

Results of the 2014 age reading exercise for Herring in 3a

Readers:

1. Stina Bjørk Stenersen Hansen – DTU Denmark
2. Marie Leiditz – SLU Sweden
3. Marianne Johansson – SLU Sweden

(Note this is the order assigned to readers in WebGR and is different to that in Tables 1-5)

Samples:

2013 Harbour samples

Length classes: 165 – 305 SC

Months: March, April, July, August, October and November

Methods:

Images of single otoliths used (either left or right) taken on a black background under reflected light and immersed in alcohol

The image set was made available on WebGR. The readers were given an image example showing which axis to annotate and were asked to annotate the nucleus and the start of each translucent zone and give a final estimation of age.

Readers were provided with information on the capture date, area and TL.

Analysis:

It was not possible to use the measurements of distance between annotations from WebGR to establish growth curves for each fish. The reason being that readers annotated different areas of the growth and non-growth zones even when they were in agreement as to the number of annuli and thus estimated age. The resulting variability between readers in the distances from the nucleus to the annuli would have confounded the results from the Linear Mixed Effect Models. Thus the growth data and a detailed examination of which structures are problematic has been omitted. It was however possible to use the estimated age data alone to analyse the agreement between readers by means of the traditional procedures:

- average % Agreement ($n_{\text{modal age}}/n_{\text{total}}*100$)
- coefficient of variation (CV) (Standard deviation/average*100)
- bias plots and tests

Results:

The average agreement between readers was 83.7% with a coefficient of variation of 15.2%. The two experienced readers (Reader 1 and 3) estimate similar ages in most cases while the trainee reader (Reader 2) often estimates the youngest fish as one year older (see Figure 1 where Reader 1 and 3 assign an age of 1 while Reader 2 assigns an age of 2). With the older fish it appears that in some examples readers from SLU are counting a ring at the edge which is not being counted by the reader from DTU (see Figure 2). The

interpretation is however difficult when the same structures are not being marked consistently. Tables 2, 3 and 4 show the number of otoliths read, CV and Agreement by modal age for each of the readers. Figure 3 shows that the largest proportion of CV is within the 0-20% range and thus overall the CV is generally low. There is a possibility of bias between SB DTU and MJ SLU (the experienced readers) and there is a certainty of bias between MJ SLU (the trainee reader) and SB DTU and MJ SLU (see Table 5 and Figure 4). Calibration between the SLU readers is recommended.



Figure 1. Sild041 showing 3 readers annotations. Reader 1 = Blue (age = 1), Reader 2 = Dark Green (age = 2) and Reader 3 = Bright Green (age = 1).

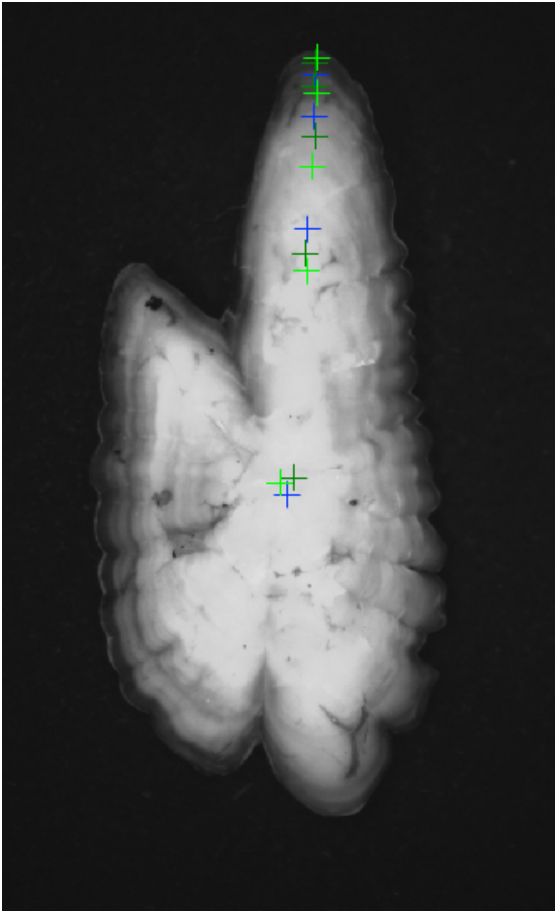


Figure 2. Sild060 showing 3 readers annotations. Reader 1 = Blue (age = 3), Reader 2 = Dark Green (age = 4) and Reader 3 = Bright Green (age = 4).

Table 1. Age composition (based on estimated ages) and the number of otoliths read

Age	SB DTU	MJ SLU	ML SLU	Total
0	-	-	-	-
1	29	29	10	68
2	27	25	39	91
3	33	31	30	94
4	7	10	17	34
5	3	4	3	10
6	-	-	-	-
7	-	-	-	-
8	-	-	1	1
9	1	1	-	2
Total	100	100	100	300

Table 2. The % agreement for each of the readers by modal age

Modal Age	SB DTU	MJ SLU	ML SLU	All Readers
0	-	-	-	-
1	100%	100%	34%	78%
2	100%	93%	78%	90%
3	100%	100%	64%	88%
4	58%	83%	83%	75%
5	100%	100%	33%	78%
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-
9	100%	100%	0%	67%
Average	95.0%	96.0%	60.0%	83.7%

Table 3. Co-efficient of Variation (CV) for each of the readers by modal age

Modal Age	SB DTU	MJ SLU	ML SLU	All Readers
0	-	-	-	-
1	0%	0%	39%	32.8%
2	0%	13%	19%	7.3%
3	0%	0%	20%	6.8%
4	14%	11%	9%	11.2%
5	0%	0%	25%	13.0%
Total	1.7%	4.8%	23.8%	15.2%

Table 4. Relative Bias for each of the readers by modal age

Modal Age	SB DTU	MJ SLU	ML SLU	All Readers
0	-	-	-	-
1	0.00	0.00	0.83	0.28
2	0.00	0.07	0.22	0.10
3	0.00	0.00	0.07	0.02
4	-0.42	0.00	0.17	-0.08
5	0.00	0.00	-1.00	-0.33
6	-	-	-	-
7	-	-	-	-
8	-	-	-	-
9	0.00	0.00	-1.00	-0.33
Total	-0.05	0.02	0.30	0.09

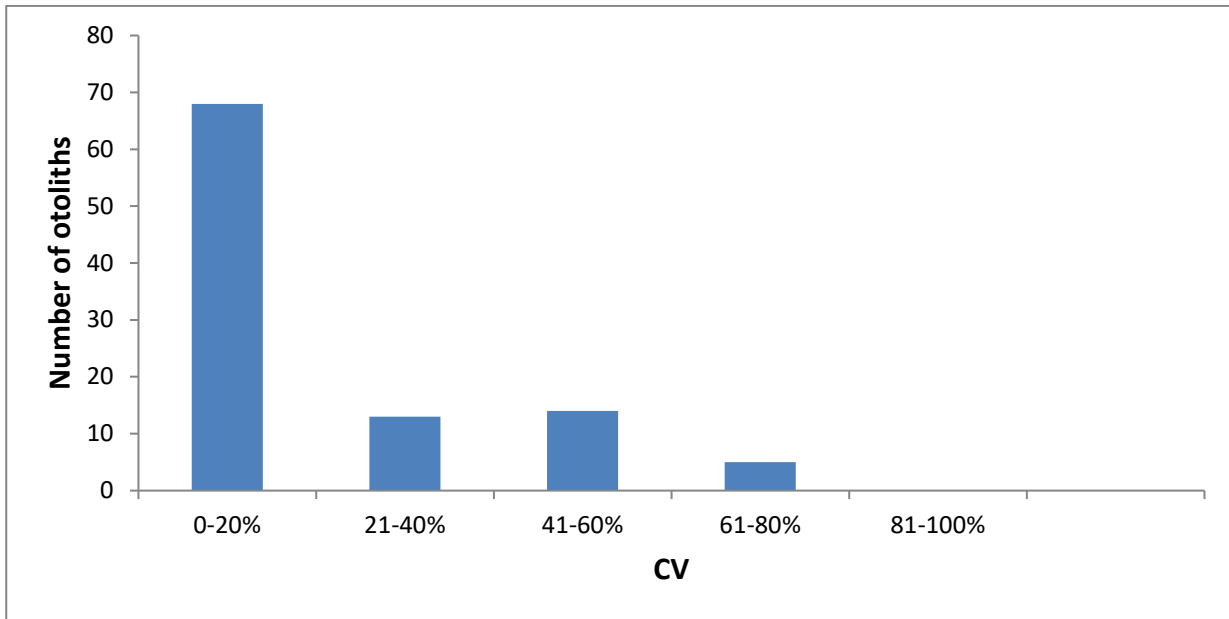


Figure 3. Histogram representing the frequency of CV's within the aged collection

Table 5. Inter-reader bias test and reader against modal age bias test

	SB DTU	MJ SLU	ML SLU
SB DTU			
MJ SLU	*		
ML SLU	**	**	
Modal age	*	—	**

—	= no sign of bias ($p > 0.05$)
*	= possibility of bias ($0.01 < p < 0.05$)
**	= certainty of bias ($p < 0.01$)

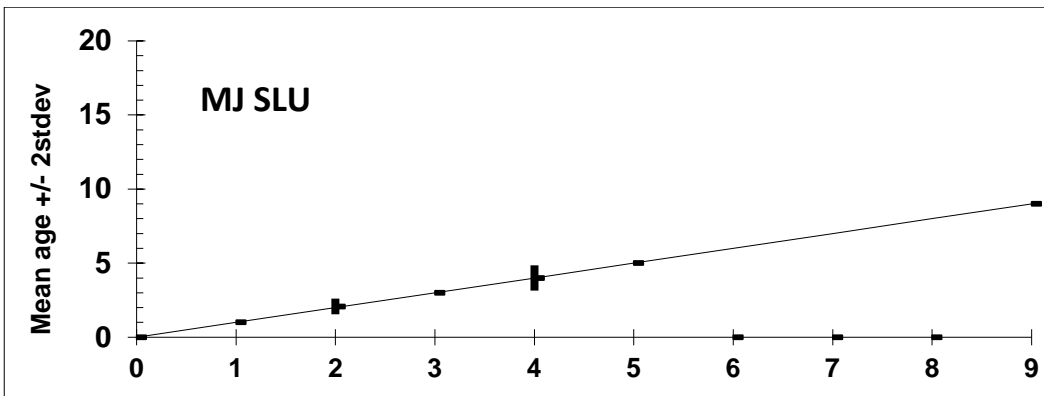
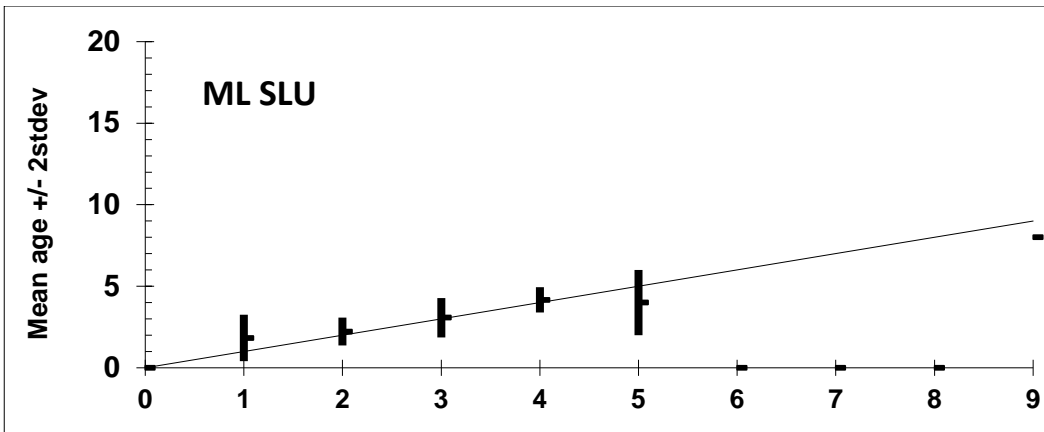
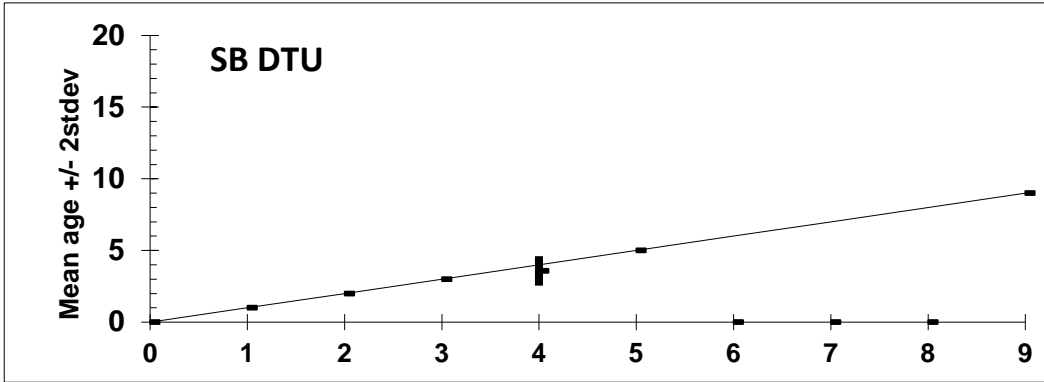


Figure 4. Age bias plots for each reader as mean age \pm 2 SD on modal age