Tristan Biomass Survey Leg1 results including data from the 2013 season

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Introduction

A number (14) of biomass surveys has been completed thus far at each of the four islands of the Tristan da Cunha group. Table 1 lists the months during which each of these surveys was undertaken at each of the four islands. For each season there is usually a Leg1 survey carried out around Aug/Sept and then a further Leg2 survey conducted around Feb/Mar. This document provides a brief summary of the biomass index data and the catch-at-length data collected thus far for the Leg1 surveys, including the most recent 2013[1] data. For stock assessment purposes, it has been decided that the operating models will fit to the Leg1 biomass survey index and catch-at-length data only. Leg2 surveys will be discontinued. The rationale for this decision was that whilst the Leg1 surveys were consistently undertaken at the start of each season, the timing of the Leg2 surveys tended to vary somewhat, particularly with respect to the amount of catch that had been taken at the time of the Leg2 survey. It is considered therefore that the Leg2 surveys would not be readily comparable from season to season.

Methods

Biomass index

At each island a number of transects is set (e.g. Tristan has eight transects) – Table 1 lists the number of transects for each island. On each transect, nine traps are set – 3 inshore, 3 mid-shore and 3 offshore. The total number of lobsters and the biomass caught from each of the nine traps has been recorded by James Glass (pers. commn). Thus for each survey at Tristan, there are 8 transects x 9 traps = 72 values of a biomass index in terms of numbers caught per trap.

For each transect (*s*) the average of the reported biomass indices for the nine traps is obtained ($\overline{B}_s$). (This analysis treats transects rather than traps as the sampling unit, both because of possible spatial correlation (non-independence) along a transect, and because lobster density may vary with depth so that the survey design is such as allows this variation to be integrated out.)

[1] The split season is denoted by the first year, i.e. 2013 refers to the 2013/14 season.

The following are then calculated where *n* is the number of transects :

Mean biomass index $\overline{B}_s = \frac{\sum_s \overline{B}_s}{n}$

Standard deviation $sd = \sqrt{\frac{n\sum \overline{B}_s^2 - (\sum \overline{B}_s)^2}{n(n-1)}}$

Standard error $se_m = \frac{sd}{\sqrt{n}}$

The mean and 95% confidence intervals for the mean biomass index calculated for each Leg1 survey are plotted in Figures 1a-d. To avoid confidence intervals overlapping zero, the assumption has been made of distribution lognormality with $CV = \frac{se_m}{\bar{B}_s}$

Catch-at-length frequencies

Catch-at-length data are recorded at 5mm carapace length intervals; as an example, the size class 60mm refers to lobsters sized 60-64mm CL. Plus- and minus-groups are created where necessary to avoid size-classes with extremely small frequencies.

% Females

The percentage females caught in these surveys is also recorded.

Results and Discussion

Biomass index

Table 2 reports the mean biomass survey index values with their associated CVs. The mean and 95% confidence intervals for the mean biomass index calculated for each Leg1 survey are plotted in Figures 1a-d. To avoid confidence intervals overlapping zero, the assumption has been made of distribution lognormality with $CV = \frac{se_m}{\bar{B}_s}$

From the plots in Figures 1a-d a similar pattern is evident for Inaccessible and Gough, with somewhat different patterns for more recent years shown for Tristan (a decline over the last three years) and Nightingale (a sharp increase over the last three years).

Catch-at-length frequencies

Tables of the biomass survey catch-at-length proportions (with males and females summing to 1.0) are reported fully in Johnston (2013). These are used as input data to the updated assessment of each island. Here, these data, including now the 2013 Leg1 data, are shown in Figures 2a-d (for each island) where the frequencies have been modified to sum to 1.0 separately for males and females (so as not to confound with the relative female to male ratio information). Note that for these plots (and for the input data into the assessments) plus- and minus-groups have been calculated to avoid extremely small proportions.

Some interesting patterns in the biomass survey CAL data are evident. It is also useful to compare the biomass survey CAL data with the CAL data collected by observers from the fishery itself (see Johnston 2014). One of the most noticeable trends is that the Nightingale CAL (males) has seen a fairly drastic shift to larger lobsters over the 2010, 2011 and 2012 seasons for the Leg1 surveys. This shift is also evident in the CAL data collected from the fishery. What is notable is that the 2003 Nightinglae male CAL data appear to have reverted to a pattern seen in 2006 and 2007. There is a similar shift evident in the Gough male 2012 Leg1 data – i.e. shift towards large lobsters – but again the 2013 data appear more "normal".

The Tristan Leg1 male data shows the opposite trend (Figure 2d), with a shift to the left over the 2006-2013 period. A trend like this could be caused by either overfishing (of the larger sized lobsters) or a recruitment increase over this period.

% Females

These data are plotted in Figures 3a-d. The very low % female value for Nightingale reported for 2012 is shown in Figure 3a. For the 2013 survey, this value is once again higher at a value seen in previous seasons. The % females from the surveys at the other three islands have been fairly consistent since 2006. It is notable that the % females caught at Gough are much higher (around 25%-35%) than at the other three islands (around 5-15%).

References

Johnston, S.J. 2013. Input data to the 2013 assessments of the Tristan da Cunha rock lobster fishery. MARAM document, MARAM/TRISTAN/2013/FEB/01.

Johnston, S.J. 2014. Updated lobster catch-at-length data from the commercial fisheries a the Tristan da Cunha group of islands. MARAM document, MARAM/TRISTAN/2014/JAN/01.

Johnston, S.J., Brandao, A. and D.S. Butterworth. 2013. GLMM- and GLM-standardised lobster CPUE from the Tristan da Cunha group of islands for the 1997-2010 period. MARAM document, MARAM/Tristan/2013/Mar/05.

Table 1: Months during which the surveys completed thus far for the four islands have taken place. Leg 1 surveys are shown in bold.

	Tristan	**Nightingale**	**Inaccessible**	**Gough**
Season 2006/07 Leg 1	**Sep 2006**	**Sep 2006**	**Sep 2006**	**Oct 2006**
Season 2006/07 Leg 2	Feb 2007	Feb 2007	Feb 2007	Feb 2007
Season 2007/08 Leg 1	**Sep 2007**	**Sep 2007**	**Sep 2007**	**Oct 2007**
Season 2007/08 Leg 2	Mar 2008	Mar 2008	Mar 2008	Feb 2008
Season 2008/09 Leg 1	**No surveys due to factory fire**			
Season 2008/09 Leg 2	Feb 2009	Feb 2009	Feb 2009	Feb 2009
Season 2009/10 Leg 1	**Sep 2009**	**Sep 2009**	**Sep 2009**	**Sep 2009**
Season 2009/10 Leg 2	Mar 2010	Mar 2010	Mar 2010	Apr 2010
Season 2010/11 Leg 1	**Sep 2010**	**Sep 2010**	**Sep 2010**	**Sep 2010**
Season 2010/11 Leg 2	Mar 2011	Mar 2011	Mar 2011	April 2011
Season 2011/12 Leg 1	**Aug 2011**	**Aug 2011**	**Aug 2011**	**Sep 2011**
Season 2011/12 Leg 2	Feb 2012	Feb 2012	Feb 2012	Feb 2012
Season 2012/13 Leg 1	**Sep 2012**	**Aug 2012**	**Sep 2012**	**Sept 2012**
Season 2012/13 Leg 2	Mar 2013	Feb 2013	Feb 2013	Jan 2013
Season 2013/14 Leg 1	**Sep 2013**	**Aug 2013**	**Aug 2013**	**Sept 2013**
# transects *n*	8	4	5	8

Table 2: Leg1 mean biomass survey index values, with associated CVs in parentheses.

	Tristan	**Nightingale**	**Inaccessible**	**Gough**
2006	31.60 (0.21)	13.86 (0.15)	17.80 (0.23)	8.03 (0.31)
2007	40.23 (0.13)	20.31 (0.19)	16.33 (0.21)	11.15 (0.28)
2008	-	-	-	-
2009	26.64 (0.13)	16.31 (0.05)	14.98 (0.36)	26.47 (0.26)
2010	25.49 (0.14)	14.00 (0.26)	10.98 (0.55)	11.15 (0.32)
2011	28.36 (0.14)	4.63 (0.51)	16.60 (0.19)	16.39 (0.26)
2012	17.96 (0.14)	18.10 (0.19)	9.51 (0.22)	9.11 (0.27)
2013	17.14 (0.13)	23.50 (0.19)	12.64 (0.30)	13.07 (0.30)

Figure 1a: Biomass indices (in terms on the average mass caught per trap) for the Leg1 surveys for **Inaccessible**. The means and (and assumed log normal) 95% confidence intervals are shown.

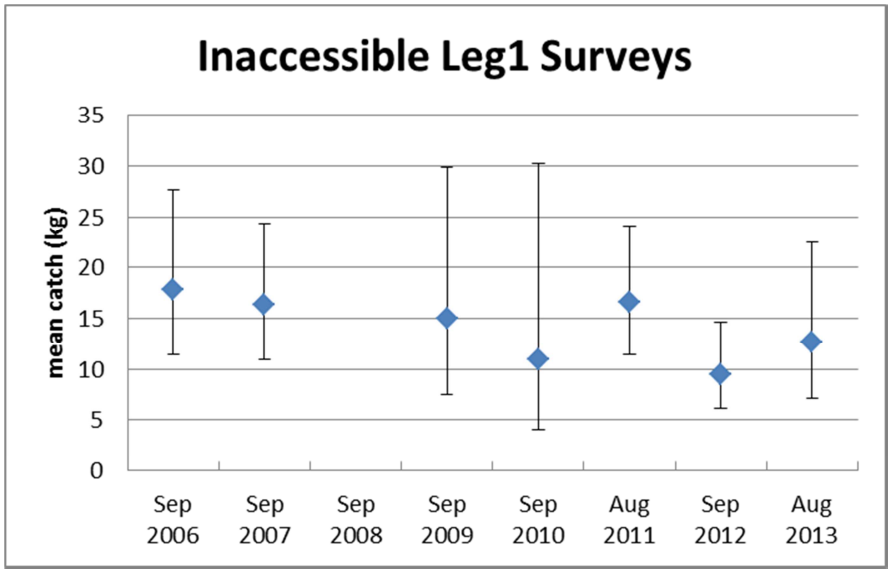


Figure 1b: Biomass indices (in terms on the average mass caught per trap) for the Leg1 surveys for **Nightingale**. The means and (and assumed log normal) 95% confidence intervals are shown.

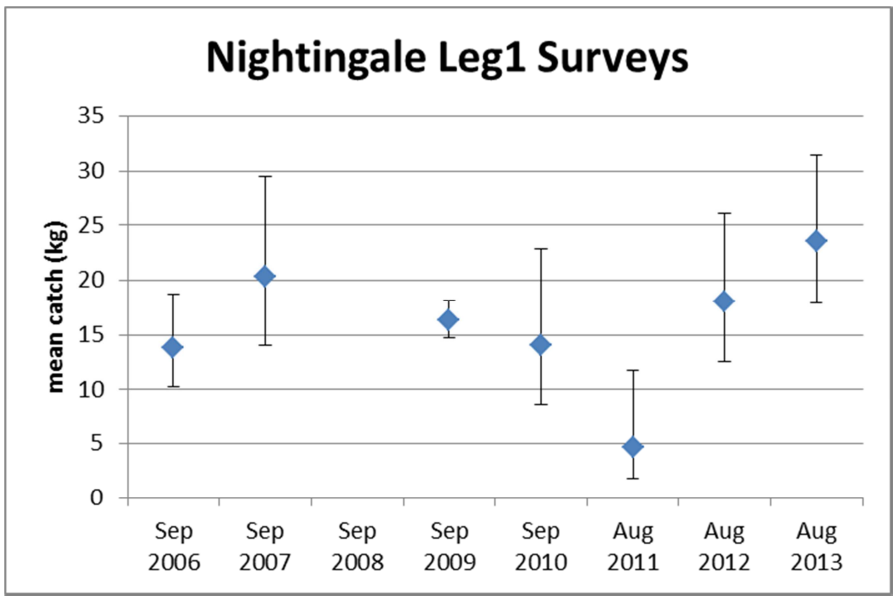


Figure 1c: Biomass indices (in terms on the average mass caught per trap) for the Leg1 surveys for **Tristan**. The means and (and assumed log normal) 95% confidence intervals are shown.

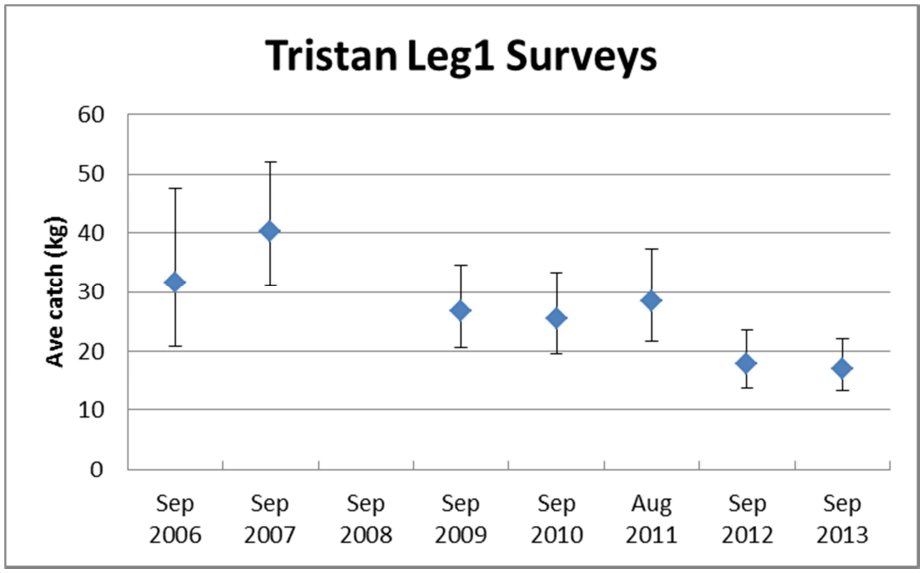


Figure 1d: Biomass indices (in terms on the average mass caught per trap) for the Leg1 surveys for **Gough**. The means and (and assumed log normal) 95% confidence intervals are shown.

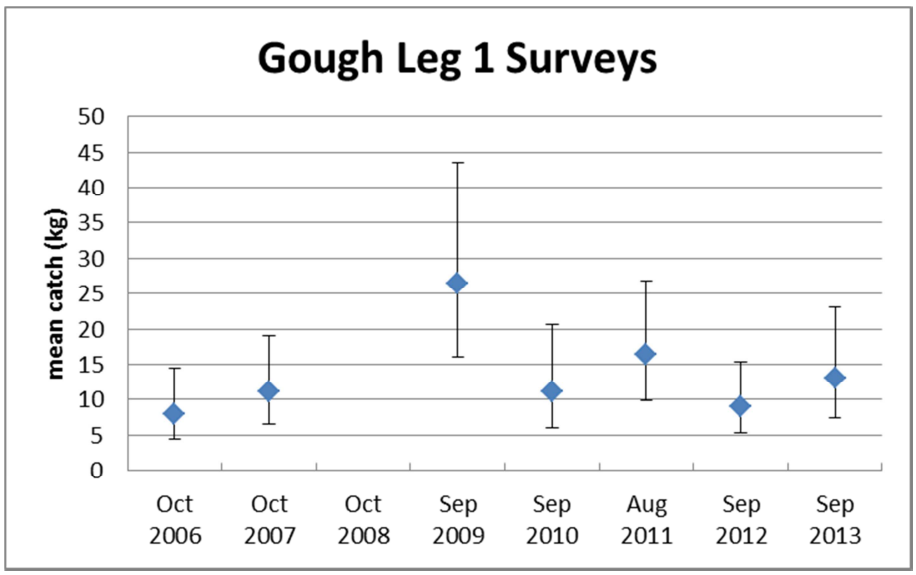


Figure 2a: Nightingale catch-at-length frequencies for males (top) and females (bottom) for the Leg1 surveys. Frequencies here sum to 1.0 separately for each sex. The smallest and largest size categories are minus- and plus-groups respectively.

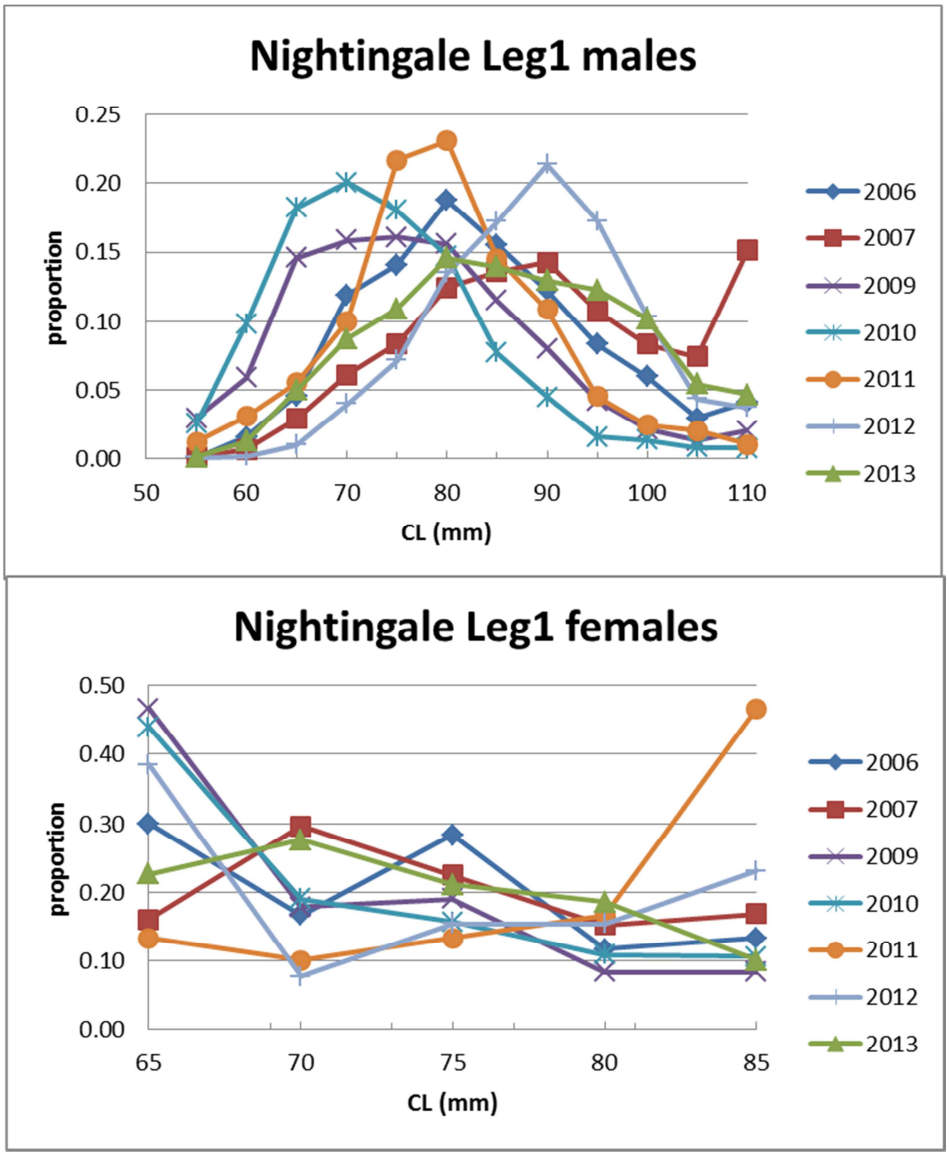


Figure 2b: inaccessible catch-at-length frequencies for males (top) and females (bottom) for the Leg1 surveys. Frequencies here sum to 1.0 separately for each sex. The smallest and largest size categories are minus- and plus-groups respectively.

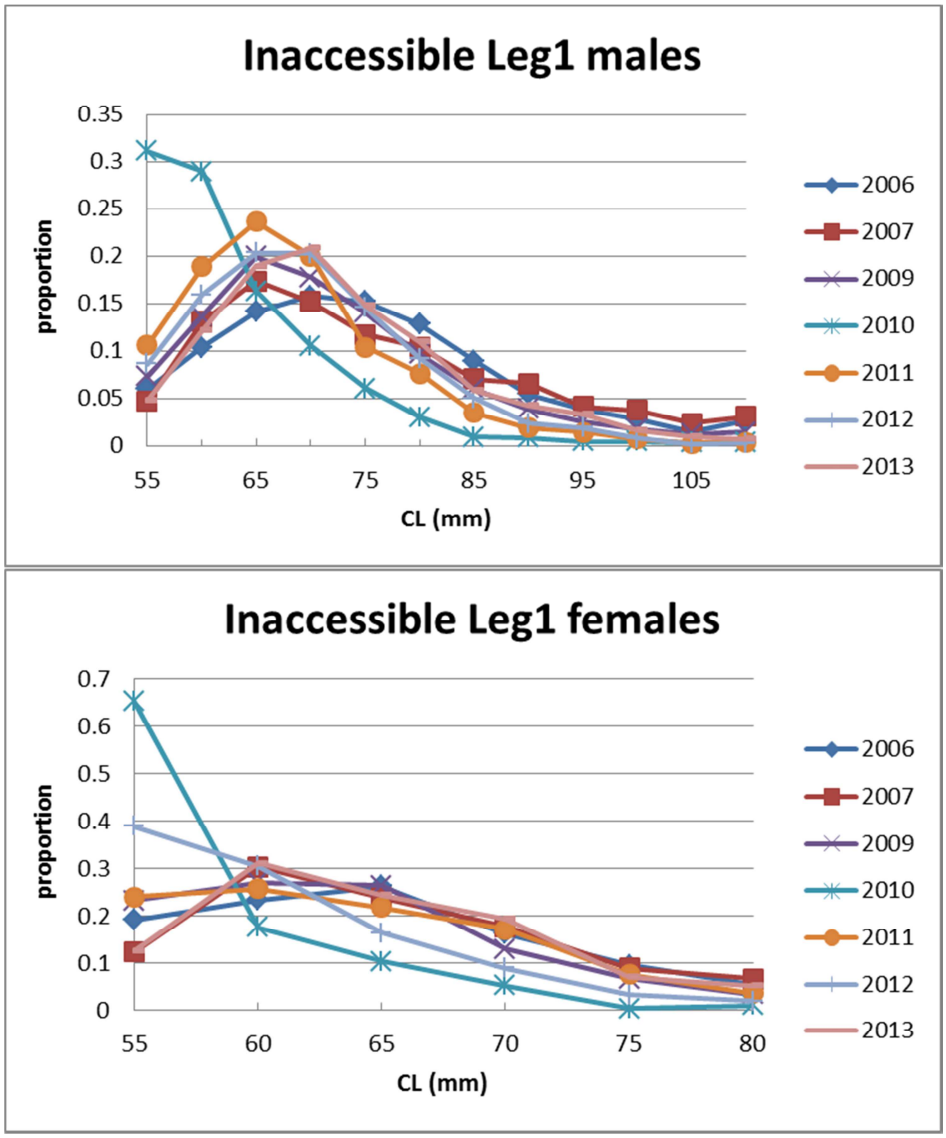
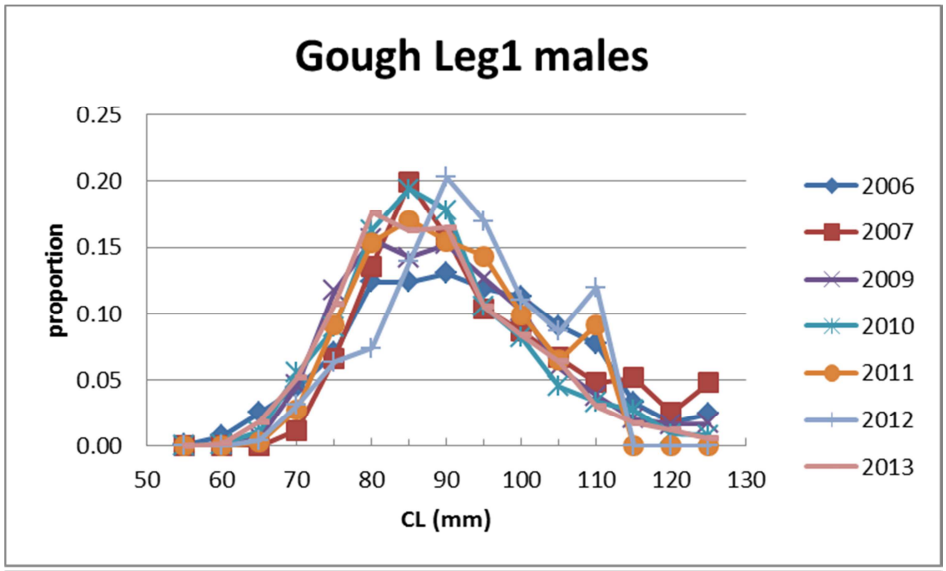


Figure 2c: Gough catch-at-length frequencies for males (top) and females (bottom) for the Leg1 surveys. Frequencies here sum to 1.0 separately for each sex. The smallest and largest size categories are minus- and plus-groups respectively.



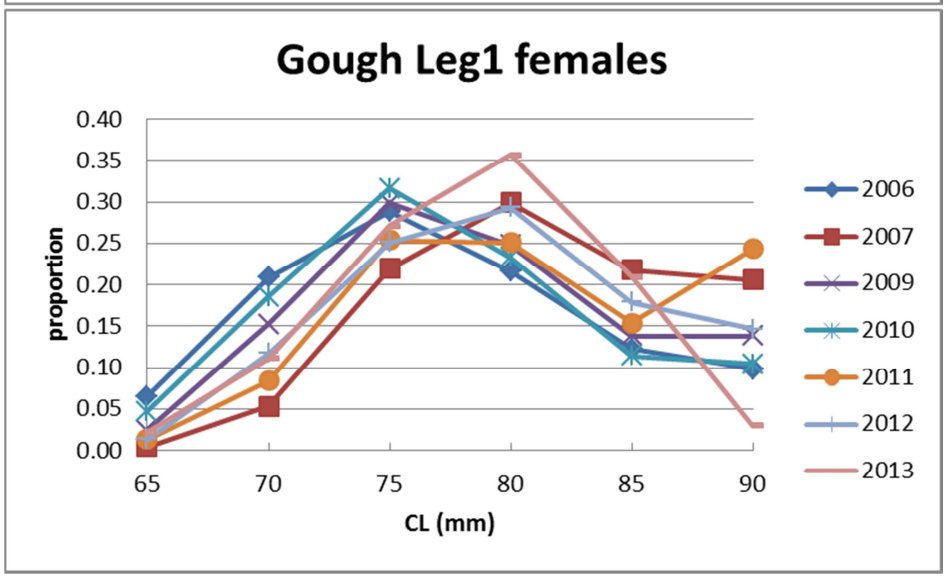


Figure 2d: Tristan catch-at-length frequencies for males (top) and females (bottom) for the Leg1 surveys. Frequencies here sum to 1.0 separately for each sex. The smallest and largest size categories are minus- and plus-groups respectively.

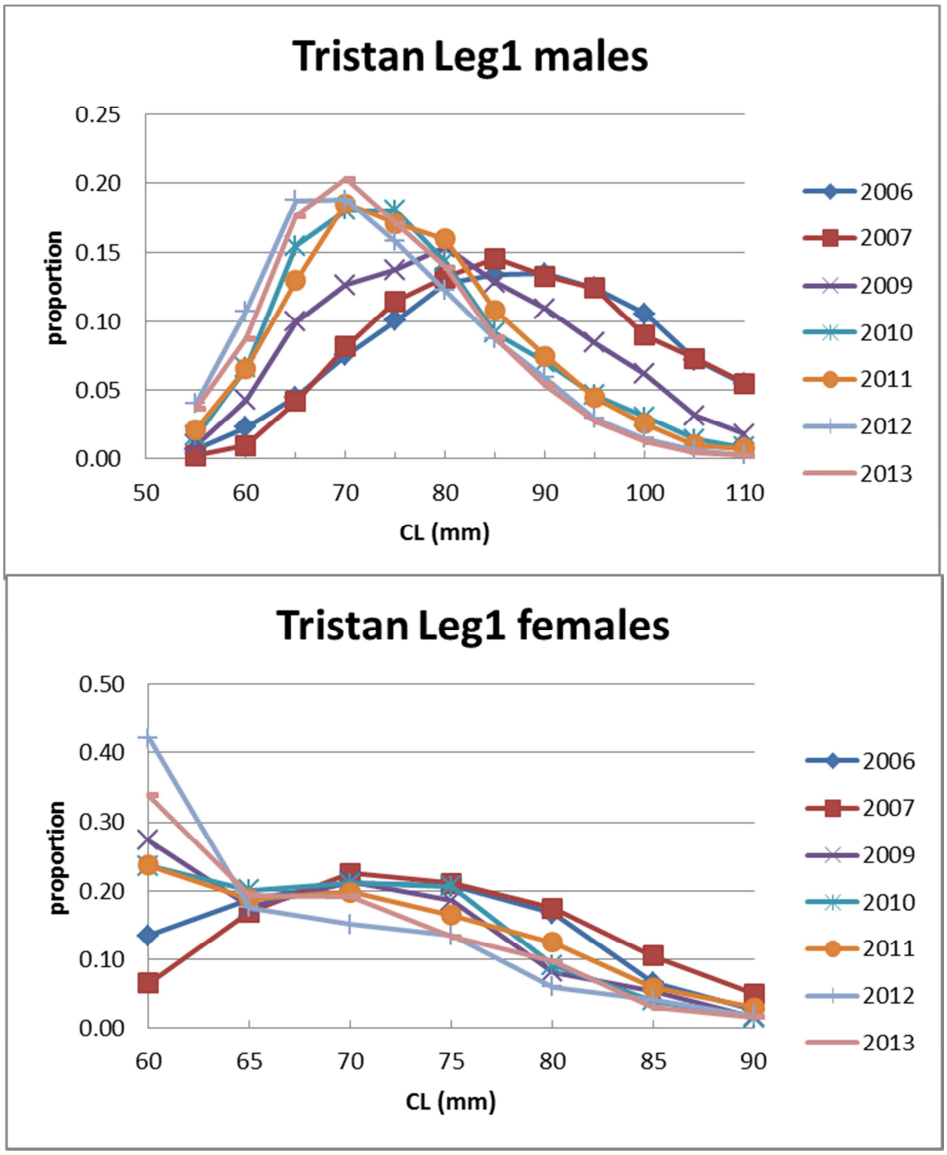


Figure 3a: % females in the Leg1 Nightingale surveys.

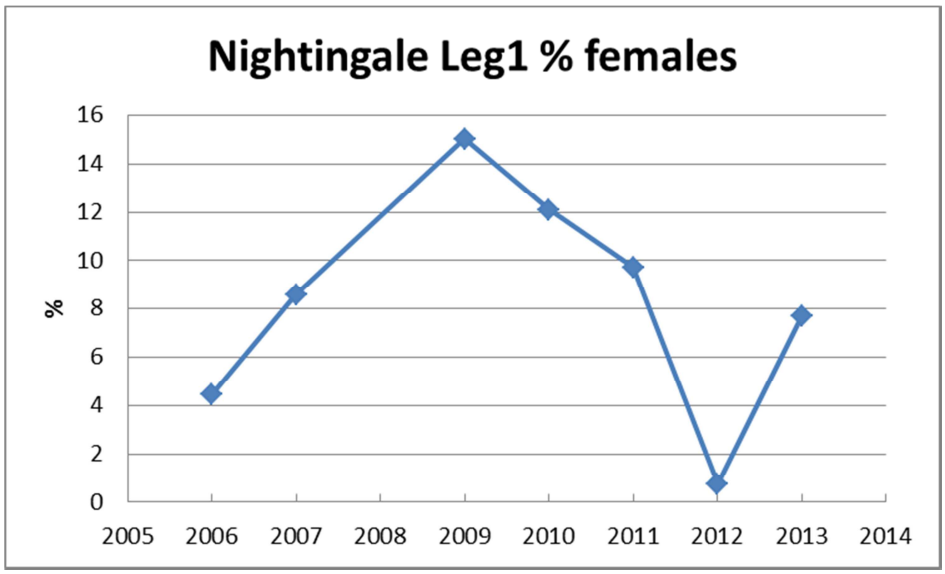


Figure 3b: % females in the Leg1 Inaccessible surveys.

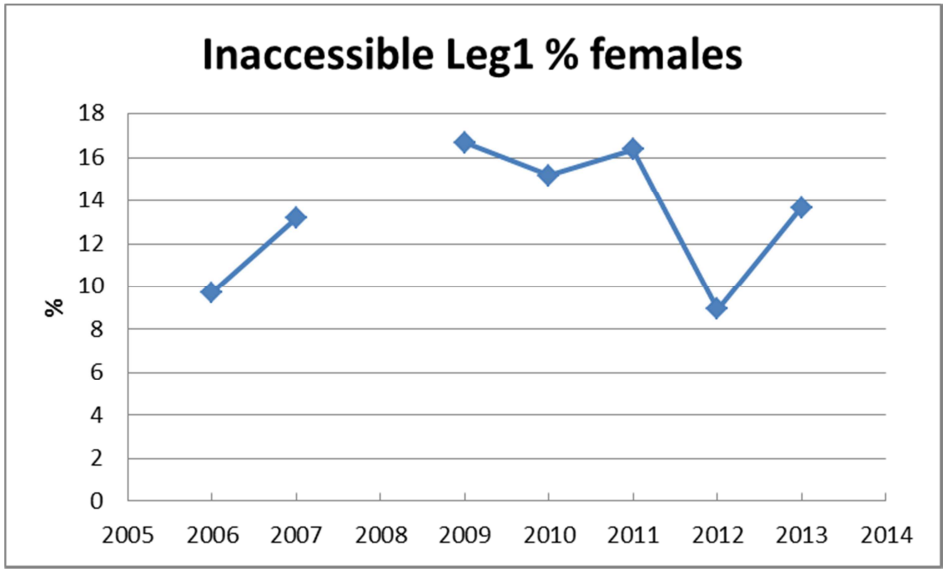


Figure 3c: % females in the Leg1 Gough surveys.

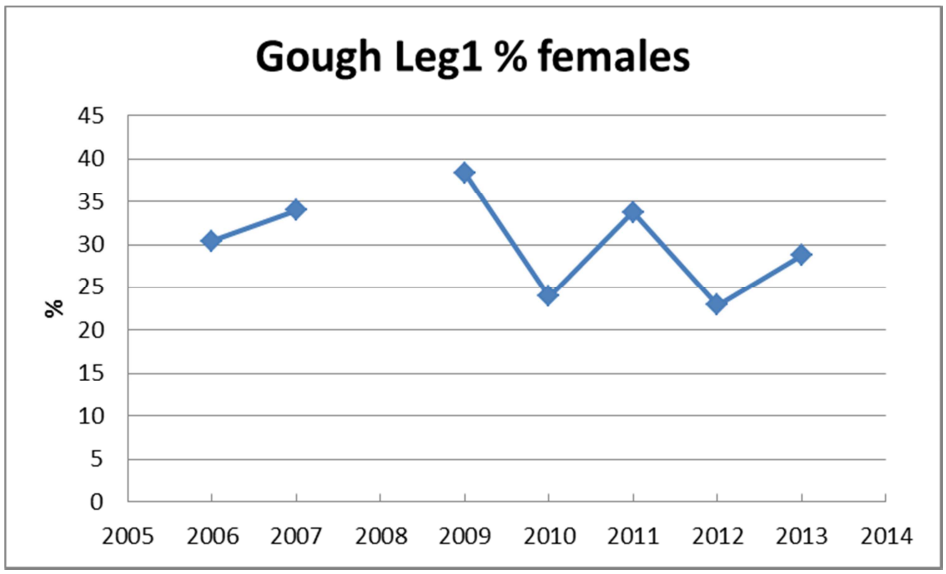


Figure 3d: % females in the Leg1 Tristan surveys.