

Kattegat Cod Age Reading Exercise 2016

Working document for WKBALT 2017

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Readers

- Lise Sindahl **LS** (DTU Aqua Denmark)
- Rajlie Sjöberg **RS** (SLU Aqua Sweden)

Samples

Otoliths pairs were provided by DTU Aqua, see Table 1 for a sample overview.

Table 1. Overview of samples used for the age reading exercise for Kattegat Cod (SD 21)

Year	Quarter			Total
	1	3	4	
2010			100-580 mm	14
2011			150-630 mm	53
2014	170-570 mm			15
2014		160-300 mm		14
2014			180-650 mm	14
Total	68	14	28	110

Methods

Readers were provided with otoliths, date of capture, fish length and area and asked to provide an estimate of age.

Analysis

The age estimations of RS (SLU Aqua) are compared against the age estimations of LS (DTU Aqua) using the traditional procedures outlined by Eltink et al., (2002):

- Percentage agreement (PA) ($n_{\text{modal age}}/n_{\text{total}}*100$)
- Coefficient of variation (CV) ($\text{Standard deviation}/\text{average}*100$)

When comparing 2 readers it is not always possible to calculate modal age and thus for this exercise the age estimations of LS (DTU Aqua) were used as modal (LS) age. As the calculation of both CV and APE poses problems if the mean age is close to 0, all observations for which modal (LS) age was 0 were omitted from the calculation of CV and APE. An index of average percentage error (APE) was calculated, based on the methods outlined by Beamish and Crawford (1981) as this method is not independent of fish age and thus provides a better estimate of precision.

An age error matrix (AEM) was produced following procedures outlined by WKSABCAL (2014) where the matrix shows the proportion of each modal (LS) age mis-aged as other ages. The sum of each row is 1, which equals 100%.

Results

The percentage agreement is 95% with a CV of 2.9% (Table 2). There is disagreement on just 11 of the 109 otoliths examined (one otolith was lost). There are no consistent patterns of bias meaning that one reader does not consistently read older or younger in comparison to the other and the APE is just 2.1%.

Table 2. Sample data with age estimates, coefficient of variation (CV) and percentage agreement (PA) per otolith

Fish ID	Capture date	Length (mm)	LS age	RS age	Modal (LS) age	CV	PA
6156430	01/11/2010	580	2	2	2	0	100
6156431	01/11/2010	250	1	1	1	0	100
6156432	01/11/2010	110	0	0	0	NA	100
6156433	01/11/2010	130	0	0	0	NA	100
6156434	01/11/2010	110	0	0	0	NA	100
6156435	01/11/2010	100	0	0	0	NA	100
6156436	01/11/2010	160	0	0	0	NA	100
6156437	01/11/2010	160	0	0	0	NA	100
6156438	01/11/2010	140	0	0	0	NA	100
6156439	01/11/2010	120	0	0	0	NA	100
6156440	01/11/2010	160	0	0	0	NA	100
6156441	01/11/2010	220	1	1	1	0	100
6156442	01/11/2010	200	1	1	1	0	100
6156443	01/11/2010	290	1	1	1	0	100
6244484	12/03/2011	510	3	3	3	0	100
6244485	12/03/2011	570	3	3	3	0	100
6244486	12/03/2011	470	3	3	3	0	100
6244487	12/03/2011	460	3	3	3	0	100
6244488	12/03/2011	410	3	3	3	0	100
6244489	12/03/2011	480	3	3	3	0	100
6244490	12/03/2011	440	3	3	3	0	100
6244491	12/03/2011	410	3	3	3	0	100
6244492	12/03/2011	410	3	3	3	0	100
6244493	12/03/2011	450	3	3	3	0	100
6244494	12/03/2011	360	3	3	3	0	100
6244495	12/03/2011	340	3	3	3	0	100
6244496	12/03/2011	390	3	3	3	0	100
6244497	12/03/2011	510	3	3	3	0	100
6244498	12/03/2011	340	2	2	2	0	100
6244499	12/03/2011	420	3	3	3	0	100
6244500	12/03/2011	310	2	2	2	0	100
6244501	12/03/2011	300	2	2	2	0	100
6244502	12/03/2011	350	3	3	3	0	100
6244503	12/03/2011	310	2	2	2	0	100
6244504	12/03/2011	400	3	2	3	28.3	50
6244505	12/03/2011	270	2	2	2	0	100
6244506	12/03/2011	370	3	3	3	0	100
6244507	12/03/2011	470	3	3	3	0	100
6244508	12/03/2011	370	3	2	3	28.3	50
6244509	12/03/2011	370	3	3	3	0	100
6244510	12/03/2011	450	3	3	3	0	100
6244511	12/03/2011	330	2	3	2	28.3	50
6244512	12/03/2011	230	2	2	2	0	100
6244513	12/03/2011	400	3	3	3	0	100
6244514	12/03/2011	450	3	3	3	0	100
6244515	12/03/2011	410	3	3	3	0	100
6244516	12/03/2011	440	3	3	3	0	100
6244517	12/03/2011	360	3	2	3	28.3	50
6244518	12/03/2011	330	2	2	2	0	100
6244519	12/03/2011	430	3	3	3	0	100
6244520	12/03/2011	290	2	3	2	28.3	50
6244521	12/03/2011	340	2	3	2	28.3	50
6244522	12/03/2011	320	2	2	2	0	100
6244523	12/03/2011	290	2	2	2	0	100
6244524	12/03/2011	170	1	1	1	0	100

6244525	12/03/2011	270	2	2	2	0	100
6244526	12/03/2011	260	2	2	2	0	100
6244527	12/03/2011	150	1	1	1	0	100
6244528	12/03/2011	280	2	2	2	0	100
6244529	12/03/2011	280	2	2	2	0	100
6244531	12/03/2011	550	3	3	3	0	100
6244532	12/03/2011	550	3	3	3	0	100
6244533	12/03/2011	480	3	3	3	0	100
6244534	12/03/2011	630	3	3	3	0	100
6244535	12/03/2011	180	1	1	1	0	100
6244536	12/03/2011	290	2	2	2	0	100
6853810	27/02/2014	440	3	3	3	0	100
6853811	27/02/2014	530	3	4	3	20.2	50
6853812	27/02/2014	570	3	3	3	0	100
6853813	27/02/2014	420	3	3	3	0	100
6853814	27/02/2014	220	2	1	2	47.1	50
6853815	27/02/2014	270	2	2	2	0	100
6853816	27/02/2014	200	1	1	1	0	100
6853817	27/02/2014	230	2	2	2	0	100
6853818	27/02/2014	230	2	2	2	0	100
6853819	27/02/2014	190	1	1	1	0	100
6853820	27/02/2014	240	2	2	2	0	100
6853821	27/02/2014	210	1	1	1	0	100
6853822	27/02/2014	170	1	1	1	0	100
6853823	27/02/2014	170	1	1	1	0	100
6853824	27/02/2014	200	1	1	1	0	100
6939517	31/07/2014	260	1	1	1	0	100
6939518	31/07/2014	290	1	1	1	0	100
6939519	31/07/2014	290	1	1	1	0	100
6939520	31/07/2014	180	0	1	0	NA	50
6939521	31/07/2014	280	1	1	1	0	100
6939522	31/07/2014	300	1	1	1	0	100
6939523	31/07/2014	200	1	1	1	0	100
6939524	31/07/2014	270	1	1	1	0	100
6939525	31/07/2014	270	1	1	1	0	100
6939526	31/07/2014	300	1	1	1	0	100
6939527	31/07/2014	260	1	1	1	0	100
6939528	31/07/2014	240	1	1	1	0	100
6939529	31/07/2014	210	1	1	1	0	100
6939530	31/07/2014	160	0	1	0	NA	50
6967378	07/11/2014	250	1	1	1	0	100
6967379	07/11/2014	310	2	1	2	47.1	50
6967380	07/11/2014	180	0	0	0	NA	100
6967381	07/11/2014	240	1	1	1	0	100
6967382	07/11/2014	240	1	1	1	0	100
6967383	07/11/2014	260	1	1	1	0	100
6967384	07/11/2014	240	1	1	1	0	100
6969091	10/11/2014	360	2	2	2	0	100
6969092	10/11/2014	400	2	2	2	0	100
6969093	10/11/2014	370	2	2	2	0	100
6969094	10/11/2014	500	3	3	3	0	100
6969095	10/11/2014	490	2	2	2	0	100
6969096	10/11/2014	650	3	3	3	0	100
6969097	10/11/2014	440	2	2	2	0	100
-	-	-	-	-	-	-	-
Means (CV and PA)	-	-	-	-	-	2.9 %	95 %
Total read	-	-	109	109	-	-	-

The age error matrix (Table 3) shows that the proportion of fish aged by RS to be in agreement with modal (LS) age ranges from 91% at age 2 to 100% at age 1. The age comparison matrix (Table 4) shows the number of fish aged by RS as ages other than modal (LS) age. Both of these tables illustrate that there is only ever a difference of one year between the age estimates of the two readers.

Table 3. Age error matrix shows the proportion of each modal (LS) age estimated by RS as other ages (values in bold indicate the proportion in agreement with modal (LS) age, those in blue indicate underestimation in comparison to modal (LS) age, those in red indicate overestimation in comparison to modal (LS) age).

Age RS	Modal (LS) Age			
	0	1	2	3
0	0.92	0	0	0
1	0.08	1	0.03	0
2	0	0	0.91	0.04
3	0	0	0.05	0.95
4	0	0	0	0.01

Table 4. Age comparison matrix shows the number of fish aged in agreement with modal (LS) age and the number of fish estimated by RS as other ages (values in bold indicate the proportion in agreement with modal (LS) age, those in blue indicate underestimation in comparison to modal (LS) age, those in red indicate overestimation in comparison to modal (LS) age).

Modal (LS) Age	Age 0	Age 1	Age 2	Age 3	Age 4	Total
0	10	2	0	0	0	12
1	0	30	0	0	0	30
2	0	2	24	3	0	29
3	0	0	3	34	1	38
Total	10	34	27	37	1	109

Conclusions

The agreement between the primary age readers from Denmark and Sweden for Kattegat cod (SD21) is very high with no consistent bias between readers. These results mean that there are no consistent ageing errors which would have an effect on the stock assessment of Kattegat cod (SD21).

References

R. J. Beamish and D. A. Fournier (1981) A method for comparing the precision of a set of age determination. Canadian Journal of Fisheries and Aquatic Sciences, 38, 982–983

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