

## Stochastic projections for the toothfish (*Dissostichus eleginoides*) resource in the Prince Edward Islands vicinity

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### ABSTRACT

For stochastic future recruitment and for annual catch levels of 0, 200, 400, 575 and 675 tonnes, the median of the spawning biomass estimates for the New Base case model drops initially, but returns to its current level within a decade. However, for variants of this model that attempt to improve the fit to the trotline CPUE or which adjust the projected recruitments to reflect a possible regime shift, only annual catches in the range of 200 to 400 tonnes maintain the spawning biomass above the current level at the end of a 20 year period. This suggests that consideration should perhaps be given to recommending some decrease in the present annual TAC of 575 tonnes.

### INTRODUCTION

This paper reports on projections that take into account stochasticity in future recruitment under future annual constant catches of 575 t (the present TAC) as well as 0, 200, 400 and 675 t. Projections are provided for three assessment model variants reported by Brandão and Butterworth (2018). These are:

- i) New Base case: in which the 2008 and 2009 trotline CPUE indices are omitted and which (would seem to) represent an optimistic status of the resource (in the context that it fails to reflect the full recent rate of decrease in the trotline CPUE).
- ii) The sensitivity to (i) that assumes a tag loss of 0.5, up-weights all CPUE indices from 2010 by a factor of 5 and reflects an intermediate status of the resource.
- iii) The sensitivity to (i) that assumes a tag loss of 0.75, up-weights all CPUE indices from 2010 by a factor of 10 and reflects a pessimistic status of the resource.

Projections for these three variants are also shown when the average of the estimated recruitment residuals over the last 10 years is applied to generated recruitment to reflect a possible regime shift.

An error in the computation of stochastic projections (as reported in Brandão and Butterworth (2017)) was found and has now been corrected.

## RESULTS AND DISCUSSION

Figure 1 shows the median spawning biomass depletion together with twenty year projections assuming future stochastic recruitment under constant future annual catches of 0, 200, 400, 575 and 675 t for the **New Base case** model and for two **sensitivity tests** that reflect an intermediate and a pessimistic status of the resource. Projections assume that in future all catches are from the trotline fishery, as has been the case since 2014, and that there are no illegal removals. As the pot fishery has not been operational since 2005, the projections assume no pot fishery. Figure 2 shows results as in Figure 1 but future projected recruitment (both for the actual future, and for the past seven years of the assessment for which the data available do not inform on recruitment strength (other than as predicted by the stock-recruitment relationship)) has been adjusted to reflect the lower than average recruitment residuals over the most recent 10 years for which the data provide sufficient information for these to be estimated (i.e. effectively assuming a regime shift). Figure 3 shows the above projections for the **New Base case** model together with their 90% probability envelopes as well as the lower 10<sup>th</sup> percentile for each of the assumed annual catches. Median, 5<sup>th</sup> and 95<sup>th</sup> percentiles for spawning biomass depletion for the **New Base case** model under several future annual catches for the current year (2018) and every 5<sup>th</sup> year thereafter are given in Table 2.

## CONCLUSIONS

For all scenarios under all future catch levels considered the median of the spawning biomass estimates drops initially, but returns to its current level inside a decade for the New Base case. Catches of 400 t for the intermediate sensitivity and of 200 t for the pessimistic maintain the median spawning biomass above the current level. If recruitment is adjusted for a possible regime shift, a constant catch of 200 t or less maintains the spawning biomass above the current level at the end of a 20 year projection period.

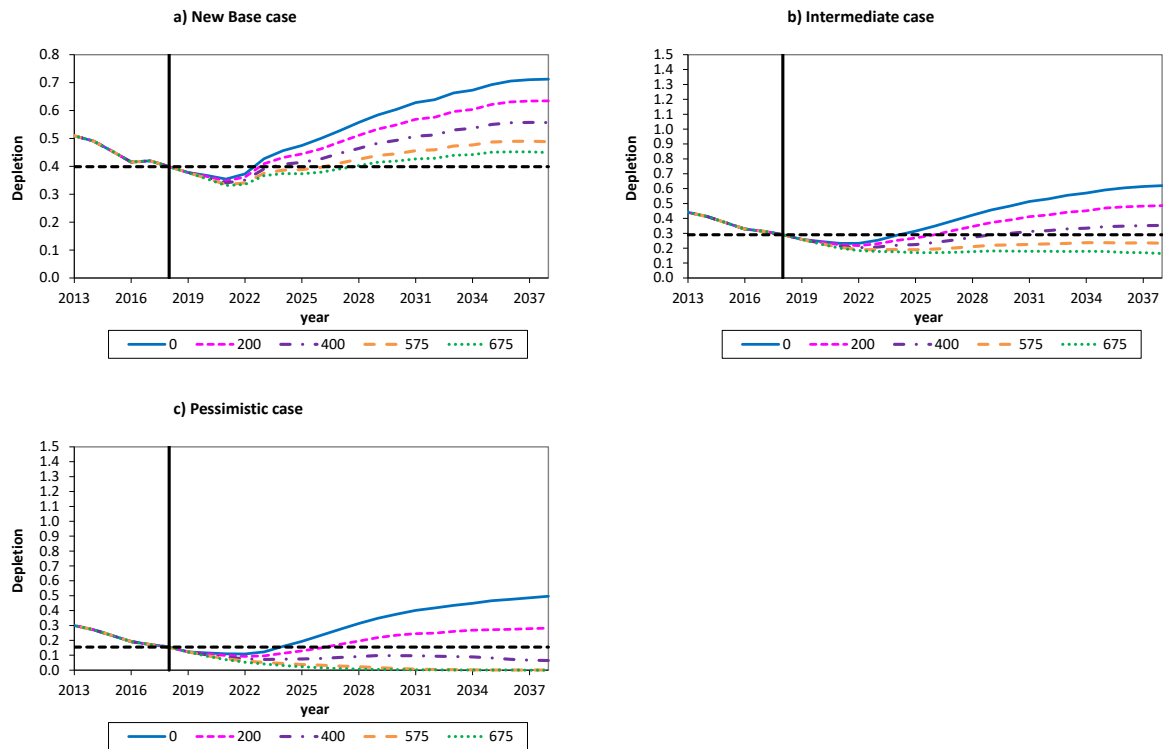
Viewed overall, these results suggest that consideration should perhaps be given to recommending some decrease in the present annual TAC of 575 t.

## REFERENCES

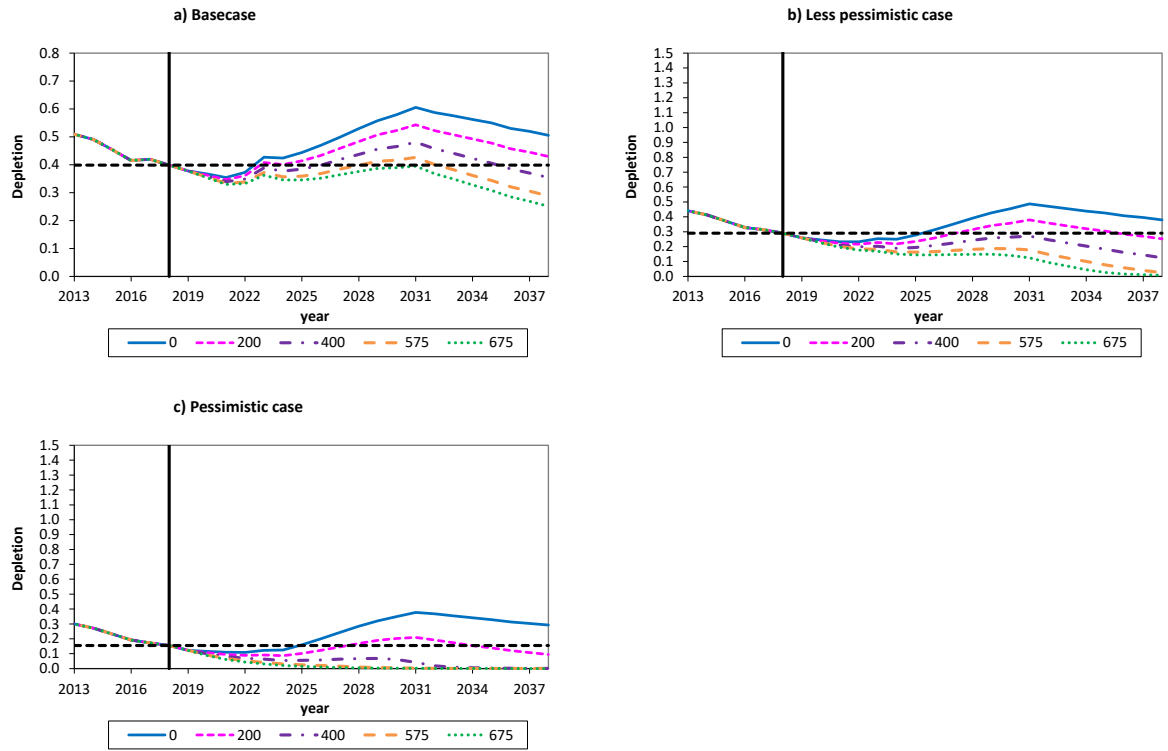
- Brandão, A. and Butterworth, D.S. 2017. Retrospective analysis of the toothfish (*Dissostichus eleginoides*) resource in the Prince Edward Islands vicinity, including stochastic projections. DAFF Branch Fisheries document: FISHERIES/2017/OCT/SWG-DEM/42.
- Brandão, A. and Butterworth, D.S. 2018. Assessment of the toothfish (*Dissostichus eleginoides*) resource in the Prince Edward Islands vicinity to include data from 1997 to 2017. DAFF Branch Fisheries document: FISHERIES/2018/OCT/SWG-DEM/60.

**Table 1.** Median, 5<sup>th</sup> and 95<sup>th</sup> percentiles for spawning biomass depletion for the **New Base case** model assuming stochastic future recruitment and under future annual catches of 0, 200, 400, 575 and 675 tonnes for the current year (2018) and every 5<sup>th</sup> year thereafter.

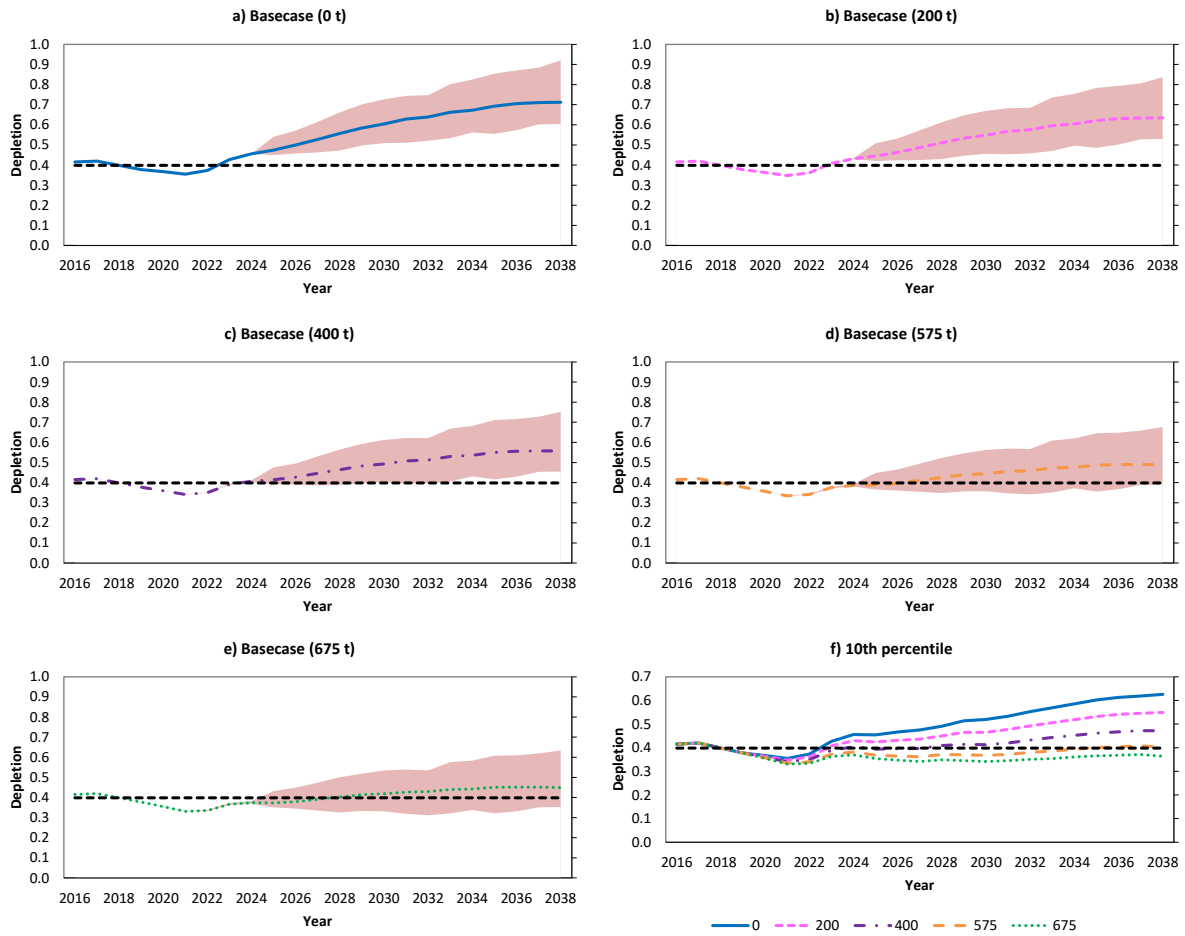
		Current (2018)	2023	2028	2033	2038
Future catch of 0 t	5 <sup>th</sup> percentile	0.398	0.427	0.472	0.534	0.604
	Median		0.427	0.557	0.663	0.712
	95 <sup>th</sup> percentile		0.427	0.662	0.802	0.921
Future catch of 200 t	5 <sup>th</sup> percentile	0.398	0.408	0.430	0.470	0.530
	Median		0.409	0.511	0.596	0.635
	95 <sup>th</sup> percentile		0.411	0.613	0.736	0.837
Future catch of 400 t	5 <sup>th</sup> percentile	0.398	0.389	0.388	0.406	0.455
	Median		0.391	0.464	0.530	0.557
	95 <sup>th</sup> percentile		0.394	0.565	0.668	0.752
Future catch of 575 t	5 <sup>th</sup> percentile	0.398	0.372	0.348	0.351	0.390
	Median		0.375	0.425	0.473	0.488
	95 <sup>th</sup> percentile		0.380	0.523	0.609	0.676
Future catch of 675 t	5 <sup>th</sup> percentile	0.398	0.362	0.326	0.321	0.352
	Median		0.366	0.403	0.439	0.449
	95 <sup>th</sup> percentile		0.372	0.501	0.576	0.634



**Figure 1.** Median spawning biomass depletion projections (shown after the vertical line) assuming stochastic future recruitment and under future annual catches of 0, 200, 400, 575 and 675 tonnes (assumed to be all from trotlines as is the case for catches taken since 2014) for the **New Base case** (a) and two **sensitivity tests** ((b) assumes a tag loss of 0.5, up-weights all CPUE indices from 2010 by a factor of 5 and reflects an intermediate status of the resource, (c) assumes a tag loss of 0.75, up-weights all CPUE indices from 2010 by a factor of 10 and reflects a pessimistic status of the resource). The dashed horizontal lines show the current (2018) depletion value for each assessment model.



**Figure 2.** As for Figure 1 but generated recruitments are adjusted to reflect the negative estimated recruitment residuals for the last years.



**Figure 3.** Median spawning biomass depletion projections assuming stochastic future recruitment and under future annual catches of 0, 200, 400, 575 and 675 tonnes (assumed to be all from trotlines as is the case for catches taken since 2014) for the **New Base case** model together with their 90% envelopes. The plot on the bottom right hand corner shows the lower 10<sup>th</sup> percentiles for each future annual catch. The dashed horizontal lines show the current (2018) depletion value for each assessment model.