Updated 2013 Tristan da Cunha rock lobster assessment

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Summary

This paper provides an updated assessment of the rock lobster resource at the island of Tristan da Cunha. This assessment has used updated input data, as well as new data that are included in the model fitting procedure.

Introduction

The age-structured population model used for this assessment is described fully in Johnston and Butterworth (2013a). Note that stock-residuals are now estimated for the period 1992-2010[1]). The model is fit to the following data (see Johnston and Butterworth 2013b for details):

1) Standardised standardised powerboat CPUE for Tristan (1994-2012) (Johnston *et al*., 2013).
2) Commercial Catch-at-length data (males and females separate) (1997-2011).
3) Biomass survey index data for Leg1 (2006-2012).
4) Biomass survey catch-at-length data for Leg1 (2006-2012).

The time periods over which the selectivity-at-length vector is assumed not to change in these assessments are: 1990-2000, 2001-2005 and 2006+.

Reference case model

The Reference case model fixes the natural mortality *M*=0.1 and the fishing proportion in 2009 to be F2009=0.3. It also assumes the stock residual variation parameter σ_R= 0.4. The catch-at-length data are down-weighted by a factor of 0.10 in the likelihood. It was found that the model consistently overestimated the number of male lobsters in the larger size classes. For this reason two further adjustments were made to improve the model fit:

i) Increase *M* to 1.5 for lobsters aged 10+.
ii) Decrease selectivity on male lobsters by 25% for lobsters CL 110mm.

The RC model fits to Biomass survey data from Leg1 only. Leg1 is the survey conducted at the start of the season and is thought to be more reliable that the Leg2 survey which is done at or near the end of the season.

[1] Note that 2010 refers to the split season 2010/11 for example

Robustness tests

A number of Robustness tests relating to underlying RC OM assumptions were developed.

RC *M*=0.1, *F*(2009)=0.3, $\sigma_R = 0.4$

R1 *M*=0.1, ***F*(2009)=0.2**, $\sigma_R = 0.4$

R2 *M*=0.1, ***F*(2009)=0.4**, $\sigma_R = 0.4$

R3 ***M*=0.05**, ***F*(2009)=0.2**, $\sigma_R = 0.4$

R4 ***M*=0.05**, *F*(2009)=0.3, $\sigma_R = 0.4$

R5 ***M*=0.05**, ***F*(2009)=0.4**, $\sigma_R = 0.4$

R6 ***M*=0.2**, ***F*(2009)=0.2**, $\sigma_R = 0.4$

R7 ***M*=0.2**, *F*(2009)=0.3, $\sigma_R = 0.4$

R8 ***M*=0.2**, ***F*(2009)=0.4**, $\sigma_R = 0.4$

SIGR1 *M*=0.1, *F*(2009)=0.3, $\boldsymbol{\sigma_R = 0.2}$

SIGR2 *M*=0.1, *F*(2009)=0.3, $\boldsymbol{\sigma_R = 0.8}$

Results

Table 1 reports the Tristan RC assessment results. Results from the 2012 assessment are reported for certain quantities in square parentheses for comparative purposes. Table 2 reports the –lnL, Bsp(2013), Bsp(2013)/K and Bexp(2012) values for the various robustness tests run. Figures 1 and 2 report the RC model fits to the input data, as well as the RC model estimated biomass trends. The fits to the data are reasonable for the abundance indices (Figure 2a), but some systematic deviations are evident for the fits to CAL data (Figures 2b and c).

The current status of the resource is estimated to be high with spawning biomass above K. The population is estimated to have increased in size over the 1990-2006 period following the good recruitments in the late 1990's. The spawning biomass is estimated to have declined by about one third since 2006 as a result of poor recruitments during the early 2000's, but appears now to be stabilising.

References

Johnston, S.J. and D.S. Butterworth. 2013a. The Age-structured Production Modelling approach for assessment of the Rock Lobster Resources at the Tristan da Cunha group of islands, MARAM/Tristan/2013/MAR/07.

Johnston, S.J. and D.S. Butterworth. 2013b. Input data for the 2013 rock lobster assessments of the Tristan da Cunha group of islands, MARAM/Tristan/2013/FEB/01.

Johnston, S.J., Brandao, A. and D.S. Butterworth. 2013b. Updated GLMM- and GLM-standardised lobster CPUE from the Tristan da Cunha group of islands. MARAM/Tristan/2013/MAR/05.

Table 1: Tristan RC assessment results. Results in square parentheses show the 2012 RC assessment estimates*. Shaded values are fixed on input.

	RC
# parameters	41
K (MT)	977 (1685)
h	0.96 (1.00)
M	0.1 (0.2)
d (discard mortality rate)	0.1 (0.1)
σ_R	0.4 (0.4)
F_{2009} fixed at	0.3 (0.3)
θ	0.381 (0.287)
-lnL total	-46.49
-lnL commercial CPUE (σ)	-35.21 (0.10)
-lnL Bio Sur Index Leg1 (σ)	-11.60 (0.16)
-lnL commercial CAL (σ)	-0.37 (0.10)
-lnL Bio Surv Leg 1 CAL (σ)	-32.39 (0.08)
SR pen	4.28
Bsp(2012) (MT)	961 [1426]
Bsp(2013) (MT)	963
Bsp(1990)/Ksp	0.38 [0.26]
Bsp(2012)/Ksp	0.98 [0.85]
Bsp(2013)/Ksp	1.00
Bsp(2013)/Bsp(1990)	2.67
Bexp(2011)/Bexp(1990)	2.60 [1.33]
Bexp(2012)/Bexp(1990)	2.51
Bexp(2011) (MT)	451 [481]
Bexp(2012) (MT)	434
Program	Trcnx.tpl

*Note that important changes have been made to the model over last year, including particularly the introduction of modifications to deal with past over-estimation of the proportions of larger sizes in the catch, so the 2012 and 2013 results are not readily comparable. Other changes include now fitting to biomass survey data, and modeling *length*-at-maturity and *weight*-at-lengths (as opposed to functions of age).

Table 2: Robustness test results.

	-lnL	Bsp(2013)	Bsp(2013)/Ksp	Bexp(2012)
RC *M*=0.1, *F*(2009)=0.3, $\sigma_R = 0.4$	-46.49	963	1.00	434
R1 *M*=0.1, *F*(2009)=0.2, $\sigma_R = 0.4$	-41.57	1137	1.09	521
R2 *M*=0.1, *F*(2009)=0.4, $\sigma_R = 0.4$	-45.20	850	1.00	330
R3 *M*=0.05, *F*(2009)=0.2, $\sigma_R = 0.4$	-45.08	993	1.02	472
R4 *M*=0.05, *F*(2009)=0.3, $\sigma_R = 0.4$	-47.38	909	1.01	427
R5 *M*=0.05, *F*(2009)=0.4, $\sigma_R = 0.4$	-47.13	768	1.01	322
R6 *M*=0.2, *F*(2009)=0.2, $\sigma_R = 0.4$	-41.91	978	0.93	388
R7 *M*=0.2, *F*(2009)=0.3, $\sigma_R = 0.4$	-41.92	913	0.93	366
R8 *M*=0.2, *F*(2009)=0.4, $\sigma_R = 0.4$	-43.11	881	0.95	345
sigR1 *M*=0.1, *F*(2009)=0.3, $\sigma_R = 0.2$	-38.63	1022	1.09	462
sigR2 *M*=0.1, *F*(2009)=0.3, $\sigma_R = 0.8$	-40.07	729	0.75	287

Figure 1a: Tristan RC model results.

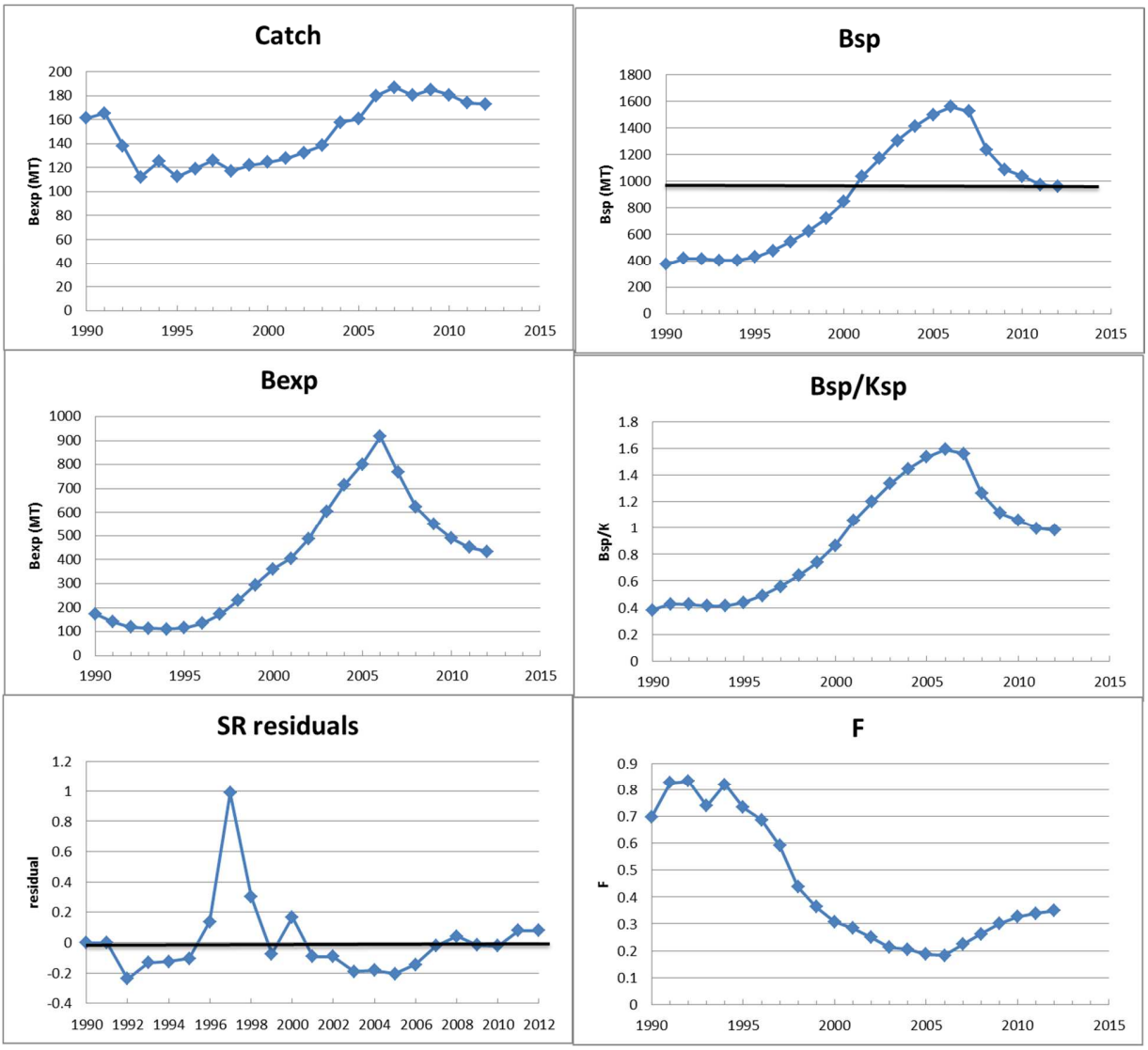
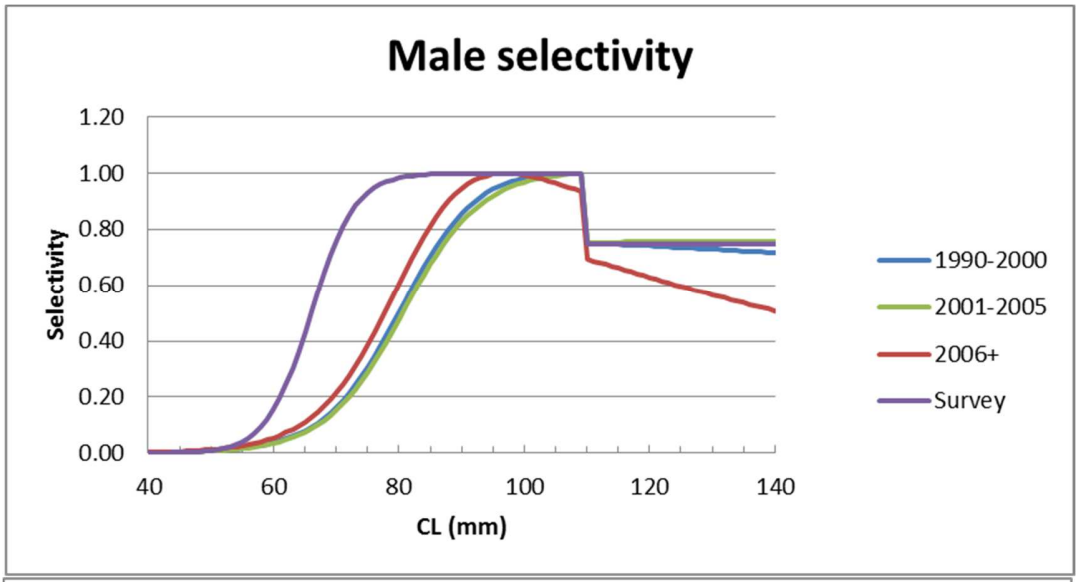


Figure 1b: Tristan RC selectivity functions.



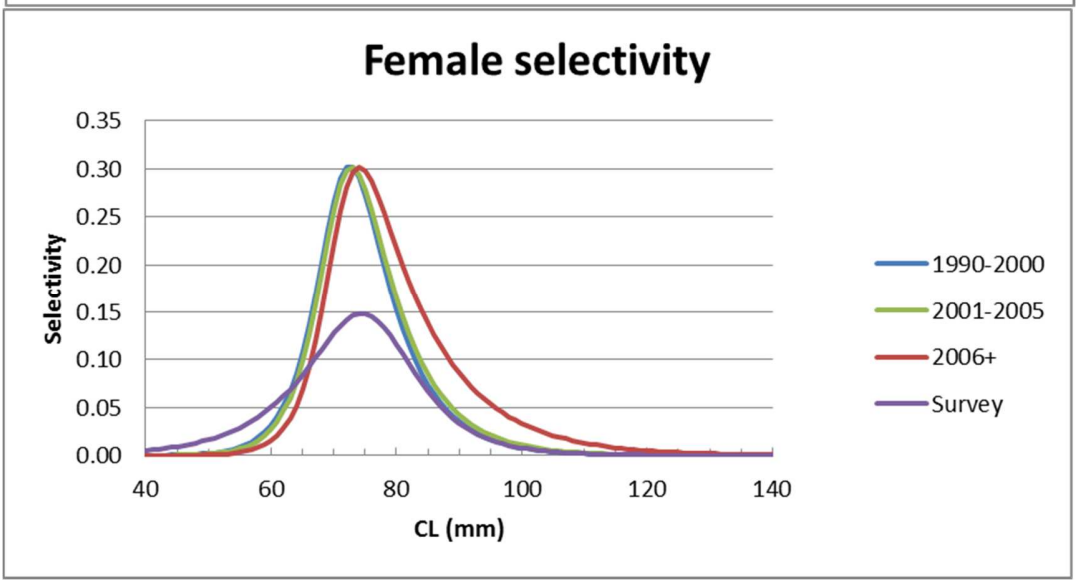


Figure 2a: Tristan RC model fits to CPUE and Biomass survey index data.

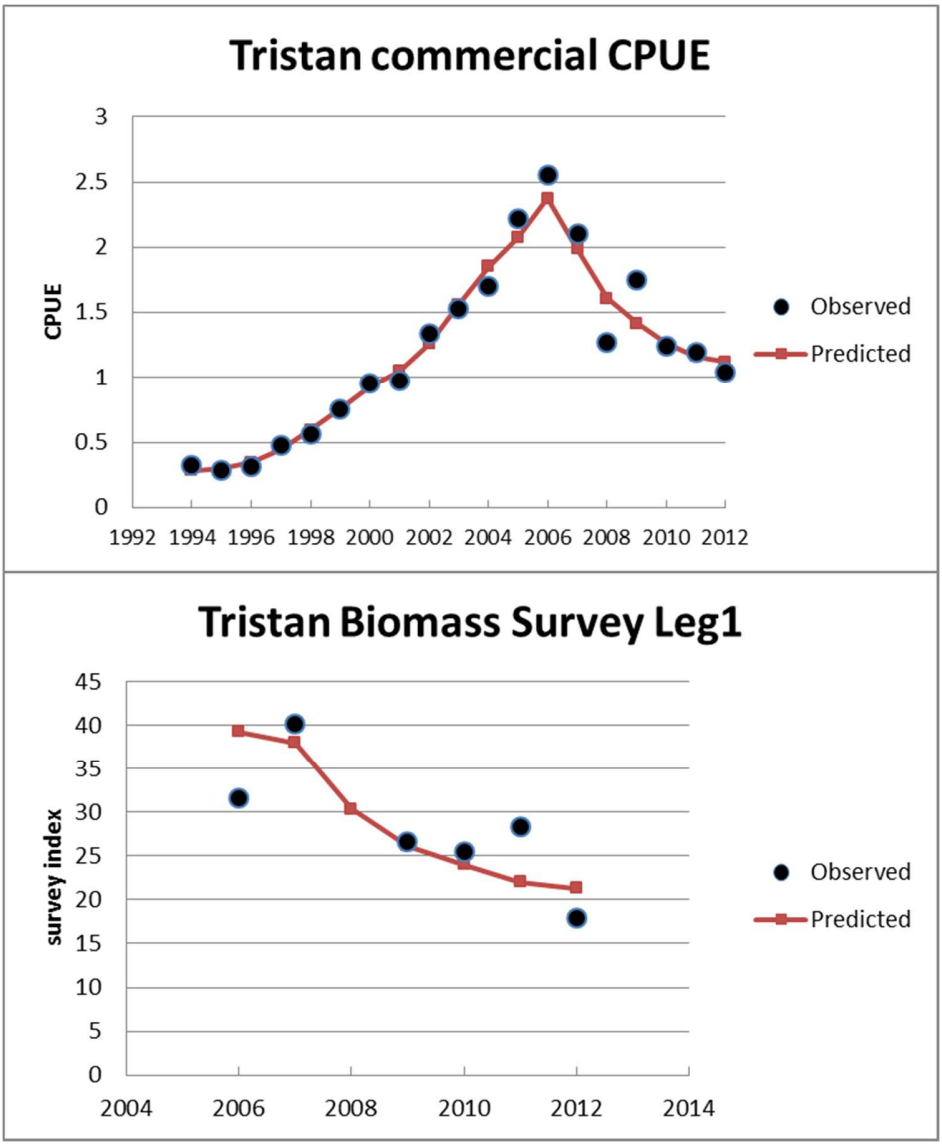


Figure 2b: Tristan average CAL results.

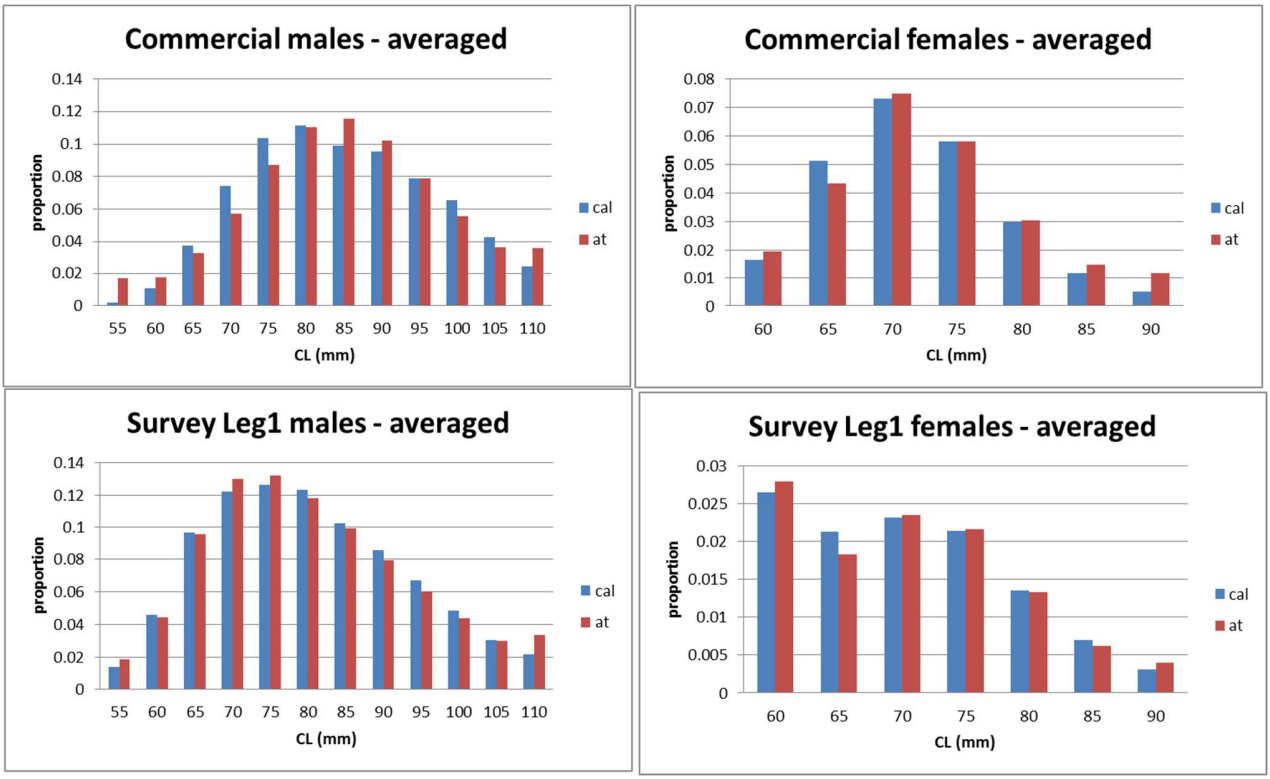


Figure 2c: Tristan standardized CAL residuals. The dark bubbles reflect positive and the light bubbles negative residuals, with the bubble radii proportional to the magnitudes of the residuals.