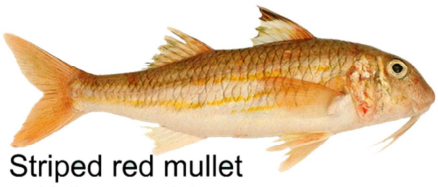
Report of the striped red mullet (*Mullus surmuletus*) and red mullet (*Mullus barbatus*) Exchange 2016



Striped red mullet
Mullus surmuletus

Red mullet
Mullus barbatus

Mahé K., Anastasopoulou, A., Bekas, P., Carbonara, P., Casciaro, L., Charilaou, C., Elleboode, R., Gonzalez, N., Guijarro, B., Indennidate, A., Kousteni, V., Massaro, A., Mytilineou, Ch., Ordines, F., Palmisano, M., Panfili, M., Pesci, P., 2016. Report of the Striped red mullet (*Mullus surmuletus*) and Red mullet (*Mullus barbatus*) Exchange 2016. 21pp.

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1. Introduction

In September 2015, the Working Group on Biological Parameters (WGBIOP) recommended an otolith exchange for *Mullus surmuletus* and *Mullus barbatus* in 2016 (Otolith Exchanges proposals for 2016/2017; ICES, 2015). Kélig Mahe (IFREMER, France) was decided to be the responsible to organise this otolith exchange. Two otolith exchanges (2008, 2011), and two age reading workshops (ICES, 2009; 2012), have been taken place until now (Mahé *et al*., 2012).

2. Participants

A total of 13 readers from 5 countries (France, Spain, Italy, Cyprus and Greece) have participated at this exchange (Tab. 1).

Table 1: List of the readers.

Reader	Name	Country	Institution
1	Elleboode Romain	France	Ifremer
2	Charilaou Charis	Cyprus	Minist Agr Nat Resources & Environm
3	Casciaro Loredana	Italy	Coispa Tecnologia & Ricerca
4	Carbonara Pierluigi	Italy	Coispa Tecnologia & Ricerca
5	Panfili Monica	Italy	Italian Society for Marine Biology (ISMAR-CNR)
6	Massaro Andrea	Italy	Italian Society for Marine Biology
7	Ordines Francesc	Spain	IEO
8	Guijarro Beatriz	Spain	IEO
9	Gonzalez Natalia	Spain	IEO
10	Palmisano Michele	Italy	Coispa Tecnologia & Ricerca
11	Indennidate Antonella	Italy	Italian Society for Marine Biology
12	Kousteni Vasiliki Anastasopoulou Aikaterini Mytilineou Chryssi Bekas Petros	Greece	Hellenic Centre for Marine Research
13	Pesci Paola	Italy	Italian Society for Marine Biology

3. Sample collection

A total of 465 otoliths from the Mediterranean area, collected from 2011 to 2014, were provided by 3 Institutes (IEO, ISMAR-CNR and DFMR) (Tab. 2, 3; Fig. 1).

Table 2: Samples examinedby *Mullus* species, area and year.

Species	Areas	2011	2012	2013	2014	Total
M. barbatus	Central Adriatic Sea (1)				117	117
	Cyprus (2)	50	15	37	7	109
	Levantine Spain (3)				119	119
M. surmuletus	Balearic Islands (4)				120	120
Total		**50**	**15**	**37**	**363**	**465**

Samples came from both the MEDITS survey and commercial fisheries. The *M. surmuletus* from Balearic Islands were caught by the trawlers (n=68) and trammel nets (n=52). For *M.barbatus from* Levantine Spain, they were sampled by trawlers (n=120).

Figure 1: Map of *Mullus* species sampling areas (*M. barbatus* : 1, 2 & 3 ; *M. surmuletus* : 4) (*Source*: https://en.wikipedia.org/wiki/Mediterranean_Sea#/media/File:Mediterranee_02_EN.jpg).

M. surmuletus length distribution ranged from 160 to 314 mm TL, whereas that of *M. barbatus* included smaller individuals (86-267 mm TL) (Fig. 2). *M. barbatus* samples came from 3 different geographical areas, while *M. surmuletus* from only one (Table 2, Fig.1). The smallest specimens, not exceeding 180 mm of total length, came from the Central Adriatic Sea, while those off Levantine Spain coasts ranged from 126 to 270 mm of TL (Fig. 2).

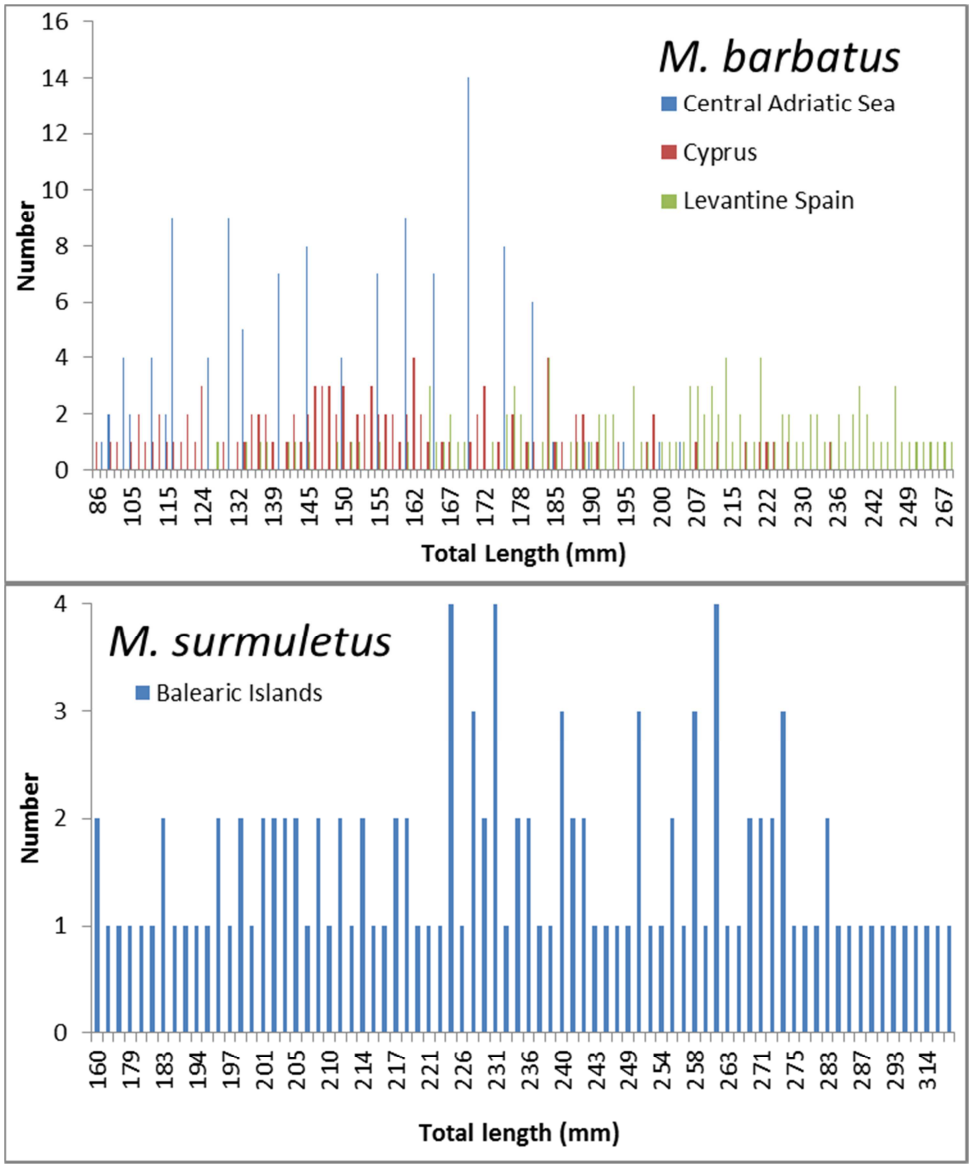

Figure 2: Length distribution of *Mullus* species by geographical areas.

4. Reading procedure

The WebGR tool was used for this exchange. The image of each otolith and the related necessary information (e.g. TL, sex, capture date) were uploaded to WebGR (http://webgr.azti.es/ce/search/myce). The use of WebGR tool has some advantages: (i) it can facilitate and accelerate the whole exchange process, (ii) it provides annotated images for every otolith, which enables to compare age readings directly and identify possible sources of bias and (iii) it facilitates the chairman to compile the results. However, the use of WebGR has also some limits: (i) It is not a very intuitive tool, (ii) it can be jammed and (iii) it is not always possible to upload a large batch of images (compatibility problems of the csv files with Windows 7).

The age was assigned taking into account the number of the transparent rings in each otolith image. All data were extracted from the WebGR and afterwards, the level of agreement between the age-readers was estimated using the Guus Eltink spreadsheet (Eltink, 2000).

5. Analysis of readings

The spreadsheet (Eltink, 2000) was completed according to the Guidelines and Tools for Age Reading Comparisons (Eltink *et al.*, 2000). Modal age was calculated for each otolith, as well as the percentage of agreement (PA), the coefficient of variation (CV) and the average percent error (APE) according to the following formulas:

$$PA = \frac{\sum |n_{diff} \leq 1|}{n}$$

$$CVj(\%) = 100.\frac{\sqrt{\sum_{i=1}^{R} \frac{(X_{ij} - X_j)^2}{R-1}}}{x_j}$$

where R is the number of times each fish is aged, X_{ij} is the i^{th} age determination of the j^{th} fish, X_j is the mean age calculated for the j^{th} fish, and n_{diff} is the difference in age determination between the two readers reading..

$$APEj(\%) = 100.\frac{1}{R}\sum_{i=1}^{R} \frac{|Xij + Xj|}{Xj}$$

where x_{ij} is the i^{th} age determination of the j^{th} fish, x_j is the average age calculated for the j^{th} fish and R is the number of times each fish was aged.

Moreover, the average values of the above precision indices were calculated by species and area.

6. Results

6.1. Precision

The results of the precision[1] analysis (including the average CV, APE and PA) by species and area are presented in Table 3. The results showed low precision with the PA ranging from 56 to 67%, the CV from 32 to 64% and the APE from 1.9 to 3.6%.

Table 3: Reading's precision by *Mullus* species.

Species	Geographical area	Otoliths (number)	Length Range (cm)	Age range (year)	PA (%)	CV (%)	APE (%)
M. barbatus	Central Adriatic Sea	117	9.0/20.5	0/3	65.0	64.6	3.60
M. barbatus	Cyprus	109	8.6/23.5	1/3	67.0	60.9	3.45
M. barbatus	Levantine Spain	119	12.6/27.9	1/4	62.7	32.5	1.87
M. surmuletus	Balearic Islands	120	16.0/32.6	0/5	56.2	31.7	1.91

The coefficient of variation (CV), percent agreement (PA) and the standard deviation (STDEV) were plotted against the MODAL age (Fig. 3). The results by area and species showed the same trend with the first age groups presenting the higher CV values and in some cases lower PA values. These results could be explained by the position of the first growth increment and the two different approaches of reading interpretation used by the readers (ICES, 2012).

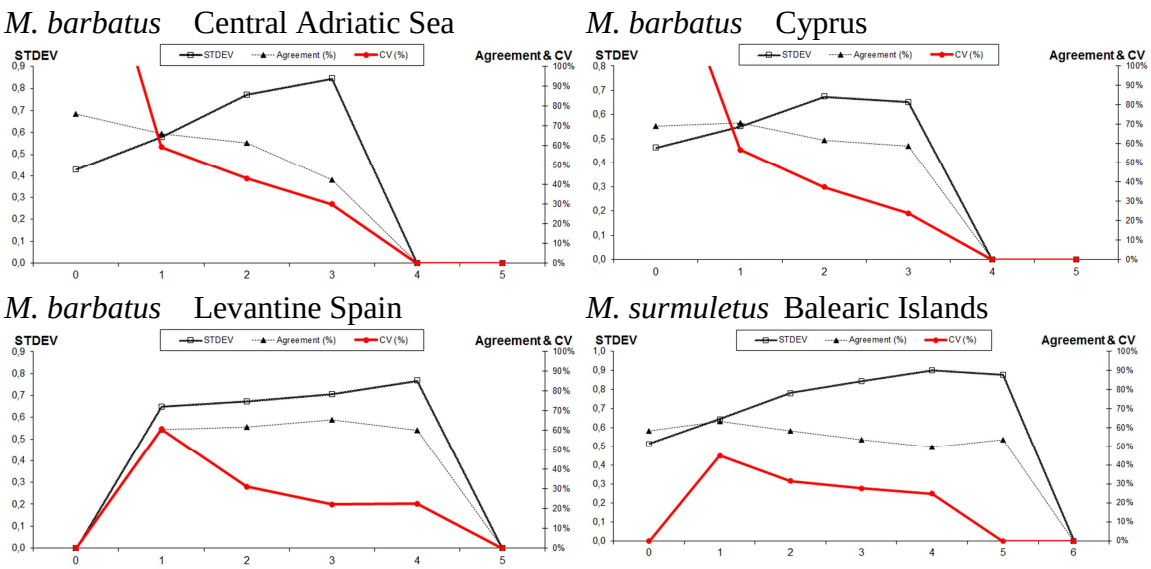

Figure 3: The coefficient of variation (CV), percent agreement (PA) and the standard deviation (STDEV) are plotted against MODAL age by *Mullus* species and geographical area.

CV is much less age dependent than the standard deviation (STDEV) and the percent

[1] Precision is defined as the variability in the age readings. The precision's errors in age readings are better described by the coefficient of variation (CV) by age group. This measure of precision is independent of the closeness to the true age (ICES, 2007).

agreement (PA). CV is therefore a better index for the precision in age reading. Problems in age reading are indicated by the relatively high CV's at age.

6.2. Relative bias (Accuracy)[2]

The minimal requirement for age reading's consistency is the absence of bias among readers and through time. The hypothesis of an absence of bias between two readers or between a reader and the modal age estimated can be tested non-parametrically with a one-sample Wilcoxon signed rank test.

6.2.1. Mullus barbatus

For *Mullus barbatus* otoliths, bias was observed between the majority of the readers and between the readers' readings and the modal ages. There was no bias between three of the readers and the modal age (23% of the readers; Table 4).

Table 4: Inter-reader bias test and reader against modal age bias test of *Mullus barbatus* otoliths (-: no sign of bias (p>0.05); *: possibility of bias (0.01<p<0.05); **: certainty of bias (p<0.01)).

		Reader1	Reader2	Reader3	Reader4	Reader5	Reader6	Reader7	Reader8	Reader9	Reader10	Reader11	Reader12	Reader13
		France	Cyprus	Italy	Italy	Italy	Italy	Spain	Spain	Spain	Italy	Italy	Greece	Italy
Reader1	France													
Reader2	Cyprus	**												
Reader3	Italy	**	**											
Reader4	Italy	**	–	**										
Reader5	Italy	**	**	**	**									
Reader6	Italy	**	**	–	*	**								
Reader7	Spain	**	**	**	**	**	**							
Reader8	Spain	**	**	**	**	**	**	–						
Reader9	Spain	**	**	**	**	**	**	**	*					
Reader10	Italy	**	–	**	*	**	**	**	**	**				
Reader11	Italy	**	–	**	*	**	**	**	**	**	–			
Reader12	Greece	**	**	–	*	–	–	**	**	**	**	*		
Reader13	Italy	**	**	**	**	**	**	**	**	**	**	**	**	
MODAL	age	**	**	–	**	**	–	**	**	**	**	**	–	**

6.2.2. Mullus surmuletus

For *Mullus surmuletus* otoliths, bias was observed between the majority of the readers and between the readers' readings and the modal ages. There was no bias between two of the readers and the modal age (15% of the readers; Table 5).

[2] In absence of calcified structures of known age, the age readings can be compared to modal age, which is defined as the age determined for an individual structure whose most of the readers have a preference. Relative bias can be defined as a systematic over- or underestimation of age compared to the modal age. The age reading comparisons to modal age provide a low estimate of relative bias compared to absolute bias, when most readers have a similar serious bias in age reading (ICES, 2007).

Table 5: Inter-reader bias test and reader against modal age bias test of *Mullus surmuletus* otoliths (-: no sign of bias (p>0.05); *: possibility of bias (0.01<p<0.05); **: certainty of bias (p<0.01)).

		Reader1	Reader2	Reader3	Reader4	Reader5	Reader6	Reader7	Reader8	Reader9	Reader10	Reader11	Reader12	Reader13
		France	Cyprus	Italy	Italy	Italy	Italy	Spain	Spain	Spain	Italy	Italy	Greece	Italy
Reader1	France													
Reader2	Cyprus	**												
Reader3	Italy	**	**											
Reader4	Italy	**	**	–										
Reader5	Italy	**	**	**	**									
Reader6	Italy	**	**	**	**	–								
Reader7	Spain	**	**	**	**	**	**							
Reader8	Spain	**	**	**	**	**	**	**						
Reader9	Spain	**	**	–	–	**	**	**	**					
Reader10	Italy	**	**	–	–	**	**	**	**	–				
Reader11	Italy	*	**	**	**	**	**	**	**	**	**			
Reader12	Greece	–	**	**	**	**	**	**	**	**	**	**		
Reader13	Italy	**	**	–	–	*	*	**	**	**	–	**	**	
MODAL age		**	**	**	**	**	–	**	**	–	**	**	**	**

7. Images of reference

7.1. Mullus barbatus

Among the otoliths of *Mullus barbatus* (n=345), only three otoliths presented 100% agreement between the readers.

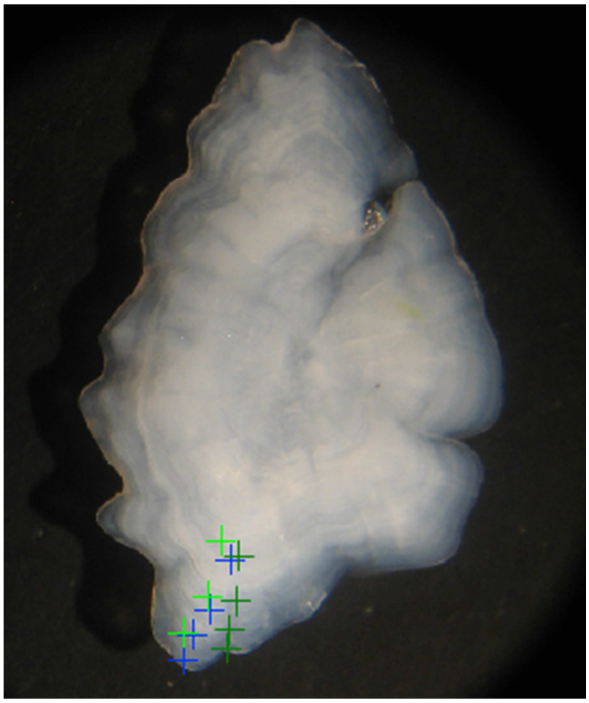

Figure 4: *Mullus barbatus* otolith image (MS-lev2015-04.JPG) from the Levantine Spain annotated by 13 readers on the WebGr tool with 100% of agreement. The specimen was female 3 years old (236 mm TL) caught in February 2014.

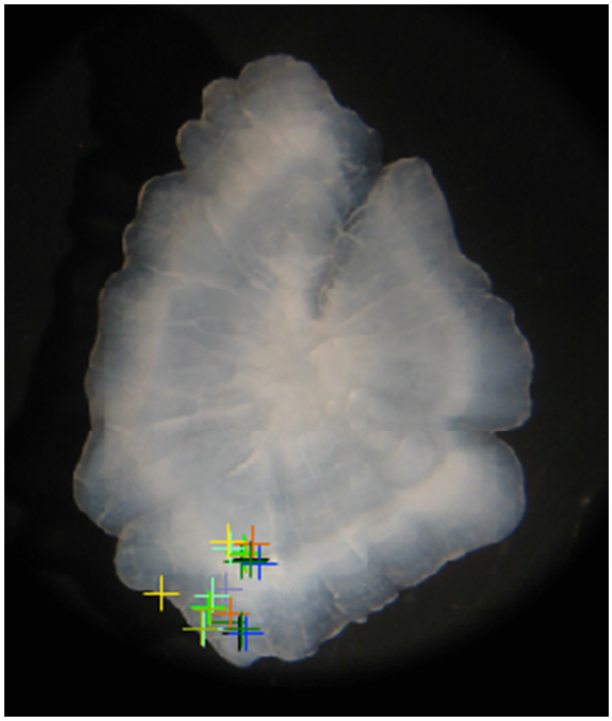

Figure 5: *Mullus barbatus* otolith image (MS-lev2015-31.JPG) from the Levantine Spain annotated by 13 readers on the WebGr tool with 100% of agreement. The specimen was male 2 years old (182 mm TL), caught in April 2014.

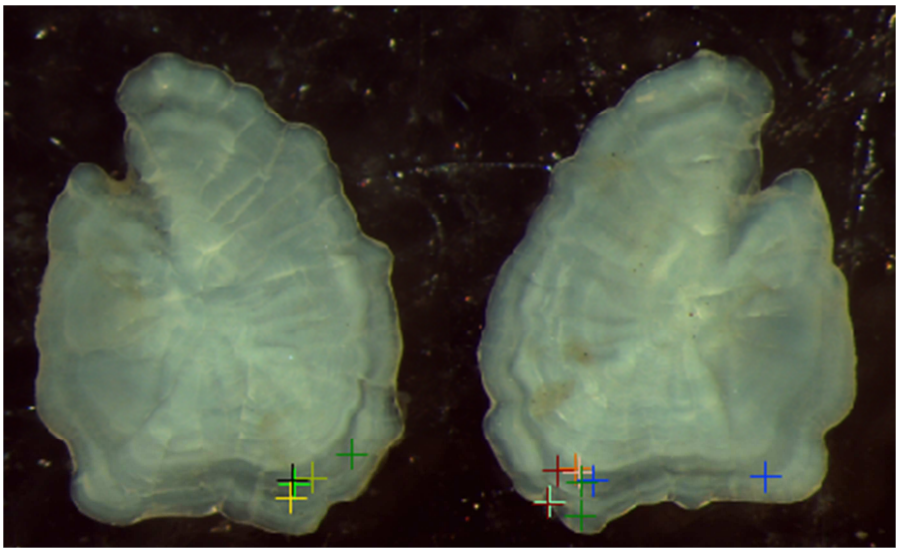

Figure 6: *Mullus barbatus* otolith image (mb 4363.JPG) from the Central Adriatic Sea annotated by 13 readers on the WebGr tool with 100% of agreement. The specimen was male 1 year old (130 mm TL) caught in August 2014.

7.2. *Mullus surmuletus*

Among the otoliths of *Mullus surmuletus* (n=120), only one otolith presented 100% agreement between the readers.

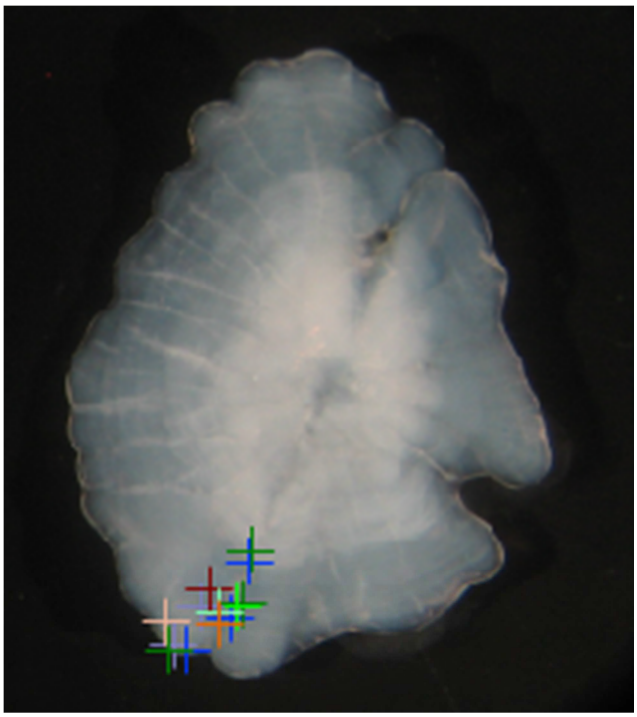

Figure 7: *Mullus surmuletus* otolith image (ms-balea-2015-59. JPG) from the Balearic Islands annotated by 13 readers on the WebGr tool with 100% of agreement. The specimen was male 1 year old (179 mm TL) caught in August 2014.

8. Abstract

In September 2015, the Working Group on Biological Parameters (WGBIOP) recommended an otolith exchange for *Mullus surmuletus* and *Mullus barbatus* in 2016 (Otolith Exchanges proposals for 2016/2017; ICES, 2015). Kélig Mahe (IFREMER, France) was decided to be the responsible to organise this otolith exchange. Two otolith exchanges (2008, 2011), and two age reading workshops (ICES, 2009; 2012), have been taken place until now (Mahé *et al*., 2012).

A total of 13 readers from 5 countries (France, Spain, Italy, Cyprus and Greece) participated at the exchange of 2016. The otoliths of 465 individuals (345 *M. barbatus* & 120 *M. surmuletus*), sampled from 2011 to 2014 in the Mediterranean Sea (Central Adriatic Sea, Cyprus, Levantine Spain coasts, Balearic Islands) were used for this exchange. For both *Mullus* species, the precision values were very low, the PA ranged between 56 and 67% the CV ranged from 32 to 64% and the APE ranged from 1.9 to 3.6%. The results by area and species showed the same trend with the first age groups presenting the higher CV values and in some cases lower PA values. These results could be explained by the position of the first growth increment and the two different approaches of reading interpretation used by the readers (ICES, 2012).

9. References

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

Eltink, A. T. G. W., Newton, A. W., Morgado, C., Santamaria, M. T. G., Modin, J., 2000. Guidelines and Tools for Age Reading. (PDF document version 1.0 October 2000) Internet : http://www.efan.no

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ICES. 2009. Report of the Workshop on Age Reading of Red mullet *Mullus barbatus* and Striped mullet *Mullus surmuletus* (WKACM), 30 March – 3 April 2009, Boulogne sur Mer, France. ICES CM 2009\ACOM:44. 42p.

ICES. 2012. Report of the workshop on age reading of red mullet and striped red mullet, 2–6 July 2012, Boulogne-sur-Mer, France. ICES CM 2012/ACOM:60. 52 pp.

ICES. 2015. First Interim Report of the Working Group on Working Group on Biologi-cal Parameters (WGBIOP), 7-11 September 2015, Malaga, Spain. ICES CM 2015/SSGIEOM:08. 67 pp.

Mahé, K., Elleboode, R., Charilaou, C., Ligas, A., Carbonara, P. and Simona, I. 2012. Striped red mullet (*Mullus surmuletus*) and red mullet (*M. barbatus*) otolith and scale exchange 2011, 30p.

Appendix 1 : List of participants

Reader	Country	Name	Email	expertise level *Mullus*	Used date of birth
1	France	Elleboode Romain	romain.elleboode@ifremer.fr	High	1/01
2	Cyprus	Charilaou Charis	ccharilaou@dfmr.moa.gov.cy	High	1/07
3	Italy	Casciaro Loredana	casciaro@coispa.it	Medium	1/07
4	Italy	Carbonara Pierluigi	carbonara@coispa.it	High	1/07
5	Italy	Panfili Monica	m.panfili@an.ismar.cnr.it	High	1/07
6	Italy	Massaro Andrea	andreamassaro@live.it	Medium	01/06
7	Spain	Ordines Francesc	xisco.ordinas@ba.ieo.es	High	1/07
8	Spain	Guijarro Beatriz	beatriz@ba.ieo.es	Low	1/07
9	Spain	Gonzalez Natalia	natalia.gonzalez@ba.ieo.es	Medium	1/06
10	Italy	Palmisano Michele	palmisano@coispa.it	Medium	1/07
11	Italy	Indennidate Antonella	indennidateanto@libero.it		
12	Greece	Kousteni Vasiliki Anastasopoulou Aikaterini Mytilineou Chryssi Bekas Petros	kousteni@hcmr.gr kanast@hcmr.gr chryssi@hcmr.gr bekasp@hcmr.gr	High	1/01
13	Italy	Pesci Paola	ppesci@unica.it	Medium	01/06

Appendix 2: Detailed results of *Mullus barbatus*

The number of age readings, the coefficient of variation (CV), the percentage of agreement (PA) and the RELATIVE bias are presented by MODAL age for each age reader and for all readers combined. A weighted mean CV and a weighted mean PA are given by reader and all readers combined. The CV's by MODAL age for each individual age reader and all readers combined indicate the precision in age reading by MODAL age. The weighted mean CV's over all MODAL age groups combined indicate the precision in age reading by reader and for all age readers combined.

NUMBER OF AGE READINGS

MODAL age	Reader1 France	Reader2 Cyprus	Reader3 Italy	Reader4 Italy	Reader5 Italy	Reader6 Italy	Reader7 Spain	Reader8 Spain	Reader9 Spain	Reader10 Italy	Reader11 Italy	Reader12 Greece	Reader13 Italy	TOTAL
0	20	20	20	20	20	20	19	20	20	20	20	20	20	259
1	144	143	142	144	142	143	143	143	141	144	144	144	139	1856
2	130	131	125	131	124	130	131	130	119	131	131	131	128	1672
3	48	48	46	48	45	47	48	46	46	48	48	48	48	614
4	2	2	2	2	1	2	2	2	2	2	2	2	2	25
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0-5	344	344	335	345	332	342	343	341	328	345	345	345	337	4426

COEFFICIENT OF VARIATION (CV)

MODAL age	Reader1 France	Reader2 Cyprus	Reader3 Italy	Reader4 Italy	Reader5 Italy	Reader6 Italy	Reader7 Spain	Reader8 Spain	Reader9 Spain	Reader10 Italy	Reader11 Italy	Reader12 Greece	Reader13 Italy	ALL Readers
0	75%	205%	447%	157%	178%	308%	0%	0%	0%	447%	93%	84%	43%	188,5%
1	68%	44%	33%	35%	58%	37%	78%	138%	197%	39%	35%	56%	39%	58,4%
2	49%	34%	23%	19%	23%	28%	43%	83%	56%	17%	28%	40%	24%	36,2%
3	37%	21%	15%	13%	20%	17%	38%	30%	30%	13%	19%	25%	11%	22,7%
4	28%	20%	0%	47%	-	0%	0%	0%	0%	0%	0%	0%	0%	22,5%
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0-5	56,8%	46,1%	51,3%	33,0%	47,0%	46,5%	54,4%	93,6%	109,4%	50,5%	33,2%	47,2%	29,1%	52,4%
RANKING	11	4	9	2	6	5	10	12	13	8	3	7	1	

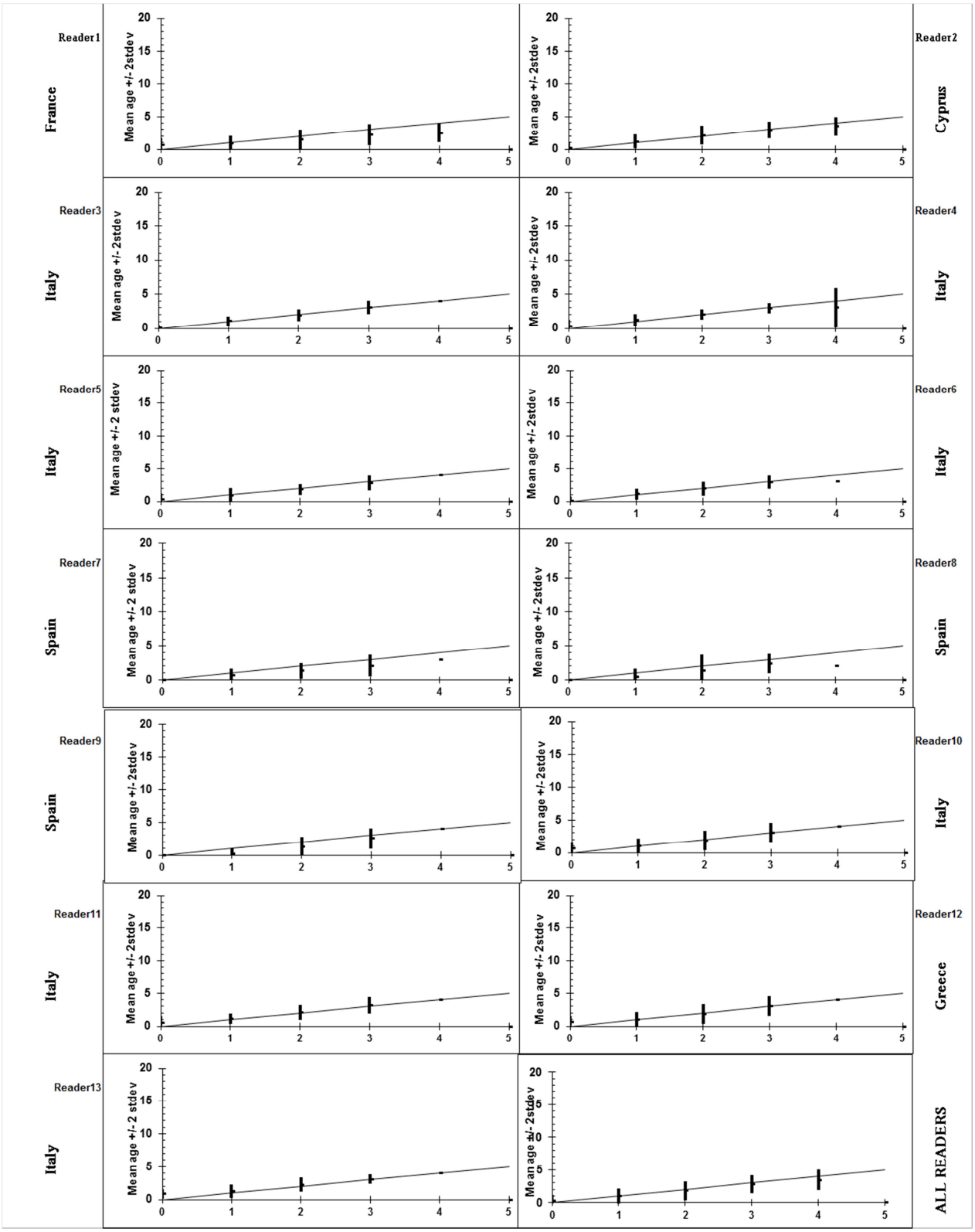
PERCENTAGE AGREEMENT

MODAL age	Reader1 France	Reader2 Cyprus	Reader3 Italy	Reader4 Italy	Reader5 Italy	Reader6 Italy	Reader7 Spain	Reader8 Spain	Reader9 Spain	Reader10 Italy	Reader11 Italy	Reader12 Greece	Reader13 Italy	ALL
0	35%	80%	95%	70%	75%	90%	100%	100%	100%	95%	45%	40%	15%	72%
1	66%	69%	88%	78%	73%	82%	62%	34%	21%	76%	83%	71%	71%	67%
2	39%	60%	80%	88%	79%	72%	38%	35%	41%	85%	72%	46%	67%	62%
3	31%	63%	78%	85%	64%	77%	23%	41%	54%	90%	69%	63%	88%	64%
4	0%	50%	100%	50%	100%	0%	0%	0%	100%	100%	100%	100%	100%	60%
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0-5	48,8%	65,1%	84,2%	82,3%	74,1%	77,5%	49,3%	39,0%	38,1%	82,3%	74,8%	58,6%	68,8%	64,9%
RANKING	11	8	1	2	6	4	10	12	13	2	5	9	7	

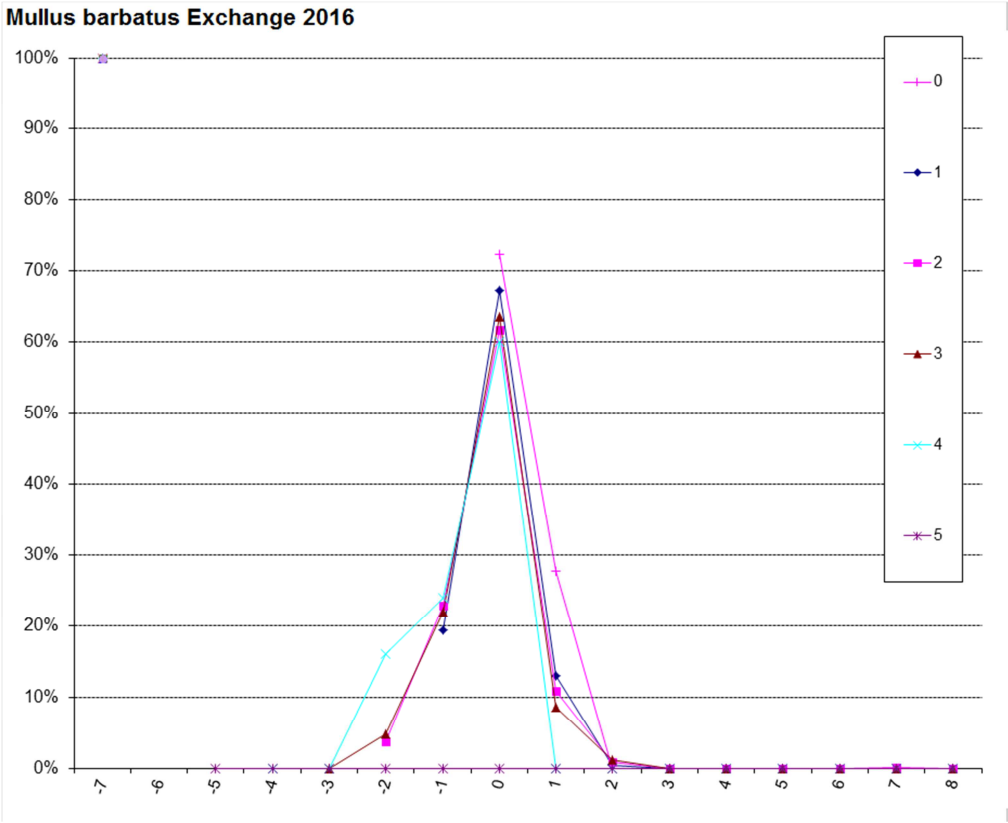
RELATIVE BIAS

MODAL age	Reader1 France	Reader2 Cyprus	Reader3 Italy	Reader4 Italy	Reader5 Italy	Reader6 Italy	Reader7 Spain	Reader8 Spain	Reader9 Spain	Reader10 Italy	Reader11 Italy	Reader12 Greece	Reader13 Italy	ALL
0	0,65	0,20	0,05	0,30	0,25	0,10	0,00	0,00	0,00	0,05	0,55	0,60	0,85	0,28
1	-0,14	0,20	0,05	0,20	-0,07	0,11	-0,36	-0,57	-0,79	0,21	0,16	-0,01	0,27	-0,06
2	-0,52	0,13	-0,09	0,01	-0,18	-0,05	-0,67	-0,60	-0,70	0,14	0,11	-0,11	0,26	-0,17
3	-0,81	-0,08	0,04	-0,06	-0,22	-0,06	-0,92	-0,59	-0,43	0,13	0,23	0,02	0,08	-0,21
4	-1,50	-0,50	0,00	-1,00	0,00	-1,00	-1,00	-2,00	0,00	0,00	0,00	0,00	0,00	-0,56
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0-5	-0,34	0,13	-0,00	0,09	-0,11	0,02	-0,54	-0,56	-0,66	0,16	0,17	-0,01	0,27	-0,10
RANKING	10	6	1	4	5	3	11	12	13	7	8	2	9	

In the age bias plots below the mean age recorded +/- 2stdev of each age reader and all readers combined are plotted against the MODAL age. The estimated mean age corresponds to MODAL age, if the estimated mean age is on the 1:1 equilibrium line (solid line). RELATIVE bias is the age difference between the estimated mean age and MODAL age.


Reader1
France
Reader2
Cyprus
Reader3
Italy
Reader4
Italy
Reader5
Italy
Reader6
Italy
Reader7
Spain
Reader8
Spain
Reader9
Spain
Reader10
Italy
Reader11
Italy
Reader12
Greece
Reader13
Italy
ALL READERS
Mean age +/- 2stdev

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. It appears to be no RELATIVE bias, if the age reading errors are normally distributed. The distributions are skewed, if RELATIVE bias occurs.



Appendix 3: Details results of *Mullus surmuletus*

The number of age readings, the coefficient of variation (CV), the percentage of agreement and the RELATIVE bias are presented by MODAL age for each age reader and for all readers combined. A weighted mean CV and a weighted mean percent agreement are given by reader and all readers combined. The CV's by MODAL age for each individual age reader and all readers combined indicate the precision in age reading by MODAL age. The weighted mean CV's over all MODAL age groups combined indicate the precision in age reading by reader and for all age readers combined.

NUMBER OF AGE READINGS

MODAL age	Reader1 France	Reader2 Cyprus	Reader3 Italy	Reader4 Italy	Reader5 Italy	Reader6 Italy	Reader7 Spain	Reader8 Spain	Reader9 Spain	Reader10 Italy	Reader11 Italy	Reader12 Greece	Reader13 Italy	TOTAL
0	1	1	1	1	1	1	1	1	1	1	1	1	-	12
1	13	12	12	13	13	13	13	13	12	13	12	13	12	164
2	48	47	49	49	49	48	49	49	49	49	49	49	46	630
3	46	46	46	44	46	42	46	45	43	46	46	46	45	587
4	10	10	10	10	10	10	10	10	9	10	10	10	10	129
5	1	1	1	1	1	1	1	1	1	1	1	1	1	13
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0-6	119	117	119	118	120	115	120	119	115	120	119	120	114	1535

COEFFICIENT OF VARIATION (CV)

MODAL age	Reader1 France	Reader2 Cyprus	Reader3 Italy	Reader4 Italy	Reader5 Italy	Reader6 Italy	Reader7 Spain	Reader8 Spain	Reader9 Spain	Reader10 Italy	Reader11 Italy	Reader12 Greece	Reader13 Italy	ALL Readers
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	37%	56%	33%	52%	28%	46%	82%	0%	47%	37%	43%	44%	36%	45,2%
2	27%	28%	26%	29%	22%	38%	45%	35%	40%	30%	23%	32%	28%	31,6%
3	35%	18%	15%	23%	13%	29%	35%	32%	27%	17%	20%	27%	18%	27,7%
4	20%	32%	11%	21%	13%	8%	28%	36%	20%	0%	25%	30%	8%	24,9%
5	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0-6	30,2%	26,8%	20,8%	28,3%	18,3%	32,5%	43,1%	29,9%	33,7%	22,8%	23,7%	30,9%	22,5%	31,7%
RANKING	9	6	2	7	1	11	13	8	12	4	5	10	3	

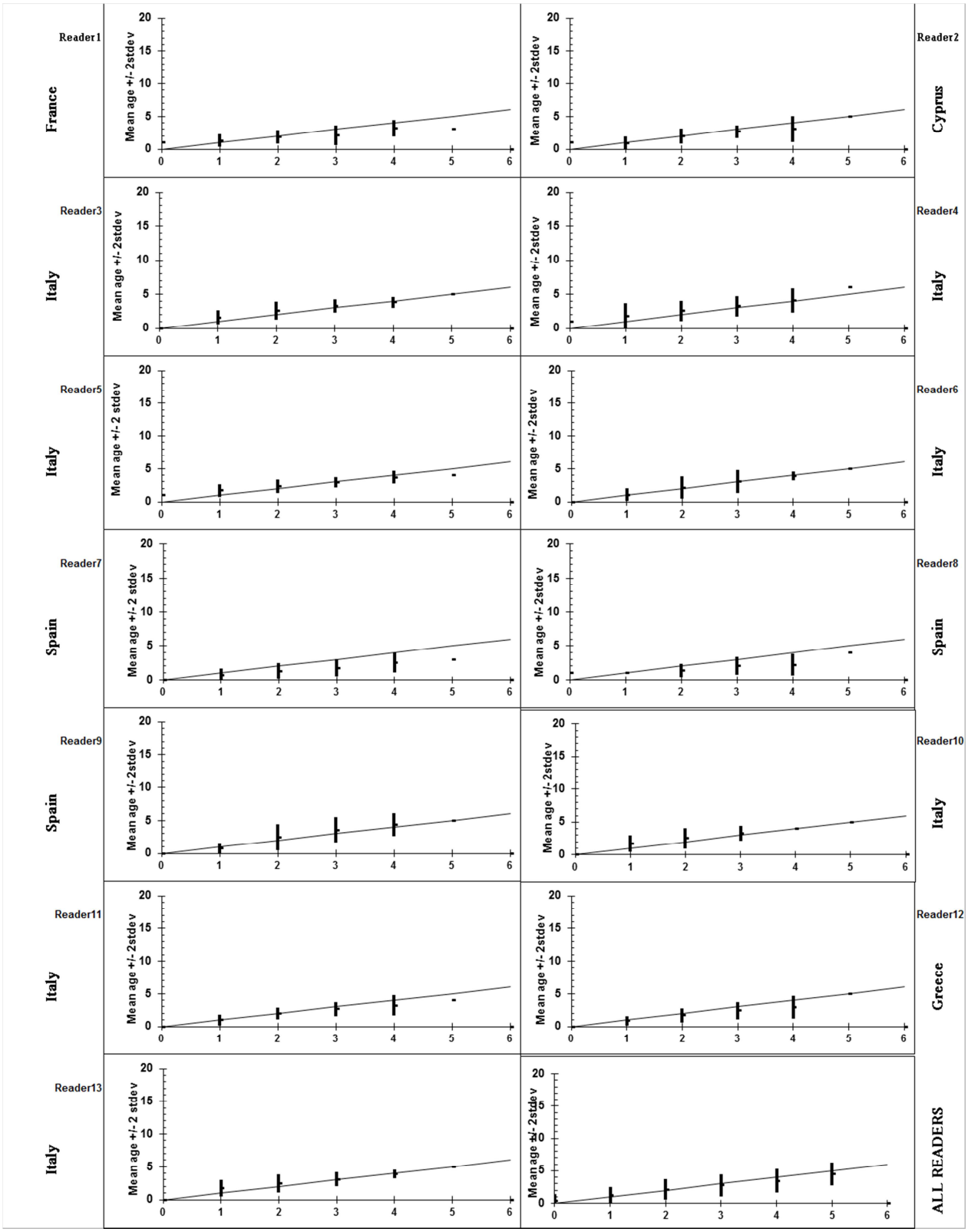
PERCENTAGE AGREEMENT

MODAL age	Reader1 France	Reader2 Cyprus	Reader3 Italy	Reader4 Italy	Reader5 Italy	Reader6 Italy	Reader7 Spain	Reader8 Spain	Reader9 Spain	Reader10 Italy	Reader11 Italy	Reader12 Greece	Reader13 Italy	ALL
0	0%	0%	100%	0%	0%	100%	100%	0%	100%	100%	100%	100%	-	58%
1	69%	75%	42%	46%	31%	77%	62%	100%	83%	38%	83%	85%	33%	63%
2	73%	68%	51%	53%	69%	50%	35%	39%	55%	63%	80%	61%	61%	58%
3	35%	67%	74%	66%	85%	57%	9%	22%	33%	74%	61%	43%	71%	54%
4	30%	20%	80%	60%	70%	90%	10%	0%	22%	100%	40%	30%	90%	50%
5	0%	100%	100%	0%	0%	100%	0%	0%	100%	100%	0%	100%	100%	54%
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0-6	52,9%	64,1%	62,2%	56,8%	70,0%	60,0%	25,8%	35,3%	47,8%	68,3%	68,9%	55,0%	64,9%	56,3%
RANKING	10	5	6	8	1	7	13	12	11	3	2	9	4	

RELATIVE BIAS

MODAL age	Reader1 France	Reader2 Cyprus	Reader3 Italy	Reader4 Italy	Reader5 Italy	Reader6 Italy	Reader7 Spain	Reader8 Spain	Reader9 Spain	Reader10 Italy	Reader11 Italy	Reader12 Greece	Reader13 Italy	ALL
0	1,00	1,00	0,00	1,00	1,00	0,00	0,00	1,00	0,00	0,00	0,00	0,00	-	0,42
1	0,31	-0,08	0,58	0,77	0,69	0,08	-0,38	0,00	-0,17	0,69	0,00	-0,15	0,75	0,24
2	-0,15	0,02	0,59	0,53	0,33	0,15	-0,71	-0,61	0,45	0,53	-0,08	-0,31	0,50	0,09
3	-0,87	-0,33	0,28	0,25	-0,02	0,05	-1,26	-0,98	0,58	0,30	-0,35	-0,59	0,07	-0,23
4	-0,80	-0,90	-0,20	0,10	-0,30	-0,10	-1,50	-1,80	0,33	0,00	-0,80	-1,10	-0,10	-0,56
5	-2,00	0,00	0,00	1,00	-1,00	0,00	-2,00	-1,00	0,00	0,00	-1,00	0,00	0,00	-0,46
6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0-6	-0,44	-0,20	0,39	0,42	0,18	0,08	-0,96	-0,77	0,42	0,41	-0,24	-0,46	0,30	-0,07
RANKING	10	3	6	9	2	1	13	12	8	7	4	11	5	

In the age bias plots below the mean age recorded +/- 2stdev of each age reader and all readers combined are plotted against the MODAL age. The estimated mean age corresponds to MODAL age, if the estimated mean age is on the 1:1 equilibrium line (solid line). RELATIVE bias is the age difference between estimated mean age and MODAL age.


Reader1
France
Mean age +/- 2stdev
Reader2
Cyprus
Reader3
Italy
Reader4
Italy
Reader5
Italy
Reader6
Italy
Reader7
Spain
Reader8
Spain
Reader9
Spain
Reader10
Italy
Reader11
Italy
Reader12
Greece
Reader13
Italy
ALL READERS

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. It appears to be no RELATIVE bias, if the age reading errors are normally distributed. The distributions are skewed, if RELATIVE bias occurs.