

Final Tristan Group Biomass Survey Leg1 results including data from the 2014 season

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Summary

This paper summarises key features of the results from the Leg 1 biomass surveys carried out since 2006 at each island in the Tristan group. Specifically the biomass index, catch-at-length distribution and female-percentage-in-the-catch trends are presented. The index shows fairly stable trends for Inaccessible and Gough. The trend at Tristan has been down for three years but is stable showing a slight increase for 2014. In contrast, there has been a sharp recent increase for Nightingale since 2011. There have been some changes over time in the length distributions, the most marked of which is a steady decrease in the mean length at Tristan. The percentage of females in the catch at Gough is about double that at the other islands.

Introduction

A number (15) 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 were undertaken at each of the four islands. For each season there has traditionally been 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 2014¹ 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.

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

The Tristan biomass index data are examined in somewhat more detail than in previous documents, due to the unusually poor CPUE achieved by the powerboats operating at the island for the 2014 season. The hope is that a more detailed look at the Tristan biomass index data at an areal level might show some interesting (and different) trends, providing some insight into these CPUE results.

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 near the middle of each transect and 3 offshore. The total number of lobsters and the biomass caught from each of the nine traps have 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 (\bar{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.)

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

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

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

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

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 proportions

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.

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

Figure 1e reports the Tristan Leg1 biomass index values which have been split by shore placement (i.e. inshore, midshore and offshore). No clear difference in the biomass index trends is evident amongst inshore, midshore and offshore transects, although comparisons between the trends for the last season show a slight increase inshore and midshore, with a slight decrease offshore.

Figure 1f shows the mean catches (over all surveys) at Tristan for each transect (each of which corresponds to a different area). This figure shows that the East and South transects produce much lower catches than the other areas. Figure 1g reports the biomass index trends from the Tristan (Leg1) surveys at a transect (area) level. Again, no clear difference amongst the trends is noticeable.

Catch-at-length proportions

Biomass survey catch-at-length proportions (with males and females together summing to 1.0) are used as input data to the updated assessment of each island. Here, these data, including now the 2014 Leg1 data, are shown in Figures 2a-d (for each island) where the proportions 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 selected in a manner that avoids 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 2015). One of the most noticeable trends is that the Nightingale CAL (males) has seen a fairly marked 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 2013 and 2014 Nightingale

male CAL data appear to have reverted to a pattern seen in 2006 and 2007. There is a similar (though lesser) shift evident in the Gough male 2012 Leg1 data – i.e. shift towards large lobsters – but again the 2013 and 2014 data appear more “normal”.

The Tristan Leg1 male data shows the opposite trend (Figure 2c), with a shift to the smaller lobsters over the 2006-2013 period. Such a trend could be caused by some combination of heavier fishing (of the larger sized lobsters) or a recruitment increase at the same stage during this period. The 2014 data show a shift back towards slightly larger lobster.

Mean size of survey catch

The mean length of the survey catch (considering both males and females combined) can be calculated. The values are plotted against season in Figures 3a-d. These plots generally show the patterns that are to be expected given the features in the length distributions and their changes over time which are mentioned above. In particular, it is evident that the mean size of the survey catch has declined steadily from 2006-2012 at Tristan (from around 87mm CL to 75mm CL), with some small increases over the last two seasons. The mean size of catch has however steadily increased at Inaccessible over the 2010-2014 period.

% Females

These data are plotted in Figures 4a-d. The very low % female value for Nightingale reported for 2012 is shown in Figure 4a. For the 2013 survey, this value is once again at the higher levels seen in previous seasons, although drops again to below 3% for the 2014 survey. The % females from the surveys at the other three islands have been fairly consistent since 2006. It is notable that the % females in the Gough catch is generally much higher (around 25%-35%) than at the other three islands (around 5-15%).

Reference

Johnston, S.J. 2015. Updated lobster catch-at-length data from the commercial fisheries at the Tristan da Cunha group of islands. MARAM document, MARAM/TRISTAN/2015/MAY/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	Sep 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	Sep 2013
Season 2014/15 Leg 1	Sep 2014	Sep 2014	Sep 2014	Sep 2014
# Leg1 transects <i>n</i>	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)
2014	18.82 (0.17)	30.92 (0.11)	11.81 (0.26)	8.50 (0.28)

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.

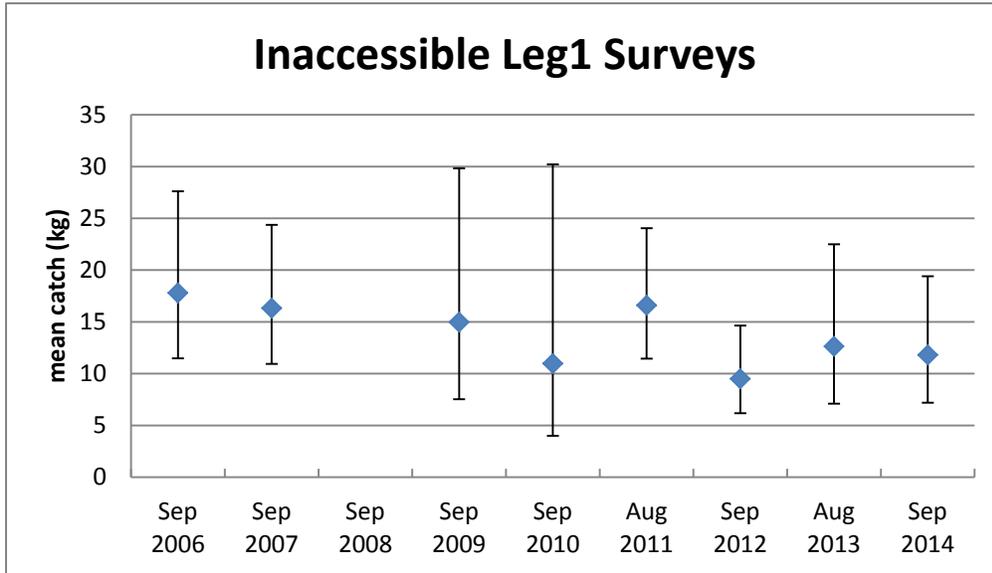


Figure 1b: Biomass indices (in terms on the average mass caught per trap) for the Leg1 surveys for **Nightingale**. The means and (and assumed log normal) 95% confidence intervals are shown.

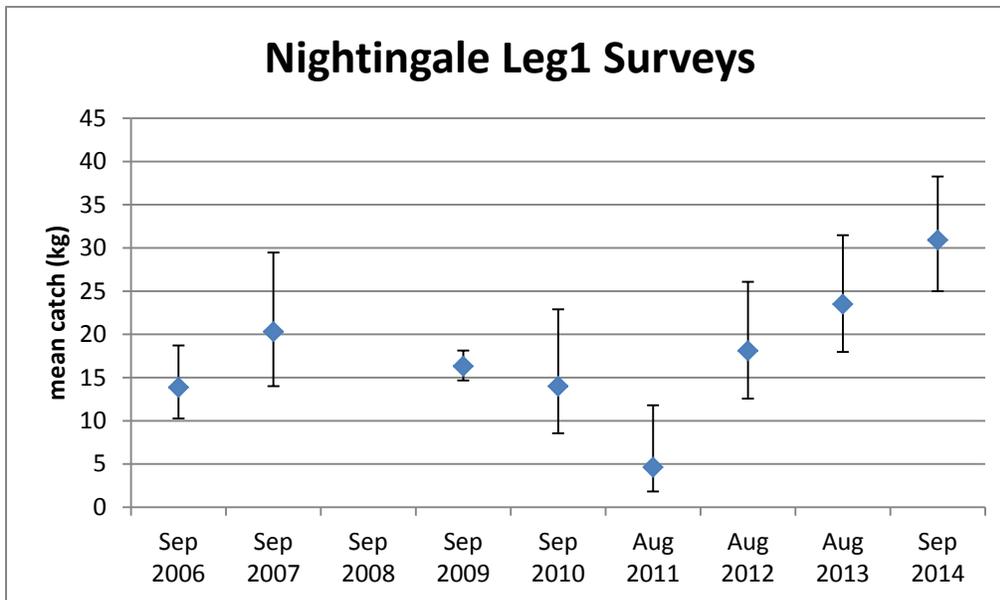


Figure 1c: Biomass indices (in terms on the average mass caught per trap) for the Leg1 surveys for **Tristan**. The means and (and assumed log normal) 95% confidence intervals are shown.

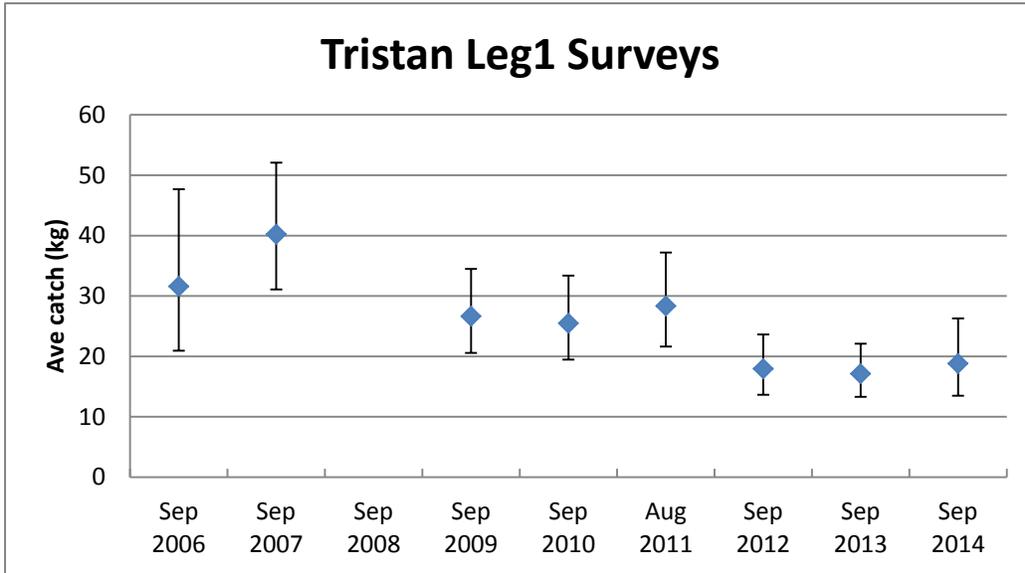


Figure 1d: Biomass indices (in terms on the average mass caught per trap) for the Leg1 surveys for **Gough**. The means and (and assumed log normal) 95% confidence intervals are shown.

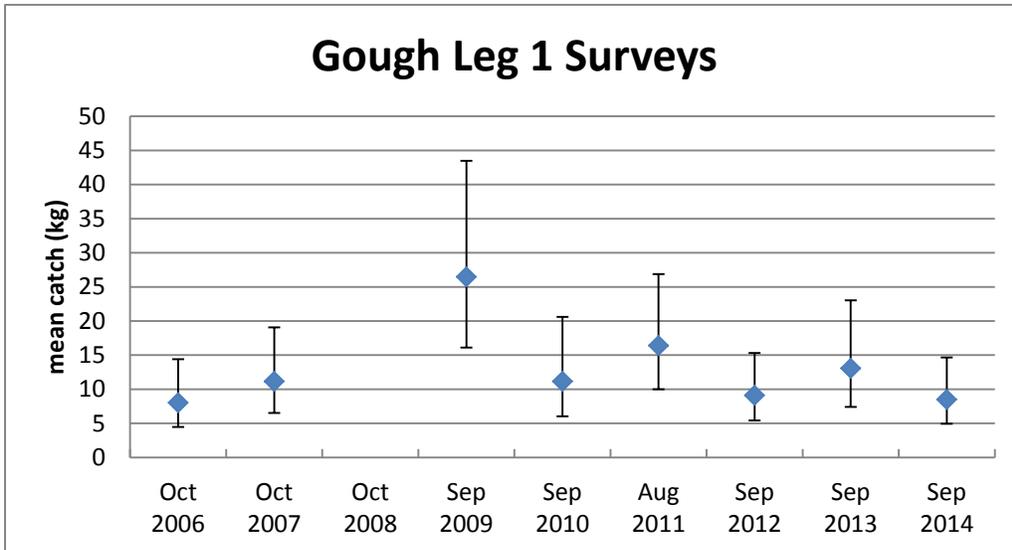


Figure 1e: **Tristan** biomass index data analysed at “shore” level i.e. inshore, midshore and offshore.

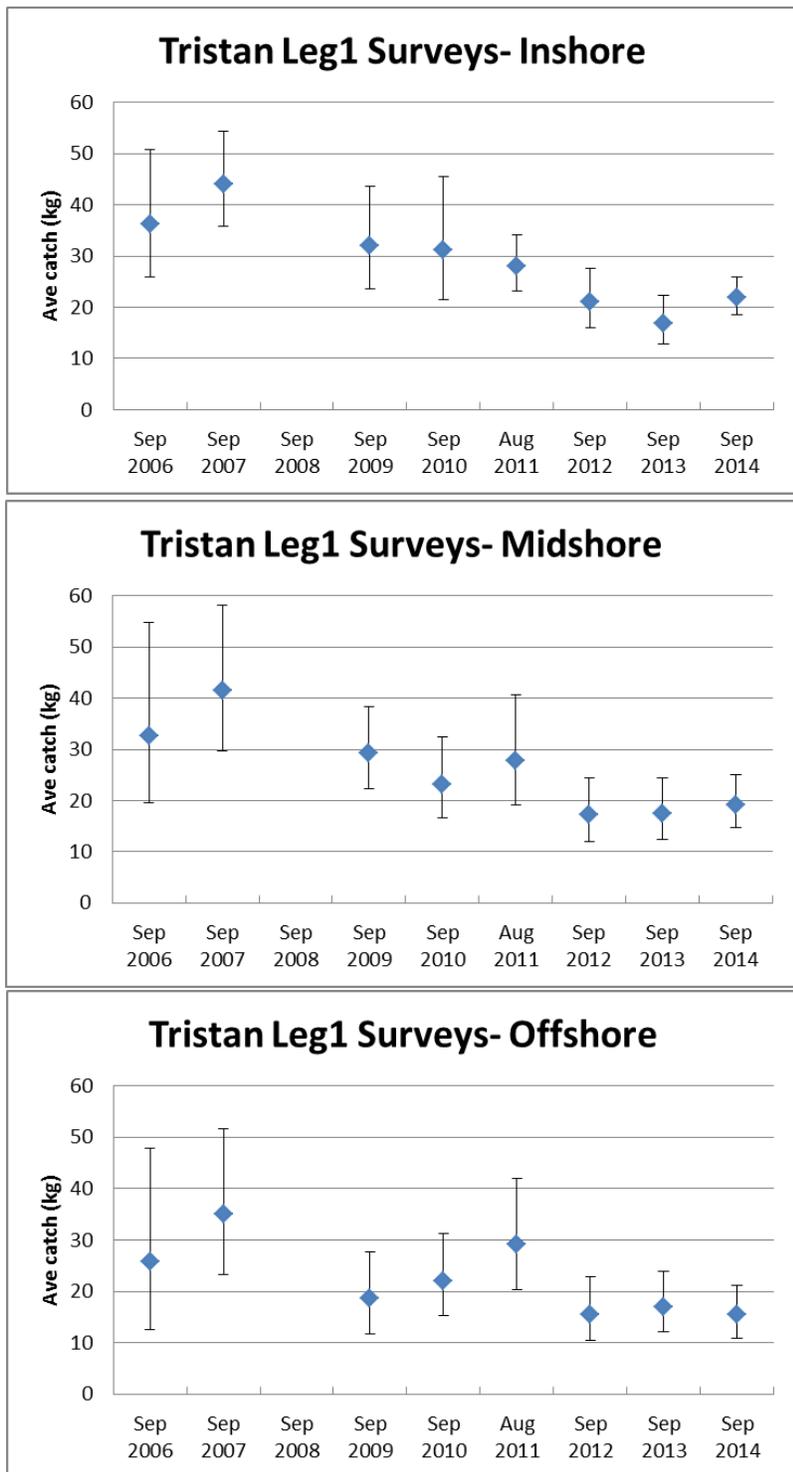


Figure 1f: Mean catches per transect (which corresponds to an area) for the **Tristan** Leg1 surveys.

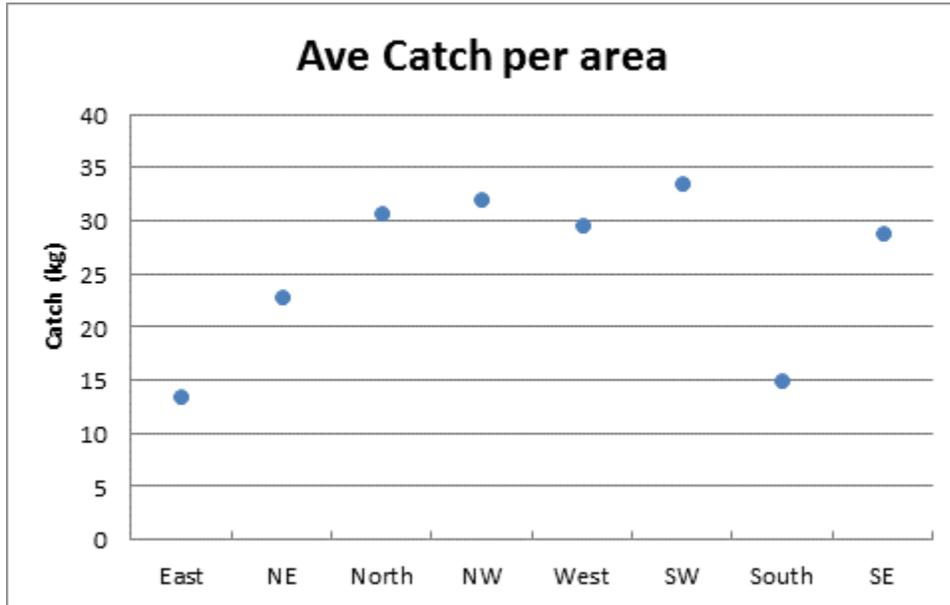


Figure 1g: Trends in the biomass index for each transect (area) for the **Tristan** Leg1 surveys.

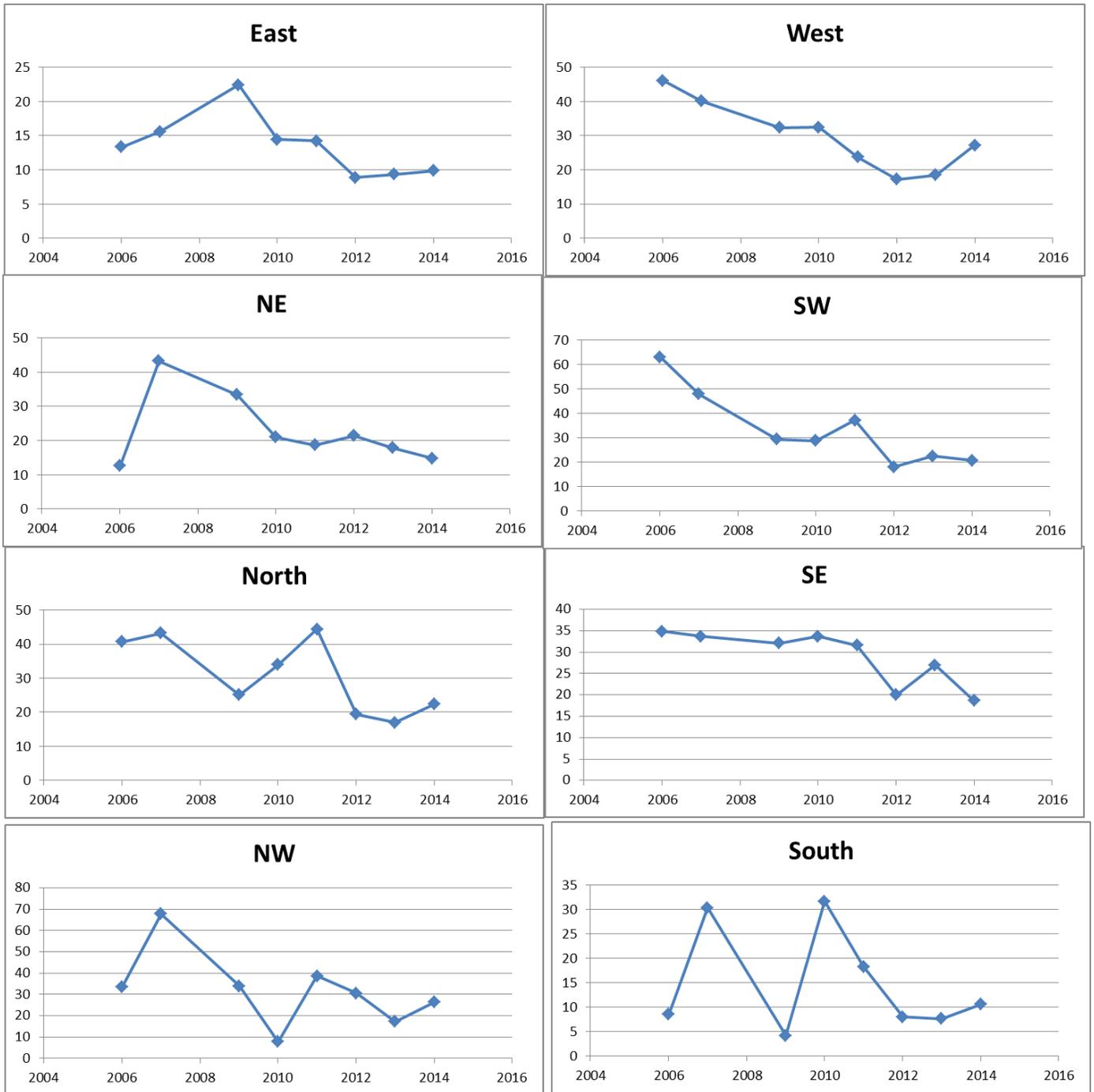


Figure 2a: **Nightingale** catch-at-length proportions for males (top) and females (bottom) for the Leg1 surveys. Proportions here sum to 1.0 separately for each sex. The smallest and largest size categories are minus- and plus-groups respectively.

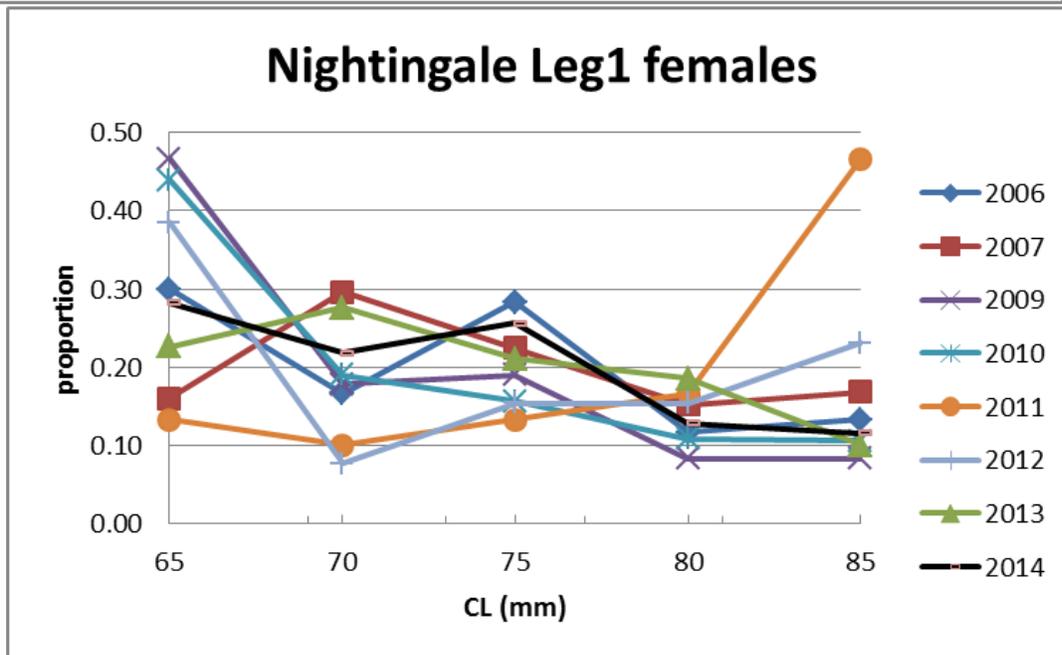
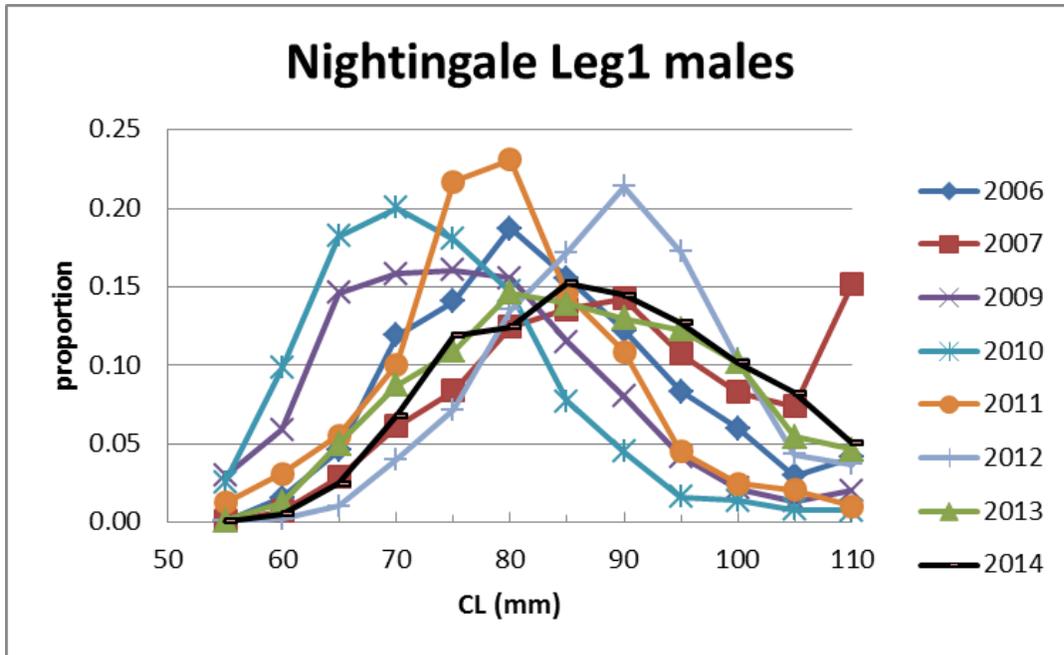


Figure 2b: **Inaccessible** catch-at-length proportions for males (top) and females (bottom) for the Leg1 surveys. Proportions here sum to 1.0 separately for each sex. The smallest and largest size categories are minus- and plus-groups respectively.

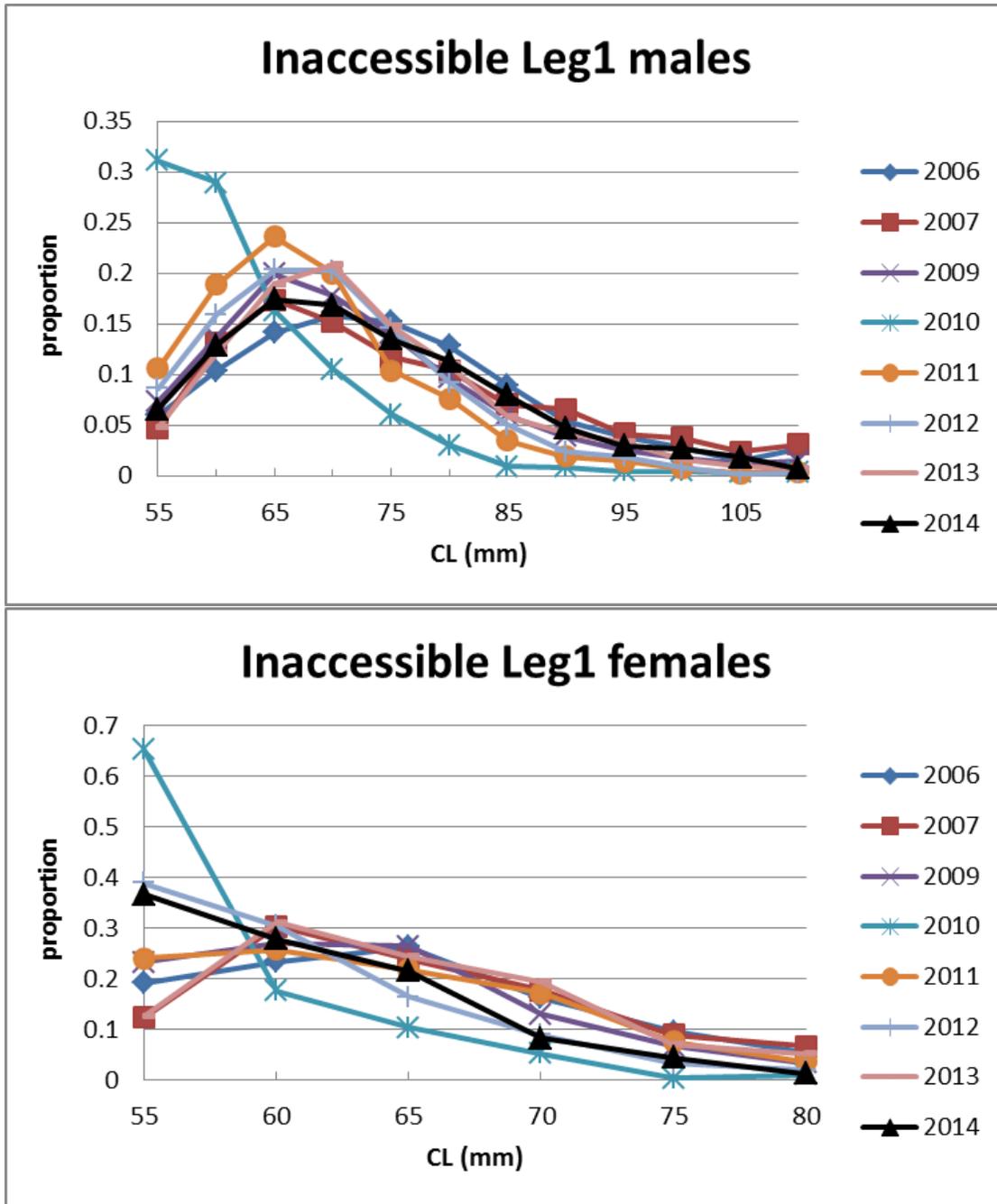


Figure 2c: **Tristan** catch-at-length proportions for males (top) and females (bottom) for the Leg1 surveys. Proportions here sum to 1.0 separately for each sex. The smallest and largest size categories are minus- and plus-groups respectively.

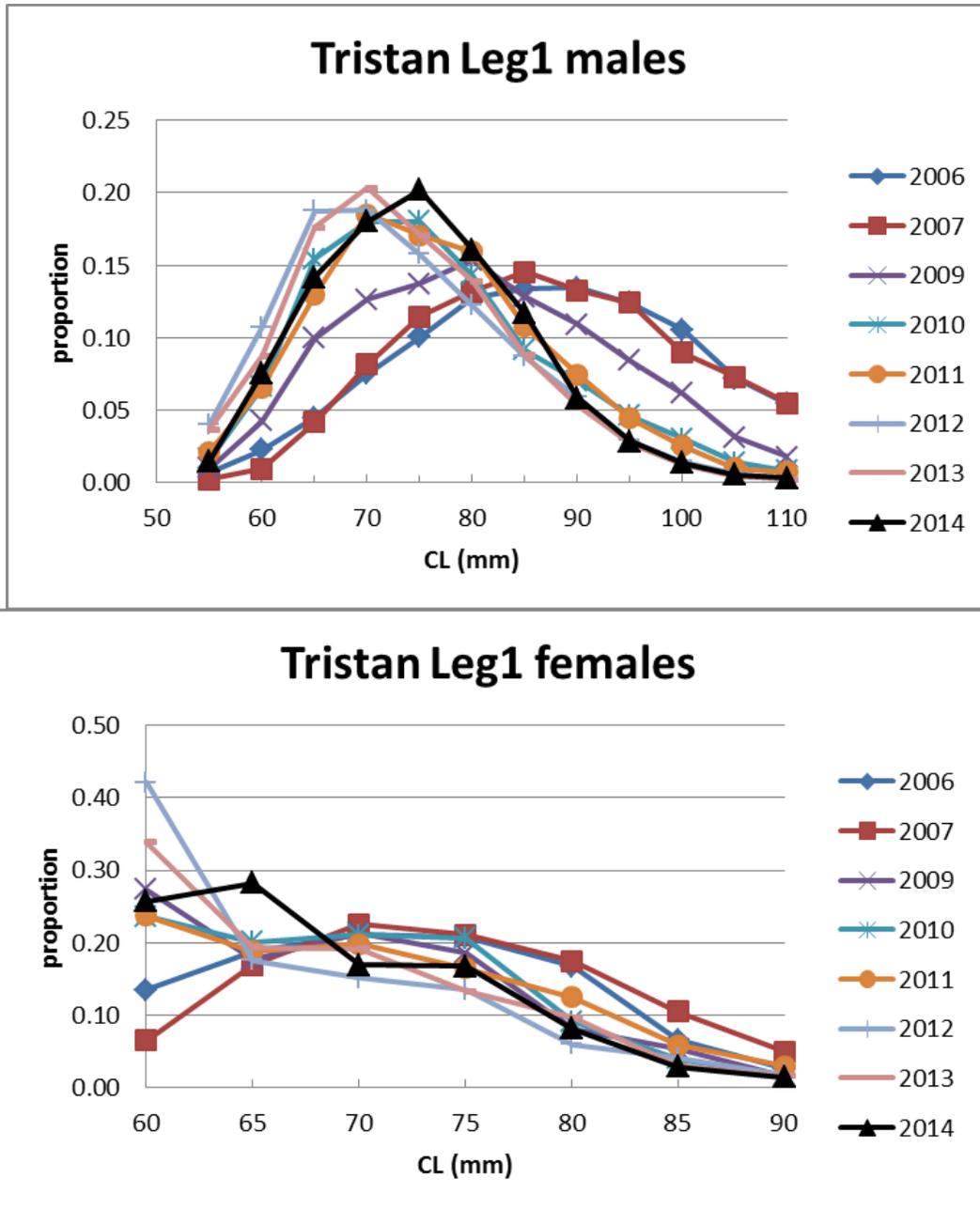


Figure 2d: **Gough** catch-at-length proportions for males (top) and females (bottom) for the Leg1 surveys. Proportions here sum to 1.0 separately for each sex. The smallest and largest size categories are minus- and plus-groups respectively.

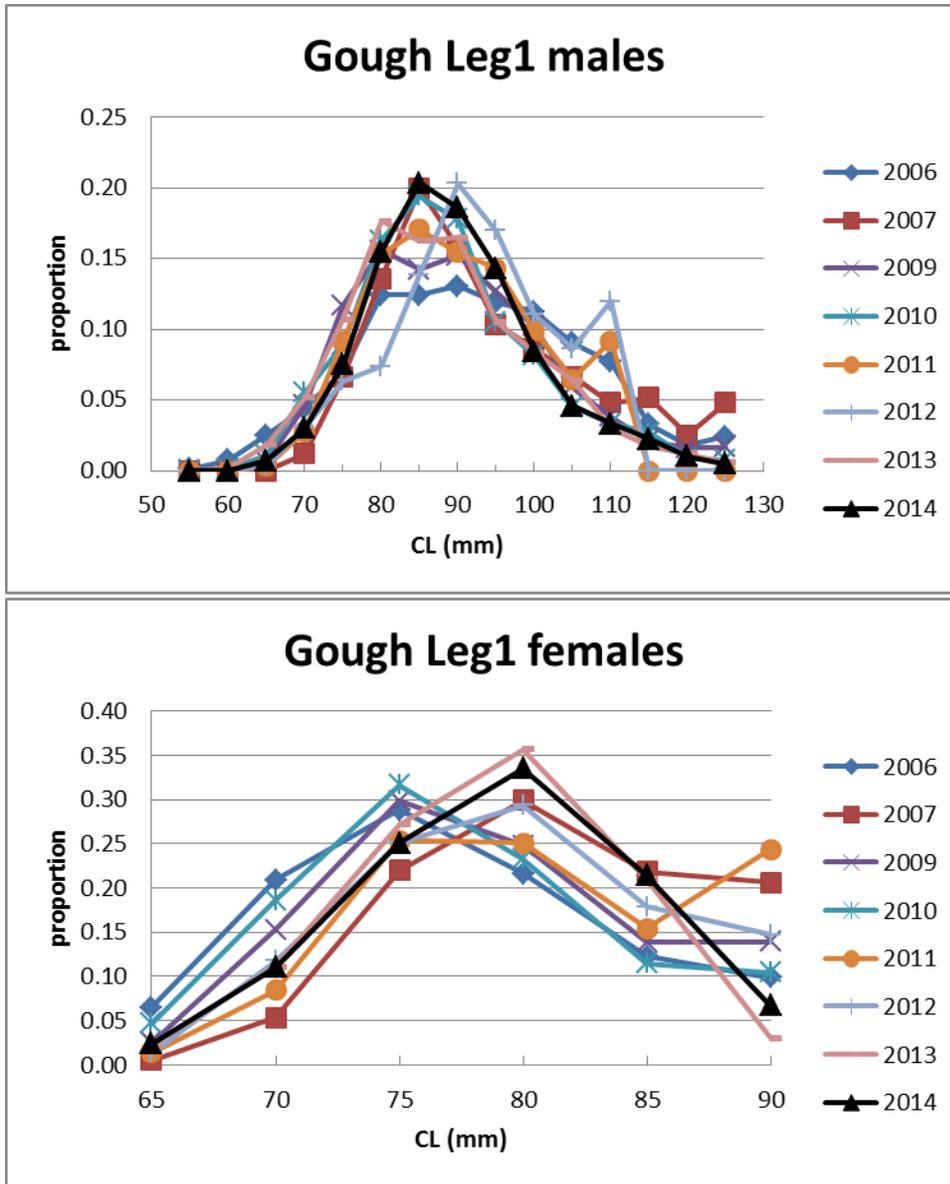


Figure 3a: Mean length of survey catch at **Nightingale**.

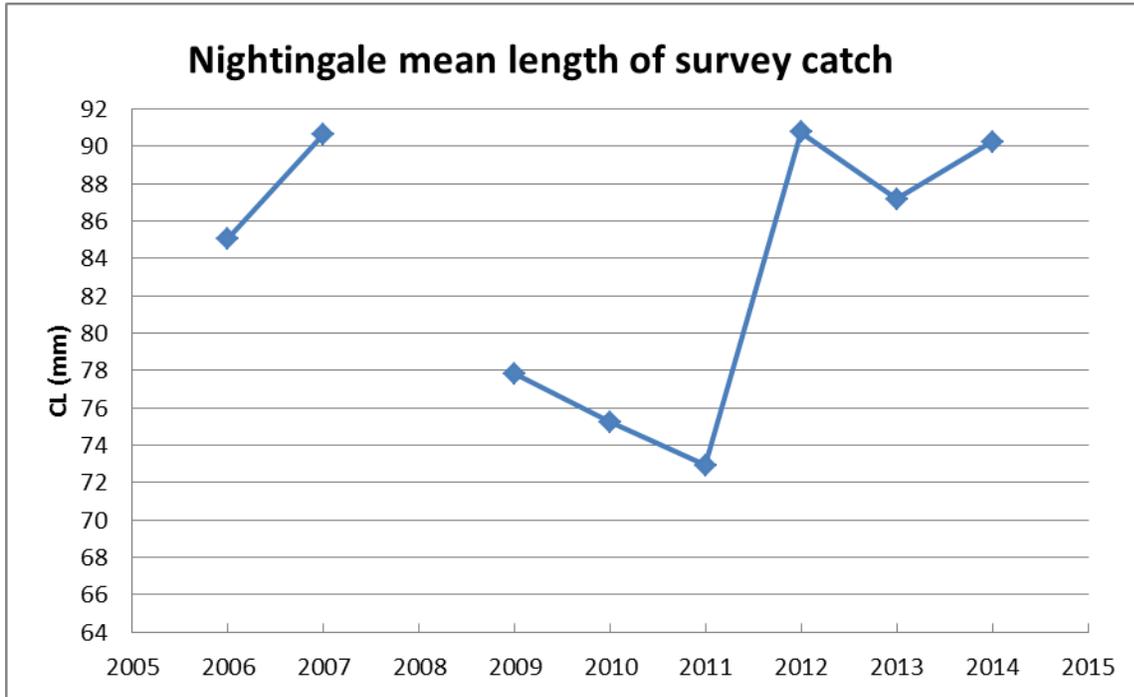


Figure 3b: Mean length of survey catch at *Inaccessible*.

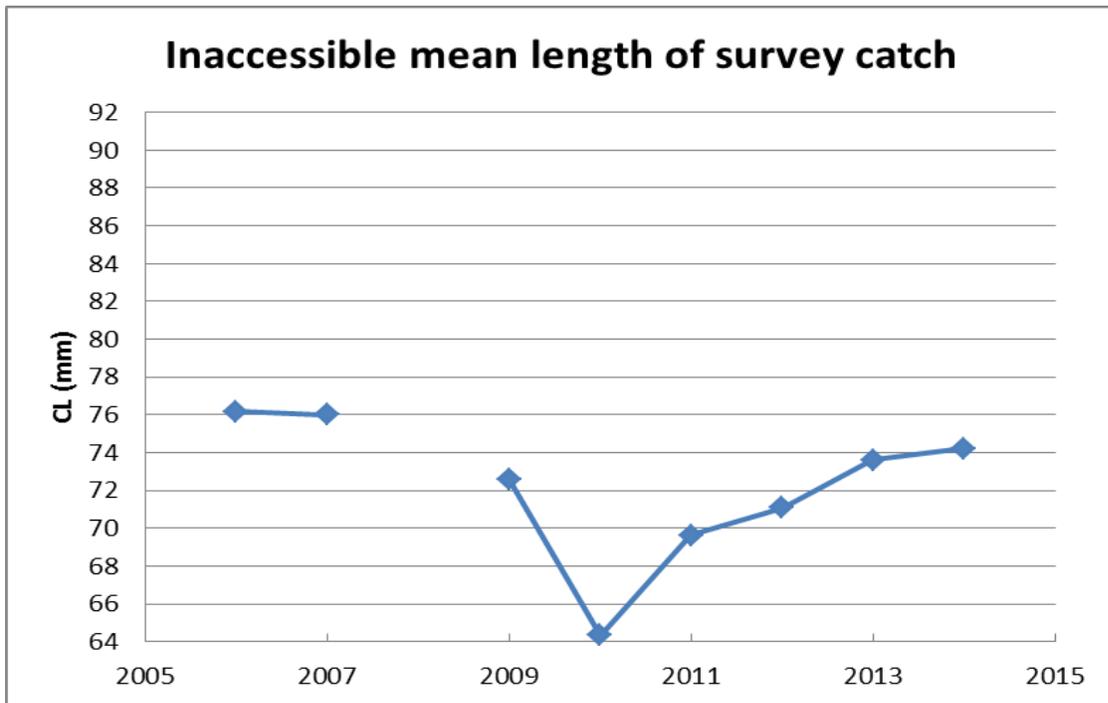


Figure 3c: Mean length of survey catch at **Gough**.

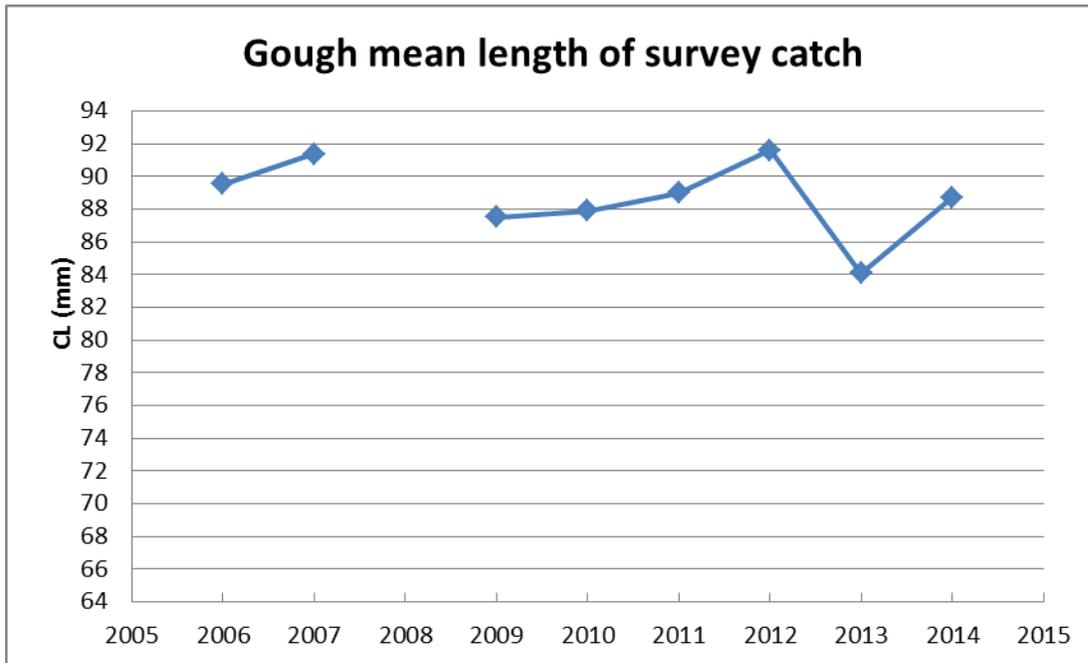


Figure 3d: Mean length of survey catch at **Tristan**.

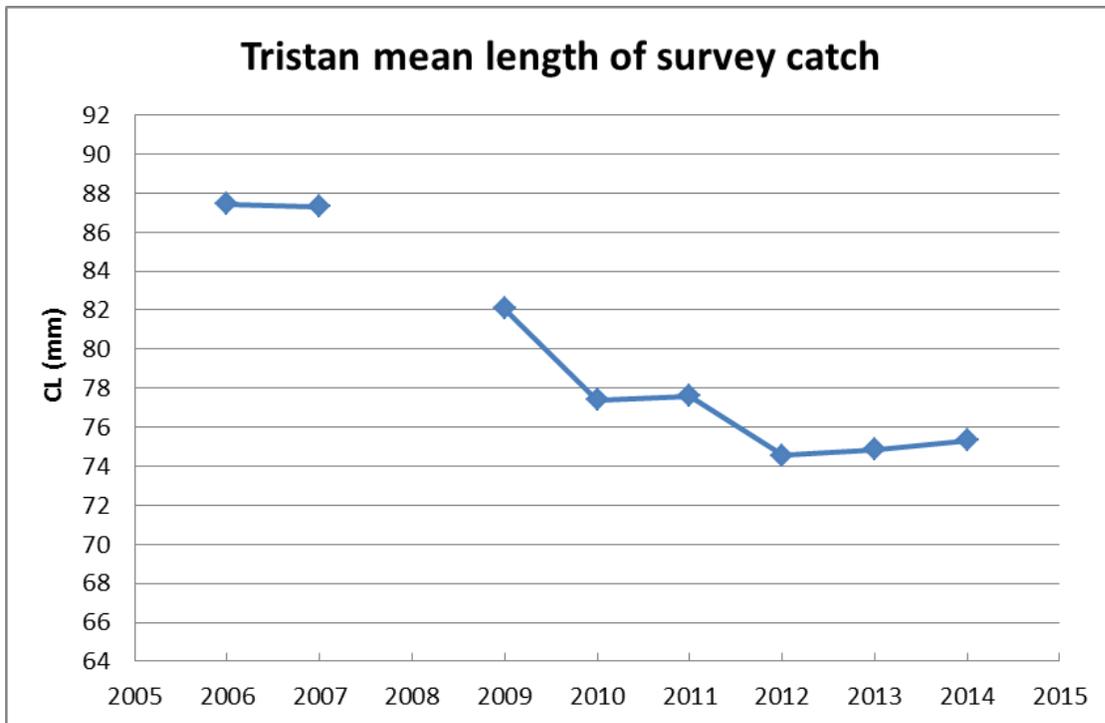


Figure 4a: % females in the Leg1 Nightingale surveys.

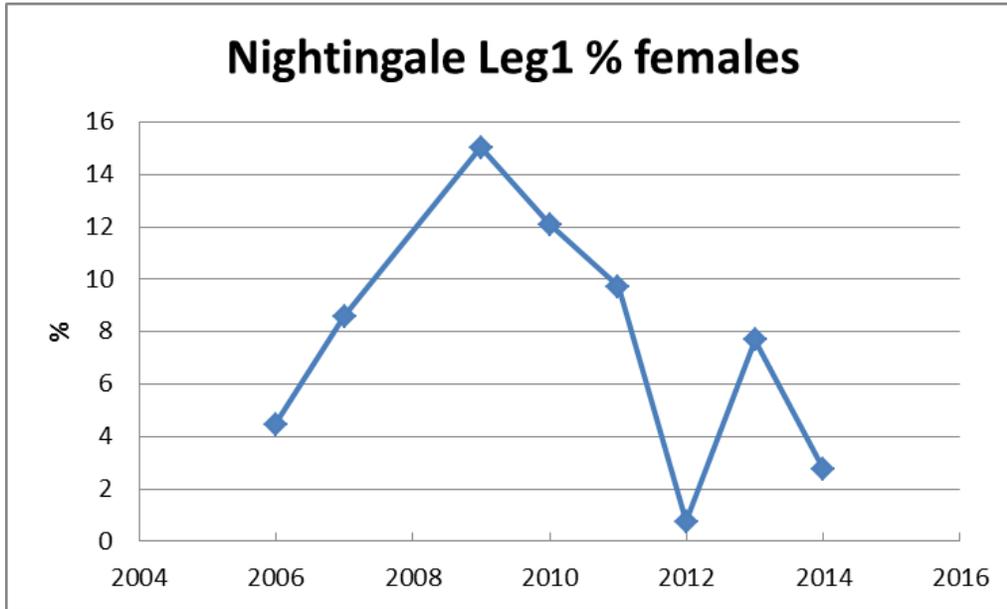


Figure 4b: % females in the Leg1 Inaccessible surveys.

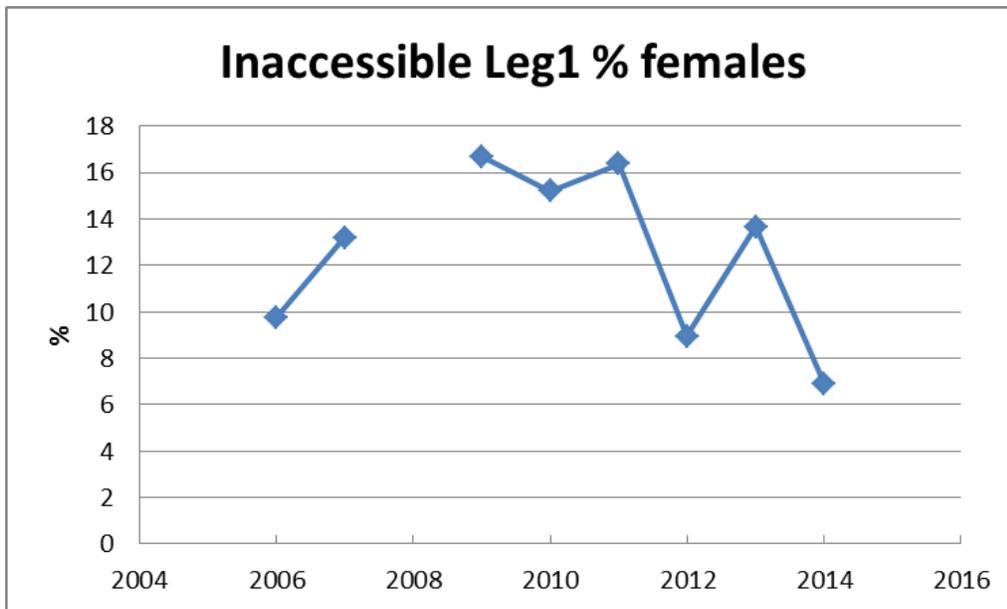


Figure 4c: % females in the Leg1 Gough surveys.

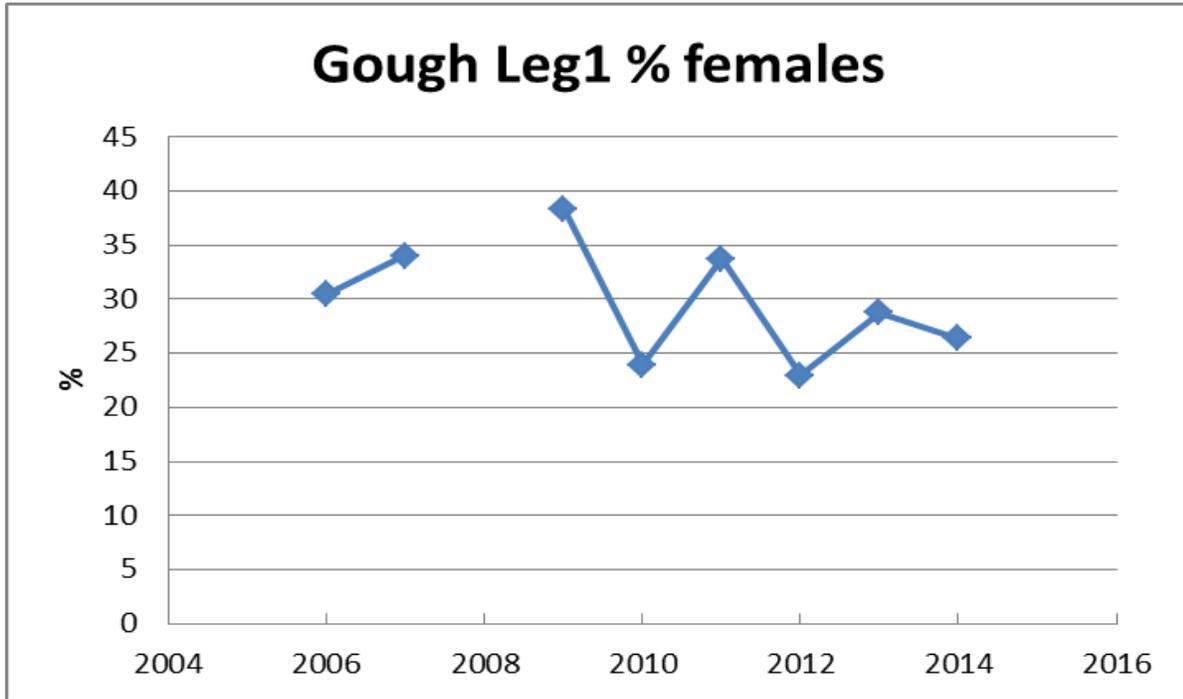


Figure 4d: % females in the Leg1 Tristan surveys.

