Albatross Research

Gibson's wandering albatross population study 2014/15

Draft report on CSP Project 4627, prepared for

Department of Conservation

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1. EXECUTIVE SUMMARY

This report presents population data on Gibson's wandering albatross collected on Adams Island during the summer of 2014-15. Similar data has been collected every summer since 1991.

Demographic data is collected from birds nesting and visiting a 61ha study area on the southern slopes of Adams Island. All chicks and nesting birds are banded and all band re-sightings are recorded. The identity of all nesting birds is determined and the success of every nest from the previous year judged. The same methods have been used since 1995.

The number of nesting birds in three areas which comprise about 12% of the population was counted.

Geolocator loggers were retrieved from 7 birds, the data recovered, and the loggers deployed on 7 new birds.

This year's data shows no significant improvement over the poor population performance recorded since 2005.

Gibson's wandering albatross (*Diomedea gibsoni*) productivity and recruitment and the number of birds breeding in the study area on Adams Island in 2014/15 were all lower than they had been in the previous two years. Ground counts of birds nesting in 3 representative blocks on Adams Island were also lower than in the previous two years.

2. INTRODUCTION

Gibson's wandering albatrosses (*Diomedea gibsoni*) are endemic to the Auckland Island archipelago, with approximately 95% of the population breeding on Adams Island, the southern-most island in the group. They forage largely in the Tasman Sea, but also along the continental shelf off southern and south eastern Australia, and off eastern New Zealand (Walker & Elliott 2006). The population has been in decline, and is listed as 'Nationally Critical' in the Department of Conservation's threat ranking (Robertson et al. 2012).

Due to the vulnerability of this long-lived, slow-breeding albatross to accidental capture in commercial surface long-line fisheries, their survival, productivity, recruitment and population trends have been monitored during almost annual visits to Adams Island since 1991. In the 1990's the population slowly increased following a major, presumably fisheries-induced, decline during the 1980's (Walker & Elliott 1999). However, between 2005 and 2008 there was a sudden drop of more than 40% in the size of the breeding population, from which recovery has been very slow. The Gibson's wandering albatross population is now only about two-thirds of its estimated size in 2004, having lost all the gains slowly made through the 1990's.

In 2014/15 Albatross Research was contracted by the Conservation Services Programme (CSP) of the Department of Conservation to collect information on the size and trend of the Gibson's wandering albatross population, and those population parameters (survival, productivity and recruitment) key to modelling and understanding the species conservation status. In addition, Albatross Research undertook to collect on their own behalf further information on the foraging range of this species to investigate potential at-sea causes of any changes in this species status.

A second component of the contract to CSP was to undertake research to find a suitable method for a whole-population census of Gibson's wandering albatross. As part of this, while on Adams Island we undertook some preliminary fieldwork investigating the likely accuracy of aerial nest counts of Gibson's wandering albatross, but this work is described in a separate report (Walker & Elliott 2015).

This report summarises the most recent findings on the current status of Gibson's wandering albatrosses, collected during the 2014/15 summer, and is the third in a series of similar annual reports on a ground-based study of population size, trends and key population parameters (Elliott & Walker 2013, Elliott & Walker 2014).

3. OBJECTIVES

The specific objectives of this project were:

1. To estimate the size and trend of the Gibson's wandering albatross population at the Auckland Islands;

2. To estimate the adult survival, productivity and recruitment of Gibson's wandering albatrosses at the Auckland Islands;

3. To record the foraging flights of a sample of birds in order to monitor possible changes associated with the changing population dynamics.

4. METHODS

Counting nests

Since 1998, all the nests in three areas (Figure 1) have been counted each year. The three areas support about 12% of the Adams Island albatross breeding population and represent high (Fly Square), medium (Astrolabe to Amherst including the mark-recapture study area) and low (Rhys's Ridge) density nesting habitat.

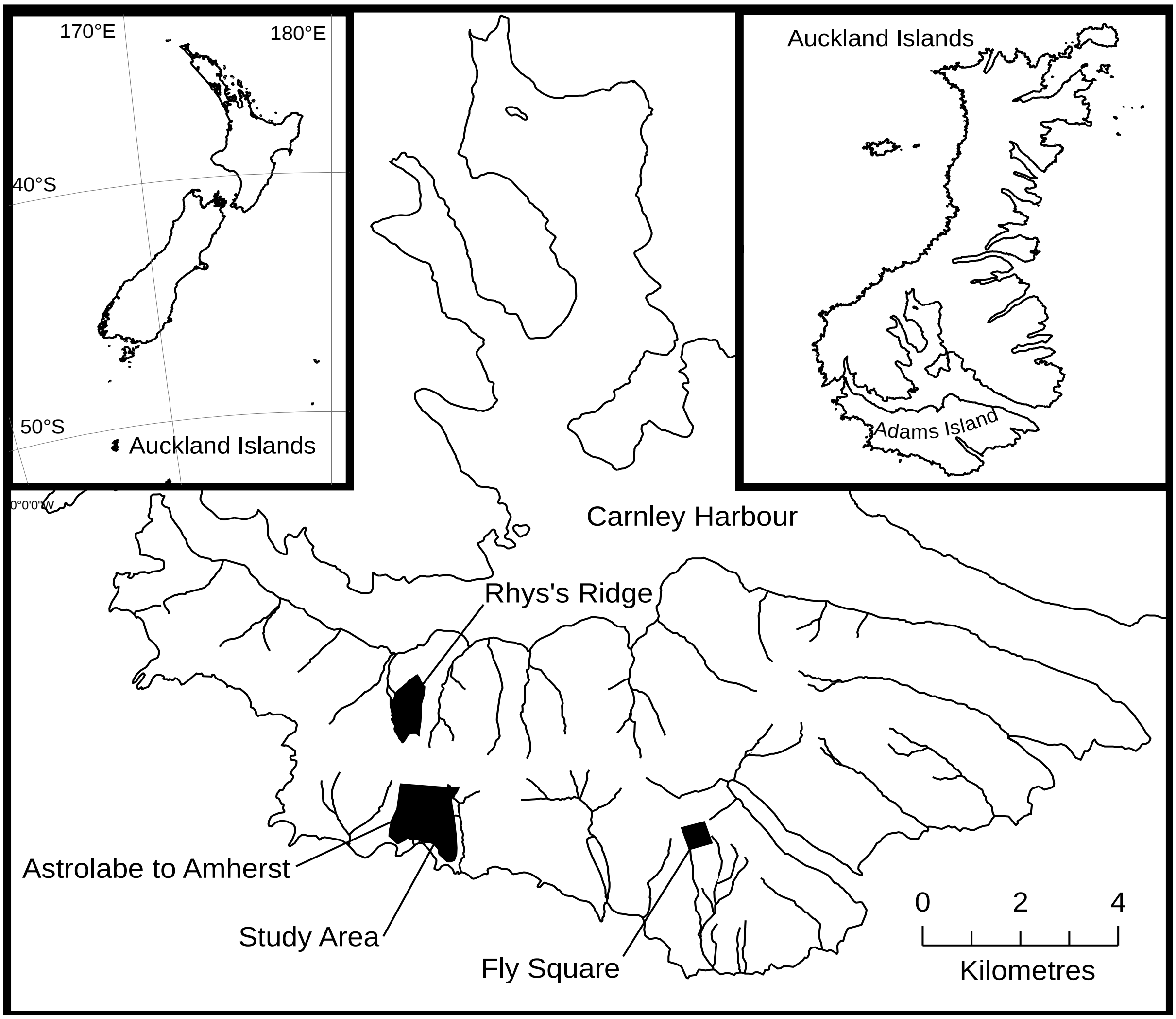

Figure 1: Adams Island, showing the Study Area (black) and the three larger areas in which annual counts of breeders have been made (shaded): Amherst to Astrolabe (162 ha, including the Study Area); Rhys's Ridge (67 ha); and Fly Square (25 ha).

Counts are carried out just after the completion of laying. A strip search method is used where two observers walk back and forth across the area to be counted about 25m apart and count all the nests with eggs in their strip. Up until 2003 the edge of strips was marked with spray paint but since 2004 the boundaries of strips are presented on maps on GPS devices. Every bird on a nest is checked for the presence of an egg, and each nest found with an egg is marked with spray paint and counted. All non-breeding birds on the ground are also counted, and they and most breeding birds on eggs are checked for bands, the number and location of which are recorded. Once the whole block has been counted, the accuracy of the census is checked by walking straight transects at right angles to the strips, checking all nests within 10-15 m of the transect for paint marks indicating the nest has been counted.

Mark-recapture study

Each year since 1991 a 61ha study area on Adams Island (Figure 1) has been visited repeatedly to band nesting birds and record the band numbers of already banded birds. All birds found nesting within the study area have been banded with numbered metal bands and since 1997 with large, individually numbered brightly coloured plastic bands. Since 1994, every cohort of chicks produced within the study area has been metal-banded, and from 1996 colour-banded, just before they fledged.

In addition, areas within a kilometre of the study area are visited less frequently and any bands seen on nesting or non-nesting birds are recorded.

Survival of birds in the study area is estimated with maximum likelihood mark-recapture statistical methods using the statistical software M-Surge (Choquet *et al.* 2005). For the models used in M-Surge, adult birds are categorised by sex and by breeding status: non-breeders, successful breeders, failed breeders and sabbatical birds taking a year off after a successful breeding attempt. Birds in each of these classes have very different probabilities of being seen on the island but similar survival rates, so the models estimate re-sighting probabilities separately for each class, but survival is estimated separately for only males and females.

Population size is estimated by multiplying the actual counts of birds in each class by its estimated re-sighting probability. The survival estimates assume no emigration which is appropriate because wandering albatrosses have strong nest site fidelity, a pair's separate nesting attempts are rarely more than a few hundred metres apart, and birds nesting at new sites within a few hundred metres of the study area are detected during the census of surrounding country (Walker & Elliott 2005).

Changes in the at-sea distribution of Gibson's wandering albatrosses

Since 2009 we have been attaching and retrieving geolocator dataloggers to Gibson's wandering albatrosses to compare the foraging locations when the population was declining from its 2004 highpoint, with those used a decade earlier when it was growing.

Locations of the birds were calculated from the light data using BASTRak, TransEdit and BirdTracker software supplied by British Antarctic Survey (Fox 2007). More "reasonable" flight paths were obtained when we used estimated longitude from the logger's light data, and estimated latitude by matching the sea temperature data recorded by the logger with the nearest sea-surface temperature at the estimated longitude. We used monthly sea-surface temperature data available from http://dss.ucar.edu.

We used kernel density plots to compare tracking data collected using geolocator loggers between 2009 and 2014 with data obtained from satellite transmitters between 1994 and 2003. Kernels were estimated using the function kde2d in the MASS package (Venables & Ripley, 2002) in the statistical language R (R Development Core Team, 2011). We used bivariate normal kernels, with a normal reference bandwidth (Venables & Ripley, 2002). Longitudes were transformed by the cosine of latitude to make units of latitude and longitude approximately equal.

5. RESULTS

Nest counts

The three blocks in which nests have been counted since 1998 were counted again in late January 2015. The slow improvement in numbers which we suggested was underway in our last report (Elliott & Walker 2014), was not evident in 2015 (Table 1, Figure 2).

Table 1: The number of Gibson's wandering albatross nests in late January in three census blocks on Adams Island in the Auckland Islands group in 1998-2015.

Year	Rhys's Ridge (low density)	Amherst-Astrolabe (medium density)	Fly Square (high density)	Total number of nests
1998	60	483	248	781
1999	60	446	237	743
2000	45	284	159	488
2001	64	410	201	675
2002	60	408	246	675
2003	71	496	217	784
2004	77	501	284	862
2005	34	323	72	412
2006	15	185	79	279
2007	38	230	132	400
2008	26	201	91	318
2009	28	238	120	386
2010	32	237	114	383
2011	33	255	137	425
2012	35	224	120	379
2013	39	315	138	492
2014	29	267	134	430
2015	39	237	105	381

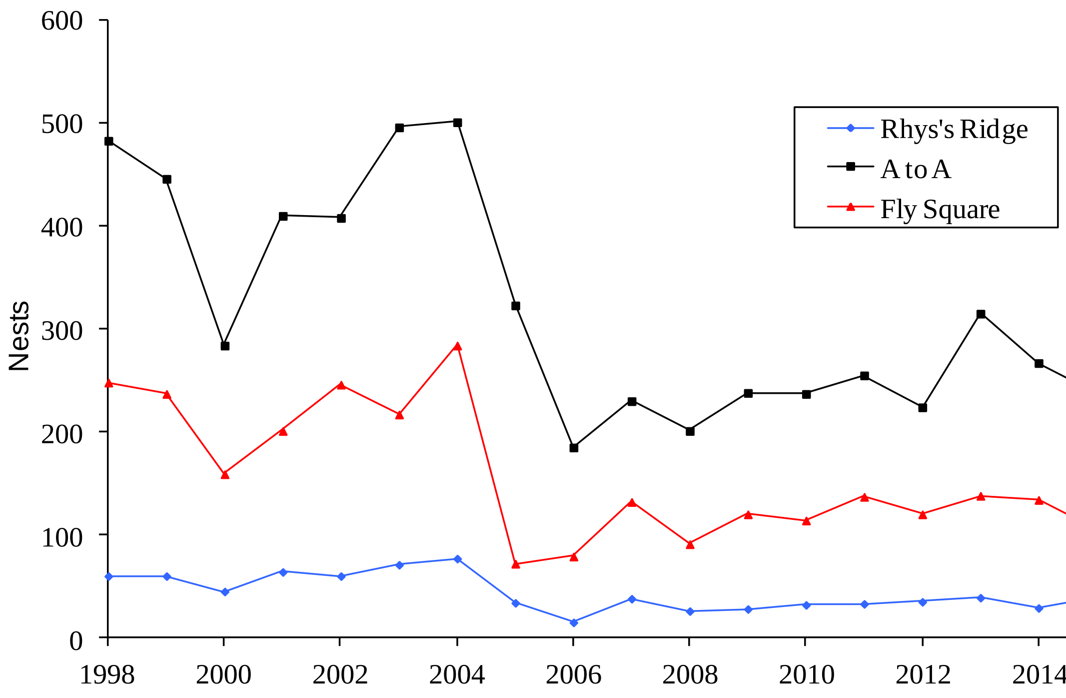

Figure 2. The number of Gibson's wandering albatross nests in late January in three census blocks on Adams Island 1998- 2015.

Total number of nests on the island

From the ratio between the number of nests in our census blocks and the total number of nests counted in all blocks on the Auckland Islands in 1997 (Walker & Elliott, 1999) we can estimate the total number of pairs each year which bred on the Auckland Islands (Table 2).

Table 2: Estimated number of pairs of Gibson's wandering albatross nesting on the Auckland Islands. Estimates are derived from the numbers of nests counted in 3 representative census blocks and the proportion of the total number of nests that were counted in these blocks in 1997.

Year	1991	1993	1994	1995	1997	1998	1999	2000	2001	2002	2003
Pairs	4964	5270	4826	6678	7417	7883	7499	4926	6813	6813	7913

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Pairs	8701	4158	2816	4037	3210	3896	3866	4290	3825	4966	4340	3845

Population size estimate from mark/recapture

The number of breeding birds in the study area estimated by mark-recapture was increasing up until 2005, but since then the population has declined with females declining more steeply and erratically than males (Figure 3).

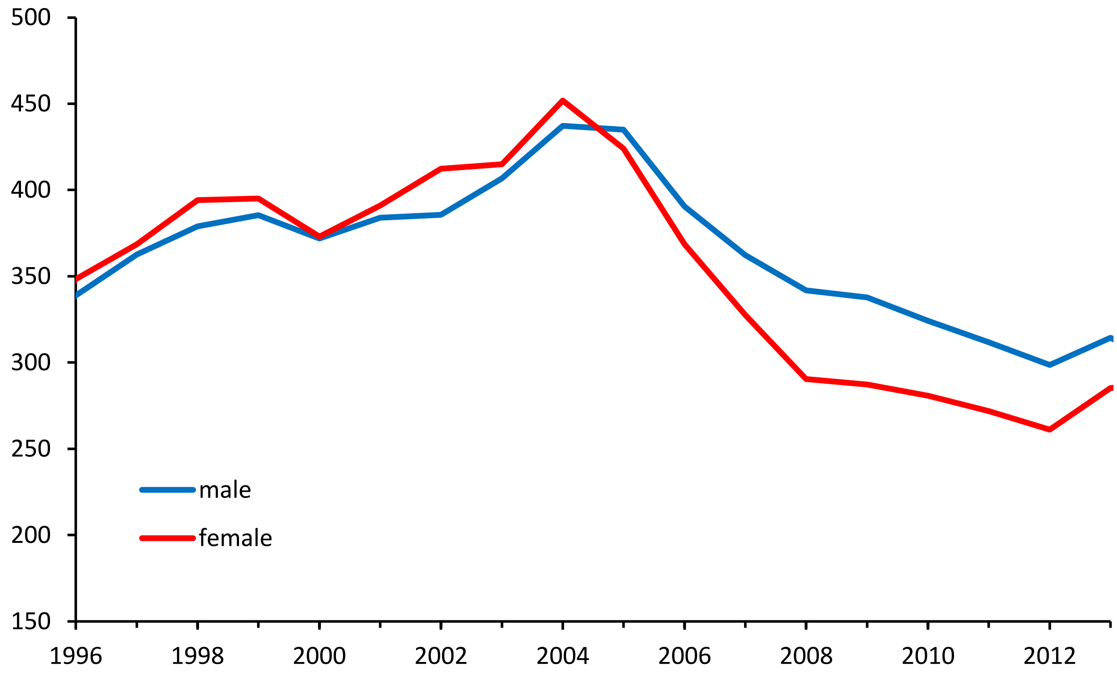

Figure 3. The number of breeding birds in the study area on Adams Island estimated by mark-recapture.

Using the modelling techniques of Francis *et al.* (2012) it is possible to estimate the size of the total population including pre-breeding birds (as opposed to the total number of breeders) but this is beyond the scope of this report.

Survivorship

Data gathered over the 2014/15 summer allowed survival during 2014 to be estimated but since the survival estimates for the last two years for biennially breeding birds invariably have very large confidence intervals, we present results only up to 2013 (Figure 4).

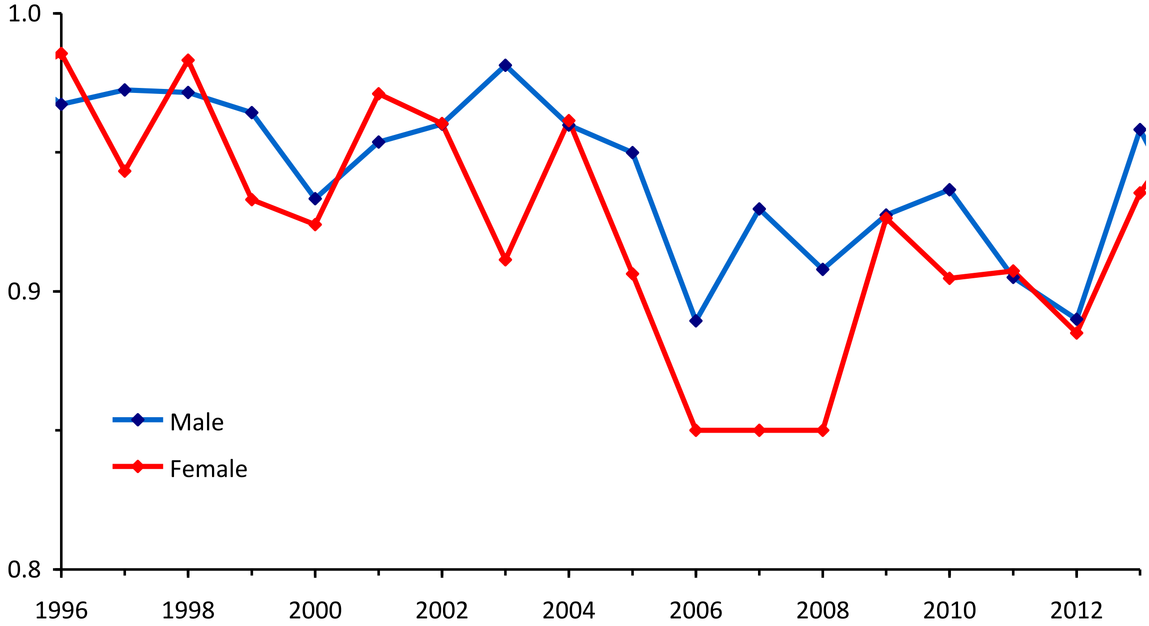

Figure 4. Annual survival of birds in the study area on Adams Island estimated by mark-recapture.

Nesting success and productivity

Nesting success in 2014 was lower than the past 3 years at 31%, with 40 chicks fledging (Figure 5).

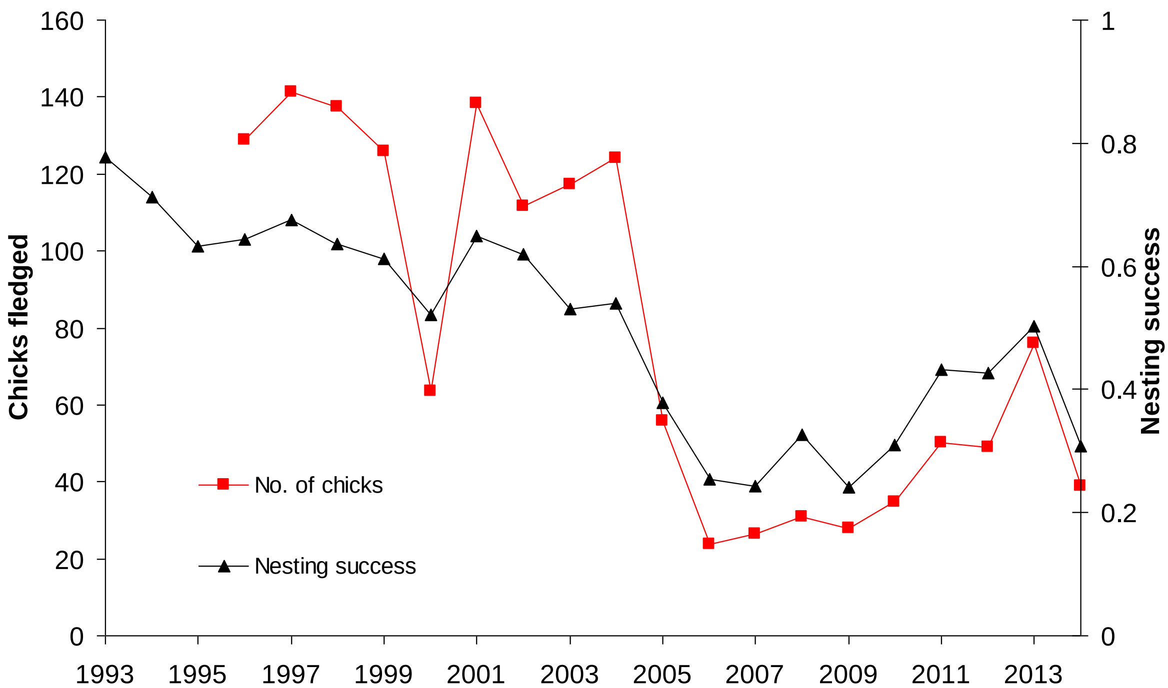

Figure 5: Nesting success and the number of chicks fledged from the study area on Adams Island

Recruitment

The number of birds breeding for the first time in the study area had been slowly rising, following

Figure 6 : Number of birds breeding in the study area on Adams Island for the first time for each year since 1996

a big decline in 2006. However, in 2014 recruitment fell again

Changes in the at-sea distribution of Gibson's wandering albatrosses

We retrieved geolocator dataloggers (GLS) and data from 7 birds (4 males, 3 females) in January 2015; 5 GLS had been on birds for 1 year, and 2 had been on for two years. After downloading, the loggers were redeployed on 7 new breeding individuals (4 males and 3 females). So far we have successfully tracked 64 birds using GLS and we have 78 bird-years of tracking data from birds, largely from non-breeding adults (mostly birds which had lost their mate, or failed early in that year's breeding attempt, but also a few successful breeders in their non-breeding "sabbatical" year) (Table 3).

Table 3: Numbers of Gibson's wandering albatrosses at different life history stages tracked using geolocator dataloggers deployed on Adams Island since 2009. The data is in bird-years as some birds were tracked for two years.

Sex	Number of birds	Non-breeders	Breeders
Female	42	37	5
Male	36	33	3

Initially we separated the GLS tracking data from the period 2009-2011 from that collected in 2012-2014, to look for any recent changes in at-sea distribution. However, preliminary analysis found no differences in the earlier and later GLS tracking periods, so all GLS tracking in 2009-2014 was eventually pooled.

We then compared the GLS tracking data collected in 2009-14 from 64 birds with that obtained from 46 birds tracked with satellite tags in 1994 to 2003 (Walker & Elliott 2006) (Table 4).

Table 4: Gibson's wandering albatross tracked by satellite between 1994 and 2003.

Sex	Number of birds	Percentage of fixes	
		Non-breeders	Breeders
Female	23	67	33
Male	23	69	31

Although the pattern of distribution of tracked birds between decades was similar, both males (Figure 7) and females (Figure 8) are foraging further north, and males further south in 2009-14 than they did in 1994-2003. The conspicuously high use of the oceans in the western Great Australian Bight particularly by female non-breeders is continuing (Figure 8), and males and females are still making more use of oceans to the east of New Zealand 14 than they did in 1994-2003 (Figures 7 & 8) and this is most obvious in non-breeding birds.

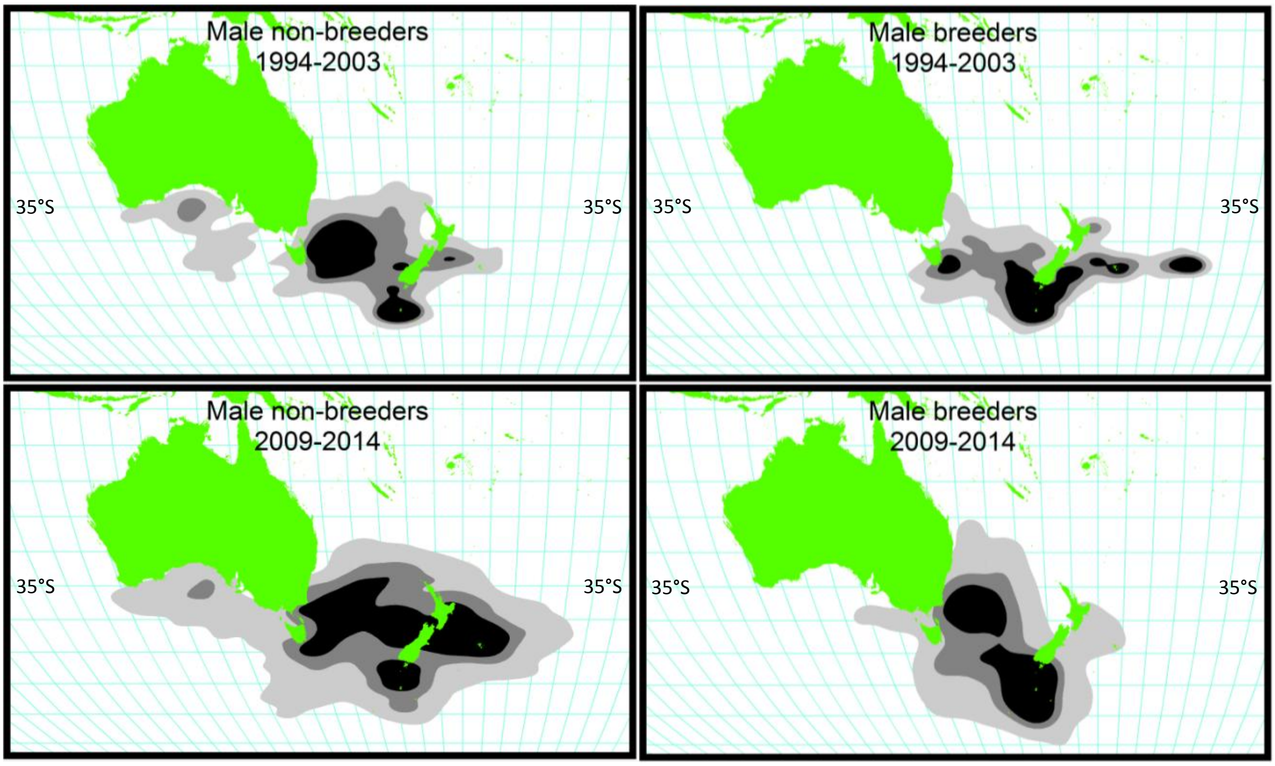

Figure 7: Kernel density plots of male Gibson's wandering albatrosses tracked while breeding and not breeding in 1994-2003 and 2009-2014. Black indicates that 50% contour, dark grey the 75% contour, and light grey the 95% contour.

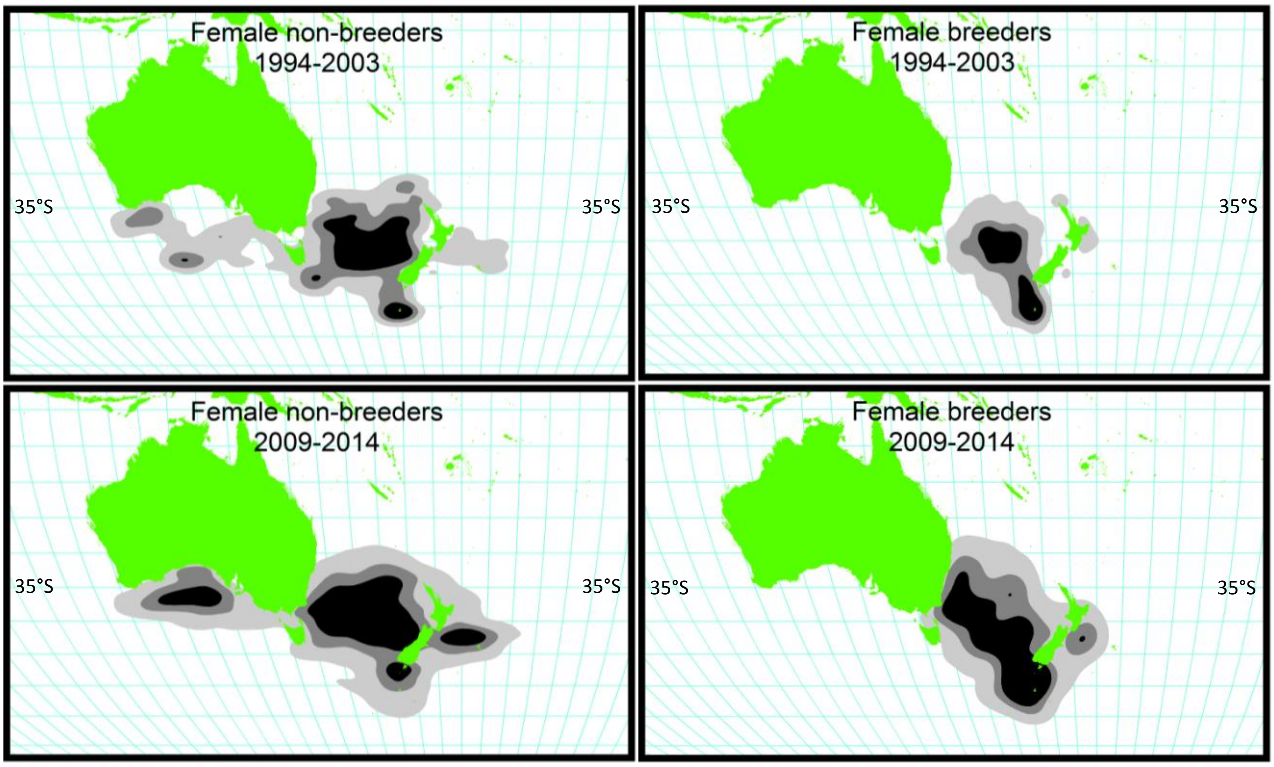

Figure 8: Kernel density plots of female Gibson’s wandering albatrosses tracked while breeding and not breeding in 1994-2003 and 2009-2014. Black indicates that 50% contour, dark grey the 75% contour, and light grey the 95% contour.

6. DISCUSSION

At-sea distribution

We have now tracked more birds with GLS than were tracked with satellite transmitters, so it is possible some of the differences in at-sea distribution pre and post the 2005 population crash described in this report are simply the result of larger sample size in later years. However, this does not seem to be the case, as the patterns recorded in 2009 when only a few birds had been tracked, remain very similar to those recorded in 2014 when a much larger sample of birds have been tracked.

Although we have now tracked the at-sea distribution of a relatively large sample of non-breeding, mostly adult birds, we have only sampled a small number of birds while they were breeding. This is partly because so few birds have been managing to successfully complete a breeding season in the post-crash years 2009-14, and partly because tracking non-breeders who return annually to the breeding grounds where loggers can be retrieved and redeployed on a different individual was considered a more efficient use of the equipment than tracking breeders who take 2 years to return.

With the collected data now heavily biased in favour of non-breeding birds, all GLS deployed in 2015 were attached to breeding birds to help make the sample more representative. However, the battery life of the loggers is nearly exhausted, and we anticipate the flow of information on at-sea distribution of Gibson's wandering albatrosses is nearing an end.

Population trends

Nearly all the population parameters with which one might assess the conservation status of Gibson’s wandering albatross have been below average since the population crash in 2005. Following the low point in 2006, a gradual improvement occurred, and in 2013 survival, recruitment, numbers breeding and productivity, while still below the lowest recorded prior to the crash, were all the highest they had been since the crash. However, this seems to have been a temporary improvement only, with smaller numbers recorded in 2014, and lower numbers again in 2015 breeding, producing chicks and recruiting to the adult population.

Survival estimates and the mark/recapture estimate of the size of the study population lag behind productivity and recruitment estimates by 2 years, as they cannot be accurately measured until enough time has elapsed to be more confident birds are dead rather than simply not attending the breeding grounds. The latest estimates of both presented in this report reflect the 2013 season at the height of the most recent improvement, and are likely to also drop back in subsequent estimates as they follow the falling attendance, productivity and recruitment trends we have recorded over the last 2 years.

There is now a 20 year (1995-2015) dataset of Gibson's wandering albatross population parameters, and it is possible to look for long-term trends that might previously have been obscured by substantial inter-annual variation. Lines fitted to productivity and survival (Figure 9), show significant gradual declines over the past 2 decades (male survival $F_{1,19}$=20.6, P=0.003, female survival $F_{1,19}$=11.6, P<0.001, nesting success $F_{1,21}$ = 39.4, P<0.001)

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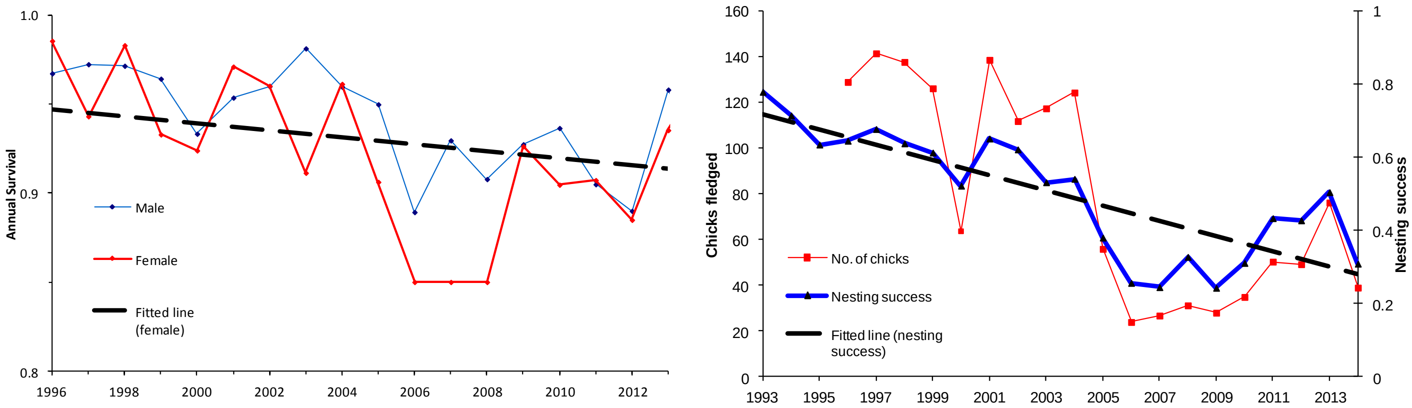

Figure 9: Trend lines fitted to female annual survival (left) and nesting success (right) of Gibson's wandering albatrosses measured in the study area on Adams Island over the last 20 years

To examine whether the changes that have occurred over the last 20 years are best explained by a gradual decline or by a dramatic change in 2005, we used AIC to compare generalised linear models corresponding to 3 explanations for the decline in survival and nesting success. Model 1 modelled a linear decline during the 20 years, model 2 modelled different rates of change before and after 2005, and model 3 modelled different and fixed values before and after 2005 (Table 5). The best models of male survival, female survival and nesting success were models where there was a substantial change in 2005.

Table 5: AIC values for three GLM models of the change in male survival, female survival and nesting success. Model 1 – a linear decline. Model 2 – different rates of change before and after 2005. Model 3 – different and fixed values before and after 2005. The best models are in bold type.

	Model 1	Model 2	Model 3
Male survival	-104.8	-109.9	**-110.6**
Female survival	-78.2	**-95.1**	-83.3
Nesting success	175.1	**159.0**	173.0

Data from the annual census of 3 parts of Adams Island between 1998 and 2015, in which the number of birds on eggs and the number of non-breeding birds on the ground, illustrate the marked change that has occurred since the population crash in 2005. Between 1998 and 2005 about 65% of birds on Adams Island about the end of January were incubating eggs while about 35%were without eggs. Each summer since 2005, at best only 50% of the birds on the breeding grounds are incubating eggs while 50% are not breeding.

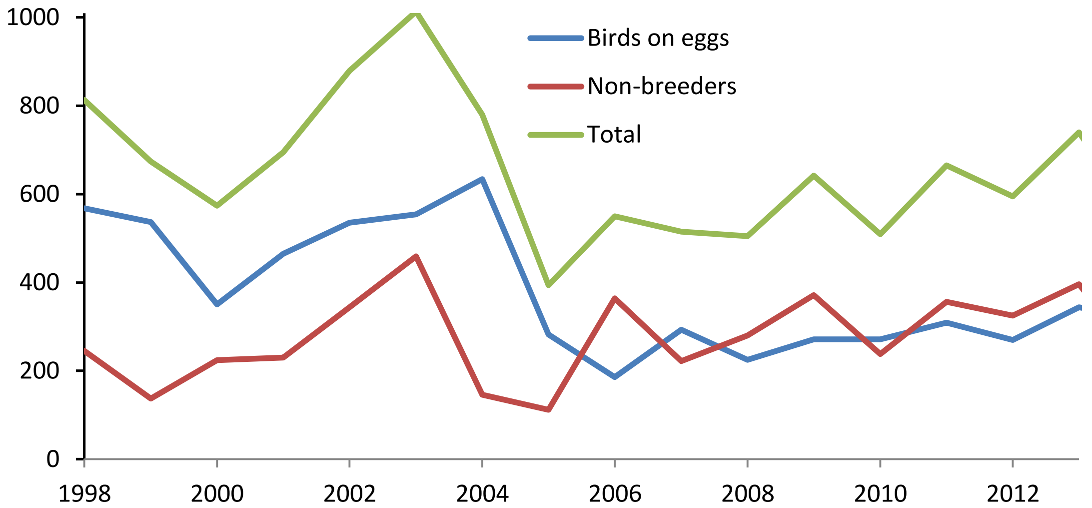

Figure 10: The number of birds on eggs and the number of non-breeding birds on the ground at Rhys's Ridge, Fly Square and Amherst to Astrolabe (excluding the Study Area) on Adams Island during censuses of those blocks in late January and early February in 1998-2015.

The large decline in the ratio of breeders to non-breeders is caused by the sex imbalance since 2005-06 which in turn is caused by the high female mortality since 2005-06. Since 2005-06 we have recorded a large number of males on our study area that are unable to find mates.

Monitoring the population structure of Gibson's wandering albatrosses on Adams Island remains an important conservation priority, as simple numbers of birds alive does not accurately reflect the conservation status of the species.

7. ACKNOWLEDGEMENTS

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