Albatross Research

Gibson's wandering albatross population study and census 2017/18

Draft Report

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Department of Conservation

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1. EXECUTIVE SUMMARY

This report presents data on the size of the Gibson’s wandering albatross nesting population in 2018, and the key demographic parameters of survival, productivity and recruitment which help identify causes of current population size and trends.

Demographic data was collected from birds nesting and visiting a 61-ha study area on the southern slopes of Adams Island. The improvement in nesting success to pre-crash levels noted in 2016 was maintained in 2017, with productivity once again 68%. The survival rate of adult males and females is now similar though it remains below the levels recorded before the 2005 population crash.

The number of birds nesting in three areas representative of high, medium, and low-density breeding sites which comprise about 10% of the population and which have been counted annually since 1998 were re-counted. The numbers of birds nesting in 2018 continued the slow post-crash increase. The total estimated number of breeding pairs of Gibson's wandering albatrosses in February 2018 was 4,829, a bit more than half the number of pairs breeding in 2004 (i.e., 8,728) before the population crashed in 2005.

The number of females choosing to breed is now roughly equal to the number not breeding, as it was before the crash. Nesting success and the proportion of females breeding each year in Gibson's wandering albatrosses appears related to the large-scale patterns of climate variability, particularly the southern oscillation.

With annual mortality a little higher than it used to be, a total population substantially smaller than it used to be and more than a decade of low chick production, population recovery is likely to be slow.

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’ (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 still only about two-thirds of its estimated size in 2004, having lost the gains slowly made through the 1990's.

In 2017/18 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 by ground counting nests in part of Adams Island, and to collect those population parameters (survival, productivity, and recruitment) key to modelling and understanding the species conservation status.

3. OBJECTIVES

The specific objectives of this project were:

1. To estimate the adult survival, productivity and recruitment of Gibson's wandering albatross.
2. To undertake ground counts in 3 census blocks and estimate the population size of Gibson's wandering albatross.
3. To identify any change in the foraging range of Gibson's wandering albatross which might explain current population trends (note this was not part of the CSP contract).

4. METHODS

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. 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. All birds found nesting within the study area have been double-banded with individually numbered metal and large coloured plastic bands, and since 1995, most chicks of every cohort have also been banded. The proportion of chicks that are banded each year depends on the timing of the research field trips which in turn is dependant on the availability of transport. In 22 of the last 28 years researchers have arrived at, or soon after, the time at which the first chicks fledge and more than 90% of the chicks were still present and were banded. In the other six years researchers arrived late and as many as 45% of the chicks had already fledged and were not banded.

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).

Counting nests in 3 representative blocks

Since 1998, all the nests in three areas (Figure 1) have been counted each year. The three areas support about 10% 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.

Counts are carried out between 23–31 January just after the completion of laying, and as close as possible to the same time at each place in each year. A strip search method is used where two observers walk back and forth across the area to be counted, each within a strip about 25 m wide displayed on a GPS, and count all the nests with eggs in their strip. 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.

Counts are corrected to take account of any eggs not laid or any failed nests at the time of counting. These corrections are based on the repeated monitoring of nests in the study area.

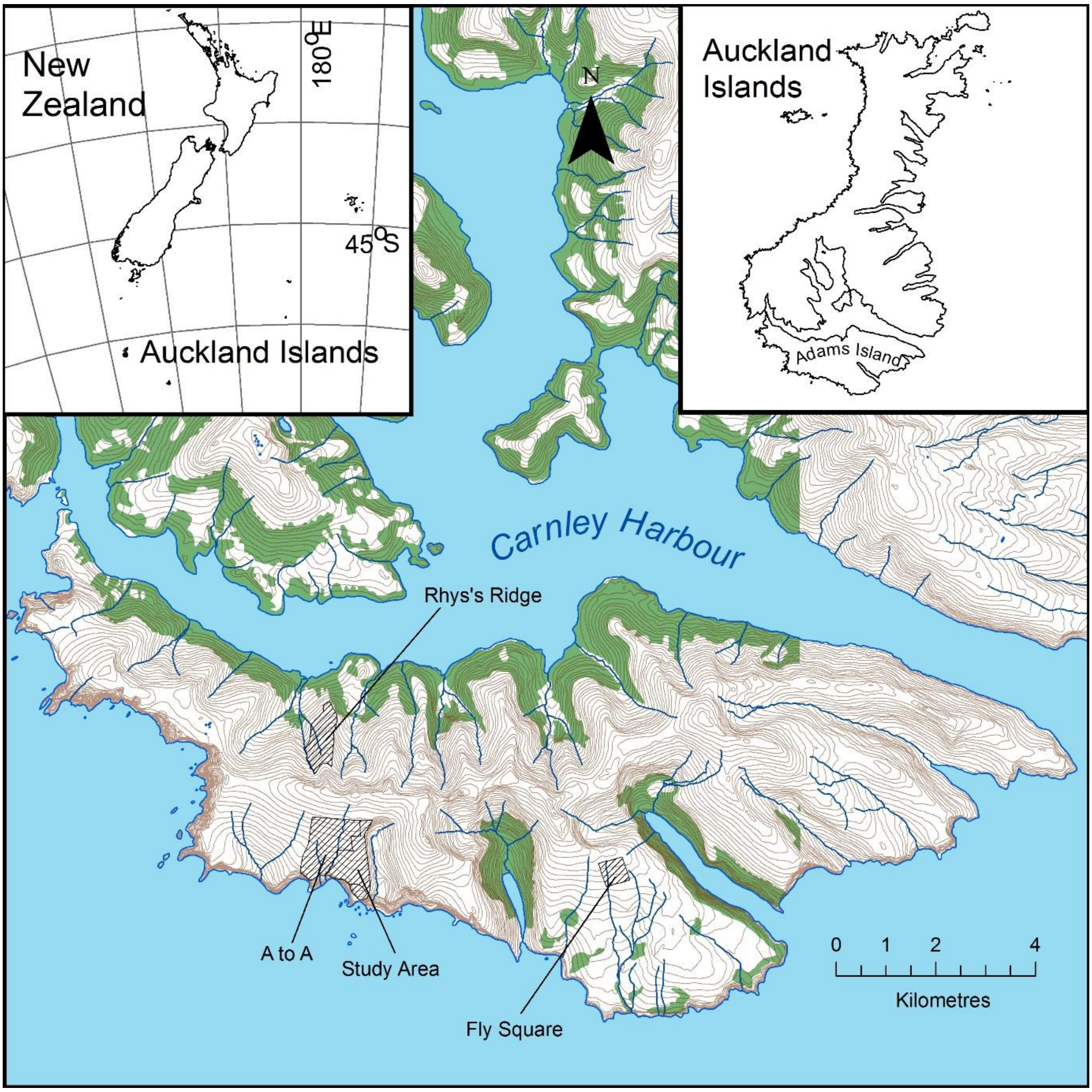

Figure 1: Adams Island, showing the Study Area (61 ha, black) and three other areas in which counts of breeders were made (shaded): A to A (101 ha) Rhys's Ridge (67 ha), and Fly Square (25 ha).

Total number of nests on the island

The number of pairs of Gibson's wandering albatross nesting on the whole of the Auckland Islands was estimated from a whole-island population count done in 1997, followed by repeated counts of parts of Adams Island, including the count in 2018. The proportion of the total population in 1997 that was nesting in those parts of the island that were subsequently repeatedly counted was used to estimate the total population using the following formula.

$$\hat{t}_i = \frac{t_{1997}}{p_{1997}} \times p_i$$

Where

$\hat{t}_i$ is the estimated total number of pairs nesting in year *i*.

t_{1997} is the total number of pairs counted nesting in 1997.

p_{1997} is the number of pairs counted nesting in 1997 in those parts of the island that were subsequently repeatedly counted.

p_i is the number of pairs counted nesting in year *i* in those parts of the island that are repeatedly counted.

This estimate assumes that the proportion $\frac{t_i}{p_i}$ is constant from year to year, which is true when the pattern of distribution of nests remains the same from year to year, as it has been found to do on Adams Island (Elliott et al. 2016).

Foraging range

Since 2009 we have been deploying and retrieving geolocator dataloggers on Gibson's wandering albatrosses to compare the foraging locations when the population was declining, 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.

5. RESULTS

Survivorship

Data gathered over the 2017/18 summer allowed survival during 2017 to be estimated but since the survival estimates for the last two years for biennially breeding birds invariably have very large confidence intervals, the 2017 results should be treated cautiously, and we have not presented those for 2018 (Figure 2).

Female survival has improved markedly since the catastrophic lows (82%) recorded in 2006-08 and the survival rates of the sexes though different each year, is now on average about the same.

Figure 2: Annual survival of birds in the study area on Adams Island estimated by mark-recapture.

Nesting success and productivity

Breeding success was 68% in 2017—the same as the previous year and higher than it has been for 20 years before that. Although nesting success has increased to above 2005 (pre-crash) levels, the number of chicks produced is still lower than prior to 2005 due to the reduced number of birds breeding (Figure 3).

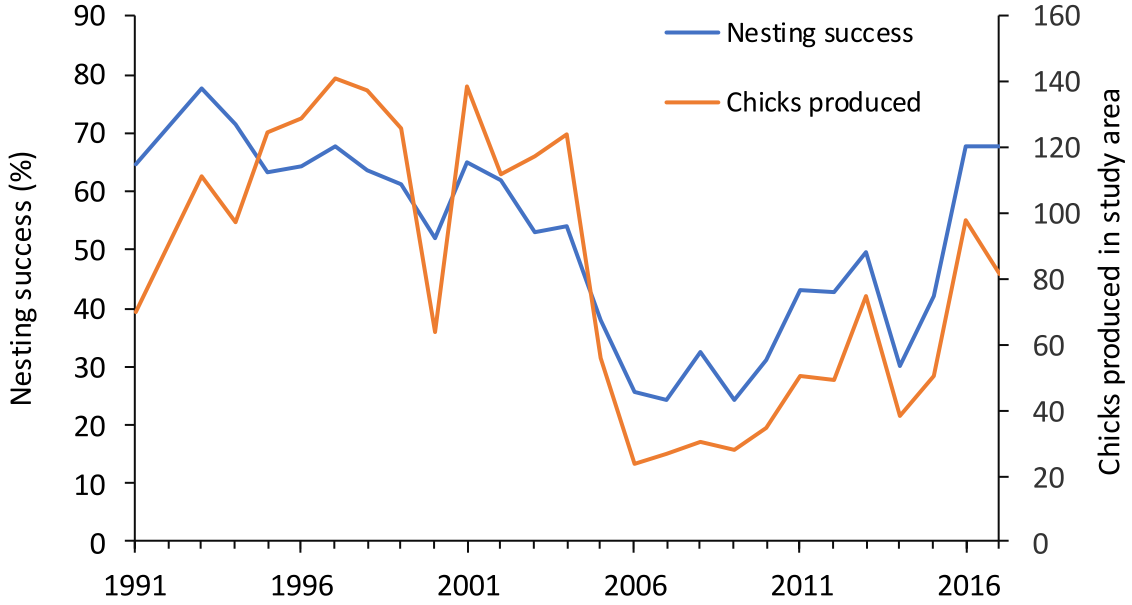

Figure 3: Nesting success and the number of chicks fledged from the study area on Adams Island

Recruitment

The number of birds breeding for the first time in the study area has been slowly and erratically rising, following the big decline in 2006 (Figure 4). Many of the birds recruiting to the breeding population now, will have fledged since the population crashed in 2006. Thus, even if survivorship of young birds is high, the number of birds reaching breeding age will be low because of the low numbers of birds breeding since 2006.

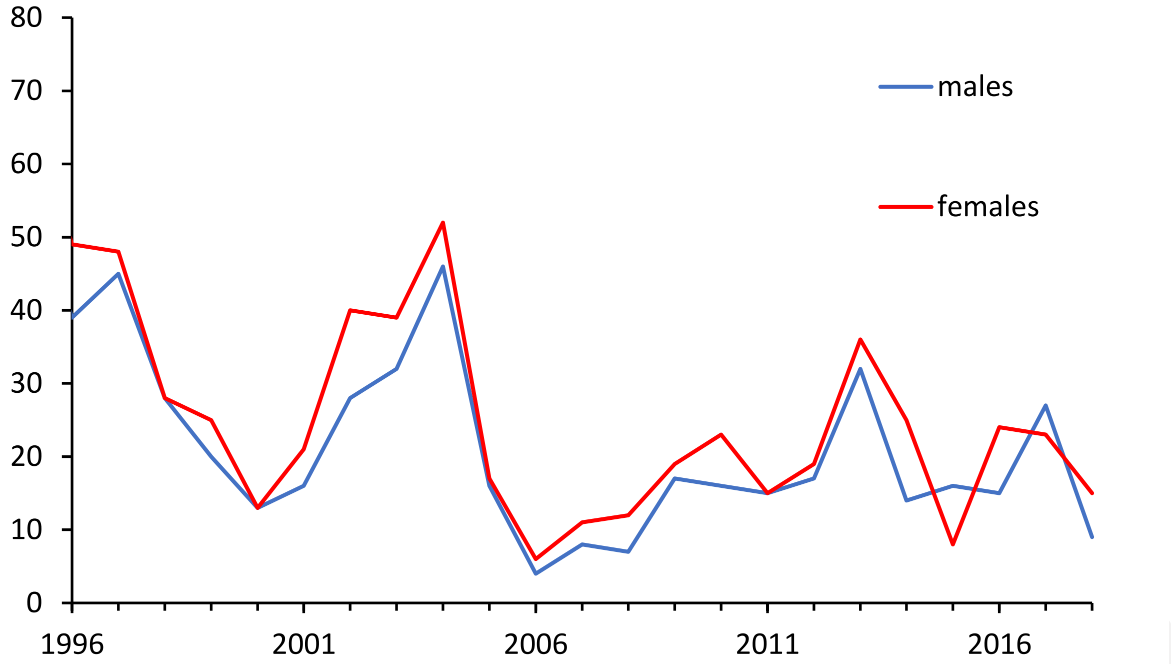

Figure 4: Number of birds breeding in the study area on Adams I for the first time for each year since 1996

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 between 2005 and 2012 the population declined rapidly. Since 2012 the female population has stabilised, and the males continued to decrease slowly (Figure 5). The continued decline in the number of breeding males is an artefact of the uneven sex ratio: there has been a shortage of females and only males that can find a mate can join the breeding population.

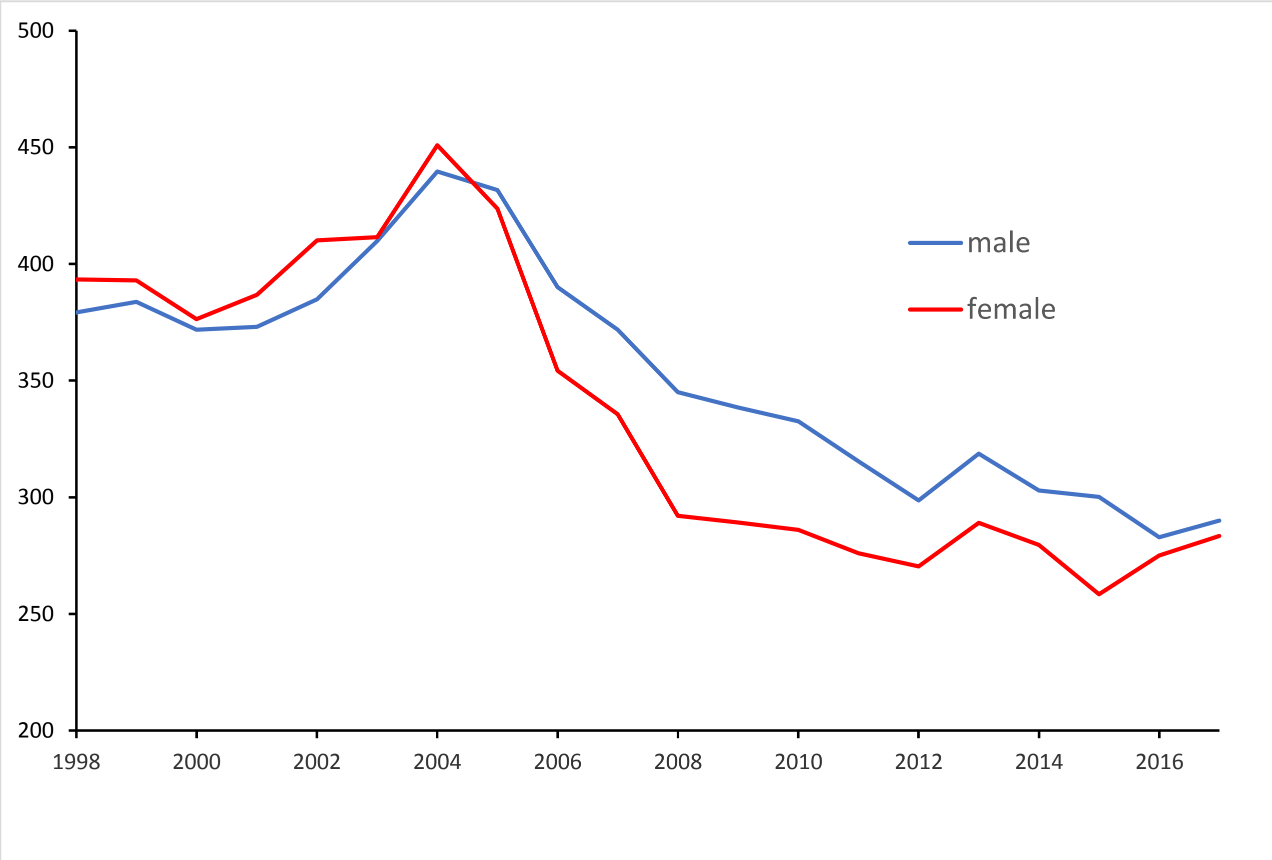

Figure 5: The number of breeding birds in the study area on Adams Island estimated by mark-recapture.

Using the modelling techniques of Francis *et al.* (2015) 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.

Nest counts in 3 representative blocks and estimate of the total number of nests on the island

The three blocks in which nests have been counted since 1998 were counted again in late January and early February 2018 and the counts "corrected" to take account of as-yet un-laid eggs and nest failures at the time of census (Elliott *et al.* 2016). There has been a slow improvement in the numbers nesting since the 2005 crash (Table 1, Figure 6).

Table 1: The number of Gibson's wandering albatross nests in late January in three census blocks on Adams Island in 1998–2018. Corrected total is the estimated number of nests in the three blocks taking account of the number of failed and un-laid nests at the time of counting. Estimated total population is the estimated number of nests on the island, based on the number of nests in the three counted blocks in 1997 when the last whole island count was undertaken.

Year	Rhys's Ridge (low density)	Amherst-Astrolabe (medium density)	Fly Square (high density)	Total no. of nests	Corrected total	Estimated total pop
1998	60	483	248	781	798	7875
1999	60	446	237	743	746	7367
2000	45	284	159	488	497	4904
2001	64	410	201	675	706	6969
2002	60	408	246	675	740	7303
2003	71	496	217	784	791	7809
2004	77	501	284	862	884	8728
2005	34	323	72	412	452	4467
2006	15	185	79	279	341	3363
2007	38	230	132	400	430	4245
2008	26	201	91	318	341	3371
2009	28	238	120	386	426	4211
2010	32	237	114	383	392	3872
2011	33	255	137	425	438	4323
2012	35	224	120	379	418	4131
2013	39	315	138	492	519	5120
2014	29	267	134	430	473	4669
2015	39	237	105	381	406	4010
2016	34	332	153	519	545	5385
2017	32	252	140	424	448	4423
2018	31	306	138	475	489	4829

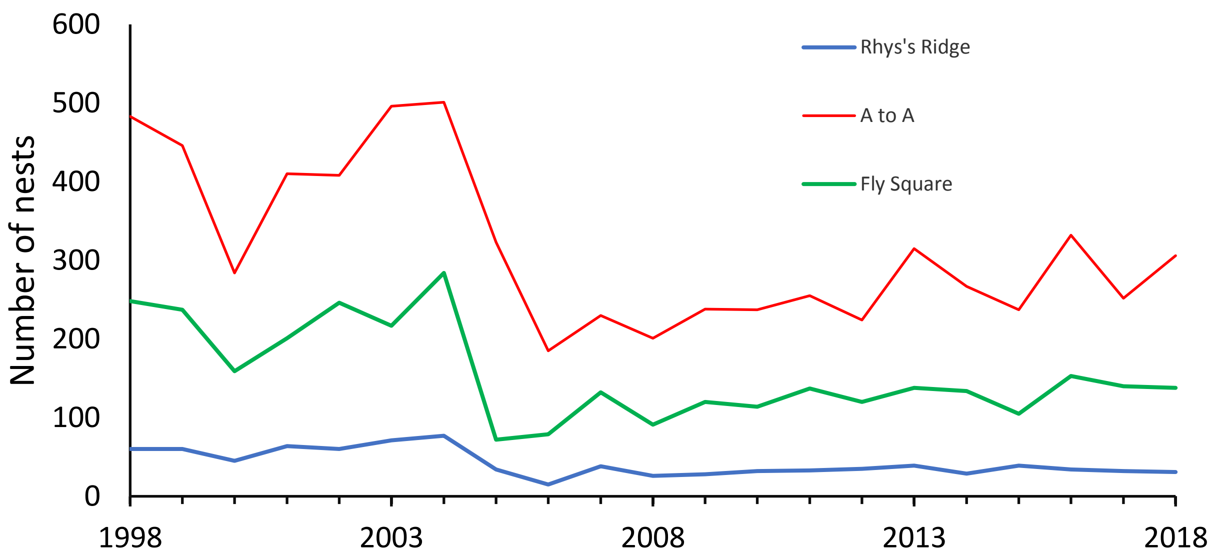

Figure 6: The number of Gibson's wandering albatross nests in late January in three census blocks on Adams I in 1998–2018.

Foraging range

Dataloggers were retrieved from 4 birds this summer bringing the total number of birds tracked since 2009 to 81. While the data was downloaded from these 4 loggers and 3 were re-deployed, the small amount of data obtained this year did not warrant re-analysis of the tracking dataset, which was analysed in full last year (Walker et al. 2017).

DISCUSSION

Population trends

The demography of Gibson's wandering albatross continues to improve following the "crash" in 2006. Nesting success has been at or above pre-crash levels for the last two years, the number of breeding females in the population is roughly stable and the number of females choosing to breed is now roughly equal to the number not breeding, as it was before the crash (Figure 7). The net effect is that the number of birds nesting on the island continues to increase. However, annual mortality is a little higher than it used to be, the population is still substantially smaller than it was in 2005, and because of this the number of chicks being produced is much lower than it used to be. Wandering albatrosses start breeding at about 12 years old and most birds joining the breeding population now, were produced during a time which chick production was very low. This along with the continued raised adult mortality is likely to continue to limit population recovery.

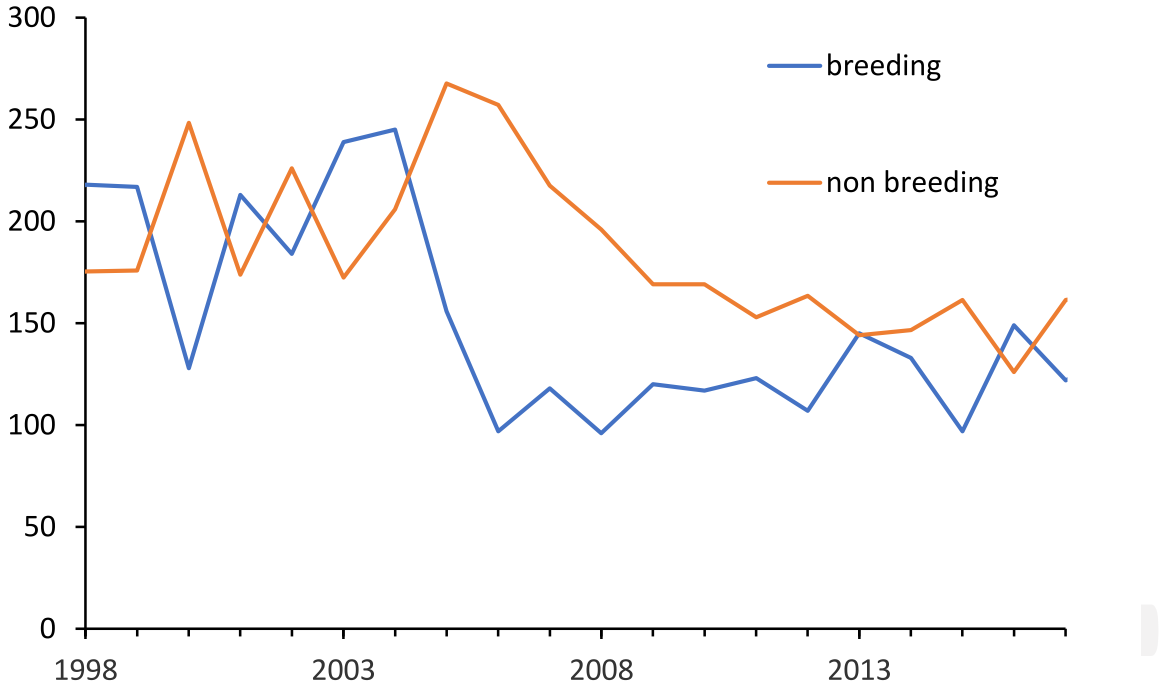

Figure 7: Total number of breeding females using the Adams Island Study Area, and the number that breed and don't breed each year.

Factors affecting population trends

To determine whether nesting success, female survival or the proportion of females that choose to breed each year might be related to El Niño or the Pacific Decadal Oscillation, we both graphically and statistically compared nesting success, proportion breeding and survival with the annual averages of the Southern Oscillation Index (SOI) and the Pacific Decadal Oscillation Index (PDO) (Figure 8).

Figure 8: The relationship between nesting success, proportion breeding and female survival and the Pacific Decadal Oscillation and the Southern Oscillation. All variables have been normalised, so they can be presented on the same scale.

Model selection (Burnham & Anderson 2002) of a suite of plausible generalised linear models of the relationships between female survival, proportion breeding and nesting success and SOI and PDO (Table 2) suggests that the SOI has a substantial impact on the proportion of females breeding each year, and it might have an influence on nesting success, but SOI has no impact on survival and PDO has little or no influence on nesting success, female survival or the proportion of birds breeding.

Table 2: Model selection table for generalised linear models of the relationship between nesting success, female survival and the proportion breeding and the Southern Oscillation Index (SOI) and the Pacific Decadal Oscillation Index (PDO).

	K	AICc	ΔAICc
Nesting success			
nesting success ~ SOI	3	76.34	0.00
nesting success ~PDO	3	77.12	0.78
nesting success ~ 1	2	77.29	0.95
nesting success ~ SOI + PDO	4	78.78	2.44
nesting success ~ SOI * PDO	5	81.83	5.49
Female survival			
female survival ~ 1	2	74.47	0.00
female survival ~ PDO	3	75.59	1.12
female survival ~SOI	3	76.29	1.82
female survival ~ SOI + PDO	4	78.44	3.97
female survival ~ SOI * PDO	5	79.16	4.69
Proportion breeding			
proportion breeding ~ SOI	3	73.9	0.00
proportion breeding ~ SOI + PDO	4	76.71	2.81
proportion breeding ~ PDO	3	76.88	2.98
proportion breeding ~ 1	2	77.29	3.39
proportion breeding ~ SOI * PDO	5	79.63	5.73

While the relatively long Gibson's wandering albatross dataset and the improving availability of climate and ocean data make it easy to examine possible correlations between them, there are many other factors, such as changes in fishing effort, that might influence albatross demography which we have not examined.

While the poor conservation status of Gibson's wandering albatross remains of concern, monitoring the size of the population and its structure and trend on Adams Island is a priority.

6. ACKNOWLEDGEMENTS

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7. REFERENCES

Burnham KP, Anderson DR. 2002. Model selection and multimodel inference: a practical information-theoretic approach. Springer Verlag, New York.

Choquet R, Reboulet AM, Pradel R, Giminez O, Lebreton JD. 2005. M-SURGE 1-8 User's Manual. CEFE, Montpellier, France. http://ftp.cefe.cnrs.fr/biom/Soft-CR/

Elliott G, Walker K, Parker G, Rexer-Huber K. 2016. Gibson's wandering albatross census and population study 2015/16. Report on CSP Project 4655, prepared for the Department of Conservation, Wellington. http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/marine-conservation-services/reports/pop2015-03gibsons-albatross-final.pdf

Fox JW. 2007. Geolocator manual version 6 (06/06/07). Unpublished report, British Antarctic Survey, Cambridge, UK.

Francis RICC, Elliott G, Walker K. 2015. Fisheries risks to the viability of Gibson's wandering albatross *Diomedea gibsoni*. *New Zealand Aquatic Environment and Biodiversity Report* **152**. Ministry of Primary Industries, Wellington.

R Core Team. 2016. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

Robertson HA, Dowding JE, Elliott GP, Hitchmough RA, Miskelly CM, O'Donnell CFJ, Powlesland RG, Sagar PM, Scofield RP, Taylor GA. 2012. Conservation status of New Zealand birds, 2012. *New Zealand threat classification series* **4**, Department of Conservation, Wellington.

Venables WN, Ripley BD. 2002. *Modern applied statistics with S*. Springer, New York.

Walker K, Elliott G. 1999. Population changes and biology of the wandering albatross *Diomedea exulans gibsoni* at the Auckland Islands. *Emu* **99**: 239–247

Walker K, Elliott G. 2005. Demographic parameters of Gibson's albatross (*Diomedea gibsoni*). Unpublished report to the Conservation Services Programme, Department of Conservation, Wellington.

Walker K, Elliott G. 2006. At-sea distribution of Gibson's and Antipodean wandering albatrosses, and relationships with long-line fisheries. *Notornis* **53** (3): 265–290.

Walker K, Elliott G, Rexer-Huber K, Parker G. 2017. Gibson's wandering albatross population study and census 2016/17. Report prepared for the Department of Conservation, Wellington. http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/marine-conservation-services/reports/gibsons-albatross-adams-island2017-finalreport.pdf