2019 North Sea Sandeel Age Reading Exchange. SmartDots ID 219

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1 Summary

The 2019 North Sea Sandeel exchange was held on the SmartDots platform (ID219). Eight readers from three institutes, IMR Norway, DTU Aqua Denmark and IMARES the Netherlands took part. Readers from Norway and Denmark provide age data for stock assessment purposes while readers from The Netherlands took part for training purposes. 120 otoliths were provided by Denmark and Norway, collected from SA1, SA3 and SA5 representing the Sandeel stocks; san.sa.1r, san.sa.3r and san.sa.5r. Those from Norway were pairs of otoliths mounted in eukit and those from Denmark were loose otoliths (some singles and some pairs), otoliths were digitised at DTU Aqua. Instructions were provided for readers on how to complete the SmartDots exchange. This summary report is based only on readers from Norway and Denmark who are providing age data for stock assessment purposes (advanced readers).

The modal age range is 0-9 years. The weighted average percentage agreement (PA) based on modal ages for all advanced readers is 81 % and the weighted average coefficient of variation (CV) is 24 %. Overall PA at age 0 is 78%, age 1 is 80%, age 2 is 89% and age 3 is 75%. Positive relative bias indicates an overestimation of age in comparison to the modal age and a negative relative bias indicates an underestimation of age in comparison to modal age. The overall relative bias, across all ages, is 0.06, with positive relative bias at modal ages 0, 1, 2 and 6 and negative relative bias at modal ages 3-9 (excluding 8). The weighted mean bias per reader indicates that for R01, R03 and R05 (from Norway) there is an overall tendency to underestimate the age while for R02, R04 and R06 (from Denmark) there is an overall tendency to overestimate the age in comparison to modal age. Some reoccurring issues to be taken up with the readers have been addressed in the main report; the most problematic being the interpretation of the edge in Q4 and the uncertainty as to whether or not there is a false winter ring laid down before the first true winter ring in some samples. The later may be area specific and otolith microstructure examination of the problematic otoliths, which are not mounted in eukit, may help clarify this.

A subset of 40 otoliths (modal age range 0-4) from san.sa.1r where 100% agreement was reached in the 2016 exchange were included in this exchange. The PA reached on this this “agreed age” collection was high at 92.5% when only those readers who took part in both exchanges were included. This shows how important it is to have all readers participate in the calibration exchanges.

2 Overview of samples and readers

Table 1: Overview of samples used for the 2019 North Sea Sandeel exchange (SmartDots ID 219).

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

2018	27.3.a.20	san.sa.3r	4	2	0	70-80 mm
2018	27.4.b	san.sa.1r	4	20	0-4	70-165 mm
2018	27.4.b	san.sa.3r	4	18	0-4	45-200 mm

Table 2: Overview of advanced readers (those providing age data for stock assessment purposes).

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

3 Results overview

3.1 PA table

Table 3: Percentage agreement (PA) table represents the PA per modal age and reader, the PA of all readers combined per modal age and a weighted mean of the PA per reader.

Modal age	R01 NO	R02 DK	R03 NO	R04 DK	R05 NO	R06 DK	all
0	100 %	70 %	100 %	75 %	100 %	17 %	**78 %**
1	88 %	91 %	100 %	84 %	90 %	30 %	**80 %**
2	91 %	89 %	95 %	93 %	95 %	72 %	**89 %**
3	70 %	80 %	50 %	90 %	90 %	70 %	**75 %**
4	91 %	80 %	64 %	82 %	100 %	36 %	**75 %**
5	50 %	100 %	100 %	100 %	50 %	0 %	**67 %**
6	100 %	0 %	100 %	0 %	100 %	0 %	**50 %**
7	67 %	67 %	67 %	100 %	67 %	0 %	**61 %**
8	-	-	-	-	-	-	**-**
9	100 %	100 %	100 %	100 %	100 %	0 %	**83 %**
Weighted Mean	**88 %**	**85 %**	**90 %**	**87 %**	**92 %**	**46 %**	**81 %**

3.2 CV table

Table 4: Coefficient of Variation (CV) table presents the CV per modal age and reader, the CV of all readers combined per modal age and a weighted mean of the CV per reader.

Modal age	R01 NO	R02 DK	R03 NO	R04 DK	R05 NO	R06 DK	all
0	-	-	-	-	-	-	**-**
1	38 %	27 %	0 %	36 %	33 %	32 %	**41 %**
2	15 %	15 %	11 %	13 %	11 %	27 %	**17 %**
3	27 %	13 %	29 %	11 %	11 %	25 %	**22 %**
4	8 %	10 %	25 %	11 %	0 %	21 %	**15 %**
5	16 %	0 %	0 %	0 %	24 %	13 %	**16 %**
6	-	-	-	-	-	-	**12 %**
7	8 %	15 %	18 %	0 %	8 %	20 %	**17 %**
8	-	-	-	-	-	-	**-**
9	-	-	-	-	-	-	**5 %**
Weighted Mean	**23 %**	**18 %**	**10 %**	**19 %**	**17 %**	**27 %**	**24 %**

3.3 Relative bias table

Table 5: Relative bias table represents the relative bias per modal age and advanced reader, the relative bias of all readers combined per modal age and a weighted mean of the relative bias per reader. Relative bias is the age difference between estimated mean age and modal age. Numbers in blue indicate a negative bias and numbers in red indicate positive bias.

Modal age	R01 NO	R02 DK	R03 NO	R04 DK	R05 NO	R06 DK	all
0	0.00	0.50	0.00	0.25	0.00	0.92	**0.28**
1	-0.12	0.09	0.00	0.09	-0.10	0.76	**0.12**
2	-0.05	0.11	0.00	0.02	0.00	0.23	**0.05**
3	-0.40	0.20	-0.60	-0.10	-0.10	0.20	**-0.13**
4	-0.09	0.20	0.00	0.00	0.00	-0.27	**-0.03**
5	0.00	0.00	0.00	0.00	0.25	-1.25	**-0.17**
6	0.00	1.00	0.00	1.00	0.00	-1.00	**0.17**
7	0.33	0.67	-0.67	0.00	0.33	-2.00	**-0.22**
8	-	-	-	-	-	-	-
9	0.00	0.00	0.00	0.00	0.00	-1.00	**-0.17**
Weighted Mean	**-0.08**	**0.17**	**-0.07**	**0.06**	**-0.02**	**0.27**	**0.06**

3.4 Bias plot

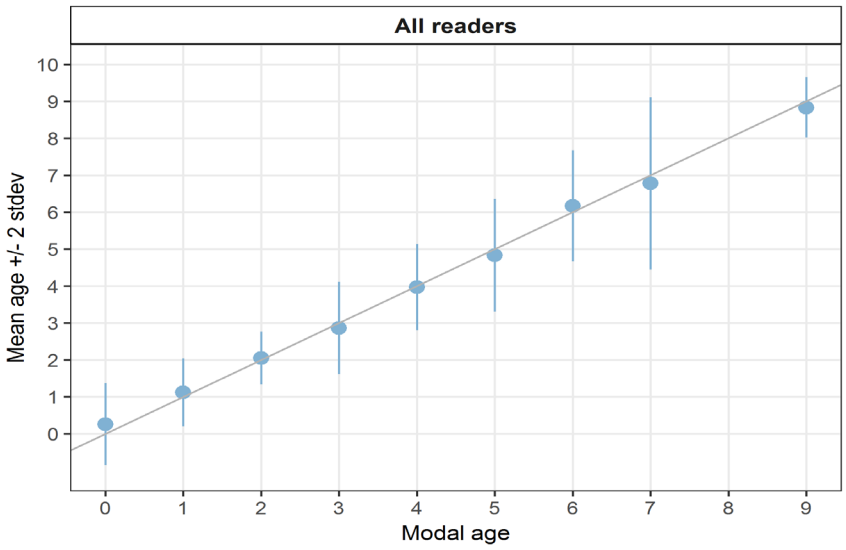

Figure 1: Age bias plot for advanced readers. The mean age recorded +/- 2stdev of all readers combined are plotted against the modal age. The estimated mean age corresponds to modal age, if the estimated mean age is on the 1:1 equilibrium line (solid line). Relative bias is the age difference between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

3.5 Growth analysis

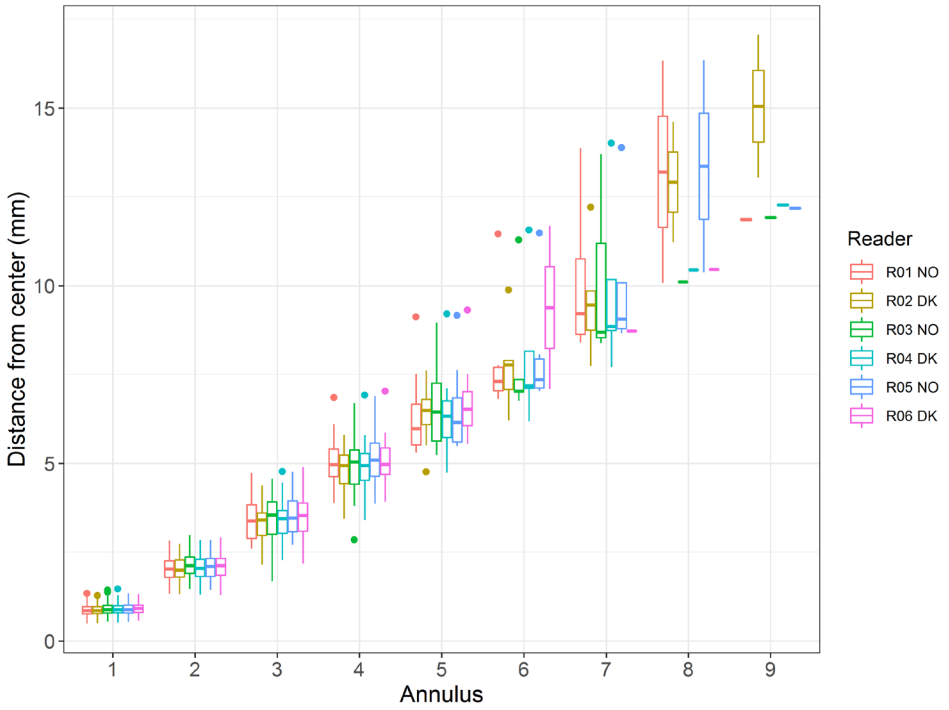

Figure 2: Plot of average distance from the centre to the winter rings for advanced readers. The boxes represent the median, upper and lower box boundaries of the interquartile range, whiskers extend no further than 1.5 * IQR (where IQR is the inter-quartile range) from the box boundary. Data beyond the end of the whiskers represent outliers and are plotted individually.

3.6 Age error matrices

Table 5: Age error matrix (AEM) for san.sa.1r.

strata	Modal age	0	1	2	3	4
san.sa.1r	Age 0	0.8	0.04	0.01	-	-
san.sa.1r	Age 1	0.2	0.82	0.02	0.08	-
san.sa.1r	Age 2	-	0.14	0.90	0.29	0.06
san.sa.1r	Age 3	-	-	0.07	0.58	0.06
san.sa.1r	Age 4	-	-	-	-	0.89
san.sa.1r	Age 5	-	-	-	0.04	-

Table 6: Age error matrix (AEM) for san.sa.3r.

strata	Modal age	0	1	2	3	4	5	6	7
san.sa.3r	Age 0	0.79	0.06	-	-	-	-	-	-
san.sa.3r	Age 1	0.15	0.78	0.04	-	-	-	-	-
san.sa.3r	Age 2	0.03	0.14	0.90	0.04	-	-	-	-
san.sa.3r	Age 3	0.03	0.03	0.05	0.972	0.14	0.08	-	-
san.sa.3r	Age 4	-	-	0.01	0.04	0.66	0.25	-	-
san.sa.3r	Age 5	-	-	-	-	0.17	0.50	-	0.17
san.sa.3r	Age 6	-	-	-	-	0.03	0.08	-	0.08
san.sa.3r	Age 7	-	-	-	-	-	0.08	-	0.50
san.sa.3r	Age 8	-	-	-	-	-	-	-	0.17
san.sa.3r	Age 9	-	-	-	-	-	-	-	0.08

Table 7: Age error matrix (AEM) for san.sa.5r.

strata	Modal age	0	1	2	3	4	5	6	7	9
san.sa.5r	Age 0	0.67	0.06	-	-	-	-	-	-	-
san.sa.5r	Age 1	0.33	0.69	-	-	-	-	-	-	-
san.sa.5r	Age 2	-	0.19	0.82	0.08	-	-	-	-	-
san.sa.5r	Age 3	-	0.06	0.17	0.75	0.17	-	-	-	-
san.sa.5r	Age 4	-	-	-	0.17	0.83	0.17	-	0.17	-
san.sa.5r	Age 5	-	-	-	-	-	0.83	0.17	-	-
san.sa.5r	Age 6	-	-	-	-	-	-	0.50	-	-
san.sa.5r	Age 7	-	-	-	-	-	-	0.33	0.83	-
san.sa.5r	Age 8	-	-	-	-	-	-	-	-	0.17
san.sa.5r	Age 9	-	-	-	-	-	-	-	-	0.83

4 Results by strata

4.1 Coefficient of Variation and Percentage Agreement by stock

Table 8: CV and PA per stock based on advanced readers.

Modal age	san.sa.1r		san.sa.3r		san.sa.5r		all	
	CV	**PA**	**CV**	**PA**	**CV**	**PA**	**CV**	**PA**
0	-	80 %	-	79 %	-	67 %	**-**	**78 %**
1	37 %	82 %	48 %	78 %	55 %	69 %	**41 %**	**80 %**
2	17 %	90 %	18 %	90 %	18 %	83 %	**17 %**	**89 %**
3	31 %	58 %	10 %	92 %	17 %	75 %	**22 %**	**75 %**
4	13 %	89 %	16 %	66 %	10 %	83 %	**15 %**	**75 %**
5	-		21 %	50 %	50 %	83 %	**83 %**	**67 %**
6	-		-		12 %	50 %	**50 %**	**50 %**
7	-		17 %	50 %	19 %	83 %	**83 %**	**61 %**
8	-		-		-		-	
9	-		-		5 %	83 %	**5 %**	**83 %**
Weighted Mean	**26 %**	84 %	**22 %**	**79 %**	**20 %**	**77 %**	**24 %**	**81 %**

Table 9: Relative bias per stock based on advanced readers.

Modal age	san.sa.1r	san.sa.3r	san.sa.5r	all
0	0.20	0.29	0.33	**0.28**
1	0.11	0.14	0.25	**0.16**
2	0.03	0.04	0.17	**0.08**
3	-0.38	0.00	0.08	**-0.10**
4	-0.17	0.09	-0.17	**-0.08**
5	-	-0.17	-0.17	-
6	-	-	0.17	-
7	-	-0.08	-0.50	-
8	-	-	-	-
9	-	-	-0.17	-
Weighted Mean	**0.04**	**0.08**	**0.06**	**0.09**

Table 10: Number of age readings per strata for advanced readers.

Modal age	san.sa.1r	san.sa.3r	san.sa.5r	total
0	30	34	9	**73**
1	142	36	16	**194**
2	144	84	35	**263**
3	24	24	12	**60**
4	18	35	12	**65**
5	0	12	12	**24**
6	0	0	6	**6**
7	0	12	6	**18**
8	0	0	0	**0**
9	0	0	6	**6**
Total	**358**	**237**	**114**	**709**

5 Conclusion

Overall, when only the readers providing age data for assessment are included in the analysis the results of this exchange are slightly poorer than the results from the 2016 exchange. Per stock, the PA decreases from 91% to 84% in SA1 (san.sa.1r) and increases from 77% to 79% in SA3 (san.sa.3r). Some reoccurring issues have been addressed in this report and have been taken up with the readers, the most problematic being the interpretation of the edge in Q4. The disagreement between Denmark and Norway as to whether or not there is a false winter ring laid down before the first true winter ring should be addressed, this may be area specific and otolith microstructure examination of the problematic otoliths which are not mounted in eukit will hopefully clarify this.

Results by stocks showed the highest PA for san.sa.1r and the AEM shows the proportions of age readings in agreement with modal age to also be high. For san.sa.3r there is much more variability around the modal age and for san.sa.5r the variability is also higher. Concerns were raised over the image quality of the otoliths mounted in eukit, which may have contributed to the lower PA for these areas/stocks.