Tristan Group Biomass Survey results including data from the 2021 season

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Summary

This paper reports the updated biomass indices (to include the 2021[1] season) obtained from the annual biomass survey at each island. The decline since the 2018 season at the outer islands of Inaccessible, Nightingale and Gough has been reversed with increases shown at all three islands by these most recent results. The Tristan biomass index value has also improved. There have been some changes over time in the size distributions, the most marked of which have been recent steady increases at Inaccessible and Tristan in the mean length of the survey catch, but these have now reversed for the 2021 data collected. The recent decline in the mean length of the catch from Gough has also changed direction. The percentage of females in the catch at Gough (around 25-35%) is much higher that at the other three islands (around 5-15%). The percent females at both Tristan and Inaccessible are the highest since the start of the surveys in 2006.

Introduction

A now fairly large number (13) of annual biomass surveys has been completed 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. This document provides a brief summary of the biomass index and catch-at-length (CAL) data collected thus far, including the most recent 2021 data. Note that the biomass survey data for the 2020 season were lost when the Geo Searcher sank in December 2021 at Gough island.

[1] The split season is denoted by the first year, i.e. 2019 refers to the 2019/2020 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, 9 traps are set – 3 inshore, 3 towards the middle of each transect 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 9 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, broadly speaking) allows this variation to be integrated out..

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

Biomass index $\bar{B} = \frac{\sum_s \bar{B}_s}{n}$

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

Catch-at-length proportions

Catch-at-length (CAL) data are recorded initially at a 1mm carapace interval, then aggregated into 5mm carapace length classes; 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. Males and females are reported separately.

% Females

The percentage females (by number) caught in these surveys is also reported.

Mean length of catch

Another informative statistic reported is the mean length of the catch (for which males and females are combined).

Results and Discussion

Biomass index

Table 2 reports the biomass survey index values with their associated CVs. The means and 95% confidence intervals for the biomass index calculated for each survey are plotted in Figures 1a-d.

The Tristan biomass index has shown a slight increase since the previous season and remains higher than the 2012-2016 values (Figure 1a). Figure 1b shows that the biomass survey index at Inaccessible which had shown a decline since 2017, has now improved substantially. Figure 1c shows the decline evident from 2018 to 2019 at Nighingale has been reversed. Similarly the Gough (Figure 1d) 2021 index has increased to reverse the downturn from 2018 to 2019.

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. These data, now including the 2021 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 be confounded 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 defined in a manner that avoids extremely small proportions.

Some interesting patterns in the biomass survey CAL data are evident. The Tristan male data (Figure 2a) show a clear shift to larger lobsters over the 2012-2019 period. This trend was also evident in the commercial catch. This trend might be caused by a strong pulse of recruitment moving though the fishery – a subsequent updated assessment will throw more light on this. The 2021 survey CAL data show, however, that this trend has shifted back to smaller sized lobsters (seen also in the decrease in mean size of catch and an increase in female percentage in catch).

The Inaccessible and CAL data (Figure 2b) also show a steady increase towards larger male lobsters over the 2013-2019 period, with the 2021 data being very similar to that from 2019.

Nightingale and GoughCAL data show no real trend over recent years (Figures 2c), with the Gough CAL data showing a slight shift to larger lobsters.

Mean length of survey catch

The mean length of the survey catch (considering both males and females combined) has also been 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 length of the survey catch declined steadily from 2006-2012 at Tristan (from around 87mm CL to 75mm CL), but increased steadily over the 2013-2018 period. The 2021 data show a reversal of this trend.

The mean length of catch has increased steadily at Inaccessible over the 2010-2019 period, with the 2021 value remaining steady. For Nightingale, no clear pattern is obvious since 2012, with fairly large inter-annual changes being evident. The mean length of the survey catches did increase sharply after the 2011 OLIVA event at Nightingale – but remains similar to the values observed in 2006 and 2007. For Gough there has been some general reduction in mean length of the catch over the 2011-2019 period (Figure 3d), but the 2021 value has reversed this trend and is the highest in the series.

% Females

These data are plotted in Figures 4a-d. The very low % female value for Nightingale reported for 2012 and 2015 is evident in Figure 4c. A sharp increase is shown for 2016, but this value has declined again for the following three seasons.

The % females from the surveys at Tristan has shown a substantial increase for the 2021 season, with that at Inaccessible showing a slight increase. For both these islands, the 2021 F% values are the highest in the series. The F% values for Nightingale remain fairly consistent with past trends. The % females for 2021 for Gough has not shown a continuation of the increase evident for the previous two years. 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%).

Table 1: Months during which the surveys completed thus far for the four islands have taken place.

	Tristan	**Nightingale**	**Inaccessible**	**Gough**
Season 2006/07	**Sep 2006**	**Sep 2006**	**Sep 2006**	**Oct 2006**
Season 2007/08	**Sep 2007**	**Sep 2007**	**Sep 2007**	**Oct 2007**
Season 2008/09	**No surveys due to factory fire**			
Season 2009/10	**Sep 2009**	**Sep 2009**	**Sep 2009**	**Sep 2009**
Season 2010/11	**Sep 2010**	**Sep 2010**	**Sep 2010**	**Sep 2010**
Season 2011/12	**Aug 2011**	**Aug 2011**	**Aug 2011**	**Sep 2011**
Season 2012/13	**Sep 2012**	**Aug 2012**	**Sep 2012**	**Sep 2012**
Season 2013/14	**Sep 2013**	**Aug 2013**	**Aug 2013**	**Sep 2013**
Season 2014/15	**Sep 2014**	**Sep 2014**	**Sep 2014**	**Sep 2014**
Season 2015/16	**Aug 2015**	**Aug 2015**	**Aug 2015**	**Sep 2015**
Season 2016/17	**Sep 2016**	**Sep 2016**	**Sep 2016**	**Sep 2016**
Season 2017/18	**Sep 2017**	**Sep 2017**	**Sep 2017**	**Oct 2017**
Season 2018/19	**Sep 2018**	**Aug 2018**	**Aug 2018**	**Sep 2018**
Season 2019/20	**Aug/Sep 2019**	**Aug 2019**	**Aug 2019**	**Sep 2019**
Season 2020/21	**Data lost with sinking of the Geo Searcher**			
Season 2021/22	**OCT 2021**	**Aug/Sep 2021**	**Sep 2021**	**Sep 2021**
# transects *n*	8	4	5	8

Table 2: Biomass survey index values (kg/trap), with associated CVs in parentheses.

	Tristan	**Inaccessible**	**Nightingale**	**Gough**
2006	31.60 (0.21)	17.80 (0.23)	13.86 (0.15)	8.03 (0.31)
2007	40.23 (0.13)	16.33 (0.21)	20.31 (0.19)	11.15 (0.28)
2008	-	-	-	-
2009	26.64 (0.13)	14.98 (0.36)	16.31 (0.05)	26.47 (0.26)
2010	25.49 (0.14)	10.98 (0.55)	14.00 (0.26)	11.15 (0.32)
2011	28.36 (0.14)	16.60 (0.19)	4.63 (0.51)	16.39 (0.26)
2012	17.96 (0.14)	9.51 (0.22)	18.10 (0.19)	9.11 (0.27)
2013	17.14 (0.13)	12.64 (0.30)	23.50 (0.19)	13.07 (0.30)
2014	18.82 (0.17)	12.22 (0.22)	30.92 (0.11)	8.50 (0.28)
2015	15.63 (0.18)	9.27 (0.36)	23.61 (0.21)	8.31 (0.33)
2016	18.99 (0.13)	18.60 (0.19)	23.58 (0.10)	9.46 (0.30)
2017	23.94 (0.15)	16.51 (0.17)	24.25 (0.10)	8.13 (0.31)
2018	20.76 (0.14)	13.44 (0.36)	25.08 (0.16)	14.81 (0.27)
2020	-	-	-	-
2021	21.94 (0.13)	15.40 (0.28)	24.00 (0.13)	15.42 (0.23)

Figure 1a: Biomass indices (in terms on the average mass caught per trap) for the surveys for **Tristan**. The means and (and assumed log normal) 95% confidence intervals are shown. The arrow shows the time of the OLIVA incident at Nightingale.

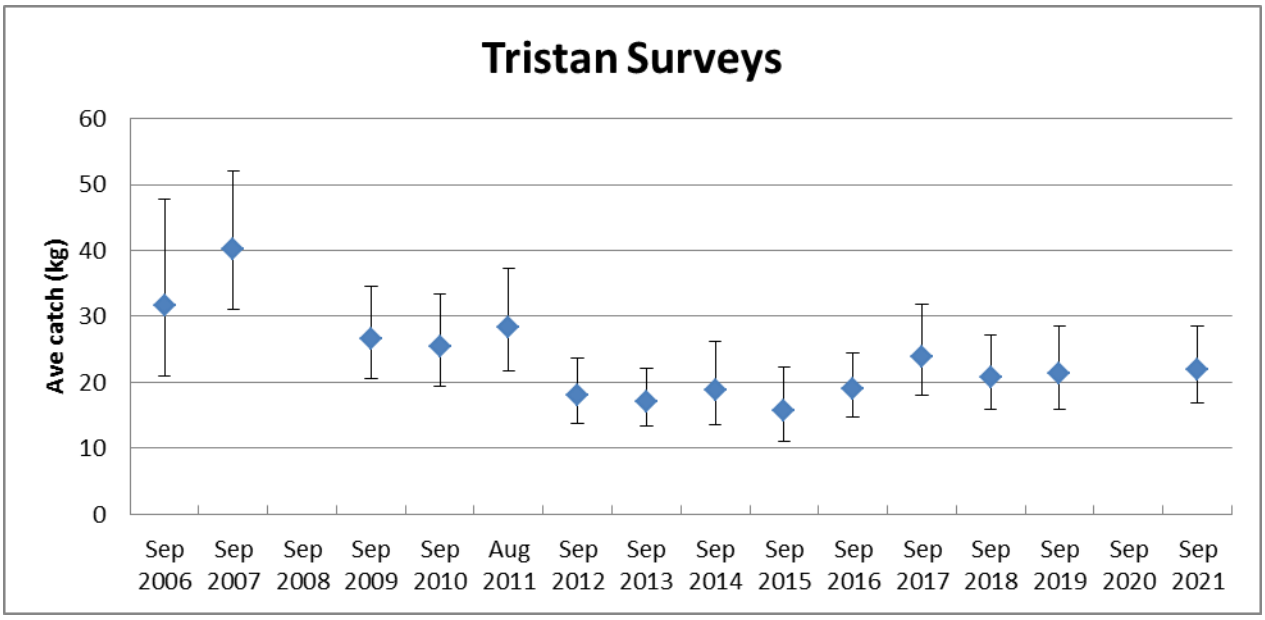

Figure 1b: Biomass indices (in terms on the average mass caught per trap) for the Leg1 surveys for **Inaccessible**. The means and (and assumed log normal) 95% confidence intervals are shown. The arrow shows the time of the OLIVA incident.

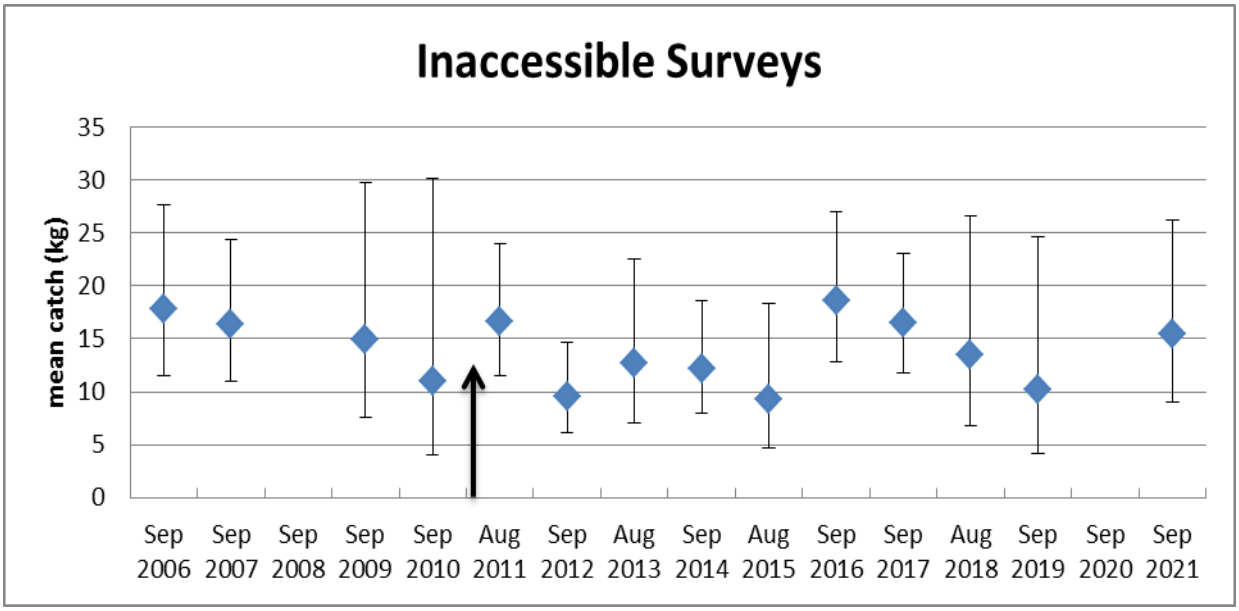

Figure 1c: Biomass indices (in terms on the average mass caught per trap) for the surveys for **Nightingale**. The means and (and assumed log normal) 95% confidence intervals are shown. The arrow shows the time of the OLIVA incident.

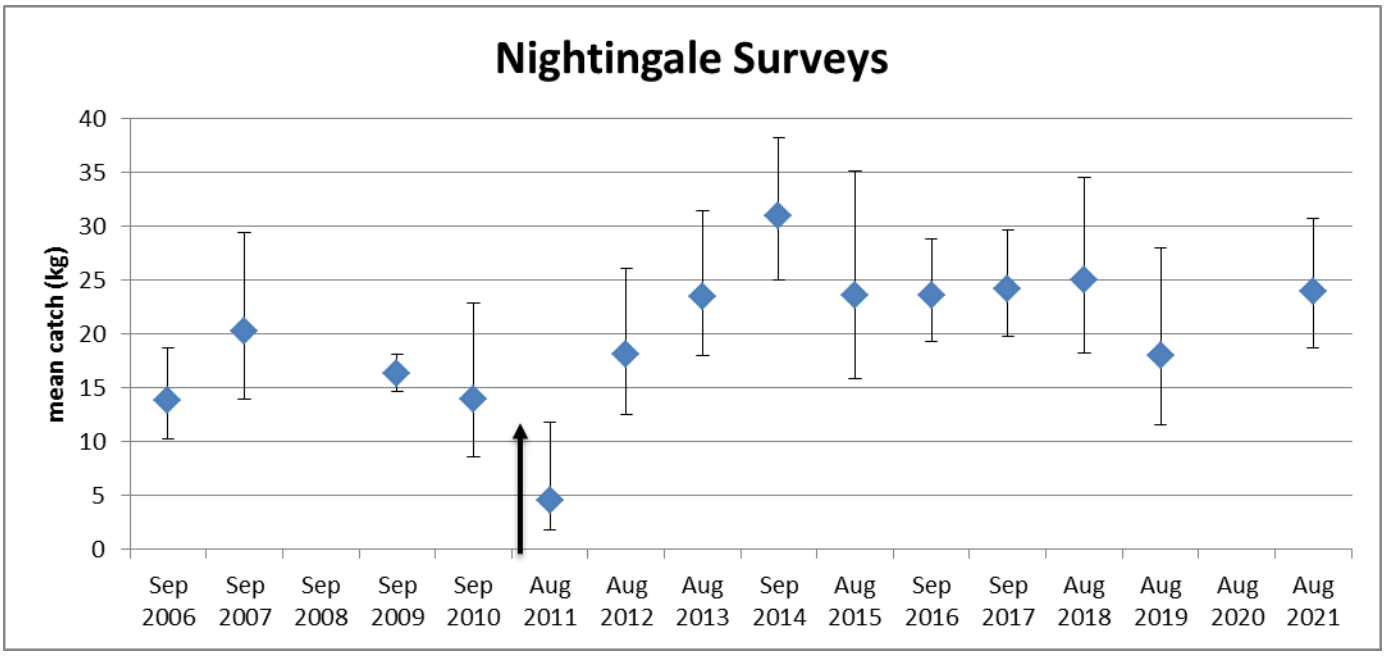

Figure 1d: Biomass indices (in terms on the average mass caught per trap) for the surveys for **Gough**. The means and (and assumed log normal) 95% confidence intervals are shown.

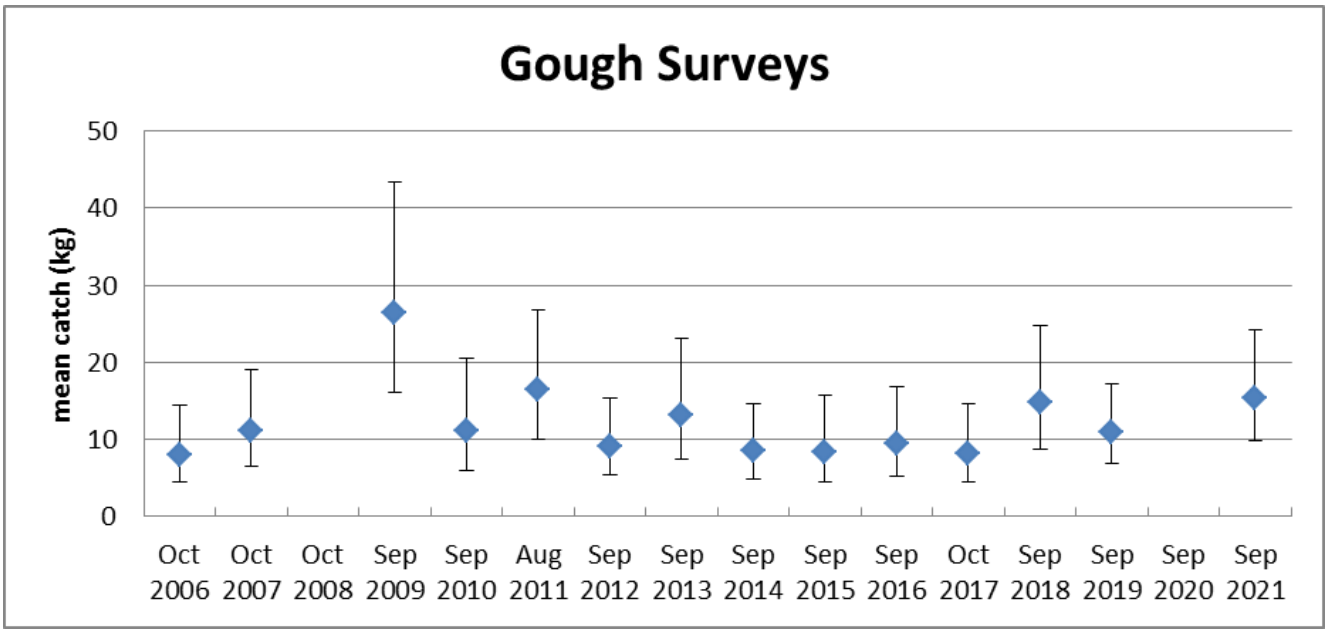

Figure 2a: **Tristan** catch-at-length proportions for males (LHS) and females (RHS) for the surveys. Proportions here sum to 1.0 separately for each sex. The smallest and largest size categories are minus- and plus-groups respectively.

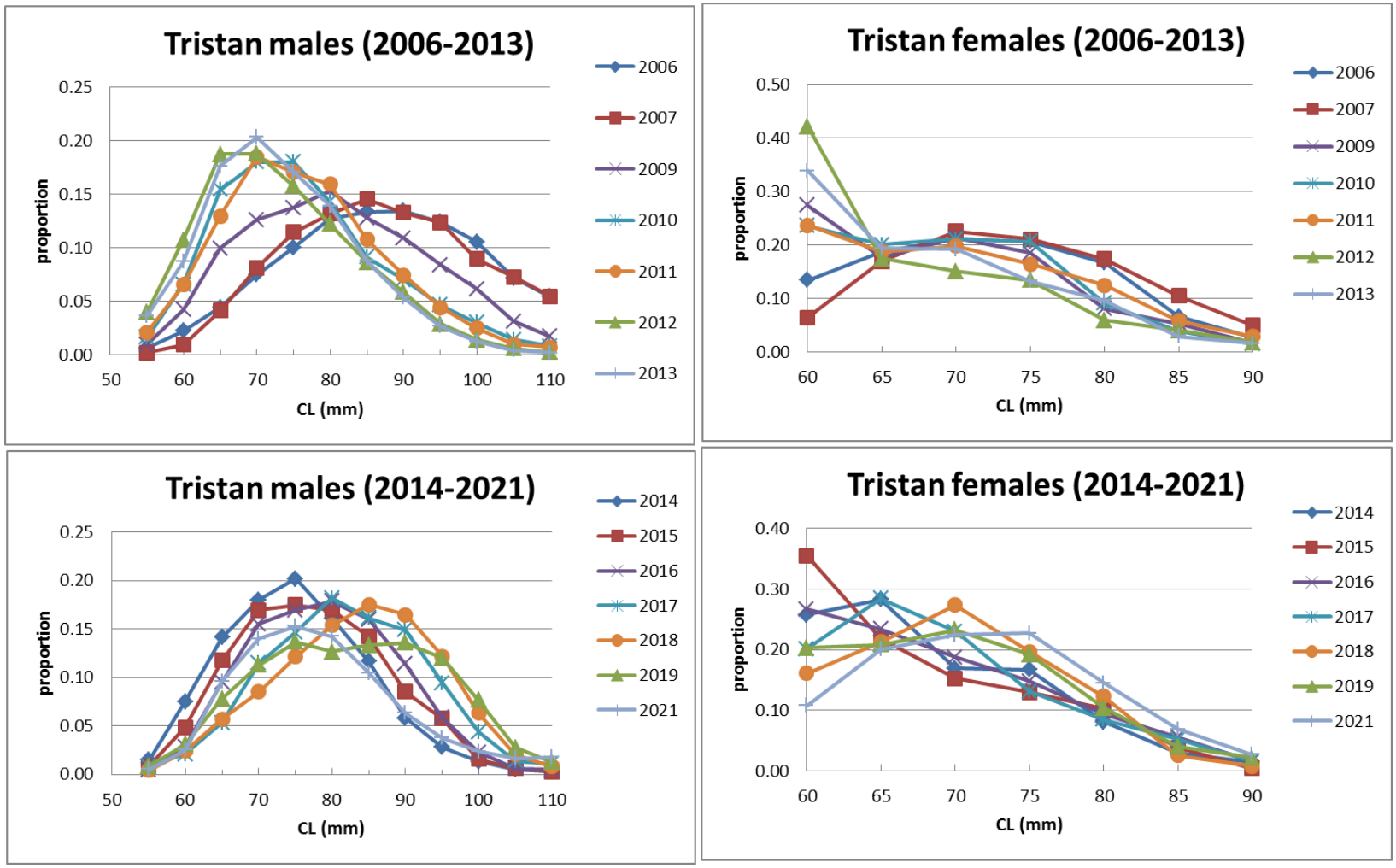

Figure 2b: **Inaccessible** catch-at-length proportions for males (LHS) and females (RHS) for the surveys. Proportions here sum to 1.0 separately for each sex. The smallest and largest size categories are minus- and plus-groups respectively.

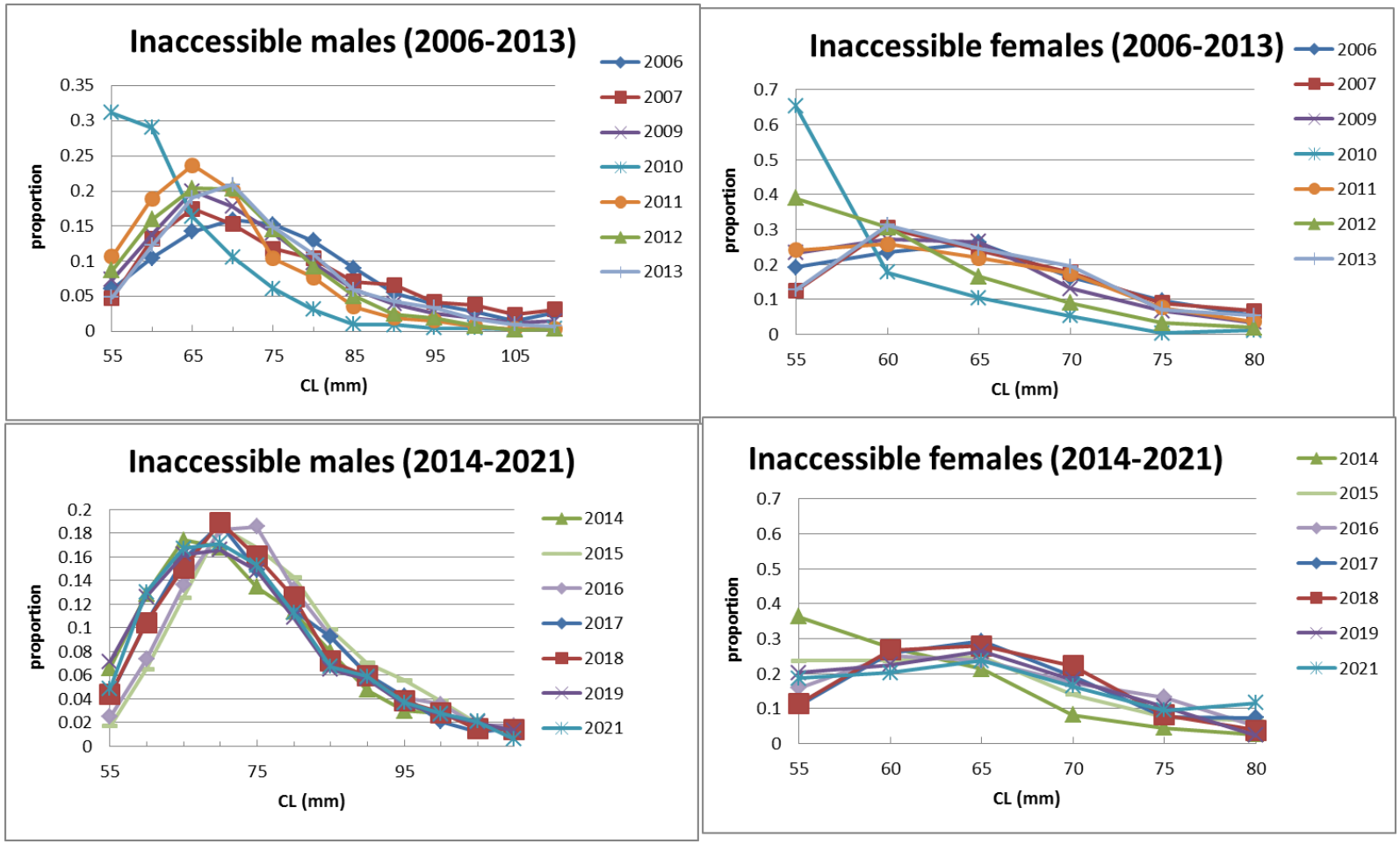

Figure 2c: **Nightingale** catch-at-length proportions for males (left) and females (right) for the surveys. Proportions here sum to 1.0 separately for each sex. The smallest and largest size categories are minus- and plus-groups respectively.

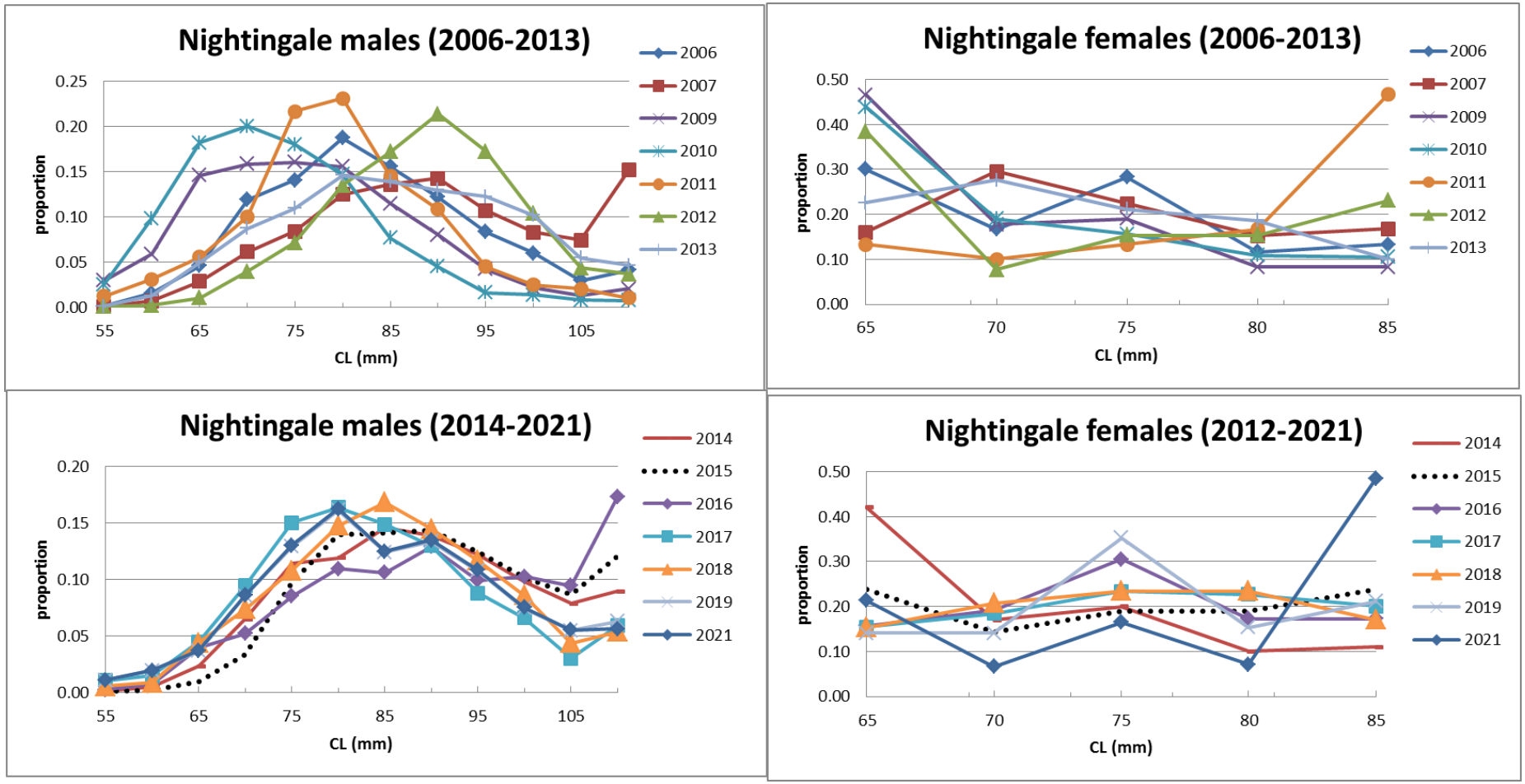

Figure 2d: **Gough** catch-at-length proportions for males (LHS) and females (RHS) for the surveys. Proportions here sum to 1.0 separately for each sex. The smallest and largest size categories are minus- and plus-groups respectively.

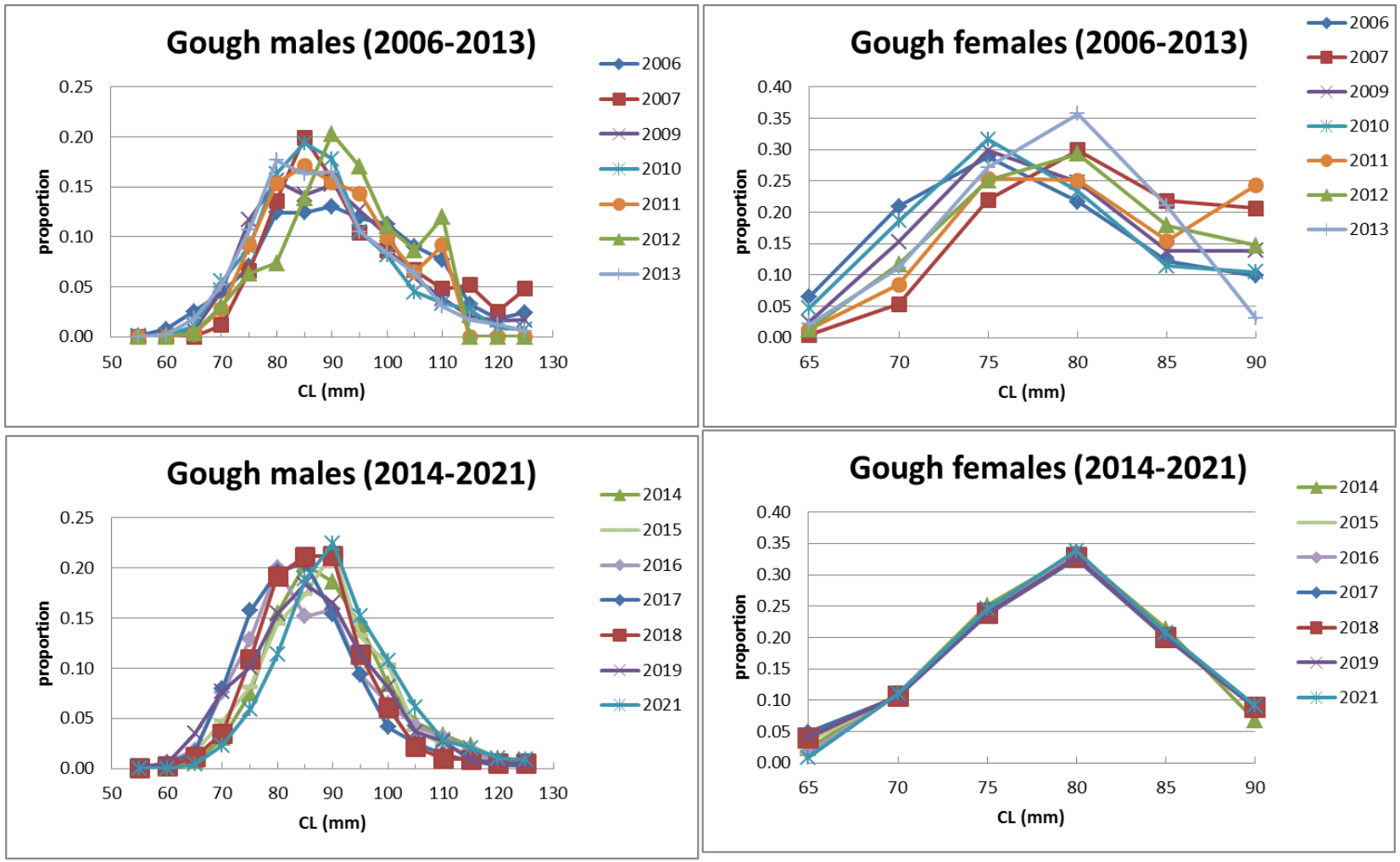

Figure 3a: Mean carapace length length of survey catch at **Tristan** (for both sexes combined).

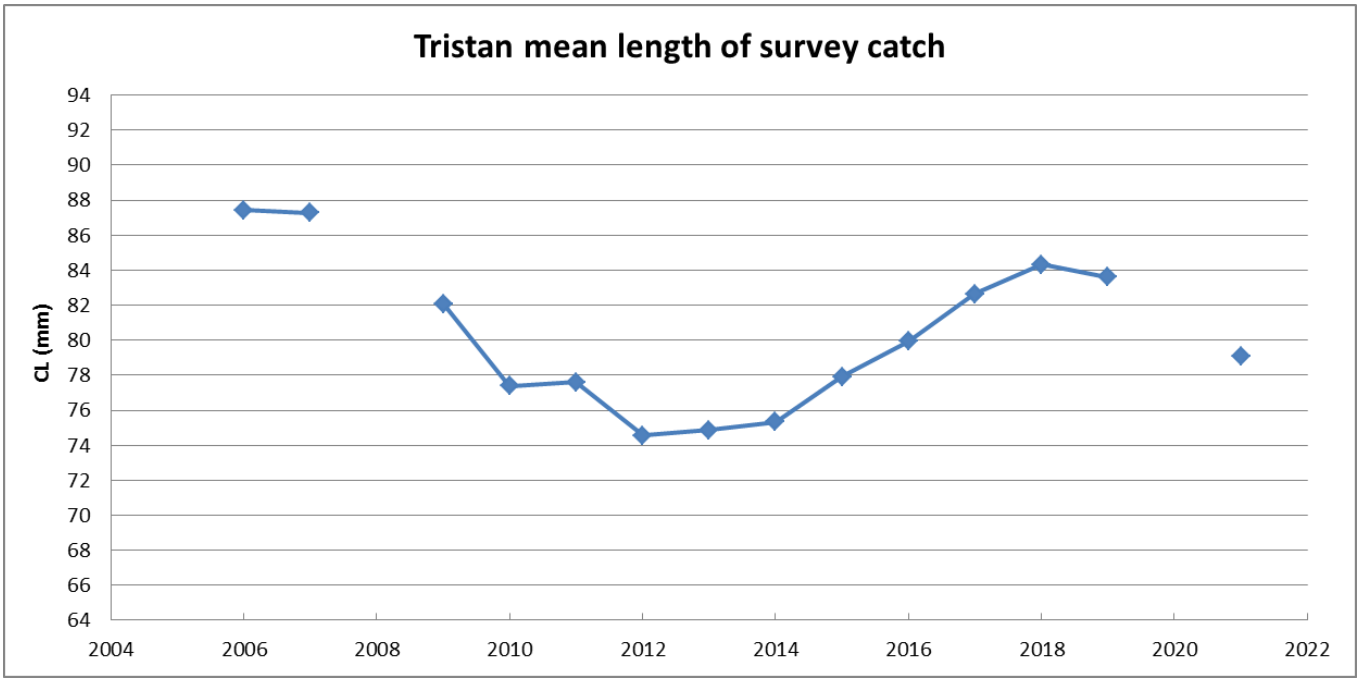

Figure 3b: Mean carapace length length of survey catch at **Inaccessible** (for both sexes combined)**.**

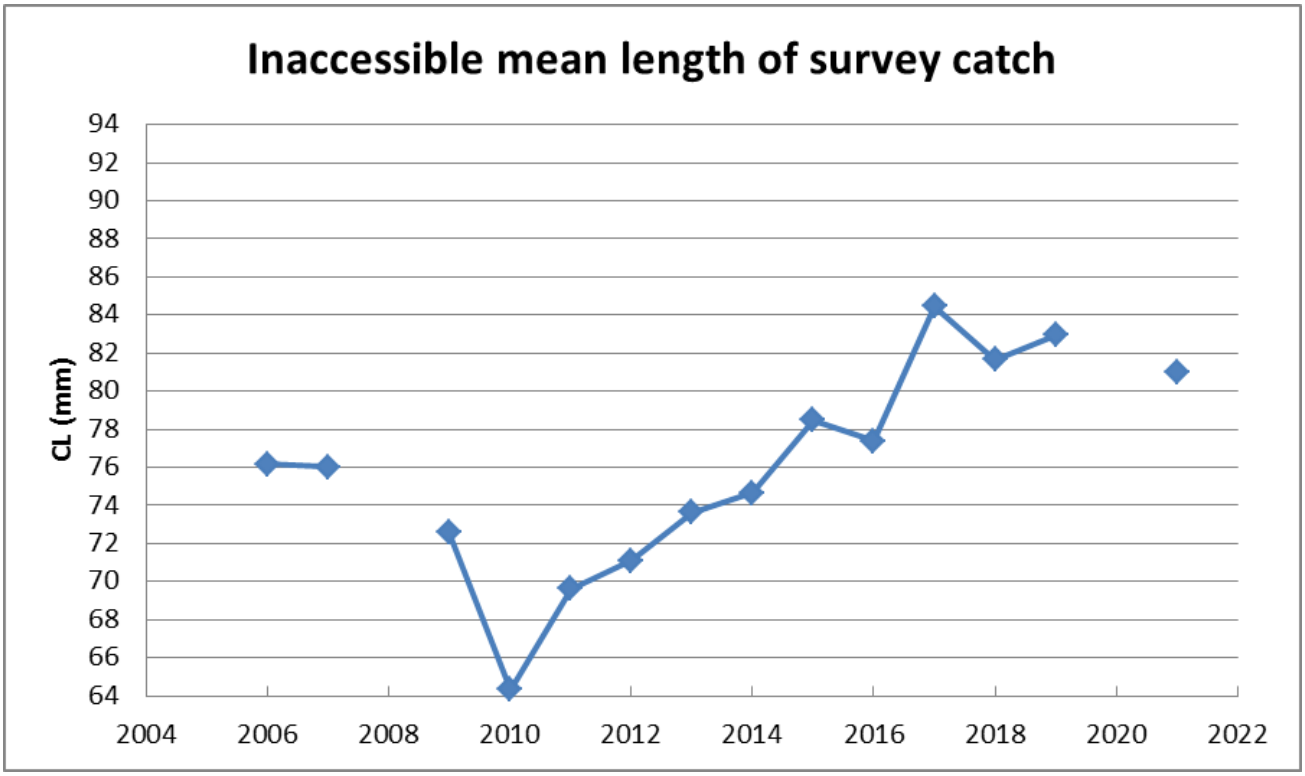

Figure 3c: Mean carapace length length of survey catch at **Nightingale** (for both sexes combined).

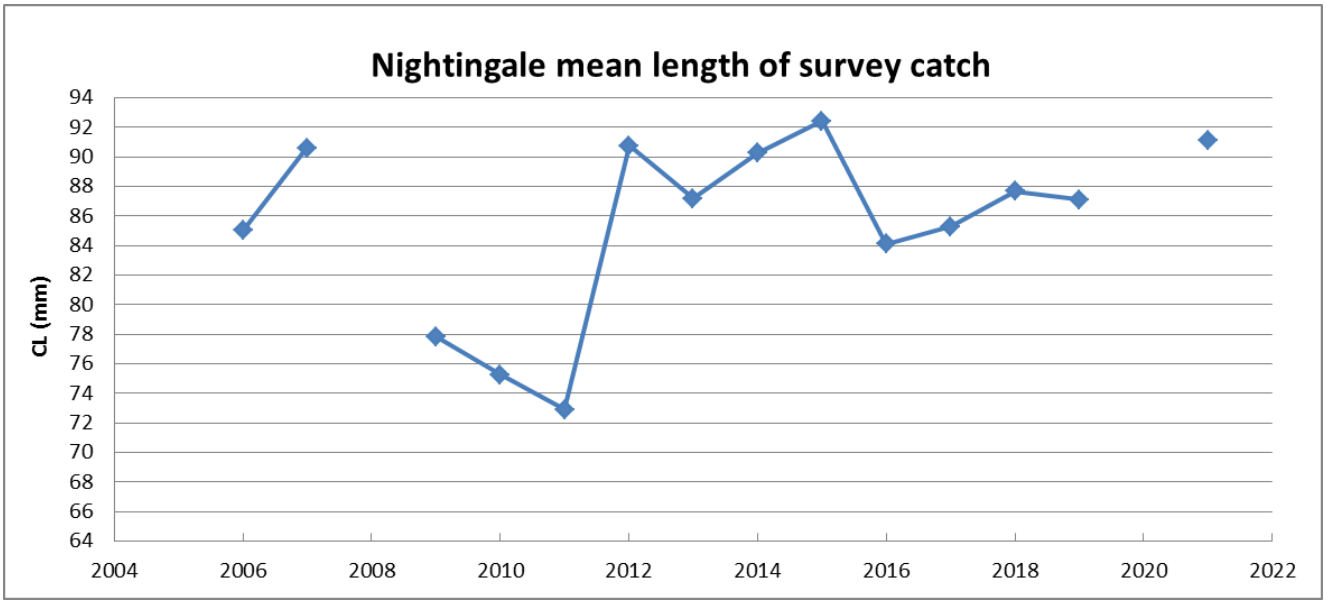

Figure 3d: Mean carapace length length of survey catch at **Gough** (for both sexes combined).

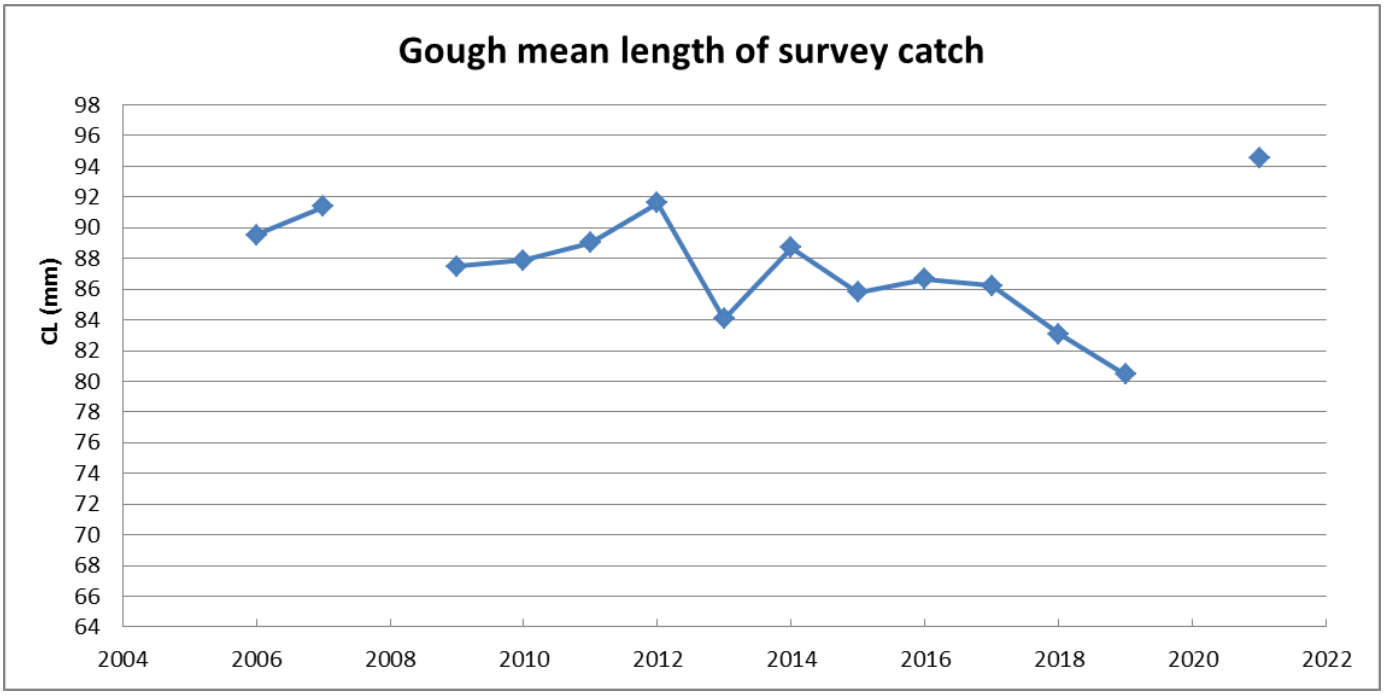

Figure 4a: Percentage females in the Tristan surveys.

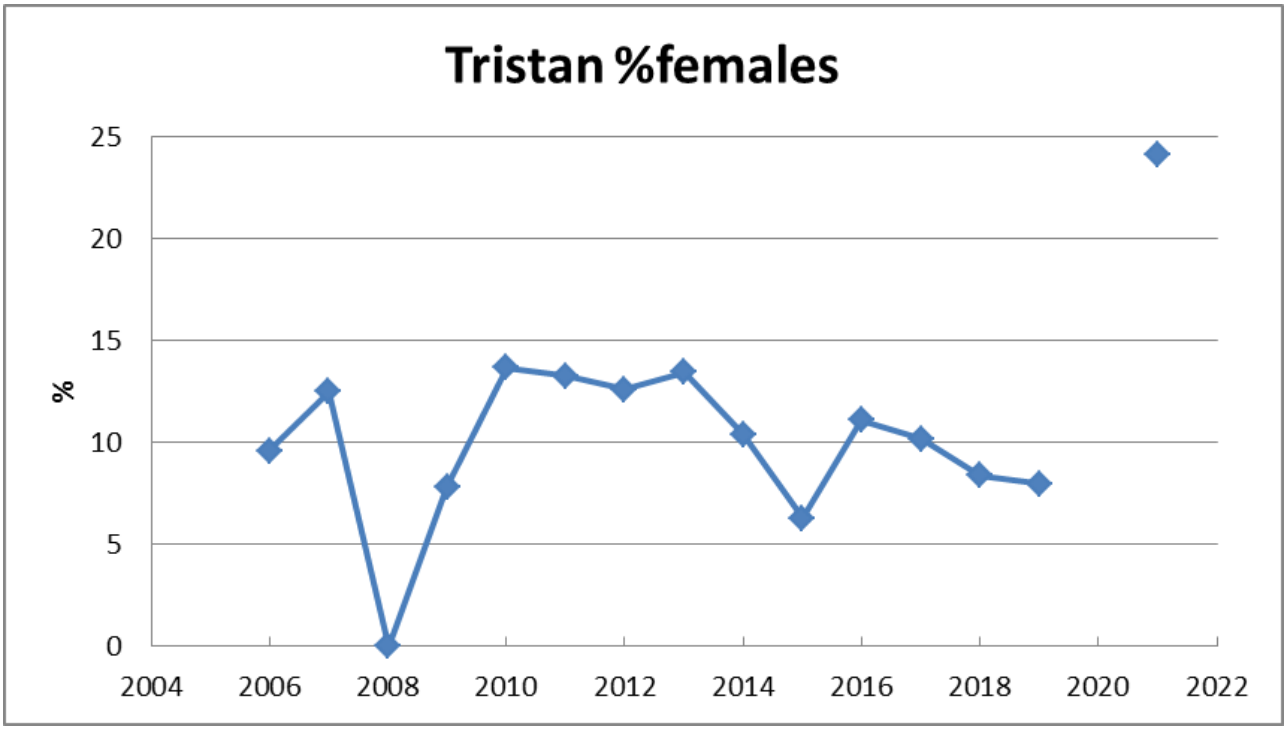

Figure 4b: Percentage females in the Inaccessible surveys.

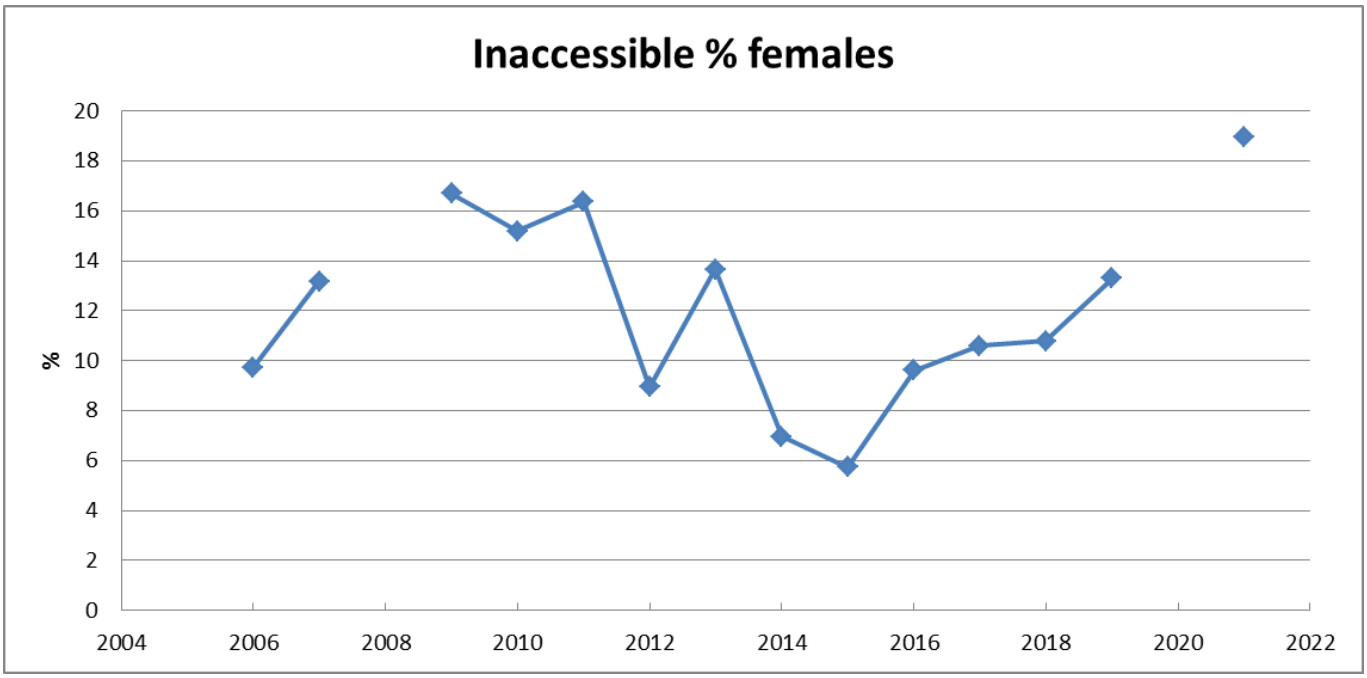

Figure 4c: Percentage females in the Nightingale surveys.

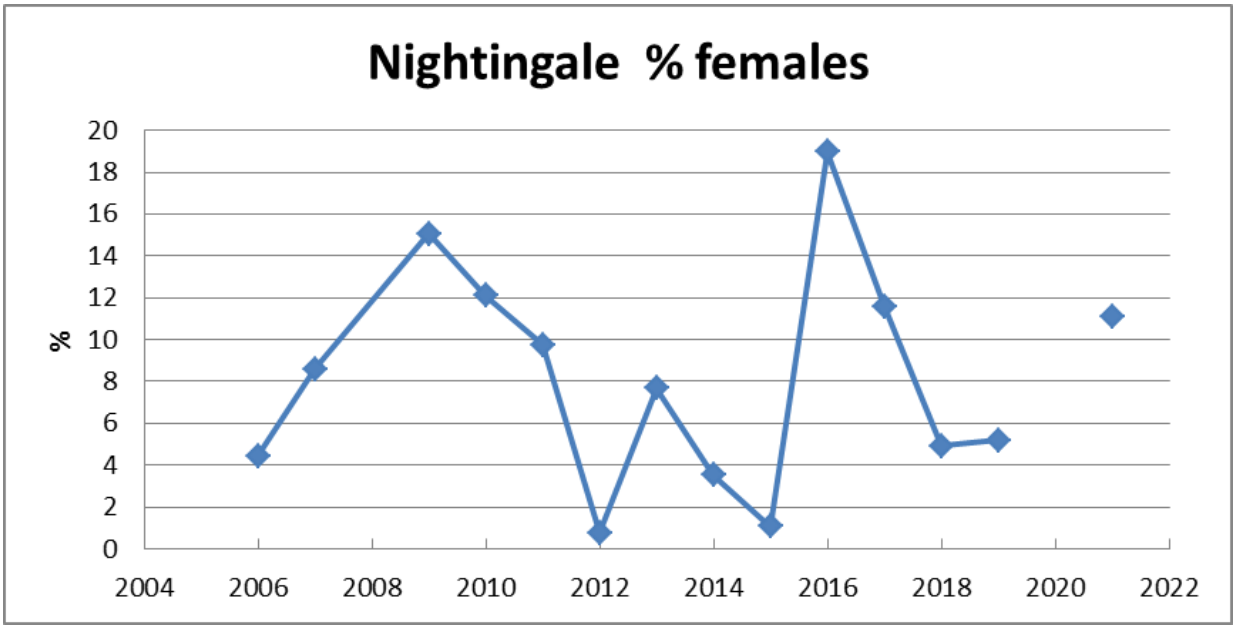

Figure 4d: Percentage females in the Gough surveys.