COULD THE TRISTAN POWERBOAT CPUE DECLINE HAVE BEEN CAUSED BY OVERFISHING?

D S Butterworth and S J Johnston

Marine Resource Assessment and Management Group (MARAM)

Department of Mathematics and Applied Mathematics

University of Cape Town

Rondebosch 7701, South Africa

From 2006 to 2014 the CPUE from the powerboats at Tristan has dropped by about 75%, suggesting that exploitable biomass fell by a similar proportion.

The Tristan assessment (Johnston and Butterworth 2015) interprets this primarily as the downside of a decline as a result of the very strong 1997 year class passing through and then out of the fishery, together with some poor recruitment over the first decade of the 21st century. This strong year-class raised the resource well above the average abundance to be expected in the absence of any fishing (the "carrying capacity"); although the assessment indicates that this abundance is now below carrying capacity, the extent by which it is below suggests that resource status is not nearly as poor as that some 75% fall suggests.

An understandable concern does, however, remain that the dominant reason for this decline could still be overfishing. To examine this possibility, we apply a simple model which makes that assumption, to check whether plausible results eventuate and so indicate that this is indeed a viable alternative interpretation.

This model assumes a constant surplus production (the net growth of the resource each year, made up of new recruits and growth in body weight, less losses to natural mortality, which is the annual sustainable yield, SY) for the resource each year, so that the change in exploitable biomass from one year to the next is made up of an increase by SY and a decrease caused the catch made that year:

$$B_{y+1} = B_y + SY - C_y \tag{1}$$

where B_y is the exploitable biomass at the start of year y, and C_y is the catch in year y.

This is linked with information from the GLM powerboat CPUE which indicates the some 75% reduction, i.e. that:

$$\frac{B_{2014}}{B_{2006}} = \frac{CPUE_{2014}}{CPUE_{2006}} = \frac{0.650}{2.518} = 0.258 \tag{2}$$

If one then sets a value for the current exploitable biomass (B_{2014}), equations (1) and (2) lead to a value for SY and an exploitable biomass trajectory from 2006 to 2014.

The Tristan assessment (Johnston and Butterworth 2015) suggests a value for B_{2014} of about 400 MT. However, that result is subject to some uncertainties, so equations (1) and (2) are applied here over a range of value for B_{2014} ranging from 200 to 600 MT.

The results are shown in Figure 1 which provides plots of the exploitable biomass trajectories for the various choices for B_{2014}, while Table 1 lists the values for the associated annual surplus production (sustainable yield, SY) and Table 2 provides the catches used for the analyses.

What is noticeable in Table 1 is that the value for the sustainable yield SY decreases as the value for B_{2014} is increased. At the low end of the B_{2014} range, the ratio of SY to B_{2014} starts to become implausibly large, as the surplus production/biomass value for lobsters (a long-lived species) cannot be too high.

For values of B_{2014} of 300 MT or larger, the value of SY becomes 70 MT or less. This implies that if the drop in CPUE since 2006 is indeed entirely a reflection of overfishing, the TAC would need to be reduced to well below 70 MT to effect a recovery of the resource, as resource growth is possible only if the annual catch is less than the sustainable yield.

But the real question here is one of plausibility – are the estimates of SY in Table 1 compatible with the history of catches in the fishery, and particularly the increase in CPUE over the decade preceding 2006? This can hardly be the case, as the average annual catch for that period was 132 MT, and must have been less than the sustainable yield then as resource abundance increased over that period, so that annual sustainable yield then was well above 70 MT.

In our view, these results therefore serve to indicate that the interpretation of overfishing being the dominant cause of the CPUE decline is not plausible. While fishing is certainly playing some role, the inference from the assessment (Johnston and Butterworth 2015 – which takes account of much more information such as the catch-at-length data) that much of the CPUE decline after 2006 reflects the consequence of one or a few strong year classes moving out of the fishery seems much more plausible than ascribing this decline entirely to overfishing.

Reference

Johnston, S.J. and Butterworth, D.S. 2015. Updated 2015 Tristan da Cunha rock lobster assessment. MARAM document, MARAM/TRISTAN/2015/FEB/01.

Table 1: Estimates of annual sustainable yield for different values for the 2014 exploitable biomass, as calculated using equation (1) and (2).

B(2014) (MT)	**SY (MT)**
600	-38
500	0
400	36
300	69
200	105

Table 2: Catches used in equation (1).

Season	**Catch (MT)**
2006	180
2007	187
2008	180
2009	185
2010	181
2011	168
2012	171
2013	166

Figure 1: Exploitable biomass trends as estimated using equations (1) and (2) for different values for the 2014 exploitable biomass (unit MT).