CCAMLR

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Update of ongoing work on age and growth of Antarctic toothfish (Dissostichus mawsoni) (2013-14 season) from Division 58.4.1 by Spain

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Update of ongoing work on age and growth of Antarctic toothfish (*Dissostichus mawsoni*) (2013-14 season) from Division 58.4.1 by Spain

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Abstract

We present preliminary results on age and growth of *Dissostichus mawsoni* for the second season (2013/14) of the Spanish research fishing in the 58.4.1 Division obtained for growth rings on otolith readings. It is included the age-length key and growth parameters estimates by sex. Growth parameters obtained using length-age pair values are: L_∞: 175.7, k: 0.1078 and t_0: 1.528 for females; L_∞: 150.3, k: 0.1491 and t_0: 1.809 for males; and L_∞: 169.8, k: 0.1087 and t_0: 1.168 all combined. These results are very similar to those reported previously for the first season (2012/13) although they differ slightly with the values used in the Ross sea assessment for males.

Introduction

From 2012-13 Spain is conducting fishing research in the 58.4.1 Division in order to get data and biological samples which enable an assessment of Antarctic toothfish in this area at the end of the whole experience. Up to now three surveys have been completed and the WG-SAM-15 requested to Spain to provide additional information on the otolith readings progress to WG-FSA-16.

The Spanish Institute of Oceanography (IEO) is working on the ageing and growth estimates of Antarctic toothfish since 2015. Thus, this document is a progress of the work presented last year (WG-FSA-15/06), following the same methodology. Samples studied were obtained in the course of research experiments conducted by the Spanish flagged vessel *Tronio* in Division 58.4.1 in the fishing season 2013-14. Otoliths from 495 specimens were used in this second approach to ageing individuals of this species in order to construct the age structure of fished population and to estimate the growth parameters.

In this process, a set of 40 otoliths used as a reference were provided by the CCAMLR Secretary to exchange and fix the ageing criteria among readers. Also coordination between readers from the Republic of Korea and Spain has been made using pics of the cut otoliths (both raw and with the interpreted age marked).

For the otolith preparations and ageing we followed the methodology described on the Manual for age determination of Antarctic toothfish (Sutton *et al*., 2012) as "bake and embed" technique.

Otolith interpretation and age determination

Table 1 includes the numbers of *D. mawsoni* otolith samples collected by Spain, prepared (mounting and sectioning) and aged by fishing season.

Table 1. Numbers of otolith samples of *D. mawsoni* obtained by Spain in the 58.4.1 Division by season.

Season	Collected	Prepared	Aged
2012	-		
2013	696	696	514
2014	1242	600	495
2015	-		
2016	562	363	-
Total	**2500**	**1659**	**1009**

In this second phase on the ageing of *D. mawsoni* from Division 58.4.1, the protocol adopted consisted of:

- Readings are still made by two pairs of readers. The first one were two experienced scientist that taught about the interpretation pattern to the other pair.
- The work is in progress. And only results from one of the two pair of readers are presented here. Final agreement on the results with two other readers is waiting for comparison.

At this stage, considering the protocol followed by the readers where the age interpretation has been made by consensus between pairs, we wait for the second pair of readers to finish the otoliths set in order to compare all readings.

Age-length key and mean length analysis

Table 2 shows the preliminary age-length key estimated for all individuals, where the length ranged from 45 cm to 200 cm total length and ages ranged from 5+ to 36+. Few individuals with more than 31 years were found in the whole sample analyzed.

Table 2. Age-length key for *D. mawsoni* from Division 58.4.1 in the fishing season 2013-14.

Length interval (cm)/ Age class (years)	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
45	1																															
50																																
55	2	1																														
60	2	2	1	1																												
65	1	5	3	8	1		1																									
70	2	4	5	4					1																							
75		2	6	1	1	2																										
80			1	2		5	1	1																								
85			2	1	2	1	2																									
90			1	2	4	1	1																									
95			3	5	3	2		4	2	2																						
100			2	4	4	5	2	1	1	2																						
105			2	2		4	4	4	2	2	1			1			1															
110	1			1	2	3	3	6	3	2			1				1															
115					2	2	2	4	2	5	1																						
120					1	4	3	1	1	2	1	4	2	1	1	1	2		1													
125						5	2	3	1	2	2	1	1	1		2	1	1	3	1	2											
130							2	3	5	3	3		1	1	1			2	2	2	1	1											
135										4	2	1		2	4	3		1	1	2	1	2					1	1					
140										1	1	3	3	4	1	4	3		1	2	2				2	1						
145											2	1	1	6	1	3	2	2	1	4	3	1			1		1					
150										1		3	5	3	3	2	5		2	2	2	1	1			1						
155									1			2	3	1		1	3	2	3	2	1		5		1		2					
160										1	2	1	2	1	1	3	4	1	2	3	1	2		1		2						
165										1		1	2	2	1		3	1	1	2	1		3	1	1	1	1				1	1
170													3	1	4	2	1		2		2	2		1								
175														1			1	1		3	1											
180																		1	1	2		1				1						
185																				1							1					
190																					1											
195																			1		1											
n	9	14	26	31	20	34	23	27	19	28	15	17	24	25	17	21	27	12	21	26	19	10	9	6	3	5	6	1	0	0	1	1
Mean length(cm)	68.06	68.93	82.88	84.92	98.75	105.44	109.24	113.06	117.24	125.00	135.83	143.09	150.21	147.30	151.32	147.50	150.09	152.50	152.02	156.54	155.66	156.00	160.28	155.83	155.83	165.50	159.17	137.50			167.50	167.50
SD	18.45	5.69	13.56	15.86	13.66	16.43	16.83	12.51	18.52	18.08	15.20	15.09	16.87	15.64	16.25	13.96	17.99	18.09	20.18	17.26	20.22	17.17	5.65	13.29	12.58	10.95	17.22					

Growth parameters

A von Bertalanffy growth function based on a least-square fitting approach from length-age pair values had been estimated. Growth parameters by sex and combined are presented in Table 3.

Table 3. Parameters of von Bertalanffy growth fitting by sex and all sex combined, for *D. mawsoni* from Division 58.4.1 and standard error estimations for 2013/14 season and number total of otoliths read.

n	Sex	t_0 (y)	k (y^{-1})	L∞ (cm)
208	Male	1.809	0.1491	150.3
287	Female	1.528	0.1078	175.7
495	Combined	1.168	0.1087	169.8
Standard error	Male	0.548	0.01781	3.562
	Female	0.596	0.01237	4.626
	Combined	0.4674	0.009768	3.593

Figure 1 shows pair values and growth curve fitted for males, females and both sex combined for the 2013/14 season as well as a comparative with the previously obtained from the 2012/13 season. Results of all sex combined are very similar although the fitted curve by sex differs slightly being the 2012/13 estimated values of L_∞ lower for females and bigger for males than the obtained with the 2013/14 season set.

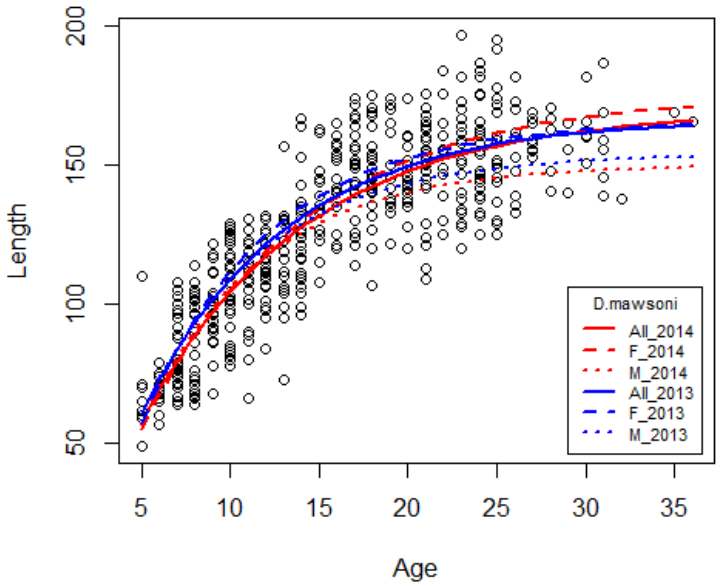

Figure 1.- Values of length-age used to estimate growth parameters and growth curves fitted for males, females and all combined by season.

Comparing visually our results with the age-length curve used in the Ross sea assessment (CCAMLR, 2015) in Figure 2, our estimates of L_{∞} are lower in all cases.

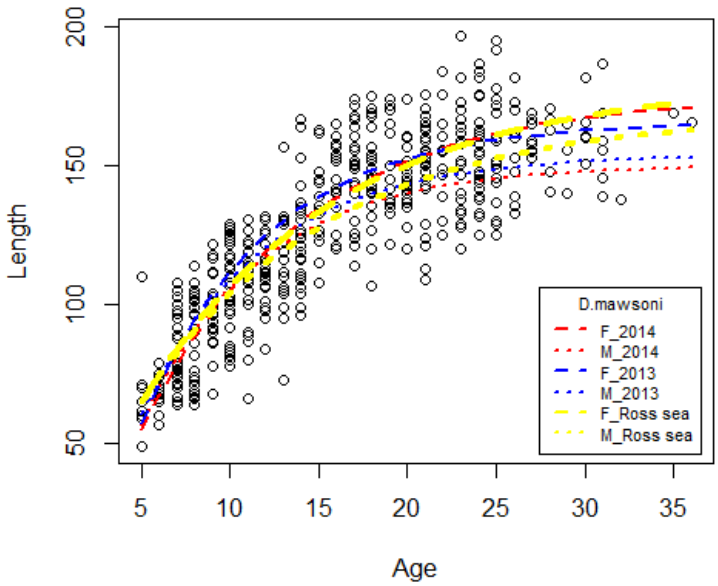

Figure 2.- Values of length-age used to estimate growth parameters and growth curves fitted for males and females by season in division 58.4.1 and the Ross sea.

Work in progress

The annually age estimation from the Antarctic toothfish samples will continue and progress reports will be reported to WG-FSA. The finalization of the ongoing otolith readings of the 2013/14 season for the two remaining readers will enable to compare between reader pairs and to obtain the final result. It is expected to finish with the 2015/16 set from the last season research survey onboard the F/V*Tronio* before the WG-SAM-2017 meeting.

A set of 40 otoliths used as a reference has been provided by the CCAMLR Secretary to coordinate the ageing among readers. Although this could be a useful tool to compare between members this set is not easy to interpret due to the confusing numeration of every otolith's cut as well as the unclear images but also due to the inherent difficulties of the otoliths of toothfish itself, that provoke that discrepancies cannot be solved.

Coordination between readers of Republic of Korea and Spain has been made using pics of the cut otoliths (both raw and with the interpreted age marked) provided by the Korean colleagues. Some important discrepancies have been found and will be discuss between both members, especially concerning the 5-6 first rings identification and placement. We consider that the Korean criteria allocate in general the readings almost equidistant between rings along three different zones of the otolith. Even when is not always observed, the criteria of the allocation of the first (La Mesa, 2007) and subsequent rings should be considered.

References

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