Stochastic projections for the 2019 assessment of 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 and 400 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. For higher catch levels of 543 and 643 tonnes, the median of the spawning biomass estimates return to current levels within only 15 and 20 years respectively. 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, it is only annual catches of 200 tonnes that maintain the spawning biomass above its 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 543 tonnes.

INTRODUCTION

This paper reports on projections that take into account stochasticity in future recruitment under future annual constant catches of 543 t (the present TAC) as well as 0, 200, 400 and 643 t. Projections are provided for New Base case assessment model and for two variants (selected as they reflect different status of the resource compared to the New Base case) reported by Brandão and Butterworth (2019). These then are:

i) New Base case: in which the 2008 and 2009 trotline CPUE indices are omitted and some cetacean depredation on trotlines is also assumed.
ii) The sensitivity to (i) that assumes a tag-reporting rate of 0.8 and reflects a slightly more depleted status of the resource.
iii) The sensitivity to (i) that assumes a tag loss of 0.5 and reflects a pessimistic status for 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 the recruitment values generated to reflect a possible regime shift.

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, 543 and 643 t for the **New Base case** model, and for two **sensitivity tests** that reflect different 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[1] 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 projections above for the **New Base case** model together with their 90% probability envelopes, as well as the lower 10th percentile for each of the assumed annual catches. Median, 5th and 95th percentiles for spawning biomass depletion for the **New Base case** model under several future annual catches for the current year (2019) and every 5th year thereafter are reported in Table 1.

CONCLUSIONS

For all scenarios under the future catch levels considered, the median of the spawning biomass estimates drops initially, but returns to its current level inside a decade for future catch levels of 400 t or less for the New Base case. For higher catch levels of 543 and 643 tonnes, the median of the spawning biomass estimates return to current levels only within 15 and 20 years respectively. Future catches of 200 tonnes for the most pessimistic assessment of the resource maintain the median spawning biomass above the current level. If recruitment is adjusted for a possible regime shift, a constant catch of 200 tonnes 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 543 t.

REFERENCES

Brandão, A. and Butterworth, D.S. 2018. Stochastic projections for the toothfish (*Dissostichus eleginoides*) resource in the Prince Edward Islands vicinity. DAFF Branch Fisheries document: FISHERIES/2018/OCT/SWG-DEM/66.

Brandão, A. and Butterworth, D.S. 2019. Updated assessment of the toothfish (*Dissostichus eleginoides*) resource in the Prince Edward Islands vicinity to include data from 1997 to 2018. DEFF Branch Fisheries document: FISHERIES/2019/OCT/SWG-DEM/34.

[1] 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).

Table 1. Median, 5th and 95th percentiles for spawning biomass depletion for the **New Base case** model assuming stochastic future recruitment and under future annual catches of 0, 200, 400, 543 and 643 tonnes for the current year (2019) and every 5th year thereafter.

		Current (2019)	2024	2029	2034	2039
Future catch of 0 t	**5th percentile**	0.397	0.378	0.439	0.508	0.578
	Median		0.378	0.503	0.614	0.720
	95th percentile		0.378	0.597	0.792	0.866
Future catch of 200 t	**5th percentile**	0.397	0.357	0.392	0.440	0.496
	Median		0.359	0.452	0.544	0.634
	95th percentile		0.361	0.545	0.719	0.777
Future catch of 400 t	**5th percentile**	0.397	0.337	0.344	0.372	0.415
	Median		0.340	0.401	0.473	0.548
	95th percentile		0.344	0.494	0.645	0.688
Future catch of 543 t	**5th percentile**	0.397	0.323	0.310	0.324	0.355
	Median		0.327	0.367	0.422	0.486
	95th percentile		0.332	0.458	0.593	0.624
Future catch of 643 t	**5th percentile**	0.397	0.313	0.287	0.291	0.312
	Median		0.317	0.343	0.387	0.441
	95th percentile		0.323	0.433	0.556	0.579

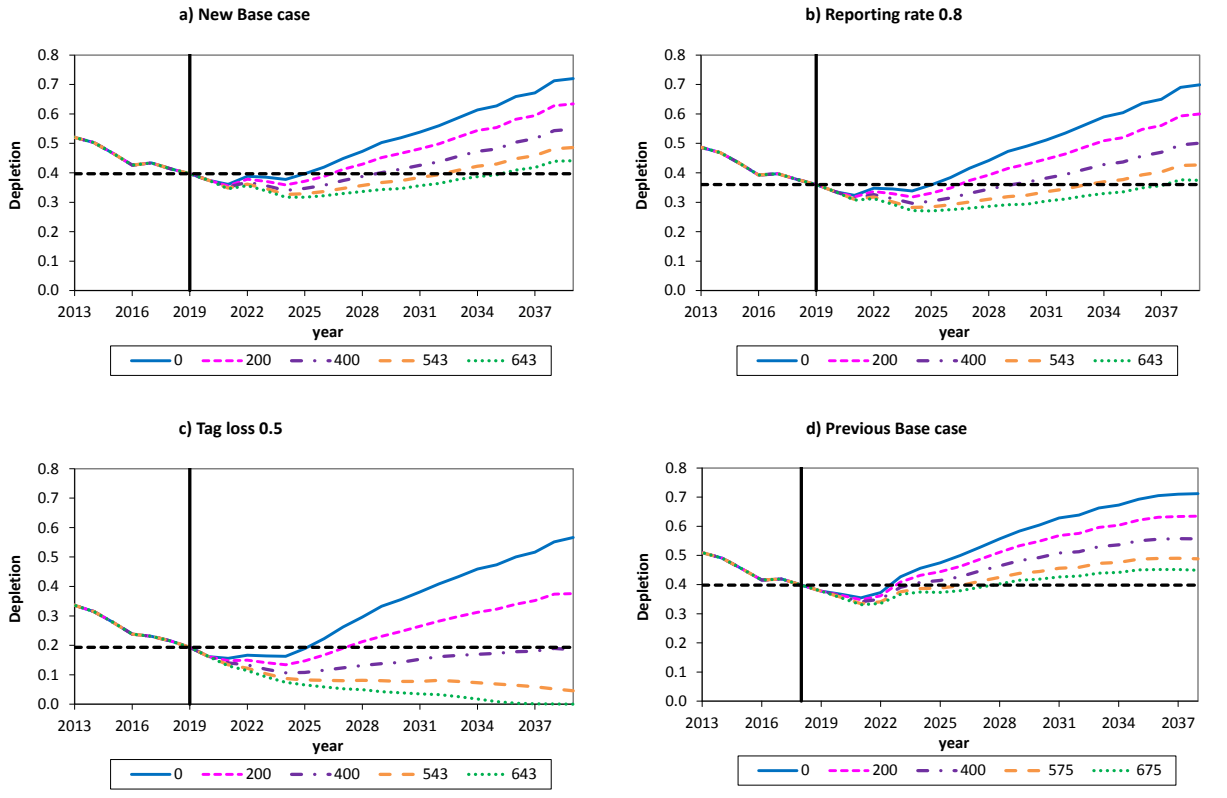

Figure 1. Median spawning biomass depletion projections (shown after the vertical line) assuming stochastic future recruitment and under future annual catches of 0, 200, 400, 543 and 643 tonnes (assumed to be all from trotlines as is the case for catches taken since 2014) for the **New Base case** (a) and two **sensitivity tests** ((b) assumes a tag-reporting rate of 0.8 and (c) assumes a tag loss of 0.5). The dashed horizontal lines show the current (2019) depletion value for each assessment model. The plot on the bottom right shows depletion projections under various annual catches for the Base case model reported in Brandão and Butterworth (2018).

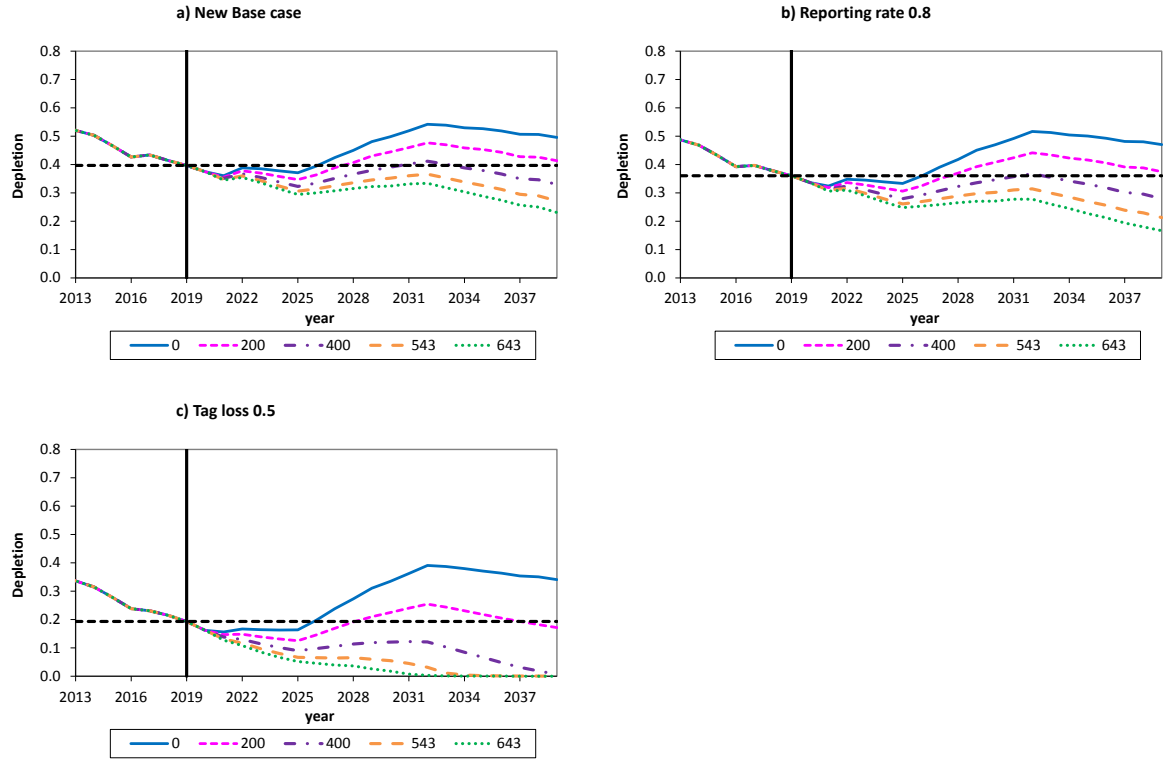

Figure 2. As for Figure 1 but the recruitments generated are adjusted to reflect the negative estimated recruitment residuals for the last 10 years.

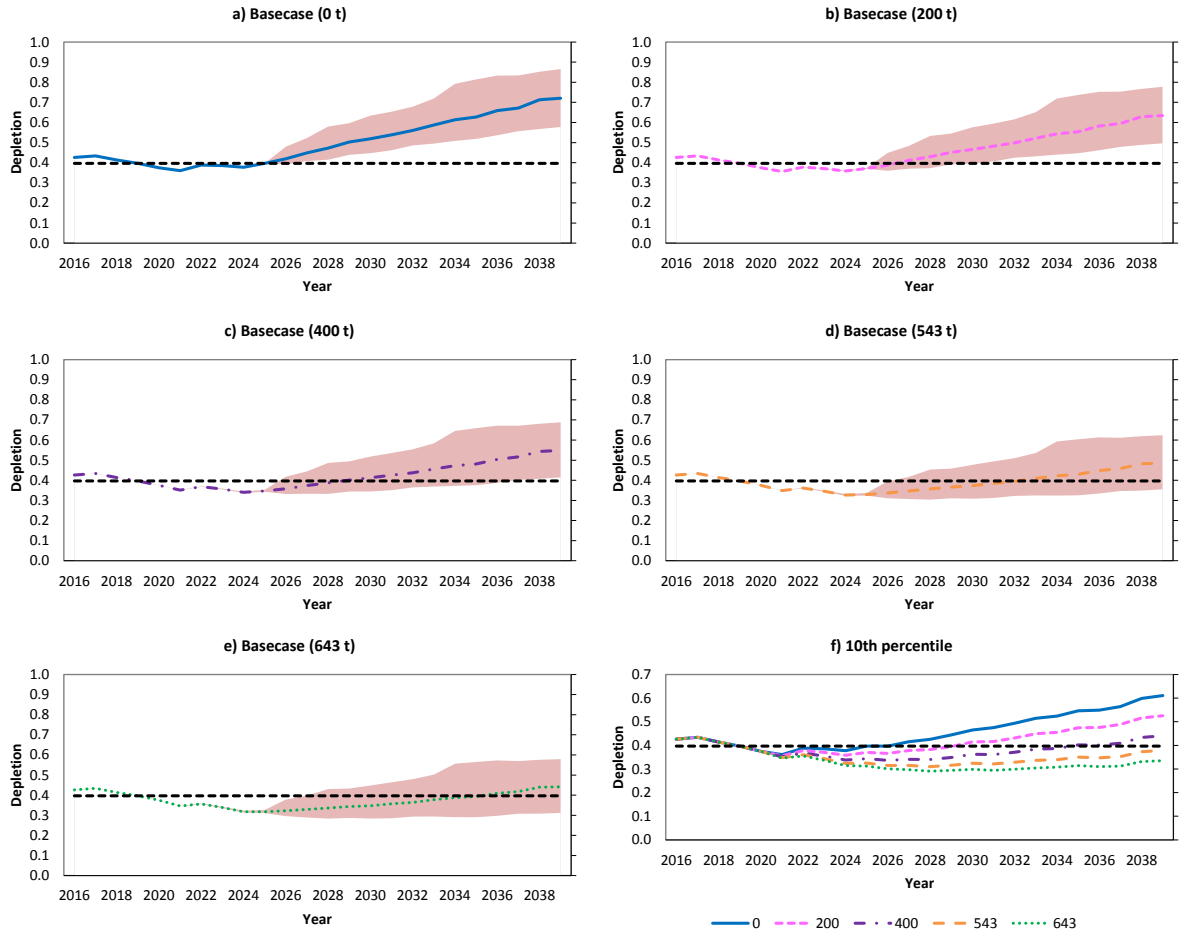

Figure 3. Median spawning biomass depletion projections assuming stochastic future recruitment and under future annual catches of 0, 200, 400, 543 and 643 tonnes (assumed to all be from trotlines, as is the case for catches taken since 2014) for the **New Base case** model, together with their 90% envelopes. The plot on the bottom right shows the lower 10th percentiles for each future annual catch. The dashed horizontal lines show the current (2019) depletion value for the New Base case assessment model.