

# Report of the spring 2019 Western Baltic cod (*Gadus morhua*) age reading exchange – SD 22

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SmartDots event ID: 201

## Introduction

In spring 2019 the first SmartDots age reading comparison for Western Baltic cod (cod2224) was conducted after the last age reading comparison that had taken place in 2014/15 (ICES,2014; ICES,2015).

This spring 2019 otolith exchange included a relatively small number of images of sliced otoliths (n=49) covering quarter 3 and 4 of recent years and the age range from 0 to 10 years. The otoliths originated from SD 22. A total of three age readers from three countries participated. It should be noted that images of sliced cod otoliths are only used in Germany. Denmark and Sweden still use broken cod otoliths for ageing.

After the analysis of the exchange, an online meeting was conducted on 20.02.2019 to discuss the results with all age readers. Frequent errors and uncertainties in the age readings were highlighted to support the learning process. The exchange was carried out using SmartDots.

The objectives of the present exchange were:

- Evaluate the accuracy and precision in age reading of sliced Western Baltic cod otoliths (SD22)
- Identify common error sources in age reading
- Discuss and agree on next steps in an online workshop

## Overview of samples and readers

Three age readers from three countries participated in the Western Baltic cod otolith exchange in spring 2019 (Table 1). All participants were advanced readers who are considered as well trained and provide age readings for the stock assessment (Germany: age reader is responsible for both survey and commercial samples; Denmark: only the age reader responsible for the commercial samples participated; Sweden: age reader is

responsible for both survey and commercial samples). All images were from sectioned otoliths; however, the age readers from Denmark and Sweden only read broken cod otoliths in their routine work.

**Table 1:** Reader overview.

Country	Reader code	Expertise	Standard method
Denmark	R02 DK	Advanced	Broken
Germany	R04 DE	Advanced	Sliced
Sweden	R06 SE	Advanced	Broken

In total, 49 otoliths covering fish total lengths between 12 and 100 cm were included in this exchange. Samples covered quarter 3 and 4 and represented samples from the Baltic International Trawl Survey (BITS) and commercial fisheries (samples in quarter 3) from the years 2017 and 2018. All otoliths were provided by Germany and covered ICES SD22.

**Table 2:** Overview of samples used for the Overview of samples used for the Western Baltic cod spring 2019 exchange.

Year	ICES area	Quarter	Number of samples	Modal age range	Length range
2017	SD 22	4	5	1	150-360 mm
2018	SD 22	3	27	3-10	650-1000 mm
2018	SD 22	4	17	0-5	120-720 mm

## Results

### All readers

#### All samples included

The weighted average percentage agreement based on modal ages for all readers was 85 %, with the weighted average CV of 15 % and APE of 9 %.

**Table 3:** 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	R02 DK	R04 DE	R06 SE	all
0	-	-	-	-
1	37 %	64 %	28 %	45 %
2	0 %	0 %	21 %	19 %
3	0 %	0 %	0 %	0 %
4	0 %	0 %	12 %	9 %
5	0 %	8 %	0 %	5 %
6	0 %	0 %	0 %	0 %
7	0 %	0 %	6 %	6 %
8	7 %	0 %	0 %	5 %
9	-	-	-	-
10	0 %	7 %	0 %	4 %
<b>Weighted Mean</b>	<b>9 %</b>	<b>16 %</b>	<b>11 %</b>	<b>15 %</b>

The percentage agreement per reader per modal age gives the percentage of readings which are equal to the modal age. The weighted mean included at the bottom of the table, is weighted according to number of age readings. At modal age 0, the PA calculated across all readers was only 67 %, with one reader having 0 % agreement. The PA of modal ages 0, 1 and 7 was below 80 %.

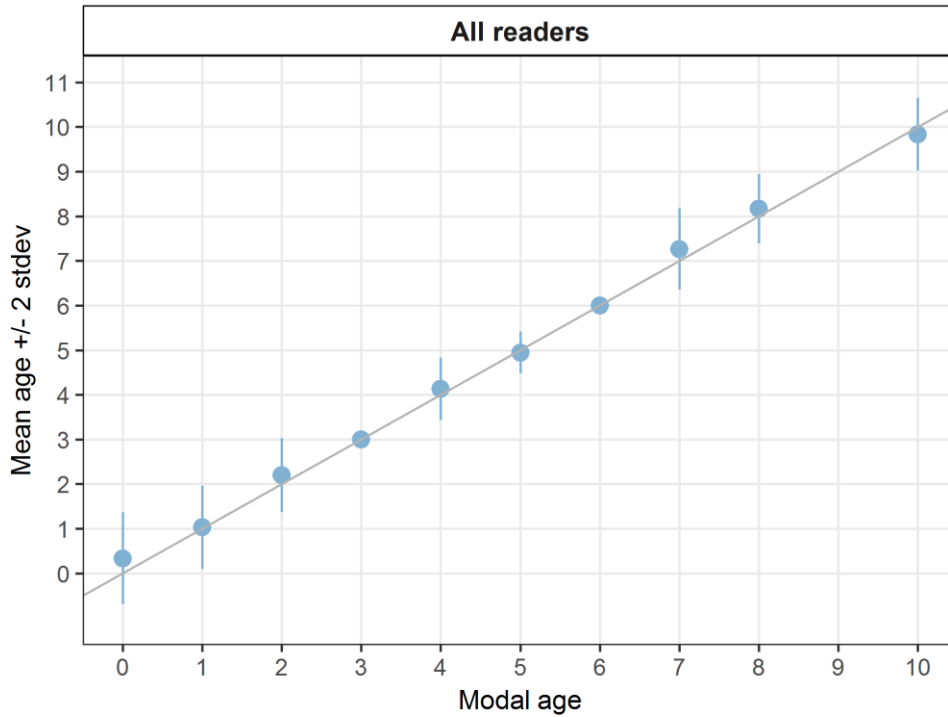
**Table 4:** Percentage agreement (PA) table represents the PA per modal age and reader, the PA of all readers combined per modal age and a weighted mean of the PA per reader.

Modal age	R02 DK	R04 DE	R06 SE	all
0	0 %	100 %	100 %	67 %
1	73 %	73 %	91 %	79 %
2	100 %	100 %	40 %	80 %
3	100 %	100 %	100 %	100 %
4	100 %	100 %	60 %	87 %
5	100 %	83 %	100 %	94 %
6	100 %	100 %	100 %	100 %
7	100 %	100 %	20 %	73 %
8	50 %	100 %	100 %	83 %
9	-	-	-	-
10	100 %	50 %	100 %	83 %
<b>Weighted Mean</b>	<b>85 %</b>	<b>90 %</b>	<b>80 %</b>	<b>85 %</b>

The relative bias is the difference between the mean age (per modal age per reader) and the modal age. A positive bias indicates an overestimation of age compared to the modal age. As for Table 5, a combined bias for all readers and weighted means were calculated. While modal ages 0-3, 4, 7 and 8 showed an overestimation of age compared to the modal age, modal age 5 and 10 showed an underestimation of age compared to the modal age. Generally, R02 DK and R06 SE overestimated the age compared to the modal age and R04 DE underestimated the age compared to modal age resulting in a slightly positive weighted mean which indicates an overestimation of age compared to the modal age.

**Table 5:** Relative bias table represents the relative bias per modal age per reader, the relative bias of all readers combined per modal age and a weighted mean of the relative bias per reader. Red and blue values indicate positive and negative bias, respectively.

Modal age	R02 DK	R04 DE	R06 SE	all
0	1.00	0.00	0.00	0.33
1	0.27	-0.27	0.09	0.03
2	0.00	0.00	0.60	0.20
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.40	0.13
5	0.00	-0.17	0.00	-0.06
6	0.00	0.00	0.00	0.00
7	0.00	0.00	0.80	0.27
8	0.50	0.00	0.00	0.17
9	-	-	-	-
10	0.00	-0.50	0.00	-0.17
<b>Weighted Mean</b>	<b>0.15</b>	<b>-0.10</b>	<b>0.20</b>	<b>0.08</b>



**Figure 1:** Age bias plot for all readers. Mean age recorded +/- 2 stdev of each reader and all readers combined are plotted against 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. Individual reader age biases can be found in the annex (Fig. 5).

**Table 6:** Age error matrix (AEM) for cod2224 resulting from the present exchange. The AEM shows the proportional distribution of age readings for each modal age. Age column should sum to one but due to rounding there might be small deviations in some cases.

Modal age	0	1	2	3	4	5	6	7	8	10
Age 0	0.5	-	-	-	-	-	-	-	-	-
Age 1	0.5	0.82	-	-	-	-	-	-	-	-
Age 2	-	0.18	0.7	-	-	-	-	-	-	-
Age 3	-	-	0.3	1	-	-	-	-	-	-
Age 4	-	-	-	-	0.8	-	-	-	-	-
Age 5	-	-	-	-	0.2	1	-	-	-	-
Age 6	-	-	-	-	-	-	1	-	-	-
Age 7	-	-	-	-	-	-	-	0.6	-	-
Age 8	-	-	-	-	-	-	-	0.4	0.75	-
Age 9	-	-	-	-	-	-	-	-	0.25	-
Age 10	-	-	-	-	-	-	-	-	-	1

## Discussion

This is the first SmartDots age reading comparison for Western Baltic cod. Since the last age reading comparison in 2015 organized by Karin Hüsey and Uwe Krumme, surprisingly the uncertainties and national differences in age interpretation of Western Baltic cod in SD 22 had increased, despite progress in age validation. Especially ages 0-2

and 7-10 showed particularly low PAs. An average PA of 85 % and a CV of 15 % for advanced readers is not satisfactory for a stock for which otolith age reading is validated and considered relatively clear and easy.

However, it has to be kept in mind that Sweden and Denmark do not read sliced otoliths on a routine basis, which were used for this and the previous exchange and readers might therefore have been less trained in reading sliced otoliths. Moreover, Swedish age readers usually do not read cod otoliths from SD22 because Sweden is not fishing in SD22 and also is not involved in surveys in SD22.

This exchange is now closed in SmartDots and can be used for further training purposes because all readers' annotations are now visible for comparisons. Table 8 gives an overview about the individual readers' ages, PA, CV and APE per sample ID.

## Outlook

After the otolith exchange the results were discussed by national age reading coordinators and age readers. The group concluded on the following:

- Regular otolith exchanges of sliced otoliths of Western Baltic cod will be continued because the quality of the age reading has to be and can be improved; the next exchange will take place in autumn 2019 and will include a larger sample size and quarter 1 otoliths. To prepare for this second exchange, another age reading online workshop between Germany, Denmark and Sweden will be organized. Germany will manage the next exchange in autumn 2019.
- Results of this and the next age reading comparison will be presented at WKBALTCOD 2019 and WGBFAS 2019.
- The routine use of different age reading methods (sectioned vs broken otoliths) in a relatively small stock with a limited number of age-read otoliths each year makes the comparison of the age readings quite difficult. In fact, one may question whether or not a comparison of 3 age readers where 2 are used to broken otoliths and 1 is used to sliced otoliths, is useful at all because the significance of an exchange on the routine age-reading of broken otoliths is unclear. There are several quality issues that clearly are in favour of the sliced method (e.g. documentation of the ageing because sliced otoliths are photographed, correction of errors, quality of the age reading because the diameter of the first ring can be measured on images (McQueen et al. 2019) but not in broken otoliths, use of images of sliced otoliths in SmartDots) but it is considered more laborious.
- Germany will send around small reports on the results of the Q1 and Q4 BITS age readings in SD22 involving images of sliced, representative otoliths, so that the age readers from Denmark and Sweden can become more and more used to age-read sliced otoliths, which will be used in the next SmartDots comparisons.
- In case it is considered helpful, the Thünen Institute offered to assist other labs by slicing up to 1000 Western Baltic cod otoliths per year.