	3	1	46	80	60
2549	81	1189	108	-	23/05/2016 00:00:00	16	0	0	1	1	1	1	2	2	1	0	0	1	1	0	0	0	1	2	1	0	0	1	1	1	2	1	48	88	72
2550	81	1190	109	-	23/05/2016 00:00:00	16	0	0	1	1	1	1	2	2	1	0	0	1	1	0	0	0	1	2	1	0	0	0	1	1	2	1	44	95	80
2551	81	1191	116	-	23/05/2016 00:00:00	16	0	0	1	1	1	1	2	2	1	0	0	-	1	0	1	0	2	2	2	0	0	0	1	1	2	0	38	-	-
2552	81	1192	116	-	23/05/2016 00:00:00	16	0	0	1	1	1	1	2	2	0	0	0	2	1	0	1	0	2	2	2	0	0	0	1	1	2	0	40	-	-
2553	81	1193	117	-	23/05/2016 00:00:00	16	0	0	1	1	1	1	2	2	1	0	0	1	1	0	1	0	1	2	1	0	0	0	1	1	0	1	48	94	80
2554	81	1194	120	-	23/05/2016 00:00:00	16	0	1	1	1	2	1	2	2	1	0	0	2	2	0	1	0	2	2	2	1	0	0	1	2	3	2	36	77	65
2555	81	1195	123	-	23/05/2016 00:00:00	16	1	1	1	1	1	1	2	2	1	0	0	2	2	0	1	0	2	2	2	2	0	0	1	2	2	2	40	69	58
2556	81	1196	147	-	21/01/2016 00:00:00	16	1	1	1	2	2	1	2	2	2	1	1	3	3	1	1	1	3	3	3	4	1	2	2	2	3	1	40	47	38
2557	81	1197	145	-	21/01/2016 00:00:00	16	1	1	1	2	2	1	3	1	3	1	1	2	2	1	2	2	3	3	3	2	1	2	2	2	4	2	40	45	34
2558	81	1198	137	-	21/01/2016 00:00:00	16	2	2	2	1	1	2	3	3	4	0	1	2	2	1	2	2	3	3	3	2	1	2	2	1	3	2	44	46	32
2559	81	1199	144	-	30/03/2016 00:00:00	16	0	1	1	2	2	1	2	2	2	1	1	3	1	1	1	1	3	3	3	2	1	2	1	-	0	1	46	57	49
2560	81	1200	145	-	30/03/2016 00:00:00	16	2	2	1	2	2	1	3	2	2	0	1	2	1	1	2	1	3	3	3	3	1	2	2	2	3	2	44	44	34
2561	81	1201	145	-	30/03/2016 00:00:00	16	2	2	1	2	2	1	3	3	2	0	1	2	1	1	2	1	2	3	2	1	1	2	2	2	4	2	48	48	36
2562	81	1202	149	-	30/03/2016 00:00:00	16	2	2	1	2	2	1	3	1	2	0	1	2	2	1	1	0	3	3	3	1	1	2	2	2	4	2	40	55	44
2563	81	1203	139	-	23/06/2016 00:00:00	16	0	1	1	2	2	1	2	2	1	0	0	1	1	1	1	0	3	2	3	2	1	1	-	2	3	1	42	67	56
2564	81	1204	137	-	23/06/2016 00:00:00	16	0	1	1	2	2	1	2	1	1	0	0	2	1	1	1	0	2	2	2	3	1	2	1	1	3	1	44	65	53
2565	81	1205	139	-	23/06/2016 00:00:00	16	1	1	1	2	2	1	2	1	2	0	0	2	1	1	1	0	2	2	2	3	1	2	1	2	4	1	40	62	50
2566	81	1216	80	-	12/07/2016 00:00:00	16	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	92	-	-
2567	81	1217	69	-	12/07/2016 00:00:00	16	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	-	-
2568	81	1218	52	-	12/07/2016 00:00:00	16	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	-	-
2569	81	1219	59	-	12/07/2016 00:00:00	16	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	-	-
2570	81	1220	52	-	12/07/2016 00:00:00	16	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	-	-
2571	81	1221	60	-	12/07/2016 00:00:00	16	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	-	-
2572	81	1222	66	-	12/07/2016 00:00:00	16	0	0	0	0	0	0	-	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	-	-	0	0	95	-	-
2573	81	1223	77	-	12/07/2016 00:00:00	16	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	-	-
2574	81	1224	57	-	12/07/2016 00:00:00	16	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	96	-	-
2575	81	1225	49	-	12/07/2016 00:00:00	16	0	0	0	0	0	0	0	0	0	1	0	0	-	0	0	0	0	0	0	0	0	0	0	0	0	0	96	-	-
2576	81	1226	128	-	25/07/2016 00:00:00	16	1	1	2	1	2	2	2	1	2	1	1	2	1	1	1	1	2	1	3	1	1	1	2	0	3	1	56	49	42
2577	81	1227	121	-	25/07/2016 00:00:00	16	-	1	2	2	2	2	2	1	2	1	1	2	1	1	1	1	2	1	3	2	1	1	2	0	0	1	46	51	44
2578	81	1228	142	-	25/07/2016 00:00:00	16	1	1	2	1	1	2	2	1	1	1	1	1	1	1	1	1	2	1	2	1	1	1	2	1	3	1	72	42	35
2579	81	1229	122	-	25/07/2016 00:00:00	16	1	1	2	2	2	2	2	1	2	1	1	2	1	1	1	1	2	1	3	2	1	1	2	0	3	1	48	47	41
2580	81	1230	125	-	30/08/2016 00:00:00	16	2	1	2	2	2	2	2	1	2	1	1	1	1	0	1	1	2	1	2	3	1	1	2	0	3	1	44	52	45
2581	81	1231	122	-	30/08/2016 00:00:00	16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	1	2	2	1	1	1	0	2	1	76	50	24
2582	81	1232	121	-	30/08/2016 00:00:00	16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	2	1	92	29	8
2583	81	1233	129	-	30/08/2016 00:00:00	16	1	2	2	2	2	2	3	1	1	1	1	1	1	1	0	1	1	2	1	2	2	1	1	2	0	3	1	48	53	45
2584	81	1234	115	-	14/09/2016	16	0	0	1	1	1	1	1	0	1	1	0	1	0	0	0	1	1	1	1	2	0	0	1	0	1	1	56	89	80

					00:00:00																																
2585	81	1235	130	-	14/09/2016 00:00:00	16	1	1	1	1	1	2	1	1	1	1	1	2	1	1	-	1	2	1	2	2	1	1	2	1	3	1	71	42	35
2586	81	1236	117	-	14/09/2016 00:00:00	16	1	1	2	2	2	2	2	2	2	1	0	1	1	1	1	1	1	2	2	2	1	1	2	0	2	2	48	46	41
2587	81	1237	118	-	14/09/2016 00:00:00	16	0	0	1	1	1	1	1	0	0	0	0	1	0	0	0	1	1	0	1	1	1	0	2	0	1	0	48	-	-
2588	81	1238	127	-	14/09/2016 00:00:00	16	0	1	2	1	1	2	1	1	1	1	0	1	1	1	1	1	2	1	2	1	1	1	2	0	1	1	68	53	34
2589	81	1239	132	-	14/09/2016 00:00:00	16	1	2	2	1	1	2	2	1	1	1	1	2	2	1	1	1	2	1	2	3	1	2	2	1	3	1	52	42	37
2590	81	1241	135	-	28/11/2016 00:00:00	16	1	2	2	2	2	2	2	1	1	1	1	2	2	1	1	1	2	2	2	2	1	2	2	1	2	2	60	31	30
2591	81	1242	128	-	28/11/2016 00:00:00	16	0	0	1	1	1	1	1	0	1	0	0	1	1	0	1	0	2	1	2	1	0	1	0	0	0	1	48	100	88
2592	81	1243	143	-	25/07/2016 00:00:00	16	1	2	2	2	2	2	2	1	1	1	1	2	1	1	1	1	3	2	3	2	2	2	3	0	3	2	44	46	38
2593	81	1244	136	-	25/07/2016 00:00:00	16	1	2	2	2	2	2	2	1	1	1	1	2	1	1	1	1	3	1	3	2	2	2	2	0	2	2	48	44	38
2594	81	1245	147	-	25/07/2016 00:00:00	16	1	2	2	3	3	2	2	1	1	1	1	2	1	1	1	1	3	1	3	2	2	2	3	0	4	1	40	53	44
2595	81	1246	144	-	25/07/2016 00:00:00	16	1	2	2	2	2	2	2	1	1	1	1	2	1	1	1	1	4	1	3	5	2	3	3	1	4	1	44	58	43
2596	81	1247	155	-	25/07/2016 00:00:00	16	1	1	2	2	2	2	2	1	1	1	1	2	1	1	1	1	4	1	4	3	2	1	2	1	0	1	52	60	47
2597	81	1248	140	-	05/10/2016 00:00:00	16	1	1	2	2	2	2	1	1	1	1	1	2	1	1	1	2	2	1	2	2	2	1	1	1	2	1	56	35	34
2598	81	1249	152	-	05/10/2016 00:00:00	16	1	2	2	2	2	2	2	1	1	1	2	2	1	1	2	2	2	2	2	2	1	2	1	0	2	64	36	32	
2599	81	1250	151	-	05/10/2016 00:00:00	16	1	1	2	2	2	2	1	2	1	1	1	2	1	1	1	2	3	2	3	2	2	1	2	1	2	2	48	39	34
2600	81	1251	147	-	05/10/2016 00:00:00	16	1	1	2	2	2	2	1	2	1	1	1	2	1	1	1	1	2	1	3	2	2	1	2	1	2	1	52	39	36
2601	81	1252	141	-	05/10/2016 00:00:00	16	1	1	2	2	2	2	1	1	1	1	1	2	2	1	1	2	2	1	2	2	2	1	2	1	3	1	48	37	34
2602	81	1253	157	-	05/10/2016 00:00:00	16	1	2	2	2	2	2	1	1	1	1	1	2	1	1	1	1	3	1	3	2	2	2	2	1	0	1	48	47	41
2603	81	1254	138	-	05/10/2016 00:00:00	16	1	1	2	2	2	2	1	1	1	1	1	2	1	1	1	1	3	2	3	2	2	1	2	0	0	1	48	53	45
2604	81	1240	133	-	10/09/2016 00:00:00	16	1	1	2	2	3	2	2	0	1	1	1	1	1	1	1	1	3	2	3	3	1	1	2	0	2	1	48	57	49
2605	81	1255	135	-	05/10/2016 00:00:00	16	1	1	2	2	2	2	1	1	1	1	1	2	1	1	1	1	2	1	2	2	1	1	2	0	2	1	56	42	38
2648	81	1256	111	-	21/01/2016 00:00:00	16	0	0	1	0	0	1	2	1	1	0	0	1	1	0	0	0	1	0	1	1	0	0	0	1	1	0	52	-	-
2649	81	1257	100	-	21/01/2016 00:00:00	16	0	0	1	0	0	1	1	1	1	0	0	1	1	0	0	0	1	1	1	1	0	0	0	1	1	1	52	98	96
2650	81	1278	150	-	03/03/2017 00:00:00	27.8.b	3	3	2	3	2	2	3	2	2	3	2	2	2	2	3	3	4	3	4	3	2	2	2	2	2	2	56	26	23
2651	81	1279	144	-	03/03/2017 00:00:00	27.8.b	1	1	1	2	2	1	1	1	1	1	1	2	1	1	2	2	3	1	3	2	0	1	2	1	0	1	56	56	46
2652	81	1280	154	-	03/03/2017 00:00:00	27.8.b	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	4	2	4	2	2	1	2	2	3	2	76	32	20
2653	81	1281	152	-	03/03/2017 00:00:00	27.8.b	3	3	3	3	3	3	3	3	3	3	3	2	1	3	2	2	4	3	4	3	2	2	2	3	3	3	64	24	18
2654	81	1282	148	-	03/03/2017 00:00:00	27.8.b	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	3	4	2	4	4	2	2	3	2	4	2	72	34	27
2655	81	1283	142	-	03/03/2017 00:00:00	27.8.b	1	1	1	2	2	1	1	1	1	1	1	1	1	1	2	1	4	1	4	2	0	1	3	2	0	1	60	70	53
2656	81	1284	146	-	03/03/2017 00:00:00	27.8.b	1	1	1	2	-	1	1	1	1	1	1	2	1	1	2	3	4	2	4	2	0	1	3	2	3	1	50	61	50
2657	81	1285	151	-	12/04/2017 00:00:00	27.8.b	1	1	2	2	2	2	2	1	1	1	1	1	0	2	2	2	3	2	3	2	0	1	3	1	0	2	40	57	49
2658	81	1286	160	-	12/04/2017 00:00:00	27.8.b	3	3	3	3	3	3	3	3	3	3	3	3	2	2	3	3	2	5	3	5	3	2	2	4	3	5	3	64	28	17
2659	81	1287	149	-	12/04/2017 00:00:00	27.8.b	1	1	1	1	2	1	1	1	1	1	1	2	2	1	2	1	3	1	3	4	0	1	2	1	0	1	60	65	50
2660	81	1288	159	-	12/04/2017 00:00:00	27.8.b	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	3	5	2	5	2	2	1	4	2	4	2	72	44	31
2661	81	1289	157	-	12/04/2017 00:00:00	27.8.b	2	2	2	2	2	2	2	2	1	2	2	2	2	2	2	2	4	2	4	2	2	1	3	2	2	2	80	31	18
2662	81	1290	150	-	12/04/2017 00:00:00	27.8.b	1	1	1	2	2	1	1	1	1	1	1	1	0	1	2	1	4	1	4	3	0	1	2	1	0	1	60	76	56

2663	81	1291	155	-	12/04/2017 00:00:00	27.8.b	3	3	3	3	3	3	3	3	2	3	3	2	2	2	3	2	3	2	4	3	2	2	3	2	4	3	56	23	19
2664	81	1292	161	-	12/04/2017 00:00:00	27.8.b	1	1	2	3	3	2	1	1	1	2	2	2	0	1	3	2	4	1	5	3	0	1	3	1	0	1	36	70	56
2665	81	1293	154	-	22/06/2017 00:00:00	27.8.b	2	2	2	2	2	2	2	2	1	2	1	2	2	2	1	3	3	2	3	3	2	1	2	2	4	2	64	34	22
2666	81	1294	146	-	22/06/2017 00:00:00	27.8.b	1	1	1	2	2	1	1	1	1	0	1	1	1	1	2	1	4	1	4	1	1	1	3	2	4	1	64	69	54
2667	81	1295	149	-	22/06/2017 00:00:00	27.8.b	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	3	2	3	1	1	1	2	2	0	1	68	52	41
2668	81	1296	139	-	22/06/2017 00:00:00	27.8.b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	3	3	1	1	2	2	0	1	76	53	37
2669	81	1297	142	-	22/06/2017 00:00:00	27.8.b	2	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	2	1	3	3	1	1	2	2	4	1	52	49	41
2670	81	1259	132	-	12/08/2016 00:00:00	27.8.b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	3	2	1	1	2	1	2	1	80	48	35
2671	81	1260	145	-	12/08/2016 00:00:00	27.8.b	2	2	2	2	2	2	2	2	2	2	2	1	1	1	2	2	2	2	2	2	1	2	2	1	3	2	76	26	18
2672	81	1261	142	-	12/08/2016 00:00:00	27.8.b	1	1	1	2	2	1	2	2	1	1	1	1	1	1	1	1	3	1	3	2	1	2	2	1	0	1	60	51	42
2673	81	1262	135	-	12/08/2016 00:00:00	27.8.b	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	3	2	1	1	1	1	0	1	84	54	31
2674	81	1263	135	-	12/08/2016 00:00:00	27.8.b	3	2	2	2	2	2	2	2	3	2	2	1	1	1	2	2	4	2	4	2	2	2	2	0	4	2	64	44	28
2675	81	1264	131	-	12/08/2016 00:00:00	27.8.b	1	1	1	2	2	1	2	1	1	1	1	1	1	1	1	1	3	1	3	2	1	2	2	0	2	1	60	51	42
2676	81	1265	120	-	12/08/2016 00:00:00	27.8.b	2	1	2	1	1	2	2	2	2	2	1	1	-	0	1	1	2	2	2	2	0	2	2	0	2	2	58	49	43
2677	81	1266	144	-	01/09/2016 00:00:00	27.8.b	3	2	2	2	2	2	2	2	2	2	1	2	1	2	2	1	3	2	3	3	3	2	2	1	3	2	60	31	21
2678	81	1267	146	-	01/09/2016 00:00:00	27.8.b	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	2	3	3	2	2	2	1	3	2	76	22	16
2679	81	1268	140	-	01/09/2016 00:00:00	27.8.b	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	3	1	3	2	1	1	2	1	3	1	76	51	40
2680	81	1269	147	-	01/09/2016 00:00:00	27.8.b	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	3	1	3	3	1	2	2	1	3	1	68	52	44
2681	81	1270	119	-	18/10/2016 00:00:00	27.8.b	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	1	0	0	0	0	0	0	0	84	-	-
2682	81	1271	143	-	18/10/2016 00:00:00	27.8.b	1	1	1	2	2	1	1	1	1	1	1	1	1	1	1	1	2	1	2	2	1	1	1	1	2	1	76	35	29
2683	81	1272	126	-	18/10/2016 00:00:00	27.8.b	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	84	-	-
2684	81	1273	127	-	18/10/2016 00:00:00	27.8.b	0	0	0	1	1	0	0	0	1	0	0	1	0	0	1	0	1	0	1	0	0	0	0	0	0	0	72	-	-
2685	81	1274	148	-	18/10/2016 00:00:00	27.8.b	1	1	1	1	2	1	1	1	1	1	1	2	1	1	1	2	3	2	3	2	1	2	2	1	3	1	60	47	41
2686	81	1275	117	-	18/10/2016 00:00:00	27.8.b	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	84	-	-
2687	81	1276	135	-	18/10/2016 00:00:00	27.8.b	2	2	2	2	2	2	2	2	2	2	1	-	1	1	1	2	3	2	3	3	2	3	3	1	3	2	54	34	23
2688	81	1277	119	-	18/10/2016 00:00:00	27.8.b	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	-	0	0	0	0	1	0	79	-	-
2689	81	1258	133	-	18/10/2016 00:00:00	27.8.b	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	2	1	2	1	0	0	0	0	0	0	76	-	-

Table 8.1.3: Number of age readings table gives an overview of number of readings per reader and modal age. The total numbers of readings per reader and per modal age are summarized at the end of the table.

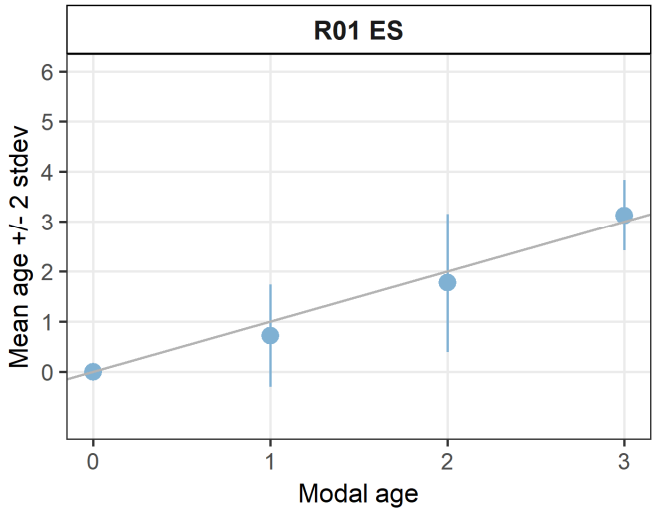
Modal age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT	total
0	41	42	42	42	42	42	39	42	42	41	42	41	41	42	42	42	42	42	42	41	42	42	41	41	42	**1040**
1	74	75	75	75	73	75	74	75	75	75	75	75	75	74	73	75	75	75	75	75	75	75	73	74	75	**1865**
2	35	35	35	35	35	35	34	35	35	35	35	33	34	35	35	35	35	35	35	35	35	35	35	35	35	**871**
3	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	**200**
Total	**158**	**160**	**160**	**160**	**158**	**160**	**155**	**160**	**160**	**159**	**160**	**157**	**158**	**159**	**158**	**160**	**160**	**160**	**160**	**159**	**160**	**160**	**157**	**158**	**160**	**3976**

Table 8.1.4: Age composition by reader gives a summary of number of readings per reader.

Modal age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R06 ES	R07 FR	R08 FR	R09 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R16 ES	R18 IT	R19 PT	R20 IT	R22 DE	R23 IT	R24 GB	R25 GR	R27 PT	R28 PT
0	65	57	30	26	29	30	27	20	23	56	65	20	27	67	38	60	15	23	15	43	67	50	38	51	**45**
1	59	61	74	62	56	72	46	73	89	72	69	68	90	71	77	67	32	67	28	29	48	63	34	61	**19**
2	22	33	48	60	62	50	66	57	28	22	18	60	30	15	34	25	43	58	40	53	42	42	64	40	**35**
3	11	9	7	11	10	7	15	9	16	9	8	9	6	6	8	8	41	12	47	27	3	5	19	5	**36**
4	1	0	1	1	1	1	1	1	3	0	0	0	5	0	1	0	24	0	22	5	0	0	2	1	**23**
5	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5	0	8	2	0	0	0	0	**2**
Total	**158**	**160**	**160**	**160**	**158**	**160**	**155**	**160**	**160**	**159**	**160**	**157**	**158**	**159**	**158**	**160**	**160**	**160**	**160**	**159**	**160**	**160**	**157**	**158**	**160**

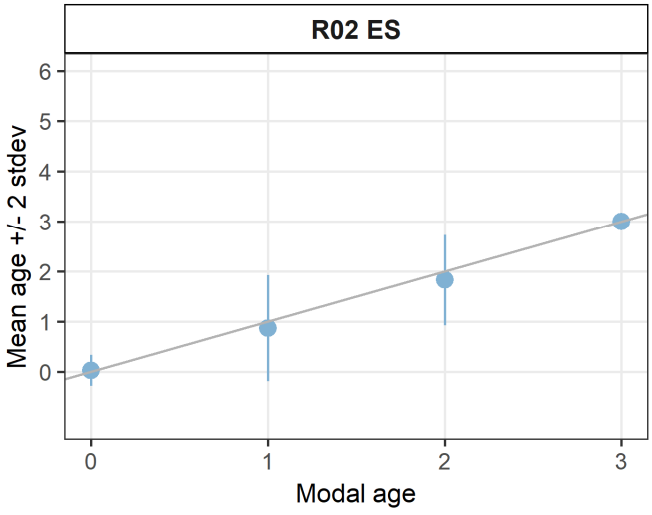
Table 8.1.5: Mean length at age per reader is calculated per reader and age (not modal age) and for all readers combined per age. A weighted mean is also given.

	R01	R02	R03	R04	R05	R06	R07	R08	R09	R10	R11	R12	R13	R14	R15	R16	R18	R19	R20	R22	R23	R24	R25	R27	R28
Age	**ES**	**ES**	**ES**	**IT**	**IT**	**ES**	**FR**	**FR**	**FR**	**ES**	**ES**	**TN**	**TN**	**HR**	**GR**	**ES**	**IT**	**PT**	**IT**	**DE**	**IT**	**GB**	**GR**	**PT**	**PT**
0	112	108	98	91	96	98	99	93	93	121	110	89	99	111	102	110	72	97	72	105	114	107	102	113	**118**
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	**mm**
1	142	140	133	129	129	133	140	135	133	129	142	128	132	142	134	139	117	135	116	130	135	137	129	135	**117**
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	**mm**
2	148	148	143	145	144	143	134	135	139	150	152	145	147	155	149	154	132	137	131	141	153	149	144	145	**129**
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	**mm**
3	159	167	168	163	162	168	156	162	159	167	170	162	164	172	167	158	145	152	143	150	166	156	154	168	**141**
	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	mm	**mm**
4	181	-	181	181	181	181	181	181	144	-	-	-	175	-	181	-	156	-	155	151	-	-	160	181	**154**
	mm		mm	mm	mm	mm	mm	mm	mm				mm		mm		mm		mm	mm			mm	mm	**mm**
5	-	-	-	-	-	-	-	-	172	-	-	-	-	-	-	-	167	-	166	158	-	-	-	-	**170**
									mm								mm		mm	mm					**mm**
Weighted	**132**	**131**	**131**	**131**	**131**	**131**	**132**	**131**	**131**	**131**	**131**	**131**	**132**	**131**	**131**	**131**	**131**	**131**	**131**	**131**	**131**	**131**	**132**	**132**	**131**
Mean	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**	**mm**

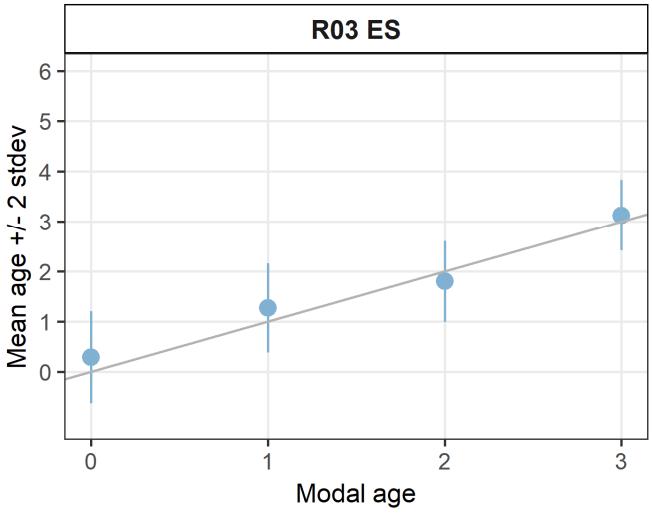

R01 ES
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

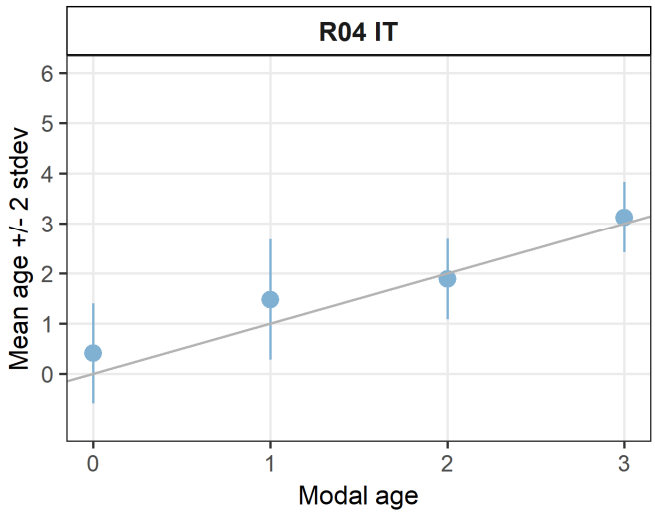
[[1]]

[[2]]


R02 ES
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

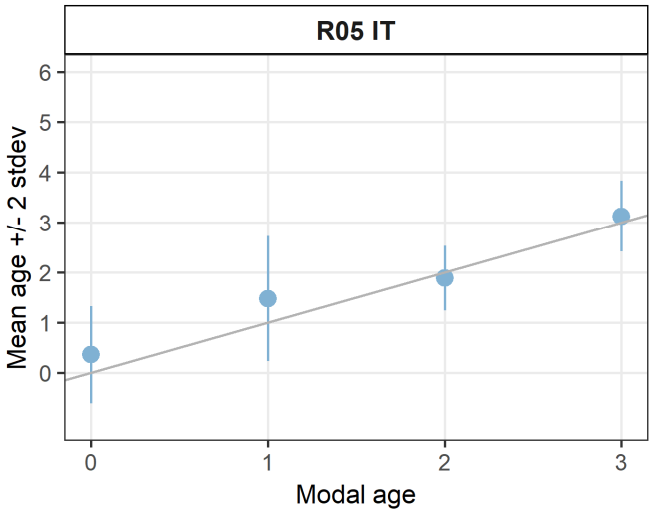
[[3]]


R03 ES
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

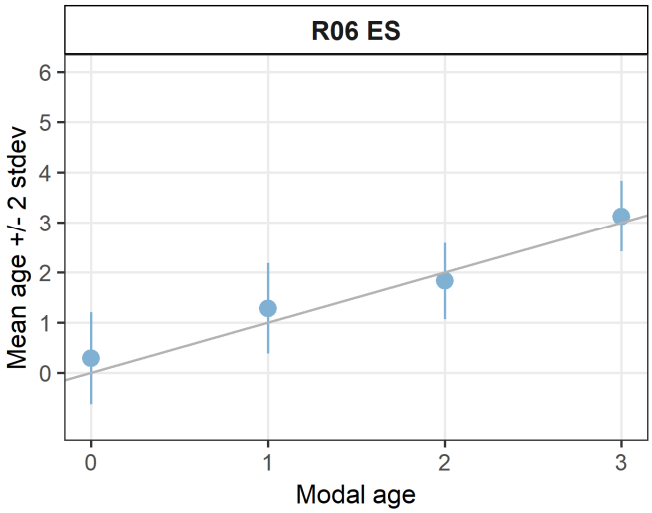

R04 IT
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

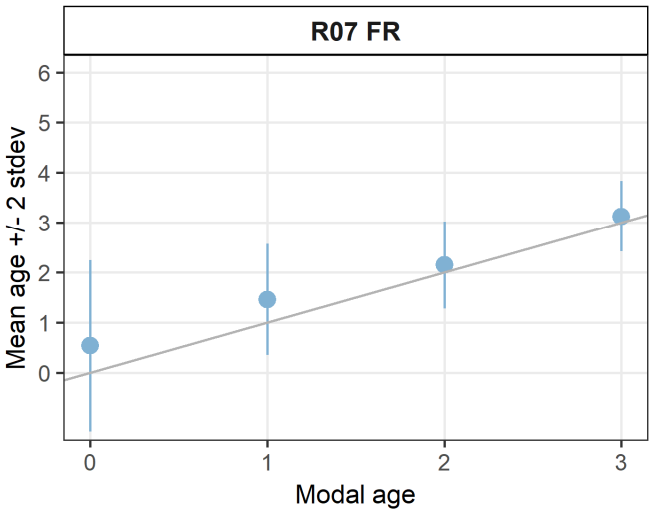
[[4]]

[[5]]


R05 IT
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

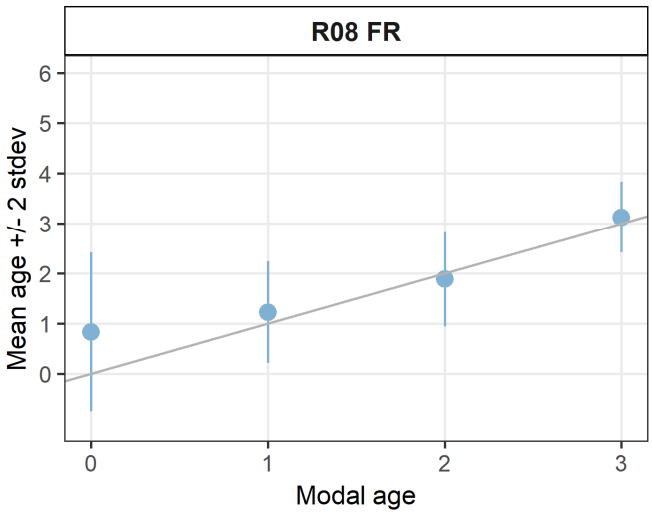
[[6]]


R06 ES
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

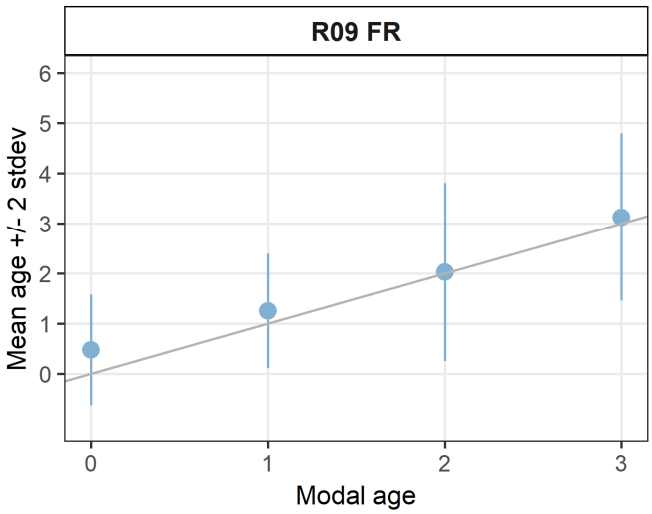

R07 FR
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

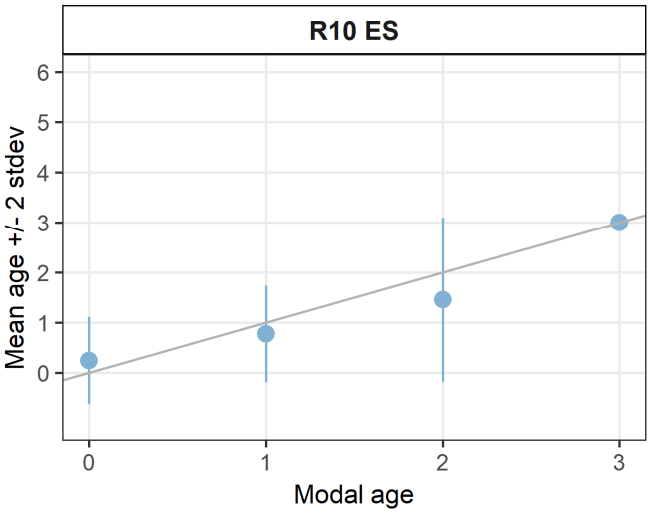
[[7]]

[[8]]


R08 FR
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

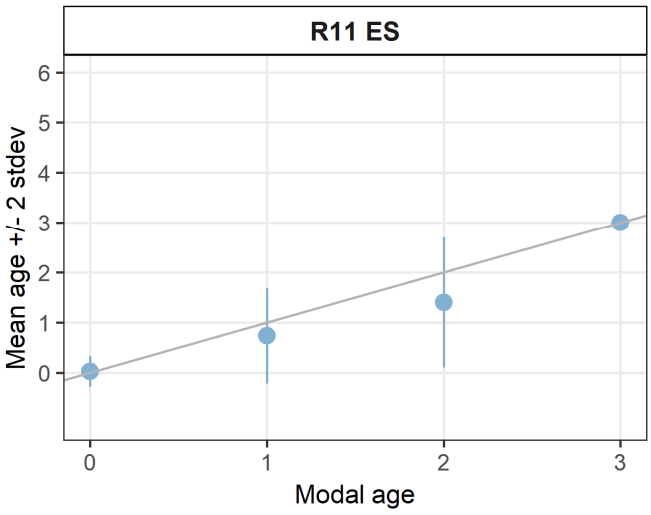
[[9]]


R09 FR
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

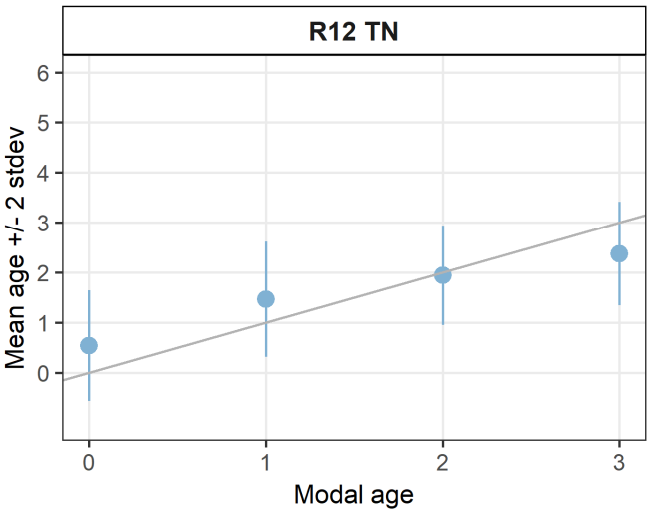

R10 ES
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

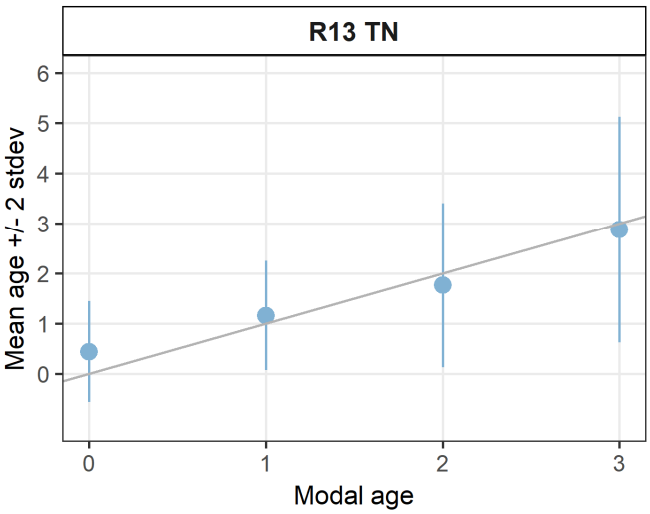
[[10]]

[[11]]


R11 ES
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

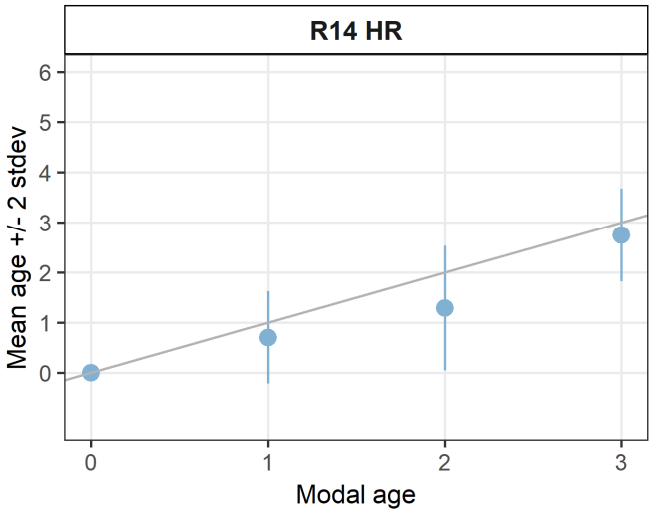
[[12]]


R12 TN
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

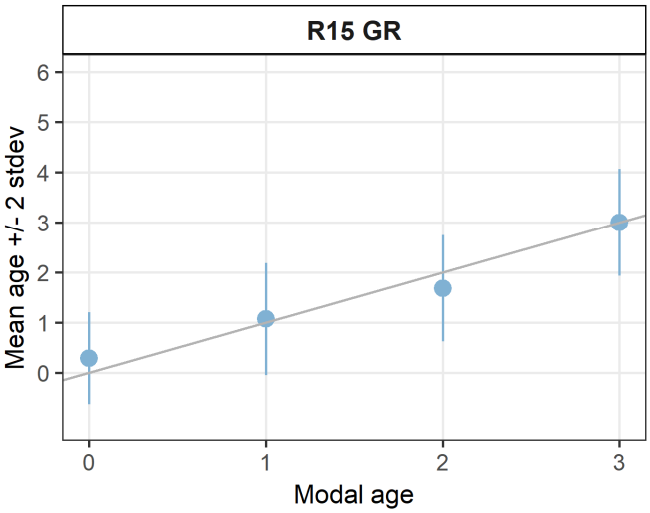

R13 TN
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

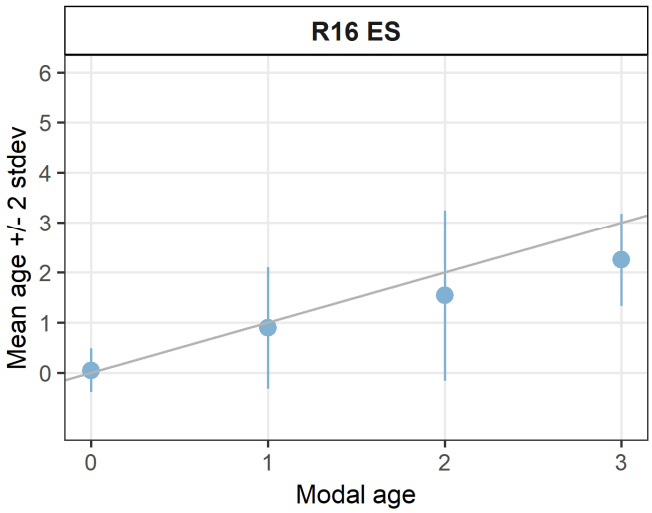
[[13]]

[[14]]


R14 HR
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

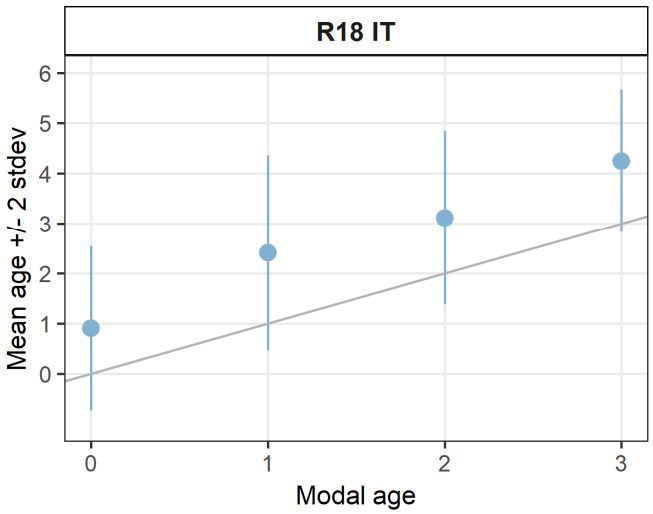
[[15]]


R15 GR
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

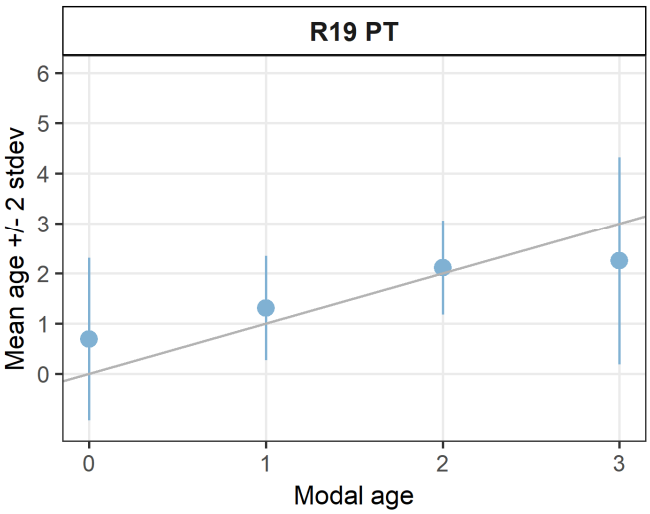

R16 ES
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

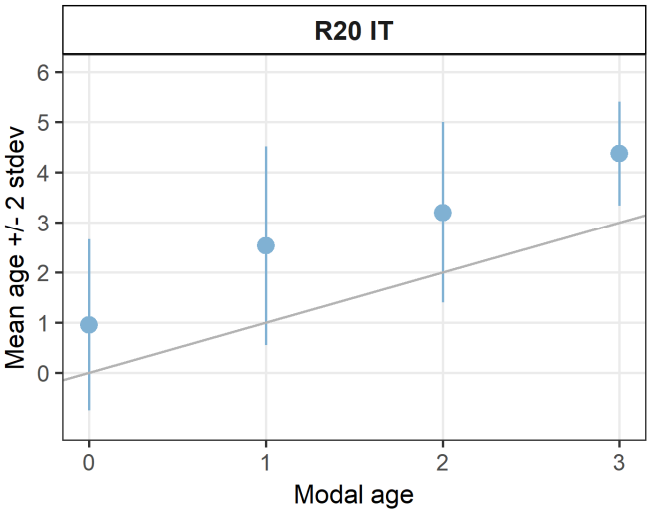
[[16]]

[[17]]


R18 IT
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

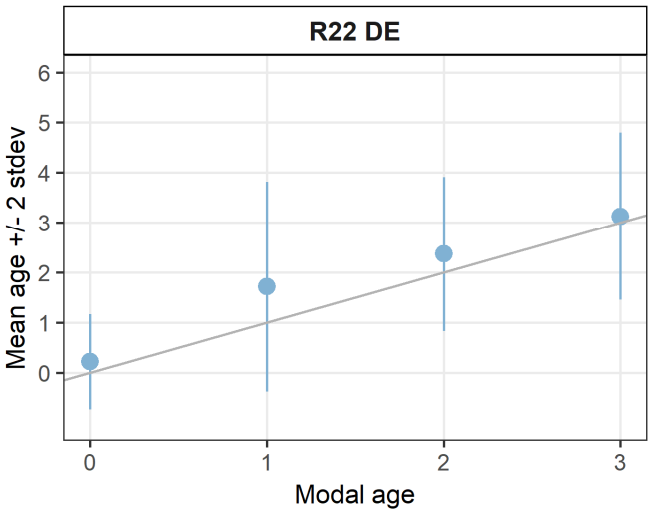
[[18]]


R19 PT
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

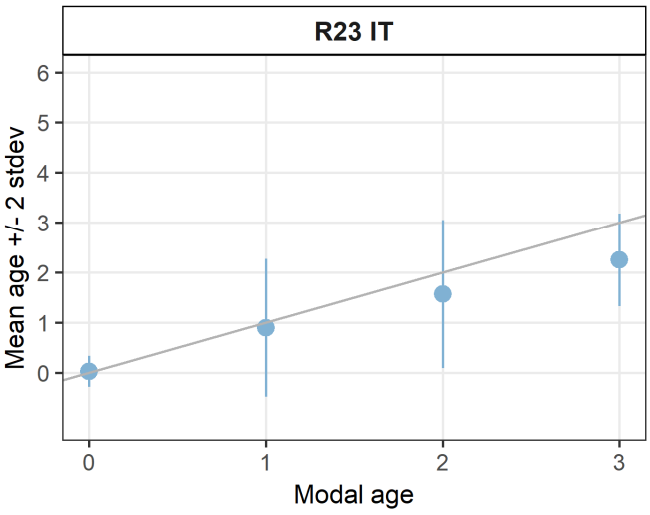

R20 IT
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

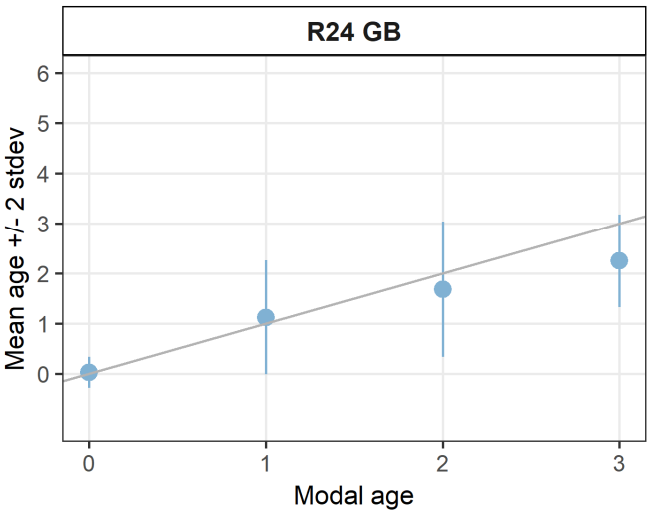
[[19]]

[[20]]


R22 DE
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

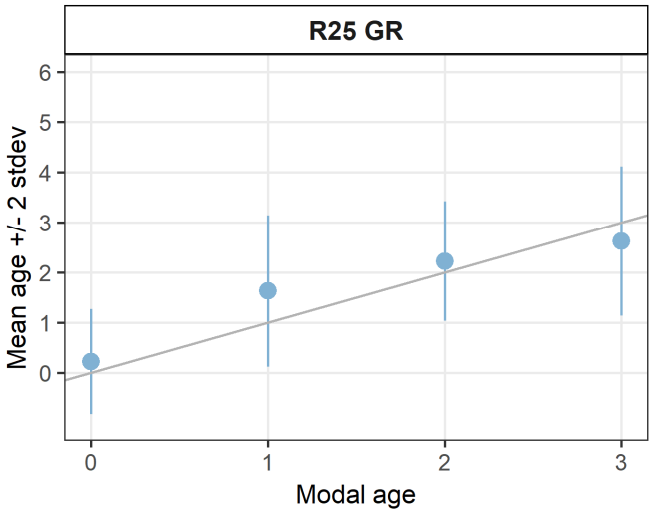
[[21]]


R23 IT
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

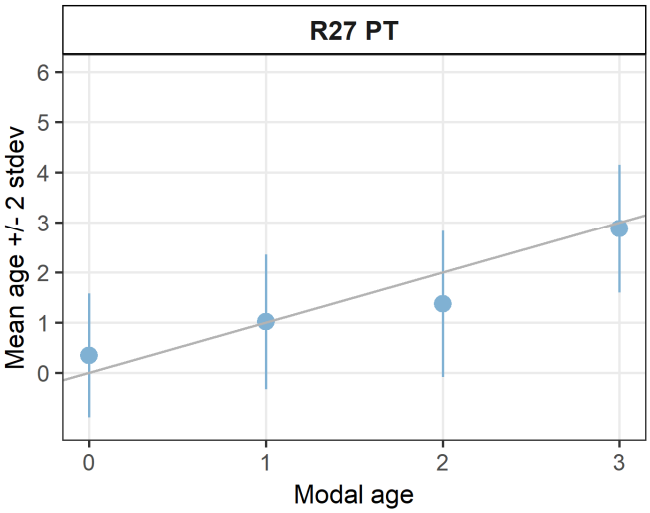

R24 GB
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

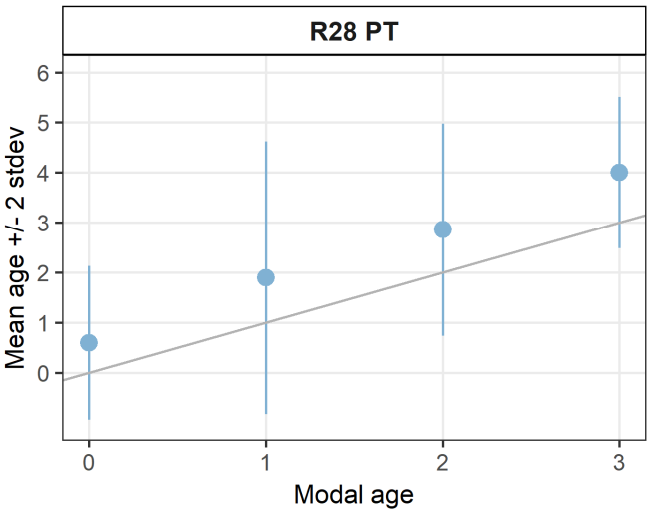
[[22]]

[[23]]


R25 GR
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

[[24]]


R27 PT
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6


R28 PT
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

[[25]]

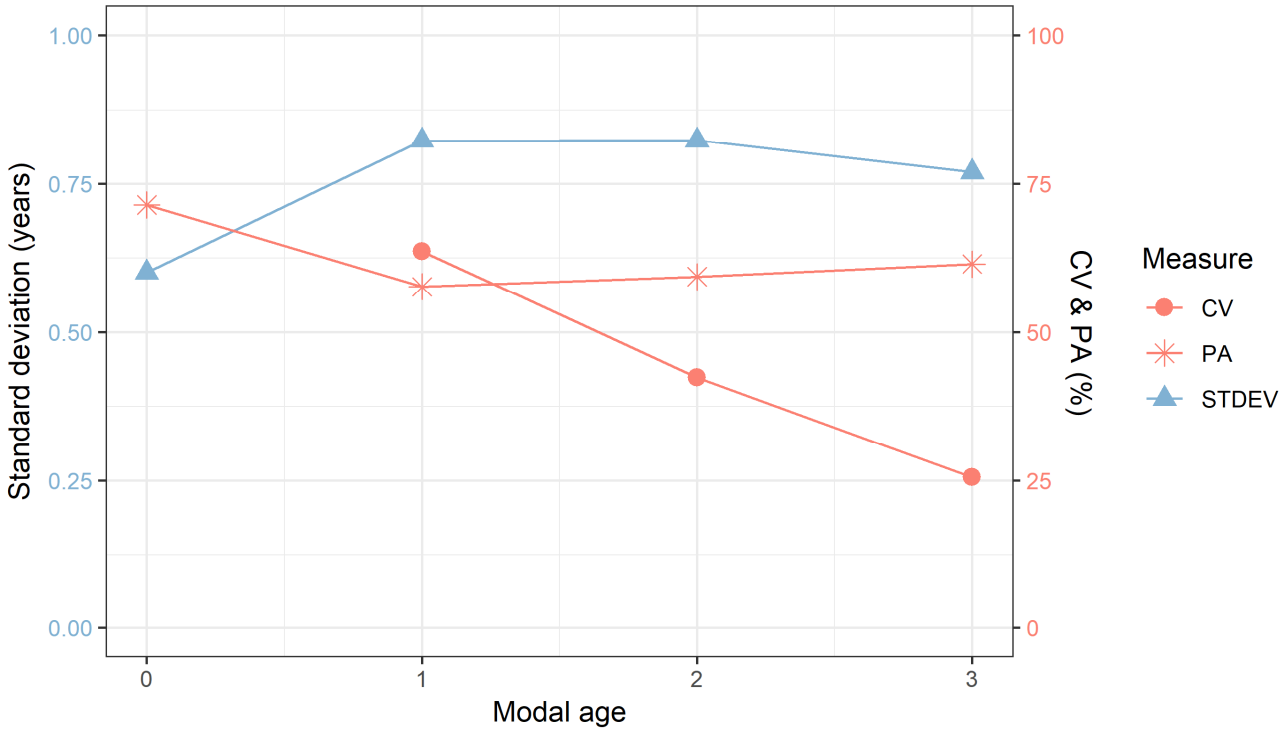


Figure 8.1.1: CV, PA and (STDEV (standard deviation) are plotted against modal age

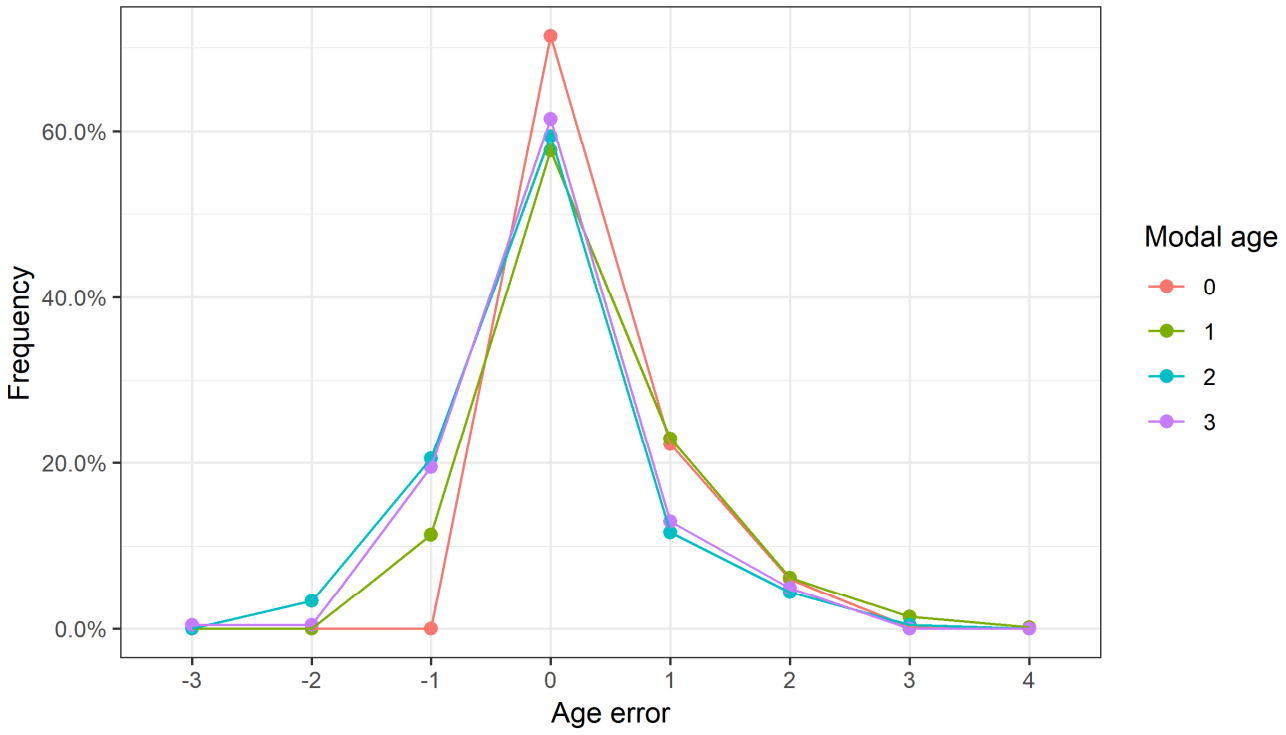


Figure 8.1.2: The distribution of the age reading errors in percentage by modal age as observed from the whole group of age readers in an age reading comparison to modal age. The achieved precision in age reading by MODAL age group is shown by the spread of the age readings errors. There appears to be no relative bias, if the age reading errors are normally distributed. The distributions are skewed, if relative bias occurs.

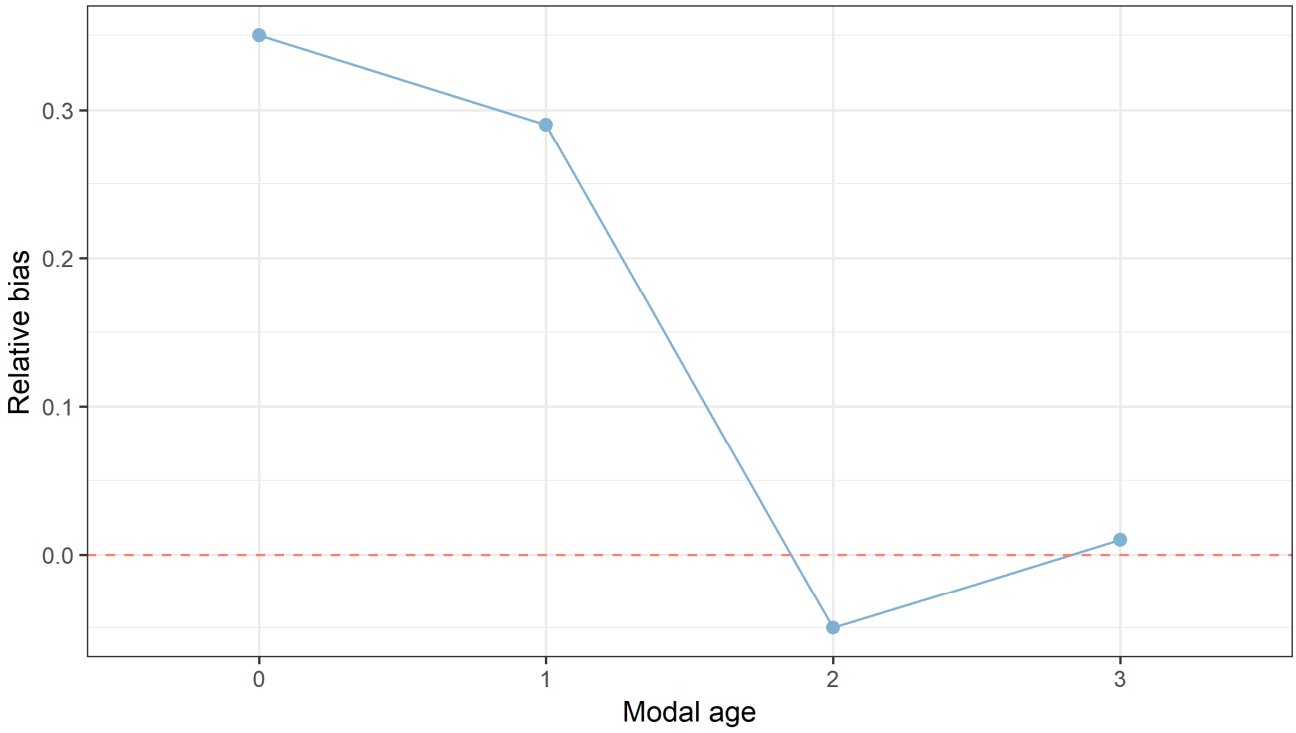


Figure 8.1.3: The relative bias by modal age as estimated by all age readers combined.

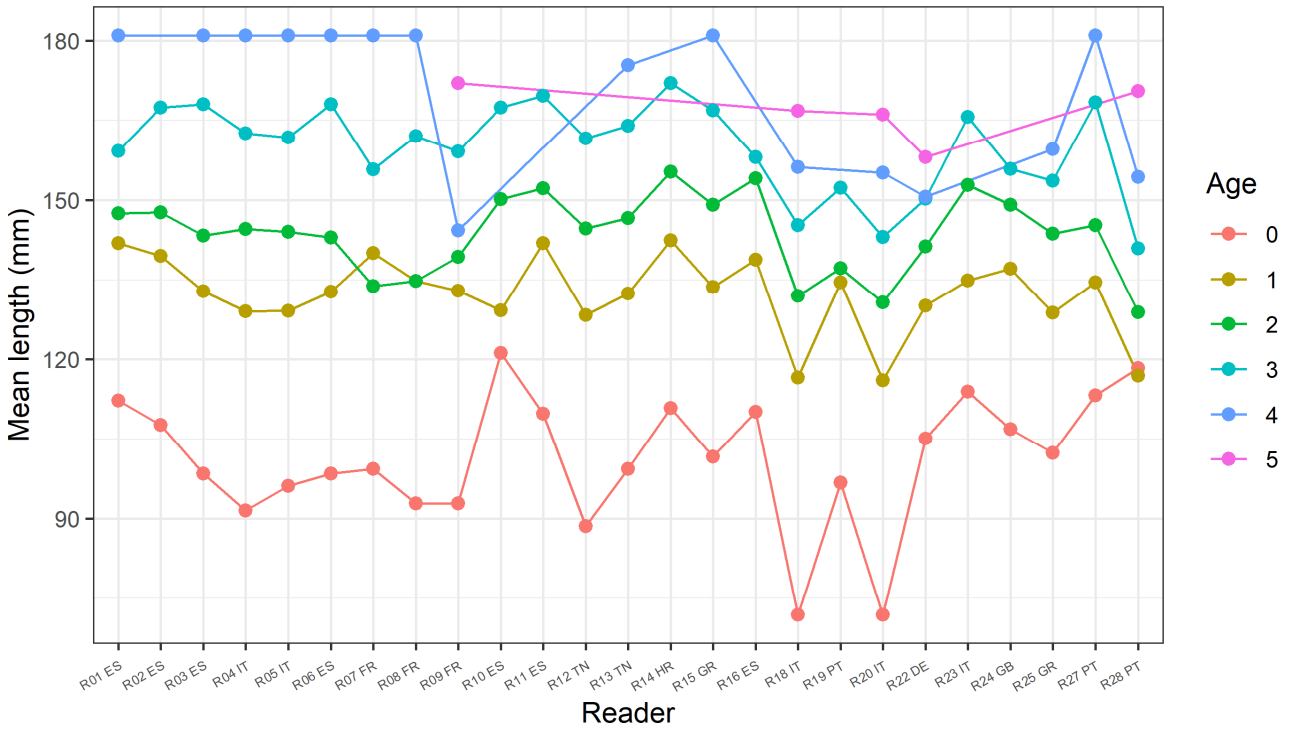


Figure 8.1.4: The mean length at age as estimated by each age reader.

8.2 Results Advanced readers

All samples included

Data Overview

Table 8.2.1: Data overview including modal age and statistics per sample.

Fish ID	Event ID	Image ID	length	sex	Catch date	ICES area	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R07 FR	R08 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R18 IT	R19 PT	R22 DE	R23 IT	Modal age	PA %	CV %	APE %
1969	81	904	123	-	19/04/2017 00:00:00	27.8.c	1	1	1	1	1	1	1	1	1	1	1	-	1	2	1	1	1	1	94	24	11
1970	81	905	130	-	05/06/2017 00:00:00	27.8.c	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	94	23	10
1971	81	906	133	-	05/06/2017 00:00:00	27.8.c	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1	1	94	23	10
1972	81	907	135	-	05/04/2017 00:00:00	27.8.c	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1	1	94	43	20
1973	81	908	137	-	19/04/2017 00:00:00	27.8.c	2	2	2	2	2	-	2	2	2	-	2	1	2	3	2	3	2	2	80	22	12
1974	81	909	147	-	19/04/2017 00:00:00	27.8.c	2	2	2	2	2	2	2	2	2	3	2	1	2	3	2	4	2	2	76	29	19
1975	81	910	148	-	31/05/2017 00:00:00	27.8.c	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	2	2	1	82	46	31
1976	81	911	151	-	19/04/2017 00:00:00	27.8.c	2	2	2	2	2	2	2	2	2	2	2	1	2	4	2	3	2	2	82	28	15
1977	81	912	154	-	05/06/2017 00:00:00	27.8.c	1	1	1	3	1	1	1	1	1	1	2	1	-	4	1	2	2	1	69	60	46
1978	81	913	156	-	05/06/2017 00:00:00	27.8.c	2	2	2	2	2	2	2	2	2	3	2	2	2	4	2	3	2	2	82	25	17
1979	81	914	157	-	05/06/2017 00:00:00	27.8.c	1	1	1	1	1	1	1	1	1	1	2	1	2	4	1	1	1	1	82	60	37
1980	81	915	162	-	05/06/2017 00:00:00	27.8.c	1	1	1	1	1	1	1	2	1	2	3	1	2	5	1	1	2	1	65	67	48
1981	81	916	162	-	16/03/2017 00:00:00	27.8.c	2	2	2	2	2	2	2	2	2	2	3	2	2	4	2	4	2	2	82	30	21
1982	81	917	168	-	05/06/2017 00:00:00	27.8.c	2	2	2	2	2	2	2	2	2	3	4	1	2	4	2	2	2	2	76	34	23
1983	81	918	170	-	16/03/2017 00:00:00	27.8.c	3	3	3	3	3	3	3	3	3	2	4	2	3	4	2	3	2	3	65	21	14
1984	81	919	172	-	31/05/2017 00:00:00	27.8.c	3	3	3	3	3	3	3	3	3	3	3	3	3	5	3	5	3	3	88	21	13
1985	81	920	172	-	16/03/2017 00:00:00	27.8.c	2	2	2	2	2	2	2	2	2	2	4	2	2	4	1	3	2	2	76	34	23
1986	81	921	179	-	31/05/2017 00:00:00	27.8.c	3	3	3	3	3	3	3	3	3	3	4	3	3	4	2	2	2	3	71	19	11
1987	81	922	181	-	31/05/2017	27.8.c	4	3	4	4	4	4	4	3	3	3	3	3	4	5	3	3	3	3	53	18	16

					00:00:00																						
1988	81	923	188	-	16/03/2017 00:00:00	27.8.c	3	3	3	3	3	3	3	3	3	2	4	3	3	4	0	3	2	3	71	31	19
1989	81	924	59	-	06/10/2017 00:00:00	27.8.c	-	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	88	-	-
1990	81	925	89	-	06/10/2017 00:00:00	27.8.c	0	0	0	0	0	0	2	0	0	1	0	0	1	0	2	1	0	0	71	-	-
1991	81	926	102	-	23/10/2017 00:00:00	27.8.c	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	82	-	-
1992	81	927	106	-	23/10/2017 00:00:00	27.8.c	0	0	0	1	1	0	1	0	0	1	0	0	0	0	0	0	0	0	76	-	-
1993	81	928	111	-	13/10/2017 00:00:00	27.8.c	0	0	0	0	0	0	1	0	0	1	0	0	0	1	0	0	0	0	82	-	-
1994	81	929	116	-	17/10/2017 00:00:00	27.8.c	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	76	-	-
1995	81	930	122	-	23/11/2016 00:00:00	27.8.c	0	0	1	1	1	0	2	0	0	1	1	0	1	1	1	2	0	1	47	97	82
1996	81	931	125	-	23/11/2016 00:00:00	27.8.c	0	0	0	0	0	0	1	0	0	0	1	0	1	1	0	0	0	0	76	-	-
1997	81	932	133	-	09/10/2016 00:00:00	27.8.c	0	0	1	1	0	0	1	0	0	1	1	0	1	2	1	1	0	0	47	-	-
1998	81	933	134	-	09/10/2017 00:00:00	27.8.c	0	0	0	0	0	0	1	0	0	0	1	0	0	2	1	0	0	0	76	-	-
1999	81	934	135	-	09/10/2017 00:00:00	27.8.c	0	0	0	1	0	0	1	0	0	0	1	0	0	2	0	0	0	0	76	-	-
2000	81	935	138	-	23/11/2016 00:00:00	27.8.c	0	0	1	1	1	1	2	0	0	1	1	0	1	2	1	2	0	1	47	88	71
2001	81	936	140	-	22/10/2016 00:00:00	27.8.c	2	2	1	2	2	2	2	2	2	2	2	1	2	3	2	2	2	2	82	22	11
2002	81	937	144	-	23/11/2016 00:00:00	27.8.c	0	0	1	1	0	1	1	1	1	1	2	0	1	2	1	1	0	1	59	77	59
2003	81	938	150	-	23/11/2016 00:00:00	27.8.c	1	1	1	1	1	1	2	1	1	1	1	1	2	3	1	1	0	1	76	54	35
2004	81	939	151	-	23/11/2016 00:00:00	27.8.c	2	2	2	1	1	2	2	2	2	2	2	2	2	4	2	2	2	2	82	31	12
2005	81	940	154	-	09/10/2017 00:00:00	27.8.c	0	1	0	1	1	0	1	0	1	1	1	0	0	3	1	0	0	0	47	-	-
2006	81	941	155	-	23/11/2016 00:00:00	27.8.c	0	1	1	1	1	1	1	1	1	1	2	0	2	3	1	2	0	1	59	70	48
2007	81	942	156	-	09/10/2016 00:00:00	27.8.c	1	1	1	2	1	1	2	1	1	2	1	1	1	3	1	2	2	1	65	44	38
2008	81	943	162	-	12/10/2016 00:00:00	27.8.c	1	1	1	2	2	1	1	1	1	2	2	1	1	3	2	1	2	1	59	42	38
2528	81	1206	119	-	21/01/2016 00:00:00	GSA16	0	0	1	1	1	2	2	0	0	1	1	0	0	1	1	0	0	0	47	-	-
2529	81	1207	128	-	21/01/2016 00:00:00	GSA16	0	0	0	1	0	1	2	0	0	1	1	0	0	1	1	0	0	0	59	-	-
2530	81	1208	114	-	30/03/2016 00:00:00	GSA16	0	0	1	0	0	2	1	0	0	1	1	0	0	1	2	0	0	0	59	-	-
2531	81	1209	124	-	30/03/2016 00:00:00	GSA16	0	0	1	1	1	-	2	0	0	1	1	0	1	2	2	0	0	0	44	-	-
2532	81	1210	123	-	30/03/2016	GSA16	0	0	1	1	1	-	2	1	0	1	1	0	1	1	2	0	0	1	50	91	75

					00:00:00																						
2533	81	1211	104	-	23/05/2016 00:00:00	GSA16	0	0	1	0	0	2	2	0	0	1	1	0	1	1	2	0	0	0	53	-	-
2534	81	1212	112	-	23/05/2016 00:00:00	GSA16	0	0	1	0	0	2	2	0	0	1	1	0	1	1	2	0	0	0	53	-	-
2535	81	1213	114	-	23/05/2016 00:00:00	GSA16	0	0	1	0	0	2	2	0	0	1	1	0	1	1	2	0	0	0	53	-	-
2536	81	1214	132	-	23/06/2016 00:00:00	GSA16	0	0	1	0	1	2	2	0	0	1	1	0	1	2	2	0	0	0	47	-	-
2537	81	1215	100	-	28/01/2016 00:00:00	GSA16	0	0	0	0	0	-	1	0	0	0	0	0	0	0	1	1	0	0	81	-	-
2538	81	1178	125	-	21/01/2016 00:00:00	GSA16	0	1	1	1	1	2	2	0	0	2	2	0	1	1	2	2	0	1	35	78	63
2539	81	1179	121	-	21/01/2016 00:00:00	GSA16	0	1	1	1	1	2	2	0	0	2	1	0	2	2	2	1	0	1	35	78	63
2540	81	1180	110	-	21/01/2016 00:00:00	GSA16	0	0	1	1	1	2	2	0	0	1	1	0	1	1	1	1	0	1	53	87	71
2541	81	1181	108	-	21/01/2016 00:00:00	GSA16	0	0	0	1	1	2	1	0	0	1	0	0	0	1	1	1	0	0	53	-	-
2542	81	1182	124	-	21/01/2016 00:00:00	GSA16	0	0	0	1	1	1	1	-	0	1	1	0	0	2	1	0	0	0	50	-	-
2543	81	1183	160	-	21/01/2016 00:00:00	GSA16	1	2	1	1	1	3	1	1	1	3	3	1	1	3	2	2	2	1	53	50	44
2544	81	1184	111	-	21/01/2016 00:00:00	GSA16	0	0	1	1	1	2	1	0	0	1	1	0	0	1	1	0	0	0	47	-	-
2545	81	1185	117	-	30/03/2016 00:00:00	GSA16	0	0	1	1	1	2	2	0	0	2	1	0	1	1	1	0	1	1	47	88	71
2546	81	1186	124	-	30/03/2016 00:00:00	GSA16	0	0	1	1	1	2	2	0	0	1	1	0	1	1	2	0	1	1	47	88	71
2547	81	1187	127	-	30/03/2016 00:00:00	GSA16	0	0	1	1	1	2	2	0	0	2	1	0	1	2	2	0	1	0	35	-	-
2548	81	1188	127	-	30/03/2016 00:00:00	GSA16	0	0	1	1	-	2	2	0	0	1	1	0	1	2	2	0	1	0	38	-	-
2549	81	1189	108	-	23/05/2016 00:00:00	GSA16	0	0	1	1	1	2	2	0	0	1	1	0	0	1	2	0	0	0	47	-	-
2550	81	1190	109	-	23/05/2016 00:00:00	GSA16	0	0	1	1	1	2	2	0	0	1	1	0	0	1	2	0	0	0	47	-	-
2551	81	1191	116	-	23/05/2016 00:00:00	GSA16	0	0	1	1	1	2	2	0	0	-	1	0	1	2	2	0	0	0	44	-	-
2552	81	1192	116	-	23/05/2016 00:00:00	GSA16	0	0	1	1	1	2	2	0	0	2	1	0	1	2	2	0	0	0	41	-	-
2553	81	1193	117	-	23/05/2016 00:00:00	GSA16	0	0	1	1	1	2	2	0	0	1	1	0	1	1	2	0	0	0	41	-	-
2554	81	1194	120	-	23/05/2016 00:00:00	GSA16	0	1	1	1	2	2	2	0	0	2	2	0	1	2	2	1	0	2	41	77	65
2555	81	1195	123	-	23/05/2016 00:00:00	GSA16	1	1	1	1	1	2	2	0	0	2	2	0	1	2	2	2	0	2	41	69	58
2556	81	1196	147	-	21/01/2016 00:00:00	GSA16	1	1	1	2	2	2	2	1	1	3	3	1	1	3	3	4	1	1	47	53	44
2557	81	1197	145	-	21/01/2016 00:00:00	GSA16	1	1	1	2	2	3	1	1	1	2	2	1	2	3	3	2	1	1	47	45	39
2558	81	1198	137	-	21/01/2016	GSA16	2	2	2	1	1	3	3	0	1	2	2	1	2	3	3	2	1	2	41	48	38

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2559	81	1199	144	-	30/03/2016 00:00:00	GSA16	0	1	1	2	2	2	2	1	1	3	1	1	1	3	3	2	1	1	47	55	47
2560	81	1200	145	-	30/03/2016 00:00:00	GSA16	2	2	1	2	2	3	2	0	1	2	1	1	2	3	3	3	1	2	41	48	38
2561	81	1201	145	-	30/03/2016 00:00:00	GSA16	2	2	1	2	2	3	3	0	1	2	1	1	2	2	3	1	1	2	41	50	41
2562	81	1202	149	-	30/03/2016 00:00:00	GSA16	2	2	1	2	2	3	1	0	1	2	2	1	1	3	3	1	1	1	41	52	44
2563	81	1203	139	-	23/06/2016 00:00:00	GSA16	0	1	1	2	2	2	2	0	0	1	1	1	1	3	2	2	1	1	41	66	54
2564	81	1204	137	-	23/06/2016 00:00:00	GSA16	0	1	1	2	2	2	1	0	0	2	1	1	1	2	2	3	1	1	41	66	54
2565	81	1205	139	-	23/06/2016 00:00:00	GSA16	1	1	1	2	2	2	1	0	0	2	1	1	1	2	2	3	1	1	47	58	48
2566	81	1216	80	-	12/07/2016 00:00:00	GSA16	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	94	-	-
2567	81	1217	69	-	12/07/2016 00:00:00	GSA16	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	94	-	-
2568	81	1218	52	-	12/07/2016 00:00:00	GSA16	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	94	-	-
2569	81	1219	59	-	12/07/2016 00:00:00	GSA16	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	94	-	-
2570	81	1220	52	-	12/07/2016 00:00:00	GSA16	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	94	-	-
2571	81	1221	60	-	12/07/2016 00:00:00	GSA16	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	94	-	-
2572	81	1222	66	-	12/07/2016 00:00:00	GSA16	0	0	0	0	0	-	0	1	0	0	0	0	0	0	0	0	0	0	94	-	-
2573	81	1223	77	-	12/07/2016 00:00:00	GSA16	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	94	-	-
2574	81	1224	57	-	12/07/2016 00:00:00	GSA16	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	94	-	-
2575	81	1225	49	-	12/07/2016 00:00:00	GSA16	0	0	0	0	0	0	0	1	0	0	-	0	0	0	0	0	0	0	94	-	-
2576	81	1226	128	-	25/07/2016 00:00:00	GSA16	1	1	2	1	2	2	1	1	1	2	1	1	1	2	1	1	1	1	71	36	32
2577	81	1227	121	-	25/07/2016 00:00:00	GSA16	-	1	2	2	2	2	1	1	1	2	1	1	1	2	1	2	1	1	56	36	34
2578	81	1228	142	-	25/07/2016 00:00:00	GSA16	1	1	2	1	1	2	1	1	1	1	1	1	1	2	1	1	1	1	82	33	25
2579	81	1229	122	-	25/07/2016 00:00:00	GSA16	1	1	2	2	2	2	1	1	1	2	1	1	1	2	1	2	1	1	59	36	34
2580	81	1230	125	-	30/08/2016 00:00:00	GSA16	2	1	2	2	2	2	1	1	1	1	1	0	1	2	1	3	1	1	53	50	43
2581	81	1231	122	-	30/08/2016 00:00:00	GSA16	1	1	1	1	1	1	1	1	1	1	1	0	0	1	1	2	1	1	82	46	24
2582	81	1232	121	-	30/08/2016 00:00:00	GSA16	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	94	26	12
2583	81	1233	129	-	30/08/2016 00:00:00	GSA16	1	2	2	2	2	3	1	1	1	1	1	0	1	2	1	2	1	1	53	50	43

2584	81	1234	115	-	14/09/2016 00:00:00	GSA16	0	0	1	1	1	1	0	1	0	1	0	0	0	1	1	2	0	0	47	-	-
2585	81	1235	130	-	14/09/2016 00:00:00	GSA16	1	1	1	1	1	1	1	1	1	2	1	1	-	2	1	2	1	1	81	34	26
2586	81	1236	117	-	14/09/2016 00:00:00	GSA16	1	1	2	2	2	2	2	1	0	1	1	1	1	1	2	2	1	1	53	45	39
2587	81	1237	118	-	14/09/2016 00:00:00	GSA16	0	0	1	1	1	1	0	0	0	1	0	0	0	1	0	1	1	0	53	-	-
2588	81	1238	127	-	14/09/2016 00:00:00	GSA16	0	1	2	1	1	1	1	1	0	1	1	1	1	2	1	1	1	1	76	50	24
2589	81	1239	132	-	14/09/2016 00:00:00	GSA16	1	2	2	1	1	2	1	1	1	2	2	1	1	2	1	3	1	1	59	42	38
2590	81	1241	135	-	28/11/2016 00:00:00	GSA16	1	2	2	2	2	2	1	1	1	2	2	1	1	2	2	2	1	2	59	32	31
2591	81	1242	128	-	28/11/2016 00:00:00	GSA16	0	0	1	1	1	1	0	0	0	1	1	0	1	2	1	1	0	1	53	94	82
2592	81	1243	143	-	25/07/2016 00:00:00	GSA16	1	2	2	2	2	2	1	1	1	2	1	1	1	3	2	2	2	2	53	37	32
2593	81	1244	136	-	25/07/2016 00:00:00	GSA16	1	2	2	2	2	2	1	1	1	2	1	1	1	3	1	2	2	1	47	39	35
2594	81	1245	147	-	25/07/2016 00:00:00	GSA16	1	2	2	3	3	2	1	1	1	2	1	1	1	3	1	2	2	1	47	45	39
2595	81	1246	144	-	25/07/2016 00:00:00	GSA16	1	2	2	2	2	2	1	1	1	2	1	1	1	4	1	5	2	1	47	62	43
2596	81	1247	155	-	25/07/2016 00:00:00	GSA16	1	1	2	2	2	2	1	1	1	2	1	1	1	4	1	3	2	1	53	52	42
2597	81	1248	140	-	05/10/2016 00:00:00	GSA16	1	1	2	2	2	1	1	1	1	2	1	1	1	2	1	2	2	1	59	36	34
2598	81	1249	152	-	05/10/2016 00:00:00	GSA16	1	2	2	2	2	2	2	1	1	2	2	1	1	2	2	2	2	2	71	28	24
2599	81	1250	151	-	05/10/2016 00:00:00	GSA16	1	1	2	2	2	1	2	1	1	2	1	1	1	3	2	2	2	1	47	39	35
2600	81	1251	147	-	05/10/2016 00:00:00	GSA16	1	1	2	2	2	1	2	1	1	2	1	1	1	2	1	2	2	1	53	35	34
2601	81	1252	141	-	05/10/2016 00:00:00	GSA16	1	1	2	2	2	1	1	1	1	2	2	1	1	2	1	2	2	1	53	35	34
2602	81	1253	157	-	05/10/2016 00:00:00	GSA16	1	2	2	2	2	1	1	1	1	2	1	1	1	3	1	2	2	1	53	41	37
2603	81	1254	138	-	05/10/2016 00:00:00	GSA16	1	1	2	2	2	1	1	1	1	2	1	1	1	3	2	2	2	1	53	41	37
2604	81	1240	133	-	10/09/2016 00:00:00	GSA16	1	1	2	2	3	2	0	1	1	1	1	1	1	3	2	3	1	1	53	57	48
2605	81	1255	135	-	05/10/2016 00:00:00	GSA16	1	1	2	2	2	1	1	1	1	2	1	1	1	2	1	2	1	1	65	36	34
2648	81	1256	111	-	21/01/2016 00:00:00	GSA16	0	0	1	0	0	2	1	0	0	1	1	0	0	1	0	1	0	0	59	-	-
2649	81	1257	100	-	21/01/2016 00:00:00	GSA16	0	0	1	0	0	1	1	0	0	1	1	0	0	1	1	1	0	0	53	-	-
2650	81	1278	150	-	03/03/2017 00:00:00	27.8.b	3	3	2	3	2	3	2	3	2	2	2	2	3	4	3	3	2	2	47	24	21
2651	81	1279	144	-	03/03/2017	27.8.b	1	1	1	2	2	1	1	1	1	2	1	1	2	3	1	2	0	1	59	52	42

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2652	81	1280	154	-	03/03/2017 00:00:00	27.8.b	1	2	2	2	2	2	2	2	2	2	2	2	2	4	2	2	2	2	88	27	11
2653	81	1281	152	-	03/03/2017 00:00:00	27.8.b	3	3	3	3	3	3	3	3	3	2	1	3	2	4	3	3	2	3	71	24	17
2654	81	1282	148	-	03/03/2017 00:00:00	27.8.b	2	2	2	2	2	2	2	2	2	2	1	2	2	4	2	4	2	2	82	33	20
2655	81	1283	142	-	03/03/2017 00:00:00	27.8.b	1	1	1	2	2	1	1	1	1	1	1	1	2	4	1	2	0	1	65	64	46
2656	81	1284	146	-	03/03/2017 00:00:00	27.8.b	1	1	1	2	-	1	1	1	1	2	1	1	2	4	2	2	0	1	56	62	47
2657	81	1285	151	-	12/04/2017 00:00:00	27.8.b	1	1	2	2	2	2	1	1	1	1	0	2	2	3	2	2	0	2	47	54	46
2658	81	1286	160	-	12/04/2017 00:00:00	27.8.b	3	3	3	3	3	3	3	3	3	2	2	3	3	5	3	3	2	3	76	22	11
2659	81	1287	149	-	12/04/2017 00:00:00	27.8.b	1	1	1	1	2	1	1	1	1	2	2	1	2	3	1	4	0	1	59	64	49
2660	81	1288	159	-	12/04/2017 00:00:00	27.8.b	2	2	2	2	2	2	2	2	2	2	2	2	2	5	2	2	2	2	94	33	15
2661	81	1289	157	-	12/04/2017 00:00:00	27.8.b	2	2	2	2	2	2	2	2	2	2	2	2	2	4	2	2	2	2	94	23	10
2662	81	1290	150	-	12/04/2017 00:00:00	27.8.b	1	1	1	2	2	1	1	1	1	1	0	1	2	4	1	3	0	1	59	74	54
2663	81	1291	155	-	12/04/2017 00:00:00	27.8.b	3	3	3	3	3	3	3	3	3	2	2	2	3	3	2	3	2	3	71	17	15
2664	81	1292	161	-	12/04/2017 00:00:00	27.8.b	1	1	2	3	3	1	1	2	2	2	0	1	3	4	1	3	0	1	35	65	54
2665	81	1293	154	-	22/06/2017 00:00:00	27.8.b	2	2	2	2	2	2	2	2	1	2	2	2	1	3	2	3	2	2	76	25	12
2666	81	1294	146	-	22/06/2017 00:00:00	27.8.b	1	1	1	2	2	1	1	0	1	1	1	1	2	4	1	1	1	1	71	66	44
2667	81	1295	149	-	22/06/2017 00:00:00	27.8.b	1	1	1	2	2	1	1	1	1	1	1	1	1	3	2	1	1	1	76	45	35
2668	81	1296	139	-	22/06/2017 00:00:00	27.8.b	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	3	1	1	88	45	26
2669	81	1297	142	-	22/06/2017 00:00:00	27.8.b	2	1	2	2	2	2	1	1	1	1	1	1	1	2	1	3	1	1	59	42	38
2670	81	1259	132	-	12/08/2016 00:00:00	27.8.b	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	2	1	1	88	45	26
2671	81	1260	145	-	12/08/2016 00:00:00	27.8.b	2	2	2	2	2	2	2	2	2	1	1	1	2	2	2	2	1	2	76	25	20
2672	81	1261	142	-	12/08/2016 00:00:00	27.8.b	1	1	1	2	2	2	2	1	1	1	1	1	1	3	1	2	1	1	65	44	38
2673	81	1262	135	-	12/08/2016 00:00:00	27.8.b	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	2	1	1	88	45	26
2674	81	1263	135	-	12/08/2016 00:00:00	27.8.b	3	2	2	2	2	2	2	2	2	1	1	1	2	4	2	2	2	2	71	35	18
2675	81	1264	131	-	12/08/2016 00:00:00	27.8.b	1	1	1	2	2	2	1	1	1	1	1	1	1	3	1	2	1	1	71	45	37
2676	81	1265	120	-	12/08/2016 00:00:00	27.8.b	2	1	2	1	1	2	2	2	1	1	-	0	1	2	2	2	0	2	50	52	45
2677	81	1266	144	-	01/09/2016	27.8.b	3	2	2	2	2	2	2	2	1	2	1	2	2	3	2	3	3	2	65	28	20

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2678	81	1267	146	-	01/09/2016 00:00:00	27.8.b	3	2	2	2	2	2	2	2	2	2	2	2	2	3	2	3	2	2	82	18	13
2679	81	1268	140	-	01/09/2016 00:00:00	27.8.b	1	1	1	1	1	1	1	1	1	2	1	1	1	3	1	2	1	1	82	46	31
2680	81	1269	147	-	01/09/2016 00:00:00	27.8.b	1	1	1	2	2	1	1	1	1	1	1	1	1	3	1	3	1	1	76	52	40
2681	81	1270	119	-	18/10/2016 00:00:00	27.8.b	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	82	-	-
2682	81	1271	143	-	18/10/2016 00:00:00	27.8.b	1	1	1	2	2	1	1	1	1	1	1	1	1	2	1	2	1	1	76	35	29
2683	81	1272	126	-	18/10/2016 00:00:00	27.8.b	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	82	-	-
2684	81	1273	127	-	18/10/2016 00:00:00	27.8.b	0	0	0	1	1	0	0	0	0	1	0	0	1	1	0	0	0	0	71	-	-
2685	81	1274	148	-	18/10/2016 00:00:00	27.8.b	1	1	1	1	2	1	1	1	1	2	1	1	1	3	2	2	1	1	71	45	37
2686	81	1275	117	-	18/10/2016 00:00:00	27.8.b	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	94	-	-
2687	81	1276	135	-	18/10/2016 00:00:00	27.8.b	2	2	2	2	2	2	2	2	1	-	1	1	1	3	2	3	2	2	62	33	23
2688	81	1277	119	-	18/10/2016 00:00:00	27.8.b	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	-	0	0	81	-	-
2689	81	1258	133	-	18/10/2016 00:00:00	27.8.b	0	0	0	1	1	0	0	0	0	0	0	0	0	2	1	1	0	0	71	-	-

Table 8.2.2: Number of age readings table gives an overview of number of readings per reader and modal age. The total numbers of readings per reader and per modal age are summarized at the end of the table.

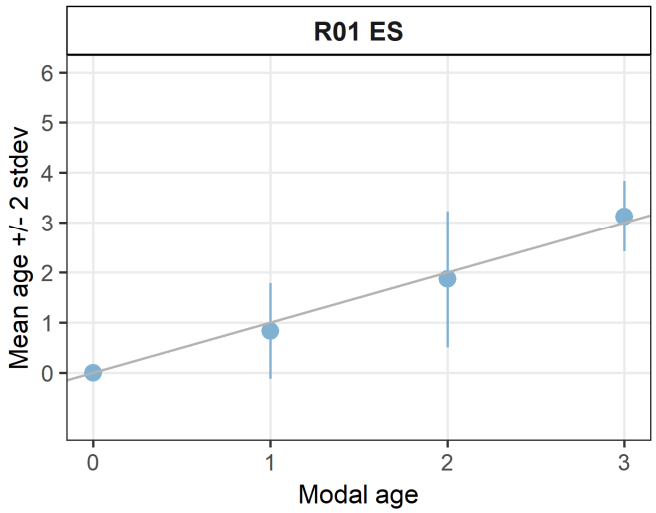
Modal age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R07 FR	R08 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R18 IT	R19 PT	R22 DE	R23 IT	total
0	49	50	50	50	49	47	50	49	50	49	49	50	50	50	50	49	50	**841**
1	71	72	72	72	71	71	72	72	72	72	72	71	70	72	72	72	72	**1218**
2	30	30	30	30	30	29	30	30	30	28	29	30	30	30	30	30	30	**506**
3	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	**136**
Total	**158**	**160**	**160**	**160**	**158**	**155**	**160**	**159**	**160**	**157**	**158**	**159**	**158**	**160**	**160**	**159**	**160**	**2701**

Table 8.2.3: Age composition by reader gives a summary of number of readings per reader.

Modal age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R07 FR	R08 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R18 IT	R19 PT	R22 DE	R23 IT
0	65	57	30	26	29	27	20	56	65	20	27	67	38	15	23	43	**67**
1	59	61	74	62	56	46	73	72	69	68	90	71	77	32	67	29	**48**
2	22	33	48	60	62	66	57	22	18	60	30	15	34	43	58	53	**42**
3	11	9	7	11	10	15	9	9	8	9	6	6	8	41	12	27	**3**
4	1	0	1	1	1	1	1	0	0	0	5	0	1	24	0	5	**0**
5	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	2	**0**
Total	**158**	**160**	**160**	**160**	**158**	**155**	**160**	**159**	**160**	**157**	**158**	**159**	**158**	**160**	**160**	**159**	**160**

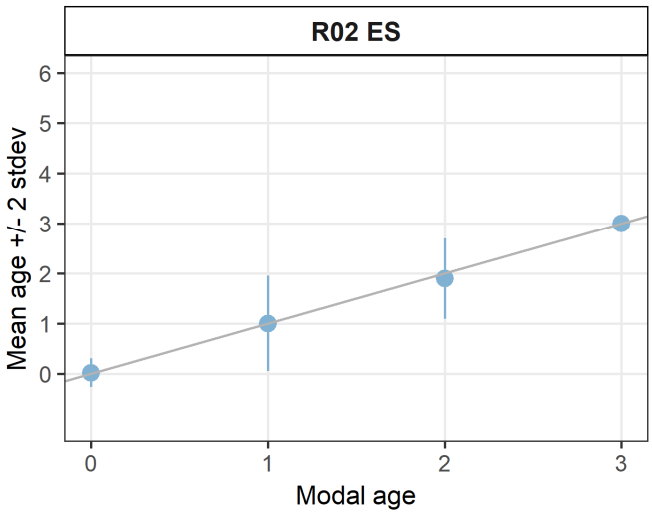
Table 8.2.4: Mean length at age per reader is calculated per reader and age (not modal age) and for all readers combined per age. A weighted mean is also given.

Age	R01 ES	R02 ES	R03 ES	R04 IT	R05 IT	R07 FR	R08 FR	R10 ES	R11 ES	R12 TN	R13 TN	R14 HR	R15 GR	R18 IT	R19 PT	R22 DE	R23 IT
0	112 mm	108 mm	98 mm	91 mm	96 mm	99 mm	93 mm	121 mm	110 mm	89 mm	99 mm	111 mm	102 mm	72 mm	97 mm	105 mm	**114 mm**
1	142 mm	140 mm	133 mm	129 mm	129 mm	140 mm	135 mm	129 mm	142 mm	128 mm	132 mm	142 mm	134 mm	117 mm	135 mm	130 mm	**135 mm**
2	148 mm	148 mm	143 mm	145 mm	144 mm	134 mm	135 mm	150 mm	152 mm	145 mm	147 mm	155 mm	149 mm	132 mm	137 mm	141 mm	**153 mm**
3	159 mm	167 mm	168 mm	163 mm	162 mm	156 mm	162 mm	167 mm	170 mm	162 mm	164 mm	172 mm	167 mm	145 mm	152 mm	150 mm	**166 mm**
4	181 mm	-	181 mm	181 mm	181 mm	181 mm	181 mm	-	-	-	175 mm	-	181 mm	156 mm	-	151 mm	**-**
5	-	-	-	-	-	-	-	-	-	-	-	-	-	167 mm	-	158 mm	**-**
Weighted Mean	**132 mm**	**131 mm**	**131 mm**	**131 mm**	**131 mm**	**132 mm**	**131 mm**	**131 mm**	**131 mm**	**131 mm**	**132 mm**	**131 mm**	**131 mm**	**131 mm**	**131 mm**	**131 mm**	**131 mm**

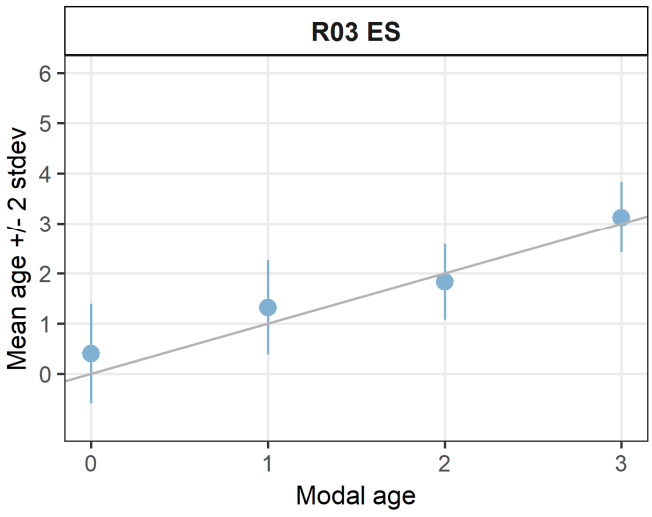

R01 ES
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

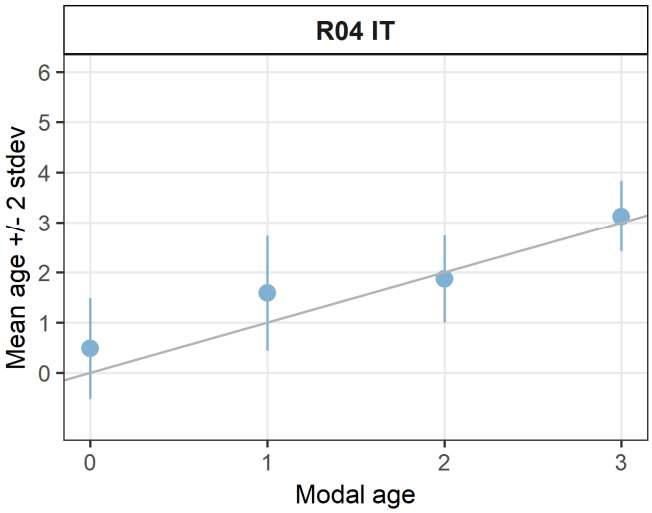
[[1]]

[[2]]


R02 ES
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

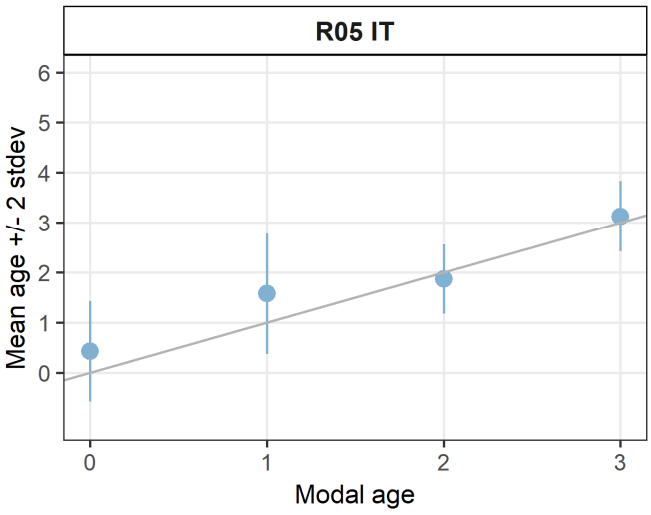
[[3]]


R03 ES
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

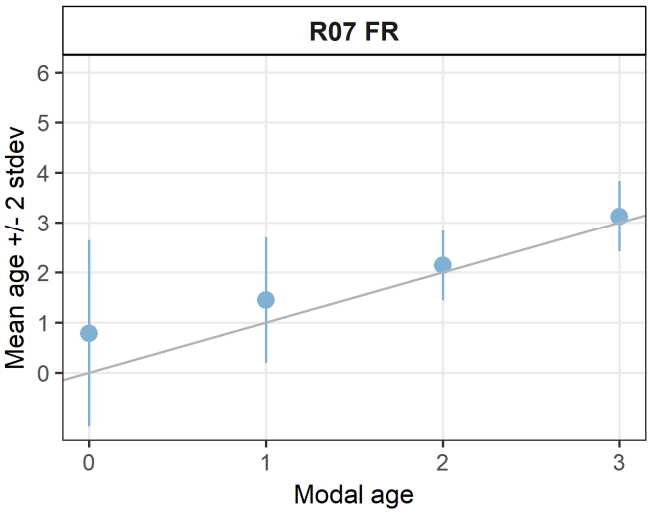

R04 IT
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

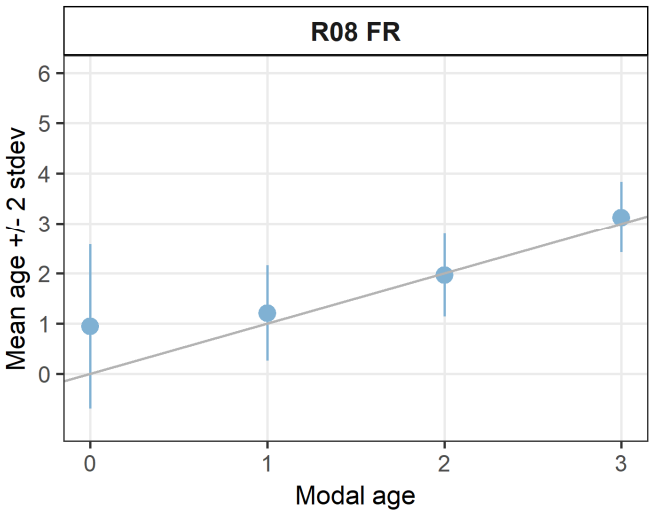
[[4]]

[[5]]


R05 IT
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

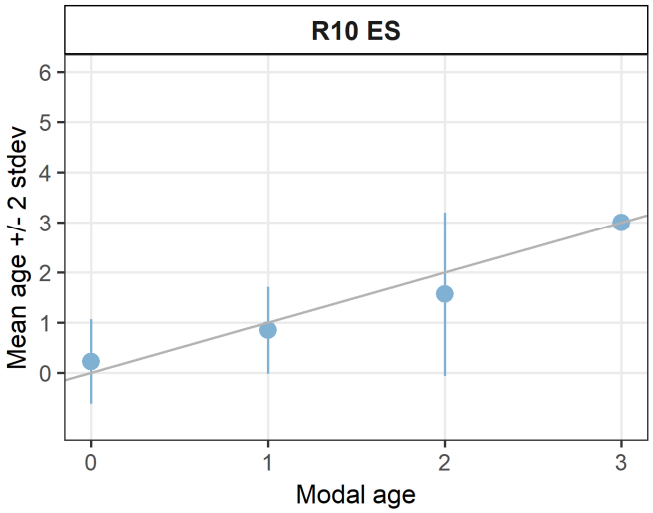
[[6]]


R07 FR
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

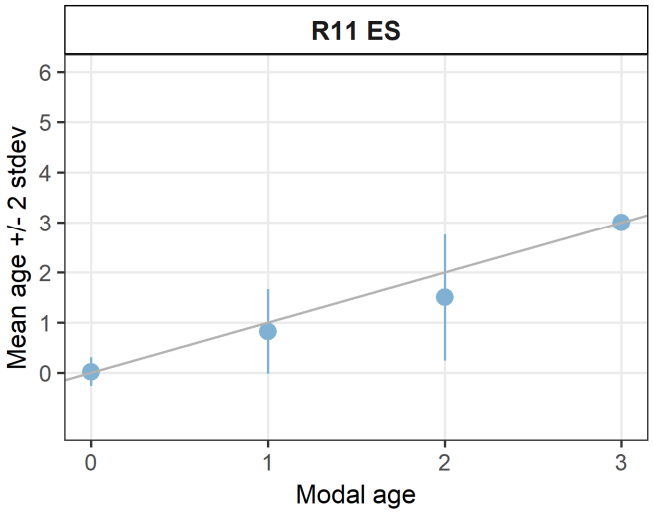

R08 FR
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

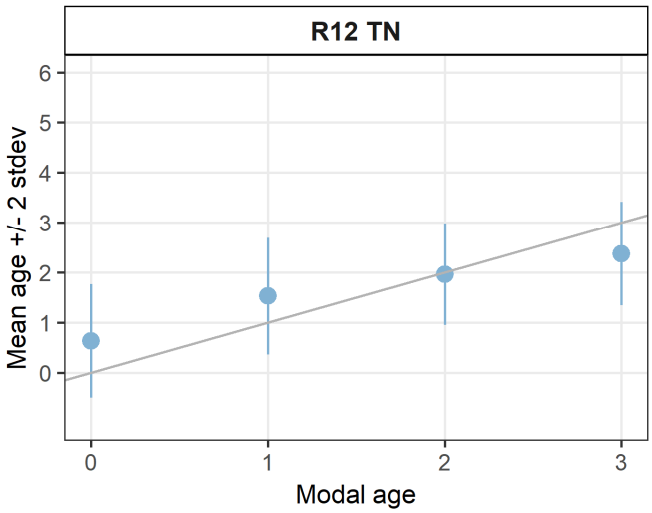
[[7]]

[[8]]


R10 ES
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

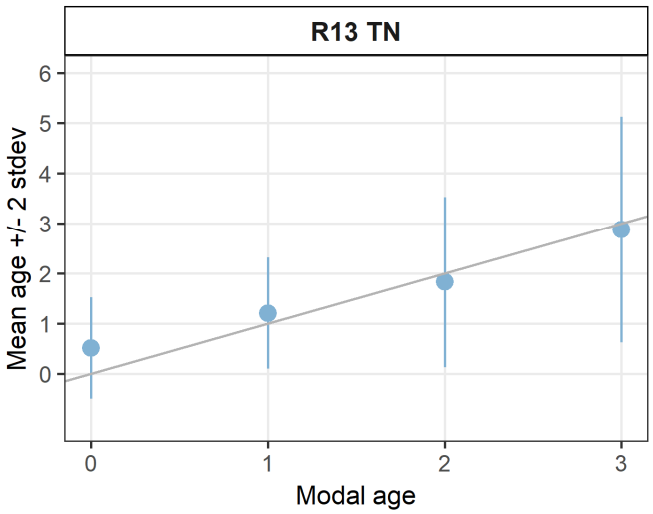
[[9]]


R11 ES
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

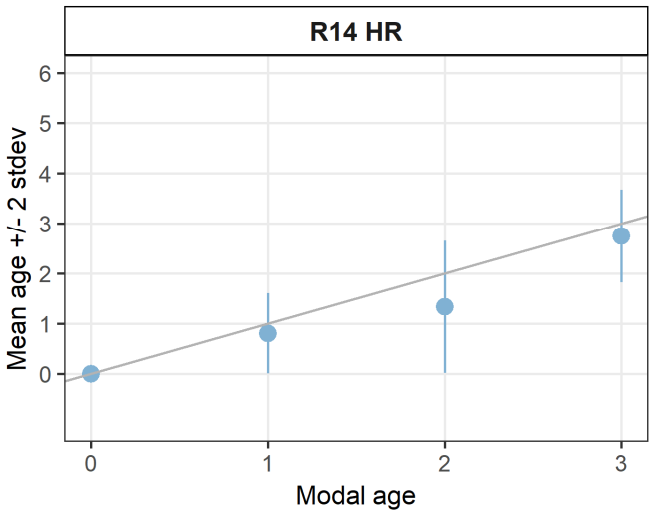

R12 TN
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

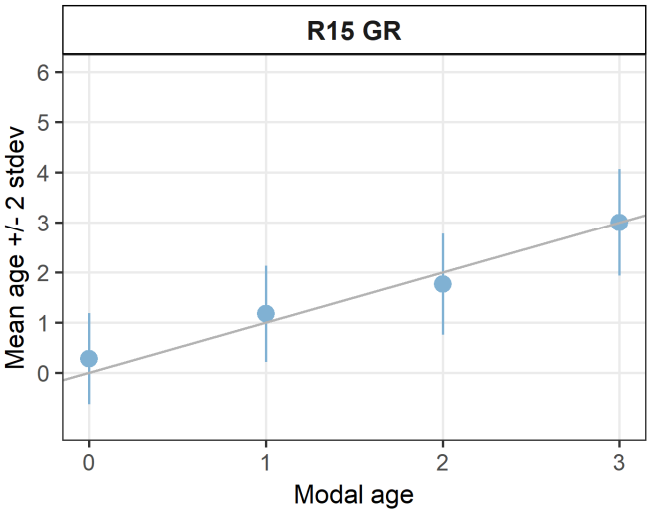
[[10]]

[[11]]


R13 TN
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

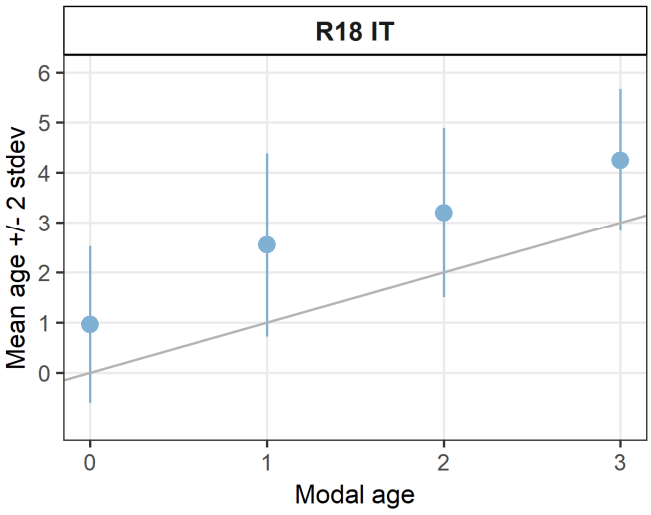
[[12]]


R14 HR
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

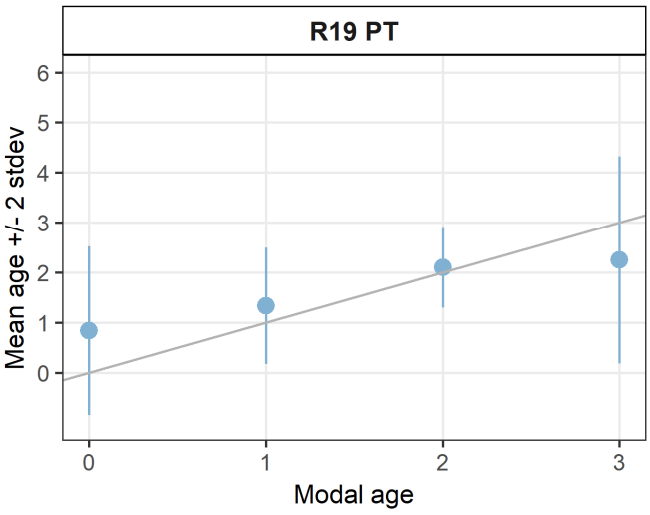

R15 GR
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

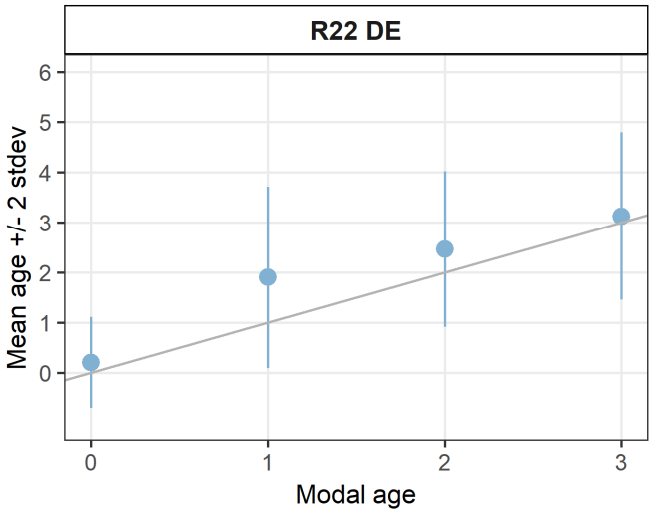
[[13]]

[[14]]


R18 IT
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6

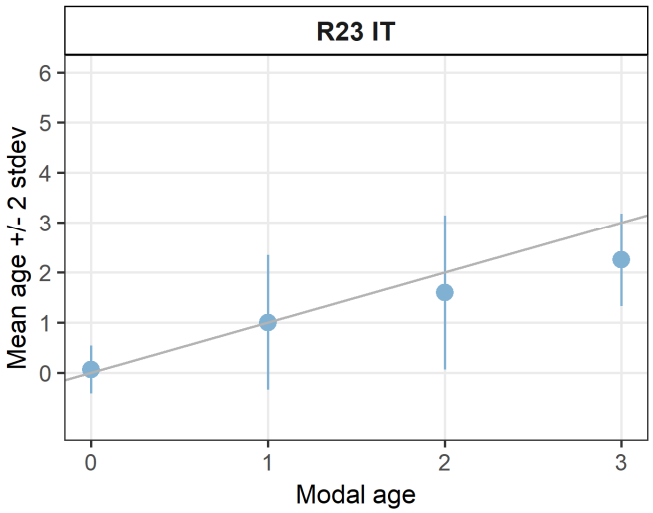
[[15]]


R19 PT
Mean age +/- 2 stdev
Modal age
0
1
2
3
4
5
6


R22 DE
Mean age +/- 2 stdev
0
1
2
3
4
5
6
0
1
2
3
Modal age

[[16]]

[[17]]


R23 IT
Mean age +/- 2 stdev
0
1
2
3
4
5
6
0
1
2
3
Modal age

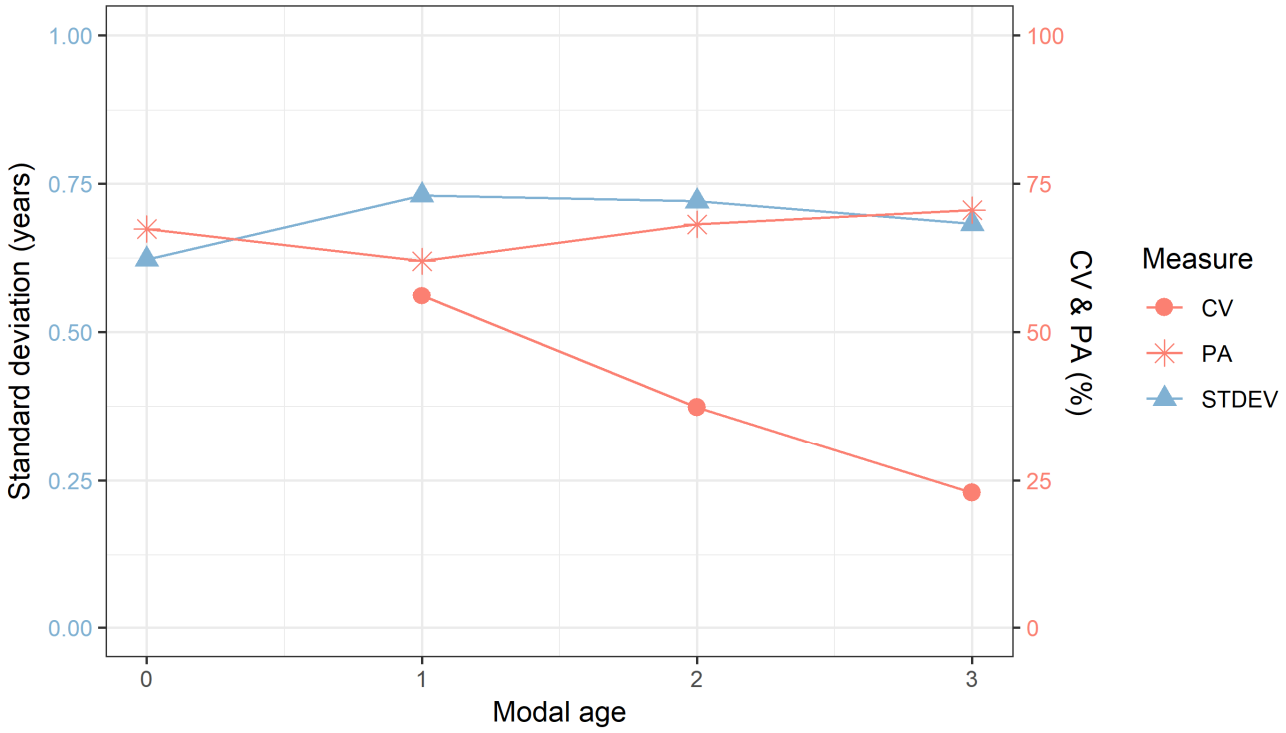


Figure 8.2.1: CV, PA and (STDEV (standard deviation) are plotted against modal age

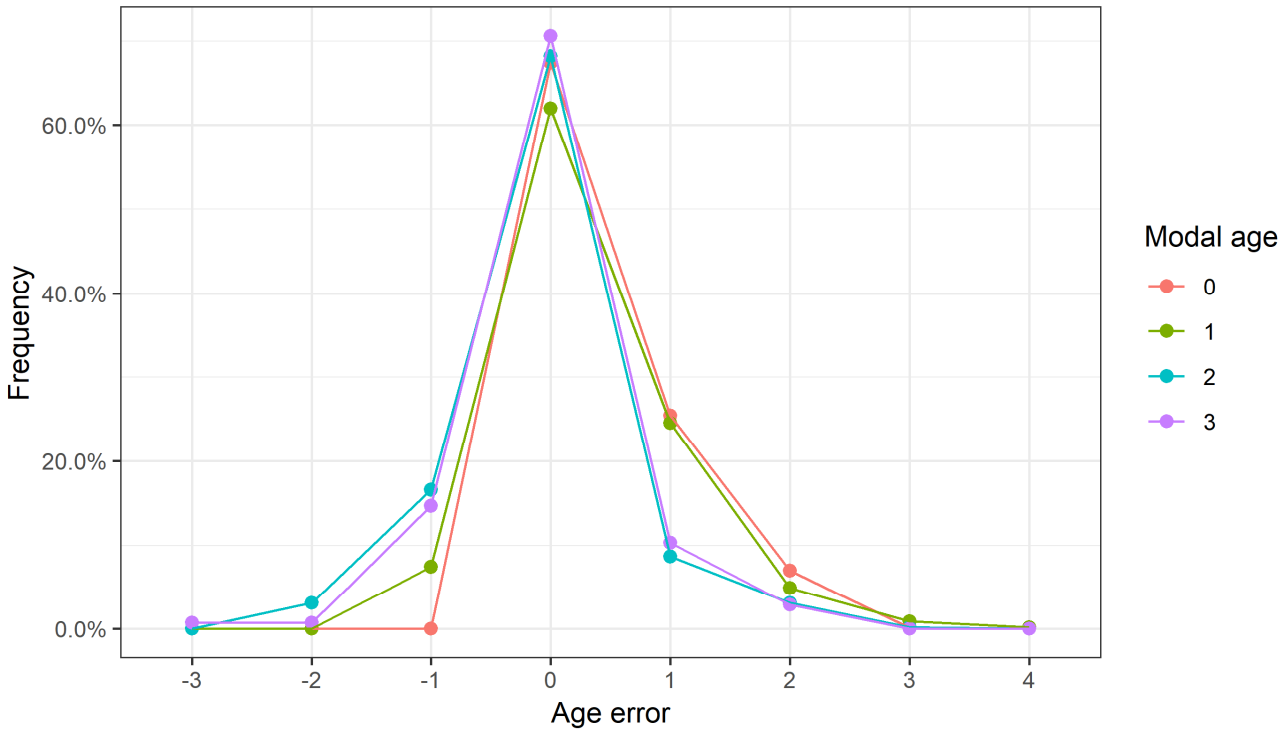


Figure 8.2.2: The distribution of the age reading errors in percentage by modal age as observed from the whole group of age readers in an age reading comparison to modal age. The achieved precision in age reading by MODAL age group is shown by the spread of the age readings errors. There appears to be no relative bias, if the age reading errors are normally distributed. The distributions are skewed, if relative bias occurs.

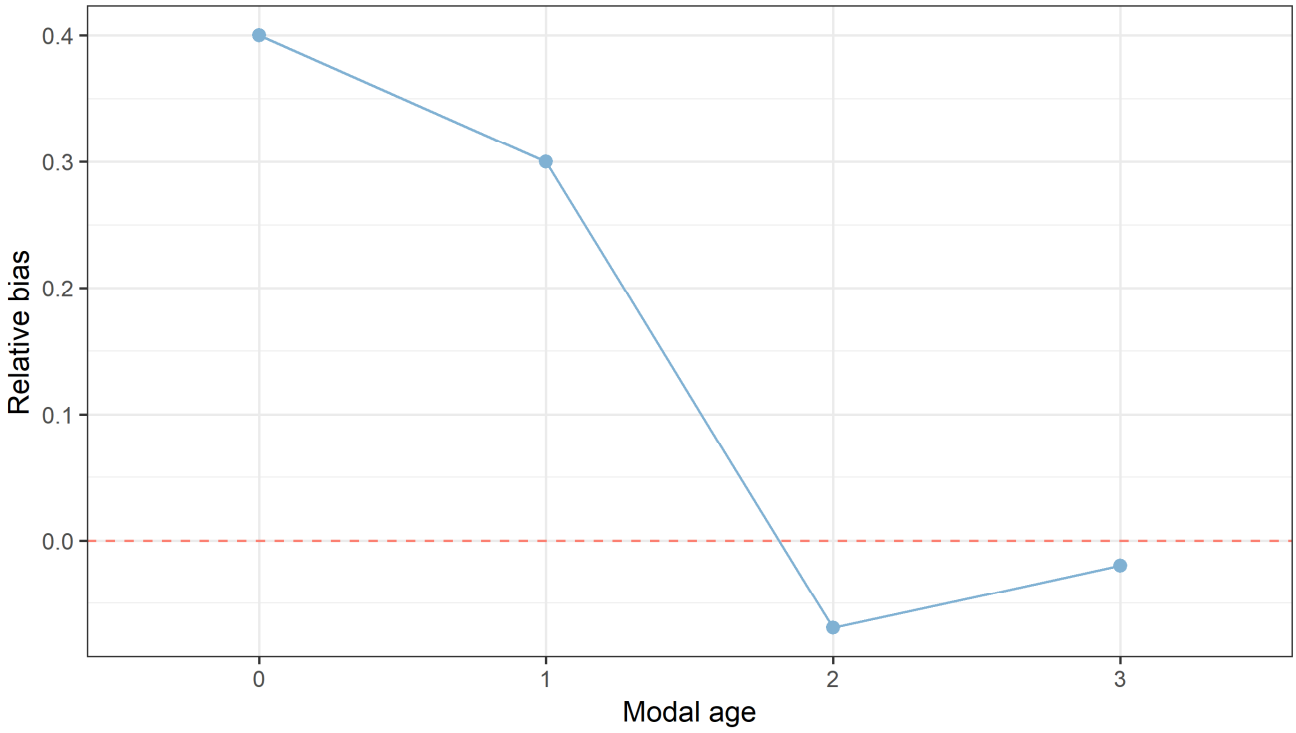


Figure 8.2.3: The relative bias by modal age as estimated by all age readers combined.

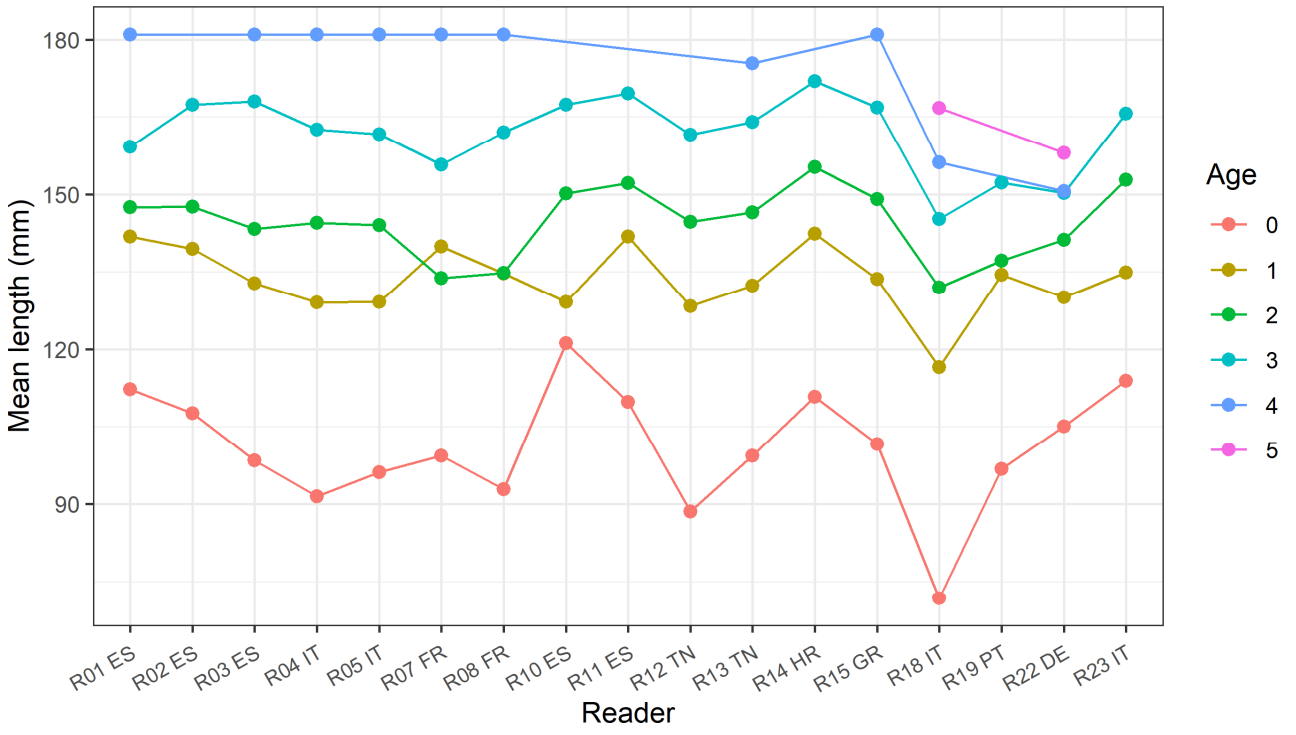


Figure 8.2.4: The mean length at age as estimated by each age reader.

9 Annex 2. Recommendations

- To carry out validation studies on age determination for the areas inhabited by the different anchovy stocks either via microincrement preparation (at least to validate the first annulus for each area) or by other methods as studies of progression of length frequency modes throughout time, for tracking cohorts, etc

- Intercalibration exercises by areas (for the different countries taking part in otolith age reading on the same stocks or adjacent stocks) are required. This becomes compulsory for regions where several countries exploit the same stock. For the Mediterranean area, in particular, given the high sharing of anchovy fish stocks among several countries, these intercalibration exercises are required and should be supported by the competent management organization (EU or FAO).

- In view of the current results and that there are new readers working with anchovy a new workshop is recommender to take place in 2021 to review age validation studies and to check the accuracy and precision of age determinations following the rules adopted for anchovy in the WKARA2 in 2016. Meanwhile, we recommend the readers to carefully read the WKARA2 report (where the age reading criteria and rules are detailed and there are many examples) and to review the collection of otoliths of reference that is in the Age Reader Forum from several areas and stocks.

- To review the convenience of setting the birthdate at the middle of the year for anchovies in some Mediterranean areas and to consider to move it to 1st January, because of the difficulties perceived during the exchange on the application of a changing rule for the first and second halves of the year (as associated to birthdate 1 July) for these stocks in the northern hemisphere (where winter marks are laid down around January-February).

10 Annex 3. Draft ToRs for next meeting

WKARA3 – Workshop on Age reading of European anchovy (*Engraulis encrasicolus*)

2021

A **Workshop on Age estimation of European anchovy** (***Engraulis encrasicolus)*** (WKARA3) chaired by Gualtiero Basilone & Andrés Uriarte (Provisional) in Mazara del Vallo (Sicily, IT) October 2021 (Provisional) to:

a) Review information on anchovy age determination, otolith exchanges, workshops and validation works done so far;
b) Analyse growth increment patterns in anchovy otoliths and to improve (if necessary) the guidelines for their interpretation;
c) Analyse the results of the exchanges carried out in 2018 and the potential source of discrepancies, in light of ToRs a) and b);
d) Increase existing reference collections of agreed aged otoliths by stocks and areas.
e) Address the generic ToRs adopted for workshops on age calibration (see 'WGBIOP Guidelines for Workshops on Age Calibration')

WKARA3 will report by XX for the attention of WGBIOP, SCICOM and ACOM.

Supporting Information

Priority:	Age determination is an essential feature in fish stock assessment to estimate the rates of mortality and growth. In order to arrive at appropriate management advice ageing procedures must be reliable. Age data are provided by different laboratories and countries using internationally agreed ageing criteria. It is necessary to continue to clarify the guideline of age interpretation. Therefore, otolith exchanges should be carried out on a regular basis, and if serious problems exist age reading workshops should be organised to solve these problems.
Scientific justification and relation to action plan:	The aim of the workshop is to identify potential problems in *Engraulis encrasicolus* age determination, assess variability of growth patterns among different ecosystems, improve the accuracy and precision of age determination, and share the methods and procedures used between different ageing laboratories. An otolith exchange was made in 2018 and at WKARA3 results from this otolith exchange will be presented and discussed. In view of the poor precision of age determination resulting from the exchange, for the workshop presentation of validation studies will be encouraged.
Resource requirements:	No specific resource requirements beyond the need for members to prepare for and participate in the meeting.
Participants:	In view of its relevance to the ICES quality assurance, the Workshop is expected to attract wide interest from both Mediterranean and Atlantic areas, ICES and GFCM. The Workshop tries to bring together international experts on anchovy age reading and fish growth and scientists involved in stock assessment to assess the accuracy and precision of the age determination.
Secretariat facilities:	None.
Financial:	
Linkages to advisory committees:	ACOM , GFCM
Linkages to other committees or groups:	SCICOM, WGBIOP, WGCOMEDA and WGHANSA
Linkages to other organisations:	WGSASP from GFCM

11Annex 4. Images of Bay of Biscay (ane.27.8) Figures 11.1 to 11.2

Figure 11.1. **Ane.27.8 (Bay of Biscay)**: Age Reading for anchovy ANE.27.8c-001.jpg (Fish SmartDots no. 1969), 123 mm, caught April 2017, 100% agreement Age 1 (excluding age quality 3 – AQ3). Conventional birthdates: 1st January. First upper right image contains the position of winter marks pointed out by all readers. The other images group the readers pointing out the winter mark at the same place.

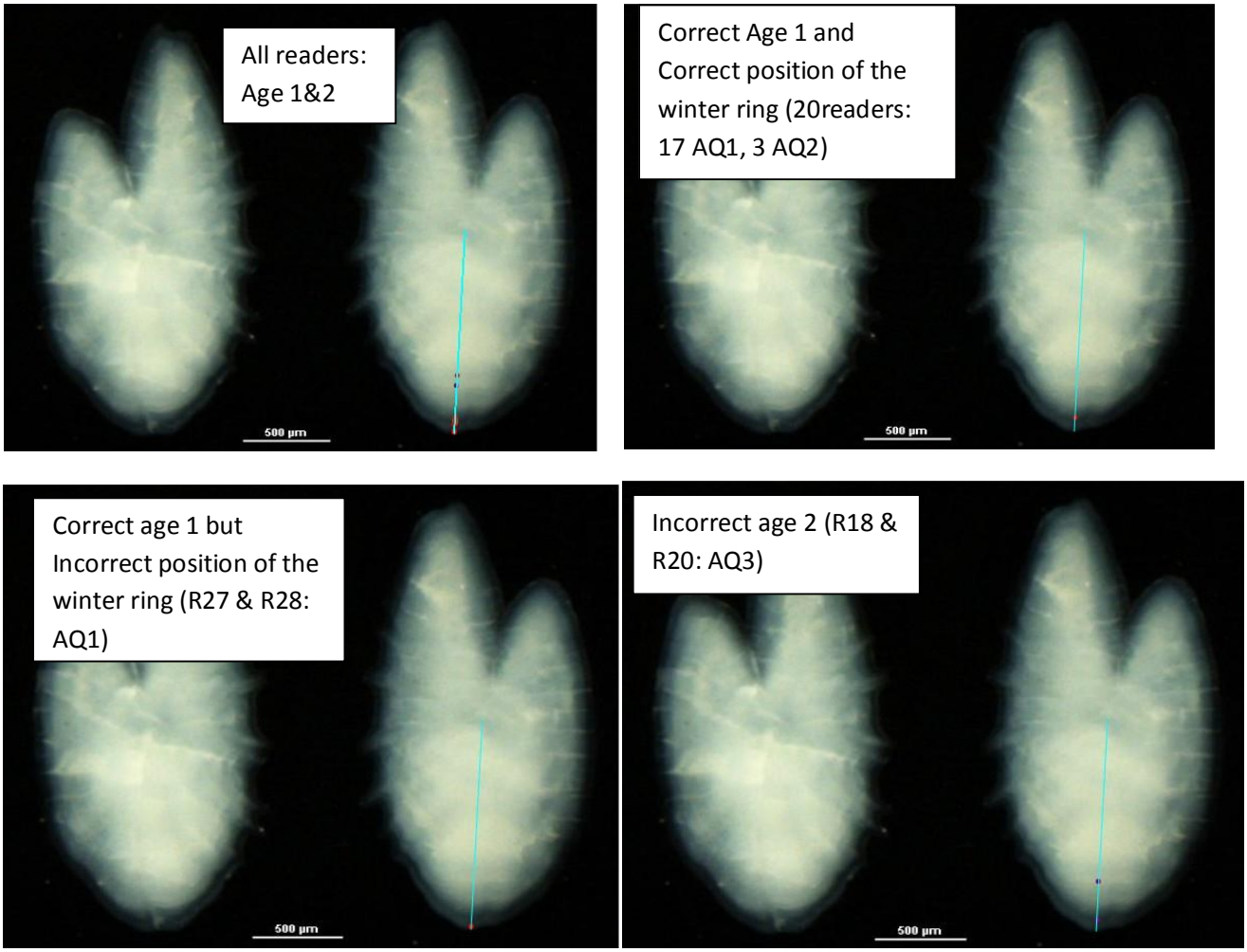
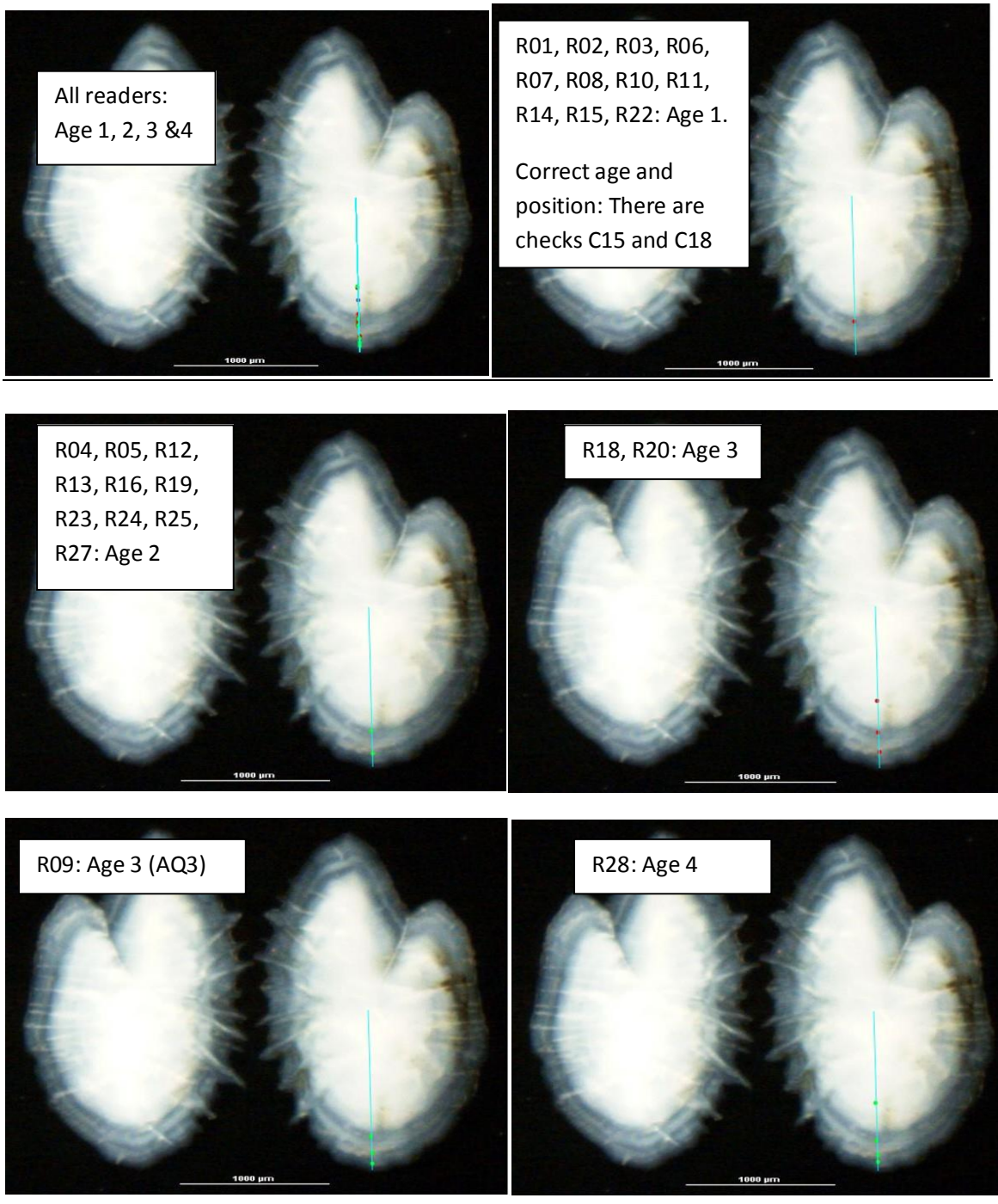


Figure 11.2. **Ane.27.8 (Bay of Biscay)**: Age Reading for anchovy ANE.27.8c-040 (Fish SmartDots no. 2008), 162 mm, caught October 2016, 46% agreement Age 1 (Expert readers Age 1 (67%); Stock readers Age 1 (100%)). Conventional birthdates: 1st January. The check marked as second winter mark in the third image is understood as a summer check by most of the expert readers and all area-stock readers (so age 1).This otolith illustrates that a bad recognition of the typical growth pattern and of checks leads to over estimation of the actual age (resulting in that case in a less intense growth pattern than expected in particular during the second year of life –as age 1).



12 Annex 5. Images of Strait of Sicily (GSA 16) Figures 12.1 to 12.2

Figure 12. 1. **GSA 16 (Strait of Sicily)**: Age Reading for anchovy AN16_53(120716)_67 (Fish SmartDots no. 2567), 69 mm, caught July 2016, 96% agreement Age 0. Conventional birthdates: 1st July. There is no winter mark (all is growth during its first months of life)

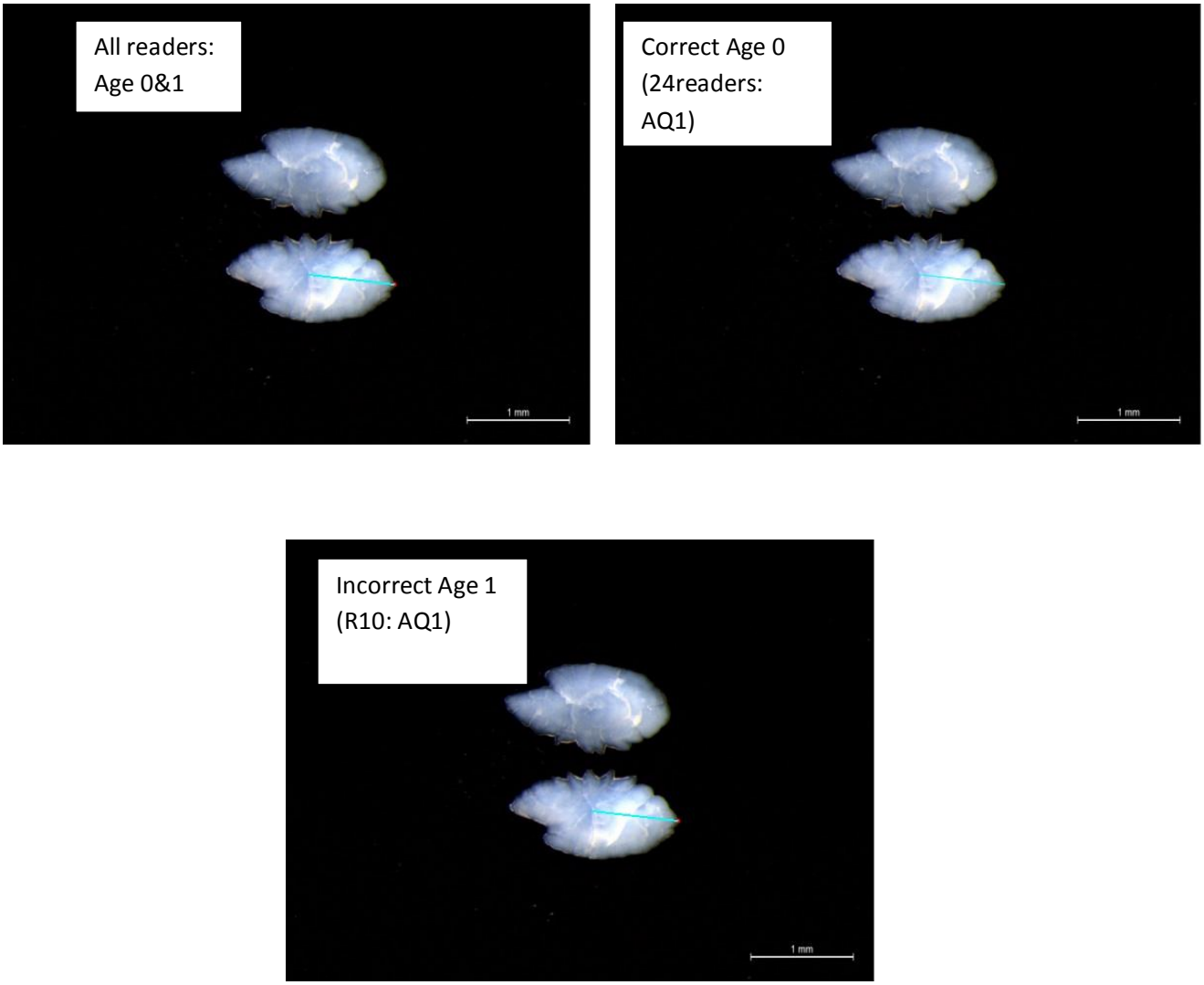
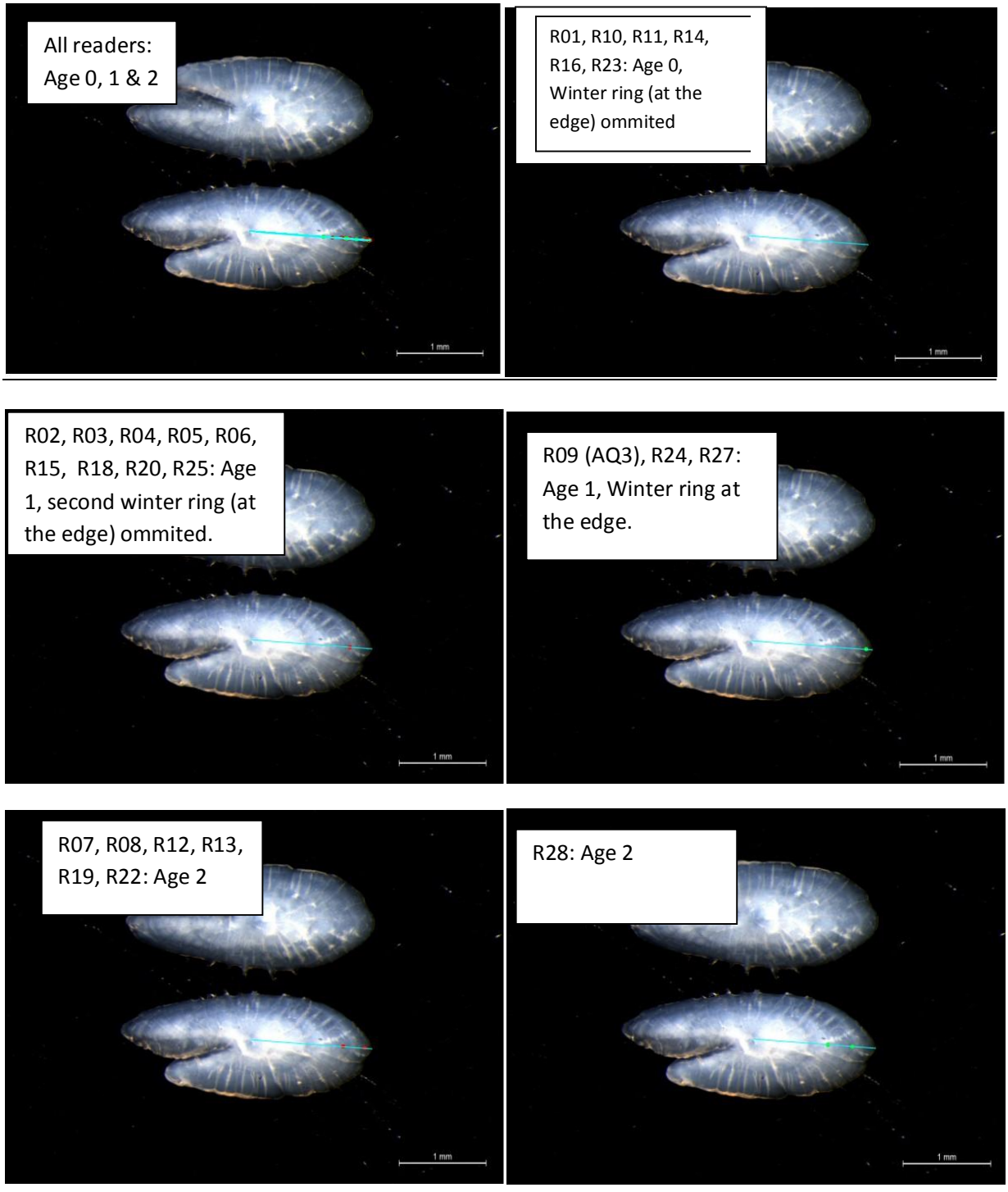


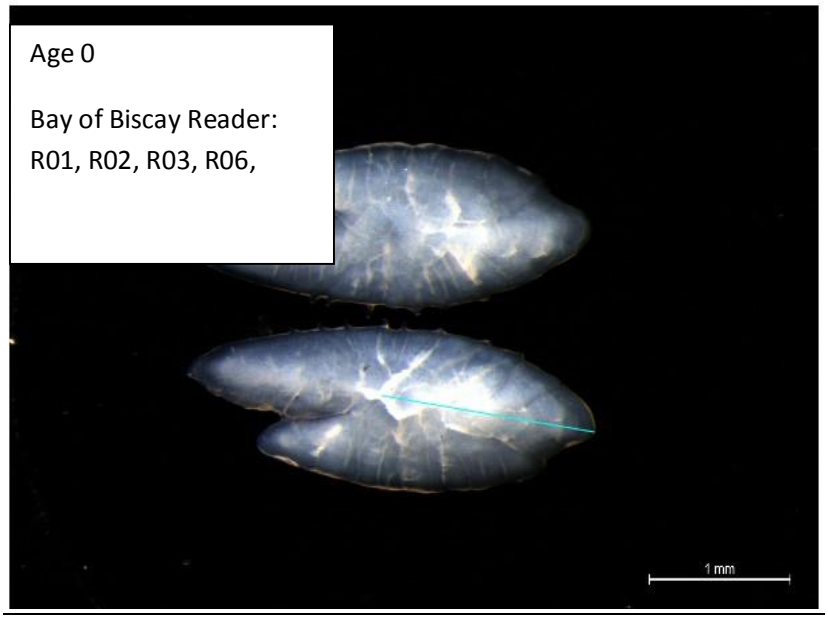
Figure 12. 2. **GSA 16 (Strait of Sicily)**: Age Reading for anchovy CB16_16(210116)_36 (Fish SmartDots no. 2538), 125 mm, caught January 2016, 48% agreement Age 1 (Expert readers Age 1 (46%); Stock readers Age 1 (100%). Conventional birthdates: 1st July. This exemplifies the complexity of winter mark identification among the several checks which can be seen (before first winter mark and after) for this GSA16 otoliths. Modal interpretation is the third figure (left middle image), where the second winter ring (at the edge) is ommited in order to avoid incorrect age determination in smartdot.



13 Annex 6. Images by semester, only with readers of Strait of Sicily and Bay of Biscay (Figures 13.1 to 13.9)

STRAIT OF SICILY (SEMESTER 1)

Figure 13.1. **GSA 16 (Strait of Sicily)**: Age Reading for anchovy CB16_21(210116)_58 (Fish SmartDots no. 2542), 124 mm, caught January 2016, 56% agreement Age 0. Conventional birthdates: 1st July. This is a typical case where there is single winter mark, and for the age determination rule for a birthdate first July this implies being age 0. Marking the winter mark in smartdot leads to wrong age determination as age 1 (as it assumes birthdate in January).



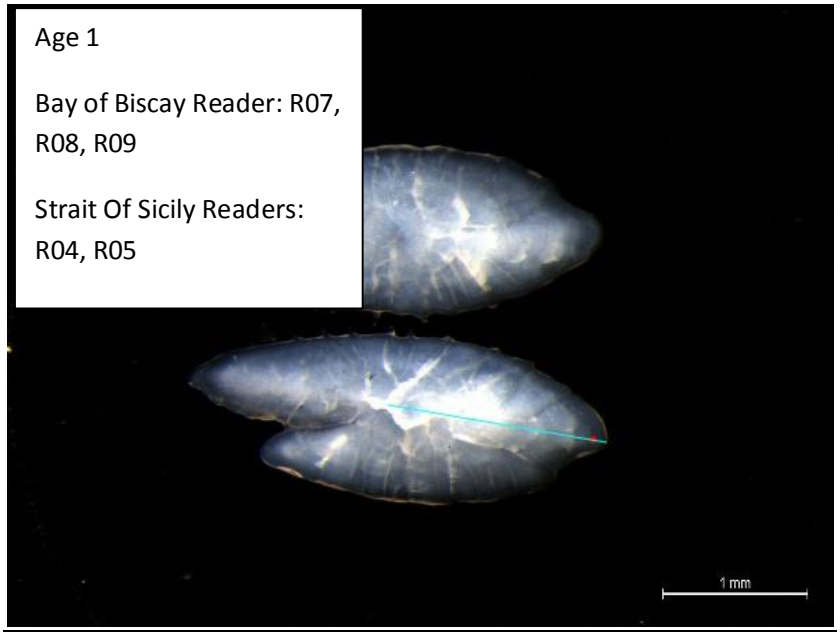
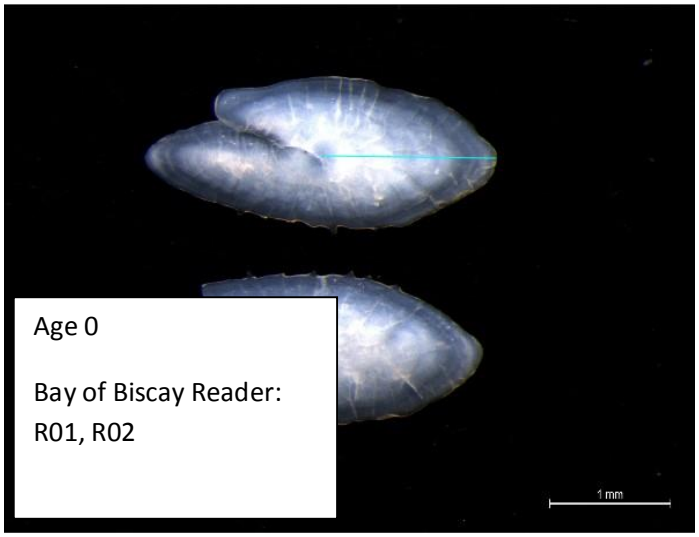


Figure 13.2. **GSA 16 (Strait of Sicily)**: Age Reading for anchovy CB16_25(300316)_46 (Fish SmartDots no. 2545), 117mm, caught March 2016, 50% agreement Age 1. Conventional birthdates: 1st July. An example where the interpretation of the edge as either a check or a winter mark leads to age assignment as age 0 or age 1 respectively (first two images). When both marks are marked as winter rings smartdot assigns wrongly this as age 2 (for a birth date in 1st July) (third image). Readers 07, 08 & 09 have annotated all winter marks they see and then smartdot assigned an age one year older than due for a birthdate 1st july.



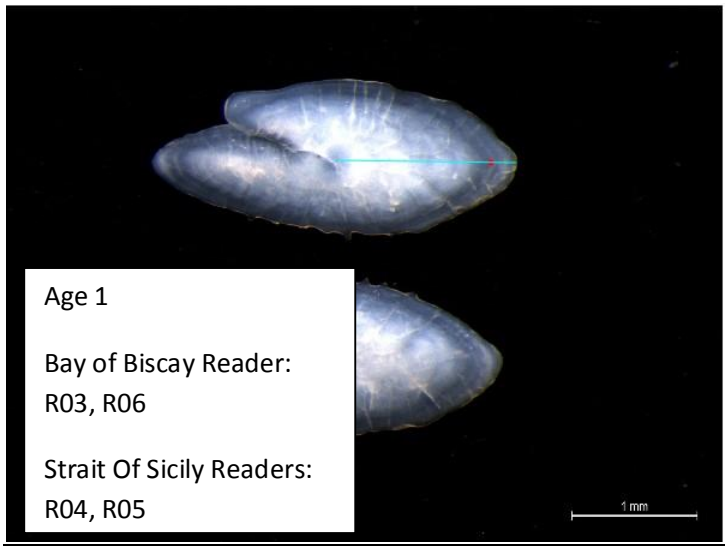
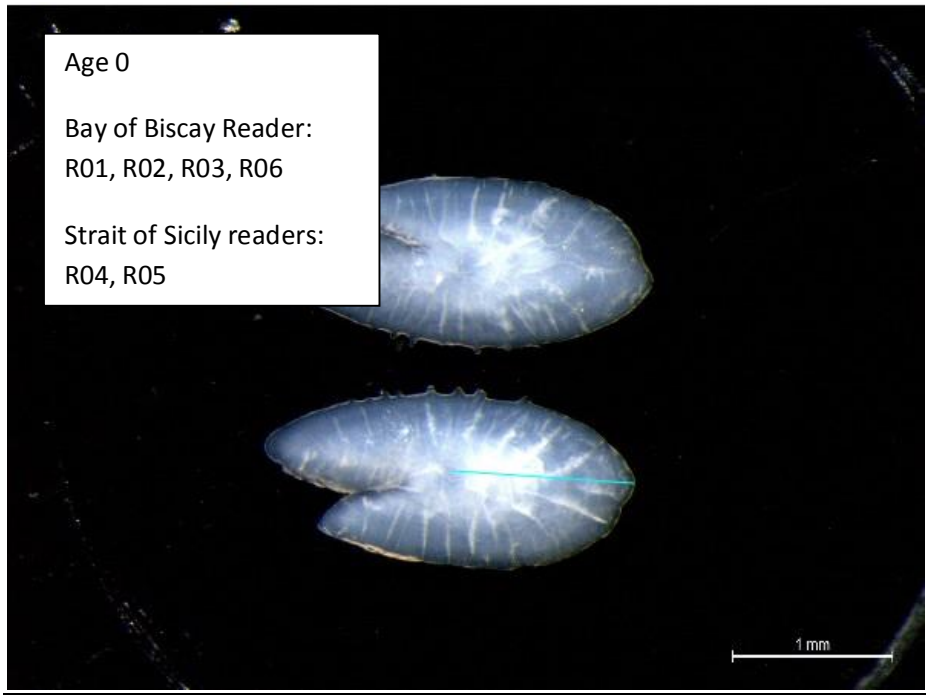
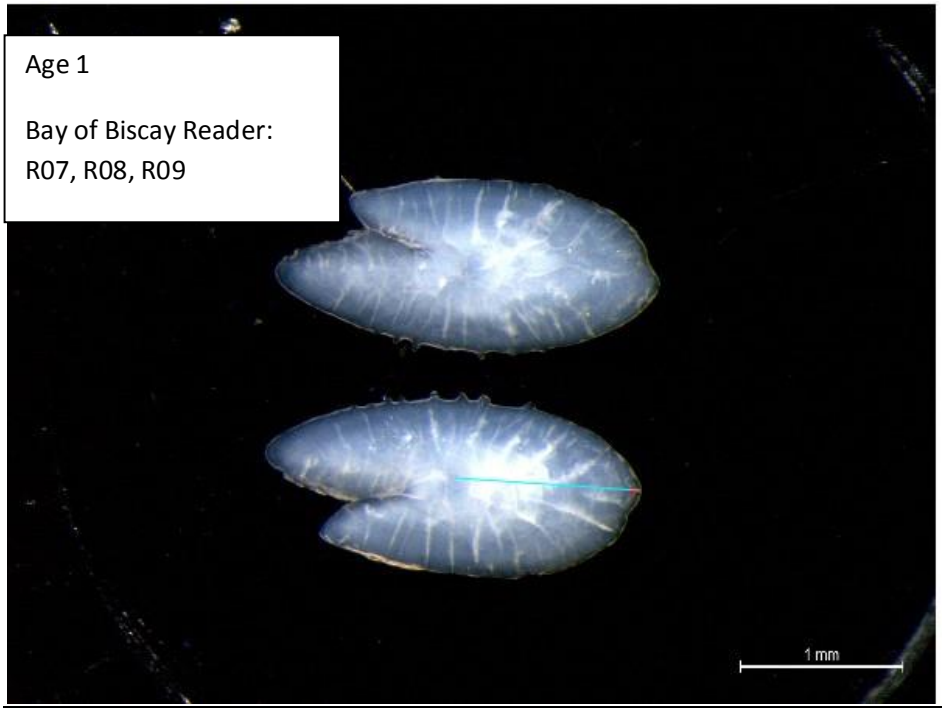


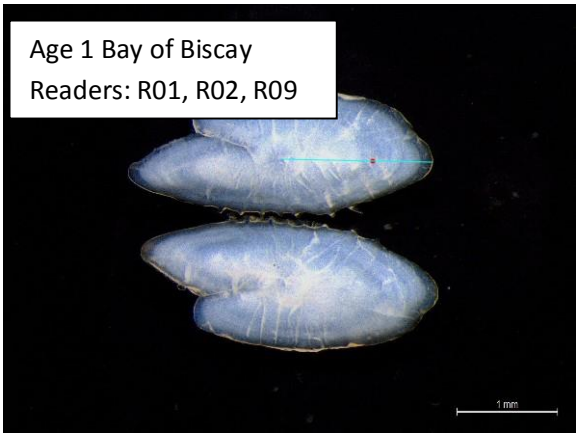
Figure 13.3. **GSA 16 (Strait of Sicily)**: Age Reading for anchovy CB16_14(280116)_60 (Fish SmartDots no. 2537), 100 mm, caught January 2016, 76% agreement Age 0. Conventional birthdates: 1st July. Here the first winter mark might be at the edge (as the start of a hyaline ring being formed). Marking it leads smartdot to wrongly assign it to age 1 (while for a birth date in 1st July this is just age 0 fish). Readers 07, 08 & 09 have annotated all winter marks they see and then smartdot assigned an age one year older than due for a birthdate 1st july.

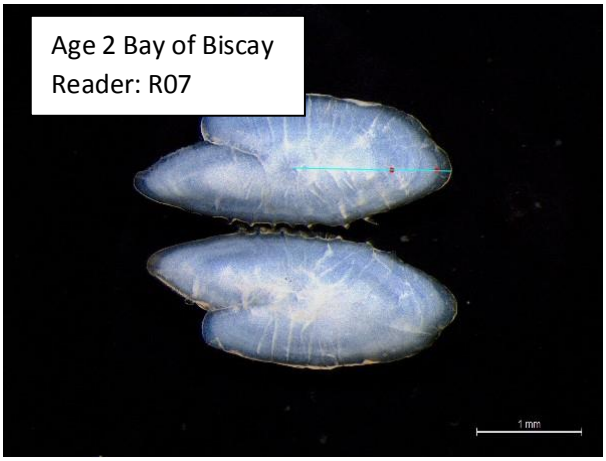


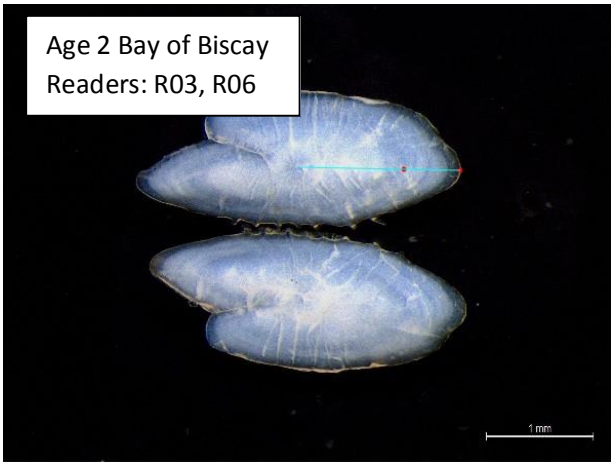


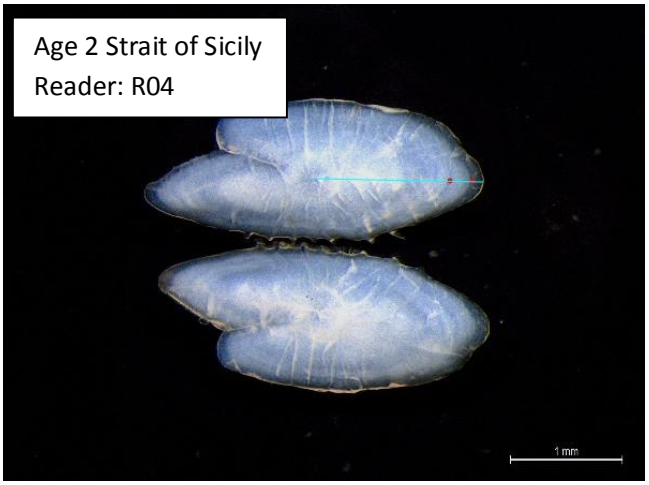
STRAIT OF SICILY (SEMESTER 2)

Figure 13.4. **GSA 16 (Strait of Sicily)**: Age Reading for anchovy CB16_82(140916)_45 (Fish SmartDots no. 2604), 133 mm, caught September 2016, 50% agreement Age 1 (all readers). Conventional birthdates: 1st July. This is an example of different identification of winter mark (and positions). It is not obvious what the true age is: correct interpretation might well be age 2 (third image), but this is uncertain.









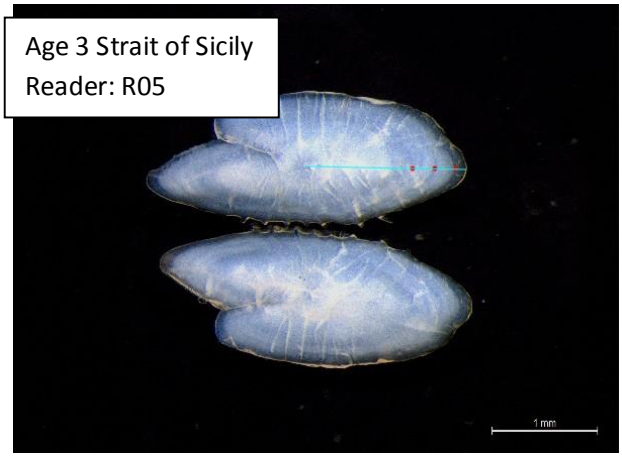
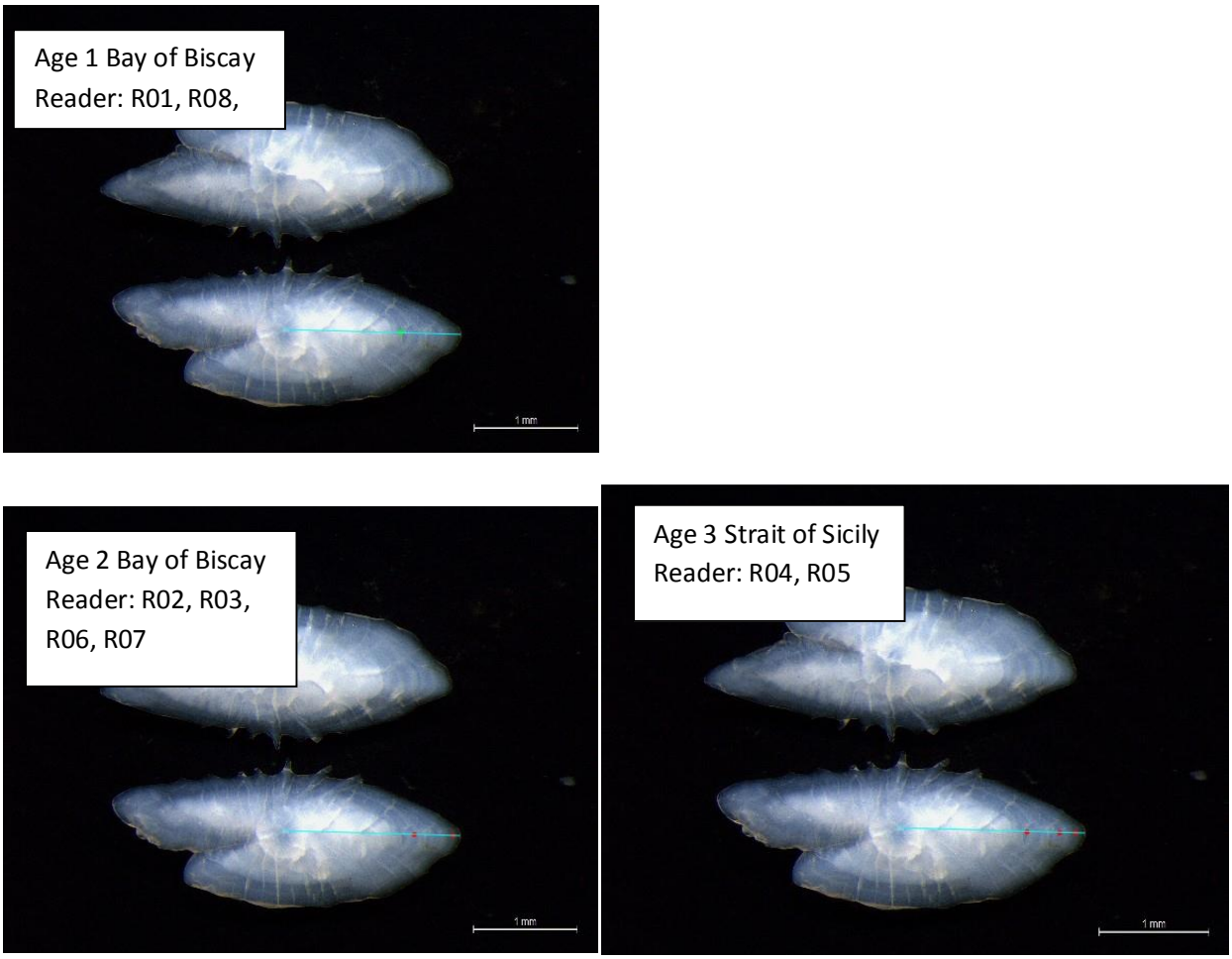


Figure 13.5. **GSA 16 (Strait of Sicily)**: Age Reading for anchovy CB16_89(250716)_30 (Fish SmartDots no. 2594), 147 mm, caught July 2016, 39% agreement Age 1. Conventional birthdates: 1st July. This is an example of different identification of winter mark (and positions). This is probably an individual 1 or 2 years old (first and second images), depending on whether the hyaline edge is a summer check of an age 1 fish, or a winter ring not followed yet by the opaque growth of the year.



BAY OF BISCAY (SEMESTER 1)

Figure 13.6. **Ane.8 (bay of Biscay)**: Age Reading for anchovy 02_IM17SEGPES_001_13 (Fish SmartDots no. 2651), 144 mm, caught March 2017, 70% agreement Age 1. Conventional birthdates: 1st January. This is a fish of age 1 (first image). Counting inner checks as true winter marks leads to ages older (second image) than age 1.

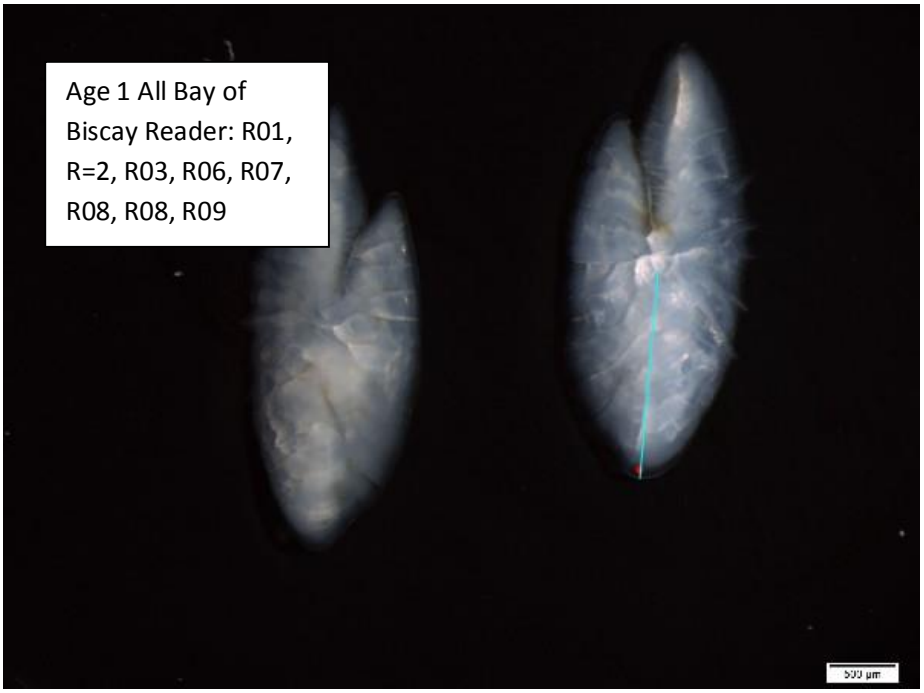
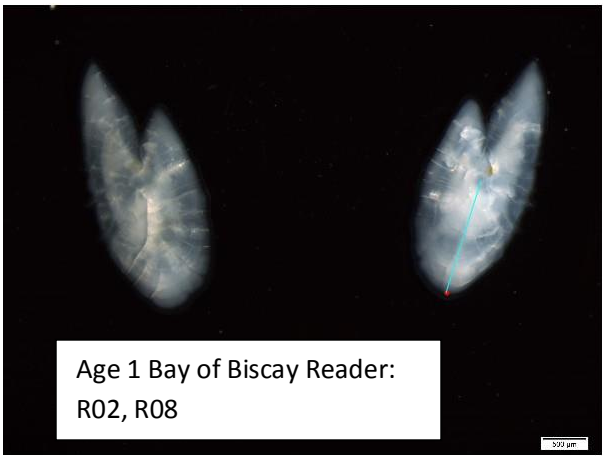
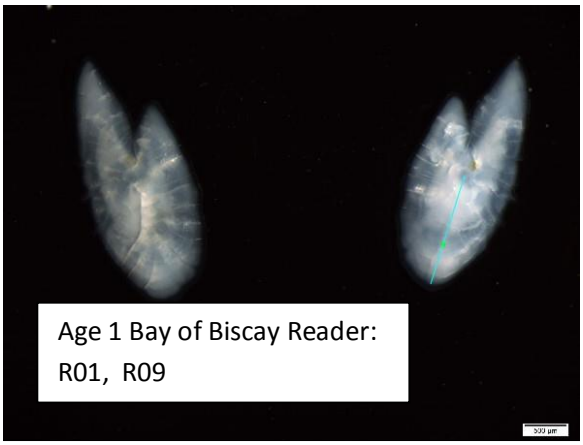
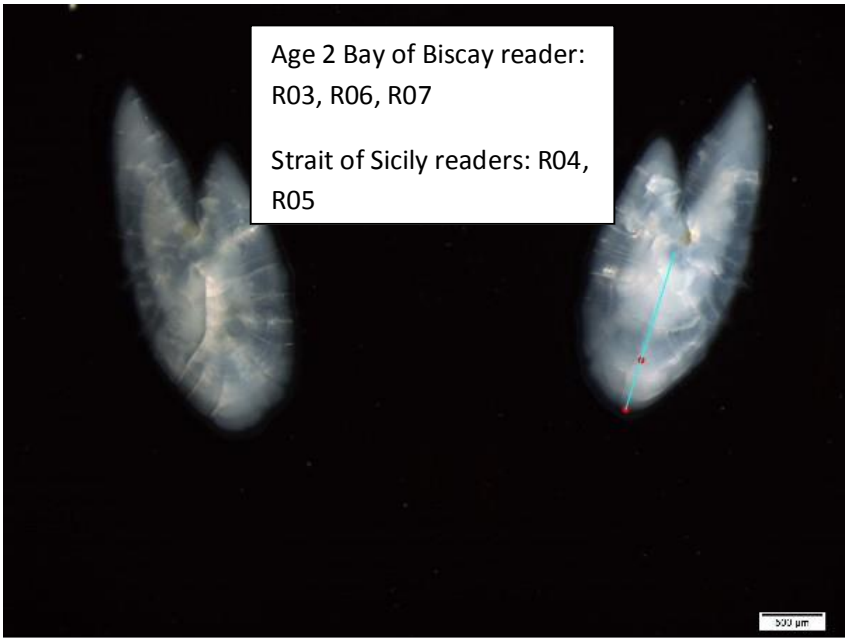


Figure 13.7. **Ane.8 (bay of Biscay)**: Age Reading for anchovy 08_IM17SEGPES_048_11 (Fish SmartDots no. 2657), 151 mm, caught April 2017, 42% agreement Age 1. Conventional birthdates: 1st January. Despite general agreement on age 1 the fact that the first mark resembles a check leads to different annotations of the first winter mark. If the inner mark and the edge are taken as winter rings then age 2 is assigned (third image).







BAY OF BISCAY (SEMESTER 2)

Figure 13.8. **Ane.8 (bay of Biscay)**: Age Reading for anchovy ANE.27.8c-023 (Fish SmartDots no. 1991), 102 mm, caught October2017, 76% agreement Age 0. Conventional birthdates: 1st January. Even if the edge may show partly hyaline, this is to be understood as age 0, because if this would be an age 1, the first winter mark in October should be placed well inside the otolith (before starting the growth of its second year of life). When marked as first winter ring (of the next coming winter) then SmartDots assignes the fish as 1 y.o. Therefore no winter ring is to be marked to prevent such wrong age determination, even though the reader may suspect the next coming winter ring is being formed.

Figure 13.9. **Ane.8 (bay of Biscay)**: Age Reading for anchovy ANE.27.8c-023 (Fish SmartDots no. 1991), 102 mm, caught October2017, 76% agreement Age 0. Conventional birthdates: 1st January. Most of the readers from the Bay of Biscay interpret as check the mark within the otolith, while the readers from Sicily consider it to be a winter mark. For the bay of Biscay readers admitting this mark to be a winter ring would imply a too little growth of the year until October for a supposed 1 year old fish, hence such contradiction supports the interpretation of the mark as a check.