Updated 2015 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, now including data that have become available since the last assessment in October 2013.

Introduction

The age-structured population model used for this assessment is described fully in Johnston and Butterworth (2013a). The previous assessment of this resource was conducted in 2013 (Johnston and Butterworth 2013b). Note that stock-residuals are now estimated for the period 1992-2011[1]). The model is fit to the following data:

1) Standardised powerboat CPUE for Tristan (1994-2013) (Johnston *et al*., 2014).
2) Commercial Catch-at-length data (males and females separate) (1997-2012).
3) Biomass survey index data for Leg1 (2006-2014).
4) Biomass survey catch-at-length data for Leg1 (2006-2013).

The time periods over which the selectivity-at-length vector is assumed not to change in this assessment (and associated robustness tests) are: 1990-2000, 2001-2005 and 2006+.

Reference case model

As for previous assessments, the Reference case (RC) model fixes the natural mortality *M*=0.1 and the fishing proportion in 2009 to be *F*(2009)=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. Previously 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 (Johnston and Butterworth 2013b):

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

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

As previously, 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 takes place at or near the end of the season.

The catch for the 2014/15 season is assumed to be 161 MT (the TAC set).

Robustness tests

A number of Robustness tests relating to underlying RC OM assumptions have been developed and conducted (changes from the Reference case assumptions are **bolded**).

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 updated 2015 Tristan RC assessment results. Results from the 2013 assessment are also reported where comparable values are available. Table 2 reports the –lnL, Bsp(2014), Bsp(2014)/K and Bexp(2014) 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 continue to be evident for the fits to CAL data (Figures 2b and c).

The current status of the resource is estimated to be reasonably high with spawning biomass 0.72 *K*, though status is marginally worse than estimated in the previous assessment (see Figure 1a). 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.

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.Further updates to the 2013 Tristan da Cunha rock lobster assessment, MARAM/Tristan/2013/OCT/13.

Johnston, S.J., Brandao, A. and D.S. Butterworth. 2014. Updated GLMM- and GLM-standardised lobster CPUE from the Tristan da Cunha group of islands. MARAM/Tristan/2014/MAY/08.

Table 1: Updated 2015 Tristan RC assessment results. Results are also reported for the 2013 RC assessment estimates. Shaded values are fixed on input, and values in parentheses are σ values.

	RC 2013	RC 2015
# parameters	41	**42**
K (MT)	1449	**1366**
h	0.96	**0.99**
M	0.1	0.1
d (discard mortality rate)	0.1	0.1
σ_R	0.4	0.4
F_{2009} fixed at	0.3	0.3
θ	0.373	**0.371**
-lnL total	-42.81	**-43.32**
-lnL commercial CPUE (σ)	-35.28 (0.09)	**-36.35 (0.09)**
-lnL Bio Sur Index Leg1 (σ)	-8.69 (0.15)	**-8.80 (0.15)**
-lnL commercial CAL (σ)	6.23 (0.11)	**11.81 (0.11)**
-lnL Bio Surv Leg 1 CAL (σ)	-30.21 (0.08)	**-33.43 (0.08)**
SR pen	4.25	**4.67**
Bsp(2012) (MT)	1084	**1002**
Bsp(2013) (MT)	1085	**980**
Bsp(2014) (MT)	-	**980**
Bsp(2015) (MT)	-	**1008**
Bsp(1990)/Ksp	0.35	**0.34**
Bsp(2012)/Ksp	0.75	**0.73**
Bsp(2013)/Ksp	0.75	**0.72**
Bsp(2014)/Ksp	-	**0.72**
Bsp(2015)/Ksp	-	**0.74**
Bsp(2013)/Bsp(1990)	2.17	**2.09**
Bsp(2014)/Bsp(1990)	-	**2.09**
Bsp(2015)/Bsp(1990)	-	**2.18**
Bexp(2011)/Bexp(1990)	2.15	**2.15**
Bexp(2012)/Bexp(1990)	2.06	**1.97**
Bexp(2013)/Bexp(1990)	-	**1.88**
Bexp(2014)/Bexp(1990)	-	**1.92**
Bexp(2011) (MT)	444	**437**
Bexp(2012) (MT)	424	**400**
Bexp(2013) (MT)	-	**383**
Bexp(2014) (MT)	-	**390**
Program	Tnewup.tpl; tup.rep	**T15.tpl, rc15.rep**

Table 2: Robustness test results.

	-lnL	Bsp(2014)	Bsp(2014)/Ksp	Bexp(2013)
RC *M*=0.1, *F*(2009)=0.3, $\sigma_R = 0.4$	**-43.32**	**980**	**0.72**	**383**
R1 *M*=0.1, *F*(2009)=0.2, $\sigma_R = 0.4$	-42.31	1341	0.73	605
R2 *M*=0.1, *F*(2009)=0.4, $\sigma_R = 0.4$	-40.01	844	0.73	306
R3 *M*=0.05, *F*(2009)=0.2, $\sigma_R = 0.4$	-42.99	1261	0.72	598
R4 *M*=0.05, *F*(2009)=0.3, $\sigma_R = 0.4$	-44.16	937	0.71	378
R5 *M*=0.05, *F*(2009)=0.4, $\sigma_R = 0.4$	-41.22	817	0.72	303
R6 *M*=0.2, *F*(2009)=0.2, $\sigma_R = 0.4$	-40.77	1552	0.74	618
R7 *M*=0.2, *F*(2009)=0.3, $\sigma_R = 0.4$	-41.30	1117	0.73	400
R8 *M*=0.2, *F*(2009)=0.4, $\sigma_R = 0.4$	-36.88	943	0.75	322
sigR1 *M*=0.1, *F*(2009)=0.3, $\sigma_R = 0.2$	-34.23	1045	0.80	420
sigR2 *M*=0.1, *F*(2009)=0.3, $\sigma_R = 0.8$	-47.71	957	0.58	369

Figure 1a: Tristan RC updated 2015 model results. The 2013 assessment results are also shown for comparative purposes. Note also that the SR residuals are now estimated up to 2011, with the 2012 value indicating the level that would be assumed for future projections.

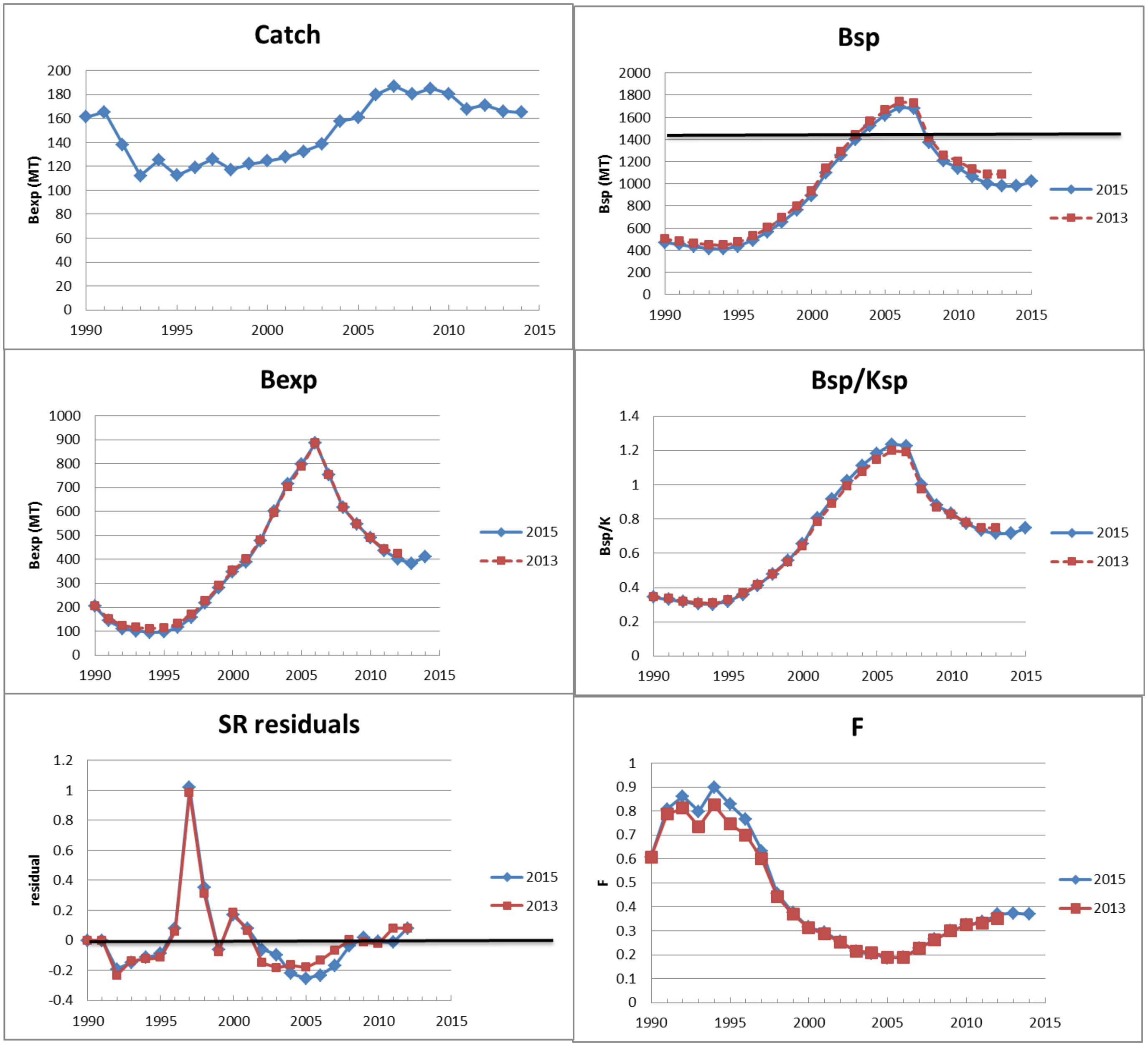


Figure 1b: Tristan RC selectivity functions.

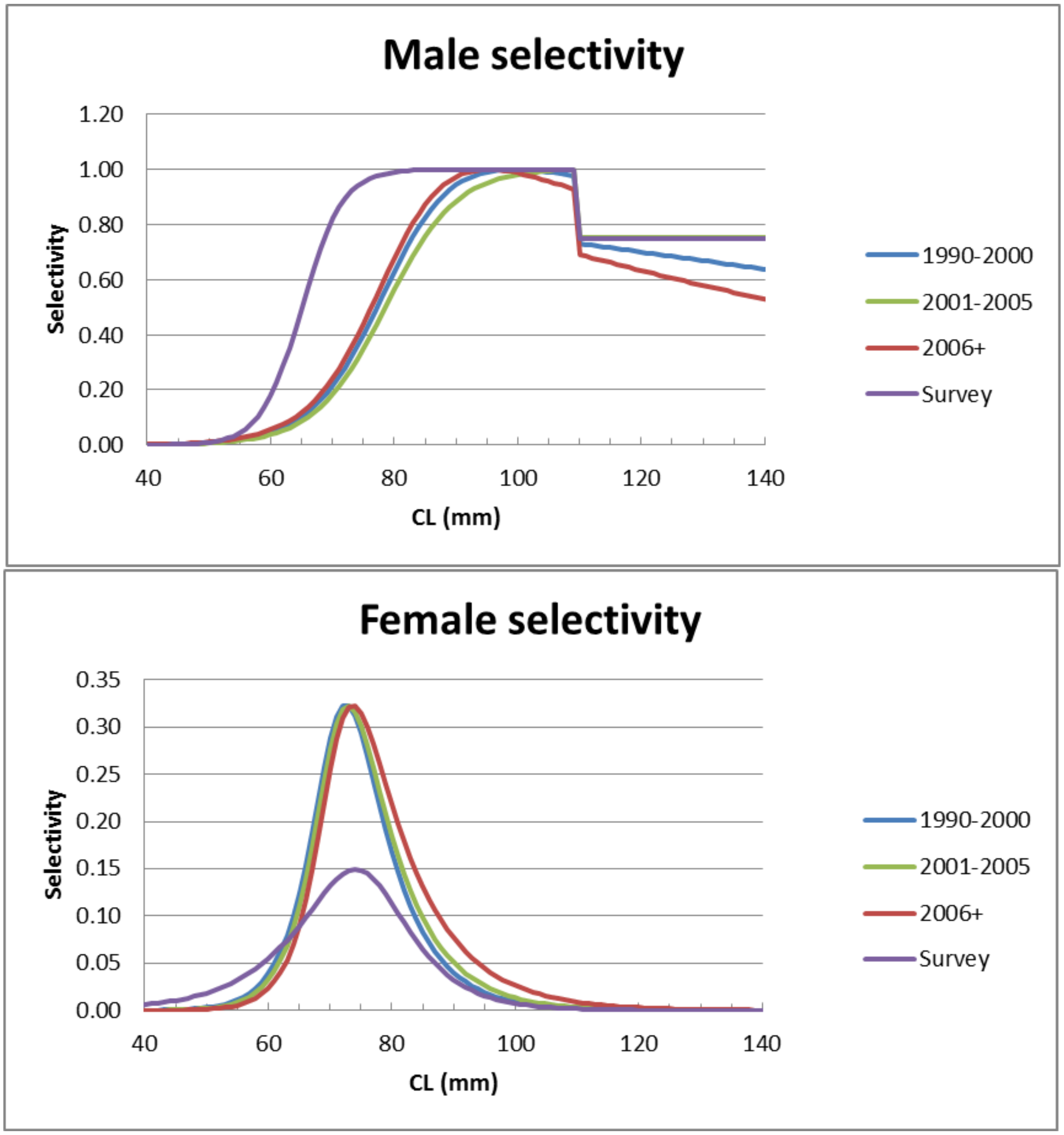
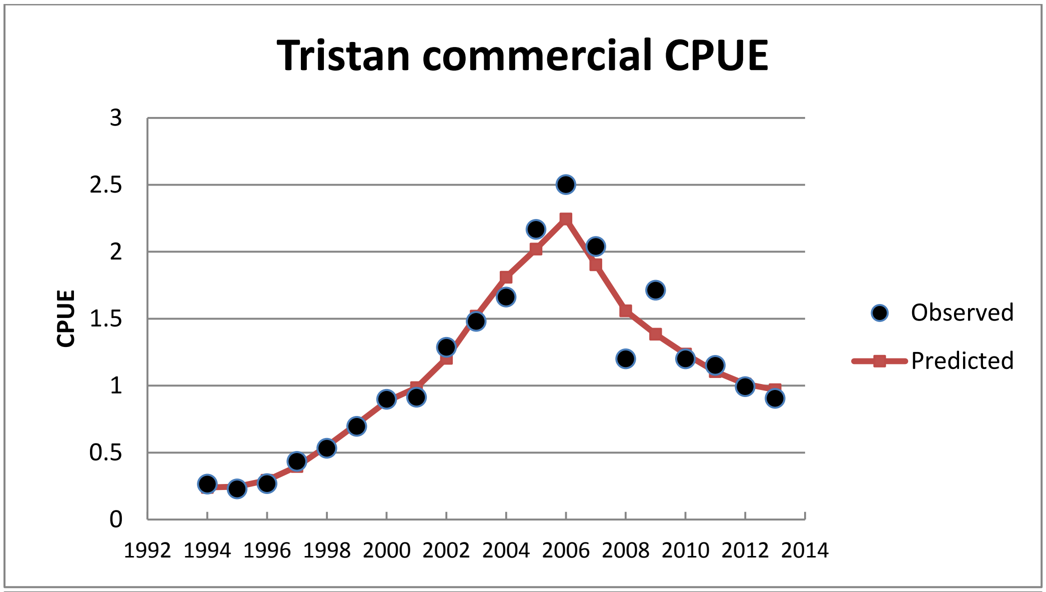


Figure 2a: Tristan RC model fits to CPUE and Biomass survey index data.



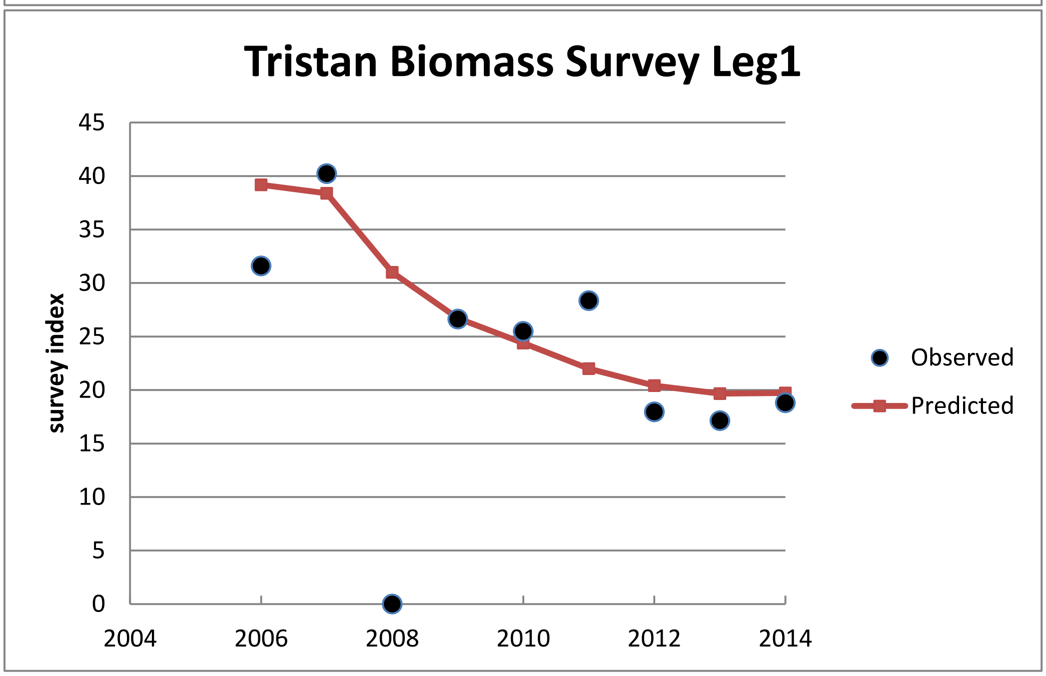


Figure 2b: Tristan average CAL results.

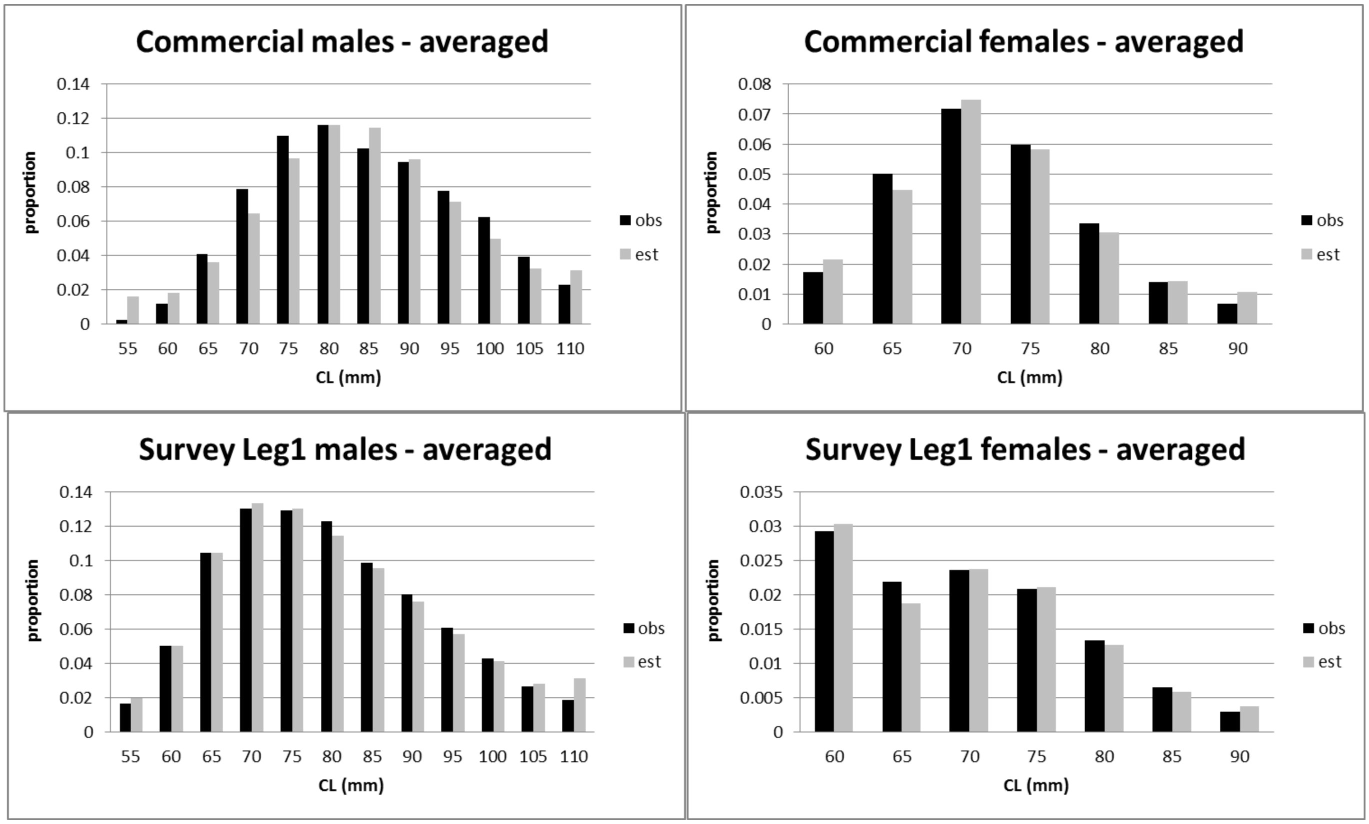


Figure 2c: Tristan standardized CAL residuals. The dark bubbles reflect positive and the light bubbles negative residuals, with the bubble radii proportional to the magnitudes of the residuals.