SmartDots Summary for event 1888

# Executive summary

This image only exchange was carried out via SmartDots. A total of 268 otolith images from the main areas of mackerel distribution were included in the exchange. Following the recommendations of WKMACQI (Workshop on Mackerel biological parameter Quality Indicators) (ICES, 2018). Every effort was made to ensure that the spatial and temporal coverage, as well as the length and age range, of the mackerel otoliths used for the exchange correspond with the coverage in the assessment

Results from advanced readers show an overall agreement of 73%, an improvement from 69% when less experienced readers were included and up from 67.8% in the previous exchange in 2021. Agreement is highest at age 0 (96%) and remains strong for ages 1-6 (71-82%), while it is lowest for ages above 10 (37-49%). The coefficient of variation (CV) is highest for ages 1-4 (up to 38%) and stabilizes for ages 6-12 (6-17%), with some increased variability at older ages. The percentage agreement varies by reader, however overall, there is no strong systemic bias, but inconsistencies are notable at specific ages and amongst certain readers.

For basic readers, the overall agreement is lower compared to advanced readers, as expected, indicating greater variability in age readings. Basic readers tend to have higher disagreement, particularly at older ages where precision is more challenging. The coefficient of variation (CV) is also generally higher, reflecting inconsistencies in age estimation. Some readers exhibit noticeable biases, either underestimating or overestimating ages, which impacts overall reliability.

It’s important to note that Basic readers tend to be new to age reading or to reading this particular species and are still training, which are factors that may contribute to the observed discrepancies.

While a marked improvement is observed, when compared with the previous exchange results in 2021, there is still room for improvement across all readers. Specific issues for individual readers to work on, are highlighted in the report.

The exchange findings highlight priorities for future work, i.e. the creation of a Training Reference Collection, active engagement with technological developments around machine learning, through WGBIOP workshops and WGSMART. Additional training and calibration to improve consistency and accuracy in age estimations is also recommended.

# Overview of samples and advanced readers

**Table 1.0:** Overview of samples used for the exchange event1888. The modal age range for all samples is 0-18.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Year** | **ICES area** | **Quarter** | **Number of samples** | **Modal age range** | **Length range** |
| 2014 | 27.4.a | 3 | 2 | 8-14 | 365-415 mm |
| 2014 | 27.4.a | 4 | 8 | 1-11 | 295-435 mm |
| 2015 | 27.4.a | 3 | 5 | 0-4 | 225-345 mm |
| 2015 | 27.7.d | 4 | 5 | 1-4 | 265-355 mm |
| 2016 | 27.4.a | 1 | 5 | 1-5 | 195-335 mm |
| 2016 | 27.7.c | 1 | 5 | 5-8 | 345-385 mm |
| 2016 | 27.7.g | 2 | 5 | 1-6 | 190-335 mm |
| 2018 | 27.7.h | 4 | 5 | 0-2 | 160-310 mm |
| 2019 | 27.2.a | 2 | 20 | 1-9 | 160-390 mm |
| 2019 | 27.4.b | 3 | 14 | 1-6 | 275-355 mm |
| 2019 | 27.5.b | 1 | 7 | 2-9 | 265-380 mm |
| 2019 | 27.5.b | 3 | 6 | 5-8 | 360-400 mm |
| 2019 | 27.5.b | 4 | 7 | 2-9 | 305-380 mm |
| 2019 | 27.6 | 2 | 3 | 3-7 | 315-370 mm |
| 2019 | 27.6 | 3 | 7 | 1-5 | 275-370 mm |
| 2019 | 27.7.b | 2 | 5 | 3-11 | 315-390 mm |
| 2019 | 27.7.f | 4 | 5 | 0-1 | 215-290 mm |
| 2019 | 27.7.j | 4 | 5 | 0-3 | 175-335 mm |
| 2019 | 27.8.a | 4 | 10 | 0-2 | 200-305 mm |
| 2019 | 27.8.c | 1 | 6 | 2-11 | 330-435 mm |
| 2019 | 27.8.c | 2 | 4 | 2-5 | 290-355 mm |
| 2019 | 27.8.c | 3 | 10 | 1-9 | 290-390 mm |
| 2019 | 27.9.a | 1 | 12 | 2-10 | 265-410 mm |
| 2019 | 27.9.a | 2 | 7 | 5-12 | 365-420 mm |
| 2019 | 27.9.a | 3 | 12 | 1-8 | 285-385 mm |
| 2019 | 27.9.a | 4 | 6 | 0-7 | 210-385 mm |
| 2020 | 27.2.b | 3 | 20 | 4-18 | 330-420 mm |
| 2020 | 27.4.b | 1 | 6 | 1-8 | 200-390 mm |
| 2020 | 27.4.c | 1 | 5 | 1 | 195-240 mm |
| 2020 | 27.5.b | 1 | 10 | 4-14 | 315-405 mm |
| 2020 | 27.8.b | 1 | 10 | 3-13 | 320-390 mm |
| 2024 | 27.4.b | 3 | 2 | 0 | 190 mm |
| 2024 | 27.4.c | 3 | 7 | 0 | 150-200 mm |
| 2024 | 27.6.a | 1 | 21 | 4-12 | 350-400 mm |
| 2024 | 27.6.a | 2 | 1 | 4 | 350 mm |

**Table 1.1:** Overview of number of readers.

|  |  |  |
| --- | --- | --- |
| **Expertise** | **strata** | **N\_readers** |
| Advanced | Strata\_1 | 9 |

# Results overview

## Multimodal cases

**Table 1.3:** Summary of statistics; Total number of samples (NSample), a percentage of cases (fish samples) with multiple modes depending on the approach to weight the experience of the reader which will be considered when defining the fish age mode. PercMM\_traditional shows the percentage of the total samples for which multiple modes are obtained when all the readers are equally weighted. PercMM\_linear\_weight shows the percentage of the total samples for which multiple modes are obtained when the weight assigned to the different readers decreases linearly with the experience, while in the PercMM\_negexp the weight applied decreases with a negative exponential shape with the experience. The PercMM\_multistage shows the percentage of multiple mode cases when a combination of the different methodologies is used, as explained in the material and methods section

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **NSample** | **PercMM\_traditional** | **PercMM\_linear\_weight** | **PercMM\_negexp\_weight** | **PercMM\_multistage** |
| 268 | 7 % | 1 % | 0 % | 0 % |

## Age readings

**Table 1.4:** Age reading table shows the number of readings by modal age.

|  |  |
| --- | --- |
| **Modal age** | **total** |
| 0 | **161** |
| 1 | **356** |
| 2 | **293** |
| 3 | **329** |
| 4 | **196** |
| 5 | **197** |
| 6 | **196** |
| 7 | **149** |
| 8 | **200** |
| 9 | **97** |
| 10 | **60** |
| 11 | **35** |
| 12 | **63** |
| 13 | **8** |
| 14 | **17** |
| 15 | **0** |
| 16 | **0** |
| 17 | **9** |
| 18 | **8** |
| **Total** | **2374** |

## CV table

**Table 1.5:** Coefficient of Variation (CV) table presents the CV per modal age for all advanced readers combined.

|  |  |
| --- | --- |
| **Modal age** | **all** |
| 0 | **-** |
| 1 | **38 %** |
| 2 | **22 %** |
| 3 | **26 %** |
| 4 | **18 %** |
| 5 | **16 %** |
| 6 | **12 %** |
| 7 | **13 %** |
| 8 | **13 %** |
| 9 | **12 %** |
| 10 | **11 %** |
| 11 | **14 %** |
| 12 | **12 %** |
| 13 | **22 %** |
| 14 | **17 %** |
| 15 | **-** |
| 16 | **-** |
| 17 | **9 %** |
| 18 | **19 %** |
| **Weighted Mean** | **21 %** |

## PA table

**Table 1.6:** Percentage agreement (PA) table represents the PA per modal age for all advanced readers combined.

|  |  |
| --- | --- |
| **Modal age** | **total** |
| 0 | **96 %** |
| 1 | **80 %** |
| 2 | **82 %** |
| 3 | **83 %** |
| 4 | **80 %** |
| 5 | **71 %** |
| 6 | **71 %** |
| 7 | **58 %** |
| 8 | **61 %** |
| 9 | **47 %** |
| 10 | **57 %** |
| 11 | **37 %** |
| 12 | **49 %** |
| 13 | **62 %** |
| 14 | **47 %** |
| 15 | **-** |
| 16 | **-** |
| 17 | **44 %** |
| 18 | **38 %** |
| **Weighted Mean** | **73 %** |

## APE table

**Table 1.7:** Average Percentage Error (APE) table represents the APE per modal age for all advanced readers combined.

|  |  |
| --- | --- |
| **Modal age** | **all** |
| 0 | **-** |
| 1 | **25 %** |
| 2 | **11 %** |
| 3 | **10 %** |
| 4 | **7 %** |
| 5 | **8 %** |
| 6 | **7 %** |
| 7 | **8 %** |
| 8 | **7 %** |
| 9 | **8 %** |
| 10 | **8 %** |
| 11 | **11 %** |
| 12 | **7 %** |
| 13 | **17 %** |
| 14 | **11 %** |
| 15 | **-** |
| 16 | **-** |
| 17 | **8 %** |
| 18 | **16 %** |
| **Weighted Mean** | **11 %** |

## Relative bias table

**Table 1.8:** The relative bias (as the difference between the mean and modal age) per modal age for all advanced readers combined.

|  |  |
| --- | --- |
| **Modal age** | **all** |
| 0 | **0.04** |
| 1 | **0.13** |
| 2 | **-0.04** |
| 3 | **0.09** |
| 4 | **0.03** |
| 5 | **0.05** |
| 6 | **0.07** |
| 7 | **0.08** |
| 8 | **0.00** |
| 9 | **0.15** |
| 10 | **-0.29** |
| 11 | **-0.61** |
| 12 | **0.00** |
| 13 | **-** |
| 14 | **-0.78** |
| 15 | **-** |
| 16 | **-** |
| 17 | **-1.22** |
| 18 | **-** |
| **Weighted Mean** | **0.03** |

##  Bias plot



**Figure 1.0:** Age bias plot for advanced readers.

## Age error matrices AEM

### General Age Error Matrix (AEM)

**Table X:** 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** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **0** | 0.96 | 0.04 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **1** | 0.03 | 0.80 | 0.16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.99 |
| **2** | - | 0.11 | 0.82 | 0.06 | 0.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.99 |
| **3** | - | 0.00 | 0.07 | 0.83 | 0.07 | 0.01 | 0.01 | - | - | - | 0.00 | 0.00 | - | - | - | - | - | - | - | - | 0.99 |
| **4** | - | - | 0.01 | 0.10 | 0.80 | 0.08 | 0.02 | - | - | - | - | 0.01 | - | - | - | - | - | - | - | - | 1.02 |
| **5** | - | - | 0.01 | 0.02 | 0.11 | 0.71 | 0.13 | 0.02 | - | - | 0.01 | - | - | - | - | - | - | - | - | - | 1.01 |
| **6** | - | - | - | 0.01 | 0.01 | 0.12 | 0.71 | 0.12 | 0.03 | 0.01 | 0.01 | - | - | - | - | - | - | - | - | - | 1.02 |
| **7** | - | - | - | - | - | 0.02 | 0.18 | 0.58 | 0.15 | 0.05 | 0.01 | 0.01 | - | - | - | - | - | - | - | - | 1.00 |
| **8** | - | - | - | - | - | 0.01 | 0.06 | 0.13 | 0.61 | 0.12 | 0.05 | 0.00 | 0.01 | 0.00 | - | - | - | - | - | - | 0.99 |
| **9** | - | - | - | - | - | - | 0.01 | 0.03 | 0.18 | 0.47 | 0.22 | 0.06 | 0.03 | - | - | - | - | - | - | - | 1.00 |
| **10** | - | - | - | - | - | - | - | 0.07 | 0.05 | 0.15 | 0.57 | 0.17 | - | - | - | - | - | - | - | - | 1.01 |
| **11** | - | - | - | - | - | - | - | 0.09 | 0.03 | 0.09 | 0.23 | 0.37 | 0.20 | - | - | - | - | - | - | - | 1.01 |
| **12** | - | - | - | - | - | - | - | - | 0.02 | 0.03 | 0.08 | 0.13 | 0.49 | 0.13 | 0.06 | 0.06 | - | - | - | - | 1.00 |
| **13** | - | - | - | - | - | - | - | 0.12 | - | 0.12 | - | - | - | 0.62 | - | 0.12 | - | - | - | - | 0.98 |
| **14** | - | - | - | - | - | - | - | 0.06 | - | 0.06 | - | - | 0.06 | 0.18 | 0.47 | 0.06 | 0.12 | - | - | - | 1.01 |
| **17** | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.11 | 0.11 | 0.11 | 0.22 | 0.44 | - | - | 0.99 |
| **18** | - | - | - | - | - | - | - | - | - | - | 0.12 | - | - | 0.12 | - | 0.12 | - | 0.12 | 0.38 | 0.12 | 0.98 |

### AEM by ICES area

**Table X:** Age error matrix (AEM) for ICES area 27.2.a.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.2.a** | 1 | 0.22 | 0.72 | 0.06 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.2.a** | 2 | - | 0.11 | 0.89 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.2.a** | 3 | - | - | 0.08 | 0.92 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.2.a** | 5 | - | - | - | - | 0.17 | 0.61 | 0.17 | 0.06 | - | - | - | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.2.a** | 7 | - | - | - | - | - | - | 0.12 | 0.62 | 0.25 | - | - | - | - | - | - | - | - | - | - | - | 0.99 |
| **27.2.a** | 8 | - | - | - | - | - | - | 0.06 | 0.28 | 0.61 | - | 0.06 | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.2.a** | 9 | - | - | - | - | - | - | - | - | 0.11 | 0.44 | 0.33 | 0.11 | - | - | - | - | - | - | - | - | 0.99 |

**Table X:** Age error matrix (AEM) for ICES area 27.2.b.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.2.b** | 4 | - | - | - | 0.33 | 0.67 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.2.b** | 5 | - | - | - | - | - | 0.56 | 0.33 | 0.11 | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.2.b** | 6 | - | - | - | - | - | 0.16 | 0.58 | 0.18 | 0.07 | 0.02 | - | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.2.b** | 8 | - | - | - | - | - | - | 0.11 | 0.17 | 0.50 | 0.17 | 0.06 | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.2.b** | 9 | - | - | - | - | - | - | - | 0.06 | 0.11 | 0.53 | 0.22 | 0.06 | 0.03 | - | - | - | - | - | - | - | 1.01 |
| **27.2.b** | 10 | - | - | - | - | - | - | - | 0.04 | 0.04 | 0.33 | 0.56 | 0.04 | - | - | - | - | - | - | - | - | 1.01 |
| **27.2.b** | 11 | - | - | - | - | - | - | - | - | - | 0.12 | 0.12 | 0.38 | 0.38 | - | - | - | - | - | - | - | 1.00 |
| **27.2.b** | 12 | - | - | - | - | - | - | - | - | - | - | - | 0.11 | 0.56 | 0.11 | - | 0.22 | - | - | - | - | 1.00 |
| **27.2.b** | 17 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.11 | 0.11 | 0.11 | 0.22 | 0.44 | - | - | 0.99 |
| **27.2.b** | 18 | - | - | - | - | - | - | - | - | - | - | 0.12 | - | - | 0.12 | - | 0.12 | - | 0.12 | 0.38 | 0.12 | 0.98 |

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.4.a** | 1 | 0.14 | 0.78 | 0.08 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.4.a** | 2 | - | - | 1.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.4.a** | 3 | - | - | - | 1.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.4.a** | 4 | - | - | - | 0.11 | 0.78 | 0.11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.4.a** | 5 | - | - | - | - | - | 1.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.4.a** | 6 | - | - | - | - | - | - | 0.78 | 0.11 | 0.11 | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.4.a** | 7 | - | - | - | - | - | 0.11 | - | 0.67 | 0.22 | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.4.a** | 8 | - | - | - | - | - | - | 0.06 | 0.22 | 0.56 | 0.11 | 0.06 | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.4.a** | 11 | - | - | - | - | - | - | - | 0.11 | - | - | 0.33 | 0.44 | 0.11 | - | - | - | - | - | - | - | 0.99 |
| **27.4.a** | 14 | - | - | - | - | - | - | - | 0.11 | - | - | - | - | 0.11 | 0.11 | 0.44 | - | 0.22 | - | - | - | 0.99 |

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.4.b** | 0 | 1.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.4.b** | 1 | 0.03 | 0.88 | 0.10 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.4.b** | 2 | - | 0.05 | 0.84 | 0.12 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.4.b** | 3 | - | - | - | 0.77 | 0.23 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.4.b** | 6 | - | - | - | - | - | 0.44 | 0.44 | 0.11 | - | - | - | - | - | - | - | - | - | - | - | - | 0.99 |
| **27.4.b** | 8 | - | - | - | - | - | - | 0.14 | 0.14 | 0.57 | - | 0.14 | - | - | - | - | - | - | - | - | - | 0.99 |

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.4.c** | 0 | 0.98 | 0.02 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.4.c** | 1 | - | 0.96 | 0.04 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |

**Table X:** Age error matrix (AEM) for ICES area 27.5.b.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.5.b** | 2 | - | - | 0.94 | 0.06 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.5.b** | 3 | - | - | - | 1.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.5.b** | 4 | - | - | - | 0.19 | 0.81 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.5.b** | 5 | - | - | - | - | 0.14 | 0.75 | 0.11 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.5.b** | 6 | - | - | - | - | - | - | 0.83 | 0.17 | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.5.b** | 7 | - | - | - | - | - | - | 0.21 | 0.56 | 0.12 | 0.06 | 0.03 | 0.03 | - | - | - | - | - | - | - | - | 1.01 |
| **27.5.b** | 8 | - | - | - | - | - | - | 0.02 | 0.04 | 0.70 | 0.17 | 0.02 | 0.02 | 0.02 | 0.02 | - | - | - | - | - | - | 1.01 |
| **27.5.b** | 9 | - | - | - | - | - | - | 0.06 | 0.06 | 0.28 | 0.61 | - | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.5.b** | 10 | - | - | - | - | - | - | - | - | 0.06 | - | 0.72 | 0.22 | - | - | - | - | - | - | - | - | 1.00 |
| **27.5.b** | 14 | - | - | - | - | - | - | - | - | - | 0.12 | - | - | - | 0.25 | 0.5 | 0.12 | - | - | - | - | 0.99 |

**Table X:** Age error matrix (AEM) for ICES area 27.6.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.6** | 1 | - | 0.89 | 0.11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.6** | 3 | - | - | 0.12 | 0.71 | 0.06 | - | - | - | - | - | 0.06 | 0.06 | - | - | - | - | - | - | - | - | 1.01 |
| **27.6** | 4 | - | - | - | 0.12 | 0.62 | 0.12 | 0.06 | - | - | - | - | 0.06 | - | - | - | - | - | - | - | - | 0.98 |
| **27.6** | 5 | - | - | - | - | 0.12 | 0.47 | 0.24 | 0.06 | - | - | 0.12 | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.6** | 7 | - | - | - | - | - | - | - | 0.56 | 0.44 | - | - | - | - | - | - | - | - | - | - | - | 1.00 |

**Table X:** Age error matrix (AEM) for ICES area 27.6.a.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.6.a** | 4 | - | - | - | 0.07 | 0.83 | 0.08 | 0.01 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.99 |
| **27.6.a** | 5 | - | - | - | - | 0.11 | 0.78 | 0.11 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.6.a** | 6 | - | - | - | - | - | 0.28 | 0.72 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.6.a** | 7 | - | - | - | - | - | - | 0.22 | 0.44 | 0.17 | 0.17 | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.6.a** | 8 | - | - | - | - | - | 0.06 | - | 0.17 | 0.50 | 0.17 | 0.06 | - | 0.06 | - | - | - | - | - | - | - | 1.02 |
| **27.6.a** | 12 | - | - | - | - | - | - | - | - | 0.03 | 0.03 | 0.08 | 0.03 | 0.50 | 0.17 | 0.11 | 0.06 | - | - | - | - | 1.01 |

**Table X:** Age error matrix (AEM) for ICES area 27.7.b.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.7.b** | 3 | - | - | 0.11 | 0.89 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.7.b** | 4 | - | - | - | - | 0.89 | 0.11 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.7.b** | 6 | - | - | - | 0.06 | 0.06 | 0.11 | 0.78 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.7.b** | 12 | - | - | - | - | - | - | - | - | - | 0.11 | 0.11 | 0.33 | 0.33 | 0.11 | - | - | - | - | - | - | 0.99 |

**Table X:** Age error matrix (AEM) for ICES area 27.7.c.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.7.c** | 5 | - | - | - | - | 0.11 | 0.78 | 0.11 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.7.c** | 6 | - | - | - | - | - | - | 1.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.7.c** | 7 | - | - | - | - | - | 0.06 | 0.22 | 0.67 | 0.06 | - | - | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.7.c** | 8 | - | - | - | - | - | - | - | 0.22 | 0.78 | - | - | - | - | - | - | - | - | - | - | - | 1.00 |

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.7.d** | 1 | - | 1.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.7.d** | 2 | - | 0.22 | 0.78 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.7.d** | 3 | - | - | - | 0.94 | - | 0.06 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.7.d** | 4 | - | - | - | - | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |

**Table X:** Age error matrix (AEM) for ICES area 27.7.f.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.7.f** | 0 | 0.94 | 0.06 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.7.f** | 1 | - | 0.81 | 0.19 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |

**Table X:** Age error matrix (AEM) for ICES area 27.7.g.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.7.g** | 1 | 0.11 | 0.89 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.7.g** | 2 | - | 0.11 | 0.89 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.7.g** | 3 | - | - | 0.22 | 0.78 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.7.g** | 5 | - | - | - | - | 0.11 | 0.89 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.7.g** | 6 | - | - | - | - | - | 0.11 | 0.89 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |

**Table X:** Age error matrix (AEM) for ICES area 27.7.h.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.7.h** | 0 | 0.96 | 0.04 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.7.h** | 1 | - | 0.56 | 0.44 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.7.h** | 2 | - | - | 1.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |

**Table X:** Age error matrix (AEM) for ICES area 27.7.j.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.7.j** | 0 | 0.88 | 0.12 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.7.j** | 1 | - | 0.78 | 0.22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.7.j** | 2 | - | 0.22 | 0.56 | 0.22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.7.j** | 3 | - | - | - | 1.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |

**Table X:** Age error matrix (AEM) for ICES area 27.8.a.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.8.a** | 0 | 1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.8.a** | 1 | - | 0.64 | 0.36 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |
| **27.8.a** | 2 | - | 0.16 | 0.60 | 0.2 | 0.04 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 |

**Table X:** Age error matrix (AEM) for ICES area 27.8.b.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.8.b** | 3 | - | - | 0.33 | 0.67 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.8.b** | 5 | - | - | - | 0.11 | - | 0.44 | 0.44 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.99 |
| **27.8.b** | 6 | - | - | - | - | - | 0.08 | 0.69 | 0.23 | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.8.b** | 7 | - | - | - | - | - | - | - | 0.89 | 0.11 | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.8.b** | 8 | - | - | - | - | - | 0.12 | 0.12 | - | 0.75 | - | - | - | - | - | - | - | - | - | - | - | 0.99 |
| **27.8.b** | 9 | - | - | - | - | - | - | - | - | 0.24 | 0.29 | 0.24 | 0.12 | 0.12 | - | - | - | - | - | - | - | 1.01 |
| **27.8.b** | 13 | - | - | - | - | - | - | - | 0.12 | - | 0.12 | - | - | - | 0.62 | - | 0.12 | - | - | - | - | 0.98 |

**Table X:** Age error matrix (AEM) for ICES area 27.8.c.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.8.c** | 1 | - | 0.67 | 0.33 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.8.c** | 2 | - | 0.22 | 0.63 | 0.15 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.8.c** | 3 | - | - | 0.08 | 0.67 | 0.22 | 0.03 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.8.c** | 4 | - | - | 0.22 | 0.11 | 0.44 | 0.22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.99 |
| **27.8.c** | 5 | - | - | - | 0.04 | 0.15 | 0.78 | 0.04 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.8.c** | 6 | - | - | - | - | - | 0.12 | 0.65 | 0.12 | 0.06 | - | 0.06 | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.8.c** | 7 | - | - | - | - | - | - | 0.29 | 0.53 | 0.06 | 0.12 | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.8.c** | 8 | - | - | - | - | - | - | 0.22 | 0.11 | 0.33 | 0.22 | 0.11 | - | - | - | - | - | - | - | - | - | 0.99 |
| **27.8.c** | 9 | - | - | - | - | - | - | - | - | 0.25 | 0.38 | 0.25 | 0.12 | - | - | - | - | - | - | - | - | 1.00 |
| **27.8.c** | 11 | - | - | - | - | - | - | - | 0.11 | 0.06 | 0.11 | 0.22 | 0.33 | 0.17 | - | - | - | - | - | - | - | 1.00 |

**Table X:** Age error matrix (AEM) for ICES area 27.9.a.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **ices\_area** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **27.9.a** | 0 | 0.78 | 0.22 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.9.a** | 1 | - | 0.63 | 0.37 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.9.a** | 2 | - | 0.17 | 0.79 | 0.03 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.99 |
| **27.9.a** | 3 | - | 0.01 | 0.08 | 0.78 | 0.07 | 0.01 | 0.05 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.9.a** | 4 | - | - | - | - | 0.89 | 0.06 | 0.06 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.9.a** | 5 | - | - | 0.06 | 0.11 | 0.06 | 0.67 | 0.11 | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.9.a** | 7 | - | - | - | - | - | 0.04 | 0.22 | 0.56 | 0.15 | 0.04 | - | - | - | - | - | - | - | - | - | - | 1.01 |
| **27.9.a** | 8 | - | - | - | - | - | - | 0.07 | 0.12 | 0.62 | 0.12 | 0.07 | - | - | - | - | - | - | - | - | - | 1.00 |
| **27.9.a** | 9 | - | - | - | - | - | - | - | - | 0.11 | 0.44 | 0.44 | - | - | - | - | - | - | - | - | - | 0.99 |
| **27.9.a** | 10 | - | - | - | - | - | - | - | 0.20 | 0.07 | - | 0.40 | 0.33 | - | - | - | - | - | - | - | - | 1.00 |
| **27.9.a** | 12 | - | - | - | - | - | - | - | - | - | - | 0.11 | 0.33 | 0.56 | - | - | - | - | - | - | - | 1.00 |

### AEM by strata

**Table X:** Age error matrix (AEM) for Strata\_Strata\_1.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **strata** | **modal\_age** | **0** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **Total** |
| **Strata\_1** | 0 | 0.96 | 0.04 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1.00 |
| **Strata\_1** | 1 | 0.03 | 0.80 | 0.16 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.99 |
| **Strata\_1** | 2 | - | 0.11 | 0.82 | 0.06 | 0.00 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.99 |
| **Strata\_1** | 3 | - | 0.00 | 0.07 | 0.83 | 0.07 | 0.01 | 0.01 | - | - | - | 0.00 | 0.00 | - | - | - | - | - | - | - | - | 0.99 |
| **Strata\_1** | 4 | - | - | 0.01 | 0.10 | 0.80 | 0.08 | 0.02 | - | - | - | - | 0.01 | - | - | - | - | - | - | - | - | 1.02 |
| **Strata\_1** | 5 | - | - | 0.01 | 0.02 | 0.11 | 0.71 | 0.13 | 0.02 | - | - | 0.01 | - | - | - | - | - | - | - | - | - | 1.01 |
| **Strata\_1** | 6 | - | - | - | 0.01 | 0.01 | 0.12 | 0.71 | 0.12 | 0.03 | 0.01 | 0.01 | - | - | - | - | - | - | - | - | - | 1.02 |
| **Strata\_1** | 7 | - | - | - | - | - | 0.02 | 0.18 | 0.58 | 0.15 | 0.05 | 0.01 | 0.01 | - | - | - | - | - | - | - | - | 1.00 |
| **Strata\_1** | 8 | - | - | - | - | - | 0.01 | 0.06 | 0.13 | 0.61 | 0.12 | 0.05 | 0.00 | 0.01 | 0.00 | - | - | - | - | - | - | 0.99 |
| **Strata\_1** | 9 | - | - | - | - | - | - | 0.01 | 0.03 | 0.18 | 0.47 | 0.22 | 0.06 | 0.03 | - | - | - | - | - | - | - | 1.00 |
| **Strata\_1** | 10 | - | - | - | - | - | - | - | 0.07 | 0.05 | 0.15 | 0.57 | 0.17 | - | - | - | - | - | - | - | - | 1.01 |
| **Strata\_1** | 11 | - | - | - | - | - | - | - | 0.09 | 0.03 | 0.09 | 0.23 | 0.37 | 0.20 | - | - | - | - | - | - | - | 1.01 |
| **Strata\_1** | 12 | - | - | - | - | - | - | - | - | 0.02 | 0.03 | 0.08 | 0.13 | 0.49 | 0.13 | 0.06 | 0.06 | - | - | - | - | 1.00 |
| **Strata\_1** | 13 | - | - | - | - | - | - | - | 0.12 | - | 0.12 | - | - | - | 0.62 | - | 0.12 | - | - | - | - | 0.98 |
| **Strata\_1** | 14 | - | - | - | - | - | - | - | 0.06 | - | 0.06 | - | - | 0.06 | 0.18 | 0.47 | 0.06 | 0.12 | - | - | - | 1.01 |
| **Strata\_1** | 17 | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.11 | 0.11 | 0.11 | 0.22 | 0.44 | - | - | 0.99 |
| **Strata\_1** | 18 | - | - | - | - | - | - | - | - | - | - | 0.12 | - | - | 0.12 | - | 0.12 | - | 0.12 | 0.38 | 0.12 | 0.98 |

***Overall comparison of results by strata***

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

|  |  |  |
| --- | --- | --- |
| **Modal age** | **Strata\_1** | **total** |
| 0 | 161 | **161** |
| 1 | 356 | **356** |
| 2 | 293 | **293** |
| 3 | 329 | **329** |
| 4 | 196 | **196** |
| 5 | 197 | **197** |
| 6 | 196 | **196** |
| 7 | 149 | **149** |
| 8 | 200 | **200** |
| 9 | 97 | **97** |
| 10 | 60 | **60** |
| 11 | 35 | **35** |
| 12 | 63 | **63** |
| 13 | 8 | **8** |
| 14 | 17 | **17** |
| 15 | 0 | **0** |
| 16 | 0 | **0** |
| 17 | 9 | **9** |
| 18 | 8 | **8** |
| **Total** | **2374** | **2374** |

*Coefficient of Variation (CV)*

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

|  |  |  |
| --- | --- | --- |
| **Modal age** | **Strata\_1** | **all** |
| 0 | - | - |
| 1 | 38 % | 38 % |
| 2 | 22 % | 22 % |
| 3 | 26 % | 26 % |
| 4 | 18 % | 18 % |
| 5 | 16 % | 16 % |
| 6 | 12 % | 12 % |
| 7 | 13 % | 13 % |
| 8 | 13 % | 13 % |
| 9 | 12 % | 12 % |
| 10 | 11 % | 11 % |
| 11 | 14 % | 14 % |
| 12 | 12 % | 12 % |
| 13 | 22 % | 22 % |
| 14 | 17 % | 17 % |
| 15 | - | - |
| 16 | - | - |
| 17 | 9 % | 9 % |
| 18 | 19 % | 19 % |
| **Weighted Mean** | **21 %** | **21 %** |

*Percentage of Agreement (PA)*

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

|  |  |  |
| --- | --- | --- |
| **Modal age** | **Strata\_1** | **total** |
| 0 | 96 % | 96 % |
| 1 | 80 % | 80 % |
| 2 | 82 % | 82 % |
| 3 | 83 % | 83 % |
| 4 | 80 % | 80 % |
| 5 | 71 % | 71 % |
| 6 | 71 % | 71 % |
| 7 | 58 % | 58 % |
| 8 | 61 % | 61 % |
| 9 | 47 % | 47 % |
| 10 | 57 % | 57 % |
| 11 | 37 % | 37 % |
| 12 | 49 % | 49 % |
| 13 | 62 % | 62 % |
| 14 | 47 % | 47 % |
| 15 | - | - |
| 16 | - | - |
| 17 | 44 % | 44 % |
| 18 | 38 % | 38 % |
| **Weighted Mean** | **73 %** | **73 %** |

*Average Percentage Error (APE)*

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

|  |  |  |
| --- | --- | --- |
| **Modal age** | **Strata\_1** | **all** |
| 0 | - | - |
| 1 | 25 % | 25 % |
| 2 | 11 % | 11 % |
| 3 | 10 % | 10 % |
| 4 | 7 % | 7 % |
| 5 | 8 % | 8 % |
| 6 | 7 % | 7 % |
| 7 | 8 % | 8 % |
| 8 | 7 % | 7 % |
| 9 | 8 % | 8 % |
| 10 | 8 % | 8 % |
| 11 | 11 % | 11 % |
| 12 | 7 % | 7 % |
| 13 | 17 % | 17 % |
| 14 | 11 % | 11 % |
| 15 | - | - |
| 16 | - | - |
| 17 | 8 % | 8 % |
| 18 | 16 % | 16 % |
| **Weighted Mean** | **11 %** | **11 %** |

*Relative bias*

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

|  |  |  |
| --- | --- | --- |
| **Modal age** | **Strata\_1** | **all** |
| 0 | 0.04 | 0.04 |
| 1 | 0.13 | 0.13 |
| 2 | -0.04 | -0.04 |
| 3 | 0.09 | 0.09 |
| 4 | 0.03 | 0.03 |
| 5 | 0.05 | 0.05 |
| 6 | 0.07 | 0.07 |
| 7 | 0.08 | 0.08 |
| 8 | 0.02 | 0.02 |
| 9 | 0.16 | 0.16 |
| 10 | -0.28 | -0.28 |
| 11 | -0.63 | -0.63 |
| 12 | 0.00 | 0.00 |
| 13 | -1.00 | -1.00 |
| 14 | -0.71 | -0.71 |
| 15 | - | - |
| 16 | - | - |
| 17 | -1.22 | -1.22 |
| 18 | -2.00 | -2.00 |
| **Weighted Mean** | **0.02** | **0.02** |

## Conclusion and Recommendations

Overall, the data highlights **improved agreement, reduced variability in key age groups, and minimal systemic bias**, across both Advanced and Basic readers which are all positive outcomes for the accuracy and reliability of mackerel age determination.

Age determination accuracy improved, particularly in younger age groups, but the results also underscore the challenges associated with older age classes. Future efforts should focus on refining methodologies for age determination in older fish, addressing inconsistencies amongst readers.

It is recommended to create a Training Reference Collection (TRC) following the guidelines proposed by WGBIOP in its 2024 Working Group report which will be available: <https://www.ices.dk/community/groups/pages/wgbiop.aspx>

This is a very worthwhile exercise and will be a useful training tool for age readers. It may be possible to use a reference collection already compiled by CEFAS as the basis for this.

It is recommended to actively engage and collaborate with WGBIOP and other Expert Groups e.g. The Working Group on Machine Learning in Marine Science (WGMLEARN) which reviews and identifies machine learning (ML) applications in marine science as well as emerging developments in the field of AI and ML. This group aims to identify key challenges and provide guidance and resources for data sharing (methods, training sets, protocols). Discussions around the fields of computer vision, Near-infrared spectroscopy, multi-dimensional shape analysis and otolith microchemistry and attempts at developing automated methods to estimate individual age & maturity will be of particular interest to age readers. <https://www.ices.dk/community/groups/Pages/WGMLEARN.aspx>

WGBIOP has also developed a draft proposal for a Workshop on Emerging Technologies for the Automated analysis of Calcified structures (WKETAC), possibly for 2025 which will also be of interest and would benefit from the active engagement of age readers.

Another exchange should be completed, after progress has been made on the actions recommended above, in order to ascertain if they have positively impacted age estimation for mackerel.