Continuation of the development of an OMP for the toothfish (*Dissostichus eleginoides*) resource in the Prince Edward Islands region

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Introduction

A list is given below of possible Operating Models (OMs) to be considered in the development of an OMP for toothfish. This has been developed from discussions that have taken place in task team meetings. These discussions, with the decisions taken and further tasks still needed to be completed were summarised in Brandão and Butterworth (2018a and 2018b). The outstanding items were then discussed at a meeting of a task team on 18 December 2018, and the results of these discussions are included here.

The list of suggested OMs below has been split (initially) into three groups:

i)   evaluation trials (these are OMs that are highly plausible and for which CMPs must perform satisfactorily),

ii)   robustness trials (these are OMs that are less plausible but under which the behaviour of the CMPs needs to be examined), and

iii)   trials that might be ignored (these are trials that were set in the previous OMP development but have not been identified as important this time around or that have been subject to assessment sensitivities examined recently with decisions taken not to consider them further).

Table 1 lists the various parameters/assumptions under the Base case OM, and alternative values that will apply for other OMs to be used as sensitivities or robustness trials.

Initial list of trials

Evaluation trials (towards selection of a Reference Set of Operating Models)

1. Base case (this is the New Base Case assessment for which the 2008 and 2009 trotline CPUE values are omitted)
2. Alternative cetacean depredation overall

3. Alternative assumption concerning cetacean depredation on trotlines
4. Multiplicatively up-weight all CPUE since 2010 by 10 in the log likelihood
5. Tag reporting rate of 0.8
6. Alternative biological parameters (other than growth parameters)
7. Alternative growth parameters
8. Alternative tag loss/mortality

Robustness trials

1. Tag loss of 75% and multiplicatively up-weight all CPUE from 2010 by 10 in the log likelihood
2. Tag loss of 50% and multiplicatively up-weight all CPUE from 2010 by 5 in the log likelihood
3. Multiplicatively up-weight last 2 indices (2016 and 2017) of trotline CPUE by 10 in the log likelihood
4. The standard deviation (σ_R) of the annual variation in the stock-recruitment function is assumed to be 0.1 for the period until 1997 and to be 0.5 thereafter.
5. Fix K_{sp} to 25 000 tonnes

Trials to ignore

1. Double 1997 IUU
2. Early longline selectivity assumed to apply in future
3. Alternative age at 50% selectivity (5.5, 6.5, 7.5)

References

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Table 1. Inputs/assumptions for the Base case OM and alternative OMs

Parameters	Base case	Alternatives	Comments
Natural Mortality	0.13	0.10 and 0.16	Values used in other CCAMLR areas range from 0.13 to 0.155 (Ziegler, 2017, Earl, 2017 and Earl and Fischer, 2017). Adopted 0.13 for base case and alternatives of 0.10 and 0.16 to encompass a plausible range. Estimating M using available data (e.g. catch curve) not viable (compromised by the selectivity issue)
Steepness parameter h	0.75	0.6 and 0 .9	0.75 used in all other areas, and no data/analyse appear to be available to inform an improved estimate. Alternatives of 0.6 and 0.9 adopted as a plausible range
Cetacean predation (longlines)	+10%	+30%	Base case value estimated using the post-2000 month estimates obtained from the "split" month factor of the longline CPUE standardisation (Brandão and Butterworth, 2014a and 2014b). Alternative value is a maximum typical of other areas (see Guinet *et al.,* 2015 for Crozet Islands and COLTO 2016 workshop report). Base case assumes an increasing trend over time: no depredation prior to 2000, but then a linear increase to "current" levels from 2000 – 2002, after which it remains at "current" levels. Based on reports from the industry. Alternative case assumes depredation prior to 2000 was half of "current", then linear increase to "current" from 2000 – 2002, after which it remains at "current". Based on observer records of presence of, and interactions with, cetaceans (see Durholtz, 2018)
Cetacean predation (trotlines)	+5%	+0% and +10%	Anecdotal evidence from observers suggest some depredation does occur on trotlines (even with excluder device) – 5% adopted for base case. Alternatives reflect no depredation on trotline and double that of the base case to encompass a plausible range.
Age at 50% selectivity	estimated		
Weight applied to length	1	none	
Weight applied to CPUE	1	5 and 10	Weighting CPUE by 10 required to force model to fit recent trotline CPUE ("pessimistic" OM). Weight of 5 adopted as an "intermediate" OM.

σ_R	0.5	0.1 (until 1997) 0.5 (after 1997)	No estimates available for other areas/stocks.
Von Bertanffy growth			
ℓ_∞	152.0	174.5	Base case values obtained from Agnew *et al.* (2006) (Subarea 48.3). Alternative values (effectively reflecting slower growth) are an average of the base case value and that estimated from analyses of the tagging data (Brandão and Butterworth, 2018c).
κ	0.067	0.0425	
t_o	-1.49	-1.4575	
Weight at length (cm to tonnes)			
c	2.54×10^{-8}	$4.091 \times 10^{-9*}$; $4.17 \times 10^{-9\dagger}$	Base case values obtained from Agnew *et al.* (2006) (Subarea 48.3). Alternative values are for Subarea 48.4* (Earl, 2017) and Division 58.5.2† (Ziegler, 2017, with values converted to the same across Subareas).
d	2.8	3.196*; 3.2064†	
Age at maturity	13	none	Base case value reflects an average from other areas (Ziegler, 2017, Earl, 2017 and Earl and Fischer, 2017). Alternative value not required
Tag reporting rate	1	0.8	Base case assumes all recaptures of tagged fish are detected and reported. Alternative value assumes some (20%) of tagged recaptures are not detected.
Tag loss/mortality (annually)	0	0.8; 0.5	Base case assumes no tags are lost, and no mortality arising from the tagging process occurs. Alternative value of 0.8 derived from the assumption required to achieve a reasonable model fit to the recent CPUE data (i.e. "pessimistic" scenario), while the alternative of 0.5 was selected to reflect an "intermediate" scenario.