

SmartDots Summary Report for event 2941 – whg.27.47d

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1 Summary

This otolith exchange was performed on whiting (*Merlangius merlangus*, Aphia code 400587), in Subdivisions 7d, 4a, 4b and 4c (North Sea, eastern English Channel) for stock **whg.27.47d** and was coordinated by Karen Bekaert and Romain Elleboode. This stock is in category 1, with an age-based assessment managed by WGNSSK assessment working group. The background and aim of the exchange were to intercalibrate the age readings and be able to identify possible issues as part of a European exchange. In this exchange event, 237 fish individuals were aged and a total of 424 images were included in the exchange:

- 97 sectioned (SE) otoliths, where each otolith was photographed with transmitted (ST) and reflected light (SR) (2 images per fish)
- 50 French sectioned (SE) otoliths, transmitted (ST) light only
- 90 broken otoliths (BR), where each otolith was photographed with transmitted (ST) and reflected light (SR) (so 2 images per fish)

Nineteen age readers from nine countries participated, with 11 readers being advanced readers and thus reading otoliths for stock assessments. This report only includes the results for these advanced readers. Sweden, Denmark, and Norway read **broken** otoliths while Belgium, the Netherlands, France, Germany and UK read **sectioned** whiting otoliths. Readers were asked to read only the preparation method they were familiar with, either broken or sectioned. They were allowed to compare both images when available (transmitted and reflected light) to annotate one image for each otolith.

All samples were collected between 2020 to 2025. A balanced distribution of samples was achieved for the sectioned otoliths across zones 7d, 4b and 4c. The broken otoliths were distributed in the North Sea, in areas 4a, 4b and 4c. Samples represented all four quarters.

Ages in the exchange ranged from 1 to 7 years. The results for the advanced readers and all samples reached an overall PA of 65 %, a CV of 30 %, and an APE of 21 %. Reading results were slightly better for broken otoliths than sectioned otoliths, with a higher percentage agreement (70 % vs 63%) and a lower CV (25% vs 31%) and APE (14% vs 23%). However, it should be noted that the results for the sectioned otoliths improved significantly (PA = 82%) without the readings from readers R06 DE and R11 DE, where a drift in age reading was noticeable. For the sectioned otoliths, the percentage agreement remained quite stable at a low level for all age classes (between 60 and 70%), while it decreased gradually for the broken otoliths from 84% in age 1 to 50% in age 7.

This exchange concluded poor overall agreement in comparison to previous workshops where overall agreement reached more than 80%. The same issues as in 2016 subsist including: interpretation of first annual ring due to split

rings and the wide range of growth that can occur, difficulties interpreting the edge and misinterpretation of split rings and Humphries shadow. This highlights that training of new readers is important as is repeated calibration amongst advanced readers. A workshop to cover this is recommended in 2026.

2 Overview of samples and advanced readers

Table 1: Overview of samples used for the exchange event2941. The modal age range for all samples is 1-7.

Year	ICES area	Strata	Quarter	Number of samples	Modal age range	Length range
2020	27.4.b	Strata_Sectioned	3	34	1-7	200-320 mm
2020	27.4.b	Strata_Sectioned	4	26	1-6	220-475 mm
2020	27.4.c	Strata_Sectioned	2	28	1-5	205-320 mm
2020	27.7.d	Strata_Sectioned	1	48	1-5	220-495 mm
2020	27.7.d	Strata_Sectioned	3	8	1-2	215-275 mm
2021	27.4.b	Strata_Sectioned	4	4	6	320-445 mm
2021	27.4.c	Strata_Sectioned	4	26	1-7	195-360 mm
2021	27.7.d	Strata_Sectioned	2	12	1-3	220-295 mm
2021	27.7.d	Strata_Sectioned	4	8	1-2	280-325 mm
2022	27.4.b	Strata_Sectioned	1	12	1-6	165-370 mm
2022	27.4.c	Strata_Sectioned	1	1	6	305 mm
2022	27.7.d	Strata_Sectioned	2	1	6	340 mm
2022	27.7.d	Strata_Sectioned	3	1	4	320 mm
2023	27.4.b	Strata_Sectioned	2	8	2-6	290-320 mm
2023	27.7.d	Strata_Sectioned	3	3	3-4	330-370 mm
2023	27.7.d	Strata_Sectioned	4	3	3-5	295-325 mm
2024	27.4.a	Strata_Broken	1	8	3-5	260-380 mm
2024	27.4.a	Strata_Broken	2	30	2-7	230-380 mm
2024	27.4.a	Strata_Broken	4	20	2-7	280-380 mm
2024	27.4.b	Strata_Broken	1	8	2-6	180-350 mm
2024	27.4.b	Strata_Broken	2	4	2	210-280 mm
2024	27.4.b	Strata_Broken	3	16	1-4	140-450 mm
2024	27.4.b	Strata_Broken	4	18	1-4	210-330 mm
2024	27.4.c	Strata_Broken	1	12	1-2	180-230 mm
2024	27.4.c	Strata_Sectioned	1	6	1-3	195-370 mm
2024	27.4.c	Strata_Broken	3	32	1-5	240-350 mm
2024	27.4.c	Strata_Sectioned	3	7	1-5	280-330 mm
2024	27.7.d	Strata_Sectioned	2	4	4-5	280-320 mm
2025	27.4.a	Strata_Broken	1	16	1-6	170-390 mm
2025	27.4.b	Strata_Broken	1	16	1-4	150-330 mm
2025	27.4.c	Strata_Sectioned	1	4	4-6	295-330 mm

Table 2: Overview of number of readers.

Expertise	strata	N_readers
Advanced	Strata_Broken	5
Advanced	Strata_Sectioned	6

Table 3: Overview results: Stock, total number of samples (NSample), coefficient of variance (CV), percentage of agreement (PA), average percentage error (APE) for all ages and advanced readers

Stock2	NSample	CV	PA	APE	N_adv
whg.27.47d	424	30 %	65 %	21 %	11

3 Results overview

3.1 Age readings

Table 4: Age reading table shows the number of readings by modal age.

Modal age	total
0	12
1	224
2	249
3	260
4	254
5	184
6	93
7	8
Total	1284

3.2 CV table

Table 5: Coefficient of Variation (CV) table presents the CV per modal age for all advanced readers combined.

Modal age	all
0	-
1	57 %
2	35 %
3	27 %
4	19 %
5	16 %
6	17 %
7	14 %
Weighted Mean	30 %

3.3 PA table

Table 6: Percentage agreement (PA) table represents the PA per modal age for all advanced readers combined.

Modal age	total
0	33 %
1	69 %
2	65 %
3	63 %
4	68 %
5	61 %
6	61 %
7	62 %
Weighted Mean	65 %

3.4 APE table

Table 7: Average Percentage Error (APE) table represents the APE per modal age for all advanced readers combined.

Modal age	all
0	-
1	44 %
2	25 %
3	19 %
4	12 %
5	10 %
6	9 %
7	12 %
Weighted Mean	21 %

3.5 Relative bias table

Table 8: The relative bias (as the difference between the mean and modal age) per modal age for all advanced readers combined.

Modal age	all
0	-
1	0.38
2	0.21
3	0.25
4	0.17
5	-0.05
6	-0.21
7	-
Weighted Mean	0.17

3.6 Bias plot

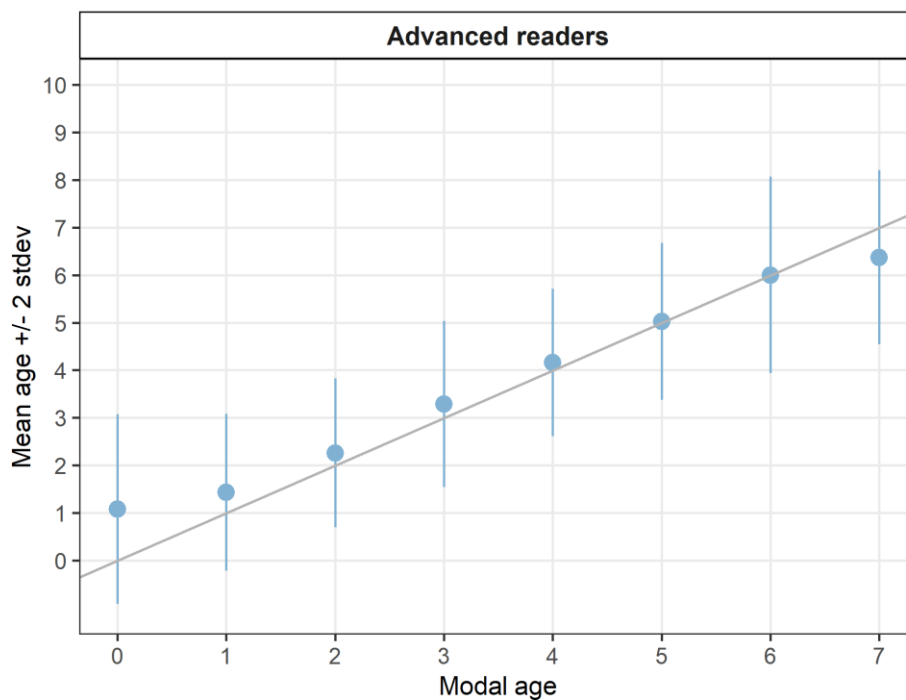


Figure 1: Age bias plot for advanced readers.

3.7 Age error matrices AEM

3.7.1 General Age Error Matrix (AEM)

Table 9: General Age error matrix (AEM). The modal age is in rows and the age classifications by the advanced readers in columns.

modal_age	0	1	2	3	4	5	6	7	8	9	Total
0	0.33	0.33	0.25	0.08	-	-	-	-	-	-	0.99
1	0.01	0.69	0.18	0.08	0.02	0.01	-	-	-	-	0.99
2	0.00	0.08	0.65	0.20	0.04	0.02	0.00	-	-	-	0.99
3	-	0.01	0.08	0.63	0.18	0.07	0.02	-	0.00	-	0.99
4	-	-	0.02	0.09	0.68	0.15	0.04	0.02	-	-	1.00
5	-	-	0.01	0.04	0.14	0.61	0.17	0.04	-	-	1.01
6	-	-	0.01	0.02	0.03	0.11	0.61	0.17	0.02	0.02	0.99
7	-	-	-	-	-	0.25	0.12	0.62	-	-	0.99

3.7.2 AEM by ICES area

Table 10: Age error matrix (AEM) for ICES area 27.4.a.

ices_area	modal_age	0	1	2	3	4	5	6	7	8	9	Total
27.4.a	1	-	1.00	-	-	-	-	-	-	-	-	1.00
27.4.a	2	-	0.07	0.80	0.13	-	-	-	-	-	-	1.00
27.4.a	3	-	-	0.10	0.73	0.16	0.02	-	-	-	-	1.01
27.4.a	4	-	-	-	0.11	0.70	0.13	0.04	0.02	-	-	1.00
27.4.a	5	-	-	0.03	0.06	0.28	0.47	0.06	0.09	-	-	0.99
27.4.a	6	-	-	-	0.12	-	0.25	0.50	0.12	-	-	0.99
27.4.a	7	-	-	-	-	-	0.50	-	0.50	-	-	1.00

Table 11: Age error matrix (AEM) for ICES area 27.4.b.

ices_area	modal_age	0	1	2	3	4	5	6	7	8	9	Total
27.4.b	0	0.33	0.33	0.25	0.08	-	-	-	-	-	-	0.99
27.4.b	1	0.01	0.67	0.16	0.09	0.04	0.02	-	-	-	-	0.99
27.4.b	2	-	0.04	0.65	0.18	0.09	0.03	0.01	-	-	-	1.00
27.4.b	3	-	0.04	0.08	0.58	0.15	0.10	0.04	-	0.01	-	1.00
27.4.b	4	-	-	0.04	0.15	0.64	0.11	0.04	0.02	-	-	1.00
27.4.b	5	-	-	-	0.03	0.14	0.54	0.23	0.06	-	-	1.00
27.4.b	6	-	-	0.02	-	0.05	0.12	0.61	0.19	-	-	0.99
27.4.b	7	-	-	-	-	-	0.17	0.17	0.67	-	-	1.01

Table 12: Age error matrix (AEM) for ICES area 27.4.c.

ices_area	modal_age	0	1	2	3	4	5	6	7	8	9	Total
27.4.c	1	0.04	0.73	0.22	-	-	-	-	-	-	-	0.99
27.4.c	2	0.01	0.17	0.64	0.14	0.03	-	-	-	-	-	0.99
27.4.c	3	-	-	0.10	0.64	0.22	0.04	0.01	-	-	-	1.01
27.4.c	4	-	-	-	0.07	0.69	0.21	0.03	-	-	-	1.00
27.4.c	5	-	-	-	0.02	0.11	0.70	0.16	0.02	-	-	1.01

ices_area	modal_age	0	1	2	3	4	5	6	7	8	9	Total
27.4.c	6	-	-	-	0.05	-	0.05	0.68	0.14	0.09	-	1.01

Table 13: Age error matrix (AEM) for ICES area 27.7.d.

ices_area	modal_age	0	1	2	3	4	5	6	7	8	9	Total
27.7.d	1	-	0.65	0.20	0.13	0.01	-	-	-	-	-	0.99
27.7.d	2	-	0.02	0.64	0.30	0.02	0.03	-	-	-	-	1.01
27.7.d	3	-	-	0.04	0.62	0.21	0.10	0.02	-	-	-	0.99
27.7.d	4	-	-	-	-	0.71	0.20	0.07	0.02	-	-	1.00
27.7.d	5	-	-	-	0.05	0.08	0.63	0.20	0.03	-	-	0.99
27.7.d	6	-	-	-	-	-	-	0.50	0.17	-	0.33	1.00

3.7.3 AEM by strata

Table 14: Age error matrix (AEM) for Strata_Strata_Broken.

strata	modal_age	0	1	2	3	4	5	6	7	8	9	Total
Strata_Broken	1	-	0.84	0.14	-	0.02	-	-	-	-	-	1.00
Strata_Broken	2	-	0.15	0.74	0.09	-	0.02	-	-	-	-	1.00
Strata_Broken	3	-	-	0.13	0.70	0.15	0.02	-	-	-	-	1.00
Strata_Broken	4	-	-	0.02	0.15	0.69	0.11	0.02	0.01	-	-	1.00
Strata_Broken	5	-	-	0.02	0.04	0.28	0.54	0.04	0.07	-	-	0.99
Strata_Broken	6	-	-	0.06	0.06	0.06	0.24	0.53	0.06	-	-	1.01
Strata_Broken	7	-	-	-	-	-	0.50	-	0.50	-	-	1.00

Table 15: Age error matrix (AEM) for Strata_Strata_Sectioned.

strata	modal_age	0	1	2	3	4	5	6	7	8	9	Total
Strata_Sectioned	0	0.33	0.33	0.25	0.08	-	-	-	-	-	-	0.99
Strata_Sectioned	1	0.02	0.65	0.19	0.10	0.02	0.01	-	-	-	-	0.99
Strata_Sectioned	2	0.01	0.05	0.61	0.25	0.07	0.01	0.01	-	-	-	1.01
Strata_Sectioned	3	-	0.02	0.05	0.60	0.20	0.09	0.03	-	0.01	-	1.00
Strata_Sectioned	4	-	-	0.02	0.05	0.66	0.19	0.06	0.02	-	-	1.00
Strata_Sectioned	5	-	-	-	0.04	0.09	0.63	0.21	0.04	-	-	1.01
Strata_Sectioned	6	-	-	-	0.01	0.03	0.08	0.63	0.20	0.03	0.03	1.01
Strata_Sectioned	7	-	-	-	-	-	0.17	0.17	0.67	-	-	1.01

3.8 Overall comparison of results by strata

Number of age readings

Table 16: Number of age readings per strata and modal age for all advanced readers combined.

Modal age	Strata_Broken	Strata_Sectioned	total
0	0	12	12
1	49	175	224
2	81	168	249
3	93	167	260
4	123	131	254
5	46	138	184
6	17	76	93
7	2	6	8
Total	411	873	1284

Coefficient of Variation (CV)

Table 17: CV per strata and modal age for all advanced readers combined.

Modal age	Strata_Broken	Strata_Sectioned	all
0	-	-	-
1	45 %	59 %	57 %
2	34 %	34 %	35 %
3	20 %	28 %	27 %
4	18 %	19 %	19 %
5	20 %	15 %	16 %
6	24 %	15 %	17 %
7	24 %	13 %	14 %
Weighted Mean	25 %	31 %	30 %

Percentage of Agreement (PA)

Table 18: Percentage Agreement per strata and modal age for all advanced readers combined.

Modal age	Strata_Broken	Strata_Sectioned	total
0	-	33 %	33 %
1	84 %	65 %	69 %
2	74 %	61 %	65 %
3	70 %	60 %	63 %
4	69 %	66 %	68 %
5	54 %	63 %	61 %
6	53 %	63 %	61 %
7	50 %	67 %	62 %
Weighted Mean	70 %	63 %	65 %

Average Percentage Error (APE)

Table 19: Average Percentage Error per strata and modal age for all advanced readers combined.

Modal age	Strata_Broken	Strata_Sectioned	all
0	-	-	-
1	28 %	47 %	44 %
2	16 %	26 %	25 %
3	12 %	22 %	19 %
4	9 %	14 %	12 %
5	15 %	10 %	10 %
6	18 %	9 %	9 %
7	17 %	10 %	12 %
Weighted Mean	14 %	23 %	21 %

Relative bias

Table 20: Relative Bias per strata and modal age for all advanced readers combined.

Modal age	Strata_Broken	Strata_Sectioned	all
0	-	1.08	-
1	0.20	0.50	0.35
2	0.01	0.38	0.20
3	0.06	0.41	0.24
4	0.01	0.31	0.16
5	-0.26	0.12	-0.07
6	-0.71	0.16	-0.27
7	-1.00	-0.50	-0.75
Weighted Mean	-0.02	0.34	0.15

4 Conclusion

The observed variability highlights the need for a dedicated workshop to further explore reader consistency and support the standardization of ageing protocols within a new workshop. This exchange concluded poor overall agreement in comparison to previous workshops where overall agreement reached more than 80%. The same issues as in 2016 subsist including: interpretation of first annual ring due to split rings and the wide range of growth that can occur, difficulties interpreting the edge and misinterpretation of split rings and Humphries shadow. This highlighted that training of new readers is important as is repeated calibration amongst advanced readers. A workshop to cover this is recommended in 2026.